POLYMET
MINING

NorthMet Project

Geotechnical Data Package
Volume 1 – Flotation Tailings Basin

Version 7 - Certified

Issue Date: July 11, 2016

This document was prepared for Poly Met Mining Inc. by Barr Engineering Co.

Certification

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

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Acronyms

Acronym	Stands For
AET	American Engineering Testing, Inc.
AMSL	above mean sea level
ASTM	American Society for Testing and Materials
CDSM	Cement Deep Soil Mix
CPT	cone penetration text
CPTu	piezocone penetrometer test
CU	consolidated-undrained
DMT	dilatometer test
DSHA	Deterministic Seismic Hazard Analysis
DV	design values
ESSA	Effective Stress Stability Analysis
FOS	factor of safety
FSFS	fully specified failure surface
FTB	Flotation Tailings Basin
FVST	field vane shear tests
G_S	specific gravity
k_o	Coefficient of lateral earth pressure at rest
ksf	kips per square foot
LL	Liquid Limit
LTVSMC	LTV Steel Mining Company
MC	moisture content
M_{DMT}	constrained modulus
MDNR	Minnesota Department of Natural Resources
MSF	Magnitude Scaling Factor
Mw	Moment Magnitude Scale
NCEER	National Center for Earthquake Engineering Research
NSF	National Science Foundation
OCR	overconsolidation ratio
PI	Plasticity Index
PL	Plastic Limit

PGA	Peak Ground Acceleration
PMP	probable maximum precipitation
PSHA	probabilistic seismic hazard analysis
PVC	polyvinyl chloride
RLB	realistic lower bound
RQD	Rock Quality Designation
RUB	realistic upper bound
SAFL	St. Anthony Falls Laboratory
SEM	scanning electron microscope
SLOPE/W	Geo-Slope International Ltd. Slope Stability Analysis Software
SPT	standard penetration tests
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
USSA	Undrained Strength Stability Analysis
USSR	undrained shear strength ratios

1.0 Introduction

The proposed NorthMet Project (Project) will produce Flotation Tailings throughout 20 years of ore processing. Flotation Tailings will be deposited in the Flotation Tailings Basin (FTB), which will be placed on Cells 1E and 2E of the existing former LTV Steel Mining Company (LTVSMC) tailings basin.

In this Geotechnical Data Package-Volume 1 – Version5 (Data Package), the FTB is the newly constructed NorthMet Flotation Tailings impoundment, and the Tailings Basin is the existing LTVSMC tailings basin as well as the combined LTVSMC tailings basin and the FTB. Coarse tailings are LTVSMC coarse tailings, fine tailings are LTVSMC fine tailings, slimes are LTVSMC slimes, and Flotation Tailings are the NorthMet bulk flotation tailings.

Geotechnical modeling and design of the FTB were updated in Geotechnical Data Package – Volume 1 – Version 4 following the geotechnical workshop held on February 25-26, 2013, (Workshop) to discuss development of the Supplemental Draft Environmental Impact Statement content regarding the FTB. Version 4 served as the foundation for Version 5; all edits incorporated into Version 4 are contained in Version 5. The modifications to the geotechnical modeling and design reflect agreements reached at the Workshop, as understood by Poly Met Mining Inc. (PolyMet) and Barr Engineering Co. (Barr); geotechnical analyses performed subsequent to the Workshop in support of the Final Environmental Impact Statement for the FTB; and agreements between PolyMet and the Minnesota Department of Natural Resources (MDNR) reached through development of the NorthMet Geotechnical Modeling Work Plan Version 3 (Attachment A).

The approved Geotechnical Modeling Work Plan has been applied to Cross-Section F (north side of Cell 2E, Figure B-2 in Attachment B), Cross-Section G (north side of Cell 2E, Figure B-3 in Attachment B) and Cross-Section N (south side of Cell 1E, Figure B-4 in Attachment B). FTB design is based on existing conditions along these cross-sections and material strength design parameters presented in Attachment C.

1.1 Scope

This Data Package presents the geotechnical data and analyses to support the FTB design as referenced in the Flotation Tailings Management Plan (Reference (1)). The Data Package contains background information, historical data, modeling methods, and analysis of the proposed design. The information is intended for use in preparing the Environmental Impact Statement for the Project and to support future phases of the project.

1.2 Outline

The outline of this Data Package is as follows:

Section 2.0	Discussion of regulatory basis for design of dams
Section 3.0	Discussion of existing facilities and site conditions
Section 4.0	Discussion of available geotechnical data and testing methods
Section 5.0	Description of physical properties of materials (existing tailings, future tailings, and native soils) for modeling proposed conditions of facilities.
Section 6.0	Description of modeling performed to assess dam stability
Section 7.0	Results of modeling performed to assess dam stability
Section 8.0	Summary of stability modeling results
Section 9.0	Operation and maintenance requirements
Section 10.0	Future analysis

As agreed by PolyMet and the MDNR, this Data Package is intended to evolve through the environmental review, permitting, operating, reclamation and long-term closure phases of the project. A Revision History is included at the end of the document.

2.0 Regulatory Basis

The FTB dams must be constructed in accordance with applicable requirements of Minnesota Rules, parts 6115.0300 through 6115.0520 – Dams. Portions of the rules are applied universally, while applicability of some rule requirements is dependent on the hazard classification of the dams. The following rule excerpt aids in establishing the hazard classification of the FTB dams:

> 6115.0340 CLASSIFICATION OF DAMS
>
> All existing and proposed dams shall be classified by the MDNR Commissioner into the following three hazard classes: those dams where failure, mis-operation, or other occurrences or conditions would probably result in:
>
> A. **Class I**: any loss of life or serious hazard, or damage to health, main highways, high-value industrial or commercial properties, major public utilities, or serious direct or indirect, economic loss to the public;
>
> B. **Class II**: possible health hazard or probable loss of high-value property, damage to secondary highways, railroads or other public utilities, or limited direct or indirect economic loss to the public other than that described in Class III; and
>
> C. **Class III**: property losses restricted mainly to rural buildings and local county and township roads which are an essential part of the rural transportation system serving the area involved.
>
> Any dam whose failure, mis-operation, or other occurrences or conditions would result only in damages to the owner and would not otherwise affect public health, safety, and welfare as described in Classes I, II, and III, shall not be subject to this hazard classification. A dam which is not classified as a hazard Class I, II, or III dam, and those which are not included in the definition of dam in part 6115.0230, subpart 5, definition of dam, shall be subject to applicable provisions of parts 6115.0200 to 6115.0260, and shall not be subject to these dam safety rules. Changes in development in the vicinity of the dam may result in future reclassification.

There is a large, sparsely populated land area to the north of the FTB (the nearest resident is separated from the FTB by a minimum buffer zone of roughly 4,000 feet). PolyMet property and infrastructure are located immediately south, west, and east of the basin. As provided by the rules, the MDNR Commissioner has established the hazard classification for the dams as Class II – Significant Hazard. The classification is subsequently used to partially define FTB dam permitting, inspection and reporting requirements, notwithstanding requirements of other rules, such as the Permit to Mine. In particular, the stability of the dams must be evaluated, including consideration of liquefaction, shear failure, seepage failure, and overturning, sliding, overstressing and excessive deformation. The FTB dams have been evaluated for those geotechnical conditions that are relevant as defined by the MDNR-approved NorthMet

Geotechnical Modeling Work Plan (Attachment A). This document presents the analysis and results.

3.0 Existing Facilities and Site Conditions

This section describes the existing Tailings Basin, reviews the seismic history of the area, and references site hydrogeology. In this Data Package, "upstream" refers to upstream of the dam (i.e., within the basin) and "downstream" refers to downstream of the dam (i.e., near the toe or below the dam). This differs from references that may relate upstream and downstream to the tailings deposition flow direction, where "upstream" indicates the crest of the dam and downstream refers to the interior of the basin.

3.1 Tailings Basin Layout

The Tailings Basin was configured as a combination of three adjacent cells, identified as Cell 1E, Cell 2E and Cell 2W. The proposed FTB will be constructed above existing Cells 1E and 2E (Figure B-1 of Attachment B). Flotation Tailings will be deposited upstream of the dams over the Tailings Basin. Details regarding deposition timing are provided in Reference (1).

The geometry at the existing Tailings Basin is formed by perimeter dams up to 200 feet high (in Cell 2W) with side slopes of approximately 3.5H:1V, and 30-foot wide benches every 40 feet vertically (Drawings – Reference (1)). Including the benches, Cell 2W dams were constructed at an approximate overall slope of 4H:1V. Interior dams separate the Tailings Basin into the three cells, as noted previously. The perimeter and interior dams consist of coarse tailings materials from previous taconite processing operations. Shallow gradient beaches extend from the perimeter and interior dams into the center of each cell. The existing cells and the dams do not have a core or cutoff other than the fine tailings or slimes that were deposited upstream of the coarse tailings perimeter dams.

Cell 2E will initially be used for deposition of Flotation Tailings. Cell 2E is located east of Cell 2W and north of Cell 1E. It is the lowest of the three cells and covers approximately 620 acres. The average Cell 2E dam height is currently about 95 feet above the surrounding ground; approximately 1,575 feet above mean sea level (AMSL). Cell 2E includes approximately 17,700 linear feet of perimeter dams, including the north and part of the east perimeters. Undisturbed natural high ground forms a portion of the east perimeter. The west perimeter is formed by an interior dam separating Cell 2E from Cell 2W. The south perimeter is formed by an interior dam separating Cell 2E from Cell 1E.

Cell 1E will be used for deposition of Flotation Tailings beginning in approximately Mine Year 7. Cell 1E is east of Cell 2W and south of Cell 2E. Cell 1E currently covers approximately 980 acres with an average dam height of about 125 feet above the surrounding ground. It includes approximately 22,500 linear feet of perimeter dams, including portions of the south and east sides of the cell. Undisturbed natural high ground forms a portion of the perimeter on the southeast corner. The west edge is formed by an interior dam between Cells 2W and 1E. The north edge is formed by an interior dam between Cells 2E and 1E.

Cells 1E and 2E are bounded on the west by Cell 2W. An interior dam comprising the eastern edge of Cell 2W separates Cell 2W from Cells 1E and 2E. Cell 2W is the largest and highest of the three cells, covering approximately 1,450 acres in surface area with an average dam height of 200 feet above the surrounding ground. Cell 2W, which has previously been constructed to approximately the elevation proposed for Cells 1E and 2E, is not proposed for storing Flotation Tailings.

3.2 Tailings Basin Development

The existing north perimeter dam in Cell 2E is of particular interest because it includes the section previously identified as critical for stability modeling due to the layer of peat on which portions of Cell 2E was constructed. The critical section is marked as Cross-Section F (Section F) on Figure B-1 of Attachment B. Cell 2E's north perimeter dam is constructed of a rock, sand, and gravel starter dam underlain by a layer of peat, overlying a deposit of glacial till. Subsequent dam lifts were constructed using the upstream method with hydraulic filling. Tailings were discharged upstream of the crest to alternate portions of the tailing basin by means of portable spigotting systems. The coarsest tailings settled out nearest the point of discharge, providing a zone of coarse tailings surrounding the rock starter dam and along the face of the dam. These coarse materials were periodically pushed up with a dozer on the dam crest to progressively raise the perimeter dams. Finer tailings and slimes settled out at greater distances from the point of discharge and are generally located near the center of the cells, though they are also less often located nearer the downstream toe in certain areas where spigot discharge did not occur for extended periods of time. The fine tailings and slimes layers are of variable thicknesses and lateral extent due to changing tailings deposition points and durations. Large Figure 1 identifies the grain size classifications of the LTVSMC coarse tailings, fine tailings, and slimes. Similar methods were used to construct and fill Cell 1E, which will eventually be combined with Cell 2E for Flotation Tailings deposition.

In summary, the geometry of the existing tailings dam consists of a shell of LTVSMC coarse tailings above the rock, sand, and gravel starter dam, with intermingling fingers of LTVSMC fine tailings and slimes. The shell material, coarse tailings, and inclusions of fine tailings and slimes are incorporated into the stability analysis presented herein. The interior of the cells consists primarily of variable layers of LTVSMC fine tailings and slimes. A relatively thin layer of peat underlies several hundred feet of the north perimeter of Cell 2E and extends north beyond the toe of the dam into a nearby wetland.

Because new dams will be constructed on LTVSMC tailings, the geotechnical characteristics of the Tailings Basin have been investigated. Future perimeter dams will be constructed of mechanically-placed and compacted LTVSMC coarse tailings borrow, and Flotation Tailings will be spigotted into the basin as described in Reference (1). Future dams are not proposed to be constructed of spigotted tailings.

3.3 Local Seismicity and Ground Motion

Northern Minnesota is not an active seismic zone. Historically, Minnesota has one of the lowest rates of earthquake occurrence in the United States. Only 20 small to moderate quakes have been documented in Minnesota since 1860.

Table 3-1 tabulates historical earthquakes in the State of Minnesota as documented by the Minnesota Geological Survey (Reference (2)). The table provides the location of the earthquake epicenter, date, approximate area impacted, maximum intensity, and earthquake magnitude. The maximum intensity measures the strength of shaking produced by the earthquake at a certain location. It is determined from effects on people, human structures, and the natural environment. The intensity is measured on a scale of one (I) through twelve (XII), with one being the least intense and twelve signifying total damage. The magnitude of an earthquake measures the energy released at the source determined by seismographs. The magnitude is measured on a scale ranging from less than 2.0 (Micro quakes) to greater than 9.0 (Great quakes), signifying increased damage with increasing magnitude. The earthquakes listed in Table 3-1 are associated with minor reactivation of ancient faults in response to stress changes. As noted below, only 9 out of the 20 earthquakes were recorded, while moment magnitudes were estimated for the remaining 11 based on Modified Mercalli intensities derived from felt reports.

Table 3-1 Historic Seismicity of Minnesota

Epicenter (nearest town)	Date (mo/day/yr)	Latitude	Longitude	Felt Area (square miles)	Maximum Intensity	Moment Magnitude Scale (*MMS* or M_W)
1 Long Prairie	1860-61	46.10	94.90	—	VI-VII	5.0
2 New Prague	12/16/1860	44.60	93.50	—	VI	4.7
3 St. Vincent	12/28/1880	49.00	97.20	—	II-IV	3.6
4 New Ulm	2/5-2/12/1881	44.30	94.50	v.local	VI	3.0-4.0
5 Red Lake	2/6/1917	47.90	95.00	—	V	3.8
6 Staples	9/3/1917	46.34	94.63	18,530	VI-VII	4.3
7 Bowstring	12/23/1928	47.50	93.80	—	IV	3.8
8 Detroit Lakes	1/28/1939	46.90	96.00	3,090	IV	3-3.9
9 Alexandria	2/15/1950	46.10	95.20	1,160	V	3.6
10 Pipestone(1)	9/28/1964	44.00	96.40	—	—	3.4
11 Morris(1)	7/9/1975	45.50	96.10	31,660	VI	4.6-4.8
12 Milaca(1)	3/5/1979	45.85	93.75	—	—	1.0
13 Evergreen(1)	4/16/1979	46.78	95.55	—	—	3.1

Epicenter (nearest town)	Date (mo/day/yr)	Latitude	Longitude	Felt Area (square miles)	Maximum Intensity	Moment Magnitude Scale (*MMS* or M_W)
14 Rush City(1)	5/14/1979	45.72	92.90	—	—	0.1
15 Nisswa(1)	7/26/1979	46.50	94.33	v.local	III	1.0
16 Cottage Grove	4/24/1981	44.84	92.93	v.local	III-IV	3.6
17 Walker	9/27/1982	47.10	97.60	v.local	II	2.0
18 Dumont(1)	6/4/1993	45.67	96.29	26,830	V-VI	4.1
19 Granite Falls(1)	2/9/1994	44.86	95.56	4,480	V	3.1
20 Alexandria(1)	4/29/2011	45.88	94.47	—	—	2.5

(1) Asterisks denote earthquakes that were recorded instrumentally. All others and their associated magnitudes are based solely on intensity data from felt reports.

According to the data in Table 3-1, the strongest documented earthquakes were associated with the 1960 Long Prairie earthquake (M_w = 5.0) and the 1975 Morris earthquake (M_w = 4.6-4.8). Near their epicenters, these earthquakes caused objects to fall, cracked masonry, and damaged chimneys. A more recent, though less dramatic event was the 1993 Dumont earthquake (M_w = 4.1). This earthquake impacted an area of approximately 27,000 square miles with associated intensity of V-VI near the epicenter (Reference (2)). The most recent earthquake occurred in Alexandria in April, 2011. This minor earthquake (M_w = 2.5) resulted in no damage or injury, and went largely unnoticed as most residents were sleeping at the time.

In summary, current knowledge indicates that a severe earthquake is unlikely in Minnesota. Weak to moderate earthquakes do occasionally occur, though the threat to the proposed FTB from seismic events is very small, as described in Section 6.4.3.

3.4 Hydrogeology

Studies have been performed to investigate the hydrogeology of the site and those results will not be reproduced again in this document, though active communication has occurred between Project geotechnical engineers and hydrogeologists to share data and results and maintain consistency between analyses, as appropriate. A separate report has been prepared to discuss the FTB hydrogeology (Reference (3)).

4.0 Available Geotechnical Information

Available geotechnical information for the FTB includes data gathered during the 2007 and 2014 geotechnical investigations as well as historical data. Available historical geotechnical data and reports are provided as Attachment D. The cumulative site data are described in these subsections. Results separated by material type are presented in Section 5.0. The approaches used to select material strength parameters for slope stability analyses using field and laboratory test results are detailed in Attachment C and summarized in Section 5.0.

4.1 History of Tailings Basin Geotechnical Investigations and Stability Analyses

The geotechnical parameters used for slope stability analysis and design of the Tailings Basin have varied throughout historical evaluations as more geotechnical test results have become available. A map presenting all known geotechnical test locations is provided in Figure B-1 of Attachment B. A summary table of the historically-reported properties used for previous analyses is also included as Table B-1 in Attachment B.

The earliest available stability analysis was conducted for Erie Mining Company (predecessor to LTVSMC) in 1977 by Ebasco Services, Inc. Ebasco presented a limited set of drained and undrained shear strength data for bulk tailings and slimes (Reference (4)). Ebasco used the term bulk tailings to refer to existing LTVSMC combined fine and coarse tailings. In 1978, Ebasco presented updated geotechnical design parameters, separating the bulk tailings into coarse and fine portions and including strength parameters for the native peat and till (Reference (5)). This Data Package uses the term ‘bulk tailings’ differently than the Ebasco reports. For the geotechnical analysis described herein, the phrase ‘LTVSMC bulk tailings’ is used to describe a mixture of tailings that will be used in future dam construction. LTVSCM bulk tailings will predominately consist of LTVSMC coarse tailings, with occasional inclusions of LTVSMC fine tailings and a small amount of slimes recovered incidentally during coarse tailings excavation.

In 1986, additional investigations were conducted by Katsoulis for the MDNR (Reference (6)). Ebasco reported supplementary geotechnical investigations, engineering parameters, and stability analyses in 1978 (Reference (5)). A liquefaction analysis and additional triaxial testing on the slimes were conducted by Barr in 1994 (Reference (7)).

Sitka Corporation conducted a large multi-phase geotechnical assessment and analysis of the Tailings Basin stability between 1995 and 1997 (Reference (8), Reference (9), Reference (10)). This included a review of existing data, a geotechnical exploration program with field and laboratory testing, and analysis of the stability of the Tailings Basin. In 2000, Barr performed further seepage and stability analyses on existing dams located in Cells 2W and 2E, which included additional strength and permeability testing (Reference (11)).

A preliminary geotechnical site exploration was conducted in 2005 to obtain updated information on the stratigraphy of the tailings in the central portion of Cell 2W and the southern portion of Cell 1E. Since closure in 2001, the basin has undergone changes due to non-use, natural dewatering, and tailings consolidation. Natural dewatering made access possible to portions of Cells 2E and 2W which had been under water during basin operation. With larger portions of the basin dewatered (including all of Cell 2W), access was possible with tracked and rubber-tired vehicles. The intent of the 2005 exploration was to provide more data for interpretation of stratigraphy at select cross-sections around the dams, to obtain preliminary design information for future lined hydrometallurgical residue cell design in Cell 2W, and to evaluate the piezometric conditions in Cells 1E and 2E.

4.2 2007 Geotechnical Investigation

A geotechnical field investigation was performed in the fall of 2007 and included examination of the central and southern portions of Cell 2W, the northern portion of Cell 2E, and the eastern and southern dams of Cell 1E. Field work included rotary wash borings with standard penetration tests (SPT), piezocone penetrometer test (CPTu) soundings, CPTu dissipation testing, dilatometer tests (DMT), field vane shear tests (FVST), and shear wave velocity tests. Laboratory testing was performed on bulk, undisturbed, and disturbed tailings and soil samples to determine index properties, permeability, and strength parameters. The resulting data were used to develop more comprehensive dam cross-sections for seepage and stability analysis, while further determining the impact on the tailings' geotechnical properties of any consolidation and dewatering that had occurred since 2001.

The 2007 geotechnical tests were performed in a particular order to allow for collection of targeted samples and performance of specific tests. In particular, the results of the CPTu and DMT testing were utilized to identify zones of slimes and fine tailings suitable for attempting undisturbed sampling and/or field vane shear testing.

Several bulk samples of LTVSMC tailings were collected from shallow test pits throughout Cell 2W to obtain information on typical in-situ conditions at shallow depths. Bulk samples were obtained from Cell 2W due to ease of access (no ponded water in Cell 2W at the time that sampling was performed) and the assumption that tailings material types in Cell 2W are the same as material types in Cells 1E and 2E. Test pit samples were submitted for laboratory testing of index properties, hydraulic conductivity, and shear strength.

All 2007 laboratory testing of materials outlined above and described hereafter was conducted by Soils Engineering Testing, Inc. of Bloomington, Minnesota. Results of all tests performed during and subsequent to the 2007 geotechnical investigation are provided in Attachment E.

4.3 2014 Geotechnical Investigation

The most recent geotechnical field investigation, which commenced in the winter of 2013/2014, had two objectives:

- provide additional detail on conditions along the Tailings Basin toes, to support design of the FTB Containment System

- provide additional detail on stratigraphy in Tailings Basin Cells 1E and 2E, to support stability modeling and FTB design

Results of the 2014 Geotechnical Investigation are presented in Attachment F. The FTB Containment System will be installed approximately 200 feet from the toe of Tailings Basin Cells 2W and 2E. The potential effects of the FTB Containment System on the FTB stability are presented in Attachment G and discussed briefly in Section 6.8.

The 2014 FTB Containment System Investigation was conducted along the northern and western edges of the Tailings Basin. It consisted of two separate field studies: the first study included Rotasonic borings and installation of standpipe piezometers. The second field study included SPT, collection of undisturbed samples in surficial deposits, rock coring, packer testing in bedrock, and in-laboratory testing of materials. Field study results along the FTB Containment System alignment are summarized below and detailed in Attachment F:

- The surficial deposits along the northern and western toe of the Tailings Basin vary in thickness by test location but are generalized as follows, from the top down:
  - Peat; 0 to 20 feet thick,
  - Tailings in isolated areas; 0 to 17 feet thick,
  - Silty sand; 0 to 6 of feet thick, fine to coarse grained, with various amounts of clay, and
  - Glacial Till; 5 to 36.5 feet thick. Cobbles and boulders were interspersed in the till, varying in size from <1 foot to approximately 4 feet in diameter.
- Depth to bedrock ranges from 2 to 47 feet with an average depth of approximately 20 feet. Bedrock was competent, with a near surface fracture zone.
- Groundwater levels were at or just below the ground surface.
- Hydraulic conductivity of the glacial till ranged from $1.5x10^{-3}$ ft/s ($4.6x10^{-2}$ cm/s) to $1.7x10^{-6}$ ft/s ($5.2x10^{-5}$ cm/s) with a geometric mean of $5.1x10^{-5}$ ft/s ($1.5x10^{-3}$ cm/s).
- Hydraulic conductivity of the upper portion of the bedrock ranged from effectively zero (the borehole produced no water) to $2.4x10^{-5}$ ft/s ($7.3x10^{-4}$ cm/s), with a geometric mean (excluding the zero inflow locations) of 1.9×10^{-6} ft/s (5.8×10^{-5} cm/s)

These results support the following findings:

- Soils suitable for installation of a seepage cutoff wall exist along the proposed system alignment.

- At isolated locations (e.g., B-14-44 and B-14-65) deep pockets of tailings and peat may need to be excavated prior to construction. Stability will be maintained by simultaneous placement of engineered fill upon tailings removal.

- When selecting construction methods, the containment system construction contractor will need to consider the presence of cobbles and boulders in the till.

The Cell 1E/ 2E investigation included cone penetration test (CPT) soundings. Field study results within the existing Tailings Basin are summarized below, and detailed in Attachment F:

- There has been little to no strength increase of the tailings in Cell 1E and 2E since 2007.

- Additional stratigraphic information confirmed existing information and filled data gaps.

- The phreatic surface in Cell 2E has decreased approximately 5 feet since 2007. In Cell 1E the phreatic surface has increased approximately 25 feet since 2007 due to pumping of excess water into this basin.

Results of the 2014 geotechnical investigation were used to update the cross-section models with depth to bedrock, bedrock seepage parameters, phreatic surface location within the dams, and permeability of the glacial till, all of which have been updated since Version 4 of this Data Package. The CPT results were used to update stratigraphy along Cross-Sections F, G, and N as well as provide approximate phreatic surface in Cells 1E and 2E in order to perform model verifications, confirming that appropriate hydraulic conductivity values are being used for seepage and stability modeling.

4.4 Field Testing Analysis Methods

4.4.1 Cone Penetrometer Tests

CPTu was performed in all cells of the Tailings Basin in 2007 and in cells 1E and 2E in 2014. 2014 CPTu data were used to confirm cross-section stratigraphy and phreatic surface location. Since 2014 strength results were similar to those from 2007, only the results from the 2007 CPT investigation were used to determine material strengths and establish contractive/dilative behavior of the LTVSMC coarse tailings, LTVSMC fine tailings, and LTVSMC slimes. A total of 37 soundings were performed in 2007, including shallow refusals and offsets. Six soundings were pushed in Cell 1E, 19 soundings in Cell 2E, and 12 soundings in Cell 2W to approximate depths ranging from 40 to 160 feet. All 2007 CPTu soundings were conducted by American Engineering Testing, Inc. (AET) of Duluth, Minnesota. The CPTu testing was performed with a 20-ton truck-mounted rig with an enclosed work space. Testing was performed in general accordance with ASTM D5778, though one significant change was made during one phase of testing. For the standard CPTu sounding, a cylindrical cone is pushed vertically into the ground at a constant rate of penetration of 20 millimeters per second (0.79 inches per second). During penetration, measurements are made of the cone tip resistance (q_c), the side friction of the cylindrical shaft (f_s) immediately above the tip, and porewater pressure generated by penetration

(u_2). However, at two locations during the 2007 investigation, the rate of advancement was increased to over 130 millimeters per second (5.1 inches per second). This test method is described later in this section.

The cones used in the investigation have a 15 cm^2 (2.3 in^2) projected cone surface area and a 60-degree apex angle. The friction sleeve area of the cones is 225 cm^2 (34.9 in^2). The fluid used to saturate the filter was glycerin. AET provided Barr with complete records of tip resistance, sleeve friction, porewater pressure, and friction ratio for each CPTu sounding, along with results of dissipation tests (Attachment H). CPTu data were also available from field investigations performed by ConeTec in 2005 in Cell 2W and in 1996 across the Tailings Basin.

Based on Barr's experience at this site and with other tailings deposits in Northern Minnesota, penetration-induced porewater pressure often dissipates quickly in fine tailings due to stratification (inclusion of coarser tailings) and layering in the tailings deposit. This experience includes staged construction over taconite tailings, wherein the porewater pressure dissipates fairly quickly, as the tailings typically classify as silts or sands. This is also reflected in CPT work and dissipation testing (discussed more in Section 4.4.2), where t_{50} values of less than 10 minutes are often observed, with a significant number of t_{50} values below 3 minutes (the significance of t_{50} is also explained further in Section 4.4.2). Many researchers have found that true undrained response is difficult to measure in intermediate silty materials such as tailings (Reference (12), Reference (13), and Reference (14)). Therefore, the undrained strength typically cannot be measured directly in these materials. However, available empirical correlations between SPT blow count or CPTu tip resistance and shear strength implicitly incorporate the prevailing drainage conditions during penetration. As a result, these correlations can be utilized to assess shear strength without an explicit knowledge of the drainage conditions during a particular in-situ test.

As noted earlier, accelerated advancement of the piezocone penetrometer (on the order of 130 mm/s, in excess of ASTM standards) was performed at sounding locations 07-03 and 07-09 (with, for example, the fast push at 07-03 denoted as 07-03F in Attachment H). These fast pushes were performed in an attempt to measure the true undrained response of the fine tailings. To most effectively ensure measurement of an undrained response in the fine tailings, the cone should have been pushed at a rate of at least 170 mm/s (Reference (14)). However, limitations with the CPT rig precluded advancement rates beyond 130 mm/s.

Relatively minimal difference was observed between the data from the fast and standard cone advancement rates. This shows that the rate of advancement was either not high enough to induce undrained behavior, the material was not fully saturated, or the material behaves similarly at both push rates. For this site, the results from the current fast push soundings can be combined with the standard push rate data to estimate drained shear strengths. Fast cone advancement should be re-visited during operations when materials are resaturated.

The CPTu data interpretation was performed using an in-house program designed by Barr. The in-house program has been cross-checked with CPTINT version 5.2 (commercially-available software) for quality assurance and has been deemed comparable. The program uses the soil behavior type classification system from CPTu data proposed in Reference (15).

Published relationships relate CPTu parameters to soil behavior type, unit weight (for fine-grained soils) or relative density (for coarse-grained soils), over-consolidation ratio, strength, deformation moduli, and contractive/dilative behavior (Reference (13), Reference (16)). The CPTu data were used in this evaluation for determining stratigraphy, strength parameters, and behavior of the soils. The raw CPTu profiles are in Attachment H. The data were divided by material type, as determined through CPTu soil behavior relationships and SPT boring logs, and used along with other test data to estimate soil shear strength.

4.4.2 Dissipation Tests

Dissipation tests were conducted at various depths in nearly all 2007 and 2014 CPTu soundings. The dissipation tests measure the penetration-induced porewater pressure decay over time until the porewater pressure measurements equilibrate to the in-situ porewater pressure. The equilibrium porewater pressure distribution obtained from CPTu dissipation tests were used to determine the porewater pressure distribution at each test location for the 2007 investigation (Attachment H) and 2014 investigation (Attachment F).

The 2007 CPTu dissipation tests were used to calculate the hydraulic conductivity values for LTVSMC fine tailings and LTVSMC slimes. While it is difficult to estimate porewater pressure conditions when a deposit is partially saturated, dissipation testing provides a method to verify equilibrium conditions within a given soil layer and is the only in-situ permeability testing that was performed at the Tailings Basin. To evaluate the soil permeability from 2007 CPTu dissipation test data, the evaluation of the decay of the penetration-induced porewater pressure is plotted against time. The pressure at which half of the penetration-induced porewater pressure has dissipated is known as the u_{50}, as described by the following equation:

$$u_{50} = \frac{(u_i - u_0)}{2}$$ **Equation 4-1**

Where:

u_o = final, equilibrated porewater pressure
u_i = peak penetration-induced porewater pressure

The time relating to the u_{50} value is termed t_{50}. Published relationships exist to correlate the t_{50} in seconds to permeability. The average correlation of t_{50} in seconds to permeability in centimeters per second used in these analyses was obtained from Reference (17), and is:

$$k = 1.0x10^{-6} * t_{50}^{-1.0666}$$ **Equation 4-2**

This method was used to evaluate the in-situ permeability of the LTVSMC tailings (Section 5.2.2). The t_{50} values for all dissipation tests performed within saturated zones are plotted against depth as Large Figure 2.

The dissipation test typically provides a better characterization of the horizontal permeability than the vertical permeability if a material is anisotropic or if there is significant horizontal layering. Differences between laboratory data and dissipation test estimates may be due to anisotropy or layering or other in-situ variations.

Pore pressure dissipation tests performed in 2014 were used to provide the approximate phreatic surface within Cells 1E and 2E, which was then applied to the existing conditions seepage models to verify that the porewater pressures in the models match the field results. The 2014 verification models are discussed in greater detail in Section 7.2.2.

4.4.3 Shear Wave Velocity Tests

The cone used in the 2007 CPTu investigation was equipped with geophones that measure the arrival time of shear waves generated at the ground surface. Shear wave testing was performed at each CPTu location; and arrival times were measured at depth intervals of approximately 10 feet to determine the interval shear wave velocity. The results of shear wave testing are in Attachment H.

Compression wave testing was performed at select locations; arrival times were measured at depth intervals of approximately 10 feet to determine the interval compression wave velocity. However, compression wave data are compromised below the groundwater table; therefore, compression wave results were poor due to the high variability of the water conditions at the site, and were therefore not utilized in this report. Compression wave data would have been used to better define the Poisson's ratio of the tailings. Because the data collected were of poor quality, Poisson's ratio was estimated for deformation analyses. A Poisson's ratio of 0.5 indicates perfect incompressibility, while a Poisson's ratio closer to zero indicates very little lateral expansion occurs when the material is compressed. The Poisson's ratio values utilized ranged from 0.33 to 0.40 which, based on a literature review, generally fall within the published range of 0.30 to 0.40 for tailings (Reference (18)).

The shear wave velocity of a soil provides the small-strain (maximum) shear modulus (G_o or G_{max}) of a soil (Reference (17)) as follows:

$$G_o = \rho V_s^2$$ **Equation 4-3**

Where:

ρ = mass density = γ / g
γ = unit weight
g = gravitational force
V_s = shear wave velocity

The small-strain shear modulus is approximately the maximum shear wave modulus that can be measured and is likely to occur in the field under small strain. In addition, the shear wave velocity itself has been related to contractive-dilative behavior of soils. The shear wave velocities (and hence the small-strain shear moduli) varied greatly over the site, particularly in different material types. The small-strain shear wave velocities varied from 37 ft/s in LTVSMC slimes to 117 ft/s in LTVSMC coarse tailings, while the subsequent G_o values varied from 470 kips per square foot (ksf) to 5,891 ksf, respectively.

4.4.4 Dilatometer Tests

Traditionally, soil compressibility parameters are obtained by performing a soil boring, taking an undisturbed Shelby tube sample, and performing a consolidation test on the undisturbed sample in the laboratory. The DMT has the advantage of providing quasi-continuous, in-situ soil compressibility information (constrained modulus of deformation) as part of the field investigation while minimizing the effects of sample disturbance on the results of the test as typically found in laboratory testing. DMT was conducted by Barr personnel in conjunction with the 2007 CPTu work and was performed in general accordance with ASTM D6635. The DMT was pushed within approximately 10 feet of the 2007 CPTu soundings.

The Marchetti, or flat-plate, dilatometer consists of a 95-millimeter (3.74-inch) wide stainless steel blade, 15 millimeters (0.59 inches) thick, with a thin, flat, expandable steel membrane (60 millimeters, or 2.36 inches, in diameter) on the side. Performing a test involves pushing the dilatometer blade vertically into the ground to the desired test depth while measuring the thrust required for penetration, then using gas pressure to expand the circular steel membrane against the soil. The test operator obtains three readings: (1) the A-pressure required to initiate movement of the membrane against the soil; (2) the B-pressure required to move the center of the membrane one millimeter (0.039 inches) into the soil; and (3) the C-pressure during deflation of the membrane, which is related to the in-situ porewater pressure in sands and penetration-induced porewater pressure in clays. The operator then pushes the blade to the next depth and repeats the test.

DMT-correlated parameters generally include the measured material index (I_d)), dilatometer modulus (E_d), horizontal stress index (K_d), constrained modulus of soil compressibility (M_{DMT}), and undrained shear strength (s_u). The constrained modulus ($\mathrm{M_{DMT}}$) is determined from the test results and can be used to estimate settlement. $\mathrm{M_{DMT}}$ values varied greatly at the site, ranging from 4 ksf in LTVSMC slimes to 3,074 ksf in LTVSMC coarse tailings (Attachment I).

The DMT results were primarily used for preliminary settlement estimates of Cell 2W for the initially proposed Hydrometallurgical Residue Facility; the location of which has since moved off and to the south of Cell 2W. As construction of the FTB will be fairly continuous, any settlement that occurs in the existing and future tailings during the 20-year construction phase will occur during the continual dam raising process. For this evaluation, therefore, the dilatometer values were only utilized to verify weak or loose zones relating to fine tailings and slimes identified with other testing methods.

4.4.5 Standard Penetration Tests (SPT)

SPT borings were drilled by AET in July and August of 2007 near the CPTu soundings (Attachment J). A total of 27 SPT borings were performed (6 in Cell 1E, 11 in Cell 2E, and 10 in Cell 2W) to depths ranging from approximately 50 to 215 feet. More recently, SPT borings were drilled by Braun Intertec in the spring of 2014 to confirm subsurface conditions along the proposed FTB Containment System to be located approximately 200 feet from the toe of the existing basin along the western and northern sides of Cell 2W and Cell 2E (Attachment F). A total of 12 SPT borings were conducted, terminating at bedrock which, per 2014 geotechnical explorations, ranged in depth from approximately 2 to 47 feet.

The borings were advanced using 4-1/4 inch inside-diameter and 6-5/8 inch inside-diameter hollow-stem augers, as well as 5 inch and 3-7/8 inch mud-rotary drilling techniques. Drilling was generally initiated with hollow-stem augers and completed with mud-rotary drilling to minimize sample disturbance. After drilling was complete, all boreholes were abandoned following Minnesota Department of Health guidelines.

In addition to standard 2-inch outer-diameter split spoon sampling performed during SPT, undisturbed or partially disturbed soil samples were obtained at multiple locations and depths. Sampling methods included direct push and sampling with 3-inch outside-diameter thin-walled tubes (in accordance with ASTM D1587), use of an Osterberg hydraulic sampler, and use of a mechanical piston sampler and denison sampler. During Osterberg sampling, the hydraulic sampler is lowered to the bottom of the hole at the depth at which the sample of undisturbed soft soil is to be collected. Once the sampler has been placed at the bottom of the hole, hydraulic pressure is applied to the ram, which advances the thin-wall tube into the soft soil. Because the head of the sampler is designed to prevent air or water pockets from developing above the sample, and either pushing soft soil ahead of it or allowing the sample to drop from the tube on recovery, Osterberg sample recovery is often better in soft soils such as the slimes. The mechanical piston sampler is similar in design to the Osterberg sampler, with the exception that a mechanical rod is used to position the head of the sampler. At this site, samples of tailings, glacial till, and peat were collected using the direct push, Osterberg, and mechanical samplers.

In the 2007 investigation glacial till and LTVSMC coarse tailings samples were collected using a 2-1/2-inch outside-diameter California modified split-spoon sampler with brass ring liners. Due to the density and coarse-grained nature of the glacial till, a 3-inch outside-diameter Pitcher-barrel sampler was used to sample dense gravelly till located below the existing tailings dams. Denison samples were attempted several times during the 2014 investigation in the glacial till but due to difficult sampling conditions and high gravel content, no samples were obtained. For this reason, all laboratory tests performed on till material were on disturbed or remolded samples. The Pitcher-barrel sampler and Denison sampler both utilize a rotating carbide cutting head which follows immediately behind the cutting edge of the thin-wall tube to cut an undisturbed sample, which is collected in a 36-inch long tube.

The direct push thin-wall, Osterberg hydraulic thin-wall, California split-spoon, and Pitcher-barrel sampling techniques were used with various levels of success to obtain undisturbed samples of the materials encountered across the site at various depths. Success was determined both by the amount of material that could be collected and by the behavior of the samples in the laboratory during testing, as described in Section 4.5. The till was sampled best with the Pitcher sampler, though the ability to collect a sample in till was dependent on whether a cobble was encountered. The fine and coarse tailings were sampled with most success using the Osterberg samplers. Direct push thin-walls were sufficient to gather samples of the slimes from within the basin as well as undisturbed tailings and peat samples from along the toe of the basin.

The peat below the existing dam, where the sampling occurred, has been subjected to consolidation and therefore is quite thin. Thin soil layers such as the peat layer are difficult to successfully target for sampling (easily missed during sampling). Attempts were made to sample thin peat layers but were unsuccessful.

The 2007 SPT drilling and sampling verified that LTVSMC coarse tailings are the dominant material in the shell of the Tailings Basin. Some borings confirm that upstream construction methods were used in the past, such that portions of the slope include zones of finer tailings. The central portion of the basin is made up of varying layers of LTVSMC coarse tailings, fine tailings, and slimes. In general, however, the uppermost layer of tailings comprising the beach at the Tailings Basin at the 2007 drilling locations is dominated by LTVSMC coarse tailings of variable thickness. While there is a desiccated layer at the ground surface, this layer will become resaturated during operations so it is not modeled as a separate layer.

The 2014 SPT drilling and sampling resulted in a limited number of thin-wall samples that were collected in the peat and tailings deposits 200 feet from the toe of the existing Cell 2W and 2E basins. Five of the nine thin-wall sample attempts were successful and resulted in acceptable sample recovery for testing. Tests performed on undisturbed peat samples included moisture content (MC), organic content, Atterberg Limits, and dry density. A total of five laboratory consolidated-undrained (CU) triaxial compression tests were performed providing the drained and undrained shear strength of the peat. Hydraulic conductivity testing was performed on undisturbed samples of peat in general accordance with the falling head method (ASTM D5084). The laboratory testing results are presented in Attachment F and described in Section 5.0.

4.4.6 Flight Auger Borings

Flight auger borings were drilled by AET in general accordance with ASTM D1452 near the western, northern, and eastern crests of the dams around Cell 2W to approximately 30 feet below ground surface. The borings were advanced using 6-inch-diameter solid-stem flight augers. The stratigraphy provided by these borings was used to estimate volumes of LTVSMC coarse tailings available around the crest of Cell 2W for use as construction borrow material. Samples collected while performing the flight auger borings were also used as bulk samples for further testing of available borrow material.

Field classification of the LTVSMC tailings involved separating the material visually by gradation into coarse tailings, fine tailings, and slimes. The conventions used for this classification were initially set forth by Ebasco Inc. in 1977, then refined in 1978 to include a gradation range for the three classifications used in studies by Sitka from 1996-1998 and this study. The grain size ranges for each classification are provided in Large Figure 1.

4.4.7 Field Vane Shear Tests (FVST)

Three field investigations to obtain FVST data were performed; one in 1977 by Ebasco Services, one in 1999 by Barr, and one in 2007 by AET under Barr's supervision. The FVST field data is provided in Attachment H. In-situ FVST were performed in general accordance with ASTM D2753, however for the 2007 geotechnical investigation the FVST method was modified as a means to measure undrained shear strength. The rotational shear rate was increased from the standard 0.1 degrees per second to rates that ranged from 2.6 to over 58 degrees per second. The rotational rate was increased in an attempt to measure undrained shear strength by allowing only minimal pore pressure dissipation during vane rotation within the non-cohesive, higher permeability tailings. The tests were typically continued through yield shear strength, such that remolded shear strength was recorded. Results of the 1977 Ebasco and 1999 Barr FVST tests suggest that those tests may not have measured undrained conditions. For more details on the 2007 FVST procedures see Section 2.5.3 of Attachment C.

FVST used in the analysis was performed in LTVSMC interior fine tailings/slimes and LTVSMC slimes within Cells 1E and 2E (depths and locations are provided in Attachment C). The field vane results were used to estimate in-situ undrained yield (i.e., peak) and remolded (i.e., large displacement) shear strengths for the fine tailings and slimes. The field vane shear testing was performed using a RocTest model M-1000 mechanical plotting vane shear torque-head device. The vane was rotated using a gear reduction driven by an electric motor. The vane sizes used were in general accordance with ASTM D2753 and were selected for each test based on the penetration resistance and the type of material encountered during CPTu or SPT testing. Vane-specific calibrations were used to determine yield and residual strengths in the tailings. Analysis and use of this data for estimation of shear strength parameters are described in Attachment C.

4.5 In-Laboratory Material Testing Methods

In-laboratory material testing was conducted on samples collected during SPT and on samples obtained from test pits.

SPT undisturbed samples, obtained via either direct push or piston sampling methods in 3-inch thin-wall tubes (Section 4.4.5), were tested to obtain information on in-situ conditions at various depths. Ideally all the samples would be undisturbed, but due to the soft nature of the deposit, this was not always the case. Disturbed split-spoon soil samples were also tested, primarily to determine soil type and stratigraphy.

Tailings samples from test pits were reconstituted in the laboratory to a range of MCs and dry densities. In general, laboratory samples were reconstituted at very loose to loose densities when simulating hydraulically-placed tailings or were compacted to reflect likely conditions following construction when simulating the LTVSMC bulk tailings proposed for use in dam construction.

4.5.1 General Material Characterization Tests

General geotechnical testing includes both index property testing, which describe the physical characteristics of a soil, and state property testing, which provides existing and past conditions to which a soil has been subjected.

Index properties are unique to a given soil, and they include gradation, percent fines (amount of material passing the #200 sieve or 0.075 mm), Atterberg limits, and specific gravity (G_S). Corresponding American Society for Testing Materials (ASTM) Test Methods are:

- Sieve and hydrometer analysis in accordance with ASTM C136 and ASTM D422, “Standard Test Method for Particle-Size Analysis of Soils”
- Atterberg Limit determinations in accordance with ASTM D4318, “Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils”
- Specific gravity tests in accordance with ASTM D854, “Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer”

The gradation and Atterberg limits help determine the classification of the soil with respect to the Unified Soil Classification System (USCS). The classifications of tested samples for each of the various existing materials at the site are described in Table 4-1.

Table 4-1 USCS Material Classification

Field Classification	USCS
LTVSMC Coarse Tailings	SM, SP-SM
LTVSMC Fine Tailings	SM, ML
LTVSMC Slimes	ML, ML/CL, CL
Till	SM with gravel
Peat	PT/OH, OH

The Atterberg limits assess the behavior of a fine-grained soil over a range of water contents. The results are useful when characterizing the behavior of fine-grained materials to assess whether they are clays or silts. Atterberg limits are provided in terms of the MC of the soil. The MC at the point of transition from semisolid to plastic state is the Plastic Limit (PL) and from plastic to liquid state is the Liquid Limit (LL).

The *Gs* is directly impacted by the mineralogy of the soil and describes the unit weight of the solids in the soil as a ratio to the unit weight of water.

Additional common soil properties, such as MC and dry density, are dependent on the state of the material, particularly when assessed relative to other similar soils. Corresponding ASTM Test Methods are:

- MC tests in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass"

- ASTM D7263-09 Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens

Samples obtained from test pits and collected during SPT were submitted for general material characterization tests. Undisturbed samples (obtained via either direct push or piston sampling methods in 3-inch thin-wall tubes as discussed in Section 4.4.5) were tested for:

- Atterberg Limits

- Hydrometer and Sieve Analysis for Grain Size

- Specific Gravity

- Moisture Content

Disturbed split-spoon soil samples were used to determine soil type and stratigraphy based on the USCS in the field and on samples analyzed in the laboratory.

4.5.2 Permeability Tests

The main parameter associated with seepage analysis is the saturated hydraulic conductivity of the tailings and foundation materials. In geotechnical practice, the term permeability is often used to describe hydraulic conductivity. The term permeability will be used in the remainder of this text.

Two laboratory test methods were used to measure permeability. The constant-head rigid-wall method is typically employed for coarse-grained soils, while the falling-head flexible-wall test is more suitable for fine-grained soils. For both tests, a hydraulic gradient is established in the soil causing water to flow through the sample. Either the change in head (flexible-wall test) or the volume of water added to maintain the head (rigid-wall test) is monitored against time and used to compute the vertical saturated permeability of the soil. Corresponding ASTM Test Methods are:

- Permeability of cohesionless soils in accordance with ASTM D2434, "Standard Test Method for Permeability of Granular Soils (Constant Head)"

- Permeability of cohesive or fine-grained soils in accordance with ASTM D5084, "Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter"

Grain size estimation can also be used to estimate the permeability of soils. With grain size data, Hazen's equation (typically applied to granular material) roughly estimates the permeability of a soil based on the particle diameter at which 10% of the sample is smaller:

$$k = cD_{10}^2$$ **Equation 4-4**

where:

k = hydraulic conductivity (permeability), cm/sec
c = unitless constant (taken equal to 1.0; [Reference (18)])
D_{10} = diameter of which 10% of the sample by weight is smaller, mm

Samples obtained from test pits and collected during SPT were submitted for permeability testing. Test pit samples were tested for constant head permeability (coarse tailings and bulk tailings mixes). SPT undisturbed samples were tested for falling head permeability (fine tailings and slimes), and constant head permeability (coarse tailings and bulk tailings mixes).

4.5.3 Triaxial Compression and Direct Shear Tests

The shear strength was assessed in the laboratory using triaxial compression and direct shear tests. Consolidation and moisture-density relationships of materials were assessed using in-laboratory material testing. Triaxial compression tests, consolidation tests, and Proctor tests were performed per the following ASTM Test Methods:

- Triaxial compressive strength in accordance with ASTM D2850, "Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils"

- Consolidation test in accordance with ASTM D2435, "Standard Test Methods for One Dimensional Consolidation of Soil Using Incremental Loading"

- Standard Proctor Density determinations in accordance with ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))"

Triaxial shear tests (isotropically-consolidated undrained or drained) were performed on test pit samples and undisturbed thin-wall samples from SPT boreholes. One-dimensional consolidation tests were performed on undisturbed thin-wall samples from SPT boreholes. Attachment C provides additional detail on triaxial testing methods.

4.6 Tailings Mineralogy

Tailings particle shape (morphology), which can be influenced by mineralogy, is a factor in estimating material strength. Existing data regarding mineralogy and shape of the LTVSMC tailings were reviewed and additional testing was performed on both LTVSMC tailings and Flotation Tailings.

Scanning electron microscope (SEM) photographs of the LTVSMC tailings were supplied in both the 1996 Tailings Dam Investigations Report (Reference (19)) and 2000 LTVSMC Tailings Dam Field Exploration and Analyses Report (Figure 1 of Reference (11)). Neither report documents the mineralogy associated with the SEM images, but there are notations of "kaolinite-size platy particles with sharp angles" (Reference (19)) or "platy-shaped particles" with and without "significant amount of edge-face interaction" present (Reference (11)).

4.6.1 Mineralogical Composition

The mineralogy of the Flotation Tailings and the LTVSMC tailings was characterized using petrographic analysis or X-ray diffraction, respectively (Reference (20)). Results are summarized in Table 4-2. Mineralogical composition is markedly different between the two types of tailings and appears to reflect the ore mineralogy. The Flotation Tailings are comprised predominantly of plagioclase with lesser amounts of olivine and pyroxenes (consistent with a Duluth Complex source); while the LTVSMC tailings are quartz-rich with lesser amounts of carbonate minerals and iron oxides (consistent with Biwabik Iron Formation source).

Table 4-2 Mineralogical Composition of Flotation Tailings (determined by petrographic analysis) and LTVSMC Tailings (by X-ray diffraction)

Flotation Tailings	LTVSMC Tailings
Plagioclase (50-80%)	Quartz (58-79%)
Olivine (10-15%)	Pyrite (0-0.4%)
Clinopyroxene (4-5%)	Calcite (0.1-1%)
Orthopyroxene (0-2%)	Ankerite (2-8%)
Biotite (1%)	Siderite (2-8%)
Chlorite (0.25-1.5%)	Hematite (1-3%)
Serpentine (0-0.25%)	Magnetite (1-4%)
Sericite/Muscovite (0.25-2%)	Biotite (1-11%)
Illmenite (0.5-1%)	Ferriphyllite (2-6%)
Pyrite (rare)	Albite low (0-5%)
Pyrrhotite (0.25-0.50%)	

Flotation Tailings	LTVSMC Tailings
Chalcopyrite (rare)	
Sphalerite (rare)	
Galena (0-0.05%)	

Results summarized from SRK ((Reference (20))

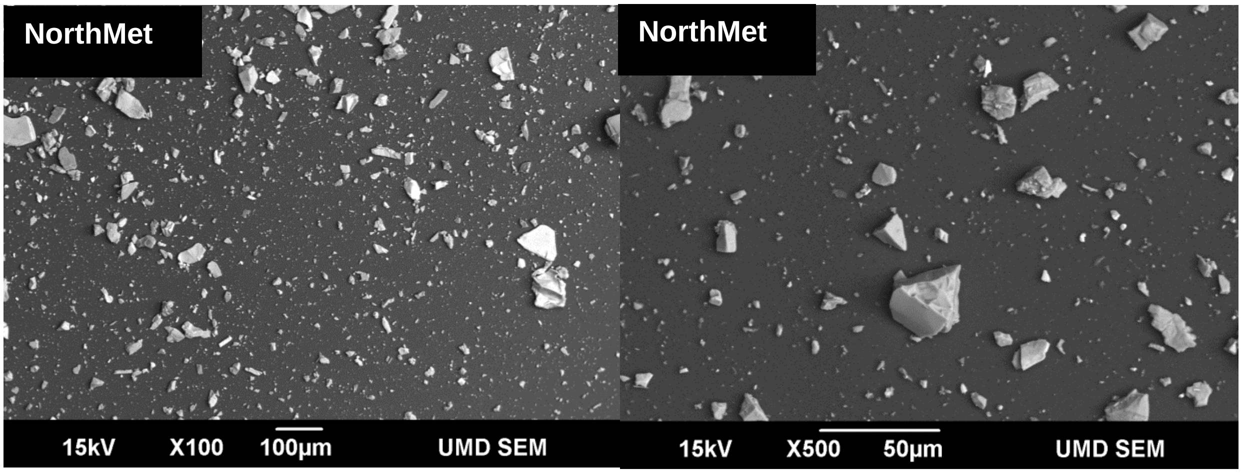
4.6.2 Particle Morphology

The Flotation Tailings could potentially be more tabular than the LTVSMC tailings because they contain plagioclase, which generally has a tabular crystal habit. However, it may also be the case that, because of potential cumulate growth restriction of crystals during formation and/or the milling/flotation process itself, the individual Flotation Tailings may be rather equant, and not reflective of plagioclase's tabular habit. To resolve this question, a side-by-side comparison of the morphology of the two types of tailings was performed. Morphologies exhibited by particles in the Flotation Tailings and LTVSMC tailings were evaluated using data collected by a SEM at the University of Minnesota Duluth's Research Instrumentation Laboratory (Attachment K).

Three types of tailings were used: (1) Flotation Tailings produced from a pilot plant for the Project, (2) slimes from LTVSMC, and (3) fine tailings from LTVSMC. The fine tailings and slimes from LTVSMC were combined at a 1:1 ratio to create one representative sample with a similar size distribution to the flotation tailings. Images of the tailings were collected by a SEM and energy dispersive x-ray spectroscopy was used for chemical analysis of selected particles. Samples were prepared for SEM analysis following the Bern et al. (2009) procedure wherein each sample was suspended in isopropanol at a concentration of approximately 10mg/ml and briefly placed in an ultrasonic bath to thoroughly mix the sample. A 10 µL drop of the resulting suspension was placed on a 0.2 µm pore size polycarbonate membrane filter affixed to an aluminum SEM sample stub. The drop was allowed to dry and the resulting particulate dispersion was coated with a conductive carbon film approximately 20 nm thick in order to make the sample electrically conductive (Attachment K).

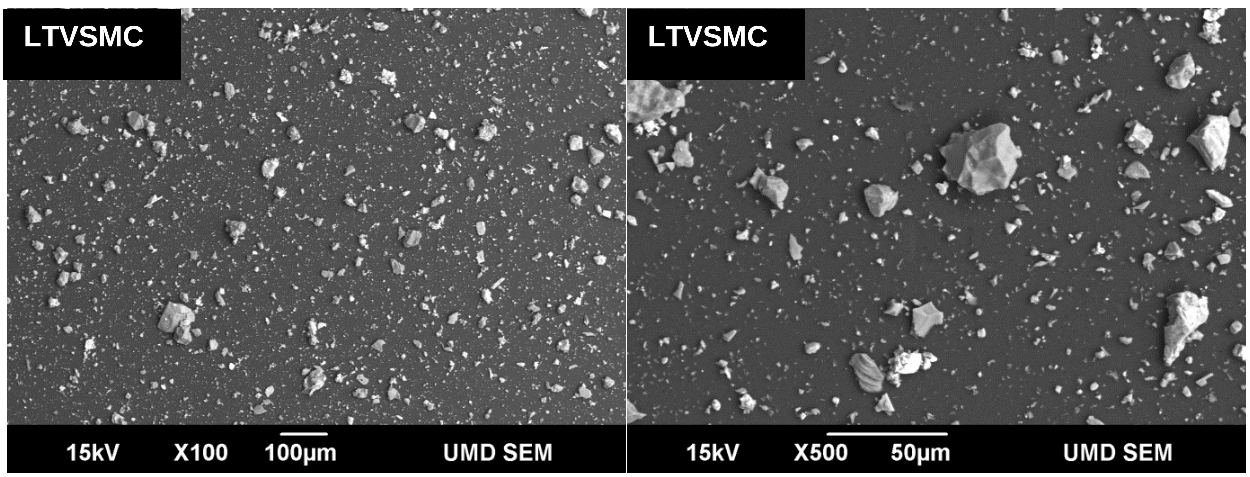
The above sample preparation method results in individual particles distributed on the filter, with some variation in particle density across the filter to be expected. Scanning electron images were collected at magnifications ranging from 100X to 2000X.

Particles in both the Flotation Tailings and the LTVSMC tailings exhibit a wide range of morphologies. Qualitatively comparing the Flotation Tailings in Figure 4-1 and the LTVSMC tailings in Figure 4-2, both types of tailings appear to be dominated by equant to subequant particles. Additional images can be found in Attachment K.



(Attachment K)

Figure 4-1 SEM Images of Flotation Tailings at 100x and 500x Magnification



(Attachment K)

Figure 4-2 SEM Images of LTVSMC Fine Tailings/Slimes at 100x and 500x Magnification

In the Flotation Tailings, the particles are smaller than the original plagioclase crystal in the ore. Plagioclase crystals in the waste rock and lean ore have been observed to range in size from 100 µm to over 2,000 µm (Attachment K), while Flotation Tailings particles appear to range in size from approximately 0.5 µm to 100 µm in the SEM images. Plagioclase has characteristic perfect cleavage on the (001) plane, good cleavage on the (010) plane, poor cleavage on the (110) planes, and displays an uneven fracture surface on all other planes (Attachment K). Both cleavage and fracture surfaces can be observed in the SEM images of Flotation Tailings.

Therefore, plagioclase particle morphology in the Flotation Tailings reflects forms created during crystal breakage, not crystal growth. It appears that liberation of the minerals during milling and flotation sufficiently crushed the individual crystals, such that they no longer retain a tabular crystal habit.

4.6.3 Long-term Weathering of Flotation Tailings

The Flotation Tailings are expected to slowly weather, as described in Attachment L. The dominant mineral in the Flotation Tailings is plagioclase (50% to 80% by volume), making up the bulk of the tailings. Microprobe work shows that composition of the plagioclase in the NorthMet Deposit is labradorite. As described in Attachment L, labradorite is expected to weather at a relatively slow rate under conditions at the earth's surface and is susceptible to the primary agent of chemical weathering that takes place at the surface of the mineral: water, oxygen, and carbonic acid. The weathering results in the formation of new stable minerals. Published weathering rates for plagioclase indicate that labradorite is estimated to weather at a maximum rate of 0.1% by mass in 20 years, 0.9% by mass in 200 years, and 9.1% by mass in 2,000 years. These published rates were assumed for weathering rates of the Flotation Tailings. However, in the FTB the kinetics are such that the dissolution rate will likely be even slower, because the cover will limit exposure of plagioclase to fresh solvent (rainwater). For the very small amount of dissolution that does occur, some of the material could leave the basin in seepage, but more typically will build up on other plagioclase surfaces with time.

The weathering will result in the formation of secondary minerals that could increase or decrease strength in the long-term. The slow weathering of primary silicate minerals (for example, plagioclase) is expected to produce a relatively minor amount of clay and other secondary products in the basin and dissolved weathering products that will be flushed out. In addition, the weathering of ferrous iron-containing minerals, including iron sulfide minerals, will produce iron oxide/oxyhydroxide coatings and cement. The tailings are projected to weather at a very slow rate.

A discussion on how the long-term weathering was applied to the slope stability models and the long-term weathering strength values are presented in Section 6.7.

4.7 Overview of Stratigraphy and Material Types

Data from geotechnical investigations were used to group materials into units for definition of stratigraphy and determination of material properties. Ten material types have been defined at the Project Site for the geotechnical analysis:

- LTVSMC coarse tailings – existing material typically located in the shell of the Tailings Basin, comprised of larger particles of tailings that settled out closer to the dam crest during hydraulic deposition, the outer/upper zone of which was reworked to form subsequent lifts for the LTVSMC dams.

- LTVSMC slimes – existing material typically located toward the center of the Tailings Basin, comprised of finer tailings particles.

- LTVSMC fine tailings – existing material typically located upstream of the slimes, comprised of mid-size particles that commonly settled out in between the slimes and coarse tailings.

- Interior LTVSMC fine tailings/slimes – existing material, referring to tailings zones within the central portion of the Tailings Basin where fine tailings and slimes are so thoroughly interbedded they cannot be individually distinguished.

- LTMSMC fine tailings/slimes – material category used only in stability modeling to represent the overall mass of fine tailings and slimes.

- Till – existing native material comprising the thick consolidated foundation layer for the existing Tailings Basin.

- Peat – existing native material overlying the native till in a discontinuous layer.

- Rock dam/buttress – existing material representing the rock starter dam under the initial lift of the Tailings Basin, also used as a future material for the proposed buttress at the toe of the dam.

- LTVSMC bulk tailings – future material to be comprised of borrowed LTVSMC coarse tailings (with occasional inclusions of finer tailings) used to construct the FTB dams.

- Flotation Tailings – future material to be impounded in the FTB upstream of the LTVSMC tailings dams.

- Granitic Bedrock – native rock underlying the native till and peat. The upper 10 feet of bedrock was modeled as fractured and bedrock below 10 feet was considered to be impermeable (Reference (21)).

The general stratigraphy along Cross-Sections F, G, and N (as discussed in greater detail in Section 7.1) is based on the field data and presented in detailed cross-sections on Figures B-2, B-3, and B-4, respectively, in Attachment B.

5.0 Physical Properties of Materials

The FTB design involves modeling the seepage conditions and slope stability anticipated as a result of the proposed FTB construction, operation, and closure. The analyses require inputs of hydraulic and strength parameters of all material zones incorporated into the seepage and stability models. Material strength characterization, including descriptions of how results of field and laboratory tests were used to select material strength parameters, is presented in Attachment C. Results of both field and laboratory testing are presented for each of the following material types:

- LTVSMC tailings (including coarse tailings, fine tailings, slimes, interior fine tailings/slimes, and bulk tailings)
- Flotation Tailings
- Native soils

5.1 Material Strength Parameter Selection Approach

The method used to select design parameters is based on Barr's experience and peer review discussions with Mr. Richard Davidson and Dr. Scott Olson, as described in Attachment C. The methodology for selection of design material strength parameters developed in consultation with Dr. Olson is detailed in (Attachment M). This method provides a systematic approach that is not reliant on statistical analysis of data that are often difficult to fit to typical data distributions (i.e., normal distribution, log normal distribution, generalized extreme distribution, triangular distribution, and possibly others). For complete details, see Attachment C, but generally, design values (DV) were selected based on the following:

- Both laboratory data and field data are included in the analysis.
- 33rd percentile drained and yield undrained shear strength is used for the Effective Stress Stability Analysis (ESSA) and Yield Undrained Strength Stability Analysis ($USSA_{yield}$), respectively (i.e., on cumulative data plots, 33% of the data yields lower strengths and 67% of the data yields higher strengths than the selected design value).
- For drained and undrained yield shear strengths, the design value was determined by averaging the individual 33rd percentile value from various types of field tests, then adding the average of the 33rd percentile laboratory test results and finding the overall average.
- Material liquefied strength analyses include only the laboratory and field test results for samples that presented contractive or quasi-steady state behavior during shear. Results for samples which dilated during shear (strain-hardening behavior) are not included in material liquefied strength analyses. The effect of this approach is that the shear strength

calculation is conservative because it discounts stronger materials that are present in the tailings.

- For undrained liquefied shear strengths, the design value was determined by averaging the individual 50th percentile value from various types of field tests, then adding the average of the 50th percentile laboratory test results and finding the overall average. Dr. Olson recommended the use of average liquefied shear strength (rather than 33rd percentile) due to the conservative nature of the sample set being tested (i.e., LTVSMC slimes and fine tailings and Flotation Tailings samples with higher strengths are not included).

- Engineering judgment was required to select an appropriate percentile value of strength (i.e., 33rd percentile, average), to weight the values appropriately that are used to assess strengths (e.g., combining averages of field and laboratory data), and to select final material strength parameter DV for liquefied shear strength.

The field and laboratory testing results used for material strength design value selection are presented in Attachment C and summarized in Section 5.2.3 for the LTVSMC tailings, Section 5.3.3 for the Flotation Tailings, and Section 5.4.3 for the native materials (the till, peat, and rock starter dam). Bedrock strength is summarized in Section 5.5.2 and the strength of the Cement Deep Soil Mix (CDSM) zone is summarized in Section 5.6.3

5.1.1 Contractive-Dilative Behavior and Liquefation

Liquefaction refers to post-yield undrained behavior of saturated, contractive silts and sands. The potential for LTVSMC coarse tailings, fine tailings, slimes, fine tailings/slimes, and NorthMet Flotation Tailings to liquefy was evaluated using laboratory and field data available at the time of the analysis in 2013 (Attachment C).

Reference (22) presents a relationship to assess the tendency for relatively clean sands to contract or dilate, based on corrected SPT blow counts (or CPT tip resistance) and effective vertical stress. Olson (Reference (16)) updated the relationship to account for variable compressibility for tailings. Contractive-dilative behavior is further discussed in Attachment C (with additional references cited), which also describes how this behavior has been identified with laboratory testing, SPT blow counts, and CPTu tip resistance. The laboratory data included some triaxial tests that displayed contractive behavior and quasi-steady state behavior. SPT and CPTu data were analyzed for contractive-dilative behavior, and only contractive data points were used to evaluate liquefied shear strength. Remolded strength was also determined from field vane shear testing.

5.2 LTVSMC Tailings

This section presents the results of field and laboratory tests available for analysis through 2013 on LTVSMC tailings. It describes general geotechnical properties, permeability, and shear strength of five types of LTVSMC tailings: coarse tailings, fine tailings, slimes, interior fine tailings/slimes, and bulk tailings.

Geotechnical modeling of the FTB uses material properties of the LTVSMC tailings in several contexts. First, LTVSMC tailings comprise the foundation for the new FTB dams. Second, portions of the proposed dams for the FTB will be constructed using LTVSMC bulk tailings (selectively LTVSMC coarse tailings, with incidental inclusions of fine tailings and slimes).

The following discussion to describe the LTVSMC tailings is subdivided into three sections:

(1) The results of laboratory testing for general geotechnical properties of the tailings;

(2) A discussion of permeability values utilized in past evaluations and data analyzed for this geotechnical evaluation, providing the DV selected for seepage modeling; and

(3) A description of shear strength parameters utilized in past evaluations and a summary of the DV selected for stability modeling.

This subsection organization is also applied to the discussion of subsequent material types. Detailed information on the analysis of data for shear strength determination is provided in Attachment C.

5.2.1 General Geotechnical Properties of LTVSMC Tailings

Multiple in-laboratory material tests were conducted on LTVSMC tailings samples to determine material index properties and strength parameters (Section 4.5). Key test results include the percent passing the #200 sieve (P_{200}, also known as the percent fines), the dry unit weight (γ_{dry}), the MC, the PL, the LL, and the G_s. Laboratory test results are provided in Attachment E. The maximum, minimum, and average values of the key test results are provided in Table 5-1 for LTVSMC coarse tailings, Table 5-2 for LTVSMC fine tailings, and Table 5-3 for LTVSMC slimes. These tables also include the standard deviation and the number of tests analyzed.

Table 5-1 Summary of Index Properties of LTVSMC Coarse Tailings

Parameter	Minimum	Maximum	Average	Standard Deviation	No. of Tests
P_{200}	3.0	19.0	13.0	3.8	38
γ_{dry} (pcf)	104.2	125.0	116.1	5.1	11
MC (%)	2.2	17.5	7.1	3.2	42
PL	--	--	NP	--	1
LL	--	--	NP	--	1
G_S	2.69	2.93	2.80	0.12	3

NP = non-plastic response

Table 5-2 Summary of Index Properties of LTVSMC Fine Tailings

Parameter	Minimum	Maximum	Average	Standard Deviation	No. of Tests
P_{200}	13.2	95.7	66.1	22.1	56
γ_{dry} (pcf)	76.2	111.4	98.5	9.0	15
MC (%)	3.6	34.7	17.8	8.3	78
PL	16.7	22.0	19.5	2.2	11
LL	17.5	29.4	23.4	4.0	11
G_S	2.62	3.03	2.94	0.08	21

Table 5-3 Summary of Index Properties of LTVSMC Slimes

Parameter	Minimum	Maximum	Average	Standard Deviation	No. of Tests
P_{200}	90.4	99.9	97.7	2.5	56
γ_{dry} (pcf)	77.9	111.5	91.6	8.1	40
MC (%)	11.0	58.2	32.6	6.9	81
PL	16.5	27.6	21	2.6	63
LL	18.6	37.9	26.9	4.2	63
G_S	2.93	2.99	3.00	0.02	8

5.2.2 Permeability of LTVSMC Tailings

The permeability values used for analysis and design of the Tailings Basin have varied throughout historical evaluations as more test results have become available (see Table B-1 of Attachment B for values from individual historic reports). Table 5-4 summarizes the LTVSMC tailings permeabilities used by previous investigators for seepage analysis. The data were compiled through a review of reports discussing the stability of the Tailings Basin.

Table 5-4 LTVSMC Saturated Permeabilities Used by Previous Investigators

Material	Historical	Barr Engineering Co.
	Permeability (cm/s)	Permeability (cm/s)
LTVSMC Coarse Tailings	5.00×10^{-5} to 1.00×10^{-2}	5.00×10^{-5} to 2.44×10^{-3}
LTVSMC Fine Tailings	1.00×10^{-5} to 5.00×10^{-4}	1.00×10^{-5} to 2.00×10^{-4}
LTVSMC Slimes	2.75×10^{-7} to 5.00×10^{-5}	2.75×10^{-7} to 9.60×10^{-7}

In Table 5-4, the historical permeability value for coarse tailings was estimated from grain size distribution (Hazen's method), and the permeability values for fine tailings and slimes were estimated by previous investigators. In fact, many previous studies (pre-2000) used monitoring data from piezometers to create a phreatic surface for stability analyses to calculate pressure heads, rather than incorporating permeability into the seepage models to estimate the seepage conditions for stability analysis.

The following sections present the laboratory and field permeability test results for each type of LTVSMC tailings, and describe how the model input parameters for permeability were chosen for the current geotechnical evaluation.

5.2.2.1 Permeability of LTVSMC Coarse Tailings

No evidence of previous permeability testing in support of historic LTVSMC coarse tailings design parameters was uncovered in the review of available published data (Attachment D). The permeability of the LTVSMC coarse tailings was evaluated in the laboratory using remolded tailings samples, due to the inherent difficulty in obtaining an undisturbed sample of granular material. The coarse-grained nature of these tailings also generally results in rapid dissipation of CPT penetration-induced porewater pressure and makes interpretation of the in-situ permeability difficult. Therefore, CPT test data was not used for determination of LTVSMC coarse tailings permeability.

LTVSMC coarse tailings permeability used in the current modeling is based on six reconstituted laboratory specimens created from bulk samples obtained from test pits. The specimens were reconstituted to dry unit weights ranging from approximately 104 to 125 pcf and tested using the constant-head rigid-wall permeability test method. Standard Proctor testing indicated that the maximum dry unit weight of the LTVSMC coarse tailings is 124.7 pcf. The maximum dry density, which occurred at an optimum MC of 11.7%, was rounded to 125 pcf. Portions of the existing LTVSMC coarse tailings were compacted in the field by rubber-tired dozers in thin lifts, so some dry densities are likely above 124.7 pcf. It was assumed that the LTVSMC coarse tailings around the perimeter may exhibit a unit weight greater than the Standard Proctor maximum dry density because the shell of the dam has and will continue to undergo compaction and consolidation. The relative density, indicating in-situ density for granular soil, for LTVSMC coarse tailings (as approximated from CPTu testing) varied from 70% to 100%, with the majority of the data plotting above the 80% line (as presented in Attachment N). The permeability tests were therefore performed on samples with densities ranging from 84% to 95% of the standard Proctor maximum dry density. Table 5-5 shows the range in coarse tailings permeability values interpreted from the test results.

Table 5-5 Range of Saturated Permeability of LTVSMC Coarse Tailings

	k (cm/sec)	k (ft/day)	k (ft/sec)
Minimum	1.62×10^{-3}	4.61	5.33×10^{-5}
Maximum	3.51×10^{-3}	9.94	1.15×10^{-4}
Standard Deviation	8.41×10^{-4}	2.38	2.76×10^{-5}
Geometric Mean(1)	2.44×10^{-3}	6.91	8.00×10^{-5}

(1) The geometric mean was selected as the design value for seepage modeling

The geometric mean is used as the seepage analysis input permeability for the LTVSMC coarse tailings for this evaluation. The geometric mean is used rather than the arithmetic average because parameters that vary over several orders of magnitude, such as permeability, are typically plotted on a log-scale. The geometric mean is computed as the average of the natural log of the permeability values. Using the log-scale and the geometric mean helps to reduce bias caused by wide variation in values.

These permeability values were compared to estimations using Hazen's equation (Reference (23)), as described in Section 4.5.2.

Based on the LTVSMC coarse tailings grain size D_{10} range of 0.20 – 0.027mm (Large Figure 1), the permeability range is estimated to be 4.0 x 10^{-2} cm/sec (1.31 x 10^{-3} ft/sec) to 7.29 x 10^{-4} cm/sec (2.39 x 10^{-5} ft/sec); a range which encompasses the values obtained by laboratory testing.

5.2.2.2 Permeability of LTVSMC Fine Tailings

Determination of the permeability of LTVSMC fine tailings has been constrained by several circumstances. First, no evidence of historical permeability testing in support of previous LTVSMC fine tailings design parameters was uncovered while reviewing available published data (Attachment D). Second, during the geotechnical explorations, the LTVSMC fine tailings were tested for permeability by in-situ dissipation testing performed during CPTu soundings. However, similar to the LTVSMC coarse tailings, the interpretation of the dissipation testing was found to be difficult at the locations tested. The relative coarseness of the fine tailings inhibits the ability to measure porewater pressure dissipation because the fine tailings are fairly permeable and any penetration-induced porewater pressure dissipates fairly quickly. Also, field investigations were unable to obtain representative undisturbed samples of the LTVSMC fine tailings (based on the Ebasco grain size distribution classifications, Large Figure 1).

Upon review of all of the materials encountered on the site, the average P_{200} grain size distributions of the LTVSMC fine tailings and Flotation Tailings were found to be similar, as can be seen by comparing Table 5-2 with Table 5-11. The measured hydraulic conductivity of the Flotation Tailings (Section 5.3.2) was therefore used as the basis for the hydraulic conductivity of the LTVSMC fine tailings. The measured grain size distribution of the LTVSMC fine tailings shown in Table 5-2 depicts these materials slightly differently than the text of Ebasco's historical reports on LTVSMC fine tailings, which indicate a range of gradations which may include "up to 95% fines" (as reported in Attachment D). While the maximum P_{200} observed from tests on LTVSMC fine tailings was 95.7%, the average P_{200} of the samples tested was 66.1%. However, the LTVSMC fine tailings samples collected as part of the supporting geotechnical investigations and tested for grain size distributions were typically on the coarser end of the range if they classified as fine tailings. Because a limited amount of fine tailings sample was collected, this material has been identified as a material that should be targeted for future testing and whose parameters may need to be updated in future analyses.

Permeability of the fine tailings was set at 2.00×10^{-5} cm/sec (6.56×10^{-7} ft/sec) which was used for proposed conditions seepage analyses. This value is near the lower bound of the Flotation Tailings data (Large Figure 3), where the relationship between overburden and permeability becomes increasingly asymptotic toward 1.00×10^{-5} cm/sec as depth increases. This value was obtained from a sample tested at a confining pressure related to approximately 80 feet of overburden. While the LTVSMC fine tailings will be under a greater overburden pressure than this at final dam height, the flow is primarily horizontal within the LTVSMC tailings, owing to the bedding that occurs during hydraulic deposition. Unlike vertical flow tested in the laboratory in a small confined soil cylinder, horizontal flow can find and follow more permeable pathways, and therefore the lower bound from the permeability testing of Flotation Tailings is considered appropriate for use in the current seepage modeling of the LTVSMC fine tailings. While anisotropy could be incorporated in an effort to account for increased horizontal flow, because of the complexity of the deposit, an isotropic permeability was used for the tailings.

5.2.2.3 Permeability of LTVSMC Slimes

The LTVSMC slimes are generally located within the interior portion of the Tailings Basin or in isolated areas under the existing dams. Permeability of the slimes was measured by two methods: 1) in-situ dissipation testing performed during CPTs; and 2) laboratory permeability testing on undisturbed samples. Over 40 in-situ dissipation tests were performed at various locations and depths within Cells 1E and 2E. The time necessary for dissipation of 50% of the peak penetration-induced porewater pressure, t_{50}, was determined, as described in Section 4.4.2. Published correlation charts for piezocone analyses were used to obtain the estimated horizontal permeability values (Reference (17)). The dissipation (k_h) and laboratory data (k_v) are plotted and presented as Large Figure 4.

Falling-head flexible-wall laboratory permeability testing of 13 undisturbed samples obtained from thin-wall (Shelby) tubes from six boring locations showed permeability values within the same range as those determined from dissipation testing. However, the laboratory values are skewed slightly lower than the field data, possibly due to potential anisotropy (the variability between horizontal permeability, as measured by dissipation testing, and vertical permeability, as measured in the laboratory). As shown in Large Figure 4, the data indicate that there is little to no sensitivity to effective overburden pressures, as the data show significant scatter with no discernible trends in either the in-situ or laboratory testing.

The geometric mean of the saturated permeability is 9.63 x 10^{-7} cm/sec (3.16 x 10^{-8} ft/sec), as presented in Table 5-6 and in Large Figure 4. This value is closer to the lower bound, but within the range used by Barr in January and March, 2000, for which laboratory testing was used to determine the permeability. This geometric mean was considered mildly conservative, as flow through the LTVSMC slimes is likely more horizontal than vertical. In horizontal flow, water will tend to follow the paths of least resistance (e.g., will seek out more permeable “fingers” of fine tailings or less clayey layers of slimes).

Table 5-6 Range of Saturated Permeability of LTVSMC Slimes

	k (cm/sec)	k (ft/day)	k (ft/sec)
Minimum	3.76 x 10^{-7}	1.07 x 10^{-3}	1.23 x 10^{-8}
Maximum	3.61 x 10^{-6}	1.02 x 10^{-2}	1.18 x 10^{-7}
Standard Deviation	9.38 x 10^{-7}	2.66 x 10^{-3}	3.08 x 10^{-8}
Geometric Mean	9.63 x 10^{-7}	2.73 x 10^{-3}	3.16 x 10^{-8}

While anisotropy could be incorporated in an effort to account for increased horizontal flow, because of the complexity of the deposit, an isotropic permeability was used for the tailings. To better reflect the available data and to increase conservatism in the geotechnical seepage model because the model represents three-dimensional conditions in a two-dimensional section, the geometric mean of 9.63 x 10^{-7} cm/sec (3.16 x 10^{-8} ft/sec) is used in the proposed conditions (future construction) modeling. Conservatism from a geotechnical standpoint is increased by using a less permeable material as it confines flow and leads to increased porewater pressure.

5.2.2.4 Permeability of LTVSMC Interior Fine Tailings/Slimes

To simplify the seepage model, the material in the interior portion of the basin where fine tailings and slimes are finely interbedded is treated as a single unit and assigned a single permeability. The interior fine tailings/slimes region is separated from the region with individual fine tailings layers and slimes layers based on CPT analyses indicating few if any coarse tailings in the interior fine tailings/slimes region relative to the fine tailings and slimes regions. This unit, used in seepage modeling, is referred to as LTVSMC interior fine tailings/slimes. This modeling simplification was made prior to the submittal of Geotechnical Data Package – Volume 1 – Version 2.

This simplification allows a reduction in the number of elements within the model and better accounts for uncertainty regarding the continuity of layers within the central portion of the section. Furthermore, this approach was recommended by Dr. Peter Robertson in Version 1 review comments provided to Barr by the MDNR. Earlier modeling had included relatively thin LTVSMC fine tailings and slimes layers throughout the entirety of the Tailings Basin. However, there is uncertainty regarding the stratigraphy of these thin layers. Very little boring data is available toward the center of the Tailings Basin, due to the presence of ponded water in the cells. Data were limited to two test locations that were over 500 feet apart. The simplified unit better represents this uncertainty.

The LTVSMC interior fine tailings/slimes region was modeled with a saturated permeability of 3.05×10^{-6} cm/s (1.00×10^{-7} ft/s). This value is the geometric mean of all the permeability test data for the LTVSMC fine tailings and slimes (provided in Sections 5.2.2.2 and 5.2.2.3). This value was assumed appropriate based on the stratigraphy shown on Figure B-2 and Figure B-3 in Attachment B, which indicates that the interior in Cell 2E is a mixture of both fine tailings and slimes. Analysis of the cross-sectional area represented by each material type along Cross-Section F indicates slightly more slimes exist than fine tailings, but amounts are similar. A limited sensitivity analysis was performed and in comparison to assigning a higher permeability (to simulate that stringers of fine tailings would dominate the response of this combined region), the selected permeability above the native soils limits vertical seepage and encourages more horizontal flow to the dam face. This is likely a conservative approach that produces a higher phreatic surface in seepage models.

5.2.2.5 Permeability of LTVSMC Bulk Tailings

The LTVSMC bulk tailings are taken as a conservative (finer grain size) representation of the coarse tailings to be excavated for use in construction of the shell along the downstream slope of the FTB dams. While the goal is to excavate only coarse tailings for use in FTB dam construction, it is impractical to assume that only coarse tailings will be excavated for construction. In reality, the excavated tailings will be mostly LTVSMC coarse tailings with some inclusions of LTVSMC fine tailings and a small amount of slimes. To investigate the effects of the inclusion of slimes and fine tailings within the coarse tailings, four mixtures of tailings with various proportions of coarse tailings, fine tailings, and slimes were prepared from samples obtained during test pitting in the Tailings Basin. For conservatism, the blends focused on slightly finer blends than the predominantly coarse tailings material that will be utilized for FTB construction. The four mixes are described in Table 5-7.

Table 5-7 LTVSMC Bulk Tailings Blends

	Blending Ratio					
Blend	**LTVSMC Coarse Tailings**	**LTVSMC Fine Tailings**	**LTVSMC Slimes**	**P_{200}(1) (% by weight)**	**USCS**	**Field Classification**
1	5 parts	4 parts	1 part	23.9	SM	Fine tailings
2	15 parts	4 parts	1 part	15.5	SM, SP-SM	Coarse tailings
3	5 parts	8 parts	2 parts	27.8	SM	Fine tailings
4	5 parts	16 parts	4 parts	43.2	SM	Fine tailings

(1) The fines content of each blend was obtained by grain size analysis, data in

Each of the mixtures was tested for permeability using the constant head, rigid wall method (ASTM D5856) with the resulting range of values shown in Table 5-8. The geometric mean value of 8.02 x 10^{-5} cm/sec (2.63 x 10^{-6} ft/sec) was used for design and is similar to the hydraulic conductivity of Blend 2 (7.0 x 10^{-5} cm/sec); the blend assumed to be most representative of what will be obtained when the LTVSMC coarse tailings are targeted for excavation and use in construction.

Table 5-8 Range of Saturated Permeability of LTVSMC Bulk Mixtures

	k (cm/sec)	k (ft/day)	k (ft/sec)
Minimum	6.61 x 10^{-5}	0.19	2.17 x 10^{-6}
Maximum	1.01 x 10^{-4}	0.29	3.33 x 10^{-6}
Standard Deviation	1.61 x 10^{-4}	0.46	5.27 x 10^{-6}
Geometric Mean	8.02 x 10^{-5}	0.23	2.63 x 10^{-6}

Note that the LTVSMC fine tailings were assumed to be more permeable than the LTVSMC bulk tailings due largely to differences in deposition. The fine tailings were hydraulically deposited and subjected to consolidation only from self-weight and pressure from subsequent overlying material. The LTVSMC bulk tailings will be compacted as a construction material, resulting in lower void ratios than would be expected in the LTVSMC fine tailings. Further, as stated previously, the LTVSMC bulk tailings may have occasional inclusions of fine tailings and slimes. For these reasons and based on engineering judgment, a lower hydraulic conductivity was assigned to the LTVSMC bulk tailings than to the fine tailings.

5.2.3 Shear Strength of LTVSMC Tailings

Both the undrained and drained conditions were examined for this design. The undrained case relates to short-term conditions, typically immediately after construction, where excess porewater pressures exist in the tailings. The drained case relates to long-term conditions, where no excess porewater pressure exists in the tailings. Evaluation of the drained and undrained yield shear strengths of the LTVSMC tailings was performed during this design and included, as appropriate, processing data from laboratory triaxial testing with pore pressure measurements, SPT, CPTu, and field vane shear testing (Attachment C).

The LTVSMC tailings shear strength parameters previously used for analysis and design of the Tailings Basin have varied throughout historical evaluations as more test results have become available and as basin configuration and drainage conditions have changed. A summary of the previously calculated strength parameters used in stability analyses are presented in Table 5-9 (see Table B-1 of Attachment B for values from individual historic reports). The table includes the high and low values previously assigned to the various tailings, as well as both drained ESSA and USSA parameters. Strengths have been characterized with an effective friction angle (ϕ') and cohesion (c') for ESSA conditions. For USSA conditions, the LTVSMC slimes and fine tailings have, at various times, been characterized with either Mohr-Coulomb parameters (undrained friction angle, ϕ_{cu}, and undrained cohesion, c_u) or undrained shear strength ratios (USSR). The USSR is defined as the ratio of the undrained shear strength, s_u, divided by the effective overburden stress, σ'_v. Previously assigned liquefied strength values are included in Table 5-9, where appropriate.

Table 5-9 LTVSMC Shear Strength Parameters Previously Used (1977 to 2000)

Material	Unit Weight, γ (pcf)	Drained (ESSA) Mohr-Coulomb		Undrained (USSA) USSR s_u/σ'_{vo}		Undrained (USSA) Mohr-Coulomb	
		c' (psf)	ϕ' (deg)	Yield	Liquefied	c_u (psf)	ϕ_{cu} (deg)
LTVSMC Coarse Tailings	125 - 130	-	35 - 41	-	-	-	38 - 40
LTVSMC Fine Tailings	120 - 130	-	27 - 40	0.25	0.10	-	36 - 40
LTVSMC Slimes	100 - 130	-	28 - 43	0.22 - 0.25	0.10 - 0.22	-	31

Further analysis was performed which included data collected in the 2007 geotechnical investigation and review of available and applicable historical data. The testing results, data analysis, and rationale for selected shear strength parameters are discussed in detail in Attachment C and are summarized in Table 5-10.

For seepage and stability modeling, the term ‘fine tailings/slimes’ has two connotations. For seepage modeling, the interior fine tailings/slimes unit has a given permeability, and the remaining fine tailings or slimes are modeled as separate layers with their own permeabilities. For stability modeling, the fine tailings/slimes unit encompasses the individual fine tailings and slimes layers from the seepage model. This fine tailings/slimes unit and the interior fine tailings/slimes unit are assigned the same liquefied strength value.

Table 5-10 LTVSMC Tailings Shear Strength Parameters

Material	Drained	Undrained	Liquefied
LTVSMC Coarse Tailings	ϕ' = 38.5°	N/A	N/A
LTVSMC Fine Tailings	ϕ' = 33.0°	$USSR_{yield}$ = 0.35	-
LTVSMC Slimes	ϕ' = 33.0°	$USSR_{yield}$ = 0.22	-
LTVSMC Fine Tailings/Slimes	ϕ' = 33.0°	$USSR_{yield}$ = 0.24	$USSR_{liq}$ = 0.10
LTVSMC Bulk Tailings	ϕ' = 38.5°	N/A	N/A

It is important to note that significantly more data were used for determination of shear strengths of the LTVSMC fine tailings/slimes than for the determination of shear strength for the fine tailings or slimes individually. This was because there were SPT and CPT logs in the Tailings Basin with significant zones of intermittent and interbedded layers of fine tailings and slimes, where it was not feasible to filter data for only slimes or only fine tailings. Data from these regions were used in addition to the individual data sets for the combined fine tailings/slimes shear strength determination. The resulting fine tailings/slimes shear strength parameters are within the range of values established for the fine tailings and slimes individually.

5.3 Flotation Tailings

This section presents the results of field and laboratory tests on Flotation Tailings. It describes their general geotechnical properties, permeability and shear strength. Geotechnical modeling of the FTB uses material properties of the Flotation Tailings for seepage and stability analysis of future conditions.

Flotation Tailings were produced during the pilot-plant processing of a bulk sample (approximately 43 tons) of ore at the SGS Lakefield facility in Lakefield, Ontario, Canada. Samples were collected for laboratory testing to determine geotechnical parameters. The pilot plant's bulk tailings are expected to be similar to the material that will be produced from the commercial plant. Mineralogy and shape of the Flotation Tailings is described in Section 4.6, with a comparison to LTVSMC tailings.

Two different grinds have been tested from the pilot plant. The first grind was obtained for laboratory testing in 2005 and the second grind was obtained in 2010. The second grind is slightly finer than the 2005 grind. However the grinds are relatively similar and the differences between the two are very likely within the anticipated range of gradations that could be expected from the plant. Therefore, testing has been performed on both samples and the data has been combined for determining properties of the Flotation Tailings. All laboratory 2007 test results are provided in Attachment E.

5.3.1 General Geotechnical Properties of Flotation Tailings

Several tests were conducted on samples of pilot plant Flotation Tailings in the laboratory to determine the materials' index properties. The results of the index testing are summarized in Table 5-11. These samples were often left sitting for some period of time or shipped dry; hence dry unit weight and MC were not tested. Two Atterberg Limits tests had previously indicated that the material was non-plastic and a test on the cycloned fines-only portion indicated that the finest material has a Plasticity Index (PI) of 4.3, which is slightly plastic behavior. Recent Atterberg Limits testing was performed on a sample of Flotation Tailings reporting a PI of 1.1 indicating very little cohesion. This is also supported by the triaxial test strength results that generally report zero cohesion.

Table 5-11 Summary of Index Properties of Flotation Tailings

Parameter	Minimum	Maximum	Average	Standard Deviation	No. of Tests
P_{200}	52.00	68.2	60.3	6.07	8
PL	16.4	16.4	16.4	-	1
LL	17.5	17.5	17.5	-	1
G_S	2.97	3.03	3.00	0.02	6

5.3.2 Permeability of Flotation Tailings

The in-situ permeability of the Flotation Tailings will depend on depositional conditions. St. Anthony Falls Laboratory (SAFL) conducted a physical model study (Attachment B of Reference (1)) which shows that, while there is some segregation of Flotation Tailings particles by grain size associated with hydraulic deposition, some fine particles are captured within the tailings matrix even close to the deposition point. Further, for the Project the deposition points will include multiple spigot locations around the basin perimeter as is common at other tailings basin facilities, but will also include deposition in interior portions of the basin (Reference (1)). Deposition of tailings within the interior of the FTB differs from the more routine perimeter spigotting of tailings. Tailings are more typically deposited only by perimeter spigotting and, if of a different gradation than Flotation Tailings, might show more pronounced segregation by particle size during hydraulic deposition. Based on the proposed method of deposition (Reference (1)), the Flotation Tailings are expected to undergo less hydraulic segregation than the LTVSMC tailings spigotted from the basin perimeter only. While some segregation will occur during subaerial flow from the spigots, significant amounts of fines will be captured within the soil matrix. Therefore, the Flotation Tailings were treated as a single material, rather than defining parameters for coarser and finer portions of the tailings.

The vertical permeability of the Flotation Tailings was determined from falling-head, flexible-wall laboratory permeability testing. Six specimens were reconstituted to dry densities ranging from 89.3 to 100.7 pcf and tested at confining stresses of 0.25 to 7.0 tsf. The results of the laboratory testing for permeability of the Flotation Tailings are shown in Table 5-12.

Table 5-12 Range of Permeability for the Flotation Tailings

	k (cm/sec)	k (ft/day)	k (ft/sec)
Minimum	1.98×10^{-5}	0.06	6.50×10^{-7}
Maximum	4.82×10^{-4}	1.37	1.58×10^{-5}
Standard Deviation	2.13×10^{-4}	0.60	6.98×10^{-6}
Geometric Mean	1.16×10^{-4}	0.33	3.81×10^{-6}

Plotting the permeability against consolidation stress reveals a strong correlation (Large Figure 3). The permeability becomes relatively constant for effective confining pressure greater than or equal to approximately 2 tsf. Accordingly, three representative values of permeability were selected for use in modeling: 6.23×10^{-6} ft/sec (1.90×10^{-4} cm/sec) for Flotation Tailings less under than 0.45 tsf effective overburden stress (equivalent to approximately 10 feet of soil with a unit weight of 90 pcf); 1.84×10^{-6} ft/sec (5.61×10^{-5} cm/sec) for tailings under 1.35 tsf effective overburden stress (equivalent to approximately 30 feet of overburden); and 6.56×10^{-7} ft/sec (2.00×10^{-5} cm/sec) for tailings under 2.29 tsf effective overburden stress (equivalent to approximately 50 feet of overburden). Beyond this stress range, the permeability appears to not vary significantly with increasing confinement.

It was observed that the average Flotation Tailings permeability is greater than the maximum permeability testing results on LTVSMC bulk tailings (consisting predominantly of coarse tailings). However, these are two entirely different materials. The LTVSMC bulk tailings are comprised of existing material that will be blended and compacted to a higher density during construction. Conversely, the Flotation Tailings will be hydraulically deposited and therefore will not be subjected to compaction beyond self-weight consolidation. The void ratios reported in the laboratory were also significantly different between the two materials. Additionally, only a small number of tests were performed on both of these materials, as they do not currently exist at the Project. Additional permeability testing is recommended for both during future explorations to verify selected parameters.

Flotation Tailings permeability values were applied to different portions of tailings within the models, such that the uppermost layer in any model used the highest permeability, the underlying layer used the middle permeability, and any layers below that used the lowest permeability. The three effective overburden pressures were selected to represent the average overburden pressure within a lift (e.g., the depth at the center of the respective layer).

The established permeabilities are for Flotation Tailings at initial and operating conditions, but these values were also used for long-term, post-closure modeling. The percent of mass weathered will still be relatively small, even at 2,000 years (Section 4.6.3). Long-term, plagioclase dissolution could cause the Flotation Tailings' permeability to be fractionally higher or lower though this effect might occur over thousands to tens of thousands of years.

5.3.3 Shear Strength of Flotation Tailings

The shear strength of the Flotation Tailings was evaluated through testing on bulk samples as described in Attachment C. In brief; triaxial tests were performed on several samples of pilot plant Flotation Tailings (similar gradation to LTVSMC fine tailings). The data collected through triaxial testing was processed and used in selection of shear strength parameters. Similar to the LTVSMC tailings triaxial testing, the Flotation Tailings triaxial sample preparation and test methods have been varied (wet, moist, or dry sample preparation on reconstituted bulk samples; slow and fast saturation) in an attempt to replicate the anticipated in-situ behavior of the tailings.

Isotropically-consolidated undrained triaxial testing was performed on Flotation Tailings, as well as on undersized and oversized samples resulting from a 2005 study of the 2005 sample from the pilot plant. The oversize and undersize portions were mechanically sieved from the Flotation Tailings to create samples for testing. During triaxial testing, both the flotation tailings oversized (similar gradation to LTVSMC coarse tailings) and undersized (similar gradation to LTVSMC slimes) samples exhibited dilative behavior. While a majority of the samples exhibited quasi-steady state behavior, one triaxial series performed on the Flotation Tailings exhibited contractive behavior, and was the only triaxial test conducted for the Project to behave as such. Sample preparation for these loose materials is very challenging and this behavior (only one contractive sample) could be the result of many aspects of sample preparation and consolidation prior to shear strength testing.

For the current evaluation, it has been conservatively assumed that all Flotation Tailings are contractive and therefore strength estimates are conservative (as discussed in greater detail in Attachment C). The strength estimates are conservative because it is possible that some portion of the deposit will not be contractive and thus would not liquefy, and would mobilize higher strengths.

The Flotation Tailings were characterized by an approximate drained friction angle of 33.0 degrees. For undrained shear strength, the Flotation Tailings were assigned a $USSR_{yield}$ value of 0.26 and a $USSR_{liq}$ value of 0.12.

5.3.4 Flotation Tailings Filter Criteria

Filter criteria for the Flotation Tailings was evaluated to determine the effectiveness of LTVSMC bulk tailings in preventing piping. As previously stated, a variety of LTVSMC bulk tailings blends were prepared and grain size analyses were performed on the blends (provided in Attachment C). Based on filter criteria suggested in Reference (24), it was determined the D15 (or the sieve diameter at which 15% of the protective material by weight will pass) of the LTVSMC bulk tailings must be greater than 0.056 mm and less than 0.48 mm, as presented in Large Figure 5. Of the blends tested and discussed in Section 5.2.2.5, a material like LTVSMC Blend 2 (15 parts coarse tailings to 4 parts fine tailings to 1 part slimes) or coarser will satisfy this requirement. This matches well with the LTVSMC material borrow plan which will focus on preferentially borrowing the LTVSMC coarse tailings as determined by visual evaluation of grain size and material MC. Zones of fine tailings and slimes, if encountered, will be preferentially excluded. A construction specification will be provided for filter material and the contractor will be required to place material that meets the specification.

5.4 Native Soils

This section presents the results of field and laboratory tests on native soils. The native soils include glacial till and peat, as well as the rock starter dam. It describes the native soils' general geotechnical properties, permeability and shear strength. Geotechnical modeling of the FTB uses material properties of the native soils for seepage model verification and proposed conditions modeling.

5.4.1 General Geotechnical Properties of Native Soils

Multiple historical and more recent 2007 and 2014 tests were conducted on native soil samples in the laboratory (as described in Attachment C and Attachment F) to determine the materials' index properties, which describe the physical characteristics of the material. The maximum, minimum, and average values are provided in Table 5-13 for the glacial till. The maximum, minimum, and average index property values for peat are provided in Table 5-14. These tables also include the standard deviation and the number of tests analyzed. The tabulated results presented below are for test results available in 2013 and do not include the results from the 2014 geotechnical investigation. Instead, the 2014 results, presented in Attachment F, were only used to validate previously selected values.

Table 5-13 Summary of Index Properties of Glacial Till

Parameter	Minimum	Maximum	Average	Standard Deviation	No. of Tests
P_{200}	0.6	60.8	25	15.7	16
γ_{dry} (pcf)	107.8	129	119.1	10.7	3
MC (%)	6	29.8	12.4	8.1	15
PL	10	23	14	5.2	7
LL	11	36	17.7	9.6	7
G_S	-	-	2.66	-	1

Table 5-14 Summary of Index Properties of Peat

Parameter	Minimum	Maximum	Average	Standard Deviation	No. of Tests
P_{200}	73.1	79	76.1	4.2	2
γ_{dry} (pcf)	13.5	69.4	26.9	15.0	11
MC (%)	49.1	407.7	194.4	89.4	11
PL	32.8	273	153	170	2
LL	66.5	407	237	241	2
G_S	1.73	2.48	2.1	0.5	2

The index properties of the peat collected during the 2014 investigation represent undisturbed virgin peat, while some of the values presented in Table 5-14 are results for compressed peat obtained from beneath the basin, explaining why the laboratory results on 2014 peat reported higher MCs, PL, and LL compared to the values presented in Table 5-14. Five peat samples were tested in 2014; having an average MC of 512% and a dry unit weight of 11 pcf and saturated unit weight of 67 pcf. PL values ranged from 198 to 536 and LLs ranged from 411 to 612, generally much higher than the values in Table 5-14.

5.4.2 Permeability of Native Soils

The permeability values previously used for analysis and design of the Tailings Basin have varied throughout historical evaluations as more test results have become available (see Table B-1 of Attachment B for values from individual historic reports). The FTB drainage is impacted by the permeability of the foundation materials. Table 5-15 summarizes the permeabilities for native soils used by previous investigators for seepage analysis. The data were compiled through a review of reports discussing the stability of the Tailings Basin.

Table 5-15 Native Soils Permeabilities Postulated by Previous Investigators

Material	Historical Permeability (cm/s)	Barr Engineering Co. Permeability (cm/s)
Virgin Peat	1.00×10^{-2} to 1.00×10^{-7}	1.01×10^{-3} to 1.0×10^{-7}
Compressed Peat		
Till	4.30×10^{-4} to 5.00×10^{-3}	4.3×10^{-7} to 5.03×10^{-3}

Based on the historical data review, these values appeared to be estimates based on grain size distribution for granular soil and/or experience of previous investigators. The following sections describe the updated design parameters and how they were developed through the testing program.

5.4.2.1 Glacial Till

Prior to 2007, to better evaluate the seepage characteristics of the foundation till, a sampling program was implemented to retrieve till samples on which laboratory testing could be performed. Although the sampling program used Pitcher-barrel sampling methods, which uses a cutting head and retractable thin-wall sampling tube for relatively undisturbed sampling, and has been successfully used on many other sites in the region with similar till materials, a sufficient number of samples could not be obtained due to the nature of the formation. The till contained not only varying amounts of clay and sand, but also cobbles and boulders that could not be penetrated, even with the cutting teeth of the sampling device. An alternate method, falling-head field permeability testing in standpipe piezometers, was then employed to estimate the permeability of the formation.

A total of four in-situ falling-head tests were performed in standpipe piezometers (locations 07-01, 07-07C, 07-10 and 07-13) installed in August 2007 along the north perimeter dam of Cell 2E. The in-situ falling-head tests consisted of preparing a standpipe piezometer by flushing it of all soils and then flooding it with a volume of water. The water was allowed to flow from the piezometer into the till and the depth to water in the piezometer was recorded over a measured period of time until equilibrium was reached. The range of values obtained from the testing program is reported in Table 5-16.

Table 5-16 Range of Permeability of Glacial Till from Falling-Head Tests

	k (cm/sec)	k (ft/day)	k (ft/sec)
Minimum	3.57×10^{-4}	1.01	1.17×10^{-5}
Maximum	7.32×10^{-4}	2.07	2.40×10^{-5}
Standard Deviation	1.90×10^{-4}	0.54	6.24×10^{-6}
Geometric Mean	5.03×10^{-4}	1.43	1.65×10^{-5}

More recently, in the spring of 2014, ten standpipe piezometers were installed 200 feet from the toe of Cells 1W and 2E along the proposed alignment of the FTB Containment System, and screened in the glacial till. Details of the results and analysis are provided in Attachment F. Slug tests were performed in the ten piezometers as well as in two wells installed previously in 2008. Details of the results are provided in Attachment F.

Three slug tests—each with slug-in and slug-out—were performed sequentially in all ten piezometers and in the two wells. A slug test consists of rapid displacement of the static water level in a piezometer or well by adding or removing a slug. The slugs used to perform these tests consisted of a solid piece of circular polyvinyl chloride (PVC) pipe that was 1-inch in diameter. A 5-foot and 2.5-foot long PVC slug was used to complete three sets of tests (slug-in and slug-out for each test) in each piezometer. The first and third test was performed with the 5-foot slug and the second test was performed with the 2.5-foot slug to confirm repeatability. A slug test in which the displacement is initiated by rapidly lowering a slug below the water level is referred to as a slug-in or falling-head test; a slug-out or rising-head test is one in which the slug is rapidly removed. The resulting water-level recovery to static, pre-test conditions, was monitored using a data-logging pressure transducer (InSitu – LevelTroll 700). Test results ranged from 1.5×10^{-3} ft/s (4.6×10^{-2} cm/s) to 1.7×10^{-6} ft/s (5.2×10^{-5} cm/s) with a geometric mean permeability of 5.1×10^{-5} ft/s (1.55×10^{-3} cm/s), which was chosen as the representative permeability of the glacial till for the seepage analyses.

This permeability value is higher than the 2007 test result; however, it appears to support previously performed water balance studies which indicated that not enough water was leaving the model to account for observed declines in pond level within the Tailings Basin. The non-homogeneous nature of the till, with variable layers of clay, sand, and gravel, likely cause more variation in the permeability of the till layer than what was measured in a limited number of discrete tests. Concurrent to discussions with hydrogeologists working on the Project, a sensitivity analysis was conducted with the existing conditions model to assess which material had the greatest impact on flux out of the system, and it was determined that the permeability of the till had the greatest impact, as discussed in Section 7.2. Based on the findings of this sensitivity analysis and verification model results simulating 2014 tailings basin conditions, the 2014 geometric mean permeability value of 5.1×10^{-5} ft/s (1.55×10^{-3} cm/s) appears to be a good representation of the glacial till permeability. The geometric mean hydraulic conductivity value was calculated based on all the piezometers that had screens installed in glacial till. Out of the six output plots generated from the slug tests performed at each piezometer location, the two data outputs that were considered to have the least amount of noise and that would provide the widest range in permeability were selected for analysis. Therefore, 12 piezometer locations, for a total of 24 permeability results, were used to calculate the geometric mean permeability value of the glacial till.

5.4.2.2 Peat

Organic matter consisting of peat exists in the tailing basin area and immediately north of the toe of the existing north perimeter dam of Cell 2E. Additionally, a significant portion of the western half of the foundation for Cell 2E consists of peat deposits covered by years of tailings deposition. In areas outside the toe of the Tailings Basin, natural or "virgin" peat, relatively unaltered by the construction of the Tailings Basin, still exists.

Permeability of the peat below the Tailings Basin was evaluated using two methods to determine two different permeabilities. The vertical permeability was determined from falling-head, flexible-wall permeability tests performed on four relatively undisturbed peat samples tested at confining stresses ranging from 1.5 to 6.0 tsf, while the horizontal permeability was measured using in-situ pore pressure dissipation testing during CPTu. The difference in permeability between the horizontal and vertical directions is attributed to the way in which peat is formed and varies highly with confining pressure, with horizontal to vertical permeability ratios as high as 15 reported at less than 1.9 tsf (180 kPa) confining pressure (Reference (25)). The confining pressures at the Project site are significantly higher, however.

The permeability of the unaltered peat, or virgin peat, which is located north of the dam, was tested on two samples collected during the 2014 investigation, yielding vertical permeability values of 2.13 x 10^{-6} cm/s (7.0 x 10^{-8} ft/s) and 1.07 x 10^{-6} cm/s (3.5 x 10^{-8} ft/s). Peat permeabilities ranging from 1 x 10^{-2} to 1 x 10^{-4} cm/sec (3.28 x 10^{-4} to 3.28 x 10^{-6} ft/s) were previously recommended by Sitka (Reference (8)). A permeability of 1.0 x 10^{-3} cm/s (3.3 x 10^{-5} ft/s) was selected for the virgin peat using isotropic permeability (Reference (25)), as the peat at the toe of the dam are surficial deposits and have little to no confinement.

The range in measured permeability for the peat material below the Tailings Basin, referred to as compressed peat, is shown in Table 5-17. The seepage modeling indicates that flow within the peat layer is much more horizontal such that the geometric mean horizontal permeability of 3.60 x 10^{-6} cm/s (1.18 x 10^{-7} ft/s) was used for the compressed peat. In SEEP/W, anisotropic flow can be entered as a ratio of ky to kx, with the saturated permeability value entered for kx. Two anisotropic ratio values were used; 0.067 (representing the upper bound of data referenced in Reference (25)), and 0.0077 (the ratio of the measured geometric means of k_v to k_h in Table 5-17) – to assess the impact of anisotropy on the model. The model with the very low ky/kx ratio essentially establishes the peat as the most impermeable layer in the model for vertical flow, creating a cutoff between the till and the tailings. This case is obviously not accurate, as the ponds have dropped and more water has left the Tailings Basin than has been observed flowing out of seeps. Therefore, the peat below the dams was modeled with a ky/kx ratio of 0.067.

Table 5-17 Range of Permeability for Compressed Peat Material

Vertical Permeability Values	k (cm/sec)	k (ft/day)	k (ft/sec)
Minimum	1.27×10^{-8}	3.60×10^{-5}	4.17×10^{-10}
Maximum	1.17×10^{-7}	3.31×10^{-4}	3.83×10^{-9}
Standard Deviation	4.97×10^{-8}	1.41×10^{-4}	1.63×10^{-9}
Geometric Mean	2.78×10^{-8}	7.88×10^{-5}	9.12×10^{-10}
Horizontal Permeability Values	**k (cm/sec)**	**k (ft/day)**	**k (ft/sec)**
Minimum	1.76×10^{-6}	4.99×10^{-3}	5.77×10^{-8}
Maximum	7.35×10^{-6}	2.08×10^{-2}	2.41×10^{-7}
Standard Deviation	3.96×10^{-6}	1.12×10^{-2}	1.30×10^{-7}
Geometric Mean	3.60×10^{-6}	1.02×10^{-2}	1.18×10^{-7}

5.4.2.3 Rock Starter Dam

On the north side of Cell 2E, a rock starter dam constructed over the peat deposit was utilized to facilitate initial dam construction. Due to the size of the material, samples of the rock could not be obtained in any manner that would allow permeability testing. Therefore, the permeability of the rock starter dam was based on the published grain size distribution (Large Figure 6, Reference (4)) and estimated using Hazen's equation.

The resulting permeability was found to range from 0.034 to 2.865 cm/sec (1.3×10^{-3} to 9.4×10^{-3} ft/sec), based on the historic range of grain size distribution, with D_{10} ranging from approximately 0.2 to 2 mm and within the acceptable range for use of the Hazen equation (Reference (24)). Based on the seepage model sensitivity analysis (described in more detail in Section 7.2), a value of 1.52 cm/sec (5.0×10^{-2} ft/sec) was chosen for the design.

5.4.3 Shear Strength of Native Soils

The shear strength of the native materials at the Tailings Basin have been explored and analyzed multiple times for various analyses of the LTVSMC site completed since the late 1960s. The shear strength parameters previously used for analysis and design of the Tailings Basin have varied throughout historical evaluations as more test results have become available. A summary of the previously calculated strength parameters used in stability analyses are presented in Table 5-18 (see Table B-1 of Attachment B for values from individual historic reports). The table includes the high and low values previously assigned to the various soils, as well as both ESSA and USSA parameters. For USSA conditions, the peat has, at various times, been characterized with either Mohr-Coulomb parameters or USSR values.

Table 5-18 Native Soils Shear Strength Parameters Previously Used (1977 to 2000)

Material	Saturated Unit Weight, γ_{sat} (pcf)	Drained (ESSA)		Undrained (USSA)		
				Strength Ratio	Mohr-Coulomb	
		c' (psf)	ϕ' (deg)	$USSR_{yield}$	c_u (psf)	ϕ_{cu} (deg)
Till	100 - 132	-	40 - 45	-	-	40
Peat	67 - 100	0 - 3,800	7-47	0.3	1,000	20

DV for the current evaluation are presented in Table 5-19. A discussion of the test data analysis and selected values are provided in Attachment C. In-laboratory material tests performed on samples collected during the 2014 investigation were used to validate the strength values for the glacial till and peat. Three remolded direct shear tests were performed on samples of glacial till, resulting in friction angles ranging from approximately 38 to 47 degrees, with a 33rd percentile value of 43 degrees; above the selected design value of 37 degrees for glacial till. Five laboratory CU triaxial compression tests were performed on undisturbed samples of peat collected during the 2014 geotechnical investigation. The undrained shear strength tests resulted in a 33rd percentile value of 0.27; above the selected design value of 0.23 for virgin and compressed peat. Drained strength values from the tests resulted in a drained cohesion of 637 psf and a drained friction angle of 30 degrees, indicating that the shear/normal function (drained friction angle design value of 27 degrees) for peat is an acceptable and conservative value.

Table 5-19 Native Soils Shear Strength Parameters

Material	Saturated Unit Weight, γ_{sat} (pcf)	Drained (ESSA)		Undrained (USSA)		
		c'	ϕ'	c_u	ϕ_{cu}	Yield Undrained Shear Strength Ratio, USSR
		psf	deg	psf	deg	
Till	135	-	36.5	-	36.5	-
Compressed Peat	85	Shear/Normal Function (1)		-	-	0.23
Virgin Peat	70					0.23

(1) Refer to Attachment C for Shear/Normal Function values, φ' = ~27°

5.5 Bedrock

The bedrock on site, evaluated along the alignment of the FTB Containment System, consists of granitic rock encountered at depths ranging from approximately 2 to 47 feet during the spring 2014 geotechnical investigation (Attachment F). Occasionally a zone of weathered bedrock was encountered above competent bedrock, ranging in thickness from one to nine feet. Rock cores were collected to confirm depth to bedrock and provide qualitative information used to validate appropriate shear strength values of the bedrock (Reference (21)).

5.5.1 Permeability of Bedrock

Packer tests were performed in five of the bedrock borehole locations at various depths across the site and at various elevations at each location, providing approximate bedrock permeability. The bedrock cores obtained during the investigation reported horizontal fractures, vertical fractures, and fractures ranging in slope from 45 to 65 degrees from the horizon. The goal of the packer tests were to perform repetitive tests that would yield reliable information on where and at what rate water flows through the rock to help evaluate a method for controlling subsurface seepage. Packer testing readings were performed by Barr personnel in accordance with guidelines provided in USBR 7310-89 (Reference (26)). Depending on test location, a single or double packer was used. All packer tests were performed at pressure increments of 15, 30, and 45 psi for 1-minute intervals. Observations of flow were made every minute until three consecutive, consistent readings were taken, representing steady-state flow. The pressure was then increased for three equal increments, followed by two decreasing pressures.

A summary of the packer test results is provided in Attachment F. The results are based on the value resulting from the first three pressure increments as these values are most likely to represent in-situ conditions. The prevalence of fractures often decreased with increasing core depth and as such the overall bedrock hydraulic conductivity will also likely decrease with depth. Therefore the seepage model uses two bedrock zones; an upper 10-foot zone of Fractured Bedrock with $K = 2.36 \times 10^{-5}$ ft/sec (7.2×10^{-4} cm/sec), and underlying Bedrock with $K = 6.3 \times 10^{-7}$ ft/sec (1.9×10^{-5} cm/sec). Per the site-specific geotechnical rock coring investigation and the data reported in Reference (21), the frequency of fractures in the bedrock is high in the upper 10-foot zone, with fracture frequency declining but fractures still present with greater depth. On this basis, and to achieve a conservative but not overly conservative seepage model calibration (modeled head higher than measured head), the upper 10-foot zone of bedrock was assigned the high hydraulic conductivity from packer tests and the underlying bedrock was assigned the geometric mean hydraulic conductivity from packer tests.

5.5.2 Shear Strength of Bedrock

Rock cores from the 2014 geotechnical evaluation provided qualitative information, including Rock Quality Designation (RQD) values and fracture characteristics. RQD, given as a percentage, is defined as the sum of the length of core pieces greater than 10 cm in length divided by the total length of the core run, multiplied by 100. The RQD values obtained during the evaluation indicate that bedrock is of poor to good quality at shallow depths, and is of good to excellent quality below a depth of about 40 feet. Results from the geotechnical evaluation showed that fractures were most prevalent in the upper 5 to 10 feet of bedrock. For this reason a 10-foot fractured bedrock zone was modeled, with a unit weight of 140 pcf and drained friction angle of 45 degrees. The more competent bedrock below the more highly fractured zone was modeled as impenetrable. As part of the slip surface wedge grid-and-radius method, the slope stability analyses also evaluated the fractured bedrock zone as "impenetrable" to evaluate the possible scenario that could result in a lower factor of safety (FOS) value where the failure surface is forced to truncate along the interface of the till and fractured bedrock. This methodology is discussed further in Section 6.3.1.

5.6 Cement Deep Soil Mix (CDSM) Zone

CDSM will be used to enhance the shear strength of select zones of the existing LTVSMC fine tailings/slimes and peat layers. This additional engineering measure has been added to the FTB design in order to achieve the required slope stability factors of safety under a modeling scenario of an unknown trigger causing liquefaction at Cross-Section F and Cross-Section G.

CDSM is a well-established in-situ soil stabilization method that mixes soil with cement or other suitable stabilizing agent. The resulting mix improves engineering properties of materials in terms of strength and stiffness and reduces the permeability and compressibility of the treated tailings. For over 40 years, national and international practitioners and researchers have documented projects where this technique has been successfully implemented to improve slope stability. Selected references describing CDSM case histories include (Reference (27); Reference (28); Reference (29)).

Shear walls are created using CDSM by augering multiple, overlapping columns. The tailings and peat encountered within the auger path are mixed with cement to create the overlapping columns (shear walls). The tailings and peat plus cement have improved strength. The augers used are hollow-stem; cement or water-cement slurry is injected from the auger blades, mixing the cement with the tailings and peat as the augers rotate and advance. To provide anchorage and to ensure CDSM shear walls will not move with the soil mass in a potential liquefaction triggering event, the shear walls will be partially drilled into the till layer that underlies the peat.

The properties of the CDSM zone depend on the width, height, thickness, spacing, area replacement ratio (the percent of a unit quantity of tailings or peat that undergoes CDSM), geometry, and location of the shear walls. Optimal location and geometry of the CDSM shear walls are determined in an iterative design process by:

1. assuming a CSDM shear wall geometry,
2. calculating the composite properties of the CDSM zone based on assumed geometry,
3. modeling the FOS against an unknown liquefaction triggering event, and
4. repeating as needed until the required FOS is obtained.

The following sections explain how the optimal locations of the CDSM shear walls were determined, and present the engineering properties of the CDSM zone that were used for stability modeling. However, the final configuration of the CDSM shear walls will be determined during final design.

5.6.1 CDSM Zone Geometry

The configuration of the shear walls (column diameter, wall length, wall height, wall-to-wall spacing, and geometry) within the CDSM zone is selected to achieve the desired improvement in shear strength along the predicted slope failure surface. Figure 5-2 presents, in plan view, a number of potential shear wall geometries within a CDSM zone, with each line segment representing a string of overlapping CDSM columns.

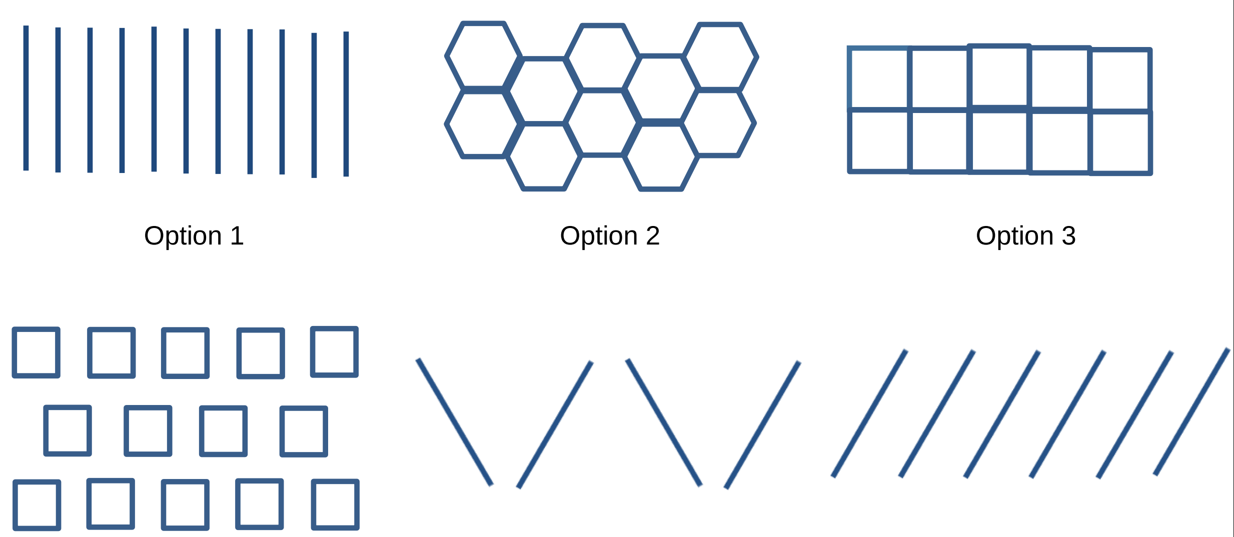


Figure 5-1 CDSM Shear Wall Geometry Illustration

Based on several modeling iterations; given that existing rock starter dams, coarse tailings dams and the proposed buttress provide initial flow confinement to liquefied tailings along the lower portion of the predicted slope failure surface; and, assuming an unconfined compressive strength ($q_{dm,spec}$) for the cement-treated tailings and peat of 300 psi, the following CDSM shear wall design was determined to meet the required FOS of 1.10 for liquefaction conditions under an unknown trigger event:

- Option 1 Shear Wall Geometry
- Cross-Section F wall length = 50 ft
- Cross-Section G wall length = 5 ft

- Wall height = 55 ft
- Wall spacing = 10 ft
- Wall thickness (column diameter) = 3 ft
- Area replacement ratio = 0.3

Non-linear elasto-plastic stress-strain simulations of Cross-Section F were completed using SIGMA/W to determine critical zones and regions in terms of anticipated high shear stresses and shear strains. Large Figure 7 and Large Figure 8 show shear stress and shear strain contours. Using the approach of reinforcing a zone subjected to high shear strain, the optimal location to mitigate the effects of liquefaction was selected and is schematically shown in Figure 5-2. To provide anchorage and to ensure CDSM shear walls would not move with the soil mass in a potential liquefaction scenario with an unknown triggering event, shear walls will be drilled into a stronger layer (i.e., till). For this design, CDSM shear walls are oriented perpendicular to the dam axis, with spacing of 10 feet and an area replacement ratio of 0.3, as indicated in Figure 5-2.

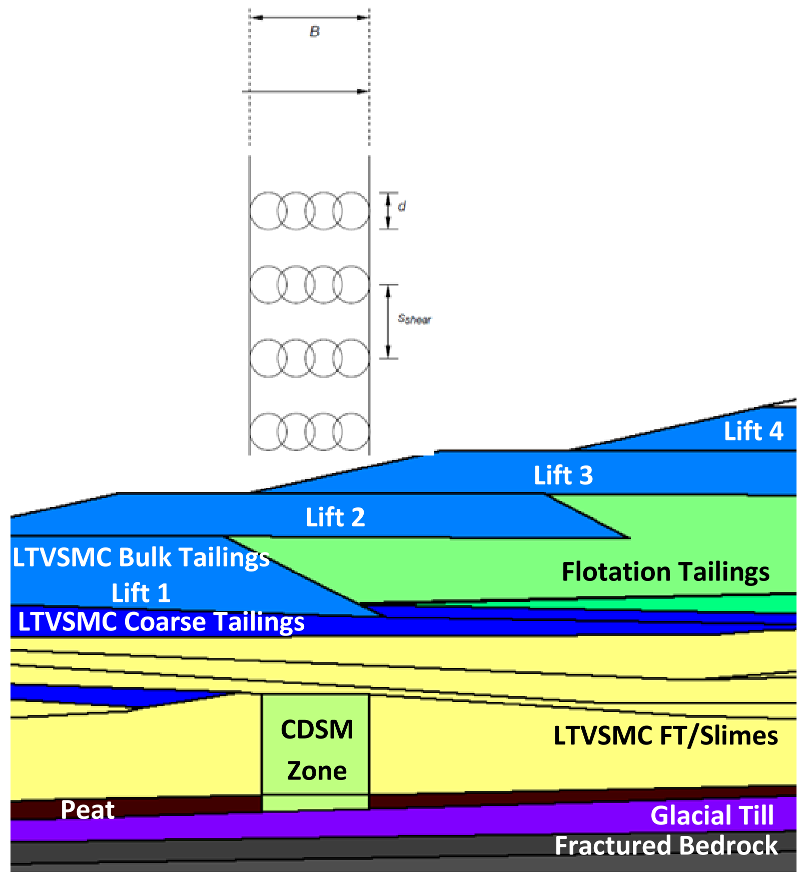


Figure 5-2 Schematic Plan View (projected above Lift 3 slope) and Cross-Section of Section F CDSM Zone

5.6.2 Permeability of CDSM Zone

The composite permeability of the CDSM zones can be calculated using the following simple parallel model (weighted average) and the selected area replacement ratio of 0.30:

$$k_{composite} = \boldsymbol{a}_{s,shear} k_{CDSM} + (1 - \boldsymbol{a}_{s,shear}) k_{soil}$$ **Equation 5-1**

Based on the literature (Reference (28)), typical values for k_{CDSM} range between 3.28 x 10^{-8} to 3.28 x 10^{-9} ft/sec. Assuming that k_{slimes}= 3.16 x 10^{-8} ft/sec, k_{peat}= 1.18 x10^{-7} ft/sec, and k_{CDSM} =3.28 x 10^{-9} ft/sec, the composite permeability for the slimes and peat zones are estimated as $k_{CDSM + slimes}$= 2.31 x 10^{-8} ft/sec and $k_{CDSM + peat}$= 8.36 x 10^{-8} ft/sec. Seepage models of Cross-Section F with and without the CDSM zone indicate that phreatic surface, porewater pressure, and hydraulic gradients are not significantly affected by the CDSM zone. This is due to the low replacement ratio and limited effect of cement on the already low permeability of the fine tailings, slimes, and peat. Per this computation to estimate the effect of the cement in the stabilized zones, the permeability of the native material is reduced to approximately 70% of its original value. Seepage models of Cross-Section F with and without the CDSM zones indicate that phreatic surface and porewater pressure are not significantly affected by the CDSM zone due to the low replacement ratio and limited effect of cement on the already low permeability of the fine tailings, slimes, and peat.

5.6.3 Shear Strength of CDSM Zone

The shear strength of the CDSM columns can be computed using the following formula:

$$s_{dm} = \frac{1}{2} f_r f_c q_{dm.spec}$$ **Equation 5-2**

where:

s_{dm}= shear strength of CDSM material

f_r= coefficient to account for residual conditions; varies from 0.65-0.90 (0.8 is recommended in FHWA design manual)

f_c= coefficient that depends on time between mixing and application of 75% of load. It accounts for curing time effect and varies from 1.00 for 28 days to 1.48 for 365 days

$q_{dm,spec}$ = unconfined compressive strength to be specified

The area replacement ratio ($a_{s,shear}$) can be calculated using the following formula:

$$a_{s,shear} = \frac{b}{s_{shear}}$$ **Equation 5-3**

where:

b= thickness of shear wall

s_{shear}= spacing of shear walls (Figure 5-3)

An area replacement ratio of 0.3 was selected for this design which represents shear wall spacing of 10 ft. and a wall thickness of 3 ft.

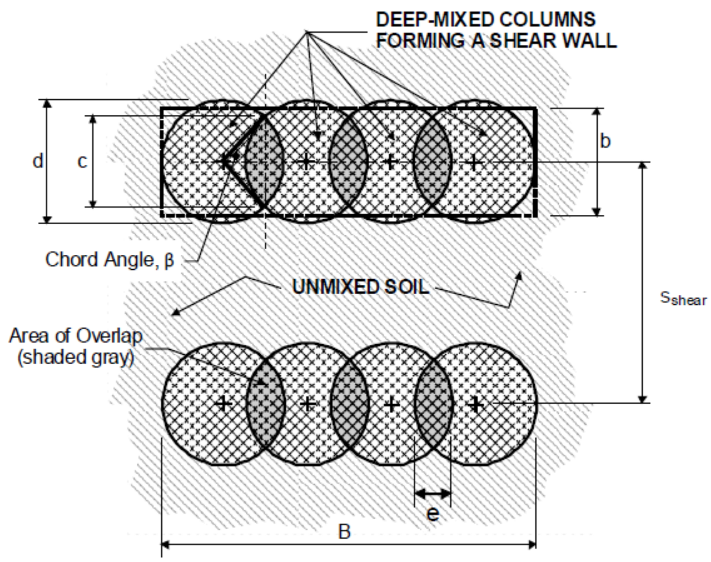


Figure 5-3 Typical Arrangement of Cement Deep Soil Mixed Columns Forming a Shear Wall

After estimating the area replacement ratio and the shear strength of CDSM material, the composite shear strength of the CDSM zones can be computed with:

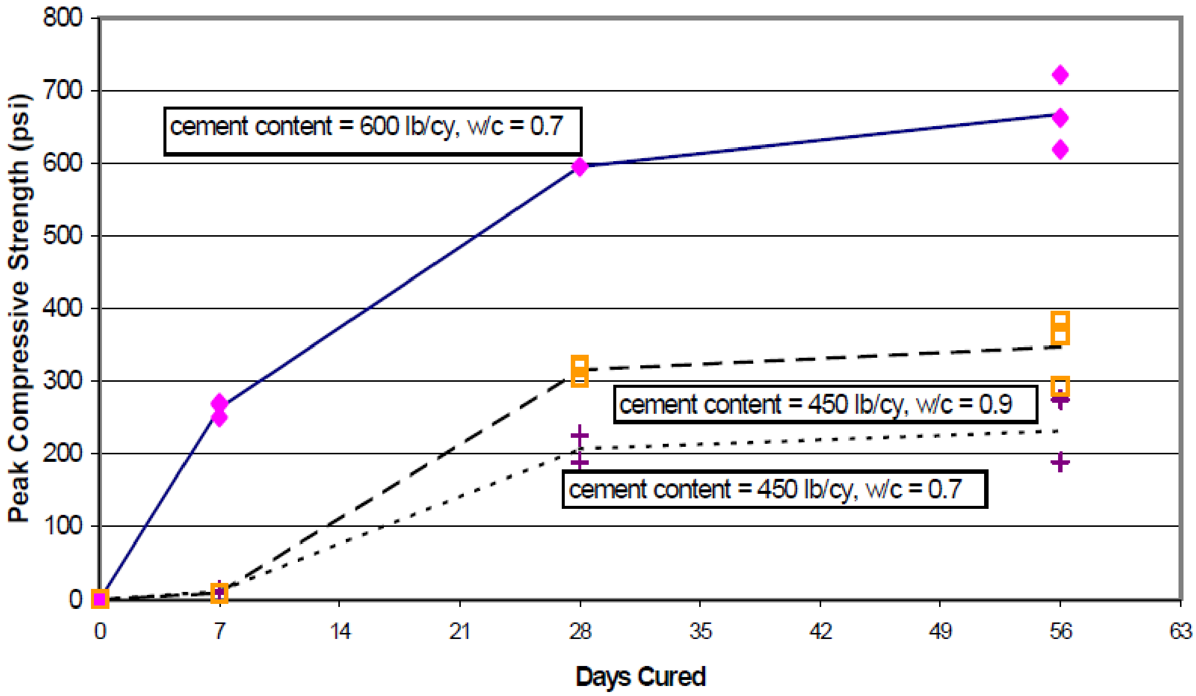
$$s_{dm,wall} = f_v a_{s,shear} s_{dm}$$ **Equation 5-4**

where:

$s_{dm,wall}$= composite shear strength of CDSM zones

f_v= coefficient to account for variability that exists in strength of tailings-cement mix. It depends on the target FOS and the intensity of the material testing and construction Quality Assurance and Quality Control program. Recommended values for this coefficient are presented in Table 12 in the FHWA report (Reference (28)).

An estimated composite CDSM shear strength of 9600 psf was obtained assuming $q_{dm,spec}$ = 300 psi, f_v= 1.25, f_r=0.8, and f_c=1.48. Figure 5-4, where w/c equals the ratio of the weight of water to the weight of cement used for the CDSM zone, shows the effect of curing time versus cement content on the compressive strength of low to medium plasticity silty soil treated with cement.



(Reference (27))

Figure 5-4 Typical Unconfined Compressive Strength (q_u) of Low to Medium Plasticity Silty Soil Treated with Cement

The possibility for tailings to squeeze or flow between the CDSM panels has been analyzed following "extrusion" analysis guidelines presented in the FHWA report (Reference (28)). The analysis, which is applicable to soft soils (i.e., soils with low shear strength such as liquefied tailings), indicates that flow (extrusion) of liquefied tailings between CDSM shear walls is highly unlikely. The extrusion factor of safety (F_e) is computed per Equation 5-5.

$$F_e = \frac{2c_e\left[2 + B\left(\frac{1}{s-d} + \frac{1}{He}\right)\right]}{\sigma_{va} - \sigma_{vp}}$$

Equation 5-5

Extrusion analysis input parameters and definitions are presented in Table 5-23. Per the methods of analysis for extrusion presented above, the computed F_e is 41.9, well in excess of the minimum acceptable extrusion factor of safety recommended by the FHWA of 1.3.

Table 5-20 CDSM Extrusion Analysis

Layer Analyzed - Slimes		
Parameter	**Value**	**Description**
σ_{va}	16,593 psf	Average value of total vertical stress in tailings layer to be analyzed for extrusion immediately adjacent to the active earth pressure side (farther into the basin) of the CDSM shear walls.
σ_{vp}	15,948 psf	Average value of total vertical stress in tailings layer to be analyzed for extrusion immediately adjacent to the passive earth pressure side (nearer the dam face) of the CDSM shear walls.
B	50 ft	Length of CDSM shear walls.
He	47 ft	Thickness of tailings layer to be analyzed for extrusion.
c_e	1,322 psf	Average value of the total stress cohesion intercept in tailings layer to be analyzed for extrusion.
s	10 ft	Spacing between CDSM shear walls.
d	3 ft	Diameter of CDSM shear wall columns.
F_e	$\geq$ 1.3	Minimum acceptable extrusion factor of safety.

5.6.4 Unit Weight of CDSM Zone

For practical applications, and considering that area replacement ratios commonly used as reported in the literature vary between 0.2 to 0.4, the change in unit weight of the CDSM zone can be assumed to be negligible (Reference (28)).

5.7 Seismic Deformation Properties

Seismic deformation properties utilized in seismic models are summarized in Table 5-21. The planned CDSM zones are small relative to the overall mass of tailings and were not considered in selection of the seismic deformation properties. The shear modulus reduction functions were estimated in the computer program based on soil consistency, maximum depth, overconsolidation ratio (OCR), void ratio (e), PI, and at-rest earth pressure coefficient (k_o). The functions are included in Large Figure 9.

Table 5-21 Summary of Seismic Modeling Parameters

Material	Saturated Unit Weight, γ_{sat} (pcf)	Poisson's Ratio	Minimum Damping Ratio	Maximum Damping Ratio	k_o	Shear Modulus Reduction Function
Glacial Till	135	0.334	0.02	0.30	1	Low Plastic
Compressed Peat	85	0.334	0.02	0.25	0.45	Peat
Virgin Peat	70	0.4	0.02	0.25	0.45	Peat
Rock Dam	140	0.3	0.02	0.35	0.7	NP
LTVSMC Coarse Tailings	135	0.3	0.02	0.35	0.6	NP
LTVSMC Fine Tailings	125	0.334	0.02	0.30	0.45	NP
LTVSMC Slimes	120	0.4	0.02	0.26	0.45	Low Plastic
LTVSMC Fine Tailings/Slimes	130	0.4	0.02	0.28	0.45	Low Plastic
LTVSMC Bulk Tailings	135	0.3	0.02	0.33	0.7	NP
Flotation Tailings	125	0.4	0.02	0.30	0.45	NP

NP = Non-Plastic

Shear modulus reduction functions were estimated in GeoStudio 2007, based on mean principle effective confining stress, cyclic shear strains, and PI. The relationship used in GeoStudio for estimating the shear modulus reduction ratios was developed by Ishibashi and Zhang in 1993 (Reference (30)). The input data used to aid in establishment of the shear modulus reduction ratios is presented in Table 5-22.

Table 5-22 Shear Modulus Reduction Function Data

Material	ko	Void Ratio	PI	OCR	Soil Consistency	Poisson's Ratio
LTVSMC Coarse Tailings	0.60	-	-	-	Medium Dense Sand	0.300
LTVSMC Fine Tailings	0.45	-	-	-	Loose Sand	0.334
LTVSMC Slimes	0.45	1.20	8	1	-	0.400
LTVSMC Bulk Tailings	0.70	-	-	-	Dense Sand	0.300
LTVSMC FT/slimes	0.45	-	-	-	Loose Sand	0.400
LTVSMC FT/slimes (Interior)		-	-	-		
Glacial Till	1.00	0.30	1	4	-	0.334
Compressed Peat	0.45	1.7	40	1	-	0.334

Material	ko	Void Ratio	PI	OCR	Soil Consistency	Poisson's Ratio
Virgin Peat	0.45	1.7	40	1	-	0.400
Rock Starter Dam	0.70	-	-	-	Dense Gravel	0.300
Flotation Tailings - 0.45 tsf		-	-	-		
Flotation Tailings - 1.35 tsf	0.30	-	-	-	Loose Sand	0.400
Flotation Tailings - 2.29 tsf		-	-	-		

5.8 Volumetric Water Content Functions

In addition to a saturated hydraulic conductivity, the volumetric water content and hydraulic conductivity functions were also input in seepage models within the GeoStudio program based on material gradation, Atterberg limits, and saturated water contents. These functions are presented in Large Figure 10 and Large Figure 11. The planned CDSM zones are small relative to the overall mass of tailings and were not considered in selection of the volumetric water content functions. Permeability and volumetric water content functions were estimated in GeoStudio 2012 for unsaturated flow modeling. The permeability function is estimated using the Van Genuchten and Fredlund and Xing methods and the volumetric water content functions are based largely on grain size, using a Modified Kovacs method (Reference (31)). The input data used in establishment of the unsaturated flow functions is presented in Table 5-23.

Table 5-23 Unsaturated Flow Functions Data

Material	Coefficient of Vertical Compressibility, M_v	Saturated WC	D_{10} (mm)	D_{60} (mm)	Liquid Limit (%)
	1/psf	ft^3/ft^3			
LTVSMC Coarse Tailings	8.84 x 10^{-7}	0.412	0.0500	0.700	0.0
LTVSMC Fine Tailings	4.80 x 10^{-7}	0.493	0.0045	0.030	25.0
LTVSMC Slimes	4.80 x 10^{-7}	0.500	0.0013	0.016	30.0
LTVSMC Bulk Tailings	7.43 x 10^{-7}	0.440	0.0300	0.250	5.0
LTVSMC FT/slimes	2.25 x 10^{-6}	0.496	0.0024	0.022	25.0
LTVSMC FT/slimes (Interior)					25.0
Glacial Till	4.49 x 10^{-6}	0.400	0.0300	0.700	18.0
Compressed Peat	9.60 x 10^{-6}		0.0150	0.200	100[(1)]
Virgin Peat	9.60 x 10^{-6}	0.900	0.0150	0.200	100[(1)]

Material	Coefficient of Vertical Compressibility, M_v	Saturated WC	D_{10} (mm)	D_{60} (mm)	Liquid Limit (%)
	1/psf	ft^3/ft^3			
Rock Starter Dam	4.80×10^{-7}	0.300	-	-	-
Flotation Tailings - 0.45 tsf	1.50×10^{-6}	0.400	0.0060	0.070	0
Flotation Tailings - 1.35 tsf					
Flotation Tailings - 2.29 tsf					
Fractured Bedrock	4.80×10^{-7}	0.200	na		
Bedrock	4.80×10^{-7}	0.200	na		

(1) Maximum value that can be applied as a SEEP/W input parameter

5.9 Effects of Stringers on Modeling Parameters

Within the LTVSMC tailings deposit there are stringers of alternate tailings types (i.e., intermittent and discontinuous zones of finer or coarser tailings of differing strength and/or permeability), as described in Section 3.2. The effects of stringers in the LTVSMC tailings is taken into account in the approach used for selection of modeling parameters, developed in consultation with Dr. Olson (Section 5.1 and Attachment C). The appropriate approach hinges on the extent, composition and continuity of stringers within the deposit as subsequently described. Several types of evidence support the conclusion that heterogeneity within the deposits is localized, so widespread and continuous stringers of the weakest material (slimes) are unlikely and isotropic parameters are appropriate. Furthermore, introducing anisotropy in liquefied shear strengths in slope stability analysis is not standard practice.

Experimental evidence is provided by a physical model study of tailing deposition by SAFL (Attachment B of Reference (1)). This study used Flotation Tailings, but it is possible that the LTVSMC tailings deposited in a similar manner. Results show complex heterogeneity within the tailings deposits (i.e., fluvial braided channelized regime, multiple channels, and rapid channel migration). The SAFL study documented that grain size range generally decreased toward the center of the pool, as would be expected, but noted that "the larger particles interacted with the smaller particles strongly, and both are deposited together" (page 57 of Attachment B of Reference (1)). Results of this study suggest that the areal extent of stringers is likely limited, and that even the finer-grained component of the tailings do not deposit without the presence of higher strength materials.

Field data from five CPT soundings along Cross-Section F indicate that the in-situ materials would be expected to be stronger than their DV selected using the method outlined in Section 5.1. These results reflect the presence of stringers of coarser material within LTVSMC fine tailings/slimes, which would help to limit the liquefied response and contribute to overall strength. The stringers are generally more dilative than the finer tailings. The presence of stringers, if any are continuous, would provide drainage paths through the finer tailings. Introducing stringers in the strength model without including the effect on drainage would not be appropriate.

The method used to select DV discounts the contribution of these coarser stringers and hence slope stability models utilizing the recommended $USSR_{liq}$ values are likely to be conservative. See Attachment C for additional details on how material strength parameters are selected, including consideration of the effects of stringers.

5.10 Summary of Material Shear Strength Parameters

The selected drained and undrained strength inputs for the various materials used in the FTB design are summarized in Table 5-24. The strength values were reviewed by Dr. Olson (whose comments are provided in Attachment M) and were presented in Geotechnical Workshops. A full summary of strength, seepage, and unit weights used for modeling is provided in Large Table 1.

Table 5-24 Summary of Shear Strength Parameters

Material	Shear Strength Parameters		
	Drained (ESSA)	Undrained (USSA)	Liquefied
LTVSMC Coarse Tailings	$\phi' = 38.5^o$		-
LTVSMC Fine Tailings	$\phi' = 33.0^o$	$USSR_{yield} = 0.25$	-
LTVSMC Slimes	$\phi' = 33.0^o$	$USSR_{yield} = 0.22$	-
LTVSMC Fine Tailings/Slimes	$\phi' = 33.0^o$	$USSR_{yield} = 0.24$	$USSR_{liq} = 0.10$
LTVSMC Bulk Tailings	$\phi' = 38.5^o$		-
Flotation Tailings	$\phi' = 33.0^o$	$USSR_{yield} = 0.26$	$USSR_{liq} = 0.12$
Peat	$\phi' = 27.0^o$	$USSR_{yield} = 0.23$	-
Glacial Till	$\phi' = 36.5^o$		-
Rock Starter Dam	$\phi' = 40^o$		-
Fractured Bedrock	$\phi' = 45^o$		-
Bedrock	Impenetrable		
Cement Deep Soil Mix (CDSM)	$\phi' = 0^o$, $c' = 9{,}600$psf		-

6.0 Engineering Models to Assess Dam Safety

Dam safety analysis and design requirements are based on Minnesota Rules (summarized in Section 2.0) and on the NorthMet Geotechnical Modeling Work Plan (Attachment A). The Work Plan requires analysis of Cross-Section F, located on the north side of Cell 2E, Cross-Section G, located on the northeast side of Cell 2E, and Cross-Section N, a section through the south perimeter dam of Cell 1E. Cross-Section F, Cross-Section G, and Cross-Section N analysis methods and outcomes are reported in Sections 6.0, and 7.0, respectively.

All three cross-sections were analyzed in a sequential manner consisting of development of the dam cross-section stratigraphy for analysis, application of the material strength and permeability characteristics, modeling of seepage conditions at the dam cross-section, followed by performance of stability analyses.

6.1 Geotechnical Modeling Work Plan

The stability analyses are consistent with the requirements of Version 3 of the NorthMet Geotechnical Modeling Work Plan (Attachment A) required by the MDNR Division of Ecological and Water Resources, Dam Safety Unit. The following steps were used to develop the FTB design:

1. Gather existing conditions data (i.e., basin topography, stratigraphy, soil and tailings strength and hydraulic characteristics, and other data as needed to support geotechnical modeling and FTB design).

2. Develop FTB slope cross-sections (i.e., geometry and stratigraphy for existing and planned conditions) for seepage and stability modeling.

3. Develop seepage and stability models of the FTB using Geo-Slope International, Inc. modeling software.

4. Using available geotechnical data, establish design data for use in ESSA and USSA. Also utilize established criteria (Olson and Stark – 2003 "Yield Strength Ratio and Liquefaction Analysis Slopes and Embankments" as updated by Olson 2009) to determine which materials behave in a contractive manner and could transition from non-liquefied strengths to liquefied (steady state) strengths.

5. Utilize design data to design slopes to achieve the following:

   a. ESSA – FOS > 1.5 for effective shear strength conditions using drained parameters for:

      i. Existing conditions

      ii. Normal operating conditions at incremental lifts and ultimate height

b. Undrained Strength Stability Analysis ($USSA_{yield}$) – FOS > 1.3 for yield undrained shear strength conditions for non-statically liquefiable soils (i.e., end of construction case per dam raise) for:

   i. Normal operating conditions at incremental lifts and ultimate height

   ii. Veneer stability computing infinite slope FOS

c. Liquefaction Triggering and Post-Liquefaction Analysis ($USSA_{liq}$) – FOS > 1.1 for post-triggering slope stability considering liquefied shear strengths (computed from design liquefied strength ratios) applied to segments of materials in the triggering stability analysis with $FOS_{triggering}$ < 1.1; design drained strengths applied to materials above the capillary zone; and yield undrained shear strength (computed from design yield strength ratios) for all other materials.

   i. From the February 2013 workshop, analyze the following credible triggering scenarios:

      1. Baseline – Lift 8

      2. Elevated Phreatic Surface (i.e., drain ineffective) – Lift 8

      3. High Construction Rate of Loading – Lift 1

      4. Local Erosion/Scour of Slope (pipe break) – Lift 8

      5. Elevated Phreatic Surface (drain ineffective) w/High Pond – Lift 1

      6. Long-Term Case (20, 200, and 2,000 years after closure)

d. Lift 8 Baseline Conditions assuming Unknown Triggering Mechanism – FOS ≥ 1.1 for post-triggering slope stability applying design liquefied shear strengths to all LTVSMC fine tailings and slimes and all Flotation Tailings below top of capillary zone.

e. Seismic Liquefaction (i.e., induced by seismic event)

   i. Perform a screening analysis for triggering of liquefaction based on Boulanger and Idriss (2004). If the FOS against triggering is greater than or equal to 1.2 for a seismic event with a 2,475-year return period, no additional analyses are required.

   ii. If the FOS against triggering is less than 1.2 for a seismic event with a 2,475-year return period, perform further seismic triggering analyses as described in the Work Plan.

6. Report final design and operating requirements necessary to maintain required slope stability safety factors and deformation requirements for the critical slope cross-section.

6.2 Seepage Analysis

The main objective of the seepage analysis is to develop a comprehensive understanding of the groundwater conditions within the Tailings Basin and FTB and assess how the groundwater conditions relate to stability of the basin dams. Groundwater porewater pressure plays a major role in the stability and construction sequence of the dam. A special emphasis was placed on calibrating the seepage model (LTVSMC end-of-operations conditions) and verifying 2014 basin condition seepage model results to observed field conditions. Subsequently, simulations were made to estimate groundwater conditions for dam elevations representing later stages of FTB development.

The seepage simulations presented in this Data Package modeled groundwater flow under steady-state conditions. The seepage analysis was conducted using SEEP/W, part of the GeoStudio 2012 Version 8.30 software package, a computer modeling program developed by GEO-SLOPE International Ltd. SEEP/W uses the finite-element analysis technique to model the water movement and porewater pressure distribution within porous materials such as tailings. This method was chosen because comprehensive formulation allows evaluation of highly complex seepage problems. It can analyze saturated and unsaturated flow, steady-state and transient conditions, and a variety of boundary conditions.

SEEP/W generates an output file containing the calculated pressure head at all nodes in the finite element mesh. Product integration of GEO-SLOPE programs allows stability or deformation models to incorporate the SEEP/W results into the slope stability program for computation of effective stresses. Therefore, it allows a more realistic evaluation of the seepage impact on future stability than simply adding a phreatic surface. SEEP/W results were used to evaluate stability under steady-state conditions of the dams.

The porewater pressures at each node of the finite element mesh were computed in SEEP/W based on the section geometry and the permeabilities assigned to each region. The permeabilities used in these analyses are presented in Large Table 1. As noted in Section 5.0, unsaturated material properties were assigned for seepage modeling, though suction was not taken into account during stability modeling.

6.2.1 Hydraulic Boundary Conditions

Plant Site water balance modeling results (Section 6.0 of Reference (3)) were used to define conditions in the Tailings Basin seepage models. In brief, hydrologic models were utilized to estimate infiltration due to precipitation and due to placement of tailings in the FTB.

- Infiltration through dams and beaches due to precipitation was computed as the remainder of Precipitation minus Evapotranspiration and Runoff. The hydrologic model calculates evapotranspiration and runoff based on soil moisture characteristics and hydraulic conductivity parameters of the Tailings Basin dams and beaches, including consideration of bentonite amendments. Calculations assume average annual precipitation at the Plant Site and no surface storage of precipitation in depressions.

- Infiltration on beaches due to spigotting of tailings was computed based on the overall length of dam along which tailings discharge will occur, the estimated discharge time at each spigot location, the length of beach between discharge point and FTB Pond, and the active flow area from end of spigot to edge of pond.

The total infiltration was then added as a unit flux to the surface of the seepage model along the different regions (bentonite-amended dam soils, non-bentonite-amended dam soils, and beach infiltration) as the respective average annual values in feet per second. The unit flux conditions are also set as potential seepage faces.

The finite element mesh of the seepage model was created to conform as closely as possible to the above conditions. An example of Cross-Section F is shown in Large Figure 12. These same boundary conditions were applied to Cross-Section G and Cross-Section N. Triangular iso-parametric elements were used to build the mesh in accordance with the geometry of the dam. Boundary conditions were defined by setting the following:

- A unit flux of 8 inches per year (2.0 x 10^{-8} ft/s) across the existing dam and the LTVSMC dams and the beach to represent infiltration from precipitation. Infiltration values from precipitation were based on rates reported in Reference (3).

- A unit flux of 6.0 inches per year (1.59 x 10^{-8} ft/s) across the proposed FTB dams, exterior slopes which will be amended with bentonite to reduce infiltration as each lift is constructed, to represent infiltration from precipitation. Infiltration values from precipitation were based on rates reported in Reference (3).

- A unit flux of 6.5 inches per year (1.72 x 10^{-8} ft/s) below the FTB Pond in closure. The bottom of the FTB Pond will be amended with bentonite during reclamation to reduce infiltration long-term. Infiltration values through the bentonite amended pond bottom were based on rates reported in Reference (3).

- A unit flux of 115 inches per year (3.04 x 10^{-7} ft/s) was applied to the Flotation Tailings to represent infiltration due to precipitation plus hydraulic deposition of the tailings. Infiltration values from precipitation and spigotting were based on rates reported in Reference (3).

- The wetlands at the toe of the dam were modeled with groundwater at the ground surface because groundwater is relatively shallow in this area.

- The tailings basin pond was modeled with its outermost edge located 625 feet beyond the inside crest of the dam. This is the same pond edge location used in the water balance and geochemical analyses. The pond is modeled as a constant total head. This total head elevation changes for each lift. For Lift 8, the total head boundary condition was 1722.8 feet AMSL.

- For the probable maximum precipitation (PMP) event at Lift 8, the pond was modeled at 1726.8 feet AMSL, or a bounce of 4 feet. A discussion of the total head value for the PMP can be found in Reference (1).
- Seepage modeling assumes the bedrock acts as a no-flow boundary.

6.2.2 Groundwater Modeling

A three-dimensional groundwater model of the Tailings Basin area was developed using MODFLOW, which is reported in the NorthMet Project Water Modeling Package Volume 2 (Reference (3)). The groundwater model utilized similar data as the geotechnical seepage model and it was calibrated to 2002-2013 conditions. Seepage parameters determined from the MODFLOW calibration were considered during development of geotechnical modeling parameters. However, the groundwater model encompasses a relatively large area in plan view, including large areas outside the Tailings Basin footprint, and is three-dimensional and, as such, the groundwater model is inclusive of and is calibrated to a greater number of piezometers than is possible for the two-dimensional SEEP/W models. The geotechnical seepage modeling focuses on more discrete layers in a two-dimensional section, which must be calibrated to the piezometers or water level data located very near and/or intersected by the SEEP/W models. Because the geotechnical seepage model and the groundwater model were designed to examine different aspects of seepage and groundwater flow, there are differences in the seepage input parameters between the two models. The differences in inputs and setup reflect the different goals of the modeling – overall water balance and groundwater flow for MODFLOW versus cross-section specific piezometric head and seepage for the SEEP/W models.

6.3 Stability Analysis and FTB Design

The slope stability of the existing and proposed FTB dams was analyzed for three strength conditions – the drained condition (through an ESSA), the yield undrained condition (through USSA) and, for specified scenarios, post-liquefaction undrained conditions. Schematics of Cross-Section F (which also apply to Cross-Section G and Cross-Section N) were created, identifying the different materials used in the various stability models, and are presented as Large Figure 13 for ESSA conditions, Large Figure 14 for USSA conditions, and Large Figure 15 for liquefied conditions.

The drained condition generally applies to long-term, steady-state hydraulic conditions. No excess porewater pressure exists in tailings basin dams and, in many scenarios and material types, the drained condition represents the most common and stable condition. The undrained condition typically applies to short-term conditions, for example during or immediately after dam construction (if such construction occurs rapidly) or immediately after filling of the lift if filling occurs rapidly, representing a case where excess porewater pressure produced in response to the rapid loading has not had time to dissipate. As the dams will be constructed slowly and in thin layers, the undrained condition may but will not always apply to the period immediately after filling a lift. The post-triggering case refers to post-yield or steady-state strength conditions for contractive materials when loading occurs in an undrained manner, shearing the material beyond its yield strength to its steady-state strength (Reference (32)).

Each strength condition has unique strength parameters (Attachment C) and specific minimum required slope stability factors of safety, as detailed in the Work Plan (Attachment A). The FTB was designed to achieve the required slope stability safety factors:

- for ESSA modeled using drained strengths – a minimum FOS of 1.5
- for USSA modeled using yield undrained strengths – a minimum FOS of 1.3
- for USSA modeled using fully liquefied strengths or where liquefied strengths are applied to zones where liquefaction is triggered – a minimum FOS of 1.1

The proposed FTB design was developed iteratively, by modeling various combinations of slope angles, lift heights, bench widths, buttresses, and CDSM zones to determine potential configurations that achieve at least the minimum required factors of safety. From these potential configurations, the proposed FTB design was selected as the configuration that best meets Project objectives.

6.3.1 Stability Analysis Method

FTB stability analyses modeled the north perimeter dam of FTB Cell 2E (Cross-Section F and Cross-Section G) and south perimeter dam of FTB Cell 1E (Cross-Section N) using a limit equilibrium approach. In the limit equilibrium approach, the soil is assumed to be at the state of limiting equilibrium and a FOS is computed. Spencer's method was used to calculate the FOS. This method is considered an adequate limit equilibrium method because it provides a FOS based on both force and moment equilibrium.

The use of analysis criteria in stability modeling is required to achieve realistic factors of safety. The following criteria were applied to these stability analyses:

- A minimum failure surface thickness (depth) of 20 feet. This precludes low FOS results due to shallow surface slumping, which does not place the dam at risk and can be controlled by operation and maintenance procedures. This primarily affects the existing slopes of coarse tailings where acceptable performance with regard to stability has been observed historically.
- For the worst-case model, the contractive saturated (soils below the top of the capillary zone, which is taken as the zone starting 10 feet above the phreatic surface) LTVSMC fine tailings/slimes and the Flotation Tailings are assumed to liquefy, whether or not

liquefaction is shown to trigger in these materials. This is considered a conservative approach to the stability modeling.

SLOPE/W, part of the GeoStudio 2012 Version 8.30 software package, uses limit equilibrium theory to compute the FOS of earth and rock slopes. It is capable of applying a variety of methods to compute the FOS of a slope while analyzing complex geometry, stratigraphy, and loading conditions. The slope stability analyses were conducted using the grid and radius circular method and the grid and radius wedge method in SLOPE/W. For circular slip surfaces, once the critical slip surface was found, the optimization technique was performed on the solution to confirm that the lowest FOS was identified.

In SLOPE/W, the critical failure surface can be circular, pseudo-wedge (wedge), or user-specified. In the circular-searching techniques, the grid of the center of slip circles (or center of blocks) and radii (or ends of blocks) are established by the user, and the computer program then searches for the circle or block yielding the lowest FOS. To account for possible wedge failures, the native materials below the FTB (which includes fractured bedrock; fractured bedrock and till; and fractured bedrock, till, and peat) were evaluated as possibly impenetrable (or significantly stronger than the overlying tailings). Applying impenetrable strengths to each of these layers forces the circular failure surface to truncate along these layers and create a wedge failure, forcing the program to identify failures that progress along possible weak soil layers that might not otherwise have been evaluated. If the stability result with the lowest factor of safety occurred when impenetrable properties were applied to the peat layer, then a weaker fine tailings / slimes material overlying the peat was determined to be the critical path for that analysis. This analysis approach identifies failures that may progress along relatively weak soil layers.

For the analyses performed in this study, the critical circular and pseudo-wedge slip surfaces were further evaluated using the optimized grid and radius failure search methods. The optimization technique uses the solution of the circular and pseudo-wedge slip surface and iteratively modifies the surface (for circular, usually idealized into multiple linear segments; hence a non-circular surface) to seek out the surface with the lowest FOS value. Optimization can sometimes generate unrealistic or kinematically inadmissible failure surfaces; therefore, engineering judgment is used to determine whether the optimized slip surface is realistic and, in cases where it is deemed unreasonable, the result for the circular slip surface is reported (Reference (33)). Criteria for slip surface acceptance evaluated the base angle of each slice along the slip surface. To be kinematically acceptable, for a given soil layer the base angle of each slip surface slice, from the entry slice or exit slice within the soil layer to the slip surface low point, must be smaller than the base angle of the preceding slice. Base angle should monotonically decrease as a function of distance when the obtained failure surface is admissible. If there are changes in base angle direction when the slip surface is within the same material of the slope, then the surface is not valid and the movement cannot be realized at the limiting state (Reference (34)).

SLOPE/W reports the critical failure surface as the slip surface with the lowest computed FOS. At times, and despite the minimum depth criterion applied to the slip surface discussed above, this critical failure surface may relate only to a relatively small or shallow slip in the buttress material. If SLOPE/W reported a slip surface only through the buttress material as the critical failure, this value was reported in a note on the results tables in Section 7.3. However, to provide a more global (and therefore truly more critical) outcome, the slip surface corresponding to a failure through the dam materials was also presented and is considered more representative of the overall stability of the FTB.

As previously mentioned, the porewater pressures produced by SEEP/W during seepage analysis are incorporated into SLOPE/W to compute effective stress, resulting in a more accurate calculation of FOS than traditional limit equilibrium software, which uses a phreatic line to simulate groundwater. As a result, this approach incorporates the calculation of seepage forces when computing the FOS.

The critical slip surface method of analysis for liquefaction triggering scenarios, along with a description of the various scenarios evaluated, are presented in Section 6.4. Liquefaction triggering was analyzed per the requirements of the Geotechnical Modeling Work Plan and results are reported in Section 7.3.4.

6.3.2 FTB Design

The primary objective of the FTB geotechnical design is to provide safe permanent storage of Flotation Tailings with efficient and effective recovery of process water for reuse in the Beneficiation Plant. In addition, the geotechnical design must provide adequate storage for the volume of tailings produced over the proposed 20-year operating life of the project, accommodate the planned wet cover system, and meet project regulatory requirements (Section 2.0).

The proposed FTB incorporates construction of new dams over the existing LTVSMC Cells 1E and 2E. The dams will be constructed using routine earthwork techniques consisting of borrowing nearby LTVSMC coarse tailings (with incidental inclusion of fine tailings and slimes), and placing the tailings in lifts with compaction to specified density to yield the desired dam lift height, geometry and strength.

The proposed FTB design was developed by iteratively modeling various combinations of slope angles, lift heights, bench widths, buttresses, and CDSM zones to determine potential configurations that achieve at least the minimum required factors of safety. In general, stability can be modified by: (1) adding or reducing buttressing to modify resisting force at the toe of the FTB; (2) including free-draining underdrain layers or drains to reduce the phreatic surface in the FTB; (3) adjusting the overall slope angle to modify driving force at the toe; (4) adjusting CDSM zone configuration and mix design to modify strength; or (5) some combination thereof. These items were amended, individually and together, until slope geometry producing adequate factors of safety was achieved. Based on requirements for the site, the most appropriate configuration for the Project was determined from these preliminary configurations for the critical section, Cross-Section F, and for Cross-Sections G and N.

To achieve the stability required for the liquefied undrained condition along Cross-Section F, an underdrain, a toe-of-dam buttress, a CDSM zone, and a mid-slope setback were incorporated into the preliminary design. Cross-Section G required a toe-of-dam buttress, CDSM zone, and a mid-slope setback. For Cross-Section F and G, a conservative assumption was made not to account for the active groundwater collection system along the toe of Cell 2E. In the event of a power outage (no pumping) and a triggering event, the dam will be stable. The effect of the FTB Containment System is discussed in Section 6.8 and results are presented in Attachment G. At Cross-Section N a toe-of-dam buttress was the only feature incorporated into the preliminary design.

An ultimate dam crest elevation of 1732 feet AMSL was selected on the basis of tailings storage capacity requirements. Construction assumes eight lifts, the first seven being 20 feet high with the final lift 10 feet in height for a total height of 150 feet. Each lift has exterior slopes of 4.5H:1V. The exterior face of each lift will be amended with bentonite to reduce infiltration. There is a 60-foot bench between lifts and there is a 625-foot beach extending from the interior crest of dam to the edge of the FTB Pond.

6.3.2.1 Cross-Section F Underdrain

To achieve the required stability along Cross-Section F, an underdrain, comprised of higher permeability material, will be placed between the existing LTVSMC tailings and the first lift of the FTB dam. Between Lifts 4 and 5 there is a 200-foot offset (yielding a 260-foot total bench) to position the driving force from the upper lifts farther upstream from the existing toe. The downstream toe is further reinforced by the addition of a buttress to crest elevation of 1538 feet AMSL. This design results in an overall dam slope of approximately 8 degrees (7H:1V) and an FTB dam slope of approximately 6.6 degrees (8.6H:1V). The proposed dam geometry with dimensions is presented in Large Figure 16.

The underdrain will provide a path for porewater pressure release if the phreatic surface is higher than expected. The presence of the coarse underdrain also provides additional stability by creating a stronger layer farther inside the basin than would normally be created by hydraulic deposition of tailings.

The effectiveness of the underdrain (in this case a high permeability foundation layer or mat below the Flotation Tailings – Large Figure 16) was evaluated through modeling. The length and thickness of the mat were varied to determine how much coarse material will be required to sufficiently lower the phreatic surface. The material was modeled both as gravel, with a unit weight of 140 pcf and a friction angle of 40 degrees, and as LTVSMC coarse tailings. The LTVSMC coarse tailings and the coarser bulk tailings blend both provide acceptable filtration for the Flotation Tailings, as discussed in Section 5.3.4. The LTVSMC coarse and bulk tailings were tested at unit weights intended to simulate in-situ density (Sections 5.2.2.1 and 5.2.2.5) and thereby long-term drain performance. Both the coarse and bulk tailings are permeable enough to significantly lower the phreatic surface and either material could be used, provided adequate filtration is included. Further analysis and design of the underdrain will be performed as part of final design.

Results show the underdrain will need to be 250 feet long (farther upstream of the initial raise of the FTB, over the Tailings Basin, and measured perpendicular to the axis of the slope) and 4 feet thick to adequately maintain a lowered phreatic surface within the new dam. As part of final design for construction, additional modeling will be conducted to ascertain if this underdrain needs to be continuous along the length of the dam, or if narrow segments of underdrain material will be effective. It is prudent to construct an underdrain at the start of operations in places where the layer does not already exist via the presence of LTVSMC coarse tailings at the surface of the Tailings Basin. Test trenching and/or auger borings will be performed prior to bidding for construction and will be used to confirm underdrain requirements. The underdrain location and configuration will be updated with future drawing updates (Reference (1)) to provide details as to underdrain location and configuration.

Modeling also evaluated the effect of the underdrain on seepage flow in the dam. In the seepage and stability modeling, the seepage in the underdrain flows into the LTVSMC coarse tailings shell in the existing dam, then out through the toe of the dam. Cell 2W serves as an analog to demonstrate that seepage-induced internal erosion with incremental pond raises will not be problematic. This potential failure was evaluated and is discussed in Section 7.2.3.1. Further, the toe of the Cell 2E dam is proposed to be embedded in a rock buttress, providing further resistance to erosion. However, any seepage due to underdrain flow could be collected with perforated piping and conveyed back into the basin or downslope (Section 6.6 of Reference (35)) to prevent saturation of the coarse tailings shell.

6.3.2.2 Buttress Design

The proposed buttress at the toe of the existing dam for Cells 1E and 2E was designed to provide a counterweight to the driving forces modeled in worst-case liquefaction scenarios (Section 7.3.6). The thickness and width of the buttress were altered to assess whether a reasonable amount of rock could be used to sufficiently increase the FOS. The material was modeled as gravel with a unit weight of 140 pcf and a friction angle of 40 degrees. Buttress material will likely consist of available waste rock from a nearby stockpile. The modeled buttress at Cross-Section F has an approximate top elevation of 1538 feet AMSL. Due to a higher ground surface elevation, at Cross-Section G the buttress has an approximate top elevation of 1553.5 feet AMSL. Each buttress has an approximate width (dimension perpendicular to the face of the dam) of 126 feet. The model also assumes that any peat that exists at the toe of the north dam of Cell 2E below the proposed location of the buttress will be removed prior to construction, allowing the buttress to key into the stronger underlying glacial till. The blanket buttress at the toe of the existing dam for Cross-Section N has a proposed top elevation of 1665 feet and an approximate length of 390 feet. Although called a buttress at Cross-Section N, construction here will consist of filling an existing low area rather than constructing a zone of increased embankment thickness.

Future analysis may be undertaken to optimize the size of the underdrain relative to the size of the buttress or assess the impact of varying the underdrain length, size, and spacing (continuous or strips).

6.3.2.3 Mid-slope Set-back

For Cross-Section F and Cross-Section G, a bench of 260 feet was designed between Lift 4 and Lift 5; in effect, the 60-foot bench plus a 200-foot offset. This mid-slope setback flattens the overall slope angle and pushes the driving forces due to the higher lifts farther from the toe of the Tailings Basin. The setback bench surface between Lifts 4 and 5 was modeled as covered with LTVSMC bulk tailings. This layer provides a construction base for Lift 5, while also supplying additional shear strength along the ground surface to help prevent shear surfaces from daylighting through the setback. This mid-slope setback also provides flexibility for potential future modifications, if needed, such as room to construct an additional upper buttress overlying the mid-slope setback to prevent failures from daylighting through the setback as the dam reaches its ultimate height, should the strength and permeability properties of the operational Flotation Tailings differ from the pilot plant sample. While adding mass to a slope may induce a decrease in slope stability safety factor for some failure surfaces, those safety factors remain at acceptable levels while safety factors for other failure surfaces simultaneously increase. If future modifications are required over the mid-slope setback, the bentonite-amended layer will be removed and then reconstructed once primary slope construction is complete.

6.3.2.4 Cement Deep Soil Mixing (CDSM) Zone

To achieve stability that is required for the fully liquefied condition with an unknown trigger along Cross-Section F and Cross-Section G, a CDSM zone was incorporated into the slope design. The location of the CDSM was modeled at approximately the same distance into the basin from the toe of the slope for both cross-sections and the CDSM zone was kept at the same height. Cross-Section F requires a zone 50-feet thick while Cross-Section G requires a much smaller zone; one that is 5-feet thick. Location of the CDSM zone for Cross-Section F is presented in the Flotation Tailings Management Plan (Reference (1)). Future analyses of the cross-sections will include optimizing the CDSM zones for final design while still maintaining a triggering-analysis $FOS_{Flow} > 1.1$.

6.3.3 Veneer Stability

Stability of the bentonite-amended layer of soil along the slope of each lift was evaluated with an infinite slope stability analysis. This type of analysis applies when failures are expected to be very shallow and parallel to the slope and is often used when assessing stability over a liner or when a weak plane (i.e., the bentonite-amended tailings layer) exists parallel to the slope which could promote sloughing. The evaluation was performed with and without seepage along the slope (Reference (18)).

The infinite slope stability FOS without seepage is determined as:

$$FOS = \frac{c'}{\gamma H cos^2\beta tan\beta} + \frac{tan\phi'}{tan\beta}$$ **Equation 6-1**

Where:

γ = moist unit weight, pcf
H = slope height, feet
β = slope angle, degrees
ϕ' = drained friction angle, degrees
c' = drained cohesion, psf

The infinite slope stability FOS with seepage, where groundwater level is assumed to coincide with the ground surface, is determined as:

$$FOS = \frac{c'}{\gamma_{sat} H \cos^2\beta \tan\beta} + \frac{\gamma'}{\gamma_{sat}}\frac{\tan\phi'}{\tan\beta}$$ **Equation 6-2**

Where:

γ' = buoyant unit weight, pcf
γ_{sat} = saturated unit weight, pcf

Modeling used a 20-foot slope height and 12.5-degree slope angle. A literature review was performed to estimate the shear strength of bentonite-amended sandy soils (References (36), Reference (37), Reference (38), and Reference (39)). Based on 3% bentonite addition, the effective friction angle was found via the literature search to range from 36 to 47 degrees with drained cohesion ranging from 130 to 430 psf. Average moist unit weight was 132 pcf and average saturated unit weight was 137 pcf. For conservatism, an effective friction angle of 30 degrees was used in the infinite slope analysis with drained cohesion of 100 psf, using the averaged moist and saturated unit weights. The cohesion value of 100 psf is less than the low cohesion value found in the referenced literature for compacted soil-bentonite mixes. This affords the opportunity to place and compact the tailings-bentonite mix at a density required to achieve the desired hydraulic conductivity, while easily achieving the modeled cohesion. Vegetation root penetration and reinforcement is assumed to be insignificant. With no seepage, the infinite slope stability safety factor is 2.78. Assuming seepage occurs; the FOS is reduced to 1.59. As noted, a minimum FOS of 1.5 is recommended for design of drained conditions.

Testing will be performed to verify strength parameters for the bentonite-amended soils at the site as part of the permitting process. The parameters and analysis will be updated as necessary at that time.

The bentonite-amended soil layer will be located below a vegetated soil surface for which erosion is anticipated to be no less and no greater than for other vegetated slopes at the facility. The bentonite-amended zone will be located approximately 3 feet below the surface; below the primary root zone of the vegetated surface. Deep rooted plants are not proposed for use in reclamation of the flotation tailings basin dams but may be beneficial to minimization of erosion potential on dam side slopes. Therefore, on the exterior face of the dams the bentonite-amended zone may be located deeper if necessary to avoid the root zone of the specific vegetation types anticipated to be utilized and to become established on site. Placement of the bentonite-amended zone at greater depth would also reduce the potential for freeze-thaw impacts on the bentonite-amended layer. Preliminary geometry of the bentonite amended cover is provided on Drawing FTB-024 of the Flotation Tailings Basin Permit Support Drawings contained in Attachment A of Reference (1). Final geometry will be adjusted once final vegetation types and corresponding root zone depths are considered. This type of bentonite layer is atypical in a tailings basin dam and a limited data search has not identified articles describing its use at other facilities. However, clay barrier layers have very frequently been used for various landfill cover systems, worldwide for many dozens of years, as a means of reducing rainwater infiltration.

As with all slopes at the facility, those that include the bentonite-amended tailings layer will require periodic inspection (Reference (1)) to identify any areas where erosion has occurred, thereby requiring repair. If erosion does occur, the eroded area will require regrading and revegetation. The frequency of any required erosion repair will likely diminish over time as the vegetative cover layer becomes well established. The cohesion provided by addition of the bentonite to the bentonite-amended soil layer should be beneficial in limiting the depth of erosion if it does occur, such that overall stability due to surface erosion will not affect overall slope stability.

6.4 Liquefaction Triggering Analyses

Liquefaction can potentially be triggered statically or seismically. Static versus seismic liquefaction represent very different scenarios from a stability standpoint. A static triggering event (for example, creating excess porewater pressures by constructing too quickly or due to erosion locally causing a steeper slope angle) is likely to be limited to a small area, impacting soils only around the event. A seismic triggering event (earthquake) occurs globally and instantly impacts all soils. Global static liquefaction could also be induced by high porewater pressures associated with a large storm event or if the entire slope was unintentionally steepened during construction.

The potential for LTVSMC fine tailings and slimes and the Flotation Tailings to liquefy in response to triggering events is due to the fact that some of these materials are hydraulically deposited and come to equilibrium under very loose to loose conditions. This very loose to loose condition can result in contractive behavior during undrained shearing. Figure 6-1 illustrates the behavior of saturated, contractive tailings during undrained loading. The yield strength, $s_{u(yield)}$, is defined as the peak strength available during undrained loading (Reference (24)). Steady-state (liquefied) undrained strength can be triggered by either static or dynamic loads, by additional strain, or under static shear stress that is larger than the liquefied shear strength, $s_{u(liq)}$.

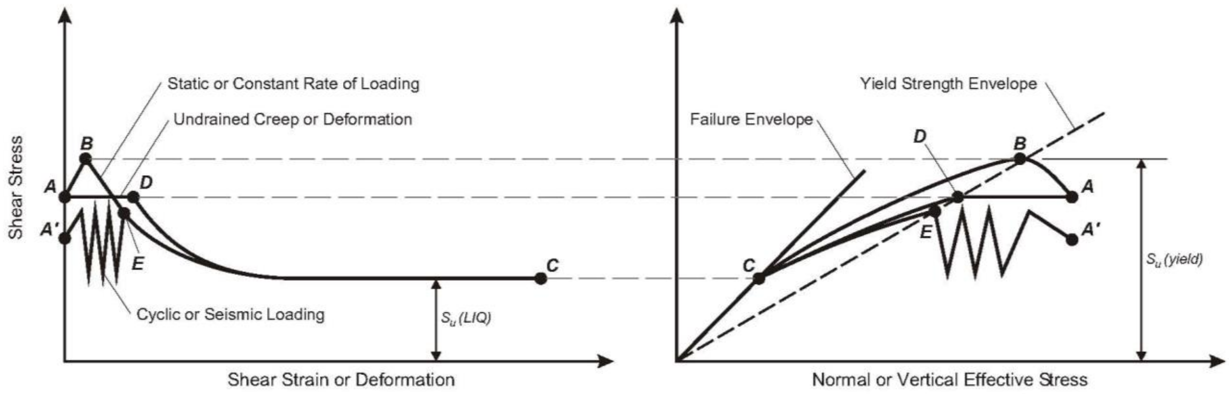


Figure 6-1 Undrained Response of Saturated Contractive Sandy Soil

Point A or Point A' on Figure 6-1 represents the prevailing stress and strain conditions in a soil element (such as the tailings). The static shear stress on the soil element at Point A or Point A' is greater than the soil's liquefied strength (Point C). The conditions that lead to the stress state represented by Point A or Point A' could have been caused by drained, partially drained, or completely undrained loading conditions during dam construction.

Stress path A-B-C considers the change in stress and strain of an element of soil within a saturated layer underlying a dam during construction which triggers static liquefaction. During placement of the next dam lift or other stress inducing loading, the stress and strain conditions in the soil element moves from Point A to Point B. This step assumes that the drainage boundaries and permeability of that element of soil result in a temporary undrained condition in the element. Point B is located on the yield strength envelope; therefore it represents the maximum shear resistance that the soil element can mobilize under undrained monotonic loading conditions. When the shear stress in the soil element exceeds Point B (the yield shear strength), the structure of the soil yields and collapses, and liquefaction is triggered. The element then moves from Point B to Point C, the liquefied strength. Note that the liquefied strength is low but is not zero.

Stress-strain and stress path A-D-C again considers the change in stress and strain of a soil element starting at Point A in Figure 6-1. Referring to this stress path, in a deformation-induced (undrained creep) failure, the static shear strain increases due to dam construction under undrained conditions, causing a drop in effective stress, shown by the element moving horizontally from Point A to Point D. This stress path also represents a constant shear stress (or constant-*q*) path that develops as a result of a rising water table. While this stress path can be drained as the effective stress approaches the yield strength envelope, as noted by Sasitharan et al. (Reference (40)), who first thoroughly documented this stress path, there is a slight increase in porewater pressure immediately prior to yield (or collapse). This suggests that the small load increment (or decrement) immediately before collapse was partially drained or undrained. Furthermore, Reference (40) indicated that the collapse process was essentially undrained. At

Point D, which is located on the yield strength envelope, liquefaction is triggered and the soil element moves from Point D to Point C, the liquefied shear strength.

For seismically induced flow failures, consider a soil element with stress and strain conditions represented by Point A' in Figure 6-1. The element is then subjected to seismic or dynamic loading. If the duration and intensity of the seismic/dynamic load is sufficient to cause porewater pressure increases large enough to shift the element from Point A' to Point E, which is located on the yield strength envelope, liquefaction is triggered and the element moves to Point C, the liquefied shear strength.

Liquefaction triggering analyses were conducted for the FTB design along Cross-Section F for the triggers identified in the Work Plan (Attachment A), as described in the subsequent sections. Additionally, an unknown trigger was evaluated for all cross-sections by performing a stability analysis assuming all saturated, contractive tailings would liquefy.

6.4.1 Evaluating Liquefaction Triggering

Both static and seismic liquefaction triggers were evaluated for Cross-Section F. Static triggering was based on limit equilibrium stresses from integrated SEEP/W and SLOPE/W analyses. Seismic triggering included a triggering screening of site-specific soil and tailings data, with an ensuing dynamic modeling analysis required if the screening indicated seismic liquefaction would be triggered.

The basic steps of the liquefaction triggering analyses for both static and seismic liquefaction, consistent with Olson and Stark's methodology (Reference (22)) prescribed by the work plan, are described below:

1. Perform a strength reduction analysis to determine the critical failure surface using limit equilibrium theory by incrementally reducing liquefied undrained shear strength values simultaneously with consistent percent reductions for the contractive undrained materials until the factor of safety equals 1.0. The triggering screening – see Attachment C – indicated that portions of the LTVSMC fine tailings and slimes layers tested were found to be contractive and subject to liquefaction and the future Flotation Tailings are assumed to deposit in a contractive state.

2. Analyze a $USSA_{yield}$ model with the identified critical failure surface input as a fully specified failure surface (FSFS) found in Step 1.

3. Use resulting stresses from the $USSA_{yield}$ model with the FSFS to assess liquefaction triggering in each slice of the failure surface. For seismic triggering, these stresses are evaluated against an increase of driving forces and for static triggering, the stresses are evaluated against either an increase in driving forces or a reduction of shear strength, depending on the static triggering mechanism.

Static liquefaction triggering scenarios and detailed analysis procedures are described in Section 6.4.2. Seismic liquefaction screening and triggering analyses are described in Section 6.4.3.

6.4.2 Static Liquefaction Triggering Analysis

The static triggering analysis used the results of the SEEP/W models, the critical failure surface identified in the SLOPE/W model for the strength reduction analysis, and the computed slice stresses to assess for liquefaction due to a load change. The method is based on procedures outlined by Olson and Stark (Reference (16), Reference (22), and Reference (41)). With their procedures, the steady-state (or liquefied) strength may be presented as a ratio by normalizing the strength to the effective overburden pressure ($USSR_{liq} = s_{u(liq)} / \sigma'_v$).

6.4.2.1 General Procedure

The Olson and Stark (Reference (22), Reference (41)) procedures can generally be summarized in the following steps:

Step 1 – Perform a limit equilibrium analysis (SLOPE/W) to determine $\tau_{driving}$ and σ'_v for each slice along the FSFS.

Step 2 – Calculate the average static shear stress ratio $\tau_{driving} / \sigma'_{v,\,ave}$ for each slice using the limit equilibrium results.

Step 3 – Estimate the average seismic shear stress $\tau_{seismic,ave}$ either using published relationships (such as in Reference (34)) or using a deformation site response analysis model.

Step 4 – Compute $s_{u(yield)} / \sigma'_v$ using corrected mean CPT and SPT penetration resistance.

Step 5 – Determine the values of $s_{u(yield)}$ and $\tau_{driving}$ along the base of each slice.

Step 6 – Calculate the FOS against liquefaction triggering as:

$$FOS_{triggering} = \frac{s_{u(yield)}}{\tau_{driving} + \tau_{seismic,ave} + \tau_{other}}$$ **Equation 6-3**

Note: τ_{other} relates to external driving stresses, such as surcharges, that would not be included within the static driving shear stress. This τ_{other} accounts for the induced change in stress due to changing conditions of the dam section, i.e., the specific triggers identified in the following section, and is determined with a limit equilibrium analysis (SLOPE/W model).

Because only static liquefaction triggering is being evaluated, there is no average seismic shear stress (Step 3, $\tau_{seismic,ave}$) in these analyses. An example triggering computation for one slice along the slip surface is provided in Attachment O to show Olson's liquefaction analysis as outlined in Steps 1 through 6 above. In static events, liquefaction is triggered by application of additional stress beyond the yield undrained shear strength (following points A-D-C in Figure 6-1).

6.4.2.2 Static Liquefaction Triggering Scenarios

Static liquefaction analyses were performed with results from SLOPE/W models. Liquefaction is triggered statically when stresses are increased rapidly (or effective stress is decreased rapidly) such that the aggregate driving shear stress exceeds the yield undrained shear strength of saturated, contractive material. Per the Work Plan (Attachment A), analyses were performed to evaluate six potential static triggering events, including:

1. Baseline – Lift 8
2. High Construction Rate of Loading – Lift 1
3. Local Erosion/Scour of Slope (pipe break) – Lift 8
4. Elevated Phreatic Surface (drain ineffective) w/High Pond – Lift 1
5. Elevated Phreatic Surface (i.e., drain ineffective) – Lift 8
6. Long-Term Case (20, 200, and 2,000 years after closure)

More detail of these cases is provided in Large Table 2. The initial five cases were performed as full triggering analyses and results are provided in Section 7.3.4. For the Baseline – Lift 8 case, the strength is locked in along the fully specified failure surface for the stress conditions due to Lift 7 and immediately before placing Lift 8. Therefore cohesion equals zero at the surface and no strength increase is attributed to placement of Lift 8. The long-term case was treated as an unknown triggering event because post-closure triggering mechanisms cannot be accurately projected. Long-term cases were analyzed with fully liquefied long-term conditions, and results are presented in Section 7.3.7.

As shown in Large Table 2, the procedure for each triggering scenario varied slightly with regards to determination of the FSFS from pre-loading slope stability models and the FOS against triggering ($FOS_{triggering}$) determined from the post-loading slope stability outputs. The analysis is detailed further in the following section and specific procedural variations for each scenario are discussed in Section 7.3.4 with their individual results for liquefaction triggering.

6.4.2.3 Determining Factor of Safety (FOS) Against Triggering

To evaluate static liquefaction triggering, results from pre-loading slope stability models are compared to results from post-loading slope stability models after there has been a load change applied (when the scenario pertains to a sudden change in conditions), as described below:

I. A slope stability model is prepared with fully liquefied strength parameters for contractive, saturated soils (soils below the top of the capillary zone, which is assumed as the zone 10 feet above the phreatic surface) to determine the FSFS. The model used to determine the FSFS for each case is described in Large Table 2, as it varies by the triggering mechanism and may use pre- or post-loading geometry. All liquefied strength ratios are incrementally altered until the overall slope stability factor of safety ($FOS_{overall}$) is approximately 1.0. The corresponding computed failure surface identified by the search routine of SLOPE/W is then traced and set as the FSFS for use in subsequent models.

Note that for certain triggering scenarios, such as Baseline and the plugged drain cases, there are no pre- and post-loading models, as the act of plugging the drain would occur over a significant amount of time and there would be no immediate change in conditions to analyze.

II. A pre-loading model with $USSA_{yield}$ strengths and the FSFS (determined in Step I) is then run to compute the pre-loading slope stability $FOS_{overall}$. From this USSA model, the mobilized shear stress and shear strength are exported from SLOPE/W as a function of distance along the FSFS or as a function of the x-coordinate (if the pre- and post-loading failure surfaces are different lengths, due to differing model geometry). The porewater pressure along the FSFS is also plotted to determine where saturated material exists. Saturated materials are defined by porewater pressures equaling or exceeding hydrostatic water pressure.

In cases where undrained shear strength (s_u) values need to be locked in for the immediate change analysis (i.e., where s_u values do not have time to change in response to a rapid change in conditions such as rapid loading or unloading), a profile of the undrained shear strength is plotted along the pre-loading FSFS, as described further subsequently. This method sets the strength of the soil layers without the benefit of consolidation occurring, which would lead to an unrealistic increase in strength from a load application. The shear strength from the pre-loading model is used to assess the $FOS_{triggering}$.

III. Depending on the triggering mechanism, the shear strength may need to be locked in along the FSFS for the post-loading model. This needs to occur if the triggering event would occur rapidly enough that effective stresses would not be redistributed (i.e., pond bounce associated with the PMP or rapid construction). To lock in the s_u, the pre-loading shear strength profile (from Step II) is subdivided into “sections”, as needed, to estimate representative shear strengths for input into the post-loading model. This is an iterative process, where these "sections" are incorporated into a version of the pre-loading model, and the s_u values are revised as needed to achieve the same slope stability $FOS_{overall}$ as the pre-loading model without the locked-in strength sections.

IV. When needed, a separate slope stability model is then created to model post-loading conditions (i.e., rapid load from subsequent dam raise, erosion, etc.). The FSFS is used to evaluate overall slope stability $FOS_{overall}$ and for direct comparison of stresses to the pre-loading model for $FOS_{triggering}$ computation of each slice. Depending on the loading mechanism, the FSFS may need to be extended up past the pre-loading ground surface (like the rapid construction case). If required based on the triggering mechanism, the post-loading model will need to include the "sections" along the FSFS to lock the s_u to the pre-loading strength values.

V. From the post-loading model, the shear strength and/or mobilized shear stress are exported from SLOPE/W as a function of distance along the failure surface or as a function of the x-coordinate (if the pre- and post-loading failure surfaces are different lengths, when model geometry differs).

VI. The $FOS_{triggering}$ is then computed as defined in Large Table 2. The pre-loading shear strength is divided by post-loading mobilized shear stress to compute $FOS_{triggering}$. Although the failure surface is fully specified, the slices may differ between the pre- and post-loading cases (especially if the pre- and post-loading slope geometry differs) and linear interpolation was required at times to compute the $FOS_{triggering}$ at all points along the FSFS.

VII. If the $FOS_{triggering}$ is below 1.1 for a given slice within the saturated zone of liquefiable materials, the region at the base of that slice is reassigned the appropriate liquefied strength ratio in SLOPE/W and a post-liquefaction slope stability $FOS_{overall}$ is computed, which must also be equal to or greater than 1.1.

6.4.2.4 Determining Post-Loading Stability

Segments or slices where the computed $FOS_{triggering} \geq 1.1$ are unlikely to liquefy, and if all segments have a $FOS_{triggering} > 1.1$, a post-loading stability analysis is not necessary (Reference (41)). Olson and Stark recommend that slices with a $FOS_{triggering} < 1.1$ have their strength values reduced to the liquefied shear strength ratio during a post-triggering analysis for the same failure surfaces. Therefore, segments of the failure surface with $FOS_{triggering} < 1.1$ were reassigned their liquefied shear strength (Reference (41)). The post-loading model was reanalyzed with the liquefied shear strengths updated for triggered slices to determine a new $FOS_{overall}$. This procedure accounts for potential deformation-induced liquefaction and progressive failure of the structure. The minimum allowable overall $FOS_{overall}$ of 1.1 was set in the Work Plan (Appendix A) as the safety factor performance criteria for the triggering analysis outcomes.

To determine the $FOS_{overall}$, yield undrained shear strength ratios ($USSR_{yield}$) are applied to materials not prone to liquefaction, but expected to behave in an undrained manner (i.e., peat). Drained strengths are applied to materials above the capillary zone and any materials that are expected to behave in a drained manner (i.e., LTVSMC coarse tailings). The capillary zone is defined as a 10-foot layer above the modeled phreatic surface.

If liquefaction is triggered in a slice of Flotation Tailings or LTVSMC fine tailings/slimes within or below the capillary zone, the strength at the base of that slice is reassigned the corresponding $USSR_{liq}$ value in SLOPE/W and the model is re-analyzed for post-loading $FOS_{overall}$ using the reassigned strength parameters.

6.4.3 Seismic Liquefaction Triggering Analysis

The potential for seismic triggering of liquefaction is assessed in two steps. The first step is to determine whether the potential for seismic triggering exists. This evaluation is performed using site-specific data including the anticipated seismic events (the potential driver for liquefaction) and in-situ soil data (the soils' resistance to liquefaction). The screening analysis is based on procedures laid out by Boulanger and Idriss (Reference (12)) and a summary report from the 1996 NCEER and 1998 NCEER/NSF Workshop (Reference (42)) that discusses the evaluation of liquefaction resistance of soils using data from in-situ testing, such as SPT and CPT.

If this screening procedure indicates that the design seismic event at the Project site could trigger liquefaction, then an analysis using a geomechanical model such as QUAKE/W would be used as part of further evaluations of stability.

6.4.3.1 Site-Specific Seismic Hazard

A site-specific probabilistic seismic hazard analysis (PSHA) was prepared for the Project site (Attachment P). A PSHA is a quantitative estimate of the hazards for ground-shaking at the site analyzed probabilistically to consider uncertainties in earthquake location, size, and frequency of occurrence. The PSHA was used to develop acceleration-time histories for dynamic stability analyses for the FTB. This site-specific analysis assesses the potential local and regional seismic sources that could affect the site, models their attenuation to the site, and provides an estimate of seismic impact at the site.

Seismicity at the site is likely to be governed by one of two conditions: (1) nearfield events, which are low magnitude earthquakes with epicenters in the Midwest (like those discussed in Section 3.3), and (2) farfield events, which are higher magnitude earthquakes caused by the New Madrid Seismic Zone. The New Madrid Seismic Zone contains the nearest active fault and is approximately 760 miles south of the site. The zone is named after New Madrid, Missouri, which is close to the northern boundary of the seismic zone.

U.S. Geological Survey (USGS) data was used to evaluate potential earthquake frequency and ground acceleration at the Project site (Reference (43)). Table 6-1 summarizes the ground motions for earthquakes with 50-year probability of exceedance of 10%, 5% and 2%. There is a 2% probability that the Peak Ground Acceleration (PGA) at the site will exceed 0.024g in 50 years. This corresponds to a 0.0004 probability of exceedance per year, or a return period of

2,475 years, which means that there is a 63.2% likelihood that this earthquake will occur in a period of 2,475 years.

Table 6-1 Summary of USGS Seismic Risk Calculation

Probability of Exceedance			
Per Annum	0.0021	0.0010	0.0004
In 50 years	10%	5%	2%
Return Period [years]	475	975	2,475
Peak Ground Acceleration [g]	0.006	0.012	0.024

The results of the PSHA include 3 earthquake records, based on a 2% probability of exceedance in 50 years, related to nearfield sources, farfield sources, and a record that aggregates these two sources. The acceleration records determined from the PSHA for the nearfield, farfield, and combined events are applied to Cross-Section F in QUAKE/W. The accelerations can be tracked throughout the duration of the shaking and along the slip surface. The input acceleration records are provided and discussed in detail in Attachment P. The PHSA results are summarized in Table 6-2.

Table 6-2 Summary of PSHA Results

			Seismic Source		
		Unit of Measure	Nearfield Earthquake	Farfield Earthquake	Combined Event (Simultaneous Nearfield and Farfield Earthquakes)
2,475-Year Return Period	Spectral Acceleration	g	0.055	0.016	0.061
	Peak Period	Seconds	0.1	2.0	0.1
975-Year Return Period	Spectral Acceleration	g	0.025	0.006	0.030
	Peak Period	Seconds	0.2	1.0	0.1
475-Year Return Period	Spectral Acceleration	g	0.013	0.000	0.017
	Peak Period	seconds	0.2	N/A	0.2
Hazard Probability		N/A	0.00052	8.13×10^{-5}	0.00062
Mean Distance		Miles	100	763	200
Mean Magnitude		M	5.62	7.73	5.92

A Deterministic Seismic Hazard Analysis (DSHA) was not performed as part of this project. The DSHA has a number of drawbacks as follows: (1) it provides no indication of the likelihood of exceeding an estimated ground motion; (2) the spectrum obtained from a DSHA is not a uniform hazard response spectrum; (3) a DSHA forces the engineer to assume that all future earthquakes which occur within the "area source" are located at the minimum distance between the site and the "area source", which in some cases is an overly conservative assumption; and (4) a DSHA does not consider the uncertainty associated with the location of earthquakes on an area source or on a fault (Reference (44)). In contrast, a PSHA considers all the uncertainties in ground motion estimation, and thus was used in this analysis.

Considerations for seismic stability are incorporated into the FTB dam design via the fully liquefied evaluation where an unknown trigger induces liquefaction.

6.4.3.2 Seismic Liquefaction Screening Evaluation

Evaluation of the potential for seismic liquefaction requires estimation of the cyclic shear stresses and the soil's ability to resist liquefaction. The analysis used the estimation method determined in workshops jointly held by the National Center for Earthquake Engineering Research (NCEER) and National Science Foundation (NSF) (Reference (42)). This evaluation used the 2,475-year return period event from the PSHA and CPT data to determine a FOS against liquefaction triggering. Several parameters were computed.

The CSR is the cyclic stress ratio, which represents the seismic demand on a soil layer. The CSR is computed as:

$$CSR = 0.65 * \frac{a_{max}}{g} * \frac{\sigma_{vo}}{\sigma'_{vo}} * r_d$$ **Equation 6-4**

Where:

- a_{max} = peak horizontal ground acceleration at the bedrock surface due to the design earthquake (2,475-year return period)
- g = acceleration due to gravity
- r_d = stress reduction coefficient, which accounts for flexibility of the soil profile
- *0.65* = reduction factor from Reference (42) to produce a *CSR* representative of the most significant cycles over the full loading duration

In Reference (42), the depth reduction factor (rd) is a shear stress reduction coefficient (or shear mass participation factor), computed as a function of depth (z) in meters by:

$$r_d = \frac{1.000 - 0.4113z^{0.5} + 0.04052\,z + 0.001753\,z^{1.5}}{1.000 - 0.4177z^{0.5} + 0.05792z - 0.006205z^{1.5} + 0.001210z^2}$$ **Equation 6-5**

The CRR is the cyclic resistance ratio, indicating the capacity of the soil to resist liquefaction. The CRR is computed using the normalized clean-sand cone penetration resistance ($q_{c1N,CS}$) from CPT data as:

$$If\ (q_{c1N})_{cs} < 50,\ \ CRR = 0.833 * \frac{(q_{c1N})_{cs}}{1000} + 0.05$$

Equation 6-6

$$If\ 50 < (q_{c1N})_{cs} < 160,\ \ CRR = 93 * (\frac{(q_{c1N})_{cs}}{1000})^3 + 0.08$$

Equation 6-7

In 1982, Seed and Idriss (Reference (45)) analyzed multiple level-ground sites where seismically induced liquefaction did or did not occur. From these analyses, relationships were proposed to identify when materials would or would not liquefy. However, because all of the earthquakes involved different magnitudes (i.e., differences in duration of shaking and frequency content), it is necessary to adjust the earthquake demand (i.e., $\tau_{seismic}$) for earthquake magnitudes higher or lower than 7.5. This adjustment is accomplished using a Magnitude Scaling Factor (MSF). Since then, multiple scaling factors have been proposed. Based on the results of the NCEER/NSF workshops, Reference (42) recommends the following MSF relationship:

$$MSF = \left(\frac{M_w}{7.5}\right)^{-2.56}$$

Equation 6-8

Reference (12) and Reference (42) suggest that when the FOS against liquefaction triggering is less than 1.0, triggering will occur. The FOS against triggering is determined as:

$$FOS_{triggering} = \frac{CRR_{7.5}}{CSR_{7.5}} * MSF * K_\sigma$$

Equation 6-9

Where:

K_σ = a correction factor to extrapolate the simplified procedure to larger overburden pressure conditions.

6.4.3.3 Screening Results

The factors of safety obtained at each CPT point for the test locations along Cross-Section F were plotted versus depth to determine if any points are susceptible to triggering based on the design earthquake presented in the PSHA. The design event corresponds to a 2,475-year return period with a probability of exceedance of 2% in 50 years (M_w = 5.92, a_{max} = 0.026g). The lowest FOS against triggering computed for all fifteen CPT locations along Cross-Section F was 1.3, triggered in CPT14-20 at a depth of approximately 3 feet in coarse tailings. All other CPT locations along Cross-Section F reported factors of safety greater than 2.5. The applied seismic event was then scaled up to determine what event would trigger liquefaction in contractive materials. It was determined that an earthquake with M_w = 5.0 and a_{max} = 0.2g would be required to trigger liquefaction. For the location of the tailings basin this event corresponds to a 100-million-year return period.

Large Figure 17 shows an example of the triggering potential at CPT location 07-06 located along Cross-Section F. The CPT tip resistance is plotted showing the material separation profile. The first triggering plot shows that no CPT data points trigger based on the design event. The second triggering plot shows that liquefaction will be triggered when an earthquake with greater PGA (and a much longer return period) is applied. Additional figures of the remaining fourteen CPT locations along Cross-Section F are provided in Attachment Q.

Results indicate that the seismic design event would not trigger liquefaction in any FTB materials. Therefore, the secondary seismic liquefaction triggering analysis using QUAKE/W is not needed and Sections G and N, which are more stable than Section F, are not analyzed.

6.5 Fully Liquefied Analysis

The worst-case scenario for flow liquefaction was modeled by assigning all contractive, saturated soils below the top of the capillary zone their liquefied strengths and then completing the overall slope stability analysis. This analysis simulates an unknown liquefaction trigger.

A 10-foot offset above the phreatic surface was established as a capillary zone. All materials within and below the capillary zone with potential to liquefy were assigned $USSR_{liq}$ DV and all materials above the phreatic surface offset were assigned drained DV. Any other saturated materials not expected to liquefy (i.e., peat) were assigned the $USSR_{yield}$ design value.

6.6 Sensitivity Analysis

Stability modeling uses the material strength DV for each of the materials that make up the Tailings Basin layers (detailed in Attachment C) to identify critical slip surfaces and calculate factors of safety (a deterministic approach). However, in geologic and geo-engineered systems, the properties of a material may vary from location to location due to variation in mineralogical composition, deposition conditions, stress history, as well as physical and mechanical decomposition (Reference (46); Reference (47); Reference (48)). Along the critical slip surface, multiple material types are present (Section 7.1), and shear strengths within each material type (Section 5.0) can vary vertically and horizontally.

The purpose of the sensitivity analyses is to quantify the uncertainty in the deterministically modeled FOS due to uncertainty and variability in the input material strength DV. Two sensitivity analyses were performed to evaluate the effect of variability in materials' strengths on calculated factors of safety:

- Analysis 1 assessed how variations in the yield undrained shear strength values ($USSR_{yield}$) could affect the FOS under normal operating conditions.
- Analysis 2 assessed how variations in the liquefied shear strength ($USSR_{liq}$) could affect the FOS in the case of the occurrence of an unknown liquefaction triggering event.

An overview of the two sensitivity analyses is presented in Table 6-3, showing the FTB configuration, loading condition, material strength, and layers for which the material strengths were varied. Sensitivity analysis was conducted in accordance with the methods in the approved NorthMet Geotechnical Modeling Work Plan – Supplement dated 08/30/2013 (Attachment A).

Table 6-3 Sensitivity Analyses Overview

	Sensitivity Analysis 1	Sensitivity Analysis 2
FTB Configuration	Maximum height, Lift 8	Maximum height, Lift 8
Loading Condition	Normal operating conditions	Unknown triggering event
Material Strength Parameter	Yield undrained shear strength ratio ($USSR_{yield}$)	Liquefied undrained shear strength ratio ($USSR_{liq}$)
Variable Material Strength Inputs	• LTVSMC fine tailings/slimes • NorthMet flotation tailings • Peat	• LTVSMC fine tailings/slimes • NorthMet flotation tailings

Sensitivity analyses were performed using the probabilistic analysis function in SLOPE/W, part of the GeoStudio 2012 software package. This function uses the Monte Carlo method to randomly select and apply material strengths, from the user-specified range of material strengths, to the slope stability model to quantify the uncertainty in the computed slope stability FOS. In the Monte Carlo simulation, the entire modeled system is simulated 20,000 times. In each individual simulation, all variable inputs (in this case material shear strength) are randomly sampled from user-defined probability distributions, and assigned to segments along the critical slip surface. The slope stability factors of safety are computed and the thousands of results (from the thousands of simulations) are then assembled into a cumulative probability distribution of the model outcome. The cumulative probability distribution represents the uncertainty in the computed FOS resulting from the uncertainty and variability in the model input parameters (the material strengths). The probabilistic analysis function of SLOPE/W requires three inputs:

- the probability distribution of the material strength values, from which values will be randomly sampled (Section 6.6.1)
- the geometry of the critical slip surface:
  - Sensitivity Analysis 1 evaluated the critical slip surface for maximum dam height with normal pool conditions (Section 7.3.3.1).
  - Sensitivity Analysis 2 evaluated the critical slip surface for the fully liquefied worst-case (Section 7.3.6).
- a specified segment distance along the critical slip surface, which dictates where the Monte Carlo algorithm will apply the strength values randomly selected from the appropriate probability distribution (Section 6.6.2)

Results of the sensitivity analyses are described in Section 7.3.8.

6.6.1 Range and Distribution of Shear Strength Values

Sensitivity analysis requires assumptions about the range and the distribution function of the shear strength values, which together determine the probability distribution of the values. The range in values for the yield and liquefied undrained shear strengths was determined by setting realistic lower bound values (RLB) and realistic upper bound (RUB) values that account for most to all of the field and laboratory strengths measured for each material as presented in Attachment C and discussed in Geotechnical Workshops.

The strength data are assumed to be normally distributed; a reasonable assumption for the data sets. Baecher and Christian (Reference (46)) documented that USSR for fine-grained soils can be either normally or log-normally distributed. The laboratory- and field vane-measured liquefied shear strength ratios for the slimes were approximately normally distributed. While the CPT and SPT penetration resistances in the slimes are log-normally distributed, the liquefied shear strength ratios estimated via empirical correlations are being treated as a single estimate of strength, as discussed during the previous Geotechnical Workshops and described in this Data Package. This process of averaging the thousands of individual CPT readings (or dozens of SPT blow counts) to obtain a single estimate of strength is consistent with current practice for defined soil formation units, soil friction angles, etc. Therefore, normal variability distributions are assumed to best reflect the data.

Having established the RLB and the RUB, and determined that it is reasonable to assume that the values are normally distributed, a probability distribution was calculated for the undrained shear strengths of each of the materials included in the analysis by using the "Three-Sigma Rule" (Reference (47)). The Three-Sigma Rule relies on the fact that 99.73% of all values of a normally distributed parameter fall within plus or minus three standard deviations (σ) of the mean. The spread between the RLB and RUB is therefore divided by six to calculate the standard deviation. The range and distribution of the shear strength values for Sensitivity Analysis 1 and 2 are summarized in Table 6-4 and Table 6-5, respectively. The maximum value is set as the design value plus 3σ, and except as noted in Table 6-5, the minimum value is set as the design value minus 3σ. Note that the minimum and maximum values encompass the RLB and RUB values. Further, for this analysis the minimum and maximum values are computed in reference to the DV rather than to the mean of the RLB and RUB. This typically produced a conservative estimate of the minimum value.

Table 6-4 Range of Yield Undrained Shear Strength Ratio ($USSR_{yield}$) Values for Sensitivity Analysis 1

Material	Yield Undrained Shear Strength Ratio, $USSR_{yield}$					
	Min value (DV - 3σ)	RLB	DV(1)	StDev (σ)	RUB	Max value (DV + 3σ)
LTVSMC FT/Slimes	0.17	0.18	0.24	0.023	0.32	0.31
Flotation Tailings	0.21	0.21	0.26	0.017	0.31	0.31
Peat	0.11	0.15	0.23	0.042	0.40	0.36

(1) Design value for yield strengths based on 33rd percentile values
StDev = standard deviation, calculated based on the Three-Sigma Rule
±3 St Dev accounts for 99.73% of the data set
RUB = realistic upper bound
RLB = realistic lower bound

Table 6-5 Range of Liquefied Undrained Shear Strength Ratio ($USSR_{liq}$) Values for Sensitivity Analysis 2

Material	Liquefied Undrained Shear Strength Ratio, $USSR_{liq}$					
	Truncated / Min value DV - 3σ	RLB	DV1	StDev (σ)	RUB	Max value (DV + 3σ)
LTVSMC FT/Slimes2	0.04	0.04	0.10	0.030	0.22	0.19
Flotation Tailings	0.05	0.05	0.12	0.024	0.19	0.19

(1) Design value for liquefied strengths based on average values
(2) $USSR_{liq}$ based on Section F average LTVSMC Slimes strength

The probability distribution was then generated within SLOPE/W, using inputs of design value, standard deviation, and the maximum and minimum values for each material. The shear strength probability distributions for each material are presented in Figures 1 through Figures 3 of Attachment R for the yield strengths and Figures 4 and 5 of Attachment R for the liquefied strengths. As shown on Figure 4 of Attachment R, the lower end of the probability distribution for LTVSMC fine tailings/slimes is truncated at a $USSR_{liq}$ value of 0.04, a conservative lower-bound value (Reference (48)). This is equal to the RLB value as shown in Table 6-5, and was selected because it is the lowest value estimated by the empirical relationships and is supported as the lowest back-calculated strength ratio in research supporting the empirical relationships. This value is also the suggested minimum strength to use in preliminary design when no data is available (Reference (48)). Truncating the function at this value eliminates unreasonably low $USSR_{liq}$ values. Upper tails were not truncated, but were assigned maximum values of the DV+3σ.

The minimum and maximum ±3 standard deviation values used for Sensitivity Analysis 1 are plotted with the measured $USSR_{yield}$ values in the following figures:

- LTVSMC fine tailings/slimes (Figure 1 of Attachment R),

- NorthMet flotation tailings (Figure 2 of Attachment R), and
- Peat (Figure 3 of Attachment R).

The minimum and maximum ±3 standard deviation values used for Sensitivity Analysis 2 are plotted with the measured $USSR_{liq}$ values in the following figures:

- LTVSMC fine tailings/slimes (Figure 4 of Attachment R) and
- NorthMet flotation tailings (Figure 5 of Attachment R).

6.6.2 Segment Length Along Critical Slip Surface

The GeoStudio sensitivity analysis program allows material strengths to be varied within segments along the critical slip surface. The segment length should be based on the thickness of the various units intersected by the critical slip surface and their material properties. When stratigraphy is complex, and the length of the critical slip surface within different materials varies, then the segment length should represent the system overall as well as possible, with particular consideration of the length of the critical slip surface as it passes through the weaker layers in the system.

For this analysis the segment length is based on the lengths of the critical slip surface as it passes through layers of LTVSMC slimes, which range from 28 to 234 feet. A summary of the segment lengths in each contractive material is provided in Table 1 of Attachment R. The upper end of this range was selected as the segment length for the sensitivity analysis (rather than an average or minimum value) for two reasons. First, this length is also representative of the expected length of the critical slip surface as it passes through zones of Flotation Tailings (as explained in a note on Table 1 of Attachment R), so it is appropriate to the overall characteristics of the system. Second, use of shorter segment lengths can have the effect of pushing results toward the mean, and might not as fully capture the potential effects of uncertainty and variability. For these reasons, the segment length was set at 234 feet, the maximum length of the critical slip surface through LTVSMC slimes.

6.6.3 Monte Carlo Analysis

The probabilistic analysis in SLOPE/W, part of the GeoStudio 2012 software package, runs the stability model thousands of times. Each run uses a Monte Carlo algorithm to sample from the material strength probability distribution. The number of required Monte Carlo runs is dependent on the desired level of confidence and number of variables. Theoretically, the more runs, the more accurate the solution will be; however the solution is no longer sensitive to the number of runs after a few thousand have been completed. The number of Monte Carlo runs appropriate for the analysis was based on the minimum number of runs that resulted in the maximum, stable probability value (Reference (49)). The liquefied probabilistic analysis was performed for 20,000 runs. This is considered to be appropriate because >5,000 runs is the suggested industry standard (Reference (50)).

Probabilistic analyses were run two ways:

- Simultaneously and randomly varying all variable material strength parameters – these results quantify the uncertainty in the Factor of Safety for the system as a whole.
- Sequentially varying only one variable material strength parameter and holding all others constant at their DV – these results indicate which material most influences the calculated Factor of Safety.

Results, presented as probability distributions, are described in Section 7.3.8.

6.6.4 Likelihood of Occurrence of an Unknown Trigger

The design objective for the FTB is a configuration that produces an acceptably low probability of undesirable performance; an acceptably low P(Failure). The P(Failure) is based on the combined probability that the FOS will be less than 1.0 [P(FOS<1.0)] and the likelihood that a triggering event will occur [P(Occurrence)]. The relationship between the probability of failure, the probability that the FOS is less than 1.0, and the probability of occurrence can be described by the following:

$$P(Failure) = P(FOS < 1.0) * P(Occurrence)$$

The probability of undesirable performance cannot be quantified without knowing P(Occurrence) of the "unknown trigger" discussed in the Work Plan. P(Occurrence) is difficult to define because the trigger to induce liquefaction is, by definition, unknown. It can be assumed that this unknown trigger is less likely to occur than many known triggers, such as seismic events, etc. Known triggers, including piping, overtopping from a PMP event, or earthquakes, have been back-calculated from case histories to have a P(Occurrence) of around $1x10^{-4}$ to $1x10^{-6}$ or less, assuming modern dam construction and design techniques are employed such as those proposed for the project (Reference (51)). These likelihoods of occurrence are often incorporated into event tree failure analyses to evaluate the combined P(Failure) from various triggers and intervention steps. The probability of an unknown trigger may be greater than that of a seismic event causing liquefaction of the tailings P(seismic triggering) ~ $1x10^{-8}$ but is likely less than that for a piping failure at P(piping) ~ $1x10^{-4}$ because properly designed and constructed filters will be used and intervention is possible on the onset of seepage.

So, while the probability of occurrence is unknown, and Sensitivity Analysis results (presented in Section 7.3.8) cannot be used to quantify the probability of failure, it is reasonable to assume that the calculated P(FOS< 1.0) would be divided by something on the order of 1,000,000 or more. So, for example if there was a 1% probability that the Factor of Safety is less than 1.0, there would be at most a 0.000001% probability of undesirable performance or failure.

6.7 Long-Term Closure Stability Inputs

The stability analysis used the SEEP/W input parameters provided in Large Table 1 to determine long-term seepage conditions. The infiltration rate applied to the long-term closure stability analysis (with bentonite amendments in place) was 6 inches per year (1.59 x 10^{-8} ft/s) on all dams of the FTB and the flotation tailings beach extending from the final dam lift to the start of the normal pond edge. An infiltration rate of 6.5 inches per year (1.72 x 10^{-8} ft/s) was applied to the bottom of the pond under normal pool conditions.

The SLOPE/W input parameters for the Flotation Tailings and LTVSMC fine tailings and slimes were amended to reflect weathering and secondary compression to compute the long-term closure FOS. The long-term strength of the Flotation Tailings and LTVSMC fine tailings and slimes was assumed to change based on (1) dewatering of the basin after bentonite amendment is completed in the pond area, (2) weathering of the tailings, and (3) secondary compression of the tailings.

1. The FTB will dewater after operations cease. While a pond will remain as part of the closure plan, the pond bottom will receive bentonite amendment, minimizing the water seepage into the underlying tailings. The seepage models for long-term scenarios show that the phreatic surface lowers and effective stresses increase in the Flotation Tailings, which will increase the stability of the FTB. The drop in the phreatic surface in the FTB also allows for more material to behave in a drained manner, thereby mobilizing higher drained strength which increases stability.

2. The Flotation Tailings may undergo some weathering (Section 4.6.3). The strength could increase or decrease in the long-term. While some of the Flotation Tailings mass may be lost due to weathering, some cementation of particles could also occur. Weathering was taken into account by assuming a reduction in strength equal to the average of the estimated range of original mass weathered, as summarized in Table 6-6. The plagioclase in the Flotation Tailings is likely to be the most susceptible to weathering. Estimates for strength reduction based on weathering of the Flotation Tailings have also been applied to the LTVSMC fine tailings and slimes. As indicated by estimates in Table 6-6, the tailings are projected to weather at a very slow rate.

Table 6-6 Assumed Strength Reduction of Tailings Due to Long-term Weathering

Years after End of Operations	Percent of Original Mass Weathered	Assumed Strength Reduction
20	0 - 0.1	0.1%
200	0.1 - 0.9	0.5%
2,000	1.4 - 9.1	5.3%

3. Secondary compression is the process by which there is slight, continuing re-arrangement and improved interlocking of soil particles over time under constant effective stress (after essentially all excess porewater pressure has dissipated), causing a slow, continued decrease in void ratio. This decrease in void ratio results in an increase in shear strength,

regardless of whether the material is saturated or unsaturated, and applies to drained, yield undrained, and liquefied shear strengths. Secondary compression is taken into account by using the consolidation data from laboratory testing and increasing the strength in relation to the anticipated continued change in void ratio over time (Reference (52)).

Based on weathering and secondary compression, the estimated long-term liquefied strengths are described in Table 6-7. The strength of the Flotation Tailings and LTVSMC fine tailings and slimes were amended because, as discussed in Section 4.6.3 and Attachment L, smaller particles are much more susceptible to weathering, relative to their mass, because their specific surface area is significantly larger than for coarse particles. These materials represent the finest materials at the FTB. Additionally, these materials will only be subjected to self-weight consolidation, whereas most other materials will be or have been compacted, either by natural processes (like the glacial till) or mechanically (existing coarse tailings by truck traffic and the bulk tailings during dam construction).

Table 6-7 Estimated Long-term Liquefied Strengths

<table>
<tr><th rowspan="2">Material</th><th colspan="7">Long-term $USSR_{liq}$ Strengths</th></tr>
<tr><th>Design Value (0 years)</th><th colspan="2">20 years</th><th colspan="2">200 years</th><th colspan="2">2,000 years</th></tr>
<tr><td rowspan="2">Flotation Tailings</td><td rowspan="2">0.12</td><td>Weathering effects
-0.0001</td><td rowspan="2">0.129</td><td>Weathering effects
-0.0006</td><td rowspan="2">0.148</td><td>Weathering effects
-0.0064</td><td rowspan="2">0.174</td></tr>
<tr><td>Secondary compression effects
0.0094</td><td>Secondary compression effects
0.0282</td><td>Secondary compression effects
0.0601</td></tr>
<tr><td rowspan="2">LTVSMC Fine Tailings/Slimes</td><td rowspan="2">0.1</td><td>Weathering effects
-0.0001</td><td rowspan="2">0.108</td><td>Weathering effects
-0.0005</td><td rowspan="2">0.114</td><td>Weathering effects
-0.0053</td><td rowspan="2">0.116</td></tr>
<tr><td>Secondary compression effects
0.0078</td><td>Secondary compression effects
0.0145</td><td>Secondary compression effects
0.0215</td></tr>
</table>

The drained and undrained strengths of the Flotation Tailings and LTVSMC fine tailings and slimes were also amended using the same approach as laid out for the liquefied strengths in Table 6-7. The long-term drained strengths are summarized in Table 6-8. Only drained strengths were computed, as the long-term scenario assumes a significant amount of time has passed and excess pore-water pressures at the end of operations have dissipated.

Table 6-8 Long-term ESSA Strengths

Material	ESSA – Friction Angle, ϕ' (degrees)			
	0 years	20 years	200 years	2,000 years
LTVSMC Fine Tailings, Slimes, and FT/Slimes	33	34.1	34.9	35.2
Flotation Tailings	33	34.2	36.5	39.8

6.8 FTB Containment System Effects on Slope Stability

Additional slope stability analyses were performed to determine the potential effects of the FTB Containment System on the factors of safety for the proposed FTB design. The purpose of the containment system is to capture water that seeps from the FTB so that it can be treated. The FTB Containment System will be installed along the northern and western sides of the FTB before the first lift of the FTB north dam is constructed; therefore, safety factors calculated in the containment system stability analysis represent FTB dam stability during and after construction of the FTB Containment System.

The segment of the FTB Containment System affected by the analysis includes a cutoff wall set back approximately 200 feet from the northern and western toe of slope of the FTB Cells 2E and Cell 2W. Three models were developed for the FTB Containment System stability analysis. The Existing Conditions Configuration under drained conditions and the Future Dam Configuration under drained and liquefied conditions. The FTB Containment System stability analysis was performed based on the configuration of the native soils, the existing tailings basin and the planned FTB dams along Cross-Section F, taken as a surrogate for modeling potential slope stability impacts along the north and west side of Cell 2W. As this cross-section is the critical cross-section, the calculated factors of safety for the proposed design are lower for this cross-section than what is anticipated for all other cross-sections that will be analyzed as part of permitting. The same boundary conditions and seepage and strength parameters were used for the FTB Containment System stability analysis as used in other stability models presented in this Data Package. Two operating conditions were modeled:

- the collection system operating with active extraction of water from the collection system
- the collection system temporarily inactive (e.g., such as in the event of an abnormally long power outage), simulated with the water table at ground surface from the toe of the dam to the cutoff wall.

Greater detail on the slope stability analyses performed to determine the effects of the FTB Containment System on the slope stability and modeling results are provided in Attachment G.

7.0 Results of Seepage and Stability Modeling

Seepage and stability modeling was conducted on the proposed design FTB along critical Cross-Section F for Cell 2E, Cross-Section G for Cell 2E, and Cross-Section N for Cell 1E. Development of the proposed design for all cross-sections involved an iterative approach, whereby various combinations of slope angles, lift heights, bench widths, buttresses, and CDSM zones were modeled to determine configurations resulting in adequate slope stability safety factors. Based on requirements for the site, the most appropriate configuration for the Project was determined from these preliminary configurations, as described in Section 6.3.2.

The proposed FTB dams have been configured to have safety factors equal to or greater than 1.5 for drained (ESSA) conditions, equal to or greater than 1.3 for undrained ($USSA_{yield}$) conditions, and equal to or greater than 1.1 for liquefied ($USSA_{liq}$) conditions. The seepage and stability modeling were performed using the FTB design that meets these factors of safety as described in Reference (1).The results of the stability modeling for worst-case fully liquefied material strength conditions control the design of the FTB. The designs for the FTB at Mine Year 20 along Cross-Sections F, G, and N are summarized in Table 7-1.

Table 7-1 Summary of FTB Design for Cross-Sections F, G, and N

Cross-Section	F	G	N
Lifts	Lifts 1-7, 20 feet high; Lift 8, 10 feet high	Lifts 1-7, 20 feet high; Lift 8, 10 feet high	Lifts 5-7, 20 feet high; Lift 8, 10 feet high
Bench width	60 feet	60 feet	60 feet
Interbench slopes	4.5H:1V	4.5H:1V	4.5H:1V
Setback distance between lifts 4 & 5	260 feet	260 feet	N/A
Buttress	Elevation = 1538 feet Height = 52 feet Top width = 126 feet	1553.5 feet Height = 51 feet Top width = 126 feet	1665 feet Height = 10 - 22 feet Top width = 390 feet
CDSM zone width into the basin	50 feet long; 55 feet in height; 3 feet wide at 10-foot center-to-center spacing	5 feet long; 31.5 feet in height; 3 feet wide at 10-foot center-to-center spacing	N/A
Underdrain	250 ft long, 4 ft high	N/A	N/A

The proposed dam geometry for Cross-Section F with dimensions is presented in Large Figure 16. The proposed dam geometry for Cross-Section G with dimensions is presented in Large Figure 18. The proposed dam geometry for Cross-Section N with dimensions is presented in Large Figure 19.

Seepage and stability modeling was conducted using the permeability and design shear strength parameters detailed in Attachment C and summarized in Section 5.0. As additional data are gathered in future operations-phase geotechnical investigations and material testing programs, the design strength and permeability parameters may be altered to reflect the outcomes of the additional investigations and material testing. As most DV selected for these seepage and slope stability analyses were chosen to be reasonably conservative, it is possible that future evaluation of the FTB may lead to an increase in FOS values and/or design optimization, reducing the need for buttresses, underdrains, CDSM, and/or offsets.

7.1 Stratigraphy

Stratigraphy for the three cross-sections was initially determined using historical boring and CPTu logs and data from the 2005 and 2007 CPT investigations. The previously identified soil layers were confirmed and new layers identified based on CPTu logs from the 2014 CPT investigation. Therefore, stratigraphy for Cross-Sections F, G and N were updated to also reflect the most-recent CPT data collected in 2014. For Cross-Section N, historical reports were reviewed to determine the location of the starter dam, confirm alternating layers of fine tailings and slimes, and confirm the construction material of the existing railroad embankment. A material to represent the railroad embankment was used in modeling Cross-Section N and was referred to as rail grade, having a unit weight of 140 pcf and a friction angle of 45 degrees. All field data and stratigraphy information have been plotted in section view for Cross-Sections F, G and N (Figures B-2, B-3, and B-4 of Attachment B).

Multiple material types were identified from the boring and CPTu logs, including till, peat, LTVSMC coarse tailings, fine tailings, and slimes. Material types were generally consistent across the three cross-sections. At the locations of all three sections, the shell consists primarily of LTVSMC coarse tailings and the interior of the basin consists of intermittent and interbedded layers of fine tailings and slimes. A layer of peat, of varying thickness and continuity, was encountered above the till along all sections. Along Cross-Section F, the layer of peat generally varies from 2 to 10 feet thick at tested locations, although a 20-foot peat layer was encountered at the toe of the initial dam. Along Cross-Section G the peat layer varied from 1 to 8.5 feet thick. Peat was encountered at three locations along Cross-Section N, ranging from 1 to 4 feet in thickness.

Depth to bedrock below the tailings basin for all three sections was based on data from top of bedrock contour maps prepared by Barr using historical maps and bedrock depths confirmed from wells and borings in the area. The 2014 geotechnical investigation performed 200 feet from the toe of Cell 2E provided depths to bedrock along Cross-Sections F and G which was used to aid in approximation of bedrock elevations for modeling. The bedrock at the toe of Section F, confirmed during the 2014 geotechnical investigation, starts at an average elevation of 1456 feet AMSL, 30-feet below the top of the till. Bedrock along Cross-Section G was modeled as 25 feet below the top of the till at an elevation of 1474 feet AMSL at the toe and increases in elevation towards the center of the basin. No borings have been extended to bedrock along Cross-Section

N, therefore depth to bedrock was assumed as 20 feet below the top of the till and increases in elevation towards the center of the basin.

Modeling used the unique stratigraphy of each cross-section along with consistent material types, physical properties, and D as presented in Section 5.0. Layers of materials thinner than 1 foot were not included in the cross-sections. Cross-section F is considered the most critical due to the 20-foot peat layer at the toe of the initial dam and the presence of LTVSMC fine tailings and slimes closer to the toe of the dam.

7.2 Seepage Modeling

7.2.1 Historical Seepage Analyses

Prior to submittal of Version 3 of the Data Package, seepage calibration and sensitivity modeling was conducted for Cross-Section F. Calibration and sensitivity analyses was conducted with a 2001 end-of-operations seepage model and were attempted concurrently, though it was understood that certain materials affected the flux or phreatic surface differently.

The sensitivity analysis was performed to assess which materials had the greatest impact on the phreatic surface and flux out of the Tailings Basin system. It was determined through this analysis that the permeability of the till had the greatest impact on the flux, followed by the permeability of the LTVSMC fine tailings and slimes. The phreatic surface was found to be more dependent on the permeability of the tailings (particularly the finer tailings, which do limit seepage), the rock starter dam, and the peat.

The calibration analysis was performed as an attempt to align the model with measured water levels at the Tailings Basin. The total heads generated by the SEEP/W model could only be compared to two measured piezometric heads along Cross-Section F, and of these, one piezometer was installed in 1999, leaving a small dataset for calibration during operations. The calibration analysis resulted in a somewhat large variation in measured to estimated heads. The total heads in the model were lower at the toe of the basin and much higher within the basin than field measurements suggested. This provided conservatism from a stability standpoint, but did not provide confidence in either the piezometer data or the initial permeability values. For this reason, seepage verification models were performed for Version 5 of the Data Package, as described in Section 7.2.2.

The calibration model was reviewed by GEO-SLOPE prior to submittal of Version 3 of the Data Package. GEO-SLOPE staff recommended altering methods slightly to improve efficiency in seepage model convergence. Because of the complexity of the model, both with regards to geometry and boundary conditions, per recommendations from GEO-SLOPE, a single transient analysis was run out until convergence was obtained for a steady state solution. Transient analyses allow the user to input an initial suggested water table in the first transient run which then serves as a starting point for seepage conversion to a steady state. The amount of transient computation time over which models were allowed to solve was varied to assess at what point a steady state solution is achieved and all convergence criteria are met. Also per the recommendation of GEO-SLOPE, to reduce system memory requirements and model run time, data from interim time steps are no longer saved and convergence tolerances were modified. Specifically, when using the Head Vector Norm solver, the model tolerance was changed from 0.01 to 0.05 (computations come to a halt when the change in the Vector Norm from one elevation to the next is less than the specified tolerance) and the conductivity was allowed to change more quickly over a larger range (in orders of magnitude, the default is a rate of change of 1.02, with a max change of 0.1 and a minimum change of 0.0001 – this was modified to a rate of change of 1.1, with a max change of 1 and a minimum change of 0.0001). The result of the model changes is a more efficient seepage model that significantly improves computational speed.

7.2.2 Seepage Verification

The 2014 geotechnical CPT and SPT investigation provided an additional set of data that allowed an evaluation of the design value permeabilities and provided field readings to compare with model heads. Version 5 of the Geotechnical Data Package includes seepage verification models for Cross-Sections F, G, and N that represent the 2014 existing basin conditions.

7.2.2.1 Cross-Section F Seepage Verification

In the 2014 seepage verification model, which replaces in its entirety the 2001 end-of-operations seepage model, total heads generated by the model were matched as closely as possible to the measured piezometric heads (at nodes representing the screened intervals of the piezometers) recorded in the field and the 2014 phreatic surface based on the CPT-estimated water levels using pore pressure dissipation tests performed during the 2014 geotechnical investigation (Attachment F). Constant head conditions were not set within the dam section. Boundary conditions (i.e., constant head, unit flux, or seepage face) were assigned only to nodes on the surface of the seepage model.

The phreatic surface in the seepage model representing existing conditions was verified with data obtained for Cell 2E from CPTu dissipation tests performed during the 2014 geotechnical investigation (Attachment F) and using data from the two permanent standpipe piezometers along Cross-Section F. The geometry of the facility in 2014 was based on 2011 LIDAR data and measurements in the facility pond recorded in July of 2014.

Due to the complex stratigraphy of the Tailings Basin, the field hydrologic conditions can be difficult to match precisely in a model. Sensitivity and verification analysis of the SEEP/W model is difficult because the model was simplified; the model cannot take into account every tailings layer that may be impacting flow in the basin. However, a reasonable approach was taken, such as neglecting coarser stringers and utilizing larger zones of only fine tailings or slimes instead. This is reasonable from a geotechnical seepage modeling standpoint, as it is likely to increase the phreatic surface within the dam. This approach also works for the stability (SLOPE/W) models, where larger zones were modeled only as the finer tailings or slimes with lower strength parameters, rather than attempting to take into account the presence of any coarser stringers with higher shear strengths.

Total heads estimated in the SEEP/W verification model using the design permeability values for Cross-Section F to represent 2014 existing conditions were compared with those measured in the field at two instrumentation locations and six CPT locations to check the accuracy of the seepage analysis models. The pond elevation of 1555 feet, measured in July 2014, was applied as a boundary condition. A unit flux of 8 inches per year (2.0×10^{-8} ft/s) was applied to the existing dam slopes to represent infiltration from precipitation. Potential seepage face nodes were applied to the nodes at the toe of the basin. Measured heads in the model compared to the field values are shown in Table 7-2. Also provided is the difference between the measured and estimated head values where a positive (+) difference value indicates that the phreatic surface in the model is above the phreatic surface measured in the field and a negative (-) value indicates that the phreatic surface in the model is below the phreatic surface measured in the field.

Table 7-2 Comparison of Measured and Estimated Total Heads (Cross-Section F)

Piezometers and CPTs	Measured Head in the Field (ft)	Estimated Head from SEEP/W Model (ft)	Difference (ft)
CPT14-04	1476.4	1487.6	+11.2
CPT14-20	1493.0	1514.4	+21.4
F-2	1510.0	1513.4	+3.4
CPT14-05	1515.5	1522.3	+6.8
PN1F-99	1511.3	1519.0	+7.7
CPT14-22	1519.0	1528.3	+9.3
CPT14-06	1526.3	1528.3	+2.0
CPT14-17	1530.0	1527.3	-2.7

The head near the toe and mid-slope of the existing basin measured 11.2 feet and 21.4 feet higher in the model than the field measurements at locations CPT14-04 and CPT14-20, respectively. However, the model total head for piezometer F-2 (1513.4 feet), at approximately the same location as CPT14-20, was only 3.4 feet higher than the field measurement (1510 feet, Large Figure 20) matching relatively well with the model head. The water levels in the model are generally consistent with field measurements under the tailings beach with a head difference of +6.8 feet at CPT14-05 and +7.7 feet at PN1F-99. This is considered a reasonable outcome because the modeled phreatic surface in the weaker material is higher than measured, which provides some conservatism from a stability modeling standpoint. At CPT locations within the basin, heads measured in the model are just above and below the heads in the field, having a range of +2.0 to -2.7 for CPT14-06 and CPT14-17, respectively.

The measured head for piezometers F-2 and PN1F-99 (see model outputs in Attachment S for locations and Attachment D for installation logs (Reference (19); Reference (53)) along Cross-Section F were not constrained by piezometer elevations. The piezometer data along Cross-Section F is plotted as Large Figure 20. Annual averages are plotted for 1997 through 2001, when operations at LTVSMC ceased. Averages between installation of the second piezometer in 1999 and end of operations in 2001 did not vary significantly. Since 2001, the current pond levels in Cell 2E are lower than during past LTVSMC operations and the existing standpipe piezometric heads along Cross-Section F have fallen in the range of 4 to 10 feet.

The installation log's ground surface elevation for Piezometer F-2 is 1545.5 feet with the bottom of piezometer at approximately -40 feet (approx. elevation 1505.5 feet). The phreatic surface elevation at piezometer F-2 in the model is at elevation 1513.4 feet, above the tip elevation of F-2. Piezometer PN1F-99 installation log's ground elevation is 1547.0 feet with bottom of piezometer at approximately -60 feet (approx. elevation 1487.0 feet), placing the tip below the model head of 1519.0 feet.

While the modeled versus measured head difference for CPT14-04 and CPT14-20 is 11.2 feet and 21.4 feet, respectively, divergence is positive (estimated is higher than measured), so is conservative for seepage and stability modeling. As the remaining piezometer and CPT location heads match field measurements, design permeability values appear to be appropriate parameters that accurately represent current conditions. An Instrumentation and Monitoring Plan will be implemented for the basin (Reference (1)) in the future. The plan will require installation of additional piezometers to monitor the dam raises. Data from these piezometers will be used throughout FTB operations to evaluate seepage model results.

7.2.2.2 Cross-Section G Seepage Model Verification

For Cross-Section G, total heads in the 2014 existing condition seepage verification model, using the design permeability values, were compared with those measured in the field at one instrumentation location (G-2, see model outputs in Attachment S for locations and Attachment D for installation logs; Ebasco, 1990 and Sitka, 1996) and three CPT locations to check the accuracy of the seepage model. The total heads generated by the model could only be compared to one measured piezometric head along Cross-Section G, at piezometer G-2, as piezometer G-3 is no longer in operation. The piezometer data along Cross-Section G is plotted as Large Figure 21. Annual averages are plotted for 1997 through 2001, when operations at LTVSMC ceased. Relative to 2001, the pond level in Cell 2E is lower than during past LTVSMC operations and the existing standpipe piezometric head at G-2 has fallen approximately 2 feet.

The phreatic surface in the seepage model representing existing conditions was verified with data obtained for Cell 2E from CPTu dissipation tests performed along Cross-Section G during the 2014 geotechnical investigation (Attachment F). The geometry of Cross-Section G was based on 2011 LIDAR data. The pond elevation of 1555 feet, measured in July 2014, was applied as a boundary condition to the model. A unit flux of 8 inches per year (2.0×10^{-8} ft/s) was applied to the existing dam slopes to represent infiltration from precipitation. Potential seepage face nodes were applied to the nodes at the toe of the basin.

Measured heads in the model as compared to the field values are shown in Table 7-3. Also provided is the difference between the measured and estimated head values where a positive (+) difference value indicates that the phreatic surface in the model is above the phreatic surface measured in the field and a negative (-) value indicates that the phreatic surface in the model is below the phreatic surface measured in the field. The head near the mid-slope of the existing basin along Cross-Section G measured 1 foot higher in the model than the field measurements at locations CPT14-07. The water levels in the model are generally consistent with field measurements under the tailings beach with a head difference of +4.1 feet at piezometer G-2 and +4.4 feet at CPT14-08. This is considered a reasonable outcome because the modeled phreatic surface in the weaker material is higher than measured, which provides some conservatism from a stability modeling standpoint. At CPT locations within the basin, CPT14-09 resulted in a model head just below the field measured head.

The measured head for piezometer G-2 was not constrained by piezometer tip elevation. The installation log's ground surface elevation for Piezometer G-2 is 1550 feet with the bottom of piezometer at approximately -50 feet (approx. elevation 1500 feet). The phreatic surface elevation at piezometer G-2 in the model is at elevation 1515.4 feet, above the tip elevation of G-2.

The differences in modeled head compared to field measurements are small for the three CPT locations and one piezometer location. The divergence is generally positive (estimated is higher than measured), so is conservative. As the modeled heads match well with field measurements, design permeability values appear to be appropriate parameters that accurately represent current conditions along Cross-Section G.

Table 7-3 Comparison of Measured and Estimated Total Heads (Cross-Section G)

Piezometer	Measured Head in the Field (ft)	Estimated Head from the Model (ft)	Difference (ft)
CPT14-07	1502.0	1503.0	+1.0
G-2	1511.3	1515.4	+4.1
CPT14-08	1517.4	1521.8	+4.4
CPT14-09	1536.0	1535.3	-0.7

7.2.2.3 Cross-Section N Seepage Model Verification

For Cross-Section N, the total heads generated by the seepage model (at nodes representing the screened intervals of the piezometers) were matched as closely as possible to the estimated 2014 phreatic surface based on pore pressure dissipation results, as no piezometers have been installed along Cross-Section N. Total heads estimated in the SEEP/W verification model using the design permeability values for Cross-Section N existing conditions were compared with those measured in the field at three CPT locations to check the accuracy of the seepage analysis models. The measured heads in the model compared to the field values are shown in Table 7-4. Also provided is the difference between the measured and estimated head values where a positive (+) difference value indicates that the phreatic surface in the model is above the phreatic surface measured in the field and a negative (-) value indicates that the phreatic surface in the model is below the phreatic surface measured in the field.

The modeled head at the CPT14-19 location, measured at the toe of the existing basin, was 17 feet higher than the field measurement. The mid-slope model head was 11.1 feet higher than the measured head at CPT14-15. The phreatic surface below the existing basin remained high within the more permeable coarse tailings and dropped in elevation starting at the toe of the basin into less permeable fine tailings and slimes, dropping the head significantly before entering the railroad embankment. This is considered a reasonable outcome because the phreatic surface in the weaker material is higher, which provides some conservatism from a stability modeling standpoint. Total head in the model within Cell 1E at CPT14-14 location was 5.4 feet higher than the measured head in the field placing the phreatic surface in a thick region of coarse tailings. The difference in modeled head compared to field measurements for the three CPT locations along Cross-Section N were positive and are therefore conservative.

Table 7-4 Comparison of Measured and Estimated Total Heads (Cross-Section N)

Piezometer	Measured Head in the Field (ft)	Estimated Head from the Model (ft)	Difference (ft)
CPT14-19	1611.0	1628.0	+17.0
CPT14-15	1632.5	1643.6	+11.1
CPT14-14	1640.2	1645.6	+5.4

7.2.3 Seepage Analysis Results

For each cross-section, seepage analyses were performed for each stage or lift of development and the ultimate dam height. Selected SEEP/W output figures are presented in Attachment S for the existing conditions and selected lifts for the proposed design at Cross-Sections F, G, and N. The outputs show the estimated phreatic surface with total head contours for each lift. The resulting porewater pressure distributions and phreatic surfaces were imported into SLOPE/W for the stability modeling. The phreatic surface and the porewater pressures at each node of the finite element mesh were computed in SEEP/W based on the section geometry and the permeabilities assigned to each region.

7.2.3.1 Cross-Section F Seepage Analysis Results

The seepage modeling results for Cross-Section F indicates that seepage from the pond initially travels in a primarily vertical direction, flowing down through the Flotation Tailings. At the location of Cross-Section F, an underdrain layer will be installed upstream of the first FTB lift, following the slope of the existing LTVSMC tailings into the basin. The underdrain layer will not daylight along the dam face or act as a "pipe" which could funnel seepage out to the face of the dam, but rather will reduce high pressure heads within the Flotation Tailings. The underdrain will provide a route for high porewater pressures to dissipate easily into the coarser LTVSMC tailings (or drainage piping if included in final design). The underdrain will help pull flow down and then out through the LTVSMC coarse tailings shell, pulling the phreatic surface back from the slope face.

Modeling results show that inclusion of the underdrain layer at Cross-Section F does not increase the potential for surface seeps, as flux out of the basin is concentrated around the toe of the existing basin with or without the underdrain layer. Modeling indicates that the global phreatic surface within the Tailings Basin is not overly sensitive to the presence of the underdrain layer, as the presence of the underdrain layer primarily influences the phreatic surface within the Flotation Tailings.

7.2.3.2 Cross-Section G Seepage Analysis Results

The seepage modeling results for Cross-Section G indicates that seepage from the pond initially travels in a primarily vertical direction, flowing down through the Flotation Tailings. As the water percolates down towards the LTVSMC FT/Slimes region, the flow tends to become less vertical, with the water traveling into the freely draining LTVSMC coarse tailings. Unlike Cross-Section F, no underdrain layer is required along Cross-Section G because there is a thick layer of LTVSMC coarse tailings upstream of the first FTB lift that will provide a route for high porewater pressures to dissipate, and help direct flow down and then out through the LTVSMC coarse tailings shell, pulling the phreatic surface back from the slope face. The till is also a relatively permeable material, which aids in pulling water down and out of the dam.

7.2.3.3 Cross-Section N Seepage Analysis Results

Cross-Section N seepage modeling results show that seepage from the pond initially travels in a primarily vertical direction, flowing down through the Flotation Tailings. At all cross-sections, the flotation tailings were assigned a higher permeability near the crest of the FTB and a decreasing permeability with depth. The Flotation Tailings located above the existing basin have the same permeability as the LTVSMC Fine Tailings. LTVSMC slimes are the least permeable material in the dam, and therefore have a significant impact on the phreatic surface location. As the water percolates down into the lower Flotation Tailings region, the flow tends to become less vertical, with the water traveling towards the freely draining existing basin consisting of LTVSMC coarse tailings. The existing basin acts as an underdrain layer which funnels the seepage through the existing basin, through the rock buttress at the toe of the basin, and down to the upstream face of the railroad embankment.

7.3 Slope Stability Analysis Results

The design of the FTB dams is based on slope stability analyses of:

- The existing Tailings Basin in year 2014 (Section 7.3.1)
- FTB dams during construction (Section 7.3.2)
- FTB dams at maximum height (Section 7.3.3)
- FTB dams subject to static liquefaction triggering events (Section F only; Section 7.3.4)
- FTB dams subject to seismic liquefaction triggering events (Section F only; Section 7.3.5)
- The fully liquefied worst-case scenario (Section 7.3.6)
- Long-term conditions (Section F only; Section 7.3.7)
- Sensitivity analyses (Section F only; Section 7.3.8)

The following subsections describe the model results for each component of the stability analysis, and document the slope stability safety factors computed for the proposed design. Stability analysis results include estimated safety factors calculated using the methods described in Section 6.3.1; the grid and radius circular method and the grid and radius wedge method.

For Cross-Sections F and G, the failure surface yielding the lowest FOS value for most ESSA conditions consisted of minor, localized sloughing failures occurring in the buttress. The Cross-Section N failure surfaces yielding the lowest FOS values for some ESSA and USSA conditions consisted of minor, localized sloughing failures occurring on the downstream face of the dam. These slough failures, which are cosmetic rather than structural and easily repaired, were reported in the notes below the tables of stability analysis results, whereas global failures impacting the existing or proposed lifts were reported within the tables of results as the lowest factors of safety that intersect the overall slope of the dam.

7.3.1 Existing Conditions Results

Stratigraphy, water levels from the 2014 CPTu investigation, and the calibrated SEEP/W model were used to model stability of existing slopes. Because there has been no new loading at the site since operations stopped in 2001, the drained condition was deemed appropriate and an ESSA model was used. The estimated factors of safety for the 2014 current conditions model at Cross-Sections F, G, and N are presented in Table 7-5.

For Cross-Section F, the wedge slip surface with impenetrable fractured bedrock resulted in the lowest FOS value. For Cross-Section G, the wedge slip surface runs along the interface of the peat and impenetrable till layer, and for Cross-Section N, the wedge slip surface along impenetrable till resulted in the lowest FOS value. All safety factors are above the target safety factor of 1.5 for ESSA conditions. The SLOPE/W outputs for these analyses are provided in Attachment T.

Table 7-5 Modeled Factors of Safety for 2014 Existing Conditions

Case	Slip Surface	Drained (ESSA)		
		Section F	Section G	Section N
2014 Existing Conditions Verification Model	Grid and Radius, Circular	1.88	2.37	3.11
	Grid and Radius, Wedge	1.83	2.21	3.14
Target Factor of Safety Value:		**1.5**	**1.5**	**1.5**

7.3.2 Interim Dam Heights Results

Of particular importance for the FTB tailings dam design is the stability of the dam during construction and operation when undrained conditions may develop. Slope stability was modelled for drained and undrained conditions for Lifts 2, 4, and 6. Only Lift 6 was modeled for Cross-Section N as Cell 1E elevation is higher than Cell 2E and depositing of tailings into this cell would not occur until Lift 5.

Interim lift modeling assumed the following configurations:

- beach length of 625 feet
- buttresses fully constructed (as described in Section 6.3.2.2)
- dam crest elevation:
    - Lift 2 – 1622 ft
    - Lift 4 – 1662 ft
    - Lift 6 – 1702 ft

For modeling purposes, the maximum tailings elevation must also be specified. Sufficient freeboard will be maintained at all times during interim lifts to accommodate a PMP precipitation event, so the maximum tailings elevation will be below the dam crest, but the exact relationship between the dam crest elevation and the maximum tailings elevation will depend on operational factors. As a simplifying and conservative assumption, the system was modeled with the maximum tailings elevation set equal to the dam crest (no freeboard). This assumption results in calculated Factors of Safety that are lower than would be calculated if the model configuration included freeboard, and is therefore conservative.

The slope stability model results for Lifts 2, 4, and 6, for ESSA and $USSA_{yield}$ conditions are shown in Table 7-6. The critical failure surface (the surface yielding the lowest slope stability FOS) for all of the ESSA models was identified as a minor, localized sloughing failure of the buttress material. If a buttress-slough was the critical failure surface, then, in order to present the estimated global FOS, the reported value provided in Table 7-6 was replaced by the slip surface with the lowest FOS that intersects the dam material. The value for the buttress-slough failure is reported as a note to the table, though the outputs provided in Attachment T reflect the values reported in the table.

Factors of safety for all ESSA and $USSA_{yield}$ conditions exceed the recommended minimum values, even for the buttress-slough values provided as notes. As expected, the ESSA condition for the proposed design produces higher safety factors than existing conditions due to the addition of the buttress. Also as expected, the ESSA condition resulted in higher factors of safety than the $USSA_{yield}$ conditions. The SLOPE/W outputs for these analyses are provided in Attachment T.

Table 7-6 Modeled Factors of Safety for Interim Lifts

Case	Slip Surface	Section F		Section G		Section N	
		$USSA_{yield}$	ESSA	$USSA_{yield}$	ESSA	$USSA_{yield}$	ESSA
Lift 2	Grid and Radius, Circular	2.57	3.12 (1)	3.44 (7)	3.48 (9)	--	--
	Grid and Radius, Wedge	1.89	3.14 (2)	2.28	3.43 (10)	--	--
Lift 4	Grid and Radius, Circular	2.03	3.18 (3)	3.40 (8)	3.42 (11)	--	--
	Grid and Radius, Wedge	1.74	3.19 (4)	2.09	3.45 (12)	--	--
Lift 6	Grid and Radius, Circular	1.95	3.19 (5)	1.93	3.45 (13)	2.21	4.48
	Grid and Radius, Wedge	1.88	3.18 (6)	1.96	3.43 (14)	1.88	4.43
Target Factor of Safety Value		**1.3**	**1.5**	**1.3**	**1.5**	**1.3**	**1.5**

(1) Buttress slough FS = 1.97
(2) Buttress slough FS = 2.01
(3) Buttress slough FS = 2.26
(4) Buttress slough FS = 2.14
(5) Buttress slough FS = 2.09
(6) Buttress slough FS = 2.08

(7) Buttress slough FS = 2.44
(8) Buttress slough FS = 2.33
(9) Buttress slough FS = 2.44
(10) Buttress slough FS = 2.38
(11)Buttress slough FS = 2.37
(12) Buttress slough FS = 2.38
(13) Buttress slough FS = 2.43
(14) Buttress slough FS = 2.44

7.3.3 Maximum Dam Height Results

The stability of the FTB dams at maximum height is increased by the use of the buttresses, the CDSM zone, and the mid-slope setback. These additional design features move the driving forces and the pond farther upstream. The following sections present the results for normal pool and PMP conditions once all 8 lifts have been constructed. The SLOPE/W outputs for these analyses are provided in Attachment T.

7.3.3.1 Slope Stability for Normal Pool Conditions

Slope stability at the maximum FTB dam height with the pool at normal condition (elevation 1722.8 feet) was modeled for both drained and undrained conditions. The resulting factors of safety are summarized in Table 7-7. Again, where appropriate, the ESSA results relate to global failures, with localized buttress-slough failures reported as notes. Factors of safety for all ESSA and $USSA_{yield}$ strength conditions are above the MDNR recommended minimum values.

Table 7-7 Modeled Factors of Safety for Maximum Dam Height with Normal Pool Conditions

Case	Slip Surface	Section F		Section G		Section N	
		$USSA_{yield}$	ESSA	$USSA_{yield}$	ESSA	$USSA_{yield}$	ESSA
Lift 8 w/Normal Pool	Grid and Radius, Circular	1.98	3.16 (1)	2.23	3.49 (3)	2.02	4.60
	Grid and Radius, Wedge	1.69	3.07 (2)	1.86	3.44 (4)	2.00	4.58
Target Factor of Safety Value		**1.3**	**1.5**	**1.3**	**1.5**	**1.3**	**1.5**

(1) Buttress slough FS = 2.13 (3) Buttress slough FS = 2.41
(2) Buttress slough FS = 2.02 (4) Buttress slough FS = 2.42

For Cross-Section F, the critical failure surface for Lift 8 ESSA conditions is the grid-and-radius wedge failure with a slip surface running along the interface of the till and impenetrable fractured bedrock. For the $USSA_{yield}$ conditions, the critical wedge failure surface resulted in the lowest FOS with a slip surface running along the interface of the peat and impenetrable till layer.

For Cross-Section G, the critical failure surface for Lift 8 ESSA conditions is the grid-and-radius wedge failure with a slip surface running along the interface of the till and impenetrable fractured bedrock. For the $USSA_{yield}$ conditions, the critical wedge grid-and-radius failure surface resulted in the lowest FOS with a slip surface running along the interface of the peat and impenetrable till layer.

For Cross-Section N, the critical failure surface for Lift 8 resulting in the lowest FOS is the grid-and-radius wedge failure for both $USSA_{yield}$ and ESSA conditions where the failure surfaces entered through Lift 8 and exited at the toe of the existing dam through the blanket buttress.

7.3.3.2 Slope Stability for PMP Pool Conditions

Slope stability at the maximum dam height was also analyzed for the PMP event. The seepage modeling conservatively assumed that PMP conditions, with the pond level elevated by 4 feet to an elevation of 1726.8 feet, remained long enough for steady-state seepage conditions to apply. Stability model outputs with the PMP conditions are provided in Attachment T, where it can be observed that the 4-foot pond bounce has a relatively small effect on the phreatic surface within the dam and hence a small effect on slope stability. The computed factors of safety for ESSA and $USSA_{yield}$ strength parameters for Lift 8 PMP conditions are listed in Table 7-8. Again, where appropriate, the ESSA results relate to global failures, with localized buttress-slough failures reported as notes. All factors of safety exceed the minimum factors of safety required by the MDNR.

Table 7-8 Modeled Factors of Safety for Maximum Dam Height with PMP Conditions

Case	Slip Surface	Section F		Section G		Section N	
		$USSA_{yield}$	ESSA	$USSA_{yield}$	ESSA	$USSA_{yield}$	ESSA
Lift 8 w/PMP Event	Grid and Radius, Circular	1.99	3.18 (1)	1.97	3.48 (2)	1.92	4.38
	Grid and Radius, Wedge	1.77	3.19 (1)	1.85	3.46 (3)	1.91	4.34
Target Factor of Safety Value		**1.3**	**1.5**	**1.3**	**1.5**	**1.3**	**1.5**

(1) Buttress-slough FS = 2.08 (2) Buttress-slough FS = 2.38
(3) Buttress-slough FS = 2.43

For Cross-Section F, the critical failure surface for the PMP ESSA condition is a circular grid-and-radius failure that enters in the existing coarse tailings dam just above the buttress and exits through the virgin peat. The $USSA_{yield}$ grid-and-radius wedge failure resulted in a slip surface along the interface of the peat and impenetrable till.

For Cross-Section G the critical failure surface is identified by the grid-and-radius wedge failure for ESSA resulting in a slip surface running along the interface of till and impenetrable fractured bedrock. For the $USSA_{yield}$ conditions, the critical failure surface is identified by the grid-and-radius wedge failure resulting in a slip surface running along the interface of peat and impenetrable till.

For Cross-Section N, the critical failure surface for Lift 8 under PMP conditions having the lowest FOS is the grid-and-radius wedge failure for both $USSA_{yield}$ and ESSA conditions where the failure surfaces entered through Lift 8 and exited at the toe of the existing dam through the blanket buttress.

7.3.4 Static Liquefaction Triggering Results

Static liquefaction triggering was evaluated for Cross-Section F using SLOPE/W, as described in Section 6.4.2. Spreadsheets and modeling outputs are provided in Attachment O. Using the results of the $USSA_{yield}$ stability analyses, the critical slip surface was analyzed for static liquefaction triggering for five loading scenarios specified in the work plan (Large Table 2). Results are presented in Table 7-9. Results of the sixth liquefaction triggering case specified in the Work Plan, long-term conditions, are presented in Section 7.3.7.

Liquefaction was triggered for portions of the critical failure surface in only one of the five credible scenarios; the case of fast construction of Lift 1 (Rapid Load). Following the procedure described in Section 6.4.2, the slices where liquefaction was triggered were reassigned liquefied shear strengths and the same critical failure surface was re-analyzed. The post-loading FOS value is reported as the $FOS_{overall}$ for the Rapid Load scenario in Table 7-9.

The $FOS_{triggering}$ represents the average of values computed for slices with the base in saturated, contractive (i.e., liquefaction susceptible) tailings. The $FOS_{overall}$ relates to $USSA_{yield}$ slope stability (which requires a minimum FOS of 1.3) for all cases (because no liquefaction was triggered) other than the Rapid Load case. The resulting factors of safety for the liquefaction triggering scenarios are all above the required minimum post-liquefaction value of 1.1.

Table 7-9 Results of Liquefaction Triggering Analyses

Liquefaction Triggering Scenario	Slope Stability $FOS_{overall}$	Average $FOS_{triggering}$ for Liquefaction Susceptible Slices
Baseline	2.06	2.06
Rapid Loading - fast construction of Lift 1	1.78	1.90
Erosion - Local erosion/pipe scour	1.99	1.99
Plugged Drain, Lift 1	1.91	1.91
Plugged Drain, Lift 8	2.06	2.06

7.3.4.1 Baseline Case

The Baseline triggering analysis was based on a single model, as noted in Large Table 2, because no immediate change in conditions was being analyzed. Rather, this allowed a review of each slice to evaluate whether the yield shear strength would be exceeded. Liquefaction was not triggered in any slice in the Baseline model.

7.3.4.2 Rapid Load

The Rapid Load case assumes that Lift 1 is constructed so rapidly that excess porewater pressures are generated causing a decrease in effective stress, which could trigger static liquefaction. The strength profile along the FSFS was locked-in based on the pre-construction model. The Lift 1 dam was then added in one instantaneous time step, which resulted in liquefaction being triggered in slices along the FSFS. The post-liquefaction $FOS_{overall}$ FOS value is below the average $FOS_{triggering}$ value, which is computed based only on the slices with bases in saturated Flotation Tailings or LTVSMC fine tailings and slimes. As shown in Table 7-9, both the $FOS_{overall}$ and the average $FOS_{triggering}$ factors of safety are above the target safety factor of 1.1 for liquefied conditions.

7.3.4.3 Erosion

The Erosion case assumes that a large portion of the LTVSMC coarse tailings above the proposed buttress rapidly erodes, which could potentially continue to erode upstream and trigger liquefaction. A segment of coarse tailings was removed and then additional zones of coarse tailings along the eroded face were subsequently removed, representing continued erosion, until the material achieved a stable configuration and the FOS was reduced to 1.0. This progressive erosion evaluation of the baseline model achieved the same task as the strength reduction procedure performed in the other triggering scenarios. The shear strength below the erosion zone was locked in based on the Baseline (pre-erosion) case, because the material is assumed to erode too quickly for the $USSR_{yield}$ material to lose strength. Liquefaction was not triggered in any slice in the Erosion model. Both the $FOS_{overall}$ and the average $FOS_{triggering}$ factors of safety are above the target safety factor of 1.1 for liquefied conditions, as shown in Table 7-9.

7.3.4.4 Plugged Drain, Lift 1

The Plugged Drain at Lift 1 case assumes that after Lift 1 is filled, finer particles plug the underdrain layer and the underdrain becomes ineffective over time. The plugged underdrain was modeled with the same permeability as the lowest permeability Flotation Tailings (6.56×10^{-7} ft/sec or 2.00×10^{-5} cm/sec) and the phreatic surface was then computed. The phreatic surface was not greatly changed by plugging of the drain, as the pond is much closer to the Lift 1 and LTVSMC dams, allowing for seepage to flow above the plugged drain into the LTVSMC bulk tailings and then into the underlying coarse tailings. Liquefaction was not triggered in any slice in the Plugged Drain, Lift 1 model and factors of safety for both the $FOS_{overall}$ and the average $FOS_{triggering}$ were above the target safety factor of 1.1 for liquefied conditions (Table 7-9).

7.3.4.5 Plugged Drain, Lift 8

The Plugged Drain at Lift 8 case assumes that finer particles plug the underdrain layer and it becomes ineffective over time. The plugged underdrain was modeled with the same permeability as the lowest permeability Flotation Tailings (6.56×10^{-7} ft/sec or 2.00×10^{-5} cm/sec) and the phreatic surface was then computed. A small increase in the phreatic surface was only noted close to the underdrain, which therefore did not have a significant impact on the slope stability and the results were identical to the Baseline case. As stratigraphy was updated based on CPTu data from the 2014 CPT investigation, a layer of coarse tailings approximately 5 feet thick was determined to be located underneath the proposed underdrain layer, which was not modeled in versions prior to this submittal. Therefore, plugging the underdrain layer had only a small impact on the phreatic surface as the existing coarse tailings layer beneath the drain continued to provide a route for porewater pressures to dissipate, helping to pull flow down and then out through the LTVSMC coarse tailings shell.

Liquefaction was not triggered in any slice in the Plugged Drain, Lift 8 model. As shown in Table 7-9, both the $FOS_{overall}$ and the average $FOS_{triggering}$ values are above the target safety factor of 1.1 for liquefied conditions.

7.3.5 Seismic Liquefaction Triggering Results

Results of the seismic liquefaction screening evaluations for Cross-Sections F, G, and N (Section 6.4.3.3) indicate that seismic triggering will not occur (Attachment Q). As the seismic design event (2,475-year return period) would not trigger liquefaction in any FTB materials, per the Work Plan (Attachment A), no additional seismic triggering analyses were necessary.

Calculations were also performed to determine the potential for seismic deformation. Swaisgood performed an extensive review of case studies of embankment dam behavior during seismic events to assess if there is a trend of seismic deformation that can be used for predictive purposes (Reference (54)). Swaisgood determined relationships between the estimated percent of crest settlement (based on the total dam height), the PGA experienced, and the earthquake magnitude (Figure 2 of Reference (54)). The relationships presented on this figure range from 0.01% to 12% crest settlement, with these deformations for seismic events with M_w = 5 to 9 and a_{max} = 0.1g to 1g. The smallest event is approximately an order of magnitude larger than the Project's design event. Using the design event parameters and the stated relationship, a crest settlement of 0.01% or 0.024 feet is computed. This amount of settlement is considered minimal and will not affect the stability or pond containment capability of the dam.

7.3.6 Fully Liquefied Worst-Case Results

The fully liquefied worst-case represents conditions at the end of operations with normal pool, when the pond bottom has not yet received bentonite amendment, the spigots are still discharging to the beaches, and the Flotation Tailings have not aged (combined effects of weathering and secondary compression), under the assumption that all saturated contractive (i.e., liquefaction susceptible) materials are reduced to their liquefied strength values. This is a hypothetical case where an unknown trigger occurs. This configuration generates the steady-state phreatic surface under normal pool conditions with the lowest $USSR_{liq}$ values.

No buttress-slough failures were identified as the critical failure surface; only global failures were reported in the modeling and provided in Table 7-10 for Cross-Sections F, G, and N. Contours of the failure surfaces were analyzed to verify that no additional critical slip surfaces exist for the model and the safety map was reviewed to verify that similar $FOS_{overall}$ values do not apply to other slip surfaces (such as a smaller surface that exits or enters through the mid-slope setback). The SLOPE/W outputs for these analyses are provided in Attachment T.

Table 7-10 Modeled Factors of Safety for Worst-Case Flow Liquefaction Conditions

Case	Slip Surface	$FOS_{overall}$		
		Section F	Section G	Section N
All Saturated Contractive Materials Liquefied to $USSR_{liq}$	Grid and Radius, Circular	1.10	1.37	1.16
	Grid and Radius, Wedge	1.10	1.25	1.16

Published required factors of safety for flow liquefaction generally range from 1.0 to 1.1 as recommended by the Natural Resources Conservation Service (as cited in Reference (55)) for seismic loading conditions, as well as the United States Department of Agriculture (Reference (56). The Federal Emergency Management Agency (Reference (57)), the Federal Energy Regulatory Commission (as cited in Reference (55)), and the Federal Register and D'Appolonia Consulting Engineers (as cited in Reference (58)) suggest that the FOS for liquefied cases be above 1.0. The Work Plan (Attachment A) requires a FOS ≥ 1.1 for this worst-case scenario. All slope stability FOS results for the flow liquefaction worst-case model are equal to or greater than 1.1.

The fully liquefied baseline case (end of operations Mine Year 20) results in a model with $FOS_{overall}$ = 1.10 for Cross-Sections F. This is the lowest $FOS_{overall}$ computed in all stability analyses. Achieving a $FOS_{overall} \geq 1.1$ for the Cross-Section F fully liquefied Baseline case requires a buttress at the toe of the basin and a CDSM zone within the basin. As discussed in Section 6.3.2, the buttress has an ultimate crest elevation of 1538 feet. The CDSM zone is discussed in Section 5.6. The long-term analyses of fully liquefied Cross-Section F scenarios (Section 7.3.7.2) show that the FOS will increase over time during reclamation and long-term closure.

For Section G, the critical circular grid-and-radius failure surface resulted in a FOS along a slip surface that enters through lift 8 and exits through the mid-slope set-back. The critical wedge grid-and-radius failure surface occurred along the interface of the LTVSMC fine tailings/slimes and impenetrable peat. Achieving a $FOS_{overall} \geq 1.1$ for Cross-Section G requires a buttress at the toe of the basin and a CDSM zone within the basin. The required buttress dimensions are discussed in Section 6.3.2.2 and the CDSM zone along Cross-Section G is discussed in Section 6.3.2.4. The geometry of these features may be optimized during final design.

Section N fully liquefied conditions resulted in an acceptable FOS value for the circular and wedge failure with a slip surface that enters through the bench of Lift 6 and exits through the blanket buttress. Achieving a $FOS_{overall} \geq 1.1$ for Cross-Section N requires a blanket buttress at the toe of the basin. The required buttress dimensions are presented in Table 7-1. The buttress geometry may be optimized during final design.

7.3.7 Long-Term Closure Stability Results

The FTB is designed to provide storage for Flotation Tailings produced during a 20-year operating period. After the FTB has been filled to its maximum height and all 8 lifts constructed, the dam will be prepared for reclamation by amending the 625-foot beach of Flotation Tailings and the bottom of the pond with bentonite. The long-term closure FTB will be effectively covered with a bentonite-amended surface on the exterior face of the dam lifts, the Flotation Tailings beach, and the pond bottom to limit seepage into the FTB.

7.3.7.1 Drained Conditions (ESSA) Long-Term Scenarios

The slope stability of the long-term closure FTB along critical Cross-Section F was analyzed for drained conditions (ESSA) at 20, 200, and 2,000 years beyond end-of-operations. The lowest FOS results of the stability models for FTB long-term closure conditions at 20, 200, and 2,000 years are provided in Table 7-11. The long-term closure slope stability safety factors are well above the target value, as dewatering and strength gain (assumed to occur due to secondary compression) increases stability after operations end. Again, where appropriate, the ESSA conditions relate to global failures, with localized buttress-slough failures reported as notes. All critical failure surfaces meet the minimum factors of safety required by the MDNR. The Slope/W outputs for these analyses are provided in Attachment T.

Table 7-11 Modeled Factors of Safety for Long-Term Closure Conditions (Cross-Section F)

Case		Section F
Long-Term Closure Drained (ESSA) Conditions	End-of-Operations	3.07 (1)
	20 years after end of operations	3.09 (2)
	200 years after end of operations	3.21 (3)
	2,000 years after end of operations	3.15 (4)
Target Factor of Safety Value		**1.5**

(1) Buttress-slough FS = 2.02
(2) Buttress-slough FS = 1.99
(3) Buttress-slough FS = 2.10
(4) Buttress-slough FS = 2.12

It should be noted that, in addition to the difficulty in estimating weathering and material strength for long-term analysis, modeling complications also arise when attempting to estimate conditions many years after operations. Seepage conditions must be modeled over very large time steps. Estimation of long-term conditions should therefore be viewed as an assessment of potential conditions based on currently available information. Monitoring and testing will be used throughout operations to continue to update long-term analyses and the closure design will be confirmed at the end of operations.

7.3.7.2 Fully Liquefied ($USSA_{liq}$) Long-Term Scenarios

The long-term fully liquefied analysis evaluated conditions at 20, 200, and 2,000 years after the end of operations. The fully liquefied condition was selected to analyze the long-term scenarios as it best represents an unknown triggering event. The results of the fully liquefied long-term scenarios are summarized in Table 7-12. The SLOPE/W outputs for these analyses are provided in Attachment T.

Table 7-12 Modeled Factors of Safety for Fully Liquefied Long-Term Conditions (Cross-Section F)

Case		Section F
Long-Term Fully Liquefied Conditions	End-of-Operations	1.10
	20 years after end of operations	1.35
	200 years after end of operations	1.45
	2,000 years after end of operations	1.53
Target Factor of Safety Value		**1.10**

The long-term models indicate that fully liquefied FOS will continue to increase over time. The estimated aggregate effects of dewatering, weathering, and secondary compression result in a decrease in material susceptibility to liquefaction, as well as an increase in liquefied strengths and effective stress in material that remains susceptible to liquefaction; thereby increasing slope stability.

7.3.8 Sensitivity Analysis Results

7.3.8.1 Analysis 1 -Yield Strength Sensitivity Analysis Results

Analysis 1 assessed how statistical variations in the yield undrained shear strengths ($USSR_{yield}$) affect the FOS under normal operating conditions. Probabilistic material strength parameters were assigned to the LTVSMC fine tailings/slimes, NorthMet flotation tailings, and peat for this analysis.

Using the yield shear strength probability distribution assigned to key materials, the sensitivity analysis (performed as described in Section 6.6) yielded a cumulative distribution function for the FOS (Figure 7 of Attachment R). The cumulative distribution function indicates that there is a 0% probability that the FOS will be less than 1.0. There is also a 0% probability that the FOS will be below 1.3, which is the minimum FOS value for USSA models using yield undrained strengths.

The sensitivity analysis included an analysis that sequentially varied the values of one material shear strength while holding the others at their DV. The results of this analysis are shown in Figure 8 of Attachment R, and illustrate that the calculated FOS is most sensitive to variations in the $USSR_{yield}$ value for the compressed peat.

7.3.8.2 Analysis 2 - Liquefied Strength Sensitivity Analysis Results

Analysis 2 assessed how statistical variations in the liquefied shear strength ($USSR_{liq}$) affect the post-liquefaction FOS for an unknown triggering event. Probabilistic material strength parameters were assigned to the LTVSMC fine tailings/slimes and NorthMet flotation tailings for this analysis.

Using the liquefied shear strength probability distribution applied to key materials, the sensitivity analysis (performed as described in Section 6.6) yielded a cumulative distribution function for the post-liquefaction FOS. The cumulative distribution function (Figure 9 of Attachment R) indicates that there is about a 4.86% probability that the post-liquefaction FOS value will be less than 1.0 in the unlikely event that liquefaction is triggered by an unknown event.

The sensitivity analysis included an analysis that sequentially varied the values of one material shear strength while holding the other at its design value. The results of this analysis are shown in Figure 10 of Attachment R, and illustrate that the calculated FOS is most sensitive to variations in the $USSR_{liq}$ value for the LTVSMC fine tailings/slimes.

It is important to understand that the probability (or likelihood) associated with a computed post-liquefaction FOS being less than 1.0 is not the same as the probability of failure of the FTB. The probability of failure of the FTB involves a series of events, each with an associated probability (or likelihood) of occurrence. In this case, the series of events involves an unknown event triggering liquefaction followed by a post-liquefaction FOS falling below one. As discussed previously, the combined probability of an unknown triggering event occurring and the FOS being less than 1.0 is very low. The probability (or likelihood) of failure of the FTB (for this case) can be estimated as the product of the likelihood of occurrence of each event (unknown trigger and post-liquefaction FOS<1.0), keeping in mind that an unknown triggering event is no more likely to occur than the known triggering events described and modeled in previous sections of this report. The results of the known triggering events show that the dams are stable under those conditions and that a fully liquefied failure does not occur. Additionally, Section 7.3.7 indicates that the strengths of the fine tailings and slimes will increase over time as a result of several mechanisms, thereby decreasing the likelihood of an unknown triggering event causing liquefaction and increasing the post-liquefaction FOS. Therefore, the probability that the FOS value will be less than 1.0 as a result of an unknown triggering event will decrease over time.

8.0 Summary of Stability Modeling Results

The stability modeling determined that the design meets required factors of safety for all expected conditions:

- Existing condition (before the FTB is constructed)
- Interim conditions (while the FTB is under construction), with normal operating conditions
- Maximum height, with normal operating conditions
- Maximum height, with normal long-term closure conditions

The modeling then determined that the design meets required factors of safety for a series of possible but increasingly less likely conditions:

- Maximum height, with a plugged drain, a rapid load, or erosion
- Maximum height, with an unknown triggering event causing all contractive materials to liquefy
- Maximum height, with a seismic event

To assess how these results might be affected by uncertainty and variability in the soil strength values, a sensitivity analysis was conducted. Sensitivity analysis results show the following:

- Cumulative probability that the FOS is less than the required value when the dam is at maximum height, with normal operating conditions, is 0%.
- Cumulative probability that the FOS is less than the required value when the dam is at maximum height, with an unknown triggering event causing all contractive materials to liquefy, is less than 5%.
- The probability of dam failure is unknown, because the likelihood of an unknown triggering event occurring is, by definition, unknown, however it would likely be many orders of magnitude smaller than the probability that the factory of safety is less than the required value.

A summary of slope stability safety factors computed for each component of the stability analysis, as required by the Work Plan, is provided in Table 8-1. The lowest FOS for each case is presented, whether determined by the grid and radius circular method or the grid and radius wedge method. All minimum factors of safety correspond to Cross-Section F, confirming that this is the critical cross-section for analysis. The design of the FTB is based on the slope stability results meeting or exceeding factors of safety of 1.5 for drained (ESSA) conditions, 1.3 for undrained ($USSA_{yield}$) conditions, and 1.1 for liquefied ($USSA_{liq}$) conditions.

Table 8-1 Summary of Stability Modeling Results

Cross-Section Location	Cross-Section F			Cross-Section G			Cross-Section N		
Case	**USSA yield**	**ESSA**	**USSA liq**	**USSA yield**	**ESSA**	**USSA liq**	**USSA yield**	**ESSA**	**USSA liq**
Target Factor of Safety	**1.3**	**1.5**	**1.1**	**1.3**	**1.5**	**1.1**	**1.3**	**1.5**	**1.1**
Design Scenarios – Steady State Seepage									
Existing Conditions	--	1.83	--	--	2.21	--	--	3.11	--
Interim Lift 2	1.89	3.12	--	2.28	3.43	--	--	--	--
Interim Lift 4	1.74	3.18	--	2.09	3.42	--	--	--	--
Interim Lift 6	1.88	3.18	--	1.93	3.43	--	1.88	4.43	--
Lift 8 w/Normal Pool	1.69	3.07	--	1.86	3.44	--	2.00	4.58	--
Lift 8 w/PMP Event	1.77	3.18	--	1.85	3.46	--	1.91	4.34	--
Long-Term Stability – Steady State Seepage									
End of Operations	--	3.07	--	--	--	--	--	--	--
20 Years after Closure	--	3.09	--	--	--	--	--	--	--
200 Years after Closure	--	3.21	--	--	--	--	--	--	--
2,000 Years after Closure	--	3.15	--	--	--	--	--	--	--
Cross-Section F Liquefaction Triggering Analysis									
Baseline	2.06	--	--	--	--	--	--	--	--
Plugged Drain	2.06	--	--	--	--	--	--	--	--
Lift 1 Rapid Loading	--	--	1.78	--	--	--	--	--	--
Erosion	1.99	--	--	--	--	--	--	--	--
Plugged Drain	1.91	--	--	--	--	--	--	--	--

Cross-Section Location	Cross-Section F			Cross-Section G			Cross-Section N		
Case	**USSA yield**	**ESSA**	**USSA liq**	**USSA yield**	**ESSA**	**USSA liq**	**USSA yield**	**ESSA**	**USSA liq**
Target Factor of Safety	**1.3**	**1.5**	**1.1**	**1.3**	**1.5**	**1.1**	**1.3**	**1.5**	**1.1**
Fully Liquefied with Unknown Trigger									
Operations	--	--	1.10	--	--	1.25	--	--	1.16
20 Years after Closure	--	--	1.35	--	--	--	--	--	--
200 Years after Closure	--	--	1.45	--	--	--	--	--	--
2,000 Years after Closure	--	--	1.53	--	--	--	--	--	--

9.0 Operation and Maintenance Requirements

Information on FTB management and facility inspection and maintenance required to maintain specified slope stability safety factors, consistent with industry practice, is presented in Reference (1).

The average angle of the existing Tailings Basin slopes is approximately 14 degrees (4H:1V), though isolated areas of the slopes do contain small, localized areas with steeper slope angles up to 25 degrees. It is recommended that routine maintenance be performed to maintain typical slope angles in the LTVSMC dams at 14 degrees. The LTSMC Tailings Basin is already in place, which represents a large portion of the FTB, and similar to other existing tailings basins, there is no practicable approach to tailings basin modification that would allow this existing basin to be left unmonitored or unmaintained forever. However, the proposed addition of the rock buttress will reduce maintenance requirements on the north side of Cell 2E.

During construction, the LTVSMC coarse tailings will be placed and compacted for each lift, and will be amended with bentonite. These lifts will also be regularly inspected and maintained to control erosion. Individual lift slopes for the FTB are proposed at 4.5H:1V (12.5 degrees). The average overall angle of the proposed FTB dams is approximately 6.6 degrees (8.6H:1V) and routine maintenance will be performed to maintain these slopes.

Prior the initiation of the Project, a comprehensive review of existing conditions will be conducted to identify any areas recommended for slope angle modification. Slope angle modification, if required, will be accomplished by adding material to the slope toe and/or cutting back the slope crest. Location-specific conditions will determine the most appropriate slope angle modification approach if modifications are required. The Contingency Action Plan for the Flotation Tailings Basin (Attachment F of Reference (1)) outlines mitigations for over-steepened side slopes.

As the dams are constructed and operation of the basin begins, monitoring data and additional testing will become available allowing for periodic updates of the models in accordance with the observational approach. This observational approach to performance monitoring and analysis update is standard for large earthen structures that are developed incrementally over long periods of time. Additional geotechnical investigations will routinely be performed during operations. These investigations will include testing of the LTVSMC tailings and Flotation Tailings.

The observational approach requires planning for potential mitigation in case future data show that design assumptions were violated. Where model updates show that adjustments to the design are needed to maintain desired slope stability safety factors, approaches typically used for modifying stability of dams are applicable to the FTB and will be utilized (as described in Section 6.3.2). These include but are not limited to: modification of bench widths between lifts of dam, modification of lift offsets, modification of lift heights, and modification of slope angles. Other modifications could include additional measures like buttresses, underdrains, mid-slope setbacks, and modification of materials used for dam construction to achieve higher strengths.

10.0 Future Analysis

Because of the potential stability issues associated with liquefaction of upstream tailings dams, it was deemed prudent at this time to retain the buttress and mid-slope setback in the design of Cross-Section F and Cross-Section G, as well as a CDSM zone, each serving to increase long-term stability of the FTB. Future analyses of all cross-sections may be used to evaluate how the buttress geometry and CDSM zone geometry could be optimized while still maintaining a triggering-analysis $FOS_{Flow} > 1.1$.

The locations for future investigations will particularly focus in areas where re-saturation is associated with Flotation Tailings deposition and where testing has been performed in the past to allow for comparison of past conditions to conditions at the time of future testing. Future investigations will also aim to target materials identified by the sensitivity analysis and evaluate the strength of the bentonite-amended material. The investigations may include a combination of the following:

- SPT drilling
- CPTu
- Rapid CPTu (with an advancement rate over 170 mm/s)
- Dissipation testing
- DMT
- Field vane shear testing
- Laboratory testing, including index properties, permeability, and strength testing

The data gathered will be compiled with the existing information and the updated data will be used to re-analyze the design sections. When appropriate, the design may be optimized using the updated data, provided that the FOS remains above the minimum values set forth in Section 6.1.

Revision History

Date	Version	Description
9/23/2011	1	Initial release
8/3/2012	2	Updated shear strength parameters and stability analyses along with text clarifications based on comments from and discussions with MDNR, Knight Piésold, USACE, and ERM
11/21/2012	3	Updated text and attachments and incorporated slope stability factor of safety results (Section 6) based on strength parameters identified in Attachment C and based on comments from MDNR, Knight Piésold, USACE, and ERM.
4/12/2013	4	Updated text and attachments, restructured to create Section 4 on available geotechnical data, and incorporated stability analysis and results in Section 6 and 7 based on strength parameters and triggering scenarios identified in Attachment C, workshops, and comments received from MDNR, Knight Piésold, USACE, and ERM.
12/30/2014	5	Updated text and attachments, performed a sensitivity and probability analysis on USSA and liquefied strengths as required by the supplement to the work plan (Attachment A), and incorporated stability analyses and results for Cross-Section G (north side of Cell 2E) and Cross-Section N (south side of Cell 1E).
2/26/2015	6	Revised to address agency comments on Version 5. Version 6 also limits the additional review by agencies.
7/11/2016	7	Updated to include signed PE certification

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Large Table 1 Summary of Seepage and Stability Modeling Parameters

Material	Saturated Permeability		Saturated Unit Weight, γ_{sat}	ESSA		USSA			
				Cohesion	Friction	Cohesion	Friction	$USSR_{yield}$	$USSR_{liq}$
				c'	ϕ'	c_u	ϕ_{cu}	$s_{u(yield)}/\sigma'_v$	$s_{u(liq)}/\sigma'_v$
	cm/s	ft/s	pcf	psf	deg	psf	deg	--	--
LTVSMC Coarse Tailings	2.44×10^{-3}	8.00×10^{-5}	135	0	38.5	0	38.5	-	-
LTVSMC Fine Tailings	2.00×10^{-5}	6.56×10^{-7}	130	0	33.0	-	-	0.25	0.1
LTVSMC Slimes	9.60×10^{-7}	3.16×10^{-8}	120	0	33.0	-	-	0.22	0.1
LTVSMC FT/Slimes & Interior FT/Slimes	3.05×10^{-6}	1.00×10^{-7}	125	0	33.0	-	-	0.24	0.1
LTVSMC Bulk Tailings	8.02×10^{-5}	2.63×10^{-6}	130	0	38.5	0	38.5	-	-
Glacial Till	1.55×10^{-3}	5.10×10^{-5}	135	0	36.5	0	36.5	-	-
Virgin Peat	1.01×10^{-3}	3.30×10^{-5}	70	Shear/normal function(2)		-	-	0.23	-
Compressed Peat(1)	3.60×10^{-6}	1.18×10^{-7}	85	Shear/normal function(2)		-	-	0.23	-
Rock Starter Dam	1.52	5.00×10^{-2}	140	0	40.0	0	40.0	-	-
Flotation Tailings(3) – 0.45 tsf	1.90×10^{-4}	6.23×10^{-6}	125	0	33.0	-	-	0.26	0.12
Flotation Tailings(3) – 1.35 tsf	5.61×10^{-5}	1.84×10^{-6}	125	0	33.0	-	-	0.26	0.12
Flotation Tailings(3) – 2.29 tsf	2.00×10^{-5}	6.56×10^{-7}	125	0	33.0	-	-	0.26	0.12
Cement Deep Soil Mix (CDSM)_Slimes	7.04×10^{-7}	2.31×10^{-8}	125	9,600	0	-	-	-	

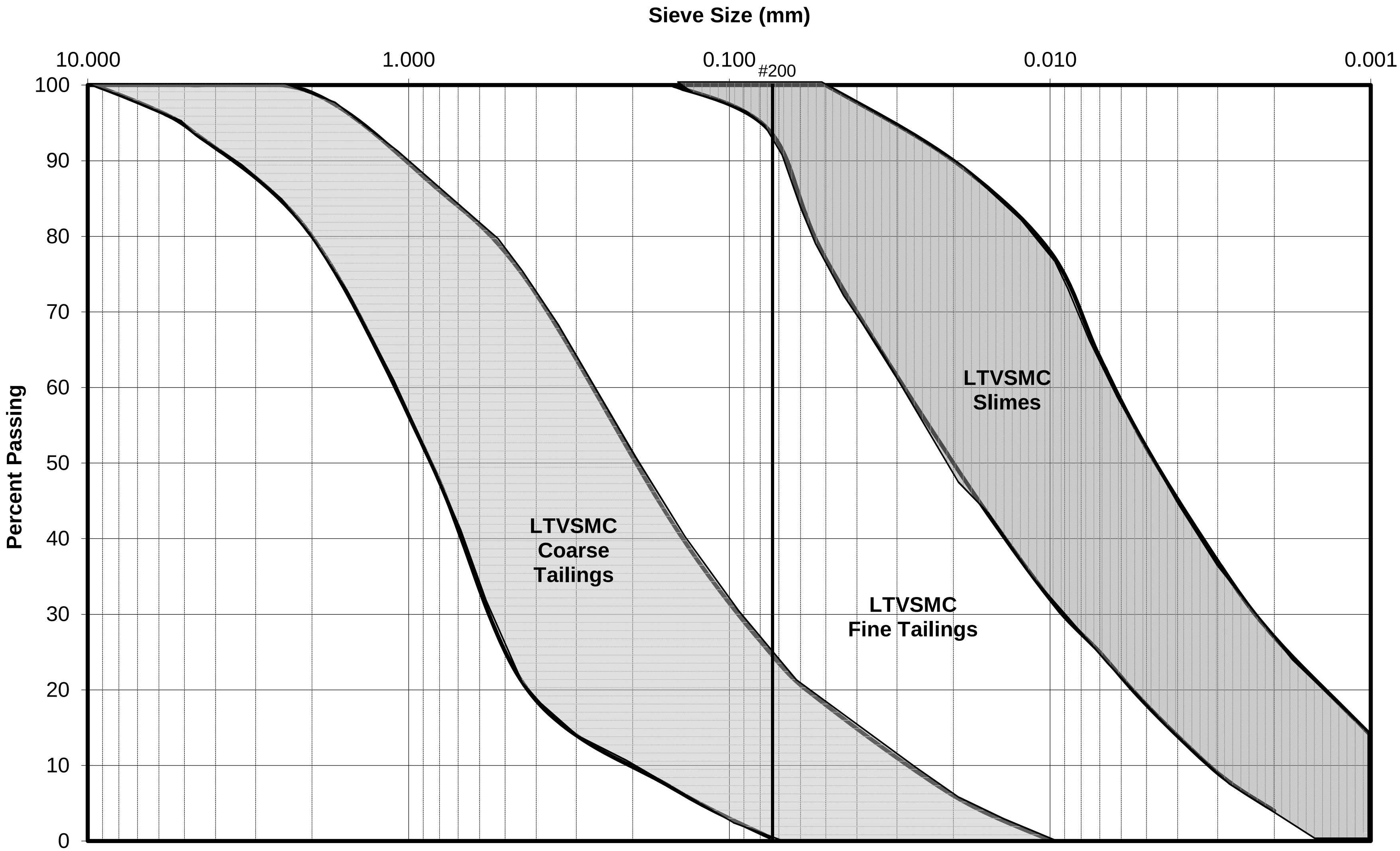
Material	Saturated Permeability cm/s	Saturated Permeability ft/s	Saturated Unit Weight, γ_{sat} pcf	ESSA Cohesion c' psf	ESSA Friction ϕ' deg	USSA Cohesion c_u psf	USSA Friction ϕ_{cu} deg	USSA USSR$_{yield}$ $s_{u(yield)}/\sigma'_v$ --	USSA USSR$_{liq}$ $s_{u(liq)}/\sigma'_v$ --
Cement Deep Soil Mix (CDSM)_Peat	2.55×10^{-6}	8.36×10^{-8}	125						
Fractured Bedrock	7.19×10^{-4}	2.36×10^{-5}	140	0	45.0	-	-	-	-
Bedrock	1.92×10^{-5}	6.30×10^{-7}	Impenetrable						
Rail Grade	1.52	5.00×10^{-2}	140	0	45	0	45	-	-

(1) Permeability of the peat below the dam was altered for anisotropy, applying a ratio of ky/kx = 0.067.
(2) Drained strength of the peat was included as a shear/normal function, as detailed in Attachment C, with ϕ' ≈ 27 degrees.
(3) Permeability of the Flotation Tailings was varied based on effective overburden pressure, as detailed in Section 5.3.2.

Large Table 2 Static Liquefaction Triggering Scenarios

Case	Strength for Triggering Analysis		Lift	Comments	Determination of Fully Specified Failure Surface	$FOS_{triggering}$
	$USSR_{yield}$	Lock in s_u				
Baseline	X		8	--	Baseline reduced strength analysis (same model)	$\frac{\text{Shear strength}_{Baseline}}{\text{Shear mobilized}_{Baseline}}$
Plugged Lift 8 - final lift + ineffective drain	X		8	Assumes CT drain is plugged & normal pond	$Plugged_{L8}$ reduced strength analysis (same model)	$\frac{\text{Shear strength}_{Plugged\ L8}}{\text{Shear mobilized}_{Plugged\ L8}}$
Rapid Loading - fast construction of Lift 1		X	0/1	15' of dam loaded with s_u-values from pre-lift conditions	Lift 0 reduced strength analysis (pre-loading)	$\frac{\text{Shear strength}_{L0}}{\text{Shear mobilized}_{L1}}$
Erosion - Local erosion/pipe scour		X	8	Evaluated erosion (continued to remove failing regions until FOS>1)	Erosion reduced strength analysis (post-loading)	$\frac{\text{Shear strength}_{Baseline}}{\text{Shear mobilized}_{Erosion}}$
Plugged Lift 1 - 1st lift + ineffective drain	X		1	Assumes CT drain is plugged	Plugged L1 reduced strength analysis (same model)	$\frac{\text{Shear strength}_{Plugged\ L1}}{\text{Shear mobilized}_{Plugged\ L1}}$
Long-term - 20 years	X		8	Assumes some strength alteration based on weathering and secondary compression	Not applicable (fully liquefied analysis)	Not applicable (fully liquefied analysis)
Long-term - 200 years	X		8			
Long-term - 2,000 years	X		8			

Large Figures



Large Figure 1. LTVSMC Tailings Classifications (Ebasco 1978)

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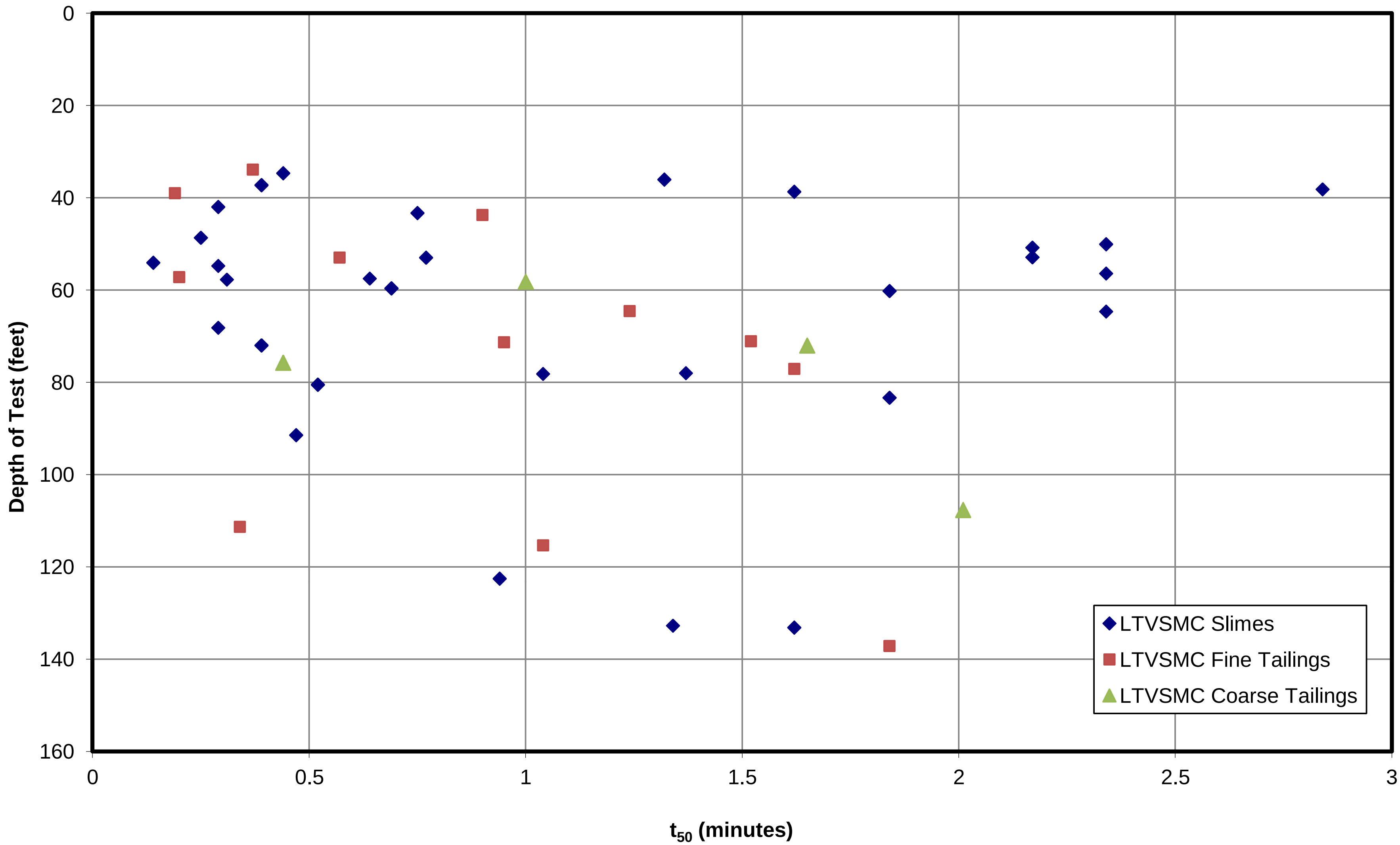

Large Figure 2. Summary of Dissipation Testing Results
2007 NorthMet Geotechnical Investigation

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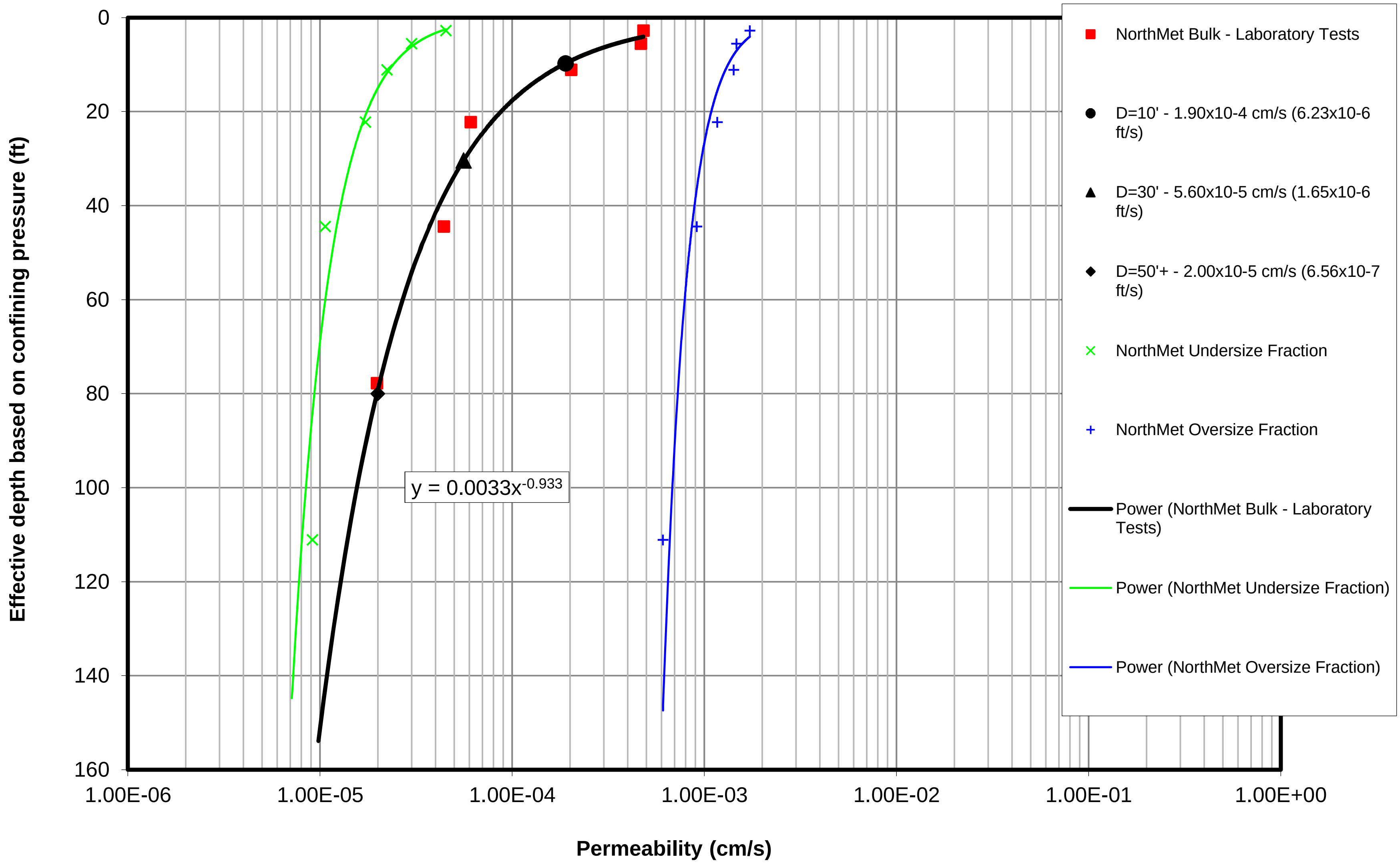

Large Figure 3. PolyMet Bulk Tailings Permeability Test Results

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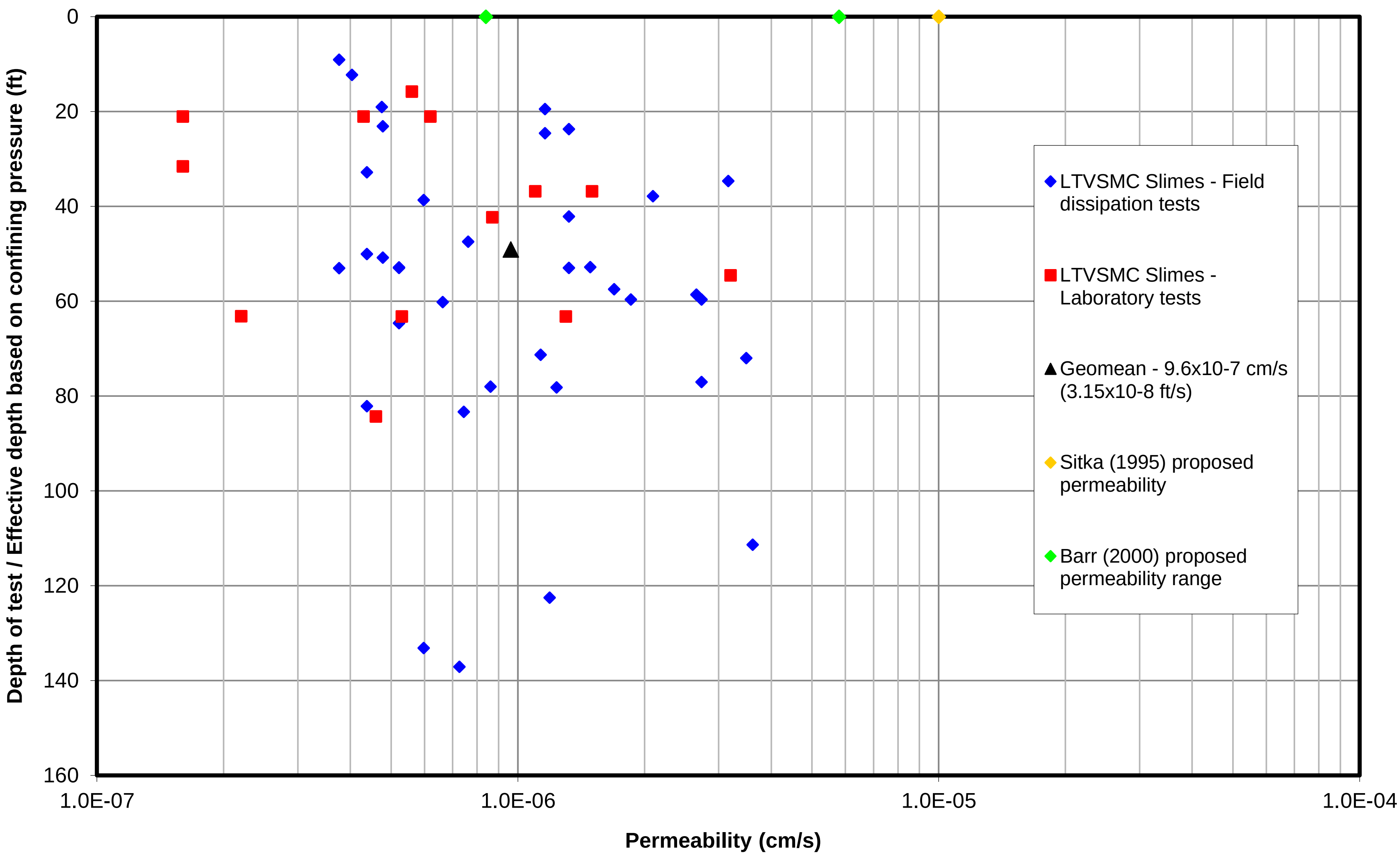

Large Figure 4. LTVSMC Slimes Permeability Test Results

(2007 dissipation test k_h based on Figure 5.42 in Lunne, Robertson, and Powell)

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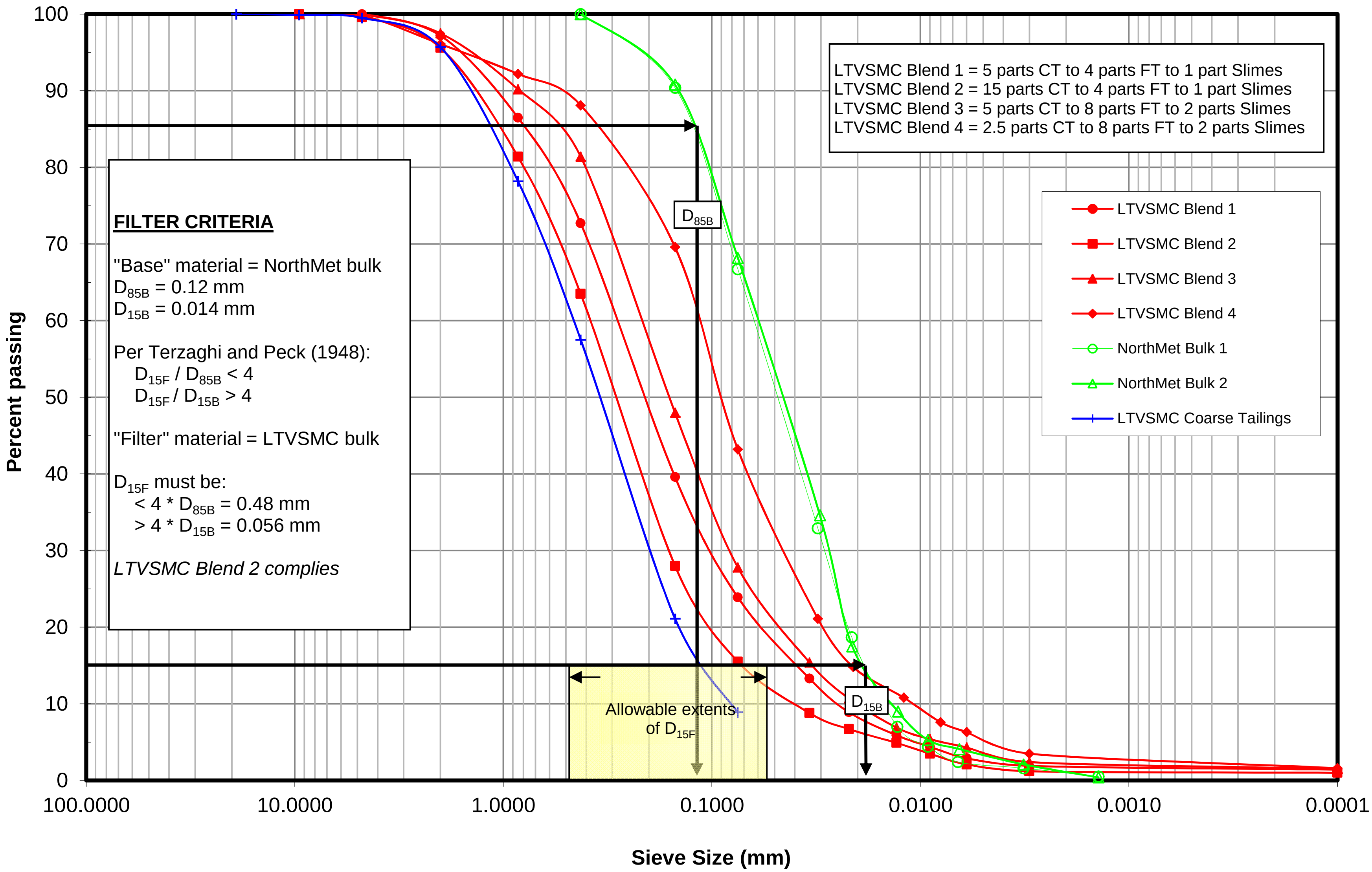
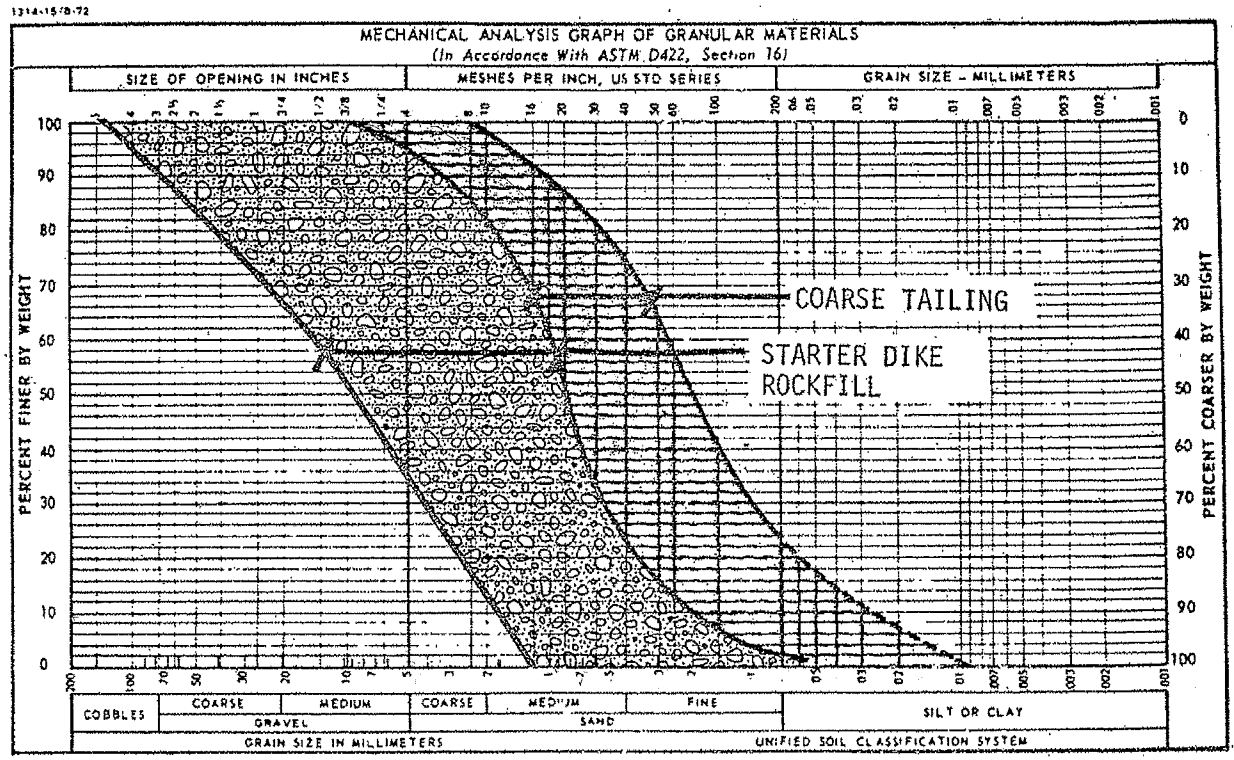


Figure 5. Filtration Criteria for PolyMet Bulk Tailings

(Erie Mining Company)

GRAIN SIZE DISTRIBUTION



COARSE TAILING (BASE - B)	STARTER DIKE FILL (FILTER - F)
D15 0.13MM	D15 0.9MM
D50 0.4MM	D50 3MM
D85 1.2MM	D85 12MM

FILTER DESIGN CRITERIA:

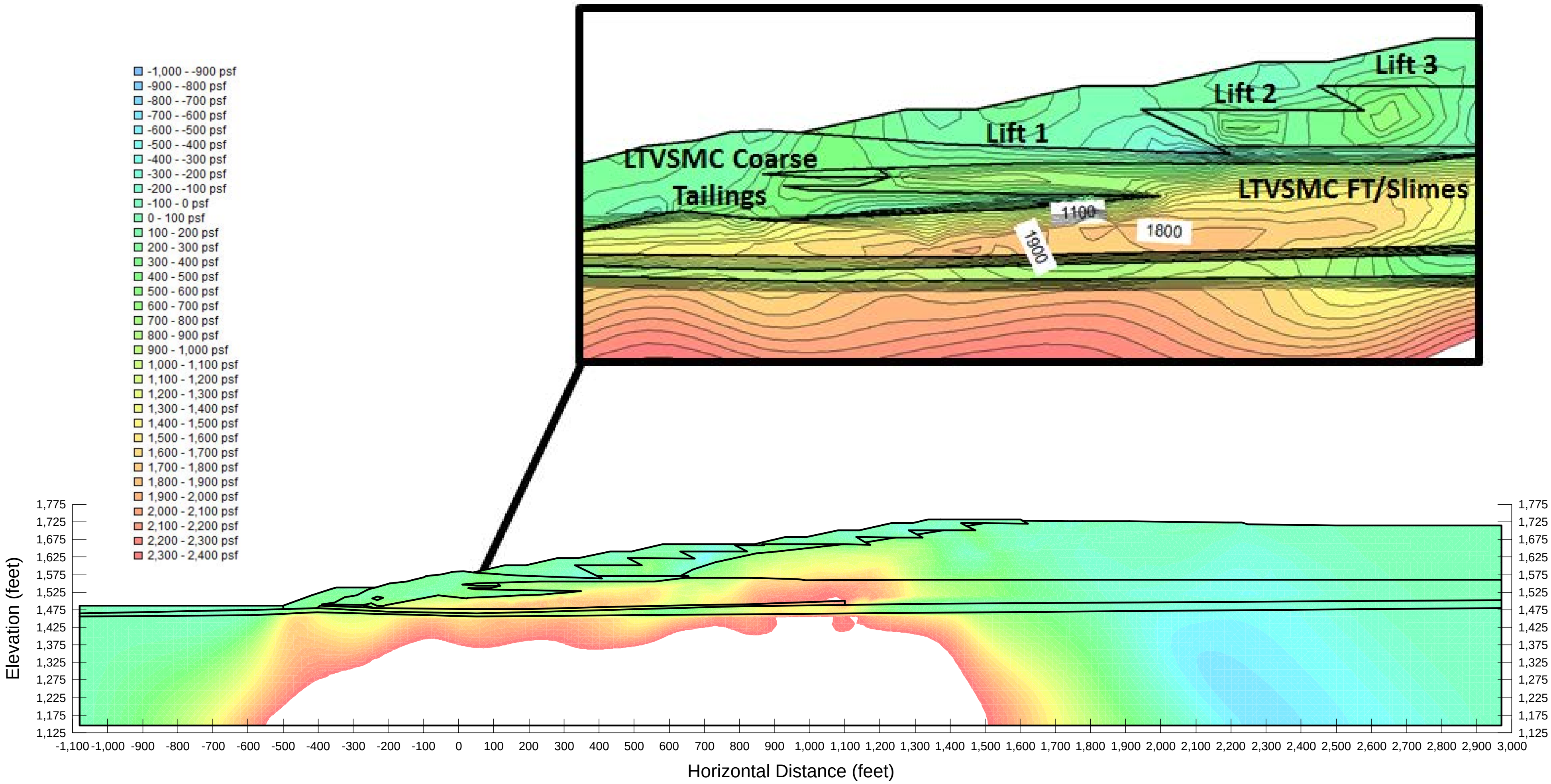
$\frac{D15F}{D85B} < 5$ $\frac{0.9MM}{1.2MM} = 0.75$ OK

$\frac{D50F}{D50B} < 25$ $\frac{3MM}{0.4MM} = 7.5$ OK

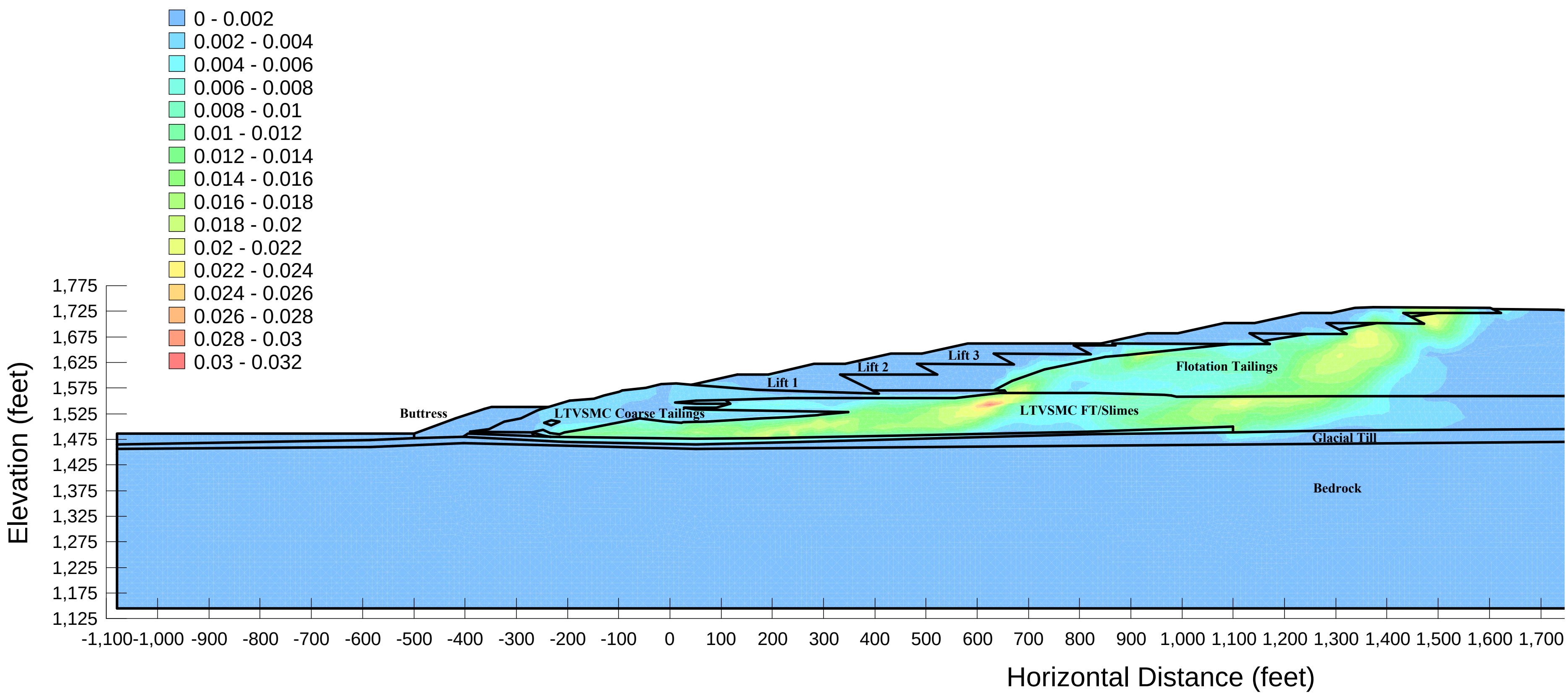
$4 < \frac{D15F}{D15B} < 20$ $\frac{0.9MM}{0.13MM} = 6.9$ OK

ERIE MINING COMPANY

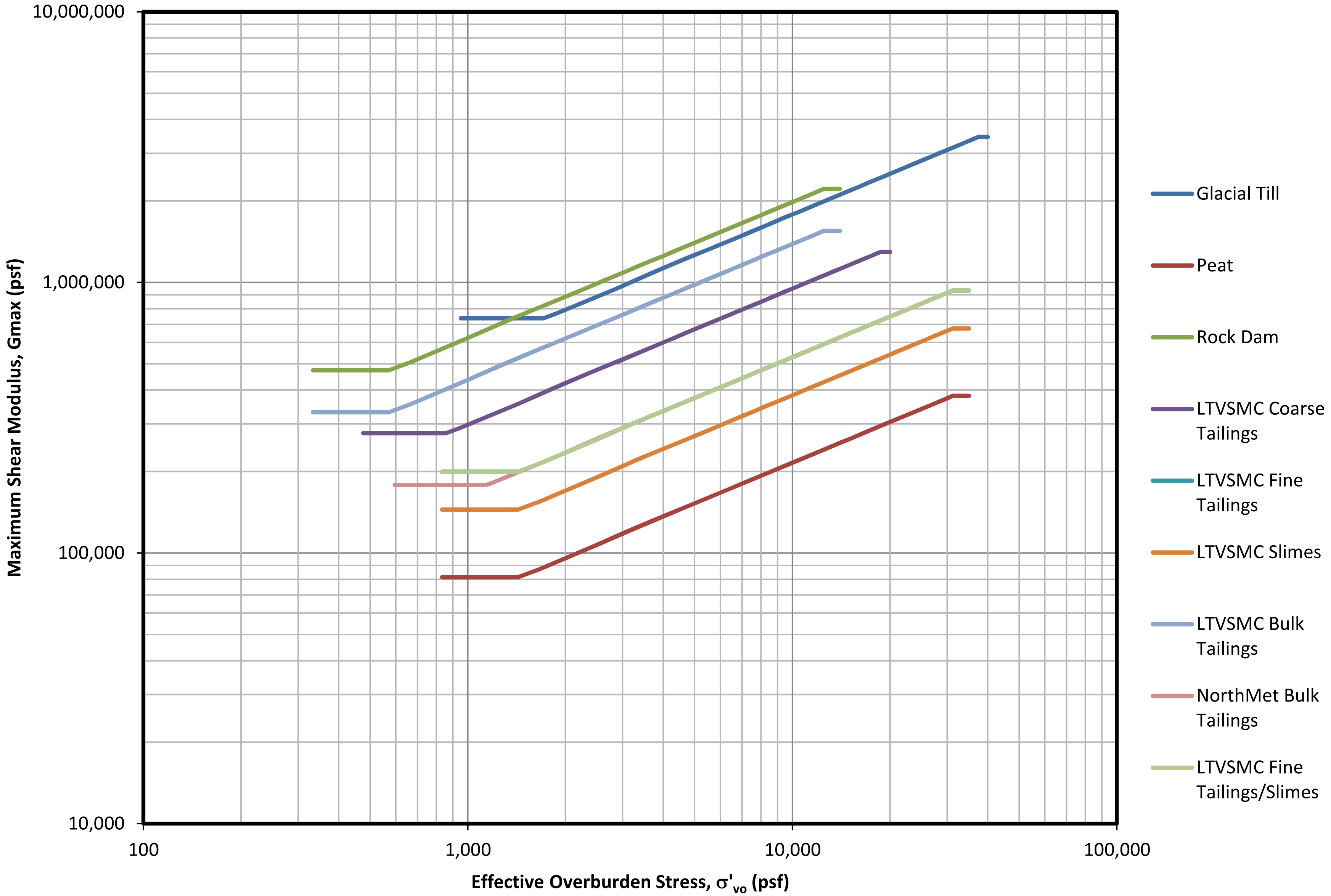
GRAIN SIZE DISTRIBUTION
SUMMARY PLOT



Large Figure 7. Elasto-plastic Finite Element based Shear Stress Contours



Large Figure 8. Maximum Shear Strain Contours (liquefaction conditions – Cross-Section F)



Large Figure 9. Shear Modulus Functions for Seismic/Deformation Modeling

NorthMet Flotation Tailings Basin Design

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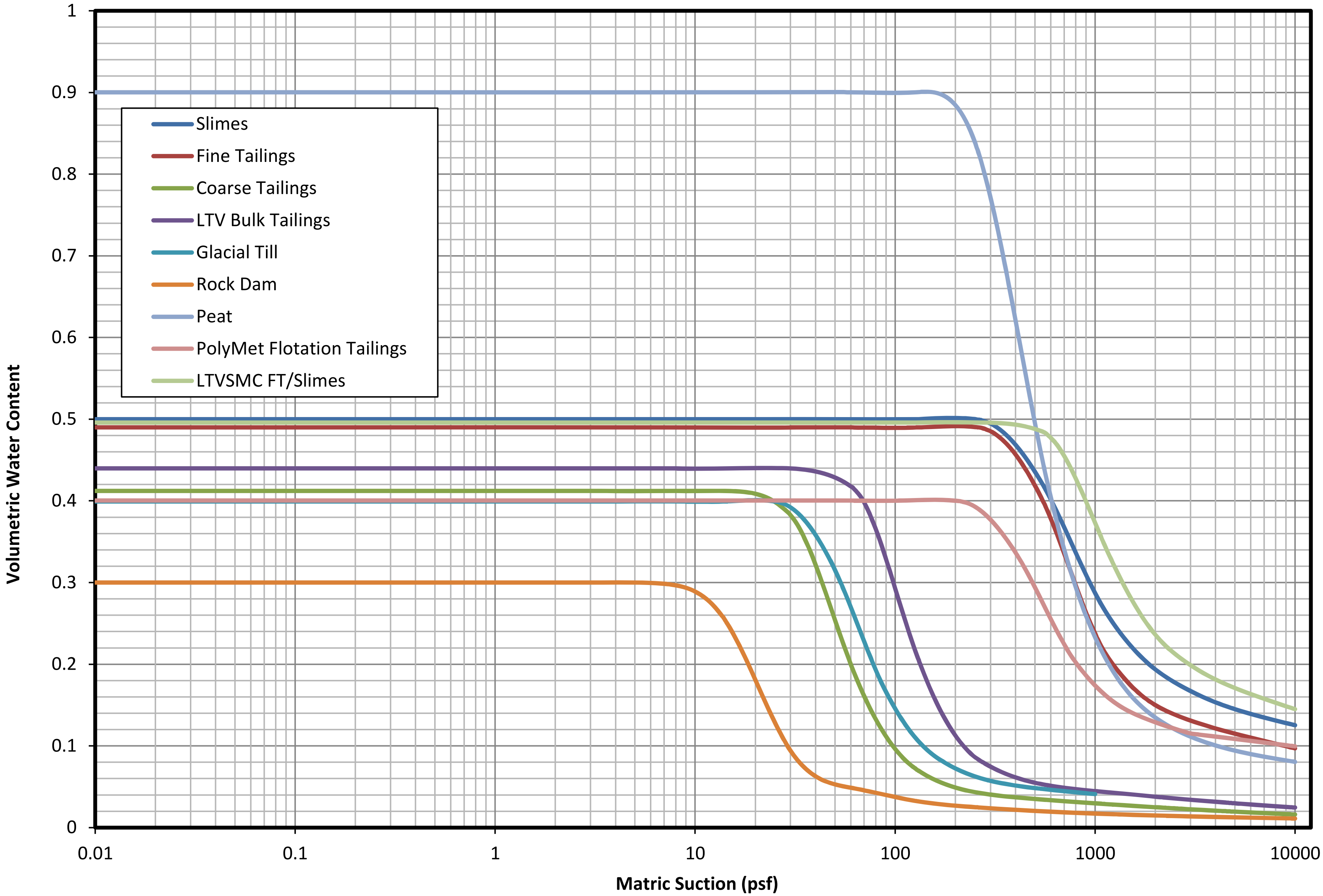
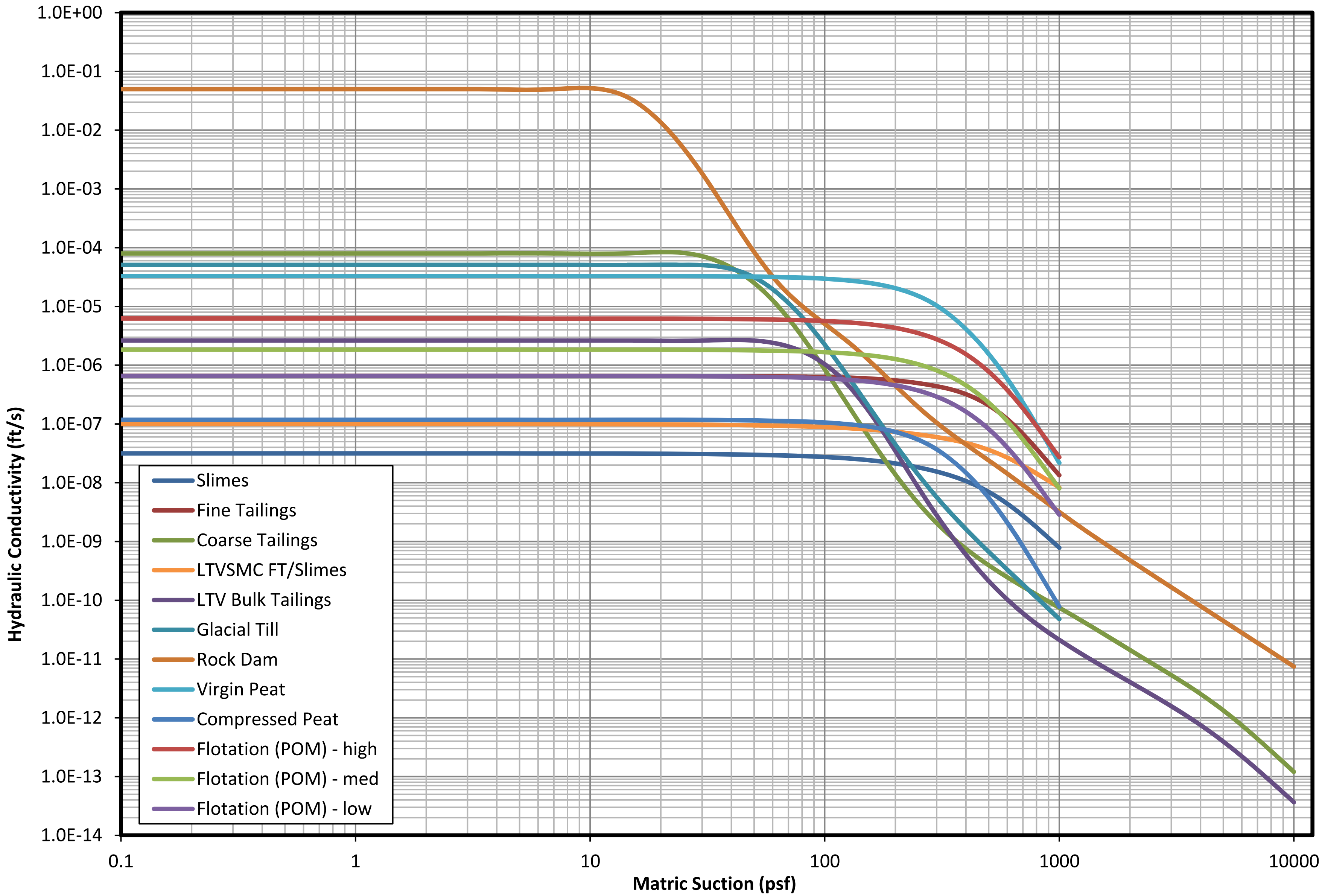
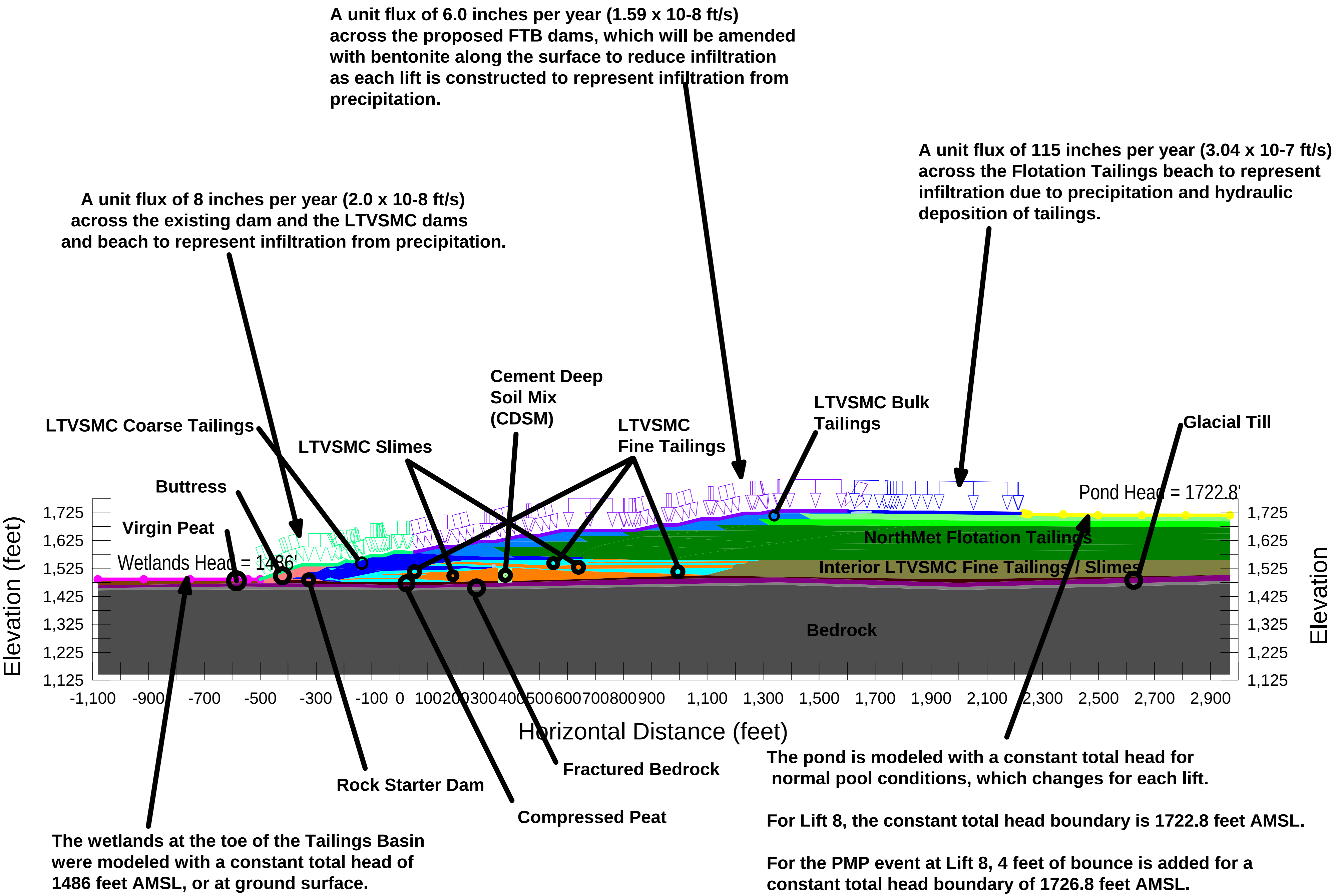


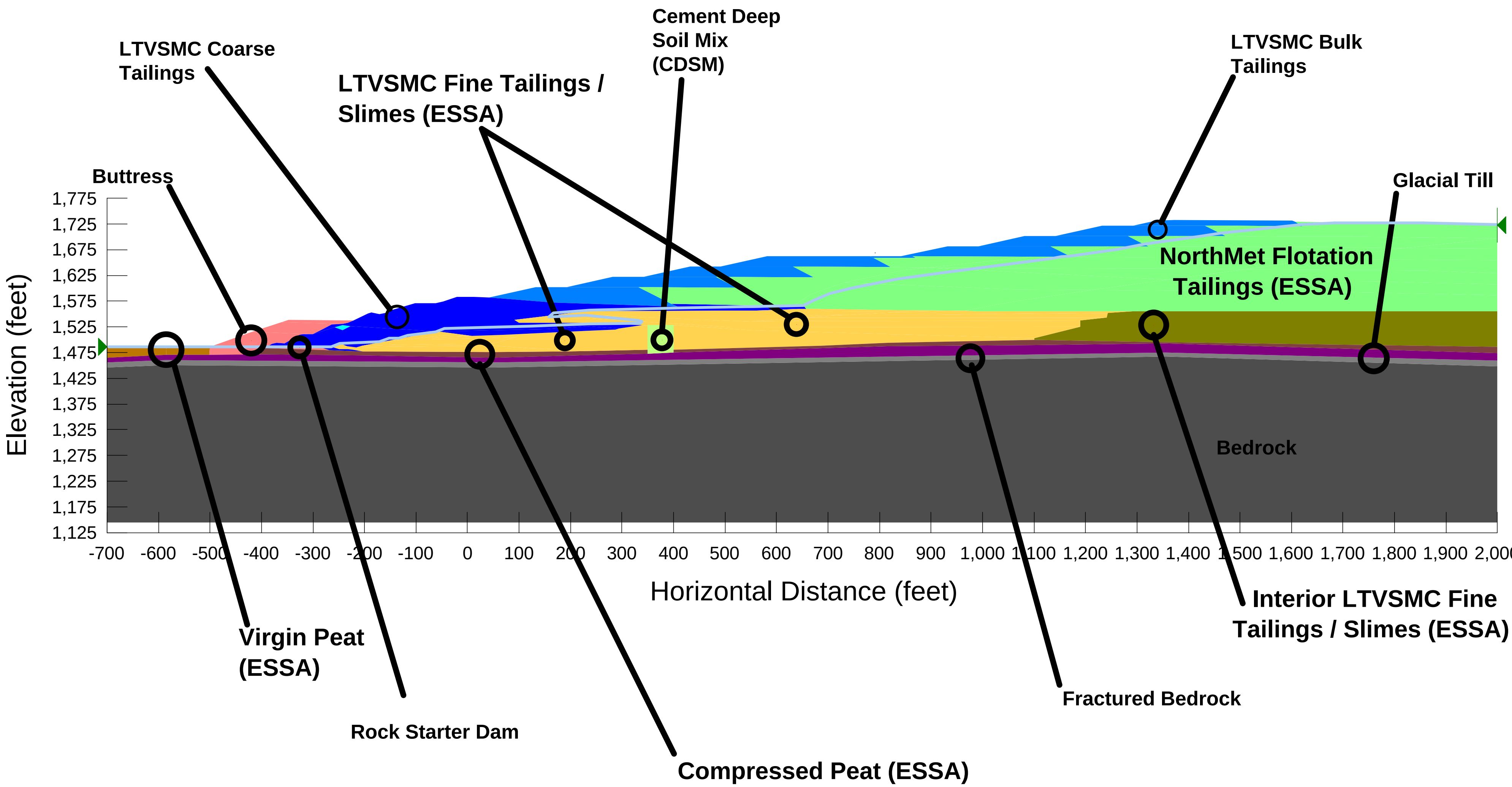
Large Figure 10. Volumetric Water Content Functions for Seepage Modeling



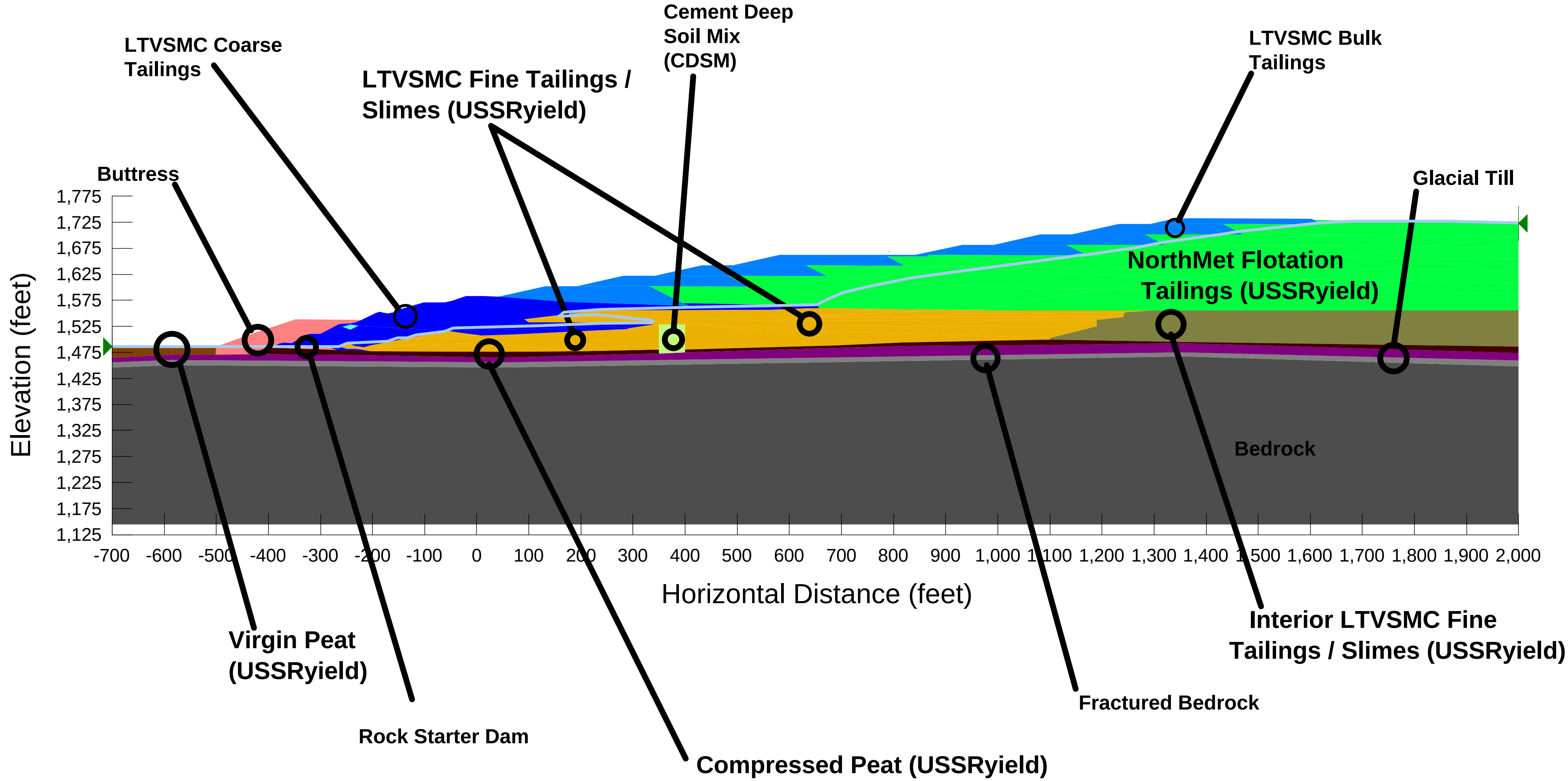
Large Figure 11. Permeability Functions for Seepage Modeling



Large Figure 12. Cross-Section F with Finite Element Mesh - Proposed Conditions Lift 8 (GeoStudio)

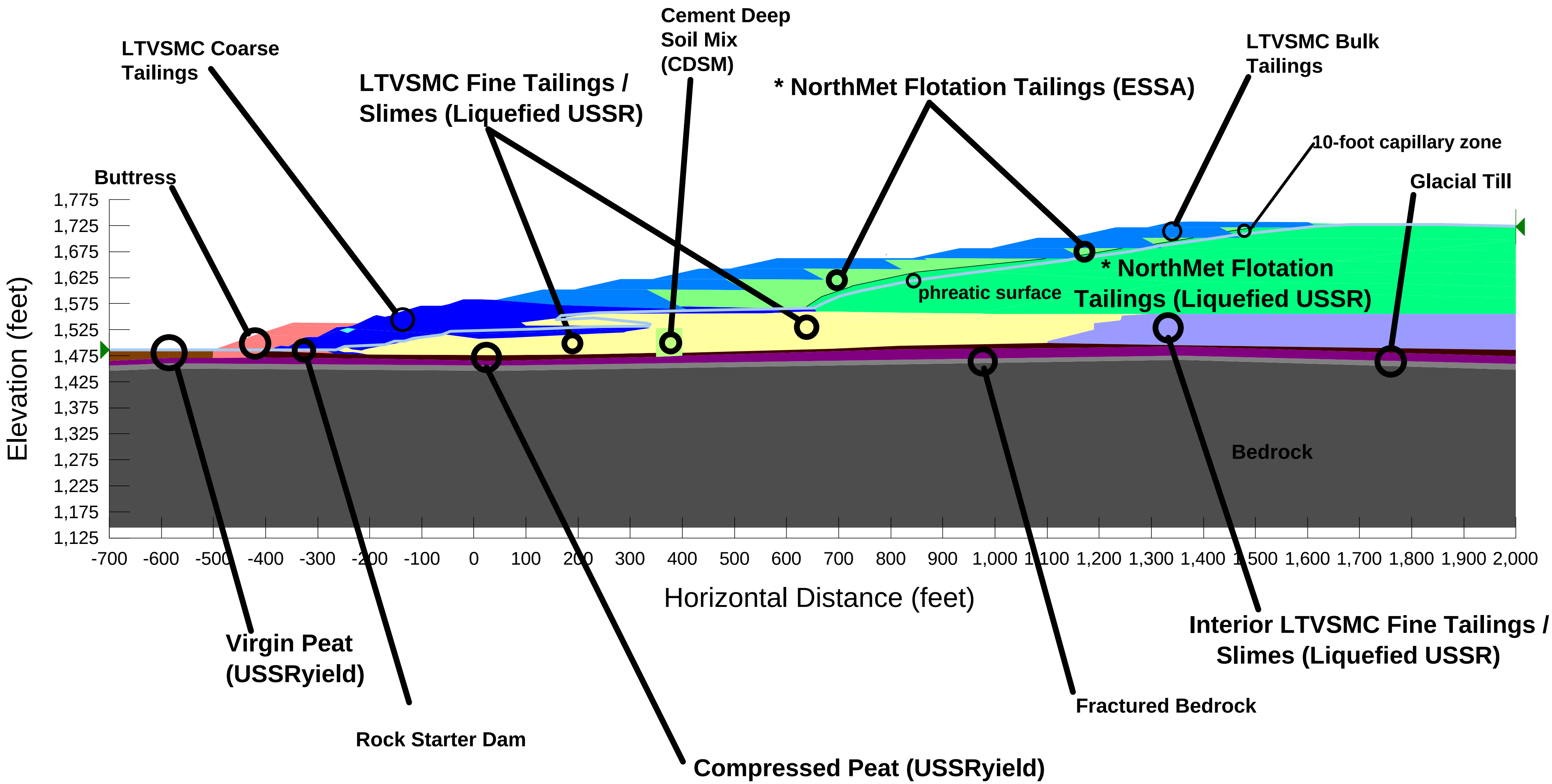


Large Figure 13. Cross-Section F Schematic of ESSA Conditions

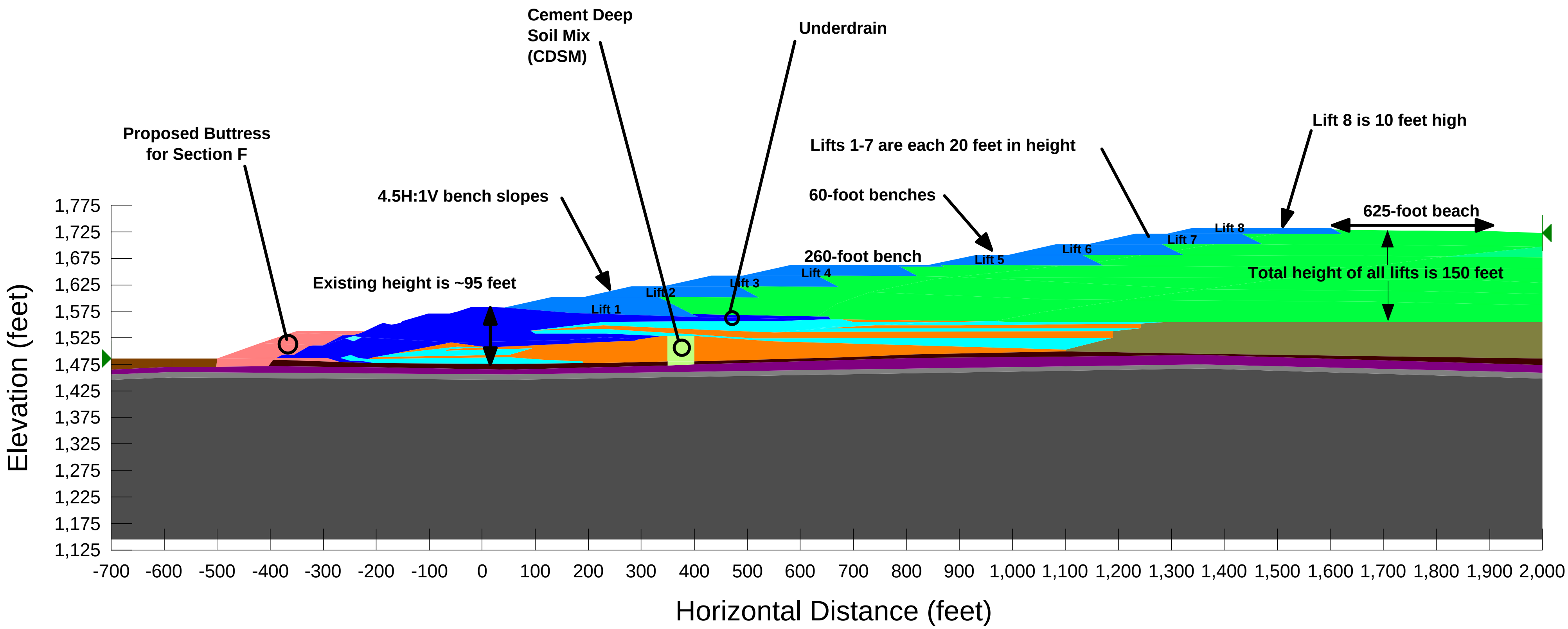


Large Figure 14. Cross-Section F Schematic of USSA Conditions

* Only saturated material beneath the phreatic surface and 10-foot capillary zone will liquefy.
Material above the phreatic surface and capillary zone was modeled with drained strengths.



Large Figure 15. Cross-Section F Schematic of Liquefied Conditions

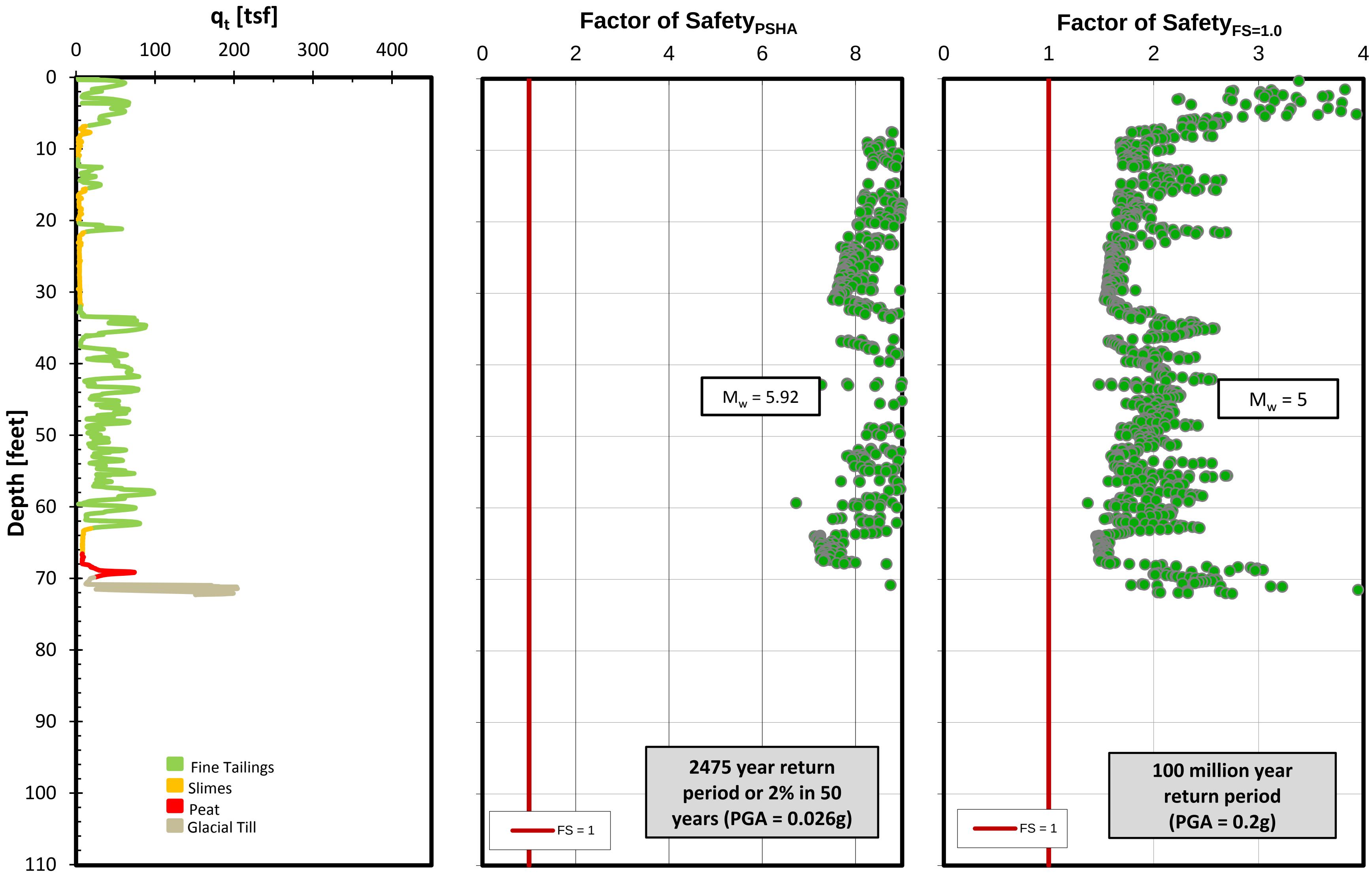


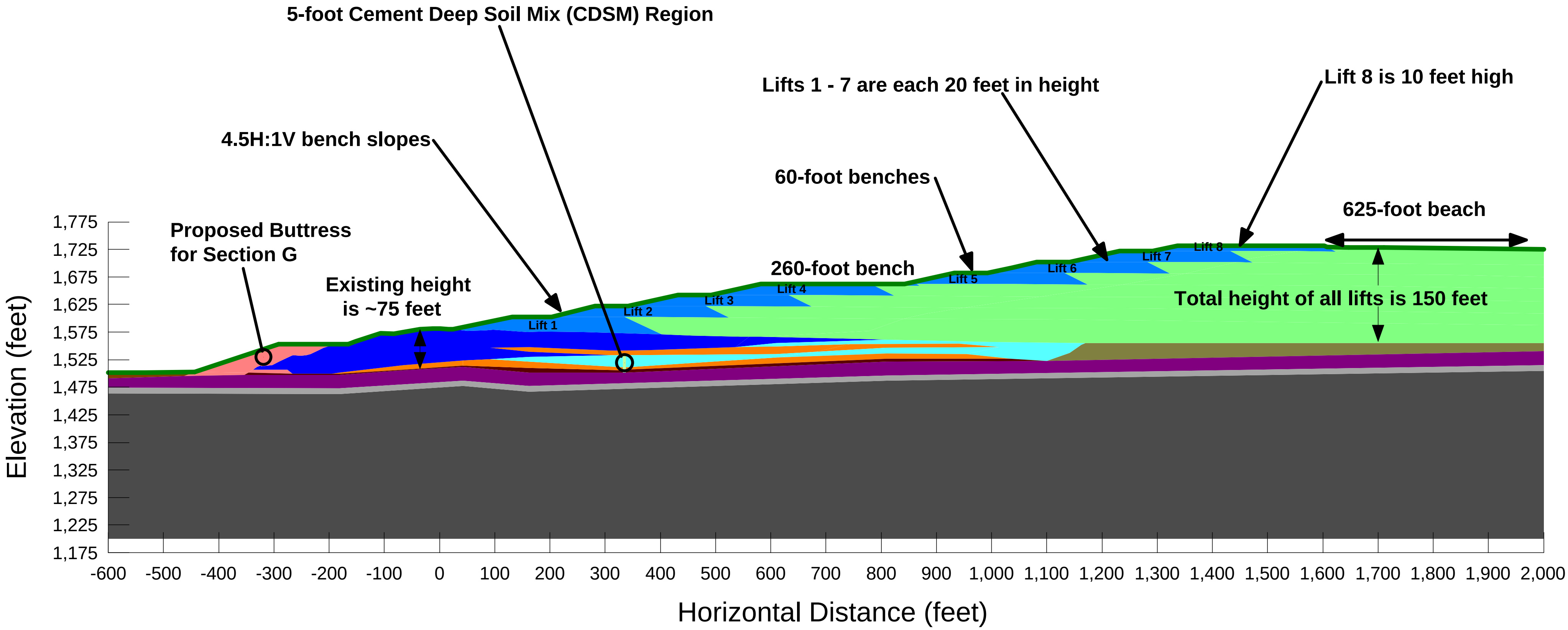
Large Figure 16. Cross-Section F Proposed FTB Design Mine Year 20

Large Figure 17. Seismic Triggering Plot

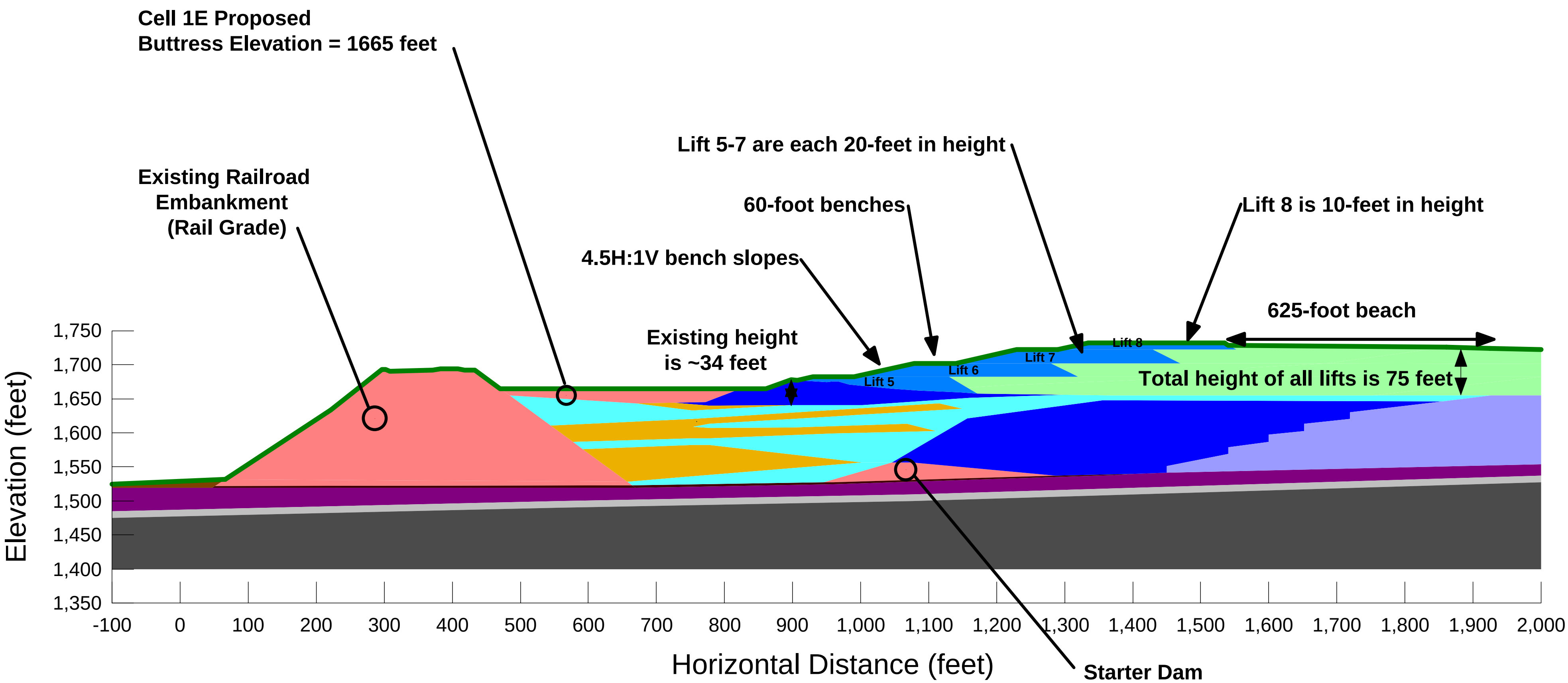
Sounding 07-06 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

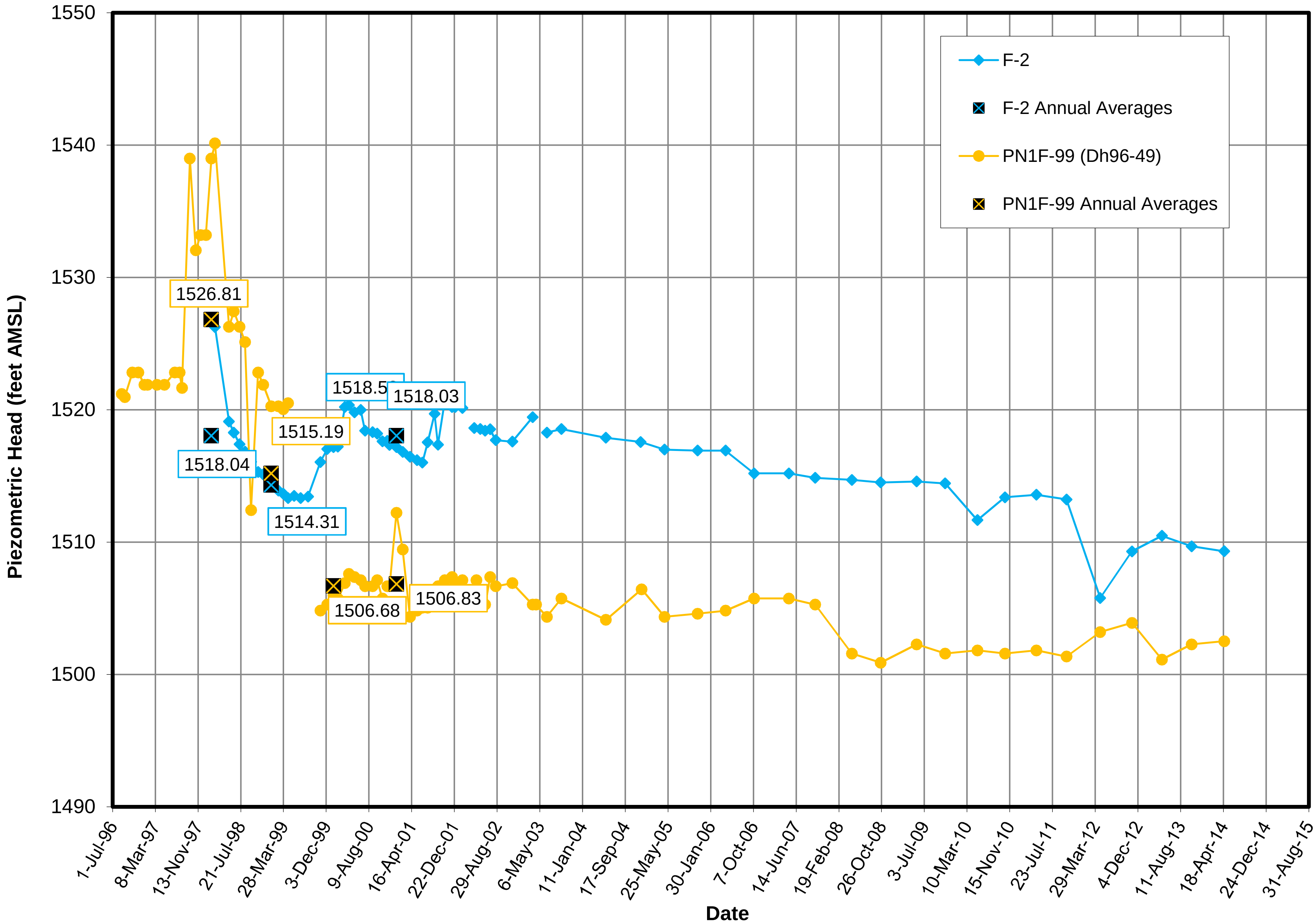




Large Figure 18. Cross-Section G Proposed FTB Design Mine Year 20



Large Figure 19. Cross-Section N Proposed FTB Design Mine Year 20



Large Figure 20. Piezometer Data for Cross-Section F

NorthMet Flotation Tailings Basin Design

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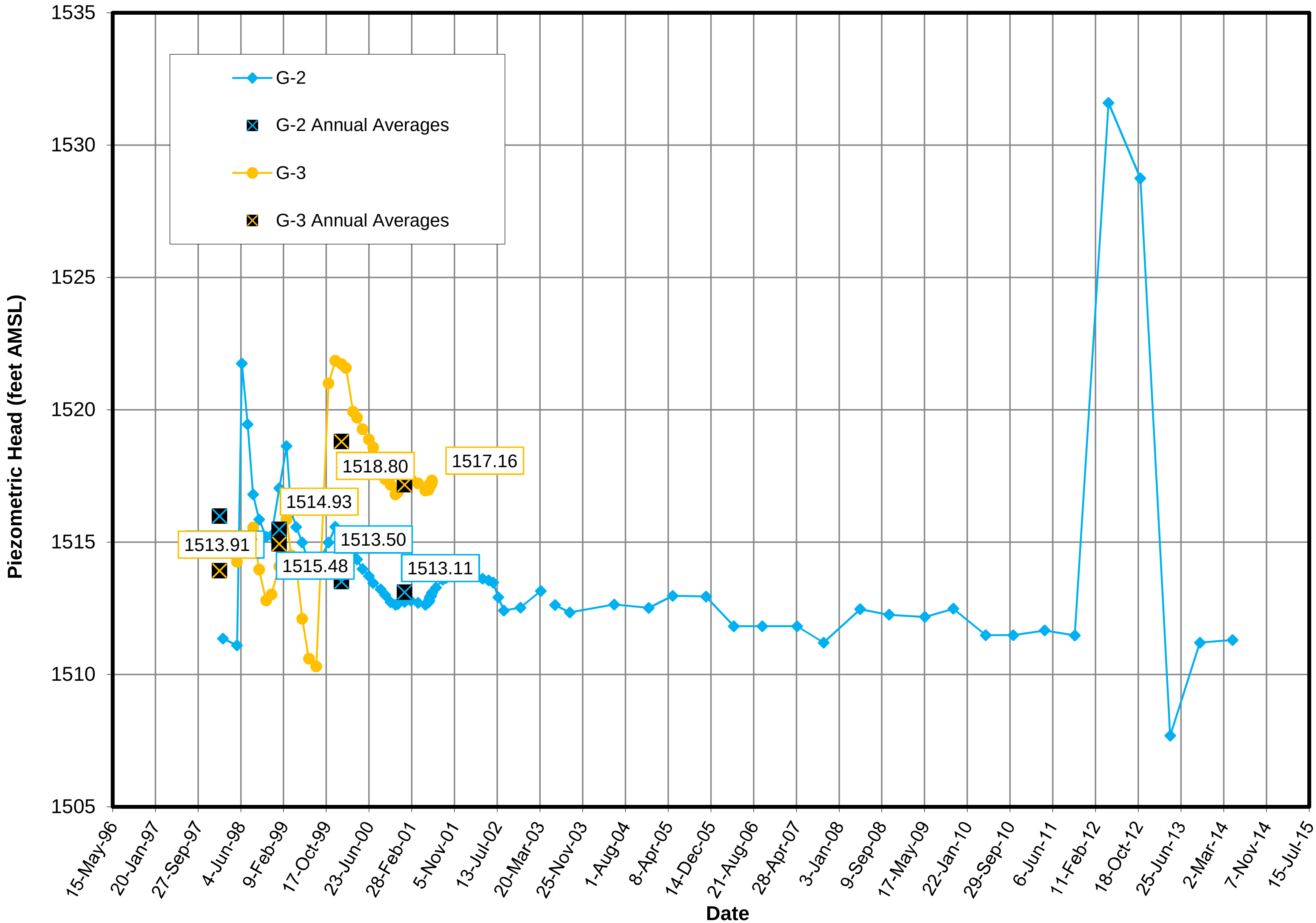


Large Figure 21. Piezometer Data for Cross-Section G

NorthMet Flotation Tailings Basin Design

P:\Mpls\23 MN\69\2369862\WorkFiles\022A GeoStudio models\2014\Section G\Version 5\Section G Piezometer Data.xlsx

Attachments

Attachment A

MDNR Geotechnical Work Plan

NorthMet Geotechnical Modeling Work Plan

Version 3 4/11/2013

This document is the Work Plan for geotechnical modeling of the NorthMet Project as requested by the Geotechnical Stability Impact Assessment Planning Summary Memo, NorthMet Project EIS, dated May 18, 2011. The findings from the geotechnical modeling will be incorporated into a 3-Volume Geotechnical Data Package – and summarized and referenced as needed. NorthMet Project Geotechnical Data Package Volumes 1 through 3 will consist of:

- Volume 1 – Flotation Tailings Basin
- Volume 2 – Hydrometallurgical Residue Facility
- Volume 3 – Stockpiles

Project:

The project that will be evaluated is the project described in the Co-lead Agency Draft Alternative Summary as amended 03/04/11. This Work Plan will be reviewed and amended as necessary in response to project changes in the event such changes require substantive changes to previously analyzed facility designs.

Background:

The NorthMet Project includes two material disposal facilities that include dams, consisting of the Flotation Tailings Basin for final deposition of flotation tailings, and the Hydrometallurgical Residue Facility for final deposition of the hydrometallurgical residue. The Flotation Tailings Basin and Hydrometallurgical Residue Facility are designed using an iterative process whereby facility capacity requirements and geotechnical requirements are utilized to determine the facility geometry and overall sizing requirements to contain the tailings and residue expected to be generated through the life of the project. A third type of material disposal facility, which does not require dams but does entail foundation and slope construction, is the waste rock stockpiles at the Mine Site (a.k.a. Stockpiles).

An important input parameter to the facility designs are the slope stability Factors of Safety. Applicable slope stability Factors of Safety are selected and then the facilities (Flotation Tailings Basin and Hydrometallurgical Residue Facility) are configured to achieve these Factors of Safety as computed by modeling performed during facility design. In the case of Stockpiles, MDNR-mandated design requirements have been developed that result in acceptable Factors of Safety.

The slope stability analysis methods that are used to compute slope stability Factors of Safety are not required universally. In other words, some types of analysis are appropriate to some facility configurations while not applicable to other configurations. For example, undrained strength stability analysis (USSA) for slope stability is appropriate for the upstream construction approach planned for the Flotation Tailings Basin. It is not necessary for the Hydrometallurgical Residue Facility which will utilize downstream construction with a liner system. Within this context the Geotechnical Modeling Work Plans for the Flotation Tailings Basin, Hydrometallurgical Residue Facility, and Stockpiles are outlined below.

Flotation Tailings Basin Geotechnical Model for SDEIS, FEIS and Permitting:

The objective of the Flotation Tailings Basin Geotechnical Modeling for the SDEIS, FEIS and Permitting is to demonstrate the ability of the Critical Cross-Section (i.e., Cross-Section F; that cross-section anticipated to yield the lowest slope stability Factors of Safety as indicated in the Preliminary Geotechnical Evaluation – March 2009) to comply with the required global slope stability Factors of Safety. The information content of the November 21, 2012 Geotechnical Data Package – Volume 1 – Version 3, Flotation Tailings Basin (which now supersedes and entirely replaces the Preliminary Geotechnical Evaluation – March 2009) will be updated and formatted to accommodate the Co-lead Agency Comments and to incorporate updated slope stability analysis for scenarios derived from the February 25 and 26, 2013 Geotechnical Workshop (February Workshop) with the Co-lead Agency geotechnical team.. This will be Geotechnical Data Package – Volume 1 – Version 4, Flotation Tailings Basin. The following is a step-by-step summary of the planned Flotation Tailings Basin geotechnical modeling process. Descriptions of previously completed process steps, outcomes of which are reported in Geotechnical Data Package – Volume 1 – Version 3, are preserved below to maintain Work Plan continuity. Work Plan updates derived specifically from the February Workshop are noted as such.

The following paragraphs describe the work that will be included in Geotechnical Data Package – Volume 1 – Version 4, Flotation Tailings Basin which is expected to provide information for the SDEIS.

1. Gather existing conditions data (i.e. basin topography, stratigraphy, soil and tailings strength and hydraulic characteristics), and other data as needed to support geotechnical modeling and Flotation Tailings Basin design. Note – this data has previously been compiled and presented in the Preliminary Geotechnical Evaluation – March 2009. This information will be incorporated into the Geotechnical Data Package – Volume 1, which will present the analyses outlined in this Work Plan. Results of in-laboratory testing of liquefied shear strength of NorthMet flotation tailings, completed subsequent the March 2009 evaluation, will be incorporated into the work prescribed in this Geotechnical Modeling Work Plan.

2. Develop Flotation Tailings Basin slope cross-sections (i.e., geometry and stratigraphy for existing and planned conditions) for the Flotation Tailings Basin for seepage and stability modeling. Models will utilize surveyed cross-sections of the existing basin and proposed cross-sections of future dam raises; existing models will be reconfigured as needed to accommodate the modeling approach outlined in this Work Plan. This information will then be incorporated into the Geotechnical Data Package – Volume 1.

3. Develop seepage and stability models of the Flotation Tailings Basin using Geo-Slope International, Inc. modeling software (i.e., SLOPE/W, SEEP/W, SIGMA/W and QUAKE/W as necessary).

4. Using geotechnical data from Step 1, establish design data for use in Effective Stress Stability Analysis and Undrained Strength Stability Analysis. Also utilize established criteria (Olson and Stark – 2003 "Yield Strength Ratio and Liquefaction Analysis of

Slopes and Embankments" as updated by Olson 2009) to determine which materials behave in a contractive manner and could transition from non-liquefied strengths to liquefied (steady state) strengths.

Produce graphical representations of each strength data set and basis for selection of design parameters. Plots should include the number of data used to develop each plot.

5. Utilize design data to design slopes to achieve the following:

   a. Effective Stress Stability Analysis (ESSA) – Factor of Safety $\geq$ 1.5 for conditions using drained (i.e., effective-stress based) shear strength parameters. Analyze the following effective stress stability scenarios:

      i. Existing conditions.
      ii. Normal operating condition at incremental lift heights up to maximum dam height for normal pool elevation with steady-state seepage conditions and including reduced infiltration rates for bentonite amended exterior face of new dams.

   b. Undrained Strength Stability Analysis (USSA) – Factor of Safety $\geq$ 1.3 for conditions using undrained yield shear strengths for materials that are expected to behave in an undrained manner (i.e., end of construction case per dam raise). Analyze the following undrained strength stability scenarios:

      i. Normal operating condition at incremental lift heights up to maximum dam height for normal pool elevation and including reduced infiltration rates for bentonite amended exterior face of new dams.
      ii. Veneer stability to evaluate the stability of the bentonite amended exterior face of new dams. Veneer stability will be evaluated by computing the infinite slope Factor of Safety (using the no-seepage formulation where tailings seepage is not emerging on the slope, and the parallel-seepage formulation where tailings seepage is emerging on the slope), with the soil friction angle chosen as a conservative value based on literature review. Laboratory direct shear testing will be performed to measure a friction angle for site-specific bentonite amended tailings and the Factor of Safety will then be recomputed. Slope design will be adjusted as needed to achieve Factor of a Safety $\geq$ 1.3 for veneer stability.

   c. Liquefaction Triggering and Post-Triggering Analysis – Factor of Safety $\geq$ 1.1 for post-triggering slope stability considering liquefied shear strengths (computed from design liquefied strength ratios) applied to segments of materials in the triggering stability analysis with $FS_{triggering} < 1.1$; design drained strengths applied to materials above the capillary zone; and yield shear strength (computed from design yield strength ratios) for all other materials. From the February 2013 workshop, analyze the following credible triggering scenarios:

      i. Baseline – Lift 8

- Realistic phreatic surface from seepage analysis including capillarity.
- Normal pool steady-state seepage.
- Capillarity – 10' above computed steady-state phreatic line.
- Liquefied shear strengths applied below top of capillary zone to materials triggered to liquefy (i.e., design liquefied shear strength utilized for flotation tailings and LTVSMC fine tailings/slimes in materials that are triggered to liquefy).

ii. Elevated Phreatic Surface (i.e., drain ineffective) – Lift 8

- Permeability of plugged drain set to permeability of flotation tailings.
- Normal pool steady-state seepage.
- Capillarity – 10' above computed steady-state phreatic line.
- Liquefied shear strengths applied below top of capillary zone to materials triggered to liquefy (i.e., design liquefied shear strength utilized for flotation tailings and LTVSMC fine tailings/slimes in materials that are triggered to liquefy).
- Consideration of baseline effective vertical stresses (prior to rise in phreatic surface).

iii. High Construction Rate of Loading – Lift 1

- 15' of construction fill placed rapidly.
- Baseline phreatic surface including capillarity.
- Normal pool steady-state seepage.
- Capillarity – 10' above computed steady-state phreatic line.
- Liquefied shear strengths applied below top of capillary zone to materials triggered to liquefy (design liquefied shear strength utilized for flotation tailings and LTVSMC fine tailings/slimes in materials that are triggered to liquefy).
- Consideration of baseline effective vertical stresses (prior to new fill placement).

iv. Local Erosion/Scour of Slope (pipe break) – Lift 8

- Incrementally remove material above buttress (retrogressive).
- Baseline phreatic surface including capillarity.
- Normal pool steady-state seepage.
- Capillarity – 10' above computed steady-state phreatic line.
- Liquefied shear strengths applied below top of capillary zone to materials triggered to liquefy (design liquefied shear strength utilized for flotation tailings and LTVSMC fine tailings/slimes in materials that are triggered to liquefy).

- Consideration of baseline effective vertical stresses (prior to erosion).

v. Elevated Phreatic Surface (drain ineffective) w/High Pond – Lift 1

- Elevated Pond (drain ineffective).
- Permeability of plugged drain set to permeability of flotation tailings.
- Steady-state seepage with elevated pond set at overflow elevation.
- Capillarity – 10' above computed steady state phreatic line.
- Liquefied shear strengths applied below top of capillary zone to materials triggered to liquefy (design liquefied shear strength utilized for flotation tailings and LTVSMC fine tailings/slimes in materials that are triggered to liquefy).
- Consideration of initial effective vertical stresses (prior to placement of 1st lift).

vi. Long-Term Case (20, 200, and 2000 years after closure)

- Final geometry including surface erosion of material above buttress.
- Impoundment phreatic surface drained down (as determined by analysis) reflecting bentonite cover.
- Surcharge load from surficial pond.
- Pond set at overflow elevation.
- Liquefied shear strengths applied to materials triggered to liquefy (design liquefied shear strength utilized for flotation tailings and LTVSMC fine tailings/slimes in materials that are triggered to liquefy).
- Design liquefied shear strength with aging factors included for decomposition and secondary compression.

d. Lift 8 Baseline Conditions assuming Unknown Triggering Mechanism – Factor of Safety ≥ 1.1 for post-triggering slope stability applying design liquefied shear strengths to all LTVSMC fine tailings and slimes and all Flotation Tailings below top of capillary zone.

i. Lift 8
ii. Realistic phreatic surface from seepage analysis including capillarity.
iii. Normal pool steady-state seepage.
iv. Capillarity – 10' above computed steady-state phreatic line.
v. Design liquefied shear strengths applied below top of capillary zone to all LTVSMC fine tailings and slimes and all Flotation Tailings.

e. Seismic Liquefaction (i.e., induced by seismic event).

i. Perform a screening analysis for triggering of liquefaction based on Boulanger and Idriss (2004). If the factor of safety against triggering is less than 1.2 for a seismic event with a 2475-year return period, perform further seismic triggering analyses as described below.
ii. Develop material damping coefficients for LTVSMC and NorthMet tailings.
iii. Use Geo-Slope software to compute initial stresses and steady-state pore-water pressure distribution.
iv. Apply earthquake loads via appropriate geomechanical models (such as QUAKE/W, FLAC, Plaxis, or others; earthquake loads to be obtained from probabilistic seismic hazard analysis [PSHA]) and compare results to a SLOPE/W yield undrained model (or other appropriate model) to identify the elements within the model that liquefy as a result of the seismic loading.
v. Use published triggering relationships and model results to determine segments along the slip surface where liquefaction will be triggered (Olson & Stark, 2003, Yield Strength Ratios and Liquefaction Analysis of Slopes and Embankments).
vi. Perform slope stability analysis in SLOPE/W or other appropriate geomechanical model (using liquefied shear strengths applied to elements shown to liquefy) to compute FS for the entire cross section.

- If FS > 1.2 no further action is needed.
- If FS < 1.0 modify or redesign cross section.
- If FS >1.0 and < 1.2, perform deformation modeling in SIGMA/W or other suitable geomechanical model to predict the magnitude of deformation. If the level of deformation is acceptable to Dam Safety, no further action is needed. If the level of deformation is unacceptable to Dam Safety, modify or redesign cross section.

6. Reporting:

Volume 1 – Version 4 will present the background/supporting information and results of the Flotation Tailings Basin geotechnical analyses described in this Work Plan. It will contain the pertinent content previously presented in the Preliminary Geotechnical Evaluation – March 2009 and Geotechnical Data Packages – Volume 1 – Versions 1 through 3. However, analysis methods and results will supersede contents of the previously published Geotechnical Evaluation and Data Packages. Included in Volume 1 – Version 4 (and/or the Flotation Tailings Management Plan) will be descriptions and drawings depicting existing conditions and what will be built, results of geotechnical analyses for operating and post-closure conditions, and presentation of all model input parameters and model outputs. Where model input parameters are derived from multiple data points, the approach utilized for input parameter selection will be described. Included will be a description of how stability is anticipated to vary over time following Flotation Tailings Basin closure. Include design and operating requirements necessary to maintain required slope stability Factors of Safety for the critical slope cross-section (assumed to be Cross-Section F for SDEIS modeling). This detail shall be included in Volume 1 – Version 4 and/or the Flotation Tailings Management Plan.

The following paragraphs describe the work that will be included in a future Geotechnical Data Package – Volume 1 – Version 5, Flotation Tailings Basin, which is expected to provide information for the FEIS and Dam Safety permitting.

1. After MDNR publication of the SDEIS and prior to Final EIS (FEIS) publication and Permitting, execute a supplement to this Work Plan to include:

    a. For normal operation conditions with maximum lift height perform a sensitivity analysis using the USSA slope stability model with yield undrained shear strength values. The Flotation Tailings Basin designer's engineering judgment shall be used to establish a range for these data inputs and the basis for the range shall be described. Evaluate the impact of data variability on computed slope stability Factors of Safety for the purpose of focusing operational-phase data gathering on the most critical stability model data inputs.

    b. Prepare and execute a second Sensitivity Analysis the intent of which is to evaluate the variation in Factor of Safety (and the probability of $FS < 1.0$) for an unknown triggering case, using the ESSA and yield USSR strengths utilized for the current Work Plan, but with $USSR_{(Liq)}$ varied within the range identified during liquefied strength design parameter evaluation.

2. Following MDNR Dam Safety review and approval of Critical Cross-Section modeling process/procedures and outcomes, proceed with modeling cross-sections G (north side of Cell 2E) and N (south side of Cell 1E) for final Flotation Tailings Basin design (for input to FEIS or Permitting as determined by MDNR).

Hydrometallurgical Residue Facility Geotechnical Models for SDEIS, FEIS and Permitting:

The objective of the Hydrometallurgical Residue Facility Geotechnical Modeling for the SDEIS, FEIS and Permitting is to:

- demonstrate the ability of the most sensitive slope cross-section to comply with the required slope stability Factors of Safety for global stability,

- demonstrate the ability of the composite liner system to comply with infinite slope stability Factor of Safety requirements, and to

- demonstrate the capability of the composite liner system to withstand the strain anticipated due to differential settlement that may occur in the facility foundation materials.

The following is a step-by-step summary of the planned Hydrometallurgical Residue Facility geotechnical modeling process.

1. Gather existing conditions data (i.e. facility foundation material stratigraphy and strength data, hydrogeologic data and other data as needed to support geotechnical modeling of the Hydrometallurgical Residue Facility). Note – portions of this data have previously been compiled and presented in the Preliminary Geotechnical Evaluation – March 2009. This information will be incorporated into the Geotechnical Data Package Volume 2 and will be supplemented with additional facility location-specific data. Data on existing baseline water sources at the site, including surface discharges from the surrounding highlands, will be gathered for consideration during hydrometallurgical residue facility design. The facility will be designed to accommodate any such surface discharges and hence these discharges will not impact geotechnical modeling of the hydrometallurgical residue facility.

2. Gather additional residue strength and hydraulic conductivity data and/or representative published data for use in facility design. This information will be incorporated into the Geotechnical Data Package Volume 2 to the extent needed to facilitate the modeling outlined herein.

3. Develop residue facility layout and slope cross-sections (i.e., geometry and stratigraphy for existing and planned conditions) for proposed residue facility stability and deformation modeling. Note – seepage through the residue facility embankments will be inhibited by the composite liner system and seepage modeling will be an unnecessary component of this analysis.

4. Develop global and infinite slope stability models and deformation models of the facility using Geo-Slope International, Inc. modeling software (i.e., SLOPE/W, SEEP/W and SIGMA/W as necessary). Model the following:

    a. Deformation of hydromet residue facility foundation and liner system.

   b. Infinite slope stability of hydromet residue facility liner system (if necessary/applicable).

   c. Global stability of hydromet residue facility embankments.

   Model maximum residue facility dam height with minimum and maximum pond elevation, and post closure – cover effective with minimum pond elevation. Model for effective shear stress conditions. Modeling for undrained shear strength conditions will not be necessary due to lined facility design with imported and mechanically placed dam fill and lack of seepage through the dam.

5. Configure geotechnical data for model input. Model input parameters will be based on data collected for and presented in the Preliminary Geotechnical Evaluation – March 2009. For materials to be imported for construction, engineering judgment will be used to select conservative shear strength parameters for input to the slope stability analysis and liner deformation analysis.

6. Use SLOPE/W to calculate the Factor of Safety for the following conditions:

   a. Effective Stress Stability Analysis (ESSA) – Factor of Safety $\geq$ 1.5

   b. Slope failures on external face and internal face of residue facility embankments.

7. Perform infinite slope stability analysis to confirm that load from residue deposition will be transferred to facility foundation soils and will not induce excess strain in facility liner materials.

8. Perform deformation modeling to predict magnitude of deformation and resulting strain in the facility liner system for comparison to allowable strain in liner system. Allowable strains are material-specific and will be determined from manufacturers specifications for the materials selected for the facility liner.

9. Report final basin design and operating requirements necessary to maintain required slope stability Factor of Safety and deformation requirements.

10. Reporting – the Geotechnical Data Package Volume 2 will present the background/supporting information and results of the Hydrometallurgical Residue Facility geotechnical analyses described in this Work Plan. Included will be descriptions and drawings depicting existing conditions and what will be built, results of geotechnical analyses for operating and post-closure conditions, and presentation of all model input parameters and model outputs. Where model input parameters are derived from multiple data points, the approach utilized for input parameter selection will be described. Included will be a description of how stability is anticipated to vary over time.

Stockpile Geotechnical Models for SDEIS, FEIS and Permitting:

The objective of the Stockpile Geotechnical Modeling for the SDEIS, FEIS and Permitting is to comply with Mn Rule 6132.2400 (stockpile slopes will be as required by 6132.2400 Subp. 2. B. and stockpile foundations will be as required by 6132.2400 Subp. 2. A. (1)). These are design requirements that have been established to insure acceptable slope stability Factors of Safety for global stability and acceptable foundation stability, the latter of which relates to the capability of the geomembrane liner system to withstand the strain anticipated due to differential settlement that may occur in the stockpile foundation materials.

The following is a step-by-step summary of the planned Stockpile geotechnical modeling process.

1. Gather existing conditions data (i.e. facility foundation material stratigraphy and strength data and other data as needed to support foundation design). Existing site information will be utilized for analysis performed in support of the SDEIS and FEIS, with additional data gathered and designs updated as needed for final design in conjunction with permitting. Existing information will be incorporated into the Geotechnical Data Package Volume 3.

2. Configure stockpile slopes to meet or exceed minimum dimensional requirements established by Mn Rule 6132.2400.

3. Perform stockpile subgrade settlement analysis to predict magnitude of deformation and resulting strain in the stockpile liners for comparison to allowable strain in the liner system. Allowable strains are material-specific and will be determined from manufacturers specifications for the materials selected for the stockpile liners.

4. Report final stockpile design and operating requirements necessary to maintain required slope stability Factors of Safety and liner performance requirements.

5. Reporting – the Geotechnical Data Package Volume 3 will present the background/supporting information and results of the Stockpile geotechnical analyses described in this Work Plan. Included will be descriptions and drawings depicting existing conditions and what will be built, results of geotechnical analyses for operating and post-closure conditions, and presentation of all model input parameters and model outputs. Where model input parameters are derived from multiple data points, the approach utilized for input parameter selection will be described. Included will be a description of how stability is anticipated to vary over time.

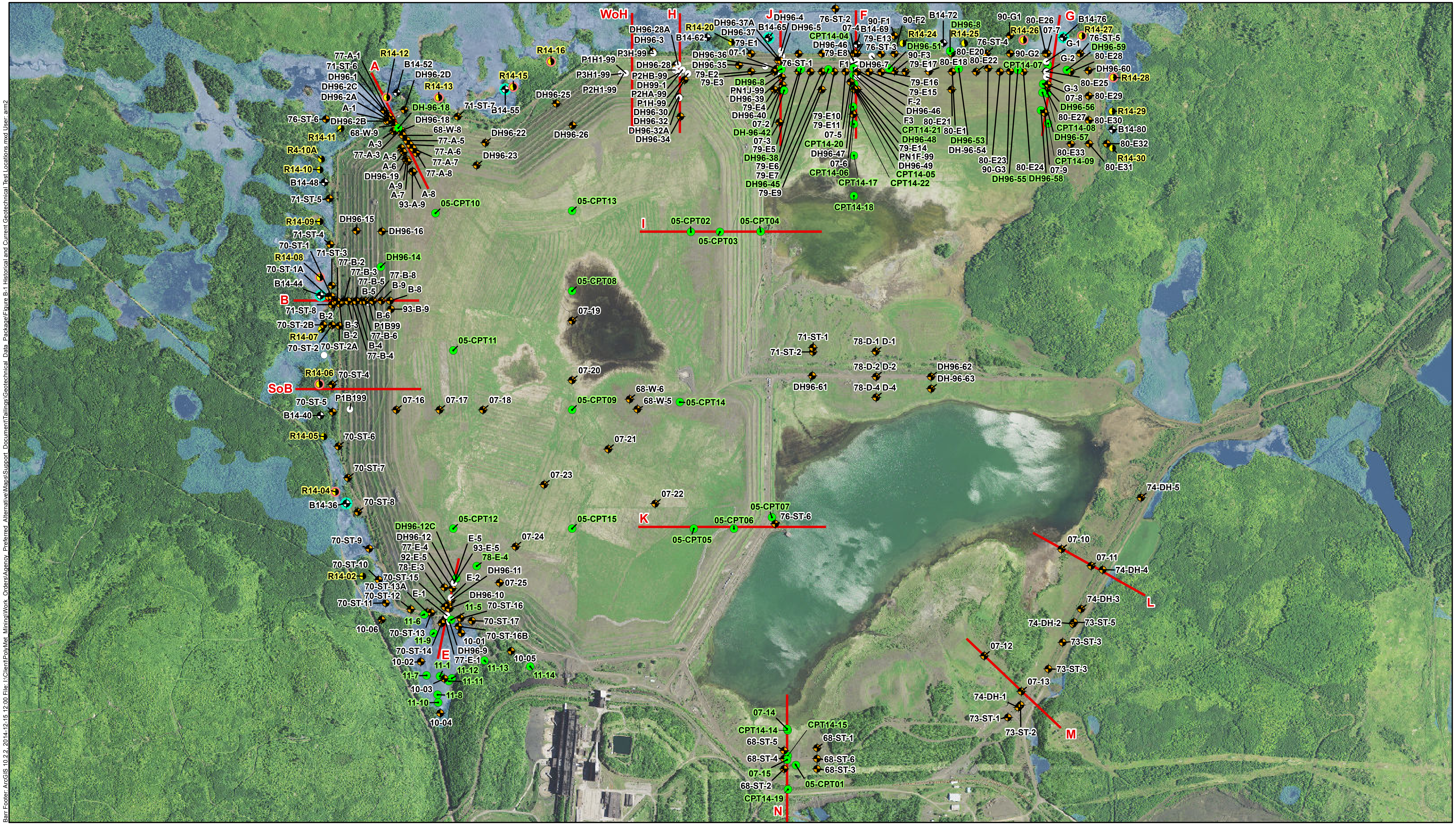
Attachment B

Oversized Figures and Maps

Table B-1
PolyMet Tailings Basin
23/69-862-022A

Summary of seepage and strength parameters used in previous analyses

Reference	Soil	Unit Wt	Drained		Undrained				Perm	Perm
		pcf	c (psf)	φ (deg)	c (psf)	φ (deg)	s_u ratio	s_u residual	cm/sec	ft/sec
Historical Stats										
	CT - high	130	0	41	0	40	0	0	1.00E-02	3.28E-04
	CT - low	125	0	35	0	38	0	0	5.00E-05	1.64E-06
	FT - high	130	0	40	0	40	0.25	0.1	5.00E-04	1.64E-05
	FT - low	120	0	27	0	36	0.25	0.1	1.00E-05	1.64E-07
	Slimes - high	130	0	43	0	34	0.25	0.1	5.00E-05	1.64E-06
	Slimes - low	100	0	28	0	23	0.22	0.1	2.75E-07	9.02E-09
	Peat - high	100	3800	47	1000	20	0.3	0	1.00E-07	3.28E-07
	Peat - low	67	0	7	1000	20	0.3	0	1.00E-07	3.28E-09
	Till - high	132	0	45	0	40	0	0	5.00E-03	1.64E-04
	Till - low	100	0	40	0	40	0	0	4.30E-04	1.41E-08
Barr 2011 Models	LTVSMC Coarse Tailings	135	0	38	0	38	—	--	2.44E-03	8.00E-05
	LTVSMC Fine Tailings	130	0	34	--	--	0.3	0.095	2.00E-04	6.56E-06
	LTVSMC Slimes	120	0	20	--	--	0.155	0.095	9.60E-07	3.15E-08
	LTVSMC fine tailings/slimes	125	0	24	--	--	0.2	0.095	3.05E-06	1.00E-07
	LTVSMC bulk tailings	130	0	33	0	33	--	--	8.02E-05	2.63E-06
	NorthMet Flotation Tailings - 0.45 tsf								1.90E-04	6.23E-06
	NorthMet Flotation Tailings - 1.35 tsf	125	0	19	--	--	0.18	0.1	5.61E-05	1.84E-06
	NorthMet Flotation Tailings - 2.29 tsf								2.00E-05	6.56E-07
	Virgin Peat	70	500	30	550	17	--	--	1.01E-03	3.30E-05
	Compressed Peat	85	500	30	550	17	--	--	3.60E-06	1.18E-07
	Glacial Till	135	0	30	0	30	--	--	5.03E-03	1.65E-04
	Rock Starter Dam	140	0	19	0	19	--	--	1.52	5.00E-02
Barr Letter	PolyMet bulk tailings							0.1	7.2e-5 to 4.8e-4	
Barr 2005 Models	LTV Coarse Tailings	125	0	41				--	5.00E-05	1.64E-06
	LTV Fine Tailings	125	0	28			0.25	0.1	1.00E-05	3.28E-07
	LTV Slimes	112	0	28			0.25	0.1	2.75E-07	9.02E-09
	Peat	--		--				--	1.00E-07	3.28E-09
	Till	--		--			--		4.30E-04	1.41E-05
	PolyMet CT	125	0	30					3.66E-02	1.20E-03
	PolyMet FT	125	0				0.28		6.83E-04	2.24E-05
Barr 2000 Models	Coarse Tailings	130		35						1.64E-06
	Fine Tailings	130		27						3.28E-07
	Slimes	100		--			0.25			9.02E-09
	Peat	100	2000	7			0.30			3.28E-09
	Till	100		45						1.41E-08
Sitka, 1997	CT	130	0	40	0	40	-		1.00E-03	3.28E-05
	FT	130	0	40	0	40	-		1.00E-04	3.28E-06
	Slimes	125	0	38	-	-	0.22		1.00E-05	3.28E-07
	Peat	90	0	40	-	-	0.3		1e-2 to 1e-7	
	Till	130	0	40	0	40	-		1e-2 to 1e-4	
Post-liquefaction										
Unsaturated	*CT*	*130*			-	*40*	-			
	FT	*130*			-	*40*	-			
	Slimes	*125*			-	-	*0.22*			
Saturated	$0<(N_1)_{60}<5$	*130*			*210*	-	-			
	$5<(N_1)_{60}<10$	*130*			*380*	-	-			
	$10<(N_1)_{60}<15$	*130*			*720*	-	-			
	Peat	*90*			-	-	*0.3*			
	Till	*130*			-	*40*	-			
Sitka, 1995	CT	130	0	38	0	38	-			
	FT	130	0	36	0	36	-			
	Slimes	130	0	34	-	-	0.2 to 0.5			
	Peat	75	500	27	-	-	0.2 to 0.6			
	Till	130	0	40	0	40	-			
Barr, 1994	CT	130	0	38	0	38				
	FT	120	0	36	0	36				
	Slimes	128.5	0	34	0	23				
	Peat	75	500	27	1000	20				
	Till	132	0	40	0	40				
Ebasco, 1990	CT	130	0	38						
	FT	120	0	36						
	Slimes	115	0	36						
		116	0	36.5						
	Peat	67	0	32						
			200	21						
			600	47						
			2000	12.5						
			3800	7						
	Till	132	0	40						
	Crushed rock	135	0	42						
Ebasco, 1978	CT	130	0	40	0	40.0			5.00E-03	1.64E-04
	FT	130	0	38	0	38			5.00E-04	1.64E-05
	Slimes	130	0	34	0	30.0			5.00E-05	1.64E-06
	Peat	75	500	27	1000	20			-	
	Till	130	0	40	0	40.0			5.00E-03	1.64E-04
Ebasco, 1977	CT & FT	130	0	40	0	40				
	Slimes	130	0	34	0	30				
			0	43	0	34				



2014 Rotasonic Location
2014 Rotasonic Location with a Piezometer
2014 Boring Locations
2014 Boring Locations with Packer

Historic Test Locations
Other/Unknown
CPT Location
SPT Location
Wetlands

0 1,500 3,000
Feet

Figure B-1
HISTORICAL AND 2014
GEOTECHNICAL TEST LOCATIONS
PolyMet Mining Inc.
Hoyt Lakes, Minnesota

Section F

A B C 0 1 2 3 DATE RELEASED	BARR Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277	Project Office: BARR ENGINEERING CO. 3128 14TH AVENUE EAST HIBBING, MN 55746 Ph: 1-800-225-1966 Fax: (218) 262-3460 www.barr.com	Scale: AS SHOWN; Date: 08/01/2011; Drawn: CAD; Checked; Designed; Approved	POLYMET MINING CORPORATION HOYT LAKES, MINNESOTA	**Figure B-2** Existing Conditions with Field and Laboratory Testing	BARR PROJECT No. 23\69-862; CLIENT PROJECT No.; DWG. No.; REV. No.

Project Office:	BARR ENGINEERING CO. 3128 14TH AVENUE EAST HIBBING, MN 55746 Ph: 1-800-225-1966 Fax: (218) 262-3460 www.barr.com
Corporate Headquarters:	Minneapolis, Minnesota Ph: 1-800-632-2277
Scale	AS SHOWN
Date	08/01/2011
Drawn	CAD
Checked	
Designed	
Approved	

POLYMET MINING CORPORATION
HOYT LAKES, MINNESOTA

Figure B-3
Existing Conditions with Field and Laboratory Testing

BARR PROJECT No. 23\69-862
CLIENT PROJECT No.
DWG. No. REV. No.

B C 0 1 2 3
DATE RELEASED

Section N

Scale	AS SHOWN	POLYMET MINING CORPORATION HOYT LAKES, MINNESOTA	**Figure B-4** Existing Conditions with Field and Laboratory Testing
Date	08/01/2011		BARR PROJECT No. 23\69-862
Drawn	CAD		CLIENT PROJECT No.
Checked			DWG. No. / REV. No.
Designed			
Approved			

BARR
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Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

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DATE RELEASED

Attachment C

Material Strength Characterization

(last updated during preparation of Geotechnical Data Package – Volume 1 – Version 4; retained without further edits for Geotechnical Data Package – Volume 1 – Versions 5 and 6)

NorthMet Project

Geotechnical Data Package – Volume 1 – Version 4
Attachment C – Material Strength Characterization

April 12, 2013

Table of Contents

1.0 Introduction

This document presents material strength data, analyses, and resulting design parameters used as inputs for stability modeling of the Flotation Tailings Basin (FTB) for the Poly Met Mining Inc. (PolyMet) NorthMet Project (Project). The design strength parameters are selected using available field and laboratory data, which includes data collected in the most recent geotechnical investigation, and where available, applicable historical data. Design strength values were determined for peat, glacial till, LTVSMC coarse tailings, LTVSMC fine tailings, LTVSMC slimes, LTVSMC bulk tailings and Flotation Tailings. These strength values were then used as inputs to the overall assessment of slope stability of FTB Cross-Section F. Results of the Cross-Section F slope stability analysis are presented in Geotechnical Data Package – Volume 1 – Version 4.

The approach used to select design parameters has evolved over the four versions of this document. A brief summary of this evolution is presented in Table 1-1. The current approach retains the basic analysis methods for drained and undrained strengths used in Geotechnical Data Package – Volume 1 – Version 3 (Version 3), but updates the approach for selecting the design parameters for liquefied strengths.

Liquefied strength analyses have been updated for Geotechnical Data Package – Volume 1 – Version 4 (Reference (1)), based on guidance from Mr. Richard Davidson and Dr. Scott Olson. The updated methods reflect agreements reached at the geotechnical workshop held on February 25-26, 2013 attended by the Minnesota Department of Natural Resources (MDNR), Knight Peisold, Environmental Resources Management (ERM), PolyMet, Barr Engineering Co. (Barr), Mr. Richard Davidson, and Dr. Scott Olson (Reference (2)). Mr. Davidson is a consultant employed by URS. Dr. Olson is a recognized expert in the fields of static and seismic slope stability and liquefaction engineering and has published over 85 peer-reviewed journal articles and conference papers on related topics. Some professional judgment is still required to account for potential data gaps, but the guidance provided by Dr. Olson and Mr. Davidson serves as a basis for the analysis and material strength design values presented in Version 4.

Mr. Davidson independently reviewed the methodology used in Version 3, and provided guidance on selection and analysis of data to determine liquefied strengths. Mr. Davidson suggested that CPT data be used to identify LTVSMC fine tailings/slimes zones (consistent with the approach previously used by Barr). Barr used the characteristic signatures of LTVSMC fine tailings/slimes within each CPT sounding to identify the depths and thicknesses of LTVSMC fine tailings/slimes zones at each sounding location.

Where liquefied strengths ($USSR_{liq}$) are required in the stability analysis, Mr. Davidson and Dr. Olson recommended use of the average liquefied shear strengths. This recommendation is based on the conservative nature of the material strength data on which the corresponding stability analysis is based (the lowest material strength condition anticipated; the liquefied strength) and based on the factor of safety requirements set in the Work Plan (Attachment A of Reference (1)). Liquefied strength values, based on field data and laboratory testing, were then assigned to these zones in the model. The procedure and results are presented in Section 5.0.

This version of Attachment C includes changes due to data screening to remove outliers and confirm inclusion of only contractive test results for estimation of liquefied strengths; incorporation of professional judgment in selection of design parameters in lieu of a strictly statistical approach; and updates to analytical methods in response to input provided by Dr. Olson and Mr. Davidson. These updates result in some changes in test-counts, data-counts and shear strengths from previous versions of Attachment C.

Table 1-1 Summary of Previous Attachment C Versions

Version	Date	Description
1		Documented data used to select material strengths
2	August 2012	Attachment C (formerly Attachment E in Version 2) included: 1) significant addition of detail describing material design parameter selection; 2) use of statistical approach for design parameter selection
3	November 2012	Incorporated guidance of Dr. Scott Olson on: 1) weighting of field and laboratory data in selection of design strengths; 2) use of 33% value for design parameters

(1) For more detail on earlier versions, see Section 1 of Attachment C of Geotechnical Data Package – Volume 1 – Version 3

In this document coarse tailings are LTVSMC coarse tailings, fine tailings are LTVSMC fine tailings, slimes are LTVSMC slimes, and Flotation Tailings are the NorthMet bulk flotation tailings. The Tailings Basin is the existing former LTVSMC tailings basin and the Flotation Tailings Basin (FTB), refers to the Tailings Basin with the Flotation Tailings impounded atop it.

The outline of this document is:

Section 2.0 Discussion of the data analysis performed for the various materials.

Section 3.0 Discussion of the drained shear strength (ϕ', c') for each material.

Section 4.0 Discussion of the undrained shear strength ($USSR_{yield}$, ϕ_{cu}, c_u) for each material.

Section 5.0 Discussion of the liquefied shear strength ($USSR_{liq}$) for contractive materials.

Section 0 Summary of selected design values for all material properties.

2.0 Data Analysis Methodology

To document the data and methods used in material strength analyses, this section:

- gives an overview of drained, undrained and liquefied conditions
- presents the available geotechnical data
- describes the screening procedures to select which data to include in material strength calculations
- details the analytical methods used to interpret each type of laboratory and field data
- documents the approach used to integrate laboratory and field results into a design value for use in stability modeling

2.1 Overview of Drained, Undrained and Liquefied Conditions

2.1.1 Drained Conditions

If shear stress is applied to a soil at such a rate and/or the drainage conditions are such that excess pore water pressure is zero when failure occurs, failure is said to occur under drained conditions, or the drained shear strength of the soil has been mobilized. This case is typically applied to long-term, steady-state seepage conditions, when any excess pore water pressures generated due to loading have dissipated. The drained condition also applies to granular materials for short-term conditions. When such materials have a high enough permeability, any excess pore water pressure is nearly immediately dissipated. The drained strength is most often described in terms of a failure envelope. The failure envelope may be linear, using the Mohr-Coulomb model to provide a drained friction angle (ϕ') or it may be represented as a non-linear failure envelope.

2.1.2 Undrained Conditions

If shear stress is applied to a soil quickly and/or if the drainage conditions are such that no shear-induced pore water pressure can dissipate when failure occurs, failure is said to occur in an undrained condition, or the undrained shear strength of the sample has been mobilized. The undrained shear strength is typically applied to short-term conditions for saturated soils, for example during or immediately after construction when construction proceeds at a fast enough rate that excess pore water pressure develops. Failure in undrained conditions may also occur for permeable, granular soils during seismic events or other events where shearing occurs so quickly that shear-induced excess pore water pressures cannot dissipate. It has been observed in soft soils that the undrained yield strength is often a function of consolidation stress. When the undrained yield strength increases linearly with pressure, the Undrained Shear Strength Ratio ($USSR_{yield}$) is generally preferred to model the material strength. The $USSR_{yield}$ is defined as the ratio of the undrained shear strength, $s_{u(yield)}$, divided by the effective overburden stress, σ'_{vo}.

2.1.3 Liquefied Conditions

It is anticipated that most of the time, loading or change in loading within the LTVSMC tailings and Flotation Tailings at the FTB will be slow enough for the LTVSMC tailings and Flotation Tailings to be sheared under drained conditions. However, there are circumstances in the field during which rapid changes in load and/or local stress may occur, that can lead to undrained loading. As a result, liquefaction potential needs to be evaluated. Liquefaction has been observed in saturated mine tailings, which are hydraulically deposited and often exhibit contractive response (Reference (3)). Therefore the state of the LTVSMC tailings and Flotation Tailings and their potential to liquefy should be analyzed.

The state of a soil dictates how a soil will respond to undrained loading. If the soil is in a compacted or dense state, it will exhibit dilative behavior and the particles will have to roll over each other thereby increasing the volume of the soil mass when sheared. If drainage is not permitted, negative porewater pressures will develop. A contractive soil is in a loose state, and when loaded and sheared, the particles will compress and become more compacted, decreasing the volume of the soil mass. If drainage is not permitted, positive porewater pressures will develop. Flow liquefaction can only be triggered in contractive soils.

To assess whether the soil at a given test location will behave in a contractive or dilative manner, the method advocated by Fear and Robertson (Reference (4)) was utilized. Olson and Stark (Reference (5)) converted the shear wave velocity-based contractive-dilative boundaries (Reference (4)) to boundaries based on overburden stress-normalized Standard Penetration Tests (SPT) blow count and Cone Penetration Test (CPT) tip resistance. In this method, as subsequently described, SPT and CPTu data are analyzed to determine whether the soil will behave in a contractive or dilative manner when sheared in undrained conditions.

When testing a typical loose soil in triaxial compression under undrained conditions, as shown in Figure 2-1, the stress-strain curve reaches a peak stress known as the yield point. Quasi-steady state (QSS) behavior occurs when soils exhibit a limited strain-softening response followed by strain-hardening (Reference (5)), also shown in Figure 2-1. This behavior is considered a temporary condition, where the sample moves from contractive to dilative behavior (Reference (6)). The initial peak observed relates to the yield shear strength or peak shear strength despite the strain-hardening observed with quasi-steady state behavior. Bobei et al. (Reference (7)) refer to anything following the initial peak as post-peak behavior. According to Robertson et al. (Reference (8)), the quasi-steady state is associated with limited strain-softening because the sample reaches peak strength and then strain softens to a QSS or minimum strength during which a certain amount of strain occurs. However, the sample then strain hardens to its ultimate state (although this commonly occurs at strains larger than can be achieved in conventional laboratory tests). For selection of material strength parameters for use in FTB stability analysis, any material strength tests that exhibited an unintended result (e.g., strain-hardening rather than anticipated strain-softening or flow response) were not used.

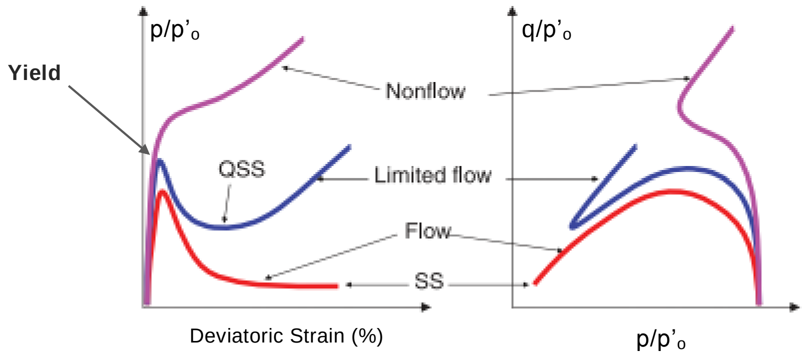

Figure 2-1 Steady state and quasi-steady state behavior (Reference (7))

The liquefied condition is a special case within the undrained condition where a contractive soil is sheared beyond the yield strength to a minimum shear stress known as the liquefied strength. The liquefied shear strength is the shear strength mobilized at large deformation by a saturated contractive soil following the triggering of a strain-softening response. The terms "steady state" (SS) or "residual" are also used to describe this case. This strength reduction can be induced in the laboratory with either cyclic triaxial (followed by monotonic loading) or undrained monotonic triaxial testing. However, preparing a contractive specimen is challenging for some soils. Many triaxial tests must be conducted to obtain one that is contractive.

The liquefied strength has also been correlated to various field data. The liquefied shear strength is presented herein either in terms of undrained shear strength or when appropriate as a function of overburden ($USSR_{liq}$). The $USSR_{liq}$ is defined as the ratio of the liquefied undrained shear strength, $s_{u(liq)}$, divided by the effective overburden stress, σ'_{vo}.

2.2 Available Geotechnical Data

Multiple testing programs have been performed throughout the history of the Tailings Basin. For details see Sections 4.1 and 4.2 of the Geotechnical Data Package – Volume 1 Version 4. The geotechnical data available for material strength analyses are summarized in Table 2-1.

Table 2-1 Data Analyzed from Geotechnical Investigations

Geotechnical Investigation Program	Laboratory Testing		Field Testing		
	DS(1)	TX(1)	SPT(1)	CPT(1)	FVST(1)
1968 Soil Engineering Services, Inc.			X		
1970 Ebasco Services		X			
1976 Braun Engineering	X				
1977 Ebasco Services	X	X			X
1978 Ebasco Services		X			
1979 Braun Engineering	X	X			
1980 Ebasco Services	X	X			
1986 MNDNR		X			
1990 Ebasco Services	X	X	X		
1994 SET#1840		X			
1996 Sitka Corp.		X	X		
1997 Sitka Corp.	X	X			
1999 Barr SPT Investigation			X		X
2000 SET#3697		X			
2005 ConeTec Investigation				X	
2005 SET#5435		X			
2007 AET Investigation			X	X	X
2007 SET#6250		X			
2007 SET#6251		X			
2008 SET#6428		X			
2008 SET#6449		X			
2009 SET#6867		X			

(1) DS = Direct Shear Test, TX = Triaxial Test, SPT = Standard Penetration Test, CPT = Cone Penetration Test, FVST = Field Vane Shear Test

2.3 Geotechnical Data Screening

Data selection depends on the type of strength being evaluated: drained, undrained, or liquefied. For drained shear strengths, results of field and laboratory tests on both dilative and contractive specimens were used.

For undrained strength estimates, results of field and laboratory tests were used. Undrained shear strengths were calculated using mostly data from contractive specimens. Because it is quite difficult to prepare all laboratory specimens to be contractive, some percentage of tests inevitably will be dilative, but some material strengths can be derived from these tests.

Liquefied strength estimates include only the laboratory test results for samples that contracted or exhibited quasi-steady state behavior during shear. Field testing (e.g., CPT and SPT) results were used to determine the location and depths of potentially contractive layers, and data (CPT, SPT and FVST) from those layers was then also used in liquefied strength calculations. Only the contractive data from SPT and CPT samples and residual strengths from FVST were used in determination of material liquefied strengths.

2.4 Laboratory Data Analysis

This section addresses the evaluation and interpretation of material strength data collected through laboratory testing. Laboratory strength testing that has been performed includes direct shear and triaxial testing.

2.4.1 Direct Shear

For direct shear test results, the ultimate stress measured in the test was used to determine the drained strength of the material. The results for the direct shear tests were plotted as shear stress versus normal effective stress to provide a drained friction angle for each appropriate material type. The drained shear strengths from direct shear tests were also plotted with triaxial test results, when possible.

2.4.2 Triaxial Shear Test

Triaxial shear testing includes isotropically-consolidated undrained (CIU) testing and consolidated-drained (CD) testing. CD triaxial testing is performed under drained conditions. The test is run at a slow enough shearing rate so that no excess pore water pressure is generated during the test. CIU triaxial testing is performed under undrained conditions. Pore water pressure must be monitored throughout the test. The pore water pressure, strain, and stress measured throughout the test can be processed to provide both drained and undrained strengths of materials. If the test is sheared to sufficient displacement and the specimen exhibits contractive behavior, the liquefied shear strength may be determined as well.

The pore water pressure was monitored throughout newer CIU tests, such that those data could be processed to determine the drained, undrained, and liquefied shear strength values.

Older CIU tests from historical investigations may not have had all pore water pressure data provided and therefore older CIU data were not always used to derive strength values.

Some tested specimens were undisturbed, while others were reconstituted in the laboratory. The reconstituted specimens in particular were used to determine the undrained shear strength parameters, especially for the liquefied strength case. Large strain failure criterion were used for determination of drained strength. This was selected to ensure that the drained strength was being determined along the failure plane identified in p-q space. The maximum deviatoric stress condition was used as the failure criterion to determine the failure envelope for undrained conditions. The shear stress at the initial yield point was used for samples exhibiting contractive QSS behavior. The minimum shear stress following the initial yield point for QSS samples or the residual stress for contractive samples was used to determine the liquefied shear strength.

The drained strength was determined from the CD triaxial tests and the applicable CIU triaxial tests. The results for these tests were processed and plotted as the shear stress versus the normal effective stress to provide a drained friction angle for each material type tested.

Undrained shear strength was determined from CIU tests. The results were plotted as the undrained shear strength versus the effective consolidation stress to provide an undrained shear strength ratio ($USSR_{yield}$) or a failure envelope, if appropriate.

Liquefied undrained shear strength ($USSR_{liq}$) was calculated from the tests that sheared sufficiently past the yield point and exhibiting steady state (SS) or quasi-steady state behavior. Results were plotted as the undrained shear strength versus the effective normal stress to provide a liquefied undrained shear strength ratio ($USSR_{liq}$).

2.5 Field Data Analysis

This section addresses the evaluation and interpretation of different data collected through field testing. Field strength testing performed includes SPT, CPT, and Field Vane Shear Tests (FVST).

The field data in combination with laboratory data (as described in Sections 1.0 and 2.6), were used to estimate drained, undrained, and liquefied strengths. In-situ SPT and CPT strength correlations are independent of drainage conditions during penetration. When determining the liquefied strengths, correlations were used to filter out data for materials that are expected to exhibit a dilative response during shearing, as described in Section 2.1.3.

2.5.1 Standard Penetration Test

The SPT data were compiled, corrected using industry standard procedures, and correlated to shear strengths, as appropriate.

The concept showing the relationship between "standard" blow counts and soil properties was introduced by Skempton (Reference (9)). Blow counts obtained in the field are typically corrected based on overburden pressure and energy. For liquefaction potential evaluation, the raw SPT blow counts (N) must be corrected to $(N_1)_{60}$-values. A number of site-specific factors are taken into account to improve repeatability. This is represented in the following equation:

$$N_{60} = E_m C_B C_S C_R N / 0.60$$

Where:

E_m = hammer efficiency
C_B = borehole diameter correction
C_S = sample barrel correction
C_R = rod length correction
N = raw SPT N-value recorded in the field, blows per foot

A correction was lacking in situations where samples were taken near the bottom of uniform soil deposits, thus exhibiting higher blow counts due to stiffer material below. The overburden correction was then termed $(N_1)_{60}$ and N_{60} is corrected using vertical effective stress, using the following equation:

$$(N_1)_{60} = N_{60} \text{ SQRT}(2000 \text{ psf} / \sigma_v')$$

2.5.1.1 Drained Shear Strength

Schmertmann's (Reference (10)) drained friction angle is calculated from N_{60} values and effective overburden stress. This calculation applies to non-plastic or coarse-grained materials as:

$$\phi' = \tan^{-1}(N_{60}/(12.2+20.3*\sigma'_{vo}))^{0.34}$$

2.5.1.2 Undrained Shear Strength

Olson and Stark's yield strength ratio analysis (Reference (11)) is a procedure that chiefly applies to non-plastic and low-plasticity materials. The undrained shear strength ratio was calculated for $(N_1)_{60}$ less than and equal to 12 blows per foot (BPF) as:

$$USSR_{yield} = 0.205 + 0.0075[(N_1)_{60}]$$

SPT tests with $(N_1)_{60}$ greater than 12 BPF generally are dilative. These soils were filtered out and not assigned an $USSR_{yield}$ value. This equation provides a lower-bound of 0.205 and an upper-bound of 0.295.

2.5.1.3 Liquefied Shear Strength

Fear and Robertson (Reference (4)) presented a relationship to assess the tendency for clean Ottawa sand to contract or dilate, based on overburden stress-normalized shear wave velocity and effective vertical stress. Olson and Stark (Reference (5)) converted this relationship to SPT and CPT-based contractive-dilative boundaries, and found that the converted Ottawa sand boundaries enveloped available liquefaction flow failure case histories. This relationship has been updated to account for the compressibility of the soil (Reference (12)).

With SPT data, corrected blow counts ($(N_1)_{60}$) are plotted against overburden pressure with the updated boundary from Olson (Reference (12)) dividing contractive and dilative behavior. Data points plotting below or to the left of the boundary are considered contractive and those values plotted above or to the right of the boundary are considered dilative.

Olson and Stark's liquefied strength ratio analysis (Reference (13)) applies to contractive soils. For the contractive points plotting below or to the left of the converted Fear and Robertson (Reference (4)) boundary as amended by Olson (Reference (12)) for medium compressible soils, the liquefied undrained shear strength ratio was calculated for $(N_1)_{60} \leq 12$ BPF as:

$$USSR_{liq} = 0.03 + 0.0075[(N_1)_{60}]$$

This equation provides a lower-bound of 0.03 and an upper-bound of 0.12. SPT tests with $(N_1)_{60}$ greater than 12 BPF generally are dilative. These soils were filtered out and not assigned an $USSR_{liq}$ value.

2.5.1.4 SPT Data Reporting

For the drained case, the data are generally presented as a friction angle.. For the undrained case, the data are plotted as the *USSR* value (yield or liquefied) versus effective overburden stress.

2.5.2 Cone Penetration Test

Cone Penetration Testing with pore water pressure measurement (CPTu) was performed in the Tailings Basin in 1996, 2005, and 2007. Zones of materials were identified by visual observations made during SPT sampling and logging and by relating measured CPT tip and sleeve resistance to density and soil behavior and analyzing them against the corresponding soil boring data. Data from zones where the material type was verified by visual observation were isolated to determine the shear strength envelopes for different material types.

The field cone penetration resistance measured at the tip is q_c for fine-grained soils, which may also be converted to a total cone resistance, q_t, by:

$$q_t = q_c + (1 - a)u$$

Where:

a = unequal end area ratio of the cone
u = pore water pressure measured between the tip and the friction sleeve

The total cone resistance is corrected to a standard effective overburden pressure of one atmosphere (p_a, typically 1 tsf) by:

$$q_{t1} = q_t \left(\frac{p_a}{\sigma'_{vo}}\right)^{0.5}$$

2.5.2.1 Drained Shear Strength

Robertson and Campanella (Reference (14)) proposed an empirical relationship to evaluate the drained shear strength of uncemented sands based on tip resistance. This method presents boundaries for drained friction angle values (ϕ') ranging from 28 to 48 degrees on a plot of measured tip resistance (q_c) against vertical effective stress (σ'_{vo}). The method applies to granular normally-consolidated soils only.

2.5.2.2 Undrained Shear Strength

The CPT data were analyzed to estimate an undrained shear strength ratio ($USSR_{yield}$). Undrained response was somewhat difficult to verify with the 2005 and 2007 data, as the Tailings Basin had been undergoing natural drainage and desaturation since operations ceased in 2001 and perched water conditions appear to have existed in some shallower, finer layers when the most recent investigations were performed.

$USSR_{yield}$ was determined using Olson's Method, developed by Olson and Stark (Reference (5)), which uses the corrected cone penetration tip resistance (q_{c1}) for q_{c1} values less than 6.5 MPa. Olson (Reference (12)) recommends that q_{c1} should be replaced by q_{t1} where pore pressure develops within the materials during penetration (Reference (5)). The $USSR_{yield}$ is calculated as:

$$USSR_{yield} = \frac{s_u}{\sigma'_{vo}} = 0.205 + 0.0143(q_{t1})$$

2.5.2.3 Liquefied Shear Strength

The liquefied strength calculation for each material type uses only data from points that exhibited contractive behavior. With CPT data, the corrected tip resistance (q_{c1}) is plotted against overburden pressure, with a boundary converted from the Fear and Robertson correlation (Reference (4)) dividing contractive and dilative behavior. Olson (Reference (12)) developed an approach to incorporate soil compressibility into the CPT-based contractive-dilative boundary. For the Tailings Basin materials, the medium soil compressibility boundary was used (Reference (12)); values plotting below the boundary are contractive and those values plotted above the boundary are dilative.

The liquefied undrained shear strength ratio ($USSR_{liq}$) was determined by analyzing the CPT data using a correlation initially developed by Olson and Stark (Reference (11)) and herein being referred to as the Olson Method. The relationship was developed based on back analysis of data from case histories of failed slopes comprised of sands, silty sands, and tailings. Olson (Reference (12)) has updated the correlation such that it utilizes the corrected tip resistance, q_{t1}, rather than q_{c1} as was originally proposed by Olson and Stark (Reference (11)). The Olson method filters out data from materials that should not be characterized with a $USSR_{liq}$, specifying that the calculation should include only data from soils that are classified as contractive using the Olson contractive/dilative screening criteria (Reference (12)) which corresponds to a tip resistance of about 6.5 MPa for many sites. The $USSR_{liq}$ is calculated as:

$$USSR_{liq} = \frac{s_{u(liq)}}{\sigma'_{vo}} = 0.03 + 0.0143(q_{t1}) \pm 0.03$$

2.5.2.4 CPT Data Reporting

For the drained friction angle, measured tip resistance (q_c) was plotted against vertical effective stress (σ'_{vo}) and strength values were assigned based on Robertson and Campanella's boundaries (Reference (14)).

Similar to SPT data, the CPT data processed with both methods for undrained shear strength were plotted as the *USSR* values versus depth. Because of the nearly continuous data recording, however, thousands of data points (an average every two centimeters) were analyzed and these plots can become difficult to read. Cumulative normalized frequency plots and plots of the undrained shear strength versus the overburden pressure were prepared to further clarify natural variations.

2.5.3 Field Vane Shear Test

Three field investigations to obtain FVST data were performed; one in 1977 by Ebasco Services (Reference (15)), one in 1999 by Barr (Reference (16)), and one in 2007 by AET under Barr's supervision, provided in Attachment E of Reference (1).

For the 2007 investigation, FVST was conducted adjacent to locations where stratigraphy was determined on a near continuous basis using CPT. Stratigraphy was confirmed at a number of these locations using SPT and laboratory testing. Zones of interest for FVST were identified using the CPT logs; focusing on zones where low tip resistances and positive pore pressure response were reported during advancement of the cone, indicating loose or soft conditions. Once zones of interest were defined in the CPT logs, an adjacent borehole (approximately 10 feet away) was advanced and FVST was conducted at the depths of interest. Availability of CPT and SPT data supports the interpretation of FVST results.

The testing program addressed possible mechanical compaction of sediments during original dam construction by (1) sampling at distances typically hundreds of feet from perimeter dams, and (2) testing only the layers of LTVSMC fine tailings and slimes; materials which were least subject to compaction. The testing locations from the 2007 investigation are located in Cells 1E and 2E. Six of the eight locations were tested within the basin at 07-02, 07-03, 07-06, 07-08, 07-09 and 07-10. One of the tests was performed below the crest of the basin dam at 07-15, and one of the test locations was near the toe of the basin at 07-07C. The intent of the FVST was to test zones with low tip resistance indicating weaker layers within the basin. Based on the SPT logs the materials tested using the vane shear apparatus are fine tailings and slimes. Due to their position inside the perimeter of the dams, fine tailings and slimes were not intentionally compacted during Tailings Basin development.

In-situ FVST were performed in general accordance with ASTM D2753, however for the 2007 geotechnical investigation the FVST method was modified as a means to measure undrained shear strength. Results of the 1977 Ebasco (Reference (15)) and 1999 Barr (Reference (16)) FVST tests suggest that those tests may not have measured undrained conditions. This conclusion is based on the time factor (T_v) calculated for each field vane test performed. T_v values of less than approximately 0.04 indicate undrained conditions, and the T_v values calculated for the earlier FVST tests were in the range of 0.0487 to 0.3574.

Time factor (T_v) values were calculated using the rate of vane rotation recorded during acquisition of the raw field data, the diameter of the vane, and c_v, the average coefficient of vertical consolidation determined from laboratory consolidation data, using the following relationship (Reference (17)):

$$T_v = \frac{c_v t_f}{d^2}$$

where:

T_v = dimensionless time factor (≤ 0.02 to 0.04 for undrained conditions)
t_f = time to failure in seconds, calculated from vane rotation rate
d = vane diameter

To increase the likelihood of inducing undrained conditions, the 2007 investigation increased the rotational shear rate to minimize pore water pressure dissipation. The modified FVST method involved increasing the rate of shear from the standard rate of approximately 0.1 degrees/sec to rates that ranged from 2.6 to over 58 degrees per second. FVST performed following ASTM D2753 “Standard Test Method for Field Vane Shear Test in Cohesive Soil typically rotate a hand crank at a specified rate to shear the soils around the vane location (). Normal rates of shear for the vane apparatus are on the order of 0.1 degrees/sec or two to five minutes to failure which is consistent with test procedures designed for clays soils. For this project the FVST equipment was modified to obtain the highest rate of shear possible, within the confines of the equipment capabilities. The equipment was modified by removing the hand crank handle on the drive unit and mounting a motor to the shearing device. At each location, the rotational shear rate was increased from the standard 0.1 degrees per second to a location-specific rate calculated to induce undrained conditions.

The rotational rate needed to induce undrained conditions was calculated based on results of CPT dissipation testing and laboratory consolidation testing. Dissipation test results were used to calculate the time to 50% consolidation, t_{50} (Section 4.3.2 and Large Figure 2 of Reference (1)). Values of t_{50}, in the range of about 8.4 to 170 seconds (0.14 to 2.83 minutes) were calculated for the FVST locations. Laboratory consolidation test data indicated that the coefficient of consolidation is in the range of 540 to 30,000 cm^2/second. Coefficient of consolidation and t_{50} values were interpreted using guidelines from Blight (Reference (17)) and Morris and Williams (Reference (18)) to evaluate the pore pressure dissipation and the time to failure to achieve undrained behavior. The estimated time to failure value for each location determined the appropriate FVST rotational rate.

Tests were typically continued through yield response so residual strength was recorded. A summary table of all FVST data is provided as Table 2-2. Table 2-2 includes FVST data gathered for Barr by AET in 2007 using the modified testing method, and data gathered in previous field investigations ((Reference (15)) and (Reference (16)). Only the 2007 data is used for the material strength analysis, as the high time factor values associated with the data from the previous investigations indicate that the tests were not performed in undrained conditions.

Table 2-2 Summary Table of Available Field Vane Shear Test Data

Location	Depth (ft.)	Material	Yield s_u (psf)	Remolded s_u (psf)	Rate (deg/sec)	Average T_v
07-10	17.7	fine tailings	1200	427	52.6	0.0006
07-10	26.8	fine tailings	1310	409	51.6	0.0006
07-10	39.6	fine tailings	1620	360	44.1	0.0012
07-02 (1)	61.7	fine tailings/slimes	1390	--	3.1	0.0164
07-08 (1)	67.5	fine tailings/slimes	2380	950	54.4	0.0009
07-03 (1)	24.8	slimes	1050	152	3.1	0.0105
07-03 (1)	25.2	slimes	670	140	40.3	0.0006
07-03 (1)	35.1	slimes	540	160	3.1	0.0062

Location	Depth (ft.)	Material	Yield s_u (psf)	Remolded s_u (psf)	Rate (deg/sec)	Average T_v
07-06 (1)	23.5	slimes	110	90	3.0	0.0031
07-06 (1)	24.5	slimes	500	120	44.0	0.0003
07-06 (1)	31.6	slimes	340	160	3.1	0.0074
07-06 (1)	32.6	slimes	1140	345	12.3	0.0025
07-07C (1)	50.7	slimes	1720	708	27.9	0.0019
07-09 (1)	30	slimes	950	240	47.8	0.0006
07-09 (1)	30.8	slimes	1050	420	49.6	0.0006
07-09 (1)	36.3	slimes	1010	540	48.3	0.0006
07-15 (1)	37.2	slimes	1120	254	58.1	0.0009
07-15 (1)	37.9	slimes	940		2.6	0.0121
07-15 (1)	38.6	slimes	1120		3.1	0.0093
07-15	36.2	slimes	810		-	-
07-07C	52.2	fine tailings	3940		50.5	0.0016
07-08	66.8	fine tailings/slimes	3940		41.9	0.0016
07-07C	51.4	slimes	2160		45.4	0.0016
07-12	43	fine tailings	1490	692	44.5	0.0009
Ebasco A-5	107.5	slimes	2250	900	0.1	0.1527
Ebasco A-5	109	slimes	5600		0.1	0.3574
Ebasco A-5	119.5	slimes	2300	1400	0.1	0.1462
Ebasco A-5	121	slimes	2900	2000	0.1	0.1949
Ebasco A-8	50	slimes	1100	400	0.1	0.0487
Ebasco A-8	51.5	slimes	1400	900	0.1	0.0650
Ebasco A-8	55	slimes	3400	1400	0.1	0.0975
Ebasco A-8	56.5	slimes	2400	2200	0.1	0.0650
Ebasco A-8	60	slimes	2700	1500	0.1	0.1300
Ebasco A-8	61.5	slimes	2600	1900	0.1	0.0585
Ebasco A-8	65	slimes	1200	800	0.1	0.0812
Ebasco A-8	66.5	slimes	3900		0.1	0.2425
Ebasco A-8	70	slimes	1200	900	0.1	0.0650
Ebasco A-8	71.5	slimes	1950	1550	0.1	0.0650
Ebasco A-8	75	slimes	2200	1800	0.1	0.1455

Location	Depth (ft.)	Material	Yield s_u (psf)	Remolded s_u (psf)	Rate (deg/sec)	Average T_v
Ebasco A-8	76.5	slimes	3600	3000	0.1	0.0812
Ebasco A-8	80	slimes	2700	1600	0.1	0.0975
Ebasco A-8	81.5	-				-
Ebasco A-8	90	slimes	2800	1900	0.1	0.0812
Ebasco A-8	91.5	slimes	3700	2400	0.1	0.0650
Ebasco A-8	95	slimes	1950	1200	0.1	0.0975
Ebasco A-8	96	slimes	3400	2500	0.1	0.0812
Ebasco A-8	100	slimes	2200	1300	0.1	0.1218
Ebasco A-8	101	slimes	3500	2200	0.1	0.0812
I1-99	89.5	slimes	330	-	0.1	-
P1H-99	75	slimes	700	-	0.1	-
P2H-99	65.9	slimes	1700	550	0.1	-
PH1-99	89	slimes	2387	2011	0.1	-

(1) Denotes field vane test results that were used for strength analysis

The increased strain rate associated with the faster rotational rates has been shown to not adversely affect FVST results for the types of materials present at the site. Numerous studies show that material strengths are not strain-rate dependent for non-plastic, coarser grained soils. (e.g., Novasad 1964 (Reference (19)); Schimming et.al. 1966 (Reference (20)); Scarlett and Todd 1969 (Reference); Savage 1982 (Reference (21)); Hungr and Morgenstern 1984 (Reference (22)); Lemos 1986 (Reference (23)); Vaid and Negussy 1988 (Reference (24); Sassa 1984, 1985, 2000 (References (25) (26) (27)); Fukuoka 1991 (Reference (28)); Tika et.al. 1996 (Reference (29); Infante-Sednao 1998 (Reference (30)); Sandrekarimi and Olson 2009 (Reference (31)). In contrast, plastic soils have shown increases in peak shear resistance of about 5 to 15% for every order of magnitude increase in strain rate (Lefebrve et.al.(Reference (32); Terzaghi et.al. (Reference (33)). Idriss and Boulanger (Reference (34)) suggest that soils with a Plasticity Index (PI) <7 generally exhibit sand-like shear behavior, so would not be strain-rate dependent. The PI of the LTVSMC tailings is generally about 2 to 7, so most of the LTVSMC tailings should exhibit sand-like behavior and show no strain-rate dependent strength increase. The strength values calculated using the data from the 2007 FVST tests conducted using increased rotation rates should therefore accurately represent the strengths of the materials tested.

The 2007 FVST results were used to estimate the in-situ undrained yield and remolded or liquefied shear strength ratios for LTVSMC fine tailings and slimes. Results from tests on material classified as LTVSMC fine tailings (third column in Table 2-2) were used with other test data described herein to determine the LTVSMC fine tailings strengths and results from tests on material classified as LTVSMC slimes was used with other test data described herein to determine the strength of LTVSMC slimes. To determine the combined LTVSMC fine tailings/slimes strength, results from tests on all material identified as LTVSMC slimes, LTVSMC fine tailings, and LTVSMC fine tailings/slimes were used. To determine undrained and liquefied undrained shear strength ratios from the field vane tests, the yield and residual strengths were divided by the effective overburden pressure (determined assuming a saturated unit weight specific to each material and assumed water depths based on CPT data). To provide corresponding undrained shear strength ratios (*USSR*) the results were plotted as the undrained shear strengths versus the effective vertical stresses.

2.6 Design Strengths

The drained, undrained yield, and liquefied shear strengths determined by each of the laboratory and field testing methods were integrated to determine design strengths for each material type.

The method used to select design parameters is based on Barr's experience and guidance from Mr. Richard Davidson and Dr. Scott Olson, as described in Section 1.0. The consistent methodology for selection of design material strength parameters developed in consultation with Dr. Olson is detailed in Attachment D. This technique for selection of material strength parameters provides a systematic approach that is not reliant on statistical analysis of data sets that often are difficult to fit to typical data distributions (i.e., normal distribution, log normal distribution, generalized extreme distribution, and possibly others). Design values were selected as follows:

- Both laboratory data and field data are included in the analysis.

- Material liquefied strength analyses include only the laboratory and field test results for samples that contracted or presented quasi-steady state behavior during shear. These samples, which exhibit strain-softening behavior, are a subset of the full sample set. Results for samples that dilated during shear (strain-hardening behavior) are not included in material liquefied strength analyses. The effect of this approach is that the calculation is conservative because it discounts stronger materials that are present in the tailings.

- Laboratory testing, particularly of man-made materials, is included because it has long provided reliable estimates of shear strength. While laboratory depositional techniques often cannot mimic natural (geomorphic) depositional conditions, they can reasonably reproduce artificial deposition procedures. Laboratory methods of reconstituting specimens can be tailored to mimic artificial deposition procedures used in the field such as deposition from a spigot. Furthermore, the mode of shear and stress conditions can be carefully-controlled in the laboratory and tailored to mimic particular failure mechanisms. Careful sample preparations and controlled testing conditions can measure yield and liquefied strengths when contractive specimens are obtained. However the method of loose sample preparation to replicate contractive conditions is very difficult (in Barr's experience usually only one of eight tests are successful). Third, and most importantly, laboratory testing can be performed on site-specific materials.

- In-situ SPT and CPT testing, which use empirical correlations, is used and is important on two levels. First, in-situ penetration resistance testing provides a measure of the actual soil state (i.e., whether a soil will contract or dilate during shear). Furthermore, it provides an estimate of shear strength based on field experience (i.e., strengths back-calculated from failures in the field).

- For the FVST test locations, the material behavior was evaluated through the use of CPT-based assessments of contractive/dilative behavior. FVST then provides a direct measure of in-situ material shear strength and were used to estimate the in-situ undrained yield and remolded shear strength ratios for LTVSMC slimes.

- 33rd percentile drained and yield undrained shear strength is used for the Effective Stress Stability Analysis (ESSA) and Yield Undrained Shear Strength Analysis (USSAyield) (i.e., on cumulative data plots 33% of the data yields lower strengths and 67% of the data yields higher strengths than the selected design value).

- For drained and undrained yield shear strengths, the design value was determined by averaging the individual 33rd percentile values of any field tests, then adding the average of the 33rd percentile laboratory test results and finding the overall average. The 33rd percentile and average values were calculated using Excel.

- The liquefied shear strengths were determined from the average of all contractive test data. Dr. Olson recommended the use of average liquefied shear strength due to the conservative nature of the sample set being tested (i.e., samples with higher strengths are not included) and the material type (LTVSMC slimes and Flotation Tailings).

- Engineering judgment was required to select an appropriate percentile value of strength (i.e., 33rd percentile), and to weight the values appropriately that are used to assess strengths (e.g., averaging field and laboratory data).

3.0 Drained Shear Strength Parameters

Drained shear strength is typically used in Effective Stress Stability Analysis (ESSA), which generally relates to long-term conditions. Drained shear strength properties are also referred to as effective stress parameters. Drained strength parameters were determined for all modeled materials. Figures related to the development of drained shear strength parameters are provided in Exhibit A.

3.1 LTVSMC Coarse Tailings

As the LTVSMC coarse tailings have a relatively high permeability which allows for rapid dissipation of excess pore water pressure and because the dams will be raised slowly over time, the drained response was assumed to be applicable for the LTVSMC coarse tailings for both short-term and long-term conditions. Additionally the coarse tailings that generally comprise the shell of the perimeter dams have been subjected to greater compaction than typical hydraulically placed tailings due to construction traffic and placement methodology and should not be susceptible to strength loss associated with liquefaction.

3.1.1 Laboratory Data

Triaxial tests were performed by Ebasco Services in 1977 and by Barr in 2008. Direct shear testing was performed in 1976 by Braun Engineering Testing. Effective friction angles determined from triaxial and direct shear testing were plotted together to determine the drained shear strength. The results are presented in Figure A-1 in Exhibit A in terms of the failure envelope. Values range from about 28 to 47 degrees. The 33rd percentile value of the laboratory data for LTVSMC coarse tailings is 36.5 degrees.

3.1.2 Field Data

Field data for the LTVSMC coarse tailings included SPT and CPT results. Data from CPT performed in 1996, 2005, and 2007 were analyzed. Data from SPT performed in 1990, 1996, 1999, and 2007 were analyzed. The resulting drained friction angles are plotted separately on Figures A-2 and A-3 for SPT and CPT, respectively. The SPT data ranges from about 26 to 50 degrees with a 33rd percentile value of 37.9 degrees. Any values higher than 50 degrees were removed from the SPT data set to prevent skewing the analysis. The CPT data generally range from about 39 to greater than 46 degrees, with a few outliers below 39 degrees, and with a 33rd percentile value of 43.0 degrees (based on the Robertson & Campanella analysis procedure described in (Reference (35)).

3.1.3 Design Value

Table 3-1 summarizes the drained shear strength testing of the LTVSMC coarse tailings, and presents the selected design value.

Table 3-1 LTVSMC Coarse Tailings Tests for Drained Shear Strength

Tests	SPT	CPT	Triaxial	Direct Shear
Number of Tests	15 borings	9 soundings	8	12
33rd Percentile ϕ'	37.9°	43.0°	36.5°	
Average ϕ'	40.5°		36.5°	
Design Value ϕ' (1)	**38.5°**			

(1) Design value is reported to nearest 0.5 degrees.

3.2 LTVSMC Fine Tailings

Based on historical definitions, the LTVSMC fine tailings can contain between 25% and 95% passing the No. 200 sieve. Because of this fines content, they have a lower permeability than the LTVSMC coarse tailings and are expected to develop excess pore water pressures during shear. As such, the fine tailings have been defined with drained strength parameters for long-term modeling and undrained strength parameters for short-term and liquefied conditions.

3.2.1 Laboratory Data

Triaxial testing was performed in 2007 and 1997 on thin-wall samples of LTVSMC fine tailings. A limited number of tests were performed as it has been difficult to identify and collect representative samples of fine tailings in the field due to inter-bedding of fine tailings and slimes.

Effective friction angles determined from isotropically consolidated undrained (CIU) triaxial compression tests and consolidated drained (CD) tests were analyzed to determine the drained shear strength. The results are presented in Figure A-4. Values range from about 32 to 40 degrees, with the 33rd percentile value of 33.0 degrees.

3.2.2 Field Data

Field data analysis methods for drained strength only apply to coarse-grained soils. Schmertmann's method for SPT analysis only applies to coarse-grained soils (Reference (10)), and Robertson and Campanella's method for CPT analysis only applies to coarse-grained soils (Reference (14)). As a result, field data are not included in analysis of the drained strength of the LTVSMC fine tailings.

3.2.3 Design Value

Table 3-2 summarizes the drained friction angle testing of the LTVSMC fine tailings and presents the selected design value.

Table 3-2 LTVSMC Fine Tailings Tests for Drained Strength

Tests	Triaxial
Number of Tests	6
33rd Percentile ϕ'	33.0^{o}
Design Value ϕ'	**33.0^{o}**

3.3 LTVSMC Slimes

The LTVSMC slimes have a minimum of 95% particles passing the No. 200 sieve, but because they are tailings with clay-size particles without clay mineralogy, the slimes have low plasticity. Similarly, the permeability of the slimes is not as low as would be expected for a naturally occurring soil with a comparable gradation. The slimes were characterized with a drained strength for long-term conditions and undrained strengths for short-term and liquefied conditions.

3.3.1 Laboratory Data

The LTVSMC slimes were evaluated in the laboratory with isotropically-consolidated, undrained (CIU) and consolidated-drained (CD) triaxial testing. While CIU triaxial testing has been performed extensively on LTVSMC slimes since 1986 (a total of 68 tests), only 14 of the available triaxial tests exhibited contractive behavior, with nine of those developing quasi-steady state (QSS) behavior. Nineteen direct shear tests were also performed by Ebasco in 1977 (Reference (15)) on the slimes.

Effective friction angles determined from triaxial and direct shear testing were plotted together to determine the drained shear strength. The results are presented in Figure A-5. Values range from about 25 to 43 degrees, with a 33rd percentile value of 34.3 degrees.

3.3.2 Field Data

Field data analysis methods for drained strength only apply to coarse-grained soils. Schmertmann's method for SPT analysis only applies to coarse-grained soils (Reference (10)), and Robertson and Campanella's method for CPT analysis only applies to coarse-grained soils (Reference (14)). As a result, field data are not included in analysis of the drained strength of the LTVSMC slimes.

3.3.3 Design Value

Table 3-3 summarizes the drained shear strength testing and the derivation of the design value for the LTVSMC slimes. Based on the material and typical behavior, a design value of

33 degrees was chosen as an appropriate representation of the drained strength for LTVSMC slimes.

Table 3-3 LTVSMC Slimes Tests for Drained Strength

Tests	Triaxial
Number of Tests	33
33rd Percentile ϕ’	34.3°
Design Value ϕ’ (1)	**33.0°**

(1) Design value based on engineering judgment.

3.4 LTVSMC Fine Tailings/Slimes

Previously the LTVSMC fine tailings and slimes had been combined only in the interior of the Tailings Basin to simplify the slope stability model. The LTVSMC fine tailings and LTVSMC slimes were analyzed together for the entire basin, hereafter called LTVSMC fine tailing/slimes. After reviewing the available CPT data for the site, Robertson suggested that fine tailings and slimes should be treated as the same material for stability analysis purposes (Reference (36)). Furthermore, some areas of slimes can be distinguished from fine tailings but due to the highly inter-bedded layering in the fine tailings and slimes, for stability analysis purposes these regions have been combined into one fine tailings/slimes region.

3.4.1 Laboratory Data

The laboratory data from LTVSMC slimes and fine tailings were combined in order to determine an effective friction angle for LTVSMC fine tailings/slimes. The triaxial and direct shear test results from fine tailings and slimes were plotted together to determine the drained shear strength. The results are presented in Figure A-6. Values range from about 25 to 43 degrees, with a 33rd percentile value of 34.1 degrees.

3.4.2 Field Data

Field data analysis methods for drained strength only apply to coarse-grained soils. Schmertmann’s method for SPT analysis only applies to coarse-grained soils (Reference (10)), and Robertson and Campanella’s method for CPT analysis only applies to coarse-grained soils (Reference (14)). As a result, field data are not included in analysis of the drained strength of the LTVSMC fine tailings/slimes.

3.4.3 Design Value

Table 3-4 summarizes the drained friction angle testing of LTVSMC fine tailings/slimes, and presents the selected design value. Based on the material and typical behavior, a design value of 33 degrees was chosen as an appropriate representation of the drained strength for LTVSMC slimes.

Table 3-4 LTVSMC Fine Tailings/Slimes Tests for Drained Strength

Tests	Triaxial
Number of Tests	39
33rd Percentile ϕ'	34.1°
Design Value ϕ' (1)	**33.0°**

(1) Design value based on engineering judgment.

3.5 LTVSMC Bulk Tailings

Future FTB dam lifts will be constructed with LTVSMC coarse tailings, with the potential for occasional inclusions of some LTVSMC fine tailings and slimes (hence the name bulk LTVSMC tailings is used). While LTVSMC coarse tailings will be preferentially borrowed, some mixing of LTVSMC fine tailings and slimes may occur during excavation, transport, and placement of the dam building materials. To evaluate the sensitivity of bulk tailings strength to various blend ratios (ratio of coarse tailings to fine tailings and slimes), four tailings mixtures were prepared from bulk samples obtained during test pitting in the Tailings Basin and the blending ratios and fines content are presented in Table 3-5.

Table 3-5 LTVSMC Bulk Tailings Blends

	Blending Ratio					
Blend	LTVSMC Coarse Tailings	LTVSMC Fine Tailings	LTVSMC Slimes	Fines Content (% by wt.)	USCS	Field Classification
1	5 parts	4 parts	1 part	23.9	SM	Fine tailings
2	15 parts	4 parts	1 part	15.5	SP-SM	Coarse tailings
3	5 parts	8 parts	2 parts	27.8	SM	Fine tailings
4	5 parts	16 parts	4 parts	43.2	SM	Fine tailings

Because the LTVSMC bulk tailings will be comprised primarily of LTVSMC coarse tailings, it is expected that they will be relatively free-draining and excess pore water pressures will dissipate quickly. During lift construction, the bulk tailings will be well-compacted, which means they will exhibit a dilative behavior when loaded. Therefore the bulk tailings were only characterized for drained strength conditions. The expected blend is Blend 2 or better (preferential borrowing of LTVSMC coarse tailings will be performed to achieve Blend 2 or a blend with even greater coarse tailings content). Blend 2 conforms with the filter criteria and matches well with the selected design value.

3.5.1 Laboratory Data

The shear strength of the LTVSMC bulk tailings was evaluated through CIU triaxial testing. Each of the four blends was tested. Eleven of the tests displayed dilative behavior and one test displayed quasi-steady state behavior. The results of the triaxial tests were analyzed for the drained friction angle by plotting the shear strength versus the confining pressure using the peak values from all triaxial tests. As shown on Figure A-7, the LTVSMC bulk tailings were characterized with a drained friction angle ranging from about 36.7 to 39.4 degrees. The 33rd percentile value is 38.3 degrees. Data from tests on all four blends were analyzed together (rather than averages from each 3-point series per blend type); however, the anticipated LTVSMC bulk tailings material is best represented by Blend 2 which has a friction angle of 38.5 degrees. All blends were analyzed to better understand how the finer material can impact the shear strength and to add a degree of conservatism for a material that has not yet been created in the field.

3.5.2 Field Data

While the LTVSMC bulk tailings do not exist in the field, LTVSMC coarse and fine tailings have been tested with CPT and SPT. Based on these field tests, the LTVSMC bulk tailings were previously assumed to have a minimum drained friction angle of 33.0 degrees based on the value determined for fine tailings (Table 3-2). The LTVSMC coarse tailings, which were not subjected to rigorous compaction methods performed during construction but were compacted by construction vehicle traffic, exhibited an average drained friction angle of approximately 38.5 degrees from field testing (Table 3-1). Because the LTVSMC bulk tailings will be subjected to mechanical compaction and comprised primarily of LTVSMC coarse tailings, as anticipated the LTVSMC bulk tailings warrant a shear strength similar to LTVSMC coarse tailings.

3.5.3 Design Value

Table 3-6 summarizes the drained friction angle testing of the LTVSMC bulk tailings, and presents the selected design value.

Table 3-6 LTVSMC Bulk Tailings Tests for Drained Strength

Tests	Triaxial
Number of Tests	12
33rd Percentile ϕ'	38.3°
Design Value ϕ' (1)	**38.5°**

(1) Design value is reported to nearest 0.5 degrees.

3.6 Flotation Tailings

The Flotation Tailings were generated in a pilot plant from processing of roughly 43 tons of ore. The Flotation Tailings have a similar gradation to the LTVSMC fine tailings. Therefore, the Flotation Tailings are defined with drained strength parameters for long-term modeling and undrained strength parameters for short-term and seismic modeling. No field data are available for the Flotation Tailings.

3.6.1 Laboratory Data

Only six of the 19 triaxial CIU tests performed on Flotation Tailings in 2005 and 2008 exhibited contractive behavior The remainder of the tests exhibited dilative behavior or behavior similar to quasi-steady state (QSS), though without a clear initial yield point. Of the 19 tests, 15 were used to determine the drained friction angle based on maximum deviator stress failure criterion. Results from the remaining four tests appear to represent high and low (outlier) values. Shear strength values were plotted together for the triaxial results to evaluate the difference in strength with each triaxial response. The test results ranged from about 19.5 to 47 degrees, as shown in Figure A-8. The 33rd percentile value is 35.7 degrees. However due to the limited amount of triaxial data, a design value of 33 degrees was chosen as an appropriate representation of the drained strength for Flotation Tailings based on the influence from triaxial test values performed under low effective normal stresses.

3.6.2 Design Value

Table 3-7 summarizes the drained friction angle testing for Flotation Tailings and presents the selected design value.

Table 3-7 Flotation Tailings Tests for Drained Strength

Tests	Triaxial
Number of Tests	15
33rd Percentile ϕ'	35.7 °
Design Value ϕ' (1)	**33.0°**

(1) Design value based on engineering judgment.

3.7 Peat

A portion of the Tailings Basin was founded on wetlands. Extensive field and laboratory testing has been conducted during previous investigations. Past testing included CPT, FVST, direct shear, and triaxial testing. However, much of the past testing did not include detailed data for particular tests. Only summary results were reported in many of the historical investigation reports.

3.7.1 Laboratory Data

Several triaxial tests were performed on peat samples in 1979, 1980, 1990, and 1996. Direct shear testing was performed in 1979, 1980 and 1990 on peat samples. The direct shear results were plotted on Figure A-9 in terms of the failure envelope. Values of effective normal stress and shear stress associated with the drained shear/normal function are tabulated on Figure A-9. The selection of the drained Peat strength is consistent with the 33rd percentile approach; one-third of the data are below the design value and two-thirds of the data are above the design value.

3.7.2 Design Value

Table 3-8 summarizes the drained friction angle testing for peat and presents the selected design value.

Table 3-8 Peat Tests for Drained Strength

Tests	Direct Shear
Number of Tests	10
Design Values ϕ', c'	**Shear/Normal Function**[1] representing a drained friction of ~27 degrees in the linear portion of the data range

3.8 Glacial Till

The glacial till comprises the foundation for the majority of the Tailings Basin, except where peat is present. In the critical design section, Cross-Section F, the glacial till exists below the peat. In general, in-situ testing or sampling of the glacial till has been very difficult, as the till is highly over-consolidated and often contains gravel, cobbles, and boulders. Therefore, limited data are available. Most samples collected of the glacial till are classified as silty sand with gravel, though varying amounts of clay, cobbles, and boulders are present.

3.8.1 Laboratory Data

Only one CIU triaxial test has been performed on the glacial till for this site, which exhibits a drained friction angle of 35.0 degrees.

3.8.2 Field Data

SPT data collected during drilling were analyzed for glacial till to determine the drained friction angle. There is a limited data set, as many borings terminated within the LTVSMC tailings or at the till interface. In the borings that penetrated the glacial till, depth to till ranged from 23 to 146 feet and the till had N_{60}-value of blow counts ranging from 14 to 68 blows per foot. As shown on Figure A-10, the 33rd percentile drained friction angle was calculated as 37.6 degrees, with results ranging from 35.7 to 51.6 degrees.

3.8.3 Design Value

Table 3-9 summarizes the drained friction angle analysis for glacial till, and presents the selected design value used to characterize the till for both drained and undrained slope stability models.

Table 3-9 Glacial Till Tests for Drained Strength

Tests	SPT	Triaxial
Number of Tests	14 borings	1
33rd Percentile ϕ'	37.6°	35.0°
Design Value ϕ' (1)	**36.5°**	

(1) Design value is reported to the nearest 0.5 degrees.

3.9 Summary of Design Values for Drained Shear Strength

Table 3-10 summarizes the drained friction angle design values.

Table 3-10 Drained Design Values

Material	Design Values
LTVSMC Coarse Tailings ϕ'	38.5°
LTVSMC Fine Tailings ϕ'	33.0°
LTVSMC Slimes ϕ'	33.0°
LTVSMC Slimes/Fine Tailings ϕ'	33.0°
LTVSMC Bulk Tailings ϕ'	38.5°
Flotation Tailings ϕ'	33.0°
Peat ϕ', c'	Shear/Normal Function (~27°)
Glacial Till ϕ'	36.5°

4.0 Undrained Yield Shear Strength Parameters

The undrained shear strength is often used to represent short-term conditions, typically immediately after construction where excess pore water pressures exist in fine-grained soils. Undrained shear strength parameters were determined for the LTVSMC fine tailings, LTVSMC slimes, LTVSMC fine tailings/slimes, Flotation Tailings, and peat. Undrained parameters were not adopted for the LTVSMC coarse tailings, LTVSMC bulk tailings, or the glacial till, as these materials are understood to behave in a drained matter under typical loading conditions. Figures related to the development of undrained shear strength parameters are provided in Exhibit B.

4.1 LTVSMC Fine Tailings

The LTVSMC fine tailings can be characterized by undrained shear strength ratio for short-term and seismic modeling.

4.1.1 Laboratory Data

Insufficient laboratory data was available for use in the analysis. Of the six triaxial CIU tests performed since 1986 on LTVSMC fine tailings, only three samples exhibited a quasi-steady state behavior where the stress-strain curve showed a peak. The results from the 1997 testing were not used to determine the undrained shear strength ratio of LTVSMC fine tailings, because they exhibited dilative behavior. Only second-hand data results were available and no raw data was provided in historical reports.

4.1.2 Field Data

Field vane tests have been performed in the LTVSMC fine tailings. Only soundings from 2007 were used when analyzing the FVST design purposes, as they were the only CPT tests available with companion soil borings to verify the LTVSMC fine tailings classifications. Two field investigations to obtain FVST data were performed; one in 1977 by EBASCO (these test data were disregarded because it was determined that testing may have been conducted under drained conditions), and one in 2007 by AET under Barr's supervision (where vane shear tests were continued through yield response so residual strength was recorded). The field data from EBASCO is provided in Attachment D of Reference (1) and AET field data is provided in Attachment F of Reference (1). The undrained shear strength ratio from in-situ vane shear testing had $USSR_{yield}$ values ranging from 0.52 to 0.74. Due to the high $USSR_{yield}$ values, the FVST strength was not used in the design strength calculation of LTVSMC fine tailings.

During geotechnical investigations, CPT and SPT have been performed in the LTVSMC fine tailings. The computed $USSR_{yield}$ values ranged from approximately 0.21 to 0.30 for CPT data and from 0.22 to 0.29 for SPT data (defined by the bounds of Olson and Stark's (Reference (11)) equation, see Section 2.5.1.2). 33rd percentile values are 0.24 and 0.25 from CPT and SPT data respectively, as shown on Figures B-1 and B-2.

Table 4-1 summarizes the undrained strength analysis of the LTVSMC fine tailings, and presents the selected design value.

Table 4-1 LTVSMC Fine Tailings Tests for Undrained Strength

Tests	SPT	CPT
Number of tests	13 borings	7 soundings
33rd Percentile	0.25	0.24
Design Value $USSR_{yield}$	0.25	

SPT and CPT data were weighted equally in determining the LTVSMC fine tailings design value. Due to the nature of CPT testing, data is collected approximately every two centimeters during penetration and provides an indication of the trend in strength through a formation. The CPT and SPT data are correlated to strength via an empirical correlation proposed in Olson and Stark (Reference (11)).

4.2 LTVSMC Slimes

4.2.1 Laboratory Data

A total of 68 triaxial CIU tests have been performed since 1986 on LTVSMC slimes. Fourteen of the tests displayed contractive behavior, nine of which developed a quasi-steady state stress-strain curve. The $USSR_{yield}$ values ranged from approximately 0.16 to 0.33. The slimes were found to have a 33rd percentile $USSR_{yield}$ value of 0.20. Figure B-3 presents strength envelope plot of the triaxial data.

4.2.2 Field Data

CPT and SPT data were collected during investigations performed in 1996, 2005, and 2007 to characterize the LTVSMC slimes. Slimes located at depths between 0 and 130 feet were tested. The computed $USSR_{yield}$ values ranged from approximately 0.21 to 0.30 for CPT data, and from 0.21 to 0.29 for SPT values data (defined by the bounds of Olson and Stark's (Reference (5), Reference (11) equation, see Section 2.5.1.2). A strength envelope plot of the $USSR_{yield}$ results from CPT data is presented in Figure B-4 displaying the 33rd percentile value of 0.22. A strength envelope plot of the $USSR_{yield}$ results from SPT data is presented in Figure B-5 displaying the 33rd percentile value of 0.22.

In-situ vane shear testing was performed at various depths in borings historically. The FVST directly measures the in-situ strength for the LTVSMC tailings at discrete locations covering a zone about 10 cm in height. However, after determining which tests were likely performed in undrained conditions, the data was limited to 14 tests from 2007. The $USSR_{yield}$ data range from 0.06 to 0.47 (Figure B-6). The 33rd percentile value is an $USSR_{yield}$ of 0.26.

4.2.3 Design Value

A summary of the triaxial tests, FVST, SPT, and CPT tests analyzed to determine yield shear strength for the LTVSMC slimes is provided in Table 4-2.

Table 4-2 LTVSMC Slimes Tests for Undrained Strength

Tests	SPT	CPT	FVST	Triaxial
Number of Tests	14 borings	16 soundings	14	14
33rd Percentile	0.22	0.22	0.26	0.20
Combined 33rd Percentile $USSR_{yield}$	0.23			0.20
Design Value $USSR_{yield}$ [(1)]	**0.22**			

(1) Design value is reported to nearest 0.01.

4.3 LTVSMC Fine Tailings/Slimes

The LTVSMC fine tailings and slimes were also analyzed as a combined data set (LTVSMC fine tailings/slimes) using results of CPT, SPT, and FVST tests, using the approach described in Section 2.6.

4.3.1 Field Data

The undrained shear strength ratio of the LTVSMC fine tailings/slimes was estimated by analyzing CPT data from 1996, 2005, and 2007 using the method described in Section 2.0. Combining the two types of tailings allowed for incorporation of additional field data beyond the individual data sets for fine tailings and slimes. Test results from areas where the fine tailings and slimes were interlayered such that it was not possible to differentiate distinct zones of one material or the other were excluded from the individual data sets, but could be included here. These results are particularly relevant to the interior portion of the Tailings Basin.

Olson's method provided $USSR_{yield}$ values ranging from approximately 0.21 to 0.30. The data resulted in a 33rd percentile value of 0.22 as shown on Figure B-7.

The undrained shear strength ratio ($USSR_{yield}$) based on SPT data for fine tailings and slimes ranged from approximately 0.205 to 0.295 as shown in Figure B-8 with a 33rd percentile value of 0.23.

There were 52 FVST performed on LTVSMC fine tailings and slimes in previous investigations; however, only 16 tests were analyzed after eliminating tests not considered to have been performed under undrained conditions. The $USSR_{yield}$ values for LTVSMC fine tailings/slimes ranged from 0.06 to 0.47 as shown on Figure B-9, with a 33rd percentile $USSR_{yield}$ value of 0.26.

4.3.2 Design Value

Table 4-3 summarizes the $USSR_{yield}$ testing of LTVSMC fine tailings/slimes, and presents the selected design value.

Table 4-3 LTVSMC Fine Tailings/Slimes Tests for Undrained Strength

Tests	CPT (Olson's Method) contractive points only	SPT	FVST
Number of Tests	71 soundings	13 borings	16
33rd Percentile $USSR_{yield}$	0.22	0.23	0.26
Design Value $USSR_{yield}$ (1)	**0.24**		

(1) Design value is rounded to the nearest 0.01.

4.4 Flotation Tailings

The Flotation Tailings triaxial tests are used to determine undrained shear strength of the material that will be produced at the plant during operations. Yield strength values were plotted together for the contractive and quasi-steady state (QSS) triaxial results to evaluate the difference in strength.

4.4.1 Laboratory Data

A total of 16 triaxial CIU tests have been performed since 2005 on Flotation Tailings. All of the yield strength values were plotted for the contractive and quasi-steady state triaxial results. While the dilative test results were omitted from this analysis, 14 test results remained for the strength analysis – six of which exhibited quasi-steady state behavior and five of which behaved in a contractive manner. For the triaxial undrained shear strength analysis of all tests, the Flotation Tailings were found to have a 33rd percentile $USSR_{yield}$ value of 0.26, with values varying between 0.21 and 0.36, as presented on Figure B-10.

4.4.2 Design Value

Table 4-4 summarizes the undrained strength testing of the Flotation Tailings, and presents the selected design value.

Table 4-4 Flotation Tailings Tests for Undrained Strength

Tests	Triaxial
Number of Tests	14
33rd Percentile $USSR_{yield}$	0.26
Design Value $USSR_{yield}$	**0.26**

As mentioned previously, the Flotation Tailings have a similar gradation to the LTVSMC fine tailings and the new design value is in line with the LTVSMC fine tailings, slimes and combined fine tailings/slimes design values.

4.5 Peat

4.5.1 Laboratory Data

Triaxial testing on peat was performed in 1979, 1980, 1990, and 1996. The undrained shear strength ratio ranged from approximately 0.10 to 0.56 with a 33rd percentile value of 0.23, as shown on Figure B-11.

4.5.2 Design Value

On the basis of the laboratory data, a design value of 0.23 undrained shear strength ratio was selected. The selection of the undrained peat strength is consistent with the 33rd percentile approach used throughout for undrained shear strength determination; one-third of the data are below the design value and two-thirds of the data are above the design value. Therefore, the lower strength test data was taken into account when selecting the design value of peat. The undrained shear strength ratio is summarized in Table 4-5 along with the selected design value.

Table 4-5 Peat Tests for Undrained Strength

Tests	Triaxial
Number of Tests	14
33rd Percentile $USSR_{yield}$	0.23
Design Value $USSR_{yield}$	**0.23**

4.6 Summary of Design Values for Undrained Shear Strength

Table 4-6 summarizes the undrained design values of the materials, selected based on the 33rd percentile values.

Table 4-6 Summary of Undrained Design Values

Material	Design Values
LTVSMC Fine Tailings $USSR_{yield}$	0.25
LTVSMC Slimes $USSR_{yield}$	0.22
LTVSMC Fine Tailings/Slimes $USSR_{yield}$	0.24
Flotation Tailings $USSR_{yield}$	0.26
Peat $USSR_{yield}$	0.23

5.0 Liquefied Shear Strength Parameters

Liquefied shear strengths are mobilized only if liquefaction is triggered by static loading, dynamic loading, or a deformation event. Regardless of the triggering mechanism, flow failure can occur if the static shear stress exceeds the net shearing resistance, including the liquefied shear strength.

Only contractive materials are susceptible to liquefaction; dilative materials are not. Dilative materials in the proposed FTB design, including glacial till, peat, and LTVSMC coarse tailings placed with compactive effort (such as those in the dam shell), are not considered subject to liquefaction so they were not evaluated for liquefied shear strength. While analyses show that some of the LTVSMC fine tailings or slimes can be dilative, it is conservative to assume that they will behave in a contractive manner. Contractive behavior is generally exhibited by loose, fine grained, hydraulically deposited sediments such as the LTVSMC tailings and the future Flotation Tailings.

Liquefied shear strength parameters were determined using a two-step analysis. The first step was material behavior evaluation. The material behavior evaluation used in-situ and laboratory data to identify zones of contractive materials and zones of dilative materials. The second step was to calculate the liquefied shear strength, including only test results from contractive zones. Figures related to the development of liquefied shear strength parameters are provided in Exhibit C and Exhibit D.

5.1 Material Behavior Evaluation

The material behavior evaluation used data from in-situ testing and laboratory testing to (1) characterize the stratigraphy at each boring location; (2) determine which materials are susceptible to liquefaction; and, (3) identify dilative layers within generally contractive zones so that those results could be excluded from liquefied shear strength calculations.

Field testing included CPT, SPT and FVST. CPT soundings were used to develop an understanding of stratigraphy in the Tailings Basin, to measure material properties to assess the potential for liquefaction and to estimate liquefied strength. The CPT soundings collected nearly continuous data streams, measuring tip resistance (q_t) sleeve friction (f_s), and pore water pressure (u_2) over the entire depth of the sounding.

Soil borings were conducted adjacent to the CPT sounding locations, performing SPT and gathering relatively undisturbed thin-wall samples. The SPT drilling and thin-wall sampling corroborated the CPT stratigraphic information and provided physical samples to evaluate material properties. Samples were characterized in the field and sent to the laboratory for index properties tests such as grain-size distributions and Atterberg Limits. Triaxial compression strength tests were also performed.

FVST testing targeted contractive zones. It was performed from behind the drill rig, at depths where the CPT testing showed low tip resistances, characteristic of contractive materials. Additional details on the field and laboratory sampling programs is provided in Section 4.0 of Geotechnical Data Package Volume 1 Version 4.

Characteristic signature plots were created to identify the stratigraphic layers at each boring location and show which materials were targeted for FVST and laboratory testing. For each boring location, the characteristic signature plot combines CPT tip resistance, SPT corrected blow counts (N-values), boring log information, field vane testing results, and some index properties available from laboratory testing. Figure C-1 shows the characteristic signature plot for the 07-06 boring/sounding which is located within the interior of the basin along the existing dam at Cross-Section F. Similar plots created for other CPT/SPT test locations along Cross-Section F are provided in Exhibit D1.

Figure C-1 shows that at location 07-06 there is an approximately 10-foot-thick layer of slimes (q_t<10 tsf) present between depths of approximately 22 and 32 feet. This characteristic signature plot also shows that the FVST and index property testing was conducted on material from this slimes layer. Zones of LTVSMC fine tailings and slimes are identified by their CPT tip resistances. Apparent on Figure C-1, fine tailings (q_t. from 50 to 100 tsf) are distinguishable from slimes (q_t less than 10 tsf), with interbedded zones exhibiting a wider range (q_t from about 10 to 100 tsf). The plot shows a thin layer of peat at the bottom of the boring above the native glacial till. The peat exhibited tip resistance similar to fine tailings, but higher pore water pressure (u_2), and sleeve friction (f_s). Finally, the native glacial till had high SPT N-values and high CPT tip resistance and indicated a dense or hard layer where the probe was terminated to prevent damage to the equipment.

CPT behavior plots were created to gather further detail on stratigraphy and assess which materials are susceptible to liquefaction. For each boring location, the CPT behavior plot combines CPT tip resistance (q_t) sleeve friction (f_s) dynamic pore water pressure (u_2), and normalized pore pressure difference. Figure C-2 shows the CPT behavior plot for the 07-06 sounding. Similar plots created for other CPT locations along Cross-Section F are provided in Exhibit D2.

The dynamic pore pressure, included on the CPT behavior plots, represents the pore pressure as the cone is advanced through the tailings. Dissipation tests are presented as purple dots on Figure C-2. They indicate an “equilibrium” water level reading at the probe depth. At some locations the dissipation tests show water levels above or below assumed hydrostatic conditions. Figure C-2 shows the variability of the dynamic pore pressure at this location, and how in certain zones the pore pressures exceed the hydrostatic conditions. These zones correspond to depths where low tip resistances were measured; they are generally identified as slimes. Zones where minimal pore pressure response is observed correspond to depths where higher tip resistances were observed, consistent with fine tailings.

The normalized pore excess pressure difference, also shown on the CPT behavior plots (e.g., Figure C-2), aids identification of contractive and dilative layers. The normalized excess pore pressure difference is the difference between the dynamic pore pressure developed during cone advancement and the estimated hydrostatic conditions interpreted from the dissipation tests normalized by dividing by the effective overburden stress (σ'_{vo}). Where the normalized pore pressure difference is positive, which is the result of dynamic pore pressure response above hydrostatic conditions, that material has a potential for contractive behavior and is susceptible to liquefaction. Where the normalized pore pressure difference is negative, dynamic pore water pressure is below the existing groundwater conditions, that soil is considered potentially dilative and will not liquefy. Figure C-2 shows that the normalized pore pressure difference is positive in the slimes and negative in LTVSMC fine tailings layers. Fine tailings zones with thin inter-bedded slimes layers show positive normalized pore pressures (e.g., Figure C-2 zone from approximately 50- to 60-foot depth). Overall, analysis of the CPT behavior plot at location 07-06 indicates that about 86% of saturated fine tailings and slimes points are potentially contractive and susceptible to liquefaction, and about 14% of the fine tailings and slimes points are potentially dilative and not susceptible to liquefaction.

The CPT behavior plots are one way to determine which materials are susceptible to liquefaction; another way is to plot CPT tip resistance relative to the medium compressibility boundary as developed by Fear and Robertson (Reference (4)) and updated by Olson (Reference (12)) for medium compressibility materials. CPT tip resistance plots show corrected tip resistance (q_{c1}) versus calculated pre-failure effective stress. Points that plot to the left of the medium compressibility boundary are potentially contractive, and points that plot to the right are potentially dilative. Figure C-3 shows the CPT tip resistance plot for CPT location 07-06. This method of analysis indicates that 94% of the fine tailings and slimes at location 07-06 are potentially contractive (100% of the slimes and 90% of the fine tailings). Comparing the two methods of analysis, we see that the CPT tip resistance plot produces a higher estimate of the amount of material susceptible to liquefaction, compared to the analysis based on normalized pore pressure difference. The CPT tip resistance plots for each CPT sounding along Cross-Section F are provided in Exhibit D3.

The material behavior evaluation used the characteristic signature plots (Exhibit D1) and the CPT behavior plots (Exhibit D2) to establish the stratigraphy and assign each data point to a material category: LTVSMC coarse tailings, LTVSME fine tailings, or LTVSMC slimes. Then, for each material type, a CPT tip resistance plot and a SPT corrected N-values plot were created using data available CPT and SPT data. These CPT and SPT plots for each material type were used to: (1) establish which material types are contractive and susceptible to liquefaction; and (2) identify tests that may have evaluated more dilative layers within generally contractive zones so that those results could be excluded from liquefied shear strength calculations.

5.1.1 LTVSMC Coarse Tailings

The vast majority of the LTVSMC coarse tailings display dilative behavior, as shown on Figure C-4. This is reasonable as the higher permeability of the coarse tailings facilitates drainage and the coarse tailings have been subjected to some amount of compaction during dam construction from rubber-tired dozers. It is probable that any points plotting to the left or below the medium compressibility boundary represent thin layers of finer tailings inter-bedded within the coarse tailings zone. Because these small, variable zones are surrounded by free-draining material, they are also much less prone to liquefaction. Therefore, the LTVSMC coarse tailings are considered dilative and not susceptible to liquefaction. They were not assigned a liquefied strength.

5.1.2 LTVSMC Fine Tailings and Slimes

Some of the LTVSMC fine tailings exhibit contractive behavior while some exhibit dilative behavior. Contractive data points represent 52% of all the CPT fine tailings data (Figure C-5) and 26% of all the SPT fine tailings data (Figure C-6). The percentage of contractive points on the CPT plot may be higher because CPT tip resistance is influenced by inter-bedded slimes layers above and below the cone tip as the cone is advanced. The result is that CPT tests may over represent the volume of fine tailings that are contractive. This effect has been documented by Lunne (Reference (37)) and other literature for cases where thin, interbedded layers exist. The conclusion of the material behavior evaluation is that the fine tailings are potentially contractive and susceptible to liquefaction.

The majority of the slimes are contractive in nature. Contractive data points represent 71% of all the CPT slimes data (Figure C-7) and 67% of the SPT slimes data (Figure C-8).

For the fully liquefied modeling and the liquefaction triggering analyses the individual layers of LTVSMC fine tailings, slimes, and inter-bedded fine tailings and slimes are modeled as a single unit, referred to as LTVSMC fine tailings/slimes. This approach is used because it is conservative to assume all of the materials will be reduced to the liquefied strength with the understanding that there is data showing that some materials are dilative. Therefore a single liquefied strength value for fine tailings/slimes was calculated, using only the contractive data from the fine tailings and the slimes.

5.1.3 Flotation Tailings

Flotation Tailings will be hydraulically deposited and are expected to behave in a contractive manner. Therefore, a liquefied shear strength was determined for the Flotation Tailings.

5.2 Liquefied Strength Evaluation

Liquefied strength values were calculated for LTVSMC fine tailings/slimes, and for Flotation Tailings, using the method described in Section 2.6.

A single design liquefied strength value was chosen for the combined LTVSMC fine tailings/slimes because they are modeled as a single unit for the fully liquefied modeling and the liquefaction triggering analyses. The LTVSMC fine tailings/slimes unit includes all layers of LTVSMC fine tailings, slimes, and inter-bedded fine tailings and slimes. This approach is consistent with the material behavior evaluation which showed that within the Tailings Basin there are deposits where fine tailings and slimes are so interbedded that they cannot practically be distinguished as separate layers. Because the LTVSMC fine tailings and the LTVSMC slimes were individually determined to behave in generally a contractive manner, the significantly interbedded intervals and the unit combined for modeling purposes are also expected to exhibit contractive behavior.

The liquefied strength calculations use only contractive data points for each material type. This approach is used because it is conservative to assume all of the materials will be reduced to the liquefied strength with the understanding that there is data showing that some materials are dilative. Excluding the dilative data from liquefied strength calculations may have the effect of underestimating the true strength of the material. In fact, stringers of coarse material will help to redistribute excess pore-water pressures and limit the liquefied response. This is a conservative approach for the LTVSMC fine tailings, portions of which display dilative behavior. The contribution of these materials to the overall strength is being ignored and hence, slope stability models utilizing the design $USSR_{liq}$ values are likely to be conservative.

5.2.1 LTVSMC Fine Tailings/Slimes

The liquefied strength design value for LTVSMC fine tailings/slimes is based on the laboratory and field tests of LTVSMC fine tailings, slimes, and interbedded zones where results showed contractive behavior.

5.2.1.1 Laboratory Data

Triaxial testing was conducted on relatively undisturbed thin-wall field samples of slimes and on samples remolded from representative materials using the moist-tamping or slurry methods to achieve very low initial densities and then consolidated to stresses expected within the FTB. Liquefied strength calculations used only the triaxial test results from samples that exhibited contractive or quasi-steady state behavior. Figure C-9 presents the results of the triaxial testing program. The inset figure shows the stress path for one sample of the test program. The stress paths for all of the samples used in the analysis are shown on Figure C-10.

The results of the testing presented on Figure C-9 show that for the nine samples where quasi-steady state and contractive behavior was observed, the liquefied strength ratio ranges from about 0.05 to 0.22 with an average $USSR_{liq}$ of about 0.15. Further triaxial testing on remolded slimes samples is ongoing.

5.2.1.2 Field Data

Field data collected in 2005 and 2007 have been used to evaluate the LTVSMC fine tailings/slimes. Field data inputs to the calculation of liquefied strength ratios included CPT, SPT, and FVST results. The strengths are based only on the test results of LTVSMC fine tailings, slimes, and interbedded zones where results showed contractive behavior.

Slimes CPT results which showed contractive behavior on the plot of corrected CPT tip resistance (Figure C-7) were used as inputs. The raw CPT data for contractive slimes samples was processed using the Olson and Stark (Reference (5)) average correlation. Figure C-11, representing all contractive data, shows the slimes liquefied strength ratio ($USSR_{liq}$) ranges from about 0.03 to 0.12 with an average of about 0.06. This is slightly higher than the value of 0.04 based on just CPT data along Cross-Section F.

Determining which fine tailings CPT data to include in liquefied strength calculations is less straightforward, and requires engineering judgment. The decision on which fine tailings data to include in liquefied strength calculations was made on the basis of their liquefied strength ratio, using the CPT data from location CPT 07-06 as a guide. Figure C-12 shows that at CPT location 07-06, the contractive fine tailings not influenced by the thin layers of interbedded slimes exhibit liquefied strength ratios from about 0.09 to 0.13 A liquefied strength ratio of 0.13 represents the upper bound strength for the LTVSMC fine tailings and approaches the boundary where the strength correlations are limited by a maximum corrected tip resistance of 6.5 MPa. Based on this analysis, contractive LTVSMC fine tailings CPT data exhibiting liquefied strength ranging from about 0.09 to 0.13 were included in the calculation of the liquefied strength of LTVSMC fine tailings/slimes. The representative average CPT correlation value for the LTVSMC fine tailings is interpreted as approximately 0.115.

SPT results which showed contractive behavior on the plot of corrected blow counts (Figure C-6) were used as inputs. The raw SPT data for contractive materials were analyzed using the SPT-based correlation presented in Olson and Stark (Reference (5)). Figure C-13, representing all contractive data, shows that the liquefied strength ratio ($USSR_{liq}$) based on SPT testing ranges from about 0.03 to 0.08 with an average of about 0.05. This is equal to the value of 0.05 based on just SPT data along Cross-Section F.

FVST results from 2007 which showed contractive behavior are presented in Figure C-14. The plot shows direct measurements of the remolded strength. These measurements were normalized with respect to the effective overburden stress and result in liquefied strength ratios ($USSR_{liq}$) ranging from 0.05 to 0.19 with an average of about 0.095.

5.2.1.3 Design Value

Determining the design value for liquefied strength of the LTVSMC fine tailings/slimes requires integrating and interpreting the results obtained from the various laboratory and field tests. To illustrate the procedure used to assign a design value, a series of figures are provided showing how the data from the various types of tests are brought together to create an understanding of reasonable upper and lower bounds for liquefied undrained shear strength, and how a design value is selected between these bounds.

Figures C-15 through C-20 illustrate the liquefied shear strength analysis along Cross-Section F. Figure C-15 presents the liquefied strength from correlations of the CPT data in the slimes. The resulting liquefied strength ratio ranged from about 0.03 to 0.11. This range varies from what was reported previously in Figure C-11 and the maximum value is slightly less because it represents only the data collected along Cross-Section F. Figure C-16 presents the SPT data correlation plotted along with the CPT. The data shows relative agreement between both methods of analyses. The SPT data has an average liquefied strength ratio of about 0.05 and ranges from about 0.03 to 0.10.

The strength values from FVST for all tests performed in slimes are presented with the CPT and SPT correlations on Figure C-17. The average remolded or *USSRliq* of FVST values is 0.095, with values ranging from 0.05 to 0.19.

Figure C-18 combines the results of the triaxial testing program for the slimes with the CPT, SPT and FVST results, and Figure C-19 adds lines showing reasonable upper and lower bounds of the strength envelope expected for the LTVSMC fine tailings/slimes based on all four types of tests. An upper-bound liquefied strength ratio of 0.22 corresponds to the triaxial quasi-steady state samples. This is appropriate because it represents the highest strength ratio observed for materials that are still considered contractive and susceptible to liquefaction. A lower-bound liquefied strength ratio of about 0.045 falls along the strength envelope consisting of CPT and SPT data when also considering the FVST data.

Finally, Figure C-20 adds results of LTVSMC fine tailings/slimes residual FVST results to the slimes data. The combined plot shows the variability in the materials while reducing the clutter from the data points.

Selection of a design value combines the evidence from all testing methods with engineering judgment. Figure C-21 presents the overall results of the analysis, plotting the average liquefied undrained shear strength correlation for each of the various types of laboratory and field tests, and showing their relation to the chosen Design Value $USSR_{liq}$ of 0.10. Flotation Tailings

5.2.2 Flotation Tailings

Triaxial tests were used to determine an $USSR_{liq}$ for the Flotation Tailings and the results are plotted as stress paths on Figure C-22. Seven samples were tested as part of the initial program. Of the seven samples tested, five samples were contractive and two exhibited quasi-steady state behavior. The results of the triaxial testing of Flotation Tailings are shown on Figure C-23. The average $USSR_{liq}$ of all the triaxial tests (five contractive and two quasi-steady state tests) is 0.12 as shown on Figure C-23. Additional testing on remolded samples is ongoing for use in further stages of the project. Table 5-1 presents a summary of the liquefied strength ratio for the Flotation Tailings.

Table 5-1 Liquefied Strength of Flotation Tailings

Tests	Triaxial
Number of Tests	7
Average $USSR_{liq}$	0.12
Design Value $USSR_{liq}$	**0.12**

5.3 Summary of Design Values for Liquefied Shear Strength

Table 5-2 summarizes the selected design values for use in slope stability analysis requiring use of liquefied strengths. Derivation of these values was described in the preceding sections.

Table 5-2 Summary of Liquefied Strength Design Values

Material	Design Values
LTVSMC Fine Tailings/Slimes $USSR_{liq}$	0.10
Flotation Tailings $USSR_{liq}$	0.12

6.0 Summary of Material Strength Properties

This document presents a summary of the available strength data for the FTB and explains the derivation of the drained, undrained, and liquefied shear strength parameters selected for the various materials included in the slope stability models. The design values for the drained, undrained, and liquefied shear strength parameters are summarized in Table 6-1. Future site exploration and material testing programs may result in updated design values, as described in Section 5 of Reference (38).

Table 6-1 Summary of Design Values

Material	Shear Strength		
	Drained (ESSA)	Undrained (USSA)	Liquefied
LTVSMC Coarse Tailings	$\phi' = 38.5^{o}$	-	-
LTVSMC Fine Tailings	$\phi' = 33.0^{o}$	$USSR_{yield} = 0.25$	-
LTVSMC Slimes	$\phi' = 33.0^{o}$	$USSR_{yield} = 0.22$	-
LTVSMC Fine Tailings/Slimes	$\phi' = 33.0^{o}$	$USSR_{yield} = 0.24$	$USSR_{liq} = 0.10$
LTVSMC Bulk Tailings	$\phi' = 38.5^{o}$	-	-
Flotation Tailings	$\phi' = 33.0^{o}$	$USSR_{yield} = 0.26$	$USSR_{liq} = 0.12$
Peat	$\phi' = 27.0^{o}$	$USSR_{yield} = 0.23$	-
Glacial Till	$\phi' = 36.5^{o}$	-	-

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Exhibit A

Figures of Drained Strength Tests

FIGURE A-1
LTVSMC Coarse Tailings
Triaxial and Direct Shear Drained Shear Strength Envelope

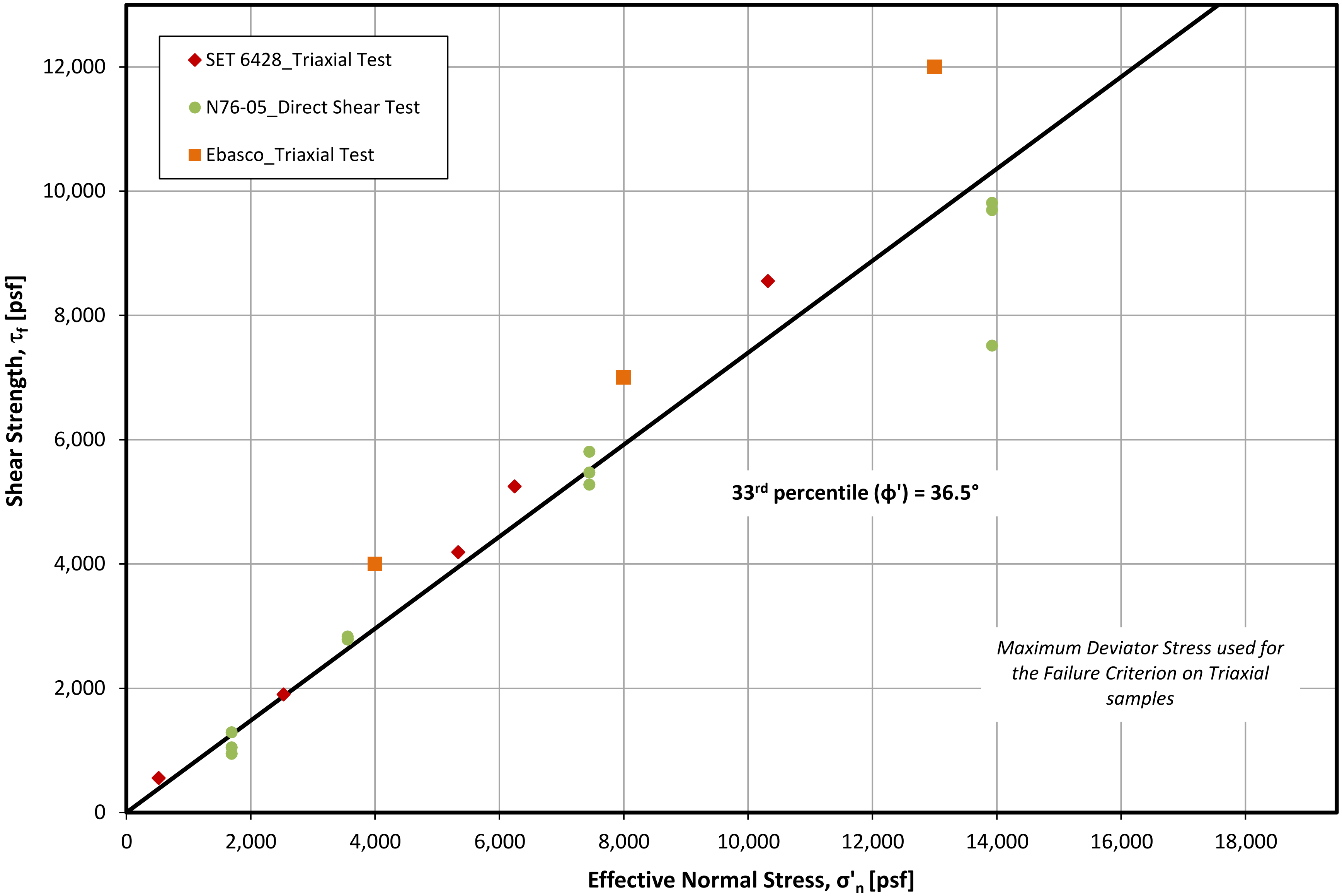


FIGURE A-2
LTVSMC Coarse Tailings
SPT Correlated Drained Shear Strength Envelope
(Schmertmann, 1975, for Granular Soil)

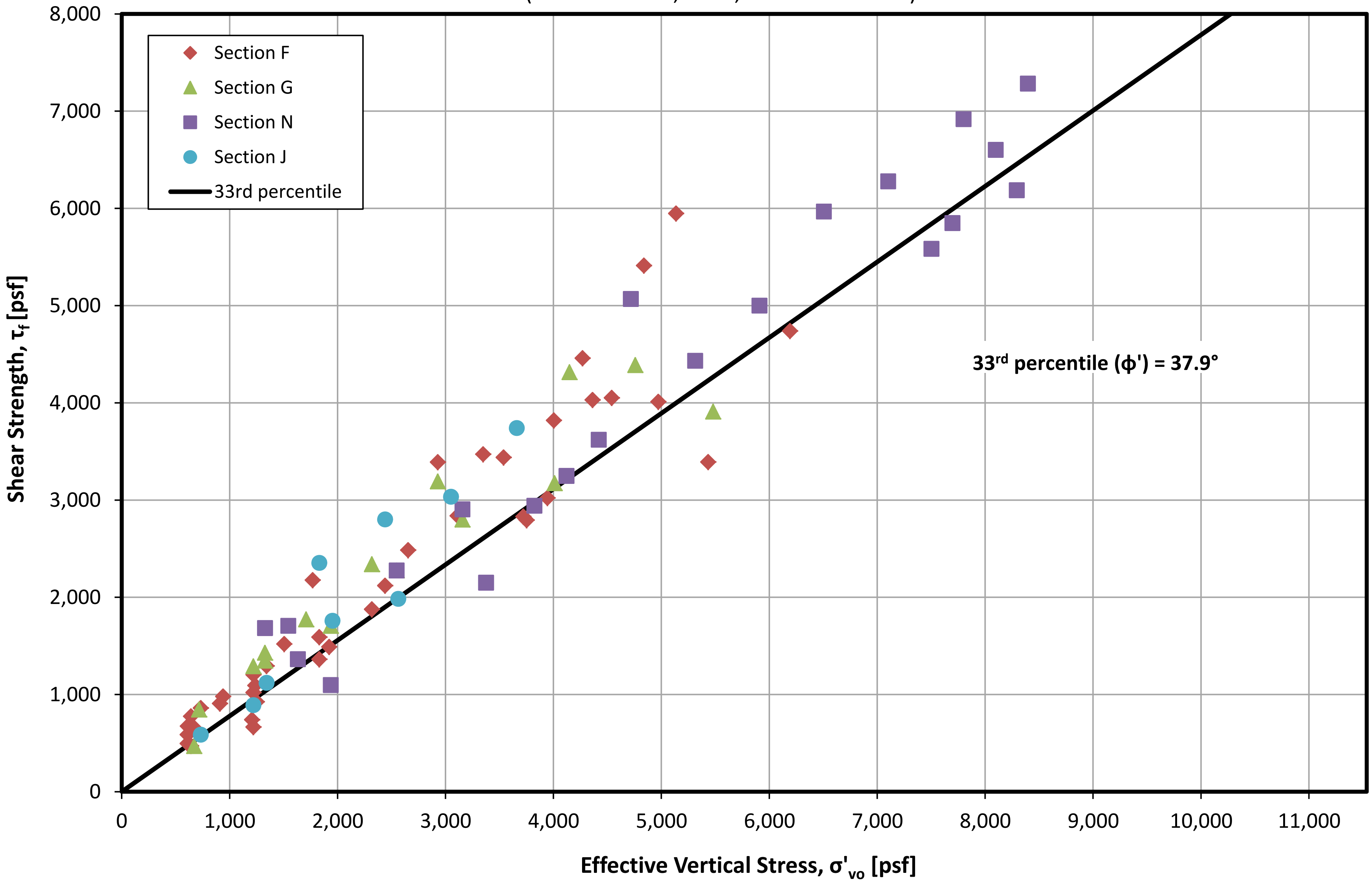
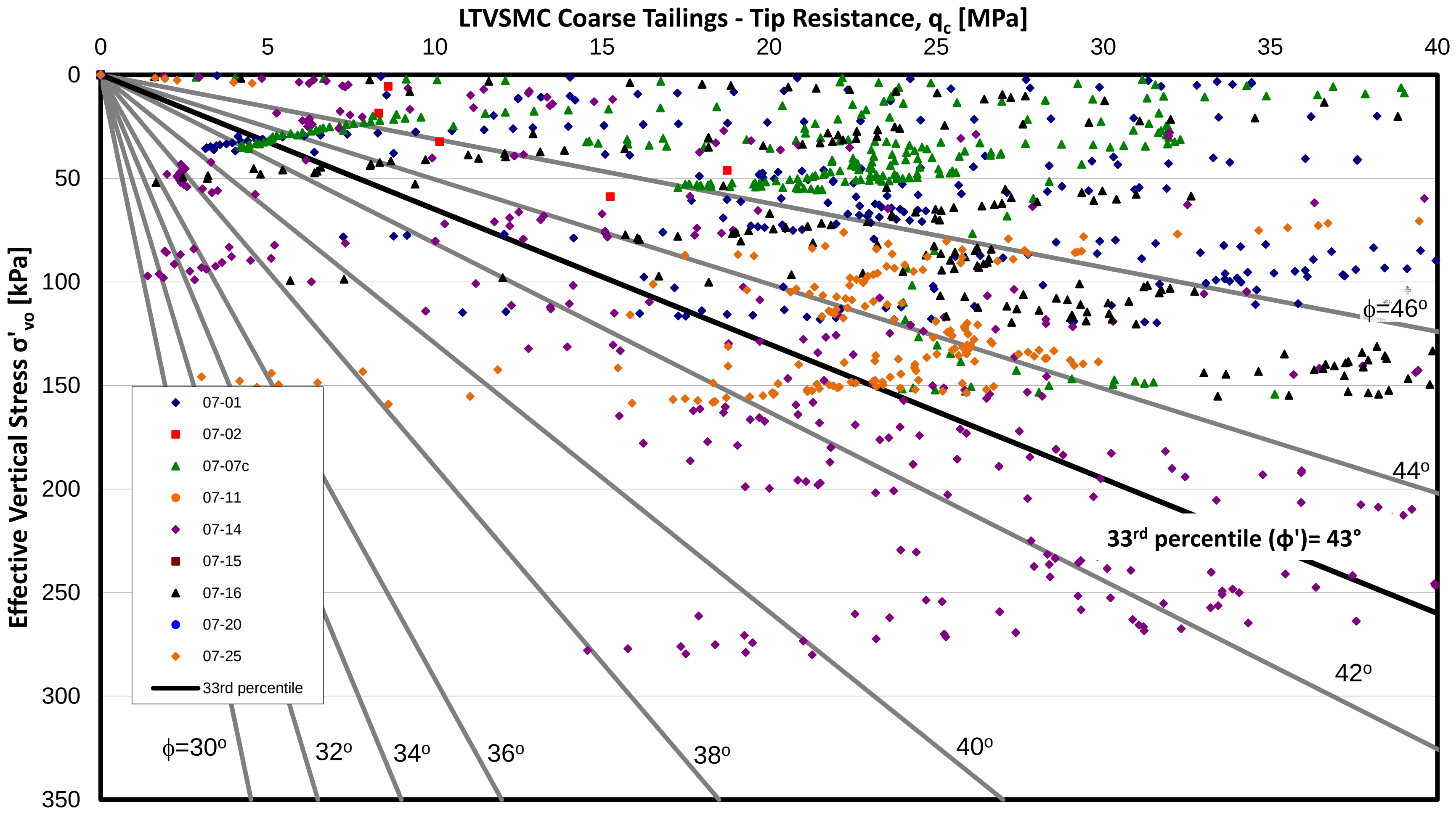


Figure A-3
LTVSMC Coarse Tailings
CPT Correlated Friction Angle Relationship
(Robertson and Campanella, 1983)



P:\Mpls\23 MN\69\2369862\WorkFiles\WO 022A Tailings Basin Permitting\2013 v4 Data Package Vol 1\Att C - Material Strength Characterization\Att C - V4_CPT\Coarse Tailings_CPTSummary_2008 analysis.xls 4/5/2013

FIGURE A-4
LTVSMC Fine Tailings
Triaxial Drained Shear Strength Envelope

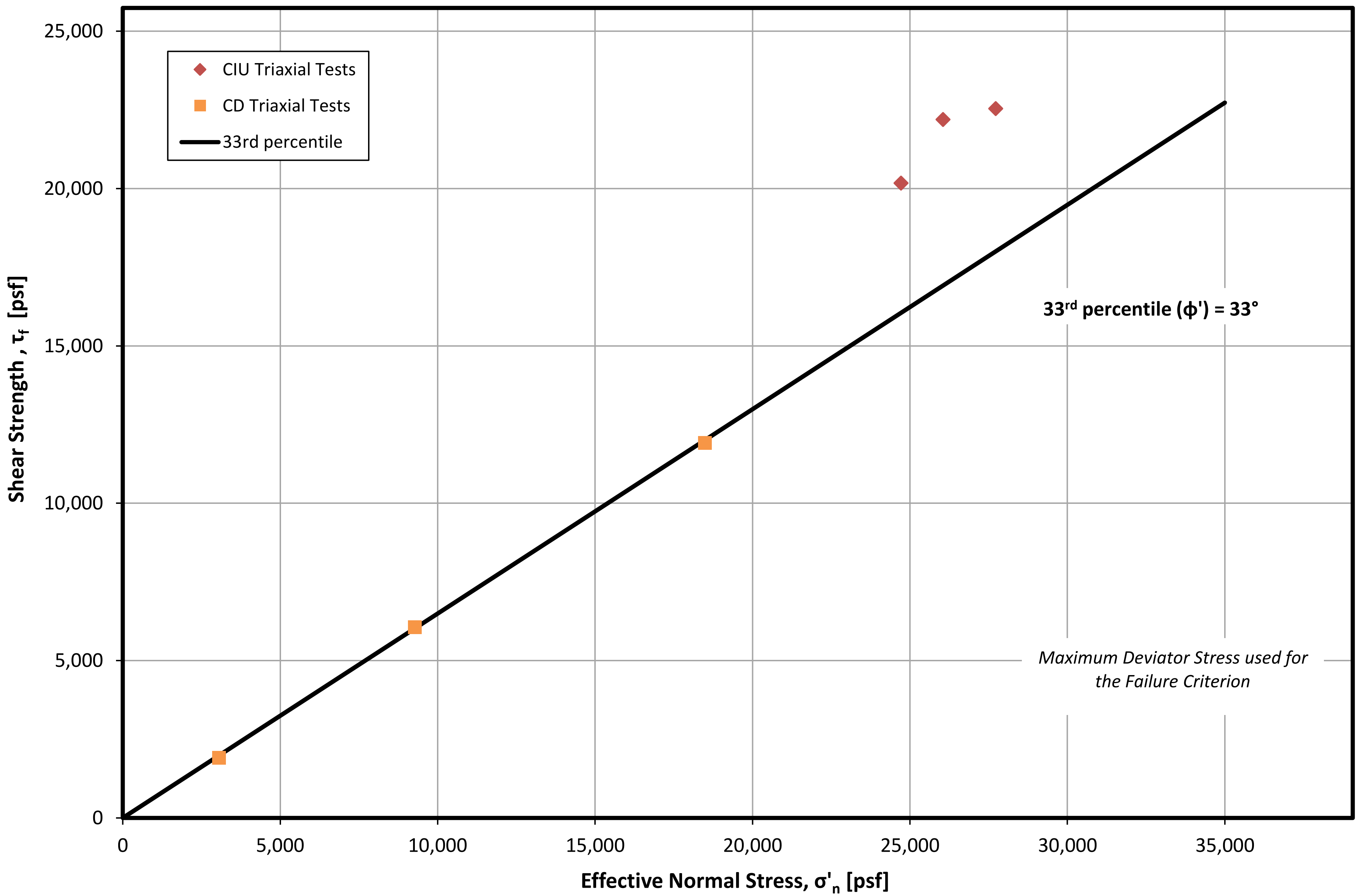


FIGURE A-5
LTVSMC Slimes
Triaxial and Direct Shear Drained Shear Strength Envelope

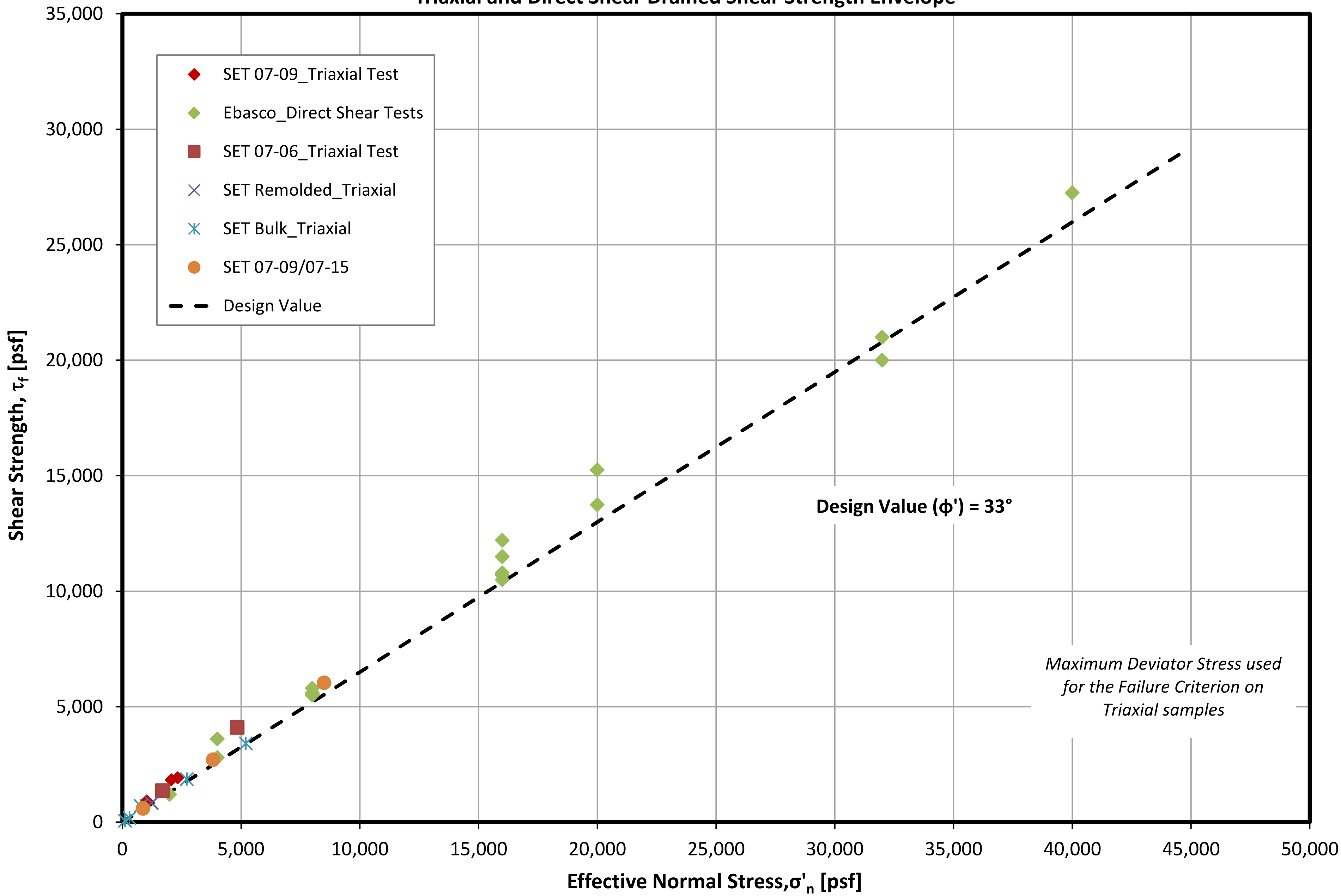


FIGURE A-6
LTVSMC Fine Tailings/Slimes
Triaxial and Direct Shear Drained Shear Strength Envelope

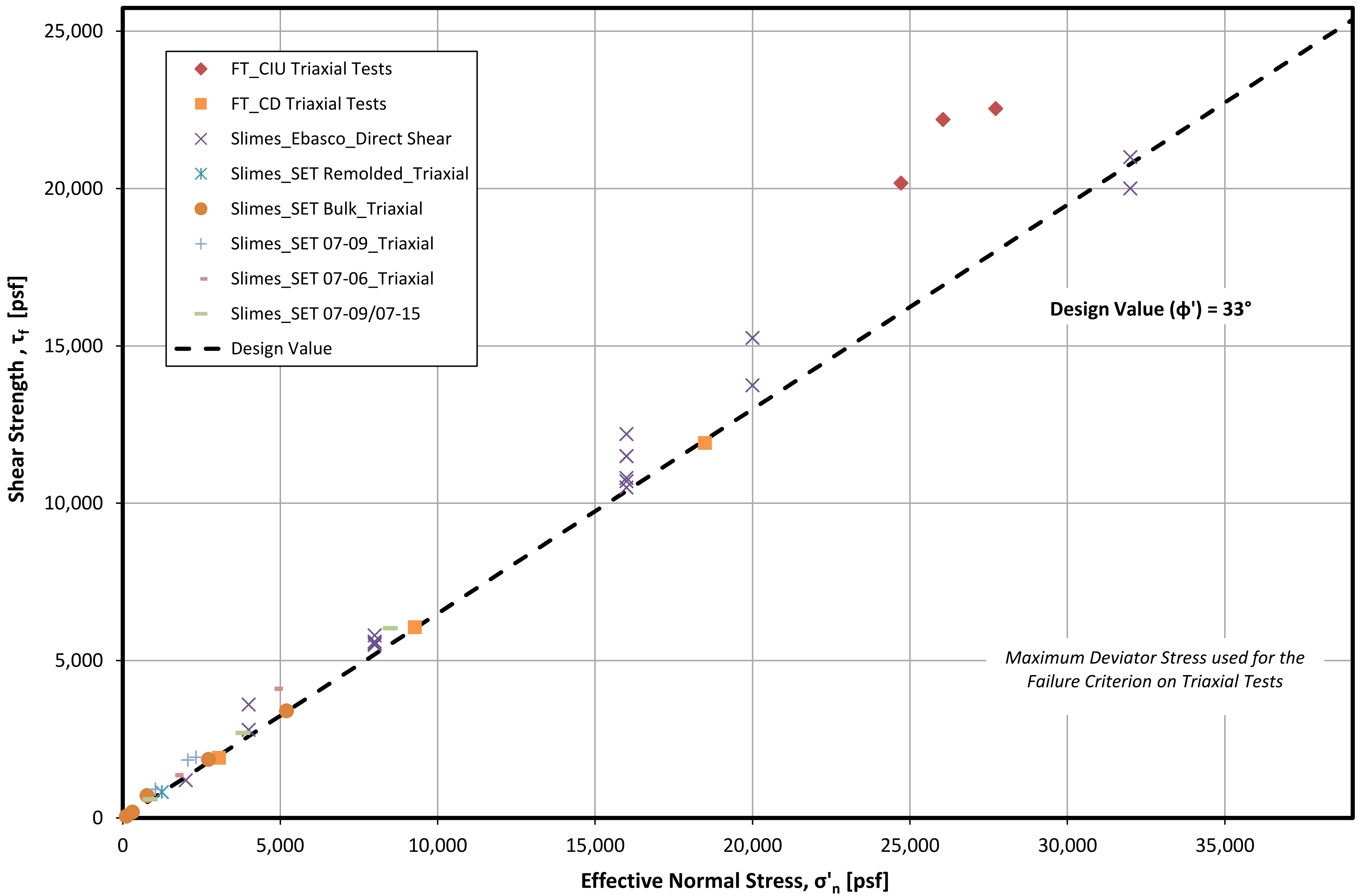


FIGURE A-7
LTVSMC Bulk Tailings
Triaxial Drained Shear Strength Envelope

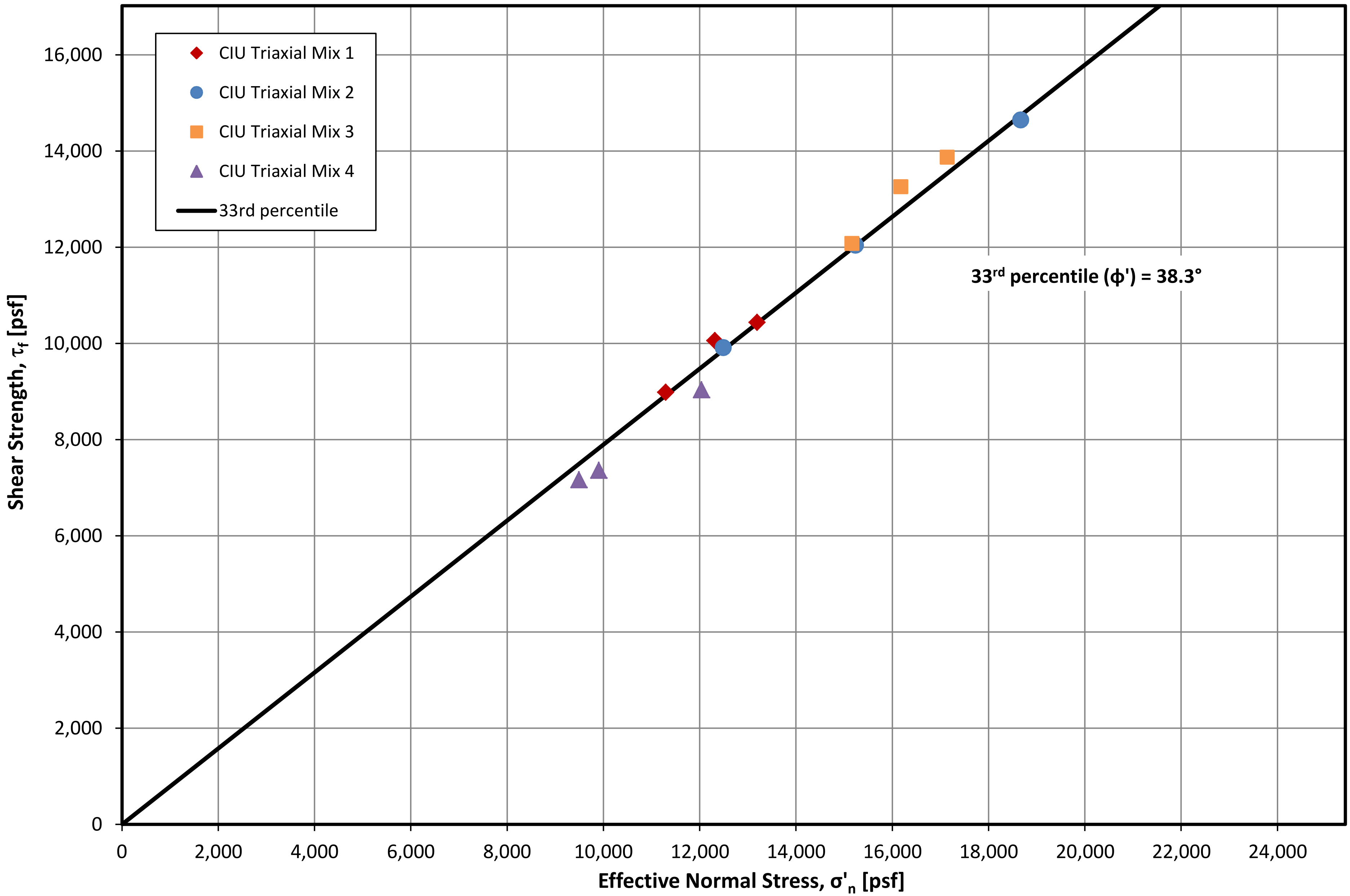


FIGURE A-8
NorthMet Flotation Tailings
Triaxial Drained Shear Strength Envelope

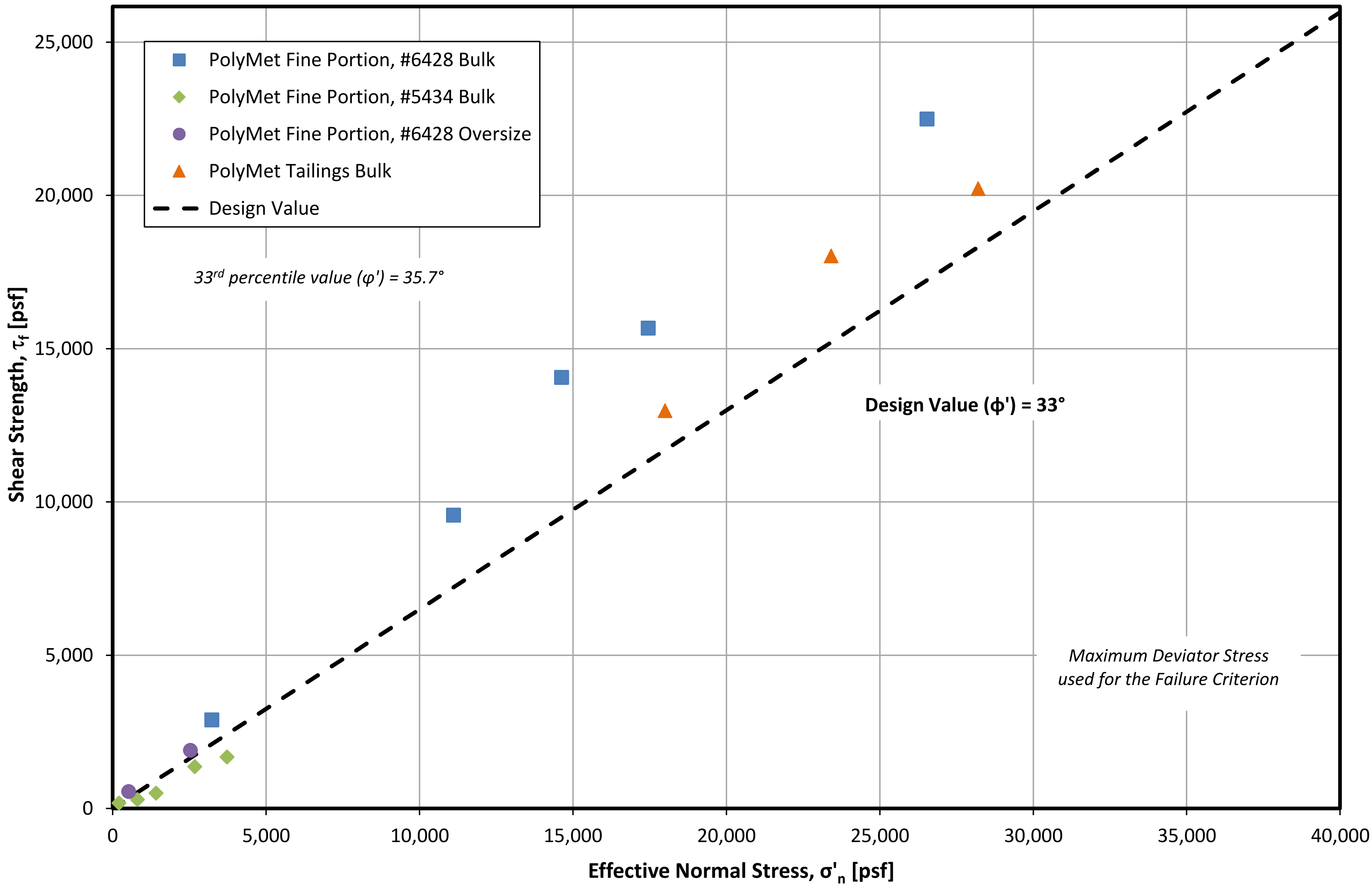


FIGURE A-9
Compressed and Virgin Peat
Direct Shear Drained Shear Strength Envelope

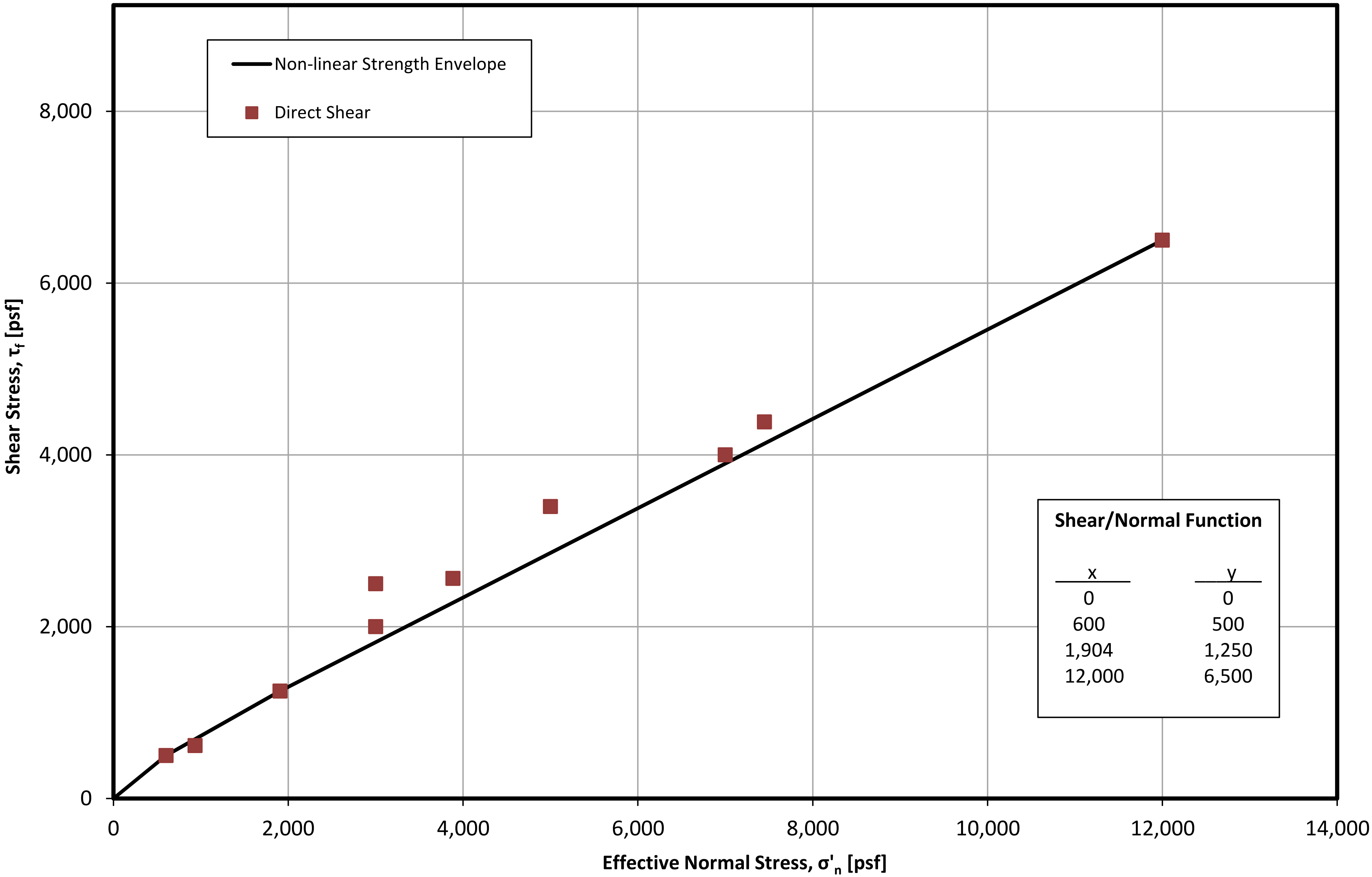


FIGURE A-10

Glacial Till

SPT Correlated Drained Shear Strength Envelope

(Schmertmann, 1975, for Granular Soil)

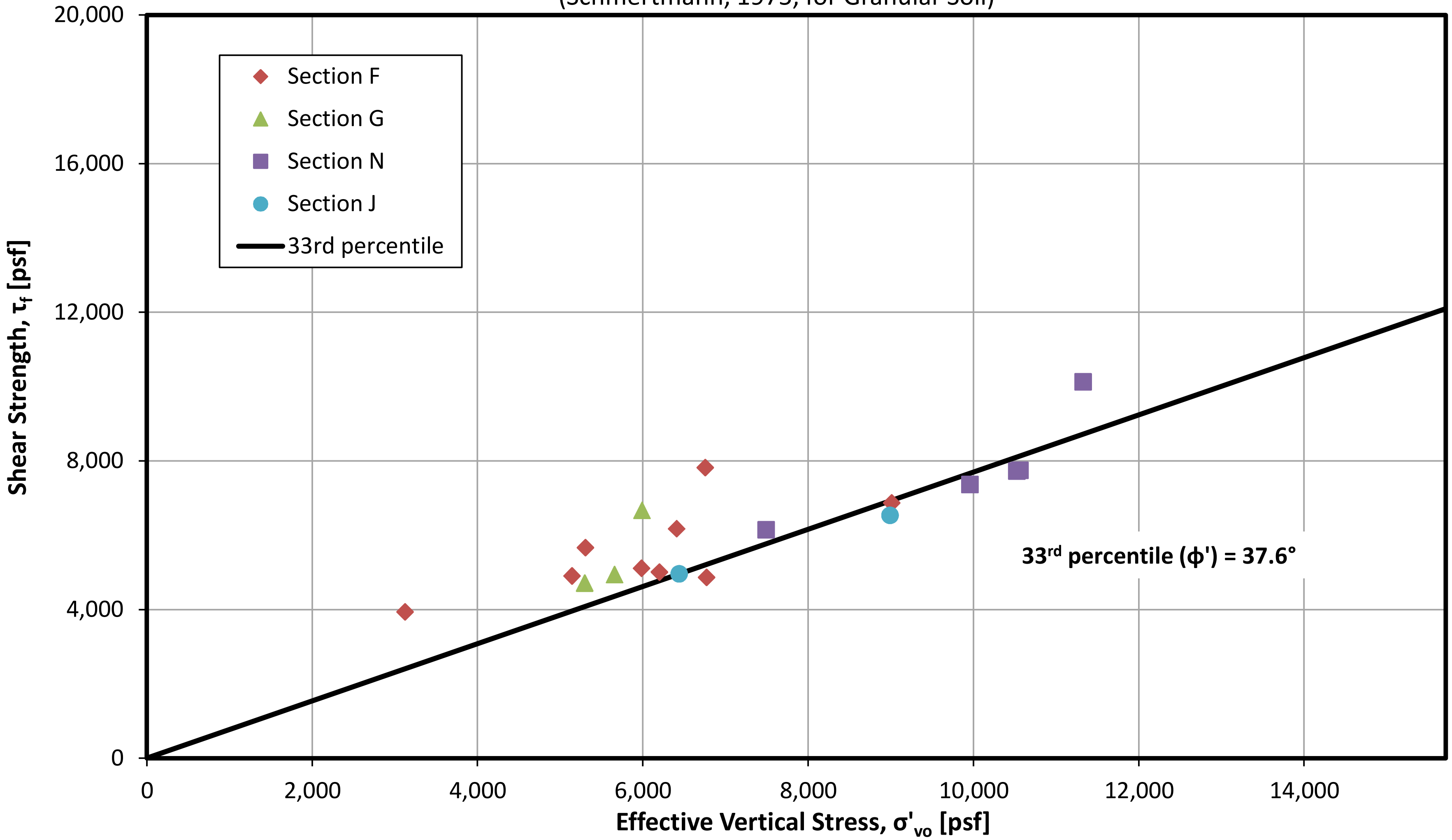


Exhibit B

Figures of Undrained Strength Tests

FIGURE B-1
LTVSMC Fine Tailings
CPT Correlated Undrained Shear Strength Envelope
(Olson and Stark, 2003)

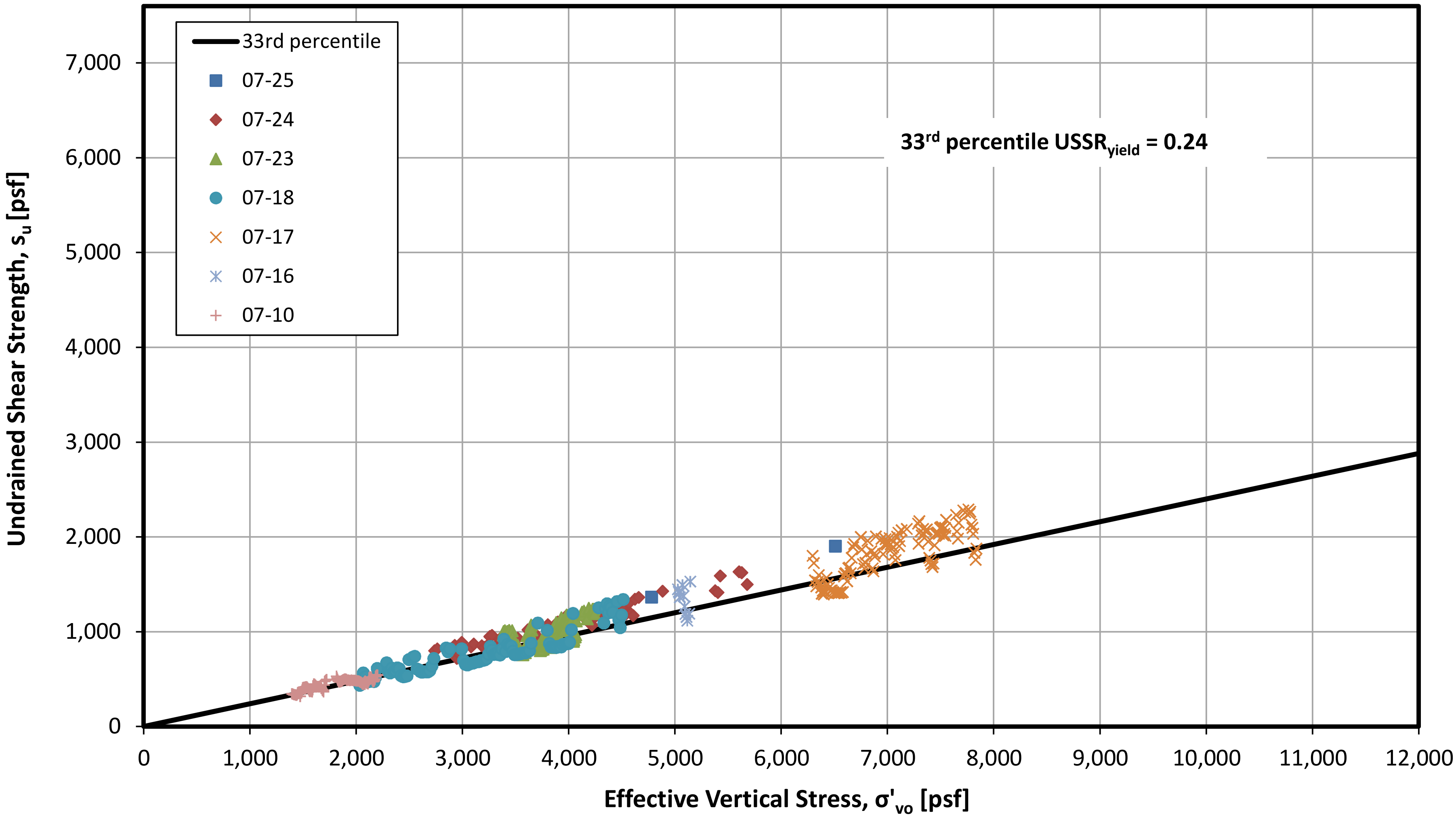


FIGURE B-2

LTVSMC Fine Tailings

SPT Correlated Undrained Shear Strength Envelope

(Olson and Stark, 2003)

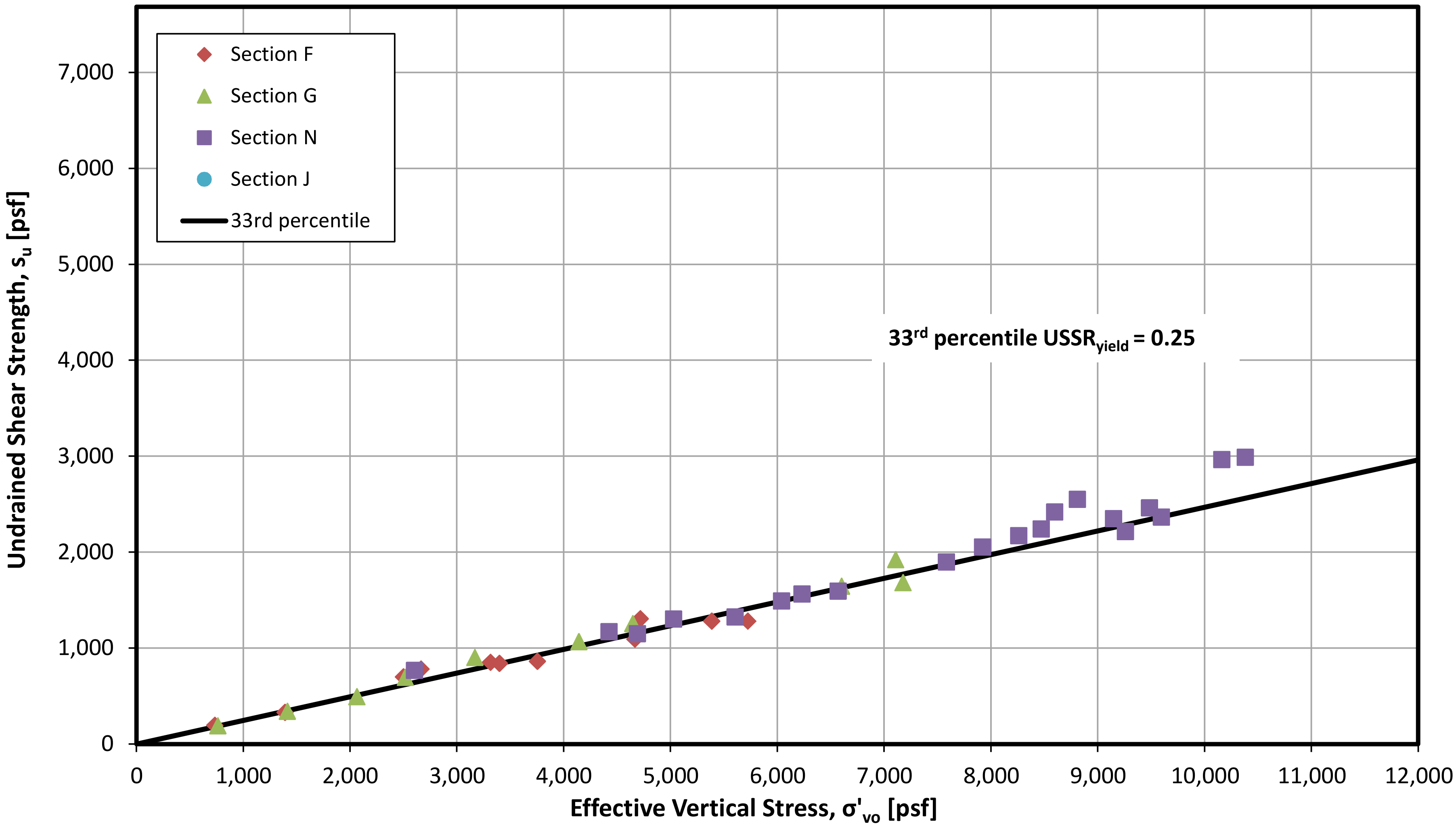


FIGURE B-3
LTVSMC Slimes
Triaxial Undrained Shear Strength Envelope

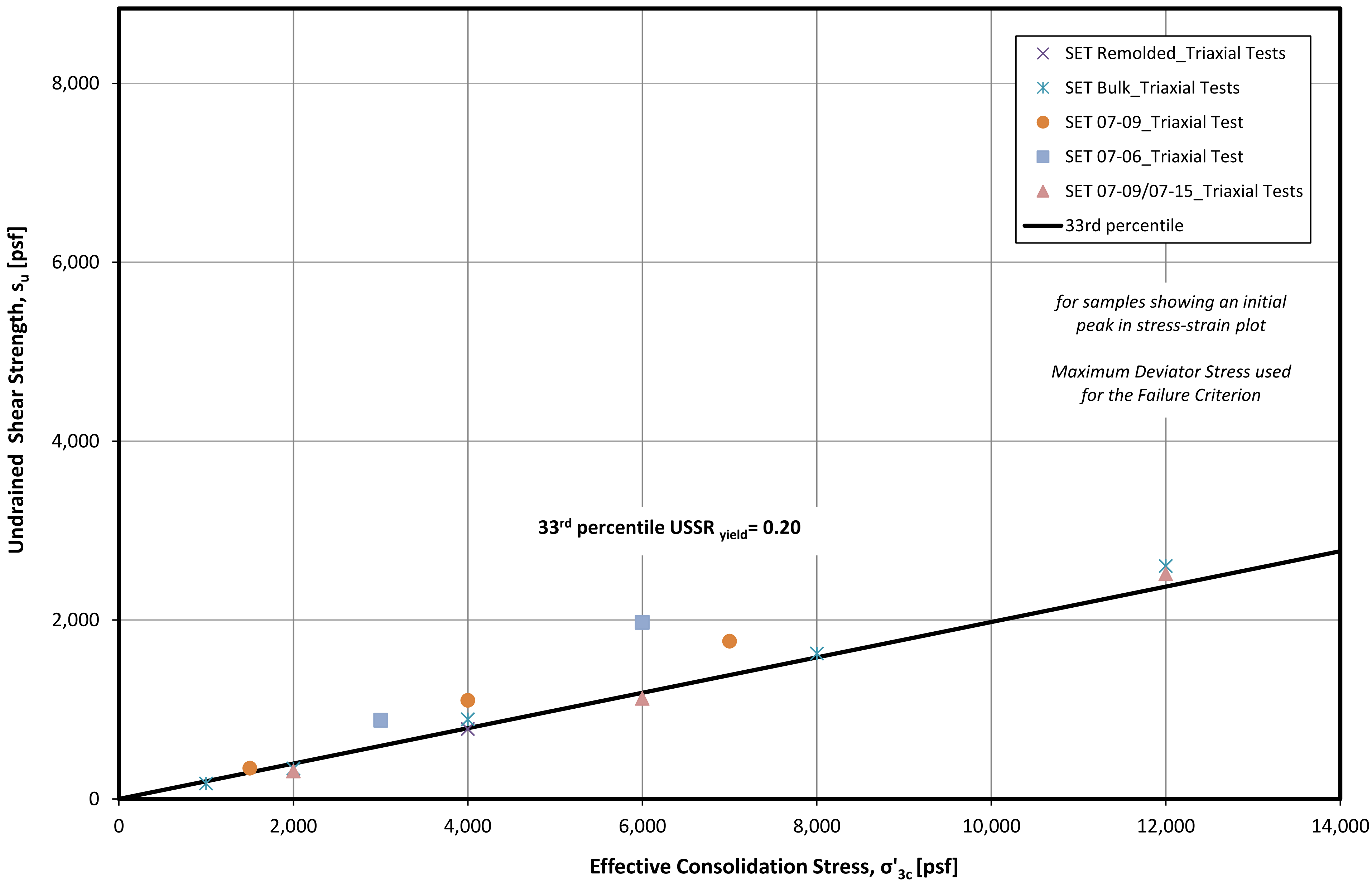


FIGURE B-4
LTVSMC Slimes
CPT Correlated Undrained Shear Strength Envelope
(Olson and Stark, 2003)

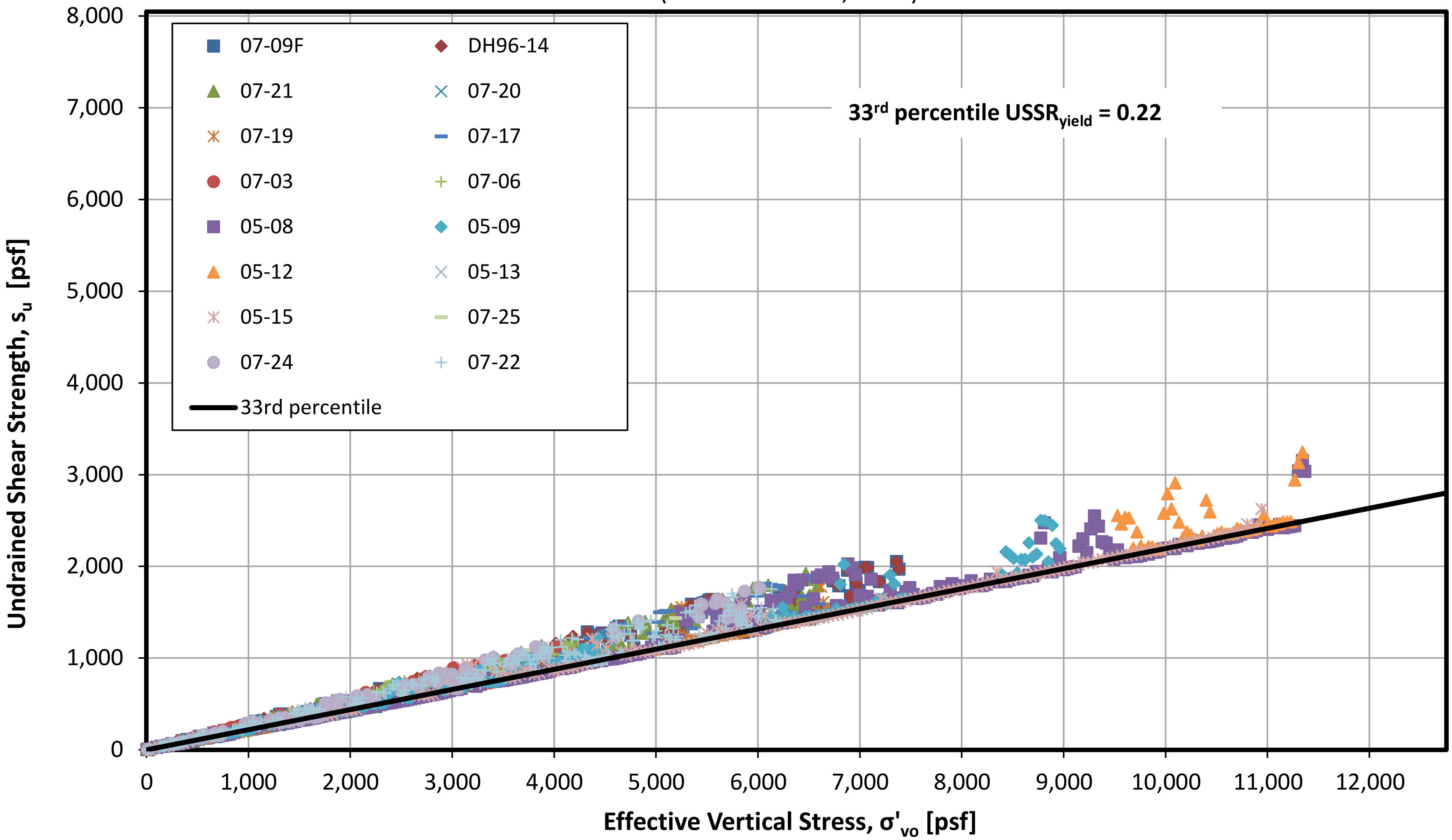


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FIGURE B-5
LTVSMC Slimes
SPT Correlated Undrained Shear Strength Envelope
(Olson and Stark, 2003)

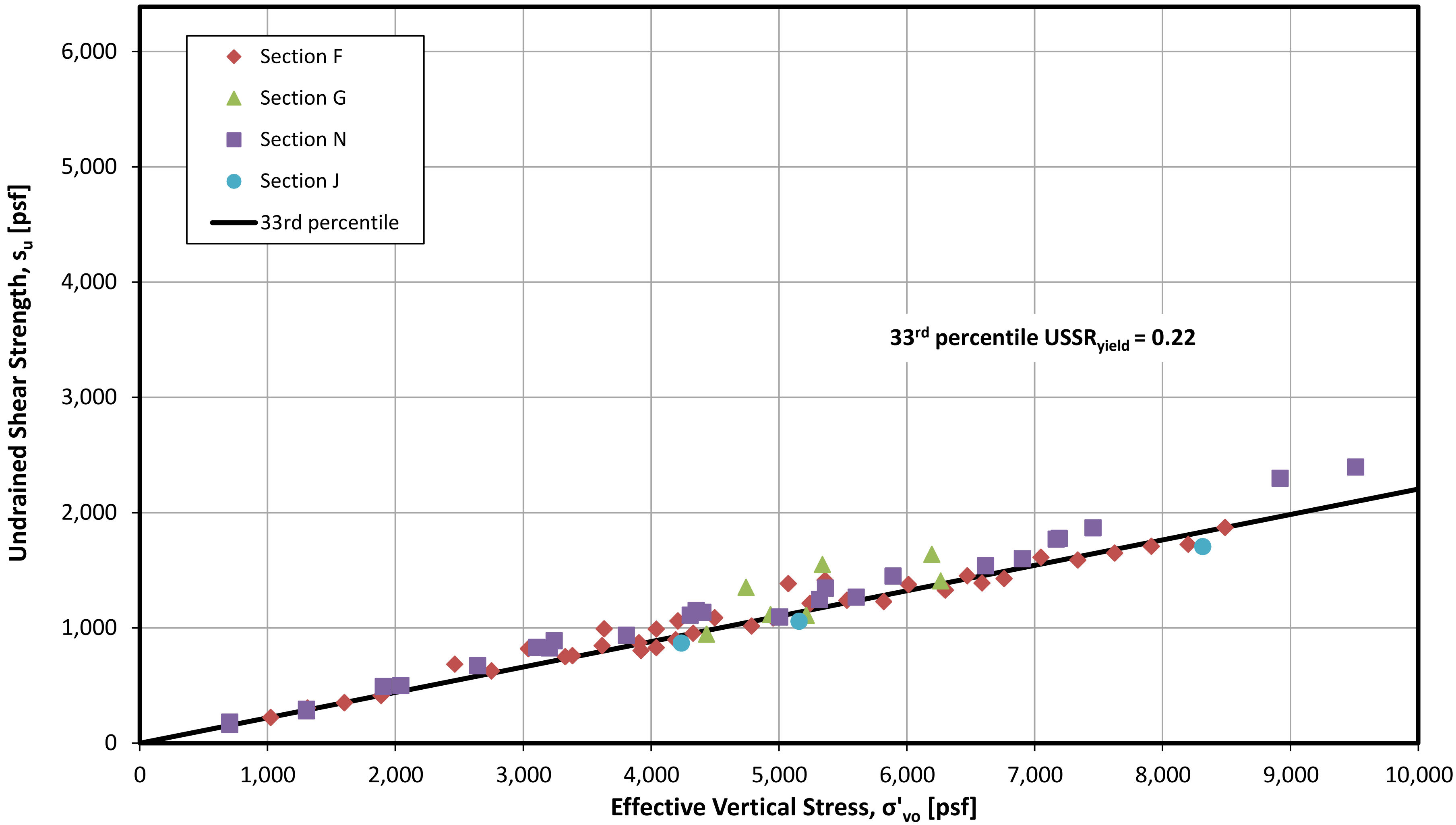


FIGURE B-6
LTVSMC Slimes
FVST Peak Undrained Shear Strength Envelope

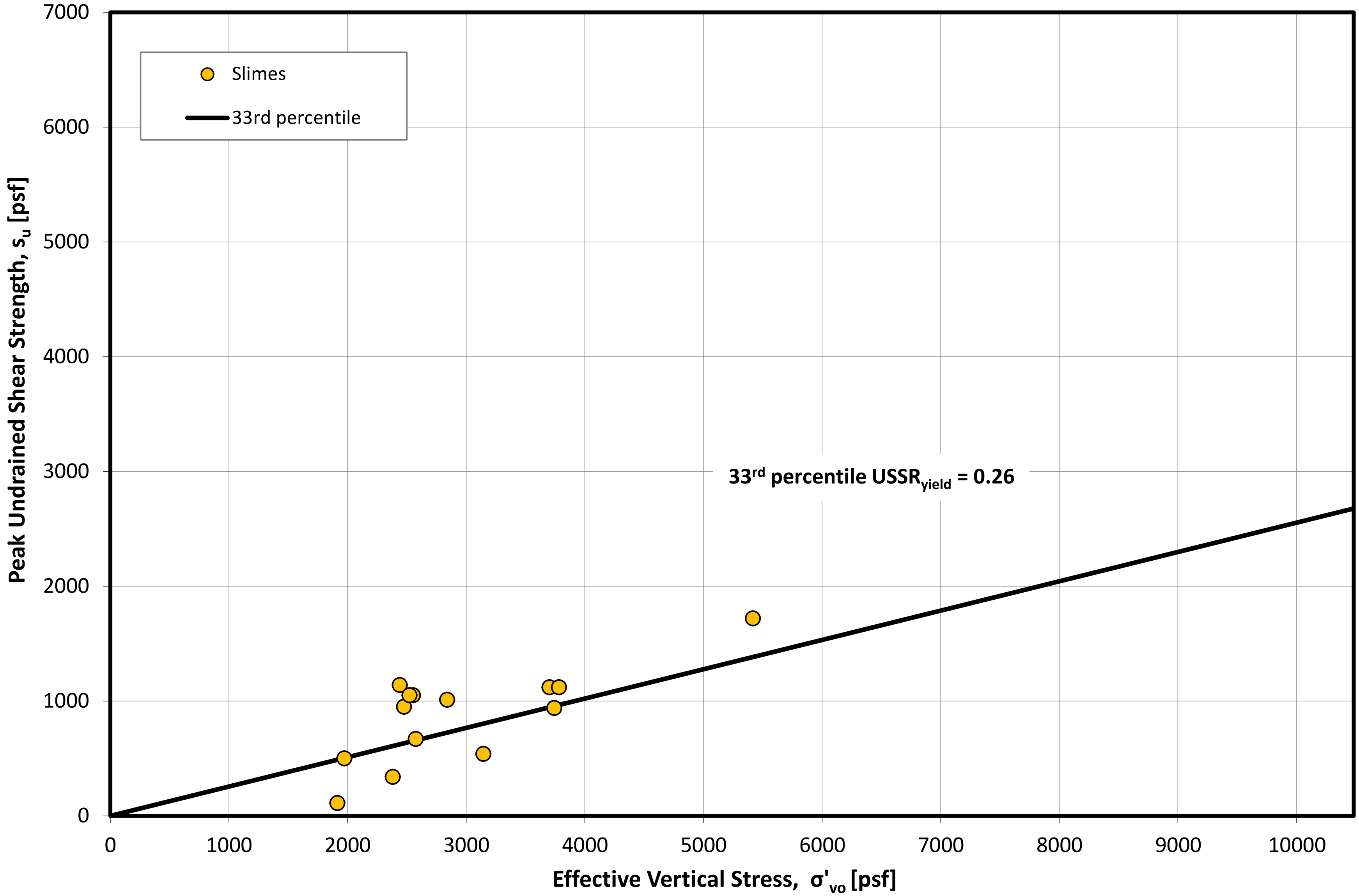


FIGURE B-7
LTVSMC Fine Tailings/Slimes
CPT Correlated Undrained Shear Strength
(Olson and Stark, 2003)

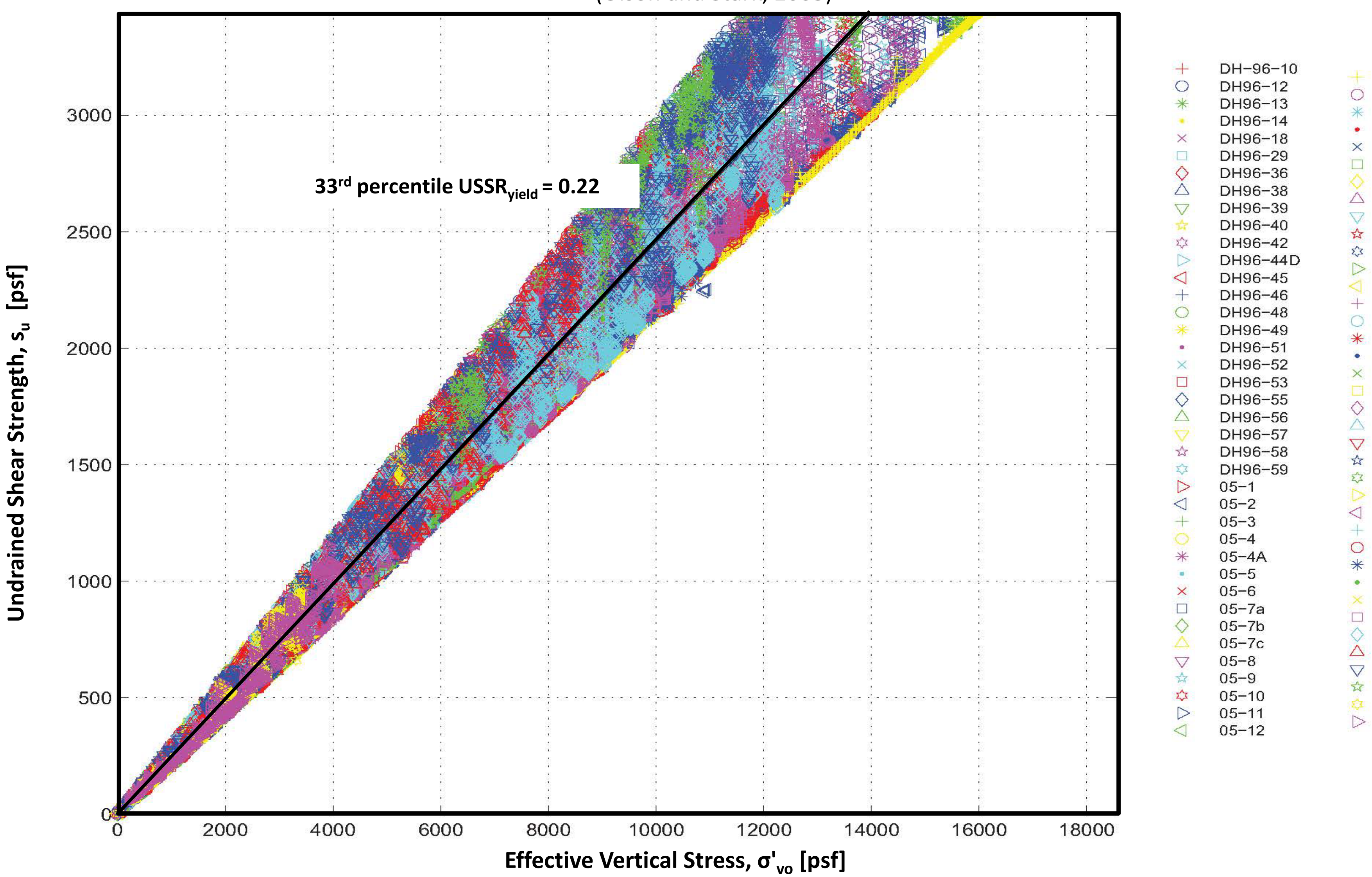


FIGURE B-8
LTVSMC Fine Tailings/Slimes
SPT Correlated Undrained Shear Strength Envelope
(Olson and Stark, 2003)

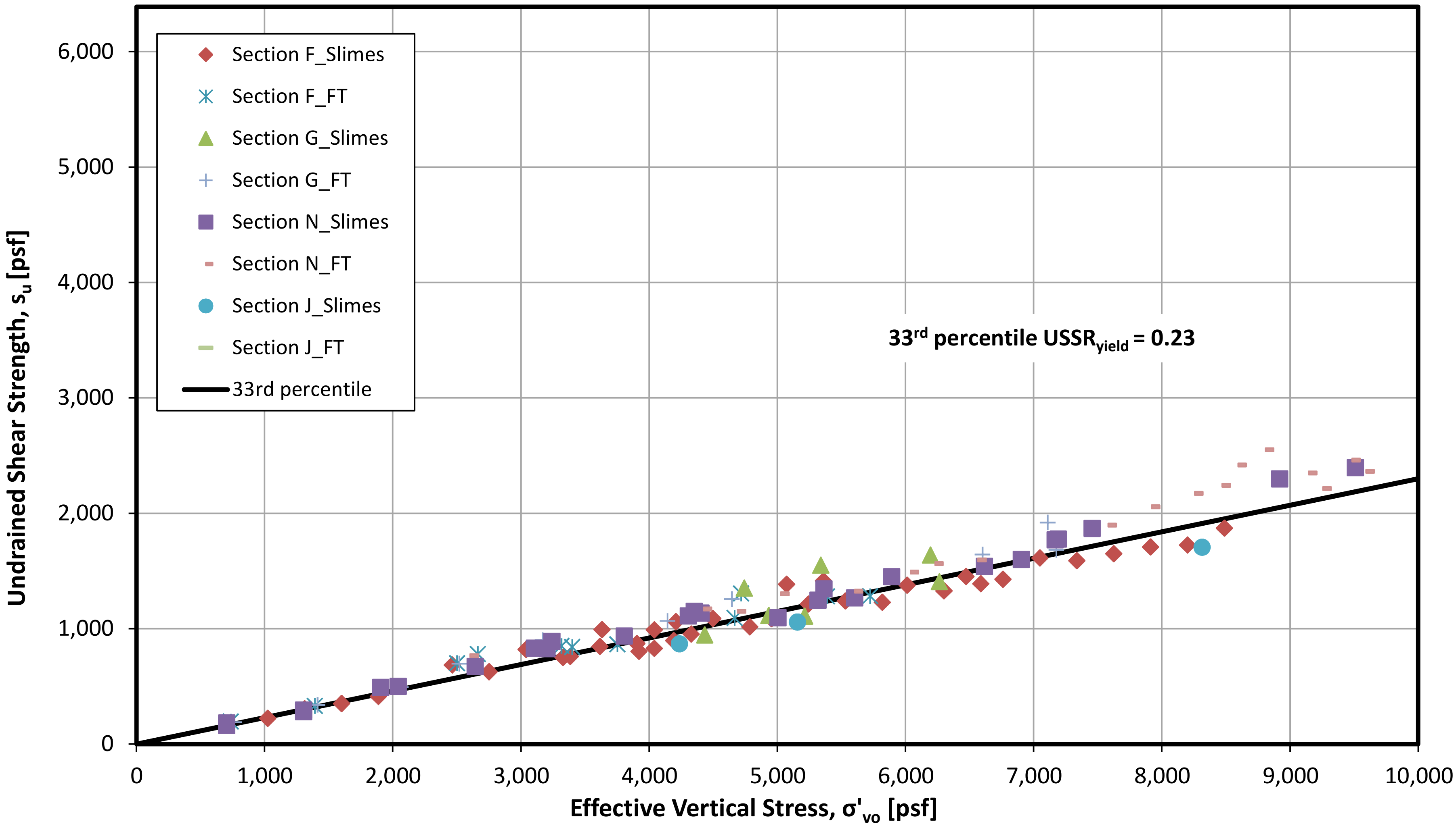


FIGURE B-9
LTVSMC Fine Tailings/Slimes
FVST Peak Undrained Shear Strength Envelope

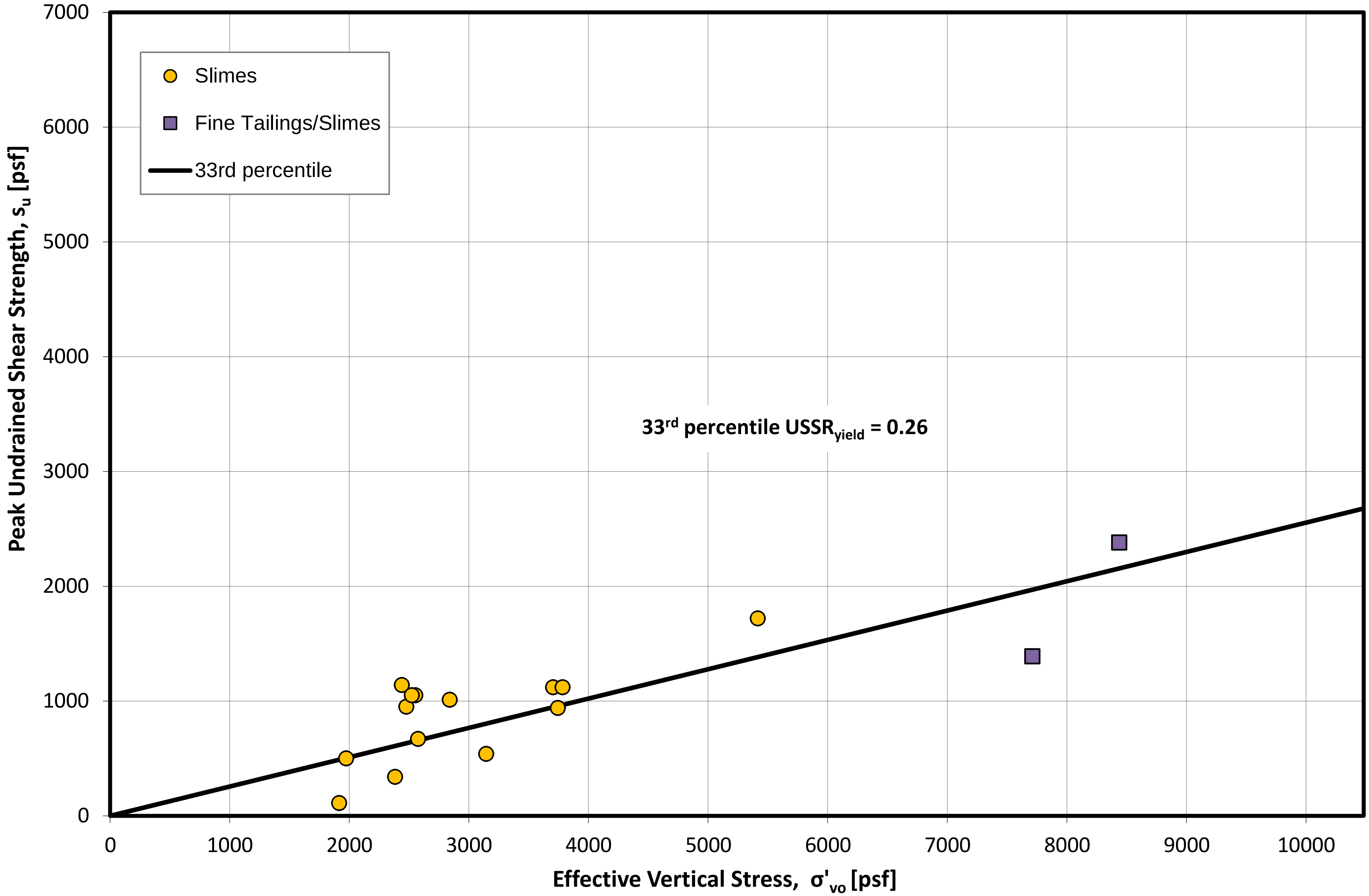


FIGURE B-10
NorthMet Flotation Tailings
Triaxial Undrained Shear Strength Envelope

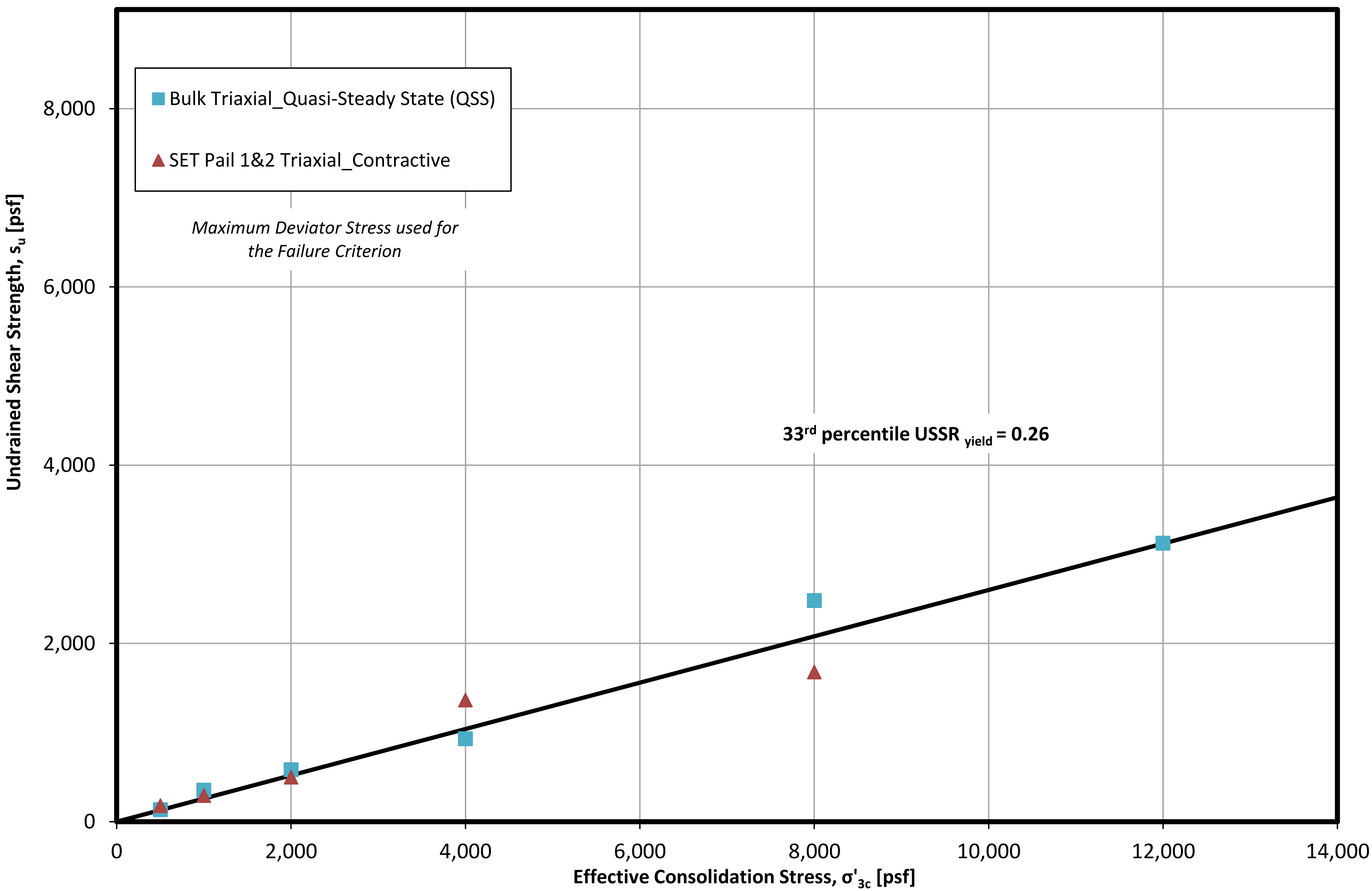


FIGURE B-11
Compressed and Virgin Peat
Triaxial Undrained Shear Strength Envelope

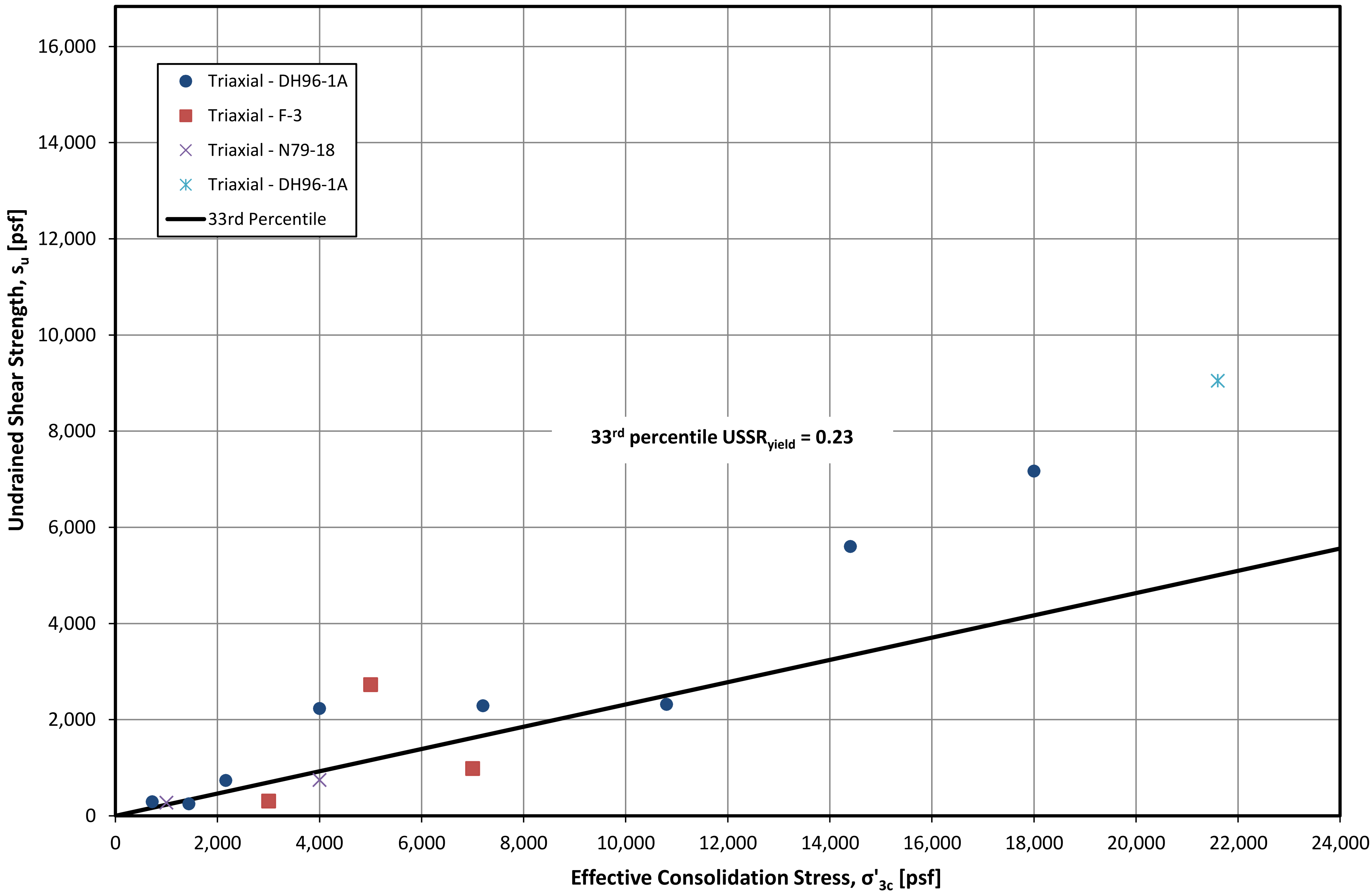


Exhibit C

Figures of Liquefied Tests

FIGURE C-1
Section F_07-06 Characterization Signature
NorthMet Flotation Tailings Basin

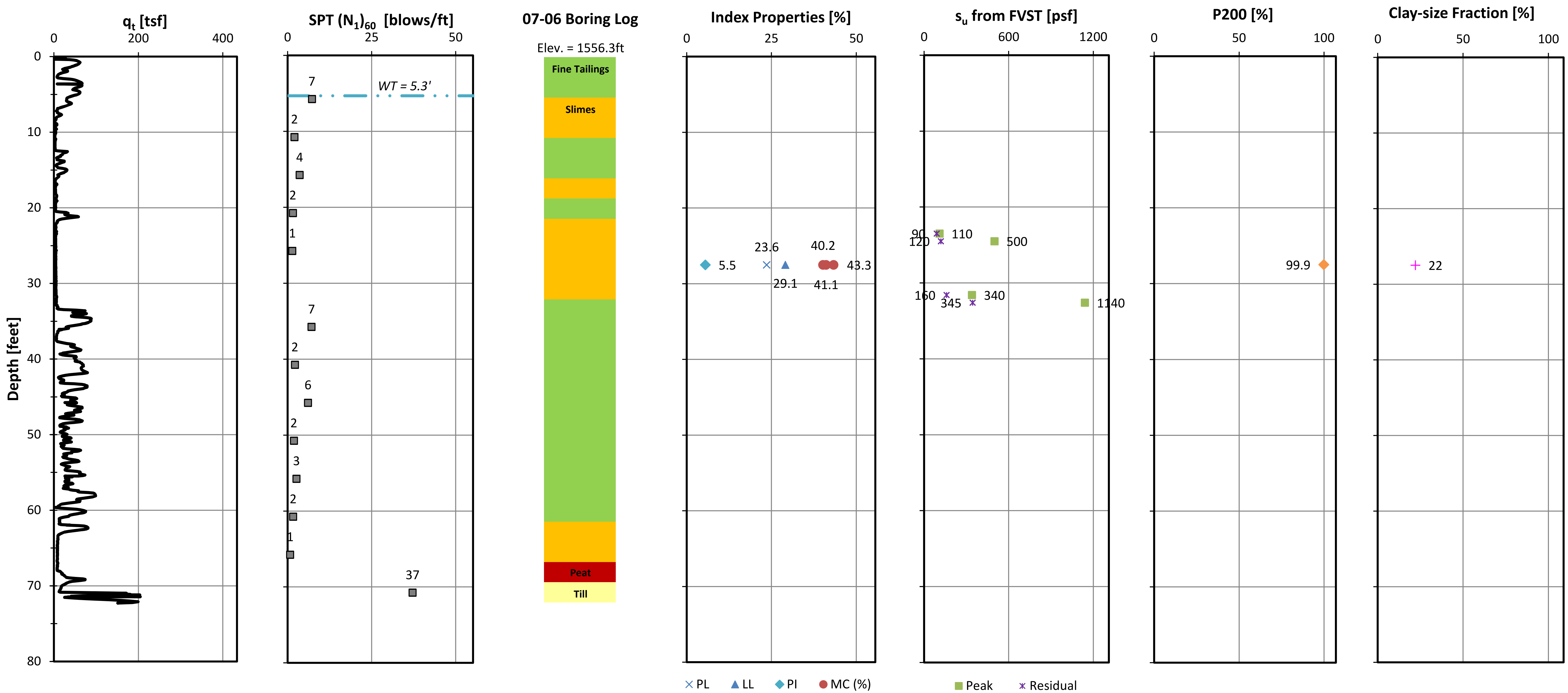


FIGURE C-2

CPT 07-06 Behavior Plot

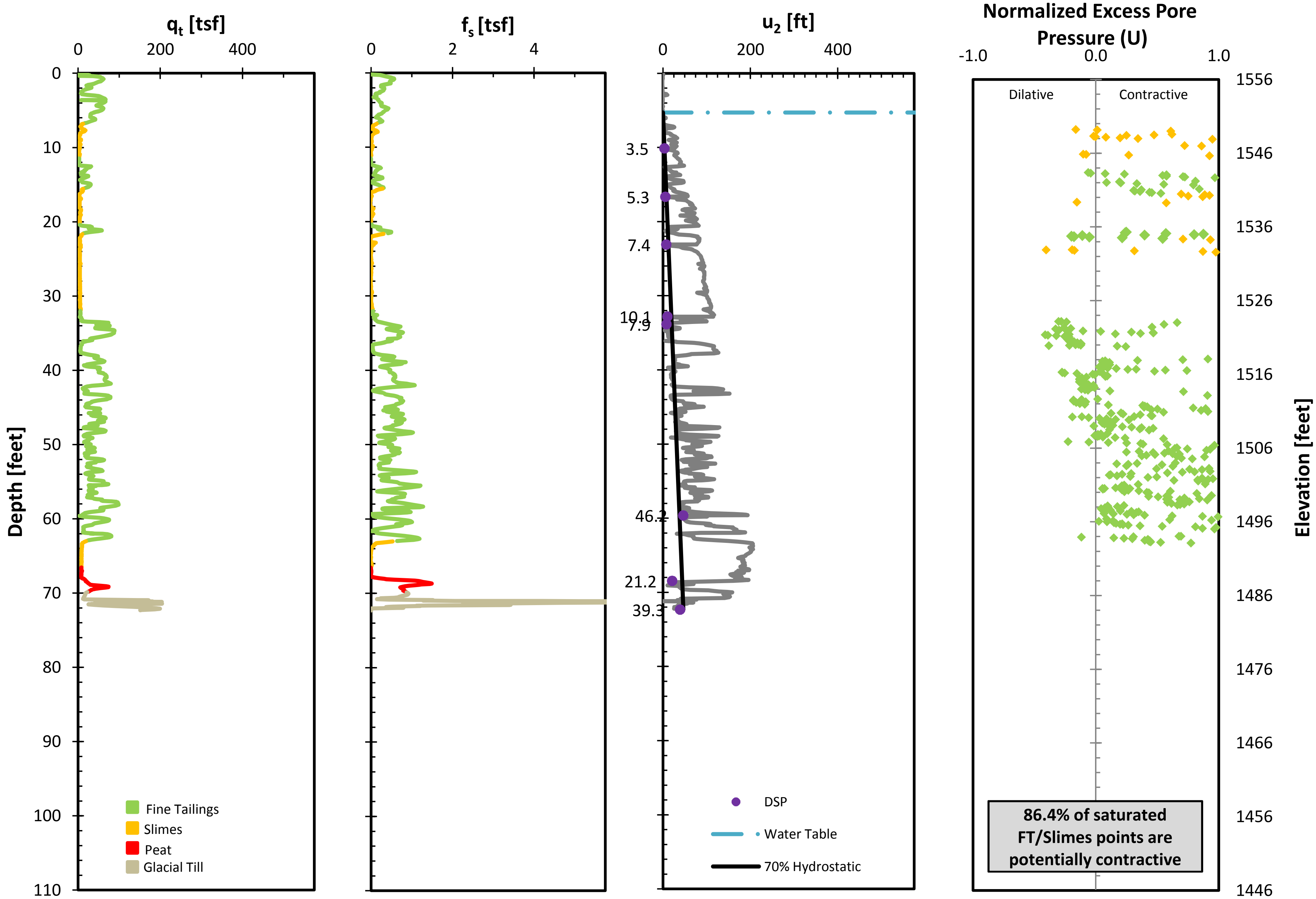


FIGURE C-3
CPT 07-06 LTVSMC Fine Tailings/Slimes
Contractive/Dilative Behavior (Olson, 2009)

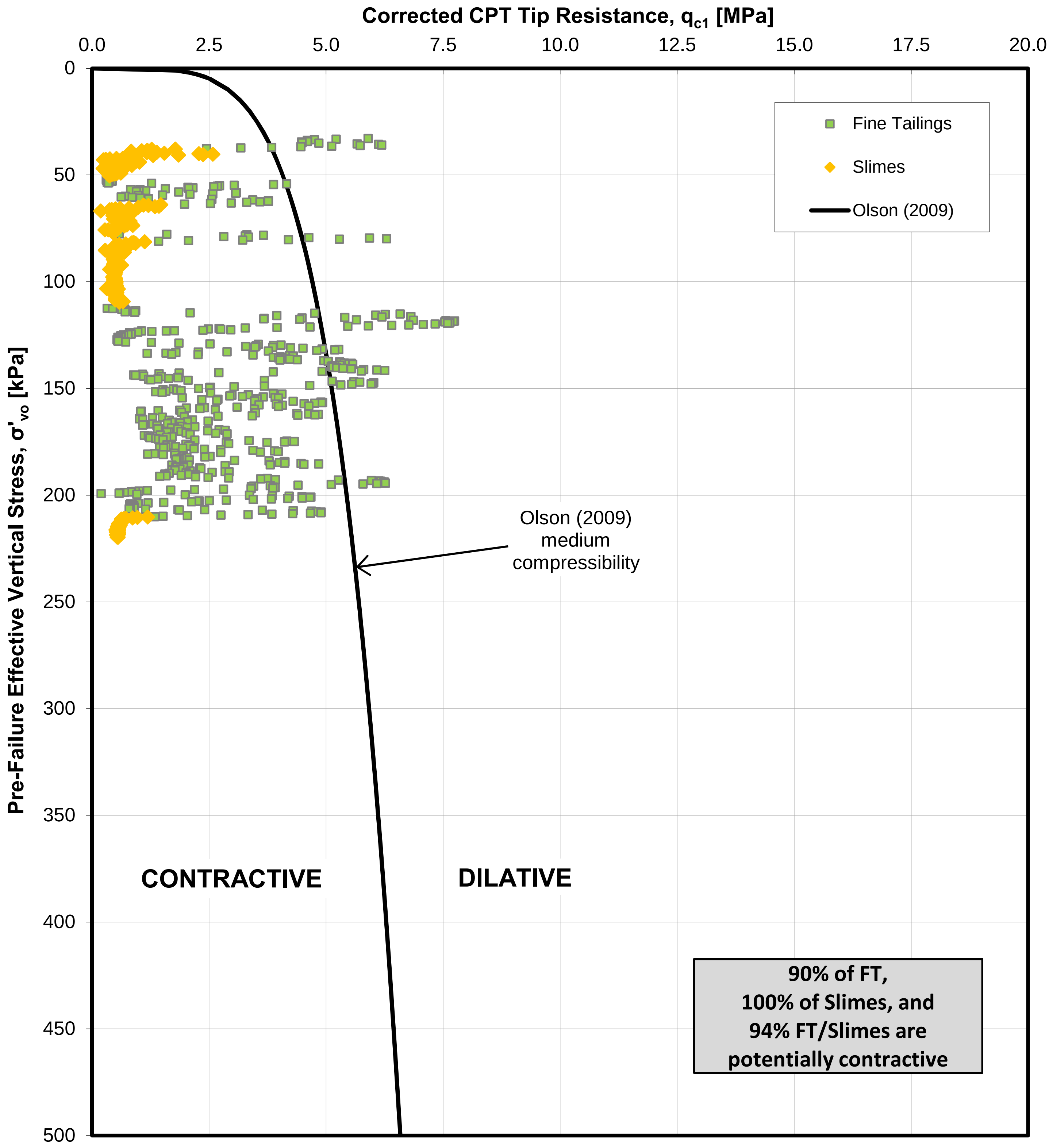


FIGURE C-4

LTVSMC Coarse Tailings Contractive/Dilative Behavior

Based on CPT Data (Olson, 2009)

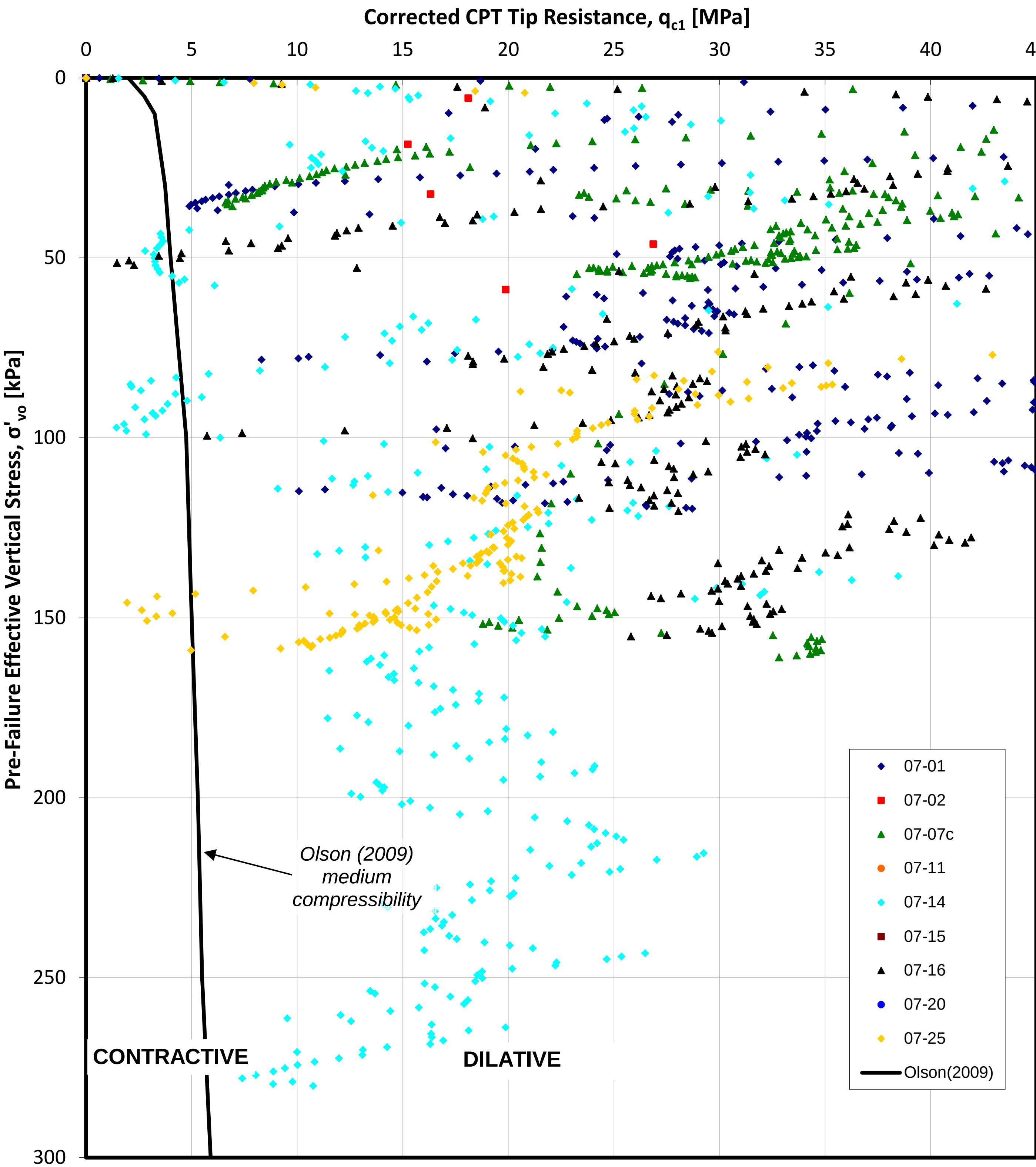


FIGURE C-5

LTVSMC Fine Tailings Contractive/Dilative Behavior

Based on CPT Data (Olson, 2009)

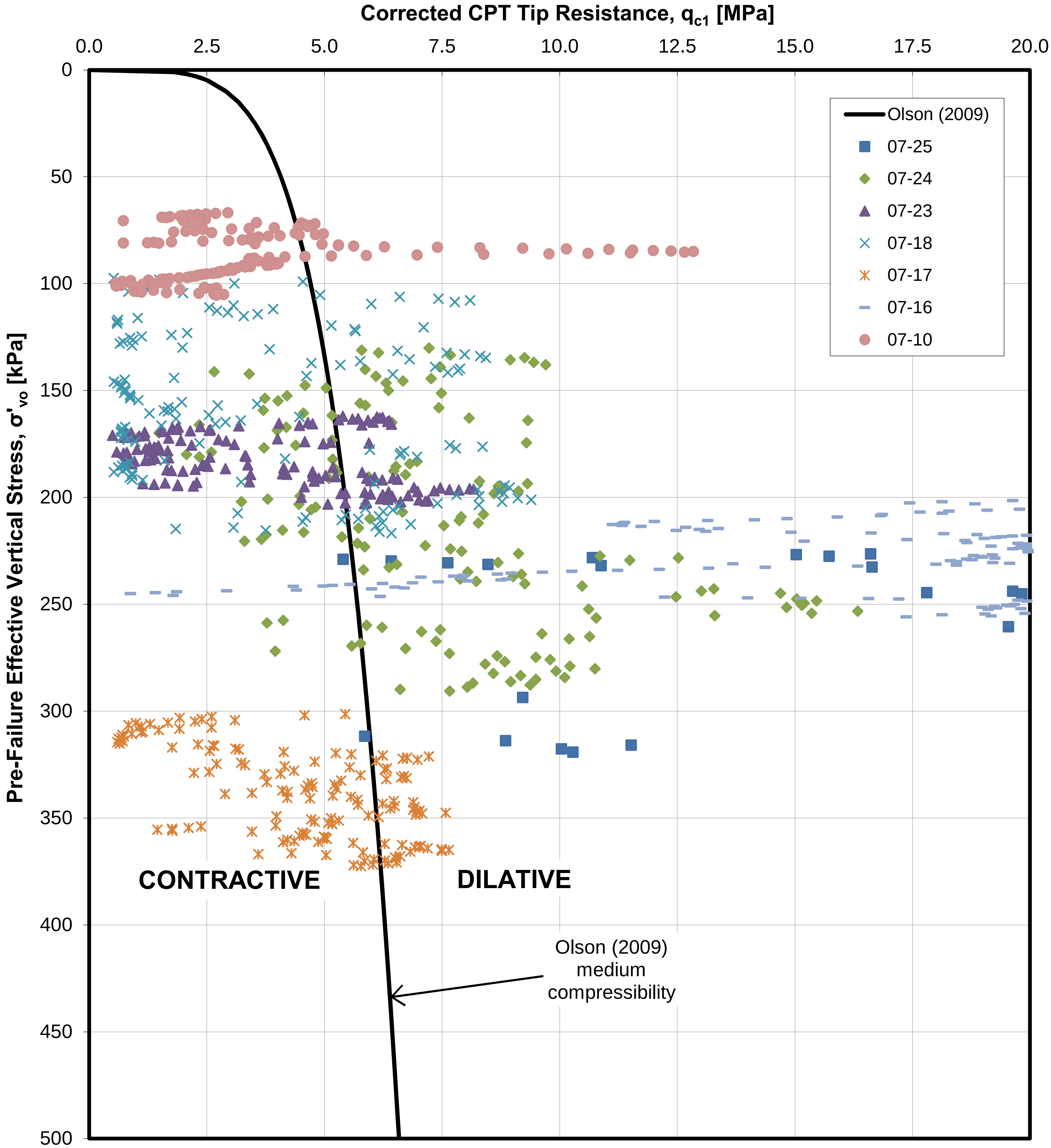


FIGURE C-6

LTVSMC Fine Tailings Contractive/Dilative Behavior

Based on SPT Data (Olson, 2009)

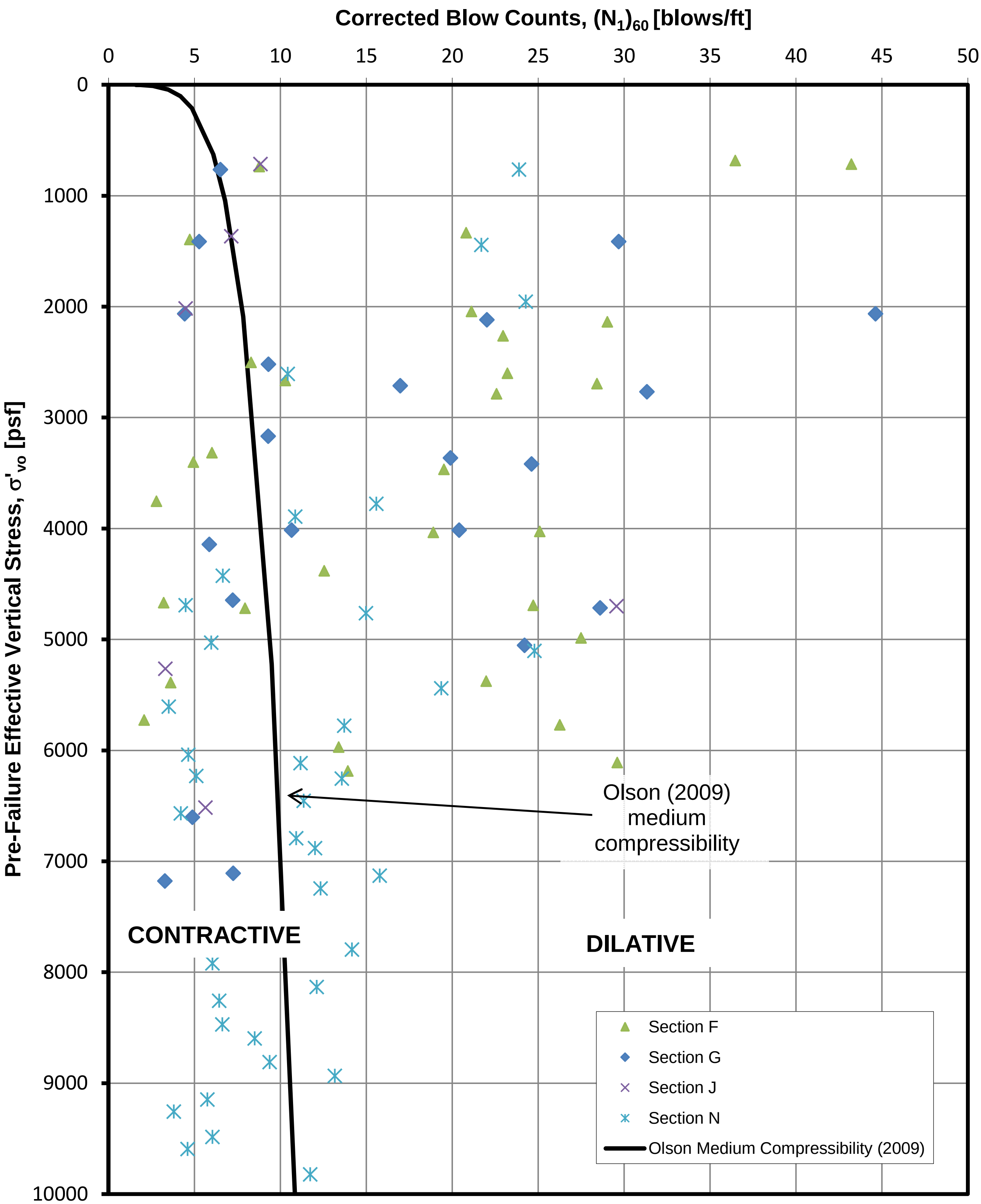


FIGURE C-7
LTVSMC Slimes Contractive/Dilative Behavior
Based on CPT Data (Olson, 2009)

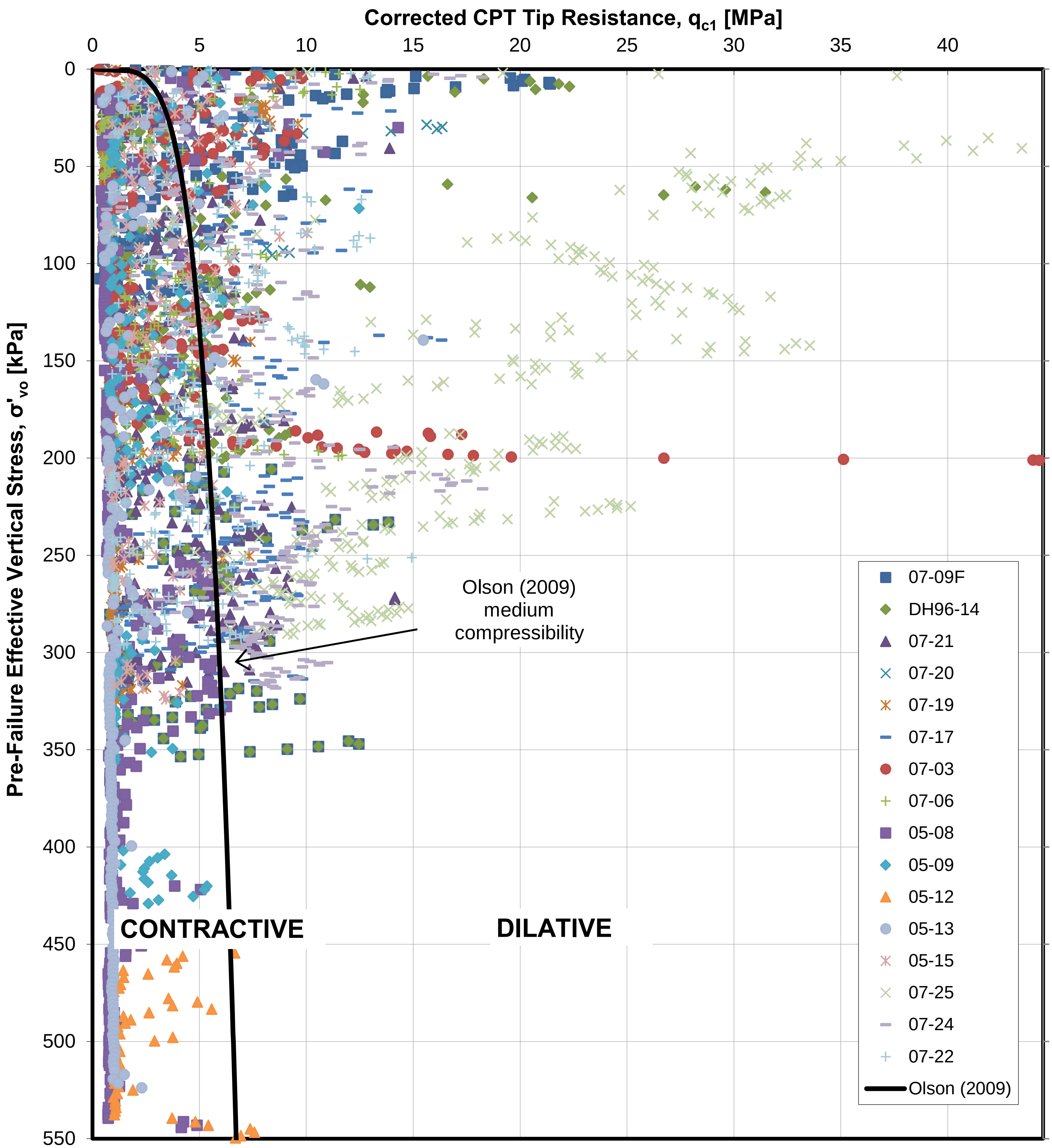


FIGURE C-8

LTVSMC Slimes Contractive/Dilative Behavior

Based on SPT Data (Olson, 2009)

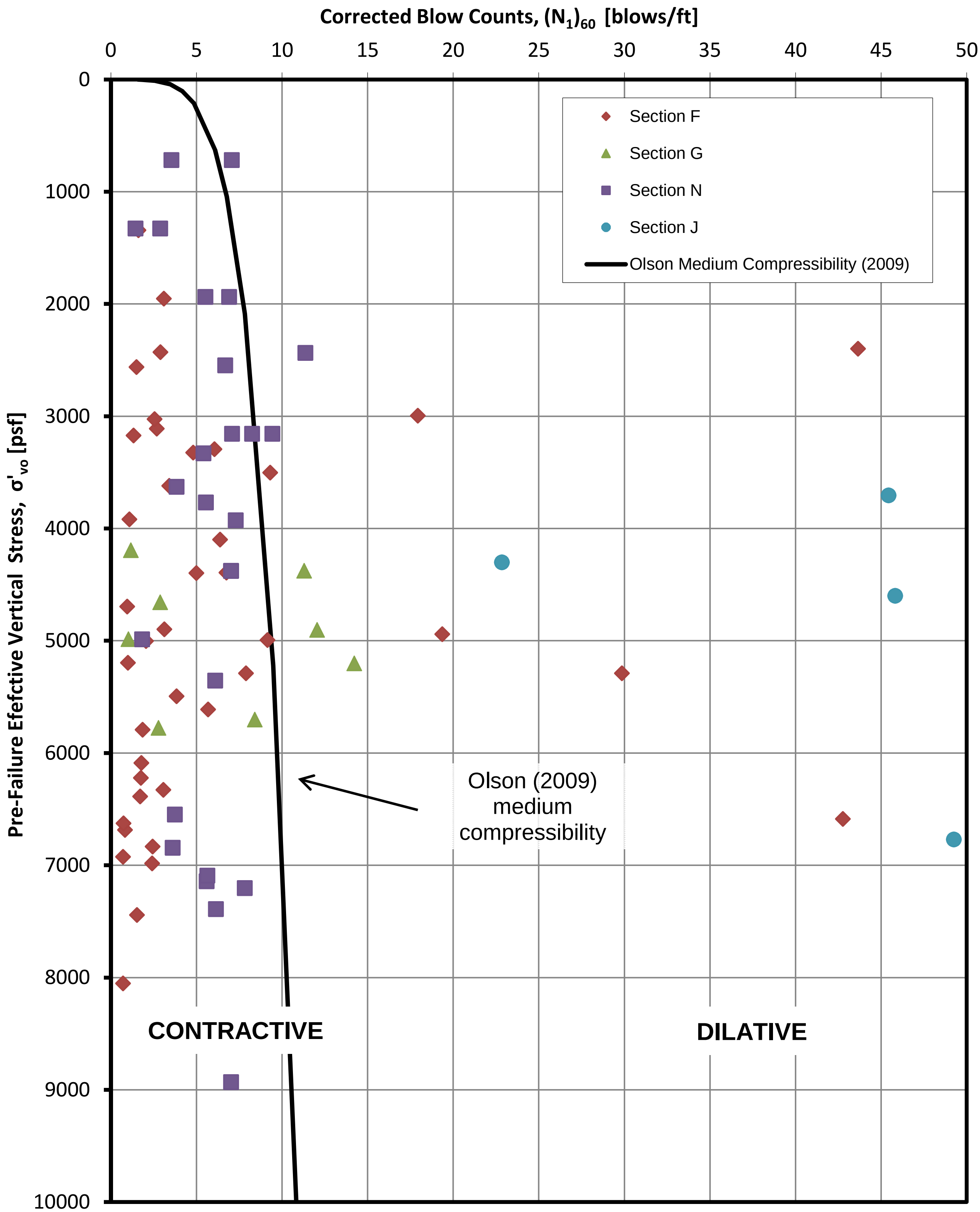


FIGURE C-9
LTVSMC Slimes along Section F
Triaxial Liquefied Undrained Shear Strength Envelope

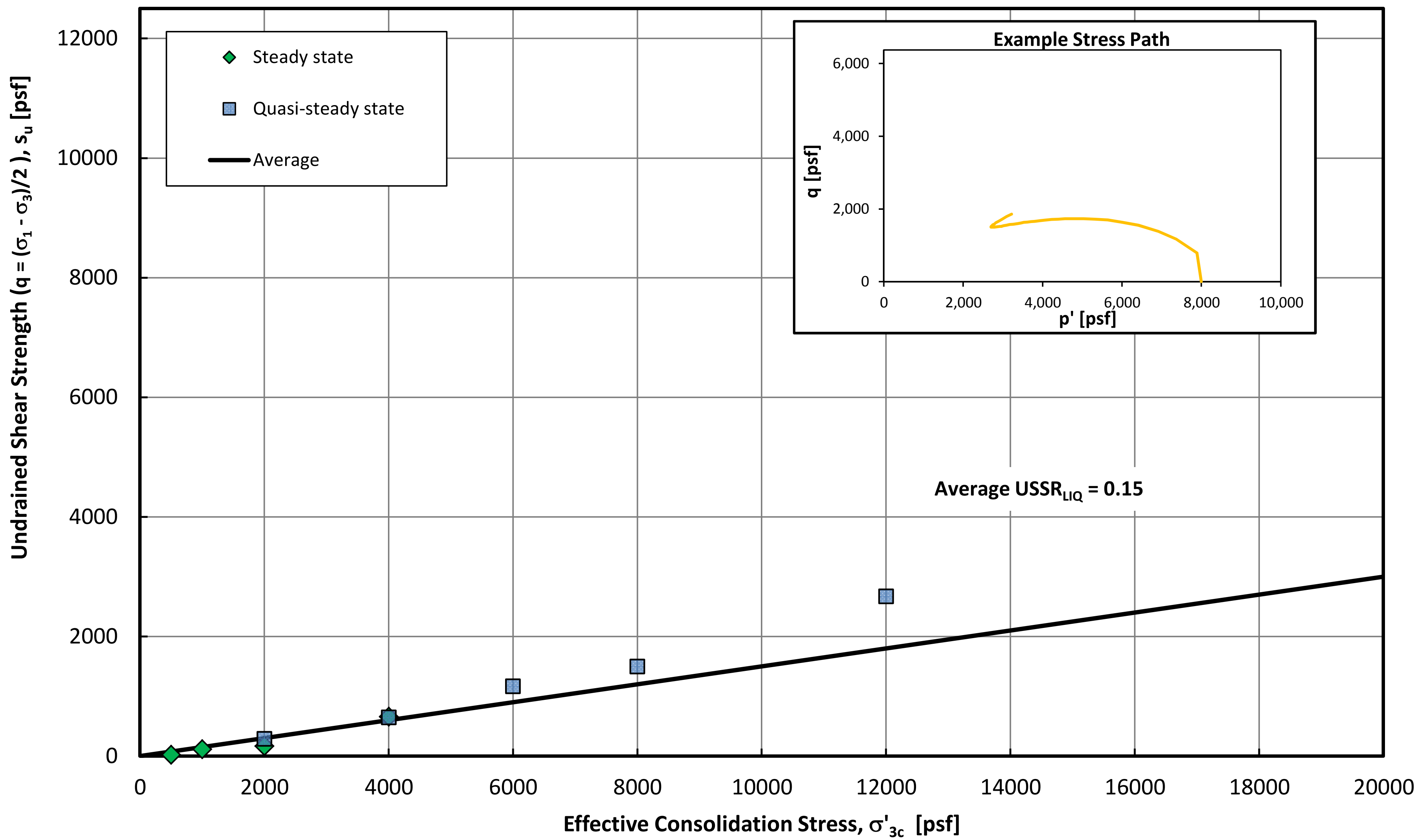


FIGURE C-10
Stress Path for LTVSMC Slimes

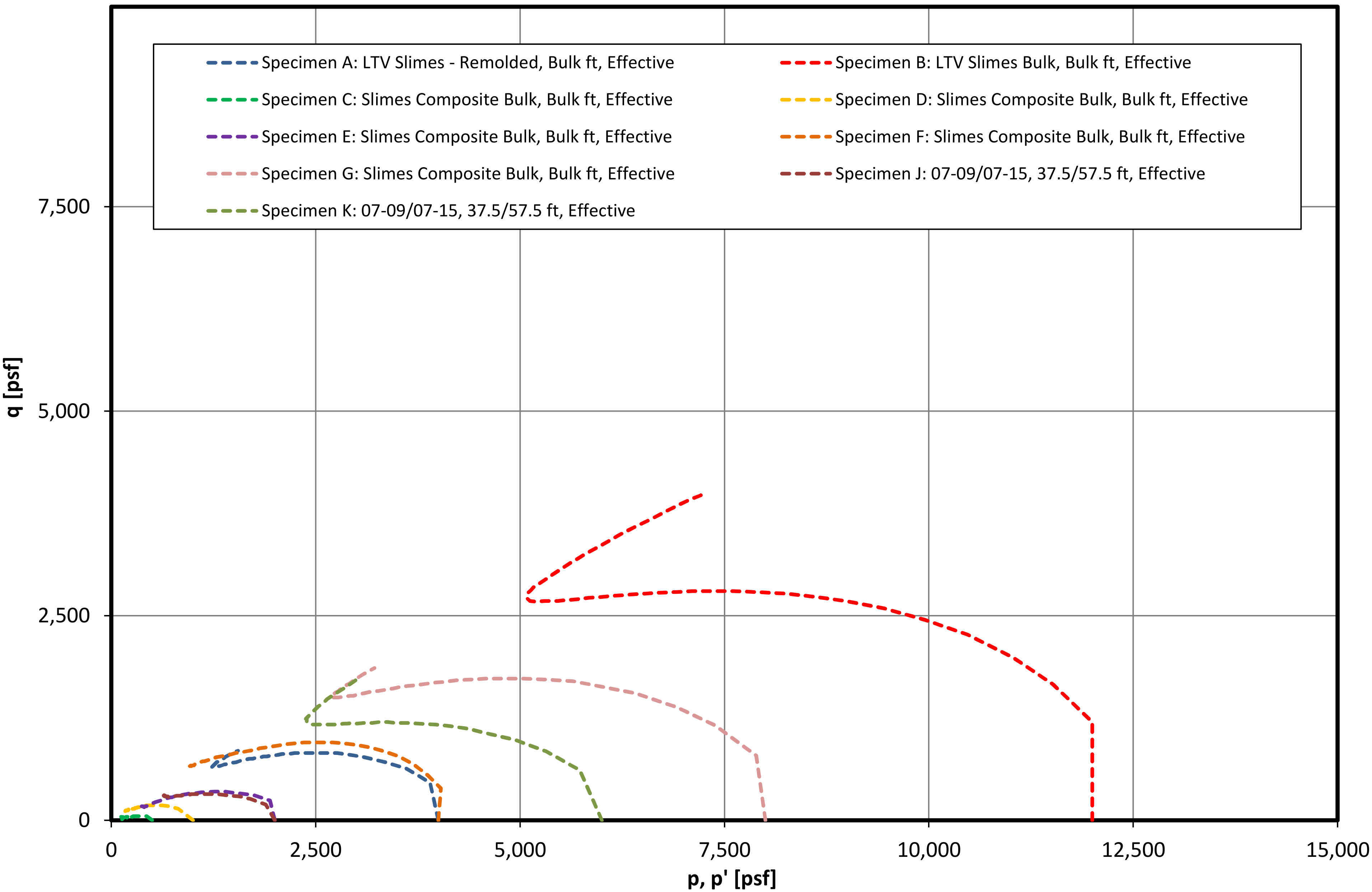


FIGURE C-11
LTVSMC Slimes
CPT Correlated Liquefied Undrained Shear Strength Envelope
(Olson and Stark, 2003)

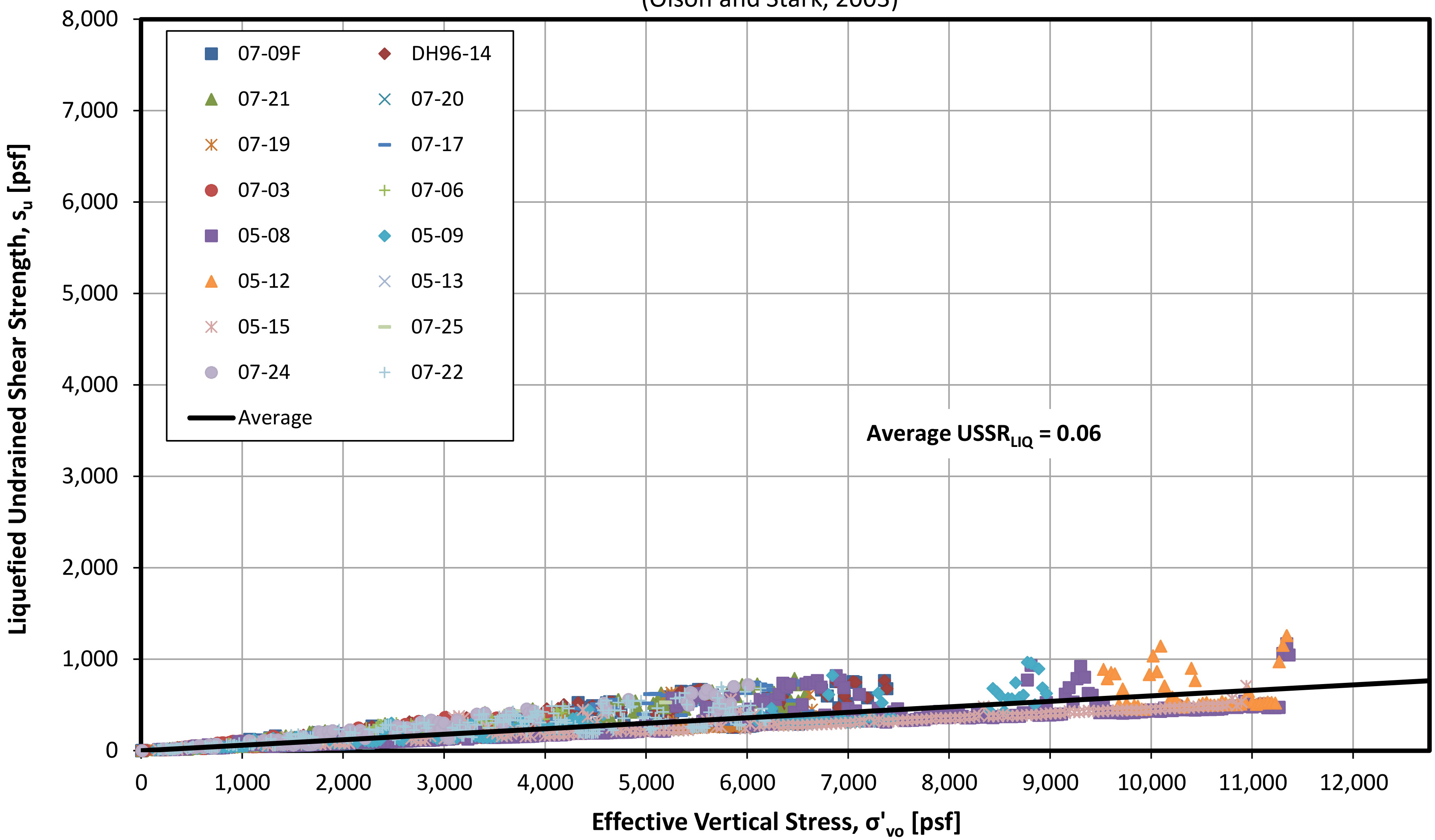


FIGURE C-12

CPT 07-06 Fine Tailings Strength Ratio

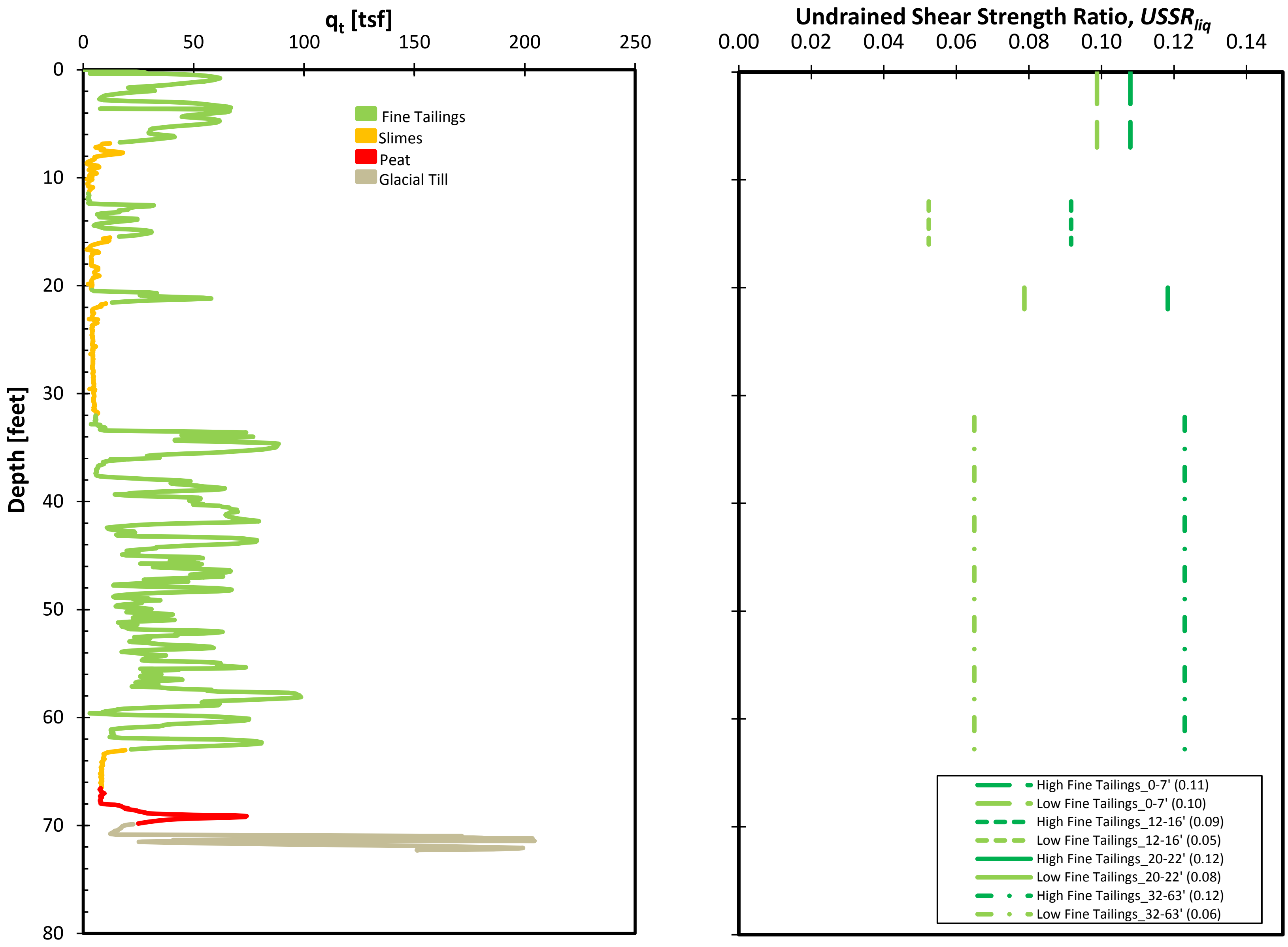


FIGURE C-13
LTVSMC Slimes
SPT Correlated Liquefied Undrained Shear Strength Envelope
(Olson and Stark, 2003)

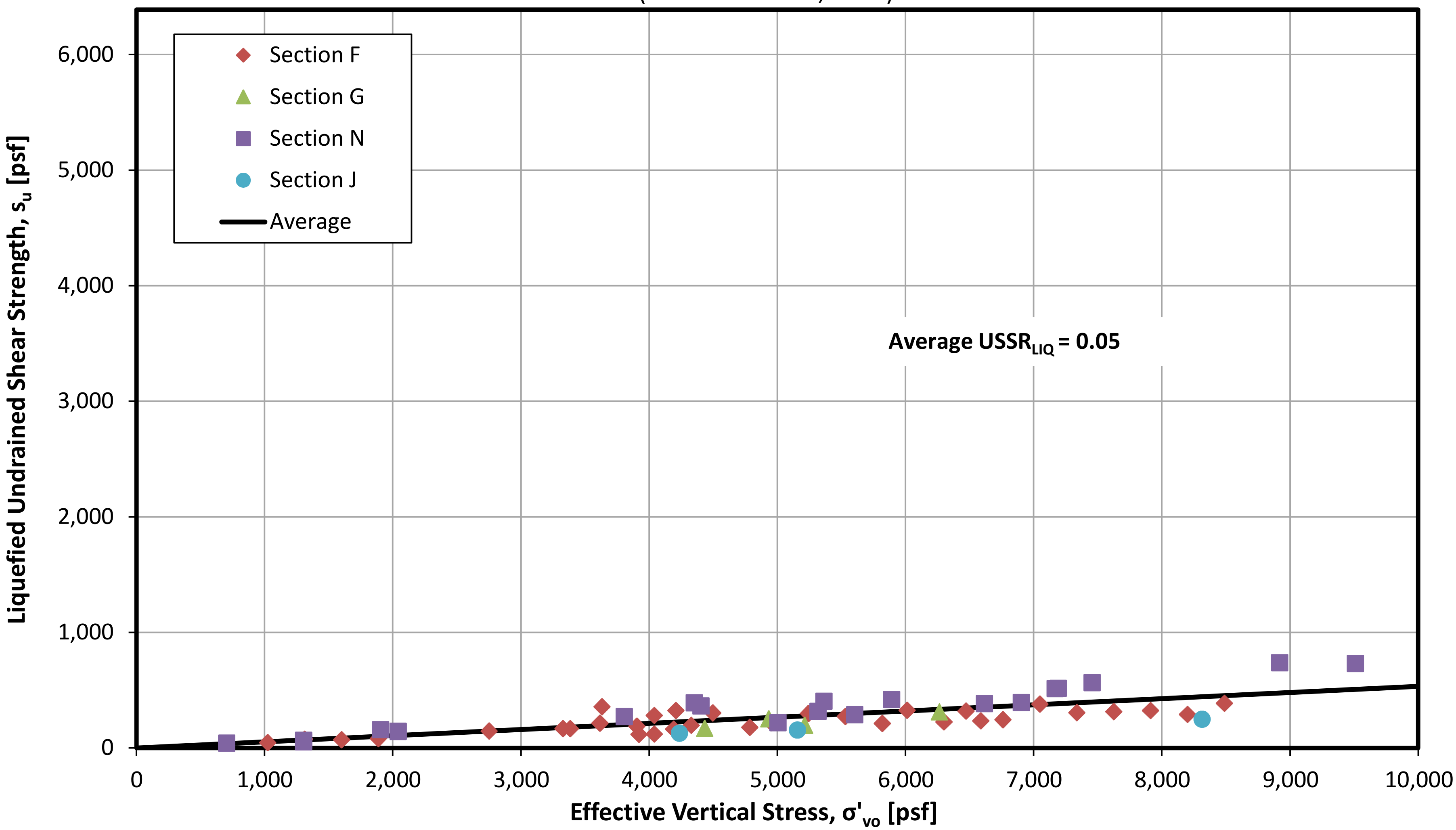


FIGURE C-14
LTVSMC Slimes
2007 FVST Residual Undrained Shear Strength Envelope

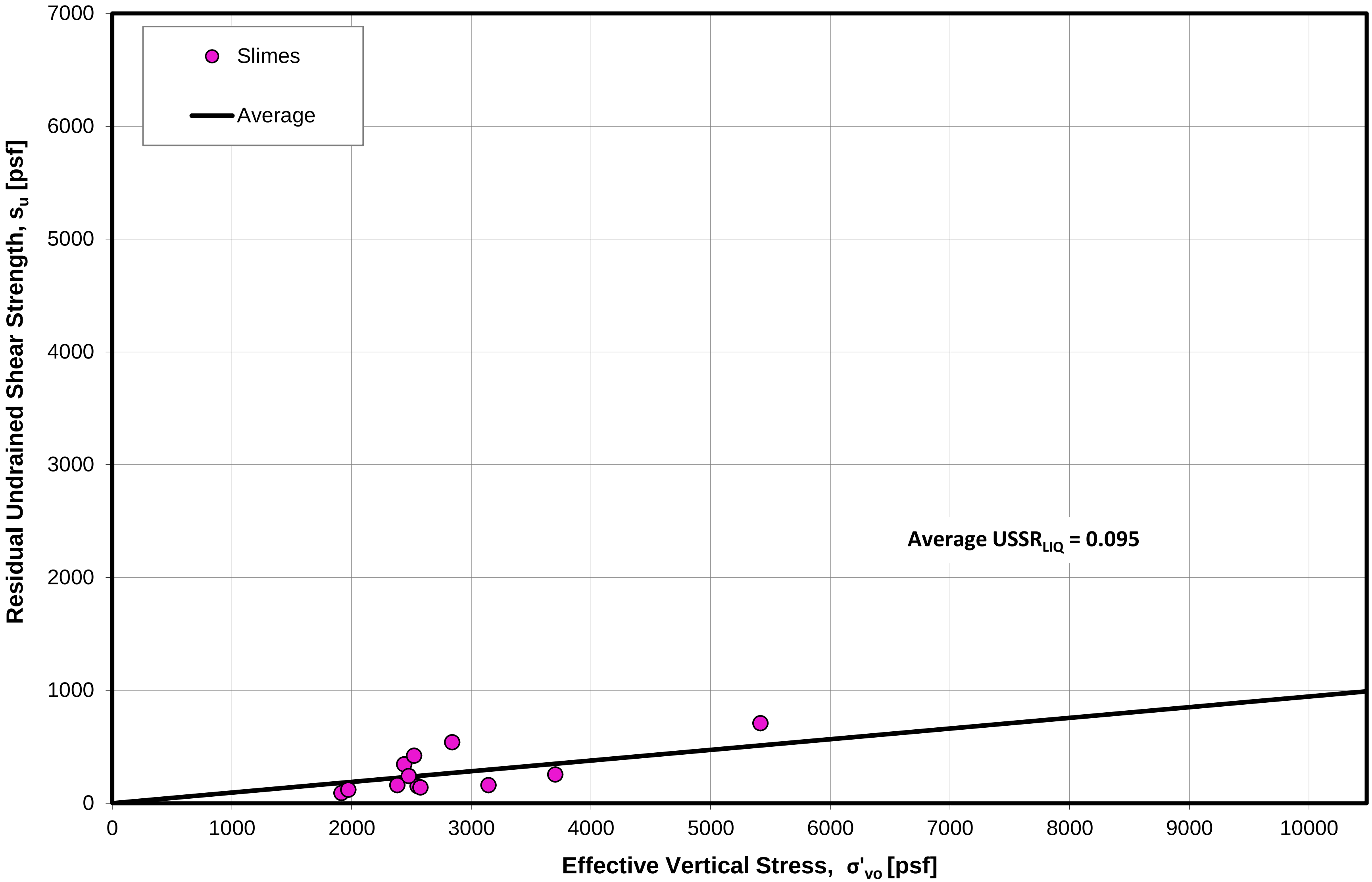


FIGURE C-15
LTVSMC Slimes along Section F
Liquefied Undrained Shear Strength
CPT Tests

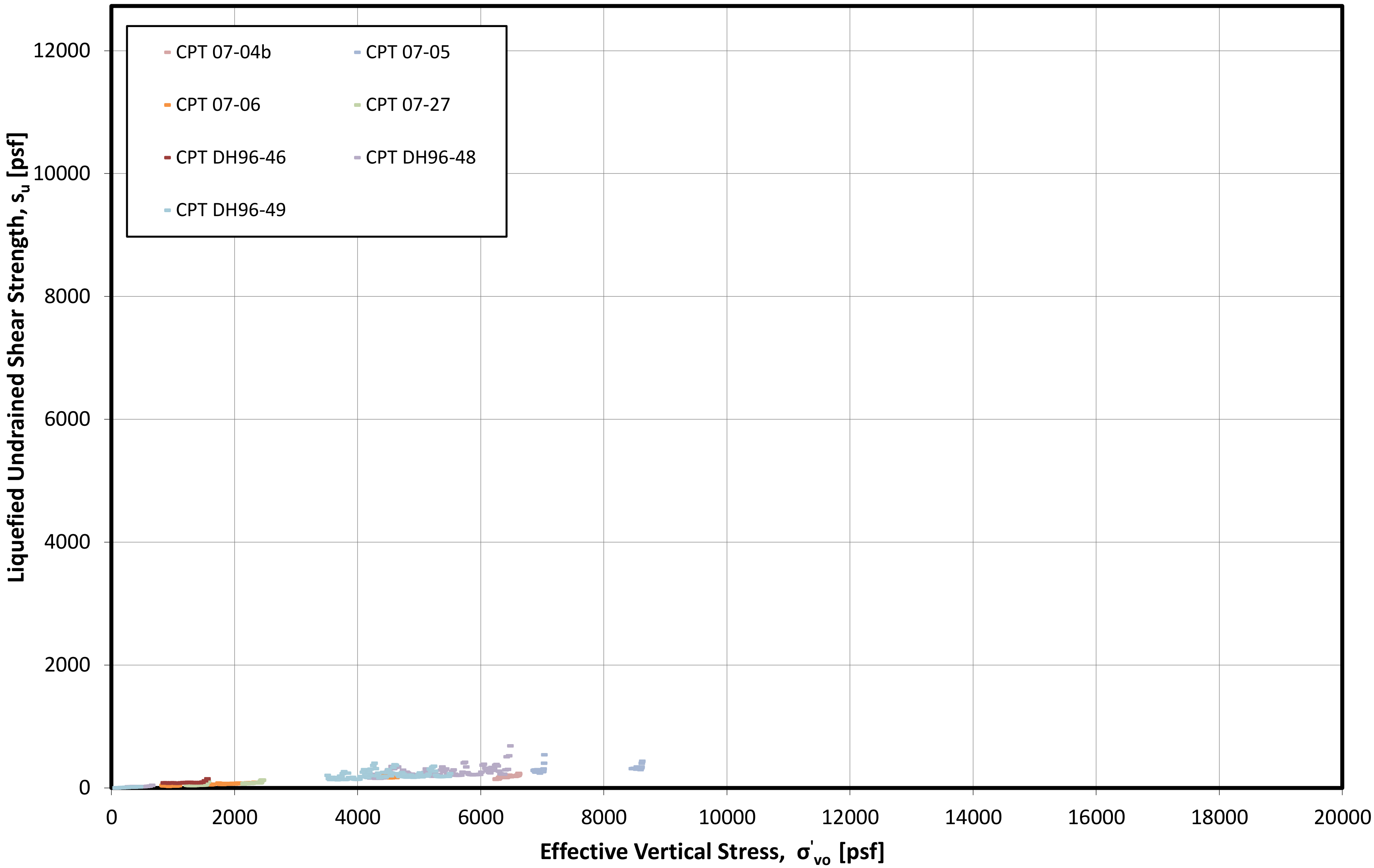


FIGURE C-16
LTVSMC Slimes along Section F
Liquefied Undrained Shear Strength
CPT and SPT Tests

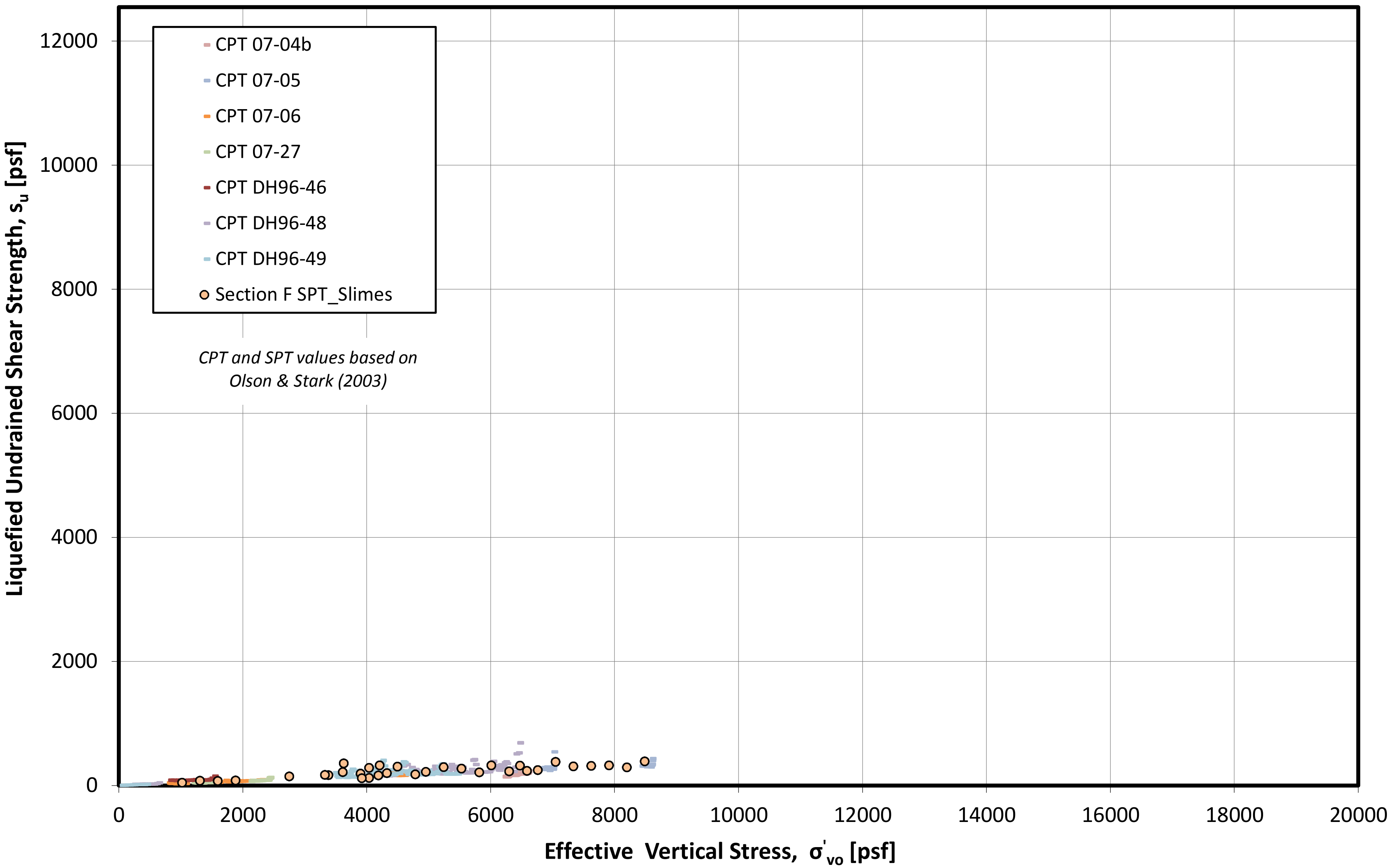


FIGURE C-17
LTVSMC Slimes along Section F
Liquefied Undrained Shear Strength
CPT, SPT, and FVST Tests

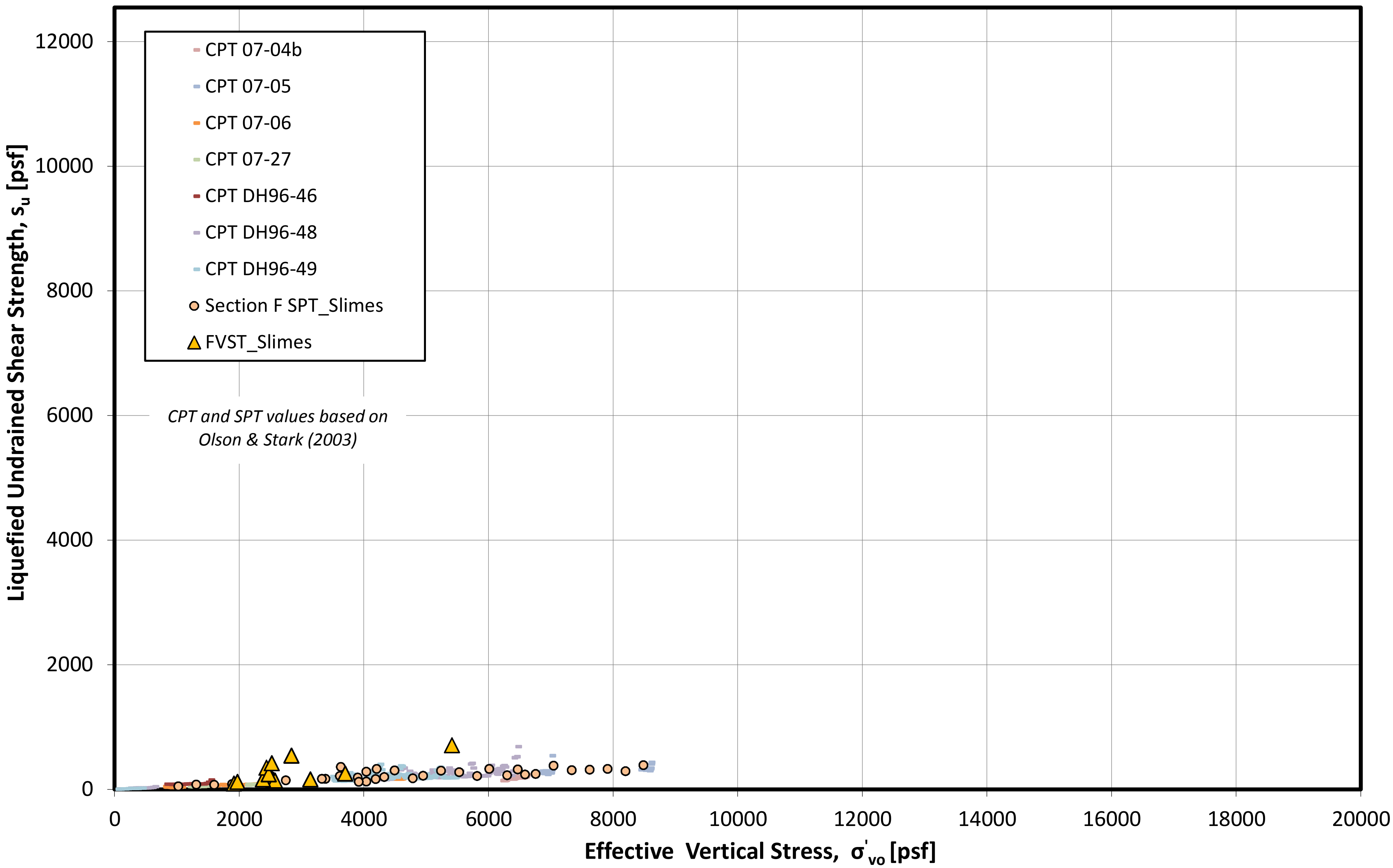


FIGURE C-18

LTVSMC Slimes along Section F

Residual or Liquefied Undrained Shear Strength

CPT, SPT, FVST, and Triaxial Tests

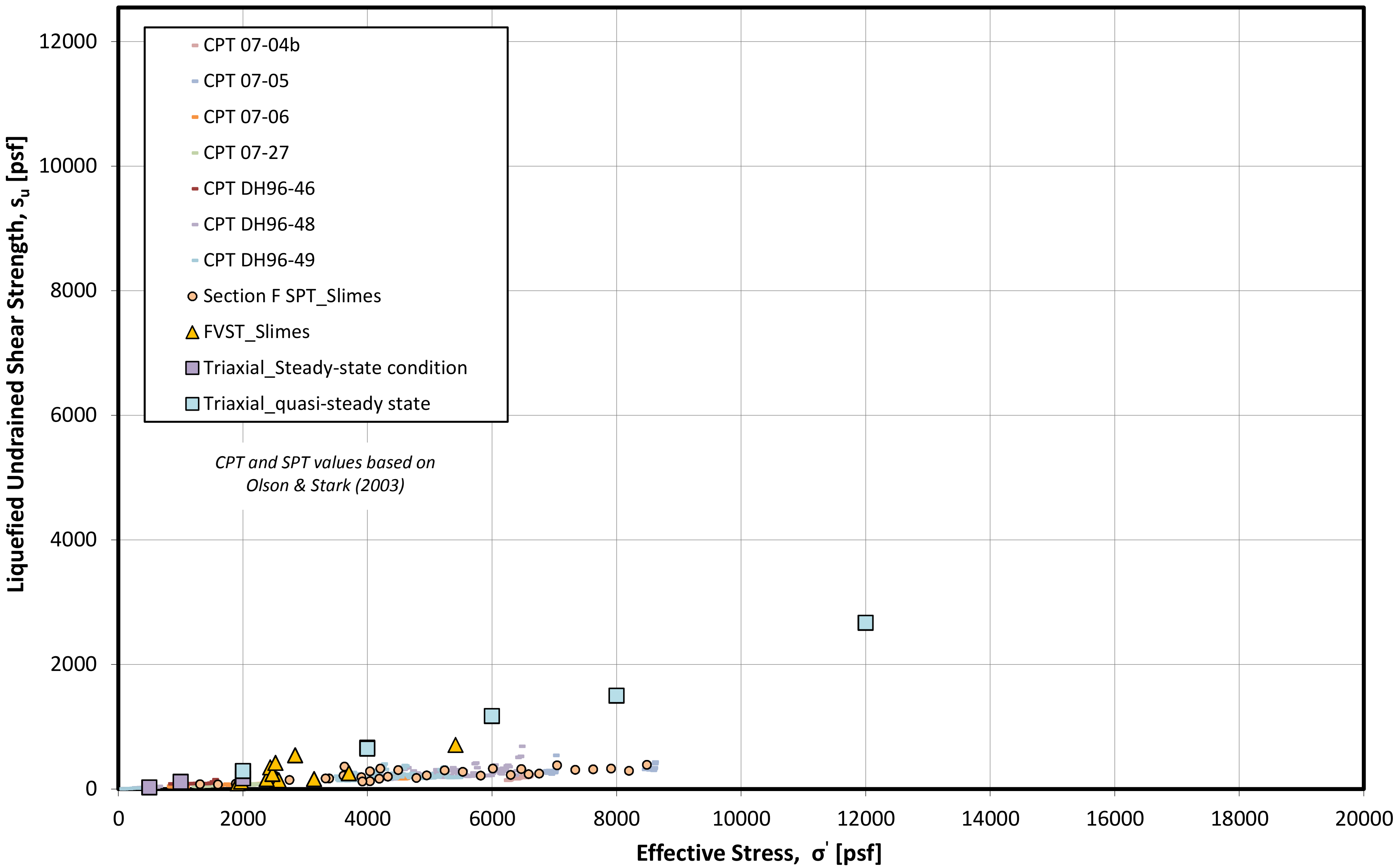


FIGURE C-19
LTVSMC Slimes along Section F
Liquefied Undrained Shear Strength
Upper and Lower Bounds of CPT, SPT, FVST, and Triaxial Tests

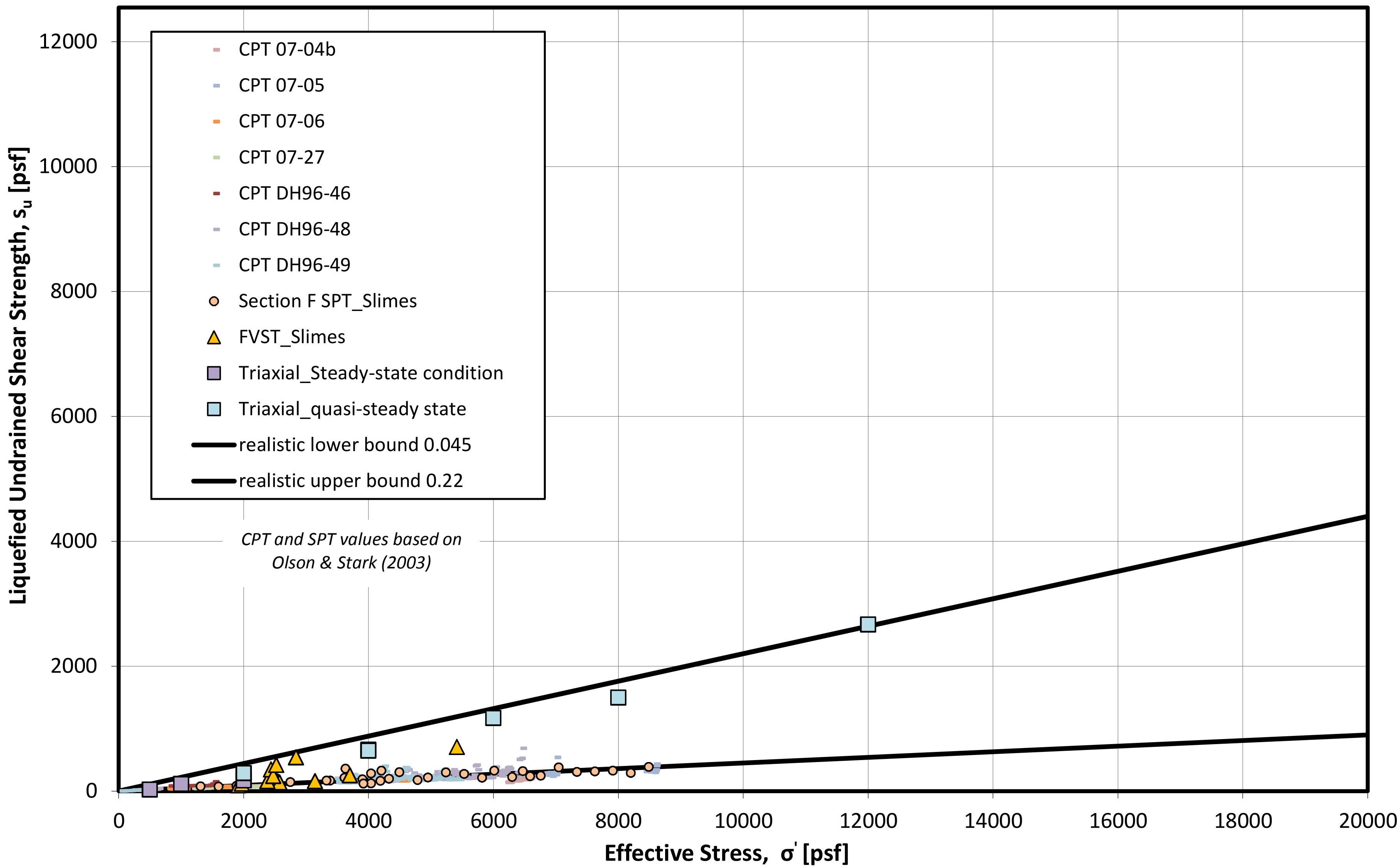


FIGURE C-20
LTVSMC Fine Tailings/Slimes along Section F
Liquefied Undrained Shear Strength
CPT, SPT, FVST, and Triaxial Tests

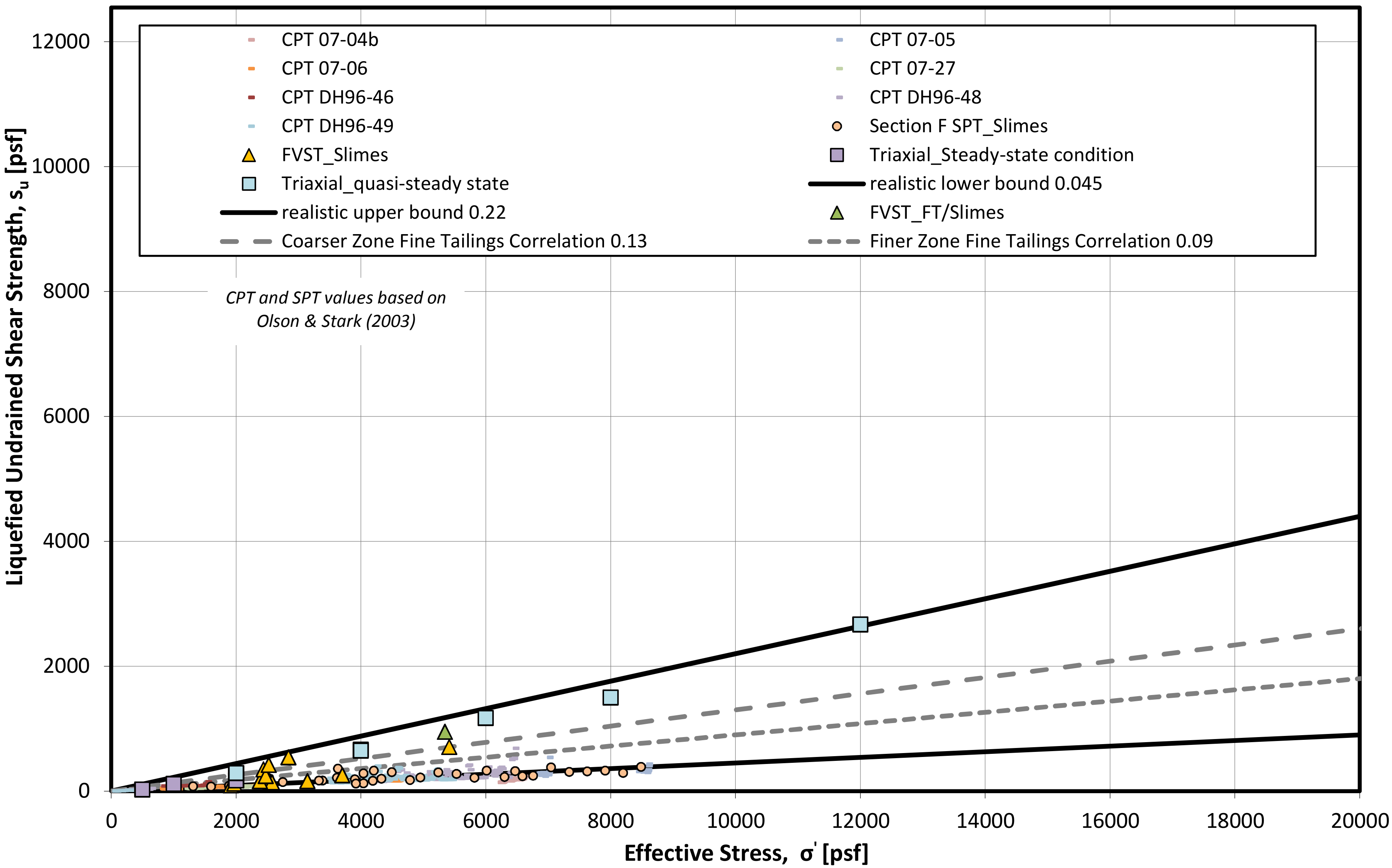


FIGURE C-21
LTVSMC Slimes along Section F
Liquefied Undrained Shear Strength
Design Value with Test Averages

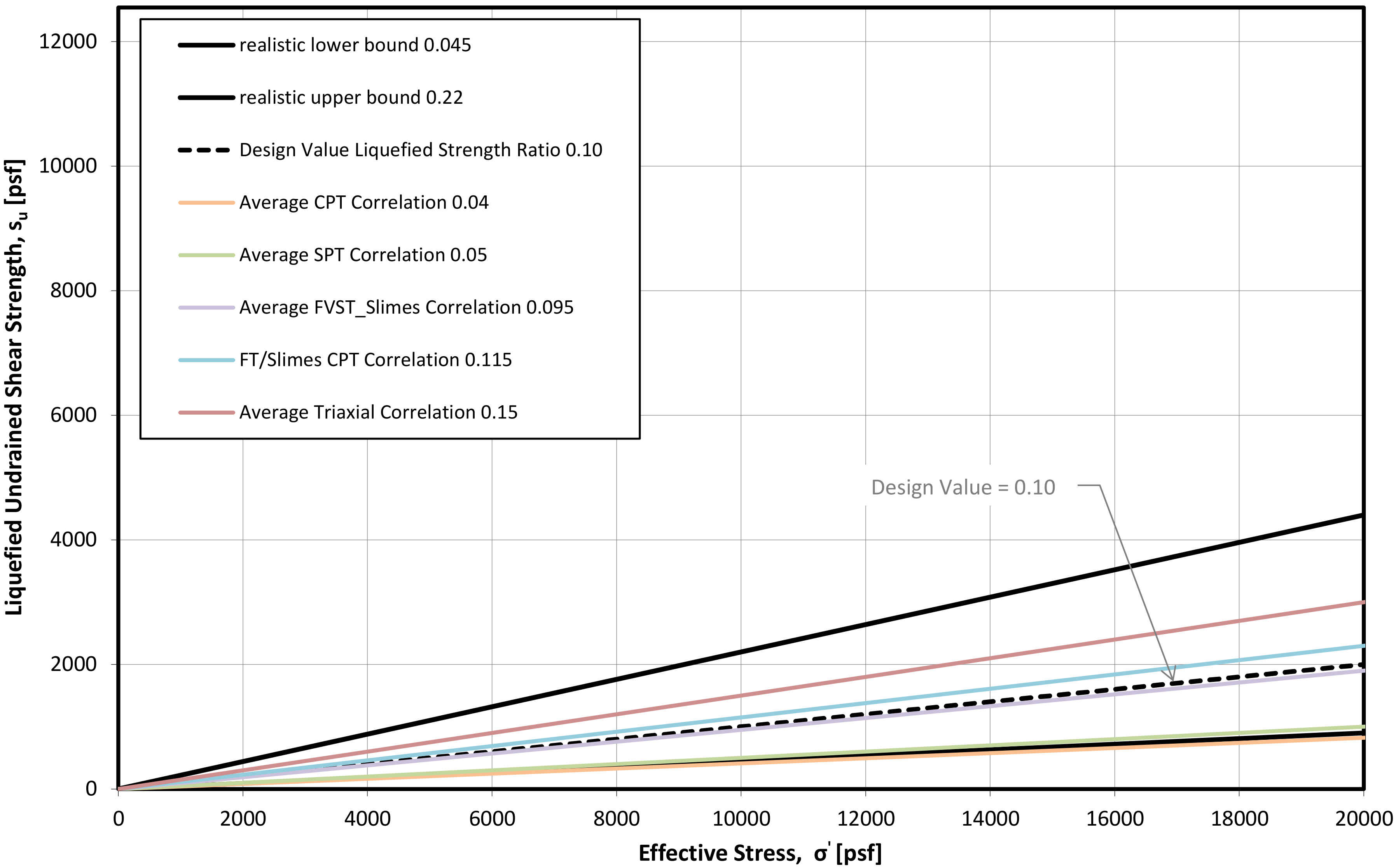


FIGURE C-22
Stress Path for FlotationTailings

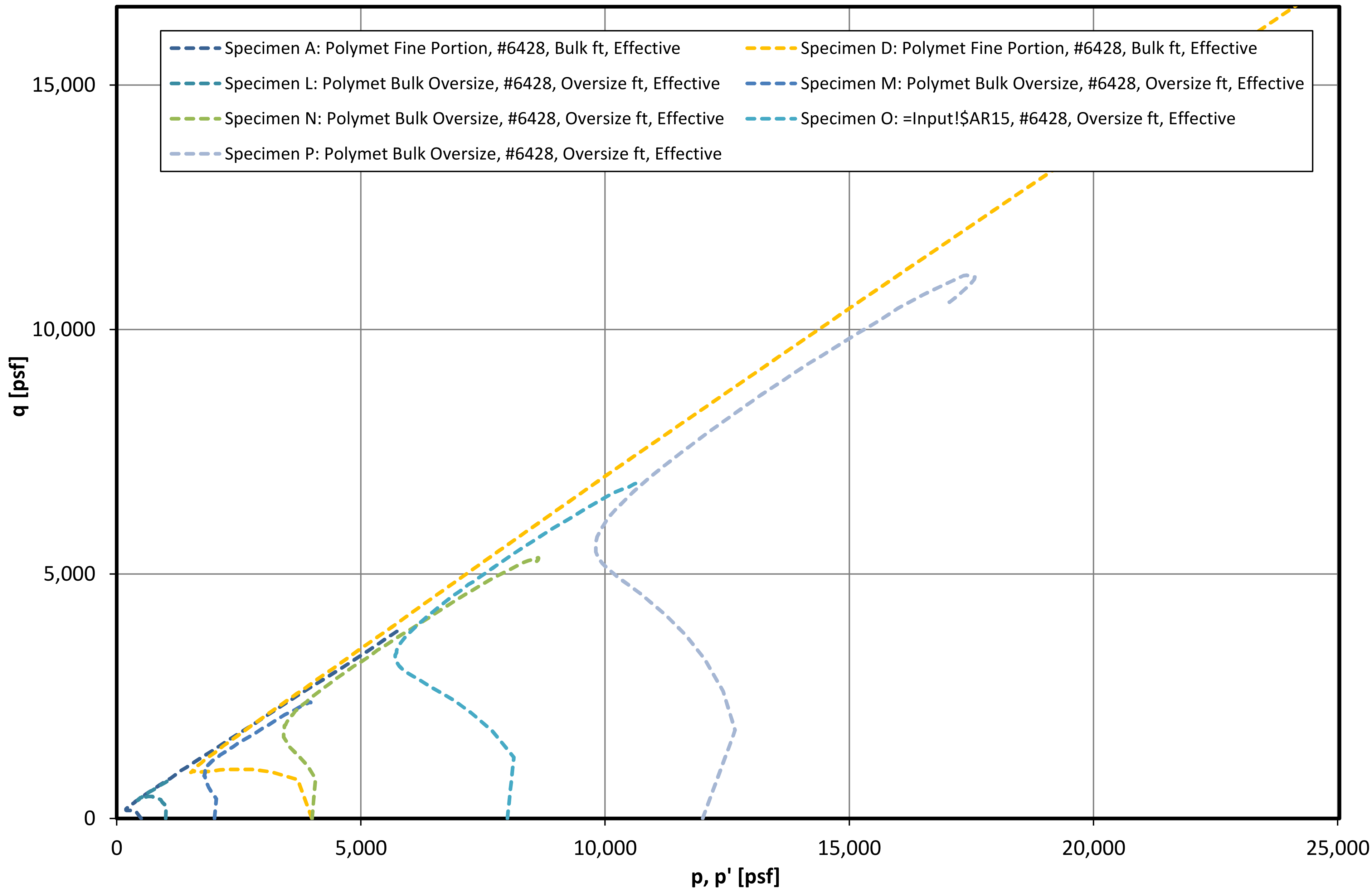


FIGURE C-23
NorthMet Flotation Tailings
Triaxial Liquefied Undrained Shear Strength Envelope

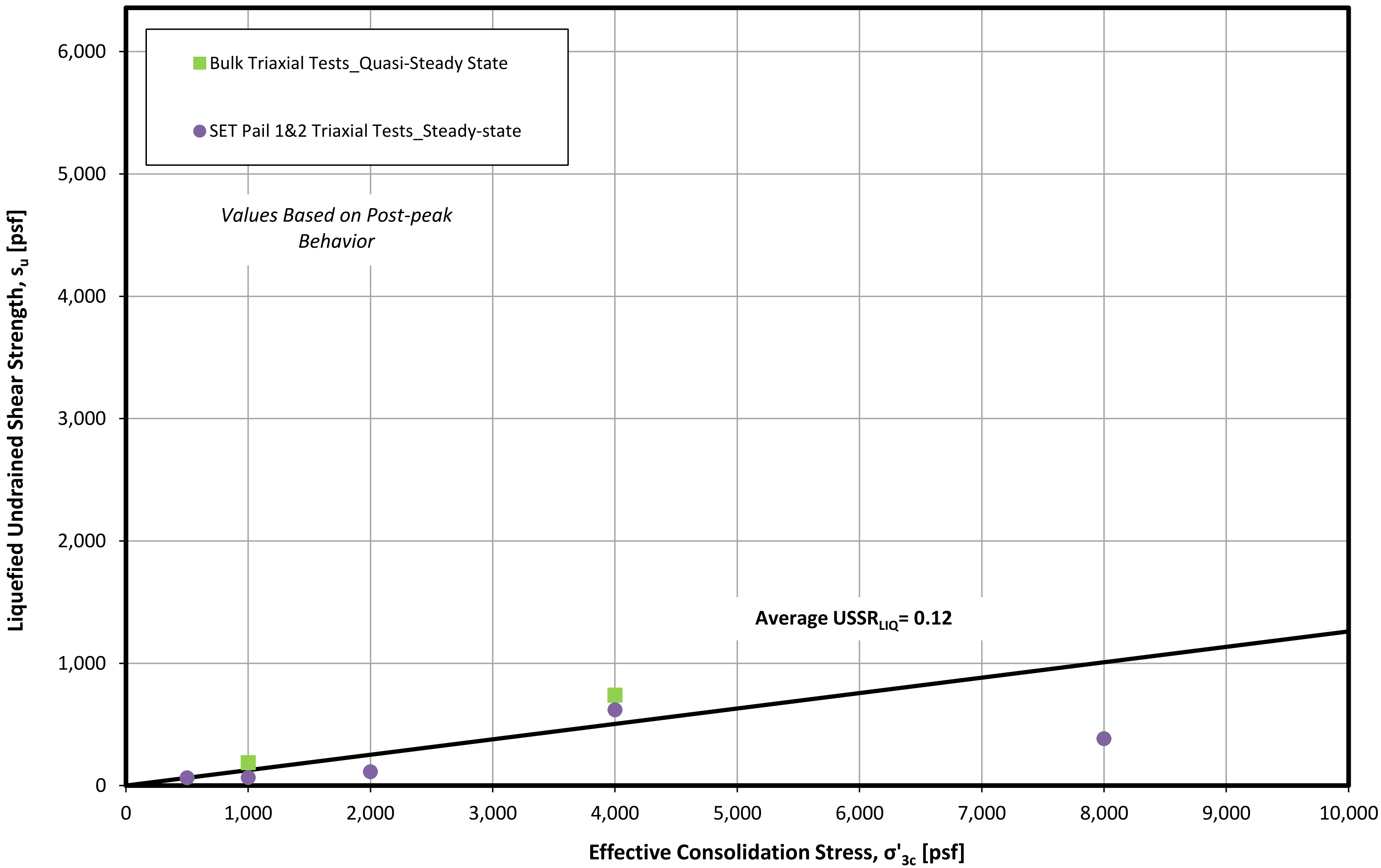


Exhibit D

Figures of Section F CPT Tests

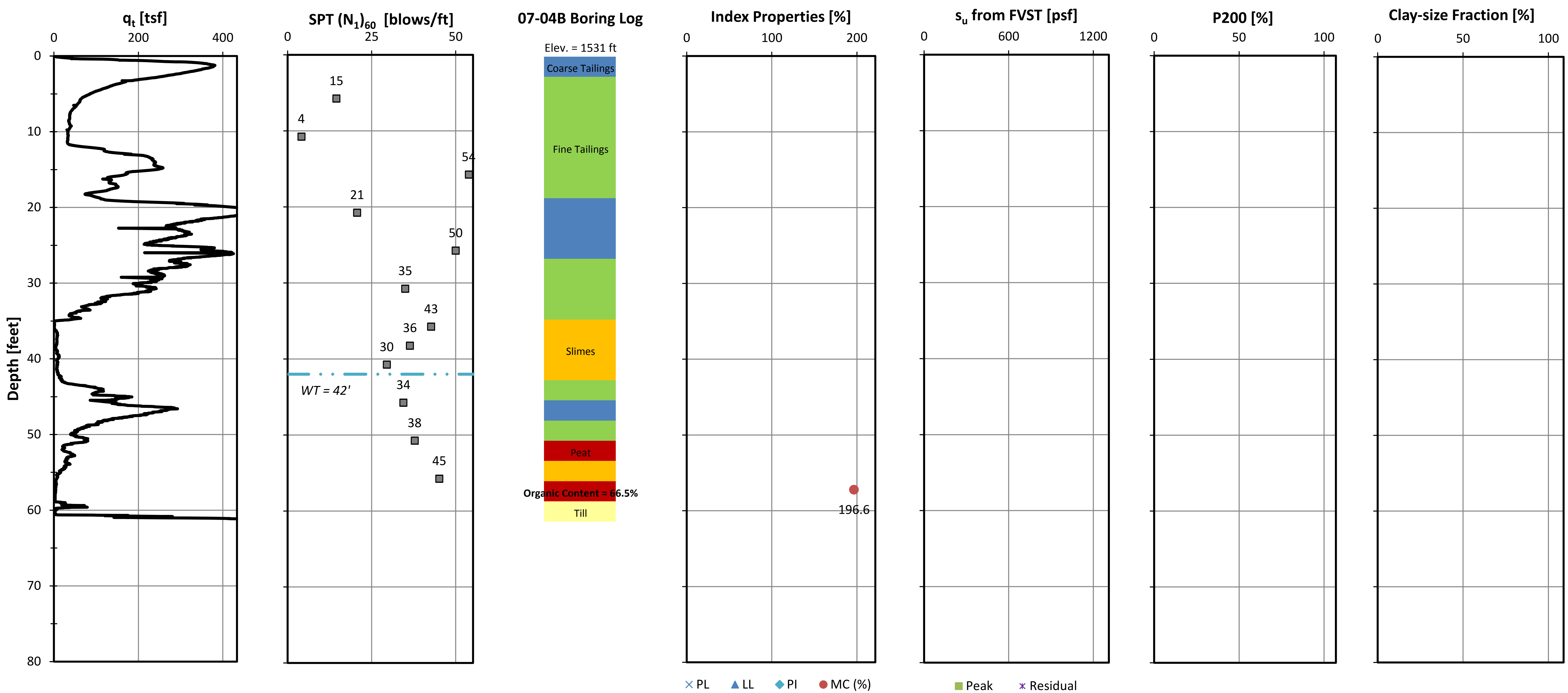
D1: Characterization Signature Plots

D2: CPT Behavior Plots

D3: Contractive/Dilative Plots

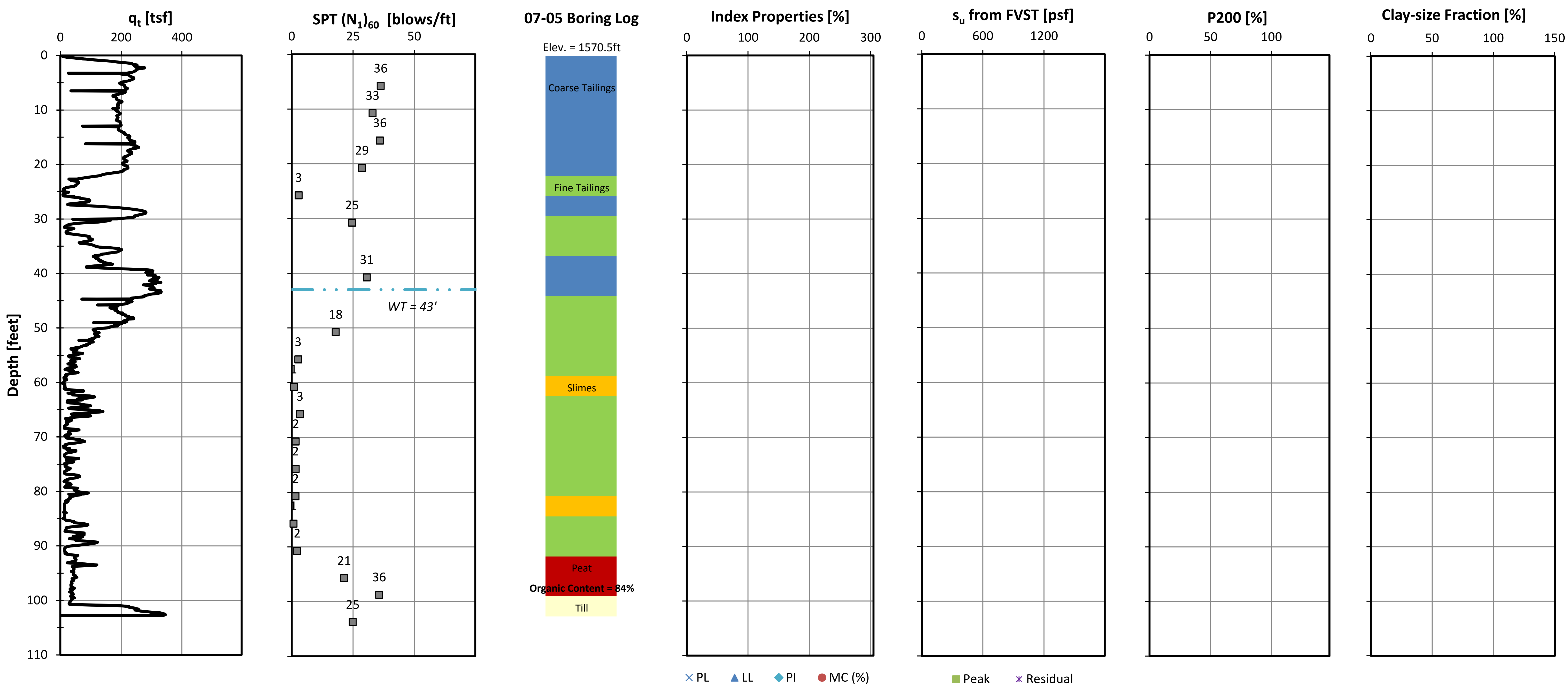
Section F_07-04B Characterization Signature

NorthMet Flotation Tailings Basin

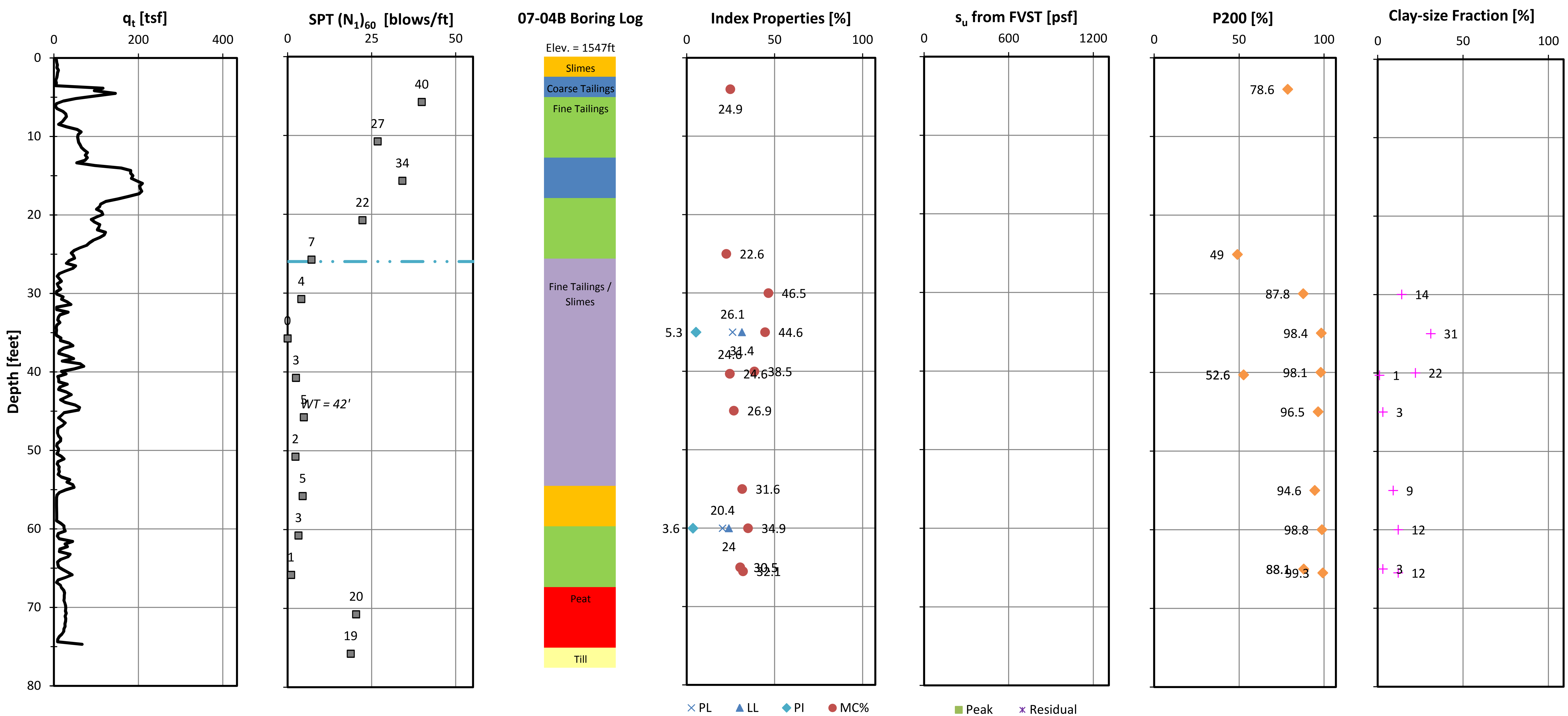


Section F_07-05 Characterization Signature

NorthMet Flotation Tailings Basin

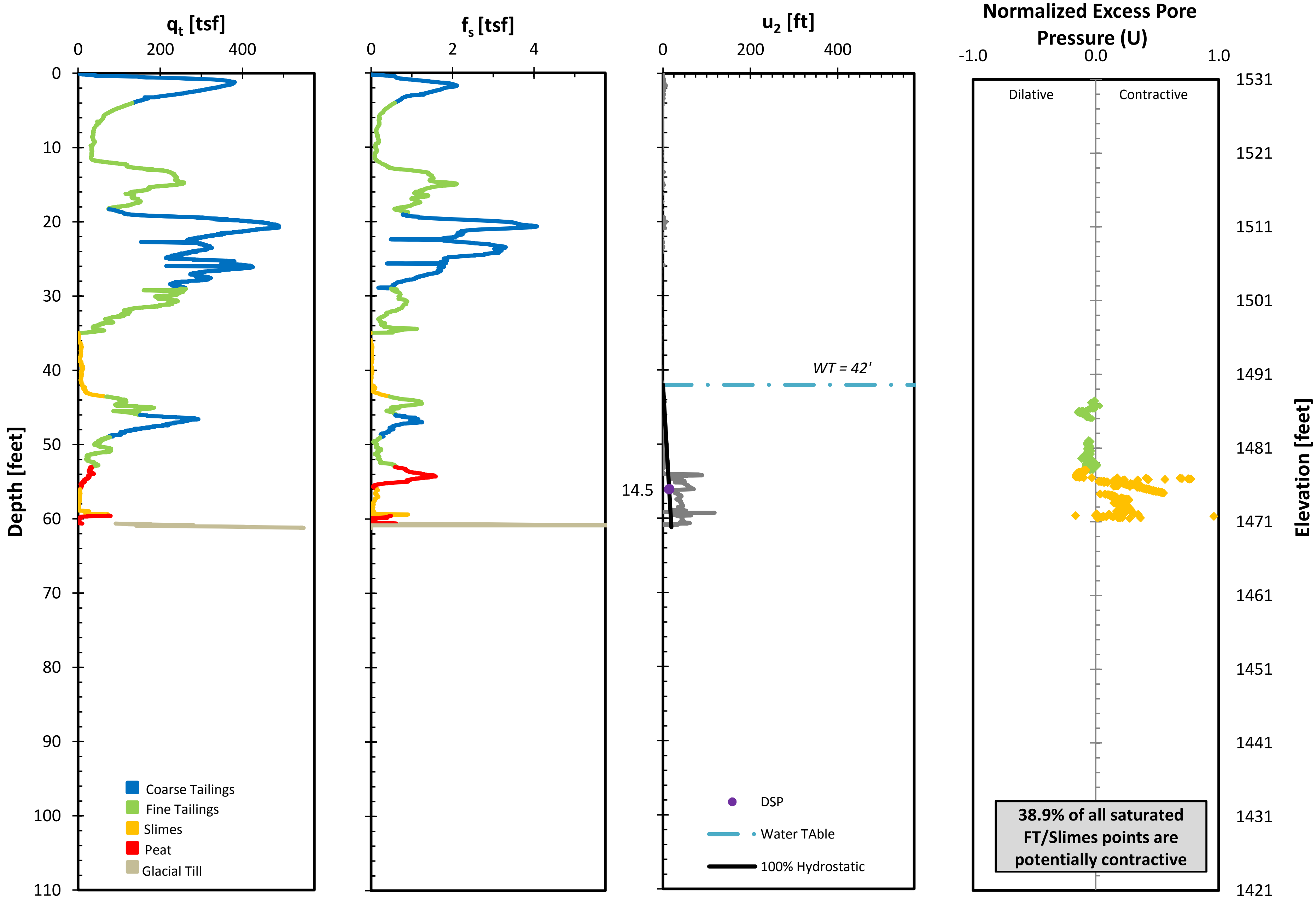


Section F_DH96-49 Characterization Signature
NorthMet Flotation Tailings Basin



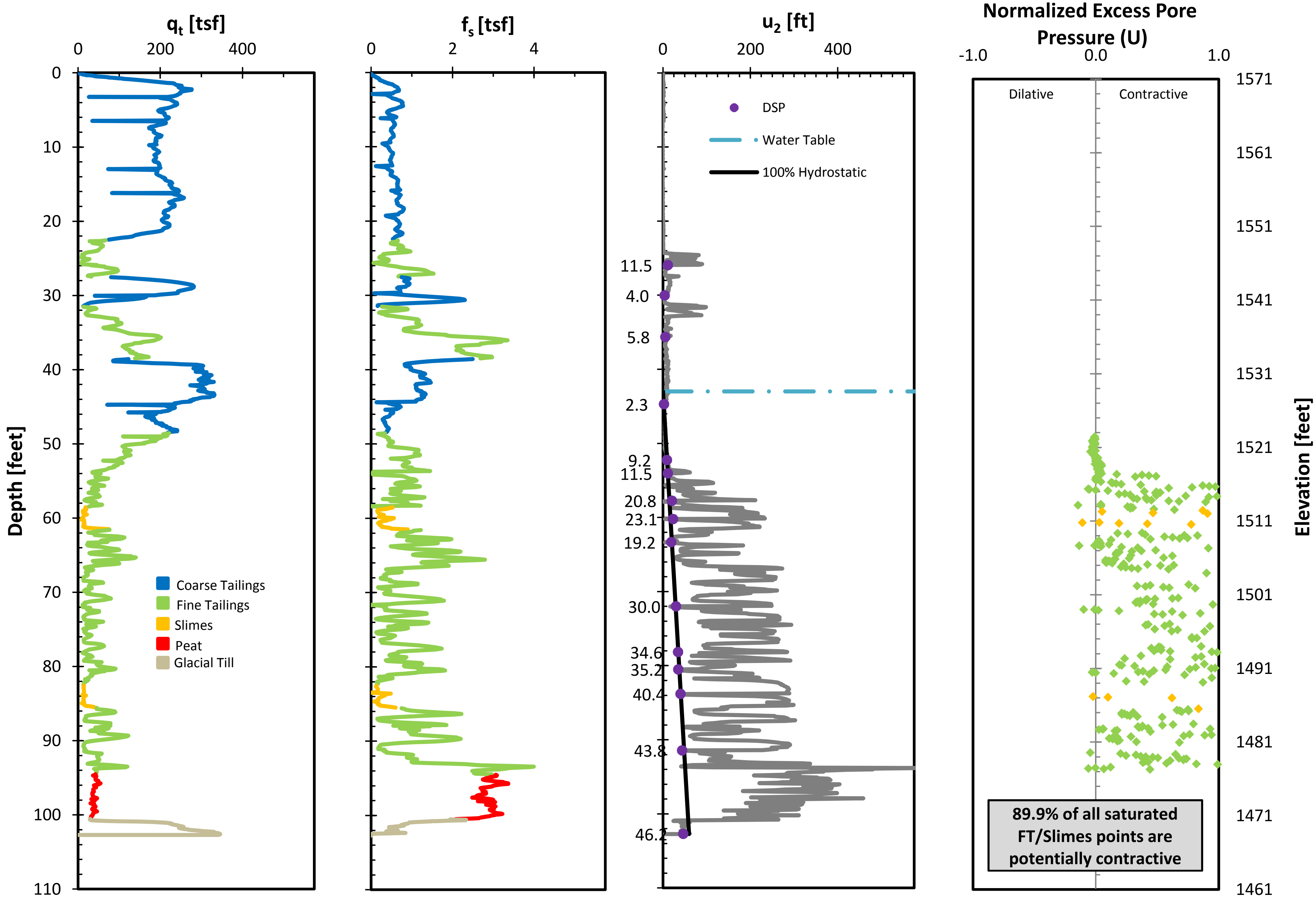
CPT 07-04B Behavior Plot

NorthMet Flotation Tailings Basin



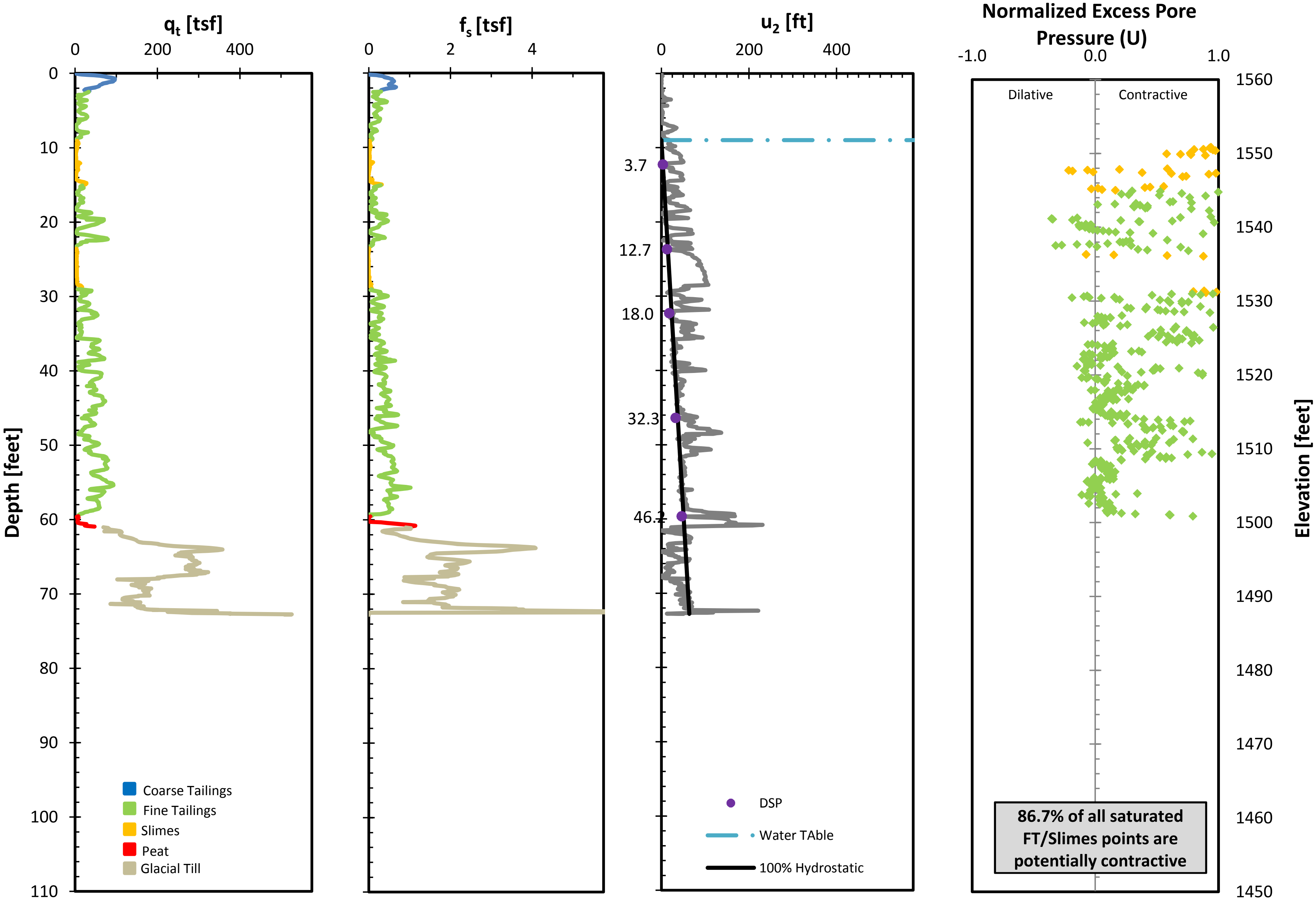
CPT 07-05 Behavior Plot

NorthMet Flotation Tailings Basin

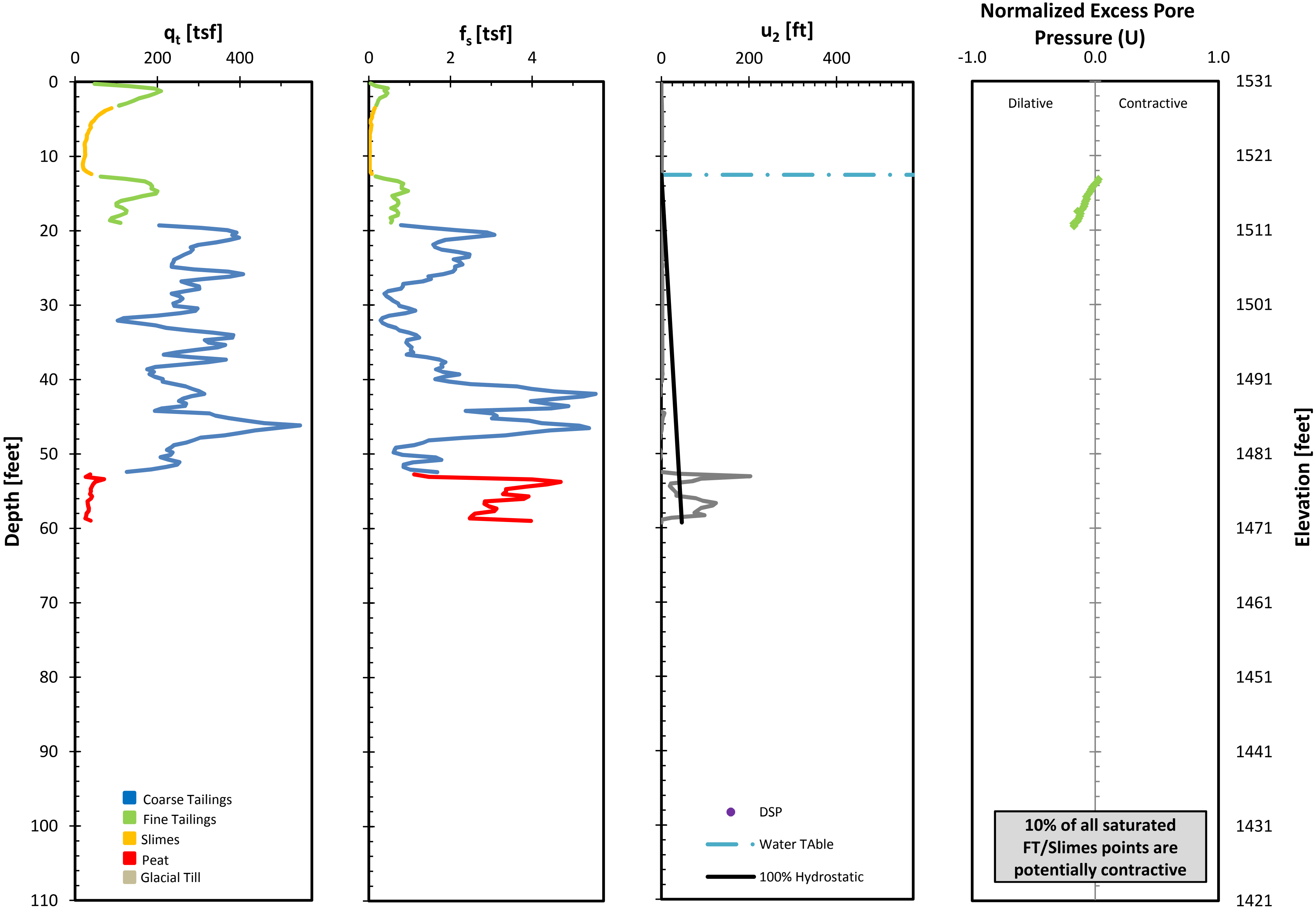


CPT 07-27 Behavior Plot

NorthMet Flotation Tailings Basin

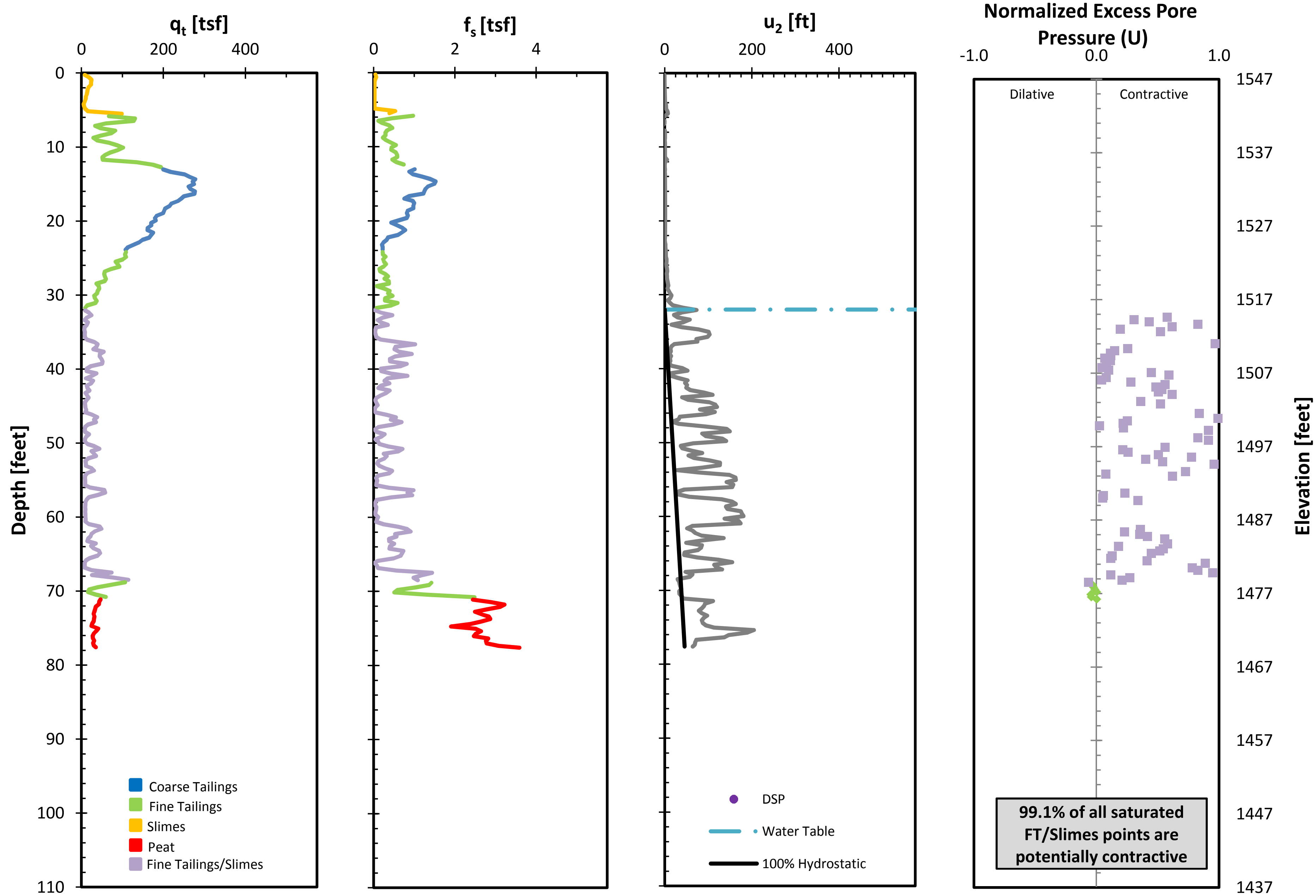


CPT DH96-46 Behavior Plot
NorthMet Flotation Tailings Basin

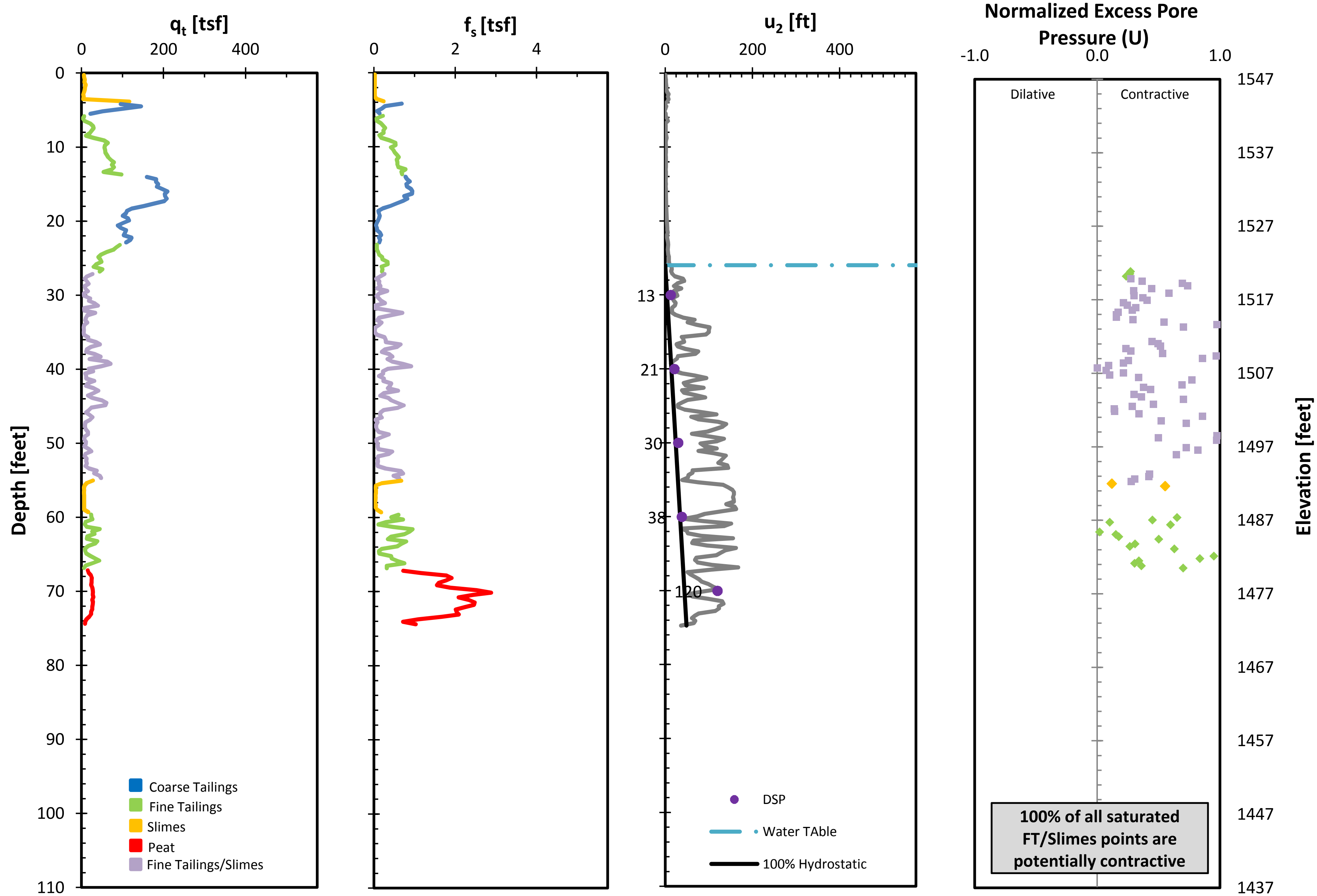


CPT DH96-48 Behavior Plot

NorthMet Flotation Tailings Basin



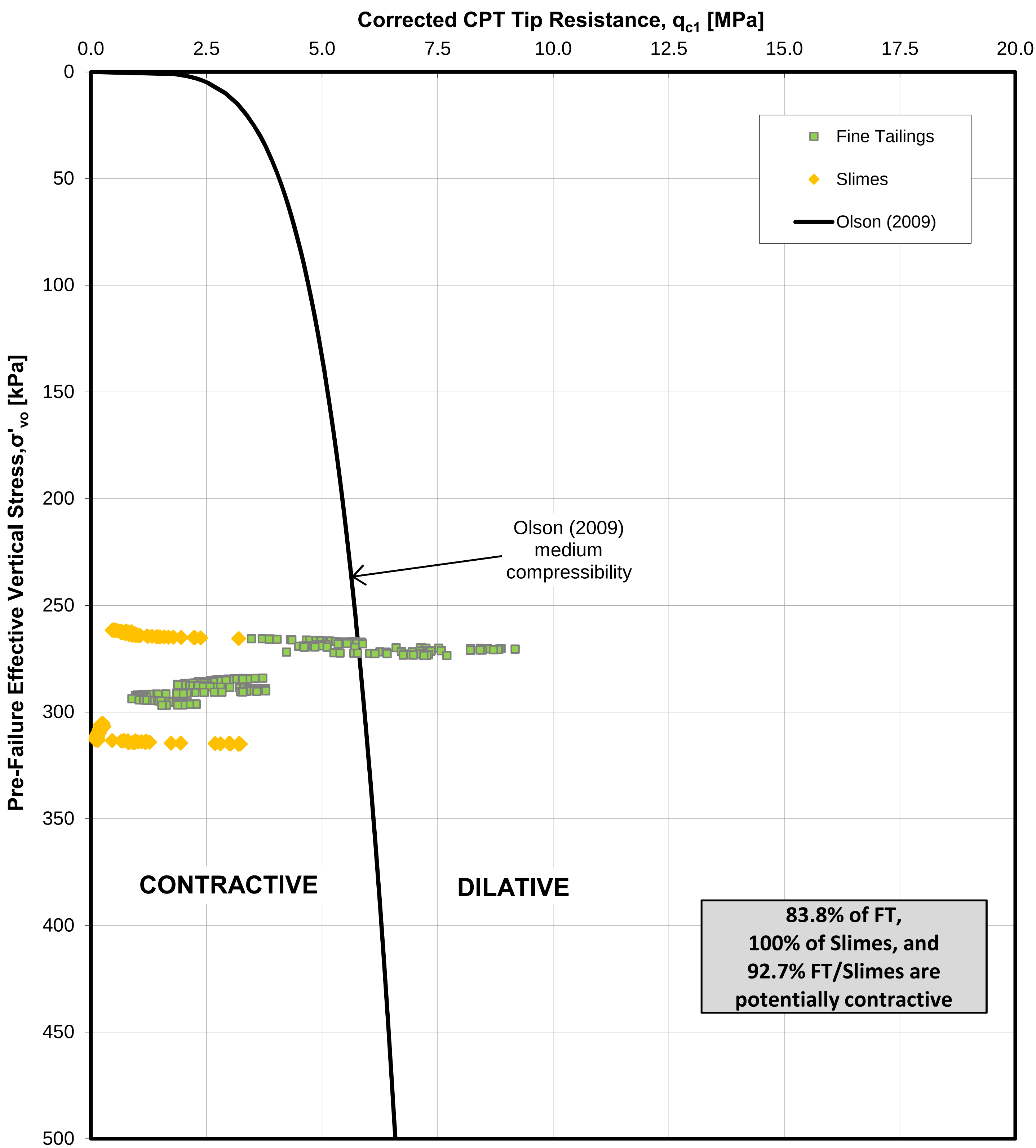
CPT DH96-49 Behavior Plot
NorthMet Flotation Tailings Basin



CPT 07-04B LTVSMC Fine Tailings/Slimes

Contractive/Dilative Behavior (Olson, 2009)

NorthMet Flotation Tailings Basin

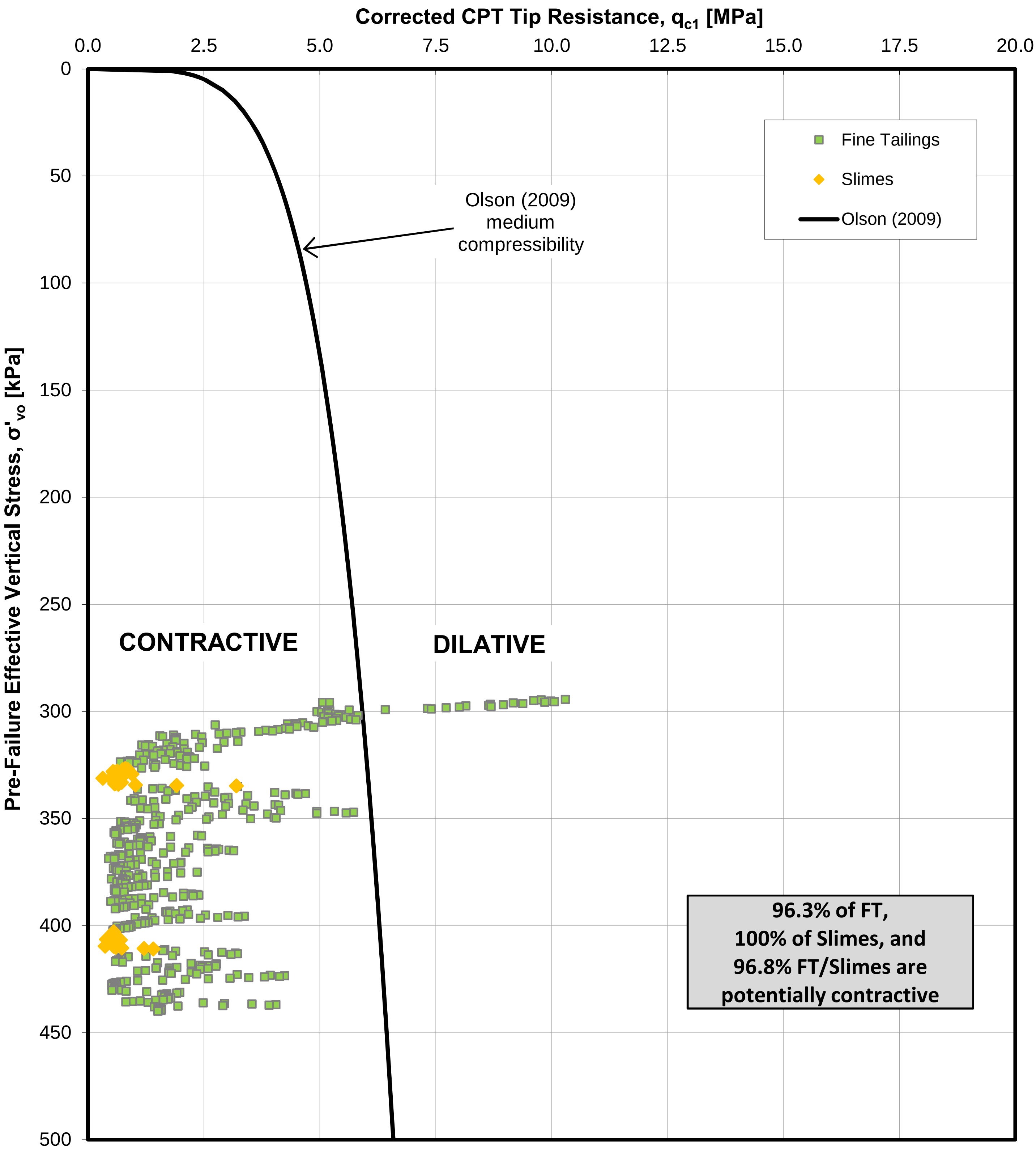


P:\Mpls\23 MN\69\2369862\WorkFiles\WO 022A Tailings Basin Permitting\2013 v4 Data Package Vol 1\Att C - Material Strength Characterization\Att C - V4_CPT\Section F\CPT_07-04B.xlsm

CPT 07-05 LTVSMC Fine Tailings/Slimes

Contractive/Dilative Behavior (Olson, 2009)

NorthMet Flotation Tailings Basin



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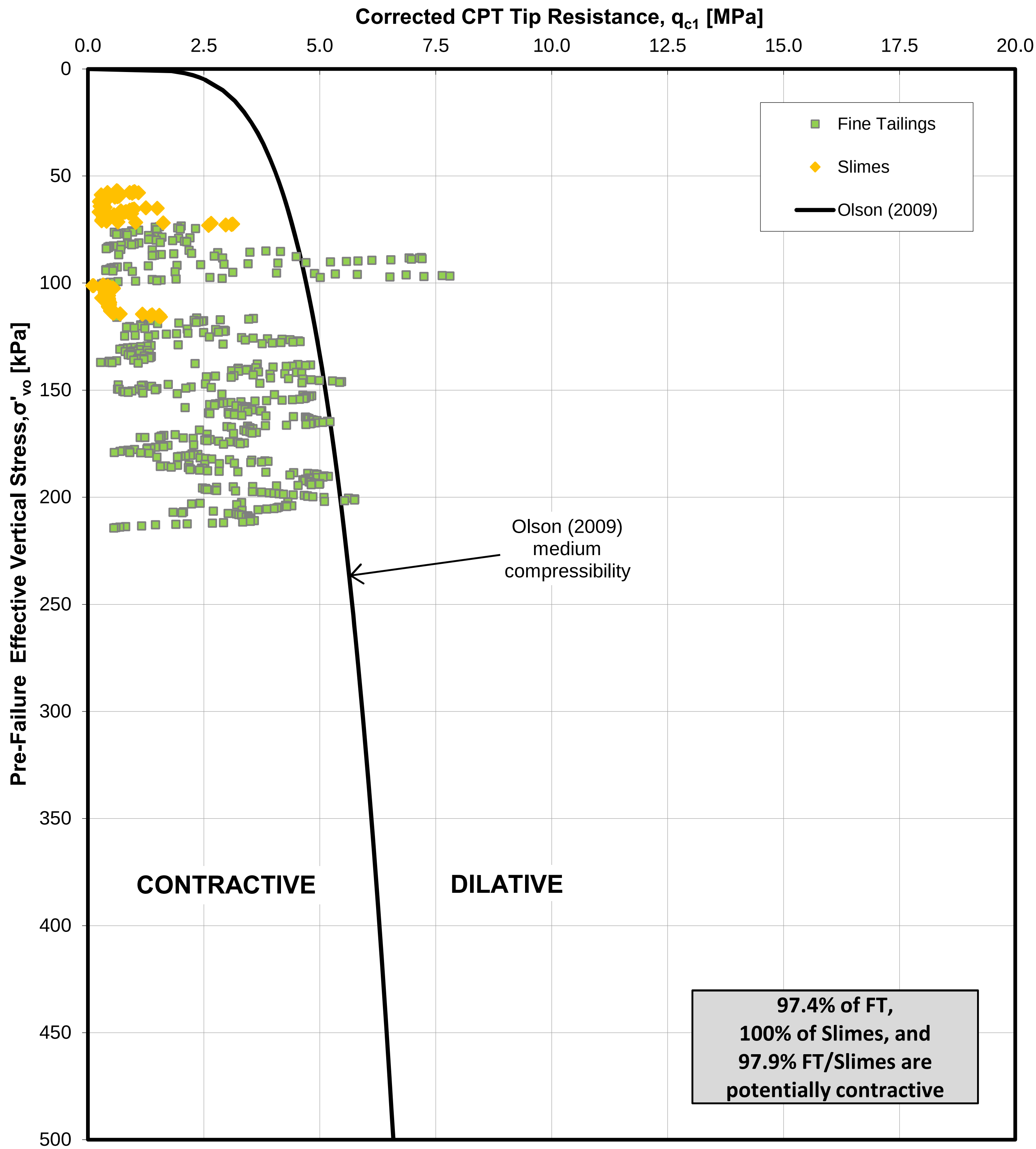
CPT 07-27 LTVSMC Fine Tailings/Slimes

Contractive/Dilative Behavior (Olson, 2009)

NorthMet Flotation Tailings Basin



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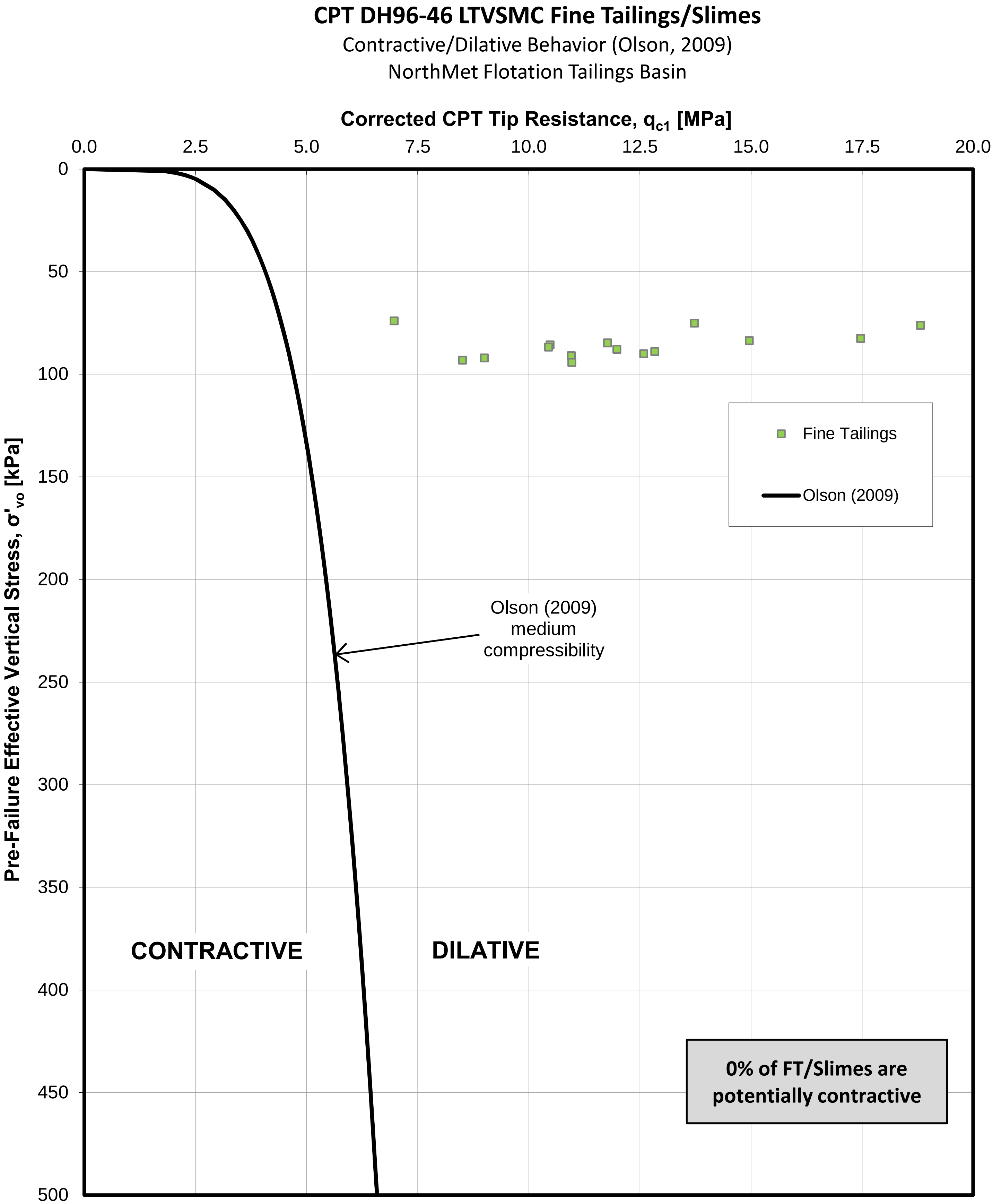

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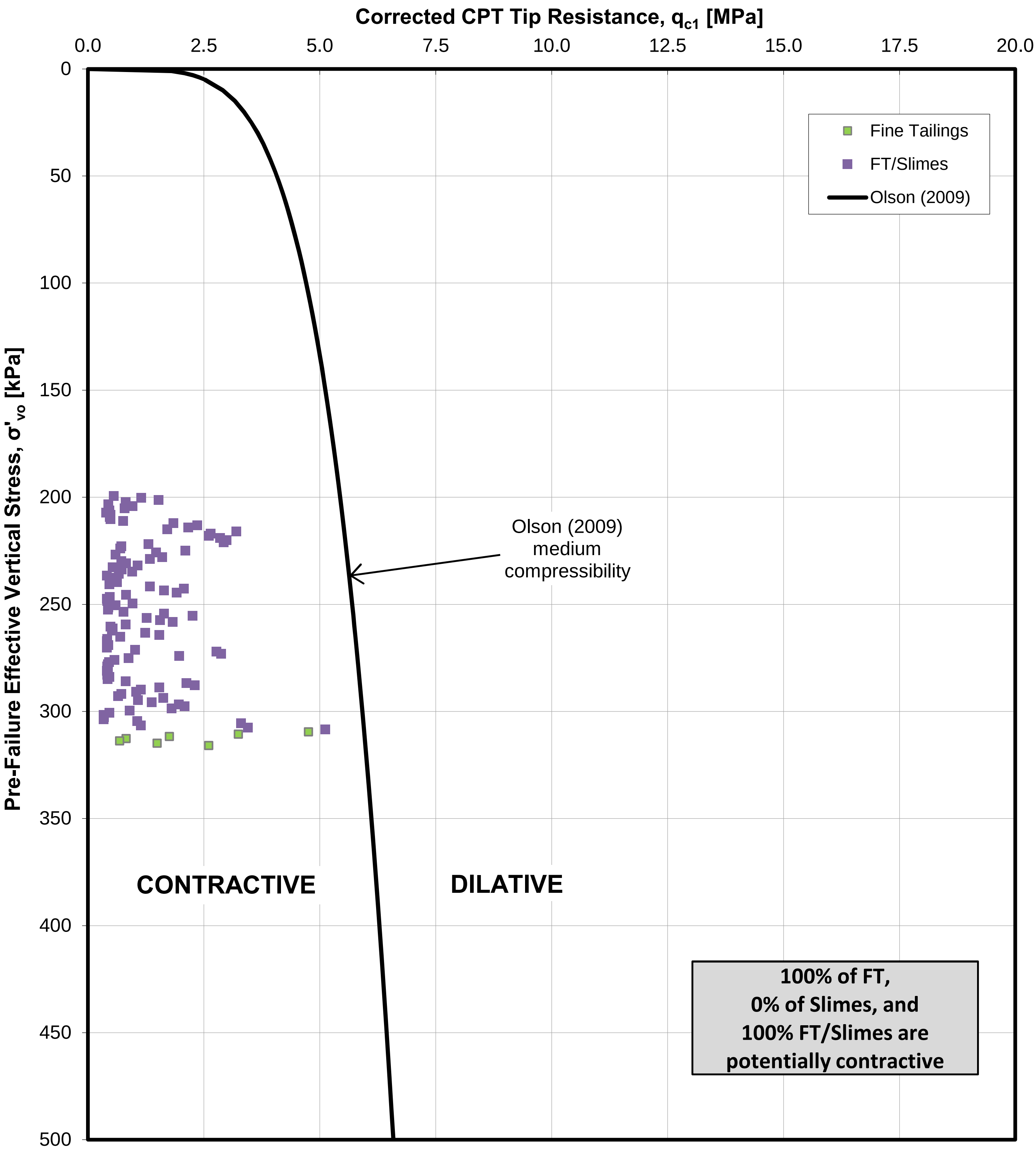
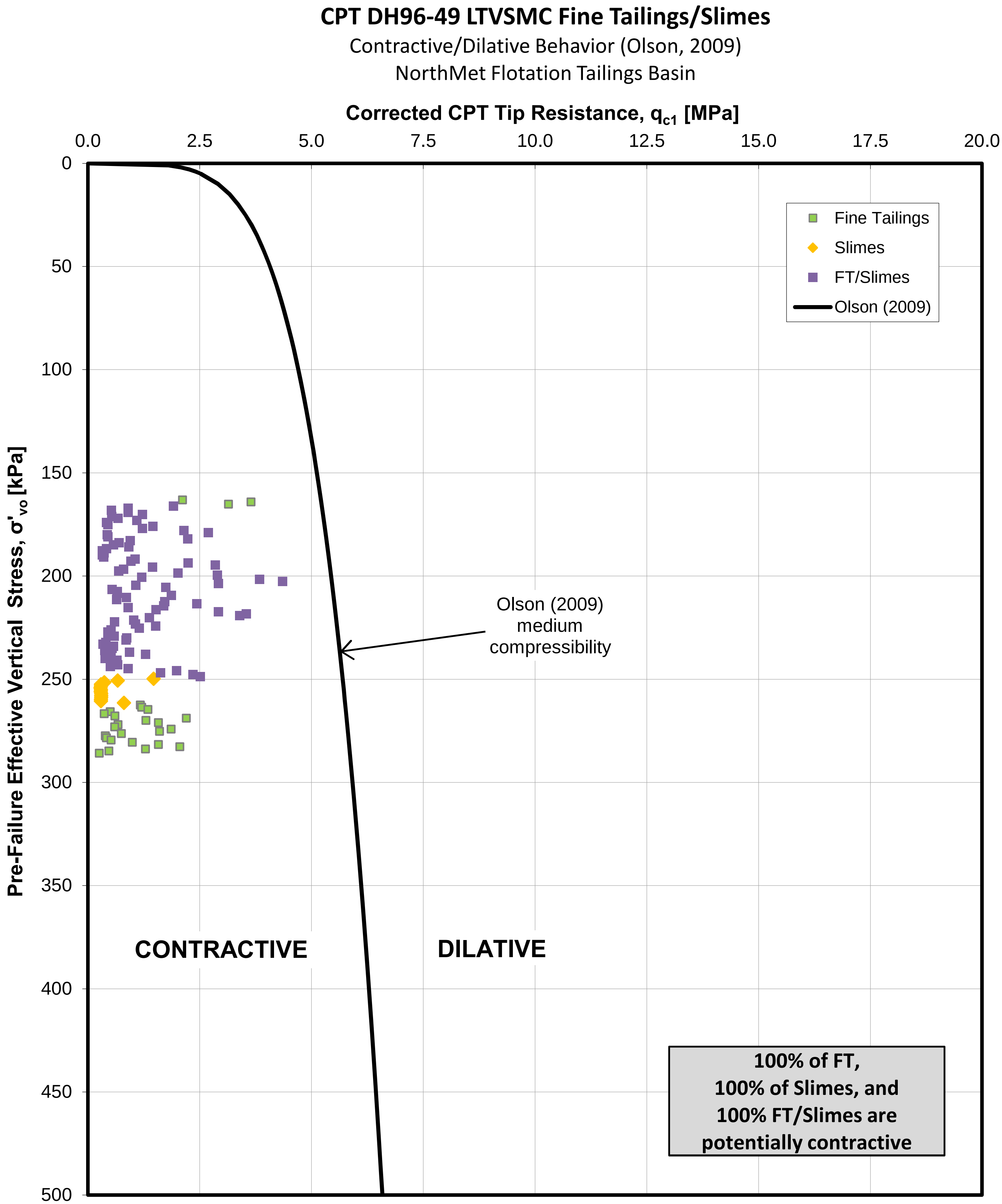
CPT DH96-48 LTVSMC Fine Tailings/Slimes

Contractive/Dilative Behavior (Olson, 2009)

NorthMet Flotation Tailings Basin





CPT DH96-49 LTVSMC Fine Tailings/Slimes
Contractive/Dilative Behavior (Olson, 2009)
NorthMet Flotation Tailings Basin
Corrected CPT Tip Resistance, q_{c1} [MPa]
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Pre-Failure Effective Vertical Stress, σ'_{vo} [kPa]
0
50
100
150
200
250
300
350
400
450
500
Fine Tailings
Slimes
FT/Slimes
Olson (2009)
Olson (2009) medium compressibility
CONTRACTIVE
DILATIVE
100% of FT, 100% of Slimes, and 100% FT/Slimes are potentially contractive

Attachment D

Historical Geotechnical Reports

(previously posted electronically – not posted with report, CDs available upon request)

Attachment E

2007 Geotechnical Investigation Laboratory Test Results

Moisture Density Curve ASTM: D698, Method B

Project: Polynet #23/69-862 | Date: 5/25/05

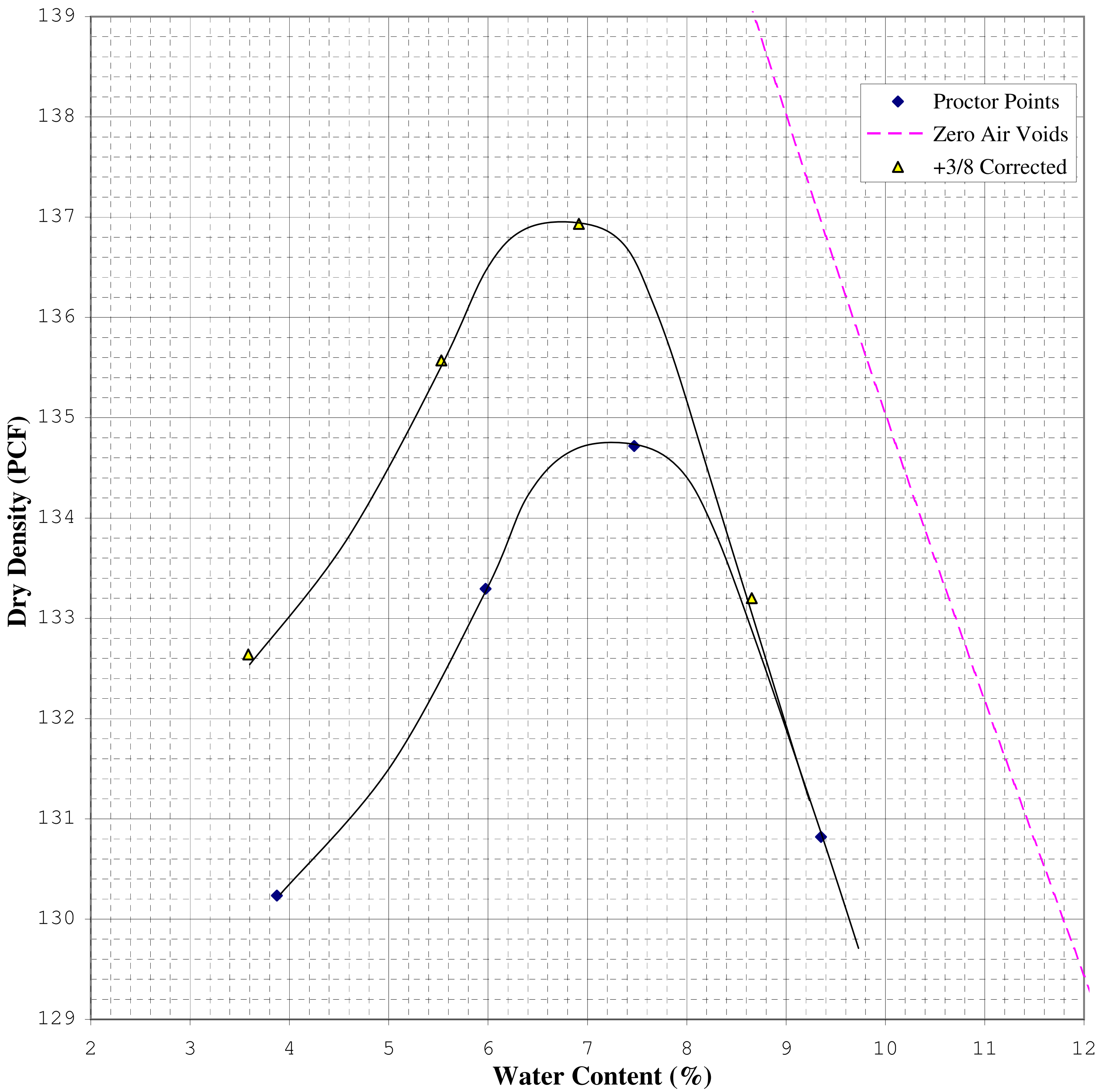
Client: Barr Engineering Company | Job No. 5333

Boring No. SB-05-09 | Sample: | Depth(ft): 8.5-12.5 | Location:

Soil Type: Silty Sand w/gravel, brown (SM)

As Received W.C. (%): 7.9 | LL: NP | PL: NP | PI: NP | Specific Gravity: 2.76 | *Assumed

	◆	△		◆	△
Maximum Dry Density (pcf):	134.7	137.0	Opt. Water Content (%):	7.2	6.7

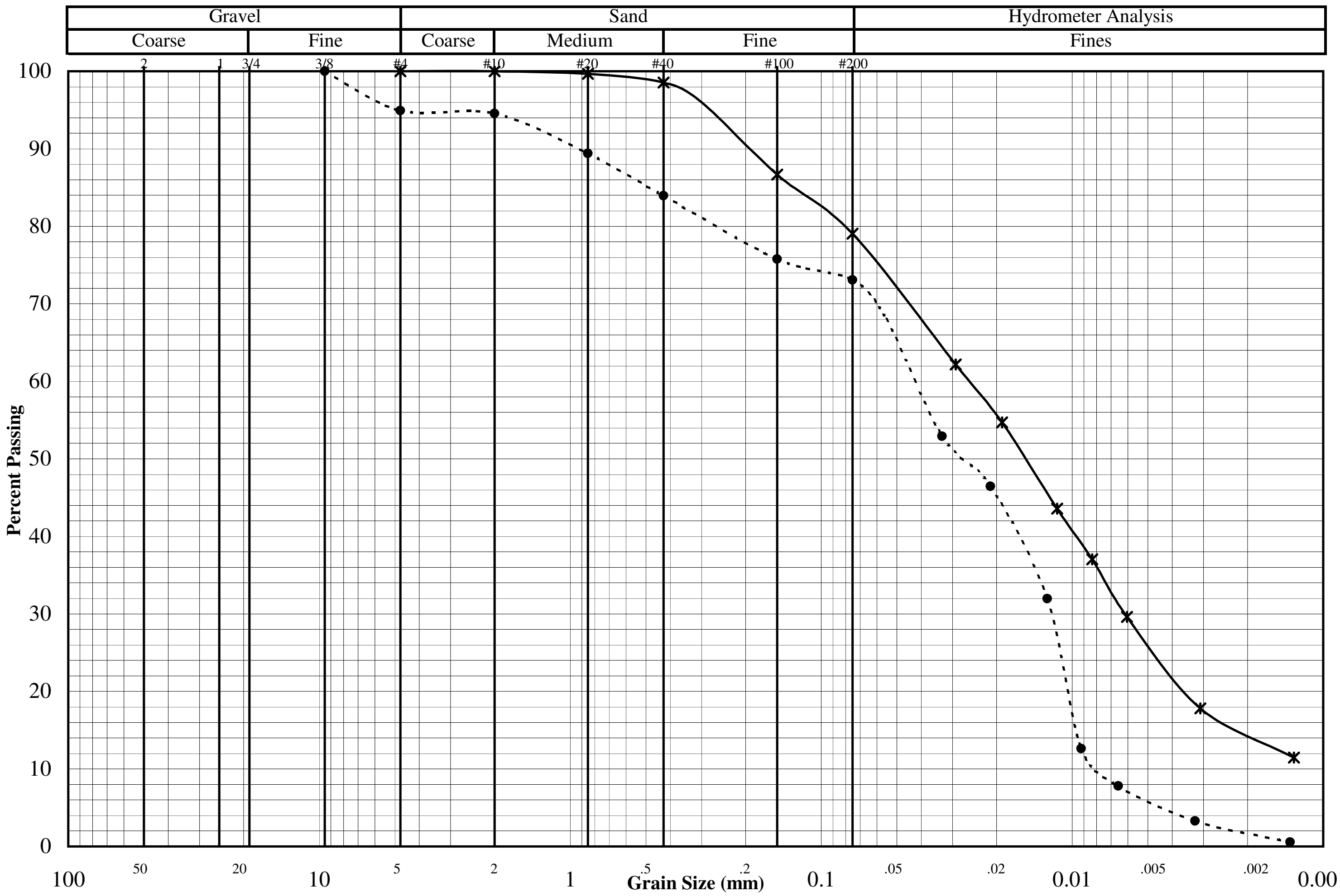


Grain Size Distribution ASTM D422

Job No. : **5333**

Project:	Polynet #23/69-862	Test Date:	5/15/05
Reported To:	Barr Engineering Company	Report Date:	5/24/05

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	SB-05-01		4-5	Bags	Organic Clay, Organic Clay w/sand, some lenses & laminations of Silty Sand, Lean Clay & Fat Clay (OH)
●	SB-05-01		6-8	Bags	Peat w/pieces of wood (PT/OH)
◇					



Other Tests

	*	●	◇
Liquid Limit	66.5	406.9	
Plastic Limit	32.8	273.0	
Plasticity Index	33.7	133.9	
Water Content	49.1	407.7	
Dry Density (pcf)	69.4	13.5	
Specific Gravity	2.48	1.73	
Porosity			
Organic Content			
pH			
Shrinkage Limit	24.7		
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	1028.0	580.0	
2"			
1.5"			
1"			
3/4"			
3/8"		100.0	
#4	100.0	94.9	
#10	100.0	94.6	
#20	99.7	89.4	
#40	98.5	83.9	
#100	86.7	75.8	
#200	79.0	73.1	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

* SB-05-01 @6-8: Pieces of wood retained on all sieves.

9301 Bryant Ave. South, Suite 107

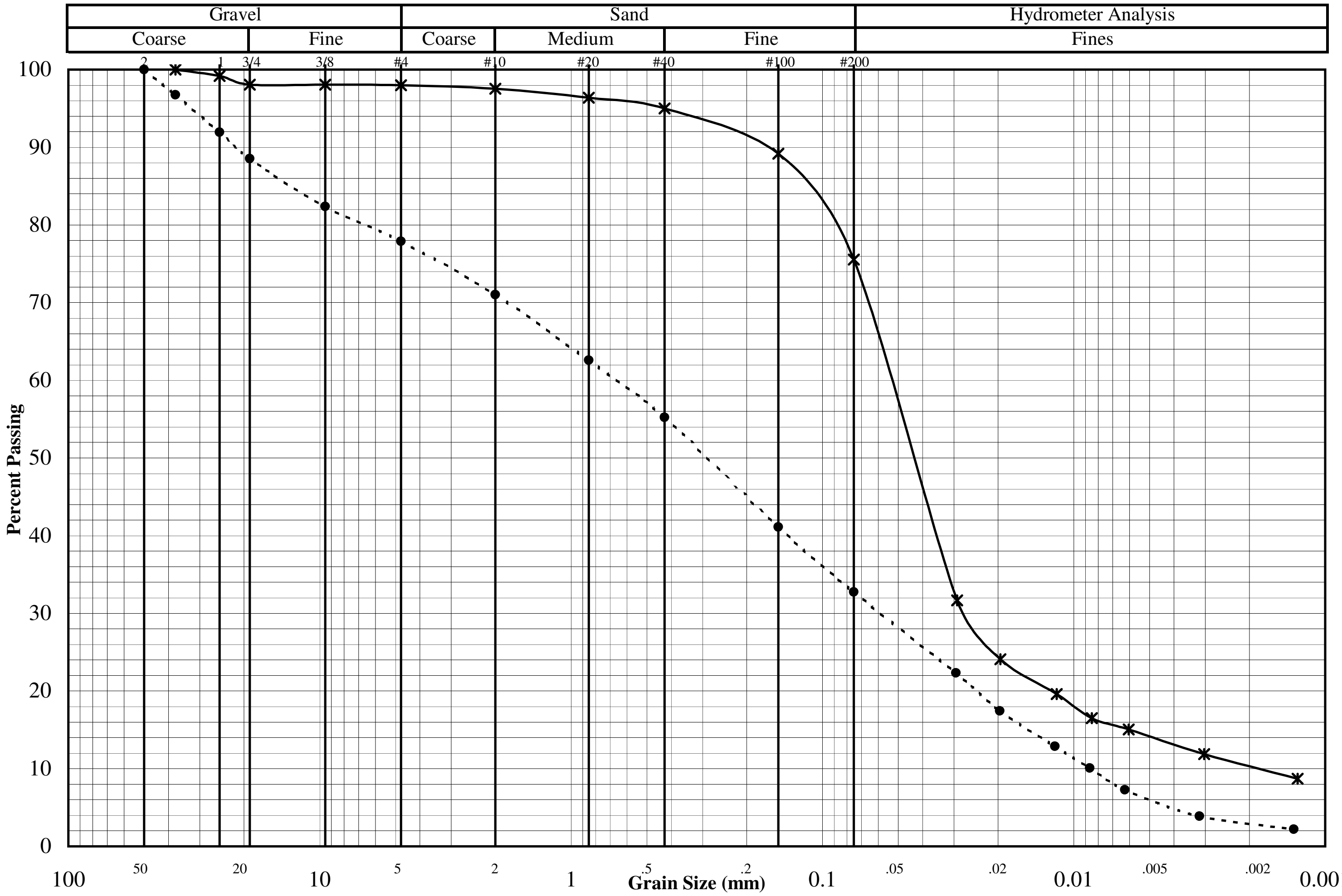
SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Project:	Polynet #23/69-862	Job No. :	5333
		Test Date:	5/15/05
Reported To:	Barr Engineering Company	Report Date:	5/24/05

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	SB-05-04		2-7.5	Bags	Silty Clay w/sand and an occasional piece of gravel, brown & some gray (CL-ML)
●	SB-05-04		8.5-15.5	Bags	Silty sand w/a little gravel, gray (SM)
◇					



Other Tests

	*	●	◇
Liquid Limit	25.6	11.1	
Plastic Limit	20.0	10.0	
Plasticity Index	5.6	1.1	
Water Content	22.0	6.0	
Dry Density (pcf)	107.8		
Specific Gravity	2.78	2.76	
Porosity			
Organic Content			
pH			
Shrinkage Limit	17.8	12.4	
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	5178.0	4568.0	
2"		100.0	
1.5"	100.0	96.8	
1"	99.2	91.9	
3/4"	98.1	88.6	
3/8"	98.1	82.4	
#4	98.0	77.9	
#10	97.5	71.0	
#20	96.4	62.6	
#40	95.0	55.2	
#100	89.2	41.1	
#200	75.5	32.7	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

Permeability Test Data

Project: Polynet - #23/69-862 Date: 6/8/2005

Reported To: Barr Engineering Company Job No.: 5333-A

Boring No.:	SB-05-04	SB-05-04	SB-05-09	SB-05-10			
Depth (ft):	2.0-7.5	8.5-15.5	8.5-12.5	1.0-4.0			
Sample Type:	Bags	Bags	Bags	Bags			
Soil Type:	Silty Clay w/Sand & an occasional piece of gravel, brown & some gray (CL-ML)	Silty Sand w/a Little Gravel, Gray (SM)	Silty Sand w/Gravel, Brown (SM)	Silty Sand w/a Little Gravel (SM/SC-SM)			
Atterberg Limits							
LL	25.6	11.1	NP	15.0			
PL	20.0	10.0	NP	12.2			
PI	5.6	1.1	NP	2.8			
Moisture Density Standard Proctor							
Opt. Water Content	13.5	7.1	7.2	9.4			
Max Dry Den. (pcf)	119.1	136.8	134.7	131.4			
Permeability Test							
Before Test Conditions: Test Wall	Flexible	Flexible	Flexible	Flexible			
Porosity:	0.325	0.228	0.237	0.251			
Ht. (in):	3.00	3.00	3.00	3.00			
Dia. (in):	2.85	2.85	2.85	2.85			
Dry Density (pcf):	112.9	129.2	127.7	125.3			
Water Content:	16.1%	9.6%	9.6%	12.0%			
Test Type:	Falling	Falling	Falling	Falling			
Max Head (ft):	3.9	3.9	3.9	3.9			
Confining press. (Effective-psi):	2.0	2.0	2.0	2.0			
Trial No.:	10-14	8-12	12-16	10-14			
Water Temp ℃:	23.0	23.0	23.0	23.0			
% Compaction	94.8%	94.5%	94.8%	95.4%			
% Saturation (After Test)	95.6%						
Coefficient of Permeability							
K @ 20 ℃ (cm/sec)	**8.7×10^{-8}**	**6.0×10^{-7}**	**1.5×10^{-6}**	**1.5×10^{-7}**			
K @ 20 ℃ (ft/min)	**1.7×10^{-7}**	**5.6×10^{-6}**	**2.9×10^{-6}**	**3.0×10^{-7}**			
Notes:							

Moisture Density Curve ASTM: D698, Method B

Project: **Polynet #23/69-862** Date: **5/25/05**

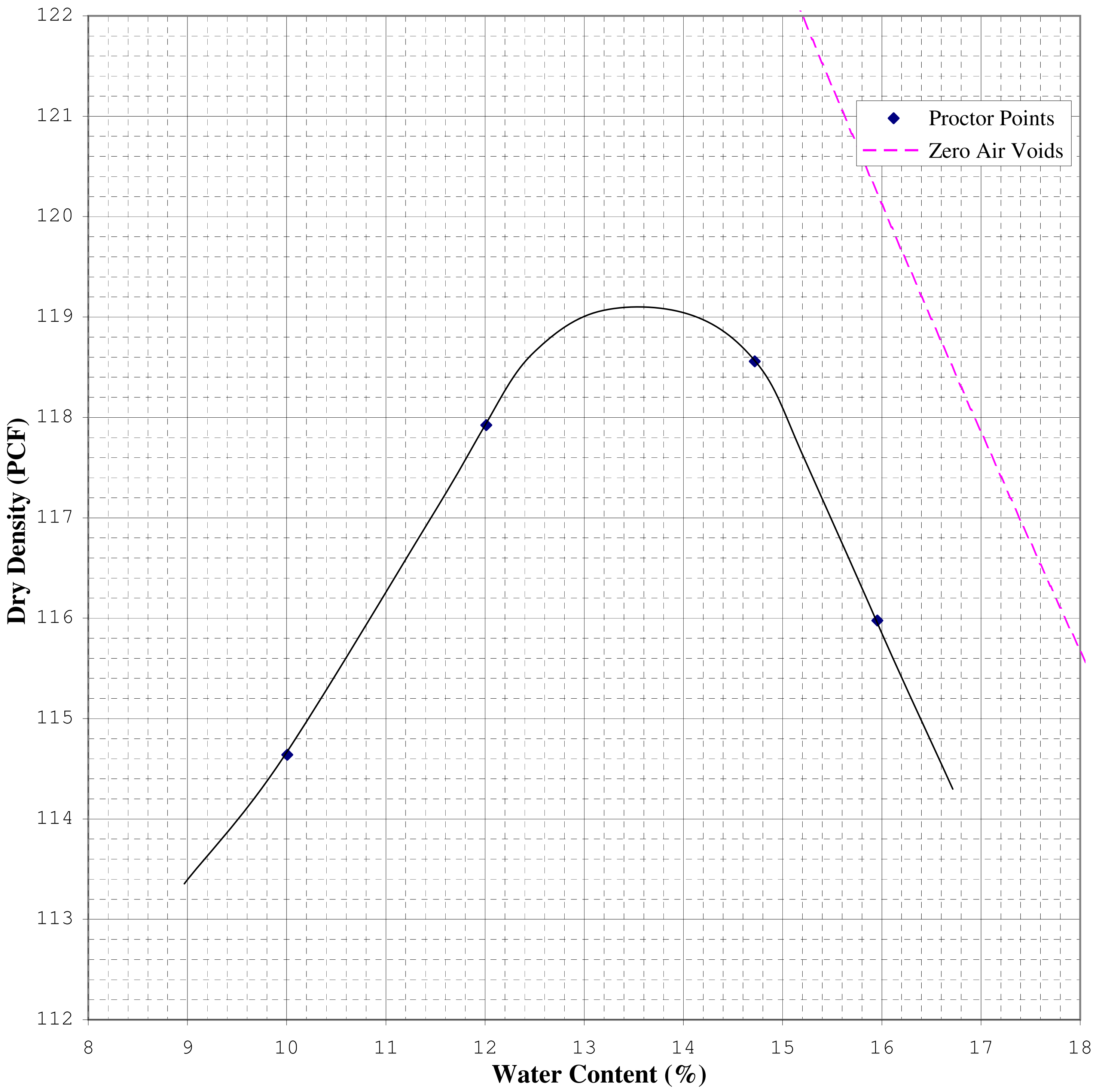
Client: **Barr Engineering Company** Job No. **5333**

Boring No. **SB-05-04** Sample: Depth(ft): **2.0-7.5** Location:

Soil Type: **Silty Clay w/sand & an occasional piece of gravel, brown & some gray (CL-ML)**

As Received W.C. (%): **22.0** LL: **25.6** PL: **20.0** PI: **5.6** Specific Gravity: **2.78** *Assumed

Maximum Dry Density (pcf): **119.1** Opt. Water Content (%): **13.5**



9301 Bryant Ave. South, Suite 107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

SET-R18a]Fina

Moisture Density Curve ASTM: D698, Method B

Project: **Polynet #23/69-862** Date: **5/25/05**

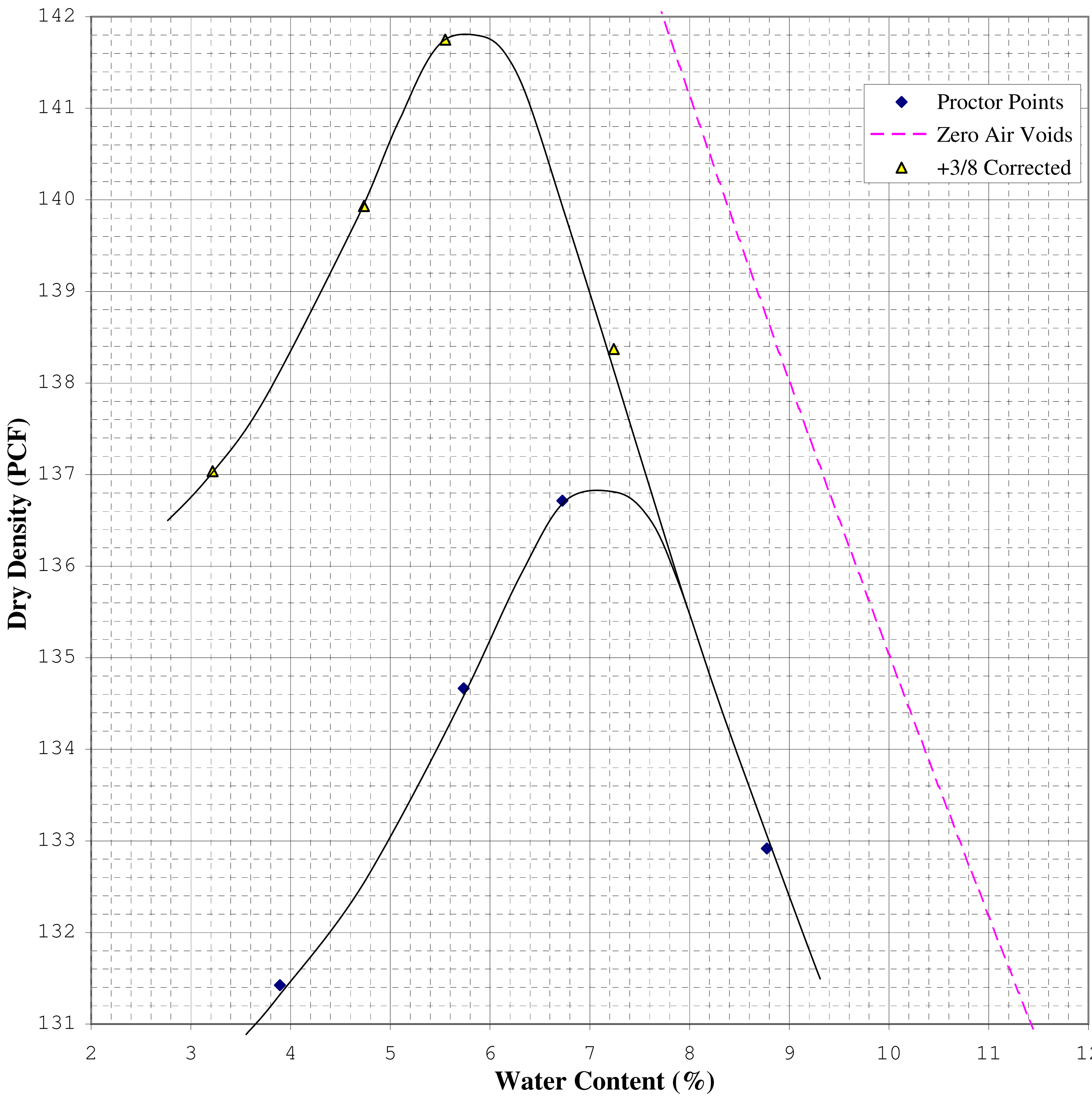
Client: **Barr Engineering Company** Job No. **5333**

Boring No. **SB-05-04** Sample: Depth(ft): **8.5-15.5** Location:

Soil Type: **Silty Sand w/a little gravel, gray (SM)**

As Received W.C. (%): **6.0** LL: **11.1** PL: **10.0** PI: **1.1** Specific Gravity: **2.76** *Assumed

	◆	△		◆	△
Maximum Dry Density (pcf):	136.8	141.7	Opt. Water Content (%):	7.1	5.8



Moisture Density Curve ASTM: D698, Method B

Project: **Polynet #23/69-862** Date: **5/25/05**

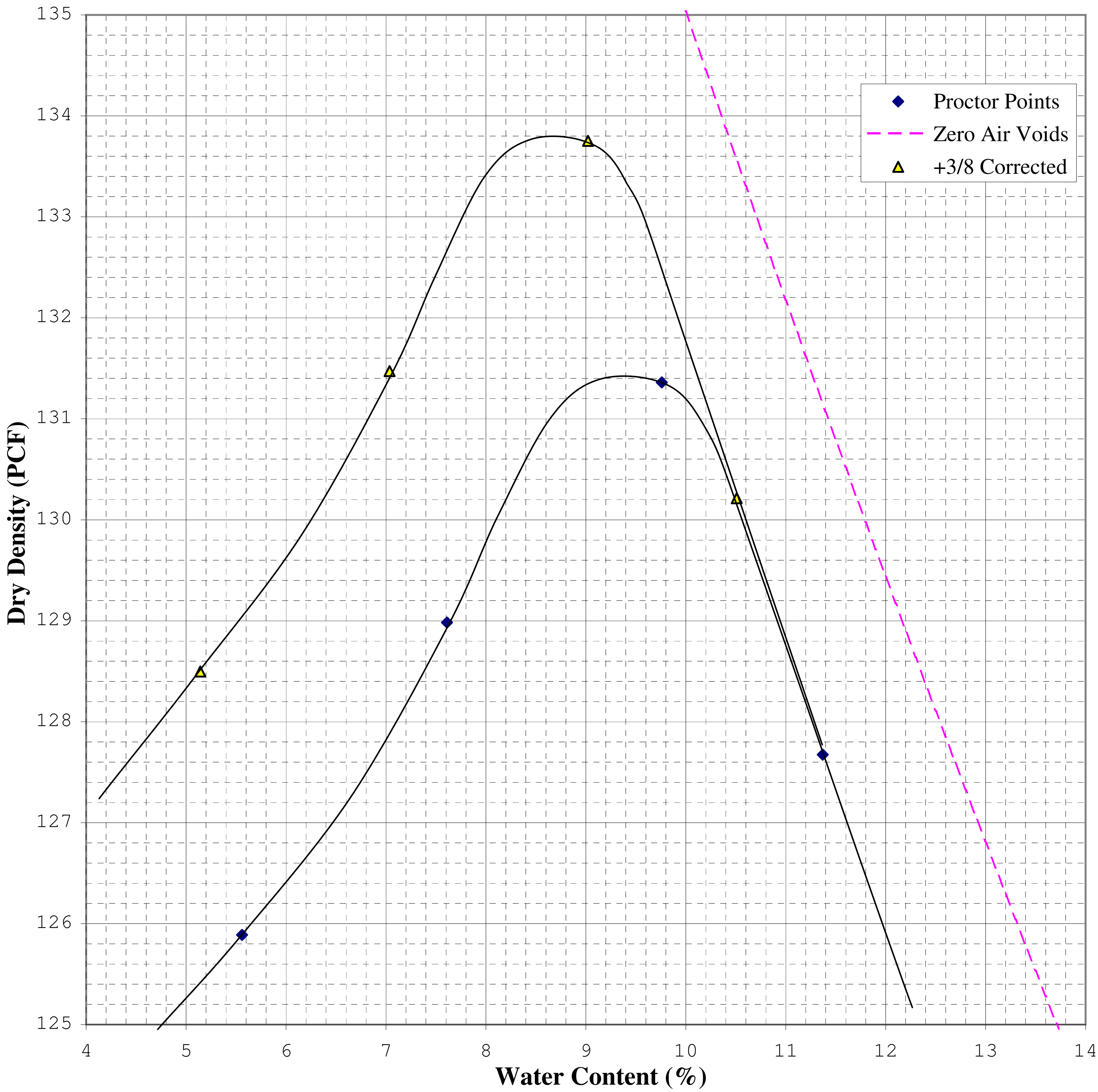
Client: **Barr Engineering Company** Job No. **5333**

Boring No. **SB-05-10** Sample: Depth(ft): **1-4** Location:

Soil Type: **Silty Sand w/a few layers of Silty Clay and a little gravel (SM/SC-SM)**

As Received W.C. (%): **11.6** LL: **15.0** PL: **12.2** PI: **2.8** Specific Gravity: **2.76** *Assumed

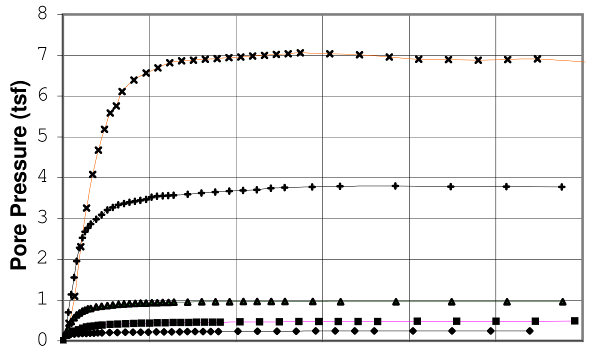
	◆	△		◆	△
Maximum Dry Density (pcf):	131.4	133.8	Opt. Water Content (%):	9.4	8.6

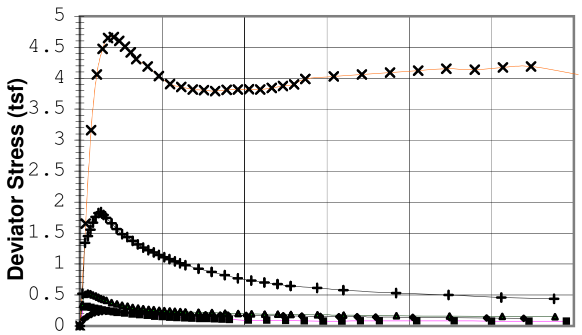


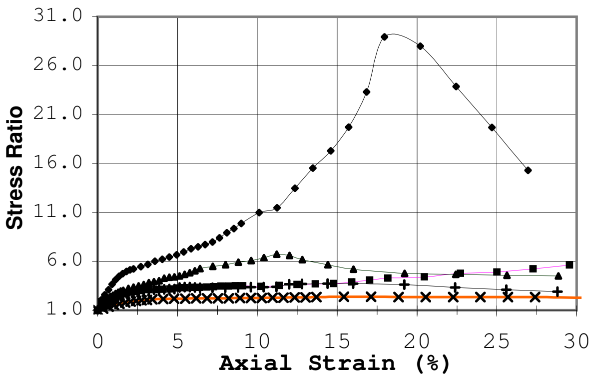
TRIAXIAL TEST ASTM: D 4767

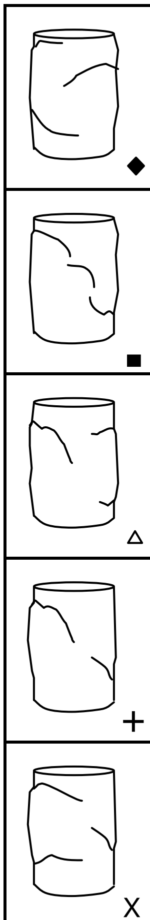
Job No. **5435**
Date: **10/10/05**

Project: **Polymet Tailings Characterization - # 23/69-862**
Boring #: Sample #: **Pail 1 & 2** Type: **Bulk** Depth (ft):
Soil Type: **Tailings, (Sandy Silt (ML))**









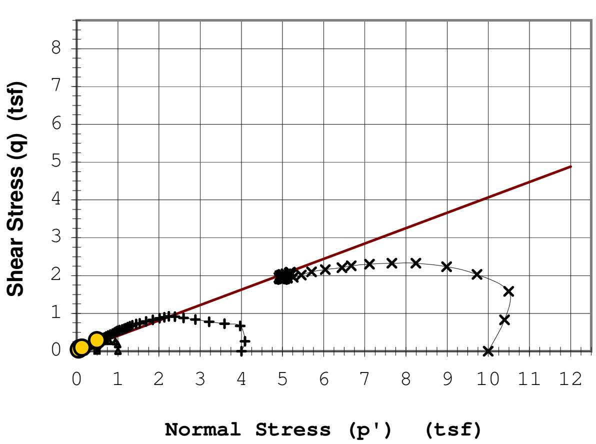
Failure Criterion:	Max. Stress Ratio
Angle of internal friction, φ' =	24.0 °
Apparent Cohesion, c' =	0.00 (tsf)

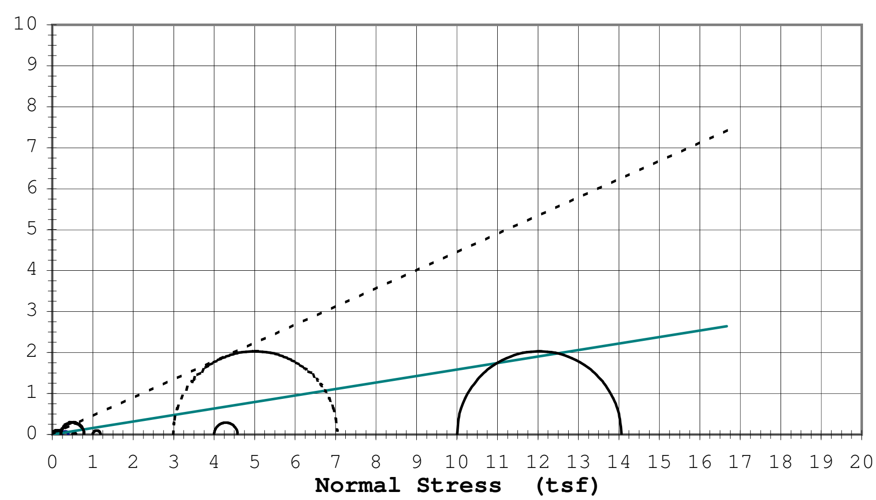
Test Date:	9/28/05	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.00236	Plasticity Index:	NP
Strain Rate (%/min):	0.053	Spec. Gravity (Actual):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	2.00	2.00	2.88	2.88	1.42
Height (in)	4.52	4.52	6.51	6.51	3.51
Water Content (%)	12.1	10.7	10.5	10.5	7.4
Dry Density (pcf)	86.7	87.6	87.8	90.7	76.2
Void Ratio	1.16	1.14	1.13	1.07	1.46
After Consolidation					
Diameter (in)	1.98	1.99	2.86	2.81	1.34
Height (in)	4.45	4.40	6.24	6.25	2.92
Water Content (%)	36.6	35.8	34.0	29.5	27.5
Dry Density (pcf)	89.3	90.3	92.7	99.3	102.6
Void Ratio	1.10	1.07	1.02	0.89	0.83
Back Pressure (tsf)	4.32	4.32	4.32	4.32	4.32
Minor Principal Stress (tsf)	0.25	0.50	1.00	4.00	10.00
Max. Deviator Stress (tsf)	0.24	0.31	0.53	1.84	4.66
Ultimate Deviator Stress (tsf)	0.13	0.08	0.15	0.44	3.90
Deviator Stress at Failure (tsf)	0.15	0.08	0.19	0.58	4.06
Max. Pore Pressure Buildup (tsf)	0.24	0.48	0.97	3.80	7.06
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	18.0	29.6	11.2	16.0	17.1

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Saturated w/a very low head & then applied a slow build-up of backpressure until "B" was 1.0, over a period of 5-8 days; Consolidated incremently from 0.072 to 10.0 tsf; [A] to 0.25 tsf, [B] to 0.50 tsf, [C] to 1.0 tsf, [D] to 4.0 tsf, [E] to 10.0 tsf; Recorded volume change; Ran a permeability test before shear; Stressed to given strains at constant rate of 0.00236"/min..





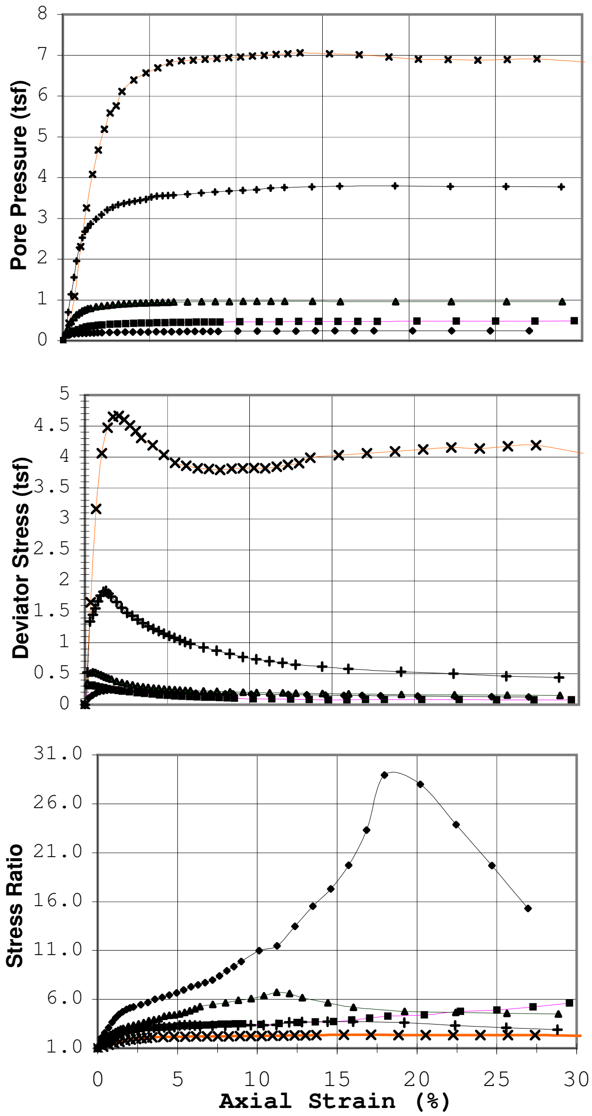
Rupture Envelope at Failure	
α = 22.1 °	a = 0.0 (tsf)

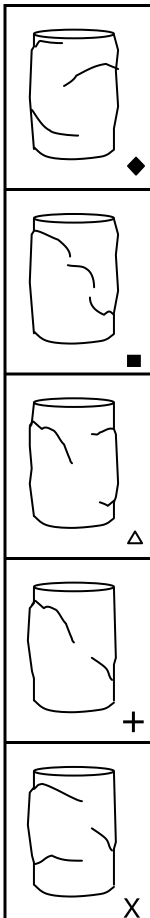
------------	Effective φ':	24.0 °	c'=	0.00 (tsf)
________	Total φ':	9.0 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **5435**
Date: **10/10/05**

Project: **Polymet Tailings Characterization - # 23/69-862**
Boring #: Sample #: **Pail 1 & 2** Type: **Bulk** Depth (ft):
Soil Type: **Tailings, (Sandy Silt (ML))**





Failure Criterion: **Max. Pore Pressure**

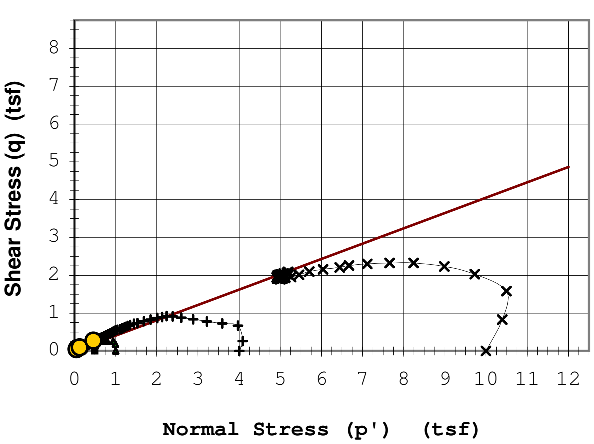
Angle of internal friction, ϕ' = **23.9 °**
Apparent Cohesion, c' = **0.00 (tsf)**

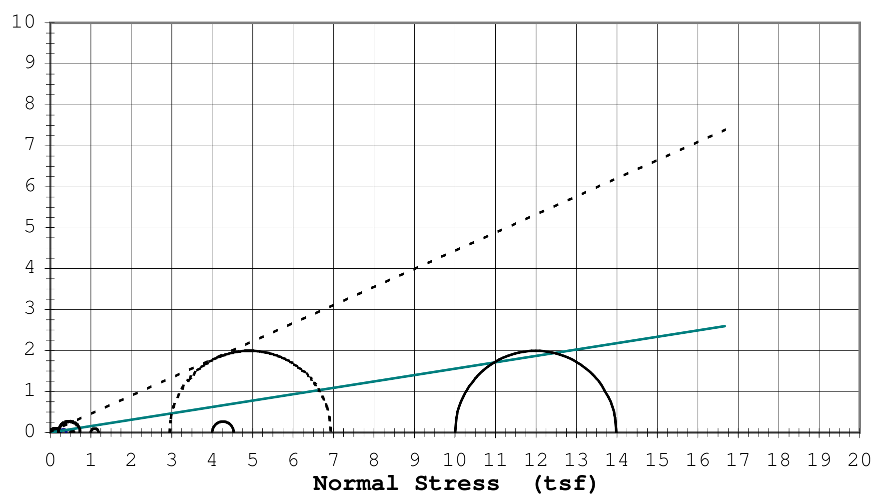
Test Date:	9/28/05	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.00236	Plasticity Index:	NP
Strain Rate (%/min):	0.053	Spec. Gravity (Actual):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	2.00	2.00	2.88	2.88	1.42
Height (in)	4.52	4.52	6.51	6.51	3.51
Water Content (%)	12.1	10.7	10.5	10.5	7.4
Dry Density (pcf)	86.7	87.6	87.8	90.7	76.2
Void Ratio	1.16	1.14	1.13	1.07	1.46
After Consolidation					
Diameter (in)	1.98	1.99	2.86	2.81	1.34
Height (in)	4.45	4.40	6.24	6.25	2.92
Water Content (%)	36.6	35.8	34.0	29.5	27.5
Dry Density (pcf)	89.3	90.3	92.7	99.3	102.6
Void Ratio	1.10	1.07	1.02	0.89	0.83
Back Pressure (tsf)	4.32	4.32	4.32	4.32	4.32
Minor Principal Stress (tsf)	0.25	0.50	1.00	4.00	10.00
Max. Deviator Stress (tsf)	0.24	0.31	0.53	1.84	4.66
Ultimate Deviator Stress (tsf)	0.13	0.08	0.15	0.44	3.90
Deviator Stress at Failure (tsf)	0.15	0.08	0.19	0.53	3.99
Max. Pore Pressure Buildup (tsf)	0.24	0.48	0.97	3.80	7.06
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	18.0	29.6	11.2	19.2	13.7

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Saturated w/a very low head & then applied a slow build-up of backpressure until "B" was 1.0, over a period of 5-8 days; Consolidated incremently from 0.072 to 10.0 tsf; [A] to 0.25 tsf, [B] to 0.50 tsf, [C] to 1.0 tsf, [D] to 4.0 tsf, [E] to 10.0 tsf; Recorded volume change; Ran a permeability test before shear; Stressed to given strains at constant rate of 0.00236"/min..





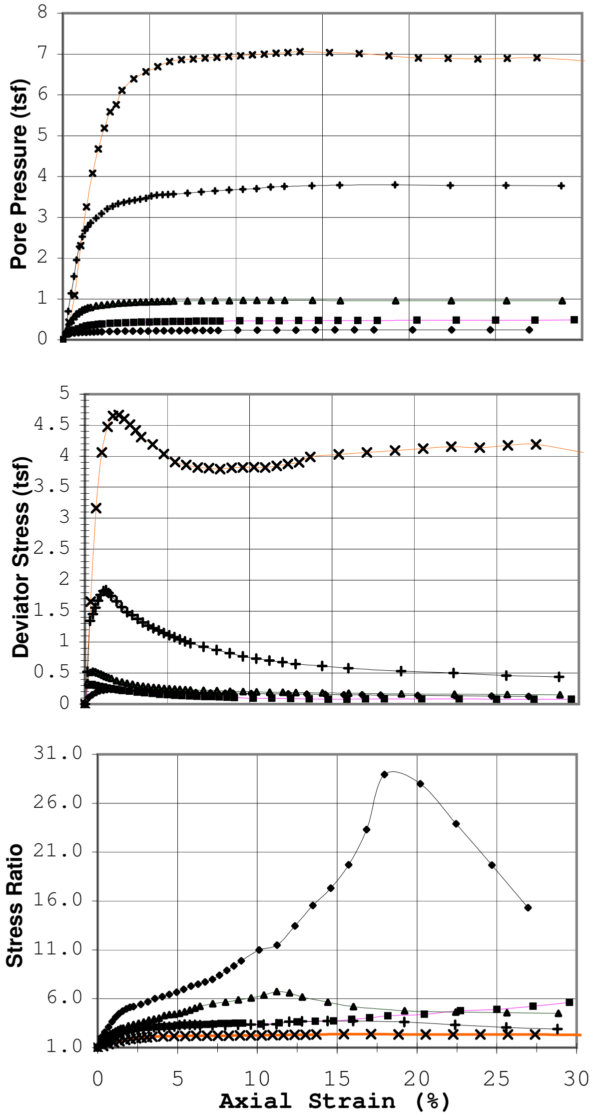
Rupture Envelope at Failure	
α = 22.1 °	a = 0.0 (tsf)

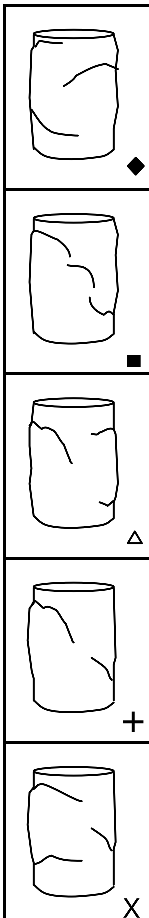
------------	Effective ϕ':	23.9 °	c'=	0.00 (tsf)
________	Total ϕ':	8.9 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 5435
Date: 10/10/05

Project: **Polymet Tailings Characterization - # 23/69-862**
Boring #: Sample #: Pail 1 & 2 Type: **Bulk** Depth (ft):
Soil Type: **Tailings, (Sandy Silt (ML))**





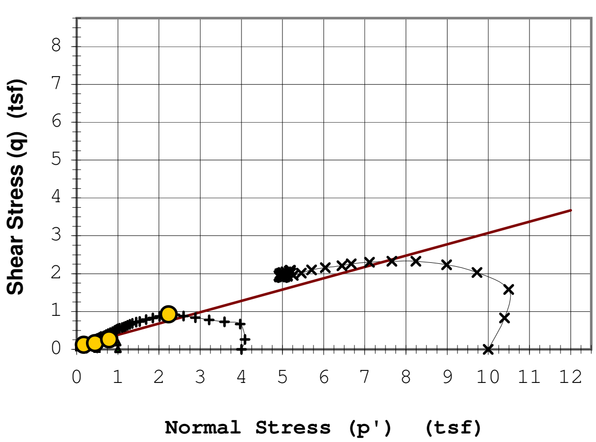
Failure Criterion:	**Max. Deviator Stress**
Angle of internal friction, φ' =	**17.4 °**
Apparent Cohesion, c' =	**0.09 (tsf)**

Test Date:	9/28/05	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.00236	Plasticity Index:	NP
Strain Rate (%/min):	0.053	Spec. Gravity (Actual):	3.00

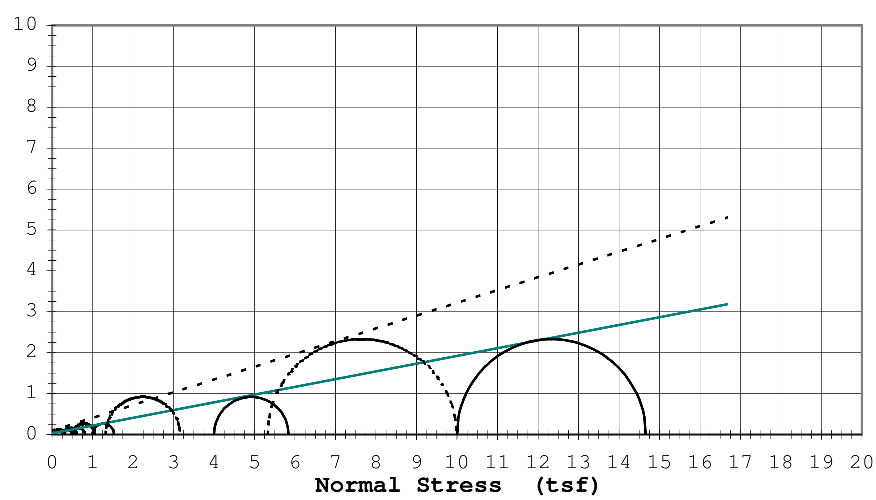
Before Consolidation	A	B	C	D	E
Diameter (in)	2.00	2.00	2.88	2.88	1.42
Height (in)	4.52	4.52	6.51	6.51	3.51
Water Content (%)	12.1	10.7	10.5	10.5	7.4
Dry Density (pcf)	86.7	87.6	87.8	90.7	76.2
Void Ratio	1.16	1.14	1.13	1.07	1.46
After Consolidation					
Diameter (in)	1.98	1.99	2.86	2.81	1.34
Height (in)	4.45	4.40	6.24	6.25	2.92
Water Content (%)	36.6	35.8	34.0	29.5	27.5
Dry Density (pcf)	89.3	90.3	92.7	99.3	102.6
Void Ratio	1.10	1.07	1.02	0.89	0.83
Back Pressure (tsf)	4.32	4.32	4.32	4.32	4.32
Minor Principal Stress (tsf)	0.25	0.50	1.00	4.00	10.00
Max. Deviator Stress (tsf)	0.24	0.31	0.53	1.84	4.66
Ultimate Deviator Stress (tsf)	0.13	0.08	0.15	0.44	3.90
Deviator Stress at Failure (tsf)	0.24	0.31	0.53	1.84	4.66
Max. Pore Pressure Buildup (tsf)	0.24	0.48	0.97	3.80	7.06
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	1.8	0.5	0.5	1.3	2.1

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Saturated w/a very low head & then applied a slow build-up of backpressure until "B" was 1.0, over a period of 5-8 days; Consolidated incremently from 0.072 to 10.0 tsf; [A] to 0.25 tsf, [B] to 0.50 tsf, [C] to 1.0 tsf, [D] to 4.0 tsf, [E] to 10.0 tsf; Recorded volume change; Ran a permeability test before shear; Stressed to given strains at constant rate of 0.00236"/min..



Rupture Envelope at Failure	
α = 16.7 °	a = 0.1 (tsf)



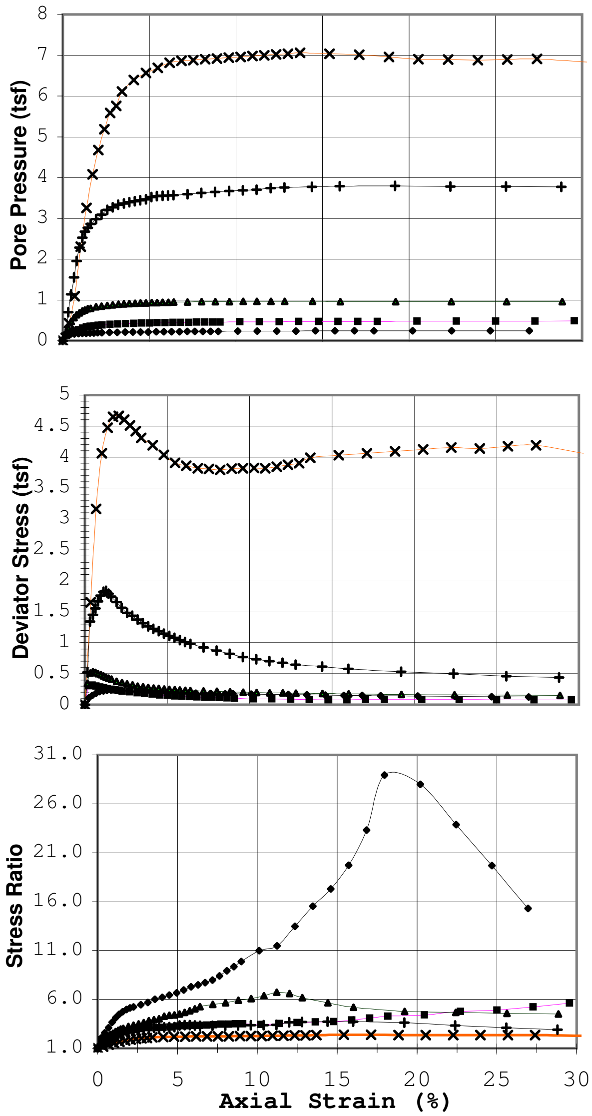
------------	Effective φ':	17.4 °	c'=	0.09 (tsf)
________	Total φ':	10.7 °	c=	0.03 (tsf)

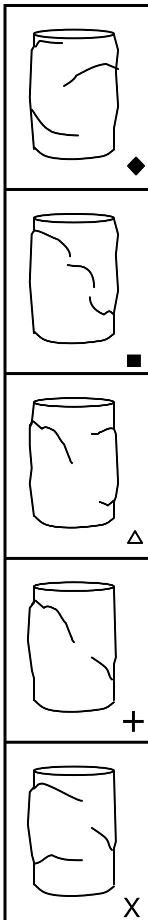
9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

TRIAXIAL TEST ASTM: D 4767

Job No. **5435**
Date: **10/10/05**

Project: **Polymet Tailings Characterization - # 23/69-862**
Boring #: Sample #: **Pail 1 & 2** Type: **Bulk** Depth (ft):
Soil Type: **Tailings, (Sandy Silt (ML))**



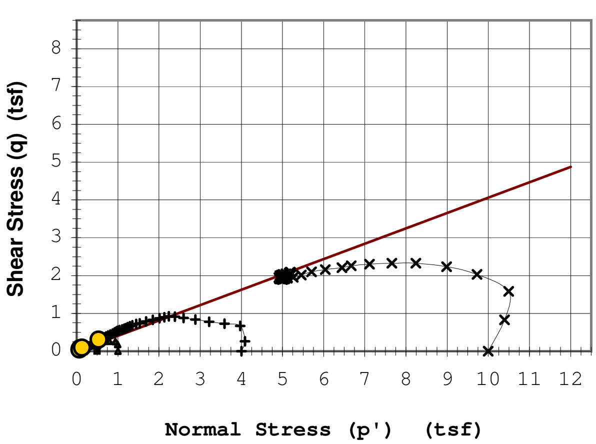


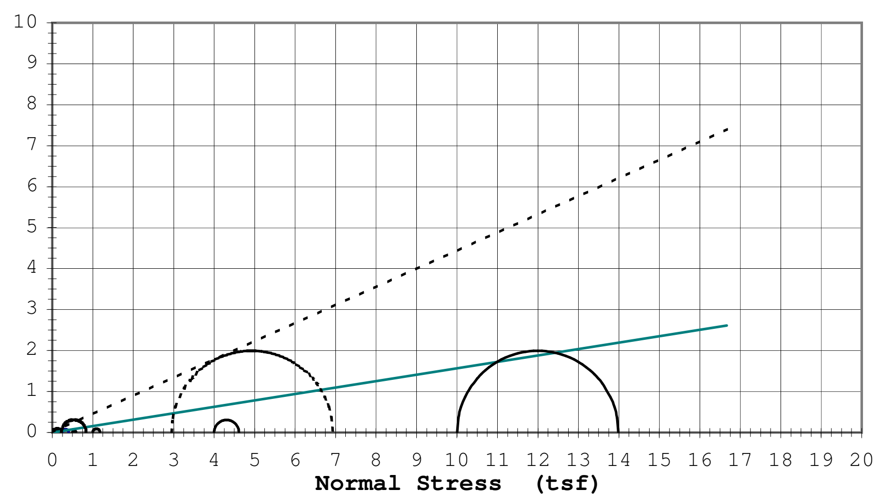
Failure Criterion:		**Given Strain of: 15%**			
Angle of internal friction, φ' =		**24.0 °**			
Apparent Cohesion, c' =		**0.00 (tsf)**			
Test Date:	9/28/05	Liquid Limit:	NP		
Test Type:	CU w/pp	Plastic Limit:	NP		
Strain Rate (in/min):	0.00236	Plasticity Index:	NP		
Strain Rate (%/min):	0.053	Spec. Gravity (Actual):	3.00		

Before Consolidation	A	B	C	D	E
Diameter (in)	2.00	2.00	2.88	2.88	1.42
Height (in)	4.52	4.52	6.51	6.51	3.51
Water Content (%)	12.1	10.7	10.5	10.5	7.4
Dry Density (pcf)	86.7	87.6	87.8	90.7	76.2
Void Ratio	1.16	1.14	1.13	1.07	1.46
After Consolidation					
Diameter (in)	1.98	1.99	2.86	2.81	1.34
Height (in)	4.45	4.40	6.24	6.25	2.92
Water Content (%)	36.6	35.8	34.0	29.5	27.5
Dry Density (pcf)	89.3	90.3	92.7	99.3	102.6
Void Ratio	1.10	1.07	1.02	0.89	0.83
Back Pressure (tsf)	4.32	4.32	4.32	4.32	4.32
Minor Principal Stress (tsf)	0.25	0.50	1.00	4.00	10.00
Max. Deviator Stress (tsf)	0.24	0.31	0.53	1.84	4.66
Ultimate Deviator Stress (tsf)	0.13	0.08	0.15	0.44	3.90
Deviator Stress at Failure (tsf)	0.16	0.08	0.18	0.61	3.99
Max. Pore Pressure Buildup (tsf)	0.24	0.48	0.97	3.80	7.06
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	15.0	15.0	15.0	15.0	15.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Saturated w/a very low head & then applied a slow build-up of backpressure until "B" was 1.0, over a period of 5-8 days; Consolidated incremently from 0.072 to 10.0 tsf; [A] to 0.25 tsf, [B] to 0.50 tsf, [C] to 1.0 tsf, [D] to 4.0 tsf, [E] to 10.0 tsf; Recorded volume change; Ran a permeability test before shear; Stressed to given strains at constant rate of 0.00236"/min..





Rupture Envelope at Failure	
α = 22.1 °	a = 0.0 (tsf)

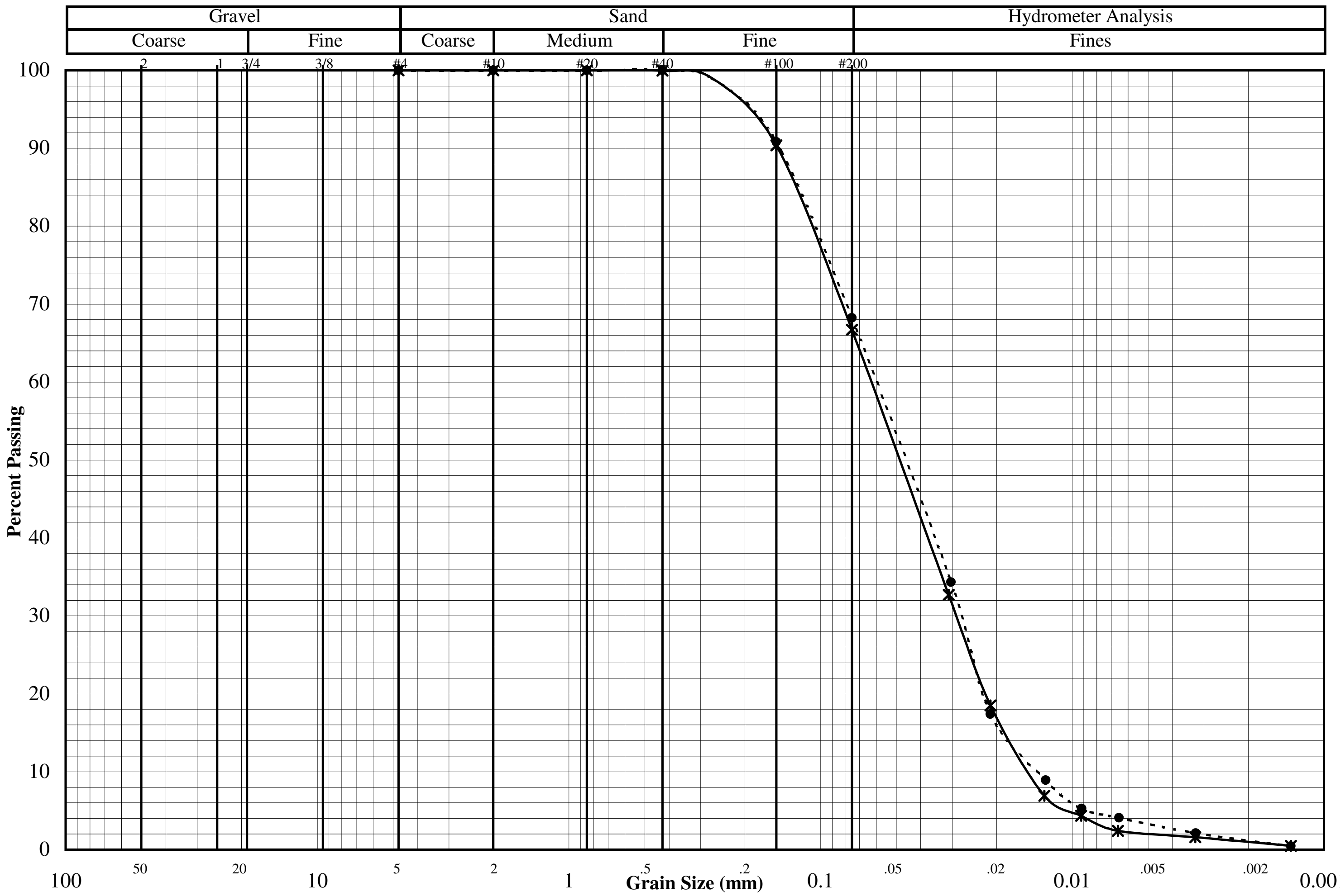
------------	Effective φ':	24.0 °	c'=	0.00 (tsf)
________	Total φ':	8.9 °	c=	0.00 (tsf)

9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

		Job No. :	**5435**
Project:	Polymet Tailings Characterization	Test Date:	8/11/05
Reported To:	Barr Engineering Company	Report Date:	8/16/05

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Parcel 3	1-Pail		Bulk	Tailings (Sandy Silt (ML))
●	Parcel 3	2-Pail		Bulk	Tailings (Sandy Silt (ML))
◇					



Other Tests

	*	●	◇
Liquid Limit	*	*	
Plastic Limit	*	*	
Plasticity Index	N.P.	N.P.	
Water Content	24.0	23.8	
Dry Density (pcf)			
Specific Gravity	3.00	3.00	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	889.3	793.3	
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	
#10	100.0	100.0	
#20	100.0	100.0	
#40	100.0	100.0	
#100	90.4	90.8	
#200	66.7	68.2	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

* Atterberg Limits Attempted

9301 Bryant Ave. South, Suite 107

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Hydrometer Data Table

Job No. : **5435**

Project:	Polymet Tailings Characterization	Test Date:	8/11/05
Reported To:	Barr Engineering Company	Report Date:	8/16/05

Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Parcel 3	1-Pail		Bulk	Tailings (Sandy Silt (ML))
Parcel 3	2-Pail		Bulk	Tailings (Sandy Silt (ML))

1- Pail	
Dia. (mm)	% Pass
0.0310	32.9
0.0212	18.6
0.0129	7.0
0.0092	4.4
0.0066	2.4
0.0032	1.6
0.0014	0.5

2- Pail	
Dia. (mm)	% Pass
0.0303	34.6
0.0212	17.5
0.0128	9.0
0.0092	5.3
0.0065	4.1
0.0032	2.1
0.0014	0.4

Permeability Test Data

Project: Polymet Tailings Characterization Date: 10/31/2005

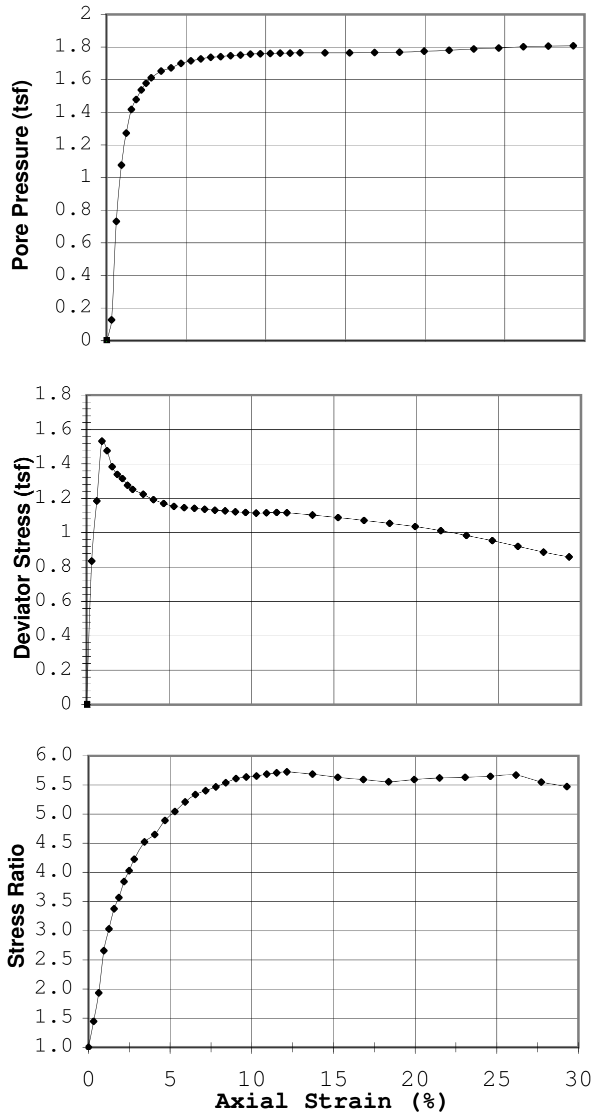
Reported To: Barr Engineering Company Job No.: 5435

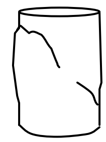
Boring No.:							
Sample No.:	Pail 2	Pail 2	Pail 1	Pail 1	Pail 1	Pail 1	
Confining Pressure	0.25 tsf	0.5 tsf	1.0 tsf	2.0 tsf	4.0 tsf	7.0 tsf	
Location:							
Sample Type:	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	
Soil Type:	Tailings (Sandy Silt (ML))	Tailings (Sandy Silt (ML))	Tailings (Sandy Silt (ML))	Tailings (Sandy Silt (ML))	Tailings (Sandy Silt (ML))	Tailings (Sandy Silt (ML))	
Atterberg Limits							
LL	NP	NP	NP	NP	NP	NP	
PL	NP	NP	NP	NP	NP	NP	
PI	NP	NP	NP	NP	NP	NP	
Permeability Test							
Void Ratio:	1.10	1.07	1.02	0.96	0.89	0.86	
Ht. (in):	4.45	4.40	6.24	2.79	6.25	2.72	
Dia. (in):	1.98	1.99	2.86	2.72	2.81	2.68	
Dry Density (pcf):	89.3	90.3	92.7	95.3	99.3	100.7	
Water Content:	36.6%	35.8%	34.0%	32.1%	29.5%	28.6%	
Confining press. (Effective-tsf):	0.3	0.5	1.0	2.0	4.0	7.0	
Trial No.:	4-7	4-8	4-8	4-8	1-5	1-5	
Water Temp ℃:	23.0	23.0	23.0	23.0	23.0	23.0	
Coefficient of Permeability							
K @ 20 ℃ (cm/sec)	**4.8×10^{-4}**	**4.7×10^{-4}**	**2.0×10^{-4}**	**6.2×10^{-5}**	**4.4×10^{-5}**	**2.0×10^{-5}**	
K @ 20 ℃ (ft/min)	**9.5×10^{-4}**	**9.2×10^{-4}**	**4.0×10^{-4}**	**1.2×10^{-6}**	**8.7×10^{-5}**	**3.9×10^{-5}**	
Notes:	The 2 ton and 7 Ton confining pressures were performed independent of triaxial samples.						

TRIAXIAL TEST ASTM: D 4767

Job No. **5435**
Date: **10/3/05**

Project: **Polymet Tailings Characterization - # 23/69-862**
Boring #: Sample #: **2-Pail** Type: **Bulk** Depth (ft):
Soil Type: **Tailings, (Sandy Silt (ML))**





Failure Criterion: **Max. Deviator Stress**
Angle of internal friction, φ' = **26.9 °**
Apparent Cohesion, c' = **0.00 (tsf)**

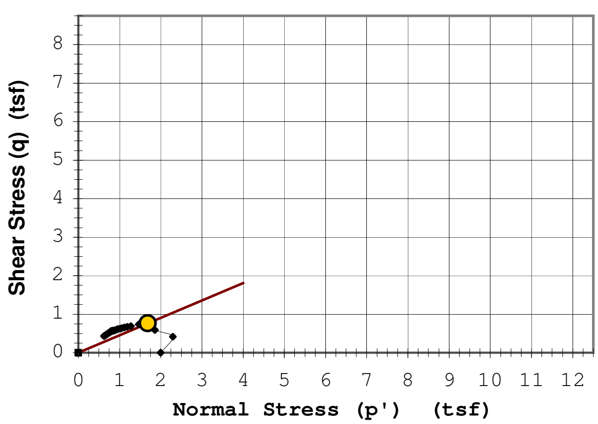
Test Date:	9/29/05	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.00177	Plasticity Index:	NP
Strain Rate (%/min):	0.055	Spec. Gravity (Actual):	3.00

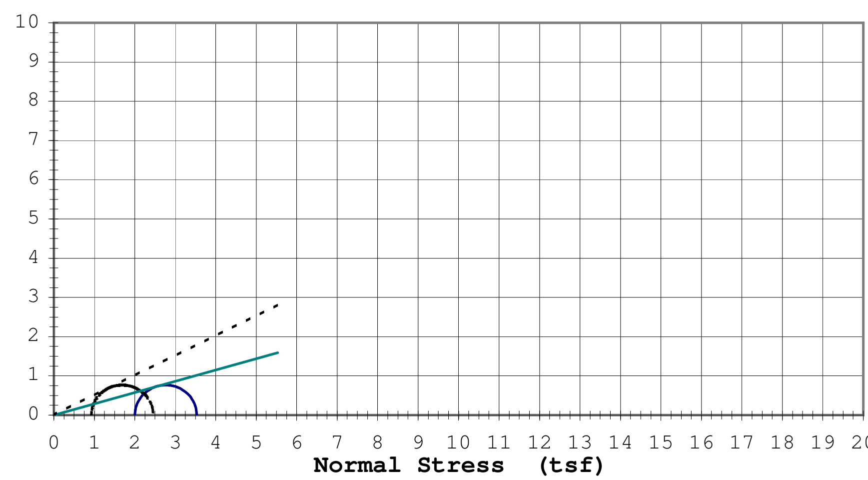
	A	B	C	D	E
Before Consolidation					
◆ Diameter (in)	1.42				
Height (in)	3.51				
Water Content (%)	7.4				
Dry Density (pcf)	76.2				
■ Void Ratio	1.46				
After Consolidation					
Diameter (in)	1.34				
Height (in)	3.21				
Water Content (%)	33.5				
△ Dry Density (pcf)	93.4				
Void Ratio	1.01				
Back Pressure (tsf)	5.76				
Minor Principal Stress (tsf)	2.00				
Max. Deviator Stress (tsf)	1.53				
Ultimate Deviator Stress (tsf)	0.86				
+ Deviator Stress at Failure (tsf)	1.53				
Max. Pore Pressure Buildup (tsf)	1.81				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	0.9				

X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Saturated w/a very low head & then applied a slow build-up of backpressure until "B" was 1.0, over a period of 7-10 days; Consolidated incremently from 0.072 to 10.0 tsf; [A] to 2.0 tsf, [B] to 10.0 tsf; Recorded volume change; Ran a permeability test before shear; Stressed to given strains at constant rate of 0.00177"/min..





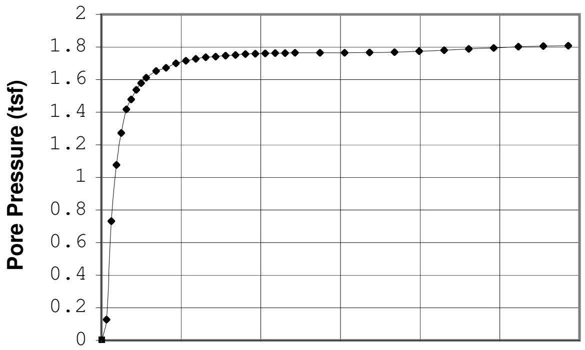
Rupture Envelope at Failure
α = 24.4 ° a = 0.0 (tsf)

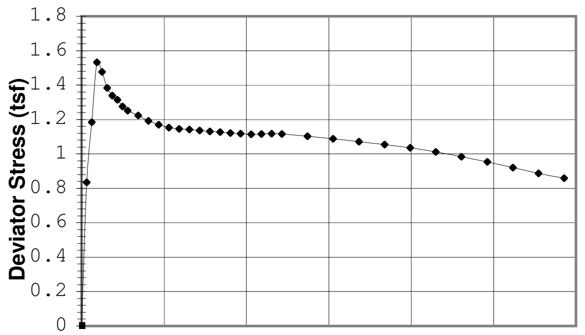
------------	Effective φ':	26.9 °	c'=	0.00 (tsf)
________	Total φ':	16.1 °	c=	0.00 (tsf)

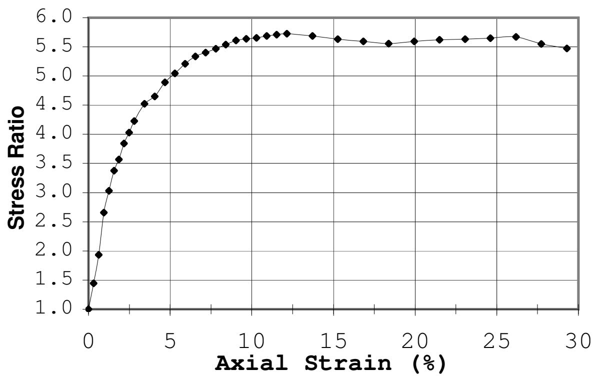
TRIAXIAL TEST ASTM: D 4767

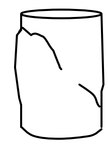
Job No. **5435**
Date: **10/3/05**

Project: **Polymet Tailings Characterization - # 23/69-862**
Boring #: Sample #: **2-Pail** Type: **Bulk** Depth (ft):
Soil Type: **Tailings, (Sandy Silt (ML))**









Failure Criterion: **Max. Pore Pressure**

Angle of internal friction, ϕ' = **43.7 °**

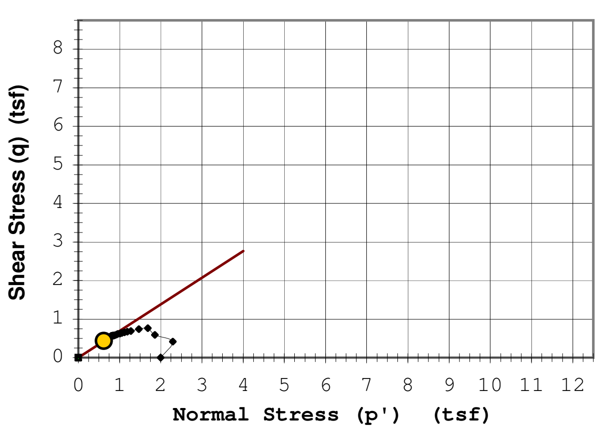
Apparent Cohesion, **c'** = **0.00 (tsf)**

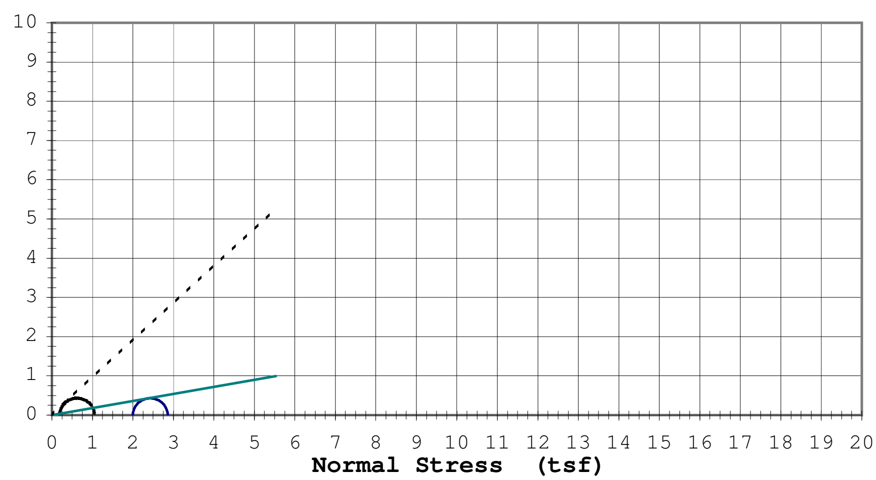
Test Date:	9/29/05	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.00177	Plasticity Index:	NP
Strain Rate (%/min):	0.055	Spec. Gravity (Actual):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.42				
Height (in)	3.51				
Water Content (%)	7.4				
Dry Density (pcf)	76.2				
Void Ratio	1.46				
After Consolidation					
Diameter (in)	1.34				
Height (in)	3.21				
Water Content (%)	33.5				
Dry Density (pcf)	93.4				
Void Ratio	1.01				
Back Pressure (tsf)	5.76				
Minor Principal Stress (tsf)	2.00				
Max. Deviator Stress (tsf)	1.53				
Ultimate Deviator Stress (tsf)	0.86				
Deviator Stress at Failure (tsf)	0.86				
Max. Pore Pressure Buildup (tsf)	1.81				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	29.3				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Saturated w/a very low head & then applied a slow build-up of backpressure until "B" was 1.0, over a period of 7-10 days; Consolidated incremently from 0.072 to 10.0 tsf; [A] to 2.0 tsf, [B] to 10.0 tsf; Recorded volume change; Ran a permeability test before shear; Stressed to given strains at constant rate of 0.00177"/min..





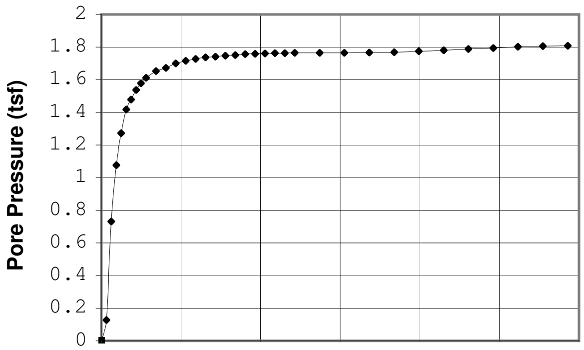
Rupture Envelope at Failure
α = 34.6 ° a = 0.0 (tsf)

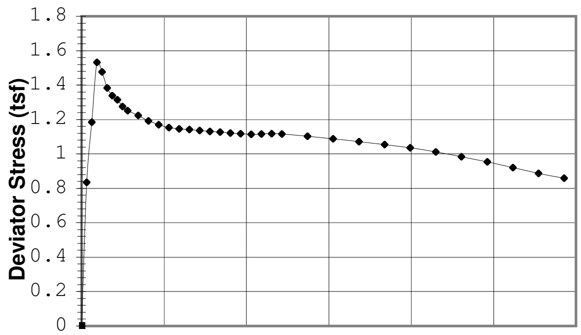
------------	Effective ϕ':	43.7 °	c'=	0.00 (tsf)
________	Total ϕ':	10.2 °	c=	0.00 (tsf)

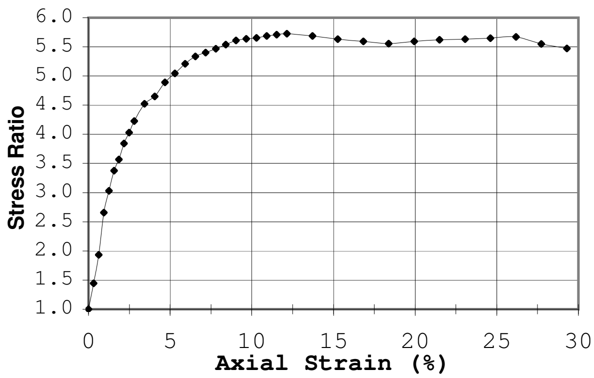
TRIAXIAL TEST ASTM: D 4767

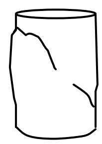
Job No. **5435**
Date: **10/3/05**

Project: **Polymet Tailings Characterization - # 23/69-862**
Boring #: Sample #: **2-Pail** Type: **Bulk** Depth (ft):
Soil Type: **Tailings, (Sandy Silt (ML))**









Failure Criterion: **Given Strain of: 15%**

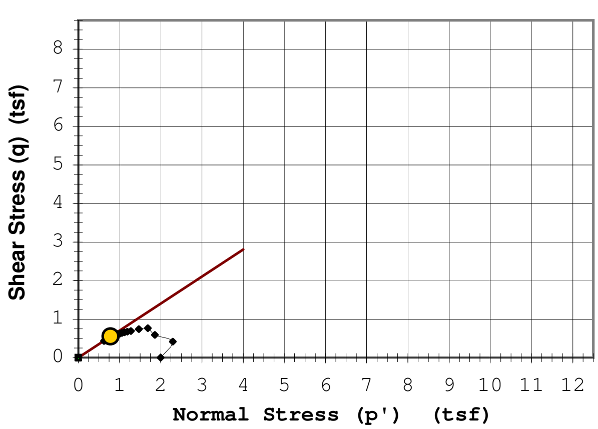
Angle of internal friction, φ' = **44.5 °**
Apparent Cohesion, c' = **0.00 (tsf)**

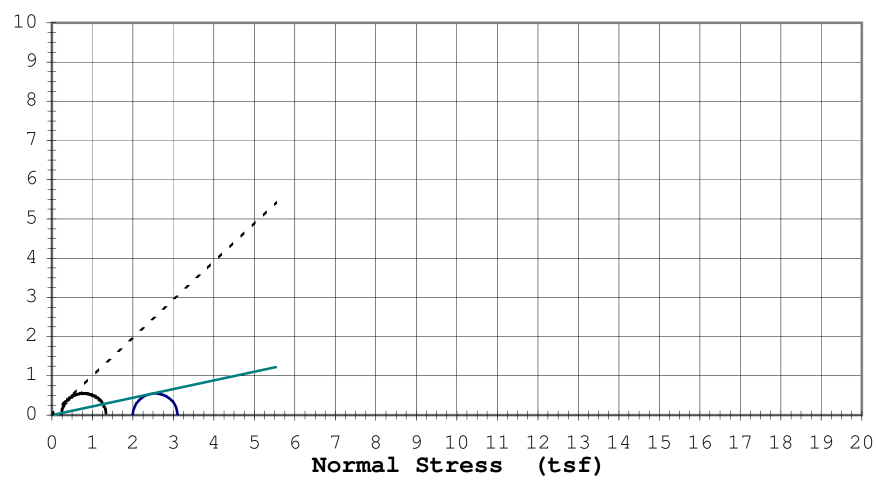
Test Date:	9/29/05	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.00177	Plasticity Index:	NP
Strain Rate (%/min):	0.055	Spec. Gravity (Actual):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.42				
Height (in)	3.51				
Water Content (%)	7.4				
Dry Density (pcf)	76.2				
Void Ratio	1.46				
After Consolidation					
Diameter (in)	1.34				
Height (in)	3.21				
Water Content (%)	33.5				
Dry Density (pcf)	93.4				
Void Ratio	1.01				
Back Pressure (tsf)	5.76				
Minor Principal Stress (tsf)	2.00				
Max. Deviator Stress (tsf)	1.53				
Ultimate Deviator Stress (tsf)	0.86				
Deviator Stress at Failure (tsf)	1.10				
Max. Pore Pressure Buildup (tsf)	1.81				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	15.0				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Saturated w/a very low head & then applied a slow build-up of backpressure until "B" was 1.0, over a period of 7-10 days; Consolidated incrementally from 0.072 to 10.0 tsf; [A] to 2.0 tsf, [B] to 10.0 tsf; Recorded volume change; Ran a permeability test before shear; Stressed to given strains at constant rate of 0.00177"/min..





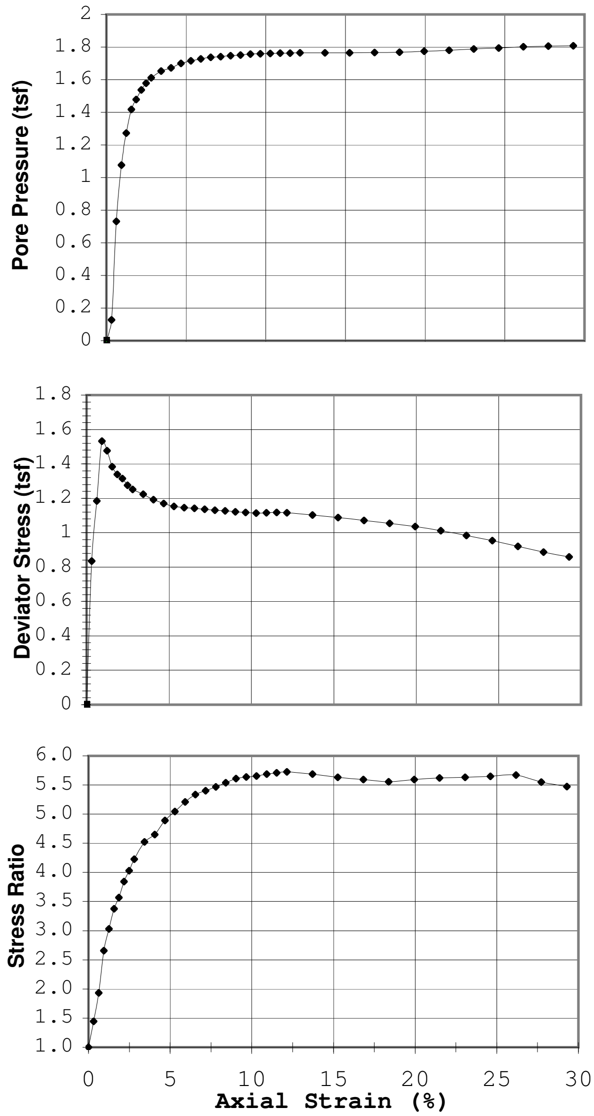
Rupture Envelope at Failure
α = 35.0 ° a = 0.0 (tsf)

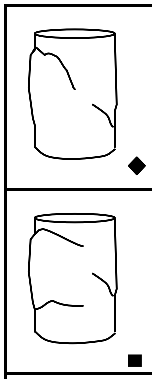
------------	Effective φ':	44.5 °	c'=	0.00 (tsf)
________	Total φ':	12.5 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **5435**
Date: **10/3/05**

Project: **Polymet Tailings Characterization - # 23/69-862**
Boring #: Sample #: **2-Pail** Type: **Bulk** Depth (ft):
Soil Type: **Tailings, (Sandy Silt (ML))**





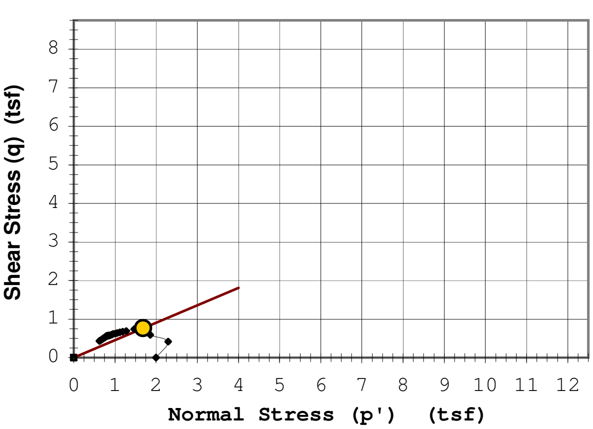
Failure Criterion: **Max. Deviator Stress**
Angle of internal friction, ϕ' = **26.9 °**
Apparent Cohesion, c' = **0.00 (tsf)**

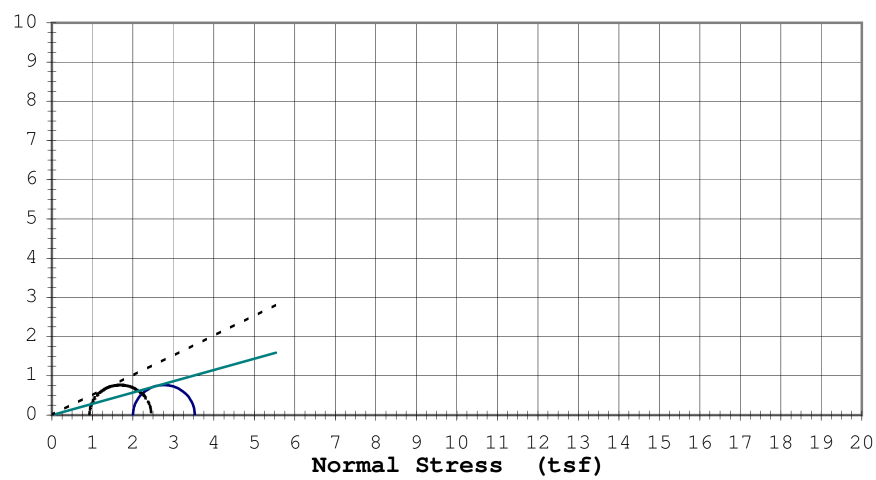
Test Date:	9/29/05	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.00177	Plasticity Index:	NP
Strain Rate (%/min):	0.055	Spec. Gravity (Actual):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.42				
Height (in)	3.51				
Water Content (%)	7.4				
Dry Density (pcf)	76.2				
Void Ratio	1.46				
After Consolidation					
Diameter (in)	1.34				
Height (in)	3.21				
Water Content (%)	33.5				
Dry Density (pcf)	93.4				
Void Ratio	1.01				
Back Pressure (tsf)	5.76				
Minor Principal Stress (tsf)	2.00				
Max. Deviator Stress (tsf)	1.53				
Ultimate Deviator Stress (tsf)	0.86				
Deviator Stress at Failure (tsf)	1.53				
Max. Pore Pressure Buildup (tsf)	1.81				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	0.9				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Saturated w/a very low head & then applied a slow build-up of backpressure until "B" was 1.0, over a period of 7-10 days; Consolidated incremently from 0.072 to 10.0 tsf; [A] to 2.0 tsf, [B] to 10.0 tsf; Recorded volume change; Ran a permeability test before shear; Stressed to given strains at constant rate of 0.00177"/min..





Rupture Envelope at Failure
α = 24.4 ° a = 0.0 (tsf)

------------ Effective ϕ':	26.9 °	c'=	0.00 (tsf)
________ Total ϕ':	16.1 °	c=	0.00 (tsf)

PolyMet Triaxial Testing Data

Job No. 5434 **Date: 11-6-04** **PolyMet Tailings Characterization** **Client: Barr Engineering Company**

Note: Percent Strains will not match across rows, due to different sample sizes, and collapse of some specimens before 30% strain.

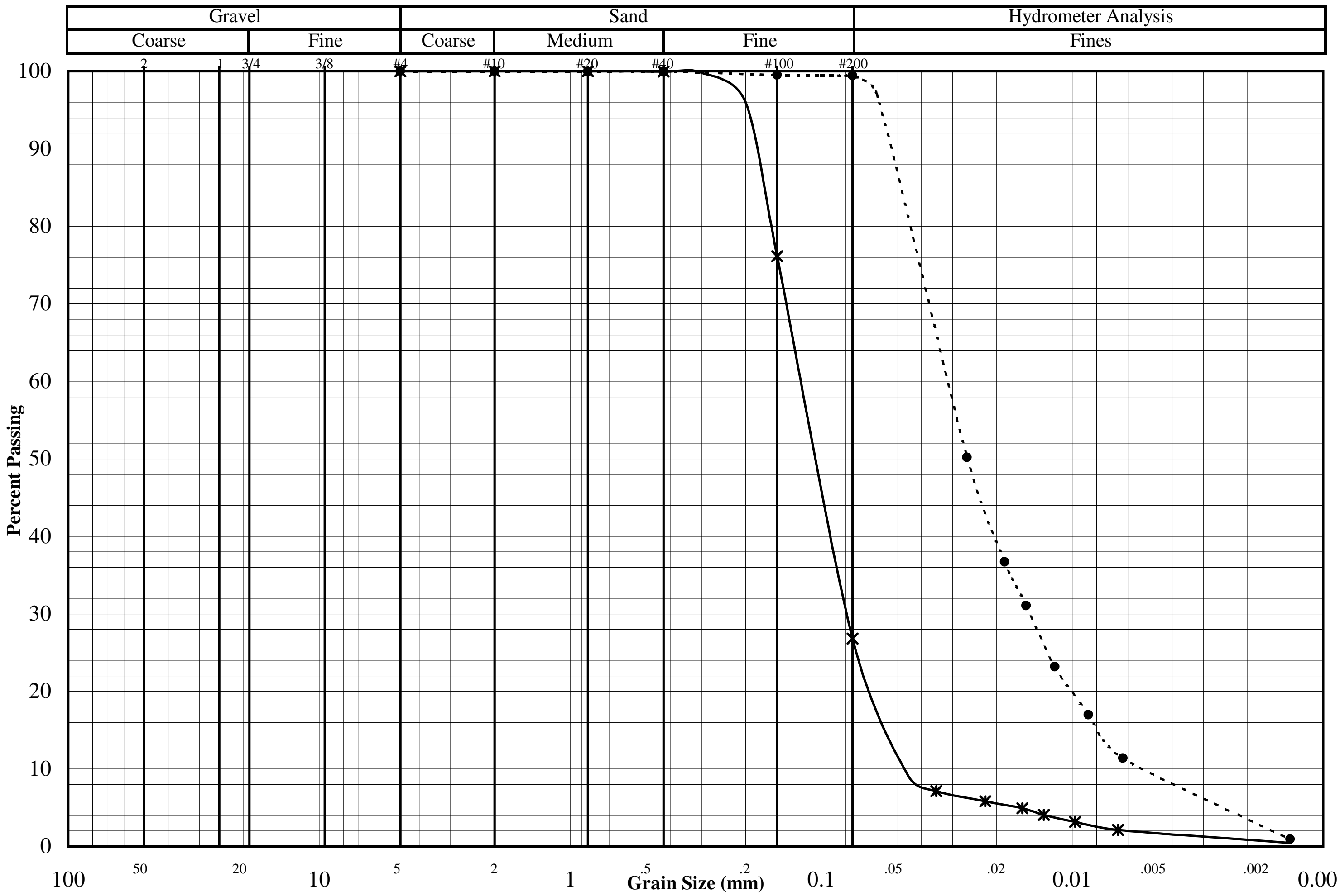
0.25 tsf			0.50 tsf			1.00 tsf			2.00 tsf			4.00 tsf			10.00 tsf		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.22	0.11	0.15	0.23	0.30	0.14	0.16	0.35	0.18	0.31	0.83	0.13	0.16	0.52	0.17	0.34	1.65	0.43
0.45	0.15	0.16	0.45	0.31	0.20	0.32	0.51	0.31	0.62	1.18	0.73	0.32	1.34	0.70	0.68	3.16	1.09
0.67	0.19	0.16	0.68	0.30	0.24	0.48	0.53	0.47	0.93	1.53	1.08	0.48	1.45	1.13	1.03	4.06	2.30
0.90	0.21	0.17	0.91	0.29	0.27	0.64	0.52	0.57	1.25	1.48	1.27	0.64	1.55	1.56	1.37	4.47	3.25
1.12	0.22	0.18	1.14	0.27	0.30	0.80	0.50	0.64	1.56	1.38	1.42	0.80	1.67	1.95	1.71	4.65	4.08
1.35	0.23	0.18	1.36	0.26	0.34	0.96	0.49	0.68	1.87	1.34	1.48	0.96	1.76	2.28	2.05	4.66	4.68
1.57	0.24	0.19	1.59	0.25	0.35	1.12	0.46	0.73	2.18	1.31	1.54	1.12	1.82	2.53	2.40	4.60	5.18
1.80	0.24	0.19	1.82	0.24	0.36	1.28	0.44	0.76	2.49	1.28	1.58	1.28	1.84	2.68	2.74	4.51	5.59
2.02	0.24	0.19	2.05	0.23	0.38	1.44	0.43	0.78	2.80	1.25	1.61	1.44	1.79	2.77	3.08	4.42	5.76
2.25	0.23	0.20	2.27	0.22	0.39	1.60	0.41	0.80	3.43	1.22	1.65	1.60	1.75	2.86	3.42	4.31	6.11
2.69	0.22	0.20	2.73	0.21	0.40	1.92	0.38	0.83	4.05	1.19	1.67	1.92	1.66	2.98	4.11	4.19	6.39
3.14	0.21	0.20	3.18	0.19	0.41	2.24	0.36	0.85	4.67	1.17	1.70	2.24	1.57	3.09	4.79	4.03	6.56
3.59	0.21	0.21	3.64	0.18	0.41	2.56	0.34	0.86	5.30	1.15	1.72	2.56	1.48	3.21	5.48	3.91	6.69
4.04	0.20	0.21	4.09	0.17	0.42	2.88	0.32	0.88	5.92	1.14	1.73	2.88	1.44	3.27	6.16	3.86	6.82
4.49	0.20	0.21	4.55	0.16	0.43	3.21	0.30	0.89	6.54	1.14	1.74	3.20	1.37	3.33	6.85	3.82	6.86
4.94	0.20	0.22	5.00	0.15	0.43	3.53	0.29	0.90	7.17	1.14	1.74	3.52	1.32	3.37	7.53	3.81	6.88
5.39	0.19	0.22	5.46	0.14	0.44	3.85	0.28	0.91	7.79	1.13	1.75	3.84	1.27	3.40	8.22	3.79	6.90
5.84	0.19	0.22	5.91	0.13	0.44	4.17	0.27	0.92	8.41	1.13	1.75	4.16	1.23	3.42	8.90	3.81	6.92
6.29	0.19	0.22	6.37	0.13	0.44	4.49	0.26	0.92	9.04	1.12	1.76	4.48	1.19	3.45	9.59	3.82	6.94
6.74	0.18	0.22	6.82	0.12	0.45	4.81	0.25	0.93	9.66	1.12	1.76	4.80	1.15	3.47	10.27	3.82	6.96
7.19	0.18	0.22	7.27	0.12	0.45	5.13	0.25	0.93	10.28	1.11	1.76	5.12	1.11	3.52	10.96	3.82	6.98
7.64	0.18	0.23	7.73	0.12	0.45	5.45	0.24	0.93	10.91	1.12	1.76	5.44	1.08	3.54	11.64	3.84	7.00
8.08	0.18	0.23	8.18	0.11	0.45	5.77	0.24	0.94	11.53	1.12	1.76	5.76	1.05	3.55	12.33	3.87	7.02
8.53	0.18	0.23	8.64	0.11	0.46	6.09	0.23	0.94	12.15	1.12	1.76	6.08	1.01	3.56	13.01	3.90	7.04
8.98	0.17	0.23	9.09	0.10	0.46	6.41	0.23	0.95	13.71	1.10	1.76	6.40	0.98	3.57	13.70	3.99	7.06
10.11	0.17	0.23	10.23	0.09	0.46	7.21	0.22	0.95	15.27	1.09	1.77	7.20	0.93	3.60	15.41	4.03	7.04
11.23	0.17	0.23	11.37	0.09	0.46	8.01	0.21	0.95	16.83	1.07	1.77	8.00	0.87	3.62	17.12	4.06	7.02
12.35	0.16	0.24	12.50	0.09	0.47	8.81	0.21	0.96	18.38	1.06	1.77	8.80	0.82	3.65	18.84	4.09	6.96
13.47	0.16	0.24	13.64	0.08	0.47	9.62	0.20	0.96	19.94	1.04	1.77	9.60	0.77	3.67	20.55	4.12	6.90
14.60	0.16	0.24	14.78	0.08	0.47	10.42	0.20	0.96	21.50	1.01	1.78	10.40	0.74	3.69	22.26	4.15	6.89
15.72	0.15	0.24	15.91	0.08	0.47	11.22	0.19	0.97	23.06	0.98	1.79	11.20	0.70	3.71	23.97	4.14	6.88
16.84	0.15	0.24	17.05	0.08	0.47	12.02	0.19	0.97	24.62	0.95	1.79	12.00	0.68	3.74	25.68	4.17	6.89
17.97	0.15	0.24	18.19	0.08	0.47	12.82	0.19	0.96	26.17	0.92	1.80	12.80	0.65	3.76	27.40	4.19	6.91
20.21	0.14	0.24	20.46	0.08	0.48	14.42	0.18	0.96	27.73	0.89	1.81	14.40	0.61	3.77	30.82	4.04	6.82
22.46	0.14	0.24	22.73	0.08	0.48	16.03	0.18	0.96	29.29	0.86	1.81	16.00	0.58	3.79	34.25	3.90	6.82
24.70	0.13	0.24	25.01	0.08	0.48	19.23	0.17	0.96				19.20	0.53	3.80			
26.95	0.13	0.24	27.28	0.08	0.48	22.44	0.16	0.96				22.40	0.50	3.78			
			29.55	0.08	0.48	25.64	0.15	0.96				25.60	0.46	3.78			
						28.85	0.15	0.96				28.80	0.44	3.77			

Grain Size Distribution ASTM D422

Job No. : **5613**

Project:	Polymet Permeability Testing	Test Date:	3/19/06
Reported To:	Barr Engineering Company	Report Date:	3/19/06

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*		Coarse		Bulk	Tailings - Silty Sand, Fine Grained (SM)
●		Fine		Bulk	Tailings - Silt (ML)
◇					



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.97*	2.97*	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	106.5	83.2	
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	
#10	100.0	100.0	
#20	100.0	100.0	
#40	100.0	100.0	
#100	76.1	99.5	
#200	26.8	99.4	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9301 Bryant Ave. South, Suite 107

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **5613**

Project:	Polymet Permeability Testing	Test Date:	3/19/06
Reported To:	Barr Engineering Company	Report Date:	3/19/06

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1		Coarse		Bulk	Tailings - Silty Sand, Fine Grained (SM)
Spec 2		Fine		Bulk	Tailings - Silt (ML)
Spec 3					

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"	50.190435	2"	
1.5"	5.826846687	1.5"	36.690435	1.5"	
1"	4.94582259	1"	31.065435	1"	
3/4"	4.064798494	3/4"	23.190435	3/4"	
3/8"	3.183774398	3/8"	17.002935	3/8"	
#4	2.126545482	#4	11.377935	#4	
#10	0.452599699	#10	0.915435	#10	
#20	0	#20	0	#20	
#40	0	#40	0	#40	
#100	0	#100	0	#100	
#200	0	#200	0	#200	

Remarks

Specimen 1	Specimen 2	Specimen 3

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SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **5613**

Project:	Polymet Permeability Testing	Test Date:	3/19/06
Reported To:	Barr Engineering Company	Report Date:	3/19/06

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1		Coarse		Bulk	Tailings - Silty Sand, Fine Grained (SM)
Spec 2		Fine		Bulk	Tailings - Silt (ML)
Spec 3					

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.0348	7.15	0.0263	50.19		
0.0222	5.83	0.0186	36.69		
0.0158	4.95	0.0153	31.07		
0.0130	4.06	0.0117	23.19		
0.0097	3.18	0.0086	17.00		
0.0066	2.13	0.0063	11.38		
0.0014	0.45	0.0014	0.92		

Permeability Test Data

Project: Polymet Permeability Testing — Date: 3/23/2006

Reported To: Barr Engineering Company — Job No.: 5613

Confining Pressure	0.25	0.5	1.0	2.0	4.0	10.0	
Sample No.:	Coarse Portion	Coarse Portion	Coarse Portion	Coarse Portion	Coarse Portion	Coarse Portion	
Depth (ft)							
Location:							
Sample Type:	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	
Soil Type:	Tailings - Silty Sand, Fine Grained (SM)	Tailings - Silty Sand, Fine Grained (SM)	Tailings - Silty Sand, Fine Grained (SM)	Tailings - Silty Sand, Fine Grained (SM)	Tailings - Silty Sand, Fine Grained (SM)	Tailings - Silty Sand, Fine Grained (SM)	
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:	0.52	0.50	0.49	0.47	0.45	0.44	
Ht. (in):	2.84	2.78	2.76	2.74	2.71	2.65	
Dia. (in):	2.77	2.73	2.71	2.69	2.65	2.64	
Dry Density (pcf):	88.6	93.2	95.2	97.4	101.2	104.8	
Water Content:	8.4%						
Test Type:	Constant	Constant	Constant	Constant	Constant	Constant	
Max Head (ft):	1.0	1.0	1.0	1.0	1.0	1.0	
Confining press. (Effective-tsf):	0.25	0.5	1.0	2.0	4.0	10.0	
Trial No.:	6-10	6-10	6-10	6-10	6-10	6-10	
Water Temp °C:	20.4	20.4	20.4	20.4	20.4	20.4	
% Compaction							
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**1.7×10^{-3}**	**1.5×10^{-3}**	**1.4×10^{-3}**	**1.2×10^{-3}**	**9.0×10^{-4}**	**6.1×10^{-4}**	
K @ 20 °C (ft/min)	**3.4×10^{-3}**	**2.9×10^{-3}**	**2.8×10^{-3}**	**2.3×10^{-3}**	**1.8×10^{-3}**	**1.2×10^{-3}**	
Notes:	Incremental confining pressures applied until at least end of primary consolidation. Filtered tap water of 200mL + thru specimens before testing and 50mL+ before each staged permeability test.						

Permeability Test Data

Project: Polymet Permeability Testing Date: 3/23/2006

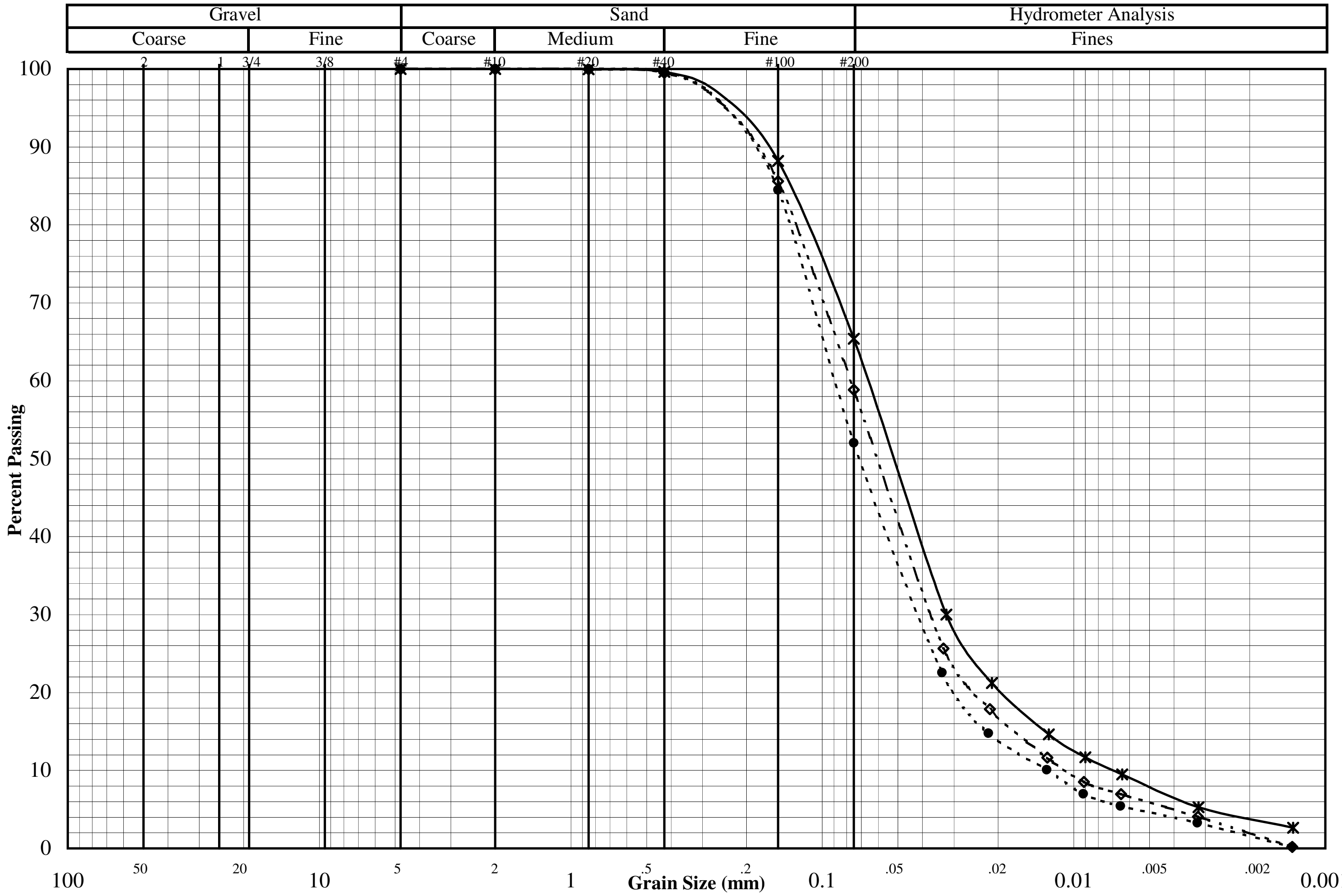
Reported To: Barr Engineering Company Job No.: 5613

Confining Pressure	0.25	0.5	1.0	2.0	4.0	10.0	
Sample No.:	Fine Portion	Fine Portion	Fine Portion	Fine Portion	Fine Portion	Fine Portion	
Depth (ft)							
Location:							
Sample Type:	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	
Soil Type:	Tailings - Silt (ML)	Tailings - Silt (ML)	Tailings - Silt (ML)	Tailings - Silt (ML)	Tailings - Silt (ML)	Tailings - Silt (ML)	
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:	0.54	0.53	0.51	0.50	0.49	0.46	
Ht. (in):	2.89	2.86	2.82	2.80	2.78	2.73	
Dia. (in):	2.72	2.69	2.66	2.64	2.62	2.59	
Dry Density (pcf):	85.1	88.0	91.2	93.2	95.3	99.9	
Water Content:	8.1%						
Test Type:	Constant	Constant	Constant	Constant	Constant	Constant	
Max Head (ft):	3.1	3.1	3.1	3.1	3.1	3.1	
Confining press. (Effective-tsf):	0.25	0.5	1.0	2.0	4.0	10.0	
Trial No.:	6-10	6-10	6-10	6-10	6-10	6-10	
Water Temp °C:	20.4	20.4	20.4	20.4	20.4	20.4	
% Compaction							
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**4.5×10^{-5}**	**3.0×10^{-5}**	**2.2×10^{-5}**	**1.7×10^{-5}**	**1.1×10^{-5}**	**9.4×10^{-6}**	
K @ 20 °C (ft/min)	**8.9×10^{-5}**	**5.9×10^{-5}**	**4.4×10^{-5}**	**3.4×10^{-5}**	**2.1×10^{-5}**	**1.8×10^{-5}**	
Notes:	Incremental confining pressures applied until at least end of primary consolidation. Filtered tap water of 100mL + thru specimens before testing and 25mL+ before each staged permeability test.						

Grain Size Distribution ASTM D422

Project:	Polymet	Job No. :	**5890-B**
		Test Date:	7/10/07
Reported To:	Barr Engineering Company	Report Date:	7/12/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*		PP-10060		Bulk	Sandy Silt (ML)
●		PP-10061		Bulk	Sandy Silt (ML)
◇		PP-10062		Bulk	Sandy Silt (ML)



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.98	3.03	3.00
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	731.8	742.6	781.4
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	100.0
#10	100.0	100.0	100.0
#20	100.0	100.0	99.9
#40	99.6	99.6	99.5
#100	88.2	84.5	85.6
#200	65.4	52.0	58.8

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

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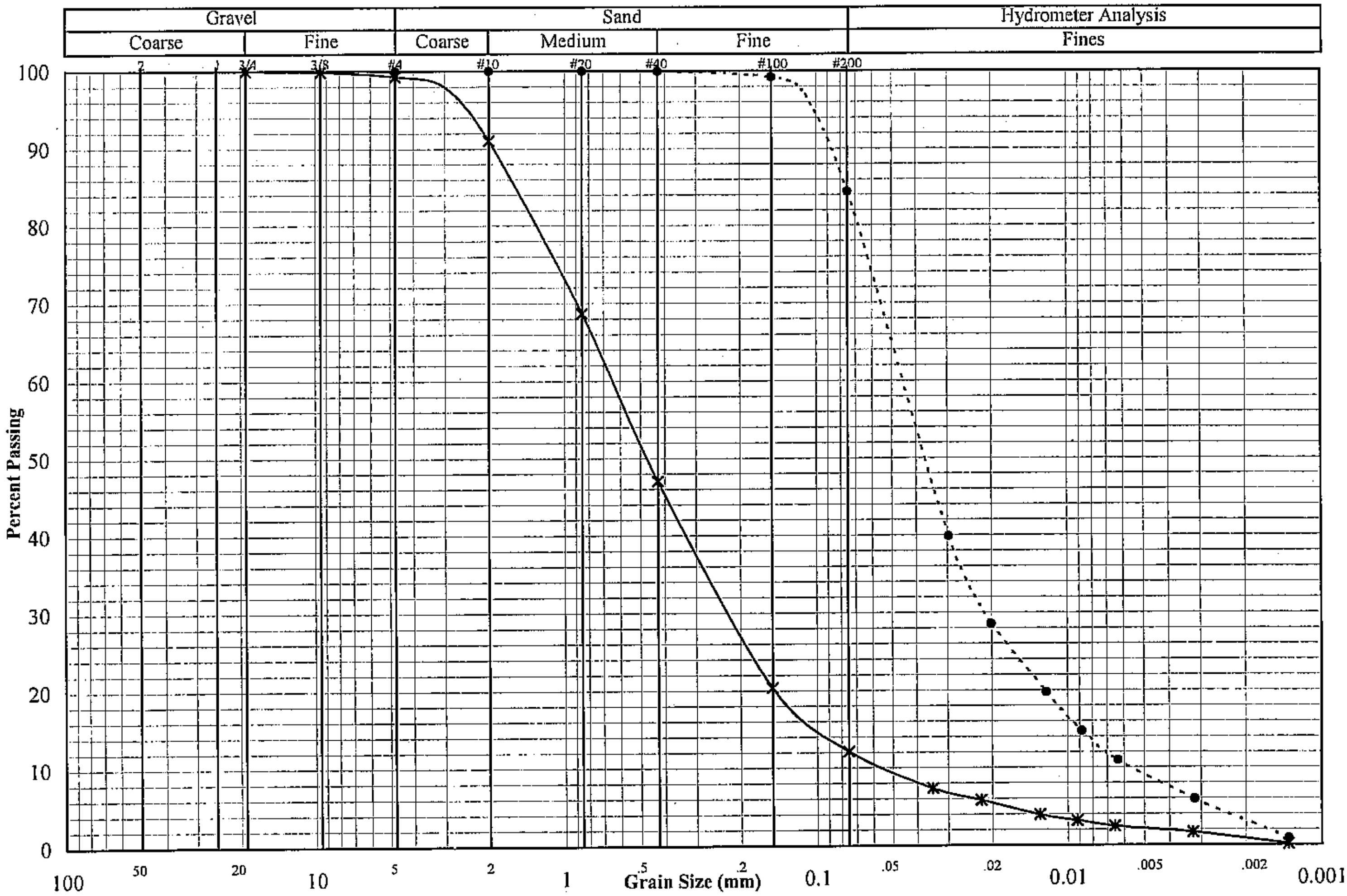
Grain Size Distribution ASTM D422

Job No. : **5890**

Project:	Polymet #23/69-862-016-020	Test Date:	11/6/06
Reported To:	Barr Engineering Company	Report Date:	11/13/06

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Test Pit	CT-A		Bag	Coarse Tailings, Silty Sand (SM/SP-SM)
●	Test Pit	FT-C		Bag	Fine Tailings, Silt with Sand (ML)
◇					



Other Tests

	*	●	◇
Liquid Limit	NP	NP	
Plastic Limit	NP	NP	
Plasticity Index	NP	NP	
Water Content	5.1	14.6	
Dry Density (pcf)			
Specific Gravity	3.00*	3.00*	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	6176.4	4409.3	
2"			
1.5"			
1"			
3/4"	100.0		
3/8"	99.9		
#4	99.3	100.0	
#10	91.1	100.0	
#20	68.7	100.0	
#40	47.0	100.0	
#100	20.4	99.2	
#200	12.1	84.4	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_u			
C_c			

Remarks:

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Grain Size Distribution ASTM D422

Job No. : **5890**

Project:	Polymet #23/69-862-016-020	Test Date:	11/6/06
Reported To:	Barr Engineering Company	Report Date:	11/13/06

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	Test Pit	CT-A		Bag	Coarse Tailings, Silty Sand (SM/SP-SM)
Spec 2	Test Pit	FT-C		Bag	Fine Tailings, Silt with Sand (ML)
Spec 3					

Hydrometer Data

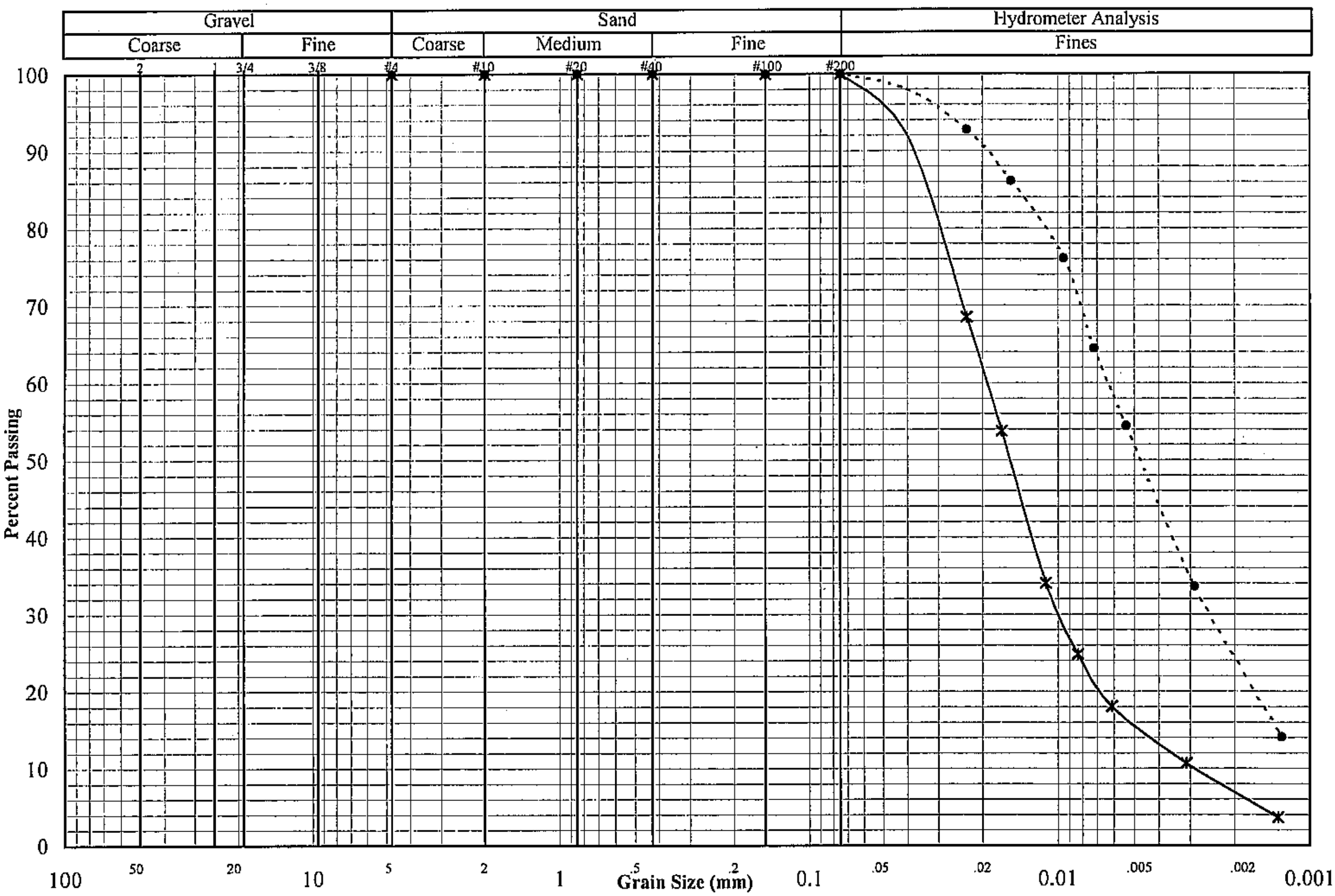
Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.0345	7.3	0.0296	39.9		
0.0221	5.8	0.0200	28.5		
0.0129	3.9	0.0121	19.7		
0.0092	3.2	0.0088	14.7		
0.0065	2.4	0.0063	10.9		
0.0032	1.7	0.0032	5.9		
0.0014	0.1	0.0014	0.9		

Grain Size Distribution ASTM D422

Job No. : **5890**

Project:	Polymet #23/69-862-016-020	Test Date:	11/6/06
Reported To:	Barr Engineering Company	Report Date:	11/13/06

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Test Pit	Silt - E		Bag	Silt (ML)
●	Test Pit	Slime - H		Bag	Slimes, Silt (ML)
◇					



Other Tests

	*	●	◇
Liquid Limit	NP	30.5	
Plastic Limit	NP	25.7	
Plasticity Index	NP	4.8	
Water Content	25.1	39.0	
Dry Density (pcf)			
Specific Gravity	3.00*	3.00*	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	1741.0	5714.9	
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	
#10	100.0	100.0	
#20	100.0	100.0	
#40	100.0	100.0	
#100	100.0	99.9	
#200	99.9	99.9	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

Grain Size Distribution ASTM D422

Job No. : **5890**

Project:	Polymet #23/69-862-016-020	Test Date:	11/6/06
Reported To:	Barr Engineering Company	Report Date:	11/13/06

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	Test Pit	Silt - E		Bag	Silt (ML)
Spec 2	Test Pit	Slime - H		Bag	Slimes, Silt (ML)
Spec 3					

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.0231	68.5	0.0231	92.8		
0.0168	53.8	0.0153	86.1		
0.0112	34.1	0.0095	76.1		
0.0083	24.8	0.0072	64.4		
0.0061	18.1	0.0054	54.4		
0.0031	10.7	0.0029	33.6		
0.0013	3.7	0.0013	14.1		

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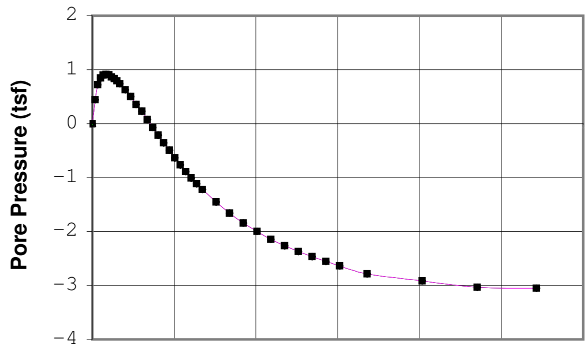
SOIL ENGINEERING TESTING, INC.

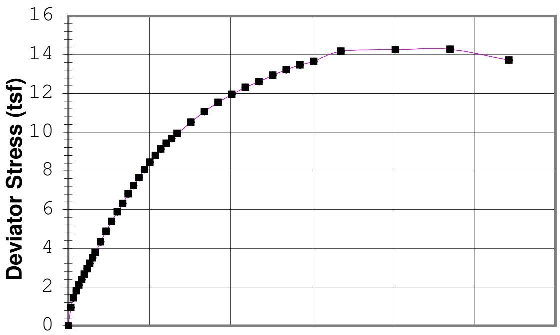
Bloomington, Minnesota 55420-3436

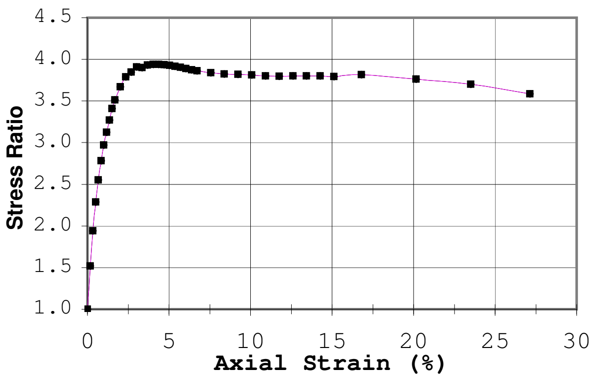
TRIAXIAL TEST ASTM: D 4767

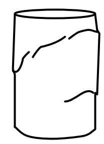
Job No. **6250**
Date: **10/16/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-07C** Sample #: Type: **3T** Depth (ft): **52.2-55.2 (Mid-Bot)**
Soil Type: **Silty Sand w/a Little Gravel (SM)**









◆ ■ △ + X

Failure Criterion: **Max. Stress Ratio**

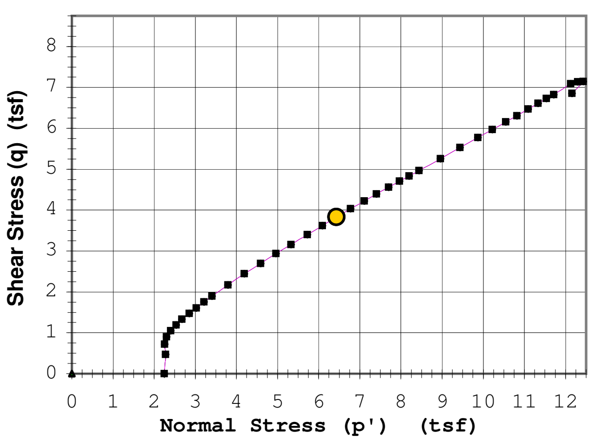
Angle of internal friction, **φ' =** °
Apparent Cohesion, **c' =** **(tsf)**

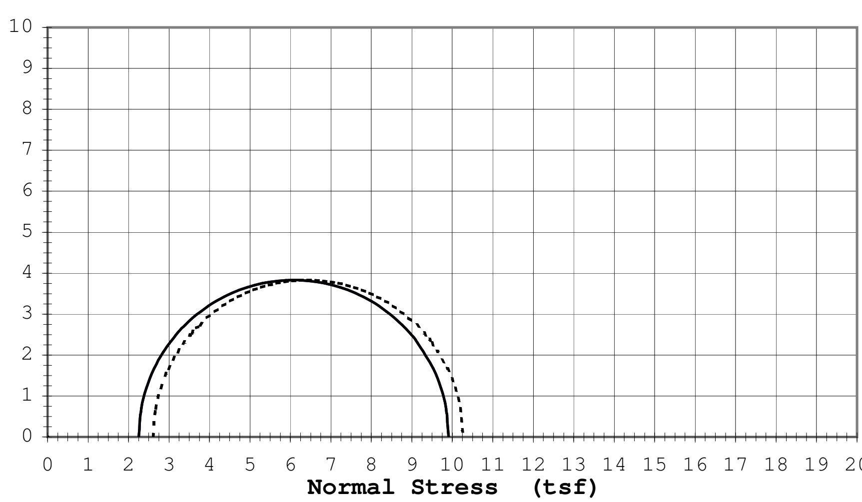
Test Date:	10/4/07	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.0039	Plasticity Index:	NP
Strain Rate (%/min):	0.066	Spec. Gravity (Actual):	2.70

Before Consolidation	A	B	C	D	E
Diameter (in)	2.86				
Height (in)	6.02				
Water Content (%)	7.6				
Dry Density (pcf)	120.5				
Void Ratio	0.40				
After Consolidation					
Diameter (in)	2.83				
Height (in)	5.95				
Water Content (%)	12.9				
Dry Density (pcf)	125.1				
Void Ratio	0.35				
Back Pressure (tsf)	5.81				
Minor Principal Stress (tsf)	2.25				
Max. Deviator Stress (tsf)	14.29				
Ultimate Deviator Stress (tsf)	13.71				
Deviator Stress at Failure (tsf)	7.66				
Max. Pore Pressure Buildup (tsf)	0.91				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	4.4				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure
α = ° a = (tsf)

------------ Effective φ':	°	c'=	(tsf)
________ Total φ':	°	c=	(tsf)

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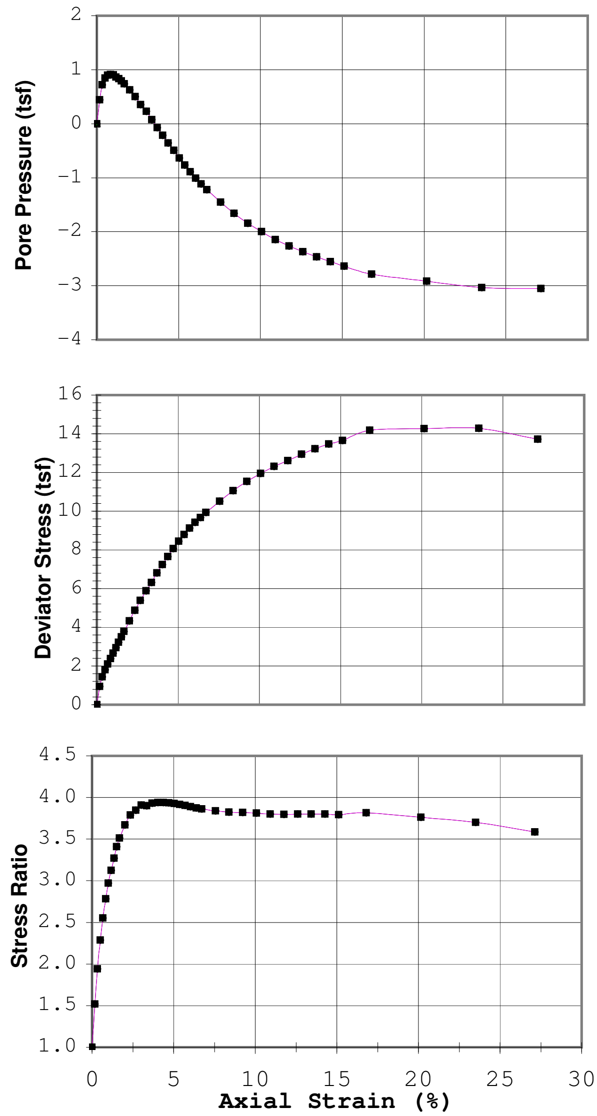
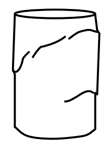
TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/16/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-07C** Sample #: Type: **3T** Depth (ft): **52.2-55.2 (Mid-Bot)**
Soil Type: **Silty Sand w/a Little Gravel (SM)**





Failure Criterion:	Max. Pore Pressure			
Angle of internal friction, ϕ' =	°			
Apparent Cohesion, c' =	(tsf)			

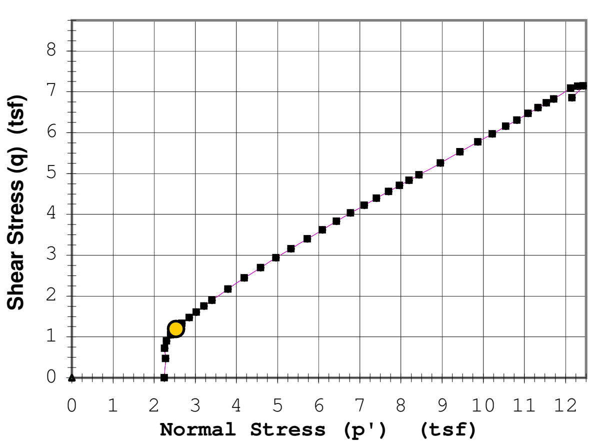
Test Date:	10/4/07	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.0039	Plasticity Index:	NP
Strain Rate (%/min):	0.066	Spec. Gravity (Actual):	2.70

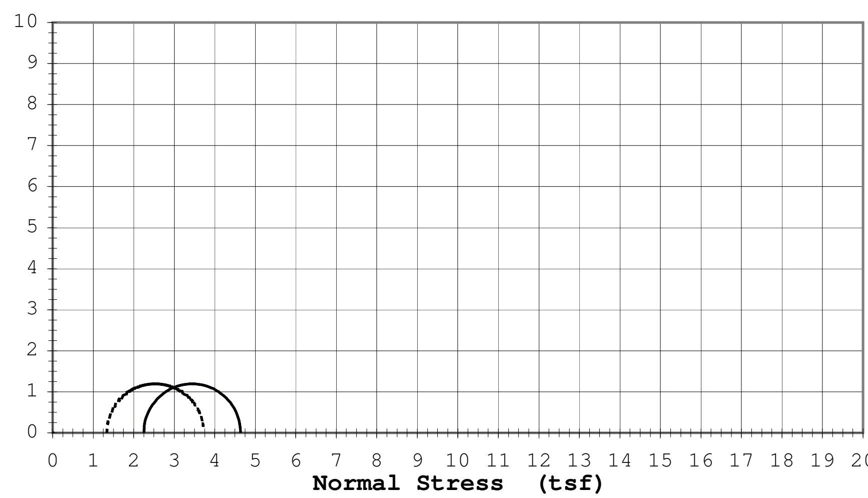
Before Consolidation	A	B	C	D	E
Diameter (in)	2.86				
Height (in)	6.02				
Water Content (%)	7.6				
Dry Density (pcf)	120.5				
Void Ratio	0.40				
After Consolidation					
Diameter (in)	2.83				
Height (in)	5.95				
Water Content (%)	12.9				
Dry Density (pcf)	125.1				
Void Ratio	0.35				
Back Pressure (tsf)	5.81				
Minor Principal Stress (tsf)	2.25				
Max. Deviator Stress (tsf)	14.29				
Ultimate Deviator Stress (tsf)	13.71				
Deviator Stress at Failure (tsf)	2.39				
Max. Pore Pressure Buildup (tsf)	0.91				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	0.8				

Symbols: ◆ ■ △ + X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





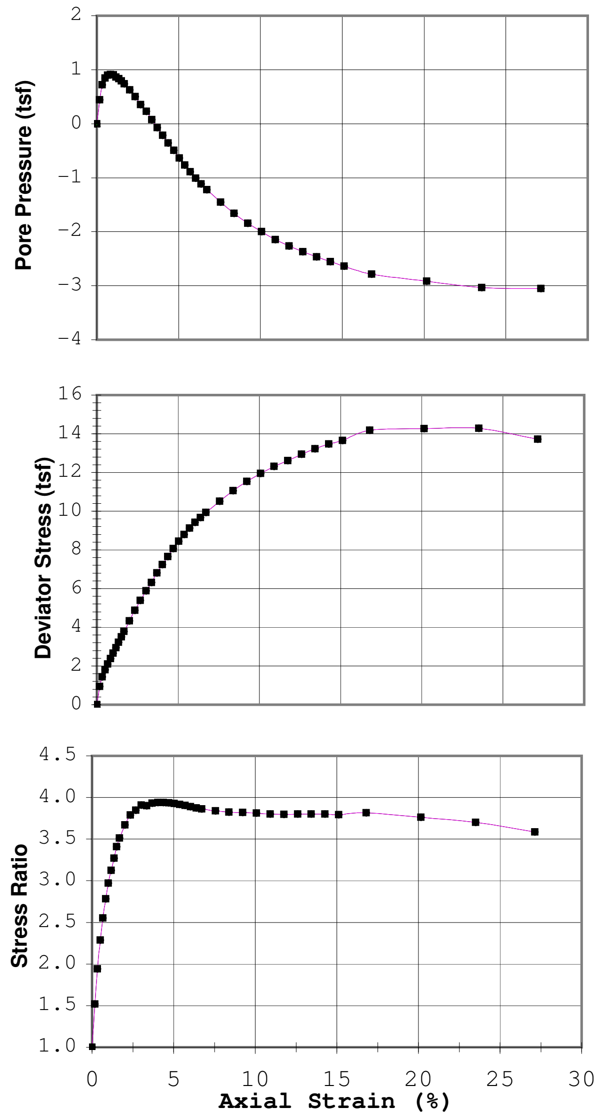
Rupture Envelope at Failure	
α = °	a = (tsf)

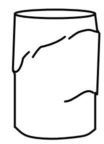
------------	Effective ϕ': °	c'=	(tsf)
________	Total ϕ': °	c=	(tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/16/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-07C** Sample #: Type: **3T** Depth (ft): **52.2-55.2 (Mid-Bot)**
Soil Type: **Silty Sand w/a Little Gravel (SM)**





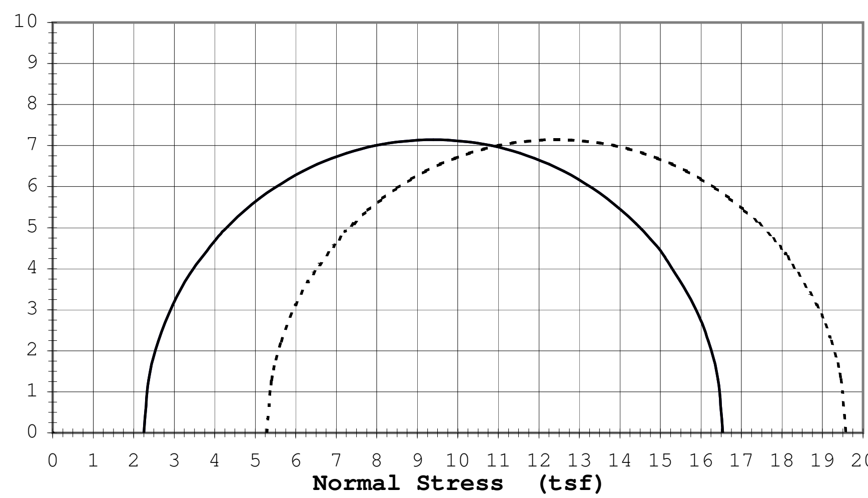
Failure Criterion:	**Max. Deviator Stress**				
Angle of internal friction, ϕ' =	°				
Apparent Cohesion, c' =	(tsf)				
Test Date: 10/4/07	Liquid Limit: NP				
Test Type: CU w/pp	Plastic Limit: NP				
Strain Rate (in/min): 0.0039	Plasticity Index: NP				
Strain Rate (%/min): 0.066	Spec. Gravity (Actual): 2.70				

Before Consolidation	A	B	C	D	E
Diameter (in)	2.86				
Height (in)	6.02				
Water Content (%)	7.6				
Dry Density (pcf)	120.5				
Void Ratio	0.40				
After Consolidation					
Diameter (in)	2.83				
Height (in)	5.95				
Water Content (%)	12.9				
Dry Density (pcf)	125.1				
Void Ratio	0.35				
Back Pressure (tsf)	5.81				
Minor Principal Stress (tsf)	2.25				
Max. Deviator Stress (tsf)	14.29				
Ultimate Deviator Stress (tsf)	13.71				
Deviator Stress at Failure (tsf)	14.29				
Max. Pore Pressure Buildup (tsf)	0.91				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	23.5				

Legend symbols: ◆ ■ △ + X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



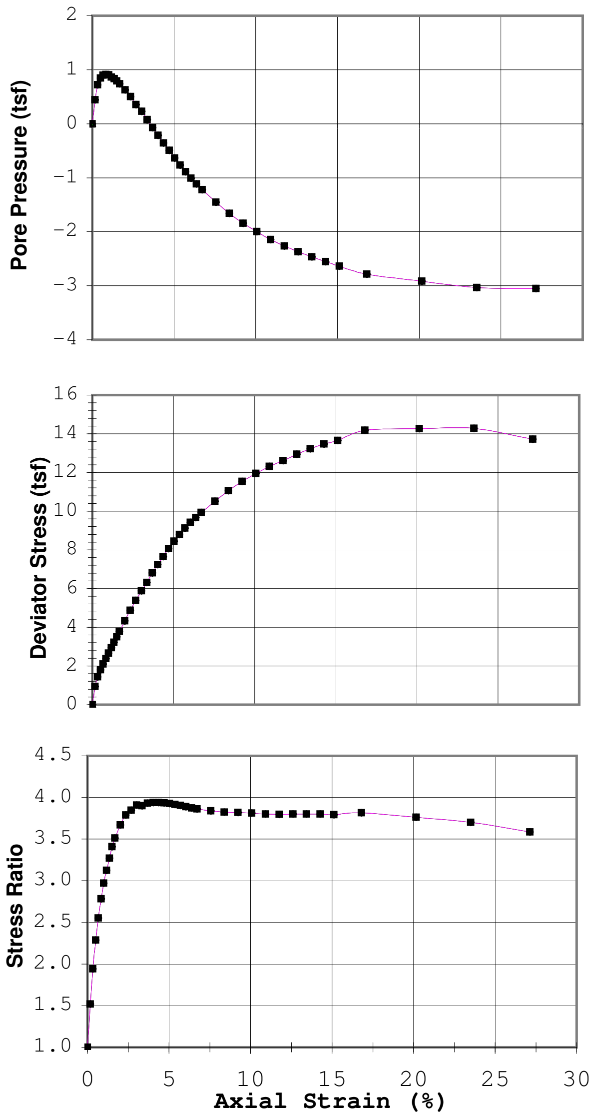
Rupture Envelope at Failure	
α = °	a = (tsf)

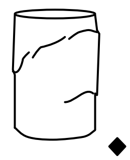
------------ Effective ϕ': °	c'=	(tsf)
________ Total ϕ': °	c=	(tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/16/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-07C** Sample #: Type: **3T** Depth (ft): **52.2-55.2 (Mid-Bot)**
Soil Type: **Silty Sand w/a Little Gravel (SM)**





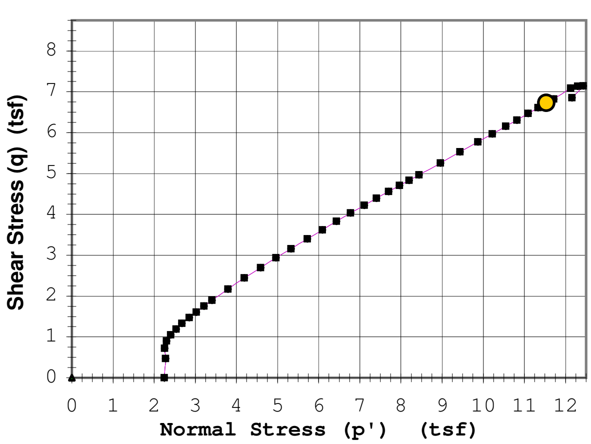
Failure Criterion:	Given Strain of: 15%
Angle of internal friction, ϕ' =	°
Apparent Cohesion, c' =	(tsf)

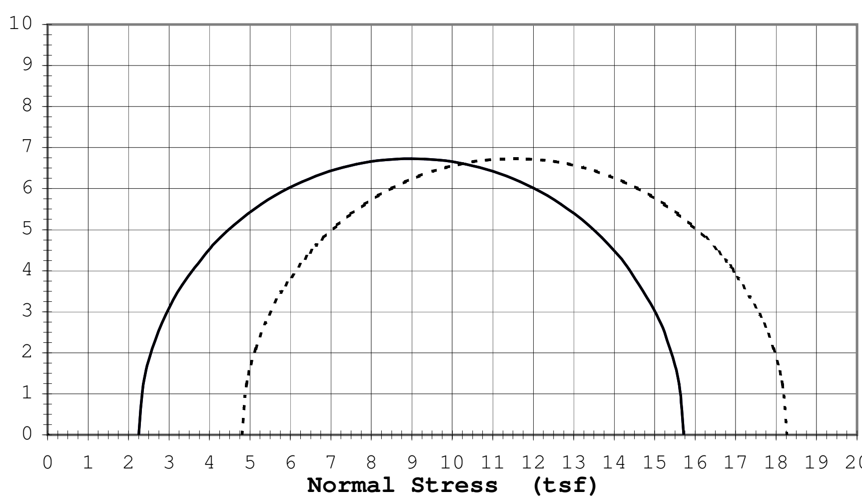
Test Date:	10/4/07	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.0039	Plasticity Index:	NP
Strain Rate (%/min):	0.066	Spec. Gravity (Actual):	2.70

Before Consolidation	A	B	C	D	E
Diameter (in)	2.86				
Height (in)	6.02				
Water Content (%)	7.6				
Dry Density (pcf)	120.5				
Void Ratio	0.40				
After Consolidation					
Diameter (in)	2.83				
Height (in)	5.95				
Water Content (%)	12.9				
Dry Density (pcf)	125.1				
Void Ratio	0.35				
Back Pressure (tsf)	5.81				
Minor Principal Stress (tsf)	2.25				
Max. Deviator Stress (tsf)	14.29				
Ultimate Deviator Stress (tsf)	13.71				
Deviator Stress at Failure (tsf)	13.47				
Max. Pore Pressure Buildup (tsf)	0.91				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	15.0				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure
α = ° a = (tsf)

------------	Effective ϕ':	°	c'=	(tsf)
________	Total ϕ':	°	c=	(tsf)

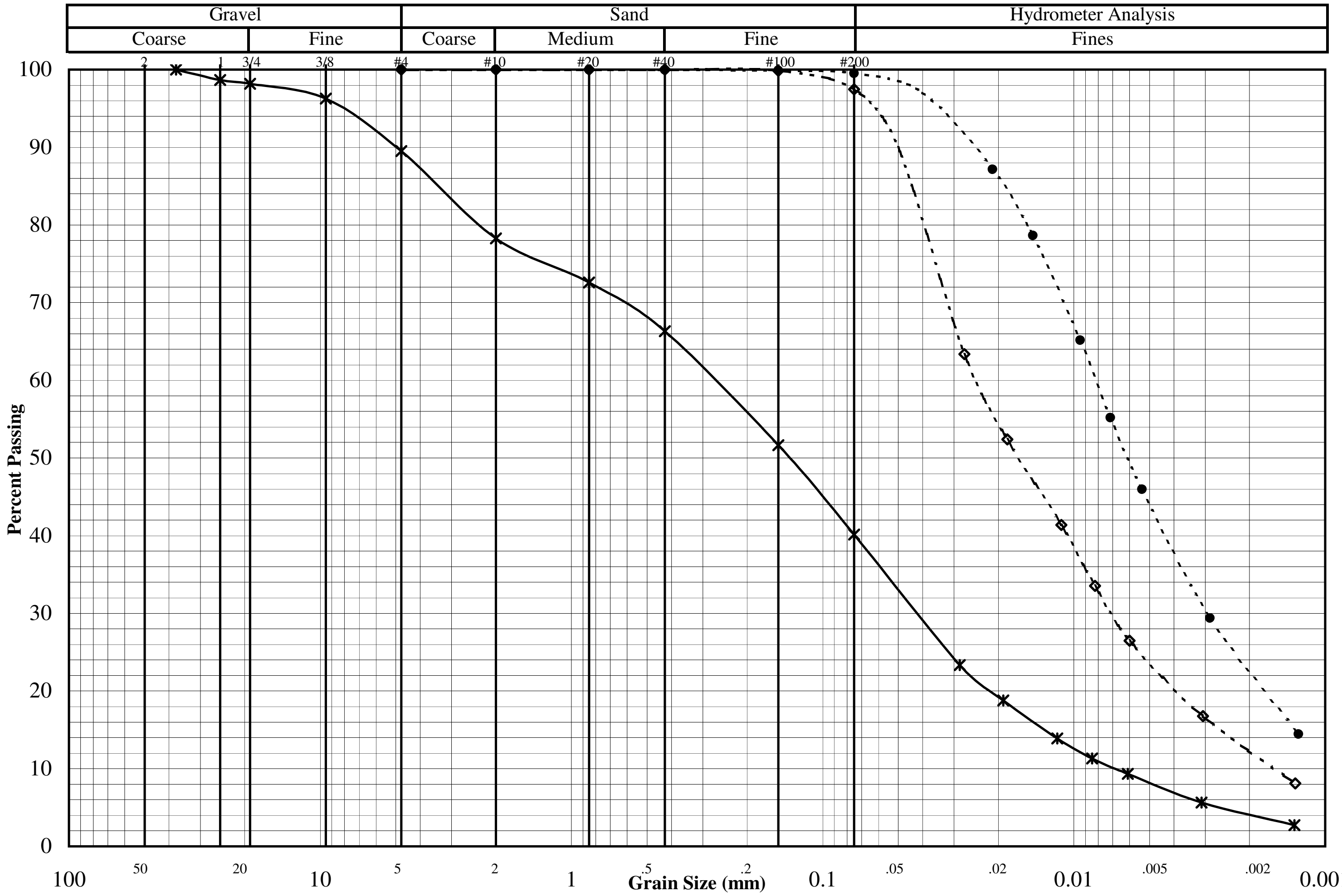
Job No.: 6250
Project: Polymet - #23/69-862-015-028
Test Type: CU w/pp
Boring No.: 07-07C, Depth (ft.): 52.2-55.2 (Mid-Bot)

Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00						
0.17	0.94	0.44						
0.34	1.44	0.72						
0.50	1.80	0.85						
0.67	2.10	0.90						
0.84	2.39	0.91						
1.01	2.66	0.90						
1.18	2.94	0.87						
1.34	3.22	0.83						
1.51	3.51	0.79						
1.68	3.79	0.74						
2.02	4.34	0.63						
2.35	4.88	0.50						
2.69	5.39	0.36						
3.02	5.88	0.23						
3.36	6.31	0.07						
3.70	6.81	-0.07						
4.03	7.25	-0.22						
4.37	7.66	-0.36						
4.70	8.06	-0.50						
5.04	8.45	-0.64						
5.38	8.79	-0.76						
5.71	9.12	-0.89						
6.05	9.42	-1.01						
6.38	9.67	-1.12						
6.72	9.94	-1.22						
7.56	10.52	-1.45						
8.40	11.05	-1.66						
9.24	11.54	-1.85						
10.08	11.95	-2.00						
10.92	12.31	-2.14						
11.76	12.62	-2.26						
12.60	12.94	-2.37						
13.44	13.22	-2.47						
14.28	13.47	-2.56						
15.12	13.65	-2.64						
16.80	14.18	-2.78						
20.16	14.27	-2.92						
23.52	14.29	-3.04						
27.14	13.71	-3.05						

Grain Size Distribution ASTM D422

Project:	Polymet #23/69-862-022B	Job No. :	6250
		Test Date:	10/11/07
Reported To:	Barr Engineering Company	Report Date:	10/17/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	07-07C		52.2-55.2	3T	Silty Sand w/a little gravel (SM)
●	07-09		36.5-38.5	3T	Slimes: Silt (ML)
◇	07-09		27.5-29.5	3T	Slimes: Silt (ML)



Other Tests

	*	●	◇
Liquid Limit	NP	28.0	21.3
Plastic Limit	NP	22.6	16.5
Plasticity Index	NP	5.4	4.8
Water Content			
Dry Density (pcf)			
Specific Gravity	2.70	2.96	2.96
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	2397.0	736.0	374.0
2"			
1.5"	100.0		
1"	98.6		
3/4"	98.2		
3/8"	96.3		
#4	89.5	100.0	100.0
#10	78.3	100.0	100.0
#20	72.6	100.0	100.0
#40	66.3	100.0	100.0
#100	51.6	99.9	99.9
#200	40.2	99.5	97.5

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9301 Bryant Ave. South, Suite 107

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6250**

Project:	Polymet #23/69-862-022B	Test Date:	10/11/07
Reported To:	Barr Engineering Company	Report Date:	10/17/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	07-07C		52.2-55.2	3T	Silty Sand w/a little gravel (SM)
Spec 2	07-09		36.5-38.5	3T	Slimes: Silt (ML)
Spec 3	07-09		27.5-29.5	3T	Slimes: Silt (ML)

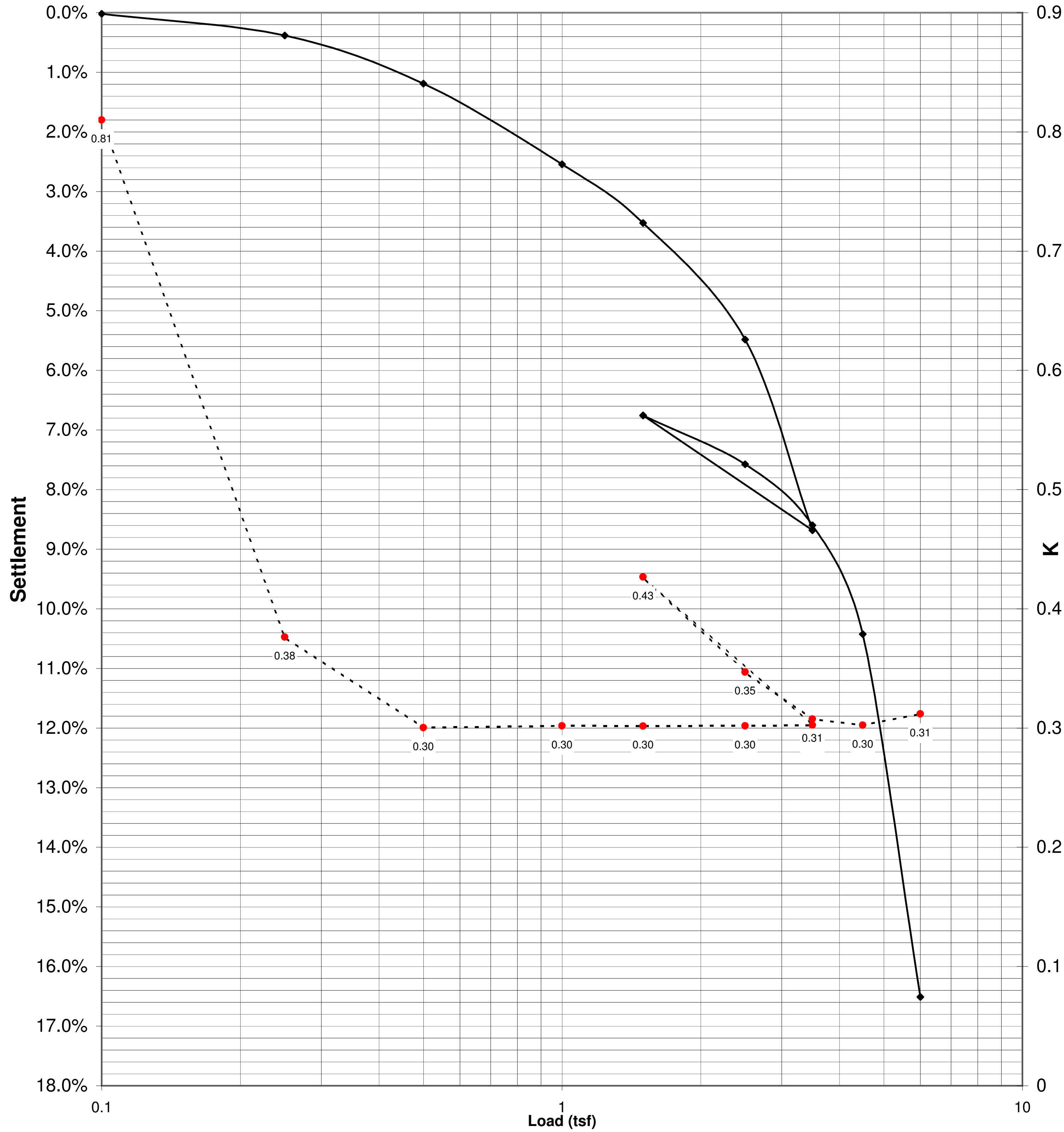
Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.028	23.3	0.021	87.2	0.027	63.4
0.019	18.8	0.015	78.6	0.018	52.4
0.012	13.9	0.009	65.1	0.011	41.4
0.008	11.3	0.007	55.2	0.008	33.5
0.006	9.3	0.005	46.0	0.006	26.5
0.003	5.6	0.003	29.4	0.003	16.8
0.001	2.7	0.001	14.5	0.001	8.1

Consolidation Report (Ko Triaxial Test)

Project: Polymet | Job: **6250**
Client: Barr Engineering Company | Date: 9/17/2007

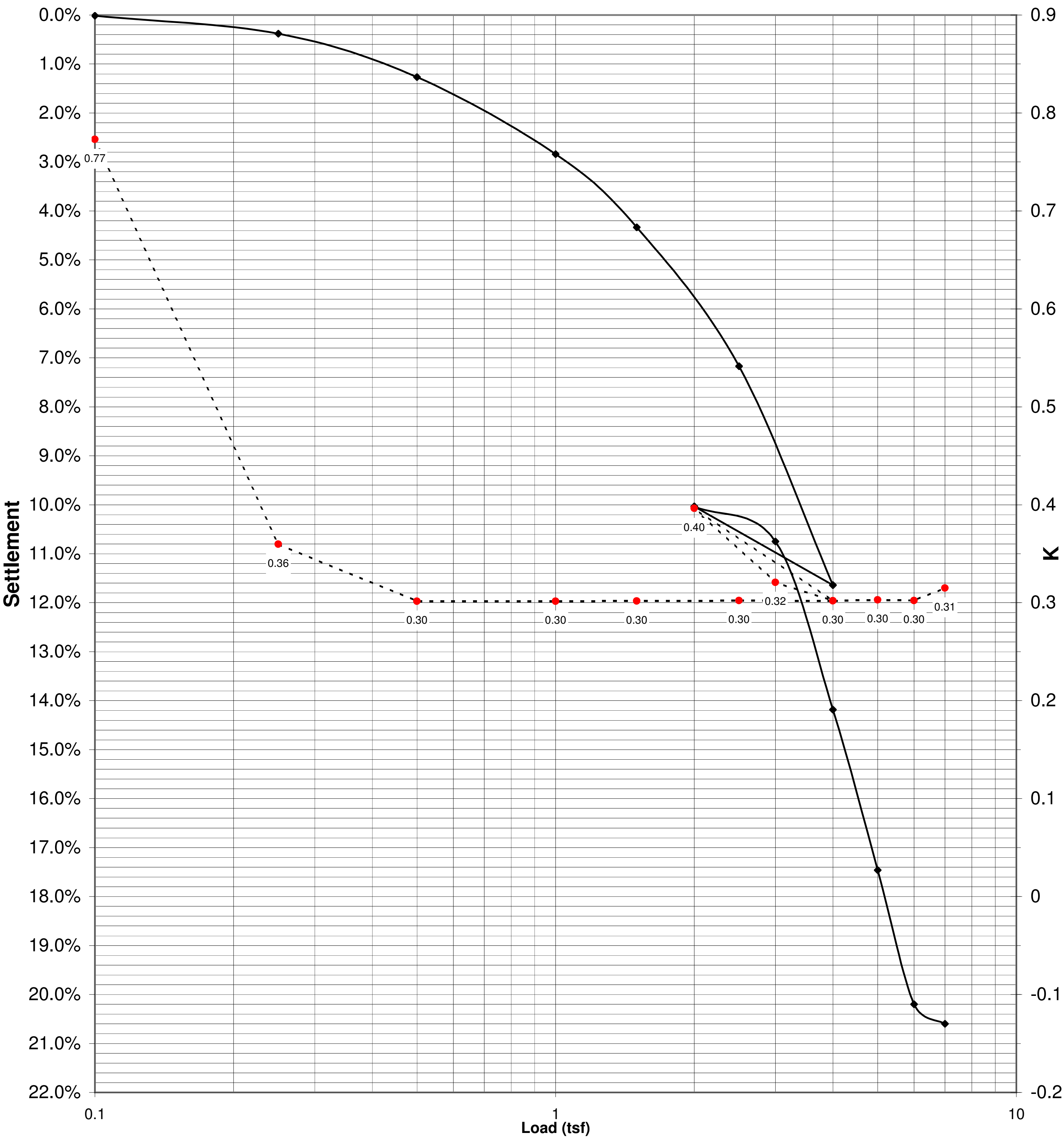
Boring: 07-4B | Sample: | Depth: 56.7-57.2
Soil Classification: Peat (PT)



Consolidation Report (Ko Triaxial Test)

Project: Polymet | Job: **6250**
Client: Barr Engineering Company | Date: 9/18/2007

Boring: 07-05 | Sample: | Depth: 98.5-99
Soil Classification: Peat (PT)



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SOIL ENGINEERING TESTING, INC.
Bloomington, MN 55420-3436

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	4.541	4.5431	4.4708	0.070148	0.072244	1.0299
2	0.012433	0	0	3.1165	4.541	4.5431	4.4714	0.069563	0.071659	1.0301
3	0.054167	0	-0.00021283	3.1165	4.5415	4.5437	4.4714	0.070113	0.072245	1.0304
4	0.10007	0	-0.00021283	3.1165	4.5415	4.5437	4.4714	0.070113	0.072245	1.0304
5	0.25028	0	-0.0006385	3.1165	4.5446	4.5437	4.4714	0.073212	0.072245	0.98679
6	0.50127	0.008965	0.0027668	3.1165	4.5669	4.5443	4.4726	0.094286	0.07166	0.76002
7	1.003	0.010758	0.011493	3.1165	4.568	4.5454	4.472	0.095972	0.073416	0.76497
8	2.0007	0.016137	0.015962	3.1165	4.5654	4.546	4.4714	0.094008	0.074586	0.7934
9	4.0041	0.018827	0.017452	3.1165	4.5691	4.5466	4.4714	0.097658	0.075172	0.76974
10	6.0035	0.02062	0.020645	3.1165	4.5702	4.5478	4.4714	0.098759	0.076342	0.77302
11	8.0027	0.021516	0.02107	3.1165	4.5707	4.5483	4.4714	0.099309	0.076928	0.77463
12	10.002	0.021516	0.021496	3.1165	4.5682	4.5489	4.4714	0.09676	0.077513	0.80108
13	12.001	0.022413	0.021709	3.1165	4.5713	4.5489	4.4714	0.099859	0.077513	0.77622
14	14.001	0.021516	0.02107	3.1165	4.5687	4.5495	4.4714	0.097311	0.078098	0.80257
15	16	0.021516	0.021709	3.1165	4.5698	4.5507	4.4714	0.098411	0.079269	0.80549
16	18.003	0.021516	0.021283	3.1165	4.5704	4.5513	4.4714	0.098962	0.079855	0.80692
17	20.003	0.021516	0.021709	3.1165	4.5709	4.5519	4.4714	0.099512	0.08044	0.80834
18	22.002	0.021516	0.021709	3.1165	4.5715	4.5524	4.4714	0.10006	0.081025	0.80975
19	24.001	0.021516	0.021922	3.1165	4.5684	4.5524	4.4714	0.096963	0.081025	0.83563
20	24.528	0.021516	0.02107	3.1165	4.5715	4.5524	4.4714	0.10006	0.081025	0.80975

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	4.5684	4.5524	4.4714	0.096963	0.081025	0.83563
2	0.012483	0	0	3.1165	4.5715	4.5524	4.4714	0.10006	0.081025	0.80975
3	0.050717	0	0	3.1165	4.5684	4.5524	4.4714	0.096963	0.081025	0.83563
4	0.10078	0	0	3.1165	4.5715	4.5524	4.4714	0.10006	0.081025	0.80975
5	0.25112	0	−0.00021283	3.1165	4.5746	4.5524	4.4714	0.10316	0.081025	0.78542
6	0.50197	0.012551	0.0034053	3.1165	4.5963	4.5524	4.4732	0.1231	0.07927	0.64395
7	1.0037	0.048411	0.040864	3.1165	4.6255	4.5571	4.4749	0.15054	0.082198	0.54602
8	2.002	0.20889	0.20155	3.1165	4.6941	4.5642	4.4767	0.21737	0.087468	0.40238
9	4.0017	0.32095	0.32095	3.1165	4.7171	4.5688	4.4726	0.24447	0.096246	0.3937
10	6.0014	0.34067	0.34032	3.1165	4.7154	4.5671	4.472	0.2434	0.095075	0.39061
11	8.0011	0.34695	0.34819	3.1165	4.7163	4.5647	4.4714	0.24488	0.093318	0.38107
12	10.001	0.35053	0.35054	3.1165	4.7189	4.5642	4.4714	0.24743	0.092733	0.37478
13	12.001	0.35322	0.35309	3.1165	4.7189	4.5642	4.4714	0.24743	0.092733	0.37478
14	14.001	0.3577	0.35692	3.1165	4.7152	4.5636	4.4714	0.24378	0.092147	0.37799
15	16.001	0.36308	0.36267	3.1165	4.7205	4.5659	4.472	0.2485	0.093904	0.37788
16	16.494	0.36308	0.36373	3.1165	4.7194	4.5647	4.4714	0.24798	0.093318	0.37631

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	4.7163	4.5647	4.4714	0.24488	0.093318	0.38107
2	0.012433	0	0	3.1165	4.72	4.5653	4.4714	0.24853	0.093904	0.37783
3	0.050483	0	0	3.1165	4.7163	4.5647	4.4714	0.24488	0.093318	0.38107
4	0.10055	0	0	3.1165	4.7163	4.5647	4.4714	0.24488	0.093318	0.38107
5	0.25078	0.0044825	0.00085133	3.1165	4.7251	4.5642	4.4726	0.25246	0.091563	0.36268
6	0.50165	0.018827	0.01128	3.1165	4.7416	4.5653	4.4743	0.2673	0.090978	0.34036
7	1.0034	0.091443	0.082792	3.1165	4.7727	4.5753	4.4732	0.29952	0.1021	0.34087
8	2.0011	0.25192	0.25072	3.1165	4.8457	4.587	4.4732	0.37251	0.11381	0.30551
9	4.0003	0.58452	0.64595	3.1165	4.9642	4.6174	4.4738	0.49042	0.14366	0.29293
10	6.0037	0.65534	0.73661	3.1165	4.9669	4.6204	4.4726	0.49434	0.14776	0.2989
11	8.0031	0.69031	0.77344	3.1165	4.9669	4.6204	4.472	0.49493	0.14834	0.29973
12	10.002	0.70555	0.79812	3.1165	4.9675	4.6209	4.472	0.49548	0.14893	0.30058
13	12.002	0.73244	0.81643	3.1165	4.9675	4.6209	4.472	0.49548	0.14893	0.30058
14	14.001	0.74768	0.83133	3.1165	4.9675	4.6209	4.472	0.49548	0.14893	0.30058
15	16.004	0.76203	0.84346	3.1165	4.968	4.6215	4.472	0.49603	0.14951	0.30142
16	18.003	0.7692	0.8541	3.1165	4.968	4.6215	4.472	0.49603	0.14951	0.30142
17	20.003	0.77368	0.86368	3.1165	4.9675	4.6209	4.4714	0.49607	0.14951	0.3014
18	22.002	0.77816	0.8724	3.1165	4.9675	4.6209	4.4714	0.49607	0.14951	0.3014
19	24.001	0.78713	0.87964	3.1165	4.968	4.6215	4.4714	0.49662	0.1501	0.30224
20	26	0.7952	0.88624	3.1165	4.968	4.6215	4.4714	0.49662	0.1501	0.30224
21	28.004	0.80506	0.89262	3.1165	4.9675	4.6209	4.4714	0.49607	0.14951	0.3014
22	28.075	0.80506	0.89283	3.1165	4.9711	4.6215	4.4714	0.49971	0.1501	0.30037

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	4.9675	4.6209	4.4714	0.49607	0.14951	0.3014
2	0.012483	0	0	3.1165	4.9717	4.6221	4.4714	0.50026	0.15068	0.30121
3	0.05065	0	0.00021283	3.1165	4.9675	4.6209	4.4714	0.49607	0.14951	0.3014
4	0.10072	0	0.00021283	3.1165	4.968	4.6215	4.4726	0.49545	0.14893	0.3006
5	0.25093	0.0026895	0.0034053	3.1165	4.9764	4.6239	4.4714	0.50502	0.15244	0.30185
6	0.5018	0.021516	0.020645	3.1165	4.9932	4.6285	4.4738	0.51947	0.15478	0.29796
7	1.0035	0.069927	0.08492	3.1165	5.0321	4.6403	4.4732	0.55896	0.16708	0.29891
8	2.0013	0.20889	0.23369	3.1165	5.0968	4.6596	4.4761	0.62068	0.18347	0.29559
9	4.0005	0.48949	0.59231	3.1165	5.2445	4.7046	4.4738	0.77077	0.23088	0.29955
10	6.0039	0.79878	0.96584	3.1165	5.3777	4.7474	4.4726	0.90509	0.27478	0.3036
11	8.0031	1.0355	1.2557	3.1165	5.4642	4.7702	4.4743	0.98989	0.29586	0.29888
12	10.002	1.0991	1.3455	3.1165	5.4653	4.7714	4.4726	0.99274	0.29878	0.30097
13	12.002	1.1395	1.3962	3.1165	5.4648	4.7708	4.4732	0.99161	0.29761	0.30013
14	14.001	1.1646	1.4332	3.1165	5.4648	4.7708	4.4726	0.99219	0.2982	0.30055
15	16.004	1.1986	1.4624	3.1165	5.4648	4.7708	4.472	0.99278	0.29878	0.30096
16	18.003	1.2148	1.4871	3.1165	5.4648	4.7708	4.472	0.99278	0.29878	0.30096
17	20.003	1.2219	1.5088	3.1165	5.4648	4.7708	4.472	0.99278	0.29878	0.30096
18	22.002	1.2434	1.5279	3.1165	5.4653	4.7714	4.4726	0.99274	0.29878	0.30097
19	24.001	1.2614	1.5456	3.1165	5.4653	4.7714	4.472	0.99333	0.29937	0.30138
20	26	1.2757	1.5609	3.1165	5.4653	4.7714	4.4726	0.99274	0.29878	0.30097
21	28.004	1.2874	1.5748	3.1165	5.4653	4.7714	4.4714	0.99391	0.29995	0.30179
22	30.003	1.3026	1.5875	3.1165	5.4653	4.7714	4.472	0.99333	0.29937	0.30138
23	32.002	1.3116	1.6001	3.1165	5.4653	4.7714	4.472	0.99333	0.29937	0.30138
24	34.001	1.325	1.6114	3.1165	5.4653	4.7714	4.472	0.99333	0.29937	0.30138
25	36.001	1.3304	1.6218	3.1165	5.4684	4.7714	4.4714	0.99701	0.29995	0.30085
26	38.001	1.3385	1.6318	3.1165	5.4653	4.7714	4.4714	0.99391	0.29995	0.30179
27	40.001	1.3465	1.6414	3.1165	5.4653	4.7714	4.4714	0.99391	0.29995	0.30179
28	41.48	1.3528	1.6482	3.1165	5.4659	4.772	4.472	0.99388	0.29996	0.3018

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	5.469	4.772	4.472	0.99698	0.29996	0.30087
2	0.012483	0	0.00021283	3.1165	5.4653	4.7714	4.4714	0.99391	0.29995	0.30179
3	0.05065	0	0.00042567	3.1165	5.4659	4.772	4.472	0.99388	0.29996	0.3018
4	0.10072	0.0008965	0.00085133	3.1165	5.469	4.772	4.472	0.99698	0.29996	0.30087
5	0.25093	0.005379	0.0044695	3.1165	5.4816	4.7755	4.4726	1.009	0.30288	0.30018
6	0.5018	0.021516	0.017878	3.1165	5.4933	4.7813	4.4743	1.0189	0.30698	0.30128
7	1.0035	0.061859	0.058103	3.1165	5.5294	4.7901	4.4732	1.0563	0.31693	0.30005
8	2.0013	0.14523	0.16218	3.1165	5.6005	4.8129	4.4726	1.1279	0.34035	0.30175
9	4.0005	0.36039	0.40928	3.1165	5.7435	4.8563	4.4755	1.268	0.38074	0.30028
10	6.0039	0.59797	0.68554	3.1165	5.8828	4.899	4.472	1.4108	0.42698	0.30265
11	8.0031	0.78175	0.9188	3.1165	5.9548	4.9195	4.4732	1.4816	0.4463	0.30123
12	10.002	0.85616	1.0063	3.1165	5.9579	4.9195	4.4726	1.4853	0.44688	0.30087
13	12.002	0.91085	1.0599	3.1165	5.9584	4.9201	4.4732	1.4853	0.44688	0.30088
14	14.001	0.93416	1.1016	3.1165	5.959	4.9206	4.4726	1.4864	0.44806	0.30144
15	16	0.96374	1.1363	3.1165	5.9595	4.9212	4.4708	1.4887	0.4504	0.30254
16	17.916	0.98705	1.1642	3.1165	5.9595	4.9212	4.4726	1.4869	0.44864	0.30172

TRIAXIAL TEST

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	5.9595	4.9212	4.4726	1.4869	0.44864	0.30172
2	0.012417	0	0.00021283	3.1165	5.959	4.9206	4.472	1.487	0.44864	0.30171
3	0.050483	0	0.00042567	3.1165	5.959	4.9206	4.472	1.487	0.44864	0.30171
4	0.10055	0.0008965	0.0010642	3.1165	5.959	4.9206	4.472	1.487	0.44864	0.30171
5	0.25077	0.007172	0.0053208	3.1165	5.9716	4.9242	4.4726	1.499	0.45157	0.30125
6	0.50163	0.01793	0.017027	3.1165	5.9858	4.9294	4.4738	1.5121	0.45567	0.30135
7	1.0034	0.060066	0.052995	3.1165	6.0169	4.9394	4.4726	1.5443	0.46679	0.30227
8	2.0011	0.13627	0.14515	3.1165	6.0916	4.9628	4.4755	1.6161	0.48728	0.30152
9	4.0007	0.34605	0.37012	3.1165	6.2366	5.0049	4.4726	1.764	0.53235	0.30179
10	6	0.57286	0.61977	3.1165	6.3779	5.0465	4.4779	1.9001	0.56864	0.29928
11	8.0034	0.80596	0.88262	3.1165	6.5142	5.0892	4.4761	2.0381	0.61313	0.30084
12	10.003	1.0453	1.1523	3.1165	6.6535	5.132	4.4761	2.1774	0.65586	0.30121
13	12.002	1.2856	1.4228	3.1165	6.8013	5.177	4.4784	2.3228	0.6986	0.30075
14	14.002	1.5384	1.6939	3.1165	6.9415	5.2174	4.4726	2.4689	0.74484	0.30168
15	16.001	1.6765	1.8638	3.1165	6.953	5.2198	4.4755	2.4775	0.74426	0.30041
16	18.004	1.7589	1.9664	3.1165	6.9505	5.2204	4.4726	2.4779	0.74777	0.30178
17	20.003	1.8262	2.0426	3.1165	6.9494	5.2192	4.4732	2.4762	0.74601	0.30127
18	22.003	1.8656	2.1036	3.1165	6.9479	5.2209	4.4732	2.4747	0.74777	0.30216
19	24.002	1.9221	2.1554	3.1165	6.9499	5.2198	4.472	2.4779	0.74777	0.30177
20	26.001	1.949	2.2007	3.1165	6.9499	5.2198	4.472	2.4779	0.74777	0.30177
21	26.235	1.9562	2.2056	3.1165	6.9505	5.2204	4.4726	2.4779	0.74777	0.30178

Consolidation/B Step: 7

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	6.9499	5.2198	4.4732	2.4767	0.7466	0.30144
2	0.012533	0.0008965	0.00042567	3.1165	6.9505	5.2204	4.472	2.4785	0.74835	0.30194
3	0.050633	0	0.00085133	3.1165	6.9468	5.2198	4.4732	2.4736	0.7466	0.30182
4	0.10072	0.001793	0.0017027	3.1165	6.9505	5.2204	4.4732	2.4773	0.74718	0.30161
5	0.25093	0.0098615	0.0061722	3.1165	6.9558	5.2227	4.4726	2.4832	0.75011	0.30208
6	0.5018	0.025102	0.017027	3.1165	6.9748	5.2297	4.4732	2.5016	0.75655	0.30243
7	1.0035	0.05379	0.044056	3.1165	7.0126	5.2403	4.4738	2.5388	0.7665	0.30191
8	2.0008	0.12013	0.11301	3.1165	7.0829	5.259	4.4749	2.6079	0.78406	0.30064
9	4.0042	0.29047	0.28711	3.1165	7.2213	5.3041	4.4743	2.747	0.82972	0.30205
10	6.0034	0.48142	0.48526	3.1165	7.3621	5.345	4.4726	2.8895	0.87245	0.30194
11	8.0028	0.68403	0.69894	3.1165	7.504	5.3872	4.4743	3.0297	0.91284	0.3013
12	10.002	0.90547	0.92348	3.1165	7.6481	5.4317	4.4743	3.1738	0.95733	0.30164
13	12.002	1.1323	1.1542	3.1165	7.7928	5.4768	4.4743	3.3184	1.0024	0.30207
14	14.001	1.3546	1.3892	3.1165	7.9321	5.5195	4.4738	3.4584	1.0457	0.30238
15	16.001	1.5097	1.5622	3.1165	7.9389	5.5201	4.4749	3.4639	1.0451	0.30172
16	18	1.6056	1.6848	3.1165	7.9414	5.5195	4.472	3.4694	1.0475	0.30192
17	20.004	1.7025	1.7827	3.1165	7.9425	5.5207	4.4738	3.4688	1.0469	0.30181
18	22.003	1.7796	1.864	3.1165	7.9389	5.5201	4.4726	3.4663	1.0475	0.30219
19	24.002	1.8468	1.9349	3.1165	7.9431	5.5212	4.4743	3.4687	1.0469	0.30181
20	26.003	1.8907	1.9964	3.1165	7.942	5.5201	4.4749	3.467	1.0451	0.30145
21	28.003	1.9409	2.0515	3.1165	7.9425	5.5207	4.4738	3.4688	1.0469	0.30181
22	30.003	1.9974	2.1017	3.1165	7.9425	5.5207	4.4732	3.4693	1.0475	0.30192
23	32.004	2.0252	2.1475	3.1165	7.9425	5.5207	4.4732	3.4693	1.0475	0.30192
24	34.004	2.0754	2.1901	3.1165	7.9425	5.5207	4.4738	3.4688	1.0469	0.30181
25	36.004	2.1122	2.2299	3.1165	7.9425	5.5207	4.4714	3.4711	1.0492	0.30228
26	38.004	2.1435	2.2665	3.1165	7.9425	5.5207	4.4732	3.4693	1.0475	0.30192
27	40.004	2.1749	2.3014	3.1165	7.9425	5.5207	4.4743	3.4682	1.0463	0.30169
28	42.003	2.2018	2.3344	3.1165	7.9431	5.5212	4.472	3.4711	1.0492	0.30228
29	44.003	2.2323	2.3659	3.1165	7.9431	5.5212	4.4708	3.4722	1.0504	0.30252
30	46.003	2.2708	2.3954	3.1165	7.9425	5.5207	4.4732	3.4693	1.0475	0.30192
31	48.003	2.2941	2.4235	3.1165	7.9425	5.5207	4.4732	3.4693	1.0475	0.30192
32	50.002	2.313	2.4506	3.1165	7.9431	5.5212	4.4738	3.4693	1.0475	0.30193
33	52.001	2.3435	2.477	3.1165	7.9431	5.5212	4.472	3.4711	1.0492	0.30228
34	54.001	2.3623	2.5025	3.1165	7.9431	5.5212	4.4738	3.4693	1.0475	0.30193
35	56.001	2.3892	2.5268	3.1165	7.9425	5.5207	4.4726	3.4699	1.0481	0.30204
36	58	2.4089	2.55	3.1165	7.9425	5.5207	4.472	3.4705	1.0486	0.30216
37	60.004	2.4286	2.5721	3.1165	7.9425	5.5207	4.472	3.4705	1.0486	0.30216
38	62.003	2.4546	2.5938	3.1165	7.9431	5.5212	4.4732	3.4699	1.0481	0.30204
39	64.002	2.4726	2.6144	3.1165	7.9431	5.5212	4.4708	3.4722	1.0504	0.30252
40	66.002	2.4905	2.634	3.1165	7.9431	5.5212	4.4732	3.4699	1.0481	0.30204
41	68.001	2.503	2.6528	3.1165	7.94	5.5212	4.4732	3.4668	1.0481	0.30231
42	70	2.5389	2.6719	3.1165	7.9431	5.5212	4.4714	3.4716	1.0498	0.3024
43	72.003	2.5532	2.6906	3.1165	7.9431	5.5212	4.4732	3.4699	1.0481	0.30204
44	74.003	2.5604	2.7083	3.1165	7.94	5.5212	4.472	3.468	1.0492	0.30255
45	76.002	2.5837	2.7258	3.1165	7.9431	5.5212	4.4732	3.4699	1.0481	0.30204
46	78.001	2.5909	2.7419	3.1165	7.94	5.5212	4.4726	3.4674	1.0486	0.30243
47	80	2.6052	2.7583	3.1165	7.9431	5.5212	4.4714	3.4716	1.0498	0.3024
48	82.004	2.6205	2.7745	3.1165	7.94	5.5212	4.4703	3.4697	1.051	0.3029
49	84.003	2.6357	2.79	3.1165	7.94	5.5212	4.4708	3.4691	1.0504	0.30279
50	86.003	2.651	2.8051	3.1165	7.94	5.5212	4.472	3.468	1.0492	0.30255
51	88.002	2.6671	2.8198	3.1165	7.9431	5.5212	4.4732	3.4699	1.0481	0.30204
52	90.001	2.6859	2.8347	3.1165	7.94	5.5212	4.472	3.468	1.0492	0.30255
53	92.001	2.6967	2.8492	3.1165	7.9405	5.5218	4.472	3.4685	1.0498	0.30267
54	94.004	2.7119	2.8632	3.1165	7.94	5.5212	4.4726	3.4674	1.0486	0.30243
55	96.003	2.7272	2.8769	3.1165	7.94	5.5212	4.4703	3.4697	1.051	0.3029
56	98.003	2.7424	2.8903	3.1165	7.94	5.5212	4.472	3.468	1.0492	0.30255
57	100	2.7496	2.9035	3.1165	7.9405	5.5218	4.4726	3.4679	1.0492	0.30255
58	102	2.7621	2.9169	3.1165	7.94	5.5212	4.4708	3.4691	1.0504	0.30279
59	104	2.7729	2.9294	3.1165	7.94	5.5212	4.4703	3.4697	1.051	0.3029
60	106	2.7827	2.9416	3.1165	7.94	5.5212	4.472	3.468	1.0492	0.30255
61	108	2.7917	2.9539	3.1165	7.94	5.5212	4.472	3.468	1.0492	0.30255
62	110	2.8007	2.966	3.1165	7.94	5.5212	4.4732	3.4668	1.0481	0.30231
63	112	2.8132	2.9775	3.1165	7.9436	5.5218	4.4726	3.471	1.0492	0.30228
64	114	2.8338	2.9895	3.1165	7.94	5.5212	4.4714	3.4685	1.0498	0.30267
65	116	2.8446	3.0007	3.1165	7.9411	5.5224	4.4726	3.4685	1.0498	0.30267
66	118	2.8589	3.0118	3.1165	7.9405	5.5218	4.4726	3.4679	1.0492	0.30255
67	120	2.867	3.0233	3.1165	7.9431	5.5212	4.4726	3.4705	1.0486	0.30216
68	122	2.8751	3.0344	3.1165	7.9405	5.5218	4.472	3.4685	1.0498	0.30267
69	124	2.8823	3.045	3.1165	7.94	5.5212	4.4703	3.4697	1.051	0.3029
70	126	2.8948	3.0554	3.1165	7.94	5.5212	4.472	3.468	1.0492	0.30255
71	128	2.9074	3.0659	3.1165	7.94	5.5212	4.4708	3.4691	1.0504	0.30279
72	130	2.9199	3.0763	3.1165	7.94	5.5212	4.4714	3.4685	1.0498	0.30267
73	132	2.9298	3.0865	3.1165	7.94	5.5212	4.4679	3.4721	1.0533	0.30337
74	134	2.9486	3.0963	3.1165	7.9405	5.5218	4.4703	3.4703	1.0516	0.30302
75	136	2.9558	3.1061	3.1165	7.94	5.5212	4.4714	3.4685	1.0498	0.30267
76	138	2.9576	3.1157	3.1165	7.9436	5.5218	4.4726	3.471	1.0492	0.30228
77	140	2.9611	3.1257	3.1165	7.94	5.5212	4.4703	3.4697	1.051	0.3029
78	142	2.9692	3.1348	3.1165	7.9405	5.5218	4.4726	3.4679	1.0492	0.30255
79	144	2.9809	3.144	3.1165	7.94	5.5212	4.4714	3.4685	1.0498	0.30267
80	146	2.9889	3.1533	3.1165	7.94	5.5212	4.4697	3.4703	1.0516	0.30302
81	148	3.0015	3.1623	3.1165	7.9405	5.5218	4.4732	3.4673	1.0486	0.30244
82	150	3.0185	3.1712	3.1165	7.9436	5.5218	4.472	3.4716	1.0498	0.3024
83	152	3.0284	3.1806	3.1165	7.94	5.5212	4.4714	3.4685	1.0498	0.30267
84	154	3.0338	3.1891	3.1165	7.9405	5.5218	4.4726	3.4679	1.0492	0.30255
85	156	3.0409	3.1978	3.1165	7.9431	5.5212	4.4708	3.4722	1.0504	0.30252
86	158	3.0481	3.2065	3.1165	7.94	5.5212	4.4708	3.4691	1.0504	0.30279
87	160	3.0544	3.2151	3.1165	7.9436	5.5218	4.4726	3.471	1.0492	0.30228
88	162	3.0633	3.2234	3.1165	7.9411	5.5224	4.4714	3.4696	1.051	0.30291
89	164	3.0705	3.2317	3.1165	7.9405	5.5218	4.4726	3.4679	1.0492	0.30255
90	166	3.0795	3.2393	3.1165	7.9405	5.5218	4.4726	3.4679	1.0492	0.30255
91	168	3.0849	3.248	3.1165	7.9405	5.5218	4.4714	3.4691	1.0504	0.30279
92	170	3.0911	3.2563	3.1165	7.9436	5.5218	4.4708	3.4728	1.051	0.30264

93	172	3.101	3.2642	3.1165	7.9436	5.5218	4.4726	3.471	1.0492	0.30228
94	174	3.11	3.2721	3.1165	7.9431	5.5212	4.472	3.4711	1.0492	0.30228
95	176	3.1136	3.2798	3.1165	7.9431	5.5212	4.4714	3.4716	1.0498	0.3024
96	178	3.1252	3.2876	3.1165	7.94	5.5212	4.4691	3.4709	1.0522	0.30314
97	180	3.1351	3.2953	3.1165	7.9431	5.5212	4.4708	3.4722	1.0504	0.30252
98	182	3.1449	3.3025	3.1165	7.9436	5.5218	4.472	3.4716	1.0498	0.3024
99	184	3.1557	3.3096	3.1165	7.94	5.5212	4.4726	3.4674	1.0486	0.30243
100	186	3.1673	3.317	3.1165	7.9405	5.5218	4.4726	3.4679	1.0492	0.30255
101	188	3.1745	3.3247	3.1165	7.9405	5.5218	4.4726	3.4679	1.0492	0.30255
102	190	3.179	3.3319	3.1165	7.94	5.5212	4.472	3.468	1.0492	0.30255
103	192	3.1808	3.3389	3.1165	7.94	5.5212	4.4714	3.4685	1.0498	0.30267
104	194	3.1826	3.3457	3.1165	7.9436	5.5218	4.4726	3.471	1.0492	0.30228
105	196	3.188	3.353	3.1165	7.9431	5.5212	4.4726	3.4705	1.0486	0.30216
106	198	3.1951	3.3602	3.1165	7.9436	5.5218	4.472	3.4716	1.0498	0.3024

TRIAXIAL TEST

Consolidation/B Step: 8

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	7.94	5.5212	4.4697	3.4703	1.0516	0.30302
2	0.012433	0	0	3.1165	7.94	5.5212	4.4703	3.4697	1.051	0.3029
3	0.050483	0	−0.00021283	3.1165	7.9369	5.5212	4.472	3.4649	1.0492	0.30282
4	0.10055	−0.0008965	0.00021283	3.1165	7.9338	5.5212	4.4703	3.4635	1.051	0.30345
5	0.25078	−0.003586	0.00042567	3.1165	7.9245	5.5212	4.4708	3.4536	1.0504	0.30414
6	0.50163	−0.007172	0	3.1165	7.9048	5.5201	4.4714	3.4334	1.0486	0.30543
7	1.0034	−0.013448	−0.0027668	3.1165	7.8725	5.5154	4.472	3.4005	1.0434	0.30683
8	2.0011	−0.018827	−0.013408	3.1165	7.8017	5.506	4.4708	3.3309	1.0352	0.31079
9	4.0003	−0.087857	−0.060657	3.1165	7.6565	5.4604	4.4714	3.1851	0.98894	0.31049
10	6.0037	−0.15151	−0.13238	3.1165	7.514	5.4077	4.4703	3.0437	0.93743	0.30799
11	8.0034	−0.23578	−0.21241	3.1165	7.3744	5.3614	4.4691	2.9053	0.89235	0.30714
12	10.003	−0.32095	−0.29988	3.1165	7.2313	5.3246	4.4691	2.7622	0.85547	0.30971
13	12.002	−0.41956	−0.39736	3.1165	7.0883	5.2812	4.4697	2.6186	0.81157	0.30992
14	14.001	−0.51818	−0.5008	3.1165	6.9487	5.2514	4.4697	2.479	0.78172	0.31534
15	16	−0.63383	−0.61253	3.1165	6.8052	5.2174	4.4685	2.3367	0.74893	0.32051
16	18.004	−0.75665	−0.73044	3.1165	6.6626	5.1911	4.4703	2.1924	0.72084	0.32879
17	20.003	−0.88843	−0.85899	3.1165	6.5158	5.1536	4.4679	2.0479	0.68571	0.33483
18	22.003	−1.0247	−0.99946	3.1165	6.3809	5.1156	4.4685	1.9124	0.64708	0.33836
19	24.002	−1.187	−1.1506	3.1165	6.2292	5.0828	4.4697	1.7595	0.61313	0.34846
20	26.001	−1.3358	−1.3134	3.1165	6.0865	5.0529	4.4656	1.6209	0.58737	0.36237
21	28	−1.516	−1.4871	3.1165	5.9632	5.0207	4.4667	1.4965	0.554	0.37021
22	30.004	−1.6056	−1.6116	3.1165	5.9693	5.0272	4.4697	1.4996	0.55752	0.37178
23	32.003	−1.689	−1.6856	3.1165	5.967	5.0676	4.4691	1.4979	0.59849	0.39956
24	34.002	−1.7509	−1.7399	3.1165	5.9649	5.0851	4.4703	1.4946	0.61489	0.4114
25	36.001	−1.8011	−1.7846	3.1165	5.9653	5.0922	4.4691	1.4962	0.62308	0.41644
26	38.001	−1.8405	−1.8227	3.1165	5.966	5.0963	4.4697	1.4964	0.62659	0.41874
27	40	−1.8728	−1.8544	3.1165	5.9639	5.1039	4.4703	1.4936	0.63362	0.42421
28	42.003	−1.9006	−1.8823	3.1165	5.9641	5.1074	4.4726	1.4915	0.63479	0.4256
29	43.698	−1.9239	−1.9038	3.1165	5.9641	5.1074	4.4697	1.4944	0.63771	0.42673

TRIAXIAL TEST

Consolidation/B Step: 9

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	5.9641	5.1074	4.4697	1.4944	0.63771	0.42673
2	0.0125	0	-0.00021283	3.1165	5.9641	5.1074	4.4703	1.4938	0.63713	0.4265
3	0.050767	0	-0.0006385	3.1165	5.9677	5.108	4.4703	1.4975	0.63771	0.42586
4	0.10082	0	-0.001277	3.1165	5.9677	5.108	4.4726	1.4951	0.63537	0.42496
5	0.25102	0	-0.0023412	3.1165	5.9739	5.108	4.4697	1.5043	0.6383	0.42432
6	0.50205	0.0026895	-0.0040438	3.1165	5.9931	5.1086	4.4732	1.5199	0.63537	0.41804
7	1.0041	0.008965	-0.0034053	3.1165	6.029	5.1138	4.472	1.557	0.64181	0.41221
8	2.0031	0.026895	0.006385	3.1165	6.0988	5.132	4.472	1.6268	0.65996	0.40569
9	4.0032	0.086961	0.063211	3.1165	6.2424	5.1858	4.4732	1.7692	0.71264	0.4028
10	6.0034	0.1784	0.15175	3.1165	6.3831	5.2432	4.4726	1.9105	0.7706	0.40335
11	8.0034	0.27792	0.25668	3.1165	6.5242	5.2976	4.4743	2.0498	0.82328	0.40164
12	10.004	0.38908	0.36905	3.1165	6.6671	5.331	4.4749	2.1922	0.85606	0.39051
13	12.004	0.52087	0.48909	3.1165	6.8167	5.3813	4.4761	2.3406	0.90523	0.38675
14	14.004	0.62755	0.61296	3.1165	6.9485	5.4194	4.4732	2.4754	0.94621	0.38225
15	16	0.68403	0.69192	3.1165	6.9496	5.4106	4.4714	2.4782	0.93918	0.37898
16	18	0.72796	0.73768	3.1165	6.9478	5.3889	4.4738	2.4741	0.91518	0.36991
17	20	0.75934	0.76194	3.1165	6.9494	5.3445	4.472	2.4774	0.87245	0.35217
18	22.001	0.79071	0.77961	3.1165	6.9495	5.338	4.4732	2.4763	0.86484	0.34924
19	24.001	0.80237	0.79685	3.1165	6.9495	5.338	4.4714	2.4781	0.8666	0.3497
20	26.001	0.81671	0.8094	3.1165	6.9502	5.3322	4.472	2.4782	0.86016	0.34709
21	26.632	0.8194	0.81281	3.1165	6.9491	5.331	4.4714	2.4777	0.85957	0.34692

TRIAXIAL TEST

Consolidation/B Step: 10

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	6.9522	5.331	4.472	2.4802	0.85899	0.34634
2	0.0125	0	0	3.1165	6.9491	5.331	4.4726	2.4765	0.8584	0.34661
3	0.0508	0	0.00021283	3.1165	6.9491	5.331	4.4726	2.4765	0.8584	0.34661
4	0.10087	0.0008965	0.0006385	3.1165	6.9517	5.3304	4.4703	2.4814	0.86016	0.34664
5	0.25103	0.0062755	0.0021283	3.1165	6.961	5.3304	4.472	2.489	0.8584	0.34488
6	0.50205	0.017034	0.0059593	3.1165	6.9787	5.3327	4.4732	2.5055	0.85957	0.34308
7	1.0034	0.025999	0.016388	3.1165	7.0152	5.3386	4.472	2.5432	0.8666	0.34076
8	2.0011	0.069927	0.045121	3.1165	7.086	5.3579	4.472	2.614	0.88591	0.33891
9	4.0003	0.15599	0.12685	3.1165	7.2293	5.4147	4.4743	2.7549	0.94035	0.34134
10	6.0037	0.25461	0.2305	3.1165	7.3718	5.4773	4.4743	2.8975	1.003	0.34616
11	8.0033	0.37115	0.345	3.1165	7.5125	5.5248	4.4726	3.0399	1.0522	0.34612
12	10.002	0.4877	0.46398	3.1165	7.6562	5.5722	4.4738	3.1825	1.0984	0.34514
13	12.002	0.60873	0.58529	3.1165	7.7988	5.6085	4.4732	3.3257	1.1353	0.34137
14	14.001	0.72617	0.70937	3.1165	7.9392	5.6424	4.4726	3.4666	1.1698	0.33745
15	16	0.79161	0.79876	3.1165	7.9389	5.6453	4.4743	3.4645	1.171	0.33799
16	18.003	0.85975	0.85665	3.1165	7.9395	5.6196	4.472	3.4674	1.1476	0.33096
17	20.003	0.89112	0.89752	3.1165	7.9422	5.5862	4.4732	3.469	1.113	0.32085
18	22.002	0.93774	0.92838	3.1165	7.9408	5.5716	4.4732	3.4676	1.0984	0.31676
19	24.001	0.95926	0.95562	3.1165	7.9419	5.5628	4.4732	3.4687	1.0896	0.31413
20	26.001	0.98346	0.97775	3.1165	7.9396	5.5505	4.472	3.4676	1.0785	0.31102
21	28	1.0023	0.99734	3.1165	7.9401	5.5411	4.4708	3.4692	1.0703	0.30851
22	29.933	1.0211	1.0146	3.1165	7.9399	5.5376	4.4708	3.469	1.0668	0.30752

TRIAXIAL TEST

Consolidation/B Step: 11

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	7.9404	5.5382	4.4714	3.469	1.0668	0.30752
2	0.012483	0	0	3.1165	7.9399	5.5376	4.4732	3.4667	1.0645	0.30705
3	0.050717	0	0.00021283	3.1165	7.9362	5.537	4.4703	3.466	1.0668	0.30779
4	0.10078	0.0008965	0.0006385	3.1165	7.9424	5.537	4.4726	3.4698	1.0645	0.30677
5	0.251	0.0044825	0.002554	3.1165	7.9517	5.537	4.4738	3.478	1.0633	0.30572
6	0.50203	0.018827	0.0061722	3.1165	7.9683	5.5382	4.4726	3.4957	1.0656	0.30484
7	1.0041	0.043032	0.017027	3.1165	8.0061	5.5488	4.472	3.5341	1.0767	0.30467
8	2.0027	0.068134	0.047887	3.1165	8.0736	5.5809	4.4738	3.5998	1.1072	0.30757
9	4.0027	0.16406	0.126	3.1165	8.2175	5.6319	4.4749	3.7426	1.1569	0.30913
10	6.0028	0.2555	0.22582	3.1165	8.3585	5.7027	4.4755	3.883	1.2272	0.31604
11	8.0035	0.37384	0.33777	3.1165	8.5041	5.7554	4.4767	4.0274	1.2787	0.3175
12	10.003	0.49039	0.45951	3.1165	8.643	5.8075	4.4743	4.1686	1.3331	0.3198
13	12.003	0.6159	0.58912	3.1165	8.7869	5.8584	4.4755	4.3114	1.3829	0.32075
14	14.003	0.75485	0.72512	3.1165	8.9314	5.9	4.4749	4.4564	1.425	0.31977
15	16.002	0.83644	0.83516	3.1165	8.9294	5.9111	4.472	4.4574	1.4391	0.32285
16	18.002	0.90726	0.91476	3.1165	8.9293	5.8812	4.4743	4.4549	1.4069	0.31581
17	20.002	0.98257	0.97733	3.1165	8.9296	5.852	4.4743	4.4553	1.3776	0.30921
18	22.002	1.0319	1.0333	3.1165	8.929	5.8414	4.472	4.457	1.3694	0.30725
19	24.001	1.0893	1.0816	3.1165	8.9304	5.8297	4.4726	4.4578	1.3571	0.30444
20	26.002	1.1386	1.1259	3.1165	8.9326	5.8221	4.4738	4.4588	1.3484	0.3024
21	28	1.1726	1.167	3.1165	8.9309	5.8204	4.4732	4.4577	1.3472	0.30221
22	30.001	1.2031	1.2057	3.1165	8.9309	5.8204	4.4743	4.4566	1.346	0.30203
23	32.003	1.2515	1.2417	3.1165	8.9309	5.8204	4.4714	4.4595	1.3489	0.30249
24	34.002	1.2802	1.2759	3.1165	8.9315	5.821	4.4743	4.4571	1.3466	0.30212
25	36.004	1.3071	1.3087	3.1165	8.9315	5.821	4.4738	4.4577	1.3472	0.30222
26	38.002	1.3277	1.3398	3.1165	8.9309	5.8204	4.4738	4.4571	1.3466	0.30212
27	40.001	1.3672	1.3692	3.1165	8.9309	5.8204	4.4726	4.4583	1.3478	0.30231
28	42	1.3968	1.3975	3.1165	8.9309	5.8204	4.4703	4.4607	1.3501	0.30267
29	44.004	1.421	1.4247	3.1165	8.9315	5.821	4.4708	4.4606	1.3501	0.30267
30	46.004	1.4425	1.4511	3.1165	8.9315	5.821	4.4703	4.4612	1.3507	0.30277
31	48.001	1.4685	1.4764	3.1165	8.9315	5.821	4.4714	4.46	1.3495	0.30258
32	50.002	1.4918	1.5007	3.1165	8.9315	5.821	4.472	4.4595	1.3489	0.30249
33	52.001	1.5133	1.5247	3.1165	8.9315	5.821	4.4691	4.4624	1.3519	0.30295
34	54.004	1.5384	1.5479	3.1165	8.9315	5.821	4.4726	4.4589	1.3484	0.3024
35	56.003	1.5599	1.5701	3.1165	8.9346	5.821	4.472	4.4626	1.3489	0.30228
36	58.003	1.5796	1.5911	3.1165	8.9315	5.821	4.4743	4.4571	1.3466	0.30212
37	60.002	1.6074	1.6122	3.1165	8.9315	5.821	4.472	4.4595	1.3489	0.30249
38	62.001	1.6191	1.6326	3.1165	8.9315	5.821	4.4726	4.4589	1.3484	0.3024
39	64.001	1.6397	1.6529	3.1165	8.9315	5.821	4.4703	4.4612	1.3507	0.30277
40	66	1.6639	1.672	3.1165	8.9346	5.821	4.4738	4.4608	1.3472	0.30201
41	68.001	1.6809	1.691	3.1165	8.9315	5.821	4.4703	4.4612	1.3507	0.30277
42	70	1.6953	1.709	3.1165	8.9346	5.821	4.4732	4.4614	1.3478	0.3021
43	72.004	1.7114	1.7271	3.1165	8.9315	5.821	4.4726	4.4589	1.3484	0.3024
44	74.004	1.7311	1.745	3.1165	8.9315	5.821	4.4697	4.4618	1.3513	0.30286
45	76.004	1.7437	1.7623	3.1165	8.9315	5.821	4.4732	4.4583	1.3478	0.30231
46	78.004	1.7625	1.7793	3.1165	8.9315	5.821	4.4708	4.4606	1.3501	0.30267
47	80	1.7805	1.7961	3.1165	8.9315	5.821	4.4738	4.4577	1.3472	0.30222
48	82	1.802	1.8127	3.1165	8.9315	5.821	4.4726	4.4589	1.3484	0.3024
49	84	1.8145	1.8291	3.1165	8.9315	5.821	4.4714	4.46	1.3495	0.30258
50	86	1.8271	1.8448	3.1165	8.9315	5.821	4.4714	4.46	1.3495	0.30258
51	86.23	1.828	1.8465	3.1165	8.9315	5.821	4.4726	4.4589	1.3484	0.3024

TRIAXIAL TEST

Consolidation/B Step: 12

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	8.932	5.8215	4.4738	4.4582	1.3478	0.30231
2	0.012483	0	0.00021283	3.1165	8.9315	5.821	4.4703	4.4612	1.3507	0.30277
3	0.050033	0	0.00042567	3.1165	8.9309	5.8204	4.4714	4.4595	1.3489	0.30249
4	0.10012	0	0.00085133	3.1165	8.9315	5.821	4.4697	4.4618	1.3513	0.30286
5	0.25033	0.0026895	0.002554	3.1165	8.9466	5.8239	4.4743	4.4723	1.3495	0.30176
6	0.50122	0.0044825	0.0061722	3.1165	8.9651	5.8303	4.4726	4.4925	1.3577	0.30222
7	1.0029	0.014344	0.015324	3.1165	8.9967	5.8409	4.4708	4.5258	1.37	0.30271
8	2.0007	0.058273	0.038523	3.1165	9.0703	5.8631	4.472	4.5983	1.3911	0.30253
9	4.0041	0.13179	0.10024	3.1165	9.2113	5.9175	4.4732	4.7381	1.4444	0.30484
10	6.0034	0.21695	0.17963	3.1165	9.3508	5.9901	4.4726	4.8783	1.5175	0.31108
11	8.0021	0.31109	0.27306	3.1165	9.4947	6.0574	4.4732	5.0215	1.5843	0.31549
12	10.001	0.40612	0.37799	3.1165	9.6382	6.1277	4.4749	5.1633	1.6528	0.3201
13	12.004	0.52087	0.49164	3.1165	9.7826	6.1856	4.4726	5.31	1.713	0.32261
14	14.002	0.64727	0.61338	3.1165	9.9265	6.253	4.4755	5.451	1.7774	0.32608
15	16.001	0.77727	0.74279	3.1165	10.067	6.3197	4.4738	5.5929	1.8459	0.33005
16	18.004	0.91712	0.87985	3.1165	10.213	6.3829	4.4767	5.7362	1.9062	0.33231
17	20.003	1.0677	1.0235	3.1165	10.353	6.4526	4.4714	5.8814	1.9811	0.33685
18	22.001	1.1915	1.1655	3.1165	10.424	6.5152	4.4761	5.948	2.0391	0.34282
19	24	1.2811	1.284	3.1165	10.421	6.5216	4.472	5.9488	2.0496	0.34455
20	26.003	1.3806	1.3834	3.1165	10.42	6.4976	4.472	5.9479	2.0256	0.34056
21	28.002	1.4676	1.4698	3.1165	10.416	6.4602	4.472	5.9437	1.9882	0.3345
22	30	1.5501	1.5475	3.1165	10.418	6.4327	4.4714	5.9463	1.9612	0.32982
23	32.003	1.6325	1.6194	3.1165	10.419	6.418	4.4738	5.9457	1.9443	0.327
24	34.002	1.6998	1.6871	3.1165	10.419	6.4104	4.4749	5.9436	1.9355	0.32564
25	36.001	1.7661	1.7518	3.1165	10.419	6.4104	4.4714	5.9471	1.939	0.32604
26	38.004	1.8298	1.8125	3.1165	10.418	6.4005	4.4708	5.9476	1.9296	0.32444
27	40.002	1.897	1.8706	3.1165	10.421	6.4028	4.4732	5.9475	1.9296	0.32445
28	42.001	1.9382	1.9264	3.1165	10.417	6.3952	4.4714	5.9452	1.9238	0.32359
29	44.004	2.0064	1.9787	3.1165	10.422	6.3876	4.4761	5.9458	1.9115	0.32149
30	46.003	2.0404	2.0304	3.1165	10.419	6.3812	4.472	5.9469	1.9091	0.32103
31	48.001	2.0987	2.0787	3.1165	10.422	6.3812	4.4755	5.9465	1.9056	0.32046
32	50	2.148	2.1247	3.1165	10.417	6.3724	4.4732	5.9437	1.8992	0.31953
33	52.003	2.1973	2.17	3.1165	10.419	6.3747	4.4697	5.9494	1.905	0.32021
34	54.002	2.235	2.2139	3.1165	10.419	6.3683	4.4749	5.9443	1.8933	0.31852
35	56	2.2843	2.2567	3.1165	10.421	6.3765	4.4708	5.9499	1.9056	0.32028
36	58.003	2.3264	2.2982	3.1165	10.418	6.3741	4.4697	5.9488	1.9045	0.32014
37	60.002	2.3695	2.3392	3.1165	10.417	6.3858	4.4714	5.9457	1.9144	0.32198
38	62.001	2.399	2.3786	3.1165	10.421	6.3771	4.4743	5.9469	1.9027	0.31995
39	64.004	2.4412	2.4159	3.1165	10.42	6.3694	4.4708	5.9494	1.8986	0.31912
40	66.002	2.4699	2.4516	3.1165	10.417	6.356	4.4743	5.9426	1.8816	0.31664
41	68.001	2.5138	2.4857	3.1165	10.419	6.3454	4.4738	5.9457	1.8717	0.3148
42	70.004	2.5479	2.5202	3.1165	10.419	6.3484	4.472	5.9471	1.8764	0.31551
43	72.003	2.5846	2.5536	3.1165	10.421	6.3507	4.4703	5.951	1.8805	0.31599
44	74.001	2.6151	2.5868	3.1165	10.42	6.356	4.4732	5.9468	1.8828	0.31661
45	76.004	2.6465	2.6191	3.1165	10.421	6.3507	4.4749	5.9463	1.8758	0.31545
46	78.003	2.6868	2.6504	3.1165	10.421	6.3501	4.4738	5.947	1.8764	0.31552
47	80.002	2.7101	2.6821	3.1165	10.42	6.356	4.472	5.948	1.884	0.31674
48	82	2.7343	2.7119	3.1165	10.423	6.3431	4.4738	5.9497	1.8693	0.31419
49	84.003	2.772	2.7402	3.1165	10.42	6.3361	4.472	5.9479	1.8641	0.3134
50	86.002	2.798	2.7698	3.1165	10.421	6.3373	4.472	5.949	1.8652	0.31354
51	88.001	2.8294	2.7983	3.1165	10.42	6.339	4.4732	5.9464	1.8658	0.31378
52	90.003	2.8563	2.8262	3.1165	10.422	6.3384	4.4761	5.946	1.8623	0.3132
53	92.002	2.8849	2.853	3.1165	10.419	6.3349	4.4743	5.9445	1.8606	0.31299
54	94.001	2.91	2.8798	3.1165	10.421	6.3337	4.472	5.9488	1.8617	0.31296
55	96.004	2.9378	2.9058	3.1165	10.42	6.3332	4.4732	5.9471	1.86	0.31275
56	98.002	2.9674	2.9316	3.1165	10.421	6.3337	4.4714	5.9494	1.8623	0.31303
57	100	2.9934	2.9575	3.1165	10.421	6.3443	4.4738	5.9477	1.8705	0.3145
58	102	3.0131	2.9833	3.1165	10.419	6.3419	4.4738	5.9455	1.8682	0.31422
59	104	3.0365	3.008	3.1165	10.421	6.3343	4.4732	5.9482	1.8611	0.31289
60	106	3.0687	3.0318	3.1165	10.422	6.3314	4.4743	5.9474	1.857	0.31225
61	108	3.0956	3.0563	3.1165	10.422	6.3413	4.4743	5.9474	1.867	0.31392
62	110	3.1162	3.0812	3.1165	10.422	6.3513	4.4708	5.951	1.8805	0.31599
63	112	3.1261	3.1042	3.1165	10.422	6.3378	4.4726	5.949	1.8652	0.31354
64	114	3.1611	3.1255	3.1165	10.422	6.3214	4.4743	5.9473	1.8471	0.31058
65	116	3.1808	3.1476	3.1165	10.42	6.3197	4.4738	5.9462	1.8459	0.31044
66	118	3.2113	3.1695	3.1165	10.42	6.3261	4.4738	5.9461	1.8524	0.31153
67	120	3.2301	3.1919	3.1165	10.42	6.3367	4.4732	5.9473	1.8635	0.31333
68	122	3.2453	3.2138	3.1165	10.42	6.3332	4.4726	5.9477	1.8606	0.31282
69	124	3.2678	3.2344	3.1165	10.419	6.3255	4.4714	5.9479	1.8541	0.31173
70	126	3.2911	3.2546	3.1165	10.422	6.322	4.4738	5.9484	1.8483	0.31072
71	128	3.3036	3.2744	3.1165	10.422	6.315	4.4697	5.9521	1.8453	0.31003
72	130	3.3323	3.2932	3.1165	10.421	6.301	4.4714	5.9496	1.8295	0.30751
73	132	3.3565	3.313	3.1165	10.42	6.3127	4.4673	5.9523	1.8453	0.31002
74	134	3.3708	3.3332	3.1165	10.42	6.3226	4.4703	5.9494	1.8524	0.31135
75	136	3.3933	3.353	3.1165	10.42	6.3232	4.4732	5.947	1.85	0.31108
76	138	3.4076	3.3723	3.1165	10.421	6.3209	4.4743	5.9467	1.8465	0.31051
77	140	3.4255	3.3913	3.1165	10.419	6.3191	4.4732	5.9463	1.8459	0.31043
78	142	3.4506	3.4096	3.1165	10.419	6.3121	4.4708	5.9482	1.8412	0.30955
79	144	3.4659	3.4281	3.1165	10.419	6.3156	4.472	5.9472	1.8436	0.30999
80	146	3.4847	3.4466	3.1165	10.422	6.315	4.4714	5.9504	1.8436	0.30983
81	148	3.5062	3.4649	3.1165	10.42	6.3162	4.4732	5.9466	1.843	0.30992
82	150	3.5197	3.4837	3.1165	10.421	6.3179	4.4738	5.9477	1.8442	0.31007
83	152	3.5448	3.5013	3.1165	10.421	6.3144	4.4732	5.9481	1.8412	0.30955
84	154	3.5663	3.52	3.1165	10.42	6.3296	4.4714	5.9486	1.8582	0.31238
85	156	3.5806	3.539	3.1165	10.421	6.3408	4.4726	5.9486	1.8682	0.31405
86	158	3.5932	3.5577	3.1165	10.421	6.3408	4.4673	5.9539	1.8734	0.31466
87	160	3.6039	3.5741	3.1165	10.422	6.3214	4.4708	5.9508	1.8506	0.31098
88	162	3.629	3.5896	3.1165	10.422	6.3086	4.4714	5.9505	1.8371	0.30874
89	164	3.6497	3.606	3.1165	10.42	6.3103	4.4743	5.9461	1.836	0.30877
90	166	3.6604	3.6224	3.1165	10.42	6.3127	4.472	5.9476	1.8407	0.30948
91	168	3.6792	3.6386	3.1165	10.421	6.308	4.4714	5.95	1.8366	0.30867
92	170	3.6981	3.6546	3.1165	10.421	6.3109	4.4714	5.9496	1.8395	0.30918

93	172	3.7115	3.6707	3.1165	10.419	6.3156	4.4708	5.9484	1.8448	0.31013
94	174	3.7294	3.6875	3.1165	10.422	6.325	4.4673	5.9545	1.8576	0.31197
95	176	3.7438	3.7035	3.1165	10.42	6.3232	4.4738	5.9464	1.8494	0.31102
96	178	3.7563	3.7193	3.1165	10.421	6.3179	4.4679	5.9535	1.85	0.31074
97	180	3.7698	3.7339	3.1165	10.419	6.3056	4.4703	5.9489	1.8354	0.30852
98	182	3.7859	3.7478	3.1165	10.421	6.2916	4.4714	5.95	1.8202	0.30591
99	184	3.8083	3.7625	3.1165	10.42	6.2969	4.4726	5.9476	1.8243	0.30672
100	186	3.829	3.7784	3.1165	10.422	6.3121	4.4697	5.9525	1.8424	0.30952
101	188	3.8379	3.7948	3.1165	10.42	6.3261	4.4726	5.9473	1.8535	0.31166
102	190	3.8478	3.8101	3.1165	10.421	6.3203	4.4697	5.9509	1.8506	0.31098
103	192	3.8603	3.8244	3.1165	10.421	6.3074	4.4708	5.95	1.8366	0.30867
104	194	3.8774	3.838	3.1165	10.422	6.2986	4.4738	5.9481	1.8249	0.3068
105	196	3.8926	3.8521	3.1165	10.421	6.2945	4.4714	5.9497	1.8231	0.30642
106	198	3.9087	3.8655	3.1165	10.423	6.2928	4.4738	5.9488	1.819	0.30578
107	200	3.924	3.8793	3.1165	10.42	6.2933	4.472	5.948	1.8213	0.30621
108	202	3.9365	3.8931	3.1165	10.422	6.2951	4.4697	5.952	1.8254	0.30669
109	204	3.9581	3.9072	3.1165	10.42	6.2998	4.4691	5.9508	1.8307	0.30764
110	206	3.9652	3.9219	3.1165	10.42	6.3103	4.4732	5.9473	1.8371	0.3089
111	208	3.9733	3.9357	3.1165	10.422	6.2992	4.4743	5.9481	1.8249	0.3068
112	210	3.9894	3.9485	3.1165	10.42	6.2904	4.4738	5.9466	1.8167	0.30549
113	212	4.0029	3.9615	3.1165	10.421	6.2811	4.4714	5.9494	1.8096	0.30417
114	214	4.0244	3.9738	3.1165	10.42	6.2834	4.4732	5.9468	1.8102	0.3044
115	216	4.0405	3.9881	3.1165	10.421	6.301	4.4738	5.9472	1.8272	0.30724
116	218	4.0459	4.0023	3.1165	10.421	6.308	4.4697	5.9517	1.8383	0.30887
117	220	4.0549	4.0155	3.1165	10.419	6.2992	4.4703	5.9491	1.8289	0.30743
118	222	4.0674	4.0274	3.1165	10.42	6.2869	4.4738	5.9464	1.8131	0.30491
119	224	4.0818	4.0396	3.1165	10.42	6.2799	4.4697	5.9501	1.8102	0.30423
120	226	4.1015	4.0517	3.1165	10.42	6.2805	4.4714	5.9489	1.809	0.3041
121	228	4.1158	4.0651	3.1165	10.422	6.2957	4.4691	5.9531	1.8266	0.30683
122	230	4.1203	4.0781	3.1165	10.42	6.3004	4.4738	5.9467	1.8266	0.30717
123	232	4.132	4.0907	3.1165	10.422	6.2887	4.4703	5.9516	1.8184	0.30554
124	234	4.1517	4.1024	3.1165	10.422	6.2852	4.4749	5.9467	1.8102	0.30441
125	236	4.1643	4.1156	3.1165	10.422	6.2957	4.4703	5.952	1.8254	0.30669
126	238	4.175	4.1285	3.1165	10.422	6.2986	4.4703	5.9516	1.8284	0.3072
127	240	4.1876	4.1409	3.1165	10.42	6.2969	4.4726	5.9476	1.8243	0.30672
128	242	4.2037	4.1534	3.1165	10.422	6.3021	4.4726	5.9495	1.8295	0.30751
129	244	4.2118	4.1662	3.1165	10.422	6.3051	4.472	5.9497	1.833	0.30809
130	246	4.2234	4.1786	3.1165	10.421	6.3045	4.4685	5.9527	1.836	0.30843
131	248	4.2315	4.1903	3.1165	10.421	6.2974	4.4714	5.9494	1.826	0.30693
132	250	4.244	4.2015	3.1165	10.421	6.2846	4.4685	5.9526	1.8161	0.30509
133	252	4.2584	4.212	3.1165	10.424	6.2775	4.4726	5.9512	1.805	0.30329
134	254	4.2745	4.2228	3.1165	10.422	6.2793	4.4738	5.9485	1.8055	0.30353
135	256	4.2844	4.235	3.1165	10.421	6.2916	4.4708	5.9506	1.8208	0.30598
136	258	4.2969	4.2477	3.1165	10.42	6.2969	4.4738	5.9465	1.8231	0.30659
137	260	4.3059	4.2599	3.1165	10.422	6.2986	4.4726	5.9493	1.826	0.30693
138	262	4.3167	4.2713	3.1165	10.423	6.2928	4.4708	5.9517	1.8219	0.30612
139	264	4.3319	4.2826	3.1165	10.42	6.2933	4.4697	5.9504	1.8237	0.30648
140	266	4.3391	4.2935	3.1165	10.425	6.2916	4.4726	5.952	1.819	0.30561
141	268	4.3516	4.3045	3.1165	10.421	6.2846	4.472	5.9491	1.8126	0.30468
142	270	4.3615	4.3152	3.1165	10.423	6.2863	4.4714	5.9513	1.8149	0.30496
143	272	4.366	4.3258	3.1165	10.419	6.2729	4.4732	5.9462	1.7997	0.30266
144	274	4.3794	4.3356	3.1165	10.421	6.2711	4.4738	5.947	1.7973	0.30222
145	276	4.3857	4.3463	3.1165	10.421	6.2717	4.4732	5.9482	1.7985	0.30236
146	278	4.3947	4.3569	3.1165	10.424	6.2711	4.4679	5.956	1.8032	0.30275
147	280	4.4144	4.3673	3.1165	10.421	6.2717	4.4679	5.9534	1.8038	0.30298
148	282	4.4278	4.378	3.1165	10.422	6.2723	4.4726	5.9493	1.7997	0.3025
149	284	4.4422	4.3886	3.1165	10.423	6.2799	4.4738	5.9491	1.8061	0.3036
150	286	4.4547	4.3997	3.1165	10.422	6.2922	4.4714	5.9506	1.8208	0.30598
151	288	4.4619	4.4114	3.1165	10.425	6.3015	4.472	5.9526	1.8295	0.30735
152	290	4.4664	4.4225	3.1165	10.423	6.2963	4.4697	5.9531	1.8266	0.30683
153	292	4.4753	4.432	3.1165	10.42	6.2799	4.4691	5.9507	1.8108	0.3043
154	294	4.4897	4.4418	3.1165	10.421	6.2717	4.4726	5.9488	1.7991	0.30243
155	296	4.5031	4.4518	3.1165	10.424	6.2746	4.472	5.9521	1.8026	0.30285
156	298	4.5139	4.462	3.1165	10.423	6.2799	4.4714	5.9514	1.8085	0.30387
157	300	4.5238	4.4725	3.1165	10.422	6.2857	4.4685	5.9537	1.8172	0.30523
158	302	4.5327	4.4827	3.1165	10.425	6.2887	4.4738	5.9512	1.8149	0.30497
159	304	4.5426	4.4933	3.1165	10.422	6.2892	4.472	5.9504	1.8172	0.3054
160	306	4.5551	4.5035	3.1165	10.42	6.2898	4.472	5.9478	1.8178	0.30563
161	308	4.5605	4.5135	3.1165	10.421	6.2881	4.4714	5.9498	1.8167	0.30533
162	310	4.5704	4.5227	3.1165	10.42	6.2799	4.4743	5.9454	1.8055	0.30369
163	312	4.5838	4.5327	3.1165	10.422	6.2787	4.4708	5.9509	1.8079	0.3038
164	314	4.5946	4.5423	3.1165	10.423	6.2805	4.472	5.9514	1.8085	0.30387
165	316	4.6089	4.5525	3.1165	10.422	6.2892	4.4732	5.9492	1.8161	0.30526
166	318	4.6197	4.5631	3.1165	10.423	6.3033	4.4732	5.95	1.8301	0.30758
167	320	4.6322	4.5744	3.1165	10.422	6.3185	4.4726	5.9494	1.8459	0.31027
168	322	4.6367	4.5859	3.1165	10.421	6.3273	4.4703	5.9507	1.857	0.31207
169	324	4.6403	4.5963	3.1165	10.423	6.3191	4.4708	5.9517	1.8483	0.31054
170	326	4.6466	4.6053	3.1165	10.421	6.298	4.4714	5.9499	1.8266	0.307
171	328	4.6582	4.6138	3.1165	10.422	6.2793	4.472	5.9503	1.8073	0.30373
172	330	4.6717	4.6217	3.1165	10.421	6.2711	4.4726	5.9482	1.7985	0.30236
173	332	4.6806	4.6302	3.1165	10.421	6.2717	4.4703	5.9511	1.8014	0.30271
174	334	4.6878	4.6387	3.1165	10.421	6.2717	4.4738	5.9476	1.7979	0.30229
175	336	4.7013	4.6476	3.1165	10.42	6.2734	4.4703	5.9497	1.8032	0.30308
176	338	4.7147	4.6566	3.1165	10.421	6.2816	4.4738	5.9476	1.8079	0.30397
177	340	4.7192	4.6662	3.1165	10.421	6.2945	4.4743	5.9468	1.8202	0.30608
178	342	4.7299	4.6759	3.1165	10.422	6.2951	4.4738	5.9479	1.8213	0.30622
179	344	4.7434	4.6859	3.1165	10.423	6.3062	4.4703	5.9526	1.836	0.30843
180	346	4.7506	4.6962	3.1165	10.42	6.3168	4.4738	5.9466	1.843	0.30993
181	348	4.7568	4.7062	3.1165	10.42	6.3162	4.4726	5.9472	1.8436	0.30999
182	350	4.7685	4.7157	3.1165	10.423	6.3168	4.4714	5.952	1.8453	0.31004
183	352	4.7766	4.7251	3.1165	10.419	6.3156	4.4714	5.9478	1.8442	0.31006
184	354	4.7855	4.7345	3.1165	10.421	6.3138	4.4726	5.9481	1.8412	0.30955
185	356	4.7936	4.7436	3.1165	10.42	6.3103	4.4697	5.9508	1.8407	0.30931
186	358	4.7999	4.7521	3.1165	10.421	6.3039	4.4732	5.9475	1.8307	0.30781
187	360	4.8088	4.7604	3.1165	10.425	6.2922	4.4708	5.9543	1.8213	0.30589
188	362	4.8142	4.7681	3.1165	10.422	6.2787	4.4703	5.9515	1.8085	0.30387
189	364	4.8232	4.7753	3.1165	10.424	6.2717	4.4738	5.9507	1.7979	0.30214
190	366	4.8339	4.7828	3.1165	10.421	6.2711	4.4738	5.947	1.7973	0.30222
191	368	4.8528	4.7909	3.1165	10.422	6.2758	4.4726	5.9495	1.8032	0.30308
192	370	4.8644	4.8004	3.1165	10.424	6.298	4.4708	5.9536	1.8272	0.30691
193	372	4.8689	4.8105	3.1165	10.424	6.3173	4.4726	5.9514	1.8448	0.30997

194	374	4.8761	4.8205	3.1165	10.425	6.325	4.4708	5.9541	1.8541	0.3114
195	376	4.8815	4.8296	3.1165	10.424	6.3244	4.4726	5.9518	1.8518	0.31113
196	378	4.8868	4.8383	3.1165	10.42	6.3162	4.4691	5.9507	1.8471	0.3104
197	380	4.894	4.846	3.1165	10.42	6.3033	4.4732	5.9469	1.8301	0.30774
198	382	4.9012	4.8537	3.1165	10.422	6.2892	4.4726	5.9498	1.8167	0.30533
199	384	4.9137	4.8609	3.1165	10.424	6.2781	4.4708	5.9535	1.8073	0.30357
200	386	4.9254	4.8683	3.1165	10.424	6.2811	4.4726	5.9514	1.8085	0.30387
201	388	4.9343	4.8764	3.1165	10.425	6.2916	4.472	5.9526	1.8196	0.30568
202	390	4.9442	4.8847	3.1165	10.422	6.2986	4.4732	5.9487	1.8254	0.30686
203	392	4.9514	4.8937	3.1165	10.422	6.3092	4.4726	5.9499	1.8366	0.30867
204	394	4.955	4.9026	3.1165	10.421	6.3109	4.4714	5.9496	1.8395	0.30918
205	396	4.9603	4.9105	3.1165	10.425	6.3015	4.4732	5.9514	1.8284	0.30721
206	398	4.9657	4.9179	3.1165	10.423	6.2869	4.4732	5.9501	1.8137	0.30482
207	400	4.9774	4.9245	3.1165	10.422	6.2723	4.4697	5.9522	1.8026	0.30285
208	402	4.9944	4.9316	3.1165	10.424	6.2775	4.4732	5.9506	1.8044	0.30323
209	404	4.9998	4.9401	3.1165	10.423	6.2933	4.472	5.9511	1.8213	0.30605
210	406	5.0052	4.9486	3.1165	10.422	6.2992	4.4732	5.9492	1.826	0.30693
211	408	5.007	4.9567	3.1165	10.424	6.2945	4.4708	5.9534	1.8237	0.30633
212	410	5.0114	4.9637	3.1165	10.42	6.2799	4.472	5.9478	1.8079	0.30396
213	412	5.0177	4.9707	3.1165	10.421	6.2717	4.4708	5.9505	1.8009	0.30264
214	414	5.0258	4.9777	3.1165	10.421	6.2717	4.4714	5.9499	1.8003	0.30257
215	416	5.0374	4.9852	3.1165	10.424	6.2717	4.4726	5.9519	1.7991	0.30227
216	418	5.0473	4.9924	3.1165	10.424	6.2717	4.472	5.9524	1.7997	0.30234
217	420	5.0599	5.0001	3.1165	10.422	6.2758	4.4685	5.9536	1.8073	0.30356
218	422	5.0643	5.0075	3.1165	10.422	6.2822	4.4714	5.9505	1.8108	0.30431
219	424	5.0697	5.0146	3.1165	10.419	6.2828	4.4732	5.9462	1.8096	0.30433
220	426	5.0805	5.0224	3.1165	10.425	6.2852	4.4732	5.9515	1.812	0.30446
221	428	5.0921	5.0301	3.1165	10.423	6.2928	4.472	5.9506	1.8208	0.30598
222	430	5.0975	5.0388	3.1165	10.423	6.3033	4.4703	5.9529	1.833	0.30792
223	432	5.1029	5.0467	3.1165	10.42	6.3068	4.4714	5.9489	1.8354	0.30853
224	434	5.1101	5.0546	3.1165	10.424	6.308	4.4726	5.9519	1.8354	0.30837
225	436	5.1154	5.0622	3.1165	10.42	6.3033	4.4726	5.9475	1.8307	0.30781
226	438	5.1217	5.0695	3.1165	10.421	6.2945	4.472	5.9491	1.8225	0.30635
227	440	5.1289	5.0763	3.1165	10.423	6.2863	4.4714	5.9513	1.8149	0.30496
228	442	5.1361	5.0827	3.1165	10.424	6.2775	4.4679	5.9558	1.8096	0.30384
229	444	5.1396	5.0886	3.1165	10.421	6.2717	4.4714	5.9499	1.8003	0.30257
230	446	5.154	5.0954	3.1165	10.425	6.2723	4.4726	5.9524	1.7997	0.30235
231	448	5.1603	5.1022	3.1165	10.422	6.2752	4.4732	5.9484	1.802	0.30294
232	450	5.1683	5.1095	3.1165	10.425	6.2787	4.4697	5.9552	1.809	0.30378
233	452	5.1764	5.1165	3.1165	10.425	6.2822	4.4726	5.9525	1.8096	0.30401
234	454	5.18	5.1235	3.1165	10.42	6.2863	4.4703	5.9494	1.8161	0.30525
235	456	5.189	5.1301	3.1165	10.422	6.2857	4.4732	5.949	1.8126	0.30468
236	458	5.1988	5.1376	3.1165	10.421	6.291	4.4726	5.9483	1.8184	0.3057
237	460	5.2051	5.1452	3.1165	10.422	6.2992	4.4726	5.9498	1.8266	0.307
238	462	5.2114	5.1529	3.1165	10.422	6.3051	4.4714	5.9503	1.8336	0.30816
239	464	5.2176	5.1599	3.1165	10.42	6.3068	4.4726	5.9477	1.8342	0.30839
240	466	5.2212	5.1669	3.1165	10.42	6.3027	4.4732	5.9464	1.8295	0.30767
241	468	5.2293	5.174	3.1165	10.421	6.2945	4.4714	5.9497	1.8231	0.30642
242	470	5.2374	5.1808	3.1165	10.421	6.291	4.4685	5.9524	1.8225	0.30618
243	472	5.2436	5.1872	3.1165	10.421	6.2881	4.4697	5.9516	1.8184	0.30553
244	474	5.2463	5.1938	3.1165	10.42	6.2799	4.4679	5.9518	1.812	0.30444
245	476	5.2526	5.1995	3.1165	10.421	6.2717	4.472	5.9493	1.7997	0.3025
246	478	5.2607	5.2057	3.1165	10.421	6.2711	4.4714	5.9494	1.7997	0.3025
247	480	5.2696	5.2116	3.1165	10.421	6.2711	4.4732	5.9476	1.7979	0.30229
248	482	5.2777	5.218	3.1165	10.421	6.2711	4.4726	5.9482	1.7985	0.30236
249	484	5.2849	5.2246	3.1165	10.422	6.2752	4.4726	5.949	1.8026	0.30301
250	486	5.2956	5.2319	3.1165	10.425	6.2822	4.4685	5.9566	1.8137	0.30449
251	488	5.301	5.2389	3.1165	10.419	6.2928	4.4697	5.9498	1.8231	0.30641
252	490	5.3073	5.2459	3.1165	10.424	6.301	4.472	5.9521	1.829	0.30728
253	492	5.3118	5.2531	3.1165	10.421	6.3039	4.4679	5.9527	1.836	0.30843
254	494	5.3172	5.2602	3.1165	10.424	6.3045	4.4732	5.9511	1.8313	0.30772
255	496	5.3234	5.2668	3.1165	10.42	6.3004	4.4703	5.9502	1.8301	0.30757
256	498	5.3333	5.2729	3.1165	10.42	6.3004	4.4726	5.9478	1.8278	0.3073
257	500	5.3405	5.2797	3.1165	10.426	6.3062	4.472	5.9539	1.8342	0.30807
258	502	5.3449	5.2863	3.1165	10.425	6.3051	4.472	5.9528	1.833	0.30793
259	504	5.353	5.2934	3.1165	10.42	6.3068	4.4714	5.9489	1.8354	0.30853
260	506	5.3611	5.2998	3.1165	10.422	6.3086	4.4726	5.9493	1.836	0.3086
261	508	5.3665	5.3068	3.1165	10.423	6.3132	4.4714	5.9518	1.8418	0.30946
262	510	5.3736	5.3136	3.1165	10.42	6.3168	4.472	5.9483	1.8448	0.31013
263	512	5.3781	5.3206	3.1165	10.42	6.3168	4.4667	5.9536	1.85	0.31074
264	514	5.3862	5.327	3.1165	10.423	6.3127	4.4726	5.9501	1.8401	0.30925
265	516	5.3916	5.3334	3.1165	10.422	6.3121	4.4726	5.9495	1.8395	0.30918
266	518	5.396	5.3393	3.1165	10.424	6.3074	4.4743	5.9496	1.833	0.3081
267	520	5.3996	5.3451	3.1165	10.422	6.2986	4.4732	5.9487	1.8254	0.30686
268	522	5.4041	5.3506	3.1165	10.422	6.2852	4.4714	5.9502	1.8137	0.30482
269	524	5.4158	5.3562	3.1165	10.423	6.2828	4.4679	5.9546	1.8149	0.30479
270	526	5.4265	5.3619	3.1165	10.421	6.2881	4.4714	5.9498	1.8167	0.30533
271	528	5.4337	5.3683	3.1165	10.426	6.2998	4.4726	5.9535	1.8272	0.30691
272	530	5.4382	5.3749	3.1165	10.42	6.3097	4.4726	5.9473	1.8371	0.3089
273	532	5.4436	5.3819	3.1165	10.42	6.3162	4.4697	5.9501	1.8465	0.31033
274	534	5.4471	5.3885	3.1165	10.424	6.3173	4.4726	5.9514	1.8448	0.30997
275	536	5.4534	5.3951	3.1165	10.424	6.3144	4.4714	5.9529	1.843	0.3096
276	538	5.4579	5.4011	3.1165	10.425	6.3086	4.4708	5.9542	1.8377	0.30864
277	540	5.4597	5.4066	3.1165	10.424	6.298	4.4726	5.9518	1.8254	0.3067
278	542	5.4669	5.4115	3.1165	10.419	6.2828	4.472	5.9474	1.8108	0.30447
279	544	5.4758	5.4162	3.1165	10.423	6.277	4.4732	5.95	1.8038	0.30315
280	546	5.4848	5.4219	3.1165	10.425	6.2793	4.4703	5.9552	1.809	0.30378
281	548	5.4884	5.4275	3.1165	10.42	6.2834	4.4708	5.9491	1.8126	0.30468
282	550	5.4947	5.433	3.1165	10.423	6.2863	4.4714	5.9513	1.8149	0.30496
283	552	5.5018	5.4387	3.1165	10.422	6.2922	4.472	5.95	1.8202	0.30591
284	554	5.509	5.4447	3.1165	10.421	6.298	4.4679	5.9534	1.8301	0.30741
285	556	5.5144	5.4509	3.1165	10.42	6.3068	4.4726	5.9477	1.8342	0.30839
286	558	5.5207	5.4575	3.1165	10.421	6.3138	4.4726	5.9481	1.8412	0.30955
287	560	5.5269	5.4636	3.1165	10.423	6.3197	4.4714	5.9517	1.8483	0.31055
288	562	5.535	5.4702	3.1165	10.424	6.3302	4.4714	5.9523	1.8588	0.31228
289	564	5.5377	5.477	3.1165	10.421	6.3337	4.472	5.9488	1.8617	0.31296
290	566	5.5395	5.4832	3.1165	10.422	6.3279	4.472	5.9495	1.8559	0.31194
291	568	5.544	5.4888	3.1165	10.425	6.315	4.472	5.9529	1.843	0.3096
292	570	5.5502	5.4939	3.1165	10.423	6.3033	4.472	5.9512	1.8313	0.30772
293	572	5.5574	5.499	3.1165	10.42	6.2963	4.4726	5.9471	1.8237	0.30665
294	574	5.5646	5.5034	3.1165	10.425	6.2916	4.4714	5.9531	1.8202	0.30575

295	576	5.5745	5.509	3.1165	10.423	6.2969	4.4703	5.9531	1.8266	0.30683
296	578	5.578	5.5147	3.1165	10.423	6.3027	4.4691	5.9535	1.8336	0.30799
297	580	5.5825	5.5202	3.1165	10.42	6.3062	4.4697	5.9501	1.8366	0.30866
298	582	5.5852	5.5256	3.1165	10.421	6.3039	4.4708	5.9498	1.833	0.30809
299	584	5.5906	5.5307	3.1165	10.42	6.2998	4.4732	5.9467	1.8266	0.30716
300	586	5.596	5.5358	3.1165	10.425	6.2957	4.472	5.9533	1.8237	0.30633
301	588	5.6022	5.5409	3.1165	10.425	6.2916	4.472	5.9526	1.8196	0.30568
302	590	5.6076	5.5462	3.1165	10.424	6.291	4.472	5.952	1.819	0.30561
303	592	5.6121	5.5511	3.1165	10.42	6.2898	4.4726	5.9472	1.8172	0.30556
304	594	5.6184	5.556	3.1165	10.422	6.2887	4.4726	5.9492	1.8161	0.30526
305	596	5.6238	5.5611	3.1165	10.42	6.2898	4.4726	5.9472	1.8172	0.30556
306	598	5.6318	5.5666	3.1165	10.421	6.2939	4.4697	5.9509	1.8243	0.30655
307	600	5.6372	5.5718	3.1165	10.422	6.3015	4.472	5.9495	1.8295	0.30751
308	602	5.6426	5.5777	3.1165	10.421	6.308	4.4726	5.9488	1.8354	0.30853
309	604	5.6453	5.583	3.1165	10.424	6.3109	4.472	5.9521	1.8389	0.30895
310	606	5.6516	5.589	3.1165	10.423	6.3132	4.4726	5.9506	1.8407	0.30932
311	608	5.6578	5.5945	3.1165	10.422	6.315	4.4732	5.9486	1.8418	0.30962
312	610	5.6596	5.5998	3.1165	10.423	6.3132	4.4726	5.9506	1.8407	0.30932
313	612	5.6632	5.605	3.1165	10.422	6.3056	4.4708	5.9514	1.8348	0.3083
314	614	5.6668	5.6094	3.1165	10.422	6.2951	4.4726	5.9491	1.8225	0.30635
315	616	5.6722	5.6137	3.1165	10.422	6.2857	4.4726	5.9496	1.8131	0.30475
316	618	5.6767	5.6179	3.1165	10.42	6.2764	4.4708	5.9487	1.8055	0.30352
317	620	5.6847	5.6222	3.1165	10.422	6.2723	4.4708	5.9511	1.8014	0.30271
318	622	5.6928	5.6265	3.1165	10.423	6.2764	4.4726	5.9501	1.8038	0.30315
319	624	5.6991	5.6311	3.1165	10.422	6.2852	4.4697	5.9519	1.8155	0.30502
320	626	5.7071	5.6369	3.1165	10.423	6.2998	4.472	5.951	1.8278	0.30714
321	628	5.7098	5.6428	3.1165	10.424	6.3138	4.4714	5.9524	1.8424	0.30953
322	630	5.7152	5.6484	3.1165	10.426	6.3226	4.4732	5.9527	1.8494	0.31069
323	632	5.7197	5.6545	3.1165	10.422	6.3285	4.4726	5.9495	1.8559	0.31194
324	634	5.7251	5.6601	3.1165	10.425	6.3314	4.4726	5.9522	1.8588	0.31229
325	636	5.7313	5.6658	3.1165	10.42	6.3367	4.472	5.9485	1.8647	0.31347
326	638	5.7349	5.6716	3.1165	10.423	6.339	4.4714	5.9512	1.8676	0.31381
327	640	5.7367	5.6773	3.1165	10.425	6.3349	4.4714	5.9536	1.8635	0.313
328	642	5.7412	5.6822	3.1165	10.423	6.3261	4.4714	5.9515	1.8547	0.31164
329	644	5.7466	5.6867	3.1165	10.421	6.3173	4.472	5.9489	1.8453	0.3102
330	646	5.7511	5.6914	3.1165	10.42	6.3103	4.4714	5.9491	1.8389	0.30911
331	648	5.7555	5.6956	3.1165	10.42	6.3004	4.472	5.9484	1.8284	0.30737
332	650	5.7618	5.6995	3.1165	10.421	6.2939	4.472	5.9486	1.8219	0.30628
333	652	5.7681	5.7035	3.1165	10.422	6.2922	4.472	5.95	1.8202	0.30591
334	654	5.7753	5.7082	3.1165	10.425	6.2986	4.472	5.953	1.8266	0.30684
335	656	5.778	5.7131	3.1165	10.424	6.3039	4.472	5.9517	1.8319	0.30779
336	658	5.7806	5.718	3.1165	10.421	6.3039	4.4697	5.951	1.8342	0.30822
337	660	5.7878	5.7222	3.1165	10.422	6.3051	4.472	5.9497	1.833	0.30809
338	662	5.7914	5.7271	3.1165	10.423	6.3097	4.472	5.951	1.8377	0.30881
339	664	5.7959	5.7318	3.1165	10.422	6.3092	4.4708	5.9516	1.8383	0.30888
340	666	5.7995	5.7365	3.1165	10.425	6.3086	4.4726	5.9524	1.836	0.30844
341	668	5.8022	5.7412	3.1165	10.424	6.3039	4.4685	5.9552	1.8354	0.3082
342	670	5.8084	5.7456	3.1165	10.426	6.2992	4.4673	5.9582	1.8319	0.30745
343	672	5.8138	5.7497	3.1165	10.422	6.2986	4.472	5.9499	1.8266	0.307
344	674	5.8201	5.7544	3.1165	10.42	6.3004	4.4697	5.9508	1.8307	0.30764
345	676	5.8255	5.7588	3.1165	10.423	6.3068	4.4726	5.9508	1.8342	0.30823
346	678	5.8309	5.7635	3.1165	10.423	6.3132	4.4749	5.9483	1.8383	0.30905
347	680	5.8389	5.7691	3.1165	10.425	6.3214	4.4714	5.9533	1.85	0.31075
348	682	5.8416	5.7742	3.1165	10.422	6.3314	4.4714	5.9503	1.86	0.31259
349	684	5.8443	5.7793	3.1165	10.422	6.3355	4.4732	5.9493	1.8623	0.31303
350	686	5.847	5.7848	3.1165	10.423	6.3332	4.4673	5.956	1.8658	0.31327
351	688	5.8497	5.7891	3.1165	10.424	6.3273	4.472	5.952	1.8553	0.31171
352	690	5.8524	5.7933	3.1165	10.425	6.3179	4.4714	5.9531	1.8465	0.31018
353	692	5.8577	5.7969	3.1165	10.422	6.3092	4.4726	5.9499	1.8366	0.30867
354	694	5.8622	5.801	3.1165	10.424	6.301	4.4703	5.9538	1.8307	0.30748
355	696	5.8685	5.8048	3.1165	10.424	6.2974	4.4714	5.9525	1.826	0.30677
356	698	5.8712	5.8084	3.1165	10.424	6.2939	4.4726	5.9511	1.8213	0.30605
357	700	5.8757	5.8123	3.1165	10.423	6.2898	4.472	5.9509	1.8178	0.30547
358	702	5.8811	5.8159	3.1165	10.419	6.2892	4.4697	5.9496	1.8196	0.30583
359	704	5.8882	5.8201	3.1165	10.422	6.2951	4.4732	5.9485	1.8219	0.30628
360	706	5.8918	5.8244	3.1165	10.425	6.3015	4.4697	5.955	1.8319	0.30762
361	708	5.8981	5.8291	3.1165	10.422	6.3092	4.4714	5.9511	1.8377	0.30881
362	710	5.9008	5.8335	3.1165	10.425	6.3156	4.4726	5.9528	1.843	0.3096
363	712	5.9053	5.8382	3.1165	10.423	6.3197	4.4732	5.9499	1.8465	0.31034
364	714	5.9097	5.8431	3.1165	10.426	6.3226	4.4732	5.9527	1.8494	0.31069
365	716	5.9133	5.8478	3.1165	10.425	6.325	4.4732	5.9518	1.8518	0.31113
366	718	5.9178	5.8527	3.1165	10.423	6.3261	4.4703	5.9527	1.8559	0.31177
367	720	5.9205	5.8567	3.1165	10.424	6.3238	4.4703	5.9536	1.8535	0.31133
368	722	5.9232	5.8608	3.1165	10.425	6.3185	4.4726	5.9525	1.8459	0.31011
369	724	5.9277	5.8653	3.1165	10.423	6.3127	4.4726	5.9501	1.8401	0.30925
370	726	5.9313	5.8684	3.1165	10.422	6.3051	4.4743	5.9474	1.8307	0.30782
371	728	5.9348	5.8721	3.1165	10.422	6.2992	4.472	5.9504	1.8272	0.30707
372	730	5.9393	5.8759	3.1165	10.424	6.2939	4.472	5.9517	1.8219	0.30612
373	732	5.9456	5.8795	3.1165	10.423	6.2933	4.472	5.9511	1.8213	0.30605
374	734	5.951	5.8836	3.1165	10.425	6.2957	4.472	5.9533	1.8237	0.30633
375	736	5.9555	5.887	3.1165	10.424	6.3004	4.4726	5.9509	1.8278	0.30714
376	738	5.9599	5.8914	3.1165	10.423	6.3068	4.472	5.9514	1.8348	0.3083
377	740	5.9653	5.8959	3.1165	10.422	6.315	4.4703	5.9515	1.8448	0.30996
378	742	5.9707	5.9006	3.1165	10.425	6.3255	4.4726	5.9529	1.853	0.31127
379	744	5.9725	5.9055	3.1165	10.425	6.332	4.472	5.9533	1.86	0.31243
380	746	5.9761	5.9102	3.1165	10.423	6.3332	4.4691	5.9543	1.8641	0.31306
381	748	5.9815	5.9146	3.1165	10.424	6.3367	4.4708	5.9527	1.8658	0.31344
382	750	5.9868	5.9189	3.1165	10.424	6.3402	4.4726	5.9512	1.8676	0.31382
383	752	5.9904	5.9236	3.1165	10.424	6.3437	4.4732	5.9508	1.8705	0.31433
384	754	5.994	5.9285	3.1165	10.424	6.3437	4.4673	5.9566	1.8764	0.315
385	756	6.0012	5.9329	3.1165	10.426	6.3454	4.4703	5.9554	1.8752	0.31487
386	758	6.003	5.937	3.1165	10.422	6.3478	4.4726	5.949	1.8752	0.31521
387	760	6.003	5.9414	3.1165	10.425	6.3419	4.472	5.9534	1.8699	0.31409
388	762	6.0021	5.9449	3.1165	10.424	6.3273	4.4726	5.9515	1.8547	0.31164
389	764	6.0057	5.948	3.1165	10.423	6.3068	4.472	5.9514	1.8348	0.3083
390	766	6.0146	5.9502	3.1165	10.423	6.2928	4.4755	5.9471	1.8172	0.30557
391	768	6.0191	5.9534	3.1165	10.422	6.2892	4.472	5.9504	1.8172	0.3054
392	770	6.0236	5.9566	3.1165	10.423	6.2904	4.472	5.9515	1.8184	0.30554
393	772	6.0281	5.9597	3.1165	10.425	6.2922	4.4691	5.956	1.8231	0.30609
394	774	6.0335	5.9636	3.1165	10.424	6.298	4.4726	5.9518	1.8254	0.3067
395	776	6.0361	5.9672	3.1165	10.423	6.3068	4.4743	5.949	1.8325	0.30803

396	778	6.0388	5.9715	3.1165	10.426	6.3127	4.472	5.9538	1.8407	0.30916
397	780	6.0424	5.9751	3.1165	10.423	6.3132	4.4726	5.9506	1.8407	0.30932
398	782	6.0451	5.9793	3.1165	10.422	6.3121	4.4708	5.9513	1.8412	0.30938
399	784	6.0496	5.9829	3.1165	10.425	6.3115	4.4726	5.9521	1.8389	0.30895
400	786	6.0541	5.9868	3.1165	10.423	6.3127	4.472	5.9507	1.8407	0.30932
401	788	6.0577	5.9906	3.1165	10.421	6.3144	4.4685	5.9527	1.8459	0.3101
402	790	6.0595	5.9944	3.1165	10.424	6.3144	4.4703	5.9541	1.8442	0.30973
403	792	6.063	5.9983	3.1165	10.424	6.3103	4.4708	5.9527	1.8395	0.30901
404	794	6.0693	6.0017	3.1165	10.423	6.3097	4.4732	5.9499	1.8366	0.30867
405	796	6.0747	6.0055	3.1165	10.424	6.3144	4.472	5.9523	1.8424	0.30953
406	798	6.0801	6.0093	3.1165	10.425	6.322	4.472	5.9533	1.85	0.31076
407	800	6.081	6.0136	3.1165	10.421	6.3273	4.472	5.9489	1.8553	0.31187
408	801.4	6.0837	6.0168	3.1165	10.425	6.3279	4.4708	5.9538	1.857	0.31191

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	4.3409	4.3435	4.2719	0.068989	0.071544	1.037
2	0.012567	0	0	3.1165	4.3409	4.3435	4.2719	0.068989	0.071544	1.037
3	0.050133	0	0	3.1165	4.3409	4.3435	4.2719	0.068989	0.071544	1.037
4	0.1002	0	0	3.1165	4.3435	4.3429	4.2719	0.071538	0.070959	0.9919
5	0.25042	0.0008965	-0.00021283	3.1165	4.3533	4.3435	4.2725	0.080801	0.070959	0.87819
6	0.5008	0.007172	0.002554	3.1165	4.3657	4.3435	4.2731	0.092613	0.070374	0.75987
7	1.0015	0.008965	0.0093647	3.1165	4.3705	4.3452	4.2725	0.097948	0.072715	0.74239
8	2.0029	0.010758	0.011919	3.1165	4.3699	4.3446	4.2719	0.097983	0.072715	0.74212
9	4.0016	0.011655	0.012344	3.1165	4.3699	4.3446	4.2719	0.097983	0.072715	0.74212
10	6.0003	0.012551	0.013196	3.1165	4.3674	4.3452	4.2719	0.095434	0.0733	0.76807
11	8.0032	0.012551	0.012344	3.1165	4.371	4.3458	4.2719	0.099083	0.073886	0.74569
12	10.002	0.013448	0.011919	3.1165	4.371	4.3458	4.2719	0.099083	0.073886	0.74569
13	12.001	0.012551	0.01277	3.1165	4.369	4.347	4.2719	0.097085	0.075056	0.7731
14	12.585	0.012551	0.01277	3.1165	4.369	4.347	4.2719	0.097085	0.075056	0.7731

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	4.369	4.347	4.2719	0.097085	0.075056	0.7731
2	0.012483	−0.0008965	0	3.1165	4.369	4.347	4.2719	0.097085	0.075056	0.7731
3	0.05415	−0.0008965	0	3.1165	4.369	4.347	4.2719	0.097085	0.075056	0.7731
4	0.10012	−0.0008965	0	3.1165	4.369	4.347	4.2719	0.097085	0.075056	0.7731
5	0.25033	0.0026895	0.0006385	3.1165	4.3814	4.347	4.2725	0.1089	0.074471	0.68387
6	0.50072	0.013448	0.003831	3.1165	4.4	4.347	4.2743	0.12574	0.072716	0.57832
7	1.0014	0.033171	0.028732	3.1165	4.427	4.3493	4.2731	0.1539	0.076228	0.4953
8	2.0028	0.20709	0.20964	3.1165	4.5009	4.3587	4.2743	0.22662	0.084424	0.37253
9	4.0016	0.30481	0.30946	3.1165	4.5186	4.361	4.2725	0.24607	0.08852	0.35973
10	6.0003	0.32453	0.32329	3.1165	4.5169	4.3593	4.2725	0.24442	0.086764	0.35498
11	8.0031	0.34426	0.345	3.1165	4.5202	4.3628	4.2719	0.24831	0.090861	0.36592
12	10.002	0.34605	0.34628	3.1165	4.5191	4.3616	4.2719	0.24721	0.089691	0.36282
13	12.001	0.34784	0.34883	3.1165	4.5186	4.361	4.2719	0.24666	0.089105	0.36125
14	14.003	0.34964	0.35288	3.1165	4.5175	4.3599	4.2719	0.24556	0.087934	0.3581
15	16.002	0.35233	0.35266	3.1165	4.5195	4.3587	4.2719	0.24755	0.086764	0.35048
16	18.001	0.3586	0.35905	3.1165	4.5175	4.3599	4.2719	0.24556	0.087934	0.3581
17	20.004	0.36488	0.36501	3.1165	4.5217	4.361	4.2725	0.24917	0.08852	0.35526
18	20.129	0.36488	0.36543	3.1165	4.5186	4.361	4.2725	0.24607	0.08852	0.35973

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	4.5217	4.361	4.2725	0.24917	0.08852	0.35526
2	0.012483	0	0.00021283	3.1165	4.518	4.3604	4.2719	0.24611	0.08852	0.35968
3	0.05415	0	0.00021283	3.1165	4.518	4.3604	4.2719	0.24611	0.08852	0.35968
4	0.10012	0.0008965	0.00021283	3.1165	4.5211	4.3604	4.2725	0.24862	0.087935	0.35369
5	0.25033	0.012551	0.002554	3.1165	4.5299	4.3599	4.2743	0.25561	0.085594	0.33486
6	0.50063	0.046618	0.025753	3.1165	4.545	4.3628	4.2743	0.27076	0.088521	0.32693
7	1.0014	0.12999	0.11727	3.1165	4.5797	4.3733	4.2737	0.30605	0.099643	0.32558
8	2.0028	0.31288	0.32053	3.1165	4.6434	4.385	4.2725	0.37091	0.11252	0.30336
9	4.0016	0.67417	0.74066	3.1165	4.7638	4.4207	4.2749	0.48892	0.14589	0.29839
10	6.0003	0.73244	0.81643	3.1165	4.7658	4.4196	4.2731	0.49267	0.14647	0.2973
11	8.0031	0.76741	0.85303	3.1165	4.7669	4.4207	4.2731	0.49377	0.14764	0.29901
12	10.002	0.79789	0.87943	3.1165	4.7674	4.4213	4.2725	0.49491	0.14881	0.30069
13	12.001	0.81851	0.89879	3.1165	4.7674	4.4213	4.2719	0.49549	0.1494	0.30152
14	14.003	0.82926	0.91412	3.1165	4.768	4.4219	4.2725	0.49546	0.1494	0.30154
15	16.002	0.83554	0.9271	3.1165	4.7674	4.4213	4.2719	0.49549	0.1494	0.30152
16	18.001	0.85078	0.93859	3.1165	4.768	4.4219	4.2725	0.49546	0.1494	0.30154
17	20.004	0.86692	0.94945	3.1165	4.768	4.4219	4.2725	0.49546	0.1494	0.30154
18	22.003	0.8723	0.9586	3.1165	4.7674	4.4213	4.2719	0.49549	0.1494	0.30152
19	24.002	0.87947	0.96669	3.1165	4.7674	4.4213	4.2725	0.49491	0.14881	0.30069
20	26	0.88395	0.97414	3.1165	4.7674	4.4213	4.2719	0.49549	0.1494	0.30152
21	28.003	0.89023	0.98073	3.1165	4.768	4.4219	4.2719	0.49604	0.14998	0.30236
22	28.346	0.89112	0.98201	3.1165	4.7674	4.4213	4.2719	0.49549	0.1494	0.30152

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	4.7674	4.4213	4.2719	0.49549	0.1494	0.30152
2	0.012533	0	0	3.1165	4.768	4.4219	4.2719	0.49604	0.14998	0.30236
3	0.050017	0.0008965	0	3.1165	4.7674	4.4213	4.2719	0.49549	0.1494	0.30152
4	0.1001	0.0008965	0	3.1165	4.768	4.4219	4.2725	0.49546	0.1494	0.30154
5	0.25038	0.0062755	0.0027668	3.1165	4.7764	4.4243	4.2749	0.50152	0.1494	0.2979
6	0.50068	0.029585	0.029584	3.1165	4.7901	4.4289	4.2743	0.5158	0.15467	0.29986
7	1.0014	0.09234	0.099393	3.1165	4.8253	4.4401	4.2749	0.55047	0.16521	0.30012
8	2.0028	0.2295	0.27306	3.1165	4.902	4.4623	4.2737	0.62834	0.18862	0.30019
9	4.0015	0.55852	0.66319	3.1165	5.0448	4.5021	4.2772	0.76762	0.22491	0.293
10	6.0003	0.8983	1.0744	3.1165	5.1785	4.5454	4.2749	0.90366	0.27057	0.29942
11	8.0031	1.1708	1.3883	3.1165	5.2636	4.57	4.276	0.98759	0.29399	0.29768
12	10.002	1.2434	1.4777	3.1165	5.2636	4.57	4.2737	0.98993	0.29633	0.29934
13	12.001	1.2883	1.5315	3.1165	5.2642	4.5706	4.2737	0.99048	0.29691	0.29977
14	14.004	1.3304	1.5728	3.1165	5.2642	4.5706	4.2725	0.99165	0.29808	0.30059
15	16.003	1.3519	1.6063	3.1165	5.2616	4.5712	4.2719	0.98969	0.29925	0.30237
16	18.001	1.3797	1.6339	3.1165	5.2647	4.5712	4.2731	0.99162	0.29808	0.3006
17	20	1.403	1.6584	3.1165	5.2647	4.5712	4.2731	0.99162	0.29808	0.3006
18	22.003	1.4156	1.6799	3.1165	5.2647	4.5712	4.2731	0.99162	0.29808	0.3006
19	24.002	1.4317	1.6995	3.1165	5.2664	4.5729	4.2725	0.99385	0.30043	0.30228
20	26	1.4487	1.7165	3.1165	5.2647	4.5712	4.2719	0.99279	0.29925	0.30143
21	28.003	1.4712	1.732	3.1165	5.2647	4.5712	4.2725	0.9922	0.29867	0.30102
22	30.002	1.4801	1.7467	3.1165	5.2658	4.5723	4.2725	0.9933	0.29984	0.30186
23	32.001	1.4936	1.7612	3.1165	5.2678	4.5712	4.2719	0.99589	0.29925	0.30049
24	34.004	1.5061	1.7742	3.1165	5.2653	4.5718	4.2725	0.99275	0.29925	0.30144
25	36.002	1.5169	1.7861	3.1165	5.2653	4.5718	4.2725	0.99275	0.29925	0.30144
26	38.001	1.5294	1.7974	3.1165	5.2647	4.5712	4.2719	0.99279	0.29925	0.30143
27	40.004	1.5429	1.8087	3.1165	5.2653	4.5718	4.2719	0.99334	0.29984	0.30185
28	42.003	1.5527	1.8195	3.1165	5.2647	4.5712	4.2719	0.99279	0.29925	0.30143
29	44.001	1.5635	1.8297	3.1165	5.2647	4.5712	4.2719	0.99279	0.29925	0.30143
30	44.803	1.5707	1.8336	3.1165	5.2647	4.5712	4.2719	0.99279	0.29925	0.30143

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	5.2678	4.5712	4.2719	0.99589	0.29925	0.30049
2	0.0125	0	0	3.1165	5.2678	4.5712	4.2719	0.99589	0.29925	0.30049
3	0.054167	0.0008965	0.00021283	3.1165	5.2647	4.5712	4.2719	0.99279	0.29925	0.30143
4	0.10012	0.0008965	0.0006385	3.1165	5.2689	4.5723	4.2713	0.99757	0.30101	0.30174
5	0.25035	0.0062755	0.005108	3.1165	5.2742	4.5747	4.2749	0.99936	0.29984	0.30003
6	0.50072	0.017034	0.022135	3.1165	5.2916	4.58	4.2754	1.0161	0.30452	0.29969
7	1.0014	0.055583	0.073427	3.1165	5.3319	4.5899	4.2754	1.0565	0.31448	0.29766
8	2.0028	0.16047	0.189	3.1165	5.3971	4.6098	4.2749	1.1223	0.33496	0.29847
9	4.0016	0.40074	0.46461	3.1165	5.537	4.6531	4.2737	1.2633	0.37945	0.30036
10	6.0003	0.66879	0.77897	3.1165	5.6888	4.6959	4.276	1.4127	0.41984	0.29718
11	8.0031	0.88754	1.0316	3.1165	5.7609	4.7199	4.2737	1.4872	0.44618	0.30001
12	10.002	0.95836	1.1206	3.1165	5.7626	4.7216	4.2737	1.4889	0.44794	0.30086
13	12.001	1.0157	1.1797	3.1165	5.7604	4.7193	4.2743	1.4861	0.44501	0.29945
14	14.004	1.0552	1.2253	3.1165	5.7615	4.7204	4.2725	1.4889	0.44794	0.30084
15	16.003	1.0857	1.2623	3.1165	5.7615	4.7204	4.2737	1.4878	0.44677	0.30029
16	18.001	1.1179	1.2951	3.1165	5.7615	4.7204	4.2731	1.4884	0.44735	0.30057
17	20	1.1377	1.324	3.1165	5.762	4.721	4.2731	1.4889	0.44794	0.30085
18	22.003	1.1663	1.3504	3.1165	5.762	4.721	4.2731	1.4889	0.44794	0.30085
19	24.002	1.1923	1.3738	3.1165	5.7615	4.7204	4.2725	1.4889	0.44794	0.30084
20	26	1.2103	1.3953	3.1165	5.762	4.721	4.2731	1.4889	0.44794	0.30085
21	28.003	1.2219	1.4149	3.1165	5.762	4.721	4.2731	1.4889	0.44794	0.30085
22	30.002	1.2408	1.4336	3.1165	5.7626	4.7216	4.2731	1.4895	0.44853	0.30113
23	32.001	1.2551	1.4511	3.1165	5.762	4.721	4.2731	1.4889	0.44794	0.30085
24	34.003	1.2784	1.4677	3.1165	5.762	4.721	4.2725	1.4895	0.44852	0.30112
25	36.002	1.2972	1.4828	3.1165	5.7626	4.7216	4.2731	1.4895	0.44853	0.30113
26	38.001	1.3071	1.4977	3.1165	5.7651	4.721	4.2725	1.4926	0.44852	0.3005
27	40.004	1.3188	1.5122	3.1165	5.762	4.721	4.2725	1.4895	0.44852	0.30112
28	42.002	1.3304	1.5264	3.1165	5.762	4.721	4.2719	1.4901	0.44911	0.3014
29	44.001	1.3537	1.5388	3.1165	5.762	4.721	4.2719	1.4901	0.44911	0.3014
30	46.004	1.36	1.5509	3.1165	5.762	4.721	4.2719	1.4901	0.44911	0.3014
31	48.003	1.3645	1.5624	3.1165	5.7615	4.7204	4.2725	1.4889	0.44794	0.30084
32	50.001	1.3681	1.5711	3.1165	5.7595	4.7216	4.2725	1.487	0.44911	0.30203
33	52	1.377	1.5824	3.1165	5.7595	4.7216	4.2702	1.4893	0.45145	0.30313
34	54.003	1.3878	1.5926	3.1165	5.762	4.721	4.2719	1.4901	0.44911	0.3014
35	56.002	1.3985	1.6026	3.1165	5.7589	4.721	4.2719	1.487	0.44911	0.30203
36	58	1.4084	1.6126	3.1165	5.7595	4.7216	4.2725	1.487	0.44911	0.30203
37	60.003	1.4156	1.6231	3.1165	5.7595	4.7216	4.2719	1.4875	0.4497	0.30231
38	62.002	1.4263	1.6329	3.1165	5.7595	4.7216	4.2725	1.487	0.44911	0.30203
39	64.001	1.4308	1.642	3.1165	5.762	4.721	4.2719	1.4901	0.44911	0.3014
40	66.004	1.4353	1.6509	3.1165	5.7595	4.7216	4.2719	1.4875	0.4497	0.30231
41	68.002	1.4487	1.6592	3.1165	5.7595	4.7216	4.2725	1.487	0.44911	0.30203
42	70.001	1.4622	1.6675	3.1165	5.7595	4.7216	4.2725	1.487	0.44911	0.30203
43	72.004	1.4747	1.6765	3.1165	5.7595	4.7216	4.2719	1.4875	0.4497	0.30231
44	74.003	1.4819	1.6846	3.1165	5.7595	4.7216	4.2719	1.4875	0.4497	0.30231
45	76.001	1.4864	1.6918	3.1165	5.762	4.721	4.2713	1.4907	0.44969	0.30167
46	78	1.4918	1.6988	3.1165	5.7626	4.7216	4.2725	1.49	0.44911	0.30141
47	79.84	1.4972	1.7054	3.1165	5.762	4.721	4.2713	1.4907	0.44969	0.30167

TRIAXIAL TEST

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	5.7589	4.721	4.2719	1.487	0.44911	0.30203
2	0.01245	0	0	3.1165	5.7595	4.7216	4.2719	1.4875	0.4497	0.30231
3	0.05	0	0	3.1165	5.7589	4.721	4.2719	1.487	0.44911	0.30203
4	0.1	0	0.00021283	3.1165	5.7589	4.721	4.2719	1.487	0.44911	0.30203
5	0.25023	0.0044825	0.0021283	3.1165	5.7673	4.7234	4.2737	1.4936	0.4497	0.30108
6	0.50067	0.019723	0.013621	3.1165	5.7841	4.7281	4.2743	1.5098	0.45379	0.30056
7	1.0013	0.048411	0.0481	3.1165	5.8188	4.7386	4.2754	1.5434	0.46316	0.3001
8	2.0028	0.12551	0.13515	3.1165	5.8902	4.7585	4.2737	1.6165	0.48482	0.29991
9	4.0015	0.30481	0.33862	3.1165	6.0374	4.803	4.2743	1.7631	0.52872	0.29987
10	6.0002	0.52176	0.57529	3.1165	6.1731	4.8451	4.276	1.8971	0.56911	0.29999
11	8.003	0.75754	0.83643	3.1165	6.3198	4.889	4.2772	2.0426	0.61185	0.29955
12	10.002	1.013	1.1138	3.1165	6.4549	4.9306	4.2743	2.1806	0.65633	0.30098
13	12.001	1.2757	1.4109	3.1165	6.6078	4.9745	4.2737	2.3341	0.70082	0.30026
14	14.003	1.5518	1.711	3.1165	6.7415	5.0178	4.2737	2.4678	0.74414	0.30154
15	16.002	1.7159	1.884	3.1165	6.7499	5.0202	4.2754	2.4744	0.74473	0.30097
16	18.001	1.8047	1.9855	3.1165	6.7499	5.0202	4.2749	2.475	0.74531	0.30114
17	20.004	1.8791	2.0624	3.1165	6.7499	5.0202	4.2743	2.4756	0.7459	0.3013
18	22.003	1.9364	2.1243	3.1165	6.7504	5.0207	4.2731	2.4773	0.74765	0.3018
19	24.001	1.9884	2.1777	3.1165	6.7504	5.0207	4.2737	2.4767	0.74707	0.30163
20	26	2.0333	2.2258	3.1165	6.7535	5.0207	4.2731	2.4804	0.74765	0.30142
21	28.003	2.0799	2.2684	3.1165	6.7535	5.0207	4.2731	2.4804	0.74765	0.30142
22	30.002	2.1131	2.3069	3.1165	6.7541	5.0213	4.2725	2.4815	0.74882	0.30176
23	32	2.1426	2.3422	3.1165	6.7535	5.0207	4.2731	2.4804	0.74765	0.30142
24	34.003	2.1642	2.3729	3.1165	6.751	5.0213	4.2731	2.4779	0.74824	0.30197
25	36.002	2.1964	2.4029	3.1165	6.751	5.0213	4.2731	2.4779	0.74824	0.30197
26	38.001	2.2332	2.4318	3.1165	6.7541	5.0213	4.2725	2.4815	0.74882	0.30176
27	40.004	2.2619	2.458	3.1165	6.753	5.0202	4.2731	2.4799	0.74707	0.30125
28	42.002	2.2879	2.4829	3.1165	6.7541	5.0213	4.2731	2.481	0.74824	0.30159
29	44.001	2.3022	2.5072	3.1165	6.7535	5.0207	4.2725	2.481	0.74824	0.30159
30	46.004	2.3345	2.5304	3.1165	6.7541	5.0213	4.2725	2.4815	0.74882	0.30176
31	48.003	2.3399	2.5506	3.1165	6.751	5.0213	4.2731	2.4779	0.74824	0.30197
32	50.001	2.3704	2.571	3.1165	6.7535	5.0207	4.2725	2.481	0.74824	0.30159
33	52.004	2.3964	2.5919	3.1165	6.7572	5.0213	4.2731	2.4841	0.74824	0.30122
34	54.003	2.4098	2.6108	3.1165	6.7541	5.0213	4.2725	2.4815	0.74882	0.30176
35	56.002	2.4206	2.6274	3.1165	6.751	5.0213	4.2731	2.4779	0.74824	0.30197
36	58	2.4304	2.6449	3.1165	6.7541	5.0213	4.2731	2.481	0.74824	0.30159
37	60.003	2.4483	2.6619	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
38	62.002	2.4752	2.6794	3.1165	6.7541	5.0213	4.2725	2.4815	0.74882	0.30176
39	64.001	2.4806	2.6945	3.1165	6.751	5.0213	4.2719	2.479	0.74941	0.3023
40	66.003	2.4977	2.7098	3.1165	6.751	5.0213	4.2708	2.4802	0.75058	0.30263
41	68.002	2.521	2.7251	3.1165	6.7546	5.0219	4.2725	2.4821	0.74941	0.30193
42	70.001	2.5362	2.7407	3.1165	6.751	5.0213	4.2713	2.4796	0.74999	0.30246
43	72.004	2.5389	2.7534	3.1165	6.7541	5.0213	4.2725	2.4815	0.74882	0.30176
44	74.002	2.5461	2.7668	3.1165	6.7546	5.0219	4.2719	2.4827	0.74999	0.30209
45	76.001	2.555	2.78	3.1165	6.7515	5.0219	4.2731	2.4784	0.74882	0.30214
46	78.004	2.5765	2.7934	3.1165	6.7515	5.0219	4.2731	2.4784	0.74882	0.30214
47	80.003	2.5972	2.8062	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
48	82.001	2.6106	2.8185	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
49	84	2.6187	2.8307	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
50	86.003	2.6321	2.8426	3.1165	6.7541	5.0213	4.2725	2.4815	0.74882	0.30176
51	88.002	2.6474	2.8541	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
52	90	2.6528	2.8656	3.1165	6.7546	5.0219	4.2725	2.4821	0.74941	0.30193
53	92.003	2.6581	2.8764	3.1165	6.7515	5.0219	4.2725	2.479	0.74941	0.3023
54	94.002	2.6698	2.8871	3.1165	6.7515	5.0219	4.2719	2.4796	0.74999	0.30247
55	96.001	2.6832	2.8975	3.1165	6.751	5.0213	4.2719	2.479	0.74941	0.3023
56	98.004	2.6931	2.9077	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
57	100	2.7047	2.9179	3.1165	6.751	5.0213	4.2719	2.479	0.74941	0.3023
58	102	2.7146	2.9279	3.1165	6.7541	5.0213	4.2713	2.4827	0.74999	0.30209
59	104	2.7227	2.9377	3.1165	6.7546	5.0219	4.2725	2.4821	0.74941	0.30193
60	106	2.7307	2.9475	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
61	108	2.7397	2.9573	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
62	110	2.7478	2.9669	3.1165	6.7541	5.0213	4.2719	2.4821	0.74941	0.30192
63	112	2.7567	2.9765	3.1165	6.751	5.0213	4.2719	2.479	0.74941	0.3023
64	114	2.7639	2.9854	3.1165	6.751	5.0213	4.2719	2.479	0.74941	0.3023
65	116	2.7765	2.9943	3.1165	6.751	5.0213	4.2713	2.4796	0.74999	0.30246
66	118	2.7863	3.0029	3.1165	6.7515	5.0219	4.2725	2.479	0.74941	0.3023
67	120	2.7998	3.0114	3.1165	6.751	5.0213	4.2713	2.4796	0.74999	0.30246
68	122	2.8132	3.0199	3.1165	6.7515	5.0219	4.2725	2.479	0.74941	0.3023
69	124	2.8204	3.0282	3.1165	6.7504	5.0207	4.2725	2.4779	0.74824	0.30196
70	126	2.8258	3.0363	3.1165	6.751	5.0213	4.2708	2.4802	0.75058	0.30263
71	127.47	2.8321	3.0418	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213

Consolidation/B Step: 7

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
2	0.012483	0	0	3.1165	6.751	5.0213	4.2725	2.4784	0.74882	0.30213
3	0.05415	-0.0008965	0.00021283	3.1165	6.7479	5.0213	4.2719	2.4759	0.74941	0.30268
4	0.10012	0	0.00042567	3.1165	6.7541	5.0213	4.2713	2.4827	0.74999	0.30209
5	0.25033	0.001793	0.0019155	3.1165	6.7625	5.0237	4.2743	2.4882	0.74941	0.30119
6	0.50072	0.007172	0.0087262	3.1165	6.7773	5.0295	4.2737	2.5036	0.75585	0.30191
7	1.0014	0.029585	0.029797	3.1165	6.812	5.0401	4.2743	2.5377	0.7658	0.30177
8	2.0028	0.08965	0.085985	3.1165	6.8839	5.0606	4.2725	2.6114	0.78804	0.30177
9	4.0016	0.21068	0.22369	3.1165	7.0233	5.1033	4.2749	2.7484	0.82843	0.30142
10	6.0003	0.36219	0.38225	3.1165	7.1705	5.1478	4.2749	2.8956	0.87292	0.30146
11	8.0031	0.53342	0.56039	3.1165	7.3109	5.1917	4.2766	3.0343	0.91507	0.30158
12	10.002	0.73424	0.7579	3.1165	7.461	5.2327	4.2784	3.1826	0.95429	0.29984
13	12.001	0.91981	0.9686	3.1165	7.5938	5.2783	4.2766	3.3172	1.0017	0.30197
14	14.003	1.1475	1.1944	3.1165	7.7335	5.3181	4.2737	3.4598	1.0444	0.30188
15	16.002	1.3806	1.4343	3.1165	7.875	5.3632	4.276	3.599	1.0872	0.30207
16	18.001	1.6361	1.6865	3.1165	8.0158	5.4042	4.2731	3.7428	1.1311	0.3022
17	20.004	1.9006	1.9487	3.1165	8.1594	5.4481	4.2743	3.8851	1.1738	0.30213
18	22.002	2.1283	2.1871	3.1165	8.2359	5.4668	4.2737	3.9622	1.1931	0.30112
19	24.001	2.2807	2.3416	3.1165	8.235	5.4691	4.2754	3.9596	1.1937	0.30147
20	26.004	2.3892	2.4614	3.1165	8.2355	5.4697	4.2754	3.9601	1.1943	0.30158
21	28.003	2.4905	2.5614	3.1165	8.2392	5.4703	4.2743	3.9649	1.196	0.30166
22	30.001	2.5694	2.647	3.1165	8.2386	5.4697	4.2731	3.9655	1.1966	0.30176
23	32	2.6501	2.7234	3.1165	8.2361	5.4703	4.2725	3.9636	1.1978	0.3022
24	34.003	2.7218	2.7922	3.1165	8.2386	5.4697	4.2749	3.9638	1.1949	0.30145
25	36.002	2.7783	2.8543	3.1165	8.2386	5.4697	4.2743	3.9644	1.1955	0.30155
26	38	2.8338	2.912	3.1165	8.2386	5.4697	4.2731	3.9655	1.1966	0.30176
27	40.003	2.8903	2.9658	3.1165	8.2392	5.4703	4.2743	3.9649	1.196	0.30166
28	42.002	2.9307	3.0152	3.1165	8.2386	5.4697	4.2737	3.965	1.196	0.30165
29	44.001	2.9764	3.0605	3.1165	8.2386	5.4697	4.2719	3.9667	1.1978	0.30196
30	46.004	3.0275	3.1035	3.1165	8.2392	5.4703	4.2743	3.9649	1.196	0.30166
31	48.002	3.0607	3.1442	3.1165	8.2361	5.4703	4.2725	3.9636	1.1978	0.3022
32	50.001	3.1055	3.1831	3.1165	8.2392	5.4703	4.2731	3.9661	1.1972	0.30186
33	52.004	3.1404	3.2202	3.1165	8.2392	5.4703	4.2737	3.9655	1.1966	0.30176
34	54.003	3.1718	3.2555	3.1165	8.2392	5.4703	4.2731	3.9661	1.1972	0.30186
35	56.001	3.2175	3.2893	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
36	58.004	3.2471	3.3217	3.1165	8.2392	5.4703	4.2731	3.9661	1.1972	0.30186
37	60.003	3.2678	3.3528	3.1165	8.2392	5.4703	4.2737	3.9655	1.1966	0.30176
38	62.002	3.3027	3.3826	3.1165	8.2397	5.4709	4.2737	3.9661	1.1972	0.30187
39	64	3.3341	3.4109	3.1165	8.2392	5.4703	4.2737	3.9655	1.1966	0.30176
40	66.003	3.3565	3.4383	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
41	68.002	3.3924	3.4653	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
42	70.001	3.4166	3.4911	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
43	72.001	3.4327	3.5154	3.1165	8.2397	5.4709	4.2737	3.9661	1.1972	0.30187
44	74.004	3.4623	3.5394	3.1165	8.2366	5.4709	4.2708	3.9659	1.2001	0.30262
45	76.003	3.4829	3.5626	3.1165	8.2397	5.4709	4.2737	3.9661	1.1972	0.30187
46	78.003	3.5053	3.5852	3.1165	8.2392	5.4703	4.2737	3.9655	1.1966	0.30176
47	80.002	3.5286	3.6075	3.1165	8.2392	5.4703	4.2719	3.9673	1.1984	0.30207
48	82.001	3.5457	3.6292	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
49	84	3.5681	3.6505	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
50	86.004	3.5896	3.6714	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
51	88.003	3.6165	3.6922	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
52	90.002	3.6344	3.7127	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
53	92.001	3.6532	3.7325	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
54	94	3.6739	3.7514	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
55	96.004	3.6918	3.7703	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
56	98.003	3.7088	3.7889	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
57	100	3.7277	3.8067	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
58	102	3.7528	3.8244	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
59	104	3.7671	3.8416	3.1165	8.2397	5.4709	4.2702	3.9696	1.2007	0.30248
60	106	3.7779	3.8587	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
61	108	3.7949	3.8753	3.1165	8.2397	5.4709	4.2737	3.9661	1.1972	0.30187
62	110	3.8164	3.8917	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
63	112	3.8352	3.9078	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
64	114	3.8451	3.9238	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
65	116	3.8675	3.9395	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
66	118	3.8899	3.9551	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
67	120	3.9061	3.9704	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
68	122	3.9141	3.9853	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
69	124	3.9195	4	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
70	126	3.9321	4.0147	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
71	128	3.9455	4.0289	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
72	130	3.9697	4.0432	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
73	132	3.9939	4.0574	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
74	134	4.0029	4.0713	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
75	136	4.0199	4.0851	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
76	138	4.028	4.0987	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
77	140	4.0369	4.1124	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
78	142	4.0504	4.1256	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
79	144	4.0603	4.1385	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
80	146	4.0764	4.1515	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
81	148	4.0872	4.1641	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
82	150	4.0979	4.1768	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
83	152	4.1087	4.1892	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
84	154	4.1212	4.2013	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
85	156	4.1365	4.2135	3.1165	8.2428	5.4709	4.2708	3.9721	1.2001	0.30214
86	158	4.1553	4.2256	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
87	160	4.1651	4.2375	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
88	162	4.1723	4.2496	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
89	164	4.1768	4.2618	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
90	166	4.1858	4.2737	3.1165	8.2397	5.4709	4.2702	3.9696	1.2007	0.30248
91	168	4.2001	4.2852	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
92	170	4.21	4.2967	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207

93	172	4.2261	4.3077	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
94	174	4.236	4.319	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
95	176	4.2512	4.3301	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
96	178	4.262	4.3409	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
97	180	4.2727	4.352	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
98	182	4.2826	4.3627	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
99	184	4.2898	4.3733	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
100	186	4.3023	4.3839	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
101	188	4.3167	4.3944	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
102	190	4.3274	4.405	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
103	192	4.3355	4.4156	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
104	194	4.3436	4.4263	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
105	196	4.3543	4.4369	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
106	198	4.3642	4.4469	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
107	200	4.3776	4.4576	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
108	202	4.392	4.4676	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
109	204	4.4018	4.4776	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
110	206	4.4108	4.4878	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
111	208	4.4153	4.4972	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
112	210	4.4207	4.5067	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
113	212	4.4296	4.5161	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
114	214	4.4431	4.5259	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
115	216	4.4502	4.5353	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
116	218	4.4619	4.5446	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
117	220	4.47	4.5538	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
118	220.04	4.47	4.554	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207

TRIAXIAL TEST

Consolidation/B Step: 8

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
2	0.012483	0	0.00021283	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
3	0.0507	0.0008965	0.00021283	3.1165	8.2366	5.4709	4.2713	3.9653	1.1996	0.30251
4	0.10077	0	0.00042567	3.1165	8.2335	5.4709	4.2719	3.9616	1.199	0.30265
5	0.251	-0.0008965	0.0006385	3.1165	8.2237	5.4703	4.2725	3.9512	1.1978	0.30315
6	0.50197	-0.0026895	0.0010642	3.1165	8.2051	5.4703	4.2725	3.9326	1.1978	0.30458
7	1.0037	-0.005379	0.00085133	3.1165	8.1683	5.4674	4.2719	3.8963	1.1955	0.30682
8	2.0015	-0.01793	-0.0055337	3.1165	8.1	5.4574	4.2708	3.8293	1.1867	0.3099
9	4.0007	-0.057376	-0.045759	3.1165	7.9582	5.4252	4.2713	3.6868	1.1539	0.31298
10	6.004	-0.1282	-0.11174	3.1165	7.8189	5.3925	4.269	3.5499	1.1235	0.31648
11	8.0033	-0.20261	-0.18836	3.1165	7.6728	5.3591	4.2702	3.4027	1.0889	0.32002
12	10.002	-0.29316	-0.27009	3.1165	7.5295	5.3187	4.2708	3.2587	1.0479	0.32158
13	12.002	-0.37474	-0.35564	3.1165	7.3828	5.2912	4.269	3.1138	1.0222	0.32828
14	14.001	-0.45542	-0.44631	3.1165	7.249	5.2643	4.2713	2.9776	0.99292	0.33346
15	16	-0.56031	-0.54592	3.1165	7.1031	5.2245	4.2678	2.8353	0.95663	0.3374
16	18.003	-0.68224	-0.65425	3.1165	6.9625	5.187	4.2708	2.6917	0.91624	0.34039
17	20.003	-0.79789	-0.77195	3.1165	6.816	5.1466	4.2713	2.5447	0.87526	0.34395
18	22.002	-0.92788	-0.90007	3.1165	6.6713	5.108	4.2696	2.4017	0.83838	0.34908
19	24.001	-1.0561	-1.0352	3.1165	6.5345	5.0746	4.2702	2.2643	0.80443	0.35526
20	26	-1.2103	-1.1804	3.1165	6.3941	5.0406	4.2702	2.1239	0.77048	0.36276
21	28.004	-1.3537	-1.3347	3.1165	6.268	5.012	4.2684	1.9996	0.74355	0.37186
22	30.003	-1.4299	-1.4319	3.1165	6.2627	5.0196	4.2702	1.9926	0.74941	0.3761
23	32.002	-1.4998	-1.4854	3.1165	6.2614	5.0412	4.2696	1.9918	0.77165	0.38741
24	34.001	-1.5402	-1.5241	3.1165	6.2626	5.0524	4.2719	1.9906	0.78043	0.39205
25	36.001	-1.5752	-1.559	3.1165	6.2636	5.0436	4.2702	1.9934	0.77341	0.38798
26	38.004	-1.5949	-1.5858	3.1165	6.2639	5.057	4.2713	1.9925	0.7857	0.39432
27	38.564	-1.6029	-1.5918	3.1165	6.261	5.0606	4.2719	1.989	0.78863	0.39648

TRIAXIAL TEST

Consolidation/B Step: 9

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	6.261	5.0606	4.2713	1.9896	0.78921	0.39666
2	0.012417	0	0	3.1165	6.261	5.0606	4.2702	1.9908	0.79038	0.39702
3	0.050467	0	-0.0006385	3.1165	6.2646	5.0611	4.2725	1.9921	0.78863	0.39588
4	0.10053	-0.0008965	-0.0010642	3.1165	6.2677	5.0611	4.2725	1.9952	0.78863	0.39526
5	0.25077	-0.0008965	-0.0021283	3.1165	6.2703	5.0606	4.2719	1.9983	0.78863	0.39464
6	0.50162	0.003586	-0.0034053	3.1165	6.29	5.0617	4.2719	2.018	0.7898	0.39137
7	1.0033	0.007172	-0.0036182	3.1165	6.3254	5.0664	4.2719	2.0534	0.79448	0.3869
8	2.0011	0.018827	0.005108	3.1165	6.3964	5.0793	4.2731	2.1233	0.80619	0.37969
9	4.0003	0.066341	0.047462	3.1165	6.5396	5.0998	4.2731	2.2665	0.82668	0.36474
10	6.0037	0.14972	0.12919	3.1165	6.6808	5.1478	4.2725	2.4083	0.87526	0.36344
11	8.0029	0.24385	0.22411	3.1165	6.8239	5.1847	4.2749	2.5491	0.9098	0.35691
12	10.002	0.34964	0.32478	3.1165	6.9663	5.2174	4.2749	2.6915	0.94258	0.35021
13	12.001	0.44556	0.42992	3.1165	7.1105	5.2455	4.2731	2.8374	0.97243	0.34272
14	14.001	0.55225	0.53676	3.1165	7.2458	5.2807	4.2749	2.9709	1.0058	0.33855
15	16.001	0.59976	0.597	3.1165	7.2476	5.276	4.2725	2.9751	1.0035	0.33729
16	18	0.62307	0.62466	3.1165	7.2477	5.2596	4.2719	2.9758	0.98765	0.3319
17	20.003	0.64369	0.63978	3.1165	7.248	5.2467	4.2719	2.976	0.97477	0.32754
18	22.003	0.65983	0.65212	3.1165	7.248	5.2467	4.2731	2.9749	0.9736	0.32728
19	24.002	0.66431	0.66212	3.1165	7.2498	5.242	4.2719	2.9778	0.97009	0.32577
20	26.001	0.67238	0.6683	3.1165	7.2494	5.235	4.2725	2.9768	0.96248	0.32332
21	28	0.68045	0.67447	3.1165	7.2508	5.2332	4.2725	2.9783	0.96073	0.32258
22	30.004	0.68672	0.68021	3.1165	7.2517	5.2309	4.2725	2.9792	0.95838	0.32169
23	32.004	0.69479	0.68617	3.1165	7.2497	5.2321	4.2719	2.9778	0.96014	0.32244
24	34.003	0.69838	0.69256	3.1165	7.2499	5.2356	4.2731	2.9768	0.96248	0.32333
25	36.002	0.70286	0.69831	3.1165	7.2477	5.2332	4.2719	2.9758	0.96131	0.32305
26	38	0.70734	0.70128	3.1165	7.25	5.2291	4.2725	2.9775	0.95663	0.32128
27	39.006	0.71182	0.7032	3.1165	7.2484	5.2274	4.2725	2.9759	0.95487	0.32087

TRIAXIAL TEST

Consolidation/B Step: 10

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	7.252	5.228	4.2725	2.9795	0.95546	0.32067
2	0.012517	0	0.00021283	3.1165	7.2489	5.228	4.2719	2.977	0.95604	0.32114
3	0.050083	0	0.00042567	3.1165	7.2509	5.2268	4.2708	2.9802	0.95604	0.3208
4	0.10015	0.0008965	0.00021283	3.1165	7.254	5.2268	4.2725	2.9815	0.95429	0.32007
5	0.251	0.005379	0.0014898	3.1165	7.2633	5.2268	4.2731	2.9902	0.9537	0.31894
6	0.50133	0.014344	0.0046823	3.1165	7.2836	5.2286	4.2725	3.0111	0.95604	0.31751
7	1.0022	0.034067	0.014898	3.1165	7.3172	5.2379	4.2731	3.0441	0.96482	0.31695
8	2.0041	0.065445	0.045333	3.1165	7.3866	5.259	4.2737	3.1129	0.98531	0.31652
9	4.0034	0.14972	0.12834	3.1165	7.5314	5.3076	4.2731	3.2583	1.0345	0.31749
10	6.004	0.25012	0.22603	3.1165	7.6755	5.3521	4.276	3.3995	1.076	0.31653
11	8.0007	0.34157	0.33159	3.1165	7.8154	5.3954	4.2731	3.5423	1.1223	0.31682
12	10.004	0.45453	0.44142	3.1165	7.9535	5.4334	4.2754	3.6781	1.158	0.31484
13	12.003	0.57824	0.55294	3.1165	8.1033	5.4609	4.2743	3.8291	1.1867	0.30991
14	14.002	0.68851	0.66681	3.1165	8.2371	5.4879	4.2749	3.9623	1.213	0.30614
15	16	0.74679	0.743	3.1165	8.2375	5.4949	4.2731	3.9644	1.2218	0.30819
16	18.004	0.78713	0.78812	3.1165	8.2382	5.4791	4.2731	3.9651	1.206	0.30416
17	20.003	0.82568	0.82047	3.1165	8.2405	5.475	4.2731	3.9674	1.2019	0.30294
18	22.002	0.8454	0.84708	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
19	24.003	0.86961	0.87091	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
20	26.003	0.89202	0.89241	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
21	28.002	0.91085	0.91263	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
22	30.001	0.92788	0.93114	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
23	32.001	0.95836	0.94838	3.1165	8.2392	5.4703	4.2719	3.9673	1.1984	0.30207
24	34.004	0.96733	0.96477	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
25	36.003	0.98167	0.98031	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
26	38.002	0.99153	0.99521	3.1165	8.2428	5.4709	4.2731	3.9697	1.1978	0.30173
27	40.002	1.0032	1.0095	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
28	42.002	1.0122	1.0231	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
29	44.001	1.0292	1.0367	3.1165	8.2428	5.4709	4.2737	3.9692	1.1972	0.30163
30	46.001	1.0408	1.0495	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
31	48.001	1.0597	1.0622	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
32	50.001	1.0785	1.0742	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
33	52	1.0857	1.0863	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
34	54	1.0946	1.0978	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
35	56.004	1.1009	1.1091	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
36	58.004	1.1099	1.1199	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
37	60.003	1.1161	1.1308	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
38	62.003	1.1323	1.1414	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
39	64.003	1.1511	1.1516	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
40	66.003	1.1646	1.1621	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
41	68.002	1.1699	1.1721	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
42	70.001	1.1744	1.1821	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
43	72.001	1.1861	1.1919	3.1165	8.2428	5.4709	4.2731	3.9697	1.1978	0.30173
44	74.004	1.1932	1.2017	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
45	76.003	1.2013	1.2112	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
46	78.003	1.213	1.2208	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
47	80.003	1.2219	1.2302	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
48	82.002	1.2318	1.2391	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
49	84.002	1.2408	1.2483	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
50	86.001	1.2524	1.257	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
51	88	1.2623	1.2657	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
52	90.003	1.2712	1.2747	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
53	92.003	1.2757	1.283	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
54	94.002	1.282	1.2917	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
55	96	1.2883	1.3002	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
56	98.004	1.2963	1.3085	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
57	100	1.3062	1.3168	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
58	102	1.3179	1.3253	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
59	104	1.3286	1.3336	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
60	106	1.3412	1.3417	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
61	108	1.3483	1.3498	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
62	110	1.3555	1.3579	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
63	112	1.3591	1.3655	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
64	114	1.3654	1.3734	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
65	116	1.3716	1.3815	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
66	118	1.3815	1.3892	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
67	120	1.3896	1.3968	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
68	122	1.4003	1.4047	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
69	124	1.4111	1.4124	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
70	126	1.4183	1.4198	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
71	128	1.4299	1.4277	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
72	130	1.4371	1.4351	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
73	132	1.4416	1.4426	3.1165	8.2397	5.4709	4.2702	3.9696	1.2007	0.30248
74	134	1.447	1.4498	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
75	136	1.4523	1.4573	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
76	138	1.4559	1.4645	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
77	140	1.4613	1.4717	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
78	142	1.4694	1.4786	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
79	144	1.4765	1.4858	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
80	146	1.4837	1.4924	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
81	148	1.4936	1.4996	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
82	150	1.5043	1.5066	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
83	152	1.507	1.5135	3.1165	8.2397	5.4709	4.2731	3.9666	1.1978	0.30197
84	154	1.5151	1.5205	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
85	156	1.5214	1.5281	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
86	158	1.525	1.535	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
87	160	1.5285	1.5413	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
88	162	1.5321	1.5481	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
89	164	1.5384	1.555	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
90	166	1.5447	1.5618	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
91	168	1.5509	1.5686	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
92	170	1.559	1.5752	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194

93	172	1.5662	1.5818	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
94	174	1.5734	1.5882	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
95	176	1.5805	1.5948	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
96	178	1.5886	1.6011	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
97	180	1.594	1.6075	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
98	182	1.602	1.6141	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
99	184	1.6083	1.6205	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238
100	186	1.6146	1.6265	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
101	188	1.62	1.6329	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
102	190	1.6263	1.6392	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
103	192	1.6334	1.6454	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
104	194	1.6397	1.6518	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
105	196	1.6442	1.6582	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
106	198	1.6532	1.6646	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
107	200	1.6603	1.6707	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
108	202	1.6657	1.6769	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
109	204	1.672	1.6831	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
110	206	1.6774	1.6893	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
111	208	1.6845	1.6952	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
112	210	1.6881	1.7012	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
113	212	1.6899	1.7073	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
114	214	1.6962	1.7133	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
115	216	1.7034	1.7193	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
116	218	1.7105	1.7252	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
117	220	1.715	1.731	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
118	222	1.7204	1.7369	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
119	224	1.7276	1.7427	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
120	226	1.7347	1.7486	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
121	228	1.7401	1.7546	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
122	230	1.7455	1.7601	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
123	232	1.7554	1.7659	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
124	234	1.7634	1.7718	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
125	236	1.767	1.7776	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
126	238	1.7724	1.7833	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
127	240	1.7769	1.7886	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
128	242	1.7805	1.7944	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
129	244	1.784	1.8004	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
130	246	1.7894	1.8057	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
131	248	1.7921	1.8114	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
132	250	1.7957	1.8167	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
133	252	1.7993	1.8223	3.1165	8.2428	5.4709	4.2702	3.9727	1.2007	0.30225
134	254	1.8047	1.8276	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
135	256	1.81	1.8331	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
136	258	1.8145	1.8385	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
137	260	1.8217	1.844	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
138	262	1.8289	1.8493	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
139	264	1.8369	1.8546	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
140	266	1.8432	1.8602	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
141	268	1.8513	1.8655	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
142	270	1.8558	1.8712	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
143	272	1.8593	1.8765	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
144	274	1.8629	1.8819	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
145	276	1.8656	1.8872	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
146	278	1.8719	1.8925	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
147	280	1.8773	1.8976	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
148	282	1.888	1.9029	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
149	284	1.8952	1.908	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
150	286	1.897	1.9136	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
151	288	1.9006	1.9183	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
152	290	1.9087	1.9234	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
153	292	1.9131	1.9285	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
154	294	1.9158	1.9334	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
155	296	1.9203	1.9389	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
156	298	1.9239	1.9438	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
157	300	1.9293	1.9489	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
158	302	1.9373	1.9542	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
159	304	1.9391	1.9591	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
160	306	1.9427	1.964	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
161	308	1.9472	1.9691	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
162	310	1.9562	1.9738	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
163	312	1.9633	1.9789	3.1165	8.2434	5.4715	4.2696	3.9738	1.2019	0.30246
164	314	1.9678	1.9836	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
165	316	1.9696	1.9885	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
166	318	1.9723	1.9934	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
167	320	1.9759	1.9983	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
168	322	1.9831	2.003	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
169	324	1.9911	2.0079	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
170	326	1.9938	2.0125	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
171	328	1.9983	2.0179	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
172	330	2.0019	2.0228	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
173	332	2.0082	2.0277	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
174	334	2.0118	2.0323	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
175	336	2.0153	2.037	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
176	338	2.0198	2.0419	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
177	340	2.0279	2.0468	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
178	342	2.036	2.0517	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
179	344	2.0404	2.0562	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
180	346	2.0458	2.0609	3.1165	8.2428	5.4709	4.2708	3.9721	1.2001	0.30214
181	348	2.0512	2.0653	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
182	350	2.0575	2.07	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
183	352	2.0629	2.0745	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
184	354	2.0673	2.079	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
185	356	2.0682	2.0836	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
186	358	2.0718	2.0883	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
187	360	2.0781	2.0928	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
188	362	2.0808	2.0973	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
189	364	2.0844	2.1017	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
190	366	2.0915	2.1062	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
191	368	2.0942	2.1105	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
192	370	2.0987	2.1151	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
193	372	2.1014	2.1198	3.1165	8.2397	5.4709	4.2708	3.969	1.2001	0.30238

194	374	2.105	2.1241	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
195	376	2.1086	2.1283	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
196	378	2.1131	2.1326	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
197	380	2.1184	2.1366	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
198	382	2.1238	2.1409	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
199	384	2.1301	2.1456	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
200	386	2.1355	2.1498	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
201	388	2.1408	2.1543	3.1165	8.2403	5.4715	4.2702	3.9701	1.2013	0.30259
202	390	2.1462	2.1583	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
203	392	2.1525	2.1626	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
204	394	2.157	2.1671	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
205	396	2.1624	2.1711	3.1165	8.2408	5.4721	4.2719	3.9689	1.2001	0.30239
206	398	2.1677	2.1754	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
207	400	2.1749	2.1798	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
208	402	2.1785	2.1841	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
209	404	2.1821	2.1883	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
210	406	2.1866	2.1924	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
211	408	2.1893	2.1966	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
212	410	2.1919	2.2007	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
213	412	2.1937	2.2047	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
214	414	2.1937	2.209	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
215	416	2.1955	2.2133	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
216	418	2.1982	2.2173	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
217	420	2.1991	2.2211	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
218	422	2.2018	2.2256	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
219	424	2.2063	2.2296	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
220	426	2.2108	2.2337	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
221	428	2.2188	2.2377	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
222	430	2.2251	2.242	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
223	432	2.2296	2.246	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
224	434	2.2359	2.2501	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
225	436	2.2413	2.2539	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
226	438	2.243	2.2579	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
227	440	2.2457	2.2618	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
228	442	2.2502	2.2656	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
229	444	2.2547	2.2697	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
230	446	2.2592	2.2737	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
231	448	2.2655	2.2777	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
232	450	2.2735	2.2816	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
233	452	2.278	2.2856	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
234	454	2.2816	2.2894	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
235	456	2.287	2.2933	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
236	458	2.2915	2.2971	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
237	460	2.2968	2.3009	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
238	462	2.2986	2.3046	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
239	464	2.3022	2.3088	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
240	466	2.3031	2.3124	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
241	468	2.3067	2.316	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
242	470	2.3094	2.3197	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
243	472	2.313	2.3233	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
244	474	2.3139	2.3271	3.1165	8.2428	5.4709	4.2702	3.9727	1.2007	0.30225
245	476	2.3175	2.3307	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
246	478	2.3219	2.3344	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
247	480	2.3255	2.3382	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
248	482	2.33	2.342	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
249	484	2.3327	2.3458	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
250	486	2.3372	2.3495	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
251	488	2.3408	2.3531	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
252	490	2.3444	2.3569	3.1165	8.2428	5.4709	4.2708	3.9721	1.2001	0.30214
253	492	2.3479	2.3603	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
254	494	2.3524	2.3641	3.1165	8.2397	5.4709	4.269	3.9707	1.2019	0.30269
255	496	2.3569	2.3676	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
256	498	2.3614	2.3712	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
257	500	2.3641	2.3748	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
258	502	2.3677	2.3782	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
259	504	2.3712	2.382	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
260	506	2.3721	2.3856	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
261	508	2.3739	2.3893	3.1165	8.2428	5.4709	4.2708	3.9721	1.2001	0.30214
262	510	2.3757	2.3929	3.1165	8.2428	5.4709	4.2702	3.9727	1.2007	0.30225
263	512	2.3775	2.3963	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
264	514	2.3793	2.3999	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
265	516	2.3811	2.4033	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
266	518	2.3838	2.4069	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
267	520	2.3892	2.4099	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
268	522	2.3946	2.4135	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
269	524	2.4008	2.4169	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
270	526	2.4089	2.4203	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
271	528	2.4134	2.4235	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
272	530	2.417	2.4269	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
273	532	2.4206	2.4308	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
274	534	2.4268	2.4342	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
275	536	2.4322	2.4376	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
276	538	2.4349	2.441	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
277	540	2.4394	2.4444	3.1165	8.2428	5.4709	4.2708	3.9721	1.2001	0.30214
278	542	2.4412	2.4476	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
279	544	2.4439	2.4508	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
280	546	2.4457	2.4542	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
281	548	2.4475	2.4574	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
282	550	2.451	2.4606	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
283	552	2.4555	2.4638	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
284	554	2.4591	2.4672	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
285	556	2.4636	2.4706	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
286	558	2.4681	2.4738	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
287	560	2.4717	2.4767	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
288	562	2.4734	2.4799	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
289	564	2.4761	2.4831	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
290	566	2.477	2.4863	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
291	568	2.4797	2.4897	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
292	570	2.4851	2.4927	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
293	572	2.4896	2.4961	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
294	574	2.4941	2.4991	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218

295	576	2.4968	2.5021	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
296	578	2.4986	2.5053	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
297	580	2.5012	2.5084	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
298	582	2.5021	2.5114	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
299	584	2.5039	2.5144	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
300	586	2.5048	2.5174	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
301	588	2.5084	2.5206	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
302	590	2.5129	2.5236	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
303	592	2.521	2.5263	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
304	594	2.5263	2.5293	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
305	596	2.5308	2.5325	3.1165	8.2392	5.4703	4.2713	3.9679	1.199	0.30217
306	598	2.5326	2.5353	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
307	600	2.5344	2.5382	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
308	602	2.5371	2.5412	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
309	604	2.5398	2.5438	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
310	606	2.5434	2.547	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
311	608	2.5452	2.55	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
312	610	2.5488	2.5529	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
313	612	2.5523	2.5555	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
314	614	2.5559	2.5583	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
315	616	2.5577	2.5608	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
316	618	2.5622	2.564	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
317	620	2.564	2.5668	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
318	622	2.5676	2.5695	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
319	624	2.5694	2.5725	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
320	626	2.5748	2.5753	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
321	628	2.5774	2.578	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
322	630	2.5828	2.5808	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
323	632	2.5864	2.5834	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
324	634	2.5882	2.5861	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
325	636	2.59	2.5891	3.1165	8.2397	5.4709	4.2696	3.9702	1.2013	0.30259
326	638	2.5909	2.5917	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
327	640	2.5927	2.5944	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
328	642	2.5945	2.5972	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
329	644	2.5963	2.6	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
330	646	2.6008	2.6025	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
331	648	2.6043	2.6051	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
332	650	2.6088	2.6081	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
333	652	2.6142	2.6106	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
334	654	2.6196	2.6134	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
335	656	2.625	2.6159	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
336	658	2.6285	2.6187	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
337	660	2.6303	2.6213	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
338	662	2.6375	2.6238	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
339	664	2.6402	2.6266	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
340	666	2.6429	2.6293	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
341	668	2.6456	2.6319	3.1165	8.2428	5.4709	4.2702	3.9727	1.2007	0.30225
342	670	2.6501	2.634	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
343	672	2.6528	2.637	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
344	674	2.6545	2.6393	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
345	676	2.6563	2.6419	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
346	678	2.659	2.6444	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
347	680	2.6608	2.6472	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
348	682	2.6626	2.6498	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
349	684	2.6662	2.6525	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
350	686	2.6671	2.6551	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
351	688	2.6671	2.6576	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
352	690	2.668	2.6602	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
353	692	2.6689	2.663	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
354	694	2.6698	2.6653	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
355	696	2.6716	2.6679	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
356	698	2.6743	2.6706	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
357	700	2.677	2.6732	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
358	702	2.6787	2.6757	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
359	704	2.6814	2.6781	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
360	706	2.6859	2.6806	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
361	708	2.6913	2.6832	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
362	710	2.694	2.6857	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
363	712	2.6976	2.6883	3.1165	8.2397	5.4709	4.2713	3.9684	1.1996	0.30228
364	714	2.7003	2.6908	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
365	716	2.703	2.6932	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
366	718	2.7065	2.6957	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
367	720	2.7074	2.6983	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
368	722	2.711	2.7006	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
369	724	2.7137	2.703	3.1165	8.2428	5.4709	4.2725	3.9703	1.1984	0.30184
370	726	2.7191	2.7055	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
371	728	2.7245	2.7079	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
372	730	2.7272	2.7104	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
373	732	2.729	2.7128	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
374	734	2.7298	2.7151	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
375	736	2.7316	2.7177	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
376	738	2.7334	2.72	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
377	740	2.7343	2.7223	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
378	742	2.7379	2.7249	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
379	744	2.7406	2.7272	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
380	746	2.7433	2.7296	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
381	748	2.7442	2.7319	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
382	750	2.7478	2.7343	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
383	752	2.7505	2.7366	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
384	754	2.7532	2.7389	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
385	756	2.7558	2.7413	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
386	758	2.7594	2.7434	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
387	760	2.7621	2.7458	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
388	762	2.7666	2.7481	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
389	764	2.7693	2.7504	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
390	766	2.772	2.7528	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
391	768	2.7756	2.7553	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
392	770	2.7792	2.7577	3.1165	8.2465	5.4715	4.2725	3.974	1.199	0.30171
393	772	2.7809	2.7602	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
394	774	2.7818	2.7626	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
395	776	2.7845	2.7649	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204

396	778	2.7881	2.767	3.1165	8.2397	5.4709	4.2719	3.9678	1.199	0.30217
397	780	2.7962	2.7694	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
398	782	2.7998	2.7721	3.1165	8.245	5.4732	4.2719	3.9731	1.2013	0.30236
399	784	2.8007	2.7745	3.1165	8.2425	5.4738	4.2702	3.9723	1.2037	0.30301
400	786	2.8016	2.7766	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
401	788	2.8034	2.7785	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
402	790	2.8052	2.7809	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
403	792	2.8069	2.7832	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
404	794	2.8087	2.7853	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
405	796	2.8114	2.7879	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
406	798	2.8141	2.7902	3.1165	8.2428	5.4709	4.2708	3.9721	1.2001	0.30214
407	800	2.8168	2.7924	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
408	802	2.8195	2.7947	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
409	804	2.8204	2.7971	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
410	806	2.8222	2.7992	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
411	808	2.824	2.8017	3.1165	8.2403	5.4715	4.2708	3.9695	1.2007	0.30249
412	810	2.8267	2.8036	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
413	812	2.8303	2.806	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
414	814	2.8312	2.8081	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
415	816	2.8321	2.8102	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
416	818	2.8338	2.8126	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
417	820	2.8338	2.8151	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
418	822	2.8356	2.8173	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
419	824	2.8392	2.8194	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
420	826	2.841	2.8217	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
421	828	2.8446	2.8241	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
422	830	2.8455	2.8262	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
423	832	2.8473	2.8286	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
424	834	2.8473	2.8309	3.1165	8.2403	5.4715	4.2713	3.969	1.2001	0.30238
425	836	2.8491	2.833	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
426	838	2.85	2.8351	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
427	840	2.8527	2.8373	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
428	842	2.8563	2.8396	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
429	844	2.8589	2.8417	3.1165	8.2397	5.4709	4.2702	3.9696	1.2007	0.30248
430	846	2.8607	2.8439	3.1165	8.2397	5.4709	4.2725	3.9672	1.1984	0.30207
431	848	2.867	2.846	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
432	850	2.8715	2.8483	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
433	852	2.8751	2.8503	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
434	854	2.8787	2.8526	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
435	856	2.8805	2.8547	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
436	858	2.8832	2.8571	3.1165	8.2434	5.4732	4.2719	3.9715	1.1996	0.30204
437	860	2.8894	2.8596	3.1165	8.2419	5.4732	4.2719	3.97	1.2013	0.3026
438	862	2.8921	2.8626	3.1165	8.2452	5.4768	4.2725	3.9727	1.2042	0.30313
439	864	2.8939	2.8654	3.1165	8.2438	5.4785	4.2725	3.9713	1.206	0.30368
440	866	2.8975	2.8688	3.1165	8.244	5.482	4.2713	3.9727	1.2107	0.30475
441	868	2.9011	2.8718	3.1165	8.2431	5.4844	4.2713	3.9718	1.213	0.30541
442	870	2.9038	2.8752	3.1165	8.2433	5.4879	4.2708	3.9726	1.2171	0.30638
443	872	2.9074	2.8784	3.1165	8.241	5.492	4.2731	3.9679	1.2189	0.30719
444	874	2.91	2.8815	3.1165	8.2395	5.4937	4.2725	3.967	1.2212	0.30784
445	876	2.9118	2.8843	3.1165	8.2421	5.4931	4.2725	3.9696	1.2206	0.3075
446	878	2.9127	2.8869	3.1165	8.2399	5.4908	4.2713	3.9685	1.2195	0.30728
447	880	2.9136	2.8884	3.1165	8.2422	5.4867	4.2725	3.9697	1.2142	0.30587
448	882	2.9154	2.8894	3.1165	8.2409	5.482	4.2719	3.969	1.2101	0.30489
449	884	2.9172	2.8903	3.1165	8.2432	5.4779	4.2725	3.9707	1.2054	0.30357
450	886	2.9199	2.8915	3.1165	8.2452	5.4768	4.2713	3.9739	1.2054	0.30333
451	888	2.9199	2.8933	3.1165	8.2441	5.4756	4.2719	3.9722	1.2037	0.30302
452	890	2.9208	2.8945	3.1165	8.2425	5.4738	4.2719	3.9706	1.2019	0.3027
453	892	2.9235	2.8962	3.1165	8.2439	5.4721	4.2713	3.9726	1.2007	0.30225
454	894	2.9253	2.8979	3.1165	8.2408	5.4721	4.2708	3.9701	1.2013	0.30259
455	896	2.9271	2.8994	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
456	898	2.9289	2.9013	3.1165	8.2439	5.4721	4.2725	3.9714	1.1996	0.30205
457	900	2.9307	2.9033	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
458	902	2.9325	2.905	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
459	904	2.9334	2.9069	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
460	906	2.9351	2.9088	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
461	908	2.936	2.9109	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
462	910	2.9396	2.9128	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
463	912	2.945	2.915	3.1165	8.2439	5.4721	4.2725	3.9714	1.1996	0.30205
464	914	2.9468	2.9177	3.1165	8.2441	5.4756	4.2725	3.9716	1.2031	0.30292
465	916	2.9486	2.9203	3.1165	8.2421	5.4768	4.2719	3.9702	1.2048	0.30347
466	918	2.9495	2.9226	3.1165	8.2421	5.4768	4.2719	3.9702	1.2048	0.30347
467	920	2.9504	2.9248	3.1165	8.2445	5.4727	4.2708	3.9737	1.2019	0.30246
468	922	2.9531	2.9262	3.1165	8.2403	5.4715	4.2731	3.9672	1.1984	0.30207
469	924	2.9549	2.9279	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
470	926	2.9585	2.9301	3.1165	8.2408	5.4721	4.2719	3.9689	1.2001	0.30239
471	928	2.9611	2.9324	3.1165	8.2414	5.4727	4.2719	3.9695	1.2007	0.30249
472	930	2.962	2.9343	3.1165	8.2388	5.4732	4.2719	3.9669	1.2013	0.30283
473	932	2.9647	2.9365	3.1165	8.2425	5.4738	4.2725	3.97	1.2013	0.3026
474	934	2.9665	2.9384	3.1165	8.2383	5.4727	4.2713	3.967	1.2013	0.30283
475	936	2.9683	2.9407	3.1165	8.245	5.4732	4.2725	3.9725	1.2007	0.30226
476	938	2.9701	2.9422	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
477	940	2.9737	2.9443	3.1165	8.2439	5.4721	4.2713	3.9726	1.2007	0.30225
478	942	2.9755	2.9467	3.1165	8.2425	5.4738	4.2719	3.9706	1.2019	0.3027
479	944	2.9782	2.9494	3.1165	8.2441	5.4756	4.2696	3.9746	1.206	0.30343
480	946	2.9791	2.9514	3.1165	8.2441	5.4756	4.2731	3.9711	1.2025	0.30281
481	948	2.9827	2.9535	3.1165	8.2445	5.4727	4.2713	3.9732	1.2013	0.30236
482	950	2.9836	2.9552	3.1165	8.245	5.4732	4.2713	3.9737	1.2019	0.30246
483	952	2.9854	2.9573	3.1165	8.2439	5.4721	4.2708	3.9732	1.2013	0.30236
484	954	2.9862	2.9588	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
485	956	2.988	2.9607	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
486	958	2.9916	2.9628	3.1165	8.2439	5.4721	4.2713	3.9726	1.2007	0.30225
487	960	2.9943	2.965	3.1165	8.2445	5.4727	4.2713	3.9732	1.2013	0.30236
488	962	2.997	2.9671	3.1165	8.2436	5.475	4.2725	3.9711	1.2025	0.30281
489	964	2.9988	2.9699	3.1165	8.2427	5.4773	4.2719	3.9708	1.2054	0.30357
490	966	2.9997	2.9718	3.1165	8.2421	5.4768	4.2725	3.9696	1.2042	0.30336
491	968	3.0015	2.9741	3.1165	8.2436	5.475	4.2713	3.9723	1.2037	0.30302
492	970	3.0033	2.9756	3.1165	8.2419	5.4732	4.2713	3.9706	1.2019	0.3027
493	972	3.006	2.9775	3.1165	8.2419	5.4732	4.2713	3.9706	1.2019	0.3027
494	974	3.0078	2.9794	3.1165	8.2425	5.4738	4.2713	3.9712	1.2025	0.3028
495	976	3.0105	2.9812	3.1165	8.2419	5.4732	4.2713	3.9706	1.2019	0.3027
496	978	3.0122	2.9835	3.1165	8.2399	5.4744	4.2719	3.968	1.2025	0.30304

497	980	3.0149	2.9858	3.1165	8.2436	5.475	4.2719	3.9717	1.2031	0.30291
498	982	3.0176	2.988	3.1165	8.2405	5.475	4.2725	3.968	1.2025	0.30305
499	984	3.0203	2.9905	3.1165	8.2421	5.4768	4.2719	3.9702	1.2048	0.30347
500	986	3.0212	2.9926	3.1165	8.2396	5.4773	4.2719	3.9677	1.2054	0.30381
501	988	3.0266	2.9954	3.1165	8.2418	5.4797	4.2713	3.9705	1.2083	0.30433
502	990	3.0275	2.9982	3.1165	8.242	5.4832	4.2713	3.9707	1.2119	0.3052
503	992	3.0311	3.0009	3.1165	8.24	5.4844	4.2719	3.9681	1.2124	0.30555
504	994	3.0347	3.0041	3.1165	8.245	5.4896	4.2725	3.9724	1.2171	0.30639
505	996	3.0373	3.0075	3.1165	8.2426	5.4937	4.2713	3.9713	1.2224	0.30781
506	998	3.0391	3.0101	3.1165	8.2446	5.4926	4.2725	3.9721	1.22	0.30715
507	1000	3.04	3.0124	3.1165	8.2435	5.4914	4.2719	3.9716	1.2195	0.30705
508	1002	3.0409	3.0141	3.1165	8.2402	5.4879	4.2725	3.9677	1.2154	0.30631
509	1004	3.0427	3.0156	3.1165	8.2431	5.4844	4.2708	3.9723	1.2136	0.30551
510	1006	3.0427	3.0163	3.1165	8.2449	5.4797	4.2719	3.973	1.2078	0.30399
511	1008	3.0445	3.0171	3.1165	8.2447	5.4762	4.2719	3.9728	1.2042	0.30312
512	1010	3.0445	3.0178	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
513	1012	3.0454	3.0186	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
514	1014	3.0454	3.0199	3.1165	8.2434	5.4715	4.2731	3.9703	1.1984	0.30184
515	1016	3.0481	3.0216	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
516	1018	3.0499	3.0231	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
517	1020	3.0535	3.0246	3.1165	8.2428	5.4709	4.2719	3.9709	1.199	0.30194
518	1022	3.0562	3.0267	3.1165	8.2445	5.4727	4.2725	3.972	1.2001	0.30215
519	1024	3.058	3.0288	3.1165	8.2445	5.4727	4.2708	3.9737	1.2019	0.30246
520	1026	3.0598	3.0307	3.1165	8.2445	5.4727	4.2713	3.9732	1.2013	0.30236
521	1028	3.0625	3.0327	3.1165	8.2425	5.4738	4.2708	3.9717	1.2031	0.30291
522	1030	3.0633	3.0344	3.1165	8.2425	5.4738	4.2725	3.97	1.2013	0.3026
523	1032	3.0651	3.0361	3.1165	8.2419	5.4732	4.2725	3.9694	1.2007	0.30249
524	1034	3.0669	3.0382	3.1165	8.2445	5.4727	4.2713	3.9732	1.2013	0.30236
525	1036	3.0669	3.0397	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
526	1038	3.0678	3.0414	3.1165	8.2403	5.4715	4.2719	3.9684	1.1996	0.30228
527	1040	3.0696	3.0431	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
528	1042	3.0723	3.045	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
529	1044	3.0741	3.0465	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
530	1046	3.0759	3.0482	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
531	1048	3.0777	3.0501	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
532	1050	3.0786	3.0518	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
533	1052	3.0813	3.0535	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
534	1054	3.084	3.0554	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
535	1056	3.0885	3.0573	3.1165	8.2439	5.4721	4.2719	3.972	1.2001	0.30215
536	1058	3.0902	3.0599	3.1165	8.2421	5.4768	4.2713	3.9708	1.2054	0.30357
537	1060	3.0947	3.0629	3.1165	8.2393	5.4803	4.2713	3.9679	1.2089	0.30468
538	1062	3.0965	3.0659	3.1165	8.2437	5.4849	4.2713	3.9723	1.2136	0.30552
539	1064	3.0992	3.0688	3.1165	8.2433	5.4879	4.2725	3.9708	1.2154	0.30608
540	1066	3.1028	3.072	3.1165	8.2435	5.4914	4.2719	3.9716	1.2195	0.30705
541	1068	3.1046	3.0752	3.1165	8.2426	5.4937	4.2708	3.9719	1.223	0.30791
542	1070	3.1073	3.0776	3.1165	8.2432	5.4943	4.2719	3.9712	1.2224	0.30781
543	1072	3.1091	3.0797	3.1165	8.2426	5.4937	4.2725	3.9701	1.2212	0.3076
544	1074	3.1136	3.082	3.1165	8.2437	5.4949	4.2725	3.9712	1.2224	0.30781
545	1076	3.1153	3.085	3.1165	8.2439	5.4984	4.2713	3.9726	1.2271	0.30889
546	1078	3.1171	3.0876	3.1165	8.245	5.4996	4.2725	3.9725	1.2271	0.30889
547	1080	3.118	3.0897	3.1165	8.2434	5.4978	4.2719	3.9714	1.2259	0.30868
548	1082	3.118	3.091	3.1165	8.2432	5.4943	4.2719	3.9712	1.2224	0.30781
549	1084	3.1198	3.0918	3.1165	8.2424	5.4902	4.2719	3.9705	1.2183	0.30684
550	1086	3.1216	3.0927	3.1165	8.2422	5.4867	4.2725	3.9697	1.2142	0.30587
551	1088	3.1216	3.0935	3.1165	8.2426	5.4838	4.2719	3.9706	1.2119	0.3052
552	1090	3.1225	3.0944	3.1165	8.2424	5.4803	4.2719	3.9704	1.2083	0.30433
553	1092	3.1252	3.0957	3.1165	8.2424	5.4803	4.2719	3.9704	1.2083	0.30433
554	1094	3.1261	3.0967	3.1165	8.2424	5.4803	4.2713	3.971	1.2089	0.30444
555	1096	3.127	3.0982	3.1165	8.2438	5.4785	4.2719	3.9719	1.2066	0.30378
556	1098	3.127	3.0991	3.1165	8.2405	5.475	4.2719	3.9686	1.2031	0.30315
557	1100	3.1288	3.0999	3.1165	8.2439	5.4721	4.2725	3.9714	1.1996	0.30205
558	1102	3.1306	3.101	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
559	1104	3.1315	3.1025	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
560	1106	3.1324	3.1037	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
561	1108	3.1342	3.1052	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
562	1110	3.1342	3.1069	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
563	1112	3.136	3.1084	3.1165	8.2428	5.4709	4.2713	3.9715	1.1996	0.30204
564	1114	3.1369	3.1101	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
565	1116	3.1396	3.1116	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
566	1118	3.1422	3.1133	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
567	1120	3.1458	3.115	3.1165	8.2408	5.4721	4.2725	3.9683	1.1996	0.30228
568	1122	3.1476	3.1172	3.1165	8.2425	5.4738	4.2719	3.9706	1.2019	0.3027
569	1124	3.1503	3.1193	3.1165	8.2447	5.4762	4.2725	3.9722	1.2037	0.30302
570	1126	3.1512	3.1216	3.1165	8.2447	5.4762	4.2725	3.9722	1.2037	0.30302
571	1128	3.1521	3.1229	3.1165	8.2445	5.4727	4.2725	3.972	1.2001	0.30215
572	1130	3.153	3.1246	3.1165	8.2428	5.4709	4.2702	3.9727	1.2007	0.30225
573	1132	3.1548	3.1259	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
574	1134	3.1584	3.1276	3.1165	8.2445	5.4727	4.2731	3.9714	1.1996	0.30205
575	1136	3.1593	3.1297	3.1165	8.2394	5.4738	4.2725	3.9669	1.2013	0.30284
576	1138	3.1611	3.1312	3.1165	8.2425	5.4738	4.2719	3.9706	1.2019	0.3027
577	1140	3.1629	3.1331	3.1165	8.2425	5.4738	4.2719	3.9706	1.2019	0.3027
578	1142	3.1647	3.1348	3.1165	8.2425	5.4738	4.2708	3.9717	1.2031	0.30291
579	1144	3.1682	3.1365	3.1165	8.2441	5.4756	4.2725	3.9716	1.2031	0.30292
580	1146	3.1718	3.1391	3.1165	8.2443	5.4791	4.2725	3.9718	1.2066	0.30378
581	1148	3.1745	3.1421	3.1165	8.2437	5.4849	4.2725	3.9711	1.2124	0.30531
582	1150	3.1772	3.1455	3.1165	8.2419	5.4896	4.2725	3.9693	1.2171	0.30663
583	1152	3.179	3.1482	3.1165	8.2435	5.4914	4.2719	3.9716	1.2195	0.30705
584	1154	3.1826	3.1512	3.1165	8.2457	5.4937	4.2708	3.975	1.223	0.30767
585	1156	3.1844	3.1535	3.1165	8.2437	5.4949	4.2719	3.9718	1.223	0.30792
586	1158	3.188	3.1563	3.1165	8.2454	5.4967	4.2719	3.9734	1.2247	0.30823
587	1160	3.1889	3.1589	3.1165	8.2439	5.4984	4.2713	3.9726	1.2271	0.30889
588	1162	3.1907	3.161	3.1165	8.2439	5.4984	4.2719	3.972	1.2265	0.30878
589	1164	3.1924	3.1629	3.1165	8.2448	5.4961	4.2719	3.9729	1.2241	0.30812
590	1166	3.1933	3.1644	3.1165	8.2426	5.4937	4.2719	3.9707	1.2218	0.30771
591	1168	3.1942	3.1655	3.1165	8.2444	5.489	4.2713	3.9731	1.2177	0.30649
592	1170	3.1951	3.1659	3.1165	8.2437	5.4849	4.2719	3.9717	1.213	0.30541
593	1172	3.1951	3.1665	3.1165	8.244	5.482	4.2731	3.9709	1.2089	0.30445
594	1174	3.196	3.1672	3.1165	8.2438	5.4785	4.2719	3.9719	1.2066	0.30378
595	1176	3.1969	3.1676	3.1165	8.2441	5.4756	4.2725	3.9716	1.2031	0.30292
596	1178	3.1987	3.1682	3.1165	8.2425	5.4738	4.2719	3.9706	1.2019	0.3027
597	1180	3.1996	3.1691	3.1165	8.245	5.4732	4.2725	3.9725	1.2007	0.30226

598	1182	3.2005	3.1704	3.1165	8.2419	5.4732	4.2719	3.97	1.2013	0.3026
599	1184	3.2032	3.1719	3.1165	8.2436	5.475	4.2719	3.9717	1.2031	0.30291
600	1186	3.205	3.1738	3.1165	8.2447	5.4762	4.2725	3.9722	1.2037	0.30302
601	1188	3.2068	3.1757	3.1165	8.2432	5.4779	4.2713	3.9719	1.2066	0.30378
602	1190	3.2086	3.1776	3.1165	8.2407	5.4785	4.2708	3.9699	1.2078	0.30422
603	1192	3.2095	3.1799	3.1165	8.2449	5.4797	4.2708	3.9741	1.2089	0.3042
604	1194	3.2113	3.1812	3.1165	8.2432	5.4779	4.2725	3.9707	1.2054	0.30357
605	1196	3.2131	3.1825	3.1165	8.2436	5.475	4.2719	3.9717	1.2031	0.30291
606	1198	3.2175	3.1846	3.1165	8.2438	5.4785	4.2708	3.973	1.2078	0.30399
607	1200	3.2193	3.187	3.1165	8.2451	5.4832	4.2719	3.9732	1.2113	0.30486
608	1202	3.2211	3.1893	3.1165	8.2442	5.4855	4.2725	3.9717	1.213	0.30542
609	1204	3.2247	3.1921	3.1165	8.2419	5.4896	4.2713	3.9705	1.2183	0.30683
610	1206	3.2265	3.1944	3.1165	8.2441	5.492	4.2725	3.9716	1.2195	0.30705
611	1208	3.2301	3.1974	3.1165	8.2417	5.4961	4.2719	3.9698	1.2241	0.30836
612	1210	3.231	3.2002	3.1165	8.2439	5.4984	4.2708	3.9732	1.2277	0.30899
613	1212	3.2337	3.2025	3.1165	8.2419	5.4996	4.2725	3.9694	1.2271	0.30913
614	1214	3.2355	3.2048	3.1165	8.245	5.4996	4.2725	3.9725	1.2271	0.30889
615	1216	3.2373	3.2068	3.1165	8.2439	5.4984	4.2719	3.972	1.2265	0.30878
616	1218	3.2382	3.2082	3.1165	8.2397	5.4972	4.2708	3.969	1.2265	0.30902
617	1220	3.24	3.2097	3.1165	8.2454	5.4967	4.2719	3.9734	1.2247	0.30823
618	1222	3.2418	3.2114	3.1165	8.2443	5.4955	4.2719	3.9723	1.2236	0.30802
619	1224	3.2435	3.2129	3.1165	8.2437	5.4949	4.2708	3.973	1.2241	0.30812
620	1226	3.2444	3.214	3.1165	8.2421	5.4931	4.2731	3.969	1.22	0.3074
621	1228	3.2462	3.2159	3.1165	8.2441	5.492	4.2713	3.9727	1.2206	0.30725
622	1230	3.248	3.2174	3.1165	8.2415	5.4926	4.2725	3.969	1.22	0.30739
623	1232	3.2489	3.2189	3.1165	8.2435	5.4914	4.2719	3.9716	1.2195	0.30705
624	1234	3.2507	3.2202	3.1165	8.2424	5.4902	4.2713	3.9711	1.2189	0.30694
625	1236	3.2525	3.2217	3.1165	8.245	5.4896	4.2725	3.9724	1.2171	0.30639
626	1238	3.2543	3.2231	3.1165	8.2419	5.4896	4.2719	3.9699	1.2177	0.30673
627	1240	3.2561	3.2246	3.1165	8.2424	5.4902	4.2719	3.9705	1.2183	0.30684
628	1242	3.2588	3.2263	3.1165	8.2435	5.4914	4.2725	3.971	1.2189	0.30694
629	1244	3.2597	3.2285	3.1165	8.2446	5.4926	4.2725	3.9721	1.22	0.30715
630	1246	3.2615	3.2306	3.1165	8.2452	5.4931	4.2719	3.9732	1.2212	0.30736
631	1248	3.2642	3.2325	3.1165	8.2452	5.4931	4.2708	3.9744	1.2224	0.30756
632	1250	3.266	3.234	3.1165	8.2437	5.4949	4.2725	3.9712	1.2224	0.30781
633	1252	3.2686	3.2363	3.1165	8.2448	5.4961	4.2713	3.9735	1.2247	0.30823
634	1254	3.2713	3.2387	3.1165	8.2439	5.4984	4.2719	3.972	1.2265	0.30878
635	1256	3.274	3.2414	3.1165	8.2441	5.5019	4.2708	3.9734	1.2312	0.30986
636	1258	3.2758	3.2438	3.1165	8.2432	5.5043	4.2725	3.9707	1.2318	0.31021
637	1260	3.2758	3.2459	3.1165	8.2427	5.5037	4.2713	3.9713	1.2323	0.31031
638	1262	3.2785	3.248	3.1165	8.2441	5.5019	4.2719	3.9722	1.23	0.30965
639	1264	3.2794	3.2493	3.1165	8.2425	5.5002	4.2719	3.9705	1.2282	0.30934
640	1266	3.2812	3.2502	3.1165	8.2434	5.4978	4.2731	3.9703	1.2247	0.30848
641	1268	3.2839	3.2519	3.1165	8.2439	5.4984	4.2725	3.9714	1.2259	0.30868
642	1270	3.2857	3.2538	3.1165	8.245	5.4996	4.2719	3.9731	1.2277	0.30899
643	1272	3.2866	3.2557	3.1165	8.2425	5.5002	4.2719	3.9705	1.2282	0.30934
644	1274	3.2893	3.2572	3.1165	8.2405	5.5013	4.2725	3.968	1.2288	0.30969
645	1276	3.2902	3.2591	3.1165	8.2436	5.5013	4.2719	3.9716	1.2294	0.30955
646	1278	3.292	3.2606	3.1165	8.2419	5.4996	4.2725	3.9694	1.2271	0.30913
647	1280	3.2937	3.2625	3.1165	8.2445	5.499	4.2713	3.9731	1.2277	0.30899
648	1282	3.2937	3.2638	3.1165	8.2428	5.4972	4.2719	3.9709	1.2253	0.30857
649	1284	3.2946	3.2653	3.1165	8.2437	5.4949	4.2719	3.9718	1.223	0.30792
650	1286	3.2982	3.2663	3.1165	8.2421	5.4931	4.2719	3.9701	1.2212	0.3076
651	1288	3.2982	3.2681	3.1165	8.2446	5.4926	4.2713	3.9733	1.2212	0.30736
652	1290	3.3	3.2691	3.1165	8.2424	5.4902	4.2719	3.9705	1.2183	0.30684
653	1292	3.3	3.2702	3.1165	8.2428	5.4873	4.2713	3.9714	1.2159	0.30617
654	1294	3.3018	3.2712	3.1165	8.2437	5.4849	4.2719	3.9717	1.213	0.30541
655	1296	3.3027	3.2719	3.1165	8.2404	5.4814	4.2719	3.9684	1.2095	0.30478
656	1298	3.3036	3.2727	3.1165	8.2418	5.4797	4.2713	3.9705	1.2083	0.30433
657	1300	3.3054	3.274	3.1165	8.2438	5.4785	4.2719	3.9719	1.2066	0.30378
658	1302	3.3072	3.2753	3.1165	8.2438	5.4785	4.2719	3.9719	1.2066	0.30378
659	1304	3.3081	3.2768	3.1165	8.2418	5.4797	4.2719	3.9699	1.2078	0.30423
660	1306	3.3099	3.2781	3.1165	8.2443	5.4791	4.2725	3.9718	1.2066	0.30378
661	1308	3.3117	3.2802	3.1165	8.2449	5.4797	4.2702	3.9747	1.2095	0.3043
662	1310	3.3126	3.2815	3.1165	8.2438	5.4785	4.2725	3.9713	1.206	0.30368
663	1312	3.3153	3.2834	3.1165	8.2424	5.4803	4.2725	3.9698	1.2078	0.30423
664	1314	3.3171	3.2851	3.1165	8.2435	5.4814	4.2719	3.9715	1.2095	0.30455
665	1316	3.318	3.287	3.1165	8.2404	5.4814	4.2719	3.9684	1.2095	0.30478
666	1318	3.3206	3.2887	3.1165	8.2429	5.4808	4.2719	3.971	1.2089	0.30444
667	1320	3.3233	3.2908	3.1165	8.2446	5.4826	4.2725	3.972	1.2101	0.30465
668	1322	3.3242	3.2927	3.1165	8.2451	5.4832	4.2719	3.9732	1.2113	0.30486
669	1324	3.326	3.2949	3.1165	8.2415	5.4826	4.2713	3.9701	1.2113	0.3051
670	1326	3.3269	3.2961	3.1165	8.2424	5.4803	4.2725	3.9698	1.2078	0.30423
671	1328	3.3296	3.2976	3.1165	8.2424	5.4803	4.2719	3.9704	1.2083	0.30433
672	1330	3.3305	3.2991	3.1165	8.2424	5.4803	4.2725	3.9698	1.2078	0.30423
673	1332	3.3323	3.301	3.1165	8.2449	5.4797	4.2725	3.9724	1.2072	0.30389
674	1334	3.3359	3.3032	3.1165	8.2454	5.4803	4.2725	3.9729	1.2078	0.30399
675	1336	3.3368	3.3049	3.1165	8.2443	5.4791	4.2713	3.973	1.2078	0.30399
676	1338	3.3395	3.3066	3.1165	8.2429	5.4808	4.2708	3.9721	1.2101	0.30464
677	1340	3.3422	3.3087	3.1165	8.2442	5.4855	4.2731	3.9711	1.2124	0.30531
678	1342	3.3457	3.3117	3.1165	8.2444	5.489	4.2719	3.9725	1.2171	0.30639
679	1344	3.3475	3.3144	3.1165	8.2446	5.4926	4.2725	3.9721	1.22	0.30715
680	1346	3.3502	3.317	3.1165	8.2432	5.4943	4.2719	3.9712	1.2224	0.30781
681	1348	3.3511	3.32	3.1165	8.2448	5.4961	4.2725	3.9723	1.2236	0.30802
682	1350	3.3529	3.3219	3.1165	8.2432	5.4943	4.2713	3.9718	1.223	0.30791
683	1352	3.3547	3.3234	3.1165	8.2395	5.4937	4.2725	3.967	1.2212	0.30784
684	1354	3.3565	3.3253	3.1165	8.2441	5.492	4.2713	3.9727	1.2206	0.30725
685	1356	3.3583	3.3264	3.1165	8.245	5.4896	4.2725	3.9724	1.2171	0.30639
686	1358	3.361	3.3285	3.1165	8.245	5.4896	4.2713	3.9736	1.2183	0.30659
687	1360	3.3619	3.33	3.1165	8.2419	5.4896	4.2719	3.9699	1.2177	0.30673
688	1362	3.3637	3.3321	3.1165	8.245	5.4896	4.2713	3.9736	1.2183	0.30659
689	1364	3.3664	3.3342	3.1165	8.2419	5.4896	4.2708	3.9711	1.2189	0.30694
690	1366	3.37	3.3364	3.1165	8.2401	5.4943	4.2719	3.9681	1.2224	0.30805
691	1368	3.3708	3.3387	3.1165	8.2417	5.4961	4.2719	3.9698	1.2241	0.30836
692	1370	3.3717	3.3408	3.1165	8.2406	5.4949	4.2719	3.9687	1.223	0.30816
693	1372	3.3726	3.3423	3.1165	8.2415	5.4926	4.2719	3.9696	1.2206	0.3075
694	1374	3.3735	3.3434	3.1165	8.2408	5.4885	4.2725	3.9682	1.2159	0.30642
695	1376	3.3753	3.3447	3.1165	8.2442	5.4855	4.2719	3.9723	1.2136	0.30552
696	1378	3.3771	3.3457	3.1165	8.2426	5.4838	4.2713	3.9712	1.2124	0.30531
697	1380	3.3798	3.3472	3.1165	8.2426	5.4838	4.2719	3.9706	1.2119	0.3052
698	1382	3.3807	3.3485	3.1165	8.2426	5.4838	4.2725	3.97	1.2113	0.3051

699	1384	3.3825	3.3502	3.1165	8.2426	5.4838	4.2719	3.9706	1.2119	0.3052
700	1386	3.3834	3.3519	3.1165	8.2435	5.4814	4.2725	3.9709	1.2089	0.30444
701	1388	3.3852	3.353	3.1165	8.2418	5.4797	4.2719	3.9699	1.2078	0.30423
702	1390	3.3879	3.3547	3.1165	8.2398	5.4808	4.2719	3.9679	1.2089	0.30468
703	1392	3.3906	3.3572	3.1165	8.2426	5.4838	4.2725	3.97	1.2113	0.3051
704	1394	3.3924	3.3598	3.1165	8.2442	5.4855	4.2713	3.9729	1.2142	0.30562
705	1396	3.3942	3.3621	3.1165	8.2428	5.4873	4.2725	3.9702	1.2148	0.30597
706	1398	3.396	3.3638	3.1165	8.2453	5.4867	4.2719	3.9734	1.2148	0.30573
707	1400	3.3977	3.366	3.1165	8.2448	5.4861	4.2725	3.9722	1.2136	0.30552
708	1402	3.4013	3.3679	3.1165	8.2442	5.4855	4.2719	3.9723	1.2136	0.30552
709	1404	3.4022	3.3698	3.1165	8.2428	5.4873	4.2719	3.9708	1.2154	0.30607
710	1406	3.4022	3.3717	3.1165	8.2422	5.4867	4.2713	3.9709	1.2154	0.30607
711	1408	3.404	3.3734	3.1165	8.2451	5.4832	4.2719	3.9732	1.2113	0.30486
712	1410	3.4058	3.3747	3.1165	8.2424	5.4803	4.2708	3.9716	1.2095	0.30454
713	1412	3.4085	3.3762	3.1165	8.2443	5.4791	4.2725	3.9718	1.2066	0.30378
714	1414	3.4094	3.3774	3.1165	8.2396	5.4773	4.2713	3.9683	1.206	0.30391
715	1416	3.4103	3.3785	3.1165	8.2441	5.4756	4.2719	3.9722	1.2037	0.30302
716	1418	3.4103	3.3796	3.1165	8.2414	5.4727	4.2719	3.9695	1.2007	0.30249
717	1420	3.4121	3.3809	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
718	1422	3.413	3.3823	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
719	1424	3.4148	3.384	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
720	1426	3.4157	3.3857	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
721	1428	3.4184	3.3872	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
722	1430	3.4211	3.3892	3.1165	8.2434	5.4715	4.2708	3.9726	1.2007	0.30225
723	1432	3.4228	3.3906	3.1165	8.2403	5.4715	4.2725	3.9678	1.199	0.30218
724	1434	3.4273	3.393	3.1165	8.243	5.4744	4.2719	3.9711	1.2025	0.30281
725	1436	3.4282	3.3958	3.1165	8.2432	5.4779	4.2713	3.9719	1.2066	0.30378
726	1438	3.43	3.3979	3.1165	8.2401	5.4779	4.2713	3.9688	1.2066	0.30402
727	1440	3.43	3.3994	3.1165	8.243	5.4744	4.2725	3.9705	1.2019	0.3027
728	1442	3.4318	3.4009	3.1165	8.2428	5.4709	4.2708	3.9721	1.2001	0.30214
729	1444	3.4318	3.4021	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
730	1446	3.4318	3.4036	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
731	1448	3.4327	3.4055	3.1165	8.2439	5.4721	4.2725	3.9714	1.1996	0.30205
732	1450	3.4327	3.4075	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
733	1452	3.4327	3.4092	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
734	1453.9	3.4336	3.4106	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194

TRIAXIAL TEST

Consolidation/B Step: 11

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	8.2434	5.4715	4.2725	3.9709	1.199	0.30194
2	0.012467	0	0.00021283	3.1165	8.2434	5.4715	4.2713	3.9721	1.2001	0.30215
3	0.054117	0	0.00021283	3.1165	8.2434	5.4715	4.2719	3.9715	1.1996	0.30204
4	0.10008	0.0008965	0.00042567	3.1165	8.2439	5.4721	4.2725	3.9714	1.1996	0.30205
5	0.2503	0.0008965	0.001277	3.1165	8.2534	5.4756	4.2737	3.9798	1.2019	0.302
6	0.5006	0.003586	0.0034053	3.1165	8.2702	5.4803	4.2713	3.9989	1.2089	0.30231
7	1.0014	0.013448	0.0093647	3.1165	8.3091	5.492	4.2731	4.036	1.2189	0.302
8	2.0028	0.028688	0.026178	3.1165	8.3816	5.513	4.2743	4.1074	1.2388	0.3016
9	4.0015	0.097719	0.074492	3.1165	8.5203	5.5616	4.2731	4.2472	1.2885	0.30338
10	6.0003	0.15509	0.13345	3.1165	8.6656	5.6009	4.2731	4.3925	1.3278	0.30227
11	8.0031	0.22054	0.2007	3.1165	8.8066	5.6453	4.2725	4.5341	1.3728	0.30278
12	10.002	0.28957	0.27604	3.1165	8.948	5.6969	4.2749	4.6732	1.422	0.30429
13	12	0.38639	0.35479	3.1165	9.0959	5.7355	4.2737	4.8223	1.4618	0.30314
14	14.003	0.45094	0.44056	3.1165	9.2309	5.7835	4.2743	4.9567	1.5092	0.30448
15	16.002	0.5137	0.50292	3.1165	9.2305	5.8028	4.2749	4.9557	1.528	0.30832
16	18.001	0.537	0.54656	3.1165	9.2334	5.7893	4.2749	4.9585	1.5145	0.30543
17	20.004	0.57824	0.57635	3.1165	9.2318	5.7712	4.2743	4.9575	1.4969	0.30195
18	22.002	0.59528	0.60232	3.1165	9.2318	5.7712	4.2731	4.9587	1.4981	0.30212
19	24.001	0.60873	0.62552	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
20	26.004	0.63831	0.64659	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
21	28.004	0.64548	0.66553	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
22	30.004	0.65803	0.68319	3.1165	9.2349	5.7712	4.2731	4.9618	1.4981	0.30193
23	32.003	0.67776	0.70001	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
24	34.001	0.69838	0.71597	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
25	36	0.71362	0.73108	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
26	38	0.73334	0.74534	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
27	40.003	0.74499	0.75896	3.1165	9.2318	5.7712	4.2737	4.9581	1.4975	0.30203
28	42.002	0.75396	0.77216	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
29	44.001	0.76472	0.78472	3.1165	9.2329	5.7724	4.2737	4.9592	1.4987	0.3022
30	46	0.77189	0.79706	3.1165	9.2318	5.7712	4.2731	4.9587	1.4981	0.30212
31	48.003	0.78444	0.80919	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
32	50.003	0.79789	0.82068	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
33	52.002	0.81133	0.83196	3.1165	9.2349	5.7712	4.2737	4.9612	1.4975	0.30184
34	54.001	0.8203	0.84303	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
35	56	0.83733	0.85389	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
36	58.004	0.84809	0.86474	3.1165	9.2323	5.7718	4.2696	4.9628	1.5022	0.30269
37	60.003	0.85437	0.87496	3.1165	9.2318	5.7712	4.2731	4.9587	1.4981	0.30212
38	62.002	0.86154	0.88517	3.1165	9.2318	5.7712	4.2731	4.9587	1.4981	0.30212
39	64.001	0.8723	0.89539	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
40	66.001	0.87947	0.90497	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
41	68.004	0.88754	0.91454	3.1165	9.2318	5.7712	4.2731	4.9587	1.4981	0.30212
42	70.003	0.89381	0.92412	3.1165	9.2354	5.7718	4.2737	4.9618	1.4981	0.30193
43	72.002	0.90547	0.93391	3.1165	9.2349	5.7712	4.2708	4.9641	1.5004	0.30226
44	74.002	0.91623	0.94349	3.1165	9.2318	5.7712	4.2696	4.9622	1.5016	0.30261
45	76.001	0.93057	0.95264	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
46	78	0.94222	0.96179	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
47	80.003	0.9494	0.97073	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
48	82.003	0.95477	0.97946	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
49	84.002	0.96553	0.9884	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
50	86.001	0.97539	0.99691	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
51	88	0.98526	1.0056	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
52	90.004	0.99512	1.0139	3.1165	9.2318	5.7712	4.2731	4.9587	1.4981	0.30212
53	92.003	1.0059	1.0224	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
54	94.002	1.013	1.0305	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
55	96.001	1.022	1.0388	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
56	98	1.0283	1.0469	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
57	100	1.031	1.055	3.1165	9.2329	5.7724	4.2725	4.9604	1.4999	0.30237
58	102	1.0337	1.0631	3.1165	9.2323	5.7718	4.2737	4.9587	1.4981	0.30212
59	104	1.0444	1.071	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
60	106	1.0579	1.0791	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
61	108	1.0686	1.0869	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
62	110	1.0767	1.0946	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
63	112	1.0821	1.1023	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
64	114	1.0875	1.1097	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
65	116	1.0919	1.1174	3.1165	9.2349	5.7712	4.2708	4.9641	1.5004	0.30226
66	118	1.0955	1.1248	3.1165	9.2318	5.7712	4.2708	4.961	1.5004	0.30245
67	120	1.1036	1.1321	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
68	122	1.1117	1.1395	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
69	124	1.1206	1.147	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
70	126	1.1287	1.1542	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
71	128	1.1395	1.1616	3.1165	9.2318	5.7712	4.2702	4.9616	1.501	0.30253
72	130	1.1502	1.1687	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
73	132	1.1637	1.1757	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
74	134	1.1681	1.1827	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
75	136	1.1726	1.1899	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
76	138	1.1735	1.1972	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
77	140	1.1789	1.204	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
78	142	1.1861	1.2108	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
79	144	1.1923	1.2176	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
80	146	1.2058	1.2242	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
81	148	1.2121	1.231	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
82	150	1.2166	1.238	3.1165	9.2323	5.7718	4.2708	4.9616	1.501	0.30253
83	152	1.2201	1.2446	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
84	154	1.2255	1.2515	3.1165	9.2318	5.7712	4.2708	4.961	1.5004	0.30245
85	156	1.2327	1.2581	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
86	158	1.2399	1.2644	3.1165	9.2318	5.7712	4.2731	4.9587	1.4981	0.30212
87	160	1.2452	1.2715	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
88	162	1.2524	1.2778	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
89	164	1.2623	1.2847	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
90	166	1.2703	1.2908	3.1165	9.2349	5.7712	4.2731	4.9618	1.4981	0.30193
91	168	1.2766	1.2974	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
92	170	1.2856	1.3036	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228

93	172	1.291	1.31	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
94	174	1.291	1.3164	3.1165	9.2323	5.7718	4.2708	4.9616	1.501	0.30253
95	176	1.2954	1.3228	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
96	178	1.2999	1.3289	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
97	180	1.3053	1.3353	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
98	182	1.3107	1.3417	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
99	184	1.3188	1.3479	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
100	186	1.3304	1.354	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
101	188	1.3439	1.3604	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
102	190	1.351	1.3666	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
103	192	1.3591	1.373	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
104	194	1.3645	1.3789	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
105	196	1.3672	1.3849	3.1165	9.2323	5.7718	4.2708	4.9616	1.501	0.30253
106	198	1.3725	1.3913	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
107	200	1.3761	1.397	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
108	202	1.3806	1.4032	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
109	204	1.3842	1.4092	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
110	206	1.3914	1.4149	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
111	208	1.3959	1.4209	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
112	210	1.4066	1.4268	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
113	212	1.4093	1.4326	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
114	214	1.4174	1.4383	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
115	216	1.4227	1.4443	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
116	218	1.4272	1.4502	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
117	220	1.4317	1.456	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
118	222	1.4362	1.4615	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
119	224	1.4434	1.4677	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
120	226	1.4523	1.4737	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
121	228	1.4604	1.4796	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
122	230	1.4721	1.4851	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
123	232	1.4747	1.4911	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
124	234	1.4783	1.4969	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
125	236	1.4819	1.5024	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
126	238	1.4855	1.5083	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
127	240	1.49	1.5139	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
128	242	1.4936	1.5192	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
129	244	1.4998	1.5249	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
130	246	1.5025	1.5305	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
131	248	1.5088	1.536	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
132	250	1.5169	1.5411	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
133	252	1.525	1.5467	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
134	254	1.533	1.5524	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
135	256	1.5393	1.5579	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
136	258	1.5456	1.5633	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
137	260	1.5509	1.5686	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
138	262	1.5536	1.5741	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
139	264	1.5572	1.5794	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
140	266	1.5599	1.5852	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
141	268	1.5644	1.5909	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
142	270	1.5671	1.596	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
143	272	1.5725	1.6014	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
144	274	1.5823	1.6069	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
145	276	1.5877	1.612	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
146	278	1.5976	1.6173	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
147	280	1.6038	1.6224	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
148	282	1.611	1.6275	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
149	284	1.6191	1.6326	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
150	286	1.6254	1.638	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
151	288	1.6316	1.6431	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
152	290	1.6352	1.6484	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
153	292	1.6352	1.6535	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
154	294	1.6361	1.6586	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
155	296	1.6379	1.6637	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
156	298	1.6406	1.669	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
157	300	1.6487	1.6741	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
158	302	1.6523	1.6795	3.1165	9.2323	5.7718	4.2702	4.9622	1.5016	0.30261
159	304	1.6585	1.6846	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
160	306	1.6657	1.6895	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
161	308	1.6729	1.6944	3.1165	9.2349	5.7712	4.2731	4.9618	1.4981	0.30193
162	310	1.6765	1.6995	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
163	312	1.6818	1.7044	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
164	314	1.6872	1.7093	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
165	316	1.6917	1.7142	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
166	318	1.6953	1.7191	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
167	320	1.7025	1.7237	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
168	322	1.7096	1.7286	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
169	324	1.715	1.7337	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
170	326	1.7186	1.7386	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
171	328	1.7213	1.7433	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
172	330	1.724	1.7486	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
173	332	1.7276	1.7533	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
174	334	1.7302	1.7582	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
175	336	1.7356	1.7631	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
176	338	1.741	1.7678	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
177	340	1.7491	1.7729	3.1165	9.2318	5.7712	4.2708	4.961	1.5004	0.30245
178	342	1.7545	1.7776	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
179	344	1.7607	1.7823	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
180	346	1.7688	1.7867	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
181	348	1.7733	1.7914	3.1165	9.2349	5.7712	4.2731	4.9618	1.4981	0.30193
182	350	1.776	1.7965	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
183	352	1.7805	1.8012	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
184	354	1.7858	1.8059	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
185	356	1.7894	1.8104	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
186	358	1.7939	1.815	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
187	360	1.7957	1.8197	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
188	362	1.8002	1.8248	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
189	364	1.8038	1.8293	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
190	366	1.8073	1.834	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
191	368	1.8145	1.8385	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
192	370	1.819	1.8431	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
193	372	1.8262	1.8476	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201

194	374	1.8307	1.8525	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
195	376	1.8351	1.857	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
196	378	1.8423	1.8614	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
197	380	1.8477	1.8657	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
198	382	1.8522	1.8702	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
199	384	1.8567	1.8744	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
200	386	1.8593	1.8791	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
201	388	1.8611	1.8836	3.1165	9.2349	5.7712	4.2702	4.9647	1.501	0.30234
202	390	1.8674	1.8876	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
203	392	1.8701	1.8921	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
204	394	1.8737	1.8961	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
205	396	1.8782	1.9006	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
206	398	1.8818	1.9053	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
207	400	1.8862	1.9095	3.1165	9.2318	5.7712	4.2702	4.9616	1.501	0.30253
208	402	1.8907	1.9138	3.1165	9.2354	5.7718	4.2696	4.9659	1.5022	0.3025
209	404	1.8952	1.9178	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
210	406	1.9024	1.9223	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
211	408	1.9087	1.9264	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
212	410	1.9149	1.931	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
213	412	1.9185	1.9351	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
214	414	1.9203	1.9393	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
215	416	1.9221	1.9434	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
216	418	1.9257	1.9474	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
217	420	1.9266	1.9515	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
218	422	1.9293	1.9557	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
219	424	1.9338	1.96	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
220	426	1.9409	1.964	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
221	428	1.9472	1.9683	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
222	430	1.9526	1.9725	3.1165	9.2323	5.7718	4.2702	4.9622	1.5016	0.30261
223	432	1.9598	1.9766	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
224	434	1.9624	1.9808	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
225	436	1.9642	1.9851	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
226	438	1.9669	1.9891	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
227	440	1.9696	1.9932	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
228	442	1.9732	1.9972	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
229	444	1.9813	2.0015	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
230	446	1.9893	2.0053	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
231	448	1.9974	2.0096	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
232	450	2.0055	2.0134	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
233	452	2.01	2.0174	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
234	454	2.0135	2.0213	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
235	456	2.0189	2.0251	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
236	458	2.0198	2.0291	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
237	460	2.0207	2.0332	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
238	462	2.0207	2.0372	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
239	464	2.0234	2.0411	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
240	466	2.0234	2.0451	3.1165	9.2349	5.7712	4.2702	4.9647	1.501	0.30234
241	468	2.0243	2.0487	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
242	470	2.0252	2.053	3.1165	9.2318	5.7712	4.2708	4.961	1.5004	0.30245
243	472	2.0288	2.0568	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
244	474	2.0386	2.0609	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
245	476	2.0431	2.0649	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
246	478	2.0494	2.0687	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
247	480	2.0593	2.0728	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
248	482	2.0646	2.0766	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
249	484	2.0727	2.0804	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
250	486	2.0754	2.0843	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
251	488	2.0799	2.0881	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
252	490	2.0826	2.0917	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
253	492	2.088	2.0958	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
254	494	2.0933	2.0994	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
255	496	2.096	2.1032	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
256	498	2.0987	2.107	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
257	500	2.1023	2.1109	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
258	502	2.1059	2.1147	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
259	504	2.1113	2.1185	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
260	506	2.1148	2.1222	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
261	508	2.1157	2.126	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
262	510	2.1175	2.1298	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
263	512	2.1193	2.1337	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
264	514	2.1202	2.1373	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
265	516	2.122	2.1413	3.1165	9.2323	5.7718	4.2702	4.9622	1.5016	0.30261
266	518	2.1247	2.1449	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
267	520	2.1274	2.1485	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
268	522	2.1319	2.1522	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
269	524	2.1382	2.156	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
270	526	2.1426	2.1596	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
271	528	2.1462	2.1634	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
272	530	2.1507	2.1669	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
273	532	2.1552	2.1707	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
274	534	2.1588	2.1743	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
275	536	2.1642	2.1783	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
276	538	2.1695	2.182	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
277	540	2.1749	2.1854	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
278	542	2.1785	2.189	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
279	544	2.1812	2.1926	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
280	546	2.1857	2.196	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
281	548	2.1893	2.2001	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
282	550	2.1955	2.2037	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
283	552	2.2036	2.2069	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
284	554	2.2072	2.2105	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
285	556	2.209	2.2141	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
286	558	2.2117	2.2175	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
287	560	2.2126	2.2216	3.1165	9.2354	5.7718	4.2696	4.9659	1.5022	0.3025
288	562	2.2144	2.225	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
289	564	2.2179	2.2281	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
290	566	2.2206	2.232	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
291	568	2.2233	2.2354	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
292	570	2.2269	2.239	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
293	572	2.2296	2.2426	3.1165	9.2323	5.7718	4.2702	4.9622	1.5016	0.30261
294	574	2.2332	2.246	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228

295	576	2.2368	2.2494	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
296	578	2.2413	2.2528	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
297	580	2.243	2.256	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
298	582	2.2493	2.2594	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
299	584	2.2547	2.2626	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
300	586	2.2601	2.266	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
301	588	2.2646	2.2699	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
302	590	2.2682	2.2731	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
303	592	2.2726	2.2765	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
304	594	2.2753	2.2797	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
305	596	2.2807	2.2833	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
306	598	2.2852	2.2869	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
307	600	2.2879	2.2903	3.1165	9.2354	5.7718	4.2702	4.9653	1.5016	0.30242
308	602	2.2906	2.2935	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
309	604	2.2941	2.2969	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
310	606	2.2977	2.3001	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
311	608	2.2995	2.3033	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
312	610	2.3022	2.3065	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
313	612	2.304	2.3101	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
314	614	2.3067	2.3131	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
315	616	2.3094	2.3165	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
316	618	2.313	2.3197	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
317	620	2.3157	2.3231	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
318	622	2.3193	2.3263	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
319	624	2.3246	2.3297	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
320	626	2.3282	2.3329	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
321	628	2.3309	2.3363	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
322	630	2.3318	2.3392	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
323	632	2.3327	2.3427	3.1165	9.2349	5.7712	4.2702	4.9647	1.501	0.30234
324	634	2.3354	2.3458	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
325	636	2.3417	2.349	3.1165	9.2323	5.7718	4.2702	4.9622	1.5016	0.30261
326	638	2.3461	2.3522	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
327	640	2.3515	2.3556	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
328	642	2.3569	2.3586	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
329	644	2.3614	2.3618	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
330	646	2.365	2.3652	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
331	648	2.3677	2.3682	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
332	650	2.3704	2.3714	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
333	652	2.3712	2.3748	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
334	654	2.373	2.3782	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
335	656	2.3739	2.3814	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
336	658	2.3757	2.3846	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
337	660	2.3793	2.3873	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
338	662	2.3874	2.3908	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
339	664	2.3937	2.3939	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
340	666	2.3972	2.3967	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
341	668	2.4008	2.4001	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
342	670	2.4017	2.4031	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
343	672	2.4026	2.4061	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
344	674	2.4035	2.4088	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
345	676	2.4062	2.4122	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
346	678	2.408	2.4152	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
347	680	2.4107	2.4184	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
348	682	2.4143	2.4216	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
349	684	2.4197	2.4248	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
350	686	2.425	2.4274	3.1165	9.2349	5.7712	4.2731	4.9618	1.4981	0.30193
351	688	2.4304	2.4306	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
352	690	2.434	2.4337	3.1165	9.2323	5.7718	4.2708	4.9616	1.501	0.30253
353	692	2.4376	2.4363	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
354	694	2.4412	2.4397	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
355	696	2.4448	2.4427	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
356	698	2.4492	2.4457	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
357	700	2.4537	2.4489	3.1165	9.2323	5.7718	4.2708	4.9616	1.501	0.30253
358	702	2.4573	2.4516	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
359	704	2.4627	2.4548	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
360	706	2.4663	2.4576	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
361	708	2.4672	2.461	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
362	710	2.4708	2.4638	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
363	712	2.4717	2.4669	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
364	714	2.4726	2.4699	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
365	716	2.4743	2.4729	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
366	718	2.4761	2.4757	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
367	720	2.4779	2.4787	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
368	722	2.4797	2.4814	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
369	724	2.4815	2.4846	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
370	726	2.4842	2.4874	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
371	728	2.4914	2.4899	3.1165	9.2354	5.7718	4.2731	4.9623	1.4987	0.30201
372	730	2.4977	2.4931	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
373	732	2.5012	2.4959	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
374	734	2.5039	2.4987	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
375	736	2.5066	2.5016	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
376	738	2.5111	2.5046	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
377	740	2.512	2.5076	3.1165	9.2318	5.7712	4.2713	4.9604	1.4999	0.30236
378	742	2.5147	2.5104	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
379	744	2.5156	2.5131	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
380	746	2.5165	2.5159	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
381	748	2.5201	2.5185	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
382	750	2.5219	2.5212	3.1165	9.2349	5.7712	4.2702	4.9647	1.501	0.30234
383	752	2.5246	2.524	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
384	754	2.5263	2.5268	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
385	756	2.529	2.5297	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
386	758	2.5317	2.5321	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
387	760	2.5326	2.5351	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
388	762	2.5353	2.5376	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
389	764	2.538	2.5406	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
390	766	2.5425	2.5434	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
391	768	2.5461	2.5459	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
392	770	2.5497	2.5489	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
393	772	2.5559	2.5517	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
394	774	2.5622	2.5542	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
395	776	2.5658	2.557	3.1165	9.2349	5.7712	4.2708	4.9641	1.5004	0.30226

396	778	2.5685	2.5591	3.1165	9.2323	5.7718	4.2731	4.9592	1.4987	0.3022
397	780	2.5712	2.5619	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
398	782	2.5757	2.5646	3.1165	9.236	5.7724	4.2702	4.9658	1.5022	0.30251
399	784	2.5792	2.5672	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
400	786	2.5801	2.5697	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
401	788	2.5828	2.5723	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
402	790	2.5846	2.5749	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
403	792	2.5873	2.5774	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
404	794	2.5891	2.5797	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
405	796	2.5936	2.5825	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
406	798	2.5972	2.5849	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
407	800	2.6034	2.5876	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
408	802	2.6079	2.5902	3.1165	9.2349	5.7712	4.2708	4.9641	1.5004	0.30226
409	804	2.6115	2.5929	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
410	806	2.6142	2.5955	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
411	808	2.6142	2.5978	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
412	810	2.616	2.6004	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
413	812	2.6187	2.6025	3.1165	9.2349	5.7712	4.2708	4.9641	1.5004	0.30226
414	814	2.6205	2.6051	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
415	816	2.6205	2.6074	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
416	818	2.6214	2.6102	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
417	820	2.6223	2.6127	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
418	822	2.6232	2.6153	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
419	824	2.625	2.6176	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
420	826	2.6268	2.6202	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
421	828	2.6303	2.623	3.1165	9.2323	5.7718	4.2708	4.9616	1.501	0.30253
422	830	2.6321	2.6255	3.1165	9.2323	5.7718	4.2702	4.9622	1.5016	0.30261
423	832	2.6348	2.6278	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
424	834	2.6375	2.63	3.1165	9.2318	5.7712	4.2725	4.9593	1.4987	0.3022
425	836	2.6402	2.6327	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
426	838	2.6429	2.6351	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
427	840	2.6438	2.6376	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
428	842	2.6465	2.6404	3.1165	9.2323	5.7718	4.2702	4.9622	1.5016	0.30261
429	844	2.6483	2.6423	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
430	846	2.651	2.6449	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
431	848	2.6536	2.6472	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
432	850	2.6536	2.6496	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
433	852	2.6554	2.6519	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
434	854	2.6581	2.6542	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
435	856	2.6617	2.6566	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
436	858	2.6653	2.6591	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
437	860	2.6707	2.6615	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
438	862	2.6752	2.6636	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
439	864	2.6787	2.6659	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
440	866	2.6823	2.6683	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
441	868	2.6868	2.6708	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
442	870	2.6922	2.6732	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
443	872	2.694	2.6757	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
444	874	2.6967	2.6779	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
445	876	2.7003	2.6802	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
446	878	2.7039	2.6825	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
447	880	2.7065	2.6849	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
448	882	2.7101	2.6872	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
449	884	2.7128	2.6891	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
450	886	2.7155	2.6915	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
451	888	2.7173	2.6938	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
452	890	2.7191	2.696	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
453	892	2.7209	2.6983	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
454	894	2.7236	2.7006	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
455	896	2.7272	2.703	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
456	898	2.7298	2.7053	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
457	900	2.7316	2.7079	3.1165	9.2318	5.7712	4.2684	4.9634	1.5028	0.30277
458	902	2.7334	2.71	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
459	904	2.7361	2.7121	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
460	906	2.7361	2.7145	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
461	908	2.7397	2.7166	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
462	910	2.7415	2.7189	3.1165	9.2349	5.7712	4.2719	4.963	1.4993	0.30209
463	912	2.7424	2.7211	3.1165	9.2323	5.7718	4.2708	4.9616	1.501	0.30253
464	914	2.7433	2.7232	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
465	916	2.7451	2.7255	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
466	918	2.7496	2.7277	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
467	920	2.7541	2.73	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
468	922	2.7576	2.7321	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
469	924	2.7585	2.7343	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
470	926	2.7612	2.7364	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
471	928	2.763	2.7385	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
472	930	2.7675	2.7409	3.1165	9.2354	5.7718	4.2702	4.9653	1.5016	0.30242
473	932	2.7702	2.7432	3.1165	9.2376	5.7741	4.2725	4.9651	1.5016	0.30243
474	934	2.7711	2.7458	3.1165	9.2365	5.773	4.2713	4.9652	1.5016	0.30243
475	936	2.7738	2.7479	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
476	938	2.7765	2.75	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
477	940	2.7783	2.7521	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
478	942	2.7801	2.7543	3.1165	9.2323	5.7718	4.2719	4.9604	1.4999	0.30236
479	944	2.7809	2.7566	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
480	946	2.7827	2.759	3.1165	9.2354	5.7718	4.2684	4.967	1.5034	0.30267
481	948	2.7863	2.7611	3.1165	9.2349	5.7712	4.2696	4.9653	1.5016	0.30242
482	950	2.789	2.763	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
483	952	2.7899	2.7651	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
484	954	2.7917	2.767	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
485	956	2.7935	2.7694	3.1165	9.2323	5.7718	4.2713	4.961	1.5004	0.30245
486	958	2.7944	2.7715	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
487	960	2.7953	2.7736	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
488	962	2.7998	2.7756	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
489	964	2.8025	2.7775	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
490	966	2.8043	2.7796	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
491	968	2.8052	2.7817	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
492	970	2.8043	2.7839	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
493	972	2.8069	2.786	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
494	974	2.8114	2.7883	3.1165	9.2349	5.7712	4.2708	4.9641	1.5004	0.30226
495	976	2.8159	2.7902	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
496	978	2.8177	2.7926	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209

497	980	2.8186	2.7947	3.1165	9.2323	5.7718	4.2725	4.9598	1.4993	0.30228
498	982	2.8195	2.7968	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
499	984	2.8204	2.799	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
500	986	2.8222	2.8009	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
501	988	2.824	2.803	3.1165	9.2318	5.7712	4.2719	4.9599	1.4993	0.30228
502	990	2.8267	2.8049	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
503	992	2.8294	2.8071	3.1165	9.2349	5.7712	4.2713	4.9635	1.4999	0.30217
504	994	2.8321	2.8092	3.1165	9.2323	5.7718	4.2708	4.9616	1.501	0.30253
505	996	2.8356	2.8111	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
506	998	2.8374	2.8132	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
507	1000	2.8392	2.8151	3.1165	9.2349	5.7712	4.2725	4.9624	1.4987	0.30201
508	1002	2.8428	2.8173	3.1165	9.2354	5.7718	4.2702	4.9653	1.5016	0.30242
509	1004	2.8455	2.8194	3.1165	9.2354	5.7718	4.2708	4.9647	1.501	0.30234
510	1006	2.85	2.8213	3.1165	9.2329	5.7724	4.2719	4.961	1.5004	0.30245
511	1008	2.8527	2.8239	3.1165	9.2356	5.7753	4.2713	4.9643	1.504	0.30295
512	1010	2.8554	2.8264	3.1165	9.2353	5.7782	4.2719	4.9634	1.5063	0.30348
513	1012	2.858	2.829	3.1165	9.2355	5.7817	4.2725	4.963	1.5092	0.3041
514	1014	2.8607	2.832	3.1165	9.2371	5.7835	4.2719	4.9652	1.5116	0.30443
515	1016	2.8634	2.8347	3.1165	9.2368	5.7864	4.2719	4.9649	1.5145	0.30504
516	1018	2.8652	2.8377	3.1165	9.2379	5.7876	4.2713	4.9666	1.5162	0.30529
517	1020	2.8661	2.8398	3.1165	9.2357	5.7852	4.2725	4.9632	1.5127	0.30479
518	1022	2.8697	2.842	3.1165	9.2377	5.7841	4.2725	4.9652	1.5116	0.30443
519	1024	2.8715	2.8441	3.1165	9.236	5.7823	4.2696	4.9665	1.5127	0.30459
520	1026	2.8733	2.8456	3.1165	9.2355	5.7817	4.2719	4.9636	1.5098	0.30418
521	1028	2.8769	2.8479	3.1165	9.2351	5.7847	4.2725	4.9626	1.5121	0.30471
522	1030	2.8796	2.8505	3.1165	9.2354	5.7882	4.2719	4.9634	1.5162	0.30548
523	1032	2.8832	2.8532	3.1165	9.2336	5.7929	4.2725	4.961	1.5203	0.30646
524	1034	2.8849	2.8562	3.1165	9.2363	5.7958	4.2702	4.9661	1.5256	0.3072
525	1036	2.8867	2.8588	3.1165	9.238	5.7975	4.2725	4.9654	1.525	0.30713
526	1038	2.8894	2.8615	3.1165	9.238	5.7975	4.2725	4.9654	1.525	0.30713
527	1040	2.8921	2.8641	3.1165	9.2354	5.7981	4.2713	4.9641	1.5268	0.30757
528	1042	2.8948	2.866	3.1165	9.2365	5.7993	4.2713	4.9652	1.528	0.30773
529	1044	2.8966	2.8688	3.1165	9.2376	5.8005	4.2719	4.9657	1.5285	0.30782
530	1046	2.9002	2.8711	3.1165	9.2382	5.801	4.2719	4.9662	1.5291	0.3079
531	1048	2.9029	2.8739	3.1165	9.2358	5.8051	4.2708	4.9651	1.5344	0.30904
532	1050	2.9047	2.8764	3.1165	9.2375	5.8069	4.2713	4.9661	1.5356	0.30921
533	1052	2.9074	2.879	3.1165	9.238	5.8075	4.2713	4.9667	1.5361	0.30929
534	1054	2.91	2.8813	3.1165	9.2355	5.8081	4.2719	4.9635	1.5361	0.30949
535	1056	2.9118	2.8837	3.1165	9.2329	5.8087	4.2719	4.961	1.5367	0.30976
536	1058	2.9136	2.886	3.1165	9.238	5.8075	4.2713	4.9667	1.5361	0.30929
537	1060	2.9163	2.8881	3.1165	9.238	5.8075	4.2731	4.9649	1.5344	0.30905
538	1062	2.9172	2.8905	3.1165	9.2369	5.8063	4.2725	4.9644	1.5338	0.30896
539	1064	2.9199	2.8924	3.1165	9.2336	5.8028	4.2719	4.9617	1.5309	0.30854
540	1066	2.9217	2.8939	3.1165	9.2325	5.8016	4.2725	4.96	1.5291	0.30829
541	1068	2.9226	2.8956	3.1165	9.2351	5.801	4.2725	4.9626	1.5285	0.30801
542	1070	2.9235	2.8973	3.1165	9.236	5.7987	4.2719	4.964	1.5268	0.30757
543	1072	2.9253	2.8986	3.1165	9.2358	5.7952	4.2719	4.9638	1.5233	0.30687
544	1074	2.9271	2.9001	3.1165	9.2361	5.7923	4.2713	4.9648	1.5209	0.30634
545	1076	2.928	2.9013	3.1165	9.2365	5.7893	4.2719	4.9645	1.5174	0.30565
546	1078	2.9307	2.9024	3.1165	9.2373	5.787	4.2725	4.9648	1.5145	0.30504
547	1080	2.9343	2.9041	3.1165	9.2365	5.7893	4.2719	4.9645	1.5174	0.30565
548	1082	2.9378	2.9064	3.1165	9.2352	5.7946	4.2713	4.9639	1.5233	0.30687
549	1084	2.9378	2.9088	3.1165	9.2334	5.7993	4.2713	4.9621	1.528	0.30793
550	1086	2.9405	2.9118	3.1165	9.2356	5.8016	4.2725	4.9631	1.5291	0.3081
551	1088	2.9423	2.9139	3.1165	9.2325	5.8016	4.2702	4.9623	1.5315	0.30862
552	1090	2.945	2.9165	3.1165	9.2351	5.801	4.2713	4.9637	1.5297	0.30818
553	1092	2.9468	2.9184	3.1165	9.2382	5.801	4.2719	4.9662	1.5291	0.3079
554	1094	2.9486	2.9205	3.1165	9.2376	5.8005	4.2725	4.9651	1.528	0.30774
555	1096	2.9495	2.9222	3.1165	9.2354	5.7981	4.2713	4.9641	1.5268	0.30757
556	1098	2.9504	2.9237	3.1165	9.2352	5.7946	4.2719	4.9633	1.5227	0.30679
557	1100	2.9522	2.9254	3.1165	9.2339	5.7899	4.2708	4.9631	1.5192	0.30609
558	1102	2.9558	2.9265	3.1165	9.2365	5.7893	4.2725	4.9639	1.5168	0.30557
559	1104	2.9585	2.9284	3.1165	9.2361	5.7923	4.2725	4.9636	1.5198	0.30618
560	1106	2.962	2.9309	3.1165	9.238	5.7975	4.2719	4.966	1.5256	0.30721
561	1108	2.9647	2.9337	3.1165	9.2378	5.804	4.2725	4.9653	1.5315	0.30843
562	1110	2.9665	2.9367	3.1165	9.2366	5.8092	4.2719	4.9646	1.5373	0.30965
563	1112	2.9683	2.9396	3.1165	9.2351	5.811	4.2725	4.9626	1.5385	0.31002
564	1114	2.971	2.9422	3.1165	9.2357	5.8116	4.2719	4.9637	1.5397	0.31018
565	1116	2.9737	2.9443	3.1165	9.2382	5.811	4.2725	4.9657	1.5385	0.30982
566	1118	2.9755	2.9465	3.1165	9.2357	5.8116	4.2725	4.9632	1.5391	0.3101
567	1120	2.9773	2.9488	3.1165	9.2337	5.8128	4.2725	4.9612	1.5402	0.31046
568	1122	2.98	2.9509	3.1165	9.2373	5.8133	4.2719	4.9654	1.5414	0.31043
569	1124	2.98	2.9528	3.1165	9.2351	5.811	4.2725	4.9626	1.5385	0.31002
570	1126	2.9818	2.9543	3.1165	9.2355	5.8081	4.2725	4.963	1.5356	0.3094
571	1128	2.9836	2.956	3.1165	9.2378	5.804	4.2713	4.9665	1.5326	0.3086
572	1130	2.9845	2.9571	3.1165	9.2356	5.8016	4.2725	4.9631	1.5291	0.3081
573	1132	2.9854	2.9584	3.1165	9.238	5.7975	4.2725	4.9654	1.525	0.30713
574	1134	2.9871	2.9597	3.1165	9.2367	5.7929	4.2719	4.9647	1.5209	0.30635
575	1136	2.9907	2.9609	3.1165	9.2381	5.7911	4.2719	4.9662	1.5192	0.3059
576	1138	2.9925	2.9622	3.1165	9.2383	5.7946	4.2731	4.9652	1.5215	0.30643
577	1140	2.9943	2.9643	3.1165	9.2343	5.797	4.2719	4.9624	1.525	0.30732
578	1142	2.9961	2.9665	3.1165	9.2349	5.7975	4.2725	4.9623	1.525	0.30732
579	1144	2.997	2.9682	3.1165	9.236	5.7987	4.2725	4.9634	1.5262	0.30749
580	1146	3.0006	2.9705	3.1165	9.2376	5.8005	4.2719	4.9657	1.5285	0.30782
581	1148	3.0033	2.9729	3.1165	9.2378	5.804	4.2725	4.9653	1.5315	0.30843
582	1150	3.0042	2.9752	3.1165	9.2364	5.8057	4.2719	4.9644	1.5338	0.30896
583	1152	3.0051	2.9773	3.1165	9.2353	5.8046	4.2708	4.9645	1.5338	0.30895
584	1154	3.006	2.979	3.1165	9.2325	5.8016	4.2719	4.9606	1.5297	0.30837
585	1156	3.0069	2.9801	3.1165	9.2363	5.7958	4.2719	4.9644	1.5239	0.30696
586	1158	3.0078	2.9812	3.1165	9.2339	5.7899	4.2713	4.9626	1.5186	0.30601
587	1160	3.0096	2.9818	3.1165	9.2362	5.7858	4.2725	4.9637	1.5133	0.30487
588	1162	3.0114	2.9831	3.1165	9.2377	5.7841	4.2725	4.9652	1.5116	0.30443
589	1164	3.014	2.9841	3.1165	9.2371	5.7835	4.2725	4.9646	1.511	0.30435
590	1166	3.0158	2.9858	3.1165	9.2351	5.7847	4.2719	4.9632	1.5127	0.30479
591	1168	3.0158	2.9869	3.1165	9.2326	5.7852	4.2719	4.9607	1.5133	0.30506
592	1170	3.0176	2.9884	3.1165	9.2357	5.7852	4.2719	4.9638	1.5133	0.30487
593	1172	3.0221	2.9905	3.1165	9.237	5.7899	4.2725	4.9645	1.5174	0.30565
594	1174	3.0239	2.9929	3.1165	9.2378	5.794	4.2719	4.9658	1.5221	0.30651
595	1176	3.0257	2.9956	3.1165	9.2349	5.7975	4.2708	4.9641	1.5268	0.30756
596	1178	3.0266	2.9978	3.1165	9.2349	5.7975	4.2702	4.9647	1.5274	0.30765
597	1180	3.0293	2.9995	3.1165	9.2354	5.7981	4.2719	4.9635	1.5262	0.30748

598	1182	3.032	3.0018	3.1165	9.2371	5.7999	4.2725	4.9646	1.5274	0.30765
599	1184	3.0365	3.0041	3.1165	9.2331	5.8022	4.2719	4.9611	1.5303	0.30846
600	1186	3.0373	3.0067	3.1165	9.2375	5.8069	4.2725	4.965	1.5344	0.30904
601	1188	3.04	3.0097	3.1165	9.2382	5.811	4.2725	4.9657	1.5385	0.30982
602	1190	3.0409	3.012	3.1165	9.2362	5.8122	4.2725	4.9637	1.5397	0.31018
603	1192	3.0454	3.0146	3.1165	9.2348	5.8139	4.2719	4.9628	1.542	0.31071
604	1194	3.0463	3.0171	3.1165	9.2339	5.8163	4.2725	4.9614	1.5438	0.31116
605	1196	3.049	3.0197	3.1165	9.2355	5.818	4.2719	4.9636	1.5461	0.31149
606	1198	3.0526	3.022	3.1165	9.2372	5.8198	4.2725	4.9647	1.5473	0.31166
607	1200	3.0553	3.0246	3.1165	9.2337	5.8227	4.2719	4.9618	1.5508	0.31254
608	1202	3.058	3.0273	3.1165	9.2356	5.828	4.2725	4.9631	1.5555	0.31341
609	1204	3.0607	3.0297	3.1165	9.2347	5.8303	4.2731	4.9616	1.5572	0.31386
610	1206	3.0625	3.0324	3.1165	9.2369	5.8327	4.2725	4.9644	1.5601	0.31427
611	1208	3.0633	3.0348	3.1165	9.2363	5.8321	4.2719	4.9644	1.5601	0.31427
612	1210	3.066	3.0369	3.1165	9.2383	5.8309	4.2725	4.9658	1.5584	0.31382
613	1212	3.0669	3.0388	3.1165	9.2356	5.828	4.2725	4.9631	1.5555	0.31341
614	1214	3.0714	3.041	3.1165	9.2376	5.8268	4.2725	4.9651	1.5543	0.31305
615	1216	3.0732	3.0427	3.1165	9.2367	5.8291	4.2725	4.9642	1.5566	0.31357
616	1218	3.0741	3.0448	3.1165	9.2383	5.8309	4.2725	4.9658	1.5584	0.31382
617	1220	3.0759	3.0469	3.1165	9.2372	5.8297	4.2719	4.9653	1.5578	0.31374
618	1222	3.0759	3.0482	3.1165	9.237	5.8262	4.2725	4.9645	1.5537	0.31296
619	1224	3.0804	3.0499	3.1165	9.2385	5.8245	4.2725	4.966	1.552	0.31252
620	1226	3.0804	3.0514	3.1165	9.2385	5.8245	4.2725	4.966	1.552	0.31252
621	1228	3.0813	3.0531	3.1165	9.2363	5.8221	4.2719	4.9644	1.5502	0.31227
622	1230	3.0822	3.0544	3.1165	9.2355	5.818	4.2725	4.963	1.5455	0.31141
623	1232	3.0822	3.0556	3.1165	9.2362	5.8122	4.2719	4.9643	1.5402	0.31026
624	1234	3.0822	3.0561	3.1165	9.2353	5.8046	4.2719	4.9633	1.5326	0.30879
625	1236	3.0831	3.0563	3.1165	9.2369	5.7964	4.2725	4.9643	1.5239	0.30696
626	1238	3.0822	3.0563	3.1165	9.2359	5.7888	4.2725	4.9634	1.5162	0.30549
627	1240	3.0858	3.0567	3.1165	9.2371	5.7835	4.2713	4.9658	1.5121	0.30451
628	1242	3.0885	3.0573	3.1165	9.2377	5.7841	4.2719	4.9658	1.5121	0.30451
629	1244	3.0893	3.0584	3.1165	9.2384	5.7882	4.2725	4.9659	1.5157	0.30521
630	1246	3.0902	3.0601	3.1165	9.2365	5.7893	4.2725	4.9639	1.5168	0.30557
631	1248	3.092	3.0618	3.1165	9.237	5.7899	4.2719	4.9651	1.518	0.30574
632	1250	3.0938	3.0633	3.1165	9.237	5.7899	4.2725	4.9645	1.5174	0.30565
633	1252	3.0956	3.065	3.1165	9.2336	5.7929	4.2713	4.9622	1.5215	0.30662
634	1254	3.0956	3.0669	3.1165	9.2367	5.7929	4.2725	4.9641	1.5203	0.30626
635	1256	3.0974	3.0684	3.1165	9.2356	5.7917	4.2725	4.963	1.5192	0.3061
636	1258	3.0974	3.0699	3.1165	9.2354	5.7882	4.2725	4.9628	1.5157	0.3054
637	1260	3.0992	3.071	3.1165	9.2357	5.7852	4.2725	4.9632	1.5127	0.30479
638	1262	3.1001	3.0725	3.1165	9.2324	5.7817	4.2708	4.9616	1.511	0.30453
639	1264	3.1037	3.0733	3.1165	9.2369	5.78	4.2725	4.9644	1.5075	0.30365
640	1266	3.1055	3.0748	3.1165	9.2329	5.7823	4.2725	4.9604	1.5098	0.30437
641	1268	3.1091	3.0767	3.1165	9.2382	5.7847	4.2719	4.9663	1.5127	0.3046
642	1270	3.1091	3.0788	3.1165	9.2354	5.7882	4.2725	4.9628	1.5157	0.3054
643	1272	3.1091	3.0808	3.1165	9.2373	5.787	4.2725	4.9648	1.5145	0.30504
644	1274	3.1127	3.0827	3.1165	9.2382	5.7847	4.2713	4.9669	1.5133	0.30468
645	1276	3.1144	3.0844	3.1165	9.2357	5.7852	4.2725	4.9632	1.5127	0.30479
646	1278	3.1162	3.0863	3.1165	9.2373	5.787	4.2719	4.9654	1.5151	0.30512
647	1280	3.1189	3.0882	3.1165	9.2323	5.7882	4.2725	4.9597	1.5157	0.30559
648	1282	3.1198	3.0901	3.1165	9.2365	5.7893	4.2719	4.9645	1.5174	0.30565
649	1284	3.1243	3.0923	3.1165	9.2381	5.7911	4.2725	4.9656	1.5186	0.30582
650	1286	3.1252	3.0946	3.1165	9.2372	5.7934	4.2713	4.9659	1.5221	0.30651
651	1288	3.1288	3.0969	3.1165	9.2374	5.797	4.2725	4.9649	1.5244	0.30704
652	1290	3.1306	3.0999	3.1165	9.2325	5.8016	4.2713	4.9612	1.5303	0.30845
653	1292	3.1342	3.1025	3.1165	9.2378	5.804	4.2713	4.9665	1.5326	0.3086
654	1294	3.1351	3.1048	3.1165	9.2358	5.8051	4.2702	4.9656	1.535	0.30912
655	1296	3.136	3.1067	3.1165	9.2347	5.804	4.2719	4.9628	1.5321	0.30871
656	1298	3.1369	3.1086	3.1165	9.2351	5.801	4.2719	4.9631	1.5291	0.3081
657	1300	3.1396	3.1101	3.1165	9.2349	5.7975	4.2719	4.9629	1.5256	0.3074
658	1302	3.1404	3.1114	3.1165	9.2378	5.794	4.2725	4.9652	1.5215	0.30643
659	1304	3.1422	3.1129	3.1165	9.2325	5.7917	4.2713	4.9611	1.5203	0.30645
660	1306	3.144	3.1146	3.1165	9.2381	5.7911	4.2719	4.9662	1.5192	0.3059
661	1308	3.1458	3.1159	3.1165	9.2339	5.7899	4.2725	4.9614	1.5174	0.30584
662	1310	3.1449	3.1172	3.1165	9.2331	5.7858	4.2719	4.9612	1.5139	0.30515
663	1312	3.1449	3.118	3.1165	9.2358	5.7788	4.2713	4.9645	1.5075	0.30365
664	1314	3.1458	3.1184	3.1165	9.2354	5.7718	4.2725	4.9629	1.4993	0.30209
665	1316	3.1476	3.1193	3.1165	9.2354	5.7718	4.2719	4.9635	1.4999	0.30218
666	1318	3.1503	3.1206	3.1165	9.2354	5.7718	4.2713	4.9641	1.5004	0.30226
667	1320	3.1557	3.1225	3.1165	9.2351	5.7747	4.2713	4.9637	1.5034	0.30287
668	1322	3.1566	3.1246	3.1165	9.2375	5.7806	4.2725	4.965	1.5081	0.30374
669	1324	3.1602	3.1272	3.1165	9.2351	5.7847	4.2725	4.9626	1.5121	0.30471
670	1326	3.1611	3.1297	3.1165	9.2359	5.7888	4.2719	4.964	1.5168	0.30557
671	1328	3.1647	3.1323	3.1165	9.2356	5.7917	4.2719	4.9636	1.5198	0.30618
672	1330	3.1682	3.1348	3.1165	9.2369	5.7964	4.2719	4.9649	1.5244	0.30704
673	1332	3.17	3.1378	3.1165	9.2351	5.801	4.2725	4.9626	1.5285	0.30801
674	1334	3.1718	3.1406	3.1165	9.2378	5.804	4.2702	4.9676	1.5338	0.30876
675	1336	3.1745	3.1431	3.1165	9.2358	5.8051	4.2713	4.9645	1.5338	0.30896
676	1338	3.1772	3.1457	3.1165	9.236	5.8087	4.2731	4.9629	1.5356	0.30941
677	1340	3.1799	3.1487	3.1165	9.2371	5.8098	4.2725	4.9646	1.5373	0.30966
678	1342	3.1817	3.1512	3.1165	9.2351	5.811	4.2708	4.9644	1.5402	0.31026
679	1344	3.1835	3.1531	3.1165	9.2371	5.8098	4.2719	4.9652	1.5379	0.30974
680	1346	3.1871	3.1555	3.1165	9.2377	5.8104	4.2708	4.9669	1.5397	0.30998
681	1348	3.1889	3.1576	3.1165	9.2351	5.811	4.2702	4.965	1.5408	0.31034
682	1350	3.188	3.1591	3.1165	9.2355	5.8081	4.2731	4.9624	1.535	0.30932
683	1352	3.1889	3.1606	3.1165	9.2325	5.8016	4.2719	4.9606	1.5297	0.30837
684	1354	3.1907	3.1616	3.1165	9.2358	5.7952	4.2719	4.9638	1.5233	0.30687
685	1356	3.1907	3.1625	3.1165	9.2365	5.7893	4.2719	4.9645	1.5174	0.30565
686	1358	3.1942	3.1633	3.1165	9.2362	5.7858	4.2719	4.9643	1.5139	0.30496
687	1360	3.1942	3.1642	3.1165	9.2351	5.7847	4.2719	4.9632	1.5127	0.30479
688	1362	3.196	3.1655	3.1165	9.2351	5.7847	4.2731	4.9621	1.5116	0.30462
689	1364	3.1978	3.1672	3.1165	9.2346	5.7841	4.2713	4.9633	1.5127	0.30479
690	1366	3.1987	3.1684	3.1165	9.2346	5.7841	4.2719	4.9627	1.5121	0.3047
691	1368	3.2005	3.1701	3.1165	9.236	5.7823	4.2719	4.9641	1.5104	0.30426
692	1370	3.2014	3.1712	3.1165	9.2355	5.7817	4.2725	4.963	1.5092	0.3041
693	1372	3.2059	3.1729	3.1165	9.2377	5.7841	4.2725	4.9652	1.5116	0.30443
694	1374	3.2086	3.1753	3.1165	9.2334	5.7893	4.2725	4.9608	1.5168	0.30576
695	1376	3.2104	3.178	3.1165	9.2372	5.7934	4.2725	4.9647	1.5209	0.30635
696	1378	3.214	3.1806	3.1165	9.2385	5.7981	4.2725	4.966	1.5256	0.30721
697	1380	3.2158	3.1831	3.1165	9.2325	5.8016	4.2731	4.9594	1.5285	0.30821
698	1382	3.2193	3.1861	3.1165	9.2369	5.8063	4.2731	4.9638	1.5332	0.30888

699	1384	3.222	3.1893	3.1165	9.2357	5.8116	4.2719	4.9637	1.5397	0.31018
700	1386	3.2229	3.1921	3.1165	9.2379	5.8139	4.2725	4.9654	1.5414	0.31043
701	1388	3.2265	3.1953	3.1165	9.2384	5.8145	4.2684	4.97	1.5461	0.31109
702	1390	3.2283	3.1972	3.1165	9.2353	5.8145	4.2725	4.9628	1.542	0.31071
703	1392	3.2319	3.1997	3.1165	9.237	5.8163	4.2725	4.9645	1.5438	0.31096
704	1394	3.2337	3.2025	3.1165	9.2361	5.8186	4.2708	4.9653	1.5479	0.31173
705	1396	3.2364	3.2048	3.1165	9.2372	5.8198	4.2725	4.9647	1.5473	0.31166
706	1398	3.2382	3.2074	3.1165	9.2377	5.8204	4.2725	4.9652	1.5479	0.31174
707	1400	3.2435	3.2097	3.1165	9.2383	5.821	4.2725	4.9658	1.5484	0.31182
708	1402	3.2444	3.2123	3.1165	9.2379	5.8239	4.2708	4.9672	1.5531	0.31268
709	1404	3.2453	3.2146	3.1165	9.2379	5.8239	4.2713	4.9666	1.5525	0.3126
710	1406	3.2462	3.2165	3.1165	9.2383	5.821	4.2708	4.9675	1.5502	0.31207
711	1408	3.248	3.218	3.1165	9.233	5.8186	4.2725	4.9605	1.5461	0.31168
712	1410	3.2516	3.22	3.1165	9.2324	5.818	4.2702	4.9623	1.5479	0.31193
713	1412	3.2516	3.2214	3.1165	9.2381	5.8174	4.2725	4.9656	1.5449	0.31113
714	1414	3.2534	3.2234	3.1165	9.2379	5.8139	4.2725	4.9654	1.5414	0.31043
715	1416	3.2552	3.2246	3.1165	9.2351	5.811	4.2725	4.9626	1.5385	0.31002
716	1418	3.2588	3.2265	3.1165	9.2362	5.8122	4.2719	4.9643	1.5402	0.31026
717	1420	3.2597	3.2285	3.1165	9.2337	5.8128	4.2725	4.9612	1.5402	0.31046
718	1422	3.2615	3.2304	3.1165	9.2351	5.811	4.2725	4.9626	1.5385	0.31002
719	1424	3.2624	3.2319	3.1165	9.238	5.8075	4.2719	4.9661	1.5356	0.30921
720	1426	3.2633	3.2331	3.1165	9.2358	5.8051	4.2719	4.9639	1.5332	0.30887
721	1428	3.2633	3.2344	3.1165	9.232	5.801	4.2719	4.96	1.5291	0.30829
722	1430	3.2651	3.2355	3.1165	9.24	5.7964	4.2725	4.9674	1.5239	0.30677
723	1432	3.2669	3.2368	3.1165	9.2356	5.7917	4.2719	4.9636	1.5198	0.30618
724	1434	3.2686	3.2378	3.1165	9.2365	5.7893	4.2725	4.9639	1.5168	0.30557
725	1436	3.2695	3.2387	3.1165	9.2368	5.7864	4.2725	4.9643	1.5139	0.30496
726	1438	3.2713	3.24	3.1165	9.2351	5.7847	4.2713	4.9638	1.5133	0.30487
727	1440	3.2731	3.2414	3.1165	9.2351	5.7847	4.2713	4.9638	1.5133	0.30487
728	1442	3.2731	3.2425	3.1165	9.2335	5.7829	4.2725	4.961	1.5104	0.30445
729	1444	3.274	3.2436	3.1165	9.2349	5.7811	4.2719	4.963	1.5092	0.30409
730	1446	3.2767	3.2451	3.1165	9.2355	5.7817	4.2725	4.963	1.5092	0.3041
731	1448	3.2776	3.2466	3.1165	9.2355	5.7817	4.2725	4.963	1.5092	0.3041
732	1450	3.2794	3.2483	3.1165	9.2369	5.78	4.2719	4.965	1.508	0.30374
733	1452	3.2803	3.2493	3.1165	9.2378	5.7776	4.2719	4.9659	1.5057	0.30321
734	1453.9	3.2803	3.2506	3.1165	9.2351	5.7747	4.2719	4.9632	1.5028	0.30279

TRIAXIAL TEST

Consolidation/B Step: 12

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	9.2351	5.7747	4.2719	4.9632	1.5028	0.30279
2	0.012433	0	0	3.1165	9.232	5.7747	4.2725	4.9595	1.5022	0.30289
3	0.050667	-0.0008965	0	3.1165	9.2351	5.7747	4.2725	4.9626	1.5022	0.3027
4	0.10072	0.0008965	0	3.1165	9.2382	5.7747	4.2725	4.9657	1.5022	0.30252
5	0.25095	0.001793	0.0006385	3.1165	9.2475	5.7747	4.2708	4.9767	1.504	0.3022
6	0.50198	0.005379	0.0019155	3.1165	9.2654	5.7806	4.2731	4.9923	1.5075	0.30196
7	1.004	0.018827	0.0059593	3.1165	9.3001	5.7911	4.2725	5.0276	1.5186	0.30205
8	2.0017	0.033171	0.017027	3.1165	9.3706	5.8133	4.2719	5.0987	1.5414	0.30232
9	4.0009	0.072617	0.04959	3.1165	9.5131	5.866	4.2737	5.2394	1.5923	0.30392
10	6.0012	0.11834	0.093221	3.1165	9.6592	5.9357	4.2737	5.3855	1.662	0.30861
11	8.0005	0.1802	0.14388	3.1165	9.8028	5.9995	4.2731	5.5297	1.7264	0.3122
12	10.004	0.21516	0.20155	3.1165	9.9452	6.0586	4.2737	5.6715	1.7849	0.31472
13	12.003	0.28688	0.26051	3.1165	10.089	6.0996	4.2731	5.816	1.8265	0.31405
14	14.003	0.3335	0.32457	3.1165	10.224	6.147	4.2731	5.9505	1.8739	0.31492
15	16.002	0.38012	0.37395	3.1165	10.228	6.1646	4.2737	5.954	1.8909	0.31758
16	18.001	0.40163	0.40992	3.1165	10.226	6.1499	4.2725	5.9538	1.8774	0.31533
17	20	0.43749	0.43673	3.1165	10.227	6.1248	4.2702	5.9573	1.8546	0.31132
18	22.004	0.45722	0.45972	3.1165	10.225	6.1189	4.2731	5.9519	1.8458	0.31012
19	24.003	0.48232	0.47994	3.1165	10.226	6.1166	4.2737	5.9522	1.8429	0.30961
20	26.002	0.49218	0.49739	3.1165	10.225	6.0996	4.2719	5.9535	1.8277	0.30699
21	28.001	0.50921	0.51165	3.1165	10.224	6.082	4.2737	5.9508	1.8083	0.30389
22	30.001	0.52356	0.52442	3.1165	10.226	6.0709	4.2731	5.9533	1.7978	0.30199
23	32.004	0.537	0.5374	3.1165	10.226	6.0709	4.2713	5.955	1.7996	0.30219
24	34.003	0.54507	0.55017	3.1165	10.226	6.0709	4.2708	5.9556	1.8002	0.30226
25	36.002	0.56121	0.5623	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
26	38.002	0.57645	0.57422	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
27	40.001	0.589	0.5855	3.1165	10.227	6.0715	4.2725	5.9544	1.799	0.30213
28	42.004	0.59707	0.59678	3.1165	10.229	6.0709	4.2708	5.9587	1.8002	0.3021
29	44.003	0.60873	0.60743	3.1165	10.227	6.0715	4.2737	5.9532	1.7978	0.30199
30	46.003	0.62038	0.61807	3.1165	10.226	6.0709	4.2725	5.9539	1.7984	0.30205
31	48.002	0.62934	0.6285	3.1165	10.227	6.0715	4.2725	5.9544	1.799	0.30213
32	50.001	0.63831	0.6385	3.1165	10.227	6.0715	4.2725	5.9544	1.799	0.30213
33	52	0.64907	0.6485	3.1165	10.226	6.0709	4.2702	5.9562	1.8007	0.30233
34	54.004	0.65534	0.65808	3.1165	10.227	6.0715	4.2719	5.955	1.7996	0.30219
35	56.003	0.66162	0.66744	3.1165	10.227	6.0715	4.2708	5.9562	1.8007	0.30233
36	58.003	0.66789	0.6766	3.1165	10.226	6.0709	4.2713	5.955	1.7996	0.30219
37	60.002	0.67776	0.68554	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
38	62.001	0.68941	0.69426	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
39	64	0.70017	0.70299	3.1165	10.226	6.0709	4.2725	5.9539	1.7984	0.30205
40	66.004	0.70734	0.7115	3.1165	10.229	6.0709	4.2719	5.9576	1.799	0.30197
41	68.003	0.71451	0.72023	3.1165	10.226	6.0709	4.2708	5.9556	1.8002	0.30226
42	70.002	0.72258	0.72853	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
43	72.001	0.73424	0.73683	3.1165	10.229	6.0709	4.2708	5.9587	1.8002	0.3021
44	74.001	0.74858	0.7447	3.1165	10.23	6.0715	4.2713	5.9587	1.8002	0.30211
45	76	0.75306	0.75258	3.1165	10.227	6.0715	4.2737	5.9532	1.7978	0.30199
46	78.004	0.75575	0.76067	3.1165	10.227	6.0715	4.2731	5.9538	1.7984	0.30206
47	80.002	0.76382	0.76897	3.1165	10.229	6.0709	4.2702	5.9593	1.8007	0.30217
48	82.002	0.7683	0.77705	3.1165	10.23	6.0715	4.2713	5.9587	1.8002	0.30211
49	84.001	0.77278	0.78493	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
50	86	0.77727	0.79259	3.1165	10.224	6.0715	4.2725	5.9513	1.799	0.30228
51	88.004	0.78354	0.79983	3.1165	10.226	6.0709	4.2749	5.9515	1.7961	0.30178
52	90.003	0.7934	0.80749	3.1165	10.224	6.0715	4.2731	5.9507	1.7984	0.30221
53	92.002	0.81044	0.81558	3.1165	10.229	6.0709	4.2731	5.9564	1.7978	0.30183
54	94.001	0.8194	0.82281	3.1165	10.227	6.0715	4.2719	5.955	1.7996	0.30219
55	96	0.82658	0.83026	3.1165	10.23	6.0715	4.2719	5.9581	1.7996	0.30204
56	98.004	0.83016	0.8375	3.1165	10.23	6.0715	4.2731	5.9569	1.7984	0.3019
57	100	0.83375	0.84452	3.1165	10.23	6.0715	4.2743	5.9558	1.7972	0.30176
58	102	0.83644	0.85154	3.1165	10.227	6.0715	4.2731	5.9538	1.7984	0.30206
59	104	0.84451	0.85814	3.1165	10.226	6.0709	4.2731	5.9533	1.7978	0.30199
60	106	0.85347	0.86517	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
61	108	0.86333	0.87198	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
62	110	0.87678	0.87879	3.1165	10.23	6.0715	4.269	5.961	1.8025	0.30238
63	112	0.89112	0.8856	3.1165	10.226	6.0709	4.2731	5.9533	1.7978	0.30199
64	114	0.8965	0.89262	3.1165	10.229	6.0709	4.2719	5.9576	1.799	0.30197
65	116	0.90098	0.89901	3.1165	10.229	6.0709	4.2696	5.9599	1.8013	0.30224
66	118	0.90816	0.90539	3.1165	10.229	6.0709	4.2719	5.9576	1.799	0.30197
67	120	0.91354	0.91199	3.1165	10.227	6.0715	4.2713	5.9556	1.8002	0.30226
68	122	0.91712	0.91837	3.1165	10.227	6.0715	4.2725	5.9544	1.799	0.30213
69	124	0.92071	0.92455	3.1165	10.229	6.0709	4.2731	5.9564	1.7978	0.30183
70	126	0.93057	0.93093	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
71	128	0.93864	0.93732	3.1165	10.227	6.0715	4.2719	5.955	1.7996	0.30219
72	130	0.94671	0.9437	3.1165	10.23	6.0715	4.2719	5.9581	1.7996	0.30204
73	132	0.95388	0.94987	3.1165	10.23	6.0715	4.2719	5.9581	1.7996	0.30204
74	134	0.96105	0.95583	3.1165	10.23	6.0715	4.2725	5.9575	1.799	0.30197
75	136	0.96374	0.96179	3.1165	10.23	6.0715	4.2725	5.9575	1.799	0.30197
76	138	0.96822	0.96796	3.1165	10.23	6.0715	4.2719	5.9581	1.7996	0.30204
77	140	0.97539	0.97414	3.1165	10.23	6.0715	4.2702	5.9599	1.8013	0.30224
78	142	0.98257	0.9801	3.1165	10.229	6.0709	4.2702	5.9593	1.8007	0.30217
79	144	0.98615	0.98584	3.1165	10.23	6.0715	4.2708	5.9593	1.8007	0.30217
80	146	0.98974	0.9918	3.1165	10.227	6.0715	4.269	5.9579	1.8025	0.30254
81	148	0.99332	0.99755	3.1165	10.23	6.0715	4.2725	5.9575	1.799	0.30197
82	150	0.99781	1.0035	3.1165	10.229	6.0709	4.2702	5.9593	1.8007	0.30217
83	152	1.0095	1.0093	3.1165	10.226	6.0709	4.2702	5.9562	1.8007	0.30233
84	154	1.0175	1.0148	3.1165	10.226	6.0709	4.2713	5.955	1.7996	0.30219
85	156	1.0265	1.0205	3.1165	10.226	6.0709	4.2725	5.9539	1.7984	0.30205
86	158	1.0346	1.0263	3.1165	10.23	6.0715	4.2731	5.9569	1.7984	0.3019
87	160	1.039	1.032	3.1165	10.23	6.0715	4.2731	5.9569	1.7984	0.3019
88	162	1.0471	1.0378	3.1165	10.227	6.0715	4.2725	5.9544	1.799	0.30213
89	164	1.0525	1.0437	3.1165	10.231	6.0721	4.2708	5.9598	1.8013	0.30224
90	166	1.0597	1.0495	3.1165	10.229	6.0738	4.2708	5.9584	1.8031	0.30261
91	168	1.0606	1.0548	3.1165	10.23	6.0715	4.2731	5.9569	1.7984	0.3019
92	170	1.0659	1.0605	3.1165	10.23	6.0715	4.2719	5.9581	1.7996	0.30204

93	172	1.0713	1.0659	3.1165	10.229	6.0709	4.2725	5.957	1.7984	0.3019
94	174	1.0749	1.0712	3.1165	10.226	6.0709	4.2731	5.9533	1.7978	0.30199
95	176	1.0794	1.0767	3.1165	10.227	6.0715	4.2713	5.9556	1.8002	0.30226
96	178	1.0875	1.082	3.1165	10.23	6.0715	4.2725	5.9575	1.799	0.30197
97	180	1.1009	1.0876	3.1165	10.231	6.0727	4.2719	5.9592	1.8007	0.30218
98	182	1.1063	1.0937	3.1165	10.231	6.082	4.2725	5.9581	1.8095	0.30371
99	184	1.1081	1.0995	3.1165	10.228	6.082	4.2713	5.9562	1.8107	0.304
100	186	1.1144	1.1052	3.1165	10.226	6.0809	4.2708	5.9557	1.8101	0.30393
101	188	1.1188	1.1106	3.1165	10.229	6.0768	4.2713	5.9574	1.8054	0.30305
102	190	1.126	1.1157	3.1165	10.228	6.0762	4.2725	5.9557	1.8037	0.30285
103	192	1.1323	1.1212	3.1165	10.228	6.0797	4.2702	5.9583	1.8095	0.3037
104	194	1.1368	1.1267	3.1165	10.228	6.082	4.2731	5.9544	1.8089	0.3038
105	196	1.1404	1.1323	3.1165	10.229	6.0803	4.2725	5.9565	1.8078	0.3035
106	198	1.1448	1.1374	3.1165	10.228	6.0762	4.2719	5.9563	1.8042	0.30291
107	200	1.1484	1.1418	3.1165	10.229	6.0709	4.2725	5.957	1.7984	0.3019
108	202	1.1538	1.1465	3.1165	10.227	6.0715	4.2731	5.9538	1.7984	0.30206
109	204	1.1583	1.1516	3.1165	10.227	6.0715	4.2713	5.9556	1.8002	0.30226
110	206	1.1628	1.1567	3.1165	10.227	6.0715	4.2696	5.9573	1.8019	0.30247
111	208	1.1681	1.1614	3.1165	10.23	6.0715	4.2731	5.9569	1.7984	0.3019
112	210	1.1744	1.1663	3.1165	10.23	6.0715	4.2708	5.9593	1.8007	0.30217
113	212	1.1807	1.1712	3.1165	10.23	6.0715	4.2708	5.9593	1.8007	0.30217
114	214	1.1861	1.1761	3.1165	10.227	6.0715	4.2713	5.9556	1.8002	0.30226
115	216	1.1897	1.1812	3.1165	10.23	6.0715	4.2708	5.9593	1.8007	0.30217
116	218	1.1932	1.1859	3.1165	10.227	6.0715	4.2725	5.9544	1.799	0.30213
117	220	1.195	1.1906	3.1165	10.23	6.0715	4.2719	5.9581	1.7996	0.30204
118	222	1.2049	1.1953	3.1165	10.229	6.0709	4.2731	5.9564	1.7978	0.30183
119	224	1.2076	1.2004	3.1165	10.23	6.0715	4.2713	5.9587	1.8002	0.30211
120	226	1.2148	1.2053	3.1165	10.227	6.0715	4.2713	5.9556	1.8002	0.30226
121	228	1.2237	1.2102	3.1165	10.231	6.0762	4.2731	5.9582	1.8031	0.30262
122	230	1.2309	1.2157	3.1165	10.229	6.0838	4.2725	5.9567	1.8113	0.30407
123	232	1.2336	1.2217	3.1165	10.226	6.0902	4.2725	5.9534	1.8177	0.30532
124	234	1.2381	1.2276	3.1165	10.225	6.0926	4.2702	5.9549	1.8224	0.30603
125	236	1.2434	1.2329	3.1165	10.226	6.0937	4.2719	5.9542	1.8218	0.30597
126	238	1.247	1.238	3.1165	10.226	6.0902	4.2725	5.9534	1.8177	0.30532
127	240	1.2488	1.2425	3.1165	10.227	6.0814	4.2702	5.9568	1.8113	0.30407
128	242	1.2542	1.2459	3.1165	10.227	6.0715	4.2713	5.9556	1.8002	0.30226
129	244	1.2614	1.2502	3.1165	10.227	6.0715	4.2731	5.9538	1.7984	0.30206
130	246	1.2686	1.2544	3.1165	10.23	6.0744	4.2731	5.9566	1.8013	0.30241
131	248	1.2712	1.2593	3.1165	10.227	6.0779	4.2725	5.9543	1.8054	0.30321
132	250	1.2739	1.264	3.1165	10.229	6.0773	4.2719	5.9574	1.8054	0.30305
133	252	1.2811	1.2689	3.1165	10.228	6.0791	4.2713	5.9565	1.8078	0.30349
134	254	1.2874	1.2736	3.1165	10.227	6.0814	4.2725	5.9545	1.8089	0.30379
135	256	1.2937	1.2791	3.1165	10.227	6.0885	4.2702	5.9572	1.8183	0.30523
136	258	1.299	1.2849	3.1165	10.228	6.0961	4.2702	5.9582	1.8259	0.30645
137	260	1.3017	1.2904	3.1165	10.225	6.099	4.2713	5.9536	1.8277	0.30699
138	262	1.3044	1.2953	3.1165	10.231	6.0955	4.2731	5.9578	1.8224	0.30588
139	264	1.3125	1.3004	3.1165	10.228	6.0961	4.2708	5.9576	1.8253	0.30639
140	266	1.3152	1.3051	3.1165	10.226	6.0937	4.2702	5.956	1.8236	0.30617
141	268	1.3188	1.3091	3.1165	10.229	6.0902	4.2731	5.9559	1.8171	0.30509
142	270	1.3205	1.3128	3.1165	10.23	6.0809	4.2725	5.957	1.8083	0.30357
143	272	1.3214	1.3162	3.1165	10.227	6.0715	4.2725	5.9544	1.799	0.30213
144	274	1.3214	1.3198	3.1165	10.229	6.0709	4.2725	5.957	1.7984	0.3019
145	276	1.3223	1.3236	3.1165	10.226	6.0709	4.2719	5.9545	1.799	0.30212
146	278	1.3241	1.3274	3.1165	10.227	6.0715	4.2719	5.955	1.7996	0.30219
147	280	1.3304	1.3315	3.1165	10.23	6.0715	4.2719	5.9581	1.7996	0.30204
148	282	1.3394	1.336	3.1165	10.23	6.0715	4.2702	5.9599	1.8013	0.30224
149	284	1.3474	1.3398	3.1165	10.229	6.0709	4.2725	5.957	1.7984	0.3019
150	286	1.3555	1.3438	3.1165	10.23	6.0715	4.2725	5.9575	1.799	0.30197
151	288	1.36	1.3481	3.1165	10.229	6.0709	4.2713	5.9581	1.7996	0.30203
152	290	1.3663	1.3526	3.1165	10.231	6.0721	4.2731	5.9575	1.799	0.30197
153	292	1.3725	1.357	3.1165	10.226	6.0803	4.2725	5.9534	1.8078	0.30365
154	294	1.3788	1.3626	3.1165	10.228	6.0891	4.2702	5.9578	1.8189	0.3053
155	296	1.3824	1.3677	3.1165	10.228	6.0961	4.2731	5.9553	1.823	0.30611
156	298	1.386	1.3732	3.1165	10.229	6.0996	4.2713	5.9572	1.8282	0.3069
157	300	1.3914	1.3783	3.1165	10.229	6.1002	4.2702	5.9589	1.83	0.3071
158	302	1.395	1.383	3.1165	10.225	6.0996	4.2719	5.9535	1.8277	0.30699
159	304	1.3985	1.3872	3.1165	10.226	6.0972	4.2708	5.9556	1.8265	0.30668
160	306	1.4048	1.3915	3.1165	10.226	6.0972	4.2731	5.9533	1.8242	0.30641
161	308	1.4084	1.3964	3.1165	10.231	6.0984	4.2725	5.958	1.8259	0.30646
162	310	1.4138	1.4007	3.1165	10.23	6.0943	4.2708	5.959	1.8236	0.30602
163	312	1.4165	1.4047	3.1165	10.229	6.0937	4.2713	5.9579	1.8224	0.30588
164	314	1.4201	1.4085	3.1165	10.228	6.0926	4.2708	5.9574	1.8218	0.30581
165	316	1.4227	1.4121	3.1165	10.229	6.0873	4.2725	5.9569	1.8148	0.30465
166	318	1.4263	1.4158	3.1165	10.228	6.082	4.2713	5.9562	1.8107	0.304
167	320	1.4299	1.4192	3.1165	10.227	6.0779	4.2702	5.9566	1.8078	0.30349
168	322	1.4335	1.4222	3.1165	10.228	6.0727	4.2719	5.9561	1.8007	0.30233
169	324	1.4407	1.4253	3.1165	10.23	6.075	4.2731	5.9571	1.8019	0.30248
170	326	1.4461	1.4296	3.1165	10.228	6.082	4.2719	5.9556	1.8101	0.30393
171	328	1.4505	1.4345	3.1165	10.229	6.0902	4.2725	5.9565	1.8177	0.30516
172	330	1.455	1.4396	3.1165	10.226	6.0967	4.2713	5.9545	1.8253	0.30655
173	332	1.4586	1.4443	3.1165	10.227	6.1008	4.2719	5.9546	1.8288	0.30713
174	334	1.4595	1.4488	3.1165	10.231	6.099	4.2725	5.9586	1.8265	0.30653
175	336	1.4676	1.4528	3.1165	10.231	6.0961	4.2725	5.9589	1.8236	0.30602
176	338	1.4721	1.4571	3.1165	10.23	6.0978	4.2725	5.9575	1.8253	0.30639
177	340	1.4765	1.4613	3.1165	10.23	6.1008	4.2731	5.9566	1.8277	0.30683
178	342	1.4819	1.4662	3.1165	10.23	6.1072	4.2713	5.9582	1.8359	0.30812
179	344	1.4864	1.4709	3.1165	10.23	6.1113	4.2725	5.9578	1.8388	0.30864
180	346	1.4873	1.4758	3.1165	10.231	6.1119	4.2719	5.9589	1.84	0.30878
181	348	1.4909	1.4798	3.1165	10.229	6.1066	4.2719	5.957	1.8347	0.30799
182	350	1.4927	1.483	3.1165	10.229	6.0996	4.2725	5.956	1.8271	0.30676
183	352	1.4954	1.486	3.1165	10.229	6.0902	4.2713	5.9577	1.8189	0.3053
184	354	1.4998	1.4886	3.1165	10.227	6.0814	4.2708	5.9562	1.8107	0.304
185	356	1.5034	1.4911	3.1165	10.229	6.0768	4.2725	5.9563	1.8042	0.30292
186	358	1.5097	1.4943	3.1165	10.226	6.0768	4.2708	5.9549	1.806	0.30328
187	360	1.5133	1.4975	3.1165	10.231	6.082	4.2725	5.9581	1.8095	0.30371
188	362	1.5178	1.5015	3.1165	10.23	6.0879	4.2719	5.958	1.816	0.30479
189	364	1.5232	1.5062	3.1165	10.229	6.0967	4.2719	5.957	1.8247	0.30632
190	366	1.5267	1.5111	3.1165	10.229	6.1031	4.2731	5.9557	1.83	0.30727
191	368	1.5312	1.516	3.1165	10.228	6.1054	4.2708	5.9571	1.8347	0.30798
192	370	1.5348	1.5203	3.1165	10.231	6.1084	4.2713	5.9593	1.837	0.30826
193	372	1.5384	1.5247	3.1165	10.228	6.109	4.2702	5.9579	1.8388	0.30863

194	374	1.5447	1.529	3.1165	10.228	6.109	4.2713	5.9567	1.8376	0.30849
195	376	1.5483	1.5335	3.1165	10.23	6.1148	4.2725	5.958	1.8423	0.30922
196	378	1.5509	1.5377	3.1165	10.232	6.116	4.2737	5.9579	1.8423	0.30922
197	380	1.5554	1.5415	3.1165	10.231	6.1119	4.2713	5.9595	1.8405	0.30884
198	382	1.5599	1.5454	3.1165	10.23	6.1107	4.2725	5.9572	1.8382	0.30857
199	384	1.5644	1.5492	3.1165	10.23	6.1113	4.2725	5.9578	1.8388	0.30864
200	386	1.5671	1.5533	3.1165	10.229	6.1131	4.2708	5.9581	1.8423	0.30921
201	388	1.5698	1.5567	3.1165	10.229	6.1101	4.2719	5.9572	1.8382	0.30857
202	390	1.5752	1.5603	3.1165	10.231	6.1084	4.2702	5.9604	1.8382	0.3084
203	392	1.5805	1.5637	3.1165	10.232	6.1095	4.2731	5.9586	1.8364	0.3082
204	394	1.5859	1.5684	3.1165	10.231	6.1189	4.2713	5.9599	1.8476	0.31
205	396	1.5877	1.5726	3.1165	10.229	6.1236	4.2725	5.9569	1.8511	0.31074
206	398	1.5877	1.5762	3.1165	10.229	6.1201	4.2725	5.9567	1.8476	0.31017
207	400	1.5886	1.5792	3.1165	10.226	6.1101	4.2737	5.9524	1.8364	0.30852
208	402	1.5931	1.582	3.1165	10.225	6.0996	4.2725	5.9529	1.8271	0.30692
209	404	1.5976	1.5845	3.1165	10.231	6.0955	4.2713	5.9596	1.8242	0.30609
210	406	1.6038	1.5873	3.1165	10.227	6.0949	4.2708	5.9565	1.8242	0.30625
211	408	1.6092	1.5907	3.1165	10.229	6.1031	4.2725	5.9562	1.8306	0.30734
212	410	1.6137	1.595	3.1165	10.23	6.1142	4.2725	5.9574	1.8417	0.30915
213	412	1.6191	1.6003	3.1165	10.229	6.1265	4.2719	5.9572	1.8546	0.31132
214	414	1.6209	1.6054	3.1165	10.229	6.1335	4.2713	5.9581	1.8622	0.31255
215	416	1.6236	1.6099	3.1165	10.231	6.1347	4.2725	5.9581	1.8622	0.31255
216	418	1.6263	1.6137	3.1165	10.229	6.13	4.2719	5.9574	1.8581	0.3119
217	420	1.6316	1.6171	3.1165	10.232	6.1259	4.2725	5.9591	1.8534	0.31102
218	422	1.6352	1.6207	3.1165	10.228	6.1253	4.2719	5.9561	1.8534	0.31118
219	424	1.637	1.6241	3.1165	10.23	6.1242	4.2725	5.9575	1.8517	0.31081
220	426	1.6406	1.6269	3.1165	10.229	6.1195	4.2731	5.9556	1.8464	0.31003
221	428	1.6451	1.6303	3.1165	10.231	6.1183	4.2702	5.9605	1.8482	0.31007
222	430	1.6496	1.6335	3.1165	10.231	6.1183	4.2725	5.9582	1.8458	0.3098
223	432	1.6523	1.6371	3.1165	10.228	6.1189	4.2702	5.958	1.8487	0.3103
224	434	1.6576	1.6403	3.1165	10.226	6.123	4.2725	5.9533	1.8505	0.31084
225	436	1.6612	1.6441	3.1165	10.23	6.1277	4.2719	5.9583	1.8558	0.31146
226	438	1.6639	1.648	3.1165	10.227	6.1312	4.2719	5.9554	1.8593	0.3122
227	440	1.6675	1.652	3.1165	10.231	6.1318	4.2719	5.959	1.8599	0.31211
228	442	1.6729	1.6561	3.1165	10.23	6.1371	4.2713	5.9583	1.8657	0.31313
229	444	1.6747	1.6599	3.1165	10.228	6.1388	4.2719	5.9563	1.8669	0.31343
230	446	1.6747	1.6631	3.1165	10.229	6.1335	4.2725	5.957	1.861	0.31241
231	448	1.6791	1.6663	3.1165	10.23	6.1277	4.2725	5.9577	1.8552	0.31139
232	450	1.6818	1.669	3.1165	10.231	6.1218	4.2719	5.9589	1.8499	0.31044
233	452	1.6836	1.6712	3.1165	10.227	6.1148	4.2713	5.956	1.8435	0.30951
234	454	1.6872	1.6729	3.1165	10.23	6.1072	4.2725	5.957	1.8347	0.30799
235	456	1.6908	1.6752	3.1165	10.227	6.1078	4.2725	5.9545	1.8353	0.30822
236	458	1.6953	1.6782	3.1165	10.227	6.1113	4.2719	5.9552	1.8394	0.30887
237	460	1.698	1.6814	3.1165	10.227	6.1142	4.2725	5.9543	1.8417	0.30931
238	462	1.7016	1.6846	3.1165	10.231	6.1183	4.2731	5.9576	1.8452	0.30973
239	464	1.7043	1.6884	3.1165	10.23	6.1212	4.2719	5.9584	1.8493	0.31037
240	466	1.7087	1.6918	3.1165	10.229	6.1236	4.2719	5.9575	1.8517	0.31081
241	468	1.7132	1.6954	3.1165	10.231	6.1283	4.2731	5.9576	1.8552	0.31139
242	470	1.7168	1.6995	3.1165	10.229	6.133	4.2713	5.9576	1.8616	0.31248
243	472	1.7213	1.7033	3.1165	10.228	6.1382	4.2725	5.9552	1.8657	0.31329
244	474	1.724	1.7071	3.1165	10.232	6.1423	4.2731	5.9584	1.8692	0.31371
245	476	1.7258	1.711	3.1165	10.226	6.1429	4.2719	5.954	1.871	0.31424
246	478	1.7294	1.7148	3.1165	10.23	6.1406	4.2702	5.9597	1.8704	0.31384
247	480	1.732	1.7178	3.1165	10.227	6.1376	4.2719	5.9552	1.8657	0.31329
248	482	1.7329	1.7203	3.1165	10.228	6.1324	4.2713	5.957	1.861	0.31241
249	484	1.7356	1.7227	3.1165	10.231	6.1253	4.2719	5.9592	1.8534	0.31102
250	486	1.7383	1.7248	3.1165	10.226	6.1171	4.2725	5.954	1.8446	0.30982
251	488	1.7401	1.7267	3.1165	10.23	6.1113	4.2725	5.9578	1.8388	0.30864
252	490	1.7437	1.7284	3.1165	10.229	6.1066	4.2725	5.9564	1.8341	0.30792
253	492	1.7464	1.7308	3.1165	10.231	6.1054	4.2725	5.9584	1.8329	0.30762
254	494	1.7491	1.7329	3.1165	10.232	6.106	4.2725	5.959	1.8335	0.30769
255	496	1.7509	1.7354	3.1165	10.23	6.1043	4.2725	5.9573	1.8318	0.30748
256	498	1.7554	1.7384	3.1165	10.228	6.106	4.2702	5.9582	1.8359	0.30812
257	500	1.7598	1.7412	3.1165	10.229	6.1101	4.2719	5.9572	1.8382	0.30857
258	502	1.7616	1.7442	3.1165	10.23	6.1148	4.2725	5.958	1.8423	0.30922
259	504	1.7643	1.7474	3.1165	10.23	6.1171	4.2731	5.9565	1.8441	0.30959
260	506	1.7679	1.751	3.1165	10.231	6.1183	4.2713	5.9593	1.847	0.30993
261	508	1.7697	1.7542	3.1165	10.229	6.1195	4.2708	5.9579	1.8487	0.3103
262	510	1.7733	1.7569	3.1165	10.228	6.1183	4.2731	5.9545	1.8452	0.30989
263	512	1.7787	1.7601	3.1165	10.23	6.1212	4.2713	5.959	1.8499	0.31044
264	514	1.7805	1.7631	3.1165	10.229	6.1236	4.2731	5.9563	1.8505	0.31068
265	516	1.7849	1.7669	3.1165	10.231	6.1253	4.2708	5.9603	1.8546	0.31116
266	518	1.7876	1.7699	3.1165	10.227	6.1277	4.2725	5.9546	1.8552	0.31156
267	520	1.7903	1.7733	3.1165	10.229	6.1294	4.2719	5.9568	1.8575	0.31183
268	522	1.7921	1.7763	3.1165	10.229	6.1294	4.2719	5.9568	1.8575	0.31183
269	524	1.7957	1.7793	3.1165	10.231	6.1289	4.2731	5.9582	1.8558	0.31146
270	526	1.7984	1.7825	3.1165	10.231	6.1289	4.2725	5.9588	1.8563	0.31153
271	528	1.802	1.7857	3.1165	10.229	6.1294	4.269	5.9597	1.8604	0.31217
272	530	1.8073	1.7886	3.1165	10.231	6.1347	4.2725	5.9581	1.8622	0.31255
273	532	1.8091	1.7921	3.1165	10.231	6.1388	4.2725	5.9588	1.8663	0.3132
274	534	1.8118	1.7955	3.1165	10.231	6.1388	4.2708	5.9606	1.8681	0.3134
275	536	1.8136	1.7984	3.1165	10.225	6.1359	4.2725	5.953	1.8634	0.31302
276	538	1.8181	1.8014	3.1165	10.227	6.1347	4.2696	5.9579	1.8651	0.31305
277	540	1.8217	1.8038	3.1165	10.231	6.1353	4.2737	5.9575	1.8616	0.31249
278	542	1.8244	1.8067	3.1165	10.229	6.1365	4.2719	5.9572	1.8645	0.31299
279	544	1.828	1.8099	3.1165	10.23	6.1406	4.2719	5.958	1.8686	0.31364
280	546	1.8307	1.8133	3.1165	10.23	6.1441	4.2725	5.9576	1.8716	0.31415
281	548	1.836	1.8167	3.1165	10.23	6.1476	4.2719	5.9584	1.8757	0.31479
282	550	1.8396	1.8204	3.1165	10.229	6.1558	4.2725	5.9562	1.8833	0.31619
283	552	1.8423	1.824	3.1165	10.229	6.1599	4.2708	5.9587	1.8891	0.31704
284	554	1.845	1.8278	3.1165	10.231	6.1616	4.2702	5.9609	1.8915	0.31731
285	556	1.8477	1.8312	3.1165	10.232	6.1622	4.2737	5.958	1.8885	0.31698
286	558	1.8504	1.8344	3.1165	10.227	6.1611	4.2725	5.9549	1.8885	0.31714
287	560	1.854	1.8372	3.1165	10.23	6.1575	4.2719	5.9584	1.8856	0.31646
288	562	1.8558	1.8397	3.1165	10.229	6.1564	4.2719	5.9573	1.8844	0.31632
289	564	1.8629	1.8427	3.1165	10.229	6.1593	4.2725	5.9564	1.8868	0.31677
290	566	1.8638	1.8463	3.1165	10.232	6.1628	4.2696	5.9626	1.8932	0.31752
291	568	1.8656	1.8491	3.1165	10.231	6.1616	4.2719	5.9592	1.8897	0.31711
292	570	1.8674	1.8516	3.1165	10.229	6.1599	4.2713	5.9581	1.8885	0.31697
293	572	1.8683	1.854	3.1165	10.228	6.1552	4.2719	5.9562	1.8833	0.31619
294	574	1.8701	1.8561	3.1165	10.231	6.1482	4.2737	5.9572	1.8745	0.31466

295	576	1.8719	1.858	3.1165	10.228	6.1417	4.2725	5.9554	1.8692	0.31387
296	578	1.8755	1.8599	3.1165	10.231	6.1388	4.2713	5.96	1.8675	0.31333
297	580	1.8782	1.8617	3.1165	10.229	6.1365	4.2719	5.9572	1.8645	0.31299
298	582	1.8818	1.864	3.1165	10.228	6.1382	4.2702	5.9575	1.8681	0.31356
299	584	1.8836	1.8665	3.1165	10.23	6.1406	4.2708	5.9591	1.8698	0.31377
300	586	1.8853	1.8691	3.1165	10.228	6.1388	4.2725	5.9557	1.8663	0.31336
301	588	1.888	1.8712	3.1165	10.227	6.1371	4.2725	5.9541	1.8645	0.31315
302	590	1.8907	1.8738	3.1165	10.23	6.1371	4.2708	5.9589	1.8663	0.31319
303	592	1.8934	1.8759	3.1165	10.229	6.1359	4.2725	5.9561	1.8634	0.31285
304	594	1.8952	1.8785	3.1165	10.23	6.1341	4.2725	5.9575	1.8616	0.31248
305	596	1.8988	1.8806	3.1165	10.229	6.133	4.2725	5.9564	1.8604	0.31234
306	598	1.8997	1.8831	3.1165	10.228	6.1324	4.2713	5.957	1.861	0.31241
307	600	1.9015	1.8848	3.1165	10.226	6.1294	4.2731	5.9525	1.8563	0.31186
308	602	1.906	1.8874	3.1165	10.226	6.13	4.2702	5.956	1.8599	0.31227
309	604	1.9078	1.89	3.1165	10.231	6.1318	4.2713	5.9596	1.8604	0.31218
310	606	1.9095	1.8925	3.1165	10.231	6.1318	4.2713	5.9596	1.8604	0.31218
311	608	1.9113	1.8946	3.1165	10.226	6.13	4.2725	5.9537	1.8575	0.312
312	610	1.9149	1.8968	3.1165	10.229	6.1294	4.2713	5.9574	1.8581	0.3119
313	612	1.9167	1.8993	3.1165	10.229	6.13	4.2725	5.9568	1.8575	0.31183
314	614	1.9185	1.9019	3.1165	10.227	6.1271	4.2731	5.9534	1.854	0.31142
315	616	1.9212	1.904	3.1165	10.231	6.1248	4.2725	5.958	1.8522	0.31088
316	618	1.9239	1.9061	3.1165	10.231	6.1248	4.2725	5.958	1.8522	0.31088
317	620	1.9266	1.9087	3.1165	10.228	6.1253	4.2713	5.9566	1.854	0.31125
318	622	1.9302	1.911	3.1165	10.23	6.1277	4.2713	5.9588	1.8563	0.31153
319	624	1.932	1.914	3.1165	10.226	6.13	4.2719	5.9543	1.8581	0.31206
320	626	1.9329	1.9163	3.1165	10.232	6.1294	4.2719	5.9599	1.8575	0.31167
321	628	1.9355	1.9185	3.1165	10.231	6.1253	4.2719	5.9592	1.8534	0.31102
322	630	1.9382	1.9206	3.1165	10.227	6.1242	4.2725	5.9544	1.8517	0.31098
323	632	1.9418	1.9229	3.1165	10.227	6.1248	4.2725	5.9549	1.8522	0.31105
324	634	1.9463	1.9259	3.1165	10.231	6.1289	4.2725	5.9588	1.8563	0.31153
325	636	1.949	1.9289	3.1165	10.231	6.1347	4.2713	5.9592	1.8634	0.31269
326	638	1.9526	1.9321	3.1165	10.231	6.1417	4.2708	5.9602	1.871	0.31391
327	640	1.9553	1.9351	3.1165	10.23	6.147	4.2743	5.9555	1.8727	0.31446
328	642	1.958	1.9387	3.1165	10.227	6.1511	4.2719	5.9555	1.8792	0.31554
329	644	1.9607	1.9421	3.1165	10.23	6.1534	4.2725	5.9571	1.8809	0.31575
330	646	1.9651	1.9453	3.1165	10.23	6.157	4.2725	5.9573	1.8844	0.31633
331	648	1.9678	1.9485	3.1165	10.231	6.1611	4.2719	5.9586	1.8891	0.31704
332	650	1.9696	1.9519	3.1165	10.232	6.1622	4.2708	5.9609	1.8915	0.31731
333	652	1.9741	1.9549	3.1165	10.226	6.1628	4.2725	5.9535	1.8903	0.31751
334	654	1.9768	1.9581	3.1165	10.228	6.1646	4.2713	5.9563	1.8932	0.31785
335	656	1.9813	1.9608	3.1165	10.231	6.1681	4.2737	5.9573	1.8944	0.318
336	658	1.984	1.9642	3.1165	10.227	6.1739	4.2708	5.9564	1.9032	0.31952
337	660	1.9849	1.9674	3.1165	10.23	6.1774	4.2708	5.9597	1.9067	0.31993
338	662	1.9893	1.9708	3.1165	10.231	6.178	4.269	5.962	1.909	0.3202
339	664	1.9902	1.9736	3.1165	10.232	6.1757	4.2708	5.9612	1.9049	0.31956
340	666	1.9929	1.9759	3.1165	10.231	6.1716	4.2719	5.9592	1.8997	0.31878
341	668	1.9956	1.9781	3.1165	10.228	6.1687	4.2719	5.9565	1.8967	0.31843
342	670	1.9965	1.9802	3.1165	10.229	6.1663	4.2719	5.9574	1.8944	0.31799
343	672	1.9992	1.9823	3.1165	10.232	6.1622	4.2731	5.9586	1.8891	0.31704
344	674	2.0037	1.9845	3.1165	10.231	6.1611	4.2725	5.958	1.8885	0.31697
345	676	2.0064	1.9866	3.1165	10.229	6.1622	4.2708	5.9578	1.8915	0.31748
346	678	2.0073	1.9889	3.1165	10.229	6.1622	4.2719	5.9566	1.8903	0.31734
347	680	2.01	1.9911	3.1165	10.228	6.1616	4.2725	5.9555	1.8891	0.31721
348	682	2.0118	1.9936	3.1165	10.231	6.1611	4.2702	5.9604	1.8909	0.31724
349	684	2.0135	1.9957	3.1165	10.229	6.1593	4.2708	5.9582	1.8885	0.31697
350	686	2.0153	1.9977	3.1165	10.23	6.157	4.2719	5.9579	1.885	0.31639
351	688	2.0171	1.9994	3.1165	10.227	6.1534	4.2719	5.9546	1.8815	0.31598
352	690	2.0198	2.0013	3.1165	10.231	6.1517	4.2719	5.9591	1.8798	0.31544
353	692	2.0216	2.003	3.1165	10.226	6.1499	4.2743	5.952	1.8757	0.31513
354	694	2.0234	2.0053	3.1165	10.229	6.1493	4.2719	5.9569	1.8774	0.31517
355	696	2.0261	2.0072	3.1165	10.231	6.1488	4.2725	5.9589	1.8762	0.31487
356	698	2.0288	2.0091	3.1165	10.232	6.1493	4.2713	5.9606	1.878	0.31507
357	700	2.0315	2.0113	3.1165	10.231	6.1517	4.2743	5.9568	1.8774	0.31517
358	702	2.0333	2.014	3.1165	10.232	6.1558	4.2708	5.961	1.885	0.31622
359	704	2.0369	2.0166	3.1165	10.231	6.1581	4.2725	5.9584	1.8856	0.31646
360	706	2.0386	2.0191	3.1165	10.227	6.1605	4.2719	5.955	1.8885	0.31714
361	708	2.0404	2.0217	3.1165	10.229	6.1622	4.2725	5.956	1.8897	0.31728
362	710	2.0422	2.0243	3.1165	10.228	6.1616	4.2725	5.9555	1.8891	0.31721
363	712	2.0458	2.0268	3.1165	10.229	6.1593	4.2713	5.9576	1.888	0.3169
364	714	2.0485	2.0289	3.1165	10.227	6.1611	4.2731	5.9544	1.888	0.31707
365	716	2.0494	2.0315	3.1165	10.232	6.1622	4.2719	5.9597	1.8903	0.31718
366	718	2.0512	2.0338	3.1165	10.226	6.1599	4.2708	5.9556	1.8891	0.3172
367	720	2.0521	2.0357	3.1165	10.229	6.1558	4.2719	5.9568	1.8839	0.31625
368	722	2.0548	2.0377	3.1165	10.227	6.1511	4.2713	5.9561	1.8798	0.3156
369	724	2.0575	2.0394	3.1165	10.23	6.1476	4.2713	5.959	1.8762	0.31486
370	726	2.0593	2.0409	3.1165	10.231	6.1452	4.2725	5.9587	1.8727	0.31429
371	728	2.062	2.0426	3.1165	10.227	6.1441	4.2719	5.9551	1.8722	0.31438
372	730	2.0637	2.0443	3.1165	10.231	6.1447	4.2731	5.9575	1.8716	0.31415
373	732	2.0655	2.0464	3.1165	10.231	6.1447	4.2719	5.9587	1.8727	0.31429
374	734	2.0691	2.0485	3.1165	10.23	6.147	4.2713	5.9584	1.8757	0.31479
375	736	2.0727	2.0509	3.1165	10.228	6.1523	4.2731	5.9554	1.8792	0.31554
376	738	2.0727	2.0536	3.1165	10.231	6.1552	4.2725	5.9587	1.8827	0.31595
377	740	2.0736	2.0558	3.1165	10.23	6.154	4.2725	5.9576	1.8815	0.31582
378	742	2.0763	2.0581	3.1165	10.23	6.1505	4.2725	5.9574	1.878	0.31524
379	744	2.0772	2.06	3.1165	10.231	6.1452	4.2713	5.9599	1.8739	0.31442
380	746	2.0781	2.0613	3.1165	10.229	6.14	4.2737	5.9557	1.8663	0.31337
381	748	2.0808	2.063	3.1165	10.229	6.1365	4.2708	5.9584	1.8657	0.31312
382	750	2.0835	2.0647	3.1165	10.231	6.1353	4.2725	5.9586	1.8628	0.31262
383	752	2.0871	2.0666	3.1165	10.23	6.1371	4.2731	5.9566	1.864	0.31292
384	754	2.0906	2.0689	3.1165	10.23	6.1412	4.2725	5.9579	1.8686	0.31364
385	756	2.0933	2.0717	3.1165	10.228	6.1482	4.2696	5.9582	1.8786	0.3153
386	758	2.0978	2.0743	3.1165	10.232	6.1558	4.2731	5.9587	1.8827	0.31596
387	760	2.0996	2.0777	3.1165	10.227	6.164	4.2725	5.9546	1.8915	0.31765
388	762	2.1032	2.0813	3.1165	10.23	6.1704	4.2725	5.9576	1.8979	0.31857
389	764	2.1068	2.0847	3.1165	10.231	6.178	4.2725	5.9585	1.9055	0.3198
390	766	2.1095	2.0883	3.1165	10.23	6.1833	4.2725	5.9573	1.9108	0.32075
391	768	2.1122	2.0915	3.1165	10.23	6.1868	4.2731	5.9569	1.9137	0.32126
392	770	2.1157	2.0949	3.1165	10.232	6.1892	4.2731	5.9591	1.9161	0.32154
393	772	2.1175	2.0979	3.1165	10.229	6.1892	4.2725	5.9566	1.9166	0.32177
394	774	2.1211	2.1009	3.1165	10.231	6.1909	4.2725	5.9582	1.9184	0.32197
395	776	2.1247	2.1039	3.1165	10.23	6.1938	4.2713	5.959	1.9225	0.32262

396	778	2.1256	2.1066	3.1165	10.23	6.1932	4.2713	5.9585	1.9219	0.32255
397	780	2.1283	2.1092	3.1165	10.231	6.1915	4.2737	5.9576	1.9178	0.32191
398	782	2.1301	2.1119	3.1165	10.229	6.1886	4.2713	5.9572	1.9172	0.32183
399	784	2.1337	2.1143	3.1165	10.228	6.188	4.2731	5.9549	1.9149	0.32157
400	786	2.1355	2.1164	3.1165	10.23	6.1868	4.2708	5.9592	1.9161	0.32153
401	788	2.1382	2.1183	3.1165	10.229	6.1856	4.2719	5.957	1.9137	0.32126
402	790	2.1408	2.1207	3.1165	10.229	6.1856	4.2731	5.9558	1.9125	0.32112
403	792	2.1426	2.1232	3.1165	10.232	6.1856	4.2713	5.9606	1.9143	0.32116
404	794	2.1444	2.1254	3.1165	10.231	6.1845	4.2725	5.9584	1.912	0.32089
405	796	2.1489	2.1277	3.1165	10.231	6.1851	4.2696	5.9618	1.9155	0.32129
406	798	2.1507	2.13	3.1165	10.232	6.1886	4.2696	5.962	1.919	0.32187
407	800	2.1516	2.1324	3.1165	10.232	6.1892	4.2725	5.9597	1.9166	0.3216
408	802	2.1534	2.1347	3.1165	10.23	6.1868	4.2737	5.9563	1.9131	0.32119
409	804	2.1543	2.1368	3.1165	10.229	6.1821	4.2713	5.9573	1.9108	0.32075
410	806	2.1552	2.1383	3.1165	10.228	6.1745	4.2702	5.9575	1.9043	0.31965
411	808	2.157	2.1396	3.1165	10.232	6.1687	4.2713	5.9602	1.8973	0.31833
412	810	2.1588	2.1409	3.1165	10.232	6.1628	4.2713	5.9609	1.8915	0.31731
413	812	2.1606	2.1422	3.1165	10.227	6.157	4.2725	5.9542	1.8844	0.31649
414	814	2.1633	2.1434	3.1165	10.231	6.1546	4.2731	5.9576	1.8815	0.31582
415	816	2.1642	2.1447	3.1165	10.229	6.1529	4.2725	5.9565	1.8803	0.31568
416	818	2.1651	2.1462	3.1165	10.227	6.1511	4.2731	5.9543	1.878	0.3154
417	820	2.1677	2.1477	3.1165	10.229	6.1499	4.2725	5.9569	1.8774	0.31517
418	822	2.1704	2.1498	3.1165	10.228	6.1523	4.2719	5.9566	1.8803	0.31568
419	824	2.174	2.152	3.1165	10.231	6.1552	4.2743	5.957	1.8809	0.31575
420	826	2.1758	2.1543	3.1165	10.229	6.1599	4.2702	5.9593	1.8897	0.3171
421	828	2.1776	2.1566	3.1165	10.229	6.1628	4.2708	5.9584	1.8921	0.31755
422	830	2.1776	2.1588	3.1165	10.229	6.1628	4.2725	5.9566	1.8903	0.31735
423	832	2.1812	2.1611	3.1165	10.23	6.1634	4.2713	5.9583	1.8921	0.31755
424	834	2.183	2.1634	3.1165	10.227	6.164	4.2725	5.9546	1.8915	0.31765
425	836	2.1857	2.1658	3.1165	10.231	6.1646	4.2731	5.9577	1.8915	0.31749
426	838	2.1884	2.1679	3.1165	10.228	6.1646	4.2719	5.9557	1.8926	0.31778
427	840	2.1911	2.1703	3.1165	10.229	6.1663	4.2725	5.9568	1.8938	0.31792
428	842	2.1928	2.1728	3.1165	10.23	6.1669	4.2708	5.9591	1.8962	0.31819
429	844	2.1946	2.1749	3.1165	10.231	6.1652	4.2719	5.9594	1.8932	0.31769
430	846	2.1964	2.1771	3.1165	10.23	6.164	4.2708	5.9595	1.8932	0.31768
431	848	2.2	2.1788	3.1165	10.226	6.1628	4.2737	5.9523	1.8891	0.31738
432	850	2.2018	2.1809	3.1165	10.229	6.1628	4.2719	5.9572	1.8909	0.31741
433	852	2.2045	2.183	3.1165	10.23	6.164	4.2725	5.9577	1.8915	0.31748
434	854	2.2081	2.1856	3.1165	10.227	6.1675	4.2725	5.9548	1.895	0.31823
435	856	2.2108	2.1883	3.1165	10.229	6.1728	4.2708	5.9584	1.902	0.31921
436	858	2.2126	2.1909	3.1165	10.232	6.1757	4.2702	5.9617	1.9055	0.31962
437	860	2.2162	2.1937	3.1165	10.233	6.1798	4.2702	5.9625	1.9096	0.32027
438	862	2.2179	2.1966	3.1165	10.232	6.1827	4.2708	5.9616	1.912	0.32071
439	864	2.2197	2.1992	3.1165	10.23	6.1833	4.2702	5.9596	1.9131	0.32102
440	866	2.2269	2.2022	3.1165	10.231	6.1915	4.2708	5.9605	1.9207	0.32224
441	868	2.2287	2.2054	3.1165	10.232	6.1991	4.2725	5.9597	1.9266	0.32327
442	870	2.2305	2.2088	3.1165	10.23	6.2061	4.2702	5.9594	1.936	0.32486
443	872	2.2332	2.212	3.1165	10.232	6.2085	4.2725	5.9592	1.936	0.32487
444	874	2.235	2.215	3.1165	10.231	6.2073	4.2749	5.9558	1.9324	0.32446
445	876	2.235	2.2175	3.1165	10.229	6.202	4.2743	5.9545	1.9278	0.32375
446	878	2.2368	2.2192	3.1165	10.23	6.1938	4.2731	5.9573	1.9207	0.32242
447	880	2.2377	2.2207	3.1165	10.231	6.1851	4.2725	5.9589	1.9125	0.32095
448	882	2.2386	2.222	3.1165	10.231	6.1745	4.2708	5.9601	1.9038	0.31942
449	884	2.2404	2.2228	3.1165	10.232	6.1657	4.2725	5.9594	1.8932	0.31769
450	886	2.2448	2.2237	3.1165	10.232	6.1593	4.2725	5.9595	1.8868	0.3166
451	888	2.2457	2.225	3.1165	10.231	6.1587	4.2713	5.9601	1.8874	0.31667
452	890	2.2475	2.2262	3.1165	10.23	6.1605	4.2725	5.9575	1.888	0.3169
453	892	2.2493	2.2275	3.1165	10.23	6.1605	4.2743	5.9557	1.8862	0.3167
454	894	2.252	2.2296	3.1165	10.232	6.1622	4.2725	5.9591	1.8897	0.31711
455	896	2.2538	2.2318	3.1165	10.231	6.1652	4.2719	5.9594	1.8932	0.31769
456	898	2.2574	2.2339	3.1165	10.23	6.1704	4.2725	5.9576	1.8979	0.31857
457	900	2.2592	2.2362	3.1165	10.228	6.1745	4.2725	5.9552	1.902	0.31939
458	902	2.2619	2.2388	3.1165	10.232	6.1786	4.2713	5.9602	1.9073	0.32
459	904	2.2655	2.2418	3.1165	10.232	6.1856	4.2725	5.9595	1.9131	0.32102
460	906	2.2682	2.245	3.1165	10.232	6.1921	4.2737	5.9582	1.9184	0.32198
461	908	2.2699	2.2479	3.1165	10.231	6.195	4.2725	5.959	1.9225	0.32262
462	910	2.2726	2.2507	3.1165	10.228	6.1979	4.2725	5.9555	1.9254	0.3233
463	912	2.2762	2.2537	3.1165	10.231	6.2009	4.2731	5.9577	1.9278	0.32358
464	914	2.278	2.2567	3.1165	10.231	6.2044	4.2708	5.9602	1.9336	0.32442
465	916	2.2807	2.2594	3.1165	10.23	6.2061	4.2725	5.957	1.9336	0.32459
466	918	2.2834	2.262	3.1165	10.226	6.2061	4.2708	5.9557	1.9354	0.32496
467	920	2.2852	2.2643	3.1165	10.23	6.2067	4.2719	5.9582	1.9348	0.32473
468	922	2.2852	2.2665	3.1165	10.23	6.2032	4.2737	5.9562	1.9295	0.32395
469	924	2.287	2.2682	3.1165	10.231	6.1979	4.2743	5.9569	1.9237	0.32293
470	926	2.2897	2.2701	3.1165	10.229	6.1927	4.2713	5.9579	1.9213	0.32248
471	928	2.2906	2.2716	3.1165	10.231	6.1874	4.2731	5.9574	1.9143	0.32133
472	930	2.2933	2.2728	3.1165	10.229	6.1827	4.2719	5.9573	1.9108	0.32075
473	932	2.2941	2.2743	3.1165	10.23	6.1804	4.2713	5.9588	1.909	0.32037
474	934	2.295	2.2754	3.1165	10.229	6.1763	4.2725	5.9569	1.9038	0.31959
475	936	2.295	2.2765	3.1165	10.23	6.1704	4.2719	5.9581	1.8985	0.31864
476	938	2.2959	2.2777	3.1165	10.229	6.1628	4.2696	5.9595	1.8932	0.31768
477	940	2.2986	2.2782	3.1165	10.23	6.1575	4.2731	5.9573	1.8844	0.31633
478	942	2.3004	2.2794	3.1165	10.229	6.1558	4.269	5.9597	1.8868	0.31659
479	944	2.3022	2.2803	3.1165	10.23	6.157	4.2725	5.9573	1.8844	0.31633
480	946	2.3049	2.2818	3.1165	10.228	6.1587	4.2737	5.9547	1.885	0.31656
481	948	2.3076	2.2839	3.1165	10.23	6.1634	4.2725	5.9571	1.8909	0.31741
482	950	2.3103	2.286	3.1165	10.232	6.1687	4.2731	5.9584	1.8956	0.31813
483	952	2.3112	2.2884	3.1165	10.23	6.1733	4.2725	5.9572	1.9008	0.31908
484	954	2.3139	2.2907	3.1165	10.227	6.1769	4.2719	5.9549	1.9049	0.31989
485	956	2.3166	2.2931	3.1165	10.232	6.1827	4.2731	5.9592	1.9096	0.32045
486	958	2.3184	2.2958	3.1165	10.231	6.1874	4.2719	5.9586	1.9155	0.32146
487	960	2.3193	2.2986	3.1165	10.227	6.1897	4.2725	5.954	1.9172	0.32201
488	962	2.3237	2.3012	3.1165	10.231	6.1909	4.2702	5.9606	1.9207	0.32224
489	964	2.3282	2.3037	3.1165	10.23	6.1968	4.2719	5.9581	1.9248	0.32306
490	966	2.3291	2.3063	3.1165	10.23	6.2032	4.2725	5.9574	1.9307	0.32408
491	968	2.3309	2.309	3.1165	10.233	6.2061	4.2719	5.9607	1.9342	0.32449
492	970	2.3309	2.3116	3.1165	10.231	6.2044	4.2713	5.9597	1.933	0.32435
493	972	2.3318	2.3135	3.1165	10.227	6.1973	4.2719	5.9556	1.9254	0.3233
494	974	2.3327	2.3148	3.1165	10.232	6.1886	4.2725	5.9591	1.9161	0.32153
495	976	2.3345	2.3156	3.1165	10.229	6.1792	4.2725	5.9565	1.9067	0.3201
496	978	2.3363	2.3165	3.1165	10.229	6.1728	4.2713	5.9578	1.9014	0.31915

497	980	2.3372	2.3173	3.1165	10.23	6.1675	4.2708	5.9597	1.8967	0.31826
498	982	2.3381	2.3182	3.1165	10.232	6.1622	4.2725	5.9591	1.8897	0.31711
499	984	2.3399	2.319	3.1165	10.227	6.1575	4.2719	5.9553	1.8856	0.31663
500	986	2.3417	2.3201	3.1165	10.232	6.1558	4.2708	5.961	1.885	0.31622
501	988	2.3435	2.3212	3.1165	10.232	6.1558	4.2713	5.9605	1.8844	0.31616
502	990	2.3461	2.3224	3.1165	10.231	6.1581	4.2719	5.959	1.8862	0.31653
503	992	2.3479	2.3243	3.1165	10.232	6.1622	4.2713	5.9603	1.8909	0.31725
504	994	2.3488	2.3261	3.1165	10.228	6.1646	4.2719	5.9557	1.8926	0.31778
505	996	2.3506	2.3282	3.1165	10.229	6.1663	4.2713	5.958	1.895	0.31806
506	998	2.3533	2.3301	3.1165	10.231	6.1681	4.2702	5.9608	1.8979	0.3184
507	1000	2.3542	2.3318	3.1165	10.23	6.1698	4.2725	5.957	1.8973	0.3185
508	1002	2.3578	2.3341	3.1165	10.231	6.1751	4.2708	5.9606	1.9043	0.31949
509	1004	2.3596	2.3365	3.1165	10.232	6.1786	4.2719	5.9596	1.9067	0.31993
510	1006	2.3614	2.3388	3.1165	10.232	6.1821	4.2725	5.9593	1.9096	0.32044
511	1008	2.3623	2.3412	3.1165	10.229	6.1827	4.2719	5.9573	1.9108	0.32075
512	1010	2.3641	2.3429	3.1165	10.229	6.1827	4.2725	5.9567	1.9102	0.32068
513	1012	2.3668	2.345	3.1165	10.23	6.1833	4.2713	5.9584	1.912	0.32088
514	1014	2.3686	2.3467	3.1165	10.23	6.1833	4.2696	5.9602	1.9137	0.32108
515	1016	2.3721	2.3488	3.1165	10.227	6.1839	4.2725	5.9547	1.9114	0.32098
516	1018	2.3739	2.3514	3.1165	10.229	6.1862	4.2708	5.9587	1.9155	0.32146
517	1020	2.3748	2.3531	3.1165	10.23	6.1868	4.2719	5.9581	1.9149	0.32139
518	1022	2.3775	2.355	3.1165	10.23	6.1868	4.2725	5.9575	1.9143	0.32133
519	1024	2.3793	2.3569	3.1165	10.227	6.1868	4.2719	5.955	1.9149	0.32156
520	1026	2.3802	2.3586	3.1165	10.23	6.1868	4.2737	5.9563	1.9131	0.32119
521	1028	2.3829	2.3605	3.1165	10.229	6.1862	4.2737	5.9557	1.9125	0.32113
522	1030	2.3847	2.3627	3.1165	10.229	6.1862	4.2719	5.9575	1.9143	0.32133
523	1032	2.3856	2.3644	3.1165	10.231	6.1851	4.2725	5.9589	1.9125	0.32095
524	1034	2.3883	2.3661	3.1165	10.231	6.1845	4.2731	5.9578	1.9114	0.32082
525	1036	2.3883	2.3676	3.1165	10.23	6.1833	4.2719	5.9579	1.9114	0.32082
526	1038	2.3901	2.3693	3.1165	10.23	6.1804	4.2708	5.9594	1.9096	0.32044
527	1040	2.3919	2.371	3.1165	10.231	6.178	4.2713	5.9597	1.9067	0.31993
528	1042	2.3937	2.3722	3.1165	10.229	6.1763	4.2725	5.9569	1.9038	0.31959
529	1044	2.3964	2.3737	3.1165	10.227	6.1769	4.2725	5.9543	1.9043	0.31983
530	1046	2.3972	2.3754	3.1165	10.23	6.1774	4.2719	5.9585	1.9055	0.3198
531	1048	2.3999	2.3769	3.1165	10.227	6.1774	4.2719	5.9554	1.9055	0.31996
532	1050	2.4008	2.3786	3.1165	10.23	6.1774	4.2725	5.958	1.9049	0.31973
533	1052	2.4044	2.3807	3.1165	10.231	6.1815	4.2725	5.9587	1.909	0.32038
534	1054	2.4062	2.3829	3.1165	10.228	6.1851	4.2725	5.9558	1.9125	0.32112
535	1056	2.4071	2.3848	3.1165	10.227	6.1868	4.2731	5.9538	1.9137	0.32143
536	1058	2.4098	2.3867	3.1165	10.227	6.1874	4.2725	5.9549	1.9149	0.32156
537	1060	2.4125	2.3888	3.1165	10.232	6.1886	4.2725	5.9591	1.9161	0.32153
538	1062	2.4143	2.391	3.1165	10.231	6.1915	4.2731	5.9582	1.9184	0.32198
539	1064	2.4179	2.3933	3.1165	10.231	6.195	4.2725	5.959	1.9225	0.32262
540	1066	2.4206	2.3959	3.1165	10.231	6.2014	4.2702	5.9612	1.9313	0.32398
541	1068	2.4223	2.3982	3.1165	10.232	6.2055	4.2725	5.9596	1.933	0.32436
542	1070	2.4241	2.4005	3.1165	10.228	6.2073	4.2719	5.9556	1.9354	0.32497
543	1072	2.4268	2.4029	3.1165	10.23	6.2096	4.2731	5.9567	1.9365	0.32511
544	1074	2.4268	2.4054	3.1165	10.23	6.2102	4.2713	5.959	1.9389	0.32537
545	1076	2.4295	2.4076	3.1165	10.231	6.2079	4.2725	5.9587	1.9354	0.3248
546	1078	2.4313	2.4093	3.1165	10.23	6.2067	4.2725	5.9576	1.9342	0.32466
547	1080	2.434	2.411	3.1165	10.231	6.2044	4.2731	5.9579	1.9313	0.32415
548	1082	2.4349	2.4129	3.1165	10.232	6.205	4.2702	5.9614	1.9348	0.32455
549	1084	2.4358	2.4144	3.1165	10.227	6.2032	4.2713	5.9555	1.9319	0.32438
550	1086	2.4367	2.4161	3.1165	10.23	6.2003	4.2713	5.9589	1.9289	0.32371
551	1088	2.4376	2.4174	3.1165	10.231	6.195	4.2719	5.9596	1.9231	0.32269
552	1090	2.4385	2.4184	3.1165	10.232	6.1892	4.2708	5.9614	1.9184	0.3218
553	1092	2.4412	2.4193	3.1165	10.232	6.1856	4.2719	5.9601	1.9137	0.32109
554	1094	2.443	2.4203	3.1165	10.231	6.1845	4.2731	5.9578	1.9114	0.32082
555	1096	2.4448	2.4218	3.1165	10.232	6.1856	4.2725	5.9595	1.9131	0.32102
556	1098	2.4466	2.4233	3.1165	10.229	6.1862	4.2719	5.9575	1.9143	0.32133
557	1100	2.4475	2.4248	3.1165	10.229	6.1856	4.2708	5.9581	1.9149	0.32139
558	1102	2.451	2.4263	3.1165	10.23	6.1868	4.2713	5.9586	1.9155	0.32146
559	1104	2.4528	2.4282	3.1165	10.231	6.1909	4.2713	5.9594	1.9196	0.32211
560	1106	2.4555	2.4301	3.1165	10.229	6.1962	4.2725	5.957	1.9237	0.32293
561	1108	2.4582	2.4325	3.1165	10.232	6.202	4.2678	5.9641	1.9342	0.32431
562	1110	2.4591	2.435	3.1165	10.23	6.2067	4.2719	5.9582	1.9348	0.32473
563	1112	2.46	2.4374	3.1165	10.232	6.2085	4.2719	5.9598	1.9365	0.32493
564	1114	2.4627	2.4395	3.1165	10.232	6.2085	4.2708	5.961	1.9377	0.32507
565	1116	2.4654	2.4414	3.1165	10.231	6.2108	4.2731	5.9578	1.9377	0.32524
566	1118	2.4672	2.4435	3.1165	10.23	6.2132	4.2731	5.9569	1.9401	0.32568
567	1120	2.4681	2.4455	3.1165	10.229	6.2126	4.2713	5.9581	1.9412	0.32581
568	1122	2.4699	2.4476	3.1165	10.231	6.2114	4.2731	5.9583	1.9383	0.32531
569	1124	2.4726	2.4495	3.1165	10.231	6.2108	4.2713	5.9595	1.9395	0.32544
570	1126	2.4743	2.4512	3.1165	10.231	6.2108	4.2713	5.9595	1.9395	0.32544
571	1128	2.4761	2.4529	3.1165	10.233	6.2126	4.2731	5.9594	1.9395	0.32545
572	1130	2.4779	2.4548	3.1165	10.231	6.2137	4.2725	5.958	1.9412	0.32582
573	1132	2.4797	2.4567	3.1165	10.231	6.2137	4.2702	5.9603	1.9436	0.32608
574	1134	2.4806	2.4584	3.1165	10.231	6.2137	4.2731	5.9574	1.9406	0.32575
575	1136	2.4833	2.4601	3.1165	10.23	6.2132	4.2737	5.9563	1.9395	0.32562
576	1138	2.4842	2.4618	3.1165	10.23	6.2132	4.2719	5.958	1.9412	0.32582
577	1140	2.486	2.4633	3.1165	10.229	6.212	4.2725	5.9563	1.9395	0.32561
578	1142	2.4887	2.465	3.1165	10.229	6.2126	4.2719	5.9575	1.9406	0.32575
579	1144	2.4896	2.4665	3.1165	10.23	6.2132	4.2731	5.9569	1.9401	0.32568
580	1146	2.4905	2.4682	3.1165	10.23	6.2132	4.2725	5.9574	1.9406	0.32575
581	1148	2.4923	2.4701	3.1165	10.231	6.2108	4.2708	5.9601	1.9401	0.32551
582	1150	2.4941	2.4714	3.1165	10.232	6.2085	4.2725	5.9592	1.936	0.32487
583	1152	2.4941	2.4725	3.1165	10.228	6.205	4.2737	5.9548	1.9313	0.32432
584	1154	2.4959	2.4738	3.1165	10.232	6.202	4.2725	5.9594	1.9295	0.32378
585	1156	2.4977	2.4748	3.1165	10.23	6.2003	4.2702	5.9601	1.9301	0.32384
586	1158	2.5021	2.4765	3.1165	10.23	6.2032	4.2702	5.9597	1.933	0.32435
587	1160	2.503	2.4784	3.1165	10.232	6.2085	4.2725	5.9592	1.936	0.32487
588	1162	2.5039	2.4804	3.1165	10.23	6.2096	4.2708	5.959	1.9389	0.32537
589	1164	2.5048	2.4818	3.1165	10.23	6.2102	4.2737	5.9566	1.9365	0.32511
590	1166	2.5066	2.4835	3.1165	10.232	6.2091	4.2725	5.9598	1.9365	0.32493
591	1168	2.5084	2.485	3.1165	10.23	6.2067	4.2725	5.9576	1.9342	0.32466
592	1170	2.512	2.4865	3.1165	10.229	6.2055	4.2719	5.9571	1.9336	0.32459
593	1172	2.5111	2.4882	3.1165	10.228	6.2073	4.2725	5.955	1.9348	0.3249
594	1174	2.5138	2.4899	3.1165	10.233	6.2061	4.2725	5.9601	1.9336	0.32442
595	1176	2.5147	2.4912	3.1165	10.233	6.2061	4.2731	5.9596	1.933	0.32436
596	1178	2.5147	2.4927	3.1165	10.227	6.2038	4.2725	5.9548	1.9313	0.32432
597	1180	2.5174	2.494	3.1165	10.232	6.2026	4.2725	5.9599	1.9301	0.32385

598	1182	2.5201	2.4955	3.1165	10.23	6.2032	4.2719	5.958	1.9313	0.32415
599	1184	2.5201	2.4972	3.1165	10.23	6.2032	4.2708	5.9591	1.9324	0.32428
600	1186	2.5228	2.4984	3.1165	10.229	6.2026	4.2731	5.9562	1.9295	0.32395
601	1188	2.5246	2.4999	3.1165	10.232	6.205	4.2731	5.9584	1.9319	0.32422
602	1190	2.5263	2.5016	3.1165	10.23	6.2067	4.2725	5.9576	1.9342	0.32466
603	1192	2.5272	2.5036	3.1165	10.232	6.2085	4.2713	5.9604	1.9371	0.325
604	1194	2.5281	2.505	3.1165	10.228	6.2073	4.2731	5.9545	1.9342	0.32483
605	1196	2.529	2.5067	3.1165	10.232	6.205	4.2719	5.9596	1.933	0.32435
606	1198	2.5308	2.508	3.1165	10.23	6.2032	4.2725	5.9574	1.9307	0.32408
607	1200	2.5326	2.5095	3.1165	10.232	6.202	4.2731	5.9588	1.9289	0.32371
608	1202	2.5326	2.5108	3.1165	10.23	6.2003	4.2731	5.9571	1.9272	0.32351
609	1204	2.5344	2.5121	3.1165	10.229	6.1956	4.2731	5.9558	1.9225	0.32279
610	1206	2.5371	2.5136	3.1165	10.23	6.1938	4.2725	5.9579	1.9213	0.32248
611	1208	2.5407	2.515	3.1165	10.233	6.1962	4.2713	5.9612	1.9248	0.32289
612	1210	2.5407	2.5163	3.1165	10.231	6.1973	4.2731	5.9575	1.9243	0.323
613	1212	2.5407	2.5178	3.1165	10.229	6.1962	4.2725	5.957	1.9237	0.32293
614	1214	2.5425	2.5195	3.1165	10.231	6.195	4.2702	5.9613	1.9248	0.32289
615	1216	2.5434	2.5208	3.1165	10.229	6.1927	4.2719	5.9574	1.9207	0.32241
616	1218	2.5452	2.5223	3.1165	10.23	6.1897	4.2702	5.9595	1.9196	0.3221
617	1220	2.5461	2.5233	3.1165	10.231	6.188	4.2725	5.9586	1.9155	0.32146
618	1222	2.547	2.5246	3.1165	10.232	6.1856	4.2713	5.9606	1.9143	0.32116
619	1224	2.5479	2.5257	3.1165	10.227	6.1839	4.2725	5.9547	1.9114	0.32098
620	1226	2.5497	2.5272	3.1165	10.23	6.1804	4.2713	5.9588	1.909	0.32037
621	1228	2.5497	2.528	3.1165	10.23	6.1769	4.2737	5.9562	1.9032	0.31953
622	1230	2.5523	2.5293	3.1165	10.231	6.1751	4.2713	5.96	1.9038	0.31942
623	1232	2.5541	2.5304	3.1165	10.227	6.1733	4.2719	5.9547	1.9014	0.31931
624	1234	2.5559	2.5312	3.1165	10.23	6.1733	4.2731	5.9566	1.9003	0.31901
625	1236	2.5568	2.5327	3.1165	10.23	6.1739	4.2708	5.9595	1.9032	0.31935
626	1238	2.5577	2.5342	3.1165	10.23	6.1733	4.2713	5.9584	1.902	0.31922
627	1240	2.5595	2.5355	3.1165	10.232	6.1722	4.2719	5.9598	1.9002	0.31885
628	1242	2.5595	2.5368	3.1165	10.23	6.1704	4.2719	5.9581	1.8985	0.31864
629	1244	2.5613	2.538	3.1165	10.232	6.1687	4.2713	5.9602	1.8973	0.31833
630	1246	2.5631	2.5393	3.1165	10.23	6.1675	4.2725	5.9579	1.895	0.31806
631	1248	2.5649	2.5406	3.1165	10.23	6.1675	4.2731	5.9573	1.8944	0.31799
632	1250	2.5676	2.5423	3.1165	10.232	6.1692	4.2713	5.9607	1.8979	0.3184
633	1252	2.5676	2.5438	3.1165	10.231	6.1716	4.2713	5.9598	1.9002	0.31884
634	1254	2.5685	2.5455	3.1165	10.232	6.1722	4.2702	5.9615	1.902	0.31905
635	1256	2.5721	2.547	3.1165	10.232	6.1722	4.2725	5.9592	1.8997	0.31878
636	1258	2.5757	2.5489	3.1165	10.232	6.1763	4.2725	5.96	1.9038	0.31943
637	1260	2.5765	2.551	3.1165	10.23	6.1804	4.2708	5.9594	1.9096	0.32044
638	1262	2.5783	2.5529	3.1165	10.232	6.1856	4.2719	5.9601	1.9137	0.32109
639	1264	2.5801	2.5553	3.1165	10.228	6.188	4.2708	5.9572	1.9172	0.32183
640	1266	2.5828	2.5574	3.1165	10.231	6.1915	4.2713	5.9599	1.9202	0.32218
641	1268	2.5846	2.56	3.1165	10.233	6.1962	4.2743	5.9583	1.9219	0.32256
642	1270	2.5855	2.5621	3.1165	10.23	6.1968	4.2725	5.9575	1.9243	0.32299
643	1272	2.5882	2.564	3.1165	10.229	6.1962	4.2731	5.9564	1.9231	0.32286
644	1274	2.59	2.5661	3.1165	10.232	6.1956	4.2702	5.9619	1.9254	0.32296
645	1276	2.59	2.5676	3.1165	10.23	6.1932	4.2725	5.9573	1.9207	0.32242
646	1278	2.5927	2.5695	3.1165	10.23	6.1897	4.2696	5.96	1.9202	0.32217
647	1280	2.5954	2.5712	3.1165	10.232	6.1892	4.2702	5.962	1.919	0.32187
648	1282	2.5963	2.5725	3.1165	10.232	6.1892	4.2731	5.9591	1.9161	0.32154
649	1284	2.599	2.574	3.1165	10.231	6.1874	4.2725	5.958	1.9149	0.3214
650	1286	2.6008	2.5759	3.1165	10.232	6.1886	4.2708	5.9609	1.9178	0.32173
651	1288	2.6025	2.5774	3.1165	10.23	6.1897	4.2749	5.9548	1.9149	0.32157
652	1290	2.6043	2.5793	3.1165	10.231	6.1909	4.2731	5.9576	1.9178	0.32191
653	1292	2.6079	2.5815	3.1165	10.231	6.195	4.2725	5.959	1.9225	0.32262
654	1294	2.6097	2.5836	3.1165	10.233	6.1997	4.2719	5.9609	1.9278	0.3234
655	1296	2.6115	2.5857	3.1165	10.226	6.2026	4.2719	5.9543	1.9307	0.32425
656	1298	2.6133	2.5878	3.1165	10.227	6.2067	4.2725	5.9545	1.9342	0.32483
657	1300	2.6151	2.5904	3.1165	10.231	6.2079	4.2713	5.9599	1.9365	0.32493
658	1302	2.616	2.5925	3.1165	10.229	6.2085	4.2719	5.9567	1.9365	0.3251
659	1304	2.6187	2.5944	3.1165	10.231	6.2073	4.2725	5.9581	1.9348	0.32473
660	1306	2.6196	2.5961	3.1165	10.228	6.205	4.2719	5.9565	1.933	0.32452
661	1308	2.6223	2.5978	3.1165	10.229	6.2055	4.2731	5.9559	1.9324	0.32446
662	1310	2.6232	2.6	3.1165	10.232	6.205	4.2702	5.9614	1.9348	0.32455
663	1312	2.625	2.6017	3.1165	10.23	6.2038	4.2719	5.9585	1.9319	0.32422
664	1314	2.625	2.6032	3.1165	10.23	6.1997	4.269	5.9607	1.9307	0.3239
665	1316	2.6268	2.604	3.1165	10.231	6.195	4.2725	5.959	1.9225	0.32262
666	1318	2.6276	2.6053	3.1165	10.228	6.1909	4.2713	5.9563	1.9196	0.32228
667	1320	2.6285	2.6064	3.1165	10.231	6.1845	4.2713	5.9595	1.9131	0.32102
668	1322	2.6294	2.6074	3.1165	10.229	6.1792	4.2702	5.9589	1.909	0.32037
669	1324	2.6312	2.6081	3.1165	10.232	6.1757	4.2725	5.9594	1.9032	0.31936
670	1326	2.6321	2.6087	3.1165	10.231	6.1716	4.2713	5.9598	1.9002	0.31884
671	1328	2.6348	2.6098	3.1165	10.231	6.171	4.2737	5.9569	1.8973	0.31851
672	1330	2.6339	2.611	3.1165	10.229	6.1692	4.2708	5.9582	1.8985	0.31863
673	1332	2.6366	2.6125	3.1165	10.232	6.1687	4.2702	5.9613	1.8985	0.31847
674	1334	2.6366	2.6134	3.1165	10.229	6.1663	4.2719	5.9574	1.8944	0.31799
675	1336	2.6384	2.6147	3.1165	10.23	6.164	4.2708	5.9595	1.8932	0.31768
676	1338	2.6393	2.6155	3.1165	10.231	6.1616	4.2737	5.9574	1.888	0.31691
677	1340	2.6411	2.6168	3.1165	10.23	6.1605	4.2708	5.9593	1.8897	0.31711
678	1342	2.6438	2.6185	3.1165	10.229	6.1622	4.2725	5.956	1.8897	0.31728
679	1344	2.6447	2.6198	3.1165	10.231	6.1652	4.2737	5.9576	1.8915	0.31749
680	1346	2.6474	2.6217	3.1165	10.231	6.1681	4.2713	5.9596	1.8967	0.31826
681	1348	2.6492	2.6234	3.1165	10.228	6.1716	4.2737	5.9544	1.8979	0.31874
682	1350	2.651	2.6255	3.1165	10.231	6.1751	4.2719	5.9594	1.9032	0.31935
683	1352	2.6519	2.6274	3.1165	10.231	6.1751	4.2731	5.9583	1.902	0.31922
684	1354	2.6528	2.6291	3.1165	10.229	6.1728	4.269	5.9602	1.9038	0.31941
685	1356	2.6528	2.6306	3.1165	10.228	6.1681	4.2731	5.9548	1.895	0.31823
686	1358	2.6554	2.6317	3.1165	10.231	6.1646	4.2725	5.9582	1.8921	0.31755
687	1360	2.6563	2.633	3.1165	10.23	6.1634	4.2719	5.9577	1.8915	0.31748
688	1362	2.6581	2.6342	3.1165	10.232	6.1628	4.2737	5.9585	1.8891	0.31705
689	1364	2.659	2.6359	3.1165	10.23	6.1605	4.2708	5.9593	1.8897	0.31711
690	1366	2.6617	2.6372	3.1165	10.227	6.1575	4.2702	5.9571	1.8874	0.31683
691	1368	2.6626	2.6383	3.1165	10.229	6.1564	4.2713	5.9579	1.885	0.31639
692	1370	2.6662	2.6396	3.1165	10.231	6.1552	4.2725	5.9587	1.8827	0.31595
693	1372	2.668	2.6413	3.1165	10.232	6.1593	4.2731	5.9589	1.8862	0.31653
694	1374	2.6698	2.6432	3.1165	10.232	6.1622	4.2713	5.9603	1.8909	0.31725
695	1376	2.6707	2.6449	3.1165	10.231	6.1646	4.2737	5.9571	1.8909	0.31742
696	1378	2.6725	2.647	3.1165	10.231	6.1681	4.2696	5.9614	1.8985	0.31847
697	1380	2.6734	2.6487	3.1165	10.232	6.1687	4.2737	5.9578	1.895	0.31807
698	1382	2.6743	2.6504	3.1165	10.228	6.1646	4.2731	5.9546	1.8915	0.31765

699	1384	2.6734	2.6519	3.1165	10.231	6.1587	4.2725	5.9589	1.8862	0.31653
700	1386	2.6752	2.6528	3.1165	10.228	6.1517	4.2708	5.9572	1.8809	0.31574
701	1388	2.6761	2.6536	3.1165	10.231	6.1452	4.2725	5.9587	1.8727	0.31429
702	1390	2.677	2.6542	3.1165	10.23	6.1406	4.2737	5.9562	1.8669	0.31344
703	1392	2.6779	2.6551	3.1165	10.229	6.1365	4.2719	5.9572	1.8645	0.31299
704	1394	2.6814	2.6562	3.1165	10.23	6.1341	4.2725	5.9575	1.8616	0.31248
705	1396	2.6823	2.6572	3.1165	10.231	6.1353	4.2731	5.958	1.8622	0.31255
706	1398	2.6841	2.6587	3.1165	10.231	6.1353	4.2702	5.961	1.8651	0.31289
707	1400	2.6859	2.6598	3.1165	10.23	6.1371	4.2708	5.9589	1.8663	0.31319
708	1402	2.6886	2.6615	3.1165	10.232	6.1423	4.2725	5.959	1.8698	0.31378
709	1404	2.6904	2.6636	3.1165	10.229	6.1464	4.2708	5.9584	1.8757	0.31479
710	1406	2.6913	2.6655	3.1165	10.229	6.1493	4.2719	5.9569	1.8774	0.31517
711	1408	2.694	2.6672	3.1165	10.23	6.1505	4.2713	5.9586	1.8792	0.31537
712	1410	2.6949	2.6691	3.1165	10.228	6.1517	4.2731	5.9549	1.8786	0.31547
713	1412	2.6976	2.6711	3.1165	10.231	6.1546	4.2725	5.9582	1.8821	0.31589
714	1414	2.7012	2.6734	3.1165	10.232	6.1593	4.2725	5.9595	1.8868	0.3166
715	1416	2.703	2.6757	3.1165	10.23	6.1634	4.2725	5.9571	1.8909	0.31741
716	1418	2.7047	2.6781	3.1165	10.23	6.1675	4.2719	5.9585	1.8956	0.31813
717	1420	2.7056	2.6802	3.1165	10.231	6.171	4.2731	5.9575	1.8979	0.31857
718	1422	2.7101	2.6825	3.1165	10.23	6.1739	4.2731	5.9572	1.9008	0.31908
719	1424	2.7128	2.6851	3.1165	10.23	6.1798	4.2737	5.9559	1.9061	0.32004
720	1426	2.7146	2.6877	3.1165	10.23	6.1839	4.2731	5.9572	1.9108	0.32075
721	1428	2.7146	2.6902	3.1165	10.231	6.1851	4.2708	5.9607	1.9143	0.32115
722	1430	2.7173	2.6921	3.1165	10.228	6.1851	4.2737	5.9546	1.9114	0.32099
723	1432	2.72	2.6943	3.1165	10.228	6.1851	4.2713	5.957	1.9137	0.32126
724	1434	2.7227	2.6964	3.1165	10.232	6.1856	4.2725	5.9595	1.9131	0.32102
725	1436	2.7245	2.6985	3.1165	10.231	6.188	4.2719	5.9592	1.9161	0.32153
726	1438	2.7272	2.7006	3.1165	10.231	6.1909	4.2725	5.9582	1.9184	0.32197
727	1440	2.7272	2.7028	3.1165	10.228	6.1915	4.2737	5.9545	1.9178	0.32208
728	1442	2.729	2.7045	3.1165	10.229	6.1886	4.2725	5.956	1.9161	0.3217
729	1444	2.729	2.7062	3.1165	10.23	6.1839	4.2719	5.9584	1.912	0.32088
730	1446	2.7298	2.7074	3.1165	10.229	6.1763	4.2725	5.9569	1.9038	0.31959
731	1448	2.7307	2.7083	3.1165	10.232	6.1687	4.2725	5.959	1.8962	0.3182
732	1450	2.7343	2.7092	3.1165	10.23	6.1634	4.2719	5.9577	1.8915	0.31748
733	1452	2.7361	2.7102	3.1165	10.231	6.1616	4.2708	5.9604	1.8909	0.31724
734	1453.9	2.7343	2.7113	3.1165	10.229	6.1564	4.2719	5.9573	1.8844	0.31632

Consolidation/B Step: 13

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	3.1165	10.23	6.157	4.2719	5.9579	1.885	0.31639
2	0.012483	0	0	3.1165	10.23	6.157	4.2725	5.9573	1.8844	0.31633
3	0.050033	0	0	3.1165	10.229	6.1564	4.2713	5.9579	1.885	0.31639
4	0.10012	0.001793	0	3.1165	10.235	6.1564	4.2719	5.9635	1.8844	0.316
5	0.25033	0.0008965	0.00042567	3.1165	10.242	6.1564	4.2708	5.9709	1.8856	0.3158
6	0.50072	0.005379	0.0010642	3.1165	10.26	6.1564	4.2708	5.9895	1.8856	0.31482
7	1.0014	0.013448	0.0036182	3.1165	10.298	6.1605	4.2725	6.0257	1.888	0.31332
8	2.0029	0.032274	0.010642	3.1165	10.368	6.1815	4.2743	6.0933	1.9073	0.31301
9	4.0017	0.064548	0.033628	3.1165	10.511	6.2582	4.2713	6.2396	1.9869	0.31843
10	6.0006	0.085168	0.064063	3.1165	10.652	6.3261	4.2754	6.3769	2.0507	0.32158
11	8.0035	0.13268	0.098755	3.1165	10.797	6.3776	4.2725	6.5243	2.1051	0.32266
12	10.002	0.16675	0.13941	3.1165	10.939	6.4567	4.2743	6.665	2.1824	0.32744
13	12.001	0.20261	0.1841	3.1165	11.082	6.5129	4.2749	6.8071	2.238	0.32877
14	14.004	0.25281	0.23114	3.1165	11.22	6.5679	4.2743	6.9462	2.2936	0.3302
15	16.003	0.28061	0.27009	3.1165	11.221	6.6048	4.2737	6.9474	2.3311	0.33553
16	18.001	0.30212	0.3018	3.1165	11.221	6.6147	4.2731	6.948	2.3416	0.33702
17	20	0.31826	0.3267	3.1165	11.219	6.5931	4.2749	6.9445	2.3182	0.33382
18	22.003	0.34157	0.34649	3.1165	11.221	6.5655	4.2743	6.9471	2.2913	0.32982
19	24.002	0.35322	0.36309	3.1165	11.221	6.5351	4.2743	6.9464	2.2608	0.32547
20	26	0.36757	0.37629	3.1165	11.218	6.5064	4.2719	6.9466	2.2345	0.32167
21	28.003	0.3846	0.38799	3.1165	11.221	6.483	4.2737	6.9476	2.2093	0.318
22	30.002	0.39625	0.39864	3.1165	11.219	6.4672	4.2737	6.9451	2.1935	0.31584
23	30.741	0.39984	0.40225	3.1165	11.22	6.4613	4.2737	6.9458	2.1877	0.31496

TRIAXIAL TEST

Project: Polymet #23/69-862-022B	Location:	Project No.: 6250
Boring No.: 07-04B	Tested By: SO	Checked By: JW
Sample No.:	Test Date: 9-4-07	Depth: 56.7-57.2
Test No.: 1	Sample Type: 3T	Elevation:

Soil Description: Peat (PT)
Remarks:

Specimen Height: 4.93 in	Piston Area: 0.19 in^2	Filter Strip Correction: 0.00 tsf
Specimen Area: 3.12 in^2	Piston Friction: 0.00 lb	Membrane Correction: 4.20 lb/in
Specimen Volume: 251.98 cc	Piston Weight: 0.00 lb	Correction Type: Uniform
Liquid Limit: ---	Plastic Limit: ---	Measured Specific Gravity: 1.66

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID		---		
Wt. Container + Wet Soil, gm	278.16	---	---	313.61
Wt. Container + Dry Soil, gm	99.06	---	---	163.29
Wt. Container, gm	8.9	---	---	73.13
Wt. Wet Soil, gm	269.26	269.26	240.48	240.48
Wt. Dry Soil, gm	90.16	90.16	90.16	90.16
Wt. Water, gm	179.1	179.1	150.32	150.32
Water Content, %	198.65	198.65	166.73	166.73
Void Ratio	---	3.64	2.77	---
Degree of Saturation, %	---	90.61	100.00	---
Dry Unit Weight, pcf	---	22.337	27.505	---

Initial

Height: 4.934 in	Moisture: 198.65 %
Area: 3.1165 in^2	Void Ratio: 3.64
Volume: 251.98 cc	Dry Unit Weight: 22.337 pcf
	Saturation: 90.61 %

End of Initialization
Time: 4.616 min

Total Vertical Stress: 0.14703 tsf	Height Change: -0.014553 in	Height: 4.9486 in	Moisture: 200.39 %
Total Horizontal Stress: 0.14459 tsf	Area Change: 0 in^2	Area: 3.1165 in^2	Void Ratio: 3.68
Pore Pressure: 0.070789 tsf	Volume Change: -2.2297 cc	Volume: 254.21 cc	Dry Unit Weight: 22.141 pcf
Effective Vertical Stress: 0.076239 tsf	Water Change: -1.5756 cc		Saturation: 90.38 %
Effective Horizontal Stress: 0.073798 tsf	Correction: 0 cc		

End of Consolidation/A
Time: 4.616 min

Total Vertical Stress: 0.14703 tsf	Height Change: -0.014553 in	Height: 4.9486 in	Moisture: 200.39 %
Total Horizontal Stress: 0.14459 tsf	Area Change: 0 in^2	Area: 3.1165 in^2	Void Ratio: 3.68
Pore Pressure: 0.070789 tsf	Volume Change: -2.2297 cc	Volume: 254.21 cc	Dry Unit Weight: 22.141 pcf
Effective Vertical Stress: 0.076239 tsf	Water Change: -1.5756 cc		Saturation: 90.38 %
Effective Horizontal Stress: 0.073798 tsf	Correction: 0 cc		

End of Saturation
Time: 456.17 min

Total Vertical Stress: 4.5487 tsf	Height Change: -0.0583 in	Height: 4.9923 in	Moisture: 223.39 %
Total Horizontal Stress: 4.5437 tsf	Area Change: 0 in^2	Area: 3.1165 in^2	Void Ratio: 3.80
Pore Pressure: 4.4714 tsf	Volume Change: -8.9322 cc	Volume: 260.91 cc	Dry Unit Weight: 21.572 pcf
Effective Vertical Stress: 0.077288 tsf	Water Change: -22.304 cc		Saturation: 97.48 %
Effective Horizontal Stress: 0.072245 tsf	Correction: 0 cc		

End of Consolidation/B
Time: 1796.8 min

Total Vertical Stress: 10.502 tsf	Height Change: 0.7563 in	Height: 4.1777 in	Moisture: 166.73 %
Total Horizontal Stress: 6.3279 tsf	Area Change: 0.12738 in^2	Area: 2.9891 in^2	Void Ratio: 2.77
Pore Pressure: 4.4708 tsf	Volume Change: 47.345 cc	Volume: 204.64 cc	Dry Unit Weight: 27.505 pcf
Effective Vertical Stress: 6.0313 tsf	Water Change: 21.649 cc		Saturation: 100.00 %
Effective Horizontal Stress: 1.857 tsf	Correction: 7.1278 cc		

End of Shear
Time: 1998.8 min

Total Vertical Stress: 12.128 tsf	Height Change: 1.5919 in	Height: 3.3421 in	Moisture: 166.73 %
Total Horizontal Stress: 6.3285 tsf	Area Change: -0.61994 in^2	Area: 3.7365 in^2	Void Ratio: 2.77
Pore Pressure: 5.5514 tsf	Volume Change: 47.345 cc	Volume: 204.64 cc	Dry Unit Weight: 27.505 pcf
Effective Vertical Stress: 6.5768 tsf	Water Change: 21.649 cc		Saturation: 100.00 %
Effective Horizontal Stress: 0.77707 tsf	Correction: 7.1278 cc		

At Failure
Time: 1821.3 min

Total Vertical Stress: 12.708 tsf	Height Change: 0.85631 in	Height: 4.0777 in	Moisture: 166.73 %
Total Horizontal Stress: 6.3285 tsf	Area Change: -0.33049 in^2	Area: 3.447 in^2	Void Ratio: 2.77
Pore Pressure: 5.9416 tsf	Volume Change: 47.345 cc	Volume: 204.64 cc	Dry Unit Weight: 27.505 pcf
Effective Vertical Stress: 6.7667 tsf	Water Change: 21.649 cc		Saturation: 100.00 %
Effective Horizontal Stress: 0.38685 tsf	Correction: 0 cc		

TRIAXIAL TEST

Project: Polymet #23/69-862-022B
Boring No.: 07-04B
Sample No.:
Test No.: 1

Location:
Tested By: SO
Test Date: 9-4-07
Sample Type: 3T

Project No.: 6250
Checked By: JW
Depth: 56.7-57.2
Elevation:

Soil Description: Peat (PT)
Remarks:

Specimen Height: 4.18 in
Specimen Area: 2.99 in^2
Specimen Volume: 204.64 cc

Piston Area: 0.19 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 4.20 lb/in
Correction Type: Uniform

Liquid Limit: ---

Plastic Limit: ---

Measured Specific Gravity: 1.66

	Time min	Vertical Strain %	Volumetric Strain %	Corrected Area in^2	Deviator Load lb	Deviator Stress tsf	Pore Pressure tsf	Horizontal Stress tsf	Vertical Stress tsf
1	0	0	0	3.3645	177.33	3.7086	4.4708	6.3279	10.036
2	1.3315	0.1207	0	3.3685	199.19	4.1709	4.7113	6.3279	10.499
3	2.5467	0.24035	0	3.3726	214.75	4.4975	4.8932	6.3279	10.825
4	3.8204	0.35999	0	3.3766	228.57	4.7862	5.0541	6.3279	11.114
5	5.106	0.47964	0	3.3807	240.51	5.0341	5.1922	6.3279	11.362
6	6.3213	0.59928	0	3.3848	250.57	5.2415	5.3063	6.3279	11.569
7	7.5152	0.71892	0	3.3888	259.02	5.4142	5.404	6.3279	11.742
8	8.7596	0.83857	0	3.3929	266.67	5.5694	5.4917	6.3279	11.897
9	10.063	0.95821	0	3.397	273.78	5.7128	5.5707	6.3279	12.041
10	11.302	1.0779	0	3.4011	279.54	5.8274	5.6351	6.3285	12.156
11	12.409	1.1975	0	3.4053	284.24	5.9191	5.6848	6.3285	12.248
12	13.775	1.3171	0	3.4094	289.34	6.019	5.7374	6.3279	12.347
13	14.877	1.4378	0	3.4136	292.83	6.0847	5.7737	6.3279	12.413
14	16.109	1.5564	0	3.4177	296.31	6.1503	5.81	6.3279	12.478
15	17.344	1.6761	0	3.4218	299.53	6.21	5.8422	6.3279	12.538
16	18.484	1.7957	0	3.426	302.08	6.2554	5.8673	6.3285	12.584
17	19.766	1.9154	0	3.4302	304.36	6.2951	5.8895	6.3285	12.624
18	20.889	2.0361	0	3.4344	306.24	6.3262	5.9059	6.3279	12.654
19	22.117	2.1547	0	3.4386	307.58	6.3461	5.9206	6.3279	12.674
20	23.365	2.2754	0	3.4428	309.19	6.3713	5.934	6.3285	12.7
21	24.497	2.3939	0	3.447	310	6.3798	5.9416	6.3285	12.708
22	27.002	2.6332	0	3.4555	310.67	6.377	5.951	6.3285	12.706
23	29.368	2.8725	0	3.464	310.53	6.3575	5.9516	6.3279	12.685
24	31.682	3.1118	0	3.4725	309.19	6.3129	5.941	6.3279	12.641
25	34.136	3.3522	0	3.4812	307.45	6.2601	5.927	6.3285	12.589
26	36.499	3.5914	0	3.4898	305.57	6.2047	5.9083	6.3285	12.533
27	38.899	3.8307	0	3.4985	302.62	6.1275	5.8796	6.3279	12.455
28	43.867	4.3093	0	3.516	296.31	5.9657	5.8076	6.3285	12.294
29	48.483	4.7879	0	3.5337	293.9	5.8845	5.7643	6.3285	12.213
30	53.428	5.2665	0	3.5515	293.5	5.8446	5.7369	6.3285	12.173
31	58.394	5.745	0	3.5696	294.57	5.8346	5.7205	6.3279	12.162
32	63.272	6.2236	0	3.5878	295.11	5.8136	5.7023	6.3279	12.141
33	67.963	6.7033	0	3.6062	297.39	5.8273	5.6965	6.3279	12.155
34	72.825	7.1818	0	3.6248	300.07	5.8486	5.6924	6.3279	12.176
35	77.696	7.6604	0	3.6436	302.75	5.8693	5.6895	6.3285	12.198
36	82.462	8.139	0	3.6626	303.42	5.85	5.6684	6.3285	12.178
37	87.391	8.6176	0	3.6818	303.42	5.8174	5.6503	6.3285	12.146
38	92.077	9.0961	0	3.7011	301.95	5.7562	5.6222	6.3279	12.084
39	96.818	9.5747	0	3.7207	299.26	5.6718	5.5941	6.3291	12.001
40	108.91	10.772	0	3.7707	282.09	5.2638	5.4771	6.3285	11.592
41	121.03	11.969	0	3.8219	282.9	5.2034	5.5338	6.3285	11.532
42	132.89	13.166	0	3.8746	283.57	5.1401	5.5333	6.3285	11.469
43	145.12	14.363	0	3.9287	292.42	5.2267	5.5806	6.3279	11.555
44	157.23	15.559	0	3.9844	299	5.2676	5.5935	6.3279	11.596
45	169.35	16.757	0	4.0417	302.08	5.2432	5.5877	6.3273	11.57
46	181.22	17.953	0	4.1007	306.51	5.2408	5.5806	6.3285	11.569
47	193.33	19.149	0	4.1614	307.04	5.1691	5.5526	6.3285	11.498
48	202.02	20.001	0	4.2056	309.46	5.1527	5.5514	6.3285	11.481

TRIAXIAL TEST

Project: Polymet #23/69-862-022B
Boring No.: 07-04B
Sample No.:
Test No.: 1

Location:
Tested By: SO
Test Date: 9-4-07
Sample Type: 3T

Project No.: 6250
Checked By: JW
Depth: 56.7-57.2
Elevation:

Soil Description: Peat (PT)
Remarks:

Specimen Height: 4.18 in
Specimen Area: 2.99 in^2
Specimen Volume: 204.64 cc

Piston Area: 0.19 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 4.20 lb/in
Correction Type: Uniform

Liquid Limit: ---

Plastic Limit: ---

Measured Specific Gravity: 1.66

	Vertical Strain %	Total Vertical Stress tsf	Total Horizontal Stress tsf	Excess Pore Pressure tsf	A Parameter	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	Stress Ratio	Effective p tsf	q tsf
1	0.00	10.036	6.3279	0	0.000	5.5656	1.857	2.997	3.7113	1.8543
2	0.12	10.499	6.3279	0.24045	0.520	5.7875	1.6166	3.580	3.702	2.0854
3	0.24	10.825	6.3279	0.4224	0.535	5.9322	1.4347	4.135	3.6834	2.2488
4	0.36	11.114	6.3279	0.58328	0.541	6.0599	1.2738	4.758	3.6669	2.3931
5	0.48	11.362	6.3279	0.72135	0.544	6.1698	1.1357	5.433	3.6528	2.5171
6	0.60	11.569	6.3279	0.83543	0.545	6.2632	1.0216	6.131	3.6424	2.6208
7	0.72	11.742	6.3279	0.93313	0.547	6.3381	0.92392	6.860	3.631	2.7071
8	0.84	11.897	6.3279	1.0209	0.549	6.4055	0.83616	7.661	3.6209	2.7847
9	0.96	12.041	6.3279	1.0999	0.549	6.47	0.75718	8.545	3.6136	2.8564
10	1.08	12.156	6.3285	1.1642	0.549	6.5208	0.69341	9.404	3.6071	2.9137
11	1.20	12.248	6.3285	1.2139	0.549	6.5628	0.64369	10.196	3.6032	2.9595
12	1.32	12.347	6.3279	1.2666	0.548	6.6095	0.59045	11.194	3.6	3.0095
13	1.44	12.413	6.3279	1.3029	0.548	6.6388	0.55417	11.980	3.5965	3.0423
14	1.56	12.478	6.3279	1.3391	0.548	6.6682	0.5179	12.875	3.593	3.0751
15	1.68	12.538	6.3279	1.3713	0.548	6.6957	0.48573	13.785	3.5907	3.105
16	1.80	12.584	6.3285	1.3965	0.548	6.7165	0.46115	14.565	3.5888	3.1277
17	1.92	12.624	6.3285	1.4187	0.548	6.734	0.43892	15.342	3.5865	3.1475
18	2.04	12.654	6.3279	1.4351	0.548	6.7481	0.42196	15.992	3.585	3.1631
19	2.15	12.674	6.3279	1.4497	0.550	6.7534	0.40733	16.580	3.5804	3.173
20	2.28	12.7	6.3285	1.4632	0.549	6.7658	0.39446	17.152	3.5801	3.1856
21	2.39	12.708	6.3285	1.4708	0.550	6.7667	0.38685	17.492	3.5768	3.1899
22	2.63	12.706	6.3285	1.4801	0.554	6.7545	0.37749	17.893	3.566	3.1885
23	2.87	12.685	6.3279	1.4807	0.559	6.7338	0.37632	17.894	3.5551	3.1788
24	3.11	12.641	6.3279	1.4702	0.565	6.6998	0.38685	17.319	3.5433	3.1565
25	3.35	12.589	6.3285	1.4562	0.570	6.6615	0.40148	16.592	3.5315	3.13
26	3.59	12.533	6.3285	1.4374	0.576	6.6249	0.4202	15.766	3.5226	3.1024
27	3.83	12.455	6.3279	1.4088	0.582	6.5758	0.44828	14.669	3.512	3.0638
28	4.31	12.294	6.3285	1.3368	0.592	6.4865	0.52083	12.454	3.5037	2.9829
29	4.79	12.213	6.3285	1.2935	0.594	6.4486	0.56412	11.431	3.5064	2.9422
30	5.27	12.173	6.3285	1.266	0.592	6.4362	0.59162	10.879	3.5139	2.9223
31	5.75	12.162	6.3279	1.2496	0.588	6.442	0.60741	10.606	3.5247	2.9173
32	6.22	12.141	6.3279	1.2315	0.585	6.4392	0.62555	10.294	3.5324	2.9068
33	6.70	12.155	6.3279	1.2256	0.578	6.4587	0.6314	10.229	3.545	2.9136
34	7.18	12.176	6.3279	1.2216	0.571	6.4841	0.63549	10.203	3.5598	2.9243
35	7.66	12.198	6.3285	1.2186	0.564	6.5083	0.639	10.185	3.5736	2.9346
36	8.14	12.178	6.3285	1.1976	0.559	6.51	0.66007	9.863	3.585	2.925
37	8.62	12.146	6.3285	1.1794	0.559	6.4956	0.6782	9.578	3.5869	2.9087
38	9.10	12.084	6.3279	1.1513	0.562	6.4619	0.7057	9.157	3.5838	2.8781
39	9.57	12.001	6.3291	1.1233	0.572	6.4068	0.73495	8.717	3.5709	2.8359
40	10.77	11.592	6.3285	1.0063	0.647	6.1152	0.85137	7.183	3.4833	2.6319
41	11.97	11.532	6.3285	1.063	0.711	5.998	0.79462	7.548	3.3963	2.6017
42	13.17	11.469	6.3285	1.0624	0.742	5.9353	0.79521	7.464	3.3653	2.57
43	14.36	11.555	6.3279	1.1098	0.731	5.9739	0.74724	7.995	3.3606	2.6133
44	15.56	11.596	6.3279	1.1227	0.720	6.002	0.73437	8.173	3.3682	2.6338
45	16.76	11.57	6.3273	1.1168	0.728	5.9828	0.73963	8.089	3.3612	2.6216
46	17.95	11.569	6.3285	1.1098	0.724	5.9886	0.74782	8.008	3.3682	2.6204
47	19.15	11.498	6.3285	1.0817	0.740	5.945	0.7759	7.662	3.3604	2.5845
48	20.00	11.481	6.3285	1.0806	0.748	5.9298	0.77707	7.631	3.3534	2.5764

TRIAXIAL TEST

Project: Polymet #23/69-862-022B
Location:
Project No.: 6250
Boring No.: 07-05
Tested By: SO
Checked By: JW
Sample No.:
Test Date: 9-10-07
Depth: 98.5-99
Test No.: 1
Sample Type: 3T
Elevation:

Soil Description: Peat (PT)
Remarks:

Specimen Height: 4.93 in
Piston Area: 0.19 in^2
Filter Strip Correction: 0.00 tsf
Specimen Area: 3.12 in^2
Piston Friction: 0.00 lb
Membrane Correction: 4.20 lb/in
Specimen Volume: 251.98 cc
Piston Weight: 0.00 lb
Correction Type: Uniform

Liquid Limit: ---
Plastic Limit: ---
Measured Specific Gravity: 1.70

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID		---		
Wt. Container + Wet Soil, gm	202.71	---	---	307.2
Wt. Container + Dry Soil, gm	93.93	---	---	157.12
Wt. Container, gm	8.9	---	---	72.09
Wt. Wet Soil, gm	193.81	193.81	235.11	235.11
Wt. Dry Soil, gm	85.03	85.03	85.03	85.03
Wt. Water, gm	108.78	108.78	150.08	150.08
Water Content, %	127.93	127.93	176.50	176.50
Void Ratio	---	4.04	3.00	---
Degree of Saturation, %	---	53.86	100.00	---
Dry Unit Weight, pcf	---	21.066	26.529	---

Initial

Height: 4.934 in
Area: 3.1165 in^2
Volume: 251.98 cc

Moisture: 127.93 %
Void Ratio: 4.04
Dry Unit Weight: 21.066 pcf
Saturation: 53.86 %

End of Initialization
Time: 5.2869 min
Total Vertical Stress: 0.14721 tsf
Total Horizontal Stress: 0.144 tsf
Pore Pressure: 0.070789 tsf
Effective Vertical Stress: 0.076423 tsf
Effective Horizontal Stress: 0.073213 tsf

Height Change: -0.020524 in
Area Change: 0 in^2
Volume Change: -3.1446 cc
Water Change: -1.5832 cc
Correction: 0 cc

Height: 4.9545 in
Area: 3.1165 in^2
Volume: 255.13 cc

Moisture: 129.79 %
Void Ratio: 4.10
Dry Unit Weight: 20.806 pcf
Saturation: 53.81 %

End of Consolidation/A
Time: 5.2869 min
Total Vertical Stress: 0.14721 tsf
Total Horizontal Stress: 0.144 tsf
Pore Pressure: 0.070789 tsf
Effective Vertical Stress: 0.076423 tsf
Effective Horizontal Stress: 0.073213 tsf

Height Change: -0.020524 in
Area Change: 0 in^2
Volume Change: -3.1446 cc
Water Change: -1.5832 cc
Correction: 0 cc

Height: 4.9545 in
Area: 3.1165 in^2
Volume: 255.13 cc

Moisture: 129.79 %
Void Ratio: 4.10
Dry Unit Weight: 20.806 pcf
Saturation: 53.81 %

End of Saturation
Time: 436.28 min
Total Vertical Stress: 4.3471 tsf
Total Horizontal Stress: 4.3435 tsf
Pore Pressure: 4.2719 tsf
Effective Vertical Stress: 0.075201 tsf
Effective Horizontal Stress: 0.071544 tsf

Height Change: -0.05047 in
Area Change: 0 in^2
Volume Change: -7.7326 cc
Water Change: -22.077 cc
Correction: 0 cc

Height: 4.9845 in
Area: 3.1165 in^2
Volume: 259.71 cc

Moisture: 153.90 %
Void Ratio: 4.19
Dry Unit Weight: 20.439 pcf
Saturation: 62.40 %

End of Consolidation/B
Time: 5439.6 min
Total Vertical Stress: 11.16 tsf
Total Horizontal Stress: 6.4613 tsf
Pore Pressure: 4.2737 tsf
Effective Vertical Stress: 6.8864 tsf
Effective Horizontal Stress: 2.1877 tsf

Height Change: 0.96579 in
Area Change: 0.039407 in^2
Volume Change: 51.886 cc
Water Change: 31.799 cc
Correction: -73.097 cc

Height: 3.9682 in
Area: 3.0771 in^2
Volume: 200.1 cc

Moisture: 176.50 %
Void Ratio: 3.00
Dry Unit Weight: 26.529 pcf
Saturation: 100.00 %

End of Shear
Time: 5641.5 min
Total Vertical Stress: 11.543 tsf
Total Horizontal Stress: 6.4619 tsf
Pore Pressure: 5.3484 tsf
Effective Vertical Stress: 6.1945 tsf
Effective Horizontal Stress: 1.1135 tsf

Height Change: 1.7595 in
Area Change: -0.72992 in^2
Volume Change: 51.886 cc
Water Change: 31.799 cc
Correction: -73.097 cc

Height: 3.1745 in
Area: 3.8464 in^2
Volume: 200.1 cc

Moisture: 176.50 %
Void Ratio: 3.00
Dry Unit Weight: 26.529 pcf
Saturation: 100.00 %

At Failure
Time: 5467.9 min
Total Vertical Stress: 13.275 tsf
Total Horizontal Stress: 6.4619 tsf
Pore Pressure: 5.9878 tsf
Effective Vertical Stress: 7.2872 tsf
Effective Horizontal Stress: 0.4741 tsf

Height Change: 1.0758 in
Area Change: -0.36603 in^2
Volume Change: 51.886 cc
Water Change: 31.799 cc
Correction: 0 cc

Height: 3.8582 in
Area: 3.4825 in^2
Volume: 200.1 cc

Moisture: 176.50 %
Void Ratio: 3.00
Dry Unit Weight: 26.529 pcf
Saturation: 100.00 %

TRIAXIAL TEST

Project: Polymet #23/69-862-022B
Boring No.: 07-05
Sample No.:
Test No.: 1

Location:
Tested By: SO
Test Date: 9-10-07
Sample Type: 3T

Project No.: 6250
Checked By: JW
Depth: 98.5-99
Elevation:

Soil Description: Peat (PT)
Remarks:

Specimen Height: 3.97 in
Specimen Area: 3.08 in^2
Specimen Volume: 200.10 cc

Piston Area: 0.19 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 4.20 lb/in
Correction Type: Uniform

Liquid Limit: ---

Plastic Limit: ---

Measured Specific Gravity: 1.70

	Time min	Vertical Strain %	Volumetric Strain %	Corrected Area in^2	Deviator Load lb	Deviator Stress tsf	Pore Pressure tsf	Horizontal Stress tsf	Vertical Stress tsf
1	0	0	0	3.386	205.96	4.2701	4.2737	6.4613	10.731
2	1.185	0.12708	0	3.3903	226.08	4.6914	4.5042	6.4619	11.153
3	2.587	0.25304	0	3.3946	244.32	5.0718	4.7353	6.4619	11.534
4	3.9348	0.38011	0	3.3989	258.94	5.3746	4.9242	6.4613	11.836
5	5.2116	0.50496	0	3.4032	270.61	5.6142	5.081	6.4619	12.076
6	6.3674	0.63092	0	3.4075	279.6	5.7964	5.2033	6.4619	12.258
7	7.7624	0.75688	0	3.4118	288.86	5.9839	5.3297	6.4613	12.445
8	9.0731	0.88284	0	3.4162	296.51	6.1369	5.4332	6.4613	12.598
9	10.217	1.0088	0	3.4205	302.14	6.2471	5.5104	6.4613	12.708
10	11.59	1.1348	0	3.4249	308.04	6.3626	5.5918	6.4619	12.825
11	12.826	1.2607	0	3.4292	312.6	6.4497	5.6544	6.4619	12.912
12	14.12	1.3867	0	3.4336	316.49	6.5226	5.7099	6.4613	12.984
13	15.522	1.5126	0	3.438	319.98	6.5867	5.7614	6.4613	13.048
14	16.808	1.6386	0	3.4424	322.93	6.6395	5.8006	6.4613	13.101
15	17.981	1.7646	0	3.4468	324.94	6.6724	5.831	6.4619	13.134
16	19.354	1.8905	0	3.4512	327.09	6.7081	5.862	6.4619	13.17
17	20.481	2.0165	0	3.4557	328.7	6.7324	5.886	6.4619	13.194
18	21.984	2.1424	0	3.4601	330.71	6.7651	5.9135	6.4619	13.227
19	23.074	2.2684	0	3.4646	331.92	6.7809	5.9299	6.4619	13.243
20	24.414	2.3944	0	3.4691	332.99	6.7939	5.9492	6.4613	13.255
21	25.733	2.5203	0	3.4735	333.93	6.8041	5.9644	6.4613	13.265
22	28.283	2.7722	0	3.4825	335.27	6.8131	5.9878	6.4619	13.275
23	30.82	3.0242	0	3.4916	336.08	6.811	6.0048	6.4619	13.273
24	33.283	3.2761	0	3.5007	336.48	6.8004	6.0159	6.4625	13.263
25	35.883	3.5291	0	3.5099	336.61	6.7843	6.0235	6.4619	13.246
26	38.383	3.781	0	3.5191	336.08	6.7546	6.0259	6.4613	13.216
27	41.033	4.033	0	3.5283	335.41	6.7221	6.0241	6.4613	13.183
28	46.132	4.5368	0	3.5469	333.26	6.6411	6.0165	6.4613	13.102
29	51.207	5.0407	0	3.5657	331.65	6.5713	6.0077	6.4619	13.033
30	56.411	5.5445	0	3.5848	330.98	6.5209	6.003	6.4613	12.982
31	61.411	6.0483	0	3.604	330.04	6.4652	5.9931	6.4619	12.927
32	66.316	6.5522	0	3.6234	328.83	6.4044	5.9779	6.4619	12.866
33	71.584	7.0571	0	3.6431	327.36	6.3385	5.9592	6.4619	12.8
34	76.604	7.561	0	3.663	325.88	6.2731	5.9363	6.4613	12.734
35	81.667	8.0648	0	3.683	326.02	6.2395	5.9206	6.4613	12.701
36	86.897	8.5687	0	3.7033	326.02	6.2032	5.9001	6.4619	12.665
37	91.905	9.0725	0	3.7238	326.28	6.1721	5.8796	6.4619	12.634
38	96.987	9.5763	0	3.7446	327.22	6.1539	5.862	6.4619	12.616
39	102.11	10.08	0	3.7656	328.56	6.1432	5.8457	6.4619	12.605
40	114.76	11.341	0	3.8191	329.24	6.0647	5.7819	6.4619	12.527
41	127.41	12.601	0	3.8742	328.16	5.9537	5.7181	6.4613	12.415
42	140.12	13.861	0	3.9309	325.48	5.8138	5.6468	6.4613	12.275
43	152.84	15.121	0	3.9892	316.89	5.569	5.5496	6.4619	12.031
44	165.62	16.38	0	4.0493	306.56	5.2979	5.4677	6.4619	11.76
45	178.28	17.641	0	4.1113	301.74	5.1288	5.4484	6.4619	11.591
46	190.97	18.901	0	4.1751	286.31	4.7798	5.3712	6.4619	11.242
47	201.88	20.001	0	4.2325	280.81	4.6174	5.3484	6.4619	11.079

TRIAXIAL TEST

Project: Polymet #23/69-862-022B
Location:
Project No.: 6250
Boring No.: 07-05
Tested By: SO
Checked By: JW
Sample No.:
Test Date: 9-10-07
Depth: 98.5-99
Test No.: 1
Sample Type: 3T
Elevation:

Soil Description: Peat (PT)
Remarks:

Specimen Height: 3.97 in
Piston Area: 0.19 in^2
Filter Strip Correction: 0.00 tsf
Specimen Area: 3.08 in^2
Piston Friction: 0.00 lb
Membrane Correction: 4.20 lb/in
Specimen Volume: 200.10 cc
Piston Weight: 0.00 lb
Correction Type: Uniform

Liquid Limit: ---
Plastic Limit: ---
Measured Specific Gravity: 1.70

	Vertical Strain %	Total Vertical Stress tsf	Total Horizontal Stress tsf	Excess Pore Pressure tsf	A Parameter	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	Stress Ratio	Effective p tsf	q tsf
1	0.00	10.731	6.4613	0	0.000	6.4577	2.1877	2.952	4.3227	2.135
2	0.13	11.153	6.4619	0.2305	0.546	6.6491	1.9578	3.396	4.3034	2.3457
3	0.25	11.534	6.4619	0.46159	0.575	6.7985	1.7267	3.937	4.2626	2.5359
4	0.38	11.836	6.4613	0.65056	0.589	6.9117	1.5371	4.497	4.2244	2.6873
5	0.50	12.076	6.4619	0.80735	0.600	6.9951	1.3809	5.066	4.188	2.8071
6	0.63	12.258	6.4619	0.92962	0.609	7.055	1.2586	5.605	4.1568	2.8982
7	0.76	12.445	6.4613	1.056	0.616	7.1155	1.1317	6.288	4.1236	2.9919
8	0.88	12.598	6.4613	1.1595	0.621	7.165	1.0281	6.969	4.0966	3.0684
9	1.01	12.708	6.4613	1.2368	0.626	7.198	0.95091	7.570	4.0745	3.1236
10	1.13	12.825	6.4619	1.3181	0.630	7.2328	0.87017	8.312	4.0515	3.1813
11	1.26	12.912	6.4619	1.3807	0.633	7.2573	0.80757	8.987	4.0324	3.2249
12	1.39	12.984	6.4613	1.4363	0.638	7.274	0.75141	9.680	4.0127	3.2613
13	1.51	13.048	6.4613	1.4877	0.642	7.2866	0.69993	10.411	3.9933	3.2934
14	1.64	13.101	6.4613	1.5269	0.644	7.3002	0.66073	11.049	3.9805	3.3197
15	1.76	13.134	6.4619	1.5574	0.648	7.3033	0.63089	11.576	3.9671	3.3362
16	1.89	13.17	6.4619	1.5884	0.651	7.308	0.59988	12.182	3.9539	3.354
17	2.02	13.194	6.4619	1.6124	0.655	7.3083	0.5759	12.690	3.9421	3.3662
18	2.14	13.227	6.4619	1.6399	0.657	7.3135	0.5484	13.336	3.931	3.3826
19	2.27	13.243	6.4619	1.6562	0.659	7.313	0.53202	13.746	3.9225	3.3905
20	2.39	13.255	6.4613	1.6755	0.664	7.3061	0.51213	14.266	3.9091	3.397
21	2.52	13.265	6.4613	1.6908	0.667	7.301	0.49692	14.693	3.899	3.402
22	2.77	13.275	6.4619	1.7142	0.674	7.2872	0.4741	15.371	3.8807	3.4066
23	3.02	13.273	6.4619	1.7311	0.681	7.2681	0.45714	15.899	3.8626	3.4055
24	3.28	13.263	6.4625	1.7422	0.688	7.247	0.44661	16.227	3.8468	3.4002
25	3.53	13.246	6.4619	1.7498	0.696	7.2227	0.43842	16.475	3.8306	3.3922
26	3.78	13.216	6.4613	1.7522	0.705	7.19	0.43549	16.510	3.8128	3.3773
27	4.03	13.183	6.4613	1.7504	0.714	7.1593	0.43724	16.374	3.7983	3.361
28	4.54	13.102	6.4613	1.7428	0.735	7.0859	0.44485	15.929	3.7654	3.3205
29	5.04	13.033	6.4619	1.734	0.753	7.0255	0.45421	15.468	3.7399	3.2857
30	5.54	12.982	6.4613	1.7294	0.768	6.9792	0.45831	15.228	3.7188	3.2604
31	6.05	12.927	6.4619	1.7194	0.783	6.934	0.46884	14.790	3.7014	3.2326
32	6.55	12.866	6.4619	1.7042	0.798	6.8885	0.48405	14.231	3.6863	3.2022
33	7.06	12.8	6.4619	1.6855	0.815	6.8413	0.50277	13.607	3.672	3.1693
34	7.56	12.734	6.4613	1.6627	0.830	6.7981	0.525	12.949	3.6616	3.1366
35	8.06	12.701	6.4613	1.6469	0.836	6.7802	0.5408	12.538	3.6605	3.1197
36	8.57	12.665	6.4619	1.6264	0.841	6.765	0.56186	12.040	3.6634	3.1016
37	9.07	12.634	6.4619	1.6059	0.844	6.7544	0.58233	11.599	3.6684	3.0861
38	9.58	12.616	6.4619	1.5884	0.843	6.7538	0.59988	11.258	3.6768	3.077
39	10.08	12.605	6.4619	1.572	0.839	6.7595	0.61627	10.968	3.6879	3.0716
40	11.34	12.527	6.4619	1.5082	0.840	6.7448	0.68003	9.918	3.7124	3.0324
41	12.60	12.415	6.4613	1.4445	0.858	6.6969	0.74322	9.011	3.7201	2.9768
42	13.86	12.275	6.4613	1.3731	0.889	6.6284	0.81459	8.137	3.7215	2.9069
43	15.12	12.031	6.4619	1.276	0.982	6.4813	0.91229	7.104	3.6968	2.7845
44	16.38	11.76	6.4619	1.1941	1.161	6.2921	0.9942	6.329	3.6432	2.649
45	17.64	11.591	6.4619	1.1748	1.367	6.1423	1.0135	6.060	3.5779	2.5644
46	18.90	11.242	6.4619	1.0975	2.152	5.8705	1.0907	5.382	3.4806	2.3899
47	20.00	11.079	6.4619	1.0747	3.092	5.7309	1.1135	5.147	3.4222	2.3087

Laboratory Test Summary

Job No. 6250

Date: 10-9-07

Project / Client: PolyMet - #23/69-862-015-028 / Barr Engineering Company

Sample Information & Classification

Boring	07-4B	07-05
Depth (ft)	56.2 - 56.7	98.5 - 99
Type or BPF	2.5" Liner	2.5" Liner
Soil Classification ASTM: D2487/2488	Peat (PT)	Peat (PT)

Organic Content

Organic Content (%)	66.5	84.0

9301 Bryant Ave. South Suite 107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

Permeability Test Data

Project: Polymet #23/69-862-022B Date: 10/25/2007

Reported To: Barr Engineering Company Job No.: 6250

Boring No.:	07-4B	07-4B	07-4B	07-4B			
Sample No.:							
Depth (ft.):	57.2 - 57.7	57.2 - 57.7	57.2 - 57.7	57.2 - 57.7			
Location:							
Sample Type:	2.5 Liner	2.5 Liner	2.5 Liner	2.5 Liner			
Soil Type:	Hemic Peat (PT)	Hemic Peat (PT)	Hemic Peat (PT)	Hemic Peat (PT)			
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:	90.0%						
Porosity:							
Ht. (in):	4.44						
Dia. (in):	1.99						
Dry Density (pcf):	22.4						
Water Content:	196.6%						
Test Type:	Falling	Falling	Falling	Falling			
Max Head (cm):	5.0	10.0	10.0	10.0			
Confining press. (Effective-psi):	20.8	41.7	62.5	83.3			
Trial No.:	6-10	22-26	44-48	52-56			
Water Temp ℃:	23.0	23.0	23.0	23.0			
% Compaction							
% Saturation (After Test)				95.3%			
Coefficient of Permeability							
K @ 20 ℃ (cm/sec)	**1.2×10^{-7}**	**3.1×10^{-8}**	**1.3×10^{-8}**	**1.3×10^{-8}**			
K @ 20 ℃ (ft/min)	**2.3×10^{-7}**	**6.0×10^{-8}**	**2.5×10^{-8}**	**2.6×10^{-8}**			
Notes:							

Permeability Test Data

Project: Polymet Date: 3/15/2008

Reported To: Barr Engineering Company Job No.: 6428

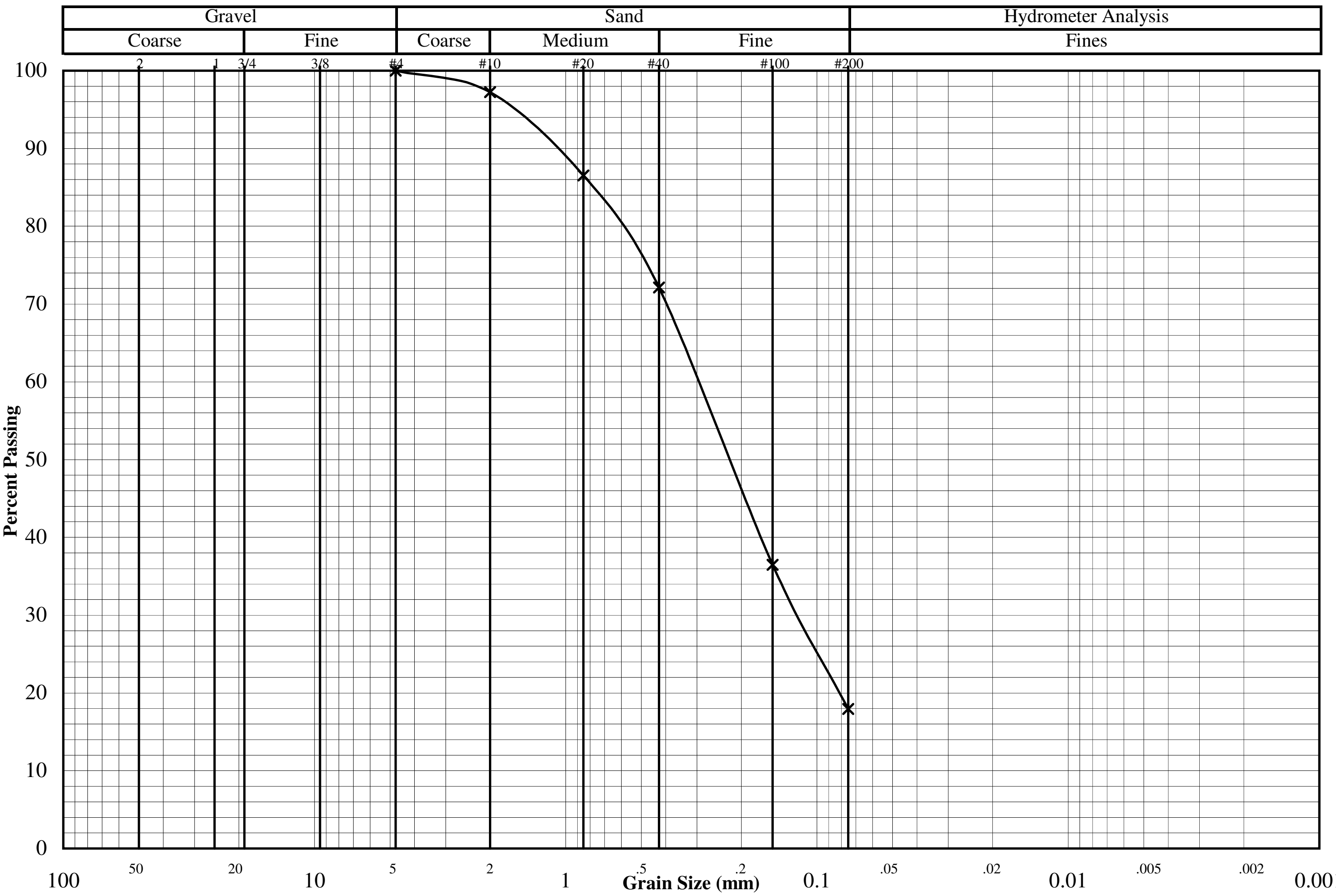
Tailings Type	Coarse Tailings	Coarse Tailings	Coarse Tailings		Fine Tailings	Fine Tailings	Fine Tailings
Sample No.:	Bucket #17	Bucket #17	Bucket #17		Bucket #11	Bucket #11	Bucket #11
Desired Density (pcf)	105	110	115		95	100	105
Location:							
Sample Type:	Bulk	Bulk	Bulk		Bulk	Bulk	Bulk
Soil Type:	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)		Fine Tailings (Silty Sand) (SM)	Fine Tailings (Silty Sand) (SM)	Fine Tailngs (Silty Sand) (SM)
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	3.83	3.99	3.99		3.93	3.99	3.99
Dia. (in):	2.89	2.89	2.89		2.89	2.89	2.89
Dry Density (pcf):	104.2	110.1	114.9		96.4	99.5	104.0
Water Content:	2.2%	2.2%	2.2%		6.8%	6.8%	6.8%
Test Type:	Constant	Constant	Constant		Constant	Constant	Constant
Max Head (cm):	9.0	11.2	10.2		8.3	8.3	12.2
Confining press. (Effective-psi):	None	None	None		None	None	None
Trial No.:	7-11	7-11	7-11		7-11	7-11	7-11
Water Temp ℃:	21.0	21.4	23.4		20.8	20.6	20.4
% Compaction							
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 ℃ (cm/sec)	**3.5×10^{-3}**	**1.7×10^{-3}**	**1.6×10^{-3}**		**3.3×10^{-3}**	**3.1×10^{-3}**	**2.1×10^{-3}**
K @ 20 ℃ (ft/min)	**6.9×10^{-3}**	**3.4×10^{-3}**	**3.2×10^{-3}**		**6.5×10^{-3}**	**6.1×10^{-3}**	**4.1×10^{-3}**
Notes:	About 200ccs thru specimens before readings.						

9301 Bryant Ave. South Suite 107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Project:	Polymet	Job No. :	**6428**
		Test Date:	3/7/08
Reported To:	Barr Engineering Company	Report Date:	3/11/08

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	TP-3	Bucket #11		Bulk	Fine Tailings (Silty Sand) (SM)
●					
◇					



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	24726.0		
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0		
#10	97.2		
#20	86.5		
#40	72.1		
#100	36.5		
#200	17.9		

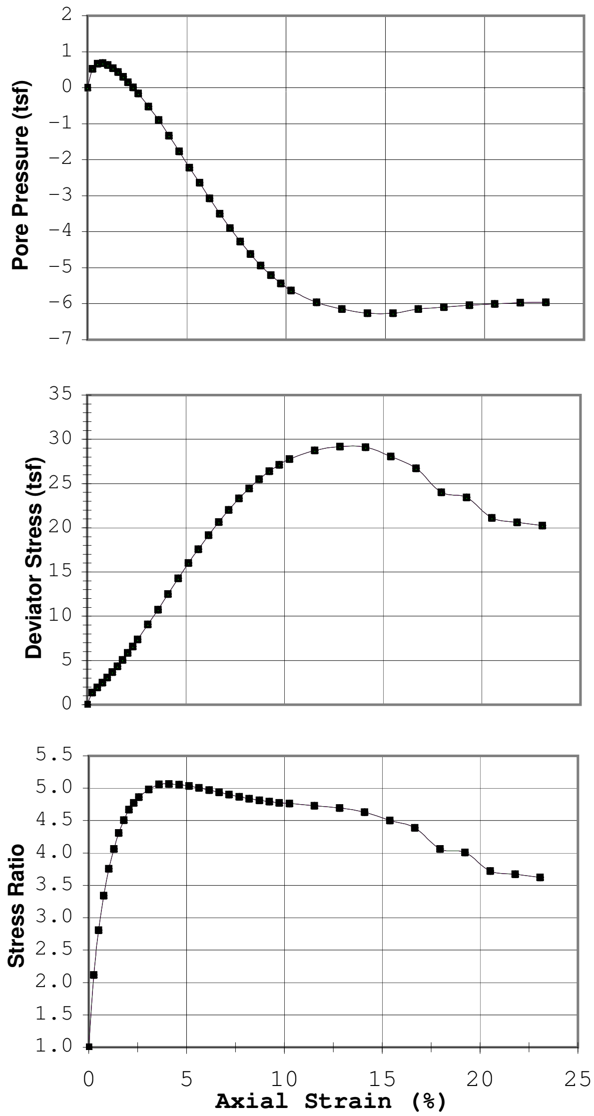
	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

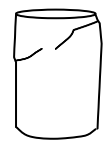
Remarks:

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-02** Sample #: Type: **3T** Depth (ft): **59 - 61**
Soil Type: **Fine Tailings (Sand w/Silt (ML))**





◆ ■ △ + X

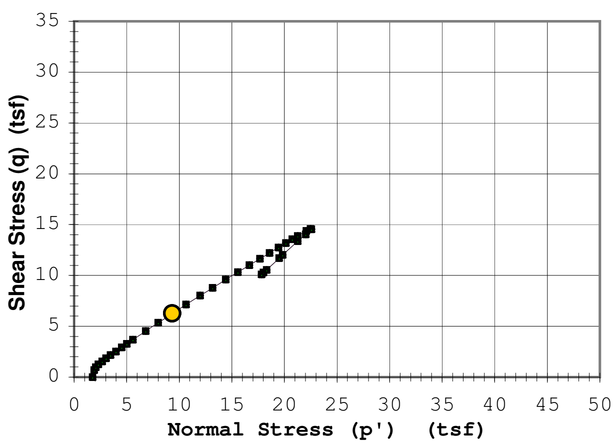
Failure Criterion:	Max. Stress Ratio
Angle of internal friction, ϕ' =	°
Apparent Cohesion, c' =	(tsf)

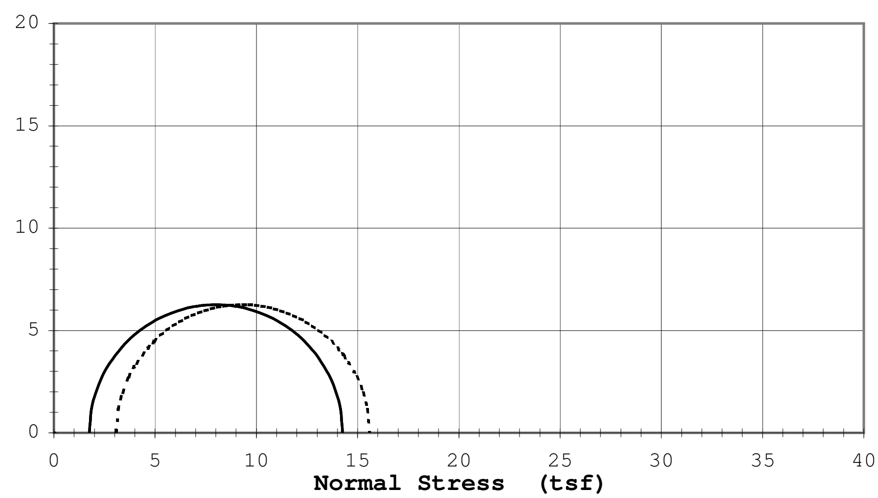
Test Date:	9/26/07	Liquid Limit:	23.7
Test Type:	CU w/pp	Plastic Limit:	20.4
Strain Rate (in/min):	0.0039	Plasticity Index:	3.3
Strain Rate (%/min):	0.100	Spec. Gravity (Actual):	2.95

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94				
Height (in)	3.98				
Water Content (%)	25.8				
Dry Density (pcf)	103.1				
Void Ratio	0.79				
After Consolidation					
Diameter (in)	1.96				
Height (in)	3.90				
Water Content (%)	26.3				
Dry Density (pcf)	103.8				
Void Ratio	0.77				
Back Pressure (tsf)	5.75				
Minor Principal Stress (tsf)	1.75				
Max. Deviator Stress (tsf)	29.16				
Ultimate Deviator Stress (tsf)	20.24				
Deviator Stress at Failure (tsf)	12.51				
Max. Pore Pressure Buildup (tsf)	0.68				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	4.1				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





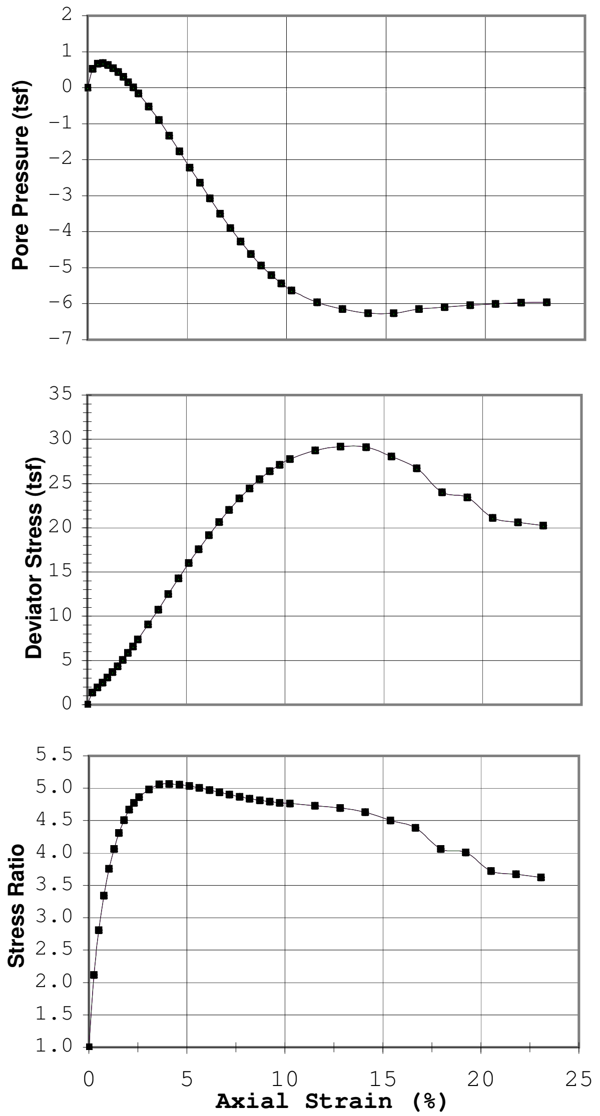
Rupture Envelope at Failure	
α = °	a = (tsf)

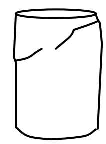
------------	Effective ϕ': °	c'= (tsf)
________	Total ϕ': °	c= (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-02** Sample #: Type: **3T** Depth (ft): **59 - 61**
Soil Type: **Fine Tailings (Sand w/Silt (ML))**

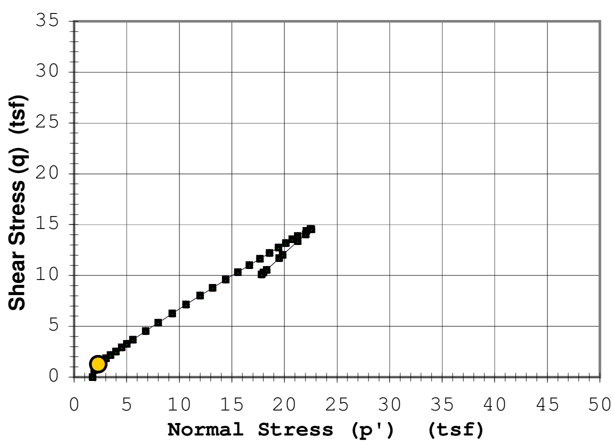


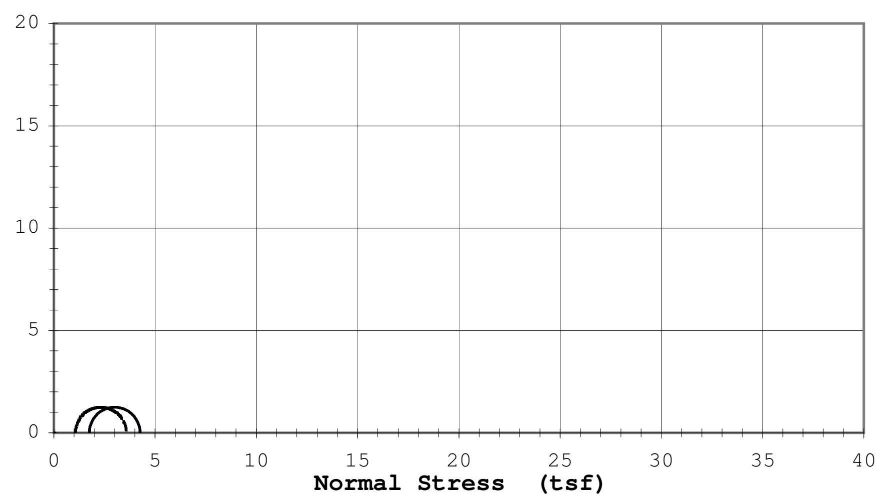


Failure Criterion:	Max. Pore Pressure				
Angle of internal friction, φ' =	°				
Apparent Cohesion, c' =	(tsf)				
Test Date: 9/26/07	Liquid Limit: 23.7				
Test Type: CU w/pp	Plastic Limit: 20.4				
Strain Rate (in/min): 0.0039	Plasticity Index: 3.3				
Strain Rate (%/min): 0.100	Spec. Gravity (Actual): 2.95				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94				
Height (in)	3.98				
Water Content (%)	25.8				
Dry Density (pcf)	103.1				
Void Ratio	0.79				
After Consolidation					
Diameter (in)	1.96				
Height (in)	3.90				
Water Content (%)	26.3				
Dry Density (pcf)	103.8				
Void Ratio	0.77				
Back Pressure (tsf)	5.75				
Minor Principal Stress (tsf)	1.75				
Max. Deviator Stress (tsf)	29.16				
Ultimate Deviator Stress (tsf)	20.24				
Deviator Stress at Failure (tsf)	2.50				
Max. Pore Pressure Buildup (tsf)	0.68				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	0.8				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





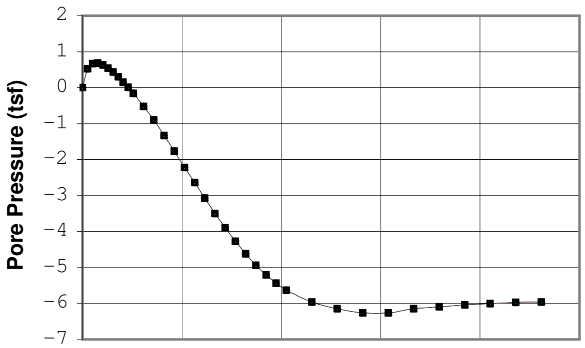
Rupture Envelope at Failure		
α = °	a =	(tsf)

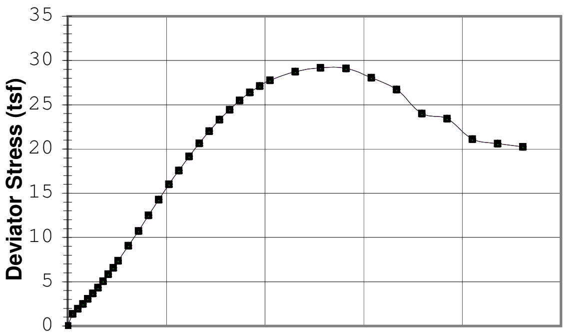
------------	Effective φ': °	c'=	(tsf)
________	Total φ': °	c=	(tsf)

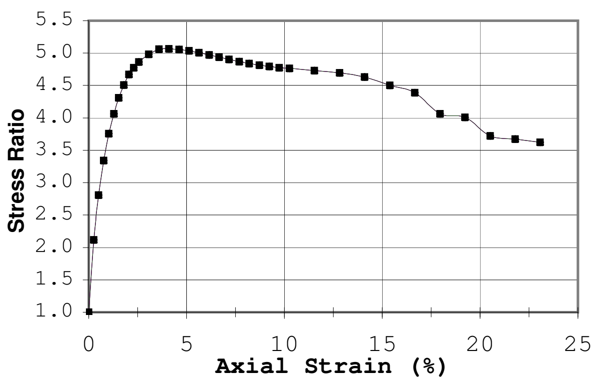
TRIAXIAL TEST ASTM: D 4767

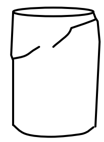
Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-02** Sample #: Type: **3T** Depth (ft): **59 - 61**
Soil Type: **Fine Tailings (Sand w/Silt (ML))**









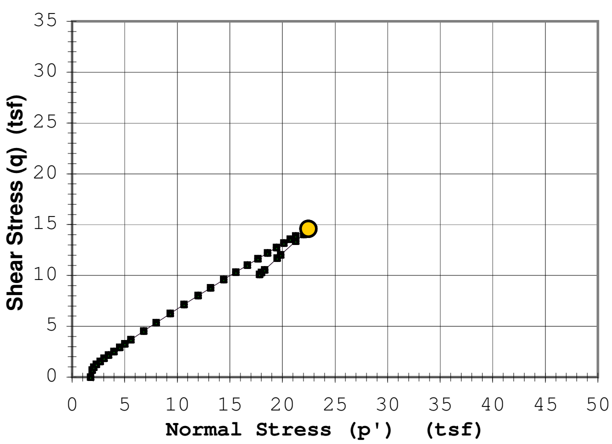
Failure Criterion:	**Max. Deviator Stress**			
Angle of internal friction, ϕ' =	°			
Apparent Cohesion, **c'** =	**(tsf)**			
Test Date:	9/26/07	Liquid Limit:	23.7	
Test Type:	CU w/pp	Plastic Limit:	20.4	
Strain Rate (in/min):	0.0039	Plasticity Index:	3.3	
Strain Rate (%/min):	0.100	Spec. Gravity (Actual):	2.95	

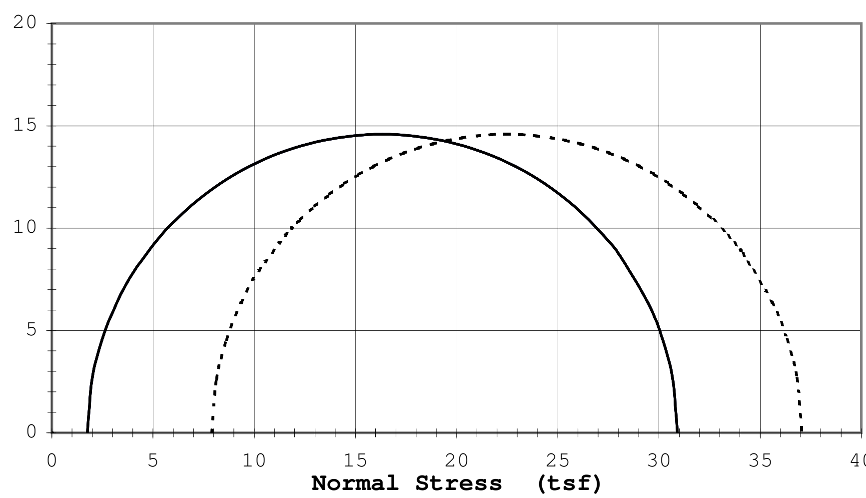
	A	B	C	D	E
Before Consolidation					
Diameter (in)	1.94				
Height (in)	3.98				
Water Content (%)	25.8				
Dry Density (pcf)	103.1				
Void Ratio	0.79				
After Consolidation					
Diameter (in)	1.96				
Height (in)	3.90				
Water Content (%)	26.3				
Dry Density (pcf)	103.8				
Void Ratio	0.77				
Back Pressure (tsf)	5.75				
Minor Principal Stress (tsf)	1.75				
Max. Deviator Stress (tsf)	29.16				
Ultimate Deviator Stress (tsf)	20.24				
Deviator Stress at Failure (tsf)	29.16				
Max. Pore Pressure Buildup (tsf)	0.68				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	12.8				

Symbols: ◆ ■ △ + X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





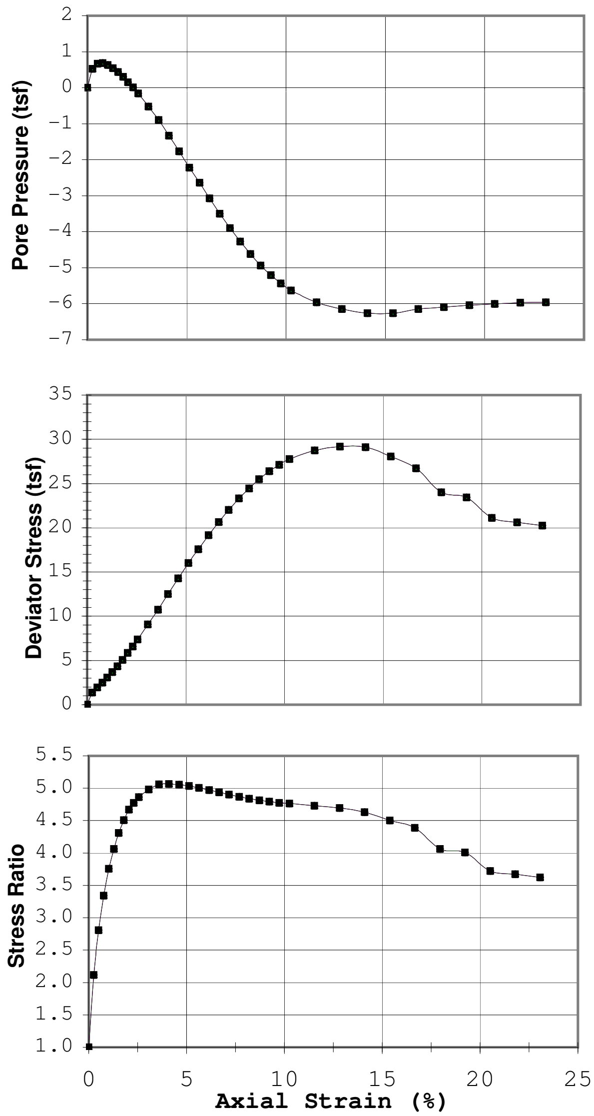
Rupture Envelope at Failure	
α = °	a = (tsf)

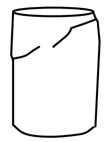
------------	Effective ϕ': °	c'=	(tsf)
________	Total ϕ': °	c=	(tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-02** Sample #: Type: **3T** Depth (ft): **59 - 61**
Soil Type: **Fine Tailings (Sand w/Silt (ML))**





Failure Criterion: **Given Strain of: 15%**

Angle of internal friction, ϕ' = °

Apparent Cohesion, c' = (tsf)

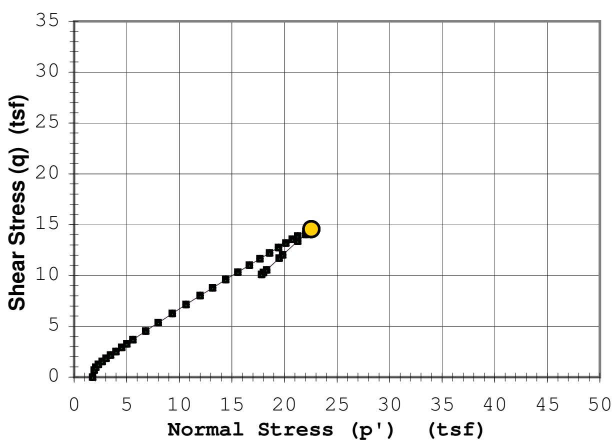
Test Date:	9/26/07	Liquid Limit:	23.7
Test Type:	CU w/pp	Plastic Limit:	20.4
Strain Rate (in/min):	0.0039	Plasticity Index:	3.3
Strain Rate (%/min):	0.100	Spec. Gravity (Actual):	2.95

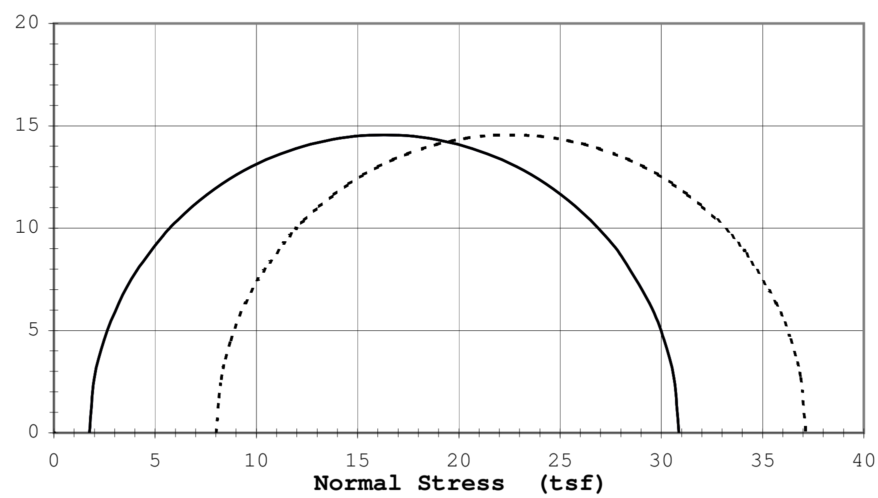
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94				
Height (in)	3.98				
Water Content (%)	25.8				
Dry Density (pcf)	103.1				
Void Ratio	0.79				
After Consolidation					
Diameter (in)	1.96				
Height (in)	3.90				
Water Content (%)	26.3				
Dry Density (pcf)	103.8				
Void Ratio	0.77				
Back Pressure (tsf)	5.75				
Minor Principal Stress (tsf)	1.75				
Max. Deviator Stress (tsf)	29.16				
Ultimate Deviator Stress (tsf)	20.24				
Deviator Stress at Failure (tsf)	29.11				
Max. Pore Pressure Buildup (tsf)	0.68				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	15.0				

Symbols: ◆ ■ △ + X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure		
α = °	a =	(tsf)

------------ Effective ϕ': °	c'=	(tsf)
________ Total ϕ': °	c=	(tsf)

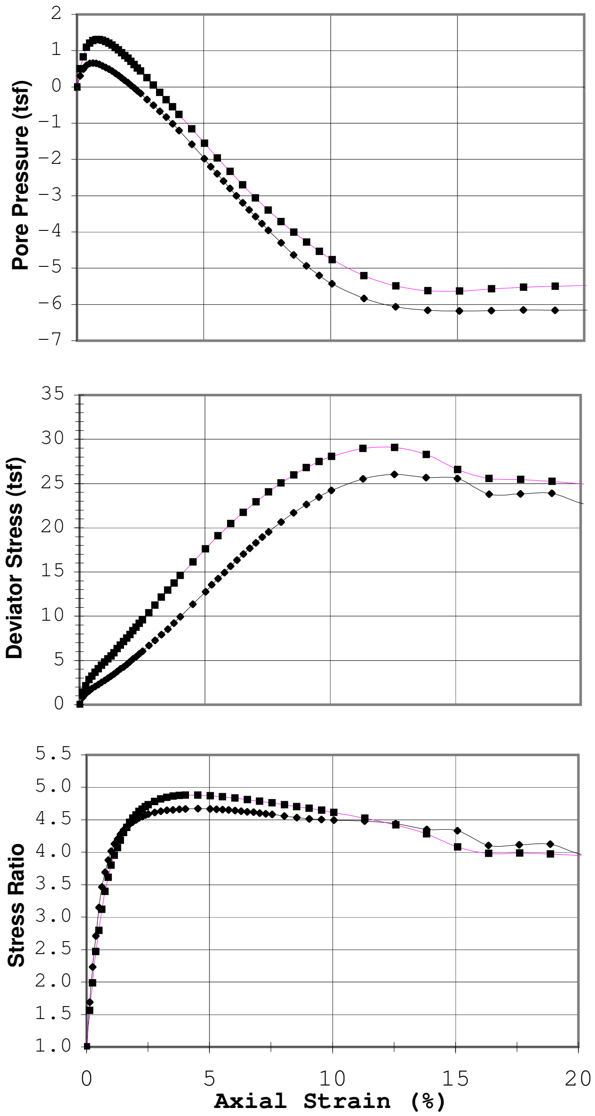
Job No.: 6250
Project: Polymet - #23/69-862-015-028 Type: CU w/pp
Boring No.: 07-02, Depth (ft.): 59 - 61, Soil Type: Fine Tailings (Sand w/Silt (ML))

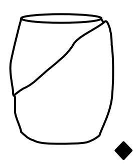
Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00						
0.26	1.37	0.52						
0.51	1.96	0.67						
0.77	2.50	0.68						
1.03	3.09	0.63						
1.28	3.69	0.55						
1.54	4.33	0.44						
1.80	5.06	0.31						
2.05	5.85	0.15						
2.31	6.57	0.01						
2.56	7.39	-0.16						
3.08	9.07	-0.53						
3.59	10.73	-0.89						
4.10	12.51	-1.33						
4.62	14.27	-1.77						
5.13	16.02	-2.22						
5.64	17.58	-2.64						
6.16	19.17	-3.08						
6.67	20.65	-3.50						
7.18	22.03	-3.90						
7.69	23.31	-4.28						
8.21	24.45	-4.62						
8.72	25.50	-4.94						
9.23	26.39	-5.21						
9.75	27.12	-5.43						
10.26	27.76	-5.63						
11.54	28.76	-5.96						
12.82	29.16	-6.15						
14.11	29.11	-6.27						
15.39	28.06	-6.27						
16.67	26.73	-6.14						
17.95	24.03	-6.09						
19.23	23.42	-6.04						
20.51	21.10	-6.01						
21.80	20.60	-5.97						
23.08	20.24	-5.96						

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-10** Sample #: Type: **3T** Depth (ft): **37-39**
Soil Type: **Fine Tailings (Silt w/sand (ML))**

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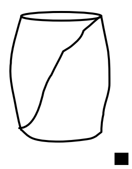
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△

+

X

Failure Criterion: **Max. Stress Ratio**

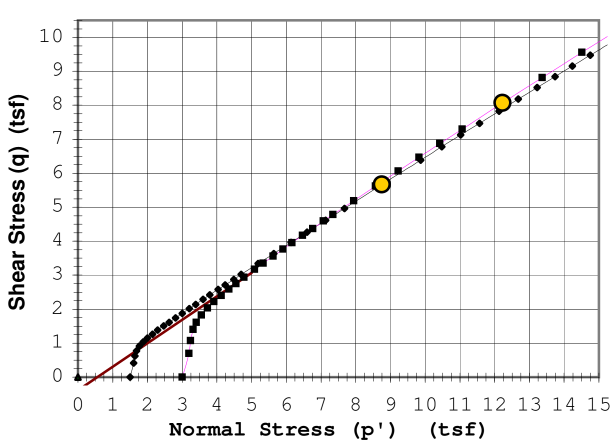
Angle of internal friction, ϕ' = **43.7 °**
Apparent Cohesion, c' = **0.00 (tsf)**

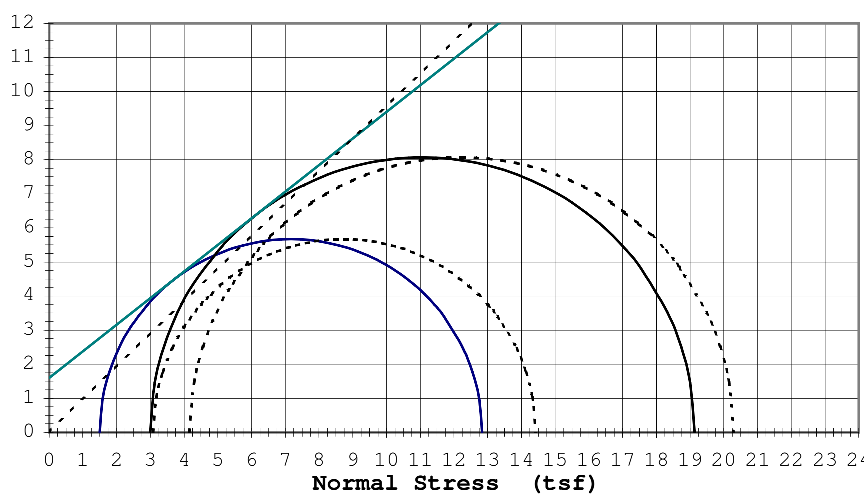
Test Date:	10/8/07	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.004	Plasticity Index:	NP
Strain Rate (%/min):	0.101	Spec. Gravity :	2.93

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	25.2	25.2			
Dry Density (pcf)	101.6	96.6			
Void Ratio	0.80	0.89			
After Consolidation					
Diameter (in)	1.94	1.93			
Height (in)	3.98	3.97			
Water Content (%)	26.8	29.3			
Dry Density (pcf)	102.4	98.4			
Void Ratio	0.79	0.86			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	26.04	29.05			
Ultimate Deviator Stress (tsf)	22.67	24.96			
Deviator Stress at Failure (tsf)	11.34	16.14			
Max. Pore Pressure Buildup (tsf)	0.66	1.30			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	4.5	4.5			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





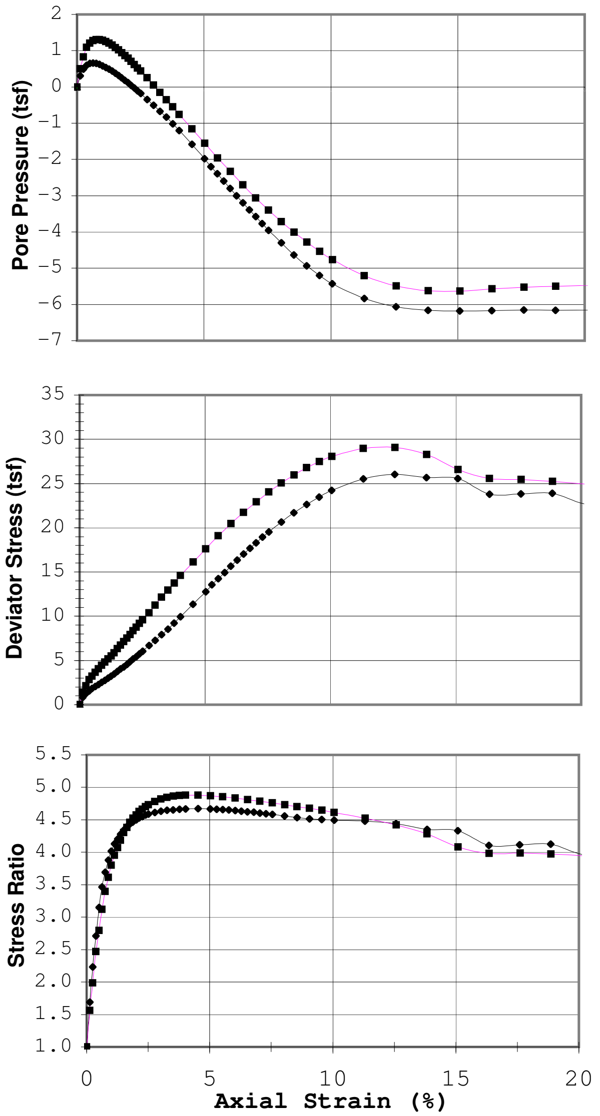
Rupture Envelope at Failure	
α = 34.6 °	a = -0.4 (tsf)

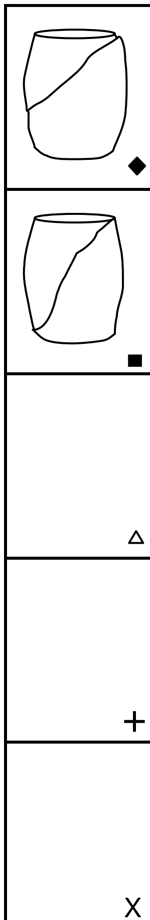
------------	Effective ϕ':	43.7 °	c'=	0.00 (tsf)
________	Total ϕ':	38.0 °	c=	1.59 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-10** Sample #: Type: **3T** Depth (ft): **37-39**
Soil Type: **Fine Tailings (Silt w/sand (ML))**

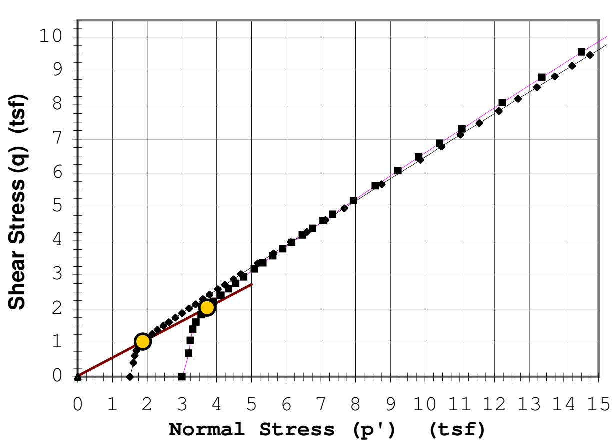


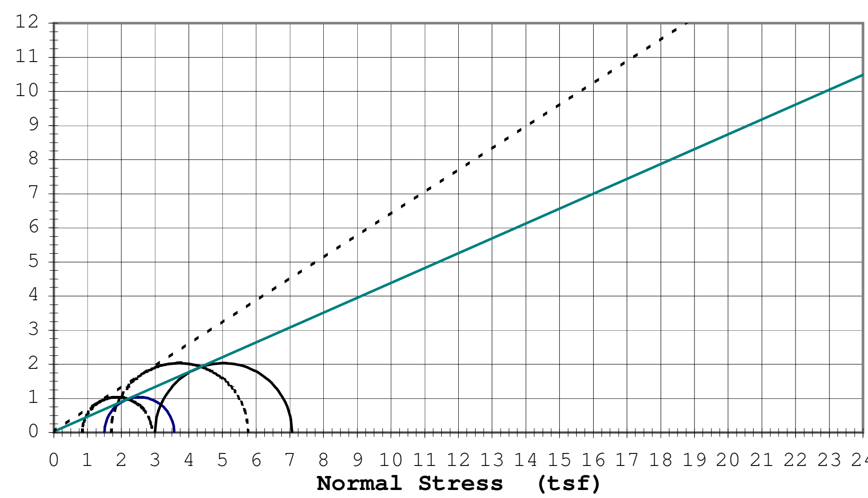


Failure Criterion:	Max. Pore Pressure				
Angle of internal friction, φ' =	32.6 °				
Apparent Cohesion, c' =	0.03 (tsf)				
Test Date: 10/8/07	Liquid Limit: NP				
Test Type: CU w/pp	Plastic Limit: NP				
Strain Rate (in/min): 0.004	Plasticity Index: NP				
Strain Rate (%/min): 0.101	Spec. Gravity : 2.93				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	25.2	25.2			
Dry Density (pcf)	101.6	96.6			
Void Ratio	0.80	0.89			
After Consolidation					
Diameter (in)	1.94	1.93			
Height (in)	3.98	3.97			
Water Content (%)	26.8	29.3			
Dry Density (pcf)	102.4	98.4			
Void Ratio	0.79	0.86			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	26.04	29.05			
Ultimate Deviator Stress (tsf)	22.67	24.96			
Deviator Stress at Failure (tsf)	2.07	4.07			
Max. Pore Pressure Buildup (tsf)	0.66	1.30			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	0.6	0.8			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





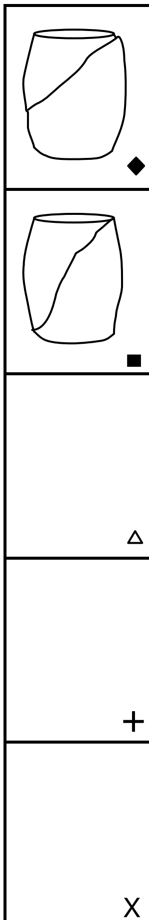
Rupture Envelope at Failure	
α = 28.3 °	a = 0.0 (tsf)

------------ Effective φ':	32.6 °	c'=	0.03 (tsf)
________ Total φ':	23.5 °	c=	0.02 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project:	**Polymet #23/69-862-022B**					
Boring #:	**07-10**	Sample #:		Type: **3T**	Depth (ft):	**37-39**
Soil Type:	**Fine Tailings (Silt w/sand (ML))**					

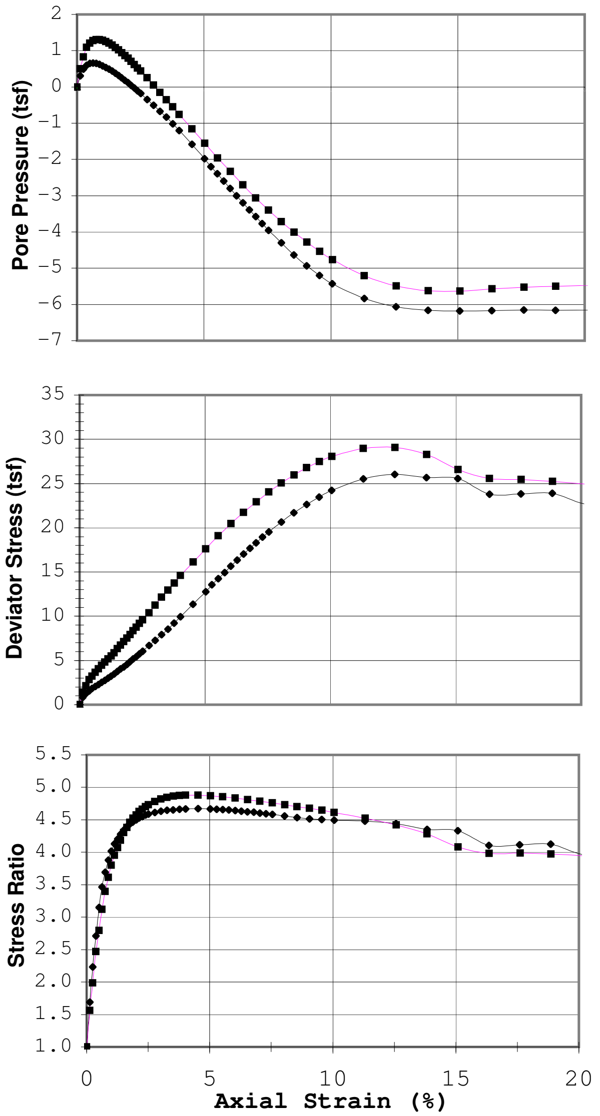


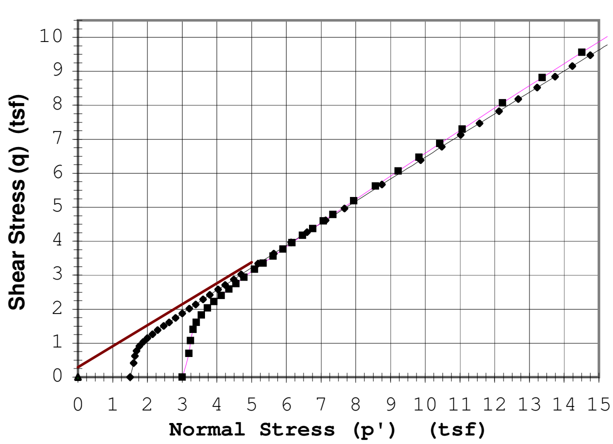
Failure Criterion:		**Max. Deviator Stress**				
Angle of internal friction, ϕ' =		**38.2 °**				
Apparent Cohesion, c' =		**0.37 (tsf)**				
Test Date:	10/8/07	Liquid Limit:	NP			
Test Type:	CU w/pp	Plastic Limit:	NP			
Strain Rate (in/min):	0.004	Plasticity Index:	NP			
Strain Rate (%/min):	0.101	Spec. Gravity :	2.93			

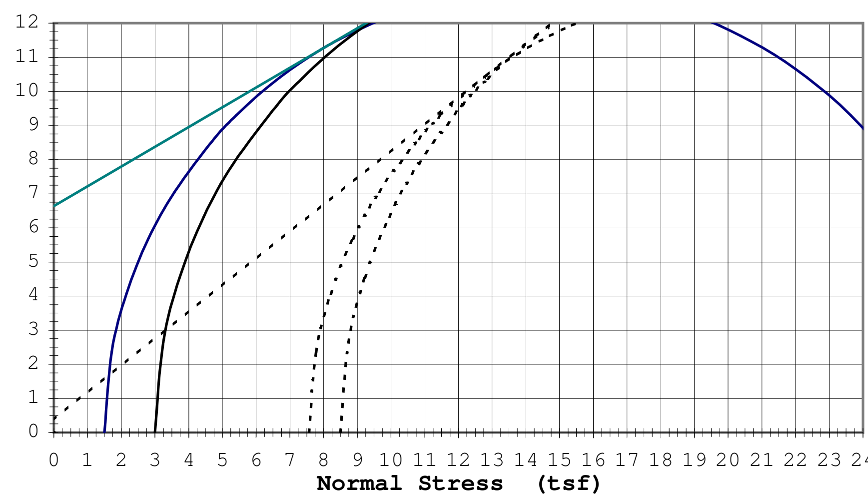
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	25.2	25.2			
Dry Density (pcf)	101.6	96.6			
Void Ratio	0.80	0.89			
After Consolidation					
Diameter (in)	1.94	1.93			
Height (in)	3.98	3.97			
Water Content (%)	26.8	29.3			
Dry Density (pcf)	102.4	98.4			
Void Ratio	0.79	0.86			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	26.04	29.05			
Ultimate Deviator Stress (tsf)	22.67	24.96			
Deviator Stress at Failure (tsf)	26.04	29.05			
Max. Pore Pressure Buildup (tsf)	0.66	1.30			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	12.6	12.6			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.







Rupture Envelope at Failure	
α = 31.7 °	a = 0.3 (tsf)

------------	Effective ϕ':	38.2 °	c'=	0.37 (tsf)
________	Total ϕ':	30.1 °	c=	6.64 (tsf)

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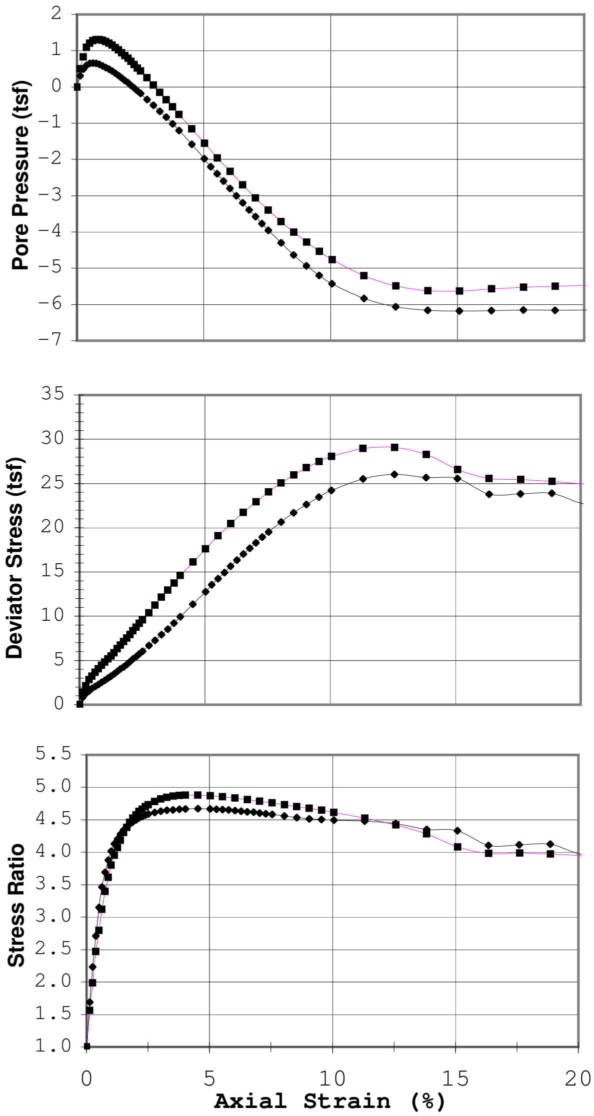
TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-10** Sample #: Type: **3T** Depth (ft): **37-39**
Soil Type: **Fine Tailings (Silt w/sand (ML))**



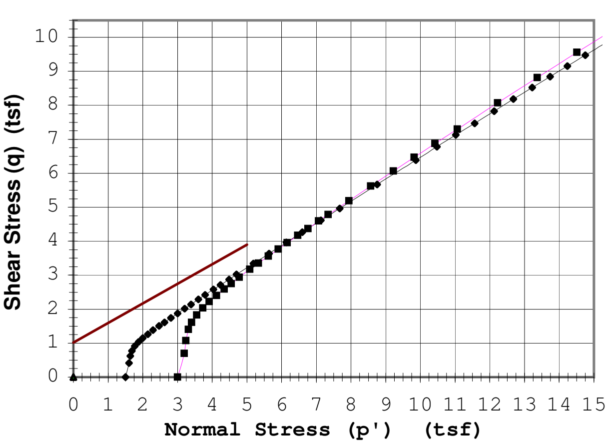
Failure Criterion:	Given Strain of: 15%
Angle of internal friction, ϕ' =	35.2 °
Apparent Cohesion, c' =	1.25 (tsf)

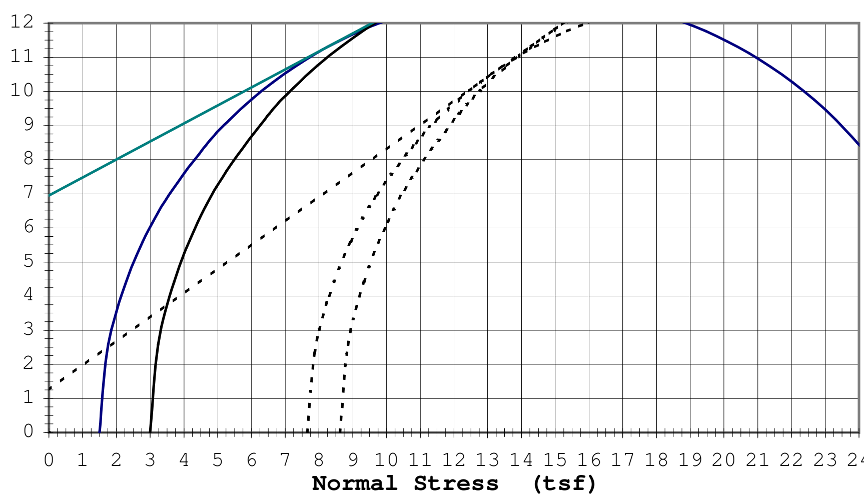
Test Date:	10/8/07	Liquid Limit:	NP
Test Type:	CU w/pp	Plastic Limit:	NP
Strain Rate (in/min):	0.004	Plasticity Index:	NP
Strain Rate (%/min):	0.101	Spec. Gravity :	2.93

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	25.2	25.2			
Dry Density (pcf)	101.6	96.6			
Void Ratio	0.80	0.89			
After Consolidation					
Diameter (in)	1.94	1.93			
Height (in)	3.98	3.97			
Water Content (%)	26.8	29.3			
Dry Density (pcf)	102.4	98.4			
Void Ratio	0.79	0.86			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	26.04	29.05			
Ultimate Deviator Stress (tsf)	22.67	24.96			
Deviator Stress at Failure (tsf)	25.67	28.29			
Max. Pore Pressure Buildup (tsf)	0.66	1.30			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 30.0 °	a = 1.0 (tsf)

------------	Effective ϕ':	35.2 °	c'=	1.25 (tsf)
________	Total ϕ':	27.8 °	c=	6.95 (tsf)

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Job No. 6250
Boring #: 07-10 Depth (ft): 37-39 Date: 10/19/07

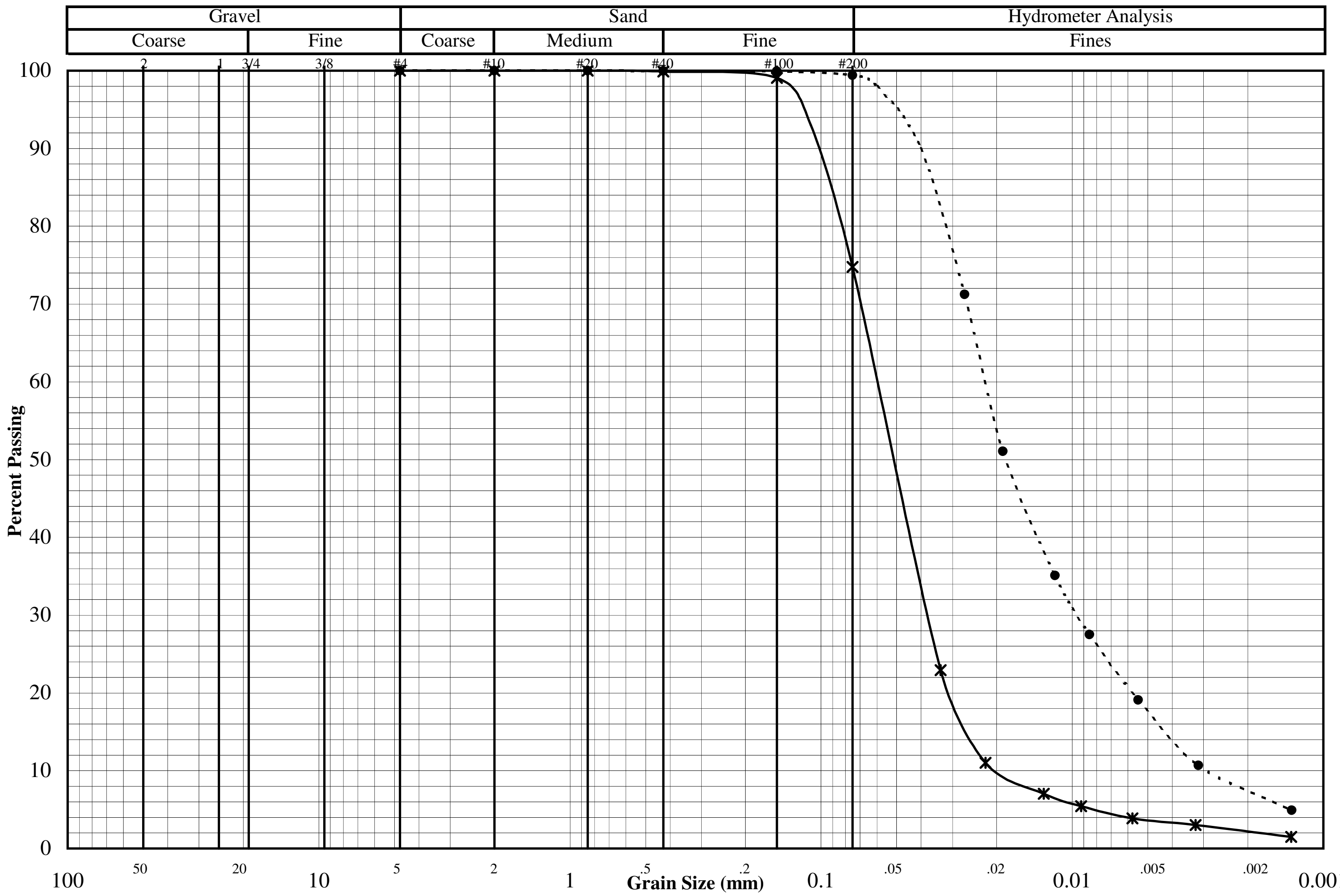
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00									
0.13	0.82	0.31	0.13	1.40	0.50									
0.25	1.25	0.49	0.25	2.14	0.83									
0.38	1.55	0.59	0.38	2.81	1.09									
0.50	1.83	0.65	0.50	3.22	1.20									
0.63	2.07	0.66	0.63	3.65	1.27									
0.75	2.29	0.65	0.76	4.07	1.30									
0.88	2.53	0.62	0.88	4.44	1.30									
1.01	2.76	0.58	1.01	4.81	1.28									
1.13	3.02	0.54	1.13	5.18	1.25									
1.26	3.23	0.49	1.26	5.51	1.21									
1.38	3.49	0.44	1.38	5.88	1.15									
1.51	3.76	0.38	1.51	6.34	1.08									
1.63	4.04	0.31	1.64	6.71	1.02									
1.76	4.28	0.25	1.76	7.12	0.94									
1.89	4.57	0.18	1.89	7.54	0.86									
2.01	4.83	0.12	2.01	7.90	0.79									
2.14	5.15	0.04	2.14	8.34	0.70									
2.26	5.42	-0.03	2.26	8.74	0.61									
2.39	5.75	-0.11	2.39	9.18	0.52									
2.51	6.04	-0.18	2.52	9.57	0.44									
2.77	6.68	-0.35	2.77	10.39	0.25									
3.02	7.28	-0.50	3.02	11.25	0.05									
3.27	7.93	-0.67	3.27	12.14	-0.16									
3.52	8.52	-0.83	3.52	12.95	-0.35									
3.77	9.23	-1.02	3.77	13.75	-0.55									
4.02	9.93	-1.21	4.03	14.60	-0.76									
4.53	11.34	-1.59	4.53	16.14	-1.16									
5.03	12.78	-1.98	5.03	17.63	-1.56									
5.28	13.56	-2.20	5.53	19.11	-1.96									
5.53	14.25	-2.40	6.04	20.45	-2.34									
5.78	14.94	-2.59	6.54	21.73	-2.71									
6.03	15.66	-2.80	7.05	22.94	-3.06									
6.29	16.36	-3.00	7.55	24.05	-3.40									
6.54	17.04	-3.20	8.05	25.05	-3.71									
6.79	17.69	-3.39	8.55	25.97	-4.01									
7.04	18.31	-3.58	9.06	26.78	-4.29									
7.29	18.96	-3.77	9.56	27.47	-4.54									
7.54	19.54	-3.95	10.06	28.06	-4.77									
8.05	20.65	-4.30	11.32	28.95	-5.21									
8.55	21.70	-4.64	12.58	29.05	-5.50									
9.05	22.62	-4.94	13.84	28.29	-5.62									
9.55	23.46	-5.20	15.10	26.58	-5.63									
10.06	24.23	-5.43	16.35	25.58	-5.57									
11.31	25.53	-5.84	17.61	25.47	-5.53									
12.57	26.04	-6.07	18.87	25.25	-5.50									
13.83	25.67	-6.16	20.13	24.96	-5.47									
15.08	25.56	-6.18												
16.34	23.80	-6.17												
17.60	23.82	-6.15												
18.86	23.91	-6.16												
20.11	22.70	-6.15												

Grain Size Distribution ASTM D422

Job No. : **6250**

Project:	Polymet #23/69-862-022B	Test Date:	9/25/07
Reported To:	Barr Engineering Company	Report Date:	10/4/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	07-02	(Top)	59-61	3T	Fine Tailings (Silt w/sand (ML))
●	07-02	(M-T)	59-61	3T	Slimes (Silt (ML))
◇					



Other Tests

	*	●	◇
Liquid Limit	23.7	22.0	
Plastic Limit	20.4	17.2	
Plasticity Index	3.3	4.8	
Water Content			
Dry Density (pcf)			
Specific Gravity	2.95	2.93	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	275.7	362.3	
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	
#10	100.0	100.0	
#20	100.0	100.0	
#40	99.9	100.0	
#100	99.1	99.9	
#200	74.8	99.4	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

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SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6250**

Project:	Polymet #23/69-862-022B	Test Date:	9/25/07
Reported To:	Barr Engineering Company	Report Date:	10/4/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	07-02	(Top)	59-61	3T	Fine Tailings (Silt w/sand (ML))
Spec 2	07-02	(M-T)	59-61	3T	Slimes (Silt (ML))
Spec 3					

Hydrometer Data

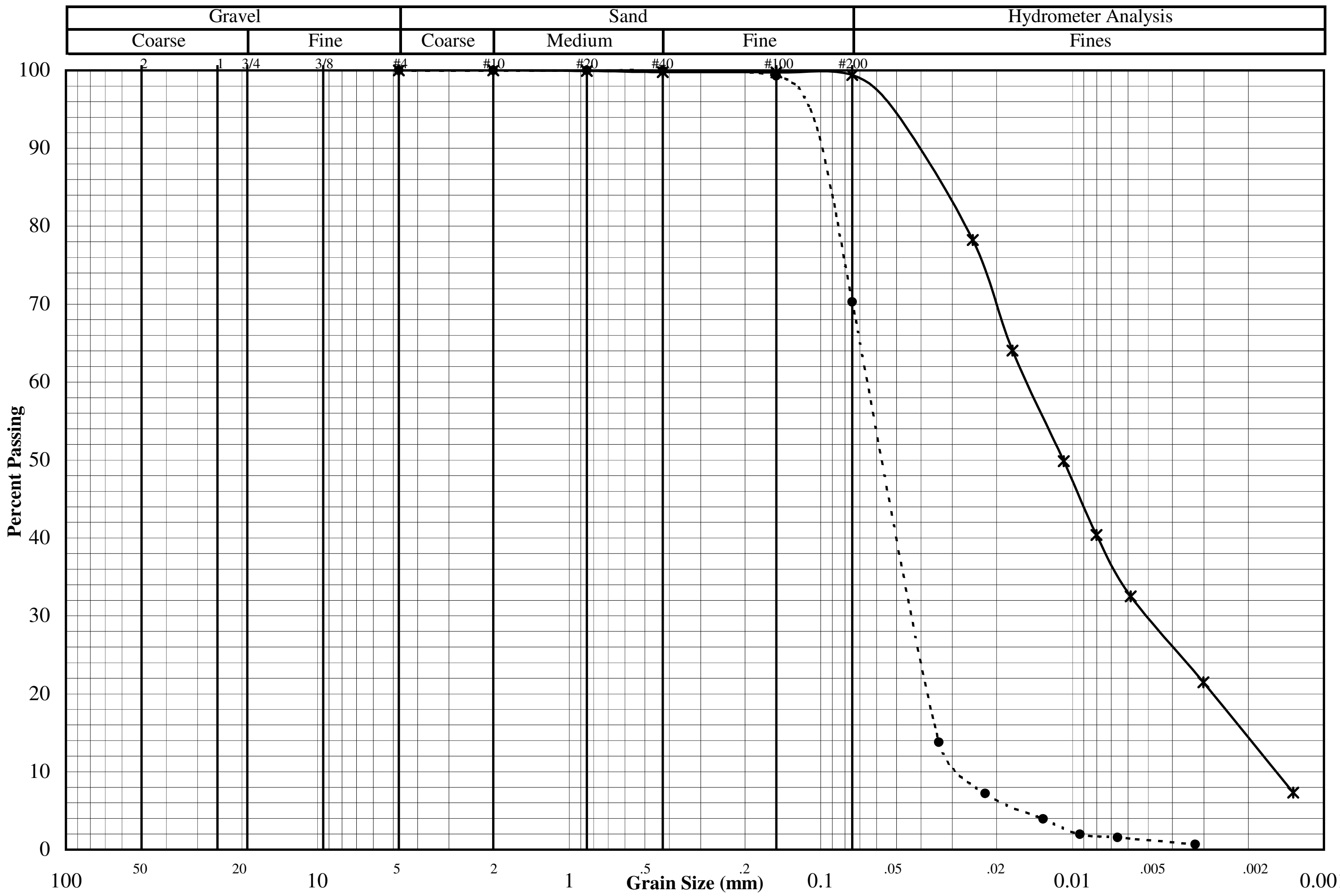
Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.033	22.9	0.027	71.2		
0.022	11.0	0.019	51.1		
0.013	7.0	0.012	35.1		
0.009	5.4	0.009	27.5		
0.006	3.9	0.005	19.1		
0.003	3.0	0.003	10.7		
0.001	1.5	0.001	4.9		

Grain Size Distribution ASTM D422

Job No. : **6250**

Project:	Polymet #23/69-862-022B	Test Date:	10/8/07
Reported To:	Barr Engineering Company	Report Date:	10/11/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	07-07C		48-50	3T	Slimes: Silt (ML)
●	07-10		37-39	3T	Fine Tailings: Silt w/sand (ML)
◇					



Other Tests

	*	●	◇
Liquid Limit	22.5	NP	
Plastic Limit	20.8	NP	
Plasticity Index	1.7	NP	
Water Content			
Dry Density (pcf)			
Specific Gravity	2.97	2.93	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	310.1	367.9	
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	
#10	100.0	100.0	
#20	99.9	100.0	
#40	99.8	100.0	
#100	99.7	99.3	
#200	99.4	70.3	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

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SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6250**

Project:	Polymet #23/69-862-022B	Test Date:	10/8/07
Reported To:	Barr Engineering Company	Report Date:	10/11/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	07-07C		48-50	3T	Slimes: Silt (ML)
Spec 2	07-10		37-39	3T	Fine Tailings: Silt w/sand (ML)
Spec 3					

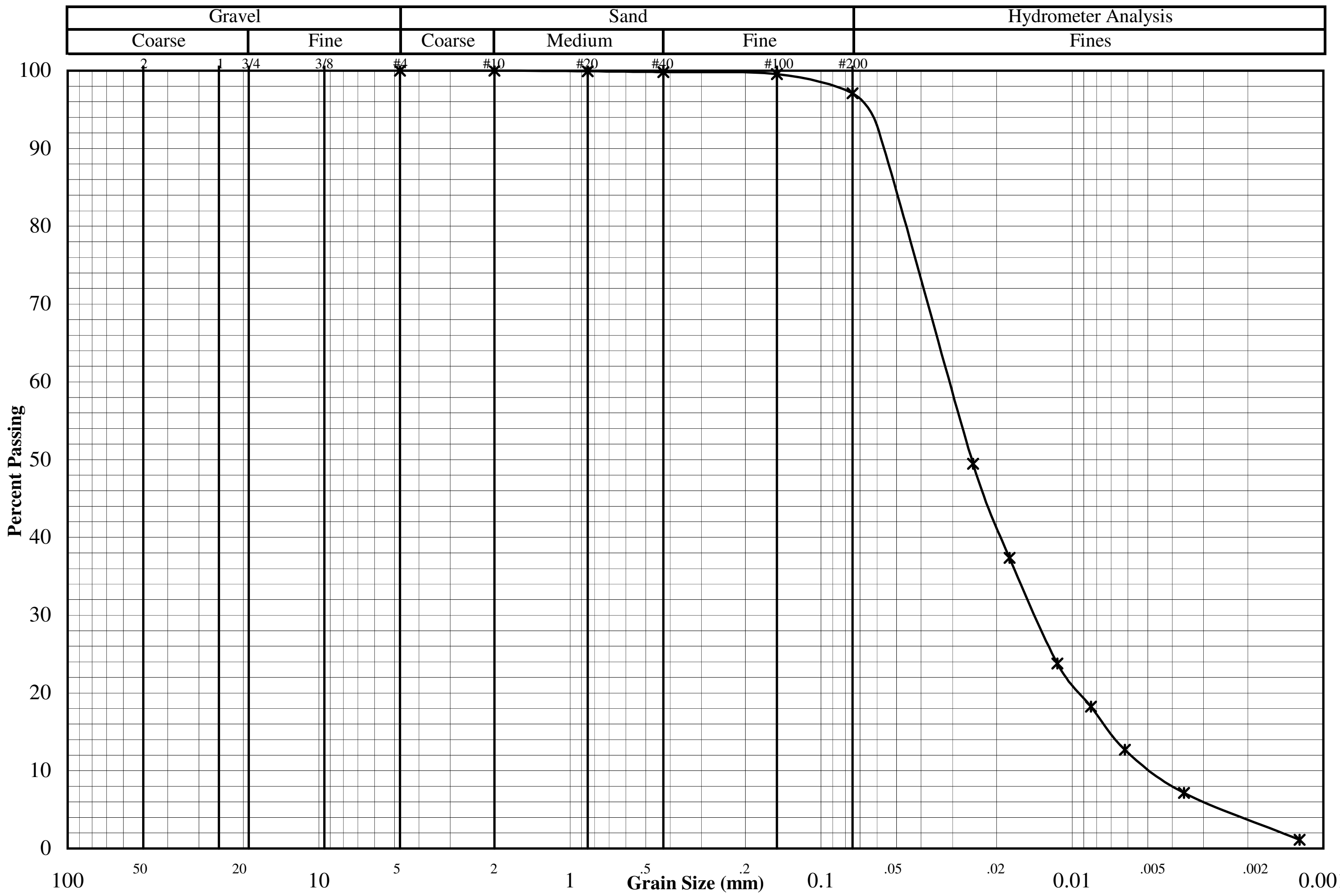
Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.025	78.2	0.034	13.8		
0.017	64.0	0.022	7.2		
0.011	49.8	0.013	3.9		
0.008	40.4	0.009	2.0		
0.006	32.5	0.007	1.5		
0.003	21.5	0.003	0.7		
0.001	7.3	0.001	-0.4		

Grain Size Distribution ASTM D422

Project:	Polymet #23/69-862-022B	Job No. :	6250
		Test Date:	9/19/07
Reported To:	Barr Engineering Company	Report Date:	10/2/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	LTV Slimes	Composite		Bulk	Slimes: Silt (ML)
●					
◇					



Other Tests

	*	●	◇
Liquid Limit	20.7		
Plastic Limit	16.7		
Plasticity Index	4.0		
Water Content			
Dry Density (pcf)			
Specific Gravity	2.99		
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	92.6		
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.8		
#100	99.6		
#200	97.1		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

Grain Size Distribution ASTM D422

Job No. : **6250**

Project:	Polymet #23/69-862-022B	Test Date:	9/19/07
Reported To:	Barr Engineering Company	Report Date:	10/2/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	LTV Slimes	Composite		Bulk	Slimes: Silt (ML)
Spec 2					
Spec 3					

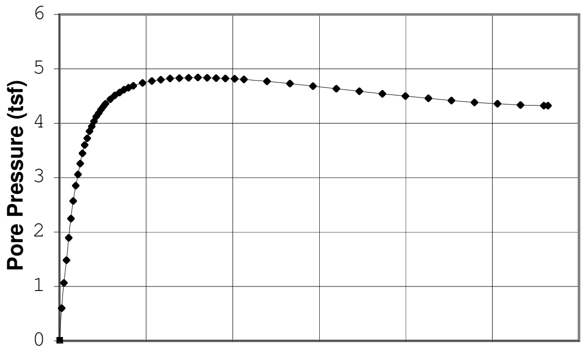
Hydrometer Data

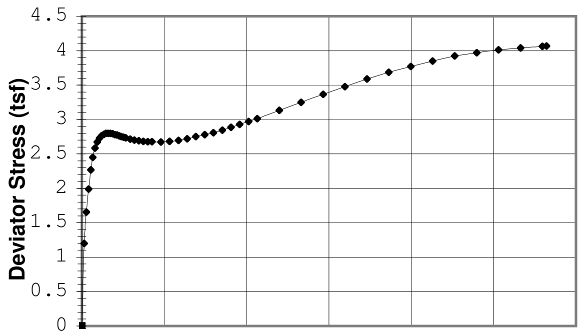
Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.025	49.4				
0.018	37.4				
0.011	23.8				
0.008	18.2				
0.006	12.7				
0.004	7.2				
0.001	1.1				

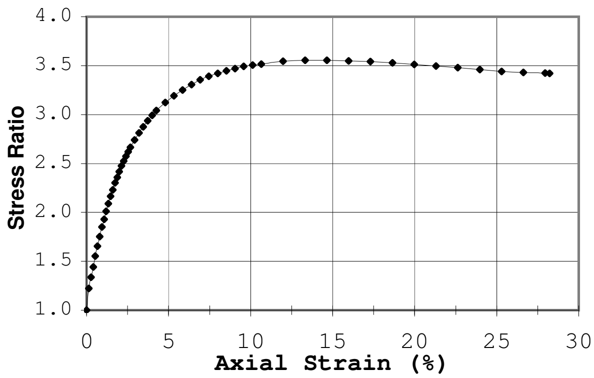
TRIAXIAL TEST ASTM: D 4767

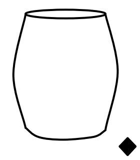
Job No. **6250**
Date: **10/18/07**

Project: **Polymet #23/69-862-022B**
Boring #: **Composite** Sample #: **LTV Slimes** Type: **Bulk** Depth (ft):
Soil Type: **Slimes: Silt (ML)**









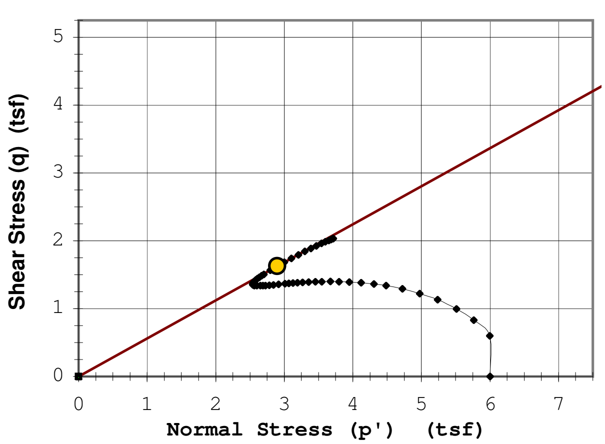
Failure Criterion:	**Max. Stress Ratio**				
Angle of internal friction, φ' =	**34.1 °**				
Apparent Cohesion, c' =	**0.00 (tsf)**				
Test Date:	10/9/07	Liquid Limit:	20.7		
Test Type:	CU w/pp	Plastic Limit:	16.7		
Strain Rate (in/min):	0.004	Plasticity Index:	4.0		
Strain Rate (%/min):	0.107	Spec. Gravity :	2.99		

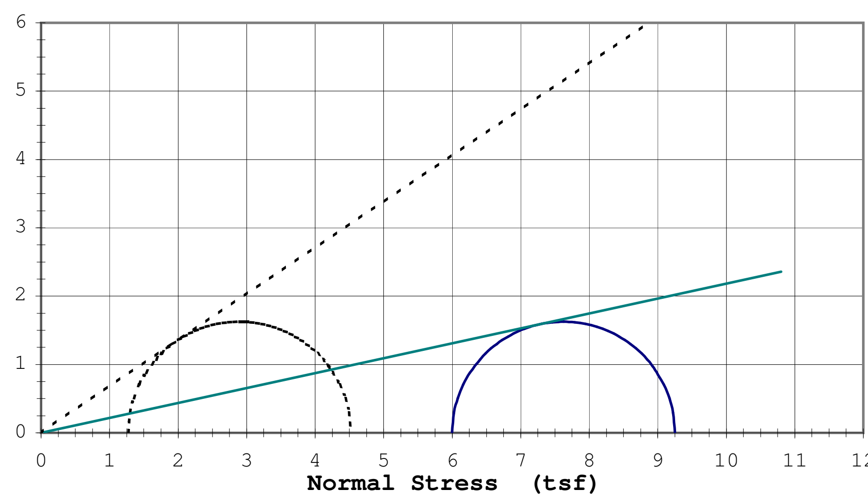
Before Consolidation	A	B	C	D	E
Diameter (in)	1.86				
Height (in)	3.78				
Water Content (%)	11.0				
Dry Density (pcf)	94.5				
Void Ratio	0.98				
After Consolidation					
Diameter (in)	1.84				
Height (in)	3.76				
Water Content (%)	31.0				
Dry Density (pcf)	96.8				
Void Ratio	0.93				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	6.00				
Max. Deviator Stress (tsf)	2.80				
Ultimate Deviator Stress (tsf)	4.07				
Deviator Stress at Failure (tsf)	3.25				
Max. Pore Pressure Buildup (tsf)	4.84				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	13.3				

◆ ■ △ + X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely at a relatively dry state; Saturated (specimens contracted upon saturation diameter and height changes during saturation estimated with a preliminary unsheared specimen, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





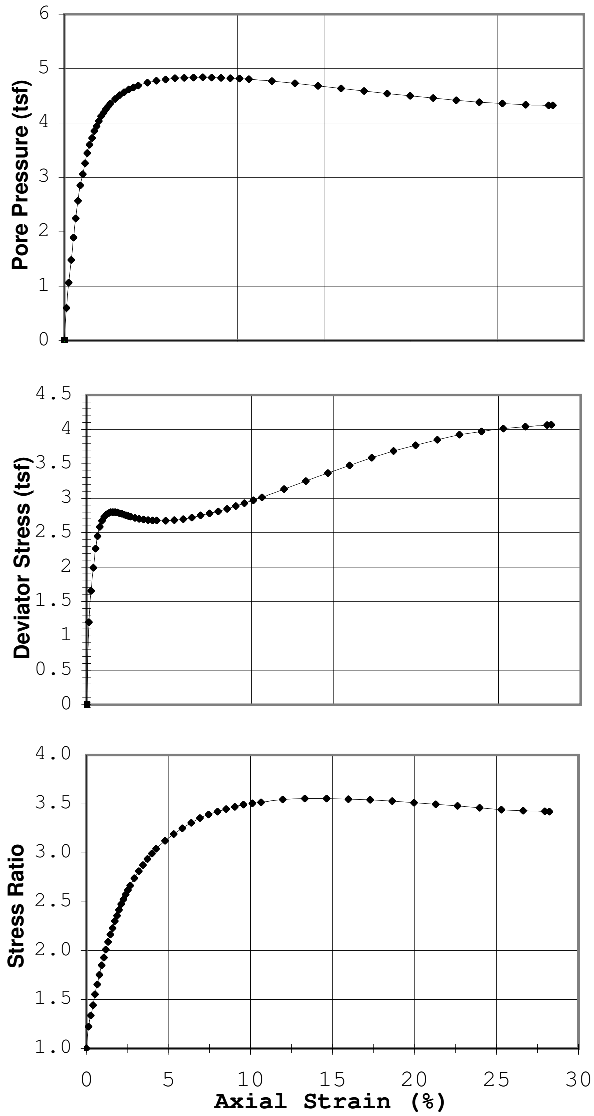
Rupture Envelope at Failure	
α = 29.3 °	a = 0.0 (tsf)

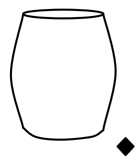
------------	Effective φ':	34.1 °	c'=	0.00 (tsf)
________	Total φ':	12.3 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/18/07**

Project: **Polymet #23/69-862-022B**
Boring #: **Composite** Sample #: **LTV Slimes** Type: **Bulk** Depth (ft):
Soil Type: **Slimes: Silt (ML)**





Failure Criterion:	**Max. Pore Pressure**
Angle of internal friction, φ' =	**33.2 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

Test Date:	10/9/07	Liquid Limit:	20.7
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.0
Strain Rate (%/min):	0.107	Spec. Gravity :	2.99

Symbol	*Before Consolidation*	A	B	C	D	E
◆	Diameter (in)	1.86				
	Height (in)	3.78				
	Water Content (%)	11.0				
	Dry Density (pcf)	94.5				
■	Void Ratio	0.98				
	After Consolidation					
	Diameter (in)	1.84				
	Height (in)	3.76				
	Water Content (%)	31.0				
△	Dry Density (pcf)	96.8				
	Void Ratio	0.93				
	Back Pressure (tsf)	5.8				
	Minor Principal Stress (tsf)	6.00				
	Max. Deviator Stress (tsf)	2.80				
	Ultimate Deviator Stress (tsf)	4.07				
+	Deviator Stress at Failure (tsf)	2.81				
	Max. Pore Pressure Buildup (tsf)	4.84				
	Pore Pressure Parameter "B"	1.0				
	Pct. Axial Strain at Failure	8.0				
X						

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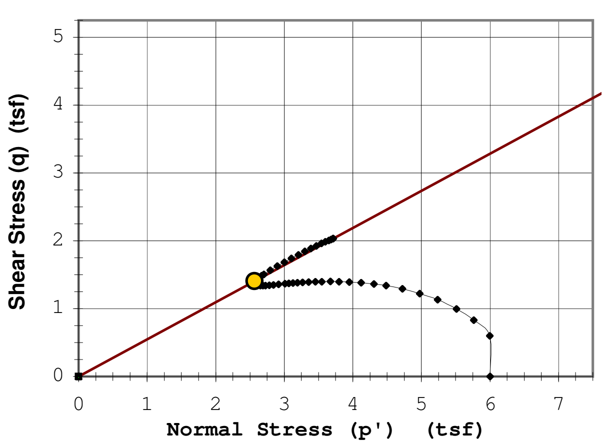
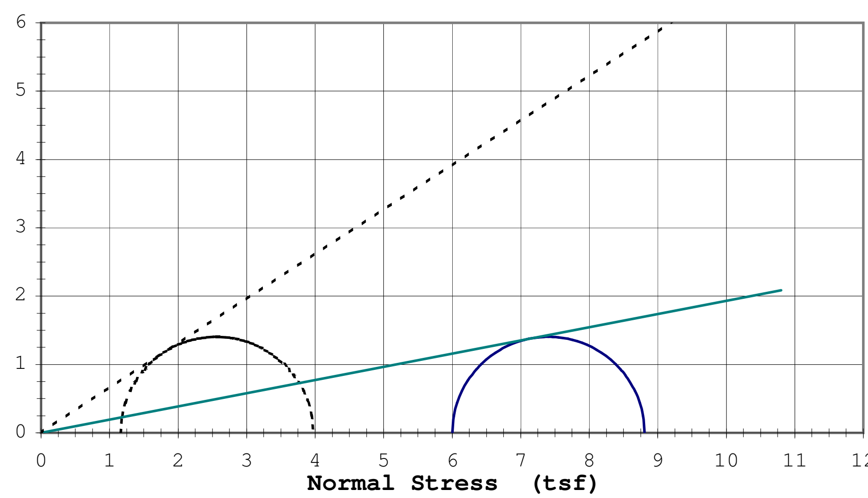
Remarks: Specimen compacted loosely at a relatively dry state; Saturated (specimens contracted upon saturation diameter and height changes during saturation estimated with a preliminary unsheared specimen, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





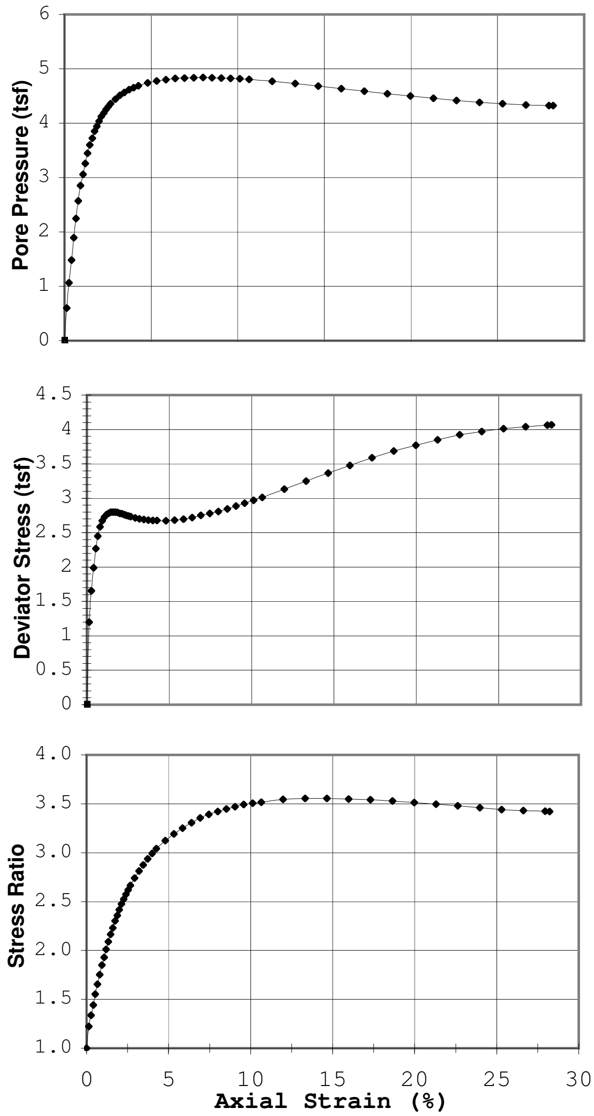
Rupture Envelope at Failure	
α = 28.7 °	a = 0.0 (tsf)

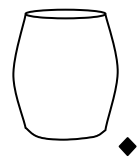
------------	Effective φ':	33.2 °	c'=	0.00 (tsf)
________	Total φ':	10.9 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/18/07**

Project: **Polymet #23/69-862-022B**
Boring #: **Composite** Sample #: **LTV Slimes** Type: **Bulk** Depth (ft):
Soil Type: **Slimes: Silt (ML)**





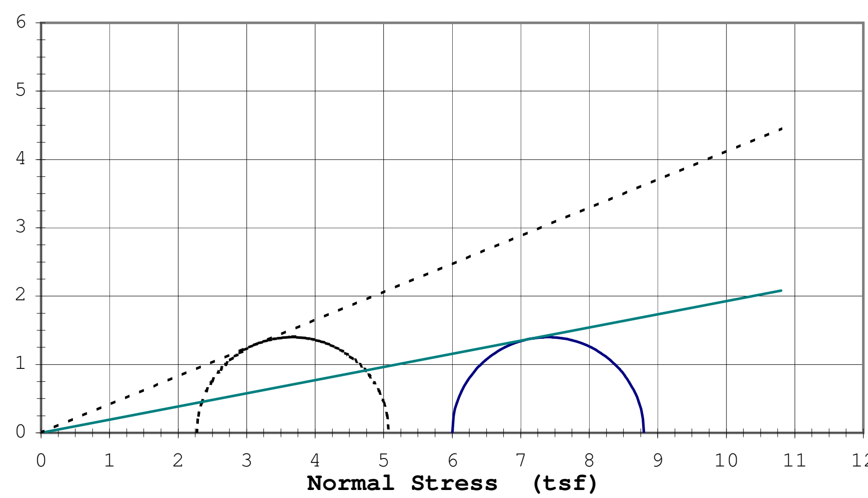
Failure Criterion:	**Max. Deviator Stress**				
Angle of internal friction, φ' =	**22.4 °**				
Apparent Cohesion, c' =	**0.00 (tsf)**				
Test Date: 10/9/07	Liquid Limit: 20.7				
Test Type: CU w/pp	Plastic Limit: 16.7				
Strain Rate (in/min): 0.004	Plasticity Index: 4.0				
Strain Rate (%/min): 0.107	Spec. Gravity : 2.99				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.86				
Height (in)	3.78				
Water Content (%)	11.0				
Dry Density (pcf)	94.5				
Void Ratio	0.98				
After Consolidation					
Diameter (in)	1.84				
Height (in)	3.76				
Water Content (%)	31.0				
Dry Density (pcf)	96.8				
Void Ratio	0.93				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	6.00				
Max. Deviator Stress (tsf)	2.80				
Ultimate Deviator Stress (tsf)	4.07				
Deviator Stress at Failure (tsf)	2.80				
Max. Pore Pressure Buildup (tsf)	4.84				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	3.7				

Symbols: ◆ A, ■ B, △ C, + D, X E

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely at a relatively dry state; Saturated (specimens contracted upon saturation diameter and height changes during saturation estimated with a preliminary unsheared specimen, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.

Rupture Envelope at Failure
α = 20.9 ° a = 0.0 (tsf)

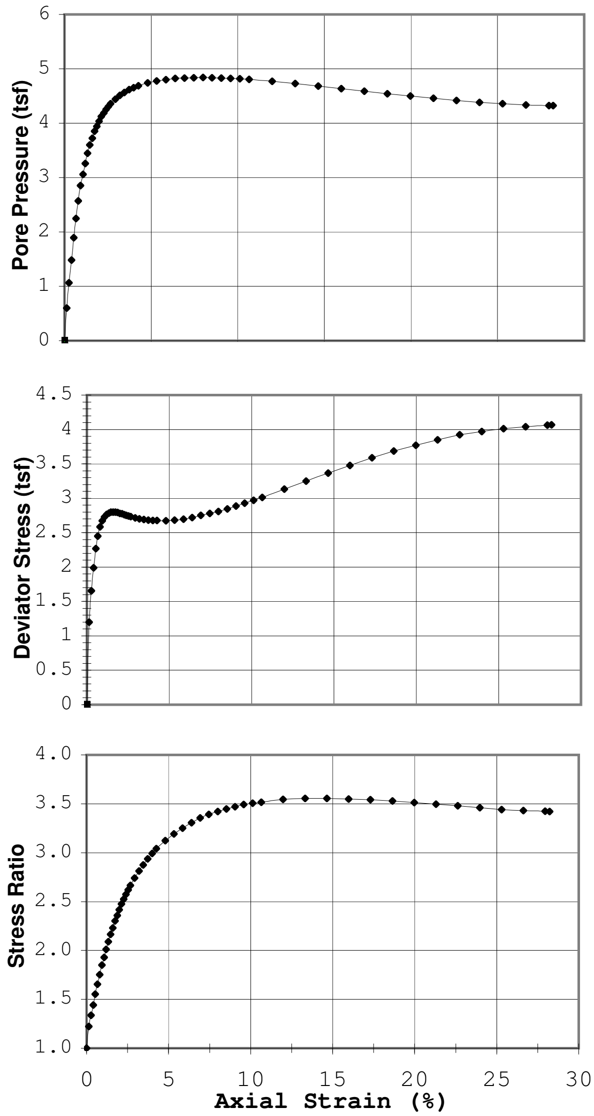


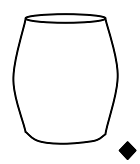
------------	Effective φ':	22.4 °	c'=	0.00 (tsf)
________	Total φ':	10.9 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/18/07**

Project: **Polymet #23/69-862-022B**
Boring #: **Composite** Sample #: **LTV Slimes** Type: **Bulk** Depth (ft):
Soil Type: **Slimes: Silt (ML)**





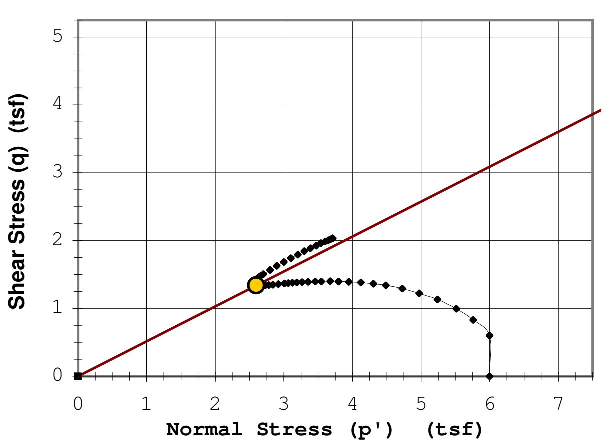
Failure Criterion:	**Given Strain of: 5%**
Angle of internal friction, ϕ' =	**31.0 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

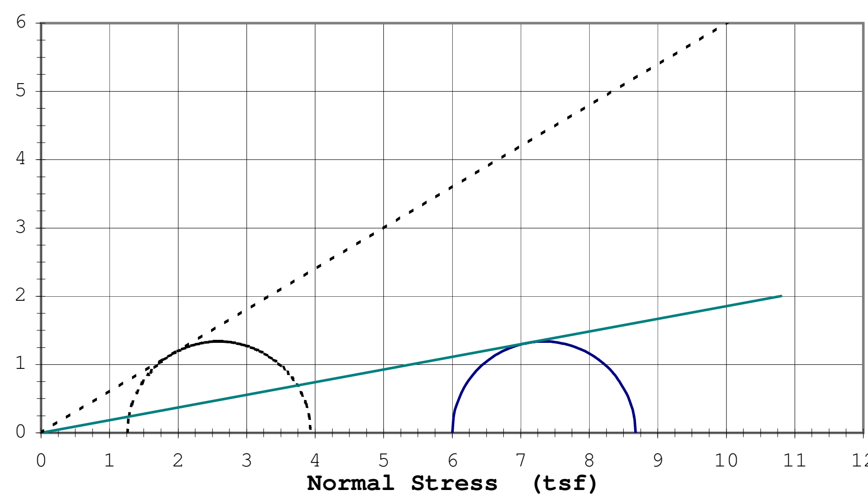
Test Date:	10/9/07	Liquid Limit:	20.7
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.0
Strain Rate (%/min):	0.107	Spec. Gravity :	2.99

Before Consolidation	A	B	C	D	E
Diameter (in)	1.86				
Height (in)	3.78				
Water Content (%)	11.0				
Dry Density (pcf)	94.5				
Void Ratio	0.98				
After Consolidation					
Diameter (in)	1.84				
Height (in)	3.76				
Water Content (%)	31.0				
Dry Density (pcf)	96.8				
Void Ratio	0.93				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	6.00				
Max. Deviator Stress (tsf)	2.80				
Ultimate Deviator Stress (tsf)	4.07				
Deviator Stress at Failure (tsf)	2.67				
Max. Pore Pressure Buildup (tsf)	4.84				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	5.0				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely at a relatively dry state; Saturated (specimens contracted upon saturation diameter and height changes during saturation estimated with a preliminary unsheared specimen, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure
α = 27.2 ° a = 0.0 (tsf)

------------	Effective ϕ':	31.0 °	c'=	0.00 (tsf)
________	Total ϕ':	10.5 °	c=	0.00 (tsf)

Bulk Composite LTV Slimes Job: 6250

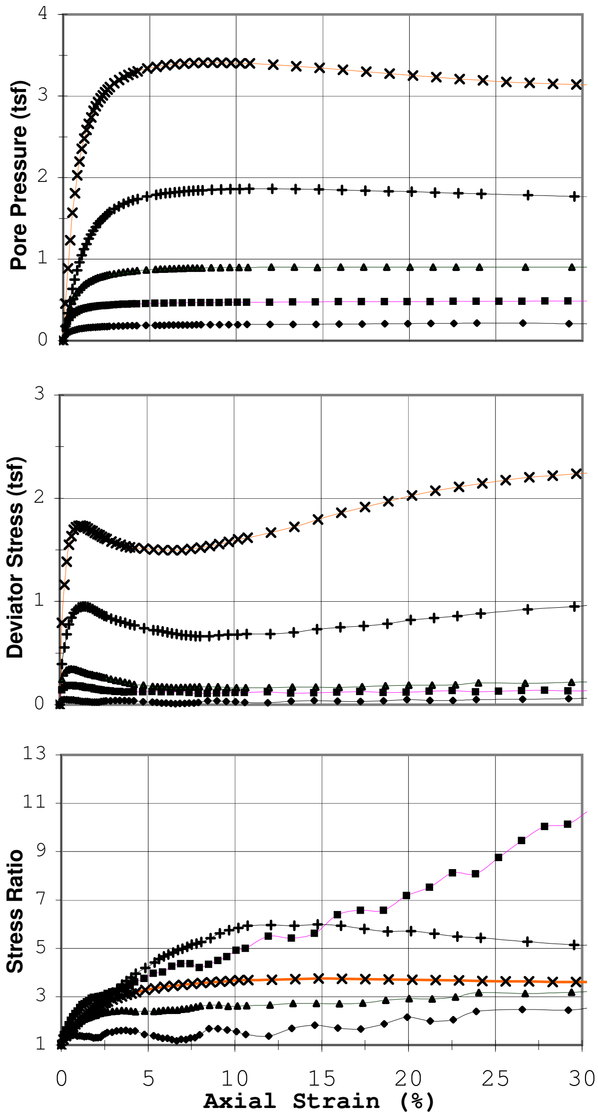
6 tsf

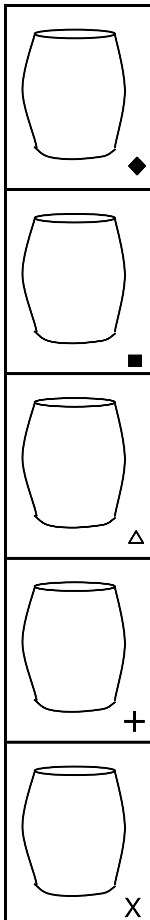
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00												
0.13	1.20	0.60												
0.27	1.66	1.07												
0.40	1.99	1.48												
0.53	2.27	1.90												
0.67	2.45	2.25												
0.80	2.59	2.57												
0.93	2.68	2.85												
1.07	2.73	3.06												
1.20	2.77	3.26												
1.33	2.79	3.45												
1.47	2.80	3.60												
1.60	2.80	3.73												
1.73	2.80	3.85												
1.86	2.79	3.94												
2.00	2.78	4.04												
2.13	2.77	4.12												
2.26	2.76	4.19												
2.40	2.75	4.25												
2.53	2.74	4.31												
2.66	2.73	4.36												
2.93	2.72	4.44												
3.20	2.70	4.51												
3.46	2.69	4.56												
3.73	2.68	4.61												
4.00	2.68	4.65												
4.26	2.68	4.69												
4.79	2.67	4.74												
5.33	2.68	4.78												
5.86	2.70	4.80												
6.39	2.72	4.82												
6.92	2.75	4.83												
7.46	2.78	4.84												
7.99	2.81	4.84												
8.52	2.85	4.84												
9.05	2.89	4.83												
9.59	2.93	4.82												
10.12	2.97	4.81												
10.65	3.01	4.80												
11.98	3.13	4.77												
13.32	3.25	4.73												
14.65	3.37	4.68												
15.98	3.48	4.64												
17.31	3.59	4.59												
18.64	3.68	4.54												
19.97	3.77	4.50												
21.30	3.85	4.46												
22.64	3.92	4.42												
23.97	3.97	4.38												
25.30	4.01	4.36												
26.63	4.04	4.34												
27.96	4.06	4.32												
28.22	4.07	4.32												

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/2/07**

Project: **Polymet #23/69-862-022B**
Boring #: **Composite** Sample #: **LTV Slimes** Type: **Bulk** Depth (ft):
Soil Type: **Slimes: Silt (ML)**



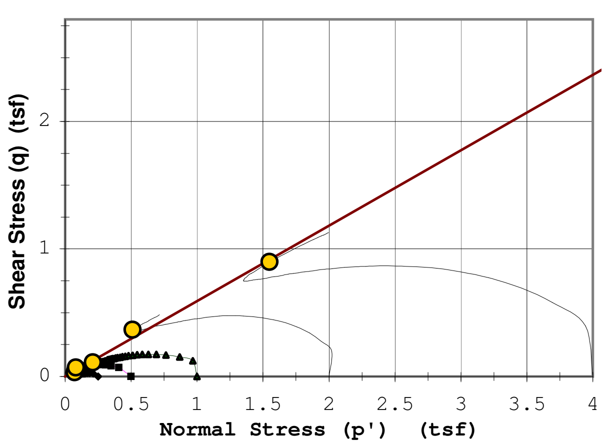


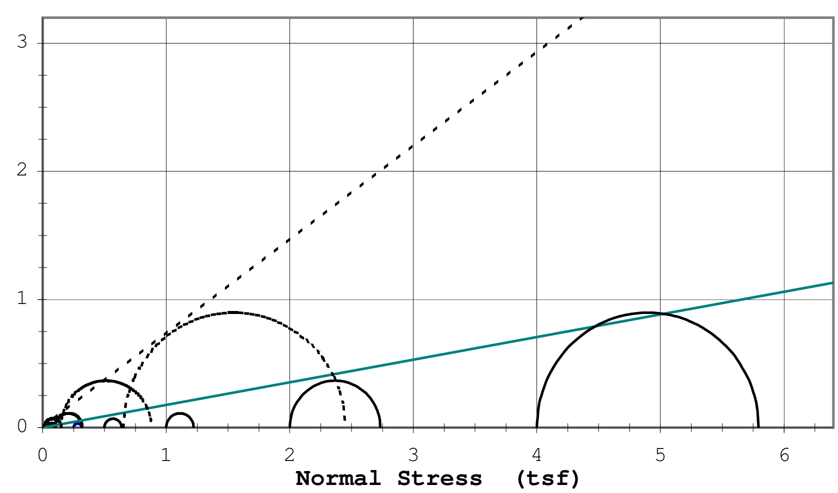
Failure Criterion:	**Max. Stress Ratio**					
Angle of internal friction, ϕ' =	**36.2 °**					
Apparent Cohesion, c' =	**0.00 (tsf)**					
Test Date: 9/21/07	Liquid Limit: 20.7					
Test Type: CU w/pp	Plastic Limit: 16.7					
Strain Rate (in/min): 0.004	Plasticity Index: 4.0					
Strain Rate (%/min): 0.106	Spec. Gravity : 2.99					

Before Consolidation	A	B	C	D	E
Diameter (in)	1.86	1.86	1.86	1.86	1.86
Height (in)	3.78	3.78	3.78	3.78	3.78
Water Content (%)	11.9	11.8	11.3	12.0	11.3
Dry Density (pcf)	93.1	95.7	94.0	91.7	94.8
Void Ratio	1.01	0.95	0.99	1.04	0.97
After Consolidation					
Diameter (in)	1.84	1.82	1.82	1.82	1.79
Height (in)	3.77	3.77	3.74	3.72	3.71
Water Content (%)	32.0	29.0	29.9	31.2	27.0
Dry Density (pcf)	95.4	100.0	98.5	96.6	103.3
Void Ratio	0.96	0.87	0.90	0.93	0.81
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.25	0.50	1.00	2.00	4.00
Max. Deviator Stress (tsf)	0.05	0.18	0.35	0.95	1.73
Ultimate Deviator Stress (tsf)	0.06	0.14	0.22	0.97	2.26
Deviator Stress at Failure (tsf)	0.06	0.14	0.22	0.73	1.79
Max. Pore Pressure Buildup (tsf)	0.21	0.49	0.90	1.86	3.41
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	30.9	31.2	30.9	14.8	14.8

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely at a relatively dry state; Saturated (specimens contracted upon saturation diameter and height changes during saturation estimated with a preliminary unsheared specimen, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





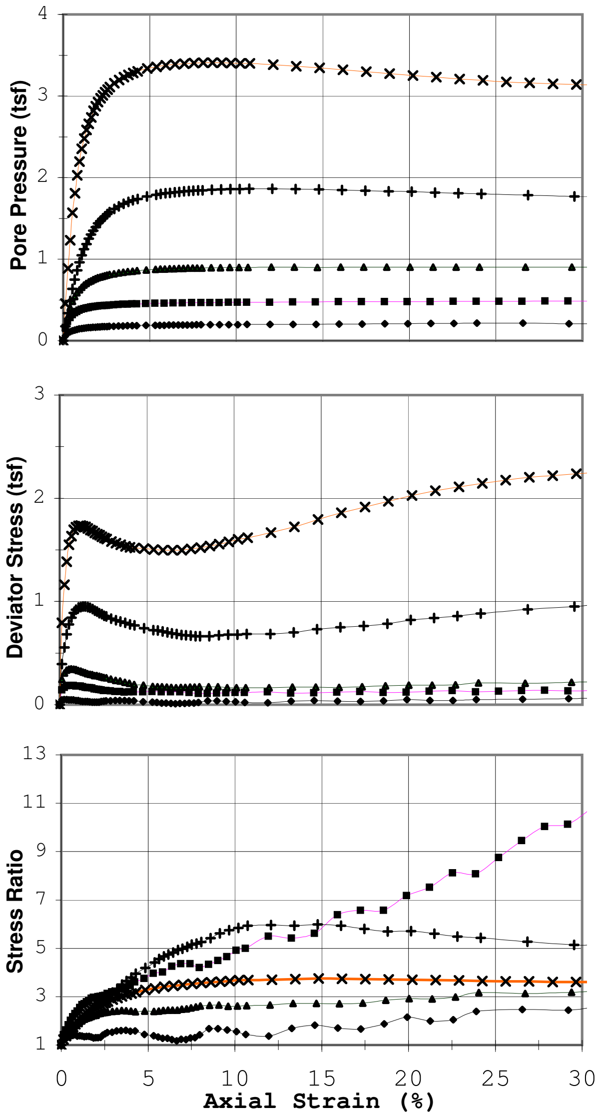
Rupture Envelope at Failure
α = 30.6 ° a = 0.0 (tsf)

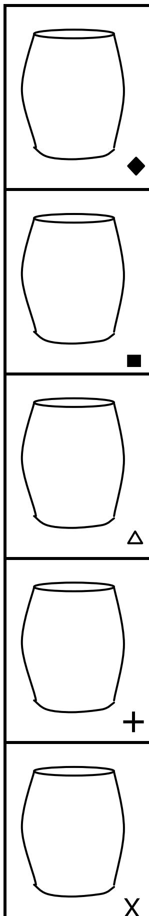
------------	Effective ϕ':	36.2 °	c'=	0.00 (tsf)
________	Total ϕ':	10.0 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/2/07**

Project: **Polymet #23/69-862-022B**
Boring #: **Composite** Sample #: **LTV Slimes** Type: **Bulk** Depth (ft):
Soil Type: **Slimes: Silt (ML)**





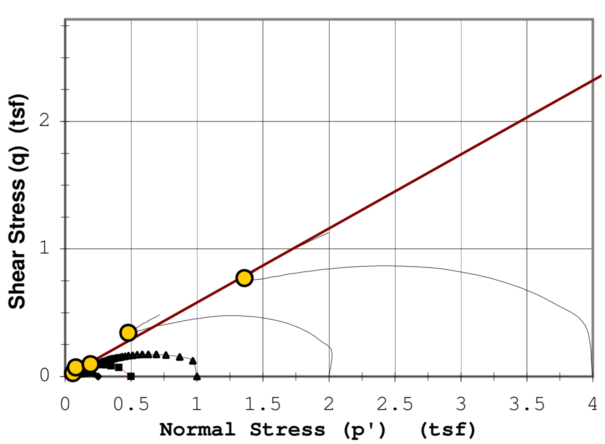
Failure Criterion:	**Max. Pore Pressure**
Angle of internal friction, φ' =	**35.5 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

Test Date:	9/21/07	Liquid Limit:	20.7
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.0
Strain Rate (%/min):	0.106	Spec. Gravity :	2.99

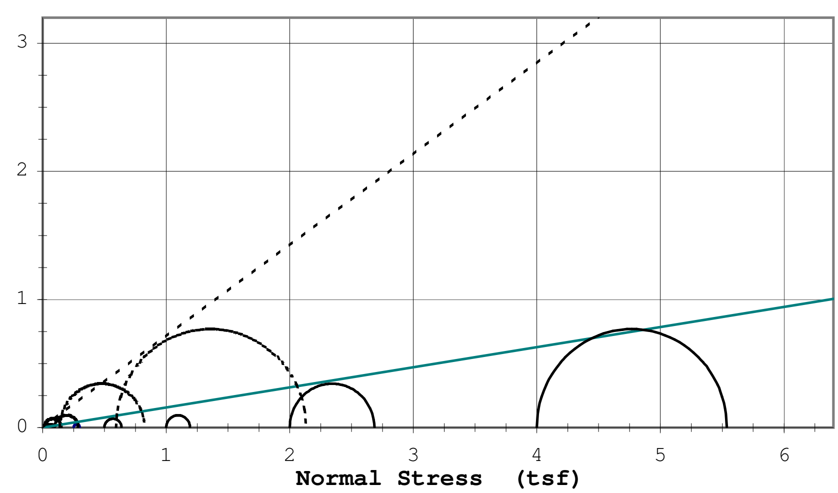
Before Consolidation	A	B	C	D	E
Diameter (in)	1.86	1.86	1.86	1.86	1.86
Height (in)	3.78	3.78	3.78	3.78	3.78
Water Content (%)	11.9	11.8	11.3	12.0	11.3
Dry Density (pcf)	93.1	95.7	94.0	91.7	94.8
Void Ratio	1.01	0.95	0.99	1.04	0.97
After Consolidation					
Diameter (in)	1.84	1.82	1.82	1.82	1.79
Height (in)	3.77	3.77	3.74	3.72	3.71
Water Content (%)	32.0	29.0	29.9	31.2	27.0
Dry Density (pcf)	95.4	100.0	98.5	96.6	103.3
Void Ratio	0.96	0.87	0.90	0.93	0.81
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.25	0.50	1.00	2.00	4.00
Max. Deviator Stress (tsf)	0.05	0.18	0.35	0.95	1.73
Ultimate Deviator Stress (tsf)	0.06	0.14	0.22	0.97	2.26
Deviator Stress at Failure (tsf)	0.05	0.14	0.19	0.68	1.54
Max. Pore Pressure Buildup (tsf)	0.21	0.49	0.90	1.86	3.41
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	23.9	31.2	22.7	12.1	8.6

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely at a relatively dry state; Saturated (specimens contracted upon saturation diameter and height changes during saturation estimated with a preliminary unsheared specimen, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



Rupture Envelope at Failure
α = 30.1 ° a = 0.0 (tsf)

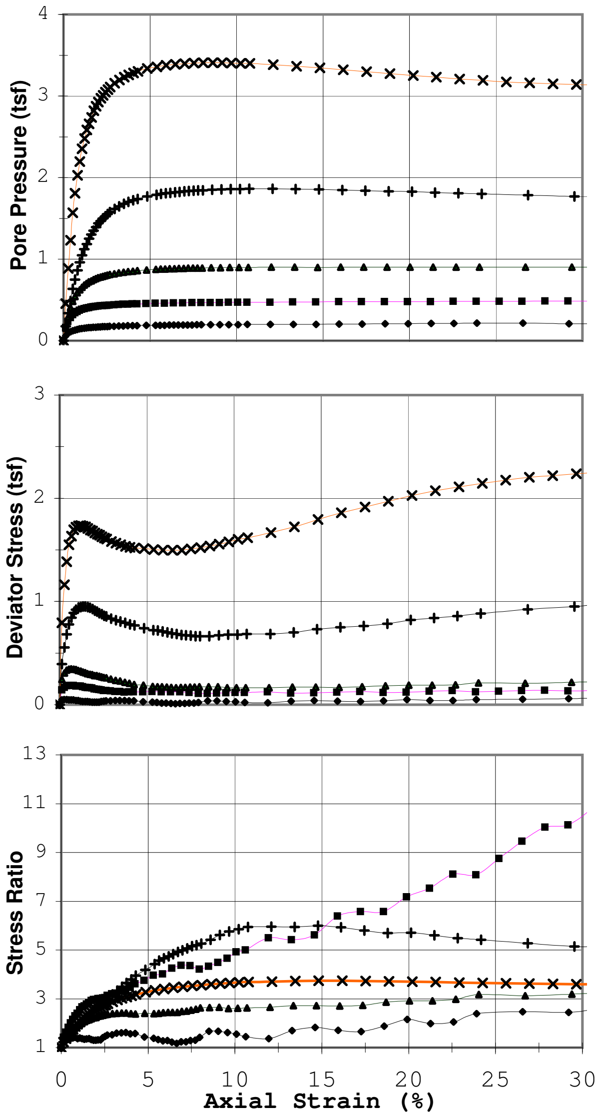


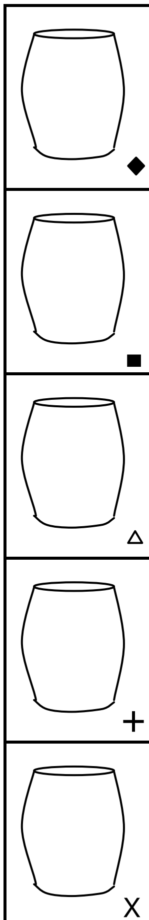
------------	Effective φ':	35.5 °	c'=	0.00 (tsf)
________	Total φ':	8.9 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/2/07**

Project: **Polymet #23/69-862-022B**
Boring #: **Composite** Sample #: **Slimes** Type: **Bulk** Depth (ft):
Soil Type: **LTV Slimes: Silt (ML)**





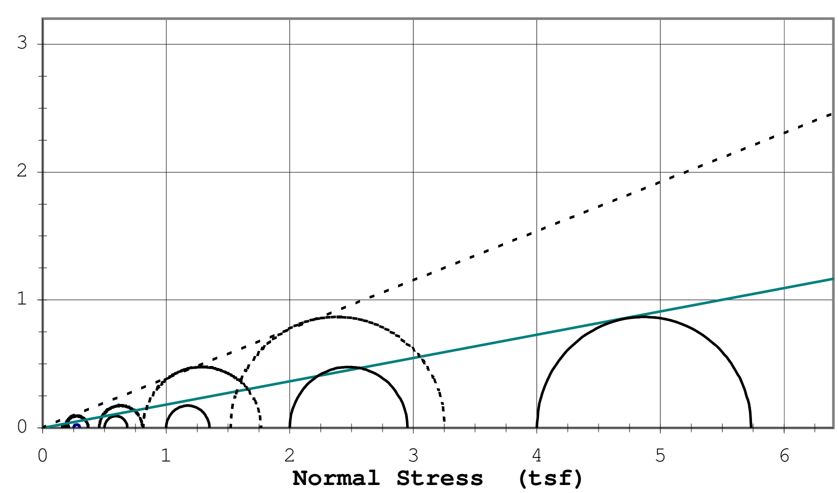
Failure Criterion:	**Max. Deviator Stress**
Angle of internal friction, ϕ' =	**21.0 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

Test Date:	9/21/07	Liquid Limit:	20.7
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.0
Strain Rate (%/min):	0.106	Spec. Gravity :	2.99

Before Consolidation	A	B	C	D	E
Diameter (in)	1.86	1.86	1.86	1.86	1.86
Height (in)	3.78	3.78	3.78	3.78	3.78
Water Content (%)	11.9	11.8	11.3	12.0	11.3
Dry Density (pcf)	93.1	95.7	94.0	91.7	94.8
Void Ratio	1.01	0.95	0.99	1.04	0.97
After Consolidation					
Diameter (in)	1.84	1.82	1.82	1.82	1.79
Height (in)	3.77	3.77	3.74	3.72	3.71
Water Content (%)	32.0	29.0	29.9	31.2	27.0
Dry Density (pcf)	95.4	100.0	98.5	96.6	103.3
Void Ratio	0.96	0.87	0.90	0.93	0.81
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.25	0.50	1.00	2.00	4.00
Max. Deviator Stress (tsf)	0.05	0.18	0.35	0.95	1.73
Ultimate Deviator Stress (tsf)	0.06	0.14	0.22	0.97	2.26
Deviator Stress at Failure (tsf)	0.05	0.18	0.35	0.95	1.73
Max. Pore Pressure Buildup (tsf)	0.21	0.49	0.90	1.86	3.41
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	0.3	0.5	0.7	1.3	1.2

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely at a relatively dry state; Saturated (specimens contracted upon saturation diameter and height changes during saturation estimated with a preliminary unsheared specimen, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



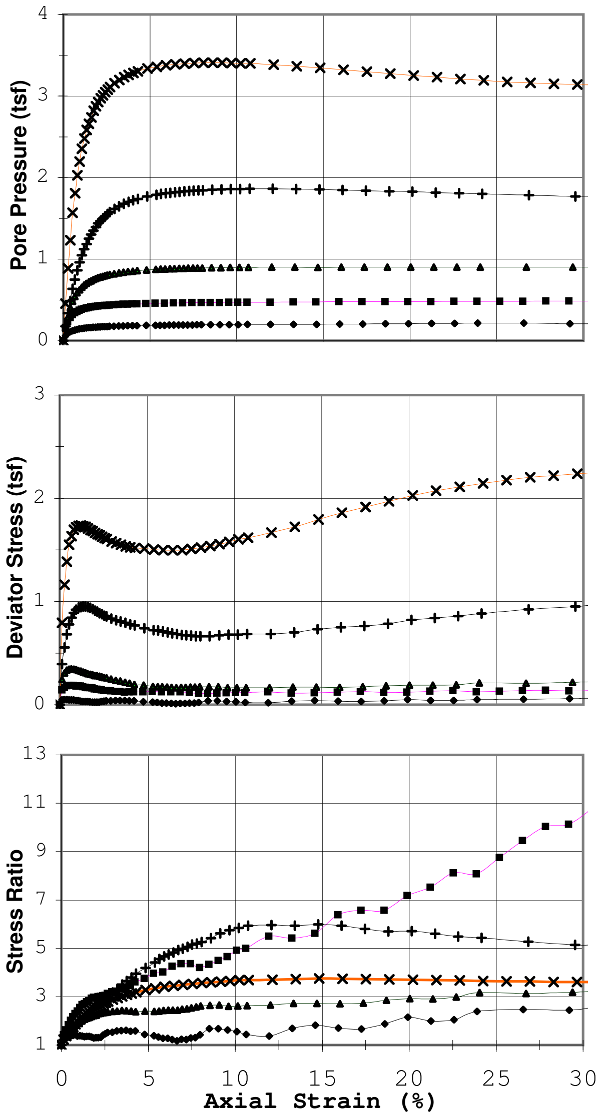
Rupture Envelope at Failure	
α = 19.7 °	a = 0.0 (tsf)

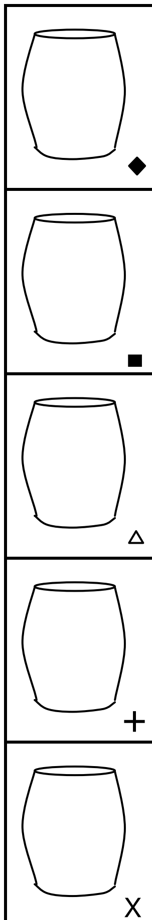
------------ Effective ϕ':	21.0 °	c'= 0.00 (tsf)
______ Total ϕ':	10.3 °	c= 0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/2/07**

Project: **Polymet #23/69-862-022B**
Boring #: **Composite** Sample #: **LTV Slimes** Type: **Bulk** Depth (ft):
Soil Type: **Slimes: Silt (ML)**





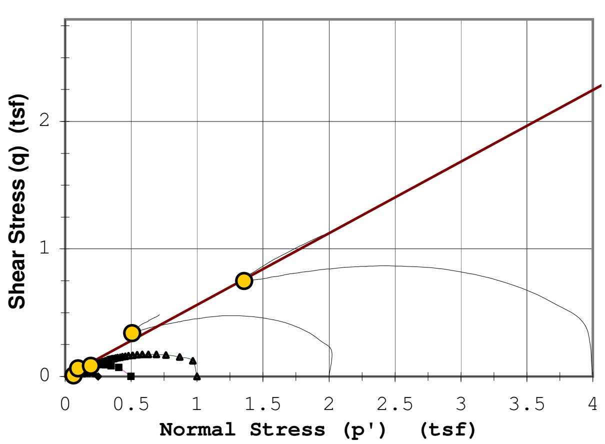
Failure Criterion:	**Given Strain of: 7%**
Angle of internal friction, ϕ' =	**34.2 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

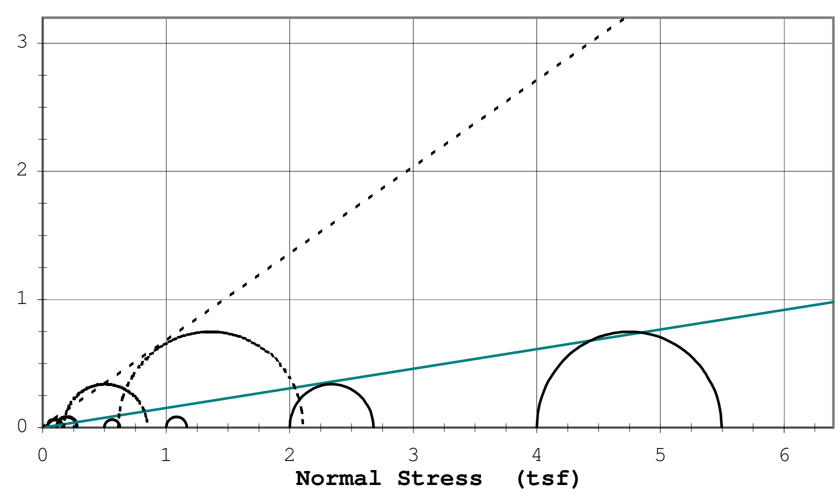
Test Date:	9/21/07	Liquid Limit:	20.7
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.0
Strain Rate (%/min):	0.106	Spec. Gravity :	2.99

Before Consolidation	A	B	C	D	E
Diameter (in)	1.86	1.86	1.86	1.86	1.86
Height (in)	3.78	3.78	3.78	3.78	3.78
Water Content (%)	11.9	11.8	11.3	12.0	11.3
Dry Density (pcf)	93.1	95.7	94.0	91.7	94.8
Void Ratio	1.01	0.95	0.99	1.04	0.97
After Consolidation					
Diameter (in)	1.84	1.82	1.82	1.82	1.79
Height (in)	3.77	3.77	3.74	3.72	3.71
Water Content (%)	32.0	29.0	29.9	31.2	27.0
Dry Density (pcf)	95.4	100.0	98.5	96.6	103.3
Void Ratio	0.96	0.87	0.90	0.93	0.81
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.25	0.50	1.00	2.00	4.00
Max. Deviator Stress (tsf)	0.05	0.18	0.35	0.95	1.73
Ultimate Deviator Stress (tsf)	0.06	0.14	0.22	0.97	2.26
Deviator Stress at Failure (tsf)	0.01	0.12	0.17	0.68	1.50
Max. Pore Pressure Buildup (tsf)	0.21	0.49	0.90	1.86	3.41
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	7.0	7.0	7.0	7.0	7.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely at a relatively dry state; Saturated (specimens contracted upon saturation diameter and height changes during saturation estimated with a preliminary unsheared specimen, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





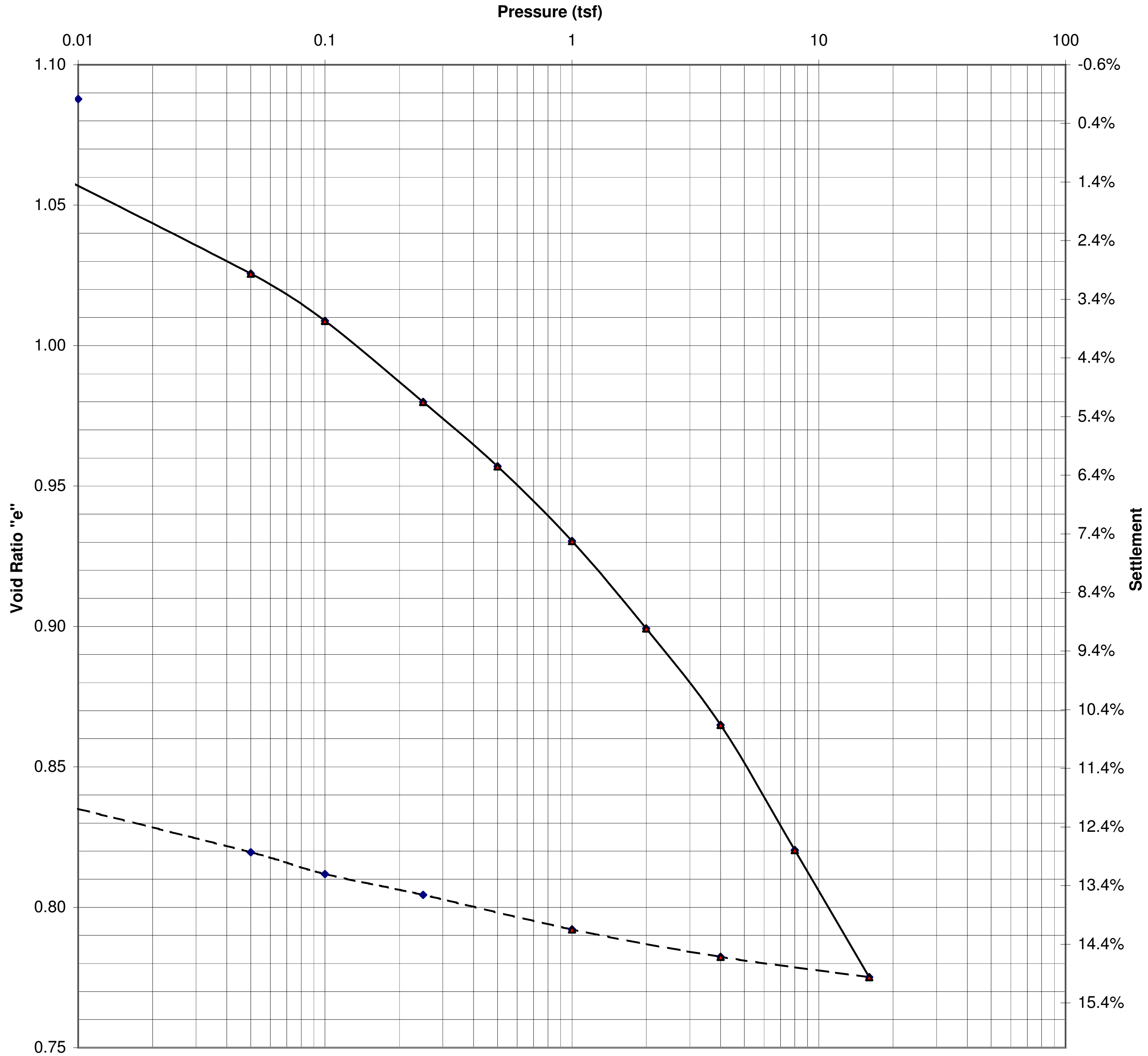
Rupture Envelope at Failure	
α = 29.3 °	a = 0.0 (tsf)

------------	Effective ϕ': 34.2 °	c'=	0.00 (tsf)
______	Total ϕ': 8.7 °	c=	0.00 (tsf)

Bulk Composite LTV Slimes Job: 6250

.25 tsf Sample 1			.5 tsf Sample 2			1 tsf Sample 3			2 tsf Sample 4			4 tsf Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.13	0.05	0.06	0.13	0.14	0.16	0.13	0.24	0.15	0.13	0.39	0.18	0.14	0.79	0.45
0.27	0.05	0.09	0.27	0.17	0.23	0.27	0.31	0.29	0.27	0.55	0.34	0.27	1.16	0.89
0.40	0.05	0.11	0.40	0.18	0.28	0.40	0.33	0.40	0.40	0.68	0.49	0.41	1.38	1.23
0.53	0.05	0.12	0.53	0.18	0.32	0.53	0.35	0.48	0.54	0.78	0.63	0.54	1.55	1.57
0.66	0.05	0.13	0.66	0.18	0.34	0.67	0.35	0.54	0.67	0.84	0.75	0.67	1.63	1.81
0.80	0.05	0.14	0.80	0.18	0.36	0.80	0.34	0.59	0.81	0.89	0.86	0.81	1.70	2.03
0.93	0.04	0.14	0.93	0.18	0.37	0.94	0.34	0.62	0.94	0.92	0.96	0.94	1.72	2.20
1.06	0.04	0.15	1.06	0.18	0.38	1.07	0.33	0.65	1.07	0.94	1.05	1.08	1.73	2.35
1.20	0.04	0.15	1.19	0.18	0.39	1.20	0.33	0.68	1.21	0.95	1.12	1.21	1.73	2.48
1.33	0.03	0.16	1.33	0.17	0.40	1.34	0.32	0.70	1.34	0.95	1.19	1.35	1.73	2.58
1.46	0.03	0.16	1.46	0.17	0.41	1.47	0.31	0.72	1.48	0.95	1.25	1.48	1.72	2.66
1.59	0.03	0.16	1.59	0.16	0.41	1.60	0.30	0.73	1.61	0.95	1.30	1.62	1.71	2.74
1.73	0.03	0.16	1.72	0.16	0.41	1.74	0.29	0.75	1.75	0.94	1.35	1.75	1.69	2.82
1.86	0.02	0.17	1.86	0.16	0.42	1.87	0.29	0.76	1.88	0.93	1.39	1.89	1.68	2.87
1.99	0.02	0.17	1.99	0.15	0.42	2.00	0.28	0.77	2.01	0.91	1.44	2.02	1.66	2.93
2.12	0.02	0.17	2.12	0.15	0.43	2.14	0.28	0.78	2.15	0.90	1.47	2.16	1.65	2.97
2.26	0.02	0.17	2.25	0.15	0.43	2.27	0.28	0.79	2.28	0.89	1.50	2.29	1.64	3.01
2.39	0.03	0.17	2.39	0.14	0.43	2.40	0.27	0.80	2.42	0.88	1.53	2.43	1.63	3.05
2.52	0.04	0.17	2.52	0.14	0.43	2.54	0.26	0.80	2.55	0.86	1.55	2.56	1.61	3.08
2.66	0.04	0.17	2.65	0.14	0.44	2.67	0.26	0.81	2.69	0.85	1.58	2.70	1.60	3.11
2.92	0.04	0.18	2.92	0.13	0.44	2.94	0.25	0.82	2.95	0.83	1.62	2.96	1.58	3.16
3.19	0.04	0.18	3.18	0.13	0.44	3.21	0.24	0.83	3.22	0.82	1.65	3.23	1.57	3.20
3.45	0.04	0.18	3.45	0.13	0.45	3.47	0.23	0.84	3.49	0.80	1.68	3.50	1.55	3.23
3.72	0.04	0.18	3.71	0.12	0.45	3.74	0.22	0.85	3.76	0.79	1.70	3.77	1.54	3.26
3.98	0.04	0.18	3.98	0.12	0.45	4.01	0.21	0.85	4.03	0.78	1.72	4.04	1.52	3.28
4.25	0.04	0.18	4.24	0.12	0.45	4.27	0.20	0.86	4.30	0.77	1.74	4.31	1.52	3.30
4.78	0.03	0.19	4.77	0.12	0.46	4.81	0.19	0.87	4.84	0.74	1.77	4.85	1.51	3.34
5.31	0.02	0.19	5.30	0.13	0.46	5.34	0.18	0.87	5.37	0.72	1.79	5.39	1.50	3.36
5.58	0.02	0.19	5.83	0.12	0.46	5.61	0.17	0.88	5.64	0.72	1.80	5.93	1.50	3.38
5.85	0.02	0.19	6.36	0.13	0.46	5.88	0.17	0.88	5.91	0.71	1.81	6.47	1.50	3.39
6.11	0.02	0.19	6.89	0.12	0.46	6.14	0.17	0.88	6.18	0.70	1.81	7.01	1.50	3.40
6.38	0.01	0.19	7.42	0.12	0.47	6.41	0.17	0.88	6.44	0.69	1.82	7.55	1.51	3.40
6.64	0.01	0.19	7.96	0.11	0.47	6.68	0.16	0.89	6.71	0.69	1.83	8.09	1.52	3.41
6.91	0.01	0.19	8.49	0.11	0.47	6.95	0.17	0.89	6.98	0.68	1.83	8.62	1.54	3.41
7.17	0.01	0.19	9.02	0.11	0.47	7.21	0.17	0.89	7.25	0.67	1.83	9.16	1.56	3.41
7.44	0.02	0.19	9.55	0.11	0.47	7.48	0.17	0.89	7.52	0.67	1.84	9.70	1.58	3.40
7.70	0.02	0.19	10.08	0.12	0.47	7.75	0.17	0.89	7.79	0.66	1.84	10.24	1.60	3.40
7.97	0.02	0.19	10.61	0.12	0.47	8.01	0.17	0.89	8.06	0.66	1.84	10.78	1.62	3.40
8.50	0.04	0.20	11.93	0.12	0.47	8.55	0.17	0.89	8.59	0.66	1.85	12.13	1.67	3.38
9.03	0.04	0.20	13.26	0.11	0.47	9.08	0.17	0.90	9.13	0.67	1.85	13.48	1.72	3.37
9.56	0.03	0.20	14.58	0.11	0.48	9.62	0.17	0.90	9.67	0.68	1.86	14.82	1.79	3.35
10.10	0.03	0.20	15.91	0.12	0.48	10.15	0.16	0.90	10.21	0.68	1.86	16.17	1.86	3.32
10.63	0.02	0.20	17.23	0.13	0.48	10.69	0.16	0.90	10.74	0.69	1.86	17.52	1.91	3.30
11.95	0.02	0.20	18.56	0.12	0.48	12.02	0.16	0.90	12.09	0.68	1.86	18.87	1.97	3.27
13.28	0.03	0.20	19.89	0.12	0.48	13.36	0.17	0.90	13.43	0.70	1.86	20.21	2.03	3.25
14.61	0.04	0.20	21.21	0.13	0.48	14.69	0.17	0.90	14.77	0.73	1.85	21.56	2.07	3.23
15.94	0.03	0.20	22.54	0.14	0.48	16.03	0.17	0.90	16.11	0.75	1.85	22.91	2.11	3.21
17.26	0.03	0.20	23.86	0.12	0.48	17.36	0.17	0.90	17.46	0.76	1.84	24.26	2.15	3.19
18.59	0.04	0.21	25.19	0.13	0.48	18.70	0.18	0.90	18.80	0.78	1.83	25.60	2.18	3.17
19.92	0.05	0.21	26.51	0.14	0.48	20.04	0.19	0.90	20.14	0.82	1.83	26.95	2.20	3.16
21.25	0.04	0.21	27.84	0.14	0.48	21.37	0.19	0.90	21.48	0.84	1.82	28.30	2.22	3.15
22.58	0.04	0.21	29.17	0.13	0.49	22.71	0.19	0.90	22.83	0.86	1.81	29.65	2.24	3.14
23.91	0.05	0.21	30.49	0.14	0.49	24.04	0.21	0.90	24.17	0.88	1.80	30.99	2.25	3.13
26.56	0.05	0.21	31.15	0.14	0.49	26.71	0.21	0.90	26.86	0.92	1.78	31.06	2.26	3.13
29.22	0.06	0.21				29.39	0.22	0.90	29.54	0.95	1.77			
30.89	0.06	0.21				30.91	0.22	0.90	30.63	0.97	1.77			

Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-022B			Date: 10/4/07
Sample #:	Boring #: 07-02	Depth ft: 59-61 (M-Bot)	Job #: 6250
Soil Type: Slimes: (Silt (ML))			
Initial W/C (%): 37.4	Dry Density (pcf): 87.6	LL: 22.0 PL: 17.2 PI: 4.8	Gs: 2.93
Organic Content (%):	Initial Height (in.): 0.785	Diameter (in.): 2.504	e_o= 1.088
Preconsolidation Pressure (Pc): 0.7 tsf	Compression Index (Cc): 0.15	Recompression Index (Cr): ≅ 0.02	
Remarks:			

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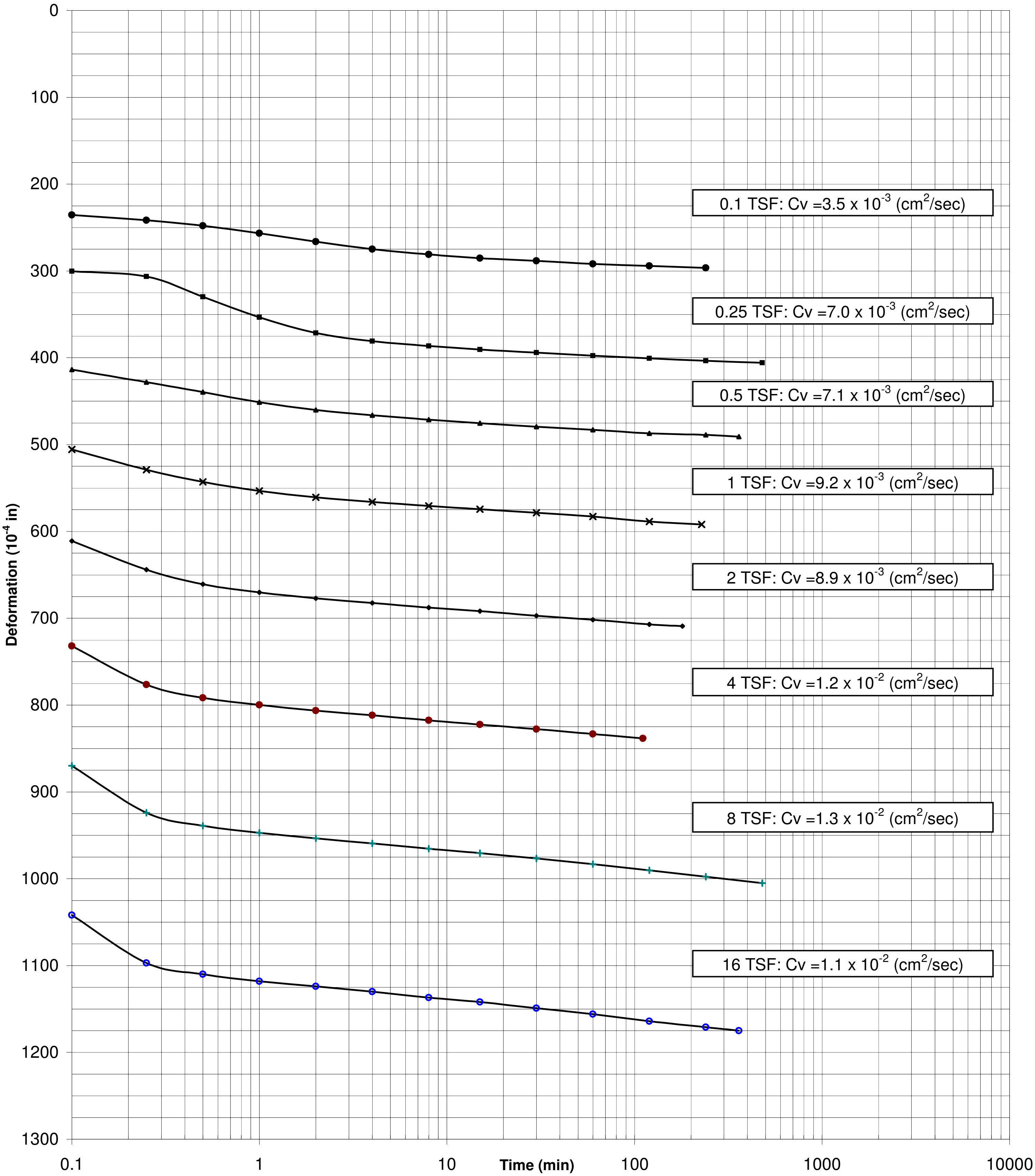
Consolidation Log of Time Curves



Project: Polymet #23/69-862-022B			Date: 10/4/07
Sample #:	Boring #: 07-02	Depth ft: 59-61 (M-Bot)	Job #: 6250

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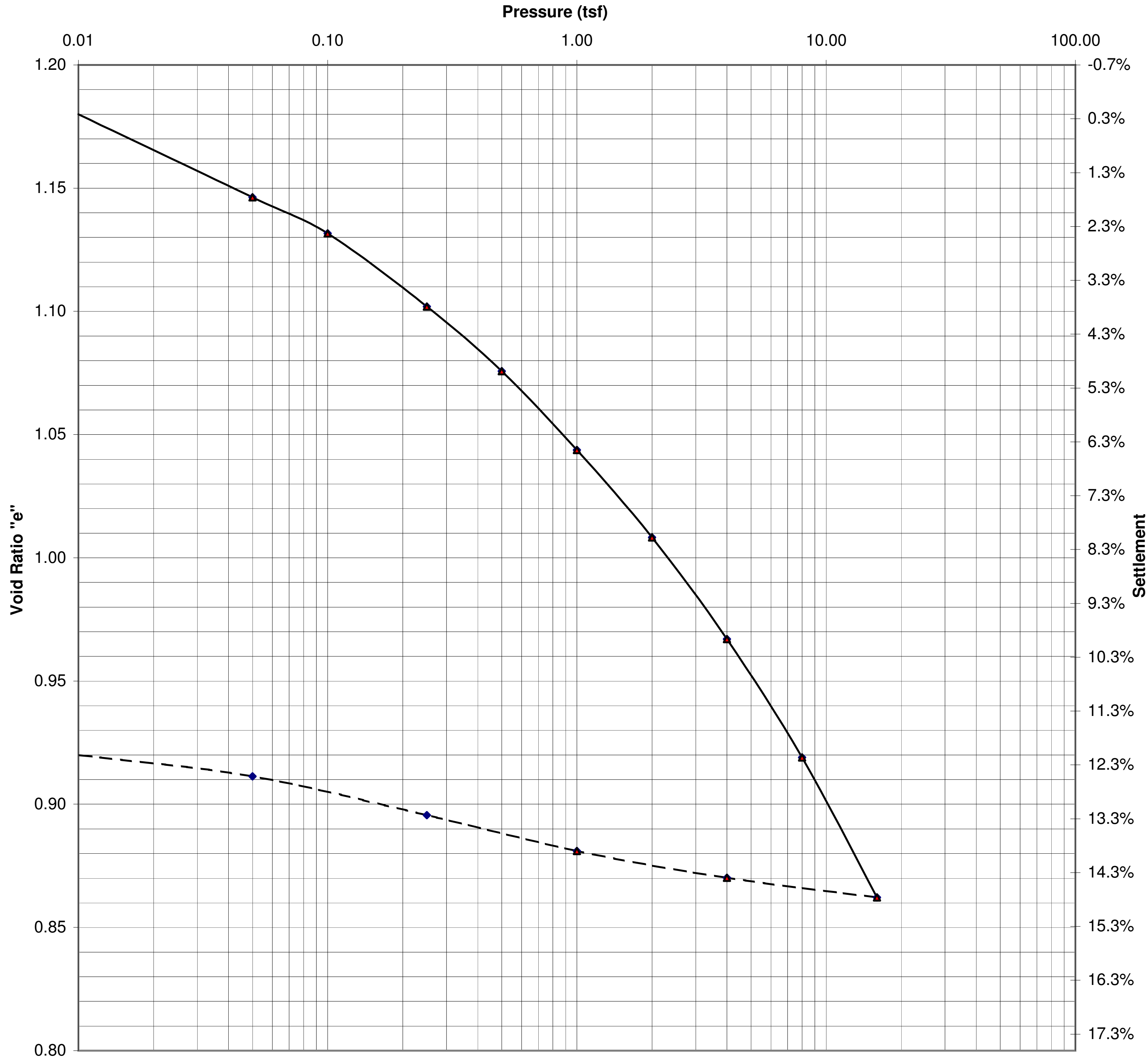
Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-022B			Date: 10/18/07
Sample #:	Boring #: 07-03	Depth ft: 30.7-32.7	Job #: 6250
Soil Type: Slimes (Silt (ML))			
Initial W/C (%): 40.9	Dry Density (pcf): 84.0	LL: 31.6 PL: 26.4 PI: 5.2	Gs: 2.94
Organic Content (%):	Initial Height (in.): 0.785	Diameter (in.): 2.504	e_o= 1.185
Preconsolidation Pressure (Pc): 0.91 tsf	Compression Index (Cc): 0.18	Recompression Index (Cr): ≅ 0.03	
Remarks:			

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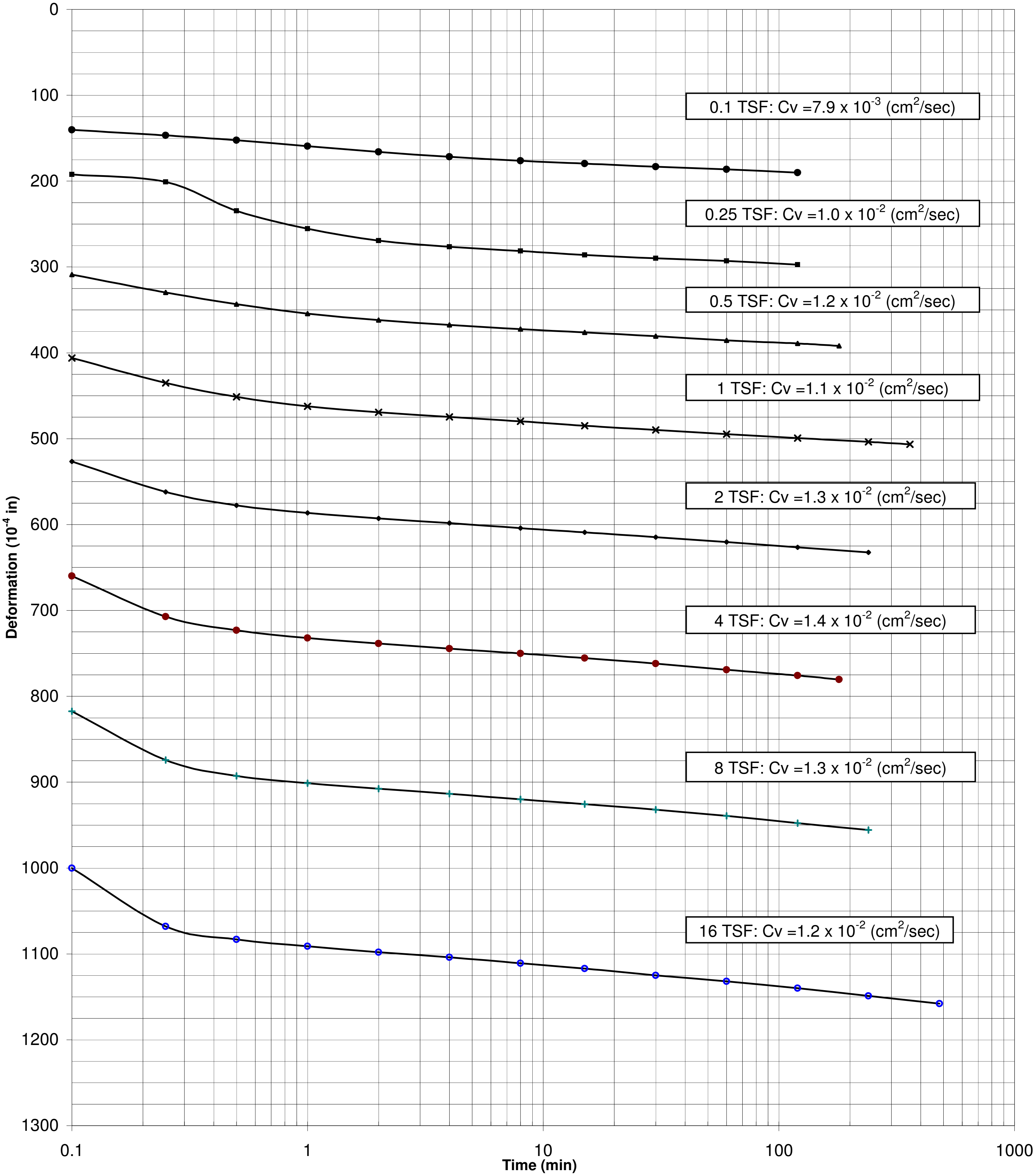
Consolidation Log of Time Curves



Project: Polymet #23/69-862-022B			Date: 10/18/07
Sample #:	Boring #: 07-03	Depth ft: 30.7-32.7	Job #: 6250

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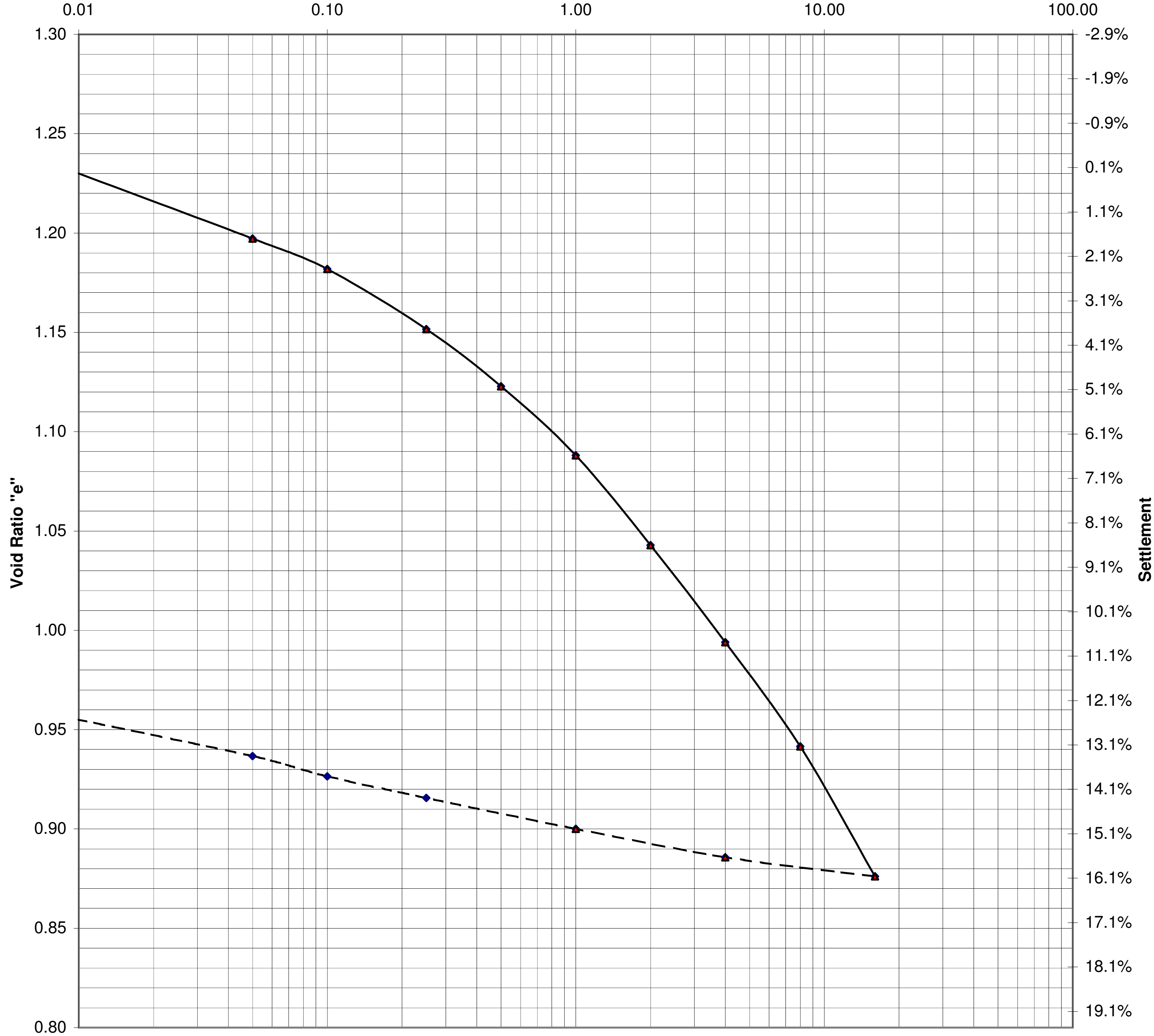
Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-022B			Date: 10/9/07
Sample #:	Boring #: 07-06	Depth ft: 27.5-29.5	Job #: 6250
Soil Type: Slimes (Silt (ML))			
Initial W/C (%): 41.1	Dry Density (pcf): 82.7	LL: 29.1 PL: 23.6 PI: 5.5	Gs: 2.96
Organic Content (%):	Initial Height (in.): 0.785	Diameter (in.): 2.504	e_o= 1.236
Preconsolidation Pressure (Pc): 0.6 tsf	Compression Index (Cc): 0.17	Recompression Index (Cr): ≅ 0.02	
Remarks:			

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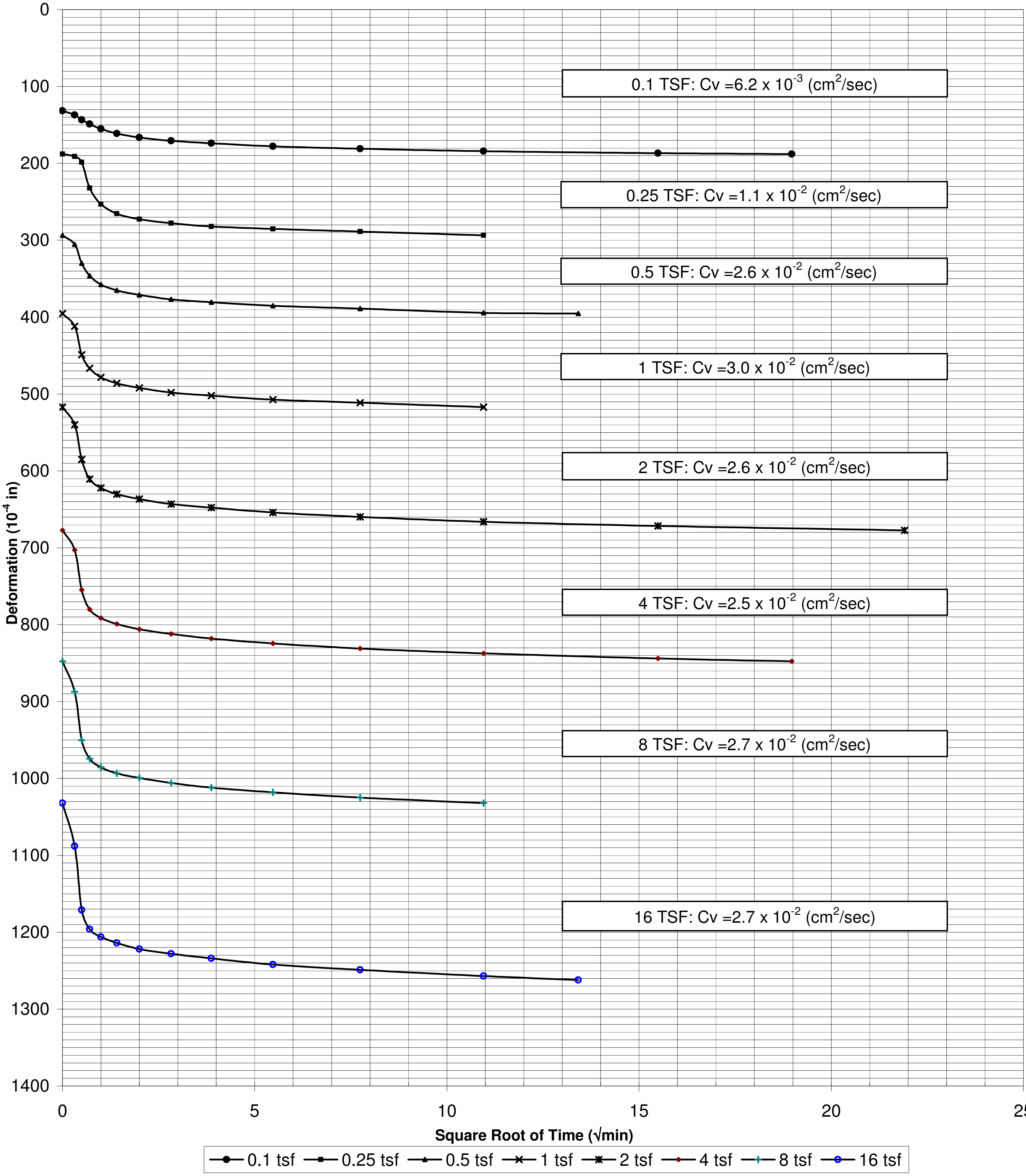
Square Root of Time Curves



Project: Polymet #23/69-862-022B			Date: 10/9/07
Sample #:	Boring #: 07-06	Depth ft: 27.5-29.5	Job #: 6250

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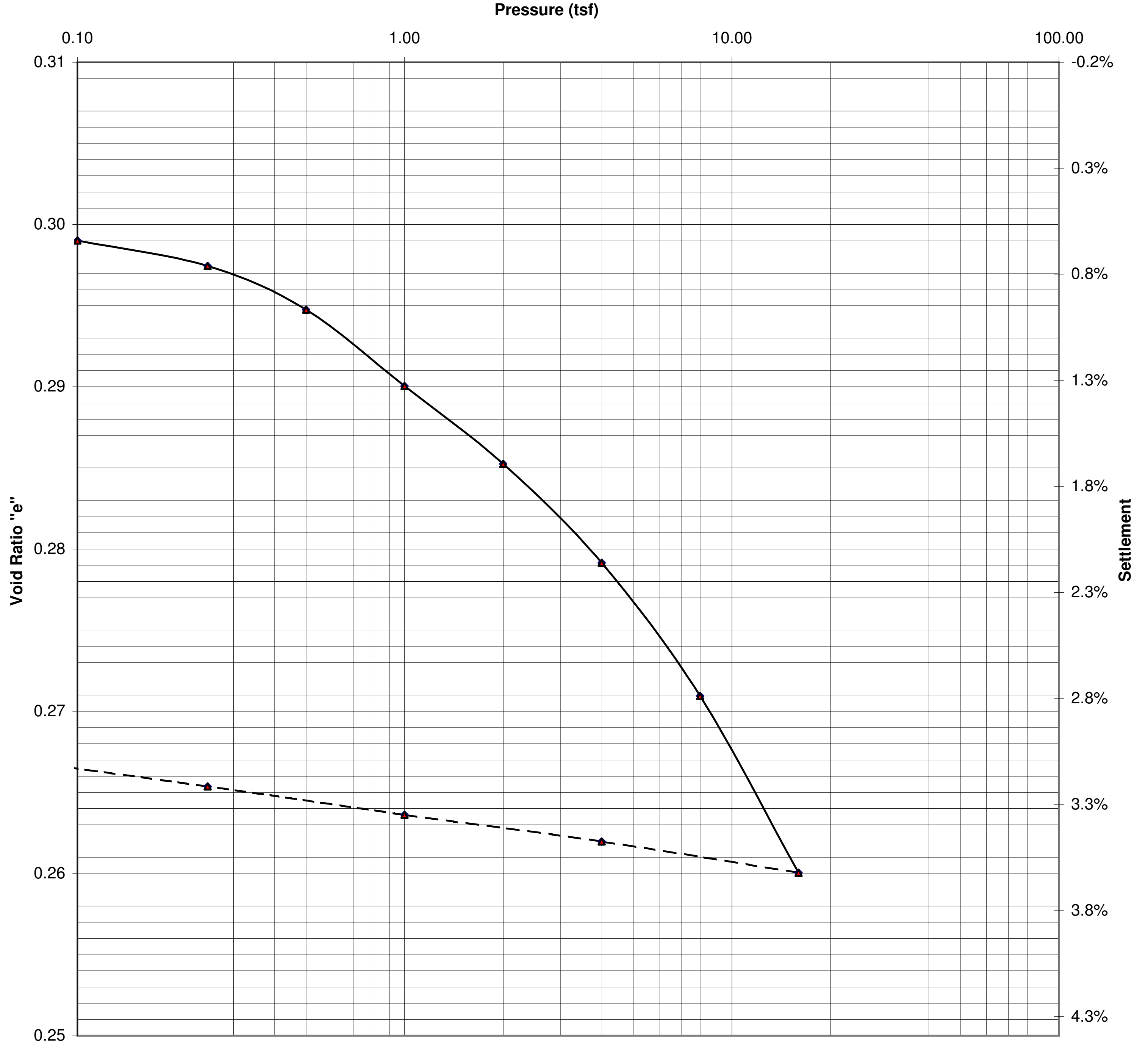
Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-022B			Date: 10/18/07
Sample #:	Boring #: 07-07C	Depth ft: 52.2-55.2 (Top)	Job #: 6250
Soil Type: Silty Sand w/a little gravel (SM)			
Initial W/C (%): 10.9	Dry Density (pcf): 129.0	LL: NP PL: NP PI: NP	Gs: 2.70
Organic Content (%):	Initial Height (in.): 0.750	Diameter (in.): 2.507	e_o= 0.307
Preconsolidation Pressure (Pc): 2.2 tsf	Compression Index (Cc): 0.04	Recompression Index (Cr): ≅ 0.01	
Remarks:			

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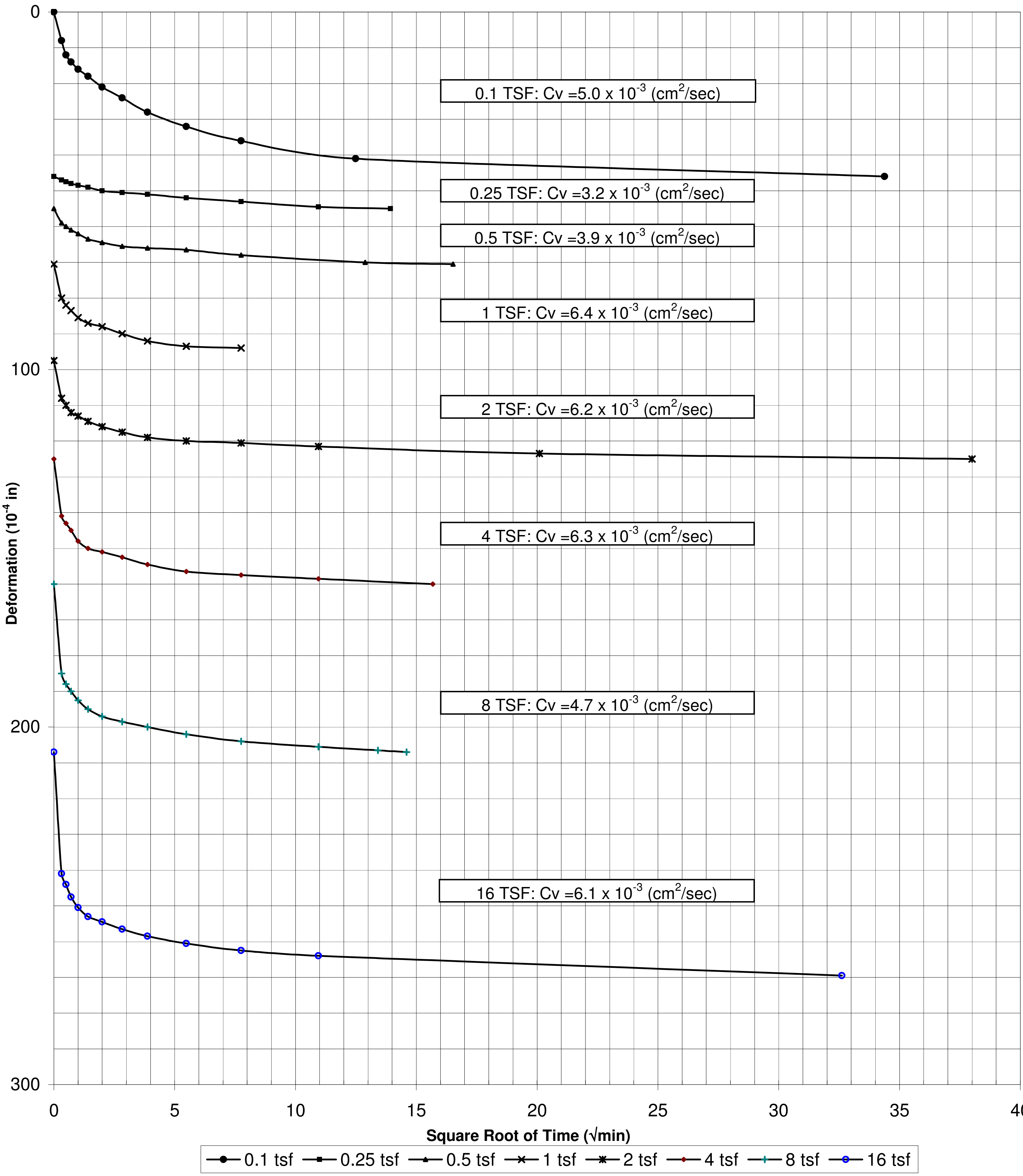
Square Root of Time Curves



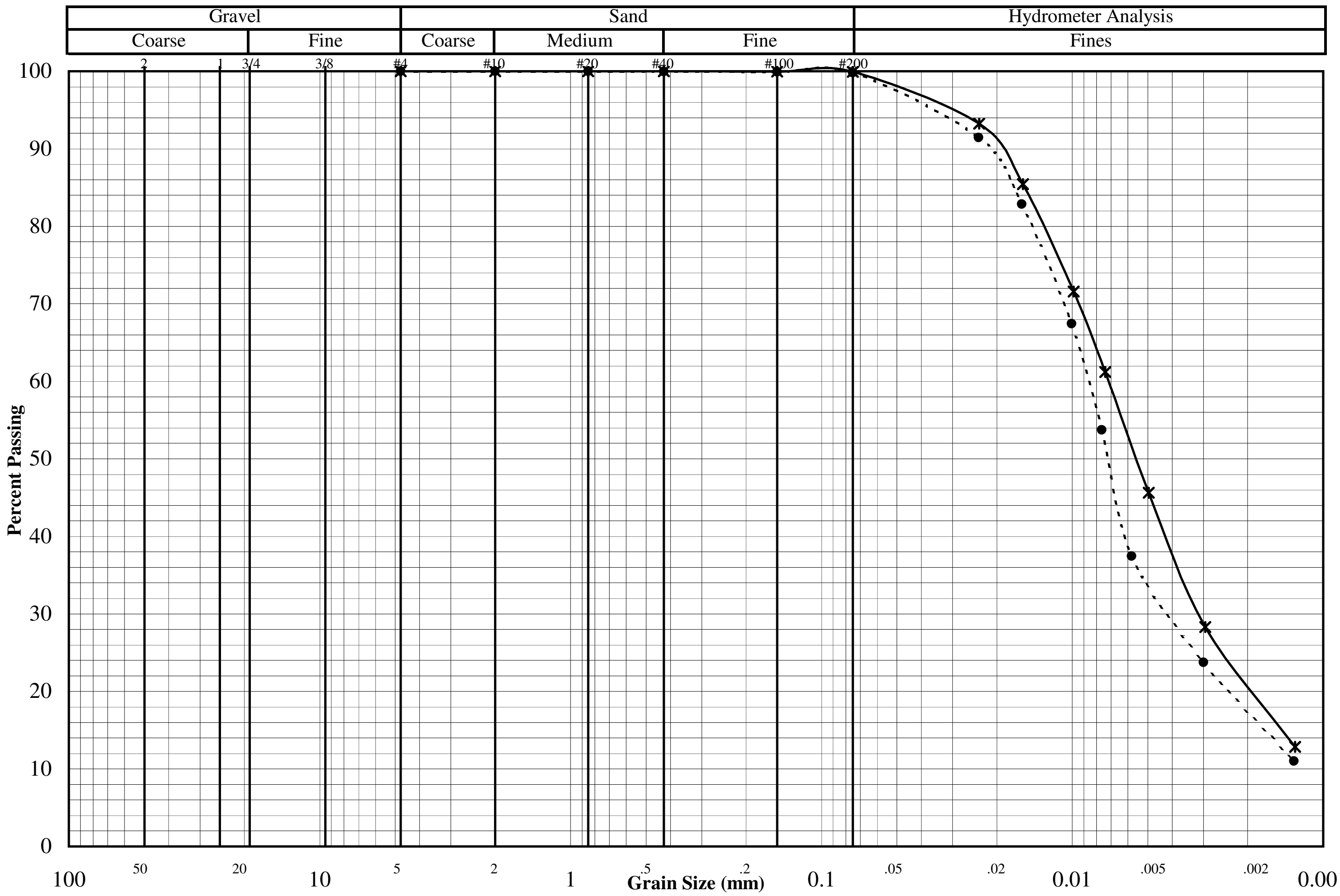
Project: Polymet #23/69-862-022B			Date: 10/18/07
Sample #:	Boring #: 07-07C	Depth ft: 52.2-55.2 (Top)	Job #: 6250

9301 Bryant Ave. South, Suite 107 — SOIL ENGINEERING TESTING, INC. — Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Project:	Polymet #23/69-862-022B	Job No. :	6250
		Test Date:	9/26/07
Reported To:	Barr Engineering Company	Report Date:	10/4/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	07-06		27.5-29.5	3T	Slimes (Silt (ML)
●	07-03		30.7-32.7	3T	Slimes (Silt (ML)
◇					



Other Tests

	*	●	◇
Liquid Limit	29.1	31.6	
Plastic Limit	23.6	26.4	
Plasticity Index	5.5	5.2	
Water Content			
Dry Density (pcf)			
Specific Gravity	2.96	2.94	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	681.9	638.3	
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	
#10	100.0	100.0	
#20	100.0	100.0	
#40	100.0	99.9	
#100	99.9	99.9	
#200	99.9	99.8	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

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SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6250**

Project:	Polymet #23/69-862-022B	Test Date:	9/26/07
Reported To:	Barr Engineering Company	Report Date:	10/4/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	07-06		27.5-29.5	3T	Slimes (Silt (ML)
Spec 2	07-03		30.7-32.7	3T	Slimes (Silt (ML)
Spec 3					

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.024	93.2	0.024	91.4		
0.016	85.4	0.016	82.9		
0.010	71.6	0.010	67.5		
0.007	61.2	0.008	53.7		
0.005	45.6	0.006	37.5		
0.003	28.3	0.003	23.8		
0.001	12.9	0.001	11.0		

Permeability Test Data

Project: Polymet #23/69-862-022B Date: 10/9/2007

Reported To: Barr Engineering Company Job No.: 6250

Boring No.:	07-02	07-02		07-03	07-03		
Sample No.:							
Depth (ft.):	59-61 (Mid-Bot)	59-61 (Mid-Bot)		30.7-32.7	30.7-32.7		
Location:							
Sample Type:	3T	3T		3T	3T		
Soil Type:	Slimes Silt (ML)	Slimes Silt (ML)		Slimes Silt (ML)	Slimes Silt (ML)		
Atterberg Limits							
LL	22.0	22.0		31.6	31.6		
PL	17.2	17.2		26.4	26.4		
PI	4.8	4.8		5.2	5.2		
Permeability Test	A	B		A	B		
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	2.42			1.10			
Dia. (in):	2.88			2.88			
Dry Density (pcf):	87.3			92.4			
Water Content:	36.8%			33.0%			
Test Type:	Falling	Falling		Falling	Falling		
Max Head (cm):	5.0	5.0		5.0	5.0		
Confining press. (Effective-psi):	24.3	69.4		13.9	55.6		
Trial No.:	4-8	12-16		10-14	22-26		
Water Temp °C:	23.0	23.0		23.0	23.0		
Gs (Actual)	2.95	2.95		2.94	2.94		
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**1.1×10^{-6}**	**9.3×10^{-8}**		**4.3×10^{-7}**	**4.6×10^{-7}**		
K @ 20 °C (ft/min)	**2.2×10^{-6}**	**1.8×10^{-7}**		**8.4×10^{-7}**	**9.1×10^{-7}**		
Notes:							

Permeability Test Data

Project: Polymet #23/69-862-022B Date: 10/9/2007

Reported To: Barr Engineering Company Job No.: 6250

Boring No.:	07-06	07-06		07-07C			
Sample No.:							
Depth (ft.):	27.5-29.5 Middle	27.5-29.5 Middle		52.2-55.2 Mid-Top			
Location:							
Sample Type:	TWT	TWT		TWT			
Soil Type:	Slimes (Silt) (ML))	Slimes (Silt) (ML))		Silty Sand w/a Little Gravel (SM)			
Atterberg Limits							
LL	29.1	29.1		NP			
PL	23.6	23.6		NP			
PI	5.5			NP			
Permeability Test	A	B					
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	1.44	1.44		2.99			
Dia. (in):	2.88	2.88		2.89			
Dry Density (pcf):	83.2	83.2		128.0			
Water Content:	40.2%	40.2%		10.5%			
Test Type:	Falling	Falling		Falling			
Max Head (ft):	5.0	5.0		5.0			
Confining press. (Effective-psi):	24.3	41.7		31.3			
Trial No.:	12-16	24-28		7-11			
Water Temp °C:	23.0	23.0		23.0			
Gs (Actual)	2.96	2.96		2.70			
% Saturation (After Test)				98.5%			
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**1.5×10^{-6}**	**1.3×10^{-6}**		**1.6×10^{-6}**			
K @ 20 °C (ft/min)	**3.0×10^{-6}**	**2.6×10^{-6}**		**3.1×10^{-6}**			
Notes:							

Permeability Test Data

Project: Polymet #23/69-862-022B Date: 10/9/2007

Reported To: Barr Engineering Company Job No.: 6250

Boring No.:	07-14	07-14					
Sample No.:							
Depth (ft)	123.0-123.5	124.0-124.5					
Location:							
Sample Type:	2.5" Liner	2.5" Liner					
Soil Type:	Mostly Lean Clay, Some Clayey Sand, A Little Silty Sand, a Trace of Gravel & Organics (CL/CL-ML)	Silty Sand, Fine Grained, a Little Gravel (SM/ML)					
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	2.36	2.81					
Dia. (in):	2.85	2.33					
Dry Density (pcf):	87.5	117.9					
Water Content:	21.9%	17.9%					
Test Type:	Falling	Falling					
Max Head (cm):	5.0	5.0					
Confining press. (Effective-psi):	2.0	2.0					
Trial No.:	16-20	25-29					
Water Temp °C:	23.0	23.0					
% Compaction							
% Saturation (After Test)	99.7%	100.5%					
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**5.8×10^{-9}**	**1.5×10^{-6}**					
K @ 20 °C (ft/min)	**1.1×10^{-8}**	**3.0×10^{-6}**					
Notes:							

Permeability Test Data

Project: Polymet #23/69-862-022B Date: 10/29/2007

Reported To: Barr Engineering Company Job No.: 6250

Boring No.:							
Sample No.:	Slimes Composite	Slimes Composite	Slimes Composite	Slimes Composite	Slimes Composite	Slimes Composite	
Depth (ft)							
Location:							
Sample Type:	Bulk	Bulk	Bulk	Bulk	Bulk	Bulk	
Soil Type:	Slimes	Slimes	Slimes	Slimes	Slimes	Slimes	
Atterberg Limits							
LL	20.7						
PL	16.7						
PI	4.0						
Permeability Test	A	B	C	D	E	F	
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	2.98					2.94	
Dia. (in):	2.85					2.76	
Dry Density (pcf):	93.6					101.4	
Water Content:	11.8%					26.7%	
Test Type:	Falling	Falling	Falling	Falling	Falling	Falling	
Max Head (ft):	2.2	2.2	2.2	2.2	2.2	2.2	
Confining press. (Effective-tsf):	0.25	0.5	1.0	2.0	4.0	6.0	
Trial No.:							
Water Temp °C:	23.0	23.0	23.0	23.0	23.0	23.0	
Compaction	Loose						
% Saturation (After Test)						95.0%	
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**5.0×10^{-5}**	**4.5×10^{-5}**	**4.4×10^{-5}**	**3.8×10^{-5}**	**3.6×10^{-5}**	**3.4×10^{-5}**	
K @ 20 °C (ft/min)	**1.0×10^{-4}**	**9×10^{-5}**	**8.8×10^{-5}**	**7.4×10^{-5}**	**7.2×10^{-5}**	**6.7×10^{-5}**	
Notes:							

Permeability Test Data

Project: Polymet #23/69-862-022B Date: 10/25/2007

Reported To: Barr Engineering Company Job No.: 6250

Boring No.:	07-4B	07-4B	07-4B	07-4B			
Sample No.:							
Depth (ft.):	57.2 - 57.7	57.2 - 57.7	57.2 - 57.7	57.2 - 57.7			
Location:							
Sample Type:	2.5 Liner	2.5 Liner	2.5 Liner	2.5 Liner			
Soil Type:	Hemic Peat (PT)	Hemic Peat (PT)	Hemic Peat (PT)	Hemic Peat (PT)			
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	4.44						
Dia. (in):	1.99						
Dry Density (pcf):	22.4						
Water Content:	196.6%						
Test Type:	Falling	Falling	Falling	Falling			
Max Head (cm):	5.0	10.0	10.0	10.0			
Confining press. (Effective-psi):	20.8	41.7	62.5	83.3			
Trial No.:	6-10	22-26	44-48	52-56			
Water Temp °C:	23.0	23.0	23.0	23.0			
% Compaction							
% Saturation (After Test)				95.3%			
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**1.2 x 10 -7**	**3.1 x 10 -8**	**1.3 x 10 -8**	**1.3 x 10 -8**			
K @ 20 °C (ft/min)	**2.3 x 10 -7**	**6.0 x 10 -8**	**2.5 x 10 -8**	**2.6 x 10 -8**			
Notes:							

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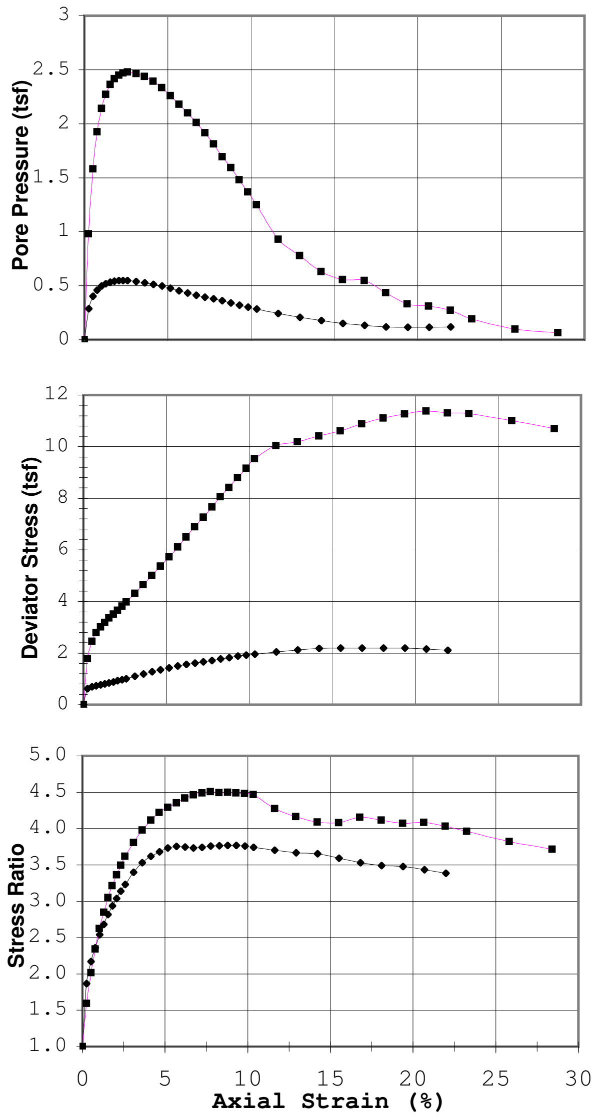
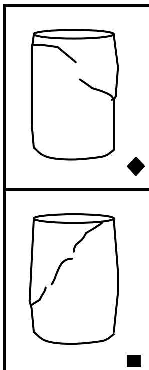
TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-03** Sample #: Type: **3T** Depth (ft): **30.7-32.7 (Top)**
Soil Type: **Slimes (Silt (ML))**





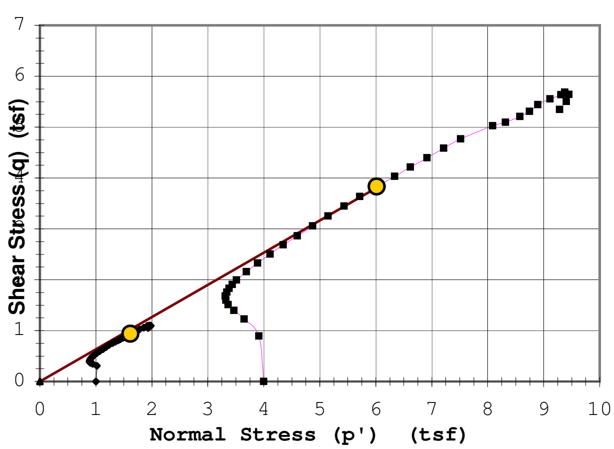
Failure Criterion:	Max. Stress Ratio
Angle of internal friction, ϕ' =	39.3 °
Apparent Cohesion, c' =	0.00 (tsf)

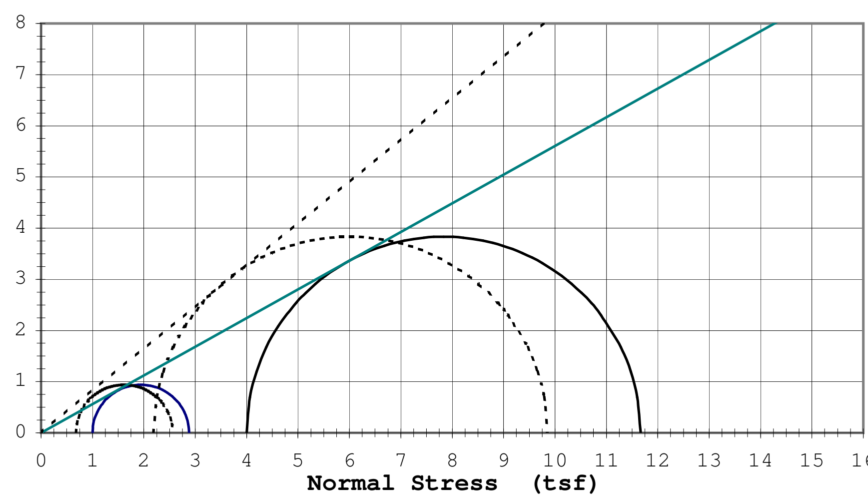
Test Date:	9/25/07	Liquid Limit:	31.6
Test Type:	CU w/pp	Plastic Limit:	26.4
Strain Rate (in/min):	0.0039	Plasticity Index:	5.2
Strain Rate (%/min):	0.101	Spec. Gravity (Actual):	2.94

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	32.9	33.0			
Dry Density (pcf)	92.4	92.4			
Void Ratio	0.99	0.99			
After Consolidation					
Diameter (in)	1.97	1.92			
Height (in)	3.87	3.87			
Water Content (%)	33.1	30.1			
Dry Density (pcf)	93.0	97.4			
Void Ratio	0.97	0.88			
Back Pressure (tsf)	5.82	5.79			
Minor Principal Stress (tsf)	1.00	4.00			
Max. Deviator Stress (tsf)	2.20	11.38			
Ultimate Deviator Stress (tsf)	2.11	10.70			
Deviator Stress at Failure (tsf)	1.88	7.67			
Max. Pore Pressure Buildup (tsf)	0.55	2.48			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	9.3	7.7			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





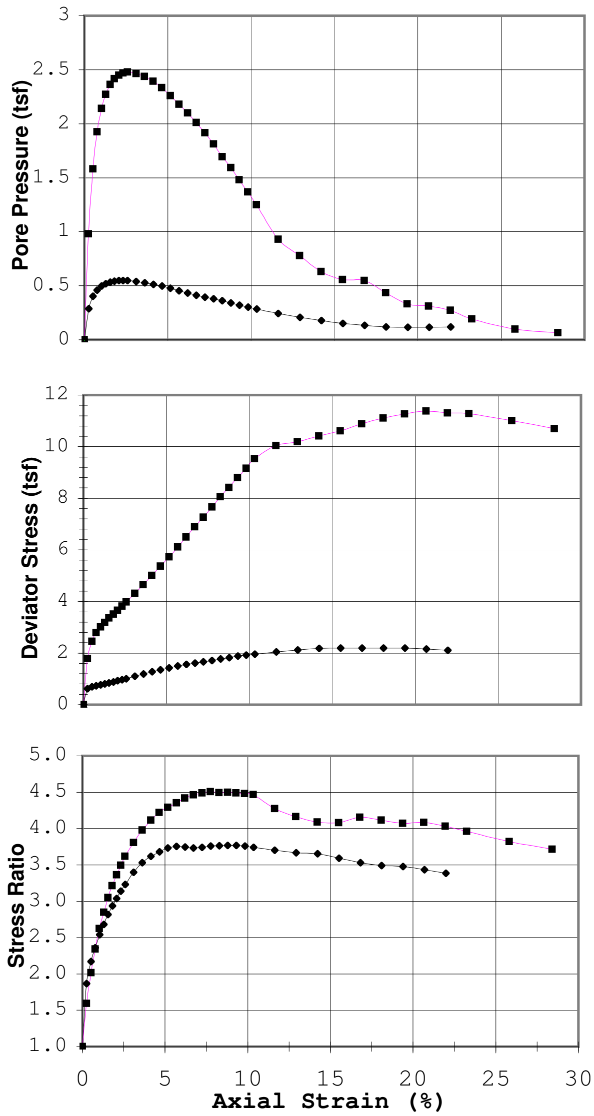
Rupture Envelope at Failure	
α = 32.3 °	a = 0.0 (tsf)

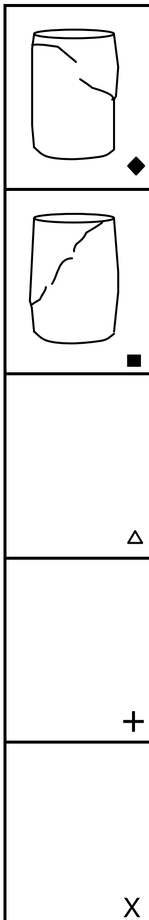
------------	Effective ϕ': 39.3 °	c'=	0.00 (tsf)
________	Total ϕ': 29.3 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-03** Sample #: Type: **3T** Depth (ft): **30.7-32.7 (Top)**
Soil Type: **Slimes (Silt (ML))**





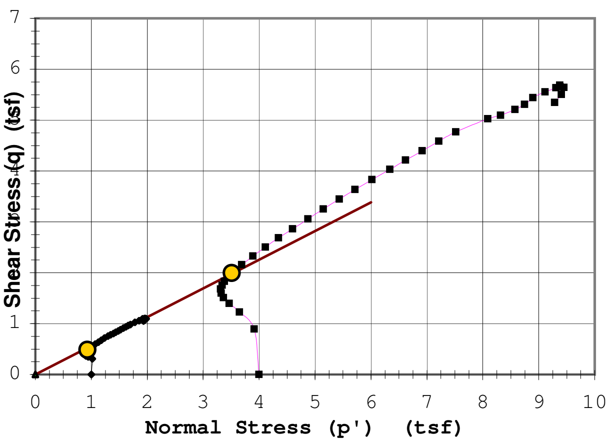
Failure Criterion:	**Max. Pore Pressure**
Angle of internal friction, ϕ' =	**34.3 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

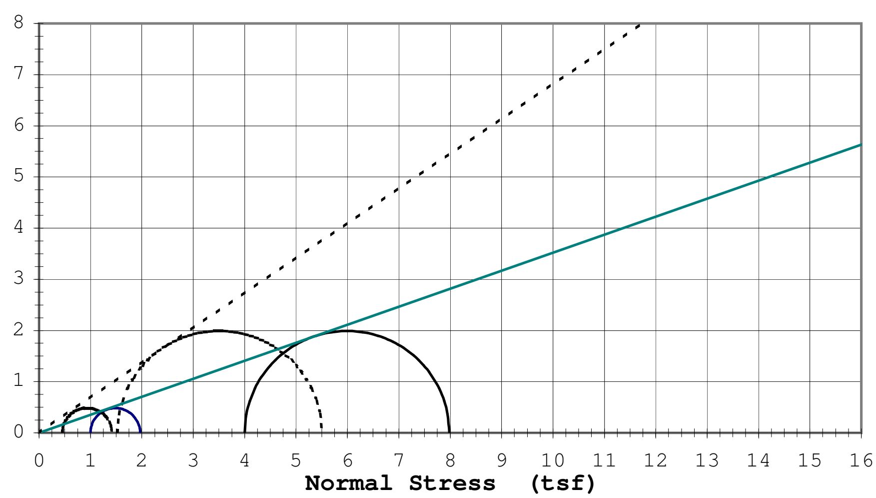
Test Date:	9/25/07	Liquid Limit:	31.6
Test Type:	CU w/pp	Plastic Limit:	26.4
Strain Rate (in/min):	0.0039	Plasticity Index:	5.2
Strain Rate (%/min):	0.101	Spec. Gravity (Actual):	2.94

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	32.9	33.0			
Dry Density (pcf)	92.4	92.4			
Void Ratio	0.99	0.99			
After Consolidation					
Diameter (in)	1.97	1.92			
Height (in)	3.87	3.87			
Water Content (%)	33.1	30.1			
Dry Density (pcf)	93.0	97.4			
Void Ratio	0.97	0.88			
Back Pressure (tsf)	5.82	5.79			
Minor Principal Stress (tsf)	1.00	4.00			
Max. Deviator Stress (tsf)	2.20	11.38			
Ultimate Deviator Stress (tsf)	2.11	10.70			
Deviator Stress at Failure (tsf)	0.97	3.98			
Max. Pore Pressure Buildup (tsf)	0.55	2.48			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	2.3	2.6			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





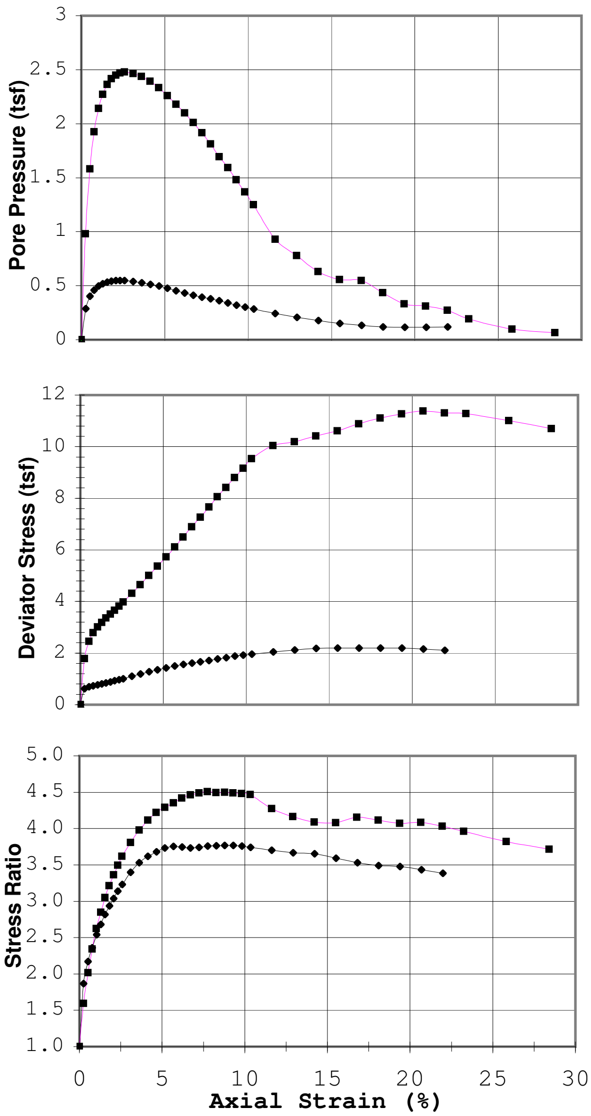
Rupture Envelope at Failure
α = 29.4 ° a = 0.0 (tsf)

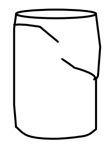
------------	Effective ϕ':	34.3 °	c'=	0.00 (tsf)
________	Total ϕ':	19.4 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-03** Sample #: Type: **3T** Depth (ft): **30.7-32.7 (Top)**
Soil Type: **Slimes (Silt (ML))**

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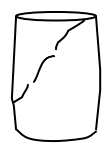
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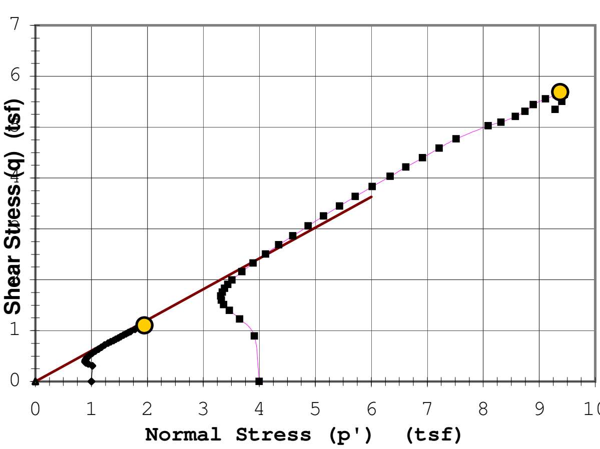
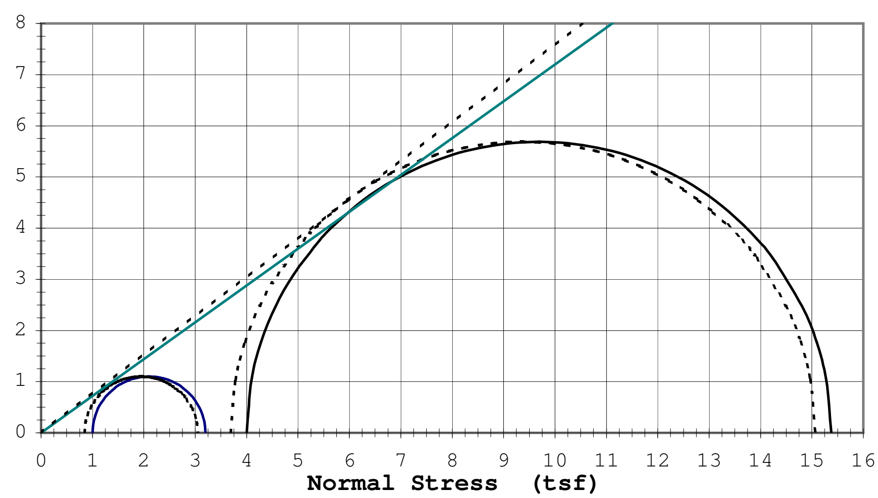
Failure Criterion:	Max. Deviator Stress				
Angle of internal friction, ϕ' =	37.2 °				
Apparent Cohesion, c' =	0.00 (tsf)				
Test Date: 9/25/07	Liquid Limit: 31.6				
Test Type: CU w/pp	Plastic Limit: 26.4				
Strain Rate (in/min): 0.0039	Plasticity Index: 5.2				
Strain Rate (%/min): 0.101	Spec. Gravity (Actual): 2.94				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	32.9	33.0			
Dry Density (pcf)	92.4	92.4			
Void Ratio	0.99	0.99			
After Consolidation					
Diameter (in)	1.97	1.92			
Height (in)	3.87	3.87			
Water Content (%)	33.1	30.1			
Dry Density (pcf)	93.0	97.4			
Void Ratio	0.97	0.88			
Back Pressure (tsf)	5.82	5.79			
Minor Principal Stress (tsf)	1.00	4.00			
Max. Deviator Stress (tsf)	2.20	11.38			
Ultimate Deviator Stress (tsf)	2.11	10.70			
Deviator Stress at Failure (tsf)	2.20	11.38			
Max. Pore Pressure Buildup (tsf)	0.55	2.48			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	15.5	20.7			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 31.2 °	a = 0.0 (tsf)

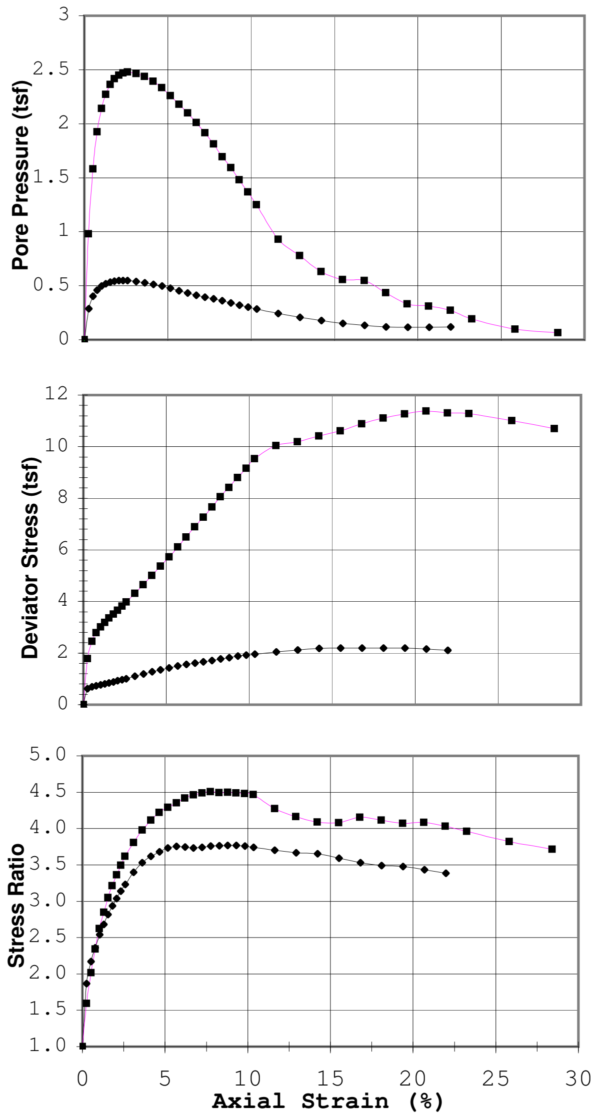
------------	Effective ϕ': 37.2 °	c'=	0.00 (tsf)
________	Total ϕ': 35.8 °	c=	0.00 (tsf)

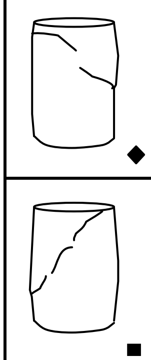
9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-03** Sample #: Type: **3T** Depth (ft): **30.7-32.7 (Top)**
Soil Type: **Slimes (Silt (ML))**





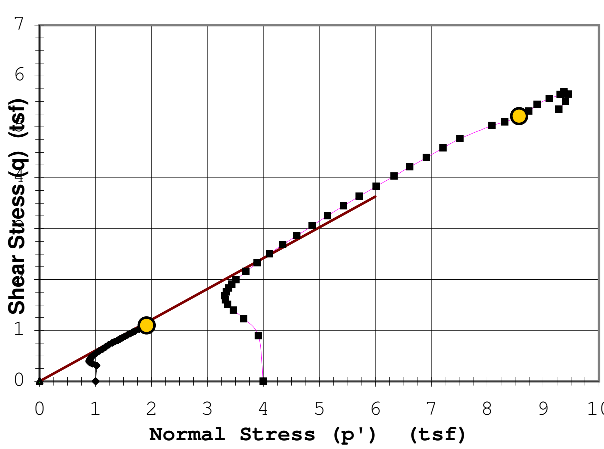
Failure Criterion:	Given Strain of: 15%
Angle of internal friction, ϕ' =	37.2 °
Apparent Cohesion, c' =	0.00 (tsf)

Test Date:	9/25/07	Liquid Limit:	31.6
Test Type:	CU w/pp	Plastic Limit:	26.4
Strain Rate (in/min):	0.0039	Plasticity Index:	5.2
Strain Rate (%/min):	0.101	Spec. Gravity (Actual):	2.94

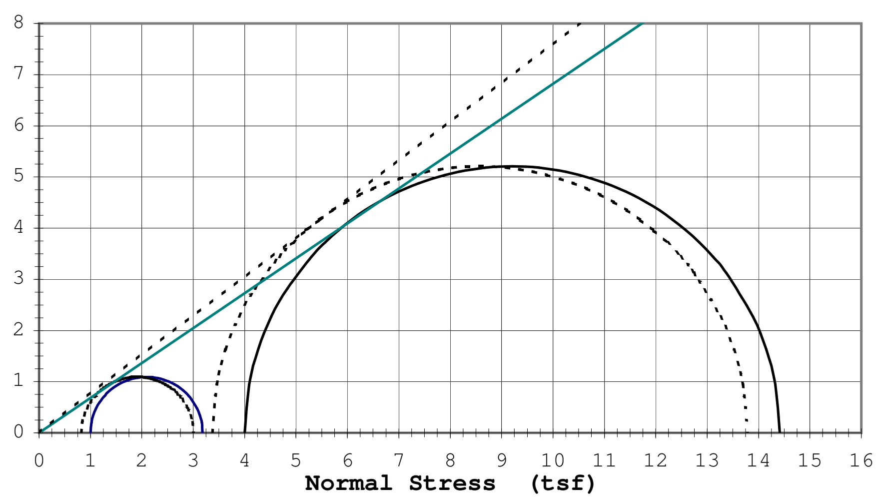
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	32.9	33.0			
Dry Density (pcf)	92.4	92.4			
Void Ratio	0.99	0.99			
After Consolidation					
Diameter (in)	1.97	1.92			
Height (in)	3.87	3.87			
Water Content (%)	33.1	30.1			
Dry Density (pcf)	93.0	97.4			
Void Ratio	0.97	0.88			
Back Pressure (tsf)	5.82	5.79			
Minor Principal Stress (tsf)	1.00	4.00			
Max. Deviator Stress (tsf)	2.20	11.38			
Ultimate Deviator Stress (tsf)	2.11	10.70			
Deviator Stress at Failure (tsf)	2.18	10.41			
Max. Pore Pressure Buildup (tsf)	0.55	2.48			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



Rupture Envelope at Failure
α = 31.2 ° a = 0.0 (tsf)



------------	Effective ϕ':	37.2 °	c'=	0.00 (tsf)
________	Total ϕ':	34.3 °	c=	0.00 (tsf)

Job No.: 6250

Project: Polymet - #23/69-862-015-028 Type: CU w/pp

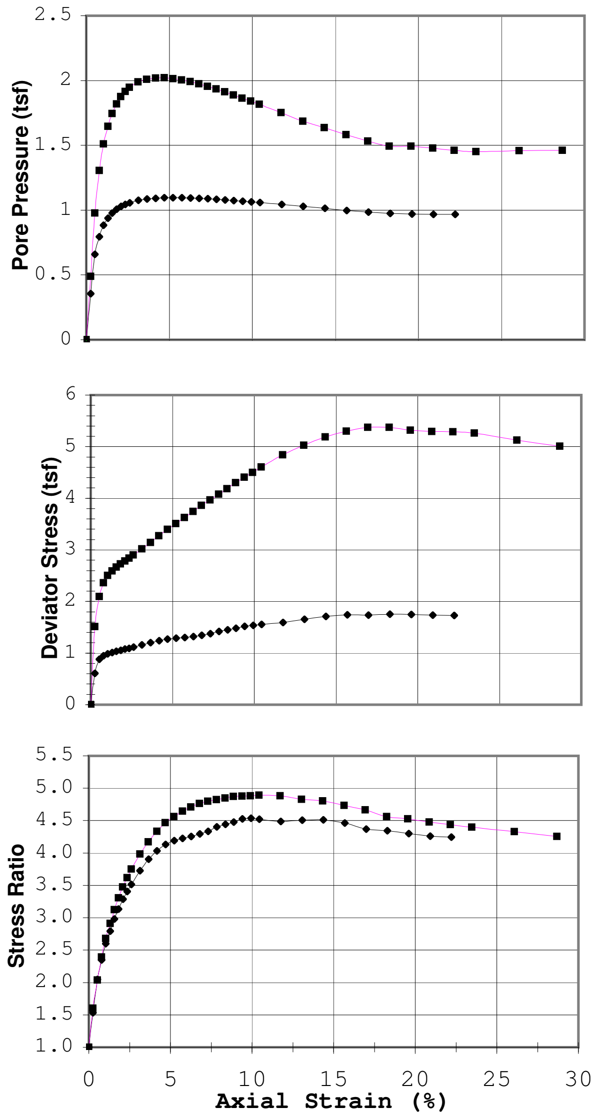
Boring No.: 07-03, Depth (ft.): 30.7-32.7 (Top) Soil Type: Slimes (Silt (ML))

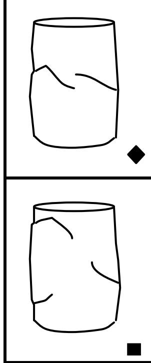
Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00			
0.26	0.62	0.29	0.26	1.79	0.98			
0.52	0.70	0.40	0.52	2.46	1.58			
0.78	0.73	0.46	0.78	2.79	1.93			
1.04	0.77	0.50	1.03	3.01	2.14			
1.29	0.81	0.52	1.29	3.19	2.27			
1.55	0.85	0.53	1.55	3.36	2.36			
1.81	0.89	0.54	1.81	3.51	2.42			
2.07	0.92	0.55	2.07	3.66	2.45			
2.33	0.97	0.55	2.33	3.82	2.47			
2.59	1.01	0.55	2.58	3.98	2.48			
3.10	1.10	0.54	3.10	4.31	2.46			
3.62	1.20	0.53	3.62	4.65	2.44			
4.14	1.27	0.51	4.13	5.01	2.39			
4.66	1.35	0.50	4.65	5.37	2.34			
5.17	1.43	0.48	5.17	5.73	2.26			
5.69	1.50	0.45	5.68	6.11	2.18			
6.21	1.56	0.43	6.20	6.50	2.10			
6.72	1.61	0.41	6.72	6.89	2.01			
7.24	1.66	0.40	7.23	7.26	1.92			
7.76	1.72	0.38	7.75	7.67	1.81			
8.28	1.77	0.36	8.27	8.06	1.69			
8.79	1.82	0.34	8.78	8.42	1.59			
9.31	1.88	0.32	9.30	8.80	1.48			
9.83	1.92	0.30	9.81	9.16	1.37			
10.35	1.96	0.28	10.33	9.53	1.25			
11.64	2.05	0.24	11.62	10.04	0.93			
12.93	2.12	0.21	12.91	10.19	0.78			
14.22	2.18	0.18	14.21	10.41	0.63			
15.52	2.20	0.15	15.50	10.61	0.56			
16.81	2.20	0.13	16.79	10.88	0.55			
18.10	2.19	0.12	18.08	11.10	0.44			
19.40	2.19	0.11	19.37	11.27	0.33			
20.69	2.16	0.11	20.66	11.38	0.31			
21.98	2.11	0.12	21.95	11.31	0.27			
			23.24	11.28	0.19			
			25.83	11.00	0.10			
			28.41	10.70	0.06			

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-06** Sample #: Type: **3T** Depth (ft): **27.5 - 29.5 (M-T)**
Soil Type: **Slimes (Silt (ML))**





Failure Criterion:	Max. Stress Ratio
Angle of internal friction, φ' =	41.2 °
Apparent Cohesion, c' =	0.00 (tsf)

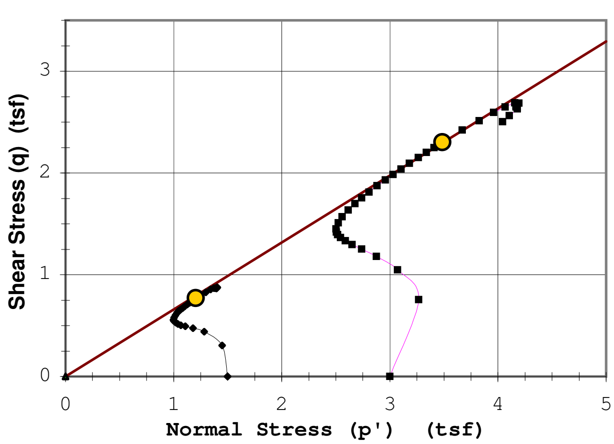
Test Date:	9/25/07	Liquid Limit:	29.1
Test Type:	CU w/pp	Plastic Limit:	23.6
Strain Rate (in/min):	0.0039	Plasticity Index:	5.5
Strain Rate (%/min):	0.102	Spec. Gravity (Actual):	2.96

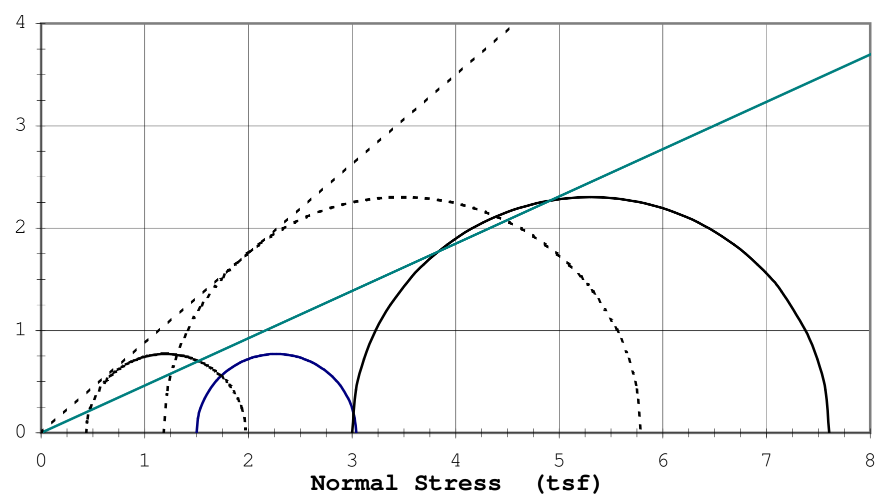
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	43.3	40.2			
Dry Density (pcf)	80.1	83.2			
Void Ratio	1.31	1.22			
After Consolidation					
Diameter (in)	1.93	1.90			
Height (in)	3.83	3.84			
Water Content (%)	40.4	35.3			
Dry Density (pcf)	84.2	90.3			
Void Ratio	1.19	1.05			
Back Pressure (tsf)	5.81	5.77			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	1.75	5.38			
Ultimate Deviator Stress (tsf)	1.73	5.01			
Deviator Stress at Failure (tsf)	1.54	4.60			
Max. Pore Pressure Buildup (tsf)	1.10	2.02			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	9.9	10.4			

Symbols: ◆ (A), ■ (B), △, +, X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





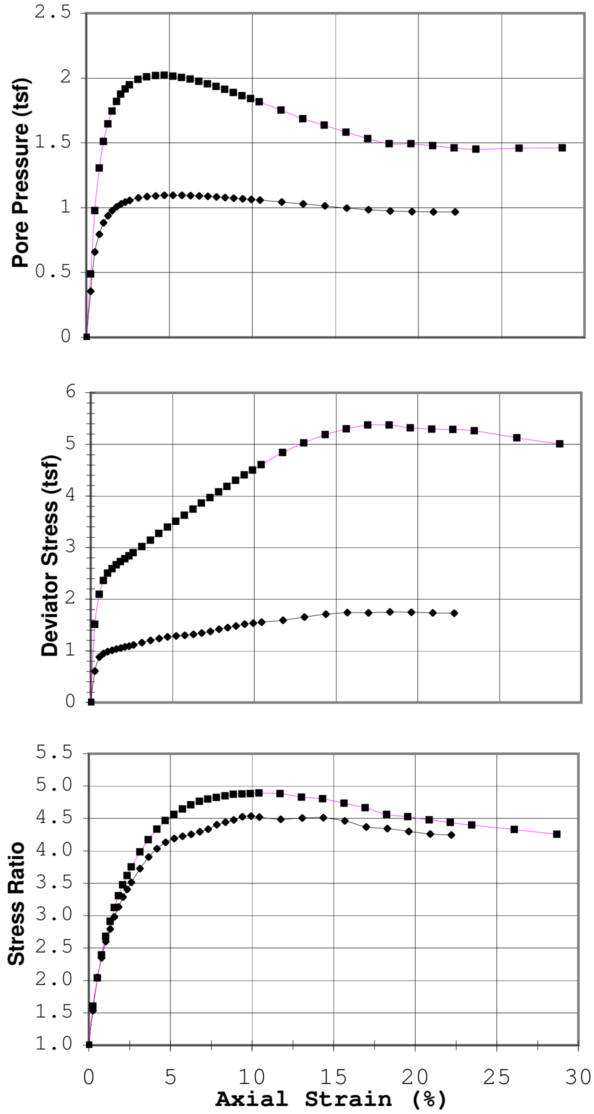
Rupture Envelope at Failure	
α = 33.4 °	a = 0.0 (tsf)

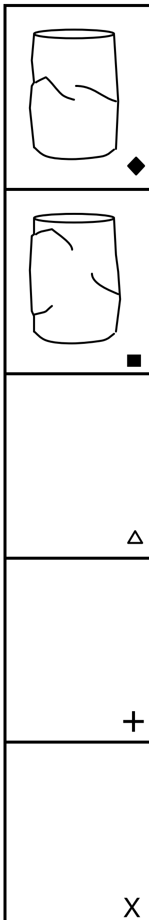
------------	Effective φ':	41.2 °	c'=	0.00 (tsf)
________	Total φ':	24.8 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-06** Sample #: Type: **3T** Depth (ft): **27.5 - 29.5 (M-T)**
Soil Type: **Slimes (Silt (ML))**





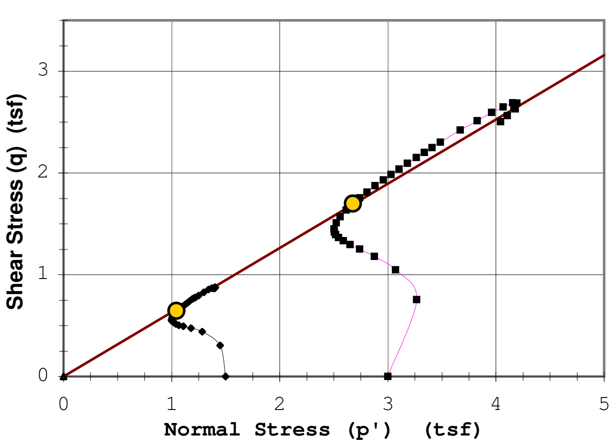
Failure Criterion:	Max. Pore Pressure				
Angle of internal friction, φ' =	39.2 °				
Apparent Cohesion, c' =	0.00 (tsf)				

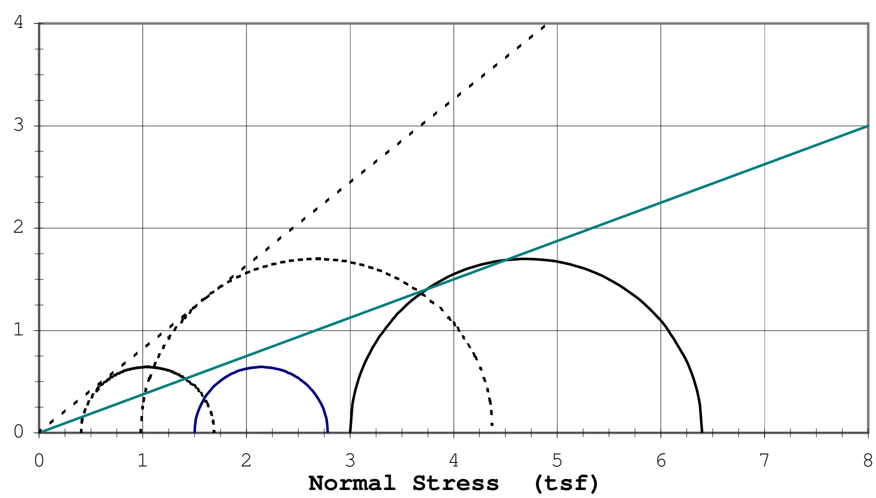
Test Date:	9/25/07	Liquid Limit:	29.1
Test Type:	CU w/pp	Plastic Limit:	23.6
Strain Rate (in/min):	0.0039	Plasticity Index:	5.5
Strain Rate (%/min):	0.102	Spec. Gravity (Actual):	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	43.3	40.2			
Dry Density (pcf)	80.1	83.2			
Void Ratio	1.31	1.22			
After Consolidation					
Diameter (in)	1.93	1.90			
Height (in)	3.83	3.84			
Water Content (%)	40.4	35.3			
Dry Density (pcf)	84.2	90.3			
Void Ratio	1.19	1.05			
Back Pressure (tsf)	5.81	5.77			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	1.75	5.38			
Ultimate Deviator Stress (tsf)	1.73	5.01			
Deviator Stress at Failure (tsf)	1.29	3.40			
Max. Pore Pressure Buildup (tsf)	1.10	2.02			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	5.2	4.7			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





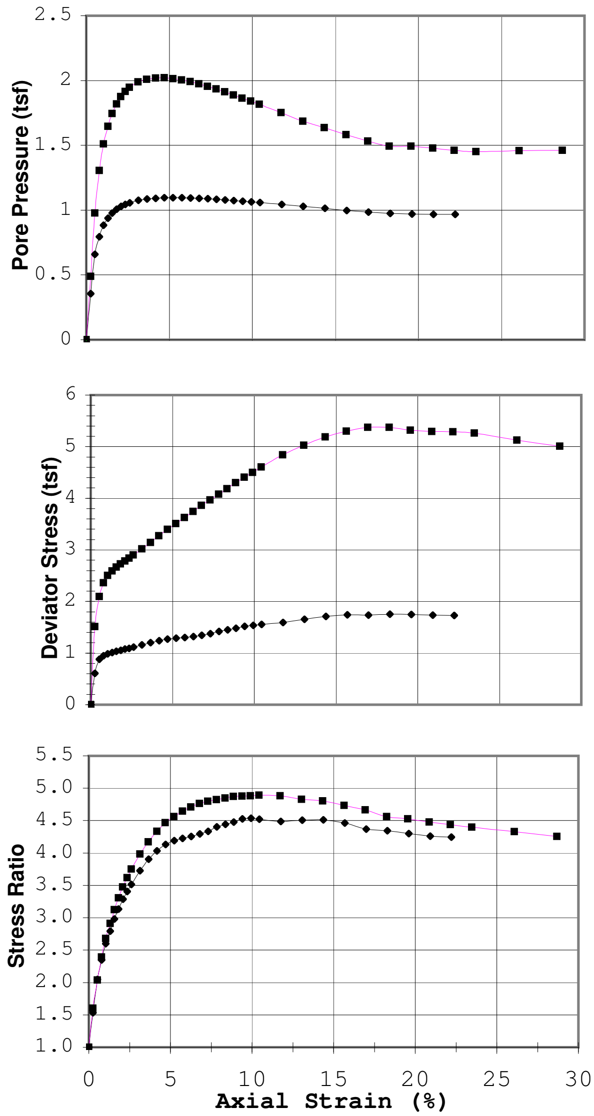
Rupture Envelope at Failure	
α = 32.3 °	a = 0.0 (tsf)

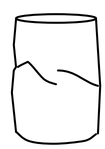
------------ Effective φ':	39.2 °	c'= 0.00 (tsf)
________ Total φ':	20.5 °	c= 0.00 (tsf)

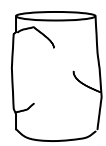
TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-06** Sample #: Type: **3T** Depth (ft): **27.5 - 29.5 (M-T)**
Soil Type: **Slimes (Silt (ML))**




◆


■

△

+

X

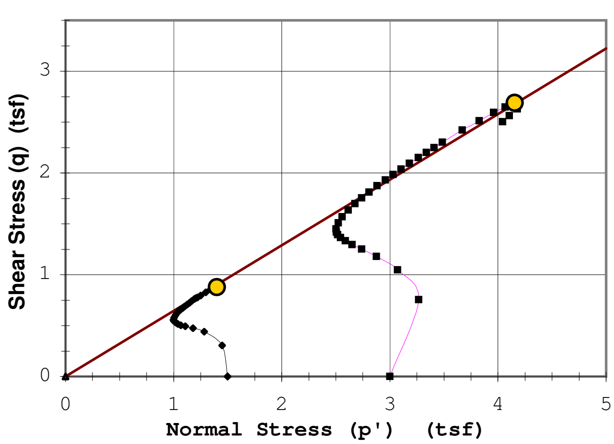
Failure Criterion:	**Max. Deviator Stress**
Angle of internal friction, ϕ' =	**40.1 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

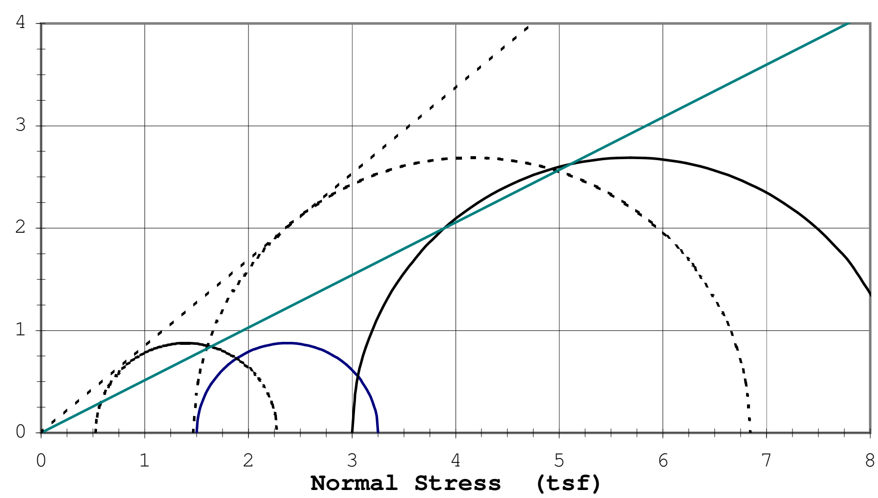
Test Date:	9/25/07	Liquid Limit:	29.1
Test Type:	CU w/pp	Plastic Limit:	23.6
Strain Rate (in/min):	0.0039	Plasticity Index:	5.5
Strain Rate (%/min):	0.102	Spec. Gravity (Actual):	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	43.3	40.2			
Dry Density (pcf)	80.1	83.2			
Void Ratio	1.31	1.22			
After Consolidation					
Diameter (in)	1.93	1.90			
Height (in)	3.83	3.84			
Water Content (%)	40.4	35.3			
Dry Density (pcf)	84.2	90.3			
Void Ratio	1.19	1.05			
Back Pressure (tsf)	5.81	5.77			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	1.75	5.38			
Ultimate Deviator Stress (tsf)	1.73	5.01			
Deviator Stress at Failure (tsf)	1.75	5.38			
Max. Pore Pressure Buildup (tsf)	1.10	2.02			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	18.3	16.9			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





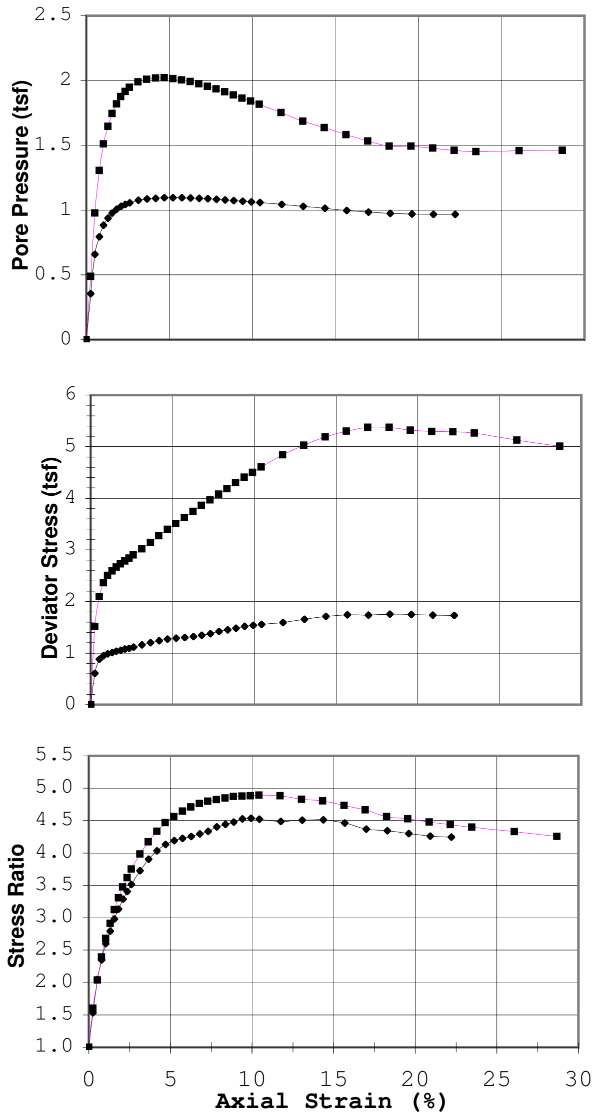
Rupture Envelope at Failure	
α = 32.8 °	a = 0.0 (tsf)

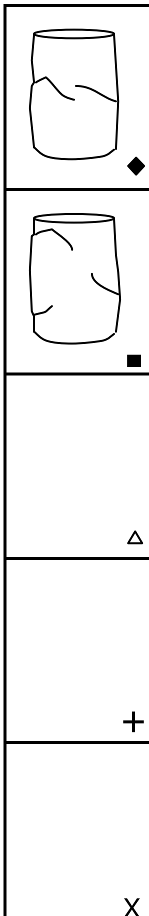
------------ Effective ϕ':	40.1 °	c'=	0.00 (tsf)
________ Total ϕ':	27.2 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/8/07**

Project: **Polymet - #23/69-862-015-028**
Boring #: **07-06** Sample #: Type: **3T** Depth (ft): **27.5 - 29.5 (M-T)**
Soil Type: **Slimes (Silt (ML))**





Failure Criterion: **Given Strain of: 15%**

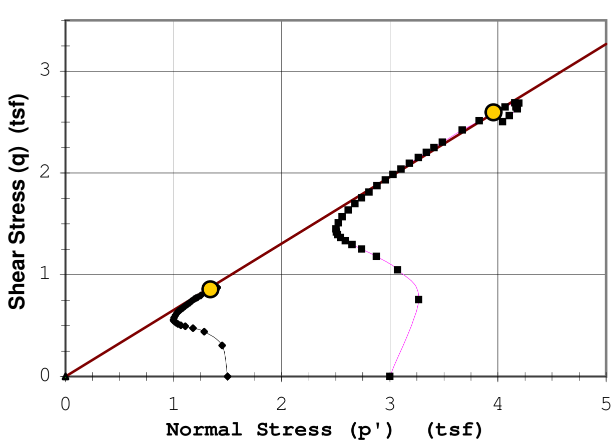
Angle of internal friction, φ' = **40.8 °**
Apparent Cohesion, c' = **0.00 (tsf)**

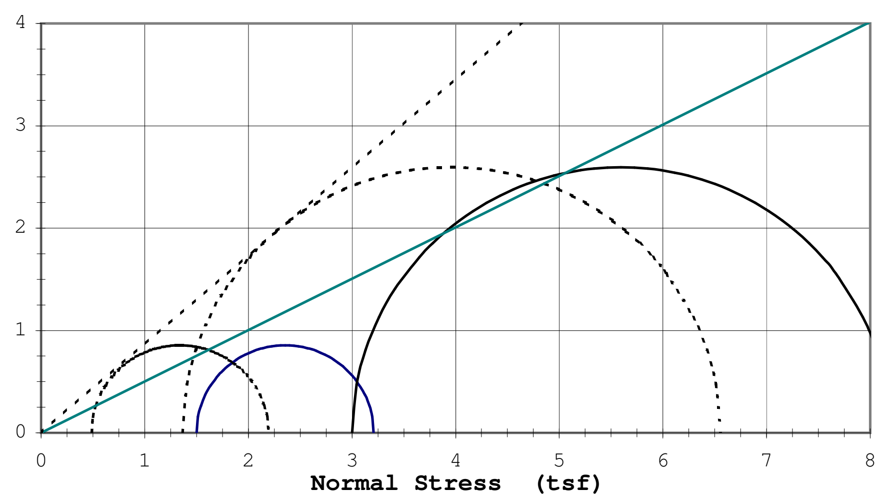
Test Date:	9/25/07	Liquid Limit:	29.1
Test Type:	CU w/pp	Plastic Limit:	23.6
Strain Rate (in/min):	0.0039	Plasticity Index:	5.5
Strain Rate (%/min):	0.102	Spec. Gravity (Actual):	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	43.3	40.2			
Dry Density (pcf)	80.1	83.2			
Void Ratio	1.31	1.22			
After Consolidation					
Diameter (in)	1.93	1.90			
Height (in)	3.83	3.84			
Water Content (%)	40.4	35.3			
Dry Density (pcf)	84.2	90.3			
Void Ratio	1.19	1.05			
Back Pressure (tsf)	5.81	5.77			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	1.75	5.38			
Ultimate Deviator Stress (tsf)	1.73	5.01			
Deviator Stress at Failure (tsf)	1.71	5.19			
Max. Pore Pressure Buildup (tsf)	1.10	2.02			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 33.2 °	a = 0.0 (tsf)

------------ Effective φ':	40.8 °	c'= 0.00 (tsf)
________ Total φ':	26.7 °	c= 0.00 (tsf)

9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

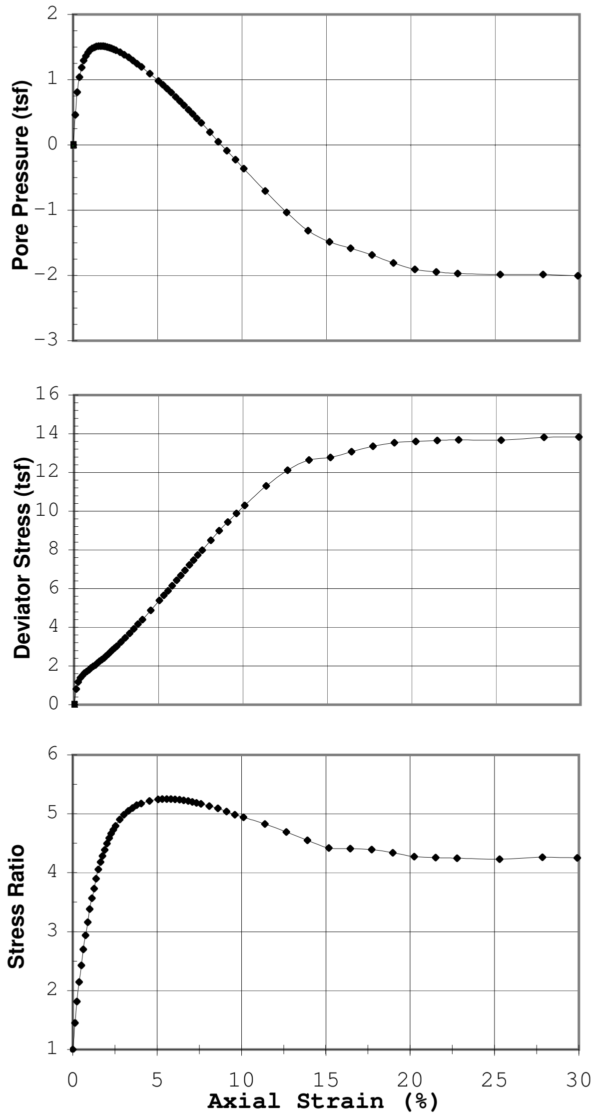
Job No.: 6250
Project: Polymet - #23/69-862-015-028
Type: CU w/pp
Boring No.: 07-06, Depth (ft.): 27.5 - 29.5 (M-T), Soil Type: Slimes (Silt (ML))

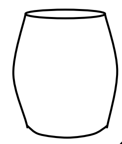
Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00			
0.26	0.61	0.36	0.26	1.51	0.49			
0.52	0.88	0.66	0.52	2.10	0.98			
0.78	0.95	0.80	0.78	2.36	1.31			
1.05	0.98	0.88	1.04	2.50	1.51			
1.31	1.01	0.94	1.30	2.59	1.65			
1.57	1.03	0.98	1.57	2.67	1.75			
1.83	1.05	1.01	1.83	2.73	1.82			
2.09	1.08	1.03	2.09	2.78	1.87			
2.35	1.09	1.05	2.35	2.84	1.91			
2.62	1.11	1.06	2.61	2.90	1.95			
3.14	1.16	1.07	3.13	3.02	1.99			
3.66	1.20	1.09	3.65	3.14	2.01			
4.18	1.24	1.09	4.17	3.27	2.02			
4.71	1.27	1.09	4.69	3.40	2.02			
5.23	1.29	1.10	5.21	3.51	2.02			
5.75	1.30	1.10	5.74	3.62	2.01			
6.27	1.32	1.09	6.26	3.75	1.99			
6.80	1.35	1.09	6.78	3.86	1.97			
7.32	1.38	1.09	7.30	3.97	1.96			
7.84	1.42	1.08	7.82	4.08	1.93			
8.37	1.45	1.08	8.34	4.19	1.91			
8.89	1.48	1.07	8.87	4.30	1.89			
9.41	1.52	1.07	9.39	4.41	1.86			
9.94	1.54	1.06	9.91	4.50	1.84			
10.46	1.55	1.06	10.43	4.60	1.82			
11.76	1.59	1.04	11.73	4.84	1.75			
13.07	1.65	1.03	13.04	5.03	1.69			
14.38	1.71	1.01	14.34	5.19	1.64			
15.69	1.74	1.00	15.64	5.30	1.58			
16.99	1.74	0.98	16.95	5.38	1.53			
18.30	1.75	0.98	18.25	5.37	1.49			
19.61	1.75	0.97	19.55	5.32	1.49			
20.91	1.73	0.97	20.86	5.29	1.48			
22.22	1.73	0.97	22.16	5.29	1.46			
			23.47	5.26	1.45			
			26.07	5.13	1.46			
			28.68	5.01	1.46			

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/11/07**

Project: **Polymet 23/69-862-022B**
Boring #: **07-07C** Sample #: Type: **3T** Depth (ft): **48-50 (Top)**
Soil Type: **Slimes (Silt (ML))**





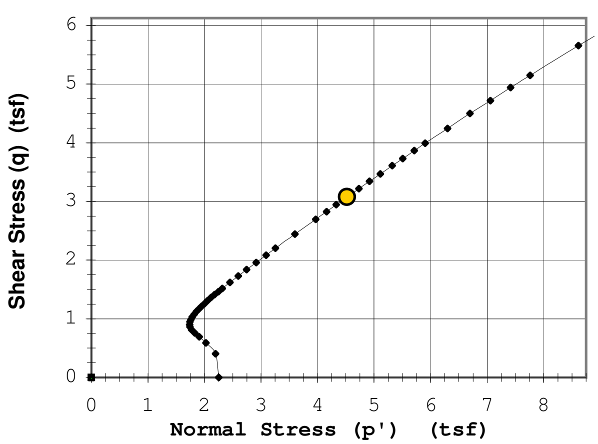
Failure Criterion:		**Max. Stress Ratio**				
Angle of internal friction, φ' =		°				
Apparent Cohesion, c' =		(tsf)				
Test Date:	10/5/07	Liquid Limit:	22.5			
Test Type:	CU w/pp	Plastic Limit:	20.8			
Strain Rate (in/min):	0.0043	Plasticity Index:	1.7			
Strain Rate (%/min):	0.109	Spec. Gravity :	2.97			

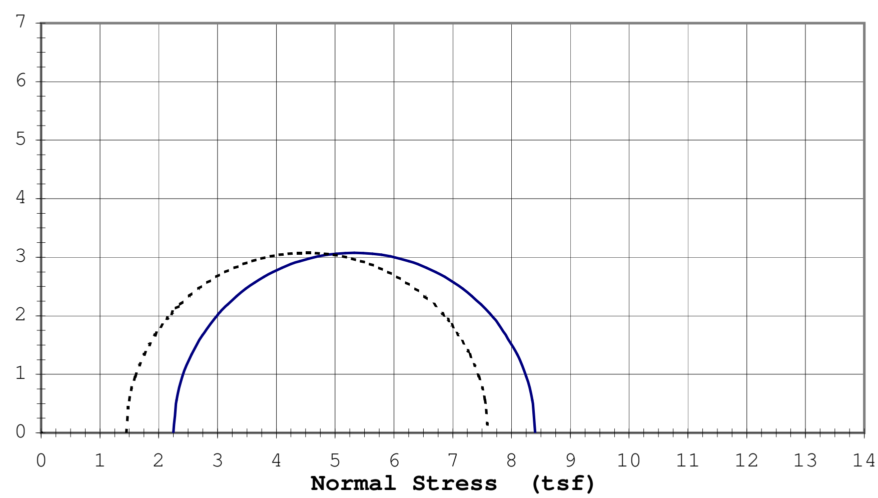
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94				
Height (in)	3.98				
Water Content (%)	26.5				
Dry Density (pcf)	102.4				
Void Ratio	0.81				
After Consolidation					
Diameter (in)	1.92				
Height (in)	3.95				
Water Content (%)	25.5				
Dry Density (pcf)	105.5				
Void Ratio	0.76				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	2.25				
Max. Deviator Stress (tsf)	13.84				
Ultimate Deviator Stress (tsf)	13.84				
Deviator Stress at Failure (tsf)	6.15				
Max. Pore Pressure Buildup (tsf)	1.52				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	5.8				

Symbols: ◆ A, ■ B, △ C, + D, X E

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





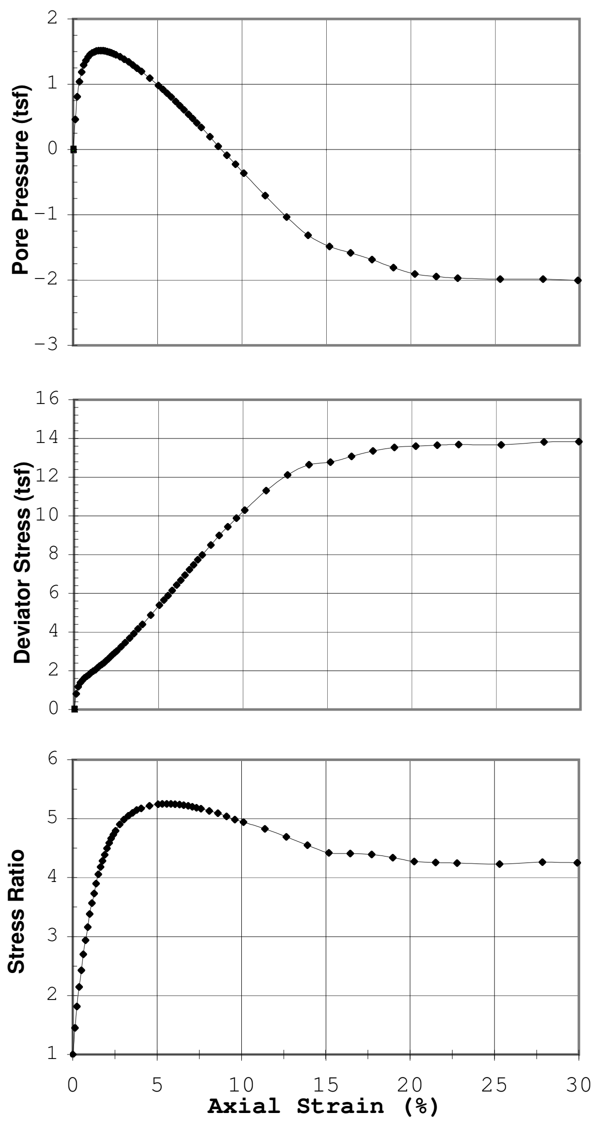
Rupture Envelope at Failure	
α = °	a = (tsf)

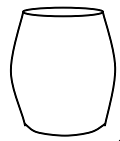
------------	Effective φ': °	c'= (tsf)
________	Total φ': °	c= (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/11/07**

Project: **Polymet 23/69-862-022B**
Boring #: **07-07C** Sample #: Type: **3T** Depth (ft): **48-50 (Top)**
Soil Type: **Slimes (Silt (ML))**





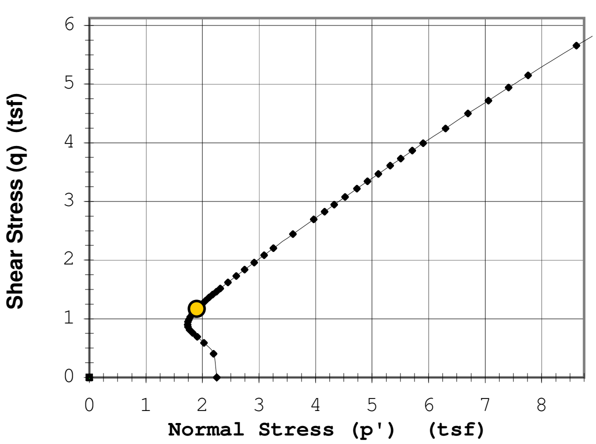
Failure Criterion:		Max. Pore Pressure	
Angle of internal friction, ϕ' =		°	
Apparent Cohesion, c' =		(tsf)	
Test Date:	10/5/07	Liquid Limit:	22.5
Test Type:	CU w/pp	Plastic Limit:	20.8
Strain Rate (in/min):	0.0043	Plasticity Index:	1.7
Strain Rate (%/min):	0.109	Spec. Gravity :	2.97

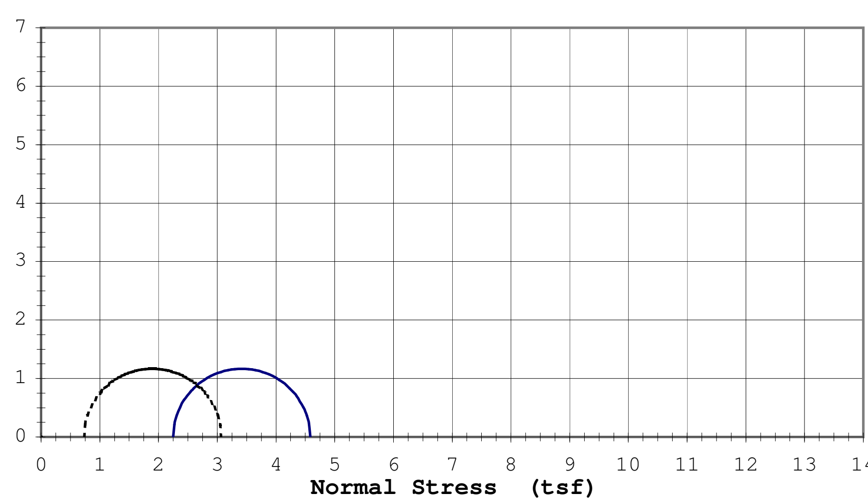
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94				
Height (in)	3.98				
Water Content (%)	26.5				
Dry Density (pcf)	102.4				
Void Ratio	0.81				
After Consolidation					
Diameter (in)	1.92				
Height (in)	3.95				
Water Content (%)	25.5				
Dry Density (pcf)	105.5				
Void Ratio	0.76				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	2.25				
Max. Deviator Stress (tsf)	13.84				
Ultimate Deviator Stress (tsf)	13.84				
Deviator Stress at Failure (tsf)	2.33				
Max. Pore Pressure Buildup (tsf)	1.52				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	1.6				

Legend: ◆ A, ■ B, △ C, + D, X E

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





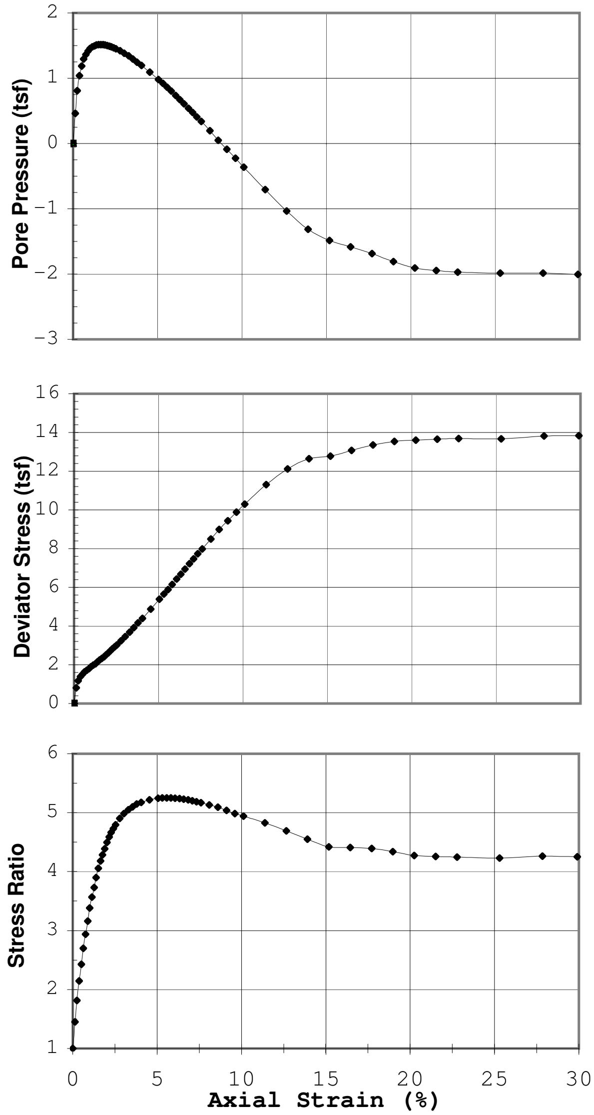
Rupture Envelope at Failure	
α = °	a = (tsf)

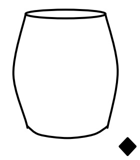
------------	Effective ϕ':	°	c'=	(tsf)
________	Total ϕ':	°	c=	(tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/11/07**

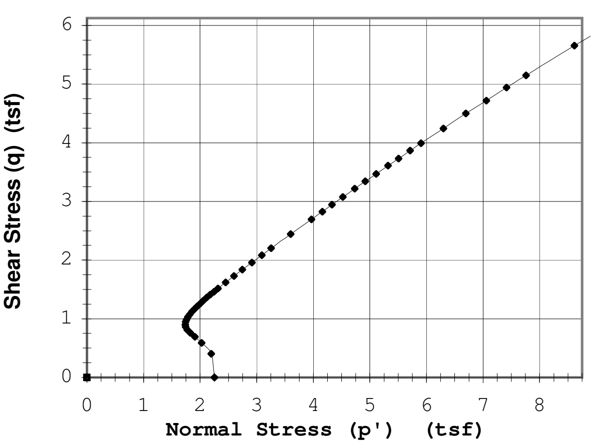
Project: **Polymet 23/69-862-022B**
Boring #: **07-07C** Sample #: Type: **3T** Depth (ft): **48-50 (Top)**
Soil Type: **Slimes (Silt (ML))**

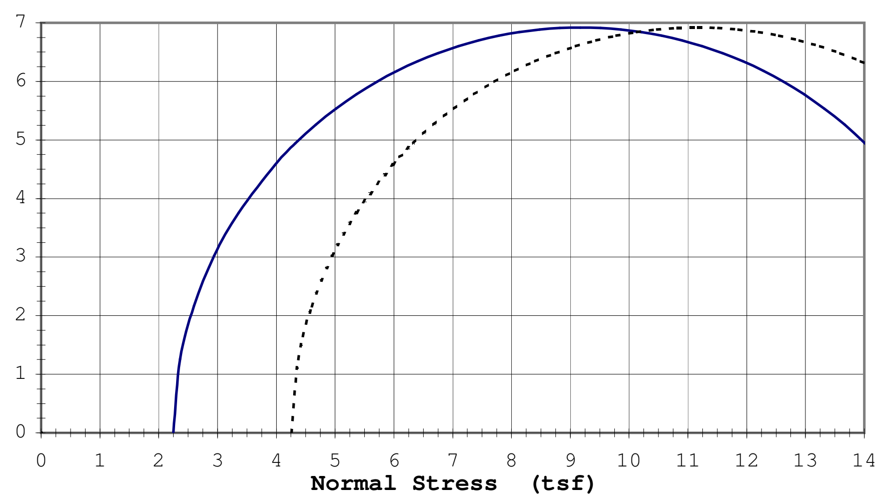




◆	Failure Criterion:	**Max. Deviator Stress**				
	Angle of internal friction, **ϕ' =**	°				
	Apparent Cohesion, **c' =**	**(tsf)**				
	Test Date: 10/5/07	Liquid Limit: 22.5				
	Test Type: CU w/pp	Plastic Limit: 20.8				
	Strain Rate (in/min): 0.0043	Plasticity Index: 1.7				
	Strain Rate (%/min): 0.109	Spec. Gravity : 2.97				
	Before Consolidation	**A**	**B**	**C**	**D**	**E**
	Diameter (in)	1.94				
	Height (in)	3.98				
	Water Content (%)	26.5				
■	Dry Density (pcf)	102.4				
	Void Ratio	0.81				
	After Consolidation					
	Diameter (in)	1.92				
	Height (in)	3.95				
	Water Content (%)	25.5				
△	Dry Density (pcf)	105.5				
	Void Ratio	0.76				
	Back Pressure (tsf)	5.8				
	Minor Principal Stress (tsf)	2.25				
	Max. Deviator Stress (tsf)	13.84				
	Ultimate Deviator Stress (tsf)	13.84				
+	Deviator Stress at Failure (tsf)	13.84				
	Max. Pore Pressure Buildup (tsf)	1.52				
	Pore Pressure Parameter "B"	1.0				
	Pct. Axial Strain at Failure	29.9				
X	"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"					

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





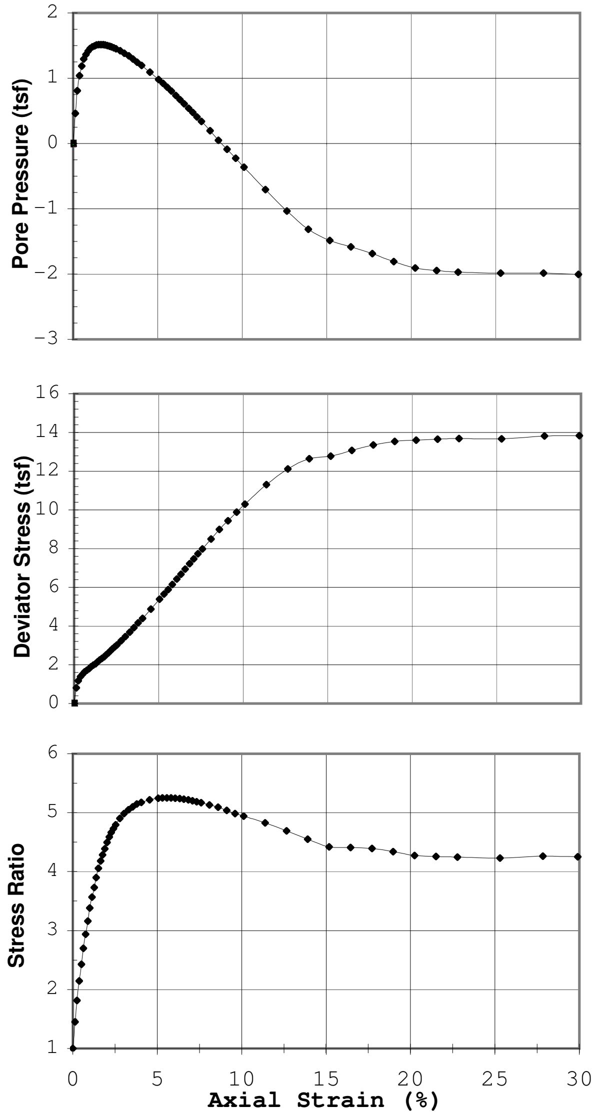
Rupture Envelope at Failure	
α = °	a = (tsf)

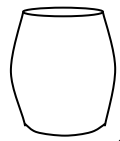
------------	Effective ϕ': °	c'= (tsf)
________	Total ϕ': °	c= (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/11/07**

Project: **Polymet 23/69-862-022B**
Boring #: **07-07C** Sample #: Type: **3T** Depth (ft): **48-50 (Top)**
Soil Type: **Slimes (Silt (ML))**



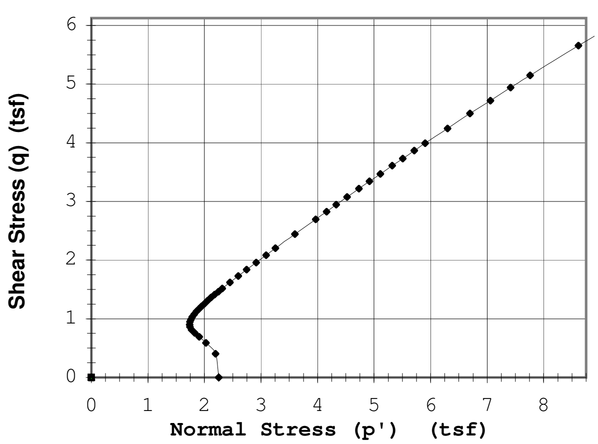


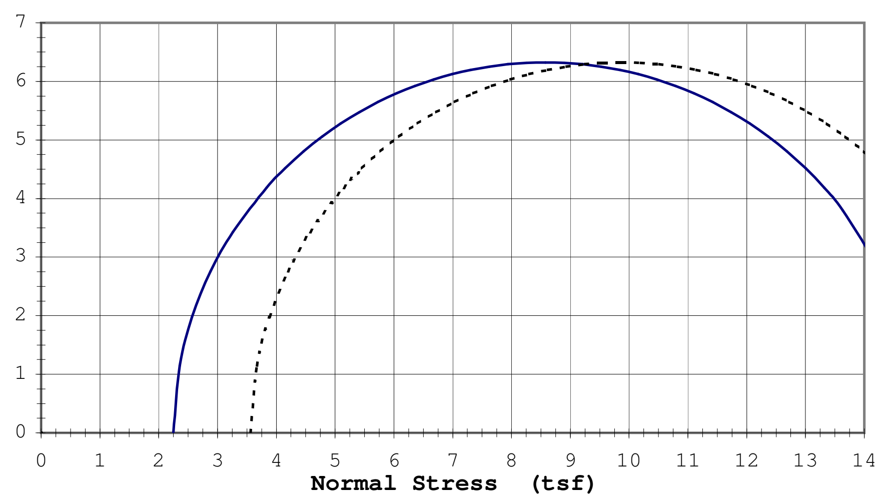
Failure Criterion:	**Given Strain of: 15%**				
Angle of internal friction, φ' =	°				
Apparent Cohesion, c' =	(tsf)				
Test Date:	10/5/07	Liquid Limit:	22.5		
Test Type:	CU w/pp	Plastic Limit:	20.8		
Strain Rate (in/min):	0.0043	Plasticity Index:	1.7		
Strain Rate (%/min):	0.109	Spec. Gravity :	2.97		

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94				
Height (in)	3.98				
Water Content (%)	26.5				
Dry Density (pcf)	102.4				
Void Ratio	0.81				
After Consolidation					
Diameter (in)	1.92				
Height (in)	3.95				
Water Content (%)	25.5				
Dry Density (pcf)	105.5				
Void Ratio	0.76				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	2.25				
Max. Deviator Stress (tsf)	13.84				
Ultimate Deviator Stress (tsf)	13.84				
Deviator Stress at Failure (tsf)	12.65				
Max. Pore Pressure Buildup (tsf)	1.52				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	15.0				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure
α = ° a = (tsf)

------------ Effective φ': ° c'= (tsf)
________ Total φ': ° c= (tsf)

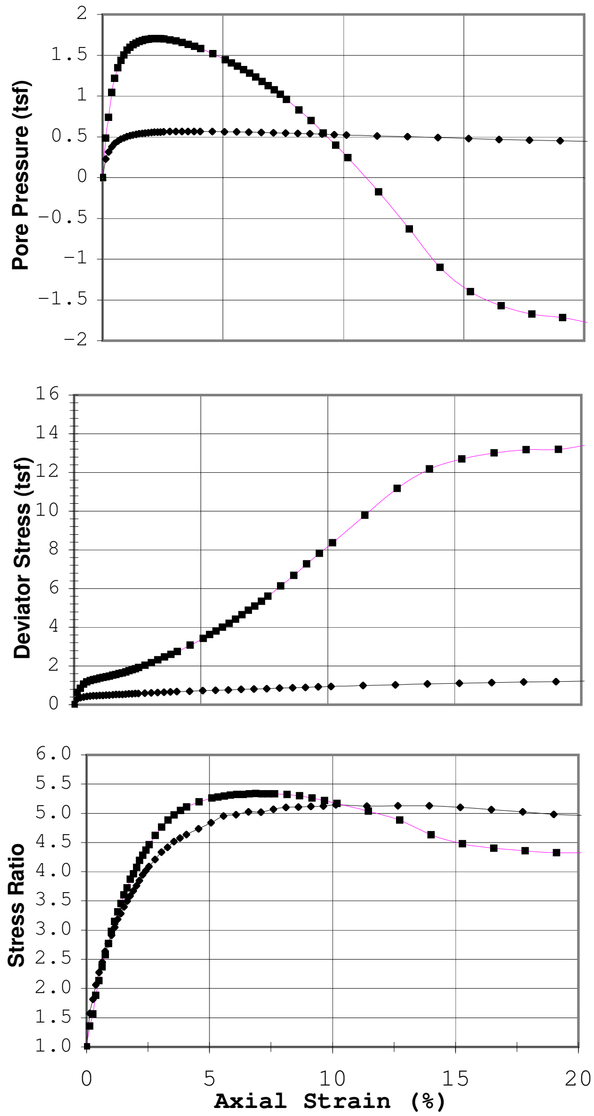
Job: 6250
Boring: 07-07C Depth: 48-50 (Top) Date: 10/11/07

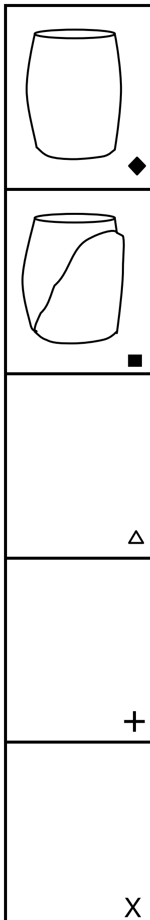
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00												
0.13	0.81	0.46												
0.25	1.17	0.81												
0.38	1.39	1.04												
0.51	1.52	1.18												
0.63	1.63	1.29												
0.76	1.72	1.36												
0.89	1.80	1.42												
1.01	1.89	1.46												
1.14	1.98	1.48												
1.27	2.06	1.50												
1.39	2.15	1.51												
1.52	2.25	1.51												
1.64	2.33	1.52												
1.77	2.42	1.51												
1.90	2.51	1.51												
2.02	2.61	1.50												
2.15	2.72	1.49												
2.28	2.82	1.48												
2.40	2.92	1.47												
2.53	3.03	1.45												
2.78	3.24	1.42												
3.04	3.46	1.38												
3.29	3.68	1.34												
3.54	3.91	1.29												
3.80	4.17	1.24												
4.05	4.40	1.20												
4.55	4.88	1.09												
5.06	5.39	0.98												
5.31	5.65	0.92												
5.57	5.89	0.86												
5.82	6.15	0.80												
6.07	6.43	0.74												
6.33	6.68	0.67												
6.58	6.94	0.61												
6.83	7.22	0.54												
7.09	7.47	0.47												
7.34	7.73	0.40												
7.59	7.98	0.34												
8.10	8.49	0.20												
8.60	9.00	0.05												
9.11	9.44	-0.09												
9.62	9.88	-0.23												
10.12	10.30	-0.36												
11.39	11.31	-0.71												
12.65	12.12	-1.03												
13.92	12.65	-1.31												
15.18	12.78	-1.48												
16.45	13.07	-1.58												
17.71	13.35	-1.69												
18.98	13.54	-1.81												
20.24	13.61	-1.91												
21.51	13.66	-1.94												
22.78	13.69	-1.97												
25.31	13.68	-1.98												
27.84	13.83	-1.99												
29.90	13.84	-2.01												

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **12-14**
Soil Type: **Slimes (Lean Clay (CL))**



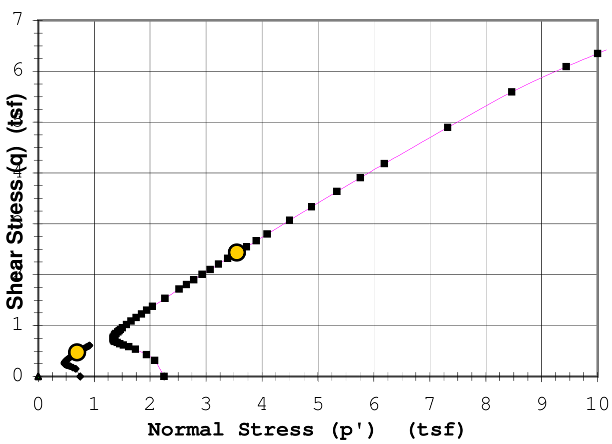


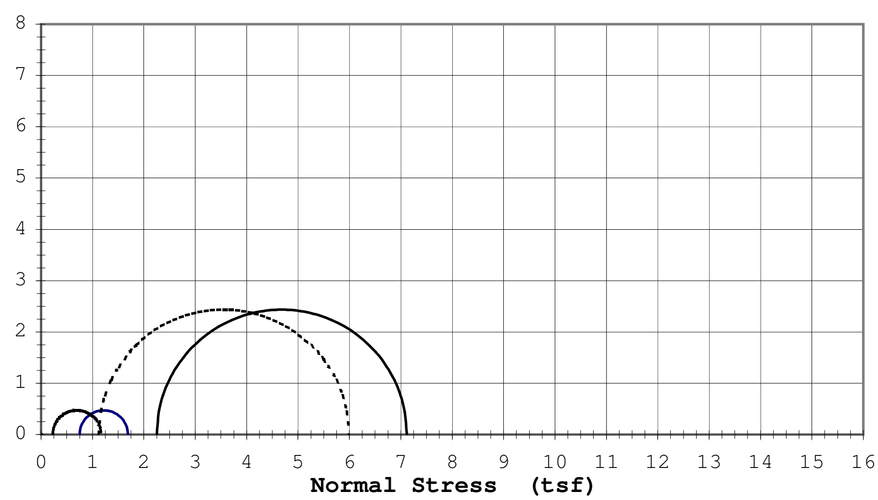
Failure Criterion:		**Max. Stress Ratio**			
Angle of internal friction, φ' =		°			
Apparent Cohesion, c' =		(tsf)			
Test Date:	10/15/07	Liquid Limit:	31.9		
Test Type:	CU w/pp	Plastic Limit:	19.4		
Strain Rate (in/min):	0.004	Plasticity Index:	12.5		
Strain Rate (%/min):	0.101	Spec. Gravity :	2.98		

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	45.3	30.9			
Dry Density (pcf)	77.9	94.2			
Void Ratio	1.39	0.98			
After Consolidation					
Diameter (in)	1.91	1.92			
Height (in)	3.95	3.92			
Water Content (%)	43.0	30.4			
Dry Density (pcf)	81.6	97.7			
Void Ratio	1.28	0.91			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	0.75	2.25			
Max. Deviator Stress (tsf)	1.22	13.45			
Ultimate Deviator Stress (tsf)	1.22	13.45			
Deviator Stress at Failure (tsf)	0.94	4.87			
Max. Pore Pressure Buildup (tsf)	0.57	1.70			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	10.1	6.9			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





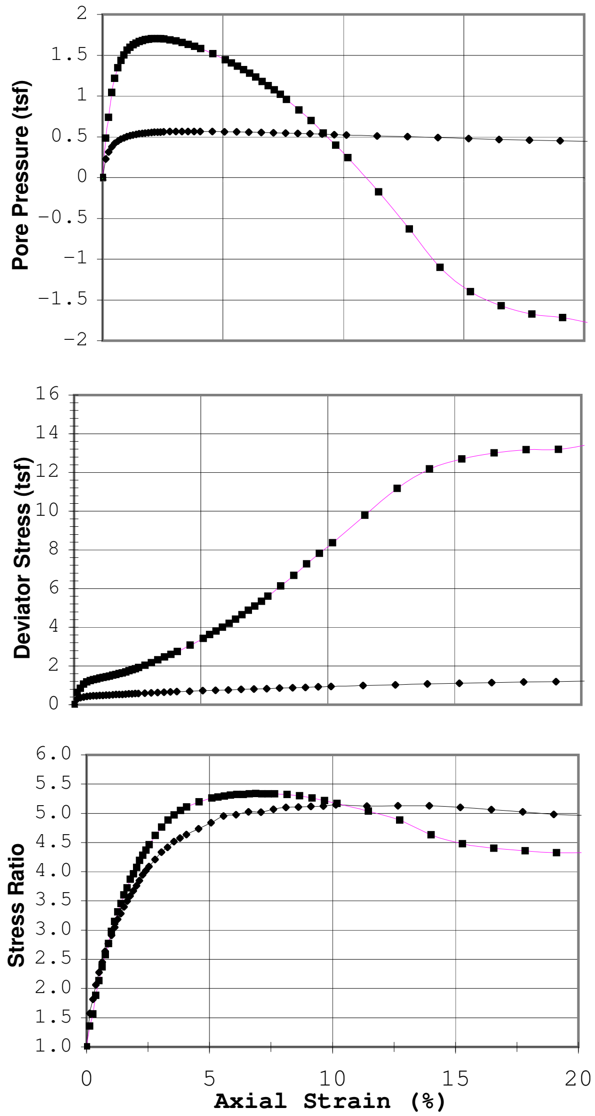
Rupture Envelope at Failure	
α = °	a = (tsf)

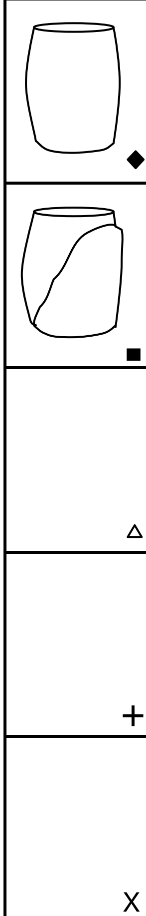
------------	Effective φ': °	c'=	(tsf)
________	Total φ': °	c=	(tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **12-14**
Soil Type: **Slimes (Lean Clay (CL))**





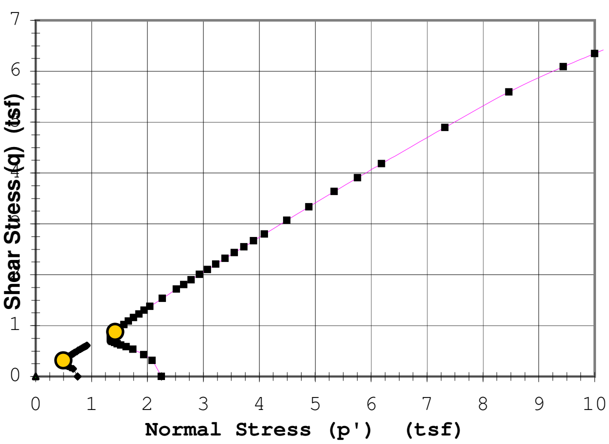
Failure Criterion:	**Max. Pore Pressure**
Angle of internal friction, **ϕ' =**	°
Apparent Cohesion, **c' =**	**(tsf)**

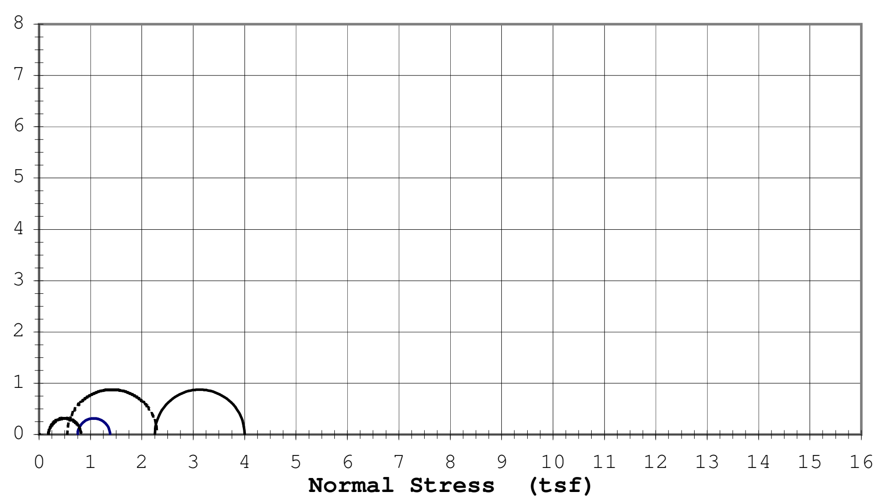
Test Date:	10/15/07	Liquid Limit:	31.9
Test Type:	CU w/pp	Plastic Limit:	19.4
Strain Rate (in/min):	0.004	Plasticity Index:	12.5
Strain Rate (%/min):	0.101	Spec. Gravity :	2.98

Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	45.3	30.9			
Dry Density (pcf)	77.9	94.2			
Void Ratio	1.39	0.98			
After Consolidation					
Diameter (in)	1.91	1.92			
Height (in)	3.95	3.92			
Water Content (%)	43.0	30.4			
Dry Density (pcf)	81.6	97.7			
Void Ratio	1.28	0.91			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	0.75	2.25			
Max. Deviator Stress (tsf)	1.22	13.45			
Ultimate Deviator Stress (tsf)	1.22	13.45			
Deviator Stress at Failure (tsf)	0.63	1.75			
Max. Pore Pressure Buildup (tsf)	0.57	1.70			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	3.3	2.2			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





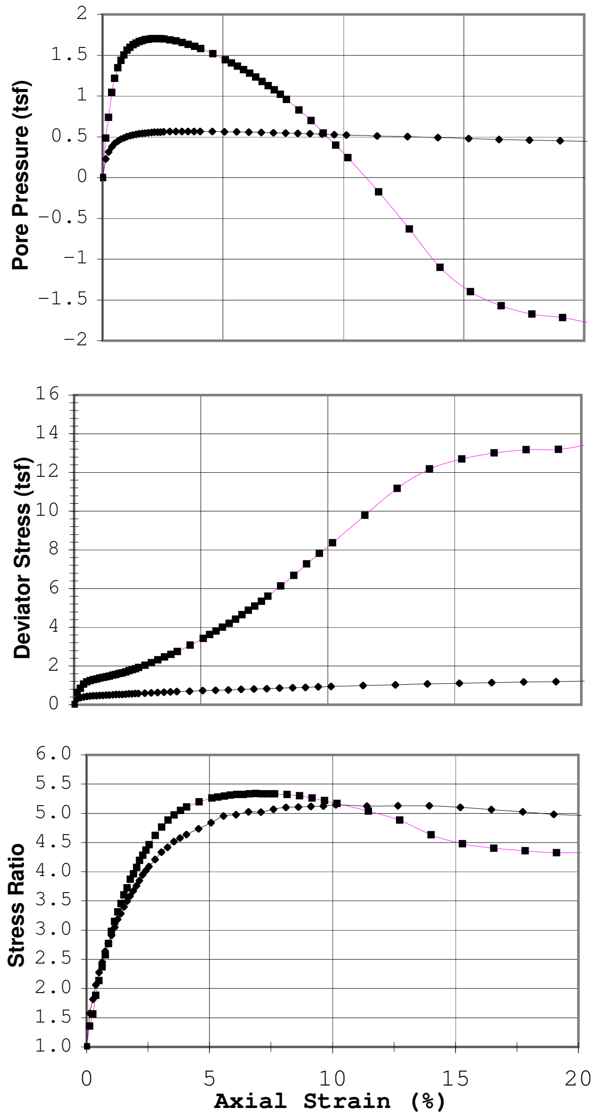
Rupture Envelope at Failure			
α =	°	a =	(tsf)

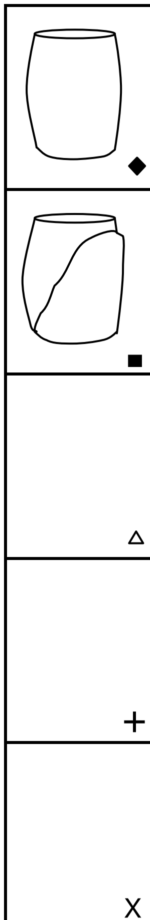
------------	Effective ϕ':	°	c'=	(tsf)
________	Total ϕ':	°	c=	(tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **12-14**
Soil Type: **Slimes (Lean Clay (CL))**

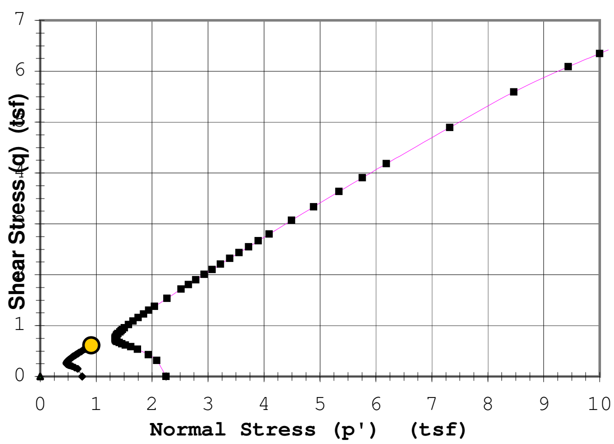


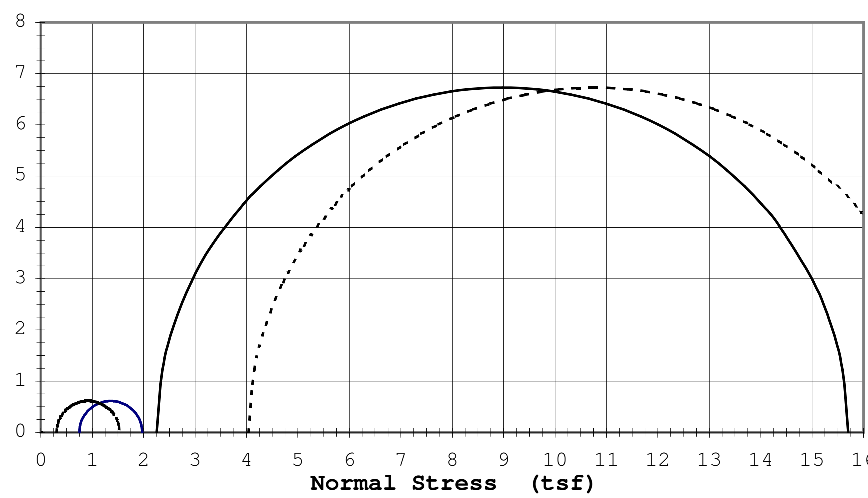


Failure Criterion:	**Max. Deviator Stress**				
Angle of internal friction, ϕ' =	°				
Apparent Cohesion, c' =	(tsf)				
Test Date: 10/15/07	Liquid Limit: 31.9				
Test Type: CU w/pp	Plastic Limit: 19.4				
Strain Rate (in/min): 0.004	Plasticity Index: 12.5				
Strain Rate (%/min): 0.101	Spec. Gravity : 2.98				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	45.3	30.9			
Dry Density (pcf)	77.9	94.2			
Void Ratio	1.39	0.98			
After Consolidation					
Diameter (in)	1.91	1.92			
Height (in)	3.95	3.92			
Water Content (%)	43.0	30.4			
Dry Density (pcf)	81.6	97.7			
Void Ratio	1.28	0.91			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	0.75	2.25			
Max. Deviator Stress (tsf)	1.22	13.45			
Ultimate Deviator Stress (tsf)	1.22	13.45			
Deviator Stress at Failure (tsf)	1.22	13.45			
Max. Pore Pressure Buildup (tsf)	0.57	1.70			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	20.3	20.4			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





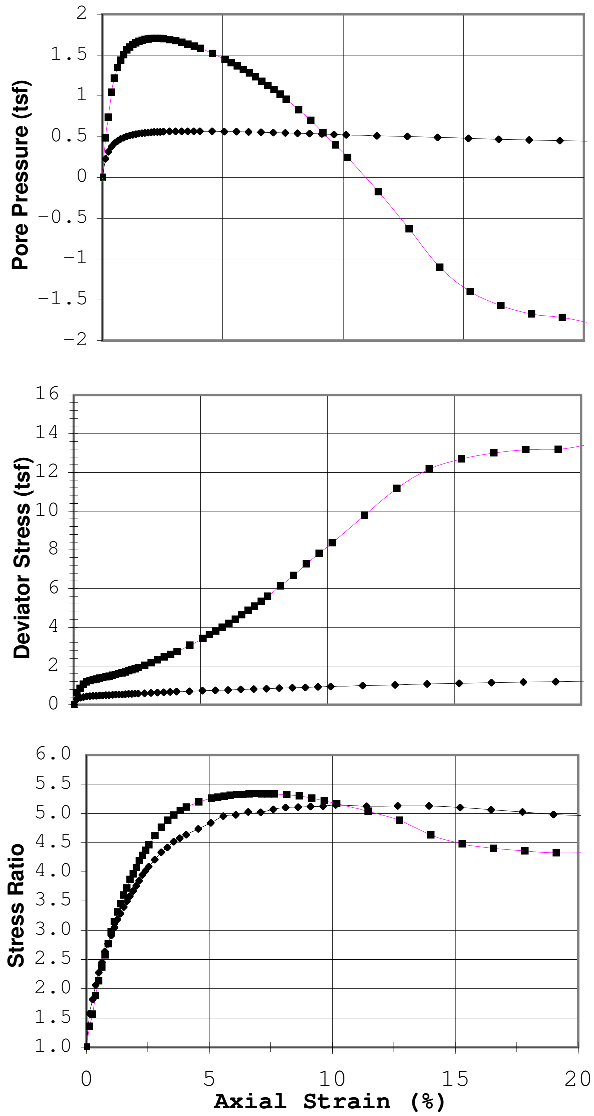
Rupture Envelope at Failure	
α = °	a = (tsf)

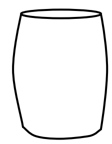
------------	Effective ϕ': °	c'= (tsf)
________	Total ϕ': °	c= (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **12-14**
Soil Type: **Slimes (Lean Clay (CL))**

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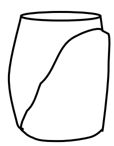
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Failure Criterion: **Given Strain of: 15%**

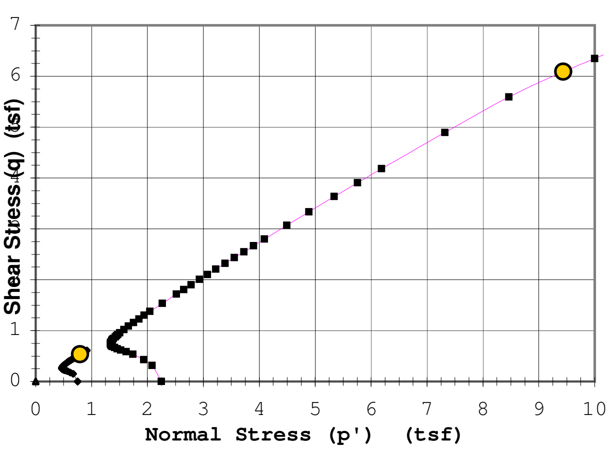
Angle of internal friction, **ϕ' =** °
Apparent Cohesion, **c' =** **(tsf)**

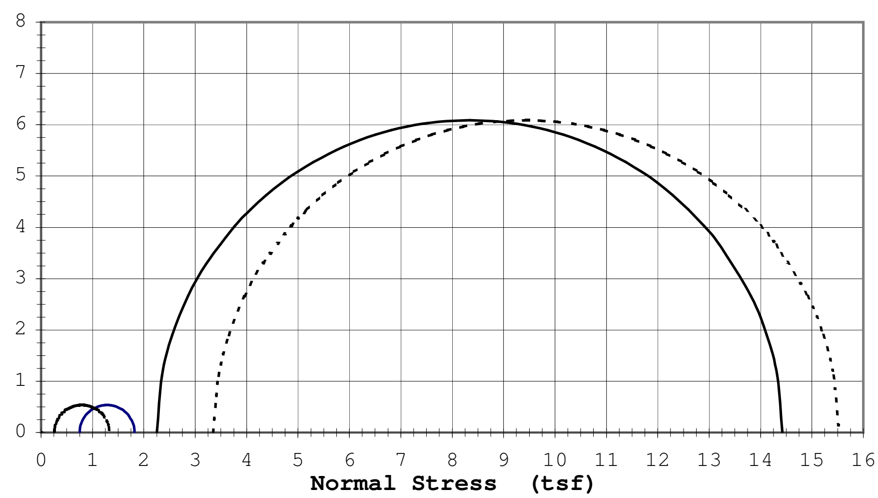
Test Date:	10/15/07	Liquid Limit:	31.9
Test Type:	CU w/pp	Plastic Limit:	19.4
Strain Rate (in/min):	0.004	Plasticity Index:	12.5
Strain Rate (%/min):	0.101	Spec. Gravity :	2.98

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	45.3	30.9			
Dry Density (pcf)	77.9	94.2			
Void Ratio	1.39	0.98			
After Consolidation					
Diameter (in)	1.91	1.92			
Height (in)	3.95	3.92			
Water Content (%)	43.0	30.4			
Dry Density (pcf)	81.6	97.7			
Void Ratio	1.28	0.91			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	0.75	2.25			
Max. Deviator Stress (tsf)	1.22	13.45			
Ultimate Deviator Stress (tsf)	1.22	13.45			
Deviator Stress at Failure (tsf)	1.07	12.17			
Max. Pore Pressure Buildup (tsf)	0.57	1.70			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure		
α = °	a =	(tsf)

------------	Effective ϕ':	°	c'=	(tsf)
________	Total ϕ':	°	c=	(tsf)

Job No. 6250

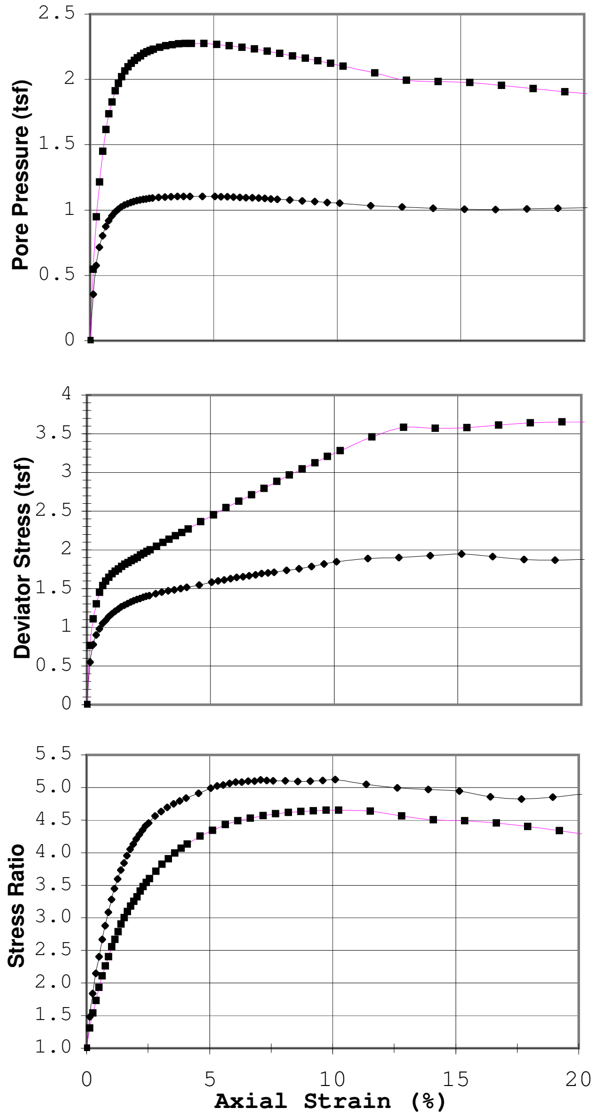
Boring #: 07-09 Depth (ft): 12-14 Date: 10/19/07

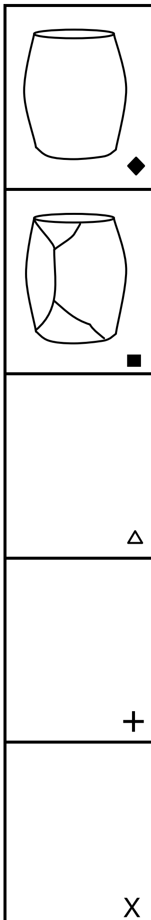
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00									
0.13	0.30	0.23	0.13	0.63	0.48									
0.25	0.36	0.31	0.25	0.85	0.74									
0.38	0.40	0.38	0.38	1.07	1.04									
0.51	0.42	0.42	0.51	1.17	1.22									
0.63	0.44	0.45	0.64	1.24	1.35									
0.76	0.46	0.47	0.76	1.29	1.44									
0.89	0.47	0.49	0.89	1.33	1.50									
1.02	0.47	0.50	1.02	1.37	1.56									
1.14	0.48	0.51	1.15	1.40	1.60									
1.27	0.50	0.52	1.27	1.44	1.63									
1.39	0.50	0.53	1.40	1.48	1.65									
1.52	0.51	0.54	1.53	1.52	1.67									
1.65	0.52	0.54	1.66	1.55	1.68									
1.77	0.53	0.55	1.78	1.61	1.69									
1.90	0.54	0.55	1.91	1.64	1.70									
2.03	0.55	0.55	2.04	1.69	1.70									
2.15	0.56	0.56	2.17	1.75	1.70									
2.28	0.57	0.56	2.29	1.80	1.70									
2.41	0.58	0.56	2.42	1.85	1.70									
2.53	0.59	0.56	2.55	1.91	1.70									
2.79	0.60	0.56	2.80	2.04	1.69									
3.04	0.62	0.56	3.06	2.17	1.67									
3.29	0.63	0.57	3.31	2.31	1.65									
3.55	0.65	0.57	3.57	2.46	1.63									
3.80	0.66	0.57	3.82	2.60	1.61									
4.05	0.67	0.57	4.08	2.75	1.58									
4.56	0.69	0.56	4.59	3.07	1.52									
5.07	0.72	0.56	5.10	3.43	1.44									
5.57	0.75	0.56	5.35	3.61	1.41									
6.08	0.77	0.56	5.61	3.80	1.37									
6.59	0.79	0.55	5.86	4.01	1.32									
7.09	0.81	0.55	6.12	4.20	1.28									
7.60	0.83	0.55	6.37	4.41	1.23									
8.11	0.86	0.54	6.63	4.64	1.18									
8.61	0.88	0.54	6.88	4.87	1.13									
9.12	0.90	0.53	7.14	5.10	1.07									
9.63	0.92	0.53	7.39	5.33	1.02									
10.13	0.94	0.52	7.64	5.60	0.96									
11.40	0.98	0.51	8.15	6.14	0.83									
12.67	1.03	0.50	8.66	6.67	0.70									
13.93	1.07	0.49	9.17	7.26	0.54									
15.20	1.11	0.48	9.68	7.82	0.40									
16.46	1.15	0.47	10.19	8.36	0.24									
17.73	1.17	0.46	11.47	9.79	-0.17									
19.00	1.20	0.45	12.74	11.18	-0.63									
20.26	1.22	0.44	14.01	12.17	-1.10									
			15.29	12.70	-1.40									
			16.56	13.00	-1.57									
			17.84	13.18	-1.67									
			19.11	13.19	-1.72									
			20.38	13.45	-1.79									

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **27.5-29.5**
Soil Type: **Slimes (Silt (ML))**





Failure Criterion: **Max. Stress Ratio**

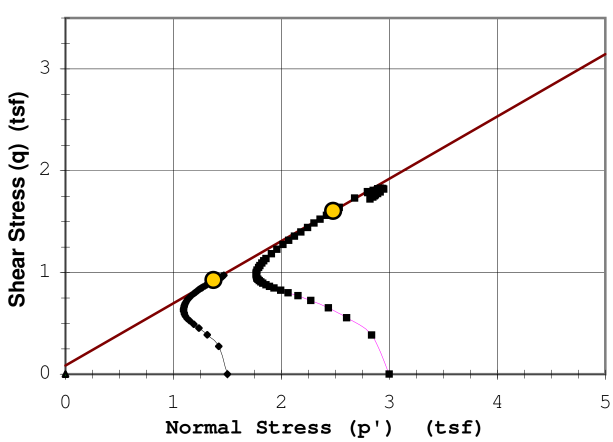
Angle of internal friction, ϕ' = **37.7 °**
Apparent Cohesion, **c'** = **0.11 (tsf)**

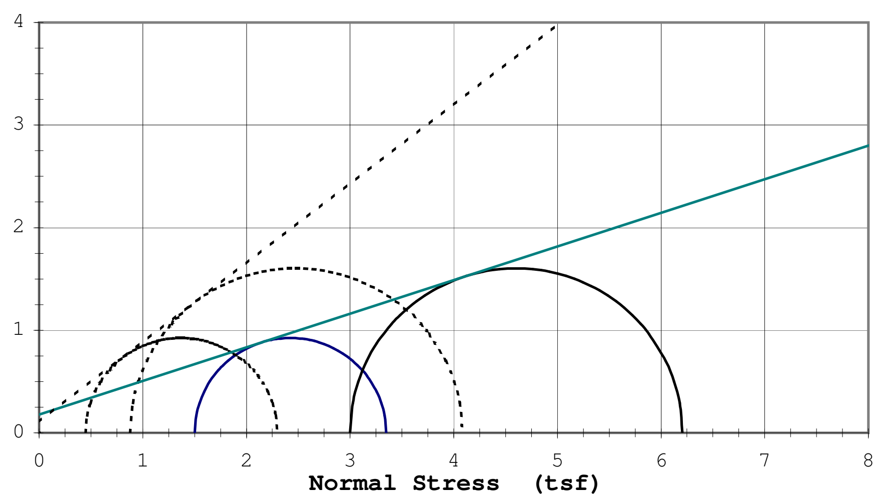
Test Date:	10/12/07	Liquid Limit:	21.3
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.6
Strain Rate (%/min):	0.101	Spec. Gravity :	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	32.7	36.1			
Dry Density (pcf)	92.6	88.0			
Void Ratio	0.99	1.10			
After Consolidation					
Diameter (in)	1.92	1.90			
Height (in)	3.96	3.90			
Water Content (%)	31.5	32.7			
Dry Density (pcf)	95.6	93.9			
Void Ratio	0.93	0.97			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	1.95	3.65			
Ultimate Deviator Stress (tsf)	1.80	3.44			
Deviator Stress at Failure (tsf)	1.85	3.21			
Max. Pore Pressure Buildup (tsf)	1.11	2.28			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	10.1	9.7			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure
α = 31.5 ° a = 0.1 (tsf)

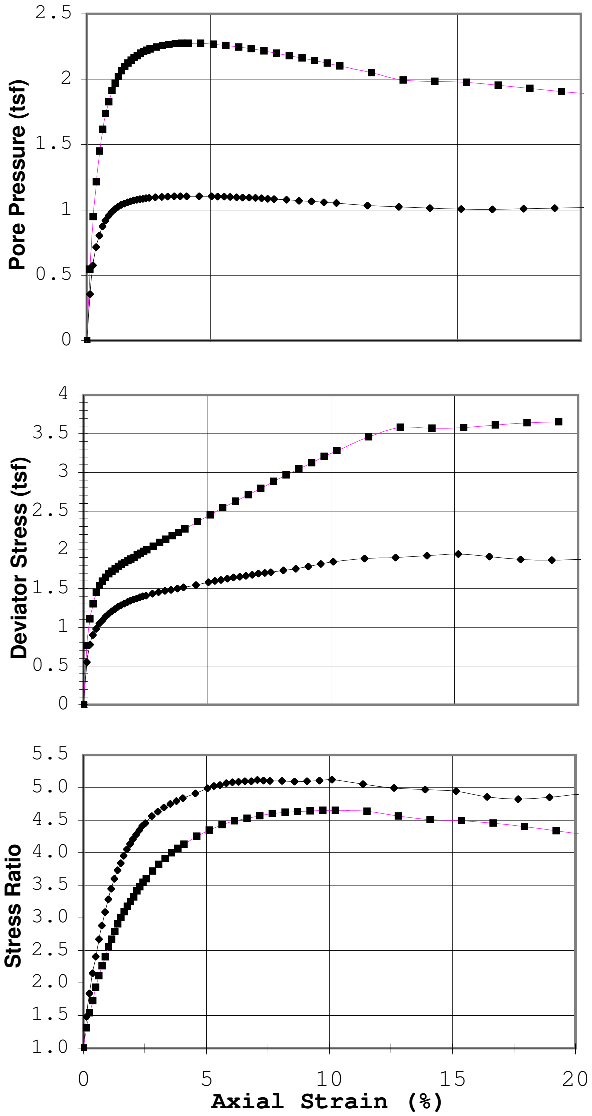
------------	Effective ϕ':	37.7 °	c'=	0.11 (tsf)
________	Total ϕ':	18.2 °	c=	0.18 (tsf)

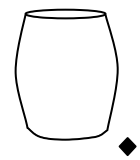
9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

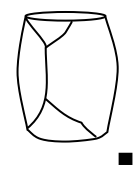
TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **27.5-29.5**
Soil Type: **Slimes (Silt (ML))**







Failure Criterion:	Max. Pore Pressure
Angle of internal friction, φ' =	32.2 °
Apparent Cohesion, c' =	0.17 (tsf)

Test Date:	10/12/07	Liquid Limit:	21.3
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.6
Strain Rate (%/min):	0.101	Spec. Gravity :	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	32.7	36.1			
Dry Density (pcf)	92.6	88.0			
Void Ratio	0.99	1.10			
After Consolidation					
Diameter (in)	1.92	1.90			
Height (in)	3.96	3.90			
Water Content (%)	31.5	32.7			
Dry Density (pcf)	95.6	93.9			
Void Ratio	0.93	0.97			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	1.95	3.65			
Ultimate Deviator Stress (tsf)	1.80	3.44			
Deviator Stress at Failure (tsf)	1.51	2.27			
Max. Pore Pressure Buildup (tsf)	1.11	2.28			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	4.0	4.1			

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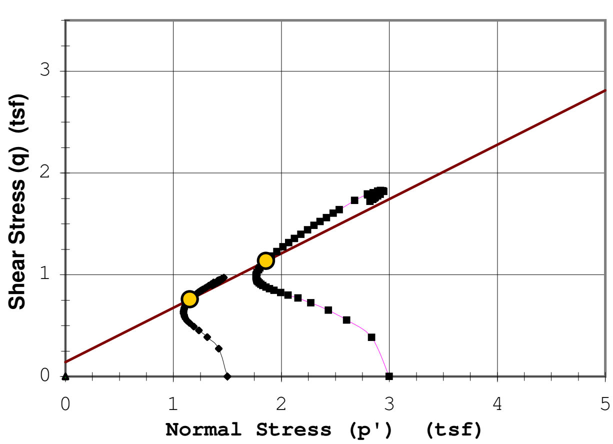
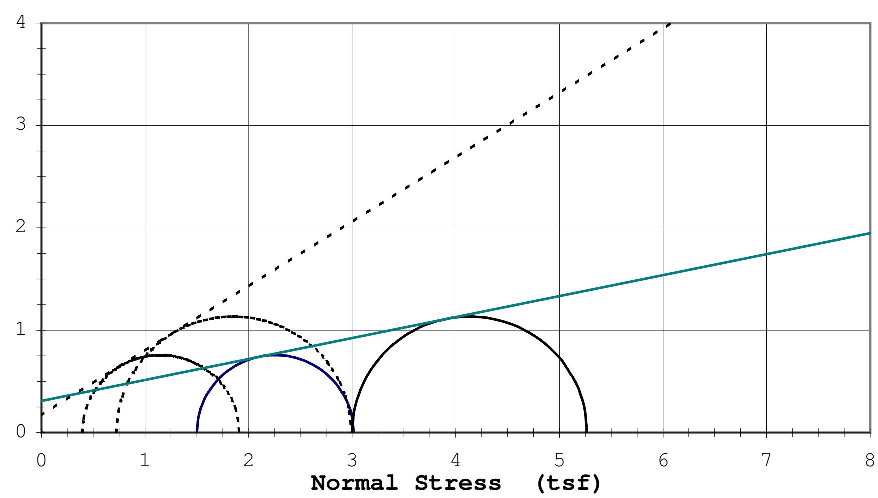
Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





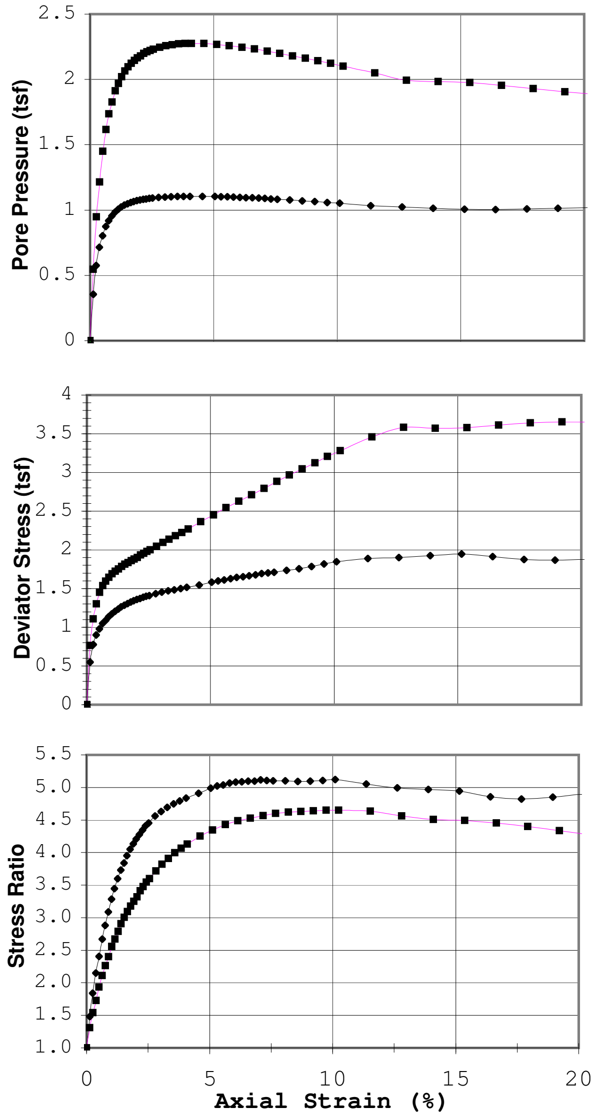
Rupture Envelope at Failure	
α = 28.1 °	a = 0.1 (tsf)

------------	Effective φ': 32.2 °	c'=	0.17 (tsf)
________	Total φ': 11.6 °	c=	0.31 (tsf)

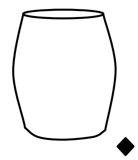
TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **27.5-29.5**
Soil Type: **Slimes (Silt (ML))**



Failure Criterion: **Max. Deviator Stress**
Angle of internal friction, ϕ' = **35.9 °**
Apparent Cohesion, c' = **0.14 (tsf)**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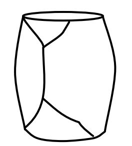
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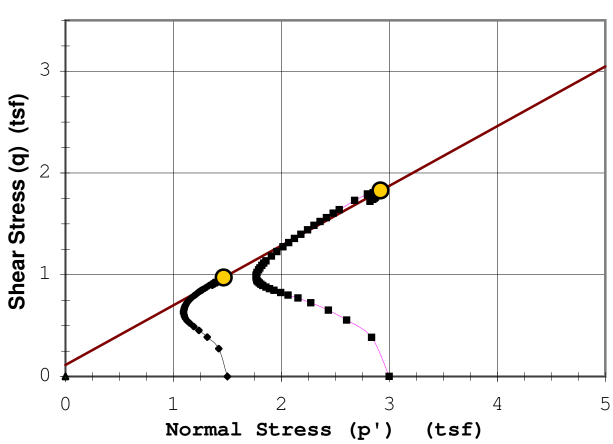
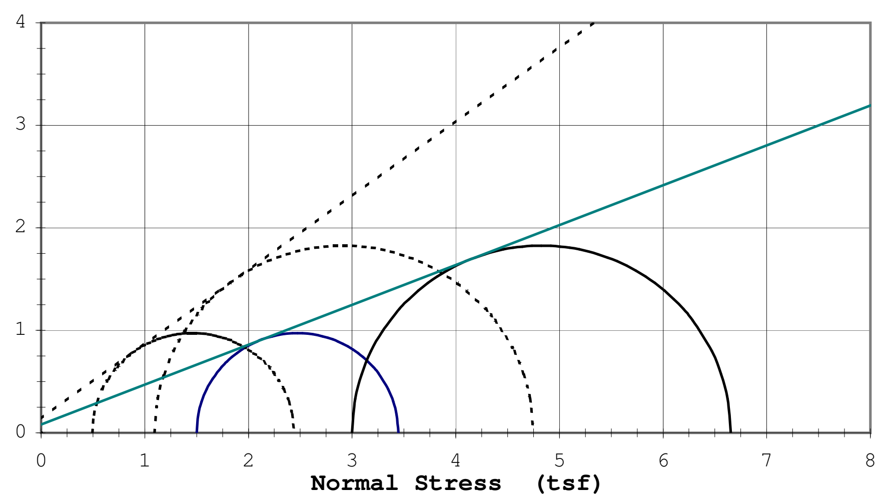
Test Date:	10/12/07	Liquid Limit:	21.3
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.6
Strain Rate (%/min):	0.101	Spec. Gravity :	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	32.7	36.1			
Dry Density (pcf)	92.6	88.0			
Void Ratio	0.99	1.10			
After Consolidation					
Diameter (in)	1.92	1.90			
Height (in)	3.96	3.90			
Water Content (%)	31.5	32.7			
Dry Density (pcf)	95.6	93.9			
Void Ratio	0.93	0.97			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	1.95	3.65			
Ultimate Deviator Stress (tsf)	1.80	3.44			
Deviator Stress at Failure (tsf)	1.95	3.65			
Max. Pore Pressure Buildup (tsf)	1.11	2.28			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	15.2	19.2			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 30.4 °	a = 0.1 (tsf)

------------	Effective ϕ':	35.9 °	c'=	0.14 (tsf)
________	Total ϕ':	21.3 °	c=	0.08 (tsf)

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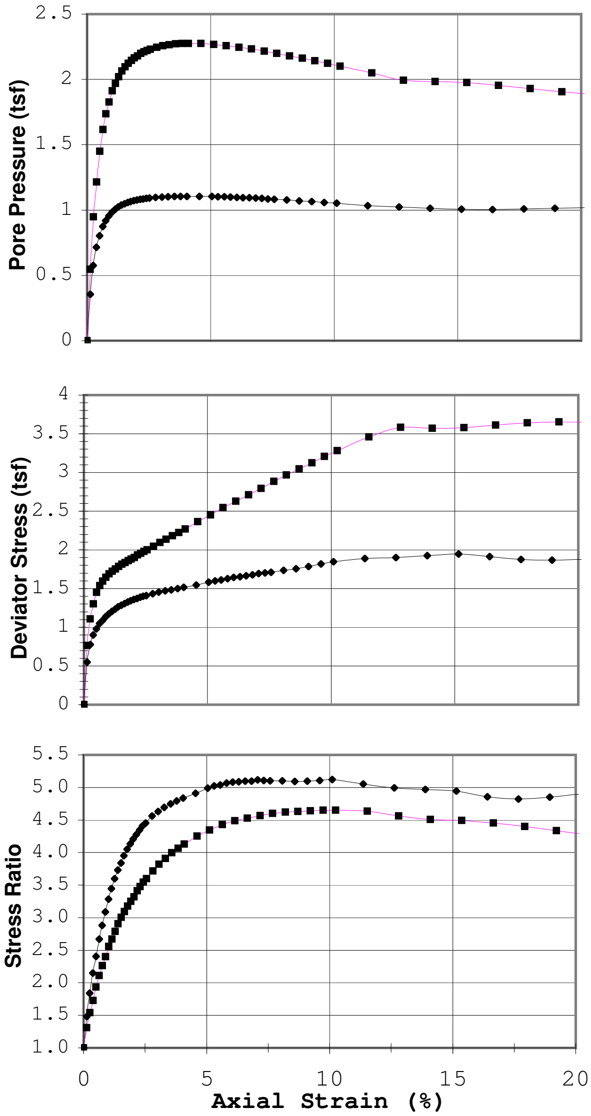
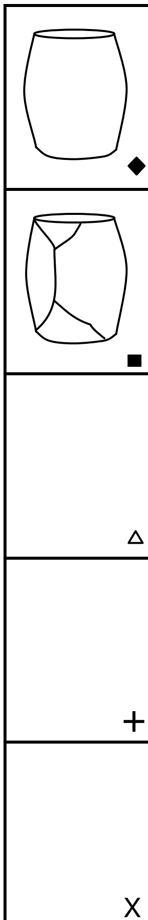
TRIAXIAL TEST ASTM: D 4767

Job No. 6250
Date: 10/19/07

Project: Polymet #23/69-862-022B
Boring #: 07-09 Sample #: Type: 3T Depth (ft): 27.5-29.5
Soil Type: Slimes (Silt (ML))





Failure Criterion: **Given Strain of: 15%**

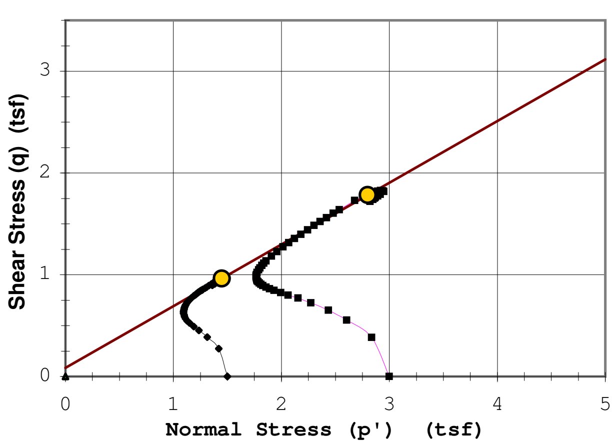
Angle of internal friction, φ' = **37.3 °**
Apparent Cohesion, c' = **0.11 (tsf)**

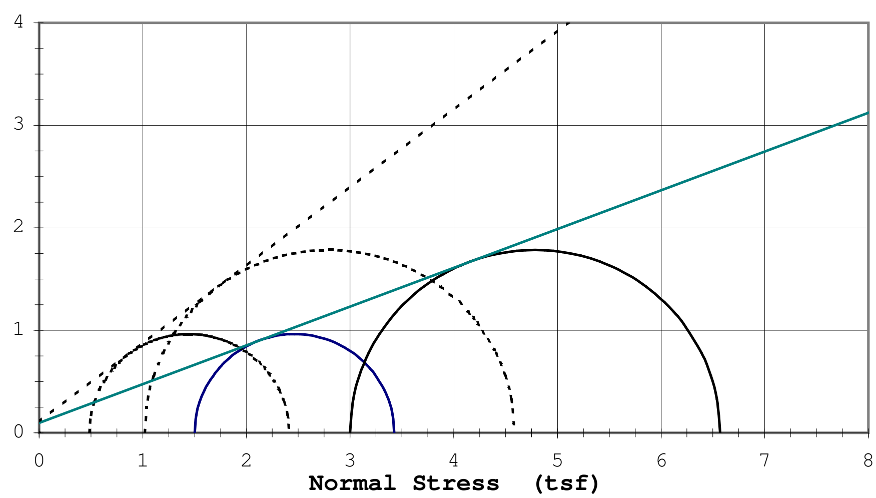
Test Date:	10/12/07	Liquid Limit:	21.3
Test Type:	CU w/pp	Plastic Limit:	16.7
Strain Rate (in/min):	0.004	Plasticity Index:	4.6
Strain Rate (%/min):	0.101	Spec. Gravity :	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	32.7	36.1			
Dry Density (pcf)	92.6	88.0			
Void Ratio	0.99	1.10			
After Consolidation					
Diameter (in)	1.92	1.90			
Height (in)	3.96	3.90			
Water Content (%)	31.5	32.7			
Dry Density (pcf)	95.6	93.9			
Void Ratio	0.93	0.97			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	1.50	3.00			
Max. Deviator Stress (tsf)	1.95	3.65			
Ultimate Deviator Stress (tsf)	1.80	3.44			
Deviator Stress at Failure (tsf)	1.93	3.57			
Max. Pore Pressure Buildup (tsf)	1.11	2.28			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 31.2 °	a = 0.1 (tsf)

------------	Effective φ':	37.3 °	c'=	0.11 (tsf)
________	Total φ':	20.7 °	c=	0.10 (tsf)

Job No. 6250

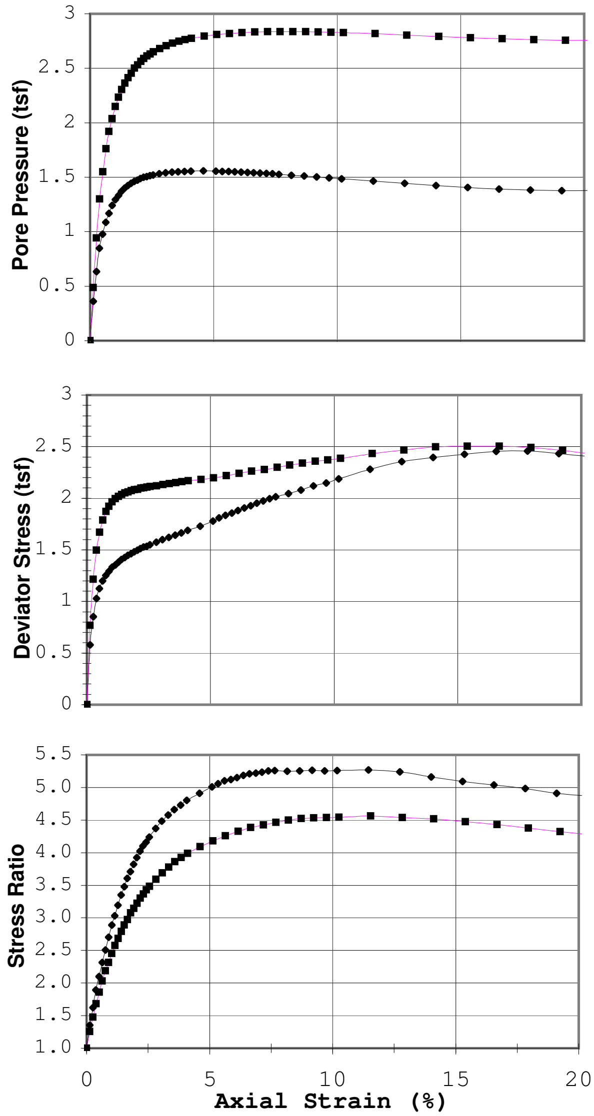
Boring #: 07-09 Depth (ft): 27.5-29.5 Date: 10/19/07

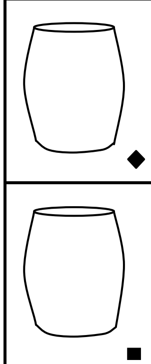
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00									
0.13	0.55	0.35	0.13	0.76	0.55									
0.25	0.78	0.57	0.26	1.11	0.95									
0.38	0.90	0.71	0.39	1.30	1.21									
0.51	0.98	0.80	0.51	1.45	1.45									
0.63	1.05	0.87	0.64	1.54	1.61									
0.76	1.09	0.92	0.77	1.60	1.74									
0.88	1.14	0.96	0.90	1.65	1.83									
1.01	1.17	0.99	1.03	1.69	1.91									
1.14	1.21	1.01	1.15	1.72	1.97									
1.26	1.24	1.02	1.28	1.75	2.02									
1.39	1.26	1.04	1.41	1.78	2.06									
1.52	1.29	1.05	1.54	1.81	2.10									
1.64	1.31	1.06	1.67	1.84	2.12									
1.77	1.33	1.07	1.79	1.86	2.15									
1.89	1.34	1.07	1.92	1.88	2.16									
2.02	1.36	1.08	2.05	1.90	2.18									
2.15	1.37	1.08	2.18	1.93	2.20									
2.27	1.39	1.09	2.31	1.95	2.21									
2.40	1.40	1.09	2.43	1.98	2.22									
2.53	1.41	1.09	2.56	2.00	2.23									
2.78	1.44	1.10	2.82	2.05	2.25									
3.03	1.45	1.10	3.07	2.09	2.26									
3.28	1.47	1.10	3.33	2.13	2.27									
3.54	1.48	1.10	3.59	2.18	2.27									
3.79	1.50	1.10	3.84	2.22	2.27									
4.04	1.51	1.11	4.10	2.27	2.28									
4.55	1.54	1.11	4.61	2.36	2.27									
5.05	1.58	1.10	5.13	2.45	2.27									
5.30	1.60	1.10	5.64	2.55	2.26									
5.56	1.61	1.10	6.15	2.63	2.25									
5.81	1.63	1.10	6.66	2.71	2.23									
6.06	1.64	1.10	7.18	2.79	2.22									
6.31	1.65	1.10	7.69	2.88	2.20									
6.57	1.67	1.09	8.20	2.97	2.18									
6.82	1.68	1.09	8.71	3.04	2.16									
7.07	1.69	1.09	9.22	3.12	2.14									
7.32	1.70	1.09	9.74	3.21	2.12									
7.58	1.71	1.08	10.25	3.28	2.10									
8.08	1.74	1.08	11.53	3.46	2.05									
8.59	1.76	1.07	12.81	3.58	1.99									
9.09	1.79	1.06	14.09	3.57	1.98									
9.60	1.82	1.06	15.37	3.58	1.97									
10.10	1.85	1.05	16.65	3.61	1.95									
11.37	1.89	1.03	17.94	3.64	1.93									
12.63	1.90	1.02	19.22	3.65	1.91									
13.89	1.93	1.01	20.50	3.65	1.88									
15.15	1.95	1.01	21.78	3.63	1.87									
16.41	1.91	1.00	23.06	3.58	1.87									
17.68	1.87	1.01	24.34	3.55	1.88									
18.94	1.87	1.01	25.62	3.52	1.89									
20.20	1.88	1.02	26.90	3.50	1.89									
21.47	1.86	1.02	28.19	3.48	1.89									
22.73	1.84	1.02	29.37	3.44	1.90									
25.25	1.82	1.03												
27.78	1.79	1.04												
29.95	1.80	1.04												

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **36.5-38.5**
Soil Type: **Slimes (Silt (ML))**





Failure Criterion: **Max. Stress Ratio**

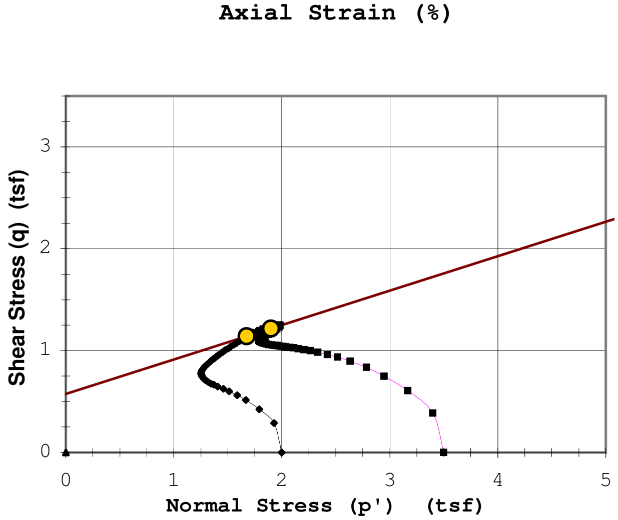
Angle of internal friction, ϕ' = **19.8 °**
Apparent Cohesion, **c'** = **0.61 (tsf)**

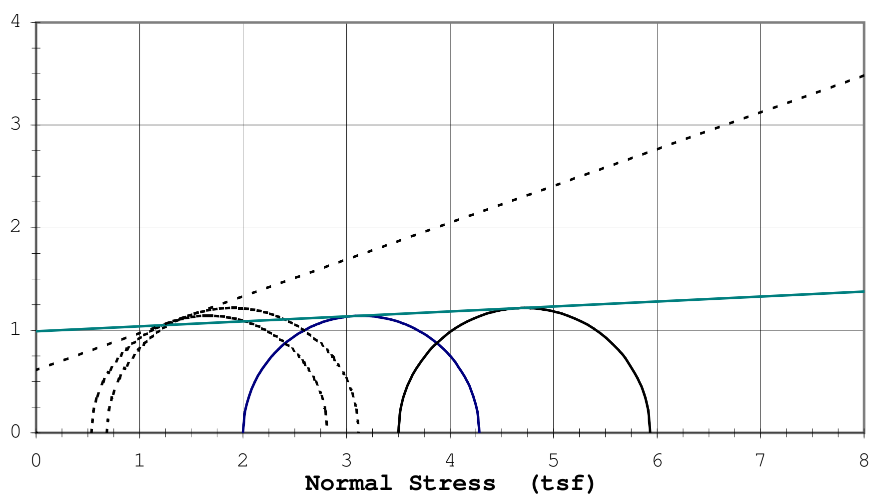
Test Date:	10/11/07	Liquid Limit:	28.0
Test Type:	CU w/pp	Plastic Limit:	22.6
Strain Rate (in/min):	0.004	Plasticity Index:	5.4
Strain Rate (%/min):	0.102	Spec. Gravity :	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	38.7	41.0			
Dry Density (pcf)	85.3	82.5			
Void Ratio	1.17	1.24			
After Consolidation					
Diameter (in)	1.90	1.89			
Height (in)	3.93	3.90			
Water Content (%)	35.5	35.9			
Dry Density (pcf)	90.1	89.6			
Void Ratio	1.05	1.06			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	2.00	3.50			
Max. Deviator Stress (tsf)	2.46	2.50			
Ultimate Deviator Stress (tsf)	2.22	2.20			
Deviator Stress at Failure (tsf)	2.28	2.43			
Max. Pore Pressure Buildup (tsf)	1.56	2.84			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	11.5	11.5			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





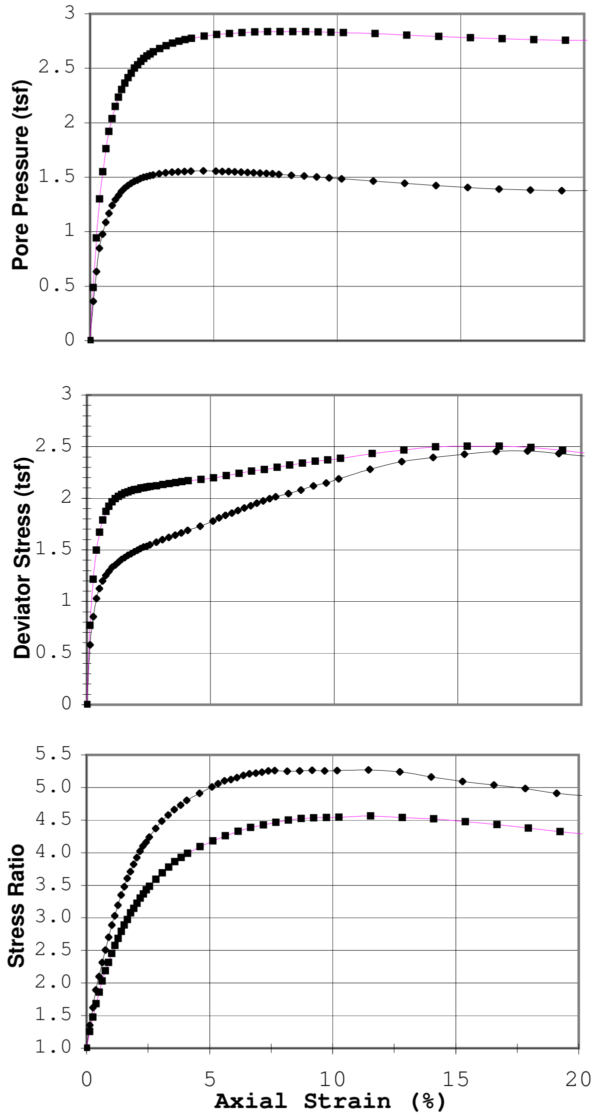
Rupture Envelope at Failure
α = 18.7 ° a = 0.6 (tsf)

------------	Effective ϕ':	19.8 °	c'=	0.61 (tsf)
________	Total ϕ':	2.8 °	c=	0.99 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **36.5-38.5**
Soil Type: **Slimes (Silt (ML))**



Failure Criterion: **Max. Pore Pressure**

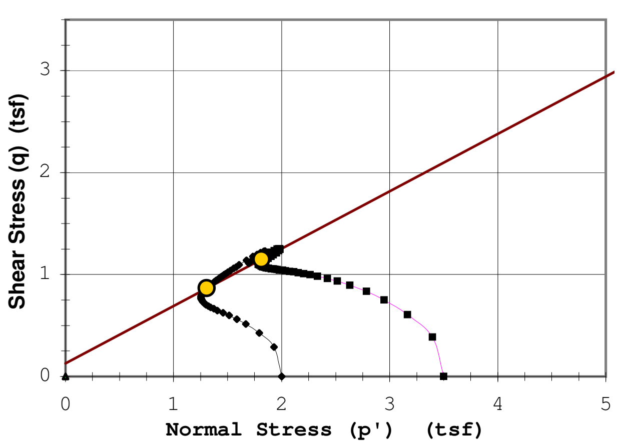
Angle of internal friction, φ' = **34.2 °**
Apparent Cohesion, c' = **0.16 (tsf)**

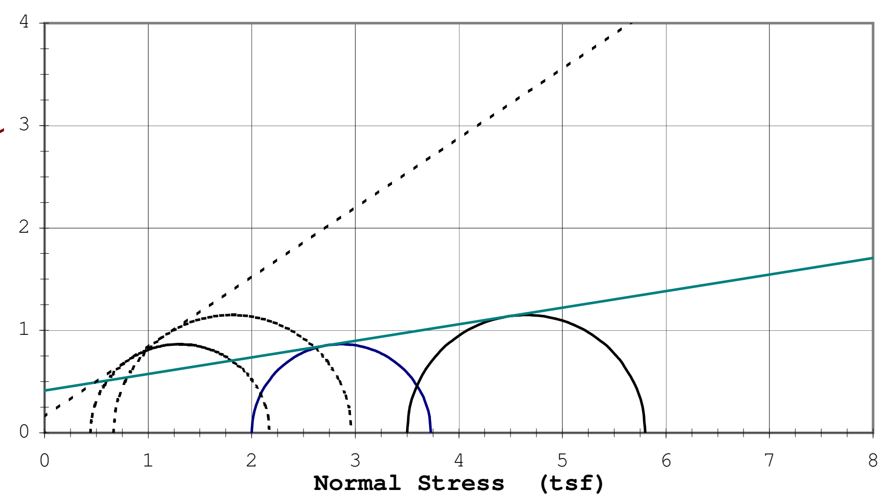
Test Date:	10/11/07	Liquid Limit:	28.0
Test Type:	CU w/pp	Plastic Limit:	22.6
Strain Rate (in/min):	0.004	Plasticity Index:	5.4
Strain Rate (%/min):	0.102	Spec. Gravity :	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	38.7	41.0			
Dry Density (pcf)	85.3	82.5			
Void Ratio	1.17	1.24			
After Consolidation					
Diameter (in)	1.90	1.89			
Height (in)	3.93	3.90			
Water Content (%)	35.5	35.9			
Dry Density (pcf)	90.1	89.6			
Void Ratio	1.05	1.06			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	2.00	3.50			
Max. Deviator Stress (tsf)	2.46	2.50			
Ultimate Deviator Stress (tsf)	2.22	2.20			
Deviator Stress at Failure (tsf)	1.73	2.30			
Max. Pore Pressure Buildup (tsf)	1.56	2.84			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	4.6	7.7			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





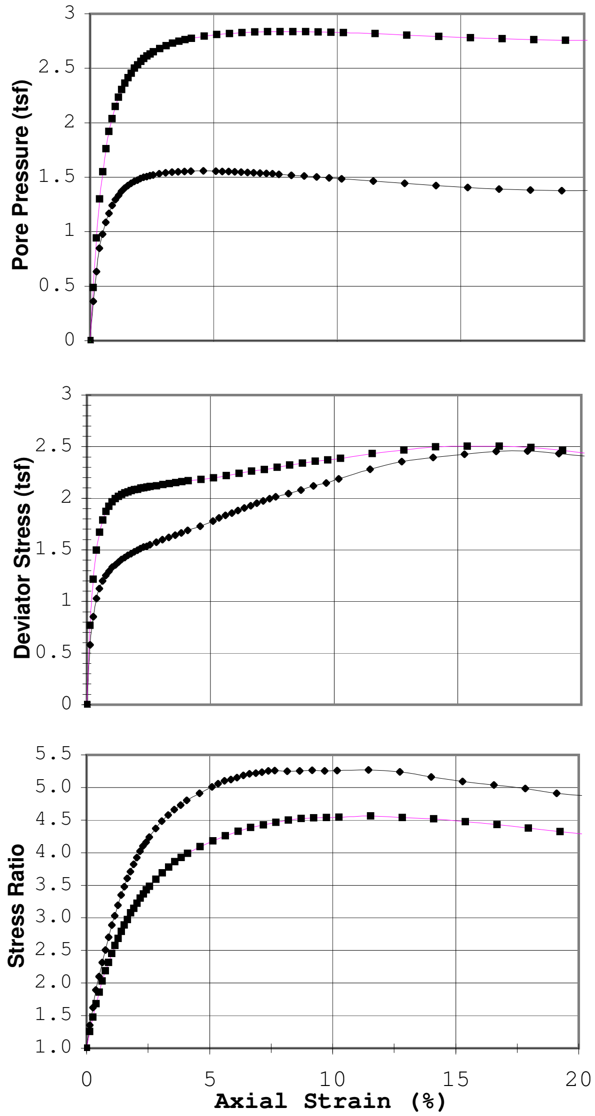
Rupture Envelope at Failure		
α = 29.4 °	a =	0.1 (tsf)

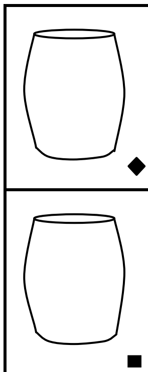
------------	Effective φ':	34.2 °	c'=	0.16 (tsf)
________	Total φ':	9.2 °	c=	0.41 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6250**
Date: **10/19/07**

Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **36.5-38.5**
Soil Type: **Slimes (Silt (ML))**





Failure Criterion: **Max. Deviator Stress**

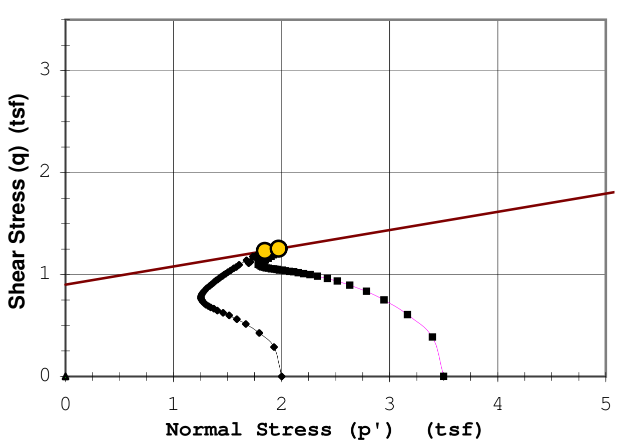
Angle of internal friction, ϕ' = **10.3 °**
Apparent Cohesion, c' = **0.91 (tsf)**

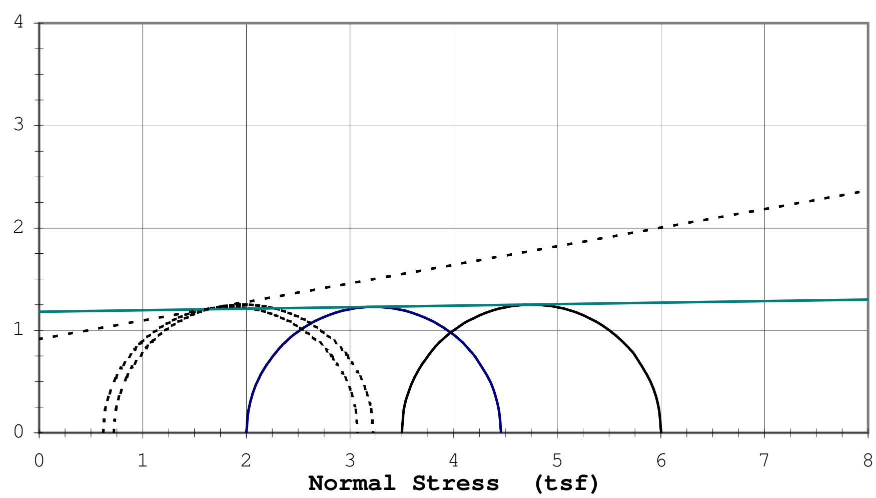
Test Date:	10/11/07	Liquid Limit:	28.0
Test Type:	CU w/pp	Plastic Limit:	22.6
Strain Rate (in/min):	0.004	Plasticity Index:	5.4
Strain Rate (%/min):	0.102	Spec. Gravity :	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	38.7	41.0			
Dry Density (pcf)	85.3	82.5			
Void Ratio	1.17	1.24			
After Consolidation					
Diameter (in)	1.90	1.89			
Height (in)	3.93	3.90			
Water Content (%)	35.5	35.9			
Dry Density (pcf)	90.1	89.6			
Void Ratio	1.05	1.06			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	2.00	3.50			
Max. Deviator Stress (tsf)	2.46	2.50			
Ultimate Deviator Stress (tsf)	2.22	2.20			
Deviator Stress at Failure (tsf)	2.46	2.50			
Max. Pore Pressure Buildup (tsf)	1.56	2.84			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	17.8	15.4			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





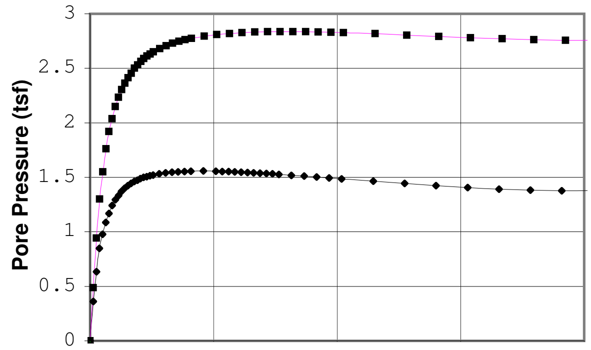
Rupture Envelope at Failure	
α = 10.1 °	a = 0.9 (tsf)

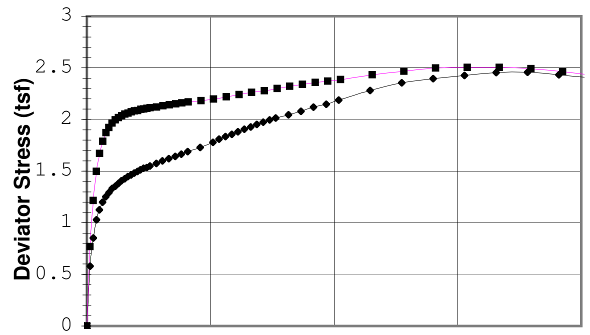
------------	Effective ϕ': 10.3 °	c'=	0.91 (tsf)
________	Total ϕ': 0.8 °	c=	1.18 (tsf)

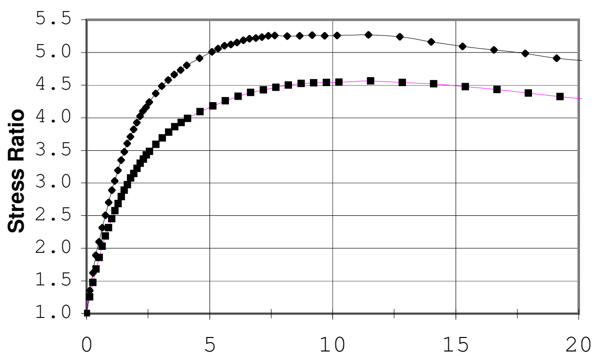
TRIAXIAL TEST ASTM: D 4767

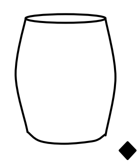
Job No. **6250**
Date: **10/19/07**

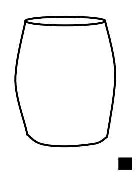
Project: **Polymet #23/69-862-022B**
Boring #: **07-09** Sample #: Type: **3T** Depth (ft): **36.5-38.5**
Soil Type: **Slimes (Silt (ML))**











Failure Criterion:	Given Strain of: 15%
Angle of internal friction, ϕ' =	16.1 °
Apparent Cohesion, c' =	0.74 (tsf)

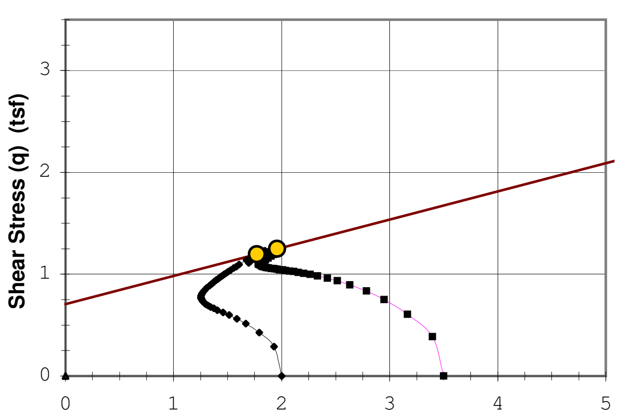
Test Date:	10/11/07	Liquid Limit:	28.0
Test Type:	CU w/pp	Plastic Limit:	22.6
Strain Rate (in/min):	0.004	Plasticity Index:	5.4
Strain Rate (%/min):	0.102	Spec. Gravity :	2.96

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94			
Height (in)	3.98	3.98			
Water Content (%)	38.7	41.0			
Dry Density (pcf)	85.3	82.5			
Void Ratio	1.17	1.24			
After Consolidation					
Diameter (in)	1.90	1.89			
Height (in)	3.93	3.90			
Water Content (%)	35.5	35.9			
Dry Density (pcf)	90.1	89.6			
Void Ratio	1.05	1.06			
Back Pressure (tsf)	5.8	5.8			
Minor Principal Stress (tsf)	2.00	3.50			
Max. Deviator Stress (tsf)	2.46	2.50			
Ultimate Deviator Stress (tsf)	2.22	2.20			
Deviator Stress at Failure (tsf)	2.39	2.50			
Max. Pore Pressure Buildup (tsf)	1.56	2.84			
Pore Pressure Parameter "B"	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0			

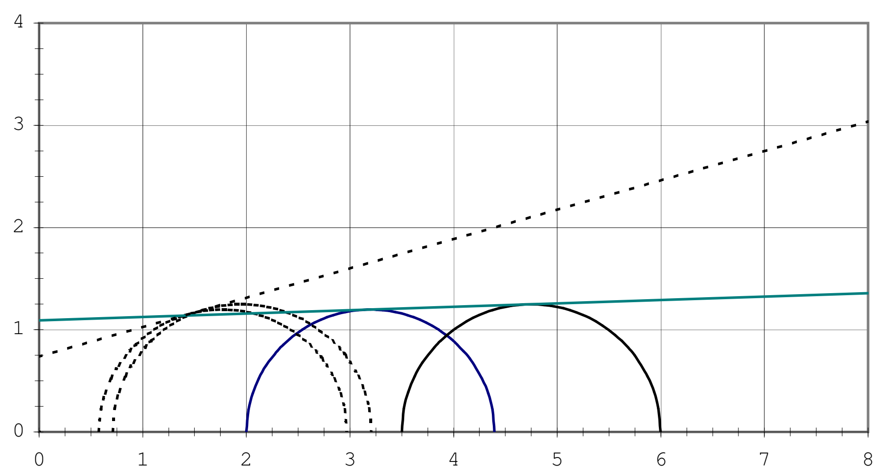
△ + X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold before the membrane was applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



Rupture Envelope at Failure		
α = 15.5 °	a = 0.7 (tsf)	



------------	Effective ϕ':	16.1 °	c'=	0.74 (tsf)
________	Total ϕ':	1.9 °	c=	1.09 (tsf)

Job No. 6250

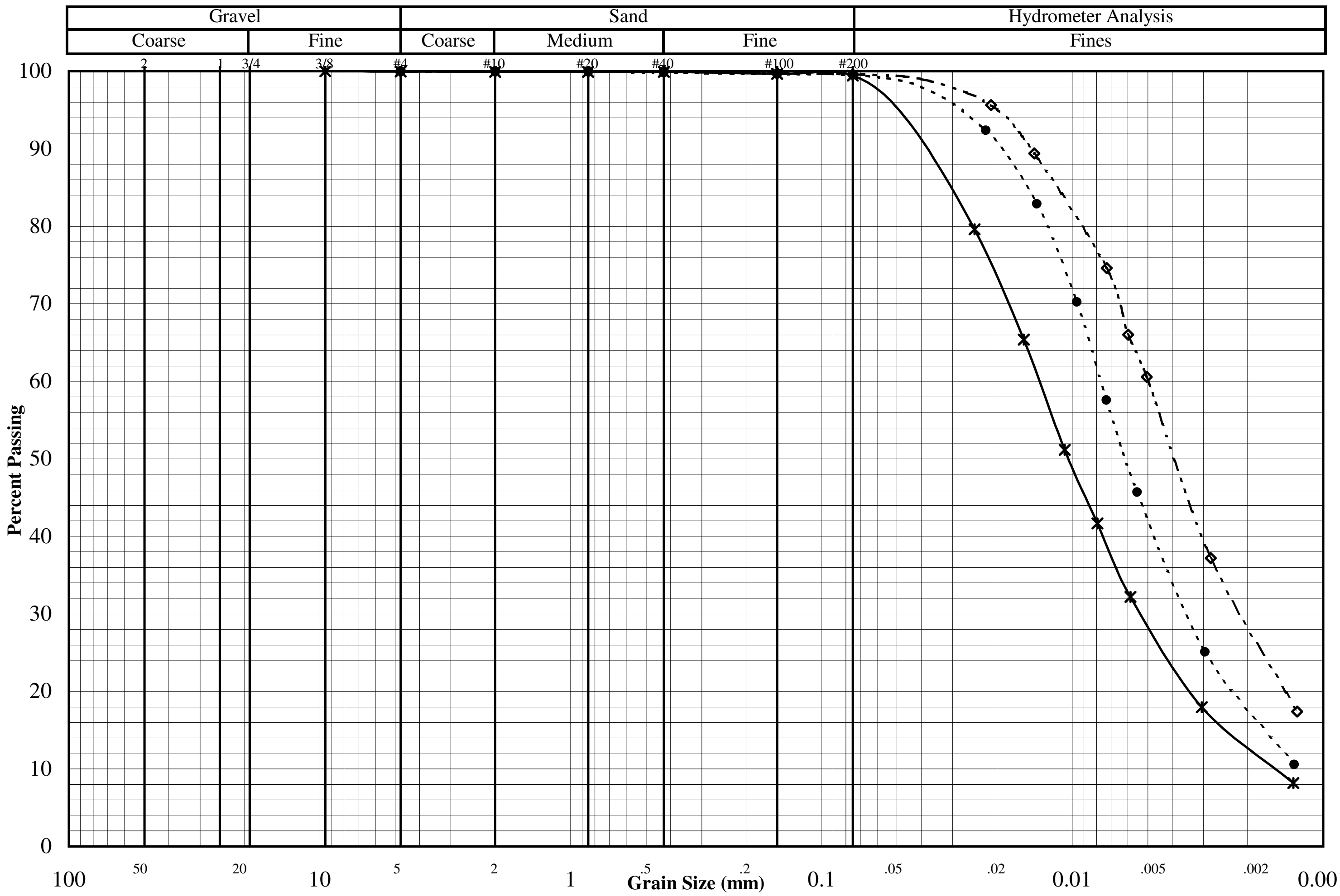
Boring #: 07-09 Depth (ft): 36.5-38.5 Date: 10/19/07

Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00									
0.13	0.58	0.36	0.13	0.77	0.49									
0.25	0.85	0.63	0.26	1.21	0.94									
0.38	1.03	0.85	0.39	1.50	1.30									
0.51	1.13	0.98	0.51	1.67	1.55									
0.64	1.20	1.09	0.64	1.79	1.76									
0.77	1.25	1.17	0.77	1.87	1.92									
0.89	1.29	1.24	0.90	1.92	2.04									
1.02	1.33	1.29	1.03	1.96	2.15									
1.15	1.35	1.33	1.16	2.00	2.23									
1.28	1.38	1.37	1.28	2.02	2.30									
1.40	1.41	1.40	1.41	2.03	2.36									
1.53	1.43	1.42	1.54	2.05	2.41									
1.66	1.45	1.44	1.67	2.06	2.46									
1.78	1.46	1.46	1.80	2.07	2.50									
1.91	1.48	1.47	1.92	2.08	2.53									
2.04	1.50	1.49	2.05	2.09	2.56									
2.17	1.51	1.50	2.18	2.10	2.59									
2.29	1.53	1.51	2.31	2.10	2.61									
2.42	1.53	1.51	2.44	2.11	2.63									
2.55	1.55	1.52	2.57	2.11	2.65									
2.80	1.57	1.53	2.82	2.12	2.68									
3.06	1.60	1.54	3.08	2.13	2.71									
3.31	1.62	1.55	3.34	2.14	2.73									
3.57	1.64	1.55	3.59	2.15	2.75									
3.82	1.66	1.55	3.85	2.16	2.76									
4.08	1.69	1.56	4.11	2.17	2.77									
4.59	1.73	1.56	4.62	2.18	2.79									
5.09	1.78	1.56	5.13	2.20	2.81									
5.35	1.81	1.55	5.65	2.22	2.82									
5.60	1.84	1.55	6.16	2.24	2.83									
5.86	1.86	1.55	6.67	2.26	2.83									
6.11	1.88	1.55	7.19	2.28	2.83									
6.37	1.91	1.54	7.70	2.30	2.84									
6.62	1.93	1.54	8.21	2.32	2.84									
6.88	1.95	1.54	8.72	2.34	2.84									
7.13	1.97	1.53	9.24	2.36	2.83									
7.39	2.00	1.53	9.75	2.37	2.83									
7.64	2.02	1.53	10.26	2.39	2.83									
8.15	2.04	1.52	11.55	2.43	2.82									
8.66	2.08	1.51	12.83	2.47	2.80									
9.17	2.12	1.50	14.11	2.50	2.79									
9.68	2.15	1.50	15.40	2.50	2.78									
10.19	2.19	1.49	16.68	2.50	2.77									
11.46	2.28	1.47	17.96	2.49	2.76									
12.73	2.35	1.44	19.25	2.47	2.76									
14.01	2.39	1.42	20.53	2.43	2.76									
15.28	2.43	1.41	21.81	2.38	2.77									
16.55	2.45	1.39	23.09	2.35	2.77									
17.83	2.46	1.38	24.38	2.32	2.78									
19.10	2.43	1.38	25.66	2.28	2.79									
20.37	2.40	1.38	26.94	2.26	2.80									
21.64	2.40	1.38	28.23	2.23	2.80									
22.92	2.37	1.38	29.51	2.21	2.81									
25.46	2.32	1.39	30.00	2.20	2.81									
28.01	2.25	1.41												
29.88	2.22	1.42												

Grain Size Distribution ASTM D422

Project:	Polymet #23/69-862-022B	Job No. :	**6250**
		Test Date:	10/15/07
Reported To:	Barr Engineering Company	Report Date:	10/18/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	07-15		34-36	3T	Slimes: Lean Clay (CL/CL-ML)
●	07-15		56.5-58.5	3T	Slimes: Lean Clay (CL)
◇	07-09		12-14	3T	Slimes: Lean Clay (CL)



Other Tests

	*	●	◇
Liquid Limit	25.2	32.3	31.9
Plastic Limit	17.9	20.3	19.4
Plasticity Index	7.3	12.0	12.5
Water Content	33.6	32.3	
Dry Density (pcf)	91.4	92.7	
Specific Gravity	2.91*	2.91*	2.98
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	518.3	544.9	309.0
2"			
1.5"			
1"			
3/4"			
3/8"	100.0		
#4	100.0	100.0	100.0
#10	99.9	100.0	100.0
#20	99.9	99.9	100.0
#40	99.9	99.8	100.0
#100	99.7	99.6	99.7
#200	99.4	99.5	99.6

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9301 Bryant Ave. South, Suite 107

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6250**

Project:	Polymet #23/69-862-022B	Test Date:	10/15/07
Reported To:	Barr Engineering Company	Report Date:	10/18/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	07-15		34-36	3T	Slimes: Lean Clay (CL/CL-ML)
Spec 2	07-15		56.5-58.5	3T	Slimes: Lean Clay (CL)
Spec 3	07-09		12-14	3T	Slimes: Lean Clay (CL)

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.025	79.6	0.022	92.4	0.021	95.6
0.016	65.4	0.014	82.9	0.014	89.4
0.011	51.2	0.010	70.2	0.007	74.6
0.008	41.7	0.007	57.6	0.006	66.0
0.006	32.2	0.006	45.7	0.005	60.6
0.003	18.0	0.003	25.1	0.003	37.2
0.001	8.2	0.001	10.6	0.001	17.4

9301 Bryant Ave. South, Suite 107

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9435	5.9436	5.8718	0.071642	0.071737	1.0013
2	0.012433	0	0	2.9681	5.9479	5.9483	5.8748	0.073078	0.0735	1.0058
3	0.05415	0	0.0044293	2.9681	5.9708	5.9729	5.8789	0.091903	0.094044	1.0233
4	0.10005	0	0.0071976	2.9681	5.9648	5.97	5.873	0.091824	0.096972	1.0561
5	0.25062	0	0.011073	2.9681	5.9654	5.9706	5.8742	0.091197	0.096387	1.0569
6	0.50147	0.0027491	0.016333	2.9681	5.9654	5.9706	5.873	0.09237	0.097559	1.0562
7	1.0032	0.0064146	0.024361	2.9681	5.9659	5.9712	5.8713	0.094674	0.099905	1.0552
8	2.001	0.013745	0.035434	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
9	4.0002	0.019244	0.05066	2.9681	5.9691	5.9712	5.8707	0.098473	0.10049	1.0205
10	6.0036	0.025658	0.06118	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
11	8.0028	0.028407	0.069484	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
12	10.002	0.03024	0.075575	2.9681	5.9665	5.9717	5.8718	0.094634	0.099905	1.0557
13	12.001	0.032073	0.082219	2.9681	5.9702	5.9723	5.8713	0.098979	0.10108	1.0212
14	14.001	0.033906	0.086925	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
15	16	0.035738	0.0908	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
16	18.004	0.037571	0.094676	2.9681	5.9691	5.9712	5.8724	0.096714	0.098732	1.0209
17	20.003	0.037571	0.097721	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
18	22.002	0.038487	0.1016	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
19	24.002	0.039404	0.10437	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
20	26.001	0.04032	0.10713	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
21	28.001	0.04032	0.10852	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
22	30	0.04032	0.11101	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
23	32.004	0.04032	0.11267	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
24	34.003	0.042153	0.11544	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
25	36.003	0.044902	0.11682	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
26	38	0.044902	0.11904	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
27	40.001	0.044902	0.12097	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
28	42.001	0.044902	0.12264	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
29	44.002	0.045818	0.12374	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
30	46.001	0.046735	0.1254	2.9681	5.9659	5.9712	5.8724	0.093502	0.098732	1.0559
31	46.774	0.046735	0.12623	2.9681	5.9697	5.9717	5.8713	0.098433	0.10049	1.0209

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9697	5.9717	5.8713	0.098433	0.10049	1.0209
2	0.012533	0	0.00055366	2.9681	5.9942	5.9946	5.8853	0.10887	0.10931	1.0041
3	0.050483	0.0018327	0.019101	2.9681	6.0845	6.102	5.8912	0.19327	0.21084	1.0909
4	0.10062	0.0064146	0.043739	2.9681	6.083	6.1108	5.8754	0.20765	0.23547	1.134
5	0.25085	0.016495	0.083049	2.9681	6.0917	6.1167	5.8806	0.21104	0.23606	1.1185
6	0.50172	0.029324	0.13177	2.9681	6.0981	6.1167	5.8724	0.22568	0.24427	1.0824
7	1.0034	0.068727	0.20402	2.9681	6.1137	6.1196	5.8783	0.23539	0.24134	1.0253
8	2.001	0.10996	0.3059	2.9681	6.1116	6.1208	5.8754	0.2362	0.24545	1.0391
9	4.004	0.14937	0.42992	2.9681	6.1121	6.1214	5.873	0.2391	0.24838	1.0388
10	6.0031	0.17594	0.49746	2.9681	6.111	6.1202	5.8736	0.23742	0.24662	1.0388
11	8.0021	0.20527	0.53899	2.9681	6.1153	6.1214	5.8736	0.24172	0.24779	1.0251
12	10.001	0.2126	0.5664	2.9681	6.1153	6.1214	5.873	0.24231	0.24838	1.0251
13	12	0.21718	0.58633	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
14	14.003	0.2181	0.601	2.9681	6.1153	6.1214	5.8724	0.24289	0.24896	1.025
15	16.002	0.22176	0.6129	2.9681	6.1153	6.1214	5.8713	0.24407	0.25014	1.0249
16	18.002	0.22634	0.62231	2.9681	6.1159	6.122	5.873	0.24285	0.24897	1.0252
17	20.002	0.23001	0.63007	2.9681	6.1153	6.1214	5.8707	0.24465	0.25072	1.0248
18	22.002	0.23276	0.63699	2.9681	6.1153	6.1214	5.8707	0.24465	0.25072	1.0248
19	24.002	0.23459	0.64252	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
20	26.001	0.23642	0.64751	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116
21	27.409	0.23826	0.65083	2.9681	6.1191	6.122	5.8713	0.24783	0.25072	1.0117

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
2	0.0125	0	0.00083049	2.9681	6.1589	6.1613	5.8935	0.26534	0.26777	1.0092
3	0.05055	0.00091637	0.031559	2.9681	6.3231	6.362	5.8947	0.42838	0.46729	1.0908
4	0.10062	0.0045818	0.06118	2.9681	6.3107	6.3555	5.8771	0.43354	0.47843	1.1035
5	0.25085	0.025658	0.11793	2.9681	6.3307	6.3702	5.8789	0.45185	0.49134	1.0874
6	0.50172	0.047651	0.18492	2.9681	6.3419	6.3649	5.8748	0.46711	0.49016	1.0494
7	1.0032	0.1063	0.2843	2.9681	6.3633	6.3673	5.8736	0.48974	0.49368	1.0081
8	2.0008	0.15487	0.41192	2.9681	6.3655	6.3696	5.8771	0.4884	0.49251	1.0084
9	4.004	0.21535	0.53899	2.9681	6.3629	6.3702	5.8742	0.48867	0.49603	1.0151
10	6.0032	0.24742	0.59629	2.9681	6.3666	6.3708	5.8718	0.49477	0.49896	1.0085
11	8.0025	0.2575	0.62813	2.9681	6.3672	6.3714	5.8742	0.49297	0.4972	1.0086
12	10.002	0.26391	0.64889	2.9681	6.3704	6.3714	5.8736	0.49677	0.49779	1.002
13	12.001	0.26575	0.66356	2.9681	6.3704	6.3714	5.873	0.49736	0.49838	1.002
14	14.004	0.26666	0.67574	2.9681	6.3709	6.372	5.8724	0.49849	0.49955	1.0021
15	16.003	0.26758	0.68488	2.9681	6.3709	6.372	5.8724	0.49849	0.49955	1.0021
16	18.003	0.26941	0.69346	2.9681	6.3672	6.3714	5.8724	0.49473	0.49896	1.0086
17	20.003	0.27583	0.70038	2.9681	6.3709	6.372	5.8724	0.49849	0.49955	1.0021
18	22.002	0.28132	0.70619	2.9681	6.3677	6.372	5.873	0.49469	0.49896	1.0086
19	23.138	0.28224	0.70924	2.9681	6.3709	6.372	5.873	0.4979	0.49896	1.0021

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3709	6.372	5.8724	0.49849	0.49955	1.0021
2	0.012433	0	0.00027683	2.9681	6.4025	6.4025	5.883	0.51954	0.51951	0.99995
3	0.050317	0.0036655	0.041801	2.9681	6.7554	6.8233	5.9146	0.84075	0.90862	1.0807
4	0.10038	0.0082473	0.093292	2.9681	6.7595	6.8415	5.8777	0.88176	0.96375	1.093
5	0.2506	0.041236	0.18631	2.9681	6.8	6.8643	5.8894	0.9106	0.97491	1.0706
6	0.5013	0.1063	0.29372	2.9681	6.8273	6.8626	5.8736	0.95371	0.98898	1.037
7	1.0027	0.17228	0.44321	2.9681	6.8408	6.8667	5.88	0.96072	0.98664	1.027
8	2.0003	0.22726	0.60432	2.9681	6.8531	6.8696	5.8742	0.97895	0.99543	1.0168
9	4.0035	0.29965	0.72419	2.9681	6.8633	6.8702	5.8759	0.98737	0.99426	1.007
10	6.0025	0.31981	0.76931	2.9681	6.8676	6.8714	5.8742	0.99343	0.9972	1.0038
11	8.0016	0.33447	0.7945	2.9681	6.8708	6.8714	5.8736	0.99723	0.99778	1.0006
12	10.001	0.34914	0.81111	2.9681	6.8676	6.8714	5.873	0.99461	0.99837	1.0038
13	12.004	0.3583	0.8244	2.9681	6.8676	6.8714	5.8689	0.99871	1.0025	1.0038
14	14.003	0.3638	0.83437	2.9681	6.8708	6.8714	5.8718	0.99899	0.99954	1.0006
15	16.002	0.36838	0.84323	2.9681	6.8708	6.8714	5.8683	1.0025	1.0031	1.0005
16	18.001	0.37021	0.85015	2.9681	6.8714	6.872	5.873	0.99836	0.99895	1.0006
17	20	0.37204	0.85679	2.9681	6.8714	6.872	5.8718	0.99954	1.0001	1.0006
18	20.477	0.37204	0.85817	2.9681	6.8708	6.8714	5.8724	0.9984	0.99895	1.0006

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.8682	6.872	5.873	0.99515	0.99895	1.0038
2	0.012483	0	0.0013842	2.9681	6.9886	6.9911	5.9035	1.0851	1.0876	1.0023
3	0.050483	0.0045818	0.071145	2.9681	7.7406	7.9031	5.9492	1.7914	1.9538	1.0907
4	0.10055	0.021993	0.18049	2.9681	7.86	8.0521	5.8871	1.9729	2.165	1.0974
5	0.25077	0.09072	0.36625	2.9681	7.9756	8.1073	5.9058	2.0697	2.2014	1.0636
6	0.50147	0.19427	0.56999	2.9681	8.0462	8.1073	5.8783	2.1679	2.229	1.0282
7	1.0029	0.31431	0.81056	2.9681	8.0646	8.1167	5.8812	2.1834	2.2354	1.0238
8	2.0005	0.42061	0.99465	2.9681	8.1091	8.1196	5.8754	2.2337	2.2442	1.0047
9	4.0037	0.46368	1.0893	2.9681	8.1134	8.1208	5.8748	2.2386	2.246	1.0033
10	6.0027	0.48109	1.1239	2.9681	8.1166	8.1208	5.8713	2.2454	2.2495	1.0019
11	8.0018	0.48751	1.1441	2.9681	8.1172	8.1214	5.8736	2.2436	2.2478	1.0019
12	10.001	0.493	1.1591	2.9681	8.1204	8.1214	5.8707	2.2497	2.2507	1.0004
13	12.004	0.4985	1.1707	2.9681	8.1209	8.122	5.873	2.2479	2.2489	1.0005
14	14.003	0.504	1.1801	2.9681	8.1209	8.122	5.873	2.2479	2.2489	1.0005
15	16.002	0.51133	1.1884	2.9681	8.1204	8.1214	5.8724	2.248	2.2489	1.0004
16	18.001	0.51866	1.1959	2.9681	8.1172	8.1214	5.8707	2.2465	2.2507	1.0019
17	19.074	0.5205	1.1992	2.9681	8.1209	8.122	5.873	2.2479	2.2489	1.0005

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9435	5.9436	5.8724	0.071056	0.07115	1.0013
2	0.012533	0	0.00027683	2.9681	5.9473	5.9477	5.8736	0.073705	0.074086	1.0052
3	0.054133	0	0.0047061	2.9681	5.9686	5.9706	5.8771	0.091478	0.093455	1.0216
4	0.10003	0	0.0080281	2.9681	5.9654	5.9706	5.8742	0.091197	0.096387	1.0569
5	0.25027	0.00091637	0.014118	2.9681	5.9654	5.9706	5.873	0.09237	0.097559	1.0562
6	0.50063	0.0027491	0.020762	2.9681	5.9659	5.9712	5.873	0.092916	0.098146	1.0563
7	1.0013	0.0064146	0.029898	2.9681	5.9654	5.9706	5.8718	0.093542	0.098732	1.0555
8	2.0028	0.010996	0.040694	2.9681	5.9659	5.9712	5.8724	0.093502	0.098732	1.0559
9	4.0015	0.013745	0.052598	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
10	6.0002	0.013745	0.059795	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
11	8.0031	0.013745	0.065609	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
12	10.002	0.014662	0.070038	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
13	12	0.014662	0.074467	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
14	14.003	0.014662	0.078066	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
15	16.002	0.014662	0.081388	2.9681	5.9729	5.9717	5.8724	0.10047	0.099319	0.98852
16	18.001	0.014662	0.08471	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
17	20.004	0.015578	0.087755	2.9681	5.9697	5.9717	5.8713	0.098433	0.10049	1.0209
18	22.002	0.015578	0.090247	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
19	24.001	0.015578	0.092738	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
20	26.004	0.015578	0.094953	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
21	28.003	0.015578	0.097444	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
22	30.001	0.015578	0.099382	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
23	32	0.015578	0.10187	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
24	34.003	0.015578	0.10409	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
25	36.002	0.015578	0.10603	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
26	38	0.015578	0.10796	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
27	40.003	0.015578	0.11018	2.9681	5.9691	5.9712	5.8707	0.098473	0.10049	1.0205
28	42.002	0.015578	0.11184	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
29	44.001	0.015578	0.1135	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
30	46.004	0.015578	0.11516	2.9681	5.9665	5.9717	5.8718	0.094634	0.099905	1.0557
31	48.002	0.015578	0.1171	2.9681	5.9665	5.9717	5.8713	0.09522	0.10049	1.0554
32	50.001	0.015578	0.11848	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
33	52.004	0.016495	0.11987	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
34	54.003	0.016495	0.12208	2.9681	5.9691	5.9712	5.8701	0.099059	0.10108	1.0204
35	56.001	0.016495	0.12347	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
36	56.581	0.016495	0.12374	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
2	0.012483	0	0.00055366	2.9681	5.9926	5.9964	5.8859	0.10671	0.11048	1.0354
3	0.05005	0.00091637	0.024638	2.9681	6.1013	6.1132	5.8894	0.21183	0.22375	1.0563
4	0.10005	0.0018327	0.047892	2.9681	6.0888	6.1067	5.88	0.20878	0.22667	1.0857
5	0.25028	0.0064146	0.10243	2.9681	6.0997	6.1185	5.8824	0.21735	0.23606	1.0861
6	0.50063	0.018327	0.16416	2.9681	6.1051	6.1173	5.8742	0.23089	0.2431	1.0529
7	1.0014	0.034822	0.24721	2.9681	6.111	6.1202	5.8748	0.23625	0.24545	1.0389
8	2.0028	0.041236	0.34189	2.9681	6.1142	6.1202	5.8748	0.23946	0.24545	1.025
9	4.0017	0.051316	0.42383	2.9681	6.1148	6.1208	5.8718	0.24293	0.24896	1.0248
10	6.0004	0.055898	0.46065	2.9681	6.1148	6.1208	5.8724	0.24235	0.24838	1.0249
11	8.0033	0.061396	0.48335	2.9681	6.1185	6.1214	5.873	0.24552	0.24838	1.0116
12	10.002	0.064146	0.4994	2.9681	6.1185	6.1214	5.8713	0.24728	0.25014	1.0116
13	12.001	0.065978	0.51186	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116
14	14.004	0.067811	0.52183	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116
15	16.002	0.069644	0.53068	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
16	18.001	0.07056	0.53788	2.9681	6.1159	6.122	5.8724	0.24344	0.24955	1.0251
17	20.004	0.071477	0.54508	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
18	20.993	0.072393	0.54812	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1191	6.122	5.8713	0.24783	0.25072	1.0117
2	0.012483	0	0.00083049	2.9681	6.1605	6.1631	5.8912	0.26932	0.27187	1.0095
3	0.050033	0.00091637	0.034604	2.9681	6.3327	6.362	5.9006	0.43216	0.46143	1.0677
4	0.1001	0.0064146	0.073083	2.9681	6.3186	6.3503	5.88	0.43854	0.47021	1.0722
5	0.25033	0.021076	0.15447	2.9681	6.3381	6.3643	5.8771	0.461	0.48723	1.0569
6	0.5007	0.032989	0.24416	2.9681	6.3488	6.3655	5.8759	0.4729	0.48958	1.0353
7	1.0014	0.054066	0.35739	2.9681	6.3591	6.3696	5.8789	0.48022	0.49075	1.0219
8	2.0029	0.086138	0.47006	2.9681	6.365	6.369	5.8742	0.49079	0.49486	1.0083
9	4.0016	0.10447	0.55394	2.9681	6.3677	6.372	5.8718	0.49586	0.50013	1.0086
10	6.0003	0.11088	0.59131	2.9681	6.3672	6.3714	5.873	0.49415	0.49838	1.0086
11	8.0031	0.11363	0.61456	2.9681	6.3704	6.3714	5.8736	0.49677	0.49779	1.002
12	10.002	0.11546	0.632	2.9681	6.3672	6.3714	5.8724	0.49473	0.49896	1.0086
13	12.001	0.11729	0.64557	2.9681	6.3672	6.3714	5.8724	0.49473	0.49896	1.0086
14	14.003	0.12096	0.65692	2.9681	6.3704	6.3714	5.8724	0.49794	0.49896	1.002
15	16.002	0.12371	0.66716	2.9681	6.3704	6.3714	5.8713	0.49912	0.50013	1.002
16	18.001	0.12554	0.67602	2.9681	6.3704	6.3714	5.8701	0.50029	0.50131	1.002
17	19.829	0.12646	0.68322	2.9681	6.3709	6.372	5.8718	0.49908	0.50013	1.0021

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3709	6.372	5.8718	0.49908	0.50013	1.0021
2	0.0125	0	0.001661	2.9681	6.456	6.4565	5.9076	0.54835	0.54888	1.001
3	0.05005	0.0045818	0.057027	2.9681	6.8037	6.8579	5.917	0.88668	0.9409	1.0612
4	0.10012	0.013745	0.12291	2.9681	6.7743	6.8332	5.8836	0.89074	0.94967	1.0662
5	0.25035	0.03024	0.25828	2.9681	6.8085	6.8561	5.8754	0.93309	0.98076	1.0511
6	0.50072	0.063229	0.39864	2.9681	6.8391	6.8614	5.8742	0.96488	0.98722	1.0232
7	1.0014	0.10905	0.5603	2.9681	6.8526	6.869	5.8718	0.98074	0.99719	1.0168
8	2.0029	0.1402	0.70038	2.9681	6.8671	6.8708	5.8765	0.99054	0.99426	1.0038
9	4.0016	0.1567	0.79533	2.9681	6.8665	6.8702	5.8736	0.99293	0.99661	1.0037
10	6.0003	0.16036	0.83852	2.9681	6.8671	6.8708	5.8689	0.99816	1.0019	1.0037
11	8.0032	0.16495	0.86593	2.9681	6.8703	6.8708	5.8718	0.99844	0.99895	1.0005
12	10.002	0.16953	0.88696	2.9681	6.8708	6.8714	5.8724	0.9984	0.99895	1.0006
13	12.001	0.17319	0.90357	2.9681	6.8714	6.872	5.8736	0.99778	0.99837	1.0006
14	14.004	0.17594	0.91797	2.9681	6.8708	6.8714	5.8701	1.0007	1.0013	1.0005
15	16.002	0.17869	0.93043	2.9681	6.8714	6.872	5.8718	0.99954	1.0001	1.0006
16	18.001	0.18052	0.9415	2.9681	6.8708	6.8714	5.8707	1.0002	1.0007	1.0005
17	19.449	0.18236	0.9487	2.9681	6.8682	6.872	5.8713	0.99691	1.0007	1.0038

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.8708	6.8714	5.8718	0.99899	0.99954	1.0006
2	0.012483	0	0.0013842	2.9681	6.9581	6.9582	5.9047	1.0534	1.0536	1.0002
3	0.05005	0.0018327	0.043462	2.9681	7.3054	7.3696	5.9047	1.4007	1.4649	1.0458
4	0.10005	0.0091637	0.087478	2.9681	7.2787	7.3409	5.8812	1.3974	1.4596	1.0445
5	0.25028	0.042153	0.18188	2.9681	7.3229	7.3608	5.8941	1.4288	1.4667	1.0265
6	0.50072	0.07056	0.28098	2.9681	7.3595	7.369	5.8859	1.4736	1.4831	1.0065
7	1.0014	0.092553	0.39172	2.9681	7.3595	7.369	5.8748	1.4847	1.4943	1.0064
8	2.0029	0.11638	0.49442	2.9681	7.3621	7.3684	5.873	1.4891	1.4954	1.0042
9	4.0016	0.13837	0.57913	2.9681	7.3675	7.3708	5.8759	1.4916	1.4948	1.0022
10	6.0003	0.15212	0.62398	2.9681	7.3707	7.3708	5.8736	1.4971	1.4972	1
11	8.0031	0.15853	0.65443	2.9681	7.3686	7.372	5.8701	1.4985	1.5019	1.0022
12	10.002	0.16128	0.6774	2.9681	7.3713	7.3714	5.8707	1.5006	1.5007	1.0001
13	12.001	0.16586	0.69623	2.9681	7.3713	7.3714	5.8724	1.4989	1.4989	1.0001
14	14.003	0.17044	0.71228	2.9681	7.3686	7.372	5.8718	1.4968	1.5001	1.0022
15	16.002	0.17319	0.72613	2.9681	7.3713	7.3714	5.873	1.4983	1.4984	1.0001
16	18.001	0.17411	0.73831	2.9681	7.3718	7.372	5.873	1.4988	1.4989	1.0001
17	20.004	0.17594	0.74993	2.9681	7.3718	7.372	5.8724	1.4994	1.4995	1.0001
18	22.003	0.17777	0.76018	2.9681	7.3713	7.3714	5.8713	1.5	1.5001	1.0001
19	22.629	0.17777	0.76294	2.9681	7.3713	7.3714	5.8724	1.4989	1.4989	1.0001

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3423	6.3437	6.271	0.071312	0.0727	1.0195
2	0.012483	0	0	2.9681	6.3461	6.3478	6.2739	0.072227	0.073872	1.0228
3	0.054133	0	0.0071976	2.9681	6.368	6.3677	6.278	0.090039	0.08968	0.99601
4	0.10003	0	0.012457	2.9681	6.3637	6.37	6.2745	0.089236	0.095531	1.0706
5	0.25025	0	0.017163	2.9681	6.3643	6.3706	6.2733	0.090954	0.097287	1.0696
6	0.50062	0	0.022146	2.9681	6.3648	6.3712	6.2727	0.092088	0.098457	1.0692
7	1.0013	0	0.029067	2.9681	6.3681	6.3712	6.2727	0.095342	0.098457	1.0327
8	2.0028	0	0.037095	2.9681	6.3686	6.3718	6.2727	0.095891	0.099043	1.0329
9	3	0	0.042078	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
10	4.0015	0	0.045954	2.9681	6.3681	6.3712	6.271	0.097097	0.10021	1.0321
11	5.0029	0	0.048169	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
12	6.0002	0	0.050106	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
13	7.0016	0	0.05149	2.9681	6.3719	6.3718	6.2716	0.10031	0.10021	0.99898
14	8.0031	0	0.052598	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
15	9.0003	0	0.053982	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
16	10.002	0	0.054812	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
17	11.003	0	0.055366	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
18	12	0	0.056473	2.9681	6.3686	6.3718	6.271	0.097646	0.1008	1.0323
19	13.002	0	0.05675	2.9681	6.3681	6.3712	6.2716	0.096512	0.099627	1.0323
20	14.003	0	0.057304	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
21	15.001	0	0.057858	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
22	16.002	0	0.058411	2.9681	6.3681	6.3712	6.2716	0.096512	0.099627	1.0323
23	17.004	0	0.058688	2.9681	6.3681	6.3712	6.2716	0.096512	0.099627	1.0323
24	18.001	0	0.058965	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
25	19.002	0	0.059242	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
26	20.004	0	0.059795	2.9681	6.3681	6.3712	6.2716	0.096512	0.099627	1.0323
27	21.001	0.0011106	0.059795	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
28	22.002	0.0011106	0.060072	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
29	23.004	0	0.060626	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
30	24.001	0.0011106	0.060903	2.9681	6.3697	6.373	6.2716	0.098158	0.10138	1.0329
31	25.003	0	0.06118	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
32	26.004	0.0011106	0.06118	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
33	27.001	0.0011106	0.061733	2.9681	6.3681	6.3712	6.2716	0.096512	0.099627	1.0323
34	28.003	0.0011106	0.061733	2.9681	6.3681	6.3712	6.2716	0.096512	0.099627	1.0323
35	28.654	0.0011106	0.061733	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
2	0.012417	0	0	2.9681	6.3774	6.3812	6.2757	0.10174	0.10548	1.0368
3	0.05415	0	0.029621	2.9681	6.5073	6.5093	6.2915	0.21586	0.21788	1.0094
4	0.10005	0.0011106	0.050106	2.9681	6.5052	6.5105	6.278	0.22715	0.23251	1.0236
5	0.25027	0.0022211	0.084156	2.9681	6.5123	6.5181	6.2798	0.23253	0.23837	1.0251
6	0.50062	0.0033317	0.12291	2.9681	6.5139	6.5199	6.2727	0.2412	0.24714	1.0246
7	1.0013	0.0044422	0.17911	2.9681	6.5134	6.5193	6.2768	0.23655	0.24246	1.025
8	2.0028	0.0055528	0.2652	2.9681	6.5134	6.5193	6.2757	0.23772	0.24363	1.0249
9	3.0001	0.0066633	0.33303	2.9681	6.5166	6.5193	6.2733	0.24332	0.24597	1.0109
10	4.0015	0.0088844	0.3895	2.9681	6.5177	6.5205	6.2739	0.24383	0.24656	1.0112
11	5.0029	0.011106	0.43822	2.9681	6.5172	6.5199	6.2745	0.2427	0.24539	1.0111
12	6.0002	0.013327	0.48085	2.9681	6.5145	6.5205	6.2745	0.23999	0.24597	1.0249
13	7.0016	0.014437	0.5185	2.9681	6.515	6.5211	6.2727	0.24229	0.24831	1.0248
14	8.0031	0.017769	0.55172	2.9681	6.5145	6.5205	6.2733	0.24116	0.24714	1.0248
15	9.0004	0.024432	0.58162	2.9681	6.5188	6.5216	6.2733	0.24551	0.24831	1.0114
16	10.002	0.031096	0.60847	2.9681	6.5188	6.5216	6.2727	0.2461	0.2489	1.0114
17	11.003	0.038869	0.63256	2.9681	6.5145	6.5205	6.2727	0.24175	0.24773	1.0247
18	12	0.044422	0.65415	2.9681	6.5183	6.5211	6.2733	0.24496	0.24773	1.0113
19	13.002	0.045533	0.67381	2.9681	6.5145	6.5205	6.2727	0.24175	0.24773	1.0247
20	14.003	0.048864	0.6918	2.9681	6.5183	6.5211	6.2727	0.24555	0.24831	1.0113
21	15.001	0.052196	0.70786	2.9681	6.5177	6.5205	6.2727	0.245	0.24773	1.0111
22	16.002	0.056638	0.7228	2.9681	6.5183	6.5211	6.2733	0.24496	0.24773	1.0113
23	17.004	0.057749	0.73637	2.9681	6.5183	6.5211	6.2722	0.24613	0.2489	1.0112
24	18.001	0.062191	0.74855	2.9681	6.515	6.5211	6.271	0.24405	0.25007	1.0247
25	19.002	0.064412	0.75962	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
26	20.004	0.065523	0.76987	2.9681	6.5183	6.5211	6.2733	0.24496	0.24773	1.0113
27	21.001	0.066633	0.77928	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
28	22.002	0.067744	0.78814	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
29	23.004	0.068854	0.79616	2.9681	6.515	6.5211	6.2716	0.24346	0.24948	1.0247
30	24.001	0.069965	0.80364	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
31	25.003	0.071076	0.81056	2.9681	6.5156	6.5216	6.2722	0.24343	0.24948	1.0249
32	26.004	0.072186	0.8172	2.9681	6.5156	6.5216	6.2727	0.24284	0.2489	1.0249
33	27.001	0.073297	0.82329	2.9681	6.5194	6.5222	6.2722	0.24723	0.25007	1.0115
34	28.003	0.073297	0.82911	2.9681	6.5183	6.5211	6.271	0.2473	0.25007	1.0112
35	29.004	0.074407	0.83437	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
36	30.001	0.074407	0.83935	2.9681	6.5156	6.5216	6.2722	0.24343	0.24948	1.0249
37	31.003	0.075518	0.84378	2.9681	6.5183	6.5211	6.2704	0.24789	0.25065	1.0112
38	32	0.075518	0.84876	2.9681	6.515	6.5211	6.271	0.24405	0.25007	1.0247
39	33.002	0.076628	0.85291	2.9681	6.5183	6.5211	6.2722	0.24613	0.2489	1.0112
40	34.003	0.076628	0.85707	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
41	35	0.076628	0.86011	2.9681	6.5183	6.5211	6.271	0.2473	0.25007	1.0112
42	36.002	0.077739	0.86426	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
43	37.003	0.077739	0.86786	2.9681	6.5183	6.5211	6.2722	0.24613	0.2489	1.0112
44	38	0.077739	0.87091	2.9681	6.5188	6.5216	6.2727	0.2461	0.2489	1.0114
45	39.002	0.078849	0.87451	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
46	40.003	0.078849	0.87617	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
47	41.001	0.078849	0.8806	2.9681	6.5183	6.5211	6.271	0.2473	0.25007	1.0112
48	42.002	0.078849	0.88337	2.9681	6.5156	6.5216	6.2716	0.24401	0.25007	1.0248
49	43.003	0.07996	0.88613	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
50	44.001	0.07996	0.88863	2.9681	6.5183	6.5211	6.2722	0.24613	0.2489	1.0112
51	45.002	0.07996	0.89029	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
52	46.004	0.07996	0.89389	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
53	47.001	0.07996	0.89582	2.9681	6.5183	6.5211	6.271	0.2473	0.25007	1.0112
54	48.002	0.07996	0.89748	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
55	49.004	0.07996	0.89998	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
56	50.001	0.07996	0.90247	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
57	51.002	0.07996	0.90441	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
58	52.004	0.081071	0.90579	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
59	52.409	0.081071	0.90662	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
2	0.012483	-0.0011106	0.0011073	2.9681	6.5594	6.5614	6.2932	0.26618	0.26823	1.0077
3	0.050033	0.0011106	0.035157	2.9681	6.7438	6.7616	6.2932	0.45055	0.46843	1.0397
4	0.10012	0.0077739	0.063948	2.9681	6.7377	6.7552	6.2768	0.4609	0.47837	1.0379
5	0.25035	0.042201	0.11821	2.9681	6.7498	6.7646	6.2862	0.46357	0.47837	1.0319
6	0.50063	0.069965	0.18077	2.9681	6.7617	6.7669	6.2768	0.48489	0.49007	1.0107
7	1.0014	0.094397	0.27683	2.9681	6.7618	6.7704	6.2745	0.48726	0.49593	1.0178
8	2.0028	0.13993	0.41303	2.9681	6.7634	6.7687	6.2733	0.49004	0.49534	1.0108
9	3.0001	0.17325	0.51823	2.9681	6.7645	6.7698	6.2751	0.48938	0.49476	1.011
10	4.0016	0.1999	0.60432	2.9681	6.7645	6.7698	6.2757	0.4888	0.49417	1.011
11	5.003	0.23877	0.67657	2.9681	6.7639	6.7693	6.2745	0.48942	0.49476	1.0109
12	6.0002	0.25099	0.73609	2.9681	6.7639	6.7693	6.2739	0.49001	0.49534	1.0109
13	7.0016	0.26431	0.78648	2.9681	6.7645	6.7698	6.2733	0.49114	0.49651	1.0109
14	8.0031	0.27431	0.82994	2.9681	6.765	6.7704	6.2733	0.49169	0.4971	1.011
15	9.0004	0.27986	0.86593	2.9681	6.7645	6.7698	6.2733	0.49114	0.49651	1.0109
16	10.002	0.28985	0.89693	2.9681	6.765	6.7704	6.2733	0.49169	0.4971	1.011
17	11.003	0.29763	0.92406	2.9681	6.765	6.7704	6.2716	0.49344	0.49885	1.011
18	12.001	0.29985	0.94704	2.9681	6.7683	6.7704	6.2739	0.49436	0.49651	1.0044
19	13.002	0.30318	0.96725	2.9681	6.7683	6.7704	6.2739	0.49436	0.49651	1.0044
20	14.003	0.30984	0.98524	2.9681	6.7656	6.771	6.2727	0.49282	0.49827	1.011
21	15.001	0.31762	1.0007	2.9681	6.765	6.7704	6.271	0.49403	0.49944	1.0109
22	16.002	0.32428	1.0146	2.9681	6.7688	6.771	6.2733	0.49549	0.49768	1.0044
23	17.004	0.32761	1.0276	2.9681	6.7688	6.771	6.2716	0.49725	0.49944	1.0044
24	18.001	0.33206	1.0389	2.9681	6.7656	6.771	6.2733	0.49224	0.49768	1.0111
25	19.002	0.33539	1.0492	2.9681	6.7688	6.771	6.271	0.49783	0.50002	1.0044
26	20.004	0.33872	1.0586	2.9681	6.7656	6.771	6.2722	0.49341	0.49885	1.011
27	21.001	0.34427	1.0672	2.9681	6.7656	6.771	6.2698	0.49575	0.50119	1.011
28	22.002	0.34649	1.0747	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045
29	23.004	0.34871	1.0821	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045
30	24.001	0.34982	1.0888	2.9681	6.7694	6.7716	6.2727	0.49662	0.49885	1.0045
31	25.003	0.35316	1.094	2.9681	6.7656	6.771	6.271	0.49458	0.50002	1.011
32	26.004	0.3576	1.1001	2.9681	6.7688	6.771	6.2733	0.49549	0.49768	1.0044
33	27.001	0.36093	1.1048	2.9681	6.7688	6.771	6.2722	0.49666	0.49885	1.0044
34	28.003	0.36204	1.1109	2.9681	6.7694	6.7716	6.2727	0.49662	0.49885	1.0045
35	29	0.36426	1.1159	2.9681	6.7688	6.771	6.271	0.49783	0.50002	1.0044
36	30.001	0.36648	1.1203	2.9681	6.7694	6.7716	6.2727	0.49662	0.49885	1.0045
37	31.003	0.3687	1.1248	2.9681	6.7694	6.7716	6.2716	0.4978	0.50002	1.0045
38	32	0.37204	1.1289	2.9681	6.7694	6.7716	6.271	0.49838	0.50061	1.0045
39	33.002	0.37315	1.1328	2.9681	6.7694	6.7716	6.2704	0.49897	0.50119	1.0045
40	34.003	0.37426	1.1358	2.9681	6.7694	6.7716	6.2727	0.49662	0.49885	1.0045
41	35	0.37537	1.1397	2.9681	6.7694	6.7716	6.2716	0.4978	0.50002	1.0045
42	36.002	0.37648	1.1425	2.9681	6.7656	6.771	6.2716	0.49399	0.49944	1.011
43	37.003	0.37759	1.1466	2.9681	6.7688	6.771	6.2716	0.49725	0.49944	1.0044
44	38	0.37981	1.1494	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045
45	39.002	0.38092	1.1516	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045
46	40.003	0.38203	1.1558	2.9681	6.7688	6.771	6.2716	0.49725	0.49944	1.0044
47	41.001	0.38203	1.1585	2.9681	6.7688	6.771	6.2722	0.49666	0.49885	1.0044
48	41.472	0.38203	1.1591	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.7694	6.7716	6.2727	0.49662	0.49885	1.0045
2	0.0125	0	0.0019378	2.9681	6.8532	6.8541	6.3038	0.54948	0.55038	1.0016
3	0.05415	0.0044422	0.05066	2.9681	7.2193	7.2621	6.3073	0.91208	0.95488	1.0469
4	0.10012	0.018879	0.096337	2.9681	7.211	7.2428	6.2798	0.93124	0.96306	1.0342
5	0.25035	0.046643	0.18354	2.9681	7.2399	7.2598	6.2885	0.95139	0.97126	1.0209
6	0.50063	0.10772	0.28126	2.9681	7.2476	7.2645	6.2827	0.96488	0.98179	1.0175
7	1.0014	0.15215	0.42549	2.9681	7.2552	7.2657	6.2739	0.98126	0.99174	1.0107
8	2.0028	0.23655	0.62785	2.9681	7.2639	7.268	6.2827	0.98119	0.9853	1.0042
9	3.0001	0.27764	0.77319	2.9681	7.2617	7.2692	6.2809	0.98079	0.98823	1.0076
10	4.0015	0.33095	0.88143	2.9681	7.2606	7.268	6.2763	0.98437	0.99174	1.0075
11	5.0029	0.34982	0.9642	2.9681	7.2655	7.2697	6.2745	0.99103	0.99525	1.0043
12	6.0003	0.3687	1.0276	2.9681	7.2661	7.2703	6.2727	0.99333	0.99759	1.0043
13	7.0017	0.39425	1.0769	2.9681	7.2655	7.2697	6.2727	0.99278	0.99701	1.0043
14	8.0032	0.41313	1.1162	2.9681	7.2655	7.2697	6.2722	0.99337	0.99759	1.0043
15	9.0004	0.42312	1.1483	2.9681	7.2655	7.2697	6.2704	0.99512	0.99935	1.0042
16	10.002	0.43645	1.1743	2.9681	7.2661	7.2703	6.2739	0.99216	0.99642	1.0043
17	11.003	0.44533	1.1962	2.9681	7.2666	7.2709	6.2745	0.99212	0.99642	1.0043
18	12.001	0.44866	1.2145	2.9681	7.2666	7.2709	6.2733	0.99329	0.99759	1.0043
19	13.002	0.452	1.2305	2.9681	7.2666	7.2709	6.271	0.99563	0.99993	1.0043
20	14.003	0.45644	1.2444	2.9681	7.2693	7.2703	6.271	0.99834	0.99935	1.001
21	15.001	0.45977	1.2568	2.9681	7.2693	7.2703	6.2692	1.0001	1.0011	1.001
22	16.002	0.46088	1.2679	2.9681	7.2699	7.2709	6.2704	0.99947	1.0005	1.001
23	17.004	0.4631	1.2778	2.9681	7.2699	7.2709	6.271	0.99889	0.99993	1.001
24	18.001	0.46532	1.2867	2.9681	7.2704	7.2715	6.2745	0.99592	0.99701	1.0011
25	19.002	0.46754	1.2953	2.9681	7.2704	7.2715	6.271	0.99944	1.0005	1.0011
26	20.004	0.46976	1.303	2.9681	7.2699	7.2709	6.2722	0.99772	0.99876	1.001
27	21.001	0.47088	1.31	2.9681	7.2699	7.2709	6.2733	0.99655	0.99759	1.001
28	22.002	0.47199	1.3169	2.9681	7.2704	7.2715	6.271	0.99944	1.0005	1.0011
29	23.004	0.47421	1.323	2.9681	7.2666	7.2709	6.2716	0.99505	0.99935	1.0043
30	24.001	0.47643	1.3288	2.9681	7.2699	7.2709	6.2727	0.99713	0.99818	1.001
31	25.003	0.47865	1.3343	2.9681	7.2699	7.2709	6.2722	0.99772	0.99876	1.001
32	26.004	0.47865	1.3396	2.9681	7.2666	7.2709	6.2722	0.99446	0.99876	1.0043
33	27.001	0.47976	1.3448	2.9681	7.2704	7.2715	6.2727	0.99768	0.99876	1.0011
34	28.003	0.47976	1.3493	2.9681	7.2666	7.2709	6.2704	0.99622	1.0005	1.0043
35	29	0.48087	1.3534	2.9681	7.2704	7.2715	6.271	0.99944	1.0005	1.0011
36	30.001	0.48198	1.3573	2.9681	7.2672	7.2715	6.2716	0.9956	0.99993	1.0044
37	31.003	0.48531	1.3617	2.9681	7.2704	7.2715	6.2722	0.99827	0.99935	1.0011
38	32	0.48753	1.3653	2.9681	7.2666	7.2709	6.271	0.99563	0.99993	1.0043
39	33.002	0.48864	1.3692	2.9681	7.2704	7.2715	6.2727	0.99768	0.99876	1.0011
40	33.974	0.48975	1.3728	2.9681	7.2699	7.2709	6.2716	0.9983	0.99935	1.001

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.2699	7.2709	6.2722	0.99772	0.99876	1.001
2	0.012483	0	0.0013842	2.9681	7.3971	7.3997	6.3043	1.0927	1.0954	1.0024
3	0.05415	0.0077739	0.064778	2.9681	8.1469	8.2344	6.3254	1.8215	1.909	1.0481
4	0.10005	0.043312	0.13343	2.9681	8.1689	8.2198	6.2839	1.8851	1.936	1.027
5	0.25027	0.10106	0.27295	2.9681	8.2442	8.2549	6.3049	1.9392	1.95	1.0056
6	0.50063	0.16436	0.42936	2.9681	8.2415	8.2625	6.2792	1.9623	1.9834	1.0107
7	1.0014	0.24654	0.64668	2.9681	8.2475	8.2655	6.2862	1.9613	1.9793	1.0091
8	2.0028	0.35649	0.93181	2.9681	8.2644	8.2696	6.2757	1.9887	1.9939	1.0026
9	3.0001	0.40202	1.1109	2.9681	8.2557	8.2672	6.2716	1.9841	1.9957	1.0058
10	4.0015	0.44866	1.228	2.9681	8.2665	8.2684	6.2774	1.9891	1.991	1.0009
11	5.0029	0.48198	1.3075	2.9681	8.266	8.2713	6.2739	1.9921	1.9974	1.0027
12	6.0003	0.50086	1.3639	2.9681	8.2649	8.2702	6.2733	1.9916	1.9968	1.0026
13	7.0017	0.52196	1.4055	2.9681	8.2617	8.2702	6.2745	1.9872	1.9957	1.0043
14	8.0032	0.53418	1.4384	2.9681	8.2655	8.2707	6.2733	1.9921	1.9974	1.0026
15	9.0004	0.54195	1.4647	2.9681	8.2655	8.2707	6.2704	1.9951	2.0003	1.0026
16	10.002	0.55306	1.486	2.9681	8.266	8.2713	6.2733	1.9927	1.998	1.0027
17	11.003	0.5575	1.5046	2.9681	8.266	8.2713	6.2745	1.9915	1.9968	1.0027
18	12.001	0.56083	1.5201	2.9681	8.266	8.2713	6.2745	1.9915	1.9968	1.0027
19	13.002	0.5686	1.5342	2.9681	8.266	8.2713	6.2727	1.9933	1.9986	1.0027
20	14.003	0.57416	1.5467	2.9681	8.266	8.2713	6.271	1.995	2.0003	1.0027
21	15.001	0.57527	1.5577	2.9681	8.2693	8.2713	6.2722	1.9971	1.9992	1.001
22	16.002	0.57749	1.568	2.9681	8.2693	8.2713	6.2716	1.9977	1.9997	1.001
23	17.004	0.57971	1.5771	2.9681	8.2671	8.2725	6.2727	1.9944	1.9997	1.0027
24	18.001	0.58193	1.5857	2.9681	8.2698	8.2719	6.2727	1.9971	1.9992	1.001
25	19.002	0.58415	1.5937	2.9681	8.2693	8.2713	6.2698	1.9995	2.0015	1.001
26	20.004	0.58859	1.6009	2.9681	8.266	8.2713	6.271	1.995	2.0003	1.0027
27	21.001	0.59304	1.6073	2.9681	8.2698	8.2719	6.2733	1.9965	1.9986	1.001
28	22.002	0.59748	1.6148	2.9681	8.2698	8.2719	6.2692	2.0006	2.0027	1.001
29	23.004	0.60081	1.6206	2.9681	8.266	8.2713	6.2704	1.9956	2.0009	1.0027
30	24.001	0.60303	1.6261	2.9681	8.2698	8.2719	6.2722	1.9977	1.9997	1.001
31	25.003	0.60858	1.6316	2.9681	8.2666	8.2719	6.2727	1.9938	1.9992	1.0027
32	26.004	0.60969	1.6375	2.9681	8.2698	8.2719	6.2727	1.9971	1.9992	1.001
33	27.001	0.61081	1.6427	2.9681	8.2698	8.2719	6.2692	2.0006	2.0027	1.001
34	28.003	0.61192	1.6474	2.9681	8.266	8.2713	6.2722	1.9939	1.9992	1.0027
35	29.004	0.61192	1.6518	2.9681	8.2698	8.2719	6.2716	1.9983	2.0003	1.001
36	29.025	0.61192	1.6518	2.9681	8.266	8.2713	6.2733	1.9927	1.998	1.0027

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.2693	8.2713	6.2716	1.9977	1.9997	1.001
2	0.012433	0	0	2.9681	8.3071	8.3082	6.2774	2.0297	2.0308	1.0005
3	0.05415	0.0044422	0.042078	2.9681	9.1671	9.2536	6.309	2.8581	2.9446	1.0303
4	0.10018	0.032206	0.093292	2.9681	9.22	9.2337	6.2786	2.9414	2.9551	1.0046
5	0.25028	0.076628	0.18686	2.9681	9.2262	9.2577	6.288	2.9383	2.9697	1.0107
6	0.50065	0.12438	0.29482	2.9681	9.241	9.2665	6.2874	2.9536	2.9791	1.0086
7	1.0014	0.17325	0.44542	2.9681	9.2502	9.2694	6.2833	2.9669	2.9861	1.0065
8	2.0028	0.26209	0.62647	2.9681	9.2562	9.2688	6.2739	2.9823	2.9949	1.0042
9	3.0001	0.28208	0.73249	2.9681	9.2594	9.2688	6.2763	2.9832	2.9925	1.0031
10	4.0015	0.32095	0.80142	2.9681	9.26	9.2694	6.2763	2.9837	2.9931	1.0032
11	5.0029	0.33872	0.84959	2.9681	9.2643	9.2706	6.2727	2.9916	2.9978	1.0021
12	6.0003	0.35094	0.8853	2.9681	9.2638	9.27	6.2745	2.9893	2.9955	1.0021
13	7.0017	0.36426	0.91382	2.9681	9.2654	9.2717	6.2722	2.9933	2.9996	1.0021
14	8.0032	0.38092	0.93679	2.9681	9.2643	9.2706	6.2733	2.991	2.9972	1.0021
15	9.0004	0.39092	0.95645	2.9681	9.2649	9.2711	6.2704	2.9945	3.0007	1.0021
16	10.002	0.39869	0.97306	2.9681	9.2649	9.2711	6.2722	2.9927	2.999	1.0021
17	11.003	0.40424	0.98801	2.9681	9.2649	9.2711	6.2698	2.9951	3.0013	1.0021
18	12.001	0.40868	1.001	2.9681	9.2649	9.2711	6.2733	2.9916	2.9978	1.0021
19	13.002	0.41091	1.0129	2.9681	9.2649	9.2711	6.2716	2.9933	2.9996	1.0021
20	14.003	0.41424	1.0237	2.9681	9.2649	9.2711	6.2722	2.9927	2.999	1.0021
21	15.001	0.41757	1.0337	2.9681	9.2649	9.2711	6.2745	2.9904	2.9966	1.0021
22	16.002	0.4209	1.0425	2.9681	9.2649	9.2711	6.271	2.9939	3.0002	1.0021
23	17.004	0.42312	1.0508	2.9681	9.2649	9.2711	6.2733	2.9916	2.9978	1.0021
24	18.001	0.42534	1.0586	2.9681	9.2681	9.2711	6.2716	2.9966	2.9996	1.001
25	19.002	0.42645	1.0661	2.9681	9.2687	9.2717	6.2722	2.9965	2.9996	1.001
26	20	0.42756	1.073	2.9681	9.2649	9.2711	6.2722	2.9927	2.999	1.0021
27	21.002	0.42867	1.0791	2.9681	9.2681	9.2711	6.2733	2.9948	2.9978	1.001
28	22.003	0.43312	1.0863	2.9681	9.2649	9.2711	6.2698	2.9951	3.0013	1.0021
29	23	0.43534	1.0915	2.9681	9.2681	9.2711	6.2733	2.9948	2.9978	1.001
30	24.002	0.43756	1.0979	2.9681	9.2681	9.2711	6.2698	2.9983	3.0013	1.001
31	25.003	0.44089	1.1023	2.9681	9.2687	9.2717	6.2739	2.9948	2.9978	1.001
32	26	0.44311	1.1084	2.9681	9.2681	9.2711	6.2727	2.9954	2.9984	1.001
33	27.002	0.44311	1.1131	2.9681	9.2687	9.2717	6.2716	2.9971	3.0002	1.001
34	28.003	0.44644	1.1181	2.9681	9.2692	9.2723	6.2681	3.0012	3.0042	1.001
35	28.863	0.44755	1.1217	2.9681	9.2687	9.2717	6.2727	2.9959	2.999	1.001

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9462	5.943	5.8718	0.074309	0.07115	0.95749
2	0.012517	0	0	2.9681	5.9468	5.9471	5.8742	0.072573	0.072913	1.0047
3	0.050017	0	0.0041525	2.9681	5.9685	5.9671	5.8742	0.094347	0.092866	0.9843
4	0.10008	0	0.0069208	2.9681	5.9686	5.9706	5.8713	0.097341	0.099318	1.0203
5	0.2503	0	0.0099659	2.9681	5.9654	5.9706	5.8736	0.091783	0.096973	1.0565
6	0.501	0	0.013842	2.9681	5.9654	5.9706	5.8718	0.093542	0.098732	1.0555
7	1.0024	0.00091637	0.019378	2.9681	5.9654	5.9706	5.8718	0.093542	0.098732	1.0555
8	2.0042	0.0036655	0.027683	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
9	4.0032	0.0054982	0.039033	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
10	6.0022	0.0064146	0.046784	2.9681	5.9665	5.9717	5.8724	0.094048	0.099319	1.0561
11	8.0013	0.0064146	0.052875	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
12	10	0.0073309	0.058134	2.9681	5.9691	5.9712	5.8724	0.096714	0.098732	1.0209
13	12.004	0.0073309	0.063117	2.9681	5.9691	5.9712	5.8677	0.1014	0.10342	1.0199
14	14.003	0.0073309	0.066716	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
15	16.002	0.0082473	0.070315	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
16	18.001	0.0073309	0.073637	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
17	20.004	0.0082473	0.077236	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
18	22.003	0.0082473	0.080281	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
19	24.002	0.0082473	0.082772	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
20	26.002	0.0082473	0.085264	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
21	28.002	0.0082473	0.088032	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
22	30.001	0.0091637	0.090247	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
23	32.001	0.0091637	0.092461	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
24	34.001	0.0091637	0.094676	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
25	36.001	0.0091637	0.097444	2.9681	5.9697	5.9717	5.8713	0.098433	0.10049	1.0209
26	38	0.0091637	0.099105	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
27	40	0.0091637	0.10077	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
28	42.004	0.0091637	0.1027	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
29	44.003	0.0091637	0.10492	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
30	46.002	0.0091637	0.1063	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
31	48.001	0.0091637	0.10824	2.9681	5.9691	5.9712	5.8724	0.096714	0.098732	1.0209
32	50	0.0091637	0.11018	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
33	52.004	0.0091637	0.11184	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
34	54.003	0.01008	0.1135	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
35	56.002	0.01008	0.11461	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
36	58.001	0.01008	0.11627	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
37	60.004	0.01008	0.11821	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
38	62.003	0.01008	0.11959	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
39	64.002	0.01008	0.12097	2.9681	5.9691	5.9712	5.8707	0.098473	0.10049	1.0205
40	66.001	0.0091637	0.12208	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
41	68	0.0091637	0.12347	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
42	68.723	0.01008	0.1243	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9665	5.9717	5.8718	0.094634	0.099905	1.0557
2	0.0125	0	0.00027683	2.9681	5.9942	5.9946	5.8836	0.11062	0.11107	1.004
3	0.050383	0	0.021593	2.9681	6.1013	6.1132	5.8836	0.21769	0.22961	1.0548
4	0.1004	0.0018327	0.035434	2.9681	6.0916	6.1132	5.8759	0.21567	0.23723	1.1
5	0.25062	0.0045818	0.060626	2.9681	6.0997	6.1185	5.8748	0.22497	0.24369	1.0832
6	0.50138	0.018327	0.091908	2.9681	6.1084	6.1208	5.8771	0.23123	0.24369	1.0539
7	1.0028	0.033906	0.14201	2.9681	6.1105	6.1196	5.8759	0.23453	0.24369	1.0391
8	2.0004	0.053149	0.22063	2.9681	6.1142	6.1202	5.873	0.24122	0.2472	1.0248
9	4.0036	0.072393	0.33856	2.9681	6.1159	6.122	5.873	0.24285	0.24897	1.0252
10	6.0026	0.093469	0.42826	2.9681	6.1142	6.1202	5.8748	0.23946	0.24545	1.025
11	8.0017	0.10905	0.49913	2.9681	6.1148	6.1208	5.8742	0.24059	0.24662	1.0251
12	10.001	0.11821	0.55671	2.9681	6.118	6.1208	5.8736	0.24439	0.24721	1.0115
13	12.004	0.12463	0.6046	2.9681	6.118	6.1208	5.873	0.24497	0.24779	1.0115
14	14.003	0.12829	0.64418	2.9681	6.118	6.1208	5.8736	0.24439	0.24721	1.0115
15	16.002	0.13471	0.67713	2.9681	6.1148	6.1208	5.8724	0.24235	0.24838	1.0249
16	18.001	0.14845	0.70481	2.9681	6.1153	6.1214	5.8736	0.24172	0.24779	1.0251
17	20.001	0.15395	0.72862	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
18	22.001	0.15761	0.74883	2.9681	6.1153	6.1214	5.8724	0.24289	0.24896	1.025
19	24	0.1622	0.76682	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116
20	26.004	0.16586	0.7826	2.9681	6.1185	6.1214	5.873	0.24552	0.24838	1.0116
21	28.003	0.16861	0.79672	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
22	30.002	0.16861	0.80945	2.9681	6.1153	6.1214	5.8718	0.24348	0.24955	1.0249
23	32.001	0.16861	0.8208	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116
24	34	0.16953	0.83132	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
25	36.004	0.16953	0.84073	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116
26	38.004	0.16953	0.84959	2.9681	6.1185	6.1214	5.8701	0.24845	0.25131	1.0115
27	40.003	0.17044	0.85734	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
28	42.003	0.17136	0.8651	2.9681	6.1191	6.122	5.8701	0.249	0.2519	1.0116
29	44.003	0.17228	0.87202	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
30	46.002	0.17228	0.87838	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116
31	48.002	0.17228	0.88475	2.9681	6.1191	6.122	5.8713	0.24783	0.25072	1.0117
32	50.002	0.17319	0.89029	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
33	52.002	0.17319	0.89582	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
34	53.968	0.17319	0.90108	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
2	0.012467	0	0.00083049	2.9681	6.1589	6.1613	5.8847	0.27413	0.27656	1.0089
3	0.050367	0	0.02879	2.9681	6.3333	6.3626	5.8906	0.44267	0.47198	1.0662
4	0.10037	0.0018327	0.048169	2.9681	6.3262	6.3585	5.8765	0.4497	0.48195	1.0717
5	0.2506	0.017411	0.087755	2.9681	6.3414	6.3679	5.8795	0.46193	0.48841	1.0573
6	0.50137	0.039404	0.13842	2.9681	6.3516	6.3685	5.8783	0.47329	0.49016	1.0357
7	1.0028	0.064146	0.21648	2.9681	6.3591	6.3696	5.8783	0.48081	0.49134	1.0219
8	2.0003	0.089804	0.33303	2.9681	6.3629	6.3702	5.8789	0.48398	0.49134	1.0152
9	4.0036	0.13379	0.50162	2.9681	6.3629	6.3702	5.8742	0.48867	0.49603	1.0151
10	6.0026	0.16678	0.62176	2.9681	6.3661	6.3702	5.8754	0.49071	0.49486	1.0085
11	8.0018	0.19977	0.71007	2.9681	6.3661	6.3702	5.8748	0.49129	0.49544	1.0084
12	10.001	0.20343	0.77734	2.9681	6.3666	6.3708	5.8742	0.49243	0.49662	1.0085
13	12.004	0.2071	0.82994	2.9681	6.3698	6.3708	5.8718	0.49798	0.49896	1.002
14	14.003	0.22084	0.87146	2.9681	6.3672	6.3714	5.8736	0.49356	0.49779	1.0086
15	16.002	0.23184	0.90441	2.9681	6.3672	6.3714	5.8724	0.49473	0.49896	1.0086
16	18.001	0.23642	0.93181	2.9681	6.3704	6.3714	5.873	0.49736	0.49838	1.002
17	20	0.24009	0.95534	2.9681	6.3704	6.3714	5.8724	0.49794	0.49896	1.002
18	22.003	0.24375	0.97527	2.9681	6.3709	6.372	5.8718	0.49908	0.50013	1.0021
19	24.003	0.24834	0.99271	2.9681	6.3704	6.3714	5.8724	0.49794	0.49896	1.002
20	26.002	0.25383	1.0071	2.9681	6.3704	6.3714	5.873	0.49736	0.49838	1.002
21	28.002	0.25658	1.0207	2.9681	6.3672	6.3714	5.8724	0.49473	0.49896	1.0086
22	30.002	0.2575	1.0329	2.9681	6.3704	6.3714	5.873	0.49736	0.49838	1.002
23	32.002	0.25842	1.0442	2.9681	6.3709	6.372	5.8718	0.49908	0.50013	1.0021
24	34.002	0.26025	1.0542	2.9681	6.3704	6.3714	5.873	0.49736	0.49838	1.002
25	36.001	0.26116	1.0636	2.9681	6.3704	6.3714	5.8718	0.49853	0.49955	1.002
26	38.001	0.26208	1.073	2.9681	6.3704	6.3714	5.8718	0.49853	0.49955	1.002
27	40.001	0.26391	1.0813	2.9681	6.3704	6.3714	5.8707	0.4997	0.50072	1.002
28	41.779	0.26391	1.0879	2.9681	6.3709	6.372	5.8724	0.49849	0.49955	1.0021

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3709	6.372	5.8724	0.49849	0.49955	1.0021
2	0.012483	0	0.0011073	2.9681	6.4495	6.453	5.8941	0.55535	0.55884	1.0063
3	0.050367	0.0018327	0.041801	2.9681	6.8102	6.8649	5.897	0.91316	0.96788	1.0599
4	0.10045	0.0073309	0.075021	2.9681	6.7901	6.8503	5.8754	0.91478	0.9749	1.0657
5	0.25062	0.037571	0.13897	2.9681	6.8188	6.8638	5.8777	0.94106	0.98605	1.0478
6	0.5014	0.066895	0.22146	2.9681	6.8472	6.8667	5.8871	0.96011	0.9796	1.0203
7	1.0028	0.098967	0.34687	2.9681	6.8531	6.8696	5.883	0.97015	0.98664	1.017
8	2.0004	0.16861	0.53124	2.9681	6.859	6.869	5.873	0.986	0.99602	1.0102
9	4.0036	0.21626	0.78122	2.9681	6.8639	6.8708	5.8765	0.98733	0.99426	1.007
10	6.0026	0.26483	0.94233	2.9681	6.8665	6.8702	5.873	0.99351	0.99719	1.0037
11	8.0016	0.29507	1.0508	2.9681	6.8633	6.8702	5.8748	0.98854	0.99544	1.007
12	10.001	0.31706	1.127	2.9681	6.8665	6.8702	5.8724	0.9941	0.99778	1.0037
13	12.004	0.32898	1.1835	2.9681	6.8671	6.8708	5.8742	0.99289	0.99661	1.0037
14	14.003	0.33264	1.2266	2.9681	6.8708	6.8714	5.8736	0.99723	0.99778	1.0006
15	16.002	0.34089	1.2612	2.9681	6.8676	6.8714	5.873	0.99461	0.99837	1.0038
16	18.001	0.35372	1.2889	2.9681	6.8708	6.8714	5.8736	0.99723	0.99778	1.0006
17	20	0.36288	1.3125	2.9681	6.8708	6.8714	5.8736	0.99723	0.99778	1.0006
18	22.004	0.36746	1.3332	2.9681	6.8676	6.8714	5.873	0.99461	0.99837	1.0038
19	24.003	0.37479	1.3512	2.9681	6.8676	6.8714	5.8724	0.99519	0.99895	1.0038
20	26.003	0.38121	1.3675	2.9681	6.8682	6.872	5.8713	0.99691	1.0007	1.0038
21	28.002	0.38396	1.3825	2.9681	6.8714	6.872	5.873	0.99836	0.99895	1.0006
22	30.002	0.38671	1.3958	2.9681	6.8708	6.8714	5.8713	0.99958	1.0001	1.0005
23	32.002	0.38854	1.4082	2.9681	6.8676	6.8714	5.8707	0.99695	1.0007	1.0038
24	33.572	0.39129	1.4168	2.9681	6.8714	6.872	5.873	0.99836	0.99895	1.0006

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.8708	6.8714	5.873	0.99782	0.99837	1.0006
2	0.0125	0	0.0013842	2.9681	6.9941	6.997	5.8941	1.1	1.1028	1.0026
3	0.050383	0.01008	0.053428	2.9681	7.7292	7.8356	5.9117	1.8175	1.9239	1.0585
4	0.10045	0.021076	0.10741	2.9681	7.7217	7.8344	5.8754	1.8464	1.959	1.061
5	0.25068	0.048567	0.21122	2.9681	7.7805	7.8561	5.8871	1.8934	1.969	1.04
6	0.50137	0.1008	0.34272	2.9681	7.8363	7.8643	5.8742	1.9621	1.9901	1.0143
7	1.0028	0.17136	0.53567	2.9681	7.831	7.8655	5.8783	1.9527	1.9872	1.0177
8	2.0003	0.26025	0.8136	2.9681	7.8449	7.8667	5.8871	1.9578	1.9796	1.0111
9	4.0039	0.35097	1.1619	2.9681	7.8578	7.8702	5.8783	1.9795	1.9919	1.0063
10	6.003	0.42153	1.3567	2.9681	7.8605	7.8696	5.8759	1.9845	1.9937	1.0046
11	8.002	0.45818	1.4738	2.9681	7.861	7.8702	5.8736	1.9874	1.9966	1.0046
12	10.001	0.47468	1.5511	2.9681	7.8642	7.8702	5.8718	1.9924	1.9984	1.003
13	12	0.49392	1.6064	2.9681	7.8642	7.8702	5.8736	1.9906	1.9966	1.003
14	14.003	0.50675	1.6488	2.9681	7.8642	7.8702	5.8707	1.9936	1.9995	1.003
15	16.002	0.51866	1.6826	2.9681	7.8648	7.8708	5.8724	1.9924	1.9984	1.003
16	18.002	0.53058	1.7105	2.9681	7.8685	7.8714	5.8724	1.9961	1.9989	1.0014
17	20.001	0.53516	1.7346	2.9681	7.8653	7.8714	5.8748	1.9906	1.9966	1.003
18	22.001	0.54249	1.7562	2.9681	7.8691	7.872	5.8718	1.9972	2.0001	1.0014
19	24	0.54799	1.775	2.9681	7.8685	7.8714	5.8742	1.9944	1.9972	1.0014
20	26.004	0.55074	1.7925	2.9681	7.8685	7.8714	5.8736	1.9949	1.9978	1.0014
21	28.004	0.55257	1.808	2.9681	7.8685	7.8714	5.8736	1.9949	1.9978	1.0014
22	30.004	0.55715	1.8227	2.9681	7.8653	7.8714	5.873	1.9923	1.9984	1.003
23	30.083	0.55715	1.8229	2.9681	7.8685	7.8714	5.8742	1.9944	1.9972	1.0014

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3423	6.3437	6.2716	0.070727	0.072115	1.0196
2	0.012567	0	0	2.9681	6.3494	6.3478	6.2745	0.074897	0.073287	0.97851
3	0.050217	0	0.0063671	2.9681	6.367	6.3665	6.2792	0.087772	0.087339	0.99507
4	0.1003	-0.0011106	0.014672	2.9681	6.3632	6.3694	6.2745	0.088687	0.094946	1.0706
5	0.25052	0	0.019655	2.9681	6.3675	6.3706	6.2733	0.094208	0.097287	1.0327
6	0.5013	0	0.024361	2.9681	6.3681	6.3712	6.2727	0.095342	0.098457	1.0327
7	1.0027	0	0.030175	2.9681	6.3654	6.3718	6.2722	0.093222	0.099628	1.0687
8	2.0003	0	0.036818	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
9	3.002	0.0011106	0.040694	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
10	4.0038	0	0.043186	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
11	5.0014	0.0011106	0.04457	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
12	6.0031	0.0011106	0.045954	2.9681	6.3681	6.3712	6.2722	0.095927	0.099042	1.0325
13	7.0007	0.0011106	0.046784	2.9681	6.3719	6.3718	6.2716	0.10031	0.10021	0.99898
14	8.0025	0.0011106	0.047615	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
15	9.0002	0.0011106	0.048169	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
16	10.002	0.0011106	0.048722	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
17	11.004	0	0.049276	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
18	12.001	0.0011106	0.049276	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
19	13.003	0	0.049829	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
20	14.001	0.0011106	0.05066	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
21	15.003	0.0011106	0.050937	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
22	16	0.0011106	0.051214	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
23	17.002	0.0011106	0.05149	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
24	18.004	0.0011106	0.052044	2.9681	6.3686	6.3718	6.271	0.097646	0.1008	1.0323
25	19.001	0.0022211	0.052044	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
26	20.003	0.0011106	0.052321	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
27	21.001	0.0022211	0.052321	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
28	22.003	0.0022211	0.052321	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
29	23.001	0.0022211	0.053151	2.9681	6.3686	6.3718	6.271	0.097646	0.1008	1.0323
30	24.003	0.0011106	0.053151	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
31	25.001	0.0011106	0.053151	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
32	26.002	0.0011106	0.053151	2.9681	6.3686	6.3718	6.2722	0.096476	0.099628	1.0327
33	26.032	0.0011106	0.053151	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3686	6.3718	6.2716	0.097061	0.10021	1.0325
2	0.012483	0	0.00083049	2.9681	6.3938	6.3952	6.2868	0.10705	0.10842	1.0128
3	0.050383	0	0.033773	2.9681	6.5073	6.5093	6.2944	0.21293	0.21496	1.0095
4	0.10038	0	0.055366	2.9681	6.5052	6.5105	6.278	0.22715	0.23251	1.0236
5	0.2506	0.0022211	0.087478	2.9681	6.5117	6.5175	6.2792	0.23257	0.23837	1.0249
6	0.50142	0.0055528	0.12097	2.9681	6.515	6.5211	6.2768	0.2382	0.24422	1.0253
7	1.0028	0.009995	0.16721	2.9681	6.5145	6.5205	6.2739	0.24058	0.24656	1.0249
8	2.0004	0.015548	0.23226	2.9681	6.5166	6.5193	6.2745	0.24215	0.2448	1.011
9	3.0021	0.017769	0.28154	2.9681	6.5139	6.5199	6.2733	0.24061	0.24656	1.0247
10	4.0039	0.023322	0.32085	2.9681	6.5177	6.5205	6.2727	0.245	0.24773	1.0111
11	5.0017	0.024432	0.35324	2.9681	6.5177	6.5205	6.2727	0.245	0.24773	1.0111
12	6.0034	0.025543	0.38092	2.9681	6.5172	6.5199	6.2727	0.24445	0.24714	1.011
13	7.0012	0.026653	0.40473	2.9681	6.5145	6.5205	6.2722	0.24233	0.24831	1.0247
14	8.003	0.028874	0.42521	2.9681	6.5177	6.5205	6.2733	0.24442	0.24714	1.0112
15	9.0006	0.029985	0.44348	2.9681	6.5177	6.5205	6.2716	0.24617	0.2489	1.0111
16	10.002	0.032206	0.45898	2.9681	6.5145	6.5205	6.2722	0.24233	0.24831	1.0247
17	11	0.033317	0.47283	2.9681	6.515	6.5211	6.2716	0.24346	0.24948	1.0247
18	12.002	0.034427	0.48501	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
19	13.004	0.034427	0.49608	2.9681	6.5177	6.5205	6.2704	0.24734	0.25007	1.011
20	14.002	0.034427	0.50577	2.9681	6.5183	6.5211	6.2722	0.24613	0.2489	1.0112
21	15.004	0.035538	0.5149	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
22	16.001	0.035538	0.52293	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
23	17.004	0.035538	0.53041	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
24	18.001	0.036648	0.53705	2.9681	6.5183	6.5211	6.2722	0.24613	0.2489	1.0112
25	19.003	0.036648	0.54342	2.9681	6.5183	6.5211	6.2722	0.24613	0.2489	1.0112
26	20.001	0.036648	0.54923	2.9681	6.515	6.5211	6.2722	0.24288	0.2489	1.0248
27	21.003	0.036648	0.55477	2.9681	6.515	6.5211	6.271	0.24405	0.25007	1.0247
28	22.001	0.036648	0.55975	2.9681	6.5183	6.5211	6.2698	0.24847	0.25124	1.0111
29	23.003	0.036648	0.56418	2.9681	6.5183	6.5211	6.271	0.2473	0.25007	1.0112
30	24	0.037759	0.56861	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
31	25.002	0.037759	0.57249	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
32	26	0.037759	0.57608	2.9681	6.5188	6.5216	6.2727	0.2461	0.2489	1.0114
33	27.002	0.037759	0.58024	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
34	28.004	0.037759	0.58356	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
35	29.002	0.037759	0.58688	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
36	30.004	0.038869	0.58937	2.9681	6.5183	6.5211	6.2716	0.24672	0.24948	1.0112
37	31.001	0.038869	0.59297	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
38	32.003	0.038869	0.59602	2.9681	6.5183	6.5211	6.271	0.2473	0.25007	1.0112
39	33.001	0.03998	0.59878	2.9681	6.5183	6.5211	6.271	0.2473	0.25007	1.0112
40	34.002	0.03998	0.60045	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
41	35.004	0.03998	0.60294	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
42	36.002	0.03998	0.60598	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
43	37.004	0.03998	0.60875	2.9681	6.5183	6.5211	6.271	0.2473	0.25007	1.0112
44	38.001	0.03998	0.61041	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
45	39.003	0.03998	0.61318	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
46	40.001	0.03998	0.61512	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
47	41.002	0.03998	0.61761	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114
48	41.311	0.03998	0.61789	2.9681	6.5188	6.5216	6.2722	0.24668	0.24948	1.0114

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5188	6.5216	6.2716	0.24727	0.25007	1.0113
2	0.0125	0	0.00083049	2.9681	6.5621	6.5609	6.2903	0.27181	0.27057	0.99542
3	0.050383	0.0033317	0.039033	2.9681	6.7487	6.7634	6.2967	0.45194	0.46667	1.0326
4	0.10045	0.009995	0.069484	2.9681	6.7361	6.7535	6.2774	0.45867	0.47603	1.0378
5	0.25068	0.031096	0.12513	2.9681	6.7541	6.7657	6.285	0.46909	0.48071	1.0248
6	0.50143	0.052196	0.18658	2.9681	6.7601	6.7687	6.2745	0.48562	0.49417	1.0176
7	1.0028	0.071076	0.27351	2.9681	6.7618	6.7704	6.2722	0.4896	0.49827	1.0177
8	2.0004	0.098839	0.39282	2.9681	6.7634	6.7687	6.2733	0.49004	0.49534	1.0108
9	3.0022	0.12216	0.48335	2.9681	6.7628	6.7681	6.2722	0.49066	0.49593	1.0107
10	4.0041	0.14104	0.55615	2.9681	6.7634	6.7687	6.2722	0.49121	0.49651	1.0108
11	5.0017	0.15659	0.61539	2.9681	6.765	6.7704	6.2745	0.49052	0.49593	1.011
12	6.0035	0.16658	0.66495	2.9681	6.7645	6.7698	6.2727	0.49173	0.4971	1.0109
13	7.001	0.17325	0.70564	2.9681	6.7672	6.7693	6.2727	0.49443	0.49651	1.0042
14	8.0028	0.17658	0.74024	2.9681	6.7677	6.7698	6.2739	0.49381	0.49593	1.0043
15	9.0004	0.18102	0.77014	2.9681	6.7683	6.7704	6.2733	0.49494	0.4971	1.0044
16	10.002	0.18324	0.79589	2.9681	6.7683	6.7704	6.2733	0.49494	0.4971	1.0044
17	11.004	0.18324	0.81776	2.9681	6.765	6.7704	6.2733	0.49169	0.4971	1.011
18	12.002	0.18435	0.83714	2.9681	6.765	6.7704	6.2733	0.49169	0.4971	1.011
19	13.004	0.18435	0.85458	2.9681	6.7688	6.771	6.2733	0.49549	0.49768	1.0044
20	14.002	0.18546	0.8698	2.9681	6.7683	6.7704	6.2722	0.49611	0.49827	1.0043
21	15.003	0.18546	0.88337	2.9681	6.7688	6.771	6.2722	0.49666	0.49885	1.0044
22	16.002	0.18657	0.89555	2.9681	6.7688	6.771	6.2727	0.49608	0.49827	1.0044
23	17.003	0.18657	0.90662	2.9681	6.7688	6.771	6.2722	0.49666	0.49885	1.0044
24	18.001	0.18879	0.91686	2.9681	6.7688	6.771	6.2716	0.49725	0.49944	1.0044
25	19.003	0.19102	0.926	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045
26	20.001	0.19213	0.93458	2.9681	6.7688	6.771	6.2722	0.49666	0.49885	1.0044
27	21.003	0.19546	0.94233	2.9681	6.7688	6.771	6.2722	0.49666	0.49885	1.0044
28	22.001	0.19657	0.94981	2.9681	6.7656	6.771	6.271	0.49458	0.50002	1.011
29	23.003	0.19768	0.95645	2.9681	6.7688	6.771	6.271	0.49783	0.50002	1.0044
30	24	0.19879	0.96254	2.9681	6.7656	6.771	6.2722	0.49341	0.49885	1.011
31	25.002	0.19879	0.9678	2.9681	6.7688	6.771	6.2716	0.49725	0.49944	1.0044
32	26	0.1999	0.97334	2.9681	6.7656	6.771	6.2716	0.49399	0.49944	1.011
33	27.002	0.1999	0.97943	2.9681	6.7688	6.771	6.2716	0.49725	0.49944	1.0044
34	28.004	0.20101	0.98441	2.9681	6.7688	6.771	6.271	0.49783	0.50002	1.0044
35	29.002	0.20212	0.98884	2.9681	6.7694	6.7716	6.2716	0.4978	0.50002	1.0045
36	30.004	0.20323	0.99271	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045
37	31.001	0.20545	0.9977	2.9681	6.7694	6.7716	6.2727	0.49662	0.49885	1.0045
38	32.003	0.20656	1.0018	2.9681	6.7694	6.7716	6.2727	0.49662	0.49885	1.0045
39	33.001	0.20767	1.006	2.9681	6.7694	6.7716	6.2704	0.49897	0.50119	1.0045
40	34.003	0.20878	1.0096	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045
41	35	0.20989	1.0126	2.9681	6.7694	6.7716	6.2722	0.49721	0.49944	1.0045
42	36.002	0.20989	1.0162	2.9681	6.7688	6.771	6.2722	0.49666	0.49885	1.0044
43	37.004	0.21101	1.0198	2.9681	6.7694	6.7716	6.2716	0.4978	0.50002	1.0045
44	38.001	0.21212	1.0234	2.9681	6.7699	6.7722	6.2716	0.49834	0.50061	1.0045
45	38.695	0.21212	1.0254	2.9681	6.7694	6.7716	6.2716	0.4978	0.50002	1.0045

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.7694	6.7716	6.2716	0.4978	0.50002	1.0045
2	0.012483	0	0.0013842	2.9681	6.8538	6.8547	6.3055	0.54827	0.54921	1.0017
3	0.050383	0.011106	0.055643	2.9681	7.2237	7.2668	6.3073	0.91647	0.95956	1.047
4	0.10045	0.028874	0.10464	2.9681	7.2137	7.2422	6.278	0.9357	0.96423	1.0305
5	0.25068	0.077739	0.19489	2.9681	7.2475	7.261	6.2891	0.95841	0.97184	1.014
6	0.50138	0.10772	0.29344	2.9681	7.2541	7.268	6.2733	0.98079	0.99466	1.0141
7	1.0028	0.14104	0.42936	2.9681	7.2628	7.2703	6.2733	0.98949	0.99701	1.0076
8	2.0005	0.18657	0.61567	2.9681	7.2628	7.2668	6.2792	0.9836	0.98764	1.0041
9	3.0023	0.20323	0.75187	2.9681	7.2612	7.2686	6.2727	0.98843	0.99583	1.0075
10	4.0041	0.23988	0.85679	2.9681	7.265	7.2692	6.2751	0.98989	0.99408	1.0042
11	5.0017	0.26209	0.93929	2.9681	7.265	7.2692	6.2751	0.98989	0.99408	1.0042
12	6.0035	0.27542	1.0054	2.9681	7.2666	7.2709	6.2722	0.99446	0.99876	1.0043
13	7.001	0.28541	1.0589	2.9681	7.2655	7.2697	6.271	0.99454	0.99876	1.0042
14	8.0028	0.2943	1.1032	2.9681	7.2661	7.2703	6.2727	0.99333	0.99759	1.0043
15	9.0004	0.3054	1.1394	2.9681	7.2655	7.2697	6.2751	0.99044	0.99467	1.0043
16	10.002	0.31096	1.1704	2.9681	7.2693	7.2703	6.2739	0.99541	0.99642	1.001
17	11.004	0.31651	1.1973	2.9681	7.2693	7.2703	6.2704	0.99892	0.99993	1.001
18	12.002	0.31762	1.2203	2.9681	7.2693	7.2703	6.2733	0.996	0.99701	1.001
19	13.003	0.32095	1.2405	2.9681	7.2699	7.2709	6.2733	0.99655	0.99759	1.001
20	14.001	0.3265	1.2587	2.9681	7.2666	7.2709	6.2739	0.99271	0.99701	1.0043
21	15.003	0.32872	1.2751	2.9681	7.2699	7.2709	6.2733	0.99655	0.99759	1.001
22	16	0.3365	1.2898	2.9681	7.2693	7.2703	6.2727	0.99658	0.99759	1.001
23	17.003	0.33983	1.303	2.9681	7.2699	7.2709	6.2722	0.99772	0.99876	1.001
24	18	0.34316	1.3149	2.9681	7.2666	7.2709	6.2733	0.99329	0.99759	1.0043
25	19.002	0.34427	1.3263	2.9681	7.2699	7.2709	6.2716	0.9983	0.99935	1.001
26	20	0.34649	1.3365	2.9681	7.2666	7.2709	6.2727	0.99388	0.99818	1.0043
27	21.002	0.34871	1.3462	2.9681	7.2666	7.2709	6.2716	0.99505	0.99935	1.0043
28	22.004	0.34871	1.3551	2.9681	7.2699	7.2709	6.2733	0.99655	0.99759	1.001
29	23.002	0.34982	1.3639	2.9681	7.2699	7.2709	6.2716	0.9983	0.99935	1.001
30	24.004	0.35094	1.3717	2.9681	7.2704	7.2715	6.2716	0.99885	0.99993	1.0011
31	25.002	0.35205	1.3794	2.9681	7.2666	7.2709	6.2716	0.99505	0.99935	1.0043
32	26.003	0.35316	1.3866	2.9681	7.2699	7.2709	6.2722	0.99772	0.99876	1.001
33	27.001	0.35427	1.3938	2.9681	7.2699	7.2709	6.2727	0.99713	0.99818	1.001
34	28.003	0.35427	1.4002	2.9681	7.2699	7.2709	6.2716	0.9983	0.99935	1.001
35	29	0.35538	1.4063	2.9681	7.2704	7.2715	6.2727	0.99768	0.99876	1.0011
36	30.002	0.35538	1.4124	2.9681	7.2672	7.2715	6.2722	0.99501	0.99935	1.0044
37	31.004	0.35649	1.4182	2.9681	7.2699	7.2709	6.271	0.99889	0.99993	1.001
38	32.002	0.3576	1.4237	2.9681	7.2666	7.2709	6.2716	0.99505	0.99935	1.0043
39	33.003	0.3576	1.4293	2.9681	7.2704	7.2715	6.2704	1	1.0011	1.0011
40	34.001	0.35871	1.4343	2.9681	7.2699	7.2709	6.2727	0.99713	0.99818	1.001
41	34.364	0.35871	1.4359	2.9681	7.2699	7.2709	6.2722	0.99772	0.99876	1.001

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.2704	7.2715	6.2727	0.99768	0.99876	1.0011
2	0.0125	0	0.0013842	2.9681	7.3927	7.395	6.3014	1.0913	1.0936	1.0021
3	0.050383	0.015548	0.070869	2.9681	8.1556	8.2438	6.3324	1.8232	1.9114	1.0484
4	0.1005	0.047754	0.15198	2.9681	8.1771	8.2216	6.2833	1.8938	1.9383	1.0235
5	0.2507	0.10883	0.2987	2.9681	8.2441	8.2514	6.3014	1.9427	1.95	1.0038
6	0.50137	0.1788	0.45788	2.9681	8.2567	8.2649	6.3002	1.9565	1.9646	1.0042
7	1.0028	0.23211	0.68211	2.9681	8.2568	8.2684	6.278	1.9788	1.9904	1.0059
8	2.0003	0.32095	0.98607	2.9681	8.2551	8.2666	6.2809	1.9742	1.9857	1.0058
9	3.0021	0.3787	1.2067	2.9681	8.2617	8.2702	6.2833	1.9784	1.9869	1.0043
10	4.0039	0.41646	1.3753	2.9681	8.2617	8.2702	6.2815	1.9802	1.9886	1.0043
11	5.0017	0.45311	1.506	2.9681	8.2655	8.2707	6.2733	1.9921	1.9974	1.0026
12	6.0035	0.49642	1.6089	2.9681	8.2617	8.2702	6.2733	1.9883	1.9968	1.0043
13	7.0011	0.50863	1.6923	2.9681	8.2644	8.2696	6.2751	1.9893	1.9945	1.0026
14	8.0028	0.52196	1.7615	2.9681	8.2655	8.2707	6.2751	1.9904	1.9957	1.0026
15	9.0006	0.5364	1.8177	2.9681	8.2644	8.2696	6.2722	1.9922	1.9974	1.0026
16	10.002	0.5475	1.8658	2.9681	8.2655	8.2707	6.2733	1.9921	1.9974	1.0026
17	11	0.55972	1.9068	2.9681	8.2649	8.2702	6.2739	1.991	1.9962	1.0026
18	12.002	0.5686	1.9428	2.9681	8.2687	8.2707	6.2727	1.996	1.998	1.001
19	13	0.5786	1.9738	2.9681	8.2655	8.2707	6.2733	1.9921	1.9974	1.0026
20	14.002	0.58415	2.0015	2.9681	8.2682	8.2702	6.2739	1.9943	1.9962	1.001
21	15.004	0.59304	2.0264	2.9681	8.2687	8.2707	6.2739	1.9948	1.9968	1.001
22	16.001	0.5997	2.0488	2.9681	8.2655	8.2707	6.2739	1.9916	1.9968	1.0026
23	17.003	0.60747	2.0693	2.9681	8.266	8.2713	6.2739	1.9921	1.9974	1.0027
24	18.001	0.61081	2.0881	2.9681	8.2687	8.2707	6.2733	1.9954	1.9974	1.001
25	19.003	0.61303	2.1056	2.9681	8.2687	8.2707	6.2733	1.9954	1.9974	1.001
26	20.001	0.61858	2.1216	2.9681	8.2693	8.2713	6.2745	1.9948	1.9968	1.001
27	21.003	0.62302	2.1371	2.9681	8.266	8.2713	6.2698	1.9962	2.0015	1.0027
28	22	0.62635	2.1507	2.9681	8.2693	8.2713	6.2739	1.9954	1.9974	1.001
29	23.002	0.62968	2.164	2.9681	8.266	8.2713	6.2727	1.9933	1.9986	1.0027
30	24.004	0.63413	2.1767	2.9681	8.2693	8.2713	6.2733	1.996	1.998	1.001
31	25.001	0.63968	2.1886	2.9681	8.266	8.2713	6.2704	1.9956	2.0009	1.0027
32	26.003	0.64523	2.1997	2.9681	8.266	8.2713	6.2722	1.9939	1.9992	1.0027
33	27.001	0.6519	2.2102	2.9681	8.2693	8.2713	6.2739	1.9954	1.9974	1.001
34	28.003	0.65412	2.2207	2.9681	8.2693	8.2713	6.271	1.9983	2.0003	1.001
35	29	0.65523	2.2307	2.9681	8.2693	8.2713	6.2692	2	2.0021	1.001
36	30.002	0.65634	2.2401	2.9681	8.266	8.2713	6.2733	1.9927	1.998	1.0027
37	31.004	0.65856	2.2492	2.9681	8.266	8.2713	6.2739	1.9921	1.9974	1.0027
38	32.002	0.65856	2.2584	2.9681	8.266	8.2713	6.2681	1.998	2.0033	1.0027
39	33.003	0.65967	2.2667	2.9681	8.266	8.2713	6.2716	1.9945	1.9997	1.0027
40	34.001	0.65967	2.275	2.9681	8.2698	8.2719	6.2716	1.9983	2.0003	1.001
41	35.003	0.65967	2.283	2.9681	8.266	8.2713	6.2722	1.9939	1.9992	1.0027
42	35.1	0.65967	2.2839	2.9681	8.2693	8.2713	6.2704	1.9989	2.0009	1.001

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.2693	8.2713	6.271	1.9983	2.0003	1.001
2	0.012483	0	0.00055366	2.9681	8.3915	8.3948	6.295	2.0966	2.0999	1.0016
3	0.050383	0.0066633	0.062564	2.9681	9.4645	9.5779	6.326	3.1385	3.2519	1.0361
4	0.10045	0.054417	0.15613	2.9681	9.6632	9.7031	6.2932	3.37	3.4099	1.0118
5	0.25067	0.13327	0.32445	2.9681	9.7196	9.7529	6.316	3.4036	3.4369	1.0098
6	0.50137	0.20212	0.50881	2.9681	9.7262	9.7599	6.2961	3.4301	3.4638	1.0098
7	1.0028	0.30318	0.7682	2.9681	9.7426	9.767	6.2745	3.4681	3.4925	1.007
8	2.0003	0.41979	1.1203	2.9681	9.7616	9.7699	6.2763	3.4853	3.4936	1.0024
9	3.0021	0.49309	1.3686	2.9681	9.7556	9.767	6.2792	3.4764	3.4878	1.0033
10	4.0038	0.55417	1.5527	2.9681	9.7632	9.7681	6.2763	3.4869	3.4919	1.0014
11	5.0014	0.61303	1.6914	2.9681	9.7594	9.7675	6.2763	3.4831	3.4913	1.0023
12	6.0032	0.63524	1.8002	2.9681	9.767	9.7722	6.278	3.489	3.4942	1.0015
13	7.0009	0.67633	1.8869	2.9681	9.7648	9.7699	6.2727	3.4921	3.4971	1.0014
14	8.0027	0.7052	1.9575	2.9681	9.7648	9.7699	6.2751	3.4898	3.4948	1.0014
15	9.0003	0.72741	2.015	2.9681	9.7648	9.7699	6.2745	3.4903	3.4954	1.0014
16	10.002	0.7363	2.0638	2.9681	9.7648	9.7699	6.2722	3.4927	3.4977	1.0014
17	11.004	0.7474	2.1053	2.9681	9.7654	9.7705	6.2745	3.4909	3.496	1.0015
18	12.001	0.76628	2.1418	2.9681	9.7665	9.7716	6.2733	3.4932	3.4983	1.0015
19	13.003	0.77739	2.1737	2.9681	9.7621	9.7705	6.2739	3.4882	3.4965	1.0024
20	14.001	0.79738	2.2019	2.9681	9.7648	9.7699	6.2751	3.4898	3.4948	1.0014
21	15.003	0.81515	2.2274	2.9681	9.7654	9.7705	6.2733	3.4921	3.4971	1.0015
22	16	0.82625	2.2506	2.9681	9.7686	9.7705	6.2739	3.4947	3.4965	1.0005
23	17.002	0.8307	2.2719	2.9681	9.7659	9.771	6.2727	3.4932	3.4983	1.0015
24	18.004	0.83403	2.2916	2.9681	9.7659	9.771	6.2692	3.4967	3.5018	1.0015
25	19.001	0.83514	2.3096	2.9681	9.7654	9.7705	6.2722	3.4932	3.4983	1.0015
26	20.003	0.83625	2.3265	2.9681	9.7654	9.7705	6.2739	3.4915	3.4965	1.0015
27	21.001	0.83847	2.3425	2.9681	9.7686	9.7705	6.2722	3.4965	3.4983	1.0005
28	22.003	0.83958	2.3575	2.9681	9.7665	9.7716	6.2722	3.4943	3.4995	1.0015
29	23.001	0.8418	2.3713	2.9681	9.7692	9.771	6.2733	3.4959	3.4977	1.0005
30	24.003	0.84624	2.3846	2.9681	9.7692	9.771	6.2739	3.4953	3.4971	1.0005
31	25	0.8518	2.3971	2.9681	9.7659	9.771	6.2727	3.4932	3.4983	1.0015
32	26.003	0.85624	2.409	2.9681	9.7692	9.771	6.2727	3.4964	3.4983	1.0005
33	27	0.85957	2.4203	2.9681	9.7659	9.771	6.2722	3.4938	3.4989	1.0015
34	28.002	0.86512	2.4311	2.9681	9.7665	9.7716	6.2727	3.4937	3.4989	1.0015
35	29	0.86956	2.4416	2.9681	9.7692	9.771	6.271	3.4982	3.5001	1.0005
36	30.002	0.87512	2.4516	2.9681	9.7659	9.771	6.2716	3.4944	3.4995	1.0015
37	31.004	0.87734	2.4613	2.9681	9.7659	9.771	6.2704	3.4955	3.5006	1.0015
38	32.001	0.87956	2.4704	2.9681	9.7659	9.771	6.2698	3.4961	3.5012	1.0015
39	33.003	0.88178	2.4793	2.9681	9.7659	9.771	6.2727	3.4932	3.4983	1.0015
40	33.509	0.88289	2.484	2.9681	9.7692	9.771	6.2698	3.4994	3.5012	1.0005

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9416	5.9439	5.872	0.069572	0.071884	1.0332
2	0.01255	0	0	2.9681	5.9449	5.9474	5.8738	0.071108	0.073641	1.0356
3	0.05005	0	0.0044293	2.9681	5.9717	5.9691	5.8755	0.09616	0.093545	0.9728
4	0.10012	0	0.0071976	2.9681	5.9695	5.9702	5.8726	0.096928	0.097641	1.0073
5	0.25035	0	0.010796	2.9681	5.9701	5.9708	5.8732	0.096892	0.097641	1.0077
6	0.5012	0	0.014672	2.9681	5.9706	5.9714	5.8732	0.097441	0.098226	1.0081
7	1.0026	0.0011106	0.020209	2.9681	5.9706	5.9714	5.8732	0.097441	0.098226	1.0081
8	2.0002	0.0011106	0.029067	2.9681	5.9706	5.9714	5.8732	0.097441	0.098226	1.0081
9	3.002	0.0011106	0.036265	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
10	4.0037	0.0011106	0.042355	2.9681	5.9706	5.9714	5.8714	0.099196	0.099981	1.0079
11	5.0013	0.0011106	0.047338	2.9681	5.9712	5.972	5.8732	0.097989	0.098812	1.0084
12	6.0031	0.0011106	0.052321	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
13	7.0007	0	0.056197	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
14	8.0025	0	0.060072	2.9681	5.9706	5.9714	5.8726	0.098026	0.098811	1.008
15	9.0001	0	0.063948	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
16	10.002	0	0.067547	2.9681	5.9712	5.972	5.8708	0.10033	0.10115	1.0082
17	11.004	0.0011106	0.070038	2.9681	5.9717	5.9726	5.8714	0.10029	0.10115	1.0086
18	12.002	0.0011106	0.073914	2.9681	5.9706	5.9714	5.8714	0.099196	0.099981	1.0079
19	13.003	0.0011106	0.076959	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
20	14.001	0.0011106	0.07945	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
21	15.003	0.0011106	0.081942	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
22	16	0.0011106	0.084433	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
23	17.002	0.0011106	0.086648	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
24	18.004	0.0011106	0.088586	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
25	19.001	0.0011106	0.0908	2.9681	5.9712	5.972	5.8732	0.097989	0.098812	1.0084
26	20.003	0.0011106	0.093015	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
27	21.001	0	0.095507	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
28	22.003	0	0.097168	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
29	23	0	0.098552	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
30	24.002	0.0011106	0.10104	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
31	25.004	0	0.1027	2.9681	5.9744	5.972	5.872	0.10241	0.099982	0.97626
32	26.002	0.0011106	0.10437	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
33	27.003	0.0011106	0.10658	2.9681	5.9712	5.972	5.8708	0.10033	0.10115	1.0082
34	28.001	0.0011106	0.10769	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
35	29.003	0.0011106	0.10935	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
36	30	0.0011106	0.11073	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
37	31.002	0.0011106	0.11239	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
38	32.004	0.0011106	0.11378	2.9681	5.9679	5.972	5.872	0.095905	0.099982	1.0425
39	33.002	0.0011106	0.11599	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
40	34.003	0.0011106	0.11738	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
41	35.001	0.0011106	0.11876	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
42	36.003	0.0011106	0.11959	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
43	37.002	0.0011106	0.12097	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
44	38.004	0.0011106	0.12319	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
45	39.003	0.0011106	0.12374	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
46	40.001	0.0011106	0.12568	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
47	41.004	0.0011106	0.12707	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
48	42.001	0.0011106	0.12817	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
49	43.004	0.0011106	0.12956	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
50	44.002	0.0011106	0.12983	2.9681	5.9679	5.972	5.872	0.095905	0.099982	1.0425
51	45	0.0011106	0.13122	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
52	46.002	0.0011106	0.13288	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
53	47.004	0.0011106	0.13316	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
54	48.002	0.0011106	0.13426	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
55	49.003	0.0011106	0.13537	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
56	50.001	0.0011106	0.13731	2.9681	5.9744	5.972	5.8714	0.103	0.10057	0.97639
57	51.003	0.0011106	0.13786	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
58	52.001	0.0011106	0.1398	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
59	53.002	0	0.14008	2.9681	5.9744	5.972	5.872	0.10241	0.099982	0.97626
60	54.004	0.0011106	0.14091	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
61	55.002	0.0011106	0.14257	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
62	56.004	0	0.14284	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
63	57.001	0	0.14368	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
64	58.003	0	0.14561	2.9681	5.9706	5.9714	5.8702	0.10037	0.10115	1.0078
65	59	0	0.14589	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
66	60.002	0	0.147	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
67	61.004	0	0.1481	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
68	62.002	0	0.14783	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
69	63.004	0	0.14921	2.9681	5.9706	5.9714	5.8708	0.099781	0.10057	1.0079
70	64.002	0.0011106	0.14977	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
71	65.004	0	0.15115	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
72	66.002	0	0.15143	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
73	67.004	0	0.15309	2.9681	5.9706	5.9714	5.8708	0.099781	0.10057	1.0079
74	68.002	0	0.15392	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
75	69.004	0.0011106	0.15503	2.9681	5.9712	5.972	5.8708	0.10033	0.10115	1.0082
76	70.001	0.0011106	0.15503	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
77	71.003	0	0.15641	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
78	72.001	0.0011106	0.15669	2.9681	5.9679	5.972	5.8708	0.097075	0.10115	1.042
79	73.003	0.0011106	0.15779	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
80	74.001	0.0011106	0.15835	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
81	75.003	0.0011106	0.15835	2.9681	5.9706	5.9714	5.8726	0.098026	0.098811	1.008
82	76	0.0011106	0.1589	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
83	77.002	0	0.16056	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
84	78.004	0.0011106	0.16056	2.9681	5.9717	5.9726	5.872	0.099708	0.10057	1.0086
85	79.001	0.0011106	0.16222	2.9681	5.9744	5.972	5.8726	0.10183	0.099397	0.97612
86	80.003	0	0.16222	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
87	81.001	0	0.16333	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
88	82.003	0	0.16416	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
89	83.001	0.0011106	0.16388	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
90	84.002	0.0011106	0.16554	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
91	85.004	0.0011106	0.16582	2.9681	5.9679	5.972	5.8726	0.09532	0.099397	1.0428
92	86.002	0.0011106	0.1661	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083

93	87.004	0.0011106	0.16638	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
94	88.002	0.0011106	0.16721	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
95	89.003	0.0022211	0.16859	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
96	90.001	0.0011106	0.16887	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
97	91.004	0.0011106	0.16887	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
98	92.001	0.0011106	0.1708	2.9681	5.9744	5.972	5.8714	0.103	0.10057	0.97639
99	93.003	0.0011106	0.17053	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
100	94.001	0.0011106	0.17163	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
101	95.002	0.0011106	0.17163	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
102	96	0	0.17219	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
103	97.002	0.0011106	0.17274	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
104	98.004	0.0011106	0.1733	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
105	99.002	0.0011106	0.17357	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
106	100	0.0011106	0.17468	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
107	101	0.0011106	0.17523	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
108	102	0.0011106	0.17496	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
109	103	0.0011106	0.17551	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
110	104	0.0011106	0.17606	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
111	105	0.0011106	0.17773	2.9681	5.9744	5.972	5.872	0.10241	0.099982	0.97626
112	106	0.0011106	0.17856	2.9681	5.9717	5.9726	5.872	0.099708	0.10057	1.0086
113	107	0	0.17856	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
114	108	0.0011106	0.17939	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
115	109	0.0011106	0.17939	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
116	110	0.0011106	0.17939	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
117	111	0.0011106	0.18077	2.9681	5.9717	5.9726	5.872	0.099708	0.10057	1.0086
118	112	0.0011106	0.18132	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
119	113	0.0011106	0.18188	2.9681	5.9674	5.9714	5.872	0.095357	0.099396	1.0424
120	114	0.0011106	0.18215	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
121	115	0.0011106	0.18271	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
122	116	0.0011106	0.18215	2.9681	5.9679	5.972	5.872	0.095905	0.099982	1.0425
123	117	0.0011106	0.18326	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
124	118	0.0011106	0.18326	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
125	119	0.0011106	0.18382	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
126	120	0.0011106	0.18465	2.9681	5.975	5.9726	5.8726	0.10238	0.099982	0.97661
127	121	0	0.18465	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
128	122	0.0011106	0.18603	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
129	123	0	0.18548	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
130	124	0.0011106	0.18575	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
131	125	0.0011106	0.18658	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
132	126	0.0011106	0.18686	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
133	127	0.0011106	0.18797	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
134	128	0.0011106	0.18824	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
135	129	0.0022211	0.18797	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
136	130	0.0022211	0.18824	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
137	131	0.0022211	0.18963	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
138	132	0.0011106	0.18935	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
139	133	0.0011106	0.18991	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
140	134	0.0011106	0.19101	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
141	135	0.0011106	0.19074	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
142	136	0.0011106	0.19101	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
143	136.76	0.0011106	0.1924	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
2	0.012483	0	0.00055366	2.9681	6.0002	5.996	5.8855	0.1147	0.11053	0.96357
3	0.050533	0	0.021316	2.9681	6.1316	6.1189	5.8831	0.24852	0.23579	0.94878
4	0.10062	-0.0011106	0.034604	2.9681	6.1099	6.1131	5.8743	0.23554	0.23872	1.0135
5	0.25083	0	0.06118	2.9681	6.1159	6.116	5.8743	0.24154	0.24164	1.0004
6	0.50168	-0.0011106	0.09523	2.9681	6.1203	6.1207	5.8778	0.24242	0.24282	1.0016
7	1.0032	-0.0011106	0.15143	2.9681	6.1192	6.1195	5.8773	0.24191	0.24223	1.0013
8	2.0008	-0.0011106	0.24278	2.9681	6.1186	6.1189	5.8749	0.2437	0.24399	1.0012
9	3.0026	-0.0011106	0.31946	2.9681	6.1165	6.1201	5.872	0.24447	0.24808	1.0148
10	4.0002	-0.0011106	0.38673	2.9681	6.1203	6.1207	5.8738	0.24651	0.24691	1.0016
11	5.0019	-0.0011106	0.44653	2.9681	6.1197	6.1201	5.8749	0.2448	0.24516	1.0015
12	6.0037	0	0.50134	2.9681	6.1192	6.1195	5.8749	0.24425	0.24457	1.0013
13	7.0013	0	0.55117	2.9681	6.1197	6.1201	5.8732	0.24655	0.24691	1.0015
14	8.0031	-0.0011106	0.59878	2.9681	6.1203	6.1207	5.8755	0.24476	0.24516	1.0016
15	9.0007	-0.0011106	0.64252	2.9681	6.1203	6.1207	5.872	0.24827	0.24867	1.0016
16	10.002	-0.0011106	0.68377	2.9681	6.1197	6.1201	5.8732	0.24655	0.24691	1.0015
17	11	-0.0011106	0.7228	2.9681	6.1192	6.1195	5.8738	0.24542	0.24574	1.0013
18	12.002	-0.0011106	0.7599	2.9681	6.1197	6.1201	5.872	0.24772	0.24808	1.0015
19	13.004	-0.0011106	0.79561	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
20	14.001	-0.0011106	0.82938	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
21	15.003	-0.0011106	0.86122	2.9681	6.1203	6.1207	5.872	0.24827	0.24867	1.0016
22	16.001	-0.0011106	0.89084	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
23	17.002	0	0.91991	2.9681	6.1197	6.1201	5.8743	0.24538	0.24574	1.0015
24	18.004	0	0.94704	2.9681	6.1203	6.1207	5.8726	0.24768	0.24808	1.0016
25	19.002	0	0.97306	2.9681	6.1203	6.1207	5.8749	0.24534	0.24574	1.0016
26	20.004	0	0.99797	2.9681	6.1203	6.1207	5.872	0.24827	0.24867	1.0016
27	21.001	0	1.0215	2.9681	6.1197	6.1201	5.8738	0.24597	0.24633	1.0015
28	22.003	0.0011106	1.0439	2.9681	6.1197	6.1201	5.8726	0.24714	0.2475	1.0015
29	23.001	0	1.065	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
30	24.003	0	1.0855	2.9681	6.1203	6.1207	5.8732	0.2471	0.2475	1.0016
31	25	0	1.1048	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
32	26.002	0	1.1237	2.9681	6.1203	6.1207	5.8726	0.24768	0.24808	1.0016
33	27.004	0	1.1416	2.9681	6.1203	6.1207	5.872	0.24827	0.24867	1.0016
34	28.001	0	1.1585	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
35	29.003	0	1.1746	2.9681	6.1203	6.1207	5.872	0.24827	0.24867	1.0016
36	30.001	0	1.1898	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
37	31.002	0.0011106	1.2048	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
38	32	0.0022211	1.2189	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
39	33.002	0.0022211	1.2319	2.9681	6.1208	6.1212	5.8743	0.24648	0.24691	1.0018
40	34.004	0.0022211	1.2452	2.9681	6.1203	6.1207	5.8726	0.24768	0.24808	1.0016
41	35.002	0.0022211	1.2576	2.9681	6.1176	6.1212	5.8732	0.24439	0.24808	1.0151
42	36.004	0.0033317	1.2695	2.9681	6.1208	6.1212	5.8714	0.2494	0.24984	1.0017
43	37.002	0.0022211	1.2806	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
44	38.004	0.0022211	1.2917	2.9681	6.1214	6.1218	5.8714	0.24995	0.25042	1.0019
45	39.001	0.0022211	1.3019	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
46	40.003	0.0022211	1.3122	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
47	41.001	0.0033317	1.3219	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
48	42.003	0.0033317	1.331	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
49	43.001	0.0022211	1.3399	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
50	44.003	0.0022211	1.3484	2.9681	6.1208	6.1212	5.8708	0.24999	0.25042	1.0017
51	45.001	0.0033317	1.3565	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
52	46.003	0.0033317	1.3642	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
53	47	0.0033317	1.3717	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
54	48.002	0.0033317	1.3783	2.9681	6.1176	6.1212	5.8732	0.24439	0.24808	1.0151
55	49.003	0.0033317	1.3861	2.9681	6.1208	6.1212	5.8714	0.2494	0.24984	1.0017
56	50.001	0.0033317	1.3925	2.9681	6.1208	6.1212	5.8738	0.24706	0.2475	1.0018
57	51.003	0.0033317	1.3994	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
58	52.001	0.0044422	1.4057	2.9681	6.1208	6.1212	5.8714	0.2494	0.24984	1.0017
59	53.003	0.0044422	1.4118	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
60	54.001	0.0044422	1.4174	2.9681	6.1214	6.1218	5.8738	0.24761	0.24808	1.0019
61	55.003	0.0044422	1.4237	2.9681	6.1208	6.1212	5.8714	0.2494	0.24984	1.0017
62	56	0.0044422	1.429	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
63	57.002	0.0055528	1.4334	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
64	58	0.0055528	1.4392	2.9681	6.1214	6.1218	5.8714	0.24995	0.25042	1.0019
65	59.002	0.0055528	1.4437	2.9681	6.1176	6.1212	5.8726	0.24498	0.24867	1.0151
66	60	0.0055528	1.4487	2.9681	6.1208	6.1212	5.8714	0.2494	0.24984	1.0017
67	61.003	0.0055528	1.4531	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
68	62.001	0.0066633	1.4575	2.9681	6.1219	6.1224	5.8708	0.25108	0.25159	1.002
69	63.003	0.0066633	1.4617	2.9681	6.1187	6.1224	5.872	0.24666	0.25042	1.0153
70	64	0.0066633	1.4653	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
71	65.002	0.0066633	1.4691	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
72	66	0.0066633	1.4733	2.9681	6.1219	6.1224	5.872	0.24991	0.25042	1.002
73	67.003	0.0077739	1.4769	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
74	68.001	0.0066633	1.4799	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
75	69.003	0.0077739	1.4841	2.9681	6.1214	6.1218	5.8714	0.24995	0.25042	1.0019
76	70.001	0.0066633	1.488	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
77	71.003	0.0066633	1.4905	2.9681	6.1214	6.1218	5.8714	0.24995	0.25042	1.0019
78	72.001	0.0077739	1.4943	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
79	73.003	0.0077739	1.4977	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
80	74.001	0.0088844	1.4996	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
81	75.003	0.0077739	1.5032	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
82	76.001	0.0077739	1.5062	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
83	77.003	0.0077739	1.5093	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
84	78.001	0.0088844	1.5109	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
85	79.003	0.0088844	1.514	2.9681	6.1214	6.1218	5.8708	0.25054	0.25101	1.0019
86	80.001	0.0077739	1.517	2.9681	6.1208	6.1212	5.8714	0.2494	0.24984	1.0017
87	81.004	0.0077739	1.5187	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
88	82.002	0.0066633	1.5209	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
89	83.003	0.0077739	1.5234	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
90	84.001	0.0077739	1.5267	2.9681	6.1219	6.1224	5.8708	0.25108	0.25159	1.002
91	85.003	0.0077739	1.5284	2.9681	6.1246	6.1218	5.8726	0.25204	0.24925	0.98896
92	86.001	0.0077739	1.5309	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019

93	87.003	0.0077739	1.5334	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
94	88.001	0.0077739	1.5356	2.9681	6.1208	6.1212	5.8708	0.24999	0.25042	1.0017
95	89.003	0.0077739	1.5378	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
96	90	0.0077739	1.5392	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
97	91.002	0.0077739	1.5411	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
98	92	0.0088844	1.5433	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
99	93.002	0.0088844	1.5461	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
100	94.004	0.0088844	1.5478	2.9681	6.1214	6.1218	5.8714	0.24995	0.25042	1.0019
101	95.002	0.0088844	1.55	2.9681	6.1214	6.1218	5.8702	0.25112	0.25159	1.0019
102	96.004	0.0077739	1.5516	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
103	97.002	0.0088844	1.553	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
104	97.119	0.0077739	1.5536	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
2	0.0125	0	0.0011073	2.9681	6.1641	6.164	5.8872	0.27691	0.27677	0.99951
3	0.050567	0.0011106	0.026576	2.9681	6.3567	6.373	5.889	0.46775	0.484	1.0347
4	0.10067	0.009995	0.045677	2.9681	6.3376	6.3595	5.8743	0.46325	0.48516	1.0473
5	0.25085	0.051086	0.085817	2.9681	6.349	6.3648	5.8749	0.47411	0.48984	1.0332
6	0.5017	0.07996	0.13509	2.9681	6.3578	6.3706	5.8743	0.48344	0.49628	1.0266
7	1.0032	0.10994	0.21122	2.9681	6.3643	6.3706	5.8767	0.48761	0.49394	1.013
8	2.0008	0.12993	0.32887	2.9681	6.3599	6.3694	5.8732	0.48677	0.49628	1.0195
9	3.0026	0.16436	0.42217	2.9681	6.3648	6.3712	5.8767	0.48816	0.49453	1.013
10	4.0002	0.19102	0.50272	2.9681	6.3637	6.37	5.8755	0.48823	0.49453	1.0129
11	5.0019	0.21989	0.57415	2.9681	6.3637	6.37	5.8732	0.49057	0.49687	1.0128
12	6.0037	0.231	0.63865	2.9681	6.3637	6.37	5.8755	0.48823	0.49453	1.0129
13	7.0013	0.24543	0.69844	2.9681	6.3637	6.37	5.8743	0.4894	0.4957	1.0129
14	8.0031	0.25765	0.7527	2.9681	6.3643	6.3706	5.8755	0.48878	0.49511	1.013
15	9.0007	0.27098	0.80281	2.9681	6.3637	6.37	5.8761	0.48764	0.49394	1.0129
16	10.002	0.29097	0.84932	2.9681	6.3643	6.3706	5.8749	0.48936	0.4957	1.0129
17	11	0.30651	0.89222	2.9681	6.3643	6.3706	5.8743	0.48995	0.49628	1.0129
18	12.002	0.31984	0.93237	2.9681	6.3643	6.3706	5.8755	0.48878	0.49511	1.013
19	13.004	0.32983	0.96946	2.9681	6.3643	6.3706	5.8743	0.48995	0.49628	1.0129
20	14.002	0.33872	1.0041	2.9681	6.3637	6.37	5.8738	0.48998	0.49628	1.0128
21	15.004	0.34316	1.0365	2.9681	6.3637	6.37	5.8726	0.49115	0.49745	1.0128
22	16.002	0.35316	1.0666	2.9681	6.3643	6.3706	5.8749	0.48936	0.4957	1.0129
23	17.004	0.35871	1.0949	2.9681	6.3643	6.3706	5.8749	0.48936	0.4957	1.0129
24	18.001	0.36537	1.1217	2.9681	6.3643	6.3706	5.8749	0.48936	0.4957	1.0129
25	19.003	0.37204	1.1464	2.9681	6.3643	6.3706	5.8714	0.49287	0.49921	1.0128
26	20.001	0.37759	1.1693	2.9681	6.3675	6.3706	5.8726	0.49496	0.49804	1.0062
27	21.003	0.37981	1.1912	2.9681	6.3643	6.3706	5.8738	0.49053	0.49687	1.0129
28	22.001	0.38092	1.2117	2.9681	6.3648	6.3712	5.872	0.49284	0.49921	1.0129
29	23.003	0.39203	1.2308	2.9681	6.3648	6.3712	5.8743	0.4905	0.49687	1.013
30	24.002	0.40202	1.2488	2.9681	6.3648	6.3712	5.8738	0.49108	0.49745	1.013
31	25.004	0.40757	1.2657	2.9681	6.3675	6.3706	5.8726	0.49496	0.49804	1.0062
32	26.002	0.41313	1.2812	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
33	27.004	0.41757	1.2964	2.9681	6.3648	6.3712	5.8738	0.49108	0.49745	1.013
34	28.002	0.42312	1.3108	2.9681	6.3648	6.3712	5.8702	0.49459	0.50096	1.0129
35	29.004	0.42645	1.3241	2.9681	6.3648	6.3712	5.8714	0.49342	0.49979	1.0129
36	30.001	0.42645	1.3365	2.9681	6.3681	6.3712	5.8714	0.49668	0.49979	1.0063
37	31.003	0.42867	1.3487	2.9681	6.3681	6.3712	5.8732	0.49492	0.49804	1.0063
38	32.001	0.42978	1.3603	2.9681	6.3648	6.3712	5.8708	0.49401	0.50038	1.0129
39	33.003	0.43201	1.3711	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
40	34	0.43312	1.3814	2.9681	6.3648	6.3712	5.872	0.49284	0.49921	1.0129
41	35.002	0.43423	1.3911	2.9681	6.3681	6.3712	5.872	0.49609	0.49921	1.0063
42	36.004	0.43645	1.3999	2.9681	6.3648	6.3712	5.872	0.49284	0.49921	1.0129
43	37.001	0.442	1.4093	2.9681	6.3681	6.3712	5.8714	0.49668	0.49979	1.0063
44	38.003	0.44644	1.4176	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
45	39.001	0.45089	1.4257	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
46	40.003	0.45533	1.4337	2.9681	6.3681	6.3712	5.8697	0.49843	0.50155	1.0063
47	41	0.45866	1.4409	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
48	42.002	0.46088	1.4478	2.9681	6.3648	6.3712	5.8732	0.49167	0.49804	1.013
49	43.003	0.46199	1.4547	2.9681	6.3681	6.3712	5.8708	0.49726	0.50038	1.0063
50	44.001	0.46532	1.4608	2.9681	6.3681	6.3712	5.872	0.49609	0.49921	1.0063
51	45.003	0.46643	1.4678	2.9681	6.3681	6.3712	5.8714	0.49668	0.49979	1.0063
52	46	0.46754	1.4738	2.9681	6.3681	6.3712	5.8702	0.49785	0.50096	1.0063
53	47.002	0.46754	1.4794	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
54	48.004	0.46754	1.4852	2.9681	6.3681	6.3712	5.8732	0.49492	0.49804	1.0063
55	49.002	0.46976	1.4905	2.9681	6.3681	6.3712	5.8732	0.49492	0.49804	1.0063
56	50.003	0.46976	1.496	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
57	51.001	0.46976	1.501	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
58	52.003	0.46976	1.506	2.9681	6.3681	6.3712	5.8708	0.49726	0.50038	1.0063
59	53.001	0.46976	1.5109	2.9681	6.3648	6.3712	5.8714	0.49342	0.49979	1.0129
60	54.003	0.47088	1.5154	2.9681	6.3681	6.3712	5.8732	0.49492	0.49804	1.0063
61	55	0.47199	1.5201	2.9681	6.3686	6.3718	5.8708	0.49781	0.50096	1.0063
62	56.002	0.47088	1.5237	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
63	57.004	0.47199	1.5281	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
64	58.002	0.47088	1.532	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
65	59	0.47199	1.5367	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
66	60.002	0.4731	1.54	2.9681	6.3648	6.3712	5.8726	0.49225	0.49862	1.0129
67	61.002	0.47532	1.5439	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
68	62.003	0.47643	1.548	2.9681	6.3681	6.3712	5.872	0.49609	0.49921	1.0063
69	63	0.47754	1.5514	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
70	64.003	0.47865	1.5544	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
71	65	0.47976	1.5583	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
72	66.002	0.48198	1.561	2.9681	6.3654	6.3718	5.8732	0.49222	0.49862	1.013
73	67.003	0.48309	1.5644	2.9681	6.3681	6.3712	5.8714	0.49668	0.49979	1.0063
74	68.001	0.4842	1.5671	2.9681	6.3681	6.3712	5.8714	0.49668	0.49979	1.0063
75	69.003	0.4842	1.5707	2.9681	6.3681	6.3712	5.8708	0.49726	0.50038	1.0063
76	70.004	0.4842	1.5741	2.9681	6.3681	6.3712	5.8691	0.49902	0.50213	1.0062
77	71.001	0.48531	1.5768	2.9681	6.3648	6.3712	5.8726	0.49225	0.49862	1.0129
78	72.003	0.48642	1.5793	2.9681	6.3686	6.3718	5.8726	0.49605	0.49921	1.0064
79	72.495	0.48753	1.5813	2.9681	6.3686	6.3718	5.8726	0.49605	0.49921	1.0064

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3686	6.3718	5.8726	0.49605	0.49921	1.0064
2	0.0125	0	0	2.9681	6.3878	6.3888	5.8773	0.51054	0.5115	1.0019
3	0.050217	0.0011106	0.015226	2.9681	6.5898	6.6112	5.8837	0.70607	0.72751	1.0304
4	0.10032	0.013327	0.029344	2.9681	6.5968	6.6118	5.8732	0.72365	0.73862	1.0207
5	0.25052	0.034427	0.05675	2.9681	6.6072	6.6159	5.8808	0.7264	0.73512	1.012
6	0.50088	0.056638	0.091077	2.9681	6.611	6.62	5.8773	0.73375	0.74272	1.0122
7	1.0016	0.063302	0.14506	2.9681	6.6132	6.6188	5.8784	0.73473	0.74038	1.0077
8	2.0032	0.10106	0.22949	2.9681	6.6143	6.62	5.8761	0.73817	0.74389	1.0078
9	3.0005	0.11772	0.29815	2.9681	6.6137	6.6194	5.8755	0.73821	0.74389	1.0077
10	4.0019	0.13327	0.35794	2.9681	6.6143	6.62	5.8738	0.74051	0.74623	1.0077
11	5.0034	0.14881	0.41109	2.9681	6.6143	6.62	5.8755	0.73876	0.74448	1.0077
12	6.0006	0.17547	0.45815	2.9681	6.6143	6.62	5.8732	0.7411	0.74682	1.0077
13	7.0021	0.19546	0.50162	2.9681	6.6148	6.6206	5.8755	0.73931	0.74507	1.0078
14	8.0035	0.20212	0.54093	2.9681	6.6143	6.62	5.8749	0.73934	0.74506	1.0077
15	9.0008	0.20989	0.57747	2.9681	6.6154	6.6212	5.8738	0.74161	0.74741	1.0078
16	10.003	0.22988	0.61096	2.9681	6.6148	6.6206	5.8714	0.7434	0.74916	1.0077
17	11.004	0.24099	0.64142	2.9681	6.6148	6.6206	5.8708	0.74399	0.74975	1.0077
18	12.001	0.24432	0.66965	2.9681	6.6148	6.6206	5.8738	0.74106	0.74682	1.0078
19	13.003	0.24876	0.69568	2.9681	6.6148	6.6206	5.8738	0.74106	0.74682	1.0078
20	14.001	0.25099	0.72004	2.9681	6.6148	6.6206	5.8714	0.7434	0.74916	1.0077
21	15	0.2521	0.74246	2.9681	6.6148	6.6206	5.8714	0.7434	0.74916	1.0077
22	16.002	0.25654	0.76378	2.9681	6.6148	6.6206	5.8708	0.74399	0.74975	1.0077
23	17.002	0.26098	0.78315	2.9681	6.6159	6.6217	5.8749	0.74099	0.74682	1.0079
24	18.002	0.26764	0.80142	2.9681	6.6148	6.6206	5.8732	0.74165	0.74741	1.0078
25	19.004	0.27431	0.81859	2.9681	6.6148	6.6206	5.8755	0.73931	0.74507	1.0078
26	20.003	0.27875	0.83492	2.9681	6.6186	6.6212	5.8738	0.74486	0.74741	1.0034
27	21.004	0.28097	0.85015	2.9681	6.6154	6.6212	5.8749	0.74044	0.74624	1.0078
28	22.001	0.2843	0.86454	2.9681	6.6186	6.6212	5.872	0.74662	0.74916	1.0034
29	23.003	0.28652	0.87783	2.9681	6.6186	6.6212	5.8749	0.74369	0.74624	1.0034
30	24.003	0.28874	0.89112	2.9681	6.6154	6.6212	5.8708	0.74453	0.75033	1.0078
31	25.002	0.29208	0.90274	2.9681	6.6154	6.6212	5.8732	0.74219	0.74799	1.0078
32	26.004	0.2943	0.91409	2.9681	6.6154	6.6212	5.8708	0.74453	0.75033	1.0078
33	27.003	0.29763	0.92489	2.9681	6.6154	6.6212	5.8708	0.74453	0.75033	1.0078
34	28.002	0.30207	0.93486	2.9681	6.6159	6.6217	5.8743	0.74157	0.74741	1.0079
35	29	0.30873	0.94455	2.9681	6.6154	6.6212	5.872	0.74336	0.74916	1.0078
36	30.004	0.31207	0.95396	2.9681	6.6186	6.6212	5.8738	0.74486	0.74741	1.0034
37	31.001	0.31873	0.96282	2.9681	6.6154	6.6212	5.8714	0.74395	0.74975	1.0078
38	32.003	0.32206	0.97112	2.9681	6.6186	6.6212	5.8726	0.74603	0.74858	1.0034
39	33.001	0.32761	0.97887	2.9681	6.6186	6.6212	5.8738	0.74486	0.74741	1.0034
40	34.003	0.33206	0.9869	2.9681	6.6154	6.6212	5.8738	0.74161	0.74741	1.0078
41	35	0.33317	0.9941	2.9681	6.6186	6.6212	5.8732	0.74545	0.74799	1.0034
42	36.003	0.3365	1.0013	2.9681	6.6192	6.6217	5.8732	0.746	0.74858	1.0035
43	37.001	0.33983	1.0082	2.9681	6.6186	6.6212	5.8714	0.7472	0.74975	1.0034
44	38.004	0.34094	1.0151	2.9681	6.6192	6.6217	5.8732	0.746	0.74858	1.0035
45	39.001	0.34094	1.0218	2.9681	6.6154	6.6212	5.8702	0.74512	0.75092	1.0078
46	40.004	0.34316	1.0276	2.9681	6.6159	6.6217	5.8732	0.74274	0.74858	1.0079
47	41.001	0.34649	1.0334	2.9681	6.6192	6.6217	5.8708	0.74834	0.75092	1.0034
48	42.003	0.34982	1.0392	2.9681	6.6192	6.6217	5.8738	0.74541	0.74799	1.0035
49	43	0.35316	1.0442	2.9681	6.6192	6.6217	5.8738	0.74541	0.74799	1.0035
50	44.001	0.35427	1.0497	2.9681	6.6192	6.6217	5.8732	0.746	0.74858	1.0035
51	45.003	0.35649	1.0547	2.9681	6.6192	6.6217	5.8732	0.746	0.74858	1.0035
52	46	0.35871	1.0597	2.9681	6.6186	6.6212	5.872	0.74662	0.74916	1.0034
53	47.002	0.35982	1.065	2.9681	6.6192	6.6217	5.872	0.74717	0.74975	1.0035
54	48.004	0.36204	1.0691	2.9681	6.6192	6.6217	5.8732	0.746	0.74858	1.0035
55	49.001	0.36204	1.0735	2.9681	6.6186	6.6212	5.8755	0.74311	0.74565	1.0034
56	50.002	0.36426	1.0783	2.9681	6.6192	6.6217	5.8732	0.746	0.74858	1.0035
57	51.003	0.36315	1.0827	2.9681	6.6192	6.6217	5.8726	0.74658	0.74916	1.0035
58	52.001	0.36426	1.0874	2.9681	6.6159	6.6217	5.8726	0.74333	0.74916	1.0078
59	53.003	0.36648	1.0915	2.9681	6.6186	6.6212	5.8726	0.74603	0.74858	1.0034
60	54	0.36648	1.0957	2.9681	6.6159	6.6217	5.8708	0.74508	0.75092	1.0078
61	55.002	0.36648	1.0993	2.9681	6.6186	6.6212	5.8726	0.74603	0.74858	1.0034
62	56	0.36648	1.1026	2.9681	6.6192	6.6217	5.8726	0.74658	0.74916	1.0035
63	57.002	0.36759	1.107	2.9681	6.6192	6.6217	5.8697	0.74951	0.75209	1.0034
64	58.004	0.36981	1.1106	2.9681	6.6192	6.6217	5.8697	0.74951	0.75209	1.0034
65	59.001	0.37093	1.114	2.9681	6.6192	6.6217	5.872	0.74717	0.74975	1.0035
66	60.003	0.37204	1.1173	2.9681	6.6154	6.6212	5.8697	0.7457	0.7515	1.0078
67	61.001	0.37315	1.1206	2.9681	6.6192	6.6217	5.8732	0.746	0.74858	1.0035
68	62.002	0.37315	1.1237	2.9681	6.6154	6.6212	5.872	0.74336	0.74916	1.0078
69	63.004	0.37426	1.1275	2.9681	6.6192	6.6217	5.8691	0.75009	0.75267	1.0034
70	64.002	0.37315	1.1306	2.9681	6.6186	6.6212	5.8732	0.74545	0.74799	1.0034
71	65.001	0.37648	1.1336	2.9681	6.6192	6.6217	5.8726	0.74658	0.74916	1.0035
72	66.003	0.37648	1.1364	2.9681	6.6192	6.6217	5.8726	0.74658	0.74916	1.0035
73	67.003	0.3787	1.1397	2.9681	6.6159	6.6217	5.8714	0.7445	0.75033	1.0078
74	68.001	0.37981	1.1425	2.9681	6.6186	6.6212	5.872	0.74662	0.74916	1.0034
75	69.003	0.38092	1.1455	2.9681	6.6192	6.6217	5.8726	0.74658	0.74916	1.0035
76	70	0.38314	1.148	2.9681	6.6186	6.6212	5.872	0.74662	0.74916	1.0034
77	70.961	0.38314	1.1508	2.9681	6.6159	6.6217	5.8726	0.74333	0.74916	1.0078

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1425	6.1437	6.0718	0.070741	0.071941	1.017
2	0.0125	0	0	2.9681	6.1463	6.1478	6.0753	0.071045	0.072532	1.0209
3	0.050333	0	0.0074744	2.9681	6.1659	6.1654	6.0817	0.084186	0.083688	0.99409
4	0.1004	0	0.018548	2.9681	6.1638	6.1701	6.0718	0.092095	0.098349	1.0679
5	0.25063	0.00091637	0.023254	2.9681	6.1644	6.1707	6.0729	0.091468	0.097764	1.0688
6	0.50148	0.00091637	0.024915	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326
7	1.0032	0.00091637	0.025468	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326
8	2.001	0.00091637	0.026022	2.9681	6.1692	6.1724	6.0718	0.097491	0.1007	1.0329
9	4.0002	0.0018327	0.026299	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326
10	6.0036	0.0018327	0.025745	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326
11	8.0028	0.0018327	0.025468	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326
12	10.002	0.0018327	0.025468	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326
13	12.003	0.0018327	0.025468	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326
14	14.003	0.0018327	0.025192	2.9681	6.1682	6.1713	6.0718	0.096399	0.099523	1.0324
15	15.895	0.0018327	0.025192	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1687	6.1719	6.0718	0.096945	0.10011	1.0326
2	0.0125	0	0.00055366	2.9681	6.1937	6.1953	6.0888	0.10499	0.10658	1.0151
3	0.050667	0.00091637	0.037095	2.9681	6.2742	6.2922	6.1198	0.15436	0.17234	1.1165
4	0.10073	0.0027491	0.090247	2.9681	6.275	6.3068	6.08	0.19502	0.22688	1.1633
5	0.25095	0.0082473	0.10879	2.9681	6.3121	6.3192	6.0729	0.23922	0.24624	1.0293
6	0.50182	0.01008	0.11295	2.9681	6.3165	6.3203	6.0718	0.2447	0.24858	1.0159
7	1.003	0.011913	0.11516	2.9681	6.3202	6.3209	6.0712	0.24904	0.24976	1.0029
8	2.0008	0.012829	0.1171	2.9681	6.3208	6.3215	6.0718	0.249	0.24976	1.003
9	4.0042	0.013745	0.11821	2.9681	6.3208	6.3215	6.0718	0.249	0.24976	1.003
10	6.0034	0.012829	0.11959	2.9681	6.3208	6.3215	6.0723	0.24842	0.24917	1.003
11	8.0026	0.013745	0.11987	2.9681	6.3208	6.3215	6.0718	0.249	0.24976	1.003
12	10.002	0.013745	0.12097	2.9681	6.3208	6.3215	6.0723	0.24842	0.24917	1.003
13	12.002	0.010996	0.10741	2.9681	6.3202	6.3209	6.0712	0.24904	0.24976	1.0029
14	14.002	0.013745	0.12153	2.9681	6.3208	6.3215	6.0718	0.249	0.24976	1.003
15	15.901	0.014662	0.12125	2.9681	6.3208	6.3215	6.0718	0.249	0.24976	1.003

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3208	6.3215	6.0718	0.249	0.24976	1.003
2	0.012483	0	0.0011073	2.9681	6.3654	6.3626	6.1005	0.26492	0.26211	0.9894
3	0.050717	0.0036655	0.066162	2.9681	6.497	6.5386	6.1304	0.36667	0.40826	1.1134
4	0.1008	0.0091637	0.12707	2.9681	6.5048	6.5539	6.0841	0.42075	0.46984	1.1167
5	0.251	0.016495	0.15669	2.9681	6.5592	6.5709	6.0741	0.4851	0.49682	1.0242
6	0.50205	0.021076	0.16416	2.9681	6.5651	6.5703	6.0729	0.49215	0.49741	1.0107
7	1.0002	0.023826	0.16942	2.9681	6.5688	6.5709	6.0723	0.4965	0.49858	1.0042
8	2.0026	0.024742	0.17385	2.9681	6.5694	6.5715	6.0723	0.49704	0.49917	1.0043
9	4.0028	0.025658	0.17773	2.9681	6.5694	6.5715	6.0718	0.49763	0.49975	1.0043
10	6.003	0.024742	0.18077	2.9681	6.5694	6.5715	6.0723	0.49704	0.49917	1.0043
11	8.0033	0.024742	0.18188	2.9681	6.5688	6.5709	6.0718	0.49708	0.49917	1.0042
12	10.003	0.025658	0.18437	2.9681	6.5688	6.5709	6.0712	0.49767	0.49975	1.0042
13	12.004	0.026575	0.1852	2.9681	6.5688	6.5709	6.0718	0.49708	0.49917	1.0042
14	14.004	0.026575	0.18492	2.9681	6.5694	6.5715	6.0718	0.49763	0.49975	1.0043
15	16	0.026575	0.18714	2.9681	6.5694	6.5715	6.0718	0.49763	0.49975	1.0043
16	18	0.026575	0.18714	2.9681	6.5694	6.5715	6.0718	0.49763	0.49975	1.0043
17	18.142	0.026575	0.18714	2.9681	6.5694	6.5715	6.0718	0.49763	0.49975	1.0043

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5694	6.5715	6.0718	0.49763	0.49975	1.0043
2	0.012433	0	0	2.9681	6.601	6.602	6.0888	0.51223	0.51327	1.002
3	0.050483	0.0018327	0.097444	2.9681	6.9109	6.987	6.1831	0.72778	0.80385	1.1045
4	0.10057	0.017411	0.20209	2.9681	6.9472	7.0398	6.0882	0.85903	0.95164	1.1078
5	0.25078	0.032073	0.2414	2.9681	7.0601	7.068	6.0753	0.98487	0.99271	1.008
6	0.50165	0.033906	0.25081	2.9681	7.0618	7.0697	6.0729	0.98885	0.99681	1.008
7	1.0034	0.034822	0.25801	2.9681	7.0687	7.0703	6.0723	0.99641	0.99799	1.0016
8	2.0011	0.035738	0.2641	2.9681	7.0693	7.0709	6.0718	0.99754	0.99916	1.0016
9	4.0003	0.036655	0.26991	2.9681	7.0693	7.0709	6.0718	0.99754	0.99916	1.0016
10	6.0037	0.036655	0.2724	2.9681	7.0687	7.0703	6.0723	0.99641	0.99799	1.0016
11	8.0029	0.037571	0.27655	2.9681	7.0693	7.0709	6.0718	0.99754	0.99916	1.0016
12	10.002	0.038487	0.27905	2.9681	7.0698	7.0715	6.0723	0.9975	0.99916	1.0017
13	12.002	0.037571	0.28181	2.9681	7.0698	7.0715	6.0718	0.99809	0.99975	1.0017
14	14.001	0.038487	0.28292	2.9681	7.0698	7.0715	6.0718	0.99809	0.99975	1.0017
15	16	0.038487	0.28514	2.9681	7.0698	7.0715	6.0723	0.9975	0.99916	1.0017
16	18.004	0.038487	0.28569	2.9681	7.0698	7.0715	6.0718	0.99809	0.99975	1.0017
17	20.004	0.039404	0.2868	2.9681	7.0698	7.0715	6.0718	0.99809	0.99975	1.0017
18	22.003	0.039404	0.28735	2.9681	7.0661	7.0709	6.0723	0.99374	0.99857	1.0049
19	23.097	0.039404	0.28984	2.9681	7.0693	7.0709	6.0706	0.99872	1.0003	1.0016

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.0698	7.0715	6.0706	0.99926	1.0009	1.0017
2	0.0125	0	0.001661	2.9681	7.156	7.1572	6.1222	1.0338	1.035	1.0012
3	0.050717	0.0018327	0.090247	2.9681	7.4359	7.541	6.1345	1.3014	1.4065	1.0807
4	0.10078	0.012829	0.13814	2.9681	7.4752	7.5521	6.0764	1.3987	1.4757	1.055
5	0.25102	0.037571	0.16112	2.9681	7.5611	7.5686	6.0735	1.4876	1.495	1.005
6	0.50205	0.04032	0.16942	2.9681	7.5649	7.5691	6.0723	1.4926	1.4968	1.0028
7	1.0039	0.043069	0.17606	2.9681	7.566	7.5703	6.0729	1.4931	1.4974	1.0029
8	2.0016	0.048567	0.18298	2.9681	7.5703	7.5715	6.0718	1.4986	1.4997	1.0008
9	4.0008	0.0504	0.18935	2.9681	7.5703	7.5715	6.0723	1.498	1.4992	1.0008
10	6.0001	0.051316	0.19295	2.9681	7.5703	7.5715	6.0718	1.4986	1.4997	1.0008
11	8.0034	0.051316	0.19683	2.9681	7.5703	7.5715	6.0718	1.4986	1.4997	1.0008
12	10.003	0.052233	0.19876	2.9681	7.5671	7.5715	6.0723	1.4948	1.4992	1.0029
13	12.003	0.053149	0.20126	2.9681	7.5671	7.5715	6.0723	1.4948	1.4992	1.0029
14	14.003	0.053149	0.20347	2.9681	7.5703	7.5715	6.0718	1.4986	1.4997	1.0008
15	16.002	0.053149	0.20347	2.9681	7.5703	7.5715	6.0723	1.498	1.4992	1.0008
16	18.001	0.053149	0.20541	2.9681	7.5703	7.5715	6.0723	1.498	1.4992	1.0008
17	20	0.053149	0.20762	2.9681	7.5703	7.5715	6.0718	1.4986	1.4997	1.0008
18	22	0.053149	0.20928	2.9681	7.5703	7.5715	6.0718	1.4986	1.4997	1.0008
19	24.001	0.053149	0.2115	2.9681	7.5698	7.5709	6.0718	1.498	1.4992	1.0008
20	26.002	0.053149	0.21261	2.9681	7.5703	7.5715	6.0718	1.4986	1.4997	1.0008
21	28.002	0.053149	0.21344	2.9681	7.5735	7.5715	6.0723	1.5012	1.4992	0.99865
22	29.711	0.053149	0.21399	2.9681	7.5698	7.5709	6.0718	1.498	1.4992	1.0008

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9416	5.9439	5.872	0.069572	0.071884	1.0332
2	0.0125	0	0	2.9681	5.9443	5.9468	5.8743	0.069975	0.072471	1.0357
3	0.054167	0	0.0091354	2.9681	5.9662	5.9667	5.8843	0.081936	0.082428	1.006
4	0.10007	0	0.02796	2.9681	5.9619	5.9655	5.8749	0.086945	0.090617	1.0422
5	0.25028	0	0.046231	2.9681	5.9706	5.9714	5.8738	0.096856	0.097641	1.0081
6	0.50115	0	0.051767	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
7	1.0029	−0.0011106	0.056197	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
8	2.0006	−0.0011106	0.059242	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
9	3.0026	−0.0011106	0.060903	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
10	4.0003	−0.0011106	0.06201	2.9681	5.9744	5.972	5.872	0.10241	0.099982	0.97626
11	5.0023	0	0.062841	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
12	6.0001	0.0011106	0.063394	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
13	7.002	0.0011106	0.063671	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
14	8.0039	0.0011106	0.064225	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
15	9.0017	0.0011106	0.064502	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
16	10.004	0.0011106	0.064778	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
17	11.001	0.0011106	0.065055	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
18	12.004	0	0.065332	2.9681	5.9674	5.9714	5.872	0.095357	0.099396	1.0424
19	13.002	0	0.065332	2.9681	5.9679	5.972	5.872	0.095905	0.099982	1.0425
20	14.004	0	0.065886	2.9681	5.9674	5.9714	5.8714	0.095942	0.099981	1.0421
21	15.001	0	0.065609	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
22	16.003	0	0.065886	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
23	17.001	−0.0011106	0.066162	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
24	18.003	0	0.066716	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
25	19.001	0	0.066716	2.9681	5.9744	5.972	5.872	0.10241	0.099982	0.97626
26	20.003	0	0.066716	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
27	21	0	0.066716	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
28	21.163	0	0.066716	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
2	0.0125	0	0.00055366	2.9681	5.9964	5.9954	5.889	0.10739	0.10643	0.99105
3	0.050667	0	0.041801	2.9681	6.0884	6.0867	5.9363	0.1521	0.15036	0.9886
4	0.1008	0	0.18852	2.9681	6.1049	6.1078	5.8667	0.23821	0.24105	1.0119
5	0.25102	0	0.23752	2.9681	6.1148	6.1183	5.8732	0.24165	0.24515	1.0145
6	0.50205	0	0.25247	2.9681	6.1165	6.1201	5.8732	0.2433	0.24691	1.0149
7	1.0039	0	0.26216	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
8	2.0016	0	0.27129	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
9	3.0036	0.0011106	0.27628	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
10	4.0013	0.0011106	0.2796	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
11	5.0033	0.0011106	0.28209	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
12	6.0011	0	0.2843	2.9681	6.1176	6.1212	5.8714	0.24615	0.24984	1.015
13	7.003	0	0.28597	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
14	8.0008	0	0.28735	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
15	9.0027	0.0011106	0.28846	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
16	10	0.0011106	0.28956	2.9681	6.1176	6.1212	5.872	0.24556	0.24925	1.015
17	11.002	0.0011106	0.29067	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
18	12	0.0011106	0.29178	2.9681	6.1208	6.1212	5.8714	0.2494	0.24984	1.0017
19	13.002	0.0011106	0.29206	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
20	14.004	0.0011106	0.29344	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
21	15.002	0.0011106	0.29399	2.9681	6.1246	6.1218	5.8726	0.25204	0.24925	0.98896
22	16	0.0011106	0.29455	2.9681	6.1246	6.1218	5.8714	0.25321	0.25042	0.98901
23	17.002	0.0011106	0.29565	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
24	18.004	0.0011106	0.29621	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
25	19.002	0.0011106	0.29649	2.9681	6.1246	6.1218	5.8726	0.25204	0.24925	0.98896
26	20.004	0.0011106	0.29704	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
27	21.001	0	0.29787	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
28	22.003	0	0.29815	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
29	22.738	0	0.2987	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
2	0.012433	0	0	2.9681	6.1411	6.1394	5.8808	0.2603	0.25862	0.99355
3	0.050483	0	0.06118	2.9681	6.3117	6.3214	5.9592	0.35253	0.36228	1.0277
4	0.10057	0	0.19101	2.9681	6.3156	6.3361	5.896	0.41966	0.4401	1.0487
5	0.25078	0.0044422	0.26188	2.9681	6.3654	6.3718	5.8784	0.48695	0.49336	1.0132
6	0.50165	0.0066633	0.27655	2.9681	6.3637	6.37	5.8738	0.48998	0.49628	1.0128
7	1.0034	0.0077739	0.28652	2.9681	6.3643	6.3706	5.8726	0.4917	0.49804	1.0129
8	2.0011	0.0088844	0.29538	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
9	3.0031	0.009995	0.30036	2.9681	6.3686	6.3718	5.8726	0.49605	0.49921	1.0064
10	4.0008	0.009995	0.30396	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
11	5.0028	0.009995	0.30701	2.9681	6.3681	6.3712	5.872	0.49609	0.49921	1.0063
12	6.0001	0.009995	0.30922	2.9681	6.3686	6.3718	5.8726	0.49605	0.49921	1.0064
13	7.002	0.009995	0.31088	2.9681	6.3681	6.3712	5.872	0.49609	0.49921	1.0063
14	8.0039	0.009995	0.31282	2.9681	6.3681	6.3712	5.872	0.49609	0.49921	1.0063
15	9.0017	0.009995	0.31448	2.9681	6.3654	6.3718	5.872	0.49339	0.49979	1.013
16	10.004	0.009995	0.31586	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
17	11.001	0.009995	0.31669	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
18	12.003	0.009995	0.31836	2.9681	6.3686	6.3718	5.8714	0.49722	0.50038	1.0063
19	13.001	0.009995	0.31919	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
20	14.003	0.009995	0.31919	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
21	15	0.0088844	0.32057	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
22	16.002	0.009995	0.32195	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
23	17	0.009995	0.32223	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
24	18.002	0.009995	0.32361	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
25	19.004	0.009995	0.32389	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
26	20.002	0.009995	0.32389	2.9681	6.3654	6.3718	5.8726	0.4928	0.49921	1.013
27	21.004	0.011106	0.32472	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
28	22.001	0.011106	0.32583	2.9681	6.3686	6.3718	5.8726	0.49605	0.49921	1.0064
29	23.003	0.011106	0.32638	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
30	24.001	0.011106	0.32611	2.9681	6.3681	6.3712	5.8714	0.49668	0.49979	1.0063
31	24.77	0.011106	0.32666	2.9681	6.3681	6.3712	5.872	0.49609	0.49921	1.0063

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
2	0.012483	-0.0011106	0.0019378	2.9681	6.452	6.4573	5.9241	0.52792	0.53319	1.01
3	0.05065	0.0022211	0.10741	2.9681	6.7391	6.7775	6.0077	0.73134	0.76973	1.0525
4	0.10072	0.023322	0.26077	2.9681	6.8052	6.8272	5.9018	0.90338	0.92538	1.0243
5	0.25093	0.043312	0.32085	2.9681	6.8626	6.8676	5.8761	0.98651	0.99151	1.0051
6	0.5018	0.046643	0.33524	2.9681	6.8642	6.8694	5.872	0.99225	0.99736	1.0052
7	1.0035	0.048864	0.34548	2.9681	6.8686	6.8705	5.872	0.9966	0.99853	1.0019
8	2.0013	0.049975	0.3549	2.9681	6.8691	6.8711	5.872	0.99715	0.99911	1.002
9	3.0032	0.051086	0.36043	2.9681	6.8691	6.8711	5.872	0.99715	0.99911	1.002
10	4.001	0.051086	0.36431	2.9681	6.8691	6.8711	5.872	0.99715	0.99911	1.002
11	5.0024	0.052196	0.36652	2.9681	6.8697	6.8717	5.8714	0.99828	1.0003	1.002
12	6.0002	0.052196	0.37012	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
13	7.0022	0.052196	0.37178	2.9681	6.8697	6.8717	5.8726	0.99711	0.99912	1.002
14	8.0041	0.052196	0.37427	2.9681	6.8697	6.8717	5.8726	0.99711	0.99912	1.002
15	9.0019	0.052196	0.37594	2.9681	6.8697	6.8717	5.8726	0.99711	0.99912	1.002
16	10.004	0.052196	0.37732	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
17	11.001	0.052196	0.37898	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
18	12.003	0.053307	0.37926	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
19	13.001	0.053307	0.38092	2.9681	6.8697	6.8717	5.8726	0.99711	0.99912	1.002
20	14.003	0.053307	0.38203	2.9681	6.8697	6.8717	5.8714	0.99828	1.0003	1.002
21	15.001	0.053307	0.38369	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
22	16.003	0.053307	0.38396	2.9681	6.8697	6.8717	5.8726	0.99711	0.99912	1.002
23	17	0.053307	0.38562	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
24	18.002	0.053307	0.38646	2.9681	6.8691	6.8711	5.8714	0.99773	0.9997	1.002
25	19	0.053307	0.38673	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
26	20.002	0.054417	0.38756	2.9681	6.8697	6.8717	5.8714	0.99828	1.0003	1.002
27	21.004	0.053307	0.38895	2.9681	6.8691	6.8711	5.872	0.99715	0.99911	1.002
28	22.002	0.053307	0.38895	2.9681	6.8697	6.8717	5.8726	0.99711	0.99912	1.002
29	23.004	0.054417	0.39005	2.9681	6.8691	6.8711	5.8714	0.99773	0.9997	1.002
30	24.001	0.054417	0.39116	2.9681	6.8659	6.8711	5.8714	0.99448	0.9997	1.0053
31	25.003	0.054417	0.39061	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
32	26.001	0.054417	0.39172	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
33	27.003	0.054417	0.39282	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
34	28.001	0.054417	0.39365	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
35	28.869	0.054417	0.3931	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.8697	6.8717	5.872	0.99769	0.9997	1.002
2	0.012533	0	0.0022146	2.9681	6.9898	6.9964	5.9352	1.0546	1.0612	1.0062
3	0.0506	0.009995	0.1888	2.9681	7.6318	7.7404	6.0639	1.5679	1.6765	1.0693
4	0.10067	0.043312	0.35213	2.9681	7.8067	7.8194	5.8907	1.916	1.9287	1.0066
5	0.25082	0.061081	0.39614	2.9681	7.856	7.8651	5.8767	1.9793	1.9884	1.0046
6	0.50168	0.065523	0.41082	2.9681	7.8631	7.8692	5.8743	1.9888	1.9948	1.0031
7	1.0034	0.068854	0.42217	2.9681	7.8636	7.8698	5.872	1.9917	1.9978	1.0031
8	2.0012	0.072186	0.43269	2.9681	7.868	7.8709	5.8726	1.9954	1.9983	1.0015
9	3.0031	0.073297	0.43905	2.9681	7.868	7.8709	5.872	1.996	1.9989	1.0015
10	4.0009	0.074407	0.44348	2.9681	7.868	7.8709	5.8714	1.9966	1.9995	1.0015
11	5.0028	0.075518	0.44653	2.9681	7.868	7.8709	5.8726	1.9954	1.9983	1.0015
12	6.0006	0.074407	0.44985	2.9681	7.8647	7.8709	5.8708	1.9939	2.0001	1.0031
13	7.0025	0.075518	0.45234	2.9681	7.8647	7.8709	5.8708	1.9939	2.0001	1.0031
14	8.0003	0.075518	0.454	2.9681	7.868	7.8709	5.8714	1.9966	1.9995	1.0015
15	9.0022	0.075518	0.45622	2.9681	7.868	7.8709	5.872	1.996	1.9989	1.0015
16	10	0.075518	0.45732	2.9681	7.8653	7.8715	5.8714	1.9939	2.0001	1.0031
17	11.002	0.075518	0.45898	2.9681	7.868	7.8709	5.8726	1.9954	1.9983	1.0015
18	12.004	0.075518	0.46065	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
19	13.002	0.076628	0.46258	2.9681	7.868	7.8709	5.872	1.996	1.9989	1.0015
20	14.004	0.075518	0.46341	2.9681	7.8647	7.8709	5.8714	1.9933	1.9995	1.0031
21	15.001	0.076628	0.46535	2.9681	7.868	7.8709	5.8708	1.9972	2.0001	1.0015
22	16.003	0.076628	0.46618	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015
23	17.001	0.076628	0.46701	2.9681	7.868	7.8709	5.8714	1.9966	1.9995	1.0015
24	18.003	0.076628	0.46812	2.9681	7.868	7.8709	5.8726	1.9954	1.9983	1.0015
25	19.001	0.076628	0.46895	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
26	20.003	0.076628	0.47061	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015
27	21	0.076628	0.47144	2.9681	7.8685	7.8715	5.8714	1.9971	2.0001	1.0015
28	22.002	0.076628	0.47172	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
29	23	0.076628	0.47255	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
30	24.002	0.076628	0.47283	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
31	25.004	0.076628	0.47449	2.9681	7.8653	7.8715	5.872	1.9933	1.9995	1.0031
32	26.002	0.076628	0.47532	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
33	27.004	0.076628	0.47615	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
34	28.002	0.076628	0.47698	2.9681	7.8685	7.8715	5.8708	1.9977	2.0007	1.0015
35	29.004	0.076628	0.47643	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015
36	30.001	0.076628	0.47809	2.9681	7.8685	7.8715	5.8702	1.9983	2.0013	1.0015
37	31.003	0.077739	0.47836	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
38	32.001	0.077739	0.47947	2.9681	7.868	7.8709	5.872	1.996	1.9989	1.0015
39	33.003	0.077739	0.48002	2.9681	7.8685	7.8715	5.8726	1.996	1.9989	1.0015
40	34.001	0.077739	0.48085	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015
41	35.003	0.077739	0.48141	2.9681	7.8685	7.8715	5.8714	1.9971	2.0001	1.0015
42	36	0.077739	0.48113	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015
43	37.002	0.077739	0.48252	2.9681	7.868	7.8709	5.8708	1.9972	2.0001	1.0015
44	38	0.077739	0.48279	2.9681	7.868	7.8709	5.872	1.996	1.9989	1.0015
45	39.002	0.077739	0.48224	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015
46	40.004	0.077739	0.48362	2.9681	7.868	7.8709	5.8726	1.9954	1.9983	1.0015
47	41.002	0.077739	0.48418	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015
48	41.854	0.077739	0.48362	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015

TRIAXIAL TEST

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.8685	7.8715	5.872	1.9966	1.9995	1.0015
2	0.0125	0	0.001661	2.9681	7.9859	7.9968	5.9293	2.0566	2.0675	1.0053
3	0.05065	0.017769	0.10962	2.9681	8.6093	8.7244	5.9872	2.6221	2.7372	1.0439
4	0.10073	0.036648	0.20319	2.9681	8.8052	8.8327	5.8738	2.9314	2.9589	1.0094
5	0.25102	0.046643	0.23171	2.9681	8.8592	8.8661	5.8755	2.9837	2.9906	1.0023
6	0.50198	0.049975	0.24416	2.9681	8.8658	8.8696	5.8743	2.9914	2.9952	1.0013
7	1.0037	0.052196	0.25496	2.9681	8.8669	8.8707	5.8738	2.9931	2.997	1.0013
8	2.0015	0.054417	0.26576	2.9681	8.8707	8.8713	5.8726	2.9981	2.9988	1.0002
9	3.0034	0.056638	0.27157	2.9681	8.8707	8.8713	5.8726	2.9981	2.9988	1.0002
10	4.0012	0.057749	0.27655	2.9681	8.8707	8.8713	5.8714	2.9992	2.9999	1.0002
11	5.0031	0.057749	0.27988	2.9681	8.8707	8.8713	5.8726	2.9981	2.9988	1.0002
12	6.0009	0.058859	0.28292	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
13	7.0028	0.058859	0.28541	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
14	8.0006	0.058859	0.28735	2.9681	8.8707	8.8713	5.8726	2.9981	2.9988	1.0002
15	9.0025	0.058859	0.28956	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
16	10	0.058859	0.2915	2.9681	8.8674	8.8713	5.8702	2.9972	3.0011	1.0013
17	11.002	0.05997	0.29206	2.9681	8.8674	8.8713	5.8726	2.9948	2.9988	1.0013
18	12	0.05997	0.29399	2.9681	8.8712	8.8719	5.8708	3.0004	3.0011	1.0002
19	13.002	0.05997	0.29621	2.9681	8.8707	8.8713	5.8714	2.9992	2.9999	1.0002
20	14.004	0.05997	0.29732	2.9681	8.8712	8.8719	5.8708	3.0004	3.0011	1.0002
21	15.002	0.05997	0.29759	2.9681	8.8707	8.8713	5.872	2.9987	2.9993	1.0002
22	16.004	0.05997	0.29981	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
23	17.001	0.05997	0.30064	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
24	18.003	0.05997	0.30202	2.9681	8.8707	8.8713	5.8714	2.9992	2.9999	1.0002
25	19.001	0.05997	0.30285	2.9681	8.8707	8.8713	5.872	2.9987	2.9993	1.0002
26	20.003	0.05997	0.30396	2.9681	8.8674	8.8713	5.872	2.9954	2.9993	1.0013
27	21	0.05997	0.30424	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
28	22.002	0.05997	0.30507	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
29	23	0.061081	0.3059	2.9681	8.8707	8.8713	5.8714	2.9992	2.9999	1.0002
30	24.002	0.05997	0.30673	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
31	25	0.05997	0.30811	2.9681	8.8707	8.8713	5.8726	2.9981	2.9988	1.0002
32	26.002	0.05997	0.3095	2.9681	8.8712	8.8719	5.8708	3.0004	3.0011	1.0002
33	27.004	0.058859	0.31005	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
34	28.002	0.05997	0.30977	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
35	29.004	0.05997	0.31143	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
36	30.002	0.05997	0.31116	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
37	31.004	0.05997	0.31282	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
38	32.001	0.061081	0.31365	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
39	33.003	0.061081	0.31365	2.9681	8.868	8.8719	5.872	2.996	2.9999	1.0013
40	34.001	0.061081	0.3142	2.9681	8.8707	8.8713	5.872	2.9987	2.9993	1.0002
41	35.003	0.061081	0.31531	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
42	36.001	0.061081	0.31586	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
43	37.003	0.061081	0.31642	2.9681	8.8707	8.8713	5.872	2.9987	2.9993	1.0002
44	38	0.061081	0.31697	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
45	39.002	0.061081	0.31669	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002
46	40	0.05997	0.31836	2.9681	8.8712	8.8719	5.8714	2.9998	3.0005	1.0002
47	41.002	0.05997	0.31863	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
48	42.004	0.061081	0.31891	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
49	43.002	0.061081	0.31919	2.9681	8.8707	8.8713	5.8726	2.9981	2.9988	1.0002
50	43.061	0.05997	0.31974	2.9681	8.8712	8.8719	5.872	2.9992	2.9999	1.0002

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1432	8.1437	8.0717	0.071448	0.071985	1.0075
2	0.01255	0	0	2.9681	8.1465	8.1472	8.0747	0.071815	0.072572	1.0105
3	0.05005	0.0011106	0.0074744	2.9681	8.17	8.1654	8.0828	0.087139	0.082528	0.94708
4	0.10012	0	0.023531	2.9681	8.163	8.1683	8.0741	0.088896	0.09423	1.06
5	0.25035	0	0.036265	2.9681	8.1684	8.1706	8.0741	0.094344	0.096572	1.0236
6	0.5012	0	0.042909	2.9681	8.1652	8.1706	8.0723	0.092845	0.098327	1.059
7	1.0029	0	0.050383	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
8	2.0007	0	0.059242	2.9681	8.169	8.1712	8.0723	0.096648	0.098912	1.0234
9	3.0026	0	0.065886	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
10	4.0004	0	0.071422	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
11	5.0023	0.0011106	0.076128	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
12	6.0001	0.0011106	0.080558	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
13	7.0021	0.0011106	0.084433	2.9681	8.169	8.1712	8.0723	0.096648	0.098912	1.0234
14	8.004	0.0011106	0.088586	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
15	9.0018	0.0011106	0.092185	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
16	10.004	0.0011106	0.095783	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
17	11.001	0.0011106	0.099105	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
18	12.003	0.0011106	0.10215	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
19	13.001	0.0011106	0.1052	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
20	14.003	0.0011106	0.10796	2.9681	8.169	8.1712	8.0723	0.096648	0.098912	1.0234
21	15.001	0.0011106	0.11073	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
22	16.003	0.0011106	0.1135	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
23	17.001	0.0011106	0.11599	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
24	18.003	0.0011106	0.11876	2.9681	8.1695	8.1718	8.0706	0.098952	0.10125	1.0233
25	19	0.0011106	0.12097	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
26	20.002	0.0011106	0.12347	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
27	21	0.0011106	0.12568	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
28	22.002	0.0011106	0.12817	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
29	23.004	0.0011106	0.13066	2.9681	8.169	8.1712	8.0711	0.097818	0.10008	1.0231
30	24.002	0.0011106	0.13288	2.9681	8.1728	8.1718	8.0717	0.10104	0.10008	0.99057
31	25.004	0	0.13509	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
32	26.001	0	0.13703	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
33	27.003	0	0.13897	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
34	28.001	0	0.14091	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
35	29.003	0	0.14257	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
36	30.001	0.0011106	0.14451	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
37	31.003	0	0.14672	2.9681	8.1695	8.1718	8.0711	0.098367	0.10067	1.0234
38	32.001	0	0.14838	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
39	33.002	0	0.15004	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
40	34	0	0.1517	2.9681	8.1663	8.1718	8.0723	0.093943	0.099498	1.0591
41	35.002	0	0.15364	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
42	36.004	0	0.15558	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
43	37.002	0	0.15724	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
44	38.004	0	0.1589	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
45	39.002	0	0.16056	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
46	40.004	0	0.16195	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
47	41.001	0	0.16361	2.9681	8.1663	8.1718	8.0717	0.094528	0.10008	1.0588
48	42.003	0.0011106	0.16527	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
49	43.001	0.0011106	0.16665	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
50	44.003	0.0011106	0.16804	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
51	45.001	0.0011106	0.16942	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
52	46.003	0.0011106	0.17108	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
53	47.001	0.0011106	0.17219	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
54	48.003	0.0011106	0.17413	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
55	49	0.0011106	0.17551	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
56	50.002	0.0011106	0.17689	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
57	51.004	0.0011106	0.17828	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
58	52.002	0.0011106	0.17966	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
59	53.004	0.0011106	0.18077	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
60	54.002	0.0011106	0.18215	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
61	55.004	0.0011106	0.18354	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
62	56.001	0.0011106	0.18465	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
63	57.003	0.0011106	0.18603	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
64	58.001	0.0011106	0.18741	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
65	59.003	0.0022211	0.18852	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
66	60.001	0.0022211	0.18991	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
67	61.003	0.0022211	0.19101	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
68	62	0.0022211	0.1924	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
69	63.002	0.0022211	0.19378	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
70	64	0.0011106	0.19461	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
71	65.002	0.0011106	0.19627	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
72	66.004	0.0011106	0.19738	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
73	67.002	0.0011106	0.19849	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
74	68.004	0.0011106	0.19959	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
75	69.002	0.0011106	0.2007	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
76	70.003	0.0011106	0.20153	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
77	71.001	0.0011106	0.20264	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
78	72.003	0.0011106	0.20375	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
79	73.001	0.0011106	0.20485	2.9681	8.1663	8.1718	8.0711	0.095113	0.10067	1.0584
80	74.003	0.0011106	0.20541	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
81	75.001	0.0011106	0.20652	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
82	76.003	0.0011106	0.2079	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
83	77	0.0011106	0.20873	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
84	78.002	0.0011106	0.21011	2.9681	8.1728	8.1718	8.0717	0.10104	0.10008	0.99057
85	79	0.0011106	0.21094	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
86	80.002	0	0.21205	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
87	81.004	0.0011106	0.21261	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
88	82.002	0.0011106	0.21399	2.9681	8.1695	8.1718	8.0711	0.098367	0.10067	1.0234
89	83.004	0.0011106	0.21454	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
90	84.002	0.0011106	0.21565	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
91	85.004	0.0011106	0.21648	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
92	86.002	0.0011106	0.21704	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235

93	87.004	0.0011106	0.21814	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
94	88.002	0.0011106	0.21897	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
95	89.004	0.0011106	0.22008	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
96	90.002	0	0.22119	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
97	91.004	0	0.22202	2.9681	8.1728	8.1718	8.0717	0.10104	0.10008	0.99057
98	92.001	0	0.22257	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
99	93.003	0	0.22368	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
100	94.001	0	0.22451	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
101	95.003	0	0.22534	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
102	95.592	0	0.22562	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
2	0.012483	0	0.00083049	2.9681	8.1985	8.1958	8.0881	0.1104	0.1077	0.97555
3	0.05065	0	0.03931	2.9681	8.308	8.2918	8.132	0.17602	0.15983	0.90799
4	0.10078	-0.0011106	0.2007	2.9681	8.3011	8.3088	8.101	0.20016	0.20781	1.0382
5	0.25102	-0.0011106	0.63643	2.9681	8.2748	8.2807	8.0852	0.18962	0.19551	1.031
6	0.50197	0	1.094	2.9681	8.2989	8.3029	8.0823	0.21665	0.22068	1.0186
7	1.0037	0.0022211	1.5763	2.9681	8.3077	8.3123	8.0764	0.23128	0.23589	1.02
8	2.0015	0.0033317	1.8437	2.9681	8.3186	8.3205	8.0735	0.24514	0.24701	1.0077
9	3.0034	0.0033317	1.9157	2.9681	8.3181	8.3199	8.0741	0.244	0.24584	1.0075
10	4.0012	0.0033317	1.9539	2.9681	8.3186	8.3205	8.0741	0.24455	0.24643	1.0077
11	5.0031	0.0033317	1.9799	2.9681	8.3186	8.3205	8.0735	0.24514	0.24701	1.0077
12	6.0009	0.0044422	1.9995	2.9681	8.3192	8.3211	8.0729	0.24627	0.24818	1.0078
13	7.0028	0.0033317	2.0153	2.9681	8.3192	8.3211	8.0729	0.24627	0.24818	1.0078
14	8.0006	0.0033317	2.0286	2.9681	8.3192	8.3211	8.0723	0.24685	0.24877	1.0077
15	9.0025	0.0044422	2.04	2.9681	8.3192	8.3211	8.0723	0.24685	0.24877	1.0077
16	10	0.0044422	2.0497	2.9681	8.3192	8.3211	8.0723	0.24685	0.24877	1.0077
17	11.002	0.0044422	2.0582	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
18	12.003	0.0044422	2.066	2.9681	8.3192	8.3211	8.0723	0.24685	0.24877	1.0077
19	13.001	0.0044422	2.0726	2.9681	8.3197	8.3217	8.0729	0.24682	0.24877	1.0079
20	14.003	0.0055528	2.0787	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
21	15.001	0.0044422	2.0851	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
22	16.003	0.0044422	2.0903	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
23	17.004	0.0044422	2.0956	2.9681	8.3197	8.3217	8.07	0.24974	0.25169	1.0078
24	18.001	0.0044422	2.1	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
25	19.003	0.0044422	2.1045	2.9681	8.3197	8.3217	8.0729	0.24682	0.24877	1.0079
26	20.001	0.0044422	2.1089	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
27	21.003	0.0044422	2.1128	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
28	22.001	0.0044422	2.1166	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
29	22.323	0.0044422	2.1178	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
2	0.012483	0	0.0013842	2.9681	8.3652	8.3632	8.0957	0.26946	0.26751	0.99277
3	0.0507	0.0011106	0.070869	2.9681	8.5254	8.5342	8.1624	0.36296	0.37175	1.0242
4	0.10077	0.0044422	0.28873	2.9681	8.5621	8.5699	8.0998	0.46228	0.47005	1.0168
5	0.25102	0.009995	0.6572	2.9681	8.548	8.5687	8.0793	0.46864	0.48936	1.0442
6	0.50203	0.11439	0.9307	2.9681	8.5632	8.571	8.0741	0.48912	0.49697	1.016
7	1.004	0.20878	1.0904	2.9681	8.5621	8.5699	8.077	0.4851	0.49287	1.016
8	2.0018	0.24543	1.1668	2.9681	8.5626	8.5704	8.0735	0.48916	0.49697	1.016
9	3.0037	0.26098	1.1967	2.9681	8.5659	8.5704	8.0735	0.49241	0.49697	1.0093
10	4.0015	0.27209	1.2156	2.9681	8.5664	8.571	8.0729	0.49354	0.49814	1.0093
11	5.0034	0.27986	1.2291	2.9681	8.5664	8.571	8.0723	0.49413	0.49872	1.0093
12	6.0012	0.28541	1.2396	2.9681	8.5664	8.571	8.0723	0.49413	0.49872	1.0093
13	7.0031	0.29097	1.2485	2.9681	8.5664	8.571	8.0711	0.4953	0.49989	1.0093
14	8.0009	0.2943	1.2557	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
15	9.0029	0.29874	1.2623	2.9681	8.5697	8.571	8.0711	0.49855	0.49989	1.0027
16	10.001	0.30318	1.2676	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
17	11.003	0.30651	1.2731	2.9681	8.567	8.5716	8.0723	0.49468	0.49931	1.0094
18	12	0.31096	1.2778	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
19	13.002	0.31318	1.2823	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
20	14	0.31429	1.2862	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
21	15.002	0.31651	1.2898	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
22	16.004	0.31762	1.2931	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
23	17.002	0.31762	1.2964	2.9681	8.567	8.5716	8.0723	0.49468	0.49931	1.0094
24	18.004	0.31762	1.2992	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
25	19.001	0.31873	1.3019	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
26	20.003	0.32095	1.305	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
27	21.001	0.32095	1.3075	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
28	22.003	0.32095	1.31	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
29	23.001	0.32095	1.3116	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
30	24.003	0.32095	1.3138	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
31	25.001	0.32206	1.3166	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
32	26.002	0.32317	1.3188	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
33	27	0.32317	1.321	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
34	28.002	0.32428	1.3227	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
35	29.004	0.32428	1.3244	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
36	30.002	0.32428	1.3263	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
37	30.081	0.32539	1.3263	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9435	5.9436	5.8718	0.071642	0.071737	1.0013
2	0.0125	0.00091637	0	2.9681	5.9462	5.9465	5.8736	0.072613	0.072912	1.0041
3	0.05005	0.00091637	0.0085817	2.9681	5.9663	5.9647	5.8842	0.082197	0.080552	0.97999
4	0.10007	0.00091637	0.036265	2.9681	5.9713	5.97	5.8777	0.093559	0.092282	0.98636
5	0.25028	0	0.097168	2.9681	5.9707	5.9694	5.8742	0.09653	0.095213	0.98635
6	0.50115	0	0.14589	2.9681	5.9664	5.9682	5.8724	0.093985	0.095798	1.0193
7	1.0029	0.00091637	0.17108	2.9681	5.967	5.9688	5.8748	0.092186	0.09404	1.0201
8	2.0006	0.00091637	0.18935	2.9681	5.9691	5.9712	5.8724	0.096714	0.098732	1.0209
9	4.004	0.00091637	0.19904	2.9681	5.9659	5.9712	5.8718	0.094088	0.099318	1.0556
10	6.0032	0.0036655	0.20153	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
11	8.0024	0.0045818	0.20264	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
12	10.002	0.011913	0.21925	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
13	12.001	0.013745	0.2187	2.9681	5.967	5.9723	5.8718	0.09518	0.10049	1.0558
14	14	0.014662	0.21842	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
15	16.003	0.014662	0.2187	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
16	18.003	0.015578	0.21814	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
17	20.002	0.014662	0.21731	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
18	21.934	0.014662	0.21731	2.9681	5.9702	5.9723	5.8718	0.098392	0.10049	1.0213

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9729	5.9717	5.8718	0.10106	0.099905	0.98858
2	0.0125	0	0.00055366	2.9681	5.9942	5.9946	5.8859	0.10828	0.10872	1.0041
3	0.05065	0	0.036818	2.9681	6.0853	6.0891	5.9305	0.15483	0.15865	1.0247
4	0.10078	0	0.18548	2.9681	6.1078	6.1202	5.8947	0.2131	0.22551	1.0583
5	0.25102	0.0036655	0.50328	2.9681	6.0774	6.0979	5.8853	0.1921	0.21259	1.1067
6	0.50203	0.021993	0.90302	2.9681	6.0879	6.1161	5.8818	0.20611	0.2343	1.1368
7	1.004	0.077891	1.3133	2.9681	6.0869	6.1185	5.8759	0.21095	0.24251	1.1496
8	2.0018	0.25017	1.5945	2.9681	6.1094	6.1185	5.8742	0.23519	0.24427	1.0386
9	4.001	0.35922	1.7382	2.9681	6.1116	6.1208	5.8707	0.24089	0.25014	1.0384
10	6.0002	0.40687	1.7878	2.9681	6.1148	6.1208	5.873	0.24176	0.24779	1.0249
11	8.0036	0.41328	1.8166	2.9681	6.1153	6.1214	5.8724	0.24289	0.24896	1.025
12	10.003	0.43527	1.8365	2.9681	6.1153	6.1214	5.8724	0.24289	0.24896	1.025
13	12.002	0.44352	1.8525	2.9681	6.1196	6.1226	5.8724	0.2472	0.25014	1.0119
14	14.001	0.45177	1.8653	2.9681	6.1159	6.122	5.8724	0.24344	0.24955	1.0251
15	16	0.4591	1.8752	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
16	18.004	0.46276	1.8841	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
17	20.003	0.46643	1.8908	2.9681	6.1153	6.1214	5.8718	0.24348	0.24955	1.0249
18	22.002	0.46918	1.8971	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
19	24.001	0.47101	1.9029	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
20	26.001	0.47376	1.9082	2.9681	6.1185	6.1214	5.8713	0.24728	0.25014	1.0116
21	28.004	0.47651	1.9123	2.9681	6.1159	6.122	5.8724	0.24344	0.24955	1.0251
22	30.003	0.48018	1.9168	2.9681	6.1213	6.1243	5.8742	0.24708	0.25014	1.0124
23	30.079	0.48018	1.9173	2.9681	6.1196	6.1226	5.8718	0.24779	0.25072	1.0119

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.7431	7.7434	7.671	0.072075	0.072405	1.0046
2	0.01245	0	-0.00027683	2.9681	7.7469	7.7475	7.6745	0.072379	0.072995	1.0085
3	0.054117	0	0.0080281	2.9681	7.7692	7.7681	7.6787	0.090595	0.089431	0.98715
4	0.10002	0	0.017163	2.9681	7.7692	7.7681	7.674	0.095285	0.094121	0.98778
5	0.25025	-0.00091637	0.024915	2.9681	7.7682	7.7704	7.6728	0.095429	0.097641	1.0232
6	0.50112	0	0.031559	2.9681	7.7677	7.7698	7.6728	0.094883	0.097054	1.0229
7	1.0033	-0.00091637	0.040971	2.9681	7.765	7.7704	7.6728	0.092216	0.097641	1.0588
8	2.0016	0	0.054536	2.9681	7.7688	7.771	7.6722	0.096561	0.098814	1.0233
9	4.0018	0	0.073637	2.9681	7.7693	7.7716	7.6728	0.09652	0.098814	1.0238
10	6.002	-0.00091637	0.088586	2.9681	7.7688	7.771	7.6716	0.097147	0.0994	1.0232
11	8.0022	-0.00091637	0.10049	2.9681	7.7693	7.7716	7.6722	0.097107	0.099401	1.0236
12	10.002	-0.00091637	0.11046	2.9681	7.7688	7.771	7.6722	0.096561	0.098814	1.0233
13	12.003	-0.00091637	0.11904	2.9681	7.7693	7.7716	7.6722	0.097107	0.099401	1.0236
14	14.003	-0.00091637	0.12983	2.9681	7.7688	7.771	7.6722	0.096561	0.098814	1.0233
15	16.003	0	0.1398	2.9681	7.7693	7.7716	7.6722	0.097107	0.099401	1.0236
16	18.003	0	0.14644	2.9681	7.7688	7.771	7.6722	0.096561	0.098814	1.0233
17	20.003	0	0.15336	2.9681	7.7688	7.771	7.6716	0.097147	0.0994	1.0232
18	22.002	-0.00091637	0.15807	2.9681	7.7661	7.7716	7.6716	0.09448	0.099987	1.0583
19	24.002	-0.00091637	0.16278	2.9681	7.7693	7.7716	7.6722	0.097107	0.099401	1.0236
20	26.003	-0.00091637	0.16748	2.9681	7.7661	7.7716	7.6704	0.095653	0.10116	1.0576
21	28.003	-0.00091637	0.17136	2.9681	7.7688	7.771	7.6716	0.097147	0.0994	1.0232
22	30.003	0	0.17496	2.9681	7.7661	7.7716	7.6716	0.09448	0.099987	1.0583
23	32.003	-0.00091637	0.17856	2.9681	7.7725	7.7716	7.6722	0.10032	0.099401	0.99084
24	34.003	-0.0018327	0.18215	2.9681	7.7693	7.7716	7.6716	0.097693	0.099987	1.0235
25	36.004	-0.0018327	0.1852	2.9681	7.7688	7.771	7.6716	0.097147	0.0994	1.0232
26	38.004	-0.00091637	0.18824	2.9681	7.7693	7.7716	7.6716	0.097693	0.099987	1.0235
27	40.004	-0.00091637	0.19074	2.9681	7.7693	7.7716	7.6722	0.097107	0.099401	1.0236
28	42	-0.00091637	0.1935	2.9681	7.7693	7.7716	7.6716	0.097693	0.099987	1.0235
29	44	-0.00091637	0.19627	2.9681	7.7693	7.7716	7.6722	0.097107	0.099401	1.0236
30	46.001	-0.0018327	0.19904	2.9681	7.7693	7.7716	7.6722	0.097107	0.099401	1.0236
31	48.001	-0.00091637	0.20126	2.9681	7.7693	7.7716	7.6716	0.097693	0.099987	1.0235
32	50.001	-0.00091637	0.20347	2.9681	7.7693	7.7716	7.6716	0.097693	0.099987	1.0235
33	52.001	-0.00091637	0.20569	2.9681	7.7661	7.7716	7.6716	0.09448	0.099987	1.0583
34	54.001	-0.00091637	0.20762	2.9681	7.7693	7.7716	7.6716	0.097693	0.099987	1.0235
35	56.002	-0.00091637	0.21039	2.9681	7.7693	7.7716	7.6716	0.097693	0.099987	1.0235
36	57.275	-0.00091637	0.21178	2.9681	7.7725	7.7716	7.6722	0.10032	0.099401	0.99084

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.7725	7.7716	7.6716	0.10091	0.099987	0.9909
2	0.012483	0	0.00055366	2.9681	7.7981	7.7957	7.6851	0.11302	0.11056	0.97829
3	0.05065	0	0.032943	2.9681	7.9075	7.8925	7.7214	0.18602	0.17105	0.9195
4	0.10072	0	0.14146	2.9681	7.8653	7.8714	7.7003	0.16499	0.17102	1.0366
5	0.25095	0	0.43739	2.9681	7.9154	7.9183	7.6751	0.24029	0.24318	1.012
6	0.5018	0	0.74052	2.9681	7.8976	7.9095	7.6816	0.21602	0.22793	1.0551
7	1.003	0.022909	1.0395	2.9681	7.8897	7.9148	7.6775	0.21218	0.23731	1.1184
8	2.0008	0.13745	1.2106	2.9681	7.9063	7.9189	7.6757	0.23061	0.24318	1.0545
9	4.0042	0.18052	1.2898	2.9681	7.9144	7.9207	7.6734	0.24102	0.24729	1.026
10	6.0034	0.19244	1.3244	2.9681	7.9149	7.9212	7.6722	0.24274	0.24905	1.026
11	8.0026	0.20435	1.3462	2.9681	7.9182	7.9212	7.6722	0.24595	0.24905	1.0126
12	10.002	0.21351	1.3615	2.9681	7.9182	7.9212	7.6722	0.24595	0.24905	1.0126
13	12.002	0.22176	1.3736	2.9681	7.9187	7.9218	7.6704	0.24826	0.25139	1.0126
14	14.001	0.22451	1.3828	2.9681	7.9155	7.9218	7.6728	0.2427	0.24905	1.0261
15	16.001	0.22634	1.3908	2.9681	7.9187	7.9218	7.6722	0.2465	0.24963	1.0127
16	18	0.22818	1.3972	2.9681	7.9187	7.9218	7.6716	0.24709	0.25022	1.0127
17	20.001	0.23092	1.4033	2.9681	7.9149	7.9212	7.6716	0.24333	0.24963	1.0259
18	22.001	0.23276	1.4082	2.9681	7.9187	7.9218	7.6722	0.2465	0.24963	1.0127
19	22.126	0.23276	1.4088	2.9681	7.9155	7.9218	7.6716	0.24387	0.25022	1.026

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.9155	7.9218	7.6716	0.24387	0.25022	1.026
2	0.012533	0	0.00083049	2.9681	7.9644	7.9641	7.6962	0.26819	0.26785	0.99872
3	0.05065	0.0018327	0.049829	2.9681	8.0996	8.1266	7.7472	0.35235	0.3794	1.0768
4	0.10073	0.0064146	0.18409	2.9681	8.0725	8.1114	7.7326	0.33996	0.3788	1.1143
5	0.25095	0.024742	0.49137	2.9681	8.0789	8.139	7.6869	0.39207	0.45211	1.1531
6	0.50182	0.075142	0.71754	2.9681	8.1023	8.1607	7.6763	0.42603	0.48438	1.1369
7	1.0035	0.19427	0.88447	2.9681	8.1534	8.1707	7.681	0.47239	0.48966	1.0366
8	2.0015	0.27491	0.98718	2.9681	8.163	8.1707	7.6745	0.48847	0.49611	1.0156
9	4.0007	0.31156	1.0437	2.9681	8.163	8.1707	7.6716	0.49141	0.49904	1.0155
10	6.0041	0.33631	1.068	2.9681	8.1668	8.1712	7.6722	0.49458	0.49904	1.009
11	8.0033	0.34639	1.0846	2.9681	8.17	8.1712	7.6716	0.49838	0.49963	1.0025
12	10.002	0.35647	1.0968	2.9681	8.1705	8.1718	7.6722	0.49834	0.49963	1.0026
13	12.002	0.3693	1.1068	2.9681	8.17	8.1712	7.671	0.49896	0.50022	1.0025
14	14.001	0.38029	1.1142	2.9681	8.1705	8.1718	7.6716	0.49892	0.50022	1.0026
15	16.001	0.38487	1.1214	2.9681	8.1673	8.1718	7.671	0.4963	0.5008	1.0091
16	18	0.38946	1.1278	2.9681	8.1668	8.1712	7.6687	0.4981	0.50256	1.009
17	20	0.39404	1.1322	2.9681	8.1705	8.1718	7.6716	0.49892	0.50022	1.0026
18	21.521	0.39495	1.1375	2.9681	8.1716	8.173	7.6722	0.49943	0.5008	1.0028

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1705	8.1718	7.6716	0.49892	0.50022	1.0026
2	0.0125	0	0.001661	2.9681	8.2582	8.2558	7.7109	0.54735	0.54486	0.99545
3	0.050717	0.0027491	0.10686	2.9681	8.5474	8.6184	7.8088	0.73863	0.80962	1.0961
4	0.10072	0.0036655	0.28846	2.9681	8.4852	8.5826	7.7613	0.72391	0.82131	1.1346
5	0.25095	0.046735	0.64529	2.9681	8.5138	8.6513	7.6745	0.83921	0.97674	1.1639
6	0.50182	0.14112	0.82329	2.9681	8.5798	8.6601	7.6775	0.90229	0.98261	1.089
7	1.0035	0.27399	0.96835	2.9681	8.6431	8.6695	7.6745	0.96857	0.99493	1.0272
8	2.0013	0.32989	1.0315	2.9681	8.6629	8.6701	7.674	0.98898	0.9961	1.0072
9	4.0005	0.36471	1.0749	2.9681	8.6667	8.6707	7.6734	0.99332	0.99728	1.004
10	6.0039	0.38029	1.0943	2.9681	8.6678	8.6718	7.6728	0.995	0.99904	1.0041
11	8.0031	0.38671	1.1079	2.9681	8.6705	8.6712	7.6722	0.99825	0.99904	1.0008
12	10.002	0.38854	1.1181	2.9681	8.6678	8.6718	7.6716	0.99617	1.0002	1.0041
13	12.002	0.39312	1.1264	2.9681	8.6715	8.6724	7.6716	0.99993	1.0008	1.0009
14	14.002	0.39587	1.1331	2.9681	8.671	8.6718	7.671	0.99997	1.0008	1.0008
15	16.002	0.3977	1.1389	2.9681	8.671	8.6718	7.6722	0.9988	0.99962	1.0008
16	18.002	0.39862	1.1439	2.9681	8.6678	8.6718	7.6722	0.99558	0.99962	1.0041
17	20.003	0.40228	1.1494	2.9681	8.6678	8.6718	7.671	0.99676	1.0008	1.0041
18	22.003	0.40595	1.1536	2.9681	8.671	8.6718	7.6722	0.9988	0.99962	1.0008
19	24.003	0.40687	1.1569	2.9681	8.671	8.6718	7.6716	0.99938	1.0002	1.0008
20	26.003	0.40962	1.1602	2.9681	8.6705	8.6712	7.671	0.99942	1.0002	1.0008
21	28.004	0.4142	1.1643	2.9681	8.6705	8.6712	7.671	0.99942	1.0002	1.0008
22	30.004	0.41695	1.1674	2.9681	8.671	8.6718	7.6716	0.99938	1.0002	1.0008
23	30.075	0.41786	1.1677	2.9681	8.671	8.6718	7.6722	0.9988	0.99962	1.0008

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1411	8.1437	8.0714	0.069686	0.072227	1.0365
2	0.0124	0	0	2.9681	8.1417	8.1443	8.0714	0.070232	0.072814	1.0368
3	0.054117	0	0.0044293	2.9681	8.1667	8.1677	8.0767	0.090005	0.091012	1.0112
4	0.10002	0	0.010243	2.9681	8.1651	8.1695	8.0726	0.092534	0.096876	1.0469
5	0.25025	0	0.014949	2.9681	8.1673	8.1718	8.0732	0.094131	0.098637	1.0479
6	0.50068	0.00091637	0.018824	2.9681	8.1668	8.1712	8.0691	0.097689	0.10215	1.0457
7	1.0013	0.0018327	0.022146	2.9681	8.1673	8.1718	8.072	0.095304	0.09981	1.0473
8	2.0028	0.0036655	0.026022	2.9681	8.1673	8.1718	8.0714	0.09589	0.1004	1.047
9	4.0015	0.0045818	0.028514	2.9681	8.1705	8.1718	8.072	0.098516	0.09981	1.0131
10	6.0003	0.0045818	0.030175	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
11	8.0037	0.0045818	0.030728	2.9681	8.1705	8.1718	8.072	0.098516	0.09981	1.0131
12	10.002	0.0045818	0.031282	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
13	12.001	0.0045818	0.031559	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
14	14.004	0.0045818	0.031005	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
15	16.003	0.0045818	0.031005	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
16	18.001	0.0036655	0.030451	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
17	18.068	0.0036655	0.030451	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
2	0.012567	0	0.00055366	2.9681	8.1934	8.193	8.0808	0.11259	0.11214	0.99604
3	0.050633	0.00091637	0.026853	2.9681	8.2912	8.3015	8.1101	0.18106	0.1914	1.0571
4	0.1007	0.0027491	0.094953	2.9681	8.2712	8.2904	8.0966	0.17453	0.19373	1.11
5	0.25092	0.015578	0.24472	2.9681	8.2795	8.3062	8.0832	0.19633	0.22306	1.1361
6	0.50195	0.042153	0.38729	2.9681	8.2898	8.3138	8.0785	0.21133	0.23538	1.1138
7	1.0038	0.098051	0.50605	2.9681	8.3054	8.3203	8.0773	0.22815	0.24301	1.0651
8	2.0015	0.15395	0.61456	2.9681	8.3087	8.3203	8.0744	0.23429	0.24594	1.0497
9	4.0009	0.20527	0.69263	2.9681	8.3151	8.3203	8.0732	0.24189	0.24711	1.0216
10	6.0016	0.22268	0.73194	2.9681	8.3156	8.3209	8.0726	0.24302	0.24828	1.0217
11	8.0017	0.23367	0.75769	2.9681	8.3156	8.3209	8.072	0.2436	0.24887	1.0216
12	10.001	0.28866	0.91825	2.9681	8.3145	8.3197	8.0714	0.2431	0.24828	1.0213
13	12.001	0.3134	0.95562	2.9681	8.3156	8.3209	8.0726	0.24302	0.24828	1.0217
14	14.004	0.32073	0.97334	2.9681	8.3156	8.3209	8.0714	0.24419	0.24946	1.0216
15	16.003	0.32531	0.98441	2.9681	8.3194	8.3215	8.072	0.24736	0.24946	1.0085
16	18.002	0.32806	0.99271	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
17	20	0.32989	0.99963	2.9681	8.3188	8.3209	8.0714	0.2474	0.24946	1.0083
18	22.004	0.33447	1.0052	2.9681	8.3194	8.3215	8.072	0.24736	0.24946	1.0085
19	24.002	0.33722	1.0096	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
20	26.001	0.33814	1.0132	2.9681	8.3194	8.3215	8.072	0.24736	0.24946	1.0085
21	28.004	0.33814	1.0162	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
22	29.477	0.33906	1.0182	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
2	0.012483	0	0.00027683	2.9681	8.3607	8.359	8.0843	0.27642	0.2747	0.9938
3	0.050533	0.00091637	0.039864	2.9681	8.5096	8.5398	8.1353	0.37428	0.40445	1.0806
4	0.10055	0.0054982	0.14617	2.9681	8.4738	8.5151	8.1078	0.36606	0.40735	1.1128
5	0.25077	0.025658	0.35794	2.9681	8.4965	8.5533	8.0779	0.41859	0.4754	1.1357
6	0.50113	0.072393	0.51906	2.9681	8.5198	8.568	8.0761	0.44363	0.49183	1.1086
7	1.0019	0.16586	0.64695	2.9681	8.5594	8.5691	8.0767	0.48269	0.49241	1.0201
8	2.0035	0.23092	0.73858	2.9681	8.5599	8.5697	8.0744	0.48558	0.49535	1.0201
9	4.0005	0.25567	0.79976	2.9681	8.5669	8.5703	8.072	0.4949	0.49828	1.0068
10	6.002	0.27674	0.8316	2.9681	8.5669	8.5703	8.0714	0.49548	0.49886	1.0068
11	8.0034	0.29049	0.85208	2.9681	8.5675	8.5709	8.0709	0.49661	0.50004	1.0069
12	10.003	0.29782	0.86676	2.9681	8.5675	8.5709	8.072	0.49544	0.49887	1.0069
13	12.002	0.3024	0.877	2.9681	8.5707	8.5709	8.072	0.49865	0.49887	1.0004
14	14.001	0.30607	0.8853	2.9681	8.5707	8.5709	8.0714	0.49924	0.49945	1.0004
15	16	0.31065	0.89167	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
16	17.203	0.3134	0.89555	2.9681	8.568	8.5715	8.0714	0.49657	0.50004	1.007

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5712	8.5715	8.072	0.4992	0.49945	1.0005
2	0.012467	0	0.00055366	2.9681	8.6449	8.6507	8.0884	0.55648	0.56226	1.0104
3	0.050633	0.0027491	0.058134	2.9681	8.9185	8.9793	8.1916	0.72689	0.78772	1.0837
4	0.1007	0.013745	0.2641	2.9681	8.8809	8.9735	8.15	0.73093	0.82347	1.1266
5	0.25093	0.064146	0.59629	2.9681	8.929	9.0562	8.0785	0.85052	0.97774	1.1496
6	0.50178	0.15303	0.78398	2.9681	8.9874	9.0603	8.0837	0.90368	0.97657	1.0807
7	1.0035	0.27491	0.92821	2.9681	9.0389	9.0674	8.0755	0.96341	0.99182	1.0295
8	2.0013	0.32073	0.99687	2.9681	9.0604	9.0697	8.0732	0.98721	0.99651	1.0094
9	4.0005	0.34089	1.0425	2.9681	9.0647	9.0709	8.0732	0.99152	0.99769	1.0062
10	6.0039	0.34914	1.0628	2.9681	9.0653	9.0715	8.0714	0.99382	1	1.0062
11	8.0031	0.36105	1.0744	2.9681	9.0653	9.0715	8.072	0.99324	0.99945	1.0063
12	10.002	0.3693	1.0855	2.9681	9.0653	9.0715	8.072	0.99324	0.99945	1.0063
13	12.001	0.38579	1.0954	2.9681	9.0647	9.0709	8.072	0.99269	0.99886	1.0062
14	14.004	0.39587	1.1043	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
15	16.003	0.39862	1.1109	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
16	16.186	0.3977	1.1115	2.9681	9.0647	9.0709	8.0709	0.99386	1	1.0062

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
2	0.012467	0	0.00027683	2.9681	9.1799	9.1947	8.089	1.0909	1.1057	1.0136
3	0.050017	0.0091637	0.10824	2.9681	9.7669	9.9224	8.2778	1.4891	1.6446	1.1044
4	0.1001	0.021993	0.41248	2.9681	9.7125	9.9365	8.2045	1.508	1.732	1.1485
5	0.25033	0.12554	0.79616	2.9681	9.8416	10.058	8.1178	1.7238	1.9402	1.1255
6	0.50072	0.263	0.98081	2.9681	10.001	10.06	8.0873	1.9139	1.973	1.0309
7	1.0014	0.35555	1.0949	2.9681	10.052	10.07	8.0755	1.9767	1.9947	1.0091
8	2.0029	0.38121	1.1519	2.9681	10.061	10.07	8.0744	1.987	1.9953	1.0042
9	4.0015	0.41328	1.1984	2.9681	10.062	10.071	8.0714	1.991	1.9994	1.0042
10	6.0003	0.43161	1.2255	2.9681	10.066	10.071	8.0726	1.993	1.9983	1.0026
11	8.0031	0.44077	1.2457	2.9681	10.066	10.071	8.072	1.9936	1.9988	1.0026
12	10.002	0.44535	1.2615	2.9681	10.069	10.071	8.0703	1.9986	2.0006	1.001
13	12.001	0.45085	1.2745	2.9681	10.066	10.071	8.0714	1.9942	1.9994	1.0026
14	14.004	0.45452	1.2856	2.9681	10.069	10.071	8.0726	1.9968	1.9988	1.001
15	16.002	0.45727	1.2958	2.9681	10.069	10.071	8.0714	1.9974	1.9994	1.001
16	18.001	0.46185	1.305	2.9681	10.073	10.071	8.072	2.0006	1.9994	0.99942
17	20	0.46551	1.3133	2.9681	10.069	10.071	8.0714	1.998	2	1.001
18	22.003	0.46735	1.3208	2.9681	10.069	10.071	8.0714	1.998	2	1.001
19	24.002	0.46826	1.3271	2.9681	10.066	10.071	8.072	1.9942	1.9994	1.0026
20	26.001	0.47101	1.3329	2.9681	10.069	10.071	8.072	1.9968	1.9988	1.001
21	28.004	0.47284	1.3385	2.9681	10.069	10.071	8.0714	1.998	2	1.001
22	30.002	0.47468	1.3424	2.9681	10.069	10.071	8.0714	1.9974	1.9994	1.001
23	31.838	0.47651	1.3454	2.9681	10.069	10.071	8.0714	1.998	2	1.001

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1417	6.1435	6.0715	0.070168	0.071999	1.0261
2	0.012583	-0.0011106	-0.00027683	2.9681	6.145	6.147	6.0738	0.071119	0.073171	1.0289
3	0.050117	0	0.0085817	2.9681	6.169	6.1657	6.082	0.086993	0.083713	0.9623
4	0.10013	0	0.024915	2.9681	6.1712	6.1681	6.0773	0.093867	0.090734	0.96663
5	0.25037	-0.0022211	0.040417	2.9681	6.1669	6.1704	6.0732	0.093649	0.097171	1.0376
6	0.50073	-0.0011106	0.047338	2.9681	6.1696	6.1698	6.0727	0.096939	0.097171	1.0024
7	1.0014	-0.0011106	0.054812	2.9681	6.1707	6.171	6.0721	0.098622	0.098927	1.0031
8	2.0029	0	0.062564	2.9681	6.1707	6.171	6.0721	0.098622	0.098927	1.0031
9	3.0002	0	0.067547	2.9681	6.1707	6.171	6.0715	0.099207	0.099512	1.0031
10	4.0016	0	0.071422	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
11	5.003	-0.0011106	0.074467	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
12	6.0003	-0.0011106	0.077513	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
13	7.0017	-0.0011106	0.080004	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
14	8.0032	-0.0022211	0.082495	2.9681	6.1745	6.1716	6.0721	0.10242	0.099512	0.97157
15	9.0005	-0.0033317	0.08471	2.9681	6.1745	6.1716	6.0715	0.10301	0.1001	0.97173
16	10.002	-0.0022211	0.086925	2.9681	6.1712	6.1716	6.0709	0.10034	0.10068	1.0034
17	11.003	-0.0022211	0.088586	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
18	12.001	-0.0022211	0.090247	2.9681	6.1707	6.171	6.0715	0.099207	0.099512	1.0031
19	13.002	-0.0022211	0.091908	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
20	14.003	-0.0011106	0.093292	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
21	15.001	-0.0022211	0.094676	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
22	16.002	-0.0022211	0.09606	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
23	17.004	-0.0022211	0.097721	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
24	18.001	-0.0022211	0.099105	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
25	19.002	-0.0033317	0.10077	2.9681	6.1745	6.1716	6.0715	0.10301	0.1001	0.97173
26	20.004	-0.0033317	0.1016	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
27	21.002	-0.0033317	0.10326	2.9681	6.1707	6.171	6.0709	0.099792	0.1001	1.0031
28	22.003	-0.0033317	0.10409	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
29	23.001	-0.0022211	0.1052	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
30	24.002	-0.0022211	0.10603	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
31	25.004	-0.0022211	0.10741	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
32	26.001	-0.0033317	0.10852	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
33	27.003	-0.0022211	0.10962	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
34	28.003	-0.0033317	0.11073	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
35	29	-0.0033317	0.11184	2.9681	6.1718	6.1722	6.0715	0.1003	0.10068	1.0038
36	30.002	-0.0022211	0.11267	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
37	31.003	-0.0033317	0.1135	2.9681	6.1707	6.171	6.0715	0.099207	0.099512	1.0031
38	32	-0.0033317	0.11433	2.9681	6.1707	6.171	6.0715	0.099207	0.099512	1.0031
39	33.002	-0.0033317	0.11488	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
40	34.003	-0.0022211	0.11544	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
41	35.001	-0.0033317	0.11655	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
42	36.002	-0.0022211	0.1171	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
43	37.003	-0.0022211	0.11821	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
44	38.001	-0.0033317	0.11931	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
45	39.002	-0.0033317	0.11987	2.9681	6.1745	6.1716	6.0721	0.10242	0.099512	0.97157
46	40.004	-0.0033317	0.12097	2.9681	6.1745	6.1716	6.0715	0.10301	0.1001	0.97173
47	41.001	-0.0033317	0.12153	2.9681	6.1729	6.1733	6.0715	0.1014	0.10185	1.0045
48	42.002	-0.0033317	0.12208	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
49	43.004	-0.0033317	0.12264	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
50	44.001	-0.0033317	0.12347	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
51	45.002	-0.0033317	0.12374	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
52	46.004	-0.0033317	0.12485	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
53	47.001	-0.0044422	0.1254	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
54	48.003	-0.0033317	0.12623	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
55	49.004	-0.0022211	0.12734	2.9681	6.1745	6.1716	6.0715	0.10301	0.1001	0.97173
56	50.001	-0.0033317	0.12762	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
57	51.003	-0.0022211	0.12817	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
58	52.004	-0.0022211	0.129	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
59	53.001	-0.0033317	0.12928	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
60	54.003	-0.0022211	0.13011	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
61	55	-0.0022211	0.13039	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
62	56.002	-0.0033317	0.13122	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
63	57.003	-0.0033317	0.13205	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
64	58	-0.0033317	0.1326	2.9681	6.1745	6.1716	6.0715	0.10301	0.1001	0.97173
65	59.002	-0.0033317	0.13316	2.9681	6.1745	6.1716	6.0721	0.10242	0.099512	0.97157
66	60.003	-0.0033317	0.13371	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
67	61	-0.0033317	0.13426	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
68	62.002	-0.0033317	0.13482	2.9681	6.168	6.1716	6.0721	0.095916	0.099512	1.0375
69	63.004	-0.0022211	0.13565	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
70	64.002	-0.0022211	0.1362	2.9681	6.168	6.1716	6.0715	0.096501	0.1001	1.0373
71	65.003	-0.0022211	0.1362	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
72	65.901	-0.0022211	0.13703	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
2	0.012483	0	0.00055366	2.9681	6.1992	6.1944	6.0855	0.11362	0.10889	0.95835
3	0.0507	0.0011106	0.037926	2.9681	6.3027	6.2875	6.1323	0.17032	0.15516	0.911
4	0.10083	0.0011106	0.20236	2.9681	6.3191	6.3086	6.1031	0.21606	0.20548	0.95103
5	0.25107	-0.0011106	0.6464	2.9681	6.269	6.2828	6.0849	0.18403	0.19786	1.0752
6	0.50202	0	1.0597	2.9681	6.3088	6.308	6.0791	0.22974	0.22888	0.99628
7	1.0041	0.0033317	1.4379	2.9681	6.3198	6.3197	6.0744	0.24539	0.24527	0.99951
8	2.002	0.0044422	1.6272	2.9681	6.3204	6.3203	6.0756	0.24477	0.24469	0.99966
9	3.0041	0.0044422	1.6848	2.9681	6.3204	6.3203	6.0727	0.24769	0.24761	0.99967
10	4.0025	0.0044422	1.7169	2.9681	6.3204	6.3203	6.0727	0.24769	0.24761	0.99967
11	5.0008	0.0044422	1.7399	2.9681	6.3215	6.3214	6.0727	0.24879	0.24878	0.99996
12	6.0027	0.0044422	1.7579	2.9681	6.3204	6.3203	6.0721	0.24828	0.2482	0.99967
13	7.001	0.0055528	1.7723	2.9681	6.3209	6.3209	6.0721	0.24883	0.24878	0.99981
14	8.0029	0.0055528	1.7844	2.9681	6.3209	6.3209	6.0721	0.24883	0.24878	0.99981
15	9.0012	0.0055528	1.795	2.9681	6.3215	6.3214	6.0721	0.24938	0.24937	0.99996
16	10.003	0.0055528	1.8044	2.9681	6.3209	6.3209	6.0709	0.25	0.24995	0.99982
17	11.001	0.0066633	1.8124	2.9681	6.3215	6.3214	6.0721	0.24938	0.24937	0.99996
18	12.003	0.0055528	1.8196	2.9681	6.3209	6.3209	6.0721	0.24883	0.24878	0.99981
19	13.002	0.0066633	1.8265	2.9681	6.3209	6.3209	6.0715	0.24941	0.24937	0.99981
20	14.004	0.0066633	1.8326	2.9681	6.3209	6.3209	6.0715	0.24941	0.24937	0.99981
21	15.002	0.0066633	1.8379	2.9681	6.3215	6.3214	6.0721	0.24938	0.24937	0.99996
22	16	0.0055528	1.8431	2.9681	6.3209	6.3209	6.0715	0.24941	0.24937	0.99981
23	17.002	0.0055528	1.8478	2.9681	6.3215	6.3214	6.0721	0.24938	0.24937	0.99996
24	18.004	0.0044422	1.8523	2.9681	6.3182	6.3214	6.0715	0.24671	0.24995	1.0132
25	19.002	0.0055528	1.8564	2.9681	6.3209	6.3209	6.0715	0.24941	0.24937	0.99981
26	20.004	0.0066633	1.8603	2.9681	6.3215	6.3214	6.0721	0.24938	0.24937	0.99996
27	21.001	0.0055528	1.8642	2.9681	6.3209	6.3209	6.0715	0.24941	0.24937	0.99981
28	21.937	0.0055528	1.8678	2.9681	6.3215	6.3214	6.0709	0.25055	0.25054	0.99996

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3209	6.3209	6.0709	0.25	0.24995	0.99982
2	0.012433	0	0.00083049	2.9681	6.3647	6.3607	6.0931	0.27158	0.26753	0.98507
3	0.050483	0.0022211	0.066993	2.9681	6.5309	6.531	6.1639	0.36695	0.36708	1.0004
4	0.1005	0.0022211	0.26853	2.9681	6.5496	6.5579	6.1142	0.4354	0.44374	1.0191
5	0.25072	0.013327	0.63588	2.9681	6.5403	6.5515	6.1142	0.42611	0.4373	1.0262
6	0.50158	0.085513	0.89776	2.9681	6.5524	6.5644	6.0867	0.46568	0.47767	1.0258
7	1.0042	0.17103	1.0412	2.9681	6.5611	6.5702	6.075	0.48612	0.49523	1.0187
8	2.0028	0.20989	1.1082	2.9681	6.5644	6.5702	6.0738	0.49054	0.4964	1.0119
9	3.0001	0.22988	1.1358	2.9681	6.5649	6.5708	6.0727	0.49226	0.49815	1.012
10	4.0015	0.23766	1.1536	2.9681	6.5649	6.5708	6.0727	0.49226	0.49815	1.012
11	5.0039	0.2421	1.1666	2.9681	6.5687	6.5714	6.0715	0.49724	0.49991	1.0054
12	6.0013	0.24765	1.1768	2.9681	6.5655	6.5714	6.0715	0.49398	0.49991	1.012
13	7.0028	0.2521	1.1854	2.9681	6.5687	6.5714	6.0721	0.49665	0.49932	1.0054
14	8.0007	0.25654	1.1929	2.9681	6.566	6.572	6.0721	0.49394	0.49991	1.0121
15	9.0021	0.25987	1.1992	2.9681	6.5687	6.5714	6.0721	0.49665	0.49932	1.0054
16	10.004	0.26098	1.205	2.9681	6.566	6.572	6.0721	0.49394	0.49991	1.0121
17	11.001	0.26653	1.2103	2.9681	6.5666	6.5726	6.0715	0.49508	0.50108	1.0121
18	12.003	0.26764	1.2153	2.9681	6.5687	6.5714	6.0709	0.49782	0.50049	1.0054
19	13.001	0.26875	1.2192	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
20	14.003	0.26875	1.2233	2.9681	6.5687	6.5714	6.0715	0.49724	0.49991	1.0054
21	15.002	0.26986	1.2269	2.9681	6.5655	6.5714	6.0715	0.49398	0.49991	1.012
22	16.003	0.27098	1.2305	2.9681	6.5693	6.572	6.0709	0.49837	0.50108	1.0054
23	17	0.27098	1.2341	2.9681	6.566	6.572	6.0721	0.49394	0.49991	1.0121
24	18.002	0.27098	1.2372	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
25	19.004	0.27209	1.2402	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
26	20.001	0.27209	1.2432	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
27	21.002	0.2732	1.2457	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
28	21.236	0.27209	1.2466	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
2	0.012417	-0.0011106	0.0019378	2.9681	6.6493	6.6504	6.1095	0.53978	0.54091	1.0021
3	0.05415	0.0055528	0.13426	2.9681	6.9624	7.0192	6.2213	0.74112	0.79795	1.0767
4	0.10417	0.018879	0.34715	2.9681	6.9082	6.9753	6.1698	0.73844	0.80553	1.0908
5	0.2502	0.20101	0.74689	2.9681	7.0184	7.0374	6.0832	0.93525	0.95416	1.0202
6	0.50058	0.33761	0.95507	2.9681	7.0519	7.0696	6.0849	0.96692	0.9846	1.0183
7	1.0015	0.3998	1.0381	2.9681	7.0676	7.069	6.0762	0.99142	0.99279	1.0014
8	2.0029	0.41979	1.0863	2.9681	7.066	7.0707	6.0732	0.99273	0.99748	1.0048
9	3.0002	0.4309	1.109	2.9681	7.066	7.0707	6.0709	0.99507	0.99982	1.0048
10	4.0016	0.43423	1.1239	2.9681	7.0665	7.0713	6.0727	0.99387	0.99865	1.0048
11	5.003	0.43756	1.1356	2.9681	7.0665	7.0713	6.0721	0.99445	0.99923	1.0048
12	6.0003	0.43978	1.1447	2.9681	7.066	7.0707	6.0721	0.9939	0.99865	1.0048
13	7.0018	0.44422	1.1524	2.9681	7.0698	7.0713	6.0721	0.99771	0.99923	1.0015
14	8.0032	0.44533	1.1594	2.9681	7.0698	7.0713	6.0721	0.99771	0.99923	1.0015
15	9.0005	0.44866	1.1655	2.9681	7.0698	7.0713	6.0715	0.99829	0.99982	1.0015
16	10.002	0.45089	1.171	2.9681	7.0698	7.0713	6.0715	0.99829	0.99982	1.0015
17	11.003	0.452	1.176	2.9681	7.0671	7.0719	6.0715	0.99559	1.0004	1.0048
18	12.001	0.45422	1.1807	2.9681	7.0698	7.0713	6.0709	0.99888	1.0004	1.0015
19	13.002	0.45644	1.1848	2.9681	7.0698	7.0713	6.0709	0.99888	1.0004	1.0015
20	14.003	0.45755	1.1887	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
21	15.001	0.46088	1.1926	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
22	16.002	0.46199	1.1959	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
23	17.004	0.4631	1.199	2.9681	7.0665	7.0713	6.0715	0.99504	0.99982	1.0048
24	18.001	0.46532	1.2026	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
25	19.002	0.46643	1.2059	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
26	20.004	0.46865	1.2086	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
27	20.98	0.46865	1.2117	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.0671	7.0719	6.0721	0.995	0.99982	1.0048
2	0.012517	0	0.00027683	2.9681	7.1038	7.1041	6.082	1.0217	1.0221	1.0003
3	0.050067	0.011106	0.13288	2.9681	7.7584	7.8651	6.3125	1.4459	1.5525	1.0738
4	0.10015	0.062191	0.47421	2.9681	7.7786	7.9283	6.2078	1.5708	1.7205	1.0953
5	0.25037	0.30762	0.8889	2.9681	7.972	8.0582	6.0803	1.8917	1.978	1.0456
6	0.5008	0.41202	1.0265	2.9681	8.0415	8.0664	6.082	1.9594	1.9844	1.0127
7	1.0014	0.45422	1.0877	2.9681	8.0594	8.0682	6.0744	1.985	1.9938	1.0044
8	2.003	0.46421	1.1286	2.9681	8.0648	8.0705	6.0732	1.9916	1.9973	1.0029
9	3.0002	0.46976	1.1494	2.9681	8.0648	8.0705	6.0715	1.9933	1.999	1.0029
10	4.0016	0.47865	1.1635	2.9681	8.0654	8.0711	6.0727	1.9927	1.9985	1.0029
11	5.0031	0.48753	1.1746	2.9681	8.0654	8.0711	6.0721	1.9933	1.999	1.0029
12	6.0003	0.49642	1.1835	2.9681	8.0654	8.0711	6.0721	1.9933	1.999	1.0029
13	7.0017	0.50419	1.1915	2.9681	8.0686	8.0711	6.0721	1.9966	1.999	1.0012
14	8.0032	0.50752	1.1984	2.9681	8.0654	8.0711	6.0715	1.9939	1.9996	1.0029
15	9.0005	0.51197	1.2045	2.9681	8.0686	8.0711	6.0715	1.9971	1.9996	1.0012
16	10.002	0.51419	1.21	2.9681	8.0659	8.0717	6.0709	1.995	2.0008	1.0029
17	11.003	0.51752	1.2147	2.9681	8.0659	8.0717	6.0721	1.9939	1.9996	1.0029
18	12.001	0.51863	1.2192	2.9681	8.0686	8.0711	6.0727	1.996	1.9985	1.0012
19	13.002	0.51863	1.2239	2.9681	8.0659	8.0717	6.0721	1.9939	1.9996	1.0029
20	14.004	0.51863	1.228	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
21	15.001	0.52196	1.2319	2.9681	8.0692	8.0717	6.0727	1.9965	1.999	1.0013
22	16.003	0.52196	1.2355	2.9681	8.0686	8.0711	6.0721	1.9966	1.999	1.0012
23	17.001	0.52307	1.2394	2.9681	8.0659	8.0717	6.0715	1.9944	2.0002	1.0029
24	18.002	0.52307	1.2424	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
25	19.004	0.52529	1.2457	2.9681	8.0654	8.0711	6.0721	1.9933	1.999	1.0029
26	20.001	0.5264	1.2488	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
27	21.003	0.52751	1.2518	2.9681	8.0659	8.0717	6.0721	1.9939	1.9996	1.0029
28	22.004	0.52862	1.2549	2.9681	8.0692	8.0717	6.0715	1.9977	2.0002	1.0013
29	23.001	0.52973	1.2576	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
30	24.003	0.53085	1.2604	2.9681	8.0686	8.0711	6.0709	1.9977	2.0002	1.0012
31	25	0.53085	1.2626	2.9681	8.0659	8.0717	6.0721	1.9939	1.9996	1.0029
32	26.002	0.53196	1.2657	2.9681	8.0686	8.0711	6.0715	1.9971	1.9996	1.0012
33	27.003	0.53196	1.2676	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
34	28	0.53307	1.2704	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
35	29.002	0.53307	1.2726	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
36	30.003	0.53307	1.2751	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
37	31	0.53418	1.2776	2.9681	8.0692	8.0717	6.0709	1.9983	2.0008	1.0013
38	31.389	0.53529	1.2784	2.9681	8.0686	8.0711	6.0709	1.9977	2.0002	1.0012

TRIAXIAL TEST

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.0654	8.0711	6.0709	1.9945	2.0002	1.0029
2	0.012483	0	0.0011073	2.9681	8.1871	8.1941	6.1095	2.0776	2.0845	1.0033
3	0.05005	0.031096	0.19489	2.9681	9.2479	9.4614	6.3383	2.9097	3.1231	1.0734
4	0.1001	0.12438	0.65553	2.9681	9.7488	10.041	6.3675	3.3812	3.6734	1.0864
5	0.25035	0.38425	1.024	2.9681	10.04	10.053	6.0744	3.9657	3.9788	1.0033
6	0.50063	0.45977	1.1187	2.9681	10.042	10.065	6.0756	3.9663	3.9899	1.006
7	1.0014	0.49531	1.1693	2.9681	10.058	10.069	6.0738	3.9844	3.9952	1.0027
8	2.0028	0.51197	1.207	2.9681	10.066	10.07	6.0738	3.992	3.9963	1.0011
9	3.0001	0.51419	1.2275	2.9681	10.066	10.071	6.0721	3.9943	3.9987	1.0011
10	4.0016	0.51863	1.2416	2.9681	10.066	10.071	6.0727	3.9937	3.9981	1.0011
11	5.0029	0.52418	1.2529	2.9681	10.066	10.071	6.0703	3.996	4.0004	1.0011
12	6.0003	0.52862	1.2621	2.9681	10.067	10.071	6.0727	3.9942	3.9987	1.0011
13	7.0017	0.53307	1.2695	2.9681	10.07	10.071	6.0732	3.9969	3.9981	1.0003
14	8.0033	0.53973	1.2773	2.9681	10.067	10.072	6.0732	3.9942	3.9987	1.0011
15	9.0005	0.54417	1.2834	2.9681	10.067	10.071	6.0715	3.9954	3.9999	1.0011
16	10.002	0.54639	1.2889	2.9681	10.071	10.072	6.0727	3.998	3.9993	1.0003
17	11.003	0.54861	1.2942	2.9681	10.067	10.071	6.0721	3.9948	3.9993	1.0011
18	12.001	0.55306	1.2992	2.9681	10.067	10.071	6.0703	3.9966	4.001	1.0011
19	13.002	0.55528	1.3036	2.9681	10.071	10.072	6.0715	3.9992	4.0004	1.0003
20	14.004	0.5575	1.3077	2.9681	10.067	10.072	6.0715	3.996	4.0004	1.0011
21	15.001	0.55861	1.3119	2.9681	10.07	10.071	6.0709	3.9992	4.0004	1.0003
22	16.002	0.55972	1.3152	2.9681	10.07	10.071	6.0715	3.9987	3.9999	1.0003
23	17.004	0.56083	1.3197	2.9681	10.07	10.071	6.0715	3.9987	3.9999	1.0003
24	18.001	0.56194	1.323	2.9681	10.07	10.071	6.0721	3.9981	3.9993	1.0003
25	19.002	0.56416	1.3266	2.9681	10.07	10.071	6.0703	3.9998	4.001	1.0003
26	20.004	0.56638	1.3296	2.9681	10.071	10.072	6.0703	4.0004	4.0016	1.0003
27	21.001	0.56749	1.3327	2.9681	10.067	10.072	6.0697	3.9977	4.0022	1.0011
28	22.003	0.5686	1.3352	2.9681	10.067	10.071	6.0709	3.996	4.0004	1.0011
29	23.004	0.56971	1.3382	2.9681	10.07	10.071	6.0715	3.9987	3.9999	1.0003
30	24.001	0.57083	1.341	2.9681	10.07	10.071	6.0715	3.9987	3.9999	1.0003
31	25.003	0.57083	1.3432	2.9681	10.07	10.071	6.0721	3.9981	3.9993	1.0003
32	26	0.57305	1.3462	2.9681	10.07	10.071	6.0721	3.9981	3.9993	1.0003
33	27.001	0.57527	1.3484	2.9681	10.071	10.072	6.0727	3.998	3.9993	1.0003
34	28.003	0.57749	1.3515	2.9681	10.071	10.072	6.0709	3.9998	4.001	1.0003
35	29	0.5786	1.3537	2.9681	10.071	10.072	6.0721	3.9986	3.9999	1.0003
36	30.002	0.58193	1.3559	2.9681	10.071	10.072	6.0721	3.9986	3.9999	1.0003
37	31.003	0.58304	1.3579	2.9681	10.07	10.071	6.0715	3.9987	3.9999	1.0003
38	32	0.58304	1.3603	2.9681	10.071	10.072	6.0715	3.9992	4.0004	1.0003
39	33.002	0.58415	1.3626	2.9681	10.067	10.071	6.0715	3.9954	3.9999	1.0011
40	34.003	0.58415	1.3642	2.9681	10.071	10.072	6.0721	3.9986	3.9999	1.0003
41	35	0.58526	1.3667	2.9681	10.07	10.071	6.0709	3.9992	4.0004	1.0003
42	36.002	0.58415	1.3689	2.9681	10.071	10.073	6.0721	3.9992	4.0004	1.0003
43	37.003	0.58526	1.3703	2.9681	10.071	10.072	6.0727	3.998	3.9993	1.0003
44	38.001	0.58637	1.3728	2.9681	10.071	10.072	6.0721	3.9986	3.9999	1.0003
45	38.535	0.58637	1.3739	2.9681	10.071	10.072	6.0721	3.9986	3.9999	1.0003

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1417	6.1435	6.0715	0.070168	0.071999	1.0261
2	0.01245	0	0	2.9681	6.146	6.1482	6.0744	0.071631	0.073757	1.0297
3	0.0541	0	0.0083049	2.9681	6.1663	6.1663	6.0803	0.086042	0.086053	1.0001
4	0.10007	0	0.02187	2.9681	6.1631	6.1663	6.0785	0.084543	0.087808	1.0386
5	0.25028	0	0.053151	2.9681	6.1653	6.1687	6.0727	0.092588	0.096	1.0369
6	0.50192	0.0011106	0.077236	2.9681	6.1663	6.1698	6.0744	0.09193	0.095416	1.0379
7	1.0016	0.0011106	0.095507	2.9681	6.1674	6.171	6.0727	0.094782	0.098342	1.0376
8	2.0031	0.0022211	0.10658	2.9681	6.168	6.1716	6.0721	0.095916	0.099512	1.0375
9	3.0004	0.0033317	0.11018	2.9681	6.1707	6.171	6.0715	0.099207	0.099512	1.0031
10	4.0018	0.0033317	0.11129	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
11	5.0032	0.0033317	0.11239	2.9681	6.1707	6.171	6.0715	0.099207	0.099512	1.0031
12	6.0007	0.0044422	0.11295	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
13	7.0021	0.0044422	0.11322	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
14	8.0035	0.0044422	0.1135	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
15	9.0032	0.0033317	0.11405	2.9681	6.1712	6.1716	6.0721	0.09917	0.099512	1.0034
16	10	0.0033317	0.11405	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
17	11.002	0.0044422	0.11461	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
18	12.004	0.0044422	0.11516	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
19	13.001	0.0044422	0.11544	2.9681	6.1745	6.1716	6.0715	0.10301	0.1001	0.97173
20	14.003	0.0044422	0.11572	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
21	15.004	0.0044422	0.11572	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
22	16.001	0.0055528	0.11544	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
23	17.003	0.0055528	0.11572	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
24	18	0.0044422	0.11572	2.9681	6.1718	6.1722	6.0715	0.1003	0.10068	1.0038
25	19.002	0.0044422	0.11599	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
26	20.003	0.0055528	0.11599	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
27	21	0.0055528	0.11627	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
28	21.409	0.0055528	0.11627	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1712	6.1716	6.0715	0.099755	0.1001	1.0034
2	0.0125	0.0011106	0.00055366	2.9681	6.1953	6.1938	6.0855	0.10982	0.1083	0.9862
3	0.05005	0	0.039587	2.9681	6.3006	6.3027	6.1177	0.18293	0.185	1.0113
4	0.10013	0.0011106	0.1016	2.9681	6.2908	6.2957	6.0984	0.1924	0.19728	1.0254
5	0.25035	0.0044422	0.20928	2.9681	6.3171	6.3203	6.0885	0.22864	0.23182	1.0139
6	0.50065	0.0055528	0.25385	2.9681	6.3166	6.3197	6.075	0.24155	0.24469	1.013
7	1.0014	0.0088844	0.26686	2.9681	6.3177	6.3209	6.0721	0.24557	0.24878	1.0131
8	2.0028	0.012216	0.27323	2.9681	6.3209	6.3209	6.0715	0.24941	0.24937	0.99981
9	3.0001	0.015548	0.27545	2.9681	6.322	6.322	6.0715	0.25051	0.25054	1.0001
10	4.0016	0.016658	0.27711	2.9681	6.3209	6.3209	6.0715	0.24941	0.24937	0.99981
11	5.003	0.016658	0.27849	2.9681	6.3182	6.3214	6.0715	0.24671	0.24995	1.0132
12	6.0003	0.018879	0.2796	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
13	7.0017	0.01999	0.27988	2.9681	6.3209	6.3209	6.0709	0.25	0.24995	0.99982
14	8.0032	0.01999	0.28126	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
15	9.0004	0.01999	0.28154	2.9681	6.3182	6.3214	6.0715	0.24671	0.24995	1.0132
16	10.002	0.01999	0.28209	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
17	11.003	0.021101	0.28237	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
18	12.001	0.021101	0.28237	2.9681	6.3215	6.3214	6.0721	0.24938	0.24937	0.99996
19	13.002	0.021101	0.28292	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
20	14.003	0.021101	0.28347	2.9681	6.3182	6.3214	6.0721	0.24612	0.24937	1.0132
21	15.001	0.021101	0.28375	2.9681	6.322	6.322	6.0721	0.24993	0.24995	1.0001
22	16.002	0.01999	0.2832	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
23	17.004	0.021101	0.28347	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
24	18.001	0.021101	0.28375	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
25	19.002	0.021101	0.28458	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
26	20.004	0.022211	0.28486	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
27	20.901	0.022211	0.28486	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3215	6.3214	6.0715	0.24996	0.24995	0.99996
2	0.0125	0	0.00083049	2.9681	6.3604	6.363	6.0931	0.26727	0.26987	1.0097
3	0.054167	0.0033317	0.052321	2.9681	6.537	6.548	6.123	0.41405	0.42501	1.0265
4	0.10007	0.0055528	0.1099	2.9681	6.5299	6.5439	6.0914	0.43854	0.4525	1.0318
5	0.2503	0.016658	0.16942	2.9681	6.5584	6.5673	6.075	0.48338	0.4923	1.0185
6	0.50073	0.023322	0.18326	2.9681	6.5638	6.5696	6.0721	0.49175	0.49757	1.0118
7	1.0014	0.027764	0.18935	2.9681	6.5655	6.5714	6.0721	0.4934	0.49932	1.012
8	2.0028	0.028874	0.1935	2.9681	6.5687	6.5714	6.0715	0.49724	0.49991	1.0054
9	3.0001	0.029985	0.196	2.9681	6.5693	6.572	6.0715	0.49778	0.50049	1.0054
10	4.0015	0.029985	0.1971	2.9681	6.5693	6.572	6.0715	0.49778	0.50049	1.0054
11	5.003	0.029985	0.19821	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
12	6.0003	0.031096	0.19932	2.9681	6.5687	6.5714	6.0715	0.49724	0.49991	1.0054
13	7.0017	0.031096	0.19959	2.9681	6.5687	6.5714	6.0715	0.49724	0.49991	1.0054
14	8.0031	0.031096	0.19959	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
15	8.5629	0.031096	0.2007	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5693	6.572	6.0721	0.4972	0.49991	1.0054
2	0.012433	0	0.0019378	2.9681	6.6466	6.6545	6.1066	0.54004	0.54793	1.0146
3	0.054083	0.0066633	0.082495	2.9681	6.9772	7.035	6.1394	0.83784	0.89566	1.069
4	0.10417	0.025543	0.15835	2.9681	6.9902	7.0385	6.082	0.90823	0.9565	1.0532
5	0.25022	0.061081	0.20292	2.9681	7.0627	7.0672	6.075	0.98769	0.99221	1.0046
6	0.50107	0.067744	0.21178	2.9681	7.0665	7.0713	6.0703	0.99621	1.001	1.0048
7	1.0033	0.069965	0.21676	2.9681	7.0692	7.0707	6.0715	0.99774	0.99923	1.0015
8	2.0011	0.073297	0.22036	2.9681	7.0709	7.0725	6.0721	0.9988	1.0004	1.0016
9	3.003	0.074407	0.22229	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
10	4.0008	0.075518	0.22396	2.9681	7.0698	7.0713	6.0715	0.99829	0.99982	1.0015
11	5.0027	0.076628	0.22534	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
12	6.0005	0.077739	0.22562	2.9681	7.0703	7.0719	6.0709	0.99942	1.001	1.0016
13	7.0024	0.078849	0.22672	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
14	8.0002	0.078849	0.22755	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
15	9.0021	0.078849	0.22839	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
16	10.004	0.07996	0.22839	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
17	11.002	0.081071	0.22866	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
18	12.004	0.07996	0.22949	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
19	13.002	0.081071	0.22949	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
20	14.003	0.07996	0.23005	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
21	15.001	0.081071	0.2306	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
22	16.003	0.081071	0.2306	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
23	17.001	0.081071	0.23088	2.9681	7.0703	7.0719	6.0721	0.99825	0.99982	1.0016
24	18.003	0.082181	0.23198	2.9681	7.0703	7.0719	6.0709	0.99942	1.001	1.0016
25	19.001	0.082181	0.23143	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
26	20.003	0.082181	0.23198	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
27	20.888	0.083292	0.23281	2.9681	7.0698	7.0713	6.0715	0.99829	0.99982	1.0015

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.0703	7.0719	6.0715	0.99884	1.0004	1.0016
2	0.0125	0	0.001661	2.9681	7.1834	7.196	6.1124	1.0709	1.0835	1.0118
3	0.05065	0.022211	0.097721	2.9681	7.8161	7.9371	6.1768	1.6393	1.7603	1.0738
4	0.10073	0.052196	0.20015	2.9681	7.9797	8.0249	6.0785	1.9012	1.9464	1.0237
5	0.25103	0.083292	0.23641	2.9681	8.0588	8.0676	6.0756	1.9833	1.992	1.0044
6	0.50205	0.087734	0.24444	2.9681	8.0648	8.0705	6.0709	1.9939	1.9996	1.0029
7	1.004	0.089955	0.2497	2.9681	8.0675	8.07	6.0727	1.9949	1.9973	1.0012
8	2.002	0.093287	0.25468	2.9681	8.0686	8.0711	6.0709	1.9977	2.0002	1.0012
9	3.0039	0.094397	0.25662	2.9681	8.0686	8.0711	6.0715	1.9971	1.9996	1.0012
10	4.0017	0.094397	0.25828	2.9681	8.0692	8.0717	6.0715	1.9977	2.0002	1.0013
11	5.0036	0.095508	0.25994	2.9681	8.0692	8.0717	6.0715	1.9977	2.0002	1.0013
12	6.0014	0.095508	0.26105	2.9681	8.0686	8.0711	6.0721	1.9966	1.999	1.0012
13	7.0033	0.095508	0.26244	2.9681	8.0692	8.0717	6.0715	1.9977	2.0002	1.0013
14	8.0011	0.095508	0.26327	2.9681	8.0686	8.0711	6.0715	1.9971	1.9996	1.0012
15	8.6569	0.096618	0.26354	2.9681	8.0686	8.0711	6.0721	1.9966	1.999	1.0012

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.0692	8.0717	6.0721	1.9971	1.9996	1.0013
2	0.012567	0	0.0013842	2.9681	8.1856	8.2028	6.1043	2.0813	2.0986	1.0083
3	0.05005	0.021101	0.11267	2.9681	9.2487	9.4345	6.2025	3.0462	3.2319	1.061
4	0.10013	0.098839	0.2904	2.9681	9.9305	9.9988	6.0966	3.8339	3.9021	1.0178
5	0.25035	0.16325	0.35711	2.9681	10.053	10.064	6.0768	3.9765	3.987	1.0026
6	0.50072	0.18102	0.37538	2.9681	10.067	10.071	6.0727	3.9942	3.9987	1.0011
7	1.0014	0.18768	0.38839	2.9681	10.065	10.07	6.0721	3.9932	3.9975	1.0011
8	2.0029	0.1899	0.4003	2.9681	10.07	10.071	6.0715	3.9981	3.9993	1.0003
9	3.0002	0.19213	0.40694	2.9681	10.07	10.071	6.0727	3.9969	3.9981	1.0003
10	4.0016	0.19213	0.41192	2.9681	10.07	10.071	6.0709	3.9992	4.0004	1.0003
11	5.003	0.19435	0.41497	2.9681	10.07	10.071	6.0715	3.9987	3.9999	1.0003
12	6.0004	0.19435	0.41857	2.9681	10.07	10.071	6.0721	3.9981	3.9993	1.0003
13	7.0017	0.19435	0.42134	2.9681	10.067	10.071	6.0715	3.9954	3.9999	1.0011
14	8.0032	0.19657	0.42383	2.9681	10.07	10.071	6.0709	3.9992	4.0004	1.0003
15	9.0004	0.19768	0.42577	2.9681	10.071	10.072	6.0709	3.9998	4.001	1.0003
16	10.002	0.19768	0.4277	2.9681	10.07	10.071	6.0721	3.9981	3.9993	1.0003
17	11.003	0.19879	0.42909	2.9681	10.07	10.071	6.0703	3.9998	4.001	1.0003
18	12.001	0.1999	0.43103	2.9681	10.07	10.071	6.0715	3.9987	3.9999	1.0003
19	13.002	0.20101	0.43213	2.9681	10.071	10.072	6.0727	3.998	3.9993	1.0003
20	14.004	0.20101	0.43407	2.9681	10.07	10.071	6.0715	3.9987	3.9999	1.0003
21	15.001	0.20101	0.43545	2.9681	10.067	10.072	6.0697	3.9977	4.0022	1.0011
22	16.002	0.20101	0.43656	2.9681	10.071	10.072	6.0703	4.0004	4.0016	1.0003
23	17.004	0.20212	0.43712	2.9681	10.071	10.072	6.0715	3.9992	4.0004	1.0003
24	18.001	0.20212	0.43878	2.9681	10.071	10.072	6.0715	3.9992	4.0004	1.0003
25	19.002	0.20323	0.43988	2.9681	10.071	10.072	6.0715	3.9992	4.0004	1.0003
26	20.004	0.20323	0.44071	2.9681	10.071	10.072	6.0697	4.001	4.0022	1.0003
27	20.717	0.20323	0.44154	2.9681	10.067	10.071	6.0703	3.9966	4.001	1.0011

TRIAXIAL TEST

Consolidation/B Step: 7

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	10.07	10.071	6.0709	3.9992	4.0004	1.0003
2	0.0125	0	0	2.9681	10.104	10.108	6.0773	4.0268	4.0303	1.0009
3	0.05005	0.013327	0.083603	2.9681	11.303	11.488	6.1826	5.1208	5.3053	1.036
4	0.10012	0.094397	0.2569	2.9681	11.918	11.988	6.1475	5.7708	5.8403	1.012
5	0.25035	0.18657	0.36625	2.9681	12.039	12.058	6.0861	5.9529	5.9714	1.0031
6	0.50078	0.20989	0.40666	2.9681	12.054	12.066	6.0744	5.9793	5.9919	1.0021
7	1.0014	0.221	0.43601	2.9681	12.062	12.069	6.0732	5.9892	5.9954	1.001
8	2.0029	0.23433	0.46175	2.9681	12.064	12.07	6.0732	5.9903	5.9966	1.0011
9	3.0009	0.24543	0.47643	2.9681	12.067	12.07	6.0732	5.9941	5.9971	1.0005
10	4.003	0.24987	0.48694	2.9681	12.068	12.072	6.0715	5.9969	6.0001	1.0005
11	5.0008	0.25654	0.49497	2.9681	12.065	12.072	6.0721	5.9931	5.9995	1.0011
12	6.0028	0.26098	0.50162	2.9681	12.068	12.071	6.0709	5.997	6.0001	1.0005
13	7.0006	0.26764	0.50715	2.9681	12.065	12.071	6.0721	5.9925	5.9989	1.0011
14	8.0025	0.27209	0.51214	2.9681	12.065	12.072	6.0721	5.9931	5.9995	1.0011
15	9.0003	0.27542	0.51629	2.9681	12.068	12.072	6.0727	5.9958	5.9989	1.0005
16	10.002	0.27764	0.52016	2.9681	12.065	12.072	6.0721	5.9931	5.9995	1.0011
17	11	0.28097	0.52404	2.9681	12.068	12.072	6.0727	5.9958	5.9989	1.0005
18	12.002	0.28208	0.52709	2.9681	12.068	12.071	6.0709	5.997	6.0001	1.0005
19	13	0.28208	0.53013	2.9681	12.068	12.071	6.0727	5.9952	5.9983	1.0005
20	14.002	0.2843	0.53262	2.9681	12.068	12.072	6.0732	5.9952	5.9983	1.0005
21	15.004	0.28541	0.53567	2.9681	12.068	12.072	6.0715	5.9969	6.0001	1.0005
22	16.002	0.28652	0.53816	2.9681	12.068	12.072	6.0727	5.9958	5.9989	1.0005
23	17.004	0.28874	0.54037	2.9681	12.068	12.072	6.0721	5.9963	5.9995	1.0005
24	18.001	0.29097	0.54231	2.9681	12.068	12.071	6.0709	5.997	6.0001	1.0005
25	19.003	0.29208	0.5448	2.9681	12.068	12.072	6.0715	5.9969	6.0001	1.0005
26	20.001	0.29319	0.54646	2.9681	12.068	12.072	6.0732	5.9952	5.9983	1.0005
27	21.003	0.2943	0.54868	2.9681	12.068	12.072	6.0721	5.9963	5.9995	1.0005
28	22.001	0.29541	0.55034	2.9681	12.068	12.072	6.0709	5.9975	6.0007	1.0005
29	23.003	0.29541	0.552	2.9681	12.065	12.071	6.0721	5.9925	5.9989	1.0011
30	24.001	0.29541	0.55394	2.9681	12.065	12.072	6.0721	5.9931	5.9995	1.0011
31	25.002	0.29652	0.55505	2.9681	12.068	12.072	6.0721	5.9963	5.9995	1.0005
32	26	0.29541	0.55698	2.9681	12.068	12.072	6.0715	5.9969	6.0001	1.0005
33	27.002	0.29763	0.55837	2.9681	12.065	12.072	6.0721	5.9931	5.9995	1.0011
34	28.004	0.29985	0.55975	2.9681	12.068	12.072	6.0721	5.9963	5.9995	1.0005
35	29.002	0.30207	0.56086	2.9681	12.068	12.072	6.0721	5.9963	5.9995	1.0005
36	30.004	0.30318	0.5628	2.9681	12.068	12.071	6.0697	5.9981	6.0012	1.0005
37	31.002	0.30318	0.5639	2.9681	12.068	12.072	6.0715	5.9969	6.0001	1.0005
38	32.004	0.30429	0.56529	2.9681	12.068	12.072	6.0721	5.9963	5.9995	1.0005
39	33.001	0.30429	0.5664	2.9681	12.068	12.072	6.0715	5.9969	6.0001	1.0005
40	34.003	0.30429	0.56778	2.9681	12.068	12.072	6.0715	5.9969	6.0001	1.0005
41	35.001	0.30429	0.56889	2.9681	12.068	12.072	6.0721	5.9963	5.9995	1.0005
42	36.003	0.30429	0.57027	2.9681	12.068	12.071	6.0709	5.997	6.0001	1.0005
43	36.049	0.30429	0.56999	2.9681	12.065	12.072	6.0715	5.9937	6.0001	1.0011

Permeability Test Data

Project: Polymet #23/69-862-023B Date: 10/8/2007

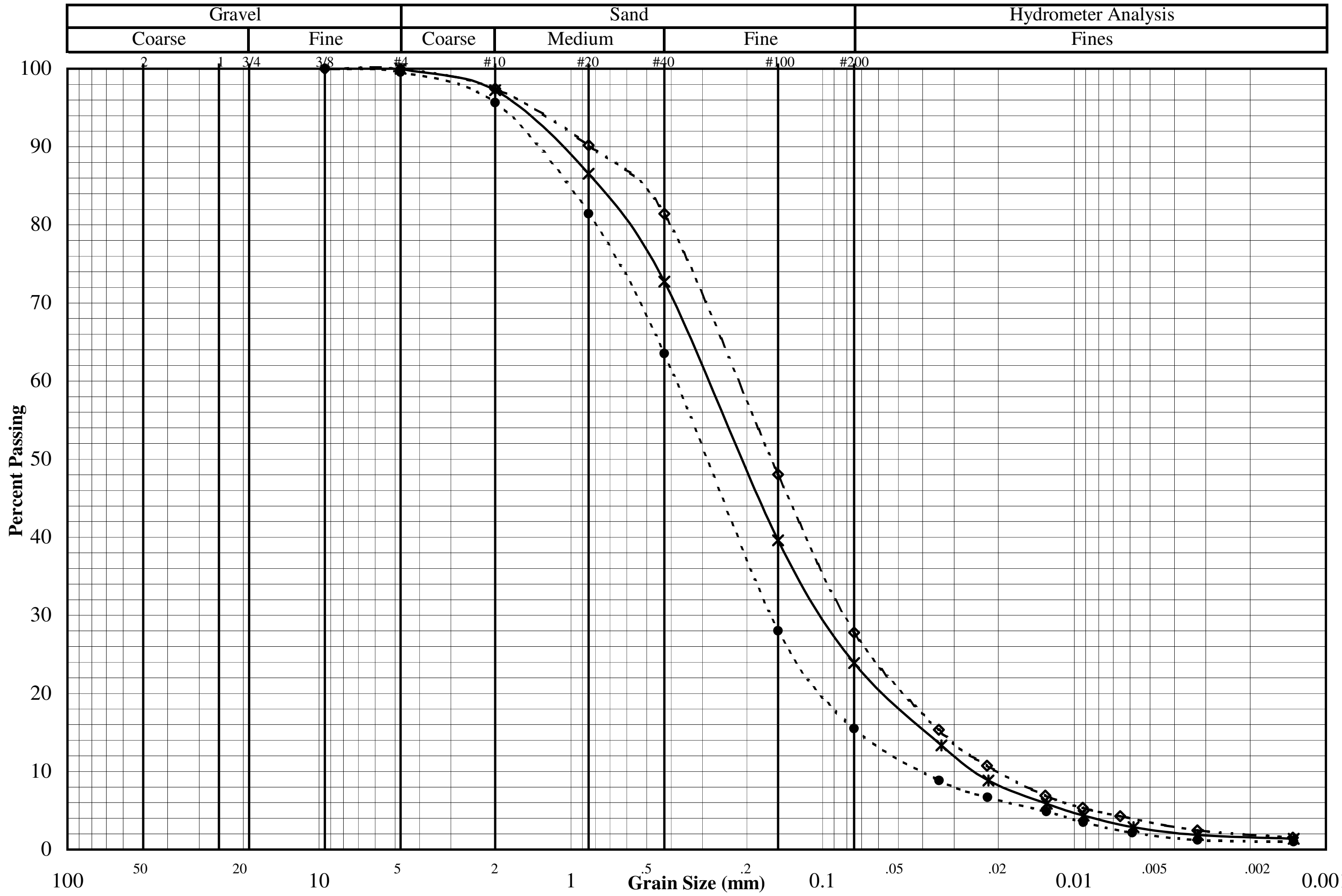
Reported To: Barr Engineering Company Job No.: 6251

Blend:	1:1	3:1	1:2	1:4			
Sample No.:	Mix #1	Mix #2	Mix #3	Mix #4			
Lift							
Blend:	5 Coarse Tailings: 4 Fine Tailings: 1 Slimes	15 Coarse Tailings: 4 Fine Tailings: 1 Slimes	5 Coarse Tailings: 8 Fine Tailings:2 Slimes	2.5Coarse Tailings: 8 Fine Tailings: 2 Slimes			
Sample Type:	Bulk - Blend	Bulk - Blend	Bulk - Blend	Bulk - Blend			
Soil Type:	Tailings Blend Silty Sand (SM)	Tailings Blend Silty Sand (SM)	Tailings Blend Silty Sand (SM)	Tailings Blend Silty Sand (SM)			
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:	0.36	0.34	0.317	0.355			
Ht. (in):	3.00	3.00	3.00	3.00			
Dia. (in):	2.85	2.85	2.85	2.85			
Dry Density (pcf):	117.0	118.9	114.3	107.8			
Water Content:	11.1%	11.7%	12.5%	14.1%			
Test Type:	Constant	Constant	Falling	Falling			
Max Head (ft):	1.4	1.4	2.5	2.5			
Confining press. (Effective-psi):	41.7	41.7	41.7	41.7			
Trial No.:	7-11	7-11	6-10	11-15			
Water Temp °C:	23.0	23.0	23.0	21.0			
% Compaction	94.8%	95.3%	95.0%	94.5%			
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**8.5×10^{-5}**	**7.0×10^{-5}**	**6.4×10^{-5}**	**1.0×10^{-4}**			
K @ 20 °C (ft/min)	**1.7×10^{-4}**	**1.4×10^{-4}**	**1.3×10^{-4}**	**2.0×10^{-4}**			
Notes:							

Grain Size Distribution ASTM D422

Project:	Polymet #23/69-862-023B	Job No. :	6251
		Test Date:	9/27/07
Reported To:	Barr Engineering Company	Report Date:	10/3/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	1:1 - 5CT:4FT:1Slimes	Mix #1		Bulk	Silty Sand (SM)
●	3:1 - 15CT:4FT:1Slimes	Mix #2		Bulk	Silty Sand (SM)
◇	1:2 - 5CT:8FT:2Slimes	Mix #3		Bulk	Silty Sand (SM)



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.91	2.88	2.92
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	124.6	176.5	561.8
2"			
1.5"			
1"			
3/4"			
3/8"		100.0	100.0
#4	100.0	99.6	100.0
#10	97.2	95.6	97.5
#20	86.5	81.4	90.2
#40	72.7	63.5	81.4
#100	39.6	28.0	48.0
#200	23.9	15.5	27.8

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9301 Bryant Ave. South, Suite 107

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6251**

Project:	Polymet #23/69-862-023B			Test Date:	9/27/07
Reported To:	Barr Engineering Company			Report Date:	10/3/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	1:1 - 5CT:4FT:1Slimes	Mix #1		Bulk	Silty Sand (SM)
Spec 2	3:1 - 15CT:4FT:1Slimes	Mix #2		Bulk	Silty Sand (SM)
Spec 3	1:2 - 5CT:8FT:2Slimes	Mix #3		Bulk	Silty Sand (SM)

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.034	13.3	0.034	8.8	0.035	15.4
0.022	8.9	0.022	6.7	0.022	10.7
0.013	5.9	0.013	4.9	0.013	6.9
0.009	4.4	0.009	3.5	0.009	5.4
0.006	2.9	0.006	2.1	0.007	4.3
0.003	1.9	0.003	1.2	0.003	2.4
0.001	1.4	0.001	1.0	0.001	1.5

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **9/27/07**

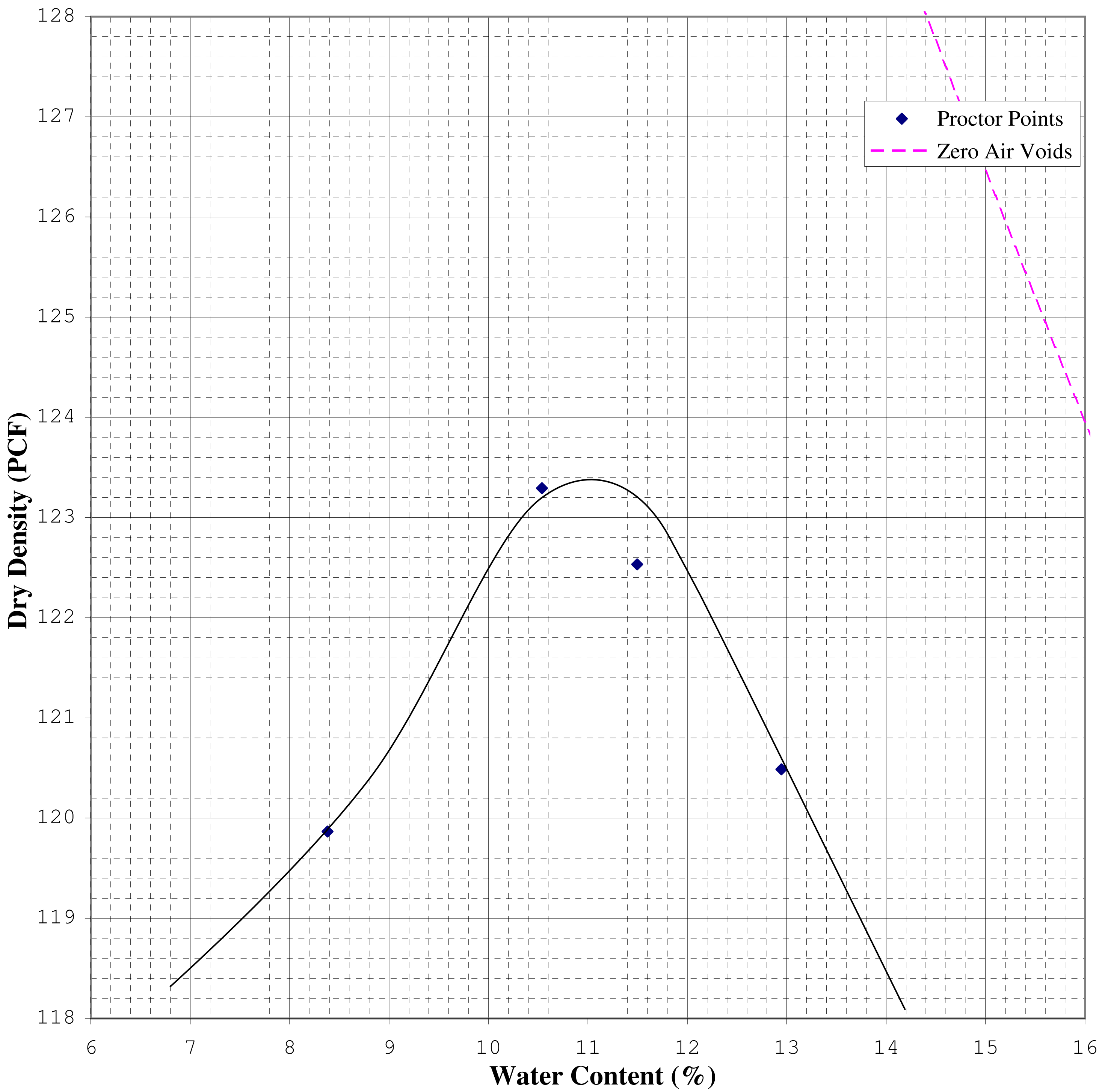
Client: **Barr Engineering Company** Job No. **6251**

Boring No. Sample: **Mix #1** Depth(ft): Location: **1:1 Blend - 5CT:FT:1Slimes**

Soil Type: **Tailings - Silty Sand (SM)**

As Received W.C. (%): LL: PL: PI: Specific Gravity: **2.91**

Maximum Dry Density (pcf): **123.4** Opt. Water Content (%): **11.1**



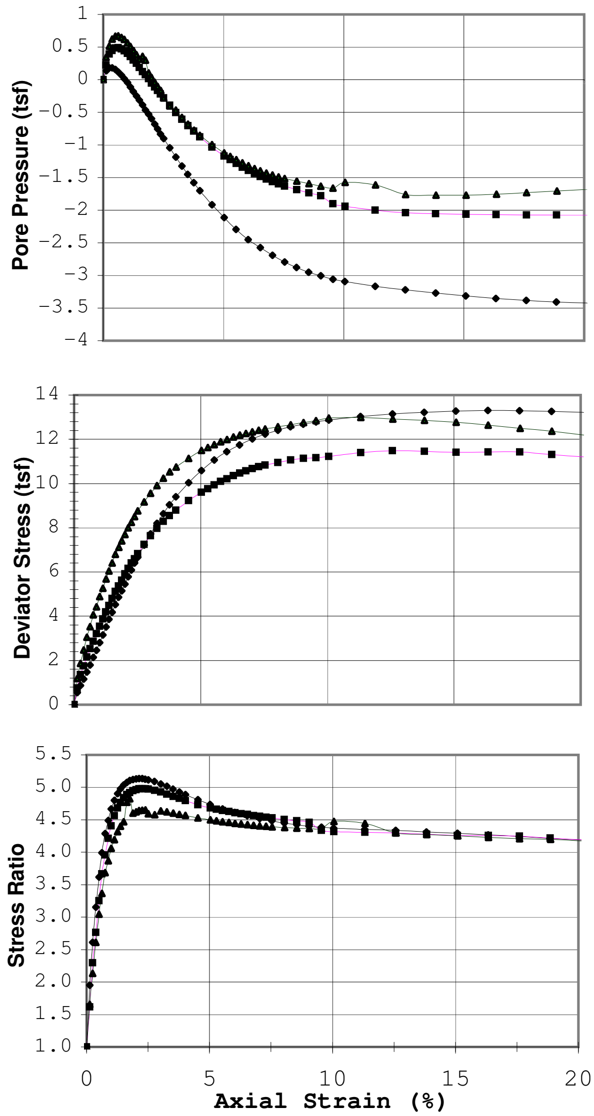
9301 Bryant Ave. South, Suite 107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

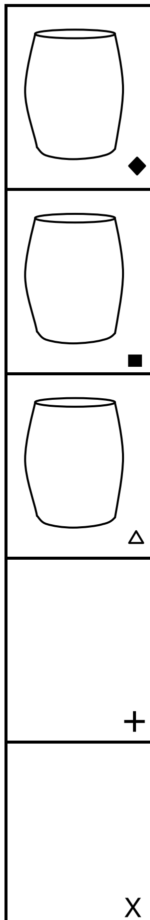
SET-R18a

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/2/07**

Project: **Polymet #23/69-862-023B**
Boring #: Sample #: **Mix #1** Type: **Bulk** Depth (ft):
Soil Type: **Blend 1:1 (Silty Sand (SM))**





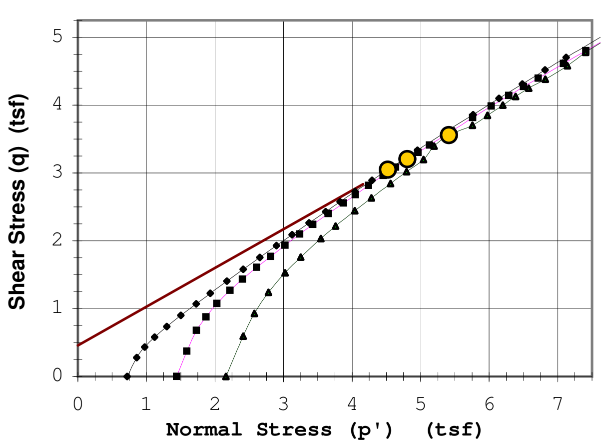
Failure Criterion: **Max. Stress Ratio**
Angle of internal friction, φ' = **34.9 °**
Apparent Cohesion, c' = **0.56 (tsf)**

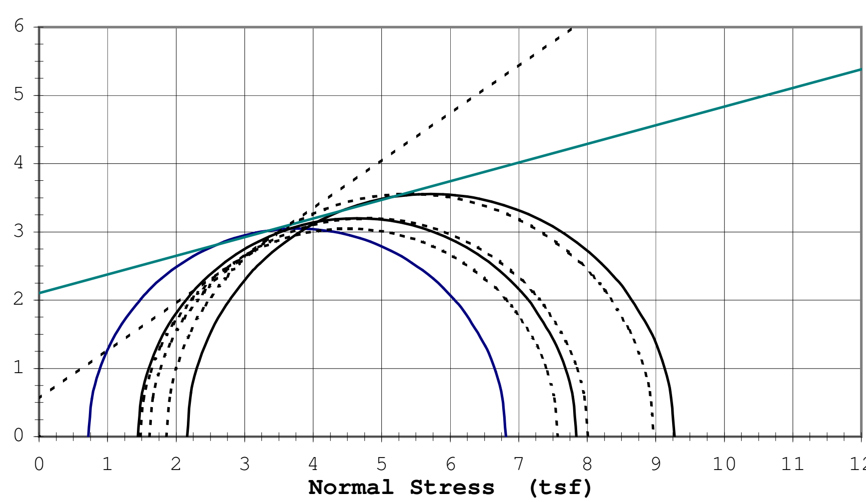
Test Date:	9/26/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity :	2.91

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	11.1	11.2	10.8		
Dry Density (pcf)	117.2	116.3	116.7		
Void Ratio	0.55	0.56	0.56		
After Consolidation					
Diameter (in)	1.94	1.93	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	18.4	18.7	18.4		
Dry Density (pcf)	118.3	117.7	118.4		
Void Ratio	0.54	0.54	0.53		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	13.31	11.48	12.99		
Ultimate Deviator Stress (tsf)	12.31	10.57	10.71		
Deviator Stress at Failure (tsf)	6.10	6.40	7.11		
Max. Pore Pressure Buildup (tsf)	0.18	0.49	0.67		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	2.3	2.3	1.8		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 29.8 °	a = 0.5 (tsf)

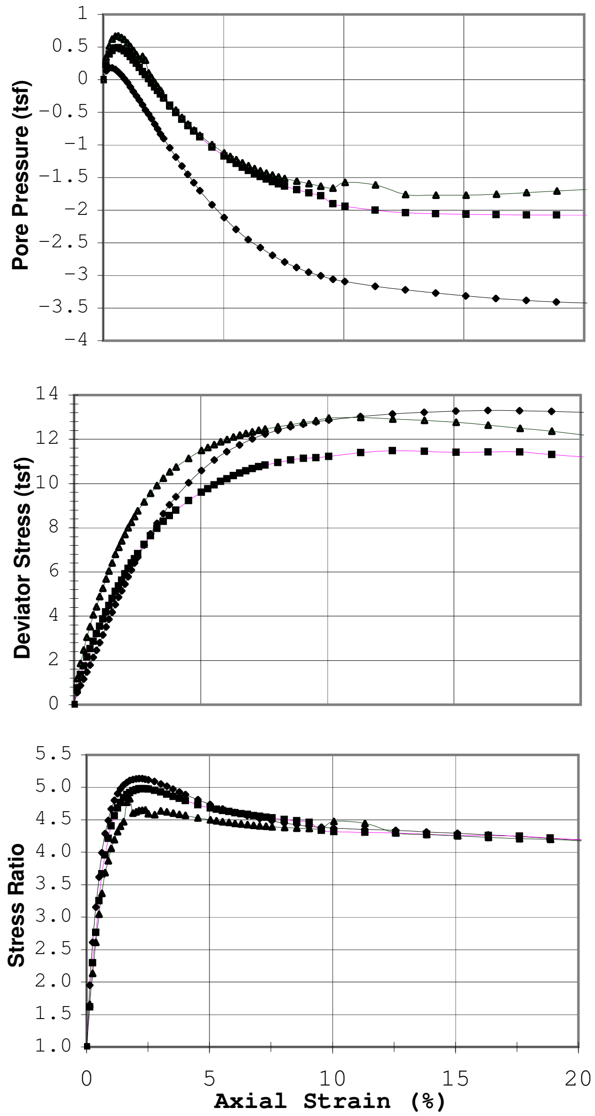
------------	Effective φ':	34.9 °	c'=	0.56 (tsf)
________	Total φ':	15.3 °	c=	2.10 (tsf)

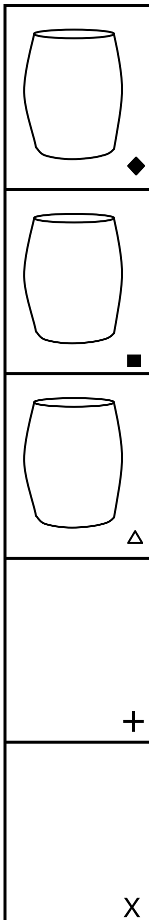
9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/2/07**

Project: **Polymet #23/69-862-023B**
Boring #: Sample #: **Mix #1** Type: **Bulk** Depth (ft):
Soil Type: **Blend 1:1 (Silty Sand (SM))**

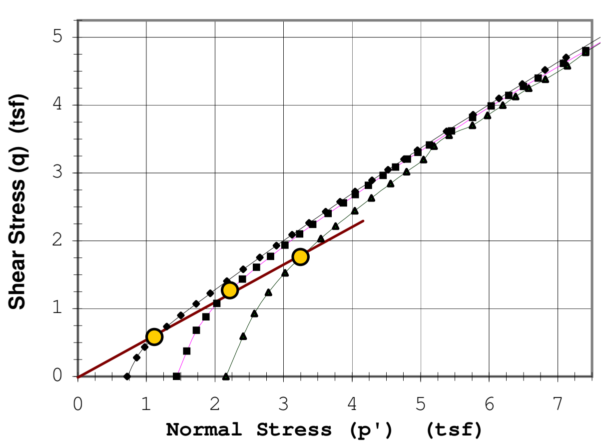


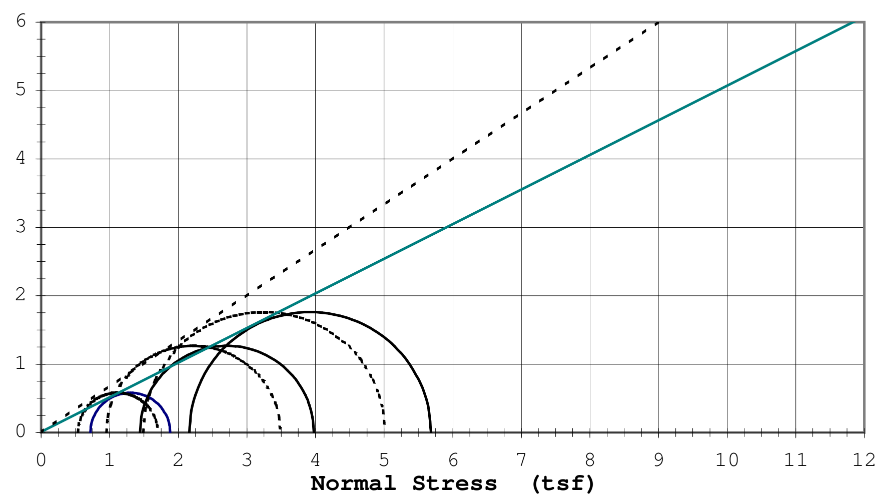


Failure Criterion:	**Max. Pore Pressure**				
Angle of internal friction, ϕ' =	**33.7 °**				
Apparent Cohesion, c' =	**0.00 (tsf)**				
Test Date:	9/26/07	Liquid Limit:			
Test Type:	CU w/pp	Plastic Limit:			
Strain Rate (in/min):	0.004	Plasticity Index:			
Strain Rate (%/min):	0.101	Spec. Gravity :	2.91		
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	11.1	11.2	10.8		
Dry Density (pcf)	117.2	116.3	116.7		
Void Ratio	0.55	0.56	0.56		
After Consolidation					
Diameter (in)	1.94	1.93	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	18.4	18.7	18.4		
Dry Density (pcf)	118.3	117.7	118.4		
Void Ratio	0.54	0.54	0.53		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	13.31	11.48	12.99		
Ultimate Deviator Stress (tsf)	12.31	10.57	10.71		
Deviator Stress at Failure (tsf)	1.16	2.54	3.52		
Max. Pore Pressure Buildup (tsf)	0.18	0.49	0.67		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	0.4	0.6	0.6		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





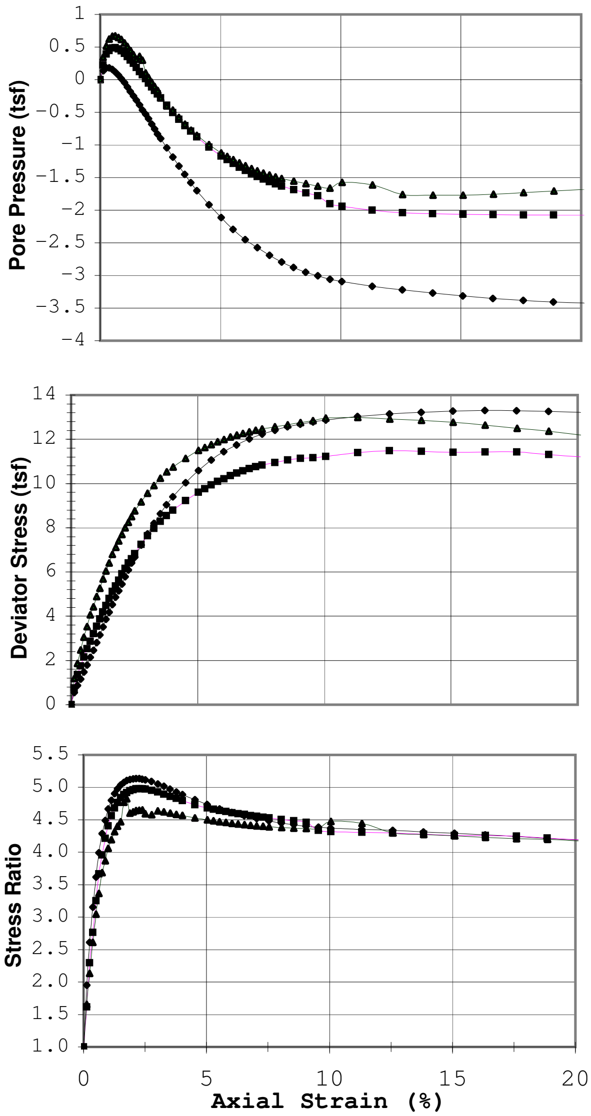
Rupture Envelope at Failure	
α = 29.0 °	a = 0.0 (tsf)

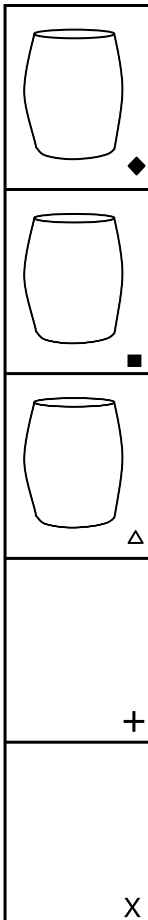
------------	Effective ϕ':	33.7 °	c'=	0.00 (tsf)
________	Total ϕ':	26.8 °	c=	0.01 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/2/07**

Project: **Polymet #23/69-862-023B**
Boring #: Sample #: **Mix #1** Type: **Bulk** Depth (ft):
Soil Type: **Blend 1:1 (Silty Sand (SM))**



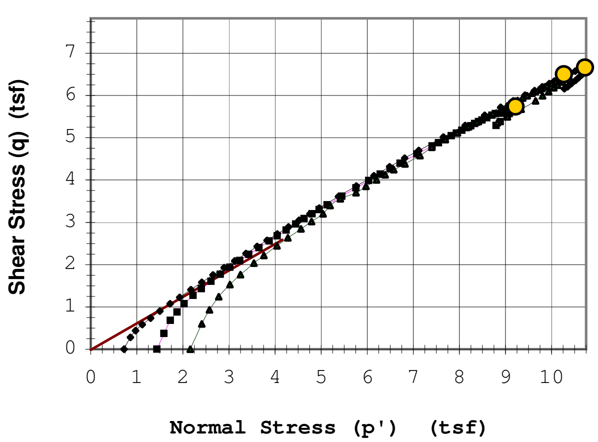


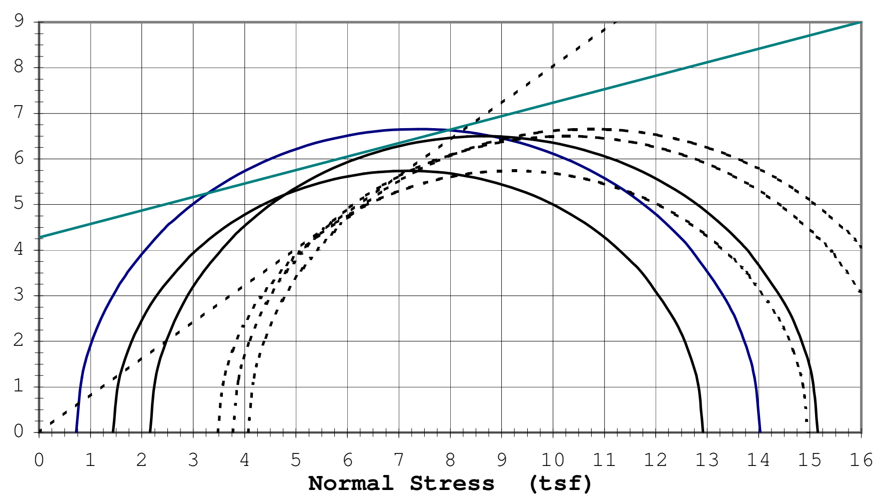
Failure Criterion:	Max. Deviator Stress				
Angle of internal friction, ϕ' =	38.8 °				
Apparent Cohesion, c' =	0.00 (tsf)				
Test Date:	9/26/07	Liquid Limit:			
Test Type:	CU w/pp	Plastic Limit:			
Strain Rate (in/min):	0.004	Plasticity Index:			
Strain Rate (%/min):	0.101	Spec. Gravity :	2.91		

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	11.1	11.2	10.8		
Dry Density (pcf)	117.2	116.3	116.7		
Void Ratio	0.55	0.56	0.56		
After Consolidation					
Diameter (in)	1.94	1.93	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	18.4	18.7	18.4		
Dry Density (pcf)	118.3	117.7	118.4		
Void Ratio	0.54	0.54	0.53		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	13.31	11.48	12.99		
Ultimate Deviator Stress (tsf)	12.31	10.57	10.71		
Deviator Stress at Failure (tsf)	13.31	11.48	12.99		
Max. Pore Pressure Buildup (tsf)	0.18	0.49	0.67		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	16.3	12.6	11.3		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





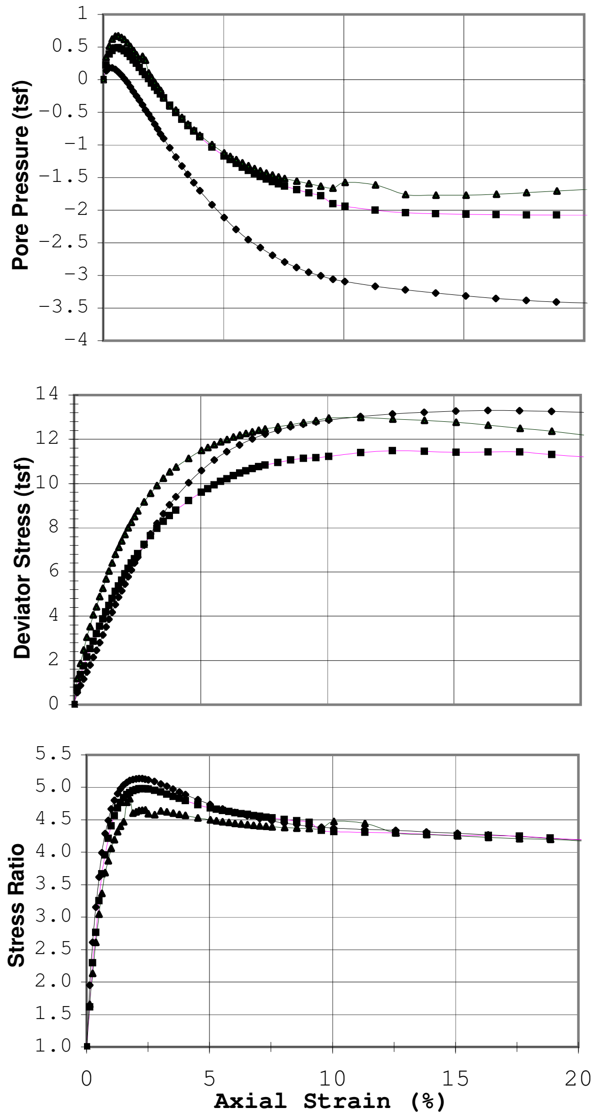
Rupture Envelope at Failure	
α = 32.1 °	a = 0.0 (tsf)

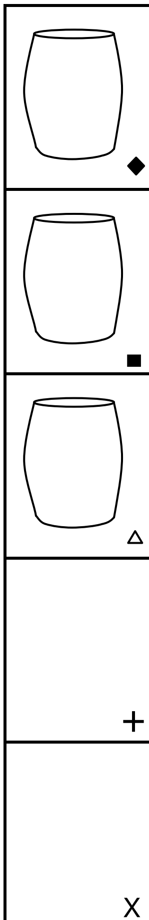
------------	Effective ϕ':	38.8 °	c'=	0.00 (tsf)
________	Total ϕ':	16.5 °	c=	4.28 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/2/07**

Project: **Polymet #23/69-862-023B**
Boring #: Sample #: **Mix #1** Type: **Bulk** Depth (ft):
Soil Type: **Blend 1:1 (Silty Sand (SM))**





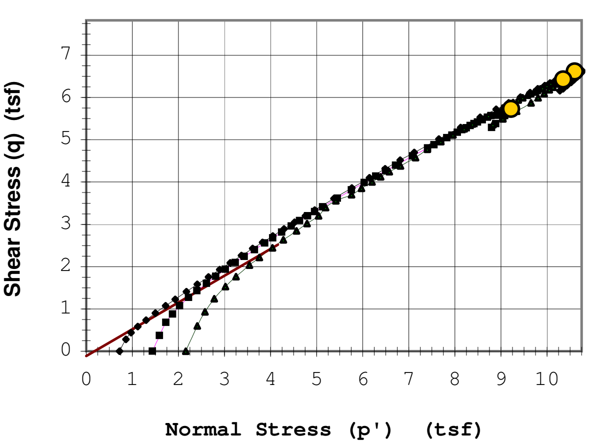
Failure Criterion:	Given Strain of: 15%
Angle of internal friction, ϕ' =	39.3 °
Apparent Cohesion, c' =	0.00 (tsf)

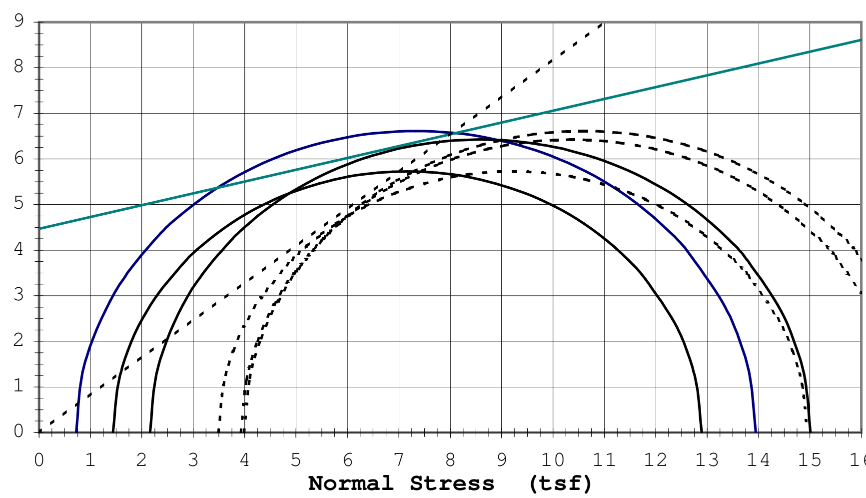
Test Date:	9/26/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity :	2.91

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	11.1	11.2	10.8		
Dry Density (pcf)	117.2	116.3	116.7		
Void Ratio	0.55	0.56	0.56		
After Consolidation					
Diameter (in)	1.94	1.93	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	18.4	18.7	18.4		
Dry Density (pcf)	118.3	117.7	118.4		
Void Ratio	0.54	0.54	0.53		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	13.31	11.48	12.99		
Ultimate Deviator Stress (tsf)	12.31	10.57	10.71		
Deviator Stress at Failure (tsf)	13.23	11.45	12.85		
Max. Pore Pressure Buildup (tsf)	0.18	0.49	0.67		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 32.3 °	a = -0.1 (tsf)

------------	Effective ϕ':	39.3 °	c'=	0.00 (tsf)
________	Total ϕ':	14.5 °	c=	4.47 (tsf)

9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

Mix 1 Job: 6251

10 psi			20 psi			30 psi								
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
0.13	0.55	0.14	0.13	0.75	0.22	0.13	1.19	0.34						
0.25	0.87	0.18	0.25	1.36	0.39	0.25	1.86	0.52						
0.38	1.16	0.18	0.38	1.76	0.45	0.38	2.48	0.62						
0.50	1.47	0.16	0.50	2.15	0.49	0.50	3.05	0.67						
0.63	1.80	0.12	0.63	2.54	0.49	0.63	3.52	0.67						
0.75	2.14	0.07	0.75	2.86	0.47	0.75	4.06	0.65						
0.88	2.45	0.02	0.88	3.22	0.44	0.88	4.43	0.62						
1.01	2.81	-0.05	1.01	3.54	0.40	1.01	4.89	0.56						
1.13	3.16	-0.11	1.13	3.87	0.35	1.13	5.27	0.51						
1.26	3.51	-0.18	1.26	4.19	0.30	1.26	5.69	0.44						
1.38	3.86	-0.25	1.38	4.48	0.25	1.38	6.04	0.38						
1.51	4.18	-0.31	1.51	4.80	0.19	1.51	6.40	0.32						
1.63	4.52	-0.39	1.63	5.12	0.12	1.63	6.79	0.36						
1.76	4.86	-0.46	1.76	5.36	0.07	1.76	7.11	0.30						
1.89	5.15	-0.53	1.89	5.63	0.01	1.89	7.40	0.11						
2.01	5.45	-0.60	2.01	5.92	-0.05	2.01	7.70	0.04						
2.14	5.78	-0.68	2.14	6.17	-0.11	2.14	8.00	-0.04						
2.26	6.10	-0.75	2.26	6.40	-0.17	2.26	8.25	-0.10						
2.39	6.41	-0.83	2.39	6.60	-0.22	2.39	8.50	-0.17						
2.51	6.67	-0.90	2.51	6.82	-0.28	2.52	8.76	-0.28						
2.76	7.22	-1.05	2.77	7.24	-0.39	2.77	9.16	-0.40						
3.02	7.72	-1.18	3.02	7.63	-0.50	3.02	9.56	-0.47						
3.27	8.20	-1.32	3.27	7.97	-0.61	3.27	9.91	-0.58						
3.52	8.63	-1.45	3.52	8.28	-0.70	3.52	10.23	-0.68						
3.77	9.03	-1.58	3.77	8.54	-0.79	3.77	10.53	-0.78						
4.02	9.40	-1.70	4.02	8.79	-0.88	4.02	10.74	-0.85						
4.52	10.04	-1.92	4.53	9.23	-1.03	4.53	11.14	-1.00						
5.03	10.58	-2.11	5.03	9.61	-1.17	5.03	11.50	-1.12						
5.53	11.07	-2.30	5.28	9.76	-1.23	5.28	11.63	-1.18						
6.03	11.45	-2.45	5.53	9.94	-1.29	5.53	11.75	-1.23						
6.53	11.74	-2.58	5.79	10.09	-1.34	5.78	11.89	-1.27						
7.04	12.01	-2.69	6.04	10.21	-1.39	6.04	11.99	-1.32						
7.54	12.23	-2.79	6.29	10.35	-1.44	6.29	12.10	-1.36						
8.04	12.41	-2.88	6.54	10.47	-1.48	6.54	12.19	-1.40						
8.54	12.57	-2.95	6.79	10.57	-1.52	6.79	12.26	-1.43						
9.05	12.68	-3.01	7.04	10.67	-1.56	7.04	12.34	-1.46						
9.55	12.79	-3.06	7.29	10.76	-1.60	7.29	12.40	-1.49						
10.05	12.86	-3.09	7.55	10.84	-1.63	7.55	12.46	-1.51						
11.31	13.03	-3.17	8.05	10.95	-1.69	8.05	12.57	-1.56						
12.56	13.15	-3.22	8.55	11.06	-1.74	8.55	12.66	-1.59						
13.82	13.23	-3.27	9.05	11.14	-1.78	9.05	12.76	-1.63						
15.08	13.28	-3.32	9.56	11.16	-1.90	9.56	12.85	-1.66						
16.33	13.31	-3.35	10.06	11.22	-1.94	10.06	12.96	-1.57						
17.59	13.29	-3.38	11.32	11.39	-2.00	11.32	12.99	-1.61						
18.85	13.26	-3.41	12.57	11.48	-2.04	12.58	12.91	-1.76						
20.10	13.22	-3.42	13.83	11.45	-2.05	13.83	12.85	-1.77						
21.36	13.17	-3.44	15.09	11.42	-2.06	15.09	12.77	-1.77						
22.62	13.07	-3.45	16.34	11.42	-2.07	16.35	12.64	-1.76						
23.87	12.96	-3.45	17.60	11.42	-2.08	17.61	12.49	-1.73						
25.13	12.83	-3.45	18.86	11.32	-2.08	18.86	12.37	-1.71						
26.39	12.71	-3.44	20.12	11.22	-2.07	20.12	12.19	-1.68						
27.64	12.56	-3.43	21.37	11.14	-2.07	21.38	11.99	-1.66						
28.90	12.41	-3.42	22.63	11.06	-2.07	22.64	11.74	-1.62						
30.02	12.31	-3.40	25.14	10.76	-2.07	25.15	11.35	-1.51						
			26.76	10.57	-2.07	27.67	10.98	-1.39						
						30.00	10.71	-1.31						

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **9/27/07**

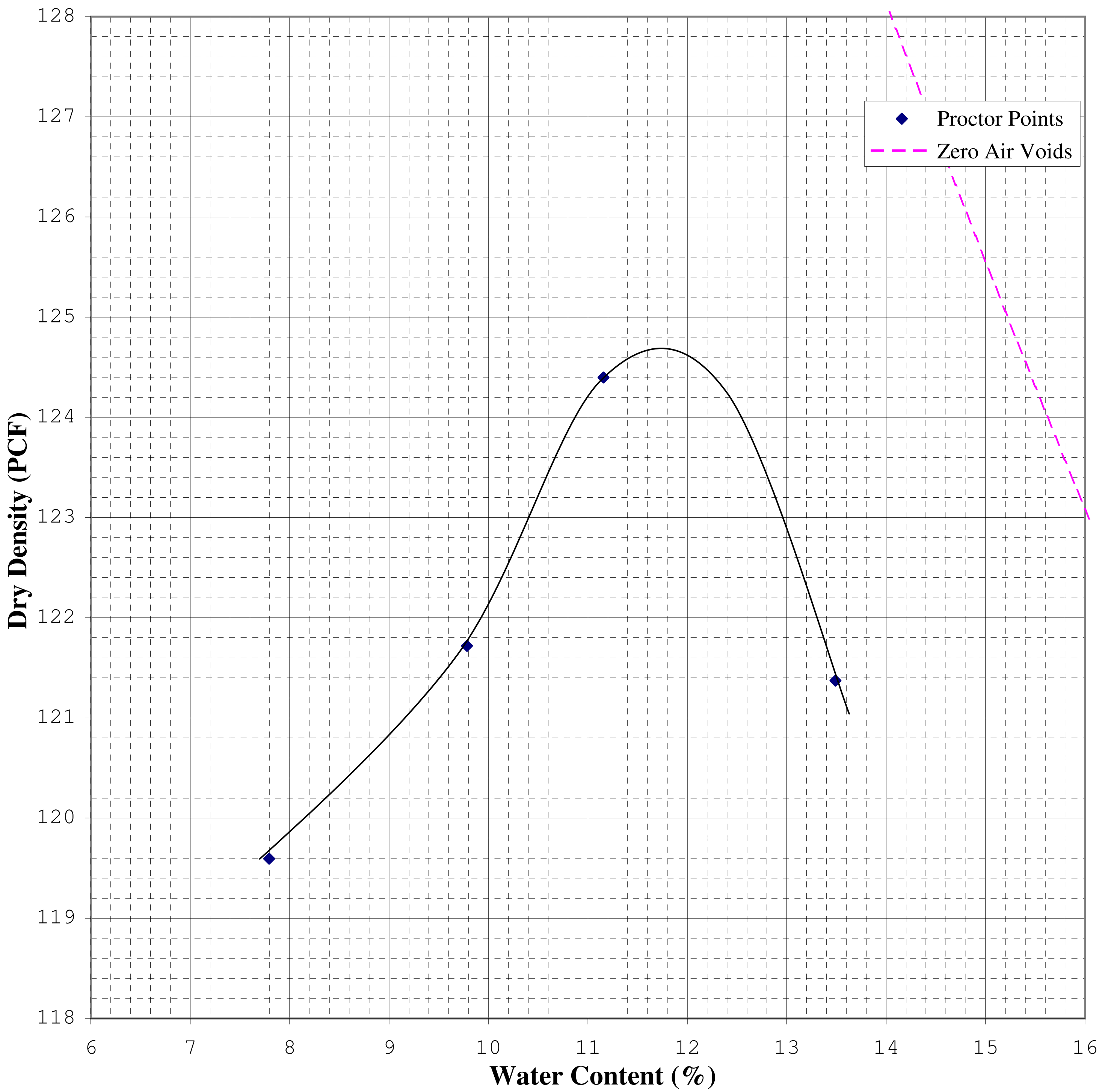
Client: **Barr Engineering Company** Job No. **6251**

Boring No. Sample: **Mix #2** Depth(ft): Location: **3:1 Blend - 15CT:4FT:1Slimes**

Soil Type: **Tailings - Silty Sand (SM)**

As Received W.C. (%): LL: PL: PI: Specific Gravity: **2.88**

Maximum Dry Density (pcf): **124.7** Opt. Water Content (%): **11.7**



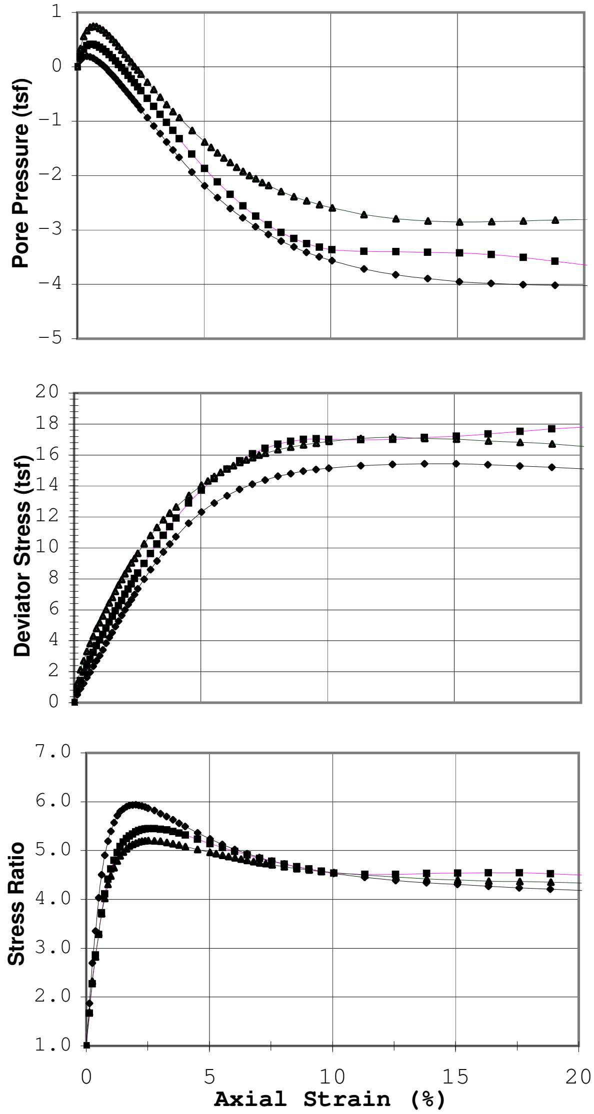
9301 Bryant Ave. South, Suite 107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

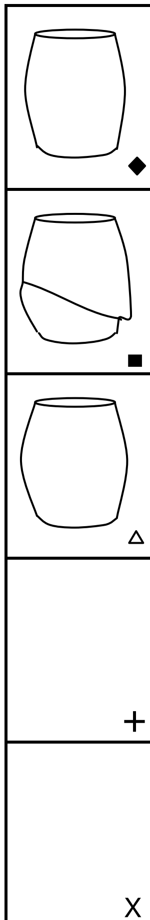
SET-R18a

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/5/07**

Project: **Polymet #23/69-862-023B**
Boring #: Sample #: **Mix #2** Type: **Bulk** Depth (ft):
Soil Type: **Blend 3:1 (Silty Sand (SM))**





Failure Criterion: **Max. Stress Ratio**

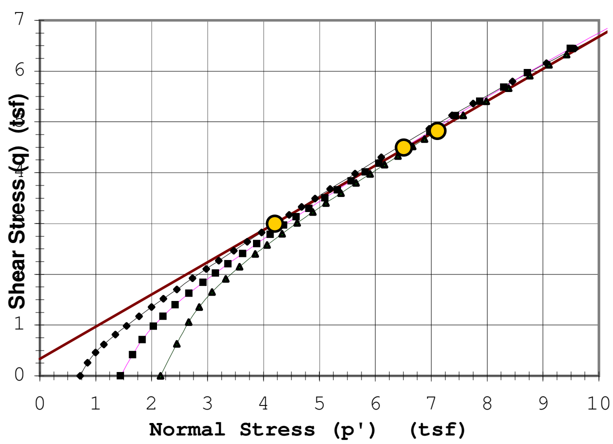
Angle of internal friction, ϕ' = **39.4 °**
Apparent Cohesion, c' = **0.43 (tsf)**

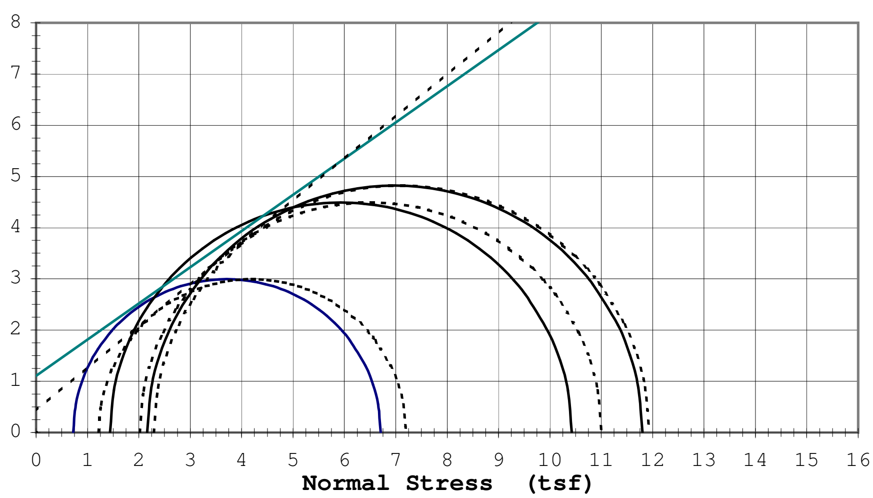
Test Date:	10/1/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity :	2.88

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	10.7	12.3	11.6		
Dry Density (pcf)	119.4	118.6	118.3		
Void Ratio	0.51	0.52	0.52		
After Consolidation					
Diameter (in)	1.94	1.93	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	17.1	17.2	17.3		
Dry Density (pcf)	120.4	120.2	120.1		
Void Ratio	0.49	0.50	0.50		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	15.44	17.85	17.14		
Ultimate Deviator Stress (tsf)	13.96	17.24	14.97		
Deviator Stress at Failure (tsf)	5.99	8.98	9.64		
Max. Pore Pressure Buildup (tsf)	0.19	0.41	0.75		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	2.0	2.8	2.5		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





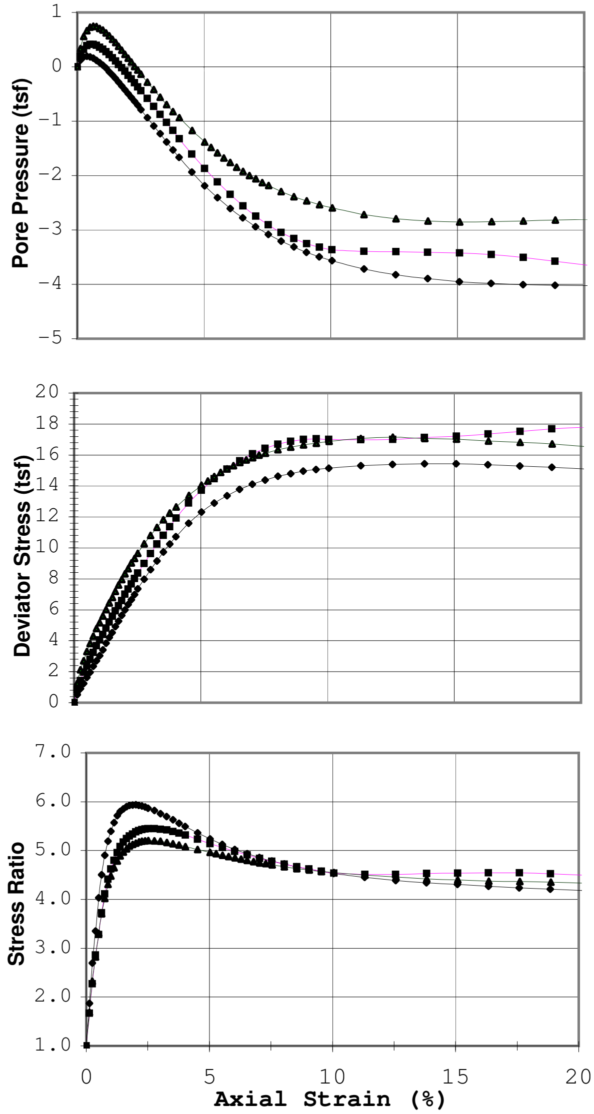
Rupture Envelope at Failure		
α = 32.4 °	a =	0.3 (tsf)

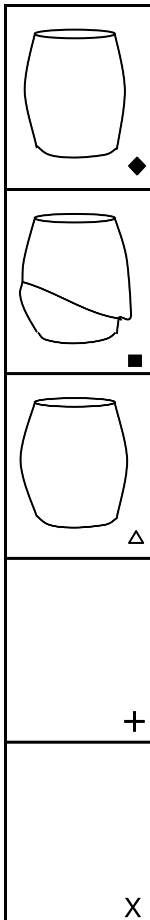
------------	Effective ϕ':	39.4 °	c'=	0.43 (tsf)
________	Total ϕ':	35.3 °	c=	1.11 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/5/07**

Project: **Polymet #23/69-862-023B**
Boring #: Sample #: **Mix #2** Type: **Bulk** Depth (ft):
Soil Type: **Blend 3:1 (Silty Sand (SM))**



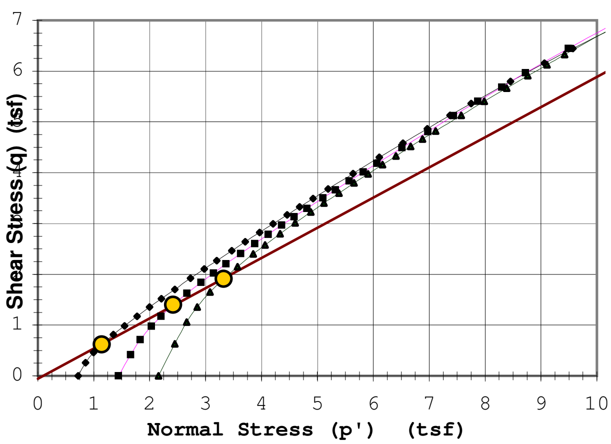


Failure Criterion:	**Max. Pore Pressure**				
Angle of internal friction, ϕ' =	**36.5 °**				
Apparent Cohesion, c' =	**0.00 (tsf)**				
Test Date: 10/1/07	Liquid Limit:				
Test Type: CU w/pp	Plastic Limit:				
Strain Rate (in/min): 0.004	Plasticity Index:				
Strain Rate (%/min): 0.101	Spec. Gravity : 2.88				

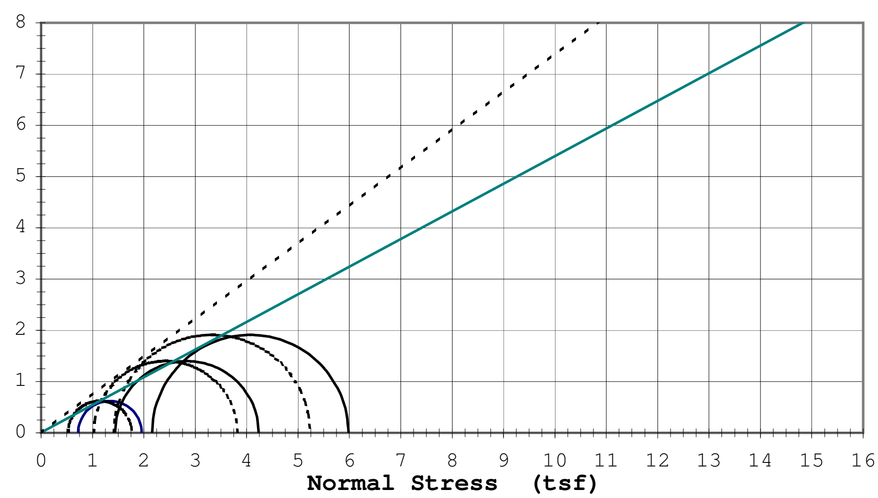
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	10.7	12.3	11.6		
Dry Density (pcf)	119.4	118.6	118.3		
Void Ratio	0.51	0.52	0.52		
After Consolidation					
Diameter (in)	1.94	1.93	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	17.1	17.2	17.3		
Dry Density (pcf)	120.4	120.2	120.1		
Void Ratio	0.49	0.50	0.50		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	15.44	17.85	17.14		
Ultimate Deviator Stress (tsf)	13.96	17.24	14.97		
Deviator Stress at Failure (tsf)	1.24	2.80	3.82		
Max. Pore Pressure Buildup (tsf)	0.19	0.41	0.75		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	0.4	0.6	0.6		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



Rupture Envelope at Failure	
α = 30.7 °	a = -0.1 (tsf)

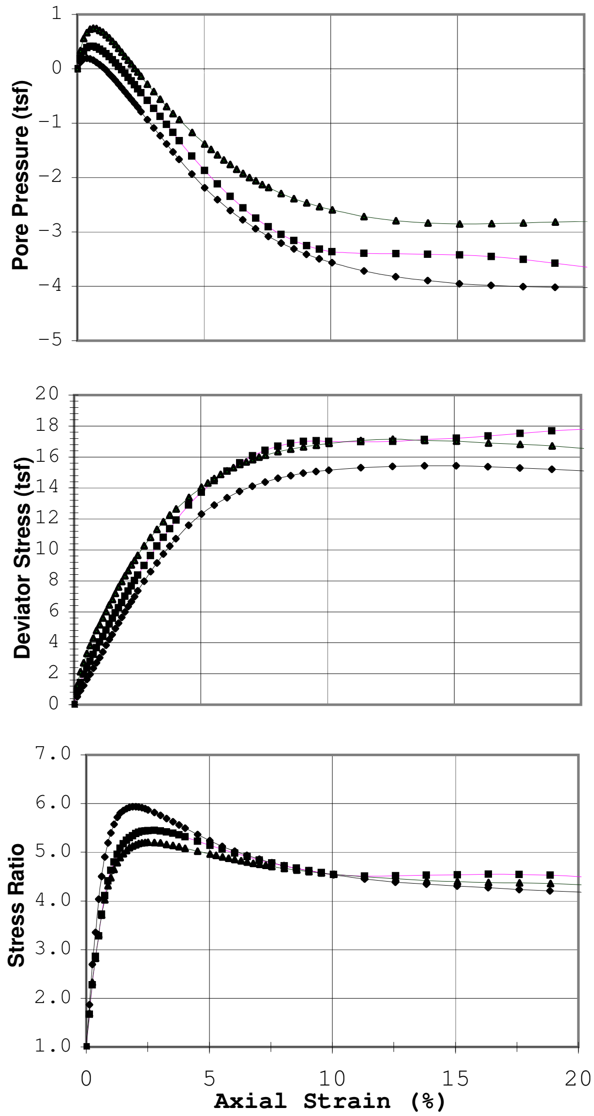


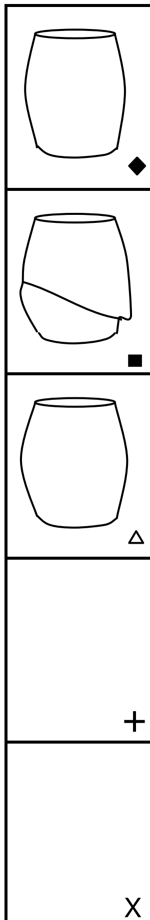
------------	Effective ϕ':	36.5 °	c'=	0.00 (tsf)
________	Total ϕ':	28.3 °	c=	0.01 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/5/07**

Project: **Polymet #23/69-862-023B**
Boring #: Sample #: **Mix #2** Type: **Bulk** Depth (ft):
Soil Type: **Blend 3:1 (Silty Sand (SM))**





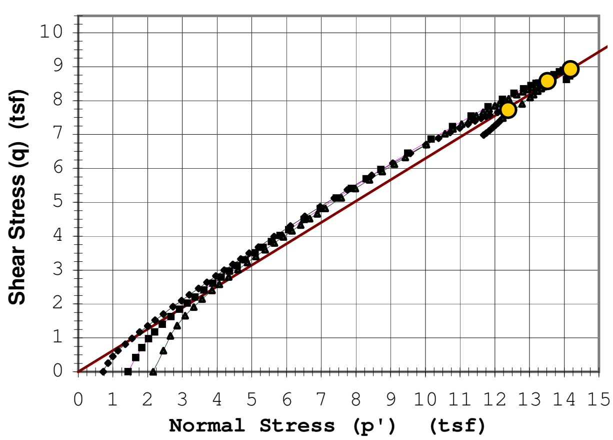
Failure Criterion:	Max. Deviator Stress
Angle of internal friction, ϕ' =	**39.0 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

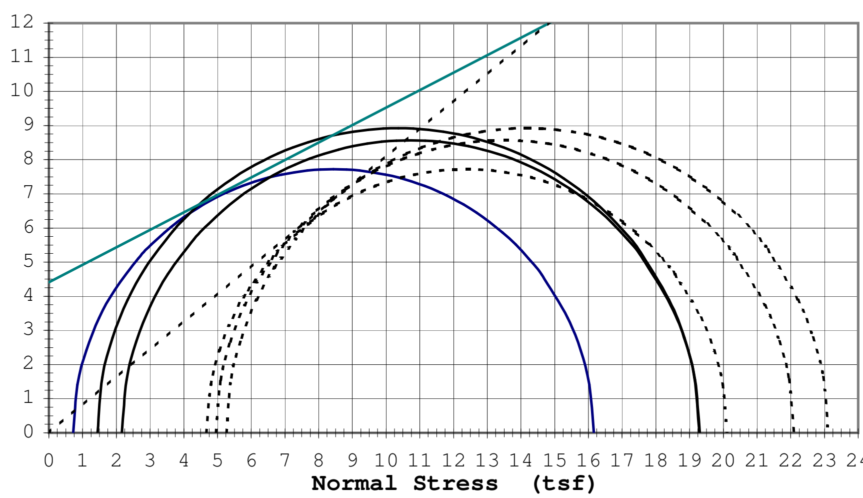
Test Date:	10/1/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity :	2.88

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	10.7	12.3	11.6		
Dry Density (pcf)	119.4	118.6	118.3		
Void Ratio	0.51	0.52	0.52		
After Consolidation					
Diameter (in)	1.94	1.93	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	17.1	17.2	17.3		
Dry Density (pcf)	120.4	120.2	120.1		
Void Ratio	0.49	0.50	0.50		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	15.44	17.85	17.14		
Ultimate Deviator Stress (tsf)	13.96	17.24	14.97		
Deviator Stress at Failure (tsf)	15.44	17.85	17.14		
Max. Pore Pressure Buildup (tsf)	0.19	0.41	0.75		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	15.1	23.9	12.6		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 32.2 °	a = 0.0 (tsf)

------------	Effective ϕ':	39.0 °	c'=	0.00 (tsf)
________	Total ϕ':	27.1 °	c=	4.41 (tsf)

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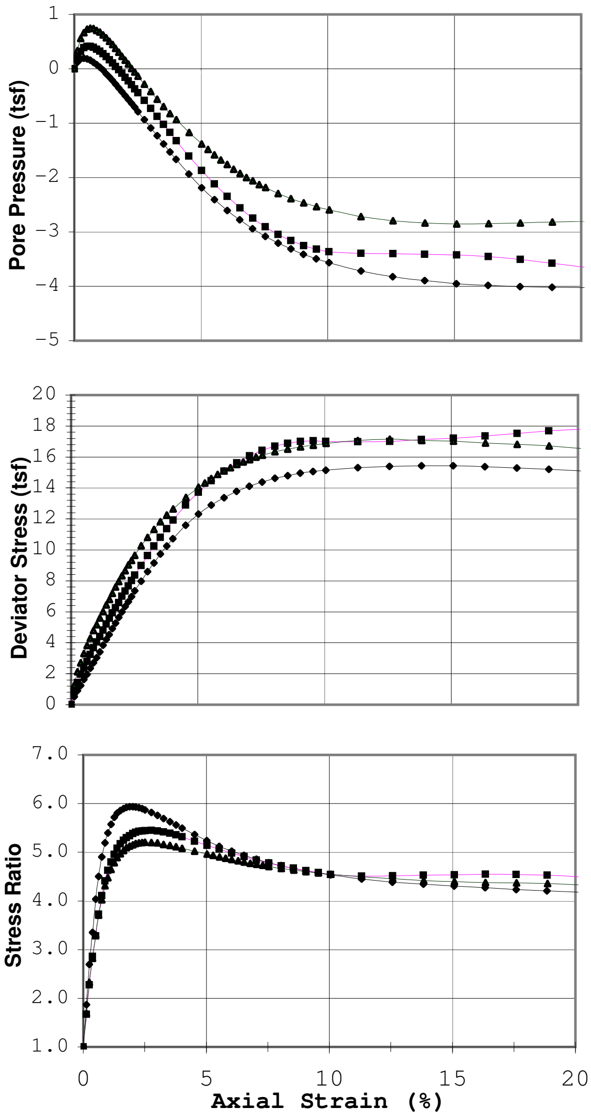
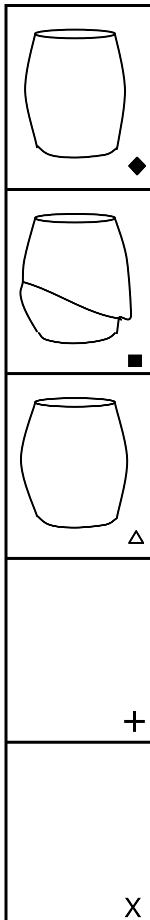
TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/5/07**

Project: **Polymet #23/69-862-023B**
Boring #: Sample #: **Mix #2** Type: **Bulk** Depth (ft):
Soil Type: **Blend 3:1 (Silty Sand (SM))**

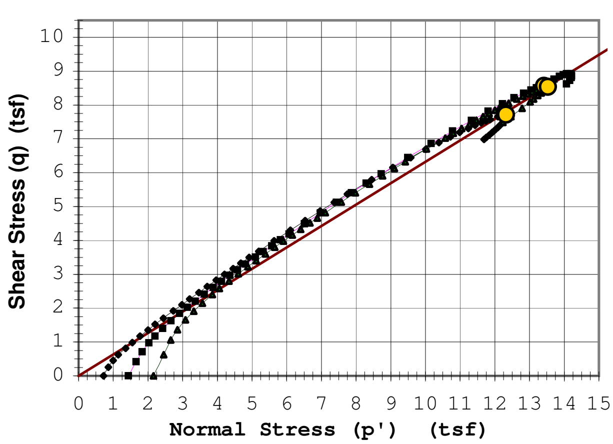


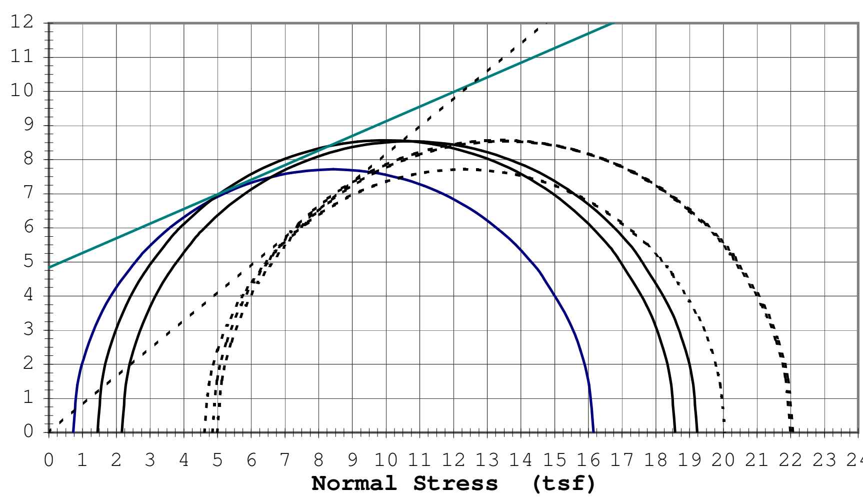


Failure Criterion:	**Given Strain of: 15%**				
Angle of internal friction, φ' =	**39.2 °**				
Apparent Cohesion, c' =	**0.00 (tsf)**				
Test Date: 10/1/07	Liquid Limit:				
Test Type: CU w/pp	Plastic Limit:				
Strain Rate (in/min): 0.004	Plasticity Index:				
Strain Rate (%/min): 0.101	Spec. Gravity : 2.88				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	10.7	12.3	11.6		
Dry Density (pcf)	119.4	118.6	118.3		
Void Ratio	0.51	0.52	0.52		
After Consolidation					
Diameter (in)	1.94	1.93	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	17.1	17.2	17.3		
Dry Density (pcf)	120.4	120.2	120.1		
Void Ratio	0.49	0.50	0.50		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	15.44	17.85	17.14		
Ultimate Deviator Stress (tsf)	13.96	17.24	14.97		
Deviator Stress at Failure (tsf)	15.43	17.13	17.07		
Max. Pore Pressure Buildup (tsf)	0.19	0.41	0.75		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure
α = 32.3 ° a = 0.0 (tsf)

------------	Effective φ':	39.2 °	c'=	0.00 (tsf)
________	Total φ':	23.2 °	c=	4.84 (tsf)

Mix #2 Job: 6251

10 psi			20 psi			30 psi								
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
0.13	0.52	0.12	0.13	0.83	0.20	0.13	1.25	0.33						
0.25	0.92	0.18	0.25	1.43	0.32	0.25	2.12	0.56						
0.38	1.24	0.19	0.38	1.96	0.39	0.38	2.71	0.67						
0.50	1.63	0.18	0.50	2.35	0.41	0.50	3.30	0.73						
0.63	1.97	0.16	0.63	2.80	0.41	0.63	3.82	0.75						
0.75	2.35	0.12	0.76	3.25	0.40	0.75	4.30	0.74						
0.88	2.71	0.07	0.88	3.68	0.36	0.88	4.80	0.71						
1.01	3.04	0.03	1.01	4.05	0.32	1.01	5.16	0.68						
1.13	3.41	-0.03	1.13	4.41	0.28	1.13	5.60	0.62						
1.26	3.84	-0.09	1.26	4.82	0.22	1.26	6.02	0.57						
1.38	4.20	-0.16	1.38	5.21	0.16	1.38	6.45	0.50						
1.51	4.53	-0.21	1.51	5.57	0.10	1.51	6.81	0.44						
1.63	4.92	-0.28	1.63	5.93	0.04	1.63	7.20	0.38						
1.76	5.28	-0.35	1.76	6.26	-0.02	1.76	7.60	0.30						
1.88	5.65	-0.42	1.89	6.59	-0.08	1.89	7.96	0.23						
2.01	5.99	-0.49	2.01	7.01	-0.16	2.01	8.32	0.16						
2.14	6.34	-0.57	2.14	7.33	-0.22	2.14	8.66	0.09						
2.26	6.65	-0.63	2.26	7.67	-0.29	2.26	9.03	0.01						
2.39	6.99	-0.71	2.39	8.02	-0.37	2.39	9.33	-0.06						
2.51	7.36	-0.79	2.51	8.37	-0.44	2.52	9.64	-0.13						
2.76	7.97	-0.93	2.77	8.98	-0.58	2.77	10.26	-0.28						
3.02	8.60	-1.09	3.02	9.62	-0.73	3.02	10.81	-0.42						
3.27	9.16	-1.23	3.27	10.24	-0.88	3.27	11.33	-0.56						
3.52	9.73	-1.38	3.52	10.81	-1.02	3.52	11.82	-0.69						
3.77	10.25	-1.53	3.77	11.37	-1.17	3.77	12.25	-0.82						
4.02	10.73	-1.67	4.02	11.93	-1.32	4.02	12.65	-0.94						
4.52	11.59	-1.94	4.53	12.89	-1.61	4.53	13.40	-1.17						
5.03	12.31	-2.19	5.03	13.71	-1.87	5.03	14.04	-1.39						
5.53	12.89	-2.41	5.53	14.46	-2.12	5.28	14.32	-1.48						
6.03	13.38	-2.60	6.03	15.08	-2.35	5.53	14.61	-1.58						
6.53	13.77	-2.78	6.54	15.62	-2.56	5.78	14.87	-1.68						
7.04	14.11	-2.94	7.04	16.07	-2.75	6.04	15.09	-1.76						
7.54	14.38	-3.08	7.54	16.42	-2.91	6.29	15.31	-1.84						
8.04	14.62	-3.20	8.05	16.69	-3.05	6.54	15.51	-1.92						
8.54	14.79	-3.31	8.55	16.89	-3.16	6.79	15.69	-2.00						
9.05	14.95	-3.41	9.05	17.01	-3.25	7.04	15.82	-2.06						
9.55	15.06	-3.49	9.55	17.04	-3.32	7.29	16.00	-2.13						
10.05	15.15	-3.57	10.06	17.00	-3.36	7.55	16.11	-2.18						
11.31	15.30	-3.72	11.31	16.98	-3.40	8.05	16.34	-2.30						
12.56	15.39	-3.82	12.57	17.00	-3.40	8.55	16.52	-2.39						
13.82	15.43	-3.90	13.83	17.13	-3.41	9.05	16.65	-2.47						
15.08	15.44	-3.95	15.08	17.20	-3.42	9.56	16.77	-2.53						
16.33	15.38	-3.98	16.34	17.35	-3.45	10.06	16.88	-2.59						
17.59	15.29	-4.01	17.60	17.52	-3.51	11.32	17.06	-2.72						
18.84	15.20	-4.02	18.86	17.70	-3.58	12.58	17.14	-2.79						
20.10	15.11	-4.03	20.11	17.78	-3.65	13.83	17.07	-2.83						
21.36	14.96	-4.03	21.37	17.83	-3.71	15.09	17.02	-2.85						
22.61	14.81	-4.03	22.63	17.84	-3.76	16.35	16.90	-2.85						
23.87	14.67	-4.03	23.88	17.85	-3.82	17.61	16.83	-2.83						
25.13	14.53	-4.02	25.14	17.79	-3.87	18.86	16.72	-2.82						
26.38	14.39	-4.01	26.40	17.72	-3.92	20.12	16.55	-2.80						
27.64	14.22	-4.00	27.66	17.61	-3.96	21.38	16.36	-2.78						
28.90	14.09	-3.99	28.91	17.44	-4.00	22.64	16.18	-2.77						
30.03	13.96	-3.98	30.01	17.24	-4.01	25.15	15.81	-2.72						
						27.67	15.31	-2.65						
						29.99	14.97	-2.59						

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **10/17/07**

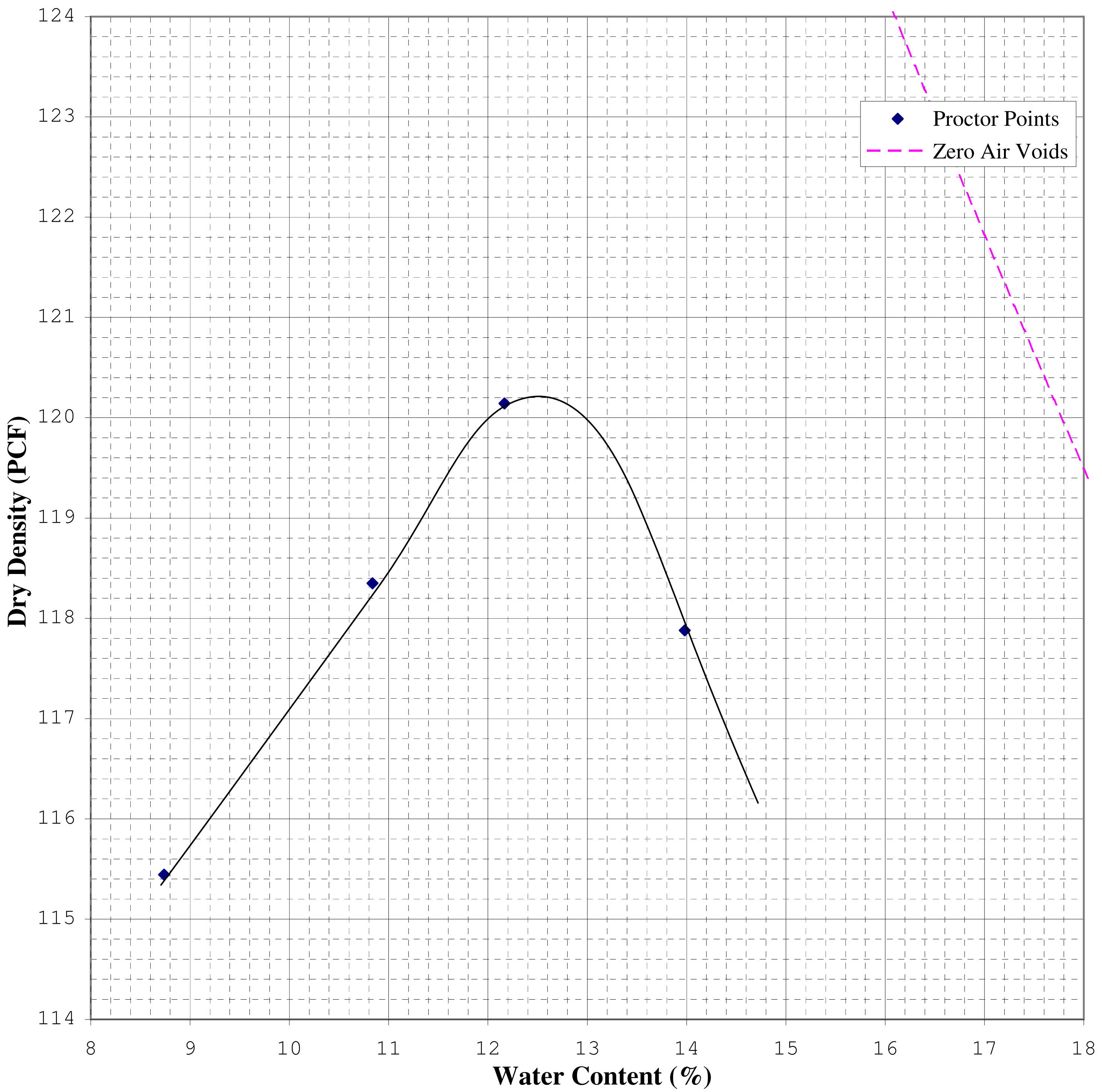
Client: **Barr Engineering Company** Job No. **6251**

Boring No. Sample: **Mix #3** Depth(ft): Blend **1:2 Blend - 5CT:8FT:2Slimes**

Soil Type: **Tailings - Silty Sand (SM)**

As Received W.C. (%): **9.0** LL: PL: PI: Specific Gravity: **2.92**

Maximum Dry Density (pcf): **120.3** Opt. Water Content (%): **12.5**



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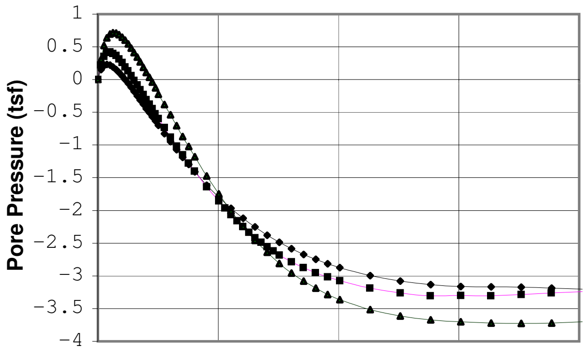
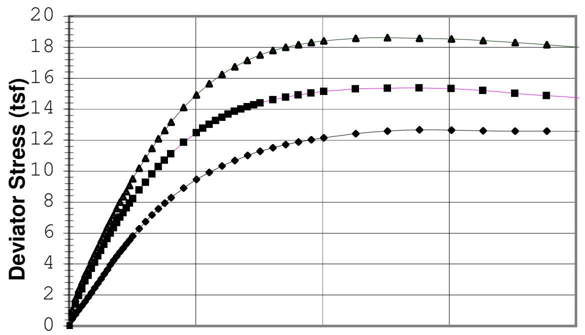
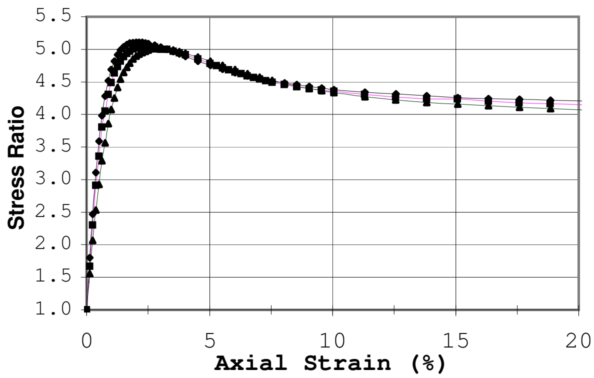
TRIAXIAL TEST ASTM: D 4767

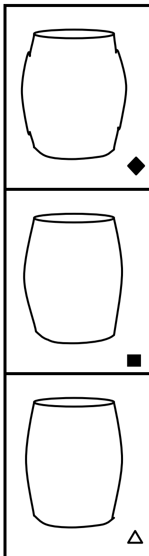
Job No. **6251**
Date: **10/25/07**

Project: **Polymet #23/69-862-023B**
Boring #: **1:2 Blend** Sample #: **Mix #3** Type: **Remoldec** Depth (ft):
Soil Type: **Blend: 5 CT : 8 FT : 2 Slimes (Silty Sand (SM))**









Failure Criterion:	**Max. Stress Ratio**				
Angle of internal friction, φ' =	**41.5 °**				
Apparent Cohesion, c' =	**0.05 (tsf)**				
Test Date:	10/18/07	Liquid Limit:			
Test Type:	CU w/pp	Plastic Limit:			
Strain Rate (in/min):	0.004	Plasticity Index:			
Strain Rate (%/min):	0.101	Spec. Gravity (Assumed):	2.97		

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	12.1	12.3	12.5		
Dry Density (pcf)	114.7	114.2	114.1		
Void Ratio	0.62	0.62	0.62		
After Consolidation					
Diameter (in)	1.94	1.94	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	20.4	20.4	20.2		
Dry Density (pcf)	115.6	115.4	115.8		
Void Ratio	0.60	0.61	0.60		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	12.66	15.36	18.62		
Ultimate Deviator Stress (tsf)	12.49	12.90	16.41		
Deviator Stress at Failure (tsf)	5.02	8.23	10.82		
Max. Pore Pressure Buildup (tsf)	0.23	0.42	0.72		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	2.1	2.5	3.0		

+

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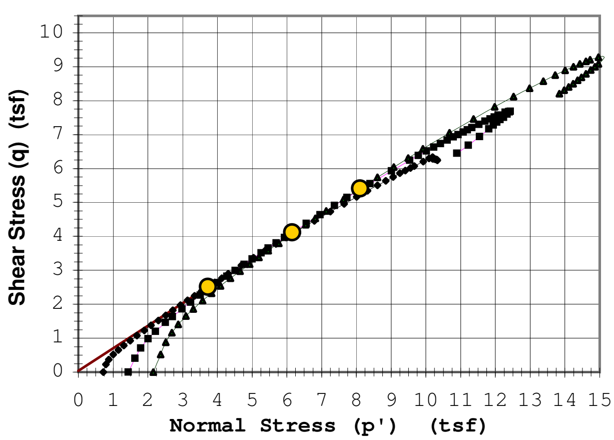
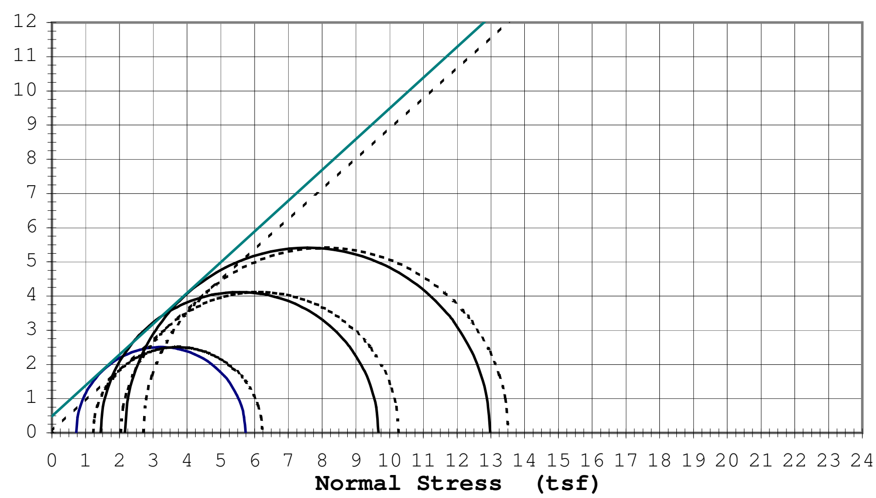
"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted to approximately 95% of maximum standard proctor density. Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





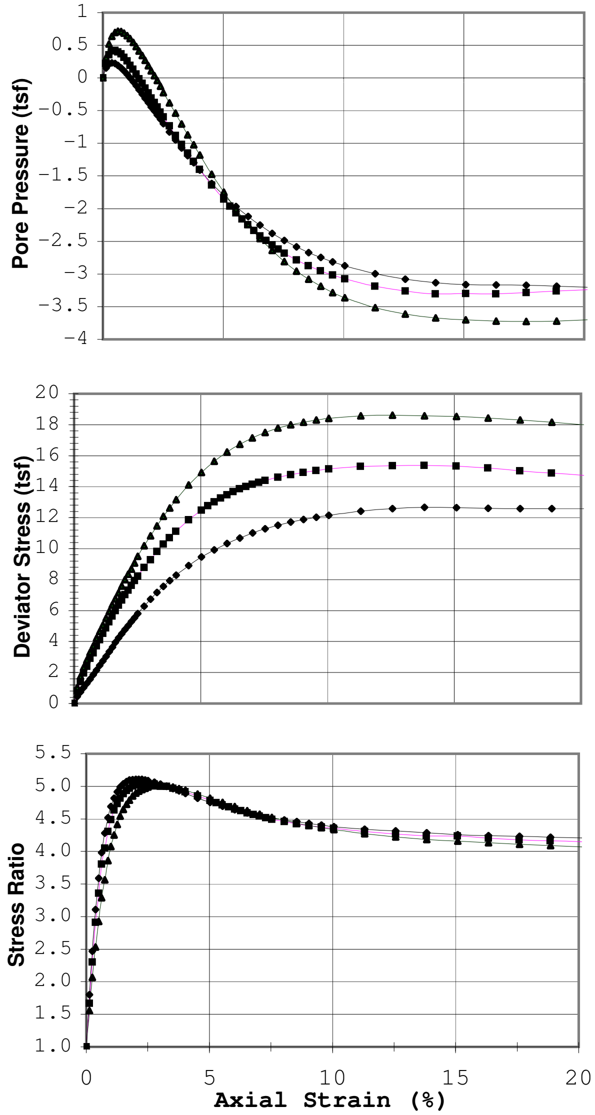
Rupture Envelope at Failure	
α = 33.5 °	a = 0.0 (tsf)

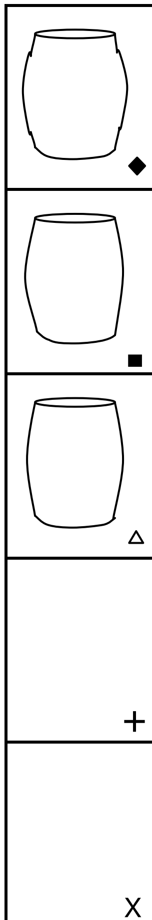
------------	Effective φ':	41.5 °	c'=	0.05 (tsf)
________	Total φ':	42.0 °	c=	0.49 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/25/07**

Project: **Polymet #23/69-862-023B**
Boring #: **1:2 Blend** Sample #: **Mix #3** Type: **Remoldec** Depth (ft):
Soil Type: **Blend: 5 CT : 8 FT : 2 Slimes (Silty Sand (SM))**





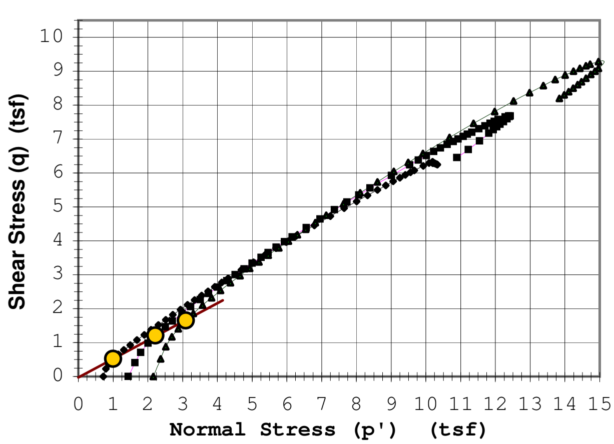
Failure Criterion:	**Max. Pore Pressure**
Angle of internal friction, ϕ' =	**33.0 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

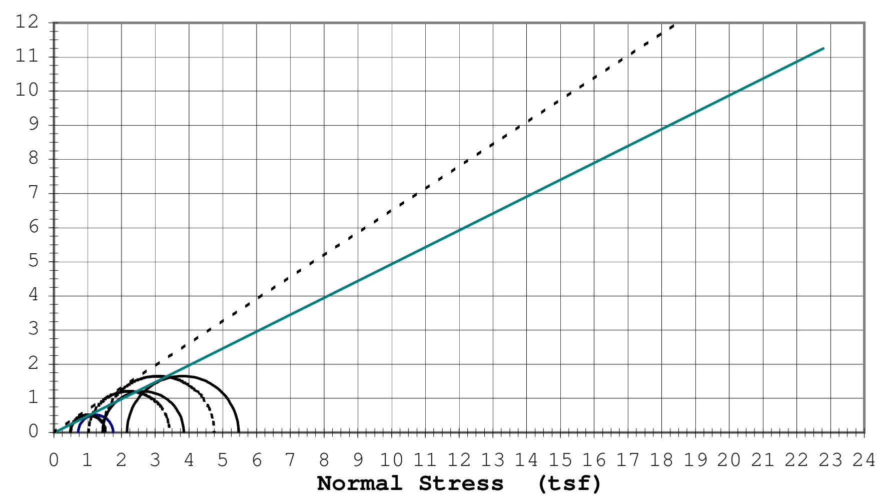
Test Date:	10/18/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity (Assumed):	2.97

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	12.1	12.3	12.5		
Dry Density (pcf)	114.7	114.2	114.1		
Void Ratio	0.62	0.62	0.62		
After Consolidation					
Diameter (in)	1.94	1.94	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	20.4	20.4	20.2		
Dry Density (pcf)	115.6	115.4	115.8		
Void Ratio	0.60	0.61	0.60		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	12.66	15.36	18.62		
Ultimate Deviator Stress (tsf)	12.49	12.90	16.41		
Deviator Stress at Failure (tsf)	1.03	2.41	3.31		
Max. Pore Pressure Buildup (tsf)	0.23	0.42	0.72		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	0.4	0.5	0.6		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted to approximately 95% of maximum standard proctor density. Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





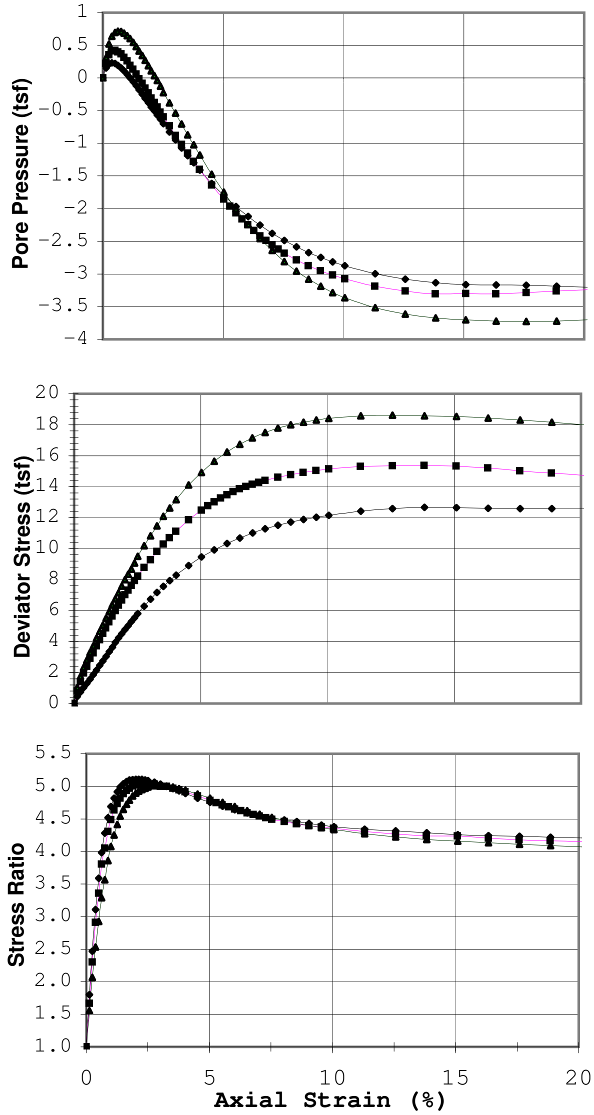
Rupture Envelope at Failure	
α = 28.6 °	a = 0.0 (tsf)

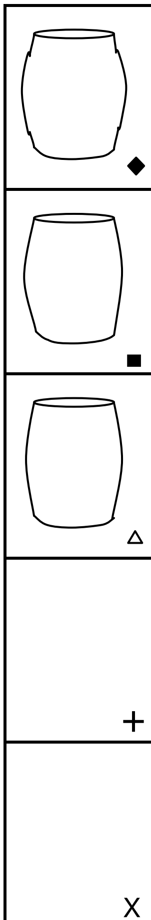
------------	Effective ϕ':	33.0 °	c'=	0.00 (tsf)
________	Total ϕ':	26.3 °	c=	-0.01 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/25/07**

Project: **Polymet #23/69-862-023B**
Boring #: **1:2 Blend** Sample #: **Mix #3** Type: **Remoldec** Depth (ft):
Soil Type: **Blend: 5 CT : 8 FT : 2 Slimes (Silty Sand (SM))**



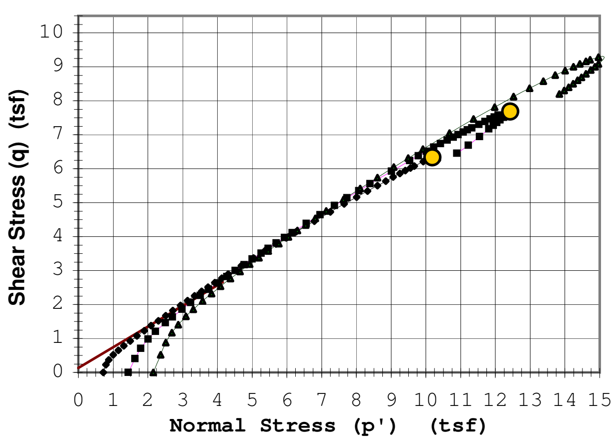


Failure Criterion:		Max. Deviator Stress			
Angle of internal friction, ϕ' =		**37.5 °**			
Apparent Cohesion, **c'** =		**0.17 (tsf)**			
Test Date:	10/18/07	Liquid Limit:			
Test Type:	CU w/pp	Plastic Limit:			
Strain Rate (in/min):	0.004	Plasticity Index:			
Strain Rate (%/min):	0.101	Spec. Gravity (Assumed):	2.97		

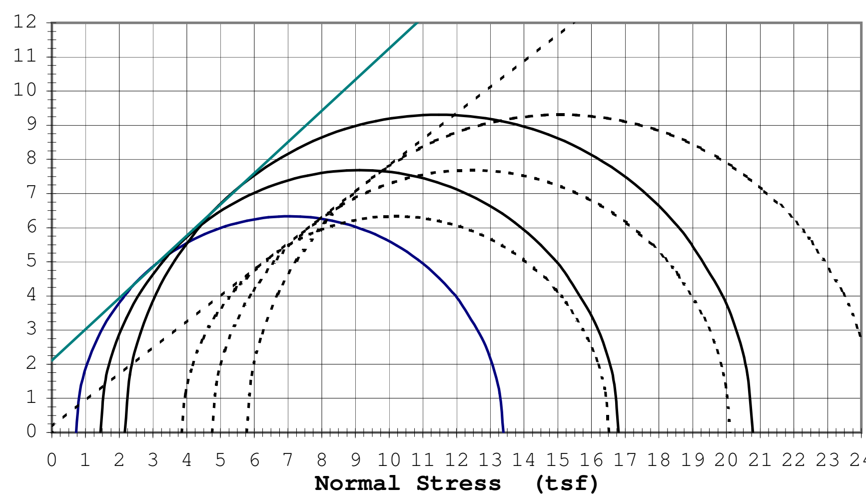
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	12.1	12.3	12.5		
Dry Density (pcf)	114.7	114.2	114.1		
Void Ratio	0.62	0.62	0.62		
After Consolidation					
Diameter (in)	1.94	1.94	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	20.4	20.4	20.2		
Dry Density (pcf)	115.6	115.4	115.8		
Void Ratio	0.60	0.61	0.60		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	12.66	15.36	18.62		
Ultimate Deviator Stress (tsf)	12.49	12.90	16.41		
Deviator Stress at Failure (tsf)	12.66	15.36	18.62		
Max. Pore Pressure Buildup (tsf)	0.23	0.42	0.72		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	13.8	13.8	12.6		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted to approximately 95% of maximum standard proctor density. Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



Rupture Envelope at Failure
α = 31.3 ° a = 0.1 (tsf)



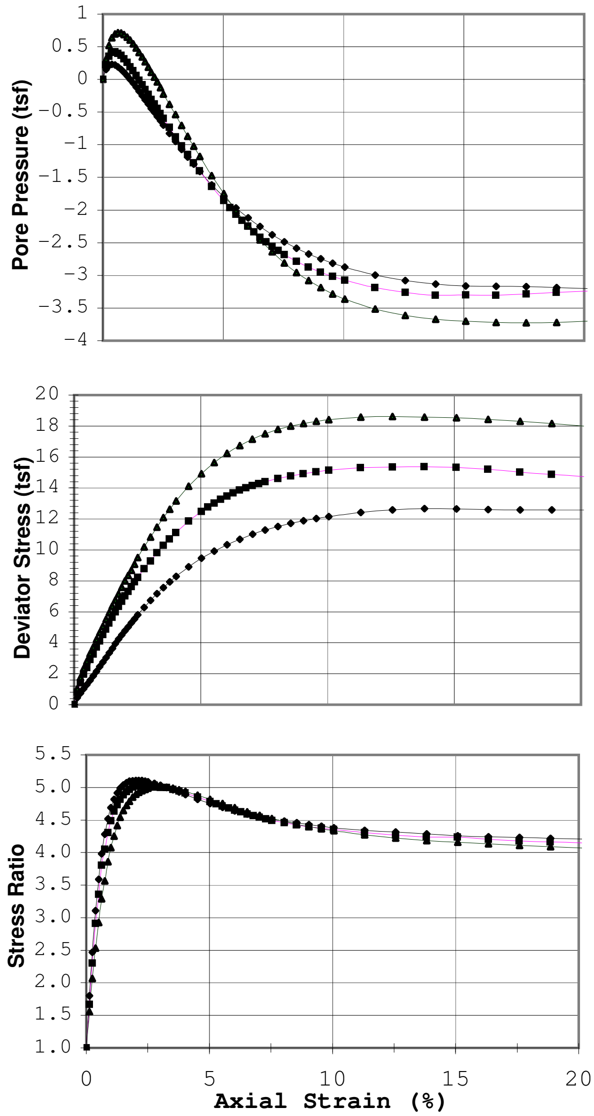
------------	Effective ϕ':	37.5 °	c'=	0.17 (tsf)
________	Total ϕ':	42.4 °	c=	2.11 (tsf)

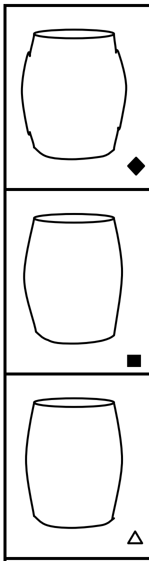
9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/25/07**

Project: **Polymet #23/69-862-023B**
Boring #: **1:2 Blend** Sample #: **Mix #3** Type: **Remoldec** Depth (ft):
Soil Type: **Blend: 5 CT : 8 FT : 2 Slimes (Silty Sand (SM))**





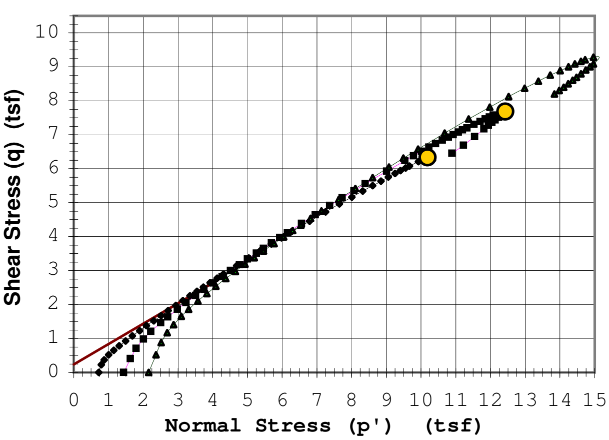
Failure Criterion:	Given Strain of: 15%
Angle of internal friction, ϕ' =	36.8 °
Apparent Cohesion, c' =	0.29 (tsf)

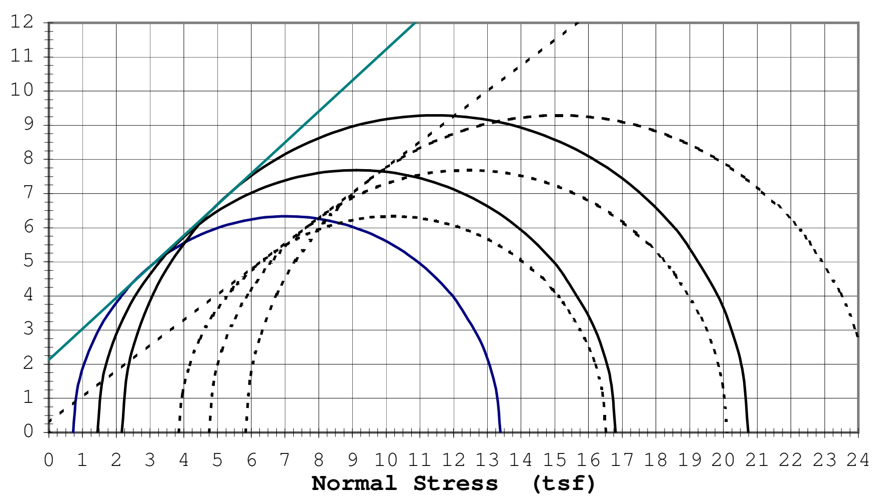
Test Date:	10/18/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity (Assumed):	2.97

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	12.1	12.3	12.5		
Dry Density (pcf)	114.7	114.2	114.1		
Void Ratio	0.62	0.62	0.62		
After Consolidation					
Diameter (in)	1.94	1.94	1.93		
Height (in)	3.98	3.98	3.98		
Water Content (%)	20.4	20.4	20.2		
Dry Density (pcf)	115.6	115.4	115.8		
Void Ratio	0.60	0.61	0.60		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	12.66	15.36	18.62		
Ultimate Deviator Stress (tsf)	12.49	12.90	16.41		
Deviator Stress at Failure (tsf)	12.66	15.36	18.58		
Max. Pore Pressure Buildup (tsf)	0.23	0.42	0.72		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted to approximately 95% of maximum standard proctor density. Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 30.9 °	a = 0.2 (tsf)

------------ Effective ϕ':	36.8 °	c'= 0.29 (tsf)
________ Total ϕ':	42.3 °	c= 2.13 (tsf)

9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

Job: 6251
Sample #: Mix #3
Date: 10/25/07

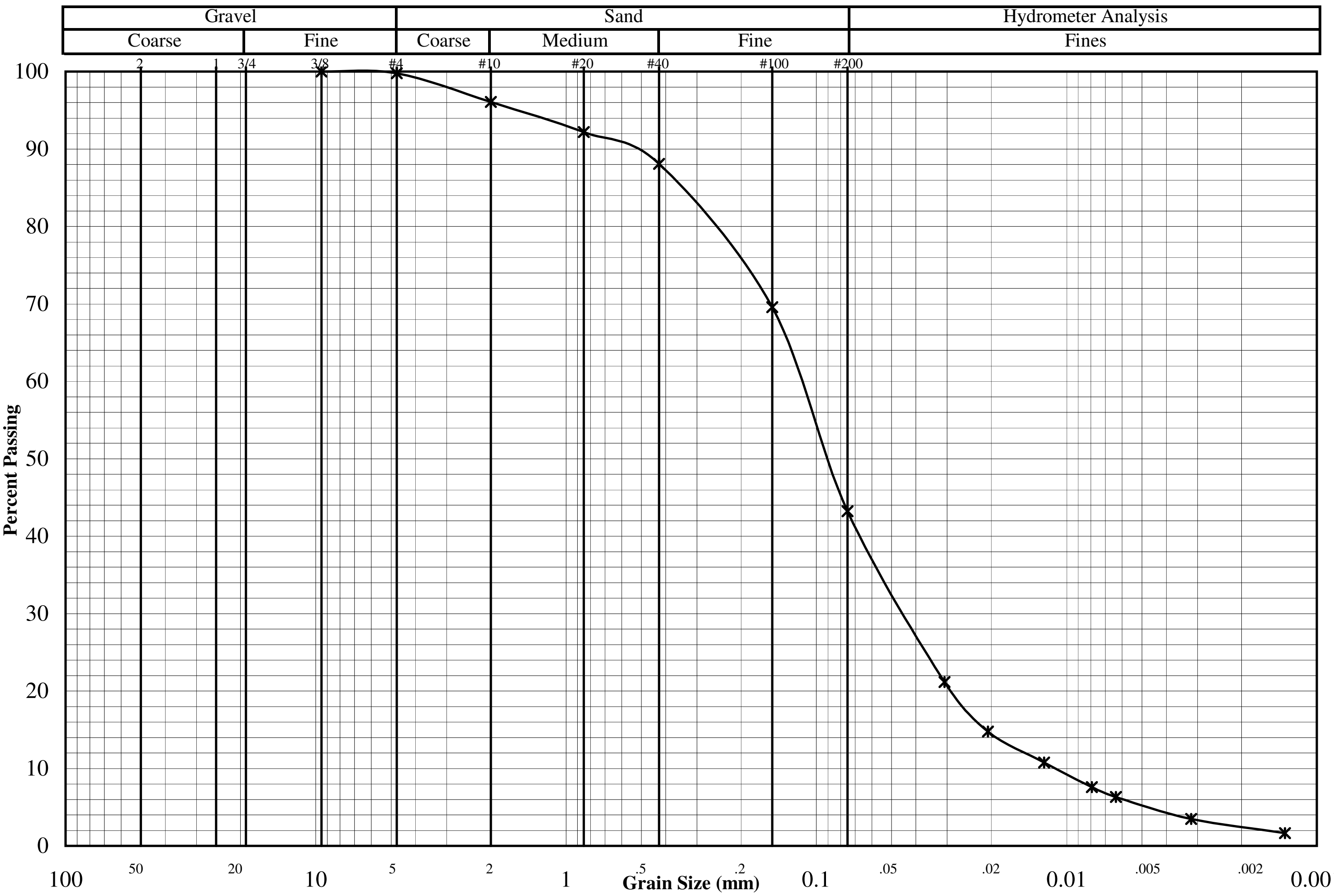
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
0.13	0.45	0.15	0.13	0.81	0.22	0.13	1.03	0.31						
0.25	0.74	0.21	0.25	1.41	0.35	0.25	1.75	0.52						
0.38	1.03	0.23	0.38	1.96	0.41	0.38	2.33	0.64						
0.50	1.30	0.22	0.50	2.41	0.42	0.50	2.82	0.69						
0.63	1.57	0.19	0.63	2.92	0.40	0.63	3.31	0.72						
0.76	1.86	0.15	0.75	3.27	0.37	0.75	3.71	0.71						
0.88	2.15	0.11	0.88	3.72	0.32	0.88	4.21	0.69						
1.01	2.46	0.05	1.01	4.11	0.26	1.01	4.64	0.65						
1.13	2.75	0.00	1.13	4.53	0.19	1.13	5.07	0.60						
1.26	3.05	-0.06	1.26	4.88	0.13	1.26	5.53	0.54						
1.38	3.35	-0.12	1.38	5.27	0.06	1.38	5.94	0.48						
1.51	3.64	-0.18	1.51	5.65	-0.01	1.51	6.37	0.41						
1.63	3.94	-0.25	1.63	5.99	-0.08	1.63	6.76	0.34						
1.76	4.23	-0.31	1.76	6.34	-0.16	1.76	7.16	0.27						
1.89	4.50	-0.38	1.88	6.68	-0.23	1.89	7.59	0.19						
2.01	4.77	-0.44	2.01	7.02	-0.31	2.01	7.99	0.11						
2.14	5.02	-0.50	2.14	7.31	-0.37	2.14	8.35	0.03						
2.26	5.28	-0.57	2.26	7.62	-0.45	2.26	8.69	-0.04						
2.39	5.54	-0.63	2.39	7.94	-0.52	2.39	9.07	-0.12						
2.51	5.80	-0.70	2.51	8.23	-0.60	2.51	9.51	-0.22						
2.77	6.29	-0.83	2.76	8.77	-0.74	2.77	10.18	-0.38						
3.02	6.74	-0.95	3.02	9.28	-0.88	3.02	10.82	-0.54						
3.27	7.16	-1.07	3.27	9.82	-1.02	3.27	11.47	-0.70						
3.52	7.56	-1.19	3.52	10.29	-1.15	3.52	12.09	-0.87						
3.77	7.93	-1.30	3.77	10.71	-1.28	3.77	12.62	-1.02						
4.02	8.28	-1.41	4.02	11.11	-1.40	4.02	13.16	-1.18						
4.53	8.91	-1.61	4.52	11.86	-1.64	4.53	14.10	-1.47						
5.03	9.46	-1.80	5.03	12.47	-1.86	5.03	14.92	-1.75						
5.53	9.92	-1.97	5.28	12.76	-1.96	5.53	15.63	-2.01						
6.03	10.33	-2.12	5.53	13.02	-2.07	6.03	16.24	-2.24						
6.54	10.68	-2.25	5.78	13.26	-2.16	6.54	16.74	-2.46						
7.04	11.00	-2.38	6.03	13.46	-2.25	7.04	17.15	-2.64						
7.54	11.27	-2.49	6.28	13.67	-2.33	7.54	17.51	-2.81						
8.04	11.50	-2.58	6.53	13.86	-2.42	8.04	17.78	-2.96						
8.55	11.72	-2.67	6.78	14.00	-2.49	8.55	18.00	-3.08						
9.05	11.88	-2.75	7.04	14.15	-2.56	9.05	18.17	-3.19						
9.55	12.03	-2.81	7.29	14.28	-2.62	9.55	18.31	-3.28						
10.05	12.14	-2.87	7.54	14.40	-2.68	10.05	18.41	-3.36						
11.31	12.42	-2.99	8.04	14.60	-2.79	11.31	18.57	-3.52						
12.57	12.59	-3.08	8.54	14.78	-2.87	12.57	18.62	-3.61						
13.83	12.66	-3.13	9.05	14.92	-2.95	13.83	18.58	-3.67						
15.08	12.65	-3.16	9.55	15.04	-3.01	15.08	18.53	-3.70						
16.34	12.60	-3.17	10.05	15.14	-3.07	16.34	18.42	-3.72						
17.60	12.59	-3.17	11.31	15.31	-3.19	17.60	18.32	-3.73						
18.85	12.58	-3.19	12.56	15.36	-3.26	18.85	18.17	-3.72						
20.11	12.58	-3.20	13.82	15.36	-3.31	20.11	18.00	-3.70						
21.37	12.59	-3.22	15.07	15.33	-3.30	21.37	17.81	-3.68						
22.62	12.57	-3.25	16.33	15.20	-3.30	22.62	17.59	-3.65						
23.88	12.55	-3.28	17.59	15.02	-3.28	23.88	17.38	-3.62						
25.14	12.53	-3.31	18.84	14.87	-3.26	25.14	17.20	-3.60						
26.39	12.52	-3.34	20.10	14.72	-3.24	26.39	16.99	-3.58						
27.33	12.49	-3.36	21.36	14.55	-3.23	27.65	16.80	-3.55						
			22.61	14.33	-3.21	28.91	16.61	-3.51						
			25.13	13.89	-3.16	30.09	16.41	-3.48						
			27.64	13.38	-3.10									
			29.99	12.90	-3.00									

Grain Size Distribution ASTM D422

Job No. : **6251-A**

Project:	Polymet #23/69-862-023B	Test Date:	11/3/07
Reported To:	Barr Engineering Company	Report Date:	11/9/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	1:4 Blend	Mix #4		Bulk	Blend: 2.5 CT : 8 FT : 2 Slimes (Silty Sand (SM))
●					
◇					



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.91		
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	578.8		
2"			
1.5"			
1"			
3/4"			
3/8"	100.0		
#4	99.8		
#10	96.1		
#20	92.2		
#40	88.1		
#100	69.6		
#200	43.2		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9301 Bryant Ave. South, Suite 107

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6251-A**

Project:	Polymet #23/69-862-023B	Test Date:	11/3/07
Reported To:	Barr Engineering Company	Report Date:	11/9/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	1:4 Blend	Mix #4		Bulk	Blend: 2.5 CT : 8 FT : 2 Slimes (Silty Sand (SM))
Spec 2					
Spec 3					

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.031	21.1				
0.021	14.8				
0.012	10.8				
0.008	7.6				
0.006	6.3				
0.003	3.5				
0.001	1.6				

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **11/5/07**

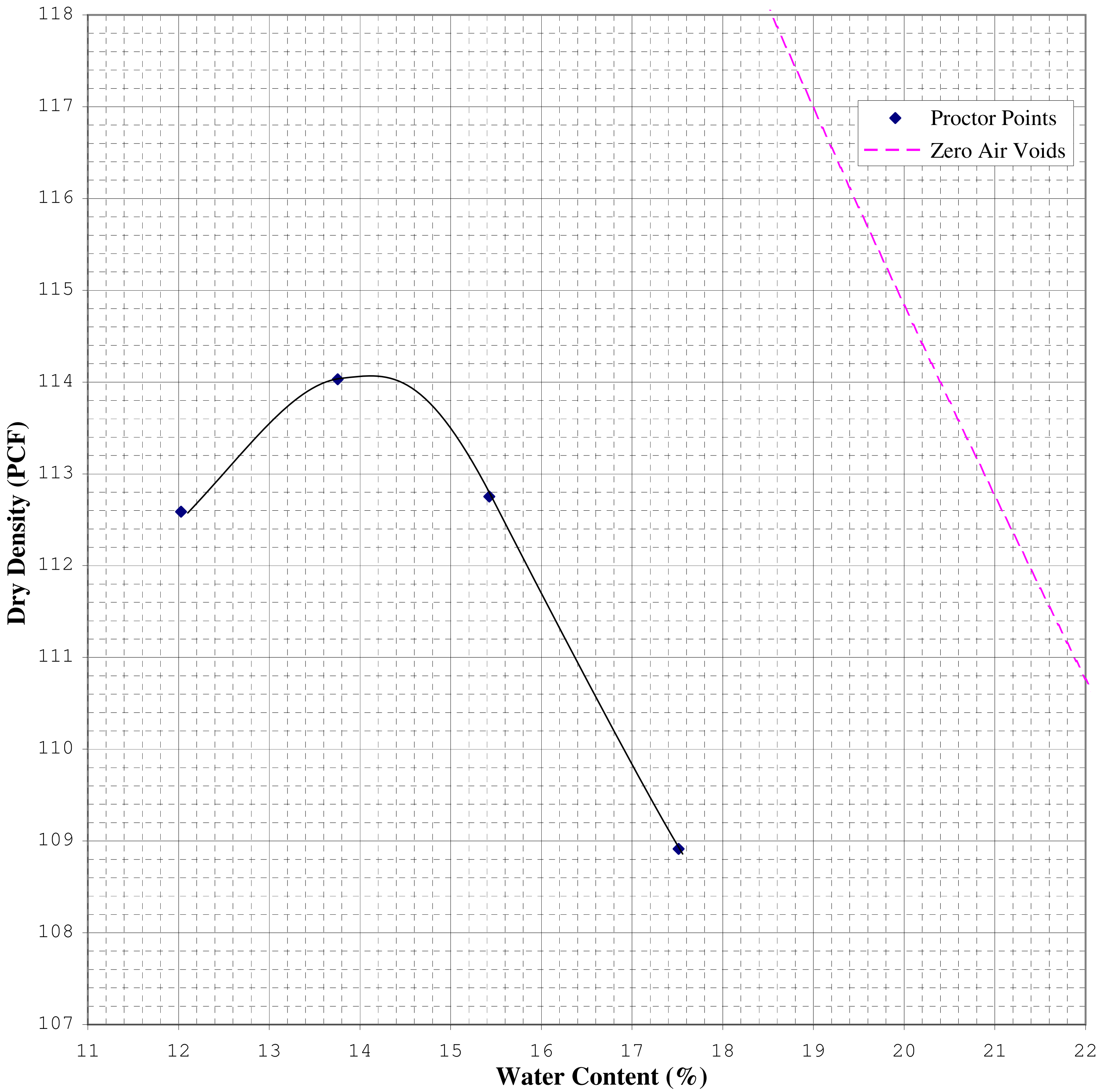
Client: **Barr Engineering Company** Job No. **6251-A**

Boring No. Sample: **Mix 4** Depth(ft): Location:

Soil Type: **1:4 Blend (2.5CT:8FT:2Slimes) - Silty Sand (SM)**

As Received W.C. (%): LL: PL: PI: Specific Gravity: **2.91** *Assumed

Maximum Dry Density (pcf): **114.1** Opt. Water Content (%): **14.1**



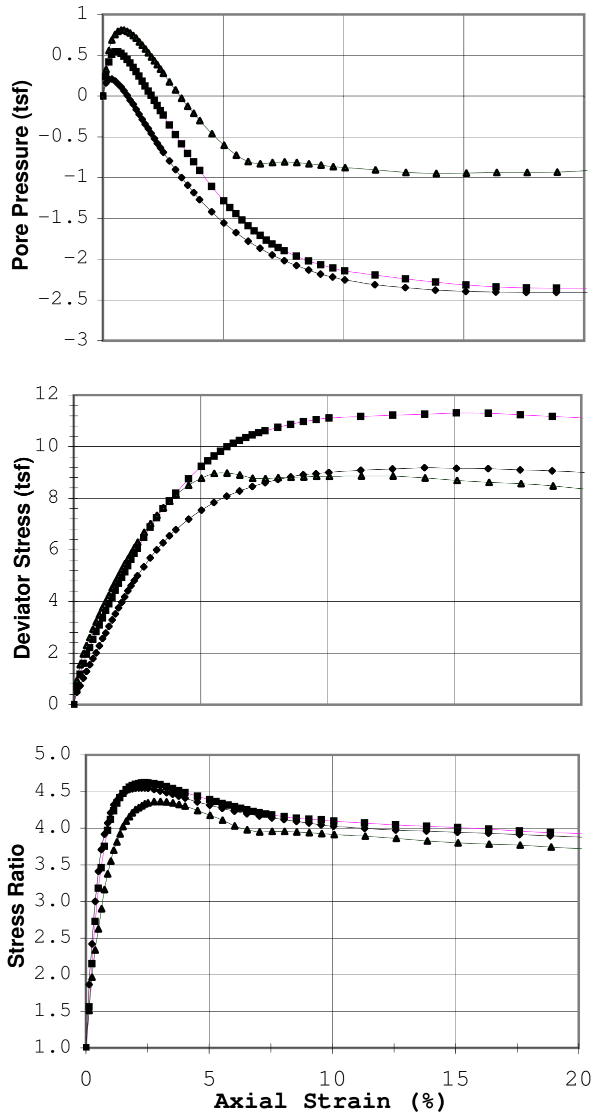
9301 Bryant Ave. South, Suite 107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

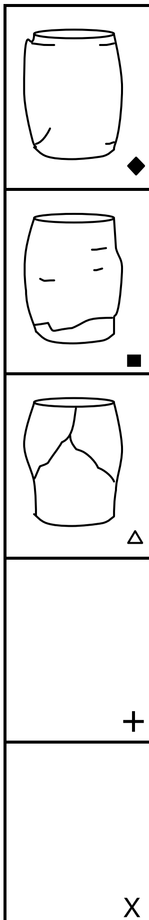
SET-R18a

TRIAXIAL TEST ASTM: D 4767

Job No. **6251-A**
Date: **11/9/07**

Project: **Polymet #23/69-862-023B**
Boring #: **Mix #4** Sample #: Type: **Remoldec** Depth (ft):
Soil Type: **Blend: Silty Sand (SM)**





Failure Criterion: **Max. Stress Ratio**

Angle of internal friction, ϕ' = **37.1 °**

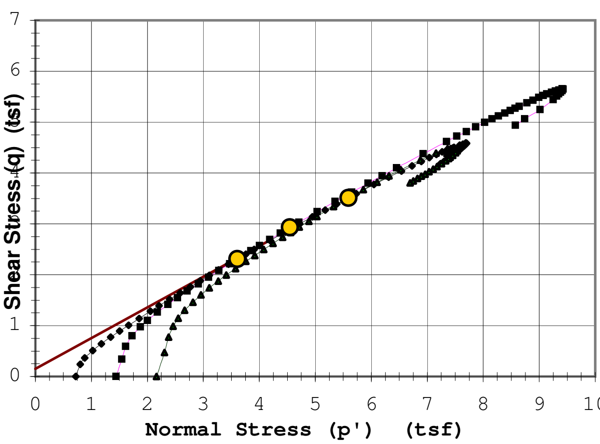
Apparent Cohesion, c' = **0.19 (tsf)**

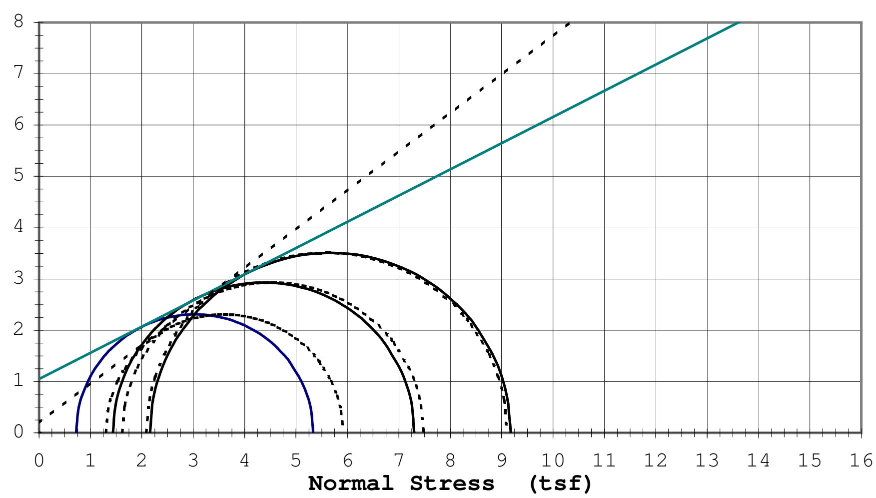
Test Date:	11/5/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.0043	Plasticity Index:	
Strain Rate (%/min):	0.108	Spec. Gravity :	2.91

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	14.0	14.4	14.0		
Dry Density (pcf)	108.5	108.0	108.4		
Void Ratio	0.67	0.68	0.68		
After Consolidation					
Diameter (in)	1.94	1.94	1.93		
Height (in)	3.98	3.98	3.97		
Water Content (%)	22.8	22.9	22.2		
Dry Density (pcf)	109.2	109.0	110.4		
Void Ratio	0.66	0.67	0.65		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	9.18	11.30	8.98		
Ultimate Deviator Stress (tsf)	8.37	9.88	7.61		
Deviator Stress at Failure (tsf)	4.62	5.86	7.02		
Max. Pore Pressure Buildup (tsf)	0.21	0.54	0.81		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	2.3	2.4	3.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





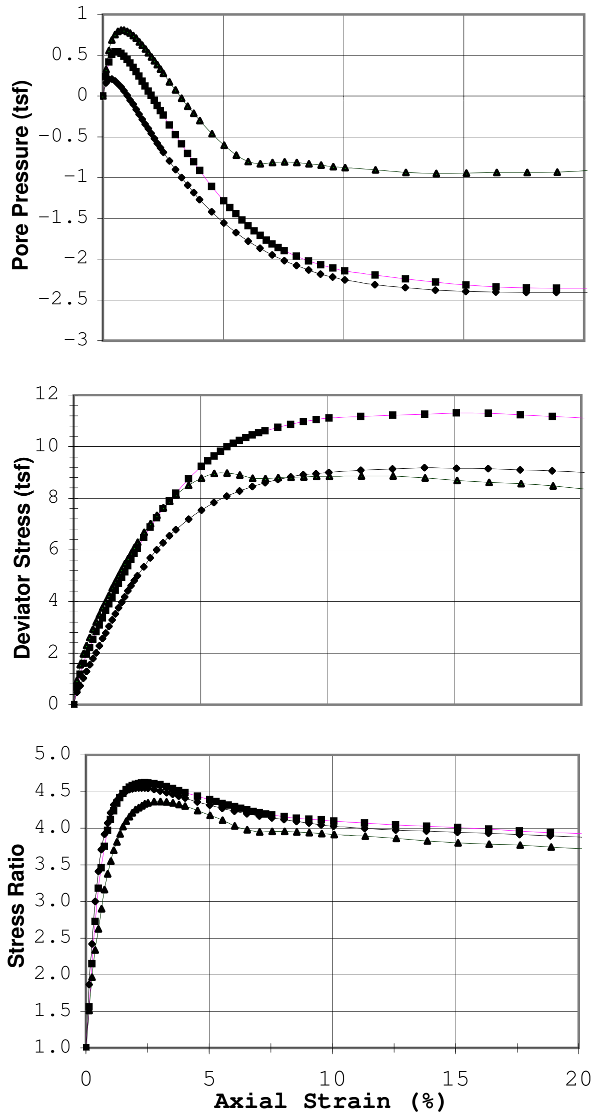
Rupture Envelope at Failure	
α = 31.1 °	a = 0.2 (tsf)

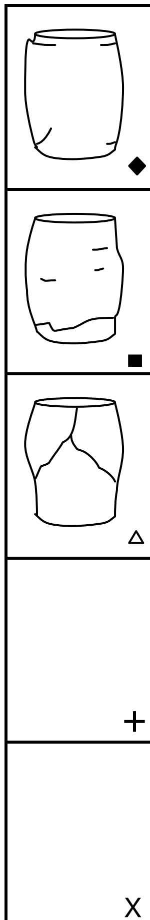
------------	Effective ϕ':	37.1 °	c'=	0.19 (tsf)
________	Total ϕ':	27.1 °	c=	1.05 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251-A**
Date: **11/9/07**

Project: **Polymet #23/69-862-023B**
Boring #: **Mix #4** Sample #: Type: **Remoldec** Depth (ft):
Soil Type: **Blend: Silty Sand (SM)**

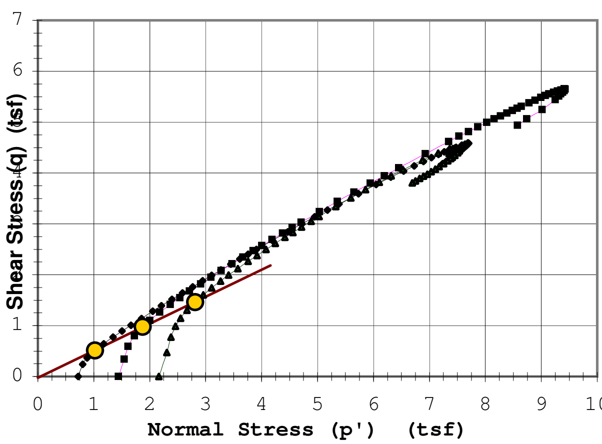


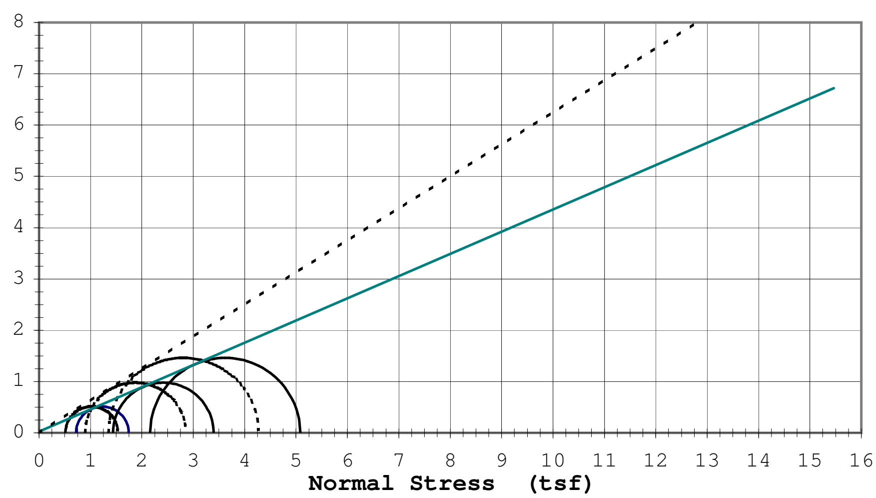


Failure Criterion:	**Max. Pore Pressure**				
Angle of internal friction, ϕ' =	**32.0 °**				
Apparent Cohesion, c' =	**0.00 (tsf)**				
Test Date: 11/5/07	Liquid Limit:				
Test Type: CU w/pp	Plastic Limit:				
Strain Rate (in/min): 0.0043	Plasticity Index:				
Strain Rate (%/min): 0.108	Spec. Gravity : 2.91				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	14.0	14.4	14.0		
Dry Density (pcf)	108.5	108.0	108.4		
Void Ratio	0.67	0.68	0.68		
After Consolidation					
Diameter (in)	1.94	1.94	1.93		
Height (in)	3.98	3.98	3.97		
Water Content (%)	22.8	22.9	22.2		
Dry Density (pcf)	109.2	109.0	110.4		
Void Ratio	0.66	0.67	0.65		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	9.18	11.30	8.98		
Ultimate Deviator Stress (tsf)	8.37	9.88	7.61		
Deviator Stress at Failure (tsf)	1.02	1.96	2.92		
Max. Pore Pressure Buildup (tsf)	0.21	0.54	0.81		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	0.4	0.5	0.8		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





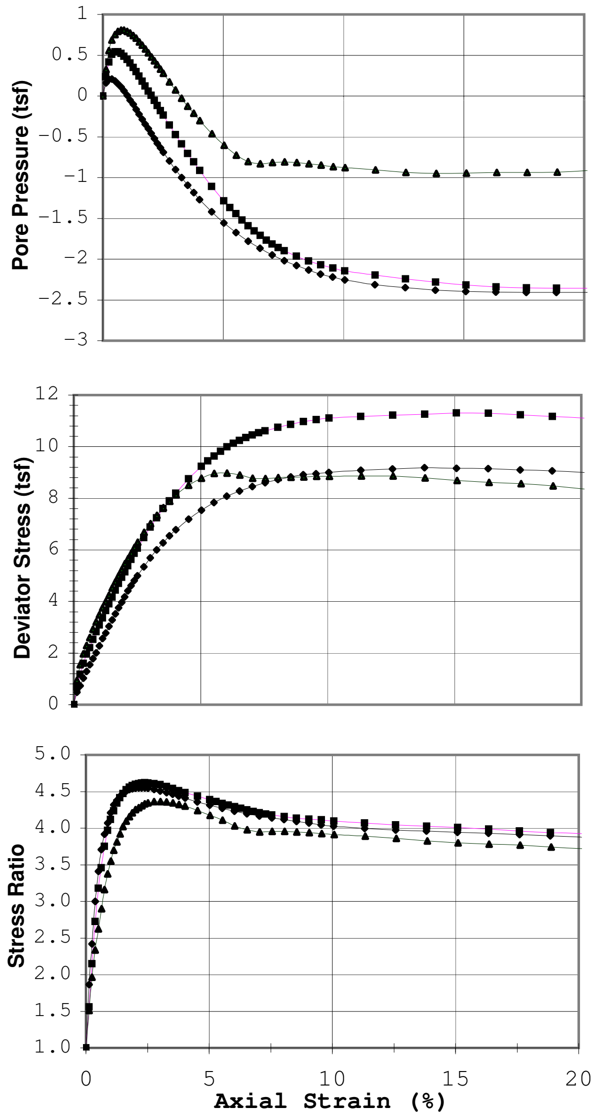
Rupture Envelope at Failure	
α = 27.9 °	a = 0.0 (tsf)

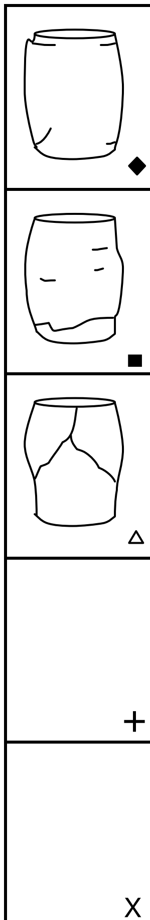
------------	Effective ϕ':	32.0 °	c'=	0.00 (tsf)
________	Total ϕ':	23.4 °	c=	0.02 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251-A**
Date: **11/9/07**

Project: **Polymet #23/69-862-023B**
Boring #: **Mix #4** Sample #: Type: **Remoldec** Depth (ft):
Soil Type: **Blend: Silty Sand (SM)**





Failure Criterion: **Max. Deviator Stress**

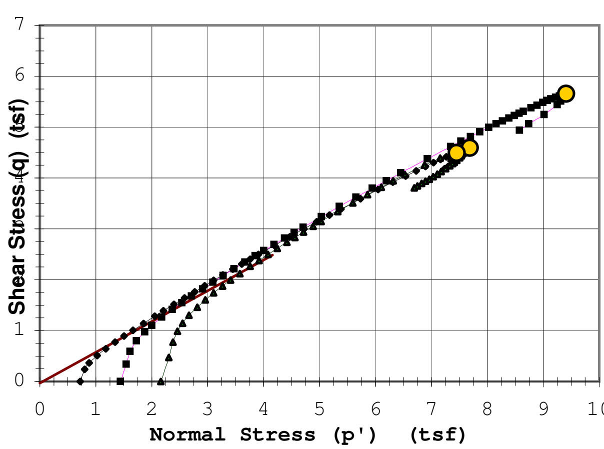
Angle of internal friction, ϕ' = **37.1 °**
Apparent Cohesion, **c'** = **0.00 (tsf)**

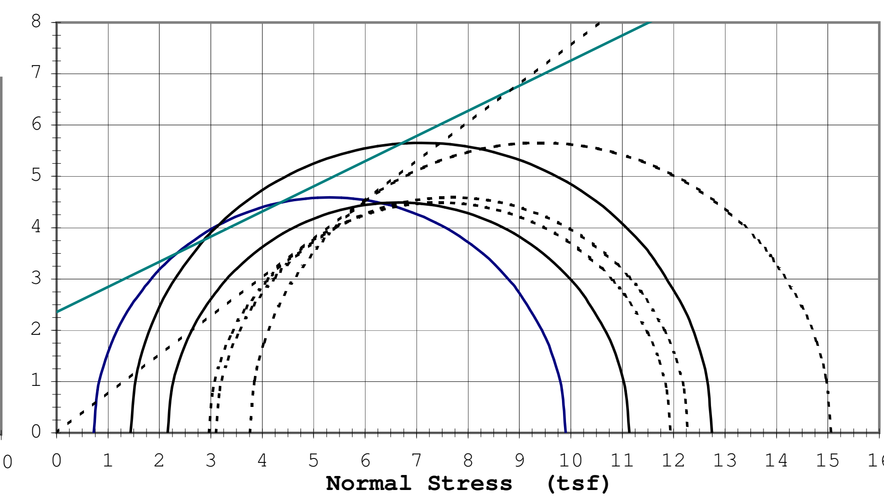
Test Date:	11/5/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.0043	Plasticity Index:	
Strain Rate (%/min):	0.108	Spec. Gravity :	2.91

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	14.0	14.4	14.0		
Dry Density (pcf)	108.5	108.0	108.4		
Void Ratio	0.67	0.68	0.68		
After Consolidation					
Diameter (in)	1.94	1.94	1.93		
Height (in)	3.98	3.98	3.97		
Water Content (%)	22.8	22.9	22.2		
Dry Density (pcf)	109.2	109.0	110.4		
Void Ratio	0.66	0.67	0.65		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	0.72	1.44	2.16		
Max. Deviator Stress (tsf)	9.18	11.30	8.98		
Ultimate Deviator Stress (tsf)	8.37	9.88	7.61		
Deviator Stress at Failure (tsf)	9.18	11.30	8.98		
Max. Pore Pressure Buildup (tsf)	0.21	0.54	0.81		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	13.8	15.1	6.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





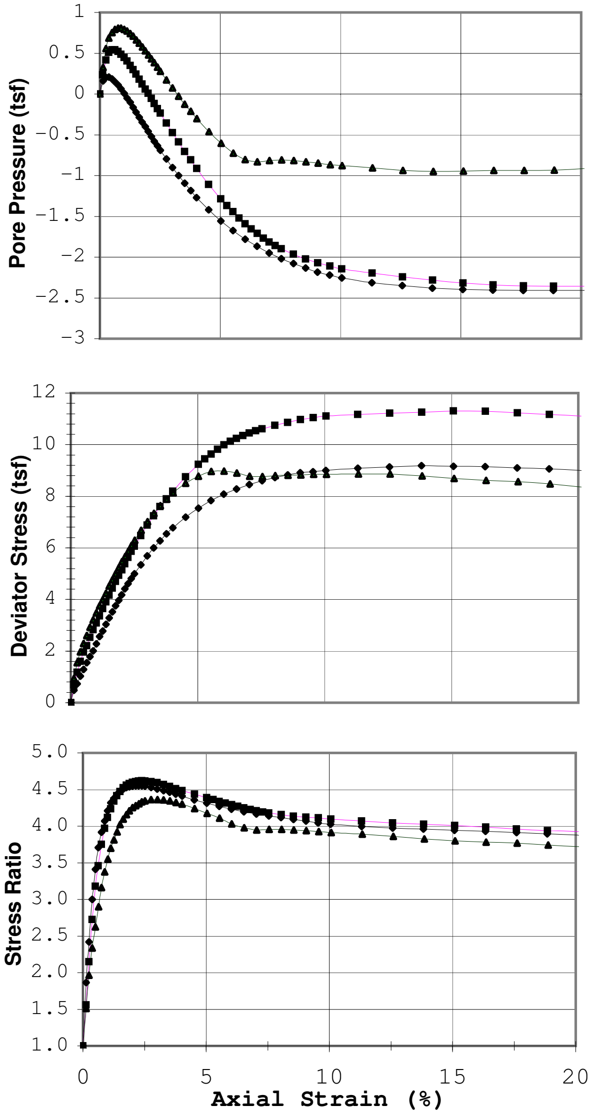
Rupture Envelope at Failure	
α = 31.1 °	a = 0.0 (tsf)

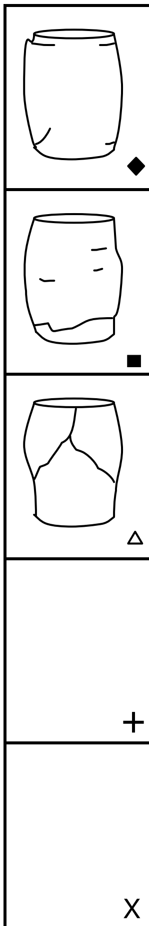
------------	Effective ϕ':	37.1 °	c'=	0.00 (tsf)
________	Total ϕ':	26.1 °	c=	2.36 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251-A**
Date: **11/9/07**

Project: **Polymet #23/69-862-023B**
Boring #: **Mix #4** Sample #: Type: **Remoldec** Depth (ft):
Soil Type: **Blend: Silty Sand (SM)**

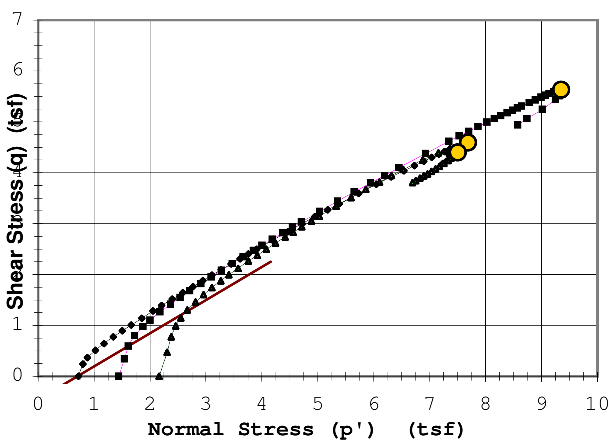


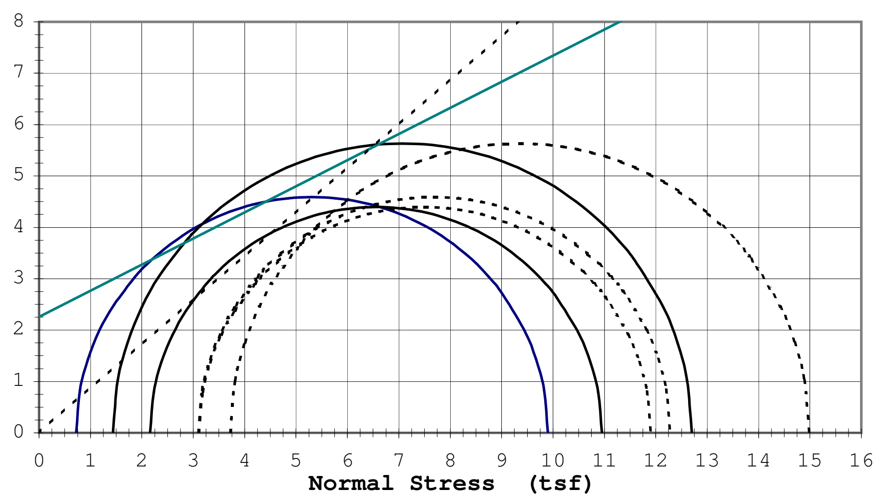


Failure Criterion:		**Given Strain of: 15%**				
Angle of internal friction, ϕ' =		**40.7 °**				
Apparent Cohesion, c' =		**0.00 (tsf)**				
Test Date: 11/5/07		Liquid Limit:				
Test Type: CU w/pp		Plastic Limit:				
Strain Rate (in/min): 0.0043		Plasticity Index:				
Strain Rate (%/min): 0.108		Spec. Gravity : 2.91				
Before Consolidation	**A**	**B**	**C**	**D**	**E**	
Diameter (in)	1.94	1.94	1.94			
Height (in)	3.98	3.98	3.98			
Water Content (%)	14.0	14.4	14.0			
Dry Density (pcf)	108.5	108.0	108.4			
Void Ratio	0.67	0.68	0.68			
After Consolidation						
Diameter (in)	1.94	1.94	1.93			
Height (in)	3.98	3.98	3.97			
Water Content (%)	22.8	22.9	22.2			
Dry Density (pcf)	109.2	109.0	110.4			
Void Ratio	0.66	0.67	0.65			
Back Pressure (tsf)	5.8	5.8	5.8			
Minor Principal Stress (tsf)	0.72	1.44	2.16			
Max. Deviator Stress (tsf)	9.18	11.30	8.98			
Ultimate Deviator Stress (tsf)	8.37	9.88	7.61			
Deviator Stress at Failure (tsf)	9.18	11.26	8.79			
Max. Pore Pressure Buildup (tsf)	0.21	0.54	0.81			
Pore Pressure Parameter "B"	1.0	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted to approximately 95% of maximum standard proctor density; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 33.1 °	a = -0.5 (tsf)

------------	Effective ϕ': 40.7 °	c'= 0.00 (tsf)
________	Total ϕ': 26.9 °	c= 2.26 (tsf)

Job: 6251-A

Sample #: Mix #4

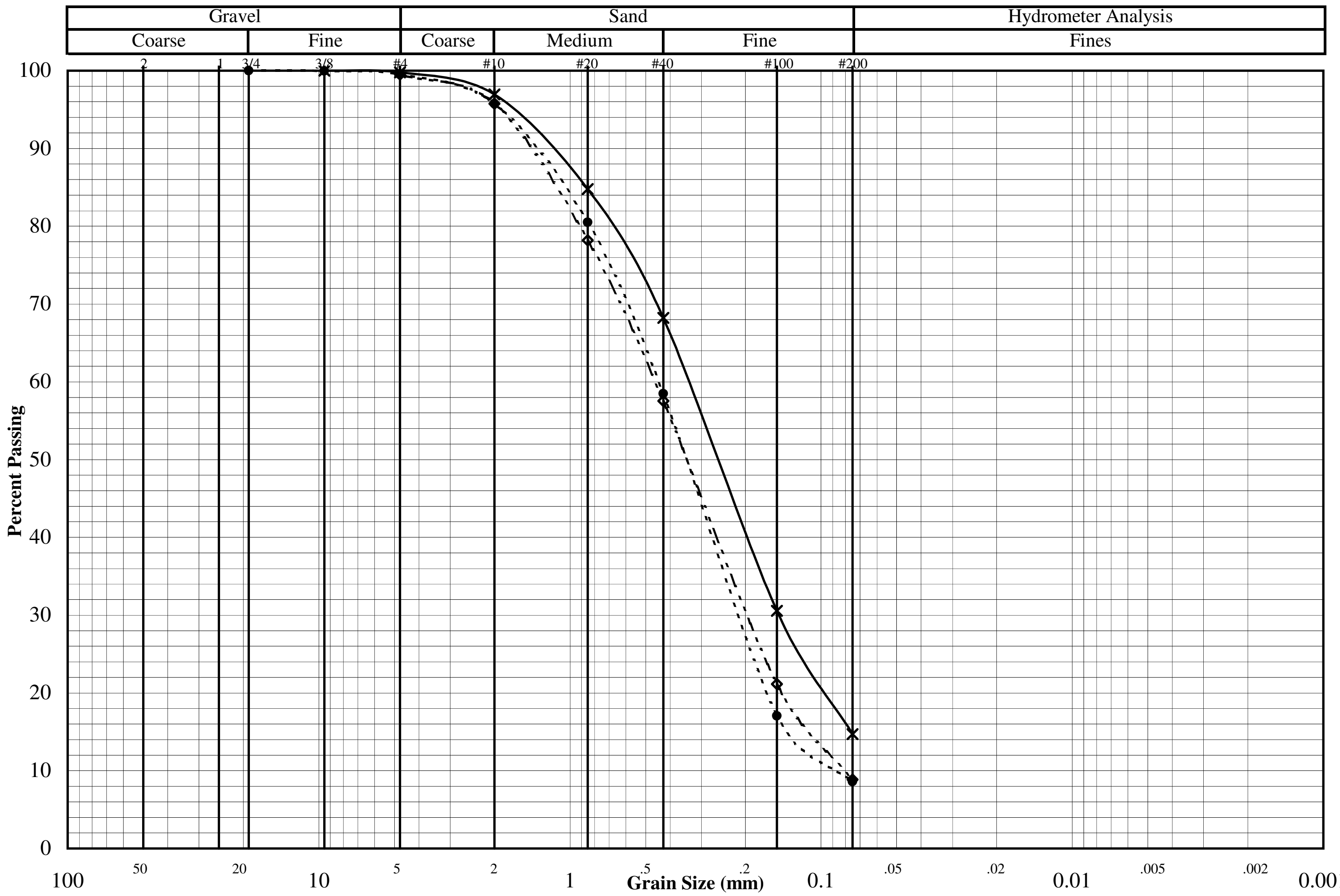
Date: 11/9/07

Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
0.13	0.48	0.16	0.13	0.68	0.24	0.13	0.94	0.32						
0.25	0.73	0.21	0.25	1.18	0.42	0.25	1.55	0.56						
0.38	1.02	0.21	0.38	1.60	0.51	0.38	1.97	0.69						
0.50	1.29	0.19	0.50	1.96	0.54	0.50	2.29	0.75						
0.63	1.55	0.15	0.63	2.21	0.54	0.63	2.60	0.79						
0.75	1.78	0.11	0.75	2.53	0.52	0.76	2.92	0.81						
0.88	2.01	0.06	0.88	2.83	0.49	0.88	3.21	0.81						
1.01	2.28	0.01	1.01	3.09	0.45	1.01	3.48	0.79						
1.13	2.56	-0.05	1.13	3.35	0.40	1.13	3.75	0.77						
1.26	2.78	-0.10	1.26	3.64	0.35	1.26	3.99	0.74						
1.38	3.03	-0.16	1.38	3.90	0.30	1.39	4.24	0.71						
1.51	3.29	-0.23	1.51	4.16	0.24	1.51	4.52	0.66						
1.63	3.53	-0.29	1.63	4.43	0.18	1.64	4.76	0.62						
1.76	3.76	-0.35	1.76	4.69	0.12	1.76	4.99	0.58						
1.89	3.97	-0.40	1.89	4.94	0.06	1.89	5.23	0.53						
2.01	4.18	-0.46	2.01	5.15	0.01	2.02	5.47	0.48						
2.14	4.41	-0.52	2.14	5.39	-0.05	2.14	5.67	0.43						
2.26	4.62	-0.58	2.26	5.63	-0.12	2.27	5.88	0.38						
2.39	4.81	-0.64	2.39	5.86	-0.18	2.39	6.10	0.33						
2.51	5.00	-0.69	2.51	6.07	-0.24	2.52	6.29	0.28						
2.76	5.35	-0.80	2.77	6.48	-0.35	2.77	6.68	0.17						
3.02	5.69	-0.90	3.02	6.88	-0.47	3.02	7.02	0.07						
3.27	6.00	-1.00	3.27	7.24	-0.59	3.27	7.34	-0.03						
3.52	6.27	-1.09	3.52	7.60	-0.70	3.53	7.64	-0.12						
3.77	6.54	-1.18	3.77	7.89	-0.81	3.78	7.89	-0.21						
4.02	6.78	-1.27	4.02	8.20	-0.91	4.03	8.13	-0.30						
4.52	7.19	-1.42	4.53	8.76	-1.11	4.53	8.50	-0.46						
5.03	7.54	-1.56	5.03	9.23	-1.29	5.04	8.78	-0.61						
5.53	7.83	-1.68	5.28	9.45	-1.37	5.54	8.96	-0.72						
6.03	8.08	-1.78	5.53	9.63	-1.44	6.04	8.98	-0.80						
6.53	8.28	-1.87	5.78	9.82	-1.52	6.55	8.91	-0.83						
7.04	8.45	-1.95	6.04	9.99	-1.59	7.05	8.77	-0.82						
7.54	8.60	-2.02	6.29	10.13	-1.66	7.56	8.77	-0.81						
8.04	8.73	-2.08	6.54	10.24	-1.71	8.06	8.80	-0.82						
8.54	8.82	-2.13	6.79	10.35	-1.77	8.56	8.82	-0.83						
9.05	8.91	-2.18	7.04	10.45	-1.82	9.07	8.83	-0.85						
9.55	8.95	-2.22	7.29	10.54	-1.86	9.57	8.85	-0.87						
10.05	9.01	-2.25	7.54	10.61	-1.90	10.07	8.85	-0.88						
11.31	9.09	-2.31	8.05	10.75	-1.97	11.33	8.87	-0.91						
12.57	9.13	-2.35	8.55	10.86	-2.02	12.59	8.87	-0.94						
13.82	9.18	-2.38	9.05	10.97	-2.07	13.85	8.79	-0.95						
15.08	9.17	-2.40	9.56	11.05	-2.11	15.11	8.70	-0.95						
16.33	9.15	-2.41	10.06	11.10	-2.14	16.37	8.62	-0.94						
17.59	9.10	-2.41	11.32	11.17	-2.20	17.63	8.57	-0.94						
18.85	9.06	-2.41	12.57	11.21	-2.24	18.89	8.48	-0.93						
20.10	9.00	-2.41	13.83	11.26	-2.28	20.15	8.36	-0.91						
21.36	8.95	-2.40	15.09	11.30	-2.32	21.40	8.25	-0.89						
22.62	8.88	-2.40	16.35	11.29	-2.34	22.66	8.15	-0.87						
23.87	8.82	-2.39	17.60	11.23	-2.35	23.92	8.05	-0.84						
25.13	8.74	-2.39	18.86	11.16	-2.36	25.18	7.96	-0.82						
26.39	8.66	-2.38	20.12	11.11	-2.36	26.44	7.87	-0.80						
27.64	8.56	-2.37	21.37	11.02	-2.36	27.70	7.79	-0.77						
28.90	8.45	-2.35	22.63	10.88	-2.37	28.96	7.69	-0.75						
30.01	8.37	-2.34	25.15	10.49	-2.33	30.03	7.61	-0.73						
			27.66	10.12	-2.24									
			30.00	9.88	-2.19									

Grain Size Distribution ASTM D422

Project:	Polymet #23/69-862-023B	Job No. :	**6251**
		Test Date:	9/12/07
Reported To:	Barr Engineering Company	Report Date:	9/18/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	TP-1	CT-1 / Bucket 1	5	Bulk	Coarse Tailings (Silty Sand (SM/SP-SM)))
●	TP-2	CT-3 / Bucket 3	12	Bulk	Coarse Tailings (Sand w/Silt, Fine to Medium Grained (SP-SM))
◇	Coarse Tailings	Bucket 17	1 - 3	Bulk	Coarse Tailings (Sand w/Silt, Fine to Medium Grained (SP-SM))



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content	4.5	5.2	2.2
Dry Density (pcf)			
Specific Gravity		2.93	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	1216.0	1897.1	1889.6
2"			
1.5"			
1"			
3/4"		100.0	100.0
3/8"	100.0	100.0	99.9
#4	99.8	99.5	99.5
#10	97.0	95.8	95.7
#20	84.8	80.5	78.2
#40	68.2	58.5	57.5
#100	30.5	17.0	21.1
#200	14.7	8.6	8.9

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

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SOIL ENGINEERING TESTING, INC.

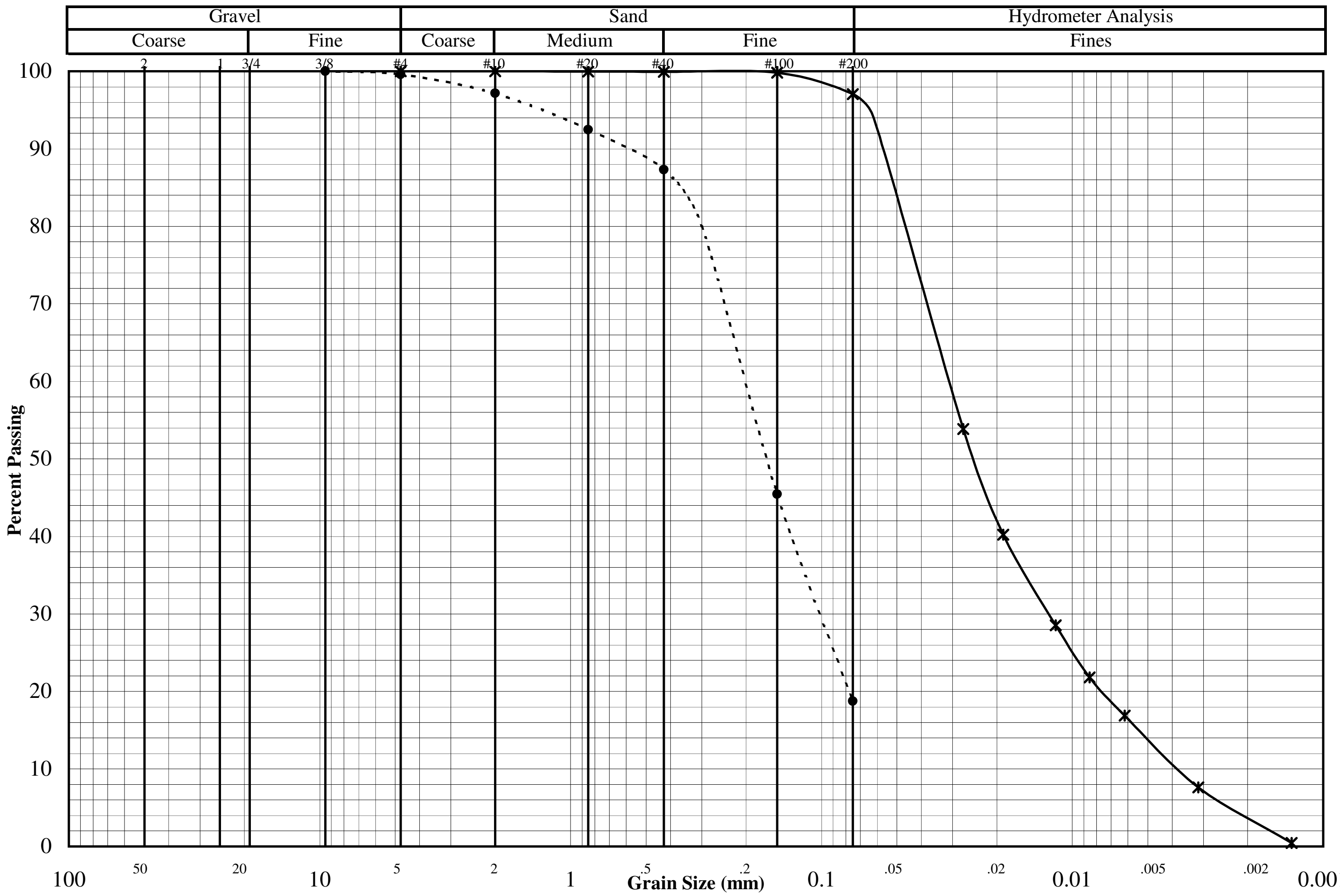
Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6251**

Project:	Polymet #23/69-862-023B	Test Date:	9/12/07
Reported To:	Barr Engineering Company	Report Date:	9/18/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	TP-2	Bucket 5	15	Bulk	Slimes (Silt (ML))
●	TP-3	Bucket 9	10	Bulk	Tailings (Silty Sand (SM))
◇					



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content	34.5	7.3	
Dry Density (pcf)			
Specific Gravity	3.01	2.86	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	1612.0	1566.8	
2"			
1.5"			
1"			
3/4"			
3/8"		100.0	
#4	100.0	99.6	
#10	100.0	97.2	
#20	100.0	92.5	
#40	99.9	87.3	
#100	99.8	45.5	
#200	97.0	18.8	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **9/20/07**

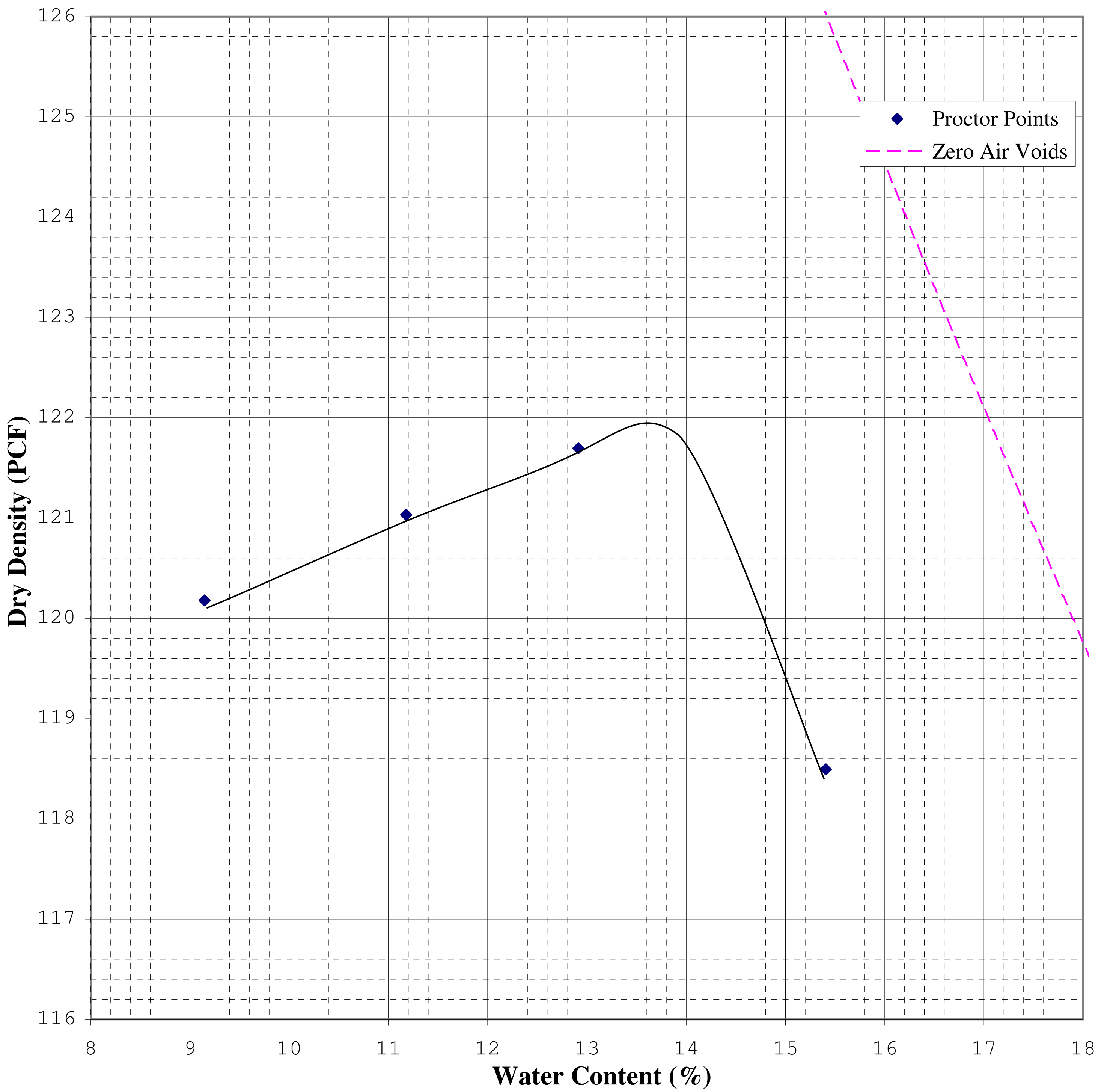
Client: **Barr Engineering Company** Job No. **6251**

Boring No. **TP-2** Sample: **Coarse Tailings** Depth(ft): **12** Location:

Soil Type: **Coarse Tailings (Sand w/Silt, Fine to Medium Grained (SP-SM))**

As Received W.C. (%): **5.2** LL: PL: PI: Specific Gravity: **2.93**

Maximum Dry Density (pcf): **122.0** Opt. Water Content (%): **13.6**



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Bloomington, Minnesota 55420-3436

SET-R18a

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **9/20/07**

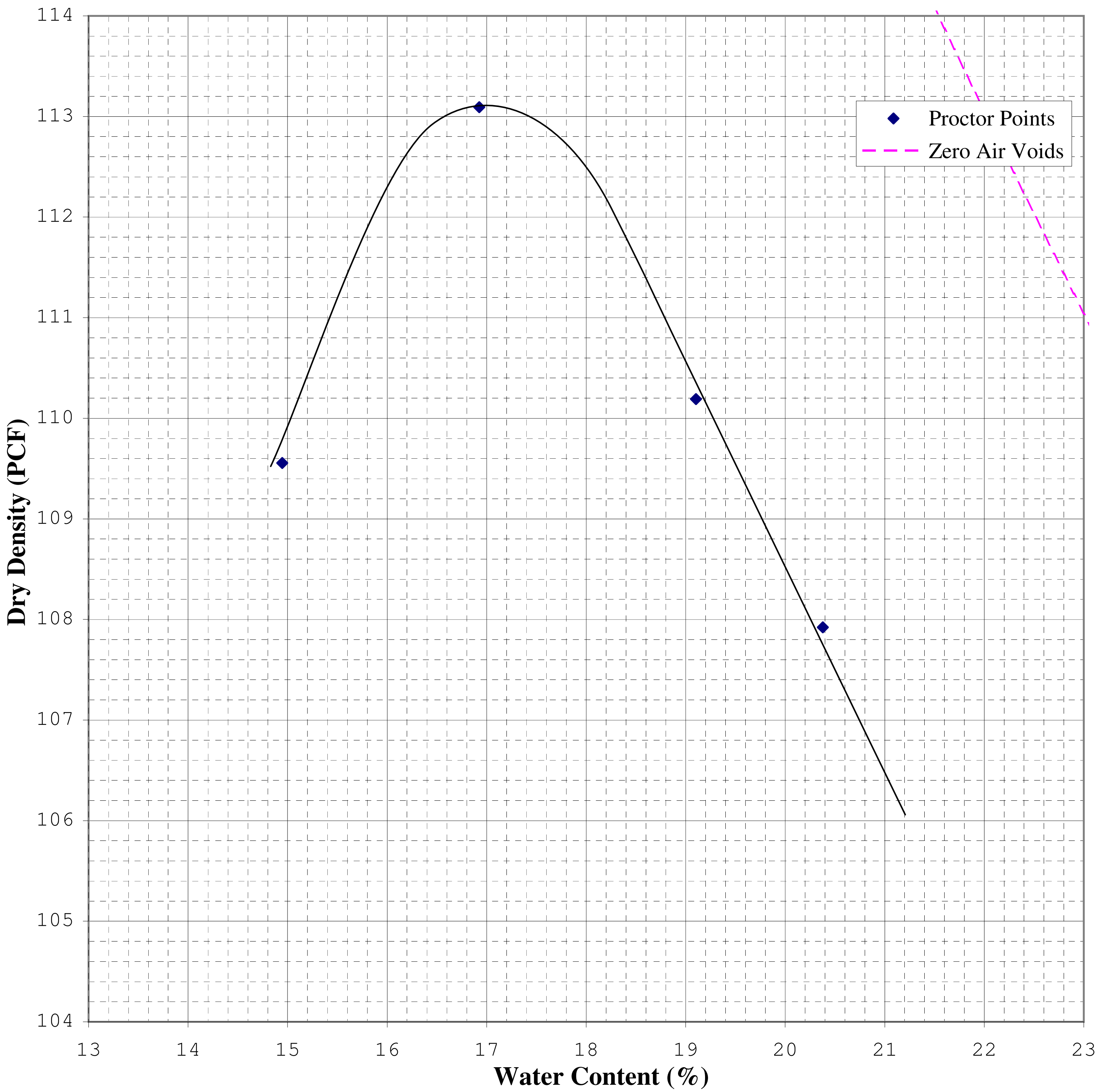
Client: **Barr Engineering Company** Job No. **6251**

Boring No. **TP-2** Sample: **Bucket #5** Depth(ft): **15** Location:

Soil Type: **Slimes (Silt (ML))**

As Received W.C. (%): **34.5** LL: PL: PI: Specific Gravity: **3.01**

Maximum Dry Density (pcf): **113.1** Opt. Water Content (%): **17.0**



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SET-R18a

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **9/20/07**

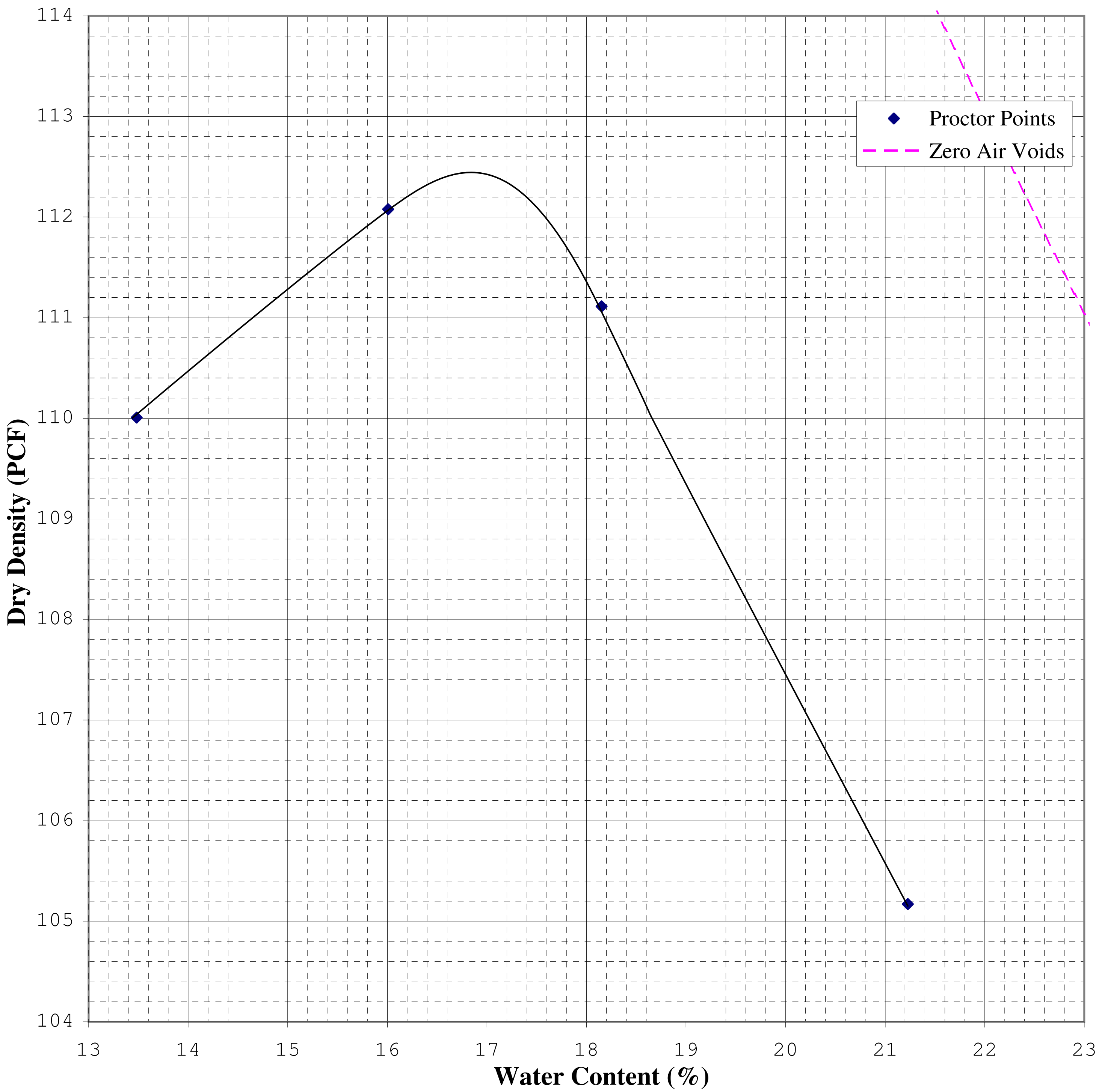
Client: **Barr Engineering Company** Job No. **6251**

Boring No. **TP-2** Sample: **Bucket #6** Depth(ft): **15** Location:

Soil Type: **Slimes (Silt (ML))**

As Received W.C. (%): LL: PL: PI: Specific Gravity: **3.01** *Assumed

Maximum Dry Density (pcf): **112.5** Opt. Water Content (%): **16.9**



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SET-R18a

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **9/20/07**

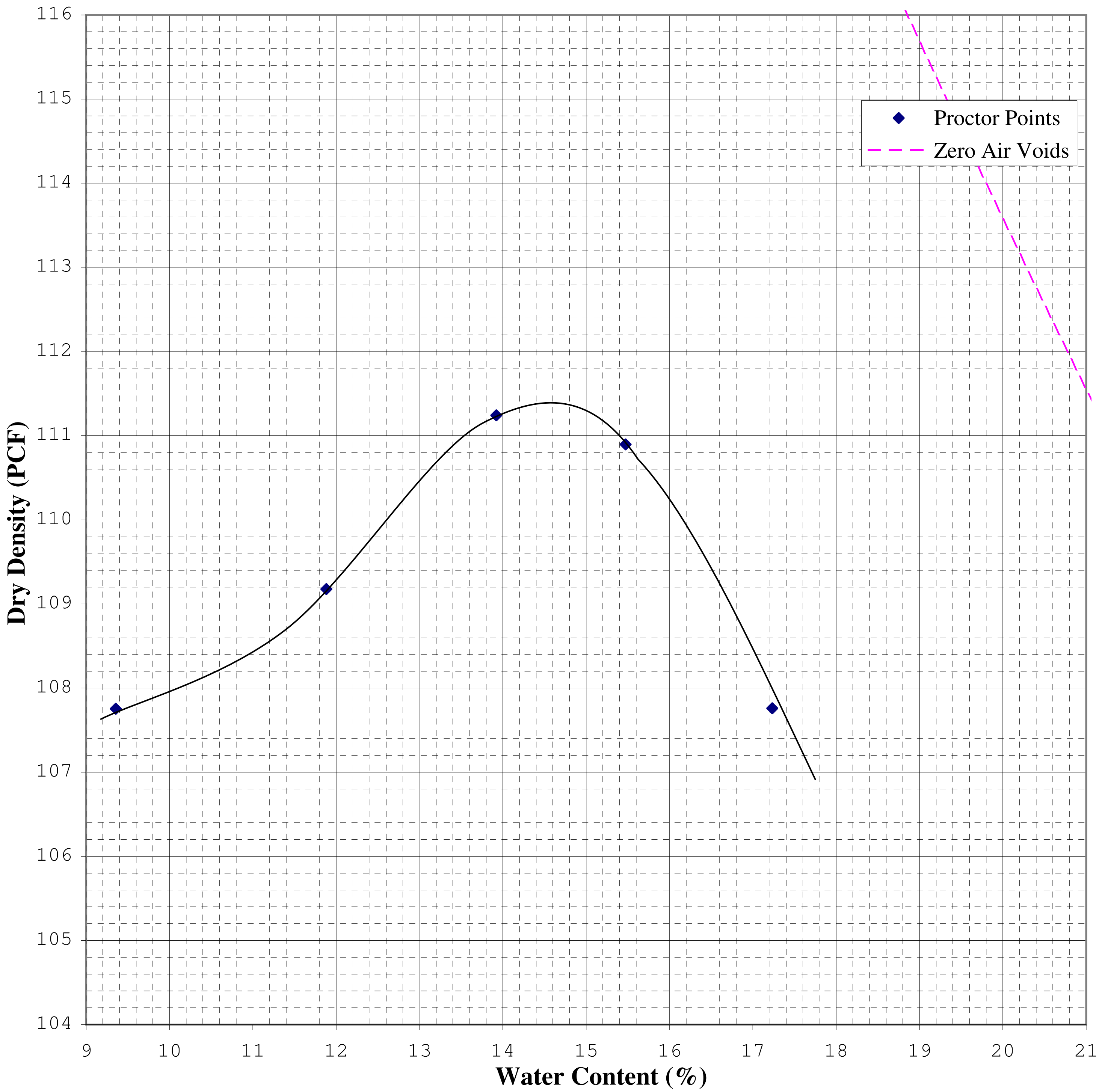
Client: **Barr Engineering Company** Job No. **6251**

Boring No. **TP-3** Sample: **Bucket #9** Depth(ft): **10** Location:

Soil Type: **Tailings (Silty Sand (SM))**

As Received W.C. (%): **7.3** LL: PL: PI: Specific Gravity: **2.86**

Maximum Dry Density (pcf): **111.4** Opt. Water Content (%): **14.5**



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SET-R18a

Moisture Density Curve ASTM: D698, Method B

Project: **Polymet #23/69-862-023B** Date: **9/20/07**

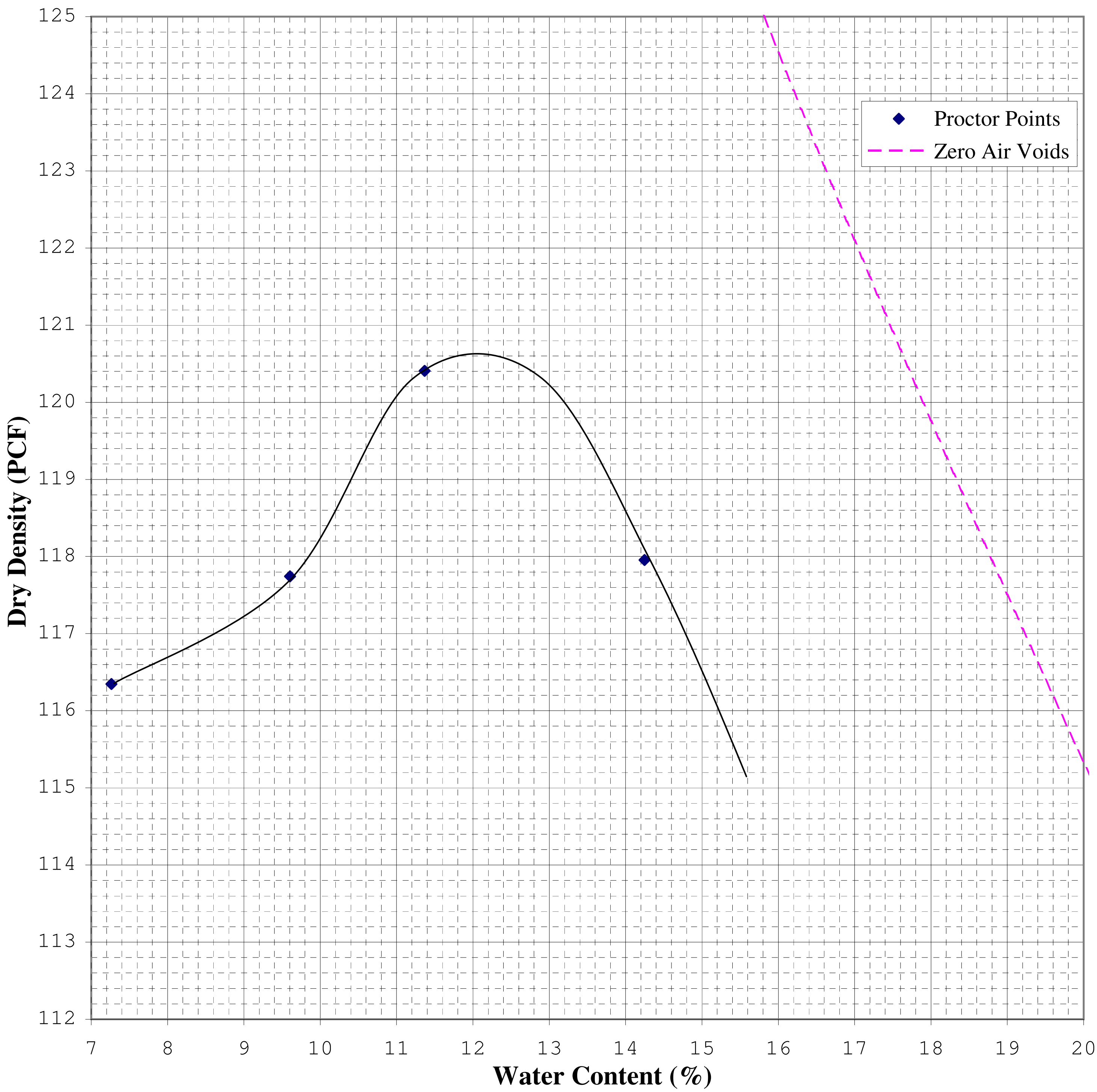
Client: **Barr Engineering Company** Job No. **6251**

Boring No. Sample: **Bucket 17** Depth(ft): **1 - 3** Location:

Soil Type: **Coarse Tailings (Sand w/Silt, Fine to Medium Grained (SP-SM))**

As Received W.C. (%): LL: PL: PI: Specific Gravity: **2.93** *Assumed

Maximum Dry Density (pcf): **120.6** Opt. Water Content (%): **12.0**



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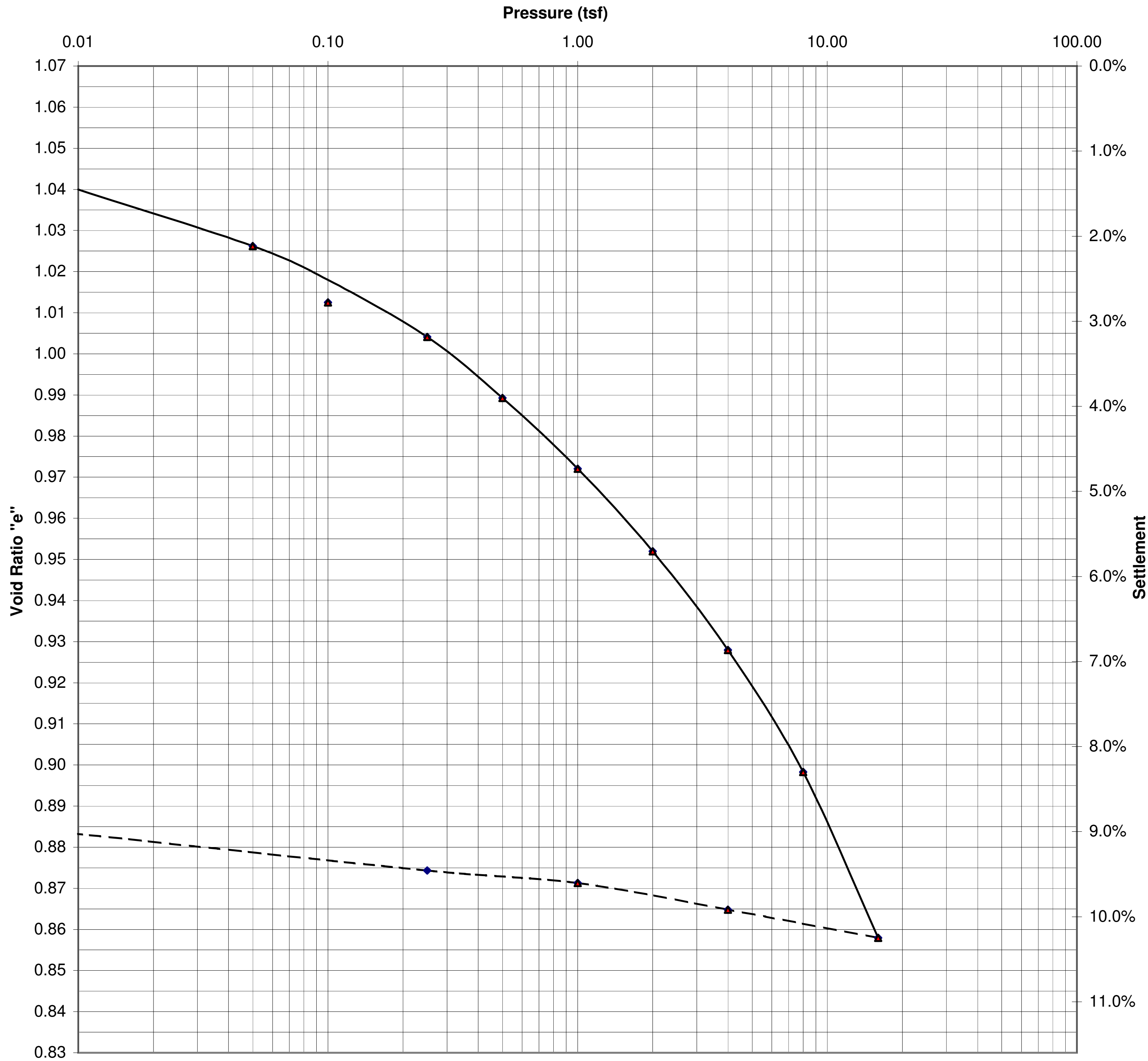
SET-R18a

Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-023B				Date: 10/26/07
Sample #:	Boring #: 07-17	Depth ft: 15-17		Job #: 6251
Soil Type: Fine Tailings (Silt w/sand (ML))				
Initial W/C (%): 31.3	Dry Density (pcf): 87.5	LL: PL: PI:		Gs: 2.90 (Assumed)
Organic Content (%):	Initial Height (in.): 0.749	Diameter (in.): 2.506	e_o= 1.069	
Preconsolidation Pressure (Pc): 1.4 tsf	Compression Index (Cc): 0.11	Recompression Index (Cr): ≅ 0.015		
Remarks:				

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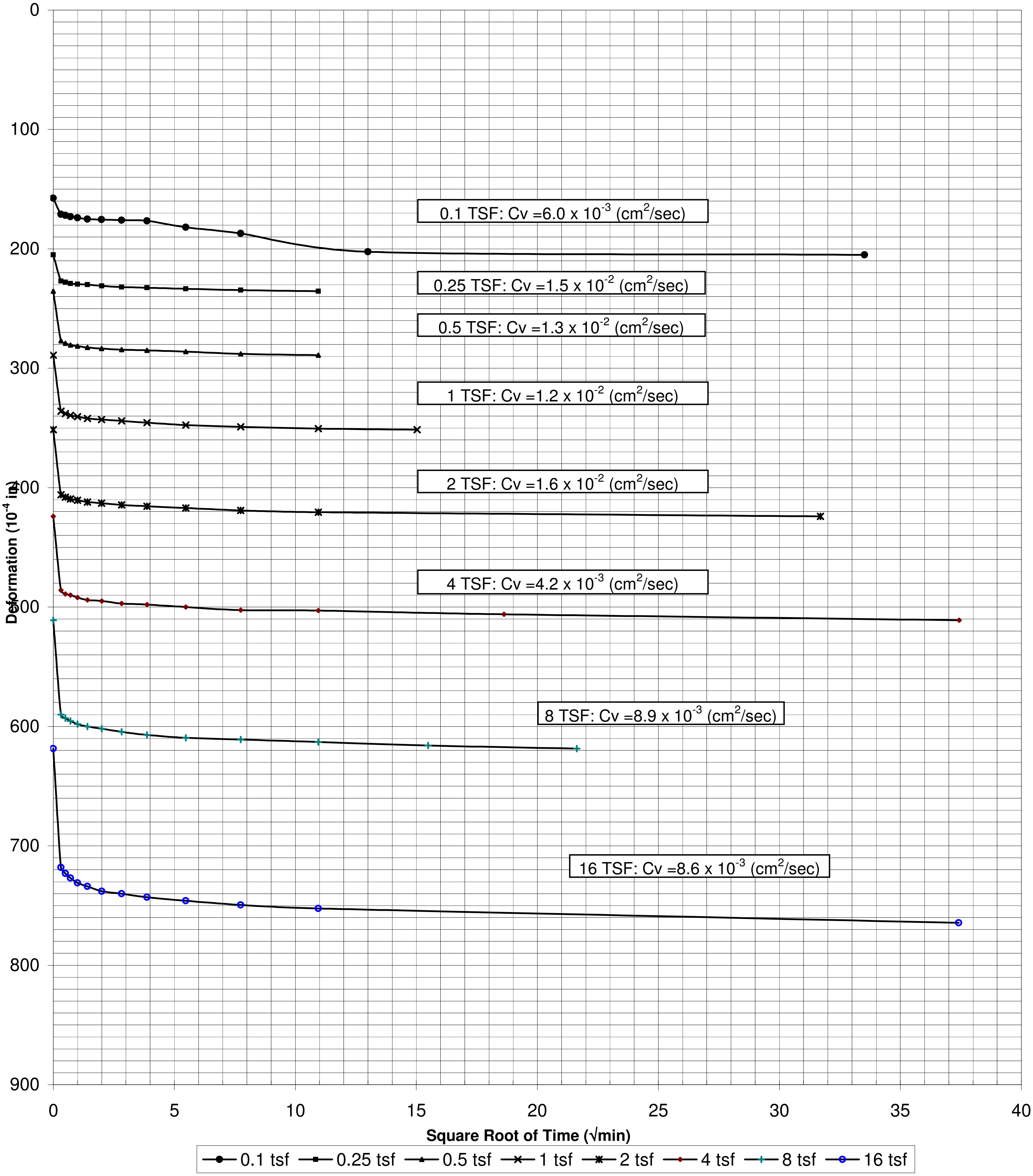
Square Root of Time Curves



Project: Polymet #23/69-862-023B			Date: 10/26/07
Sample #:	Boring #: 07-17	Depth ft: 15-17	Job #: 6251

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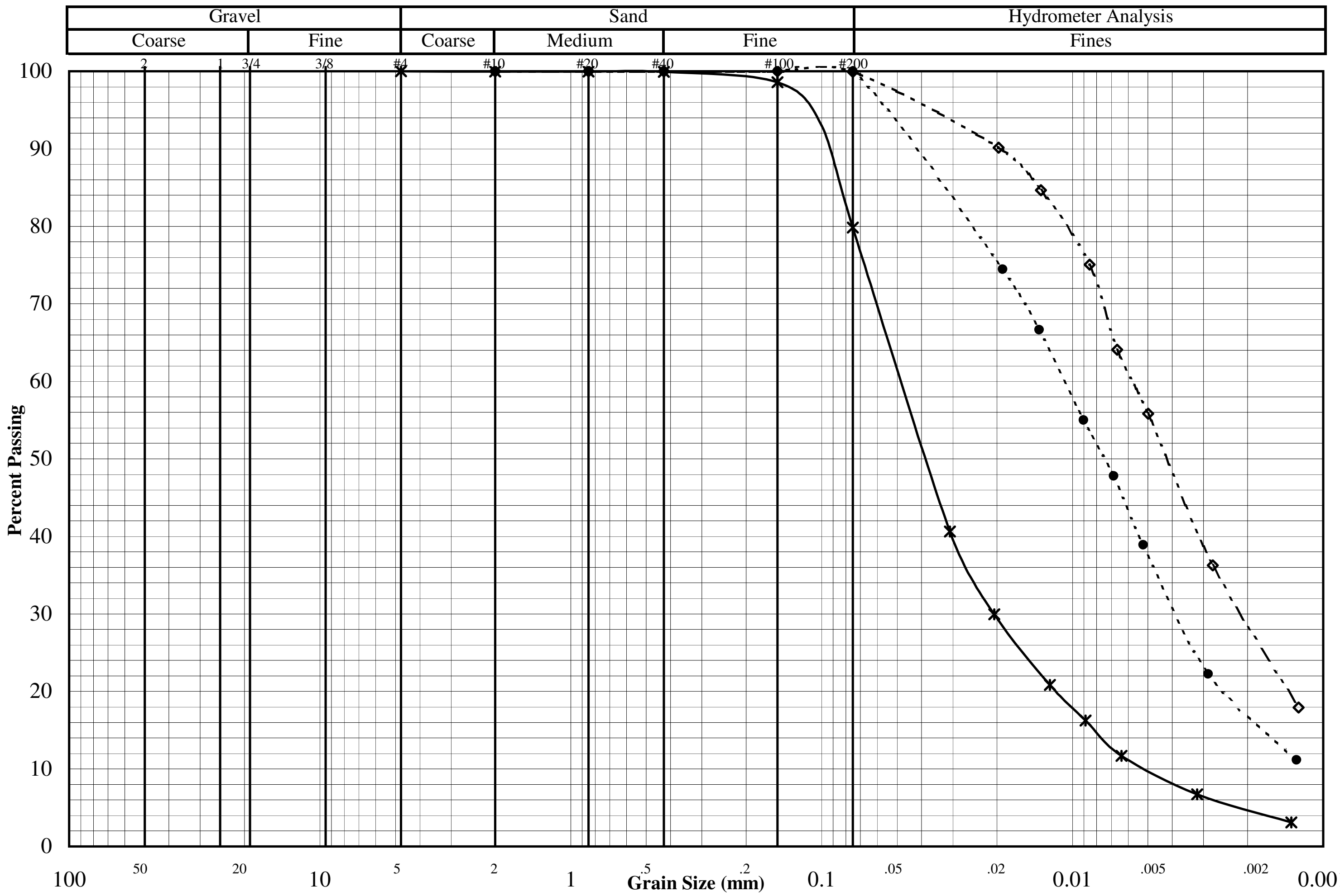
SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Project:	Polymet #23/69-862-023B	Job No. :	6251
		Test Date:	10/15/07
Reported To:	Barr Engineering Company	Report Date:	10/28/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	07-17		15-17	TWT	Slimes - Silt (ML)
●	07-17		72-74	TWT	Fine Tailings - Silt w/Sand (ML)
◇	07-21		38-40	TWT	Slimes - Silt (ML)



Other Tests

	*	●	◇
Liquid Limit		29.4	31.3
Plastic Limit		21.4	25.0
Plasticity Index		8.0	6.3
Water Content			
Dry Density (pcf)			
Specific Gravity	2.98*	2.94*	2.94
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	209.0	461.2	559.1
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0		
#10	100.0	100.0	100.0
#20	100.0	100.0	100.0
#40	99.9	100.0	100.0
#100	98.6	100.0	100.0
#200	79.9	100.0	99.9

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

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Grain Size Distribution ASTM D422

Job No. : **6251**

Project:	Polymet #23/69-862-023B	Test Date:	10/15/07
Reported To:	Barr Engineering Company	Report Date:	10/28/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	07-17		15-17	TWT	Slimes - Silt (ML)
Spec 2	07-17		72-74	TWT	Fine Tailings - Silt w/Sand (ML)
Spec 3	07-21		38-40	TWT	Slimes - Silt (ML)

Hydrometer Data

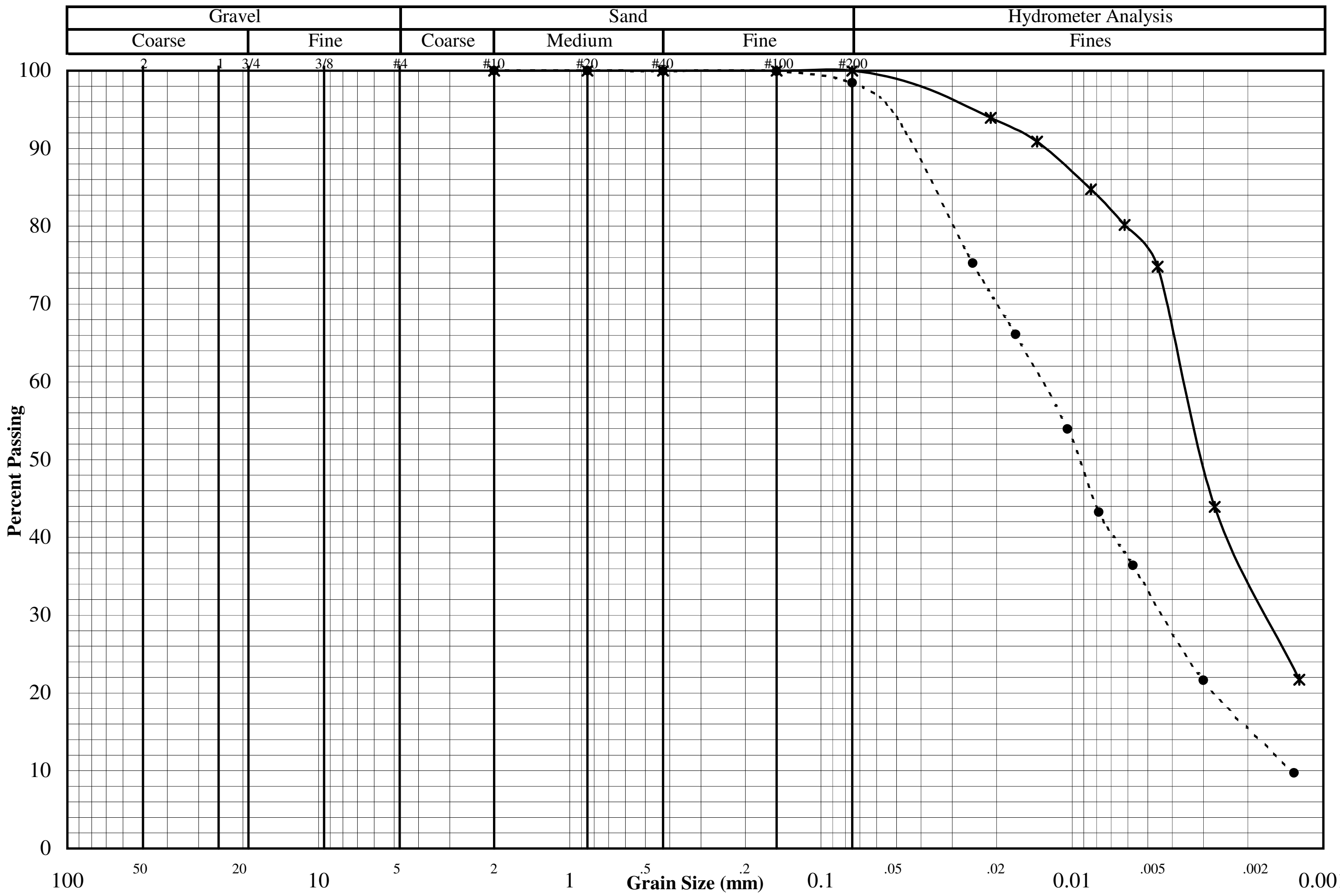
Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.031	40.6	0.019	74.4	0.020	90.1
0.020	30.0	0.014	66.7	0.013	84.7
0.012	20.8	0.009	55.0	0.009	75.0
0.009	16.3	0.007	47.8	0.007	64.1
0.006	11.7	0.005	38.9	0.005	55.8
0.003	6.7	0.003	22.3	0.003	36.3
0.001	3.1	0.001	11.2	0.001	17.9

Grain Size Distribution ASTM D422

Job No. : **6251**

Project:	Polymet #23/69-862-023B	Test Date:	10/16/07
Reported To:	Barr Engineering Company	Report Date:	10/27/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	07-23		26-28	TWT	Slimes - Silt (ML)
●	07-23		56-58	TWT	Slimes - Silt (ML)
◇					



Other Tests

	*	●	◇
Liquid Limit	37.9	29.3	
Plastic Limit	27.6	20.2	
Plasticity Index	10.3	9.1	
Water Content			
Dry Density (pcf)			
Specific Gravity	2.94	3.06	
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	129.2	495.0	
2"			
1.5"			
1"			
3/4"			
3/8"			
#4			
#10	100.0	100.0	
#20	100.0	100.0	
#40	100.0	100.0	
#100	100.0	99.9	
#200	100.0	98.5	

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

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SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Grain Size Distribution ASTM D422

Job No. : **6251**

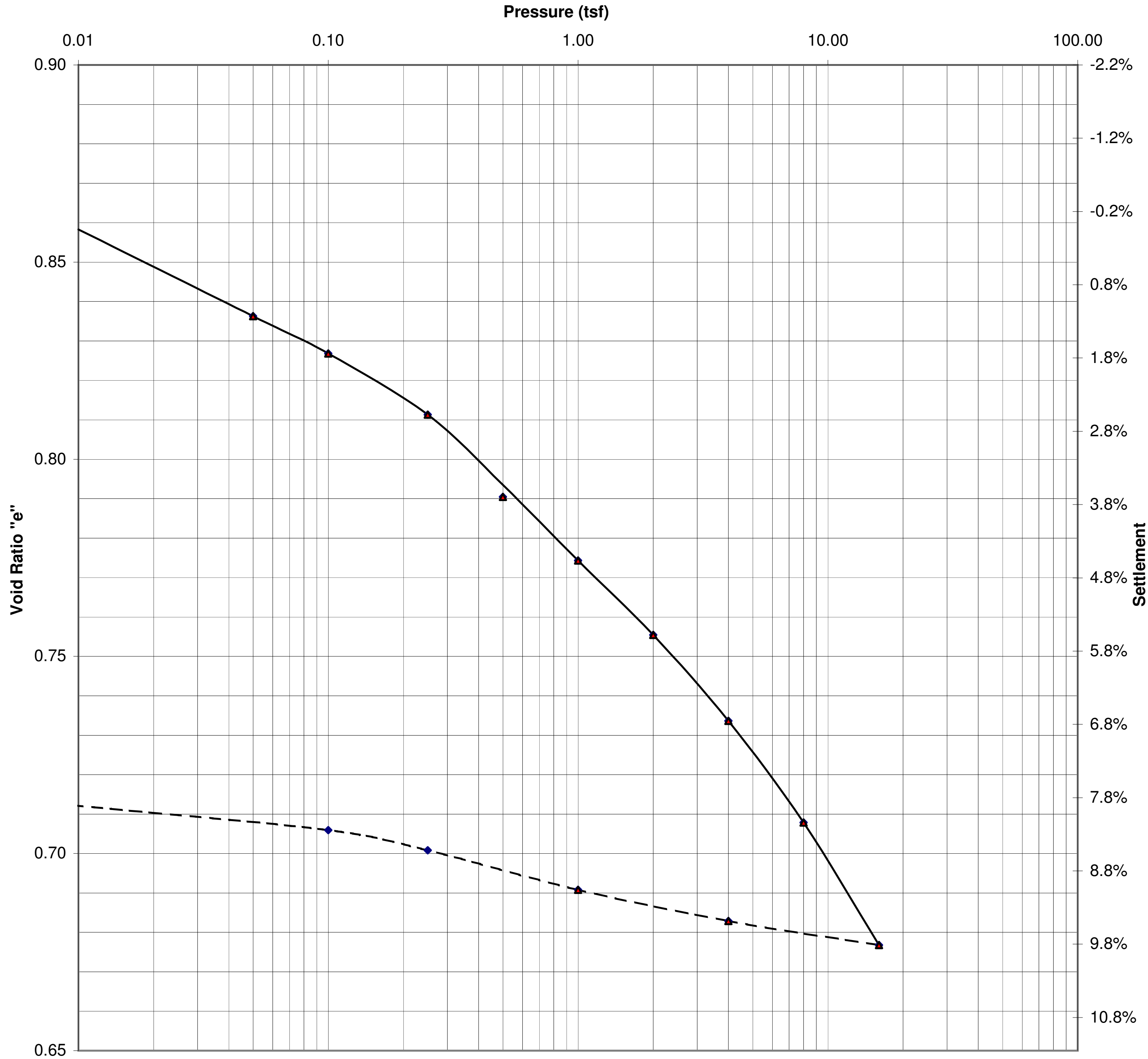
Project:	Polymet #23/69-862-023B	Test Date: 10/16/07
Reported To:	Barr Engineering Company	Report Date: 10/27/07

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	07-23		26-28	TWT	Slimes - Silt (ML)
Spec 2	07-23		56-58	TWT	Slimes - Silt (ML)
Spec 3					

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.021	93.9	0.025	75.3		
0.014	90.9	0.017	66.1		
0.008	84.8	0.010	53.9		
0.006	80.2	0.008	43.2		
0.005	74.8	0.006	36.4		
0.003	43.9	0.003	21.6		
0.001	21.7	0.001	9.7		

Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-023B			Date: 10/31/07
Sample #:	Boring #: 07-23	Depth ft: 56-58	Job #: 6251
Soil Type: Mixture: Fine Tailings and Slimes: (Lean Clay (CL))			
Initial W/C (%): 27.9	Dry Density (pcf): 102.8	LL: 29.3 PL: 20.2 PI: 9.1	Gs: 3.06
Organic Content (%):	Initial Height (in.): 0.785	Diameter (in.): 2.504	e_o= 0.858
Preconsolidation Pressure (Pc): 1.0 tsf	Compression Index (Cc): 0.10	Recompression Index (Cr): ≅ 0.01	
Remarks:			

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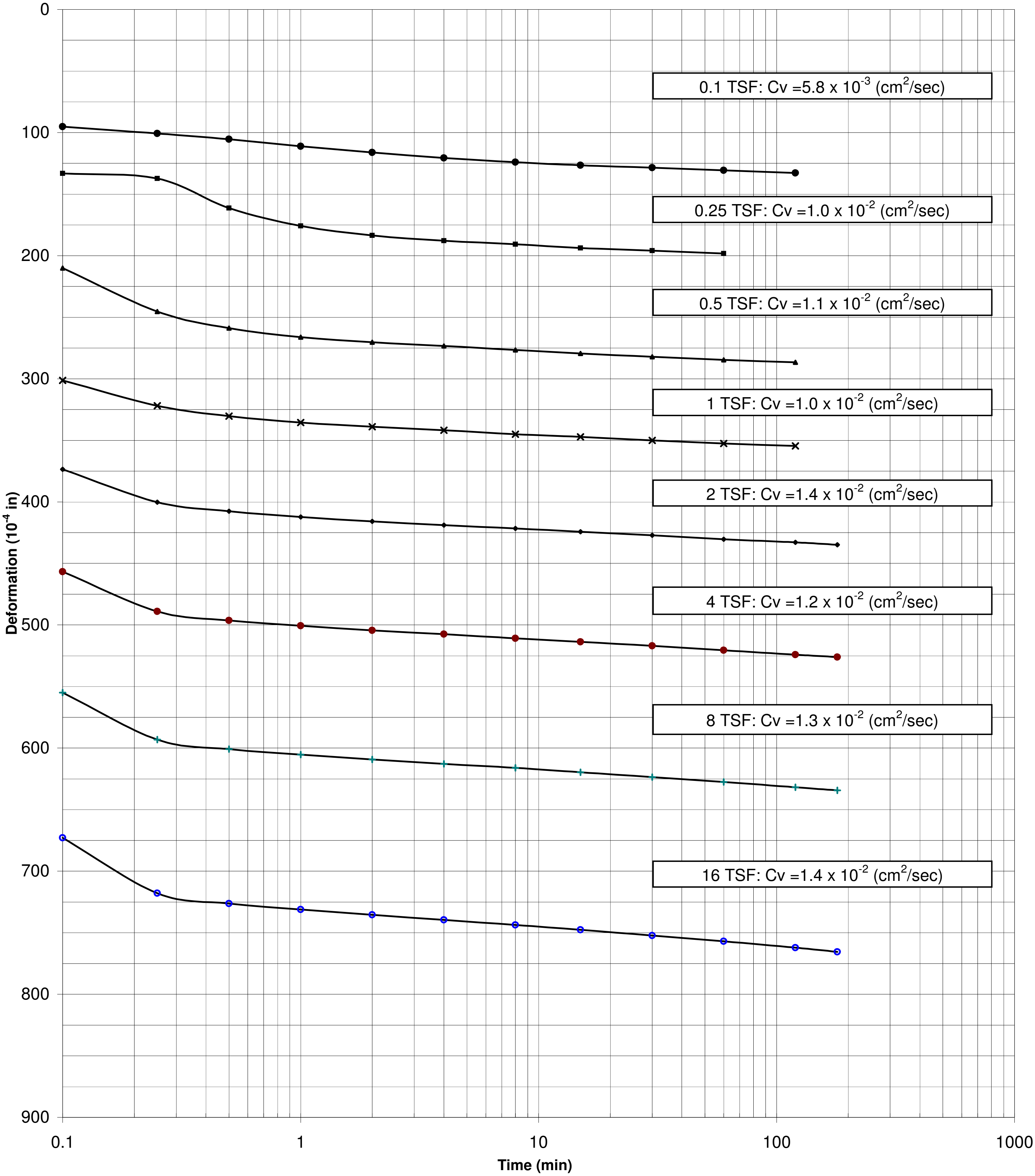
Consolidation Log of Time Curves



Project: Polymet #23/69-862-023B			Date: 10/31/07
Sample #:	Boring #: 07-23	Depth ft: 56-58	Job #: 6251

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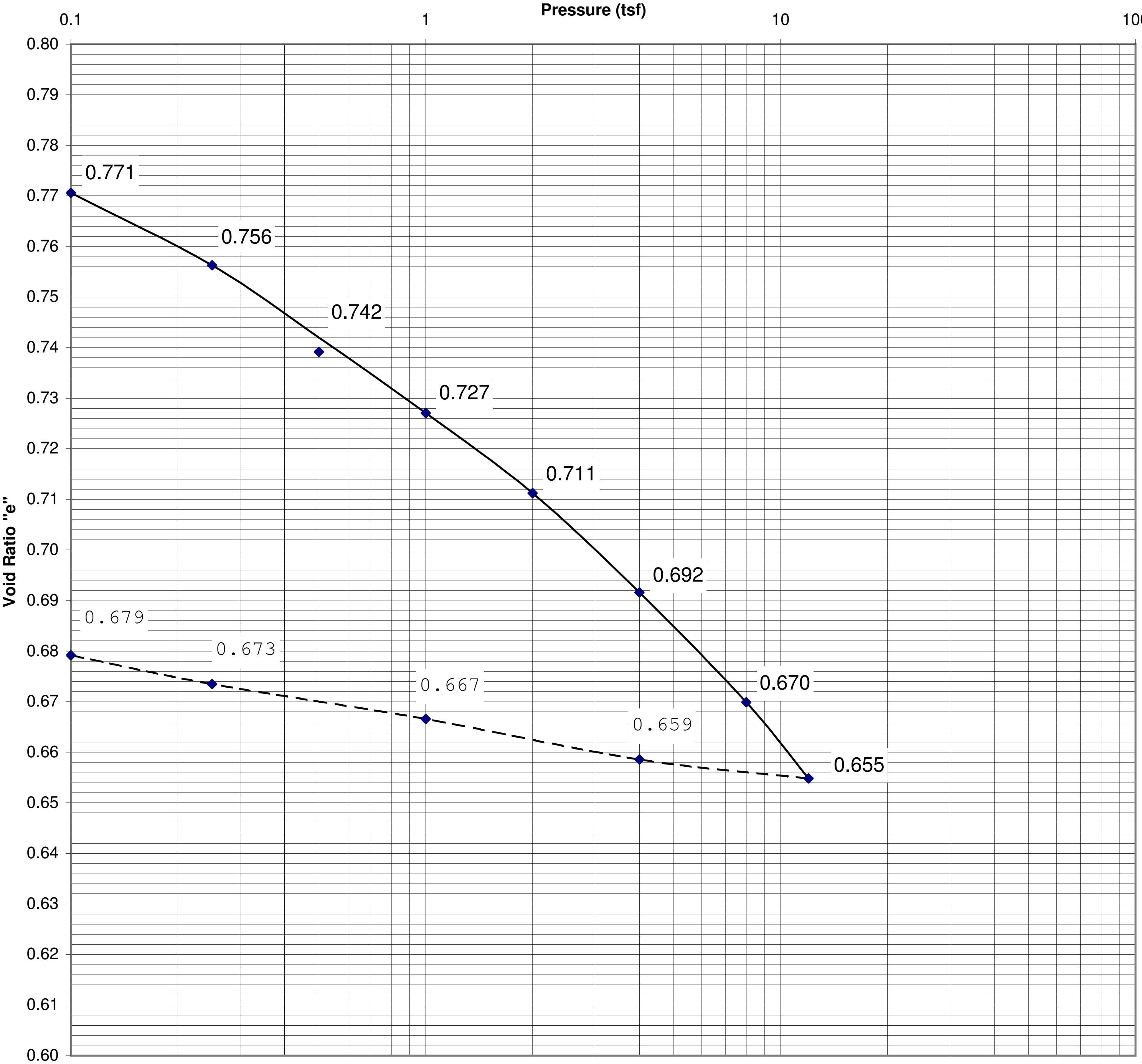
Void Ratio vs. Log of Pressure



Project: Polymet #23/69-862-023B			Date: 12/28/07
Sample #:	Boring #: TP-2	Depth ft: 15	Job #: 6251-B
Soil Type: Slimes (Silt (ML))			
Initial W/C (%): 24.1	Dry Density (pcf): 101.8	LL: PL: PI:	Gs: 3.01
Organic Content (%):	Initial Height (in.): 3.983	Diameter (in.): 1.944	e_o= 0.846
Preconsolidation Pressure (Pc):	Compression Index (Cc): 0.07	Recompression Index (Cr): ≅ 0.01	
Remarks:			

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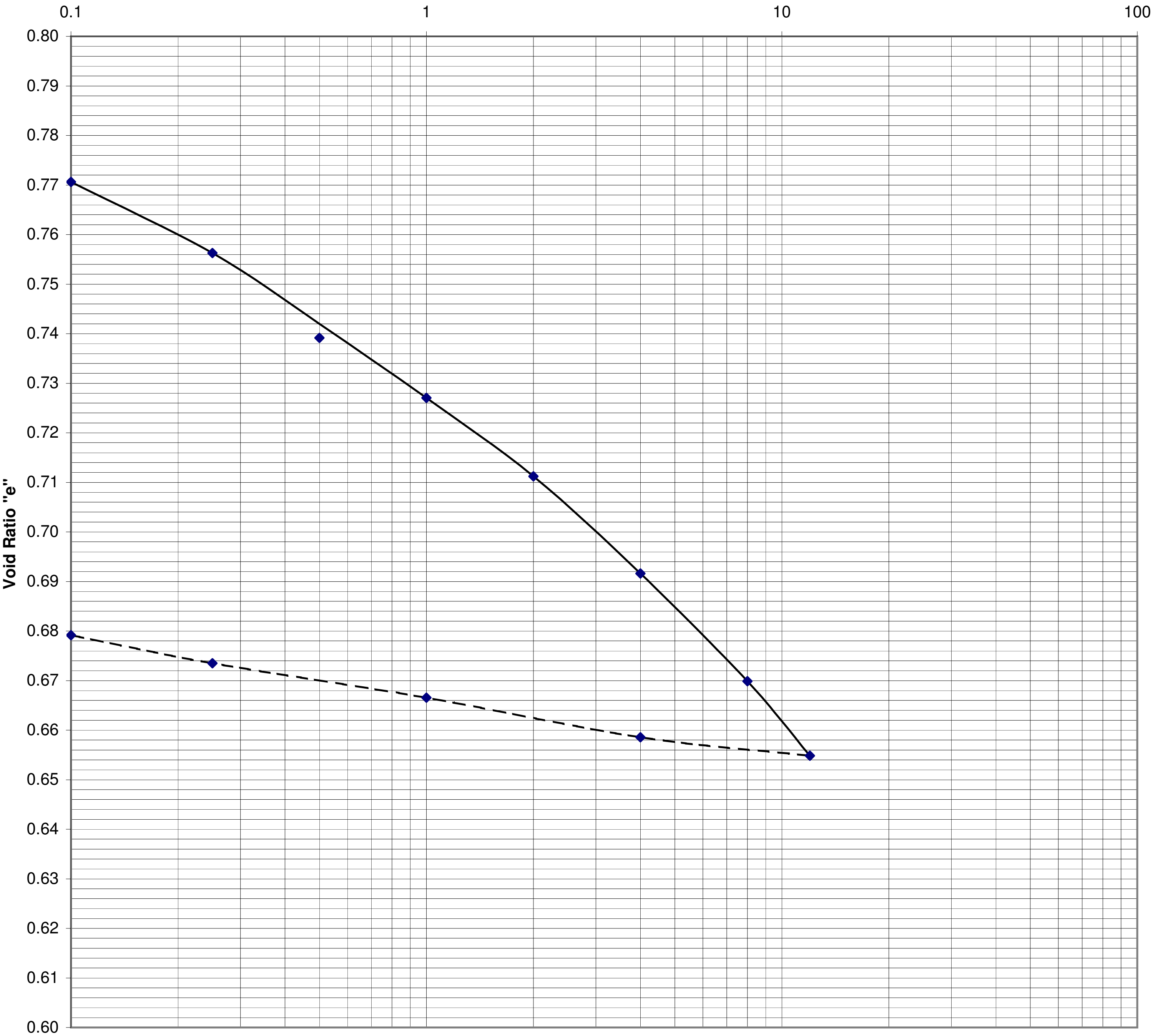
Void Ratio vs. Log of Pressure



Project: Polymet #23/69-862-023B			Date: 12/28/07
Sample #:	Boring #: TP-2	Depth ft: 15	Job #: 6251-B
Soil Type: Slimes (Silt (ML))			
Initial W/C (%): 24.1	Dry Density (pcf): 101.8	LL: PL: PI:	Gs: 3.01
Organic Content (%):	Initial Height (in.): 3.983	Diameter (in.): 1.944	e_o= 0.846
Preconsolidation Pressure (Pc):	Compression Index (Cc): 0.07	Recompression Index (Cr): ≅ 0.01	
Remarks:			

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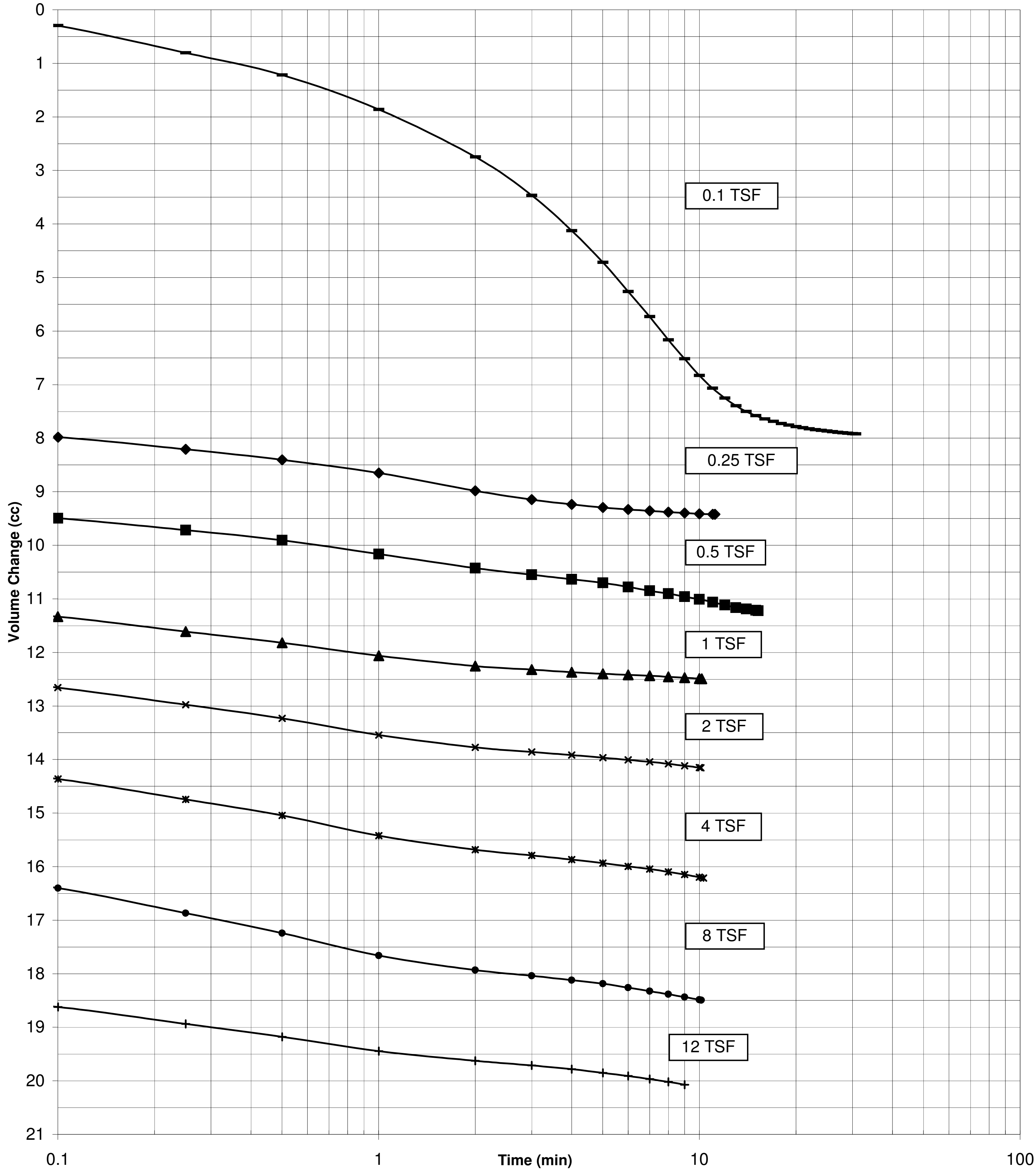
Consolidation Log of Time Curves



Project: Polymet #23/69-862-023B			Date: 12/28/07
Sample #:	Boring #: TP-2	Depth ft: 15	Job #: 6251-B

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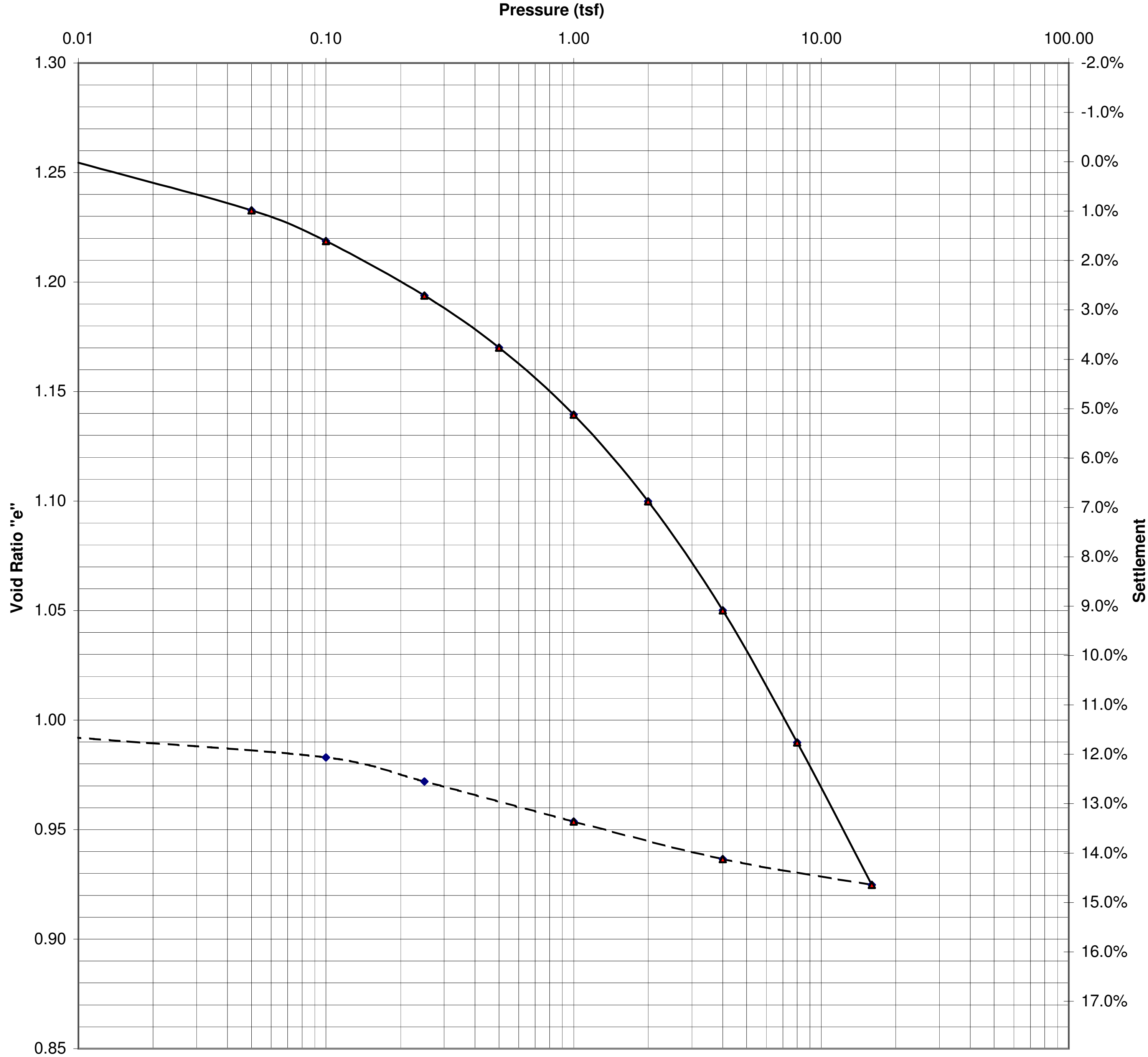
Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-023B			Date: 10/26/07
Sample #:	Boring #: 07-21	Depth ft: 38-40 (Top)	Job #: 6251
Soil Type: Slimes (Silt (ML))			
Initial W/C (%): 43.7	Dry Density (pcf): 81.4	LL: 31.3 PL: 25.0 PI: 6.3	Gs: 2.94
Organic Content (%):	Initial Height (in.): 0.749	Diameter (in.): 2.504	e_o= 1.254
Preconsolidation Pressure (Pc): 1.1 tsf	Compression Index (Cc): 0.21	Recompression Index (Cr): ≅ 0.03	
Remarks:			

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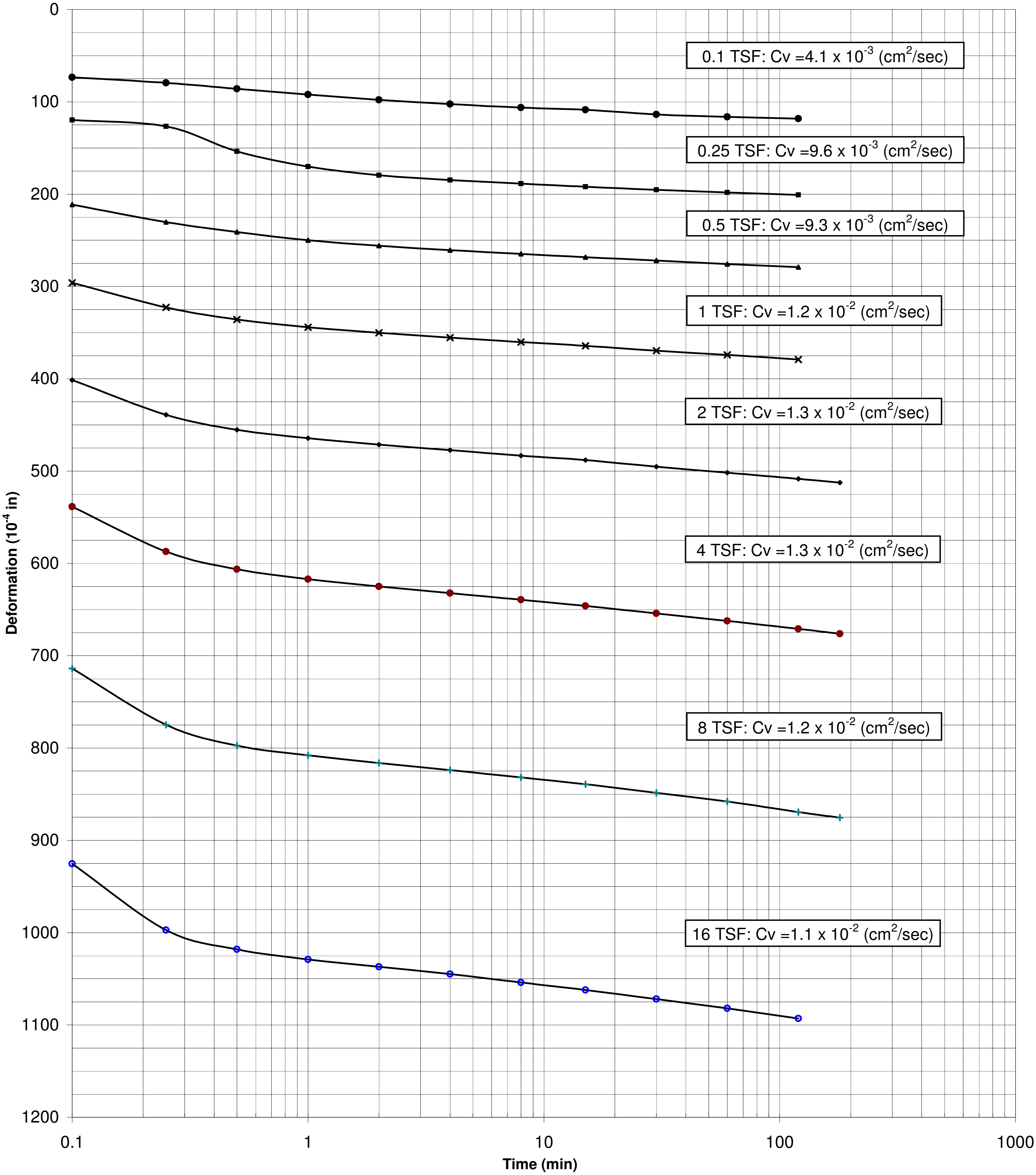
Consolidation Log of Time Curves



Project: Polymet #23/69-862-023B			Date: 10/26/07
Sample #:	Boring #: 07-21	Depth ft: 38-40 (Top)	Job #: 6251

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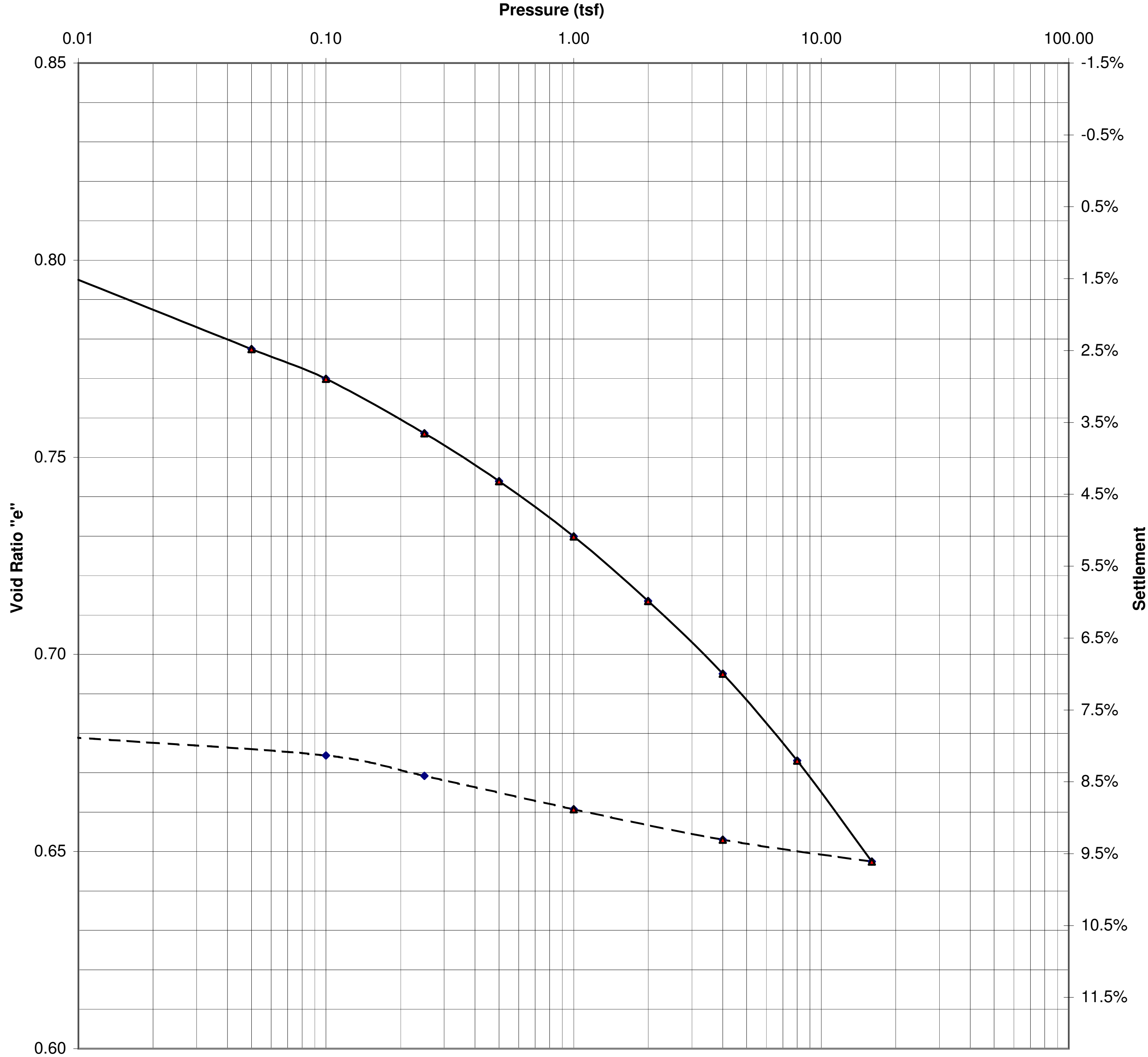
Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-023B				Date: 10/26/07
Sample #:	Boring #: 07-21	Depth ft: 82-84 (Top)		Job #: 6251
Soil Type: Slimes (Silt (ML))				
Initial W/C (%): 27.7	Dry Density (pcf): 100.7	LL: PL: PI:		Gs: 2.94
Organic Content (%):	Initial Height (in.): 0.785	Diameter (in.): 2.504	e_o= 0.823	
Preconsolidation Pressure (Pc): 1.0 tsf	Compression Index (Cc): 0.08	Recompression Index (Cr): ≅ 0.01		
Remarks:				

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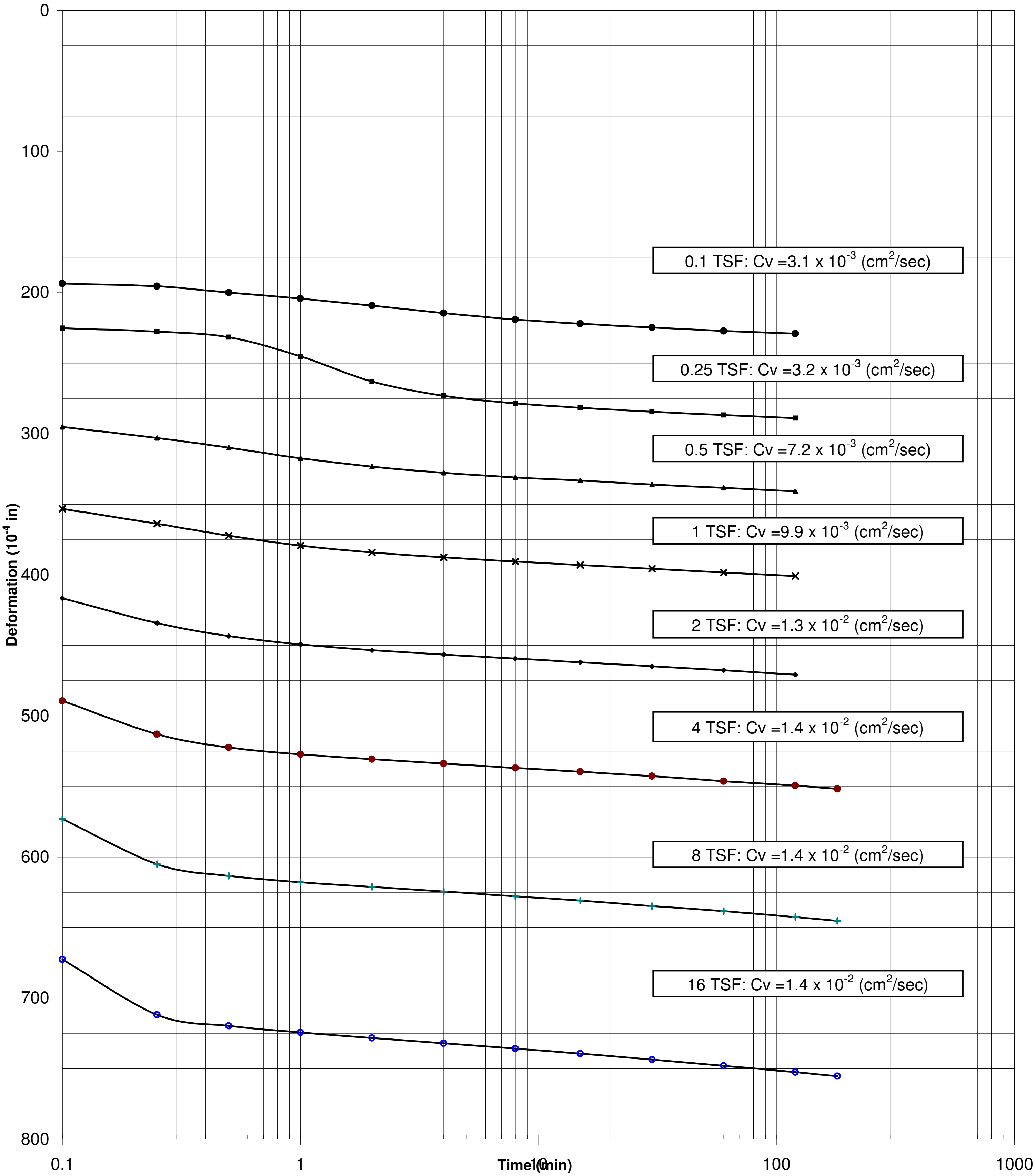
Consolidation Log of Time Curves



Project: Polymet #23/69-862-023B			Date: 10/26/07
Sample #:	Boring #: 07-21	Depth ft: 82-84 (Top)	Job #: 6251

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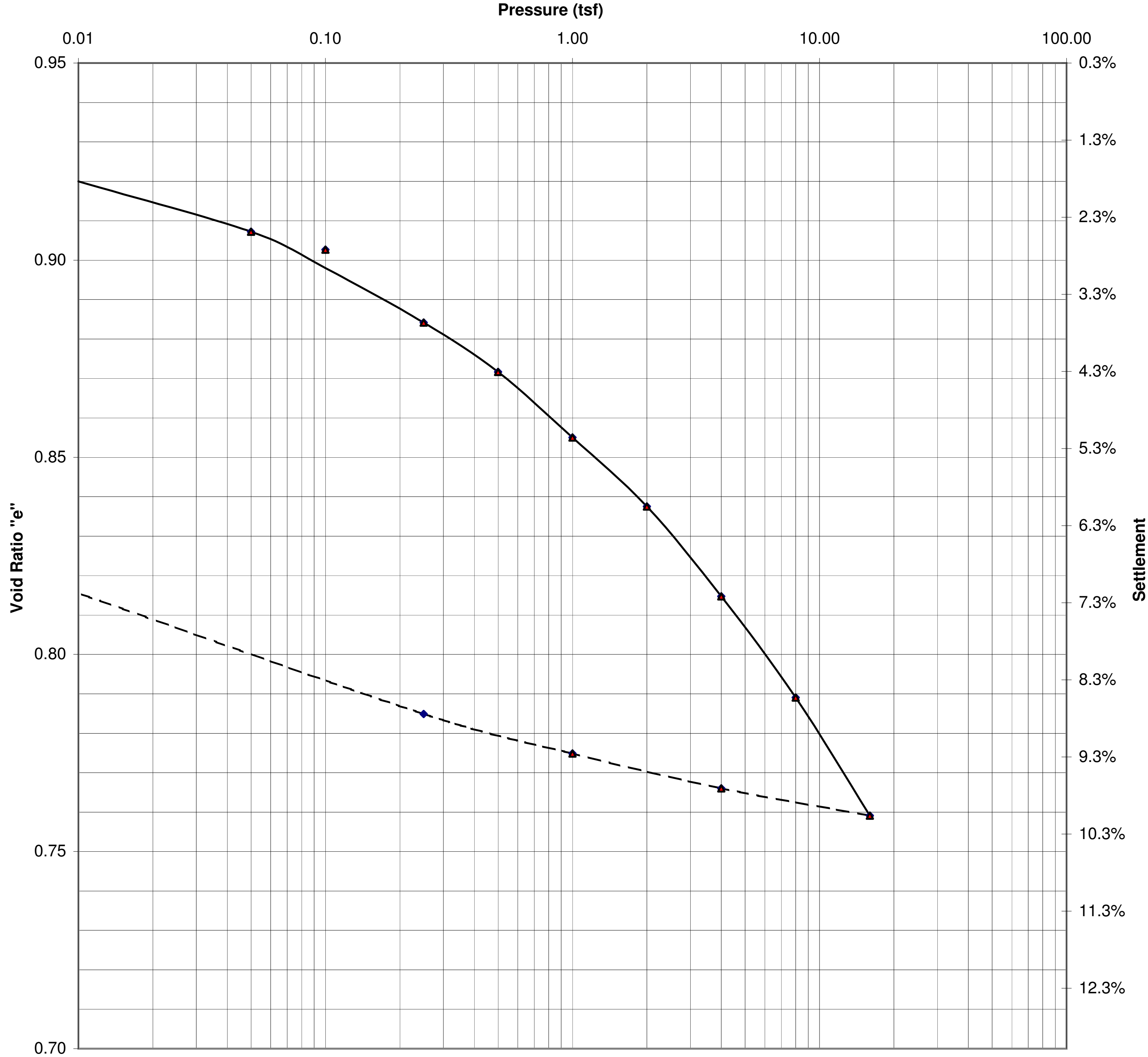
Void Ratio and % Settlement vs. Log of Pressure



Project: Polymet #23/69-862-023B				Date: 10/30/07
Sample #:	Boring #: 07-22	Depth ft: 138-140		Job #: 6251
Soil Type: Slimes (Silt (ML))				
Initial W/C (%): 32.0	Dry Density (pcf): 95.8	LL:	PL: PI:	Gs: 3.00
Organic Content (%):	Initial Height (in.): 0.750	Diameter (in.): 2.503	e_o= 0.955	
Preconsolidation Pressure (Pc): 0.91 tsf	Compression Index (Cc): 0.10	Recompression Index (Cr): ≅ 0.015		
Remarks:				

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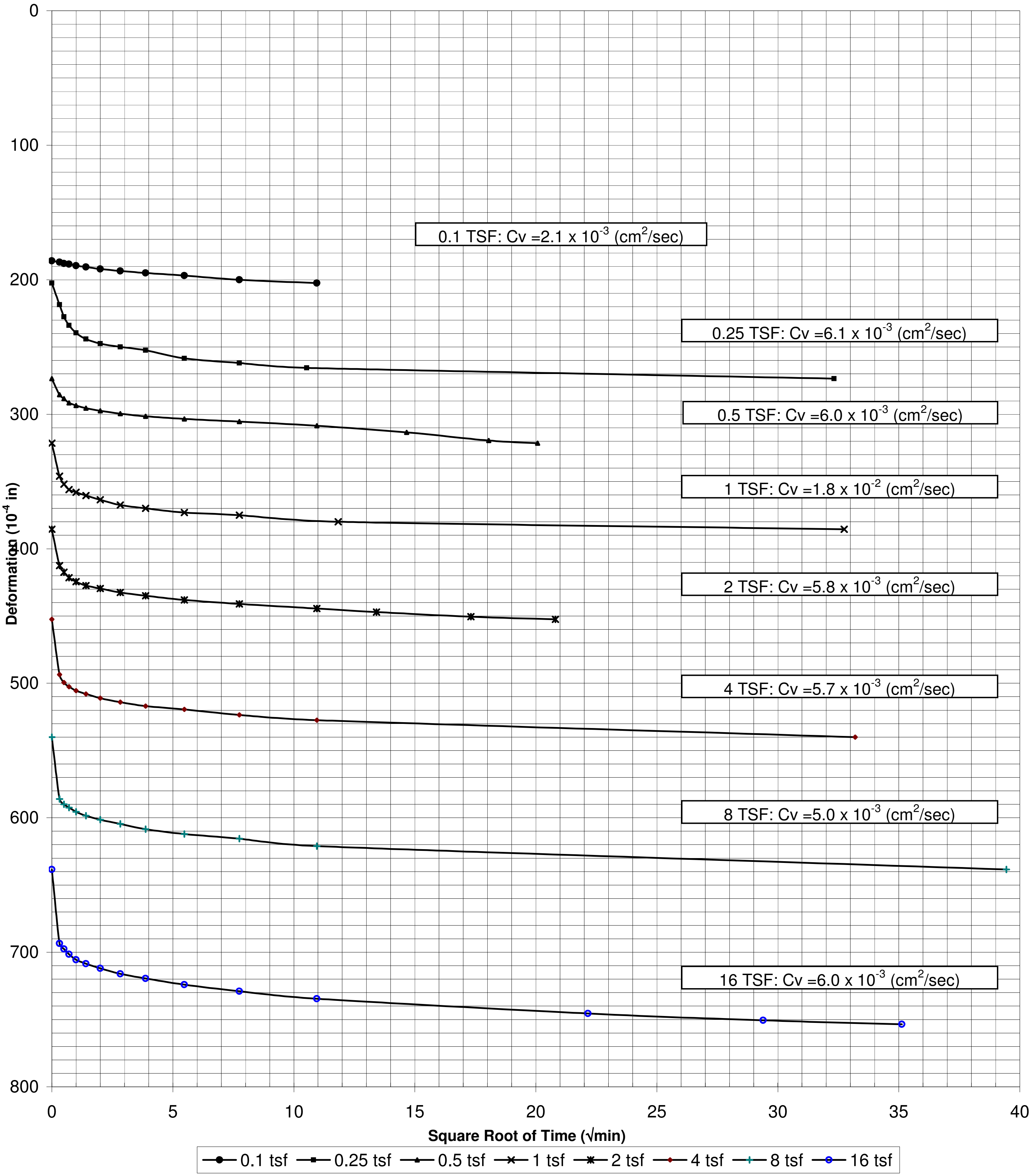
Bloomington, Minnesota 55420-3436

Square Root of Time Curves



Project: Polymet #23/69-862-023B			Date: 10/30/07
Sample #:	Boring #: 07-22	Depth ft: 138-140	Job #: 6251

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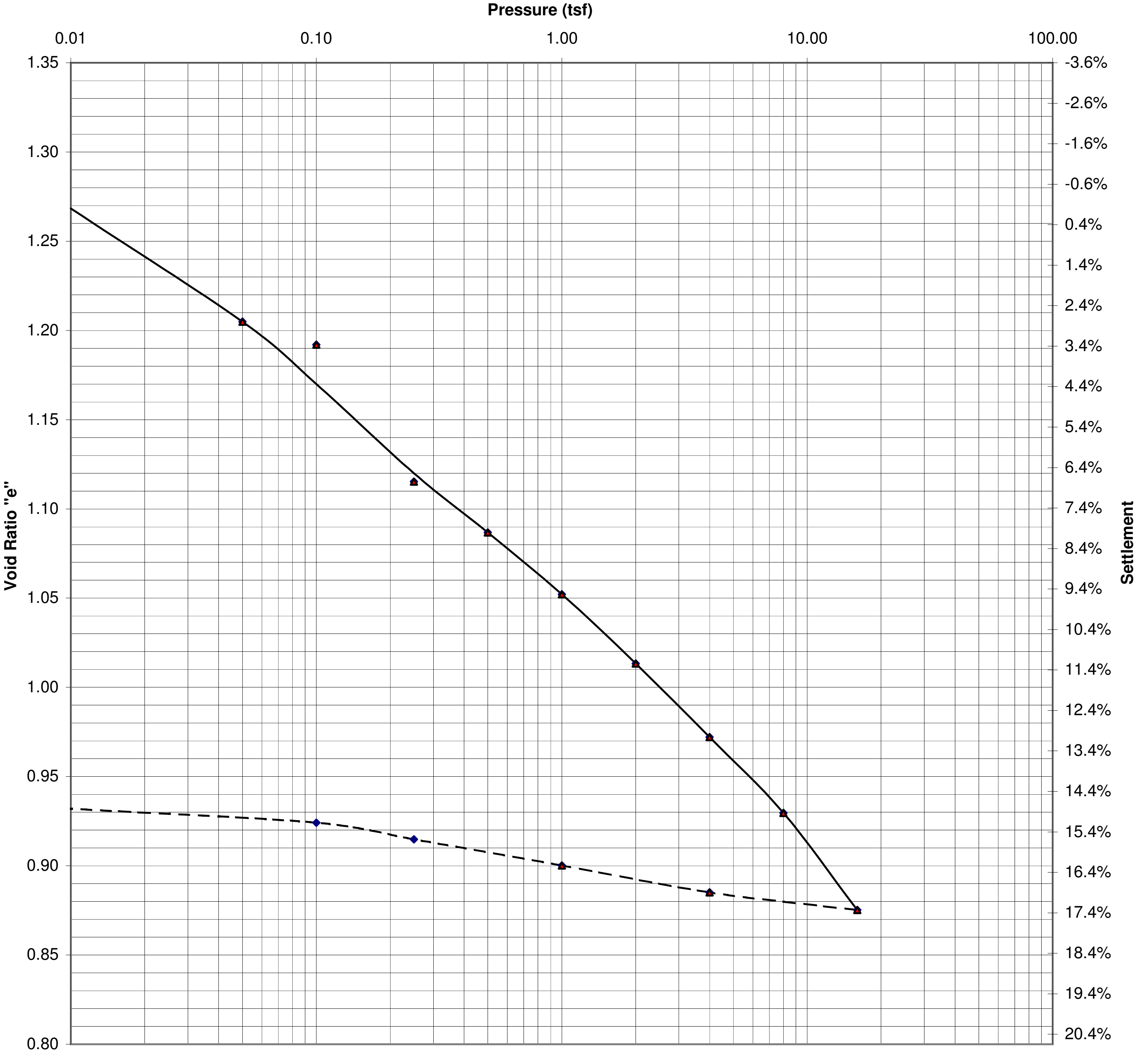
Void Ratio and % Settlement vs. Log of Pressure



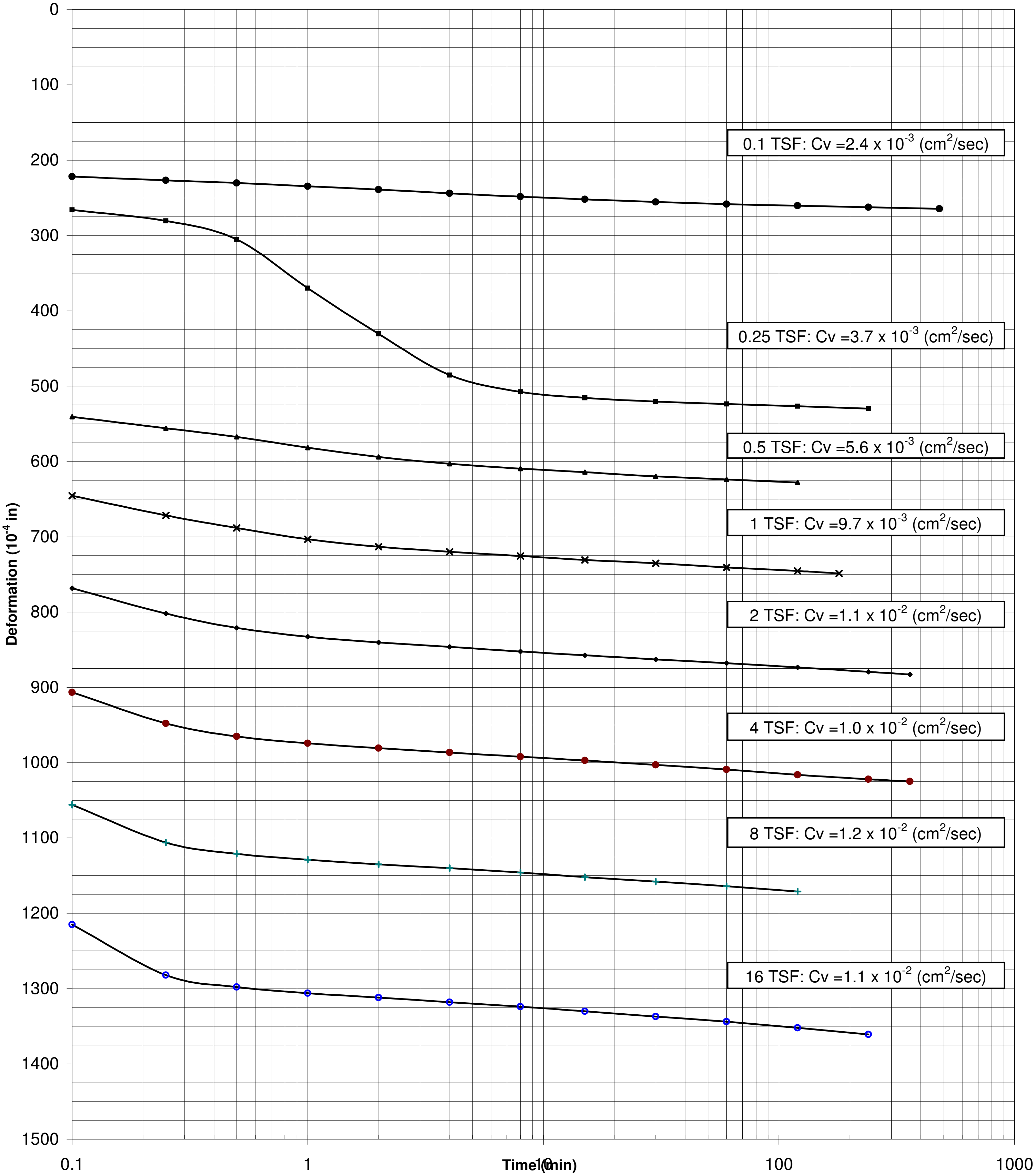
Project: Polymet #23/69-862-023B			Date: 10/31/07
Sample #:	Boring #: 07-23	Depth ft: 26-28	Job #: 6251
Soil Type: Slimes (Silt (ML))			
Initial W/C (%): 42.2	Dry Density (pcf): 80.9	LL: 37.9 PL: 27.6 PI: 10.3	Gs: 2.94
Organic Content (%):	Initial Height (in.): 0.785	Diameter (in.): 2.504	e_o= 1.268
Preconsolidation Pressure (Pc): 0.38 tsf	Compression Index (Cc): 0.17	Recompression Index (Cr): ≅ 0.02	
Remarks:			

9301 Bryant Ave. South, Suite 107

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55420-3436

Consolidation Log of Time Curves



Project: Polymet #23/69-862-023B			Date: 10/31/07
Sample #:	Boring #: 07-23	Depth ft: 26-28	Job #: 6251

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Bloomington, Minnesota 55420-3436

Laboratory Test Summary

Job No. 6251

Date: 10-15-07

Project / Client: PolyMet - #23/69-862-023B / Barr Engineering Company

Sample Information & Classification

Boring	07-17	07-17
Depth (ft)	72-74	124-126
Type or BPF	TWT	TWT
Soil Classification ASTM: D2487/2488	Slimes Silt (ML)	Slimes Silt (ML)

Water Content and Dry Density

Water Content (%)	34.4	34.8
Dry Density (pcf)	90.8	90.5

Atterberg Limits

Liquid Limit	29.4	
Plastic Limit	21.4	
Plasticity Index	8.0	

Permeability Test Data

Project: Polymet #23/69-862-023B Date: 10/28/2007

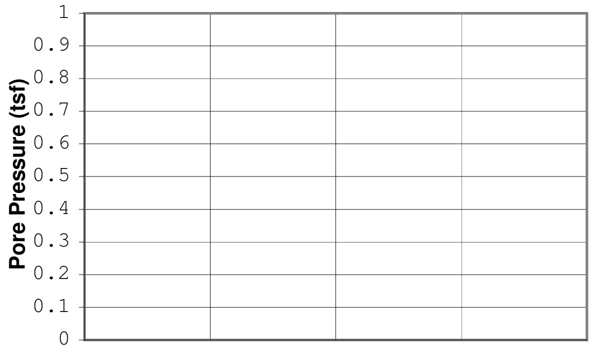
Reported To: Barr Engineering Company Job No.: 6251

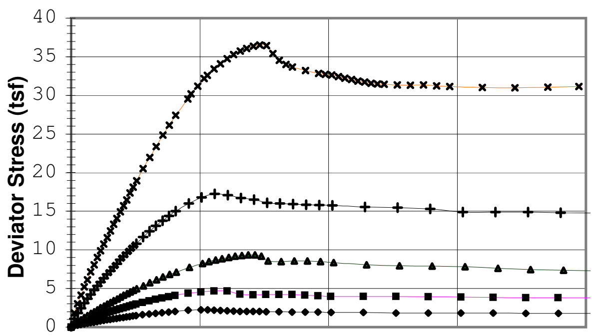
Boring No.:	07-21	07-23	07-23	07-23			
Sample No.:							
Depth (ft)	82-84	26-28	26-28	26-28			
Location:							
Sample Type:	TWT	TWT	TWT	TWT			
Soil Type:	Slimes Silt (ML)	Slimes Silt (ML)	Slimes Silt (ML)	Slimes Silt (ML)			
Atterberg Limits							
LL		37.9					
PL		27.6					
PI		10.3					
Permeability Test		A	B	C			
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	1.96	2.50					
Dia. (in):	2.88	2.88					
Dry Density (pcf):	105.9	85.8					
Water Content:	24.5%	38.4%					
Test Type:	Falling	Falling	Falling	Falling			
Max Head (ft):	5.0	5.0	5.0	5.0			
Confining press. (Effective-psi):	36.0	13.9	27.9	41.7			
Trial No.:	12-16	14-18	6-10	6-10			
Water Temp °C:	23.0	23.0	23.0	23.0			
% Compaction							
% Saturation (After Test)	97.4%			96.8%			
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**3.2×10^{-6}**	**6.2×10^{-7}**	**5.7×10^{-7}**	**5.3×10^{-7}**			
K @ 20 °C (ft/min)	**6.3×10^{-6}**	**1.2×10^{-6}**	**1.1×10^{-6}**	**1.0×10^{-6}**			
Notes:							

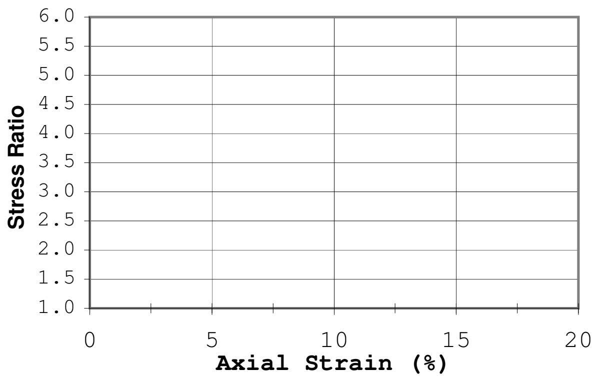
TRIAXIAL TEST ASTM: D 4767

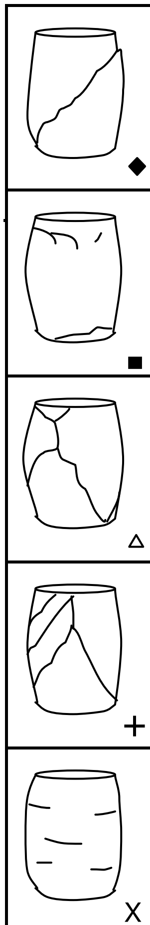
Job No. **6251-B**
Date: **12/28/07**

Project:	**Polymet**						
Boring #:	**TP-2**	Sample #:		Type:	**Reconstituted**	Depth (ft):	**15**
Soil Type:	**Slimes (Silt (ML))**						









Failure Criterion: **Max. Deviator Stress**

Angle of internal friction, ϕ = **43.9 °**

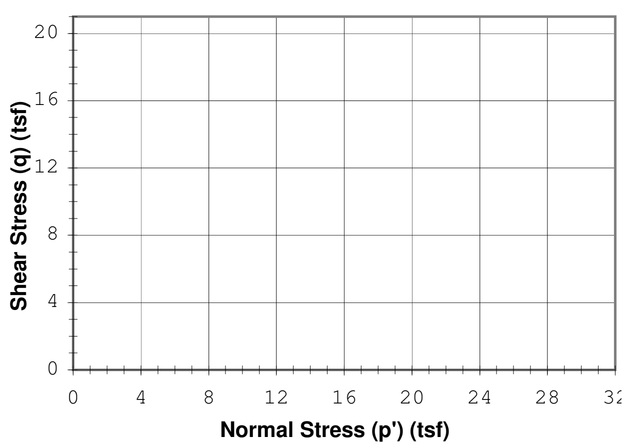
Apparent Cohesion, **c'** = **0.00 (tsf)**

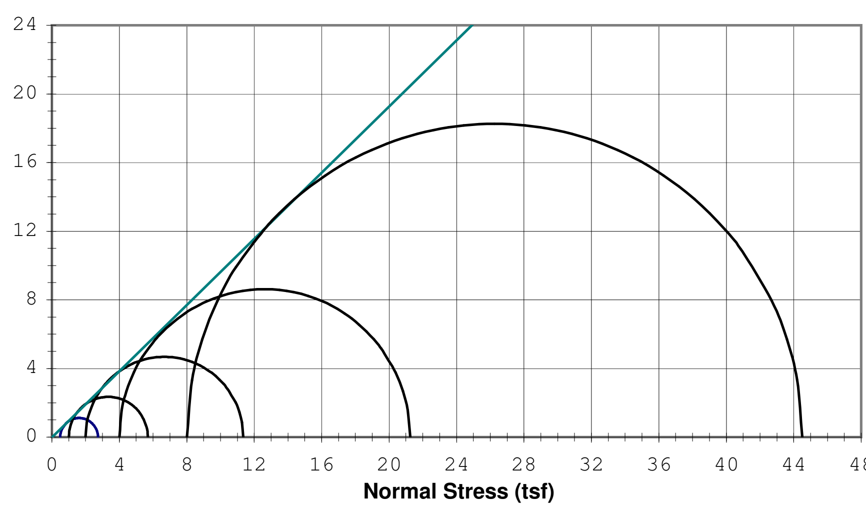
Test Date:	12/12/07	Liquid Limit:	
Test Type:	CD	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity :	3.01

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	23.8	24.9	24.1	24.0	25.2
Dry Density (pcf)	102.2	101.1	103.8	104.1	104.8
Void Ratio	0.84	0.86	0.81	0.81	0.79
After Consolidation					
Diameter (in)	1.91	1.90	1.92	1.90	1.88
Height (in)	3.96	3.96	3.92	3.94	3.93
Water Content (%)	25.7	25.2	24.3	23.7	21.5
Dry Density (pcf)	106.0	106.9	108.6	109.6	114.0
Void Ratio	0.77	0.76	0.73	0.71	0.65
Back Pressure (tsf)					
Minor Principal Stress (tsf)	0.50	1.00	2.00	4.00	8.00
Max. Deviator Stress (tsf)	2.23	4.69	9.35	17.25	36.51
Ultimate Deviator Stress (tsf)	1.76	3.77	7.35	14.8	31.135
Deviator Stress at Failure (tsf)	2.23	4.69	9.35	17.25	36.51
Max. Pore Pressure Buildup (tsf)					
Pore Pressure Parameter "B"					
Pct. Axial Strain at Failure	5.0	5.6	6.9	5.6	7.3

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks:





Total ϕ': 43.9 ° c= -0.01 (tsf)

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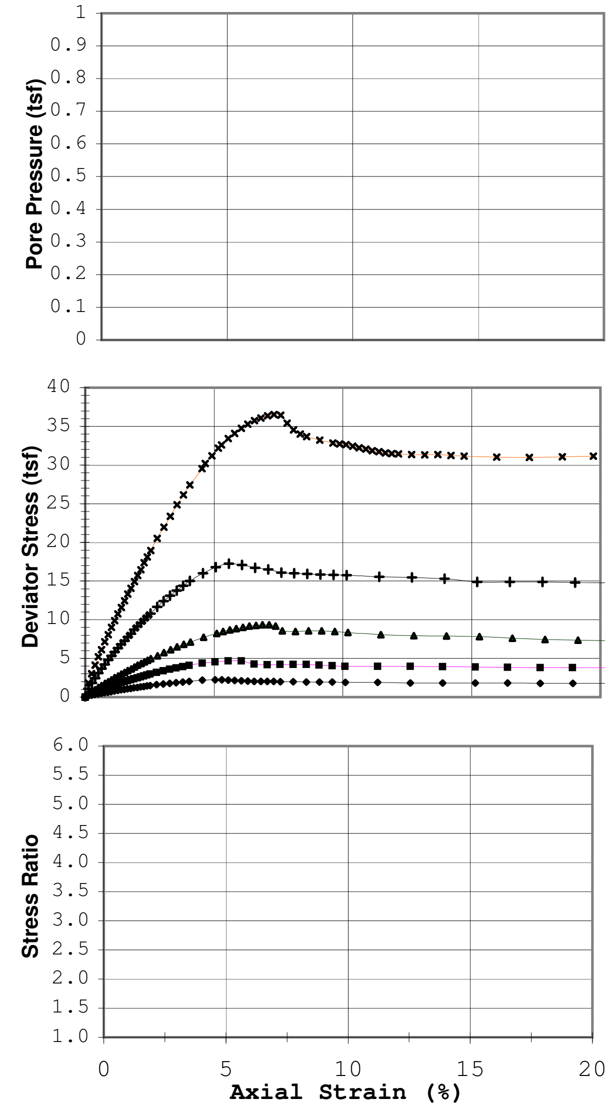
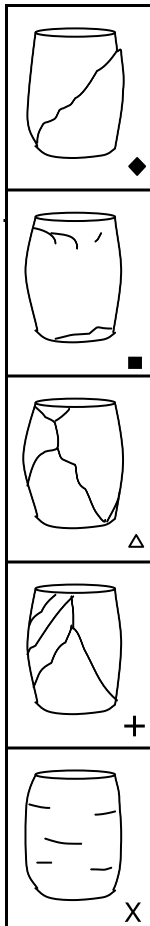
TRIAXIAL TEST ASTM: D 4767

Job No. **6251-B**
Date: **12/28/07**

Project:	**Polymet**						
Boring #:	**TP-2**	Sample #:		Type:	**Reconstituted**	Depth (ft):	**15**
Soil Type:	**Slimes (Silt (ML))**						





Failure Criterion: **Given Strain of: 15%**

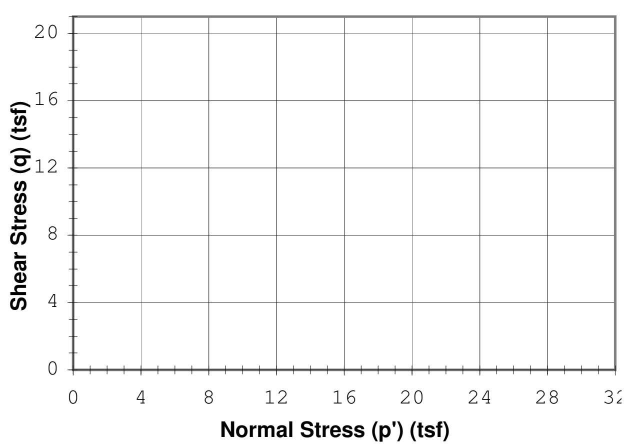
Angle of internal friction, ϕ = **41.3 °**
Apparent Cohesion, **c'** = **0.00 (tsf)**

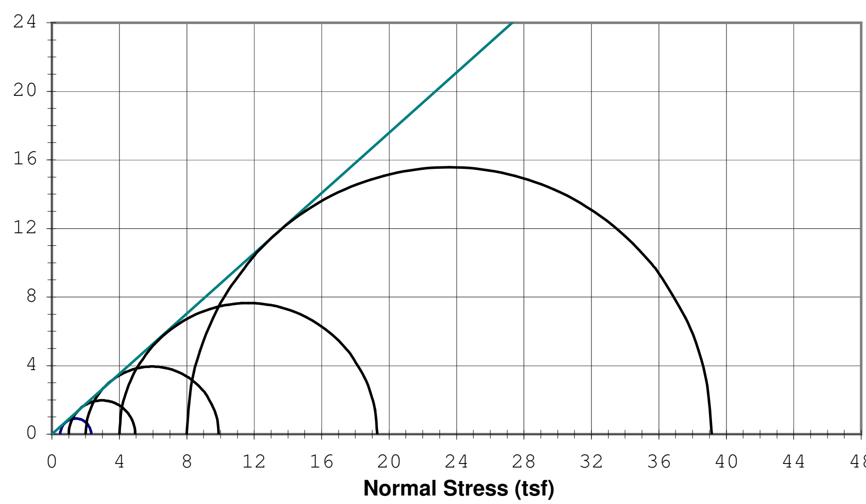
Test Date:	12/12/07	Liquid Limit:	
Test Type:	CD	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity :	3.01

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	23.8	24.9	24.1	24.0	25.2
Dry Density (pcf)	102.2	101.1	103.8	104.1	104.8
Void Ratio	0.84	0.86	0.81	0.81	0.79
After Consolidation					
Diameter (in)	1.91	1.90	1.92	1.90	1.88
Height (in)	3.96	3.96	3.92	3.94	3.93
Water Content (%)	25.7	25.2	24.3	23.7	21.5
Dry Density (pcf)	106.0	106.9	108.6	109.6	114.0
Void Ratio	0.77	0.76	0.73	0.71	0.65
Back Pressure (tsf)					
Minor Principal Stress (tsf)	0.50	1.00	2.00	4.00	8.00
Max. Deviator Stress (tsf)	2.23	4.69	9.35	17.25	36.51
Ultimate Deviator Stress (tsf)	1.76	3.77	7.35	14.8	31.135
Deviator Stress at Failure (tsf)	1.83	3.94	7.89	15.29	31.14
Max. Pore Pressure Buildup (tsf)					
Pore Pressure Parameter "B"					
Pct. Axial Strain at Failure	15.0	15.0	15.0	15.0	15.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks:





Total ϕ': 41.3 ° c= -0.01 (tsf)

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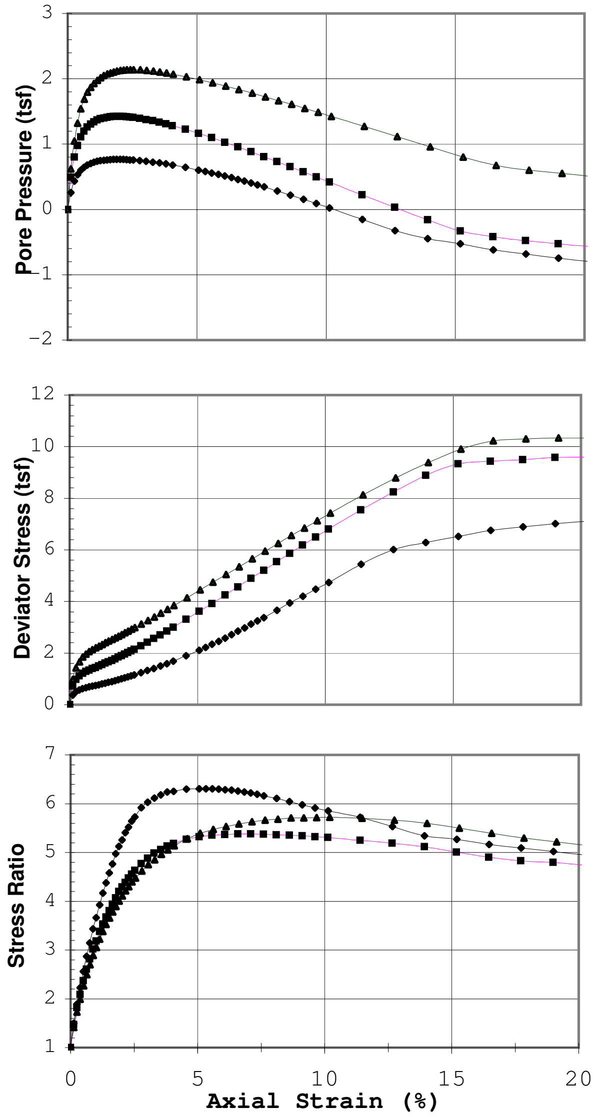
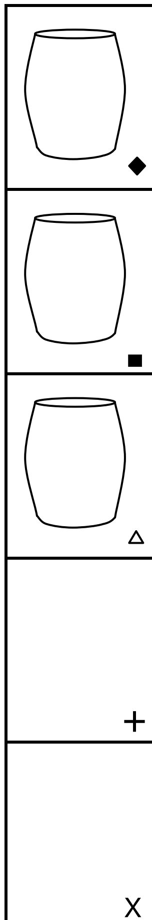
TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/26/07**

Project: **Polymet #23/69-862-023B**
Boring #: **07-22** Sample #: Type: **3T** Depth (ft): **116-118**
Soil Type: **Slimes (Silt (ML))**





Failure Criterion: **Max. Stress Ratio**

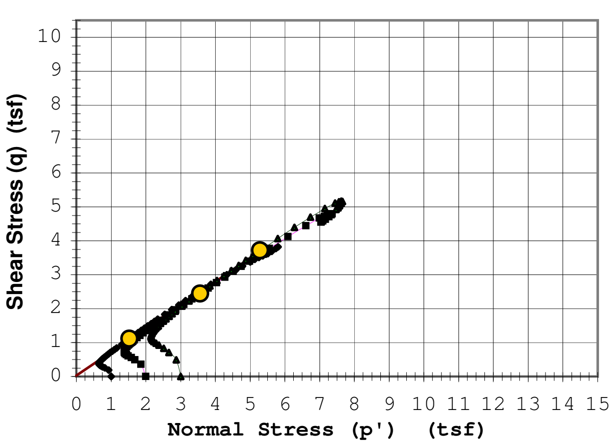
Angle of internal friction, ϕ' = **43.8 °**
Apparent Cohesion, **c'** = **0.04 (tsf)**

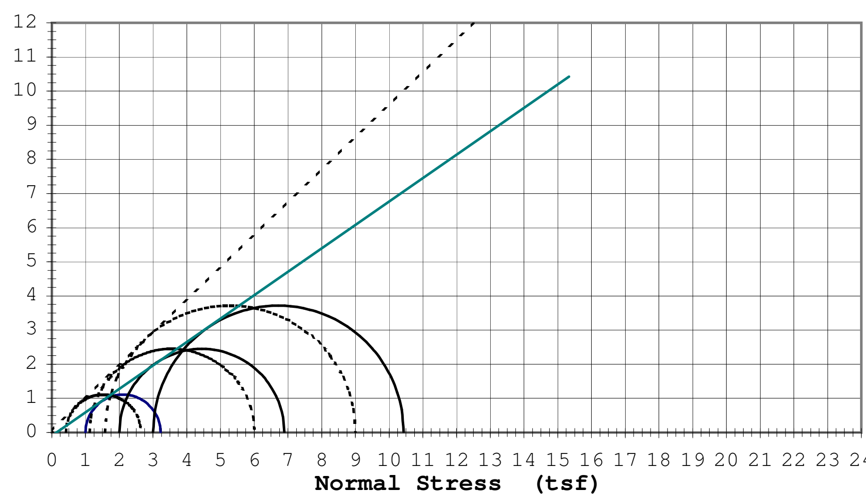
Test Date:	10/22/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity (Assumed):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	35.3	33.7	37.1		
Dry Density (pcf)	89.6	91.7	86.9		
Void Ratio	1.09	1.04	1.16		
After Consolidation					
Diameter (in)	1.93	1.91	1.91		
Height (in)	3.95	3.95	3.92		
Water Content (%)	34.4	32.1	34.8		
Dry Density (pcf)	92.2	95.5	91.6		
Void Ratio	1.03	0.96	1.04		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	1.00	2.00	3.00		
Max. Deviator Stress (tsf)	7.65	9.59	10.33		
Ultimate Deviator Stress (tsf)	7.65	9.18	9.86		
Deviator Stress at Failure (tsf)	2.22	4.89	7.43		
Max. Pore Pressure Buildup (tsf)	0.77	1.42	2.14		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	5.3	7.1	10.2		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold, membrane applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





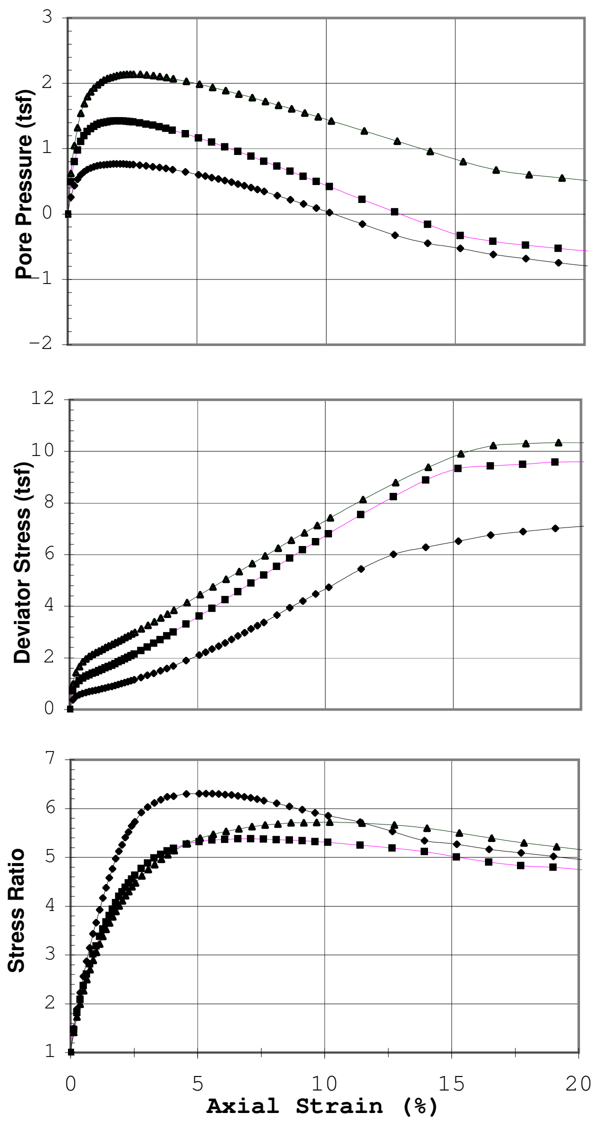
Rupture Envelope at Failure
α = 34.7 ° a = 0.0 (tsf)

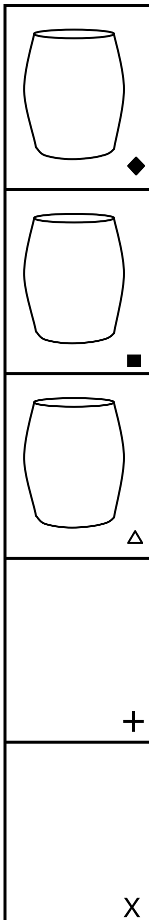
------------	Effective ϕ':	43.8 °	c'=	0.04 (tsf)
________	Total ϕ':	34.5 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/26/07**

Project: **Polymet #23/69-862-023B**
Boring #: **07-22** Sample #: Type: **3T** Depth (ft): **116-118**
Soil Type: **Slimes (Silt (ML))**





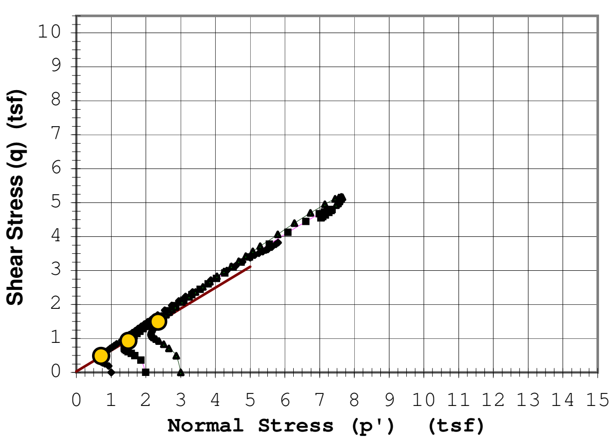
Failure Criterion: **Max. Pore Pressure**
Angle of internal friction, ϕ' = **38.2 °**
Apparent Cohesion, c' = **0.03 (tsf)**

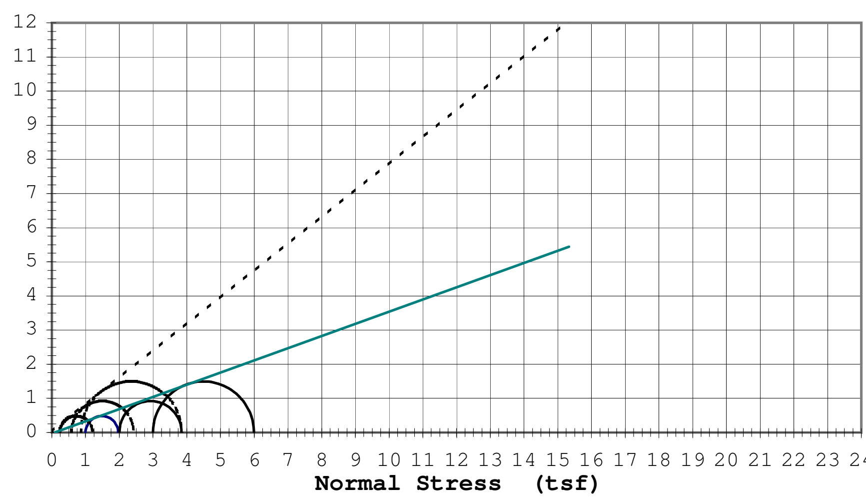
Test Date:	10/22/07	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.004	Plasticity Index:	
Strain Rate (%/min):	0.101	Spec. Gravity (Assumed):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	35.3	33.7	37.1		
Dry Density (pcf)	89.6	91.7	86.9		
Void Ratio	1.09	1.04	1.16		
After Consolidation					
Diameter (in)	1.93	1.91	1.91		
Height (in)	3.95	3.95	3.92		
Water Content (%)	34.4	32.1	34.8		
Dry Density (pcf)	92.2	95.5	91.6		
Void Ratio	1.03	0.96	1.04		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	1.00	2.00	3.00		
Max. Deviator Stress (tsf)	7.65	9.59	10.33		
Ultimate Deviator Stress (tsf)	7.65	9.18	9.86		
Deviator Stress at Failure (tsf)	0.97	1.84	2.99		
Max. Pore Pressure Buildup (tsf)	0.77	1.42	2.14		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	1.9	1.9	2.6		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold, membrane applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





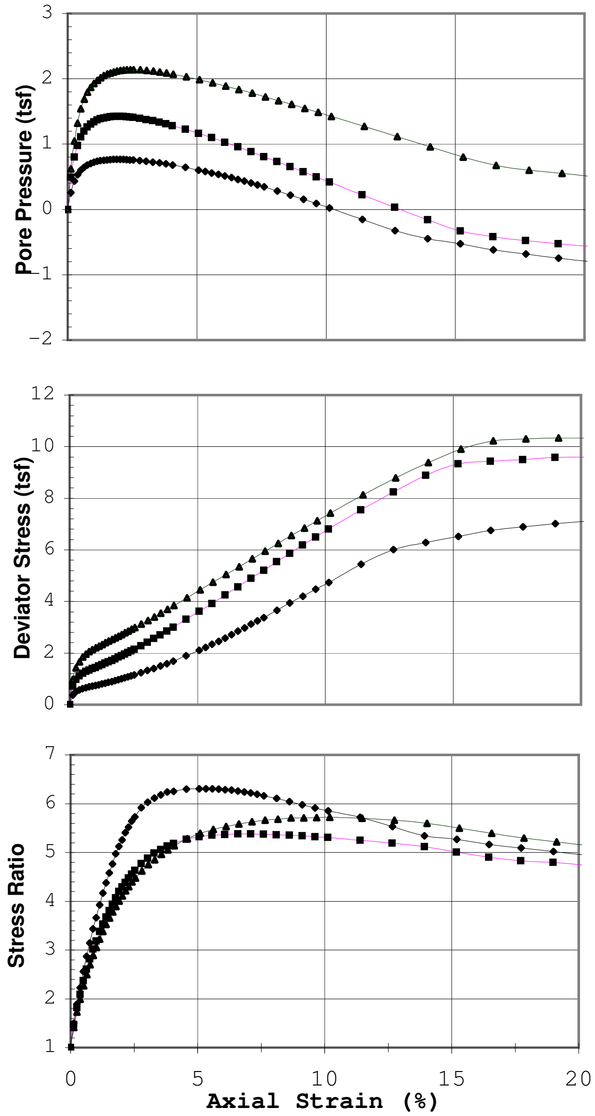
Rupture Envelope at Failure
α = 31.7 ° a = 0.0 (tsf)

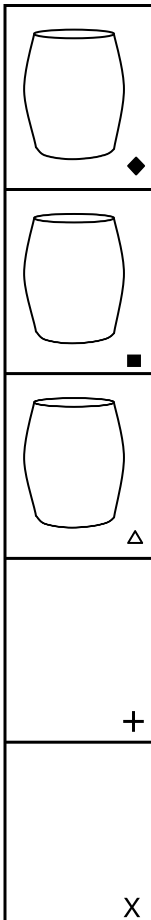
------------	Effective ϕ':	38.2 °	c'=	0.03 (tsf)
______	Total ϕ':	19.7 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/26/07**

Project: **Polymet #23/69-862-023B**
Boring #: **07-22** Sample #: Type: **3T** Depth (ft): **116-118**
Soil Type: **Slimes (Silt (ML))**



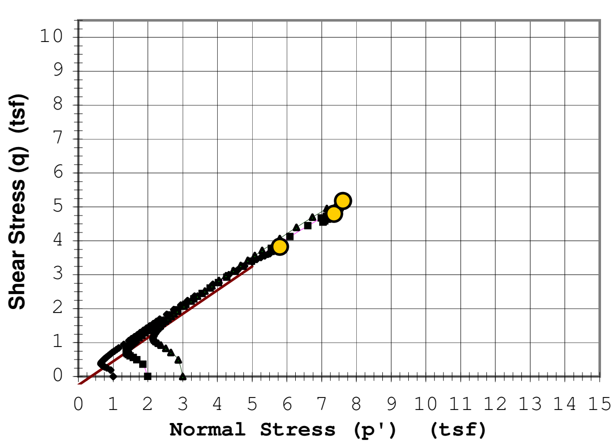


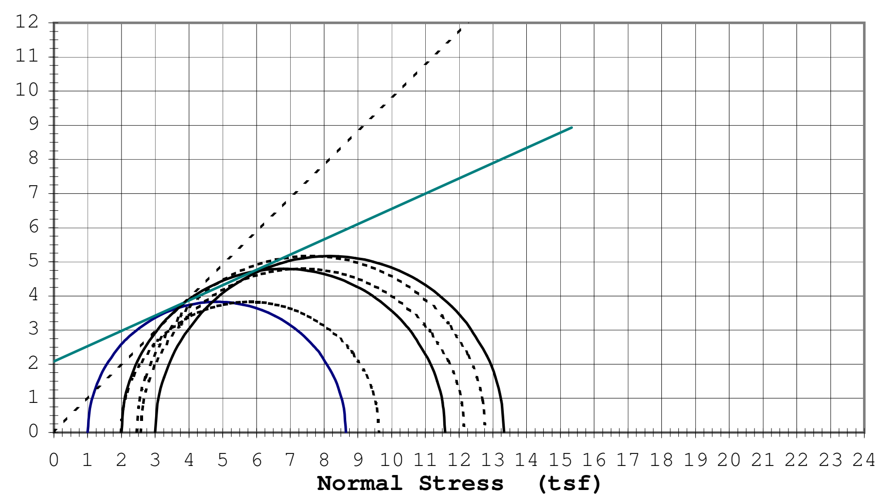
Failure Criterion:			Max. Deviator Stress		
Angle of internal friction, φ' =			44.5 °		
Apparent Cohesion, c' =			0.00 (tsf)		
Test Date:	10/22/07	Liquid Limit:			
Test Type:	CU w/pp	Plastic Limit:			
Strain Rate (in/min):	0.004	Plasticity Index:			
Strain Rate (%/min):	0.101	Spec. Gravity (Assumed):	3.00		

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	35.3	33.7	37.1		
Dry Density (pcf)	89.6	91.7	86.9		
Void Ratio	1.09	1.04	1.16		
After Consolidation					
Diameter (in)	1.93	1.91	1.91		
Height (in)	3.95	3.95	3.92		
Water Content (%)	34.4	32.1	34.8		
Dry Density (pcf)	92.2	95.5	91.6		
Void Ratio	1.03	0.96	1.04		
Back Pressure (tsf)	5.8	5.8	5.8		
Minor Principal Stress (tsf)	1.00	2.00	3.00		
Max. Deviator Stress (tsf)	7.65	9.59	10.33		
Ultimate Deviator Stress (tsf)	7.65	9.18	9.86		
Deviator Stress at Failure (tsf)	7.65	9.59	10.33		
Max. Pore Pressure Buildup (tsf)	0.77	1.42	2.14		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	29.8	20.3	19.1		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold, membrane applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





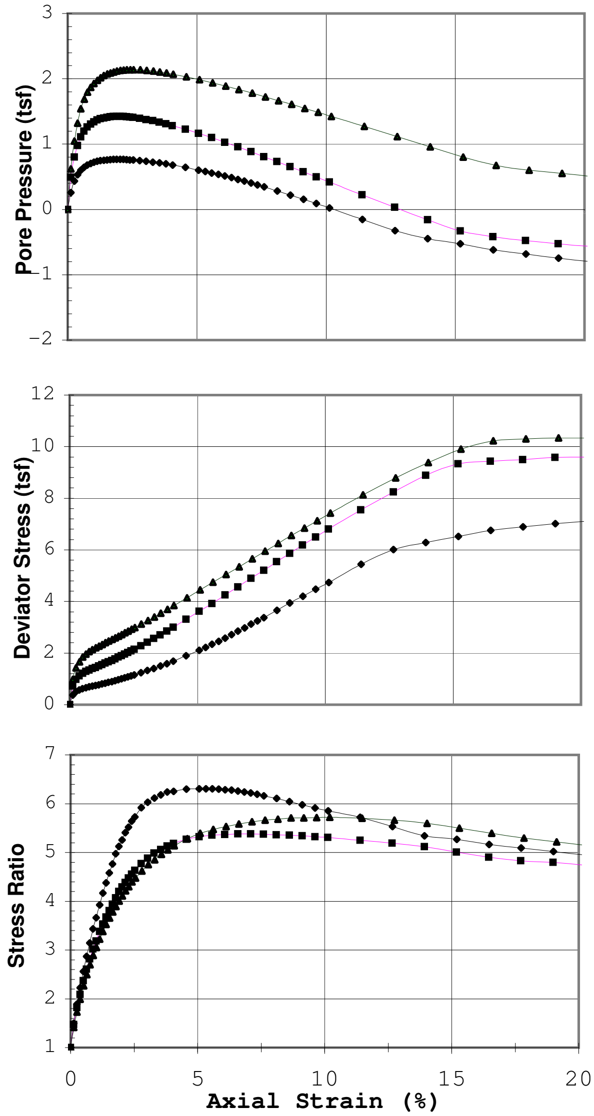
Rupture Envelope at Failure	
α = 35.0 °	a = -0.3 (tsf)

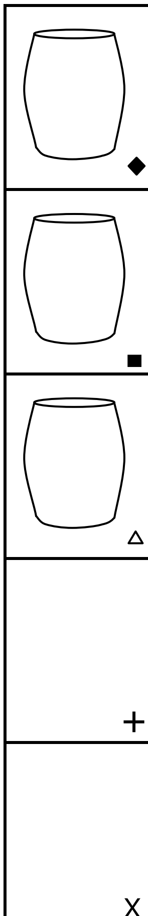
------------	Effective φ':	44.5 °	c'=	0.00 (tsf)
________	Total φ':	24.1 °	c=	2.09 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/26/07**

Project: **Polymet #23/69-862-023B**
Boring #: **07-22** Sample #: Type: **3T** Depth (ft): **116-118**
Soil Type: **Slimes (Silt (ML))**

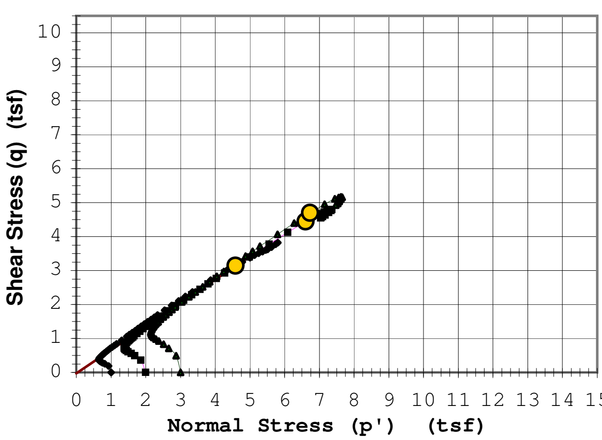


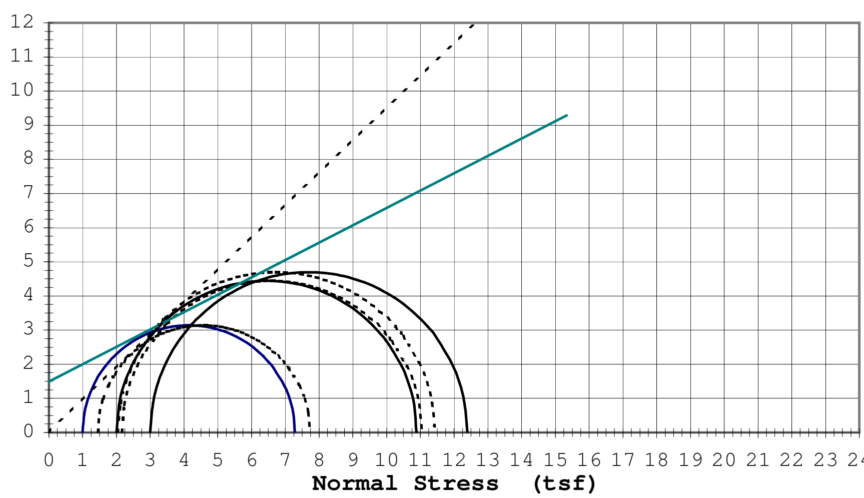


Failure Criterion:	**Given Strain of: 15%**					
Angle of internal friction, **φ' =**	**43.6 °**					
Apparent Cohesion, **c' =**	**0.00 (tsf)**					
Test Date: 10/22/07	Liquid Limit:					
Test Type: CU w/pp	Plastic Limit:					
Strain Rate (in/min): 0.004	Plasticity Index:					
Strain Rate (%/min): 0.101	Spec. Gravity (Assumed): 3.00					
Before Consolidation	**A**	**B**	**C**	**D**	**E**	
Diameter (in)	1.94	1.94	1.94			
Height (in)	3.98	3.98	3.98			
Water Content (%)	35.3	33.7	37.1			
Dry Density (pcf)	89.6	91.7	86.9			
Void Ratio	1.09	1.04	1.16			
After Consolidation						
Diameter (in)	1.93	1.91	1.91			
Height (in)	3.95	3.95	3.92			
Water Content (%)	34.4	32.1	34.8			
Dry Density (pcf)	92.2	95.5	91.6			
Void Ratio	1.03	0.96	1.04			
Back Pressure (tsf)	5.8	5.8	5.8			
Minor Principal Stress (tsf)	1.00	2.00	3.00			
Max. Deviator Stress (tsf)	7.65	9.59	10.33			
Ultimate Deviator Stress (tsf)	7.65	9.18	9.86			
Deviator Stress at Failure (tsf)	6.28	8.89	9.39			
Max. Pore Pressure Buildup (tsf)	0.77	1.42	2.14			
Pore Pressure Parameter "B"	1.0	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen extruded directly into trimming mold, membrane applied; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure		
α = 34.6 °	a = 0.0 (tsf)	

------------	Effective φ':	43.6 °	c'=	0.00 (tsf)
________	Total φ':	26.9 °	c=	1.49 (tsf)

Job No. 6251

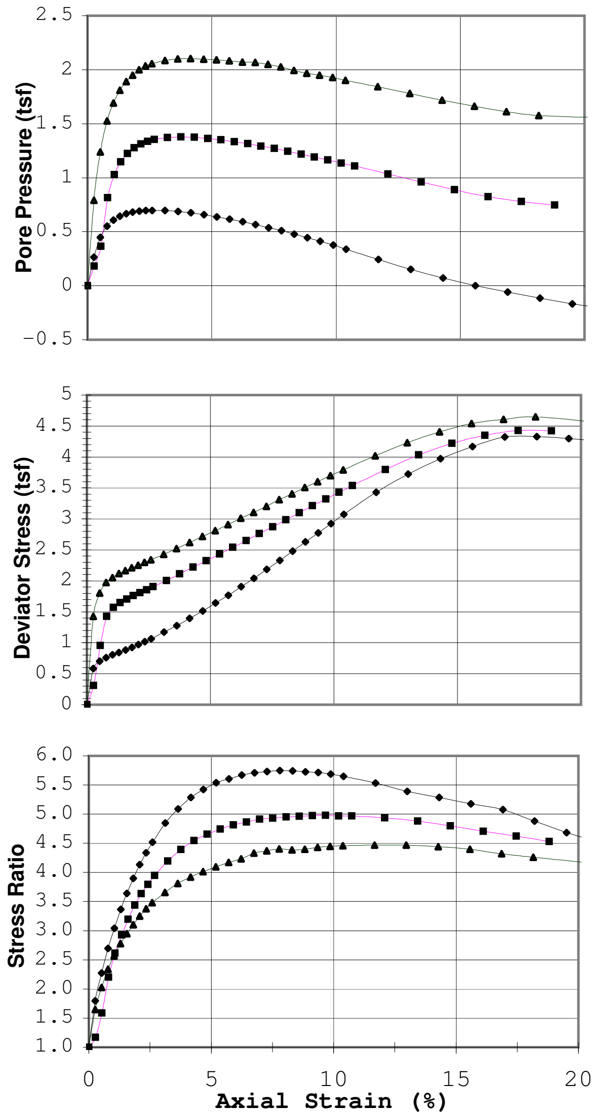
Boring #: 07-22 Depth (ft): 116-118 Date: 10/26/07

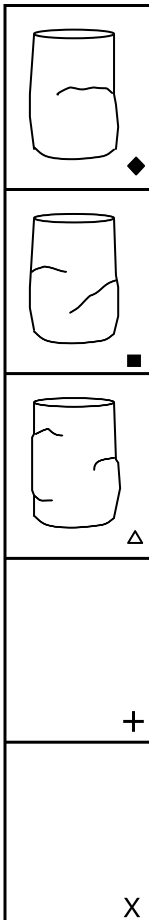
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
0.13	0.37	0.26	0.13	0.71	0.49	0.13	0.99	0.62						
0.26	0.51	0.43	0.25	0.98	0.80	0.26	1.42	1.05						
0.38	0.57	0.53	0.38	1.12	0.98	0.38	1.67	1.32						
0.51	0.63	0.60	0.51	1.22	1.11	0.51	1.85	1.54						
0.63	0.66	0.65	0.63	1.29	1.20	0.64	1.96	1.69						
0.76	0.69	0.68	0.76	1.34	1.26	0.77	2.05	1.79						
0.89	0.72	0.70	0.89	1.40	1.31	0.89	2.13	1.87						
1.01	0.74	0.72	1.01	1.44	1.34	1.02	2.20	1.93						
1.14	0.77	0.74	1.14	1.50	1.37	1.15	2.27	1.98						
1.27	0.81	0.75	1.27	1.55	1.39	1.28	2.34	2.02						
1.39	0.83	0.75	1.39	1.61	1.40	1.40	2.40	2.05						
1.52	0.86	0.76	1.52	1.66	1.41	1.53	2.46	2.07						
1.65	0.90	0.76	1.65	1.71	1.42	1.66	2.53	2.09						
1.77	0.93	0.77	1.77	1.77	1.42	1.79	2.59	2.11						
1.90	0.97	0.77	1.90	1.84	1.42	1.91	2.65	2.12						
2.03	1.00	0.77	2.03	1.90	1.42	2.04	2.72	2.13						
2.15	1.04	0.76	2.15	1.95	1.42	2.17	2.79	2.13						
2.28	1.08	0.76	2.28	2.02	1.42	2.30	2.85	2.14						
2.41	1.12	0.76	2.41	2.08	1.41	2.42	2.92	2.14						
2.53	1.16	0.76	2.53	2.15	1.41	2.55	2.99	2.14						
2.79	1.24	0.75	2.79	2.28	1.39	2.81	3.13	2.14						
3.04	1.32	0.74	3.04	2.42	1.38	3.06	3.27	2.13						
3.30	1.41	0.73	3.29	2.56	1.36	3.32	3.39	2.12						
3.55	1.49	0.71	3.55	2.70	1.33	3.57	3.55	2.10						
3.80	1.59	0.70	3.80	2.86	1.31	3.83	3.69	2.09						
4.06	1.68	0.68	4.05	3.00	1.28	4.08	3.84	2.07						
4.56	1.89	0.64	4.56	3.31	1.23	4.59	4.15	2.03						
5.07	2.11	0.60	5.06	3.62	1.16	5.10	4.45	1.99						
5.32	2.22	0.58	5.57	3.92	1.10	5.61	4.74	1.94						
5.57	2.35	0.56	6.08	4.25	1.03	6.12	5.04	1.89						
5.83	2.46	0.54	6.58	4.57	0.96	6.63	5.34	1.83						
6.08	2.58	0.51	7.09	4.89	0.88	7.14	5.65	1.78						
6.33	2.72	0.49	7.60	5.21	0.81	7.65	5.95	1.72						
6.59	2.85	0.46	8.10	5.54	0.73	8.16	6.25	1.67						
6.84	2.97	0.43	8.61	5.86	0.65	8.67	6.55	1.61						
7.09	3.12	0.40	9.12	6.19	0.58	9.18	6.84	1.55						
7.35	3.25	0.37	9.62	6.49	0.50	9.69	7.13	1.49						
7.60	3.38	0.35	10.13	6.80	0.42	10.20	7.43	1.43						
8.11	3.65	0.28	11.39	7.55	0.22	11.48	8.13	1.27						
8.61	3.94	0.22	12.66	8.25	0.03	12.75	8.79	1.12						
9.12	4.20	0.16	13.93	8.89	-0.16	14.03	9.39	0.96						
9.63	4.47	0.09	15.19	9.33	-0.33	15.30	9.90	0.80						
10.14	4.74	0.02	16.46	9.44	-0.42	16.58	10.22	0.67						
11.40	5.44	-0.15	17.72	9.49	-0.48	17.85	10.30	0.60						
12.67	6.01	-0.33	18.99	9.59	-0.52	19.13	10.33	0.55						
13.93	6.28	-0.45	20.26	9.59	-0.57	20.40	10.32	0.50						
15.20	6.52	-0.53	21.52	9.52	-0.57	21.68	10.20	0.48						
16.47	6.76	-0.62	22.79	9.42	-0.56	22.95	10.10	0.48						
17.73	6.90	-0.68	24.05	9.26	-0.54	24.23	10.06	0.46						
19.00	7.01	-0.75	25.32	9.16	-0.51	25.50	9.95	0.45						
20.27	7.12	-0.80	26.59	9.11	-0.49	26.36	9.86	0.46						
21.53	7.20	-0.85	27.85	9.10	-0.49									
22.80	7.25	-0.88	29.12	9.14	-0.48									
25.34	7.38	-0.93	30.04	9.18	-0.49									
27.87	7.55	-0.96												
29.82	7.65	-0.98												

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/30/07**

Project: **Polymet - #23/69-862-024B**
Boring #: **SB-23** Sample #: Type: **3T** Depth (ft): **26 - 28**
Soil Type: **Slimes, Silt (ML)**



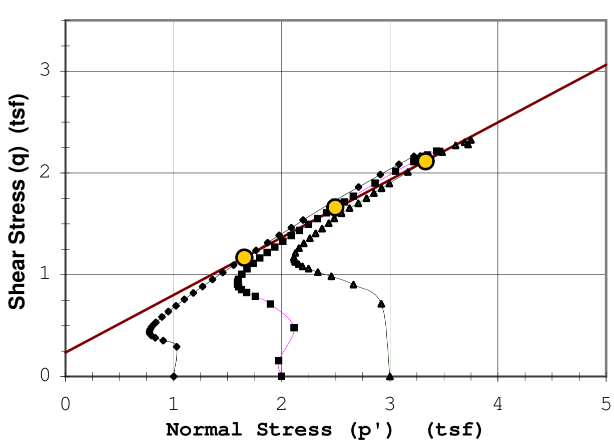


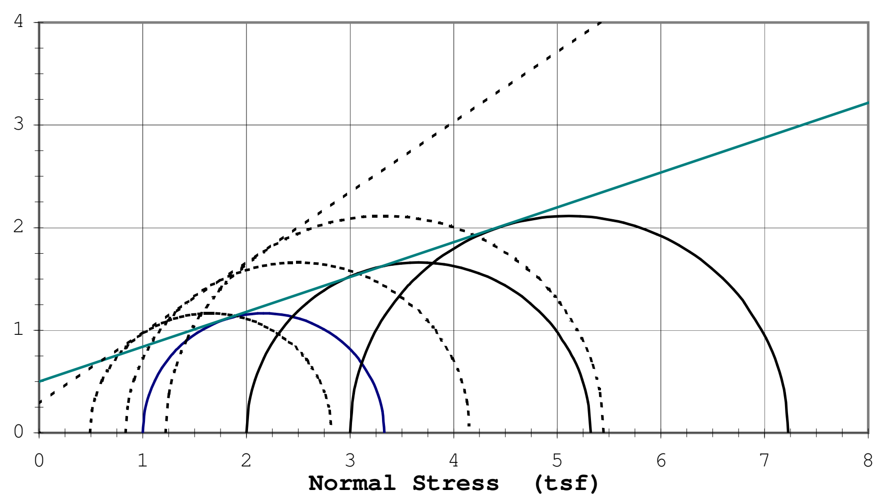
Failure Criterion:		**Max. Stress Ratio**			
Angle of internal friction, ϕ' =		**34.5 °**			
Apparent Cohesion, c' =		**0.29 (tsf)**			
Test Date:	10/10/07	Liquid Limit:	37.9		
Test Type:	CU w/pp	Plastic Limit:	27.6		
Strain Rate (in/min):	0.0039	Plasticity Index:	10.3		
Strain Rate (%/min):	0.101	Spec. Gravity (Actual):	2.94		

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	40.2	43.7	44.2		
Dry Density (pcf)	83.3	79.7	79.4		
Void Ratio	1.20	1.30	1.31		
After Consolidation					
Diameter (in)	1.94	1.96	1.91		
Height (in)	3.84	3.72	3.85		
Water Content (%)	38.3	40.1	39.1		
Dry Density (pcf)	86.4	84.3	85.4		
Void Ratio	1.12	1.18	1.15		
Back Pressure (tsf)	5.76	5.76	5.76		
Minor Principal Stress (tsf)	1.00	2.00	3.00		
Max. Deviator Stress (tsf)	4.33	4.43	4.65		
Ultimate Deviator Stress (tsf)	4.26	4.42	4.56		
Deviator Stress at Failure (tsf)	2.33	3.32	4.23		
Max. Pore Pressure Buildup (tsf)	0.70	1.38	2.10		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	7.8	9.7	13.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given sizes; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





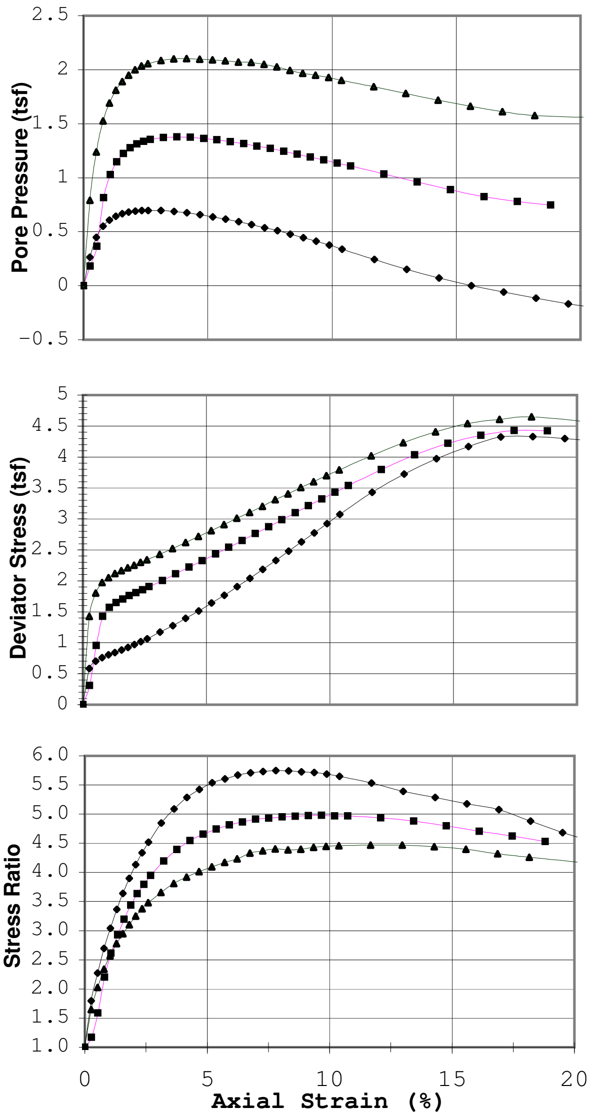
Rupture Envelope at Failure		
α = 29.5 °	a = 0.2	(tsf)

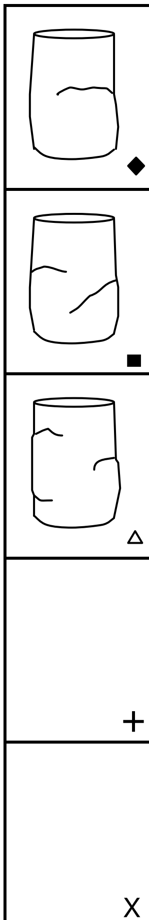
------------	Effective ϕ':	34.5 °	c'=	0.29 (tsf)
________	Total ϕ':	18.8 °	c=	0.50 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/30/07**

Project: **Polymet - #23/69-862-024B**
Boring #: **SB-23** Sample #: Type: **3T** Depth (ft): **26 - 28**
Soil Type: **Slimes, Silt (ML)**

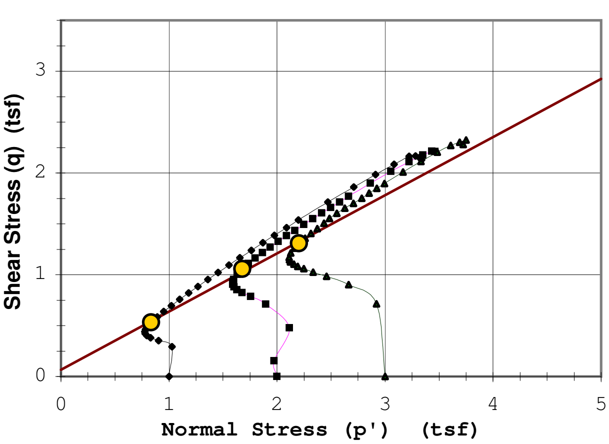


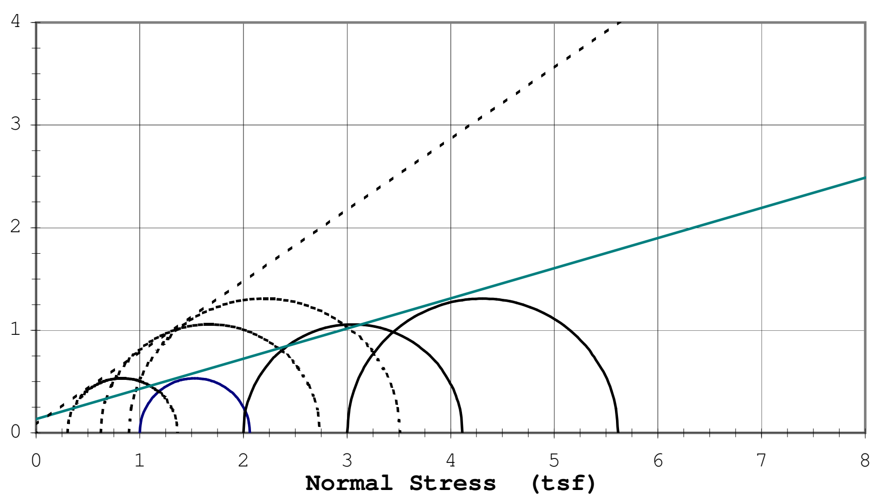


Failure Criterion:		Max. Pore Pressure			
Angle of internal friction, ϕ' =		34.9 °			
Apparent Cohesion, c' =		0.08 (tsf)			
Test Date: 10/10/07		Liquid Limit:	37.9		
Test Type: CU w/pp		Plastic Limit:	27.6		
Strain Rate (in/min): 0.0039		Plasticity Index:	10.3		
Strain Rate (%/min): 0.101		Spec. Gravity (Actual):	2.94		
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	40.2	43.7	44.2		
Dry Density (pcf)	83.3	79.7	79.4		
Void Ratio	1.20	1.30	1.31		
After Consolidation					
Diameter (in)	1.94	1.96	1.91		
Height (in)	3.84	3.72	3.85		
Water Content (%)	38.3	40.1	39.1		
Dry Density (pcf)	86.4	84.3	85.4		
Void Ratio	1.12	1.18	1.15		
Back Pressure (tsf)	5.76	5.76	5.76		
Minor Principal Stress (tsf)	1.00	2.00	3.00		
Max. Deviator Stress (tsf)	4.33	4.43	4.65		
Ultimate Deviator Stress (tsf)	4.26	4.42	4.56		
Deviator Stress at Failure (tsf)	1.06	2.11	2.62		
Max. Pore Pressure Buildup (tsf)	0.70	1.38	2.10		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	2.6	3.8	4.2		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given sizes; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





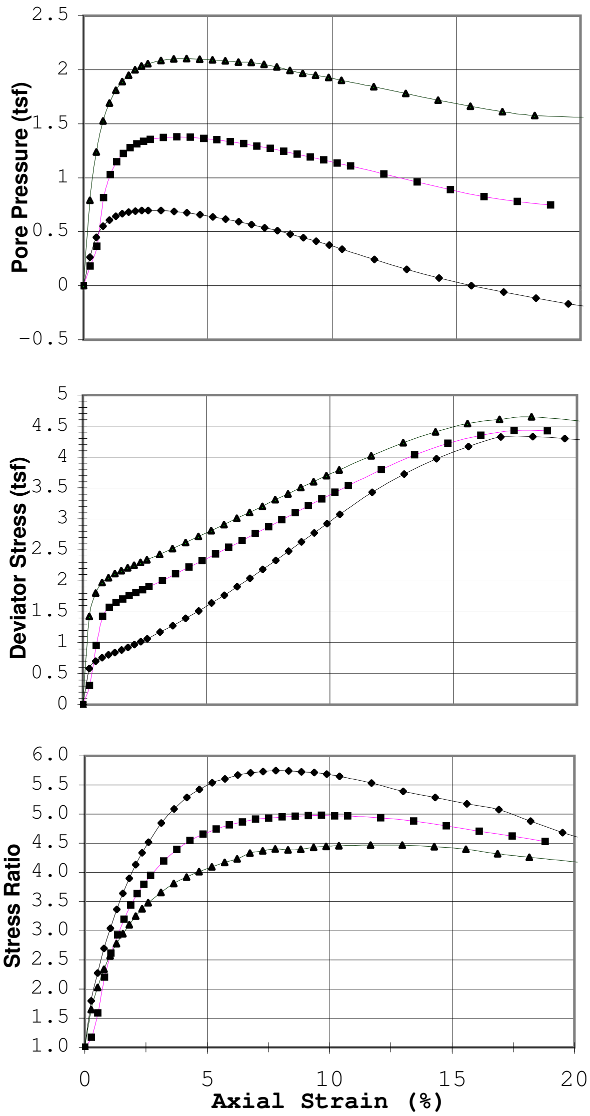
Rupture Envelope at Failure
α = 29.8 ° a = 0.1 (tsf)

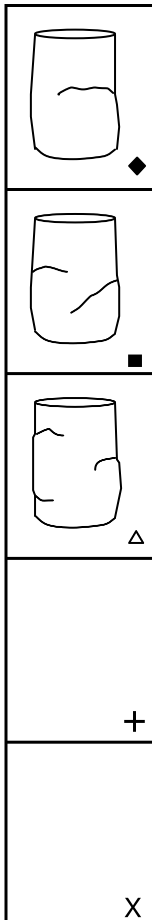
------------	Effective ϕ':	34.9 °	c'=	0.08 (tsf)
________	Total ϕ':	16.4 °	c=	0.13 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/30/07**

Project: **Polymet - #23/69-862-024B**
Boring #: **SB-23** Sample #: Type: **3T** Depth (ft): **26 - 28**
Soil Type: **Slimes, Silt (ML)**





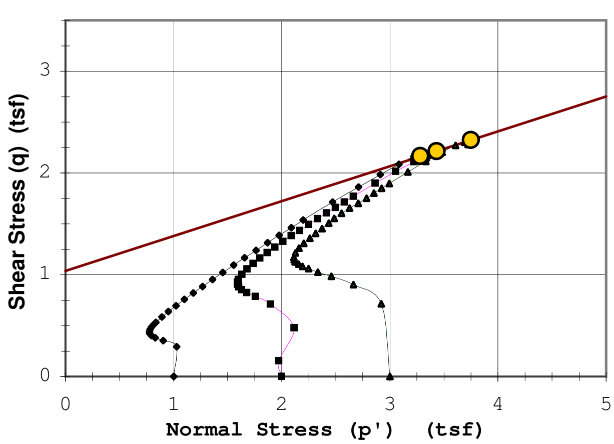
Failure Criterion:	Max. Deviator Stress
Angle of internal friction, ϕ' =	20.1 °
Apparent Cohesion, c' =	1.11 (tsf)

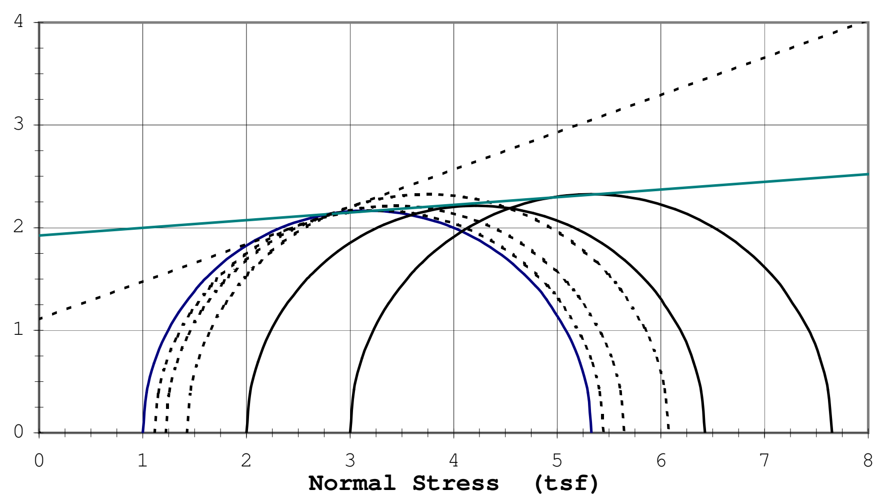
Test Date:	10/10/07	Liquid Limit:	37.9
Test Type:	CU w/pp	Plastic Limit:	27.6
Strain Rate (in/min):	0.0039	Plasticity Index:	10.3
Strain Rate (%/min):	0.101	Spec. Gravity (Actual):	2.94

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	40.2	43.7	44.2		
Dry Density (pcf)	83.3	79.7	79.4		
Void Ratio	1.20	1.30	1.31		
After Consolidation					
Diameter (in)	1.94	1.96	1.91		
Height (in)	3.84	3.72	3.85		
Water Content (%)	38.3	40.1	39.1		
Dry Density (pcf)	86.4	84.3	85.4		
Void Ratio	1.12	1.18	1.15		
Back Pressure (tsf)	5.76	5.76	5.76		
Minor Principal Stress (tsf)	1.00	2.00	3.00		
Max. Deviator Stress (tsf)	4.33	4.43	4.65		
Ultimate Deviator Stress (tsf)	4.26	4.42	4.56		
Deviator Stress at Failure (tsf)	4.33	4.43	4.65		
Max. Pore Pressure Buildup (tsf)	0.70	1.38	2.10		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	18.2	17.5	18.2		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given sizes; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





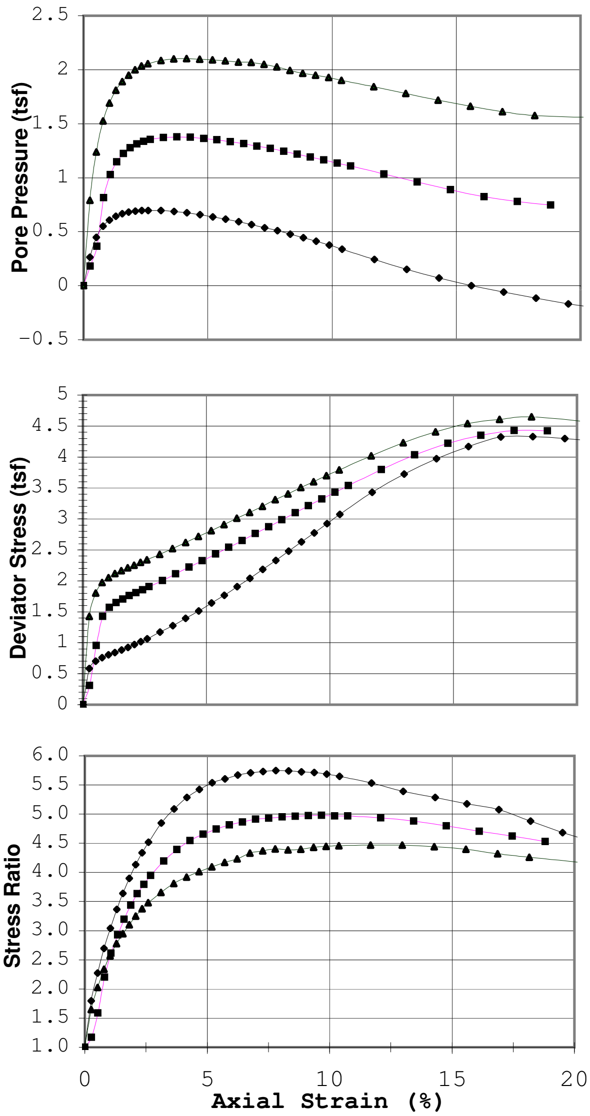
Rupture Envelope at Failure	
α = 18.9 °	a = 1.0 (tsf)

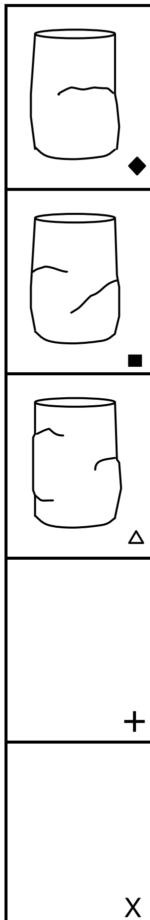
------------	Effective ϕ': 20.1 °	c'=	1.11 (tsf)
________	Total ϕ': 4.3 °	c=	1.92 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6251**
Date: **10/30/07**

Project: **Polymet - #23/69-862-024B**
Boring #: **SB-23** Sample #: Type: **3T** Depth (ft): **26 - 28**
Soil Type: **Slimes, Silt (ML)**





Failure Criterion: **Given Strain of: 15%**

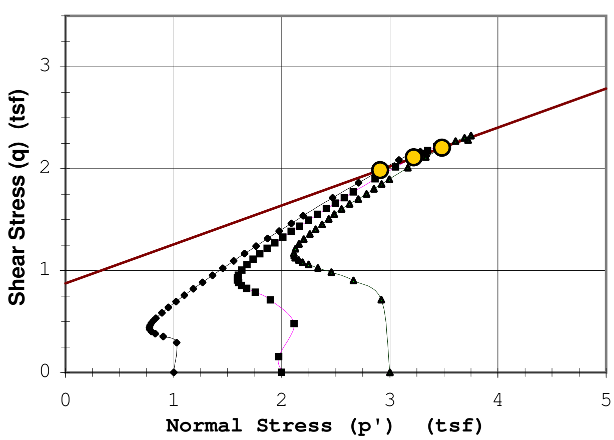
Angle of internal friction, ϕ' = **22.5 °**
Apparent Cohesion, **c'** = **0.94 (tsf)**

Test Date:	10/10/07	Liquid Limit:	37.9
Test Type:	CU w/pp	Plastic Limit:	27.6
Strain Rate (in/min):	0.0039	Plasticity Index:	10.3
Strain Rate (%/min):	0.101	Spec. Gravity (Actual):	2.94

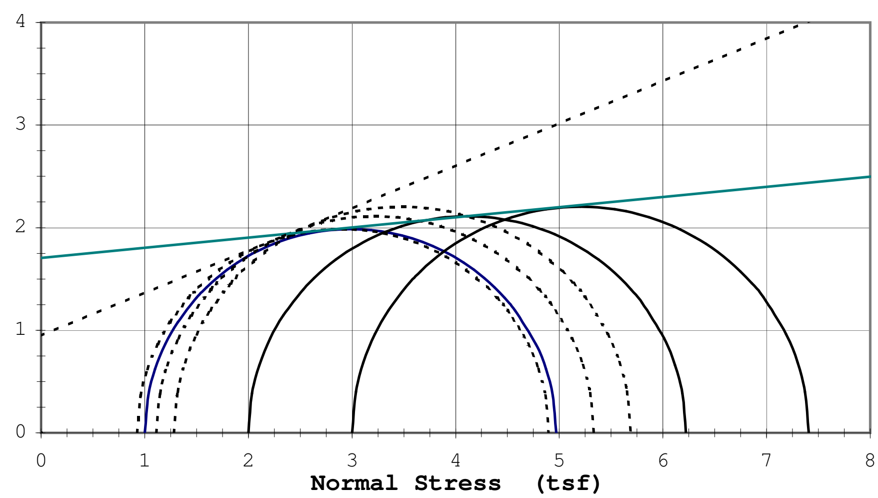
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94		
Height (in)	3.98	3.98	3.98		
Water Content (%)	40.2	43.7	44.2		
Dry Density (pcf)	83.3	79.7	79.4		
Void Ratio	1.20	1.30	1.31		
After Consolidation					
Diameter (in)	1.94	1.96	1.91		
Height (in)	3.84	3.72	3.85		
Water Content (%)	38.3	40.1	39.1		
Dry Density (pcf)	86.4	84.3	85.4		
Void Ratio	1.12	1.18	1.15		
Back Pressure (tsf)	5.76	5.76	5.76		
Minor Principal Stress (tsf)	1.00	2.00	3.00		
Max. Deviator Stress (tsf)	4.33	4.43	4.65		
Ultimate Deviator Stress (tsf)	4.26	4.42	4.56		
Deviator Stress at Failure (tsf)	3.97	4.22	4.41		
Max. Pore Pressure Buildup (tsf)	0.70	1.38	2.10		
Pore Pressure Parameter "B"	1.0	1.0	1.0		
Pct. Axial Strain at Failure	15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given sizes; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



Rupture Envelope at Failure
α = 20.9 ° a = 0.9 (tsf)



------------	Effective ϕ':	22.5 °	c'=	0.94 (tsf)
________	Total ϕ':	5.7 °	c=	1.70 (tsf)

Job No.: 6251
Project: Polymet - #23/69-862-024B
Test Type: CU w/pp
Boring No.: SB-23, Depth (ft.): 26 - 28

Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.26	0.58	0.27	0.27	0.31	0.18	0.26	1.43	0.79
0.52	0.70	0.45	0.54	0.96	0.36	0.52	1.80	1.24
0.78	0.76	0.55	0.81	1.42	0.82	0.78	1.97	1.53
1.04	0.80	0.61	1.08	1.57	1.03	1.04	2.05	1.69
1.30	0.84	0.64	1.34	1.65	1.15	1.30	2.12	1.81
1.56	0.88	0.67	1.61	1.70	1.22	1.56	2.17	1.89
1.82	0.93	0.68	1.88	1.76	1.28	1.82	2.21	1.95
2.08	0.97	0.69	2.15	1.81	1.31	2.08	2.25	2.00
2.34	1.02	0.70	2.42	1.85	1.34	2.34	2.30	2.03
2.60	1.06	0.70	2.69	1.90	1.35	2.59	2.34	2.06
3.12	1.17	0.70	3.22	2.01	1.37	3.11	2.43	2.09
3.64	1.28	0.69	3.76	2.11	1.38	3.63	2.52	2.10
4.16	1.39	0.68	4.30	2.22	1.37	4.15	2.62	2.10
4.68	1.51	0.66	4.84	2.33	1.36	4.67	2.71	2.10
5.20	1.64	0.64	5.37	2.43	1.35	5.19	2.81	2.09
5.72	1.77	0.62	5.91	2.54	1.33	5.71	2.91	2.08
6.24	1.90	0.59	6.45	2.65	1.31	6.23	3.01	2.07
6.77	2.04	0.57	6.99	2.76	1.29	6.75	3.11	2.07
7.28	2.19	0.54	7.52	2.87	1.27	7.26	3.21	2.05
7.80	2.33	0.51	8.06	2.98	1.25	7.78	3.31	2.03
8.33	2.48	0.48	8.60	3.10	1.22	8.30	3.40	1.99
8.85	2.63	0.44	9.14	3.21	1.19	8.82	3.51	1.97
9.37	2.77	0.41	9.67	3.32	1.17	9.34	3.60	1.95
9.89	2.93	0.38	10.21	3.43	1.14	9.86	3.70	1.93
10.41	3.07	0.34	10.75	3.54	1.11	10.38	3.79	1.90
11.71	3.43	0.24	12.09	3.80	1.03	11.68	4.02	1.84
13.01	3.73	0.15	13.43	4.03	0.96	12.97	4.23	1.78
14.31	3.97	0.07	14.78	4.22	0.89	14.27	4.41	1.72
15.61	4.17	0.00	16.12	4.35	0.83	15.57	4.54	1.66
16.91	4.33	-0.06	17.46	4.43	0.78	16.86	4.61	1.61
18.21	4.33	-0.12	18.81	4.42	0.75	18.16	4.65	1.57
19.51	4.30	-0.17				20.75	4.56	1.55
20.81	4.26	-0.21						

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9435	5.9436	5.8724	0.071056	0.07115	1.0013
2	0.012483	0	0	2.9681	5.95	5.9471	5.8736	0.076372	0.073499	0.96239
3	0.054133	0	0.003322	2.9681	5.9734	5.9723	5.8759	0.097501	0.096388	0.98859
4	0.10003	0	0.0052598	2.9681	5.9675	5.9694	5.8724	0.095077	0.096972	1.0199
5	0.25027	-0.00091637	0.0077513	2.9681	5.9691	5.9712	5.8724	0.096714	0.098732	1.0209
6	0.50095	0	0.0099659	2.9681	5.9659	5.9712	5.8736	0.092329	0.09756	1.0567
7	1.0023	0.0018327	0.014118	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
8	2.0041	0.0045818	0.020209	2.9681	5.9697	5.9717	5.873	0.096674	0.098733	1.0213
9	4.0032	0.0082473	0.029621	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
10	6.0022	0.0082473	0.036542	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
11	8.0012	0.0091637	0.042632	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
12	10	0.01008	0.047892	2.9681	5.9691	5.9712	5.8707	0.098473	0.10049	1.0205
13	12.004	0.01008	0.051767	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
14	14.003	0.01008	0.056473	2.9681	5.9691	5.9712	5.8707	0.098473	0.10049	1.0205
15	16.003	0.010996	0.060903	2.9681	5.9691	5.9712	5.8724	0.096714	0.098732	1.0209
16	18.003	0.012829	0.065332	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
17	20.003	0.012829	0.068377	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
18	22.003	0.012829	0.072253	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
19	24.003	0.012829	0.074744	2.9681	5.9691	5.9712	5.8724	0.096714	0.098732	1.0209
20	26.003	0.012829	0.078066	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
21	28.003	0.013745	0.080004	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
22	30.003	0.013745	0.083049	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
23	32.002	0.013745	0.085264	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
24	34.002	0.013745	0.087478	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
25	36.003	0.021076	0.090247	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
26	38.003	0.021993	0.093569	2.9681	5.9691	5.9712	5.8713	0.097887	0.099905	1.0206
27	40.002	0.021993	0.095507	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
28	42.002	0.021076	0.096891	2.9681	5.9729	5.9717	5.8724	0.10047	0.099319	0.98852
29	44.003	0.02016	0.099936	2.9681	5.9691	5.9712	5.8707	0.098473	0.10049	1.0205
30	46.003	0.021993	0.1016	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
31	48.002	0.021993	0.10326	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
32	50.002	0.023826	0.1052	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
33	52.002	0.023826	0.10686	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
34	54.002	0.023826	0.10852	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
35	56.001	0.024742	0.10962	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
36	58.001	0.024742	0.11184	2.9681	5.9697	5.9717	5.8707	0.099019	0.10108	1.0208
37	60.001	0.024742	0.11267	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
38	62	0.024742	0.11461	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
39	64.003	0.024742	0.11627	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
40	66.002	0.022909	0.11655	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
41	68.001	0.024742	0.11848	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
42	70	0.024742	0.12097	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
43	72.003	0.025658	0.12208	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
44	74.002	0.026575	0.12319	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
45	76.001	0.026575	0.12513	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
46	78.001	0.026575	0.12596	2.9681	5.9659	5.9712	5.8718	0.094088	0.099318	1.0556
47	80	0.026575	0.12762	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
48	82.004	0.025658	0.12873	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
49	84.003	0.025658	0.12983	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
50	86.002	0.026575	0.13122	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
51	88.002	0.025658	0.13232	2.9681	5.9697	5.9717	5.8713	0.098433	0.10049	1.0209
52	90.002	0.026575	0.13316	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
53	92.001	0.026575	0.13316	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
54	94	0.026575	0.13537	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
55	96.004	0.027491	0.13592	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
56	98.003	0.027491	0.13703	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
57	100	0.026575	0.13731	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
58	102	0.026575	0.13925	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
59	104	0.026575	0.14008	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
60	106	0.026575	0.14035	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
61	108	0.026575	0.14229	2.9681	5.9702	5.9723	5.8718	0.098392	0.10049	1.0213
62	110	0.025658	0.14229	2.9681	5.9697	5.9717	5.8713	0.098433	0.10049	1.0209
63	112	0.026575	0.14257	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
64	114	0.026575	0.14395	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
65	116	0.026575	0.14478	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
66	118	0.026575	0.14534	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
67	120	0.026575	0.14644	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
68	122	0.026575	0.14644	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
69	124	0.026575	0.14783	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
70	126	0.026575	0.14866	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
71	128	0.027491	0.14866	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
72	130	0.026575	0.15032	2.9681	5.9702	5.9723	5.8724	0.097806	0.099906	1.0215
73	132	0.026575	0.15115	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
74	134	0.026575	0.15143	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
75	136	0.026575	0.15281	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
76	138	0.026575	0.15336	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
77	140	0.027491	0.15392	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
78	142	0.026575	0.15475	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
79	144	0.027491	0.15558	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
80	146	0.027491	0.15641	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
81	148	0.027491	0.15696	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
82	150	0.027491	0.15724	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
83	152	0.027491	0.15752	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
84	154	0.027491	0.15862	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
85	156	0.027491	0.15973	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
86	158	0.027491	0.16056	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
87	160	0.027491	0.16112	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
88	162	0.027491	0.16195	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
89	164	0.027491	0.16222	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
90	166	0.027491	0.1625	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
91	168	0.027491	0.16305	2.9681	5.9665	5.9717	5.8724	0.094048	0.099319	1.0561
92	170	0.027491	0.16361	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212

93	172	0.027491	0.16471	2.9681	5.9729	5.9717	5.8718	0.10106	0.099905	0.98858
94	174	0.026575	0.16527	2.9681	5.9691	5.9712	5.8718	0.097301	0.099318	1.0207
95	176	0.026575	0.1661	2.9681	5.9702	5.9723	5.8718	0.098392	0.10049	1.0213
96	178	0.026575	0.1661	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
97	180	0.026575	0.16721	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
98	182	0.027491	0.16748	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
99	184	0.027491	0.16831	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
100	186	0.027491	0.16887	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
101	188	0.027491	0.16942	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
102	190	0.027491	0.16914	2.9681	5.9697	5.9717	5.8724	0.09726	0.099319	1.0212
103	192	0.028407	0.1697	2.9681	5.9691	5.9712	5.8724	0.096714	0.098732	1.0209
104	194	0.028407	0.1708	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
105	196	0.028407	0.17053	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021
106	196.31	0.028407	0.17163	2.9681	5.9697	5.9717	5.8718	0.097846	0.099905	1.021

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9697	5.9717	5.8713	0.098433	0.10049	1.0209
2	0.0125	0	0.00027683	2.9681	5.9958	5.9964	5.8836	0.11226	0.11283	1.005
3	0.050483	0.00091637	0.016056	2.9681	6.0948	6.1097	5.8836	0.2112	0.22609	1.0705
4	0.10062	0.00091637	0.027406	2.9681	6.0949	6.1167	5.8736	0.22129	0.2431	1.0985
5	0.25085	0.0036655	0.0454	2.9681	6.0976	6.1196	5.8748	0.22285	0.24486	1.0988
6	0.50172	0.012829	0.069761	2.9681	6.1078	6.1202	5.8765	0.23127	0.24369	1.0537
7	1.0034	0.026575	0.10879	2.9681	6.1099	6.119	5.8759	0.23398	0.2431	1.039
8	2.0013	0.053149	0.17053	2.9681	6.1105	6.1196	5.8742	0.23629	0.24545	1.0388
9	4.001	0.092553	0.26465	2.9681	6.1142	6.1202	5.8742	0.24004	0.24603	1.0249
10	6.0009	0.11271	0.33773	2.9681	6.1142	6.1202	5.8748	0.23946	0.24545	1.025
11	8.0008	0.12279	0.39753	2.9681	6.1142	6.1202	5.8724	0.2418	0.24779	1.0248
12	10	0.13379	0.44625	2.9681	6.1148	6.1208	5.873	0.24176	0.24779	1.0249
13	12.003	0.15028	0.48778	2.9681	6.118	6.1208	5.8724	0.24556	0.24838	1.0115
14	14.002	0.16586	0.52266	2.9681	6.1148	6.1208	5.8724	0.24235	0.24838	1.0249
15	16.001	0.17503	0.55255	2.9681	6.1153	6.1214	5.8718	0.24348	0.24955	1.0249
16	18	0.18327	0.57802	2.9681	6.1153	6.1214	5.8724	0.24289	0.24896	1.025
17	20.002	0.19335	0.60017	2.9681	6.1153	6.1214	5.8736	0.24172	0.24779	1.0251
18	22.001	0.20068	0.61927	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
19	24.001	0.20801	0.6356	2.9681	6.1191	6.122	5.8736	0.24548	0.24838	1.0118
20	26.001	0.2126	0.65027	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
21	28	0.21443	0.66329	2.9681	6.1185	6.1214	5.8701	0.24845	0.25131	1.0115
22	30	0.2181	0.67464	2.9681	6.1185	6.1214	5.8713	0.24728	0.25014	1.0116
23	32.004	0.21993	0.68488	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
24	34.004	0.22451	0.69429	2.9681	6.1185	6.1214	5.8724	0.24611	0.24896	1.0116
25	36.003	0.22818	0.70204	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
26	38.003	0.23001	0.71007	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
27	40.003	0.23092	0.71727	2.9681	6.1185	6.1214	5.8707	0.24787	0.25072	1.0115
28	42.002	0.23184	0.72336	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
29	44.002	0.23367	0.72889	2.9681	6.1185	6.1214	5.8718	0.24669	0.24955	1.0116
30	46.002	0.23459	0.73443	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
31	48.002	0.23551	0.74052	2.9681	6.1185	6.1214	5.8701	0.24845	0.25131	1.0115
32	50.001	0.23551	0.74495	2.9681	6.1191	6.122	5.8707	0.24841	0.25131	1.0117
33	52.001	0.23734	0.74883	2.9681	6.1191	6.122	5.8718	0.24724	0.25014	1.0117
34	54.004	0.23917	0.75298	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
35	56.003	0.24009	0.75796	2.9681	6.1223	6.122	5.8718	0.25045	0.25014	0.99875
36	58.002	0.24009	0.76267	2.9681	6.1191	6.122	5.8713	0.24783	0.25072	1.0117
37	60.001	0.24009	0.76544	2.9681	6.1191	6.122	5.8724	0.24665	0.24955	1.0118
38	60.282	0.24009	0.76682	2.9681	6.1191	6.122	5.8707	0.24841	0.25131	1.0117

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1191	6.122	5.8707	0.24841	0.25131	1.0117
2	0.012483	0	0.00027683	2.9681	6.1611	6.1636	5.89	0.27104	0.27363	1.0096
3	0.050533	0	0.025192	2.9681	6.3415	6.3749	5.8842	0.45737	0.49076	1.073
4	0.10062	0.0027491	0.039587	2.9681	6.3268	6.3626	5.8736	0.45324	0.48899	1.0789
5	0.25083	0.013745	0.069208	2.9681	6.343	6.3661	5.873	0.46996	0.49309	1.0492
6	0.5017	0.028407	0.10741	2.9681	6.3559	6.3696	5.8748	0.48111	0.49486	1.0286
7	1.0034	0.063229	0.16748	2.9681	6.3548	6.3685	5.8759	0.47885	0.49251	1.0285
8	2.001	0.096218	0.25967	2.9681	6.3602	6.3708	5.8754	0.48483	0.49544	1.0219
9	4.0042	0.12921	0.39338	2.9681	6.3655	6.3696	5.8742	0.49133	0.49544	1.0084
10	6.0032	0.16953	0.48916	2.9681	6.365	6.369	5.8742	0.49079	0.49486	1.0083
11	8.0023	0.1961	0.5603	2.9681	6.3661	6.3702	5.8748	0.49129	0.49544	1.0084
12	10.001	0.20985	0.61401	2.9681	6.3666	6.3708	5.8736	0.49301	0.4972	1.0085
13	12.001	0.21901	0.65637	2.9681	6.3677	6.372	5.8742	0.49352	0.49779	1.0087
14	14.004	0.23551	0.68958	2.9681	6.3693	6.3702	5.8736	0.49568	0.49662	1.0019
15	16.003	0.24009	0.71588	2.9681	6.3672	6.3714	5.8718	0.49532	0.49955	1.0085
16	18.002	0.24834	0.73748	2.9681	6.3672	6.3714	5.873	0.49415	0.49838	1.0086
17	20.001	0.25475	0.75575	2.9681	6.3672	6.3714	5.8713	0.4959	0.50013	1.0085
18	22	0.2575	0.77097	2.9681	6.3709	6.372	5.8724	0.49849	0.49955	1.0021
19	24.003	0.26025	0.78426	2.9681	6.3709	6.372	5.8713	0.49966	0.50072	1.0021
20	26.002	0.263	0.79533	2.9681	6.3677	6.372	5.873	0.49469	0.49896	1.0086
21	28.001	0.26483	0.80585	2.9681	6.3704	6.3714	5.8724	0.49794	0.49896	1.002
22	30	0.26575	0.81444	2.9681	6.3704	6.3714	5.8724	0.49794	0.49896	1.002
23	32.004	0.26666	0.82274	2.9681	6.3704	6.3714	5.8713	0.49912	0.50013	1.002
24	34.003	0.2685	0.83021	2.9681	6.3709	6.372	5.8718	0.49908	0.50013	1.0021
25	36.002	0.27124	0.83769	2.9681	6.3709	6.372	5.8713	0.49966	0.50072	1.0021
26	38.001	0.27583	0.8435	2.9681	6.3704	6.3714	5.8724	0.49794	0.49896	1.002
27	40.001	0.27674	0.84959	2.9681	6.3677	6.372	5.8724	0.49528	0.49955	1.0086
28	42.004	0.27674	0.85513	2.9681	6.3709	6.372	5.873	0.4979	0.49896	1.0021
29	42.259	0.27674	0.85596	2.9681	6.3704	6.3714	5.8701	0.50029	0.50131	1.002

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3672	6.3714	5.8701	0.49708	0.50131	1.0085
2	0.012483	0	0.00083049	2.9681	6.4533	6.4571	5.9012	0.55213	0.55591	1.0068
3	0.050483	0.0027491	0.032112	2.9681	6.7917	6.8485	5.8906	0.90111	0.95789	1.063
4	0.10062	0.01008	0.060072	2.9681	6.7951	6.8555	5.8742	0.92087	0.98135	1.0657
5	0.2509	0.042153	0.11018	2.9681	6.8246	6.8632	5.8736	0.95104	0.98957	1.0405
6	0.50172	0.062313	0.17385	2.9681	6.8558	6.869	5.8759	0.97985	0.99309	1.0135
7	1.0034	0.11363	0.27046	2.9681	6.851	6.8708	5.873	0.978	0.99778	1.0202
8	2.001	0.15761	0.41054	2.9681	6.8563	6.8696	5.8771	0.97923	0.9925	1.0136
9	4.0042	0.21351	0.59574	2.9681	6.8671	6.8708	5.8754	0.99171	0.99544	1.0038
10	6.0032	0.25475	0.70952	2.9681	6.8633	6.8702	5.8742	0.98913	0.99602	1.007
11	8.0023	0.28499	0.78315	2.9681	6.8671	6.8708	5.8724	0.99465	0.99837	1.0037
12	10.001	0.2969	0.83326	2.9681	6.8671	6.8708	5.8718	0.99523	0.99895	1.0037
13	12	0.3134	0.86897	2.9681	6.8708	6.8714	5.8724	0.9984	0.99895	1.0006
14	14.004	0.3189	0.89555	2.9681	6.8708	6.8714	5.873	0.99782	0.99837	1.0006
15	16.003	0.32623	0.91659	2.9681	6.8676	6.8714	5.8707	0.99695	1.0007	1.0038
16	18.002	0.32989	0.93347	2.9681	6.8676	6.8714	5.8718	0.99578	0.99954	1.0038
17	20.001	0.33356	0.94759	2.9681	6.8708	6.8714	5.8724	0.9984	0.99895	1.0006
18	22.004	0.33997	0.96005	2.9681	6.8682	6.872	5.873	0.99515	0.99895	1.0038
19	24.004	0.34364	0.97057	2.9681	6.8708	6.8714	5.873	0.99782	0.99837	1.0006
20	26.003	0.34822	0.97998	2.9681	6.8714	6.872	5.873	0.99836	0.99895	1.0006
21	28.002	0.34914	0.98856	2.9681	6.8708	6.8714	5.8724	0.9984	0.99895	1.0006
22	30.002	0.35005	0.99631	2.9681	6.8708	6.8714	5.8724	0.9984	0.99895	1.0006
23	31.225	0.35005	1.001	2.9681	6.8708	6.8714	5.873	0.99782	0.99837	1.0006

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5424	6.5433	6.4717	0.070738	0.071645	1.0128
2	0.012567	0	0	2.9681	6.5473	6.5486	6.4746	0.072751	0.073988	1.017
3	0.050067	0	0.0055366	2.9681	6.5746	6.5673	6.4763	0.098313	0.090965	0.92526
4	0.10013	0	0.0096891	2.9681	6.5579	6.5702	6.4728	0.085042	0.097402	1.1453
5	0.25037	0.0011106	0.013288	2.9681	6.5682	6.5708	6.4722	0.095938	0.098573	1.0275
6	0.50105	0.0011106	0.016887	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
7	1.0026	0.0011106	0.021316	2.9681	6.572	6.5714	6.4717	0.10033	0.099743	0.99419
8	2.0002	0.0022211	0.027129	2.9681	6.572	6.5714	6.4722	0.099741	0.099158	0.99416
9	3.002	0.0011106	0.031559	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
10	4.0039	0	0.034327	2.9681	6.5725	6.572	6.4722	0.10029	0.099743	0.99456
11	5.0015	0	0.037372	2.9681	6.5687	6.5714	6.4711	0.097657	0.10033	1.0274
12	6.0033	0.0011106	0.03931	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
13	7.0009	0	0.040971	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
14	8.0027	0	0.042909	2.9681	6.5693	6.572	6.4711	0.098205	0.10091	1.0276
15	9.0003	0.0011106	0.044293	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
16	10.002	0	0.0454	2.9681	6.5687	6.5714	6.4705	0.098242	0.10091	1.0272
17	11.004	0	0.046508	2.9681	6.5693	6.572	6.4722	0.097035	0.099743	1.0279
18	12.001	0	0.047338	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
19	13.003	0.0011106	0.048445	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
20	14.001	0	0.049553	2.9681	6.566	6.572	6.4717	0.094366	0.10033	1.0632
21	15.003	0	0.050383	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
22	16	0	0.051214	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
23	17.002	0	0.05149	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
24	18.004	0	0.052321	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
25	19.001	0	0.053428	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
26	20.003	0	0.053705	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
27	21.001	0	0.054259	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
28	22.002	0.0011106	0.055089	2.9681	6.5693	6.572	6.4722	0.097035	0.099743	1.0279
29	23	0	0.055643	2.9681	6.5725	6.572	6.4717	0.10087	0.10033	0.99459
30	24.002	0	0.056197	2.9681	6.5725	6.572	6.4717	0.10087	0.10033	0.99459
31	25.004	0	0.05675	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
32	26.002	0	0.057304	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
33	27.004	0	0.057858	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
34	28.001	0	0.058411	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
35	29.004	0.0011106	0.059242	2.9681	6.5693	6.572	6.4722	0.097035	0.099743	1.0279
36	30.002	0	0.059242	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
37	31.004	0	0.060072	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
38	32.001	0	0.060072	2.9681	6.566	6.572	6.4717	0.094366	0.10033	1.0632
39	33.004	0.0011106	0.06118	2.9681	6.5693	6.572	6.4705	0.09879	0.1015	1.0274
40	34.001	0.0011106	0.060903	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
41	35.003	0	0.061733	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
42	36.001	0	0.061733	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
43	37.003	0.0011106	0.06201	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
44	38.001	0	0.062287	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
45	39.004	0	0.063117	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
46	40.001	0	0.063394	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
47	41.003	0	0.063948	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
48	42.001	0.0011106	0.063948	2.9681	6.5693	6.572	6.4711	0.098205	0.10091	1.0276
49	43.003	0.0011106	0.064225	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
50	44.001	0.0011106	0.064502	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
51	45.003	0.0011106	0.065055	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
52	46	0.0011106	0.065609	2.9681	6.5693	6.572	6.4711	0.098205	0.10091	1.0276
53	47.002	0	0.066162	2.9681	6.5725	6.572	6.4722	0.10029	0.099743	0.99456
54	48.004	0	0.065886	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
55	49.001	0	0.066716	2.9681	6.566	6.572	6.4717	0.094366	0.10033	1.0632
56	49.916	0	0.066993	2.9681	6.5693	6.572	6.4711	0.098205	0.10091	1.0276

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5687	6.5714	6.4711	0.097657	0.10033	1.0274
2	0.012483	0	0	2.9681	6.601	6.5954	6.4869	0.11412	0.10853	0.95107
3	0.050483	-0.0022211	0.02187	2.9681	6.7074	6.7054	6.4845	0.22285	0.22092	0.99136
4	0.10062	-0.0033317	0.038756	2.9681	6.7091	6.7142	6.4728	0.23627	0.2414	1.0217
5	0.25083	-0.0033317	0.061733	2.9681	6.7151	6.7172	6.4763	0.23876	0.24082	1.0086
6	0.5017	-0.0033317	0.0908	2.9681	6.7222	6.7213	6.4728	0.24936	0.24843	0.99625
7	1.0034	-0.0033317	0.13482	2.9681	6.714	6.7195	6.4746	0.23945	0.24492	1.0228
8	2.0011	-0.0033317	0.20707	2.9681	6.7173	6.7195	6.4746	0.24271	0.24492	1.0091
9	3.0032	-0.0033317	0.26853	2.9681	6.7222	6.7213	6.4734	0.24878	0.24784	0.99625
10	4.0008	-0.0033317	0.3214	2.9681	6.7178	6.7201	6.4722	0.2456	0.24784	1.0091
11	5.0029	-0.0033317	0.36902	2.9681	6.7178	6.7201	6.4734	0.24443	0.24667	1.0092
12	6.0005	-0.0033317	0.41109	2.9681	6.7173	6.7195	6.4728	0.24446	0.24667	1.009
13	7.0027	-0.0033317	0.4493	2.9681	6.7146	6.7201	6.4722	0.24234	0.24784	1.0227
14	8.0003	-0.0033317	0.48335	2.9681	6.7184	6.7207	6.4728	0.24556	0.24784	1.0093
15	9.0024	-0.0033317	0.51463	2.9681	6.7184	6.7207	6.474	0.24439	0.24667	1.0093
16	10.004	-0.0033317	0.54231	2.9681	6.7184	6.7207	6.474	0.24439	0.24667	1.0093
17	11.002	-0.0033317	0.56806	2.9681	6.7184	6.7207	6.4728	0.24556	0.24784	1.0093
18	12.004	-0.0033317	0.59076	2.9681	6.7184	6.7207	6.4728	0.24556	0.24784	1.0093
19	13.002	-0.0033317	0.61152	2.9681	6.7157	6.7213	6.4734	0.24227	0.24784	1.023
20	14.004	-0.0033317	0.63062	2.9681	6.7189	6.7213	6.4734	0.24552	0.24784	1.0094
21	15.001	-0.0033317	0.64778	2.9681	6.7189	6.7213	6.4728	0.24611	0.24843	1.0094
22	16.003	-0.0033317	0.66329	2.9681	6.7189	6.7213	6.4722	0.24669	0.24901	1.0094
23	17.001	-0.0033317	0.6774	2.9681	6.7189	6.7213	6.4722	0.24669	0.24901	1.0094
24	18.003	-0.0033317	0.69069	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
25	19.001	-0.0033317	0.70287	2.9681	6.7189	6.7213	6.4693	0.24962	0.25194	1.0093
26	20.003	-0.0033317	0.71395	2.9681	6.7189	6.7213	6.4699	0.24903	0.25135	1.0093
27	21.001	-0.0044422	0.72391	2.9681	6.7189	6.7213	6.4711	0.24786	0.25018	1.0094
28	22.002	-0.0044422	0.73305	2.9681	6.7189	6.7213	6.4705	0.24845	0.25077	1.0093
29	23	-0.0044422	0.7408	2.9681	6.7222	6.7213	6.4734	0.24878	0.24784	0.99625
30	24.002	-0.0044422	0.7491	2.9681	6.7184	6.7207	6.4711	0.24731	0.2496	1.0092
31	25	-0.0033317	0.75713	2.9681	6.7189	6.7213	6.4722	0.24669	0.24901	1.0094
32	26.002	-0.0044422	0.76405	2.9681	6.7189	6.7213	6.4722	0.24669	0.24901	1.0094
33	27.004	-0.0033317	0.7707	2.9681	6.7189	6.7213	6.4711	0.24786	0.25018	1.0094
34	28.002	-0.0033317	0.77679	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
35	29.004	-0.0033317	0.78232	2.9681	6.7195	6.7218	6.4728	0.24666	0.24901	1.0096
36	30.001	-0.0033317	0.78786	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
37	31.003	-0.0033317	0.79284	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
38	32.001	-0.0033317	0.79783	2.9681	6.7195	6.7218	6.4705	0.249	0.25135	1.0095
39	33.003	-0.0022211	0.80225	2.9681	6.7195	6.7218	6.4722	0.24724	0.2496	1.0095
40	34.001	-0.0022211	0.80668	2.9681	6.7189	6.7213	6.4705	0.24845	0.25077	1.0093
41	35.003	-0.0033317	0.80945	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
42	36	-0.0022211	0.81471	2.9681	6.7189	6.7213	6.4711	0.24786	0.25018	1.0094
43	37.002	-0.0022211	0.81831	2.9681	6.7189	6.7213	6.4728	0.24611	0.24843	1.0094
44	38.004	-0.0022211	0.82219	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
45	39.002	-0.0022211	0.82523	2.9681	6.7189	6.7213	6.4711	0.24786	0.25018	1.0094
46	40.004	-0.0022211	0.82828	2.9681	6.7189	6.7213	6.4711	0.24786	0.25018	1.0094
47	41.002	-0.0022211	0.83132	2.9681	6.7227	6.7218	6.4728	0.24991	0.24901	0.99641
48	42.003	-0.0033317	0.8352	2.9681	6.7195	6.7218	6.4711	0.24841	0.25077	1.0095
49	43.001	-0.0033317	0.83797	2.9681	6.7195	6.7218	6.4722	0.24724	0.2496	1.0095
50	44.003	-0.0022211	0.84073	2.9681	6.7195	6.7218	6.4728	0.24666	0.24901	1.0096
51	45.001	-0.0033317	0.8435	2.9681	6.7189	6.7213	6.4722	0.24669	0.24901	1.0094
52	46.003	-0.0033317	0.84599	2.9681	6.7189	6.7213	6.4711	0.24786	0.25018	1.0094
53	47.001	-0.0033317	0.84876	2.9681	6.7189	6.7213	6.4705	0.24845	0.25077	1.0093
54	48.003	-0.0033317	0.84987	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
55	49.001	-0.0033317	0.85236	2.9681	6.7195	6.7218	6.4722	0.24724	0.2496	1.0095
56	50.002	-0.0033317	0.85568	2.9681	6.7189	6.7213	6.4705	0.24845	0.25077	1.0093
57	51	-0.0033317	0.8579	2.9681	6.7195	6.7218	6.4728	0.24666	0.24901	1.0096
58	52.002	-0.0022211	0.85901	2.9681	6.7195	6.7218	6.4722	0.24724	0.2496	1.0095
59	53.004	-0.0022211	0.8615	2.9681	6.7189	6.7213	6.4711	0.24786	0.25018	1.0094
60	54.002	-0.0033317	0.86288	2.9681	6.7195	6.7218	6.4722	0.24724	0.2496	1.0095
61	55.004	-0.0022211	0.86482	2.9681	6.7189	6.7213	6.4722	0.24669	0.24901	1.0094
62	56.001	-0.0033317	0.86676	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
63	57.004	-0.0022211	0.86842	2.9681	6.7195	6.7218	6.4722	0.24724	0.2496	1.0095
64	58.001	-0.0022211	0.87174	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
65	59.003	-0.0033317	0.87257	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
66	60.001	-0.0033317	0.87451	2.9681	6.7195	6.7218	6.4722	0.24724	0.2496	1.0095
67	60.36	-0.0033317	0.87589	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
2	0.0125	0	0.00083049	2.9681	6.7736	6.7622	6.4898	0.28382	0.27244	0.95991
3	0.050533	0	0.030451	2.9681	6.9846	6.97	6.4863	0.49835	0.48376	0.97071
4	0.1006	0	0.048722	2.9681	6.9617	6.9595	6.474	0.48775	0.48551	0.9954
5	0.25083	-0.0011106	0.081942	2.9681	6.9613	6.9659	6.4834	0.47791	0.48258	1.0098
6	0.5017	-0.0011106	0.12457	2.9681	6.9689	6.9706	6.474	0.49492	0.49663	1.0035
7	1.0032	-0.0011106	0.19129	2.9681	6.964	6.9689	6.4728	0.49119	0.49604	1.0099
8	2.0008	0.0011106	0.29427	2.9681	6.964	6.9689	6.4758	0.48826	0.49312	1.0099
9	3.0026	0.0077739	0.37621	2.9681	6.9646	6.9695	6.4758	0.48881	0.4937	1.01
10	4.0002	0.017769	0.44293	2.9681	6.9657	6.9706	6.4722	0.49342	0.49838	1.0101
11	5.0019	0.032206	0.49885	2.9681	6.9651	6.97	6.474	0.49111	0.49604	1.01
12	6.0037	0.048864	0.54591	2.9681	6.9651	6.97	6.4717	0.49345	0.49838	1.01
13	7.0013	0.061081	0.58522	2.9681	6.9651	6.97	6.4746	0.49053	0.49546	1.01
14	8.0031	0.065523	0.61844	2.9681	6.9657	6.9706	6.4734	0.49225	0.49721	1.0101
15	9.0007	0.067744	0.6464	2.9681	6.9662	6.9712	6.4717	0.49455	0.49955	1.0101
16	10.002	0.071076	0.67021	2.9681	6.97	6.9718	6.4728	0.49718	0.49897	1.0036
17	11	0.073297	0.69069	2.9681	6.9657	6.9706	6.4699	0.49576	0.50072	1.01
18	12.002	0.077739	0.70841	2.9681	6.9689	6.9706	6.4711	0.49784	0.49955	1.0034
19	13.004	0.081071	0.72363	2.9681	6.9695	6.9712	6.4728	0.49664	0.49838	1.0035
20	14.001	0.082181	0.7372	2.9681	6.9662	6.9712	6.4722	0.49397	0.49897	1.0101
21	15.003	0.085513	0.74938	2.9681	6.9695	6.9712	6.4699	0.49956	0.50131	1.0035
22	16.001	0.093287	0.75907	2.9681	6.9695	6.9712	6.4717	0.49781	0.49955	1.0035
23	17.003	0.098839	0.76931	2.9681	6.9695	6.9712	6.4734	0.49605	0.4978	1.0035
24	18.001	0.10106	0.77817	2.9681	6.9695	6.9712	6.4717	0.49781	0.49955	1.0035
25	19.003	0.10217	0.7862	2.9681	6.9695	6.9712	6.4711	0.49839	0.50014	1.0035
26	20	0.10439	0.79284	2.9681	6.97	6.9718	6.474	0.49601	0.4978	1.0036
27	21.002	0.10661	0.80004	2.9681	6.97	6.9718	6.4734	0.4966	0.49838	1.0036
28	22.004	0.10772	0.80613	2.9681	6.9695	6.9712	6.4711	0.49839	0.50014	1.0035
29	23.001	0.10883	0.81167	2.9681	6.97	6.9718	6.4728	0.49718	0.49897	1.0036
30	24.003	0.10994	0.81693	2.9681	6.9695	6.9712	6.4722	0.49722	0.49897	1.0035
31	25	0.10994	0.82163	2.9681	6.9695	6.9712	6.4722	0.49722	0.49897	1.0035
32	26.003	0.10994	0.82662	2.9681	6.9662	6.9712	6.4705	0.49572	0.50072	1.0101
33	27.001	0.11106	0.83049	2.9681	6.97	6.9718	6.4722	0.49777	0.49955	1.0036
34	28.002	0.11106	0.83492	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
35	29	0.11217	0.83852	2.9681	6.9695	6.9712	6.4711	0.49839	0.50014	1.0035
36	30.002	0.11328	0.84156	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
37	31	0.11439	0.84572	2.9681	6.97	6.9718	6.4722	0.49777	0.49955	1.0036
38	32.002	0.1155	0.84876	2.9681	6.97	6.9718	6.4728	0.49718	0.49897	1.0036
39	33	0.11772	0.85208	2.9681	6.97	6.9718	6.4705	0.49952	0.50131	1.0036
40	34.002	0.11772	0.85485	2.9681	6.97	6.9718	6.4722	0.49777	0.49955	1.0036
41	35.004	0.11772	0.85817	2.9681	6.97	6.9718	6.4711	0.49894	0.50072	1.0036
42	36.002	0.11772	0.86067	2.9681	6.97	6.9718	6.4728	0.49718	0.49897	1.0036
43	37.004	0.11772	0.86426	2.9681	6.97	6.9718	6.4734	0.4966	0.49838	1.0036
44	38.002	0.11772	0.86731	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
45	39.003	0.11661	0.87008	2.9681	6.9695	6.9712	6.4722	0.49722	0.49897	1.0035
46	40.001	0.11661	0.87146	2.9681	6.9695	6.9712	6.4722	0.49722	0.49897	1.0035
47	41.003	0.11661	0.87395	2.9681	6.97	6.9718	6.4728	0.49718	0.49897	1.0036
48	42	0.11661	0.877	2.9681	6.9695	6.9712	6.4699	0.49956	0.50131	1.0035
49	42.719	0.11772	0.87894	2.9681	6.9695	6.9712	6.4722	0.49722	0.49897	1.0035

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.9695	6.9712	6.4717	0.49781	0.49955	1.0035
2	0.0125	0	0.0013842	2.9681	7.0566	7.0537	6.4997	0.55684	0.55401	0.99491
3	0.050483	0.0011106	0.035988	2.9681	7.3964	7.4407	6.498	0.89845	0.9427	1.0492
4	0.10062	0.013327	0.070315	2.9681	7.4323	7.4512	6.4758	0.95659	0.97546	1.0197
5	0.25083	0.042201	0.12707	2.9681	7.4541	7.4606	6.4746	0.97955	0.986	1.0066
6	0.50163	0.084402	0.19406	2.9681	7.4662	7.4699	6.4734	0.99275	0.99654	1.0038
7	1.003	0.12771	0.2951	2.9681	7.464	7.4711	6.4851	0.9789	0.98601	1.0073
8	2.001	0.15659	0.44016	2.9681	7.4645	7.4682	6.4769	0.9876	0.99127	1.0037
9	3.0027	0.18546	0.54536	2.9681	7.4689	7.4694	6.474	0.99488	0.99537	1.0005
10	4.0007	0.22766	0.62204	2.9681	7.4673	7.4711	6.4746	0.99268	0.99654	1.0039
11	5.0024	0.24987	0.6799	2.9681	7.4662	7.4699	6.474	0.99217	0.99595	1.0038
12	6.0004	0.26098	0.72419	2.9681	7.4667	7.4705	6.4752	0.99155	0.99537	1.0039
13	7.0022	0.27431	0.75907	2.9681	7.4662	7.4699	6.4717	0.99451	0.99829	1.0038
14	8.0001	0.27986	0.78592	2.9681	7.4667	7.4705	6.4717	0.99506	0.99888	1.0038
15	9.0019	0.2843	0.80807	2.9681	7.4678	7.4717	6.4693	0.9985	1.0024	1.0039
16	10.004	0.28763	0.82606	2.9681	7.4673	7.4711	6.4722	0.99502	0.99888	1.0039
17	11.002	0.29319	0.84073	2.9681	7.47	7.4705	6.4722	0.99773	0.99829	1.0006
18	12.004	0.29874	0.8543	2.9681	7.4705	7.4711	6.4734	0.99711	0.99771	1.0006
19	13.001	0.30318	0.86565	2.9681	7.4673	7.4711	6.4734	0.99385	0.99771	1.0039
20	14.003	0.30429	0.87561	2.9681	7.4673	7.4711	6.4746	0.99268	0.99654	1.0039
21	15.001	0.30651	0.88475	2.9681	7.4705	7.4711	6.4699	1.0006	1.0012	1.0006
22	16.003	0.30762	0.89278	2.9681	7.4673	7.4711	6.4717	0.99561	0.99946	1.0039
23	17.001	0.30984	0.89998	2.9681	7.4673	7.4711	6.4705	0.99678	1.0006	1.0039
24	18.003	0.31207	0.9069	2.9681	7.4711	7.4717	6.4699	1.0012	1.0018	1.0006
25	19	0.31429	0.91326	2.9681	7.4673	7.4711	6.4717	0.99561	0.99946	1.0039
26	20.003	0.31762	0.91769	2.9681	7.4711	7.4717	6.4734	0.99765	0.99829	1.0006
27	21	0.31873	0.92351	2.9681	7.4705	7.4711	6.4705	1	1.0006	1.0006
28	22.002	0.31984	0.92877	2.9681	7.4705	7.4711	6.4722	0.99828	0.99888	1.0006
29	23.004	0.32095	0.93347	2.9681	7.4705	7.4711	6.4711	0.99945	1	1.0006
30	24.002	0.32095	0.93818	2.9681	7.4705	7.4711	6.4728	0.99769	0.99829	1.0006
31	25.004	0.32206	0.94316	2.9681	7.4673	7.4711	6.4693	0.99795	1.0018	1.0039
32	26.002	0.32206	0.94648	2.9681	7.4705	7.4711	6.4717	0.99886	0.99946	1.0006
33	27.003	0.32206	0.95036	2.9681	7.4711	7.4717	6.4728	0.99824	0.99888	1.0006
34	28.001	0.32428	0.95479	2.9681	7.4705	7.4711	6.4717	0.99886	0.99946	1.0006
35	29.003	0.32539	0.95839	2.9681	7.4711	7.4717	6.4734	0.99765	0.99829	1.0006
36	30.001	0.3265	0.96199	2.9681	7.4705	7.4711	6.4699	1.0006	1.0012	1.0006
37	31.003	0.3265	0.96558	2.9681	7.4711	7.4717	6.4722	0.99882	0.99946	1.0006
38	32.001	0.32761	0.96863	2.9681	7.4711	7.4717	6.4717	0.99941	1	1.0006
39	33.003	0.32761	0.9714	2.9681	7.4705	7.4711	6.4705	1	1.0006	1.0006
40	33.207	0.32761	0.97195	2.9681	7.4711	7.4717	6.4705	1.0006	1.0012	1.0006

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.4711	7.4717	6.4717	0.99941	1	1.0006
2	0.012417	0	0	2.9681	7.5116	7.508	6.4798	1.0317	1.0281	0.99652
3	0.0503	0.0044422	0.045123	2.9681	8.2965	8.3837	6.5021	1.7944	1.8816	1.0486
4	0.10038	0.028874	0.094399	2.9681	8.418	8.4335	6.4775	1.9405	1.956	1.008
5	0.2506	0.064412	0.18215	2.9681	8.4285	8.4551	6.4781	1.9504	1.977	1.0136
6	0.5013	0.1155	0.28264	2.9681	8.4482	8.4692	6.4793	1.9689	1.9899	1.0107
7	1.0027	0.17769	0.42964	2.9681	8.4547	8.4692	6.4752	1.9795	1.994	1.0073
8	2.0003	0.24876	0.62259	2.9681	8.4601	8.468	6.4793	1.9809	1.9887	1.004
9	3.0021	0.28541	0.74191	2.9681	8.4618	8.4698	6.4752	1.9866	1.9946	1.004
10	4.0035	0.30318	0.81859	2.9681	8.4612	8.4692	6.4746	1.9866	1.9946	1.004
11	5.0011	0.32539	0.86952	2.9681	8.4661	8.4709	6.4728	1.9933	1.9981	1.0024
12	6.0029	0.34649	0.90551	2.9681	8.465	8.4698	6.4728	1.9922	1.9969	1.0024
13	7.0005	0.35649	0.93237	2.9681	8.4656	8.4703	6.4699	1.9957	2.0004	1.0024
14	8.0023	0.36648	0.95313	2.9681	8.4656	8.4703	6.4722	1.9933	1.9981	1.0024
15	9.004	0.36981	0.97001	2.9681	8.4694	8.4709	6.4752	1.9942	1.9958	1.0008
16	10.002	0.37204	0.98413	2.9681	8.4667	8.4715	6.474	1.9927	1.9975	1.0024
17	11.003	0.37426	0.99631	2.9681	8.4694	8.4709	6.4734	1.996	1.9975	1.0008
18	12.001	0.37759	1.0074	2.9681	8.4661	8.4709	6.4705	1.9956	2.0004	1.0024
19	13.003	0.37759	1.0168	2.9681	8.4694	8.4709	6.4722	1.9971	1.9987	1.0008
20	14	0.37981	1.0254	2.9681	8.4694	8.4709	6.4728	1.9965	1.9981	1.0008
21	15.002	0.38092	1.0334	2.9681	8.4699	8.4715	6.4699	2	2.0016	1.0008
22	16.004	0.38203	1.0403	2.9681	8.4694	8.4709	6.4717	1.9977	1.9993	1.0008
23	17.002	0.38203	1.0467	2.9681	8.4661	8.4709	6.4711	1.995	1.9999	1.0024
24	18.003	0.38203	1.0525	2.9681	8.4688	8.4703	6.474	1.9948	1.9964	1.0008
25	19.001	0.38314	1.0583	2.9681	8.4694	8.4709	6.4734	1.996	1.9975	1.0008
26	20.003	0.38314	1.0641	2.9681	8.4699	8.4715	6.4728	1.9971	1.9987	1.0008
27	21	0.38425	1.0694	2.9681	8.4699	8.4715	6.474	1.9959	1.9975	1.0008
28	22.002	0.38536	1.0749	2.9681	8.4694	8.4709	6.4717	1.9977	1.9993	1.0008
29	23	0.38647	1.0791	2.9681	8.4699	8.4715	6.4728	1.9971	1.9987	1.0008
30	24.002	0.38647	1.0841	2.9681	8.4694	8.4709	6.4734	1.996	1.9975	1.0008
31	25.004	0.3898	1.0879	2.9681	8.4694	8.4709	6.4734	1.996	1.9975	1.0008
32	26.002	0.39203	1.0929	2.9681	8.4699	8.4715	6.4705	1.9994	2.001	1.0008
33	27.003	0.39314	1.0971	2.9681	8.4667	8.4715	6.4728	1.9938	1.9987	1.0024
34	28.001	0.39425	1.1012	2.9681	8.4694	8.4709	6.4722	1.9971	1.9987	1.0008
35	28.511	0.39425	1.1029	2.9681	8.4694	8.4709	6.4717	1.9977	1.9993	1.0008

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9416	5.9439	5.872	0.069572	0.071884	1.0332
2	0.012567	0	0	2.9681	5.9454	5.948	5.8749	0.070487	0.073056	1.0365
3	0.05005	0.0011106	0.0047061	2.9681	5.9738	5.9679	5.8749	0.098902	0.092959	0.93991
4	0.10013	0	0.0071976	2.9681	5.9663	5.9702	5.8738	0.092504	0.09647	1.0429
5	0.25035	0	0.01052	2.9681	5.9668	5.9708	5.8726	0.094223	0.098226	1.0425
6	0.5013	0	0.013565	2.9681	5.9674	5.9714	5.872	0.095357	0.099396	1.0424
7	1.003	0	0.018271	2.9681	5.9706	5.9714	5.8732	0.097441	0.098226	1.0081
8	2.0008	0	0.025745	2.9681	5.9744	5.972	5.8726	0.10183	0.099397	0.97612
9	3.0027	-0.0011106	0.031836	2.9681	5.9712	5.972	5.8732	0.097989	0.098812	1.0084
10	4.0006	0	0.037372	2.9681	5.9706	5.9714	5.8708	0.099781	0.10057	1.0079
11	5.0025	0	0.041801	2.9681	5.9706	5.9714	5.8714	0.099196	0.099981	1.0079
12	6.0004	0	0.045677	2.9681	5.9706	5.9714	5.8726	0.098026	0.098811	1.008
13	7.0023	-0.0011106	0.049276	2.9681	5.9706	5.9714	5.8726	0.098026	0.098811	1.008
14	8.0001	-0.0011106	0.052321	2.9681	5.9744	5.972	5.8732	0.10124	0.098812	0.97598
15	9.002	-0.0011106	0.055366	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
16	10.004	-0.0011106	0.058134	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
17	11.001	-0.0011106	0.06118	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
18	12.003	-0.0011106	0.063948	2.9681	5.9706	5.9714	5.8702	0.10037	0.10115	1.0078
19	13.001	-0.0011106	0.065609	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
20	14.003	0	0.068377	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
21	15.001	0	0.070038	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
22	16.003	0	0.071976	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
23	17	0	0.074467	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
24	18.002	0	0.076405	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
25	19	0	0.078343	2.9681	5.9744	5.972	5.872	0.10241	0.099982	0.97626
26	20.002	0	0.079727	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
27	21.004	0	0.081665	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
28	22.002	0	0.083603	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
29	23.004	0	0.084433	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
30	24.001	0	0.085817	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
31	25.003	0	0.087755	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
32	26.001	-0.0011106	0.088586	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
33	27.003	-0.0011106	0.08997	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
34	28.001	-0.0011106	0.091077	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
35	29.003	-0.0011106	0.092461	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
36	30.001	-0.0022211	0.093846	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
37	31.002	-0.0011106	0.09523	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
38	32	-0.0011106	0.09606	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
39	33.002	-0.0011106	0.097721	2.9681	5.9744	5.972	5.872	0.10241	0.099982	0.97626
40	34.004	-0.0011106	0.098828	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
41	35.002	-0.0011106	0.10021	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
42	36.004	-0.0011106	0.10132	2.9681	5.9712	5.972	5.8708	0.10033	0.10115	1.0082
43	37.002	-0.0011106	0.10243	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
44	38.004	-0.0011106	0.10353	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
45	39.001	0	0.10381	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
46	40.003	0	0.10492	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
47	41.001	-0.0011106	0.1063	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
48	42.003	-0.0011106	0.10658	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
49	43.001	-0.0011106	0.10741	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
50	44.003	-0.0011106	0.10879	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
51	45.001	-0.0011106	0.1099	2.9681	5.9706	5.9714	5.8714	0.099196	0.099981	1.0079
52	46.003	-0.0011106	0.11046	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
53	47	-0.0022211	0.11073	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
54	48.002	-0.0022211	0.11267	2.9681	5.9744	5.972	5.8714	0.103	0.10057	0.97639
55	49.004	-0.0022211	0.11267	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
56	50.002	-0.0022211	0.11405	2.9681	5.9712	5.972	5.8708	0.10033	0.10115	1.0082
57	51.004	-0.0011106	0.11488	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
58	52.002	-0.0022211	0.11572	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
59	53.004	-0.0011106	0.11572	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
60	54.002	-0.0011106	0.1171	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
61	55.003	-0.0011106	0.11765	2.9681	5.9679	5.972	5.8726	0.09532	0.099397	1.0428
62	56.001	-0.0011106	0.11793	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
63	57.003	-0.0011106	0.11931	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
64	58.001	-0.0011106	0.11959	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
65	59.003	-0.0011106	0.1207	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
66	60.001	-0.0011106	0.12097	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
67	61.003	-0.0022211	0.12181	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
68	62	-0.0011106	0.12236	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
69	63.002	-0.0011106	0.12291	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
70	64	-0.0022211	0.12457	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
71	65.002	-0.0022211	0.12513	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
72	66.004	-0.0022211	0.12568	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
73	67.002	-0.0011106	0.12568	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
74	68.004	-0.0011106	0.12707	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
75	69.001	-0.0011106	0.12762	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
76	70.003	-0.0022211	0.1279	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
77	71.001	-0.0011106	0.129	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
78	72.003	-0.0022211	0.12956	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
79	73.001	-0.0011106	0.12928	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
80	74.002	-0.0022211	0.12983	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
81	75	-0.0022211	0.13039	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
82	76.002	-0.0022211	0.13149	2.9681	5.9706	5.9714	5.8726	0.098026	0.098811	1.008
83	77.004	-0.0011106	0.13149	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
84	78.002	-0.0022211	0.13288	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
85	79.004	-0.0011106	0.13316	2.9681	5.975	5.9726	5.8726	0.10238	0.099982	0.97661
86	80.002	-0.0022211	0.13426	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
87	81.003	-0.0022211	0.13482	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
88	82.001	-0.0022211	0.13454	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
89	83.003	-0.0022211	0.13509	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
90	84.001	-0.0011106	0.1362	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
91	85.003	-0.0011106	0.13592	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
92	86.001	-0.0011106	0.13731	2.9681	5.9679	5.972	5.872	0.095905	0.099982	1.0425

93	87.003	-0.0011106	0.13758	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
94	88	-0.0011106	0.13758	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
95	89.002	-0.0011106	0.13869	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
96	90	-0.0011106	0.13869	2.9681	5.9679	5.972	5.872	0.095905	0.099982	1.0425
97	91.002	-0.0011106	0.13897	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
98	92.004	-0.0011106	0.13952	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
99	93.002	-0.0011106	0.14008	2.9681	5.9744	5.972	5.872	0.10241	0.099982	0.97626
100	94.004	-0.0011106	0.14174	2.9681	5.9744	5.972	5.8708	0.10358	0.10115	0.97653
101	95.002	-0.0011106	0.14118	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
102	96.003	-0.0011106	0.14257	2.9681	5.9706	5.9714	5.8708	0.099781	0.10057	1.0079
103	97.001	-0.0022211	0.14284	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
104	98.003	-0.0022211	0.14257	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
105	99.001	-0.0022211	0.1434	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083
106	100	-0.0022211	0.14395	2.9681	5.9679	5.972	5.8726	0.09532	0.099397	1.0428
107	101	-0.0033317	0.14451	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
108	102	-0.0022211	0.14506	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
109	103	-0.0022211	0.14506	2.9681	5.9712	5.972	5.8714	0.099744	0.10057	1.0082
110	104	-0.0022211	0.14589	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
111	105	-0.0011106	0.14589	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
112	106	-0.0022211	0.14672	2.9681	5.9706	5.9714	5.872	0.098611	0.099396	1.008
113	107	-0.0011106	0.147	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
114	108	-0.0011106	0.147	2.9681	5.9712	5.972	5.872	0.099159	0.099982	1.0083
115	108.24	-0.0011106	0.14783	2.9681	5.9712	5.972	5.8726	0.098574	0.099397	1.0083

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	5.9744	5.972	5.8726	0.10183	0.099397	0.97612
2	0.012483	0	0.00055366	2.9681	6.0029	5.9954	5.8843	0.11858	0.11111	0.93701
3	0.05055	0	0.020209	2.9681	6.1278	6.1183	5.8814	0.24648	0.23696	0.96141
4	0.10062	0	0.031836	2.9681	6.1207	6.1142	5.8738	0.24699	0.24047	0.97362
5	0.25083	-0.0011106	0.053428	2.9681	6.1192	6.1195	5.879	0.24015	0.24048	1.0013
6	0.50172	-0.0011106	0.081111	2.9681	6.1192	6.1195	5.8743	0.24483	0.24516	1.0013
7	1.0034	-0.0011106	0.12457	2.9681	6.1235	6.1207	5.8755	0.24801	0.24516	0.98848
8	2.0012	-0.0011106	0.1935	2.9681	6.1208	6.1212	5.8743	0.24648	0.24691	1.0018
9	3.0031	-0.0011106	0.25109	2.9681	6.1203	6.1207	5.8761	0.24417	0.24457	1.0016
10	4.0011	-0.0022211	0.30202	2.9681	6.1197	6.1201	5.8732	0.24655	0.24691	1.0015
11	5.003	-0.0011106	0.3477	2.9681	6.1203	6.1207	5.8743	0.24593	0.24633	1.0016
12	6.0008	0	0.38922	2.9681	6.117	6.1207	5.8732	0.24384	0.2475	1.015
13	7.0027	0.0022211	0.4277	2.9681	6.1203	6.1207	5.8738	0.24651	0.24691	1.0016
14	8.0005	0.0044422	0.46341	2.9681	6.1203	6.1207	5.8726	0.24768	0.24808	1.0016
15	9.0024	0.0088844	0.49663	2.9681	6.1165	6.1201	5.8738	0.24271	0.24633	1.0149
16	10	0.014437	0.52681	2.9681	6.117	6.1207	5.8726	0.24443	0.24808	1.0149
17	11.002	0.017769	0.55532	2.9681	6.117	6.1207	5.8738	0.24326	0.24691	1.015
18	12	0.01999	0.58162	2.9681	6.1203	6.1207	5.8714	0.24885	0.24925	1.0016
19	13.002	0.023322	0.60626	2.9681	6.1203	6.1207	5.8743	0.24593	0.24633	1.0016
20	14.004	0.027764	0.62924	2.9681	6.117	6.1207	5.8726	0.24443	0.24808	1.0149
21	15.002	0.029985	0.65083	2.9681	6.1203	6.1207	5.8702	0.25002	0.25042	1.0016
22	16.004	0.034427	0.67076	2.9681	6.1208	6.1212	5.8714	0.2494	0.24984	1.0017
23	17.001	0.035538	0.68958	2.9681	6.117	6.1207	5.8708	0.24618	0.24984	1.0148
24	18.003	0.038869	0.70675	2.9681	6.1176	6.1212	5.8743	0.24322	0.24691	1.0152
25	19.001	0.043312	0.7228	2.9681	6.1208	6.1212	5.8743	0.24648	0.24691	1.0018
26	20.003	0.045533	0.73803	2.9681	6.1176	6.1212	5.8726	0.24498	0.24867	1.0151
27	21.001	0.047754	0.75187	2.9681	6.1176	6.1212	5.8738	0.24381	0.2475	1.0151
28	22.003	0.049975	0.76516	2.9681	6.1203	6.1207	5.8743	0.24593	0.24633	1.0016
29	23.001	0.053307	0.77734	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
30	24.002	0.054417	0.78869	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
31	25	0.055528	0.79949	2.9681	6.1176	6.1212	5.8714	0.24615	0.24984	1.015
32	26.002	0.05997	0.80945	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
33	27.004	0.062191	0.81914	2.9681	6.1176	6.1212	5.872	0.24556	0.24925	1.015
34	28.002	0.064412	0.82717	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
35	29.004	0.065523	0.83686	2.9681	6.1214	6.1218	5.8708	0.25054	0.25101	1.0019
36	30.002	0.067744	0.84433	2.9681	6.1176	6.1212	5.8743	0.24322	0.24691	1.0152
37	31.004	0.069965	0.85264	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
38	32.001	0.071076	0.85984	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
39	33.003	0.072186	0.86593	2.9681	6.1176	6.1212	5.872	0.24556	0.24925	1.015
40	34.001	0.076628	0.87312	2.9681	6.1208	6.1212	5.8732	0.24765	0.24808	1.0018
41	35.003	0.078849	0.87921	2.9681	6.1214	6.1218	5.8738	0.24761	0.24808	1.0019
42	36.001	0.07996	0.88503	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
43	37.003	0.082181	0.89056	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
44	38.001	0.084402	0.89582	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
45	39.003	0.085513	0.90053	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
46	40.001	0.086623	0.90524	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
47	41.002	0.086623	0.90939	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
48	42	0.087734	0.91382	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
49	43.002	0.088844	0.91825	2.9681	6.1208	6.1212	5.8708	0.24999	0.25042	1.0017
50	44.004	0.089955	0.92074	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
51	45.002	0.091066	0.92517	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
52	46.004	0.092176	0.92849	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
53	47.002	0.092176	0.93292	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
54	48.004	0.093287	0.93596	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
55	49.001	0.096618	0.93929	2.9681	6.1214	6.1218	5.8714	0.24995	0.25042	1.0019
56	50.003	0.096618	0.94178	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
57	51.001	0.096618	0.94482	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
58	52.003	0.097729	0.9487	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
59	53.001	0.098839	0.95174	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
60	54.003	0.098839	0.95313	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
61	55	0.09995	0.95673	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
62	56.002	0.09995	0.95866	2.9681	6.1208	6.1212	5.8708	0.24999	0.25042	1.0017
63	57	0.09995	0.9606	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
64	58.002	0.09995	0.96392	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
65	59.004	0.10106	0.96642	2.9681	6.1208	6.1212	5.8708	0.24999	0.25042	1.0017
66	60.002	0.10106	0.96863	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
67	61.004	0.10106	0.97112	2.9681	6.1208	6.1212	5.8708	0.24999	0.25042	1.0017
68	62.001	0.10106	0.97251	2.9681	6.1208	6.1212	5.8697	0.25116	0.25159	1.0017
69	63.003	0.10106	0.97444	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
70	64.001	0.10217	0.97583	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
71	65.003	0.10106	0.97887	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
72	66.001	0.10106	0.98136	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
73	67.003	0.10217	0.9833	2.9681	6.1208	6.1212	5.8726	0.24823	0.24867	1.0018
74	68.001	0.10217	0.98413	2.9681	6.1214	6.1218	5.8732	0.2482	0.24867	1.0019
75	69.003	0.10217	0.98607	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
76	70	0.10217	0.98912	2.9681	6.1214	6.1218	5.8708	0.25054	0.25101	1.0019
77	71.002	0.10328	0.99078	2.9681	6.1214	6.1218	5.8714	0.24995	0.25042	1.0019
78	72	0.10439	0.99105	2.9681	6.1208	6.1212	5.872	0.24882	0.24925	1.0017
79	73.002	0.10439	0.99382	2.9681	6.1208	6.1212	5.8702	0.25057	0.25101	1.0017
80	74.004	0.10439	0.99548	2.9681	6.1208	6.1212	5.8702	0.25057	0.25101	1.0017
81	75.002	0.10439	0.99714	2.9681	6.1214	6.1218	5.8726	0.24878	0.24925	1.0019
82	75.566	0.10439	0.99797	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.1214	6.1218	5.872	0.24937	0.24984	1.0019
2	0.0125	0	0.00083049	2.9681	6.1625	6.1622	5.8884	0.27409	0.27385	0.9991
3	0.050567	0.0033317	0.023254	2.9681	6.3491	6.3718	5.8843	0.46483	0.48751	1.0488
4	0.10055	0.011106	0.037649	2.9681	6.3414	6.3601	5.8738	0.46764	0.48633	1.04
5	0.25078	0.031096	0.069484	2.9681	6.3577	6.3671	5.872	0.48574	0.49511	1.0193
6	0.50163	0.042201	0.10769	2.9681	6.3605	6.37	5.8749	0.48556	0.49511	1.0197
7	1.0034	0.064412	0.1661	2.9681	6.3583	6.3677	5.8732	0.48512	0.49452	1.0194
8	2.0011	0.097729	0.25441	2.9681	6.3637	6.37	5.8738	0.48998	0.49628	1.0128
9	3.0031	0.12105	0.32528	2.9681	6.3637	6.37	5.8743	0.4894	0.4957	1.0129
10	4.0009	0.13882	0.38562	2.9681	6.3675	6.3706	5.8732	0.49437	0.49745	1.0062
11	5.0029	0.15992	0.4385	2.9681	6.3637	6.37	5.8726	0.49115	0.49745	1.0128
12	6.0006	0.16658	0.48473	2.9681	6.3637	6.37	5.8749	0.48881	0.49511	1.0129
13	7.0026	0.1788	0.5257	2.9681	6.3643	6.3706	5.8732	0.49112	0.49745	1.0129
14	8.0003	0.19657	0.56169	2.9681	6.3643	6.3706	5.8749	0.48936	0.4957	1.0129
15	9.0023	0.20989	0.5938	2.9681	6.3643	6.3706	5.8743	0.48995	0.49628	1.0129
16	10	0.22211	0.62231	2.9681	6.3675	6.3706	5.8743	0.4932	0.49628	1.0062
17	11.002	0.23433	0.64806	2.9681	6.3643	6.3706	5.8755	0.48878	0.49511	1.013
18	12.004	0.23877	0.67076	2.9681	6.3643	6.3706	5.872	0.49229	0.49862	1.0129
19	13.002	0.24099	0.69097	2.9681	6.3654	6.3718	5.8761	0.48929	0.4957	1.0131
20	14.004	0.24099	0.70979	2.9681	6.3654	6.3718	5.8714	0.49397	0.50038	1.013
21	15.002	0.24543	0.7264	2.9681	6.3648	6.3712	5.8738	0.49108	0.49745	1.013
22	16.004	0.24765	0.74191	2.9681	6.3675	6.3706	5.8702	0.4973	0.50038	1.0062
23	17.001	0.2521	0.75547	2.9681	6.3681	6.3712	5.8738	0.49434	0.49745	1.0063
24	18.003	0.25543	0.76793	2.9681	6.3681	6.3712	5.8738	0.49434	0.49745	1.0063
25	19.001	0.26098	0.77872	2.9681	6.3681	6.3712	5.8714	0.49668	0.49979	1.0063
26	20.003	0.26875	0.79035	2.9681	6.3681	6.3712	5.8738	0.49434	0.49745	1.0063
27	21.001	0.2732	0.80004	2.9681	6.3681	6.3712	5.8743	0.49375	0.49687	1.0063
28	22.003	0.27542	0.80945	2.9681	6.3681	6.3712	5.8708	0.49726	0.50038	1.0063
29	23.001	0.27875	0.81776	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
30	24.003	0.28208	0.82551	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
31	25	0.2843	0.83271	2.9681	6.3681	6.3712	5.8732	0.49492	0.49804	1.0063
32	26.002	0.28763	0.83935	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
33	27	0.28874	0.84599	2.9681	6.3648	6.3712	5.8732	0.49167	0.49804	1.013
34	28.002	0.29208	0.85181	2.9681	6.3681	6.3712	5.8732	0.49492	0.49804	1.0063
35	29.004	0.29208	0.85734	2.9681	6.3654	6.3718	5.8714	0.49397	0.50038	1.013
36	30.002	0.29208	0.86205	2.9681	6.3686	6.3718	5.8743	0.4943	0.49745	1.0064
37	31.004	0.29208	0.86703	2.9681	6.3681	6.3712	5.8708	0.49726	0.50038	1.0063
38	32.002	0.29208	0.87146	2.9681	6.3654	6.3718	5.8732	0.49222	0.49862	1.013
39	33.003	0.29319	0.87672	2.9681	6.3681	6.3712	5.8708	0.49726	0.50038	1.0063
40	34.001	0.2943	0.88115	2.9681	6.3681	6.3712	5.872	0.49609	0.49921	1.0063
41	35.003	0.2943	0.88503	2.9681	6.3654	6.3718	5.8738	0.49163	0.49804	1.013
42	36.001	0.2943	0.88863	2.9681	6.3686	6.3718	5.8714	0.49722	0.50038	1.0063
43	37.003	0.29541	0.89333	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
44	38.001	0.29541	0.89693	2.9681	6.3686	6.3718	5.8726	0.49605	0.49921	1.0064
45	39.003	0.29541	0.8997	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
46	40	0.29652	0.90413	2.9681	6.3686	6.3718	5.8726	0.49605	0.49921	1.0064
47	41.002	0.29652	0.90717	2.9681	6.3686	6.3718	5.8714	0.49722	0.50038	1.0063
48	42.004	0.29874	0.90967	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
49	43.002	0.29985	0.91326	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
50	44.004	0.30096	0.91548	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
51	45.002	0.30207	0.91908	2.9681	6.3681	6.3712	5.8714	0.49668	0.49979	1.0063
52	46.004	0.30207	0.92212	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
53	47.001	0.30318	0.92461	2.9681	6.3681	6.3712	5.8726	0.49551	0.49862	1.0063
54	48.003	0.30207	0.92711	2.9681	6.3686	6.3718	5.8714	0.49722	0.50038	1.0063
55	49.001	0.30429	0.92987	2.9681	6.3686	6.3718	5.872	0.49664	0.49979	1.0063
56	50.003	0.30429	0.93264	2.9681	6.3686	6.3718	5.8697	0.49898	0.50213	1.0063
57	51.001	0.3054	0.93458	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
58	52.003	0.3054	0.93735	2.9681	6.3686	6.3718	5.8708	0.49781	0.50096	1.0063
59	52.959	0.30651	0.93901	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.3686	6.3718	5.8732	0.49547	0.49862	1.0064
2	0.012483	-0.0011106	0.0019378	2.9681	6.453	6.4549	5.8983	0.55472	0.55659	1.0034
3	0.050533	0.0033317	0.033773	2.9681	6.8269	6.8746	5.8901	0.93674	0.98449	1.051
4	0.10055	0.013327	0.057027	2.9681	6.8277	6.8512	5.8743	0.95337	0.97687	1.0246
5	0.25077	0.061081	0.1063	2.9681	6.8566	6.8647	5.8814	0.97524	0.98332	1.0083
6	0.50172	0.078849	0.16582	2.9681	6.8572	6.8688	5.8761	0.98109	0.99268	1.0118
7	1.0034	0.12105	0.25275	2.9681	6.8588	6.8705	5.8743	0.98449	0.99619	1.0119
8	2.0012	0.14992	0.38258	2.9681	6.8621	6.8705	5.8732	0.98892	0.99736	1.0085
9	3.0033	0.18435	0.48335	2.9681	6.861	6.8694	5.8743	0.98665	0.99502	1.0085
10	4.0011	0.22655	0.56363	2.9681	6.8648	6.8699	5.8778	0.98694	0.99209	1.0052
11	5.003	0.24987	0.63007	2.9681	6.8642	6.8694	5.8767	0.98757	0.99268	1.0052
12	6.0008	0.26542	0.6846	2.9681	6.8648	6.8699	5.8743	0.99045	0.9956	1.0052
13	7.0027	0.27875	0.73	2.9681	6.8653	6.8705	5.8743	0.991	0.99619	1.0052
14	8.0004	0.2943	0.7671	2.9681	6.8686	6.8705	5.8738	0.99484	0.99677	1.0019
15	9.0024	0.30429	0.79893	2.9681	6.8653	6.8705	5.8743	0.991	0.99619	1.0052
16	10	0.31318	0.82606	2.9681	6.8653	6.8705	5.8732	0.99217	0.99736	1.0052
17	11.002	0.31873	0.84959	2.9681	6.8697	6.8717	5.8755	0.99418	0.99619	1.002
18	12.004	0.32539	0.8698	2.9681	6.8659	6.8711	5.8708	0.99506	1.0003	1.0052
19	13.002	0.32983	0.88724	2.9681	6.8691	6.8711	5.8755	0.99364	0.9956	1.002
20	14.004	0.33095	0.90247	2.9681	6.8659	6.8711	5.8732	0.99272	0.99794	1.0053
21	15.002	0.33539	0.91603	2.9681	6.8659	6.8711	5.8714	0.99448	0.9997	1.0053
22	16.003	0.33872	0.92821	2.9681	6.8659	6.8711	5.8726	0.99331	0.99853	1.0053
23	17.001	0.34205	0.93901	2.9681	6.8659	6.8711	5.8738	0.99214	0.99736	1.0053
24	18.003	0.34316	0.94925	2.9681	6.8691	6.8711	5.8697	0.99949	1.0015	1.002
25	19.001	0.34538	0.95811	2.9681	6.8697	6.8717	5.8749	0.99477	0.99678	1.002
26	20.003	0.34871	0.96614	2.9681	6.8691	6.8711	5.8743	0.99481	0.99677	1.002
27	21.001	0.35094	0.97389	2.9681	6.8691	6.8711	5.8732	0.99598	0.99794	1.002
28	22.003	0.35205	0.98136	2.9681	6.8691	6.8711	5.872	0.99715	0.99911	1.002
29	23	0.35427	0.98773	2.9681	6.8664	6.8717	5.872	0.99444	0.9997	1.0053
30	24.002	0.35871	0.9941	2.9681	6.8697	6.8717	5.8738	0.99594	0.99795	1.002
31	25	0.35982	0.99991	2.9681	6.8697	6.8717	5.8732	0.99652	0.99853	1.002
32	26.002	0.36093	1.0049	2.9681	6.8702	6.8723	5.8732	0.99707	0.99912	1.002
33	27.004	0.36315	1.0102	2.9681	6.8691	6.8711	5.872	0.99715	0.99911	1.002
34	28.002	0.36426	1.0154	2.9681	6.8697	6.8717	5.8755	0.99418	0.99619	1.002
35	29.004	0.36537	1.0207	2.9681	6.8697	6.8717	5.8697	1	1.002	1.002
36	30.002	0.36537	1.0251	2.9681	6.8664	6.8717	5.8732	0.99327	0.99853	1.0053
37	31.004	0.36537	1.029	2.9681	6.8691	6.8711	5.8749	0.99422	0.99619	1.002
38	32.001	0.36648	1.0337	2.9681	6.8697	6.8717	5.8708	0.99886	1.0009	1.002
39	33.003	0.36759	1.0373	2.9681	6.8697	6.8717	5.8749	0.99477	0.99678	1.002
40	34.001	0.36759	1.0412	2.9681	6.8659	6.8711	5.8726	0.99331	0.99853	1.0053
41	35.003	0.3687	1.0453	2.9681	6.8697	6.8717	5.8749	0.99477	0.99678	1.002
42	36.001	0.3687	1.0486	2.9681	6.8691	6.8711	5.8743	0.99481	0.99677	1.002
43	37.003	0.3687	1.0525	2.9681	6.8697	6.8717	5.8708	0.99886	1.0009	1.002
44	38.001	0.36981	1.0567	2.9681	6.8697	6.8717	5.8691	1.0006	1.0026	1.002
45	39.003	0.36981	1.0597	2.9681	6.8697	6.8717	5.8726	0.99711	0.99912	1.002
46	40	0.37093	1.0625	2.9681	6.8697	6.8717	5.8708	0.99886	1.0009	1.002
47	40.084	0.37093	1.0633	2.9681	6.8691	6.8711	5.8697	0.99949	1.0015	1.002

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.8691	6.8711	5.8702	0.9989	1.0009	1.002
2	0.012433	0	0.00055366	2.9681	6.9876	6.9905	5.9048	1.0828	1.0858	1.0027
3	0.050483	0.0088844	0.042909	2.9681	7.7707	7.8504	5.9007	1.87	1.9498	1.0426
4	0.10055	0.043312	0.083603	2.9681	7.8226	7.8364	5.8761	1.9465	1.9603	1.0071
5	0.25072	0.088844	0.15586	2.9681	7.8283	7.8598	5.8743	1.954	1.9855	1.0161
6	0.50165	0.12549	0.24416	2.9681	7.8463	7.8686	5.8749	1.9714	1.9937	1.0113
7	1.0034	0.17547	0.37234	2.9681	7.8522	7.868	5.8761	1.9761	1.9919	1.008
8	2.0011	0.23322	0.5556	2.9681	7.8538	7.8662	5.8761	1.9778	1.9902	1.0063
9	3.0031	0.29541	0.68709	2.9681	7.8582	7.8674	5.8773	1.9809	1.9902	1.0047
10	4.0008	0.32095	0.7826	2.9681	7.8593	7.8686	5.8743	1.985	1.9943	1.0047
11	5.0028	0.33761	0.85596	2.9681	7.8598	7.8692	5.8761	1.9838	1.9931	1.0047
12	6.0005	0.34982	0.90994	2.9681	7.8636	7.8698	5.8738	1.9899	1.996	1.0031
13	7.0025	0.36759	0.9523	2.9681	7.8669	7.8698	5.8761	1.9908	1.9937	1.0014
14	8.0003	0.38203	0.98524	2.9681	7.8669	7.8698	5.8755	1.9914	1.9943	1.0014
15	9.0022	0.39092	1.0124	2.9681	7.8642	7.8703	5.8761	1.9881	1.9943	1.0031
16	10	0.39647	1.0351	2.9681	7.8647	7.8709	5.8749	1.9898	1.996	1.0031
17	11.002	0.40202	1.0539	2.9681	7.868	7.8709	5.8691	1.9989	2.0019	1.0015
18	12.004	0.40313	1.0699	2.9681	7.868	7.8709	5.8743	1.9937	1.9966	1.0015
19	13.002	0.40646	1.0841	2.9681	7.8647	7.8709	5.8714	1.9933	1.9995	1.0031
20	14.004	0.40646	1.0965	2.9681	7.8674	7.8703	5.872	1.9955	1.9983	1.0015
21	15.001	0.40868	1.1076	2.9681	7.8647	7.8709	5.8738	1.991	1.9972	1.0031
22	16.004	0.41424	1.1176	2.9681	7.868	7.8709	5.8743	1.9937	1.9966	1.0015
23	17.001	0.4209	1.127	2.9681	7.868	7.8709	5.8691	1.9989	2.0019	1.0015
24	18.003	0.42645	1.1353	2.9681	7.8647	7.8709	5.8732	1.9916	1.9978	1.0031
25	19.001	0.42978	1.143	2.9681	7.868	7.8709	5.8697	1.9983	2.0013	1.0015
26	20.003	0.43423	1.1508	2.9681	7.868	7.8709	5.8702	1.9978	2.0007	1.0015
27	21.001	0.43867	1.1569	2.9681	7.8647	7.8709	5.8732	1.9916	1.9978	1.0031
28	22.003	0.44089	1.1635	2.9681	7.8674	7.8703	5.8726	1.9949	1.9978	1.0015
29	23.001	0.44533	1.1702	2.9681	7.868	7.8709	5.8749	1.9931	1.996	1.0015
30	24.002	0.44644	1.176	2.9681	7.868	7.8709	5.8732	1.9948	1.9978	1.0015
31	25	0.44755	1.1812	2.9681	7.868	7.8709	5.8738	1.9942	1.9972	1.0015
32	26.002	0.44866	1.1865	2.9681	7.868	7.8709	5.8767	1.9913	1.9943	1.0015
33	27.004	0.45089	1.1923	2.9681	7.8685	7.8715	5.8691	1.9995	2.0024	1.0015
34	28.002	0.45311	1.1967	2.9681	7.8653	7.8715	5.8726	1.9927	1.9989	1.0031
35	29.004	0.45422	1.202	2.9681	7.8685	7.8715	5.8732	1.9954	1.9983	1.0015
36	30.002	0.45644	1.2067	2.9681	7.8685	7.8715	5.8708	1.9977	2.0007	1.0015
37	31.004	0.45755	1.2111	2.9681	7.868	7.8709	5.8743	1.9937	1.9966	1.0015
38	32.001	0.45866	1.215	2.9681	7.8653	7.8715	5.8738	1.9915	1.9978	1.0031
39	33.003	0.45866	1.2194	2.9681	7.868	7.8709	5.8738	1.9942	1.9972	1.0015
40	33.521	0.45866	1.2217	2.9681	7.868	7.8709	5.8685	1.9995	2.0024	1.0015

TRIAXIAL TEST

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.8674	7.8703	5.8697	1.9978	2.0007	1.0014
2	0.012483	0.0011106	0.00027683	2.9681	7.9941	7.9985	5.8983	2.0958	2.1002	1.0021
3	0.050533	0.0033317	0.029067	2.9681	8.818	8.8672	5.8913	2.9267	2.9759	1.0168
4	0.10062	0.017769	0.054812	2.9681	8.8286	8.8473	5.8925	2.9362	2.9549	1.0064
5	0.25085	0.056638	0.10713	2.9681	8.8467	8.8596	5.872	2.9747	2.9876	1.0044
6	0.5017	0.082181	0.16887	2.9681	8.8527	8.8696	5.8802	2.9726	2.9894	1.0057
7	1.0034	0.1055	0.25994	2.9681	8.856	8.8661	5.8825	2.9734	2.9835	1.0034
8	2.0012	0.15326	0.38313	2.9681	8.8652	8.869	5.872	2.9932	2.997	1.0013
9	3.0031	0.18213	0.46563	2.9681	8.8658	8.8696	5.8784	2.9873	2.9911	1.0013
10	4.0009	0.20101	0.52293	2.9681	8.8663	8.8702	5.8755	2.9908	2.9947	1.0013
11	5.0028	0.22211	0.56556	2.9681	8.8669	8.8707	5.8714	2.9954	2.9993	1.0013
12	6.0006	0.23544	0.59795	2.9681	8.8663	8.8702	5.8673	2.999	3.0028	1.0013
13	7.0025	0.24099	0.62398	2.9681	8.8669	8.8707	5.8749	2.9919	2.9958	1.0013
14	8.0003	0.24876	0.64529	2.9681	8.8669	8.8707	5.8738	2.9931	2.997	1.0013
15	9.0023	0.25654	0.66301	2.9681	8.8707	8.8713	5.8755	2.9952	2.9958	1.0002
16	10	0.25987	0.67851	2.9681	8.8707	8.8713	5.8749	2.9957	2.9964	1.0002
17	11.002	0.2632	0.69152	2.9681	8.8674	8.8713	5.8761	2.9913	2.9952	1.0013
18	12.004	0.26764	0.70398	2.9681	8.8674	8.8713	5.8749	2.9925	2.9964	1.0013
19	13.002	0.26986	0.7145	2.9681	8.8707	8.8713	5.8743	2.9963	2.997	1.0002
20	14.004	0.27209	0.72419	2.9681	8.8674	8.8713	5.8732	2.9942	2.9982	1.0013
21	15.001	0.2732	0.73332	2.9681	8.8669	8.8707	5.8685	2.9984	3.0023	1.0013
22	16.003	0.27431	0.74135	2.9681	8.8707	8.8713	5.8697	3.001	3.0017	1.0002
23	17.001	0.27764	0.74938	2.9681	8.8707	8.8713	5.8738	2.9969	2.9976	1.0002
24	18.003	0.27875	0.7563	2.9681	8.8707	8.8713	5.8702	3.0004	3.0011	1.0002
25	19.001	0.27986	0.7635	2.9681	8.8707	8.8713	5.8726	2.9981	2.9988	1.0002
26	20.003	0.28319	0.76959	2.9681	8.8707	8.8713	5.8749	2.9957	2.9964	1.0002
27	21	0.28541	0.77623	2.9681	8.8674	8.8713	5.8708	2.9966	3.0005	1.0013
28	22.002	0.28985	0.78205	2.9681	8.8674	8.8713	5.8732	2.9942	2.9982	1.0013
29	23	0.29319	0.78758	2.9681	8.868	8.8719	5.8743	2.9936	2.9976	1.0013
30	24.002	0.2943	0.79284	2.9681	8.8674	8.8713	5.8749	2.9925	2.9964	1.0013
31	25.004	0.29652	0.79783	2.9681	8.8712	8.8719	5.8732	2.998	2.9988	1.0002
32	26.002	0.29874	0.80336	2.9681	8.8707	8.8713	5.8726	2.9981	2.9988	1.0002
33	27.004	0.30096	0.80807	2.9681	8.8712	8.8719	5.8732	2.998	2.9988	1.0002
34	28.002	0.30207	0.81277	2.9681	8.8712	8.8719	5.8732	2.998	2.9988	1.0002
35	29.004	0.3054	0.81748	2.9681	8.868	8.8719	5.872	2.996	2.9999	1.0013
36	30.001	0.30762	0.82163	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
37	31.003	0.31096	0.82634	2.9681	8.8712	8.8719	5.8726	2.9986	2.9993	1.0002
38	31.166	0.31096	0.82634	2.9681	8.8718	8.8725	5.8708	3.0009	3.0017	1.0002

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1432	8.1437	8.0717	0.071448	0.071985	1.0075
2	0.012467	0	0	2.9681	8.147	8.1478	8.0747	0.072363	0.073157	1.011
3	0.05	0	0.010243	2.9681	8.1667	8.1654	8.0858	0.08096	0.079603	0.98323
4	0.10008	-0.0011106	0.042078	2.9681	8.1652	8.1706	8.0747	0.090505	0.095987	1.0606
5	0.2503	0	0.053428	2.9681	8.1652	8.1706	8.0729	0.09226	0.097742	1.0594
6	0.50067	0.0011106	0.057581	2.9681	8.1657	8.1712	8.0723	0.093394	0.098912	1.0591
7	1.0014	0.0011106	0.060903	2.9681	8.1657	8.1712	8.0717	0.093979	0.099497	1.0587
8	2.0028	0.0022211	0.062287	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
9	3.0001	0.0033317	0.063117	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
10	4.0015	0.0033317	0.063394	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
11	5.0031	0.0033317	0.063948	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
12	6.0004	0.0033317	0.063671	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
13	7.0019	0.0033317	0.063394	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
14	8.0033	0.0022211	0.063671	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
15	9.0006	0.0033317	0.063671	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
16	10.002	0.0022211	0.063671	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
17	11.003	0.0022211	0.063671	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
18	12.001	0.0033317	0.064502	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
19	13.002	0.0033317	0.064502	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
20	14.004	0.0033317	0.063948	2.9681	8.1728	8.1718	8.0711	0.10162	0.10067	0.99062
21	15.001	0.0033317	0.063671	2.9681	8.1728	8.1718	8.0717	0.10104	0.10008	0.99057
22	16.002	0.0033317	0.063117	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
23	17.004	0.0033317	0.062841	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
24	18.001	0.0033317	0.062841	2.9681	8.1695	8.1718	8.0711	0.098367	0.10067	1.0234
25	19.003	0.0033317	0.062287	2.9681	8.1695	8.1718	8.0711	0.098367	0.10067	1.0234
26	20.004	0.0033317	0.06201	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
27	20.893	0.0033317	0.061733	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1663	8.1718	8.0717	0.094528	0.10008	1.0588
2	0.012483	0	0.00083049	2.9681	8.1953	8.1958	8.0904	0.10481	0.10536	1.0053
3	0.05005	0	0.053705	2.9681	8.2863	8.2895	8.1373	0.14904	0.15222	1.0214
4	0.10005	0.0022211	0.18658	2.9681	8.2821	8.3059	8.0729	0.20923	0.23296	1.1134
5	0.25028	0.015548	0.21122	2.9681	8.3148	8.3199	8.0735	0.24133	0.24643	1.0211
6	0.50072	0.018879	0.21759	2.9681	8.3154	8.3205	8.0723	0.24305	0.24818	1.0211
7	1.0016	0.021101	0.22285	2.9681	8.3159	8.3211	8.0723	0.2436	0.24877	1.0212
8	2.003	0.022211	0.22783	2.9681	8.3165	8.3217	8.0717	0.24473	0.24994	1.0213
9	3.0003	0.022211	0.2306	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
10	4.0017	0.022211	0.23254	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
11	5.0032	0.023322	0.23337	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
12	6.0004	0.023322	0.23475	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
13	7.0019	0.023322	0.23558	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
14	8.0033	0.023322	0.23641	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
15	9.0006	0.023322	0.23697	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
16	10.002	0.024432	0.23752	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
17	11.004	0.023322	0.23669	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
18	12.001	0.024432	0.23807	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
19	13.002	0.023322	0.23835	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
20	14.004	0.023322	0.23835	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
21	15.001	0.023322	0.2389	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
22	16.002	0.023322	0.2389	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
23	17.004	0.025543	0.2389	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
24	18.001	0.024432	0.23918	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
25	19.003	0.025543	0.24029	2.9681	8.323	8.3217	8.0717	0.25124	0.24994	0.99481
26	20	0.025543	0.24029	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
27	21.002	0.024432	0.2389	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
28	22.003	0.023322	0.24029	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
29	23	0.023322	0.24001	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
30	23.66	0.023322	0.24029	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
2	0.012483	0	0.0013842	2.9681	8.3603	8.3615	8.0981	0.26222	0.26342	1.0046
3	0.050033	0.0011106	0.076405	2.9681	8.5079	8.526	8.1577	0.3502	0.36823	1.0515
4	0.10005	0.0055528	0.18548	2.9681	8.5135	8.5424	8.0887	0.42483	0.45366	1.0679
5	0.25027	0.015548	0.23171	2.9681	8.5615	8.5693	8.0729	0.48864	0.49638	1.0158
6	0.50068	0.018879	0.23946	2.9681	8.5659	8.5704	8.0729	0.49299	0.49755	1.0092
7	1.0013	0.01999	0.24499	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
8	2.0029	0.021101	0.24998	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
9	3.0001	0.022211	0.25247	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
10	4.0016	0.021101	0.25441	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
11	5.003	0.022211	0.25607	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
12	6.0003	0.022211	0.25718	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
13	7.0017	0.023322	0.25773	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
14	8.0031	0.023322	0.25939	2.9681	8.5697	8.571	8.0711	0.49855	0.49989	1.0027
15	9.0004	0.023322	0.26022	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
16	10.002	0.023322	0.26105	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
17	11.003	0.023322	0.26105	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
18	12.001	0.023322	0.26244	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
19	13.002	0.024432	0.26271	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
20	14.003	0.024432	0.26327	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
21	15.001	0.024432	0.2641	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
22	16.002	0.023322	0.26437	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
23	17.004	0.023322	0.26465	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
24	18.001	0.024432	0.2652	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
25	19.002	0.023322	0.2641	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
26	20.004	0.024432	0.26686	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
27	21.001	0.024432	0.26659	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
28	22.003	0.023322	0.26742	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
29	23.004	0.024432	0.26825	2.9681	8.5735	8.5716	8.0717	0.50177	0.49989	0.99626
30	24.001	0.024432	0.26853	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
31	25.003	0.024432	0.2688	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
32	26.001	0.024432	0.26908	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
33	26.761	0.023322	0.26936	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
2	0.012467	0	0.00083049	2.9681	8.6064	8.6067	8.094	0.51246	0.51278	1.0006
3	0.050717	0.0033317	0.058411	2.9681	8.7404	8.7636	8.1261	0.61429	0.63749	1.0378
4	0.10077	0.009995	0.11267	2.9681	8.765	8.7759	8.0858	0.67919	0.69015	1.0161
5	0.25098	0.01999	0.13869	2.9681	8.7841	8.7894	8.0735	0.71061	0.7159	1.0074
6	0.50202	0.023322	0.14506	2.9681	8.7852	8.7905	8.0723	0.71287	0.71824	1.0075
7	1.0002	0.025543	0.15032	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
8	2.0021	0.026653	0.15503	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
9	3.0004	0.027764	0.15779	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
10	4.0025	0.027764	0.15862	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
11	5.0009	0.027764	0.16167	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
12	6.0031	0.027764	0.16278	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
13	7.001	0.027764	0.16305	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
14	8.0032	0.028874	0.16333	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
15	9.0011	0.028874	0.16638	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
16	10.003	0.028874	0.16721	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
17	11.001	0.028874	0.1661	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
18	12.003	0.028874	0.16887	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
19	13.002	0.029985	0.16887	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
20	14.001	0.029985	0.17053	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
21	15.003	0.029985	0.17108	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
22	16.001	0.029985	0.17025	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
23	17.003	0.029985	0.17191	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
24	18.001	0.029985	0.17191	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
25	19.003	0.029985	0.17385	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
26	20.001	0.031096	0.17468	2.9681	8.7922	8.7911	8.0717	0.72052	0.71941	0.99846
27	21.003	0.029985	0.17357	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
28	22.001	0.031096	0.17523	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
29	23.003	0.031096	0.17634	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003
30	24.001	0.031096	0.17551	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
31	25.003	0.031096	0.17662	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
32	26.001	0.032206	0.178	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
33	27.003	0.032206	0.17883	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
34	28.001	0.031096	0.17966	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
35	29.003	0.031096	0.17883	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
36	30.001	0.031096	0.18077	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
37	31.003	0.031096	0.17994	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
38	32.001	0.032206	0.18022	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
39	33.003	0.032206	0.18243	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
40	34	0.032206	0.18077	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
41	35.002	0.031096	0.18188	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
42	36	0.032206	0.18382	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
43	37.002	0.032206	0.18354	2.9681	8.7863	8.7917	8.0711	0.71514	0.72058	1.0076
44	38.004	0.033317	0.18492	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
45	39.002	0.032206	0.18382	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
46	40.004	0.032206	0.1852	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
47	41.002	0.032206	0.18658	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
48	42.003	0.032206	0.18714	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
49	43.001	0.033317	0.18741	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
50	44.003	0.033317	0.18631	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
51	45	0.033317	0.18852	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
52	46.003	0.034427	0.18686	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
53	47.001	0.033317	0.18908	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
54	48.003	0.035538	0.18908	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
55	49.001	0.034427	0.18824	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
56	50.004	0.034427	0.19074	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
57	51.002	0.034427	0.18963	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
58	52	0.035538	0.19184	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
59	53.002	0.035538	0.1924	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
60	54	0.034427	0.19267	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
61	55.003	0.034427	0.19212	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
62	56.001	0.035538	0.19184	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
63	57.003	0.034427	0.19323	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
64	58.002	0.034427	0.19434	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
65	59.003	0.035538	0.19323	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
66	60.001	0.034427	0.19461	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
67	61.003	0.035538	0.19544	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
68	62.001	0.035538	0.19655	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
69	63.003	0.035538	0.19544	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
70	64.001	0.034427	0.19655	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
71	65.003	0.035538	0.19738	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
72	66	0.035538	0.19821	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
73	67.002	0.034427	0.19683	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
74	68	0.035538	0.19904	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
75	69.002	0.035538	0.19793	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
76	70.004	0.034427	0.19959	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
77	71.002	0.035538	0.19876	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
78	72.004	0.036648	0.2007	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
79	73.002	0.036648	0.20043	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
80	74.004	0.036648	0.20181	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
81	75.002	0.036648	0.20209	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
82	76.004	0.037759	0.20209	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
83	77.001	0.037759	0.20292	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
84	78.003	0.036648	0.20319	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
85	79.001	0.037759	0.20236	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
86	80.003	0.036648	0.20375	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
87	81.001	0.036648	0.20375	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
88	82.003	0.036648	0.20485	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
89	83.001	0.036648	0.20569	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
90	84.003	0.037759	0.20652	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
91	85.001	0.037759	0.20652	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
92	86.003	0.037759	0.20735	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

93	87.001	0.037759	0.20596	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
94	88.003	0.038869	0.20818	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
95	89.001	0.037759	0.20735	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
96	90.004	0.038869	0.20735	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
97	91.001	0.038869	0.20873	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
98	92.003	0.037759	0.20956	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
99	93.001	0.036648	0.20845	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
100	94.003	0.036648	0.20901	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
101	95.001	0.035538	0.21094	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
102	96.003	0.036648	0.21039	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
103	97	0.036648	0.21178	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
104	98.002	0.036648	0.21011	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
105	99	0.037759	0.21233	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
106	100	0.037759	0.21261	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
107	101	0.038869	0.21288	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
108	102	0.038869	0.21344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
109	103	0.038869	0.21261	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
110	104	0.038869	0.21482	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
111	105	0.038869	0.2151	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
112	106	0.038869	0.21371	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
113	107	0.038869	0.21399	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
114	108	0.038869	0.21454	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
115	109	0.038869	0.21648	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
116	110	0.038869	0.2151	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
117	111	0.038869	0.21731	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
118	112	0.038869	0.21565	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
119	113	0.038869	0.21842	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
120	114	0.038869	0.21759	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
121	115	0.038869	0.21787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
122	116	0.038869	0.21897	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
123	117	0.038869	0.21953	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
124	118	0.038869	0.2187	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
125	119	0.038869	0.21897	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
126	120	0.038869	0.22091	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
127	121	0.038869	0.2198	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
128	122	0.038869	0.22146	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
129	123	0.038869	0.22202	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
130	124	0.03998	0.22257	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
131	125	0.038869	0.22313	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
132	126	0.03998	0.22396	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
133	127	0.03998	0.22285	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
134	128	0.038869	0.22257	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
135	129	0.038869	0.22313	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
136	130	0.038869	0.22313	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
137	131	0.038869	0.22534	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
138	132	0.038869	0.22423	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
139	133	0.038869	0.22562	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
140	134	0.038869	0.227	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
141	135	0.038869	0.22562	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
142	136	0.038869	0.22783	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
143	137	0.038869	0.22728	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
144	138	0.038869	0.227	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
145	139	0.038869	0.22672	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
146	140	0.038869	0.22894	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
147	141	0.038869	0.22949	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
148	142	0.03998	0.22783	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
149	143	0.038869	0.23005	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
150	144	0.03998	0.22977	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
151	145	0.03998	0.23115	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
152	146	0.038869	0.23143	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
153	147	0.038869	0.23005	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
154	148	0.038869	0.23005	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
155	149	0.038869	0.23226	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
156	150	0.038869	0.23254	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003
157	151	0.038869	0.23281	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
158	152	0.03998	0.23309	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
159	153	0.03998	0.23364	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
160	154	0.038869	0.2342	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
161	155	0.03998	0.23281	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
162	156	0.03998	0.23309	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
163	157	0.038869	0.23392	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
164	158	0.038869	0.23337	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
165	159	0.038869	0.23558	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
166	160	0.038869	0.2342	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
167	161	0.038869	0.23503	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
168	162	0.038869	0.23669	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
169	163	0.03998	0.23697	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
170	164	0.03998	0.23586	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
171	165	0.03998	0.23641	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
172	166	0.03998	0.23835	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
173	167	0.03998	0.23835	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
174	168	0.038869	0.23724	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
175	169	0.03998	0.23946	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
176	170	0.041091	0.24001	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
177	171	0.041091	0.23918	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
178	172	0.041091	0.24084	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
179	173	0.03998	0.24112	2.9681	8.7933	8.7923	8.0717	0.72161	0.72058	0.99857
180	174	0.03998	0.23974	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
181	175	0.038869	0.24223	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
182	176	0.03998	0.24057	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
183	177	0.03998	0.24057	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
184	178	0.03998	0.2425	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
185	179	0.03998	0.2414	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
186	180	0.038869	0.24333	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
187	181	0.03998	0.24333	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
188	182	0.03998	0.24389	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
189	183	0.041091	0.24306	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
190	184	0.041091	0.24499	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
191	185	0.03998	0.24333	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
192	186	0.03998	0.24555	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
193	187	0.03998	0.24583	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003

194	188	0.041091	0.24444	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
195	189	0.041091	0.24499	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
196	190	0.041091	0.24666	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
197	191	0.042201	0.24693	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
198	192	0.03998	0.2461	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
199	193	0.03998	0.24804	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
200	194	0.03998	0.24666	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
201	195	0.041091	0.24887	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
202	196	0.03998	0.24693	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
203	197	0.041091	0.24749	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
204	198	0.041091	0.24776	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
205	199	0.041091	0.24832	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
206	200	0.042201	0.24887	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
207	201	0.041091	0.2497	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
208	202	0.042201	0.24887	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
209	203	0.042201	0.25109	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
210	204	0.042201	0.25192	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
211	205	0.041091	0.25219	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
212	206	0.041091	0.25247	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
213	207	0.041091	0.25192	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
214	208	0.042201	0.2533	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
215	209	0.042201	0.25164	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
216	210	0.042201	0.25192	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
217	211	0.042201	0.25413	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
218	212	0.043312	0.25302	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
219	213	0.043312	0.25496	2.9681	8.7933	8.7923	8.0723	0.72103	0.71999	0.99857
220	214	0.043312	0.25524	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
221	215	0.042201	0.25441	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
222	216	0.042201	0.25635	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
223	217	0.041091	0.25607	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
224	218	0.042201	0.25551	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
225	219	0.042201	0.25524	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
226	220	0.042201	0.2569	2.9681	8.7863	8.7917	8.0711	0.71514	0.72058	1.0076
227	221	0.042201	0.25635	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
228	222	0.042201	0.25828	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
229	223	0.041091	0.25856	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
230	224	0.041091	0.25911	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
231	225	0.041091	0.25801	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
232	226	0.041091	0.25967	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
233	227	0.041091	0.25856	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
234	228	0.03998	0.26022	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
235	229	0.042201	0.26022	2.9681	8.7863	8.7917	8.0723	0.71397	0.71941	1.0076
236	230	0.041091	0.25939	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
237	231	0.042201	0.26022	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
238	232	0.042201	0.2616	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
239	233	0.041091	0.26216	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
240	234	0.042201	0.26271	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
241	235	0.042201	0.2616	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
242	236	0.042201	0.26299	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
243	237	0.041091	0.26216	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
244	238	0.041091	0.26382	2.9681	8.7857	8.7911	8.0717	0.71401	0.71941	1.0076
245	239	0.042201	0.2641	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
246	240	0.042201	0.26299	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
247	241	0.043312	0.26465	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
248	242	0.043312	0.26382	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
249	243	0.043312	0.26548	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
250	244	0.043312	0.26576	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
251	245	0.043312	0.26493	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
252	246	0.043312	0.26659	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
253	247	0.043312	0.26686	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
254	248	0.043312	0.26686	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
255	249	0.043312	0.26742	2.9681	8.7906	8.7929	8.0717	0.71891	0.72116	1.0031
256	250	0.043312	0.26714	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
257	251	0.042201	0.26603	2.9681	8.7857	8.7911	8.0717	0.71401	0.71941	1.0076
258	252	0.043312	0.26714	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
259	253	0.042201	0.2688	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
260	254	0.043312	0.26908	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
261	255	0.043312	0.26963	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
262	256	0.043312	0.2688	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
263	257	0.043312	0.26825	2.9681	8.7922	8.7911	8.0717	0.72052	0.71941	0.99846
264	258	0.043312	0.27074	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
265	259	0.043312	0.27074	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
266	260	0.043312	0.27129	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
267	261	0.043312	0.26963	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
268	262	0.043312	0.27019	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
269	263	0.043312	0.27212	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
270	264	0.043312	0.27295	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
271	265	0.042201	0.27268	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
272	266	0.042201	0.27157	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
273	267	0.043312	0.27268	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
274	268	0.043312	0.27351	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
275	269	0.042201	0.27406	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
276	270	0.043312	0.27434	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
277	271	0.044422	0.27462	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
278	272	0.044422	0.27462	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
279	273	0.044422	0.27379	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
280	274	0.044422	0.27572	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
281	275	0.044422	0.27489	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
282	276	0.043312	0.27489	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
283	277	0.043312	0.27655	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
284	278	0.042201	0.27683	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
285	279	0.041091	0.27683	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
286	280	0.043312	0.27655	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
287	281	0.043312	0.27628	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
288	282	0.044422	0.27711	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
289	283	0.043312	0.27628	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
290	284	0.043312	0.27849	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
291	285	0.043312	0.27821	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
292	286	0.043312	0.27905	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
293	287	0.043312	0.27738	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
294	288	0.043312	0.27905	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003

295	289	0.043312	0.27821	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
296	290	0.043312	0.28015	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
297	291	0.042201	0.2796	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
298	292	0.042201	0.28098	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
299	293	0.042201	0.28126	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
300	294	0.043312	0.27988	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
301	295	0.042201	0.28209	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
302	296	0.043312	0.28015	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
303	297	0.042201	0.28043	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
304	298	0.042201	0.28264	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
305	299	0.043312	0.28126	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
306	300	0.042201	0.28347	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
307	301	0.042201	0.28347	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
308	302	0.042201	0.28237	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
309	303	0.041091	0.28375	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
310	304	0.041091	0.28458	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
311	305	0.041091	0.28458	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
312	306	0.041091	0.28292	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
313	307	0.041091	0.28541	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
314	308	0.041091	0.28541	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
315	309	0.041091	0.28375	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
316	310	0.041091	0.28403	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
317	311	0.041091	0.28541	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
318	312	0.042201	0.28403	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
319	313	0.042201	0.28652	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
320	314	0.042201	0.28486	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
321	315	0.041091	0.28735	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
322	316	0.041091	0.28569	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
323	317	0.041091	0.28763	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
324	318	0.041091	0.28597	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
325	319	0.041091	0.28818	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
326	320	0.041091	0.28652	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
327	321	0.042201	0.28818	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
328	322	0.042201	0.28846	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
329	323	0.042201	0.28735	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
330	324	0.042201	0.28818	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
331	325	0.042201	0.28763	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
332	326	0.042201	0.28929	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
333	327	0.042201	0.28873	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
334	328	0.043312	0.28873	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
335	329	0.041091	0.28929	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
336	330	0.041091	0.28873	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
337	331	0.042201	0.29095	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
338	332	0.041091	0.29095	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
339	333	0.041091	0.29012	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
340	334	0.041091	0.29067	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
341	335	0.041091	0.29178	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
342	336	0.03998	0.29123	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
343	337	0.041091	0.29095	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
344	338	0.041091	0.29095	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
345	339	0.041091	0.29316	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
346	340	0.041091	0.29344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
347	341	0.041091	0.29261	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
348	342	0.041091	0.29206	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
349	343	0.041091	0.29399	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
350	344	0.03998	0.29261	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
351	345	0.03998	0.29482	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
352	346	0.03998	0.2951	2.9681	8.7922	8.7911	8.0711	0.7211	0.71999	0.99846
353	347	0.041091	0.29344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
354	348	0.03998	0.29316	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
355	349	0.03998	0.29344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
356	350	0.041091	0.29344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
357	351	0.041091	0.29372	2.9681	8.7857	8.7911	8.0717	0.71401	0.71941	1.0076
358	352	0.03998	0.29482	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
359	353	0.03998	0.29455	2.9681	8.7901	8.7923	8.0711	0.71894	0.72116	1.0031
360	354	0.03998	0.29621	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
361	355	0.03998	0.29676	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
362	356	0.03998	0.29482	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
363	357	0.03998	0.29704	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
364	358	0.03998	0.29704	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
365	359	0.041091	0.29732	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
366	360	0.041091	0.29759	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
367	361	0.041091	0.29787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
368	362	0.041091	0.29787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
369	363	0.041091	0.29759	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
370	364	0.03998	0.29842	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
371	365	0.041091	0.29815	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
372	366	0.041091	0.29704	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
373	367	0.041091	0.29759	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
374	368	0.03998	0.29953	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
375	369	0.041091	0.29953	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
376	370	0.042201	0.30008	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
377	371	0.041091	0.30036	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
378	372	0.042201	0.30036	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
379	373	0.042201	0.30091	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
380	374	0.041091	0.30119	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
381	375	0.041091	0.30147	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
382	376	0.041091	0.30147	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
383	377	0.041091	0.30008	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
384	378	0.041091	0.30036	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
385	379	0.03998	0.3023	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
386	380	0.041091	0.30036	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
387	381	0.041091	0.30119	2.9681	8.7857	8.7911	8.0711	0.71459	0.71999	1.0076
388	382	0.03998	0.30091	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
389	383	0.03998	0.30119	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
390	384	0.041091	0.30341	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
391	385	0.041091	0.30175	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
392	386	0.041091	0.30396	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
393	387	0.041091	0.3023	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
394	388	0.041091	0.30258	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
395	389	0.041091	0.30451	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

396	390	0.041091	0.30285	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
397	391	0.03998	0.30479	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
398	392	0.03998	0.30313	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
399	393	0.041091	0.30534	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
400	394	0.041091	0.30534	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
401	395	0.041091	0.30396	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
402	396	0.041091	0.30451	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
403	397	0.041091	0.30645	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
404	398	0.041091	0.30479	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
405	399	0.041091	0.30701	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
406	400	0.042201	0.30701	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
407	401	0.041091	0.30728	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
408	402	0.042201	0.3059	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
409	403	0.042201	0.30784	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
410	404	0.042201	0.30811	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
411	405	0.042201	0.30701	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
412	406	0.041091	0.30894	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
413	407	0.041091	0.30839	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
414	408	0.041091	0.30894	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
415	409	0.03998	0.30977	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
416	410	0.03998	0.30977	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
417	411	0.03998	0.30922	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
418	412	0.041091	0.30867	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
419	413	0.03998	0.3106	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
420	414	0.041091	0.31088	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
421	415	0.03998	0.31143	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
422	416	0.03998	0.31199	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
423	417	0.03998	0.30977	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
424	418	0.03998	0.31226	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
425	419	0.038869	0.31226	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
426	420	0.038869	0.31254	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
427	421	0.038869	0.31088	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
428	422	0.038869	0.31282	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
429	423	0.038869	0.31116	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
430	424	0.03998	0.31143	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
431	425	0.03998	0.3131	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
432	426	0.038869	0.31282	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
433	427	0.03998	0.31226	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
434	428	0.03998	0.31448	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
435	429	0.038869	0.31448	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
436	430	0.038869	0.31254	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
437	431	0.038869	0.31282	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
438	432	0.03998	0.31448	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
439	433	0.038869	0.3131	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
440	434	0.038869	0.31337	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
441	435	0.038869	0.31531	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
442	436	0.038869	0.31559	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
443	437	0.03998	0.31559	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
444	438	0.03998	0.31503	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
445	439	0.03998	0.31448	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
446	440	0.03998	0.3142	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
447	441	0.03998	0.31614	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
448	442	0.03998	0.31476	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
449	443	0.03998	0.31586	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
450	444	0.03998	0.31669	2.9681	8.7863	8.7917	8.0711	0.71514	0.72058	1.0076
451	445	0.03998	0.31642	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
452	446	0.038869	0.31697	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
453	447	0.03998	0.31725	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
454	448	0.03998	0.31752	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
455	449	0.03998	0.31752	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
456	450	0.03998	0.31586	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
457	451	0.041091	0.3178	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
458	452	0.041091	0.31808	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
459	453	0.041091	0.31836	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
460	454	0.042201	0.31642	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
461	455	0.042201	0.31697	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
462	456	0.042201	0.31725	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
463	457	0.042201	0.31891	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
464	458	0.041091	0.31919	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
465	459	0.041091	0.31752	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
466	460	0.041091	0.31808	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
467	461	0.041091	0.31808	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
468	462	0.041091	0.31946	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
469	463	0.041091	0.32002	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
470	464	0.041091	0.31808	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
471	465	0.042201	0.31808	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
472	466	0.041091	0.32029	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
473	467	0.041091	0.32029	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
474	468	0.041091	0.32112	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
475	469	0.042201	0.32057	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
476	470	0.042201	0.32085	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
477	471	0.041091	0.32112	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
478	472	0.041091	0.32112	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
479	473	0.041091	0.31919	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
480	474	0.041091	0.31974	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
481	475	0.042201	0.32195	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
482	476	0.041091	0.32029	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
483	477	0.042201	0.32251	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
484	478	0.043312	0.32278	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
485	479	0.042201	0.32251	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
486	480	0.042201	0.32278	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
487	481	0.042201	0.32085	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
488	482	0.041091	0.32278	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
489	483	0.041091	0.32334	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
490	484	0.041091	0.32334	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
491	485	0.042201	0.32334	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
492	486	0.042201	0.32361	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
493	487	0.042201	0.32417	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
494	488	0.042201	0.32306	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
495	489	0.042201	0.32251	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
496	490	0.041091	0.32251	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003

497	491	0.042201	0.32417	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
498	492	0.042201	0.32445	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
499	493	0.041091	0.32472	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
500	494	0.041091	0.325	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
501	495	0.041091	0.32555	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
502	496	0.041091	0.32555	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
503	497	0.041091	0.32445	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
504	498	0.041091	0.32417	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
505	499	0.041091	0.32417	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
506	500	0.042201	0.32611	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
507	501	0.042201	0.32638	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
508	502	0.042201	0.32611	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
509	503	0.043312	0.32417	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
510	504	0.043312	0.32528	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
511	505	0.042201	0.325	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
512	506	0.042201	0.32555	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
513	507	0.042201	0.32721	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
514	508	0.042201	0.32721	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
515	509	0.041091	0.32583	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
516	510	0.041091	0.32749	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
517	511	0.042201	0.32555	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
518	512	0.041091	0.32777	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
519	513	0.042201	0.32777	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
520	514	0.042201	0.32777	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
521	515	0.042201	0.3286	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
522	516	0.042201	0.32666	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
523	517	0.042201	0.32887	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
524	518	0.042201	0.32694	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
525	519	0.041091	0.32887	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
526	520	0.041091	0.32943	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
527	521	0.042201	0.32721	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
528	522	0.041091	0.32943	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
529	523	0.041091	0.32777	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
530	524	0.041091	0.32971	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
531	525	0.041091	0.32998	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
532	526	0.041091	0.32832	2.9681	8.7933	8.7923	8.0717	0.72161	0.72058	0.99857
533	527	0.042201	0.3286	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
534	528	0.042201	0.33054	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
535	529	0.042201	0.3286	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
536	530	0.042201	0.32915	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
537	531	0.042201	0.3286	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
538	532	0.042201	0.32887	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
539	533	0.042201	0.33109	2.9681	8.7863	8.7917	8.0723	0.71397	0.71941	1.0076
540	534	0.041091	0.32915	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
541	535	0.042201	0.33137	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
542	536	0.041091	0.33164	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
543	537	0.041091	0.32998	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
544	538	0.041091	0.33192	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
545	539	0.03998	0.33137	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
546	540	0.041091	0.33192	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
547	541	0.042201	0.33026	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
548	542	0.041091	0.32998	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
549	543	0.042201	0.3322	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
550	544	0.042201	0.33247	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
551	545	0.042201	0.33303	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
552	546	0.042201	0.33303	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
553	547	0.042201	0.33137	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
554	548	0.042201	0.3333	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
555	549	0.041091	0.33137	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
556	550	0.041091	0.33164	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
557	551	0.041091	0.33164	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
558	552	0.041091	0.33358	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
559	553	0.042201	0.33164	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
560	554	0.042201	0.33413	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
561	555	0.041091	0.33247	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
562	556	0.042201	0.33358	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
563	557	0.042201	0.33303	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
564	558	0.042201	0.33496	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
565	559	0.042201	0.33275	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
566	560	0.042201	0.33496	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
567	561	0.041091	0.33552	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
568	562	0.042201	0.33552	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
569	563	0.042201	0.33358	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
570	564	0.042201	0.3358	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
571	565	0.042201	0.33607	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
572	566	0.042201	0.33413	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
573	567	0.042201	0.33635	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
574	568	0.042201	0.33663	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
575	569	0.042201	0.33663	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
576	570	0.042201	0.33441	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
577	571	0.041091	0.33441	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
578	572	0.042201	0.33663	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
579	573	0.042201	0.33718	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
580	574	0.042201	0.33552	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
581	575	0.042201	0.33746	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
582	576	0.042201	0.3358	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
583	577	0.041091	0.33773	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
584	578	0.041091	0.33773	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
585	579	0.041091	0.3358	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
586	580	0.041091	0.3358	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
587	581	0.041091	0.33773	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
588	582	0.03998	0.33635	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
589	583	0.03998	0.33663	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
590	584	0.042201	0.3369	2.9681	8.7933	8.7923	8.0717	0.72161	0.72058	0.99857
591	585	0.041091	0.3369	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
592	586	0.042201	0.3369	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
593	587	0.041091	0.3369	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
594	588	0.041091	0.3369	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
595	589	0.042201	0.33884	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
596	590	0.041091	0.33912	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
597	591	0.042201	0.33912	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

598	592	0.042201	0.33746	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
599	593	0.042201	0.33939	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
600	594	0.041091	0.33967	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
601	595	0.042201	0.33801	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
602	596	0.042201	0.33801	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
603	597	0.042201	0.34022	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
604	598	0.043312	0.33829	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
605	599	0.043312	0.3405	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
606	600	0.042201	0.3405	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
607	601	0.042201	0.33856	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
608	602	0.042201	0.33912	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
609	603	0.042201	0.34106	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
610	604	0.042201	0.34106	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
611	605	0.041091	0.33967	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
612	606	0.042201	0.33939	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
613	607	0.042201	0.34133	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
614	608	0.042201	0.34161	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
615	609	0.042201	0.33967	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
616	610	0.041091	0.34161	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
617	611	0.042201	0.34078	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
618	612	0.042201	0.34216	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
619	613	0.041091	0.34022	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
620	614	0.03998	0.34244	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
621	615	0.03998	0.34216	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
622	616	0.041091	0.3405	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
623	617	0.041091	0.34078	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
624	618	0.042201	0.34272	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
625	619	0.042201	0.34272	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
626	620	0.042201	0.34272	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
627	621	0.041091	0.34272	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
628	622	0.041091	0.34327	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
629	623	0.042201	0.34133	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
630	624	0.041091	0.34355	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
631	625	0.042201	0.34355	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
632	626	0.042201	0.34161	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
633	627	0.042201	0.34355	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
634	628	0.042201	0.34189	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
635	629	0.042201	0.34382	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
636	630	0.042201	0.34382	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
637	631	0.041091	0.3441	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
638	632	0.041091	0.34438	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
639	633	0.041091	0.34327	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
640	634	0.041091	0.34493	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
641	635	0.041091	0.34272	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
642	636	0.041091	0.34299	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
643	637	0.042201	0.34299	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
644	638	0.041091	0.34299	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
645	639	0.041091	0.34521	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
646	640	0.041091	0.34548	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
647	641	0.041091	0.34493	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
648	642	0.03998	0.34382	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
649	643	0.03998	0.34604	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
650	644	0.03998	0.34382	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
651	645	0.041091	0.34493	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
652	646	0.041091	0.34382	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
653	647	0.041091	0.34382	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
654	648	0.041091	0.34382	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
655	649	0.041091	0.34576	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
656	650	0.041091	0.3441	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
657	651	0.041091	0.34659	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
658	652	0.03998	0.34659	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
659	653	0.03998	0.34659	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
660	654	0.03998	0.34659	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
661	655	0.03998	0.34659	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
662	656	0.03998	0.34493	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
663	657	0.03998	0.34659	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
664	658	0.03998	0.34687	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
665	659	0.03998	0.34687	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
666	660	0.038869	0.34687	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
667	661	0.03998	0.34521	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
668	662	0.03998	0.34548	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
669	663	0.038869	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
670	664	0.038869	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
671	665	0.038869	0.34548	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
672	666	0.038869	0.34548	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
673	667	0.038869	0.34548	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
674	668	0.038869	0.34742	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
675	669	0.038869	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
676	670	0.038869	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
677	671	0.038869	0.34576	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
678	672	0.038869	0.34798	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
679	673	0.037759	0.34798	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
680	674	0.038869	0.3477	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
681	675	0.038869	0.34825	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
682	676	0.038869	0.34825	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
683	677	0.038869	0.34853	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
684	678	0.038869	0.34631	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
685	679	0.038869	0.34853	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
686	680	0.038869	0.34631	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
687	681	0.038869	0.34853	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
688	682	0.038869	0.34742	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
689	683	0.038869	0.34687	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
690	684	0.037759	0.34715	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
691	685	0.037759	0.3477	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
692	686	0.037759	0.34742	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
693	687	0.037759	0.34742	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
694	688	0.037759	0.34742	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
695	689	0.037759	0.34742	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
696	690	0.037759	0.34715	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
697	691	0.036648	0.34715	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
698	692	0.037759	0.34936	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

699	693	0.037759	0.34798	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
700	694	0.036648	0.34964	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
701	695	0.037759	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
702	696	0.037759	0.34964	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
703	697	0.037759	0.34964	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
704	698	0.037759	0.34853	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
705	699	0.037759	0.34742	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
706	700	0.037759	0.34936	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
707	701	0.037759	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
708	702	0.037759	0.34964	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
709	703	0.037759	0.34853	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
710	704	0.037759	0.34825	2.9681	8.7933	8.7923	8.0723	0.72103	0.71999	0.99857
711	705	0.037759	0.35047	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
712	706	0.037759	0.34798	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
713	707	0.037759	0.34798	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
714	708	0.037759	0.3477	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
715	709	0.038869	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
716	710	0.037759	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
717	711	0.037759	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
718	712	0.037759	0.3477	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
719	713	0.037759	0.35019	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
720	714	0.037759	0.34825	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
721	715	0.037759	0.34881	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
722	716	0.037759	0.35047	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
723	717	0.037759	0.34853	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
724	718	0.037759	0.35047	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
725	719	0.037759	0.35047	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
726	720	0.037759	0.34825	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
727	721	0.037759	0.35074	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
728	722	0.037759	0.34825	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
729	723	0.037759	0.34853	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
730	724	0.037759	0.35102	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
731	725	0.038869	0.34964	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
732	726	0.037759	0.34991	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
733	727	0.037759	0.34908	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
734	728	0.037759	0.34908	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
735	729	0.038869	0.34908	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
736	730	0.037759	0.34908	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
737	731	0.037759	0.34964	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
738	732	0.038869	0.34936	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
739	733	0.037759	0.35074	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
740	734	0.038869	0.35157	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
741	735	0.037759	0.35185	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
742	736	0.037759	0.35019	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
743	737	0.037759	0.35213	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
744	738	0.037759	0.35213	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
745	739	0.037759	0.34964	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
746	740	0.037759	0.35213	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
747	741	0.037759	0.35047	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
748	742	0.037759	0.34964	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
749	743	0.037759	0.34964	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
750	744	0.037759	0.34964	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
751	745	0.036648	0.35185	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
752	746	0.036648	0.35019	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
753	747	0.036648	0.35268	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
754	748	0.036648	0.35213	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
755	749	0.037759	0.35019	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
756	750	0.036648	0.35019	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
757	751	0.036648	0.34991	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
758	752	0.036648	0.34991	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
759	753	0.036648	0.34991	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
760	754	0.037759	0.34991	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
761	755	0.036648	0.34991	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
762	756	0.036648	0.35241	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
763	757	0.036648	0.35241	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
764	758	0.036648	0.35296	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
765	759	0.036648	0.35268	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
766	760	0.037759	0.35047	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
767	761	0.037759	0.35047	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
768	762	0.037759	0.35268	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
769	763	0.037759	0.35047	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
770	764	0.037759	0.3513	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
771	765	0.036648	0.35047	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
772	766	0.037759	0.35268	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
773	767	0.037759	0.35324	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
774	768	0.037759	0.35102	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
775	769	0.037759	0.35102	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
776	770	0.037759	0.35324	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
777	771	0.036648	0.35324	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
778	772	0.037759	0.35324	2.9681	8.7857	8.7911	8.0717	0.71401	0.71941	1.0076
779	773	0.037759	0.35241	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
780	774	0.037759	0.35102	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
781	775	0.037759	0.35324	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
782	776	0.037759	0.35296	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
783	777	0.037759	0.3513	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
784	778	0.037759	0.35379	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
785	779	0.037759	0.35213	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
786	780	0.037759	0.35407	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
787	781	0.037759	0.35407	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
788	782	0.037759	0.35351	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
789	783	0.037759	0.35351	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
790	784	0.037759	0.35185	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
791	785	0.037759	0.35185	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
792	786	0.038869	0.35434	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
793	787	0.037759	0.35296	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
794	788	0.037759	0.35351	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
795	789	0.037759	0.35462	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
796	790	0.038869	0.35324	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
797	791	0.038869	0.35268	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
798	792	0.038869	0.35241	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
799	793	0.038869	0.35241	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076

800	794	0.038869	0.35213	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
801	795	0.038869	0.35462	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
802	796	0.038869	0.35213	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
803	797	0.038869	0.35434	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
804	798	0.038869	0.35434	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
805	799	0.038869	0.35296	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
806	800	0.038869	0.3549	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
807	801	0.037759	0.35517	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
808	802	0.037759	0.35517	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
809	803	0.037759	0.35517	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
810	804	0.037759	0.35296	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
811	805	0.037759	0.35268	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
812	806	0.037759	0.35268	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
813	807	0.037759	0.3549	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
814	808	0.037759	0.3549	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
815	809	0.037759	0.3549	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
816	810	0.037759	0.35379	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
817	811	0.037759	0.35545	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
818	812	0.038869	0.35379	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
819	813	0.037759	0.35573	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
820	814	0.038869	0.35324	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
821	815	0.038869	0.35324	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
822	816	0.037759	0.35324	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
823	817	0.038869	0.35324	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
824	818	0.038869	0.35324	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
825	819	0.038869	0.35351	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
826	820	0.038869	0.35517	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
827	821	0.037759	0.356	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
828	822	0.037759	0.35407	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
829	823	0.037759	0.35434	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
830	824	0.037759	0.35628	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
831	825	0.038869	0.35628	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
832	826	0.037759	0.35407	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
833	827	0.038869	0.35407	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
834	828	0.038869	0.35407	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
835	829	0.038869	0.35407	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
836	830	0.038869	0.35628	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
837	831	0.038869	0.35462	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
838	832	0.038869	0.35683	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
839	833	0.038869	0.3549	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
840	834	0.038869	0.35573	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
841	835	0.037759	0.3549	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
842	836	0.037759	0.3549	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
843	837	0.037759	0.35711	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
844	838	0.038869	0.35711	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
845	839	0.038869	0.35711	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
846	840	0.037759	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
847	841	0.037759	0.35462	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
848	842	0.037759	0.35711	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
849	843	0.037759	0.3549	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
850	844	0.038869	0.35767	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
851	845	0.038869	0.35739	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
852	846	0.037759	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
853	847	0.037759	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
854	848	0.037759	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
855	849	0.037759	0.35711	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
856	850	0.037759	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
857	851	0.037759	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
858	852	0.037759	0.35739	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
859	853	0.037759	0.35711	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
860	854	0.037759	0.35767	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
861	855	0.037759	0.35794	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
862	856	0.037759	0.356	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
863	857	0.037759	0.35794	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
864	858	0.037759	0.356	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
865	859	0.038869	0.35794	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
866	860	0.038869	0.35794	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
867	861	0.037759	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
868	862	0.037759	0.35573	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
869	863	0.037759	0.35794	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
870	864	0.038869	0.35794	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
871	865	0.038869	0.35794	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
872	866	0.038869	0.3585	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
873	867	0.038869	0.35711	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
874	868	0.036648	0.3585	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
875	869	0.036648	0.3585	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
876	870	0.036648	0.35711	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
877	871	0.036648	0.35628	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
878	872	0.036648	0.35628	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
879	873	0.036648	0.356	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
880	874	0.036648	0.356	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
881	875	0.036648	0.356	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003
882	876	0.036648	0.35877	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
883	877	0.036648	0.3585	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
884	878	0.036648	0.35905	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
885	879	0.036648	0.35905	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
886	880	0.035538	0.35905	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
887	881	0.036648	0.35905	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
888	882	0.035538	0.35683	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
889	883	0.036648	0.35905	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
890	884	0.036648	0.35933	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
891	885	0.036648	0.35905	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
892	886	0.036648	0.35711	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
893	887	0.036648	0.3596	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
894	888	0.036648	0.35877	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
895	889	0.036648	0.35988	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
896	890	0.036648	0.35767	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
897	891	0.036648	0.35767	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
898	892	0.036648	0.35767	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
899	893	0.036648	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
900	894	0.036648	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

901	895	0.036648	0.35739	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003
902	896	0.036648	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
903	897	0.036648	0.35739	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
904	898	0.036648	0.35933	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
905	899	0.036648	0.35988	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
906	900	0.036648	0.35988	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
907	901	0.036648	0.35794	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
908	902	0.036648	0.3585	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
909	903	0.037759	0.35822	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
910	904	0.037759	0.35933	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003
911	905	0.036648	0.36016	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
912	906	0.037759	0.36016	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
913	907	0.037759	0.36016	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
914	908	0.037759	0.36016	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
915	909	0.037759	0.36016	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
916	910	0.036648	0.36043	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
917	911	0.036648	0.35877	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
918	912	0.036648	0.36071	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
919	913	0.036648	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
920	914	0.036648	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
921	915	0.037759	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
922	916	0.037759	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
923	917	0.037759	0.3585	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
924	918	0.037759	0.3585	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
925	919	0.037759	0.3585	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
926	920	0.037759	0.3585	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
927	921	0.037759	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
928	922	0.037759	0.36071	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
929	923	0.037759	0.36126	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
930	924	0.036648	0.36154	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
931	925	0.036648	0.36154	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
932	926	0.036648	0.36154	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
933	927	0.037759	0.36154	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
934	928	0.037759	0.36154	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
935	929	0.037759	0.36154	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
936	930	0.037759	0.36154	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
937	931	0.037759	0.35988	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
938	932	0.037759	0.35905	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
939	933	0.038869	0.3596	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
940	934	0.037759	0.36209	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
941	935	0.037759	0.36154	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
942	936	0.037759	0.35988	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
943	937	0.037759	0.36182	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
944	938	0.037759	0.36182	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
945	939	0.037759	0.36182	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
946	940	0.037759	0.36016	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
947	941	0.037759	0.36182	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
948	942	0.037759	0.36182	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
949	943	0.037759	0.3596	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
950	944	0.037759	0.36182	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
951	945	0.037759	0.35988	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
952	946	0.037759	0.36016	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
953	947	0.037759	0.36265	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
954	948	0.037759	0.36265	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
955	949	0.037759	0.36265	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
956	950	0.037759	0.36154	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
957	951	0.037759	0.36265	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
958	952	0.037759	0.36237	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
959	953	0.037759	0.36237	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
960	954	0.037759	0.36265	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
961	955	0.037759	0.36043	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
962	956	0.037759	0.36265	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
963	957	0.038869	0.36292	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
964	958	0.037759	0.36292	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
965	959	0.037759	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
966	960	0.037759	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
967	961	0.037759	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
968	962	0.037759	0.36043	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
969	963	0.038869	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
970	964	0.038869	0.36292	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
971	965	0.037759	0.36071	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
972	966	0.037759	0.3632	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
973	967	0.037759	0.3632	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
974	968	0.037759	0.36348	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
975	969	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
976	970	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
977	971	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
978	972	0.037759	0.36237	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
979	973	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
980	974	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
981	975	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
982	976	0.037759	0.36265	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
983	977	0.037759	0.36154	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
984	978	0.036648	0.36403	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
985	979	0.037759	0.36431	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
986	980	0.037759	0.36209	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
987	981	0.037759	0.36265	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
988	982	0.037759	0.36459	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
989	983	0.037759	0.36459	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
990	984	0.037759	0.36209	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
991	985	0.037759	0.36431	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
992	986	0.037759	0.36209	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
993	987	0.037759	0.36209	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
994	988	0.037759	0.36209	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
995	989	0.037759	0.36209	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
996	990	0.037759	0.36209	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
997	991	0.037759	0.36459	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
998	992	0.037759	0.36403	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
999	993	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1000	994	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1001	995	0.037759	0.36376	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003

1002	996	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1003	997	0.038869	0.36292	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1004	998	0.038869	0.36292	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1005	999	0.038869	0.36265	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1006	1000	0.038869	0.36486	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1007	1001	0.038869	0.36292	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1008	1002	0.038869	0.36542	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1009	1003	0.038869	0.3632	2.9681	8.7933	8.7923	8.0717	0.72161	0.72058	0.99857
1010	1004	0.038869	0.36569	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1011	1005	0.037759	0.36569	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1012	1006	0.037759	0.36569	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1013	1007	0.038869	0.36569	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1014	1008	0.038869	0.36569	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1015	1009	0.038869	0.36542	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1016	1010	0.037759	0.36542	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1017	1011	0.037759	0.36597	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1018	1012	0.038869	0.36348	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1019	1013	0.038869	0.36597	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1020	1014	0.037759	0.36376	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1021	1015	0.037759	0.36403	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1022	1016	0.037759	0.36652	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1023	1017	0.037759	0.36652	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1024	1018	0.037759	0.36652	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1025	1019	0.037759	0.36652	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1026	1020	0.037759	0.36652	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1027	1021	0.037759	0.36652	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1028	1022	0.037759	0.36652	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1029	1023	0.038869	0.36652	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1030	1024	0.038869	0.36652	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1031	1025	0.038869	0.3668	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1032	1026	0.038869	0.36708	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1033	1027	0.038869	0.3668	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1034	1028	0.037759	0.36486	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1035	1029	0.037759	0.36486	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1036	1030	0.037759	0.36459	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1037	1031	0.037759	0.36431	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1038	1032	0.038869	0.36459	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1039	1033	0.038869	0.36459	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1040	1034	0.038869	0.36459	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1041	1035	0.03998	0.36459	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1042	1036	0.03998	0.3668	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1043	1037	0.038869	0.36735	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1044	1038	0.038869	0.36735	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1045	1039	0.038869	0.36542	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1046	1040	0.038869	0.36514	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1047	1041	0.038869	0.36514	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1048	1042	0.038869	0.36514	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1049	1043	0.038869	0.36514	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1050	1044	0.038869	0.36708	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003
1051	1045	0.038869	0.36735	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1052	1046	0.03998	0.36735	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1053	1047	0.03998	0.36763	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1054	1048	0.038869	0.36542	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1055	1049	0.038869	0.36791	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1056	1050	0.038869	0.36597	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1057	1051	0.038869	0.36569	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1058	1052	0.038869	0.36569	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1059	1053	0.038869	0.36569	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1060	1054	0.038869	0.36569	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1061	1055	0.038869	0.36569	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1062	1056	0.038869	0.36597	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1063	1057	0.038869	0.36708	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1064	1058	0.038869	0.36569	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1065	1059	0.038869	0.36846	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1066	1060	0.038869	0.36846	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1067	1061	0.037759	0.36625	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1068	1062	0.037759	0.36791	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1069	1063	0.038869	0.36874	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1070	1064	0.038869	0.36874	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1071	1065	0.038869	0.36818	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1072	1066	0.037759	0.36874	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1073	1067	0.037759	0.36874	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1074	1068	0.037759	0.36874	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1075	1069	0.038869	0.36874	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1076	1070	0.038869	0.36874	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1077	1071	0.038869	0.36874	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1078	1072	0.038869	0.36652	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1079	1073	0.038869	0.36763	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1080	1074	0.038869	0.36708	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1081	1075	0.038869	0.36708	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1082	1076	0.03998	0.36708	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1083	1077	0.038869	0.36929	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1084	1078	0.03998	0.36929	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1085	1079	0.038869	0.36902	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1086	1080	0.038869	0.3668	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1087	1081	0.038869	0.36902	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1088	1082	0.038869	0.36708	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1089	1083	0.03998	0.36929	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1090	1084	0.038869	0.36957	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1091	1085	0.03998	0.36735	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1092	1086	0.03998	0.36957	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1093	1087	0.03998	0.36763	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1094	1088	0.03998	0.36985	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1095	1089	0.03998	0.36708	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1096	1090	0.03998	0.36957	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1097	1091	0.03998	0.36957	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1098	1092	0.038869	0.36957	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1099	1093	0.038869	0.36985	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1100	1094	0.038869	0.36735	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1101	1095	0.038869	0.36763	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1102	1096	0.038869	0.3704	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

1103	1097	0.037759	0.37068	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1104	1098	0.038869	0.37068	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1105	1099	0.037759	0.36791	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1106	1100	0.038869	0.3704	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1107	1101	0.037759	0.36846	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1108	1102	0.037759	0.36791	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1109	1103	0.037759	0.36763	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1110	1104	0.038869	0.3704	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1111	1105	0.037759	0.36818	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1112	1106	0.037759	0.36791	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1113	1107	0.037759	0.37012	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1114	1108	0.037759	0.36846	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1115	1109	0.038869	0.37095	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1116	1110	0.037759	0.36846	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1117	1111	0.037759	0.36818	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1118	1112	0.038869	0.37068	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1119	1113	0.038869	0.37068	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1120	1114	0.038869	0.37068	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1121	1115	0.038869	0.37068	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1122	1116	0.038869	0.37068	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1123	1117	0.038869	0.36818	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1124	1118	0.038869	0.36846	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1125	1119	0.038869	0.36846	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1126	1120	0.037759	0.36902	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1127	1121	0.038869	0.37068	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1128	1122	0.038869	0.37123	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1129	1123	0.038869	0.37123	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1130	1124	0.038869	0.36874	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1131	1125	0.038869	0.36874	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1132	1126	0.038869	0.36874	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1133	1127	0.038869	0.37123	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1134	1128	0.038869	0.37068	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1135	1129	0.038869	0.37068	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1136	1130	0.038869	0.37151	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1137	1131	0.038869	0.37068	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1138	1132	0.038869	0.37206	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1139	1133	0.038869	0.36957	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1140	1134	0.038869	0.36957	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1141	1135	0.038869	0.37206	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1142	1136	0.038869	0.37206	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1143	1137	0.03998	0.36957	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1144	1138	0.038869	0.36957	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1145	1139	0.03998	0.37206	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1146	1140	0.03998	0.37206	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1147	1141	0.038869	0.37206	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1148	1142	0.038869	0.37178	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1149	1143	0.038869	0.37234	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1150	1144	0.038869	0.37012	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1151	1145	0.038869	0.3704	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1152	1146	0.037759	0.37012	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1153	1147	0.038869	0.36985	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1154	1148	0.038869	0.36985	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1155	1149	0.038869	0.37234	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1156	1150	0.038869	0.37234	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1157	1151	0.038869	0.36957	2.9681	8.7863	8.7917	8.0723	0.71397	0.71941	1.0076
1158	1152	0.038869	0.36985	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1159	1153	0.038869	0.37234	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1160	1154	0.038869	0.37234	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1161	1155	0.038869	0.37012	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1162	1156	0.038869	0.37095	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1163	1157	0.038869	0.37317	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1164	1158	0.038869	0.37317	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1165	1159	0.038869	0.37317	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1166	1160	0.038869	0.37289	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1167	1161	0.038869	0.37289	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1168	1162	0.038869	0.3704	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1169	1163	0.038869	0.3704	2.9681	8.7857	8.7911	8.0717	0.71401	0.71941	1.0076
1170	1164	0.038869	0.3704	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1171	1165	0.038869	0.37068	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1172	1166	0.038869	0.37317	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1173	1167	0.038869	0.37095	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1174	1168	0.038869	0.37095	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1175	1169	0.037759	0.37344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1176	1170	0.037759	0.37289	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1177	1171	0.038869	0.37095	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1178	1172	0.038869	0.37095	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1179	1173	0.038869	0.37095	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1180	1174	0.038869	0.37095	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1181	1175	0.038869	0.37344	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1182	1176	0.038869	0.37317	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1183	1177	0.038869	0.37123	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1184	1178	0.038869	0.37123	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1185	1179	0.038869	0.374	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1186	1180	0.038869	0.37372	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
1187	1181	0.038869	0.37427	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1188	1182	0.037759	0.37178	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1189	1183	0.037759	0.37206	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1190	1184	0.037759	0.37151	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1191	1185	0.038869	0.37372	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1192	1186	0.037759	0.37427	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1193	1187	0.038869	0.374	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1194	1188	0.038869	0.37178	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1195	1189	0.038869	0.374	2.9681	8.7857	8.7911	8.0711	0.71459	0.71999	1.0076
1196	1190	0.038869	0.37151	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1197	1191	0.038869	0.37234	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1198	1192	0.038869	0.37206	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1199	1193	0.038869	0.37455	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1200	1194	0.038869	0.37455	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1201	1195	0.037759	0.37206	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1202	1196	0.037759	0.37178	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1203	1197	0.037759	0.37455	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076

1204	1198	0.038869	0.374	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1205	1199	0.038869	0.37234	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1206	1200	0.038869	0.37206	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1207	1201	0.038869	0.37206	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1208	1202	0.038869	0.374	2.9681	8.7863	8.7917	8.0711	0.71514	0.72058	1.0076
1209	1203	0.03998	0.37483	2.9681	8.7901	8.7923	8.0723	0.71777	0.71999	1.0031
1210	1204	0.038869	0.37289	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1211	1205	0.038869	0.37261	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1212	1206	0.03998	0.37261	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1213	1207	0.03998	0.37511	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1214	1208	0.038869	0.37511	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1215	1209	0.038869	0.37511	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1216	1210	0.038869	0.37344	2.9681	8.7857	8.7911	8.0711	0.71459	0.71999	1.0076
1217	1211	0.038869	0.37511	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1218	1212	0.038869	0.37538	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1219	1213	0.038869	0.37538	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1220	1214	0.03998	0.37289	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1221	1215	0.038869	0.37344	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1222	1216	0.038869	0.37594	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1223	1217	0.03998	0.37344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1224	1218	0.038869	0.37372	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1225	1219	0.038869	0.37566	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1226	1220	0.038869	0.37372	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1227	1221	0.038869	0.37344	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1228	1222	0.038869	0.37344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1229	1223	0.038869	0.37344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1230	1224	0.038869	0.37344	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1231	1225	0.038869	0.37344	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1232	1226	0.038869	0.37566	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1233	1227	0.038869	0.37372	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1234	1228	0.038869	0.37677	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1235	1229	0.038869	0.374	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1236	1230	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1237	1231	0.038869	0.37621	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1238	1232	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1239	1233	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1240	1234	0.038869	0.37566	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1241	1235	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1242	1236	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1243	1237	0.038869	0.37372	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1244	1238	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1245	1239	0.038869	0.37677	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1246	1240	0.03998	0.37704	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1247	1241	0.038869	0.37455	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1248	1242	0.038869	0.37455	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1249	1243	0.038869	0.37427	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1250	1244	0.03998	0.37427	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1251	1245	0.03998	0.37427	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1252	1246	0.03998	0.37427	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1253	1247	0.038869	0.37427	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1254	1248	0.038869	0.37427	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1255	1249	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1256	1250	0.038869	0.37704	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1257	1251	0.038869	0.37732	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1258	1252	0.038869	0.3776	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1259	1253	0.038869	0.37511	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1260	1254	0.038869	0.3776	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1261	1255	0.038869	0.3776	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1262	1256	0.038869	0.37511	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1263	1257	0.03998	0.37732	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1264	1258	0.03998	0.3776	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1265	1259	0.03998	0.37787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1266	1260	0.038869	0.3776	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1267	1261	0.038869	0.37566	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1268	1262	0.037759	0.37787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1269	1263	0.037759	0.37538	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1270	1264	0.037759	0.37566	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1271	1265	0.037759	0.37594	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1272	1266	0.037759	0.37594	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1273	1267	0.037759	0.37566	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1274	1268	0.037759	0.37538	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1275	1269	0.037759	0.37538	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1276	1270	0.037759	0.37538	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1277	1271	0.038869	0.37787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1278	1272	0.037759	0.37815	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1279	1273	0.037759	0.37815	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1280	1274	0.037759	0.37787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1281	1275	0.037759	0.3776	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1282	1276	0.038869	0.37621	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1283	1277	0.038869	0.37843	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1284	1278	0.038869	0.37621	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1285	1279	0.038869	0.37594	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1286	1280	0.038869	0.37843	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1287	1281	0.038869	0.37843	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1288	1282	0.038869	0.37843	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1289	1283	0.038869	0.37843	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1290	1284	0.038869	0.37594	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1291	1285	0.038869	0.37621	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1292	1286	0.038869	0.37843	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1293	1287	0.037759	0.37621	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1294	1288	0.037759	0.37898	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1295	1289	0.038869	0.37677	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
1296	1290	0.038869	0.37926	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1297	1291	0.038869	0.37677	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1298	1292	0.038869	0.37926	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1299	1293	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1300	1294	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1301	1295	0.038869	0.37843	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1302	1296	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1303	1297	0.03998	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1304	1298	0.038869	0.37649	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

1305	1299	0.038869	0.37926	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1306	1300	0.038869	0.37843	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1307	1301	0.038869	0.37981	2.9681	8.7928	8.7917	8.0723	0.72048	0.71941	0.99851
1308	1302	0.038869	0.37981	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1309	1303	0.038869	0.37787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1310	1304	0.038869	0.37704	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1311	1305	0.038869	0.37981	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1312	1306	0.038869	0.37787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1313	1307	0.038869	0.37953	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1314	1308	0.038869	0.37704	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1315	1309	0.038869	0.37981	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1316	1310	0.038869	0.37981	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1317	1311	0.038869	0.38009	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1318	1312	0.037759	0.37787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1319	1313	0.037759	0.38037	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1320	1314	0.037759	0.37787	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1321	1315	0.037759	0.38037	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1322	1316	0.037759	0.38037	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1323	1317	0.038869	0.37981	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1324	1318	0.038869	0.3776	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1325	1319	0.037759	0.3776	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1326	1320	0.038869	0.3776	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1327	1321	0.038869	0.3776	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1328	1322	0.038869	0.3776	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1329	1323	0.038869	0.38009	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1330	1324	0.037759	0.37953	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1331	1325	0.037759	0.38092	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1332	1326	0.037759	0.37815	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1333	1327	0.037759	0.37843	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1334	1328	0.037759	0.37815	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1335	1329	0.038869	0.38064	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1336	1330	0.038869	0.38092	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1337	1331	0.038869	0.38092	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1338	1332	0.038869	0.37843	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1339	1333	0.038869	0.38092	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1340	1334	0.038869	0.38092	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1341	1335	0.038869	0.37815	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1342	1336	0.038869	0.37843	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1343	1337	0.038869	0.38147	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1344	1338	0.037759	0.37898	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1345	1339	0.037759	0.38147	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1346	1340	0.037759	0.37898	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1347	1341	0.037759	0.3812	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1348	1342	0.038869	0.38147	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1349	1343	0.038869	0.3787	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1350	1344	0.038869	0.38175	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1351	1345	0.038869	0.37898	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1352	1346	0.038869	0.37898	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1353	1347	0.038869	0.37926	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1354	1348	0.038869	0.38064	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1355	1349	0.037759	0.38203	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1356	1350	0.037759	0.38037	2.9681	8.7928	8.7917	8.0711	0.72165	0.72058	0.99852
1357	1351	0.037759	0.37981	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1358	1352	0.036648	0.38037	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1359	1353	0.037759	0.37953	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1360	1354	0.037759	0.38064	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1361	1355	0.037759	0.37953	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1362	1356	0.037759	0.38203	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1363	1357	0.037759	0.38147	2.9681	8.7863	8.7917	8.0711	0.71514	0.72058	1.0076
1364	1358	0.037759	0.37953	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1365	1359	0.037759	0.3812	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1366	1360	0.037759	0.38203	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1367	1361	0.037759	0.38203	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1368	1362	0.037759	0.38037	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1369	1363	0.036648	0.37981	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1370	1364	0.037759	0.37981	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1371	1365	0.037759	0.37981	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1372	1366	0.037759	0.37953	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1373	1367	0.037759	0.37953	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1374	1368	0.038869	0.37953	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1375	1369	0.038869	0.37953	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1376	1370	0.038869	0.3823	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1377	1371	0.038869	0.3823	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1378	1372	0.038869	0.3823	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1379	1373	0.038869	0.38258	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1380	1374	0.038869	0.38258	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1381	1375	0.038869	0.38286	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1382	1376	0.037759	0.38009	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1383	1377	0.038869	0.38286	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1384	1378	0.038869	0.38286	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1385	1379	0.038869	0.38286	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1386	1380	0.038869	0.38286	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1387	1381	0.037759	0.38092	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
1388	1382	0.038869	0.38009	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1389	1383	0.038869	0.38037	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1390	1384	0.037759	0.38009	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1391	1385	0.038869	0.38313	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1392	1386	0.038869	0.3812	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1393	1387	0.038869	0.38369	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
1394	1388	0.038869	0.38369	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1395	1389	0.037759	0.38147	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
1396	1390	0.038869	0.38369	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1397	1391	0.038869	0.38341	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1398	1392	0.038869	0.38341	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1399	1393	0.038869	0.38341	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1400	1394	0.038869	0.38341	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1401	1395	0.038869	0.38369	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1402	1396	0.038869	0.38369	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1403	1397	0.038869	0.38092	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1404	1398	0.038869	0.38147	2.9681	8.7901	8.7923	8.0717	0.71836	0.72058	1.0031
1405	1399	0.037759	0.38175	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

1406	1400	0.037759	0.38147	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1407	1401	0.037759	0.38175	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1408	1402	0.037759	0.38147	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1409	1403	0.037759	0.38452	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1410	1404	0.038869	0.38258	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1411	1405	0.037759	0.38175	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1412	1406	0.037759	0.38175	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1413	1407	0.037759	0.38452	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1414	1408	0.037759	0.38452	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1415	1409	0.037759	0.38452	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1416	1410	0.037759	0.38479	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1417	1411	0.037759	0.38203	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1418	1412	0.037759	0.38258	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1419	1413	0.037759	0.38203	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1420	1414	0.037759	0.38203	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1421	1415	0.037759	0.38203	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1422	1416	0.037759	0.38452	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1423	1417	0.037759	0.38479	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1424	1418	0.037759	0.38479	2.9681	8.7863	8.7917	8.0717	0.71456	0.71999	1.0076
1425	1419	0.037759	0.38479	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1426	1420	0.038869	0.38507	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
1427	1421	0.037759	0.38452	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1428	1422	0.037759	0.38507	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1429	1423	0.037759	0.38507	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1430	1424	0.037759	0.38313	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1431	1425	0.037759	0.38258	2.9681	8.7928	8.7917	8.0717	0.72106	0.71999	0.99851
1432	1426	0.037759	0.38258	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1433	1427	0.038869	0.3823	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1434	1428	0.037759	0.38535	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1435	1429	0.037759	0.38507	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1436	1430	0.037759	0.38341	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1437	1431	0.037759	0.3823	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
1438	1432	0.037759	0.38507	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.5414	7.5439	7.4717	0.069724	0.072201	1.0355
2	0.012483	0	0	2.9681	7.5453	7.548	7.4746	0.070614	0.073377	1.0391
3	0.05415	0	0.0099659	2.9681	7.5643	7.565	7.4846	0.079692	0.08043	1.0093
4	0.10005	0	0.037095	2.9681	7.573	7.5709	7.4758	0.097157	0.095092	0.97874
5	0.25028	0	0.057304	2.9681	7.5687	7.5697	7.4735	0.095198	0.096263	1.0112
6	0.50072	0	0.064225	2.9681	7.5681	7.5691	7.4723	0.095824	0.096849	1.0107
7	1.0014	0	0.068654	2.9681	7.5698	7.5709	7.4717	0.098048	0.099195	1.0117
8	2.0028	0	0.069761	2.9681	7.5703	7.5715	7.4723	0.098008	0.099196	1.0121
9	4.0016	0.00091637	0.070038	2.9681	7.5698	7.5709	7.4717	0.098048	0.099195	1.0117
10	6.0003	0	0.069208	2.9681	7.5703	7.5715	7.4711	0.099181	0.10037	1.012
11	8.0031	0	0.068654	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
12	10.002	0	0.06727	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
13	12.001	0	0.066439	2.9681	7.5703	7.5715	7.4711	0.099181	0.10037	1.012
14	14.003	0	0.065609	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
15	16.002	0.00091637	0.064778	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
16	18.001	0.00091637	0.063948	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
17	20.004	0.00091637	0.063394	2.9681	7.5735	7.5715	7.4717	0.10181	0.099782	0.98011
18	22.002	0	0.063117	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
19	24.001	0	0.06201	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
20	26.004	0	0.06118	2.9681	7.5698	7.5709	7.4717	0.098048	0.099195	1.0117
21	28.003	0.00091637	0.060349	2.9681	7.5698	7.5709	7.4717	0.098048	0.099195	1.0117
22	30.001	0.00091637	0.059519	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
23	30.052	0.00091637	0.059519	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.5703	7.5715	7.4717	0.098594	0.099782	1.012
2	0.012533	0.00091637	0.00055366	2.9681	7.5991	7.5955	7.4875	0.11157	0.10801	0.9681
3	0.050033	0.00091637	0.040971	2.9681	7.6923	7.6853	7.5362	0.15608	0.14914	0.95557
4	0.1001	0.00091637	0.16859	2.9681	7.6824	7.7024	7.5004	0.18197	0.20192	1.1096
5	0.25033	0.0082473	0.20707	2.9681	7.7014	7.7194	7.4711	0.23033	0.24825	1.0778
6	0.50068	0.02016	0.2162	2.9681	7.7116	7.72	7.4723	0.23934	0.24767	1.0348
7	1.0014	0.021993	0.22146	2.9681	7.7191	7.7211	7.4723	0.24686	0.24884	1.008
8	2.0029	0.021993	0.22479	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
9	4.0016	0.021993	0.22672	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
10	6.0003	0.021993	0.22728	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
11	8.0031	0.021993	0.22728	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
12	10.002	0.022909	0.22755	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
13	12.001	0.022909	0.22645	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
14	14.004	0.021993	0.22589	2.9681	7.7197	7.7217	7.4711	0.24857	0.2506	1.0082
15	16.002	0.021993	0.22589	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
16	18.001	0.021993	0.22506	2.9681	7.7229	7.7217	7.4717	0.2512	0.25001	0.99528
17	20.004	0.022909	0.22479	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
18	22.003	0.022909	0.22423	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
19	24.001	0.022909	0.22423	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
20	26	0.022909	0.22617	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
21	28.003	0.022909	0.22562	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
22	30.002	0.022909	0.22589	2.9681	7.7197	7.7217	7.4717	0.24799	0.25001	1.0082
23	30.081	0.023826	0.22589	2.9681	7.7202	7.7223	7.4717	0.24853	0.2506	1.0083

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.7229	7.7217	7.4717	0.2512	0.25001	0.99528
2	0.012433	0	0.00055366	2.9681	7.7561	7.754	7.4916	0.26451	0.26236	0.99189
3	0.05415	0	0.070038	2.9681	7.9119	7.9318	7.5532	0.35873	0.37862	1.0555
4	0.10005	0.0018327	0.17163	2.9681	7.9029	7.9359	7.4934	0.40949	0.44252	1.0807
5	0.25033	0.019244	0.23586	2.9681	7.9501	7.9694	7.4746	0.47543	0.49473	1.0406
6	0.50072	0.021993	0.24721	2.9681	7.9667	7.97	7.4735	0.49321	0.49649	1.0066
7	1.0014	0.024742	0.25385	2.9681	7.9678	7.9711	7.4729	0.49489	0.49825	1.0068
8	2.0028	0.026575	0.25828	2.9681	7.9715	7.9717	7.4723	0.49924	0.49943	1.0004
9	4.0015	0.026575	0.26188	2.9681	7.9715	7.9717	7.4723	0.49924	0.49943	1.0004
10	6.0003	0.025658	0.26382	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
11	8.0031	0.026575	0.26465	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
12	10.002	0.026575	0.26548	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
13	12.001	0.026575	0.26631	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
14	14.003	0.026575	0.26686	2.9681	7.9747	7.9717	7.4717	0.50304	0.50001	0.99399
15	16.002	0.027491	0.2652	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
16	18.001	0.027491	0.26548	2.9681	7.971	7.9711	7.4723	0.49869	0.49884	1.0003
17	20.004	0.028407	0.26659	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
18	22.002	0.027491	0.26686	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
19	24.001	0.027491	0.26576	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
20	26.004	0.027491	0.26853	2.9681	7.9747	7.9717	7.4717	0.50304	0.50001	0.99399
21	28.003	0.034822	0.31725	2.9681	7.9629	7.9658	7.4811	0.48177	0.48476	1.0062
22	30.001	0.037571	0.34299	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
23	32.003	0.037571	0.34576	2.9681	7.971	7.9711	7.4717	0.49928	0.49942	1.0003
24	34.003	0.037571	0.34853	2.9681	7.971	7.9711	7.4717	0.49928	0.49942	1.0003
25	36.004	0.037571	0.34991	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
26	38.004	0.037571	0.35102	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
27	40.003	0.037571	0.35185	2.9681	7.971	7.9711	7.4717	0.49928	0.49942	1.0003
28	42.002	0.037571	0.35241	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
29	44.002	0.037571	0.35241	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
30	46.001	0.038487	0.35213	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
31	48.002	0.038487	0.35296	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
32	50.002	0.037571	0.35324	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
33	52.002	0.037571	0.35379	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
34	54.001	0.038487	0.35434	2.9681	7.9683	7.9717	7.4717	0.49661	0.50001	1.0068
35	56	0.038487	0.35434	2.9681	7.971	7.9711	7.4717	0.49928	0.49942	1.0003
36	58.004	0.038487	0.35407	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
37	60.003	0.038487	0.35324	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
38	62.003	0.037571	0.3549	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
39	62.149	0.037571	0.3549	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.9715	7.9717	7.4717	0.49982	0.50001	1.0004
2	0.012417	0	0	2.9681	8.0047	8.0005	7.4864	0.51834	0.51411	0.99184
3	0.050467	0.0027491	0.10132	2.9681	8.329	8.3802	7.6054	0.72363	0.77479	1.0707
4	0.10055	0.010996	0.24416	2.9681	8.3518	8.4289	7.4963	0.8555	0.93254	1.0901
5	0.25077	0.031156	0.30091	2.9681	8.4505	8.4694	7.4741	0.97648	0.99531	1.0193
6	0.50163	0.037571	0.31337	2.9681	8.4671	8.47	7.4735	0.99368	0.99648	1.0028
7	1.0033	0.038487	0.32057	2.9681	8.4677	8.4705	7.4717	0.99598	0.99883	1.0029
8	2.0011	0.038487	0.32638	2.9681	8.4682	8.4711	7.4717	0.99653	0.99942	1.0029
9	4.0003	0.039404	0.33164	2.9681	8.4682	8.4711	7.4717	0.99653	0.99942	1.0029
10	6.0037	0.04032	0.33441	2.9681	8.4682	8.4711	7.4717	0.99653	0.99942	1.0029
11	8.0029	0.04032	0.33635	2.9681	8.4682	8.4711	7.4717	0.99653	0.99942	1.0029
12	10.002	0.04032	0.33773	2.9681	8.4682	8.4711	7.4717	0.99653	0.99942	1.0029
13	12.001	0.041236	0.33856	2.9681	8.4682	8.4711	7.4717	0.99653	0.99942	1.0029
14	14.001	0.041236	0.33912	2.9681	8.4688	8.4717	7.4723	0.99649	0.99942	1.0029
15	16	0.042153	0.33967	2.9681	8.4682	8.4711	7.4717	0.99653	0.99942	1.0029
16	18	0.042153	0.34106	2.9681	8.4688	8.4717	7.4717	0.99707	1	1.0029
17	20.001	0.043069	0.34133	2.9681	8.4682	8.4711	7.4711	0.99711	1	1.0029
18	22.001	0.043069	0.34216	2.9681	8.4688	8.4717	7.4717	0.99707	1	1.0029
19	24.002	0.043069	0.34299	2.9681	8.4688	8.4717	7.4717	0.99707	1	1.0029
20	26.002	0.043069	0.34355	2.9681	8.472	8.4717	7.4717	1.0003	1	0.99972
21	28.003	0.043069	0.34299	2.9681	8.4688	8.4717	7.4717	0.99707	1	1.0029
22	30.003	0.043986	0.3441	2.9681	8.4682	8.4711	7.4717	0.99653	0.99942	1.0029
23	30.074	0.043069	0.3441	2.9681	8.472	8.4717	7.4717	1.0003	1	0.99972

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.4688	8.4717	7.4717	0.99707	1	1.0029
2	0.012483	0	0.001661	2.9681	8.5482	8.5433	7.5069	1.0413	1.0364	0.99527
3	0.050633	0.0045818	0.071145	2.9681	8.7786	8.8496	7.5467	1.2318	1.3029	1.0577
4	0.10072	0.011913	0.14063	2.9681	8.8162	8.8866	7.484	1.3322	1.4026	1.0529
5	0.251	0.025658	0.17219	2.9681	8.9022	8.9066	7.4758	1.4264	1.4308	1.003
6	0.50197	0.028407	0.18132	2.9681	8.906	8.9107	7.4729	1.4332	1.4378	1.0032
7	1.0037	0.03024	0.18852	2.9681	8.9093	8.9107	7.4717	1.4375	1.439	1.001
8	2.0015	0.031156	0.19461	2.9681	8.9098	8.9113	7.4711	1.4387	1.4401	1.001
9	4.0007	0.031156	0.19987	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001
10	6.0002	0.032073	0.20347	2.9681	8.9103	8.9118	7.4699	1.4404	1.4419	1.001
11	8.0036	0.032073	0.20541	2.9681	8.9098	8.9113	7.4717	1.4381	1.4396	1.001
12	10.003	0.032989	0.20707	2.9681	8.9087	8.9101	7.4723	1.4364	1.4378	1.001
13	12.002	0.032073	0.20818	2.9681	8.9103	8.9118	7.4723	1.4381	1.4396	1.001
14	14.001	0.033906	0.21011	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001
15	16.002	0.033906	0.21067	2.9681	8.9103	8.9118	7.4723	1.4381	1.4396	1.001
16	18.002	0.033906	0.21205	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001
17	20.001	0.033906	0.21233	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001
18	22	0.033906	0.21371	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001
19	24.004	0.033906	0.21427	2.9681	8.9109	8.9124	7.4723	1.4386	1.4401	1.0011
20	26.004	0.034822	0.21482	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001
21	28	0.033906	0.21565	2.9681	8.9103	8.9118	7.4723	1.4381	1.4396	1.001
22	30	0.033906	0.21593	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001
23	32.001	0.033906	0.2162	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001
24	32.619	0.033906	0.21648	2.9681	8.9103	8.9118	7.4717	1.4386	1.4401	1.001

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1411	8.1437	8.0709	0.070272	0.072814	1.0362
2	0.012533	0	0	2.9681	8.1449	8.1478	8.0738	0.071162	0.07399	1.0397
3	0.050033	0	0.0074744	2.9681	8.1672	8.1648	8.0843	0.082867	0.080457	0.97092
4	0.1001	-0.00091637	0.037095	2.9681	8.17	8.1712	8.0761	0.093867	0.095119	1.0133
5	0.25033	0	0.060903	2.9681	8.1651	8.1695	8.075	0.090189	0.094531	1.0481
6	0.50118	0.0027491	0.067547	2.9681	8.1662	8.1707	8.072	0.094212	0.098636	1.047
7	1.0029	0.0027491	0.07253	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
8	2.0007	0.0036655	0.073914	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
9	4.0041	0.0045818	0.074744	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
10	6.0033	0.0045818	0.075021	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
11	8.0025	0.0054982	0.074191	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
12	10.002	0.0054982	0.074191	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
13	12.002	0.0045818	0.074191	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
14	14.001	0.0036655	0.07336	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
15	16.002	0.0036655	0.07253	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
16	18.002	0.0045818	0.071976	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
17	20.002	0.0045818	0.071422	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
18	22.002	0.0064146	0.24306	2.9681	8.1694	8.1707	8.072	0.097425	0.098636	1.0124
19	24.003	0.0064146	0.24721	2.9681	8.1705	8.1718	8.0709	0.099689	0.10098	1.013
20	26.003	0.0064146	0.15143	2.9681	8.1852	8.1806	8.0603	0.12486	0.12034	0.96382
21	28.003	-0.00091637	0.089139	2.9681	8.1711	8.1724	8.0714	0.099649	0.10098	1.0134
22	30.003	-0.00091637	0.086371	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
23	32.003	0.0054982	0.23863	2.9681	8.1662	8.1707	8.072	0.094212	0.098636	1.047
24	34.004	0.0027491	0.088863	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
25	36.004	-0.00091637	0.086094	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
26	38.004	-0.0018327	0.085264	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
27	40	-0.00091637	0.08388	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
28	42	-0.00091637	0.083326	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
29	44.001	0.0018327	0.082495	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
30	46.001	0.0027491	0.081665	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
31	48.001	0	0.081388	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
32	50.001	-0.00091637	0.081111	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
33	52.001	-0.00091637	0.080281	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
34	53.188	-0.00091637	0.079727	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
2	0.012533	0	0.00055366	2.9681	8.1961	8.1959	8.0861	0.11004	0.1098	0.99781
3	0.05065	0.00091637	0.040971	2.9681	8.2882	8.2845	8.1353	0.15287	0.14917	0.97581
4	0.10073	0	0.15752	2.9681	8.2799	8.2998	8.0843	0.19558	0.21543	1.1015
5	0.25095	0.0091637	0.196	2.9681	8.3134	8.3185	8.075	0.23849	0.24359	1.0214
6	0.50182	0.01008	0.20292	2.9681	8.3151	8.3203	8.0738	0.2413	0.24652	1.0216
7	1.0035	0.01008	0.20707	2.9681	8.3156	8.3209	8.0714	0.24419	0.24946	1.0216
8	2.0013	0.010996	0.21039	2.9681	8.3188	8.3209	8.0714	0.2474	0.24946	1.0083
9	4.0005	0.010996	0.21288	2.9681	8.3188	8.3209	8.0714	0.2474	0.24946	1.0083
10	6.0039	0.010996	0.21427	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
11	8.0031	0.010996	0.2151	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
12	10.002	0.010996	0.2151	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
13	12.002	0.010996	0.21565	2.9681	8.3188	8.3209	8.0714	0.2474	0.24946	1.0083
14	14.001	0.010996	0.21593	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
15	16.001	0.010996	0.21593	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
16	18	0.01008	0.21593	2.9681	8.3188	8.3209	8.0709	0.24799	0.25004	1.0083
17	20	0.01008	0.21593	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
18	22.004	0.01008	0.21593	2.9681	8.3188	8.3209	8.0714	0.2474	0.24946	1.0083
19	24.004	0.01008	0.21537	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
20	26.003	0.01008	0.21537	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
21	28.003	0.010996	0.2151	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
22	30.003	0.010996	0.2151	2.9681	8.3188	8.3209	8.0714	0.2474	0.24946	1.0083
23	30.083	0.010996	0.2151	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
2	0.012433	0	0	2.9681	8.3368	8.3367	8.0802	0.25656	0.25651	0.99978
3	0.050483	0.00091637	0.06118	2.9681	8.5034	8.5192	8.1535	0.34985	0.36573	1.0454
4	0.10055	0.0045818	0.16444	2.9681	8.5081	8.5451	8.0896	0.4185	0.45546	1.0883
5	0.25078	0.015578	0.21011	2.9681	8.5524	8.5685	8.0744	0.47806	0.49417	1.0337
6	0.50163	0.021993	0.22091	2.9681	8.5664	8.5697	8.072	0.49435	0.49769	1.0068
7	1.0034	0.024742	0.22672	2.9681	8.5707	8.5709	8.072	0.49865	0.49887	1.0004
8	2.0011	0.026575	0.23171	2.9681	8.5707	8.5709	8.072	0.49865	0.49887	1.0004
9	4.0003	0.026575	0.23531	2.9681	8.5707	8.5709	8.0714	0.49924	0.49945	1.0004
10	6.0037	0.027491	0.23752	2.9681	8.5712	8.5715	8.072	0.4992	0.49945	1.0005
11	8.0029	0.027491	0.23863	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
12	10.002	0.027491	0.24001	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
13	12.001	0.028407	0.24084	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
14	14.001	0.028407	0.24389	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
15	16.004	0.027491	0.24499	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
16	18.003	0.027491	0.24555	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
17	20.003	0.027491	0.24555	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
18	22.004	0.028407	0.24638	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
19	24.004	0.028407	0.24666	2.9681	8.5712	8.5715	8.0709	0.50037	0.50062	1.0005
20	26.001	0.028407	0.24721	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
21	28.001	0.028407	0.24749	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
22	30.001	0.028407	0.22506	2.9681	8.5712	8.5715	8.0703	0.50096	0.50121	1.0005
23	30.077	0.028407	0.22396	2.9681	8.5712	8.5715	8.0709	0.50037	0.50062	1.0005

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5744	8.5715	8.0703	0.50417	0.50121	0.99413
2	0.012467	0	0.0019378	2.9681	8.6589	8.6554	8.1207	0.53825	0.53471	0.99344
3	0.050617	0.0018327	0.10658	2.9681	8.9228	8.977	8.2051	0.71765	0.77188	1.0756
4	0.1007	0.013745	0.25081	2.9681	8.9435	9.0304	8.0955	0.84805	0.93492	1.1024
5	0.25092	0.03024	0.30507	2.9681	9.0486	9.0674	8.0755	0.97305	0.99182	1.0193
6	0.50178	0.036655	0.31282	2.9681	9.0636	9.0697	8.072	0.9916	0.99768	1.0061
7	1.0035	0.038487	0.31033	2.9681	9.0674	9.0703	8.0709	0.99653	0.99944	1.0029
8	2.0013	0.04032	0.29815	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
9	4.0005	0.041236	0.2677	2.9681	9.0679	9.0709	8.0703	0.99766	1.0006	1.003
10	6.0039	0.042153	0.24001	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
11	8.0031	0.042153	0.2115	2.9681	9.0679	9.0709	8.0703	0.99766	1.0006	1.003
12	10.002	0.042153	0.17939	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
13	12.001	0.042153	0.1481	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
14	14.001	0.043069	0.11544	2.9681	9.0685	9.0715	8.0732	0.99528	0.99827	1.003
15	16.004	0.043986	0.096337	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
16	18.003	0.044902	0.063394	2.9681	9.0696	9.0726	8.0703	0.9993	1.0024	1.0031
17	20.002	0.044902	0.030451	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
18	22.002	0.044902	-0.003322	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
19	24.001	0.043986	-0.037372	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
20	26	0.044902	-0.075575	2.9681	9.0722	9.0721	8.0703	1.002	1.0018	0.99983
21	28.003	0.043986	-0.11156	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
22	30.003	0.043986	-0.14589	2.9681	9.0674	9.0703	8.0709	0.99653	0.99944	1.0029
23	32.002	0.043986	-0.1816	2.9681	9.0685	9.0715	8.0691	0.99938	1.0024	1.003
24	34.001	0.043986	-0.21731	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
25	36	0.043986	-0.25275	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
26	38.004	0.043986	-0.28873	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
27	40.003	0.044902	-0.32528	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
28	42.002	0.043986	-0.36237	2.9681	9.0674	9.0703	8.0697	0.9977	1.0006	1.0029
29	44.001	0.043986	-0.39974	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
30	46.001	0.043986	-0.43656	2.9681	9.0685	9.0715	8.0697	0.99879	1.0018	1.003
31	48.004	0.043986	-0.47393	2.9681	9.0701	9.0732	8.072	0.99809	1.0012	1.0031
32	50.003	0.043986	-0.5102	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
33	52.002	0.044902	-0.54453	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
34	54.002	0.044902	-0.57913	2.9681	9.0679	9.0709	8.0697	0.99825	1.0012	1.003
35	56.001	0.044902	-0.6129	2.9681	9.0679	9.0709	8.0697	0.99825	1.0012	1.003
36	58.004	0.044902	-0.64585	2.9681	9.0679	9.0709	8.0884	0.97949	0.98244	1.003
37	60.003	0.044902	-0.67159	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
38	62.003	0.045818	-0.70426	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
39	64.002	0.045818	-0.73637	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
40	66.001	0.045818	-0.76322	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
41	68.001	0.045818	-0.79866	2.9681	9.0679	9.0709	8.0703	0.99766	1.0006	1.003
42	70	0.045818	-0.84212	2.9681	9.0717	9.0715	8.0697	1.002	1.0018	0.99978
43	72.003	0.044902	-0.88503	2.9681	9.069	9.0721	8.0709	0.99817	1.0012	1.003
44	74.003	0.044902	-0.92738	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
45	76.002	0.045818	-0.96891	2.9681	9.0685	9.0715	8.0697	0.99879	1.0018	1.003
46	78.001	0.045818	-1.0096	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
47	80.001	0.045818	-1.05	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
48	82	0.044902	-1.0902	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
49	84	0.044902	-1.1295	2.9681	9.069	9.0721	8.0703	0.99875	1.0018	1.003
50	86.003	0.045818	-1.1674	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
51	88.003	0.045818	-1.205	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
52	90.002	0.045818	-1.2394	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
53	92.001	0.046735	-1.2729	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
54	94	0.045818	-1.3058	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
55	96.004	0.045818	-1.3379	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
56	98.003	0.045818	-1.3692	2.9681	9.0679	9.0709	8.0703	0.99766	1.0006	1.003
57	100	0.045818	-1.3997	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
58	102	0.045818	-1.4296	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
59	104	0.046735	-1.4592	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
60	106	0.046735	-1.488	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
61	108	0.045818	-1.5165	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
62	110	0.045818	-1.545	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
63	112	0.046735	-1.5702	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
64	114	0.046735	-1.597	2.9681	9.0679	9.0709	8.0703	0.99766	1.0006	1.003
65	116	0.046735	-1.6233	2.9681	9.0685	9.0715	8.0703	0.99821	1.0012	1.003
66	118	0.0504	-1.6159	2.9681	9.0679	9.0709	8.0709	0.99707	1	1.003
67	120	0.0504	-1.6377	2.9681	9.0717	9.0715	8.0703	1.0014	1.0012	0.99978
68	122	0.0504	-1.6624	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
69	124	0.049484	-1.7125	2.9681	9.0722	9.0721	8.0709	1.0014	1.0012	0.99983
70	126	0.048567	-1.7379	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
71	128	0.049484	-1.7617	2.9681	9.0679	9.0709	8.0709	0.99707	1	1.003
72	130	0.049484	-1.7853	2.9681	9.0685	9.0715	8.0726	0.99586	0.99886	1.003
73	132	0.049484	-1.8069	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
74	134	0.049484	-1.8279	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
75	136	0.0504	-1.849	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
76	138	0.0504	-1.8692	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
77	140	0.051316	-1.8894	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
78	142	0.0504	-1.9093	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
79	144	0.0504	-1.9179	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
80	146	0.0504	-1.9212	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
81	148	0.051316	-1.9245	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
82	150	0.052233	-1.9273	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
83	152	0.052233	-1.9298	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
84	154	0.051316	-1.9317	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
85	156	0.051316	-1.9328	2.9681	9.0717	9.0715	8.0703	1.0014	1.0012	0.99978
86	158	0.051316	-1.9345	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
87	160	0.051316	-1.9381	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
88	162	0.052233	-1.9417	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
89	164	0.052233	-1.9445	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
90	166	0.051316	-1.9475	2.9681	9.0679	9.0709	8.0709	0.99707	1	1.003
91	168	0.051316	-1.95	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
92	170	0.051316	-1.9525	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003

93	172	0.052233	−1.9553	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
94	174	0.052233	−1.9575	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
95	176	0.053149	−1.9605	2.9681	9.0717	9.0715	8.0714	1.0002	1	0.99978
96	176.96	0.053149	−1.9622	2.9681	9.0685	9.0715	8.0726	0.99586	0.99886	1.003

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
2	0.0125	0	0.0019378	2.9681	9.1544	9.1466	8.1136	1.0408	1.0329	0.99248
3	0.05005	0.0027491	0.081388	2.9681	9.4179	9.4817	8.1301	1.2879	1.3516	1.0495
4	0.10007	0.0054982	0.12873	2.9681	9.4363	9.4911	8.0802	1.3561	1.4108	1.0404
5	0.25028	0.014662	0.15226	2.9681	9.5041	9.5087	8.075	1.4291	1.4337	1.0032
6	0.50082	0.016495	0.15945	2.9681	9.5052	9.5098	8.0732	1.432	1.4366	1.0033
7	1.0015	0.016495	0.16444	2.9681	9.5057	9.5104	8.072	1.4337	1.4384	1.0033
8	2.003	0.018327	0.16831	2.9681	9.5068	9.5116	8.072	1.4348	1.4396	1.0033
9	4.0017	0.02016	0.17025	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
10	6.0004	0.021993	0.17025	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
11	8.0034	0.021993	0.16914	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
12	10.002	0.022909	0.16748	2.9681	9.51	9.5116	8.0726	1.4374	1.439	1.0011
13	12.001	0.022909	0.1661	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
14	14.004	0.022909	0.16499	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
15	16.002	0.022909	0.16333	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
16	18.001	0.022909	0.16167	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
17	20.004	0.022909	0.15973	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
18	22.003	0.022909	0.15779	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
19	24.001	0.022909	0.15586	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
20	26	0.022909	0.15392	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
21	28.003	0.022909	0.15198	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
22	30.002	0.022909	0.14977	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
23	30.064	0.022909	0.14977	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011

TRIAXIAL TEST

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
2	0.0125	0	0.001661	2.9681	9.6115	9.6137	8.1219	1.4896	1.4919	1.0015
3	0.05005	0.0064146	0.11987	2.9681	10.049	10.163	8.1734	1.8751	1.9896	1.061
4	0.10012	0.019244	0.19821	2.9681	10.104	10.202	8.0796	2.0248	2.1227	1.0484
5	0.25035	0.0504	0.22783	2.9681	10.218	10.228	8.075	2.1429	2.1526	1.0045
6	0.50072	0.054066	0.23697	2.9681	10.226	10.23	8.0732	2.1532	2.1567	1.0016
7	1.0014	0.055898	0.24361	2.9681	10.228	10.231	8.072	2.1555	2.1591	1.0016
8	2.003	0.057731	0.24887	2.9681	10.231	10.231	8.0714	2.1593	2.1596	1.0002
9	4.0017	0.058647	0.25247	2.9681	10.231	10.231	8.0714	2.1593	2.1596	1.0002
10	6.0004	0.058647	0.25358	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
11	8.0033	0.059564	0.25358	2.9681	10.231	10.231	8.0714	2.1593	2.1596	1.0002
12	10.002	0.059564	0.2533	2.9681	10.231	10.232	8.0709	2.1604	2.1608	1.0002
13	12.001	0.06048	0.25164	2.9681	10.231	10.231	8.0726	2.1581	2.1585	1.0002
14	14.004	0.06048	0.25053	2.9681	10.231	10.231	8.0714	2.1593	2.1596	1.0002
15	16.003	0.061396	0.24915	2.9681	10.231	10.232	8.0709	2.1604	2.1608	1.0002
16	18.001	0.061396	0.24749	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
17	20.004	0.061396	0.24583	2.9681	10.231	10.231	8.0709	2.1599	2.1602	1.0002
18	22.003	0.061396	0.24416	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
19	24.002	0.062313	0.24223	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
20	26	0.063229	0.24057	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
21	28.003	0.063229	0.23918	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
22	30.002	0.063229	0.23752	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
23	30.069	0.063229	0.23752	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.5418	7.5437	7.4715	0.070318	0.072223	1.0271
2	0.01255	0	0	2.9681	7.5489	7.5478	7.4744	0.074488	0.073396	0.98534
3	0.05005	0.0011106	0.0085817	2.9681	7.5643	7.5642	7.4855	0.078733	0.07867	0.99921
4	0.10012	0.0011106	0.042078	2.9681	7.5654	7.5689	7.4762	0.089228	0.092714	1.0391
5	0.25033	0.0011106	0.063394	2.9681	7.5659	7.5695	7.4732	0.092702	0.096225	1.038
6	0.5012	0.0011106	0.068377	2.9681	7.5708	7.5712	7.4721	0.098772	0.099151	1.0038
7	1.0029	0.0022211	0.072253	2.9681	7.5708	7.5712	7.4709	0.099942	0.10032	1.0038
8	2.0007	0.0022211	0.073637	2.9681	7.5681	7.5718	7.4721	0.096067	0.099736	1.0382
9	3.0026	0.0022211	0.074467	2.9681	7.5676	7.5712	7.4715	0.096103	0.099736	1.0378
10	4.0004	0.0022211	0.075021	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
11	5.0023	0.0022211	0.075021	2.9681	7.5714	7.5718	7.4721	0.099321	0.099736	1.0042
12	6.0001	0.0022211	0.075298	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
13	7.002	0.0022211	0.075575	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
14	8.004	0.0022211	0.074744	2.9681	7.5746	7.5718	7.4715	0.10316	0.10032	0.97248
15	9.0018	0.0022211	0.074467	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
16	10.004	0.0022211	0.073914	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
17	11.001	0.0022211	0.07336	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
18	12.003	0.0022211	0.073083	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
19	13.001	0.0022211	0.073083	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
20	14.003	0.0022211	0.07253	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
21	15.001	0.0022211	0.072253	2.9681	7.5708	7.5712	7.4709	0.099942	0.10032	1.0038
22	16.003	0.0022211	0.071976	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
23	17.001	0.0022211	0.072253	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
24	18.003	0.0022211	0.072253	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
25	19	0.0022211	0.071699	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
26	20.002	0.0011106	0.070869	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
27	20.875	0.0011106	0.070592	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.5714	7.5718	7.4715	0.099906	0.10032	1.0042
2	0.012483	0	0.00083049	2.9681	7.6004	7.5958	7.4896	0.11077	0.10619	0.9586
3	0.05065	0.0011106	0.046784	2.9681	7.6848	7.6824	7.5423	0.14257	0.14017	0.98317
4	0.10078	0.0011106	0.21537	2.9681	7.695	7.7176	7.4732	0.22174	0.24432	1.1019
5	0.25102	0.0077739	0.24915	2.9681	7.7161	7.7193	7.475	0.24115	0.24432	1.0132
6	0.50197	0.0088844	0.25911	2.9681	7.7205	7.7205	7.4727	0.24785	0.24784	0.99996
7	1.0037	0.0088844	0.26493	2.9681	7.7178	7.7211	7.4721	0.24572	0.24901	1.0134
8	2.0015	0.0088844	0.26963	2.9681	7.7216	7.7217	7.4721	0.24953	0.24959	1.0003
9	3.0034	0.009995	0.27185	2.9681	7.7216	7.7217	7.4721	0.24953	0.24959	1.0003
10	4.0012	0.009995	0.27351	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
11	5.0031	0.011106	0.27434	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
12	6.0009	0.011106	0.27517	2.9681	7.721	7.7211	7.4715	0.24956	0.24959	1.0001
13	7.0028	0.011106	0.27572	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
14	8.0006	0.009995	0.27628	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
15	9.0027	0.011106	0.27683	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
16	10	0.011106	0.27711	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
17	11.003	0.011106	0.27683	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
18	12.001	0.011106	0.27738	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
19	13.003	0.011106	0.27738	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
20	14.001	0.011106	0.27738	2.9681	7.721	7.7211	7.4715	0.24956	0.24959	1.0001
21	15.003	0.011106	0.27766	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
22	16.001	0.011106	0.27766	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
23	17.004	0.011106	0.27711	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
24	18.001	0.011106	0.27683	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
25	19.004	0.011106	0.27655	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
26	20.002	0.011106	0.27655	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
27	21.004	0.011106	0.27738	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
28	21.213	0.011106	0.27766	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.7216	7.7217	7.4715	0.25011	0.25018	1.0003
2	0.012483	0	0.0011073	2.9681	7.7665	7.7626	7.4996	0.26694	0.26307	0.9855
3	0.050633	0	0.068377	2.9681	7.9048	7.9137	7.5686	0.3362	0.34506	1.0264
4	0.10082	0.0055528	0.2234	2.9681	7.9257	7.9429	7.4873	0.43844	0.45565	1.0393
5	0.251	0.021101	0.27572	2.9681	7.9651	7.971	7.4744	0.49066	0.49662	1.0122
6	0.50203	0.024432	0.28458	2.9681	7.9645	7.9704	7.4721	0.49245	0.49838	1.012
7	1.004	0.026653	0.29123	2.9681	7.9683	7.971	7.4715	0.49684	0.49955	1.0055
8	2.0018	0.028874	0.29676	2.9681	7.9689	7.9716	7.4721	0.4968	0.49955	1.0055
9	3.0037	0.029985	0.29953	2.9681	7.9683	7.971	7.4715	0.49684	0.49955	1.0055
10	4.002	0.028874	0.30119	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
11	5.0039	0.029985	0.30202	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
12	6.0022	0.029985	0.30341	2.9681	7.9683	7.971	7.4715	0.49684	0.49955	1.0055
13	7.0041	0.029985	0.30451	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
14	8.0024	0.029985	0.30451	2.9681	7.9683	7.971	7.4709	0.49742	0.50013	1.0054
15	9.0002	0.029985	0.30562	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
16	10.003	0.031096	0.30617	2.9681	7.9689	7.9716	7.4721	0.4968	0.49955	1.0055
17	11	0.029985	0.30701	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
18	12.003	0.029985	0.30784	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
19	13.001	0.031096	0.30756	2.9681	7.9683	7.971	7.4715	0.49684	0.49955	1.0055
20	14.003	0.031096	0.30839	2.9681	7.9683	7.971	7.4715	0.49684	0.49955	1.0055
21	15.001	0.031096	0.30894	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
22	16.003	0.031096	0.30894	2.9681	7.9683	7.971	7.4715	0.49684	0.49955	1.0055
23	17.001	0.029985	0.30922	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
24	18.003	0.029985	0.3095	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
25	19.001	0.029985	0.31005	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
26	20.004	0.031096	0.30977	2.9681	7.9689	7.9716	7.4721	0.4968	0.49955	1.0055
27	21.001	0.031096	0.3106	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
28	21.148	0.031096	0.3106	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.9689	7.9716	7.4715	0.49739	0.50013	1.0055
2	0.012483	0	0.00083049	2.9681	8.005	8.0067	7.4943	0.51074	0.51244	1.0033
3	0.050683	0.0044422	0.063671	2.9681	8.1401	8.1613	7.5347	0.60544	0.62661	1.035
4	0.10065	0.014437	0.12956	2.9681	8.1565	8.1718	7.4873	0.66922	0.68453	1.0229
5	0.25088	0.024432	0.16471	2.9681	8.1881	8.1882	7.4732	0.71489	0.71496	1.0001
6	0.50175	0.025543	0.17274	2.9681	8.1876	8.1911	7.4727	0.71496	0.71848	1.0049
7	1.0035	0.026653	0.17883	2.9681	8.1909	8.1911	7.4721	0.7188	0.71906	1.0004
8	2.0007	0.027764	0.18409	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
9	3.0022	0.027764	0.18686	2.9681	8.1914	8.1917	7.4721	0.71935	0.71965	1.0004
10	4.0041	0.027764	0.18908	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
11	5.0019	0.028874	0.19046	2.9681	8.1882	8.1917	7.4715	0.71668	0.72023	1.005
12	6.0038	0.029985	0.19157	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
13	7.0016	0.029985	0.19267	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
14	8.0035	0.031096	0.1935	2.9681	8.1914	8.1917	7.4721	0.71935	0.71965	1.0004
15	9.0013	0.031096	0.19434	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
16	10.003	0.031096	0.19489	2.9681	8.1909	8.1911	7.4709	0.71997	0.72023	1.0004
17	11.001	0.029985	0.19544	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
18	12.003	0.031096	0.19627	2.9681	8.1882	8.1917	7.4715	0.71668	0.72023	1.005
19	13.001	0.031096	0.19627	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
20	14.003	0.031096	0.1971	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
21	15	0.031096	0.19766	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
22	16.002	0.031096	0.19821	2.9681	8.1947	8.1917	7.4721	0.7226	0.71965	0.99591
23	17	0.031096	0.19849	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
24	18.002	0.031096	0.19904	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
25	19.004	0.032206	0.19849	2.9681	8.1914	8.1917	7.4709	0.72052	0.72082	1.0004
26	20.002	0.032206	0.19932	2.9681	8.1909	8.1911	7.4721	0.7188	0.71906	1.0004
27	21.004	0.032206	0.19987	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
28	22.001	0.032206	0.19987	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
29	23.003	0.032206	0.19959	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
30	24.001	0.032206	0.19959	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
31	25.003	0.032206	0.20043	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
32	26.001	0.032206	0.20098	2.9681	8.1914	8.1917	7.4721	0.71935	0.71965	1.0004
33	27.003	0.032206	0.20126	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
34	28.001	0.032206	0.20153	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004
35	29.003	0.032206	0.20126	2.9681	8.1914	8.1917	7.4709	0.72052	0.72082	1.0004
36	30.001	0.032206	0.20209	2.9681	8.1909	8.1911	7.4715	0.71939	0.71965	1.0004
37	30.072	0.033317	0.20236	2.9681	8.1914	8.1917	7.4715	0.71993	0.72023	1.0004

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1432	8.1437	8.0717	0.071448	0.071985	1.0075
2	0.01255	0	0	2.9681	8.147	8.1478	8.0747	0.072363	0.073157	1.011
3	0.050033	0	0.0085817	2.9681	8.1656	8.1642	8.0864	0.079278	0.077847	0.98195
4	0.1001	0	0.041248	2.9681	8.1673	8.1695	8.0758	0.091492	0.093646	1.0235
5	0.25033	0	0.062564	2.9681	8.1646	8.1701	8.0735	0.091127	0.096572	1.0598
6	0.50118	0	0.068377	2.9681	8.1657	8.1712	8.0706	0.095149	0.10067	1.058
7	1.0029	0	0.072253	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
8	2.0007	0.0011106	0.073637	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
9	3.0028	0.0011106	0.073914	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
10	4.0008	0.0011106	0.074191	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
11	5.0028	0.0011106	0.074191	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
12	6.0008	0.0011106	0.073914	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
13	7.0029	0.0011106	0.073637	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
14	8.0009	0.0011106	0.07336	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
15	9.0032	0.0011106	0.073083	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
16	10.001	0.0022211	0.072806	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
17	11.003	0.0022211	0.072253	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
18	12.001	0.0022211	0.072253	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
19	13.003	0.0022211	0.071699	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
20	14.001	0.0022211	0.071422	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
21	15.003	0.0011106	0.071145	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
22	16	0.0011106	0.070869	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
23	17.002	0.0011106	0.070592	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
24	18	0.0011106	0.070592	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
25	19.002	0.0022211	0.070592	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
26	20.004	0.0022211	0.070315	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
27	20.902	0.0022211	0.069761	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1733	8.1724	8.0717	0.10158	0.10067	0.99098
2	0.012433	0	0	2.9681	8.1821	8.1818	8.0776	0.10451	0.10418	0.99686
3	0.0505	0	0.047338	2.9681	8.2879	8.2842	8.1413	0.14651	0.14286	0.97504
4	0.10057	0.0011106	0.19932	2.9681	8.2979	8.3123	8.0776	0.22034	0.23472	1.0653
5	0.25078	0.0077739	0.25081	2.9681	8.3143	8.3193	8.0752	0.23903	0.24409	1.0212
6	0.50165	0.013327	0.26327	2.9681	8.3148	8.3199	8.0723	0.2425	0.2476	1.021
7	1.0034	0.017769	0.26963	2.9681	8.3192	8.3211	8.0723	0.24685	0.24877	1.0077
8	2.0011	0.01999	0.27379	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
9	3.0031	0.01999	0.276	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
10	4.0008	0.01999	0.27711	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
11	5.0028	0.021101	0.27794	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
12	6.0006	0.021101	0.27877	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
13	7.0025	0.01999	0.27905	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
14	8.0003	0.01999	0.2796	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
15	9.0022	0.01999	0.28015	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
16	10.004	0.01999	0.28015	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
17	11.002	0.01999	0.28071	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
18	12.004	0.01999	0.28071	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
19	13.002	0.01999	0.28043	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
20	14.004	0.01999	0.28015	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
21	15.002	0.01999	0.28015	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
22	16.004	0.01999	0.28098	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
23	17.002	0.021101	0.28098	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
24	18.004	0.021101	0.28098	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
25	19.002	0.021101	0.28098	2.9681	8.3224	8.3211	8.0717	0.25069	0.24935	0.99465
26	20.004	0.021101	0.28098	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
27	21.001	0.022211	0.28098	2.9681	8.3197	8.3217	8.0711	0.24857	0.25052	1.0078
28	21.064	0.022211	0.28071	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3203	8.3223	8.0717	0.24854	0.25052	1.008
2	0.012483	0	0.0011073	2.9681	8.3625	8.3638	8.1004	0.26208	0.26342	1.0051
3	0.050633	0.0033317	0.069761	2.9681	8.5024	8.5131	8.1671	0.33528	0.34599	1.032
4	0.10077	0.0088844	0.23198	2.9681	8.5151	8.5406	8.0893	0.42586	0.45132	1.0598
5	0.251	0.015548	0.29261	2.9681	8.5626	8.5704	8.0735	0.48916	0.49697	1.016
6	0.50203	0.016658	0.3023	2.9681	8.5664	8.571	8.0729	0.49354	0.49814	1.0093
7	1.004	0.017769	0.30922	2.9681	8.5708	8.5722	8.0717	0.49906	0.50048	1.0028
8	2.002	0.017769	0.31448	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
9	3.0041	0.017769	0.31725	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
10	4.0021	0.018879	0.31891	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
11	5.0041	0.01999	0.32029	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
12	6.002	0.01999	0.3214	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
13	7	0.01999	0.32223	2.9681	8.5697	8.571	8.0711	0.49855	0.49989	1.0027
14	8.0021	0.01999	0.32168	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
15	9	0.01999	0.32334	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
16	10.002	0.01999	0.32389	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
17	11	0.01999	0.32445	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
18	12.002	0.01999	0.32472	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
19	13	0.01999	0.325	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
20	14.002	0.01999	0.32555	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
21	15	0.01999	0.32528	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
22	16.002	0.01999	0.32583	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
23	17.004	0.01999	0.32638	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
24	18.002	0.01999	0.32638	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
25	19.004	0.01999	0.32638	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
26	20.002	0.021101	0.32666	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
27	20.933	0.01999	0.32666	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5735	8.5716	8.0717	0.50177	0.49989	0.99626
2	0.0125	0	0.0024915	2.9681	8.6574	8.6577	8.1261	0.53126	0.53153	1.0005
3	0.050667	0.0011106	0.12208	2.9681	8.9188	8.9644	8.2309	0.68798	0.73355	1.0662
4	0.1008	0.018879	0.31974	2.9681	9.0123	9.0294	8.1086	0.90369	0.9208	1.0189
5	0.25102	0.043312	0.38701	2.9681	9.0669	9.0668	8.0735	0.99343	0.99336	0.99994
6	0.50205	0.048864	0.39891	2.9681	9.0669	9.0704	8.0735	0.99346	0.99688	1.0034
7	1.0034	0.052196	0.40666	2.9681	9.0669	9.0704	8.0723	0.99463	0.99805	1.0034
8	2.0013	0.052196	0.41303	2.9681	9.0707	9.0709	8.0723	0.99844	0.99863	1.0002
9	3.0032	0.053307	0.41663	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
10	4.001	0.053307	0.41857	2.9681	9.0707	9.0709	8.0723	0.99844	0.99863	1.0002
11	5.003	0.054417	0.42078	2.9681	9.0707	9.0709	8.0711	0.99961	0.9998	1.0002
12	6.0007	0.053307	0.42189	2.9681	9.0707	9.0709	8.0723	0.99844	0.99863	1.0002
13	7.0022	0.053307	0.42327	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
14	8.0036	0.053307	0.42383	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
15	9.0014	0.054417	0.42466	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
16	10.003	0.053307	0.42577	2.9681	9.0713	9.0715	8.0711	1.0002	1.0004	1.0002
17	11.001	0.053307	0.42632	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
18	12.003	0.053307	0.42632	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
19	13.001	0.053307	0.42715	2.9681	9.0707	9.0709	8.0717	0.99902	0.99922	1.0002
20	14.003	0.053307	0.42743	2.9681	9.068	9.0715	8.0717	0.99632	0.9998	1.0035
21	15.001	0.053307	0.42632	2.9681	9.068	9.0715	8.0717	0.99632	0.9998	1.0035
22	16.003	0.053307	0.42743	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
23	17	0.053307	0.42826	2.9681	9.0707	9.0709	8.0717	0.99902	0.99922	1.0002
24	18.002	0.054417	0.42826	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
25	19	0.054417	0.42826	2.9681	9.0707	9.0709	8.0717	0.99902	0.99922	1.0002
26	20.002	0.054417	0.42881	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
27	20.925	0.054417	0.42853	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
2	0.0125	0	0.0019378	2.9681	9.1459	9.1476	8.1203	1.0256	1.0273	1.0017
3	0.05065	0.0011106	0.089139	2.9681	9.393	9.4391	8.1653	1.2277	1.2738	1.0375
4	0.10072	0.013327	0.18215	2.9681	9.4836	9.4836	8.0928	1.3908	1.3908	1.0001
5	0.25095	0.024432	0.21814	2.9681	9.5028	9.5076	8.0741	1.4287	1.4336	1.0034
6	0.50182	0.026653	0.22783	2.9681	9.5055	9.5106	8.0729	1.4326	1.4377	1.0035
7	1.0035	0.027764	0.23503	2.9681	9.5088	9.5106	8.0723	1.4365	1.4382	1.0012
8	2.0013	0.027764	0.24167	2.9681	9.5093	9.5111	8.0717	1.4376	1.4394	1.0013
9	3.0032	0.028874	0.24499	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
10	4.001	0.028874	0.24749	2.9681	9.5061	9.5111	8.0717	1.4344	1.4394	1.0035
11	5.0029	0.028874	0.24915	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
12	6.0007	0.029985	0.25053	2.9681	9.5093	9.5111	8.0717	1.4376	1.4394	1.0013
13	7.0027	0.029985	0.25192	2.9681	9.5099	9.5117	8.0711	1.4387	1.4406	1.0013
14	8.0004	0.029985	0.25219	2.9681	9.5093	9.5111	8.0723	1.437	1.4388	1.0013
15	9.0024	0.029985	0.2533	2.9681	9.5099	9.5117	8.0723	1.4376	1.4394	1.0013
16	10	0.029985	0.25441	2.9681	9.5099	9.5117	8.0723	1.4376	1.4394	1.0013
17	11.002	0.029985	0.25441	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
18	12.004	0.031096	0.25579	2.9681	9.5093	9.5111	8.0717	1.4376	1.4394	1.0013
19	13.002	0.031096	0.25662	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
20	14.004	0.031096	0.25551	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
21	15.001	0.031096	0.25745	2.9681	9.5093	9.5111	8.0717	1.4376	1.4394	1.0013
22	16.003	0.032206	0.2569	2.9681	9.5099	9.5117	8.0723	1.4376	1.4394	1.0013
23	17.001	0.032206	0.25801	2.9681	9.5061	9.5111	8.0717	1.4344	1.4394	1.0035
24	18.003	0.032206	0.25856	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
25	19.001	0.033317	0.25884	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
26	20.003	0.032206	0.25801	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
27	21.001	0.033317	0.25967	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
28	22.003	0.033317	0.25994	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
29	23	0.033317	0.26022	2.9681	9.5093	9.5111	8.0711	1.4382	1.44	1.0013
30	24.002	0.033317	0.25939	2.9681	9.5099	9.5117	8.0723	1.4376	1.4394	1.0013
31	25	0.033317	0.25967	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
32	26.002	0.033317	0.26022	2.9681	9.5093	9.5111	8.0717	1.4376	1.4394	1.0013
33	27	0.033317	0.26133	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013
34	27.247	0.033317	0.2605	2.9681	9.5099	9.5117	8.0717	1.4382	1.44	1.0013

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1411	8.1437	8.0714	0.069686	0.072227	1.0365
2	0.012567	0	0	2.9681	8.1449	8.1478	8.0744	0.070576	0.073404	1.0401
3	0.05005	0	0.0069208	2.9681	8.1634	8.1642	8.082	0.081453	0.082215	1.0093
4	0.10013	0	0.021316	2.9681	8.1657	8.1701	8.0726	0.09308	0.097463	1.0471
5	0.25035	0.0018327	0.027683	2.9681	8.1694	8.1707	8.0714	0.098011	0.099222	1.0124
6	0.50123	0.0018327	0.030728	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
7	1.0029	0.0027491	0.032112	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
8	2.0007	0.0027491	0.032943	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
9	4.0001	0.0027491	0.03405	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
10	6.0035	0.0036655	0.034604	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
11	8.0027	0.0027491	0.034881	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
12	10.002	0.0027491	0.034881	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
13	12.001	0.0027491	0.034881	2.9681	8.1705	8.1718	8.072	0.098516	0.09981	1.0131
14	14.002	0.0036655	0.034604	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
15	16.001	0.0027491	0.035988	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
16	18.003	0.0036655	0.035434	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
17	20.002	0.0027491	0.035711	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
18	22.001	0.0027491	0.035711	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
19	24	0.0027491	0.036265	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
20	26.004	0.0027491	0.036265	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
21	28.003	0.0027491	0.036542	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
22	30.002	0.0018327	0.036818	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
23	30.053	0.0018327	0.036818	2.9681	8.1711	8.1724	8.0714	0.099649	0.10098	1.0134

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1743	8.1724	8.0714	0.10286	0.10098	0.98174
2	0.012433	0	0	2.9681	8.1793	8.1812	8.075	0.10432	0.10627	1.0187
3	0.050467	0	0.038203	2.9681	8.2808	8.2904	8.1265	0.15427	0.16383	1.062
4	0.10055	0.0018327	0.11488	2.9681	8.2767	8.2998	8.0855	0.19119	0.21426	1.1206
5	0.25077	0.0054982	0.15669	2.9681	8.3076	8.3191	8.0732	0.23437	0.24594	1.0494
6	0.50163	0.012829	0.16471	2.9681	8.3151	8.3203	8.0726	0.24247	0.2477	1.0215
7	1.0034	0.014662	0.17025	2.9681	8.3188	8.3209	8.072	0.24682	0.24887	1.0083
8	2.0011	0.016495	0.17468	2.9681	8.3194	8.3215	8.072	0.24736	0.24946	1.0085
9	4.0003	0.017411	0.17883	2.9681	8.3194	8.3215	8.072	0.24736	0.24946	1.0085
10	6.0037	0.017411	0.18132	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
11	8.0029	0.018327	0.18326	2.9681	8.3162	8.3215	8.0714	0.24474	0.25004	1.0217
12	10.002	0.018327	0.18465	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
13	12.001	0.018327	0.18575	2.9681	8.3188	8.3209	8.0714	0.2474	0.24946	1.0083
14	14.004	0.019244	0.18686	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
15	16.002	0.019244	0.18714	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
16	18.003	0.019244	0.18824	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
17	20.001	0.02016	0.18935	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
18	22	0.019244	0.18991	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
19	24.003	0.02016	0.19046	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
20	26.003	0.021076	0.19129	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
21	28.002	0.021076	0.19157	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
22	30.002	0.02016	0.19267	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
23	30.073	0.02016	0.19267	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3226	8.3215	8.0714	0.25116	0.25004	0.99554
2	0.012483	0	0.0011073	2.9681	8.3618	8.3602	8.0943	0.26754	0.26591	0.9939
3	0.050033	0.0027491	0.069208	2.9681	8.5041	8.5304	8.1476	0.35645	0.38275	1.0738
4	0.1001	0.010996	0.16471	2.9681	8.5113	8.5451	8.0925	0.41878	0.45253	1.0806
5	0.25033	0.023826	0.2162	2.9681	8.5594	8.5691	8.075	0.48445	0.49417	1.0201
6	0.5007	0.027491	0.22645	2.9681	8.5664	8.5697	8.0726	0.49376	0.49711	1.0068
7	1.0013	0.029324	0.23309	2.9681	8.5707	8.5709	8.0714	0.49924	0.49945	1.0004
8	2.0038	0.029324	0.23863	2.9681	8.5712	8.5715	8.072	0.4992	0.49945	1.0005
9	4.0032	0.03024	0.24361	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
10	6.0024	0.031156	0.24749	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
11	8.0016	0.031156	0.2497	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
12	10.001	0.031156	0.25109	2.9681	8.5712	8.5715	8.072	0.4992	0.49945	1.0005
13	12.004	0.031156	0.25302	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
14	14.003	0.031156	0.25441	2.9681	8.5712	8.5715	8.0709	0.50037	0.50062	1.0005
15	16.003	0.032073	0.25579	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
16	18.002	0.032073	0.2569	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
17	20.001	0.032073	0.25773	2.9681	8.5712	8.5715	8.072	0.4992	0.49945	1.0005
18	22	0.032073	0.25884	2.9681	8.5744	8.5715	8.0714	0.503	0.50004	0.99411
19	24.004	0.032073	0.25884	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
20	26.003	0.032989	0.25856	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
21	28.002	0.032989	0.26105	2.9681	8.568	8.5715	8.0714	0.49657	0.50004	1.007
22	30.002	0.033906	0.26216	2.9681	8.5712	8.5715	8.0709	0.50037	0.50062	1.0005
23	30.077	0.033906	0.26188	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
2	0.012483	0	0.0022146	2.9681	8.6573	8.6536	8.1201	0.53719	0.53354	0.99319
3	0.0507	0.0045818	0.1279	2.9681	8.9468	9.0028	8.1975	0.74929	0.80533	1.0748
4	0.10072	0.0073309	0.25247	2.9681	8.9558	9.0298	8.0996	0.85625	0.93023	1.0864
5	0.25093	0.017411	0.30784	2.9681	9.0577	9.0668	8.0761	0.98155	0.99065	1.0093
6	0.5018	0.021993	0.31919	2.9681	9.0642	9.0703	8.0726	0.99156	0.99769	1.0062
7	1.0035	0.023826	0.32666	2.9681	9.0642	9.0703	8.0714	0.99273	0.99886	1.0062
8	2.0013	0.025658	0.3333	2.9681	9.069	9.0721	8.0709	0.99817	1.0012	1.003
9	4.0005	0.026575	0.33939	2.9681	9.0674	9.0703	8.0714	0.99594	0.99886	1.0029
10	6.0039	0.025658	0.34327	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
11	8.0031	0.026575	0.34659	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
12	10.002	0.026575	0.34881	2.9681	9.0679	9.0709	8.0709	0.99707	1	1.003
13	12.002	0.027491	0.35074	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
14	14.001	0.027491	0.35296	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
15	16.004	0.028407	0.35407	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
16	18.003	0.028407	0.35628	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
17	20.003	0.028407	0.35739	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
18	22.002	0.029324	0.35794	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
19	24.001	0.028407	0.36043	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
20	26	0.028407	0.36182	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
21	28	0.028407	0.36265	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
22	30.004	0.029324	0.3632	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
23	32.003	0.029324	0.36514	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
24	34.002	0.029324	0.36569	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
25	34.591	0.029324	0.3668	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
2	0.012483	0	0.0019378	2.9681	9.1458	9.1442	8.1095	1.0363	1.0347	0.99849
3	0.0507	0.0027491	0.08997	2.9681	9.4039	9.4735	8.1424	1.2615	1.3311	1.0552
4	0.10077	0.01008	0.1506	2.9681	9.4288	9.4899	8.0814	1.3474	1.4085	1.0453
5	0.25143	0.027491	0.17828	2.9681	9.5041	9.5087	8.0744	1.4297	1.4343	1.0032
6	0.5023	0.029324	0.18686	2.9681	9.5041	9.5087	8.0732	1.4309	1.4355	1.0032
7	1.004	0.03024	0.1935	2.9681	9.5089	9.5104	8.072	1.4369	1.4384	1.001
8	2.0018	0.032073	0.20015	2.9681	9.5063	9.511	8.0714	1.4348	1.4396	1.0033
9	4.001	0.032989	0.20624	2.9681	9.5095	9.511	8.0714	1.4381	1.4396	1.0011
10	6.0007	0.034822	0.21011	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
11	8.0001	0.035738	0.21233	2.9681	9.5095	9.511	8.072	1.4375	1.439	1.0011
12	10.004	0.035738	0.21427	2.9681	9.5095	9.511	8.0714	1.4381	1.4396	1.0011
13	12.003	0.037571	0.21842	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
14	14.004	0.037571	0.22036	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
15	16.003	0.037571	0.22229	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
16	18.001	0.039404	0.22423	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
17	20	0.039404	0.22479	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
18	22.003	0.04032	0.22755	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
19	24.002	0.04032	0.22866	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
20	26.002	0.039404	0.23088	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
21	28.001	0.04032	0.23088	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
22	30	0.039404	0.23337	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
23	32.003	0.039404	0.23475	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
24	34.002	0.039404	0.23558	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
25	36.001	0.04032	0.23586	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
26	38	0.04032	0.23835	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
27	40.004	0.041236	0.23946	2.9681	9.5132	9.5116	8.0709	1.4424	1.4408	0.99886
28	42.003	0.041236	0.24057	2.9681	9.5095	9.511	8.0714	1.4381	1.4396	1.0011
29	44.003	0.042153	0.2414	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
30	46.002	0.043069	0.24195	2.9681	9.5063	9.511	8.0714	1.4348	1.4396	1.0033
31	48.001	0.043069	0.24361	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
32	50	0.043069	0.24472	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
33	52.004	0.043986	0.24555	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
34	54.003	0.042153	0.24666	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
35	56.002	0.043069	0.24832	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
36	58.002	0.043986	0.24749	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
37	60.001	0.043986	0.24859	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
38	62	0.043986	0.25136	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
39	64	0.044902	0.25136	2.9681	9.5068	9.5116	8.0714	1.4354	1.4402	1.0033
40	66.002	0.044902	0.2533	2.9681	9.5095	9.511	8.0709	1.4386	1.4402	1.0011
41	68.003	0.044902	0.25468	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
42	70.002	0.045818	0.25551	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
43	72.001	0.045818	0.25551	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
44	74.004	0.045818	0.25579	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
45	76.003	0.046735	0.25856	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
46	78.001	0.045818	0.25967	2.9681	9.5068	9.5116	8.0709	1.436	1.4408	1.0033
47	80.004	0.045818	0.2605	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
48	82.003	0.043986	0.25994	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
49	84.002	0.044902	0.26105	2.9681	9.5095	9.511	8.0714	1.4381	1.4396	1.0011
50	86	0.045818	0.26299	2.9681	9.5095	9.511	8.0714	1.4381	1.4396	1.0011
51	88.003	0.046735	0.2641	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
52	90.002	0.047651	0.26437	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
53	92.001	0.046735	0.26382	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
54	94.003	0.046735	0.26659	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
55	96.002	0.047651	0.26742	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
56	98.001	0.047651	0.26825	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
57	100	0.047651	0.26742	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
58	102	0.047651	0.2688	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
59	104	0.047651	0.27074	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
60	106	0.047651	0.27185	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
61	108	0.047651	0.27268	2.9681	9.5132	9.5116	8.0714	1.4418	1.4402	0.99886
62	110	0.048567	0.27323	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
63	112	0.047651	0.27406	2.9681	9.5106	9.5122	8.072	1.4386	1.4402	1.0011
64	114	0.047651	0.27545	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
65	116	0.047651	0.27628	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
66	118	0.047651	0.27711	2.9681	9.5132	9.5116	8.0714	1.4418	1.4402	0.99886
67	120	0.047651	0.27794	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
68	122	0.048567	0.27877	2.9681	9.5068	9.5116	8.072	1.4348	1.4396	1.0033
69	124	0.047651	0.2796	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
70	126	0.047651	0.28071	2.9681	9.5132	9.5116	8.0714	1.4418	1.4402	0.99886
71	128	0.047651	0.28126	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
72	130	0.047651	0.28209	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
73	132	0.047651	0.28292	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
74	134	0.047651	0.28375	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
75	136	0.047651	0.28403	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
76	138	0.047651	0.2843	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
77	140	0.047651	0.28486	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
78	142	0.047651	0.2868	2.9681	9.5095	9.511	8.0714	1.4381	1.4396	1.0011
79	144	0.048567	0.28763	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
80	146	0.048567	0.28707	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
81	148	0.048567	0.28901	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
82	150	0.048567	0.28901	2.9681	9.5095	9.511	8.0709	1.4386	1.4402	1.0011
83	152	0.047651	0.29095	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
84	154	0.048567	0.29178	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
85	156	0.048567	0.29095	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
86	158	0.048567	0.29316	2.9681	9.5095	9.511	8.0714	1.4381	1.4396	1.0011
87	160	0.048567	0.29372	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
88	162	0.048567	0.29344	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
89	164	0.048567	0.29482	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
90	166	0.048567	0.29621	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
91	168	0.048567	0.29593	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
92	170	0.048567	0.29787	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011

93	172	0.048567	0.2987	2.9681	9.5106	9.5122	8.0714	1.4391	1.4408	1.0011
94	174	0.048567	0.29842	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
95	176	0.048567	0.29981	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
96	178	0.048567	0.29981	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
97	180	0.048567	0.30036	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
98	182	0.048567	0.30175	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
99	184	0.048567	0.30147	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
100	186	0.048567	0.30175	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
101	188	0.048567	0.30285	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
102	190	0.048567	0.30396	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
103	192	0.048567	0.30534	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
104	194	0.049484	0.30617	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
105	196	0.049484	0.30562	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
106	198	0.049484	0.30617	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
107	200	0.049484	0.30728	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
108	202	0.0504	0.30867	2.9681	9.5068	9.5116	8.072	1.4348	1.4396	1.0033
109	204	0.0504	0.30839	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
110	206	0.049484	0.30977	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
111	208	0.049484	0.3095	2.9681	9.5106	9.5122	8.0714	1.4391	1.4408	1.0011
112	210	0.048567	0.31116	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
113	212	0.048567	0.31143	2.9681	9.5138	9.5122	8.072	1.4418	1.4402	0.99889
114	214	0.048567	0.31116	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
115	216	0.048567	0.31199	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
116	218	0.048567	0.3131	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
117	220	0.048567	0.3131	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
118	222	0.048567	0.31393	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
119	224	0.048567	0.31586	2.9681	9.5095	9.511	8.0709	1.4386	1.4402	1.0011
120	226	0.049484	0.31476	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
121	228	0.048567	0.31697	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
122	230	0.048567	0.31669	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
123	232	0.049484	0.3178	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
124	234	0.049484	0.31836	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
125	236	0.049484	0.31808	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
126	238	0.049484	0.31919	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
127	240	0.049484	0.31974	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
128	240.36	0.0504	0.32085	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011

TRIAXIAL TEST

Consolidation/B Step: 6

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
2	0.012433	0	0.0022146	2.9681	9.6158	9.6149	8.1219	1.4939	1.493	0.99942
3	0.05015	0.0036655	0.11655	2.9681	10.053	10.165	8.16	1.8934	2.0048	1.0588
4	0.10067	0.014662	0.18409	2.9681	10.118	10.203	8.0814	2.0364	2.1215	1.0418
5	0.25088	0.029324	0.21261	2.9681	10.218	10.228	8.075	2.1429	2.1526	1.0045
6	0.50275	0.033906	0.22174	2.9681	10.228	10.231	8.0732	2.1543	2.1579	1.0017
7	1.0008	0.038487	0.22894	2.9681	10.227	10.23	8.072	2.155	2.1585	1.0016
8	2.0027	0.041236	0.23503	2.9681	10.228	10.231	8.0709	2.1567	2.1602	1.0016
9	4.003	0.042153	0.24167	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
10	6.0022	0.042153	0.24583	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
11	8.0029	0.042153	0.24942	2.9681	10.231	10.231	8.0703	2.1605	2.1608	1.0002
12	10.002	0.042153	0.25192	2.9681	10.231	10.231	8.0714	2.1593	2.1596	1.0002
13	12.001	0.042153	0.25275	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
14	14.001	0.043069	0.25635	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
15	16.001	0.043069	0.25773	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
16	18	0.043986	0.25911	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
17	20.004	0.043986	0.25967	2.9681	10.234	10.232	8.0714	2.1631	2.1602	0.99869
18	22.002	0.043986	0.26105	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
19	24.001	0.043986	0.26244	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
20	26.004	0.043986	0.2652	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
21	28.003	0.043986	0.26659	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
22	30.002	0.043986	0.26742	2.9681	10.228	10.232	8.0703	2.1578	2.1614	1.0017
23	32	0.044902	0.2688	2.9681	10.231	10.231	8.0709	2.1599	2.1602	1.0002
24	34.004	0.044902	0.26963	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
25	36.002	0.044902	0.26991	2.9681	10.231	10.231	8.0714	2.1593	2.1596	1.0002
26	38.002	0.043986	0.27185	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
27	40.001	0.044902	0.27212	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
28	42.003	0.044902	0.27434	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
29	44.002	0.044902	0.27406	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
30	46.001	0.044902	0.27655	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
31	48.004	0.043986	0.27794	2.9681	10.231	10.232	8.0703	2.161	2.1614	1.0002
32	50.002	0.043986	0.27766	2.9681	10.231	10.232	8.0709	2.1604	2.1608	1.0002
33	52.001	0.044902	0.2796	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
34	54.004	0.044902	0.28015	2.9681	10.231	10.232	8.0726	2.1587	2.1591	1.0002
35	56.003	0.044902	0.28098	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
36	58.001	0.043986	0.28071	2.9681	10.228	10.232	8.0714	2.1566	2.1602	1.0017
37	60	0.044902	0.28154	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
38	62.003	0.044902	0.28264	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
39	64.002	0.044902	0.28347	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
40	66	0.044902	0.28514	2.9681	10.231	10.232	8.0709	2.1604	2.1608	1.0002
41	68.003	0.044902	0.28624	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
42	70.002	0.044902	0.28707	2.9681	10.231	10.232	8.072	2.1593	2.1596	1.0002
43	72.002	0.044902	0.2879	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
44	74.001	0.044902	0.28735	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002
45	76.004	0.044902	0.28929	2.9681	10.231	10.231	8.072	2.1587	2.1591	1.0002
46	78.003	0.045818	0.28901	2.9681	10.228	10.232	8.0714	2.1566	2.1602	1.0017
47	79.694	0.045818	0.29012	2.9681	10.231	10.232	8.0714	2.1598	2.1602	1.0002

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1432	8.1437	8.0717	0.071448	0.071985	1.0075
2	0.012483	0	0	2.9681	8.147	8.1478	8.0747	0.072363	0.073157	1.011
3	0.050033	0	0.010243	2.9681	8.1635	8.1654	8.084	0.079461	0.081358	1.0239
4	0.10012	0	0.034604	2.9681	8.1581	8.1665	8.0741	0.083996	0.092474	1.1009
5	0.25038	0	0.04457	2.9681	8.1646	8.1701	8.0735	0.091127	0.096572	1.0598
6	0.50072	0.0022211	0.048999	2.9681	8.1657	8.1712	8.0723	0.093394	0.098912	1.0591
7	1.0017	0.0033317	0.052044	2.9681	8.1663	8.1718	8.0717	0.094528	0.10008	1.0588
8	2.0035	0.0033317	0.053151	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
9	3.0008	0.0033317	0.053705	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
10	4.0022	0.0033317	0.053982	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
11	5.0037	0.0033317	0.054259	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
12	6.0009	0.0044422	0.054536	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
13	7.0024	0.0044422	0.054812	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
14	8.0038	0.0055528	0.054259	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
15	9.0011	0.0055528	0.053982	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
16	10.004	0.0055528	0.053705	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
17	11.001	0.0055528	0.053428	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
18	12.003	0.0055528	0.053428	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
19	13.001	0.0055528	0.053428	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
20	14.003	0.0055528	0.052875	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
21	15	0.0055528	0.052598	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
22	16.002	0.0055528	0.052321	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
23	17	0.0055528	0.052598	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
24	18.002	0.0055528	0.052875	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
25	19.004	0.0055528	0.052044	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
26	20.001	0.0055528	0.051767	2.9681	8.1728	8.1718	8.0717	0.10104	0.10008	0.99057
27	20.916	0.0055528	0.05149	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1728	8.1718	8.0717	0.10104	0.10008	0.99057
2	0.012483	0	0.00083049	2.9681	8.1947	8.1952	8.0893	0.10543	0.10595	1.0049
3	0.050467	0	0.043462	2.9681	8.2786	8.2848	8.1367	0.14198	0.14812	1.0433
4	0.10062	-0.0011106	0.17828	2.9681	8.2724	8.3059	8.0758	0.19654	0.23004	1.1704
5	0.25087	0.009995	0.20984	2.9681	8.3148	8.3199	8.0747	0.24016	0.24526	1.0212
6	0.5017	0.013327	0.21731	2.9681	8.3154	8.3205	8.0729	0.24247	0.2476	1.0212
7	1.0032	0.021101	0.22368	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
8	2.0008	0.027764	0.22866	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
9	3.0026	0.027764	0.23115	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
10	4.0002	0.028874	0.23281	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
11	5.0019	0.028874	0.23337	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
12	6.0037	0.028874	0.2342	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
13	7.0013	0.027764	0.2342	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
14	8.0031	0.027764	0.23475	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
15	9.0007	0.027764	0.23558	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
16	10.002	0.028874	0.23503	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
17	11	0.028874	0.23614	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
18	12.003	0.027764	0.23558	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
19	13	0.028874	0.23614	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
20	14.002	0.028874	0.23614	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
21	15.004	0.028874	0.23641	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
22	16.002	0.028874	0.23669	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
23	17.004	0.028874	0.23614	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
24	18.002	0.029985	0.23586	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
25	19.004	0.028874	0.23697	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
26	20.002	0.028874	0.23669	2.9681	8.3192	8.3211	8.0711	0.24802	0.24994	1.0077
27	20.912	0.029985	0.23724	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
2	0.012483	0	0.0011073	2.9681	8.3603	8.3615	8.0986	0.26164	0.26283	1.0046
3	0.050533	0.0022211	0.075298	2.9681	8.5069	8.5283	8.1542	0.35265	0.37409	1.0608
4	0.10055	0.014437	0.17994	2.9681	8.5097	8.5418	8.0934	0.41635	0.44839	1.077
5	0.25077	0.051086	0.23946	2.9681	8.5653	8.5699	8.0729	0.49245	0.49697	1.0092
6	0.50147	0.053307	0.2497	2.9681	8.5653	8.5699	8.0735	0.49186	0.49638	1.0092
7	1.0029	0.054417	0.25635	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
8	2.0005	0.055528	0.26133	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
9	3.0022	0.055528	0.26437	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
10	4.004	0.056638	0.26576	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
11	5.0021	0.056638	0.26686	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
12	6.0039	0.057749	0.26825	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
13	7.0015	0.056638	0.2688	2.9681	8.5697	8.571	8.0723	0.49738	0.49872	1.0027
14	8.0033	0.056638	0.26936	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
15	9.0009	0.056638	0.26963	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
16	10.002	0.057749	0.27074	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
17	11.004	0.056638	0.27019	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
18	12.002	0.057749	0.27129	2.9681	8.5697	8.571	8.0711	0.49855	0.49989	1.0027
19	13.003	0.057749	0.27102	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
20	14.001	0.057749	0.27268	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
21	15.003	0.057749	0.27268	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
22	16	0.057749	0.2724	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
23	17.002	0.056638	0.2724	2.9681	8.5697	8.571	8.0711	0.49855	0.49989	1.0027
24	18.004	0.056638	0.27268	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
25	19.002	0.057749	0.27379	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
26	20.004	0.057749	0.27406	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
27	20.922	0.057749	0.27406	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
2	0.012483	0	0.0011073	2.9681	8.6064	8.6067	8.094	0.51246	0.51278	1.0006
3	0.050483	0	0.046784	2.9681	8.7251	8.7507	8.1261	0.59897	0.62461	1.0428
4	0.10055	0.0055528	0.10741	2.9681	8.7514	8.7718	8.0869	0.66442	0.68488	1.0308
5	0.25078	0.018879	0.14257	2.9681	8.7852	8.7905	8.0747	0.71053	0.7159	1.0075
6	0.50113	0.021101	0.15087	2.9681	8.7852	8.7905	8.0729	0.71229	0.71765	1.0075
7	1.0025	0.022211	0.15752	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003
8	2.0001	0.023322	0.16305	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
9	3.0019	0.022211	0.1661	2.9681	8.789	8.7911	8.0723	0.71668	0.71882	1.003
10	4.0037	0.022211	0.16804	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
11	5.0013	0.023322	0.1697	2.9681	8.7895	8.7917	8.0711	0.7184	0.72058	1.003
12	6.0031	0.022211	0.17053	2.9681	8.789	8.7911	8.0711	0.71785	0.71999	1.003
13	7.0007	0.022211	0.17163	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
14	8.0024	0.022211	0.17191	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
15	9	0.023322	0.17302	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
16	10.002	0.022211	0.17247	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
17	11.004	0.022211	0.17302	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
18	12.001	0.023322	0.1733	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
19	13.003	0.023322	0.17413	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
20	14.001	0.023322	0.1744	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
21	15.003	0.023322	0.17606	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
22	16.001	0.023322	0.17523	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
23	17.003	0.023322	0.17551	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
24	18	0.023322	0.17662	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
25	19.002	0.023322	0.17579	2.9681	8.7895	8.7917	8.0723	0.71723	0.71941	1.003
26	20.004	0.023322	0.17745	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
27	21.002	0.024432	0.17662	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003
28	22.004	0.024432	0.17773	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
29	23.002	0.023322	0.17689	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
30	24.004	0.024432	0.17745	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
31	25.002	0.024432	0.17883	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
32	26.003	0.024432	0.178	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
33	27.001	0.024432	0.178	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
34	28.003	0.024432	0.17828	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
35	29.001	0.024432	0.17939	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
36	30.003	0.024432	0.17828	2.9681	8.7895	8.7917	8.0717	0.71781	0.71999	1.003
37	30.07	0.024432	0.17828	2.9681	8.789	8.7911	8.0717	0.71726	0.71941	1.003

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1411	8.1437	8.0714	0.069686	0.072227	1.0365
2	0.012467	0	0	2.9681	8.1433	8.146	8.0726	0.070697	0.073402	1.0383
3	0.050017	0	0.0074744	2.9681	8.164	8.1648	8.082	0.081999	0.082802	1.0098
4	0.1001	0	0.021316	2.9681	8.1646	8.1689	8.0726	0.091988	0.096289	1.0468
5	0.25033	-0.00091637	0.025745	2.9681	8.1694	8.1707	8.0732	0.096252	0.097464	1.0126
6	0.50068	0	0.027683	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
7	1.0014	0	0.028514	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
8	2.0028	0	0.029621	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
9	4.0015	0	0.029621	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
10	6.0003	0	0.029621	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
11	8.0021	0	0.029898	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
12	10.002	0.00091637	0.029898	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
13	12.001	0.00091637	0.029621	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
14	14.004	0	0.029898	2.9681	8.1711	8.1724	8.0714	0.099649	0.10098	1.0134
15	16.003	0	0.029898	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
16	18	0	0.029067	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
17	20.004	0	0.029344	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
18	22.003	0.00091637	0.029067	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
19	24.003	0	0.02879	2.9681	8.1705	8.1718	8.072	0.098516	0.09981	1.0131
20	26.002	-0.00091637	0.02879	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
21	28.001	-0.00091637	0.028514	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
22	30.004	0	0.028237	2.9681	8.1673	8.1718	8.0714	0.09589	0.1004	1.047
23	30.054	0	0.028237	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
2	0.012517	0	0.00055366	2.9681	8.1956	8.1953	8.0873	0.10832	0.10804	0.9974
3	0.050233	0	0.046231	2.9681	8.2868	8.2968	8.123	0.16379	0.1738	1.0611
4	0.10033	0.00091637	0.11516	2.9681	8.2902	8.3039	8.0843	0.20582	0.21954	1.0666
5	0.25132	0.0091637	0.15198	2.9681	8.3076	8.3191	8.075	0.23261	0.24418	1.0497
6	0.50167	0.010996	0.15973	2.9681	8.3151	8.3203	8.0726	0.24247	0.2477	1.0215
7	1.0029	0.011913	0.16471	2.9681	8.3188	8.3209	8.072	0.24682	0.24887	1.0083
8	2.0017	0.011913	0.16831	2.9681	8.3188	8.3209	8.0709	0.24799	0.25004	1.0083
9	4.0007	0.011913	0.17108	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
10	6.0039	0.011913	0.17302	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
11	8.003	0.010996	0.17357	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
12	10.002	0.011913	0.17468	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
13	12.002	0.010996	0.17551	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
14	14.001	0.011913	0.17606	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
15	16.004	0.011913	0.17606	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
16	18.003	0.011913	0.17662	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
17	20.002	0.011913	0.17745	2.9681	8.3226	8.3215	8.0714	0.25116	0.25004	0.99554
18	22.001	0.011913	0.17745	2.9681	8.3194	8.3215	8.072	0.24736	0.24946	1.0085
19	24	0.010996	0.17856	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
20	26.004	0.010996	0.17883	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
21	28.003	0.011913	0.17856	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
22	30.002	0.010996	0.14921	2.9681	8.3199	8.3221	8.0714	0.2485	0.25063	1.0086
23	30.073	0.01008	0.14921	2.9681	8.3194	8.3215	8.0709	0.24854	0.25063	1.0084

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3194	8.3215	8.0709	0.24854	0.25063	1.0084
2	0.012483	0.00091637	0.0011073	2.9681	8.3618	8.3602	8.0966	0.2652	0.26357	0.99385
3	0.050533	0	0.068377	2.9681	8.5171	8.5374	8.1406	0.37646	0.39682	1.0541
4	0.10055	0.00091637	0.14451	2.9681	8.5145	8.5451	8.0896	0.42492	0.45546	1.0719
5	0.25077	0.0073309	0.19101	2.9681	8.5546	8.5674	8.0755	0.47901	0.49183	1.0268
6	0.50147	0.011913	0.20098	2.9681	8.568	8.5715	8.0726	0.4954	0.49887	1.007
7	1.0029	0.012829	0.20679	2.9681	8.5686	8.5721	8.0714	0.49712	0.50063	1.0071
8	2.0005	0.013745	0.21011	2.9681	8.568	8.5715	8.0714	0.49657	0.50004	1.007
9	4.0037	0.013745	0.21261	2.9681	8.5707	8.5709	8.0714	0.49924	0.49945	1.0004
10	6.0027	0.013745	0.21399	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
11	8.0021	0.013745	0.21454	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
12	10.001	0.013745	0.21593	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
13	12	0.013745	0.21648	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
14	14.003	0.013745	0.21731	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
15	16.003	0.013745	0.21731	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
16	18.002	0.013745	0.21759	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
17	20.001	0.014662	0.21897	2.9681	8.5712	8.5715	8.0709	0.50037	0.50062	1.0005
18	22	0.013745	0.21787	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
19	24.004	0.013745	0.21814	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
20	26.003	0.013745	0.21842	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
21	28.003	0.013745	0.21925	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
22	30.002	0.014662	0.21953	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
23	30.073	0.014662	0.21925	2.9681	8.5712	8.5715	8.0709	0.50037	0.50062	1.0005

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5712	8.5715	8.0709	0.50037	0.50062	1.0005
2	0.0125	0	0.0022146	2.9681	8.661	8.6542	8.1201	0.54095	0.53413	0.98738
3	0.0506	0	0.1279	2.9681	8.9489	9.0016	8.1987	0.75024	0.80298	1.0703
4	0.10067	0.0036655	0.25551	2.9681	8.9634	9.0345	8.092	0.87145	0.94254	1.0816
5	0.25078	0.02016	0.30562	2.9681	9.0523	9.0679	8.0755	0.97681	0.99241	1.016
6	0.50148	0.022909	0.31614	2.9681	9.0636	9.0697	8.0738	0.98984	0.99593	1.0061
7	1.0029	0.024742	0.32306	2.9681	9.0674	9.0703	8.072	0.99536	0.99827	1.0029
8	2.0005	0.024742	0.32887	2.9681	9.0679	9.0709	8.072	0.9959	0.99886	1.003
9	4.0039	0.024742	0.33441	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
10	6.0031	0.024742	0.33718	2.9681	9.0717	9.0715	8.072	0.99966	0.99945	0.99978
11	8.0027	0.024742	0.33939	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
12	10.002	0.025658	0.34189	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
13	12.001	0.024742	0.34244	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
14	14.001	0.024742	0.3441	2.9681	9.0653	9.0715	8.0714	0.99382	1	1.0062
15	16.001	0.024742	0.34521	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
16	18	0.024742	0.34659	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
17	20.004	0.024742	0.34715	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
18	22.003	0.024742	0.34742	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
19	24.002	0.024742	0.34798	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
20	26.001	0.024742	0.34964	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
21	28.001	0.025658	0.34991	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
22	30.004	0.024742	0.35047	2.9681	9.0679	9.0709	8.0709	0.99707	1	1.003
23	30.075	0.024742	0.35019	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.0717	9.0715	8.072	0.99966	0.99945	0.99978
2	0.012483	0	0.0022146	2.9681	9.1458	9.1442	8.1136	1.0322	1.0306	0.99848
3	0.0505	0.00091637	0.075575	2.9681	9.3803	9.4447	8.1476	1.2327	1.2971	1.0522
4	0.10055	0.0045818	0.147	2.9681	9.4261	9.487	8.082	1.3441	1.405	1.0453
5	0.25077	0.015578	0.17523	2.9681	9.503	9.5075	8.0732	1.4298	1.4343	1.0031
6	0.50147	0.017411	0.18409	2.9681	9.5052	9.5098	8.0732	1.432	1.4366	1.0033
7	1.0029	0.02016	0.19101	2.9681	9.5089	9.5104	8.0709	1.4381	1.4396	1.001
8	2.0005	0.02016	0.19683	2.9681	9.5095	9.511	8.072	1.4375	1.439	1.0011
9	4.0038	0.021993	0.20236	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
10	6.0029	0.022909	0.20569	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
11	8.0019	0.022909	0.20818	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011
12	10.001	0.022909	0.21067	2.9681	9.5095	9.511	8.072	1.4375	1.439	1.0011
13	12.001	0.023826	0.21233	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
14	14	0.024742	0.21399	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
15	16.003	0.024742	0.21482	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
16	18.002	0.023826	0.2162	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
17	20.001	0.023826	0.21787	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
18	22	0.023826	0.21897	2.9681	9.5095	9.511	8.0709	1.4386	1.4402	1.0011
19	24.003	0.023826	0.21953	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
20	26.002	0.024742	0.22063	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
21	28.001	0.024742	0.22036	2.9681	9.5068	9.5116	8.0714	1.4354	1.4402	1.0033
22	30.003	0.025658	0.22202	2.9681	9.5068	9.5116	8.072	1.4348	1.4396	1.0033
23	32.002	0.024742	0.22285	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
24	32.26	0.024742	0.22257	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1432	8.1437	8.0717	0.071448	0.071985	1.0075
2	0.0125	0	0	2.9681	8.1497	8.1472	8.0747	0.075069	0.072572	0.96674
3	0.050483	0	0.0083049	2.9681	8.1629	8.1648	8.0852	0.077743	0.079603	1.0239
4	0.10057	0	0.036542	2.9681	8.1575	8.166	8.0711	0.086372	0.094814	1.0977
5	0.25087	0	0.047615	2.9681	8.169	8.1712	8.0735	0.095478	0.097742	1.0237
6	0.5017	0	0.051767	2.9681	8.169	8.1712	8.0723	0.096648	0.098912	1.0234
7	1.0034	0	0.054536	2.9681	8.1695	8.1718	8.0723	0.097197	0.099498	1.0237
8	2.0011	0.0011106	0.055643	2.9681	8.1728	8.1718	8.0717	0.10104	0.10008	0.99057
9	3.0029	0	0.056197	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
10	4.0005	0	0.056197	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
11	5.0023	0	0.056197	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
12	6.0041	−0.0011106	0.056197	2.9681	8.1663	8.1718	8.0717	0.094528	0.10008	1.0588
13	7.0017	−0.0011106	0.056197	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
14	8.0034	−0.0011106	0.056197	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
15	9.001	−0.0011106	0.055643	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
16	10.003	−0.0011106	0.055366	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
17	11	0	0.055366	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
18	12.002	0	0.055089	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
19	13.004	0.0011106	0.054812	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
20	14.002	0	0.054812	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
21	15.003	0.0011106	0.054536	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
22	16.001	0.0011106	0.054536	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
23	17.003	0.0011106	0.055089	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
24	18	0.0011106	0.054536	2.9681	8.1695	8.1718	8.0717	0.097782	0.10008	1.0235
25	19.002	0.0011106	0.053982	2.9681	8.1728	8.1718	8.0717	0.10104	0.10008	0.99057
26	20.004	0.0011106	0.053705	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
27	20.906	0.0011106	0.053428	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.169	8.1712	8.0717	0.097233	0.099497	1.0233
2	0.012483	0	0.00055366	2.9681	8.1996	8.197	8.0904	0.10916	0.10653	0.97594
3	0.050467	0	0.044293	2.9681	8.296	8.286	8.1355	0.16052	0.15046	0.93736
4	0.10055	−0.0011106	0.178	2.9681	8.3022	8.31	8.0665	0.23577	0.2435	1.0328
5	0.25077	−0.0011106	0.21122	2.9681	8.3148	8.3199	8.0747	0.24016	0.24526	1.0212
6	0.50147	−0.0011106	0.21925	2.9681	8.3148	8.3199	8.0729	0.24192	0.24701	1.0211
7	1.0028	−0.0011106	0.22451	2.9681	8.3192	8.3211	8.0723	0.24685	0.24877	1.0077
8	2.0004	−0.0011106	0.22866	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
9	3.0022	−0.0011106	0.2306	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
10	4.004	0	0.23198	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
11	5.0016	0	0.23281	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
12	6.0034	0	0.23364	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
13	7.001	0	0.23448	2.9681	8.3192	8.3211	8.0711	0.24802	0.24994	1.0077
14	8.0027	0	0.23475	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
15	9.0003	−0.0011106	0.23531	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
16	10.002	0	0.23558	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
17	11.004	−0.0011106	0.23586	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
18	12.001	−0.0011106	0.23586	2.9681	8.323	8.3217	8.0717	0.25124	0.24994	0.99481
19	13.003	−0.0011106	0.23641	2.9681	8.3197	8.3217	8.0723	0.2474	0.24935	1.0079
20	14.001	−0.0011106	0.23669	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
21	15.003	−0.0011106	0.23697	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
22	16	−0.0011106	0.23641	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
23	17.002	−0.0011106	0.23586	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
24	18.004	−0.0011106	0.23586	2.9681	8.3192	8.3211	8.0717	0.24744	0.24935	1.0077
25	19.001	−0.0011106	0.23586	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
26	20.003	−0.0022211	0.23724	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
27	20.934	−0.0011106	0.23669	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3197	8.3217	8.0717	0.24799	0.24994	1.0079
2	0.012483	0	0.0011073	2.9681	8.3733	8.365	8.1027	0.2706	0.26225	0.96916
3	0.050533	-0.0011106	0.07862	2.9681	8.5231	8.5283	8.1566	0.36658	0.37175	1.0141
4	0.10055	-0.0011106	0.19184	2.9681	8.5254	8.5412	8.0928	0.43266	0.44839	1.0364
5	0.25077	0.0022211	0.24721	2.9681	8.5653	8.5699	8.0741	0.49128	0.4958	1.0092
6	0.50147	0.0022211	0.2569	2.9681	8.5686	8.5699	8.0735	0.49512	0.49638	1.0026
7	1.003	0.0022211	0.26354	2.9681	8.5664	8.571	8.0729	0.49354	0.49814	1.0093
8	2.0006	0.0022211	0.26908	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
9	3.0024	0.0022211	0.27212	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
10	4.0042	0.0022211	0.27379	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
11	5.0018	0.0022211	0.27545	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
12	6.0035	0.0022211	0.27655	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
13	7.0011	0.0022211	0.27766	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
14	8.0029	0.0033317	0.27849	2.9681	8.5702	8.5716	8.0711	0.4991	0.50048	1.0028
15	9.0005	0.0022211	0.27849	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
16	10.002	0.0022211	0.27988	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
17	11.004	0.0022211	0.28015	2.9681	8.5702	8.5716	8.0723	0.49793	0.49931	1.0028
18	12.002	0.0022211	0.28098	2.9681	8.5697	8.571	8.0711	0.49855	0.49989	1.0027
19	13.003	0.0033317	0.28098	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
20	14.001	0.0022211	0.28043	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
21	15.003	0.0033317	0.28154	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
22	16	0.0022211	0.28098	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
23	17.002	0.0022211	0.28209	2.9681	8.5708	8.5722	8.0717	0.49906	0.50048	1.0028
24	18.004	0.0033317	0.28209	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
25	19.002	0.0033317	0.28264	2.9681	8.5697	8.571	8.0717	0.49797	0.49931	1.0027
26	20.003	0.0033317	0.28292	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
27	21.001	0.0033317	0.2832	2.9681	8.5735	8.5716	8.0717	0.50177	0.49989	0.99626
28	21.135	0.0033317	0.2832	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5702	8.5716	8.0717	0.49852	0.49989	1.0028
2	0.0125	0	0.0024915	2.9681	8.6628	8.66	8.125	0.53788	0.53505	0.99473
3	0.050483	0.0022211	0.11433	2.9681	8.9569	8.9738	8.2168	0.74009	0.75696	1.0228
4	0.10057	0.014437	0.27268	2.9681	9.0117	9.0288	8.1004	0.91133	0.9284	1.0187
5	0.25083	0.03998	0.33164	2.9681	9.0642	9.0674	8.0752	0.98897	0.99219	1.0033
6	0.50148	0.041091	0.34355	2.9681	9.0702	9.0704	8.0735	0.99672	0.99688	1.0002
7	1.0029	0.043312	0.35157	2.9681	9.0713	9.0715	8.0729	0.9984	0.99863	1.0002
8	2.0005	0.045533	0.35822	2.9681	9.0707	9.0709	8.0717	0.99902	0.99922	1.0002
9	3.0022	0.047754	0.36182	2.9681	9.0707	9.0709	8.0723	0.99844	0.99863	1.0002
10	4.004	0.047754	0.36403	2.9681	9.0707	9.0709	8.0717	0.99902	0.99922	1.0002
11	5.0016	0.047754	0.36542	2.9681	9.0707	9.0709	8.0717	0.99902	0.99922	1.0002
12	6.0034	0.048864	0.36763	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
13	7.001	0.048864	0.36735	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
14	8.0028	0.049975	0.36985	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
15	9.0004	0.051086	0.37012	2.9681	9.0713	9.0715	8.0723	0.99899	0.99922	1.0002
16	10.002	0.052196	0.37012	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
17	11.004	0.051086	0.37123	2.9681	9.0713	9.0715	8.0711	1.0002	1.0004	1.0002
18	12.002	0.052196	0.37178	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
19	13.003	0.052196	0.37289	2.9681	9.0713	9.0715	8.0723	0.99899	0.99922	1.0002
20	14.001	0.052196	0.37372	2.9681	9.0707	9.0709	8.0717	0.99902	0.99922	1.0002
21	15.003	0.054417	0.37427	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
22	16	0.054417	0.37289	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
23	17.002	0.055528	0.37483	2.9681	9.0713	9.0715	8.0723	0.99899	0.99922	1.0002
24	18.004	0.056638	0.37427	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
25	19.001	0.056638	0.37566	2.9681	9.0713	9.0715	8.0723	0.99899	0.99922	1.0002
26	20.003	0.056638	0.37455	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
27	21	0.056638	0.37621	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
28	21.326	0.056638	0.37649	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.0713	9.0715	8.0717	0.99957	0.9998	1.0002
2	0.012483	0	0.0024915	2.9681	9.2034	9.2021	8.1367	1.0667	1.0654	0.99875
3	0.050033	0.0088844	0.21704	2.9681	9.9286	10.025	8.2747	1.6539	1.7498	1.058
4	0.10005	0.032206	0.41968	2.9681	10.155	10.165	8.0992	2.0555	2.0658	1.005
5	0.25027	0.043312	0.47421	2.9681	10.217	10.224	8.0752	2.1414	2.1489	1.0035
6	0.50063	0.047754	0.48778	2.9681	10.224	10.229	8.0735	2.1508	2.1553	1.0021
7	1.0014	0.048864	0.49746	2.9681	10.229	10.23	8.0723	2.1563	2.1577	1.0006
8	2.0029	0.049975	0.50577	2.9681	10.23	10.231	8.0723	2.1574	2.1588	1.0007
9	3.0001	0.049975	0.51048	2.9681	10.23	10.231	8.0711	2.1585	2.16	1.0007
10	4.0016	0.051086	0.51352	2.9681	10.23	10.232	8.0711	2.1591	2.1606	1.0007
11	5.003	0.052196	0.51574	2.9681	10.23	10.232	8.0729	2.1573	2.1588	1.0007
12	6.0004	0.052196	0.5174	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
13	7.0019	0.052196	0.51906	2.9681	10.23	10.231	8.0729	2.1568	2.1583	1.0007
14	8.0033	0.053307	0.51906	2.9681	10.23	10.232	8.0717	2.1585	2.16	1.0007
15	9.0006	0.053307	0.52016	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
16	10.002	0.053307	0.52293	2.9681	10.23	10.231	8.0706	2.1591	2.1606	1.0007
17	11.003	0.054417	0.52238	2.9681	10.23	10.232	8.0717	2.1585	2.16	1.0007
18	12.001	0.054417	0.52321	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
19	13.002	0.054417	0.52542	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
20	14.004	0.054417	0.52459	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
21	15.001	0.054417	0.52542	2.9681	10.23	10.232	8.0717	2.1585	2.16	1.0007
22	16.002	0.055528	0.52653	2.9681	10.23	10.232	8.0717	2.1585	2.16	1.0007
23	17.004	0.054417	0.52792	2.9681	10.23	10.232	8.0717	2.1585	2.16	1.0007
24	18.001	0.054417	0.52847	2.9681	10.23	10.231	8.0717	2.158	2.1594	1.0007
25	19.003	0.055528	0.52875	2.9681	10.23	10.232	8.0717	2.1585	2.16	1.0007
26	20	0.055528	0.52958	2.9681	10.23	10.232	8.0711	2.1591	2.1606	1.0007
27	21.002	0.055528	0.52875	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
28	22.003	0.055528	0.53013	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
29	23	0.055528	0.53068	2.9681	10.23	10.231	8.0717	2.158	2.1594	1.0007
30	24.002	0.055528	0.53068	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
31	25.003	0.056638	0.53151	2.9681	10.23	10.232	8.0723	2.1579	2.1594	1.0007
32	25.692	0.056638	0.53068	2.9681	10.23	10.232	8.0711	2.1591	2.1606	1.0007

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.9425	7.9435	7.8716	0.070889	0.071869	1.0138
2	0.012517	0	0	2.9681	7.9464	7.9476	7.8752	0.071219	0.072457	1.0174
3	0.05	0	0.0085817	2.9681	7.965	7.964	7.8851	0.079888	0.078902	0.98765
4	0.10008	0	0.032112	2.9681	7.9639	7.9663	7.8734	0.09053	0.092944	1.0267
5	0.2503	0	0.039864	2.9681	7.971	7.9704	7.8722	0.098794	0.098211	0.9941
6	0.50122	0	0.042632	2.9681	7.9683	7.971	7.8716	0.096674	0.099382	1.028
7	1.0029	0	0.044016	2.9681	7.9683	7.971	7.8716	0.096674	0.099382	1.028
8	2.0012	0	0.044847	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
9	3.0032	0	0.045123	2.9681	7.9683	7.971	7.8716	0.096674	0.099382	1.028
10	4.0014	0	0.045123	2.9681	7.9656	7.9716	7.8722	0.093383	0.099382	1.0642
11	5.0034	0	0.044847	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
12	6.0016	0	0.044847	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
13	7.0036	0.0011106	0.044847	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
14	8.0018	0.0011106	0.044293	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
15	9.0037	0	0.044293	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
16	10.002	0.0011106	0.044016	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
17	11.004	0.0011106	0.043739	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
18	12.002	0.0011106	0.043739	2.9681	7.9683	7.971	7.8716	0.096674	0.099382	1.028
19	13	0.0011106	0.043462	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
20	14.002	0.0011106	0.043462	2.9681	7.9721	7.9716	7.8716	0.10048	0.099967	0.99493
21	15	0.0011106	0.043462	2.9681	7.9721	7.9716	7.8716	0.10048	0.099967	0.99493
22	16.003	0.0011106	0.043186	2.9681	7.9721	7.9716	7.8716	0.10048	0.099967	0.99493
23	17	0.0022211	0.042909	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
24	18.003	0.0011106	0.042632	2.9681	7.9683	7.971	7.8716	0.096674	0.099382	1.028
25	19.001	0.0011106	0.042355	2.9681	7.9656	7.9716	7.8716	0.093968	0.099967	1.0638
26	20.003	0.0011106	0.042078	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
27	20.864	0.0011106	0.042078	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.9689	7.9716	7.8716	0.097222	0.099967	1.0282
2	0.012417	0	0	2.9681	7.9776	7.981	7.8769	0.10073	0.10407	1.0331
3	0.050483	0.0011106	0.043462	2.9681	8.0791	8.0858	7.9331	0.14603	0.15269	1.0456
4	0.10062	0.0011106	0.13869	2.9681	8.0902	8.108	7.8787	0.21152	0.22934	1.0842
5	0.25083	0.0077739	0.16361	2.9681	8.1136	8.1191	7.8728	0.24081	0.24631	1.0228
6	0.5017	0.011106	0.16859	2.9681	8.1147	8.1203	7.8722	0.24249	0.24807	1.023
7	1.0036	0.012216	0.17247	2.9681	8.1185	8.1209	7.8716	0.24688	0.24924	1.0095
8	2.0015	0.012216	0.17523	2.9681	8.1191	8.1215	7.8722	0.24684	0.24924	1.0097
9	3.0003	0.012216	0.17717	2.9681	8.1185	8.1209	7.8711	0.24747	0.24982	1.0095
10	4.0023	0.013327	0.17773	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
11	5.0007	0.013327	0.17745	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
12	6.0026	0.013327	0.17883	2.9681	8.1185	8.1209	7.8716	0.24688	0.24924	1.0095
13	7.0009	0.013327	0.17911	2.9681	8.1185	8.1209	7.8716	0.24688	0.24924	1.0095
14	8.0028	0.013327	0.17966	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
15	9.0012	0.013327	0.17994	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
16	10.003	0.013327	0.17994	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
17	11.001	0.013327	0.17994	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
18	12.003	0.013327	0.18022	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
19	13.002	0.013327	0.17939	2.9681	8.1185	8.1209	7.8716	0.24688	0.24924	1.0095
20	14.004	0.013327	0.17994	2.9681	8.1185	8.1209	7.8716	0.24688	0.24924	1.0095
21	15.002	0.013327	0.18049	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
22	16.004	0.013327	0.17966	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
23	17.002	0.013327	0.17966	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
24	18.004	0.013327	0.18077	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
25	19.002	0.014437	0.18077	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
26	20	0.013327	0.17994	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
27	20.919	0.013327	0.17994	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1191	8.1215	7.8716	0.24743	0.24982	1.0097
2	0.012417	0	0	2.9681	8.1382	8.1384	7.881	0.25723	0.25744	1.0008
3	0.050483	0.0011106	0.063394	2.9681	8.2985	8.3199	7.9518	0.34675	0.36811	1.0616
4	0.10062	0.0088844	0.16278	2.9681	8.3287	8.3521	7.8886	0.44011	0.46349	1.0531
5	0.25083	0.038869	0.19821	2.9681	8.3642	8.3691	7.8734	0.49075	0.49568	1.01
6	0.5017	0.043312	0.20513	2.9681	8.3653	8.3703	7.8722	0.49302	0.49802	1.0101
7	1.0034	0.044422	0.20984	2.9681	8.3691	8.3708	7.8728	0.49624	0.49802	1.0036
8	2.0014	0.045533	0.21399	2.9681	8.3696	8.3714	7.8722	0.49737	0.49919	1.0037
9	3.0032	0.045533	0.21648	2.9681	8.3696	8.3714	7.8711	0.49854	0.50036	1.0037
10	4.0011	0.045533	0.21787	2.9681	8.3691	8.3708	7.8716	0.49741	0.49919	1.0036
11	5.003	0.045533	0.2187	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
12	6.0008	0.045533	0.21897	2.9681	8.3658	8.3708	7.8722	0.49357	0.49861	1.0102
13	7.0027	0.045533	0.2198	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
14	8.0013	0.046643	0.22008	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
15	9.0034	0.046643	0.22119	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
16	10.002	0.046643	0.22119	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
17	11.004	0.046643	0.22063	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
18	12.002	0.046643	0.22174	2.9681	8.3691	8.3708	7.8716	0.49741	0.49919	1.0036
19	13.004	0.046643	0.22285	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
20	14.002	0.046643	0.22257	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
21	15.004	0.046643	0.2234	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
22	16.002	0.046643	0.22368	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
23	17	0.047754	0.22396	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
24	18.003	0.047754	0.2234	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
25	19	0.046643	0.22285	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
26	20.003	0.046643	0.22451	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
27	21.001	0.046643	0.22368	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
28	21.581	0.046643	0.22396	2.9681	8.3696	8.3714	7.8711	0.49854	0.50036	1.0037

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3696	8.3714	7.8716	0.49796	0.49978	1.0037
2	0.012483	0	0.00083049	2.9681	8.4063	8.4071	7.8974	0.50893	0.50974	1.0016
3	0.05055	0.0044422	0.056473	2.9681	8.5366	8.5669	7.9173	0.61929	0.64966	1.049
4	0.10062	0.011106	0.10077	2.9681	8.5627	8.5775	7.8822	0.68054	0.6953	1.0217
5	0.25083	0.022211	0.12264	2.9681	8.5867	8.5892	7.8728	0.71389	0.71637	1.0035
6	0.5017	0.026653	0.12928	2.9681	8.5845	8.5904	7.8728	0.71173	0.71754	1.0082
7	1.0034	0.027764	0.13426	2.9681	8.5851	8.5909	7.8716	0.71345	0.71929	1.0082
8	2.0012	0.029985	0.13897	2.9681	8.5883	8.5909	7.8711	0.71729	0.71988	1.0036
9	3.0031	0.031096	0.14118	2.9681	8.5889	8.5915	7.8722	0.71667	0.71929	1.0037
10	4.0009	0.031096	0.14229	2.9681	8.5921	8.5915	7.8722	0.71992	0.71929	0.99913
11	5.0028	0.031096	0.14395	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
12	6.0006	0.031096	0.14506	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
13	7.0026	0.031096	0.14617	2.9681	8.5883	8.5909	7.8716	0.7167	0.71929	1.0036
14	8.0003	0.031096	0.14672	2.9681	8.5883	8.5909	7.8716	0.7167	0.71929	1.0036
15	9.0023	0.031096	0.14644	2.9681	8.5889	8.5915	7.8711	0.71784	0.72046	1.0037
16	10	0.029985	0.14727	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
17	11.002	0.031096	0.14672	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
18	12.004	0.031096	0.14866	2.9681	8.5883	8.5909	7.8716	0.7167	0.71929	1.0036
19	13.002	0.031096	0.14783	2.9681	8.5889	8.5915	7.8722	0.71667	0.71929	1.0037
20	14.004	0.031096	0.14949	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
21	15.001	0.031096	0.14949	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
22	16.003	0.032206	0.14866	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
23	17.001	0.032206	0.14949	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
24	18.003	0.032206	0.14949	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
25	19.001	0.032206	0.15004	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
26	20.003	0.032206	0.15004	2.9681	8.5883	8.5909	7.8716	0.7167	0.71929	1.0036
27	21	0.032206	0.1506	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
28	22.002	0.032206	0.15004	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
29	23	0.031096	0.1517	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
30	24.002	0.032206	0.15032	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
31	25.004	0.032206	0.15253	2.9681	8.5883	8.5909	7.8716	0.7167	0.71929	1.0036
32	26.002	0.032206	0.1517	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
33	27.004	0.033317	0.15281	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
34	28.002	0.033317	0.15309	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
35	29.004	0.032206	0.15226	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037
36	30.001	0.032206	0.15336	2.9681	8.5889	8.5915	7.8722	0.71667	0.71929	1.0037
37	30.068	0.032206	0.15364	2.9681	8.5889	8.5915	7.8716	0.71725	0.71988	1.0037

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1411	8.1437	8.0714	0.069686	0.072227	1.0365
2	0.012517	0	0	2.9681	8.1455	8.1484	8.075	0.070536	0.073405	1.0407
3	0.050017	0	0.0071976	2.9681	8.1651	8.166	8.0796	0.085436	0.08632	1.0103
4	0.10008	0	0.017163	2.9681	8.1657	8.1701	8.0714	0.094252	0.098636	1.0465
5	0.25082	0	0.019932	2.9681	8.163	8.1707	8.072	0.090999	0.098636	1.0839
6	0.50167	0	0.021316	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
7	1.0034	0.00091637	0.022146	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
8	2.0019	0.00091637	0.022977	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
9	4.0013	0.0018327	0.023807	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
10	6.0006	0.0018327	0.023531	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
11	8.0042	0.0018327	0.023531	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
12	10.003	0.0018327	0.023807	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
13	12.003	0.0018327	0.023531	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
14	14.002	0.0018327	0.023254	2.9681	8.17	8.1712	8.0714	0.098557	0.099809	1.0127
15	16.002	0.0018327	0.023531	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
16	18.001	0.0018327	0.023531	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
17	20.004	0.0018327	0.022977	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
18	22.003	0.0018327	0.022977	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
19	24.003	0.0018327	0.023254	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
20	26.002	0.0018327	0.0227	2.9681	8.1673	8.1718	8.0714	0.09589	0.1004	1.047
21	28.001	0.0018327	0.022977	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
22	30.001	0.0018327	0.022423	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
23	30.047	0.0018327	0.022423	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131

TRIAXIAL TEST

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.1705	8.1718	8.0714	0.099103	0.1004	1.0131
2	0.012483	0	0.00055366	2.9681	8.1967	8.1965	8.089	0.10766	0.10746	0.99814
3	0.050533	-0.00091637	0.044293	2.9681	8.2826	8.2992	8.1172	0.16541	0.18201	1.1004
4	0.1006	0.00091637	0.097721	2.9681	8.2795	8.3062	8.0832	0.19633	0.22306	1.1361
5	0.25083	0.011913	0.12734	2.9681	8.3081	8.3197	8.072	0.23609	0.2477	1.0492
6	0.50172	0.018327	0.13509	2.9681	8.3151	8.3203	8.072	0.24306	0.24828	1.0215
7	1.0034	0.02016	0.13952	2.9681	8.3188	8.3209	8.0714	0.2474	0.24946	1.0083
8	2.0013	0.02016	0.14284	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
9	4.0009	0.021076	0.14561	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
10	6.0003	0.021076	0.147	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
11	8.0036	0.021076	0.1481	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
12	10.003	0.021076	0.14866	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
13	12.003	0.021076	0.14949	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
14	14.002	0.021993	0.14977	2.9681	8.3226	8.3215	8.0714	0.25116	0.25004	0.99554
15	16.001	0.021993	0.15087	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
16	18	0.021076	0.15087	2.9681	8.3226	8.3215	8.0714	0.25116	0.25004	0.99554
17	20.004	0.021993	0.1517	2.9681	8.3226	8.3215	8.0714	0.25116	0.25004	0.99554
18	22.003	0.021993	0.15198	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
19	24.002	0.021993	0.15143	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
20	26.002	0.021993	0.15281	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
21	28.001	0.021993	0.15281	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
22	30	0.021993	0.15253	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
23	30.071	0.021993	0.15226	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084

TRIAXIAL TEST

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.3194	8.3215	8.0714	0.24795	0.25004	1.0084
2	0.012483	0	0.0013842	2.9681	8.3646	8.3631	8.1013	0.26324	0.26181	0.99458
3	0.05055	0.00091637	0.068377	2.9681	8.5053	8.5386	8.1394	0.36587	0.39917	1.091
4	0.10055	0.0054982	0.1398	2.9681	8.5001	8.5468	8.089	0.41108	0.4578	1.1137
5	0.25078	0.026575	0.18077	2.9681	8.553	8.5691	8.0755	0.47744	0.49359	1.0338
6	0.50163	0.031156	0.19101	2.9681	8.5669	8.5703	8.0726	0.49431	0.49769	1.0068
7	1.0034	0.032073	0.19738	2.9681	8.5707	8.5709	8.072	0.49865	0.49887	1.0004
8	2.0011	0.032989	0.20236	2.9681	8.5707	8.5709	8.0714	0.49924	0.49945	1.0004
9	4.0004	0.032989	0.20679	2.9681	8.5707	8.5709	8.0703	0.50041	0.50062	1.0004
10	6.0001	0.032989	0.20928	2.9681	8.568	8.5715	8.072	0.49599	0.49945	1.007
11	8.0035	0.033906	0.21122	2.9681	8.5707	8.5709	8.0714	0.49924	0.49945	1.0004
12	10.003	0.033906	0.21233	2.9681	8.5707	8.5709	8.0714	0.49924	0.49945	1.0004
13	12.002	0.033906	0.21371	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
14	14.001	0.033906	0.21454	2.9681	8.5712	8.5715	8.072	0.4992	0.49945	1.0005
15	16	0.032989	0.2151	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
16	18	0.033906	0.21593	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
17	20.004	0.033906	0.21704	2.9681	8.5712	8.5715	8.0709	0.50037	0.50062	1.0005
18	22.003	0.033906	0.21787	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
19	24.002	0.033906	0.21842	2.9681	8.5707	8.5709	8.0714	0.49924	0.49945	1.0004
20	26.002	0.033906	0.21897	2.9681	8.5712	8.5715	8.072	0.4992	0.49945	1.0005
21	28.001	0.033906	0.21842	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
22	30.004	0.034822	0.21953	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
23	30.075	0.034822	0.21953	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	8.5712	8.5715	8.0714	0.49979	0.50004	1.0005
2	0.012433	0	0	2.9681	8.6094	8.609	8.089	0.52035	0.52001	0.99934
3	0.050483	0.0018327	0.10187	2.9681	8.9213	8.9858	8.1934	0.72793	0.79241	1.0886
4	0.10055	0.0064146	0.22313	2.9681	8.943	9.0333	8.092	0.85108	0.94137	1.1061
5	0.25083	0.023826	0.27157	2.9681	9.0507	9.0662	8.0744	0.97634	0.99182	1.0159
6	0.50172	0.04032	0.28347	2.9681	9.0631	9.0691	8.0738	0.98929	0.99534	1.0061
7	1.0034	0.044902	0.29095	2.9681	9.0642	9.0703	8.0709	0.99332	0.99944	1.0062
8	2.0012	0.046735	0.29704	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
9	4.0004	0.047651	0.30258	2.9681	9.0647	9.0709	8.072	0.99269	0.99886	1.0062
10	6.0037	0.047651	0.30617	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
11	8.0029	0.048567	0.30867	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
12	10.002	0.048567	0.3095	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
13	12.001	0.048567	0.31171	2.9681	9.0679	9.0709	8.0709	0.99707	1	1.003
14	14.001	0.048567	0.31393	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
15	16	0.049484	0.31476	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
16	18.004	0.0504	0.31586	2.9681	9.0685	9.0715	8.0709	0.99762	1.0006	1.003
17	20.003	0.0504	0.31752	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
18	22.002	0.049484	0.31725	2.9681	9.0717	9.0715	8.0726	0.99907	0.99886	0.99978
19	24.002	0.0504	0.31946	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
20	26.001	0.0504	0.32029	2.9681	9.0685	9.0715	8.0714	0.99703	1	1.003
21	28	0.0504	0.31946	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003
22	30.004	0.049484	0.32195	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
23	32.003	0.049484	0.32278	2.9681	9.0679	9.0709	8.0709	0.99707	1	1.003
24	34.002	0.049484	0.32334	2.9681	9.0679	9.0709	8.0714	0.99649	0.99944	1.003
25	34.332	0.0504	0.32361	2.9681	9.0685	9.0715	8.072	0.99645	0.99945	1.003

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	9.0717	9.0715	8.0714	1.0002	1	0.99978
2	0.012417	0	0	2.9681	9.0995	9.1014	8.0861	1.0134	1.0153	1.0018
3	0.050483	0.0027491	0.070038	2.9681	9.3789	9.4535	8.1406	1.2383	1.3129	1.0603
4	0.10055	0.014662	0.13122	2.9681	9.4192	9.4899	8.0802	1.3389	1.4097	1.0528
5	0.25085	0.027491	0.15945	2.9681	9.5019	9.5063	8.0755	1.4264	1.4308	1.0031
6	0.50168	0.033906	0.16859	2.9681	9.5046	9.5093	8.0732	1.4314	1.4361	1.0032
7	1.0029	0.037571	0.17579	2.9681	9.5052	9.5098	8.072	1.4332	1.4378	1.0032
8	2.0006	0.04032	0.18215	2.9681	9.5095	9.511	8.072	1.4375	1.439	1.0011
9	4.0004	0.042153	0.18797	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
10	6.0038	0.043986	0.19101	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
11	8.0031	0.044902	0.1935	2.9681	9.5095	9.511	8.0709	1.4386	1.4402	1.0011
12	10.002	0.044902	0.19627	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
13	12.002	0.045818	0.19932	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
14	14.001	0.045818	0.19959	2.9681	9.5132	9.5116	8.0714	1.4418	1.4402	0.99886
15	16	0.045818	0.20153	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
16	18.003	0.045818	0.20264	2.9681	9.5095	9.511	8.072	1.4375	1.439	1.0011
17	20.003	0.046735	0.20485	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
18	22.002	0.046735	0.20485	2.9681	9.5132	9.5116	8.0714	1.4418	1.4402	0.99886
19	24.001	0.047651	0.20624	2.9681	9.5132	9.5116	8.0714	1.4418	1.4402	0.99886
20	26.001	0.047651	0.20845	2.9681	9.5068	9.5116	8.072	1.4348	1.4396	1.0033
21	28	0.047651	0.20928	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
22	30.003	0.047651	0.21039	2.9681	9.5095	9.511	8.0714	1.4381	1.4396	1.0011
23	32.003	0.047651	0.21094	2.9681	9.51	9.5116	8.072	1.438	1.4396	1.0011
24	34.002	0.047651	0.21205	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
25	36.002	0.047651	0.21288	2.9681	9.51	9.5116	8.0714	1.4386	1.4402	1.0011
26	36.198	0.047651	0.21233	2.9681	9.51	9.5116	8.0709	1.4392	1.4408	1.0011

TRIAXIAL TEST

Consolidation/B Step: 1

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5429	6.5439	6.4722	0.070702	0.071645	1.0133
2	0.012567	0	0.00027683	2.9681	6.5468	6.548	6.4746	0.072202	0.073403	1.0166
3	0.050167	0	0.01052	2.9681	6.5659	6.565	6.4857	0.08025	0.079263	0.9877
4	0.10013	0	0.040694	2.9681	6.5644	6.5702	6.4775	0.08687	0.092722	1.0674
5	0.25035	0	0.066439	2.9681	6.5611	6.5702	6.4722	0.088881	0.097987	1.1025
6	0.50128	0	0.07253	2.9681	6.5649	6.5708	6.4728	0.092099	0.097988	1.0639
7	1.003	0.0011106	0.076959	2.9681	6.5693	6.572	6.4722	0.097035	0.099743	1.0279
8	2.0007	0.0011106	0.078897	2.9681	6.5655	6.5714	6.4717	0.093818	0.099743	1.0632
9	3.0027	0.0011106	0.079174	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
10	4.0005	0.0022211	0.078897	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
11	5.0024	0.0022211	0.078897	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
12	6.0003	0.0022211	0.078897	2.9681	6.5725	6.572	6.4717	0.10087	0.10033	0.99459
13	7.0023	0.0022211	0.079174	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
14	8.0001	0.0022211	0.07862	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
15	9.002	0.0022211	0.078066	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
16	10.004	0.0022211	0.077789	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
17	11.002	0.0022211	0.077513	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
18	12	0.0022211	0.076959	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
19	13.002	0.0033317	0.076682	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
20	14	0.0033317	0.076405	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
21	15.002	0.0033317	0.075852	2.9681	6.5693	6.572	6.4722	0.097035	0.099743	1.0279
22	16.001	0.0033317	0.076128	2.9681	6.5687	6.5714	6.4711	0.097657	0.10033	1.0274
23	17.003	0.0033317	0.075298	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
24	18.001	0.0033317	0.075021	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
25	19.003	0.0033317	0.074744	2.9681	6.5687	6.5714	6.4717	0.097072	0.099743	1.0275
26	20.001	0.0033317	0.074467	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
27	20.911	0.0022211	0.074191	2.9681	6.5693	6.572	6.4711	0.098205	0.10091	1.0276

Consolidation/B Step: 2

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.5693	6.572	6.4717	0.09762	0.10033	1.0277
2	0.012483	0.0011106	0.00083049	2.9681	6.5945	6.5954	6.4892	0.10527	0.10619	1.0088
3	0.050533	0.0022211	0.055366	2.9681	6.6834	6.6902	6.5407	0.14266	0.14954	1.0482
4	0.10062	0.0077739	0.20984	2.9681	6.6967	6.7183	6.4746	0.22209	0.24375	1.0975
5	0.25083	0.023322	0.25773	2.9681	6.7113	6.7201	6.4763	0.23499	0.24375	1.0373
6	0.5017	0.028874	0.27295	2.9681	6.7151	6.7207	6.4728	0.24231	0.24784	1.0229
7	1.0034	0.031096	0.28015	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
8	2.0011	0.031096	0.28486	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
9	3.0031	0.031096	0.2868	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
10	4.0009	0.031096	0.28818	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
11	5.0028	0.031096	0.28901	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
12	6.0006	0.032206	0.28984	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
13	7.0025	0.032206	0.28984	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
14	8.0003	0.032206	0.29067	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
15	9.0024	0.032206	0.29067	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
16	10	0.032206	0.29067	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
17	11.002	0.032206	0.29067	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
18	12.004	0.032206	0.29067	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
19	13.002	0.032206	0.29067	2.9681	6.7189	6.7213	6.4717	0.24728	0.2496	1.0094
20	14.004	0.032206	0.2915	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
21	15.002	0.032206	0.2915	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
22	16.004	0.033317	0.29067	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
23	17.002	0.032206	0.2904	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
24	18.004	0.033317	0.29012	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
25	19.002	0.032206	0.29012	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
26	20	0.033317	0.29012	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
27	20.861	0.033317	0.28984	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095

Consolidation/B Step: 3

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.7195	6.7218	6.4717	0.24783	0.25018	1.0095
2	0.012483	-0.0011106	0.0011073	2.9681	6.7611	6.7628	6.4997	0.2614	0.26308	1.0064
3	0.050033	0.0022211	0.077789	2.9681	6.9077	6.9261	6.5612	0.34653	0.36497	1.0532
4	0.10005	0.0077739	0.21427	2.9681	6.91	6.9355	6.4951	0.41491	0.44044	1.0615
5	0.25027	0.034427	0.29233	2.9681	6.9646	6.9695	6.4722	0.49232	0.49721	1.0099
6	0.50118	0.037759	0.30645	2.9681	6.9646	6.9695	6.4728	0.49174	0.49663	1.0099
7	1.0029	0.037759	0.31586	2.9681	6.9651	6.97	6.4711	0.49404	0.49897	1.01
8	2.0007	0.038869	0.32306	2.9681	6.9662	6.9712	6.4722	0.49397	0.49897	1.0101
9	3.0026	0.03998	0.32666	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
10	4.0005	0.042201	0.32943	2.9681	6.9695	6.9712	6.4717	0.49781	0.49955	1.0035
11	5.0025	0.043312	0.33109	2.9681	6.9695	6.9712	6.4717	0.49781	0.49955	1.0035
12	6.0003	0.043312	0.3322	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
13	7.0022	0.045533	0.33386	2.9681	6.97	6.9718	6.4711	0.49894	0.50072	1.0036
14	8.0041	0.045533	0.33469	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
15	9.0019	0.045533	0.33524	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
16	10.004	0.045533	0.33607	2.9681	6.9695	6.9712	6.4717	0.49781	0.49955	1.0035
17	11.002	0.045533	0.33635	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
18	12.004	0.046643	0.3369	2.9681	6.9695	6.9712	6.4717	0.49781	0.49955	1.0035
19	13.002	0.045533	0.33746	2.9681	6.9695	6.9712	6.4717	0.49781	0.49955	1.0035
20	14	0.046643	0.3369	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
21	15.002	0.046643	0.33829	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
22	16.004	0.046643	0.33856	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
23	17.001	0.047754	0.33884	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
24	18.003	0.047754	0.33856	2.9681	6.97	6.9718	6.4722	0.49777	0.49955	1.0036
25	19.001	0.047754	0.33884	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
26	20.003	0.047754	0.33967	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
27	20.942	0.047754	0.33884	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036

TRIAXIAL TEST

Consolidation/B Step: 4

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	6.97	6.9718	6.4717	0.49835	0.50014	1.0036
2	0.012433	0	0.00027683	2.9681	7.0062	7.0069	6.4886	0.51756	0.51829	1.0014
3	0.050483	0.0077739	0.12734	2.9681	7.3865	7.4266	6.6489	0.7376	0.77771	1.0544
4	0.10062	0.036648	0.35379	2.9681	7.4507	7.4916	6.5132	0.93748	0.97841	1.0437
5	0.25083	0.057749	0.45539	2.9681	7.5342	7.546	6.4775	1.0567	1.0685	1.0112
6	0.5017	0.063302	0.47504	2.9681	7.5435	7.549	6.474	1.0695	1.075	1.0051
7	1.0037	0.068854	0.4875	2.9681	7.5451	7.5507	6.4717	1.0735	1.0791	1.0052
8	2.0016	0.073297	0.49719	2.9681	7.5489	7.5513	6.4722	1.0767	1.0791	1.0022
9	3.0036	0.075518	0.50245	2.9681	7.5495	7.5519	6.4705	1.079	1.0814	1.0022
10	4.0014	0.075518	0.50522	2.9681	7.5489	7.5513	6.4717	1.0773	1.0797	1.0022
11	5.0037	0.075518	0.50826	2.9681	7.5457	7.5513	6.4717	1.074	1.0797	1.0052
12	6.0014	0.076628	0.50964	2.9681	7.5489	7.5513	6.4717	1.0773	1.0797	1.0022
13	7.0038	0.076628	0.51158	2.9681	7.5489	7.5513	6.4717	1.0773	1.0797	1.0022
14	8.0017	0.076628	0.51297	2.9681	7.5495	7.5519	6.4717	1.0778	1.0802	1.0022
15	9.0041	0.076628	0.51407	2.9681	7.5489	7.5513	6.4717	1.0773	1.0797	1.0022
16	10.002	0.076628	0.5149	2.9681	7.5495	7.5519	6.4722	1.0772	1.0797	1.0022
17	11	0.076628	0.51574	2.9681	7.5495	7.5519	6.4722	1.0772	1.0797	1.0022
18	12.002	0.076628	0.51657	2.9681	7.5495	7.5519	6.4722	1.0772	1.0797	1.0022
19	13	0.076628	0.51684	2.9681	7.5495	7.5519	6.4717	1.0778	1.0802	1.0022
20	14.002	0.077739	0.51767	2.9681	7.5495	7.5519	6.4717	1.0778	1.0802	1.0022
21	15.001	0.077739	0.51878	2.9681	7.5489	7.5513	6.4717	1.0773	1.0797	1.0022
22	16.002	0.077739	0.51823	2.9681	7.5495	7.5519	6.4717	1.0778	1.0802	1.0022
23	17.001	0.077739	0.51961	2.9681	7.5489	7.5513	6.4717	1.0773	1.0797	1.0022
24	18.002	0.077739	0.51989	2.9681	7.5489	7.5513	6.4711	1.0779	1.0802	1.0022
25	19.001	0.077739	0.51989	2.9681	7.5489	7.5513	6.4717	1.0773	1.0797	1.0022
26	20.003	0.078849	0.521	2.9681	7.5495	7.5519	6.4717	1.0778	1.0802	1.0022
27	20.939	0.078849	0.52127	2.9681	7.5495	7.5519	6.4717	1.0778	1.0802	1.0022

TRIAXIAL TEST

Consolidation/B Step: 5

	Time min	Axial Strain %	Volumetric Strain %	Corrected Area in^2	Vertical Stress tsf	Horizontal Stress tsf	Sample Pressure tsf	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	K
1	0	0	0	2.9681	7.5495	7.5519	6.4722	1.0772	1.0797	1.0022
2	0.012467	0	0.0022146	2.9681	7.6696	7.6766	6.5261	1.1435	1.1505	1.0061
3	0.050533	0.014437	0.19378	2.9681	8.3636	8.4657	6.6752	1.6883	1.7904	1.0605
4	0.1006	0.058859	0.41691	2.9681	8.5131	8.5488	6.5044	2.0086	2.0444	1.0178
5	0.25077	0.11217	0.50854	2.9681	8.618	8.6225	6.4787	2.1393	2.1439	1.0021
6	0.5017	0.11994	0.53151	2.9681	8.6246	8.6296	6.4722	2.1523	2.1573	1.0023
7	1.0034	0.12327	0.54563	2.9681	8.6284	8.6302	6.4734	2.1549	2.1567	1.0008
8	2.0012	0.1266	0.55726	2.9681	8.6289	8.6307	6.4717	2.1573	2.1591	1.0009
9	3.0031	0.12771	0.5639	2.9681	8.6295	8.6313	6.4699	2.1596	2.1614	1.0009
10	4.0009	0.12993	0.56778	2.9681	8.6295	8.6313	6.4722	2.1572	2.1591	1.0009
11	5.0028	0.13105	0.5711	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
12	6.0006	0.13105	0.57304	2.9681	8.63	8.6319	6.4717	2.1583	2.1603	1.0009
13	7.0025	0.13216	0.57553	2.9681	8.6295	8.6313	6.4722	2.1572	2.1591	1.0009
14	8.0003	0.13327	0.57747	2.9681	8.6295	8.6313	6.4705	2.159	2.1608	1.0009
15	9.0022	0.13327	0.57858	2.9681	8.63	8.6319	6.4722	2.1578	2.1597	1.0009
16	10	0.13438	0.58024	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
17	11.002	0.13438	0.58134	2.9681	8.63	8.6319	6.4722	2.1578	2.1597	1.0009
18	12.004	0.13438	0.58245	2.9681	8.63	8.6319	6.4717	2.1583	2.1603	1.0009
19	13.002	0.13438	0.58273	2.9681	8.63	8.6319	6.4722	2.1578	2.1597	1.0009
20	14.004	0.13438	0.58356	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
21	15.001	0.13438	0.58494	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
22	16.004	0.13549	0.58522	2.9681	8.63	8.6319	6.4722	2.1578	2.1597	1.0009
23	17.002	0.13549	0.5866	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
24	18.004	0.13549	0.5866	2.9681	8.63	8.6319	6.4711	2.1589	2.1608	1.0009
25	19.002	0.13549	0.58743	2.9681	8.6295	8.6313	6.4722	2.1572	2.1591	1.0009
26	20.004	0.13549	0.58771	2.9681	8.63	8.6319	6.4722	2.1578	2.1597	1.0009
27	21.002	0.13549	0.58826	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
28	22	0.13438	0.58937	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
29	23.002	0.13549	0.58993	2.9681	8.63	8.6319	6.4717	2.1583	2.1603	1.0009
30	24	0.13549	0.59048	2.9681	8.63	8.6319	6.4717	2.1583	2.1603	1.0009
31	25.002	0.13549	0.5902	2.9681	8.63	8.6319	6.4717	2.1583	2.1603	1.0009
32	26.001	0.13549	0.59131	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
33	27.002	0.13549	0.59159	2.9681	8.6295	8.6313	6.4717	2.1578	2.1597	1.0009
34	28.001	0.13549	0.59214	2.9681	8.6295	8.6313	6.4705	2.159	2.1608	1.0009
35	29.003	0.13549	0.59159	2.9681	8.63	8.6319	6.4717	2.1583	2.1603	1.0009
36	30.001	0.1366	0.59186	2.9681	8.63	8.6319	6.4717	2.1583	2.1603	1.0009
37	30.139	0.13549	0.59186	2.9681	8.63	8.6319	6.4717	2.1583	2.1603	1.0009

Sample Info For DSS Specimens

Project: **Polymet** Job: **6428**

Client: **Barr Engineering Company** Date: **4/12/2008**

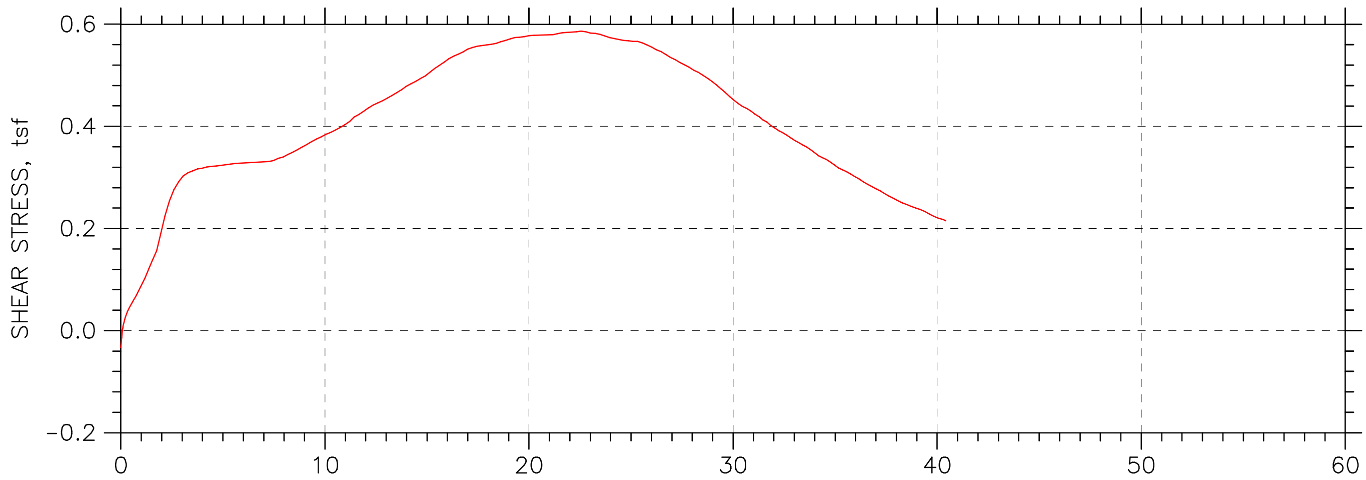
Test #	Boring	Bucket #	Depth (ft)	WC %	Initial Density (PCF)	Before Shear Density (PCF)	Normal Load (TSF)	Additional Testing Gs	LL	PL	PI
1	**Slimes**	**6**		**27.2**	**102.3**	**108.9**	**2.0 tsf**	**-------**			

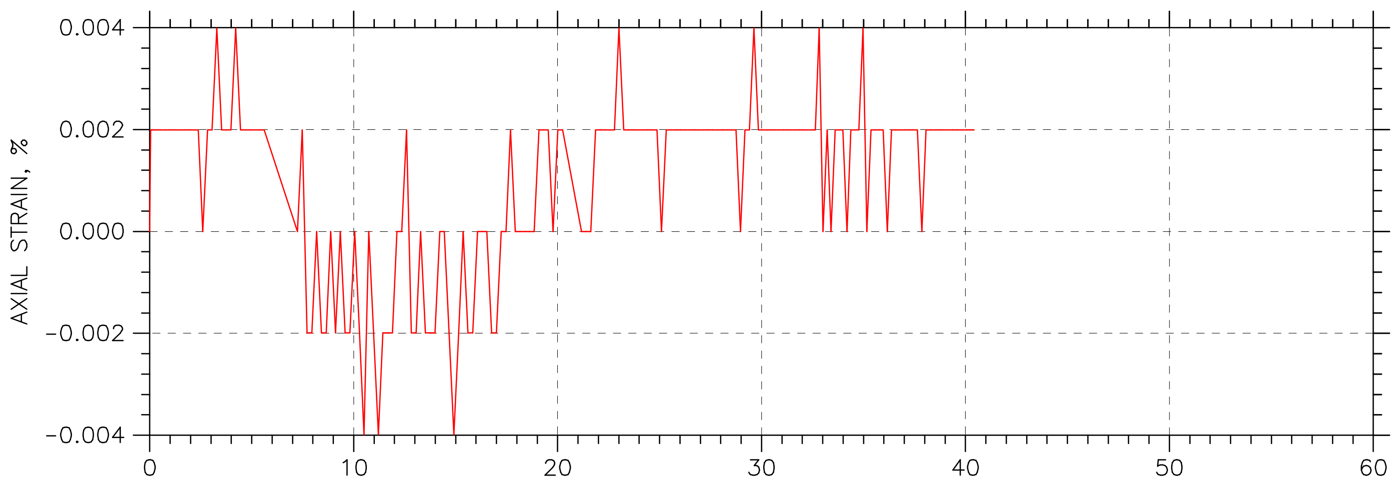
Supplemental: Incremental Consolidation Data

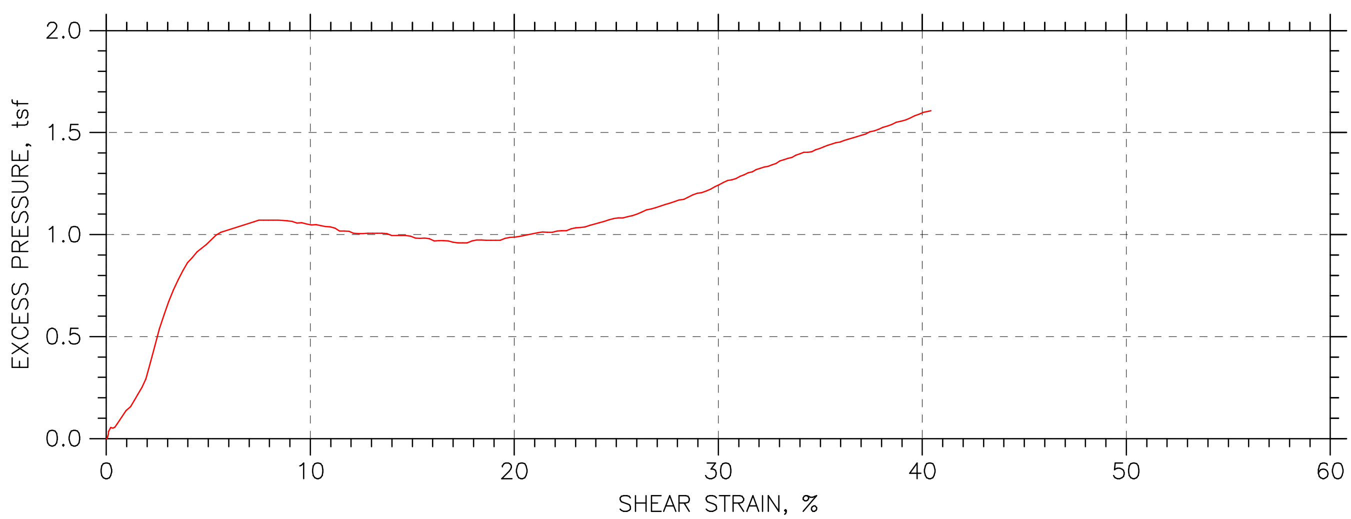
Load	Density	Void Ratio	% Saturation
Initial	**102.3**	**0.831**	**98.2%**
0.1 tsf	**104.5**	**0.792**	**-**
0.25 tsf	**105.6**	**0.774**	**-**
0.5 tsf	**106.5**	**0.759**	**-**
1.0 tsf	**107.6**	**0.741**	**-**
2.0 tsf	**108.9**	**0.720**	**-**

SOIL ENGINEERING TESTING, INC.

DIRECT SIMPLE SHEAR TEST







Project: Polymet	Location: Slimes	Project No.: 6428
Boring No.:	Tested By: SO	Checked By: JW
Sample No.: Bucket #6	Test Date: 4-12-08	Depth:
Test No.: 1	Sample Type: Bulk	Elevation:
Description: Slimes		
Remarks: ASTM D 6528		
File: \\Dell\geocomp\Software\DSS\6428-rev.dat		

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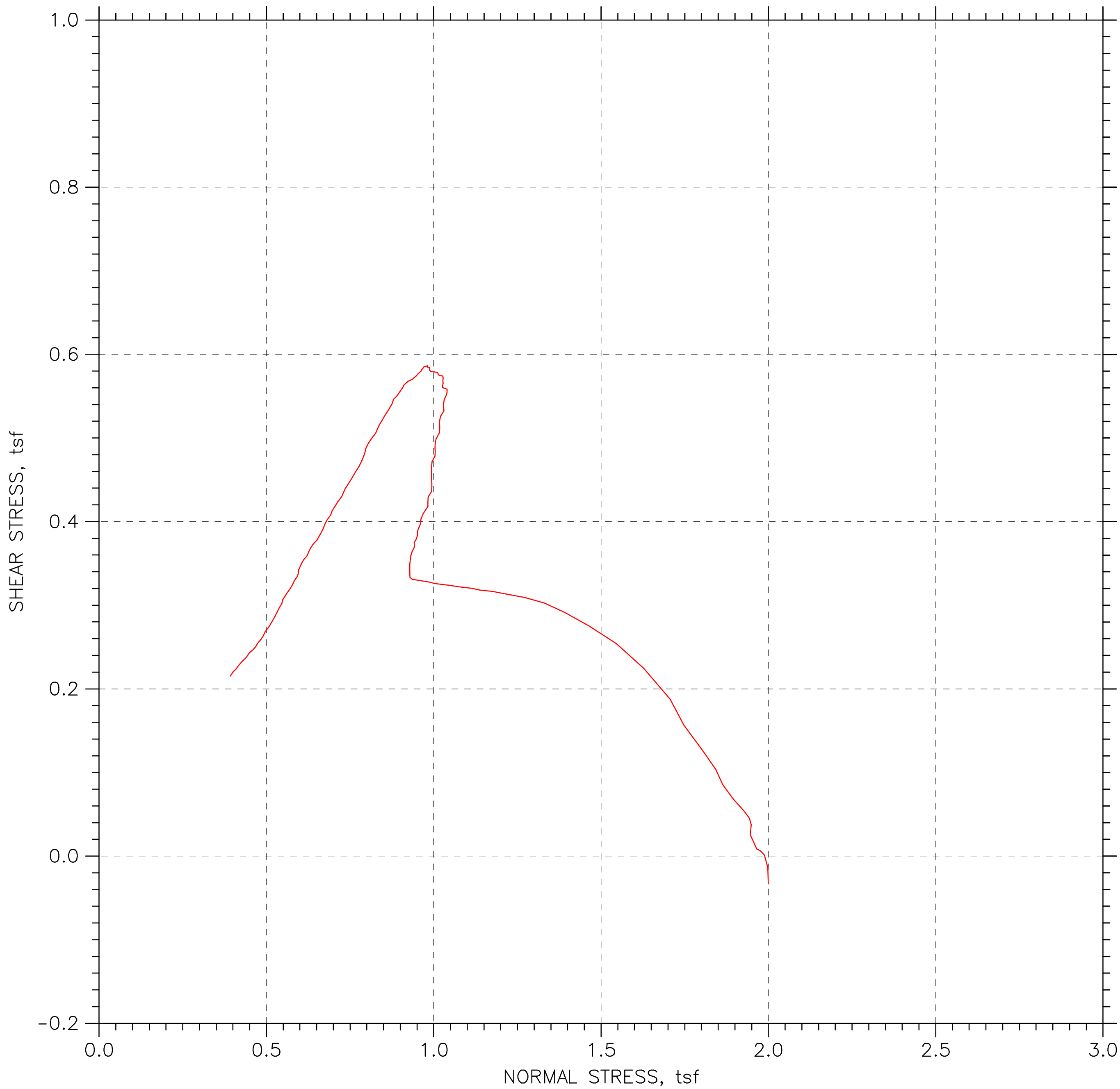
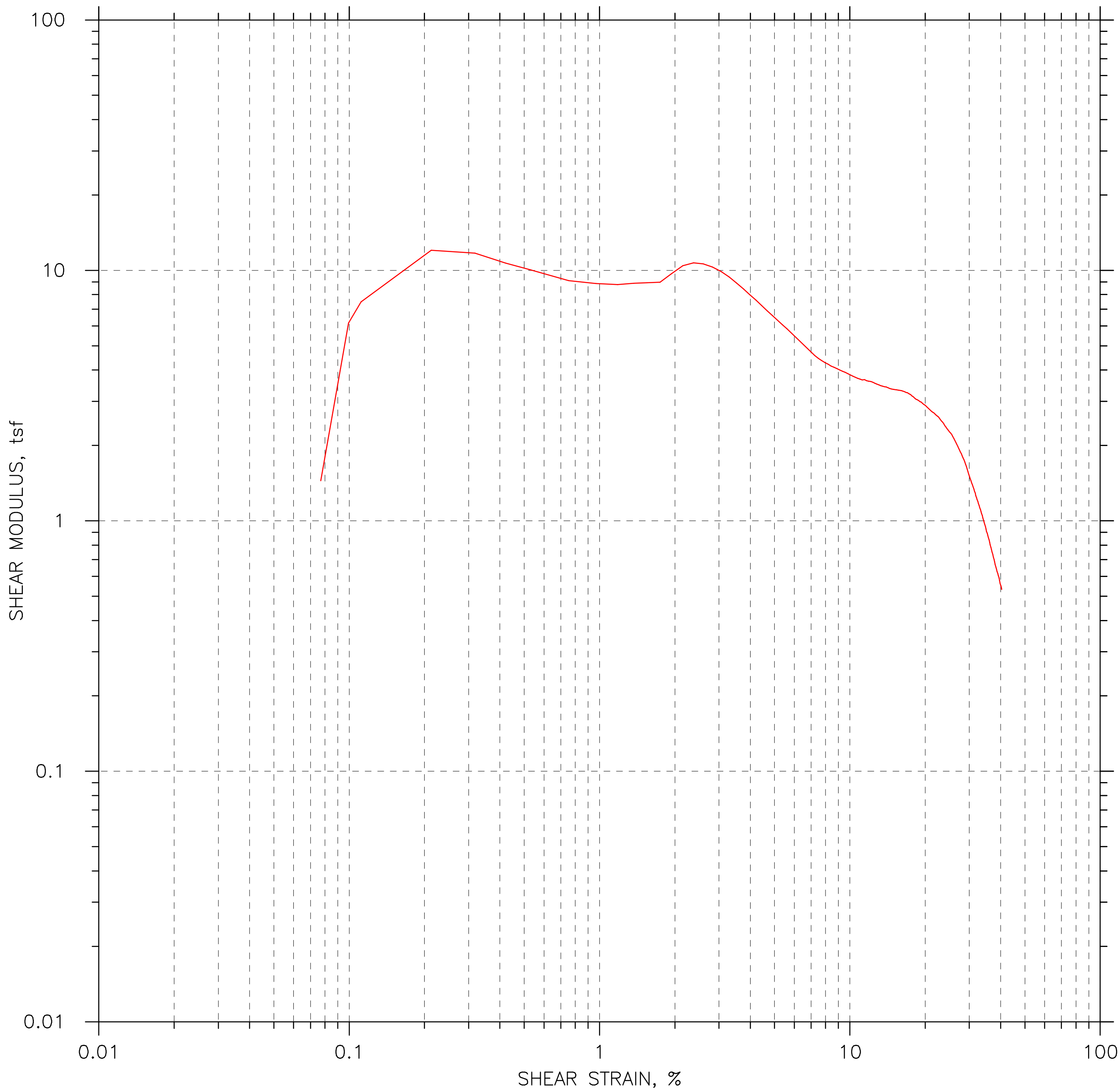
DIRECT SIMPLE SHEAR TEST



Project: Polymet	Location: Slimes	Project No.: 6428
Boring No.:	Tested By: SO	Checked By: JW
Sample No.: Bucket #6	Test Date: 4-12-08	Depth:
Test No.: 1	Sample Type: Bulk	Elevation:
Description: Slimes		
Remarks: ASTM D 6528		
File: \\Dell\geocomp\Software\DSS\6428-rev.dat		

Sat, 12-APR-2008 10:47:12

DIRECT SIMPLE SHEAR TEST



Project: Polymet	Location: Slimes	Project No.: 6428
Boring No.:	Tested By: SO	Checked By: JW
Sample No.: Bucket #6	Test Date: 4-12-08	Depth:
Test No.: 1	Sample Type: Bulk	Elevation:
Description: Slimes		
Remarks: ASTM D 6528		
File: \\Dell\geocomp\Software\DSS\6428-rev.dat		

Sat, 12-APR-2008 10:47:12

Permeability Test Data

Project: Polymet Date: 3/15/2008

Reported To: Barr Engineering Company Job No.: 6428

Tailings Type	Coarse Tailings	Coarse Tailings	Coarse Tailings		Fine Tailings	Fine Tailings	Fine Tailings
Sample No.:	Bucket #17	Bucket #17	Bucket #17		Bucket #11	Bucket #11	Bucket #11
Desired Density (pcf)	105	110	115		95	100	105
Location:							
Sample Type:	Bulk	Bulk	Bulk		Bulk	Bulk	Bulk
Soil Type:	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)		Fine Tailings (Silty Sand) (SM)	Fine Tailings (Silty Sand) (SM)	Fine Tailngs (Silty Sand) (SM)
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	3.83	3.99	3.99		3.93	3.99	3.99
Dia. (in):	2.89	2.89	2.89		2.89	2.89	2.89
Dry Density (pcf):	104.2	110.1	114.9		96.4	99.5	104.0
Water Content:	2.2%	2.2%	2.2%		6.8%	6.8%	6.8%
Test Type:	Constant	Constant	Constant		Constant	Constant	Constant
Max Head (cm):	9.0	11.2	10.2		8.3	8.3	12.2
Confining press. (Effective-psi):	None	None	None		None	None	None
Trial No.:	7-11	7-11	7-11		7-11	7-11	7-11
Water Temp °C:	21.0	21.4	23.4		20.8	20.6	20.4
% Compaction							
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**3.5×10^{-3}**	**1.7×10^{-3}**	**1.6×10^{-3}**		**3.3×10^{-3}**	**3.1×10^{-3}**	**2.1×10^{-3}**
K @ 20 °C (ft/min)	**6.9×10^{-3}**	**3.4×10^{-3}**	**3.2×10^{-3}**		**6.5×10^{-3}**	**6.1×10^{-3}**	**4.1×10^{-3}**
Notes:	About 200ccs thru specimens before readings.						

Permeability Test Data

Project: Polymet Date: 3/15/2008

Reported To: Barr Engineering Company Job No.: 6428

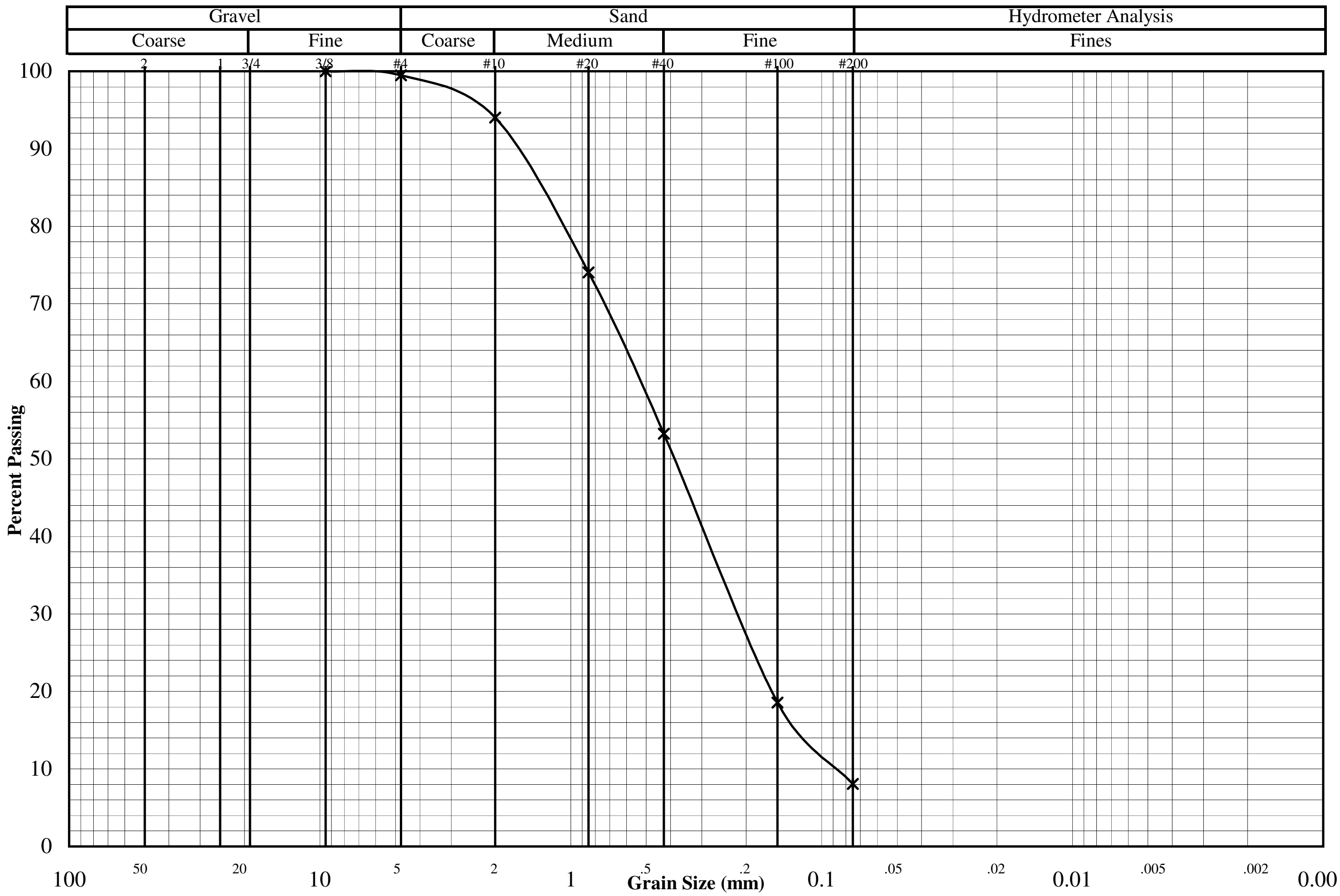
Tailings Type	Coarse Tailings	Coarse Tailings	Coarse Tailings		Fine Tailings	Fine Tailings	Fine Tailings
Sample No.:	Bucket #17	Bucket #17	Bucket #17		Bucket #11	Bucket #11	Bucket #11
Desired Density (pcf)	105	110	115		95	100	105
Location:							
Sample Type:	Bulk	Bulk	Bulk		Bulk	Bulk	Bulk
Soil Type:	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)	Coarse Tailings (Sand w/Silt, Fine to Medium Grained) (SP-SM)		Fine Tailings (Silty Sand) (SM)	Fine Tailings (Silty Sand) (SM)	Fine Tailngs (Silty Sand) (SM)
Atterberg Limits							
LL							
PL							
PI							
Permeability Test							
Before Test Conditions: Saturation %:							
Before Test Conditions: Porosity:							
Before Test Conditions: Ht. (in):	3.83	3.99	3.99		3.93	3.99	3.99
Before Test Conditions: Dia. (in):	2.89	2.89	2.89		2.89	2.89	2.89
Before Test Conditions: Dry Density (pcf):	104.2	110.1	114.9		96.4	99.5	104.0
Before Test Conditions: Water Content:	2.2%	2.2%	2.2%		6.8%	6.8%	6.8%
Test Type:	Constant	Constant	Constant		Constant	Constant	Constant
Max Head (cm):	9.0	11.2	10.2		8.3	8.3	12.2
Confining press. (Effective-psi):	None	None	None		None	None	None
Trial No.:	7-11	7-11	7-11		7-11	7-11	7-11
Water Temp ℃:	21.0	21.4	23.4		20.8	20.6	20.4
% Compaction							
% Saturation (After Test)							
Coefficient of Permeability							
K @ 20 ℃ (cm/sec)	**3.5×10^{-3}**	**1.7×10^{-3}**	**1.6×10^{-3}**		**3.3×10^{-3}**	**3.1×10^{-3}**	**2.1×10^{-3}**
K @ 20 ℃ (ft/min)	**6.9×10^{-3}**	**3.4×10^{-3}**	**3.2×10^{-3}**		**6.5×10^{-3}**	**6.1×10^{-3}**	**4.1×10^{-3}**
Notes:	About 200ccs thru specimens before readings.						

Grain Size Distribution ASTM D422

Job No. : **6428**

Project:	Polymet	Test Date:	4/7/08
Reported To:	Barr Engineering Company	Report Date:	4/8/08

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Coarse Tailings			Bulk	Coarse Tailings (Sand w/silt medium to fine grained (SP-SM))
●					
◇					



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content	2.1		
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	381.0		
2"			
1.5"			
1"			
3/4"			
3/8"	100.0		
#4	99.5		
#10	94.0		
#20	74.0		
#40	53.2		
#100	18.6		
#200	8.1		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

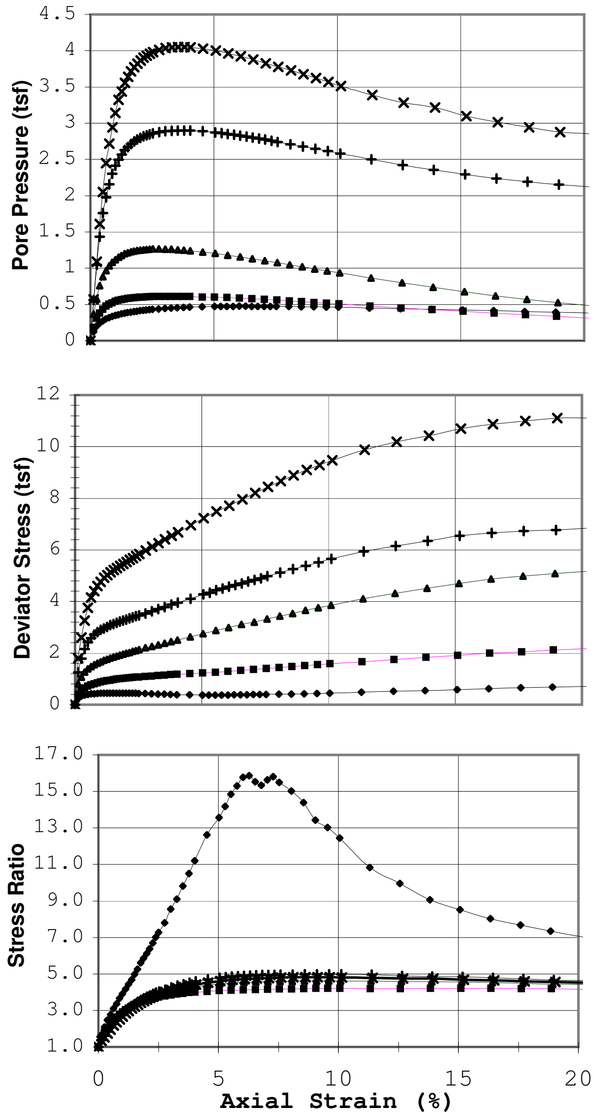
Remarks:

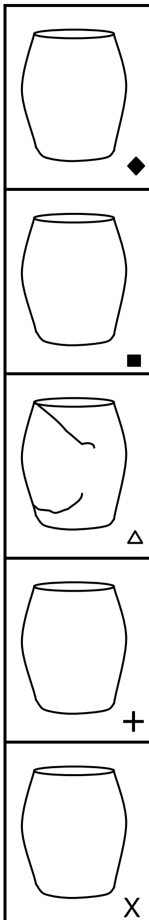
9301 Bryant Ave. South, Suite 107
SOIL ENGINEERING TESTING, INC.
Bloomington, Minnesota 55420-3436

TRIAXIAL TEST ASTM: D 4767

Job No. **6428**
Date: **4/9/08**

Project: **Polymet**
Boring #: **Coarse Tailings** Sample #: Type: **Bulk** Depth (ft):
Soil Type: **Coarse Tailings (Sand w/silt, medium to fine grained (SP-SM))**





Failure Criterion: **Max. Stress Ratio**

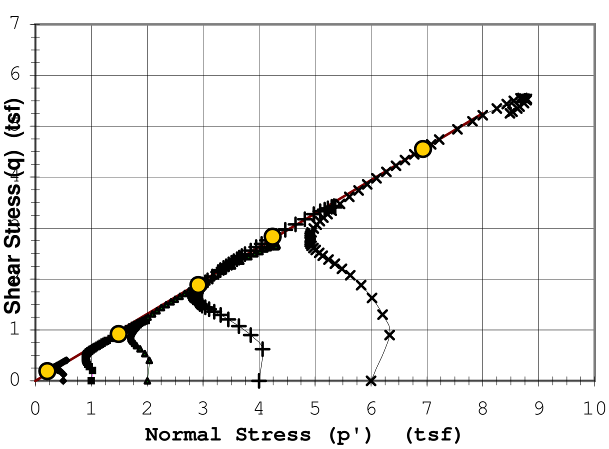
Angle of internal friction, ϕ' = **41.1 °**
Apparent Cohesion, c' = **0.00 (tsf)**

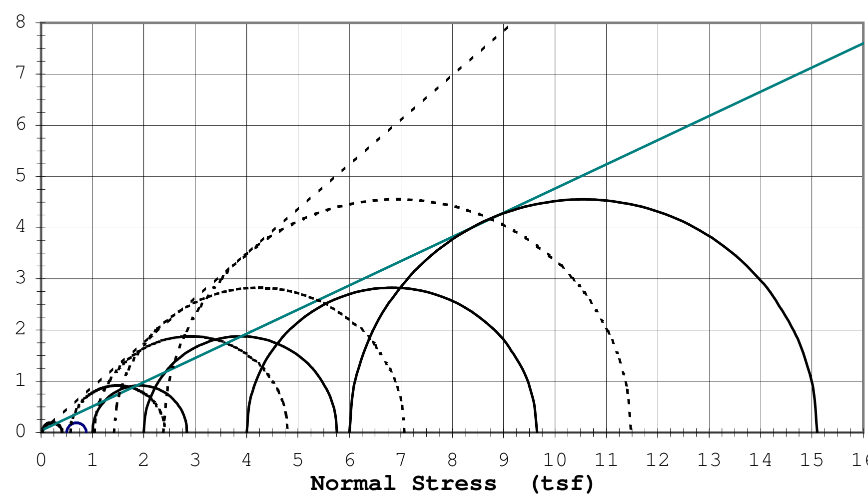
Test Date:	4/4/08	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.043	Plasticity Index:	
Strain Rate (%/min):	1.080	Spec. Gravity (Assumed):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	2.7	2.1	2.2	2.2	1.6
Dry Density (pcf)	105.9	106.1	108.1	105.2	109.3
Void Ratio	0.77	0.76	0.73	0.78	0.71
After Consolidation					
Diameter (in)	1.93	1.92	1.91	1.90	1.90
Height (in)	3.98	3.97	3.96	3.95	3.94
Water Content (%)	24.7	24.1	22.3	22.9	20.6
Dry Density (pcf)	107.7	108.7	112.2	111.0	115.8
Void Ratio	0.74	0.72	0.67	0.69	0.62
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.50	1.00	2.00	4.00	6.00
Max. Deviator Stress (tsf)	0.81	2.38	5.33	6.86	11.11
Ultimate Deviator Stress (tsf)	0.81	2.37	5.26	6.806	10.5
Deviator Stress at Failure (tsf)	0.38	1.84	3.76	5.65	9.10
Max. Pore Pressure Buildup (tsf)	0.47	0.61	1.27	2.90	4.05
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	6.3	13.8	9.6	10.1	9.1

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





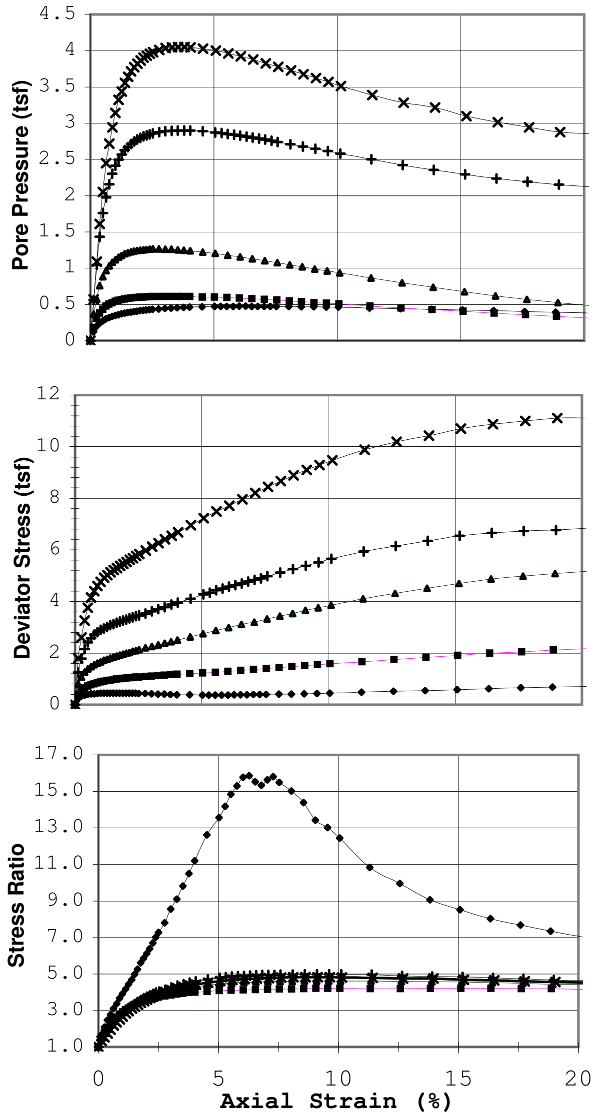
Rupture Envelope at Failure		
α = 33.3 °	a =	0.0 (tsf)

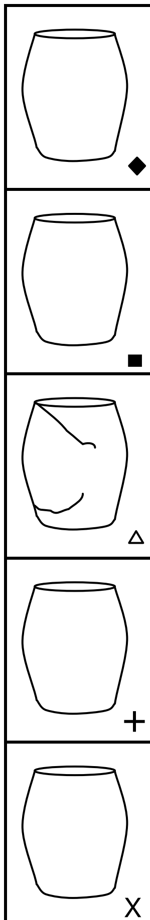
------------	Effective ϕ':	41.1 °	c'=	0.00 (tsf)
________	Total ϕ':	25.3 °	c=	0.04 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6428**
Date: **4/9/08**

Project: **Polymet**
Boring #: **Coarse Tailings** Sample #: Type: **Bulk** Depth (ft):
Soil Type: **Coarse Tailings (Sand w/silt, medium to fine grained (SP-SM))**



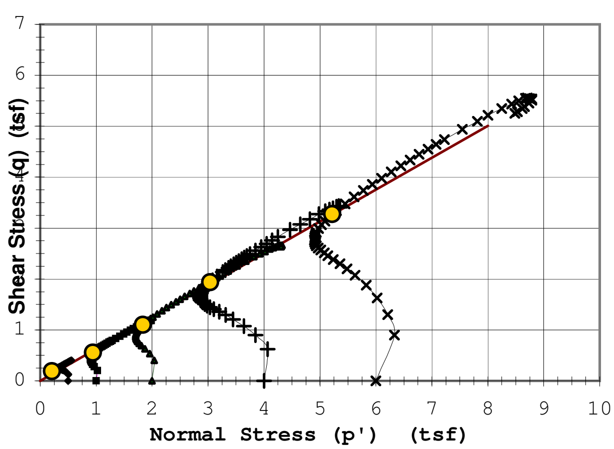


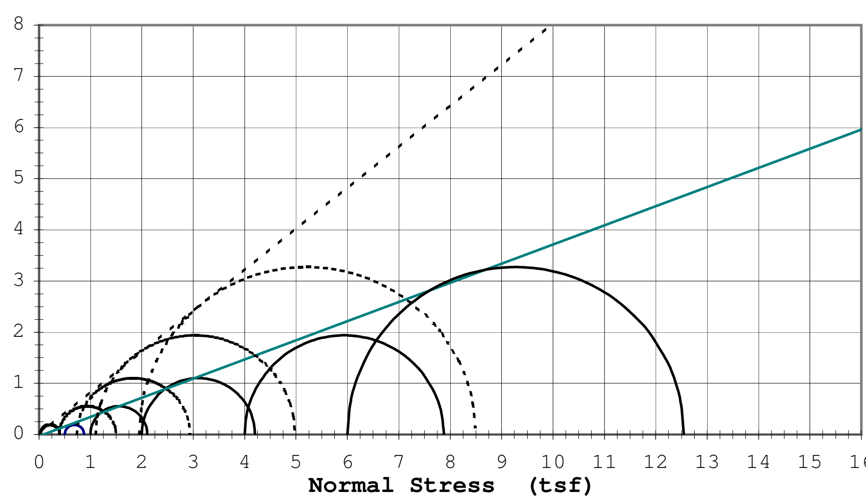
Failure Criterion:		**Max. Pore Pressure**				
Angle of internal friction, ϕ' =		**38.8 °**				
Apparent Cohesion, c' =		**0.00 (tsf)**				
Test Date:	4/4/08	Liquid Limit:				
Test Type:	CU w/pp	Plastic Limit:				
Strain Rate (in/min):	0.043	Plasticity Index:				
Strain Rate (%/min):	1.080	Spec. Gravity (Assumed):		3.00		

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	2.7	2.1	2.2	2.2	1.6
Dry Density (pcf)	105.9	106.1	108.1	105.2	109.3
Void Ratio	0.77	0.76	0.73	0.78	0.71
After Consolidation					
Diameter (in)	1.93	1.92	1.91	1.90	1.90
Height (in)	3.98	3.97	3.96	3.95	3.94
Water Content (%)	24.7	24.1	22.3	22.9	20.6
Dry Density (pcf)	107.7	108.7	112.2	111.0	115.8
Void Ratio	0.74	0.72	0.67	0.69	0.62
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.50	1.00	2.00	4.00	6.00
Max. Deviator Stress (tsf)	0.81	2.38	5.33	6.86	11.11
Ultimate Deviator Stress (tsf)	0.81	2.37	5.26	6.806	10.5
Deviator Stress at Failure (tsf)	0.38	1.11	2.20	3.88	6.55
Max. Pore Pressure Buildup (tsf)	0.47	0.61	1.27	2.90	4.05
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	6.0	3.0	2.8	3.8	3.8

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 32.0 °	a = 0.0 (tsf)

------------	Effective ϕ':	38.8 °	c'=	0.00 (tsf)
________	Total ϕ':	20.5 °	c=	-0.03 (tsf)

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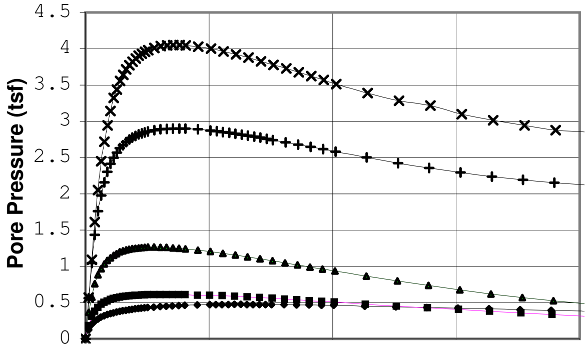
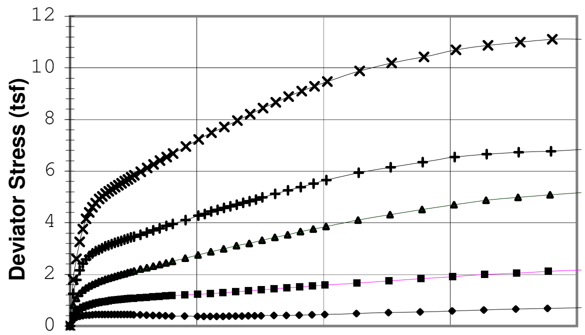
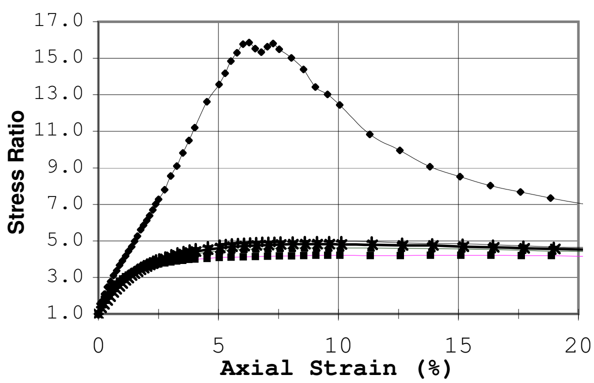
TRIAXIAL TEST ASTM: D 4767

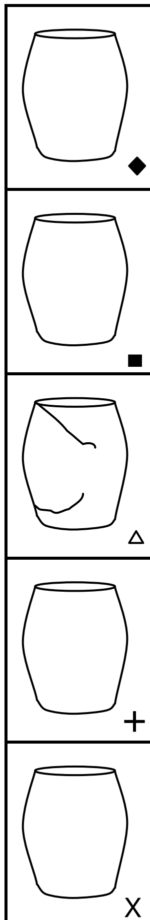
Job No. **6428**
Date: **4/9/08**

Project: **Polymet**
Boring #: **Coarse Tailings** Sample #: Type: **Bulk** Depth (ft):
Soil Type: **Coarse Tailings (Sand w/silt, medium to fine grained (SP-SM))**









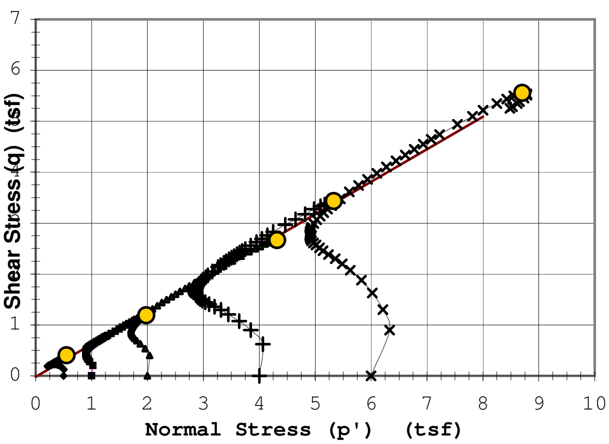
Failure Criterion:	Max. Deviator Stress
Angle of internal friction, φ' =	39.7 °
Apparent Cohesion, c' =	0.00 (tsf)

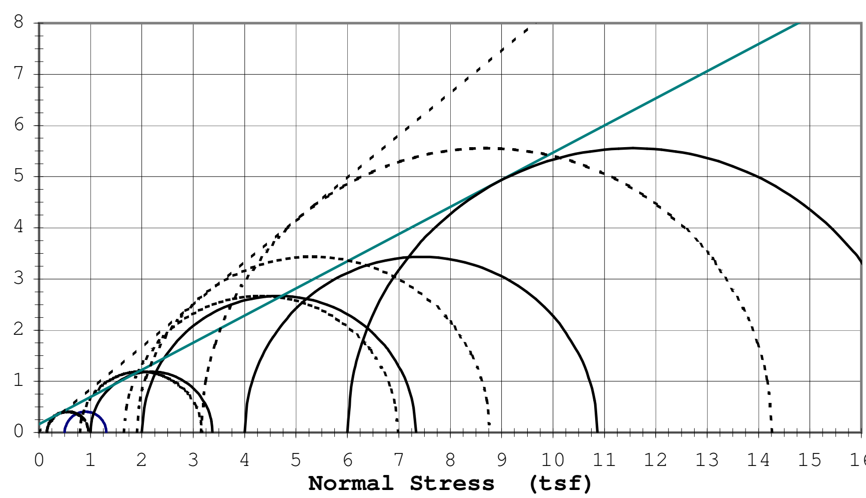
Test Date:	4/4/08	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.043	Plasticity Index:	
Strain Rate (%/min):	1.080	Spec. Gravity (Assumed):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	2.7	2.1	2.2	2.2	1.6
Dry Density (pcf)	105.9	106.1	108.1	105.2	109.3
Void Ratio	0.77	0.76	0.73	0.78	0.71
After Consolidation					
Diameter (in)	1.93	1.92	1.91	1.90	1.90
Height (in)	3.98	3.97	3.96	3.95	3.94
Water Content (%)	24.7	24.1	22.3	22.9	20.6
Dry Density (pcf)	107.7	108.7	112.2	111.0	115.8
Void Ratio	0.74	0.72	0.67	0.69	0.62
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.50	1.00	2.00	4.00	6.00
Max. Deviator Stress (tsf)	0.81	2.38	5.33	6.86	11.11
Ultimate Deviator Stress (tsf)	0.81	2.37	5.26	6.806	10.5
Deviator Stress at Failure (tsf)	0.81	2.38	5.33	6.86	11.11
Max. Pore Pressure Buildup (tsf)	0.47	0.61	1.27	2.90	4.05
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	25.1	28.9	26.5	21.5	20.3

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





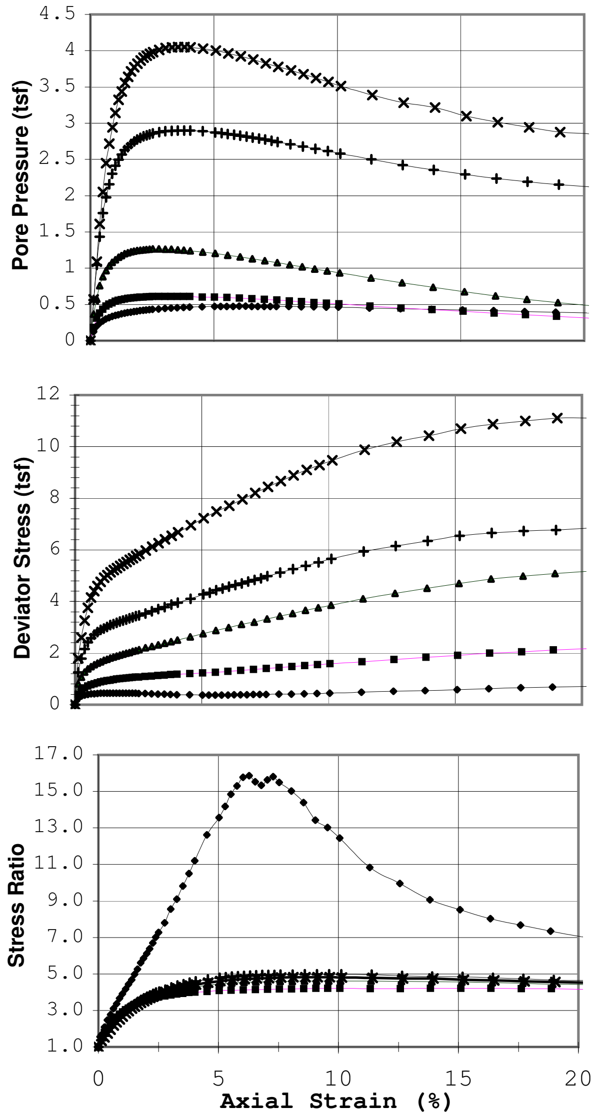
Rupture Envelope at Failure	
α = 32.6 °	a = 0.0 (tsf)

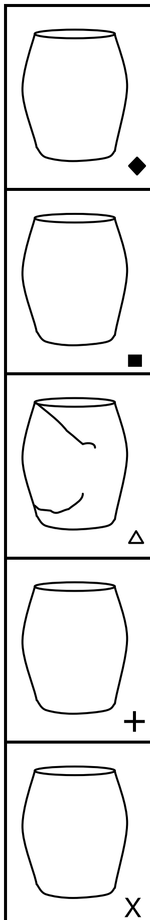
------------	Effective φ':	39.7 °	c'=	0.00 (tsf)
________	Total φ':	28.0 °	c=	0.16 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6428**
Date: **4/9/08**

Project: **Polymet**
Boring #: **Coarse Tailings** Sample #: Type: **Bulk** Depth (ft):
Soil Type: **Coarse Tailings (Sand w/silt, medium to fine grained (SP-SM))**



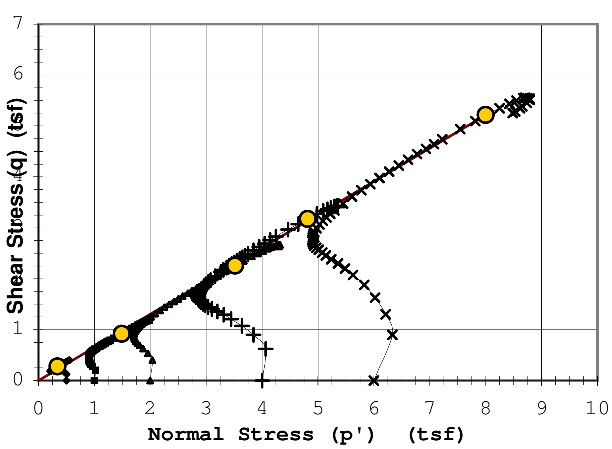


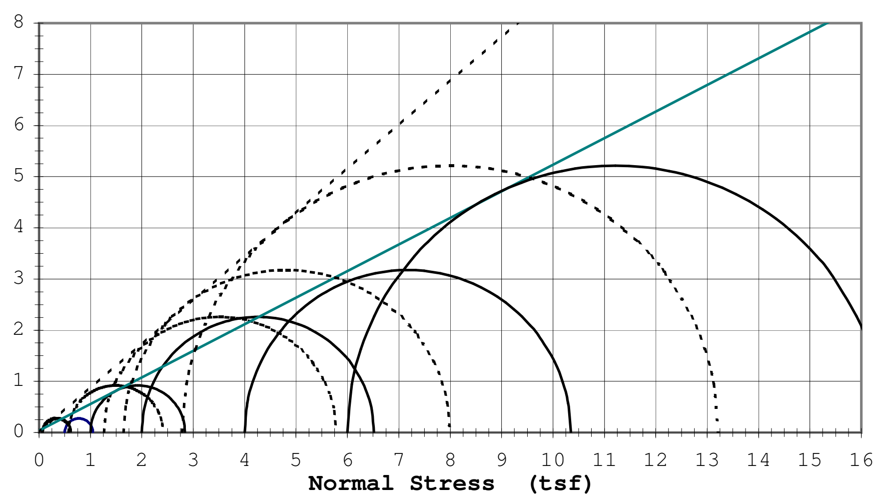
Failure Criterion:		Given Strain of: 15%			
Angle of internal friction, φ' =		40.7 °			
Apparent Cohesion, c' =		0.00 (tsf)			
Test Date:	4/4/08	Liquid Limit:			
Test Type:	CU w/pp	Plastic Limit:			
Strain Rate (in/min):	0.043	Plasticity Index:			
Strain Rate (%/min):	1.080	Spec. Gravity (Assumed):	3.00		

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	2.7	2.1	2.2	2.2	1.6
Dry Density (pcf)	105.9	106.1	108.1	105.2	109.3
Void Ratio	0.77	0.76	0.73	0.78	0.71
After Consolidation					
Diameter (in)	1.93	1.92	1.91	1.90	1.90
Height (in)	3.98	3.97	3.96	3.95	3.94
Water Content (%)	24.7	24.1	22.3	22.9	20.6
Dry Density (pcf)	107.7	108.7	112.2	111.0	115.8
Void Ratio	0.74	0.72	0.67	0.69	0.62
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.50	1.00	2.00	4.00	6.00
Max. Deviator Stress (tsf)	0.81	2.38	5.33	6.86	11.11
Ultimate Deviator Stress (tsf)	0.81	2.37	5.26	6.806	10.5
Deviator Stress at Failure (tsf)	0.55	1.84	4.52	6.35	10.43
Max. Pore Pressure Buildup (tsf)	0.47	0.61	1.27	2.90	4.05
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	15.0	15.0	15.0	15.0	15.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 33.1 °	a = 0.0 (tsf)

------------	Effective φ': 40.7 °	c'=	0.00 (tsf)
________	Total φ': 27.5 °	c=	0.04 (tsf)

Polymet Triaxial Test Data Job: 6428

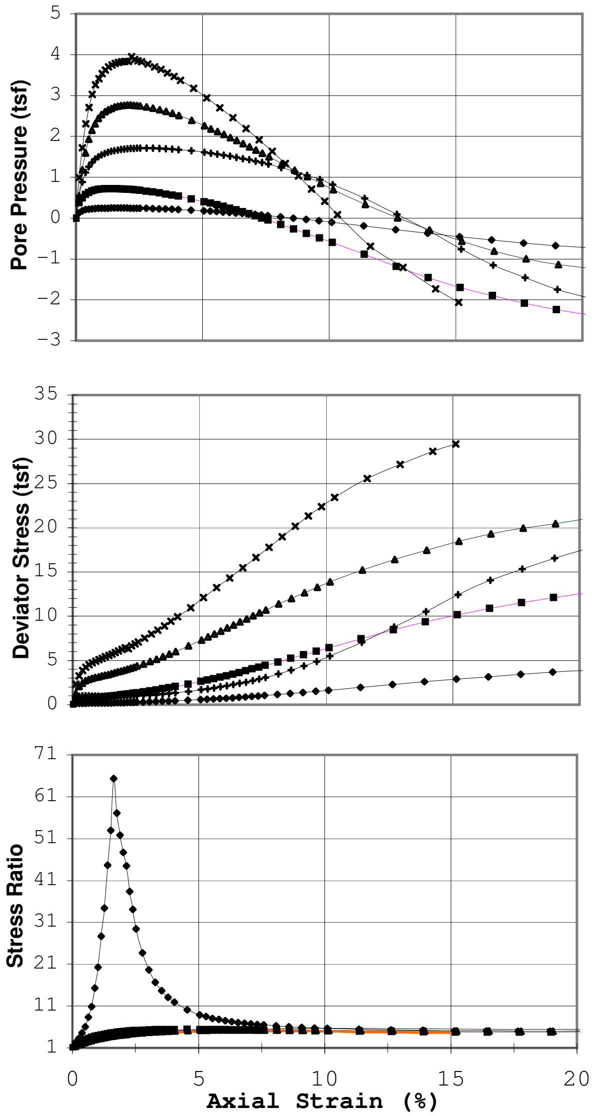
Sample: Coarse Tailings Date: 4/9/2008

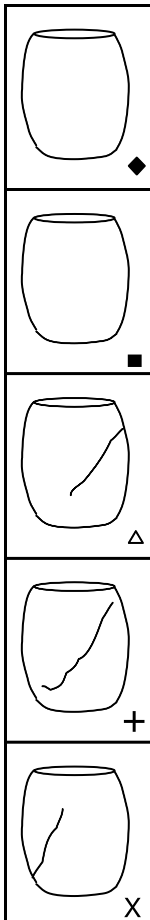
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.13	0.25	0.12	0.13	0.40	0.18	0.13	0.81	0.37	0.13	1.25	0.56	0.13	1.80	0.57
0.25	0.33	0.20	0.25	0.55	0.31	0.25	1.06	0.57	0.25	1.79	1.05	0.26	2.60	1.09
0.38	0.38	0.24	0.38	0.64	0.38	0.38	1.26	0.76	0.38	2.15	1.44	0.38	3.26	1.61
0.50	0.40	0.27	0.50	0.71	0.43	0.51	1.38	0.88	0.51	2.42	1.76	0.51	3.75	2.05
0.63	0.42	0.30	0.63	0.77	0.47	0.63	1.47	0.97	0.63	2.58	1.98	0.64	4.15	2.45
0.75	0.43	0.32	0.76	0.81	0.50	0.76	1.55	1.03	0.76	2.71	2.16	0.76	4.40	2.72
0.88	0.44	0.33	0.88	0.85	0.52	0.88	1.61	1.08	0.89	2.82	2.30	0.89	4.60	2.94
1.00	0.44	0.35	1.01	0.87	0.54	1.01	1.66	1.12	1.01	2.90	2.41	1.02	4.77	3.14
1.13	0.45	0.36	1.13	0.90	0.55	1.14	1.72	1.15	1.14	2.96	2.49	1.14	4.92	3.32
1.26	0.45	0.37	1.26	0.93	0.56	1.26	1.76	1.17	1.26	3.02	2.57	1.27	5.03	3.44
1.38	0.45	0.38	1.39	0.95	0.57	1.39	1.81	1.20	1.39	3.08	2.63	1.40	5.14	3.56
1.51	0.45	0.39	1.51	0.97	0.58	1.52	1.85	1.21	1.52	3.12	2.67	1.52	5.22	3.64
1.63	0.45	0.39	1.64	0.99	0.59	1.64	1.89	1.23	1.64	3.17	2.71	1.65	5.30	3.71
1.76	0.45	0.40	1.76	1.00	0.59	1.77	1.92	1.23	1.77	3.22	2.75	1.78	5.38	3.77
1.88	0.45	0.41	1.89	1.01	0.60	1.89	1.96	1.24	1.90	3.26	2.77	1.90	5.45	3.82
2.01	0.45	0.41	2.01	1.03	0.60	2.02	2.00	1.25	2.02	3.30	2.80	2.03	5.53	3.86
2.14	0.44	0.42	2.14	1.04	0.60	2.15	2.03	1.25	2.15	3.34	2.82	2.16	5.61	3.90
2.26	0.44	0.42	2.27	1.05	0.60	2.27	2.07	1.26	2.28	3.39	2.83	2.28	5.68	3.93
2.39	0.44	0.43	2.39	1.06	0.61	2.40	2.10	1.26	2.40	3.43	2.85	2.41	5.76	3.96
2.51	0.44	0.43	2.52	1.07	0.61	2.53	2.13	1.26	2.53	3.46	2.86	2.54	5.84	3.98
2.76	0.43	0.44	2.77	1.09	0.61	2.78	2.20	1.27	2.78	3.53	2.88	2.79	5.98	4.01
3.01	0.42	0.44	3.02	1.11	0.61	3.03	2.26	1.26	3.04	3.62	2.89	3.05	6.13	4.04
3.27	0.41	0.45	3.27	1.12	0.61	3.28	2.32	1.26	3.29	3.71	2.90	3.30	6.27	4.05
3.52	0.40	0.45	3.53	1.14	0.61	3.54	2.39	1.25	3.54	3.79	2.90	3.55	6.40	4.05
3.77	0.39	0.46	3.78	1.16	0.61	3.79	2.44	1.25	3.79	3.88	2.90	3.81	6.55	4.05
4.02	0.39	0.46	4.03	1.18	0.61	4.04	2.51	1.24	4.05	3.95	2.90	4.06	6.68	4.05
4.52	0.38	0.47	4.53	1.21	0.60	4.55	2.63	1.22	4.55	4.10	2.89	4.57	6.95	4.03
5.02	0.38	0.47	5.03	1.23	0.60	5.05	2.75	1.20	5.06	4.28	2.87	5.08	7.22	4.00
5.28	0.37	0.47	5.54	1.26	0.59	5.56	2.87	1.18	5.31	4.34	2.86	5.58	7.48	3.96
5.53	0.37	0.47	6.04	1.29	0.59	6.06	2.99	1.15	5.57	4.43	2.85	6.09	7.72	3.92
5.78	0.38	0.47	6.55	1.33	0.58	6.56	3.11	1.13	5.82	4.50	2.84	6.60	7.95	3.88
6.03	0.38	0.47	7.05	1.36	0.57	7.07	3.20	1.10	6.07	4.57	2.83	7.11	8.20	3.83
6.28	0.38	0.47	7.55	1.40	0.56	7.58	3.32	1.07	6.32	4.64	2.81	7.61	8.44	3.78
6.53	0.38	0.47	8.06	1.43	0.55	8.08	3.44	1.05	6.58	4.70	2.80	8.12	8.67	3.73
6.78	0.39	0.47	8.56	1.47	0.54	8.58	3.53	1.02	6.83	4.78	2.79	8.63	8.89	3.67
7.03	0.39	0.47	9.06	1.52	0.53	9.09	3.65	0.99	7.08	4.84	2.77	9.14	9.10	3.62
7.29	0.40	0.47	9.57	1.55	0.52	9.59	3.76	0.96	7.34	4.90	2.76	9.64	9.29	3.57
7.54	0.40	0.47	10.07	1.58	0.51	10.10	3.85	0.93	7.59	4.98	2.74	10.15	9.47	3.51
8.04	0.41	0.47	11.33	1.66	0.48	11.36	4.10	0.86	8.09	5.12	2.71	11.42	9.87	3.39
8.54	0.41	0.47	12.59	1.75	0.45	12.62	4.32	0.80	8.60	5.25	2.68	12.69	10.19	3.28
9.04	0.42	0.47	13.85	1.84	0.43	13.89	4.52	0.74	9.11	5.38	2.65	13.96	10.43	3.22
9.55	0.43	0.46	15.10	1.91	0.40	15.15	4.70	0.68	9.61	5.51	2.62	15.23	10.70	3.10
10.05	0.44	0.46	16.36	1.99	0.38	16.41	4.87	0.62	10.12	5.65	2.58	16.50	10.87	3.01
11.31	0.48	0.45	17.62	2.05	0.36	17.67	4.99	0.57	11.38	5.93	2.50	17.77	10.99	2.94
12.56	0.53	0.44	18.88	2.12	0.34	18.94	5.08	0.52	12.65	6.15	2.42	19.03	11.10	2.88
13.82	0.55	0.43	20.14	2.17	0.31	20.20	5.17	0.48	13.91	6.35	2.36	20.30	11.11	2.85
15.07	0.58	0.42	21.40	2.21	0.29	21.46	5.23	0.45	15.18	6.54	2.29	21.57	11.08	2.80
16.33	0.61	0.41	22.66	2.26	0.27	22.72	5.27	0.42	16.44	6.66	2.24	22.84	11.07	2.75
17.59	0.66	0.40	23.91	2.29	0.26	23.98	5.30	0.39	17.71	6.73	2.19	24.11	11.02	2.73
18.84	0.68	0.39	25.17	2.32	0.24	25.25	5.32	0.37	18.97	6.77	2.15	25.38	10.91	2.72
20.10	0.71	0.38	26.43	2.34	0.23	26.51	5.33	0.35	20.24	6.84	2.12	26.65	10.76	2.73
21.35	0.74	0.37	27.69	2.36	0.22	27.77	5.32	0.34	21.50	6.86	2.10	27.92	10.69	2.73
22.61	0.78	0.36	28.95	2.38	0.21	29.03	5.29	0.33	22.77	6.83	2.07	29.18	10.57	2.75
25.12	0.81	0.35	30.05	2.37	0.20	30.02	5.26	0.33	25.10	6.81	2.04	30.03	10.50	2.77
25.12	0.81	0.35												

TRIAXIAL TEST ASTM: D 4767

Job No. **6428**
Date: **3/11/08**

Project: **Polymet**
Boring #: **Fine Tailings** Sample #: Type: **Bulk** Depth (ft):
Soil Type: **Fine Tailings**





Failure Criterion: **Max. Stress Ratio**

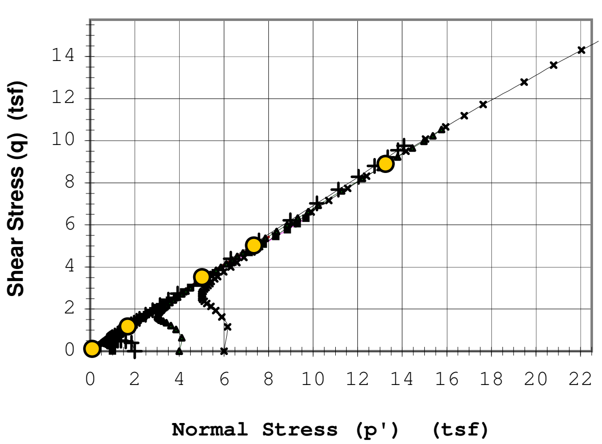
Angle of internal friction, φ' = **42.0 °**
Apparent Cohesion, c' = **0.09 (tsf)**

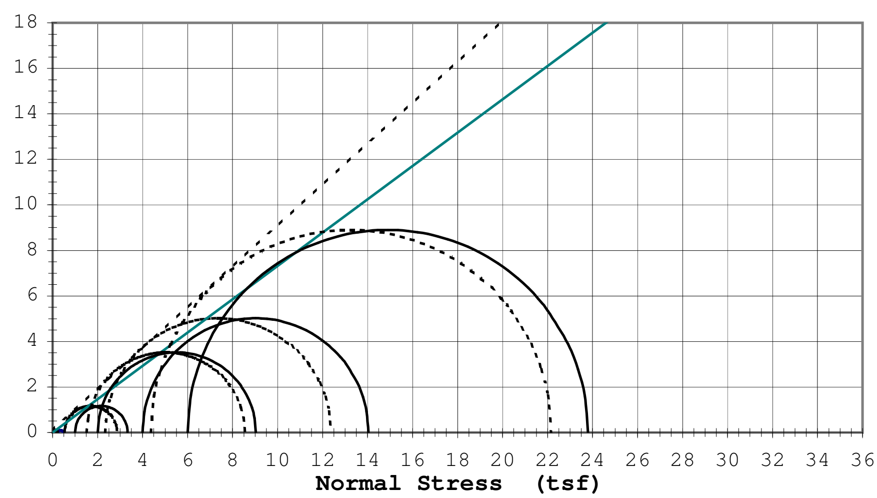
Test Date:	2/22/08	Liquid Limit:	21.4
Test Type:	CU w/pp	Plastic Limit:	17.1
Strain Rate (in/min):	0.004	Plasticity Index:	4.3
Strain Rate (%/min):	0.101	Spec. Gravity (Assumed):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	27.1	26.4	26.4	25.6	24.1
Dry Density (pcf)	98.3	99.5	101.0	103.7	103.9
Void Ratio	0.91	0.88	0.86	0.81	0.80
After Consolidation					
Diameter (in)	1.93	1.93	1.92	1.93	1.91
Height (in)	3.96	3.95	3.94	3.95	3.87
Water Content (%)	29.0	27.8	26.3	25.2	23.3
Dry Density (pcf)	100.1	102.0	104.7	106.7	110.3
Void Ratio	0.87	0.84	0.79	0.76	0.70
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.25	1.00	4.00	2.00	6.00
Max. Deviator Stress (tsf)	3.88	12.63	21.06	19.51	29.48
Ultimate Deviator Stress (tsf)	3.88	12.63	21.06	19.511	29.475
Deviator Stress at Failure (tsf)	0.20	2.33	10.04	7.03	17.80
Max. Pore Pressure Buildup (tsf)	0.25	0.72	2.77	1.71	3.95
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	1.6	4.6	7.1	11.4	7.8

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted loosely; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 33.8 °	a = 0.1 (tsf)

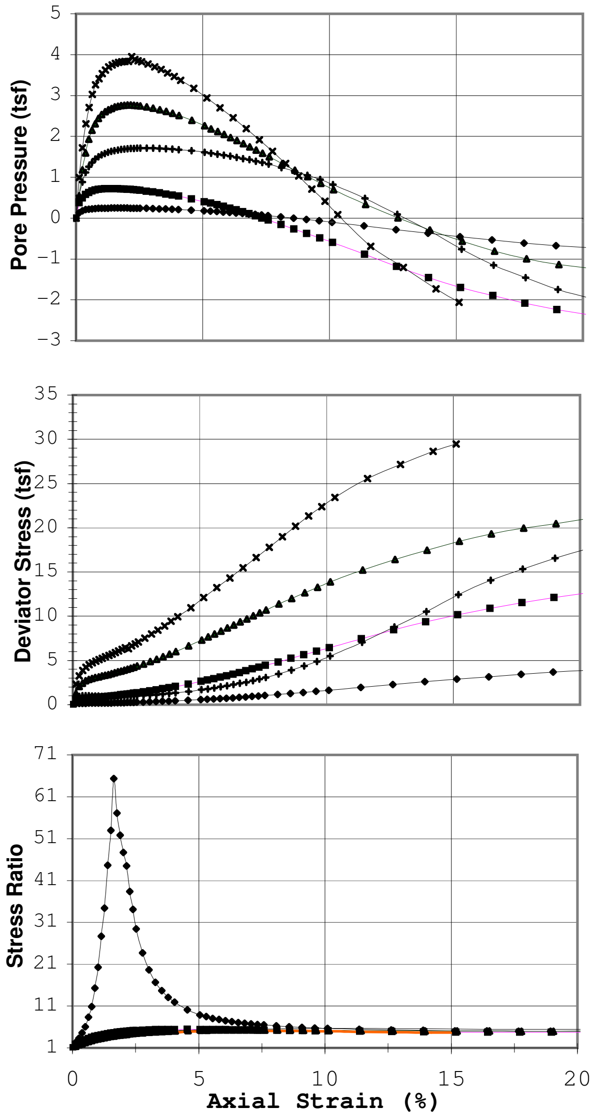
------------	Effective φ': 42.0 °	c'= 0.09 (tsf)
________	Total φ': 36.2 °	c= 0.00 (tsf)

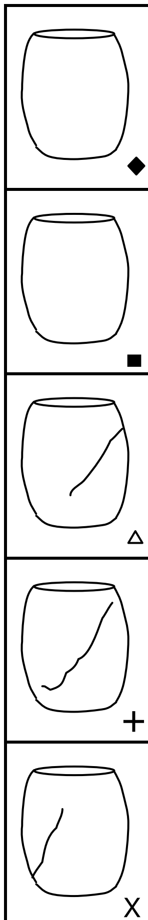
9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

TRIAXIAL TEST ASTM: D 4767

Job No. **6428**
Date: **3/11/08**

Project: **Polymet**
Boring #: **Fine Tailings** Sample #: Type: **Bulk** Depth (ft):
Soil Type: **Fine Tailings**

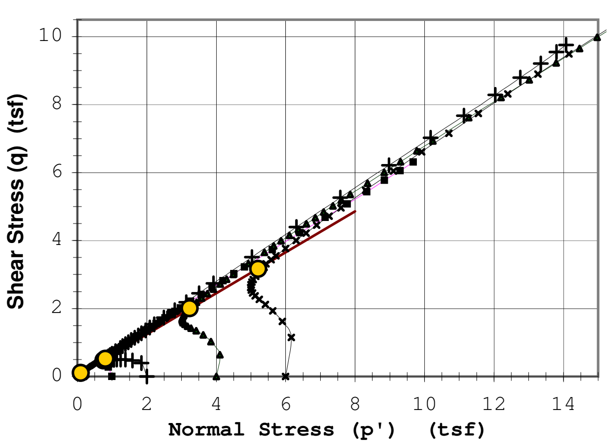


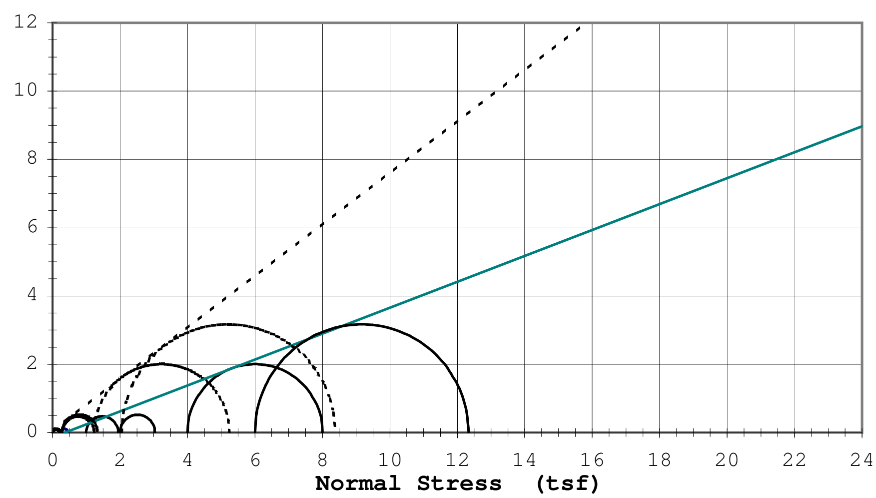


Failure Criterion:	**Max. Pore Pressure**				
Angle of internal friction, φ' =	**37.1 °**				
Apparent Cohesion, c' =	**0.04 (tsf)**				
Test Date: 2/22/08	Liquid Limit: 21.4				
Test Type: CU w/pp	Plastic Limit: 17.1				
Strain Rate (in/min): 0.004	Plasticity Index: 4.3				
Strain Rate (%/min): 0.101	Spec. Gravity (Assumed): 3.00				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	27.1	26.4	26.4	25.6	24.1
Dry Density (pcf)	98.3	99.5	101.0	103.7	103.9
Void Ratio	0.91	0.88	0.86	0.81	0.80
After Consolidation					
Diameter (in)	1.93	1.93	1.92	1.93	1.91
Height (in)	3.96	3.95	3.94	3.95	3.87
Water Content (%)	29.0	27.8	26.3	25.2	23.3
Dry Density (pcf)	100.1	102.0	104.7	106.7	110.3
Void Ratio	0.87	0.84	0.79	0.76	0.70
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.25	1.00	4.00	2.00	6.00
Max. Deviator Stress (tsf)	3.88	12.63	21.06	19.51	29.48
Ultimate Deviator Stress (tsf)	3.88	12.63	21.06	19.511	29.475
Deviator Stress at Failure (tsf)	0.20	0.95	4.01	1.04	6.34
Max. Pore Pressure Buildup (tsf)	0.25	0.72	2.77	1.71	3.95
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	1.6	1.4	2.2	2.8	2.2

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted loosely; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





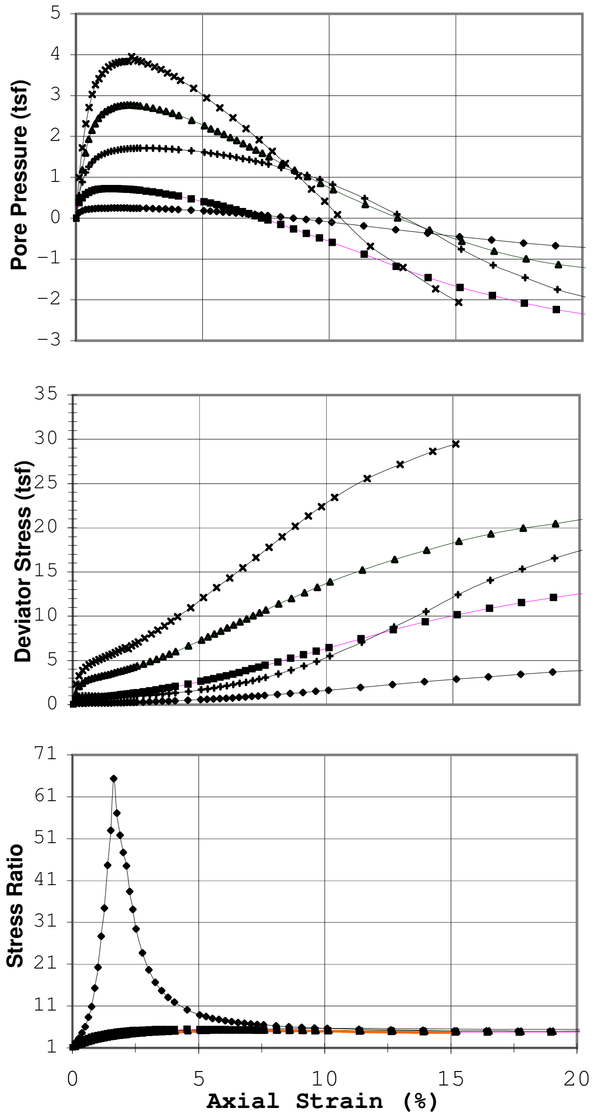
Rupture Envelope at Failure
α = 31.1 ° a = 0.0 (tsf)

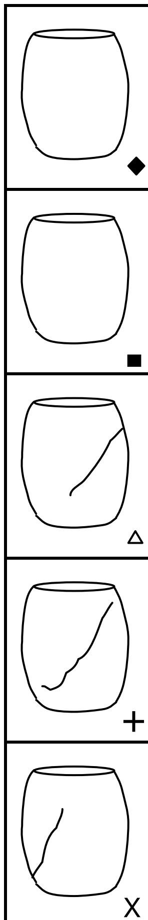
------------ Effective φ':	37.1 °	c'=	0.04 (tsf)
________ Total φ':	20.8 °	c=	-0.14 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6428**
Date: **3/11/08**

Project: **Polymet**
Boring #: **Fine Tailings** Sample #: Type: **Bulk** Depth (ft):
Soil Type: **Fine Tailings**





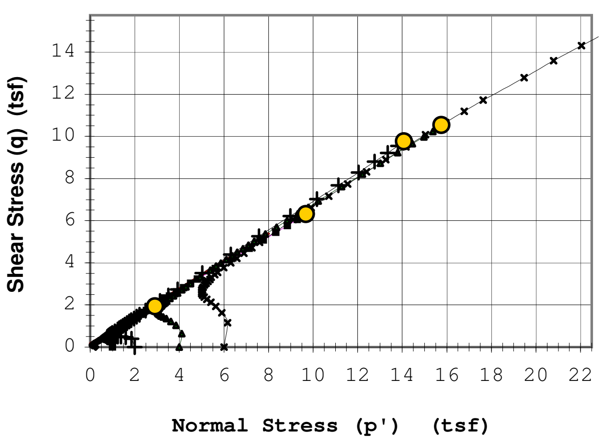
Failure Criterion:	Max. Deviator Stress				
Angle of internal friction, ϕ' =	40.6 °				
Apparent Cohesion, c' =	0.23 (tsf)				

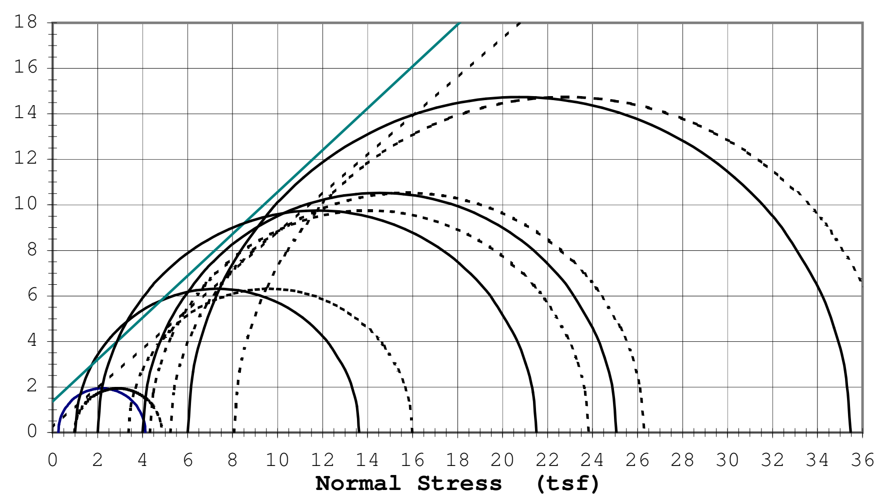
Test Date:	2/22/08
Test Type:	CU w/pp
Strain Rate (in/min):	0.004
Strain Rate (%/min):	0.101
Liquid Limit:	21.4
Plastic Limit:	17.1
Plasticity Index:	4.3
Spec. Gravity (Assumed):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	27.1	26.4	26.4	25.6	24.1
Dry Density (pcf)	98.3	99.5	101.0	103.7	103.9
Void Ratio	0.91	0.88	0.86	0.81	0.80
After Consolidation					
Diameter (in)	1.93	1.93	1.92	1.93	1.91
Height (in)	3.96	3.95	3.94	3.95	3.87
Water Content (%)	29.0	27.8	26.3	25.2	23.3
Dry Density (pcf)	100.1	102.0	104.7	106.7	110.3
Void Ratio	0.87	0.84	0.79	0.76	0.70
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.25	1.00	4.00	2.00	6.00
Max. Deviator Stress (tsf)	3.88	12.63	21.06	19.51	29.48
Ultimate Deviator Stress (tsf)	3.88	12.63	21.06	19.511	29.475
Deviator Stress at Failure (tsf)	3.88	12.63	21.06	19.51	29.48
Max. Pore Pressure Buildup (tsf)	0.25	0.72	2.77	1.71	3.95
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	20.2	20.2	20.3	23.6	15.1

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted loosely; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





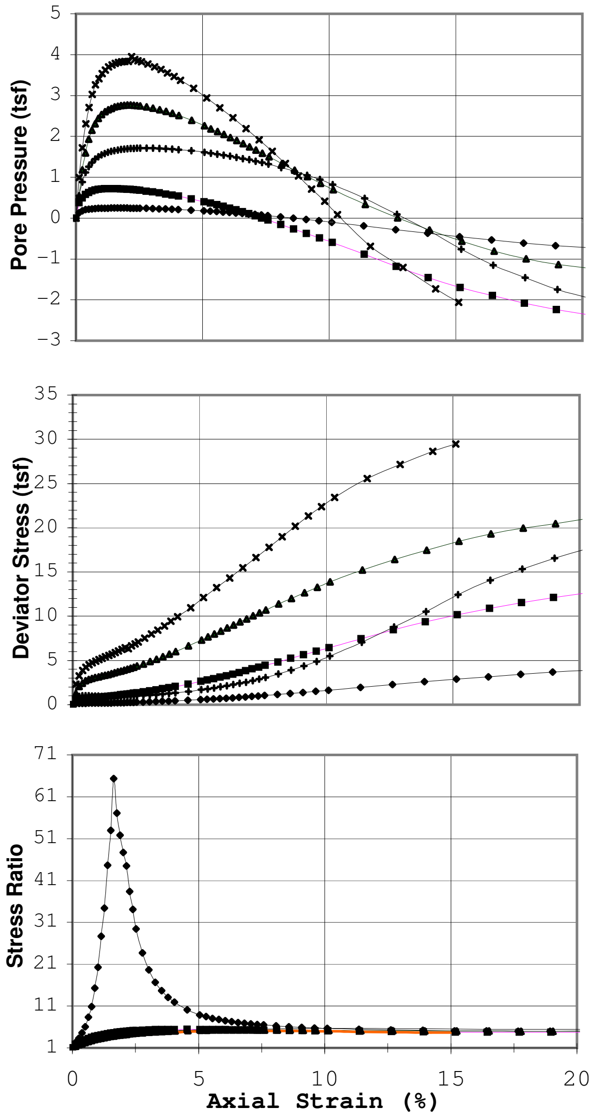
Rupture Envelope at Failure	
α = 33.0 °	a = 0.2 (tsf)

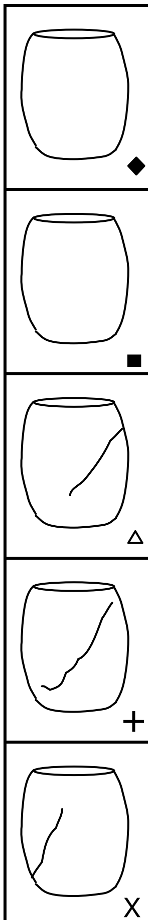
------------	Effective ϕ': 40.6 °	c'= 0.23 (tsf)
________	Total ϕ': 42.6 °	c= 1.36 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6428**
Date: **3/11/08**

Project: **Polymet**
Boring #: **Fine Tailings** Sample #: Type: **Bulk** Depth (ft):
Soil Type: **Fine Tailings**

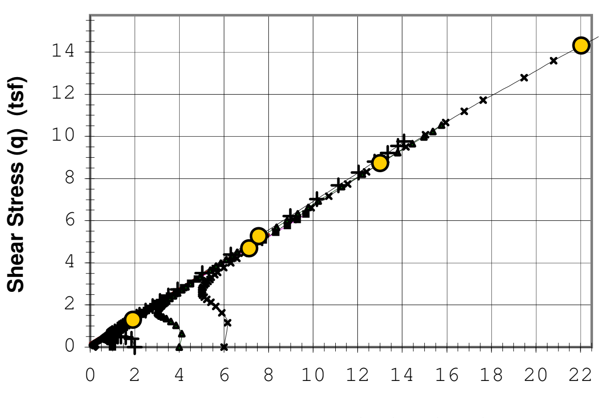


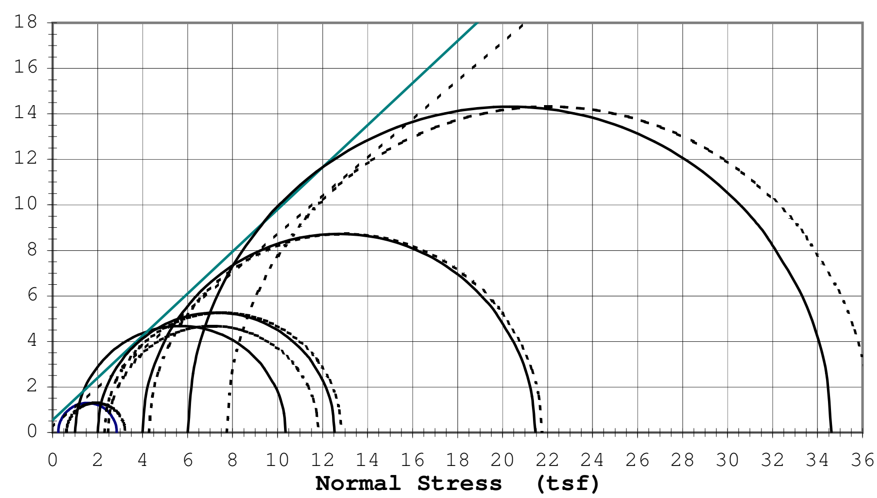


Failure Criterion:	Given Strain of: 15%				
Angle of internal friction, φ' =	40.2 °				
Apparent Cohesion, c' =	0.24 (tsf)				
Test Date: 2/22/08	Liquid Limit: 21.4				
Test Type: CU w/pp	Plastic Limit: 17.1				
Strain Rate (in/min): 0.004	Plasticity Index: 4.3				
Strain Rate (%/min): 0.101	Spec. Gravity (Assumed): 3.00				
Before Consolidation	A	B	C	D	E
Diameter (in)	1.94	1.94	1.94	1.94	1.94
Height (in)	3.98	3.98	3.98	3.98	3.98
Water Content (%)	27.1	26.4	26.4	25.6	24.1
Dry Density (pcf)	98.3	99.5	101.0	103.7	103.9
Void Ratio	0.91	0.88	0.86	0.81	0.80
After Consolidation					
Diameter (in)	1.93	1.93	1.92	1.93	1.91
Height (in)	3.96	3.95	3.94	3.95	3.87
Water Content (%)	29.0	27.8	26.3	25.2	23.3
Dry Density (pcf)	100.1	102.0	104.7	106.7	110.3
Void Ratio	0.87	0.84	0.79	0.76	0.70
Back Pressure (tsf)	5.8	5.8	5.8	5.8	5.8
Minor Principal Stress (tsf)	0.25	1.00	4.00	2.00	6.00
Max. Deviator Stress (tsf)	3.88	12.63	21.06	19.51	29.48
Ultimate Deviator Stress (tsf)	3.88	12.63	21.06	19.511	29.475
Deviator Stress at Failure (tsf)	2.60	9.36	17.46	10.53	28.63
Max. Pore Pressure Buildup (tsf)	0.25	0.72	2.77	1.71	3.95
Pore Pressure Parameter "B"	1.0	1.0	1.0	1.0	1.0
Pct. Axial Strain at Failure	15.0	15.0	15.0	15.0	15.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens compacted loosely; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 32.9 °	a = 0.2 (tsf)

------------	Effective φ':	40.2 °	c'=	0.24 (tsf)
________	Total φ':	42.8 °	c=	0.54 (tsf)

Triaxial Shear Data

Job: 6428

Polymet Fine Tailings

Date: 3/12/2008

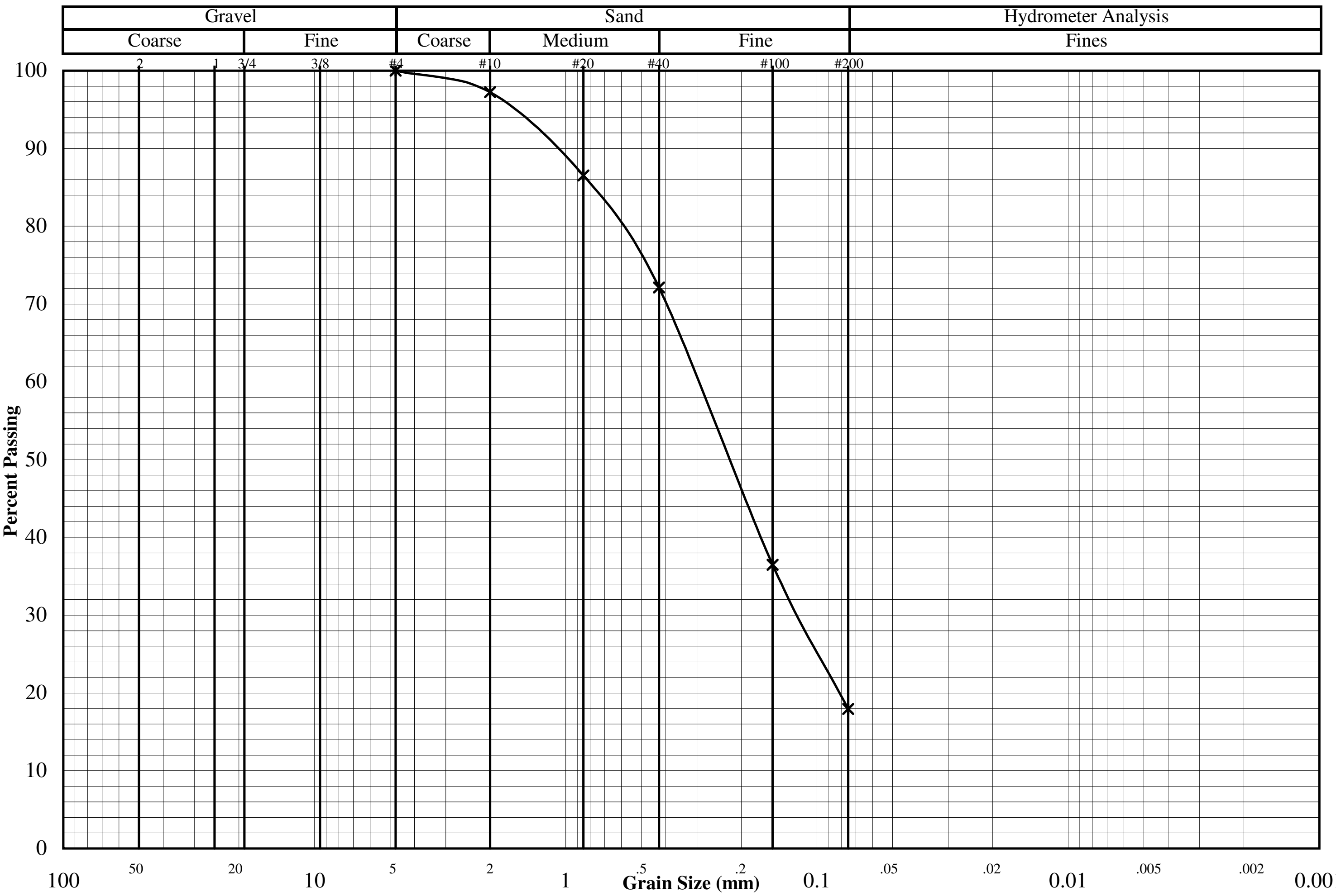
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.13	0.15	0.13	0.13	0.54	0.37	0.13	1.28	0.54	0.13	0.79	0.54	0.13	2.30	0.99
0.25	0.16	0.18	0.25	0.63	0.49	0.25	2.06	1.18	0.25	0.95	0.89	0.26	3.25	1.72
0.38	0.16	0.21	0.38	0.69	0.58	0.38	2.44	1.59	0.38	1.00	1.12	0.39	3.87	2.30
0.50	0.16	0.22	0.51	0.73	0.63	0.51	2.70	1.93	0.51	1.00	1.26	0.52	4.24	2.71
0.63	0.16	0.23	0.63	0.76	0.66	0.64	2.85	2.15	0.63	1.00	1.36	0.65	4.53	3.03
0.76	0.16	0.23	0.76	0.79	0.68	0.76	2.96	2.31	0.76	0.99	1.44	0.78	4.75	3.26
0.88	0.17	0.24	0.89	0.82	0.70	0.89	3.07	2.44	0.89	0.97	1.50	0.90	4.91	3.41
1.01	0.17	0.24	1.01	0.85	0.71	1.02	3.16	2.53	1.01	0.96	1.55	1.03	5.08	3.54
1.14	0.18	0.24	1.14	0.88	0.71	1.14	3.25	2.60	1.14	0.96	1.58	1.16	5.24	3.63
1.26	0.18	0.24	1.27	0.91	0.72	1.27	3.33	2.65	1.27	0.95	1.61	1.29	5.41	3.70
1.39	0.19	0.25	1.39	0.95	0.72	1.40	3.41	2.69	1.39	0.95	1.63	1.42	5.56	3.75
1.52	0.20	0.25	1.52	0.99	0.72	1.52	3.51	2.72	1.52	0.95	1.65	1.55	5.70	3.78
1.64	0.20	0.25	1.64	1.03	0.72	1.65	3.60	2.74	1.65	0.95	1.67	1.68	5.90	3.81
1.77	0.21	0.25	1.77	1.06	0.71	1.78	3.71	2.75	1.77	0.96	1.68	1.81	6.06	3.83
1.89	0.22	0.25	1.90	1.11	0.71	1.91	3.80	2.76	1.90	0.96	1.69	1.94	6.24	3.84
2.02	0.23	0.25	2.03	1.15	0.70	2.03	3.90	2.77	2.03	0.97	1.69	2.07	6.42	3.84
2.15	0.24	0.24	2.15	1.20	0.70	2.16	4.01	2.77	2.15	0.94	1.71	2.20	6.34	3.95
2.27	0.25	0.24	2.28	1.25	0.69	2.29	4.12	2.76	2.28	0.97	1.71	2.33	6.64	3.88
2.40	0.26	0.24	2.40	1.30	0.68	2.41	4.24	2.76	2.41	0.98	1.71	2.45	6.87	3.85
2.52	0.27	0.24	2.53	1.35	0.68	2.54	4.37	2.75	2.54	1.00	1.71	2.58	7.10	3.83
2.78	0.30	0.24	2.78	1.45	0.66	2.79	4.61	2.72	2.79	1.04	1.71	2.84	7.53	3.77
3.03	0.32	0.23	3.04	1.56	0.64	3.05	4.87	2.69	3.04	1.08	1.71	3.10	8.01	3.70
3.28	0.35	0.23	3.29	1.67	0.61	3.30	5.15	2.65	3.30	1.13	1.70	3.36	8.44	3.63
3.53	0.38	0.22	3.54	1.79	0.59	3.56	5.44	2.61	3.55	1.19	1.70	3.62	8.90	3.56
3.79	0.41	0.22	3.80	1.91	0.56	3.81	5.73	2.56	3.80	1.25	1.69	3.88	9.43	3.46
4.04	0.44	0.21	4.05	2.04	0.53	4.06	6.01	2.51	4.06	1.34	1.67	4.13	9.93	3.37
4.54	0.50	0.20	4.55	2.33	0.47	4.57	6.64	2.39	4.56	1.49	1.65	4.65	10.95	3.17
5.05	0.57	0.18	5.06	2.62	0.40	5.08	7.30	2.26	5.07	1.68	1.61	5.17	12.09	2.94
5.30	0.60	0.17	5.31	2.77	0.36	5.33	7.68	2.19	5.32	1.78	1.59	5.68	13.23	2.70
5.55	0.64	0.16	5.57	2.94	0.32	5.59	7.98	2.12	5.58	1.90	1.57	6.20	14.32	2.46
5.81	0.68	0.15	5.82	3.10	0.29	5.84	8.31	2.05	5.83	2.02	1.54	6.72	15.49	2.19
6.06	0.72	0.14	6.07	3.27	0.24	6.10	8.67	1.97	6.09	2.14	1.52	7.23	16.63	1.92
6.31	0.77	0.13	6.33	3.45	0.20	6.35	8.99	1.90	6.34	2.27	1.49	7.75	17.80	1.63
6.56	0.82	0.11	6.58	3.63	0.15	6.60	9.35	1.82	6.59	2.42	1.46	8.27	18.99	1.33
6.82	0.87	0.10	6.83	3.83	0.10	6.86	9.68	1.75	6.84	2.55	1.43	8.78	20.16	1.03
7.07	0.92	0.09	7.08	4.04	0.05	7.11	10.04	1.66	7.10	2.72	1.39	9.30	21.32	0.71
7.32	0.98	0.08	7.34	4.23	0.00	7.37	10.37	1.58	7.35	2.89	1.36	9.82	22.39	0.41
7.57	1.04	0.06	7.59	4.43	-0.05	7.62	10.72	1.50	7.61	3.06	1.32	10.33	23.43	0.08
8.08	1.15	0.03	8.10	4.82	-0.16	8.13	11.38	1.33	8.11	3.46	1.24	11.63	25.56	-0.69
8.58	1.27	0.00	8.60	5.23	-0.27	8.64	12.02	1.17	8.62	3.91	1.14	12.92	27.17	-1.21
9.09	1.39	-0.04	9.11	5.64	-0.38	9.14	12.64	1.01	9.13	4.37	1.05	14.21	28.63	-1.73
9.59	1.51	-0.07	9.62	6.05	-0.49	9.65	13.27	0.85	9.63	4.90	0.94	15.12	29.48	-2.06
10.10	1.63	-0.10	10.12	6.44	-0.60	10.16	13.87	0.70	10.14	5.48	0.82			
11.36	1.94	-0.19	11.39	7.46	-0.88	11.43	15.23	0.34	11.41	7.03	0.49			
12.62	2.27	-0.28	12.65	8.46	-1.18	12.70	16.43	0.01	12.68	8.80	0.09			
13.89	2.60	-0.37	13.92	9.36	-1.46	13.97	17.46	-0.29	13.94	10.53	-0.31			
15.15	2.89	-0.46	15.18	10.16	-1.70	15.24	18.46	-0.56	15.21	12.43	-0.76			
16.41	3.16	-0.54	16.45	10.87	-1.90	16.51	19.31	-0.80	16.48	14.05	-1.15			
17.67	3.43	-0.61	17.71	11.54	-2.08	17.78	19.96	-1.00	17.74	15.35	-1.46			
18.94	3.68	-0.67	18.98	12.12	-2.24	19.05	20.47	-1.14	19.01	16.57	-1.75			
20.20	3.88	-0.72	20.24	12.63	-2.36	20.32	21.06	-1.23	20.28	17.60	-1.96			
									21.55	18.43	-2.13			
									22.81	19.09	-2.26			
									23.62	19.51	-2.32			

Grain Size Distribution ASTM D422

Job No. : **6428**

Project:	Polymet	Test Date:	3/7/08
Reported To:	Barr Engineering Company	Report Date:	3/11/08

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	TP-3	Bucket #11		Bulk	Fine Tailings (Silty Sand) (SM)
●					
◇					



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	24726.0		
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0		
#10	97.2		
#20	86.5		
#40	72.1		
#100	36.5		
#200	17.9		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9301 Bryant Ave. South, Suite 107

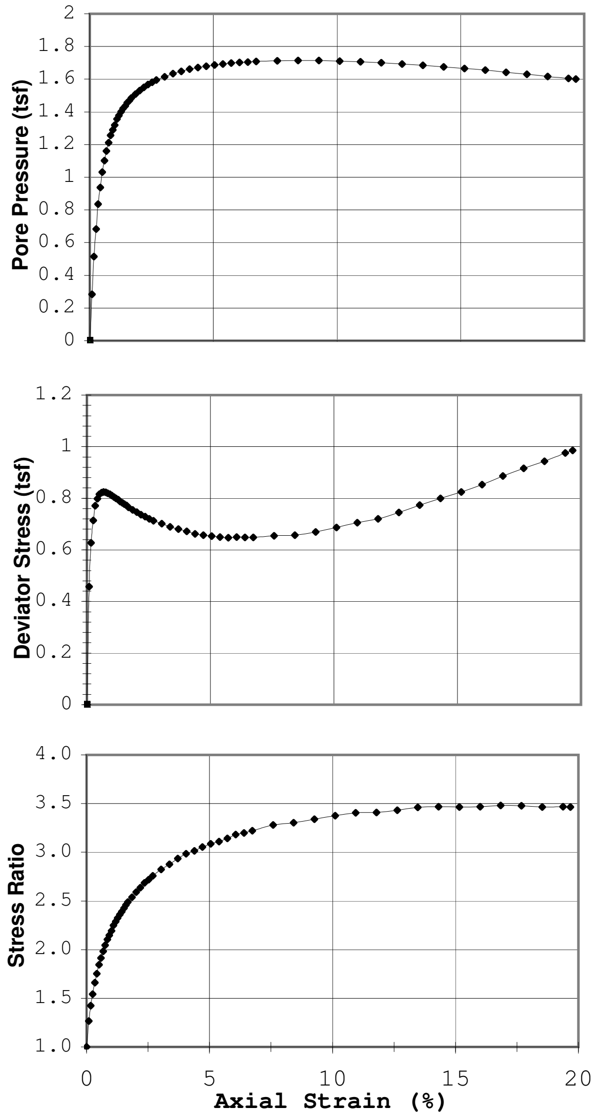
SOIL ENGINEERING TESTING, INC.

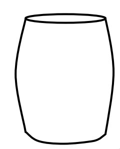
Bloomington, Minnesota 55420-3436

TRIAXIAL TEST ASTM: D 4767

Job No. **6449**
Date: **6/20/08**

Project:
Boring #: **LTV Slimes** Sample #: Type: **Remoldec** Depth (ft):
Soil Type: **Slimes**





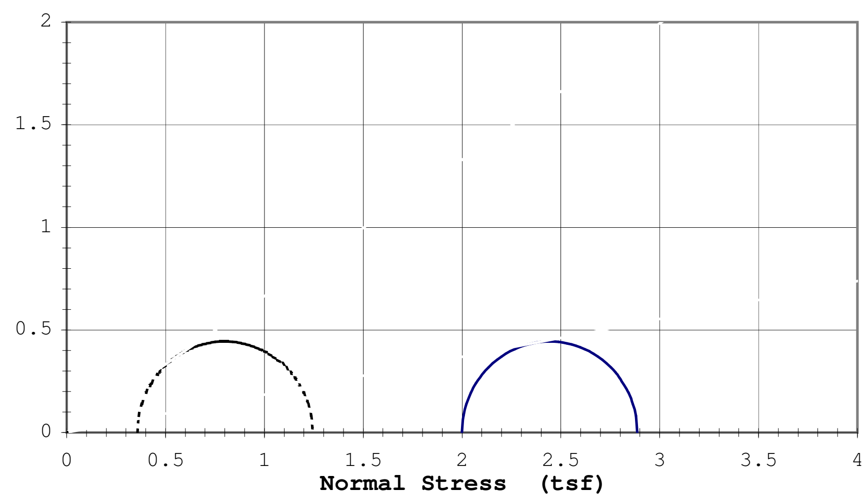
Failure Criterion:	Max. Stress Ratio
Angle of internal friction, ϕ' =	°
Apparent Cohesion, c' =	(tsf)

Test Date:	6/21/08	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.0594	Plasticity Index:	
Strain Rate (%/min):	1.000	Spec. Gravity (Assumed):	3.00

Before Consolidation	A	B	C	D	E
Diameter (in)	2.86				
Height (in)	6.02				
Water Content (%)	14.6				
Dry Density (pcf)	82.1				
Void Ratio	1.28				
After Consolidation					
Diameter (in)	2.81				
Height (in)	5.94				
Water Content (%)	38.9				
Dry Density (pcf)	86.4				
Void Ratio	1.17				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	2.00				
Peak Deviator Stress (tsf)	0.82				
Ultimate Deviator Stress (tsf)	0.99				
Deviator Stress at Failure (tsf)	0.89				
Max. Pore Pressure Buildup (tsf)	1.71				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	16.8				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely. Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



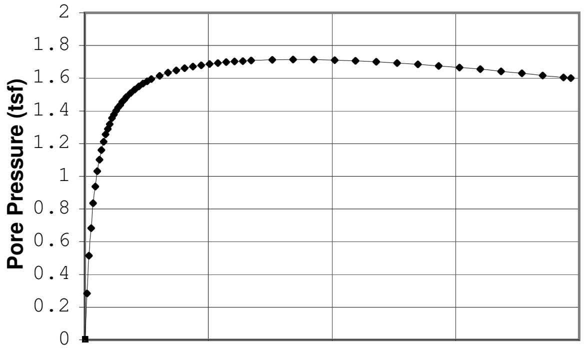
Rupture Envelope at Failure	
α = °	a = (tsf)

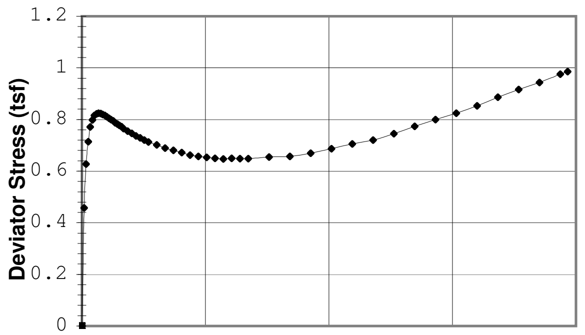
------------ Effective ϕ':	°	c'= (tsf)
________ Total ϕ':	°	c= (tsf)

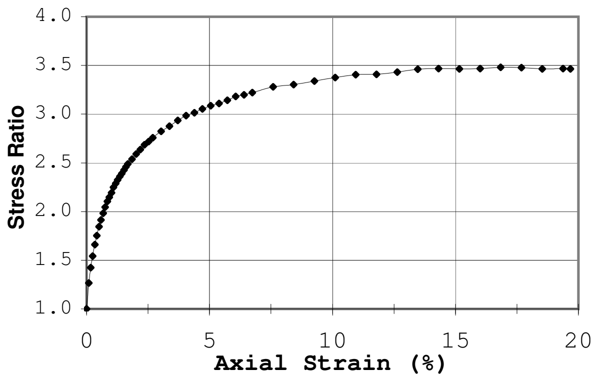
TRIAXIAL TEST ASTM: D 4767

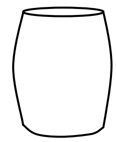
Job No. **6449**
Date: **6/20/08**

Project:
Boring #: **LTV Slimes** Sample #: Type: **Remoldec** Depth (ft):
Soil Type: **Slimes**









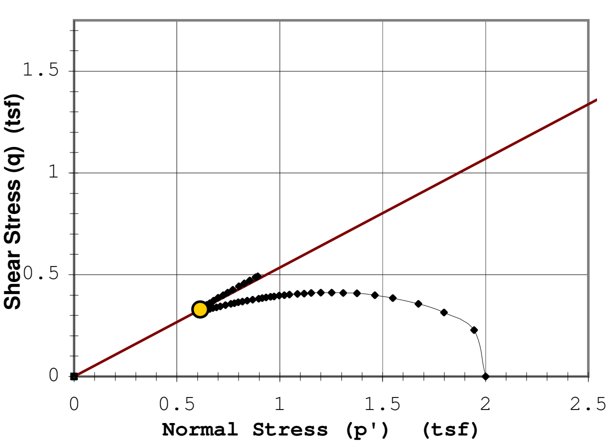
Failure Criterion:	**Max. Pore Pressure**
Angle of internal friction, ϕ' =	°
Apparent Cohesion, c' =	**(tsf)**

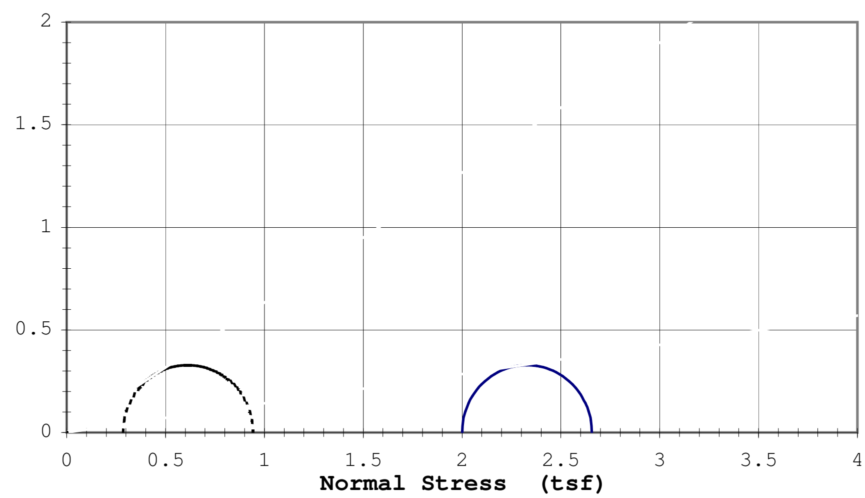
Test Date:	6/21/08	Liquid Limit:	
Test Type:	CU w/pp	Plastic Limit:	
Strain Rate (in/min):	0.0594	Plasticity Index:	
Strain Rate (%/min):	1.000	Spec. Gravity (Assumed):	3.00

Symbol		A	B	C	D	E
◆	*Before Consolidation*					
	Diameter (in)	2.86				
	Height (in)	6.02				
	Water Content (%)	14.6				
	Dry Density (pcf)	82.1				
■	Void Ratio	1.28				
	After Consolidation					
	Diameter (in)	2.81				
	Height (in)	5.94				
△	Water Content (%)	38.9				
	Dry Density (pcf)	86.4				
	Void Ratio	1.17				
	Back Pressure (tsf)	5.8				
	Minor Principal Stress (tsf)	2.00				
	Peak Deviator Stress (tsf)	0.82				
	Ultimate Deviator Stress (tsf)	0.99				
+	Deviator Stress at Failure (tsf)	0.66				
	Max. Pore Pressure Buildup (tsf)	1.71				
	Pore Pressure Parameter "B"	1.0				
	Pct. Axial Strain at Failure	8.4				
X						

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely. Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = °	a = (tsf)

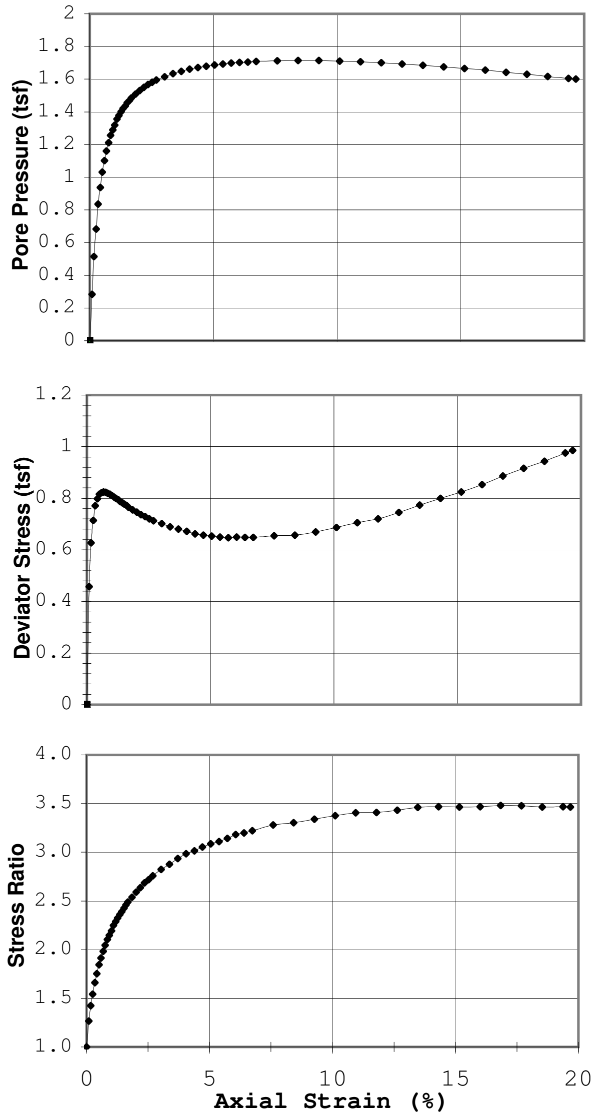
------------ Effective ϕ':	°	c'=	(tsf)
________ Total ϕ':	°	c=	(tsf)

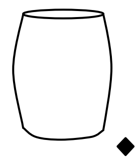
9301 Bryant Ave. South Suite #107 SOIL ENGINEERING TESTING, INC. Bloomington, Minnesota 55420-3436

TRIAXIAL TEST ASTM: D 4767

Job No. **6449**
Date: **6/20/08**

Project:
Boring #: **LTV Slimes** Sample #: Type: **Remoldec** Depth (ft):
Soil Type: **Slimes**



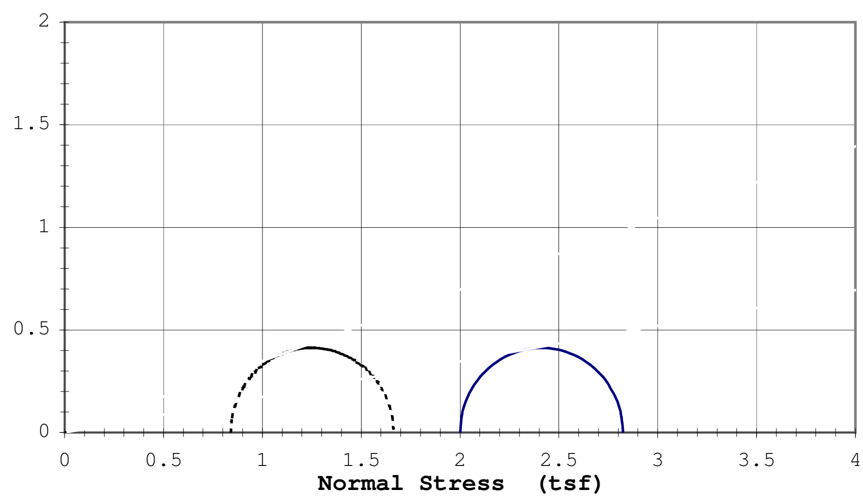


Failure Criterion:	**Max. Deviator Stress**				
Angle of internal friction, φ' =	°				
Apparent Cohesion, c' =	(tsf)				
Test Date: 6/21/08	Liquid Limit:				
Test Type: CU w/pp	Plastic Limit:				
Strain Rate (in/min): 0.0594	Plasticity Index:				
Strain Rate (%/min): 1.000	Spec. Gravity (Assumed): 3.00				
Before Consolidation	**A**	**B**	**C**	**D**	**E**
Diameter (in)	2.86				
Height (in)	6.02				
Water Content (%)	14.6				
Dry Density (pcf)	82.1				
Void Ratio	1.28				
After Consolidation					
Diameter (in)	2.81				
Height (in)	5.94				
Water Content (%)	38.9				
Dry Density (pcf)	86.4				
Void Ratio	1.17				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	2.00				
Peak Deviator Stress (tsf)	0.82				
Ultimate Deviator Stress (tsf)	0.99				
Deviator Stress at Failure (tsf)	0.82				
Max. Pore Pressure Buildup (tsf)	1.71				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	0.7				

Symbols: ◆ ■ △ + X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely. Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



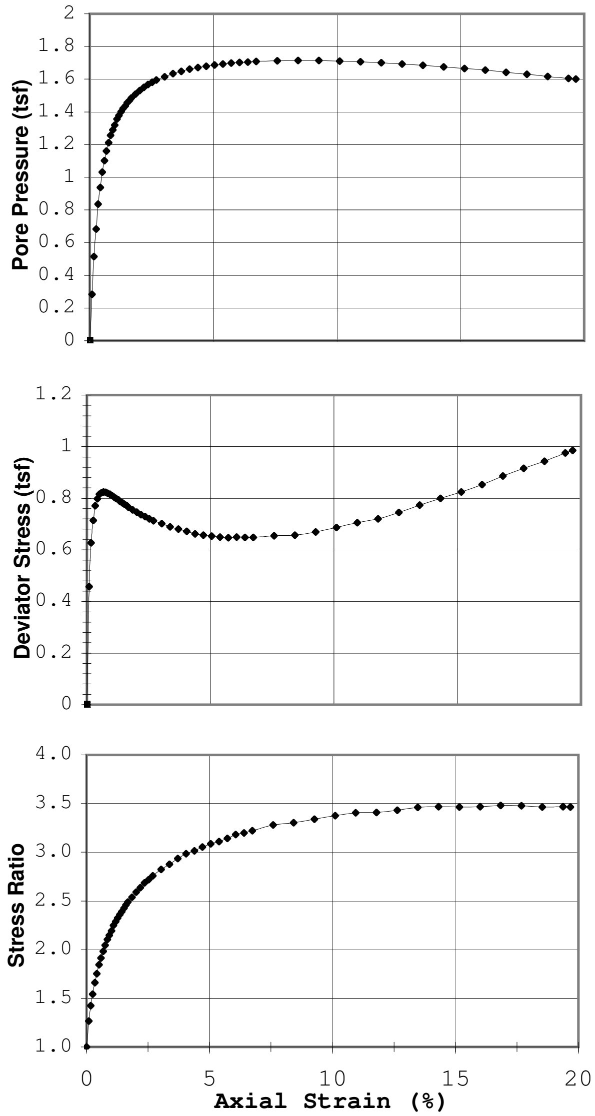
Rupture Envelope at Failure	
α = °	a = (tsf)

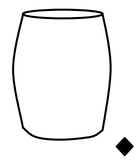
------------ Effective φ': °	c'=	(tsf)
________ Total φ': °	c=	(tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **6449**
Date: **6/20/08**

Project:
Boring #: **LTV Slimes** Sample #: Type: **Remoldec** Depth (ft):
Soil Type: **Slimes**



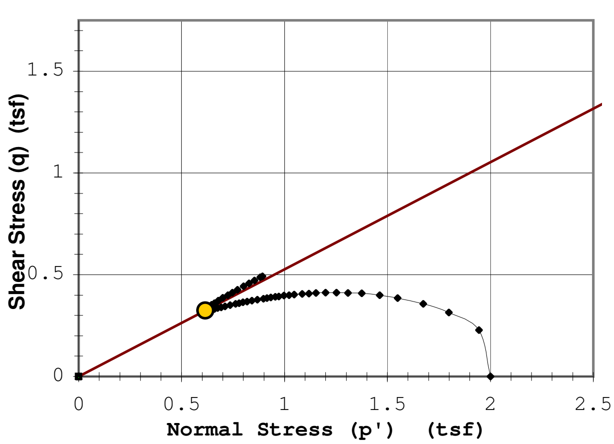


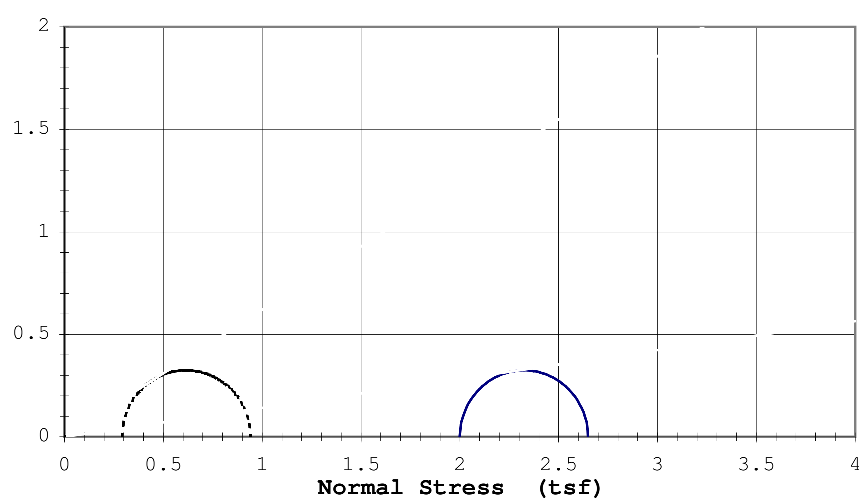
Failure Criterion:	**Given Strain of: 7.5%**				
Angle of internal friction, ϕ' =	°				
Apparent Cohesion, c' =	**(tsf)**				
Test Date:	6/21/08	Liquid Limit:			
Test Type:	CU w/pp	Plastic Limit:			
Strain Rate (in/min):	0.0594	Plasticity Index:			
Strain Rate (%/min):	1.000	Spec. Gravity (Assumed):	3.00		

Before Consolidation	A	B	C	D	E
Diameter (in)	2.86				
Height (in)	6.02				
Water Content (%)	14.6				
Dry Density (pcf)	82.1				
Void Ratio	1.28				
After Consolidation					
Diameter (in)	2.81				
Height (in)	5.94				
Water Content (%)	38.9				
Dry Density (pcf)	86.4				
Void Ratio	1.17				
Back Pressure (tsf)	5.8				
Minor Principal Stress (tsf)	2.00				
Peak Deviator Stress (tsf)	0.82				
Ultimate Deviator Stress (tsf)	0.99				
Deviator Stress at Failure (tsf)	0.65				
Max. Pore Pressure Buildup (tsf)	1.71				
Pore Pressure Parameter "B"	1.0				
Pct. Axial Strain at Failure	7.5				

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen compacted loosely. Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure			
α =	°	a =	(tsf)

------------	Effective ϕ':	°	c'=	(tsf)
________	Total ϕ':	°	c=	(tsf)

Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00												
0.09	0.46	0.28												
0.17	0.63	0.51												
0.25	0.71	0.68												
0.34	0.77	0.84												
0.42	0.80	0.94												
0.51	0.82	1.03												
0.59	0.82	1.10												
0.67	0.82	1.16												
0.76	0.82	1.21												
0.84	0.82	1.26												
0.93	0.82	1.29												
1.01	0.81	1.32												
1.10	0.81	1.36												
1.18	0.80	1.38												
1.26	0.79	1.40												
1.35	0.79	1.42												
1.43	0.78	1.44												
1.52	0.78	1.46												
1.60	0.77	1.47												
1.68	0.77	1.49												
1.85	0.75	1.51												
2.02	0.75	1.53												
2.19	0.74	1.55												
2.36	0.73	1.57												
2.53	0.72	1.58												
2.70	0.71	1.59												
3.03	0.70	1.62												
3.37	0.69	1.63												
3.71	0.68	1.65												
4.04	0.67	1.66												
4.38	0.66	1.67												
4.72	0.66	1.68												
5.05	0.65	1.69												
5.39	0.65	1.69												
5.73	0.65	1.70												
6.06	0.65	1.70												
6.40	0.65	1.71												
6.74	0.65	1.71												
7.58	0.65	1.71												
8.42	0.66	1.71												
9.26	0.67	1.71												
10.11	0.69	1.71												
10.95	0.71	1.71												
11.79	0.72	1.70												
12.63	0.75	1.69												
13.47	0.77	1.69												
14.32	0.80	1.68												
15.16	0.82	1.67												
16.00	0.85	1.65												
16.84	0.89	1.64												
17.68	0.92	1.63												
18.53	0.94	1.62												
19.37	0.98	1.61												
19.67	0.99	1.60												

Attachment F

2014 Geotechnical Investigation Report

Winter 2013/2014 Geotechnical Investigation

Prepared for
Poly Met Mining Inc.

December 2014

Winter 2013/2014 Geotechnical Investigation
Poly Met Mining Inc.

Hoyt Lakes, Minnesota

December 2014

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List of Exhibits

Certifications

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

Draft

Thomas J. Radue, P.E. PE #20951	December 30, 2014

Executive Summary

During winter 2013/2014, Barr Engineering Co. (Barr) under authorization and contract with Poly Met Mining Inc. (PolyMet) completed a geotechnical investigation at the NorthMet Plant Site with two objectives:

- to provide additional detail on existing conditions along the Tailings Basin toe of dam, to support design of the Flotation Tailings Basin (FTB) Seepage Containment System
- to provide additional detail on stratigraphy in Tailings Basin Cells 1E and 2E to support stability modeling and FTB design

Investigation for the FTB Containment System consisted of two separate field studies: the first study included Rotasonic borings and installation of standpipe piezometers, then performing slug tests in the standpipe piezometers. The second study included standard penetration test (SPT) drilling, collection of undisturbed samples in surficial deposits, rock coring, packer testing in bedrock, and in-laboratory testing of materials. Field study results along the FTB Containment System alignment are summarized below.

- The surficial deposits along the northern and western toe of the Tailings Basin vary in thickness by test location but stratigraphy is generalized as follows, from the top down:
- peat.; 0 to 20 feet thick
- tailings; 0 to 17 feet thick, in isolated locations
- silty sand; 0 to 6 of feet thick, fine to coarse grained, with various amounts of clay
- glacial till; 5 to 36.5 feet thick, with cobbles and boulders interspersed, varying in size from <1 foot to approximately 4 feet in diameter
- Depth to bedrock ranges from 2 to 47 feet with an average depth of approximately 20 feet.
- Groundwater levels were at the surface or just below.
- Hydraulic conductivity of the glacial till ranged from 1.5×10^{-3} ft/s (4.6×10^{-2} cm/s) to 1.7×10^{-6} ft/s (5.2×10^{-5} cm/s) with a geometric mean of 5.1×10^{-5} ft/s (1.5×10^{-3} cm/s).
- Hydraulic conductivity of the upper portion of the bedrock ranged from effectively 0 (the borehole produced no water) to 2.4×10^{-5} ft/s (7.3×10^{-4} cm/s), with a geometric mean (excluding the zero inflow locations) of 1.9×10^{-6} ft/s (5.8×10^{-5} cm/s).

These results support the following findings:

- Soils suitable for installation of a cutoff wall exist along the proposed FTB Containment System alignment.

- At isolated locations (e.g., B-14-44 and B-14-65) deep pockets of tailings and peat may need to be excavated prior to construction.

- When selecting construction methods, the FTB Containment System construction contractor will need to consider the presence of cobbles and boulders in the till.

The Cell 1E/ 2E investigation consisted of cone penetration test (CPT) soundings. Field study results within the existing Tailings Basin are summarized below.

- There has been little to no strength increase of the tailings in Cell 1E and 2E since 2007.

- Additional stratigraphic information confirmed existing information and filled data gaps.

- The phreatic surface in Cell 2E has decreased approximately 5 feet since 2007. In Cell 1E the phreatic surface has increased approximately 25 feet since 2007 due to recent pumping of excess water into this basin.

1.0 Introduction

This report describes the Geotechnical Investigation performed during the winter of 2013/2014 at the former LTV Steel Mining Company (LTVSMC) Tailings Basin located at Poly Met Mining Inc.'s (Poly Met) NorthMet Plant Site. PolyMet plans to build the Flotation Tailings Basin (FTB) atop the existing Tailings Basin Cells 1E and 2E to store future NorthMet Flotation Tailings. In this report, the FTB is the newly constructed NorthMet Flotation Tailings impoundment, and the Tailings Basin is the existing LTVSMC tailings basin as well as the combined LTVSMC tailings basin and the FTB.

In order to manage potential water quality impacts from the Tailings Basin, PolyMet plans to install the FTB Containment System along the northern, western, and portions of the eastern sides of the Tailings Basin. The FTB Containment System will consist of a cutoff wall and a collection trench to capture seepage from the Tailings Basin, installed approximately 200 feet downstream from the toe of the Tailings Basin.

This document summarizes methods and results of the 2014 geotechnical investigation, which had two objectives:

- provide additional detail on existing conditions along the Tailings Basin toes to support design of the FTB Containment System
- provide additional detail on stratigraphy in Tailings Basin Cells 1E and 2E to support stability modeling and FTB design

1.1 Site Description

The NorthMet Project (Project) is located approximately five miles north of Hoyt Lakes, Minnesota, in St. Louis County as shown in Large Figure 1. Large Figure 2 shows the general site layout, including the existing Tailings Basin consisting of Cells 1W, 1E and 2E.

Native unconsolidated deposits at the Plant Site are a relatively thin mantle of glacial till and associated reworked sediments. In places the glacial deposits are overlain by a varying thickness of peat.

The uppermost bedrock unit is the Precambrian Giant's Range granite. Depth to bedrock is generally less than 50 feet, although the thickness of the native sediments beneath the existing Tailings Basin is unknown. There are two outcrops of bedrock that abut the southeastern corner of Cell 1E at the Tailings Basin that consist of schist of sedimentary and volcanic origin.

Much of the area between the Tailings Basin and the Embarrass River, to the north of Cells 2W and 2E, is covered by wetlands that are groundwater fed and represent surficial expressions of the water table.

1.2 Investigation Overview

The investigation targeted locations that are only accessible to heavy equipment when the ground is frozen, so the fieldwork was scheduled for winter and early spring when there was deep snowpack and below-freezing temperatures. Barr assisted PolyMet with the development of winter roads to provide access to proposed geotechnical drilling locations. Geotechnical drilling locations and access routes were chosen to avoid wetlands, open water, and areas too steep to allow safe drill rig descent. Existing ramps and trails were used as much as possible. The geotechnical field test locations are shown on Large Figure 2.

Two separate field studies were performed along the FTB Containment System alignment. The first included Rotasonic borings and installation of standpipe piezometers, with subsequent slug testing of the new piezometers installed in glacial till, as described in Section 2.0. The second included standard penetration test (SPT) drilling, collection of undisturbed samples in surficial deposits, rock coring and packer testing in bedrock, and laboratory testing, as described in Section 3.0. The field investigations were performed to evaluate:

- soil type and thickness
- presence of cobbles and boulders within the glacial till
- depth to bedrock
- groundwater levels
- hydraulic conductivity of the soils and bedrock

Field work performed in Tailings Basin Cells 1E and 2E included cone penetration test (CPT) soundings, as described in Section 4.0, to:

- confirm the strength, compressibility, stiffness, and density characteristics of the existing tailings
- evaluate if consolidation has occurred since the close of the LTVSMC mine in 2001 and since previous testing was performed in 2007
- fill stratigraphy gaps along three previously identified cross-sections analyzed for slope stability of the proposed FTB

2.0 Rotasonic Work

As part of the FTB Containment System investigation, the Rotasonic work consisted of Rotasonic coring and collection of soil and rock samples, installation of standpipe piezometers, and slug testing. The Rotasonic work began on March 10, 2014 and was completed on March 18, 2014. During this time, ground conditions remained frozen and temperatures remained below freezing. A total of 22 Rotasonic borings were performed as part of the work including: R14-02, 04, 05, 06, 07, 08, 09, 10, 10A, 11, 12, 13, 15, 16, 20, 24, 25, 26, 27, 28, 29, and 30 (Large Figure 2). The Rotasonic logs are provided in Exhibit A.

Large Figure 2 shows the overall project layout. Large Figure 3 shows the locations of only the Rotasonic borings completed for the project and identifies which Rotasonic locations had instrumentation installed in the hole once drilling was complete. Boring coordinates, depth of bedrock, depth of water table, stationing, and piezometer installation information are included in Table 2-1 .

2.1 Field Work

2.1.1 Rotasonic Cores

There were 30 proposed Rotasonic locations; however, due to open water conditions, some of the proposed locations were not accessible and therefore a total of 22 Rotasonic cores were completed. The naming convention for the Rotasonic locations begins with a capital R, the year (14 for 2014), and the location number. For example, R14-01 is a Rotasonic hole that was performed in 2014 and is identified as location 01. Each location was drilled to the assumed top of bedrock, and usually extended an additional 3 to 8.5 feet into competent rock to confirm that bedrock, rather than a boulder, was encountered. If rock was encountered shallower than anticipated, offset holes were performed as needed to confirm bedrock depth. Water levels were also recorded during the investigation, providing an approximate depth to groundwater (described in Section 5.1.3). Note that these water levels are not actual phreatic surface values and thus locations R14-15, 20, 24, and 27 reported a water level deeper than is expected to be encountered during construction.

All locations were cored along the proposed FTB Containment System alignment, approximately 200 feet downstream from the toe of the Tailings Basin. The Rotasonic drilling was performed by Cascade Drilling out of Little Falls, Minnesota. Soil sampling and classification was performed by a Barr representative on site during the entire field investigation. Samples were collected representing the core and also any unusual or unique soils. All work was performed in accordance with ASTM D5092 and soil samples were classified based on the United States Classification System (USCS). All samples were sealed in bags in the field in order to preserve the in-situ moisture content.

Table 2-1 Flotation Tailings Basin Containment System SPT Borehole and Rotasonic Borehole Installation Summary

Borehole	Station(1)	Piezo-meter Installed	Packer Test Performed	Ground Surface Elevation(3) (feet)	Coordinates [NAD83 MN State Plane] Easting	Northing	Estimated Depth to Bedrock(2) (feet)	Actual Depth to Weathered Bedrock (feet)	Actual Depth to Competent Bedrock (feet)	Total Drilled (incl. Rock Coring) (feet)
SPT Borings										
B14-36	19+54		x	1554.7	2,857,818.0	735,479.9	14	--	13.5	26.5
B14-40	35+25			1534.0	2,857,381.9	736,963.9	16	--	15.0	30.5
B14-44	55+48		x	1502.9	2,857,382.8	738,984.5	28	31.5	36.5	46.0
B14-48	74+92			1491.8	2,857,452.1	740,886.7	34	9.5	15	25
B14-52	96+85			1486.0	2,858,667.8	742,396.5	42	--	47.0	65.8
B14-55	115+34		x	1494.8	2,860,494.0	742,451.6	20	30.0	39.0	50.5
B14-62	152+53			1493.3	2,863,894.1	743,327.3	30	17.0	>27.0	27.0
B14-65	162+85		x	1487.2	2,864,926.5	743,316.0	20	20.5	22.0	37.0
B14-69	178+36			1485.1	2,866,416.5	743,207.5	20	29.0	>34.0	34.0
B14-72	192+86			1493.0	2,867,866.5	743,232.9	5	--	10.0	25.0
B14-76	213+12		x	1501.2	2,869,888.1	743,328.6	10	25.0	27.0	42.5
B14-80	235+33			1523.4	2,870,717.9	741,777.3	6	--	10.0	21.0
Rotasonic Borings										
R14-02	7+15			1566.4	2,858,091.9	734,259.7	8	--	7.5	11.0
R14-04	22+07	x		1545.4	2,857,633.8	735,679.7	14	12.0	13.0	15.0
R14-05	31+64			1539.3	2,857,437.1	736,606.1	16	7.0	8.5	15.0
R14-06	40+50	x		1526.4	2,857,364.4	737,489.5	20	17.0	17.5	20.0
R14-07	49+76			1504.9	2,857,400.7	738,412.4	19	--	5.3	12.0

Borehole	Station(1)	Piezo-meter Installed	Packer Test Performed	Ground Surface Elevation(3)	Coordinates [NAD83 MN State Plane]		Estimated Depth to Bedrock(2)	Actual Depth to Weathered Bedrock	Actual Depth to Competent Bedrock	Total Drilled (incl. Rock Coring)
				(feet)	Easting	Northing	(feet)	(feet)	(feet)	(feet)
R14-08	58+50	x		1502.8	2,857,372.0	739,287.6	27	--	21.0	24.0
R14-09	67+90			1493.3	2,857,373.8	740,225.4	26	13.0	15.0	19.0
R14-10	76+99			1492.8	2,857,371.8	741,099.5	29	--	2.0	10.0
R14-10A	78+81			1493.0	2,857,400.1	741,279.3	29	--	14.0	21.0
R14-11	85+72			1483.1	2,857,729.4	741,794.5	35	--	10.0	16.0
R14-12	95+14	x		1480.3	2,858,500.4	742,311.8	35	--	31.0	35.0
R14-13	103+85	x		1489.1	2,859,372.0	742,310.5	35	--	39.0	45.0
R14-15	116+67	x		1494.8	2,860,626.1	742,493.1	29	--	32.0	35.0
R14-16	124+31	x		1507.6	2,861,262.2	742,916.4	26	--	25.5	30.0
R14-20	156+61			1487.3	2,864,302.4	743,246.7	23	--	31.0	35.0
R14-24	186+08			1491.1	2,867,188.8	743,227.5	7	--	5.5	14.0
R14-25	196+47			1497.2	2,868,226.9	743,227.7	2	--	3.5	10.5
R14-26	206+41	x		1502.5	2,869,216.9	743,283.6	2	--	21.5	28.0
R14-27	216+26	x		1502.8	2,870,201.4	743,350.1	8	--	26.0	30.0
R14-28	226+60	x		1509.5	2,870,734.5	742,651.3	14	--	10.5	16.5
R14-29	232+26			1521.5	2,870,713.4	742,084.4	10	--	29.0	34.0
R14-30	238+49			1529.2	2,870,719.3	741,461.2	3	--	26.0	29.0

(1) Borehole station location is shown (±25 feet). Actual station location may vary due to offsets.
(2) Estimated depth to bedrock was based on previously available GIS maps and boring logs.
(3) Ground surface elevations are based on 2010 LIDAR data.

2.1.2 Piezometer Installation

Standpipe piezometers were installed in ten (10) Rotasonic boreholes (R14-04, 06, 08, 12, 13, 15, 16, 26, 27, and 28) to depths ranging from 10 to 35 feet. The piezometers consist of a PVC riser with a 5-foot screened tip at the bottom. Sand pack was placed in the annulus around the screened interval and a bentonite seal was placed above the sand pack to isolate the porewater pressure in the screened interval. The piezometers were then backfilled with bentonite grout to prevent unwanted vertical migration of water. The screened zone was installed in glacial till at depths that were determined at the time of drilling and typically corresponded to zones assumed to have a higher permeability than the surrounding soil, usually located just above bedrock. Table 2-2 summarizes the piezometer installations. Piezometer logs are provided in Exhibit B.

Table 2-2 Piezometer Summary

Instrument Name	Coordinates [NAD83 MN State Plane]		Ground Elevation [ft]	Instrument Tip Elevation [ft]	Instrument Tip Depth [ft]
	Easting	Northing			
R14-04	2,857,633.8	735,679.7	1545.4	1534.4	10
R14-06	2,857,364.4	737,489.5	1526.4	1509.4	17
R14-08	2,857,372.0	739,287.6	1502.8	1482.3	20.5
R14-12	2,858,500.4	742,311.8	1480.3	1460.3	20
R14-13	2,859,372.0	742,310.5	1489.1	1454.1	35
R14-15	2,860,626.1	742,493.1	1494.8	1463.8	31
R14-16	2,861,262.2	742,916.4	1507.6	1482.6	25
R14-26	2,869,216.9	743,283.6	1502.5	1482.5	20
R14-27	2,870,201.4	743,350.1	1502.8	1477.8	25
R14-28	2,870,734.5	742,651.3	1509.5	1499.5	10

The piezometers were bailed three times during the geotechnical investigation by Barr field staff in order to develop the wells and establish flow through the screens. Water level readings were recorded using a water level indicator. Readings were taken just before the wells were bailed and approximately 12 hours later to allow the levels to stabilize. Once water levels were stabilized, slug tests were performed in the wells shortly after.

2.2 Slug Testing

After the wells were fully developed, Barr staff performed slug testing in all ten of the standpipe piezometers, and in several monitoring wells (GW001, GW006, GW007, and GW012) that were accessible and had been installed in 2008.

The slug tests used a solid piece of PVC pipe to rapidly displace the static water level in the piezometer or well. The slug testing was performed with 5-foot or 2.5-foot long, 1-inch diameter PVC slugs. Three sets of tests (slug in and slug out for each test) were performed in each piezometer. The first and third test was performed with the 5-foot slug and the second test was performed with the 2.5-foot slug to confirm repeatability. A slug test in which the displacement is initiated by rapidly lowering a slug below the water level is referred to as a slug-in or falling-head test; a slug-out or rising-head test is one in which the slug is rapidly removed. The resulting water-level recovery to static, pre-test conditions was monitored using a data-logging pressure transducer (InSitu – LevelTroll 700). Slug testing results are provided in Exhibit C.

3.0 SPT Work

The SPT work was performed by Braun Intertec (Braun) out of their Duluth, Minnesota, office. An all-terrain drill rig was mobilized to the site to conduct the borings utilizing hollow-stem auger methods at shallow depths and via mud rotary at greater depths below the water table.

Soil sampling and material classification was performed at 2.5-foot intervals to a depth of 10 feet and at 5-foot intervals thereafter. All split spoon sampling and standard penetration testing was performed in accordance with ASTM D1586. Soft clay and organic soil samples were collected with 3-inch thin-wall samplers, when feasible, in accordance with ASTM D1587. All soil samples were sealed in the field in order to preserve the in-situ moisture content. Samples were transported to the Soil Engineering Testing Inc. (SET) laboratory in Richfield, Minnesota, for testing.

Coring was performed when apparent bedrock was encountered, typically indicated by SPT results in excess of 50 blows for less than one-half foot of penetration. Packer testing was also performed in the bedrock. Copies of the boring logs are provided in Exhibit D.

The SPT work began on March 26, 2014 and was completed on May 20, 2014. The highest priority locations were completed first in order to avoid wetland disturbance. Ground conditions remained frozen until approximately April 17, 2014. The locations completed before April 17 included B14-44, B14-65, B14-69, B14-72, B14-76, and B14-80. These were priority locations; most of them were located in documented wetlands. The next three borings (B14-52, B14-55, and B14-62) were located on high ground, where there were no open water concerns or wetlands disturbance issues. However; because of the thawed conditions, access limitations required that the last three borings (B14-46, B14-40, and B14-48) be offset from their initial staked locations to higher ground so that no drilling occurred in known wetlands locations.

Large Figure 2 shows the overall project layout, including the SPT investigation locations. Large Figure 4 shows the plan location of all SPT locations completed for the project and which SPT boreholes had packer testing performed in the bedrock. Boring coordinates, depth of bedrock, depth of water table, stationing, and whether packer testing was performed is included in Table 2-1.

3.1 Field Work

3.1.1 SPT Soil Borings

A total of 12 soil borings were performed. Where possible, soil borings were completed along the proposed FTB Containment System alignment. Due to wetlands access issues because of spring thaw, two of the proposed locations were offset towards the Tailings basin. Soil borings were drilled to the top of bedrock, except where noted. B14-62 was abandoned in a boulder field at 27 feet due to difficult drilling conditions and time and resource constraints. B14-69 was abandoned when artesian flow was encountered in weathered bedrock.

3.1.2 In situ Testing

3.1.2.1 Standard Penetration Tests

Standard Penetration Tests (SPT) were performed on soils at the site to supplement the suite of laboratory tests performed on soil samples, to aid in material classification, and to estimate strength properties. SPTs were performed in accordance with ASTM D1586. The number of blow counts, or the N-value, required to advance the sampler 1 foot into the ground is the standard penetration resistance of the soil. A summary of corrected N-values is provided in Table 3-1. These N-values were not corrected for overburden stress, hammer efficiency, borehole diameter, sampling method, and rod length. The average N-value for all of the SPT samples is 35 blows/foot.

Table 3-1 Blow Count Summary

Boring	Number of SPT Samples	Minimum	Maximum	Average
B14-36	5	6	50/3"	66
B14-40	4	28	58	42
B14-44	9	2	50/2"	37
B14-48	4	WH(1)	72/8"	29
B14-52	10	5	50/2.5"	23
B14-55	10	5	50/3"	34
B14-62	5	23	50/4"	55
B14-65	5	1	14	5
B14-69	8	WH(1)	61	24
B14-72	5	14	50/5"	43
B14-76	6	WH(1)	90	25
B14-80	4	14	50/1"	70

(1) WH = weight of hammer

Large Figure 5 plots the blow counts versus depth for each boring location. The varying amount of sand, clay, and gravel within each sample led to high variability in the blow count values within each boring and between boring locations, as would be expected in variable soil types. Note that some N-values in excess of 100 blows/foot were reported, however these are not shown on Large Figure 5 to maintain a readable scale on the x-axis at lower N-values.

3.1.2.2 Undisturbed Samples

A limited number of thin-wall samples were collected in the peat. Five of the nine thin-wall sample attempts were successful and resulted in acceptable sample recovery for testing. Thin-wall samples are important because they provide a soil sample that is relatively undisturbed by the sampling technique. An undisturbed sample provides ideal laboratory strength testing material because it is representative of the in-situ soil, whereas split-barrel samples from SPTs are considered “disturbed” samples and are used primarily for index testing of moisture contents and Atterberg limits.

Retrieval of undisturbed samples was attempted several times in the glacial till but due to difficult sampling conditions and high gravel content, no samples were successfully obtained. For this reason, all laboratory tests performed on glacial till material are on disturbed or remolded samples.

3.1.3 Rock Cores

The bedrock encountered was strong to very strong with zones that appear to have previously been highly fractured, but are now filled in with green and red cohesive sediment. Fractures were present in most of the cored bedrock from the site and the rock cores were considered to be slightly to moderately fractured. Bedrock contained horizontal fractures, vertical fractures, and fractures ranging from 45 to 65 degrees from the horizontal plane. The fractures are slightly decomposed and occasionally were in-filled with non-cohesive sediment. The fracturing was most prevalent in the upper 5 to 10 feet of bedrock. A summary of the rock quality designation (RQD) is provided in Table 3-2.

Table 3-2 Rock Quality Designation Summary

Borehole	Depth (feet)	Average Test Depth (feet)	Test Elevation (feet)	Rock Quality Designation (RQD)
B14-36	13.5-17.5	15.5	1539.2	77
	17.5-21.5	19.5	1535.2	48
	21.5-26.5	24	1530.7	100
B14-40	15.5-20.5	18	1516	68
	20.5-25.5	23	1511	47
	25.5-30.5	28	1506	92
B14-44	31.5-37	34	1468.9	33
	37-42	39.5	1463.4	77
	42-46	44	1458.9	92
B14-48	11-15	13	1478.8	15
	15-20	17.5	1474.3	72
	20-25	22.5	1469.3	88

Borehole	Depth (feet)	Average Test Depth (feet)	Test Elevation (feet)	Rock Quality Designation (RQD)
B14-52	42.5-44	43	1443	100
	44-47	45.5	1440.5	100
	50-55	52.5	1433.5	86
	55-59	57	1429	84
	59-61.5	60.5	1425.5	90
	63.5-65.8	64.5	1421.5	75
B14-55	35.5-39	38.5	1456.3	33
	39-44	41.5	1453.3	63
	44-47.5	46	1448.8	85
	47.5-50.5	49	1445.8	91
B14-62	17-20	18.5	1474.8	53
	20-25	22.5	1470.8	13
	25-27	26	1467.3	0
B14-65	22-27	24.5	1462.7	86
	27-32	29.5	1457.7	80
	32-37	34.5	1452.7	51
B14-69	29-34	31.5	1453.6	20
B14-72	11-16	13.5	1479.5	63
	16-21	18.5	1474.5	50
	21-25	23	1470	56
B14-76	27-30	28.5	1472.7	53
	30-35	32.5	1468.7	87
	35-40	37.5	1463.7	53
	40-42.5	41.5	1459.7	63
B14-80	11.5-16.5	14	1509.4	67.5
	16.5-19.5	18	1505.4	79
	19.5-21	20.5	1502.9	100

The Duluth Complex rock at NorthMet is massive with fractures being observed near the surface. RQD data from this coring indicate that rock quality is good to excellent, with an average RQD for the Duluth Complex starting 40 feet below ground surface of 84%. At depths less than 40 feet, rock quality is fair to excellent, with an average RQD of 62%. The 10-foot moving average of RQD with depth within the Duluth Complex is shown in Large Figure 6.

3.1.4 Packer Testing

Packer testing was performed in five of the 12 boring locations. Several testing intervals were performed in bedrock so there ranged from one to three packer tests per boring location. The packer testing interval was determined in the field with the intent to obtain the most representative data possible and provide hydraulic conductivity values of the bedrock.

Calibration of the flow meter, gages, and head loss was initially conducted before any of the packer testing began. All calibration was performed according to the standard methods in USBR 7310-89 (Reference (1)). Calibration of the flow meter and pressure gages confirmed that the parts being used were accurate. For data analysis purposes, a typical head loss value of 0.10 ft/ft was assumed based on the pipe diameter, pipe material, and pressure readings.

Packer testing methods outlined in Reference (1) were followed in order to obtain results that could be replicated and were consistent for each testing interval. Packer testing readings were performed by Barr personnel in accordance with the USBR 7310-89 guidelines. For appropriate situations, a single- or double-packer was used. All packer tests were performed at the same pressure increments of 15, 30, and 45 psi for 1-minute intervals. Observations of flow were made every minute until three consecutive, consistent readings were taken representing steady-state flow. The pressure was then increased for three equal increments, followed by two decreasing pressures.

Packer tests are summarized in Table 3-3 and results are provided in Exhibit E. The results presented are the lowest permeability values from the first three pressure increments for each test location. This is a conservative value most likely to represent in-situ, or laminar flow through a porous media, for steady-state conditions. Packer testing in zones containing factures had a higher average hydraulic conductivity than tests in bedrock without fracturing.

Table 3-3 Packer Test Summary

Boring	Depth [ft]	Test Length [ft]	Packer	RQD	Permeability [ft/sec]	Permeability [cm/sec]
B14-36	14 - 18.5	4.5	Double	93	0(1)	0(1)
B14-36	20.5 - 26.5	6.0	Single	83	4.8E-08	1.4E-06
B14-55	37 - 41.5	4.5	Single	30	2.4E-05	7.2E-04
B14-55	41.5 - 46.5	5.0	Double	100	0(1)	0(1)
B14-55	46 - 50.5	4.5	Single	48	0(1)	0(1)
B14-44	34 - 42	8.0	Single	69	1.3E-06	3.9E-05
B14-44	42 - 46	4.0	Double	92	1.9E-06	5.8E-05
B14-65	24 - 30	6.0	Double	81	1.7E-06	5.2E-05
B14-65	27.5 - 33.5	6.0	Double	74	6.2E-06	1.9E-04
B14-72	37 - 42	5.0	Single	70	3.0E-06	9.0E-05

(1) Indicates no flow accepted into formation during packer testing.

3.2 Laboratory Testing

The following tests were performed by Soil Engineering Testing (SET) on undisturbed peat samples collected during the investigation:

- Moisture content tests were performed in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass."
- Atterberg Limit determinations were made in accordance with ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils".
- Organic content tests were performed in accordance with ASTM D2974, "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils".
- Consolidated-Undrained triaxial compressive strength tests were performed in accordance with ASTM D4767, "Standard Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils".
- Consolidation tests were performed in accordance with ASTM D2435, "Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading".
- Hydraulic Conductivity tests were performed in accordance with ATSM D5084, "Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter".

The following tests were performed by Soil Engineering Testing (SET) on jar samples collected during the investigation:

- Moisture content tests were performed in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass".
- Atterberg Limit determinations were made in accordance with ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils".
- Sieve and hydrometer analysis were performed in accordance with ASTM D422, "Standard Test Method for Particle-Size Analysis of Soils".
- Dry density tests were performed in accordance with ASTM D7263, "Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens".
- Direct shear testing was performed in accordance with ASTM D3080, "Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions".
- Standard Proctor Density determinations were in accordance with ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))".
- Consolidation tests were performed in accordance with ASTM D2435, "Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading".

All laboratory test results are provided in Exhibit F.

4.0 CPT Work

The CPT work, conducted in April of 2014, consisted of 14 CPT soundings in Cells 1E and 2E. Porewater pressure dissipation testing (PPD) was also performed in 11 of the 14 CPT locations. The CPT investigation was performed by Twin Ports Testing Inc. (TPT) of Superior, Wisconsin. CPT soundings were performed to evaluate the strength, compressibility, stiffness, and density characteristics of the tailings impounded in the FTB and to fill stratigraphy gaps along three previously identified cross-sections analyzed for slope stability of the proposed FTB. Large Figure 7 shows the CPT investigation locations. A summary of the CPT investigation is provided in Table 4-1.

Table 4-1 CPT Investigation Summary

CPT Sounding	Previous Sounding	Section	Cell	Total Depth [ft]	Number of PPD Tests Performed
CPT14-04	07-04B	F	Cell 2E	47.5	0
CPT14-05	07-05	F	Cell 2E	100.8	2
CPT14-06	07-06	F	Cell 2E	71	2
CPT14-17	07-27	F	Cell 2E	72.8	2
CPT14-18	-	F	Cell 2E	76.4	2
CPT14-20	F-2	F	Cell 2E	107.4	2
CPT14-21	F-3	F	Cell 2E	51.5	0
CPT14-22	b/w 07-05 and 07-06	F	Cell 2E	82.7	4
CPT14-07	07-07C	G	Cell 2E	54.8	1
CPT14-08	07-08	G	Cell 2E	71.7	2
CPT14-09	07-09	G	Cell 2E	32.2	1
CPT14-14	07-14	N	Cell 1E	74.2	0
CPT14-15	07-15	N	Cell 1E	111.4	4
CPT14-19	-	N	Cell 1E	72.9	6

4.1 Field Work

4.1.1 Cone Penetration Test

All equipment was in accordance with ASTM D-5778. For the CPT test, a cylindrical cone is pushed vertically into the ground at a constant rate of penetration of 20 mm/sec. During penetration, measurements are made of the cone tip resistance (q_c), the side friction of the cylindrical shaft (f_s) just above the tip, and porewater pressure generated by cone penetration (u_2). The cones used in the investigation have a 15 cm^2 base area and a 60-degree apex angle. The sleeve area of the cones is 300 cm^2. The fluid used for saturation of the filter was glycerin. CPT data have been related empirically to soil behavior types (to estimate stratigraphy) and multiple geotechnical parameters. TPT provided Barr with complete records of tip resistance, sleeve friction, pore pressure, and friction ratio of all CPT soundings. CPT logs are included in Exhibit G.

4.1.2 Pore Pressure Dissipation Testing

A total of 28 pore pressure dissipation (PPD) tests were performed in 11 of the 14 CPT soundings. The PPD test is performed by monitoring dissipation of excess porewater pressures generated as the cone advances through a soil and then stops. The results can be used to estimate hydraulic conductivity of the soil by means of empirical methods (Reference (2)) and theoretical methods through the calculation of the coefficient of consolidation (Reference (3)). The PPD plots are included in Exhibit H.

5.0 Results

Sections 2.0 through 4.0 describe the field and laboratory investigation procedures. Section 5.1 presents the results of the FTB Containment System investigation (Rotasonic and SPT work), and Section 5.2 presents the results of the Cell 1E/2E investigation.

5.1 FTB Containment System Investigation

The results of the Rotasonic and SPT soil borings (Exhibit A and Exhibit D) and laboratory tests (Exhibit F) were compiled to obtain an understanding of the lithology, stratigraphy, and water levels along the FTB Containment System alignment. A stratigraphy profile along the FTB Containment System alignment is shown in Large Figure 8.

5.1.1 Unconsolidated Deposits

The surficial deposits generally consist of Rainy Lobe Till (glacial till), which functions as the surficial aquifer, glacial outwash deposits, and peat. LTVSMC tailings were also encountered. The surficial deposits along the northern and western toes of the Tailings Basin include the following layers, from the ground surface down:

- peat; 0 to 20 feet thick, dark brown, saturated, sapric, with low blow counts
- tailings; 0 to 17 feet thick, fine- to coarse-grained, with low blow counts
- silty sand; 0 to 6 of feet thick, fine- to coarse-grained, with variable blow counts
- glacial till (Rainy Lobe Reference (4)); 5 to 36.5 feet thick, silty sand, brown to gray in color, with weathered granite fragments throughout, with cobbles and boulders interspersed and varied in size from <1 foot to approximately 4 feet in diameter

The overburden soils tend to be non-cohesive silty to gravelly sands with minimal amounts of clay. The material appears to be suitable for mass earthwork and grading projects. However, peat is considered unsatisfactory as a foundation for the FTB Containment System and should be removed if encountered areas along the alignment.

5.1.1.1 Topsoil

Due to the varying topography along the toe of the FTB, the topsoil was generally 0 to 30 inches thick, with little to no topsoil in high ground areas and up to 30 inches in lowland areas. Where present, the topsoil generally consisted of a root zone with varying amounts of organics, roots, and gravel. Localized zones of thicker topsoil should be expected, particularly in lowland locations.

5.1.1.2 Peat

The peat encountered in the subsurface exploration performed along the FTB Containment System alignment was characterized as sapric with wood and root inclusions. Sapric peat is highly decomposed with low fiber content and a massive or solid appearance. Occasional layers of gray silt (possibly tailings) were usually observed directly overlying the peat. At some locations the peat overlies organic silt and clay. The thickness of the peat ranged from approximately 0.3 feet up to 20 feet. The thickest areas of peat were located on the north side of the Tailings Basin directly north of Cell 2E; however several locations on the northwest side were not accessible due to open water so the extent of the peat in this region is uncertain. Undisturbed samples were collected and SSPTs conducted in the peat ranged from 0 to 4 blows per foot. These results indicate that the peat has a very soft to soft consistency.

5.1.1.3 Organic Silt

Organic silt was encountered in five (5) of the SPT and Rotasonic boring locations. At three (3) of the locations it was observed below a layer of peat and ranged in thickness of 1 to 5 feet. The organic silt was saturated with average blow counts of 1 blow per foot indicating it has a very soft consistency. Higher blow counts were observed but are contributed to frozen conditions.

5.1.1.4 Tailings

Tailings were encountered mainly on the west side of the site at SPT location B14-36 and B14-44. It is possible that the rotasonic investigation encountered tailings as well, but materials were not classified as such. The tailings ranged from thickness of 7 to 17 feet with blow counts ranging from 2 to 38 blows per foot. Blow counts of 6 to 22 were reported from the B14-36 location which was offset from the cutoff wall alignment due to wetland access issues.

5.1.1.5 Glacial Till

Glacial Till comprised most of the soil on site. The till was identified as the Rainy Lobe Till and was classified as silty sand (SM) or silty gravel (GM) with the gravel consisting of weathered granite fragments. The silty sand was almost always encountered above the silty gravel and the gravel content consistently increased with depth. The till was reported as moist to wet and contained various amounts of sand and clay. Till was encountered from 0 to 20 feet with a thickness ranging from 5 to 36.5 feet. The till resulted in blow counts ranging from 4 to 50 blows for 2 inches indicating the native soil is a very loose to very dense relative density. The silty sand resulted in blow counts of 4 to 50 blows for 3 inches with an average of 40 blows per foot. The silty gravel resulted in blow counts of 11 to 50 blows for 2 inches with an average of 72 blows per foot.

5.1.1.6 Cobbles and Boulders

Cobbles and boulders were frequently encountered on the surface and within the till at various depths. The largest boulder encountered during the investigation was 4 feet in diameter. All boulders were composed of granite with coloring and quality similar to the underlying bedrock.

5.1.2 Bedrock

Along the FTB Containment System alignment, the depth to bedrock ranges from 2 to 47 feet with an average depth of approximately 20 feet, as reported in the site boring logs (Exhibit A and Exhibit D) and Table 2-1. There were individual locations that reported bedrock at greater depths, such as B14-44 (36.5 feet), B14-69 (34 feet), and B14-76 (27 feet) indicating that the bedrock surface undulates across the site.

Bedrock was the deepest on the northwest side of the Tailings Basin, an area which is believed to be one of the few areas in the region with significant quantities of outwash (Reference (5)). On the northwest side of the Tailings Basin the average bedrock depth is 35 feet based on the 2014 Investigation.

The bedrock encountered during the investigation was granite mottled red, white, and black. Occasionally a zone of weathered bedrock ranging in thickness of one to nine feet was encountered above competent bedrock. Bedrock fractures were generally in-filled, with hydraulic conductivity of bedrock fracture zones two orders of magnitude less than hydraulic conductivity of overlying glacial till. The SPT borings indicated that the bedrock is strong to very strong with zones that appear to previously have been fractured. Fractures were present in most of the cored bedrock from the site and the rock cores were considered to be slightly to moderately fractured. Bedrock contained horizontal fractures, vertical fractures, and fractures ranging from 45° to 65° from the horizontal. The fracture faces are slightly decomposed and fractures occasionally are in-filled with non-cohesive sediment or weathered rock. Packer testing zones containing factures had a higher average hydraulic conductivity than bedrock without fracturing. The fracturing was most prevalent in the upper 5 to 10 feet of bedrock. Rock cores were collected to confirm depth to bedrock and provide qualitative information, including Rock Quality Designation (RQD) values and fracture characteristics. The RQD values obtained during the exploration were plotted versus depth in the borehole as shown on Large Figure 6. The plot indicates that bedrock is of poor to good quality at shallow depths, and is of good to excellent quality below a depth of 40 feet.

5.1.3 Groundwater Conditions

Groundwater along the FTB Containment System alignment was usually encountered at the surface or just below. The water level depths measured during the investigations and water level readings in the ten piezometers installed during the Rotasonic investigation are summarized in Table 5-1.

Table 5-1 Water Depth Summary

Borehole	Depth to Water at time of Drilling [feet]	Depth to Water after Piezometer Installed [feet]
SPT Borings		
B14-36	0	--
B14-40	4.3	--
B14-44	2	--
B14-48	3	--
B14-52	4	--
B14-55	10	--
B14-62	12	--
B14-65	0	--
B14-69	0	--
B14-72	1	--
B14-76	0	--
B14-80	7	--
Rotasonic Borings		
R14-02	--	--
R14-04	6	1.1
R14-05	4	--
R14-06	11	6.9
R14-07	3	--
R14-08	10	0.6
R14-09	5	--
R14-10	--	--
R14-10A	5	--
R14-11	4	--
R14-12	2	-0.3(1)
R14-13	5	1.9
R14-15	20(2)	6.8
R14-16	16	16.8

Borehole	Depth to Water at time of Drilling [feet]	Depth to Water after Piezometer Installed [feet]
R14-20	27[(2)]	--
R14-24	--	--
R14-25	--	--
R14-26	4	1.6
R14-27	10	1.7
R14-28	6	4.3
R14-29	5	--
R14-30	10	--

(1) Negative value indicates water level above ground surface.
(2) Reported depth does not appear to accurately represent groundwater depths.

Groundwater levels range from a depth of 0 to 20 feet below ground surface. Piezometer water level readings were all shallower than those reported during the Rotasonic investigation (except for R14-16) indicating a water table stabilizing slightly below ground surface. At one piezometer location, R14-12, the groundwater stabilized 0.3 feet above ground surface. During the Rotasonic investigation, artesian flow was encountered in R14-20 with a head of 3 feet above ground surface. During the SPT work, localized artesian flow was encountered at B14-69, where a head of up to 1 foot above ground surface was observed. In general, water levels are relatively shallow along the proposed FTB Containment System alignment and should be a factor in the design and construction of the cutoff wall. It was also noted that even during cold winter months, there was still open water that did not freeze due to seepage at some locations, particularly along the northwest corner of the Tailings Basin.

5.1.4 Slug Testing

Slug testing data, collected during the Rotasonic work in piezometers installed in glacial till, was analyzed using methods appropriate for an unconfined aquifer. The data was processed by normalizing and plotting the head versus time. Out of the six output plots generated from the three tests performed at each location, the two data outputs that were considered to have the least amount of noise and that would provide the widest range in permeability were selected for analysis. The selected outputs were analyzed using the Hvorslev method or the KGS model. The KGS model, which usually resulted in the best-fit for the data, was used to analyze tests performed in partially penetrating wells. The Hvorslev model was used to analyze R14-04 and R14-06 to meet the requirements of the translation method, using a straight-line to account for significant storage effects.

The slug tests performed in the standpipe piezometers located in the glacial till showed hydraulic conductivity ranging from 1.5×10^{-3} ft/s (4.6×10^{-2} cm/s) to 1.7×10^{-6} ft/s (5.2×10^{-5} cm/s) with a geometric mean of 5.1×10^{-5} ft/s (1.5×10^{-3} cm/s) based on the KGS and Hvorslev models. These values for the glacial till were considered to be the best representation of in-situ conditions, as the results showed the data had not been impacted by insufficient development and the analyses used a fully transient solution for overdamped slug tests that accounts for elastic storage in the unconfined aquifer. The slug testing results for horizontal flow from the 2007 and 2014 investigations are plotted on Large Figure 9. The slug testing results including normalized plots and a summary table of hydraulic conductivities is provided in Exhibit C.

5.1.5 Packer Testing

Packer testing readings and analyses were performed by Barr personnel in accordance with Reference (1). Data were plotted as flow rate versus pressure for each pressure step in order to assess the test results. The resulting curves indicated that the bedrock packer testing exhibited:

- ideal results where flow is laminar
- tight fractures
- variable permeability
- increase in permeability with increased pressure at some test locations, indicating that fracture fill material was forced out of fracture due to test pressure
- decrease in permeability with increased pressure at some test locations, indicating that fracture fill material further blocked fractures due to test pressure

The packer results were analyzed to determine the relative potential for groundwater flow through bedrock fractures. The selected permeability from each test was based on the lowest permeability values from the first three pressure increments for each test location. This is a conservative value most likely to represent in-situ, or laminar flow through a porous media, for steady-state conditions. A total of ten (10) packer tests were performed in five (5) of the 22 SPT borings ranging from a depth of 14 to 50.5 feet. The testing intervals were 4.5 to 8 feet in length. There does not appear to be a relationship between packer depth and hydraulic conductivity or RQD. Hydraulic conductivity results were fairly consistent across the site with slightly lower hydraulic conductivity observed in B14-36 and B-55 located on the west side of the site. At three locations the formation did not take any water. This very low hydraulic conductivity indicates that the tested bedrock zone is unfractured or has infilled fractures. The prevalence of fractures often decreased with increasing core depth, so it is reasonable to expect that bedrock hydraulic conductivity may also decrease with depth.

From the packer test results the geometric mean hydraulic conductivity of the bedrock, excluding the zero inflow locations, is 1.9×10^{-6} ft/s (5.8×10^{-5} cm/s), a value that is low and typical of poor-draining soils and impervious sections of earth dams and dikes (Reference (6)). For reference, a hydraulic conductivity value of 3.3×10^{-9} ft/s (1.0×10^{-7} cm/s) is considered practically impervious. The geometric mean hydraulic conductivity of the bedrock was also calculated including the zero inflow locations, by assuming that the hydraulic conductivity at those locations is equal to the lowest measured value (B14-36 from 20.5 to 26.5). Including the zero inflow locations, the geometric mean hydraulic conductivity of the bedrock is 6.3×10^{-7} ft/s (1.9×10^{-5} cm/s); a value that is a representative measurement of potential flow through bedrock joints or fractures.

5.1.6 General Soil Laboratory Testing

All laboratory test results are included in Exhibit F.

5.1.6.1 Moisture Content

A total of 23 moisture content tests were conducted on soil samples collected from the soil borings performed as part of the geotechnical investigation – 18 on till samples and 5 on peat samples. The soils tested included silty sand with gravel, silt, organic silt, and peat. The peat exhibited a moisture content ranging from 413% to 616%, with an average of 512%, indicating the peat was in a saturated condition and has a very high liquid limit. The silty soils typically exhibited moisture contents ranging from 7% to 19% with an average of 12%, indicating the sand was generally in a moist to wet condition. The silt exhibited moisture contents ranging from 10% to 25%, indicating the sand was generally in a moist to wet condition. The organic silt exhibited a moisture content of 73%. Moisture content test results are summarized in Exhibit F.

5.1.6.2 Organic Content

A total of five (5) organic content tests were conducted on undisturbed peat samples. The organic content ranged from 76% to 84%, with an average of 80%. The organic content test results are summarized in Exhibit F.

5.1.6.3 Atterberg Limits

Atterberg limits testing was performed on selected samples and used to classify the material encountered in the soil borings. A total of 23 Atterberg limits tests were conducted on selected samples from the borings. The majority of samples tested at the site were classified as silty sand with gravel (SM) and were classified as non-plastic. Several silt samples were tested having liquid limits ranging from 13% to 24% and plastic limits ranging from 12% to 18%. Plasticity indices varied between 2% and 7%. Atterberg limits tests on organic silt indicate a liquid limit of 68% with a plastic limit of 46% and plasticity indices of 22%. Five samples were tested on peat having liquid limits ranging from 411% to 612% (approximately the same values as the moisture content) and plastic limits ranging from 198% to 536%. This results in plasticity indices varying between 17% and 396%. Atterberg limits test results are plotted in Large Figure 10.

5.1.6.4 Grain Size Analysis

Grain size analyses were performed on 23 soil samples collected at various depths from the soil borings. Based on the results of the grain size analyses, the samples were classified as silty sand with gravel (SM), sandy silt (ML), and clayey sand (SC). The percent fines (percent by weight passing the number 200 sieve) ranged from approximately 7% to 72% in the silty sand soil samples and from 20% to 95% in silt and organic/clay silt soils. Gradation test results are plotted in Large Figure 11. In general, most of the soils on site can be classified at silty sand (SM) with weathered granite. Fine-grained soils were observed to be concentrated on the northwest side of the Tailings Basin in R14-12, B14-52, and R14-13 which also happens to be the locations that encountered the deepest bedrock.

5.1.6.5 Dry Unit Weight Testing

Dry unit weight values were reported for two (2) peat samples and three till samples. The dry unit weight of peat ranged from 10 pound per cubic foot (pcf) to 12.5 pcf with an average of 11 pcf. The dry unit weight of till ranged from 122 pcf to 125 pcf with an average of 124 pcf. Dry unit weight results are provided in Exhibit F.

5.1.6.6 Standard Proctor Density Testing

One (1) laboratory compaction test was conducted on a remolded sample comprised of disturbed glacial till samples collected from across the site. Standard Proctor density testing indicated a soil maximum dry density of 132 pcf, with a corresponding optimum moisture content of 7.6%. The results of the compaction test can be found in Exhibit F.

5.1.6.7 Shear Strength

Undrained Shear Strength of Peat

A total of five (5) laboratory consolidated-undrained (CU) triaxial compression tests were performed on selected 3-inch diameter undisturbed samples of peat collected during the geotechnical investigation. The undrained shear strength values from the tests ranged from 594 to 3300 psf. The triaxial tests performed in 2014 were plotted with previous triaxial results and are displayed on Large Figure 12. The yield undrained shear strength ratio of the peat samples collected in 2014 resulted in a 33^{rd} percentile value of 0.27 and an average value of 0.28, above the 33^{rd} percentile design value of 0.23 for virgin and compressed peat.

Drained Friction Angle of Peat

A total of 5 laboratory consolidated-undrained (CU) triaxial compression tests were performed on selected 3-inch diameter undisturbed samples of peat collected during the geotechnical investigation. Drained strength values from the tests resulted in a drained cohesion of 637 psf and a drained friction angle of 30 degrees. The triaxial test results performed in 2014 were plotted with previous triaxial and direct shear results and are displayed on Large Figure 13. The 2014 investigation results indicate that the drained friction angle for the non-linear failure envelope design value of 27 degrees for peat is a reasonable value.

Drained Friction Angle of Glacial Till

Three remolded direct shear tests were performed on samples of silty sand and silty gravel (glacial till) encountered during the investigation to better understand the friction angle of the material through laboratory testing. The results of the testing indicated that the soil has an internal friction angle ranging from approximately 38 to 47 degrees with a 33^{rd} percentile value of 43 degrees. These values are above the design value for glacial till of 37 degrees. The direct shear test results are plotted with a previously performed test on Large Figure 14.

5.1.6.8 Hydraulic Conductivity Testing

The results of the hydraulic conductivity tests can be found in Exhibit F.

Hydraulic Conductivity of Peat

Hydraulic conductivity testing was performed in general accordance with the falling head method (ASTM D5084) on thin-wall samples of peat collected from the borings performed along the cutoff wall alignment. The results indicate that virgin peat has a vertical permeability ranging from $3.5x10^{-8}$ ft/s ($1.06x10^{-6}$ cm/s) to $7.0x10^{-8}$ ft/s ($2.12x10^{-6}$ cm/s) with a geometric average value of $4.95x10^{-8}$ ft/s ($1.50x10^{-6}$ cm/s).

Hydraulic Conductivity of Glacial Till

Hydraulic conductivity testing was also performed on remolded samples of glacial till soils collected in the borings. Permeability values were recorded at various pressure levels during consolidation testing performed on three (3) remolded glacial till samples. The results indicate that the till on-site has a vertical permeability ranging from $1.3x10^{-5}$ to $1.8x10^{-7}$ ft/s ($4.1x10^{-4}$ to $5.5x10^{-6}$ cm/s), with a geometric mean of $2.5x10^{-6}$ ft/s ($7.6x10^{-5}$ cm/s). The vertical hydraulic conductivity for glacial till is plotted with the horizontal flow from the 2007 and 2014 slug testing investigations on Large Figure 9.

5.1.6.9 Consolidation Testing

Laboratory consolidation testing was performed on three (3) samples of remolded glacial till obtained from the SPT soil borings. The results of the laboratory testing are summarized in Table 5-2.

Table 5-2 Consolidation Data Summary

Borehole	Depth (feet)	Soil Classification	C_c	C_r	e_o	P_c (tsf)
B14-40	3.5 – 11.5	SM	0.06	0.01	0.327	8.5
B14-62	2.5 – 17.0	SM	0.09	0.01	0.325	10.0
B14-65	5.0 – 7.0	PEAT	3.80	0.65	8.801	0.20
B14-69	2.5 – 4.5	PEAT	2.75	0.45	7.275	0.21
B14-76	10.0 – 25.0	SM	0.03	0.01	0.370	10.0

The results of the laboratory consolidation testing indicate that the glacial till (SM) soils are very slightly to slightly compressible due to the low compression index value (C_c). The consolidation testing on the peat samples indicate that this material is highly to very highly compressible.

5.2 Cell 1E/2E Investigation

Results of the CPT investigation (Exhibit G and Exhibit H) have been related empirically to soil behavior types (to estimate stratigraphy) and multiple geotechnical parameters. Graphs of the CPT results with depth, including interpreted material classification, are presented in Exhibit G.

5.2.1 CPT Data Interpretation

The following describes the procedures used to interpret the CPT data and the stratigraphy inferred from the CPT soil behavior type. The CPT data interpretation was performed using an in-house program designed by Barr specifically for use on CPT projects. The in-house program has been cross checked with CPTINT Version 5.2 for quality assurance and has been found to be compliant.

Cone Penetration Testing with porewater pressure measurement (CPTu) was performed in the Tailings Basin in 1996, 2005, and 2007. Zones of materials were identified by visual observations made during SPT sampling and logging and by relating measured CPT tip and sleeve resistance to density and soil behavior and analyzing them against the corresponding soil boring data. Data from zones where the material type was verified by visual observation were isolated to determine the shear strength envelopes for different material types.

The field cone penetration resistance measured at the tip is q_c for fine-grained soils, which may also be converted to a total cone resistance, q_t, by:

$$q_t = q_c + (1 - a)u_2$$ **Equation F1**

Where:

a = unequal end area ratio of the cone (a = 0.859)
u_2 = porewater pressure measured between the tip and the friction sleeve

5.2.2 Stratigraphy and Material Properties

Results of the 2014 CPT investigation were compared to CPT soundings previously performed in 2007 where applicable. Exhibit G shows the results of the investigation including plots of tip resistance, sleeve friction, and pore pressure readings with dissipation results. The comparison of tip resistance indicates that there has been little to no strength increase of the tailings in Cell 1E and 2E since 2007. Where tip resistance (q_t) increase was observed, it occurred in the coarse tailings regions. Slimes and fine tailings zones occasionally reported a tip resistance increase of up to 20 tsf in soundings located beneath or close to the existing coarse tailings dam and beach. Soundings performed towards the center of the basins generally observed no increase in tip resistance. The 2014 CPT data were also used to confirm stratigraphy in the basins and fill data gaps.

5.2.3 Pore Pressure Dissipation Results

CPT PPD tests were used to estimate the water level at each sounding location. Porewater pressures recorded during the soundings were analyzed with dissipation data and water levels were interpreted. These water levels are shown on the plots in Exhibit G and were used to verify seepage parameters used in the FTB modeling.

Results show that water levels in Cell 2E have decreased approximately 5 feet since 2007 and water levels in Cell 1E have risen approximately 25 feet since 2007. The Cell 1E pond level has risen because seepage from the Tailings Basin's southern dam is being pumped into Cell 1E. The PPD curves are provided in Exhibit H. PPD tests were performed at depths ranging from 20.5 to 85 feet.

Hydraulic conductivity can also be interpreted from PPD results. These calculations were not performed on the data from the 2014 PPD tests, although data provided in Exhibit H could be used for that purpose in future analyses.

6.0 Limitations of Analysis

The analysis and conclusions provided are based on the results of field work from recent investigations. Using generally accepted engineering methods and practices, the investigations performed have made every reasonable effort to characterize the site. However, the likelihood that conditions may vary from any specific location tested is still possible, and careful attention to soil conditions should be undertaken during the time of construction by qualified personnel.

7.0 References

1. **U. S. Department of the Interior.** Procedure for Constant Head Hydraulic Conductivity Tests in Single Drill Holes, USBR 7310-89. 3rd *Earth Manual, Part 2, A Water Resources Technical Publication.* Denver, Colorado : Bureau of Reclamation, 1990.

2. **Robertson, P. K., Woeller, D. J. and Finn, W. D. L.** Seismic cone penetration test for evaluating liquefaction potential under cyclic loading. *Canadian Geotechnical Journal.* 1992, Vol. 29, 4, pp. 686-695.

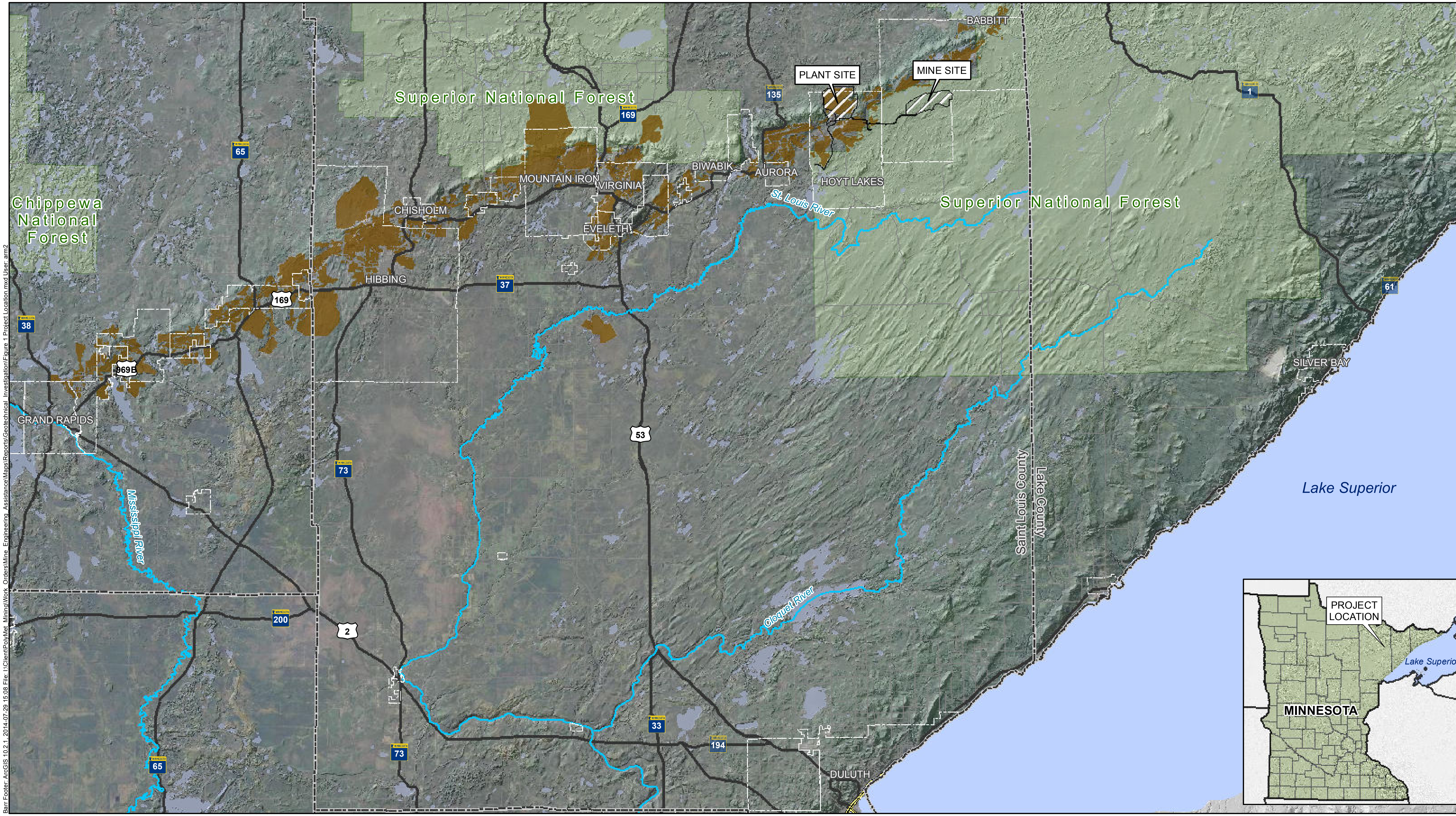
3. *Analysis of the piezocone in clay. Proceedings International Symposium on Penetration Testing.* **Houlsby, G. T. and Teh, C. I.** Rotterdam, Netherlands : s.n., 1988. Vol. 1, pp. 777-783.

4. **Jennings, C. E. and Reynolds, W. K.** M-164 Surficial geology of the Mesabi Iron Range, Minnesota. s.l. : Minnesota Geological Survey. Retrieved from the University of Minnesota Digital Conservancy, http://purl.umn.edu/58160, 2005.

5. **Olcott, P. G. and Siegel, D. I.** Physiography and Surficial Geology of the Copper-Nickel Study Region, Northeastern Minnesota: U.S. Geological Survey Water-Resources Investigations Open-File Report 78-51. 1978.

6. **Holtz, Robert, William D. Kovacs, Thomas C Sheehan.** An Introduction To Geotechnical Engineering. 2nd Edition s.l. : Prentice Hall, October 2010.

Large Figures



Project Areas
Mesabi Iron Range
National Forest Boundary
County Boundaries
City Boundaries
Major River
Lakes

0 3.75 7.5 15
Miles

Large Figure 1
PROJECT LOCATION
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, Minnesota

Rotasonic Location

Rotasonic Location with a Piezometer

Boring Locations

Boring Locations with Packer

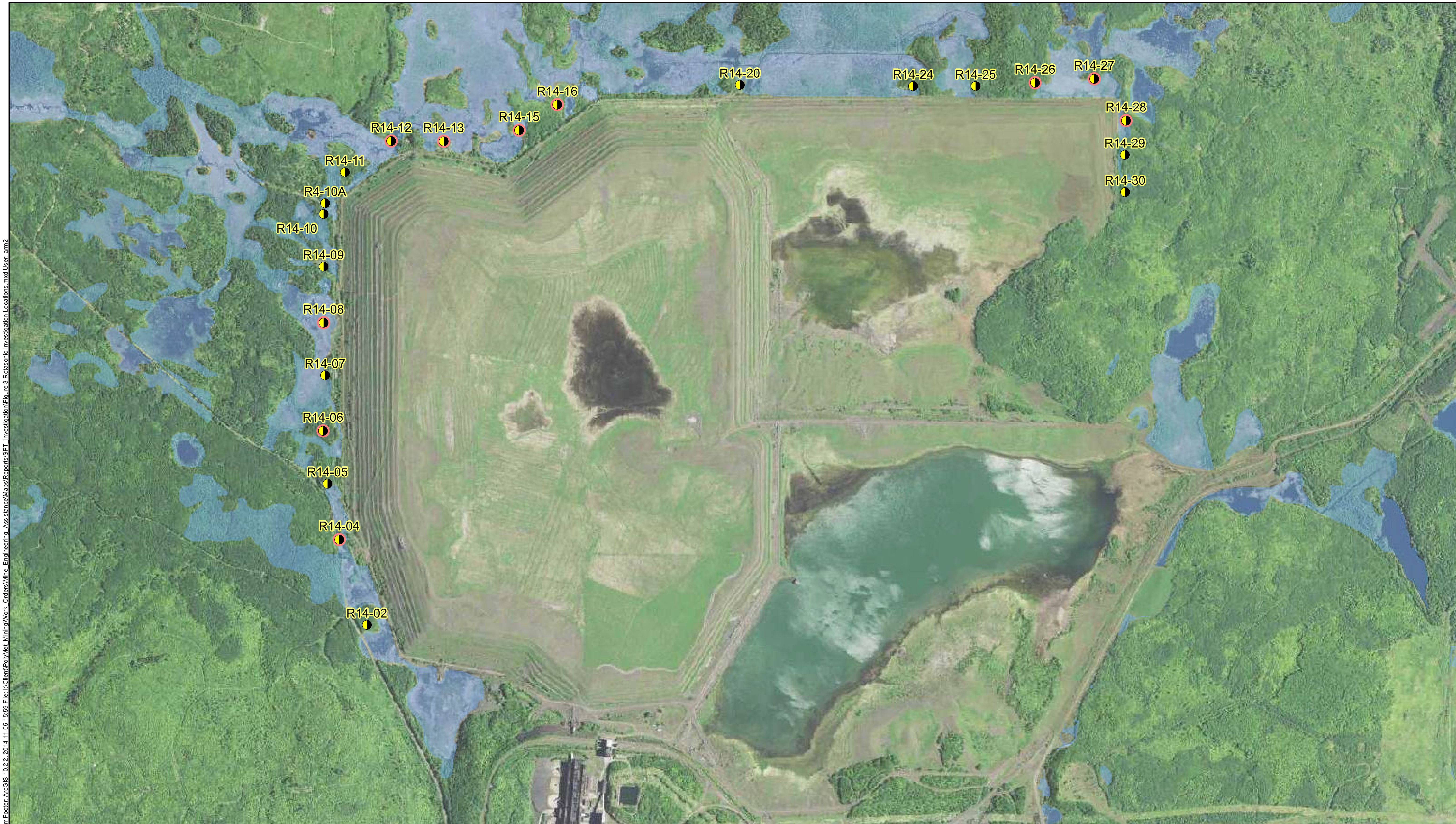
CPT Locations

Wetlands

0 1,500 3,000

Feet

Large Figure 2
2014 GEOTECHNICAL
INVESTIGATION LOCATIONS
NorthMet Project
PolyMet Mining Inc.
Hoyt Lakes, Minnesota



Rotasonic Location

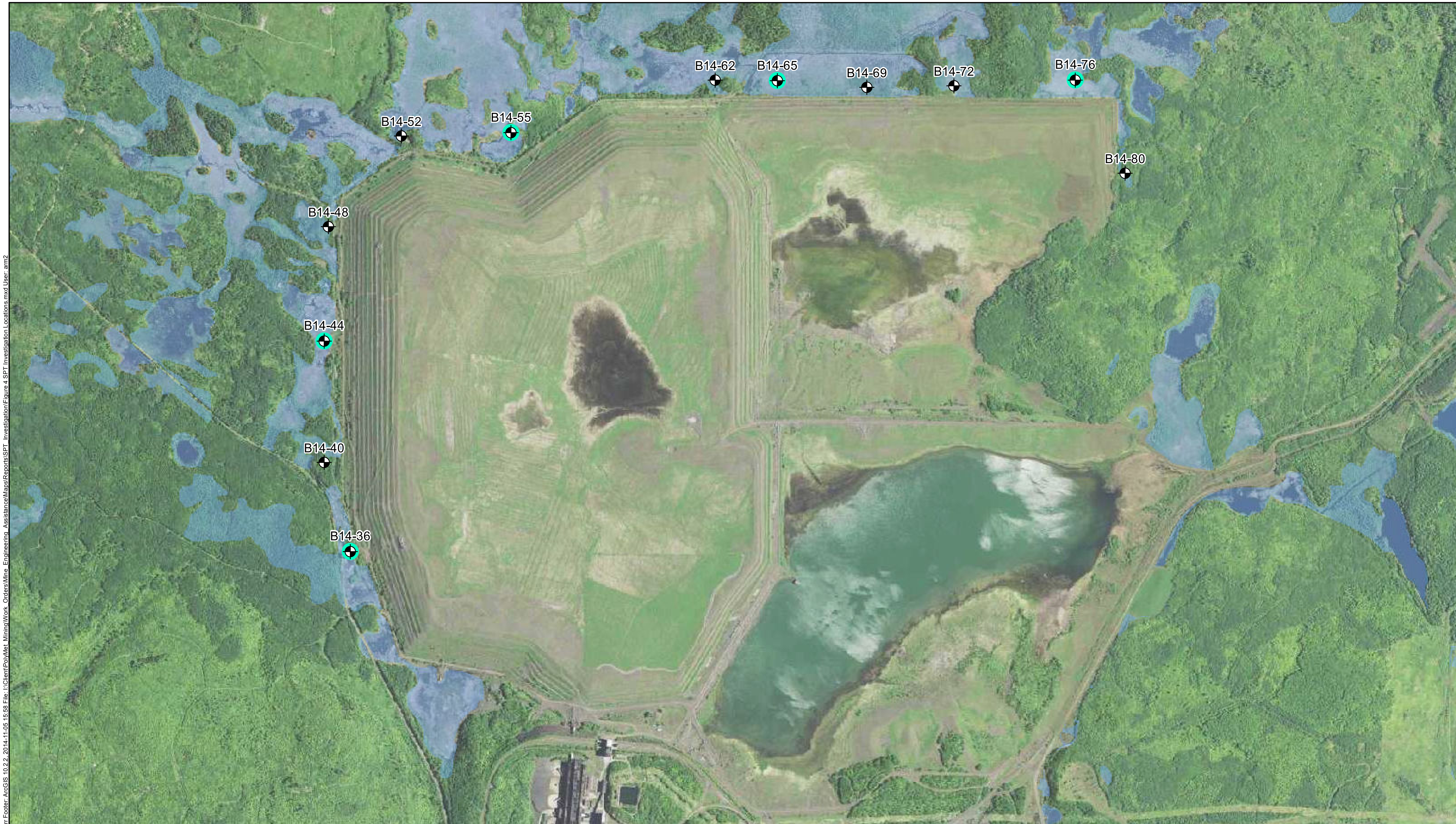
Rotasonic Location with a Piezometer

Wetlands

0 1,500 3,000

Feet

Large Figure 3
ROTASONIC INVESTIGATION LOCATIONS
NorthMet Project
PolyMet Mining Inc.
Hoyt Lakes, Minnesota



Boring Locations

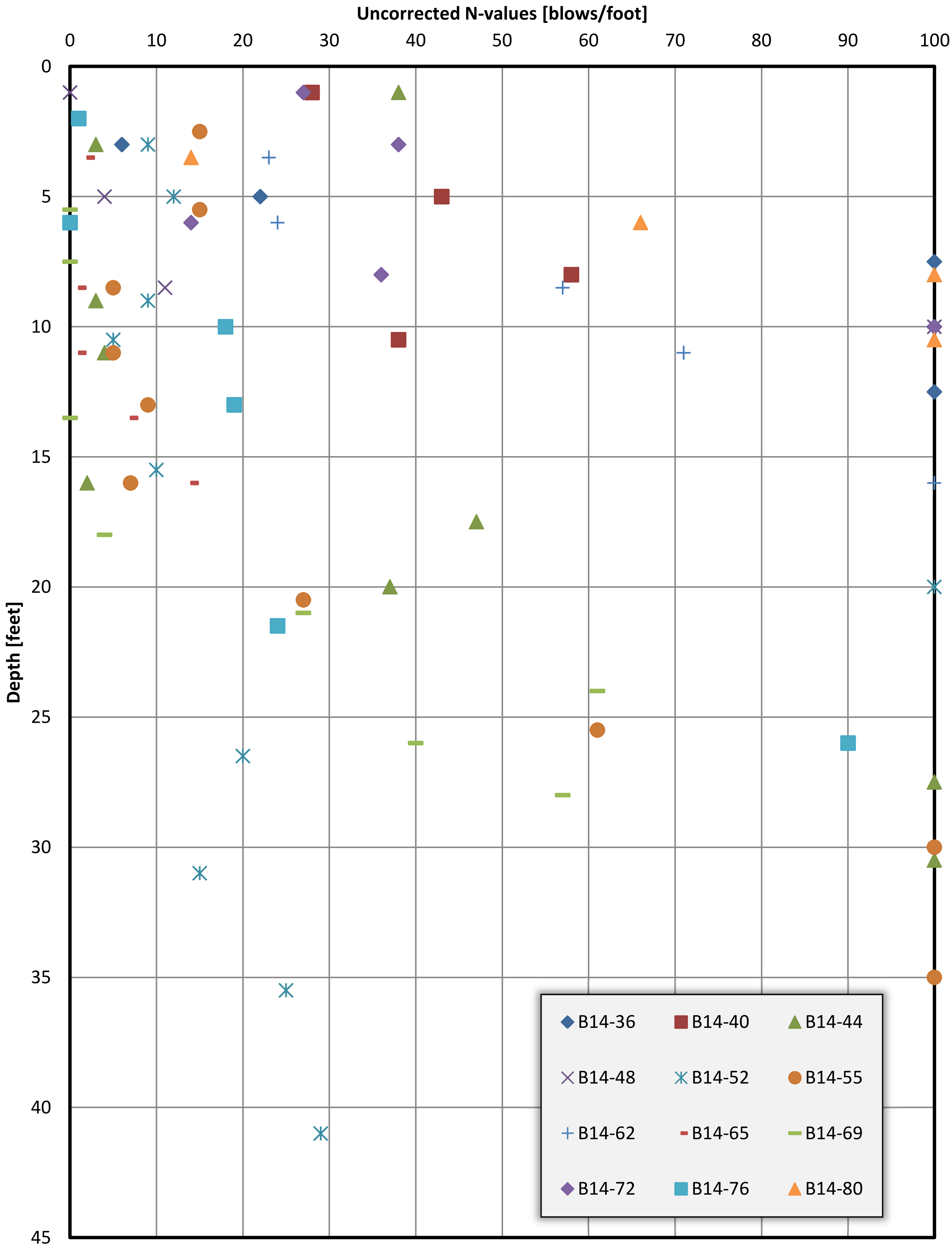
Boring Locations with Packer

Wetlands

0 1,500 3,000

Feet

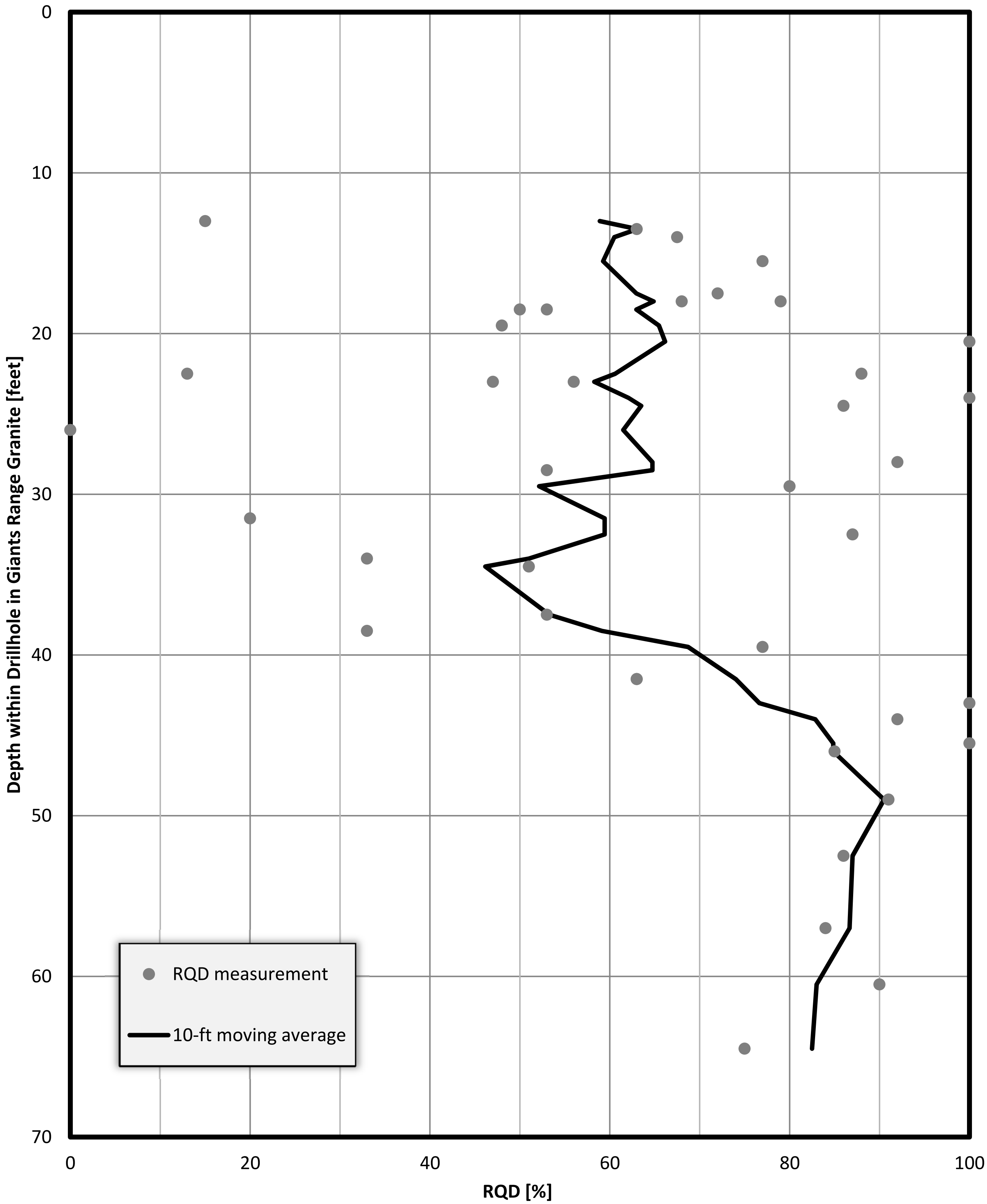
Large Figure 4
SPT INVESTIGATION LOCATIONS
NorthMet Project
PolyMet Mining Inc.
Hoyt Lakes, Minnesota



Large Figure 5

Blow Counts Versus Depth

PolyMet Winter 2013/2014 SPT Investigation



Large Figure 6

Rock Quality Designation Versus Depth in Drillhole

PolyMet Winter 2013/2014 Geotechnical Investigation

CPT Locations

Wetlands

0 1,500 3,000

Feet

Large Figure 7

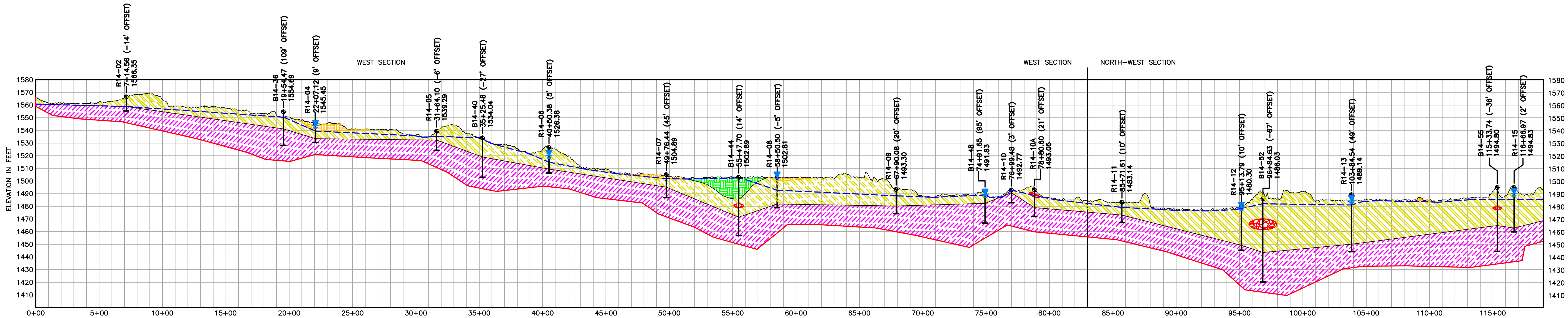
2014 CPT INVESTIGATION LOCATIONS

NorthMet Project

PolyMet Mining Inc.

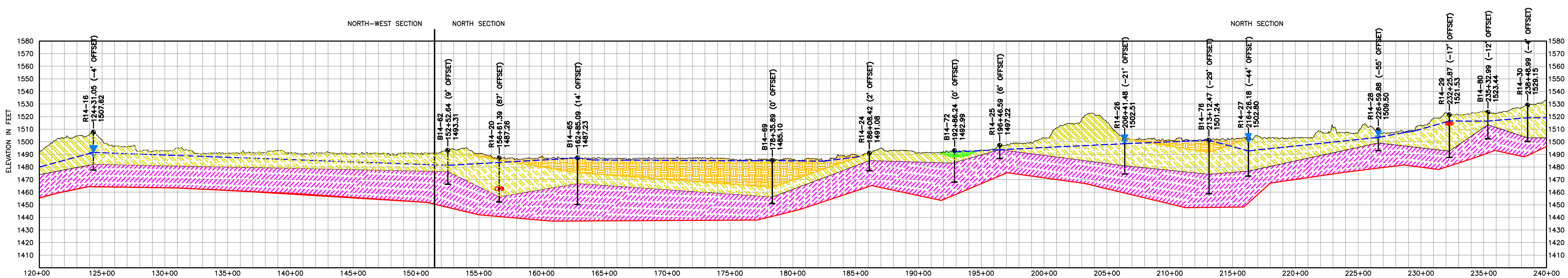
Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.2, 2014-08-19 22:26 File: I:\Client\PolyMet_Mining\Work_Orders\Mine_Engineering_Assistance\Maps\Reports\Geotechnical_Investigation\Data_Package\Volume1\Version5\Figure 6 2014 CPT Investigation Locations.mxd User: arm2



1 PROFILE: STATION 0+00 TO STATION 120+00

0 400 800
SCALE IN FEET



2 PROFILE: STATION 120+00 TO STATION 240+00

0 400 800
SCALE IN FEET

LEGEND:

- ORGANIC SOIL/PEAT
- GLACIAL TILL
- TAILINGS
- BOULDER
- BEDROCK
- WATER TABLE AFTER PIEZOMETER INSTALLED
- WATER TABLE DURING DRILLING

NOTES:

1. GROUND SURFACE ELEVATIONS ARE BASED ON 2010 LIDAR DATA (NAVD88) BORING ELEVATIONS SHOWN ARE BASED ON 2010 LIDAR DATA (NAVD88) ADJUSTED AFTER COLLECTION (3-11-2014 THRU 5-20-2014) STRATIGRAPHY AND WATER TABLES ARE BASED ON THE 2014 FIELD INVESTIGATION LOGS.
2. BORING LOCATION OFFSETS FROM PROPOSED CUTOFF WALL ALIGNMENT ARE SHOWN. SUBSURFACE CONDITIONS ON WALL ALIGNMENT WILL DIFFER FROM THOSE SHOWN.
3. AREAS OF COBBLES AND BOULDERS BETWEEN BORING LOCATIONS AND ADJACENT BORING LOCATIONS SHOULD BE ASSUMED TO EXIST.

VER NO	DATE	DESCRIPTION
2	06/19/14	VERSION 2

DRAWING STATUS	ISSUED	VERSION	DATE
FOR PERMITTING			
FOR CONSTRUCTION			

PERMIT DRAWINGS – NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE ____
PRINTED NAME ____
DATE ____ REG. NO. ____

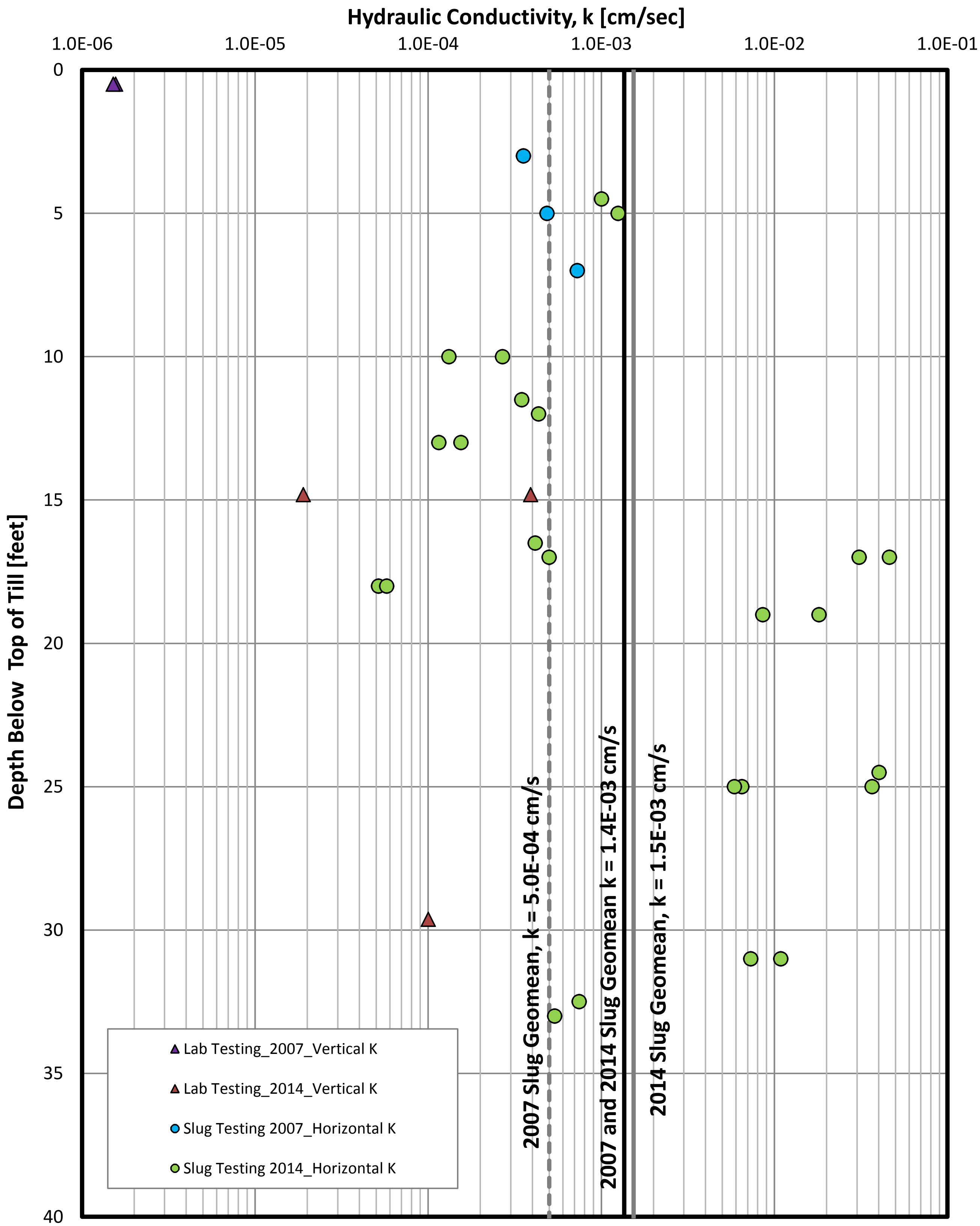
DRAWN: BDP
CHECKED: KNA
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

FLOTATION TAILINGS BASIN SEEPAGE CAPTURE SYSTEM CUTOFF WALL PROFILE

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

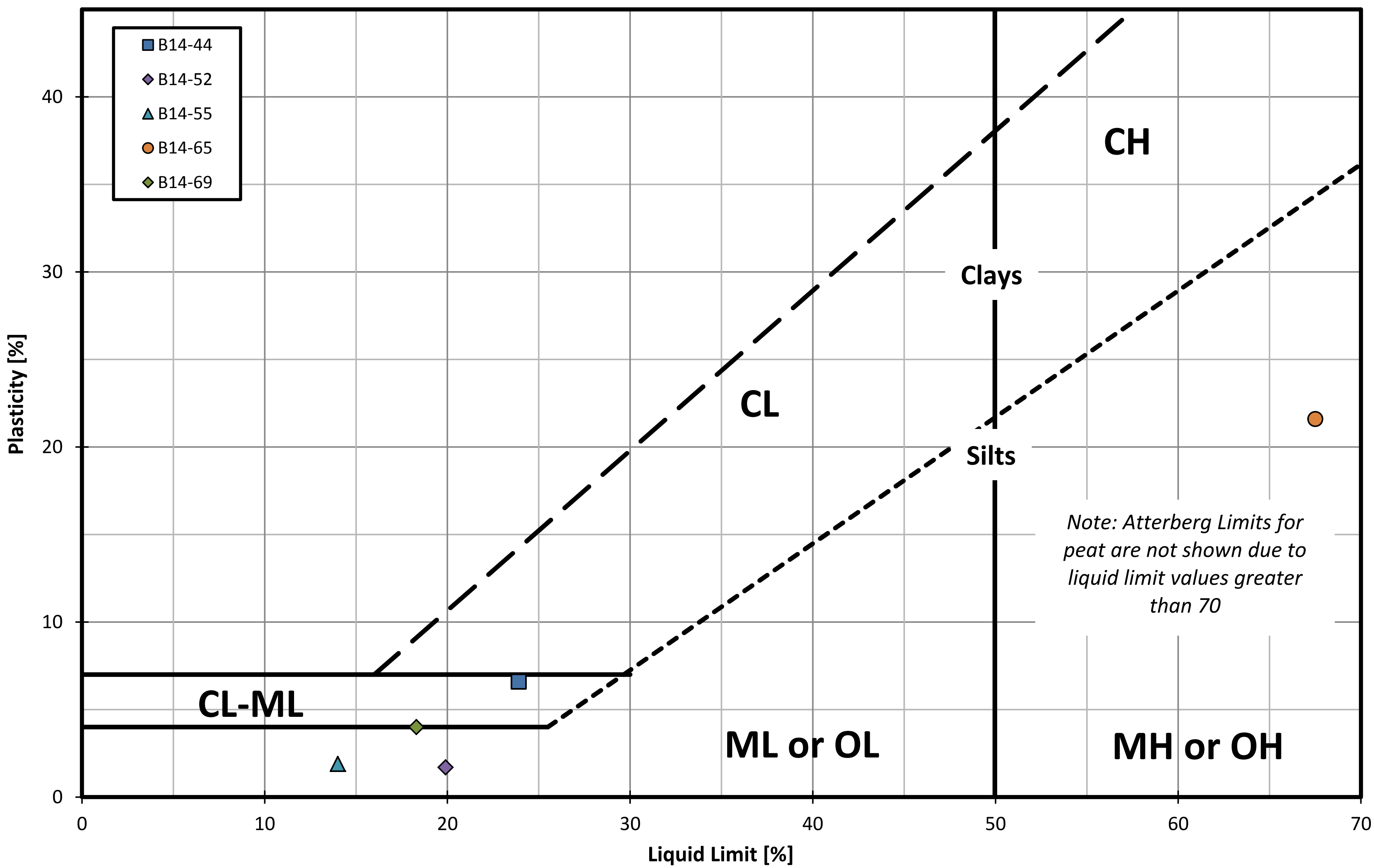
DWG. NO. LARGE FIGURE 8
REV A



Large Figure 9

Hydraulic Conductivity Testing Results of Glacial Till

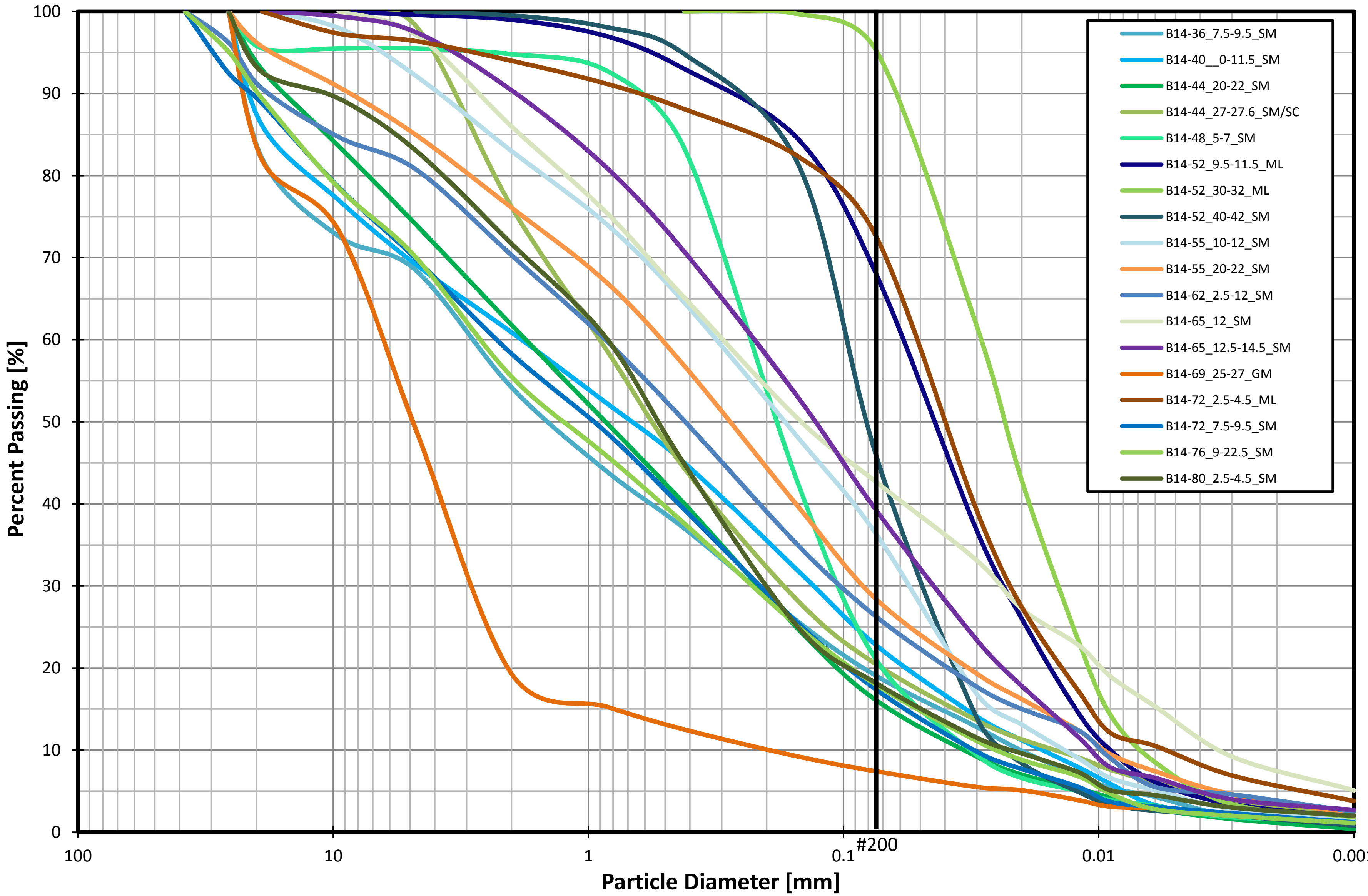
PolyMet 2013/2014 Winter Geotechnical Investigation



Large Figure 10

Atterberg Limits Results

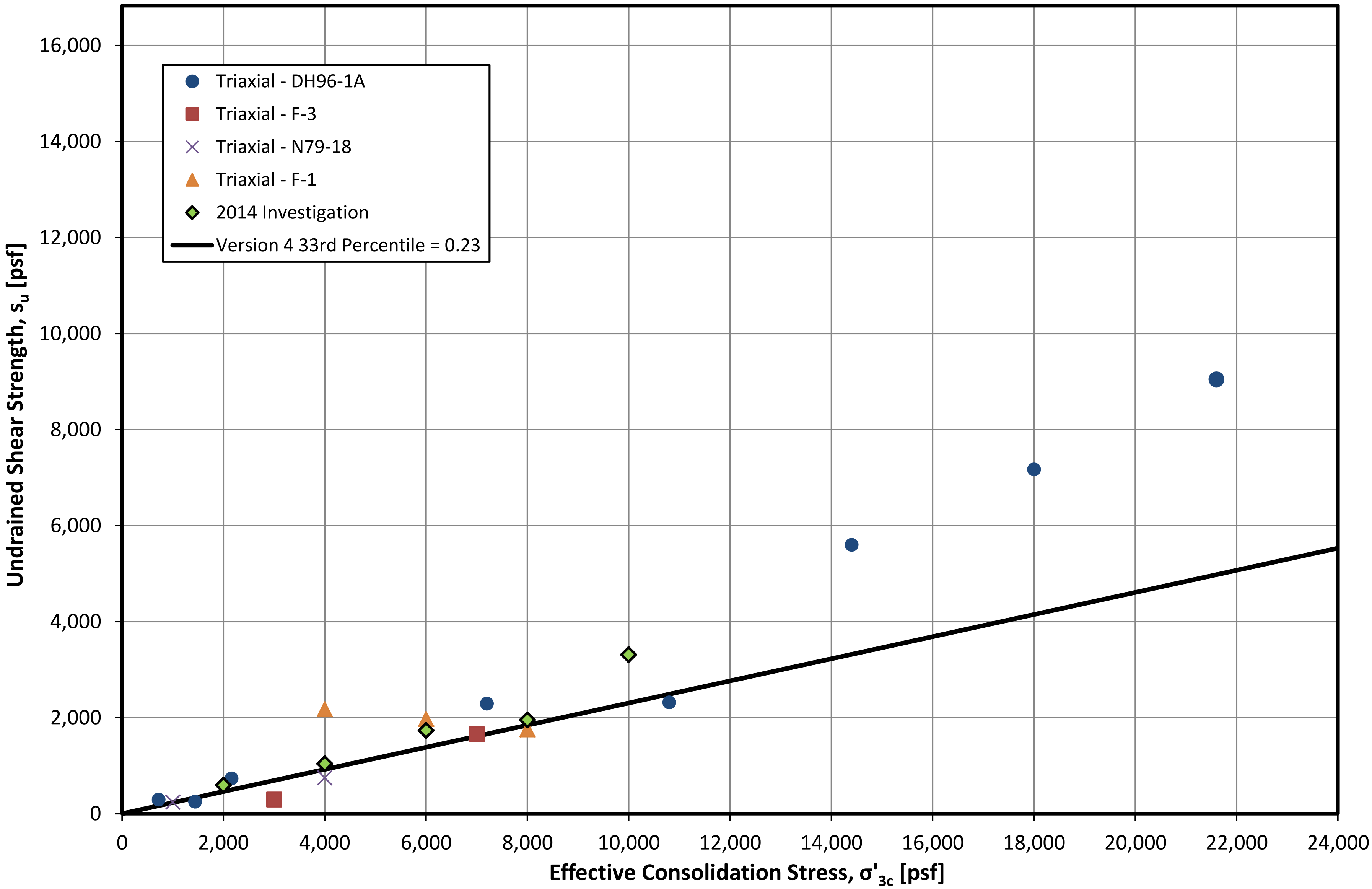
PolyMet Winter 2013/2014 Geotechnical Investigation



Large Figure 11

Sieve and Hydrometer Results

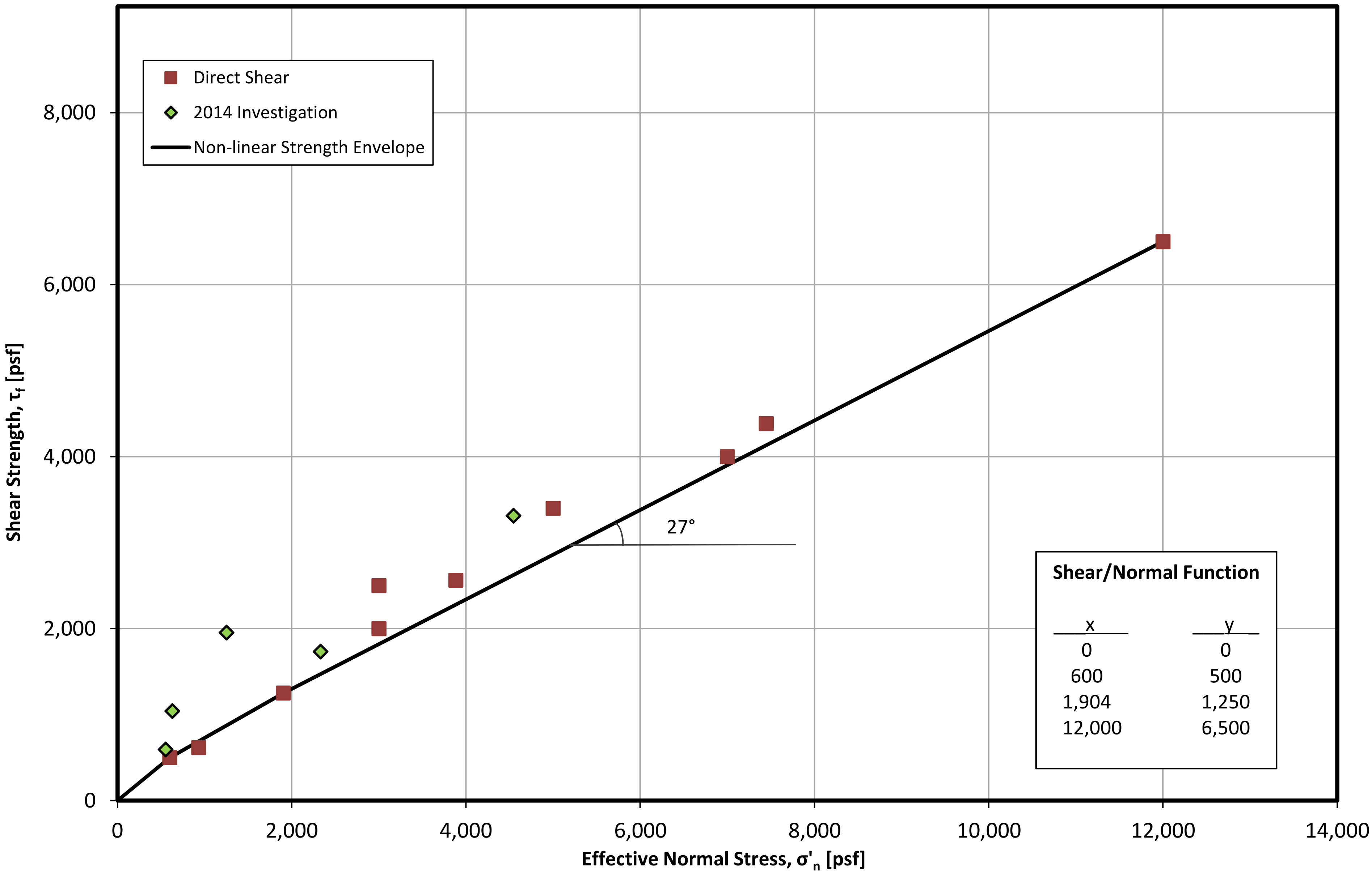
PolyMet 2013/2014 Geotechnical Investigation



Large Figure 12

Triaxial Undrianed Shear Strength Envelope for Compressed and Virgin Peat

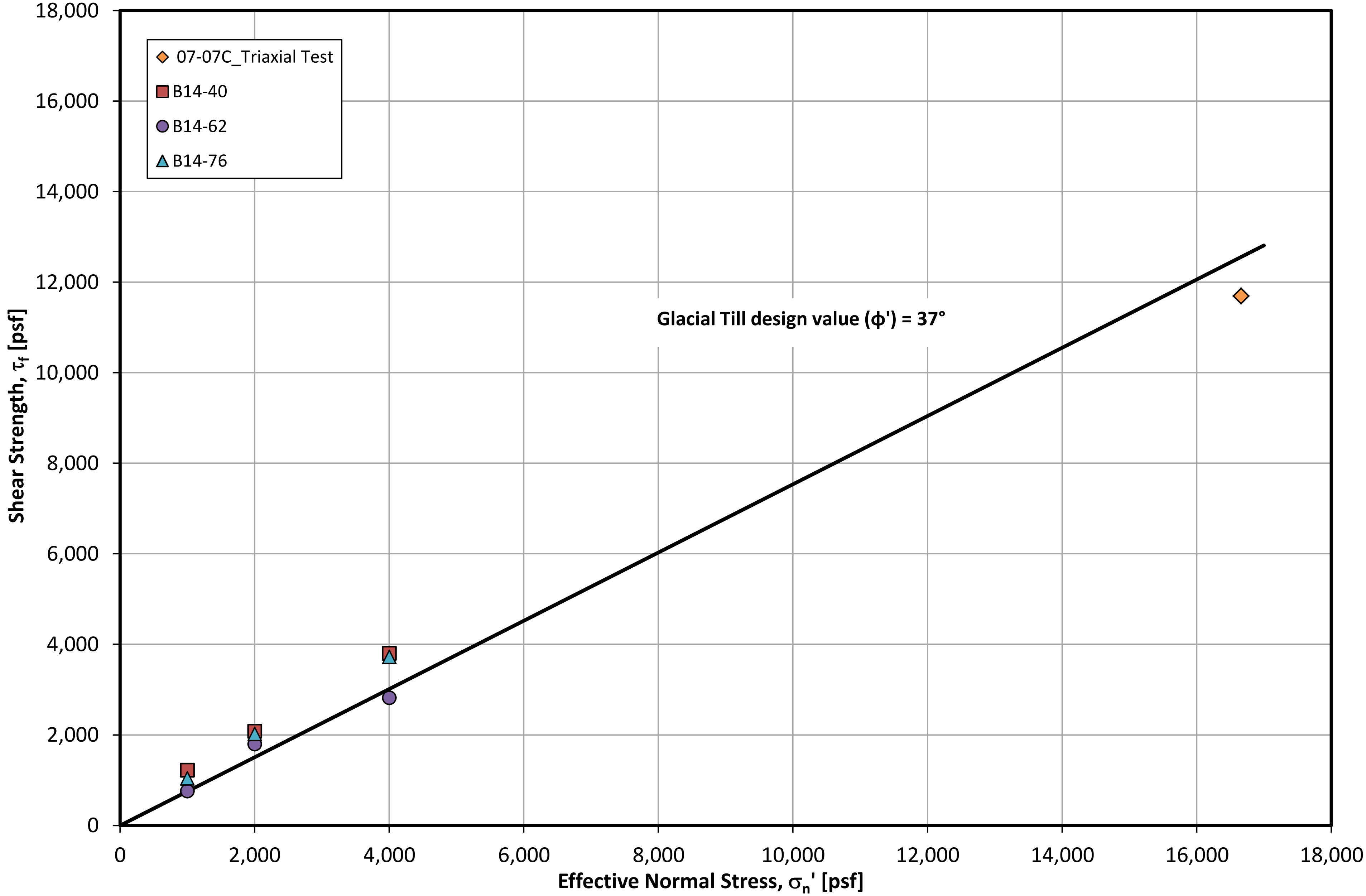
PolyMet 2013/2014 Winter Geotechnical Investigation



Large Figure 13

Drained Shear Strength Envelope for Compressed and Virgin Peat

PolyMet 2013/2014 Winter Geotechnical Investigation



Large Figure 14

Drained Shear Strength Envelope for Glacial Till

PolyMet 2013/2014 Winter Geotechnical Investigation

Exhibit A

Rotasonic Logs

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING R14-02

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1566.4 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 734,259.7 ft E 2,858,091.9 ft	Completion Depth:	11.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1566.4 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Graphic Log	Samples	Sample No.	% Recovery	SPT, N value or RQD %	STANDARD PENETRATION TEST DATA N in blows/ft / REC% / RQD % / SHEAR STRENGTH, tsf
1566.4	0	TOPSOIL (OL): dark brown; moist; with roots and leaves; top 2.5 feet frozen.						
1564.9 ft	1.5ft	SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown to gray at 4 feet; moist; weathered granite fragments; some clay below 5 feet; [Till].			A, B	100		
						100		
1558.9 ft	7.5ft	GRANITE; mottled red, black, and white; [Bedrock].			C	67		
1555.4 ft	11.0ft	Bottom of Boring at 11.0 feet						

Date Boring Started:	3/11/14 7:45 am	Water Levels (ft)	Remarks:
Date Boring Completed:	3/11/14 8:35 am	At Time of Drilling: Dry	
Logged By:	BJL2		
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 30F, partly cloudy

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING R14-04

Sheet 1 of 1

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1545.4 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 735,679.7 ft E 2,857,633.8 ft	Completion Depth:	15.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1545.4 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Depth to base	Sample No.	% Recovery
1545	0	PEAT (PT): dark brown; moist; sapric; woody debris; top 1.5 feet frozen. 1543.9 ft	1.5ft	A	30
		LEAN CLAY (CL): moist; some sand; some sapric peat. 1539.9 ft	5.5ft		
1540	5	POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; wet; with clay and gravel; [Till]. 1535.9 ft	9.5ft	B, C	70
1535	10	POORLY GRADED GRAVEL (GM): medium grained; brown; moist; some clay; [Till]. 1533.4 ft	12.0ft	D	83
		GRANITE; mottled red, black, and white; highly weathered to 13 feet; competent bedrock below; [Bedrock]. 1530.4 ft	15.0ft		100
	15	Bottom of Boring at 15.0 feet			

Column headings also include: Graphic Log; Samples; SPT, N value or RQD %; STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC%; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5); INSTRUMENTATION.

Date Boring Started:	3/11/14 9:30 am	Water Levels (ft)	
Date Boring Completed:	3/11/14 10:15 am	At Time of Drilling	6.0
Logged By:	BJL2	After Install	1.1
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		

Remarks:

Weather: 30F, partly cloudy

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

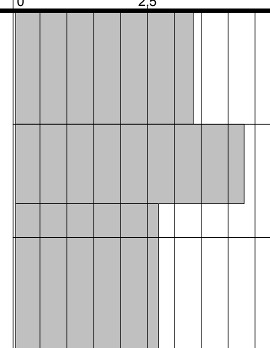
LOG OF BORING R14-05

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1539.3 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 736,606.1 ft E 2,857,437.1 ft	Completion Depth:	15.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1539.3 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery
1539.3	0	TOPSOIL (OL): dark brown; roots; top 1.5 feet frozen.		
1537.8 ft	1.5ft	SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; moist to wet; weathered granite fragments throughout; changes to gray at 3 feet; [Till].		67
1532.3 ft	7.0ft	GRANITE; mottled red, black, and white; weathered to 8.5 feet, competent rock below; [Bedrock].	A	86
				54
1524.3 ft	15.0ft	Bottom of Boring at 15.0 feet		

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5)



Date Boring Started:	3/11/14 12:30 pm
Date Boring Completed:	3/11/14 2:00 pm
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
At Time of Drilling 4.0
Estimated

Remarks: A second boring was offset 8 feet southwest where bedrock was encountered at 8 feet and boring was terminated in bedrock at 13.5 feet.

Weather: 30F, partly cloudy

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING R14-06

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1526.4 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 737,489.5 ft E 2,857,364.4 ft	Completion Depth:	20.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1526.4 ft

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5)

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery	SPT, N value or RQD %
1526.4	0	SILTY SAND (SM): fine to medium grained; brown; moist; top 1.5 feet frozen; weathered granite fragments and cobbles; [Till].	A	92	
				80	
1518.9 ft	7.5ft	Granite boulder from 6.5 to 7.5 feet.			
1515.4 ft	11.0ft	SILTY SAND (SM): fine to medium grained; gray; moist; with weathered granite fragments; [Till].			
	12.5ft	10-15 feet: cobble clogged barrel, poor recovery.	B	30	
1513.9 ft		SANDY SILT (ML): fine grained; gray; wet; with cobbles; [Till].			
1509.4 ft	17.0ft	SILTY SAND WITH GRAVEL (SM): medium to coarse grained; gray; wet; [Till].	C	50	
1506.4 ft	20.0ft	GRANITE; mottled red, black, and white; weathered granite to 17.5 feet; [Bedrock].		100	

Bottom of Boring at 20.0 feet

INSTRUMENTATION

Date Boring Started:	3/11/14 3:00 pm
Date Boring Completed:	3/11/14 4:30 pm
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
- At Time of Drilling: 11.0
- After Install: 6.9

Remarks:

Weather: 30F, partly cloudy

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
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LOG OF BORING R14-07

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1504.9 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 738,412.4 ft E 2,857,400.7 ft	Completion Depth:	12.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1504.9 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery	SPT, N value or RQD %
	0	PEAT (PT): dark brown; moist; sapric; wood debris; top 2 feet frozen.	A	80	
1501.9 ft	3.0ft	SILTY SAND (SM): fine to medium grained; brown; wet; [Till].			
1499.7 ft	5.3ft	GRANITE; mottled red, black, and white; [Bedrock].	B	100	
				50	
				75	
1492.9 ft	12.0ft	Bottom of Boring at 12.0 feet			

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC%; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5)

Date Boring Started:	3/12/14 8:00 am
Date Boring Completed:	3/12/14 10:00 am
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
At Time of Drilling 3.0

Remarks: A second boring was offset ~8 feet west where bedrock was encountered at 7 feet and the boring was terminated in bedrock at 11 feet.

Weather: 0 to 20F, sunny

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LOG OF BORING R14-08

Sheet 1 of 1

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1502.8 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 739,287.6 ft E 2,857,372.0 ft	Completion Depth:	24.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1502.8 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery
1502.8	0	PEAT (PT): dark brown; moist; top 2 feet frozen. 1498.8 ft	A	40
1498.8	4.0ft	SILTY SAND (SM): fine to medium grained; brown; moist; trace gravel; [Till]. 1492.8 ft	B	80
1492.8	10.0ft	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM): medium to coarse grained; brown; wet; with cobbles from 18 to 21 feet; [Till]. 1481.8 ft	C	23
				100
				33
1481.8	21.0ft	GRANITE; mottled red, black, and white; [Bedrock]. 1478.8 ft		83
	24.0ft	Bottom of Boring at 24.0 feet		

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5); INSTRUMENTATION

Date Boring Started:	3/12/14 11:00 am
Date Boring Completed:	3/12/14 12:45 pm
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
- At Time of Drilling 10.0
- After Install 0.6

Remarks:

Weather: 0 to 20F, sunny

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LOG OF BORING R14-09

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1493.3 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 740,225.4 ft E 2,857,373.8 ft	Completion Depth:	19.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1493.3 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery	SPT, N value or RQD %
	0	SILTY SAND (SM): medium grained; brown; moist to wet; trace gravel; with cobbles below 5 feet; top 2 feet frozen; [Till].	A	100	
1490	5	5-10 feet: poor recovery likely due to cobble in shoe.		30	
1485	10			50	
		1480.3 ft			
1480	13.0ft	GRANITE; mottled red, black, and white; weathered granite from 13 to 15 feet; [Bedrock].			
	15			67	
1475		1474.3 ft			
	19.0ft	Bottom of Boring at 19.0 feet			

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5)

Date Boring Started:	3/12/14 2:30 pm
Date Boring Completed:	3/12/14 4:00 pm
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
At Time of Drilling 5.0

Remarks:

Weather: 10 to 20F, sunny

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LOG OF BORING R14-10

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1492.8 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 741,099.5 ft E 2,857,371.8 ft	Completion Depth:	10.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1492.8 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Depth	Graphic Log	Samples	Sample No.	% Recovery	SPT, N value or RQD %
	0	TOPSOIL (OL): dark brown; moist; roots; top 2 feet frozen. 1492.6 ft	0.3ft					
1490		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; with weathered granite fragments; organic material; [Till]. 1490.8 ft	2.0ft				100	
1485	5	GRANITE; mottled red, black, and white; [Bedrock]. 1482.8 ft					83	
	10	Bottom of Boring at 10.0 feet	10.0ft					

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40)
REC% | RQD % ◆ (20, 40, 60, 80)
SHEAR STRENGTH, tsf (0, 2.5, 5)

Date Boring Started:	3/13/14 10:00 am	Water Levels (ft)	Remarks: A second boring was offset ~30 feet south where bedrock was encountered at 3 feet. A third boring was offset ~10 feet east of the first boring where bedrock was encountered at 1.5 feet.
Date Boring Completed:	3/13/14 11:30 am	At Time of Drilling Dry	
Logged By:	BJL2		
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 20 to 40F, overcast

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LOG OF BORING R14-10A

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1493.0 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 741,279.3 ft E 2,857,400.1 ft	Completion Depth:	21.0 ft
Datum:	NAD83 Minnesota State Plane		

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Depth	Graphic Log	Samples	Sample No.	% Recovery	SPT, N value or RQD %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ / REC% / RQD % ◆ / SHEAR STRENGTH, tsf
		Surface Elev.: 1493.0 ft							
1492.5 ft	0	TOPSOIL (OL): dark brown; moist; roots and organics; top 2 feet frozen.	0.5ft			A	100		
1490.5 ft		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; with weathered granite fragments; [Till].	2.5ft						
1488.0 ft	5	BOULDER: mottled red, black, and white.	5.0ft			B	80		
1479.0 ft		POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; brown; wet; gray below 10 feet; with weathered granite fragments; [Till].					100		
1472.0 ft	14	GRANITE; mottled red, black, and white; drilling bit wore out - no recovery from 20 to 21 feet; [Bedrock].	14.0ft				67		
							0		
		Bottom of Boring at 21.0 feet	21.0ft						

Elevation scale: 1490, 1485, 1480, 1475. Depth scale: 0, 5, 10, 15, 20. Chart scales: 10, 20, 30, 40; 20, 40, 60, 80; 0, 2.5, 5.

Date Boring Started:	3/18/14 11:30 am
Date Boring Completed:	3/18/14 12:15 pm
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
At Time of Drilling 5.0

Remarks:

Weather: 20F, overcast

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LOG OF BORING R14-11

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1483.1 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotasonic Soil Core
Coordinates:	N 741,794.5 ft E 2,857,729.4 ft	Completion Depth:	16.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1483.1 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Depth	Sample No.	% Recovery	SPT, N value or RQD %
1482.8	0.3	TOPSOIL (OL): dark browm; moist; organics with roots; top 1.5 feet frozen.	0.3ft			
1479.1	4.0	SILTY SAND (SM): fine to medium grained; brown; moist; 6-inch clay layer at 1.5 feet; [Till].	4.0ft	A	77	
1474.1	9.0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; wet; [Till].	9.0ft	B	100	
1473.1	10.0	POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; gray; wet; with cobbles and weathered granite fragments; [Till].	10.0ft			
1467.1	16.0	GRANITE; mottled red, black, and white; [Bedrock].	16.0ft	C	83	

Bottom of Boring at 16.0 feet

Layer elevations as printed: 1482.9 ft, 1479.1 ft, 1474.1 ft, 1473.1 ft, 1467.1 ft. Water level symbol at 1480 (4.0 ft).

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5)

Date Boring Started:	3/13/14 8:00 am	Water Levels (ft)	Remarks:
Date Boring Completed:	3/13/14 9:10 am	At Time of Drilling 4.0	
Logged By:	BJL2		
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 20 to 40F, overcast

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LOG OF BORING R14-12

Sheet 1 of 1

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1480.3 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 742,311.8 ft E 2,858,500.4 ft	Completion Depth:	35.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1480.3 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Depth	Sample No.	% Recovery
1479.8 ft	0	TOPSOIL (OL): dark brown; moist; with wood and leaf debris.	0.5ft		
1478.3 ft		SILT (ML): brown; moist; with sand.	2.0ft	A, B	100
1467.3 ft	5	POORLY GRADED SAND WITH SILT (SP-SM): fine to coarse grained; gray to brown; wet; some weathered granite fragments to 13 feet; [Till].	13.0ft		40
				C	100
1465.3 ft		SILTY SAND (SM): fine grained; gray; wet; [Till].	15.0ft		
1462.3 ft	15	SILT (ML): gray; moist; with sand; little clay at 18 feet; [Till].	18.0ft	D	80
1451.3 ft		SILTY SAND (SM): fine to medium grained; gray; wet; [Till].	29.0ft		92
				E	50
					90
1449.3 ft	30	POORLY GRADED GRAVEL WITH SAND (GP): gray; wet; some cobbles with weathered granite fragments; [Till].	31.0ft		
1445.3 ft		GRANITE; mottled red, black, and white; [Bedrock].	35.0ft		83
	35	Bottom of Boring at 35.0 feet	35.0ft		

Column headings: Graphic Log; Samples; Sample No.; % Recovery; SPT, N value or RQD %; STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5); INSTRUMENTATION

Elevation scale: 1475, 1470, 1465, 1460, 1455, 1450. Depth scale: 0, 5, 10, 15, 20, 25, 30, 35.

Date Boring Started:	3/13/14 1:45 pm
Date Boring Completed:	3/13/14 3:30 pm
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
- At Time of Drilling 2.0
- After Install -0.3

Remarks:

Weather: 20 to 40F, overcast

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LOG OF BORING R14-13

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1489.1 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 742,310.5 ft E 2,859,372.0 ft	Completion Depth:	45.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1489.1 ft

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION
0.3	1488.9	TOPSOIL (OL): dark brown; moist; roots and organics; top 1.5 feet frozen.
2.5	1486.6	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; with granite fragments.
5.0	1484.1	SILTY SAND (SM): fine to medium grained; brown; moist; some gravel, clay, and cobbles; [Till].
14.5	1474.6	POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; brown; wet; with weathered granite fragments; [Till].
15.5	1473.6	SILTY SAND (SM): fine to medium grained; brown; wet; [Till].
22.0	1467.1	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown to gray; wet; weathered granite fragments; [Till].
34.5	1454.6	SILTY SAND (SM): fine grained; gray; wet; with 3 to 6 inch silt and sand layers from 30 to 34.5 feet; [Till].
39.0	1450.1	POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; gray; wet; with cobbles and weathered granite fragments; brown below 37 feet; [Till].
45.0	1444.1	GRANITE; mottled red, black, and white; [Bedrock].
45.0		Bottom of Boring at 45.0 feet

Sample No.	% Recovery
A, B	80
C	100
D	80
E	60
F	60
G	20
	100
	100
	50

Column headings: Elevation, feet; Depth, feet; MATERIAL DESCRIPTION; Graphic Log; Samples; Sample No.; % Recovery; SPT, N value or RQD %; STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC%; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5); INSTRUMENTATION

Date Boring Started:	3/14/14 8:00 am	
Date Boring Completed:	3/14/14 12:00 pm	
Logged By:	BJL2	
Drilling Contractor:	Cascade	
Drill Rig:	CRS-17-C	

Water Levels (ft)

At Time of Drilling	5.0
After Install	1.9

Remarks:

Weather: 20 to 30F, overcast

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LOG OF BORING R14-15

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1494.8 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 742,493.1 ft E 2,860,626.1 ft	Completion Depth:	35.0 ft
Datum:	NAD83 Minnesota State Plane		

Columns: Elevation, feet | Depth, feet | MATERIAL DESCRIPTION | Graphic Log | Samples | Sample No. | % Recovery | SPT, N value or RQD % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC%; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5) | INSTRUMENTATION

Surface Elev.: 1494.8 ft

Depth (ft)	Material Description
0.5ft	TOPSOIL (OL): dark brown; moist; roots and sticks. 1494.3 ft
4.5ft	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; dark brown to brown; moist; with weathered granite fragments. 1490.3 ft
29.0ft	SILTY SAND WITH GRAVEL (SM): medium to coarse grained; brown; moist to wet; with cobbles from 5 to 10 feet; with weathered granite fragments; [Till]. Saturated zone at 20 feet. 1465.8 ft
32.0ft	POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; brown to gray; wet; with cobbles and weathered granite fragments; [Till]. 1462.8 ft
35.0ft	GRANITE; mottled red, black, and white; [Bedrock]. 1459.8 ft

Bottom of Boring at 35.0 feet

Sample No.	% Recovery
A	83
B	40
	80
	100
C	80
	80
	100
	75

Date Boring Started:	3/14/14 1:30 pm
Date Boring Completed:	3/14/14 4:00 pm
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
After Install 6.8

Remarks:

Weather: 15 to 20F, overcast

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LOG OF BORING R14-16

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1507.6 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 742,916.4 ft E 2,861,262.2 ft	Completion Depth:	30.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1507.6 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery
1507.1 ft	0.5ft	TOPSOIL (OL): brown; moist; organics and leaf debris.		
		SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; moist to wet; [Till].	A	100
				100
		Cobbles and granite fragments from 9 to 9.5 feet.		90
				50
1483.1 ft	24.5ft		B	100
1482.1 ft	25.5ft	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; wet; [Till].		100
1477.6 ft	30.0ft	GRANITE; red; highly weathered; poor recovery due to drilling with water; [Bedrock].		13

Bottom of Boring at 30.0 feet

Column headings: Elevation, feet; Depth, feet; MATERIAL DESCRIPTION; Graphic Log; Samples; Sample No.; % Recovery; SPT, N value or RQD %; STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC%; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5); INSTRUMENTATION

Date Boring Started:	3/15/14 8:30 am	Water Levels (ft)		Remarks:
Date Boring Completed:	3/15/14 9:15 am	At Time of Drilling	16.0	
Logged By:	BJL2	After Install	16.8	
Drilling Contractor:	Cascade			
Drill Rig:	CRS-17-C			Weather: 5 to 20F, overcast

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LOG OF BORING R14-20

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1487.3 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 743,246.7 ft E 2,864,302.4 ft	Completion Depth:	35.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1487.3 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery
1486.3 ft	0–1.0ft	PEAT (PT): dark brown; moist; sapric; woody debris; top 1.5 feet frozen.	A	100
1470.3 ft	1.0–17.0ft	SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; moist; with clay and cobbles; [Till].	A	100, 100, 88
1469.3 ft	17.0–18.0ft	BOULDER: mottled red, black, and white.	B	100
1463.3 ft	18.0–24.0ft	CLAYEY SAND WITH GRAVEL (SC): fine to medium grained; brown; moist; with cobbles; boulder from 17 to 18 feet; [Till].	B	100
1460.3 ft	24.0–27.0ft	BOULDER: mottled red, black, and white.	C	67
1456.3 ft	27.0–31.0ft	POORLY GRADED GRAVEL WITH SAND (GP): brown and gray; wet; medium to coarse sand; [Till].	C	67
1452.3 ft	31.0–35.0ft	GRANITE; mottled red, black, and white; highly weathered; [Bedrock].		100
	35.0ft	Bottom of Boring at 35.0 feet		

Other log columns: Graphic Log; Samples; SPT, N value or RQD %; STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ▭; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5).

Date Boring Started:	3/15/14 12:00 pm	Water Levels (ft)	Remarks: Artesian flow of ~10-12 gpm started at 31 feet. Static water level was ~34-36 inches above ground surface.
Date Boring Completed:	3/15/14 4:00 pm	At Time of Drilling 5.0	
Logged By:	BJL2		
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 5 to 15F, sunny

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LOG OF BORING R14-24

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1491.1 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 743,227.5 ft E 2,867,188.8 ft	Completion Depth:	14.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1491.1 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery	SPT, N value or RQD %
1491.1–1490.1	0–1.0	TOPSOIL (OL): brown; moist; with roots and leaf debris.	A, B	100	
1490.1–1485.6	1.0–5.5	SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; moist; some cobbles and weathered granite fragments; [Till].		100	
1485.6–1477.1	5.5–14.0	GRANITE; mottled red, black, and white; [Bedrock].		100	
				50	
				100	
	14.0	Bottom of Boring at 14.0 feet			

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5)

Date Boring Started:	3/16/14 8:30 am
Date Boring Completed:	3/16/14 11:30 am
Logged By:	BJL2
Drilling Contractor:	Cascade
Drill Rig:	CRS-17-C

Water Levels (ft)
At Time of Drilling Dry

Remarks:

Weather: -10 to 10F, sunny

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LOG OF BORING R14-25

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1497.2 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 743,227.7 ft E 2,868,226.9 ft	Completion Depth:	10.5 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1497.2 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Graphic Log	Samples	Sample No.	% Recovery	SPT, N value or RQD %
	0	BOULDER: mottled red, black, and white.					
1495		1496.2 ft (1.0ft)			A	57	
		SILTY SAND WITH GRAVEL: fine to medium grained; brown; moist; with weathered granite fragments; [Till].					
	5	1493.7 ft (3.5ft)				88	
1490		GRANITE; mottled red, black, and white; [Bedrock].					
						56	
	10	1486.7 ft (10.5ft)					
		Bottom of Boring at 10.5 feet					

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40)
REC% / RQD % ◆ (20, 40, 60, 80)
SHEAR STRENGTH, tsf (0, 2.5, 5)

Date Boring Started:	3/16/14 12:00 pm	Water Levels (ft)	Remarks:
Date Boring Completed:	3/16/14 1:40 pm	At Time of Drilling: Dry	
Logged By:	BJL2		
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 10 to 20F, sunny

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LOG OF BORING R14-26

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1502.5 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 743,283.6 ft E 2,869,216.9 ft	Completion Depth:	28.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1502.5 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery
1502.5	0	PEAT (PT): dark brown; frozen; wood and leaf debris; top 1 foot frozen.		
1501.5 ft	1.0ft	SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; moist to wet; some cobbles; [Till].	A	60
			B	100
				100
				40
1481.0 ft	21.5ft	GRANITE; mottled red, black, and white; [Bedrock].		100
				100
1474.5 ft	28.0ft	Bottom of Boring at 28.0 feet		

Column headings also include: Graphic Log; Samples; SPT, N value or RQD %; STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC%; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5); INSTRUMENTATION.

Date Boring Started:	3/16/14 2:00 pm	Water Levels (ft)	Remarks:
Date Boring Completed:	3/16/14 4:00 pm	At Time of Drilling 4.0	
Logged By:	BJL2	After Install 1.6	
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 15 to 20F, sunny

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LOG OF BORING R14-27

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1502.8 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 743,350.1 ft E 2,870,201.4 ft	Completion Depth:	30.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1502.8 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Layer Depth	Sample No.	% Recovery
1502.8	0	PEAT (PT): dark brown; moist; with roots and sticks; frozen. 1502.3 ft	0.5ft		
1500		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist to wet; with cobbles and weathered granite fragments; [Till].		A	80
1495	5				100
	10	Weight of barrel pushed sampler from 10 to 13 feet.			
1490		1487.8 ft			30
	15	POORLY GRADED SAND (SP): medium grained; brown; wet; with cobbles and weathered granite fragments; [Till]. 1483.3 ft	15.0ft	B	30
1485	20	POORLY GRADED GRAVEL WITH SILT (GP): gray; wet; with cobbles and weathered granite fragments; sand layer from 23-24 feet; [Till]. 1477.8 ft	19.5ft	C	80
1480	25	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; gray; wet; [Till]. 1476.8 ft	25.0ft		100
1475		GRANITE; mottled red, black, and white; fracture at 29.5 feet; [Bedrock]. 1472.8 ft	26.0ft		75
	30	Bottom of Boring at 30.0 feet	30.0ft		

Column headings: Graphic Log; Samples; Sample No.; % Recovery; SPT, N value or RQD %; STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC%; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5); INSTRUMENTATION

Date Boring Started:	3/17/14 8:00 am	Water Levels (ft)		Remarks:
Date Boring Completed:	3/17/14 10:00 am	At Time of Drilling	10.0	
Logged By:	BJL2	After Install	1.7	
Drilling Contractor:	Cascade			
Drill Rig:	CRS-17-C			Weather: 20F, overcast, some wind

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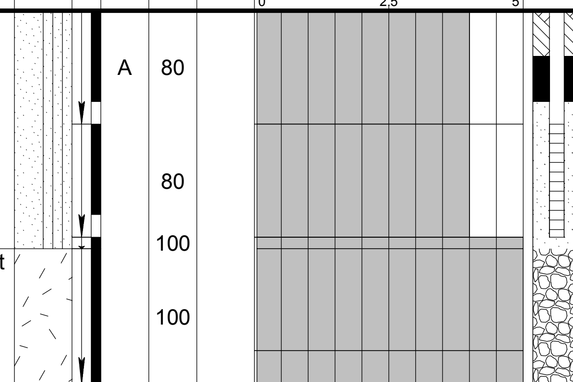
LOG OF BORING R14-28

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1509.5 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 742,651.3 ft E 2,870,734.5 ft	Completion Depth:	16.5 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1509.5 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Samples	Sample No.	% Recovery	SPT, N value or RQD %
	0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; with cobbles and weathered granite fragments; top 1 foot frozen; [Till].		A	80	
1505	5				80	
1500	10	1499.0 ft			100	
		GRANITE; mottled red, black, and white; [Bedrock]. 10.5ft			100	
1495	15	1493.0 ft				
		Bottom of Boring at 16.5 feet 16.5ft				

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5); Graphic Log; INSTRUMENTATION



Date Boring Started:	3/17/14 1:00 pm	Water Levels (ft)	Remarks:
Date Boring Completed:	3/17/14 2:00 pm	At Time of Drilling 6.0	
Logged By:	BJL2	After Install 4.3	
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 20F, overcast

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LOG OF BORING R14-29

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1521.5 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 742,084.4 ft E 2,870,713.4 ft	Completion Depth:	34.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1521.5 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Sample No.	% Recovery
1521.5–1515.5	0–6.0	SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; moist; with cobbles and weathered granite fragments; [Till].	A	40
1515.5–1513.5	6.0–8.0	BOULDER: mottled red, black, and white.		80
1513.5–1502.0	8.0–19.5	SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; wet; with cobbles and weathered granite fragments; [Till].		70
			B	80
1502.0–1492.5	19.5–29.0	POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; gray; wet; with cobbles and weathered granite fragments; [Till].		100
				75
1492.5–1487.5	29.0–34.0	GRANITE; mottled red, black, and white; fracture at 33 feet; [Bedrock].		87

Bottom of Boring at 34.0 feet — 34.0ft

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40); REC% ; RQD % ◆ (20, 40, 60, 80); SHEAR STRENGTH, tsf (0, 2.5, 5)

Columns: Graphic Log, Samples, Sample No., % Recovery, SPT, N value or RQD %

Date Boring Started:	3/17/14 3:00 pm	Water Levels (ft)	Remarks:
Date Boring Completed:	3/17/14 5:00 pm	At Time of Drilling 5.0	
Logged By:	BJL2		
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 20F, overcast

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LOG OF BORING R14-30

Project:	Winter 2013/2014 Rotasonic Investigation	Surface Elevation:	1529.2 ft
Job No.:	23690C29.13	Drilling Method:	Sonic
Location:	Hoyt Lakes, MN	Sampling Method:	Rotosonic Soil Core
Coordinates:	N 741,461.2 ft E 2,870,719.3 ft	Completion Depth:	29.0 ft
Datum:	NAD83 Minnesota State Plane		

Surface Elev.: 1529.2 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Graphic Log	Samples	Sample No.	% Recovery	SPT, N value or RQD %
1529.2	0	BOULDER: gray.					
1528.7 ft	0.5ft	POORLY GRADED SAND WITH SILT (SP-SM): medium grained; reddish brown; moist; trace weathered granite fragments; [Till].			A	73	
1524.2 ft	5.0ft	POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; brown; moist to wet; with cobbles and weathered granite fragments increasing with depth; [Till].			B	40	
	10–15					50	
	15	Pushed a rock from 15 to 20 feet.				0	
	20–25					80	
1503.2 ft	25					100	
	26.0ft	GRANITE; mottled red, black, and white; fractured bedrock; no water return during drilling; [Bedrock].				83	
1500.2 ft	29.0ft	Bottom of Boring at 29.0 feet					

STANDARD PENETRATION TEST DATA N in blows/ft ◎ (10, 20, 30, 40)
REC% (bar)
RQD % ◆ (20, 40, 60, 80)
SHEAR STRENGTH, tsf (0, 2.5, 5)

Date Boring Started:	3/18/14 8:15 am	Water Levels (ft)	Remarks:
Date Boring Completed:	3/18/14 10:40 am	At Time of Drilling 10.0	
Logged By:	BJL2		
Drilling Contractor:	Cascade		
Drill Rig:	CRS-17-C		Weather: 20F, overcast

Exhibit B

Piezometer Logs

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LOG OF PIEZOMETER R14-04

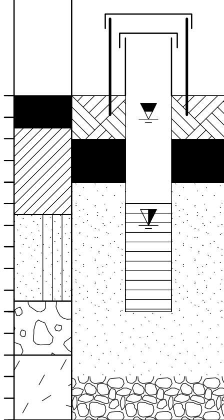
Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1545.4 ft	Top of Casing Elevation: 1547.7

STRATA

DESCRIPTION	DEPTH, ft
PEAT (PT): dark brown; moist; sapric; woody debris; top 1.5 feet frozen. 1543.9 ft	0
LEAN CLAY (CL): moist; some sand; some sapric peat. 1539.9 ft	5
POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; wet; with clay and gravel; [Till]. 1535.9 ft	10
POORLY GRADED GRAVEL (GM): medium grained; brown; moist; some clay; [Till]. 1533.4 ft	15
GRANITE; mottled red, black, and white; highly weathered to 13 feet; competent bedrock below; [Bedrock]. 1530.4 ft	

Bottom of Boring at 15.0 feet

PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-2.5	TPC	1547.9
-2.3	TRC	1547.7
0.0	GS	1545.4
2.0		1543.4
4.0	BS	1541.4
10.0	BSC	1535.4
13.0	TD	1532.4
15.0		1530.4

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5 - 4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-5**

GROUT
Type: **Cement**
Interval: **0-2**

SEAL
Type: **Bentonite Chips**
Interval: **2-4**

SANDPACK
Type: **Silica Sand**
Interval: **4-13**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **5-10**

Remarks:

Completion Depth:	15.0 ft
Date Started:	3/11/14
Date Completed:	3/11/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 735,679.7 ft E 2,857,633.8 ft

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling	6.0
After Install	1.1

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF PIEZOMETER R14-06

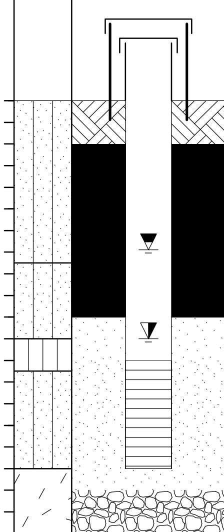
Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1526.4 ft	Top of Casing Elevation: 1528.7

STRATA

DESCRIPTION	DEPTH, ft
SILTY SAND (SM): fine to medium grained; brown; moist; top 1.5 feet frozen; weathered granite fragments and cobbles; [Till]. 1518.9 ft	0
SILTY SAND (SM): fine to medium grained; gray; moist; with weathered granite fragments; [Till]. 1515.4 ft	
SANDY SILT (ML): fine grained; gray; wet; with cobbles; [Till]. 1513.9 ft	
SILTY SAND WITH GRAVEL (SM): medium to coarse grained; gray; wet; [Till]. 1509.4 ft	
GRANITE; mottled red, black, and white; weathered granite to 17.5 feet; [Bedrock]. 1506.4 ft	20

Bottom of Boring at 20.0 feet

PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-2.5	TPC	1528.9
-2.3	TRC	1528.7
0.0	GS	1526.4
2.0		1524.4
10.0	BS	1516.4
17.0	BSC	1509.4
18.0	TD	1508.4
20.0		1506.4

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-12**

GROUT
Type: **Cement**
Interval: **0-2**

SEAL
Type: **Bentonite Chips**
Interval: **2-10**

SANDPACK
Type: **Silica Sand**
Interval: **10-18**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **12-17**

Remarks:

Completion Depth:	20.0 ft
Date Started:	3/11/14
Date Completed:	3/11/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 737,489.5 ft E 2,857,364.4 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling	11.0
After Install	6.9

The stratification lines represent approximate boundaries. The transition may be gradual.

M:\GINTPROJECTS\23690C29.13 POLYMET TAILINGS BASIN.GPJ BARRLIBRARY.GLB INSTRUMENT LOG REPORT BARR GEOTECH TEMPLATE.GDT

LOG OF PIEZOMETER R14-08

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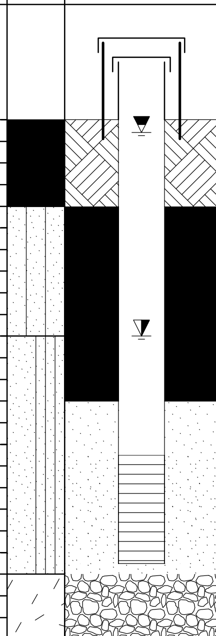
Minneapolis, MN 55435
Telephone: 952-832-2600

Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1502.8 ft	Top of Casing Elevation: 1505.0

STRATA DESCRIPTION	DEPTH, ft	DEPTH, ft		ELEVATION, ft
		-2.5	TPC	1505.3
		-2.2	TRC	1505.0
	0	0.0	GS	1502.8
PEAT (PT): dark brown; moist; top 2 feet frozen. 1498.8 ft		4.0		1498.8
SILTY SAND (SM): fine to medium grained; brown; moist; trace gravel; [Till]. 1492.8 ft	5, 10			
POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM): medium to coarse grained; brown; wet; with cobbles from 18 to 21 feet; [Till]. 1481.8 ft	15, 20	13.0	BS	1489.8
		20.5	BSC	1482.3
		21.0	TD	1481.8
GRANITE; mottled red, black, and white; [Bedrock]. 1478.8 ft		24.0		1478.8
Bottom of Boring at 24.0 feet				



PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.2-15.5**

GROUT
Type: **Cement**
Interval: **0-4**

SEAL
Type: **Bentonite Chips**
Interval: **4-13**

SANDPACK
Type: **Silica Sand**
Interval: **13-21**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **15.5-20.5**

Remarks:

Completion Depth:	24.0 ft
Date Started:	3/12/14
Date Completed:	3/12/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 739,287.6 ft E 2,857,372.0 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC TOP OF PROTECTIVE CASING
TRC TOP OF RISER CASING
BPC BASE PROTECTIVE CASING
GS GROUND SURFACE
BS BENTONITE SEAL
FP FILTER PACK
TSC TOP OF SCREEN
BSC BOTTOM OF SCREEN
TD TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling 10.0
After Install 0.6

The stratification lines represent approximate boundaries. The transition may be gradual.

BARR

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LOG OF PIEZOMETER R14-12

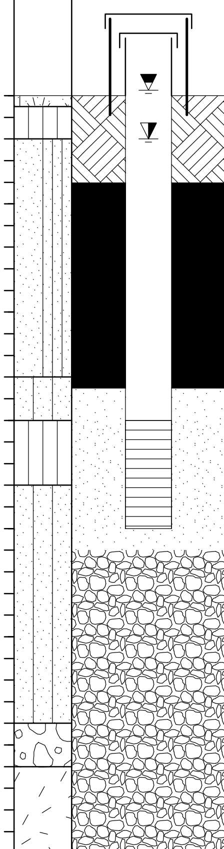
Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1480.3 ft	Top of Casing Elevation: 1482.6

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL (OL): dark brown; moist; with wood and leaf debris. 1479.8 ft	0
SILT (ML): brown; moist; with sand. 1478.3 ft	5
POORLY GRADED SAND WITH SILT (SP-SM): fine to coarse grained; gray to brown; wet; some weathered granite fragments to 13 feet; [Till]. 1467.3 ft	10
SILTY SAND (SM): fine grained; gray; wet; [Till]. 1465.3 ft	15
SILT (ML): gray; moist; with sand; little clay at 18 feet; [Till]. 1462.3 ft	20
SILTY SAND (SM): fine to medium grained; gray; wet; [Till]. 1451.3 ft	25
POORLY GRADED GRAVEL WITH SAND (GP): gray; wet; some cobbles with weathered granite fragments; [Till]. 1449.3 ft	30
GRANITE; mottled red, black, and white; [Bedrock]. 1445.3 ft	35

Bottom of Boring at 35.0 feet

SYMBOL / PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-2.5	TPC	1482.8
-2.3	TRC	1482.6
0.0	GS	1480.3
4.0		1476.3
13.5	BS	1466.8
20.0	BSC	1460.3
21.0	TD	1459.3
35.0		1445.3

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-15**

GROUT
Type: **Cement**
Interval: **0-4**

SEAL
Type: **Bentonite Chips**
Interval: **4-13.5**

SANDPACK
Type: **Silica Sand**
Interval: **13.5-21**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **15-20**

Remarks:

Completion Depth:	35.0 ft
Date Started:	3/13/14
Date Completed:	3/13/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 742,311.8 ft E 2,858,500.4 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC TOP OF PROTECTIVE CASING
TRC TOP OF RISER CASING
BPC BASE PROTECTIVE CASING
GS GROUND SURFACE
BS BENTONITE SEAL
FP FILTER PACK
TSC TOP OF SCREEN
BSC BOTTOM OF SCREEN
TD TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling 2.0
After Install -0.3

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF PIEZOMETER R14-13

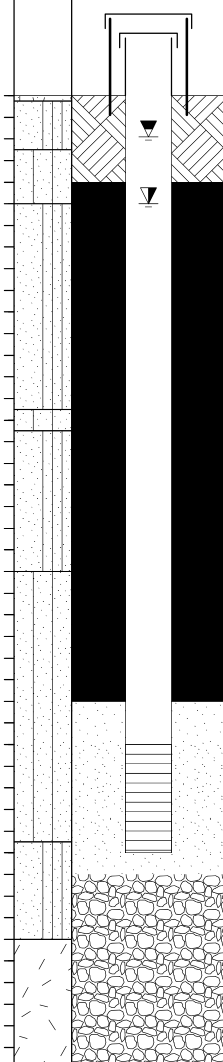
Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1489.1 ft	Top of Casing Elevation: 1491.4

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL (OL): dark brown; moist; roots and organics; top 1.5 feet frozen. 1488.9 ft	0
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; with granite fragments. 1486.6 ft	5
SILTY SAND (SM): fine to medium grained; brown; moist; some gravel, clay, and cobbles; [Till]. 1484.1 ft	15
POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; brown; wet; with weathered granite fragments; [Till]. 1474.6 ft	20
SILTY SAND (SM): fine to medium grained; brown; wet; [Till]. 1473.6 ft	30
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown to gray; wet; weathered granite fragments; [Till]. 1467.1 ft	35
SILTY SAND (SM): fine grained; gray; wet; with 3 to 6 inch silt and sand layers from 30 to 34.5 feet; [Till]. 1454.6 ft	45
POORLY GRADED SAND WITH SILT (SP-SM): medium to	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45

PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-2.5	TPC	1491.6
-2.3	TRC	1491.4
0.0	GS	1489.1
4.0		1485.1
28.0	BS	1461.1
35.0	BSC	1454.1
36.0	TD	1453.1
45.0		1444.1

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-30**

GROUT
Type: **Cement**
Interval: **0-4**

SEAL
Type: **Bentonite Chips**
Interval: **4-28**

SANDPACK
Type: **Silica Sand**
Interval: **28-36**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **30-35**

Remarks:

Completion Depth:	45.0 ft
Date Started:	3/14/14
Date Completed:	3/14/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 742,310.5 ft E 2,859,372.0 ft

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling	5.0
After Install	1.9

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

LOG OF PIEZOMETER R14-13

Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1489.1 ft	Top of Casing Elevation: 1491.4

STRATA DESCRIPTION	DEPTH, ft	SYMBOL	PIEZOMETER DETAILS	DEPTH, ft		ELEVATION, ft
coarse grained; gray; wet; with cobbles and weathered granite fragments; brown below 37 feet; [Till]. 1450.1 ft						
GRANITE; mottled red, black, and white; [Bedrock]. 1444.1 ft						
Bottom of Boring at 45.0 feet						

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-30**

GROUT
Type: **Cement**
Interval: **0-4**

SEAL
Type: **Bentonite Chips**
Interval: **4-28**

SANDPACK
Type: **Silica Sand**
Interval: **28-36**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **30-35**

Remarks:

Completion Depth:	45.0 ft
Date Started:	3/14/14
Date Completed:	3/14/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 742,310.5 ft E 2,859,372.0 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling	5.0
After Install	1.9

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF PIEZOMETER R14-15

Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1494.8 ft	Top of Casing Elevation: 1497.1

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL (OL): dark brown; moist; roots and sticks. 1494.3 ft	0
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; dark brown to brown; moist; with weathered granite fragments. 1490.3 ft	5
SILTY SAND WITH GRAVEL (SM): medium to coarse grained; brown; moist to wet; with cobbles from 5 to 10 feet; with weathered granite fragments; [Till]. 1465.8 ft	10–25
POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; brown to gray; wet; with cobbles and weathered granite fragments; [Till]. 1462.8 ft	30
GRANITE; mottled red, black, and white; [Bedrock]. 1459.8 ft	35

Bottom of Boring at 35.0 feet

PIEZOMETER DETAILS

DEPTH, ft		ELEVATION, ft
-2.5	TPC	1497.3
-2.3	TRC	1497.1
0.0	GS	1494.8
4.0		1490.8
24.0	BS	1470.8
31.0	BSC	1463.8
31.5	TD	1463.3
35.0		1459.8

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-26**

GROUT
Type: **Cement**
Interval: **0-4**

SEAL
Type: **Bentonite Chips**
Interval: **4-24**

SANDPACK
Type: **Silica Sand**
Interval: **24-31.5**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **26-31**

Remarks:

Completion Depth:	35.0 ft
Date Started:	3/14/14
Date Completed:	3/14/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 742,493.1 ft E 2,860,626.1 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

After Install 6.8

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF PIEZOMETER R14-16

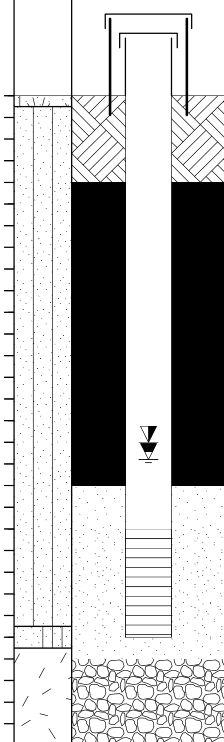
Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1507.6 ft	Top of Casing Elevation: 1509.9

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL (OL): brown; moist; organics and leaf debris. 1507.1 ft	0
SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; moist to wet; [Till]. 1483.1 ft	5, 10, 15, 20
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; wet; [Till]. 1482.1 ft	25
GRANITE; red; highly weathered; poor recovery due to drilling with water; [Bedrock]. 1477.6 ft	30

Bottom of Boring at 30.0 feet

SYMBOL / PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-2.5	TPC	1510.1
-2.3	TRC	1509.9
0.0	GS	1507.6
4.0		1503.6
18.0	BS	1489.6
25.0	BSC	1482.6
26.0	TD	1481.6
30.0		1477.6

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-20**

GROUT
Type: **Cement**
Interval: **0-4**

SEAL
Type: **Bentonite Chips**
Interval: **4-18**

SANDPACK
Type: **Silica Sand**
Interval: **18-26**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **20-25**

Remarks:

Completion Depth:	30.0 ft
Date Started:	3/15/14
Date Completed:	3/15/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 742,916.4 ft E 2,861,262.2 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling	16.0
After Install	16.8

The stratification lines represent approximate boundaries. The transition may be gradual.

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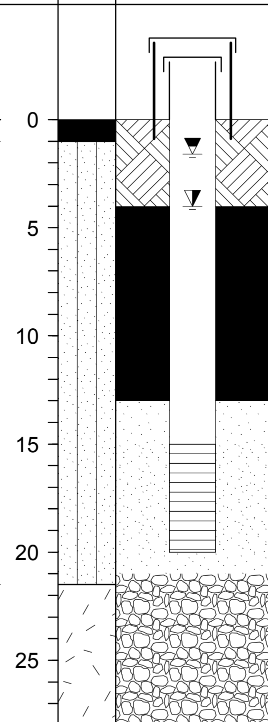
LOG OF PIEZOMETER R14-26

Sheet 1 of 1

Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1502.5 ft	Top of Casing Elevation: 1504.8

STRATA

DESCRIPTION	DEPTH, ft
PEAT (PT): dark brown; frozen; wood and leaf debris; top 1 foot frozen. 1501.5 ft	0
SILTY SAND WITH GRAVEL (SM): fine to medium grained; brown; moist to wet; some cobbles; [Till]. 1481.0 ft	
GRANITE; mottled red, black, and white; [Bedrock]. 1474.5 ft	
Bottom of Boring at 28.0 feet	



DEPTH, ft		ELEVATION, ft
-2.5	TPC	1505.0
-2.3	TRC	1504.8
0.0	GS	1502.5
4.0		1498.5
13.0	BS	1489.5
20.0	BSC	1482.5
21.0	TD	1481.5
28.0		1474.5

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-15**

GROUT
Type: **Cement**
Interval: **0-4**

SEAL
Type: **Bentonite Chips**
Interval: **4-13**

SANDPACK
Type: **Silica Sand**
Interval: **13-21**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **15-20**

Remarks:

Completion Depth:	28.0 ft
Date Started:	3/16/14
Date Completed:	3/16/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 743,283.6 ft E 2,869,216.9 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling	4.0
After Install	1.6

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF PIEZOMETER R14-27

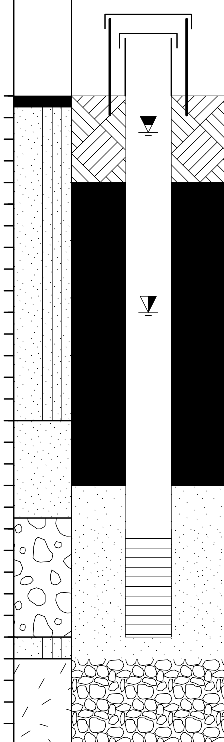
Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1502.8 ft	Top of Casing Elevation: 1505.1

STRATA

DESCRIPTION	DEPTH, ft
PEAT (PT): dark brown; moist; with roots and sticks; frozen. 1502.3 ft	0
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist to wet; with cobbles and weathered granite fragments; [Till]. 1487.8 ft	5, 10
POORLY GRADED SAND (SP): medium grained; brown; wet; with cobbles and weathered granite fragments; [Till]. 1483.3 ft	15
POORLY GRADED GRAVEL WITH SILT (GP): gray; wet; with cobbles and weathered granite fragments; sand layer from 23-24 feet; [Till]. 1477.8 ft	20
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; gray; wet; [Till]. 1476.8 ft	25
GRANITE; mottled red, black, and white; fracture at 29.5 feet; [Bedrock]. 1472.8 ft	30

Bottom of Boring at 30.0 feet

PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-2.5	TPC	1505.3
-2.3	TRC	1505.1
0.0	GS	1502.8
4.0		1498.8
18.0	BS	1484.8
25.0	BSC	1477.8
26.0	TD	1476.8
30.0		1472.8

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-20**

GROUT
Type: **Cement**
Interval: **0-4**

SEAL
Type: **Bentonite Chips**
Interval: **4-18**

SANDPACK
Type: **Silica Sand**
Interval: **18-26**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **20-25**

Remarks:

Completion Depth:	30.0 ft
Date Started:	3/17/14
Date Completed:	3/17/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 743,350.1 ft E 2,870,201.4 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling	10.0
After Install	1.7

The stratification lines represent approximate boundaries. The transition may be gradual.

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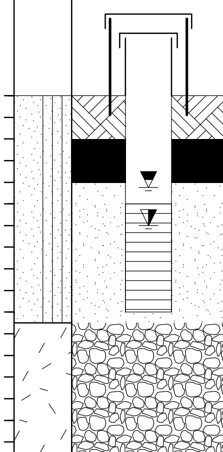
LOG OF PIEZOMETER R14-28

Project: Winter 2013/2014 Piezometers	Location: Hoyt Lakes, MN	Client: PolyMet
Barr Project Number: 23690C29.13	Surface Elevation: 1509.5 ft	Top of Casing Elevation: 1511.8

STRATA

DESCRIPTION	DEPTH, ft
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; with cobbles and weathered granite fragments; top 1 foot frozen; [Till]. 1499.0 ft	0–10.5
GRANITE; mottled red, black, and white; [Bedrock]. 1493.0 ft	10.5–16.5
Bottom of Boring at 16.5 feet	

PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-2.5	TPC	**1512.0**
-2.3	TRC	**1511.8**
0.0	GS	**1509.5**
2.0		1507.5
4.0	BS	1505.5
10.0	BSC	1499.5
10.5	TD	1499.0
16.5		1493.0

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **6 inches**
Type: **Steel**
Interval: **-2.5-4.5**

RISER CASING
Diameter: **2 inches**
Type: **PVC**
Interval: **-2.3-5**

GROUT
Type: **Cement**
Interval: **0-2**

SEAL
Type: **Bentonite Chips**
Interval: **2-4**

SANDPACK
Type: **Silica Sand**
Interval: **4-10.5**

SCREEN
Diameter: **2 inches**
Type: **Continuous 0.01" slotted PVC**
Interval: **5-10**

Remarks:

Completion Depth:	16.5 ft
Date Started:	3/17/14
Date Completed:	3/17/14
Logged By:	BJL2
Drilling Contractor:	Cascade
Drilling Method:	Sonic
Datum:	NAD83 Minnesota State Plane
Coordinates:	N 742,651.3 ft E 2,870,734.5 ft

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL

TPC TOP OF PROTECTIVE CASING
TRC TOP OF RISER CASING
BPC BASE PROTECTIVE CASING
GS GROUND SURFACE
BS BENTONITE SEAL
FP FILTER PACK
TSC TOP OF SCREEN
BSC BOTTOM OF SCREEN
TD TOTAL DEPTH

WATER LEVELS(ft)

At Time of Drilling	6.0
After Install	4.3

The stratification lines represent approximate boundaries. The transition may be gradual.

Exhibit C

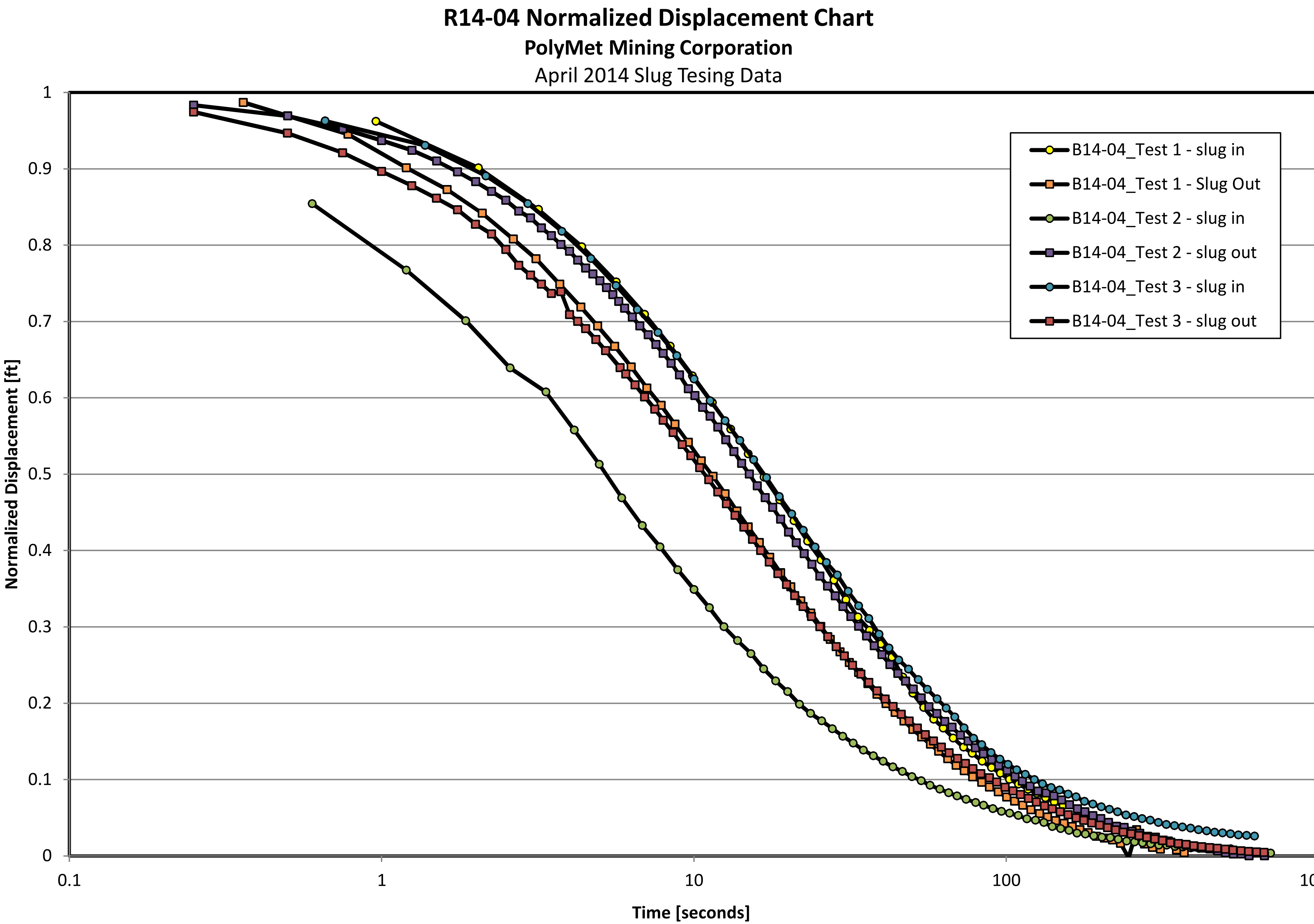
Slug Testing Results

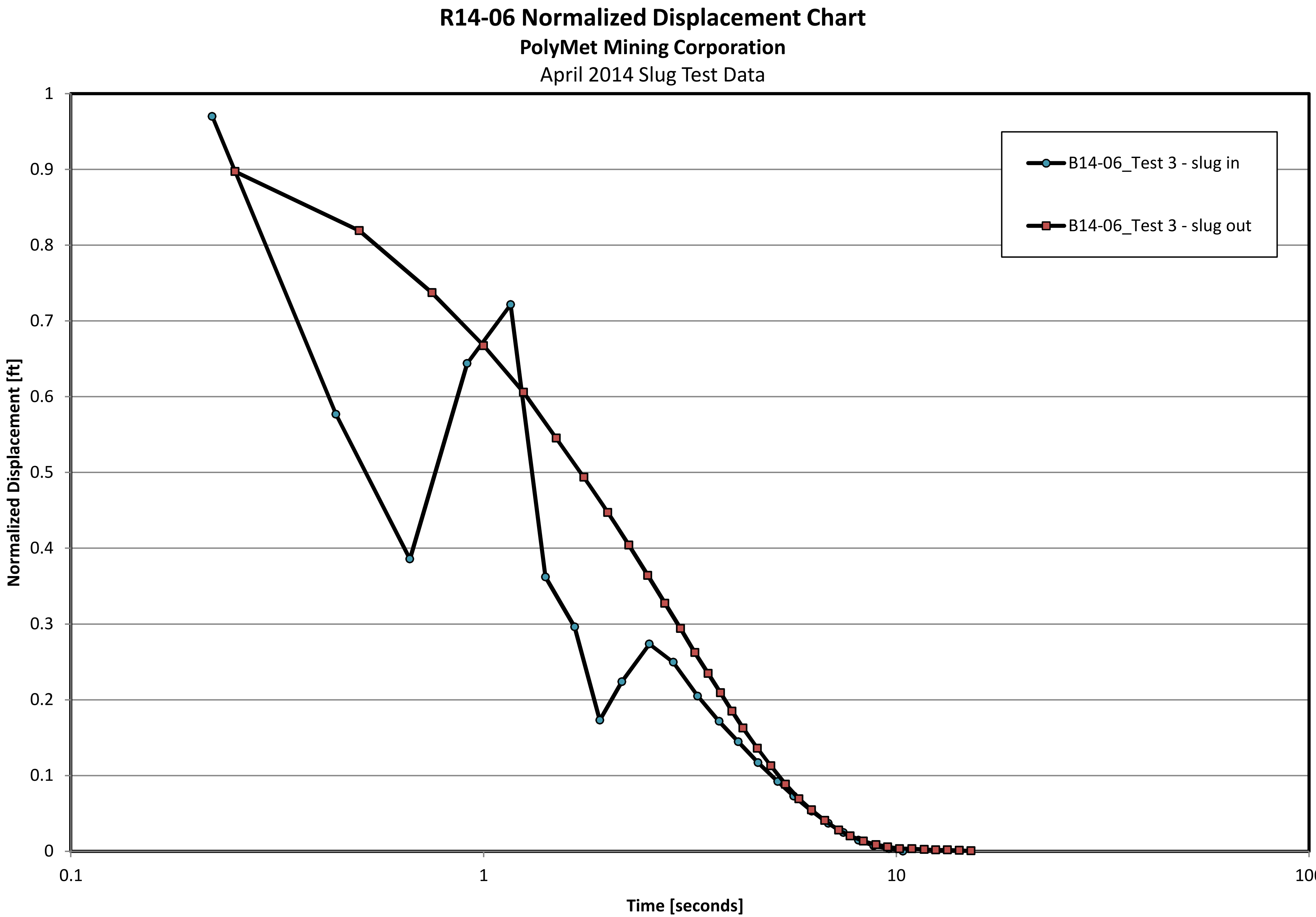
	ft/s	cm/s
GeoMean	5.1E-05	1.5E-03
Median	2.9E-05	8.7E-04
Min	1.7E-06	5.2E-05
Max	1.5E-03	4.6E-02

Summary Statistics

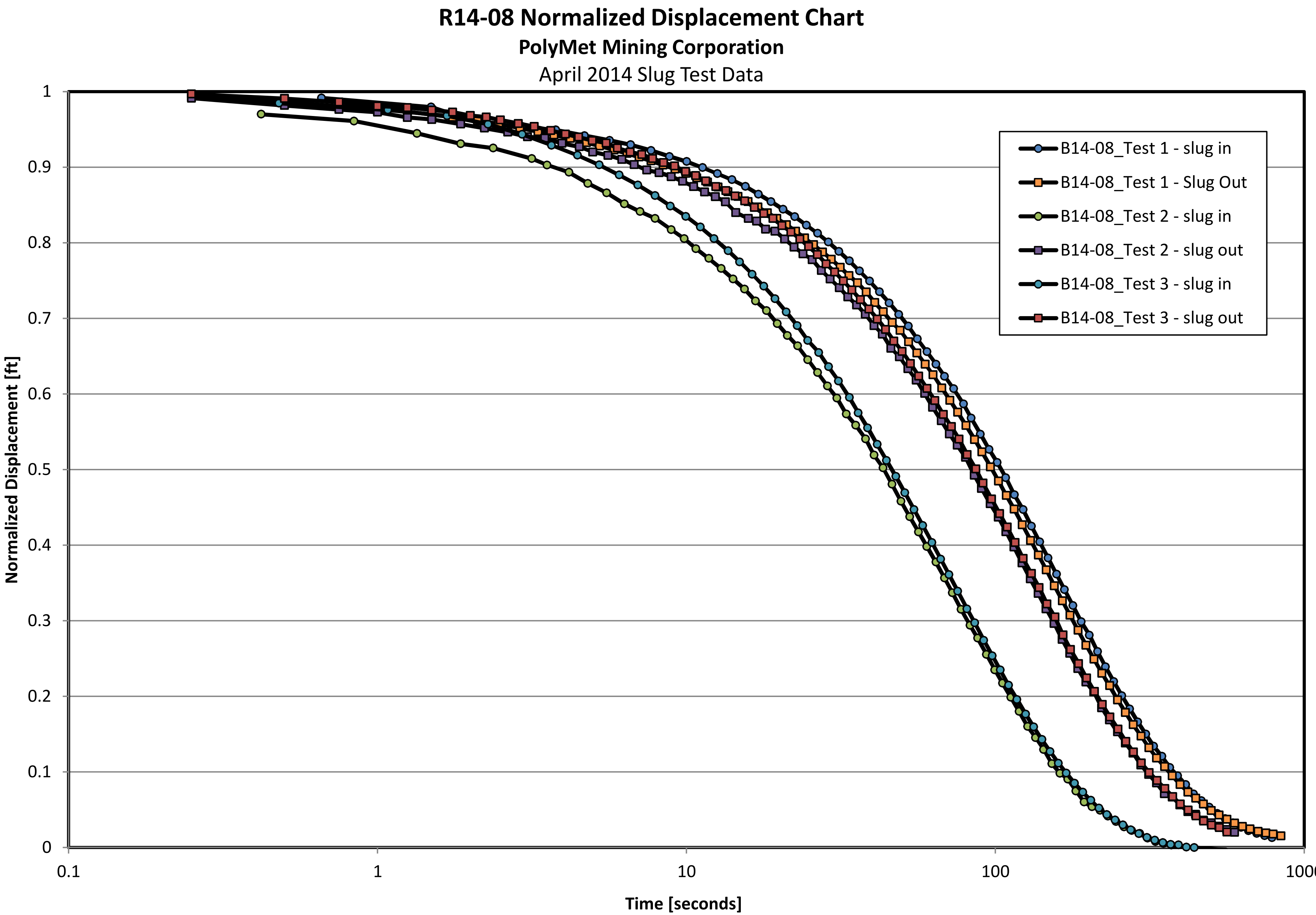
Well	Depth Below Ground Surface [feet]	Depth Below Till [ft]	Elevation [ft]	Material Type	Test	Hydraulic Conductivity Estimate		Analytical Solution	Comments
						Kr, ft/sec	Kr, cm/sec		
R14-04	10	5	1535	SP	test 3 - in	3.3E-05	1.0E-03	Hvorslev	
					test 3 - out	4.1E-05	1.3E-03	Hvorslev	
R14-06	17	17	1509	SM	test 2 - out	1.5E-03	4.6E-02	Hvorslev	
					test 3 - out	1.0E-03	3.1E-02	Hvorslev	
R14-08	21	17	1482	SP-SM	test 1 - in	1.4E-05	4.2E-04	KGS	
					test 2 - out	1.6E-05	5.0E-04	KGS	
R14-12	20	18	1460	ML	test 1 - out	1.7E-06	5.2E-05	KGS	*Water elevation higher than ground surface elevation*
					test 2 - out	1.9E-06	5.8E-05	KGS	
R14-13	35	33	1454	SP-SM	test 2 - out	2.5E-05	7.4E-04	KGS	
					test 3 - in	1.8E-05	5.4E-04	KGS	
R14-15	31	31	1464	SP-SM	test 1 - in	2.4E-04	7.3E-03	KGS	
					test 2 - out	3.6E-04	1.1E-02	KGS	
R14-16	25	25	1483	SM	test 2 - out	2.1E-04	6.5E-03	KGS	
					test 3 - in	1.9E-04	5.9E-03	KGS	
R14-26	20	19	1483	SM	test 2 - out	6.0E-04	1.8E-02	KGS	
					test 3 - in	2.8E-04	8.6E-03	KGS	
R14-27	25	25	1478	GP w/ Sand	test 2 - out	1.3E-03	4.0E-02	KGS	
					test 3 - out	1.2E-03	3.7E-02	KGS	
R14-28	10	10	1500	SP-SM	test 1 - in	4.4E-06	1.3E-04	KGS	
					test 2 - out	8.9E-06	2.7E-04	KGS	
GW-001	18	12	1474	SP	test 1 - in	1.1E-05	3.5E-04	KGS	*Water elevation higher than ground surface elevation; 10' screen*
					test 3 - out	1.4E-05	4.3E-04	KGS	
GW-006	*17*	*11*		*Tailings*	*test 1 - out*	*6.8E-05*	*2.1E-03*	*KGS*	*10' screen*
					test 2 - out	*6.8E-05*	*2.1E-03*	*KGS*	
GW-007	*17*	*11*		*Tailings*	*test 1 -out*	*9.5E-05*	*2.9E-03*	*KGS*	*10' screen*
					test 3 - in	*1.0E-04*	*3.0E-03*	*KGS*	
GW-012	18	13	1477	SM	test 1 - in	5.1E-06	1.5E-04	KGS	10' screen
					test 2 - in	3.8E-06	1.1E-04	KGS	

Shaded values were not included in the hydraulic conductivity analysis due to the screen being installed in tailings and not glacial till

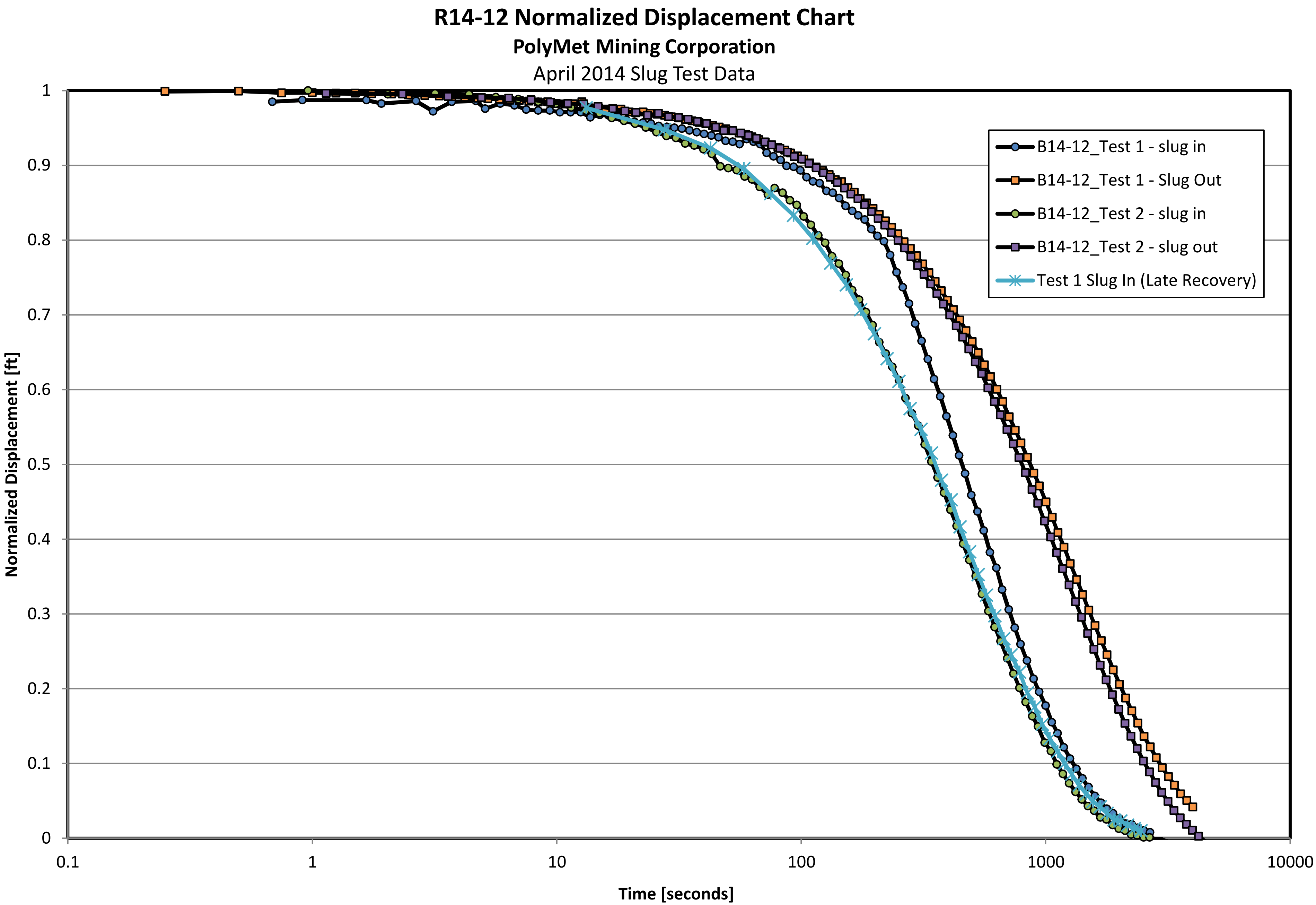

R14-04 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Tesing Data
Normalized Displacement [ft]
Time [seconds]
B14-04_Test 1 - slug in
B14-04_Test 1 - Slug Out
B14-04_Test 2 - slug in
B14-04_Test 2 - slug out
B14-04_Test 3 - slug in
B14-04_Test 3 - slug out
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100
1000



R14-06 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
B14-06_Test 3 - slug in
B14-06_Test 3 - slug out
Normalized Displacement [ft]
Time [seconds]
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100



R14-08 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.1
1
10
100
1000
B14-08_Test 1 - slug in
B14-08_Test 1 - Slug Out
B14-08_Test 2 - slug in
B14-08_Test 2 - slug out
B14-08_Test 3 - slug in
B14-08_Test 3 - slug out

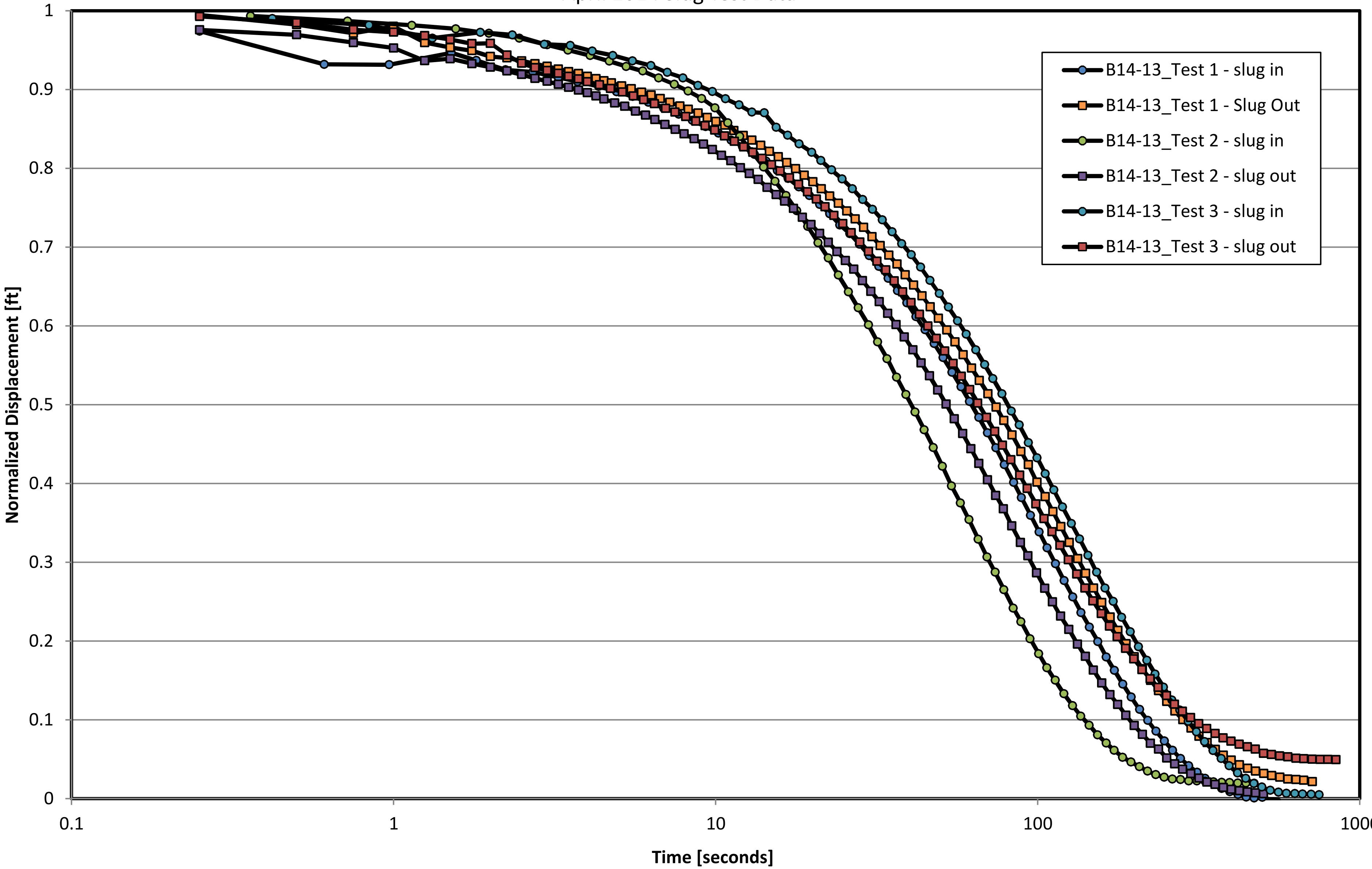


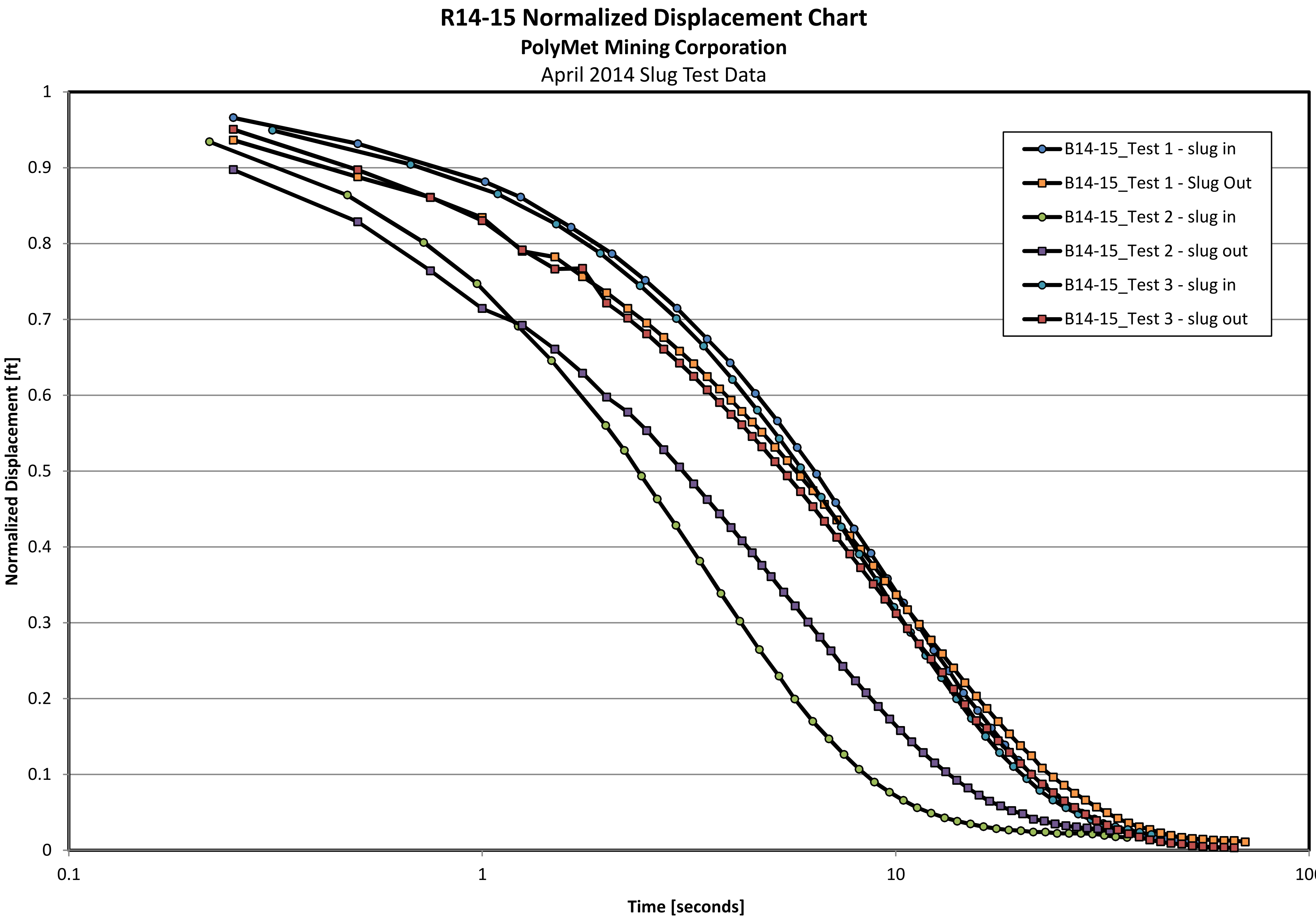
R14-12 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
B14-12_Test 1 - slug in
B14-12_Test 1 - Slug Out
B14-12_Test 2 - slug in
B14-12_Test 2 - slug out
Test 1 Slug In (Late Recovery)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100
1000
10000

R14-13 Normalized Displacement Chart

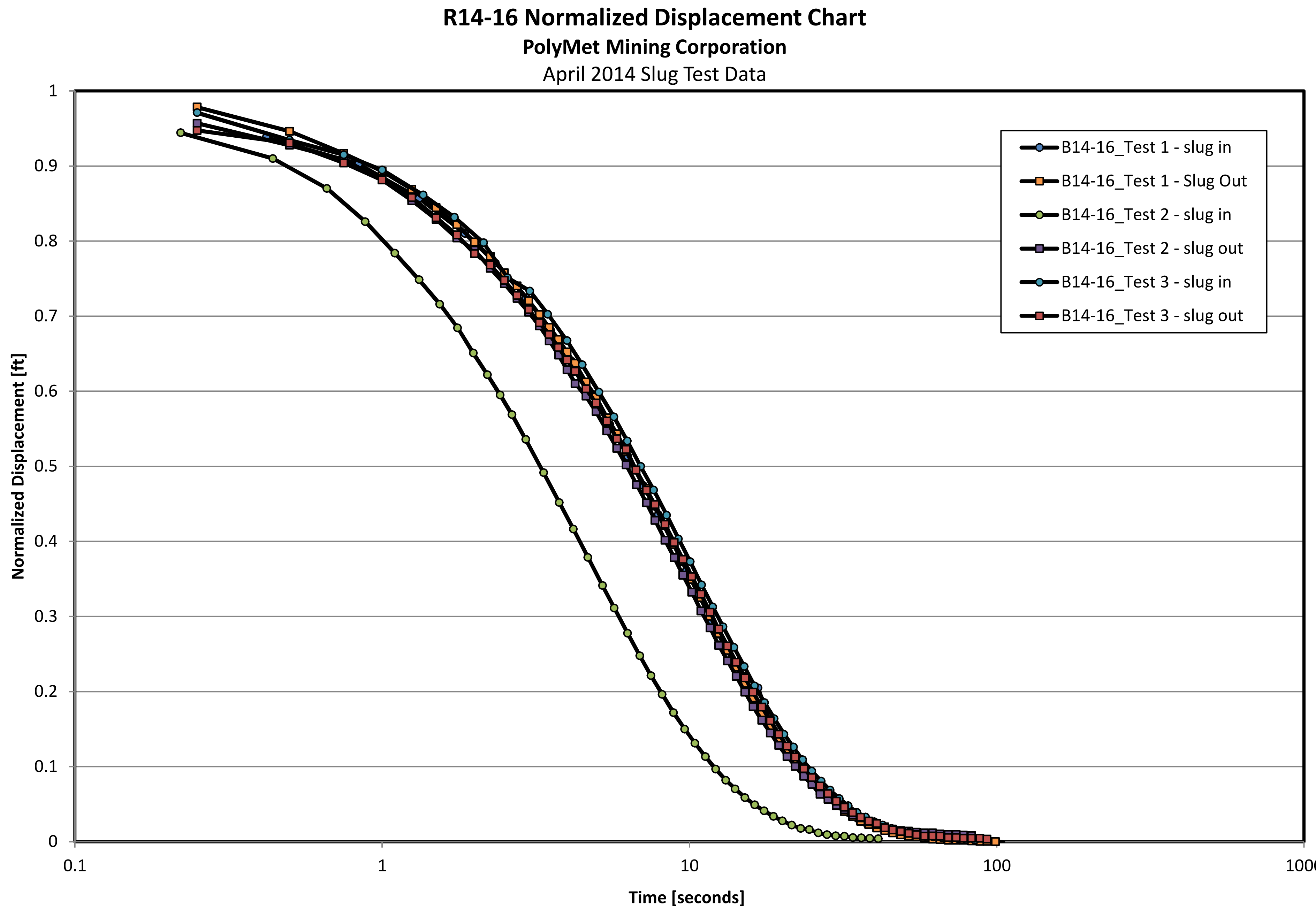
PolyMet Mining Corporation

April 2014 Slug Test Data

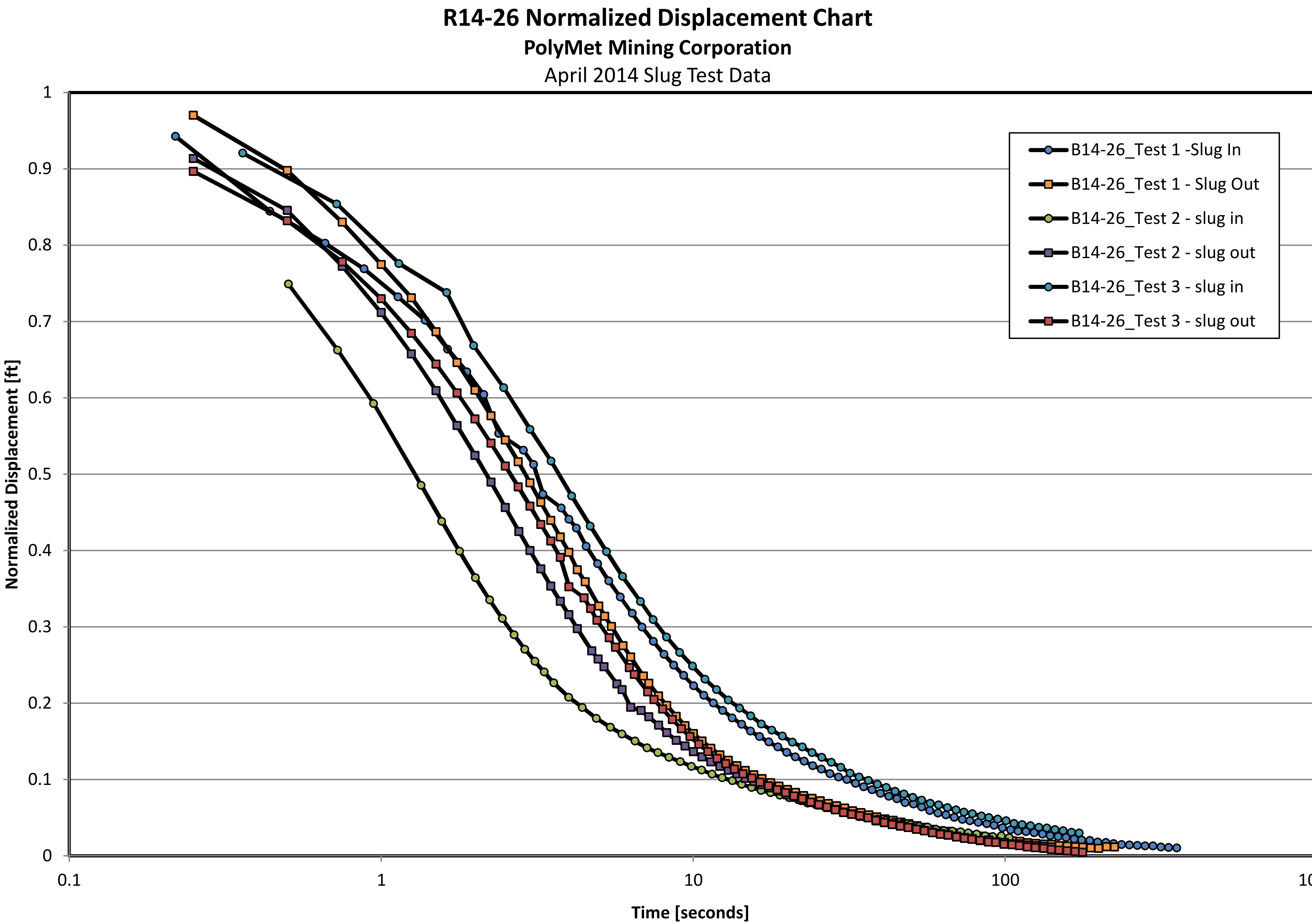


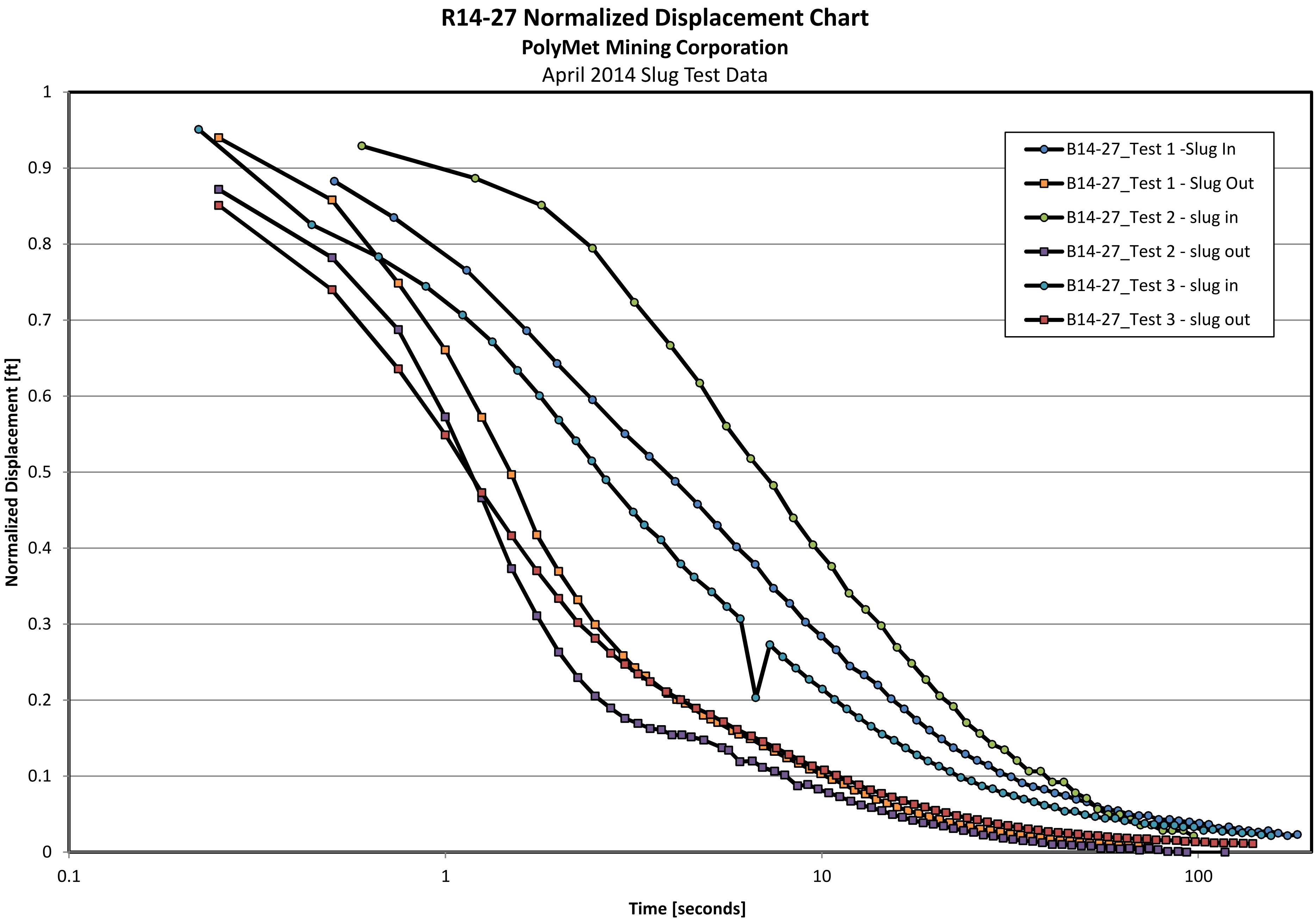


R14-15 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100
B14-15_Test 1 - slug in
B14-15_Test 1 - Slug Out
B14-15_Test 2 - slug in
B14-15_Test 2 - slug out
B14-15_Test 3 - slug in
B14-15_Test 3 - slug out

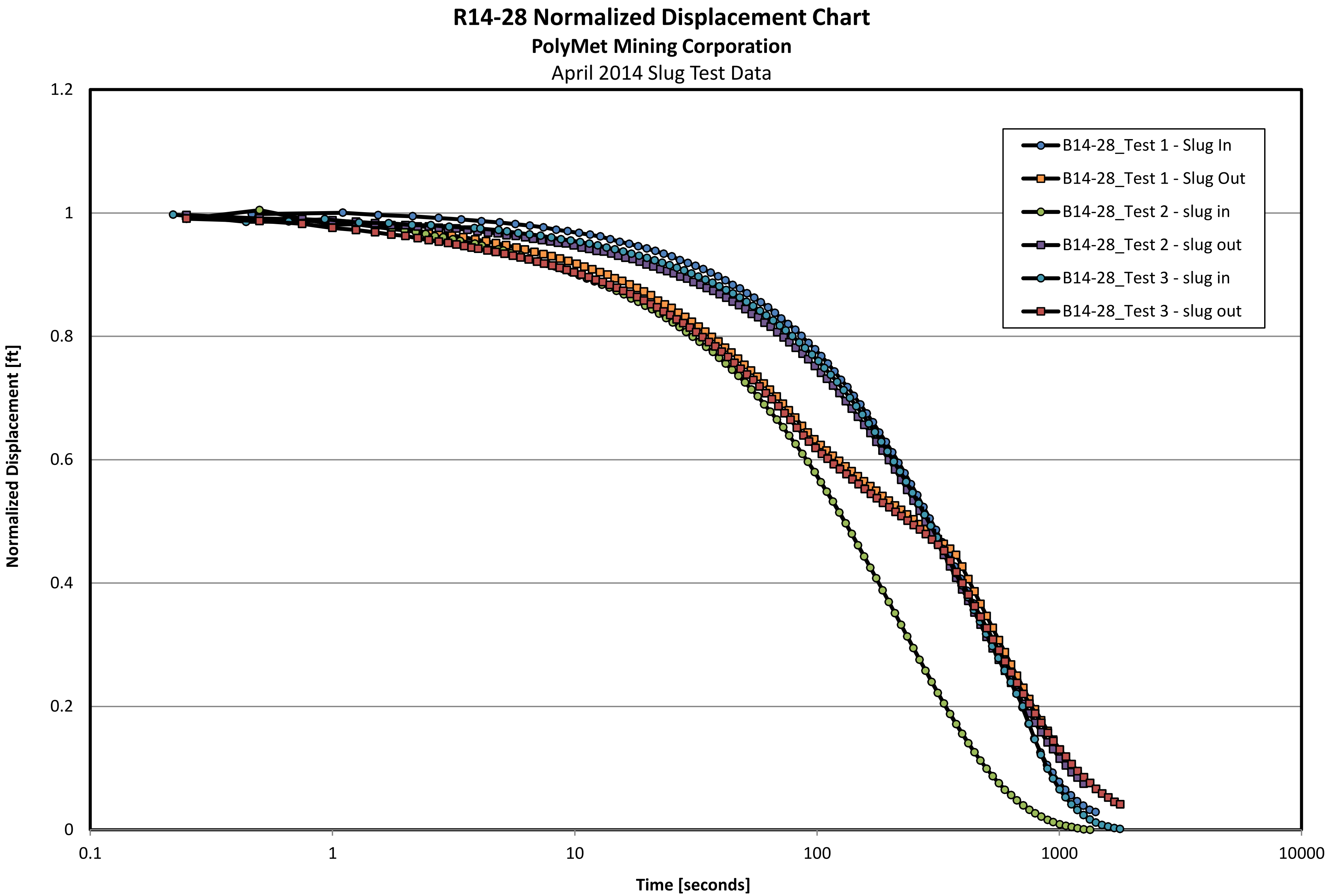


R14-16 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.1
1
10
100
1000
B14-16_Test 1 - slug in
B14-16_Test 1 - Slug Out
B14-16_Test 2 - slug in
B14-16_Test 2 - slug out
B14-16_Test 3 - slug in
B14-16_Test 3 - slug out


R14-26 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
B14-26_Test 1 -Slug In
B14-26_Test 1 - Slug Out
B14-26_Test 2 - slug in
B14-26_Test 2 - slug out
B14-26_Test 3 - slug in
B14-26_Test 3 - slug out
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100
1000



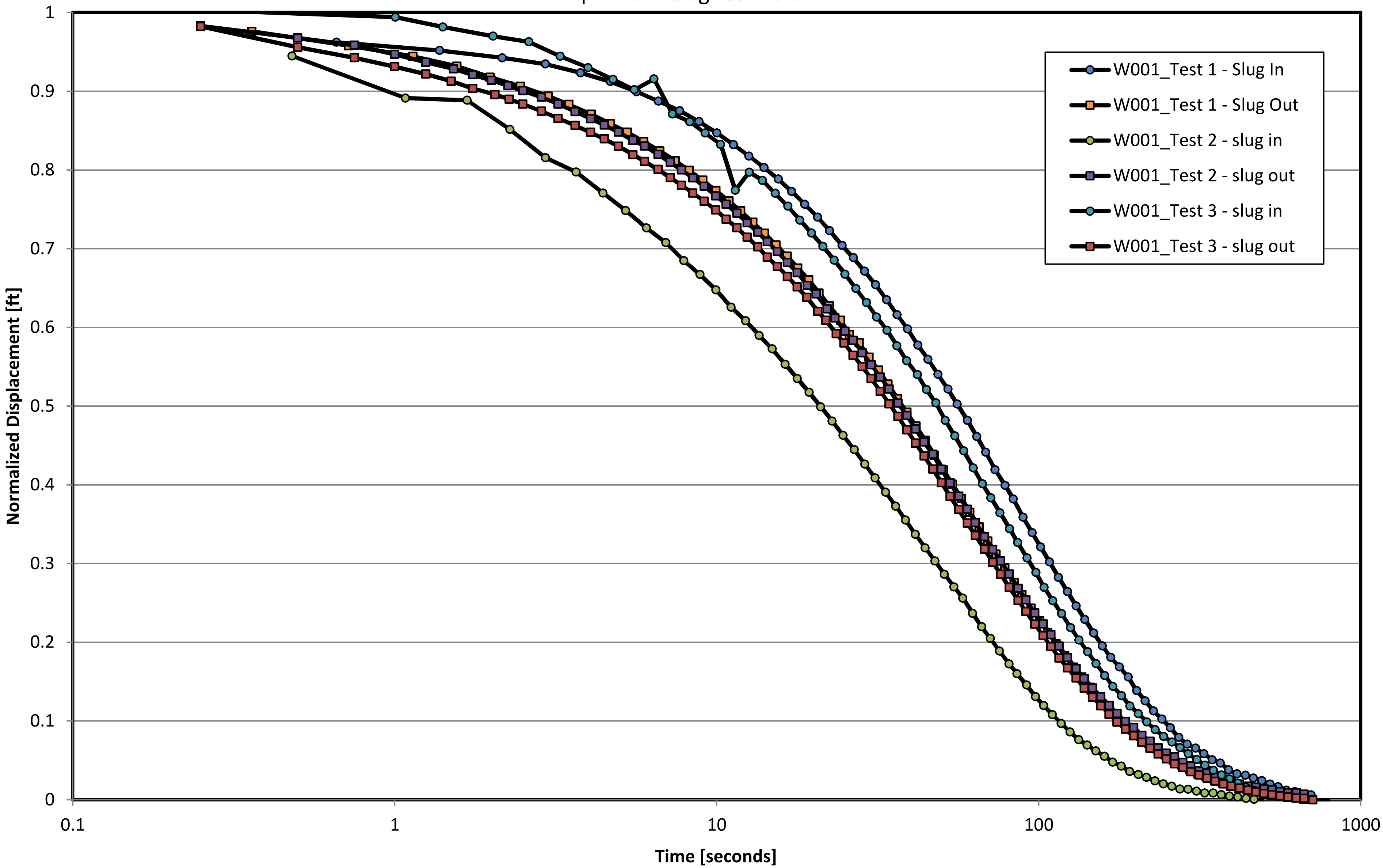
R14-27 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.1
1
10
100
B14-27_Test 1 -Slug In
B14-27_Test 1 - Slug Out
B14-27_Test 2 - slug in
B14-27_Test 2 - slug out
B14-27_Test 3 - slug in
B14-27_Test 3 - slug out

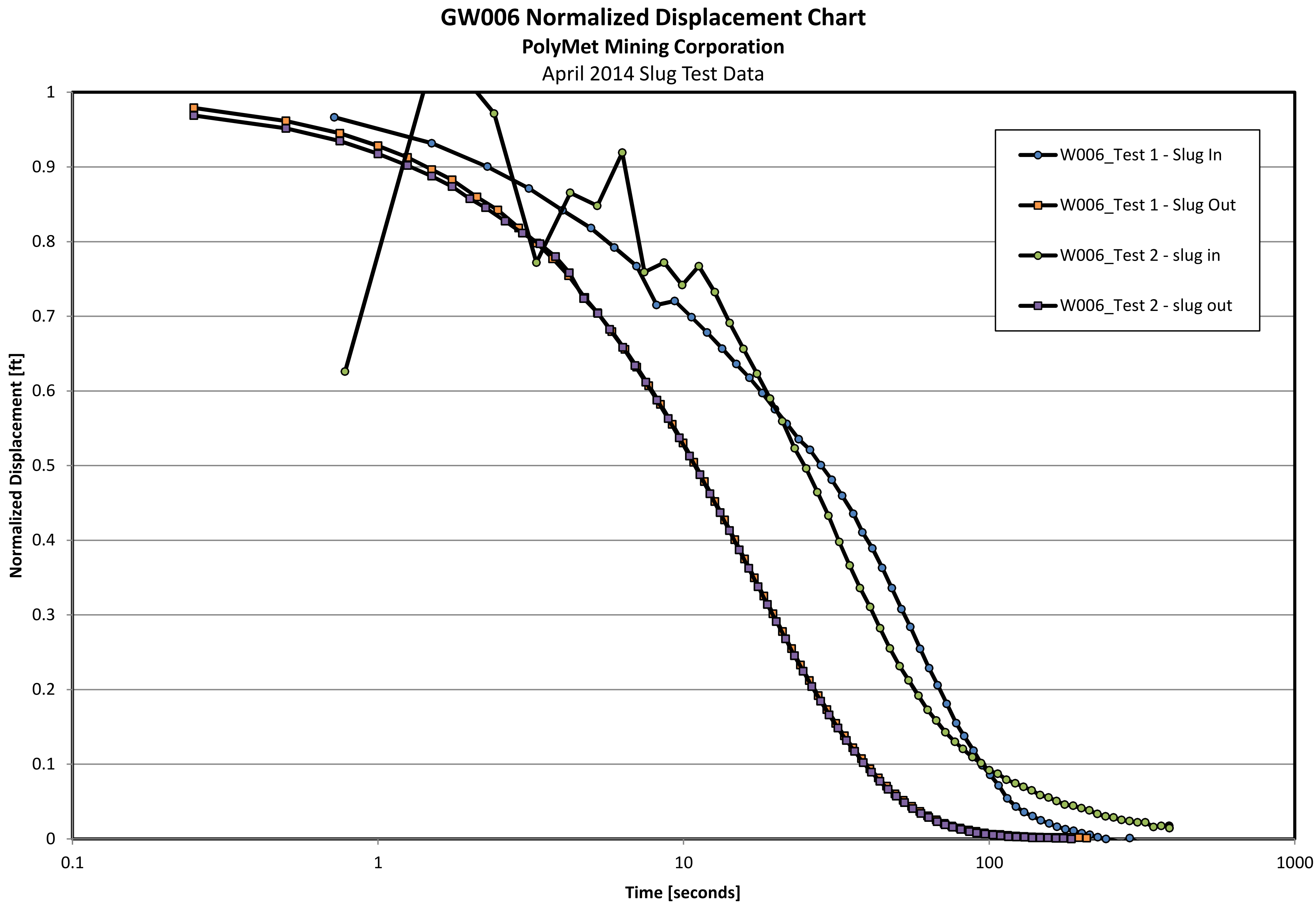

R14-28 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
B14-28_Test 1 - Slug In
B14-28_Test 1 - Slug Out
B14-28_Test 2 - slug in
B14-28_Test 2 - slug out
B14-28_Test 3 - slug in
B14-28_Test 3 - slug out
0
0.2
0.4
0.6
0.8
1
1.2
0.1
1
10
100
1000
10000

GW001 Normalized Displacement Chart

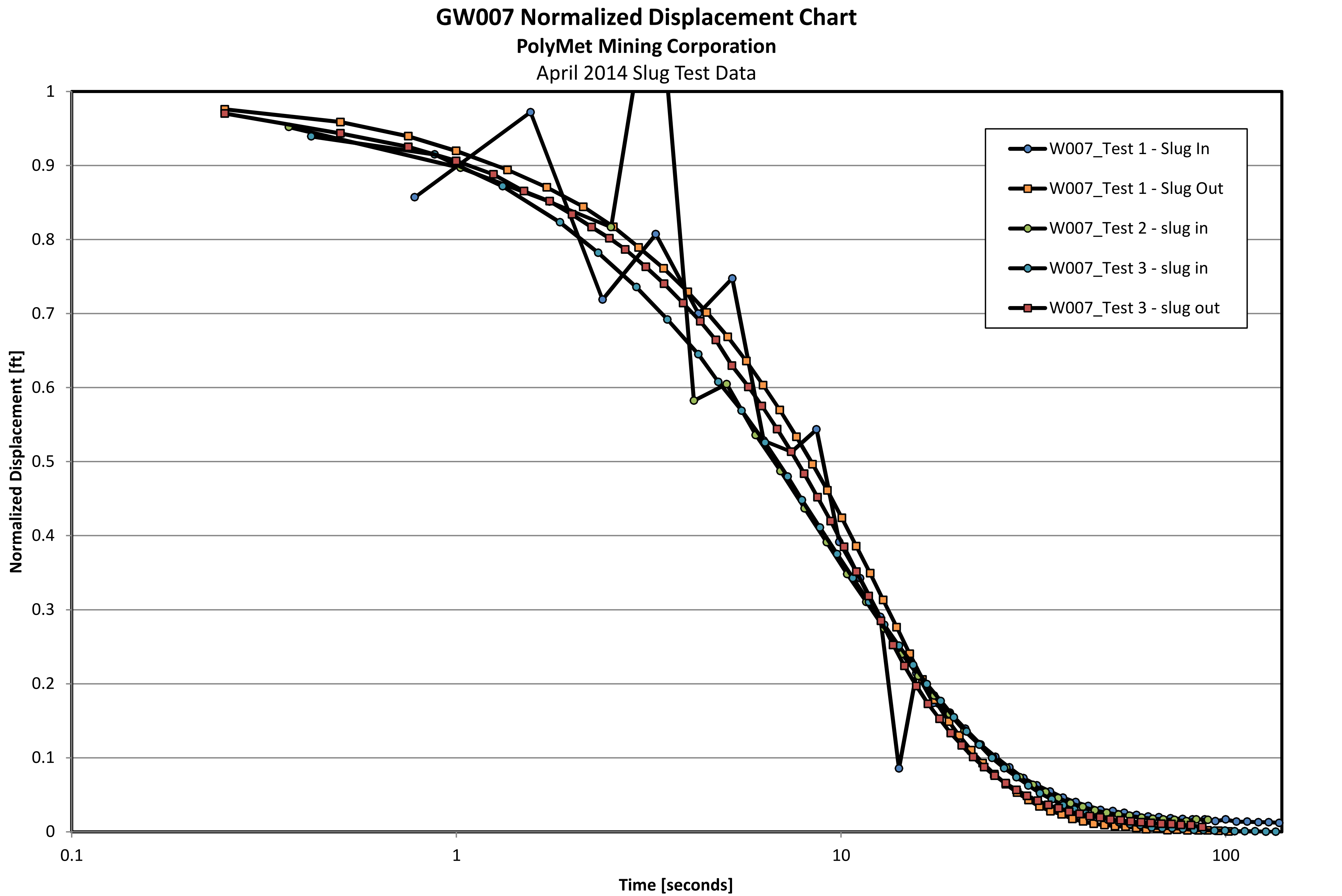
PolyMet Mining Corporation

April 2014 Slug Test Data





GW006 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
W006_Test 1 - Slug In
W006_Test 1 - Slug Out
W006_Test 2 - slug in
W006_Test 2 - slug out
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100
1000


GW007 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
W007_Test 1 - Slug In
W007_Test 1 - Slug Out
W007_Test 2 - slug in
W007_Test 3 - slug in
W007_Test 3 - slug out
Normalized Displacement [ft]
Time [seconds]
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.1
1
10
100

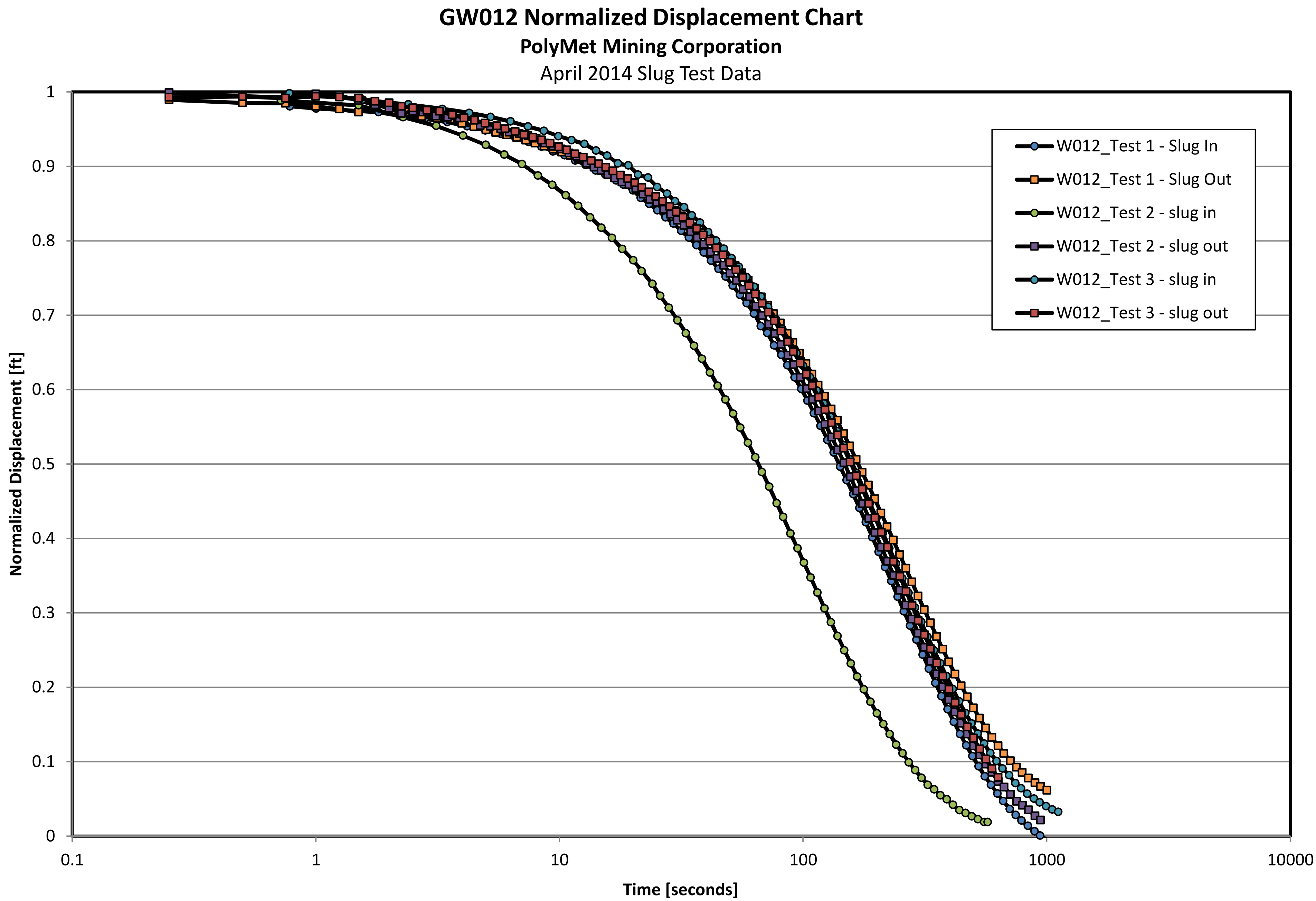

GW012 Normalized Displacement Chart
PolyMet Mining Corporation
April 2014 Slug Test Data
Normalized Displacement [ft]
Time [seconds]
W012_Test 1 - Slug In
W012_Test 1 - Slug Out
W012_Test 2 - slug in
W012_Test 2 - slug out
W012_Test 3 - slug in
W012_Test 3 - slug out
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100
1000
10000

Exhibit D

SPT Boring Logs

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

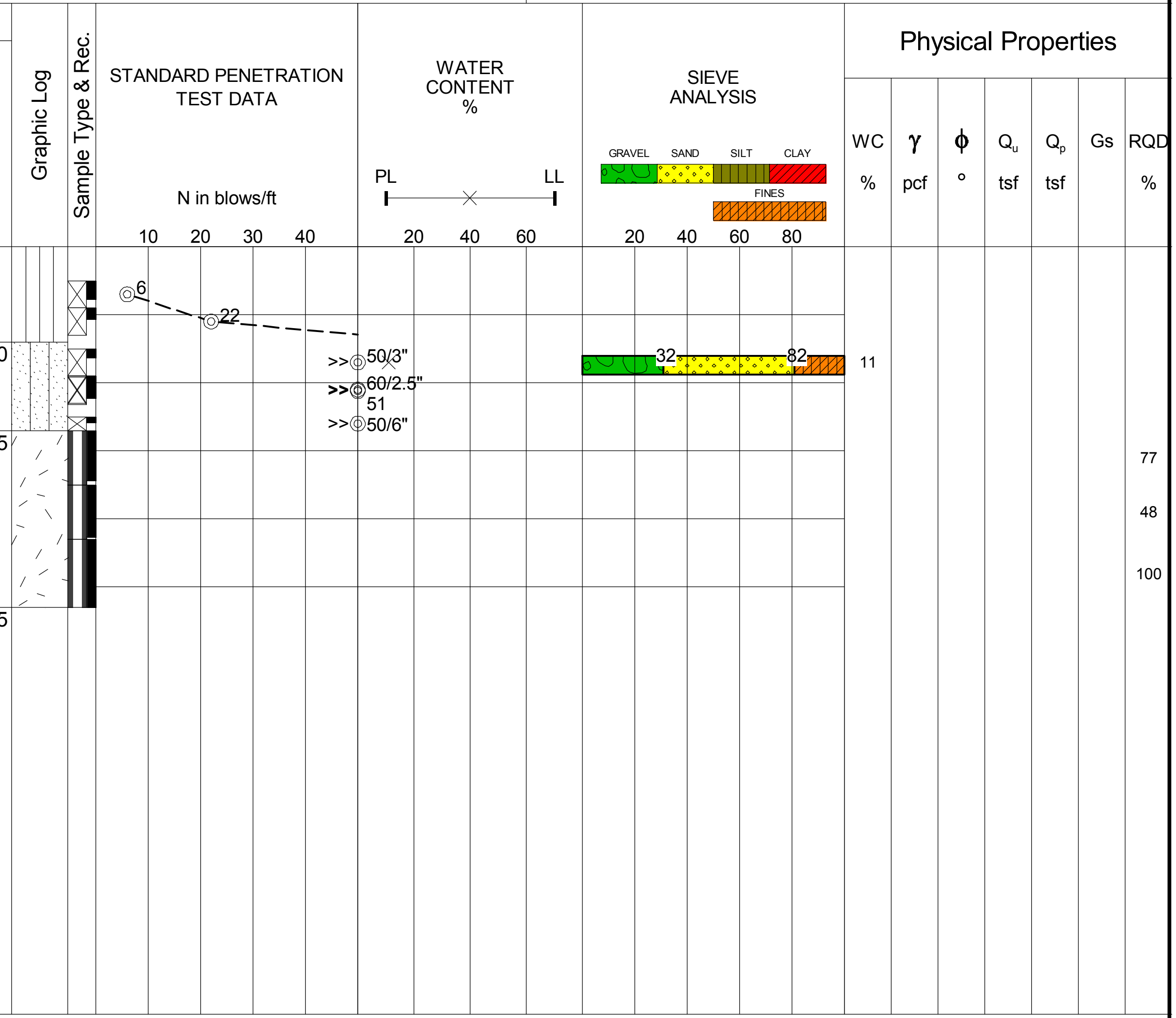
LOG OF BORING B14-36

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1554.7 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Standard Penetration Test Data (N in blows/ft)	Sieve Analysis	WC %	RQD %
1554.7	0	FINE TAILINGS (ML): fine grained; black and gray metallic; saturated.	6; 22			
1547.7	7.0	SILTY SAND (SM): fine to coarse grained; gray; saturated; with weathered granite fragments; [Till].	>>50/3"; >>60/2.5"; 51; >>50/6"	32; 82	11	
1541.2	13.5	GRANITE; mottled black, red and white; massive; strong to very strong; slightly decomposed; slightly to moderately fractured; horizontal and 60 degree fractures; mostly healed; trace green inclusions throughout; [Bedrock].				77; 48; 100
1528.2	26.5	Bottom of Boring at 26.5 feet				



Completion Depth:	26.5
Date Boring Started:	5/8/14
Date Boring Completed:	5/13/14
Logged By:	GFS
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1554.7
Coordinates:	N 735,479.9 ft E 2,857,818.0 ft
Datum:	NAD83 Minnesota State Plane

Remarks: Modified location to avoid wetlands. 6 1/4" ID augers. Due to sealing difficulty, samples 1&2 are from the first hole, 3&4 are from the second hole and 4B&5 are from the final hole. Packer performed from 14-18.5 feet and 20.5-26.5 feet.

SAMPLE TYPES: Split Spoon, Rock Core

WATER LEVELS (ft): At Time of Drilling 0.0

LEGEND

- MC Moisture Content
- γ Dry Unit Weight
- φ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING B14-40

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1534.0 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	SPT N (blows/ft)	Sieve Analysis	WC %	γ pcf	φ °	RQD %
1533.3	0.8	TOPSOIL (OL): dark brown; moist; large boulders (2 to 3 feet) interbedded.	28					
1519.0	15.0	SILTY SAND (SM): fine to medium grained; gray; very moist to saturated; with weathered granite fragments throughout increasing with depth; [Till].	43, >>58, 38	31, 78	8	125	47	
1503.5	30.5	GRANITE; mottled black and white with red; massive; strong to very strong; slightly decomposed; slightly to moderately fractured; 30 to 60 degrees fractures; moderately healed; 2-foot vertical fracture through sample from 22 to 24 feet; 6 inch red quartz-rich zone at 18 feet; 6 inch green zone at 28 feet; [Bedrock].						68, 47, 92

Bottom of Boring at 30.5 feet

Completion Depth: 30.5
Date Boring Started: 5/15/14
Date Boring Completed: 5/16/14
Logged By: GFS
Drilling Contractor: Braun Intertec
Drilling Method: HSA / Mud Rotary / NQ Coring
Ground Surface Elevation: 1534.0
Coordinates: N 736,963.9 ft E 2,857,381.9 ft
Datum: NAD83 Minnesota State Plane

Remarks: Modified location to avoid wetlands. 6 1/4" ID augers. Started mud rotary at 11.5 feet.

SAMPLE TYPES: Split Spoon; No Recovery; Rock Core

WATER LEVELS (ft): At Time of Drilling 4.3

LEGEND: MC Moisture Content; γ Dry Unit Weight; φ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING B14-44

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

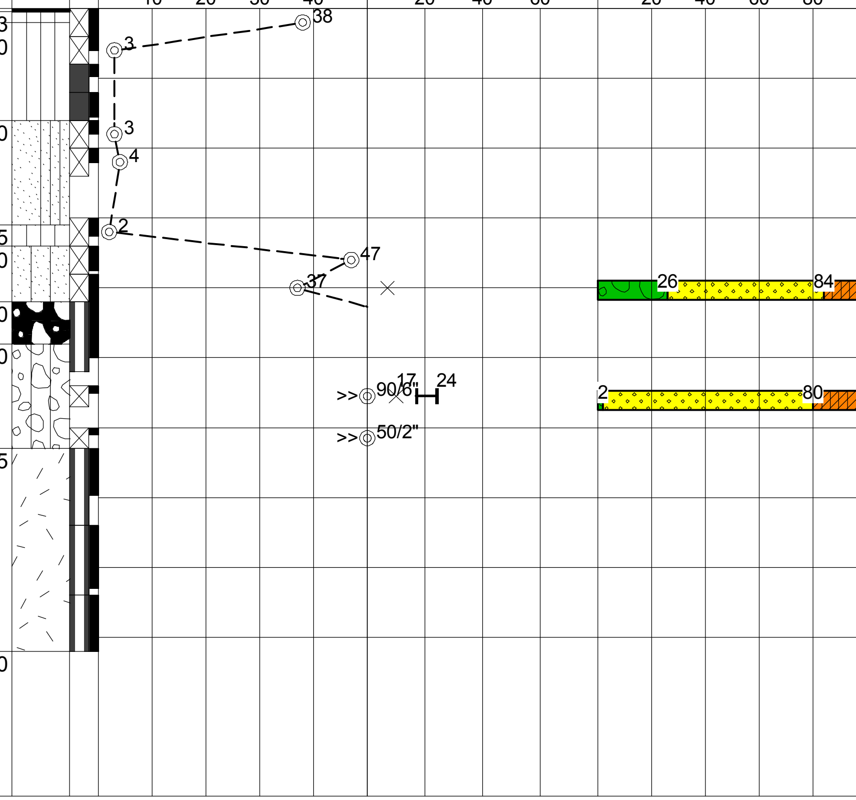
Barr Project Number: 23690C29.13

Surface Elev.: 1502.9 ft

MATERIAL DESCRIPTION (ASTM D2488)

Elevation, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth, feet
1502.7	PEAT (PT): dark brown; moist; cattail roots and wood	0.3
1501.9	inclusions; stripped during clearing; top 2 feet frozen.	1.0
1494.9	FINE TAILINGS (ML): black; wet; appears to be contaminated with petroleum product; oily; slight smell; frozen.	8.0
1487.4	FINE TAILINGS (ML): very fine to fine grained; gray with black streaks; wet; soft; [magnetite tailings].	15.5
1485.9	COARSE TAILINGS (SP-SM): fine to coarse grained; dark brown; saturated; very loose; heavy.	17.0
1481.9	FINE TAILINGS (ML): very fine to fine grained; dark gray; saturated; very loose; heavy; liquefiable behavior.	21.0
1478.9	SILTY SAND (SM): fine to coarse grained; grayish brown; wet; with weathered granite fragments; interspersed with cobbles (1-2 inches); [Till].	24.0
1471.4	BOULDER; mottled black, red, and white; strong; slightly decomposed; moderately fractured; fractures occur at 60 degree angles; some fully healed locations.	31.5
1456.9	SILTY GRAVEL (GM): fine to coarse grained; grayish brown; wet; with sand; trace clay; interspersed with cobbles (1-2 inches); green and yellow staining; copper-colored inclusions; [Till].	46.0
	GRANITE; mottled black, red, and white; massive; strong to very strong; slightly decomposed; slightly to moderately fractured; first 5 feet is weathered and becomes increasingly competent with depth; color transition occurs at 40 feet where rock becomes slightly stronger; [Bedrock].	

Bottom of Boring at 46.0 feet



Physical Properties

Depth (ft)	WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
~20	7						
~24							76
~28	10						
~34							33
~40							77
~44							92

Completion Depth:	46.0
Date Boring Started:	3/28/14
Date Boring Completed:	4/3/14
Logged By:	KNA
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1502.9
Coordinates:	N 738,984.5 ft E 2,857,382.8 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 4 1/2" ID augers. Started mud rotary at 20 feet. Core performed in offset hole at : N=738977.63ft, E=2857368.8ft; Packer testing performed at 33-42 feet and 42-46 feet.

SAMPLE TYPES
Split Spoon; 3-inch Shelby Tube; Rock Core

WATER LEVELS (ft)

At Time of Drilling	2.0
24 hrs After Drilling	0.0

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING B14-48

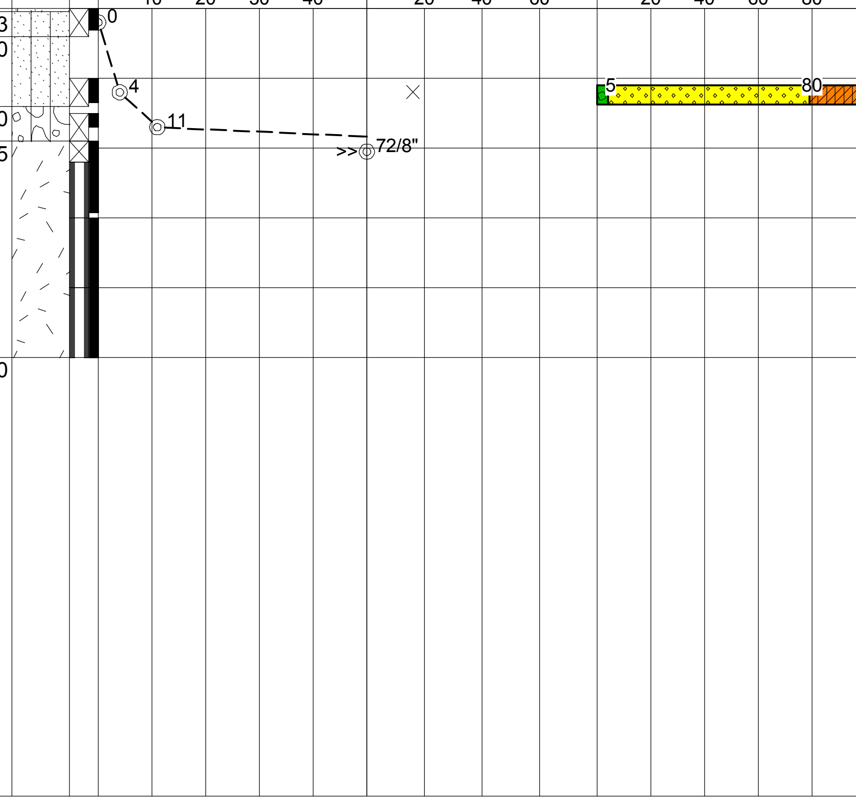
Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1491.8 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)
1491.6	0.3	TOPSOIL (OL): dark brown; moist; wood and root inclusions; some clay; trace sand and gravel.
1489.8	2.0	SILTY SAND (SM): fine to medium grained; brown; wet to saturated; very loose; trace roots and gravel; [Till].
1484.8	7.0	SILTY SAND (SM): fine to coarse grained; gray; wet to saturated; very loose to medium dense; trace roots and clay; subangular; [Till].
1482.3	9.5	SILTY GRAVEL (GM): fine to coarse grained; gray; wet; very dense; little sand; trace clay; [Till].
1466.8	25.0	GRANITE; mottled black and white with red; massive; strong to very strong; slightly decomposed; slightly to moderately fractured; vertical fracture from 12.5 to 14 feet; gray sediment in fractures; becomes increasingly competent with depth; gold-colored inclusions; [Bedrock].

Bottom of Boring at 25.0 feet



Physical Properties

Depth, feet	WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
~6	16						
~12.5–15							15
~15–20							72
~20–25							88

Completion Depth:	25.0
Date Boring Started:	5/19/14
Date Boring Completed:	5/20/14
Logged By:	KNA
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1491.8
Coordinates:	N 740,886.7 ft E 2,857,452.1 ft
Datum:	NAD83 Minnesota State Plane

Remarks: Modified location to avoid wetlands. 6 1/4" ID augers. Started mud rotary at 10 feet.

SAMPLE TYPES

Split Spoon | Rock Core

WATER LEVELS (ft)

At Time of Drilling	3.0
0.5 hrs After Drilling	2.5

LEGEND

- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING B14-52

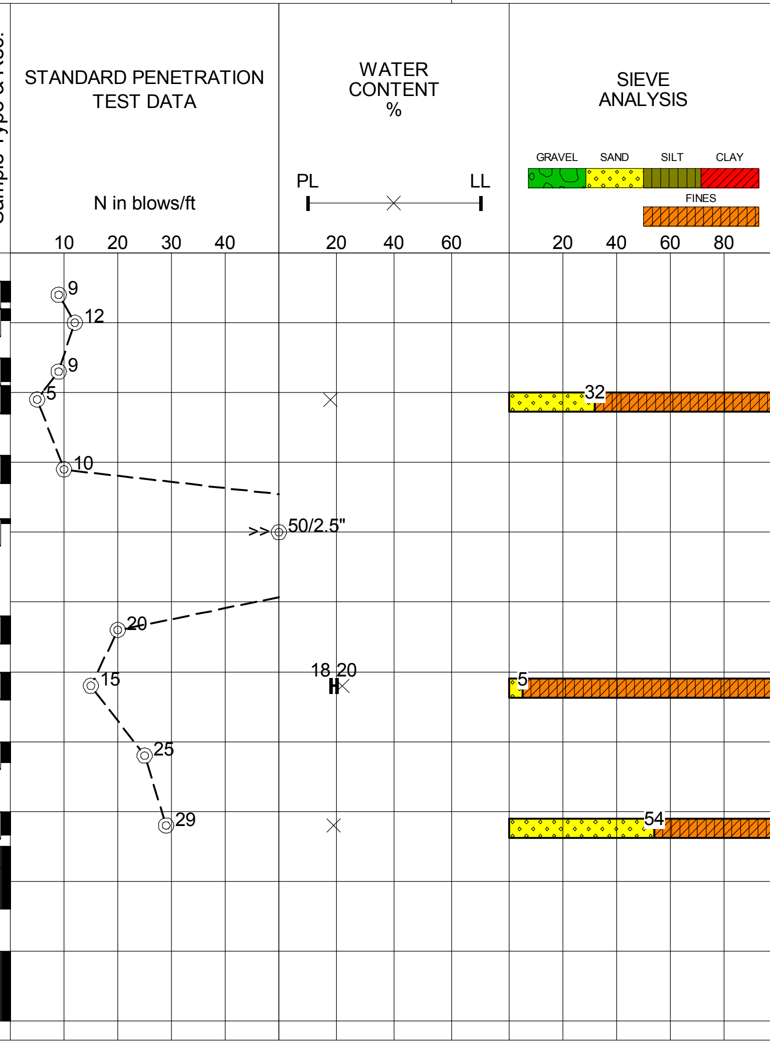
Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1486.0 ft

MATERIAL DESCRIPTION (ASTM D2488)

Elevation, feet	Depth, feet	Material Description
1484.0	2.0	TOPSOIL (OL): dark brown; moist; interbedded with large (2') boulders at surface.
1480.0	6.0	CLAYEY SAND (SC): fine to coarse grained; dark tan; moist to saturated; with 2-inch diameter gravel.
1469.5	16.5	SILTY SAND (SM): fine to medium grained; tan; saturated; small to medium gravel (weathered, rounded); silt content decreases with depth; gravel content increases with depth.
1462.0	24.0	BOULDER: grayish black; crushed granite.
1448.0	38.0	SILT (ML): gray; saturated; little to no inclusions from 26-35 feet; trace sand from 35-38 feet.
1443.5	42.5	SILTY SAND (SM): fine to medium grained; gray; saturated; [Till].
1442.0	44.0	GRANITE; Strong; no fractures until bottom of sample; green marbel zone at bottom 6 inches.
1439.0	47.0	GRANITE; highly weathered granite.



Physical Properties

Depth, feet (approx.)	WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
10.5	18						
31	22						
41	19						
43							100
45							100
52							86

Water level symbol at approx. 4.0 ft depth.

Continued Next Page

Completion Depth: 65.8
Date Boring Started: 5/5/14
Date Boring Completed: 5/7/14
Logged By: GFS
Drilling Contractor: Braun Intertec
Drilling Method: HSA / Mud Rotary / NQ Coring
Ground Surface Elevation: 1486.0
Coordinates: N 742,396.5 ft E 2,858,667.8 ft
Datum: NAD83 Minnesota State Plane

Remarks: 6 1/4" ID augers. Started mud rotary at 20 feet.

SAMPLE TYPES	WATER LEVELS (ft)	LEGEND
Split Spoon; Rock Core	At Time of Drilling 4.0	MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

LOG OF BORING B14-52

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	RQD %
1430	55	GRANITE; mottled red and white with black; massive; very strong; slightly decomposed; slightly to moderately fractured; fractures at horizontal and 65 degree angles; moderately healed; black/oxidized on healed joints; 6 inch quartz-rich zones; [Bedrock]. *(Continued)*	84
1425	60		90
1420.3	65.8		75
		Bottom of Boring at 65.8 feet	

Columns: Graphic Log; Sample Type & Rec.; STANDARD PENETRATION TEST DATA (N in blows/ft; 10, 20, 30, 40); WATER CONTENT % (PL, LL; 20, 40, 60); SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES; 20, 40, 60, 80); Physical Properties (WC %, γ pcf, ϕ °, Q_u tsf, Q_p tsf, Gs, RQD %)

Depth scale: 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110

Completion Depth:	65.8
Date Boring Started:	5/5/14
Date Boring Completed:	5/7/14
Logged By:	GFS
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1486.0
Coordinates:	N 742,396.5 ft E 2,858,667.8 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 6 1/4" ID augers. Started mud rotary at 20 feet.

SAMPLE TYPES
Split Spoon; Rock Core

WATER LEVELS (ft)
At Time of Drilling 4.0

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING B14-55

Sheet 1 of 1

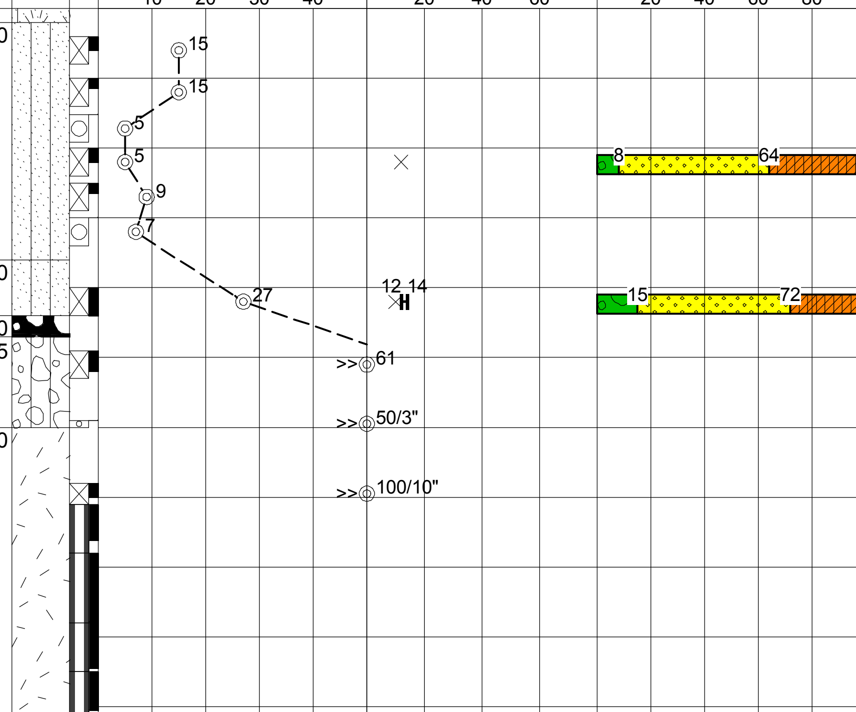
Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1494.8 ft

MATERIAL DESCRIPTION (ASTM D2488)

Elevation, feet	Depth, feet	Material Description	Bottom Depth
1493.8	0–1.0	TOPSOIL (OL): reddish brown; moist; roots; small shrubs and grass.	1.0
1476.8	1.0–18.0	SILTY SAND (SM): fine to coarse grained; brown; moist to saturated; loose to medium dense; with gravel up to 1 inch in diameter; round to angular; increasing sand content with depth; [Till].	18.0
1472.8	18.0–22.0	SILTY SAND WITH GRAVEL (SM): medium to coarse grained; gray; moist to wet; medium dense; trace clay; slightly cohesive; 1/2-inch diameter weathered granite fragments; [Till].	22.0
1471.3	22.0–23.5	BOULDER: molted red with black and white; crushed granite.	23.5
1464.8	23.5–30.0	SILTY GRAVEL (GM): fine to coarse grained; gray; saturated; very dense; green and orange oxidation staining; seams of weathered granite; [Till].	30.0
1444.3	30.0–50.5	GRANITE; mottled red with black and white; massive; very strong; slightly decomposed; slightly to moderately fractured; fractures at 45 to 80 degree angles; moderately healed; black on oxidized fractured faces and healed locations; green zone at 42.5 feet; [Bedrock].	50.5
		Bottom of Boring at 50.5 feet	



Physical Properties

Depth, feet	WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
~11	12						
~21	10						
~37–41.5							33
~41.5							63
~46							85
~49							91

Completion Depth:	50.5
Date Boring Started:	4/28/14
Date Boring Completed:	5/2/14
Logged By:	KNA
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1494.8
Coordinates:	N 742,451.6 ft E 2,860,494.0 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 6 1/4" ID augers. Started mud rotary at 20 feet. Packer performed from 37-41.5 feet, 41.5-46.5 feet, and 46-50.5 feet.

SAMPLE TYPES: Split Spoon; No Recovery; Rock Core

WATER LEVELS (ft): At Time of Drilling 10.0

LEGEND

- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
4700 West 77th St. Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING B14-62

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1493.3 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	SPT N (blows/ft)	Water Content %	Sieve Analysis	WC %	γ pcf	φ °	Qu tsf	Qp tsf	Gs	RQD %
1493.1	0.3	TOPSOIL (OL): dark brown; moist; root inclusions; some sand.	0									
1491.3	2.0	SILTY SAND (SM): fine to medium grained; orangish brown; saturated; some clay; cohesive.	23	×	Gravel 19, Sand 74	8	125	38				
		SILTY SAND WITH GRAVEL (SM): medium to coarse grained; brownish gray to gray; moist to wet; trace clay; slightly cohesive; trace black inclusions; weathered granite fragments up to 1-inch in diameter; subangular; [Till].	24									
			>>57									
			>>71									
1476.3	17.0		>>50/4"									
		GRANITE; highly weathered bedrock; appears to be silty gravel with up to 1-foot boulders throughout; cobbles in 2-inch diameter in various colors; [Bedrock].										53
												13
1466.3	27.0											0
	27.0	Bottom of Boring at 27.0 feet										

Water level symbol at approx. 12 ft.

Completion Depth:	27.0
Date Boring Started:	4/21/14
Date Boring Completed:	4/28/14
Logged By:	KNA
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1493.3
Coordinates:	N 743,327.3 ft E 2,863,894.1 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 6 1/4" ID augers. Mud rotary started at 10 feet.

SAMPLE TYPES: Split Spoon; Rock Core

WATER LEVELS (ft): At Time of Drilling 12.0

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- φ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING B14-65

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1487.2 ft

MATERIAL DESCRIPTION (ASTM D2488)

Elevation, feet	Depth, feet	Material Description	Layer Bottom Depth (ft)
1487.0	0.3	TOPSOIL (ML): gray; saturated; silt; very fine; smears; top 2 feet frozen [magnetite tailings].	0.3
1480.2	7.0	PEAT (PT): dark brown; saturated; very soft; cattail roots and wood inclusions; top 4.5 feet frozen. 1 foot of gray magnetite tailings at 5 feet.	7.0
1475.2	12.0	ORGANIC SILT (OH): dark brown; saturated; very soft; wood inclusions.	12.0
1474.2	13.0	SILTY SAND (SM): medium to coarse grained; gray; wet; some gravel and organics; [Till].	13.0
1472.2	15.0	POORLY GRADED SAND WITH SILT (SP-SM): medium to coarse grained; orangish brown; wet; loose; subangular to angular; trace clay; [Till].	15.0
1466.7	20.5	SILTY SAND (SM): medium to coarse grained; gray; saturated; medium dense; with weathered granite fragments; [Till].	20.5
1450.2	37.0	GRANITE; red mottled with black and white; massive; strong to very strong; slightly decomposed; slightly to moderately fractured; fractures are at 0, 45, or 60 degree angles; appears to previously have been highly fractured but is now fully healed with green sediment; [Bedrock].	37.0

Bottom of Boring at 37.0 feet

Test Data

Standard Penetration Test Data (N in blows/ft): 2, 1, 1, 7, 14

Water Content (%): PL 46, LL 68; values 449, 479, 496

Sieve Analysis: 3 (gravel), 61 (fines)

Physical Properties:

WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
496						
73						
15						
						86
						80
						51

Completion Depth:	37.0
Date Boring Started:	4/16/14
Date Boring Completed:	4/17/14
Logged By:	KNA
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1487.2
Coordinates:	N 743,316.0 ft E 2,864,926.5 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 6 1/4" ID augers. Hit refusal at 10 feet, offset 10 feet East and blind-drilled to 10 feet. Started mud rotary at 15 feet. Packer performed from 24-30 feet and 27.5-33.5 feet.

SAMPLE TYPES: Split Spoon; 3-inch Shelby Tube; Undisturbed Sample; Rock Core

WATER LEVELS (ft): At Time of Drilling 0.0

LEGEND

- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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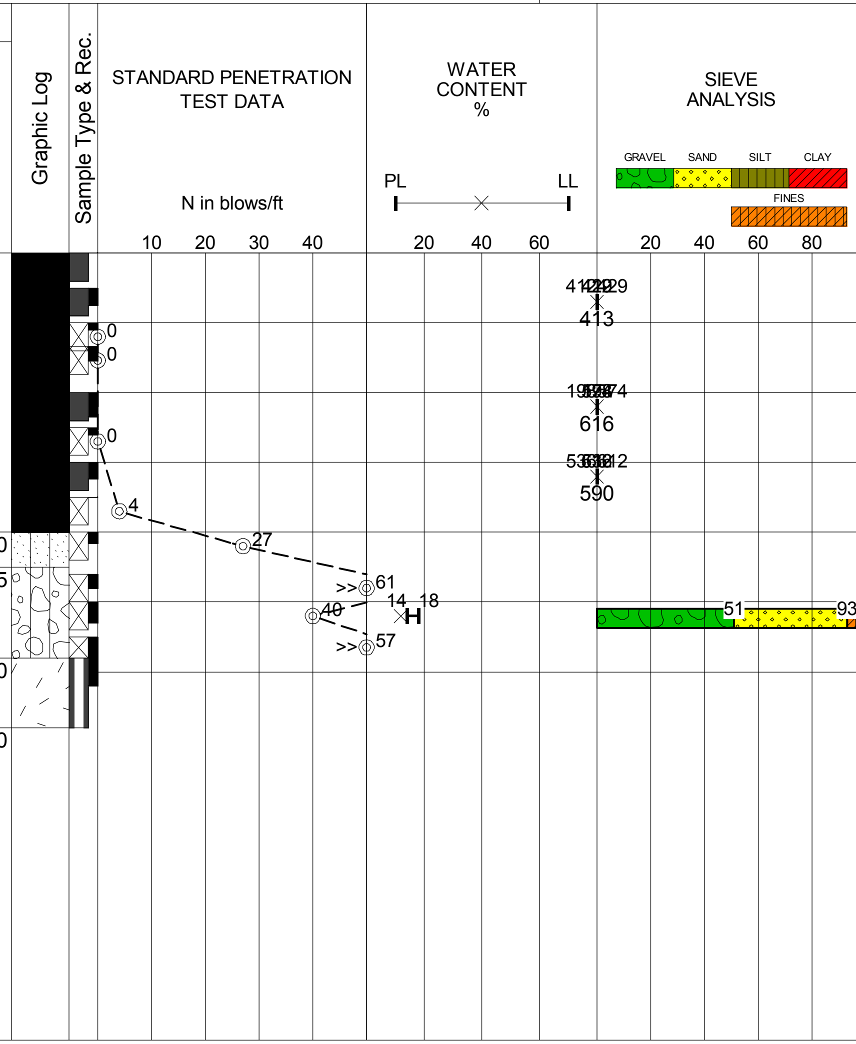
LOG OF BORING B14-69

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1485.1 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	PEAT (PT): dark brown; saturated; very soft; sapric; wood interspersed throughout increasing with depth; top 1.5 feet frozen.	413	13				1.7	
			616						
			590						
1465.1		Gray silt (magnetite tailings) at 17.5 feet.							
1462.6	20.0	SILTY SAND WITH GRAVEL (SM): medium to coarse grained; dark brown; wet; medium dense; 1/2-inch cobbles and weathered granite fragments; [Till].	12						
1456.1	22.5	SILTY GRAVEL (GM): gray; very dense; 1 inch weathered granite fragments; some gray clayey sand; [Till].							
1451.1	29.0	GRANITE; mottled red and black with white; 60 degree fracture at 29-30 feet; most of core consisted of 2-inch cobbles; [Highly Weathered Bedrock].							20
	34.0	Bottom of Boring at 34.0 feet							



Completion Depth:	34.0
Date Boring Started:	4/7/14
Date Boring Completed:	4/8/14
Logged By:	KNA/GFS
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1485.1
Coordinates:	N 743,207.5 ft E 2,866,416.5 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 4 1/2" ID augers. With the augers at 24 feet, artesian flow started around teh outside of the augers after sample at 23 feet was collected. Before flow started, water was 1-foot above ground surface in the augers.

SAMPLE TYPES: 3-inch Shelby Tube; Split Spoon; Rock Core

WATER LEVELS (ft)

End of Drilling	-1.0
At Time of Drilling	0.0

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
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LOG OF BORING B14-72

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1493.0 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	SPT N (blows/ft)	WC %	Sieve	RQD %
1492.5	0.5	PEAT (PT): dark grown; moist; frozen; sapric; roots and wood inclusions.	27, 38	25	4 / 28	
1488.0	5.0	SILT (ML): gray; wet; medium dense to dense; frozen; roots and wood inclusions; seams of coarse sand; [Tailings].	14, 36	9	30 / 83	
1483.0	10.0	SILTY SAND WITH GRAVEL (SM): fine to coarse grained; brown; wet; medium dense to very dense; 1/8 - 1 inch weathered granite fragments; [Till].	>>50/5"			
1468.0	25.0	GRANITE; dark red mottled with black and white; massive; strong to very strong; slightly decomposed; moderately fractured becoming more competent with depth; highly fractured at 17.5, 20-22, and 23-23.5 feet; healed throughout; 60 degree fractures from 21 25 feet, otherwise horizontal or 90 degree fractures; green and brown in-filling; [Bedrock].				63, 50, 56

Bottom of Boring at 25.0 feet

Completion Depth:	25.0
Date Boring Started:	4/4/14
Date Boring Completed:	4/7/14
Logged By:	KNA
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1493.0
Coordinates:	N 743,232.9 ft E 2,867,866.5 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 4 1/2" ID augers. Tried Denison sample at 7.5 feet. Started mud rotary at 7.5 feet.

SAMPLE TYPES: Split Spoon; Rock Core

WATER LEVELS (ft): At Time of Drilling 1.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING B14-76

Sheet 1 of 1

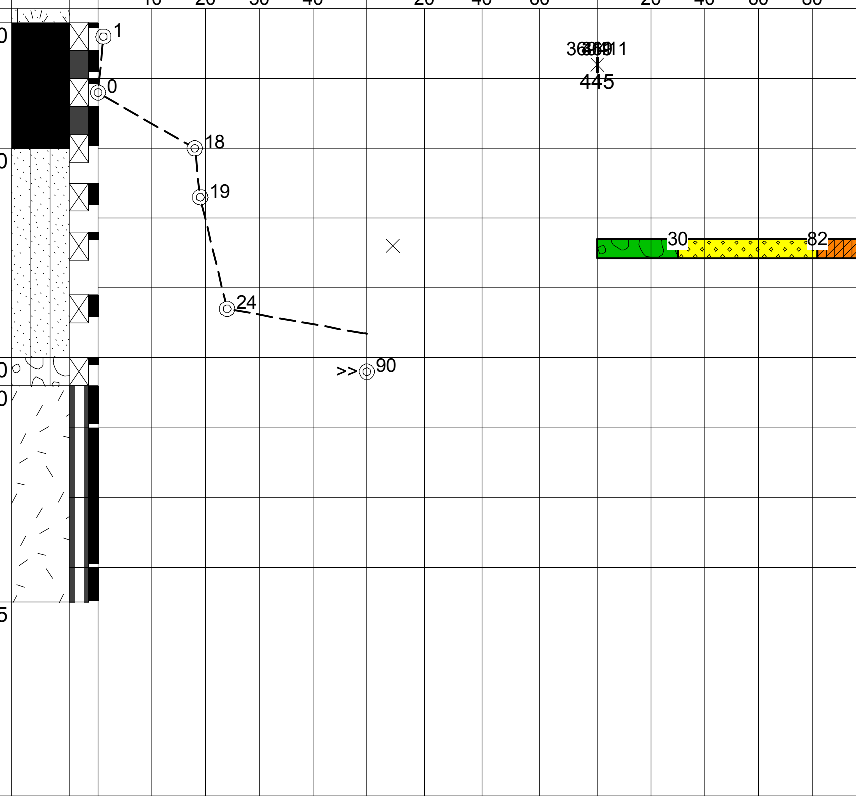
Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1501.2 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
1500.2	1.0	TOPSOIL (OL): dark brown; wet; frozen; roots; trace silt.							
1491.2	10.0	PEAT (PT): dark brown; saturated; very soft; sapric; some silt and clay; trace sand and <1-inch gravel.	445						
1476.2	25.0	SILTY SAND (SM): gray; saturated; loose to medium dense; trace clay; sand and gravel amount increases with depth; gravel <1 inch to 4 inches in diameter; [Till].	9	122	45				
1474.2	27.0	SILTY GRAVEL (GM): gray and red; saturated; with weathered granite fragments; [Till].							
1458.7	42.5	GRANITE; red mottled with black and white; massive; strong to very strong; slightly decomposed; moderately fractured decreasing with depth; 60 to 80 degree fractures; appears previously highly fractured but is now fully healed; green and brown in-filling; [Bedrock].							53, 87, 53, 63

Bottom of Boring at 42.5 feet



Completion Depth:	42.5
Date Boring Started:	4/9/14
Date Boring Completed:	4/11/14
Logged By:	GFS
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1501.2
Coordinates:	N 743,328.6 ft E 2,869,888.1 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 4 1/2" ID augers. Started mud rotary at 13 feet.

SAMPLE TYPES: Split Spoon; 3-inch Shelby Tube; Rock Core

WATER LEVELS (ft): At Time of Drilling 0.0

LEGEND:
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
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LOG OF BORING B14-80

Project: Winter 2013/2014 SPT Investigation | Location: Hoyt Lakes, MN | Client: PolyMet

Barr Project Number: 23690C29.13

Surface Elev.: 1523.4 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth	SPT N in blows/ft	WC %	Sieve (Gravel/Sand/Fines)	RQD %
1523.2	0.3	TOPSOIL (SM): dark brown; moist; organics and roots; with gravel; top 2 feet frozen.	0.3				
		SILTY SAND (SM): medium to coarse grained; brown; moist to wet; medium dense to very dense; with angular to subangular weathered granite fragments; gray clay content increasing with depth; [Till].		14; >>66; >>50/5"; >>50/1"	8	17 / 82	
1513.4	10.0	GRANITE; mottled red, black, and white; massive; very strong; slightly decomposed; slightly to moderately fractured becoming more competent with depth; fractures 45 and 60 degrees angles; totally healed with red and green sediment; [Bedrock].	10.0				67.5; 79; 100
1502.4	21.0	Bottom of Boring at 21.0 feet	21.0				

Columns: Graphic Log; Sample Type & Rec.; STANDARD PENETRATION TEST DATA (N in blows/ft: 10, 20, 30, 40); WATER CONTENT % (PL, LL: 20, 40, 60); SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES: 20, 40, 60, 80); Physical Properties: WC %, γ pcf, ϕ °, Q_u tsf, Q_p tsf, Gs, RQD %.

Completion Depth:	21.0
Date Boring Started:	3/26/14
Date Boring Completed:	3/27/14
Logged By:	KNA
Drilling Contractor:	Braun Intertec
Drilling Method:	HSA / Mud Rotary / NQ Coring
Ground Surface Elevation:	1523.4
Coordinates:	N 741,777.3 ft E 2,870,717.9 ft
Datum:	NAD83 Minnesota State Plane

Remarks: 4 1/2" ID augers. Drilled to 7.5 feet then offset 5 feet east and blind-drilled to 10 feet. Started mud rotary at 10 feet.

SAMPLE TYPES: Split Spoon; No Recovery; Rock Core

WATER LEVELS (ft): At Time of Drilling 7.0

LEGEND:
MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Exhibit E

Packer Testing Results

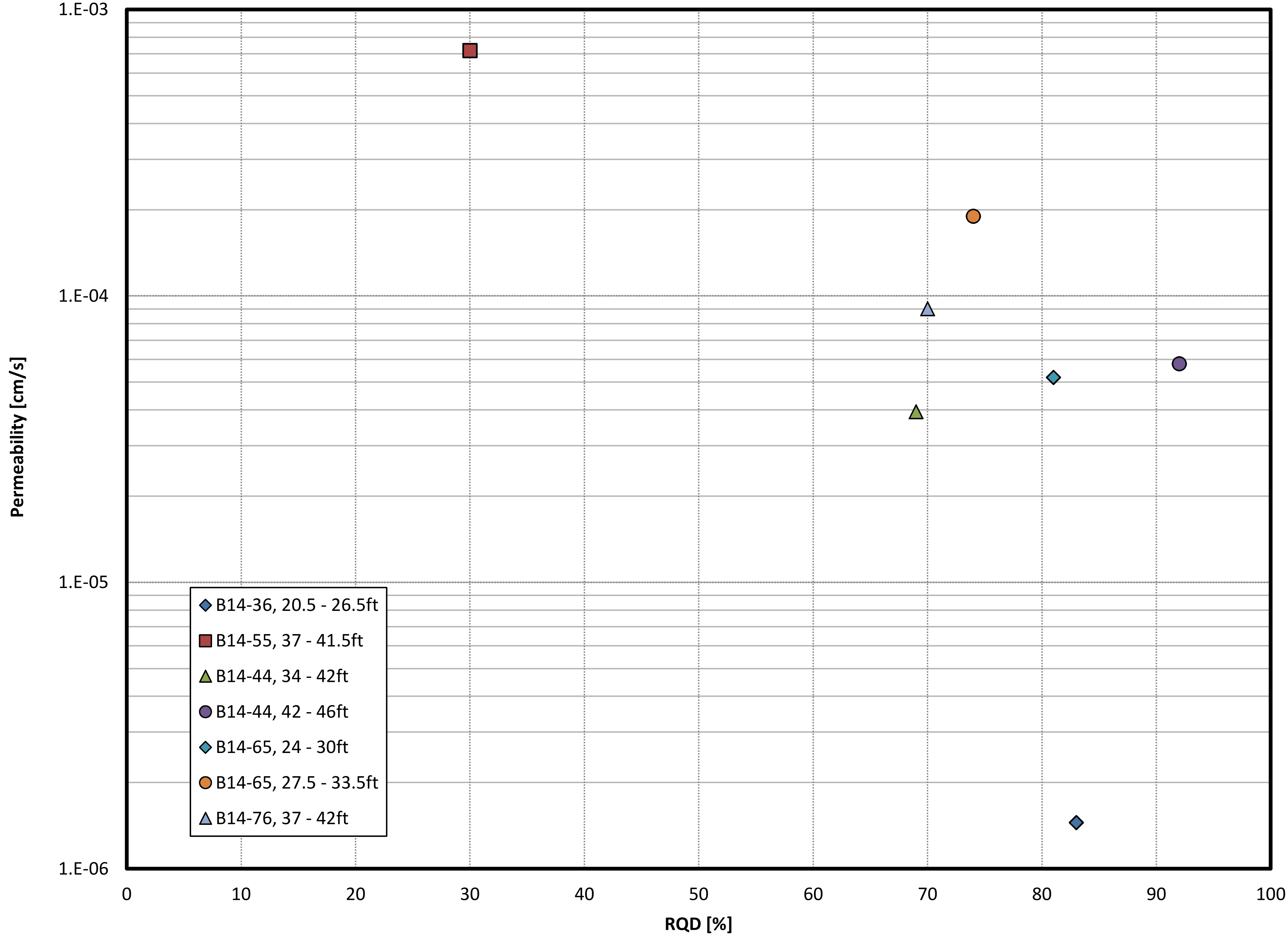
PolyMet 2014 Packer Test Data Summary - FTB Seepage Containment System Borings

Boring	Test Interval	Testing Length	Packer	RQD	Leakage Through Fractures / Bedrock Permeability			
					Test Results[1]		Test and Inferred Results[2]	
	feet	feet			cm/s	ft/s	cm/s	ft/s
B14-36	14 - 18.5	4.5	Double	93	0	0	1.4E-06	4.8E-08
B14-36	20.5 - 26.5	6	Single	83	1.4E-06	4.8E-08	1.4E-06	4.8E-08
B14-55	37 - 41.5	4.5	Single	30	7.2E-04	2.4E-05	7.2E-04	2.4E-05
B14-55	41.5 - 46.5	5	Double	100	0	0	1.4E-06	4.8E-08
B14-55	46 - 50.5	4.5	Single	48	0	0	1.4E-06	4.8E-08
B14-44	34 - 42	8	Single	69	3.9E-05	1.3E-06	3.9E-05	1.3E-06
B14-44	42 - 46	4	Double	92	5.8E-05	1.9E-06	5.8E-05	1.9E-06
B14-65	24 - 30	6	Double	81	5.2E-05	1.7E-06	5.2E-05	1.7E-06
B14-65	27.5 - 33.5	6	Double	74	1.9E-04	6.2E-06	1.9E-04	6.2E-06
B14-76	37 - 42	5	Single	70	9.0E-05	3.0E-06	9.0E-05	3.0E-06
				Geomean =	5.8E-05	1.9E-06	1.9E-05	6.3E-07

[1] *Based on the lowest permeability value resulting from the first three pressure increments as the value most likely to represent in-situ conditions. Geomean excludes values where zero inflow is observed during testing.*

[2] *For Packer Test Results where zero inflow is observed during testing, permeability values are selected based on inference from lowest packer test result obtained. Geomean includes all test intervals.*

The resulting permeability is not a true permeability since the rock is not a true porous media. Instead, the packer test provides a relative measurement of potential leakage through bedrock joints or fractures.



1.E-03
1.E-04
1.E-05
1.E-06
Permeability [cm/s]
0
10
20
30
40
50
60
70
80
90
100
RQD [%]
B14-36, 20.5 - 26.5ft
B14-55, 37 - 41.5ft
B14-44, 34 - 42ft
B14-44, 42 - 46ft
B14-65, 24 - 30ft
B14-65, 27.5 - 33.5ft
B14-76, 37 - 42ft

PolyMet 2014 Packer Testing

Performed: 5/13/2014

Analyzed: 5/21/2014

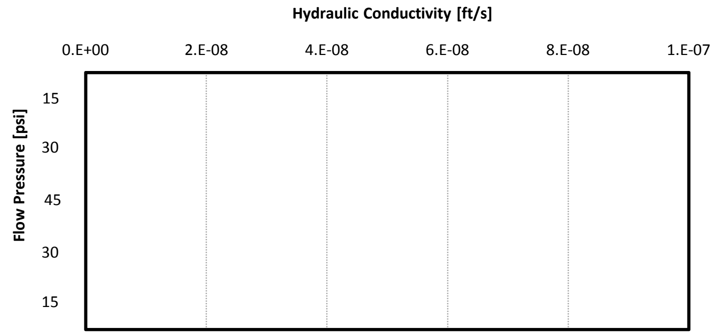
B14-36, 14 - 18.5ft

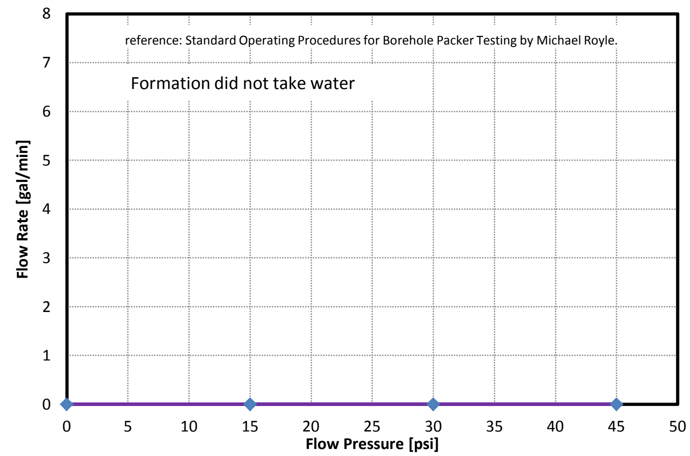
Notes: Double Packer Test

Packer length (ft) =	2
Screened interval (ft) =	3
Total depth of boring (ft) =	26.5
Test interval top (ft) =	14
Test interval bottom (ft) =	18.5
Original GWT (ft) =	4.7
GWT before inflation (ft) =	4.7
GWT after inflation (ft) =	4.7
GWT during test (ft) =	4.7
GWT at end of test (ft) =	4.7
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	93
Borehole radius (inches) =	1.5

Total testing interval (ft) =	4.5
Length of pipe above ground (ft) =	3
Length of pipe below ground (ft) =	12
Total length for losses (ft) =	15

Hydraulic Conductivity =	0.00E+00	cm/s	0.00E+00	ft/s
Maximum =	0.00E+00	cm/s	0.00E+00	ft/s
Minimum =	0.00E+00	cm/s	0.00E+00	ft/s





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0
1	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0
2	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0
3	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0
4	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0
5	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0	80.64	0.0	0.0

Average Flowrate (gal/min) =	0.0	0.0	0.0	0.0	0.0
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	1.2	1.2	1.2	1.2	1.2
Effective pressure (psi) =	13.8	28.8	43.8	28.8	13.8

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	0.0	0.0	0.0	0.0	0.0
L (length of the test interval), cm =	137.2	137.2	137.2	137.2	137.2
H_g (distance from ground water to pressure gauge), cm =	234.7	234.7	234.7	234.7	234.7
H_p (linear units of water head), cm =	974.8	2030.9	3087.1	2030.9	974.8
H (total gravity and pressure differential head), cm=	1209.5	2265.6	3321.8	2265.6	1209.5
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
k (hydraulic conductivity), ft/s =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PolyMet 2014 Packer Testing

Performed: 5/13/2014

Analyzed: 5/21/2014

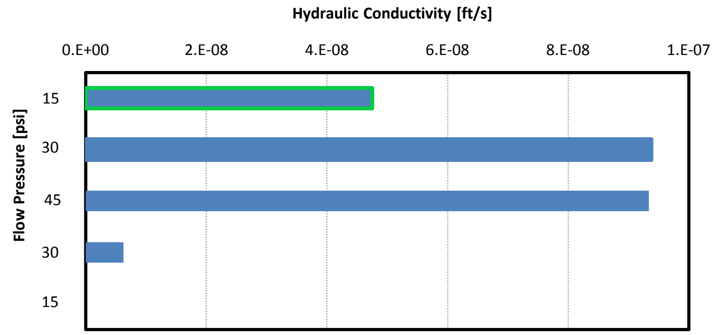
B14-36, 20.5 - 26.5ft

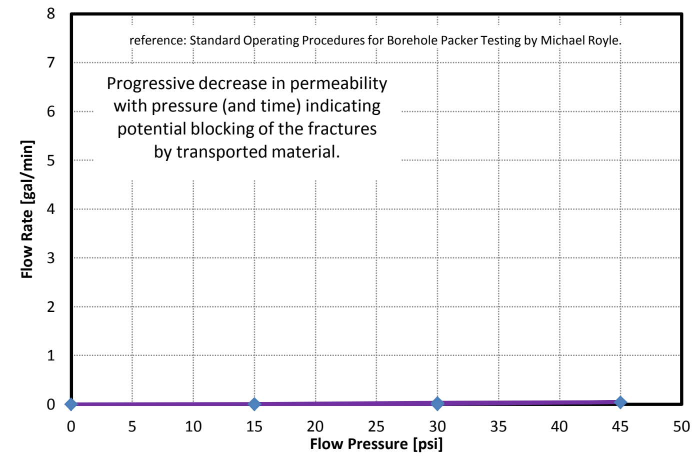
Hydraulic Conductivity =	1.45E-06	cm/s		4.75E-08	ft/s
Maximum =	2.86E-06	cm/s		9.38E-08	ft/s
Minimum =	0.00E+00	cm/s		0.00E+00	ft/s

Notes: Double Packer Test

Packer length (ft) =	2
Screened interval (ft) =	
Total depth of boring (ft) =	26.5
Test interval top (ft) =	20.5
Test interval bottom (ft) =	26.5
Original GWT (ft) =	4.7
GWT before inflation (ft) =	4.7
GWT after inflation (ft) =	4.7
GWT during test (ft) =	4.7
GWT at end of test (ft) =	4.7
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	83
Borehole radius (inches) =	1.5

Total testing interval (ft) =	6
Length of pipe above ground (ft) =	3
Length of pipe below ground (ft) =	18.5
Total length for losses (ft) =	21.5





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	80.80	0.0	0.0	80.88	0.0	0.0	81.05	0.0	0.0	81.27	0.0	0.0	81.28	0.0	0.0
1	80.81	0.0	0.0	80.92	0.0	0.0	81.11	0.1	0.1	81.28	0.0	0.0	81.28	0.0	0.0
2	80.81	0.0	0.0	80.95	0.1	0.0	81.17	0.1	0.1	81.28	0.0	0.0	81.28	0.0	0.0
3	80.82	0.0	0.0	80.98	0.1	0.0	81.21	0.2	0.0	81.28	0.0	0.0	81.28	0.0	0.0
4	80.83	0.0	0.0	81.01	0.1	0.0	81.24	0.2	0.0	81.28	0.0	0.0	81.28	0.0	0.0
5	80.84	0.0	0.0	81.03	0.2	0.0	81.27	0.2	0.0	81.28	0.0	0.0	81.28	0.0	0.0

Average Flowrate (gal/min) =	0.0	0.0	0.04	0.00	0.00
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	1.7	1.7	1.7	1.7	1.7
Effective pressure (psi) =	13.3	28.3	43.3	28.3	13.3

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	0.5	1.9	2.8	0.1	0.0
L (length of the test interval), cm =	182.9	182.9	182.9	182.9	182.9
H_g (distance from ground water to pressure gauge), cm =	234.7	234.7	234.7	234.7	234.7
H_p (linear units of water head), cm =	939.6	1995.7	3051.8	1995.7	939.6
H (total gravity and pressure differential head), cm=	1174.3	2230.4	3286.5	2230.4	1174.3
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	1.45E-06	2.86E-06	2.85E-06	1.91E-07	0.00E+00
k (hydraulic conductivity), ft/s =	4.75E-08	9.38E-08	9.34E-08	6.25E-09	0.00E+00

PolyMet 2014 Packer Testing

Performed: 5/2/2014

Analyzed: 5/21/2014

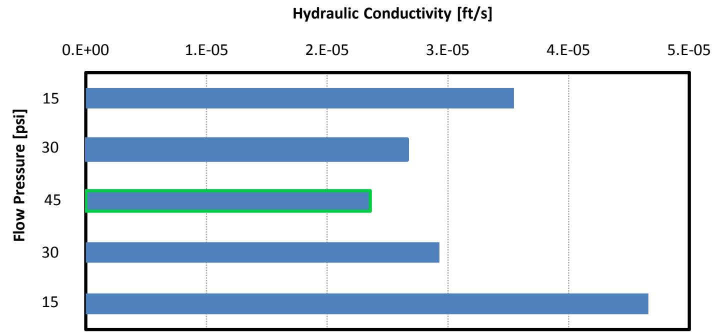
B14-55, 37 - 41.5ft

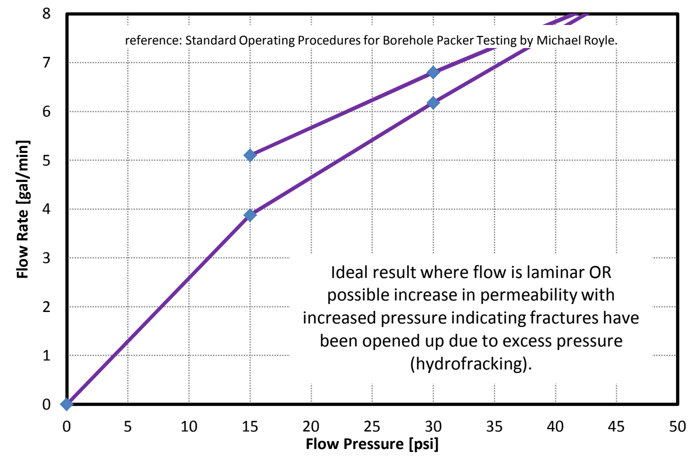
Hydraulic Conductivity =	7.18E-04	**cm/s**		2.36E-05	**ft/s**
Maximum =	1.42E-03	**cm/s**		4.66E-05	**ft/s**
Minimum =	7.18E-04	**cm/s**		2.36E-05	**ft/s**

Notes: Double Packer Test

Packer length (ft) =	2
Screened interval (ft) =	3
Total depth of boring (ft) =	50.5
Test interval top (ft) =	37
Test interval bottom (ft) =	41.5
Original GWT (ft) =	0
GWT before inflation (ft) =	0
GWT after inflation (ft) =	0
GWT during test (ft) =	0
GWT at end of test (ft) =	0
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	30
Borehole radius (inches) =	1.5

Total testing interval (ft) =	4.5
Length of pipe above ground (ft) =	3
Length of pipe below ground (ft) =	35
Total length for losses (ft) =	38





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	0.40	0.0	0.0	2.50	0.0	0.0	5.20	0.0	0.0	9.70	0.0	0.0	5.70	0.0	0.0
1	4.50	4.1	4.1	8.50	6.0	6.0	13.40	8.2	8.2	16.30	6.6	6.6	10.80	5.1	5.1
2	8.20	7.8	3.7	14.60	12.1	6.1	21.90	16.7	8.5	23.20	13.5	6.9	15.90	10.2	5.1
3	12.00	11.6	3.8	20.90	18.4	6.3	30.30	25.1	8.4	30.00	20.3	6.8	21.00	15.3	5.1
4	15.50	15.1	3.5	27.00	24.5	6.1	38.50	33.3	8.2	36.90	27.2	6.9	26.20	20.5	5.2
5	19.80	19.4	4.3	33.40	30.9	6.4	47.00	41.8	8.5	43.70	34.0	6.8	31.20	25.5	5.0

Average Flowrate (gal/min) =	3.88	6.18	8.36	6.80	5.10
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	2.9	2.9	2.9	2.9	2.9
Effective pressure (psi) =	12.1	27.1	42.1	27.1	12.1

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	244.8	389.9	527.4	429.0	321.8
L (length of the test interval), cm =	137.2	137.2	137.2	137.2	137.2
H_g (distance from ground water to pressure gauge), cm =	91.4	91.4	91.4	91.4	91.4
H_p (linear units of water head), cm =	850.1	1906.2	2962.4	1906.2	850.1
H (total gravity and pressure differential head), cm=	941.6	1997.7	3053.8	1997.7	941.6
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	1.08E-03	8.12E-04	7.18E-04	8.93E-04	1.42E-03
k (hydraulic conductivity), ft/s =	3.55E-05	2.66E-05	2.36E-05	2.93E-05	4.66E-05

PolyMet 2014 Packer Testing

Performed: 5/2/2014
Analyzed: 5/21/2014

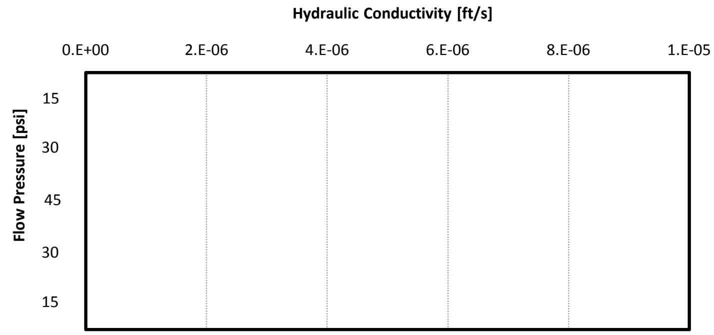
B14-55, 41.5 - 46.5ft

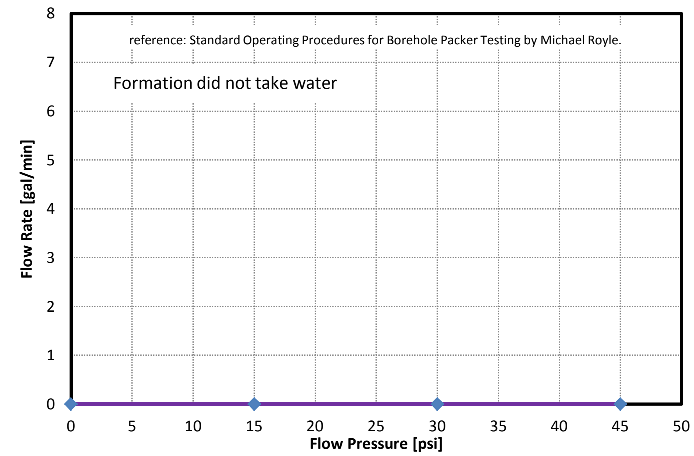
Hydraulic Conductivity =	0.00E+00	cm/s		0.00E+00	ft/s
Maximum =	0.00E+00	cm/s		0.00E+00	ft/s
Minimum =	0.00E+00	cm/s		0.00E+00	ft/s

Notes: Double Packer Test

Packer length (ft) =	2
Screened interval (ft) =	3
Total depth of boring (ft) =	50.5
Test interval top (ft) =	41.5
Test interval bottom (ft) =	46
Original GWT (ft) =	0
GWT before inflation (ft) =	0
GWT after inflation (ft) =	0
GWT during test (ft) =	0
GWT at end of test (ft) =	0
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	100
Borehole radius (inches) =	1.5

Total testing interval (ft) =	4.5
Length of pipe above ground (ft) =	3
Length of pipe below ground (ft) =	39.5
Total length for losses (ft) =	42.5





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0
1	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0
2	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0
3	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0
4	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0
5	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0	5.50	0.0	0.0

Average Flowrate (gal/min) =	0.0	0.0	0.0	0.0	0.0
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	3.3	3.3	3.3	3.3	3.3
Effective pressure (psi) =	11.7	26.7	41.7	26.7	11.7

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	0.0	0.0	0.0	0.0	0.0
L (length of the test interval), cm =	137.2	137.2	137.2	137.2	137.2
H_g (distance from ground water to pressure gauge), cm =	91.4	91.4	91.4	91.4	91.4
H_p (linear units of water head), cm =	825.7	1881.9	2938.0	1881.9	825.7
H (total gravity and pressure differential head), cm=	917.2	1973.3	3029.4	1973.3	917.2
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
k (hydraulic conductivity), ft/s =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PolyMet 2014 Packer Testing

Performed: 5/2/2014

Analyzed: 5/21/2014

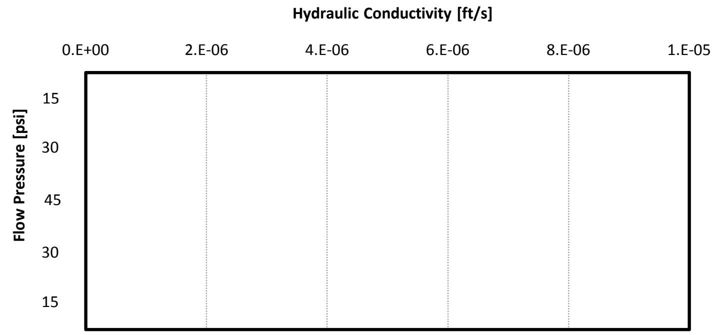
B14-55, 46 - 50.5ft

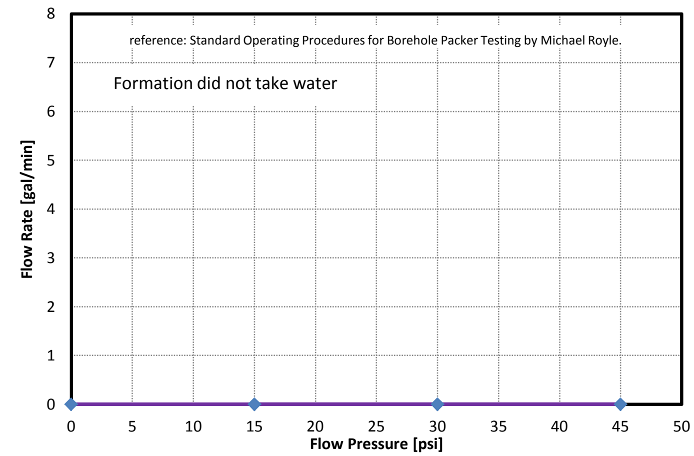
Hydraulic Conductivity =	0.00E+00	cm/s		0.00E+00	ft/s
Maximum =	0.00E+00	cm/s		0.00E+00	ft/s
Minimum =	0.00E+00	cm/s		0.00E+00	ft/s

Notes: Single Packer Test

Packer length (ft) =	2
Screened interval (ft) =	
Total depth of boring (ft) =	50.5
Test interval top (ft) =	46
Test interval bottom (ft) =	50.5
Original GWT (ft) =	0
GWT before inflation (ft) =	0
GWT after inflation (ft) =	0
GWT during test (ft) =	0
GWT at end of test (ft) =	0
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	48
Borehole radius (inches) =	1.5

Total testing interval (ft) =	4.5
Length of pipe above ground (ft) =	3
Length of pipe below ground (ft) =	44
Total length for losses (ft) =	47





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	1.20	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0
1	1.20	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0
2	1.20	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0
3	1.20	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0
4	1.20	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0
5	1.20	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0	1.30	0.0	0.0

Average Flowrate (gal/min) =	0.0	0.0	0.0	0.0	0.0
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	3.6	3.6	3.6	3.6	3.6
Effective pressure (psi) =	11.4	26.4	41.4	26.4	11.4

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	0.0	0.0	0.0	0.0	0.0
L (length of the test interval), cm =	137.2	137.2	137.2	137.2	137.2
H_g (distance from ground water to pressure gauge), cm =	91.4	91.4	91.4	91.4	91.4
H_p (linear units of water head), cm =	801.3	1857.5	2913.6	1857.5	801.3
H (total gravity and pressure differential head), cm=	892.8	1948.9	3005.0	1948.9	892.8
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
k (hydraulic conductivity), ft/s =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PolyMet 2014 Packer Testing

Performed: 4/3/2014

Analyzed: 5/21/2014

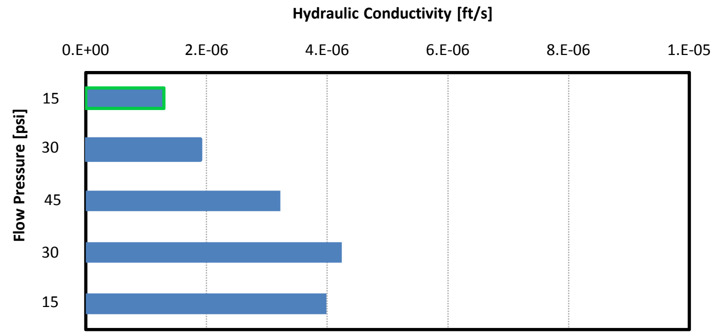
B14-44, 34 - 42ft

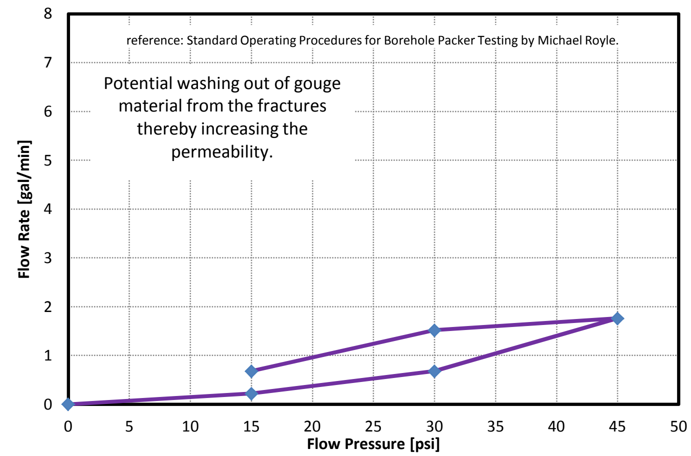
Hydraulic Conductivity =	3.93E-05	**cm/s**	1.29E-06	**ft/s**
Maximum =	1.29E-04	**cm/s**	4.24E-06	**ft/s**
Minimum =	3.93E-05	**cm/s**	1.29E-06	**ft/s**

Notes: Single Packer Test

Packer length (ft) =	2
Screened interval (ft) =	
Total depth of boring (ft) =	42
Test interval top (ft) =	34
Test interval bottom (ft) =	42
Original GWT (ft) =	0
GWT before inflation (ft) =	0
GWT after inflation (ft) =	0
GWT during test (ft) =	0
GWT at end of test (ft) =	0
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	69
Borehole radius (inches) =	1.5

Total testing interval (ft) =	8
Length of pipe above ground (ft) =	3
Length of pipe below ground (ft) =	32
Total length for losses (ft) =	35





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	7.0	0.0	0.0	8.5	0.0	0.0	2.6	0.0	0.0	2.7	0.0	0.0	0.5	0.0	0.0
1	7.1	0.1	0.1	9.2	0.7	0.7	3.9	1.3	1.3	4.0	1.3	1.3	1.1	0.6	0.6
2	7.4	0.4	0.3	9.9	1.4	0.7	5.8	3.2	1.9	5.6	2.9	1.6	1.8	1.3	0.7
3	7.7	0.7	0.3	10.5	2.0	0.6	6.7	4.1	0.9	7.1	4.4	1.5	2.6	2.1	0.8
4	7.9	0.9	0.2	11.2	2.7	0.7	8.3	5.7	1.6	8.7	6.0	1.6	3.3	2.8	0.7
5	8.1	1.1	0.2	11.9	3.4	0.7	11.4	8.8	3.1	10.3	7.6	1.6	3.9	3.4	0.6

Average Flowrate (gal/min) =	0.2	0.7	1.8	1.5	0.7
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	2.7	2.7	2.7	2.7	2.7
Effective pressure (psi) =	12.3	27.3	42.3	27.3	12.3

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	13.9	42.9	111.0	95.9	42.9
L (length of the test interval), cm =	243.8	243.8	243.8	243.8	243.8
H_g (distance from ground water to pressure gauge), cm =	91.4	91.4	91.4	91.4	91.4
H_p (linear units of water head), cm =	866.4	1922.5	2978.6	1922.5	866.4
H (total gravity and pressure differential head), cm=	957.8	2014.0	3070.1	2014.0	957.8
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	3.93E-05	5.78E-05	9.82E-05	1.29E-04	1.22E-04
k (hydraulic conductivity), ft/s =	1.29E-06	1.90E-06	3.22E-06	4.24E-06	3.99E-06

PolyMet 2014 Packer Testing

Performed: 4/3/2014

Analyzed: 5/21/2014

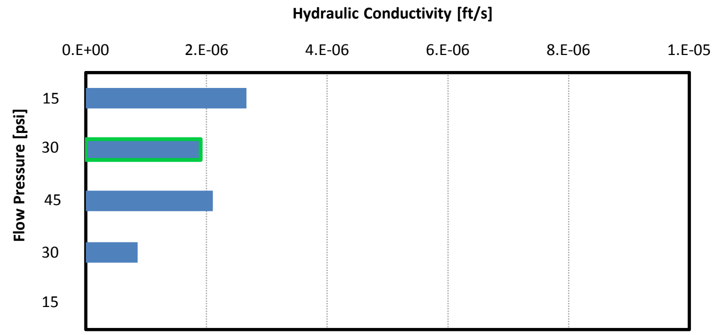
B14-44, 42 - 46ft

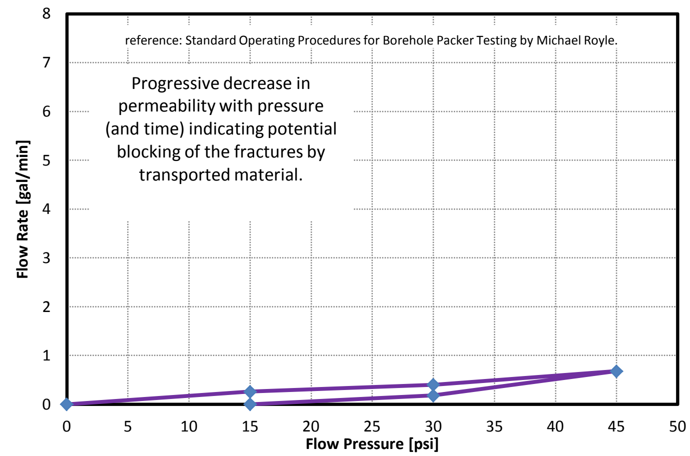
Notes: Double Packer Test

Packer length (ft) =	2
Screened interval (ft) =	3
Total depth of boring (ft) =	46
Test interval top (ft) =	42
Test interval bottom (ft) =	46
Original GWT (ft) =	0
GWT before inflation (ft) =	0
GWT after inflation (ft) =	0
GWT during test (ft) =	0
GWT at end of test (ft) =	0
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	92
Borehole radius (inches) =	1.5

Total testing interval (ft) =	4
Length of pipe above ground (ft) =	3
Length of pipe below ground (ft) =	40
Total length for losses (ft) =	43

Hydraulic Conductivity =	5.79E-05	**cm/s**	1.90E-06	**ft/s**
Maximum =	8.12E-05	**cm/s**	2.66E-06	**ft/s**
Minimum =	0.00E+00	**cm/s**	0.00E+00	**ft/s**





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	4.6	0.0	0.0	6.3	0.0	0.0	9.2	0.0	0.0	2.9	0.0	0.0	3.8	0.0	0.0
1	4.9	0.3	0.3	6.8	0.5	0.5	9.9	0.7	0.7	3.1	0.2	0.2	3.8	0.0	0.0
2	5.2	0.6	0.3	7.1	0.8	0.3	10.6	1.4	0.7	3.3	0.4	0.2	3.8	0.0	0.0
3	5.5	0.9	0.3	7.5	1.2	0.4	11.2	2.0	0.6	3.3	0.4	0.0	3.8	0.0	0.0
4	5.7	1.1	0.2	7.9	1.6	0.4	11.9	2.7	0.7	3.4	0.5	0.1	3.8	0.0	0.0
5	5.9	1.3	0.2	8.3	2.0	0.4	12.6	3.4	0.7	3.8	0.9	0.4	3.8	0.0	0.0

Average Flowrate (gal/min) =	0.3	0.4	0.7	0.2	0.0
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	3.3	3.3	3.3	3.3	3.3
Effective pressure (psi) =	11.7	26.7	41.7	26.7	11.7

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	16.4	25.2	42.9	11.4	0.0
L (length of the test interval), cm =	121.9	121.9	121.9	121.9	121.9
H_g (distance from ground water to pressure gauge), cm =	91.4	91.4	91.4	91.4	91.4
H_p (linear units of water head), cm =	823.0	1879.1	2935.3	1879.1	823.0
H (total gravity and pressure differential head), cm=	914.4	1970.6	3026.7	1970.6	914.4
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	8.12E-05	5.79E-05	6.41E-05	2.61E-05	0.00E+00
k (hydraulic conductivity), ft/s =	2.66E-06	1.90E-06	2.10E-06	8.55E-07	0.00E+00

PolyMet 2014 Packer Testing

Performed: 4/18/2014

Analyzed: 5/21/2014

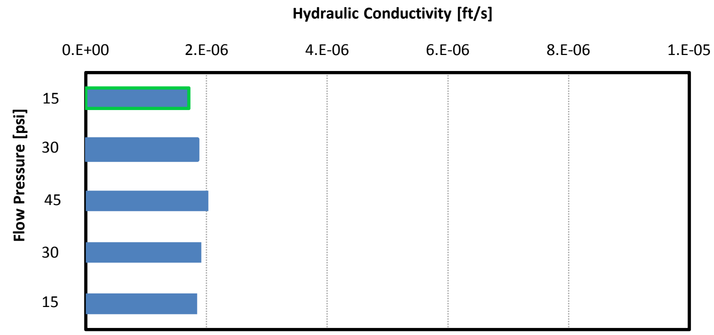
B14-65, 24 - 30ft

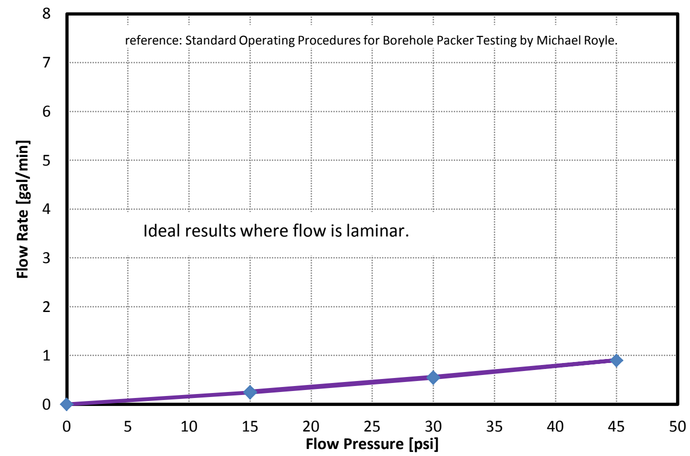
Notes: Double Packer Test

Packer length (ft) =	2
Screened interval (ft) =	5
Total depth of boring (ft) =	37
Test interval top (ft) =	24
Test interval bottom (ft) =	30
Original GWT (ft) =	0
GWT before inflation (ft) =	0
GWT after inflation (ft) =	0
GWT during test (ft) =	0
GWT at end of test (ft) =	0
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	81
Borehole radius (inches) =	1.5

Total testing interval (ft) =	6
Length of pipe above ground (ft) =	8.5
Length of pipe below ground (ft) =	22
Total length for losses (ft) =	30.5

Hydraulic Conductivity =	5.19E-05	**cm/s**	1.70E-06	**ft/s**
Maximum =	6.18E-05	**cm/s**	2.03E-06	**ft/s**
Minimum =	5.19E-05	**cm/s**	1.70E-06	**ft/s**





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	4.5	0.0	0.0	6.1	0.0	0.0	9.7	0.0	0.0	4.5	0.0	0.0	7.3	0.0	0.0
1	4.7	0.2	0.2	6.6	0.5	0.5	10.6	0.9	0.9	5.0	0.5	0.5	7.5	0.2	0.2
2	4.9	0.4	0.2	7.2	1.1	0.6	11.5	1.8	0.9	5.6	1.1	0.6	7.8	0.5	0.3
3	5.2	0.7	0.3	7.7	1.6	0.5	12.3	2.6	0.8	6.2	1.7	0.6	8.0	0.7	0.2
4	5.5	1.0	0.3	8.3	2.2	0.6	13.3	3.6	1.0	6.7	2.2	0.5	8.3	1.0	0.3
5	5.7	1.2	0.2	8.8	2.7	0.5	14.2	4.5	0.9	7.3	2.8	0.6	8.6	1.3	0.3

Average Flowrate (gal/min) =	0.2	0.5	0.9	0.6	0.3
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	2.3	2.3	2.3	2.3	2.3
Effective pressure (psi) =	12.7	27.7	42.7	27.7	12.7

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	15.1	34.1	56.8	35.3	16.4
L (length of the test interval), cm =	182.9	182.9	182.9	182.9	182.9
H_g (distance from ground water to pressure gauge), cm =	91.4	91.4	91.4	91.4	91.4
H_p (linear units of water head), cm =	890.8	1946.9	3003.0	1946.9	890.8
H (total gravity and pressure differential head), cm=	982.2	2038.3	3094.5	2038.3	982.2
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	5.19E-05	5.63E-05	6.18E-05	5.84E-05	5.63E-05
k (hydraulic conductivity), ft/s =	1.70E-06	1.85E-06	2.03E-06	1.92E-06	1.85E-06

PolyMet 2014 Packer Testing

Performed: 4/18/2014

Analyzed: 5/21/2014

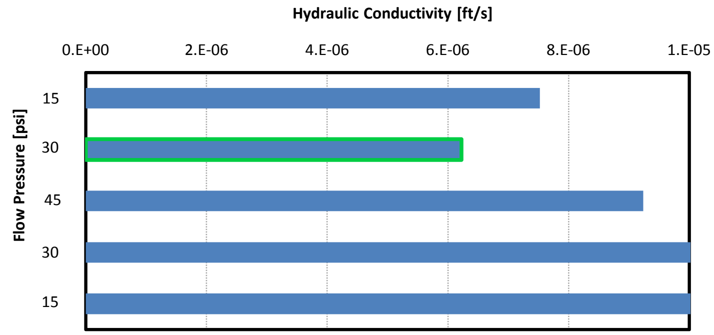
B14-65, 27.5 - 33.5ft

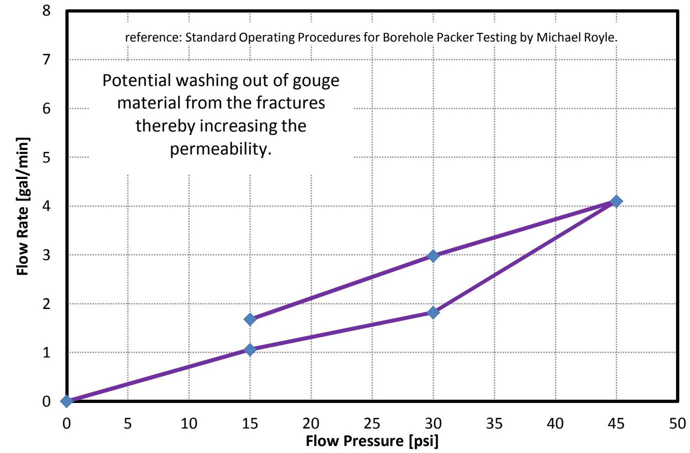
Notes: Double Packer Test

Packer length (ft) =	2
Screened interval (ft) =	5
Total depth of boring (ft) =	37
Test interval top (ft) =	27.5
Test interval bottom (ft) =	33.5
Original GWT (ft) =	0
GWT before inflation (ft) =	0
GWT after inflation (ft) =	0
GWT during test (ft) =	0
GWT at end of test (ft) =	0
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	74
Borehole radius (inches) =	1.5

Total testing interval (ft) =	6
Length of pipe above ground (ft) =	5
Length of pipe below ground (ft) =	25.5
Total length for losses (ft) =	30.5

Hydraulic Conductivity =	1.90E-04	cm/s	6.23E-06	ft/s
Maximum =	3.64E-04	cm/s	1.19E-05	ft/s
Minimum =	1.90E-04	cm/s	6.23E-06	ft/s





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	0.0	0.0	0.0	6.5	0.0	0.0	7.5	0.0	0.0	9.1	0.0	0.0	4.3	0.0	0.0
1	1.1	1.1	1.1	8.5	2.0	2.0	10.7	3.2	3.2	12.0	2.9	2.9	5.9	1.6	1.6
2	2.1	2.1	1.0	10.3	3.8	1.8	14.5	7.0	3.8	15.0	5.9	3.0	7.6	3.3	1.7
3	3.2	3.2	1.1	12.1	5.6	1.8	18.8	11.3	4.3	17.9	8.8	2.9	9.2	4.9	1.6
4	4.1	4.1	0.9	13.9	7.4	1.8	23.5	16.0	4.7	21.0	11.9	3.1	11.0	6.7	1.8
5	5.3	5.3	1.2	15.6	9.1	1.7	28.0	20.5	4.5	24.0	14.9	3.0	12.7	8.4	1.7

Average Flowrate (gal/min) =	1.1	1.8	4.1	3.0	1.7
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	2.3	2.3	2.3	2.3	2.3
Effective pressure (psi) =	12.7	27.7	42.7	27.7	12.7

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	66.9	114.8	258.7	188.0	106.0
L (length of the test interval), cm =	182.9	182.9	182.9	182.9	182.9
H_g (distance from ground water to pressure gauge), cm =	91.4	91.4	91.4	91.4	91.4
H_p (linear units of water head), cm =	890.8	1946.9	3003.0	1946.9	890.8
H (total gravity and pressure differential head), cm=	982.2	2038.3	3094.5	2038.3	982.2
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	2.29E-04	1.90E-04	2.82E-04	3.11E-04	3.64E-04
k (hydraulic conductivity), ft/s =	7.53E-06	6.23E-06	9.24E-06	1.02E-05	1.19E-05

PolyMet 2014 Packer Testing

Performed: 4/3/2014

Analyzed: 5/21/2014

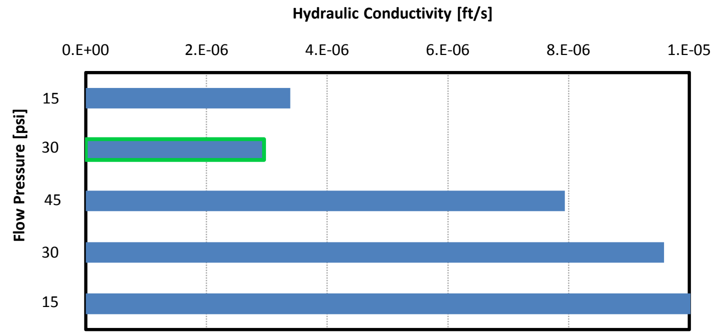
B14-76, 37 - 42ft

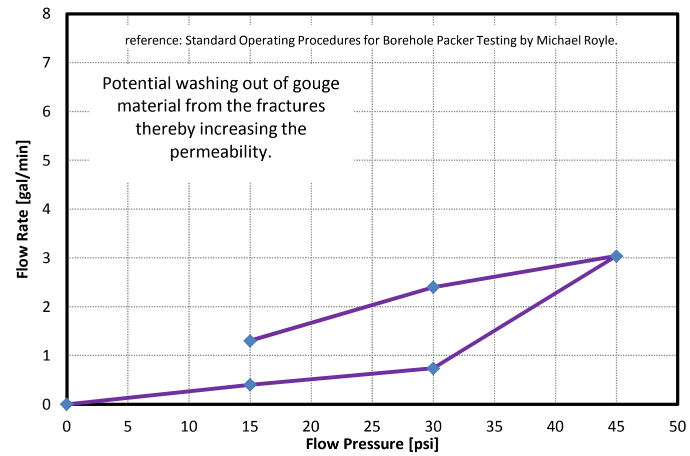
Notes: Single Packer Test

Packer length (ft) =	2
Screened interval (ft) =	5
Total depth of boring (ft) =	42
Test interval top (ft) =	37
Test interval bottom (ft) =	42
Original GWT (ft) =	0
GWT before inflation (ft) =	0
GWT after inflation (ft) =	0
GWT during test (ft) =	0
GWT at end of test (ft) =	0
Height of pressure gauge (ft) =	3
Packer inflation pressure (psi) =	140
RQD for test interval (%) =	70
Borehole radius (inches) =	1.5

Total testing interval (ft) =	5
Length of pipe above ground (ft) =	3
Length of pipe below ground (ft) =	35
Total length for losses (ft) =	38

Hydraulic Conductivity =	9.00E-05	cm/s	2.95E-06	ft/s
Maximum =	3.36E-04	cm/s	1.10E-05	ft/s
Minimum =	9.00E-05	cm/s	2.95E-06	ft/s





Flow Pressure (psi) =	15			30			45			30			15		
Time (min)	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow	Flow (gal)	Cumulative	Partial Flow
0	9.5	0.0	0.0	2.5	0.0	0.0	8.0	0.0	0.0	4.0	0.0	0.0	8.4	0.0	0.0
1	10.0	0.5	0.5	3.2	0.7	0.7	10.8	2.8	2.8	6.7	2.7	2.7	9.7	1.3	1.3
2	10.5	1.0	0.5	3.9	1.4	0.7	14.0	6.0	3.2	9.1	5.1	2.4	11.1	2.7	1.4
3	10.5	1.0	0.0	4.7	2.2	0.8	17.0	9.0	3.0	11.5	7.5	2.4	12.4	4.0	1.3
4	11.0	1.5	0.5	5.5	3.0	0.8	20.1	12.1	3.1	13.9	9.9	2.4	13.6	5.2	1.2
5	11.5	2.0	0.5	6.2	3.7	0.7	23.2	15.2	3.1	16.0	12.0	2.1	14.9	6.5	1.3

Average Flowrate (gal/min) =	0.4	0.7	3.0	2.4	1.3
Applied pressure (psi) =	15	30	45	30	15
Friction loss/foot (psi) =	0.08	0.08	0.08	0.08	0.08
Friction loss (psi) =	2.9	2.9	2.9	2.9	2.9
Effective pressure (psi) =	12.1	27.1	42.1	27.1	12.1

USBR 7310-89 Calculation for Hydraulic Conductivity

q (constant rate of flow into the test interval), cm^3/s =	25.2	46.7	191.8	151.4	82.0
L (length of the test interval), cm =	152.4	152.4	152.4	152.4	152.4
H_g (distance from ground water to pressure gauge), cm =	91.4	91.4	91.4	91.4	91.4
H_p (linear units of water head), cm =	850.1	1906.2	2962.4	1906.2	850.1
H (total gravity and pressure differential head), cm=	941.6	1997.7	3053.8	1997.7	941.6
r (radius of borehole), cm =	3.8	3.8	3.8	3.8	3.8
k (hydraulic conductivity), cm/s =	1.03E-04	9.00E-05	2.42E-04	2.92E-04	3.36E-04
k (hydraulic conductivity), ft/s =	3.39E-06	2.95E-06	7.94E-06	9.58E-06	1.10E-05

Exhibit F

Laboratory Test Results

Laboratory Test Summary

Project: PolyMet #23690C29 Job: 9352

Client: Barr Engineering Company Date: 6/3/2014

Sample Information & Classification

Boring #	B-14-65	B-14-69	B-14-69	B-14-69	B-14-96			
Sample #								
Depth (ft)	5-7	2.5-4.5	10-12	15-17	3-5			
Type or BPF	3T	3T	3T	3T	3T			
Material Classification	Peat (PT)	Peat (PT)	Peat (PT)	Peat (PT)	Peat (PT)			
Organic Content (ASTM:D2974)								
Organic Content (%)	83.7	77.4	78.4	83.9	76.0			
Atterberg Limits (ASTM:D4318)								
Liquid Limit (%)	479.3	429.0	574.2	612.3	411.4			
Plastic Limit (%)	440.9	412.2	198.3	536.2	368.6			
Plasticity Index (%)	38.4	16.8	375.9	76.1	42.8			
Water Content (ASTM:D2216)								
Water Content (%)	496.2	413.1	616.4	590.4	445.4			

Laboratory Test Summary

Project:	PolyMet Winter Investigation #23690C29.13	Job:	9352-A
Client:	Barr Engineering Company	Date:	7/11/2014

Sample Information & Classification

Boring #	B14-36	B14-40	B14-44	B14-44	B14-48	B14-52	B14-52	B14-52
Location								
Depth (ft)	7.5-9.5	0-11.5	20-22	27-27.5	5-7	9.5-11.5	30-32	40-42
Type or BPF	Jar	Composite	Jar	Jar	Jar	Jar	Jar	Jar
Material Classification	Silty Sand w/ gravel (SM)	Silty Sand w/ gravel (SM)	Silty Sand w/ gravel (SM)	Silty Clayey Sand (SC-SM/SC)	Silty Sand w/a little gravel (SM)	Sandy Silt (ML)	Silt (ML)	Silty Sand (SM)

Sample Information & Classification

Liquid Limit (%)	13.1	NP	NP	23.9	NP	NP	19.9	NP
Plastic Limit (%)	NP	NP	NP	17.3	NP	NP	18.2	NP
Plasticity Index (%)	NP	NP	NP	6.6	NP	NP	1.7	NP

Sample Information & Classification

Boring #	B14-55	B14-55	B14-62	B14-65	B14-65	B14-69	B14-72	B14-72
Location								
Depth (ft)	10-12	20-22	2.5-12	10-12	12.5-14.5	25-27	2.5-4.5	7.5-9.5
Type or BPF	Jar	Jar	Composite	Jar	Jar	Jar	Jar	Jar
Material Classification	Silty Sand w/a little gravel (SM)	Silty Sand w/ gravel (SM)	Silty Sand w/ gravel (SM)	Clayey Sand w/a trace of gravel and organic fines (SC)	Silty Sand w/a trace of gravel (SM)	Gravel w/ silt and sand (GP-GM/GC-GM)	Silt w/ sand and a trace of gravel (SP-SM)	Silty Sand w/ gravel

Atterberg Limits

Liquid Limit (%)	NP	14.0	NP	67.5	NP	18.3	NP	NP
Plastic Limit (%)	NP	12.1	NP	45.9	NP	14.3	NP	NP
Plasticity Index (%)	NP	1.9	NP	21.6	NP	4.0	NP	NP

Laboratory Test Summary

Project: PolyMet Winter Investigation #23690C29.13 Job: 9352-A

Client: Barr Engineering Company Date: 7/11/2014

Sample Information & Classification

Boring #	B14-76	B14-80						
Location								
Depth (ft)	9-22.5	2.5-4.5						
Type or BPF	Composite	Jar						
Material Classification	Silty Sand w/ gravel (SM)	Silty Sand w/ gravel (SM)						

Atterberg Limits

Liquid Limit (%)	13.1	NP						
Plastic Limit (%)	NP	NP						
Plasticity Index (%)	NP	NP						

Sample Information & Classification

Boring #								
Location								
Depth (ft)								
Type or BPF								
Material Classification								

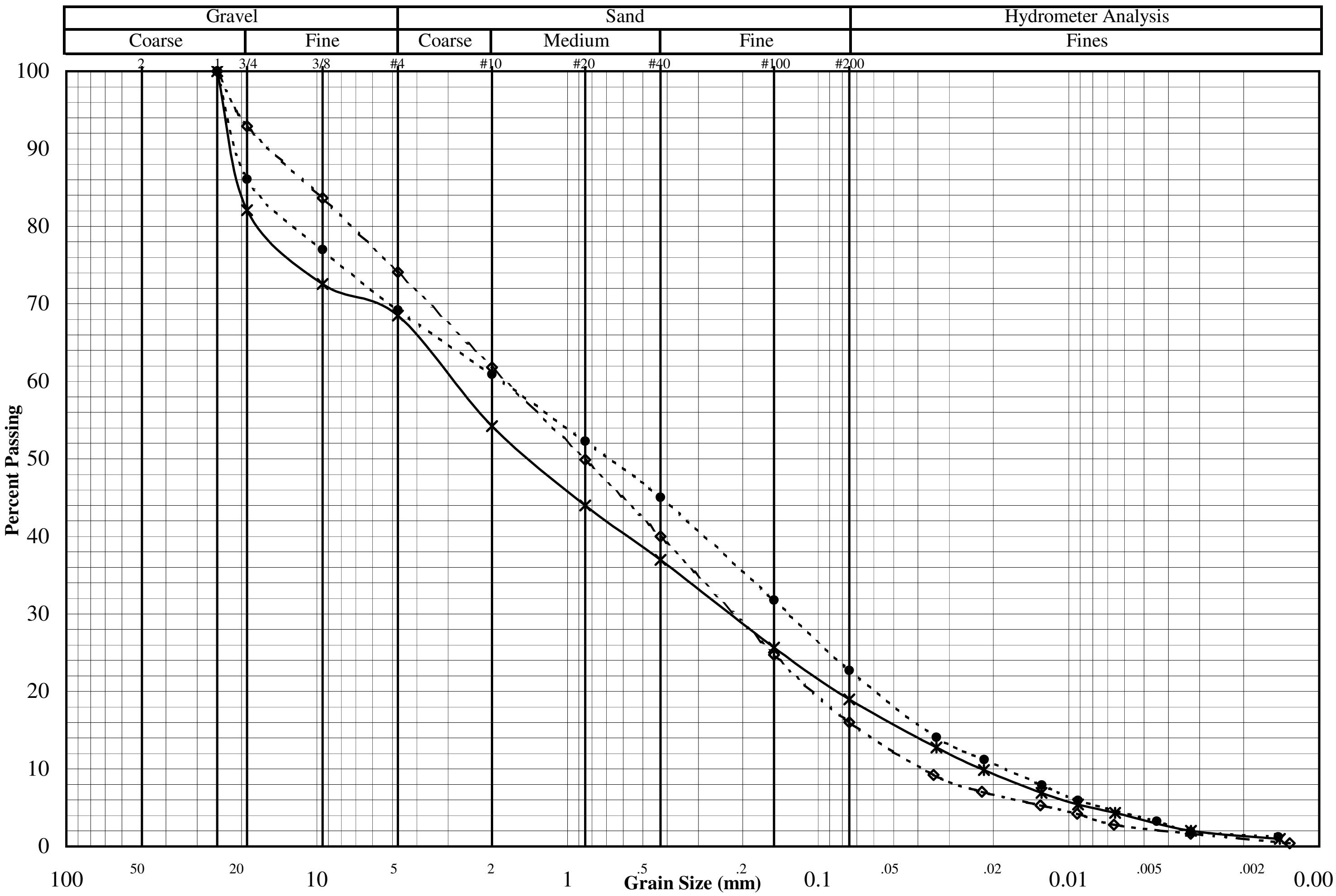
Atterberg Limits

Liquid Limit (%)								
Plastic Limit (%)								
Plasticity Index (%)								

Grain Size Distribution ASTM D422

Project:	PolyMet Winter Investigation #23690C29.13	Job No. :	**9352-A**
		Test Date:	6/25/14
Reported To:	Barr Engineering Company	Report Date:	7/11/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	B14-36		7.5-9.5	SB	Silty Sand with gravel (SM)
●	B14-40		0-2, 4-6, 7-9, 9.5-11.5	SB	Silty Sand with gravel (SM)
◇	B14-44		20-22	SB	Silty Sand with gravel (SM)



Other Tests

	*	●	◇
Liquid Limit	NP	NP	NP
Plastic Limit	NP	NP	NP
Plasticity Index	NP	NP	NP
Water Content	10.8	8.0	7.7
Dry Density (pcf)			
Specific Gravity	2.68*	2.68*	2.68*
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	206.6	865.0	321.3
2"			
1.5"			
1"	100.0	100.0	100.0
3/4"	82.1	86.1	92.9
3/8"	72.6	77.0	83.6
#4	68.5	69.2	74.1
#10	54.2	60.9	61.8
#20	44.0	52.3	49.9
#40	37.0	45.0	40.0
#100	25.6	31.8	24.7
#200	19.0	22.7	16.0

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/25/14
Reported To:	Barr Engineering Company	Report Date:	7/11/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	B14-36		7.5-9.5	SB	Silty Sand with gravel (SM)
Spec 2	B14-40		0-2, 4-6, 7-9, 9.5-11.5	SB	Silty Sand with gravel (SM)
Spec 3	B14-44		20-22	SB	Silty Sand with gravel (SM)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"	100.0	1"	100.0	1"	100.0
3/4"	82.1	3/4"	86.1	3/4"	92.9
3/8"	72.6	3/8"	77.0	3/8"	83.6
#4	68.5	#4	69.2	#4	74.1
#10	54.2	#10	60.9	#10	61.8
#20	44.0	#20	52.3	#20	49.9
#40	37.0	#40	45.0	#40	40.0
#100	25.6	#100	31.8	#100	24.7
#200	19.0	#200	22.7	#200	16.0

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.034	12.8	0.034	14.1	0.035	9.2
0.022	9.9	0.022	11.2	0.022	7.0
0.013	6.9	0.013	7.9	0.013	5.3
0.009	5.4	0.009	5.9	0.009	4.2
0.007	4.3	0.004	3.3	0.007	2.8
0.003	2.0	0.003	2.0	0.003	1.6
0.001	1.0	0.001	1.2	0.001	0.4

Remarks

Specimen 1	Specimen 2	Specimen 3

2401 West 66th Street

SOIL ENGINEERING TESTING, INC.

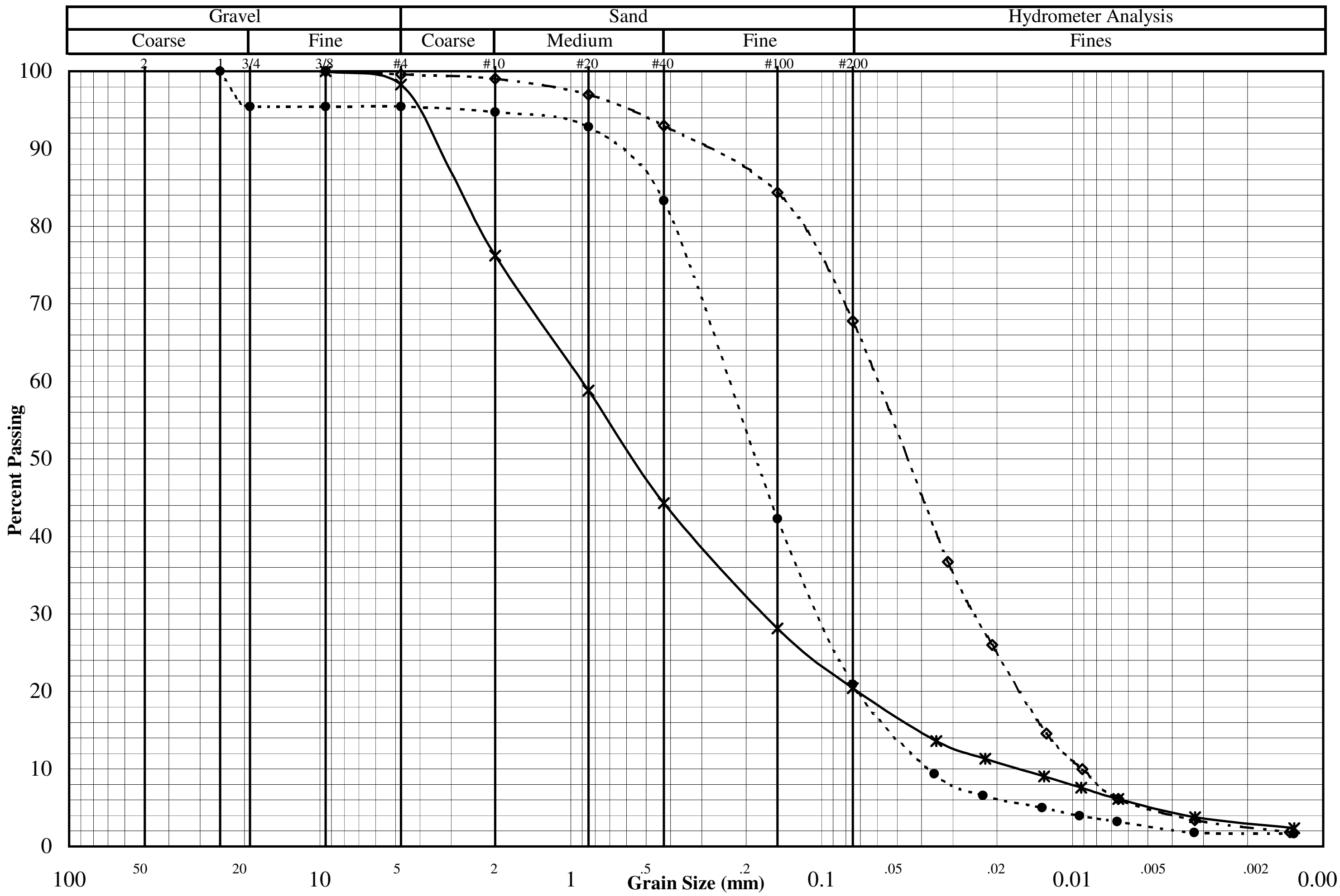
Richfield, MN 55423

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/20/14
Reported To:	Barr Engineering Company	Report Date:	7/14/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
✱	B14-44		27-27.6	SB	Silty Clayey Sand (SC-SM/SC)
●	B14-48		5-7	SB	Silty Sand w/a little gravel (SM)
◇	B14-52		9.5-11.5	SB	Sandy Silt (ML)



Other Tests

	✱	●	◇
Liquid Limit	23.9	NP	NP
Plastic Limit	17.3	NP	NP
Plasticity Index	6.6	NP	NP
Water Content	10.1	16.4	18.0
Dry Density (pcf)			
Specific Gravity	2.68*	2.68*	2.68*
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	✱	●	◇
Mass (g)	240.2	246.2	260.4
2"			
1.5"			
1"		100.0	
3/4"		95.5	
3/8"	100.0	95.5	100.0
#4	98.3	95.5	99.6
#10	76.2	94.8	99.0
#20	58.8	92.8	97.0
#40	44.3	83.3	93.0
#100	28.1	42.3	84.4
#200	20.4	20.9	67.8

	✱	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/20/14
Reported To:	Barr Engineering Company	Report Date:	7/14/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	B14-44		27-27.6	SB	Silty Clayey Sand (SC-SM/SC)
Spec 2	B14-48		5-7	SB	Silty Sand w/a little gravel (SM)
Spec 3	B14-52		9.5-11.5	SB	Sandy Silt (ML)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"	100.0	1"	
3/4"		3/4"	95.5	3/4"	
3/8"	100.0	3/8"	95.5	3/8"	100.0
#4	98.3	#4	95.5	#4	99.6
#10	76.2	#10	94.8	#10	99.0
#20	58.8	#20	92.8	#20	97.0
#40	44.3	#40	83.3	#40	93.0
#100	28.1	#100	42.3	#100	84.4
#200	20.4	#200	20.9	#200	67.8

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.035	13.6	0.036	9.4	0.031	36.7
0.022	11.3	0.023	6.6	0.021	26.0
0.013	9.1	0.013	5.0	0.013	14.5
0.009	7.6	0.009	3.9	0.009	10.0
0.007	6.1	0.007	3.2	0.007	6.1
0.003	3.8	0.003	1.8	0.003	3.4
0.001	2.3	0.001	1.6	0.001	1.8

Remarks

Specimen 1	Specimen 2	Specimen 3

2401 West 66th Street

SOIL ENGINEERING TESTING, INC.

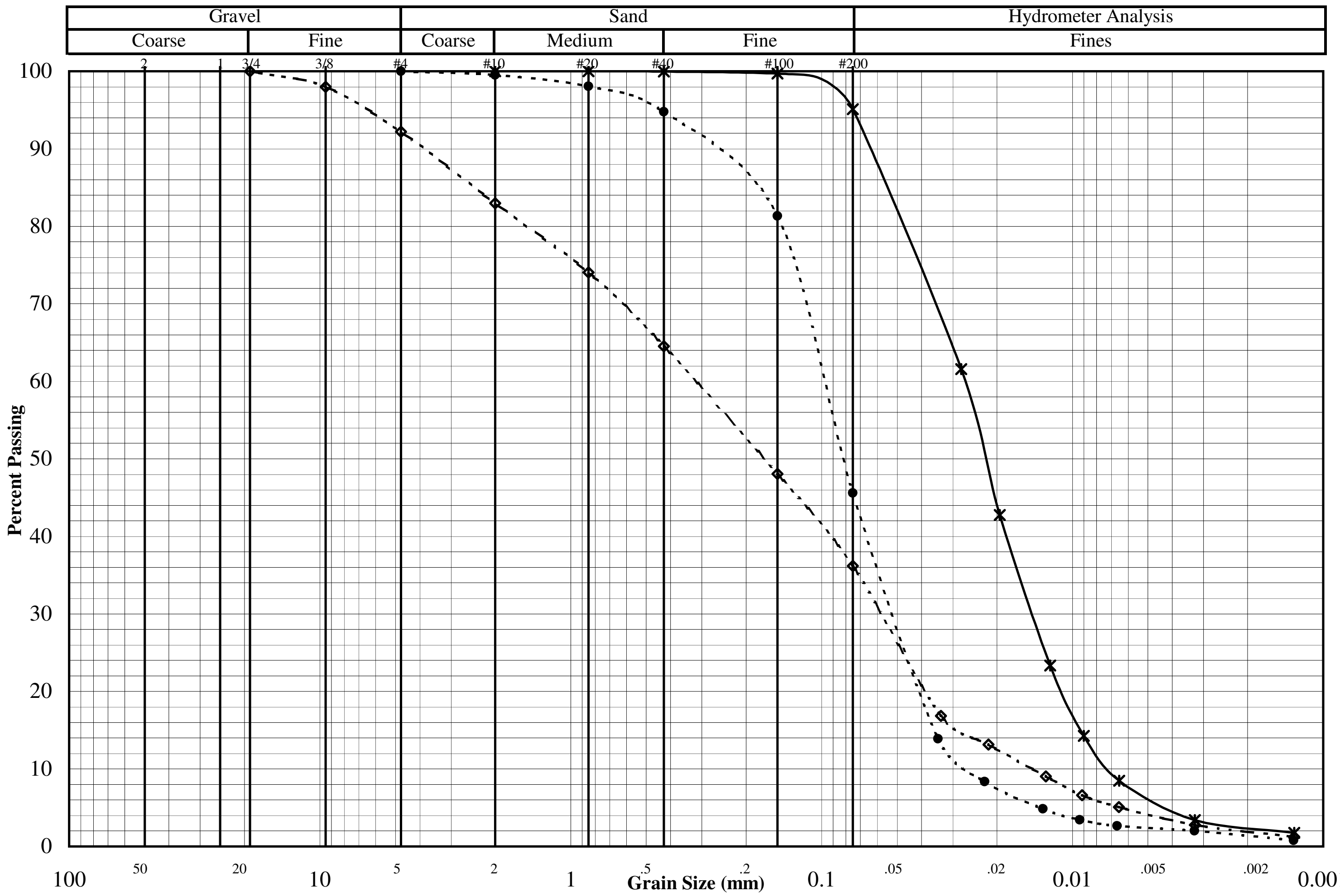
Richfield, MN 55423

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/19/14
Reported To:	Barr Engineering Company	Report Date:	6/24/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	B14-52		30-32	SB	Silt (ML)
●	B14-52		40-42	SB	Silty Sand (SM)
◇	B14-55		10-12	SB	Silty Sand with a little gravel (SM)



Other Tests

	*	●	◇
Liquid Limit	19.9	NP	NP
Plastic Limit	18.2	NP	NP
Plasticity Index	1.7	NP	NP
Water Content	22.0	18.8	11.7
Dry Density (pcf)			
Specific Gravity	2.68*	2.68*	2.68*
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	148.8	243.2	386.4
2"			
1.5"			
1"			
3/4"			100.0
3/8"			98.0
#4		100.0	92.2
#10	100.0	99.5	83.0
#20	100.0	98.1	74.1
#40	100.0	94.8	64.5
#100	99.7	81.3	48.0
#200	95.1	45.6	36.2

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/19/14
Reported To:	Barr Engineering Company	Report Date:	6/24/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	B14-52		30-32	SB	Silt (ML)
Spec 2	B14-52		40-42	SB	Silty Sand (SM)
Spec 3	B14-55		10-12	SB	Silty Sand with a little gravel (SM)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"		1"	
3/4"		3/4"		3/4"	100.0
3/8"		3/8"		3/8"	98.0
#4		#4	100.0	#4	92.2
#10	100.0	#10	99.5	#10	83.0
#20	100.0	#20	98.1	#20	74.1
#40	100.0	#40	94.8	#40	64.5
#100	99.7	#100	81.3	#100	48.0
#200	95.1	#200	45.6	#200	36.2

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.028	61.6	0.034	13.9	0.033	16.8
0.019	42.8	0.022	8.4	0.022	13.1
0.012	23.3	0.013	4.9	0.013	9.0
0.009	14.3	0.009	3.4	0.009	6.6
0.007	8.5	0.007	2.6	0.007	5.1
0.003	3.4	0.003	2.0	0.003	2.8
0.001	1.8	0.001	0.8	0.001	1.3

Remarks

Specimen 1	Specimen 2	Specimen 3

2401 West 66th Street

SOIL ENGINEERING TESTING, INC.

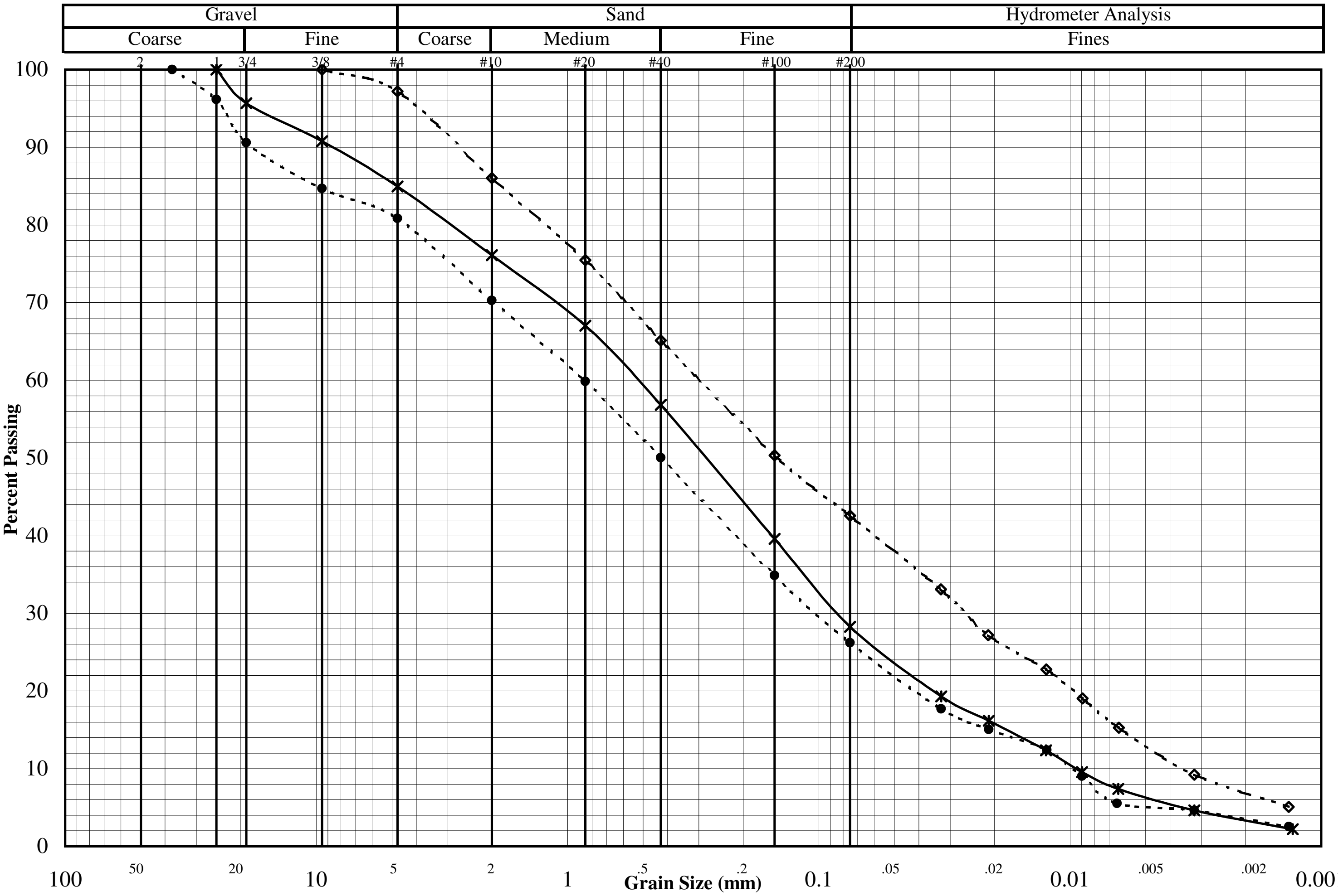
Richfield, MN 55423

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/25/14
Reported To:	Barr Engineering Company	Report Date:	7/2/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	B14-55		20-22	SB	Silty Sand with gravel (SM)
●	B14-62		2.5-4.5, 5-7, 7.5-9.5, 10-12	SB	Silty Sand with gravel (SM)
◇	B14-65		10-12	SB	Clayey Sand with a trace of gravel and organic fines (SC)



Other Tests

	*	●	◇
Liquid Limit	14.0	NP	67.5
Plastic Limit	12.1	NP	45.9
Plasticity Index	1.9	NP	21.6
Water Content	9.6	7.8	72.5
Dry Density (pcf)			
Specific Gravity	2.68*	2.68*	2.68*
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	309.6	1076.3	82.8
2"			
1.5"		100.0	
1"	100.0	96.2	
3/4"	95.7	90.6	
3/8"	90.8	84.7	100.0
#4	85.0	80.8	97.2
#10	76.1	70.3	86.0
#20	67.0	59.9	75.5
#40	56.8	50.1	65.1
#100	39.6	34.9	50.3
#200	28.3	26.2	42.6

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/25/14
Reported To:	Barr Engineering Company	Report Date:	7/2/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	B14-55		20-22	SB	Silty Sand with gravel (SM)
Spec 2	B14-62		2.5-4.5, 5-7, 7.5-9.5, 10-12	SB	Silty Sand with gravel (SM)
Spec 3	B14-65		10-12	SB	Clayey Sand with a trace of gravel and organic fines (SC)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"	100.0	1.5"	
1"	100.0	1"	96.2	1"	
3/4"	95.7	3/4"	90.6	3/4"	
3/8"	90.8	3/8"	84.7	3/8"	100.0
#4	85.0	#4	80.8	#4	97.2
#10	76.1	#10	70.3	#10	86.0
#20	67.0	#20	59.9	#20	75.5
#40	56.8	#40	50.1	#40	65.1
#100	39.6	#100	34.9	#100	50.3
#200	28.3	#200	26.2	#200	42.6

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.033	19.3	0.033	17.7	0.033	33.1
0.021	16.2	0.021	15.0	0.021	27.2
0.012	12.4	0.012	12.4	0.012	22.8
0.009	9.5	0.009	9.0	0.009	19.0
0.006	7.4	0.006	5.5	0.006	15.3
0.003	4.6	0.003	4.6	0.003	9.2
0.001	2.2	0.001	2.5	0.001	5.1

Remarks

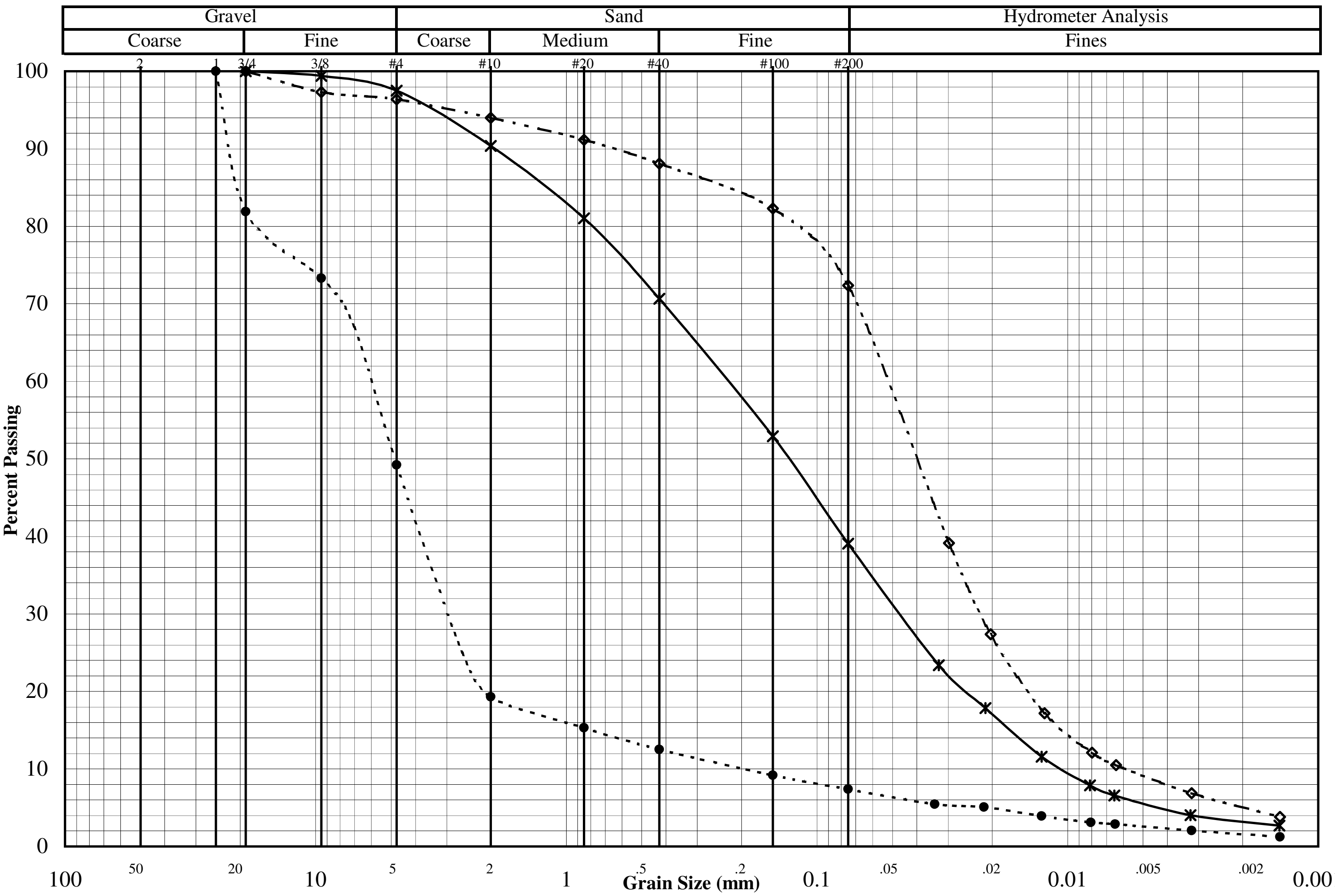
Specimen 1	Specimen 2	Specimen 3

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/19/14
Reported To:	Barr Engineering Company	Report Date:	6/24/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	B14-65		12.5-14.5	SB	Silty sand with a trace of gravel (SM)
●	B14-69		25-27	SB	Gravel with silt and sand (GP-GM/GC-GM)
◇	B14-72		2.5-4.5	SB	Silt with sand and a trace of gravel (ML)



Other Tests

	*	●	◇
Liquid Limit	15.4	18.3	22.0
Plastic Limit	NP	14.3	NP
Plasticity Index	NP	4.0	NP
Water Content	15.1	12.4	24.6
Dry Density (pcf)			
Specific Gravity	2.68*	2.68*	2.68*
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	338.3	107.2	188.6
2"			
1.5"			
1"		100.0	
3/4"	100.0	81.9	100.0
3/8"	99.4	73.3	97.3
#4	97.5	49.2	96.4
#10	90.4	19.3	94.0
#20	81.0	15.3	91.2
#40	70.7	12.5	88.1
#100	52.9	9.2	82.3
#200	39.1	7.4	72.4

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/19/14
Reported To:	Barr Engineering Company	Report Date:	6/24/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	B14-65		12.5-14.5	SB	Silty sand with a trace of gravel (SM)
Spec 2	B14-69		25-27	SB	Gravel with silt and sand (GP-GM/GC-GM)
Spec 3	B14-72		2.5-4.5	SB	Silt with sand and a trace of gravel (ML)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"	100.0	1"	
3/4"	100.0	3/4"	81.9	3/4"	100.0
3/8"	99.4	3/8"	73.3	3/8"	97.3
#4	97.5	#4	49.2	#4	96.4
#10	90.4	#10	19.3	#10	94.0
#20	81.0	#20	15.3	#20	91.2
#40	70.7	#40	12.5	#40	88.1
#100	52.9	#100	9.2	#100	82.3
#200	39.1	#200	7.4	#200	72.4

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.033	23.4	0.034	5.5	0.030	39.1
0.021	17.8	0.022	5.1	0.020	27.4
0.013	11.6	0.013	3.9	0.012	17.2
0.008	7.9	0.008	3.1	0.008	12.1
0.007	6.6	0.006	2.9	0.006	10.5
0.003	4.0	0.003	2.0	0.003	6.9
0.001	2.7	0.001	1.2	0.001	3.8

Remarks

Specimen 1	Specimen 2	Specimen 3

2401 West 66th Street

SOIL ENGINEERING TESTING, INC.

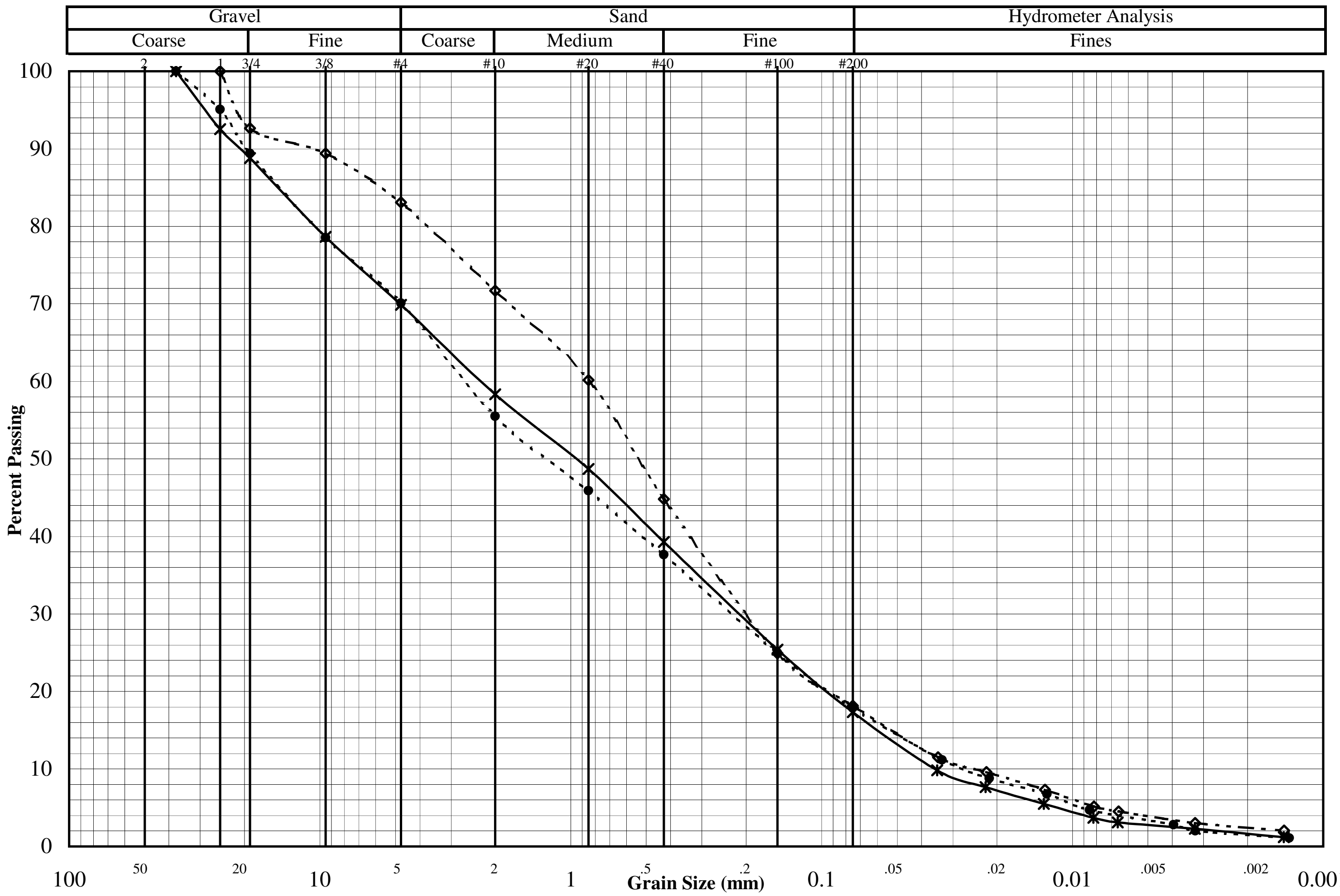
Richfield, MN 55423

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/27/14
Reported To:	Barr Engineering Company	Report Date:	7/2/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	B14-72		7.5-9.5	SB	Silty Sand with gravel (SM)
●	B14-76		9-11, 12.5-14.5, 16-18, 20.5-22.5	SB	Silty Sand with gravel (SM)
◇	B14-80		2.5-4.5	SB	Silty Sand with gravel (SM)



Other Tests

	*	●	◇
Liquid Limit	NP	NP	NP
Plastic Limit	NP	NP	NP
Plasticity Index	NP	NP	NP
Water Content	9.2	9.2	8.3
Dry Density (pcf)			
Specific Gravity	2.68*	2.68*	2.68*
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	296.3	805.6	216.7
2"			
1.5"	100.0	100.0	
1"	92.5	95.1	100.0
3/4"	88.8	89.4	92.6
3/8"	78.6	78.5	89.4
#4	69.9	70.1	83.1
#10	58.3	55.5	71.7
#20	48.7	45.9	60.2
#40	39.3	37.6	44.8
#100	25.4	25.0	24.9
#200	17.3	17.9	18.1

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

Grain Size Distribution ASTM D422

Job No. : **9352-A**

Project:	PolyMet Winter Investigation #23690C29.13	Test Date:	6/27/14
Reported To:	Barr Engineering Company	Report Date:	7/2/14

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	B14-72		7.5-9.5	SB	Silty Sand with gravel (SM)
Spec 2	B14-76		9-11, 12.5-14.5, 16-18, 20.5-22.5	SB	Silty Sand with gravel (SM)
Spec 3	B14-80		2.5-4.5	SB	Silty Sand with gravel (SM)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"	100.0	1.5"	100.0	1.5"	
1"	92.5	1"	95.1	1"	100.0
3/4"	88.8	3/4"	89.4	3/4"	92.6
3/8"	78.6	3/8"	78.5	3/8"	89.4
#4	69.9	#4	70.1	#4	83.1
#10	58.3	#10	55.5	#10	71.7
#20	48.7	#20	45.9	#20	60.2
#40	39.3	#40	37.6	#40	44.8
#100	25.4	#100	25.0	#100	24.9
#200	17.3	#200	17.9	#200	18.1

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.035	9.8	0.033	11.1	0.034	11.5
0.022	7.7	0.021	8.8	0.022	9.6
0.013	5.5	0.013	6.8	0.013	7.3
0.008	3.7	0.009	4.7	0.008	5.1
0.007	3.1	0.004	2.8	0.007	4.5
0.003	2.3	0.003	2.0	0.003	3.0
0.001	1.2	0.001	1.1	0.001	2.0

Remarks

Specimen 1	Specimen 2	Specimen 3

Moisture Density Curve ASTM: D698, Method B

Project: **PolyMet Winter Investigation #23690C29.13** Date: **6/30/14**

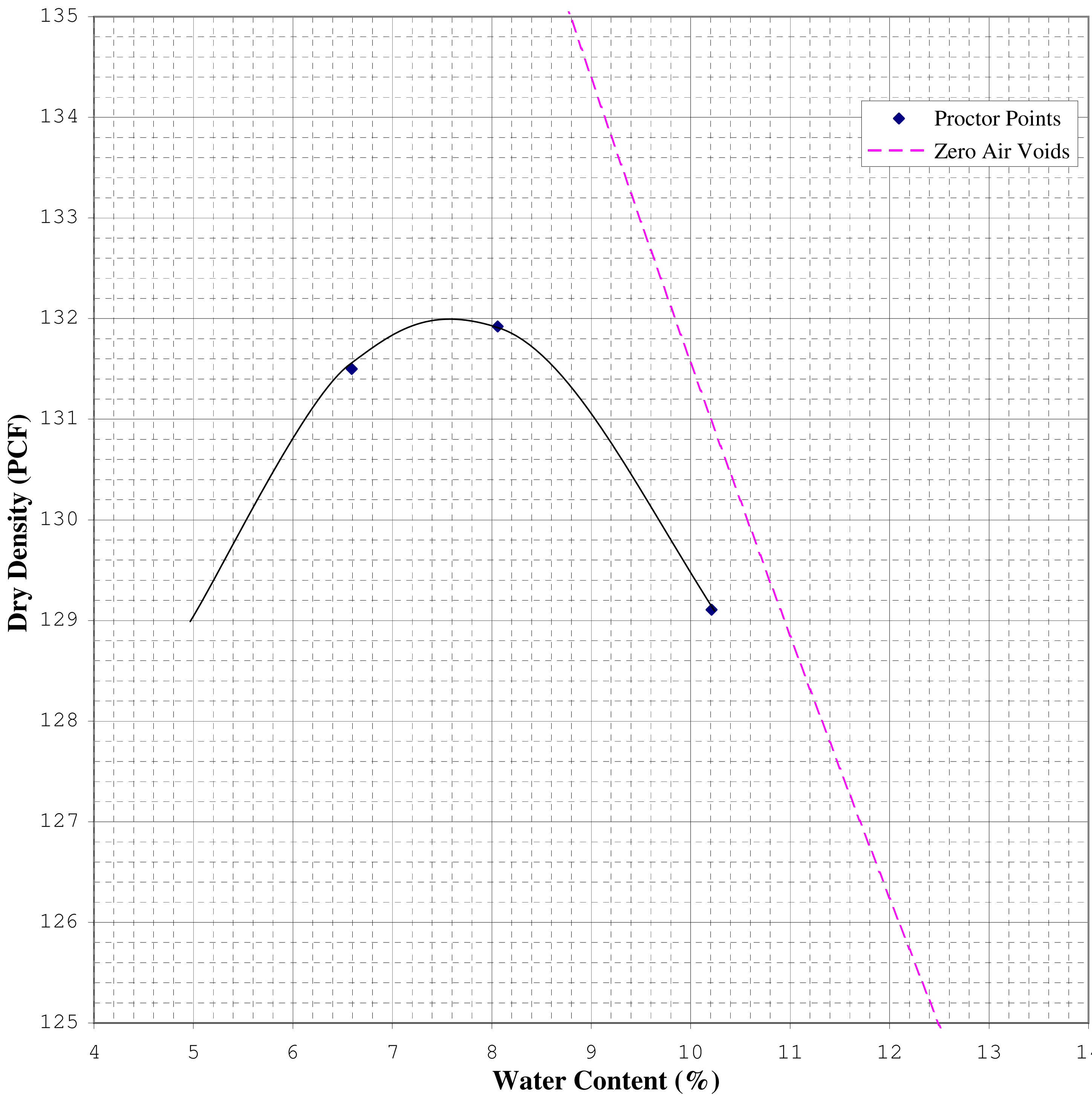
Client: **Barr Engineering Company** Job No. **9352A**

Sample: **Composite** Location: Depth(ft): **7.5-21** Boring: **B14-36,44,48,52**

Soil Type: **Composite of mostly Silty Sand w/ a little Clayey Sand (SM/SP-SM)**

As Received W.C. (%): **10.2** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **132.0** Opt. Water Content (%): **7.6**



2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

SET-R18a

Direct Shear Test

ASTM: D3080

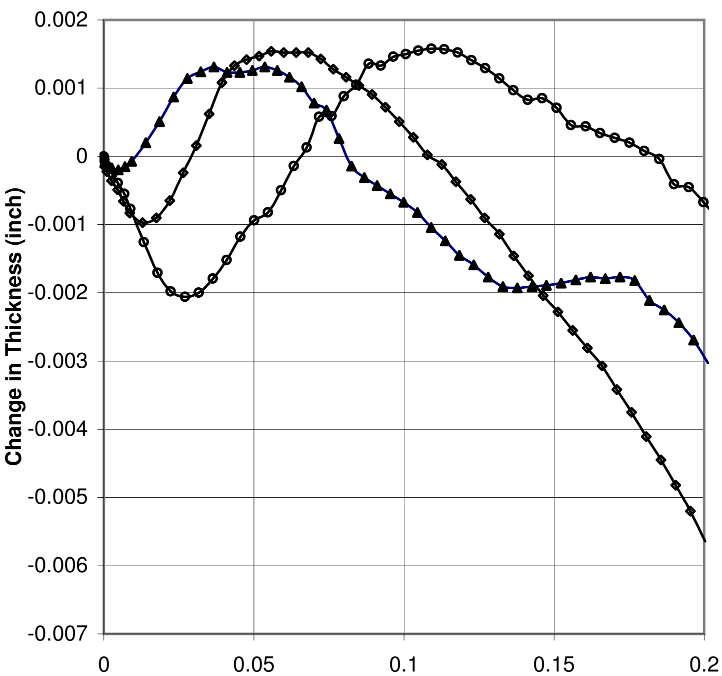
Job No.: 9352-A

Project/Client:	**PolyMet 2014 Investigation / Barr Engineering Company**		
Boring No.:	**B14-40**	Sample No.	Depth: **41643**
Location:			Sample Type: **Bag**
Soil Type:	**Silty Sand with gravel (SM)**		

Test Date:	**6/25/2014**
Date Reported:	**6/30/2014**
Shear Rate	**0.005** (in/min)
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
Specific Gravity (*):	**2.65**

Remarks: Specimens compacted to approximately 135 pcf wet density at as received moisture content using -#4 material; Inundated after applying normal load. Consolidated and sheared to given displacements at constant rate of 0.005 inches/minute.

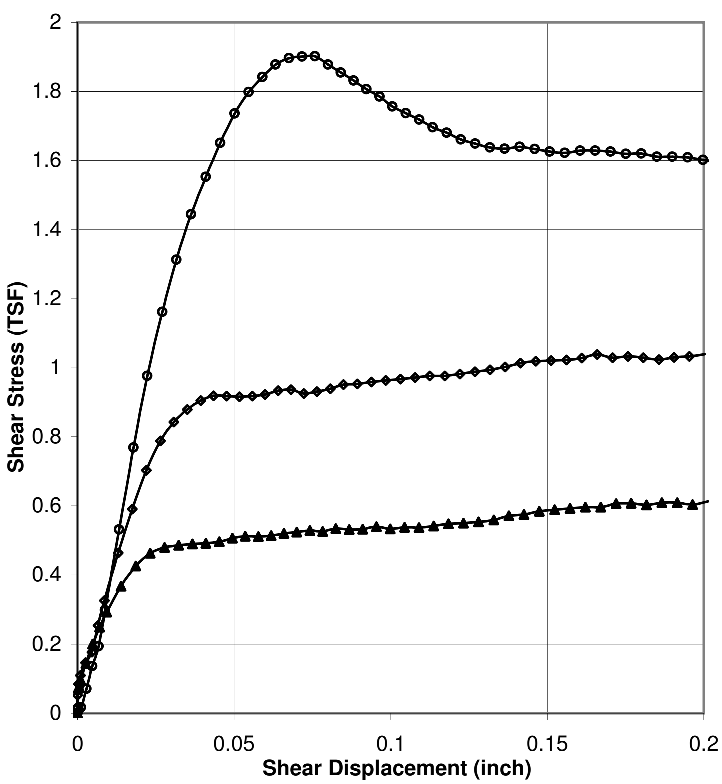
(*) = Assumed Specific Gravity

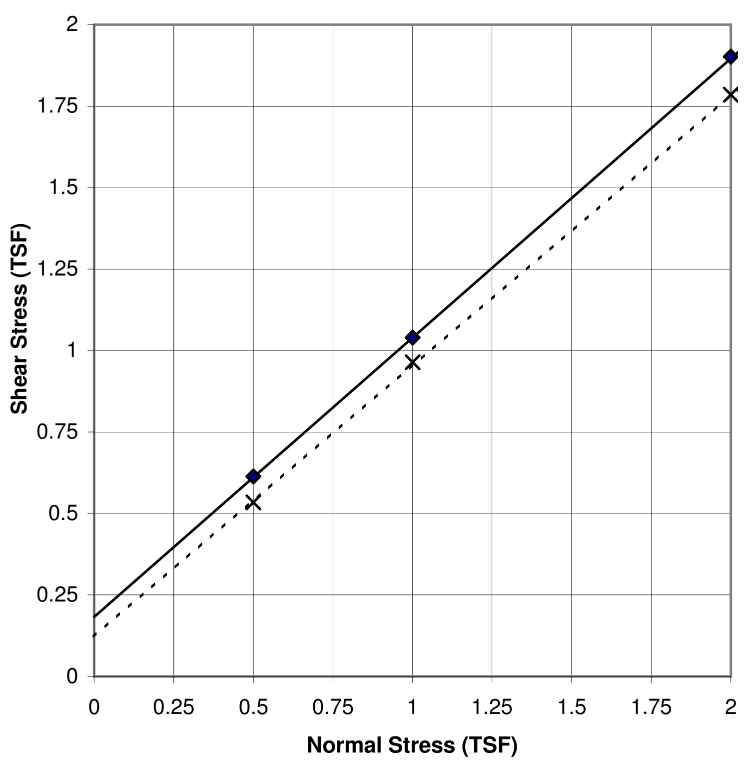


Failure Criterion:				
Max Stress	A	B	C	D
Initial	▲	◇	○	X
Diameter (In.)	2.50	2.50	2.50	
Thickness (In.)	1.03	1.03	1.03	
Water Content (%)	7.7	7.7	7.7	
Dry Density (pcf)	125.4	125.4	125.4	
Before Shear				
Thickness (In.)	1.02	1.02	1.01	
Water Content (%)	11.6	11.3	10.8	
Dry Density (pcf)	126.6	127.3	128.6	
Normal Stress	0.50	1.00	2.00	
Shear Stress	0.61	1.04	1.90	

"These tests are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design."

Peak Conditions		At Given Shear Disp. Of:	0.1
Friction Angle:	ϕ= **40.6 deg.**	Friction Angle:	ϕ= **39.7 deg.**
Apparent Cohesion	**0.182 TSF**	Apparent Cohesion	**0.123 TSF**





2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

Direct Shear Test

ASTM: D3080

Job No.: 9352-A

Project/Client: **PolyMet 2014 Investigation / Barr Engineering Company**

Boring No.: **B14-62** Sample No. Depth:

Location: Sample Type: **Bag**

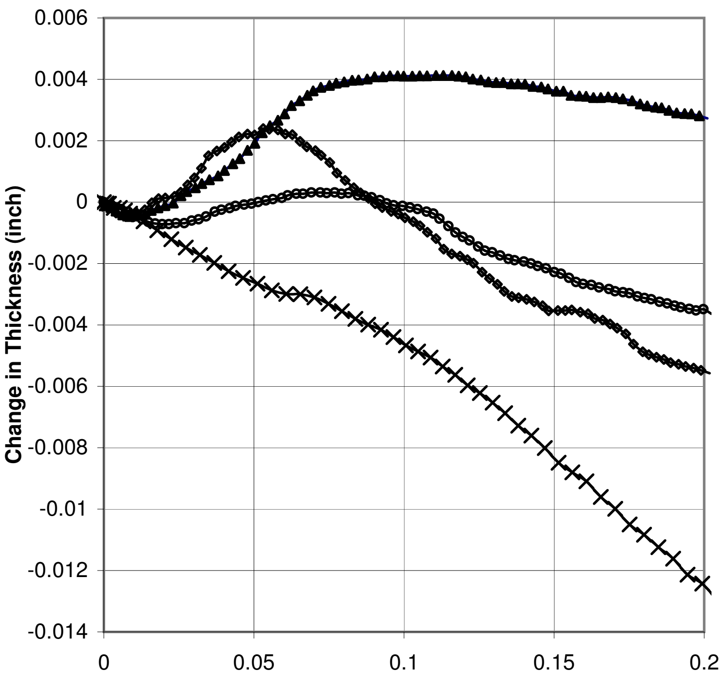
Soil Type: **Silty Sand with gravel (SM)**

Test Date:	**6/25/2014**
Date Reported:	**6/30/2014**
Shear Rate	**0.005** (in/min)

Remarks: Specimens compacted to approximately 135 pcf wet density at as received moisture content using -#4 material; Inundated after applying normal load. Consolidated and sheared to given displacements at constant rate of 0.005 inches/minute.

(*) = Assumed Specific Gravity

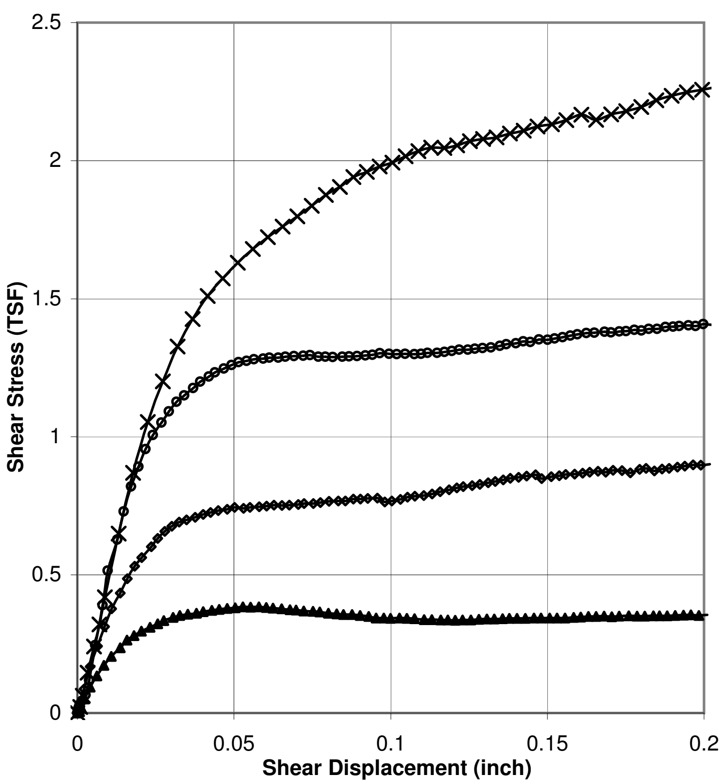
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
Specific Gravity (*):	**2.65**

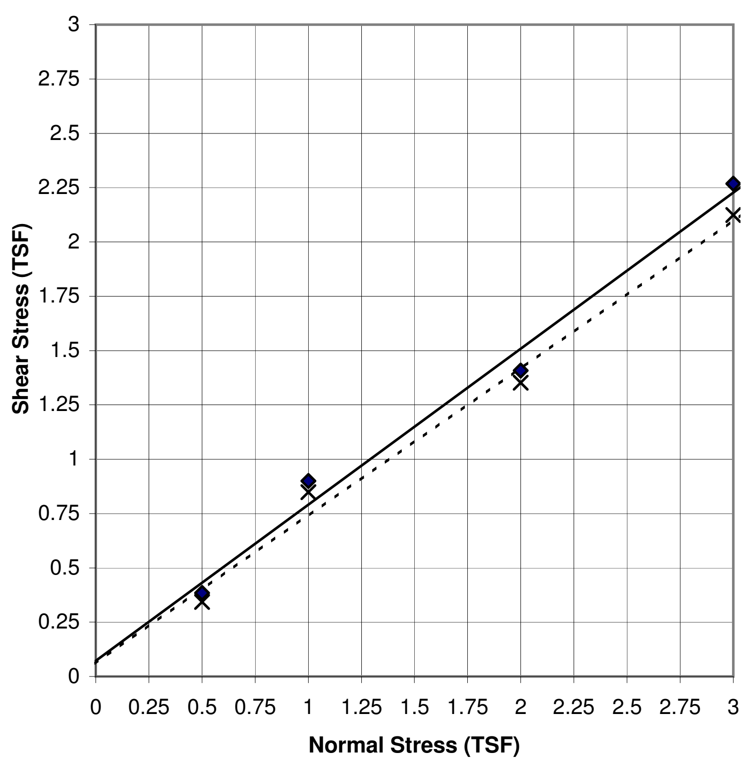


Failure Criterion:				
Max Stress	A	B	C	D
Initial	▲	◇	○	X
Diameter (In.)	2.50	2.50	2.50	2.50
Thickness (In.)	1.03	1.03	1.03	1.03
Water Content (%)	7.7	7.7	7.7	7.7
Dry Density (pcf)	125.4	125.4	125.4	125.4
Before Shear				
Thickness (In.)	1.02	1.02	1.02	1.01
Water Content (%)	11.6	11.4	11.2	11.0
Dry Density (pcf)	126.6	127.0	127.6	128.0
Normal Stress	0.50	1.00	2.00	3.00
Shear Stress	0.38	0.90	1.41	2.27

"These tests are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design."

Peak Conditions		At Given Shear Disp. Of:	0.15
Friction Angle:	ϕ= **35.7 deg.**	Friction Angle:	ϕ= **34.2 deg.**
Apparent Cohesion	**0.072 TSF**	Apparent Cohesion	**0.060 TSF**





Direct Shear Test

ASTM: D3080

Job No.: 9352-A

Project/Client: **PolyMet 2014 Investigation / Barr Engineering Company**

Boring No.: **B14-76** Sample No. Depth:

Location: Sample Type: **Bag**

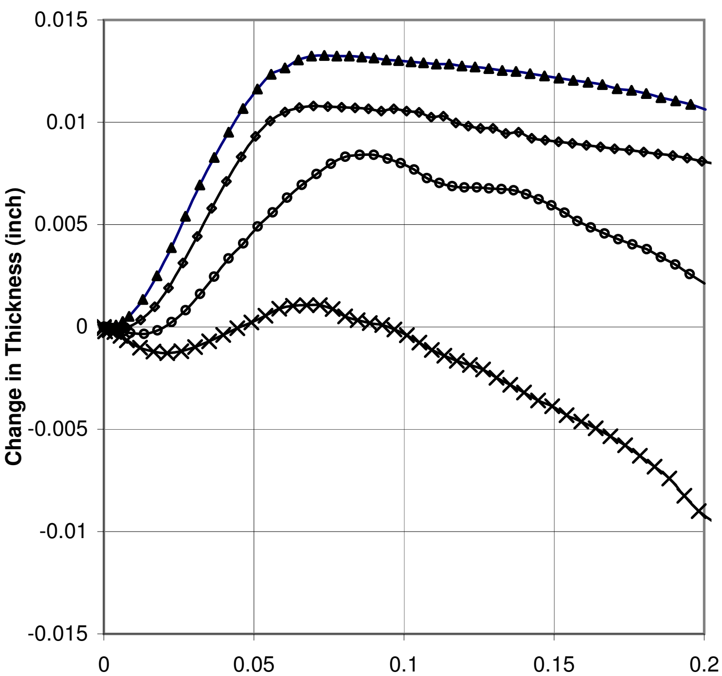
Soil Type:

Test Date:	**6/25/2014**
Date Reported:	**6/30/2014**
Shear Rate	
0.005 (in/min)	

Remarks: Specimens compacted to approximately 135 pcf wet density at as received moisture content using -#4 material; Inundated after applying normal load. Consolidated and sheared to given displacements at constant rate of 0.005 inches/minute.

(*) = Assumed Specific Gravity

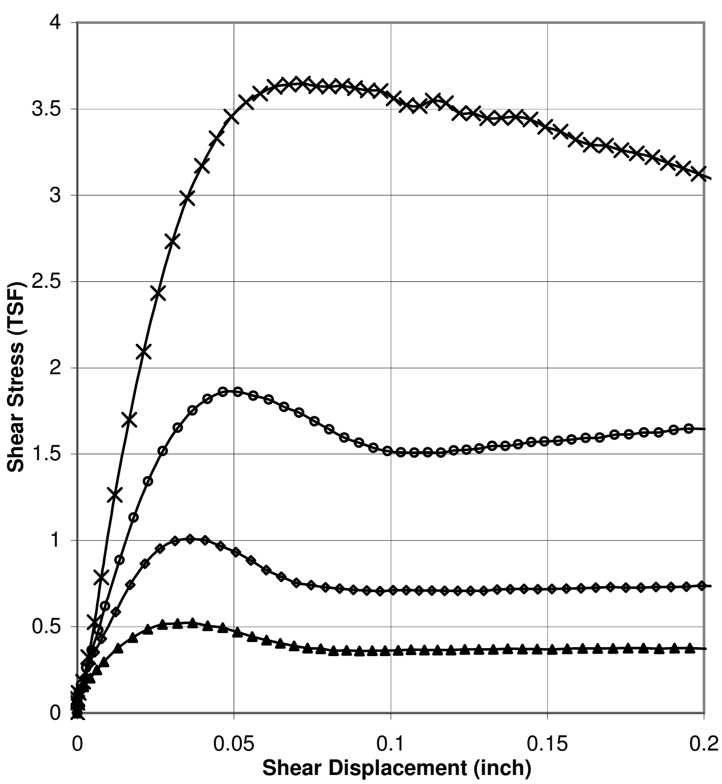
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
Specific Gravity (*):	**2.65**

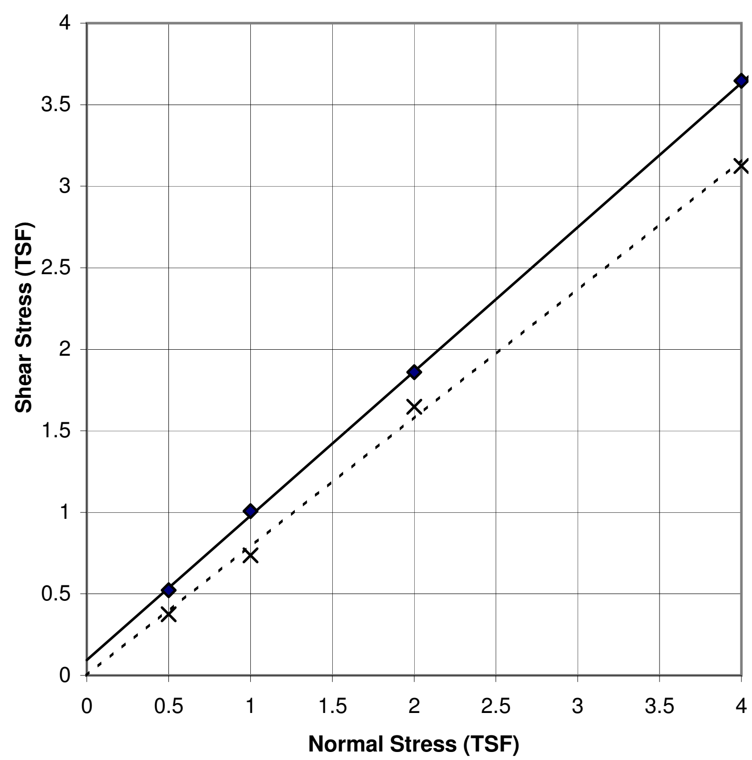


Failure Criterion:				
Max Stress	A	B	C	D
Initial	▲	◇	○	X
Diameter (In.)	2.50	2.50	2.50	2.50
Thickness (In.)	1.03	1.03	1.03	1.03
Water Content (%)	9.0	9.0	9.0	9.0
Dry Density (pcf)	123.9	123.9	123.9	123.9
Before Shear				
Thickness (In.)	1.02	1.02	1.02	1.00
Water Content (%)	12.2	12.1	11.9	11.1
Dry Density (pcf)	124.9	125.3	125.7	127.8
Normal Stress	0.50	1.00	2.00	4.00
Shear Stress	0.52	1.01	1.86	3.65

"These tests are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design."

Peak Conditions			At Given Shear Disp. Of:		0.2
Friction Angle:	ϕ=	**41.5 deg.**	Friction Angle:	ϕ=	**38.3 deg.**
Apparent Cohesion		**0.095 TSF**	Apparent Cohesion		**0.000 TSF**

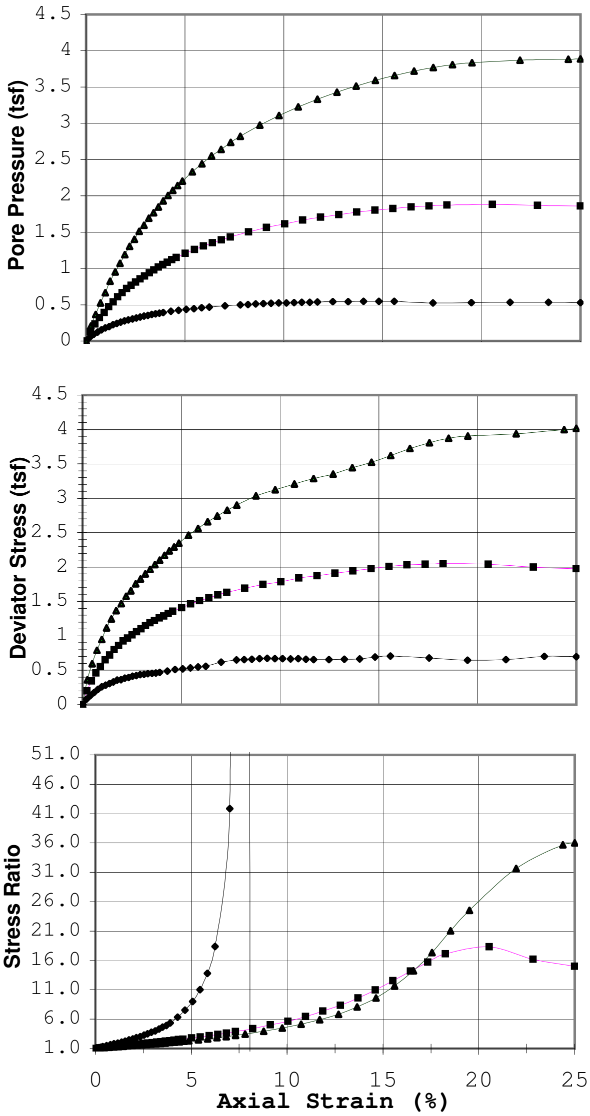




TRIAXIAL TEST ASTM: D 4767

Job No. **9352**
Date: **6/11/14**

Project: **PolyMet #23690C29**
Boring #: **B14-65** Sample #: Type: **3T** Depth (ft): **5-7**
Soil Type: **Peat (PT)**

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Failure Criterion: **Max. Stress Ratio**

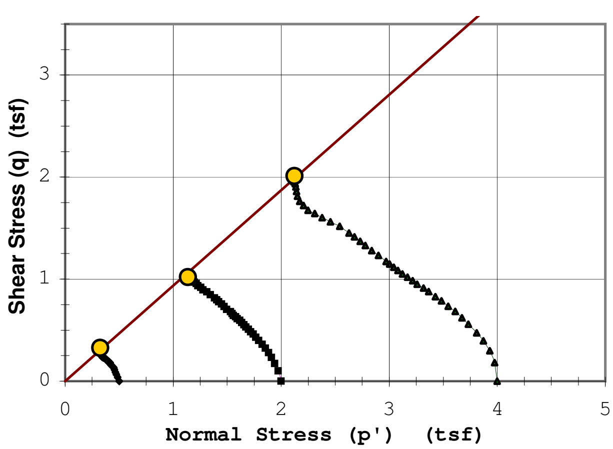
Angle of internal friction, ϕ' = **69.4 °**
Apparent Cohesion, c' = **0.00 (tsf)**

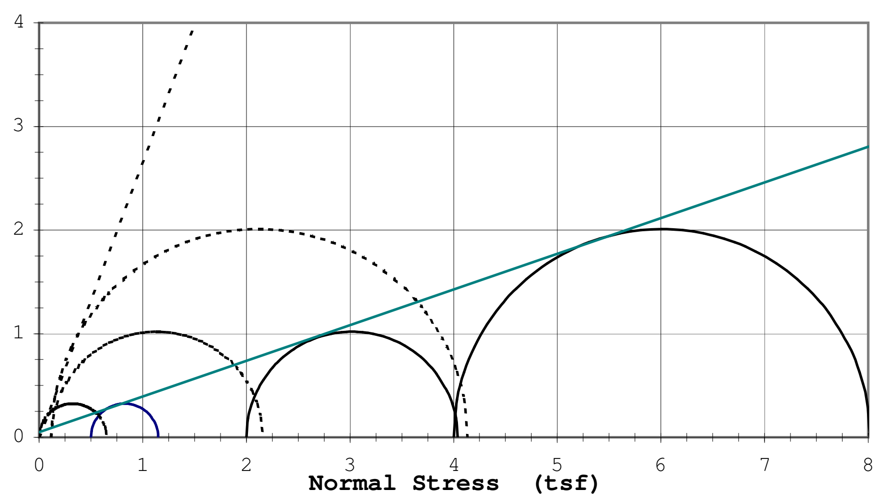
Test Date:	5/8/14	Liquid Limit:	479.3
Test Type:	CU w/pp	Plastic Limit:	440.9
Strain Rate (in/min):	0.001282	Plasticity Index:	38.4
Strain Rate (%/min):	0.050	Spec. Gravity :	1.61

Before Consolidation	A	B	C	D	E
Diameter (in)	1.43	1.43	1.43		
Height (in)	2.89	2.89	2.95		
Water Content (%)	452.0	448.6	462.1		
Dry Density (pcf)	11.0	10.8	10.4		
Void Ratio	8.17	8.30	8.66		
After Consolidation					
Diameter (in)	1.36	1.29	1.30		
Height (in)	2.57	2.19	2.05		
Water Content (%)	393.0	294.6	281.5		
Dry Density (pcf)	13.7	17.5	18.2		
Void Ratio	6.33	4.74	4.53		
Back Pressure (tsf)	3.7	3.5	3.7		
Minor Principal Stress (tsf)	0.50	2.00	4.00		
Max. Deviator Stress (tsf)	0.71	2.05	4.02		
Ultimate Deviator Stress (tsf)	0.70	1.97	4.02		
Deviator Stress at Failure (tsf)	0.65	2.04	4.02		
Max. Pore Pressure Buildup (tsf)	0.55	1.88	3.89		
Pore Pressure Parameter "B"	0.95	0.95	0.95		
Pct. Axial Strain at Failure	7.8	20.5	25.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





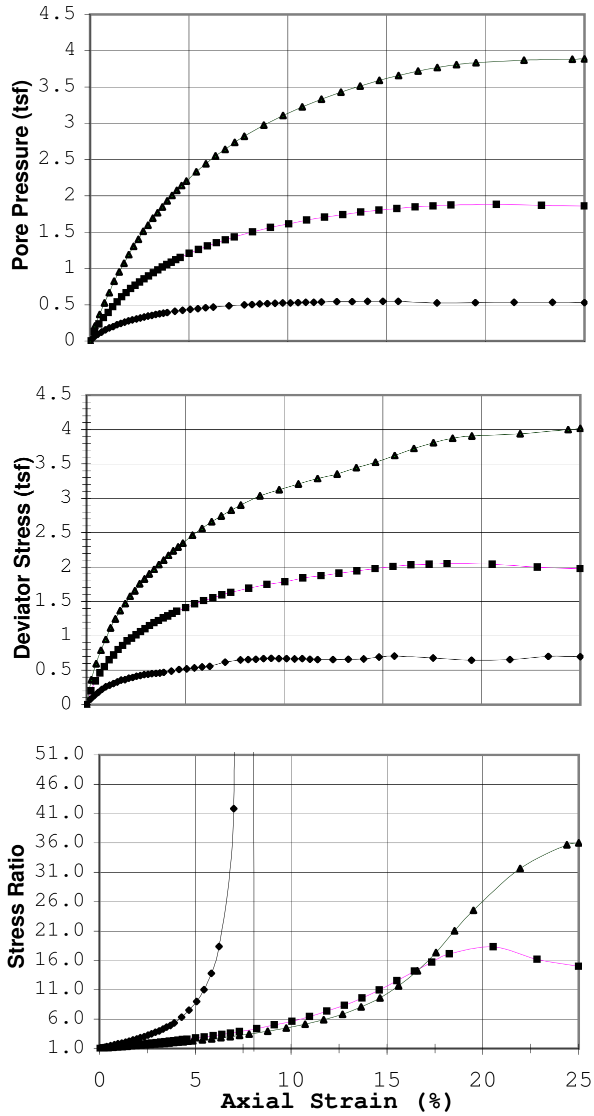
Rupture Envelope at Failure	
α = 43.1 °	a = 0.0 (tsf)

------------	Effective ϕ':	69.4 °	c'=	0.00 (tsf)
________	Total ϕ:	19.0 °	c=	0.05 (tsf)

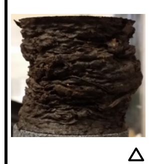
TRIAXIAL TEST ASTM: D 4767

Job No. **9352**
Date: **6/11/14**

Project: **PolyMet #23690C29**
Boring #: **B14-65** Sample #: Type: **3T** Depth (ft): **5-7**
Soil Type: **Peat (PT)**







Failure Criterion:	Max. Deviator Stress
Angle of internal friction, φ' =	**66.0 °**
Apparent Cohesion, c' =	**0.09 (tsf)**

Test Date:	5/8/14	Liquid Limit:	479.3
Test Type:	CU w/pp	Plastic Limit:	440.9
Strain Rate (in/min):	0.001282	Plasticity Index:	38.4
Strain Rate (%/min):	0.050	Spec. Gravity :	1.61

Before Consolidation	A	B	C	D	E
Diameter (in)	1.43	1.43	1.43		
Height (in)	2.89	2.89	2.95		
Water Content (%)	452.0	448.6	462.1		
Dry Density (pcf)	11.0	10.8	10.4		
Void Ratio	8.17	8.30	8.66		
After Consolidation					
Diameter (in)	1.36	1.29	1.30		
Height (in)	2.57	2.19	2.05		
Water Content (%)	393.0	294.6	281.5		
Dry Density (pcf)	13.7	17.5	18.2		
Void Ratio	6.33	4.74	4.53		
Back Pressure (tsf)	3.7	3.5	3.7		
Minor Principal Stress (tsf)	0.50	2.00	4.00		
Max. Deviator Stress (tsf)	0.71	2.05	4.02		
Ultimate Deviator Stress (tsf)	0.70	1.97	4.02		
Deviator Stress at Failure (tsf)	0.71	2.05	4.02		
Max. Pore Pressure Buildup (tsf)	0.55	1.88	3.89		
Pore Pressure Parameter "B"	0.95	0.95	0.95		
Pct. Axial Strain at Failure	15.6	18.3	25.0		

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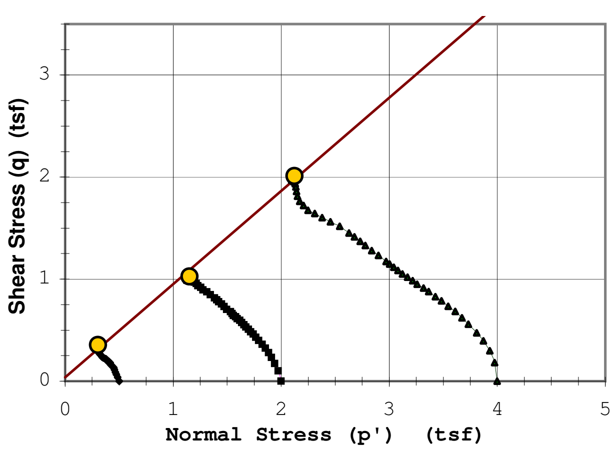
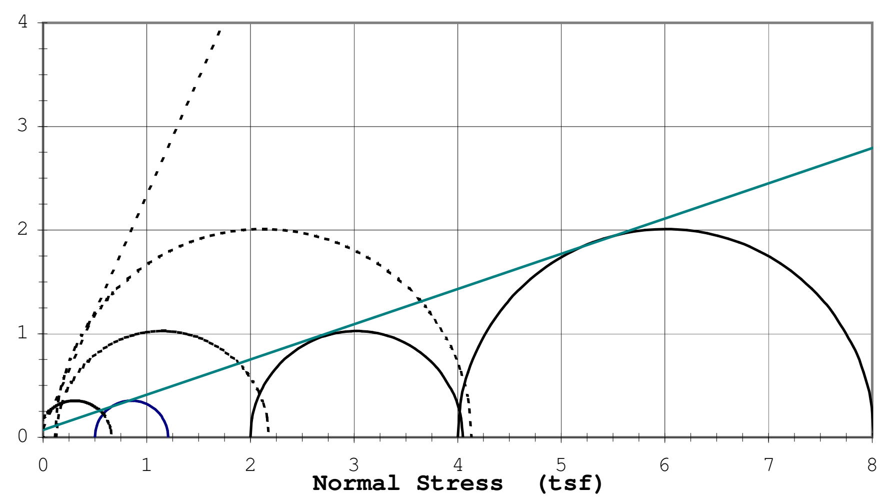
Remarks: Specimen trimmed to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





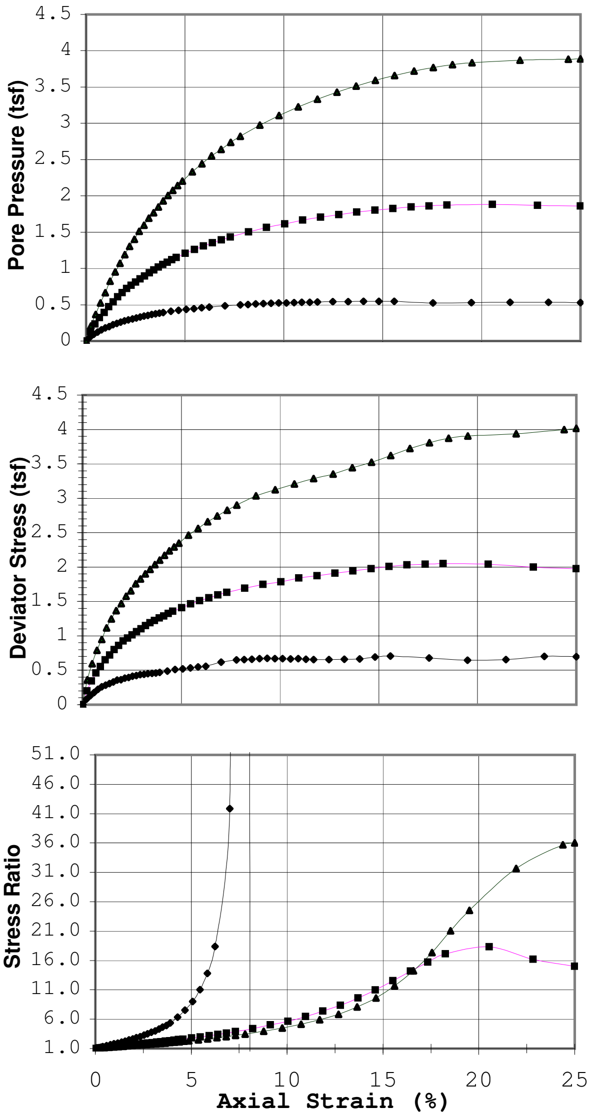
Rupture Envelope at Failure	
α = 42.4 °	a = 0.0 (tsf)

------------	Effective φ':	66.0 °	c'=	0.09 (tsf)
________	Total φ:	18.8 °	c=	0.07 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. **9352**
Date: **6/11/14**

Project: **PolyMet #23690C29**
Boring #: **B14-65** Sample #: Type: **3T** Depth (ft): **5-7**
Soil Type: **Peat (PT)**



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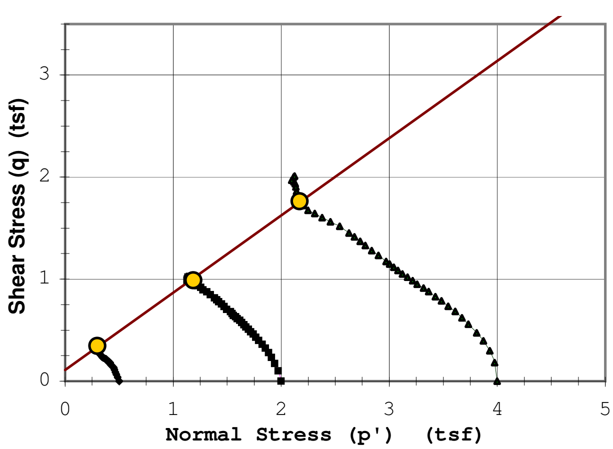
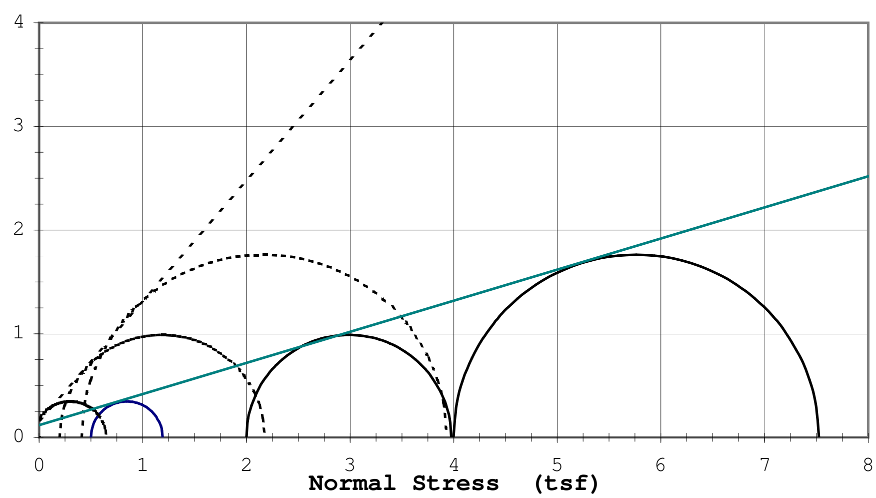
Failure Criterion:			**Given Strain of: 15%**		
Angle of internal friction, ϕ' =	**49.2 °**				
Apparent Cohesion, c' =	**0.17 (tsf)**				
Test Date: 5/8/14			Liquid Limit:	479.3	
Test Type: CU w/pp			Plastic Limit:	440.9	
Strain Rate (in/min): 0.001282			Plasticity Index:	38.4	
Strain Rate (%/min): 0.050			Spec. Gravity :	1.61	

Before Consolidation	A	B	C	D	E
Diameter (in)	1.43	1.43	1.43		
Height (in)	2.89	2.89	2.95		
Water Content (%)	452.0	448.6	462.1		
Dry Density (pcf)	11.0	10.8	10.4		
Void Ratio	8.17	8.30	8.66		
After Consolidation					
Diameter (in)	1.36	1.29	1.30		
Height (in)	2.57	2.19	2.05		
Water Content (%)	393.0	294.6	281.5		
Dry Density (pcf)	13.7	17.5	18.2		
Void Ratio	6.33	4.74	4.53		
Back Pressure (tsf)	3.7	3.5	3.7		
Minor Principal Stress (tsf)	0.50	2.00	4.00		
Max. Deviator Stress (tsf)	0.71	2.05	4.02		
Ultimate Deviator Stress (tsf)	0.70	1.97	4.02		
Deviator Stress at Failure (tsf)	0.69	1.98	3.52		
Max. Pore Pressure Buildup (tsf)	0.55	1.88	3.89		
Pore Pressure Parameter "B"	0.95	0.95	0.95		
Pct. Axial Strain at Failure	15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure		
α = 37.1 °	a = 0.1 (tsf)	

------------	Effective ϕ':	49.2 °	c'=	0.17 (tsf)
________	Total ϕ:	16.7 °	c=	0.12 (tsf)

Triaxial Data

Job: **9352**

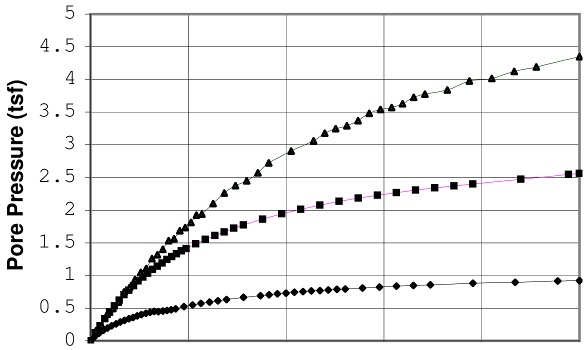
Boring: B14-65 Sample: Depth: 5-7 Date: 6/11/14

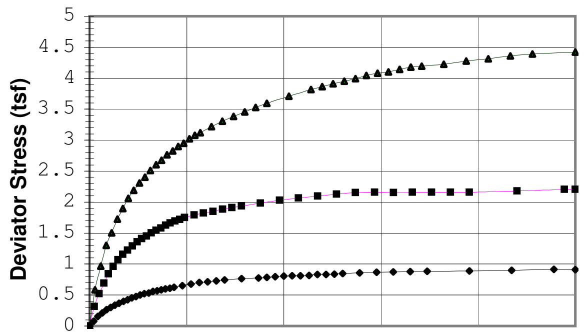
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
0.19	0.08	0.05	0.23	0.20	0.13	0.25	0.36	0.21						
0.39	0.13	0.09	0.46	0.35	0.23	0.49	0.59	0.37						
0.58	0.18	0.12	0.69	0.46	0.32	0.73	0.79	0.52						
0.78	0.22	0.16	0.91	0.56	0.39	0.98	0.95	0.67						
0.97	0.26	0.18	1.14	0.65	0.47	1.22	1.11	0.83						
1.17	0.28	0.20	1.37	0.72	0.54	1.46	1.24	0.95						
1.36	0.31	0.22	1.60	0.80	0.61	1.71	1.37	1.07						
1.56	0.33	0.24	1.83	0.86	0.66	1.95	1.47	1.19						
1.75	0.36	0.26	2.06	0.92	0.72	2.20	1.57	1.30						
1.95	0.36	0.28	2.28	0.97	0.77	2.44	1.66	1.40						
2.14	0.39	0.29	2.51	1.01	0.81	2.68	1.76	1.51						
2.34	0.39	0.30	2.74	1.06	0.86	2.93	1.83	1.59						
2.53	0.42	0.32	2.97	1.10	0.90	3.17	1.90	1.69						
2.73	0.42	0.33	3.20	1.15	0.94	3.42	1.97	1.77						
2.92	0.44	0.34	3.42	1.19	0.98	3.66	2.04	1.85						
3.12	0.44	0.35	3.65	1.22	1.02	3.90	2.10	1.93						
3.31	0.45	0.36	3.88	1.26	1.05	4.15	2.17	2.00						
3.51	0.46	0.37	4.11	1.29	1.08	4.39	2.23	2.08						
3.70	0.46	0.38	4.34	1.33	1.12	4.63	2.29	2.14						
3.90	0.47	0.39	4.57	1.36	1.15	4.88	2.35	2.20						
4.29	0.49	0.41	5.02	1.41	1.21	5.37	2.46	2.33						
4.68	0.51	0.42	5.48	1.46	1.26	5.85	2.56	2.44						
5.07	0.52	0.44	5.93	1.51	1.31	6.34	2.66	2.55						
5.46	0.53	0.45	6.39	1.55	1.35	6.83	2.74	2.64						
5.85	0.55	0.46	6.85	1.59	1.39	7.32	2.83	2.74						
6.24	0.56	0.47	7.31	1.63	1.43	7.80	2.90	2.82						
7.02	0.62	0.48	8.22	1.69	1.50	8.78	3.04	2.98						
7.80	0.65	0.50	9.13	1.75	1.56	9.75	3.12	3.11						
8.19	0.65	0.50	10.04	1.78	1.62	10.73	3.21	3.22						
8.57	0.66	0.51	10.96	1.84	1.66	11.70	3.29	3.33						
8.96	0.67	0.51	11.87	1.87	1.71	12.68	3.35	3.43						
9.35	0.67	0.52	12.78	1.91	1.74	13.66	3.44	3.51						
9.74	0.67	0.52	13.70	1.94	1.77	14.63	3.52	3.59						
10.13	0.67	0.53	14.61	1.98	1.80	15.61	3.62	3.66						
10.52	0.67	0.53	15.52	2.01	1.83	16.58	3.72	3.72						
10.91	0.67	0.53	16.43	2.03	1.85	17.56	3.81	3.77						
11.30	0.66	0.54	17.35	2.04	1.86	18.53	3.87	3.81						
11.69	0.66	0.54	18.26	2.05	1.87	19.51	3.90	3.83						
12.47	0.66	0.54	20.54	2.04	1.88	21.95	3.94	3.87						
13.25	0.66	0.54	22.83	2.00	1.87	24.38	4.00	3.88						
14.03	0.67	0.54	25.00	1.97	1.86	25.00	4.02	3.89						
14.81	0.69	0.55												
15.59	0.71	0.55												
17.54	0.68	0.52												
19.49	0.65	0.53												
21.44	0.66	0.53												
23.39	0.70	0.53												
25.00	0.70	0.53												

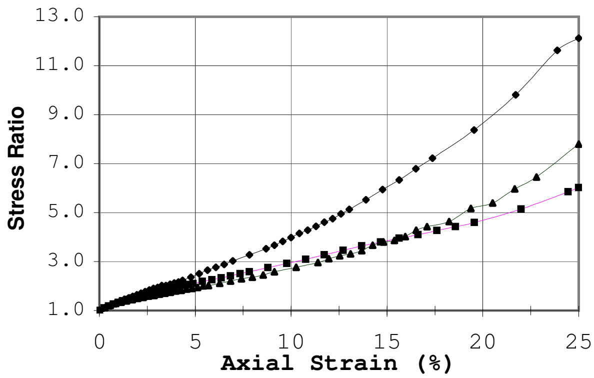
TRIAXIAL TEST ASTM: D 4767

Job No. **9352**
Date: **6/11/14**

Project: **PolyMet #23690C29**
Boring #: **B14-69** Sample #: Type: **3T** Depth (ft): **10-12**
Soil Type: **Peat (PT)**





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Failure Criterion: **Max. Stress Ratio**

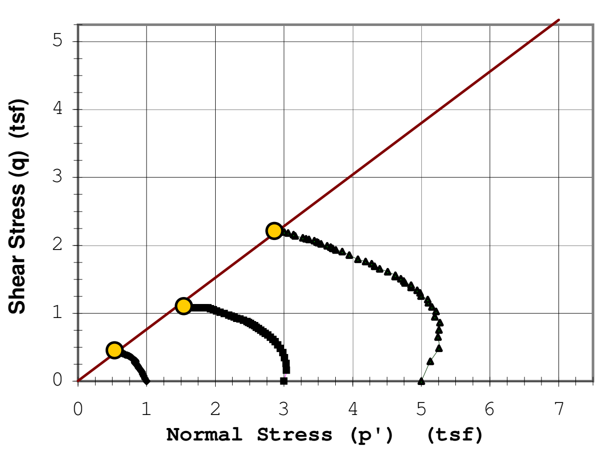
Angle of internal friction, ϕ' = **49.4 °**
Apparent Cohesion, c' = **0.01 (tsf)**

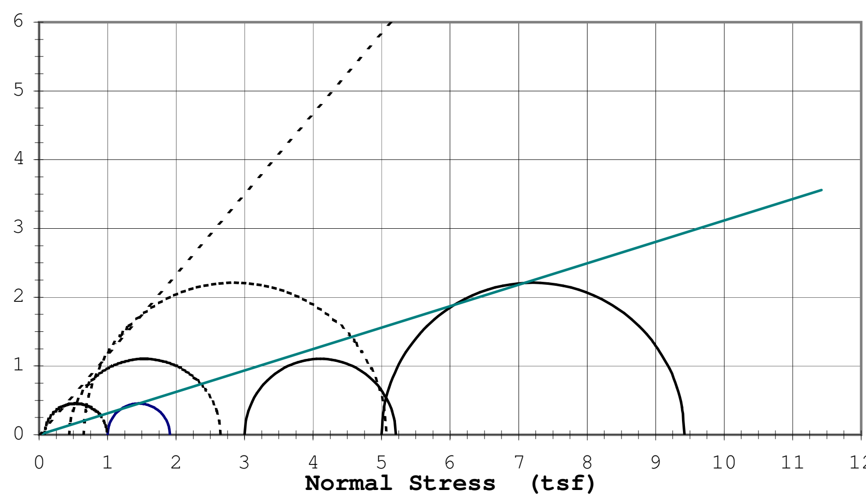
Test Date:	5/8/14	Liquid Limit:	574.2
Test Type:	CU w/pp	Plastic Limit:	198.3
Strain Rate (in/min):	0.00115	Plasticity Index:	375.9
Strain Rate (%/min):	0.050	Spec. Gravity (Assumed):	1.61

Before Consolidation	A	B	C	D	E
Diameter (in)	1.43	1.43	1.43		
Height (in)	2.87	2.89	2.87		
Water Content (%)	711.5	754.1	709.0		
Dry Density (pcf)	7.6	7.2	7.5		
Void Ratio	12.30	12.98	12.41		
After Consolidation					
Diameter (in)	1.23	1.20	1.13		
Height (in)	2.30	2.05	1.75		
Water Content (%)	432.0	369.9	258.8		
Dry Density (pcf)	12.6	14.5	19.5		
Void Ratio	6.95	5.96	4.17		
Back Pressure (tsf)	3.5	5.8	4.6		
Minor Principal Stress (tsf)	1.00	3.00	5.00		
Max. Deviator Stress (tsf)	0.91	2.21	4.42		
Ultimate Deviator Stress (tsf)	0.91	2.21	4.42		
Deviator Stress at Failure (tsf)	0.91	2.21	4.42		
Max. Pore Pressure Buildup (tsf)	0.92	2.56	4.35		
Pore Pressure Parameter "B"	0.95	0.95	0.95		
Pct. Axial Strain at Failure	25.0	25.0	25.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





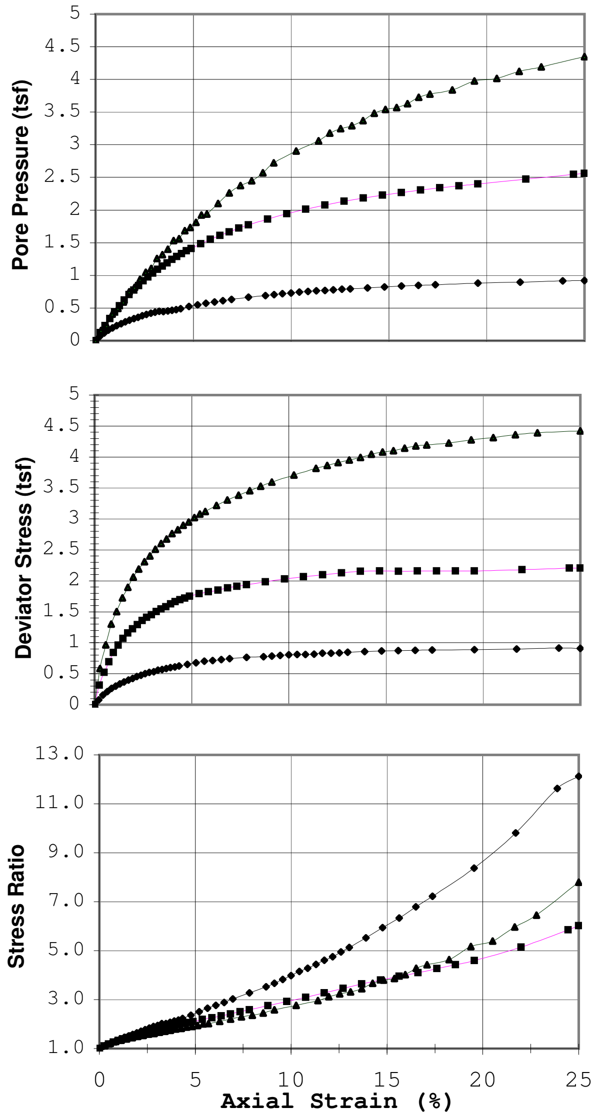
Rupture Envelope at Failure
α = 37.2 ° a = 0.0 (tsf)

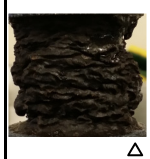
------------	Effective ϕ':	49.4 °	c'=	0.01 (tsf)
________	Total ϕ:	17.3 °	c=	0.00 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 9352
Date: 6/11/14

Project: **PolyMet #23690C29**
Boring #: **B14-69** Sample #: Type: **3T** Depth (ft): **10-12**
Soil Type: **Peat (PT)**





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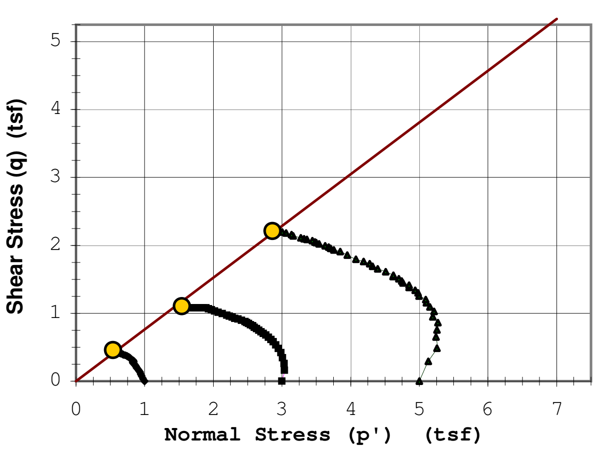
Failure Criterion:	**Max. Deviator Stress**
Angle of internal friction, ϕ' =	**49.6 °**
Apparent Cohesion, c' =	**0.00 (tsf)**

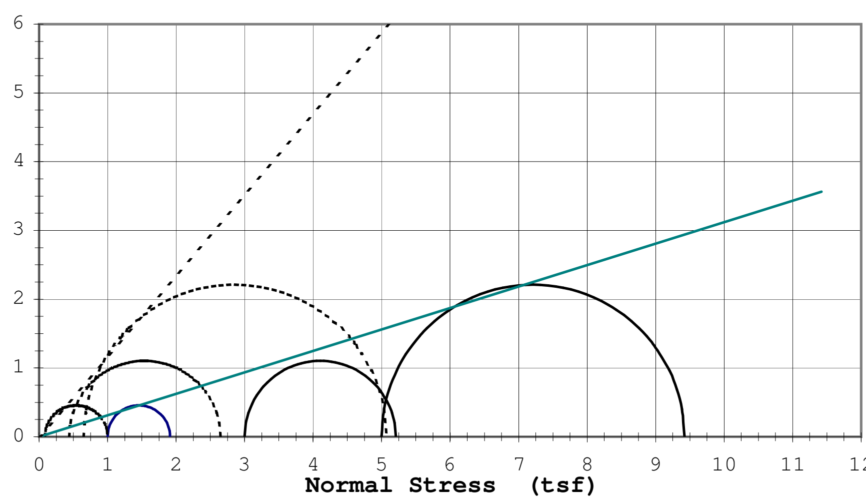
Test Date:	5/8/14	Liquid Limit:	574.2
Test Type:	CU w/pp	Plastic Limit:	198.3
Strain Rate (in/min):	0.00115	Plasticity Index:	375.9
Strain Rate (%/min):	0.050	Spec. Gravity (Assumed):	1.61

Before Consolidation	A	B	C	D	E
Diameter (in)	1.43	1.43	1.43		
Height (in)	2.87	2.89	2.87		
Water Content (%)	711.5	754.1	709.0		
Dry Density (pcf)	7.6	7.2	7.5		
Void Ratio	12.30	12.98	12.41		
After Consolidation					
Diameter (in)	1.23	1.20	1.13		
Height (in)	2.30	2.05	1.75		
Water Content (%)	432.0	369.9	258.8		
Dry Density (pcf)	12.6	14.5	19.5		
Void Ratio	6.95	5.96	4.17		
Back Pressure (tsf)	3.5	5.8	4.6		
Minor Principal Stress (tsf)	1.00	3.00	5.00		
Max. Deviator Stress (tsf)	0.91	2.21	4.42		
Ultimate Deviator Stress (tsf)	0.91	2.21	4.42		
Deviator Stress at Failure (tsf)	0.91	2.21	4.42		
Max. Pore Pressure Buildup (tsf)	0.92	2.56	4.35		
Pore Pressure Parameter "B"	0.95	0.95	0.95		
Pct. Axial Strain at Failure	23.9	25.0	25.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





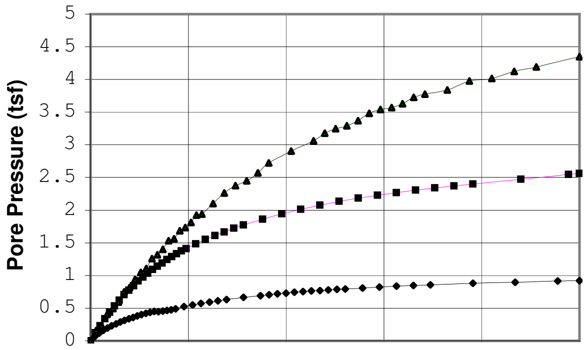
Rupture Envelope at Failure	
α = 37.3 °	a = 0.0 (tsf)

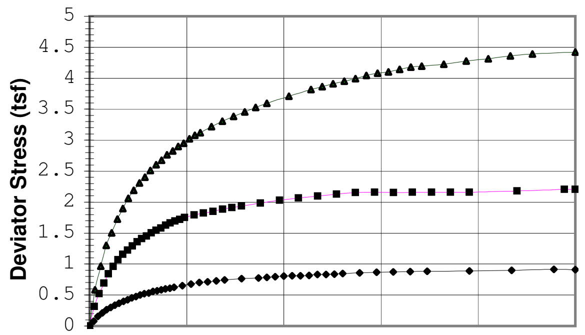
------------	Effective ϕ': 49.6 °	c'=	0.00 (tsf)
________	Total ϕ: 17.3 °	c=	0.00 (tsf)

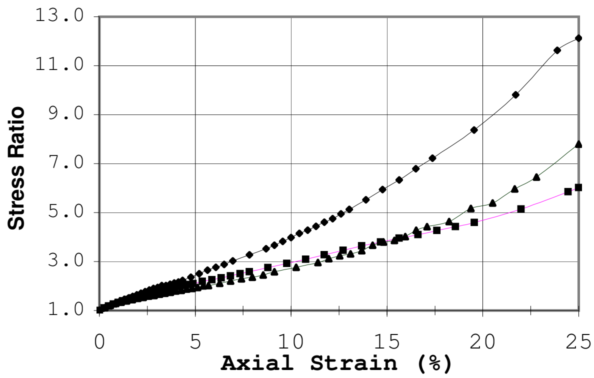
TRIAXIAL TEST ASTM: D 4767

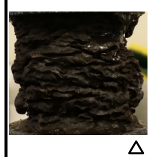
Job No. **9352**
Date: **6/11/14**

Project: **PolyMet #23690C29**
Boring #: **B14-69** Sample #: Type: **3T** Depth (ft): **10-12**
Soil Type: **Peat (PT)**









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X

Failure Criterion: **Given Strain of: 15%**

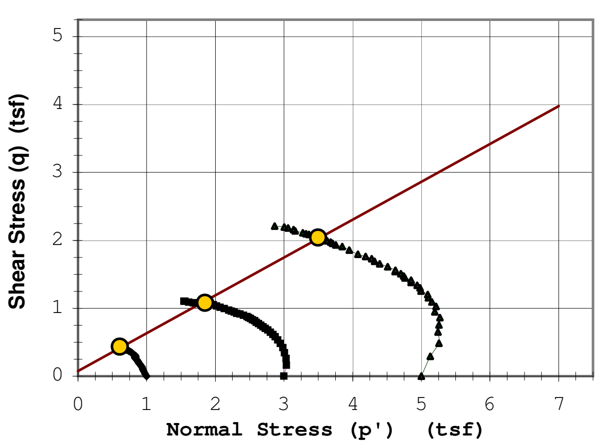
Angle of internal friction, ϕ' = **33.9 °**
Apparent Cohesion, **c'** = **0.09 (tsf)**

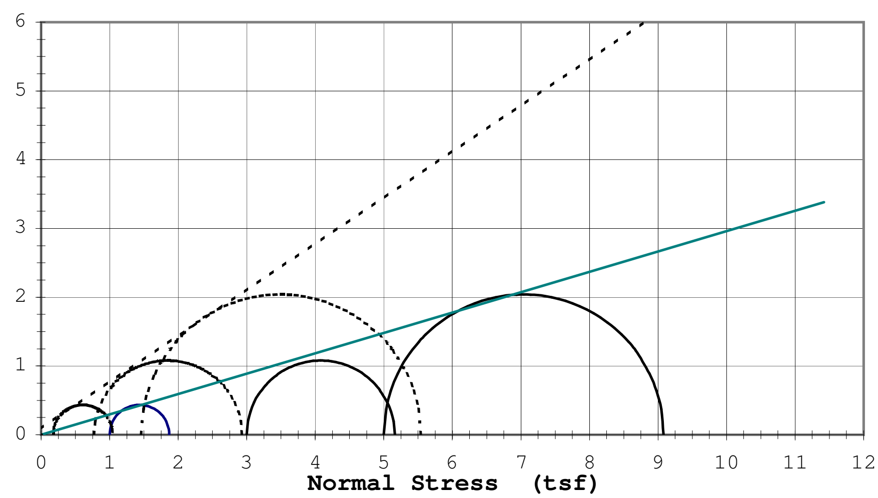
Test Date:	5/8/14	Liquid Limit:	574.2
Test Type:	CU w/pp	Plastic Limit:	198.3
Strain Rate (in/min):	0.00115	Plasticity Index:	375.9
Strain Rate (%/min):	0.050	Spec. Gravity (Assumed):	1.61

Before Consolidation	A	B	C	D	E
Diameter (in)	1.43	1.43	1.43		
Height (in)	2.87	2.89	2.87		
Water Content (%)	711.5	754.1	709.0		
Dry Density (pcf)	7.6	7.2	7.5		
Void Ratio	12.30	12.98	12.41		
After Consolidation					
Diameter (in)	1.23	1.20	1.13		
Height (in)	2.30	2.05	1.75		
Water Content (%)	432.0	369.9	258.8		
Dry Density (pcf)	12.6	14.5	19.5		
Void Ratio	6.95	5.96	4.17		
Back Pressure (tsf)	3.5	5.8	4.6		
Minor Principal Stress (tsf)	1.00	3.00	5.00		
Max. Deviator Stress (tsf)	0.91	2.21	4.42		
Ultimate Deviator Stress (tsf)	0.91	2.21	4.42		
Deviator Stress at Failure (tsf)	0.87	2.16	4.08		
Max. Pore Pressure Buildup (tsf)	0.92	2.56	4.35		
Pore Pressure Parameter "B"	0.95	0.95	0.95		
Pct. Axial Strain at Failure	15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimen trimmed to given dimensions; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.





Rupture Envelope at Failure	
α = 29.2 °	a = 0.1 (tsf)

------------	Effective ϕ':	33.9 °	c'=	0.09 (tsf)
________	Total ϕ:	16.5 °	c=	0.00 (tsf)

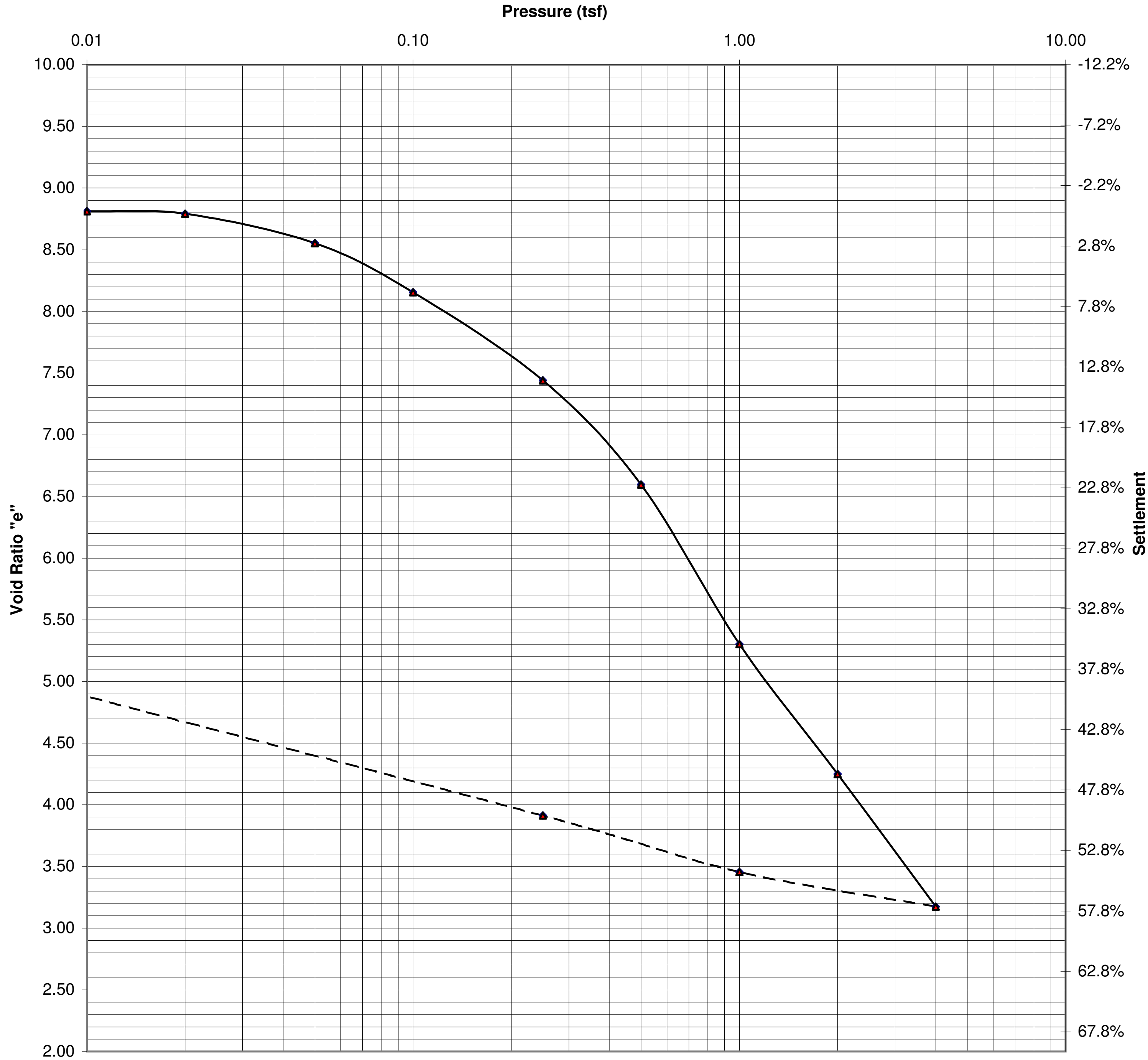
Triaxial Data

Job: **9352**

Boring: B14-69 Sample: Depth: 10-12 Date: 6/11/14

Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
0.22	0.08	0.07	0.24	0.32	0.12	0.29	0.58	0.16						
0.44	0.15	0.12	0.49	0.52	0.23	0.57	0.97	0.23						
0.65	0.21	0.16	0.73	0.69	0.34	0.86	1.30	0.41						
0.87	0.26	0.20	0.98	0.84	0.44	1.14	1.51	0.50						
1.09	0.30	0.23	1.22	0.96	0.53	1.43	1.73	0.59						
1.31	0.33	0.26	1.47	1.07	0.62	1.71	1.90	0.75						
1.52	0.37	0.29	1.71	1.16	0.71	1.99	2.06	0.82						
1.74	0.40	0.32	1.96	1.22	0.77	2.28	2.19	0.94						
1.96	0.42	0.34	2.20	1.29	0.84	2.57	2.31	1.05						
2.17	0.46	0.36	2.45	1.36	0.91	2.85	2.40	1.11						
2.39	0.48	0.38	2.69	1.41	0.97	3.14	2.51	1.26						
2.61	0.50	0.40	2.94	1.45	1.03	3.42	2.60	1.32						
2.82	0.52	0.42	3.18	1.50	1.09	3.70	2.68	1.40						
3.04	0.53	0.44	3.42	1.55	1.14	3.99	2.76	1.53						
3.26	0.56	0.45	3.67	1.58	1.19	4.28	2.82	1.56						
3.48	0.57	0.44	3.91	1.63	1.24	4.56	2.90	1.69						
3.69	0.58	0.45	4.16	1.66	1.29	4.85	2.95	1.73						
3.91	0.60	0.47	4.40	1.70	1.33	5.13	3.02	1.81						
4.13	0.61	0.48	4.64	1.72	1.37	5.42	3.08	1.92						
4.34	0.62	0.49	4.89	1.75	1.41	5.70	3.12	1.94						
4.78	0.65	0.52	5.38	1.79	1.49	6.27	3.22	2.10						
5.21	0.68	0.55	5.87	1.83	1.55	6.84	3.31	2.26						
5.65	0.70	0.57	6.36	1.85	1.61	7.41	3.39	2.37						
6.08	0.71	0.59	6.85	1.88	1.66	7.98	3.46	2.45						
6.52	0.73	0.61	7.34	1.91	1.72	8.55	3.53	2.57						
6.95	0.74	0.63	7.82	1.94	1.77	9.12	3.60	2.72						
7.82	0.76	0.66	8.80	1.99	1.86	10.26	3.71	2.90						
8.69	0.78	0.69	9.78	2.03	1.94	11.40	3.82	3.06						
9.12	0.79	0.71	10.76	2.07	2.01	11.97	3.86	3.18						
9.56	0.79	0.72	11.74	2.10	2.08	12.54	3.91	3.25						
9.99	0.80	0.73	12.71	2.13	2.13	13.11	3.95	3.29						
10.43	0.81	0.74	13.69	2.15	2.18	13.68	3.99	3.37						
10.86	0.81	0.75	14.67	2.16	2.23	14.25	4.05	3.48						
11.29	0.82	0.76	15.65	2.16	2.27	14.82	4.08	3.54						
11.73	0.83	0.77	16.62	2.16	2.30	15.39	4.10	3.57						
12.16	0.83	0.78	17.60	2.16	2.34	15.96	4.14	3.63						
12.60	0.84	0.79	18.58	2.16	2.37	16.53	4.18	3.73						
13.03	0.85	0.80	19.56	2.16	2.40	17.10	4.19	3.78						
13.90	0.86	0.81	22.00	2.18	2.47	18.24	4.23	3.84						
14.77	0.87	0.82	24.45	2.20	2.55	19.38	4.28	3.97						
15.64	0.87	0.84	25.00	2.21	2.56	20.52	4.31	4.02						
16.51	0.88	0.85				21.66	4.36	4.12						
17.38	0.88	0.86				22.80	4.39	4.19						
19.55	0.89	0.88				25.00	4.42	4.35						
21.72	0.90	0.90												
23.89	0.91	0.91												
25.00	0.91	0.92												

Void Ratio and % Settlement vs. Log of Pressure



Project: PolyMet #23690C29			Date: 6/3/14
Sample #:	Boring #: B14-65	Depth ft: 5-7	Job #: 9352
Soil Type: Peat (PT)			
Initial W/C (%): 496.2	Dry Density (pcf): 10.3	LL: 479.3 PL: 440.9 PI: 38.4	Gs: 1.61
Organic Content (%):	Initial Height (in.): 0.748	Diameter (in.): 2.503	e_o= 8.801
Preconsolidation Pressure (Pc): 0.20 tsf	Compression Index (Cc): 3.80	Recompression Index (Cr): ≅ 0.65	

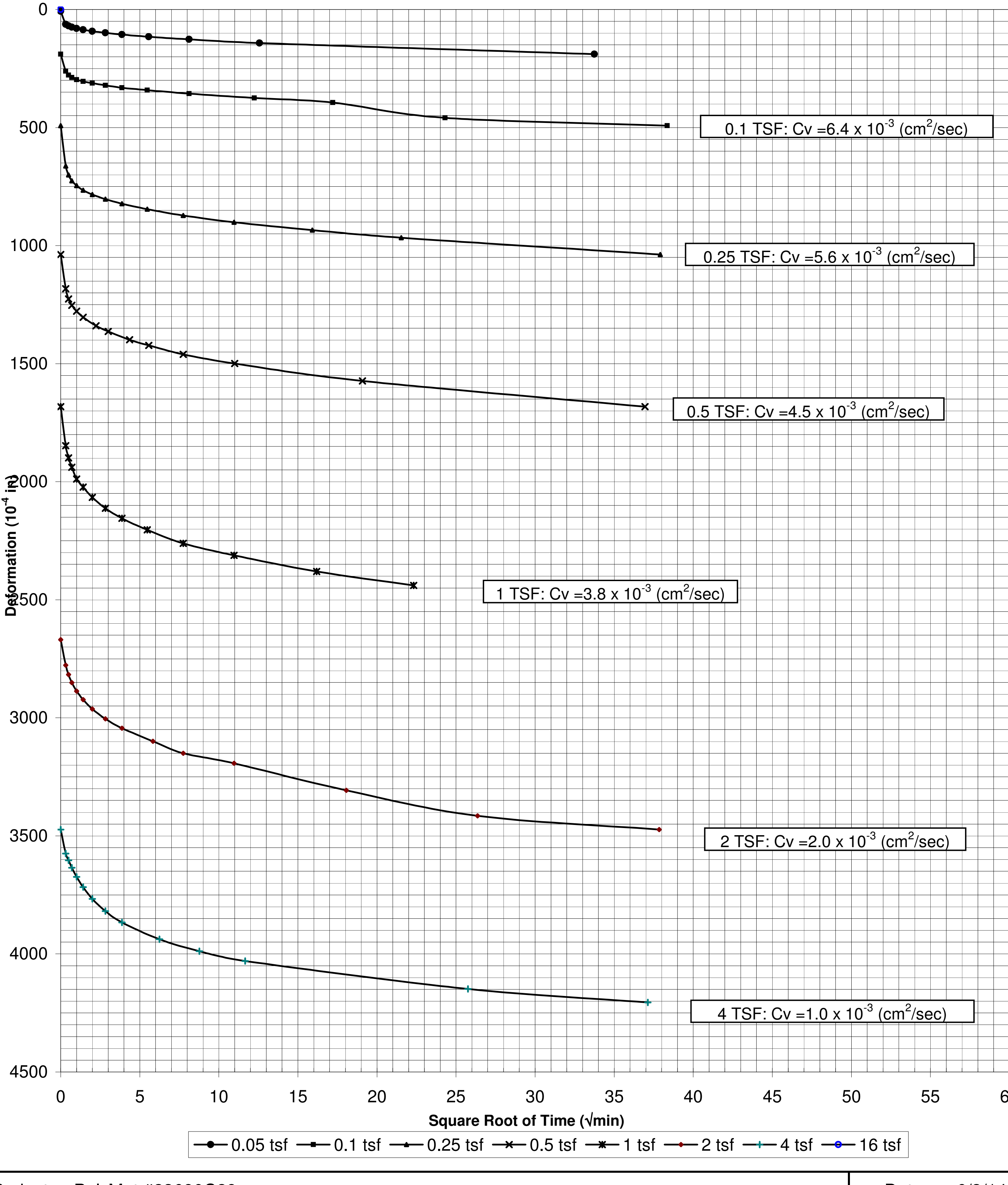
Remarks: Testing performed in general accordance with ASTM:D2435

2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

Square Root of Time Curves



Project: PolyMet #23690C29			Date: 6/3/14
Sample #:	Boring #: B14-65	Depth ft: 5-7	Job #: 9352

2401 W 66th Street

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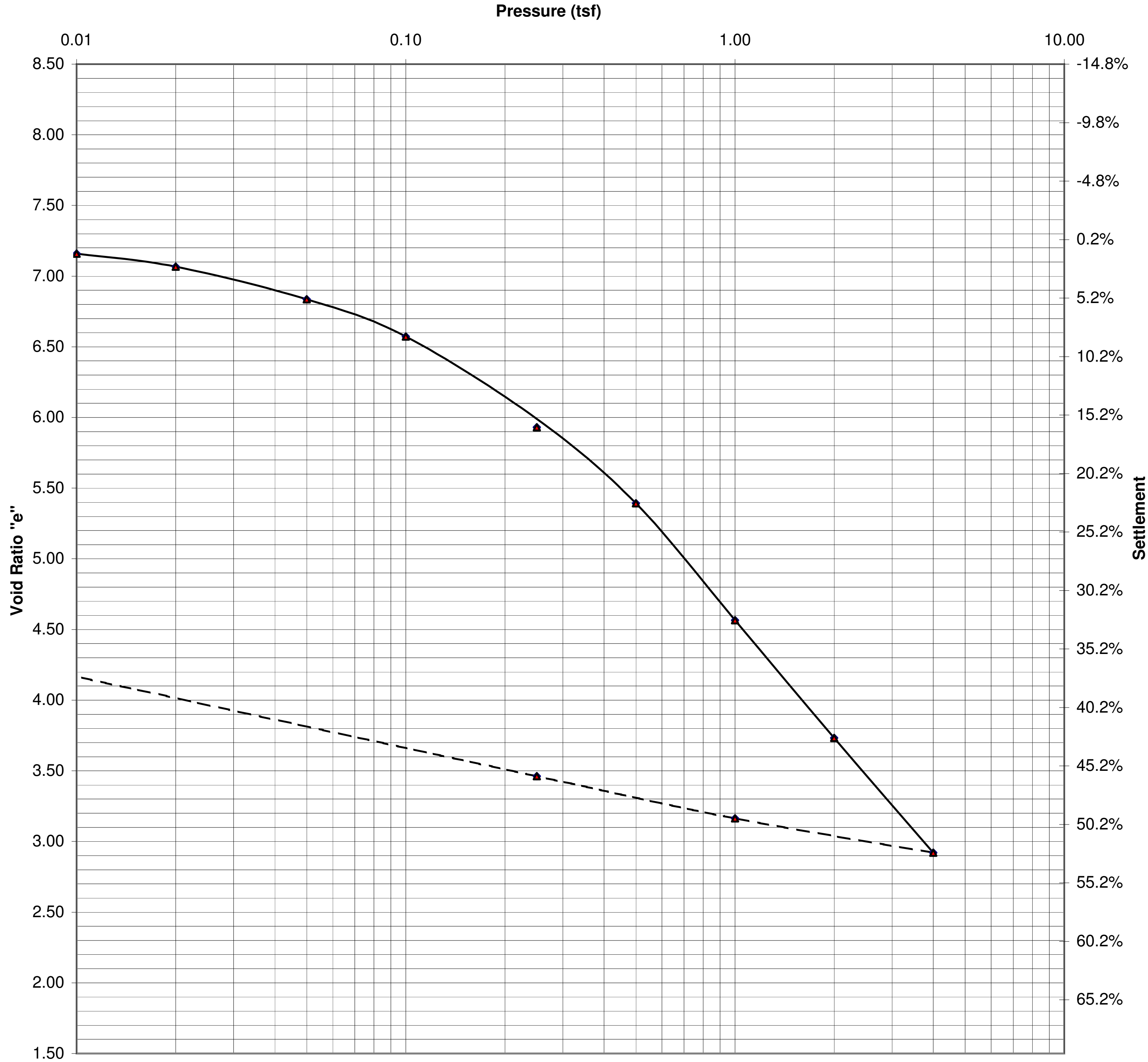
Void Ratio and % Settlement vs. Log of Pressure



Project: PolyMet #23690C29					Date: 6/4/14
Sample #:	Boring #: B14-69		Depth ft: 2.5-4.5		Job #: 9352
Soil Type: Peat (PT)					
Initial W/C (%): 413.1	Dry Density (pcf): 12.5	LL: 429.0	PL: 412.2	PI: 16.8	Gs: 1.66
Organic Content (%):	Initial Height (in.): 0.745		Diameter (in.): 2.503		e_o= 7.275
Preconsolidation Pressure (Pc): 0.21 tsf		Compression Index (Cc): 2.75		Recompression Index (Cr): ≅ 0.45	

Remarks: Testing performed in general accordance with ASTM:D2435

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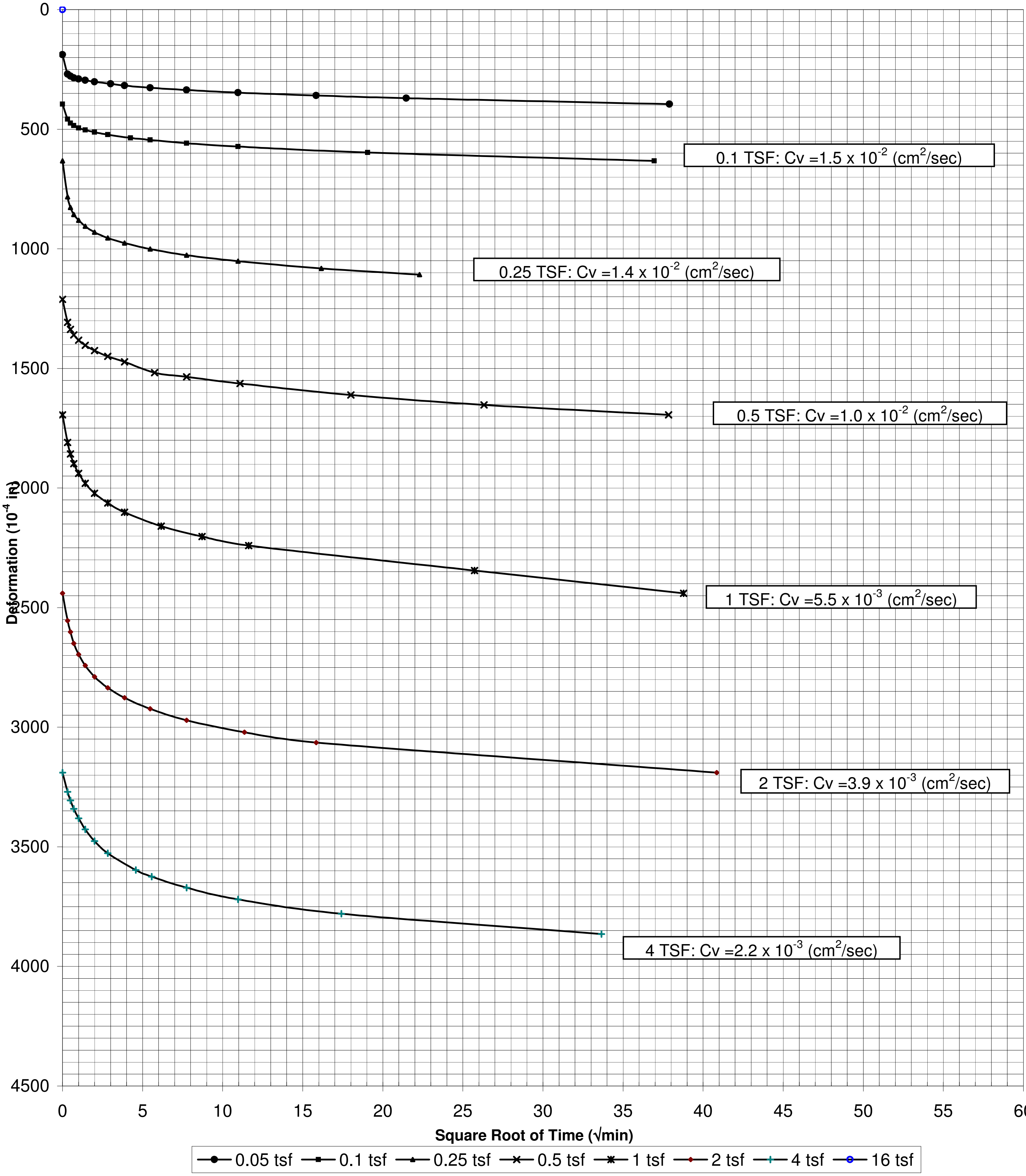
Square Root of Time Curves



Project: PolyMet #23690C29			Date: 6/4/14
Sample #:	Boring #: B14-69	Depth ft: 2.5-4.5	Job #: 9352

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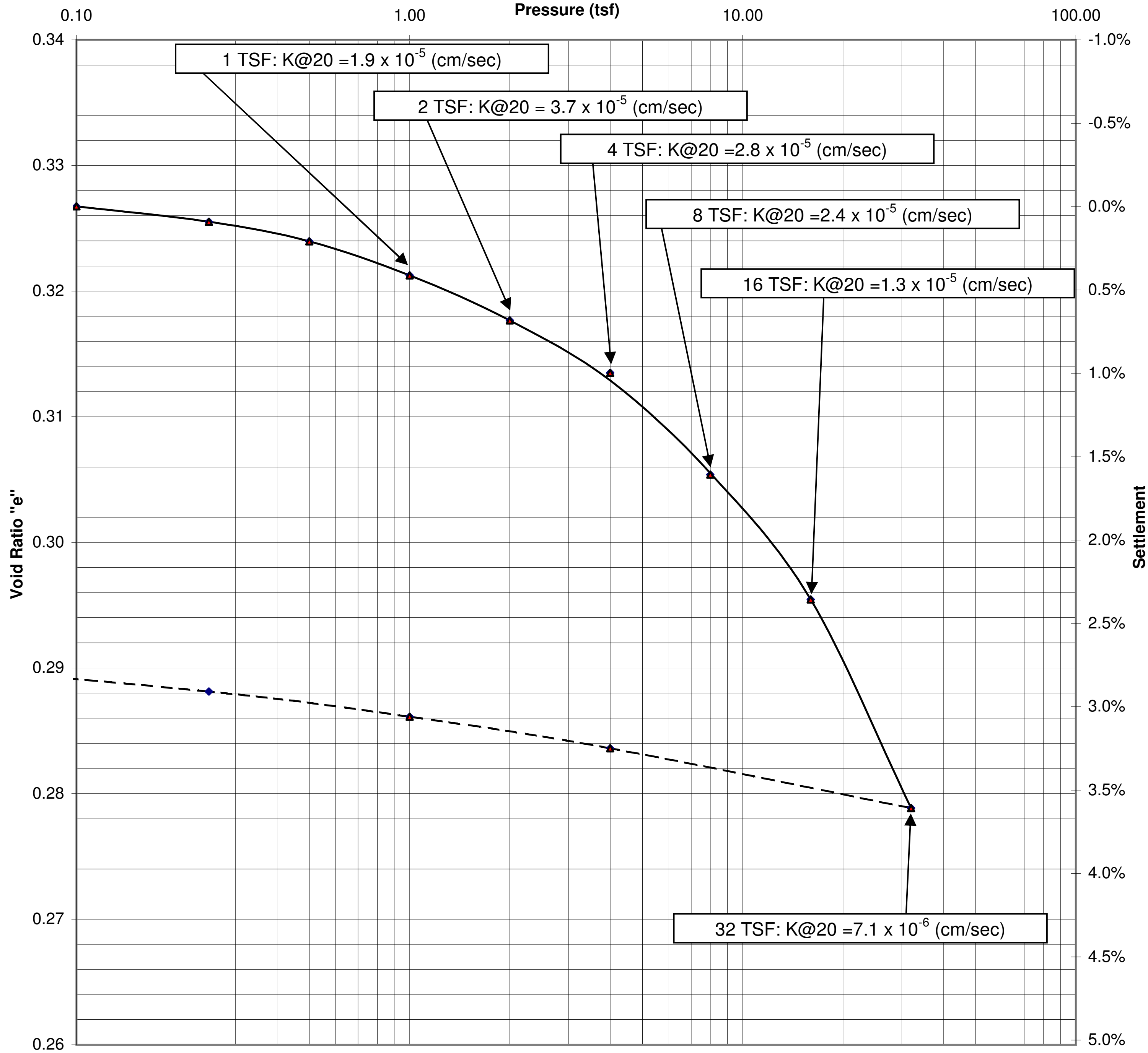
Richfield, Minnesota 55423-2031

Void Ratio and % Settlement vs. Log of Pressure



Project: PolyMet Winter Investigation #23690C29.13			Date: 7/1/14
Sample #:	Boring #: B14-40	Depth ft:	Job #: 9352-A
Soil Type: Silty Sand w/gravel (SM)			
Initial W/C (%): 8.4	Dry Density (pcf): 124.6	LL: PL: PI:	Gs: 2.65 (Assumed)
Organic Content (%):	Initial Height (in.): 0.761	Diameter (in.): 2.503	e_o= 0.327
Preconsolidation Pressure (Pc): 8.5 tsf	Compression Index (Cc): 0.06	Recompression Index (Cr): ≅ 0.01	

Remarks: Testing performed in general accordance with ASTM:D2435

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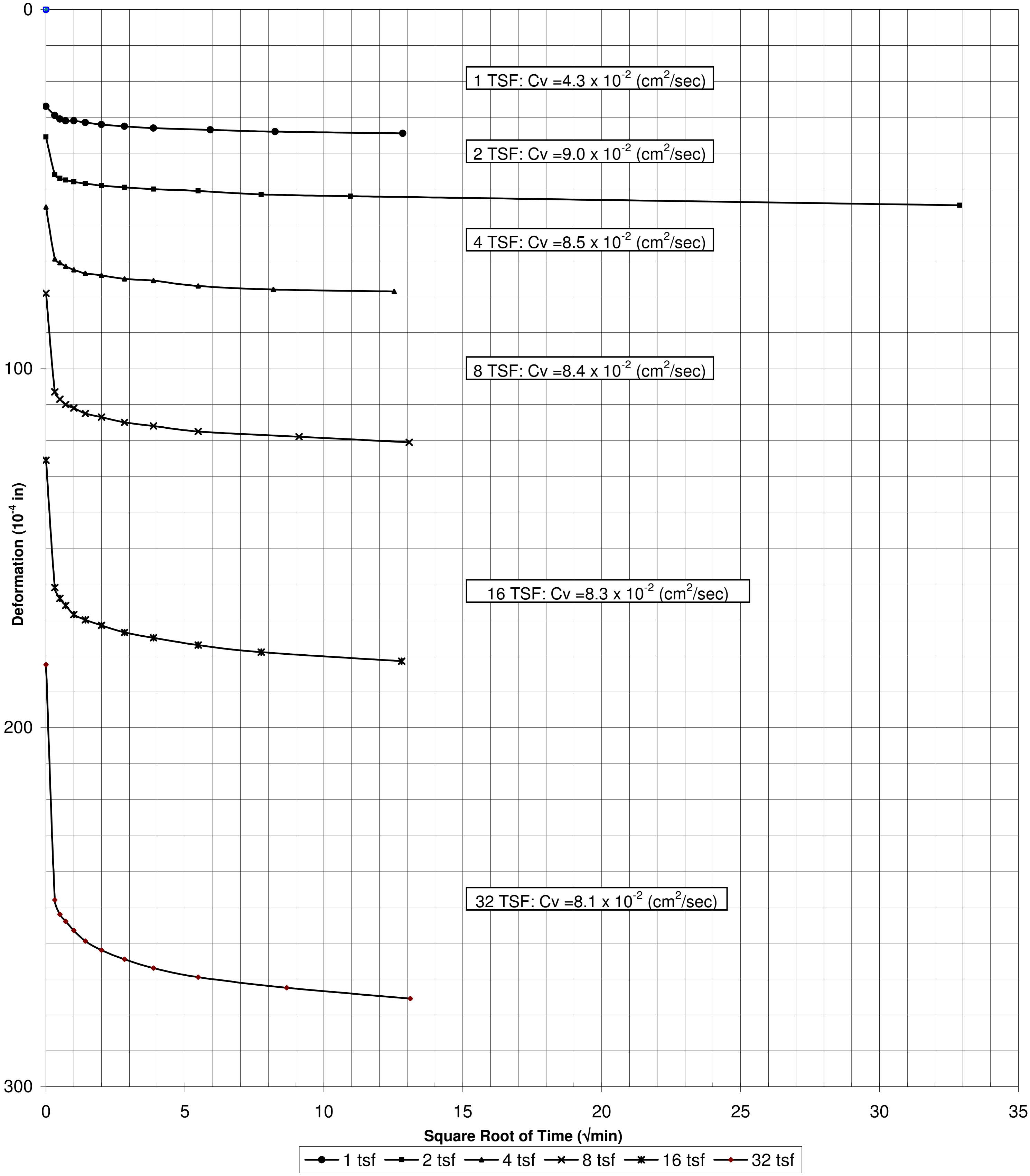
Square Root of Time Curves



Project: PolyMet Winter Investigation #23690C29.13			Date: 7/1/14
Sample #:	Boring #: B14-40	Depth ft:	Job #: 9352-A

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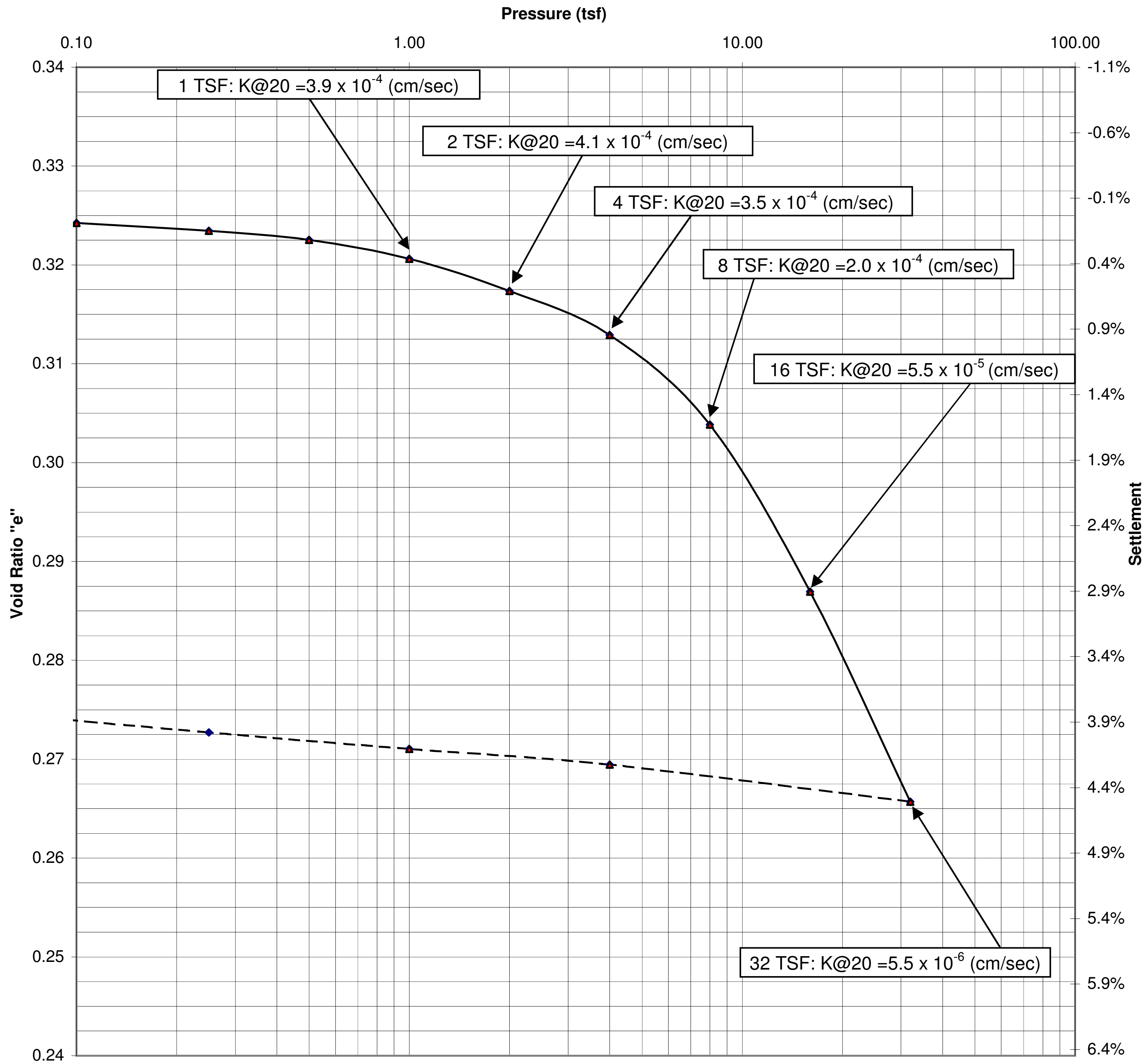
Void Ratio and % Settlement vs. Log of Pressure



Project: PolyMet Winter Investigation #23690C29.13			Date: 7/1/14
Sample #: Composite	Boring #: B14-62	Depth ft:	Job #: 9352-A
Soil Type:			
Initial W/C (%): 8.0	Dry Density (pcf): 124.9	LL: PL: PI:	Gs: 2.65 (Assumed)
Organic Content (%):	Initial Height (in.): 1.000	Diameter (in.): 2.505	e_o= 0.325
Preconsolidation Pressure (Pc): 10.0 tsf	Compression Index (Cc): 0.09	Recompression Index (Cr): ≅ 0.01	

Remarks: Testing performed in general accordance with ASTM:D2435

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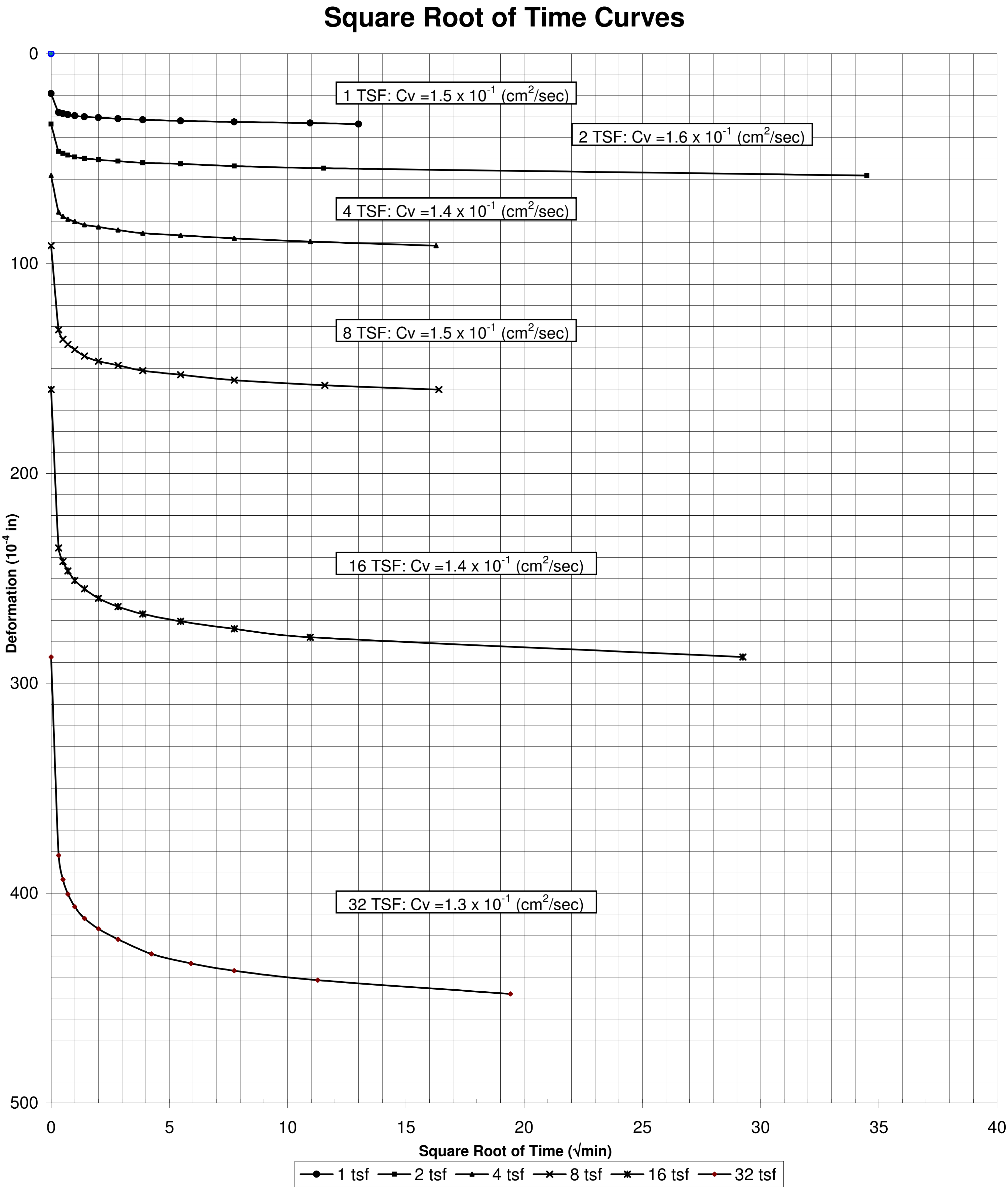
Richfield, Minnesota 55423-2031



Project: PolyMet Winter Investigation #23690C29.13			Date: 7/1/14
Sample #: Composite	Boring #: B14-62	Depth ft:	Job #: 9352-A

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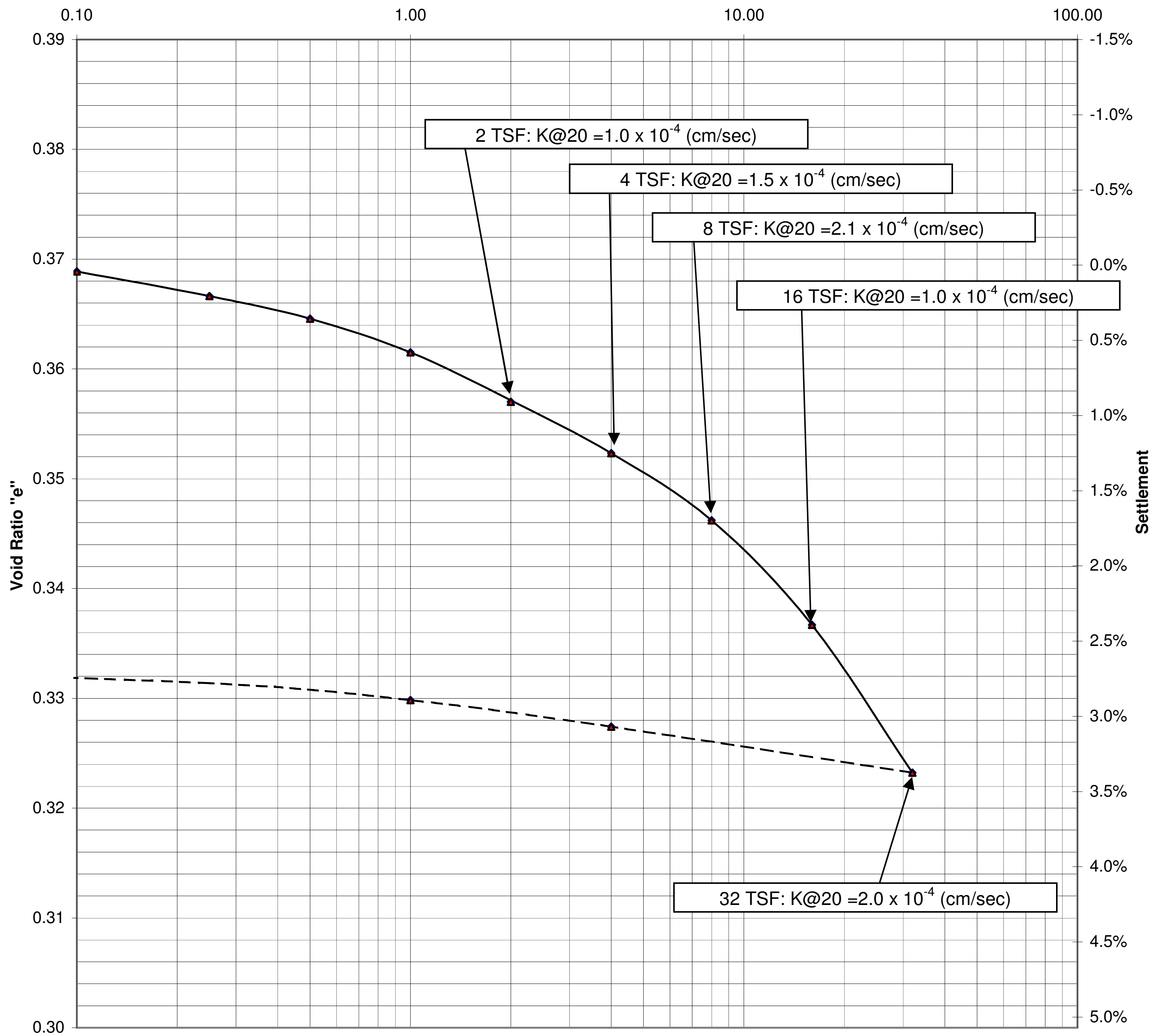
Richfield, Minnesota 55423-2031

Void Ratio and % Settlement vs. Log of Pressure



Project: PolyMet Winter Investigation #23690C29.13				Date: 7/1/14
Sample #:	Boring #: B14-76	Depth ft: 9-11, 11-13, 20.5-22.5		Job #: 9352-A
Soil Type:				
Initial W/C (%): 10.2	Dry Density (pcf): 122.1	LL: PL: PI:		Gs: 2.68 (Assumed)
Organic Content (%):	Initial Height (in.): 0.761	Diameter (in.): 2.503	e_o= 0.370	
Preconsolidation Pressure (Pc): 10.0 tsf	Compression Index (Cc): 0.03	Recompression Index (Cr): ≅ 0.01		

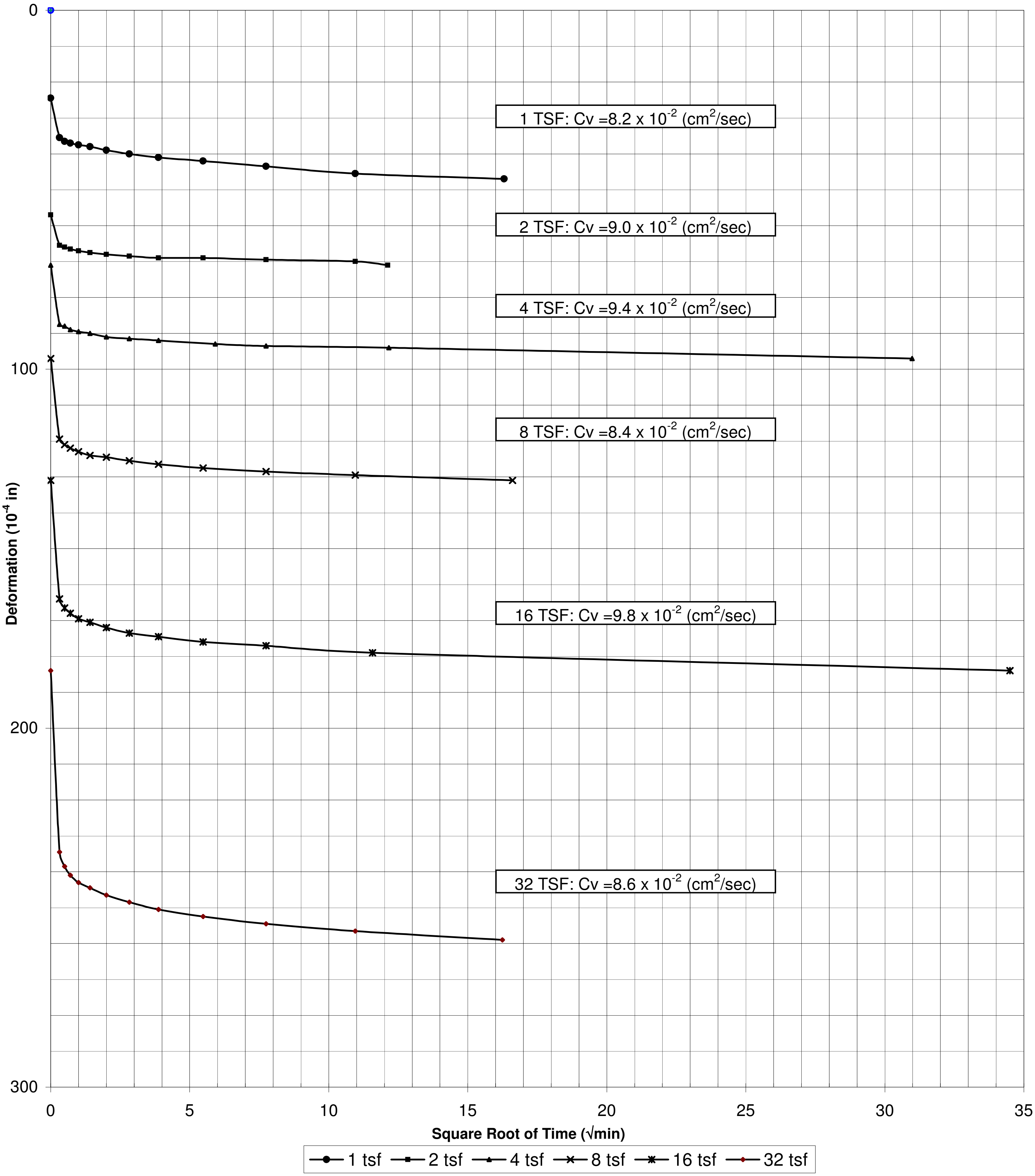
Remarks: Testing performed in general accordance with ASTM:D2435

2401 W 66th Street

SOIL ENGINEERING TESTING, INC.

Richfield, Minnesota 55423-2031

Square Root of Time Curves



Project: PolyMet Winter Investigation #23690C29.13			Date: 7/1/14
Sample #:	Boring #: B14-76	Depth ft: 9-11, 11-13, 20.5-22.5	Job #: 9352-A

2401 W 66th Street SOIL ENGINEERING TESTING, INC. Richfield, Minnesota 55423-2031

Hydraulic Conductivity Test Data ASTM D5084

Project: PolyMet #23690C29 Date: 5/26/2014

Reported To: Barr Engineering Company Job No.: 9352

Boring No.:	B14-69	B14-96					
Sample No.:							
Depth (ft):	10-12 Mid	3-5					
Location:							
Sample Type:	TWT	TWT					
Soil Type:	Peat (PT)	Peat (PT)					
Atterberg Limits							
LL	574.1	411.4					
PL	198.3	368.6					
PI	375.8	42.8					
Permeability Test	Intact	Intact					
Before Test Conditions: Saturation %:							
Before Test Conditions: Porosity:							
Before Test Conditions: Ht. (in):	2.19	2.13					
Before Test Conditions: Dia. (in):	2.92	1.94					
Before Test Conditions: Dry Density (pcf):	8.9	11.4					
Before Test Conditions: Water Content:	616.4%	445.4%					
Test Type:	Falling	Falling					
Max Head (5.0):	5.0	5.0					
Confining press. (Effective-psi):	2.0	2.0					
Trial No.:	12-16	12-16					
Water Temp ℃:	21.0	21.0					
% Compaction							
% Saturation (After Test)	98.8%	99.0%					
Coefficient of Permeability							
K @ 20 ℃ (cm/sec)	**1.0×10^{-6}**	**2.1×10^{-6}**					
K @ 20 ℃ (ft/min)	**2.0×10^{-6}**	**4.2×10^{-6}**					
Notes:							

Exhibit G

Cone Penetration Test Results

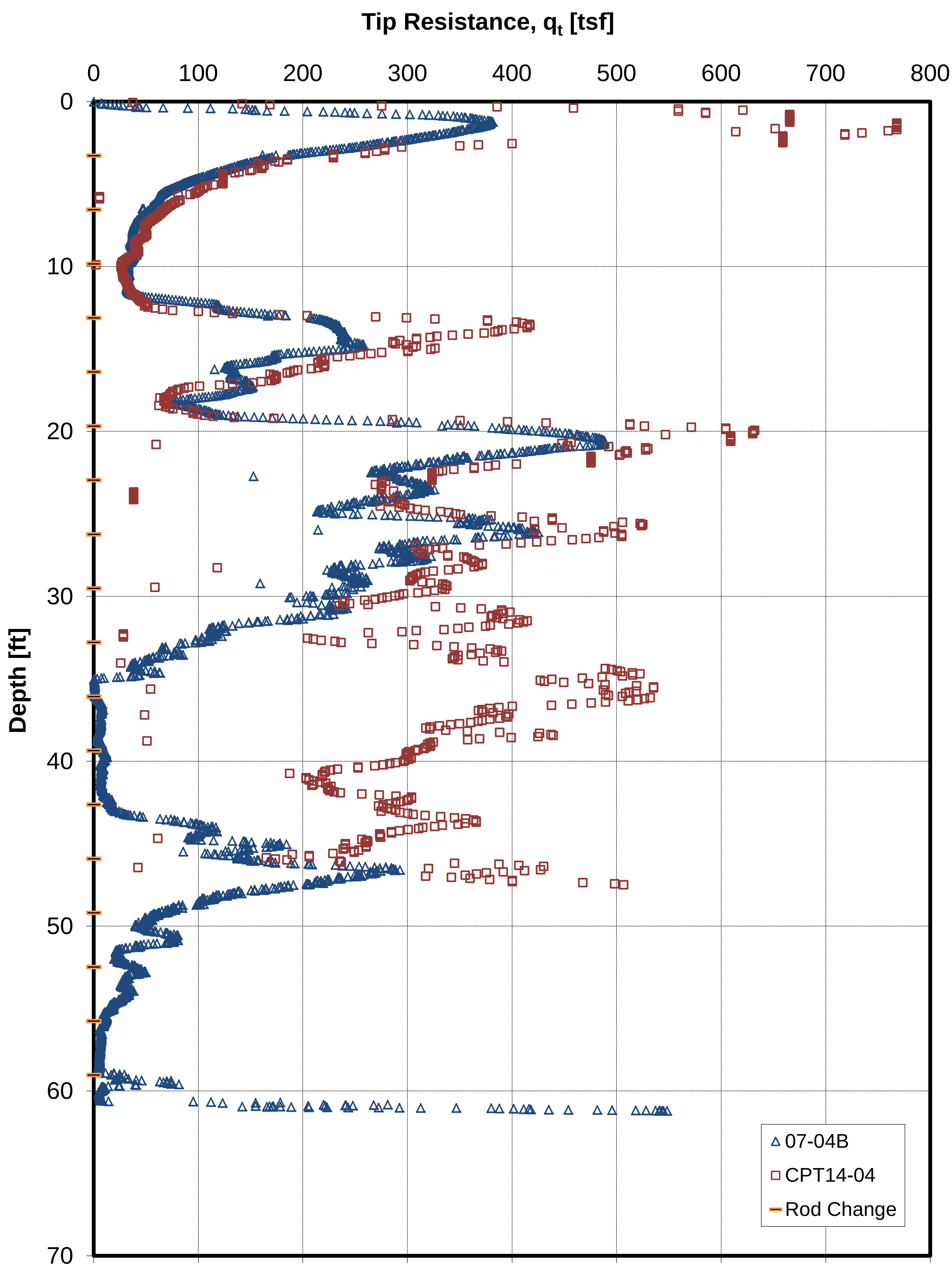


Figure G-1a. CPT 07-04B/CPT14-04 Tip Resistance vs. Depth

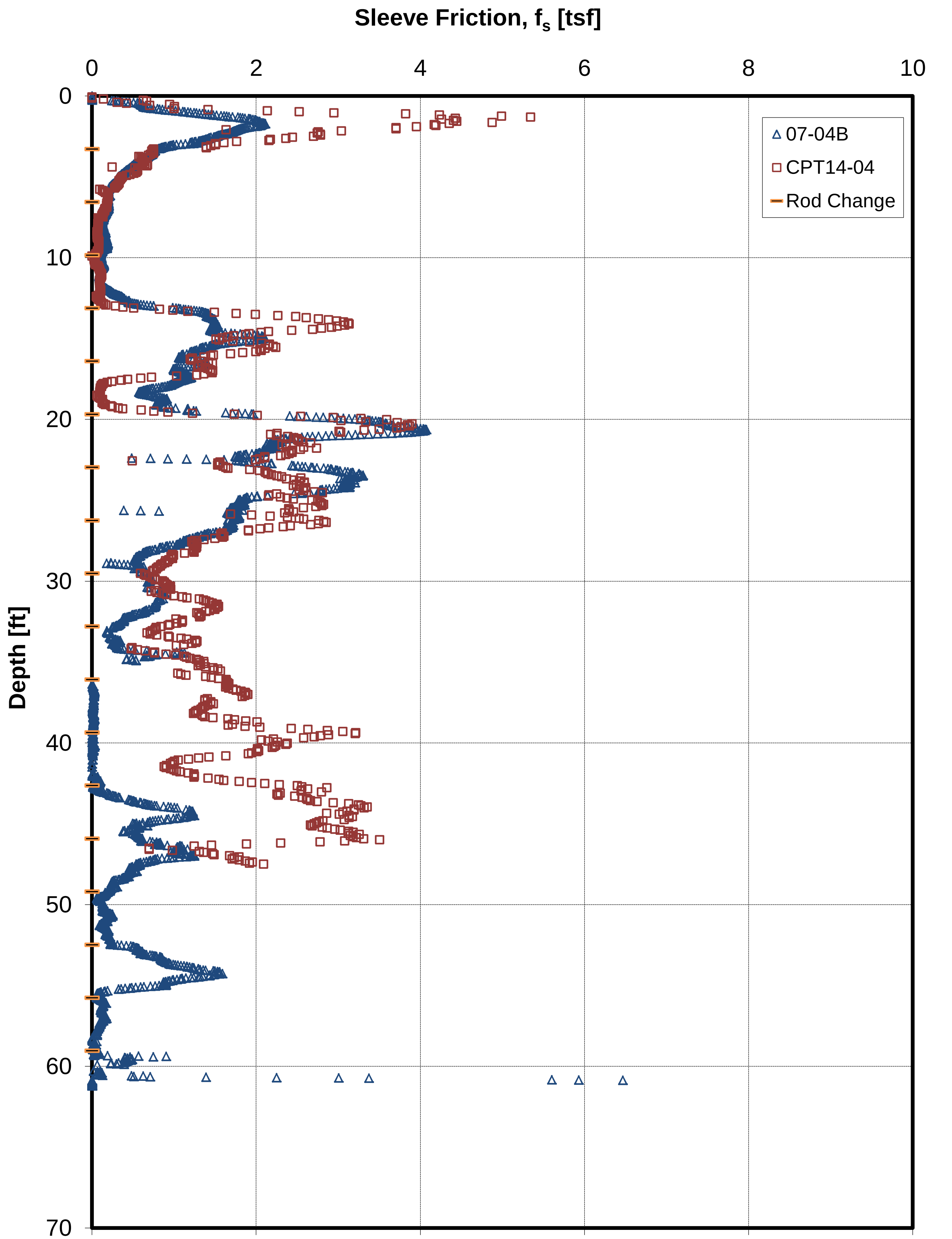


Figure G-1b. CPT 07-04B/CPT14-04 Sleeve Friction vs. Depth

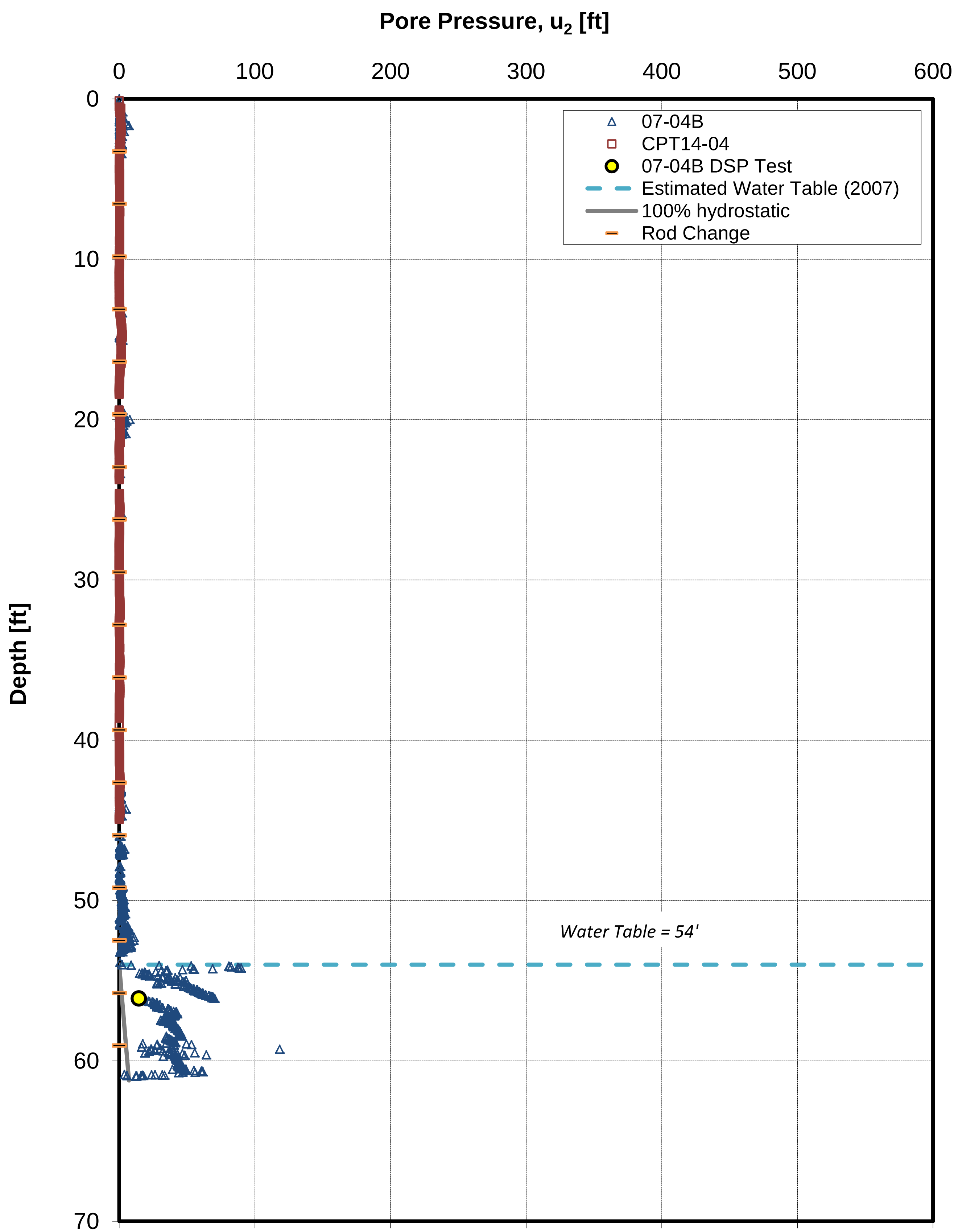
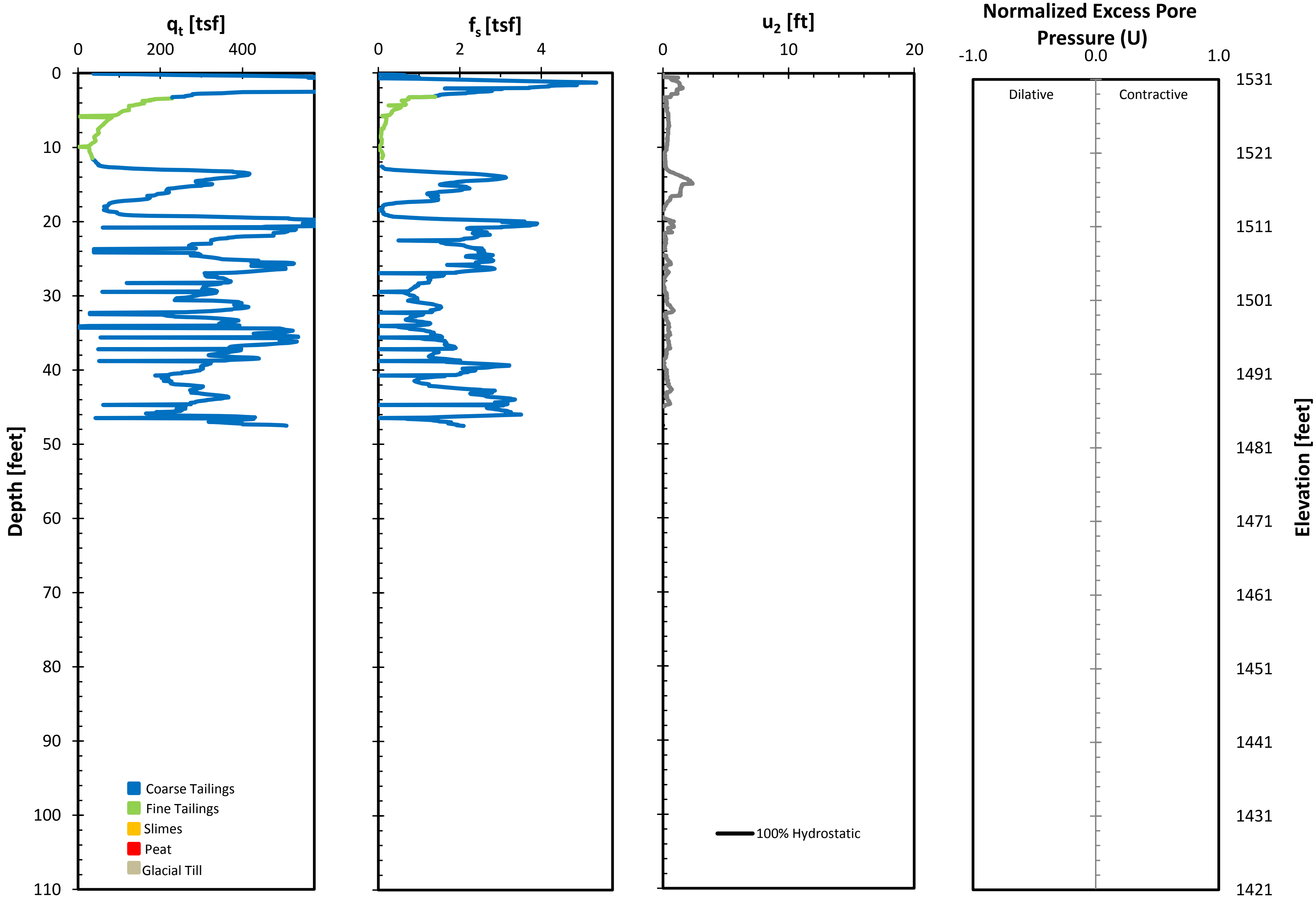


Figure G-1c. CPT 07-04B/CPT14-04 Pore Pressure vs. Depth

FIGURE G-1d
CPT14-04 Behavior Plot



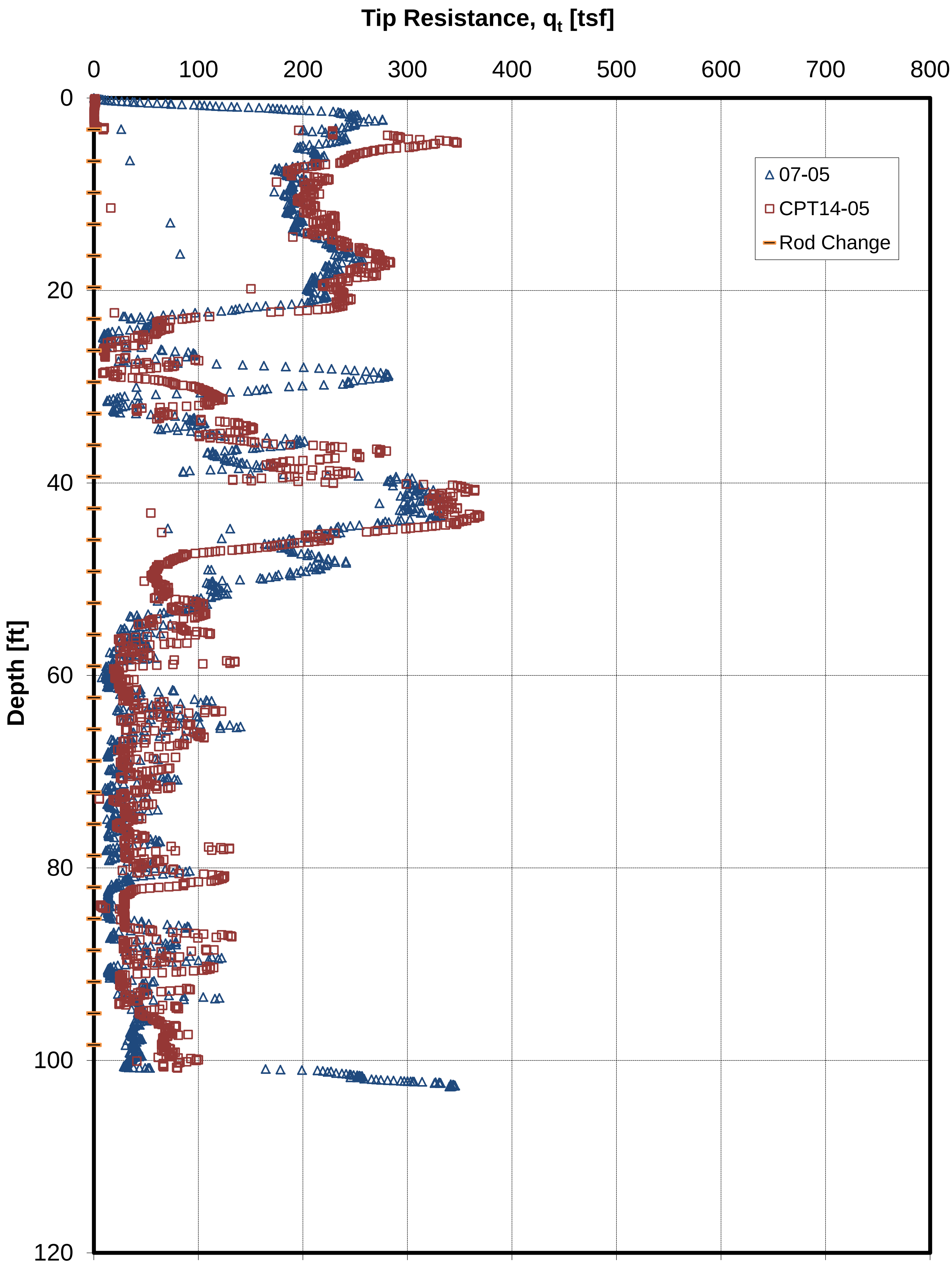


Figure G-2a. CPT 07-05/CPT14-05 Tip Resistance vs. Depth

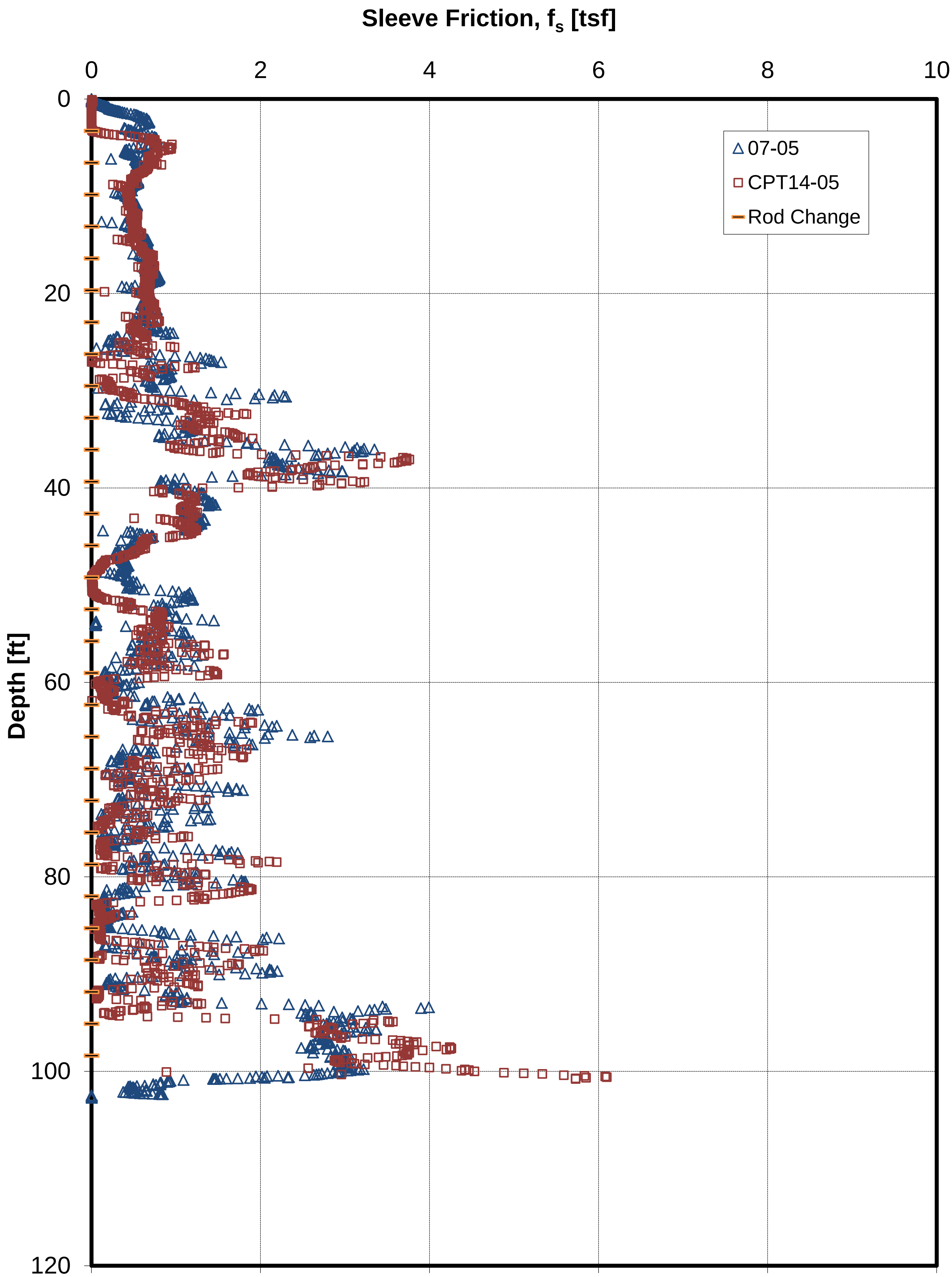


Figure G-2b. CPT 07-05/CPT14-05 Sleeve Friction vs. Depth

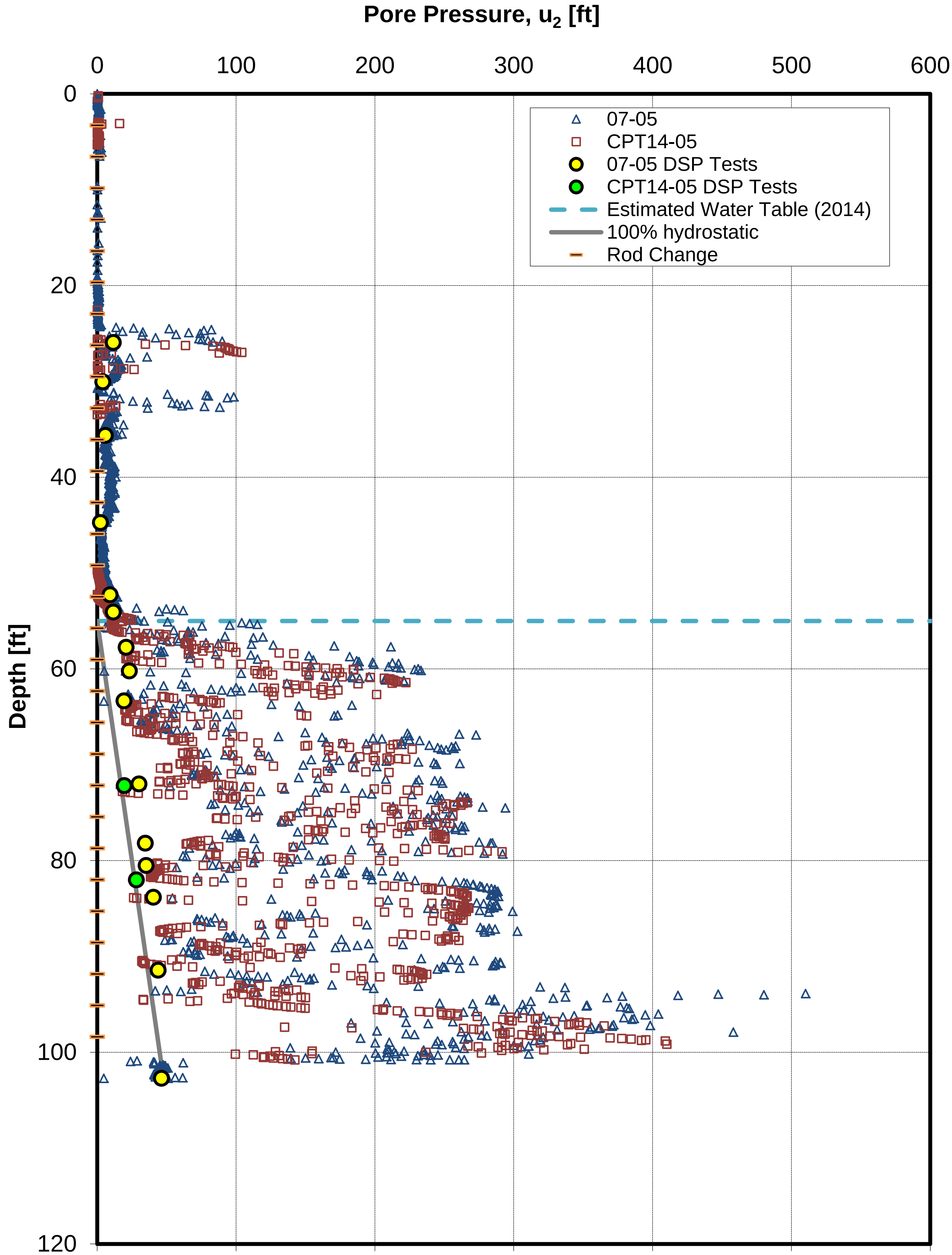
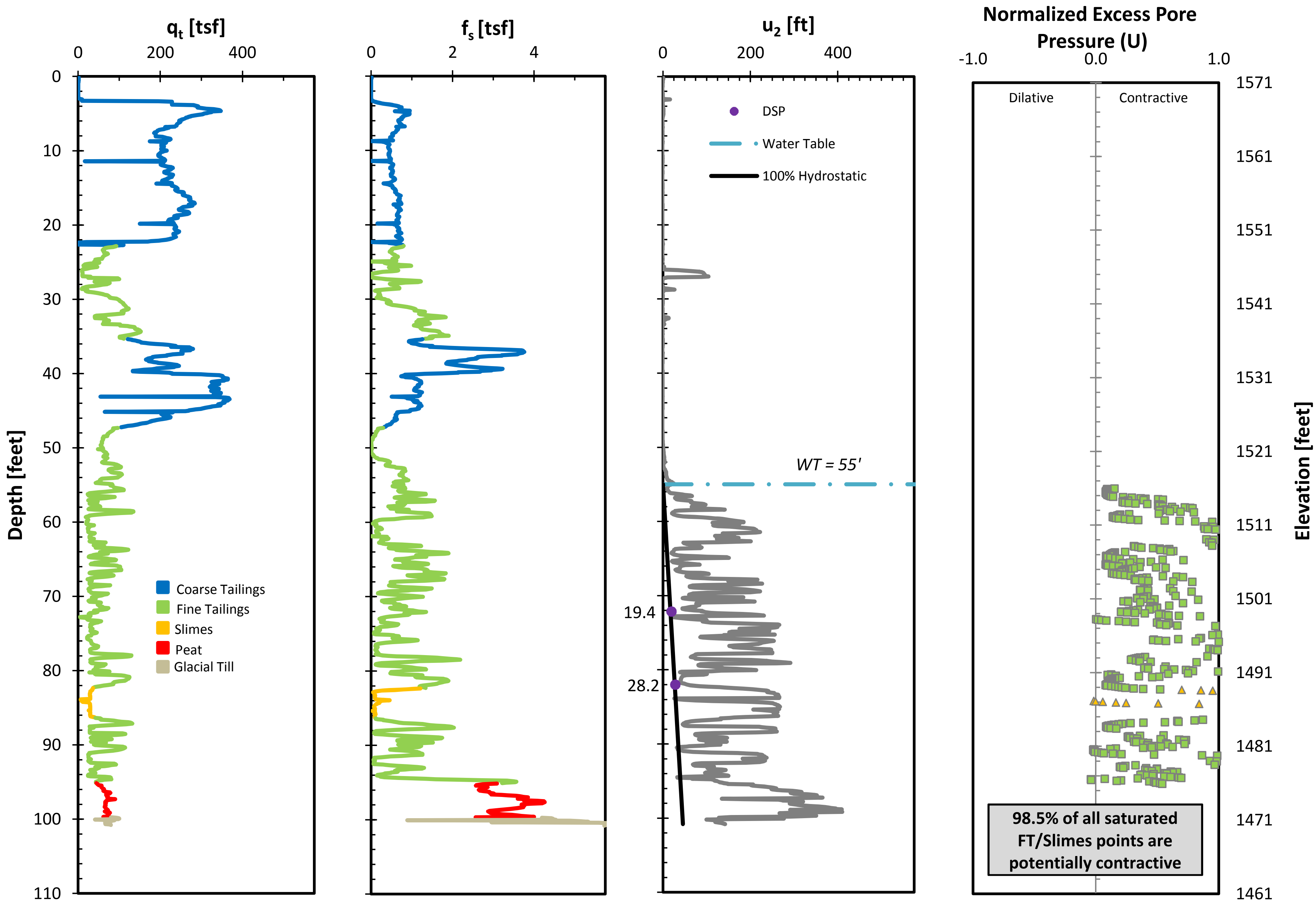


Figure G-2c. CPT 07-05/CPT14-05 Pore Pressure vs. Depth

FIGURE G-2d
CPT14-05 Behavior Plot



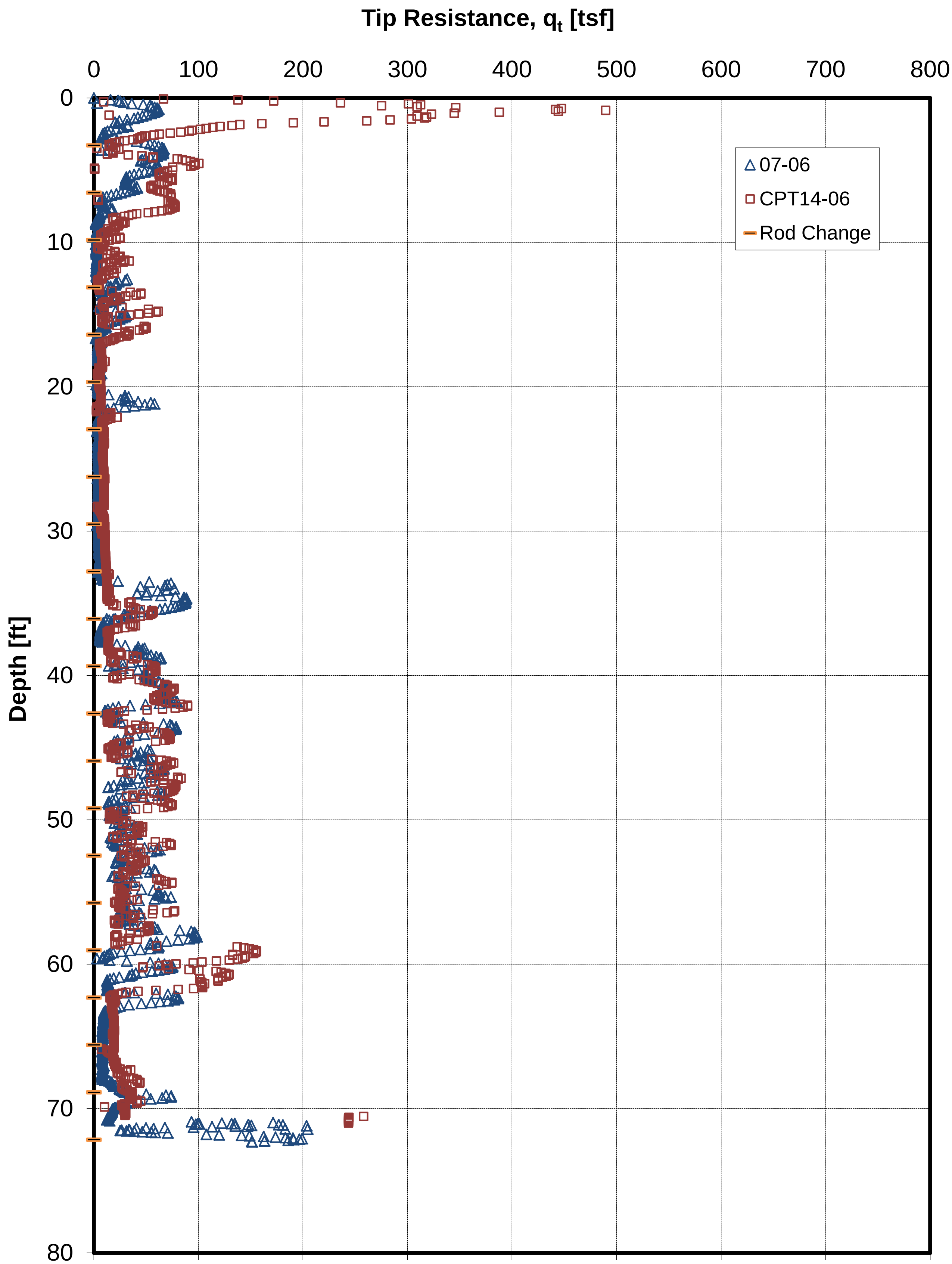


Figure G-3a. CPT 07-06/CPT14-06 Tip Resistance vs. Depth

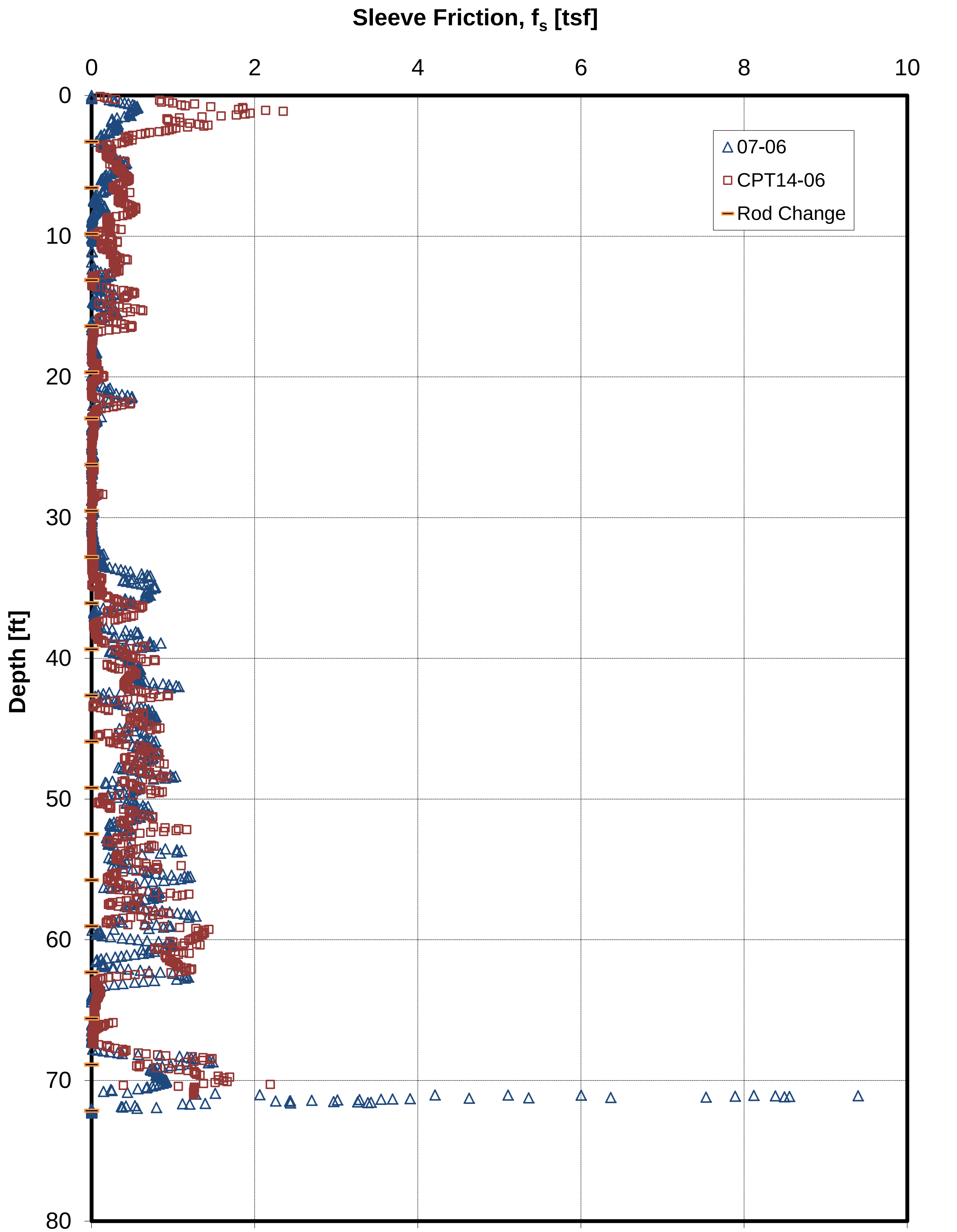


Figure G-3b. CPT 07-06/CPT14-06 Sleeve Friction vs. Depth

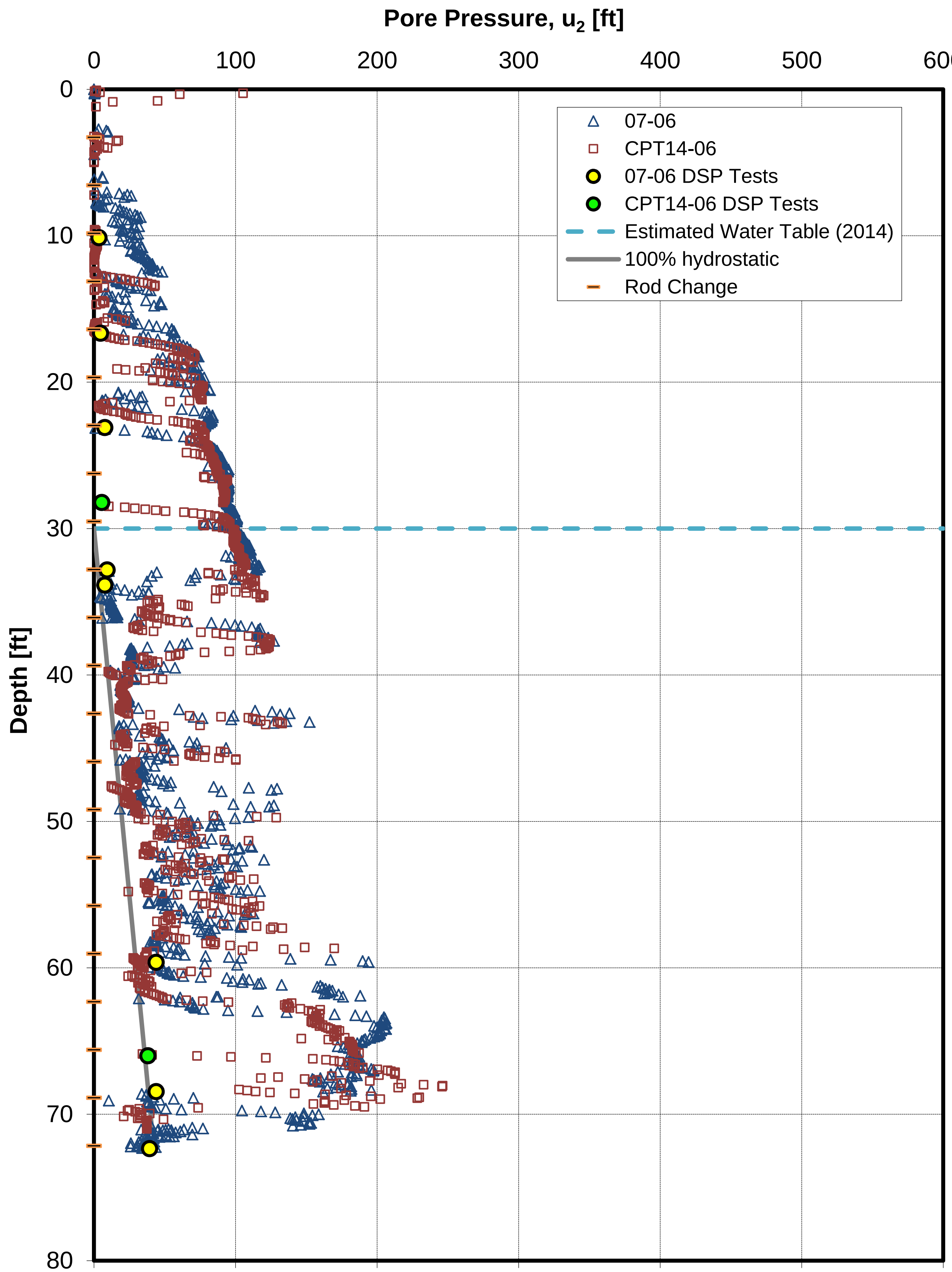
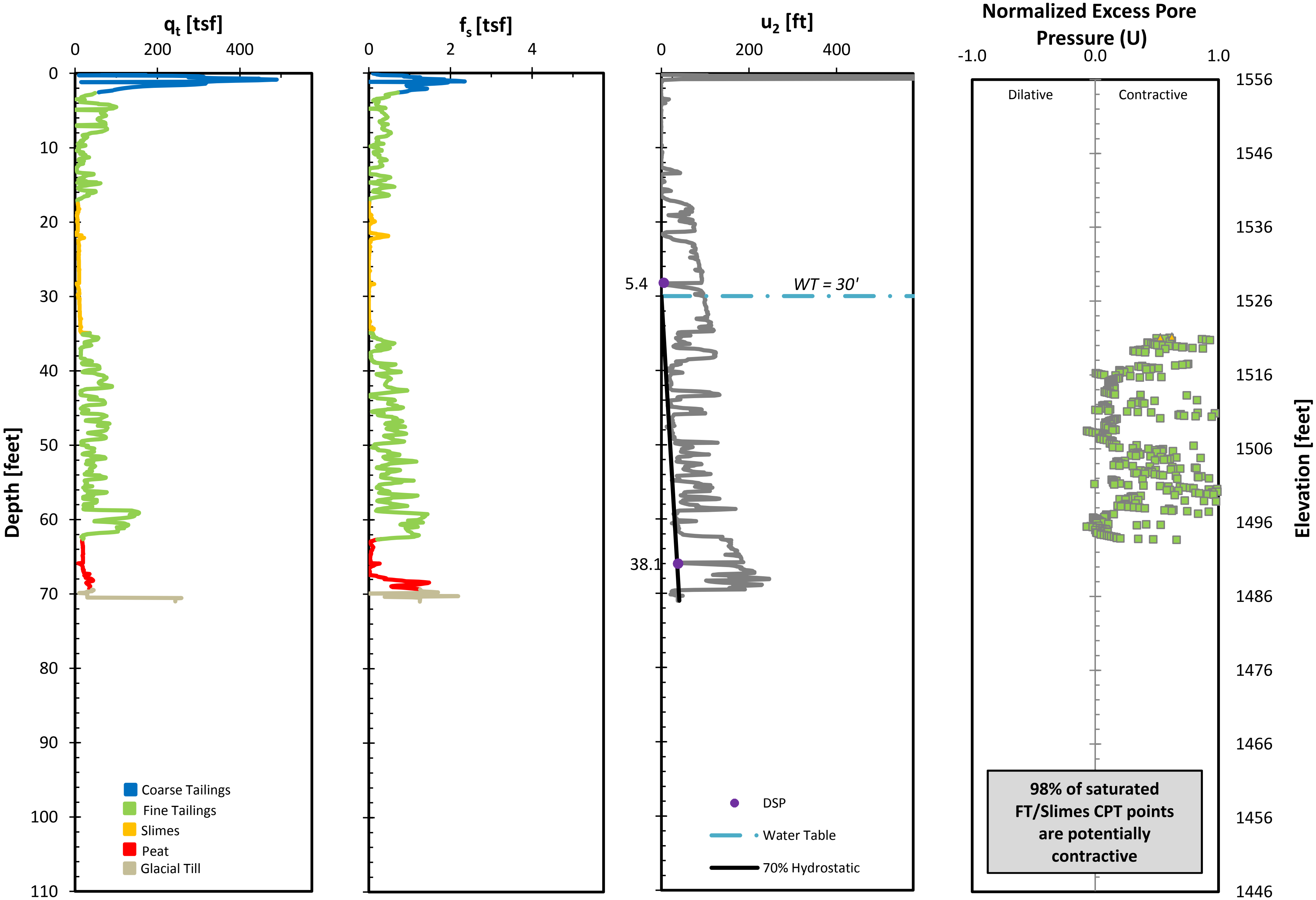


Figure G-3c. CPT 07-06/CPT14-06 Pore Pressure vs. Depth

FIGURE G-3d
CPT14-06 Behavior Plot



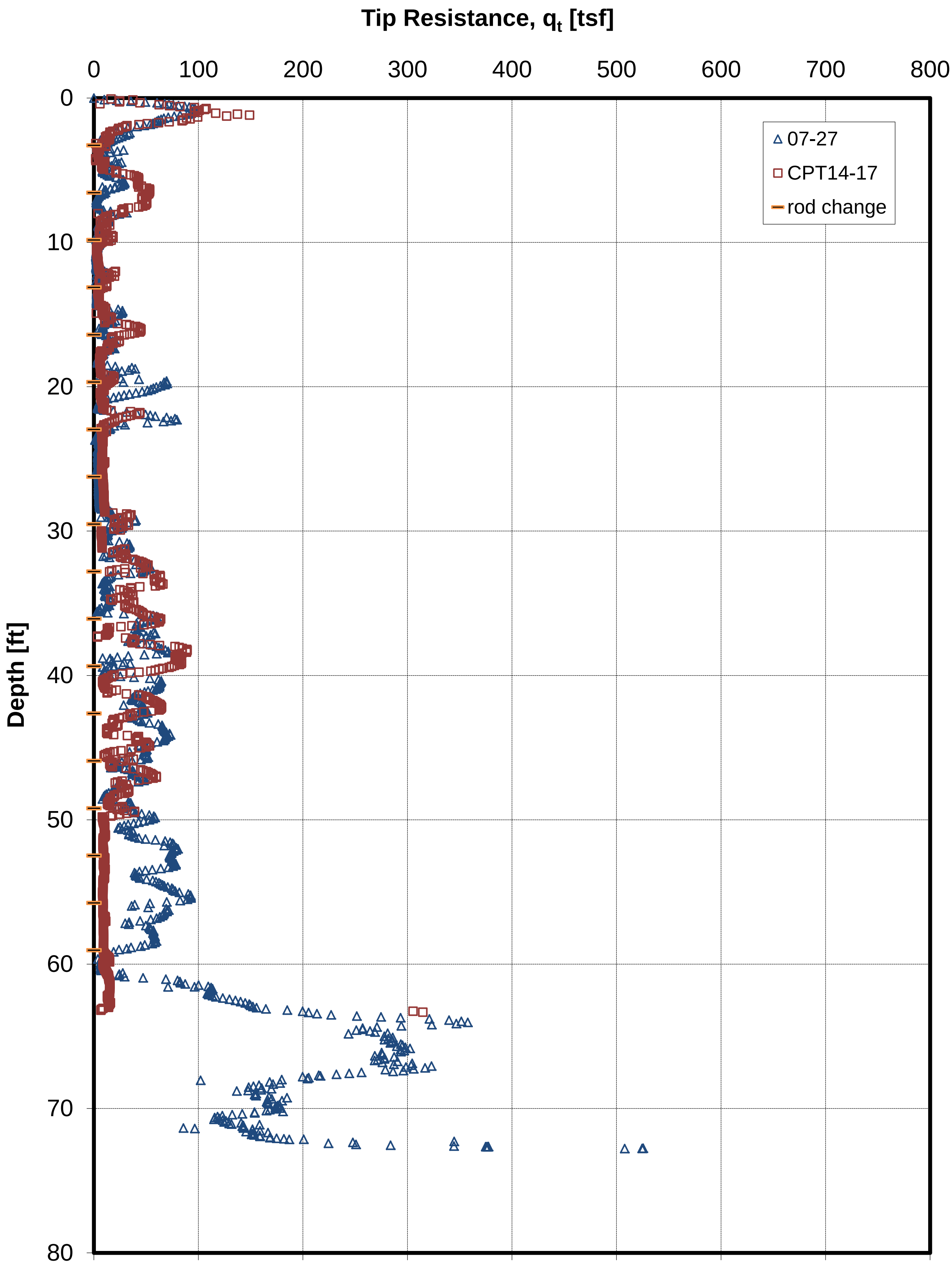


Figure G-4a. CPT 07-27/CPT14-17 Tip Resistance vs. Depth

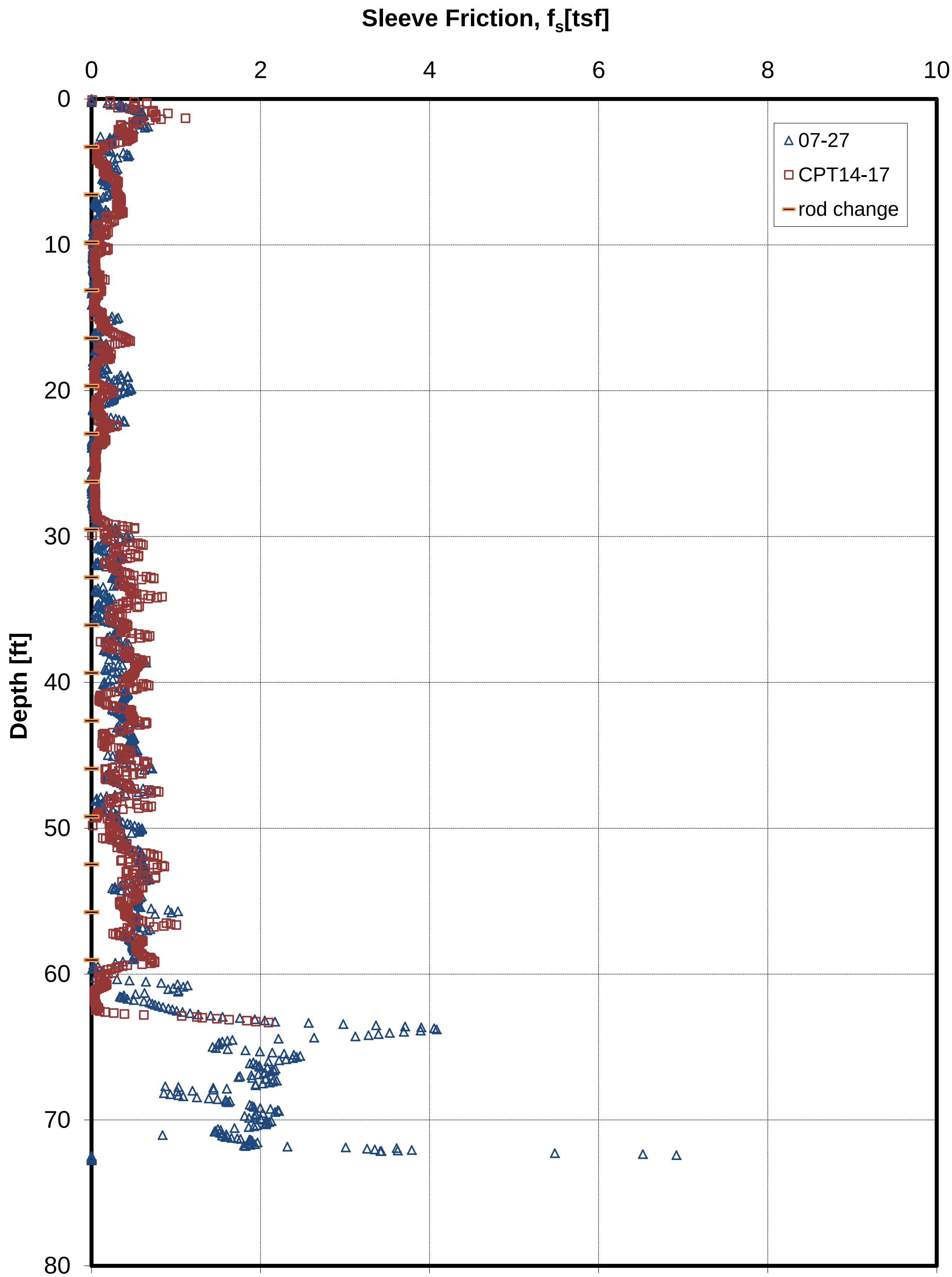


Figure G-4b. CPT 07-27/CPT14-17 Sleeve Friction vs. Depth

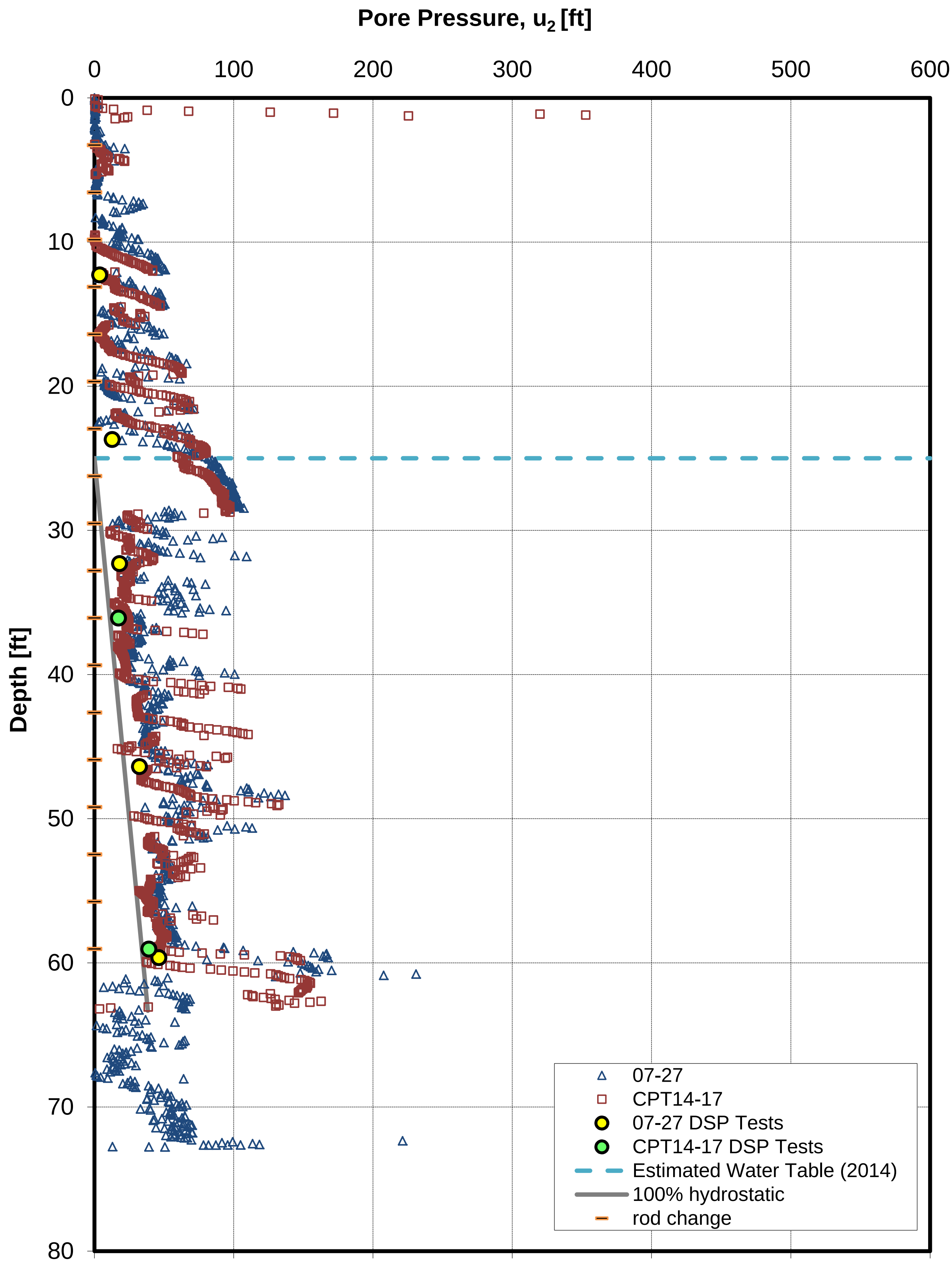
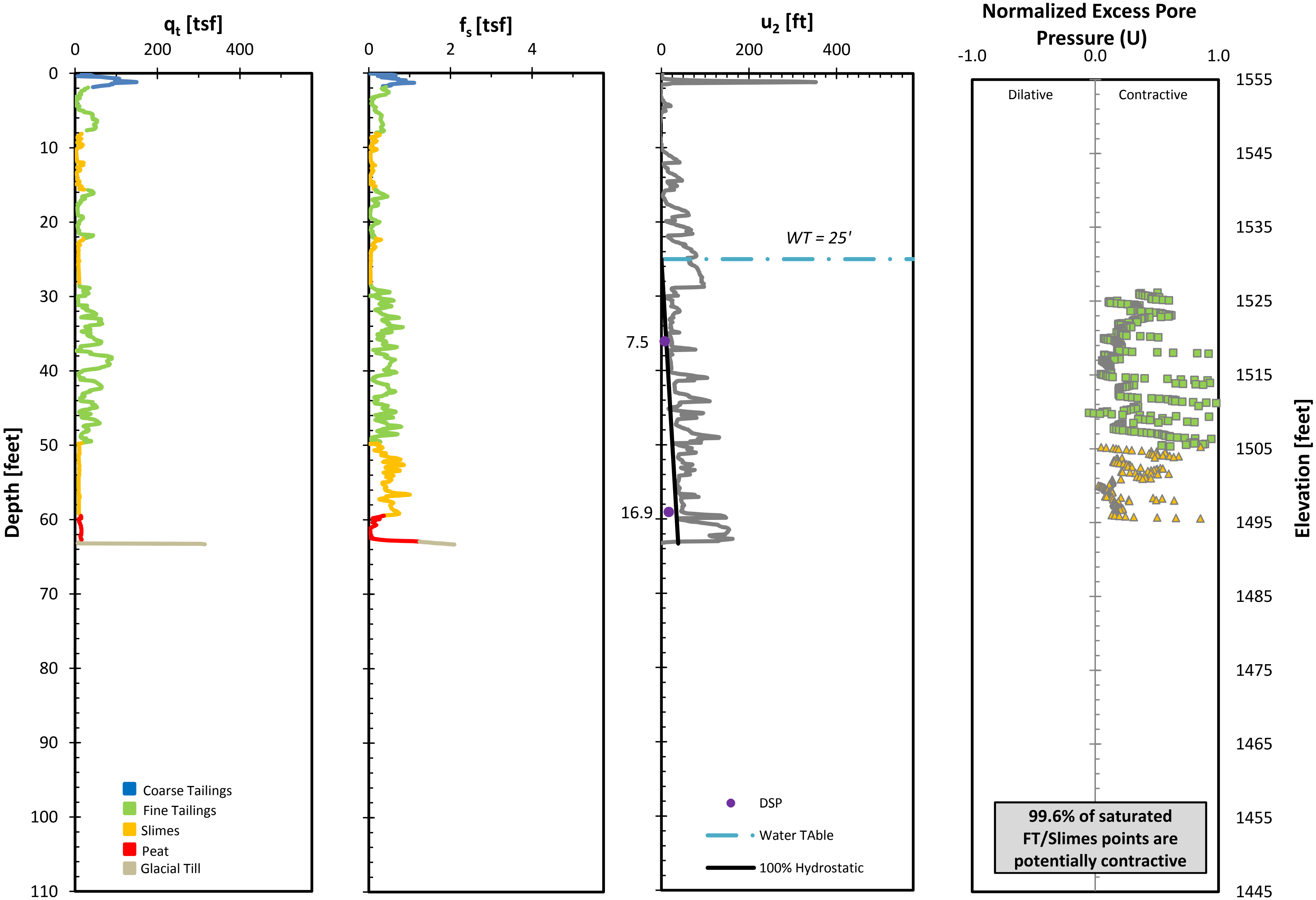


Figure G-4c. CPT 07-27/CPT14-17 Pore Pressure vs. Depth

FIGURE G-4d
CPT 14-17 Behavior Plot



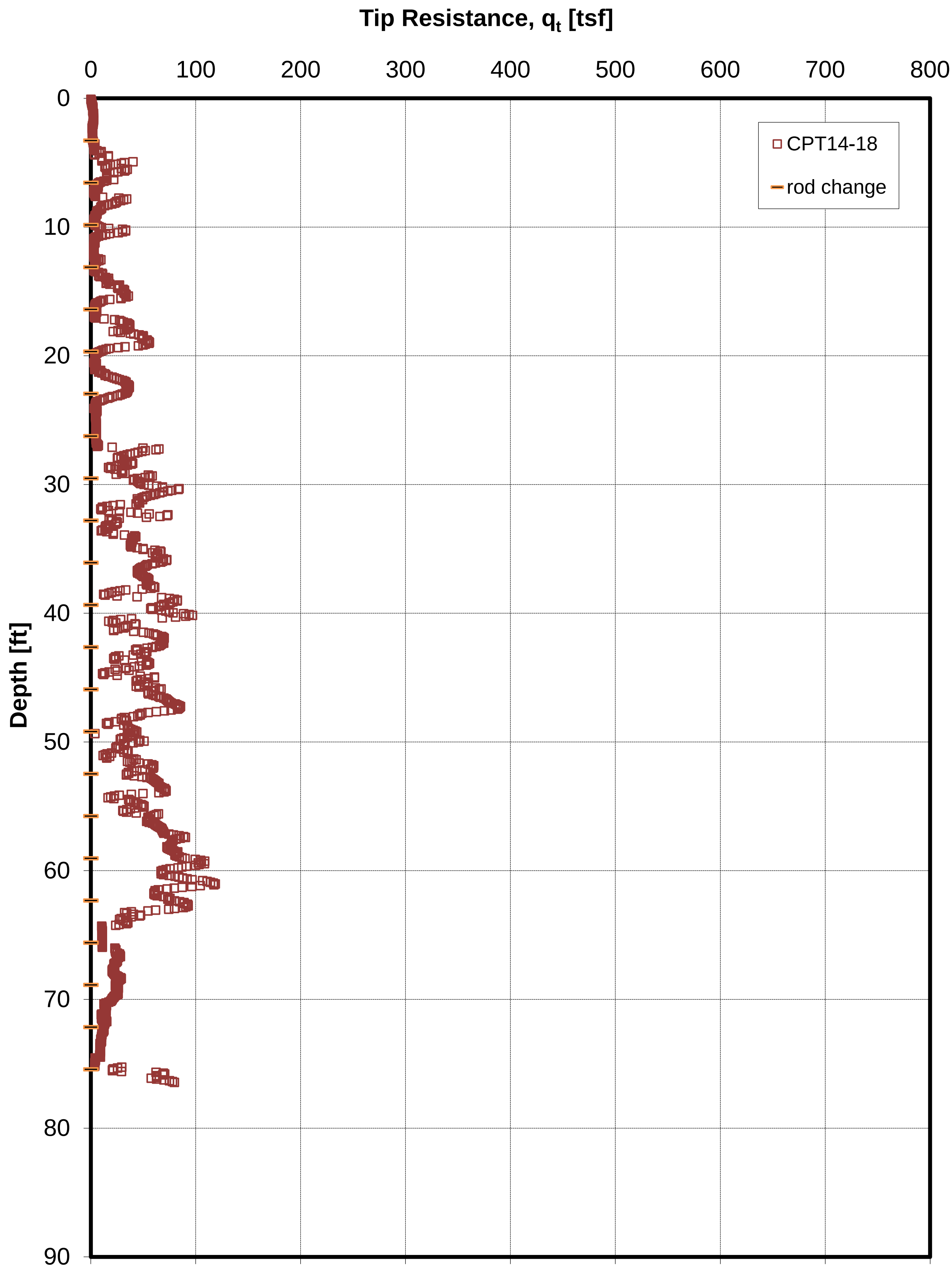


Figure G-5a. CPT14-18 Tip Resistance vs. Depth

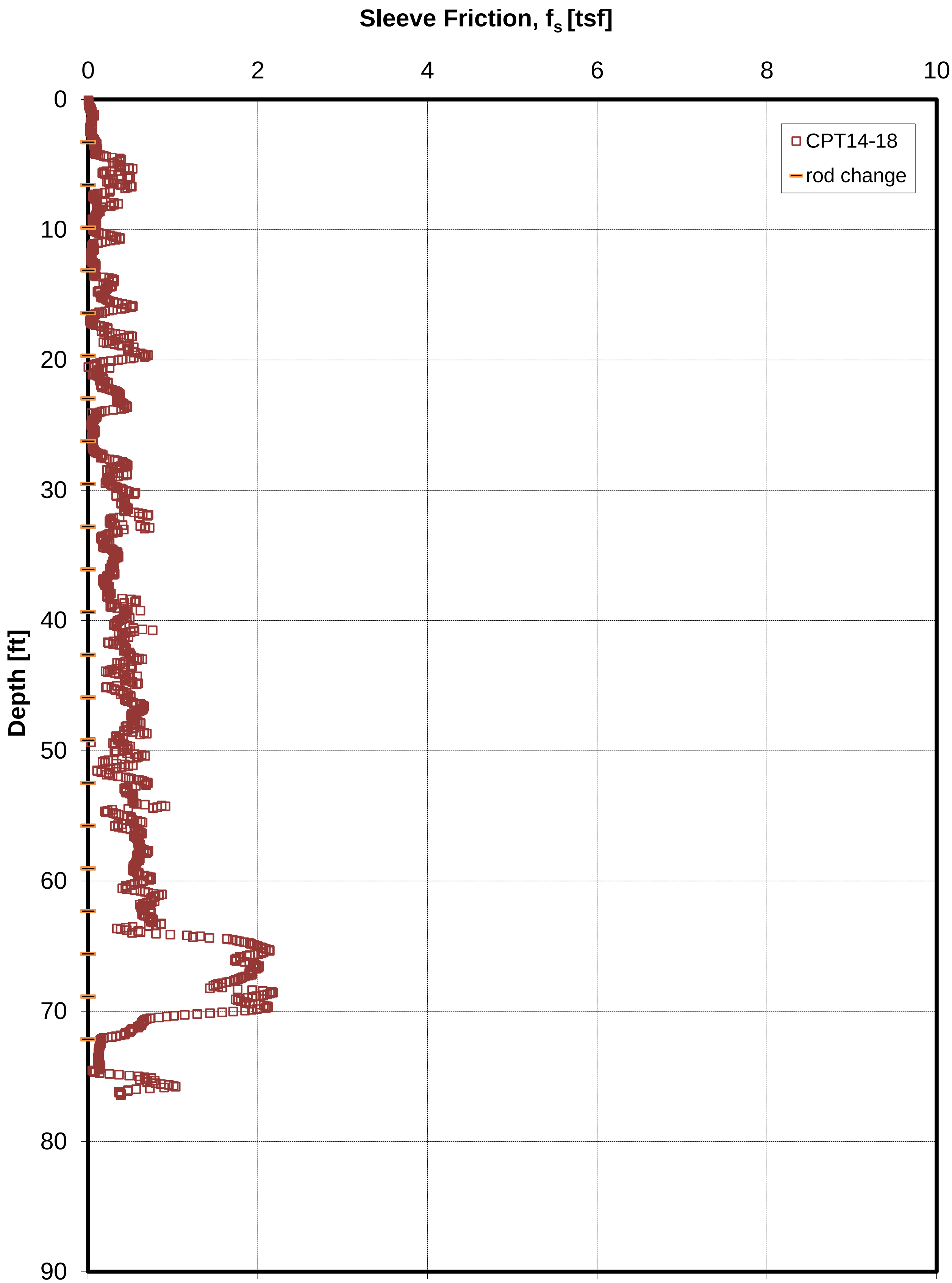


Figure G5-b. CPT14-18 Sleeve Friction vs. Depth

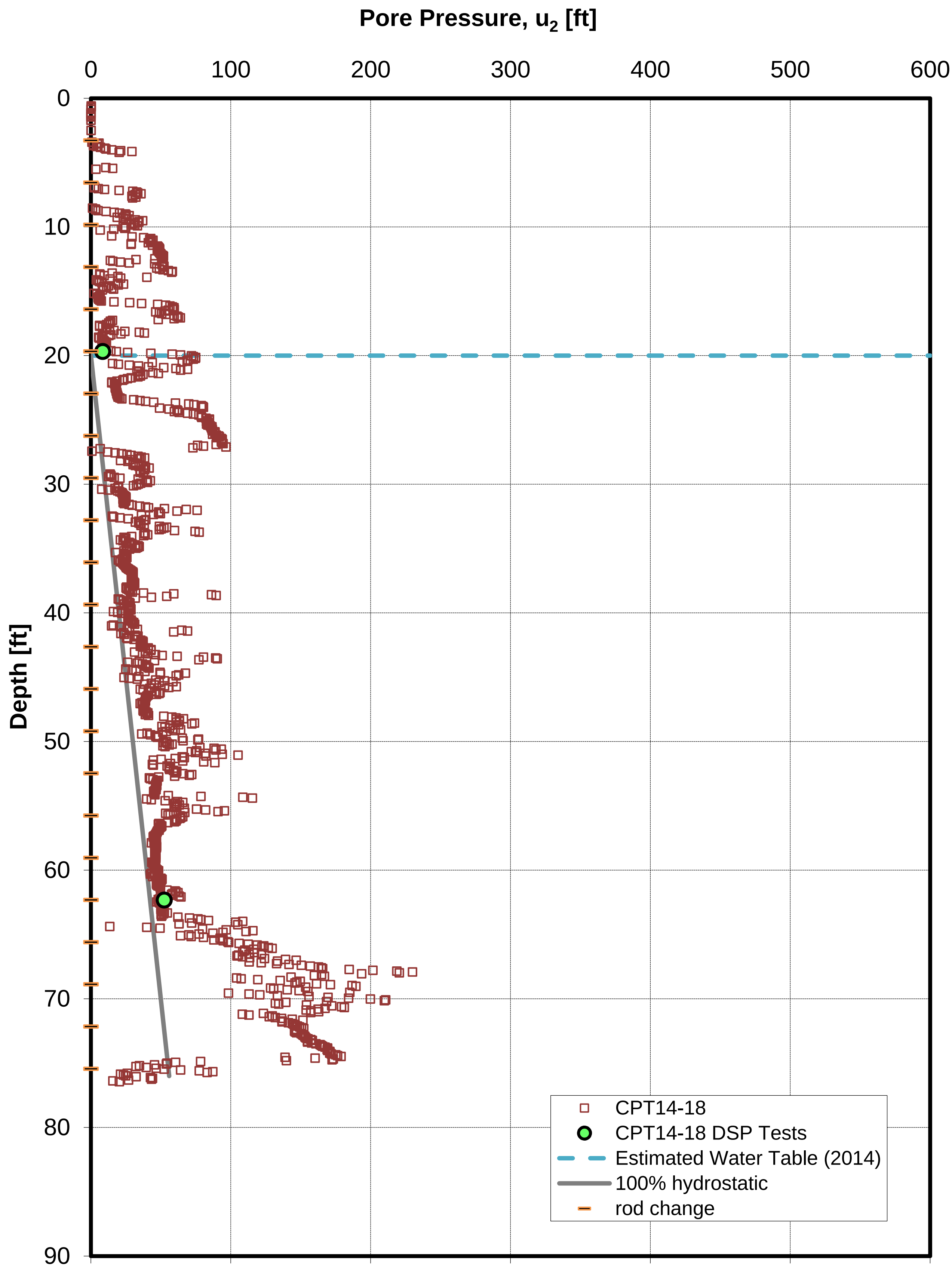
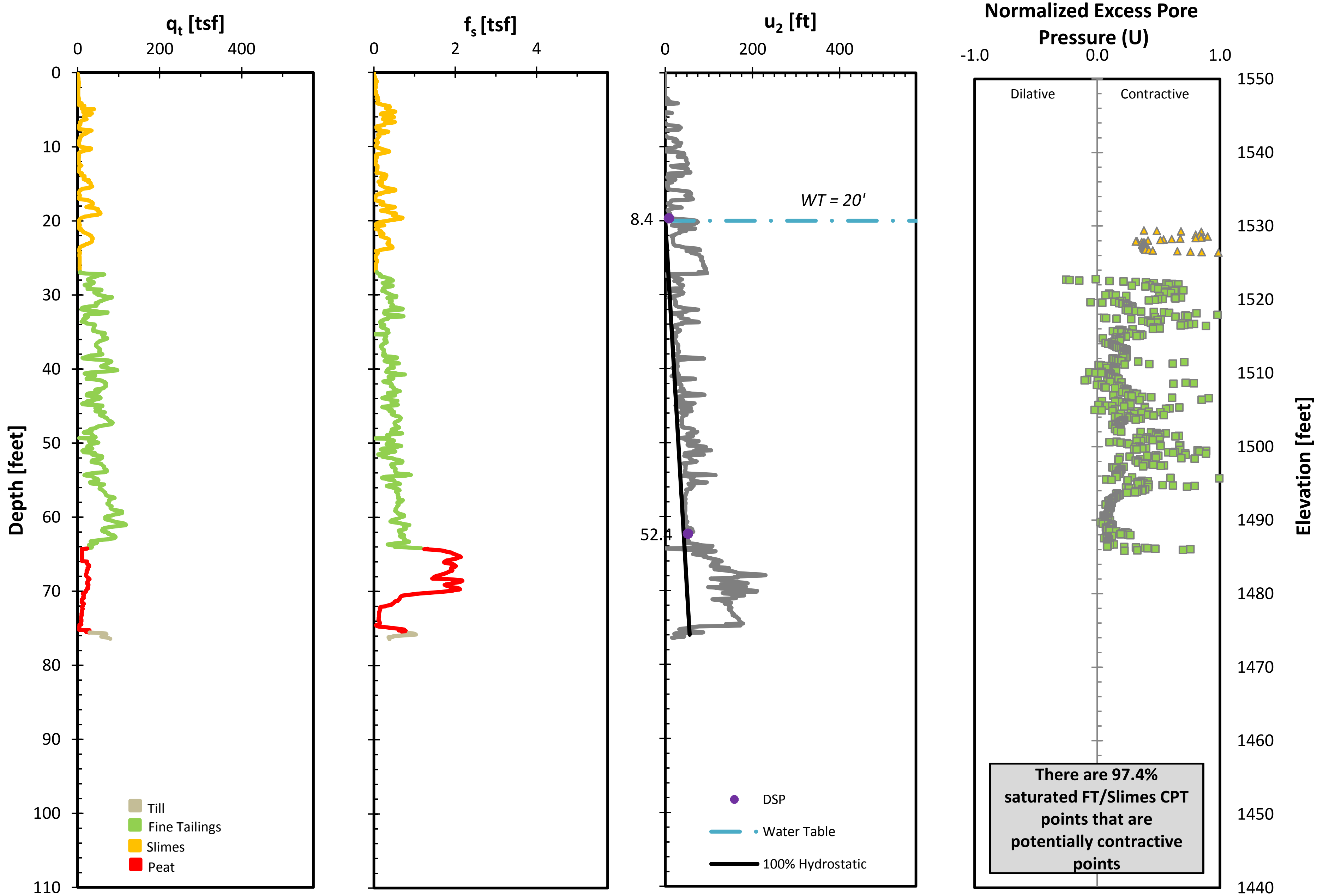


Figure G-5c. CPT14-18 Pore Pressure vs. Depth

FIGURE G-5d
CPT14-18 Behavior Plot



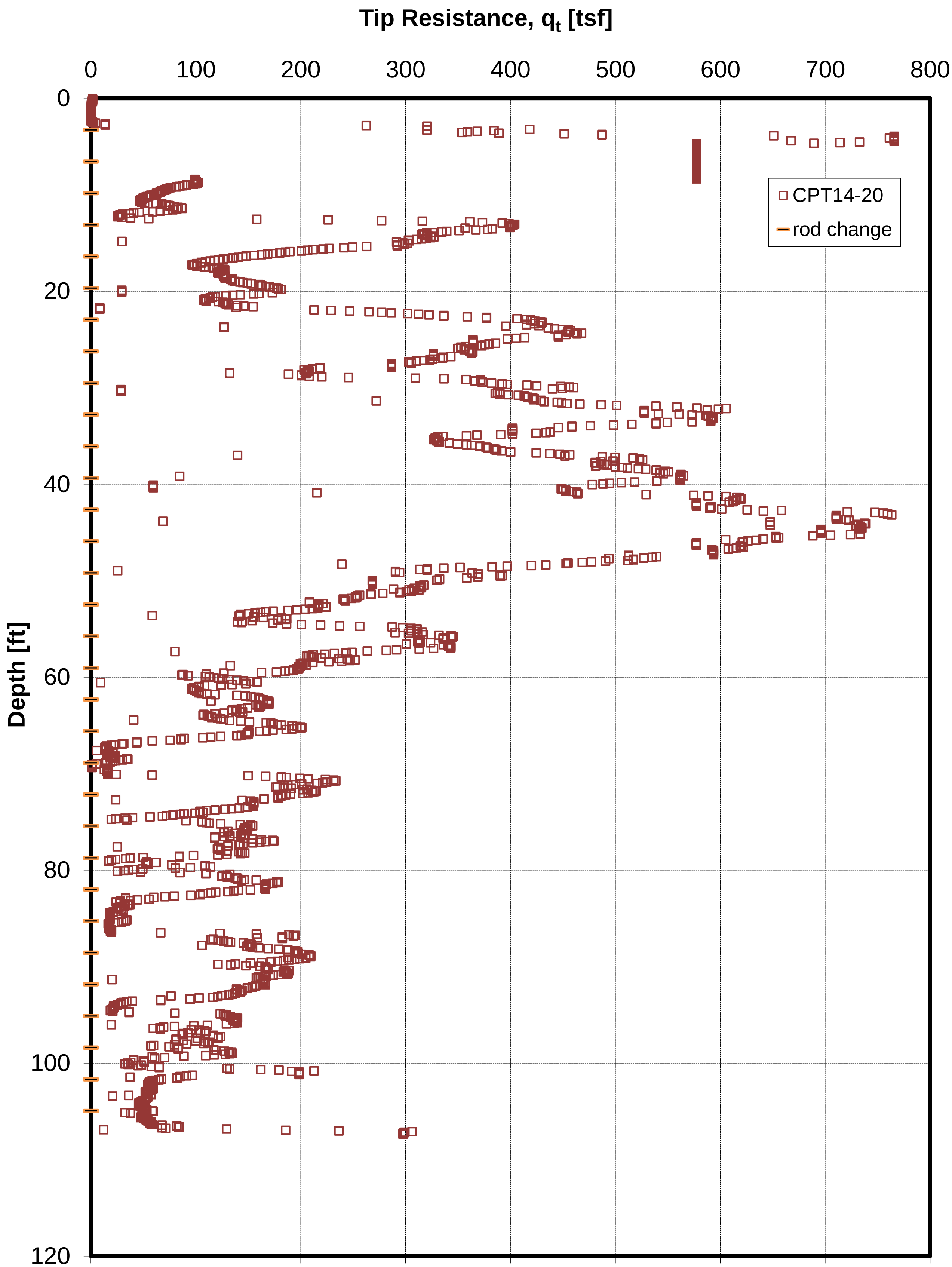


Figure G-6a. CPT 14-20 Tip Resistance vs. Depth

P:\Mpls\23 MN\69\2369C29 PolyMet NorthMet Engineering\Work Authorization 13\Other Costs\Soil Borings\Geotech Investigations\Winter Geotechnical Explorations 2013_2014\SOW 14_Part 1_CPT\processed results\Section F\CPT14-20.xlsm

11/3/2014

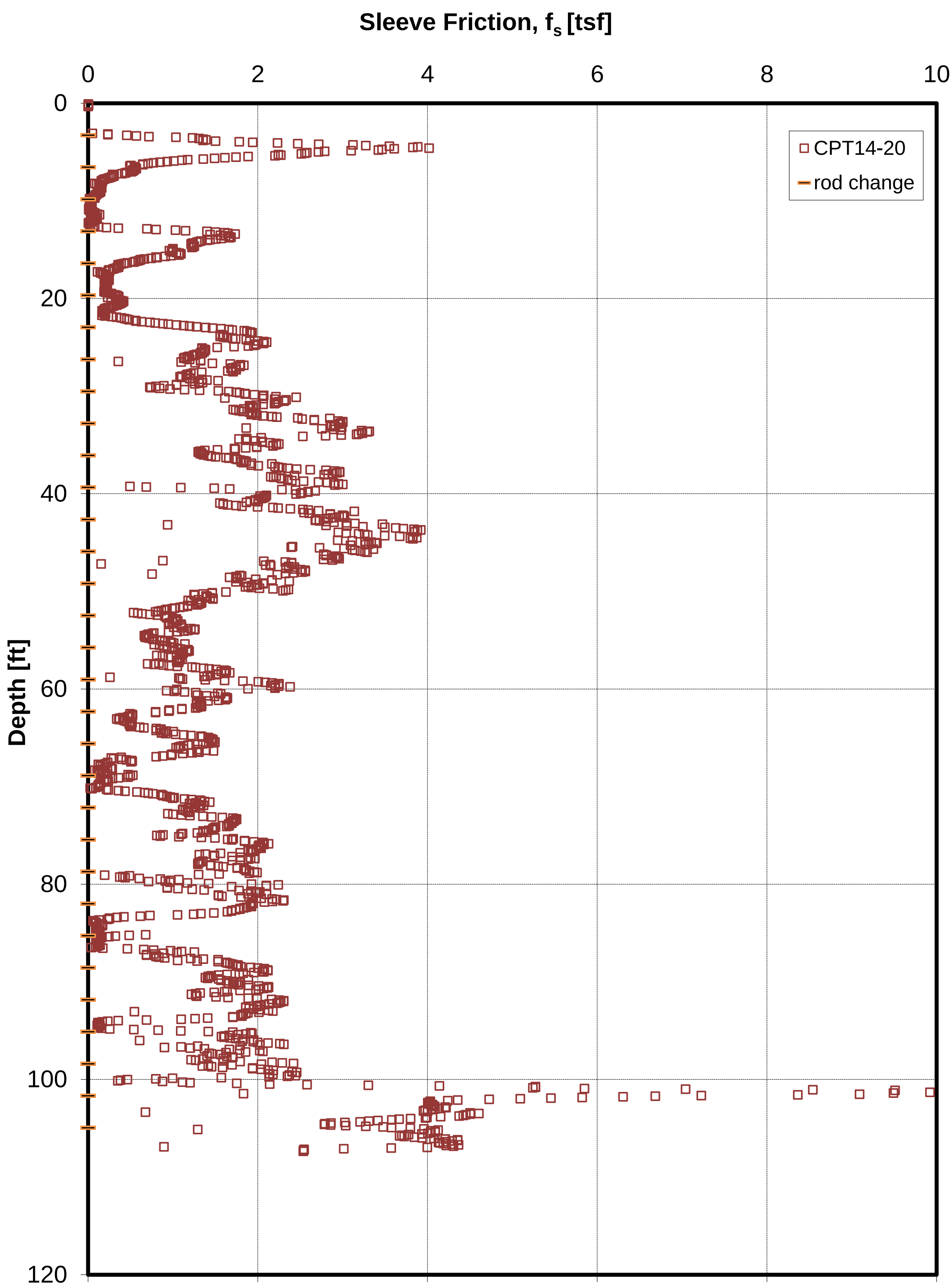


Figure G-6b. CPT14-20 Sleeve Friction vs. Depth

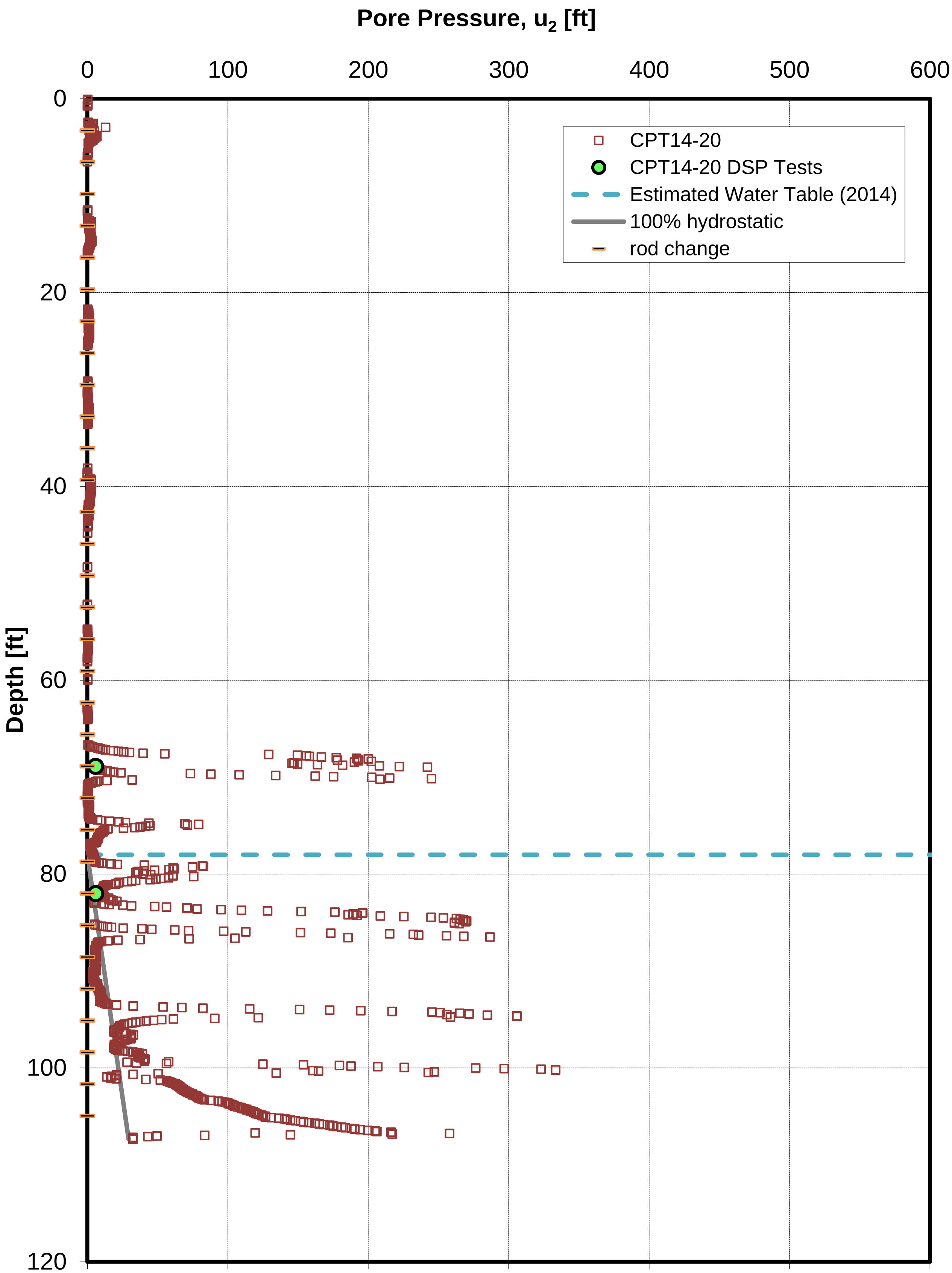
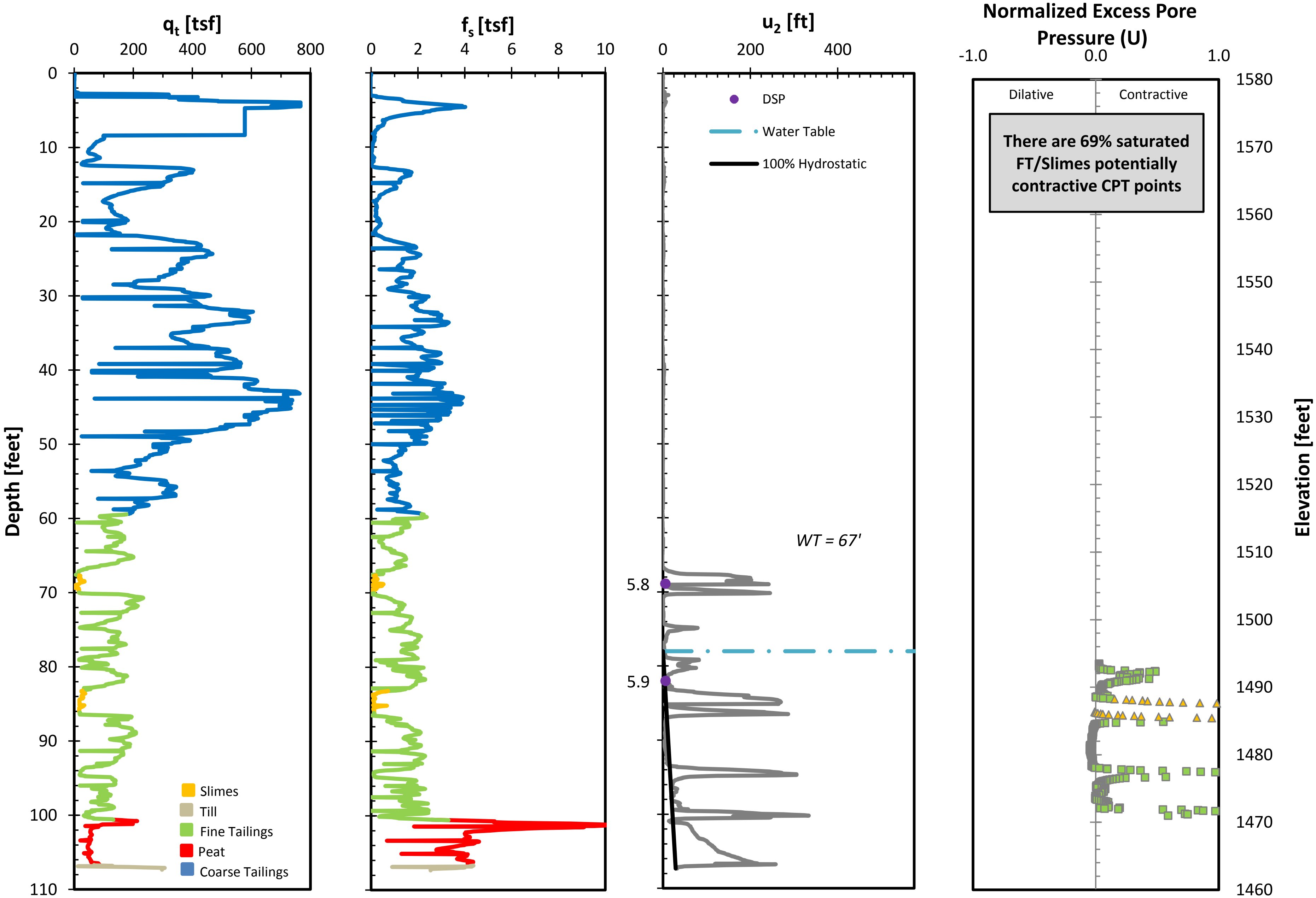


Figure G-6c. CPT14-20 Pore Pressure vs. Depth

FIGURE G-6d
CPT14-20 Behavior Plot



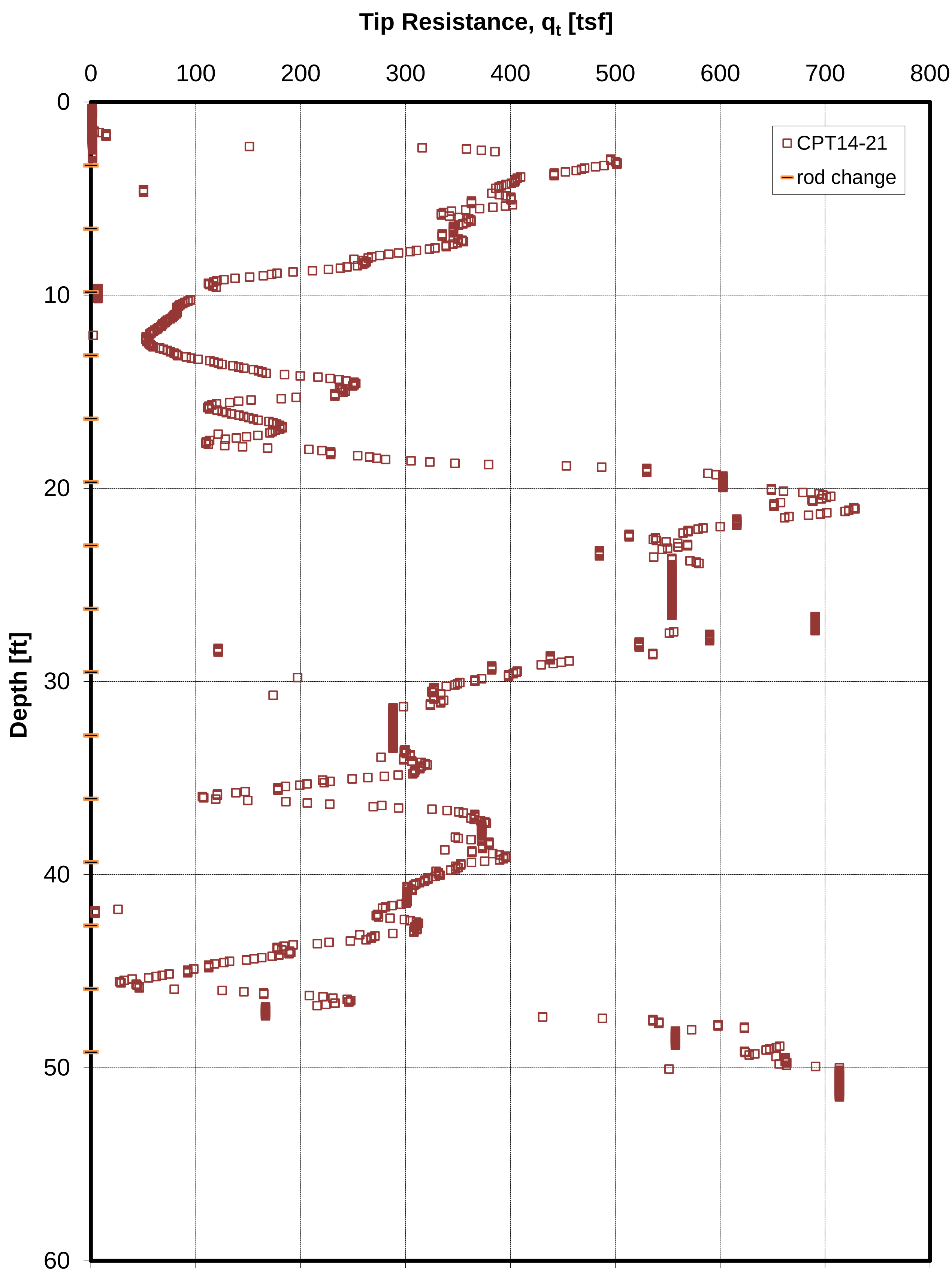


Figure G-7a. CPT14-21 Tip Resistance vs. Depth

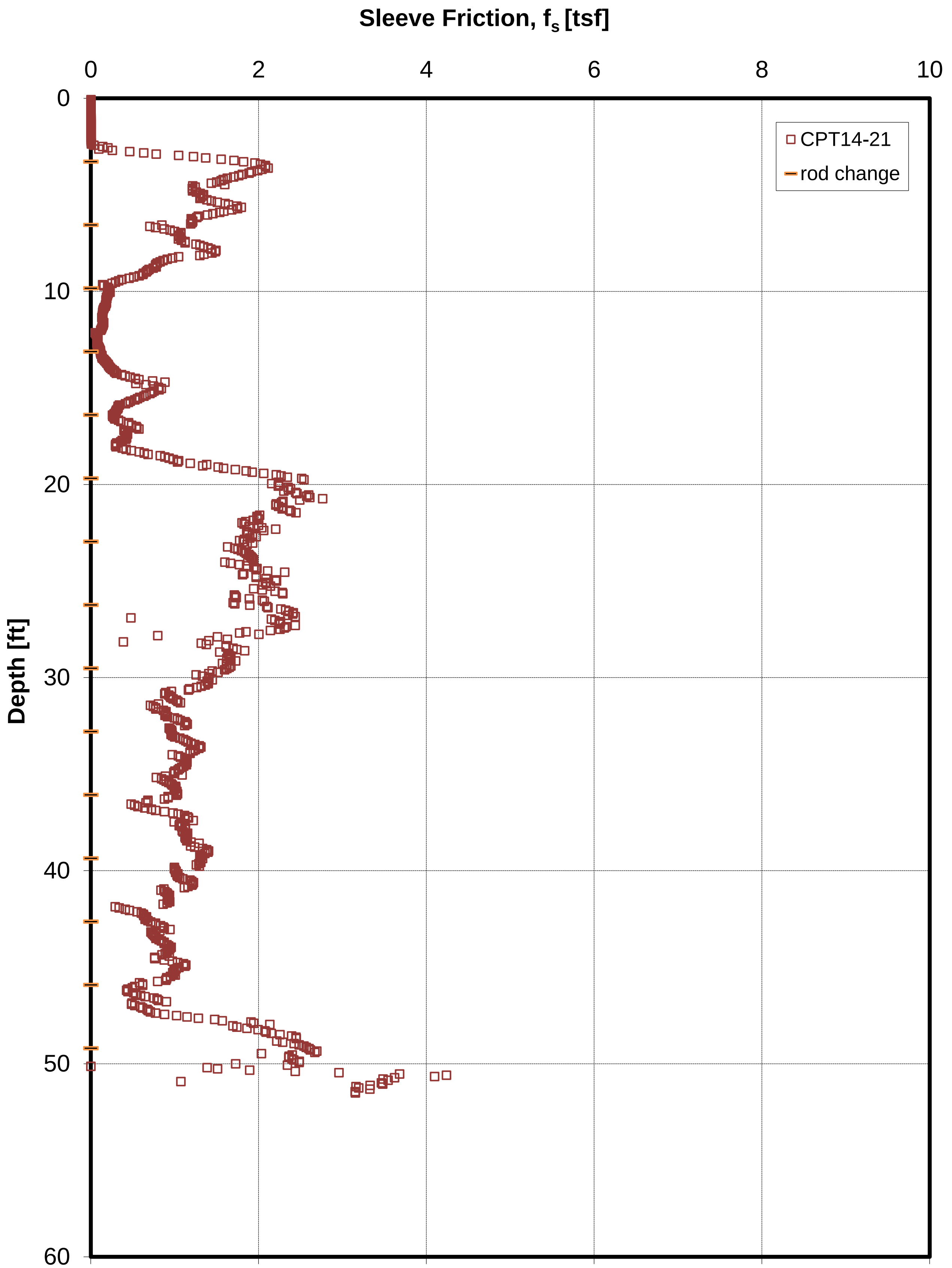


Figure G-7b. CPT14-21 Sleeve Friction vs. Depth

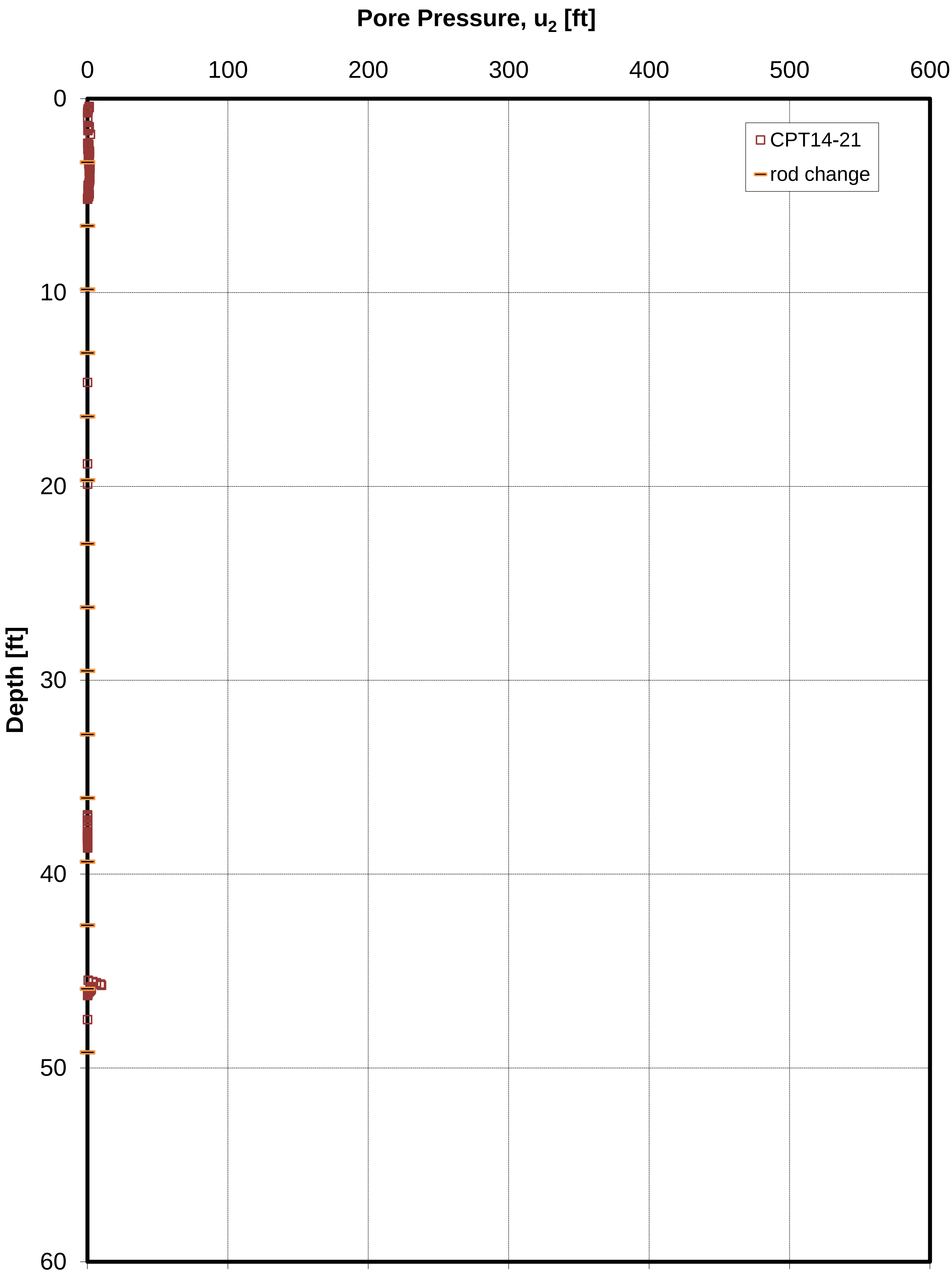
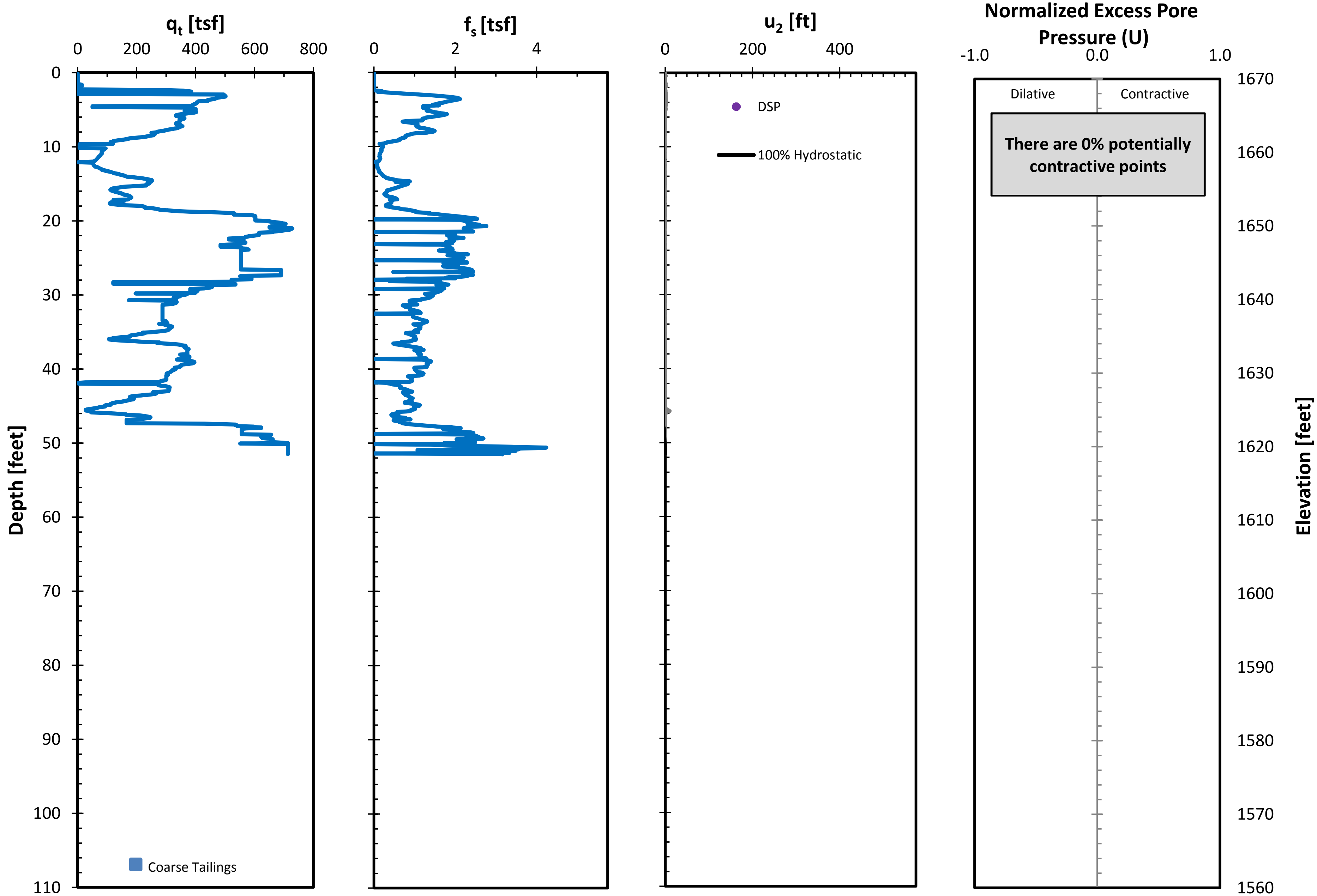


Figure G-7c. CPT14-21 Pore Pressure vs. Depth

FIGURE G-7d

CPT14-21 Behavior Plot



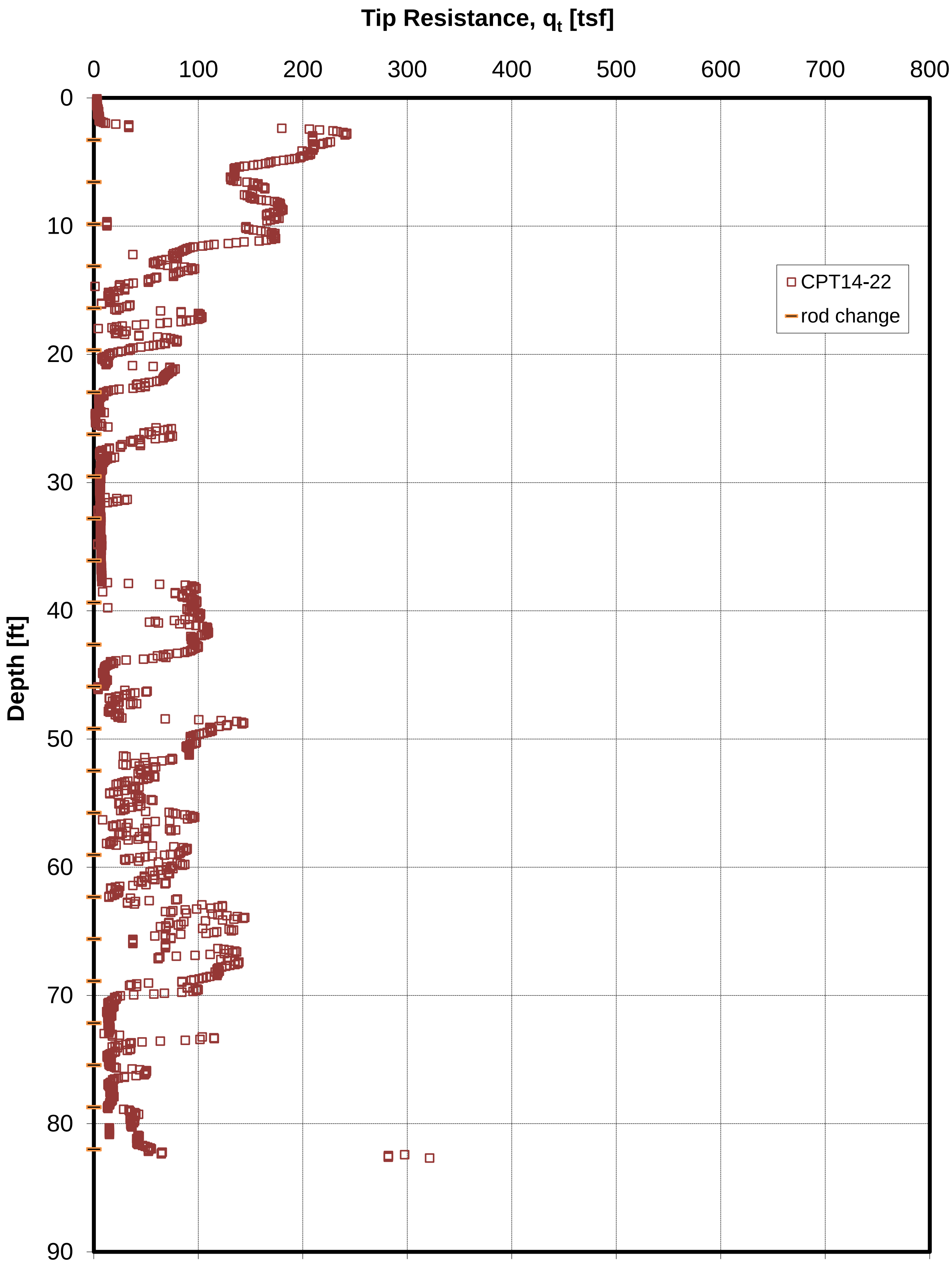


Figure G-8a. CPT14-22 Tip Resistance vs. Depth

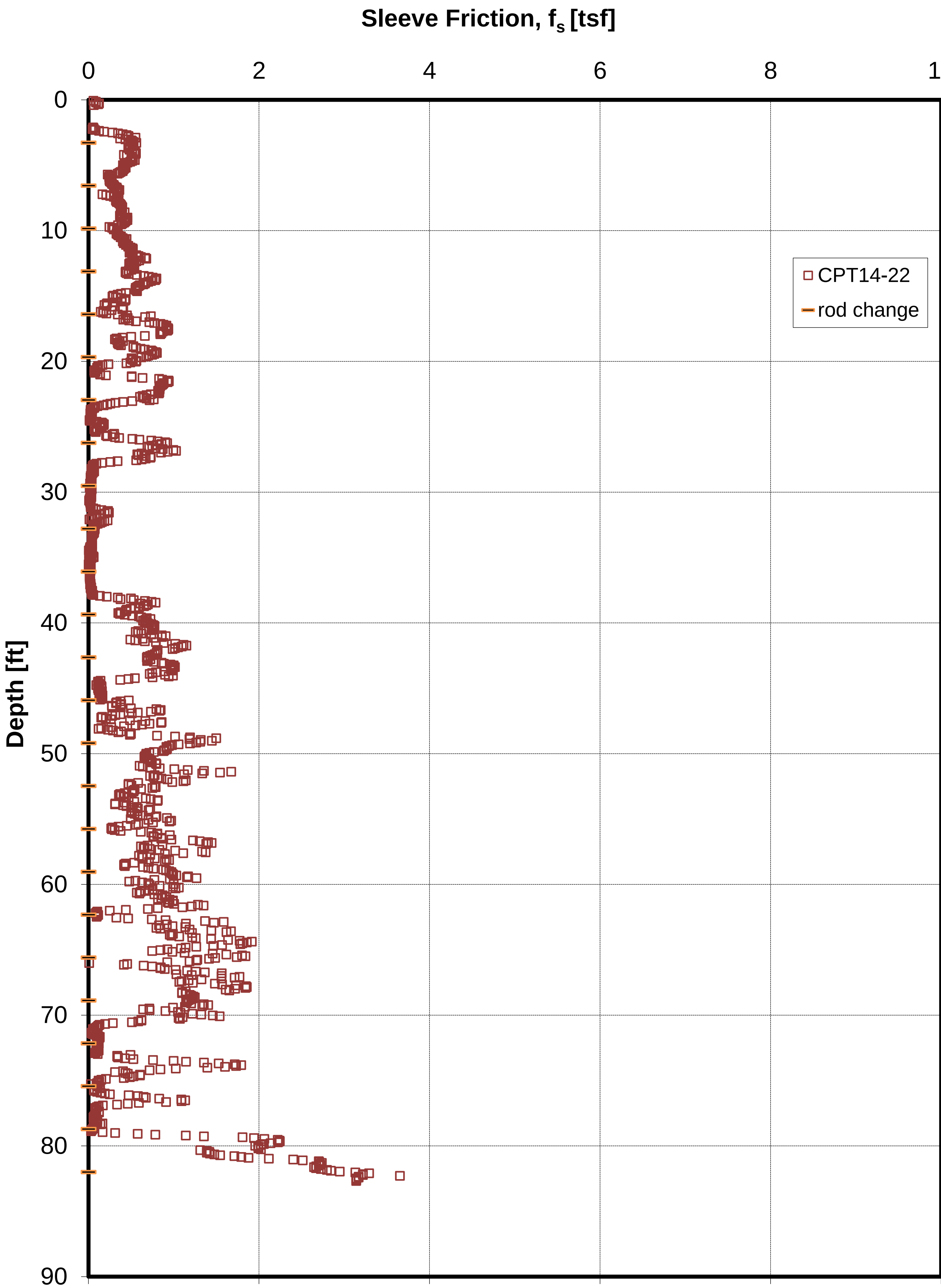


Figure G-8b. CPT14-22 Sleeve Friction vs. Depth

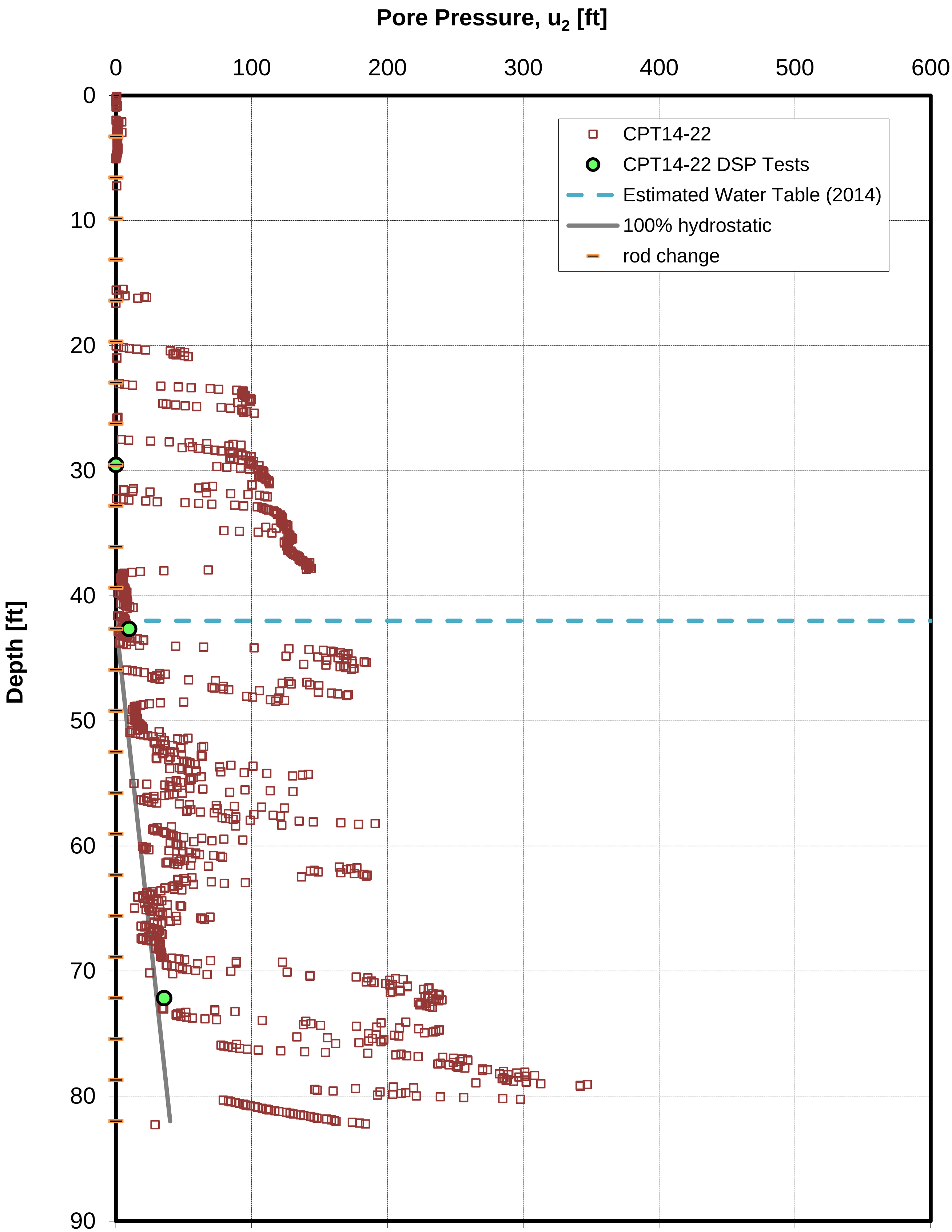
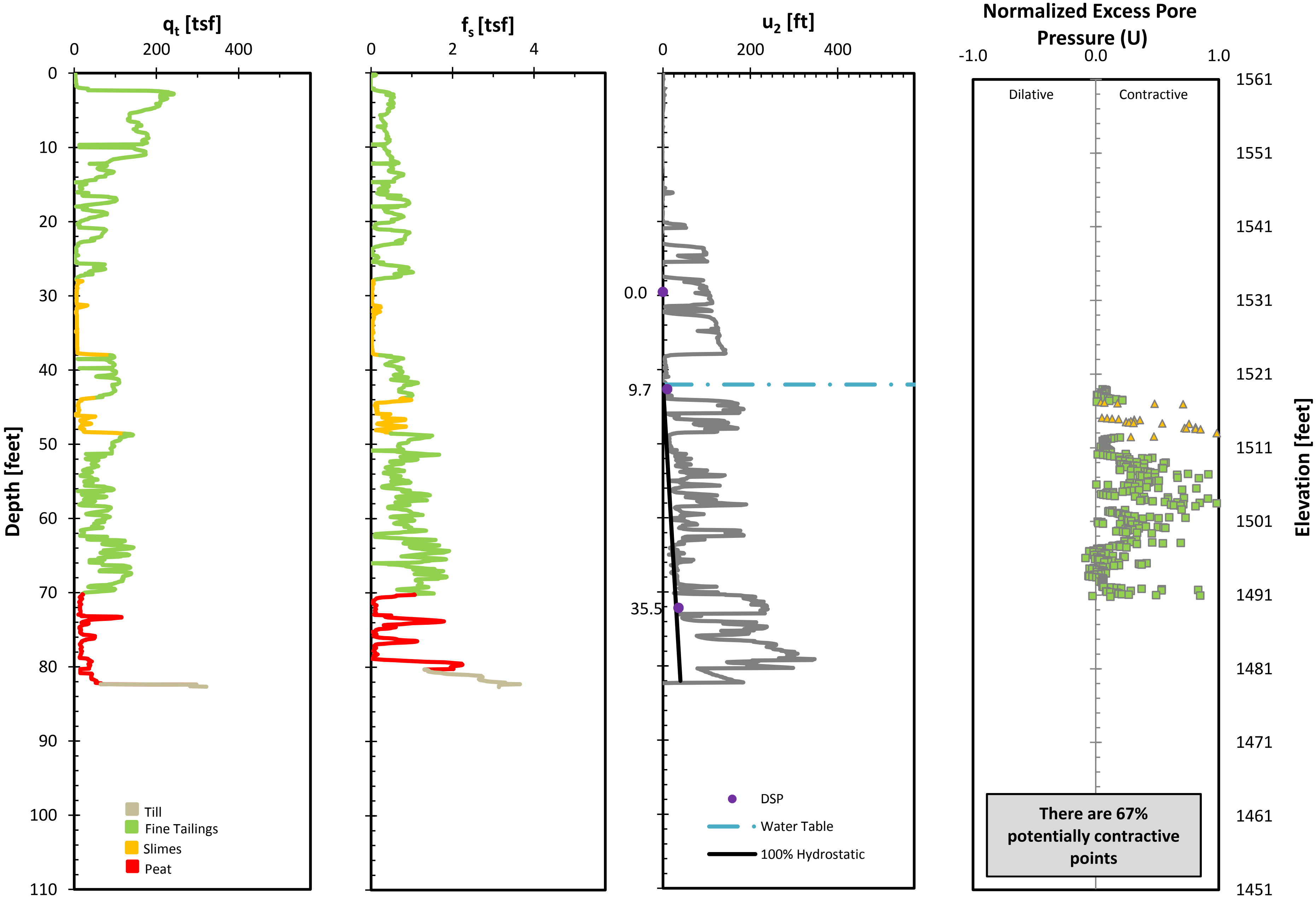


Figure G-8c. CPT14-22 Pore Pressure vs. Depth

FIGURE G-8d
CPT14-22 Behavior Plot



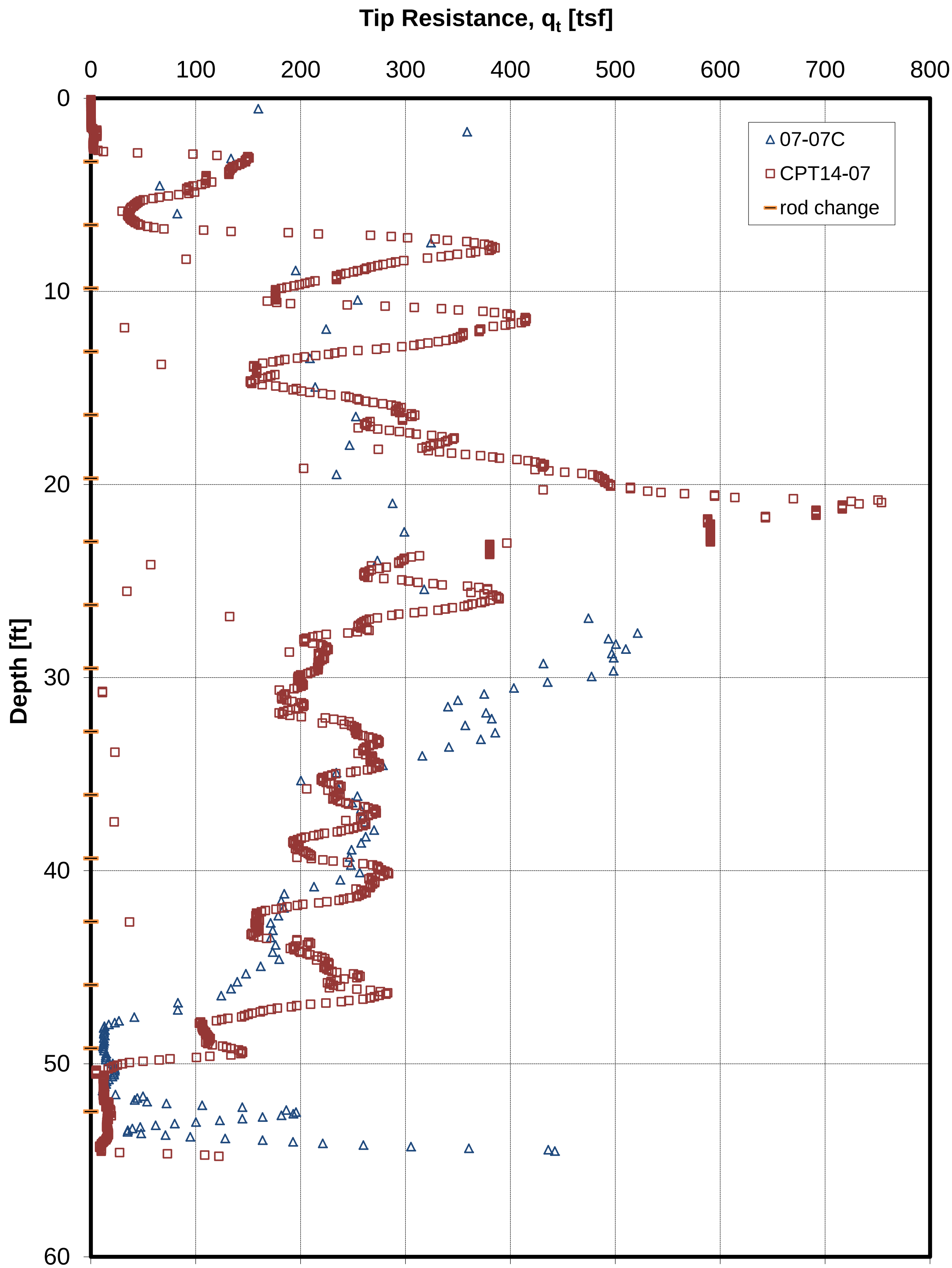


Figure G-9a. CPT 07-07C/CPT14-07 Tip Resistance vs. Depth

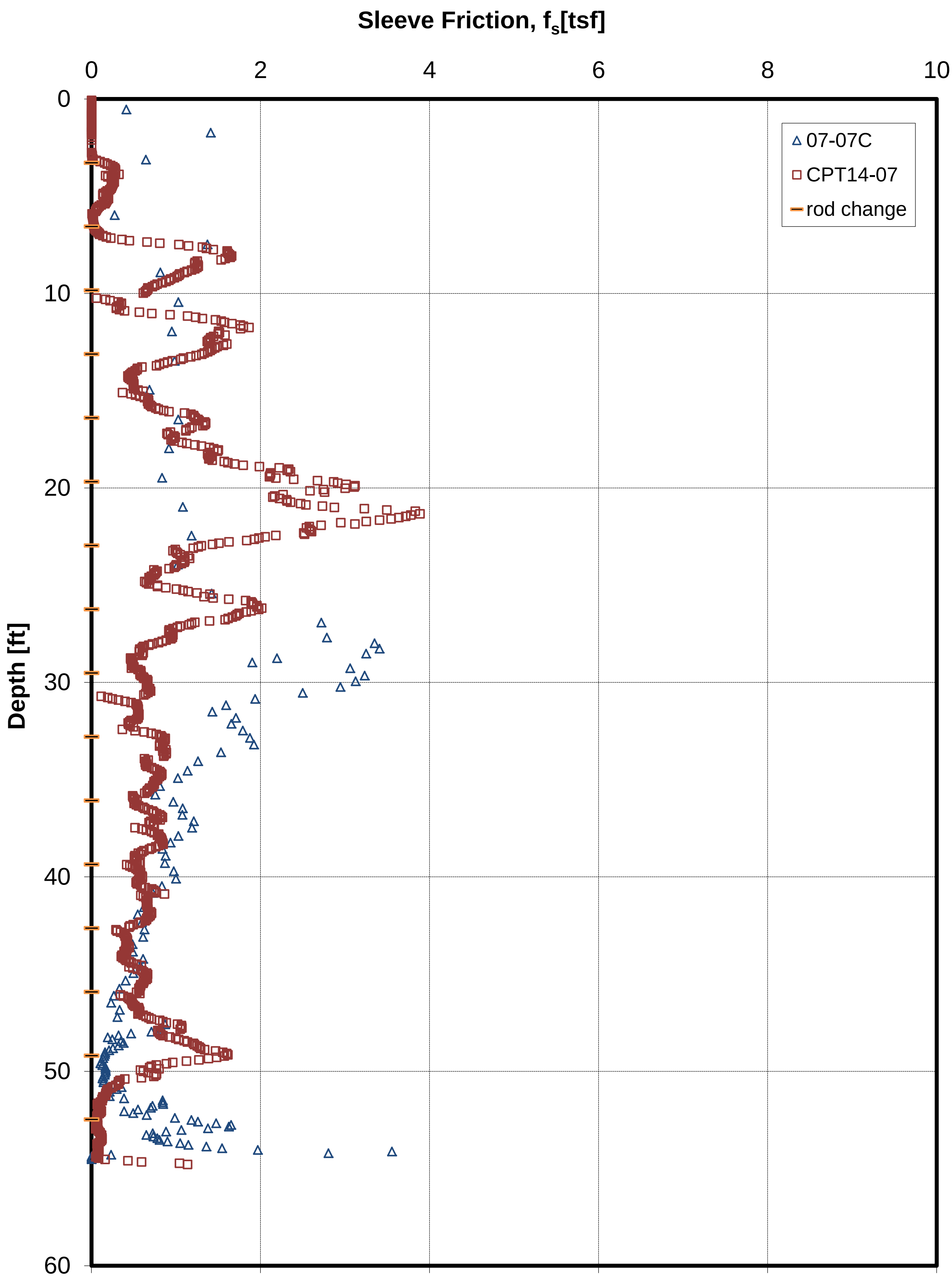


Figure G-9b. CPT 07-07C/CPT14-07 Sleeve Friction vs. Depth

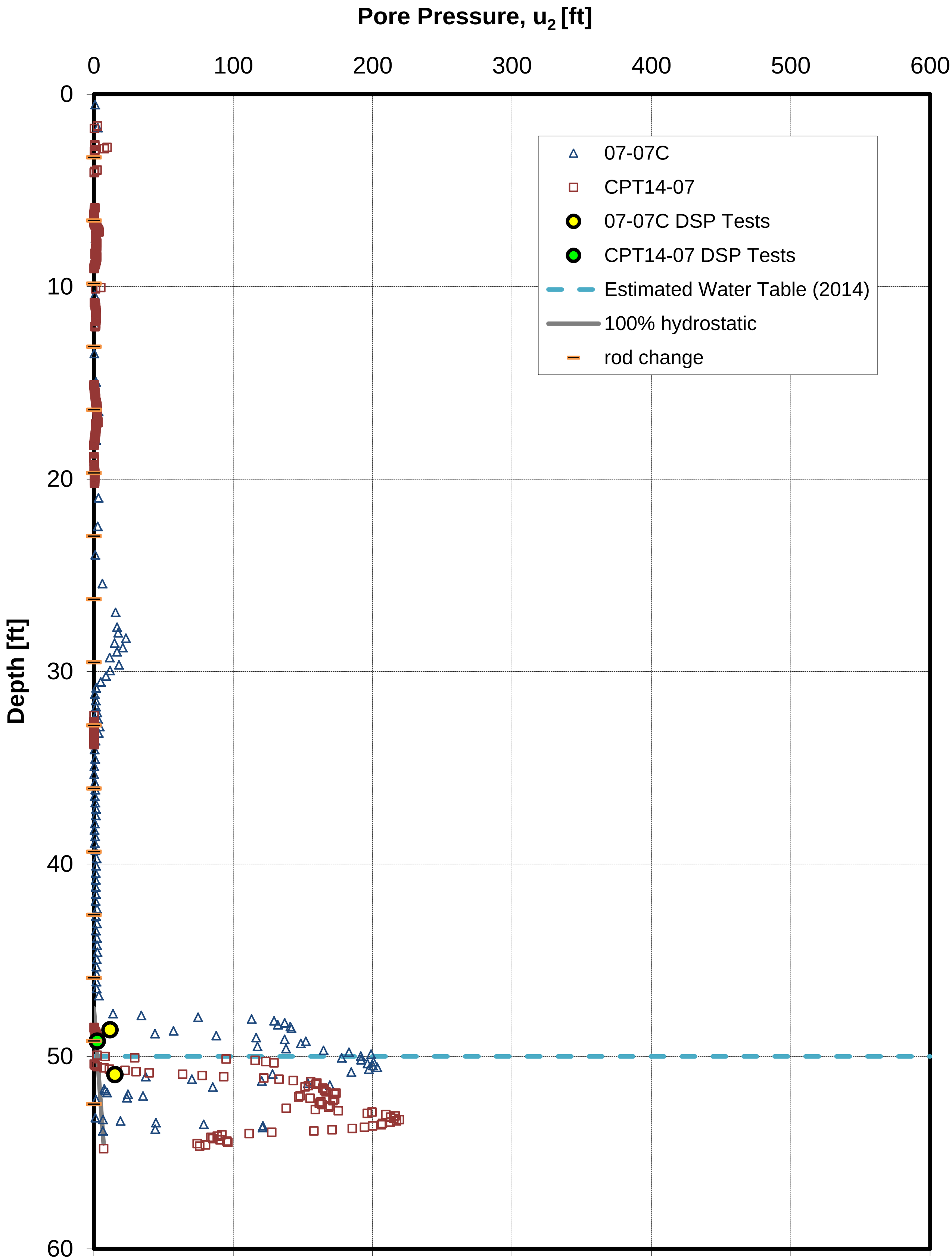
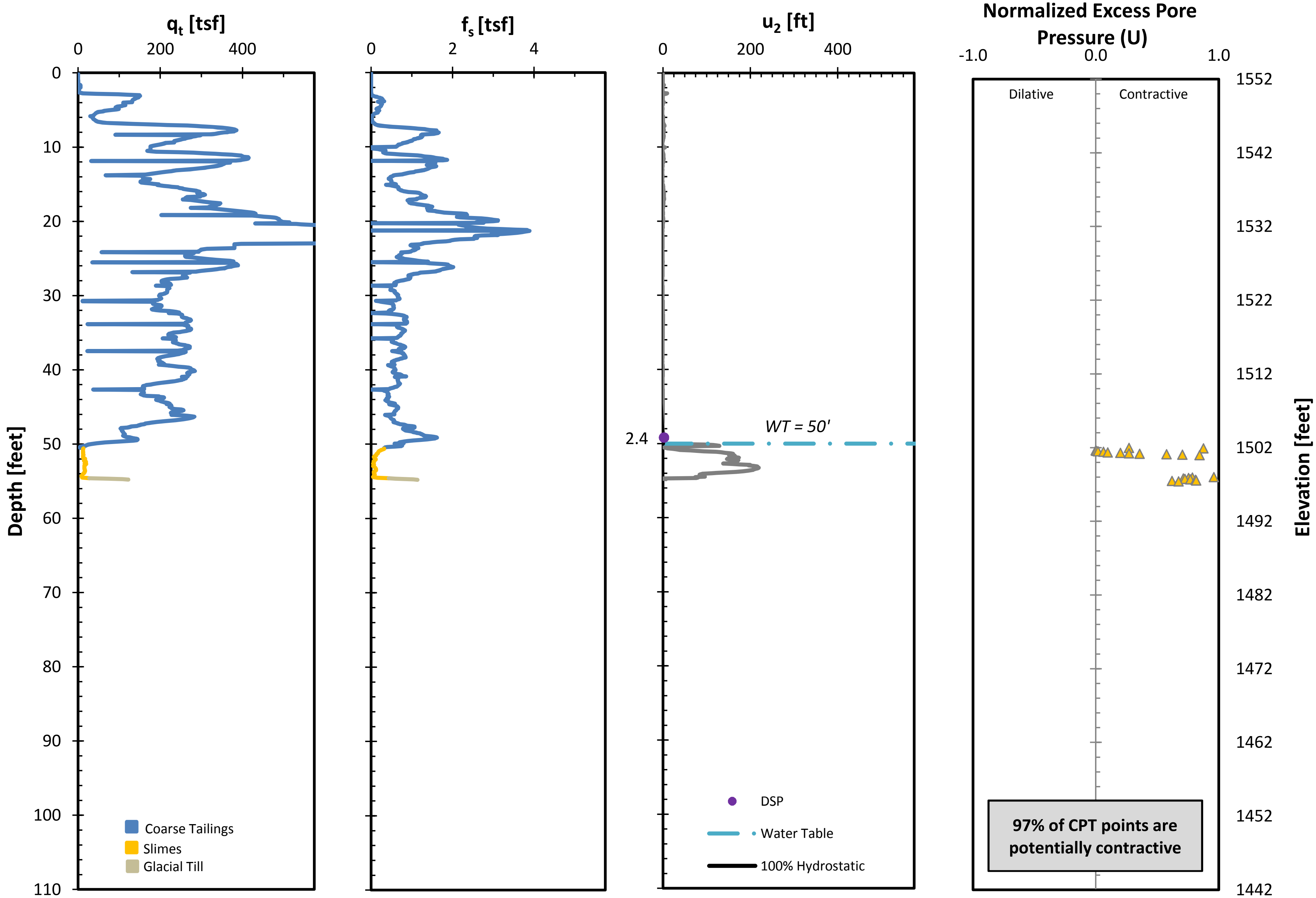


Figure G-9c. CPT 07-07C/CPT14-07 Pore Pressure vs. Depth

FIGURE G-9d

CPT 14-07 Behavior Plot



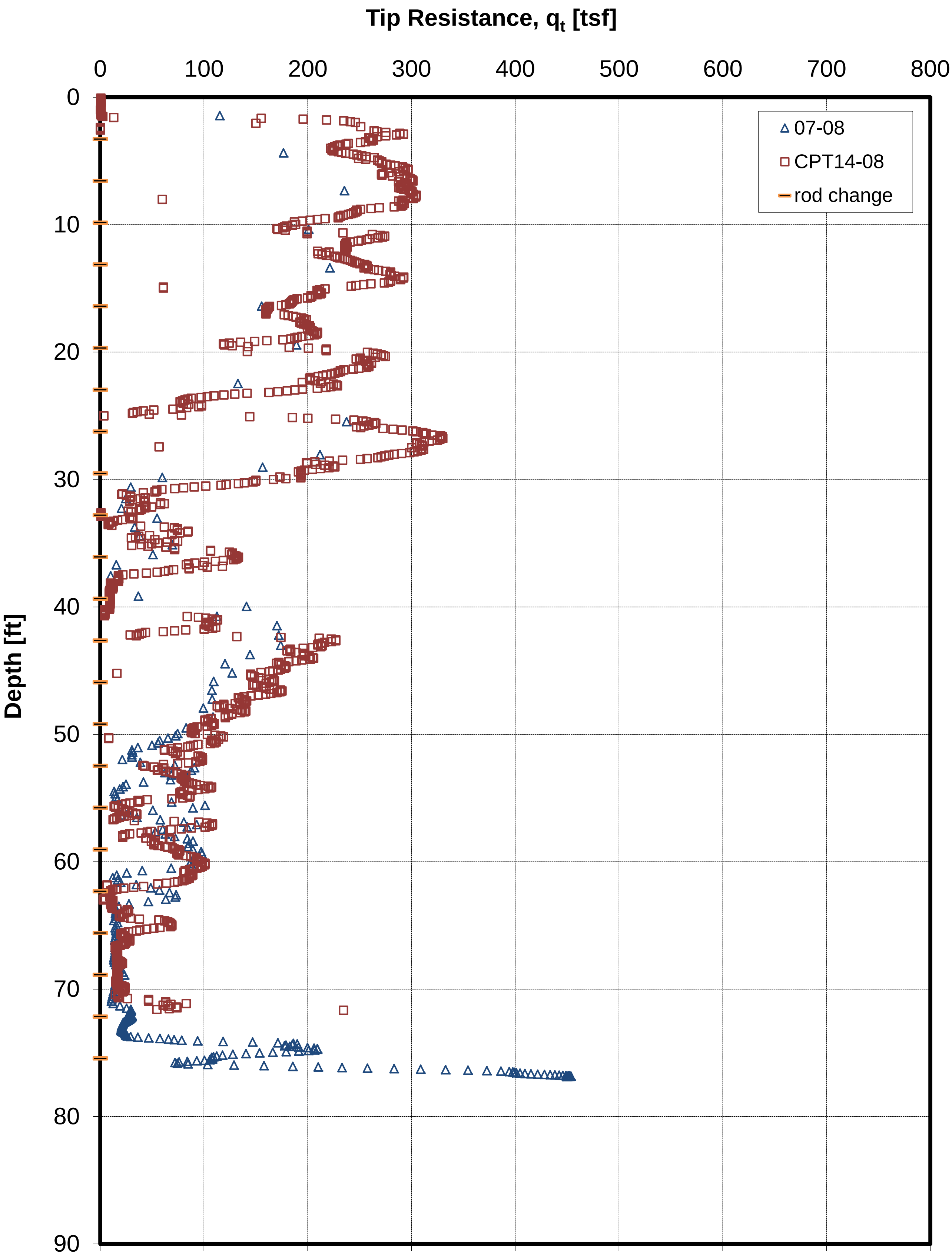


Figure G-10a. CPT 07-08/CPT14-08 Tip Resistance vs. Depth

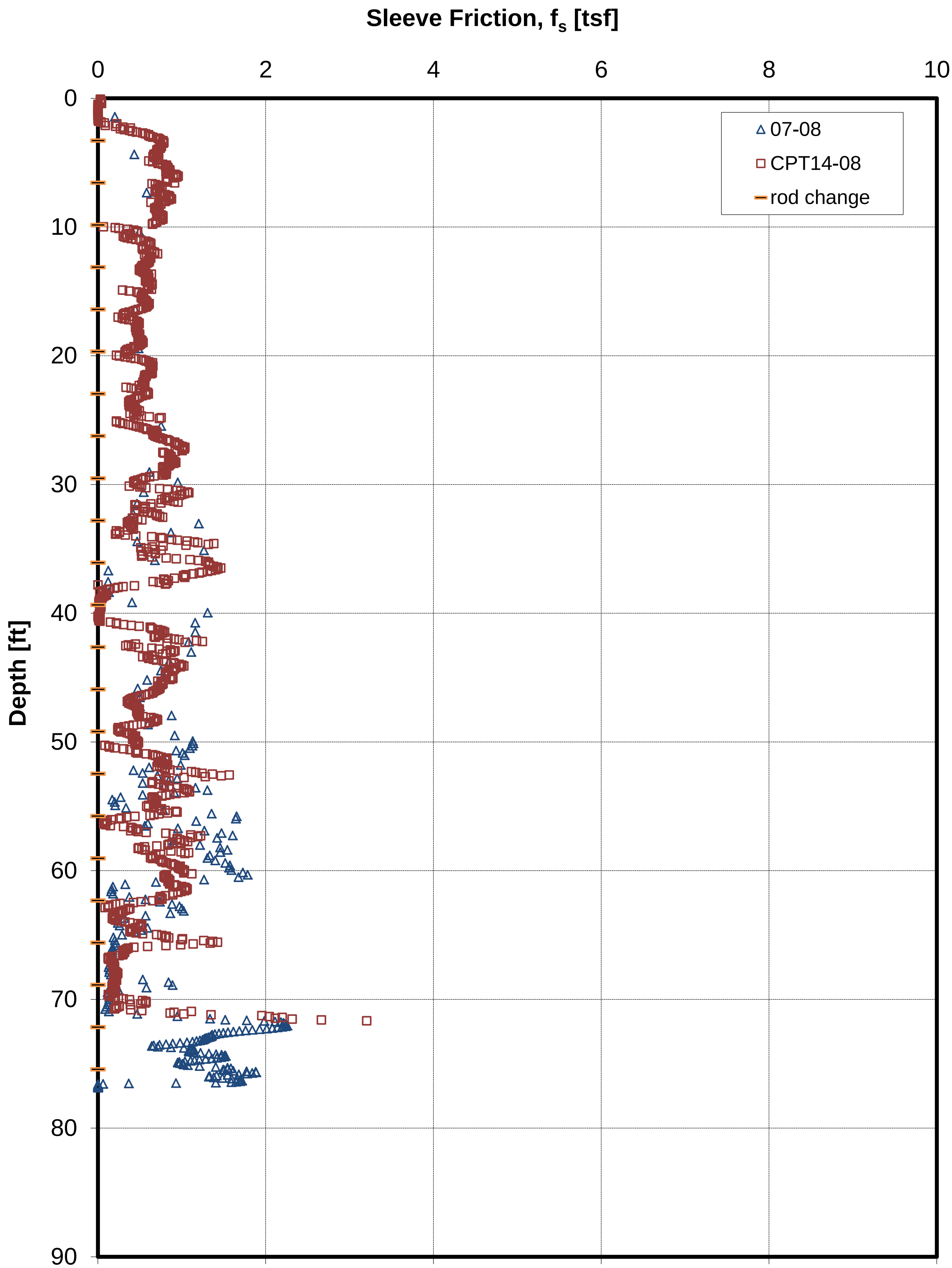


Figure G-10b. CPT 07-08/CPT14-08 Sleeve Friction vs. Depth

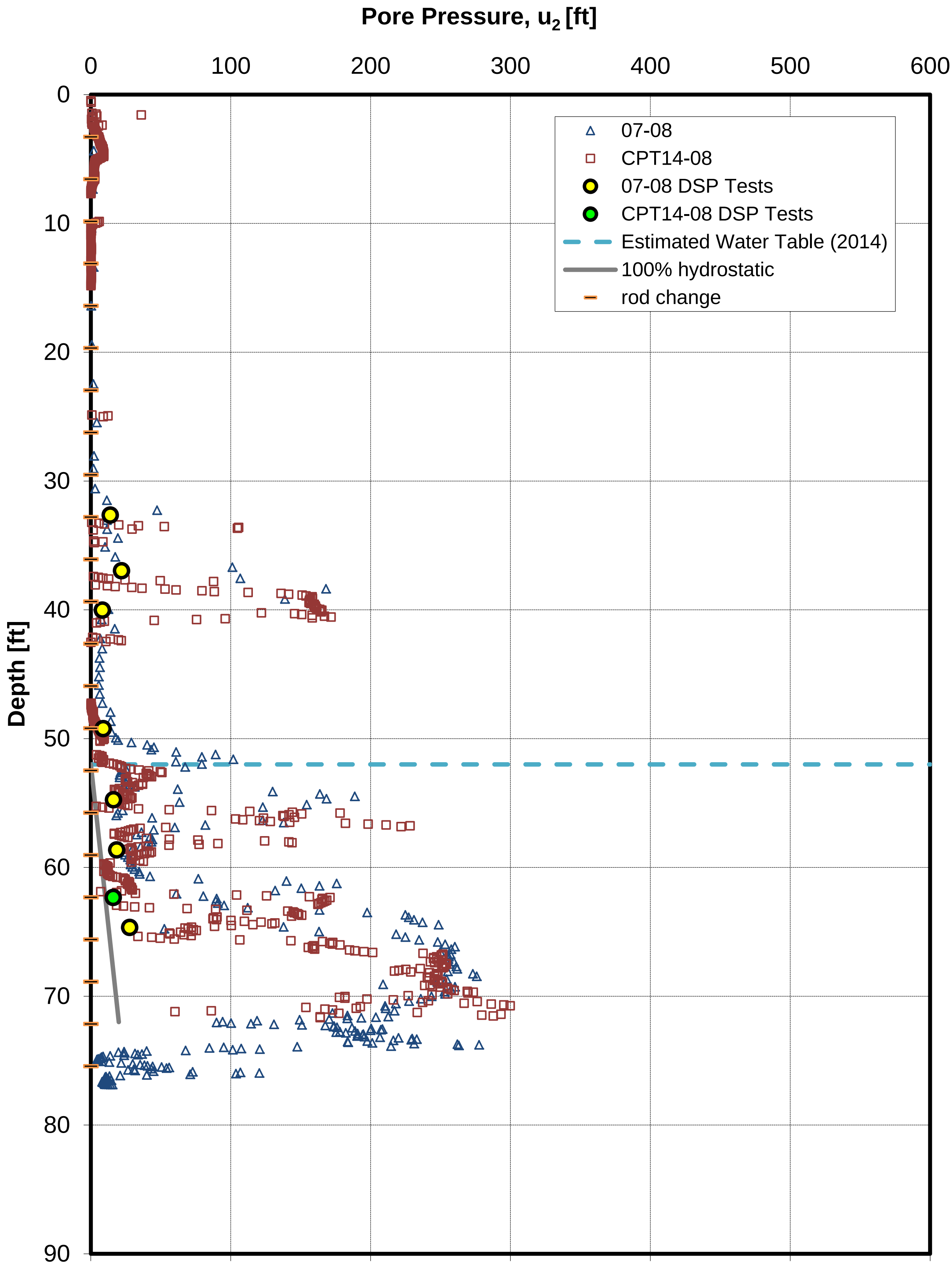
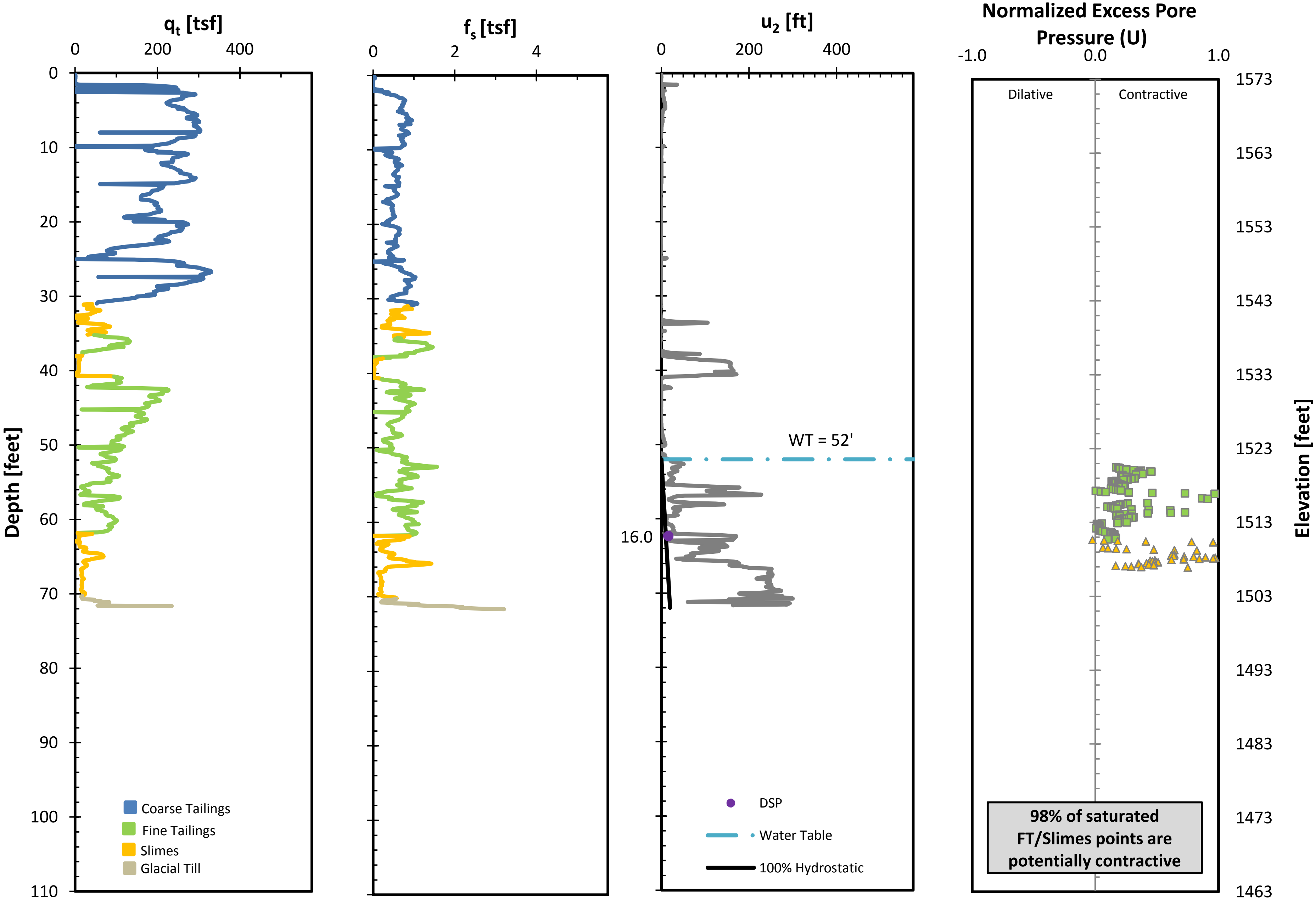


Figure G-10c. CPT 07-08/CPT14-08 Pore Pressure vs. Depth

FIGURE G-10d

CPT14-08 Behavior Plot



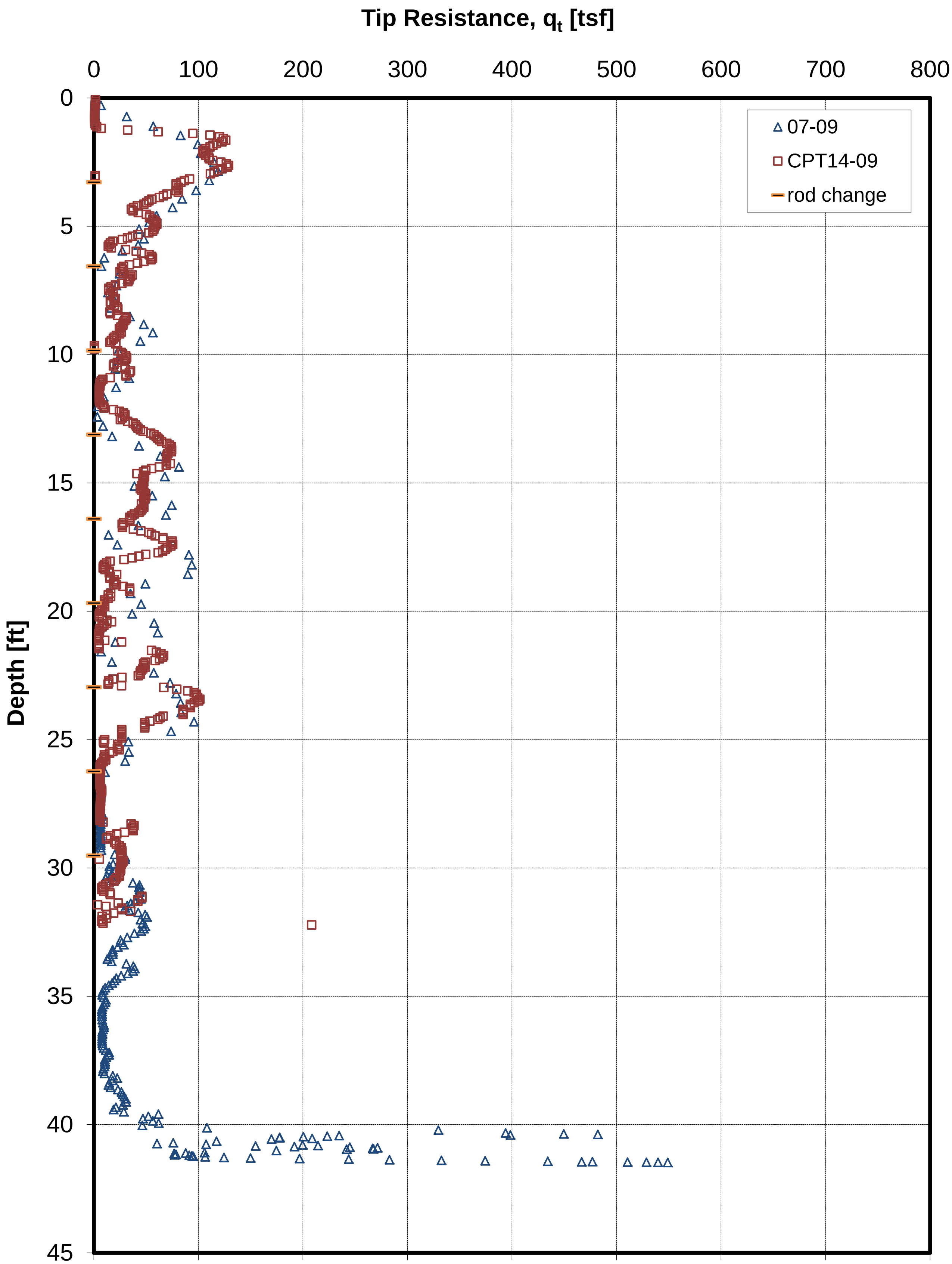


Figure G-11a. CPT 07-09/CPT14-09 Tip Resistance vs. Depth

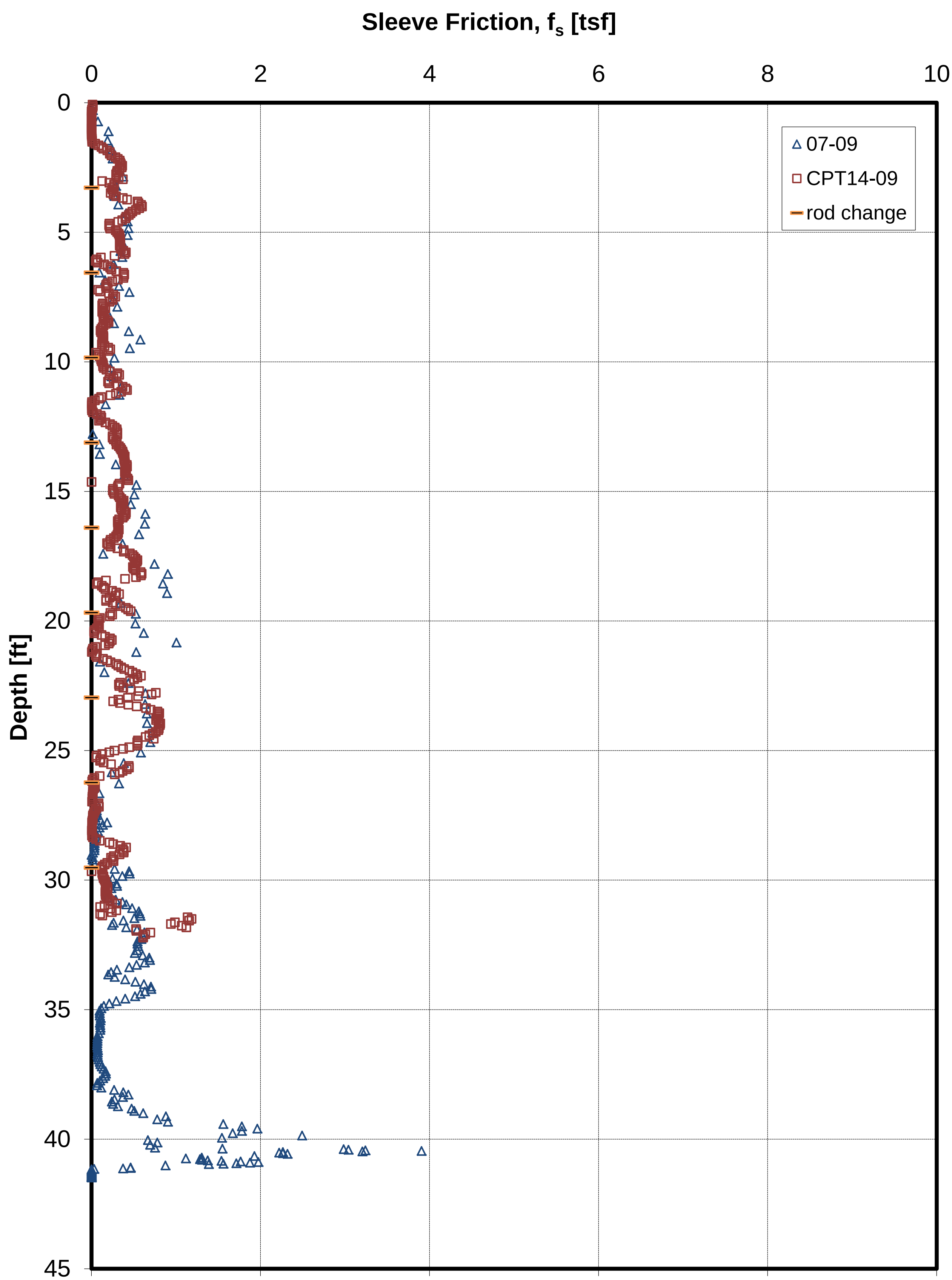


Figure G-11b. CPT 07-09/CPT14-09 Sleeve Friction vs. Depth

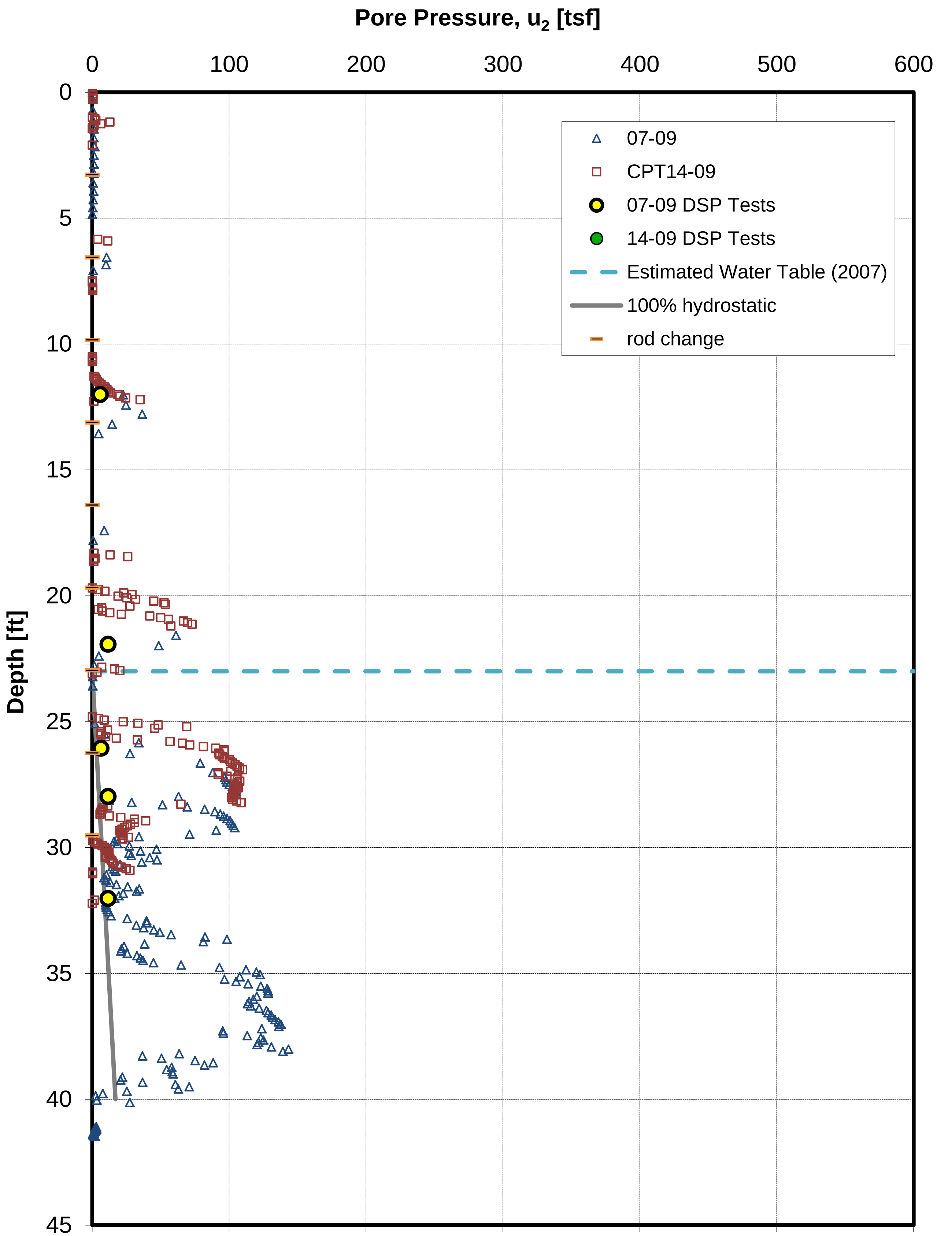
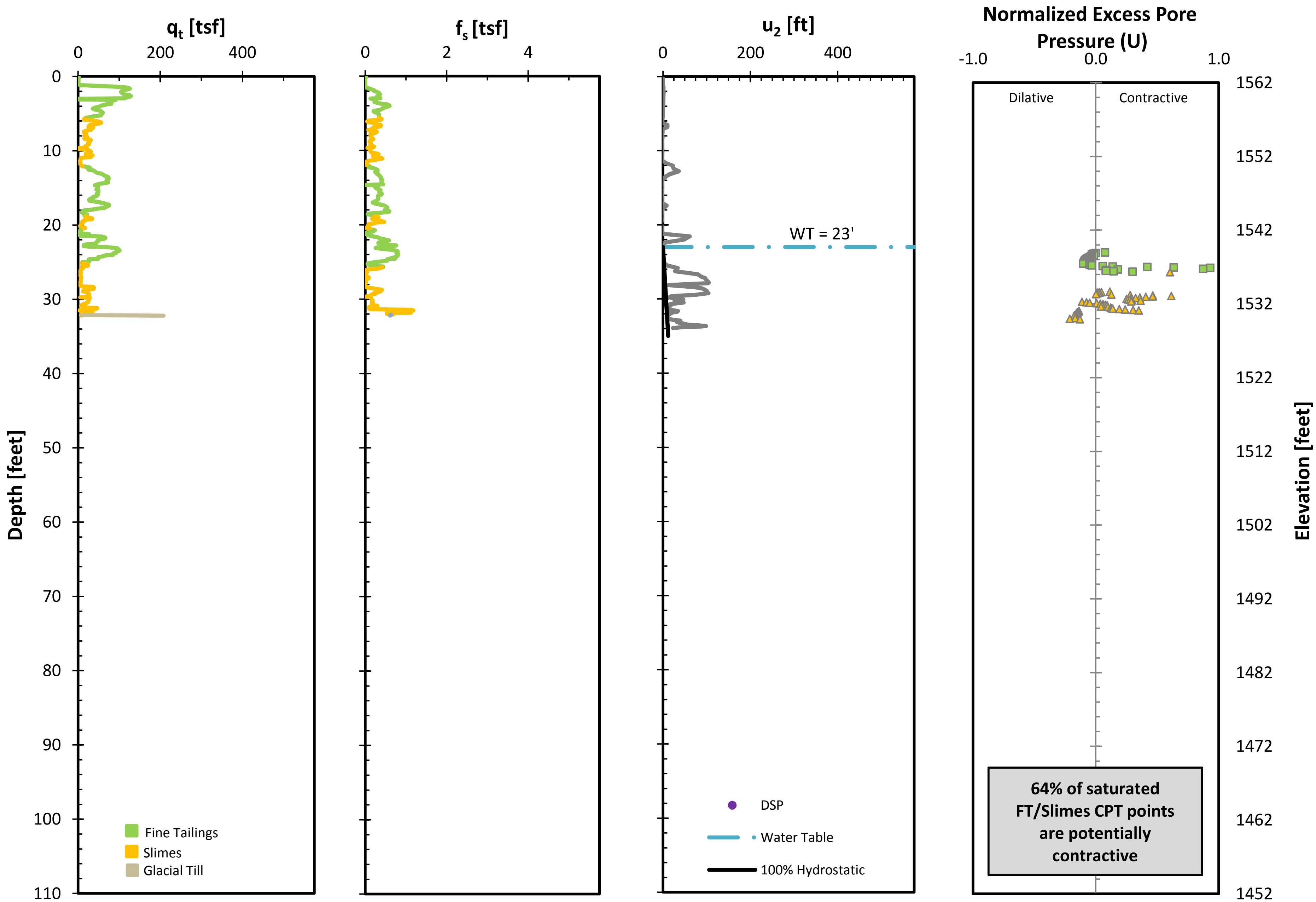


Figure G-11c. CPT 07-09/CPT14-09 Pore Pressure vs. Depth

FIGURE G-11d

CPT14-09 Behavior Plot



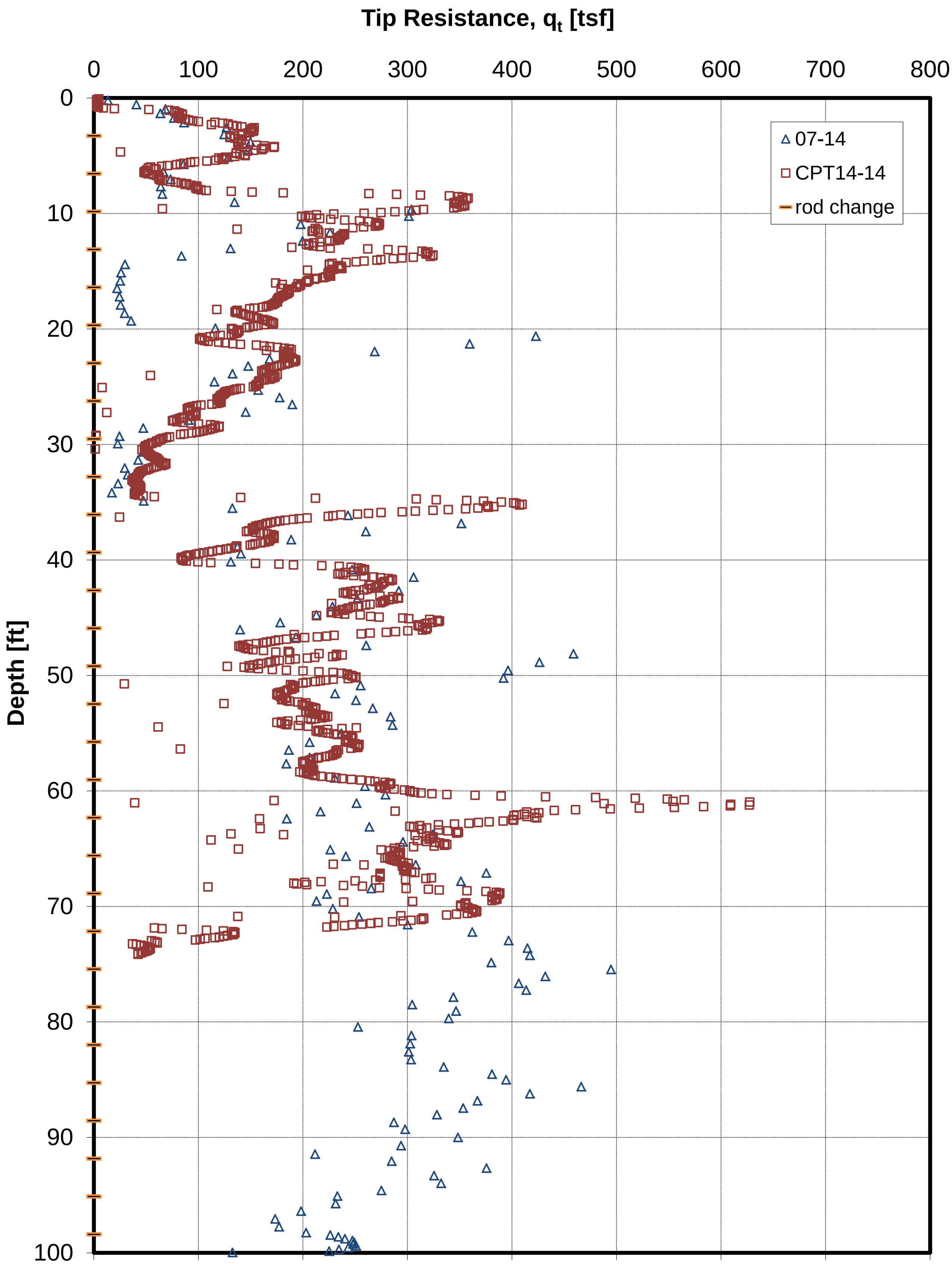


Figure G-12a. CPT 07-14/CPT14-14 Tip Resistance vs. Depth

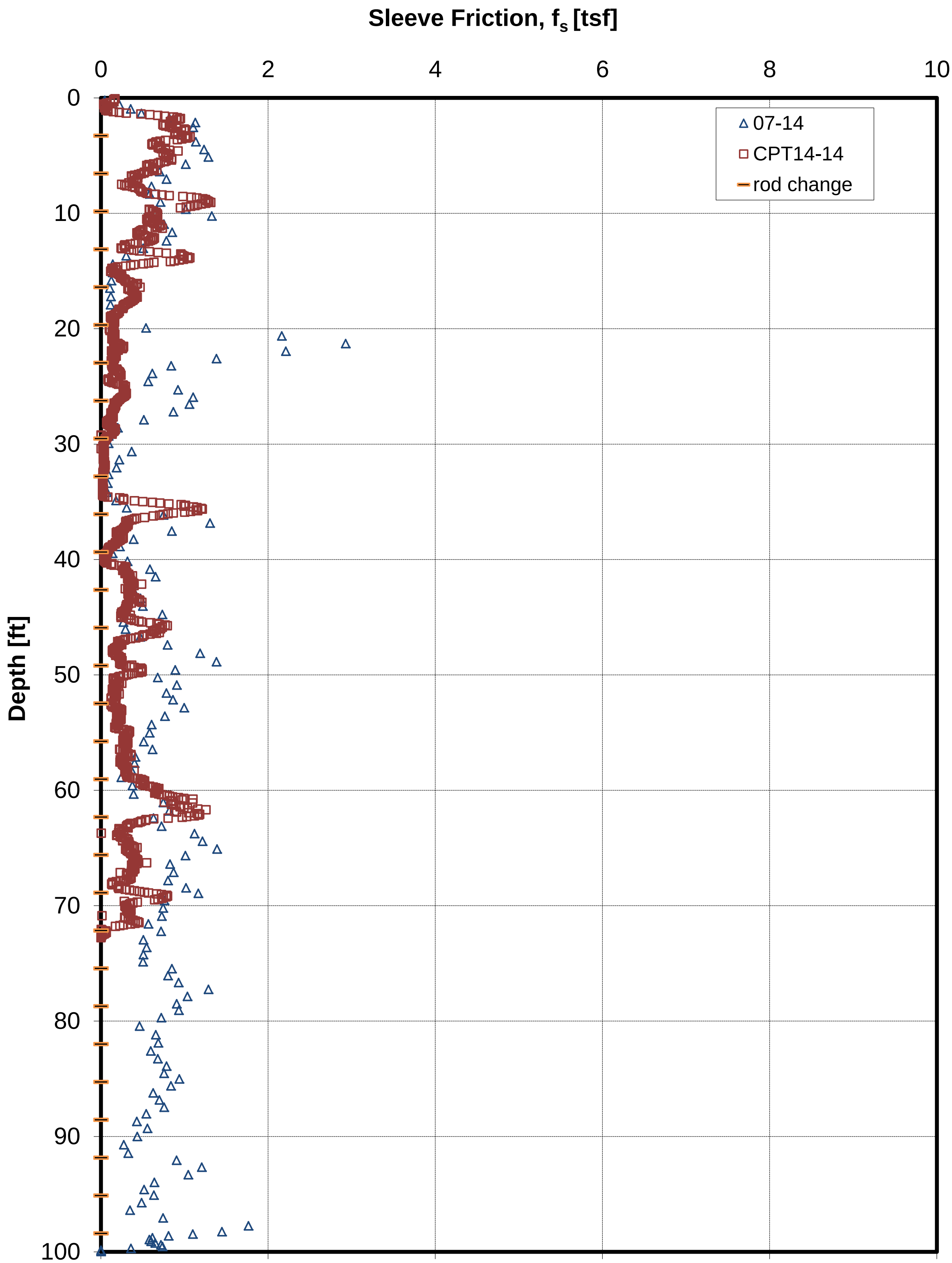


Figure G-12b. CPT 07-14/CPT14-14 Sleeve Friction vs. Depth

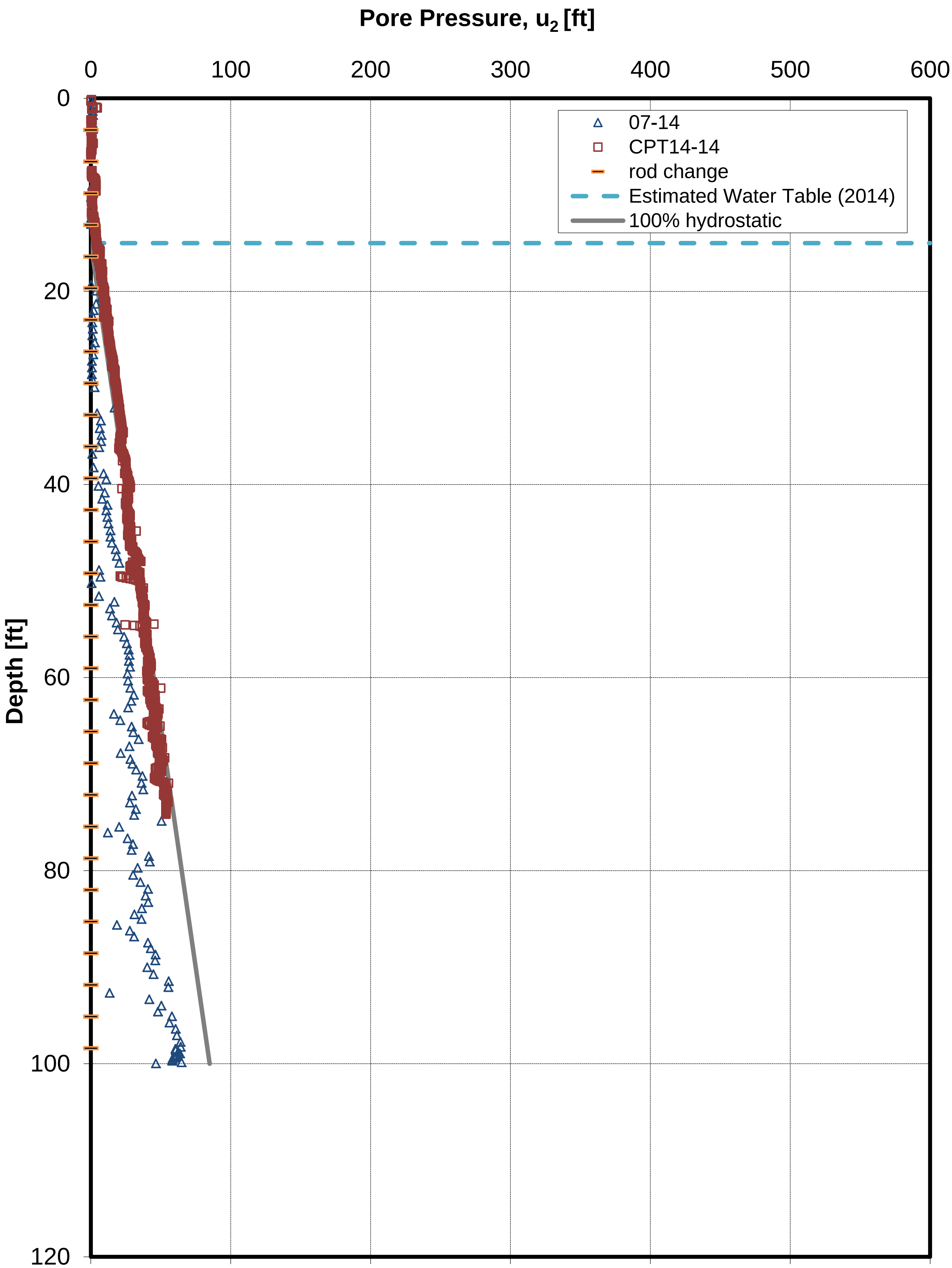
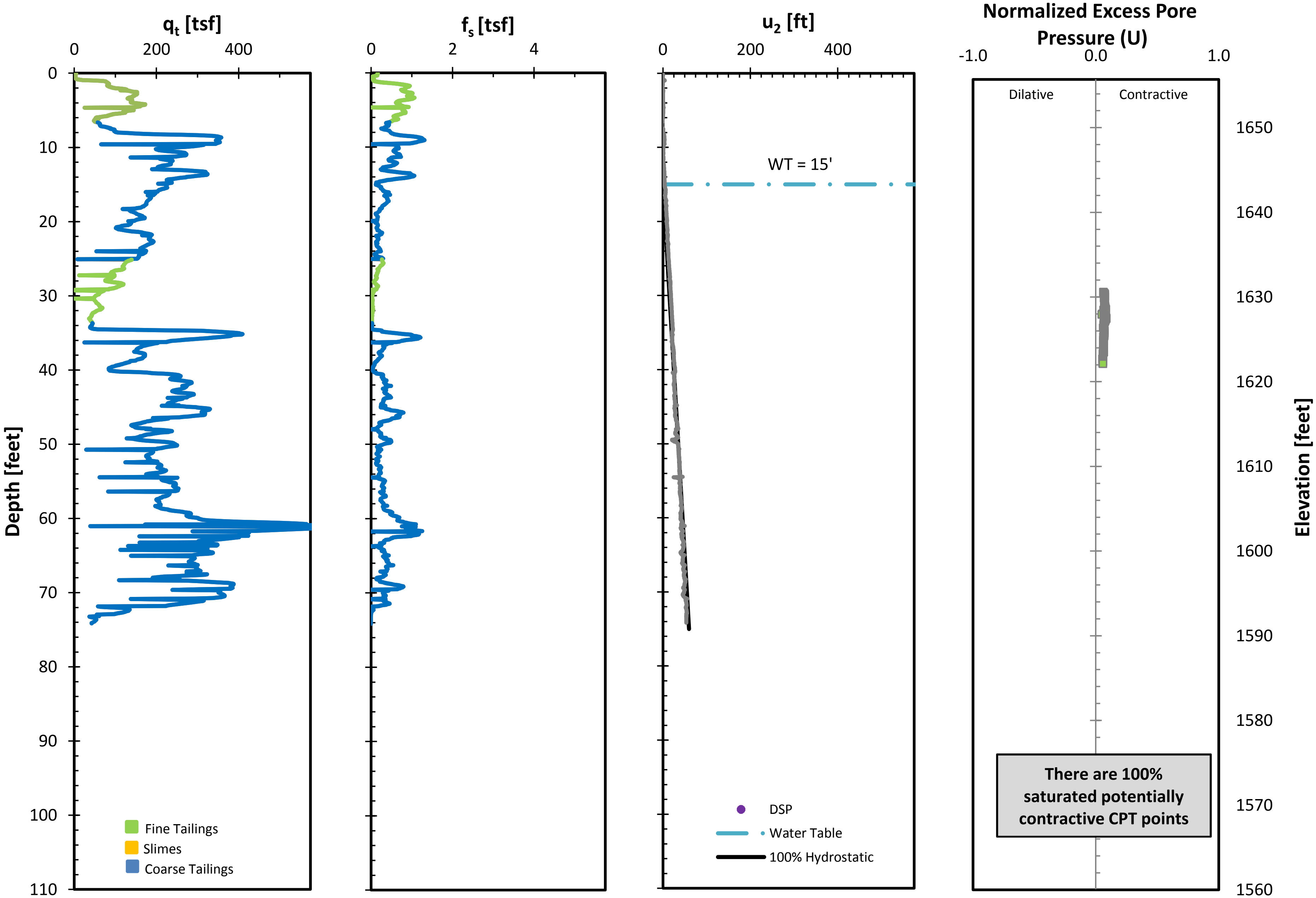


Figure G-12c. CPT 07-14/CPT14-14 Pore Pressure vs. Depth

FIGURE G-12d

CPT14-14 Behavior Plot



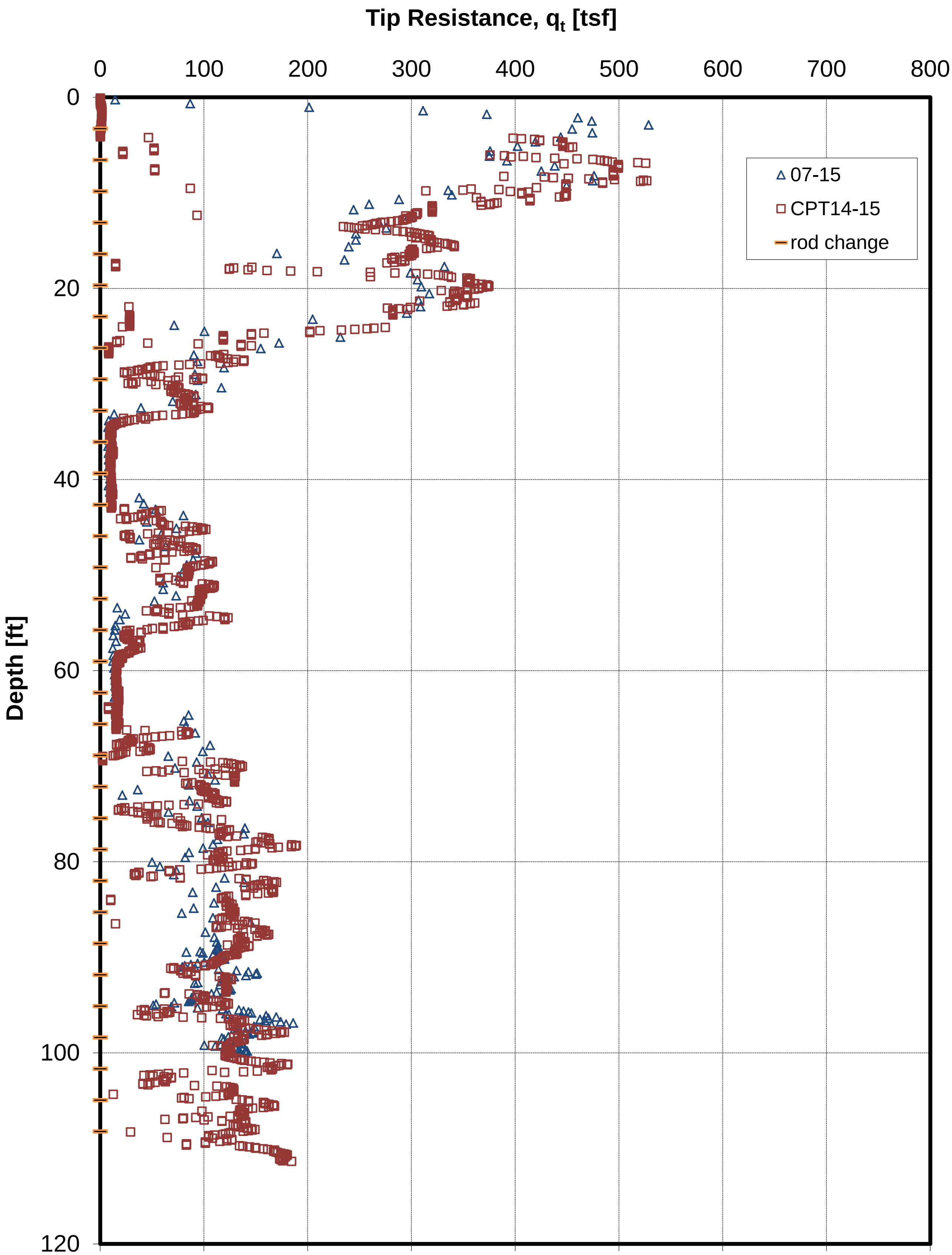


Figure G-13a. CPT 07-15/CPT14-15 Tip Resistance vs. Depth

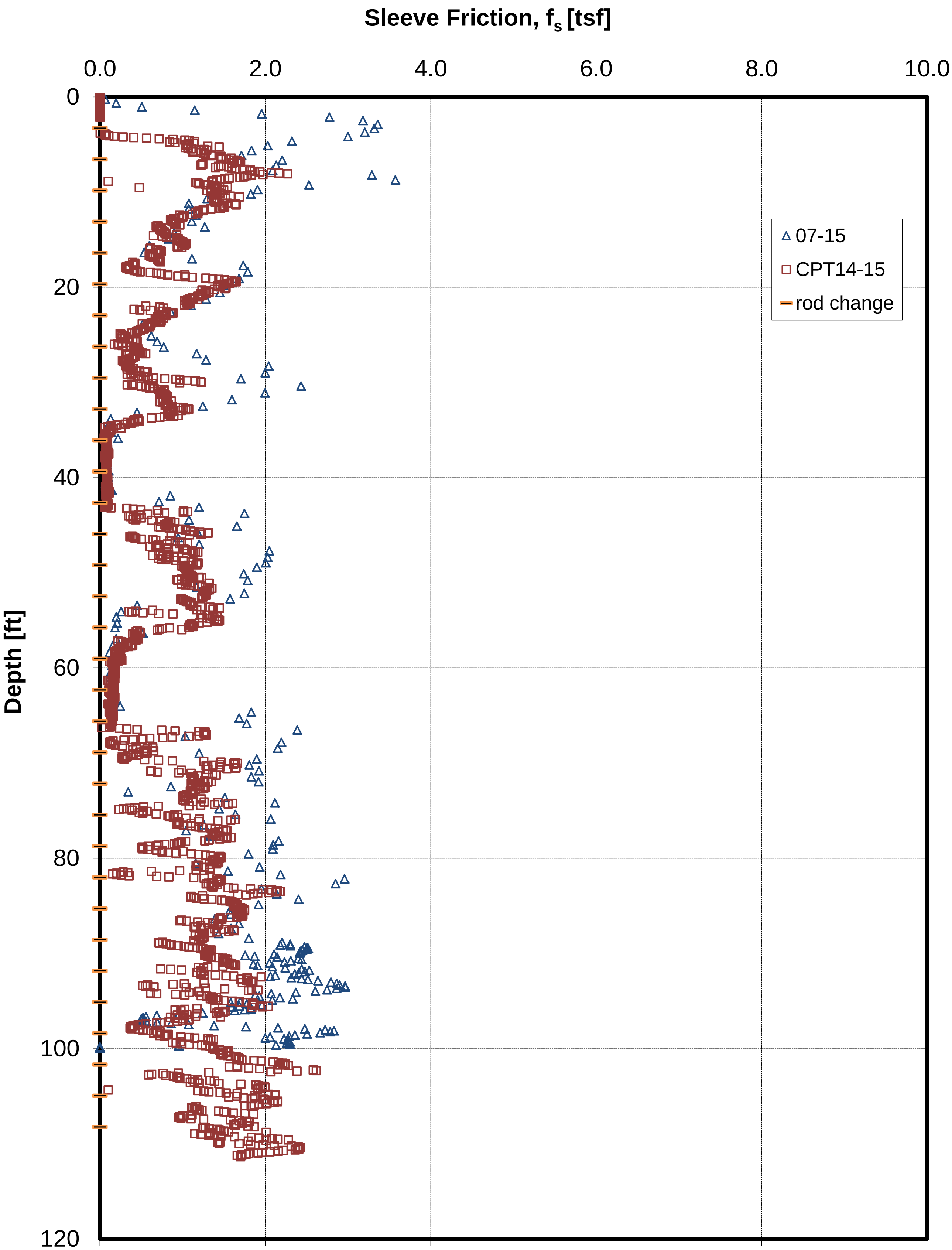


Figure G-13b. CPT 07-15/CPT14-15 Sleeve Friction vs. Depth

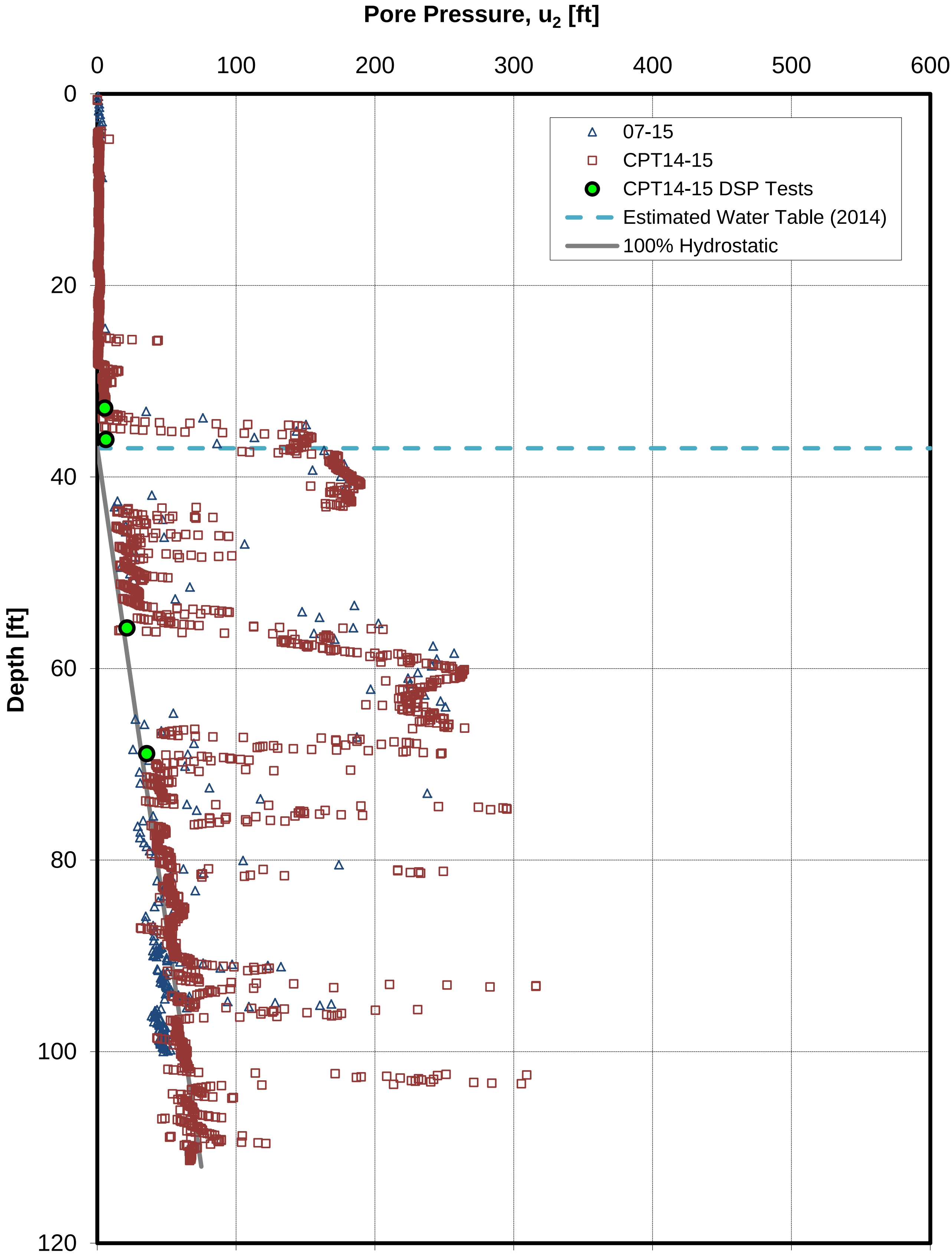
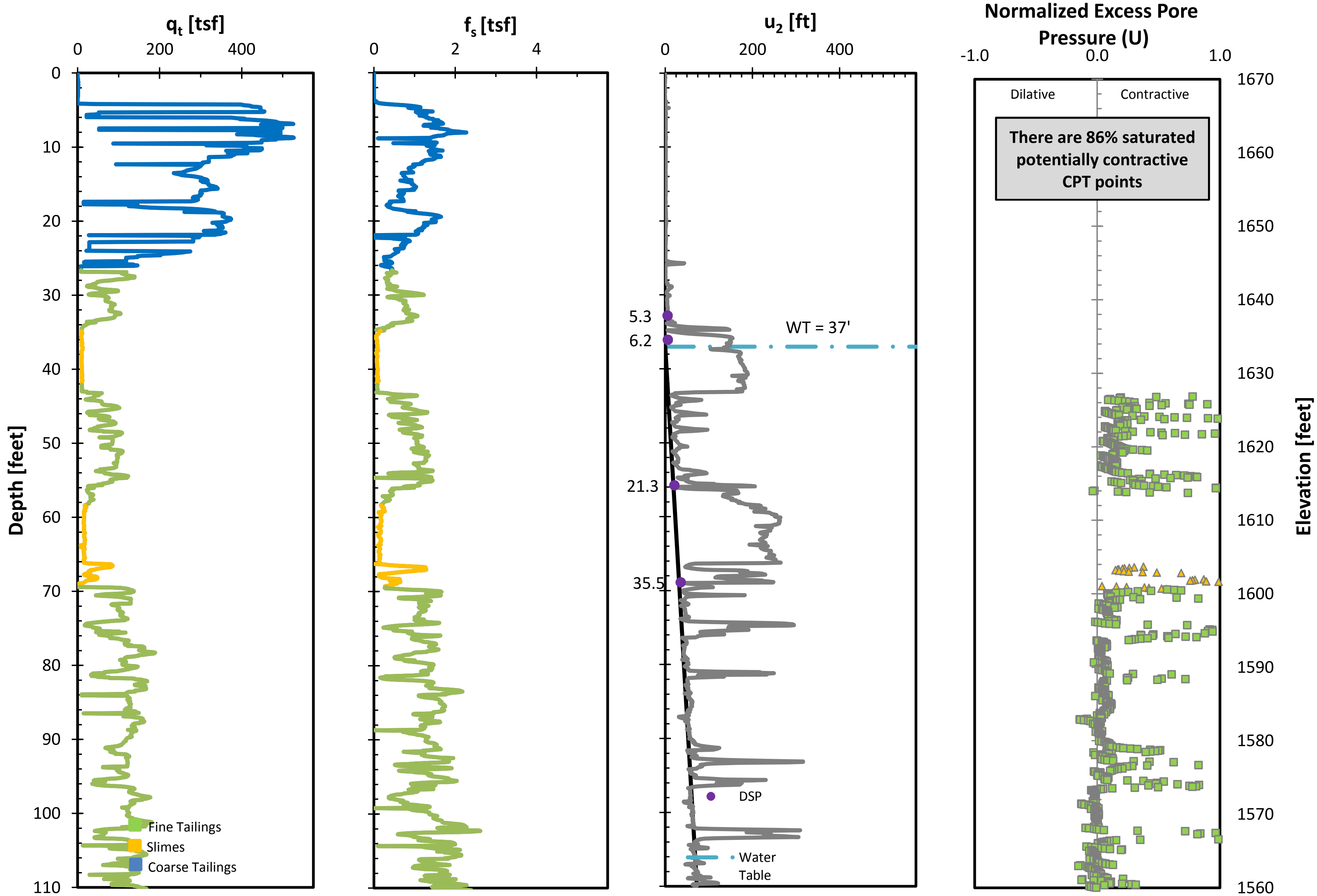


Figure G-13c. CPT 07-15/CPT14-15 Pore Pressure vs. Depth

FIGURE G-13d
CPT14-15 Behavior Plot



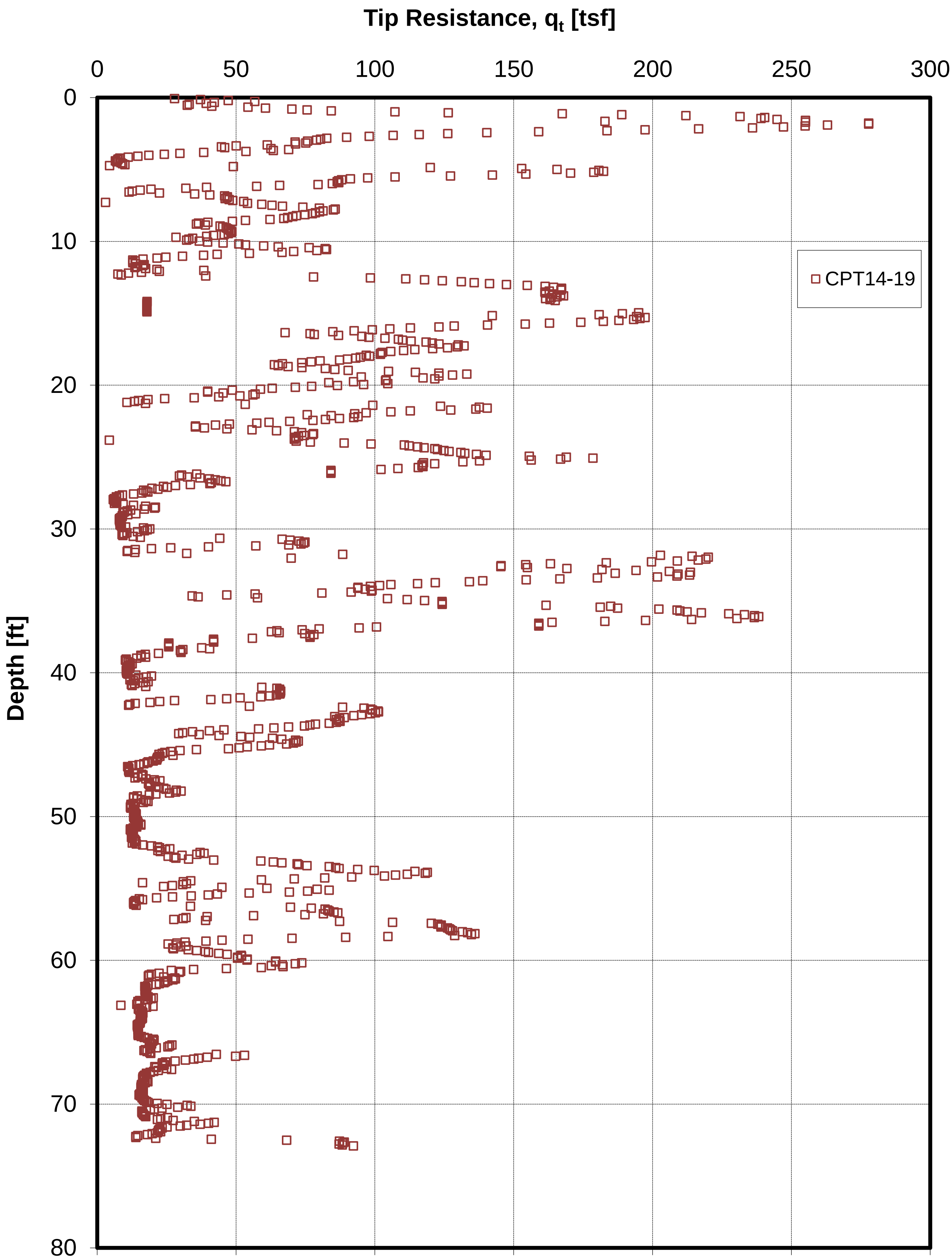


Figure G-14a. CPT14-19 Tip Resistance vs. Depth

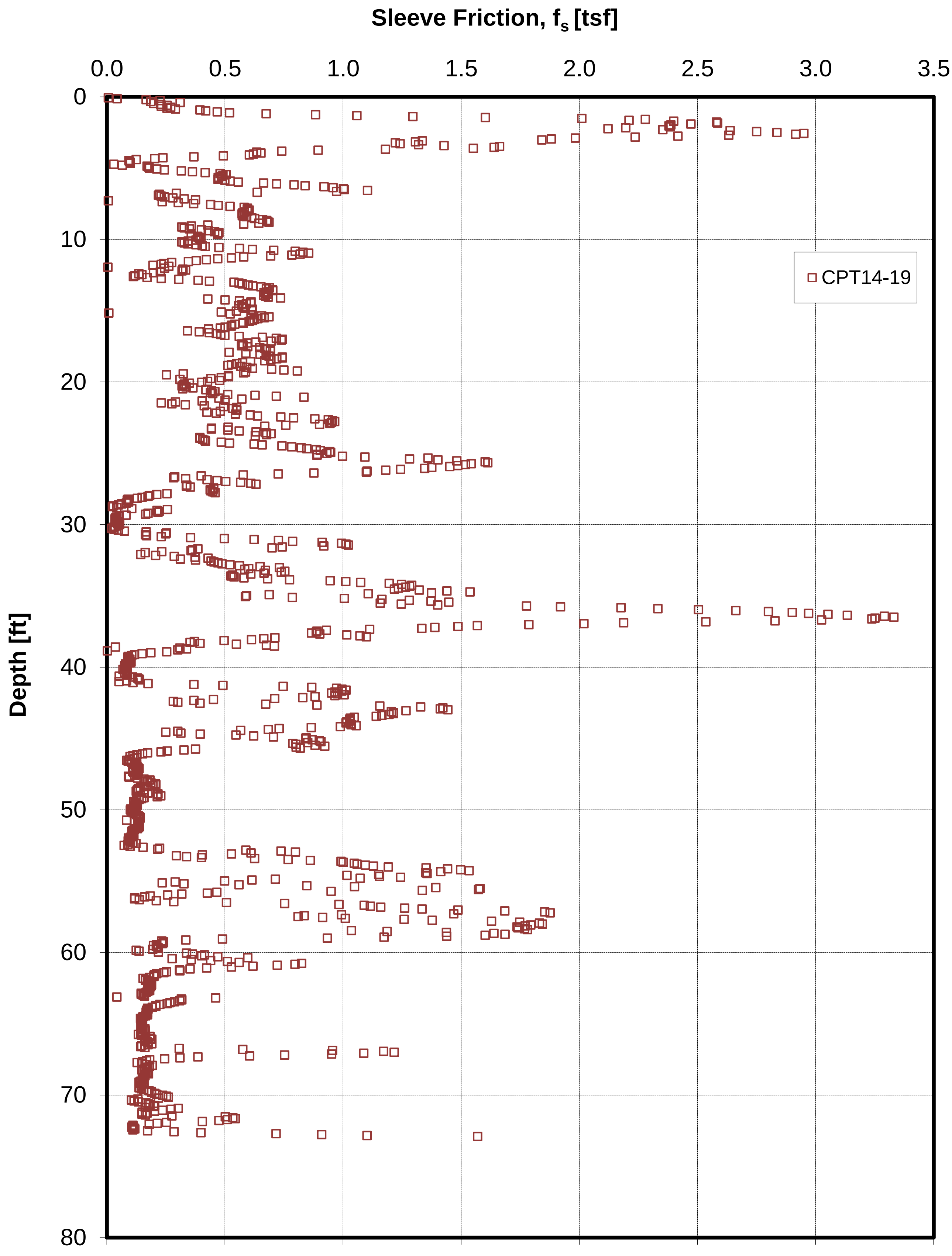


Figure G-14b. CPT14-19 Sleeve Friction vs. Depth

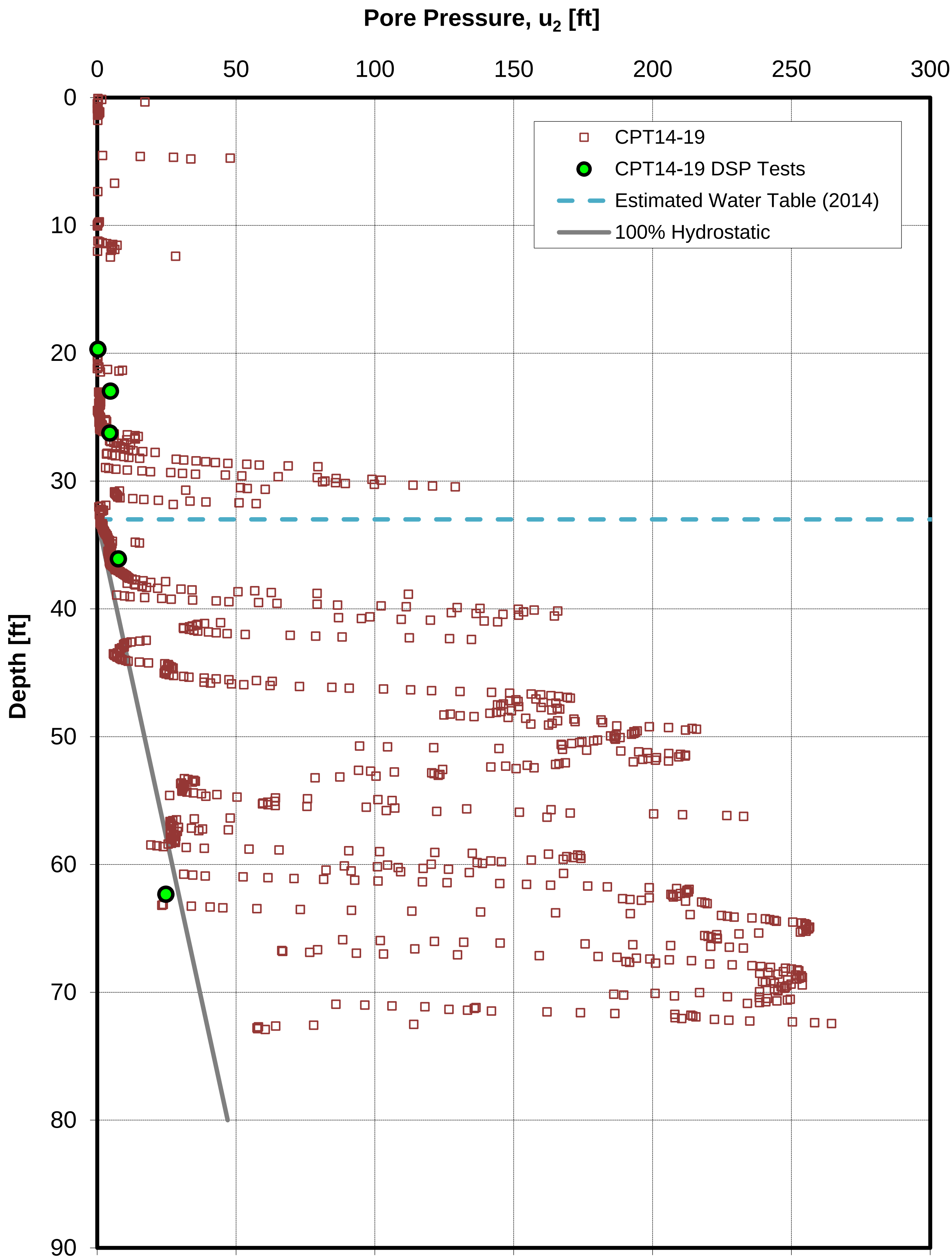


Figure G-14c. CPT14-19 Pore Pressure vs. Depth

FIGURE G-14d

CPT14-19 Behavior Plot

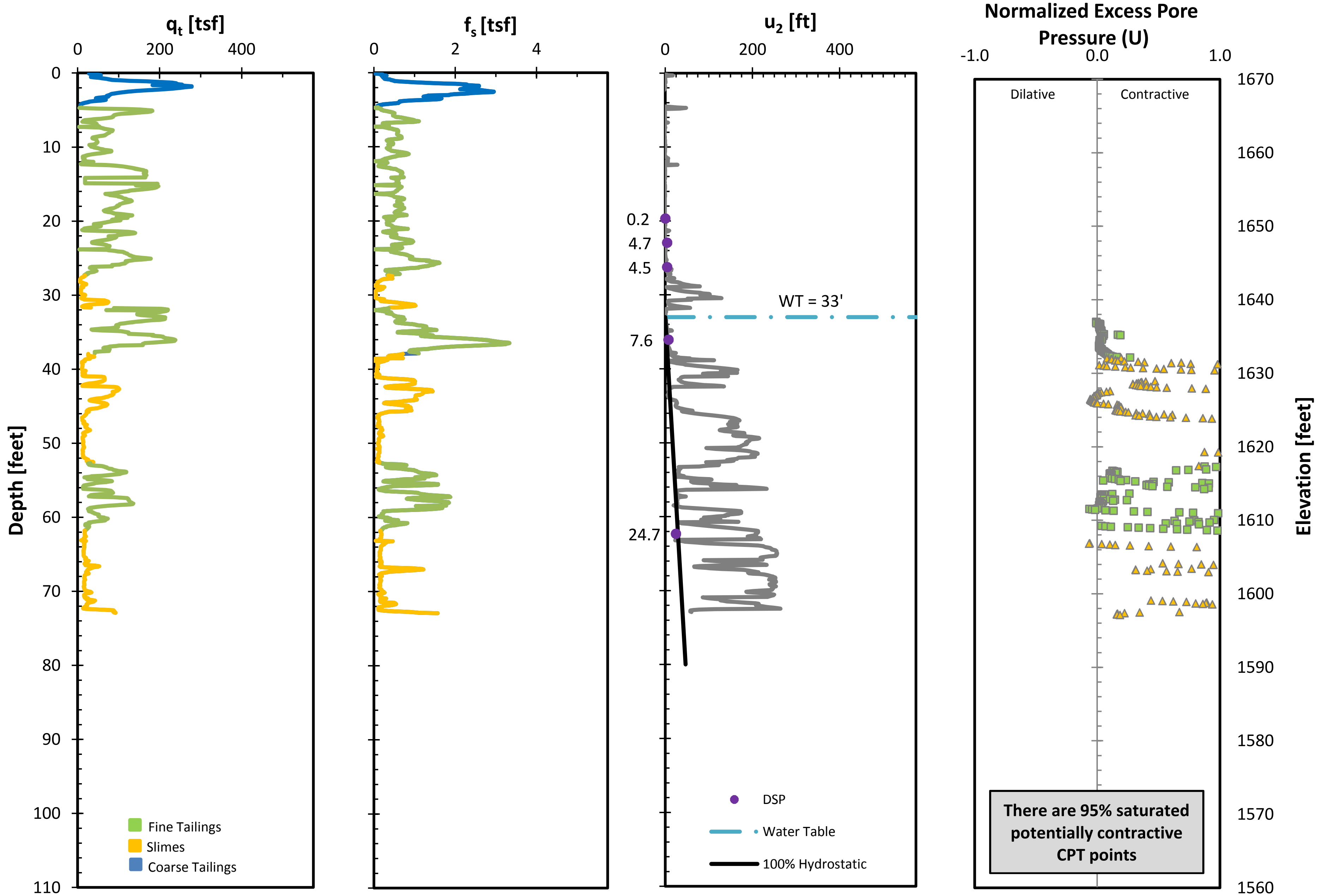
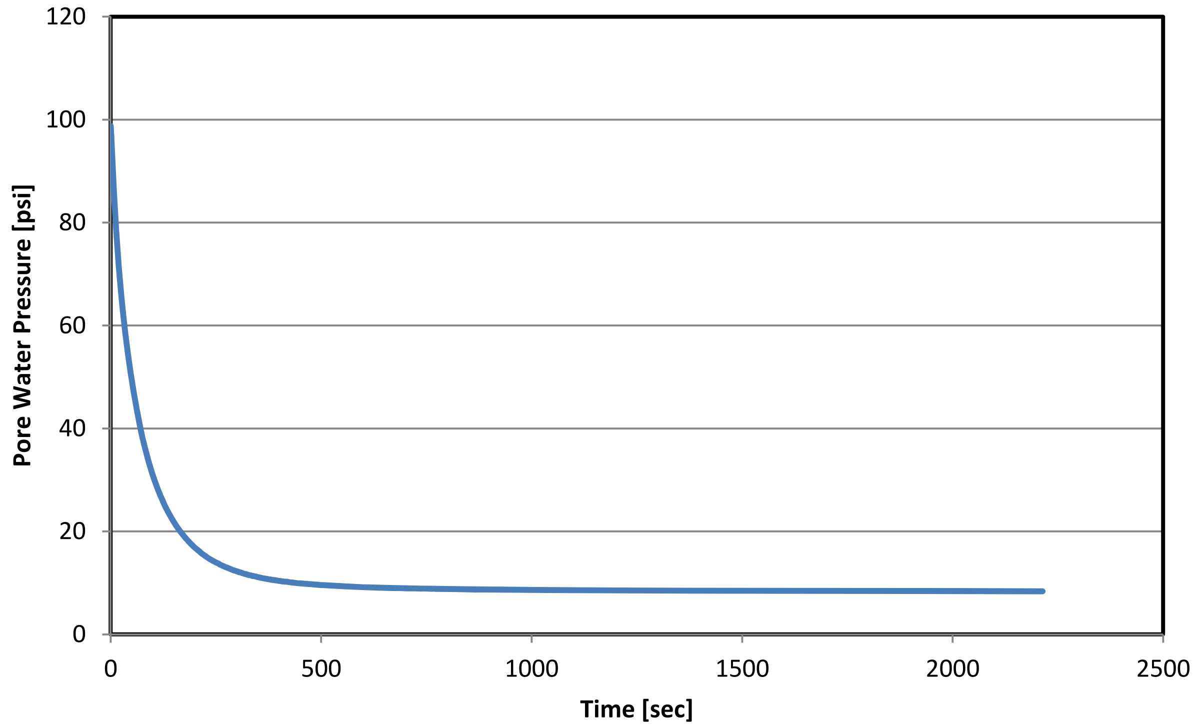


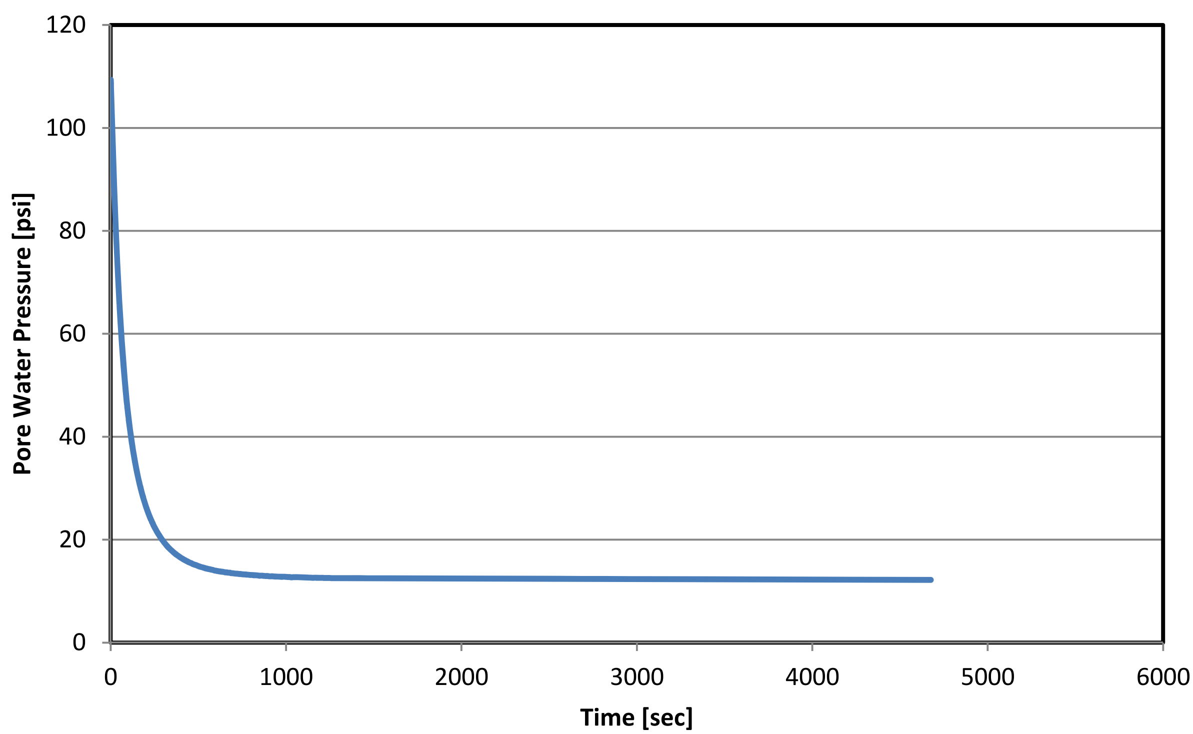
Exhibit H

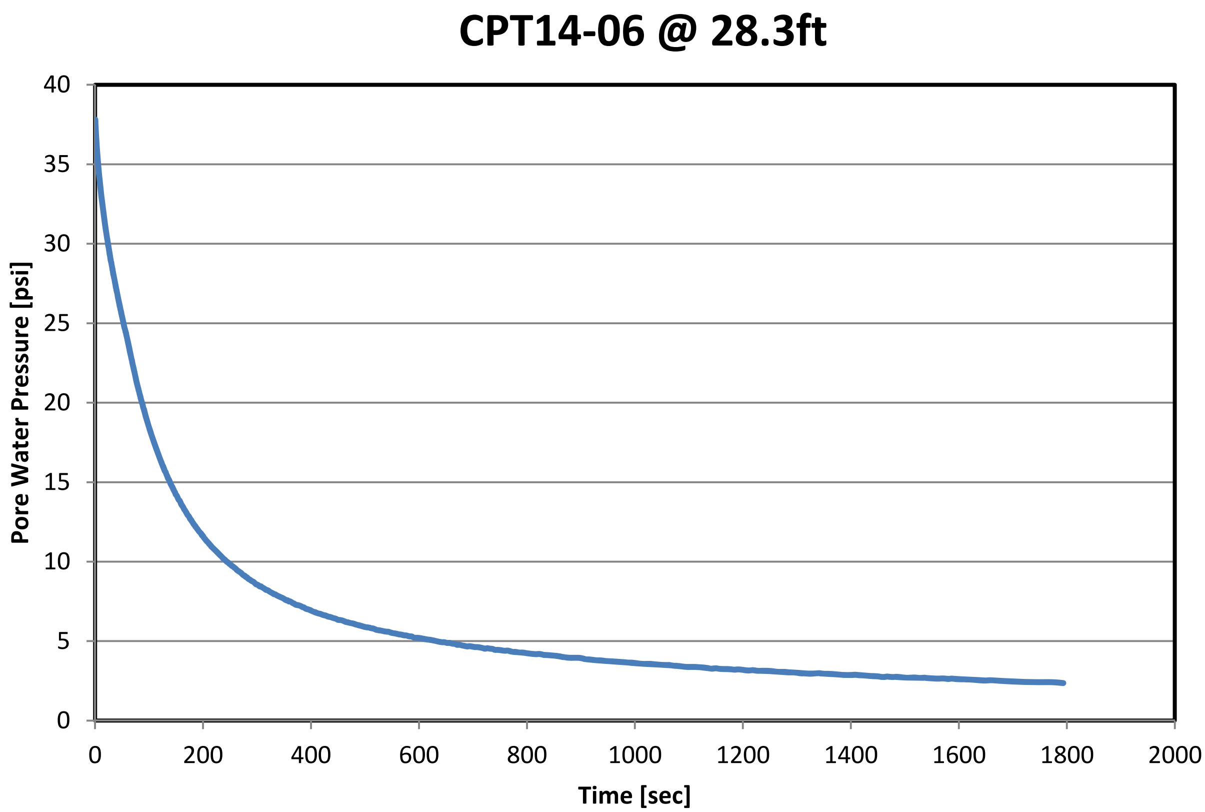
Pore Pressure Dissipation Test Results

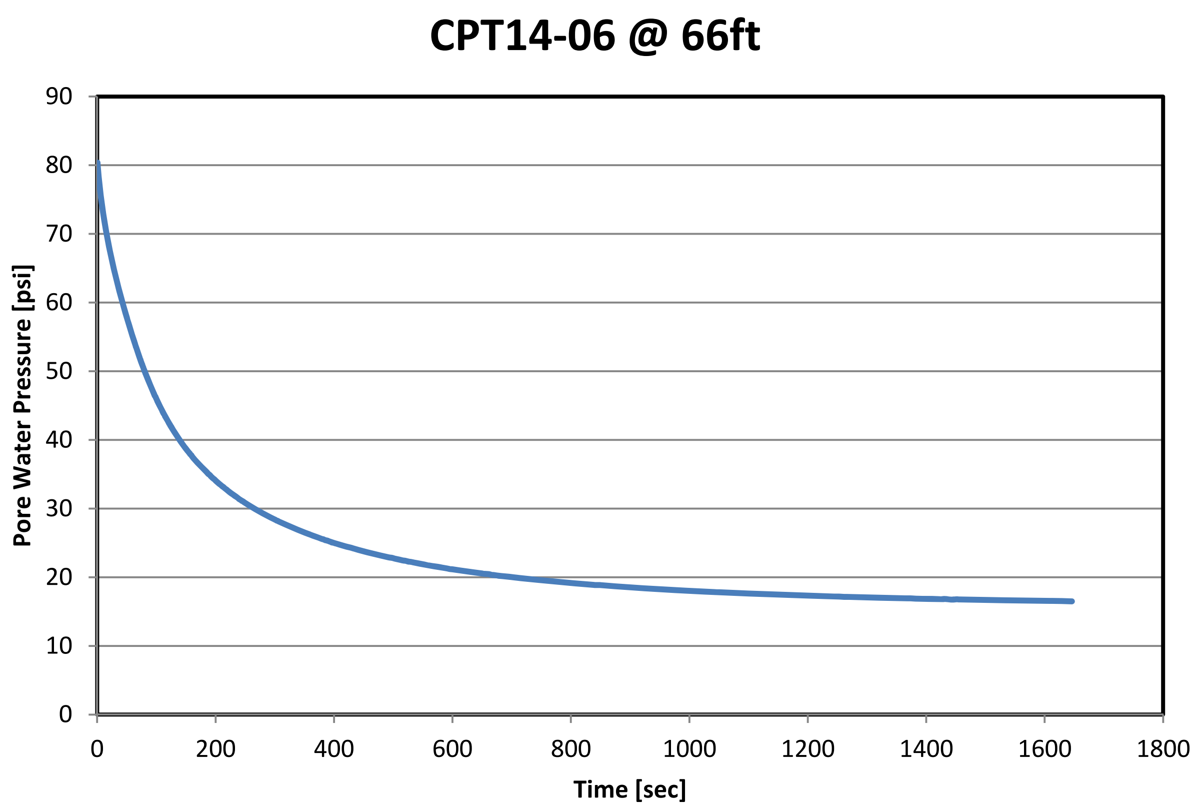
CPT14-05 @ 72.7ft

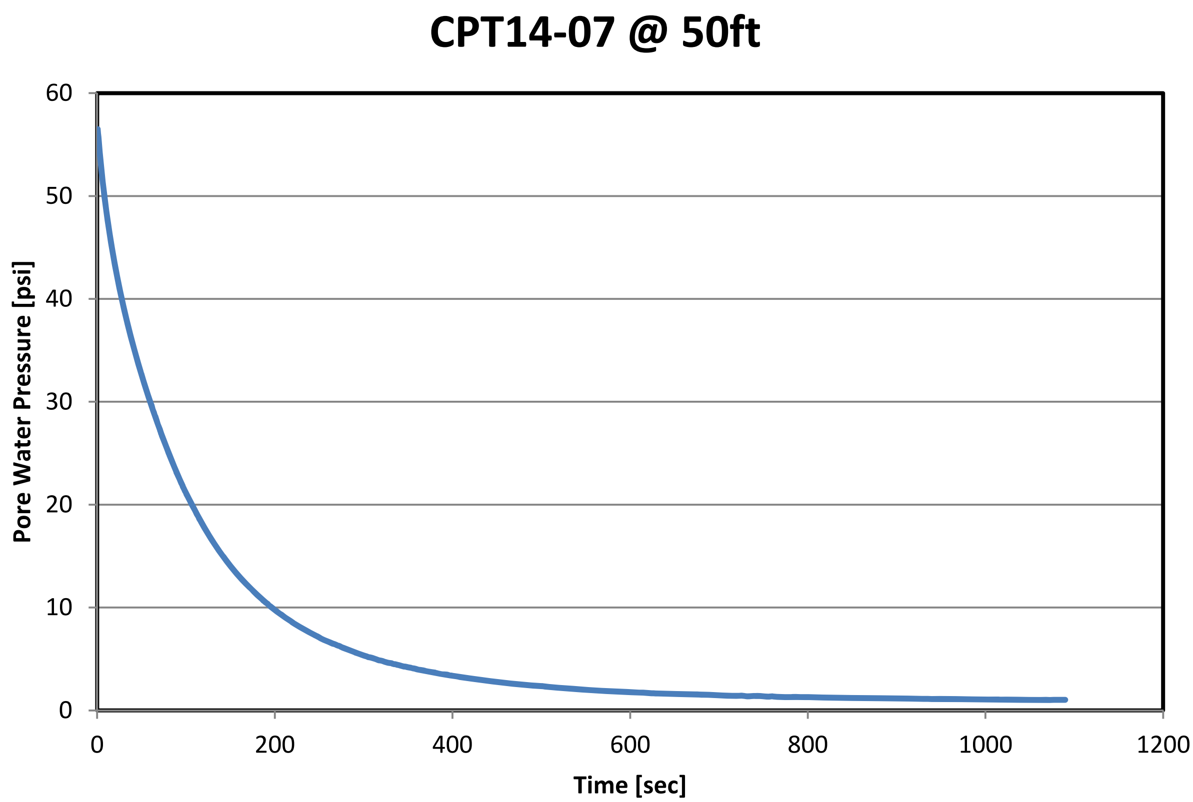


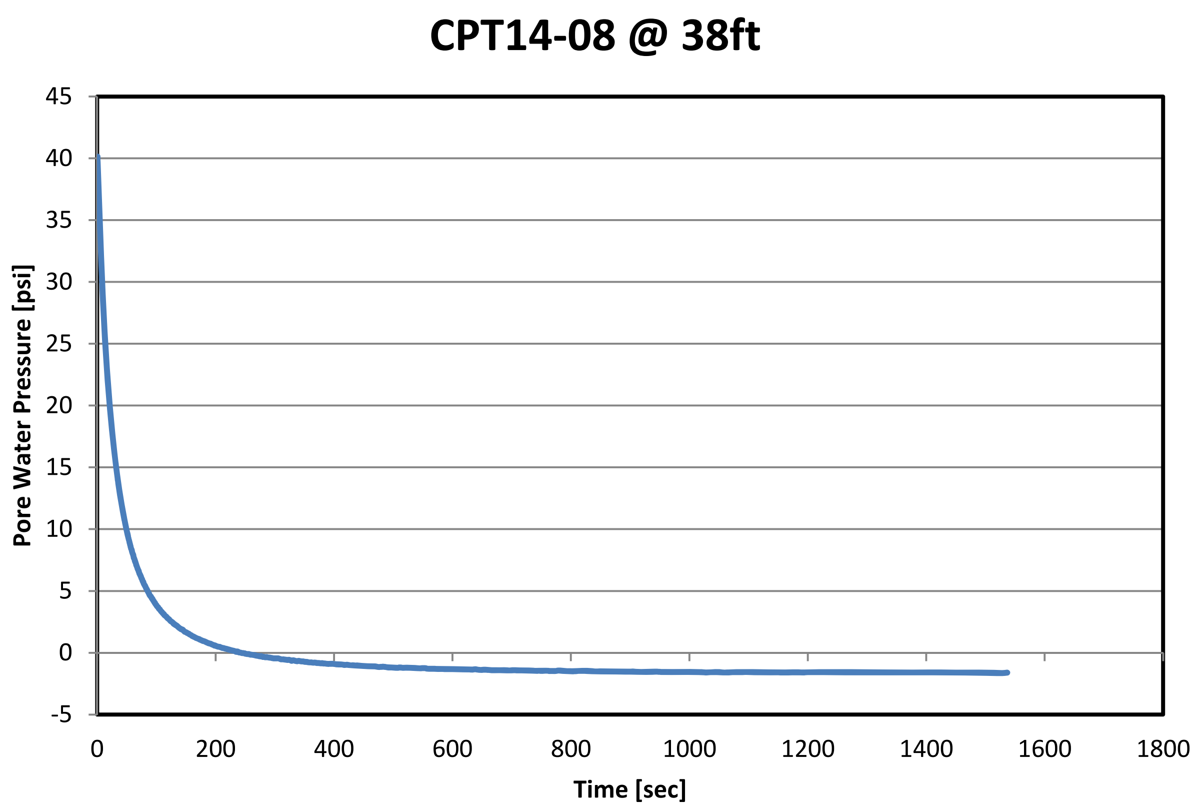
CPT14-05 @ 83.8ft



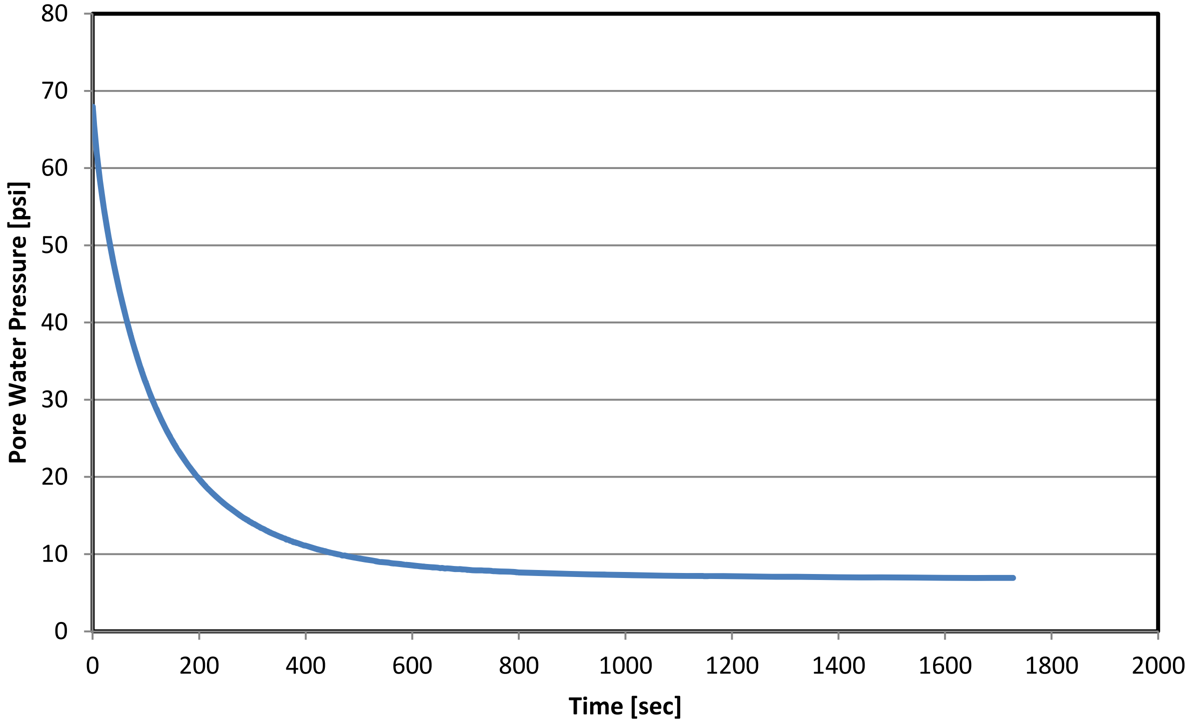

CPT14-06 @ 28.3ft
Pore Water Pressure [psi]
0
5
10
15
20
25
30
35
40
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Time [sec]


CPT14-06 @ 66ft
Pore Water Pressure [psi]
0
10
20
30
40
50
60
70
80
90
0
200
400
600
800
1000
1200
1400
1600
1800
Time [sec]

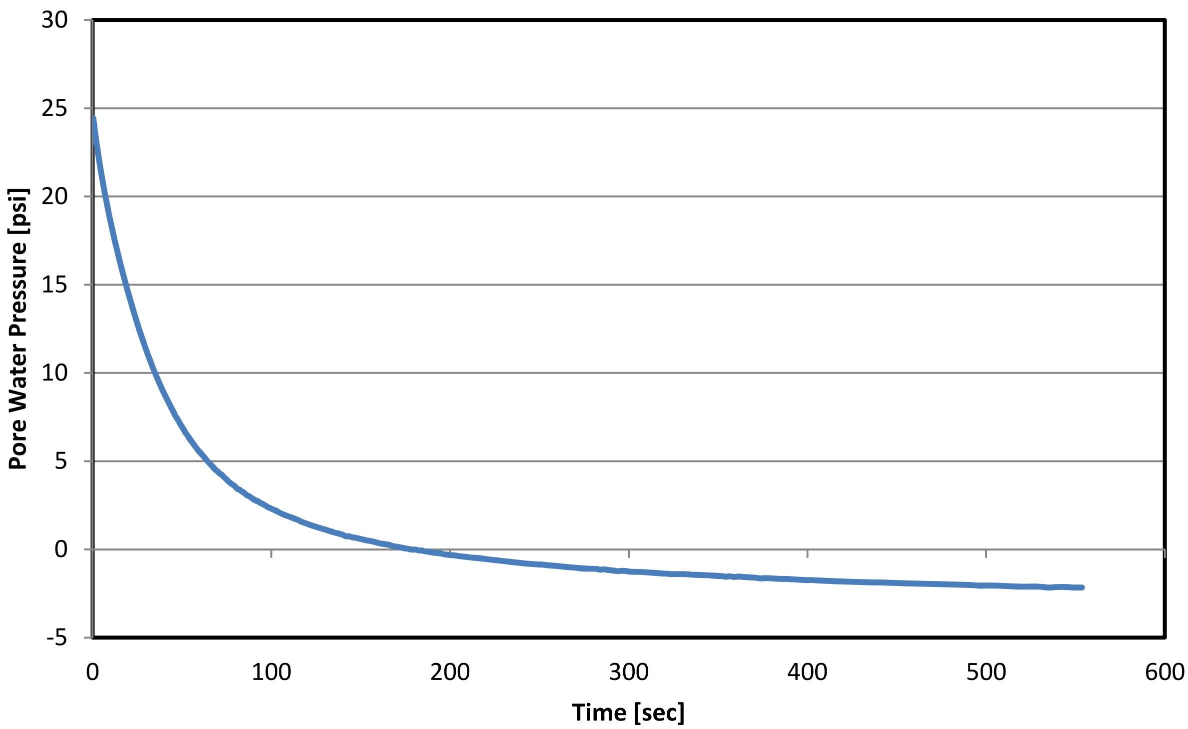

CPT14-07 @ 50ft
Pore Water Pressure [psi]
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200
Time [sec]

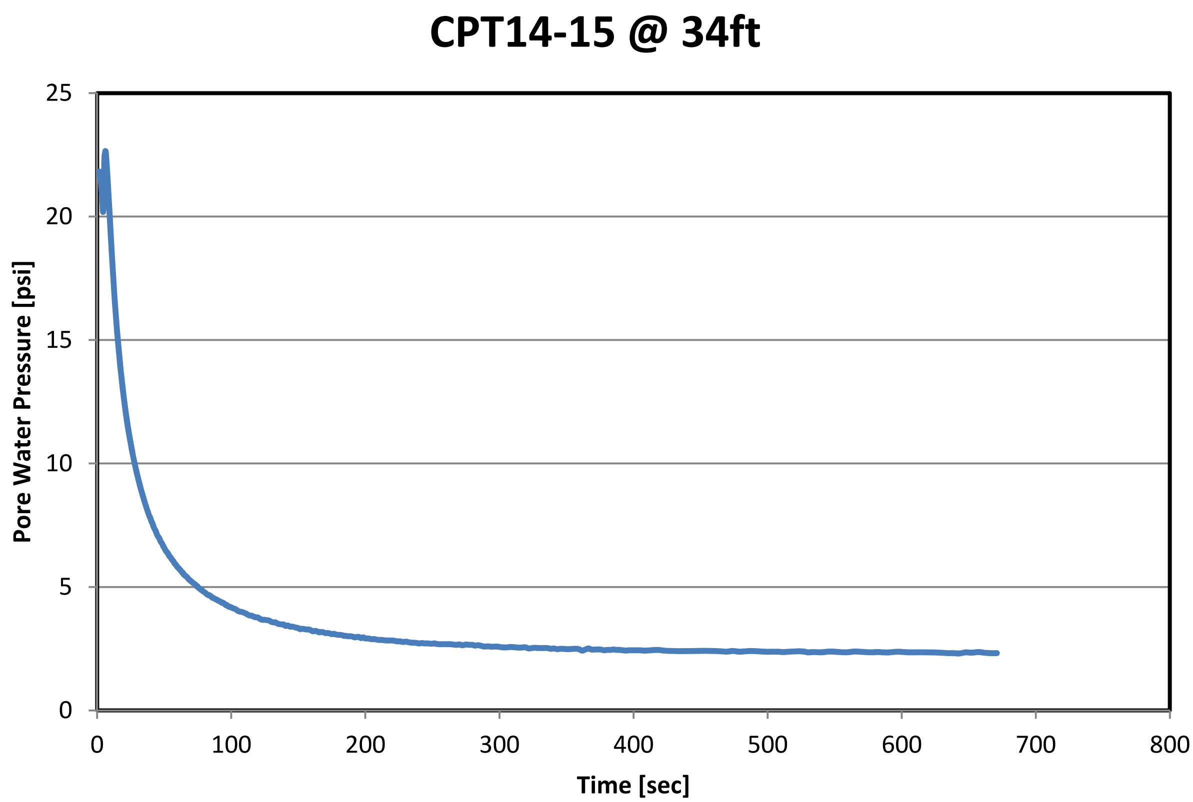

CPT14-08 @ 38ft
Pore Water Pressure [psi]
45
40
35
30
25
20
15
10
5
0
-5
0
200
400
600
800
1000
1200
1400
1600
1800
Time [sec]

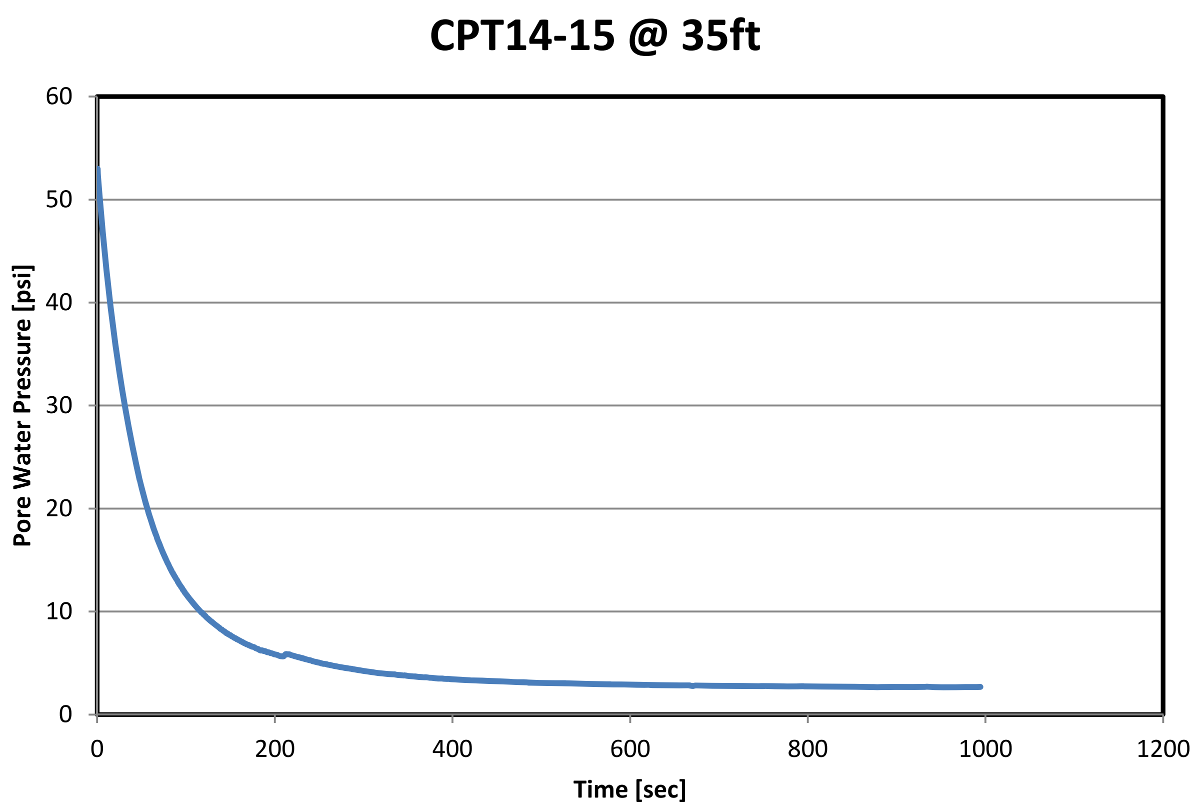
CPT14-08 @ 63ft

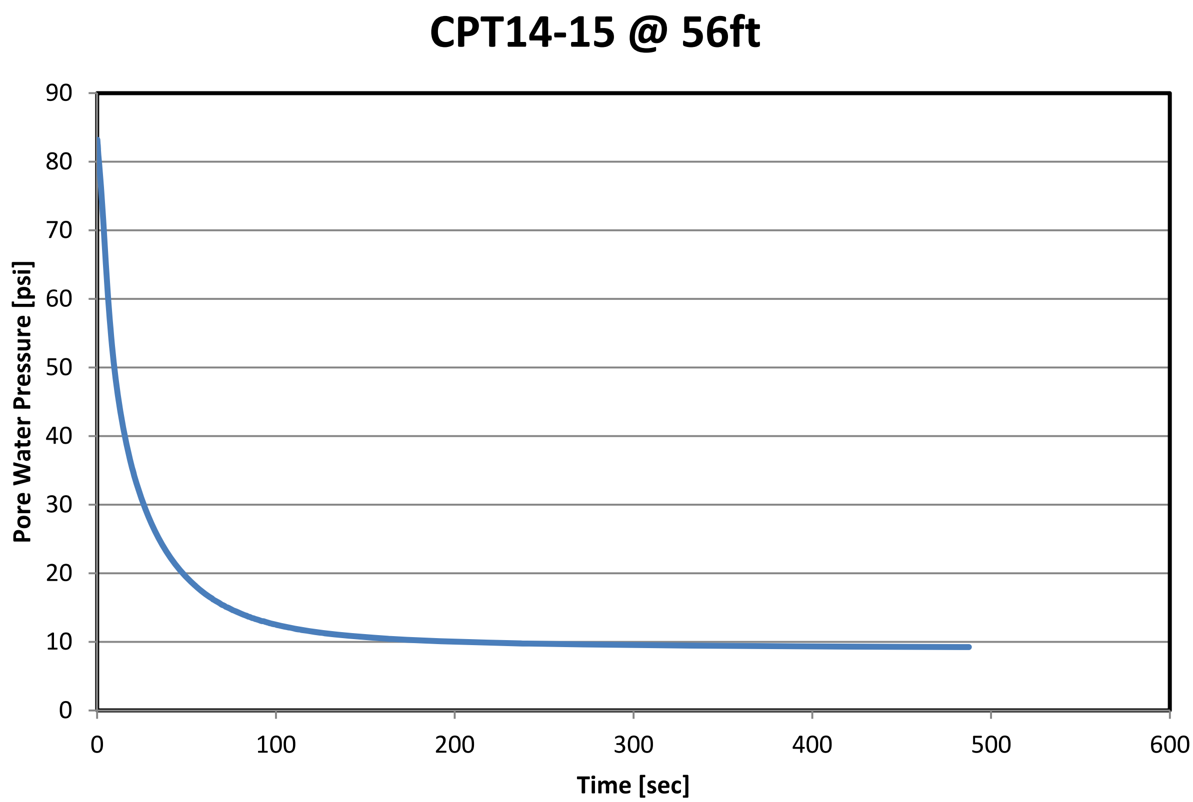


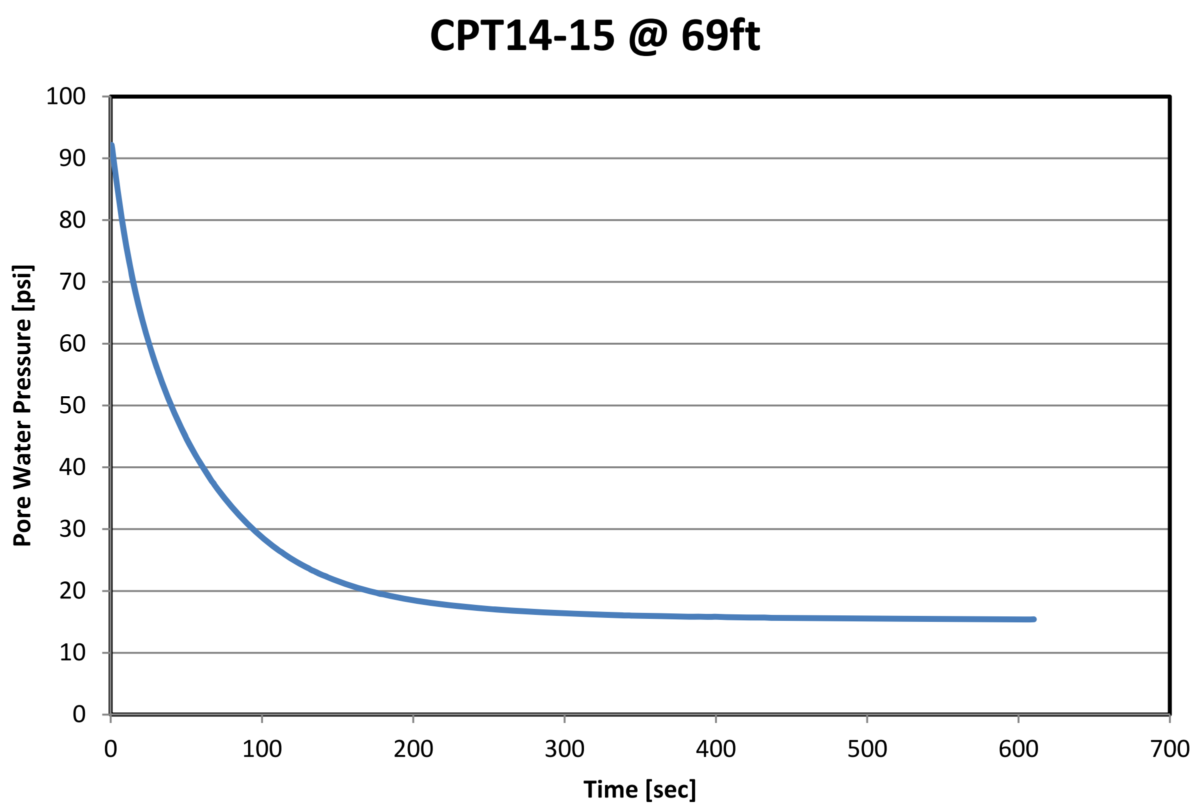
CPT14-09 @ 21ft

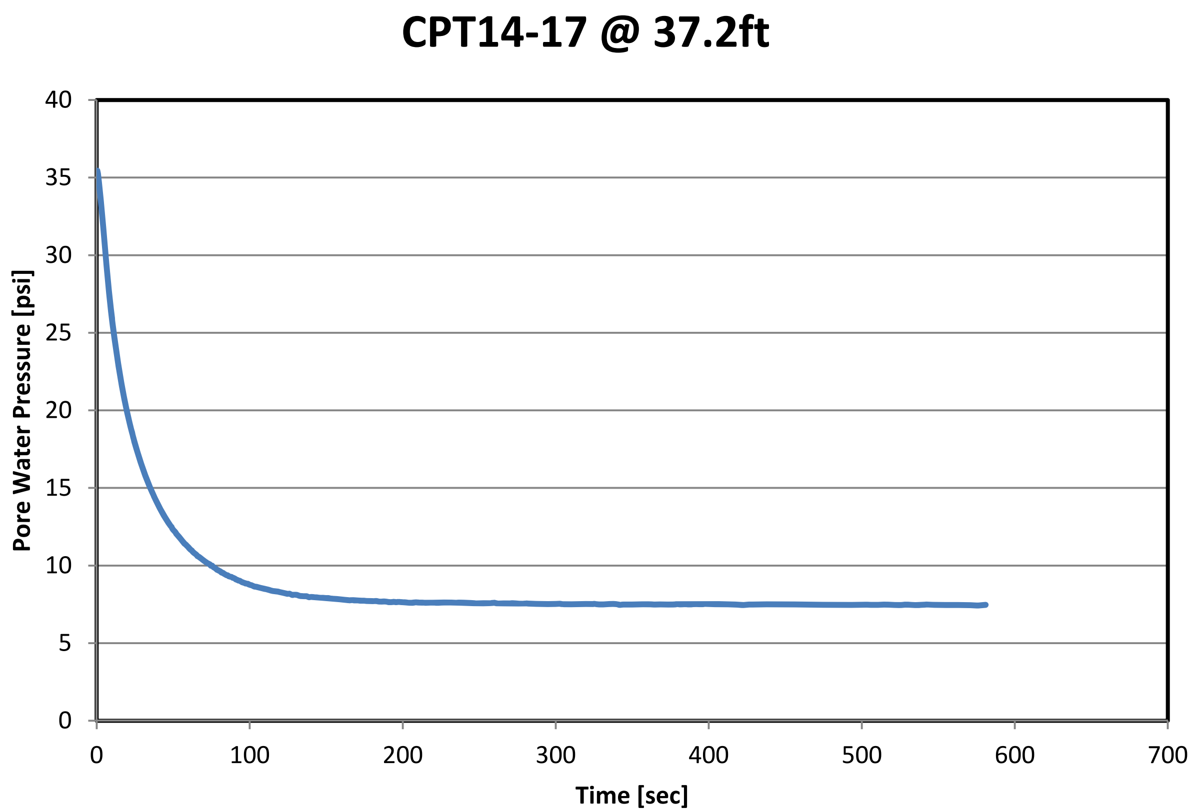


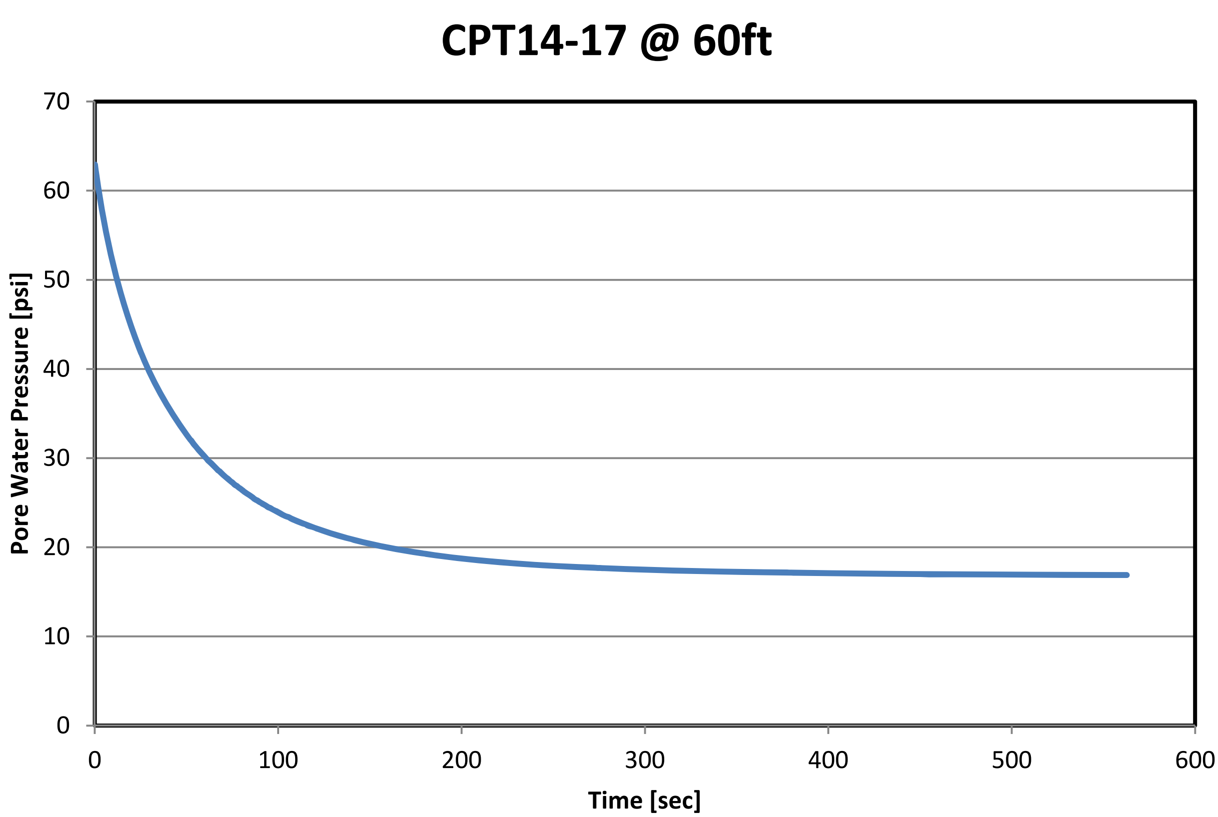

CPT14-15 @ 34ft
Pore Water Pressure [psi]
Time [sec]
25
20
15
10
5
0
0
100
200
300
400
500
600
700
800

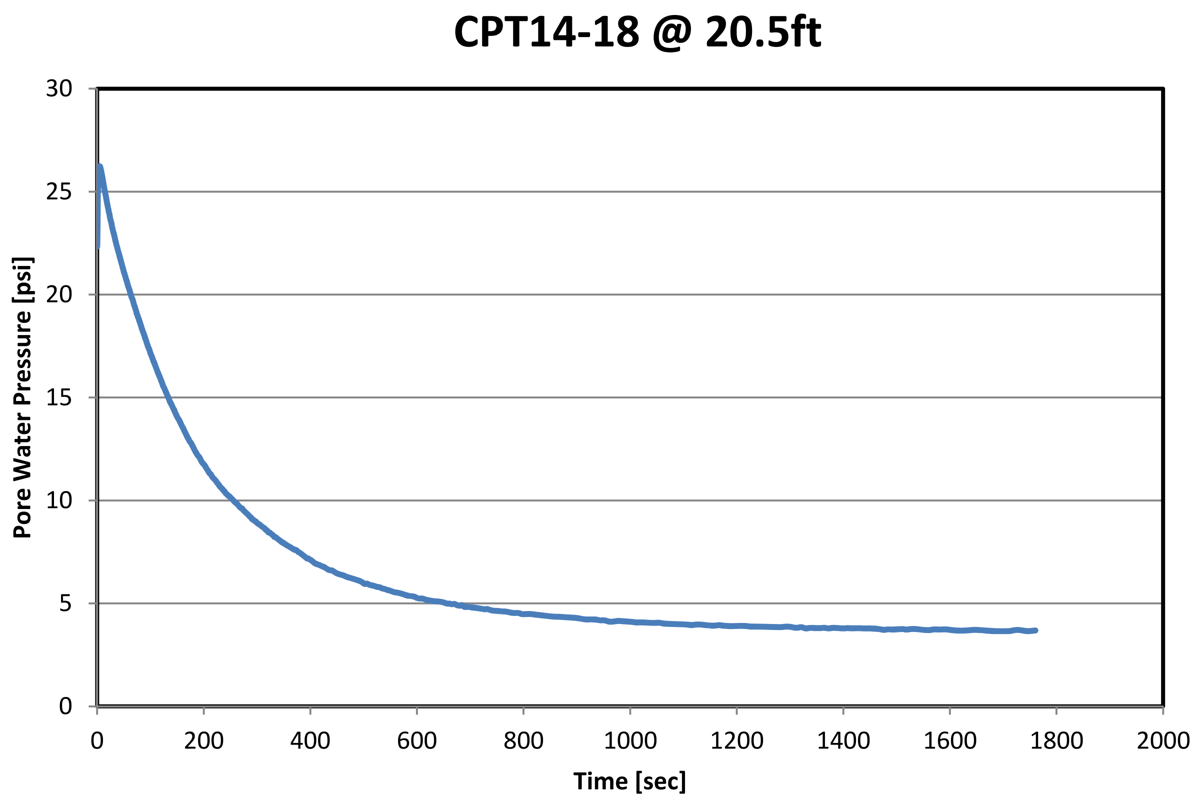

CPT14-15 @ 35ft
Pore Water Pressure [psi]
Time [sec]
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200

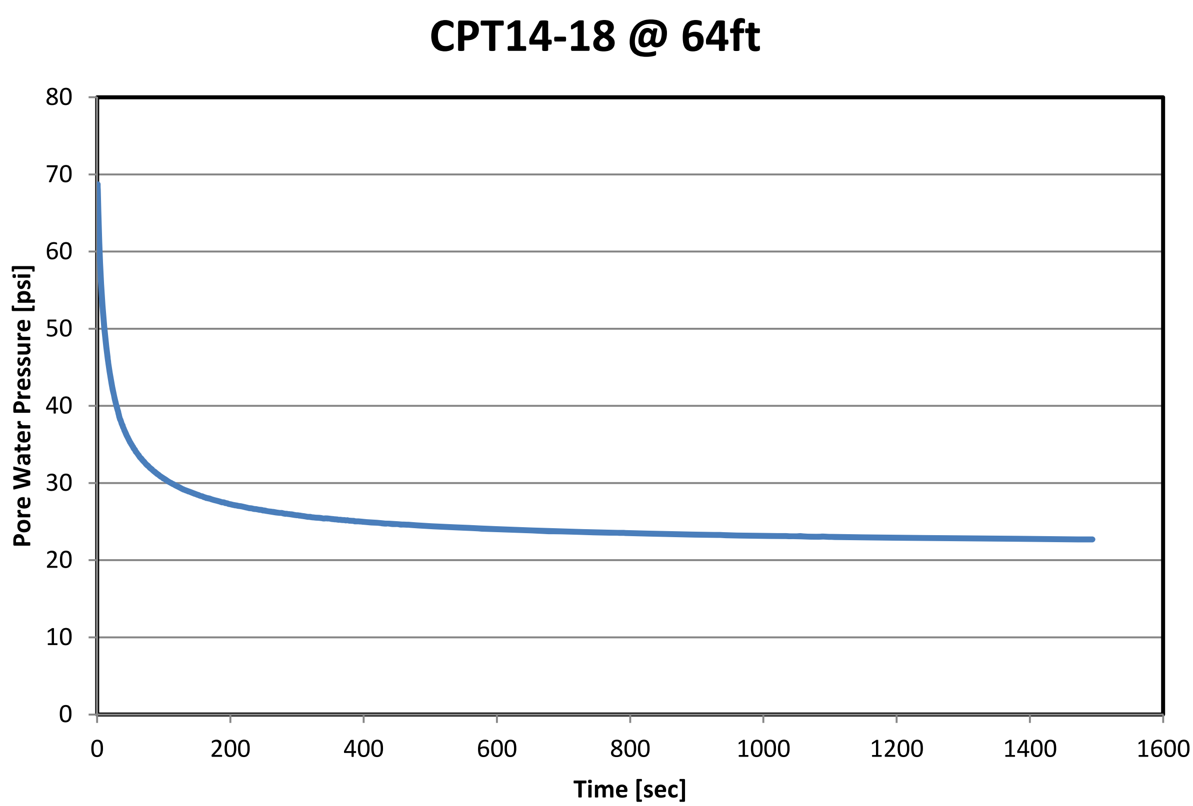

CPT14-15 @ 56ft
Pore Water Pressure [psi]
0
10
20
30
40
50
60
70
80
90
0
100
200
300
400
500
600
Time [sec]

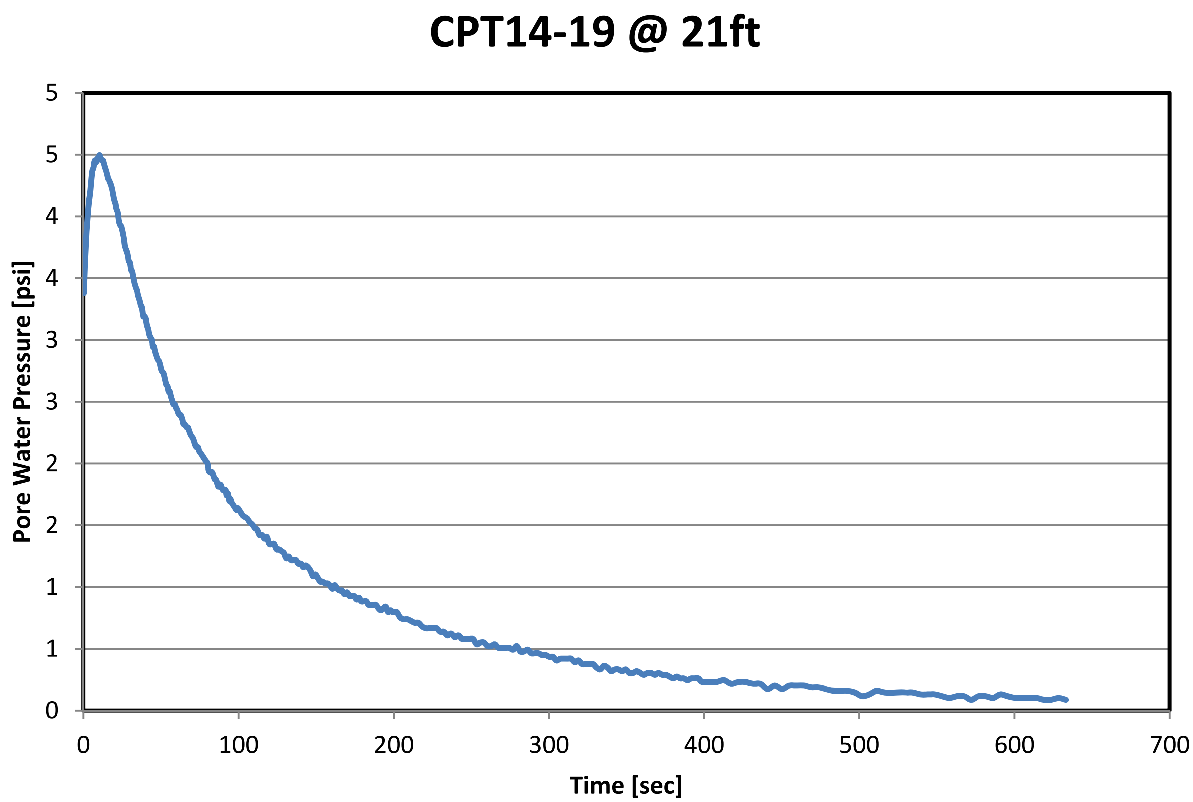

CPT14-15 @ 69ft
Pore Water Pressure [psi]
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
Time [sec]

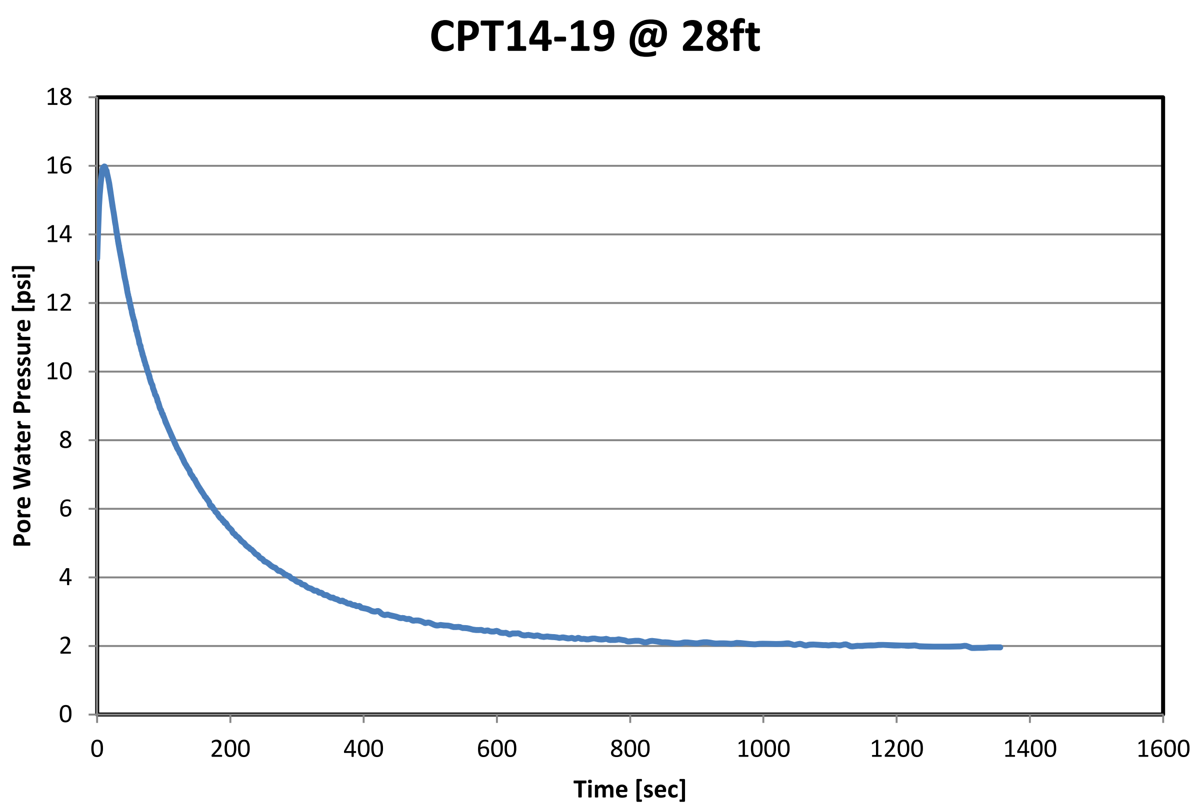

CPT14-17 @ 37.2ft
Pore Water Pressure [psi]
Time [sec]
0
5
10
15
20
25
30
35
40
0
100
200
300
400
500
600
700

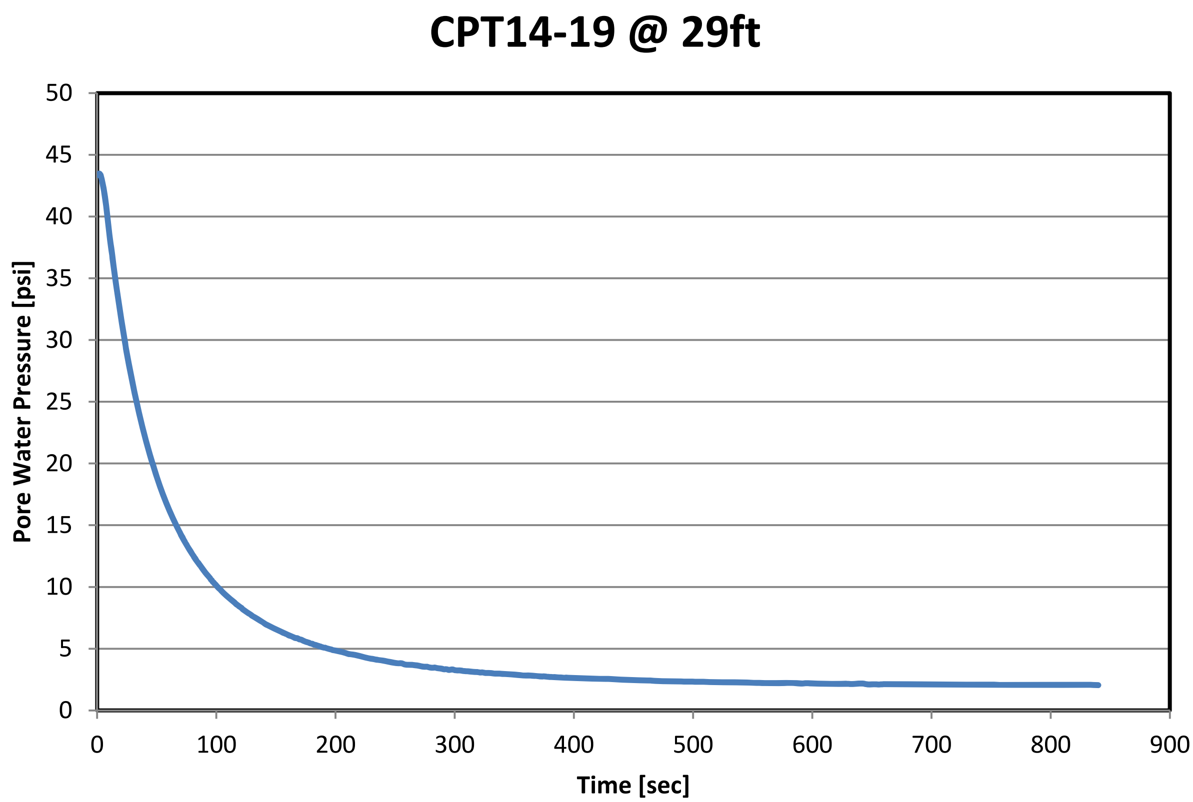

CPT14-17 @ 60ft
Pore Water Pressure [psi]
Time [sec]
0
10
20
30
40
50
60
70
0
100
200
300
400
500
600

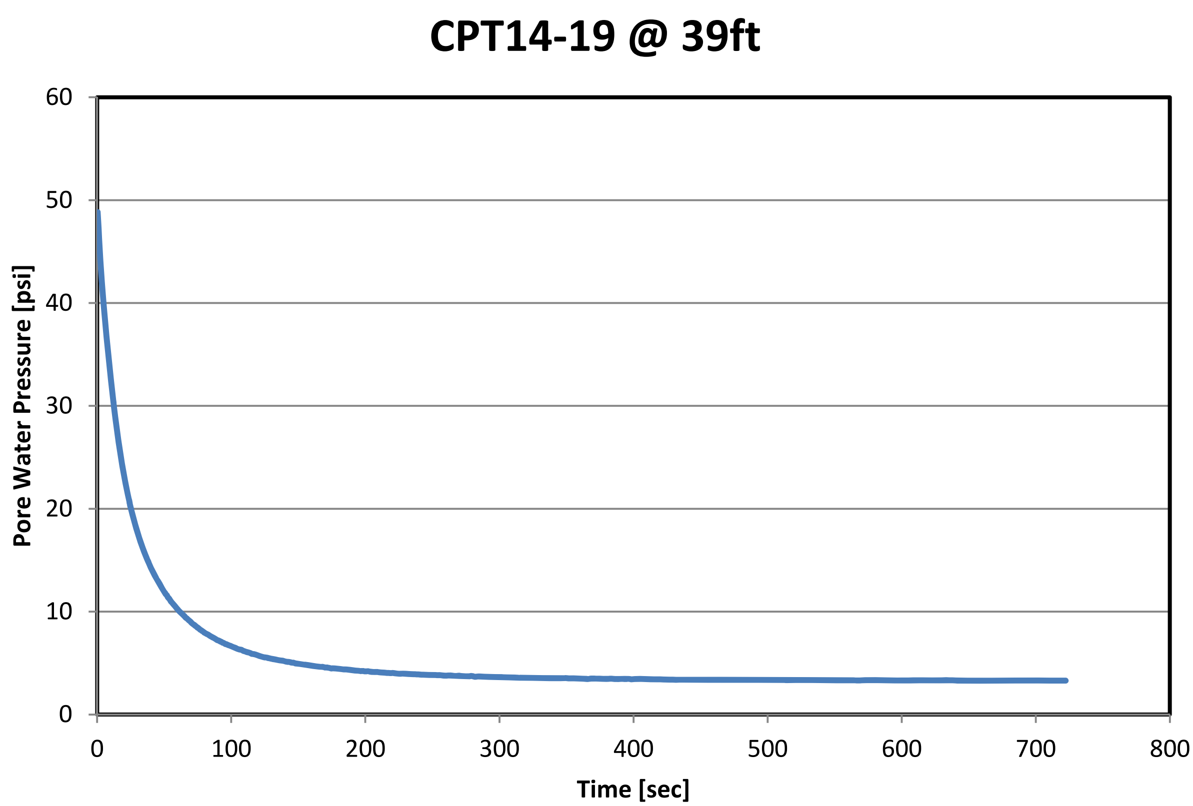

CPT14-18 @ 20.5ft
Pore Water Pressure [psi]
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Time [sec]


CPT14-18 @ 64ft
Pore Water Pressure [psi]
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200
1400
1600
Time [sec]

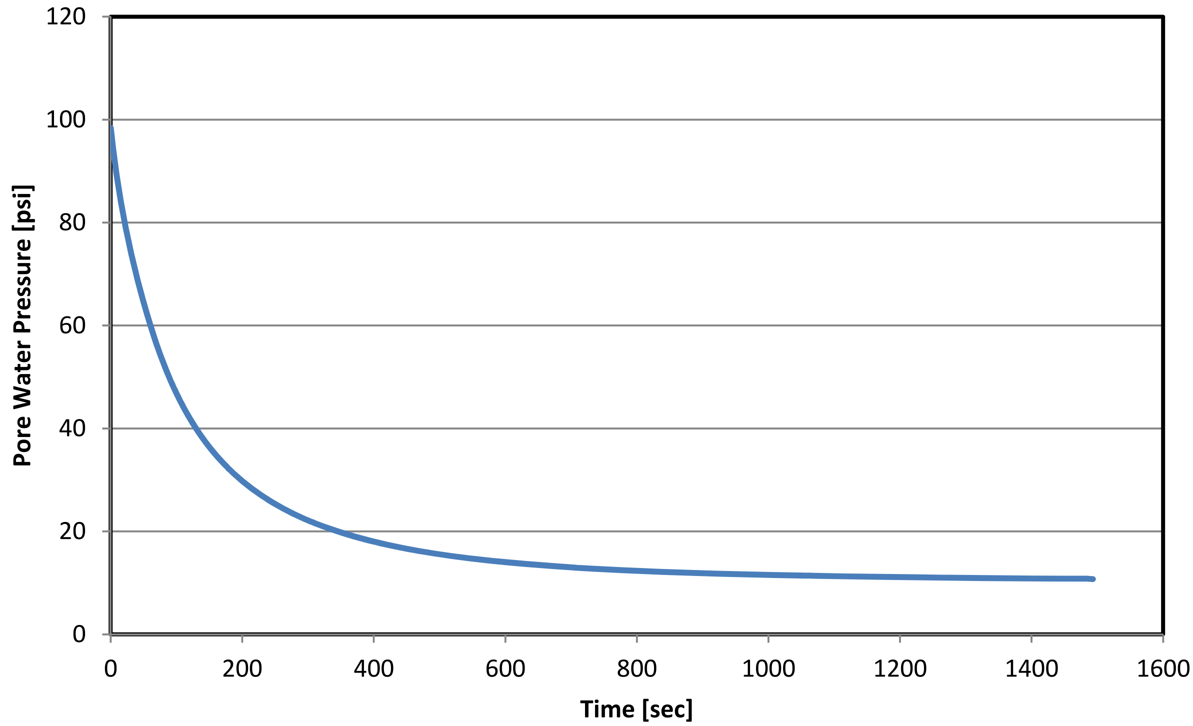

CPT14-19 @ 21ft
Pore Water Pressure [psi]
0
1
1
2
2
3
3
4
4
5
5
0
100
200
300
400
500
600
700
Time [sec]


CPT14-19 @ 28ft
Pore Water Pressure [psi]
0
2
4
6
8
10
12
14
16
18
0
200
400
600
800
1000
1200
1400
1600
Time [sec]

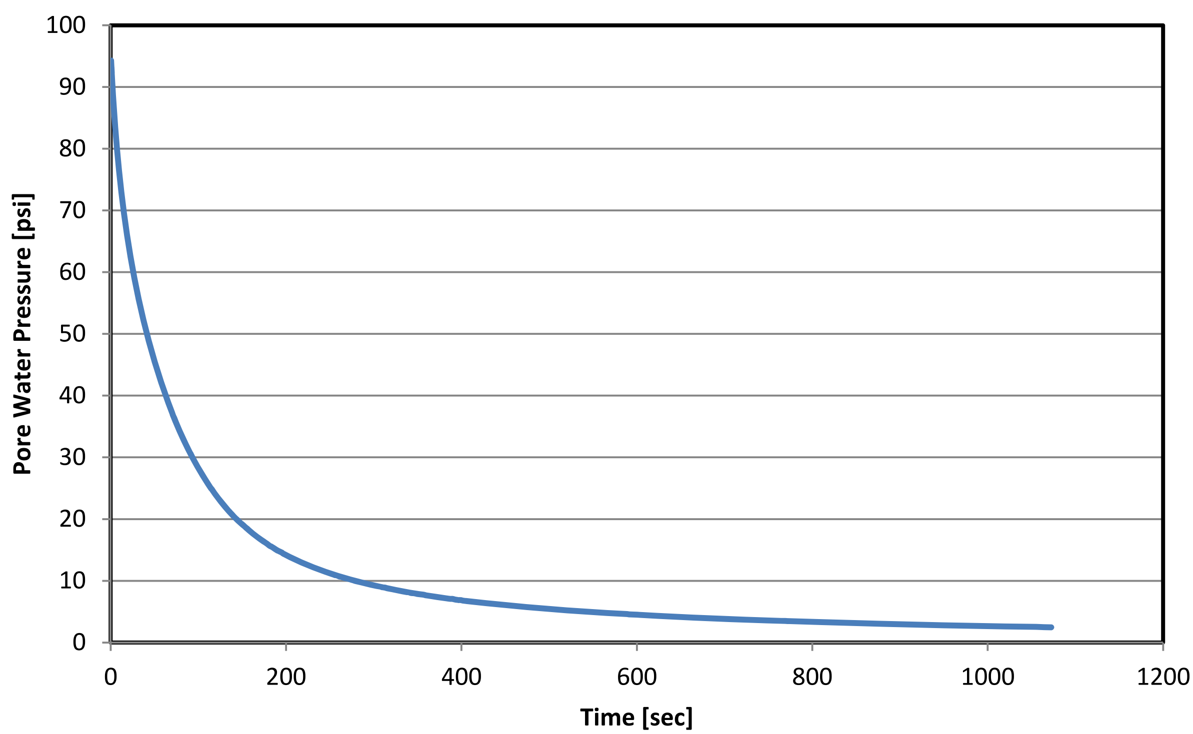

CPT14-19 @ 29ft
Pore Water Pressure [psi]
Time [sec]
0
5
10
15
20
25
30
35
40
45
50
0
100
200
300
400
500
600
700
800
900

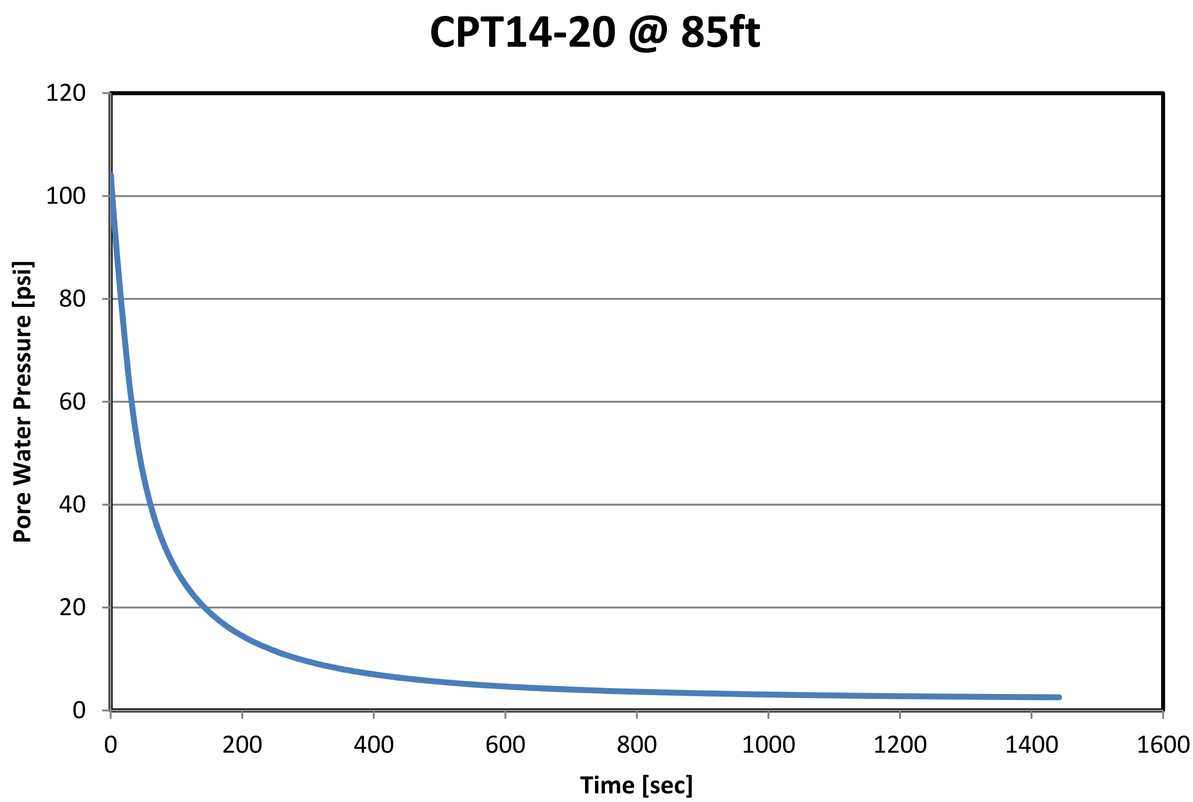

CPT14-19 @ 39ft
Pore Water Pressure [psi]
Time [sec]
0
10
20
30
40
50
60
0
100
200
300
400
500
600
700
800

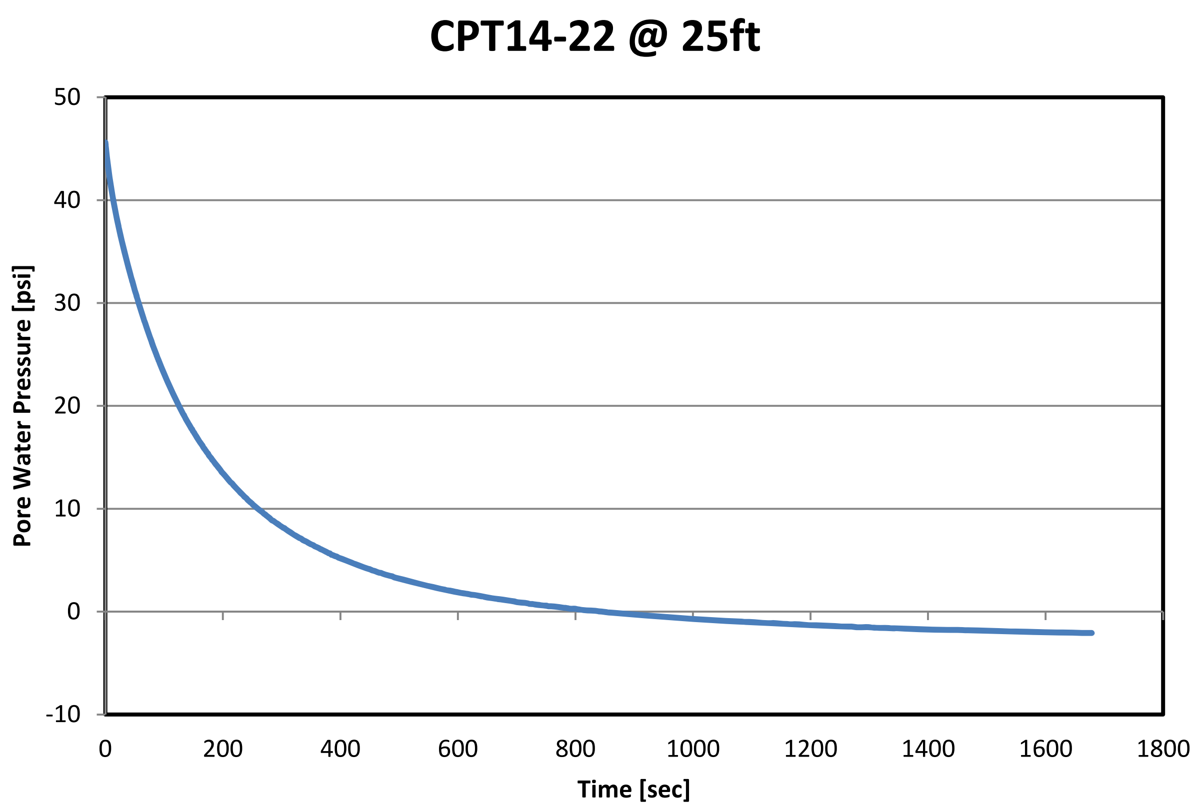
CPT14-19 @ 63ft

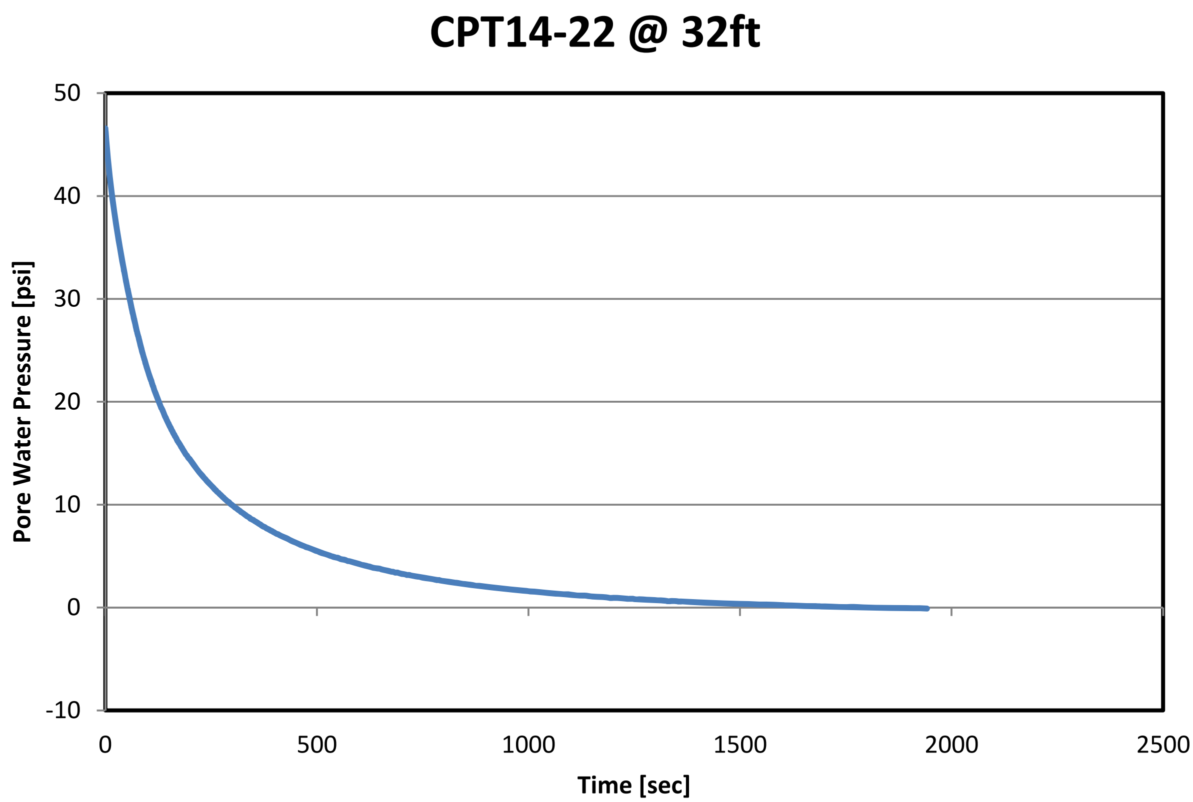


CPT14-20 @ 69ft

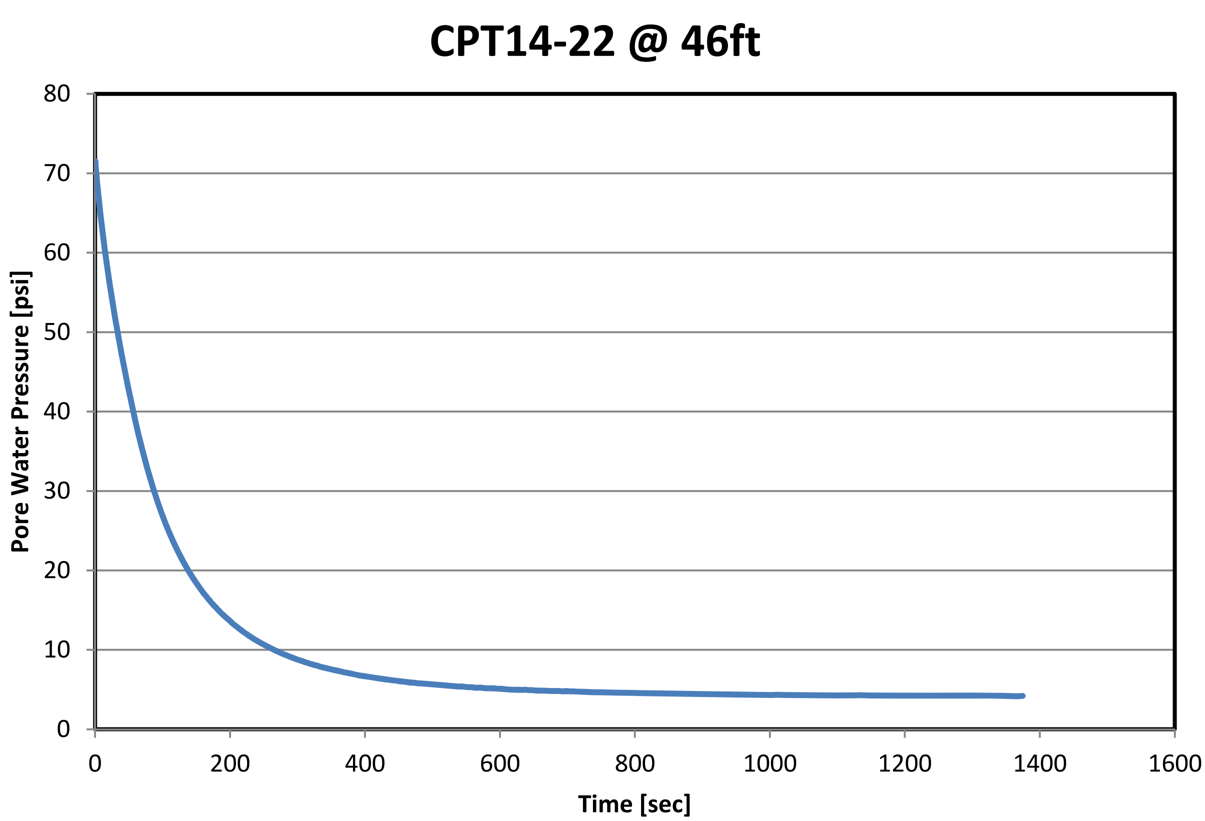



CPT14-20 @ 85ft
Pore Water Pressure [psi]
120
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
1600
Time [sec]


CPT14-22 @ 25ft
Pore Water Pressure [psi]
50
40
30
20
10
0
-10
0
200
400
600
800
1000
1200
1400
1600
1800
Time [sec]

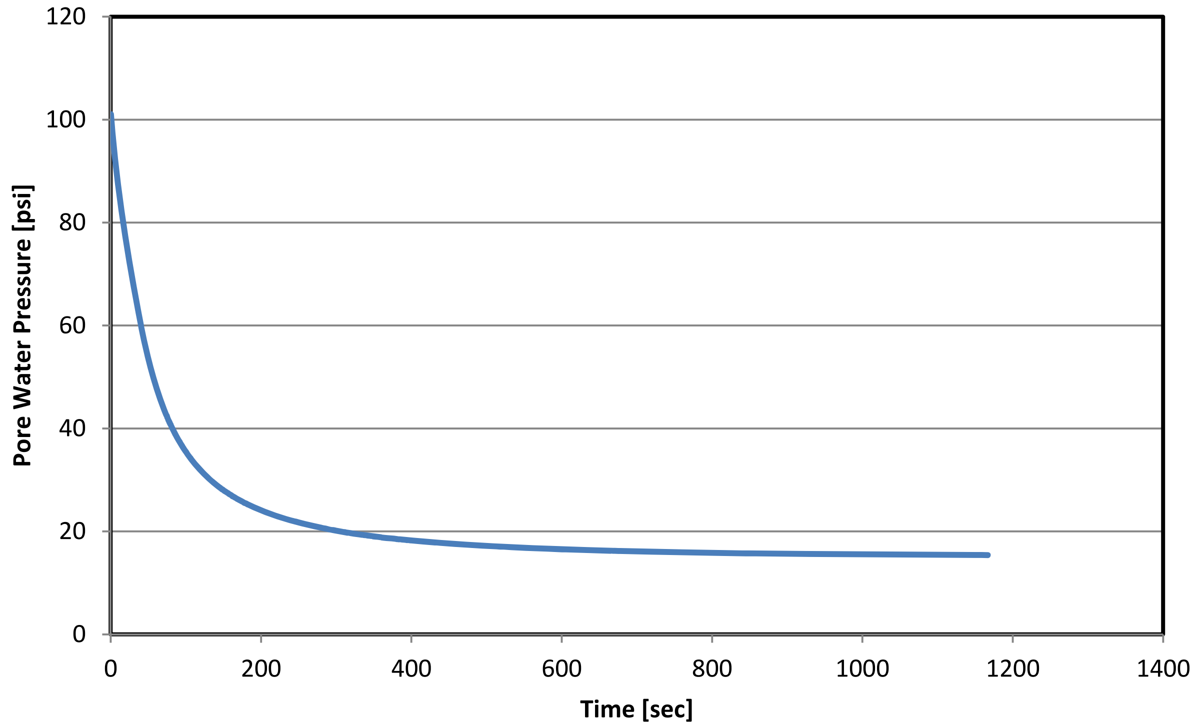


CPT14-22 @ 32ft
50
40
30
20
10
0
-10
0
500
1000
1500
2000
2500
Pore Water Pressure [psi]
Time [sec]



CPT14-22 @ 46ft
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200
1400
1600
Pore Water Pressure [psi]
Time [sec]

CPT14-22 @ 73ft



Attachment G

FTB Containment System Slope Stability Impacts

Technical Memorandum

To: Poly Met Mining Inc.

From: Tom Radue, Bethany Kelly, and Kristin Alstadt

Subject: NorthMet Flotation Tailings Basin: Seepage Containment System Effects on Slope Stability

Date: December 30, 2014

The purpose of this memorandum is to provide the Minnesota Department of Natural Resources Division of Ecological and Water Resources, Dam Safety Unit, information on the potential effects of the Flotation Tailings Basin (FTB) Seepage Containment System (Containment System) on FTB dam stability. Results indicate that slope stability factors of safety remain at or above those required (as specified in NorthMet Geotechnical Modeling Work Plan (Work Plan) – Version 3), through Containment System construction and operations. As described within this memo, Containment System construction methods are selected to avoid construction-related impacts on slope stability.

Background

FTB slope stability analyses completed under the Work Plan and reported in the NorthMet Project Geotechnical Data Package Volume 1 – Version 5 (December 30, 2014), show that the proposed FTB design meets all required factors of safety. These analyses did not, however, evaluate the effects of the Containment System on FTB slope stability. Barr conducted additional slope stability analyses to determine the potential effects of the Containment System on the factors of safety for the proposed FTB design. This Containment System stability analysis followed the analysis methods and geotechnical data selection approaches specified by the Work Plan. The safety factors calculated by the Containment System stability analysis represent FTB dam stability during and after construction of the FTB Containment System.

The proposed design and construction sequence for the Flotation Tailings Basin (FTB) Seepage Containment System are detailed in the Water Management Plan Plant – Version 3, Section 2.1.4. The Containment System will be installed before the first lift of the FTB north dam is constructed. The purpose of the Containment System is to capture water that seeps from the Tailings Basin so that it can be treated. This stability analysis assessed the main segment of the Containment System, which is set back approximately 200 feet from the northern and western toe of slope of Tailings Basin Cell 2E and Cell 2W (Figure 1). The Containment System includes a cutoff wall to bedrock, accompanied by a collection trench located on the tailings basin side of the cutoff wall. The collection trench was modeled as 8 feet deep with vertical trench slopes and a width of 3 feet. Sitting at the bottom of the trench is a perforated drain pipe placed in a granular backfill as shown in Figure 2.

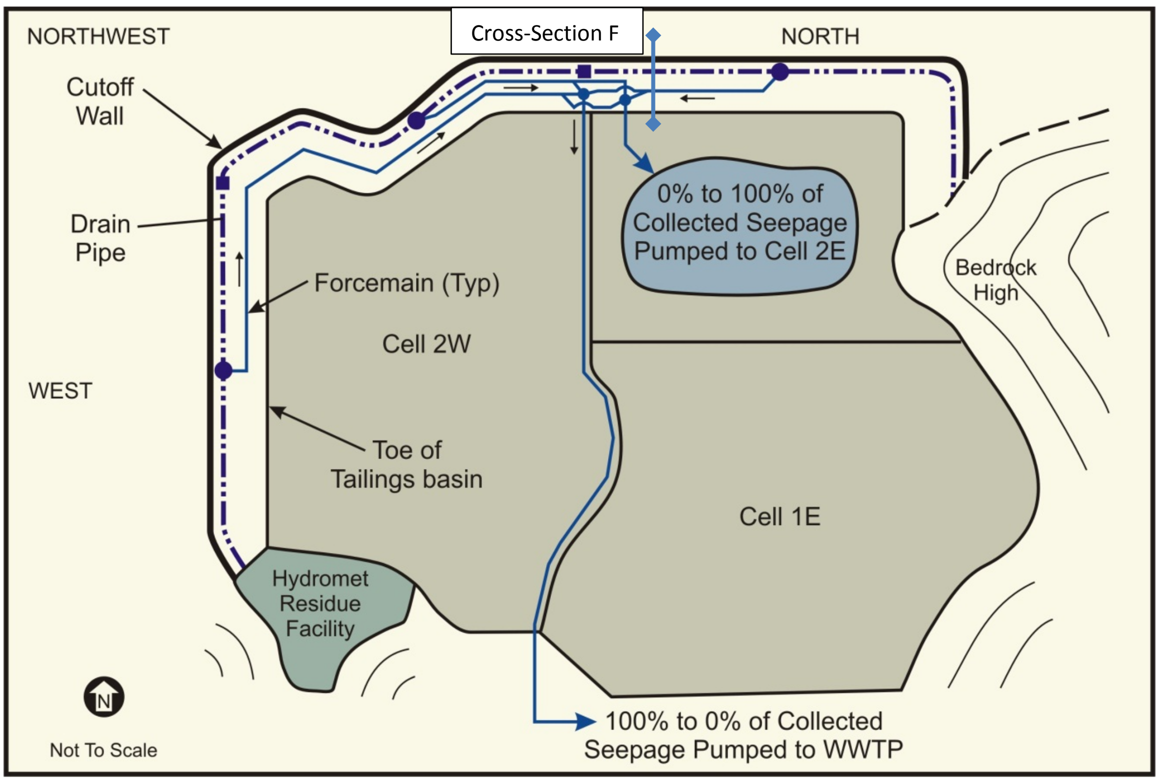


Figure 1 Conceptual Plan View: FTB Groundwater Containment System

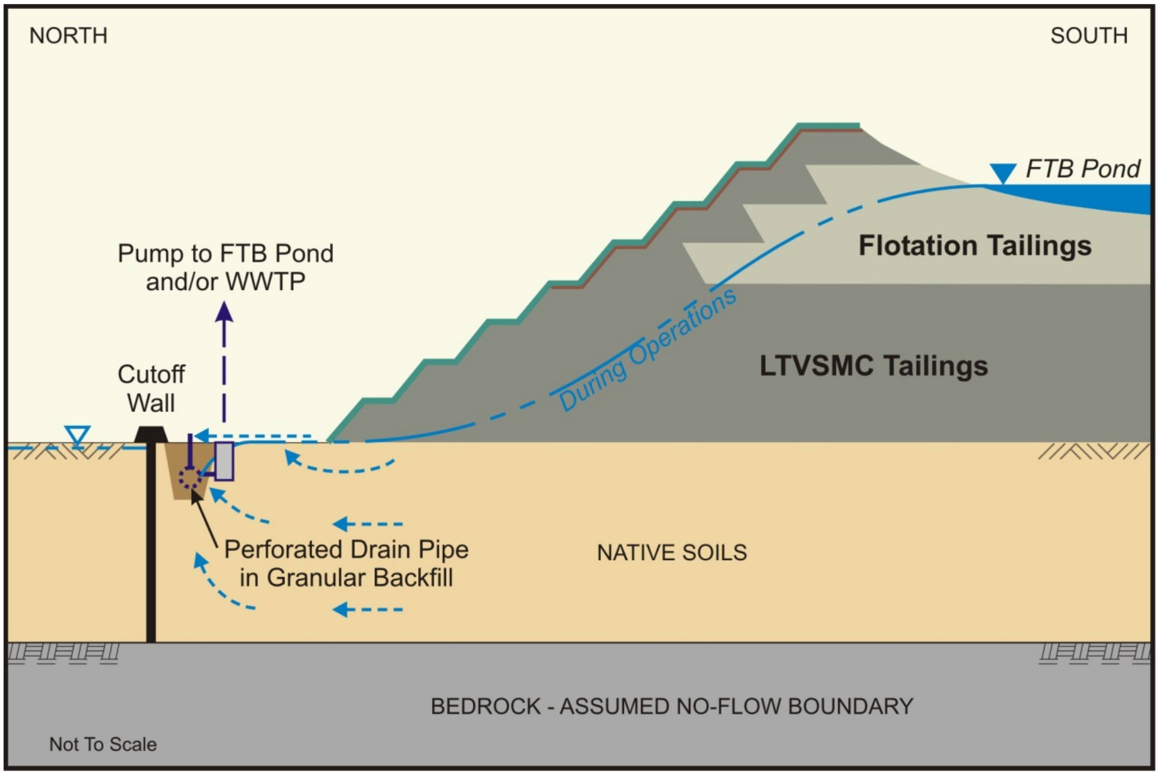


Figure 2 Conceptual Cross-Section: FTB Containment System

The slope stability analysis is for Cross-Section F, with approximate location shown on Figure 1. Cross-Section F represents the critical slope cross-section; the location yielding the lowest slope stability factor of safety. An additional segment of the Containment System not shown on Figure 1 will be installed near the toe of the Cell 1E east dam. The east dam will be relatively small in comparison to that at Cross-Section F and the effects of the Containment System on east dam stability will be analyzed concurrent with final dam design for construction.

The following summarizes the general installation approach anticipated for each of the primary Containment System components. The system will be constructed in the sequence presented (Manholes, Collection Trench, Cutoff Wall) so that system dewatering can be initiated if needed prior to the cutoff wall completion. Further, the construction methods and sequence are selected to maintain adequate slope stability safety factors for effective stress stability conditions throughout construction and operation; hence, Effective Stress Stability Analysis (ESSA) has been performed. ESSA analyses are appropriate because:

- trenchless construction techniques are proposed as the primary means of containment system construction as described later in this memorandum,
- the collection trench, when in operation, will draw down water levels on the tailings basin side of the cutoff wall only several feet, thereby representing a minimal change in hydraulic and soil stress conditions at the tailings basin, and
- in the unlikely event of a prolonged collection system failure, water levels on the tailings basin side of the cutoff would only rise to current water levels or just above (due to elevation control by the cutoff), again representing a minimal change in hydraulic conditions and soil stress conditions at the tailings basin.

For consistency with other slope stability analyses performed for the FTB, as presented in Geotechnical Data Package – Volume 1 – Version 5, it has been assumed that an unknown triggering mechanism induces liquefaction and analyses have been performed to confirm achievement of a factor of safety ≥ 1.1 for post-liquefaction slope stability, applying design liquefied shear strengths to all LTVSMC fine tailings and slimes and all NorthMet flotation tailings below the top of the capillary zone.

The following is a summary of the primary components of the Containment System:

- Manholes – the manholes will generally be installed using typical excavation and backfill techniques, with an average excavation depth at each manhole of 10 to 15 feet. Sheet piling or shoring will be used as needed to isolate manhole installation locations from surrounding soils and to minimize construction dewatering requirements.
- Collection Trench – the collection trench will be constructed using trenchless technology such as that provided by DeWind One-Pass Trenching of Zeeland, Michigan, Hayward Baker of Bloomington, Minnesota, or other qualified contractor. The seepage collection trench and drain pipe depth has not yet been finalized, but we assume an average depth of 8 feet to prevent system freezing and maintain operations through-out winter (exact depth will be determined during final design and construction). With one-pass trenching excavated material is immediately replaced with the collection trench drain pipe and

granular fill and the need to maintain an open dewatered trench for construction is avoided. The excavated soils will be used for other construction purposes or placed in the FTB.

- Cutoff Wall – the cutoff wall will be constructed using trenchless in-situ construction techniques whereby a mechanical mixer is inserted into the ground along the cutoff wall alignment. As the mixer ‘walks’ down the cutoff wall alignment, it mixes the soil along the cutoff wall location with bentonite. The soil-bentonite mixing occurs in-situ and an open trench is not utilized. DeWind One-Pass Trenching and Hayward Baker are examples of companies that provide such services. At locations where boulders are encountered that interfere with trenchless construction, the boulders will be removed using conventional excavation methods. Small diameter cobbles and boulders are expelled from the excavation as part of the trenchless construction process.

Slope Stability Analysis Methods

Slope stability was modeled for a system installed via the planned in-situ construction. The seepage and slope stability modeling was performed using the GeoStudio suite of geotechnical software to determine if existing and proposed conditions are stable. The Containment System stability analysis was performed based on the configuration of the native soils, the existing Tailings Basin and the planned FTB dams along a cross-section through the north dam of Cell 2E, referred to as Cross-Section F. This cross-section is the critical cross-section – in other words, the calculated factors of safety for the proposed design are lower for this cross-section than for other cross-sections that have been analyzed.

Three models were developed for the Containment System stability analysis. The Existing Conditions Configuration under drained conditions and the Future Dam Configuration under drained and liquefied conditions. The Existing Conditions Configuration is used for the drained conditions (Effective Stress Stability Analysis; ESSA) analysis to assess potential slope stability impacts of the Containment System along the north side of Cell 2E prior FTB operations. The Future Dam Configuration model is used to assess how the Containment System might affect slope stability when the FTB dams are at maximum height, for drained conditions and in the event of an unknown triggering mechanism.

The results of stability models of Cross-Section F are assumed to be representative of potential slope stability impacts along the north and west side of Cell 2W. This assumption is valid based on the outcome of the slope stability modeling, which shows that the slope stability failure surface in the Cell 2E existing conditions model occurs within the existing Tailings Basin dam, which has a slope configuration mirroring that along the northern and western sides of Cell 2W.

For stability modeling the collection trench and/or cutoff wall are offset approximately 200 feet from the existing toe of dam. One objective of the final design of the cutoff wall will be to identify areas of shallower bedrock to serve as a lower cutoff for the system, thereby limiting the overall cutoff wall depth and cost. Hence, final cutoff wall offset distance from the toe of dam will be somewhat variable depending on future findings about bedrock depth. For this analysis, the cutoff wall is modeled as 36 feet deep, extending through fractured bedrock and terminating at the top of competent bedrock. The 36 foot depth is an estimated maximum depth to bedrock at the cutoff wall location for stability modeling; actual depth to bedrock will require confirmation during construction and may vary somewhat for water quality modeling purposes. The cutoff wall was assumed to be 3 feet thick and was modeled with material properties similar to those of a slurry wall, with a permeability of 3.28×10^{-9} ft/s (1×10^{-7} cm/s), unit weight of 70 pcf, and cohesion of 50 psf. The granular backfill in the collection trench adjacent the cutoff was assumed to have the same properties as the rock dam buttress (friction angle of 40 degrees and unit weight of 140 pcf). Potential seepage face boundary conditions were applied to the drain pipe sitting at the bottom of the collection trench to allow water to flow out of the system. Beyond the cutoff wall, potential seepage face boundary conditions were applied to the wetlands area.

The remaining tailings basin and native stratigraphy seepage parameters and material strength design parameters are based on previously established design values used for stability analysis presented in Geotechnical Data Package – Volume 1 – Version 5. The phreatic surface within the existing dam has been verified with available data from piezometers installed in the perimeter dam along Cross-Section F and using water levels determined from CPTu data collected in the winter/spring of 2014. Two operating conditions were modeled:

- the collection system operating with active extraction of water from the collection system, and
- the collection system temporarily inactive (e.g., such as in the event of an abnormally long power outage), simulated with the water table at ground surface from the toe of the dam to the cutoff wall.

Stability Analysis Outcomes

The slope stability analysis was conducted using SLOPE/W, part of the GeoStudio 2012 Version 8.3 software package. SLOPE/W uses limit equilibrium theory to compute the factor of safety of earth and rock slopes while analyzing complex geometry, stratigraphy, and loading conditions. Spencer's method, using a 20-foot minimum slip surface depth, was used to calculate the factor of safety of the Tailings Basin and FTB dams with the Containment System constructed. The grid and radius search criterion was used for this analysis. With the grid and radius search technique, the grid of the center of slip circles (or center of blocks) and radii (or ends of blocks) are established by the user, and the computer program then searches for the circle or block yielding the lowest factor of safety. After the grid and radius slip surface was found, optimization was used to determine a minimum factor of safety to identify the most critical, non-circular failure surface.

The optimization technique uses the solution of the circular slip surface and iteratively adjusts the slip surface geometry (usually idealized into multiple relatively linear segments) to identify the surface yielding the lowest factor of safety value, resulting in a non-circular slip surface. Optimization can sometimes result in unrealistic or kinematically inadmissible failure surfaces; therefore, engineering judgment is used to determine whether the optimized slip surface is realistic and, in cases where it is deemed unreasonable, the result for the circular slip surface is reported.

The drained condition is typically considered a long-term case in which loading is slow enough (or the material has high enough permeability) that no shear-induced porewater pressures are able to develop during loading. The drained condition applies to this analysis of Containment System construction impacts because the Containment System will be constructed before flotation tailings are placed in the FTB and the existing Tailings Basin dams are currently in a long-term stable drained state. Further, trenchless construction technology and temporary braced excavations are proposed so that open dewatered excavations that could induce undrained loading conditions will not be present. As noted previously, conditions of an unknown trigger for liquefaction have also been considered. The factor of safety values specified in the Work Plan for the drained condition (ESSA) is F.S. $\geq$ 1.5 and for the liquefied condition is F.S. $\geq$ 1.1. Table 1 provides a summary of the stability results. The model outputs are attached as Figure 3 through Figure 8.

Table 1 Summary of Containment System Stability Results

Dam Condition Modeled	Soil Stress Conditions	Collection System (Active/Inactive)	Target Factor of Safety	Modeled Factor of Safety
Existing Conditions Configuration	ESSA (Fig. 3)	Inactive	1.5	1.87 (1)
Existing Conditions Configuration	ESSA (Fig. 4)	Active	1.5	2.13 (1)
Future Dam Configuration – Section F	ESSA (Fig. 5)	Inactive	1.5	2.01 (2)
Future Dam Configuration – Section F	ESSA (Fig. 6)	Active	1.5	2.15 (3)
Future Dam Configuration – Section F	All Saturated Contractive Soils Liquefied to $USSR_{Liq}$ (Fig. 7)	Inactive	1.1	1.10 (1)
Future Dam Configuration – Section F	All Saturated Contractive Soils Liquefied to $USSR_{Liq}$ (Fig. 8)	Active	1.1	1.11 (4)

(1) Non-optimized factor of safety value for a wedge failure occurring along the top of impenetrable till.
(2) Non-optimized factor of safety value for a circular failure occurring within the buttress.
(3) Optimized factor of safety value for a wedge failure occurring within the buttress having a slip surface terminating along the top of impenetrable fractured bedrock.
(4) Non-optimized factor of safety value for a circular and wedge failure.

The factor of safety results are at or above the target slope stability factor of safety values for drained conditions and for liquefied conditions given an unknown trigger, with the Containment System active or inactive. The inactive results only apply during extended interruptions of collection system operations due to temporary blockage of seepage. Note that the factors of safety are fractionally higher when the Containment System is active than when it is inactive. Also, the factors of safety are fractionally higher when the FTB is modeled with an active containment system than when it is modeled without the Containment System (NorthMet Project Geotechnical Data Package Volume 1 – Version 5). This indicates that the Containment System, when active, helps to improve the stability of the Tailings Basin by lowering the water level at the toe.

Conclusions

As demonstrated by the slope stability factors of safety reported in Table 1, computed slope stability safety factors at Cross-Section F with the Containment System in place meet safety factor requirements.

Field geotechnical conditions and piezometer readings should be monitored throughout Containment System construction to confirm that the conditions actually encountered are consistent with the conditions that have been modeled, with construction methods adjusted as needed to maintain the required slope stability throughout Containment System construction and operation.

FIGURE 3. Existing ESSA Conditions_Inactive Collection System

PolyMet Flotation Tailings Basin
Containment System for Existing Conditions
Date Last Saved: 12/26/2014
File Name: Containment System_SecF_Existing_Nonactive.gsz

Case: 1.2 No Lifts - ESSA_till wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.87

Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Slurry Wall Model: Mohr-Coulomb Unit Weight: 70 pcf Cohesion': 50 psf Phi': 0 °

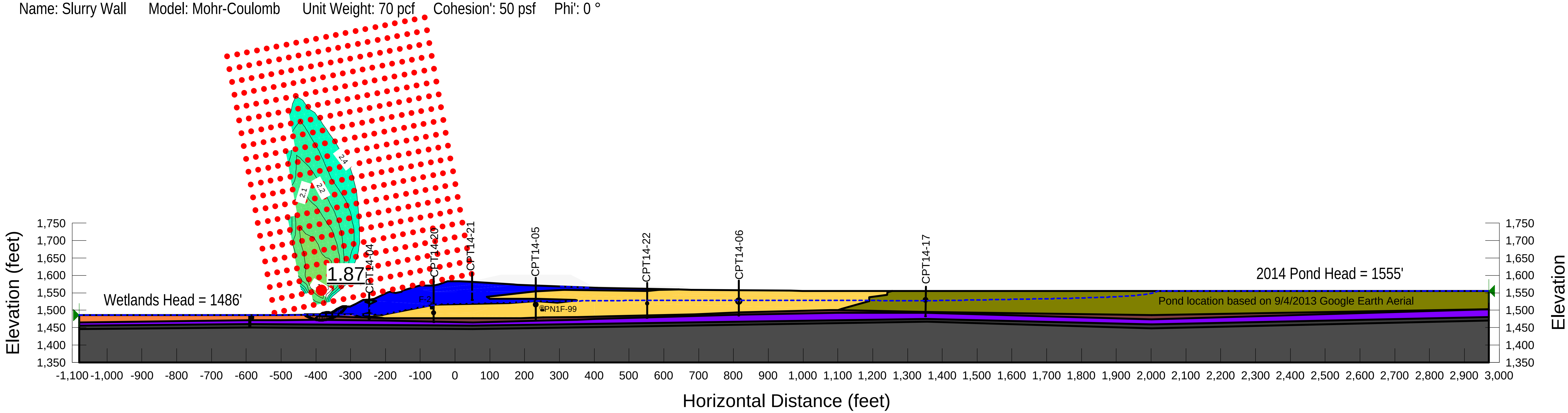


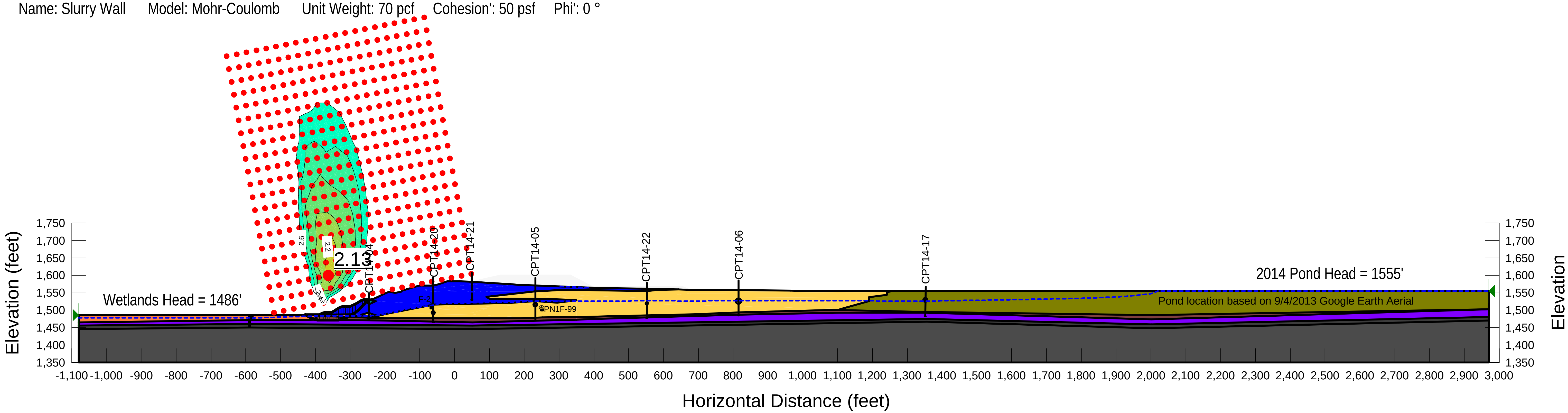
FIGURE 4. Existing ESSA Conditions_Active Collection System

PolyMet Flotation Tailings Basin
Containment System for Existing Conditions
Date Last Saved: 12/26/2014
File Name: Containment System_SecF_Existing_Active.gsz

Case: 1.2 No Lifts - ESSA_till wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 2.13

Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Slurry Wall Model: Mohr-Coulomb Unit Weight: 70 pcf Cohesion': 50 psf Phi': 0 °



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Project #23690862-037

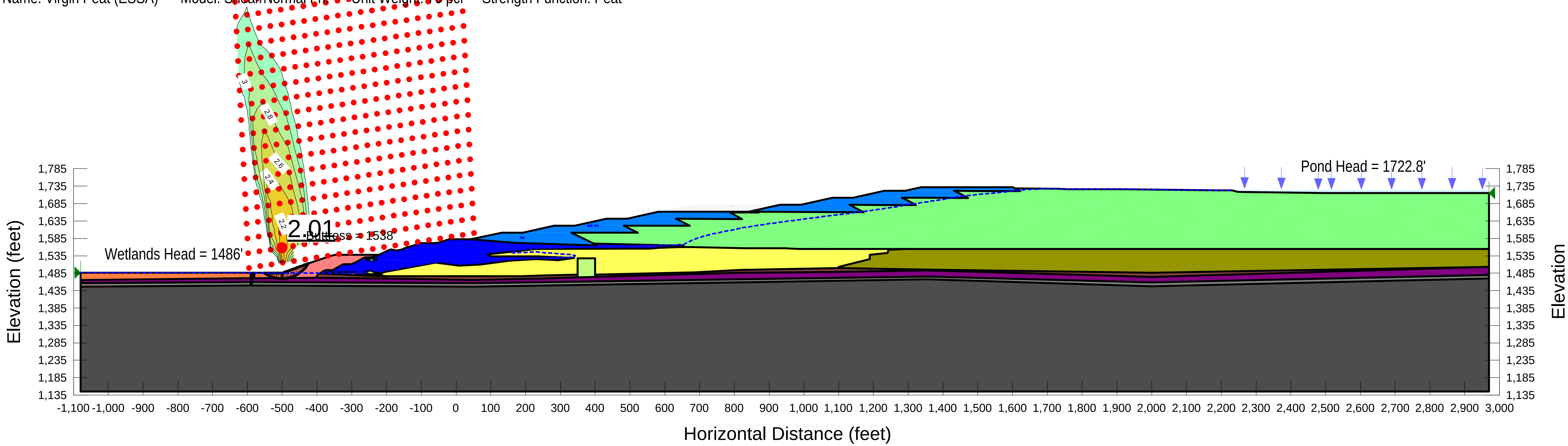
FIGURE 5. Lift 8 Normal Pool ESSA Conditions_Inactive Collection System

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/27/2014
File Name: Containment System_SecF_Lift8__Nonactive.gsz

2.0 Lift 8 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 2.01

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Slurry Wall Model: Mohr-Coulomb Unit Weight: 70 pcf Cohesion': 50 psf Phi': 0 °
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat



P:\Mpls\23 MN\69\2369862\WorkFiles\022A GeoStudio models\2014\Containment System\Lift 8\

Project #23690862-037

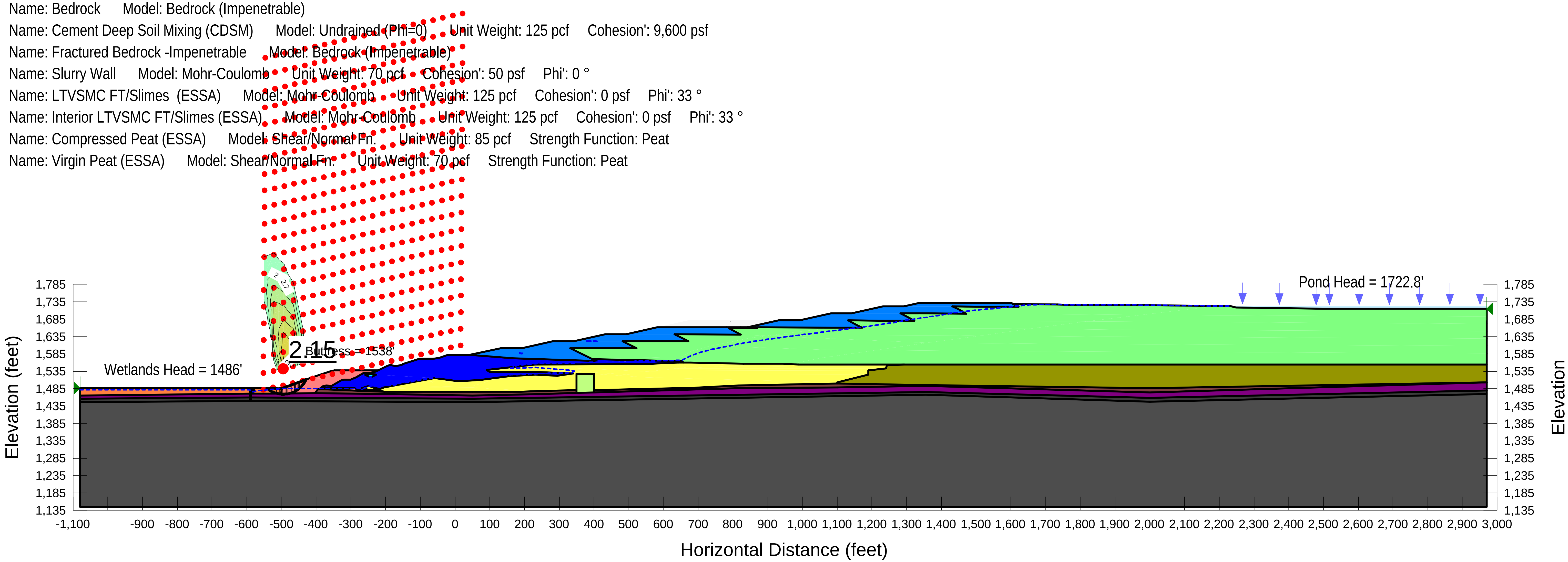
FIGURE 6. Lift 8 Normal Pool ESSA Conditions_Active Collection System

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/26/2014
File Name: Containment System_SecF_Lift8_Active.gsz

2.1 Lift 8 - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 2.15

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Fractured Bedrock -Impenetrable Model: Bedrock (Impenetrable)
Name: Slurry Wall Model: Mohr-Coulomb Unit Weight: 70 pcf Cohesion': 50 psf Phi': 0 °
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat



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Project #23690862-037

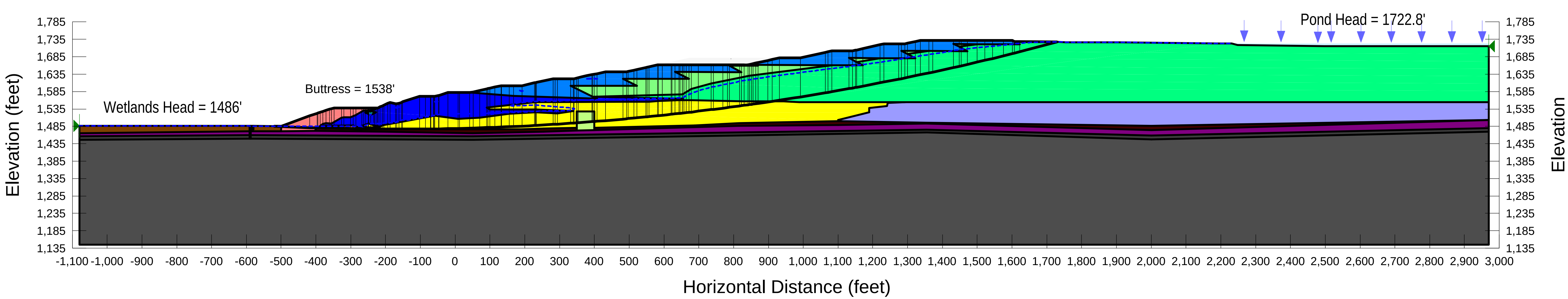
FIGURE 7. Lift 8 Normal Pool Liquefied Conditions_Inactive Collection System

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/27/2014
File Name: Containment System_SecF_Lift8__Nonactive.gsz

1.1 Lift 8 - LIQ_bedrock wedge (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.10

Name: Glacial Till   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 36.5 °
Name: Compressed Peat   Model: S=f(overburden)   Unit Weight: 85 pcf   Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA)   Model: S=f(overburden)   Unit Weight: 70 pcf   Tau/Sigma Ratio: 0.23
Name: Rock Dam   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 40 °
Name: LTVSMC Coarse Tailings   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: LTVSMC Fine Tailings   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 33 °
Name: LTVSMC Bulk Tailings   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Flotation Tailings (Liquefied)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.12
Name: Flotation Tailings (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: Interior LTVSMC FT/Slimes (Liquefied)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.1
Name: LTVSMC FT/Slimes (Liquefied)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.1
Name: Bedrock   Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM)   Model: Undrained (Phi=0)   Unit Weight: 125 pcf   Cohesion': 9,600 psf
Name: Fractured Bedrock -Impenetrable   Model: Bedrock (Impenetrable)
Name: Slurry Wall   Model: Mohr-Coulomb   Unit Weight: 70 pcf   Cohesion': 50 psf   Phi': 0 °



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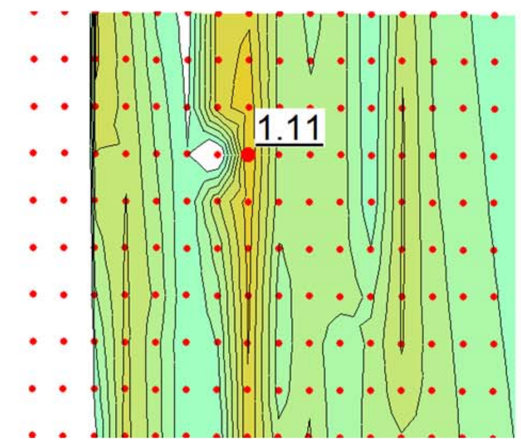
Project #23690862-037

FIGURE 8. Lift 8 Normal Pool Liquefied Conditions_Active Collection System

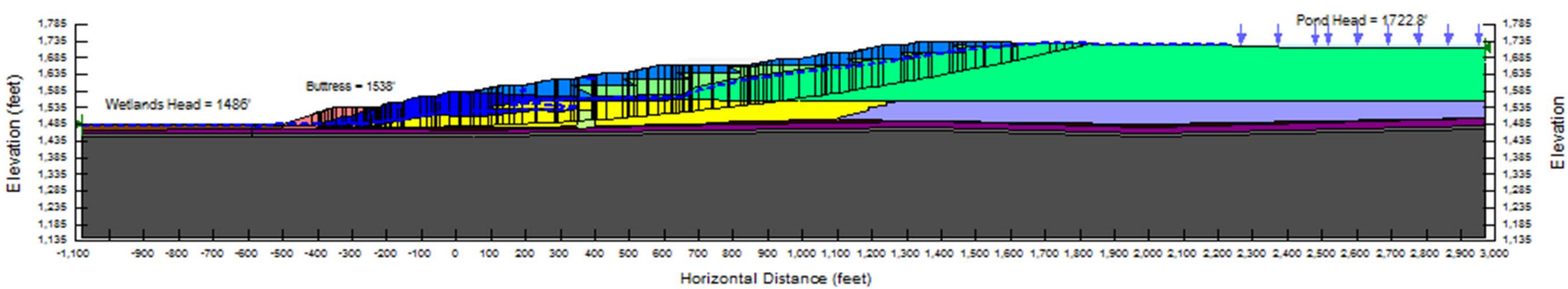
PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/26/2014
File Name: Containment System_SecF_Lift8_Active.gsz

1.0 Lift 8 - LIQ (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular

Factor of Safety: 1.11



Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.12
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: LTVSMC FT/Slimes (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Slurry Wall Model: Mohr-Coulomb Unit Weight: 70 pcf Cohesion': 50 psf Phi': 0 °



Attachment H

2007 Geotechnical Investigation CPTu Sounding Logs and Dissipation Test Results

Results

REPORT OF CPTu TESTING

PolyMet Tailings Basin

Hoyt Lakes, Minnesota

AET #01-03612

Date:

October 10, 2007

Prepared for:

Barr Engineering Company
4700 West 77th Street
Minneapolis, MN 55435

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

October 10, 2007

Barr Engineering Company
4700 West 77th Street
Minnespolis, MN 55435

Attn: Mr. Aaron Grosser, P.E.

RE: Report of CPTu Testing
PolyMet Tailings Basin
Hoyt Lakes, Minnesota
AET #01-03612

Dear Mr. Grosser:

This report presents the results of the CPT testing recently completed for the referenced project. We are submitting four (4) copies of the report to you.

Please call if you have any questions about the report.

Sincerely,

James C. Rudd, PE
Principal Engineer
Phone: (651) 659-1367
Fax: (651) 659-1379

550 Cleveland Avenue North • St. Paul, MN 55114
Phone 651-659-9001 • Toll Free 800-972-6364 • Fax 651-659-1379 • www.amengtest.com
Offices throughout Florida, Minnesota, South Dakota & Wisconsin

TABLE OF CONTENTS

RESULTS OF CPT TESTING FOR POLYMET TAILINGS BASIN HOYT LAKES, MINNESOTA

AET #01-03612

INTRODUCTION

This report presents the results of Cone Penetration Testing (CPTu) completed at the referenced site. The work was done on during the period of July 23 to August 22, 2007.

SCOPE OF SERVICES

AET mobilized a 20-ton Cone Penetrometer Test rig to the site, which is located within the LTV Mine just north of Hoyt Lakes, Minnesota. The locations of the CPT soundings were specified by Barr personnel. Barr personnel also directed the field work.

The scope of the CPT test program is summarized Table 1, which is attached in Appendix A. The work scope included the following: thirty-six (36) CPT sounding locations to maximum depths of 164 feet; two (2) rapid rate CPT soundings to depths of 42 to 72 feet; 118 pore pressure dissipation tests, and 235 shear wave velocity tests (on approximate 10 foot vertical intervals in CPT soundings). The scope also included pushing a flat plate dilatometer, which was supplied by Barr. Data collection for the dilatometer was done by Barr personnel.

Our work scope also included compression wave velocity testing; however, the quality of the P wave data was poor due to excessive noise. AET used a 15 cm^2 electronic seismic piezocone manufactured by Vertek. The shear wave source is located within the front leveling beam of the push rig. A 300 pound hydraulically actuated slide weight generates the shear wave within the leveling pad. A pair of geophones within the electronic cone detect the shear wave at periodic depths in the sounding.

RESULTS

CPTu Soundings

Logs of the CPTu soundings are included in Appendix A. Soundings 07-06F and 07-09F were run at an increased push rate of approximately 13 cm/sec.

Seismic Testing

Plots of shear waves and computed shear wave velocities are included in Appendix B. Since the quality of the P waves was poor, this data is not included.

Dissipation Tests

Plots of pore pressure dissipation tests are included in Appendix C.

SIGNATURE

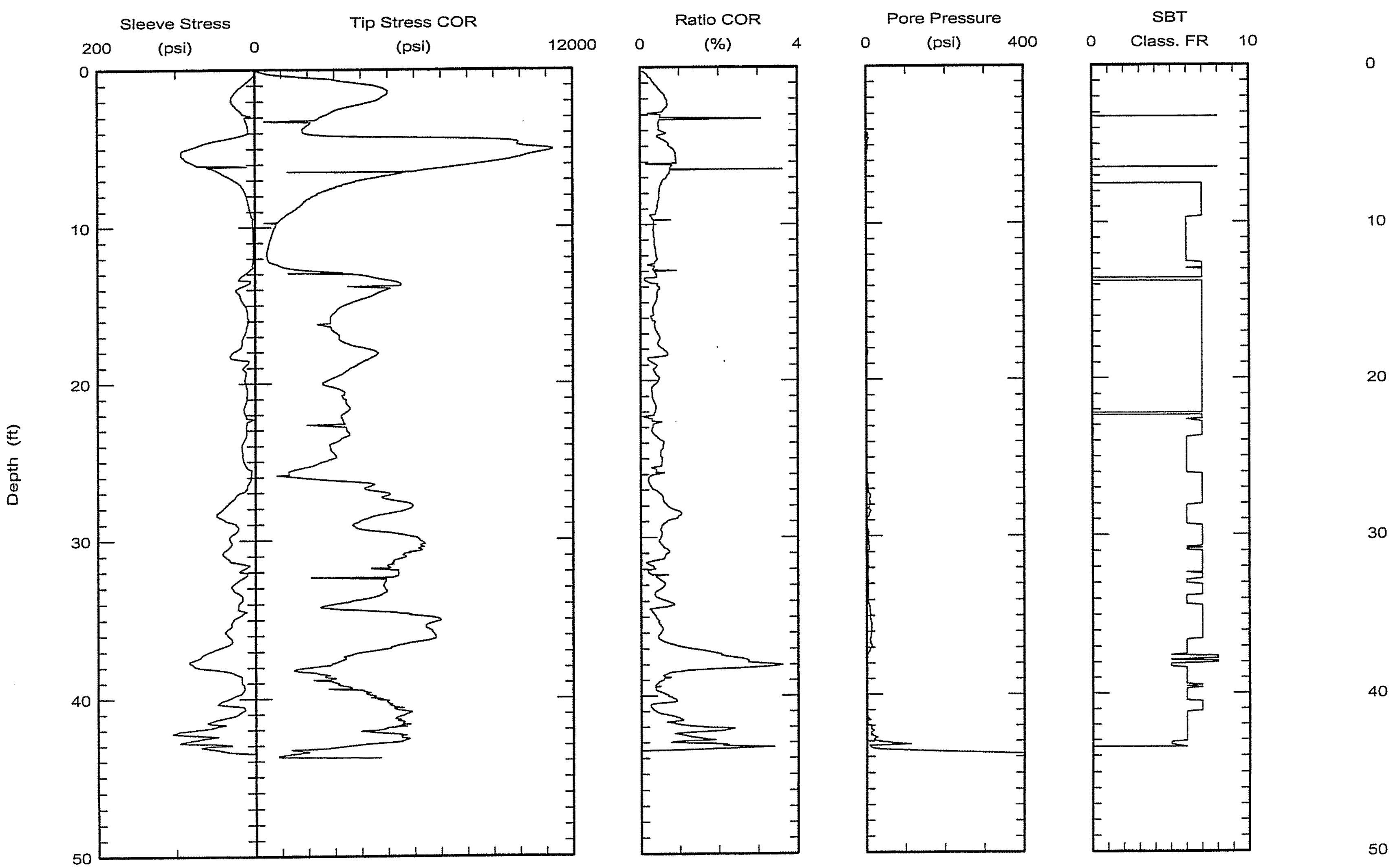
Report Prepared by:

James C. Rudd, PE
Principal Engineer
MN Reg. No. 13996

TABLE 1 – SUMMARY OF WORK SCOPE

Sounding #	Depth	Type	Dissipation tests	Shear Wave Tests
07-01	44	Normal push rate	2 tests	4 tests
07-02	83	Normal push rate	10 tests	8 tests
07-03	73	Normal push rate	5 tests	8 tests
07-03F	67	Rapid push rate	None	
07-4A	25	Normal push rate	None	2 tests
07-4B	61	Normal push rate	1 test	6 tests
07-05	103	Normal push rate	15 tests	10 tests
07-06	72	Normal push rate	8 tests	7 tests
07-07A	72	Normal push rate	None	
07-07B	7	Normal push rate	1 test	3 tests
07-07C	55	Normal push rate	2 tests	5 tests
07-08	77	Normal push rate	8 tests	7 tests
07-09	42	Normal push rate	6 tests	5 tests
07-09F	42	Rapid push rate	None	
07-10	42	Normal push rate	3 tests	4 tests
07-11	46	Normal push rate	4 tests	4 tests
07-12	43	Normal push rate	2 tests	4 tests
07-13	12	Normal push rate	None	
07-13A	10	Normal push rate	None	
07-13B	13	Normal push rate	None	
07-13C	9	Normal push rate	None	
07-13D	15	Normal push rate	None	
07-13E	14	Normal push rate	None	
07-14	100	Normal push rate	4 tests	10 tests
07-15	100	Normal push rate	4 tests	10 tests
07-16	99	Normal push rate	2 tests	10 tests
07-17	134	Normal push rate	4 tests	13 tests
07-18	131	Normal push rate	4 tests	13 tests
07-19	135	Normal push rate	3 tests	13 tests
07-20	83	Normal push rate	1 test	8 tests
07-21	168	Normal push rate	4 tests	16 tests
07-22	163	Normal push rate	5 tests	17 tests
07-23	98	Normal push rate	3 tests	10 tests
07-24	132	Normal push rate	5 tests	13 tests
07-25	123	Normal push rate	4 tests	12 tests
07-26	50	Normal push rate	3 tests	5 tests
07-27	73	Normal push rate	5 tests	7 tests

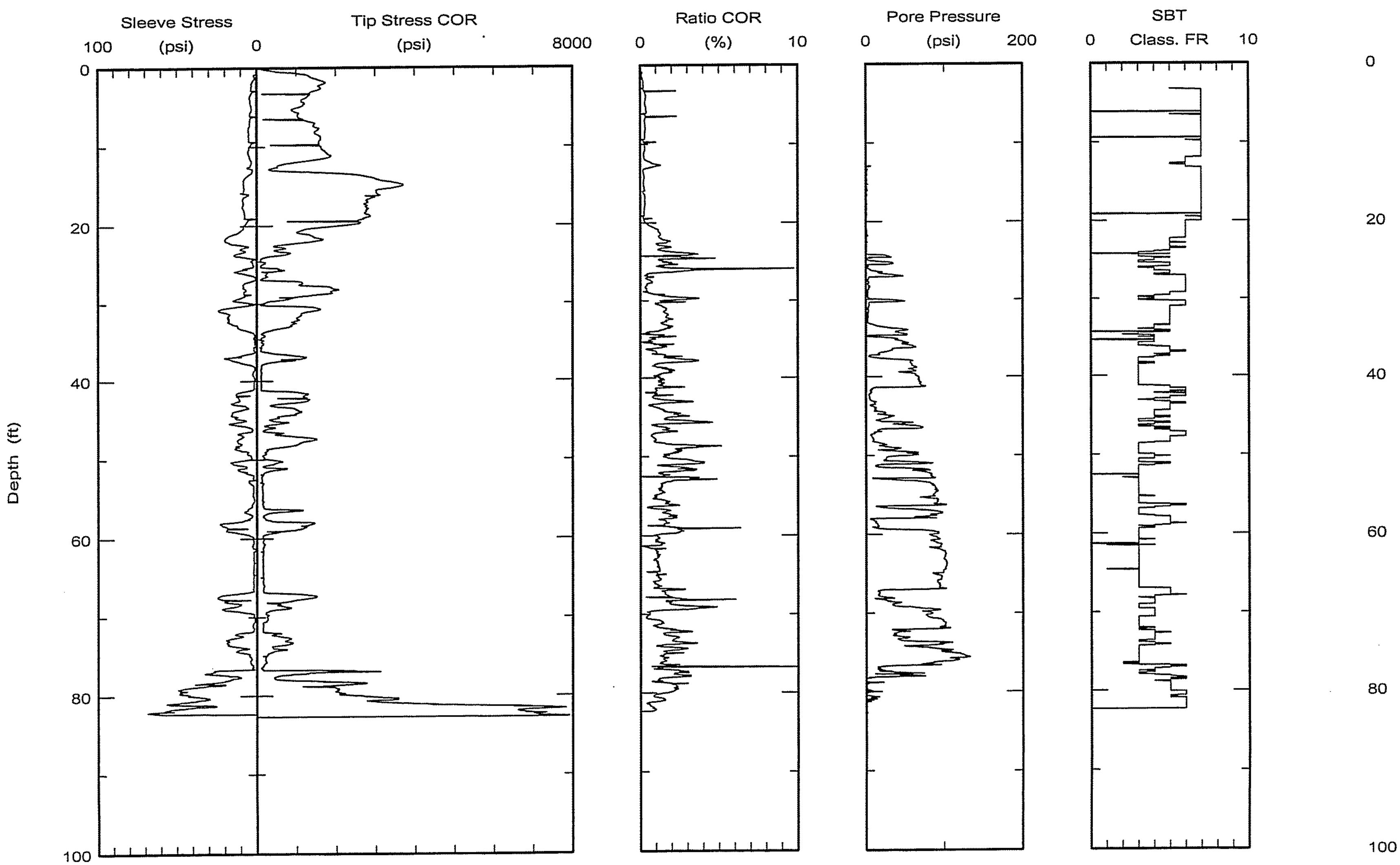
American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 26/Jul/2007 Test ID: C-07-01B Project: 01-03612
	Client: Site: PolyMet Tailing Basin	



Maximum depth: 43.81 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 24/Jul/2007 Test ID: C-07-02 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

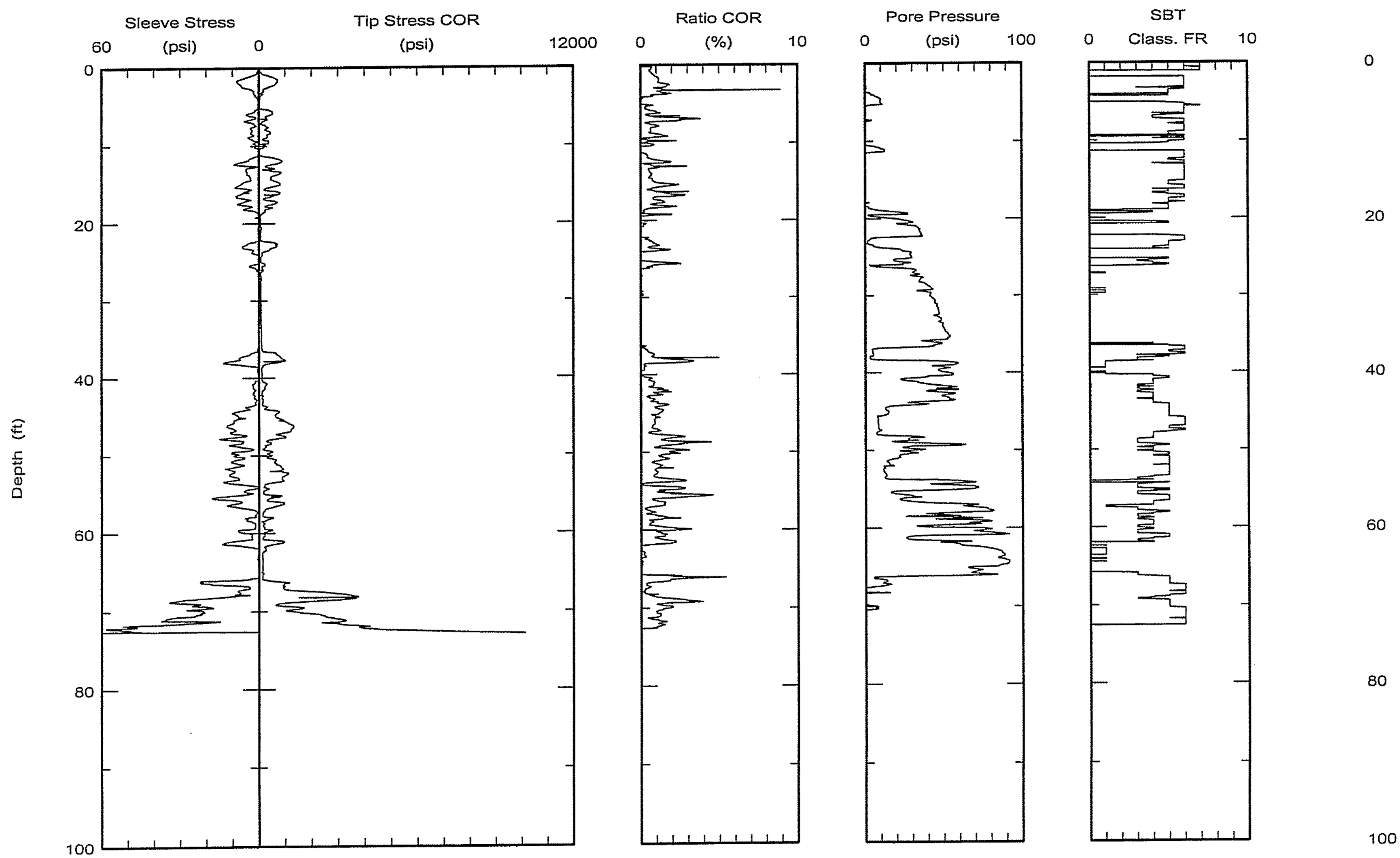


Maximum depth: 82.72 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-02
File: 2024L0705C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 23/Jul/2007 Test ID: C-07-03 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

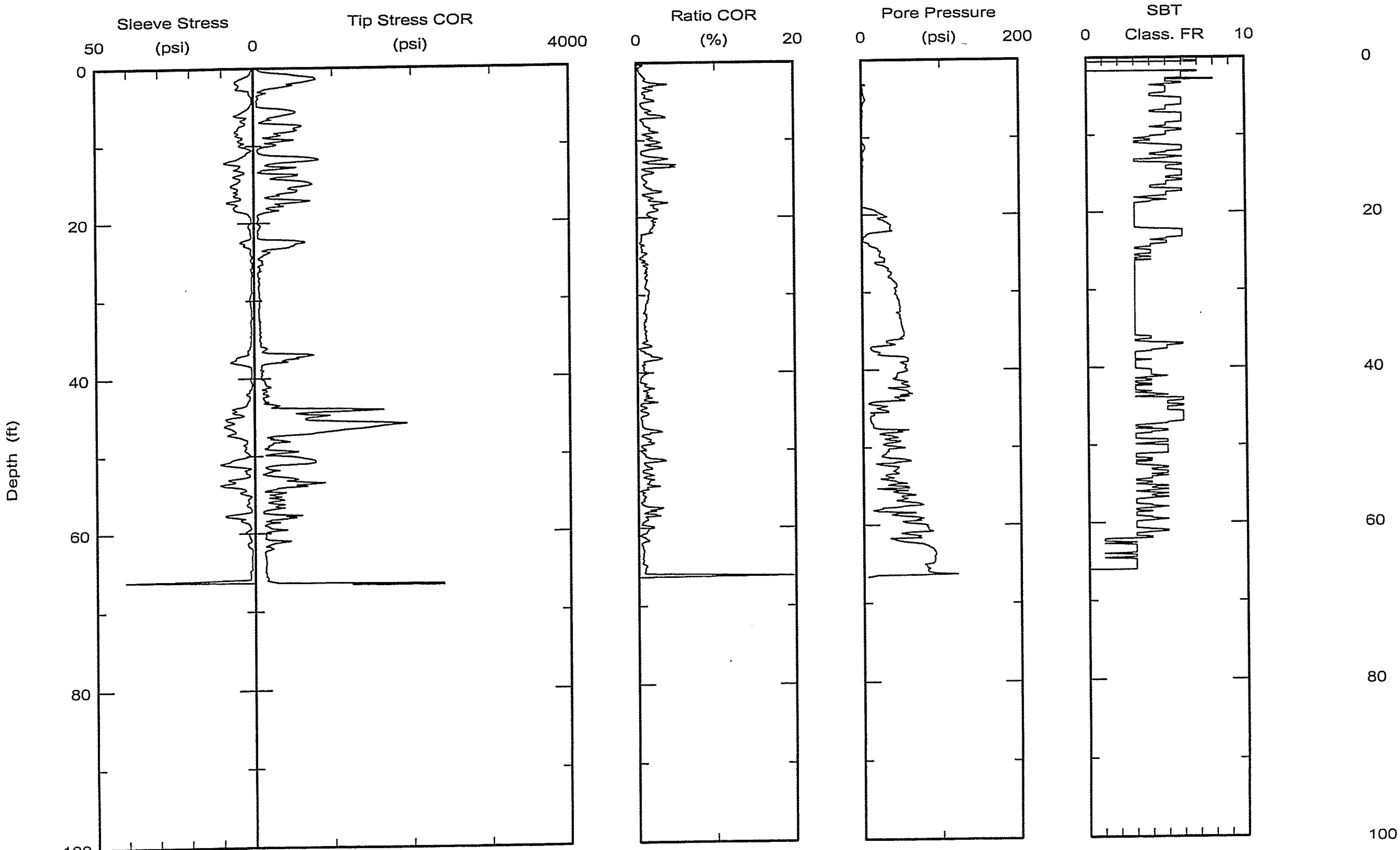


Maximum depth: 72.95 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-03
File: 2023L0701C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 23/Jul/2007 Test ID: C-07-3CF Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

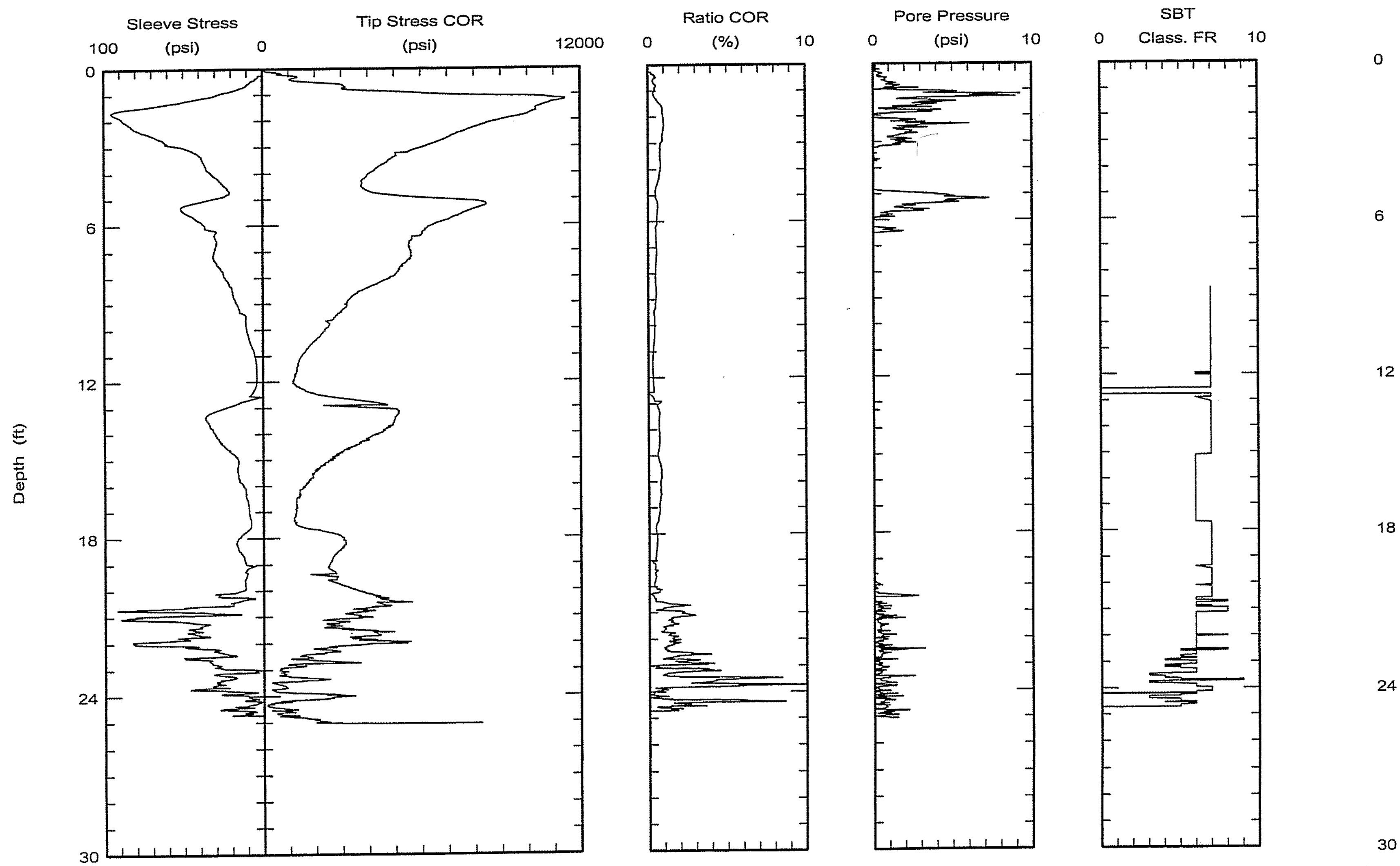


Maximum depth: 66.67 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-3CF
File: 2023L0703C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 25/Jul/2007 Test ID: C-07-04A Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

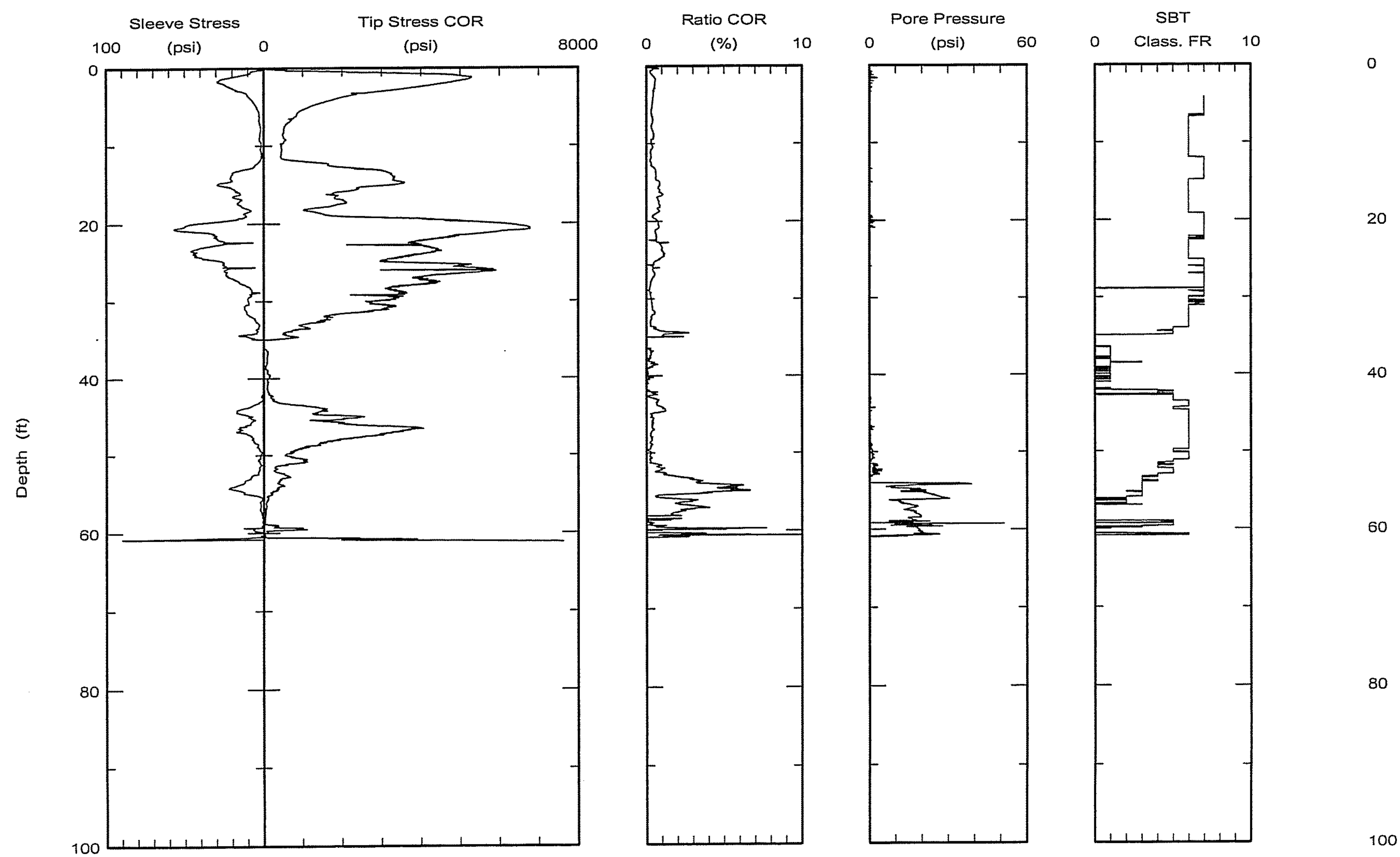


Maximum depth: 25.07 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-04A
File: 2025L0708C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 26/Jul/2007 Test ID: C-07-04B Project: 01-03612
	Client: Site: PolyMet Tailing Basin	



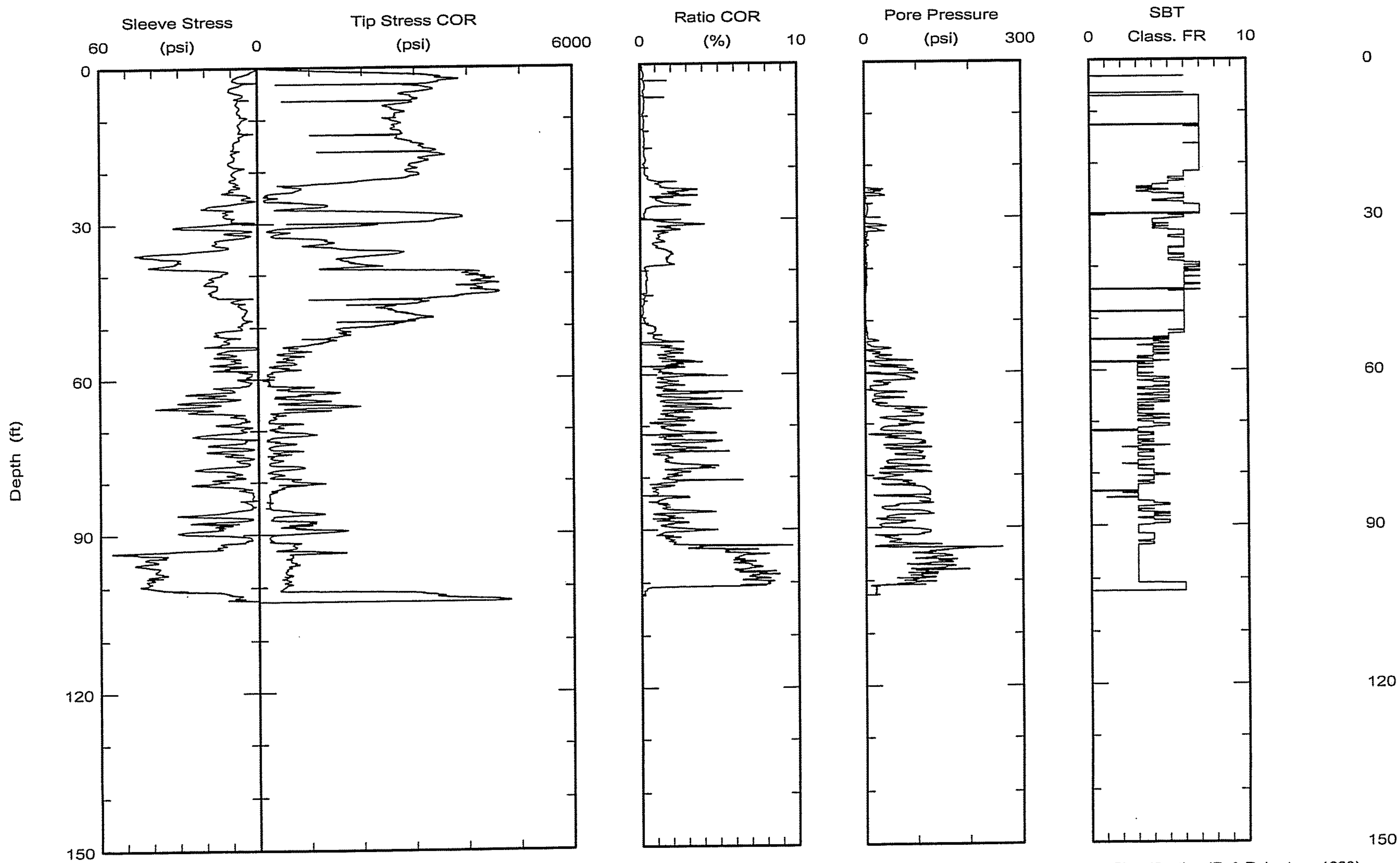
Maximum depth: 61.21 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-04B
File: 2026L0701C.ECP

American Engineering Testing, Inc.
550 Cleveland Avenue North
St. Paul, MN 55114

Northing:	Date: 24/Jul/2007
Easting:	Test ID: C-07-05
Elevation:	Project: 01-03612
Client:	
Site: PolyMet Tailing Basin	

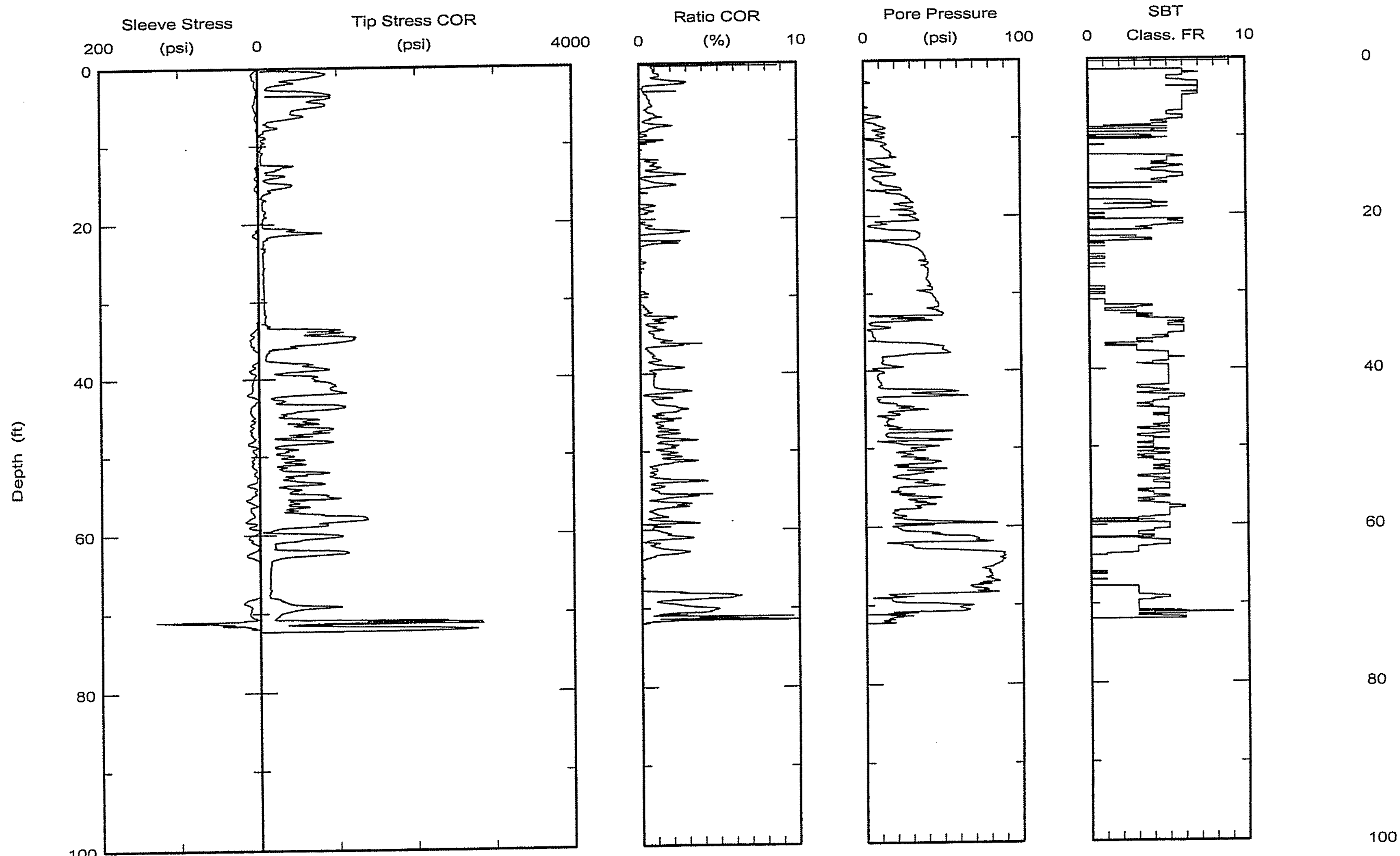


Maximum depth: 102.72 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-05
File: 2024L0702C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 24/Jul/2007 Test ID: C-07-06 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

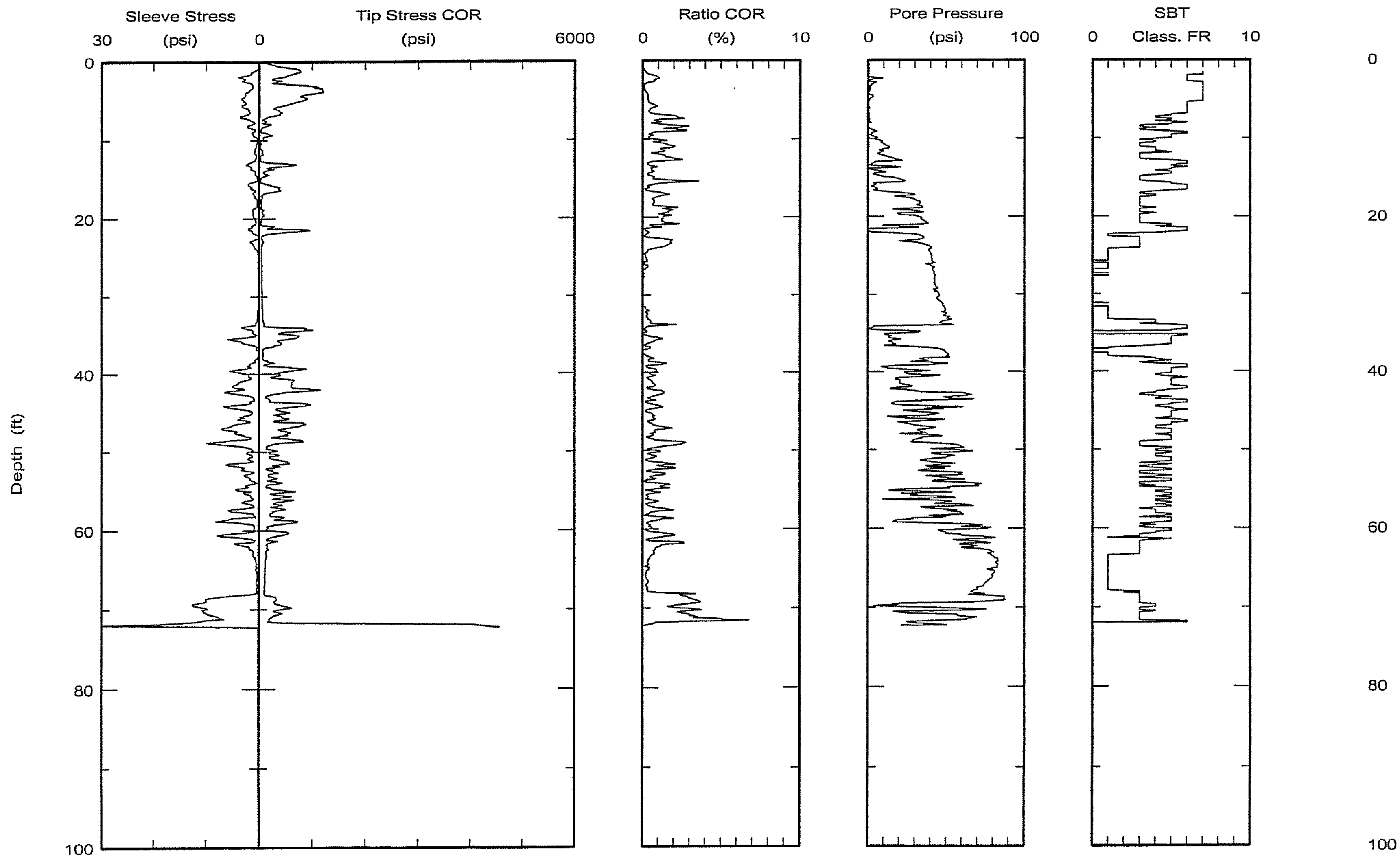


Maximum depth: 72.34 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-06
File: 2024L0701C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 24/Jul/2007 Test ID: C-07-06CF Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

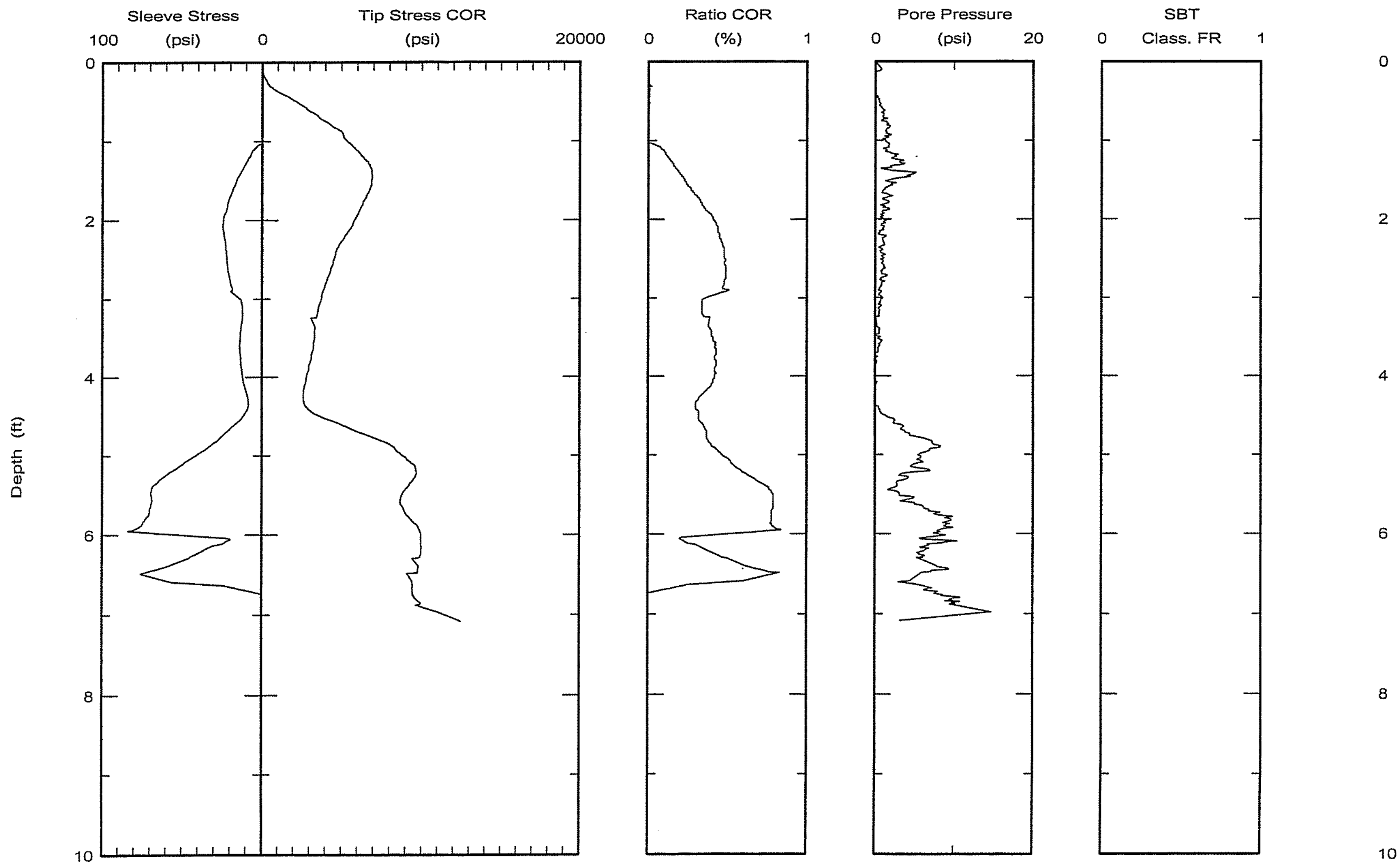


Maximum depth: 72.33 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-06CF
File: 2024L0704C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:		Date: 25/Jul/2007 Test ID: C-07-07 Project: 01-03612
	Client: Site: PolyMet Tailing Basin		

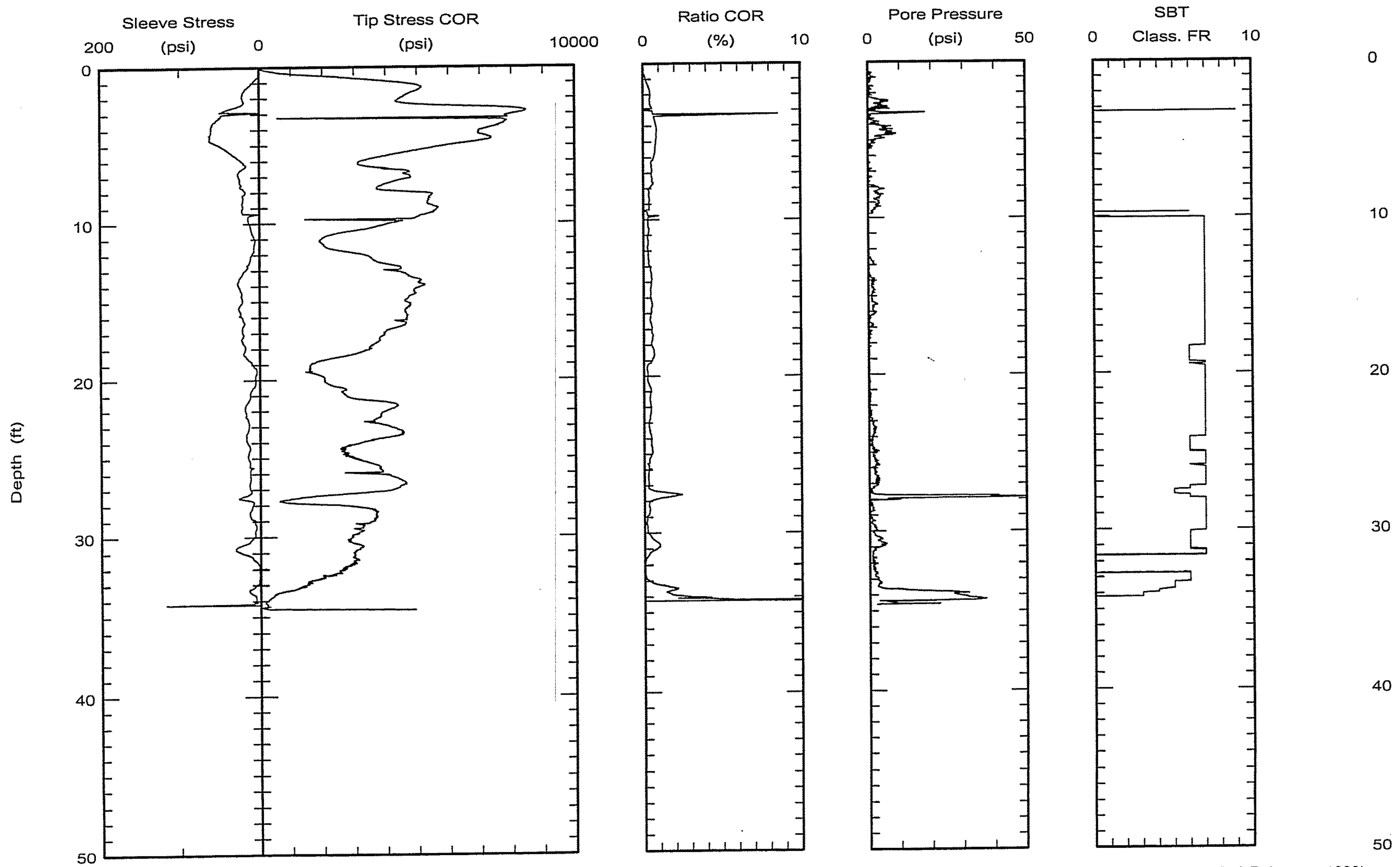


Maximum depth: 7.08 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-07
File: 2025L0705C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 25/Jul/2007 Test ID: C-07-07B Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

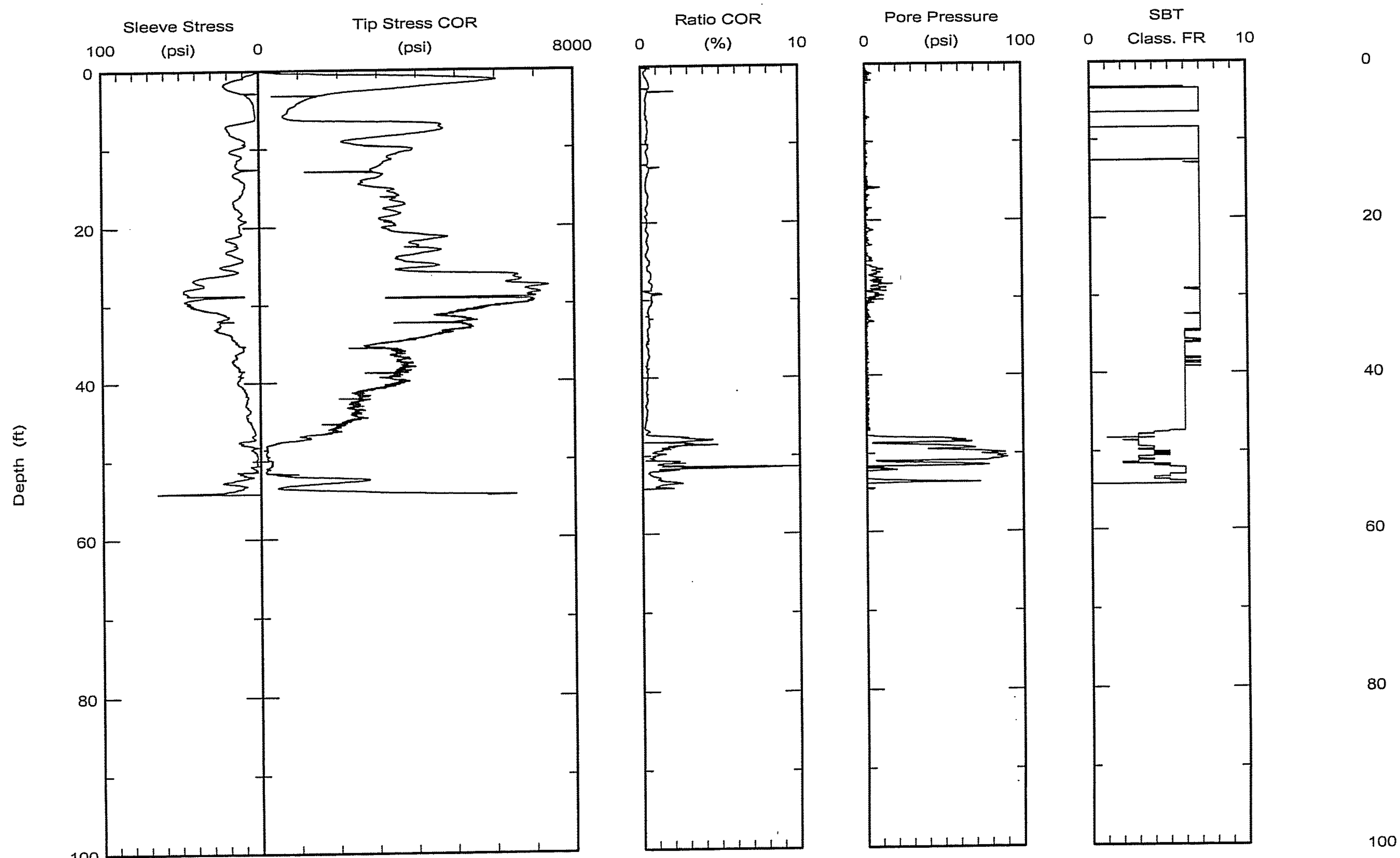


Maximum depth: 34.59 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-07B
File: 2025L0706C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 25/Jul/2007 Test ID: C-07-07C Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

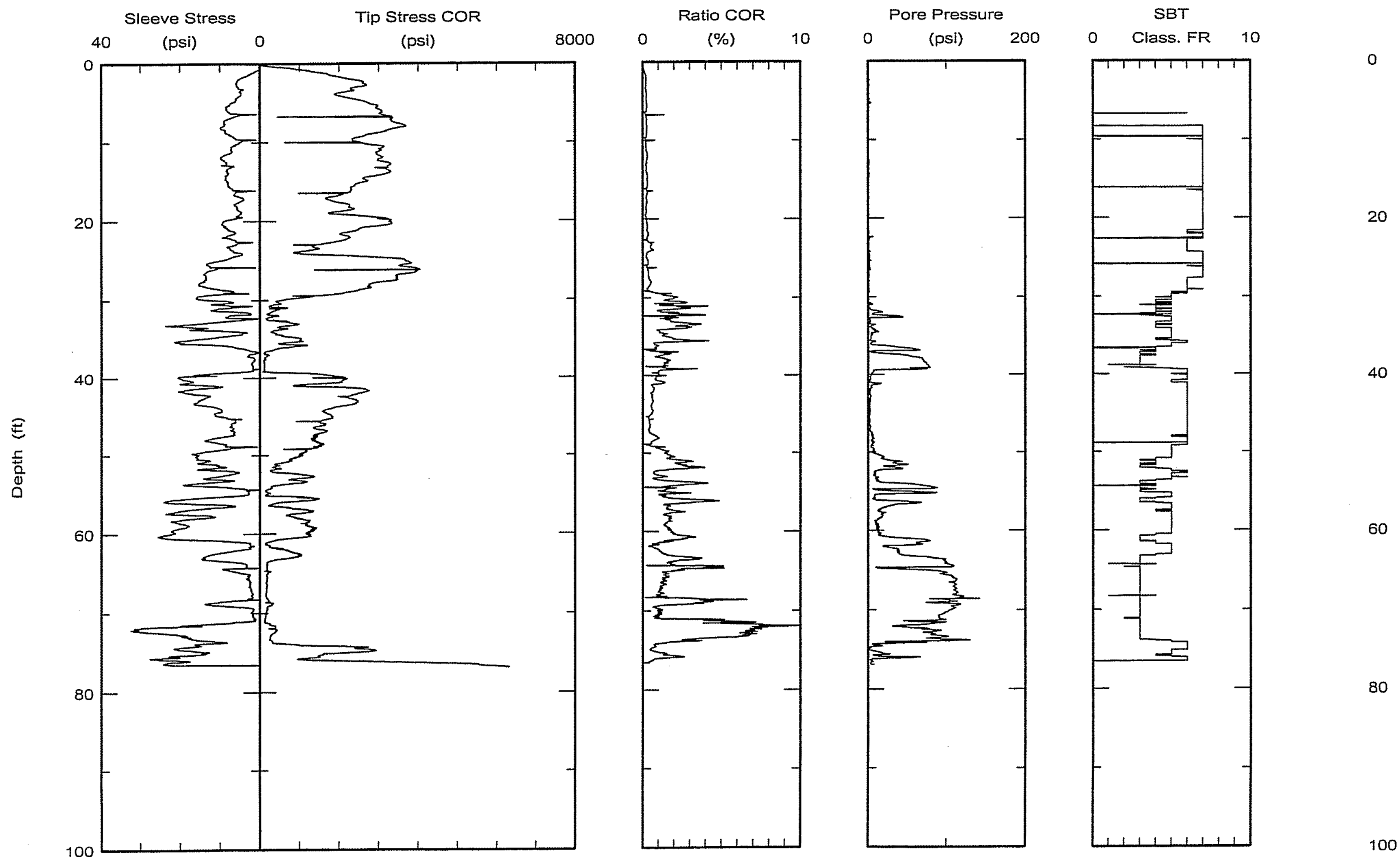


Maximum depth: 54.57 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-07C
File: 2025L0707C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 25/Jul/2007 Test ID: C-07-08 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

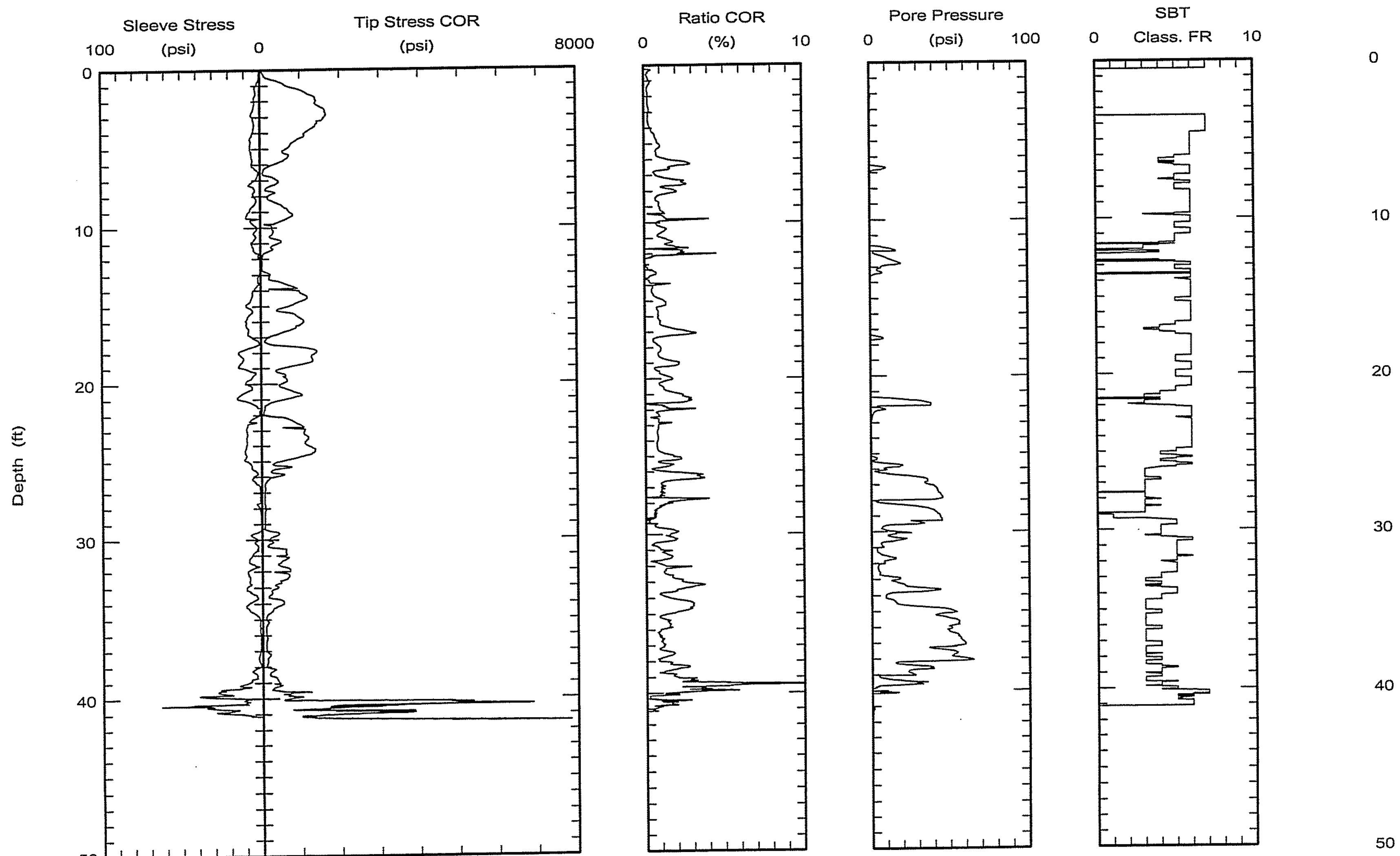


Maximum depth: 76.86 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-08
File: 2025L0704C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 25/Jul/2007 Test ID: C-07-09 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	



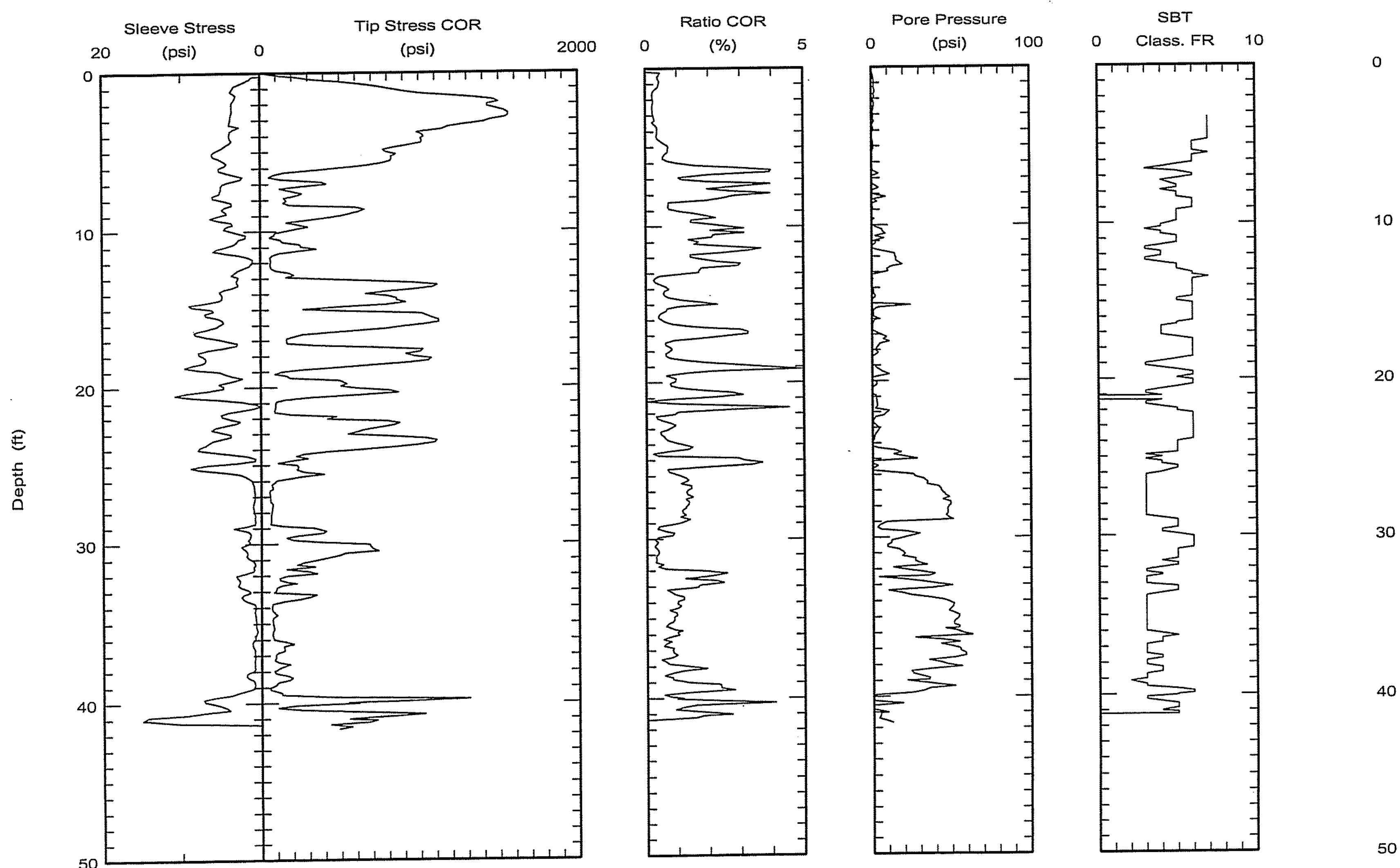
Maximum depth: 41.48 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-09
File: 2025L0701C.ECP

American Engineering Testing, Inc.
550 Cleveland Avenue North
St. Paul, MN 55114

Northing:	Date: 25/Jul/2007
Easting:	Test ID: C-07-09CF
Elevation:	Project: 01-03612
Client:	
Site: PolyMet Tailing Basin	

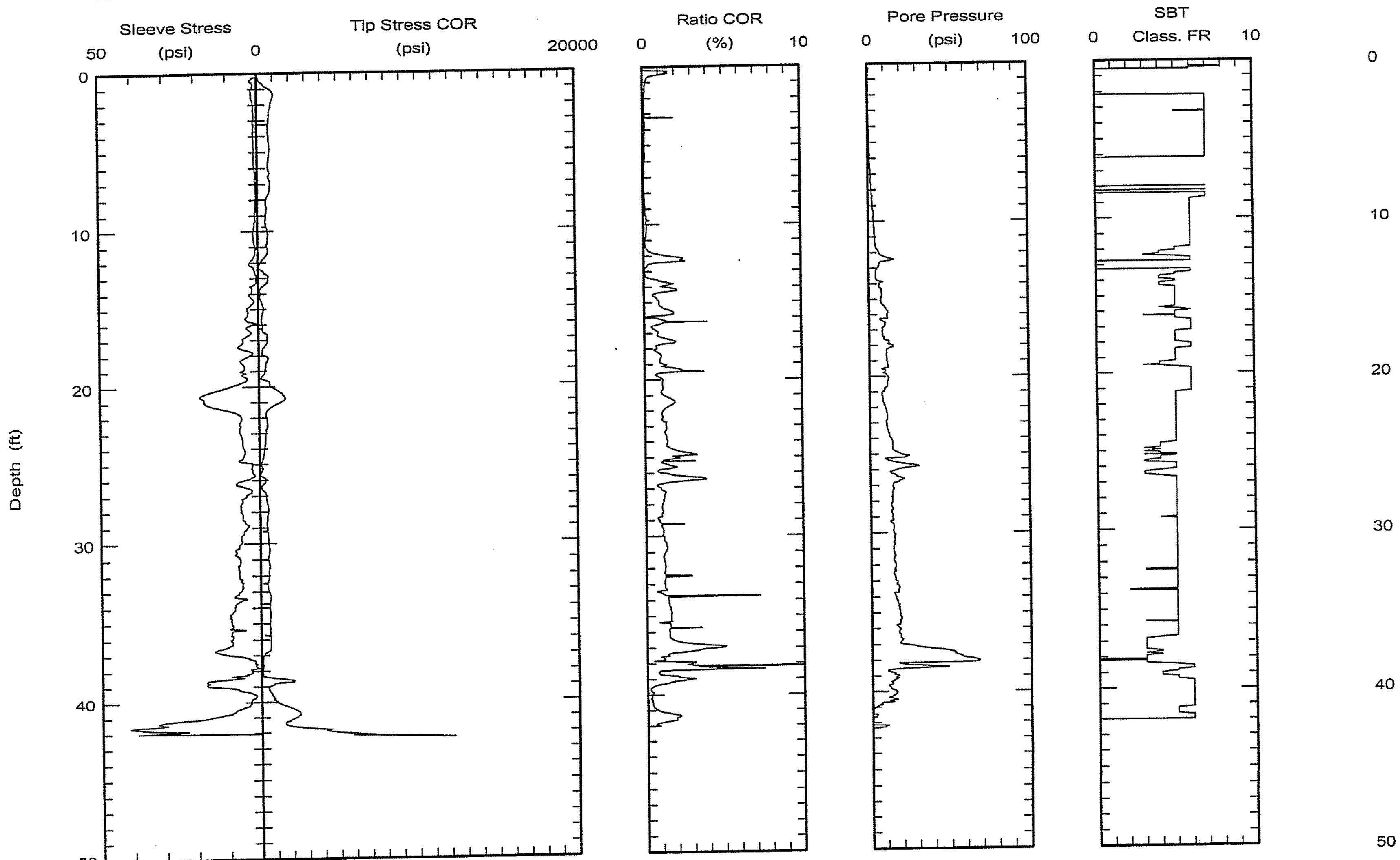


Maximum depth: 41.68 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-09CF
File: 2025L0703C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 27/Jul/2007 Test ID: C-07-10 Project: 01-03612
	Client: Site: TAILINGS PONDS	

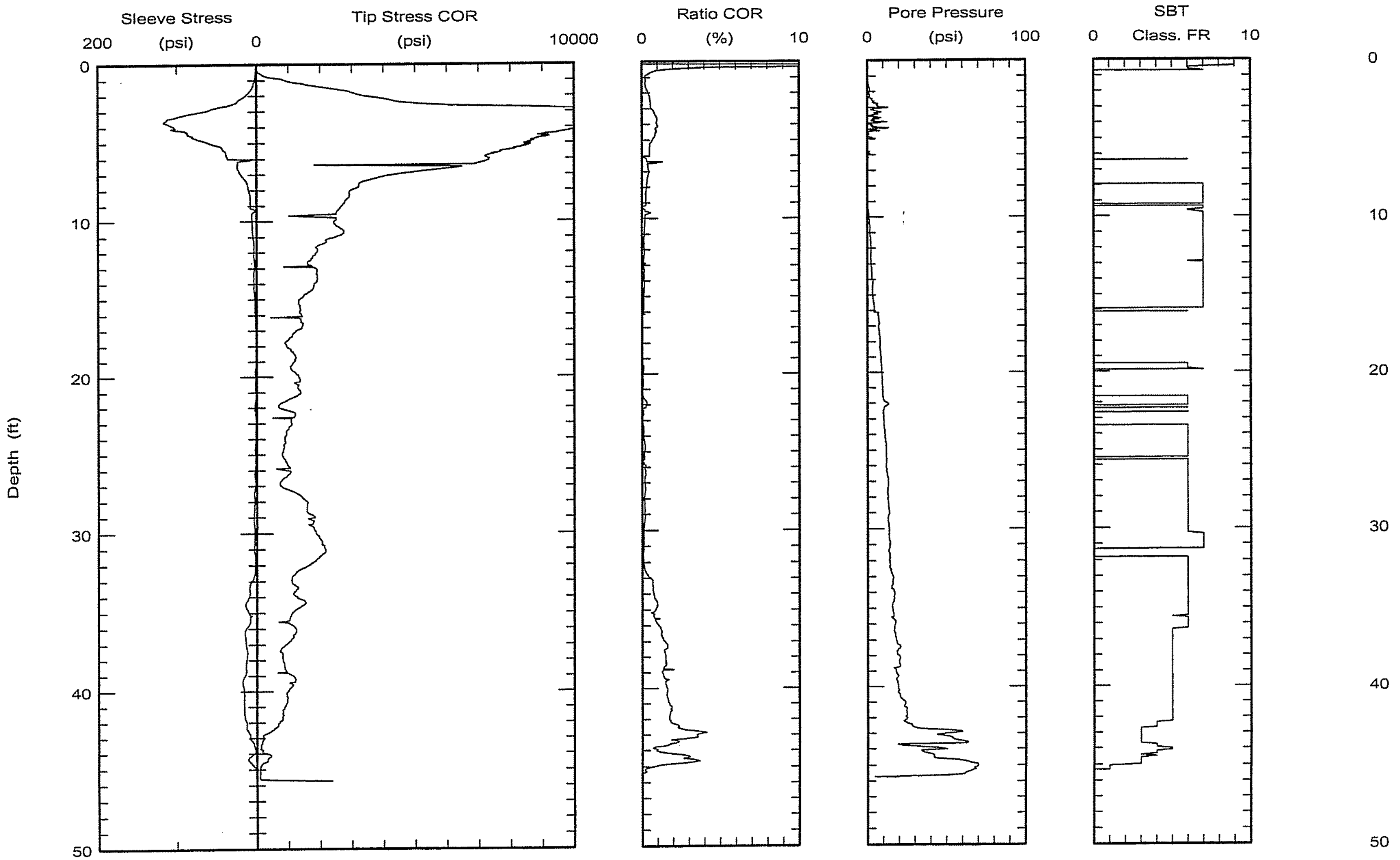


Maximum depth: 42.37 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-10
File: 2027L0705C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 26/Jul/2007 Test ID: C-07-11 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

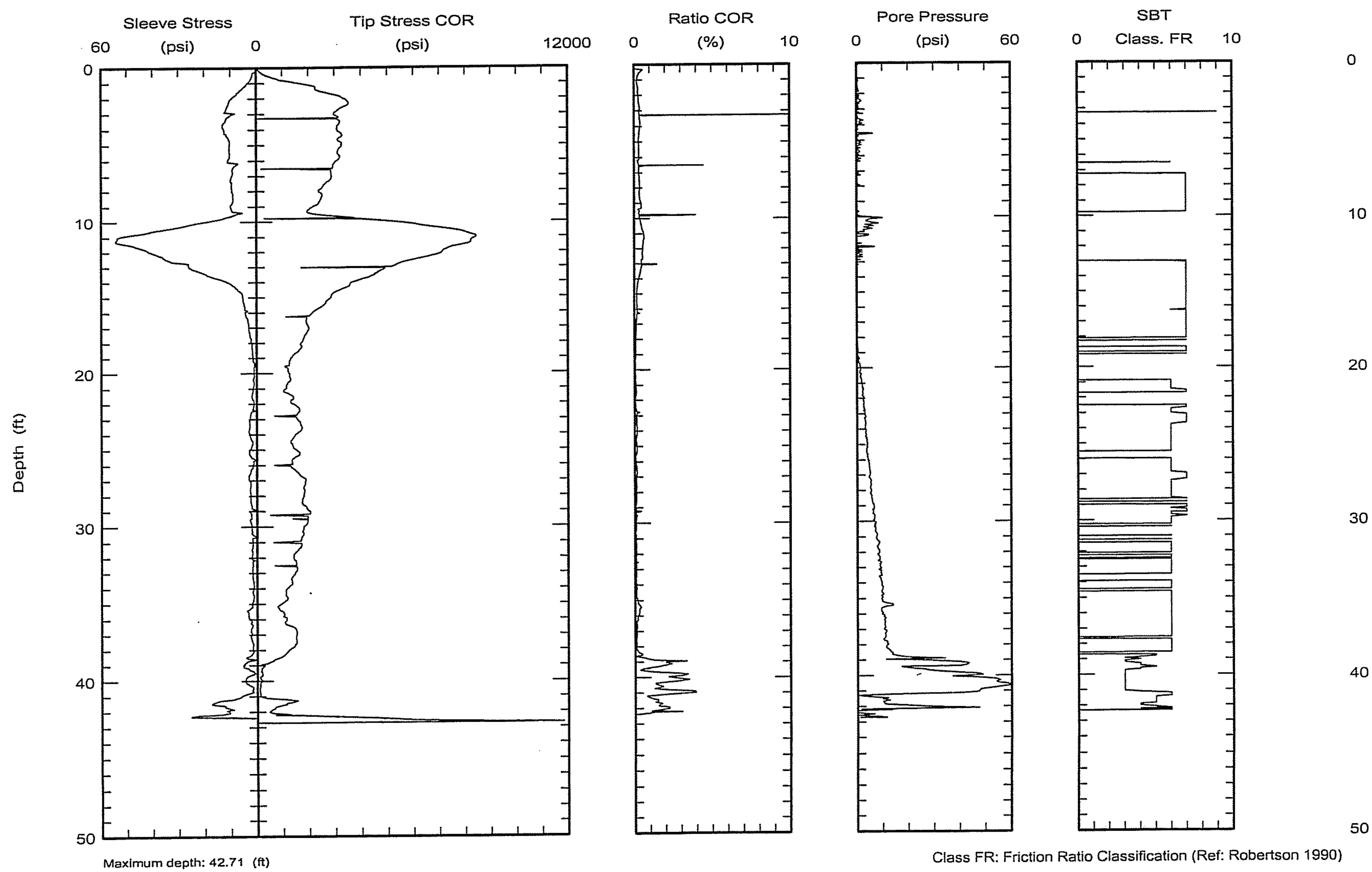


Maximum depth: 45.74 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-11
File: 2026L0703C.ECP

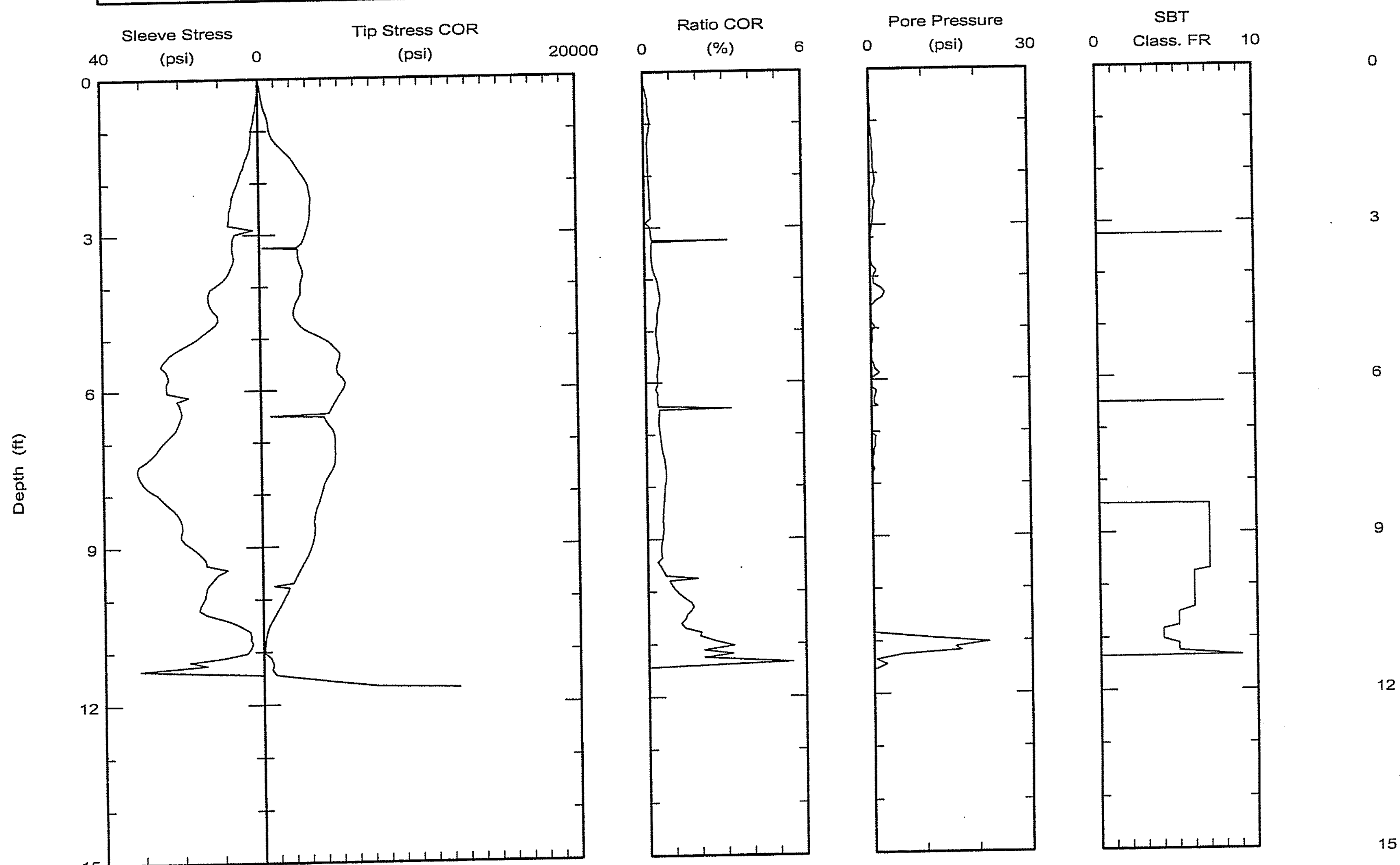
American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 27/Jul/2007 Test ID: C-07-12 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	



Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-12
File: 2027L0701C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 26/Jul/2007 Test ID: C-07-13 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	



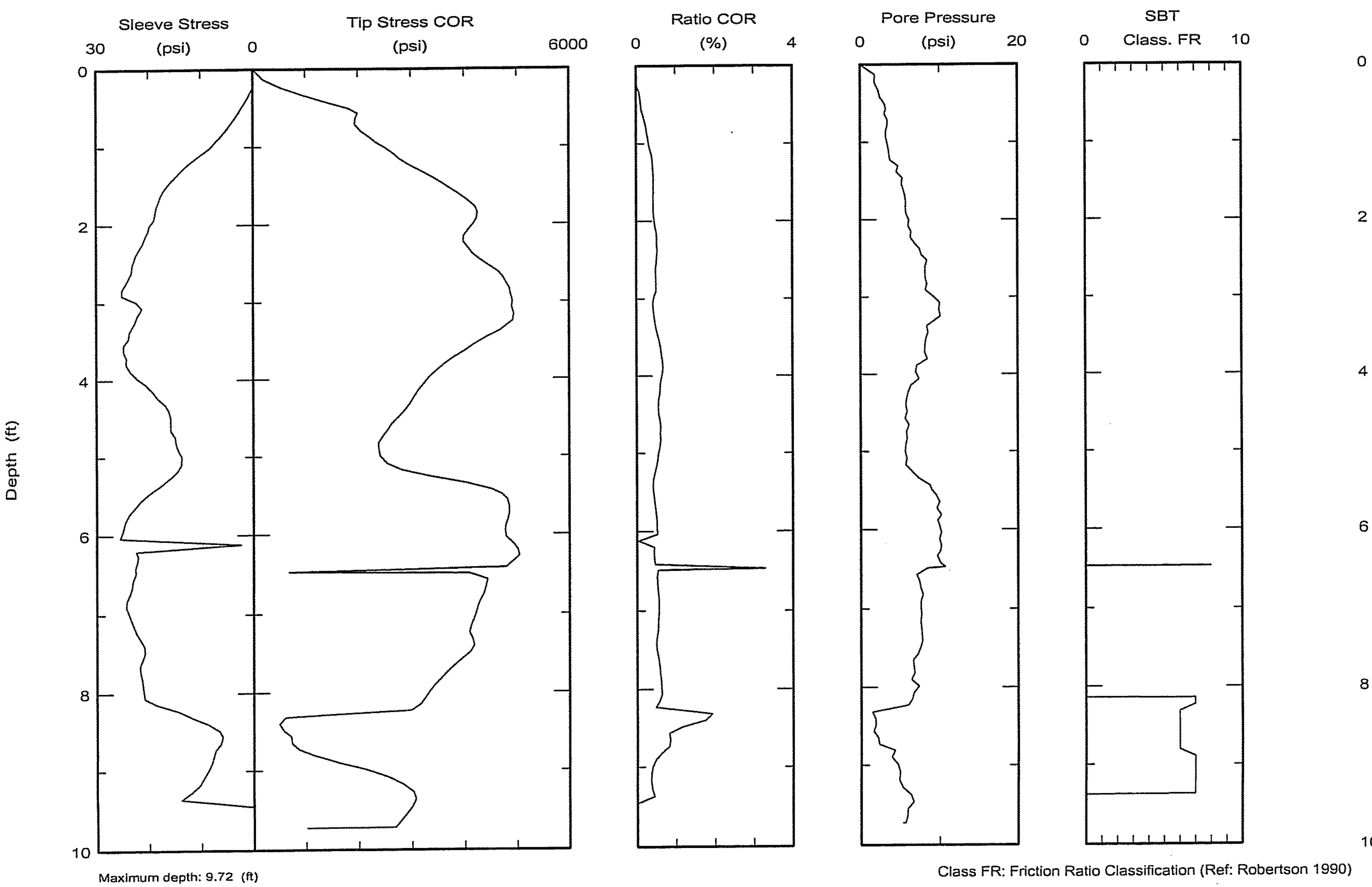
Maximum depth: 11.71 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-13
File: 2026L0704C.ECP

American Engineering Testing, Inc.
550 Cleveland Avenue North
St. Paul, MN 55114

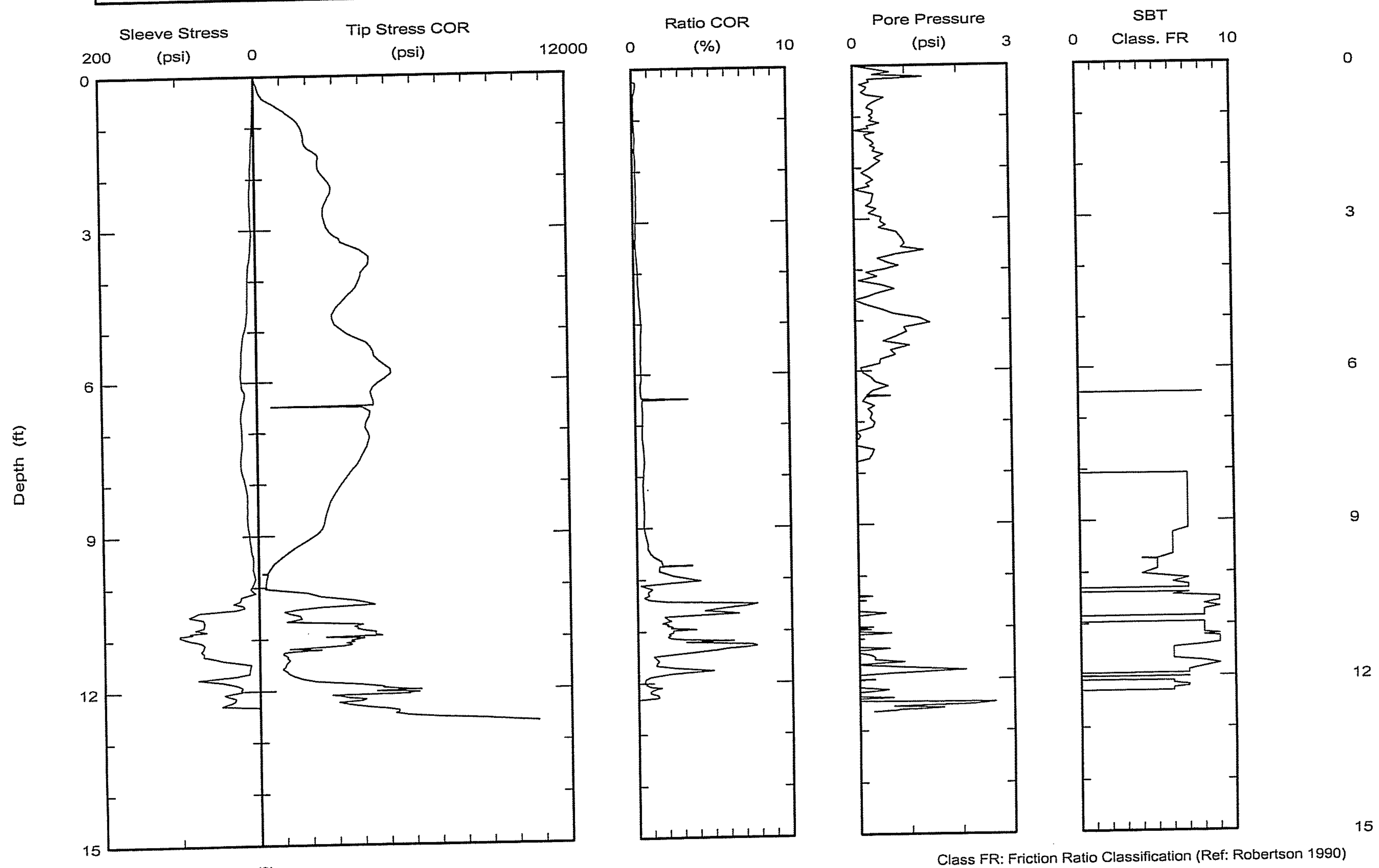
Northing: Easting: Elevation:	Date: 26/Jul/2007 Test ID: C-07-13A Project: 01-03612	
Client: Site: PolyMet Tailing Basin		



Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-13A
File: 2026L0705C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 26/Jul/2007 Test ID: C-07-13B Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

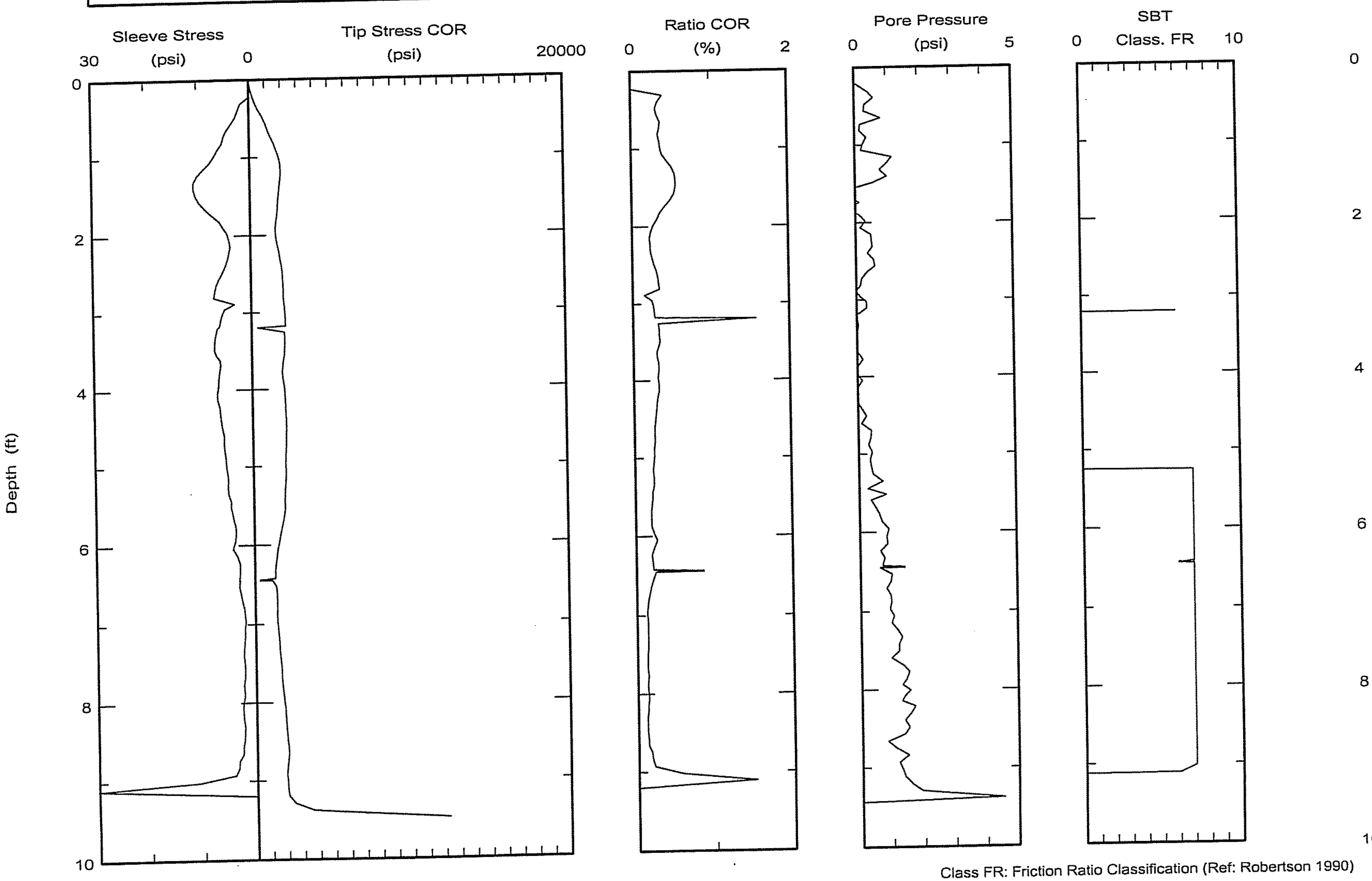


Maximum depth: 12.63 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-13B
File: 2026L0706C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 27/Jul/2007 Test ID: C-07-13C Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

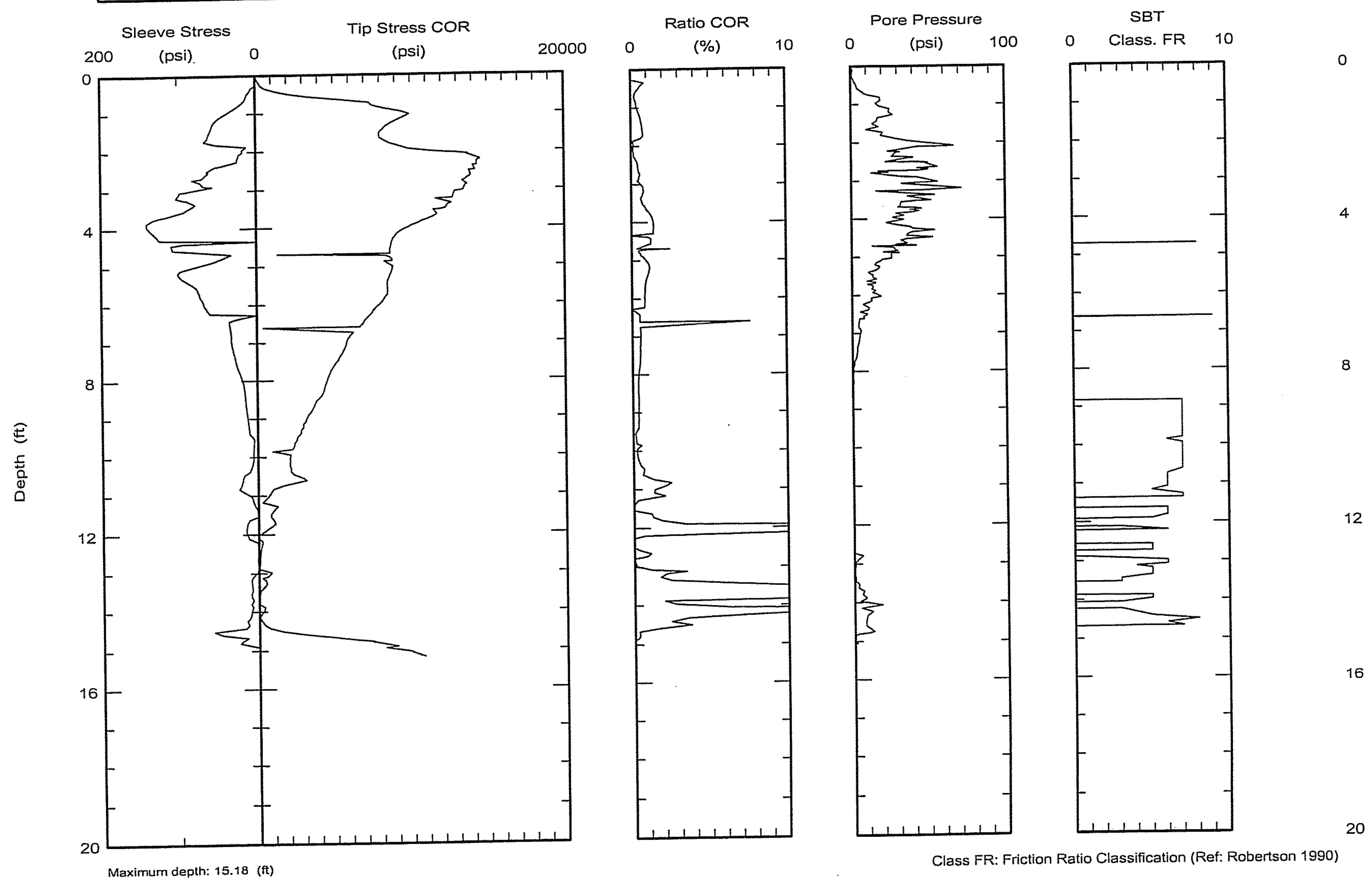


Maximum depth: 9.49 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-13C
File: 2027L0702C.ECP

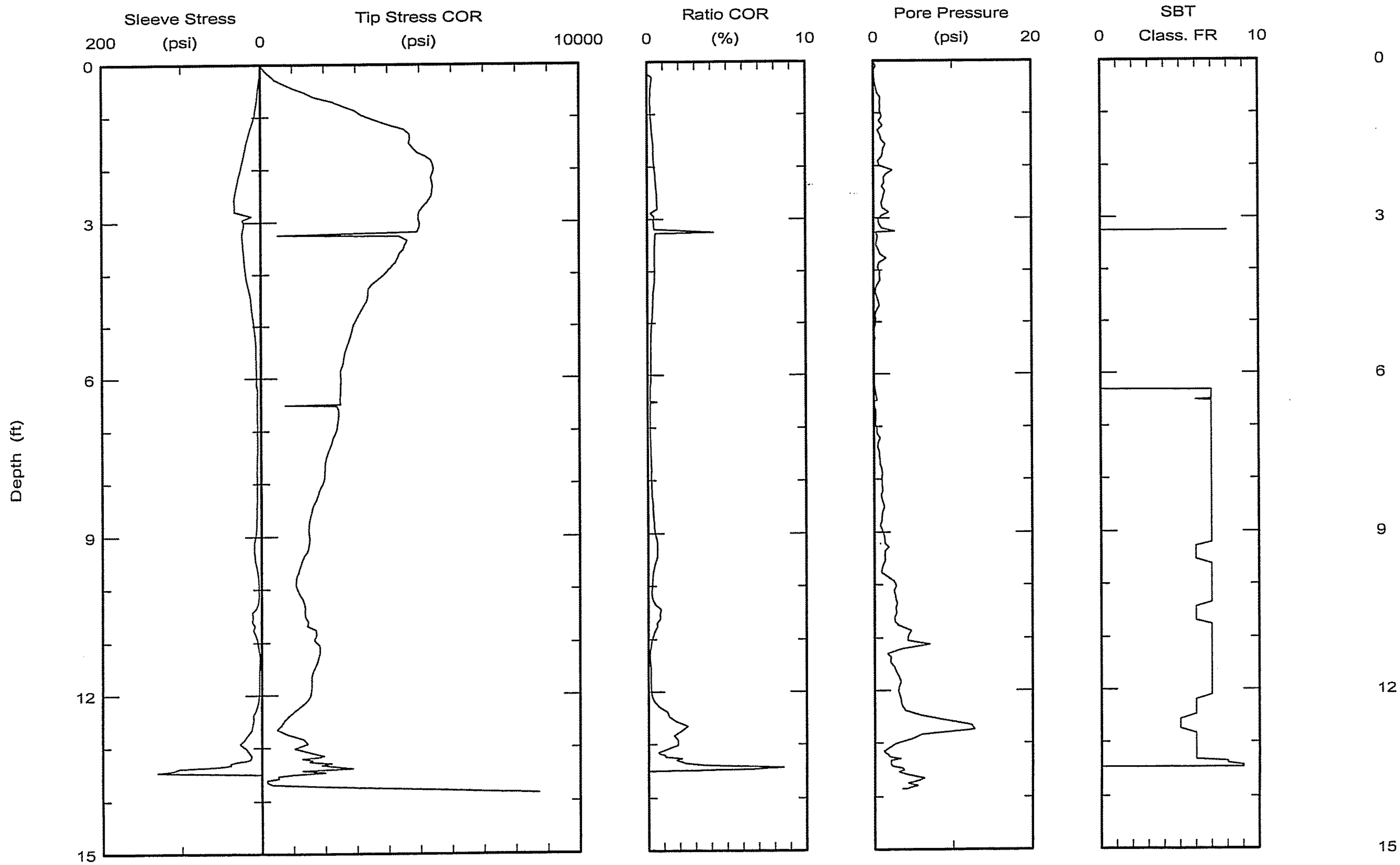
American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 27/Jul/2007 Test ID: C-07-13D Project: 01-03612
	Client: Site: TAILINGS PONDS	



Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-13D
File: 2027L0703C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 27/Jul/2007 Test ID: C-07-13E Project: 01-03612
	Client: Site: TAILINGS PONDS	

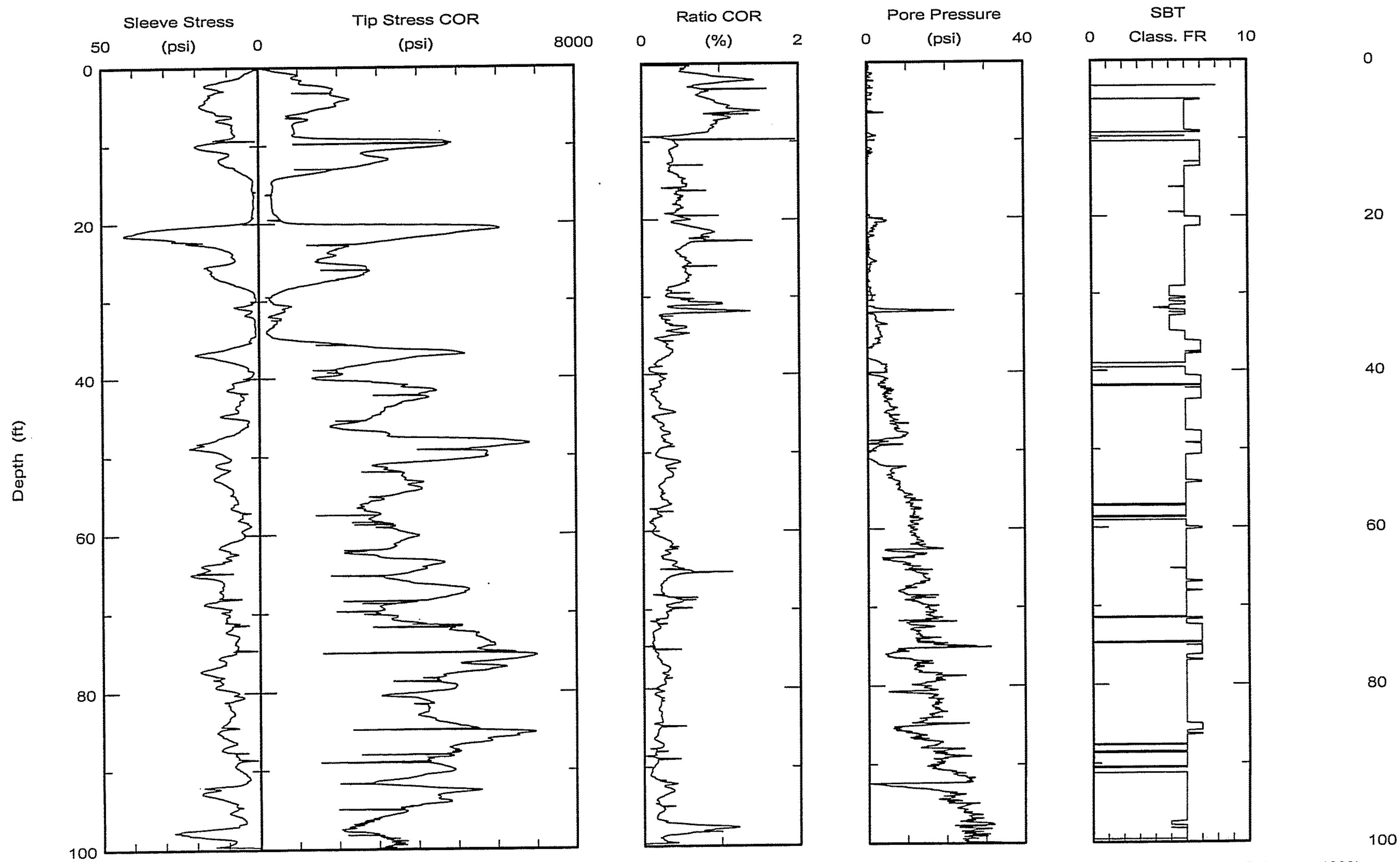


Maximum depth: 13.85 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-13E
File: 2027L0704C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 27/Jul/2007 Test ID: C-07-14 Project: 01-03612
	Client: Site: TAILINGS PONDS	

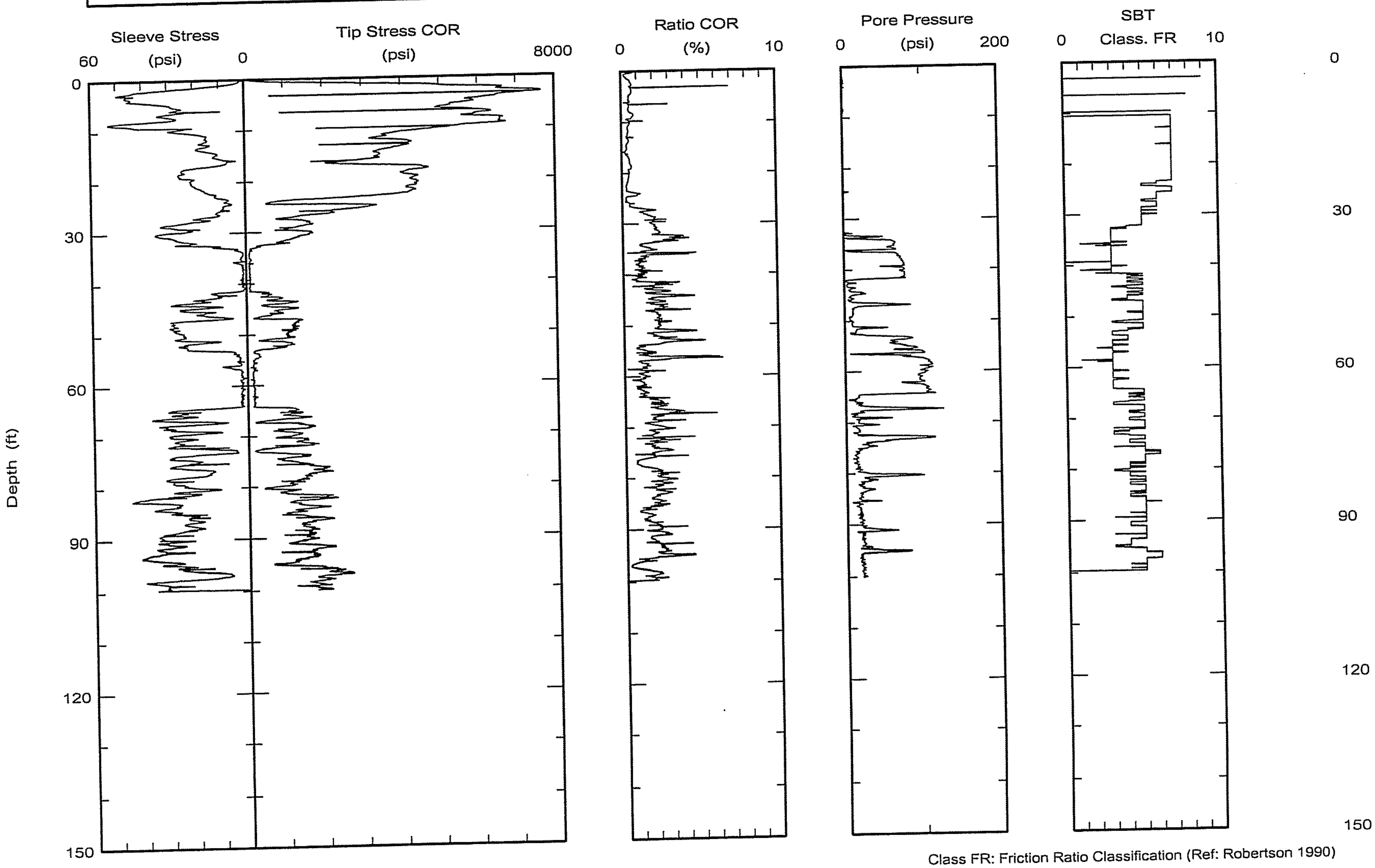


Maximum depth: 100.00 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-14
File: 2027L0707C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 27/Jul/2007 Test ID: C-07-15 Project: 01-03612
	Client: Site: TAILINGS PONDS	

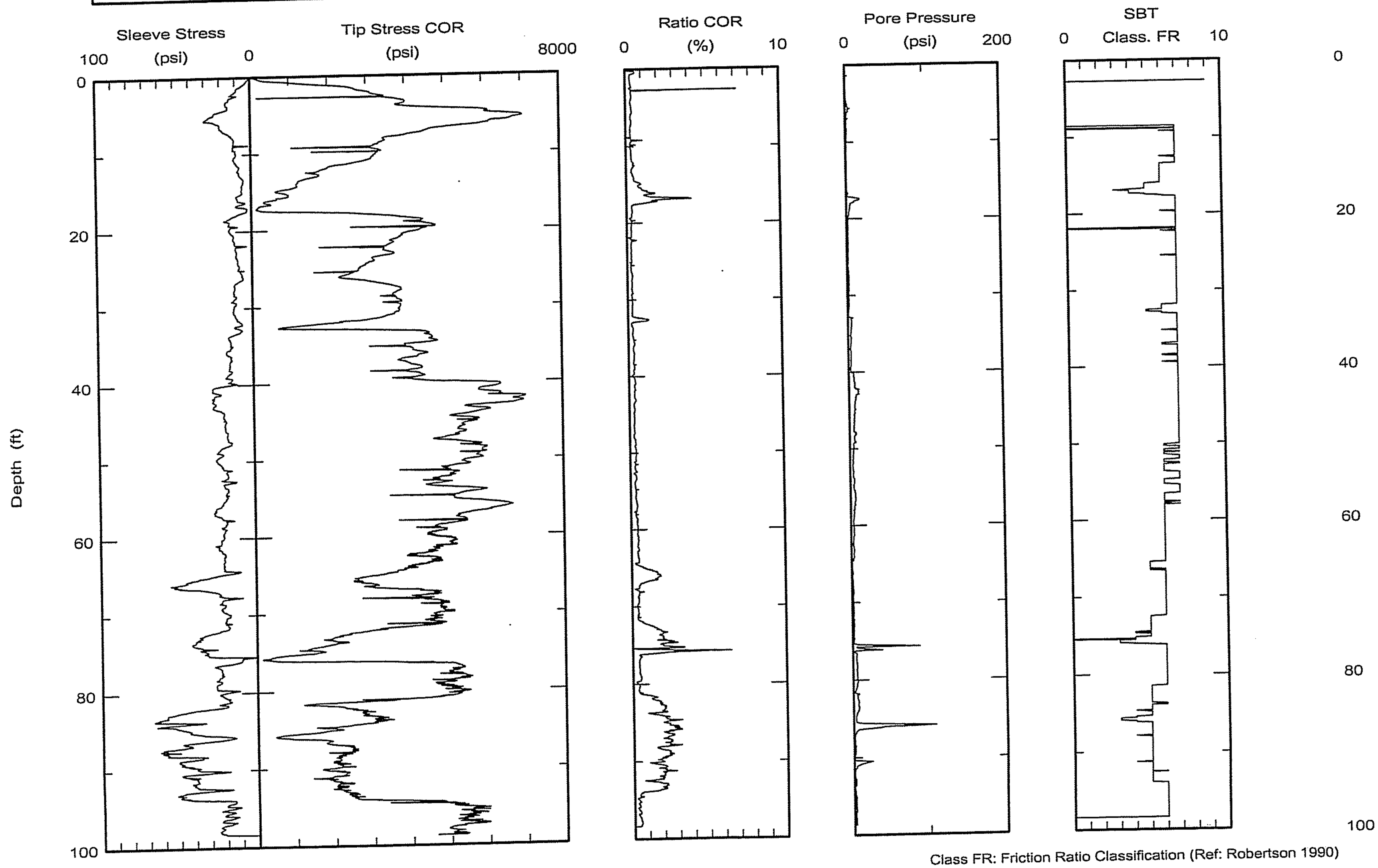


Maximum depth: 100.04 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-15
File: 2027L0706C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 15/Aug/2007 Test ID: C-07-16 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

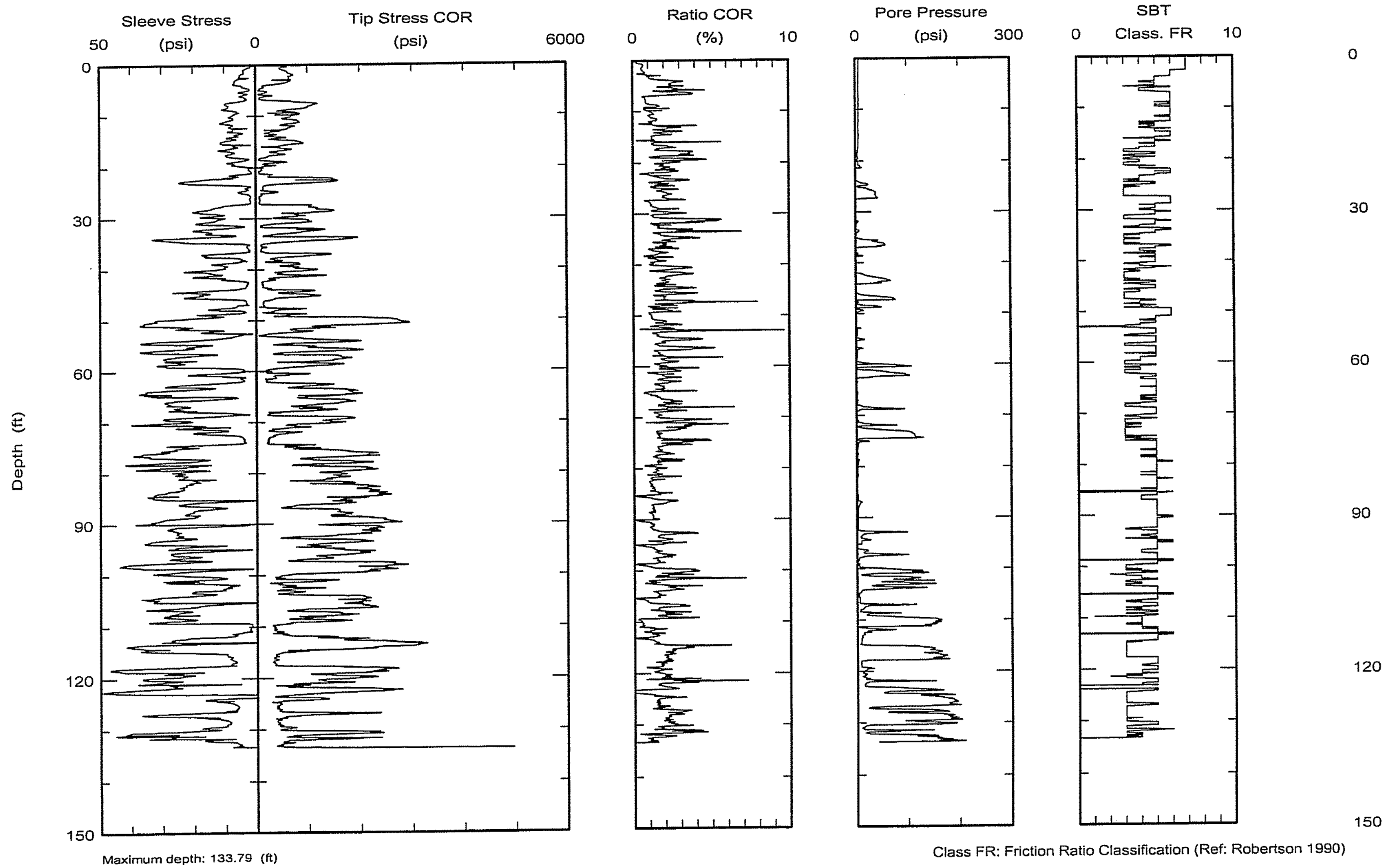


Maximum depth: 98.73 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-16
File: 2015G0701C.ECP

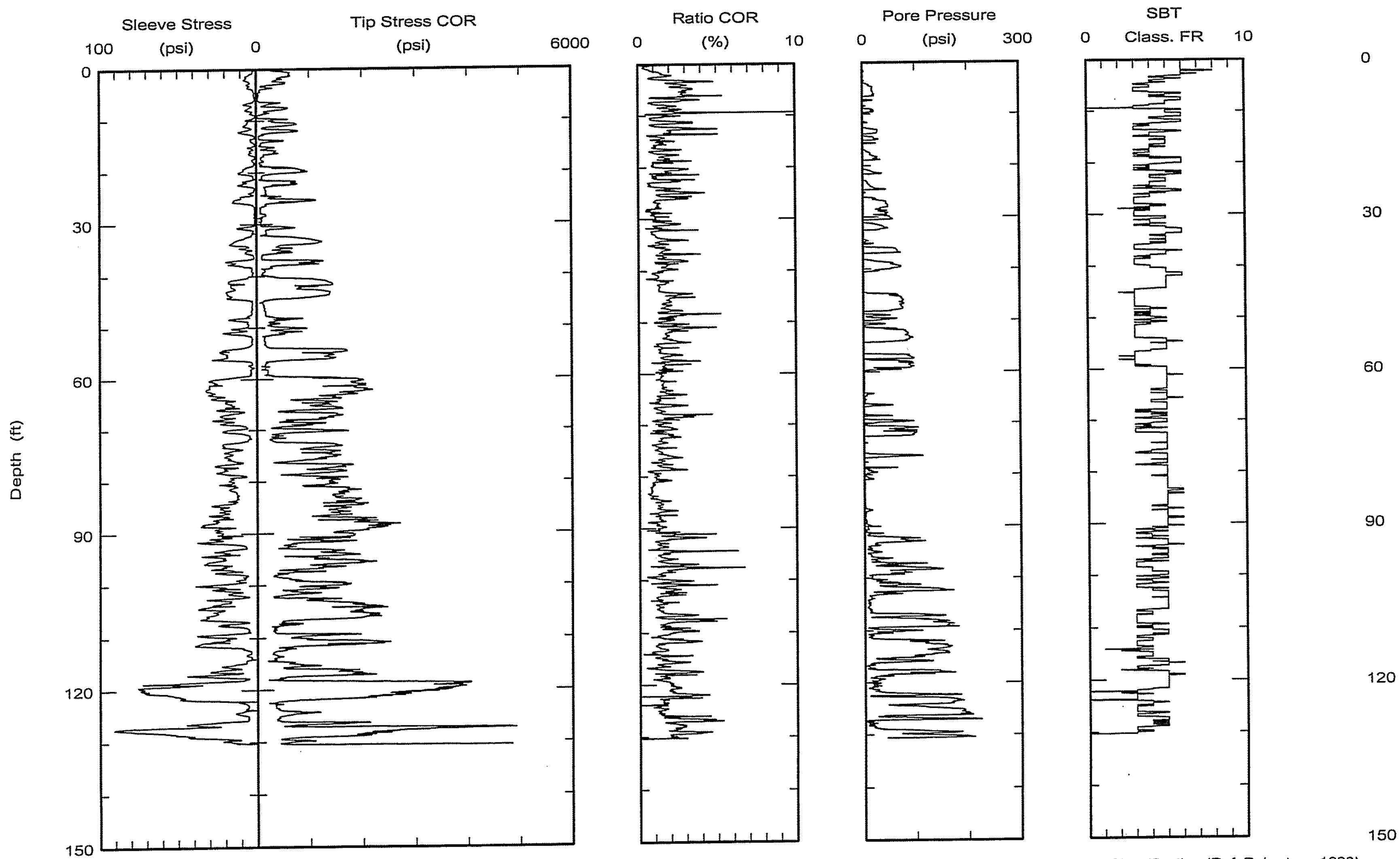
American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 14/Aug/2007 Test ID: C-07-17 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	



Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-17
File: 2014G0703C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 14/Aug/2007 Test ID: C-07-18 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

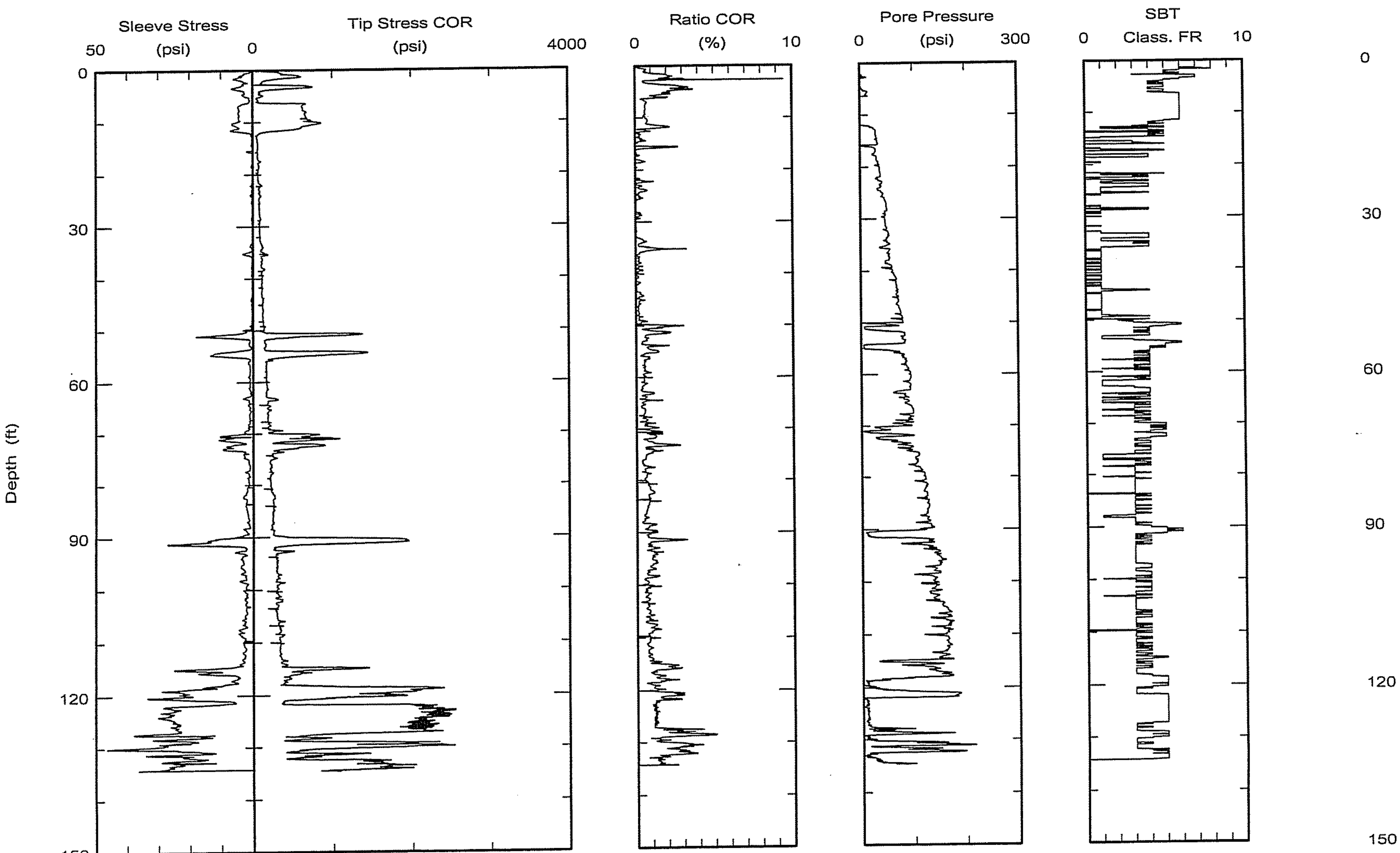


Maximum depth: 130.65 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-18
File: 2014G0702C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 13/Aug/2007 Test ID: 07-19 Project: 01-03612
	Client: Barr Engineering Site: PolyMet Tailing Basin	

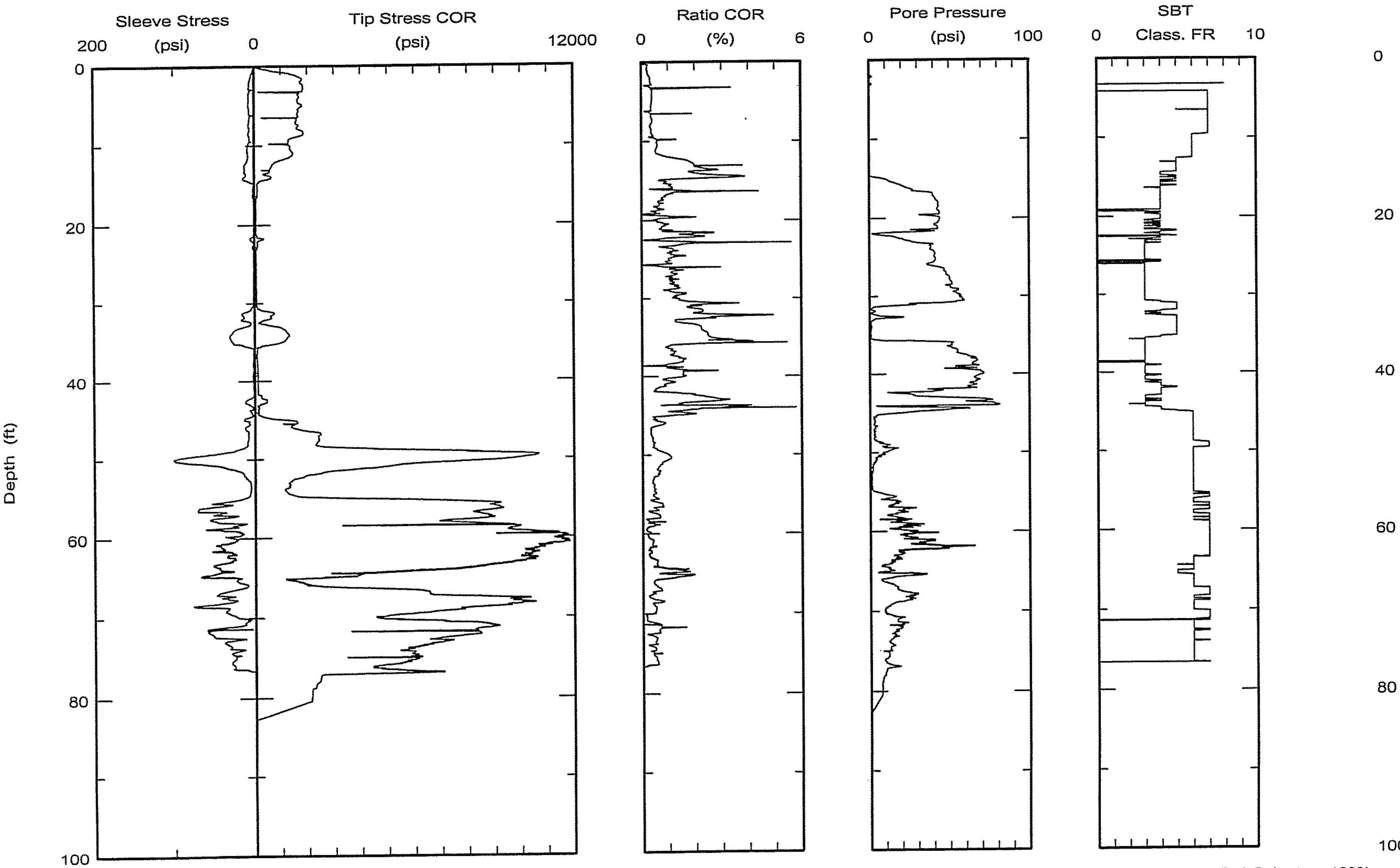


Maximum depth: 134.62 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: 07-19
File: 2013G0701C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 28/Jul/2007 Test ID: C-07-20 Project: 01-03612
	Client: Barr Engineering Site: PolyMet Tailing Basin	

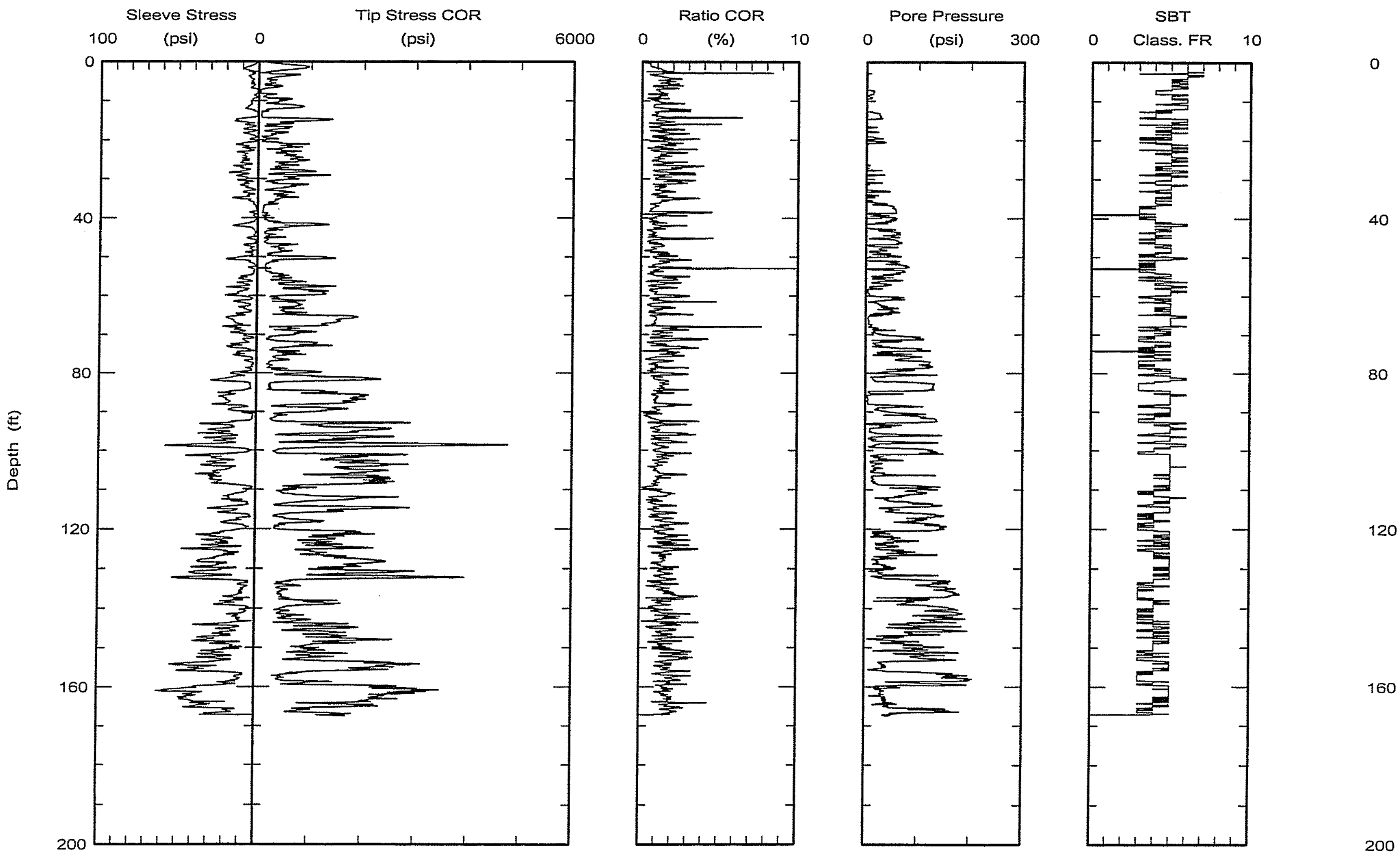


Maximum depth: 82.74 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-20
File: 2028L0701C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 14/Aug/2007 Test ID: C-07-21 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

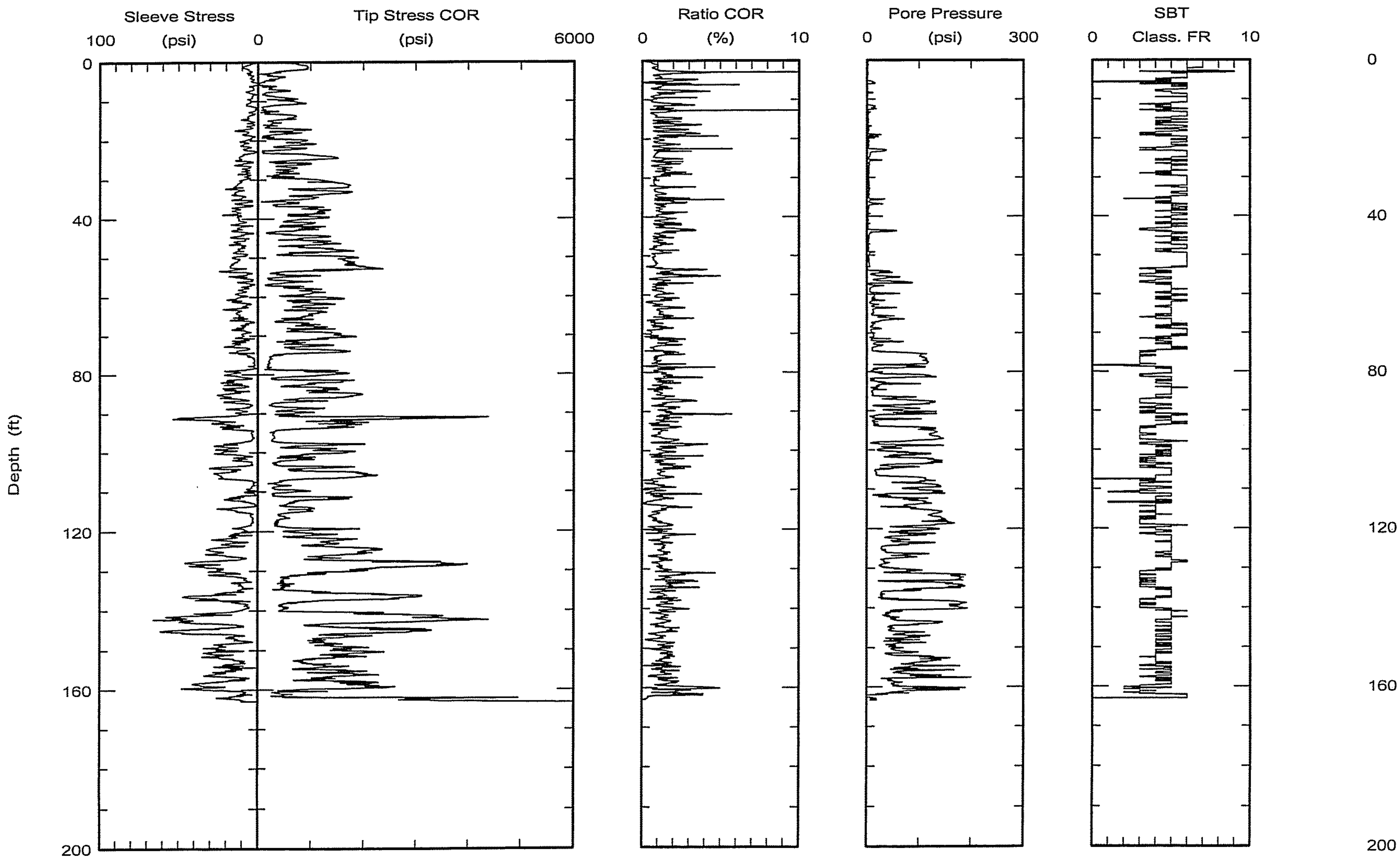


Maximum depth: 167.48 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-21
File: 2014G0701C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 16/Aug/2007 Test ID: C-07-22 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

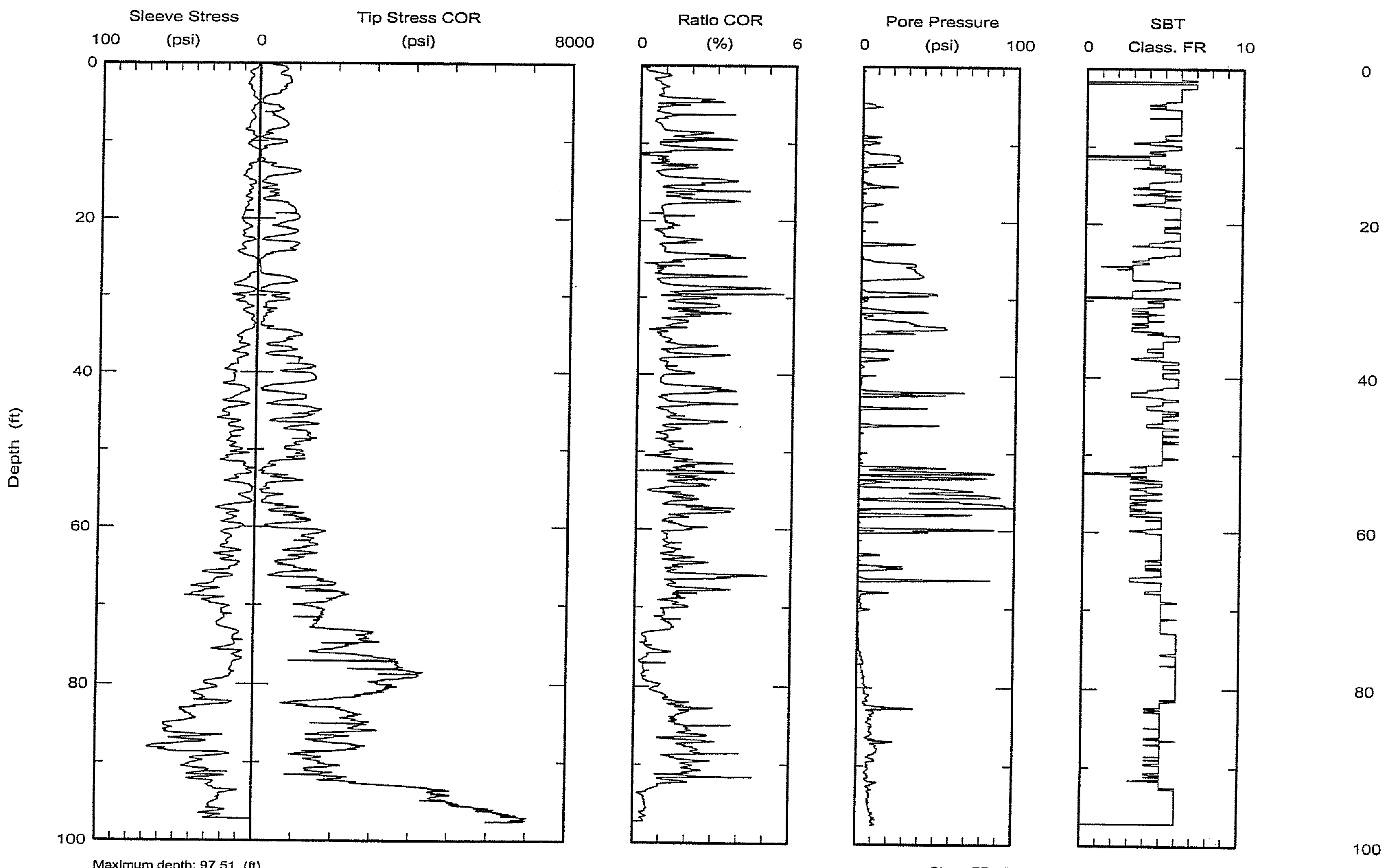


Maximum depth: 163.40 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-22
File: 2016G0701C.ECP

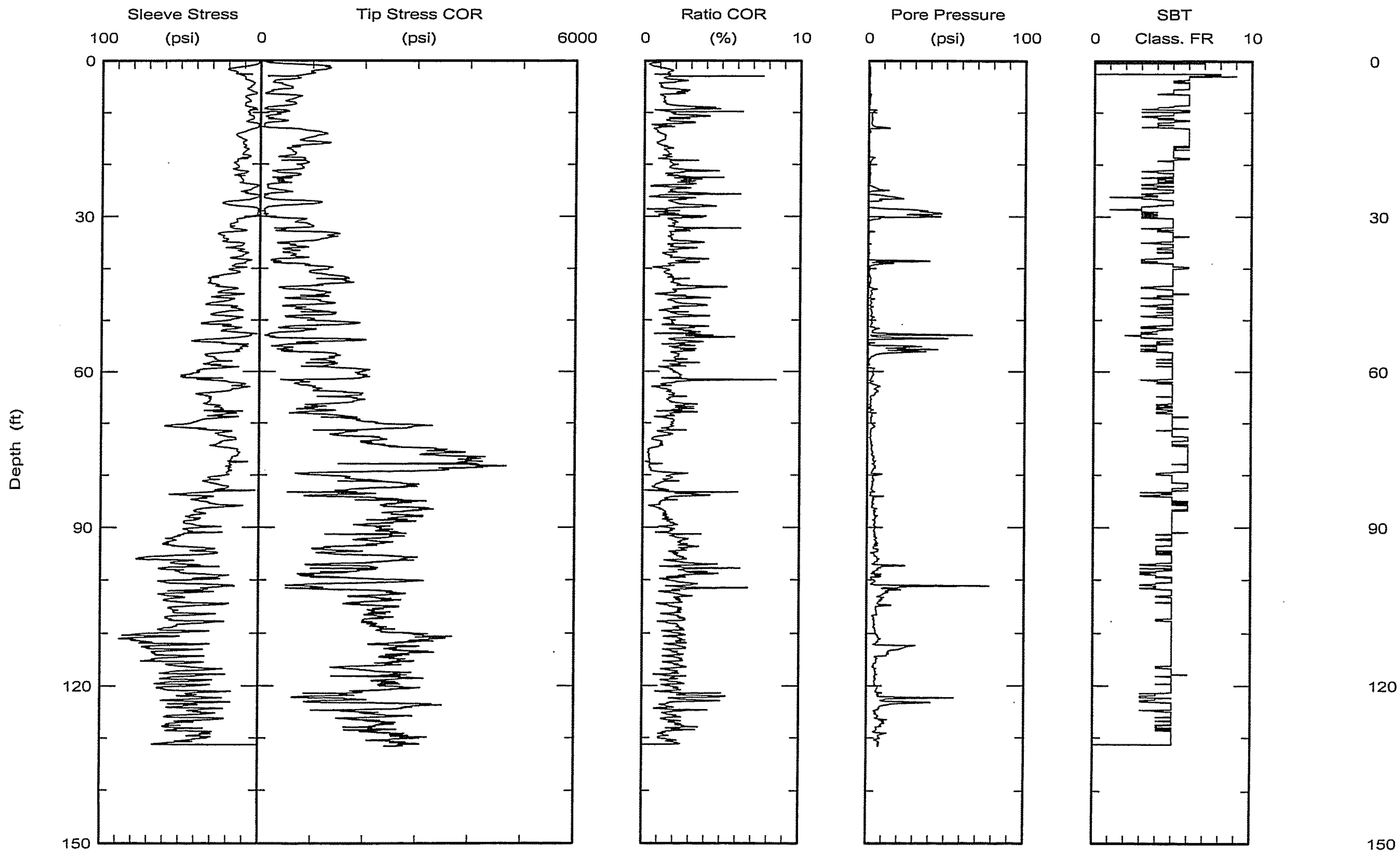
American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 15/Aug/2007 Test ID: C-07-23 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	



Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-23
File: 2015G0702C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 15/Aug/2007 Test ID: C-07-24 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

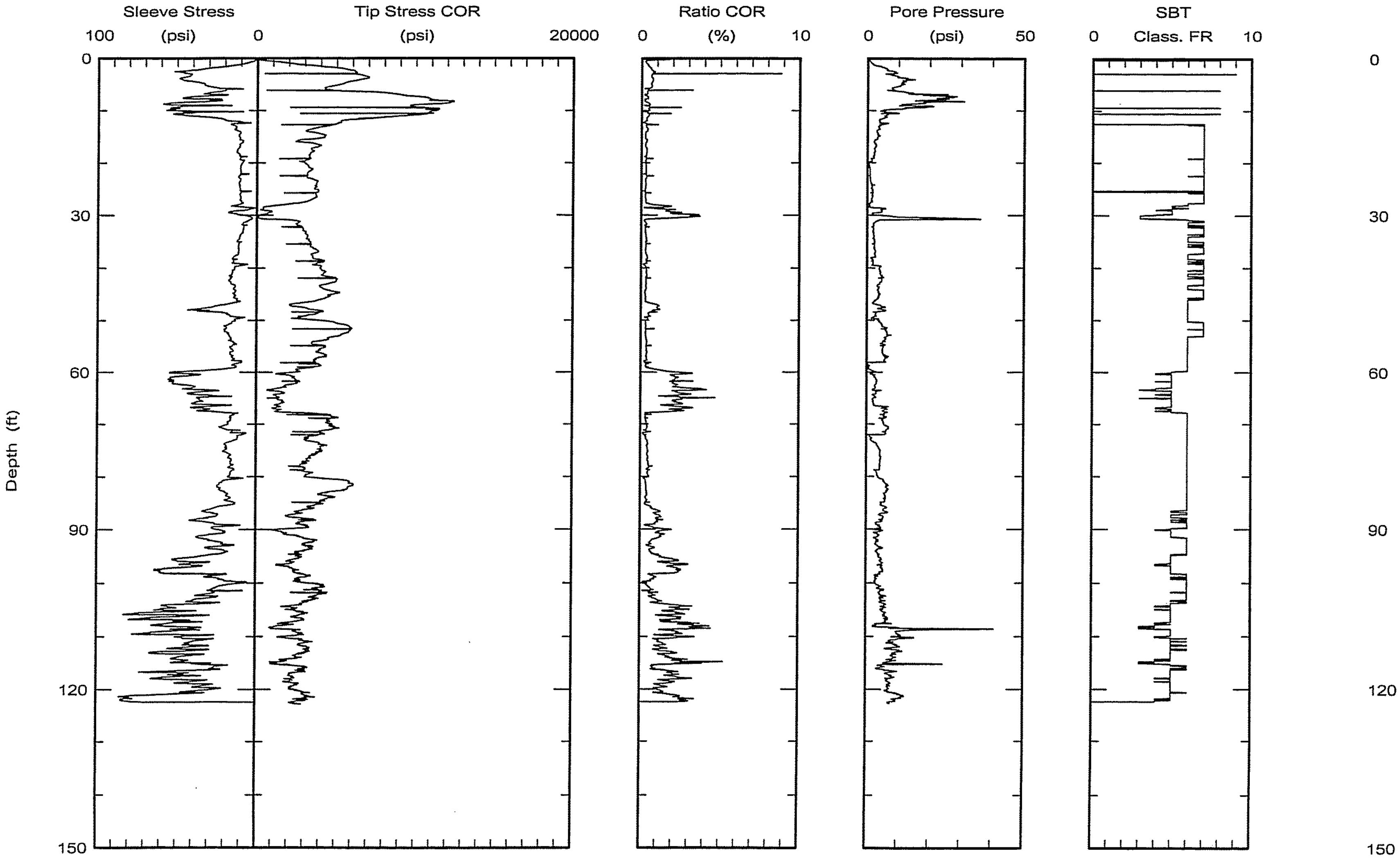


Maximum depth: 131.63 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-24
File: 2015G0703C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 15/Aug/2007 Test ID: C-07-25A Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

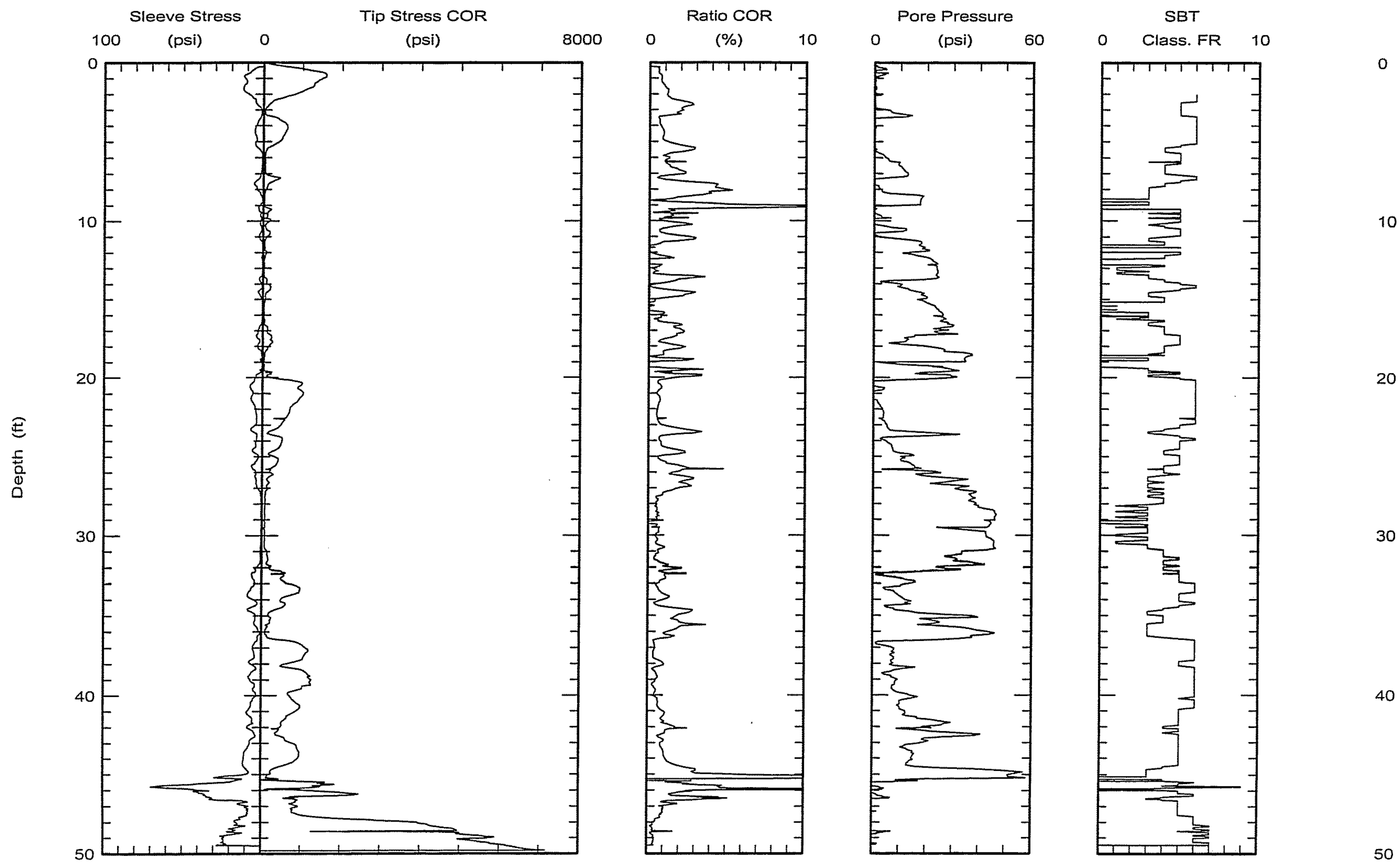


Maximum depth: 122.72 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-25A
File: 2015G0705C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 16/Aug/2007 Test ID: C-07-26 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

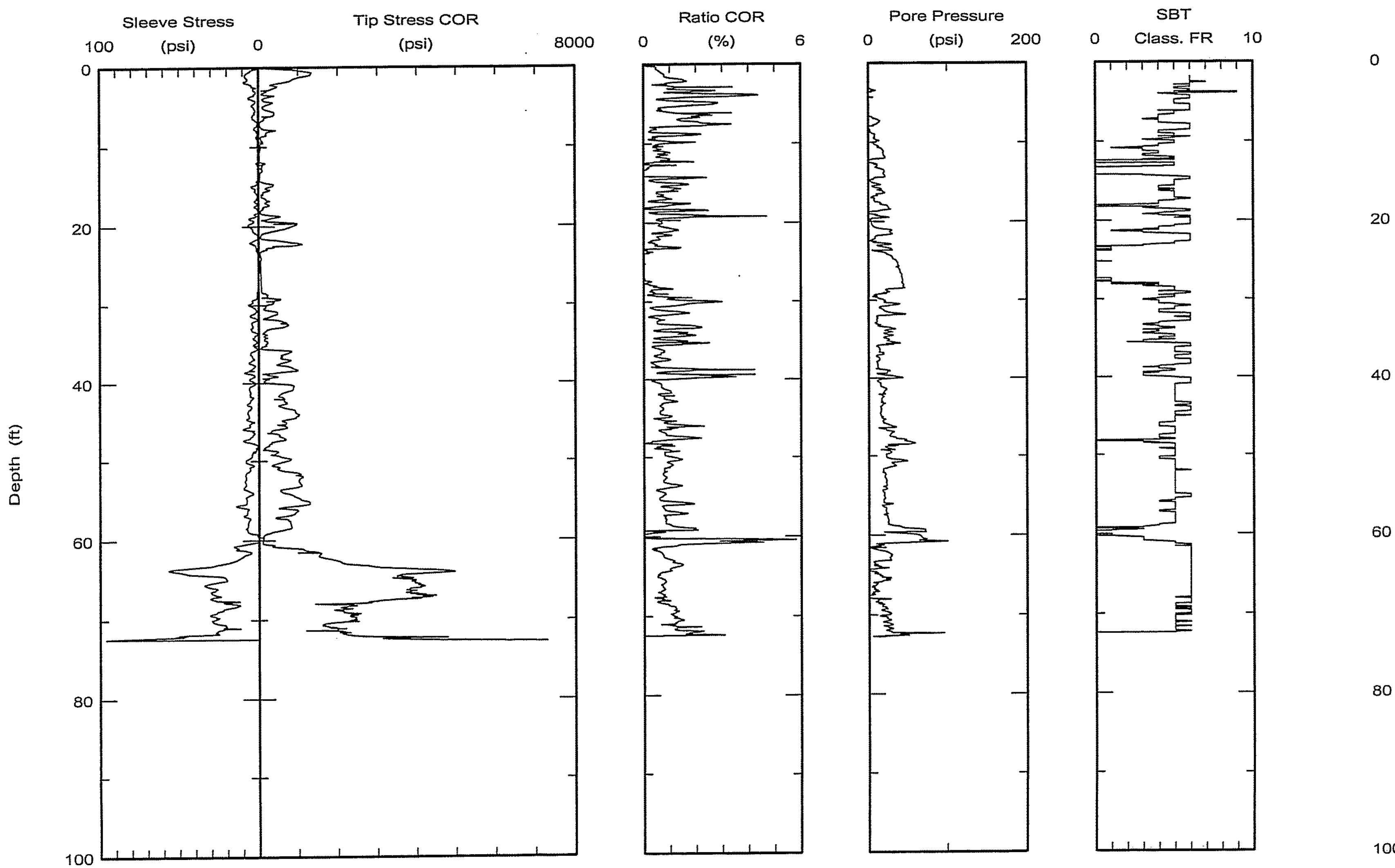


Maximum depth: 49.83 (ft)

Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-26
File: 2016G0702C.ECP

American Engineering Testing, Inc. 550 Cleveland Avenue North St. Paul, MN 55114	Northing: Easting: Elevation:	Date: 16/Aug/2007 Test ID: C-07-27 Project: 01-03612
	Client: Site: PolyMet Tailing Basin	

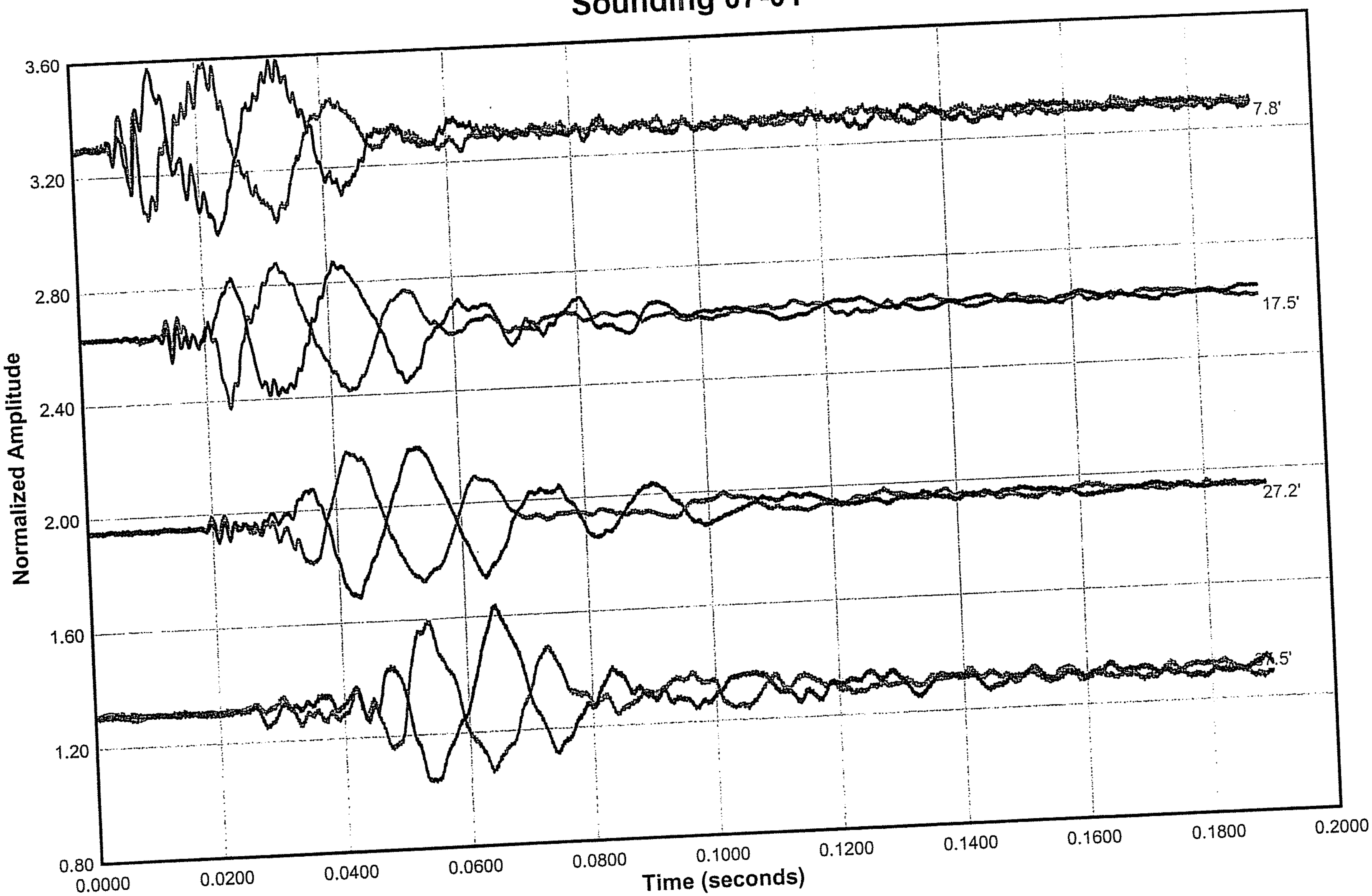


Maximum depth: 72.77 (ft)

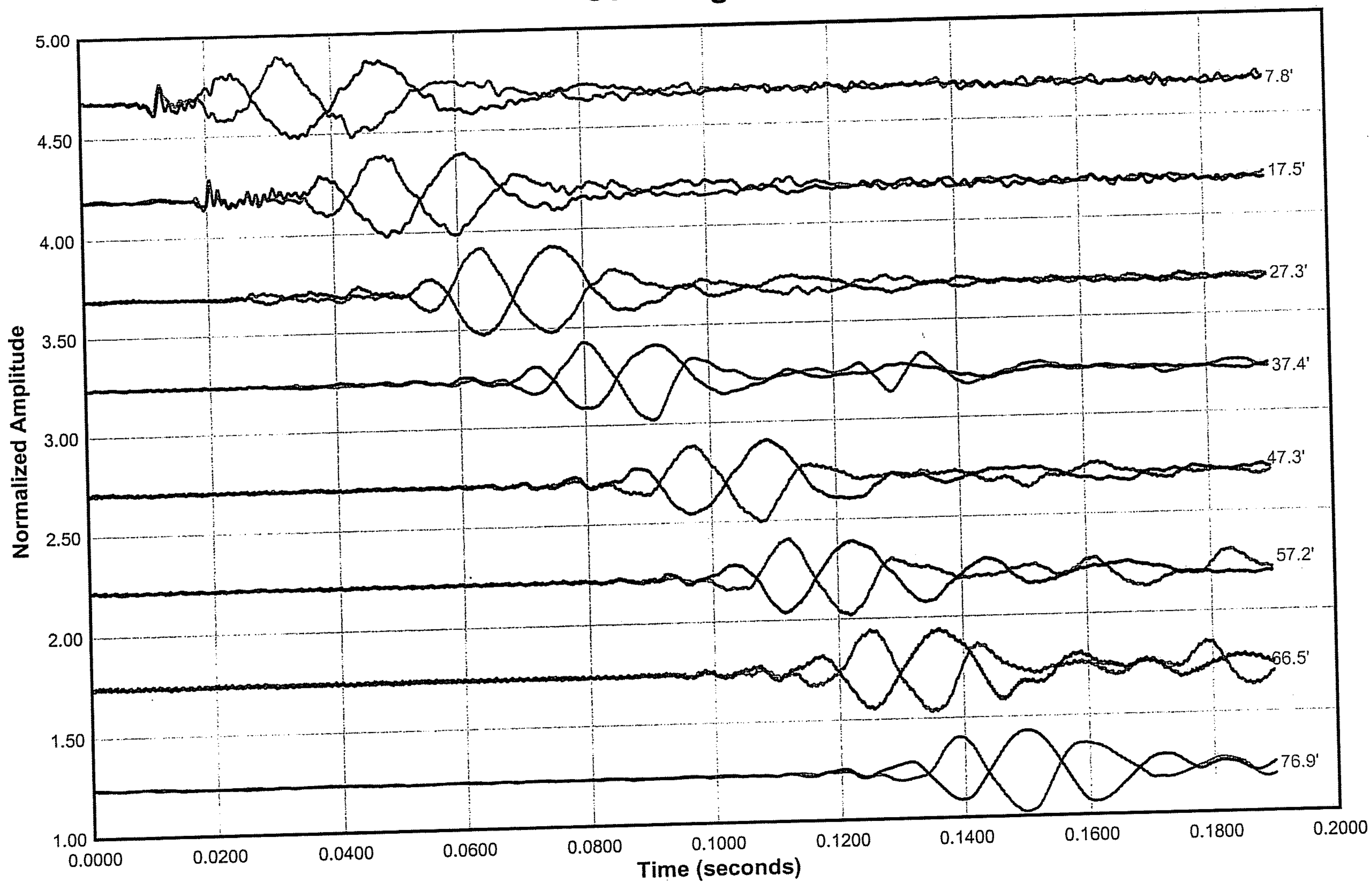
Class FR: Friction Ratio Classification (Ref: Robertson 1990)

Test ID: C-07-27
File: 2016G0703C.ECP

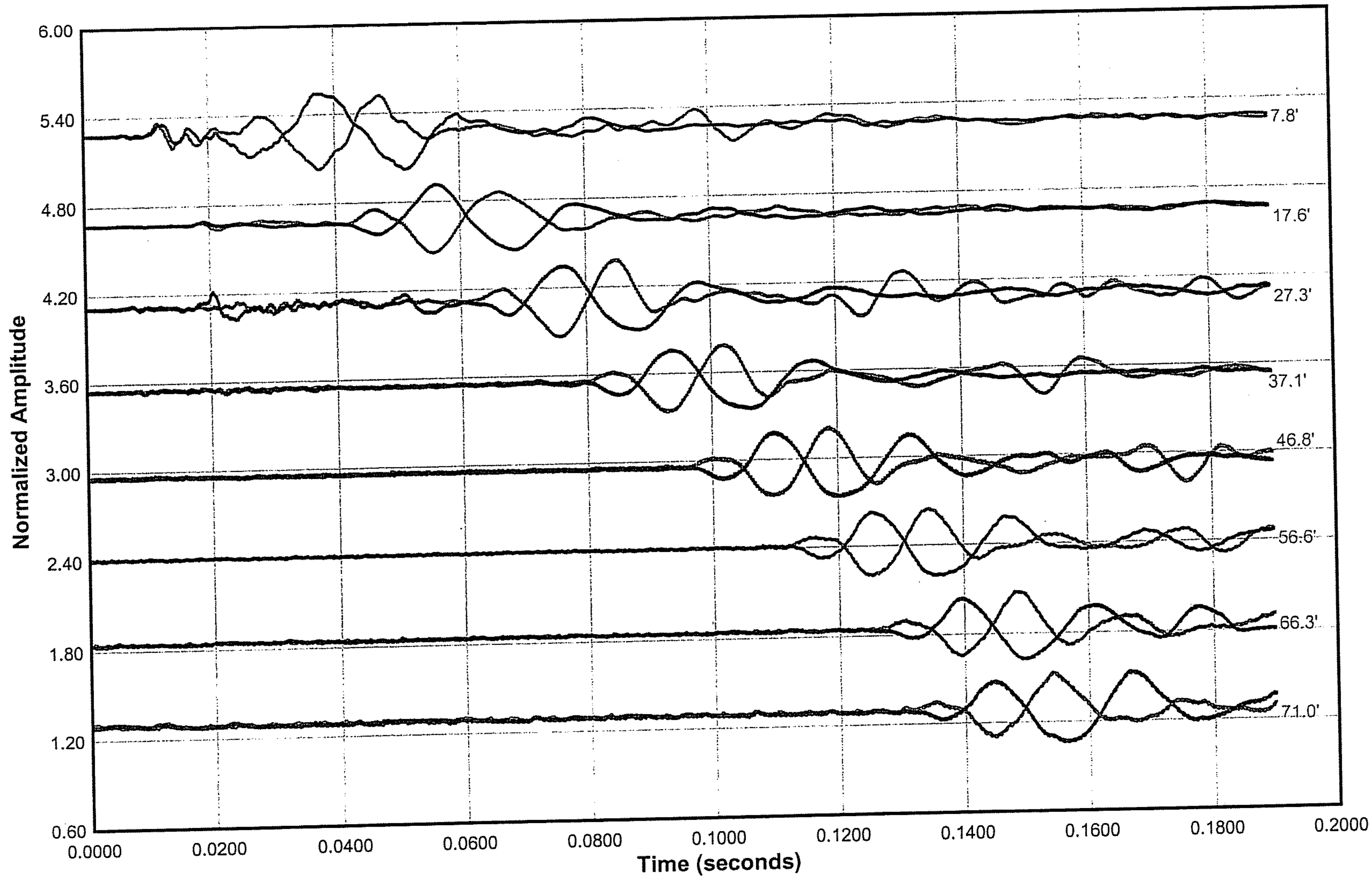
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-01



PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-02



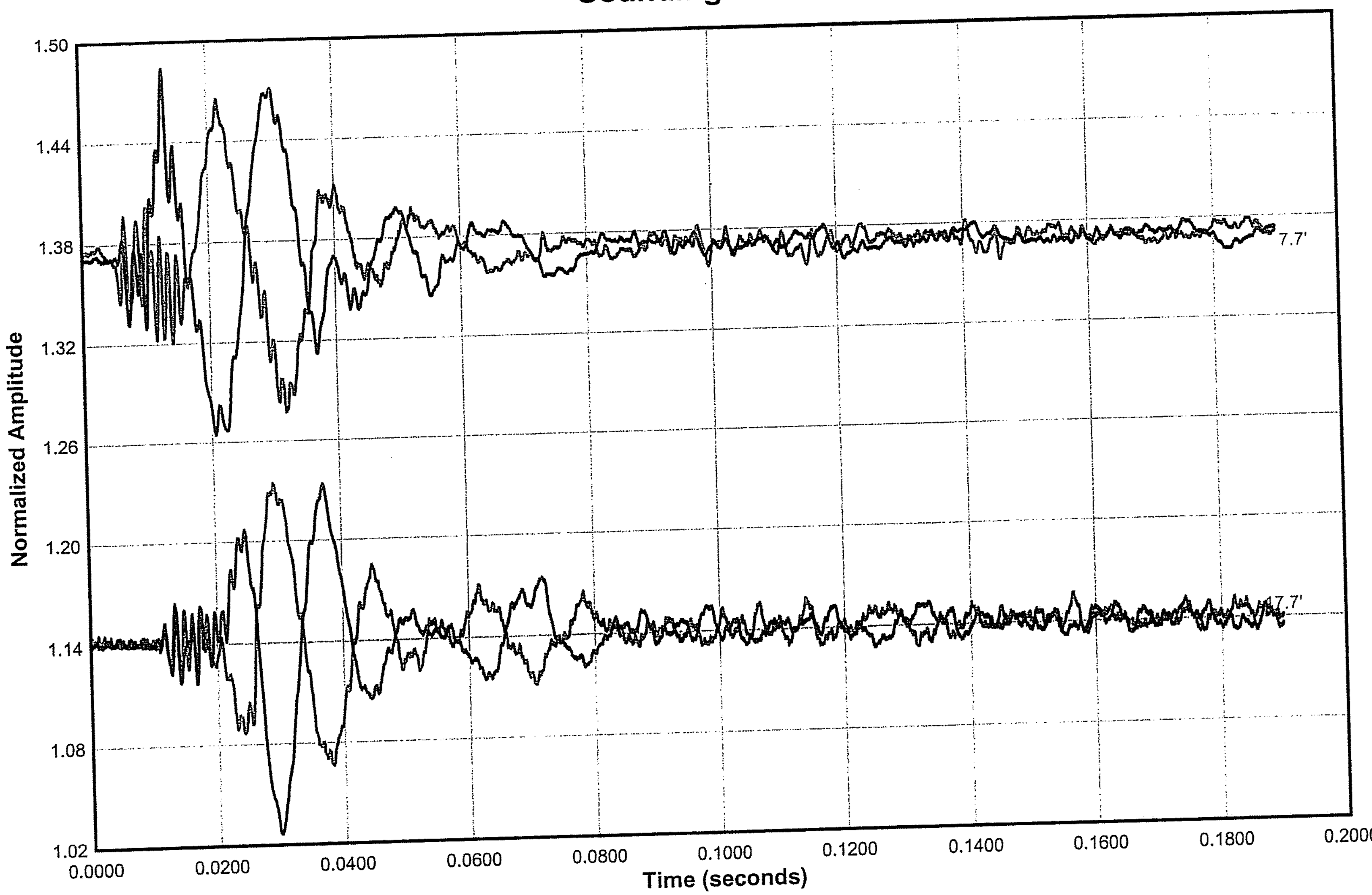
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-03



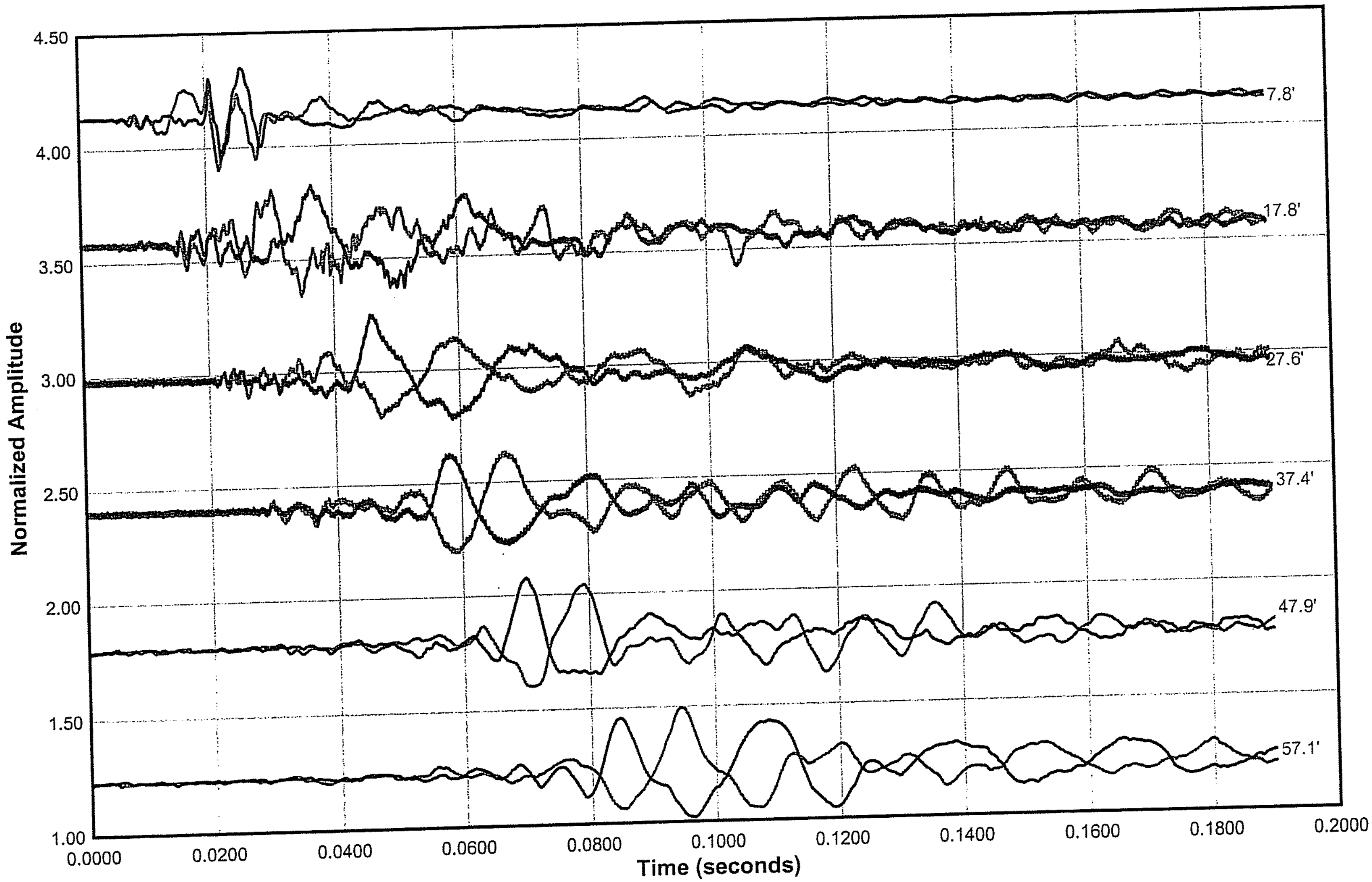
PolyMet Tailings Basin

AET Project No. 01-03612

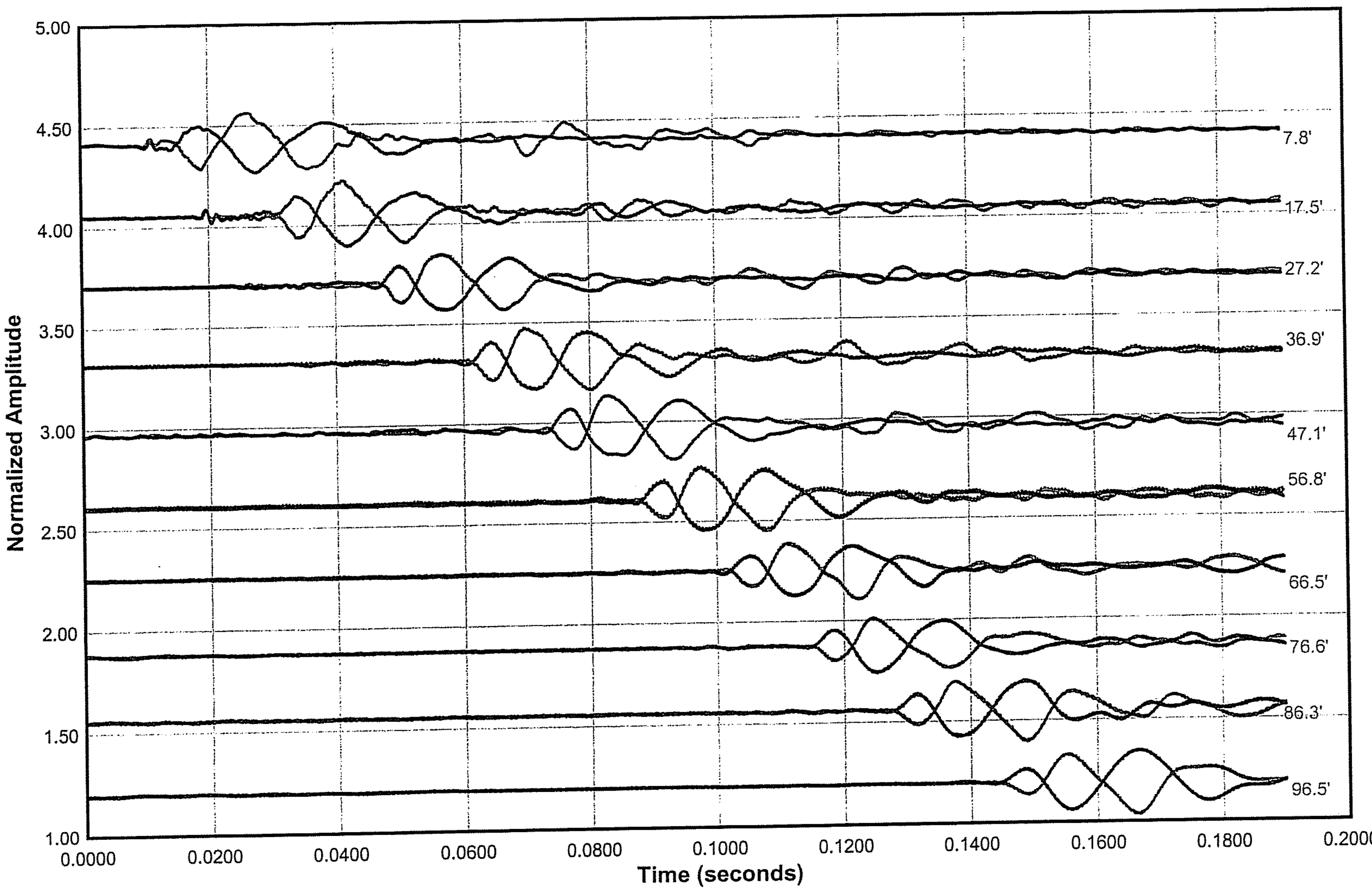
Sounding 07-04A



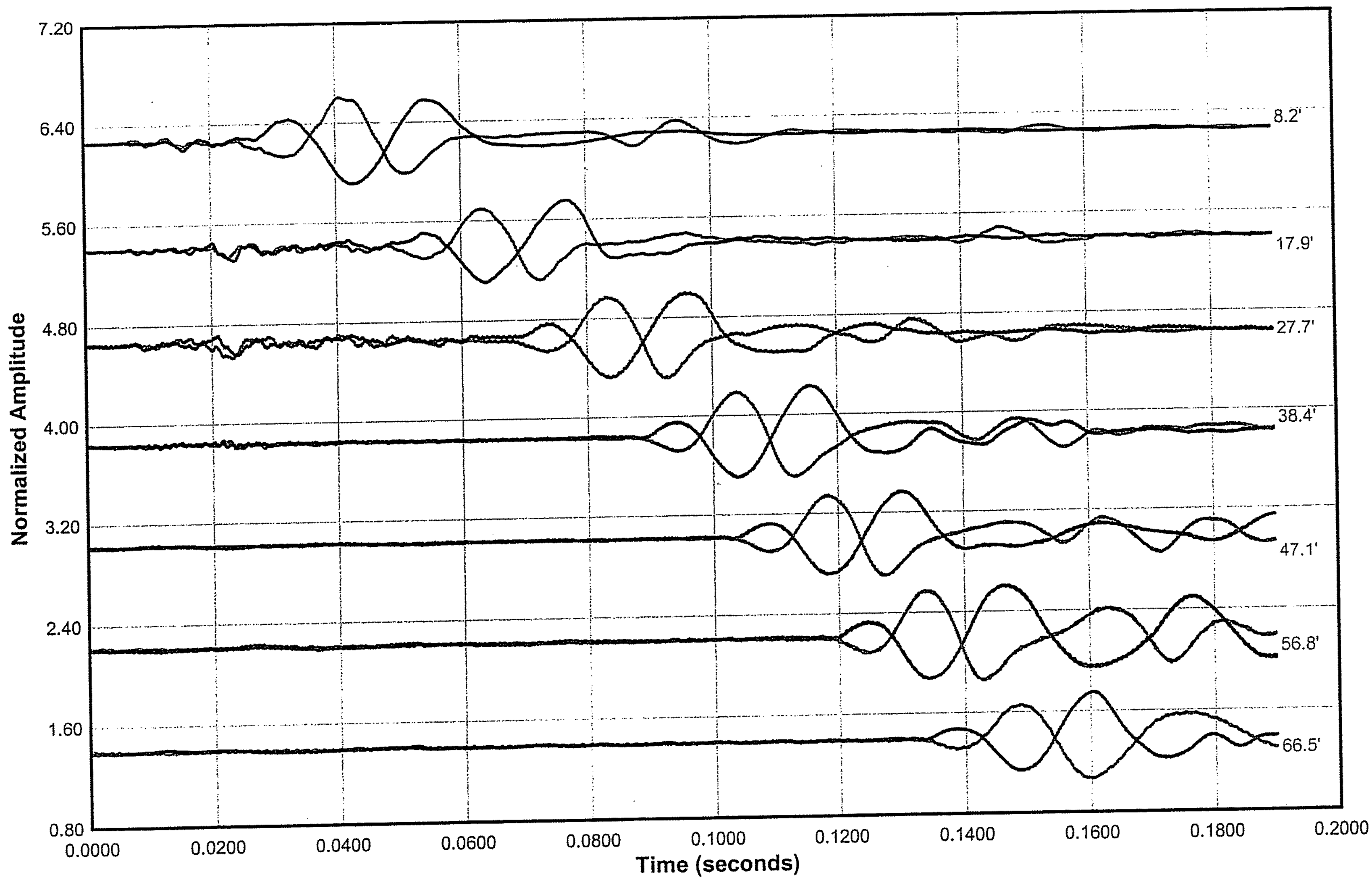
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-04B



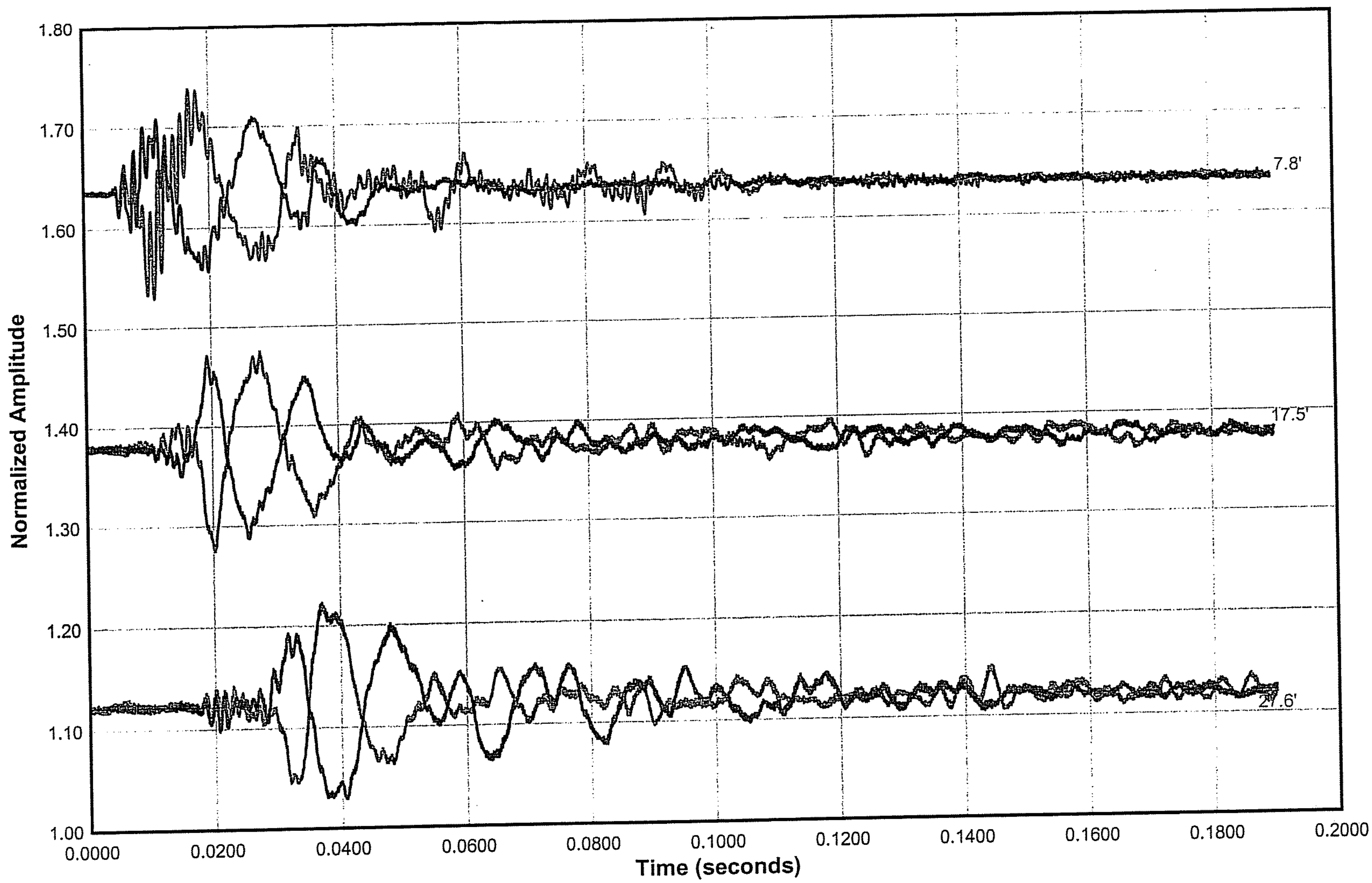
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-05



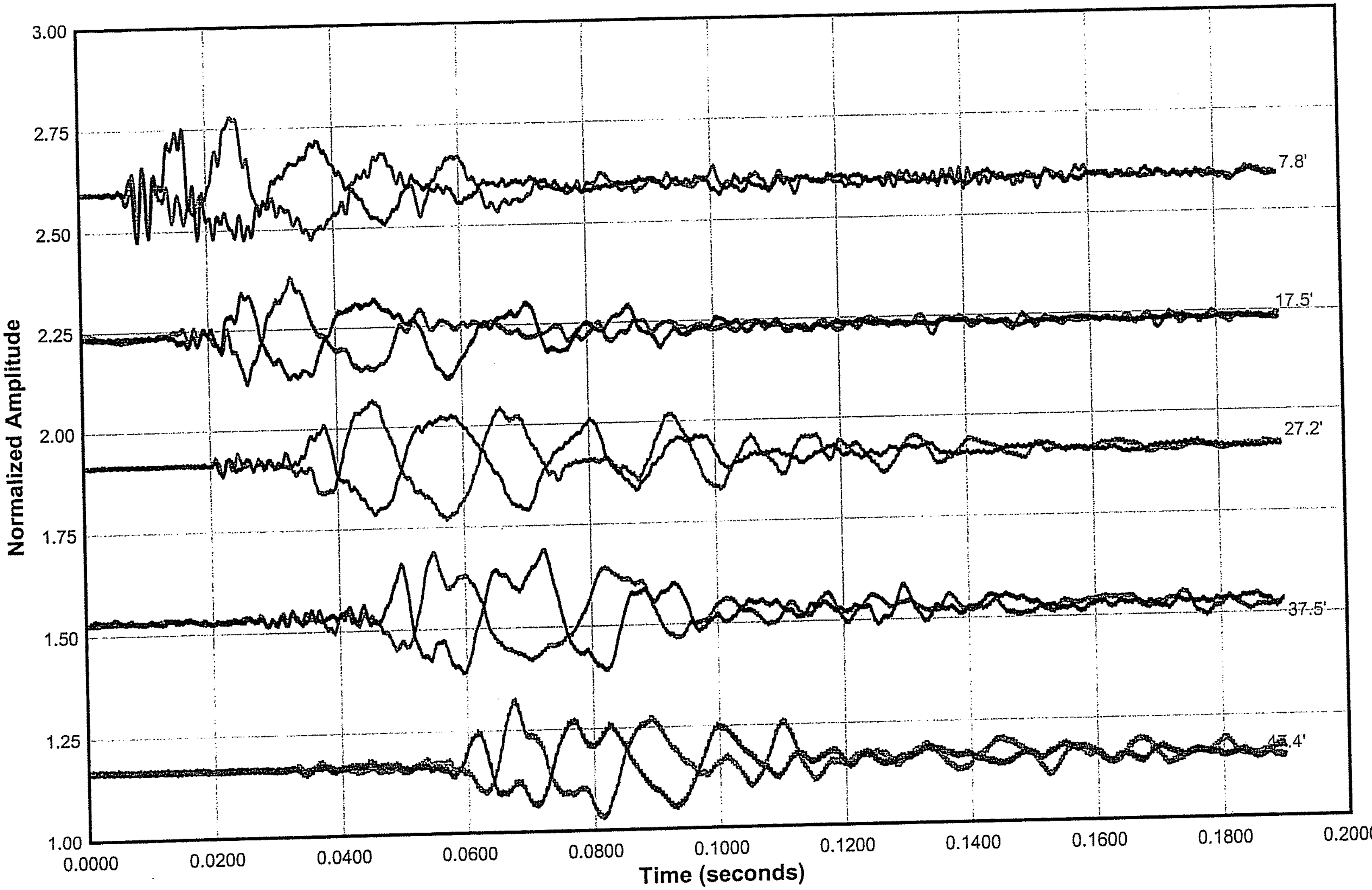
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-06



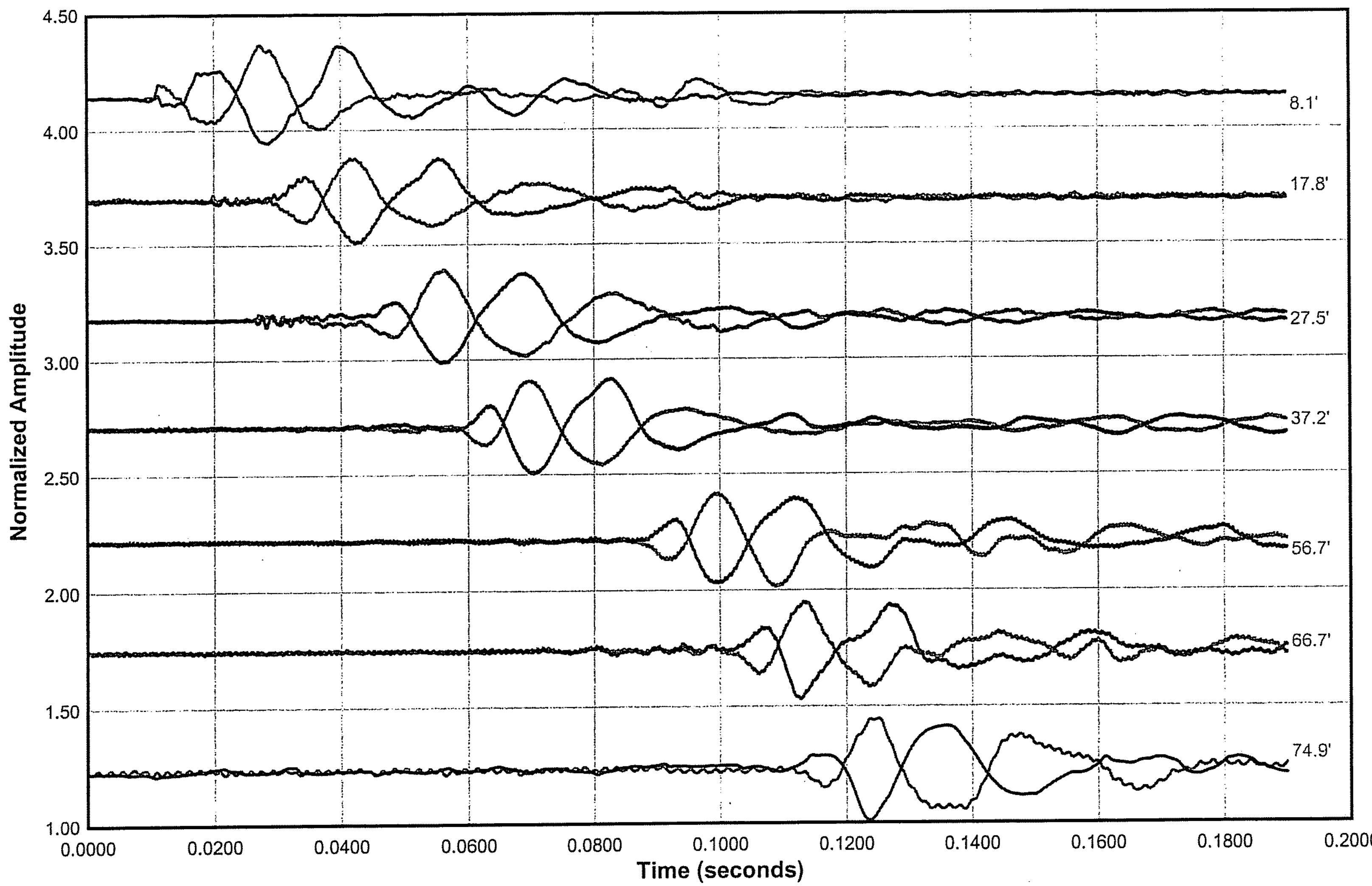
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-07B



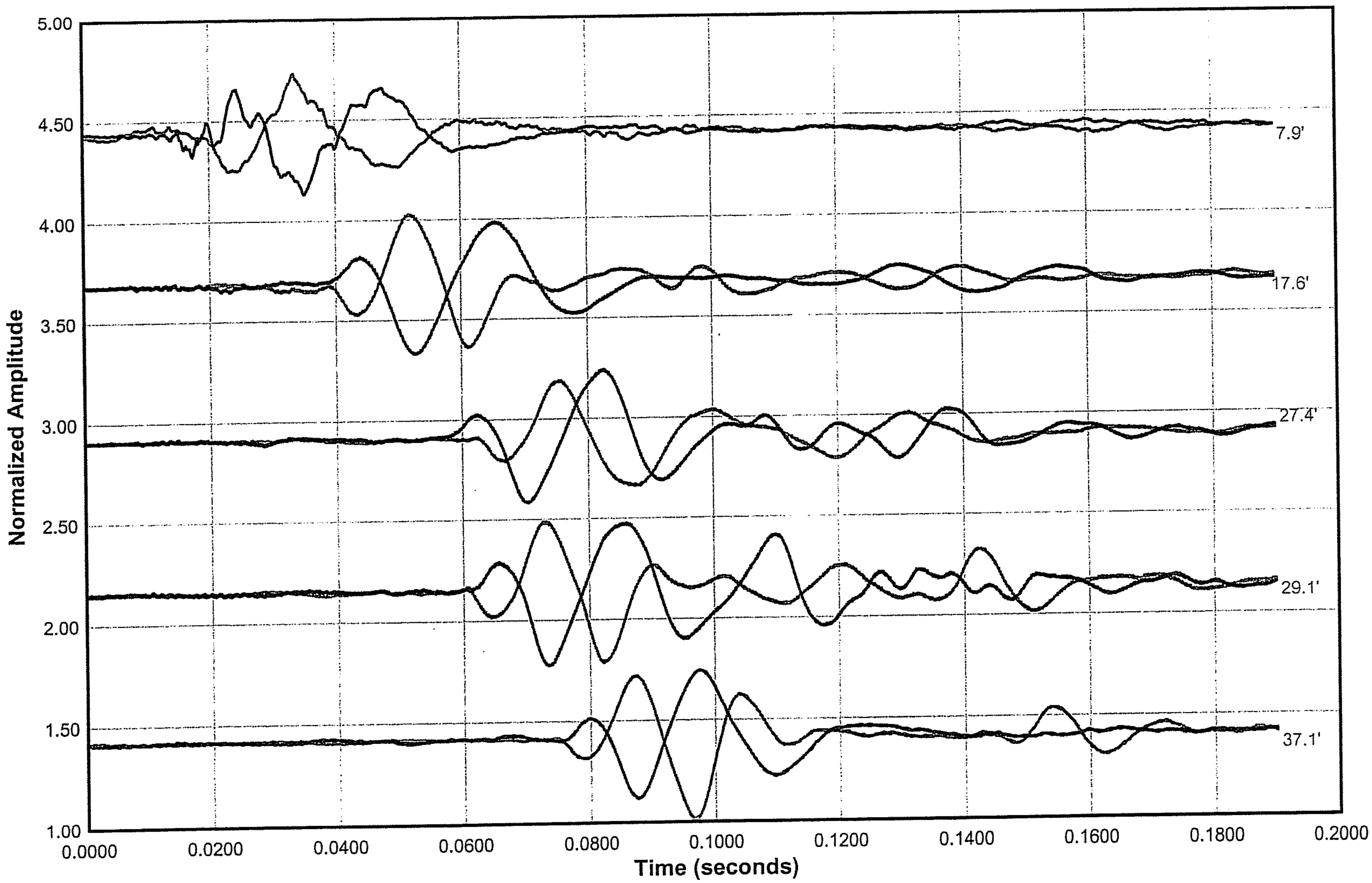
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-07C



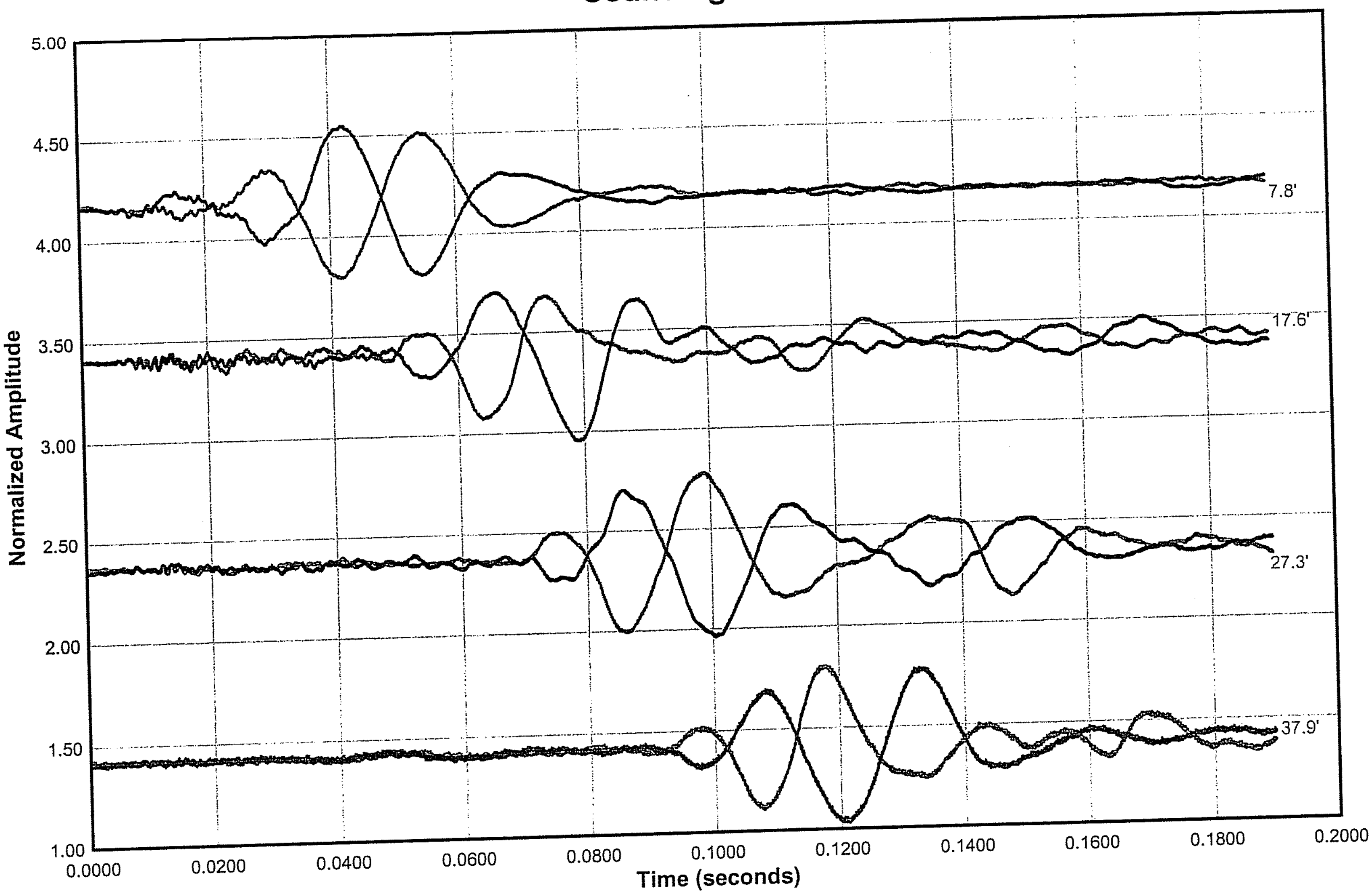
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-08



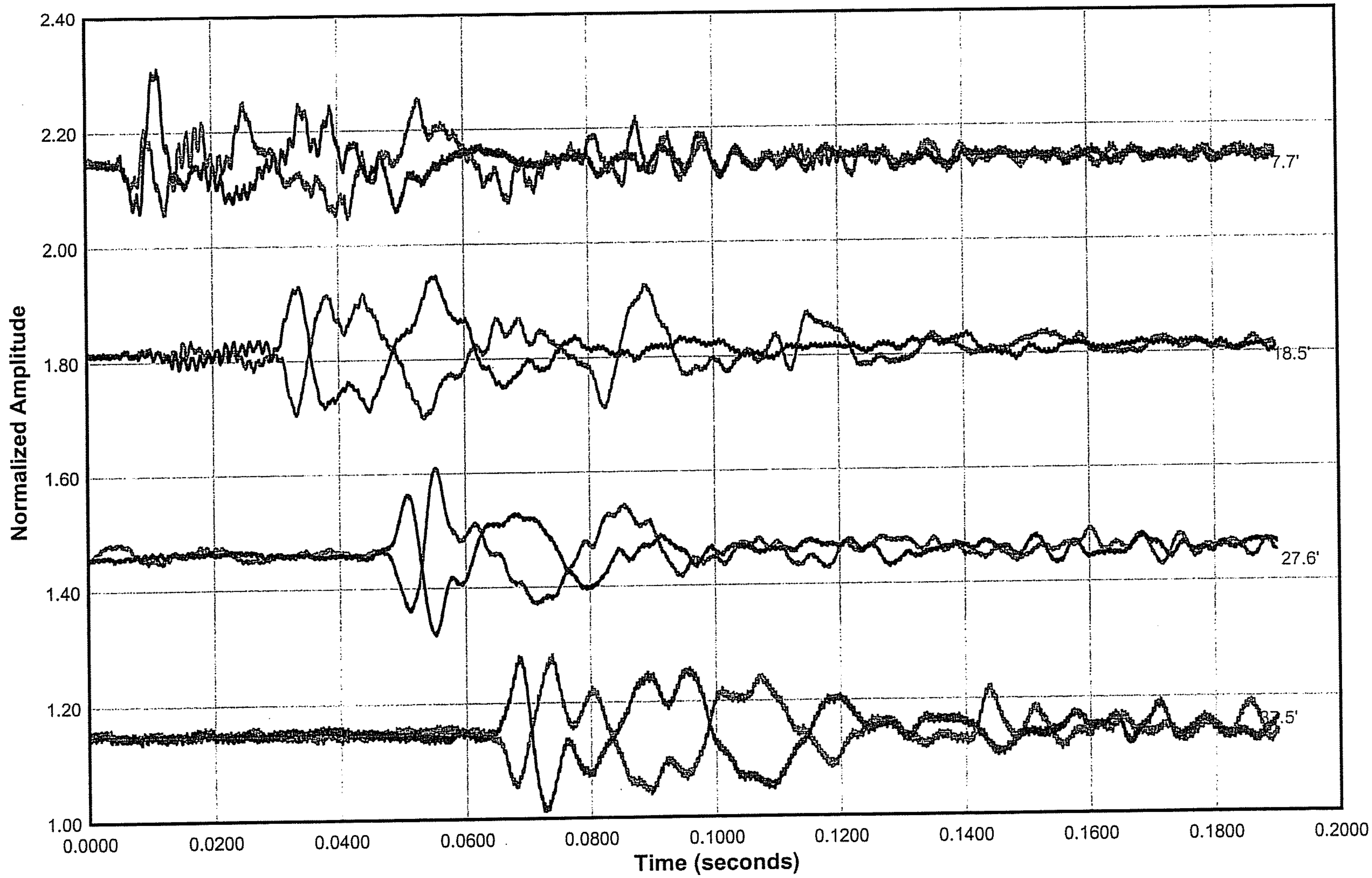
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-09



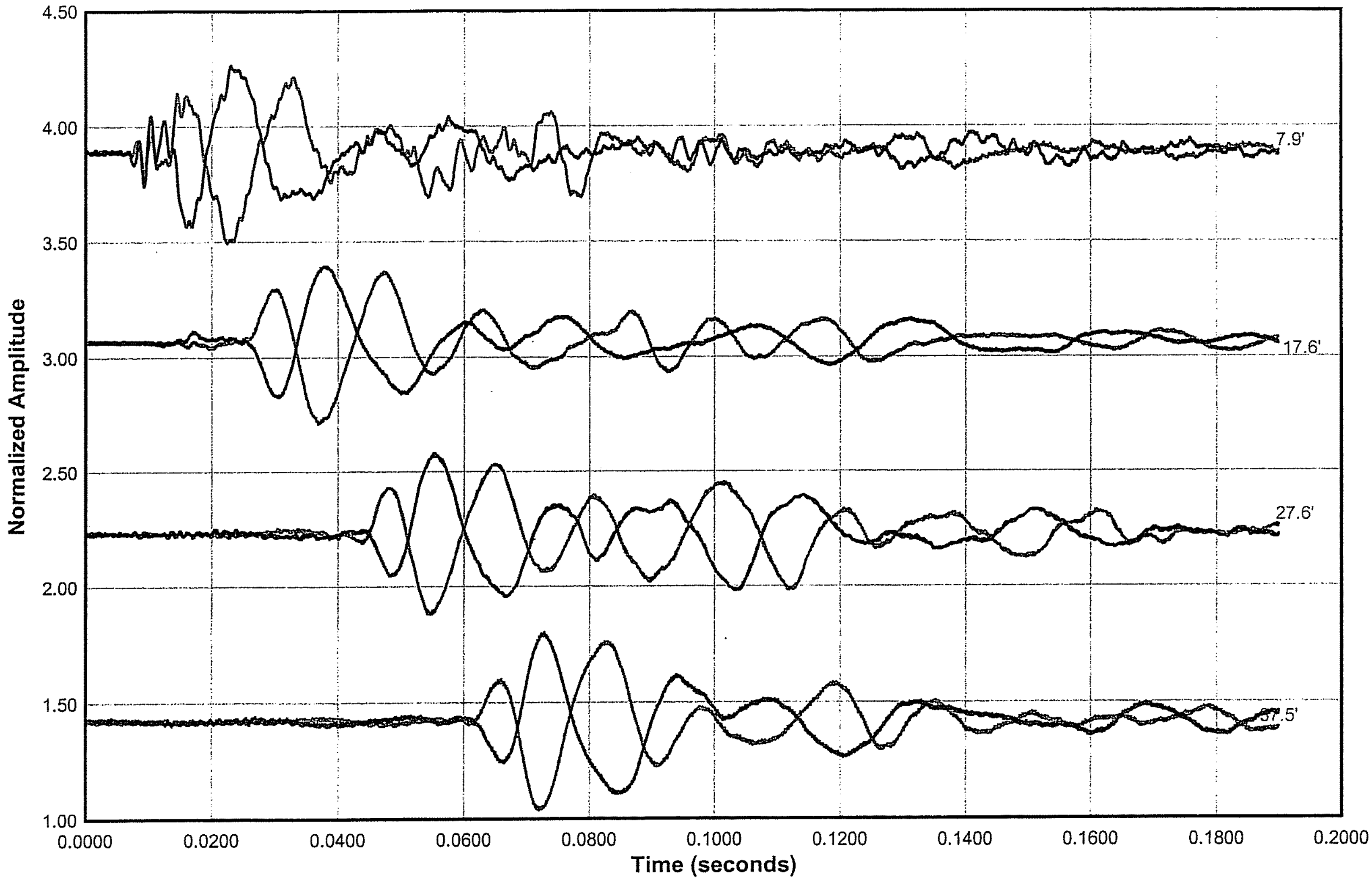
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-10



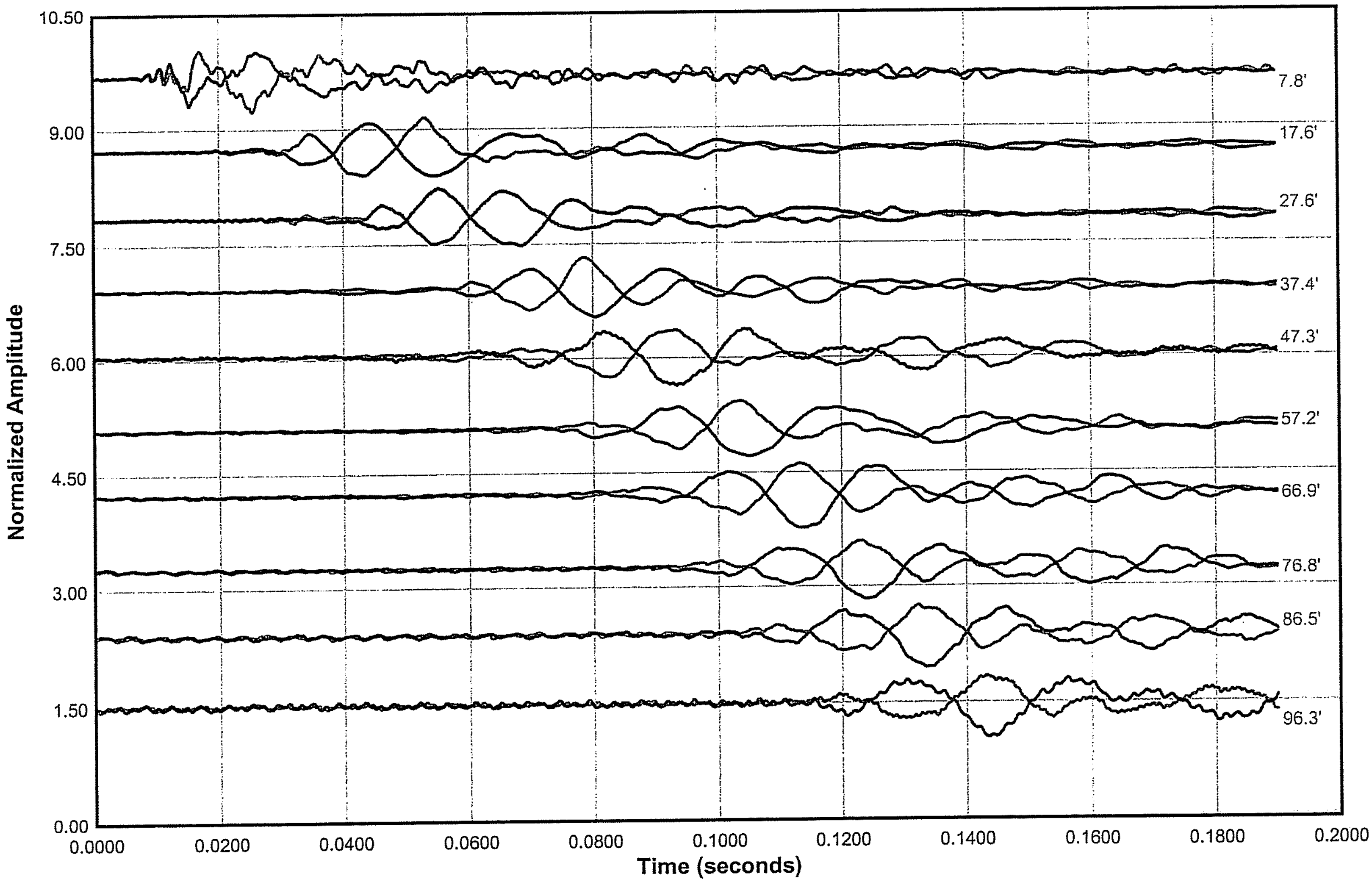
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-11



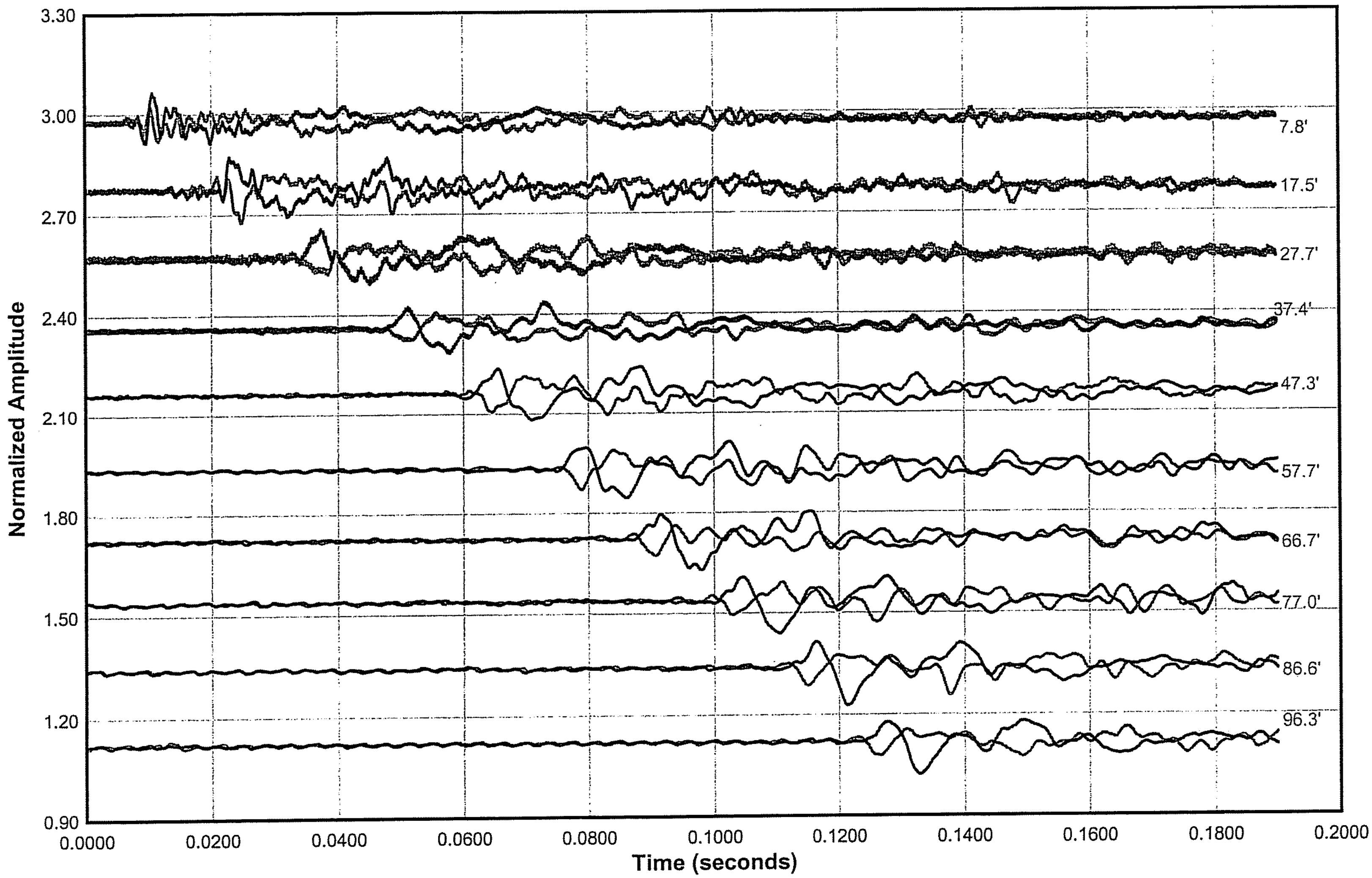
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-12



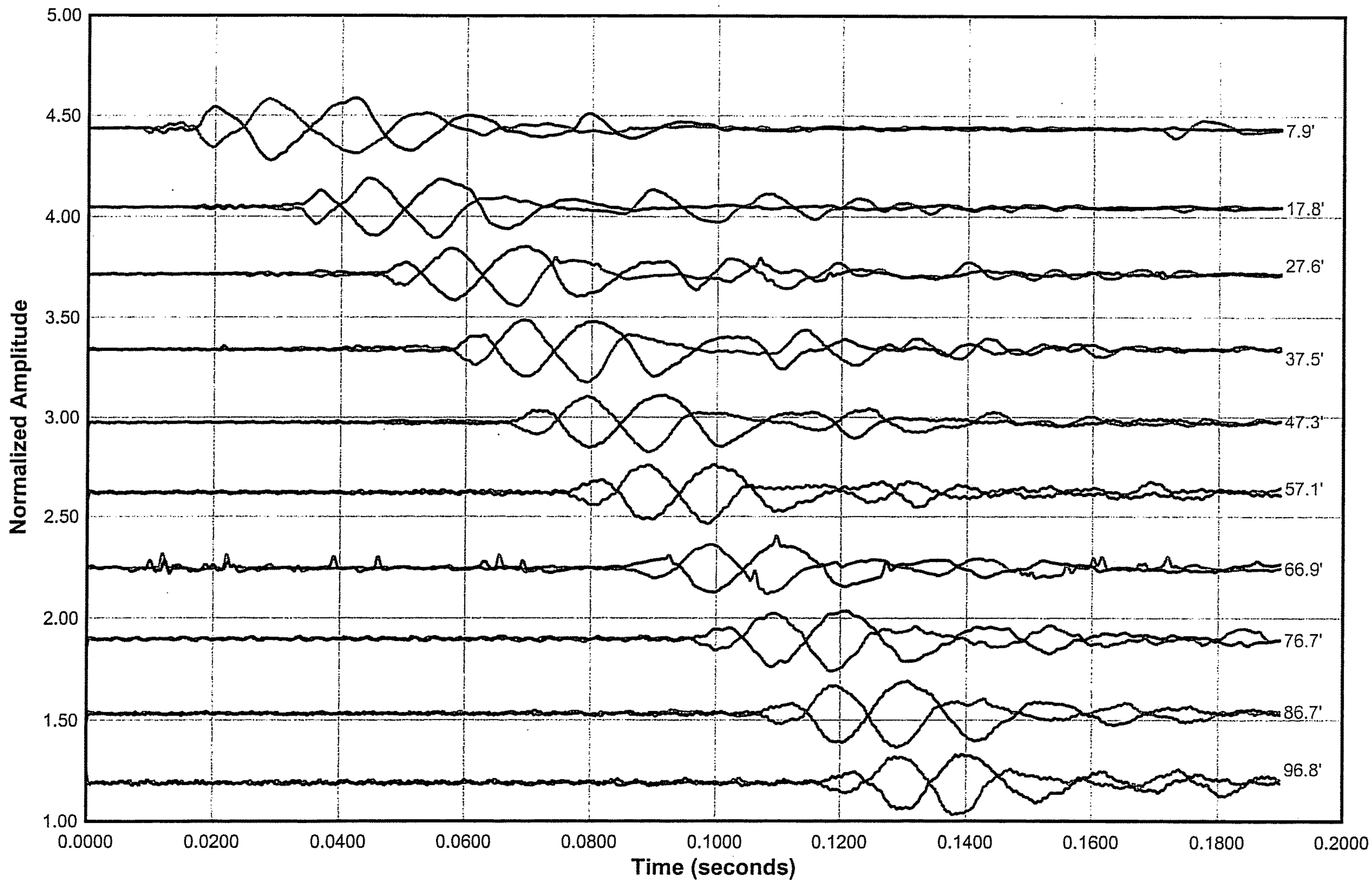
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-14



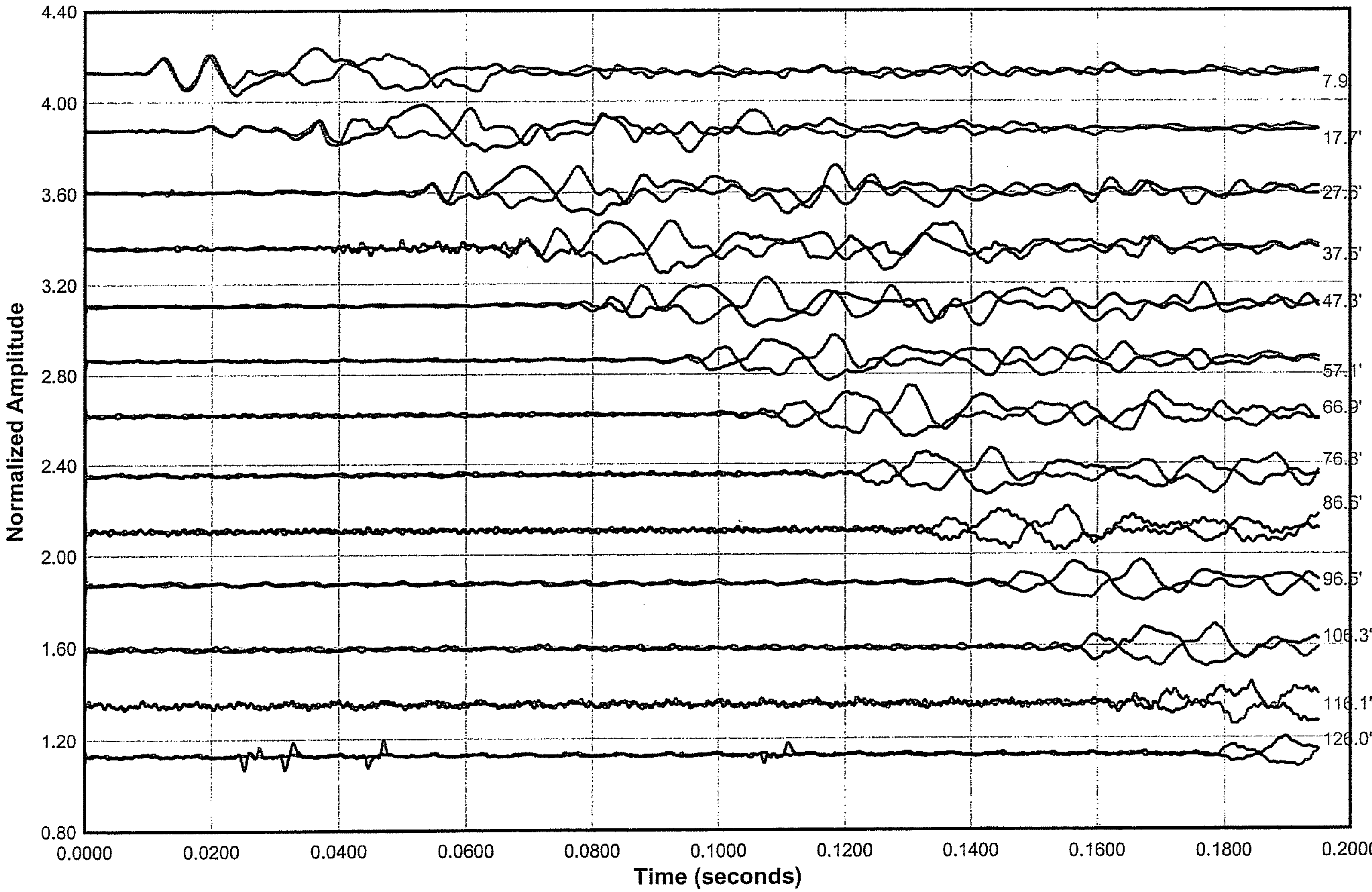
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-15



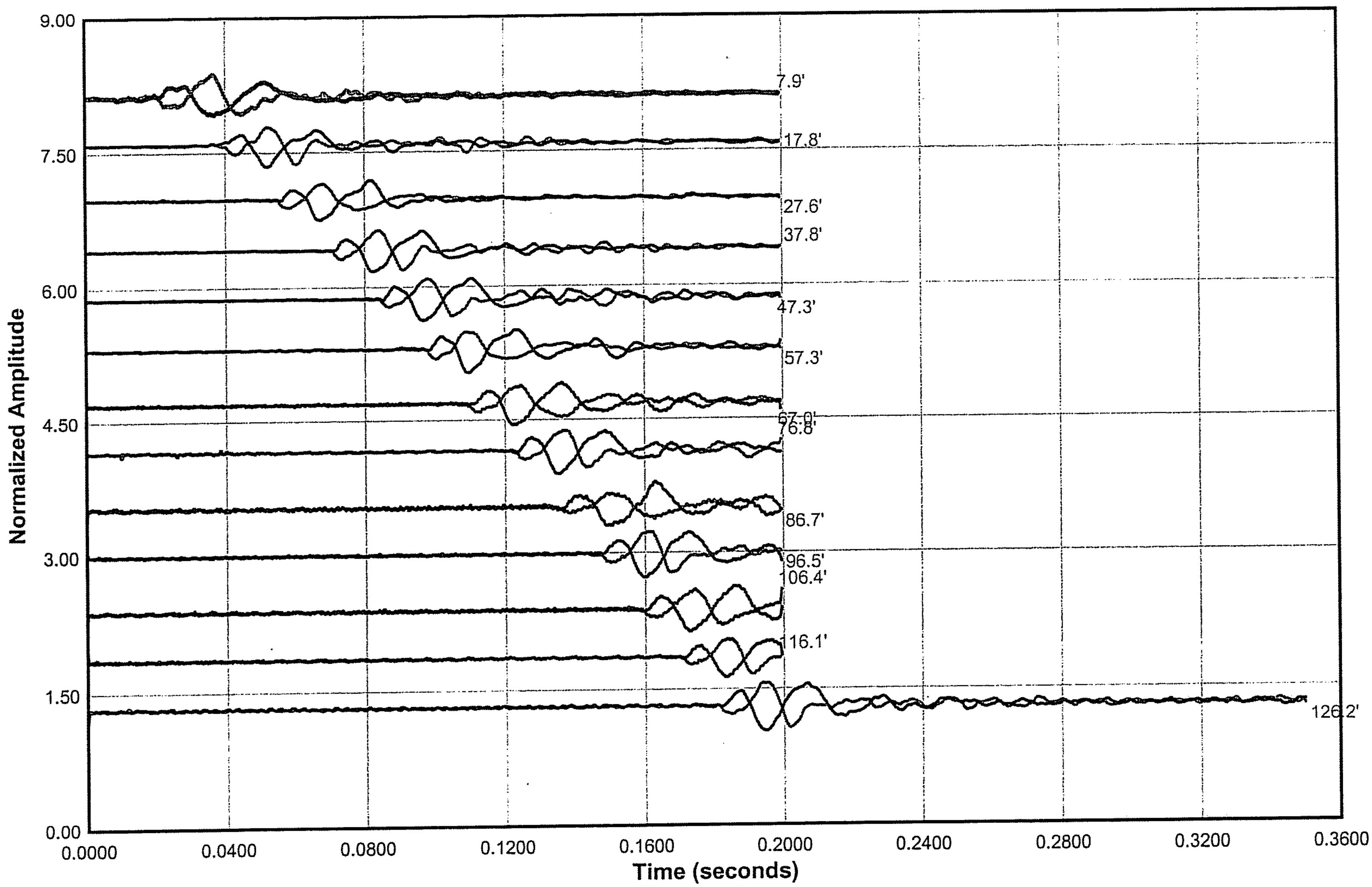
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-16



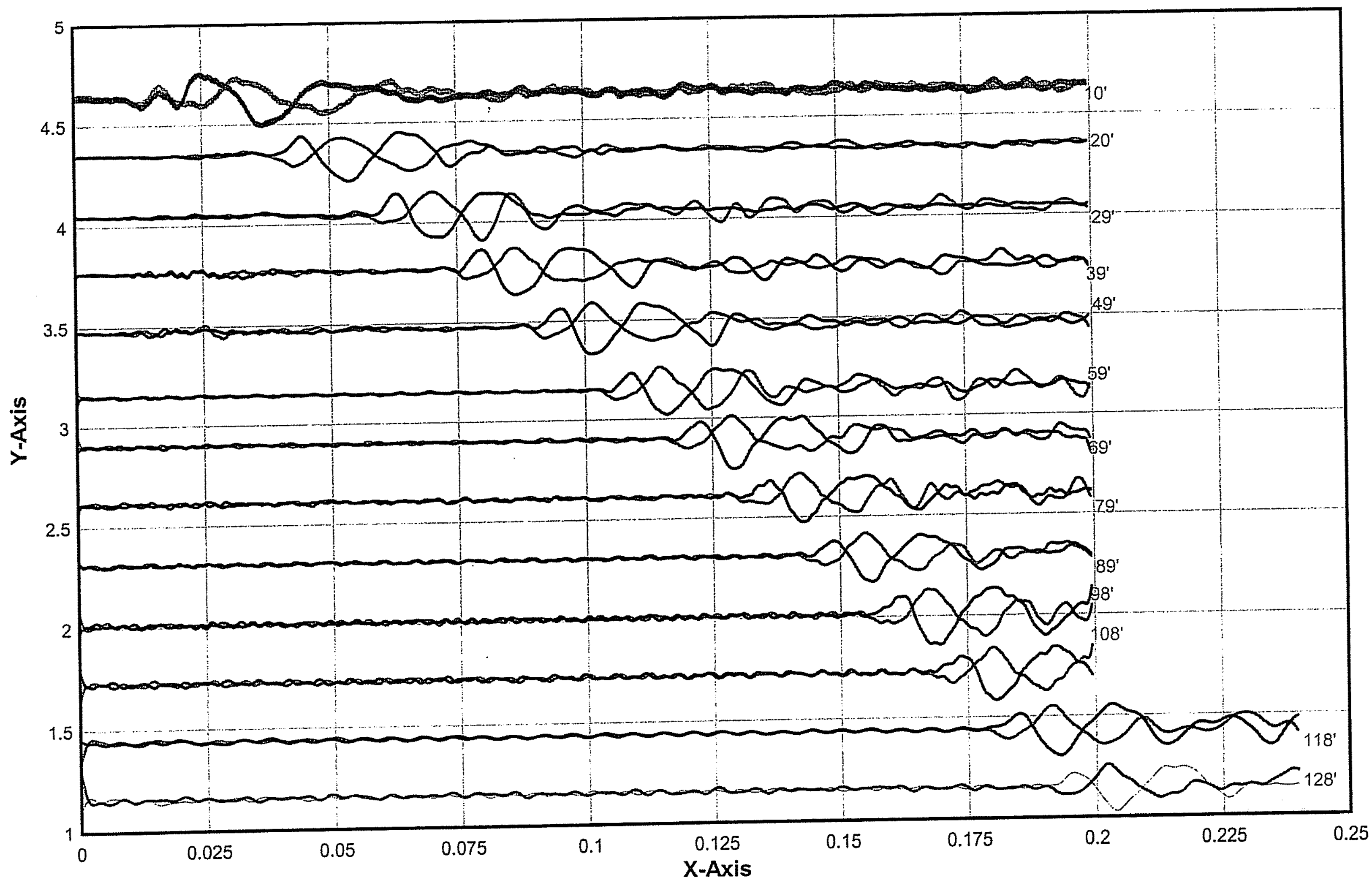
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-17



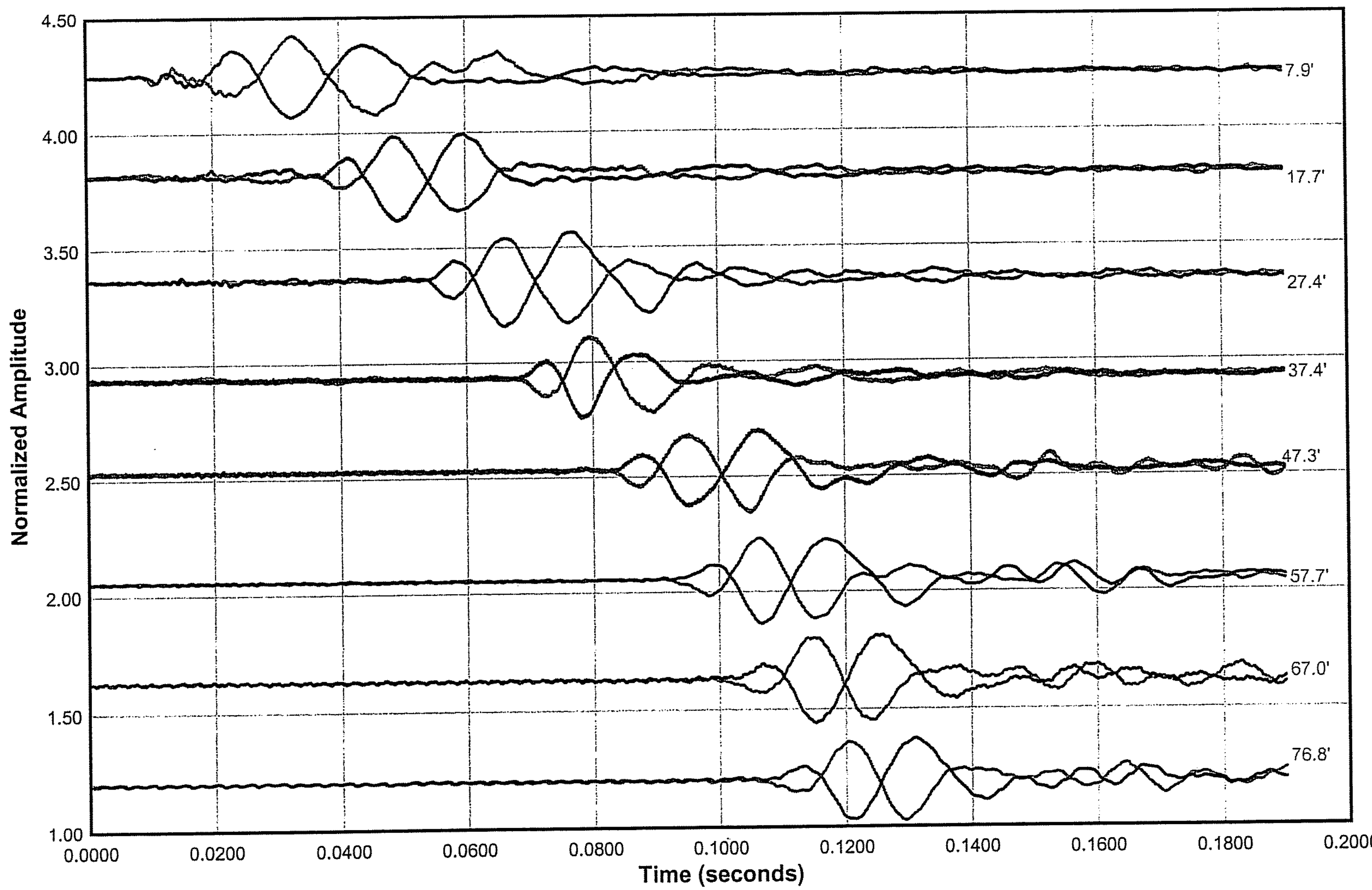
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-18



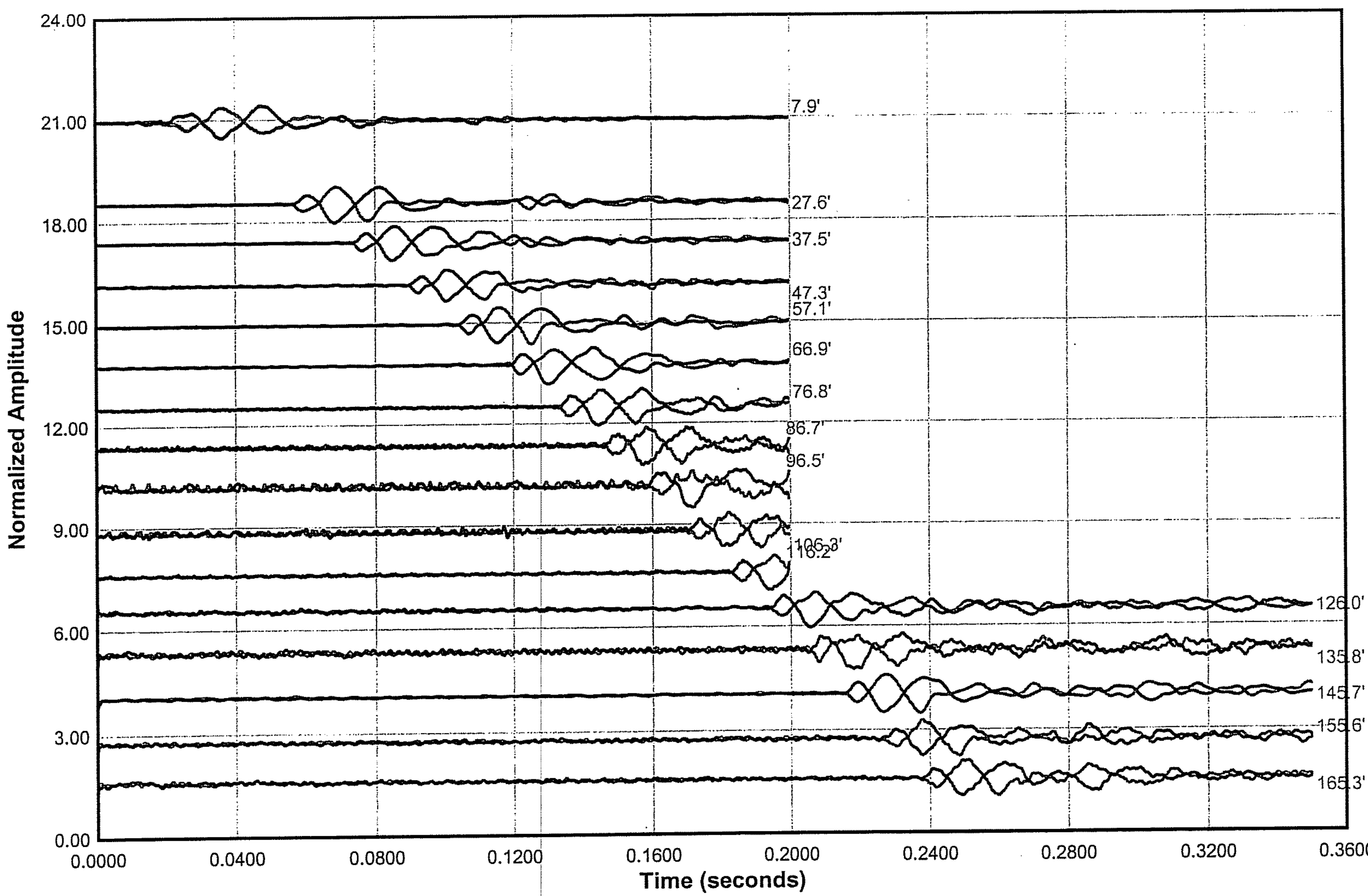
S Wave Results
Sounding 07-19
PolyMet Tailings Basin; AET 01-3612



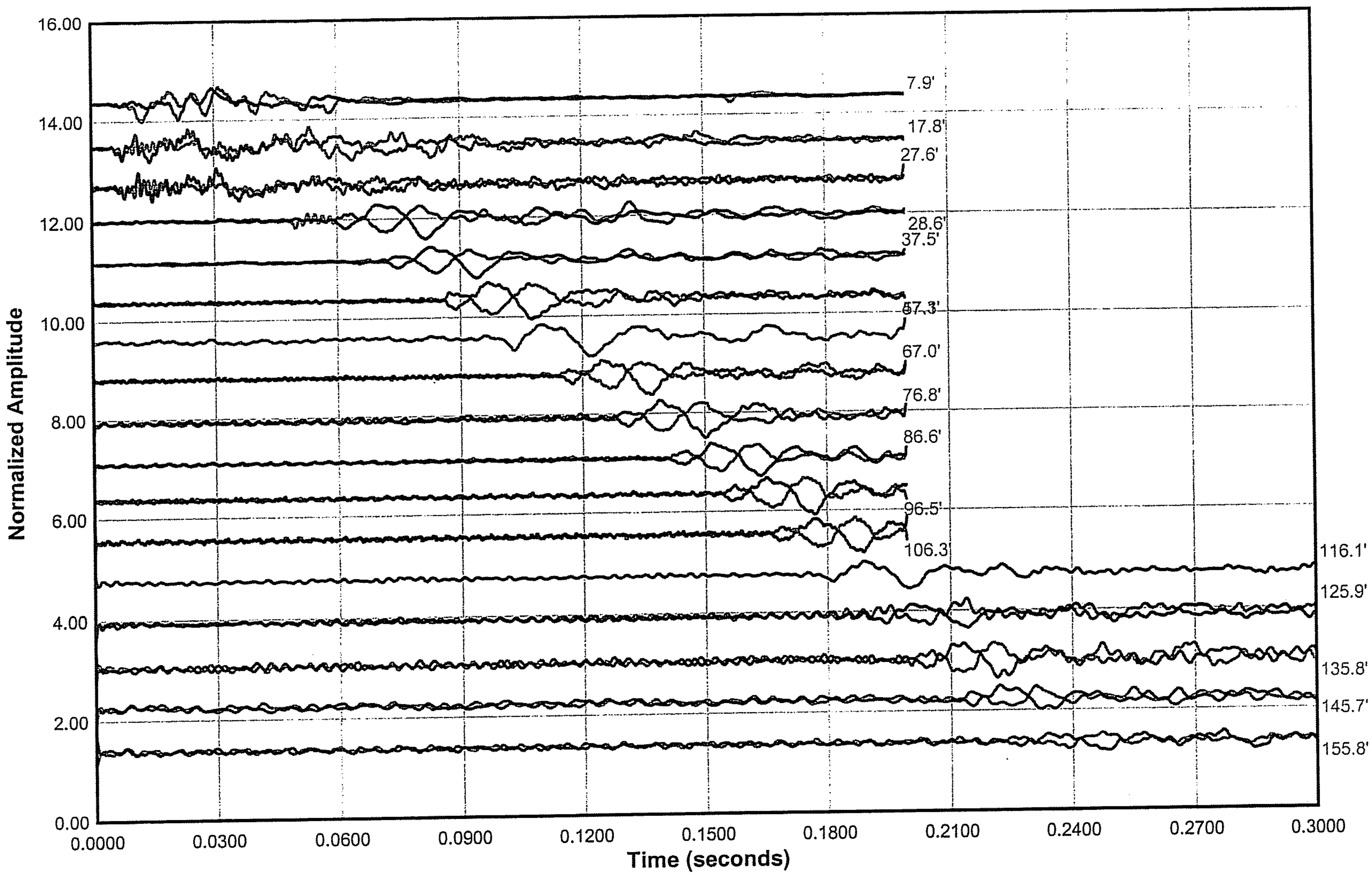
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-20



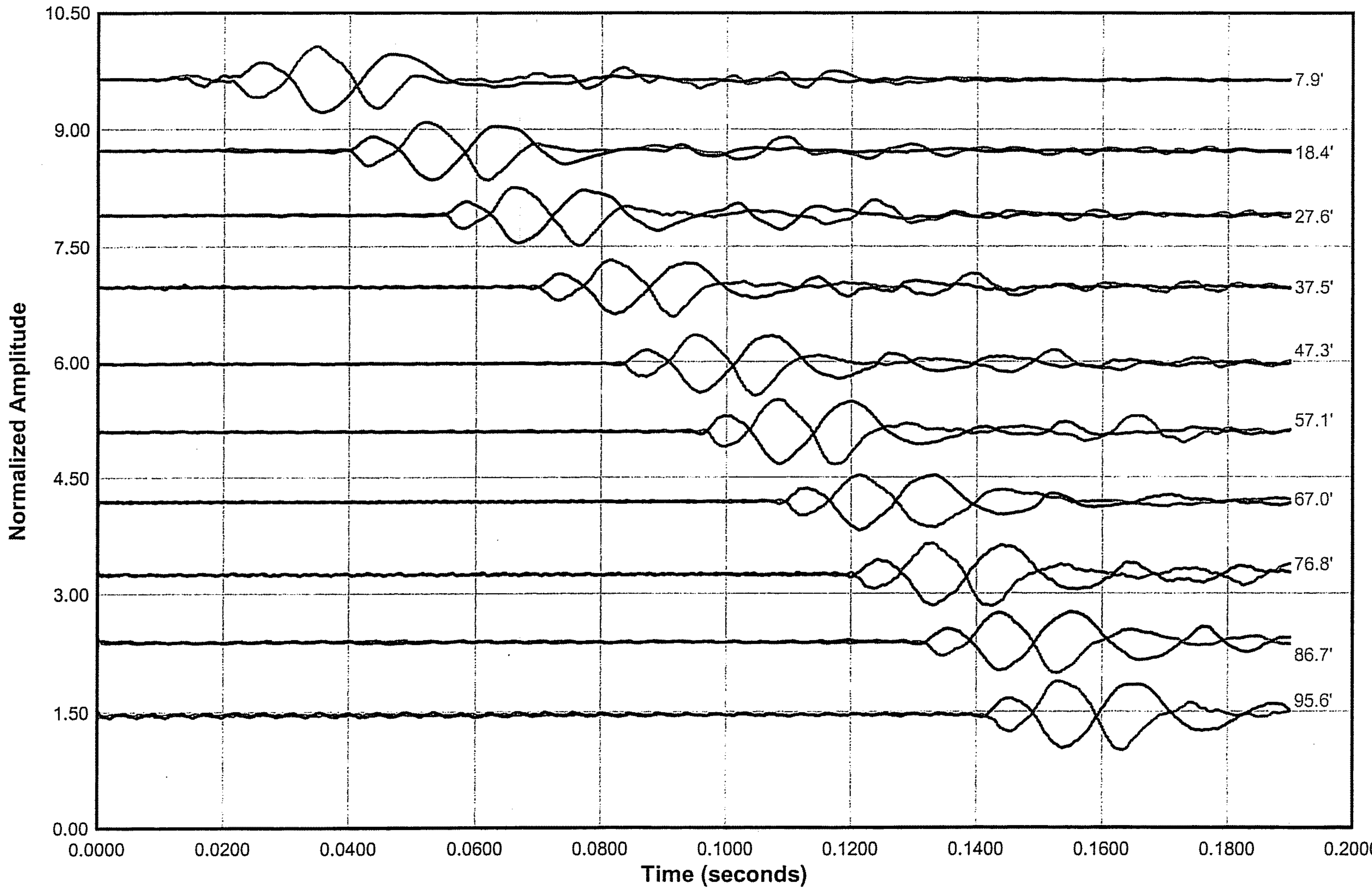
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-21



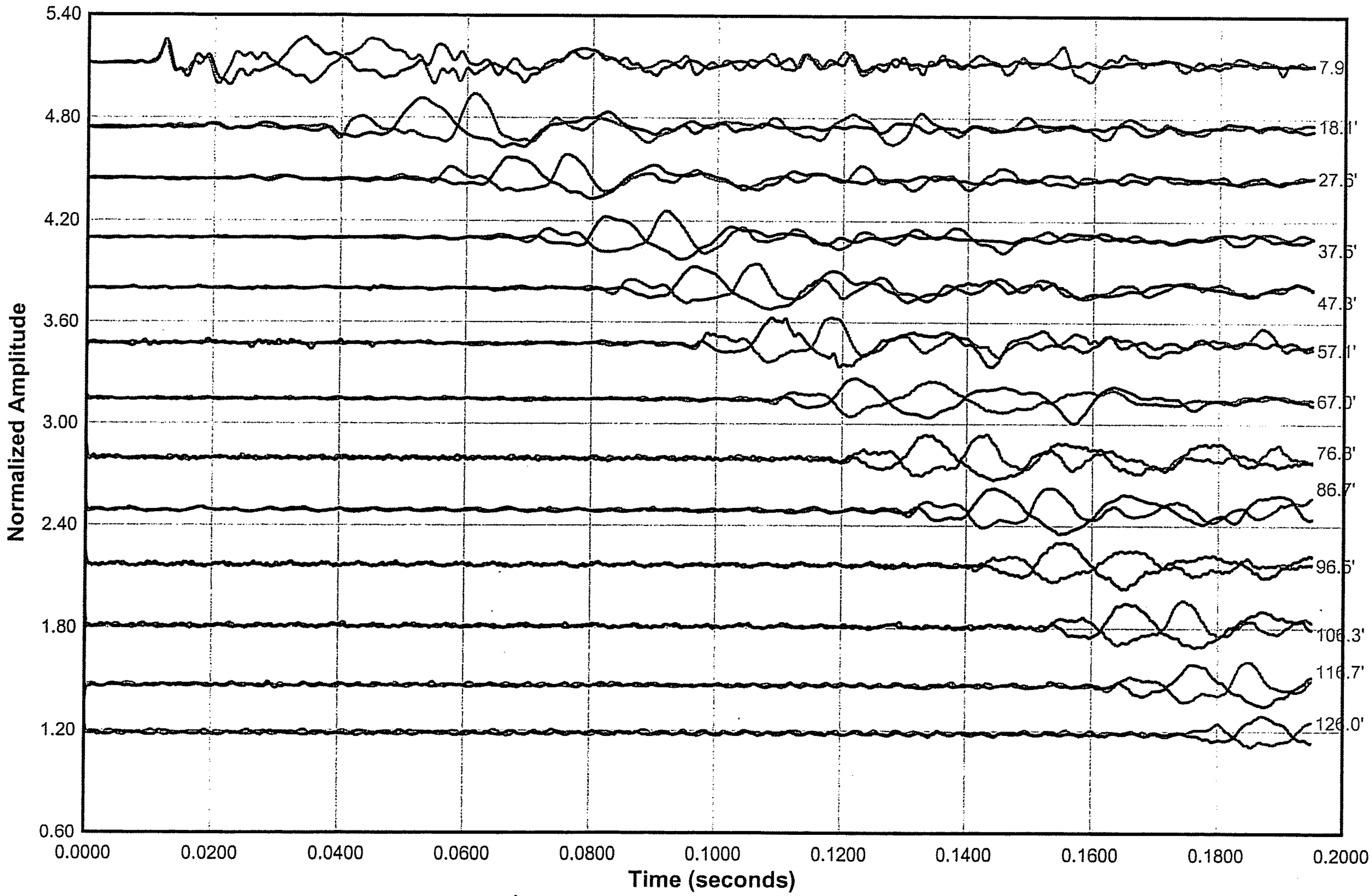
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-22



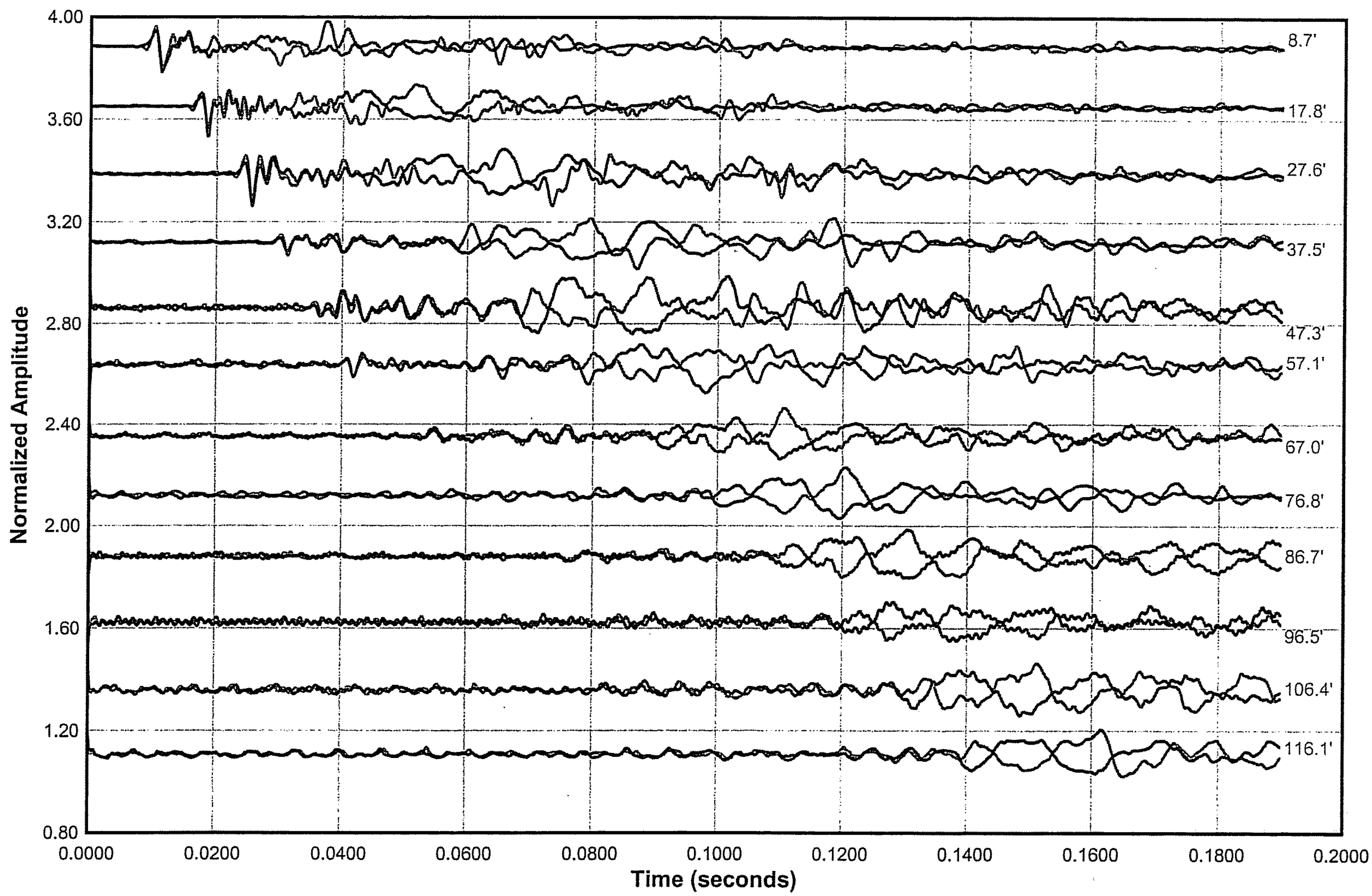
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-23



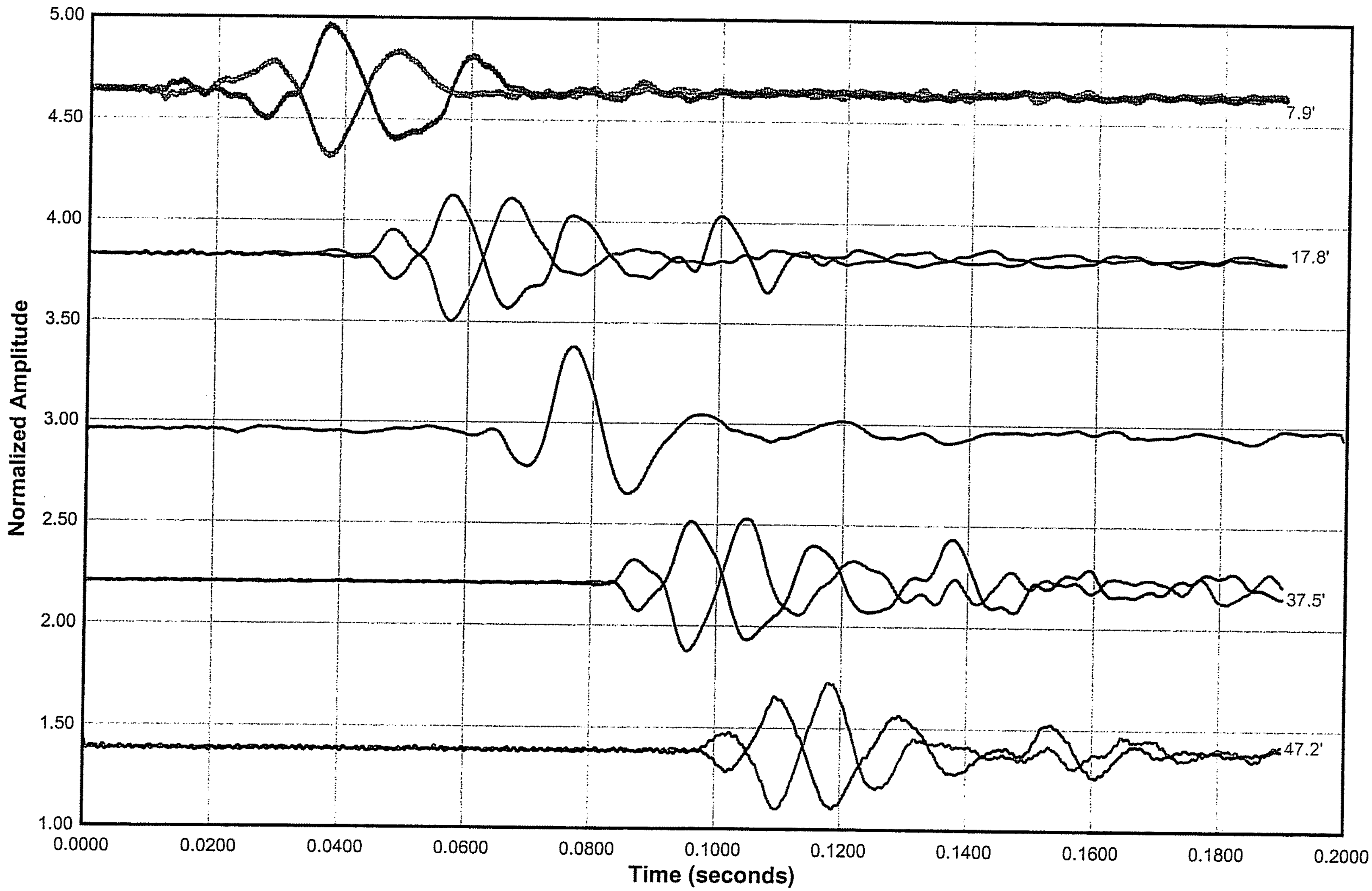
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-24



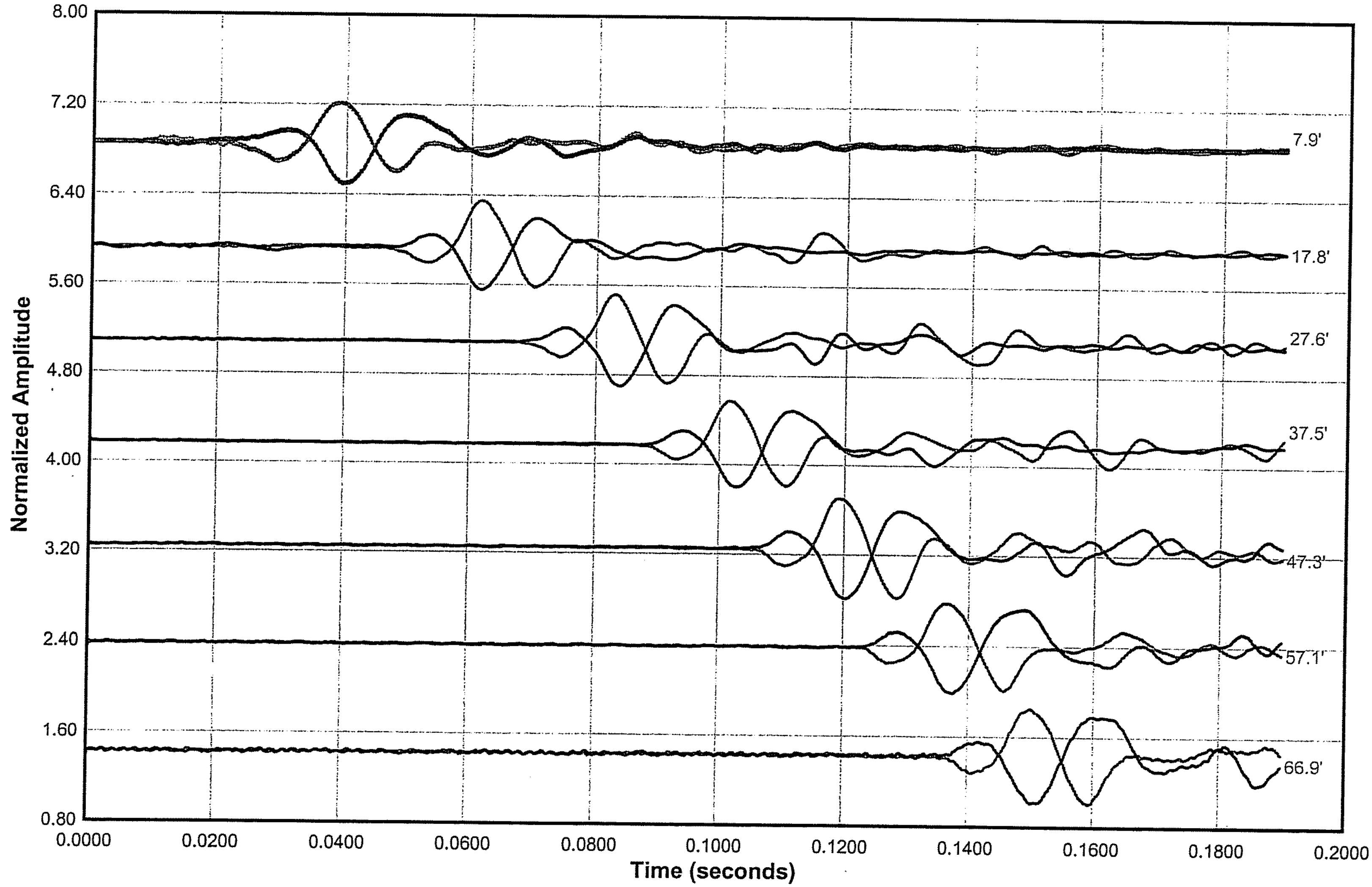
PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-25



PolyMet Tailings Basin
AET Project No. 01-03612
Sounding 07-26



PolyMet Tailings Basine
AET Project No. 01-03612
Sounding 07-27



Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-01

Transducer Offset (in) 23.0 center of the transducers from the probe tip

Source Offset Distance 48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.71	0.01520	7.8	8.76	576.31	
19.43	0.02650	17.5	17.96	677.90	815
29.12	0.03830	27.2	27.50	717.91	808
39.40	0.05010	37.5	37.70	752.42	864

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-02

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.74	0.02720	7.8	8.79	323.04	
19.44	0.04210	17.5	17.97	426.94	617
29.17	0.05820	27.3	27.55	473.29	594
39.32	0.07470	37.4	37.62	503.57	610
49.22	0.09160	47.3	47.47	518.25	583
59.08	0.10670	57.2	57.30	537.05	651
68.44	0.11980	66.5	66.64	556.29	713
78.83	0.13430	76.9	77.02	573.47	715

Wavespeed Calculation

Project: PolyMet
Project No.: 01--3612
Sounding: 07-03

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.76	0.03190	7.8	8.80	276.00	
19.50	0.05030	17.6	18.03	358.50	502
29.25	0.06970	27.3	27.62	396.33	494
39.00	0.08790	37.1	37.30	424.33	532
48.76	0.10480	46.8	47.01	448.61	575
58.50	0.12060	56.6	56.72	470.35	615
68.25	0.13450	66.3	66.45	494.08	700
72.95	0.13950	71.0	71.15	510.01	938

Wavespeed Calculation

Project: PolyMet
Project No.: 01-3612
Sounding: 07-04A

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.66	0.02590	7.7	8.72	336.50	
19.61	0.03340	17.7	18.14	543.11	1257

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-4B

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.75	0.02590	7.8	8.80	339.60	
19.67	0.03660	17.8	18.20	497.22	879
29.47	0.04580	27.6	27.84	607.91	1048
39.32	0.05800	37.4	37.62	648.56	801
49.80	0.06970	47.9	48.05	689.38	892
59.02	0.08450	57.1	57.24	677.44	621

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-05

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.72	0.02200	7.8	8.77	398.58	
19.44	0.03700	17.5	17.97	485.79	614
29.16	0.05240	27.2	27.54	525.49	621
38.86	0.06670	36.9	37.16	557.11	673
49.01	0.07940	47.1	47.26	595.25	796
58.72	0.09390	56.8	56.94	606.43	668
68.44	0.10780	66.5	66.64	618.21	698
78.49	0.12110	76.6	76.68	633.18	754
88.23	0.13430	86.3	86.41	643.38	737
98.43	0.15140	96.5	96.60	638.02	596

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-06

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
10.13	0.03570	8.2	9.14	255.90	
19.85	0.05780	17.9	18.37	317.89	418
29.58	0.07740	27.7	27.95	361.12	489
40.29	0.09780	38.4	38.58	394.49	521
49.00	0.11270	47.1	47.25	419.28	582
58.73	0.12830	56.8	56.95	443.91	622
68.45	0.14270	66.5	66.65	467.09	674

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-07B

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.74	0.02270	7.8	8.79	387.08	
19.45	0.03120	17.5	17.98	576.40	1082
29.48	0.04300	27.6	27.85	647.72	836

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-07C

Transducer Offset (in)	23.0	center of the transducers from the probe tip
Source Offset Distance (	48.0	center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.72	0.01930	7.8	8.77	454.34	
19.41	0.02840	17.5	17.94	631.86	1008
29.12	0.04020	27.2	27.50	683.98	809
39.44	0.05160	37.5	37.74	731.32	898
49.34	0.06370	47.4	47.59	747.12	815

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-08

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.98	0.02330	8.1	9.00	386.31	
19.70	0.03700	17.8	18.23	492.64	673
29.44	0.05090	27.5	27.81	546.41	690
39.15	0.06550	37.2	37.45	571.72	660
58.63	0.09480	56.7	56.85	599.73	662
68.60	0.10930	66.7	66.80	611.19	686
76.86	0.11910	74.9	75.05	630.14	842

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-09

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance 48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.78	0.03420	7.9	8.82	257.96	
19.53	0.05260	17.6	18.06	343.38	502
29.31	0.07020	27.4	27.68	394.36	547
31.00	0.07340	29.1	29.36	399.96	523
39.04	0.08730	37.1	37.34	427.70	574

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-10

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.75	0.03490	7.8	8.80	252.02	
19.49	0.05880	17.6	18.02	306.51	386
29.24	0.07980	27.3	27.61	346.05	457
39.84	0.10180	37.9	38.13	374.59	478

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-11

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.64	0.01090	7.7	8.70	797.95	
20.38	0.03320	18.5	18.89	569.03	457
29.48	0.05070	27.6	27.85	549.35	512
39.44	0.06840	37.5	37.74	551.69	558

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-12

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.77	0.01880	7.9	8.81	468.79	
19.53	0.03320	17.6	18.06	544.03	642
29.50	0.05090	27.6	27.87	547.58	554
39.41	0.06820	37.5	37.71	552.88	568

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-14

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.74	0.02990	7.8	8.79	293.87	
19.48	0.04870	17.6	18.01	369.88	491
29.49	0.06030	27.6	27.86	462.06	849
39.31	0.07450	37.4	37.61	504.79	686
49.19	0.08700	47.3	47.44	545.31	787
59.08	0.09840	57.2	57.30	582.35	865
68.78	0.10740	66.9	66.98	623.68	1076
78.68	0.11730	76.8	76.87	655.31	998
88.43	0.12720	86.5	86.61	680.86	984
98.17	0.13760	96.3	96.34	700.12	936

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-15

Transducer Offset (in)	23.0	center of the transducers from the probe tip
Source Offset Distance (	48.0	center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.73	0.01520	7.8	8.78	577.48	
19.46	0.02720	17.5	17.99	661.53	768
29.61	0.04000	27.7	27.98	699.52	780
39.31	0.05280	37.4	37.61	712.25	752
49.22	0.06720	47.3	47.47	706.43	685
59.63	0.08130	57.7	57.85	711.58	736
68.62	0.09300	66.7	66.82	718.53	767
78.93	0.10650	77.0	77.12	724.10	763
88.52	0.11830	86.6	86.70	732.85	812
98.21	0.12980	96.3	96.38	742.50	842

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-16

Transducer Offset (in)	23.0	center of the transducers from the probe tip
Source Offset Distance (	48.0	center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.82	0.02440	7.9	8.86	363.03	
19.68	0.03980	17.8	18.21	457.49	607
29.50	0.05260	27.6	27.87	529.88	755
39.40	0.06460	37.5	37.70	583.53	819
49.21	0.07470	47.3	47.46	635.37	967
58.99	0.08410	57.1	57.21	680.30	1037
68.82	0.09390	66.9	67.02	713.77	1001
78.64	0.10400	76.7	76.83	738.73	971
88.58	0.11470	86.7	86.76	756.37	928
98.73	0.12410	96.8	96.90	780.79	1079

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-17

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.83	0.03140	7.9	8.87	282.38	
19.64	0.04710	17.7	18.17	385.76	593
29.49	0.06240	27.6	27.86	446.51	634
39.38	0.07790	37.5	37.68	483.65	633
49.21	0.09130	47.3	47.46	519.85	730
59.00	0.10310	57.1	57.22	555.03	827
68.83	0.11540	66.9	67.03	580.87	798
78.69	0.12830	76.8	76.88	599.20	763
88.52	0.13950	86.6	86.70	621.47	877
98.41	0.15200	96.5	96.58	635.37	790
108.21	0.16320	106.3	106.37	651.77	874
117.98	0.175	116.1	116.13	663.61	827
127.95	0.1851	126.0	126.10	681.24	987

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-18

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.85	0.02980	7.9	8.88	298.14	
19.68	0.04690	17.8	18.21	388.23	545
29.56	0.06320	27.6	27.93	441.95	597
39.68	0.07830	37.8	37.97	484.99	665
49.21	0.09220	47.3	47.46	514.77	683
59.22	0.10540	57.3	57.44	545.00	756
68.90	0.11820	67.0	67.10	567.70	755
78.70	0.13100	76.8	76.89	586.93	764
88.61	0.14490	86.7	86.79	598.93	712
98.41	0.15540	96.5	96.58	621.47	932
108.30	0.16780	106.4	106.46	634.44	797
118.01	0.1783	116.1	116.16	651.50	924
128.08	0.1899	126.2	126.23	664.70	868

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-19

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance ı 48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.84	0.02990	7.9	8.88	296.85	
19.76	0.04740	17.8	18.29	385.78	538
29.48	0.06568	27.6	27.85	424.06	523
39.40	0.08236	37.5	37.70	457.70	590
49.21	0.09746	47.3	47.46	486.99	647
58.99	0.11123	57.1	57.21	514.37	708
68.86	0.12470	66.9	67.06	537.79	731
78.68	0.13880	76.8	76.87	553.80	695
88.63	0.15100	86.7	86.81	574.87	815
98.46	0.16390	96.5	96.63	589.54	761
108.21	0.17610	106.3	106.37	604.02	799
118.1	0.1875	116.2	116.25	620.01	867
127.9	0.1989	126.0	126.05	633.72	859

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-20

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.79	0.02720	7.9	8.83	324.67	
19.57	0.04360	17.7	18.10	415.16	565
29.28	0.06120	27.4	27.65	451.87	543
39.30	0.07510	37.4	37.60	500.62	715
49.17	0.09070	47.3	47.42	522.85	630
59.59	0.10160	57.7	57.81	569.01	953
68.88	0.11020	67.0	67.08	608.74	1078
78.76	0.11590	76.8	76.95	663.91	1731

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-21

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.84	0.03080	7.9	8.88	288.17	
19.76	0.04750	17.8	18.29	384.97	563
29.48	0.06400	27.6	27.85	435.19	580
39.40	0.08030	37.5	37.70	469.44	604
49.21	0.09630	47.3	47.46	492.86	610
58.99	0.11120	57.1	57.21	514.51	654
68.86	0.12600	66.9	67.06	532.24	665
78.68	0.14000	76.8	76.87	549.05	700
88.63	0.15290	86.7	86.81	567.73	770
98.46	0.16580	96.5	96.63	582.79	761
108.21	0.17750	106.3	106.37	599.26	833
118.1	0.1896	116.2	116.25	613.14	817
127.9	0.2005	126.0	126.05	628.66	899
137.7	0.2122	135.8	135.84	640.16	837
147.6	0.2223	145.7	145.74	655.59	980
157.47	0.2332	155.6	155.60	667.26	905
167.18	0.2446	165.3	165.31	675.85	851

Wavespeed Calculation

Project: PolyMet
Project No.: 01-03612
Sounding: 07-22

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance 48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.82		7.9	8.86		
19.69		17.8	18.22		
29.52		27.6	27.89		
30.56	0.07670	28.6	28.92		
39.38	0.08870	37.5	37.68	424.76	730
49.24	0.10240	47.3	47.49	463.79	716
59.01	0.11770	57.1	57.23	486.26	637
68.89	0.13100	67.0	67.09	512.16	741
78.71	0.14460	76.8	76.90	531.79	721
88.52	0.15760	86.6	86.70	550.10	754
98.44	0.17060	96.5	96.61	566.27	762
108.21	0.182	106.3	106.37	584.44	856
118.03	0.1947	116.1	116.18	596.72	773
127.86	0.2067	125.9	126.01	609.61	819
137.74	0.2174	135.8	135.88	625.03	923
147.6	0.2288	145.7	145.74	636.97	865
157.74	0.2412	155.8	155.87	646.25	817

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-23

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.85	0.03010	7.9	8.88	295.17	
20.35	0.04760	18.4	18.86	396.27	570
29.51	0.06200	27.6	27.88	449.71	626
39.40	0.07710	37.5	37.70	488.93	650
49.26	0.09060	47.3	47.51	524.42	727
59.01	0.10380	57.1	57.23	551.38	736
68.89	0.11650	67.0	67.09	575.90	776
78.75	0.12790	76.8	76.94	601.54	864
88.58	0.13890	86.7	86.76	624.59	893
97.51	0.14900	95.6	95.68	642.13	883

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-24

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.82	0.03980	7.9	8.86	222.56	
20.04	0.05830	18.1	18.56	318.34	524
29.55	0.07340	27.6	27.92	380.40	620
39.40	0.08850	37.5	37.70	425.95	647
49.22	0.10230	47.3	47.47	464.05	708
58.98	0.11470	57.1	57.20	498.72	785
68.88	0.12720	67.0	67.08	527.38	790
78.70	0.13890	76.8	76.89	553.55	838
88.58	0.15010	86.7	86.76	577.99	881
98.43	0.16020	96.5	96.60	602.97	974
108.26	0.17090	106.3	106.42	622.69	918
118.61	0.1817	116.7	116.76	642.61	958
127.91	0.192	126.0	126.06	656.55	902

Wavespeed Calculation

Project: PolyMet
Project No.: 01-3612
Sounding: 07-25

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance (48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
10.57	0.03380	8.7	9.53	282.04	
19.71	0.04650	17.8	18.24	392.20	685
29.51	0.05940	27.6	27.88	469.39	748
39.40	0.07280	37.5	37.70	517.80	732
49.18	0.08270	47.3	47.43	573.55	983
59.01	0.09390	57.1	57.23	609.51	875
68.90	0.10550	67.0	67.10	636.04	851
78.71	0.11500	76.8	76.90	668.67	1031
88.57	0.12420	86.7	86.75	698.43	1070
98.40	0.13480	96.5	96.57	716.37	926
108.30	0.14420	106.4	106.46	738.27	1052
117.98	0.1537	116.1	116.13	755.58	1018

Wavespeed Calculation

Project:	PolyMet
Project No.:	01-03612
Sounding:	07-26

Transducer Offset (in) 23.0 center of the transducers from the probe tip
Source Offset Distance ı 48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.82	0.03760	7.9	8.86	235.58	
19.69	0.05730	17.8	18.22	317.94	475
29.51	0.07680	27.6	27.88	363.04	496
39.40	0.09580	37.5	37.70	393.49	517
49.09	0.10970	47.2	47.34	431.56	694

Wavespeed Calculation

Project: PolyMet

Project No.: 01-03612

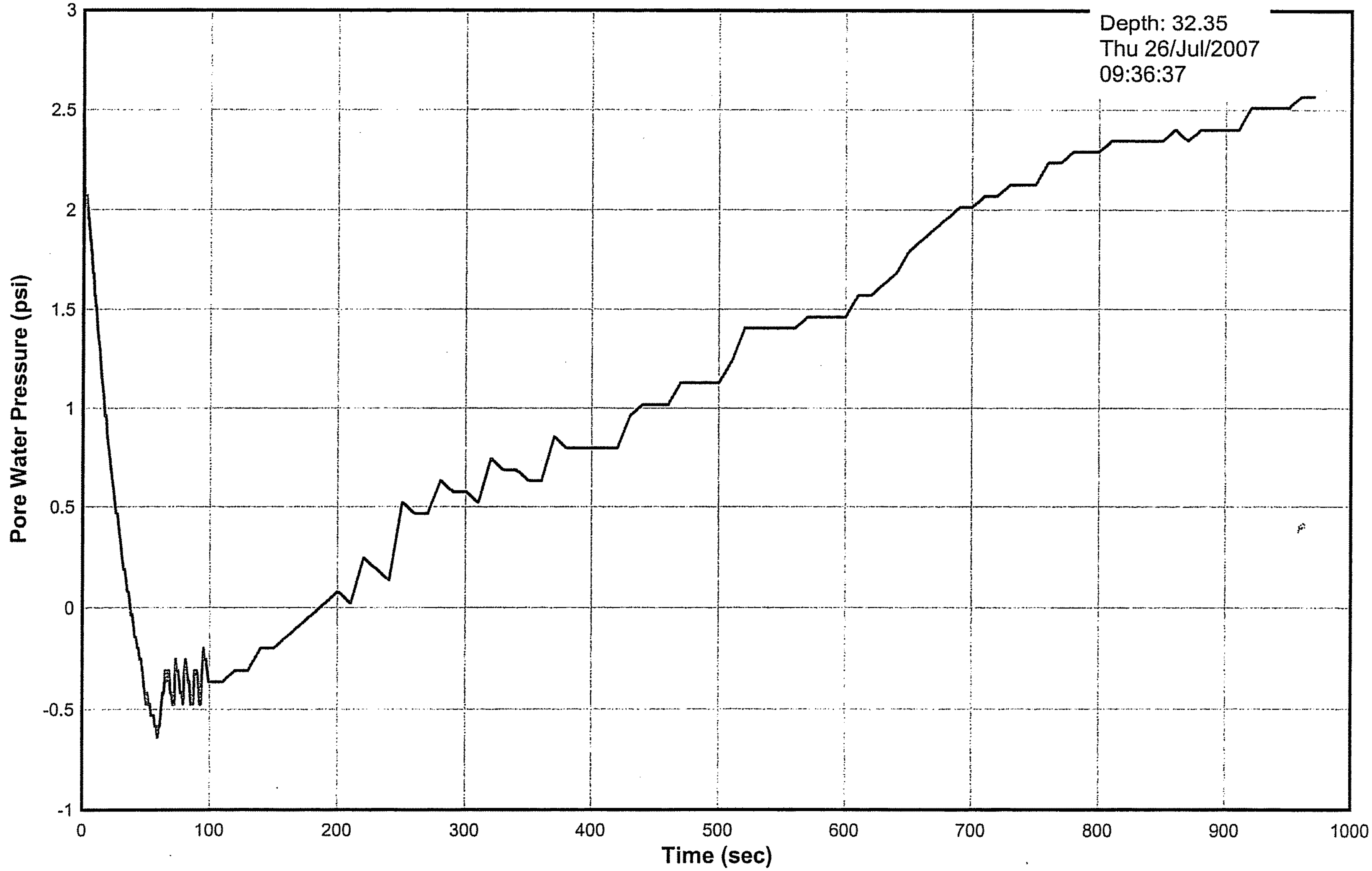
Sounding: 07-27

Transducer Offset (in) 23.0 center of the transducers from the probe tip

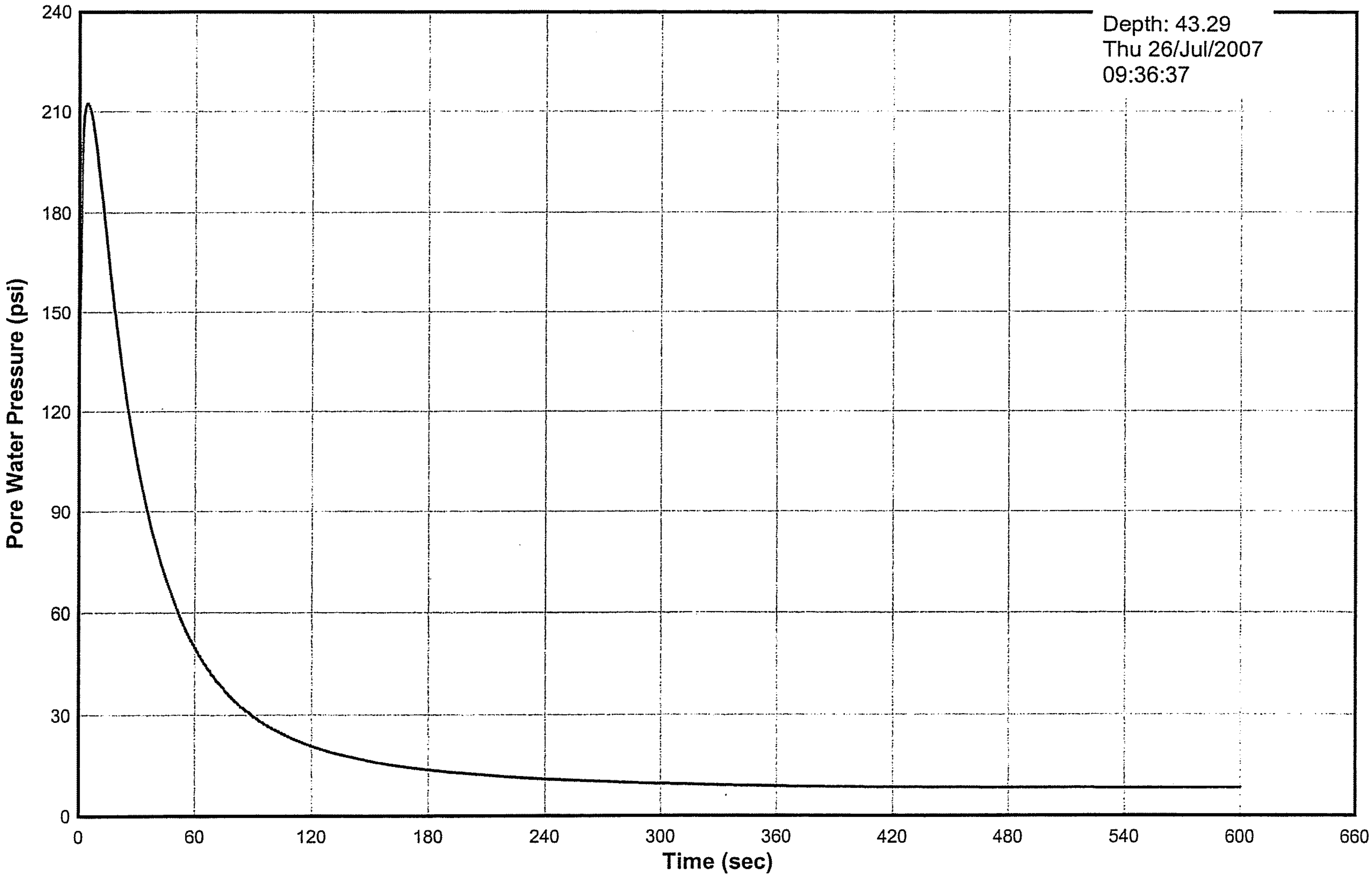
Source Offset Distance 48.0 center of the rod from edge of the source

Probe Depth (ft)	Arrival Time (s)	Trans. Depth (ft)	Travel Distance (ft)	Average Waves (ft/s)	Interval Wavespeed (ft/s)
9.81	0.03380	7.9	8.85	261.80	
19.68	0.05690	17.8	18.21	320.00	405
29.50	0.07810	27.6	27.87	356.87	456
39.41	0.09730	37.5	37.71	387.52	512
49.21	0.11510	47.3	47.46	412.36	548
58.99	0.13200	57.1	57.21	433.43	577
68.78	0.14500	66.9	66.98	461.95	752

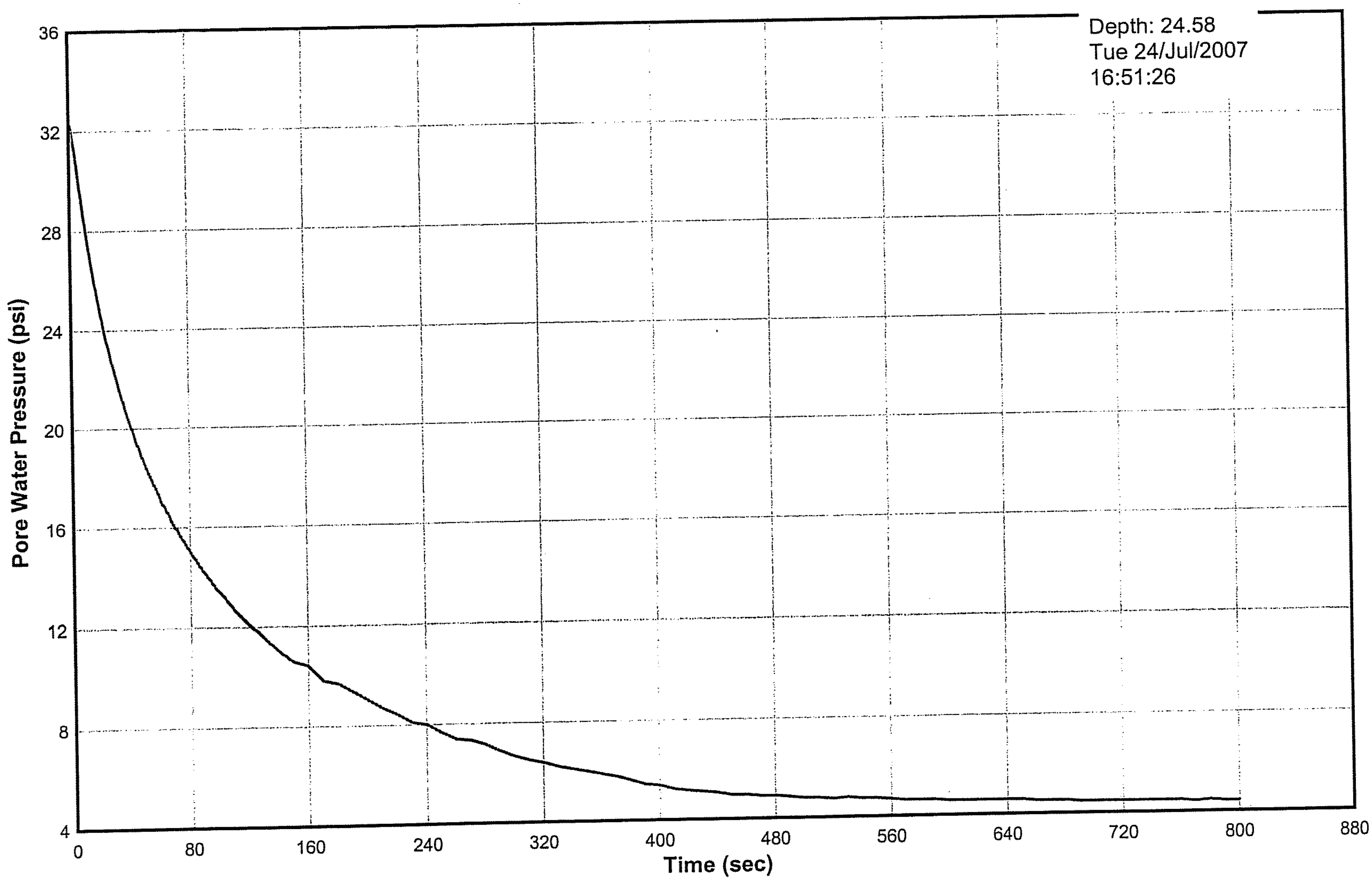
Pore Pressure Dissipation Test
Sounding 07-01
AET #01-03612



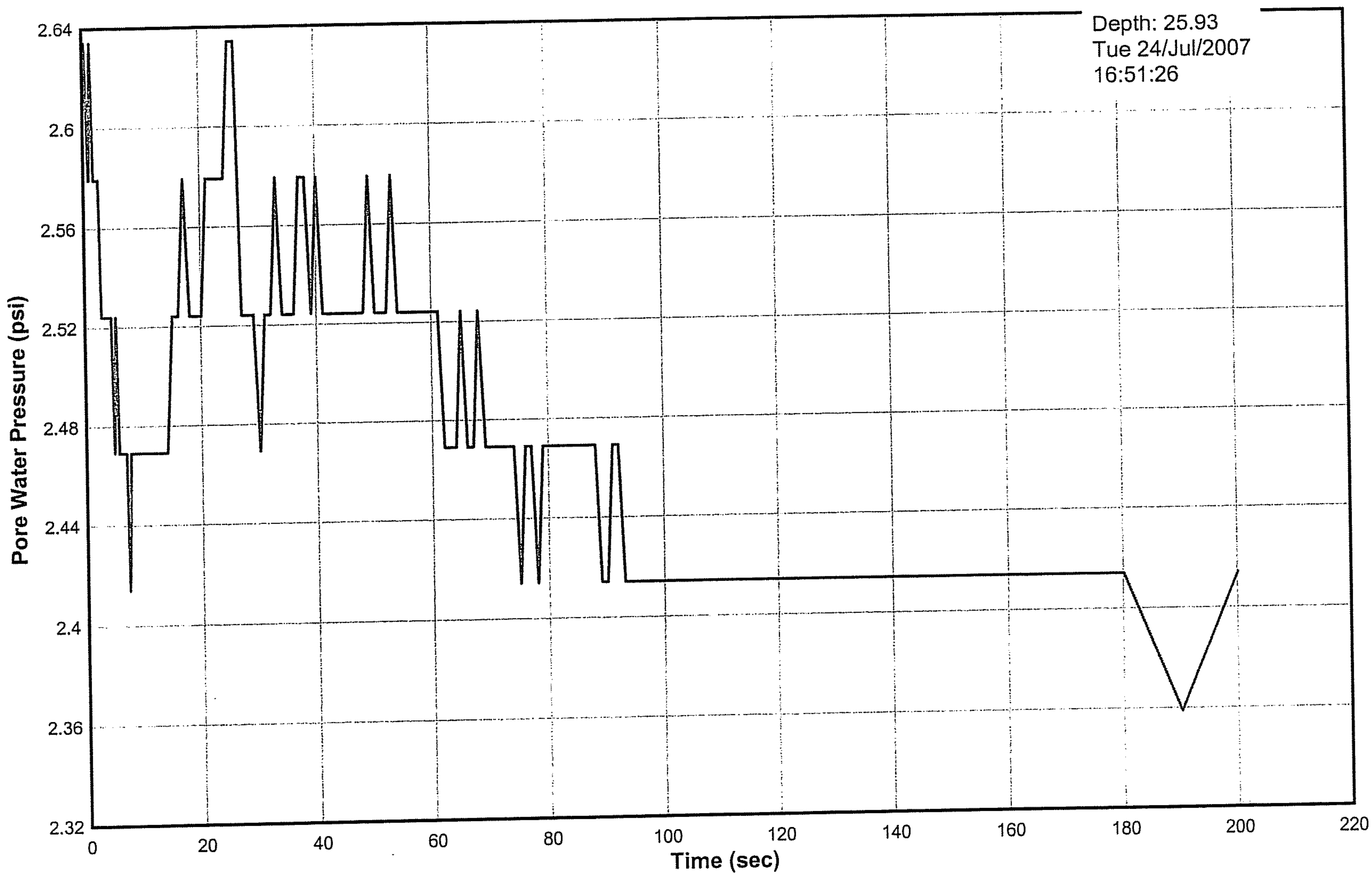
Pore Pressure Dissipation Test
Sounding 07-01
AET #01-03612



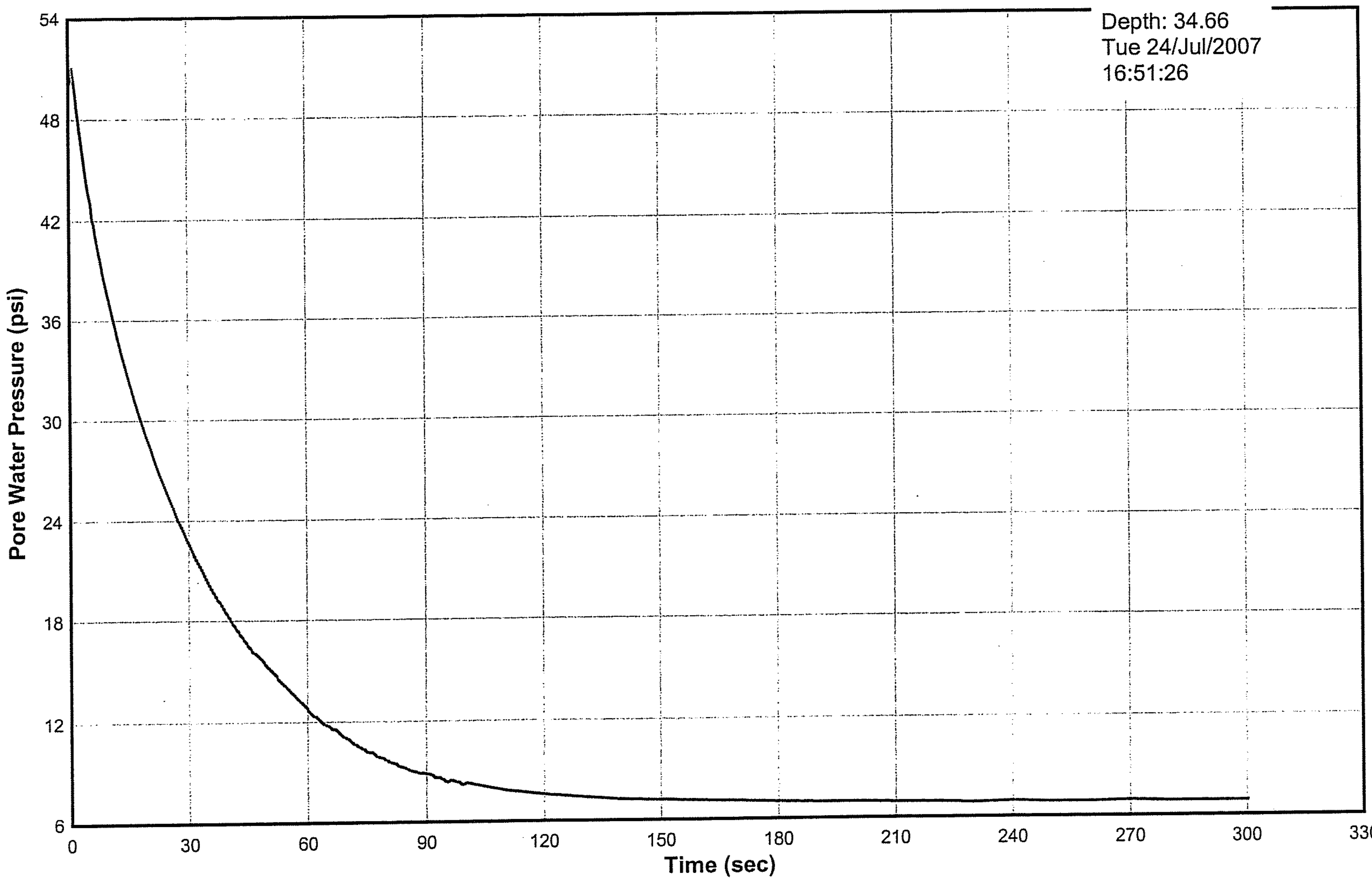
Pore Pressure Dissipation Test
Sounding 07-02
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-02
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-02
AET #01-03612



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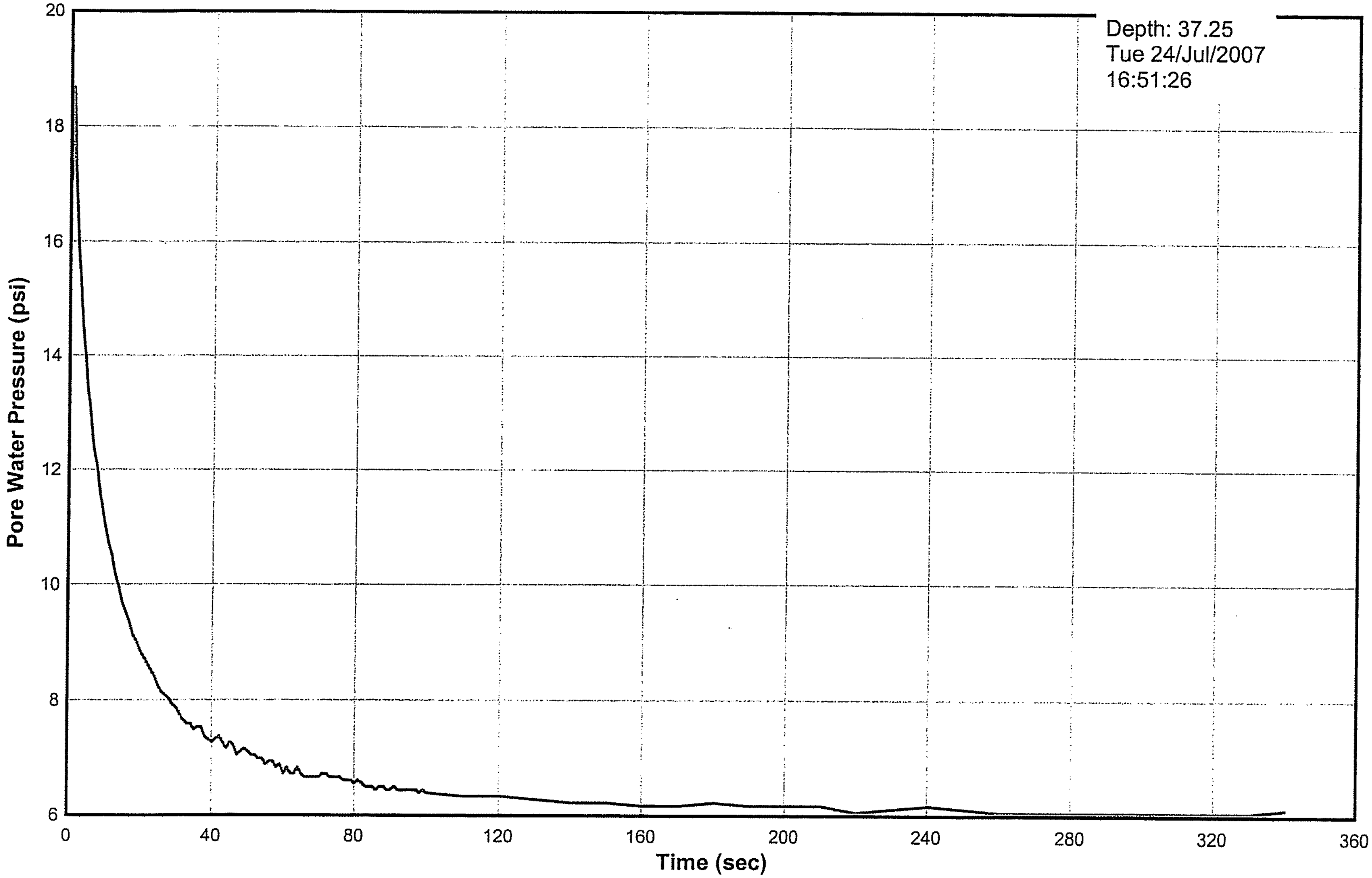
Sounding 07-02
AET #01-03612



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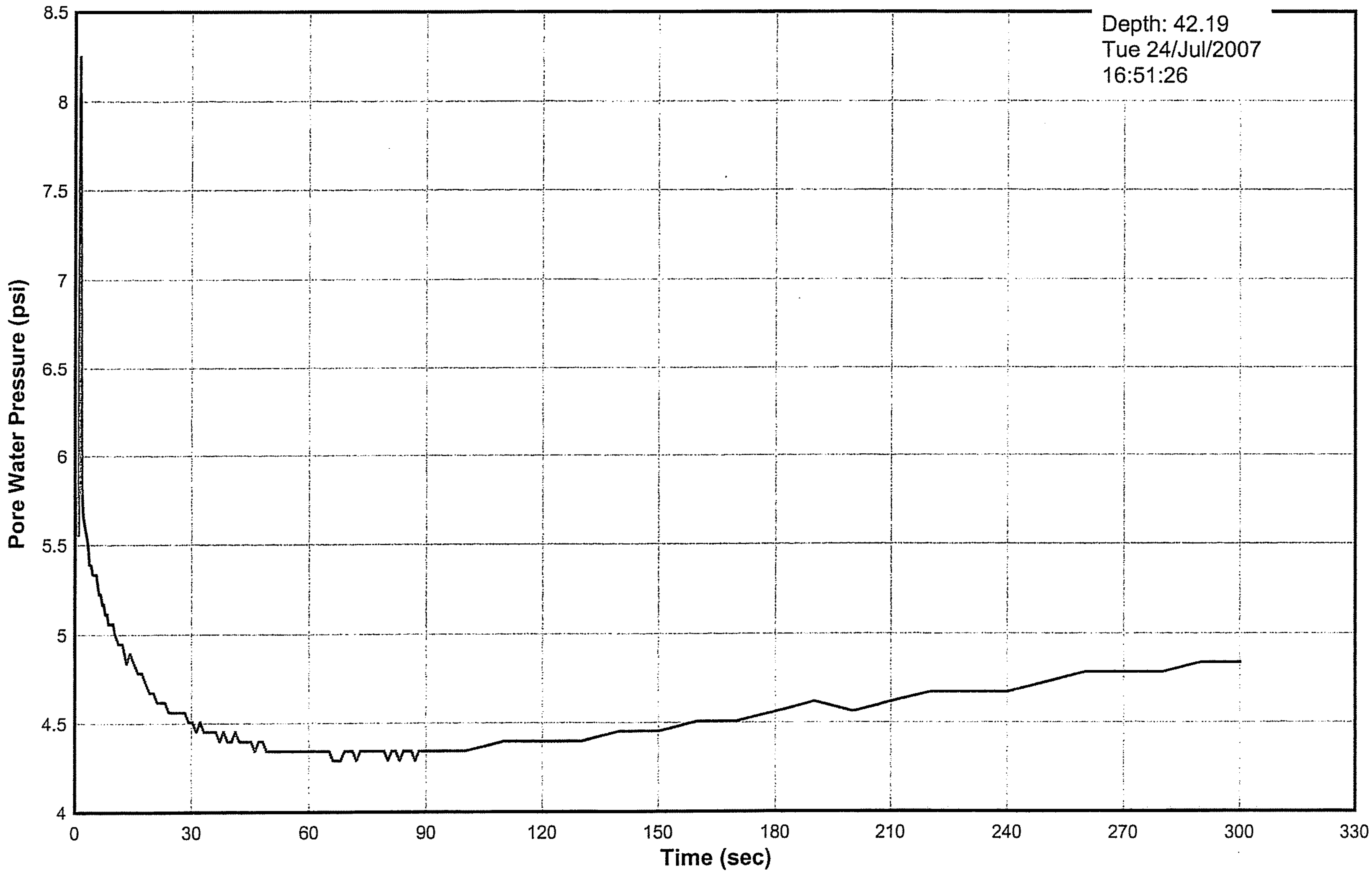
Sounding 07-02
AET #01-03612



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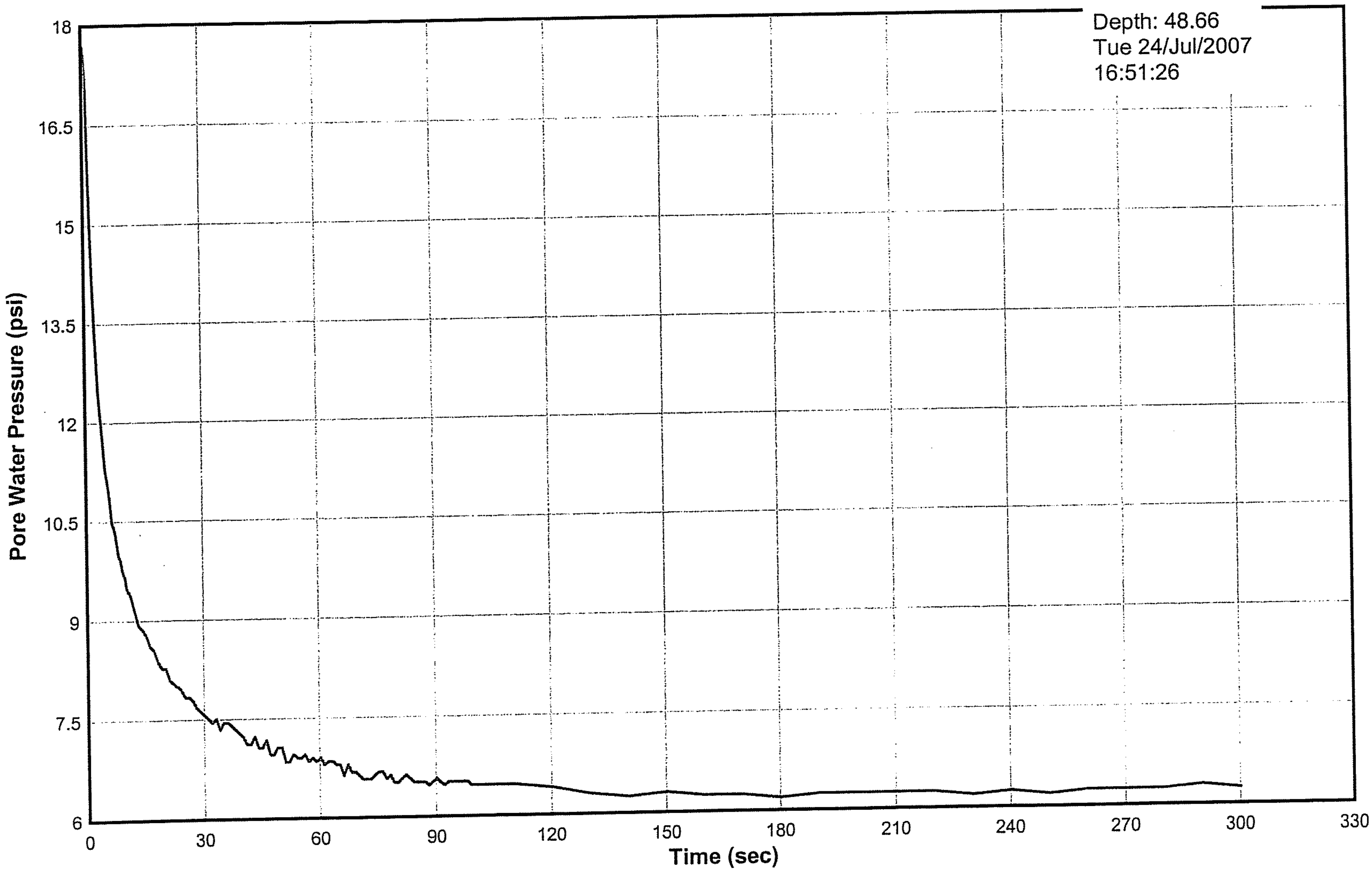

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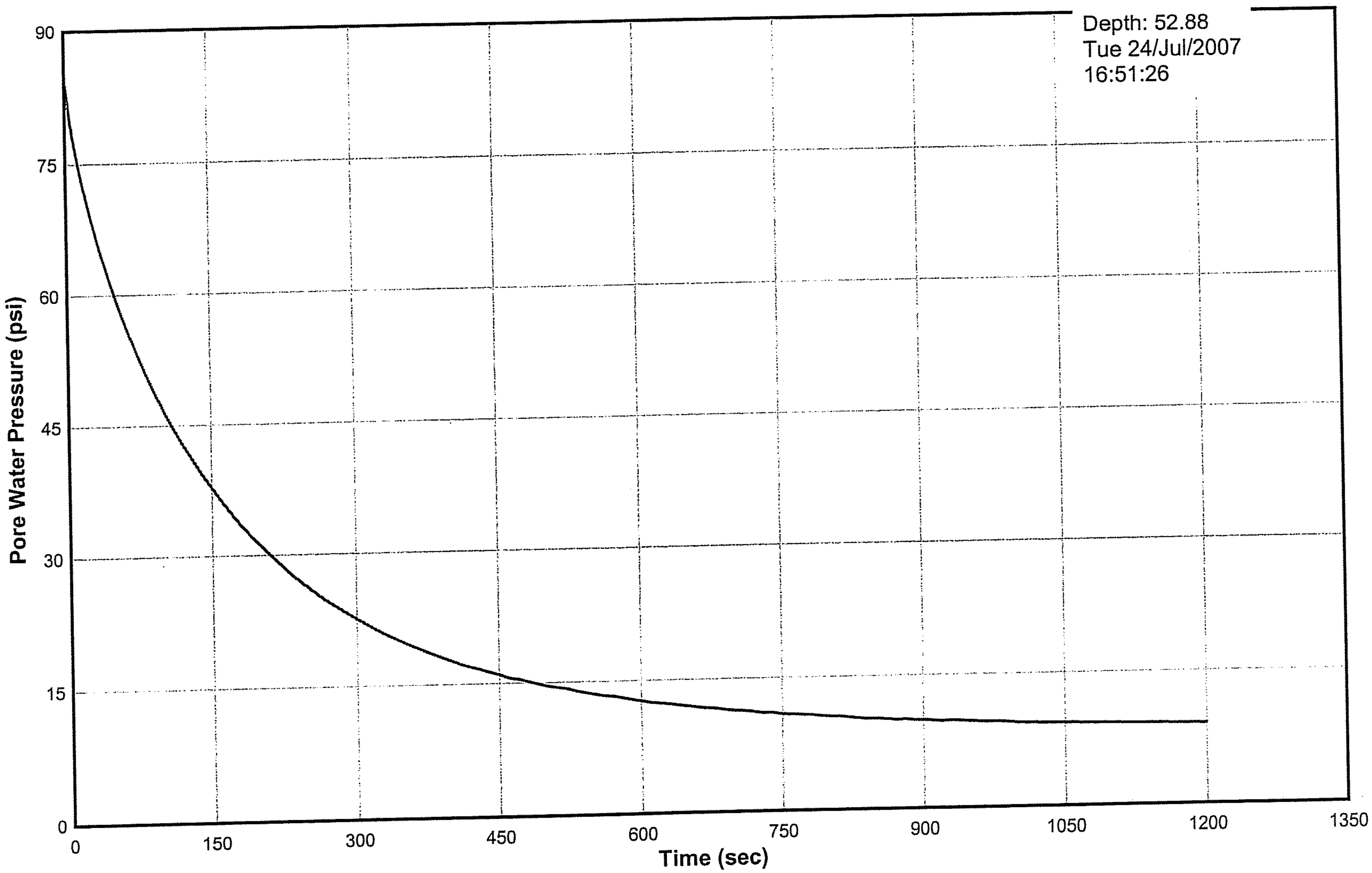
Sounding 07-02
AET #01-03612



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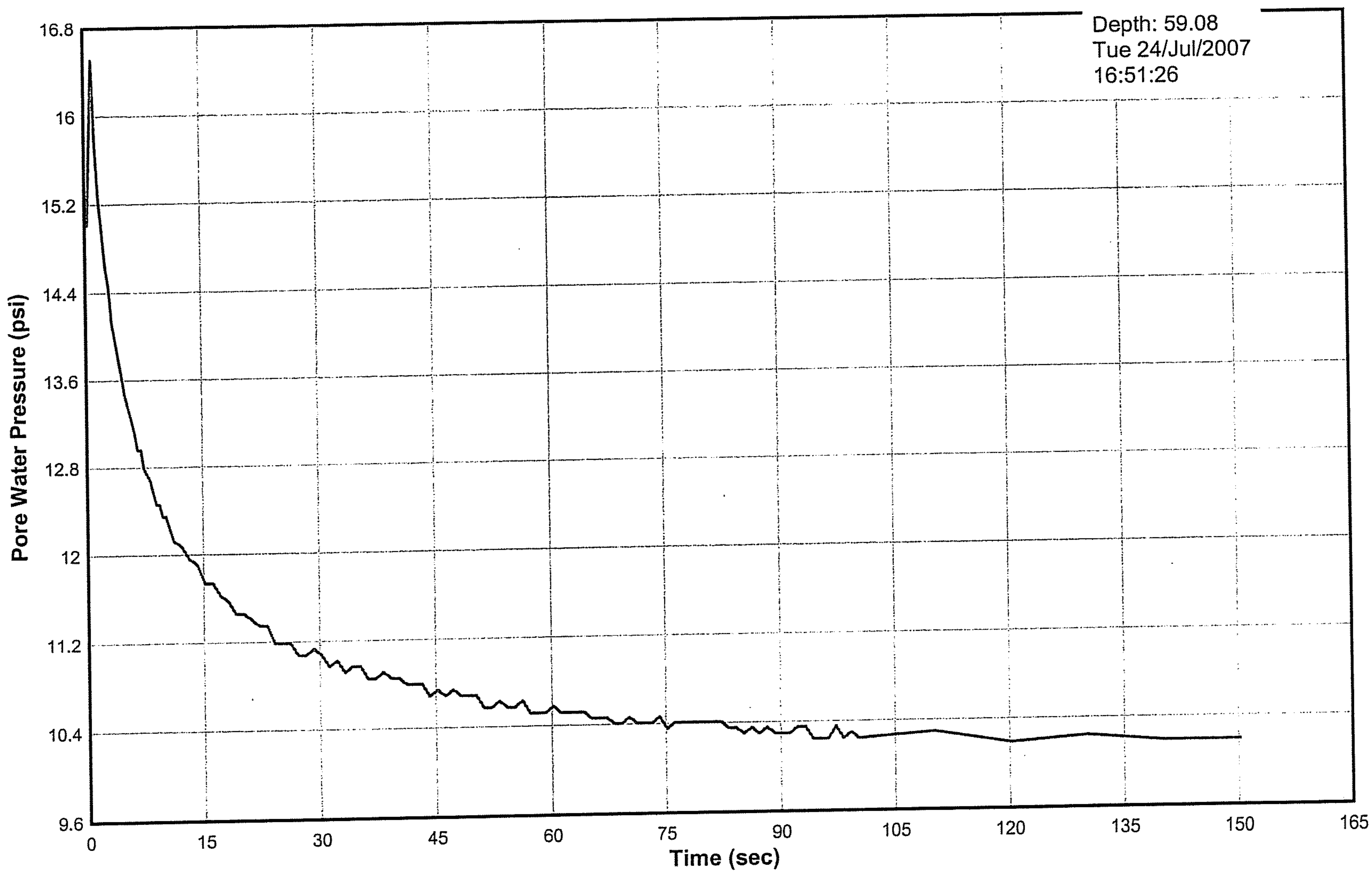

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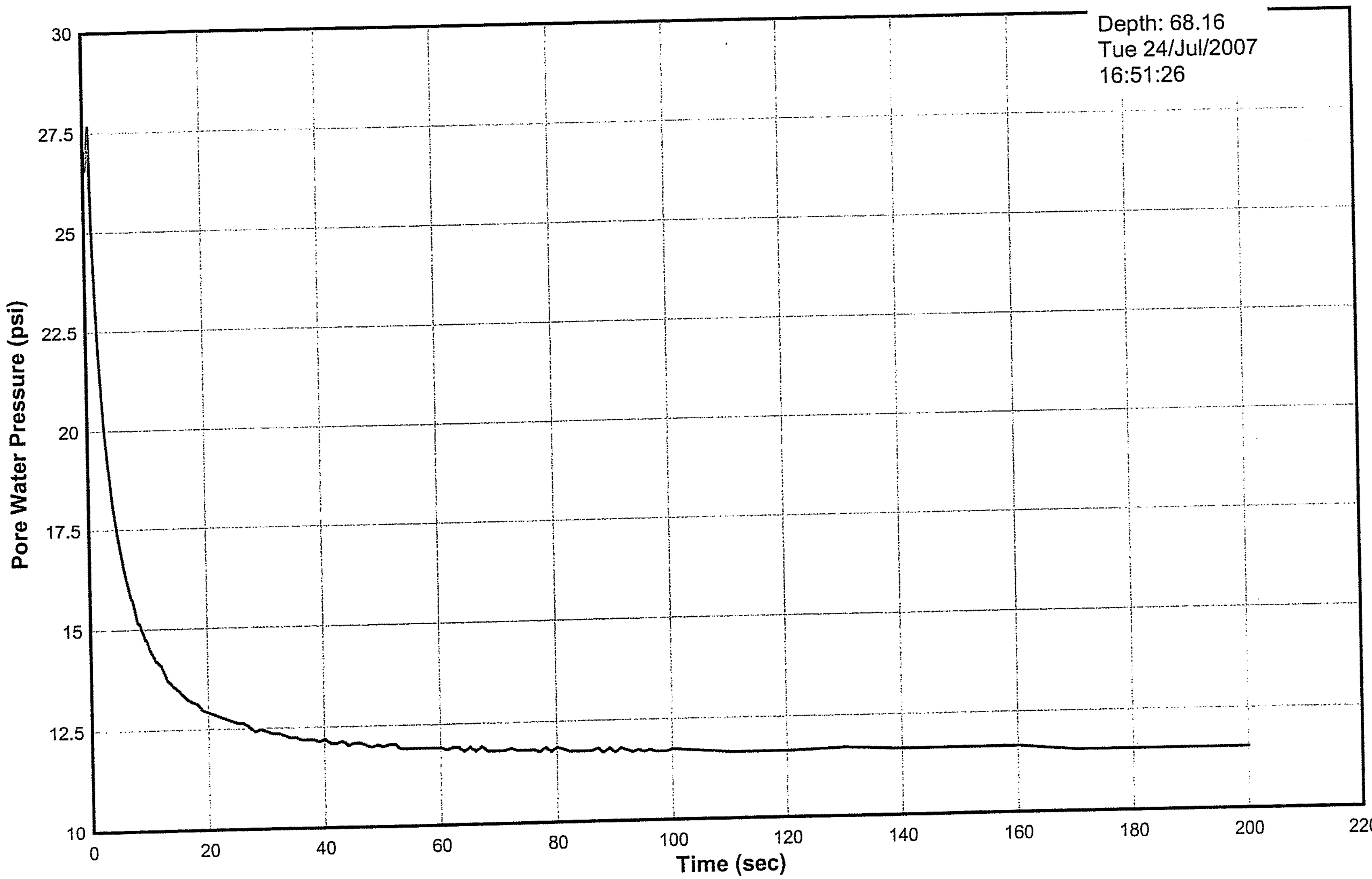

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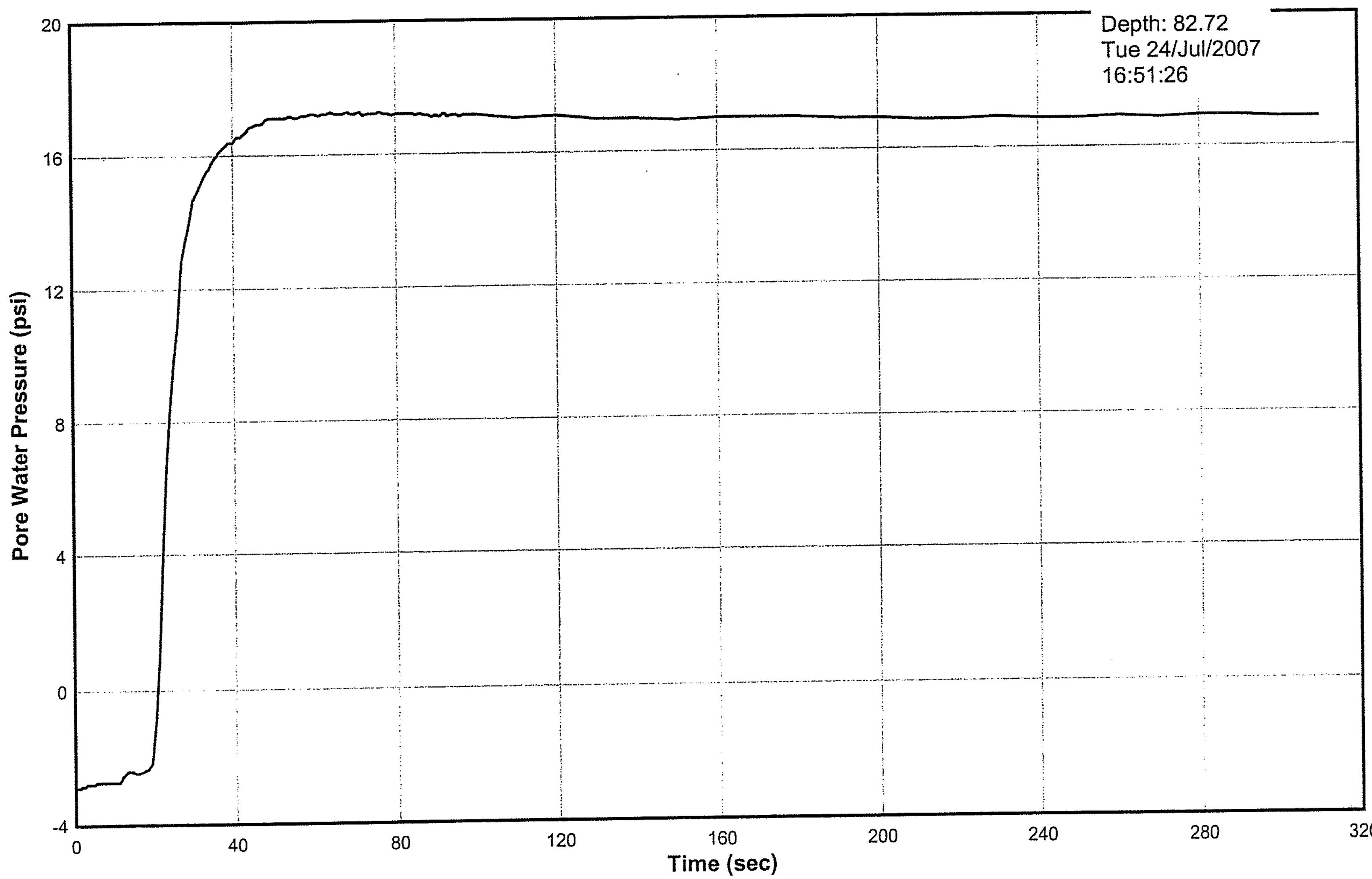
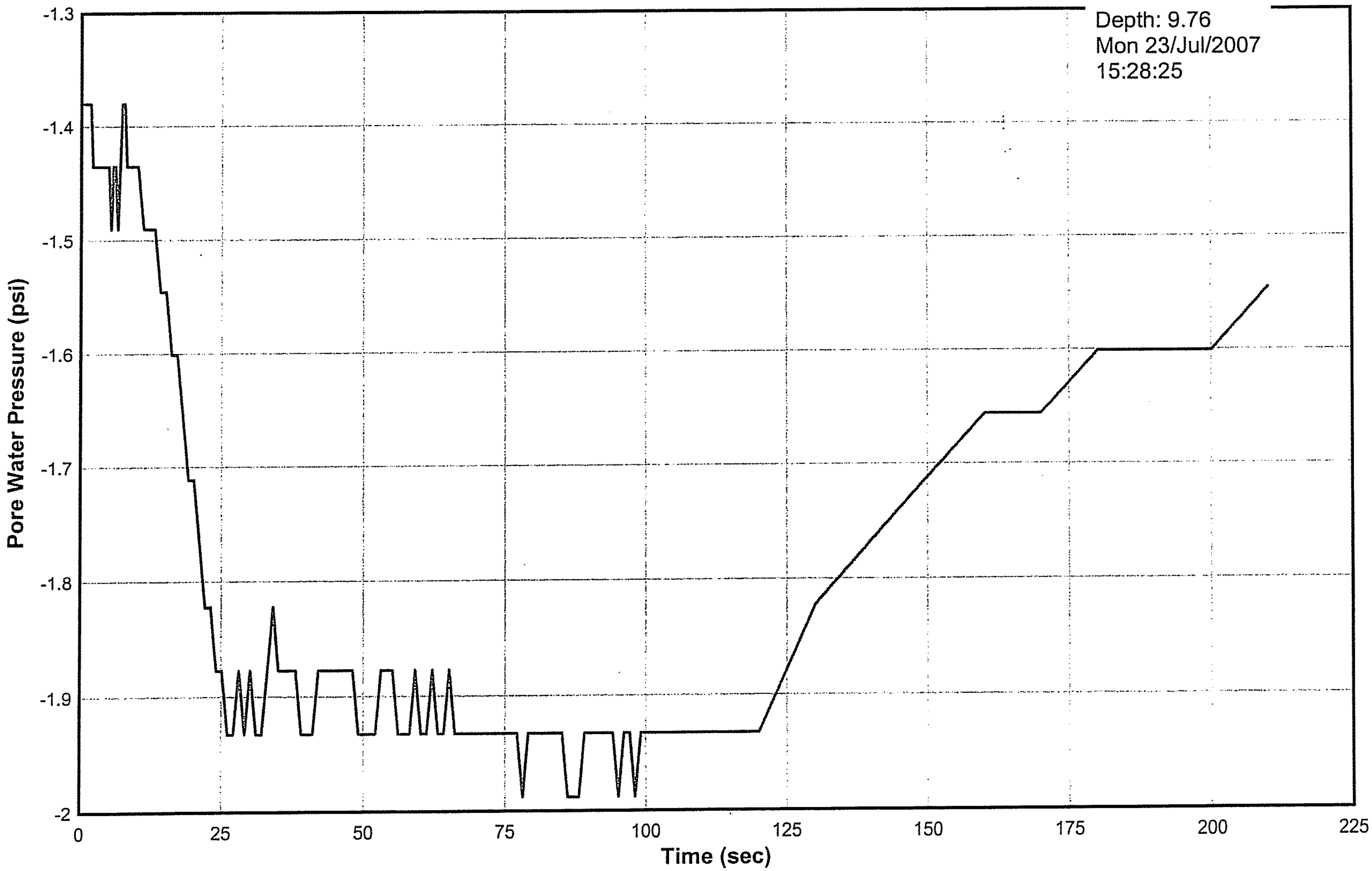
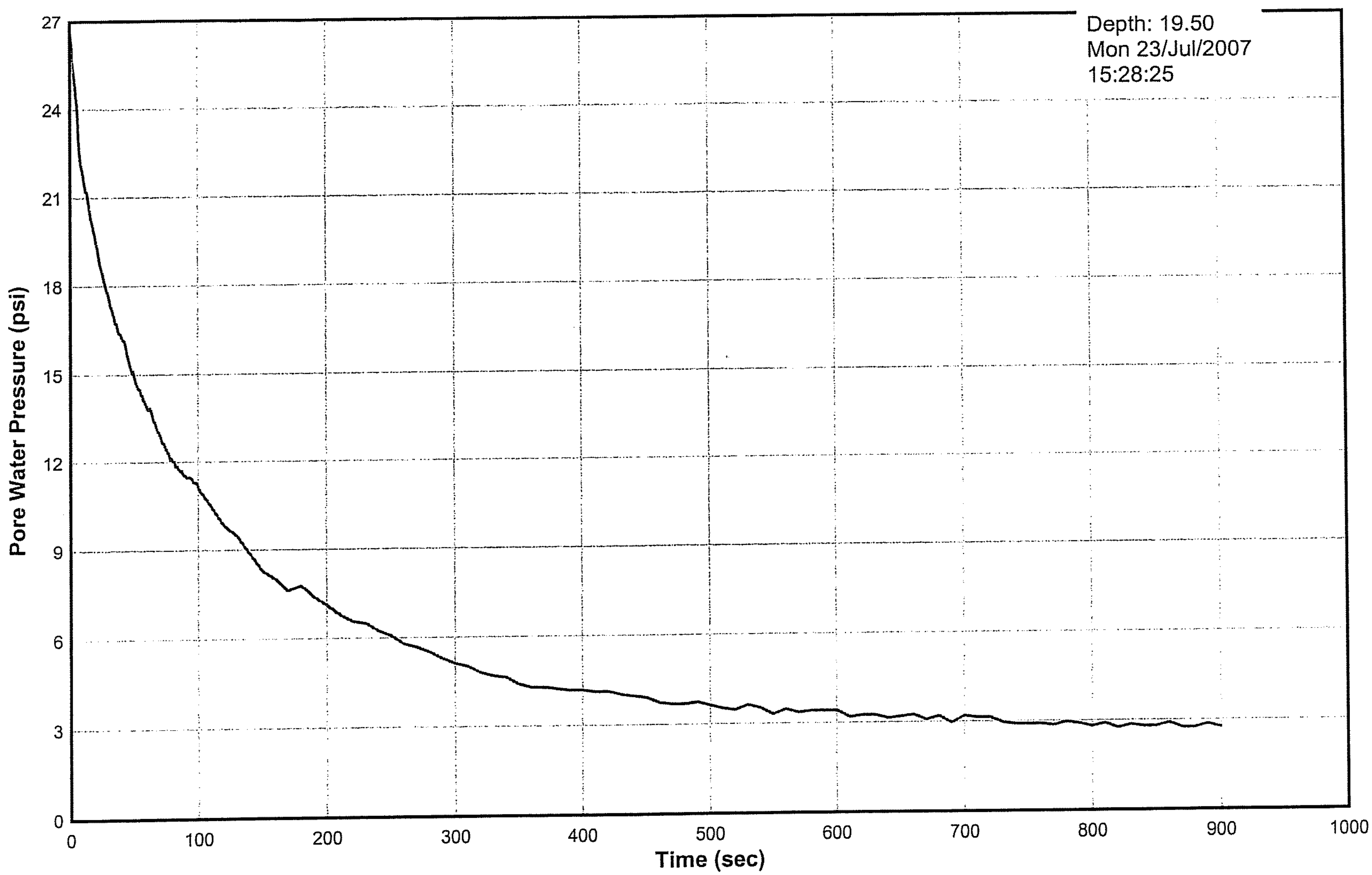
Sounding 07-02
AET #01-03612



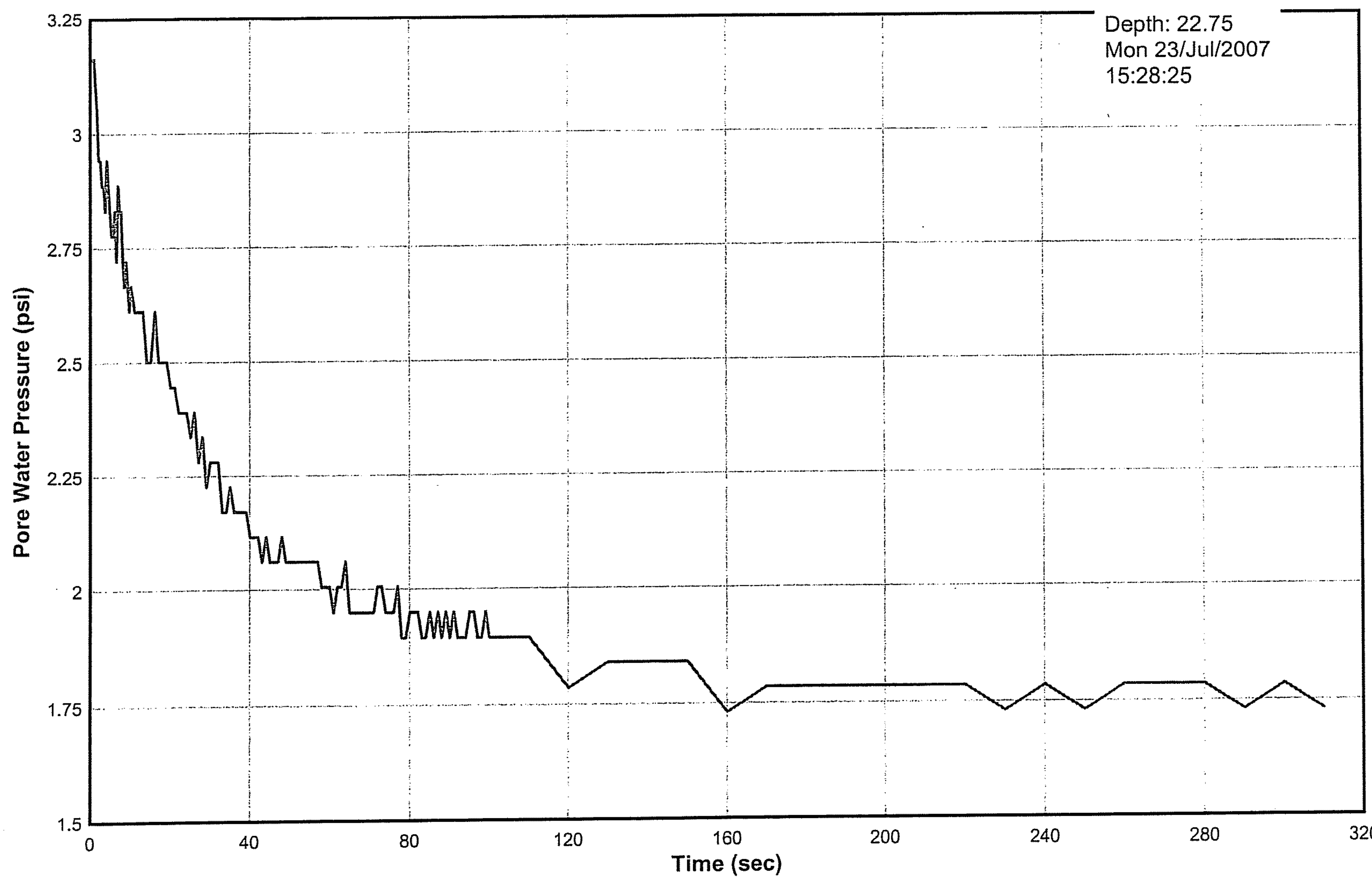
Pore Pressure Dissipation Test
Sounding 07-03
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-03
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-03
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-03
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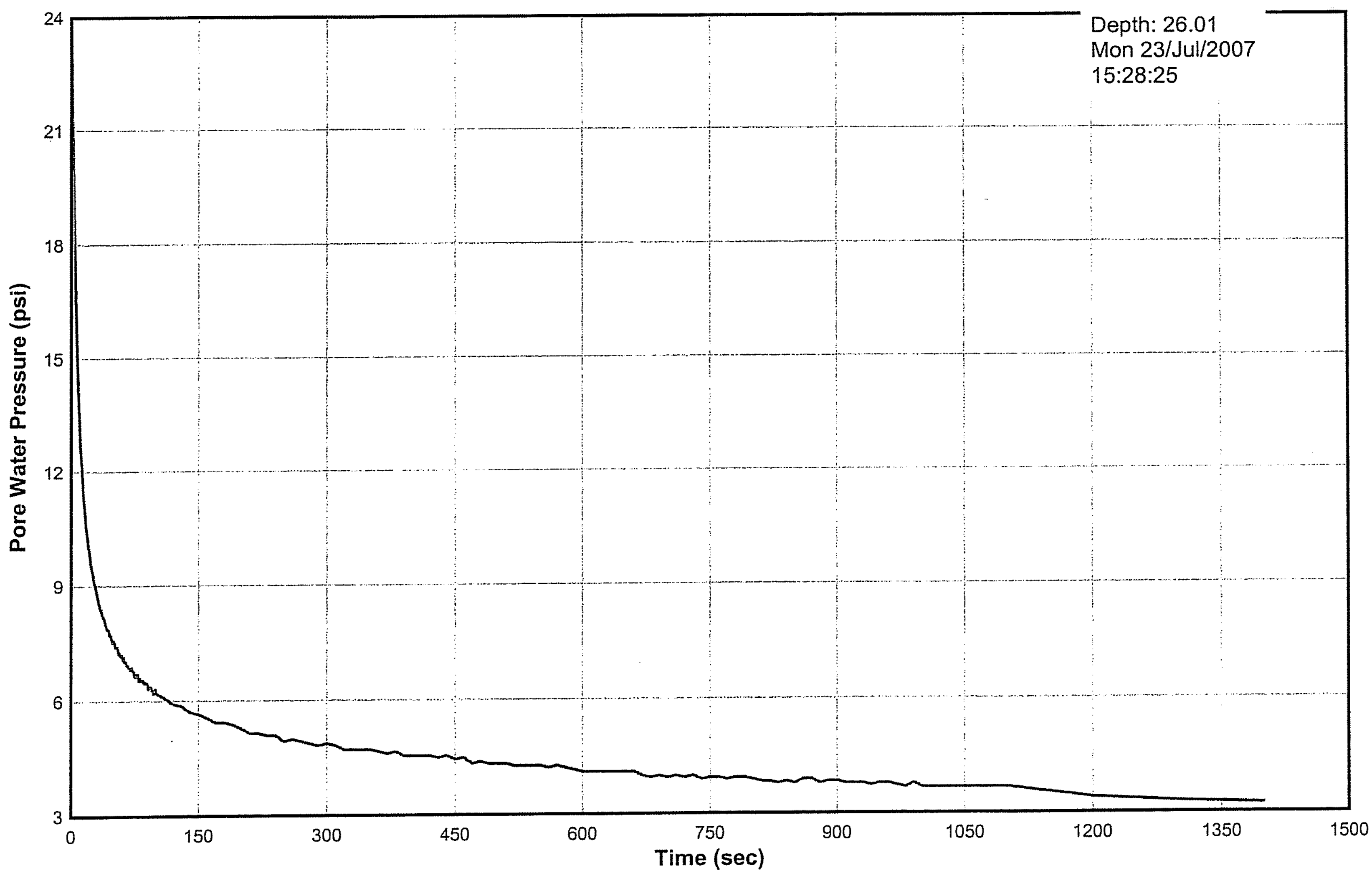
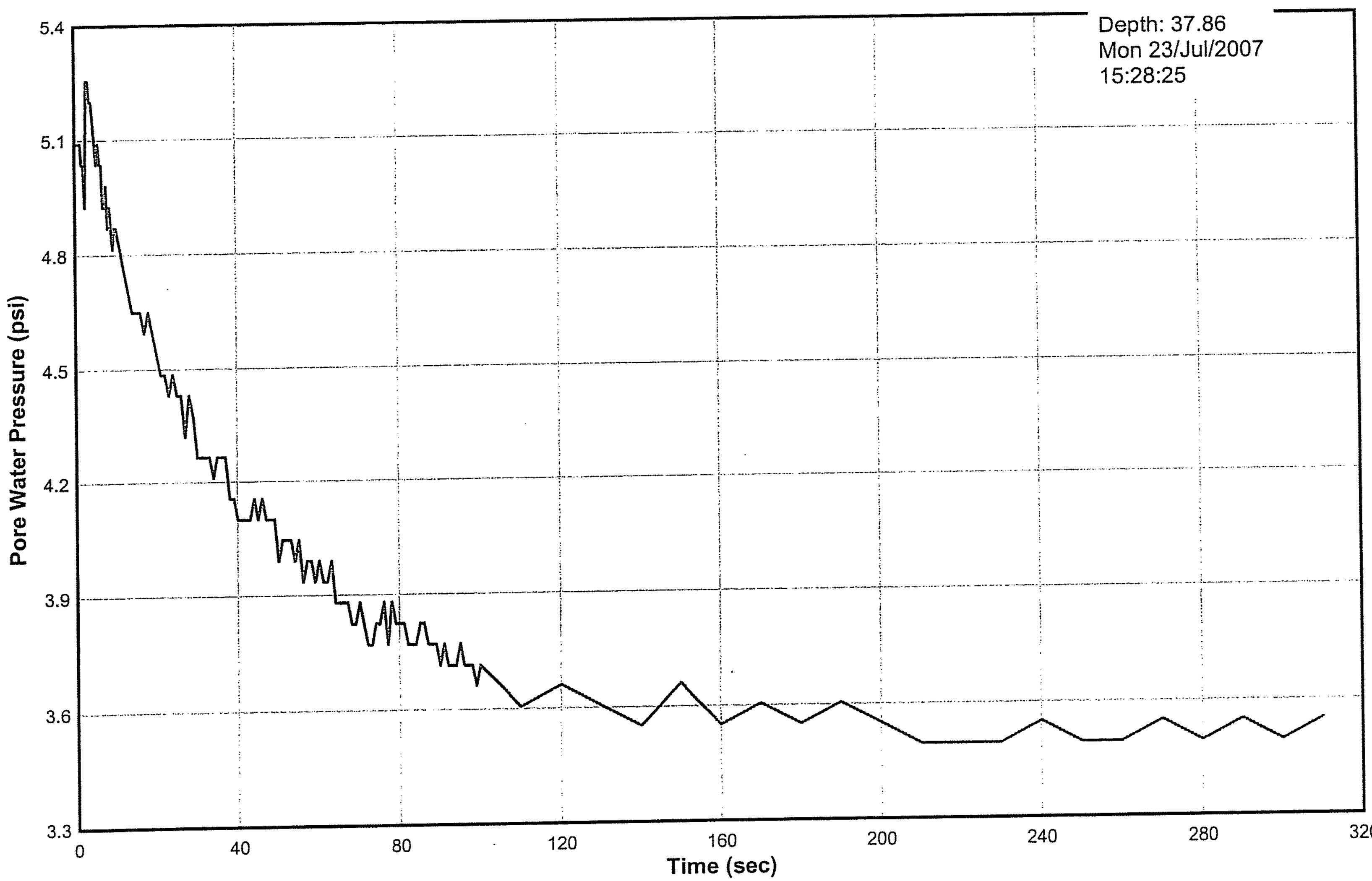
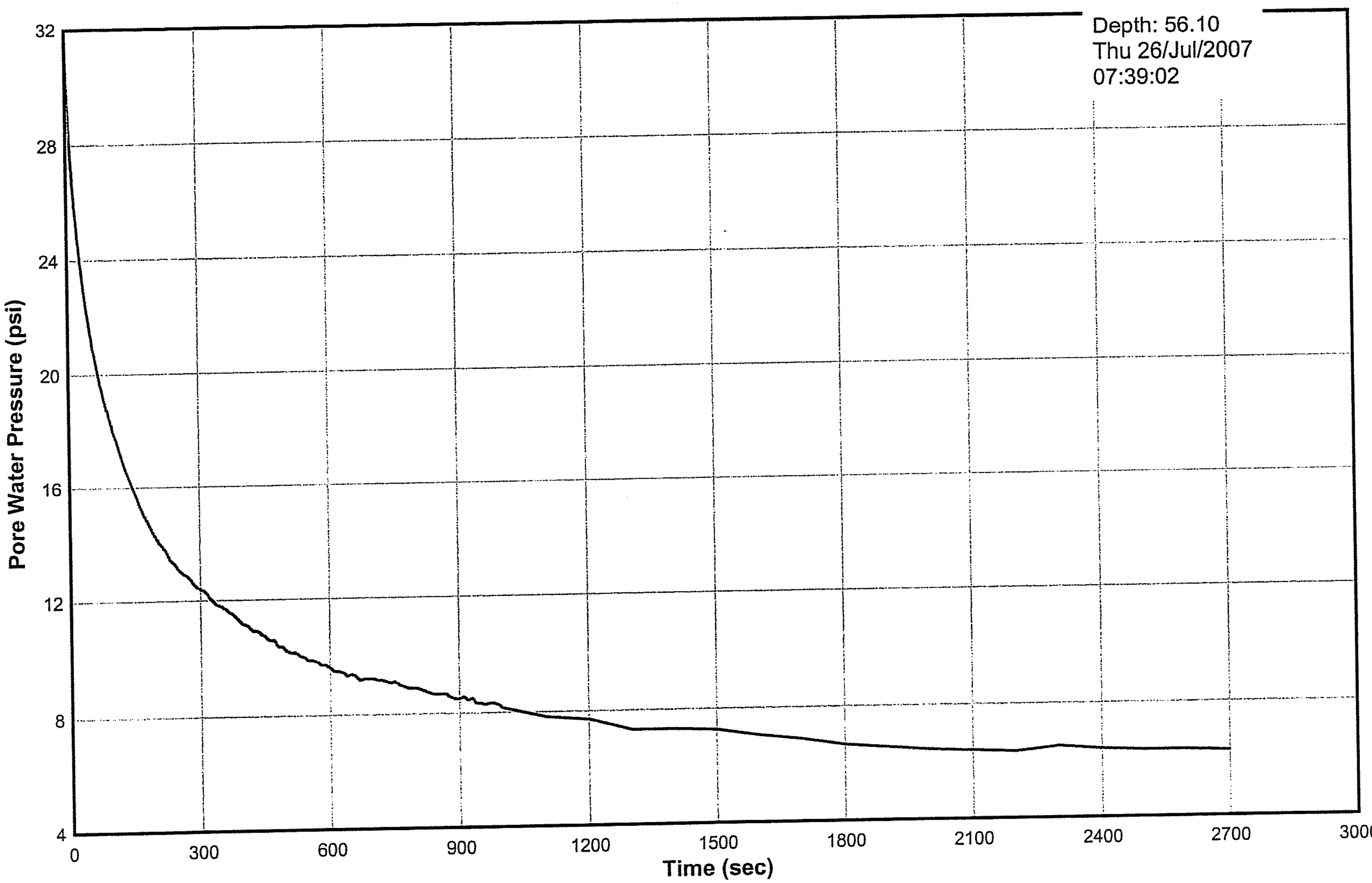


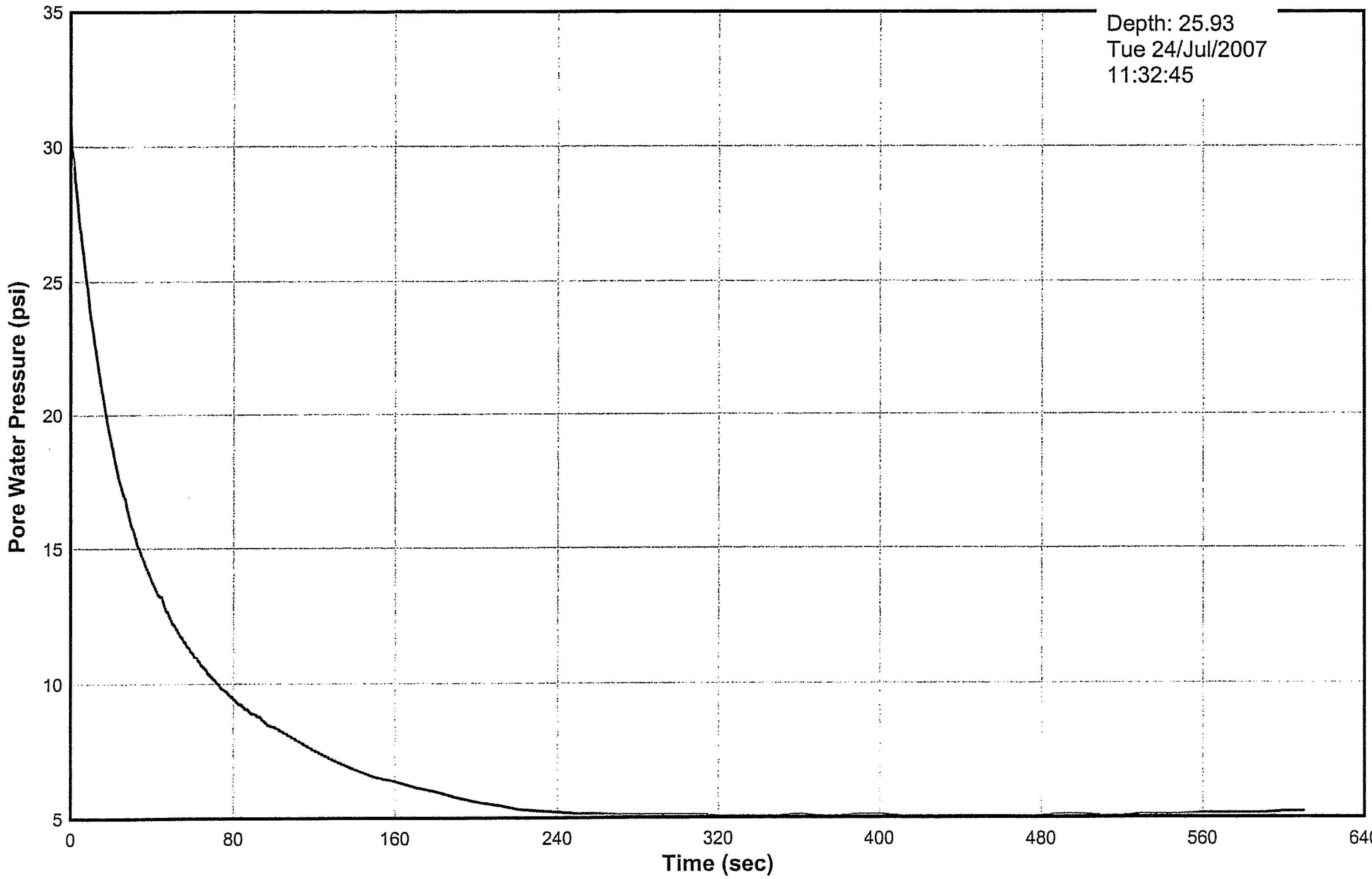
Pore Pressure Dissipation Test
Sounding 07-03
AET #01-03612



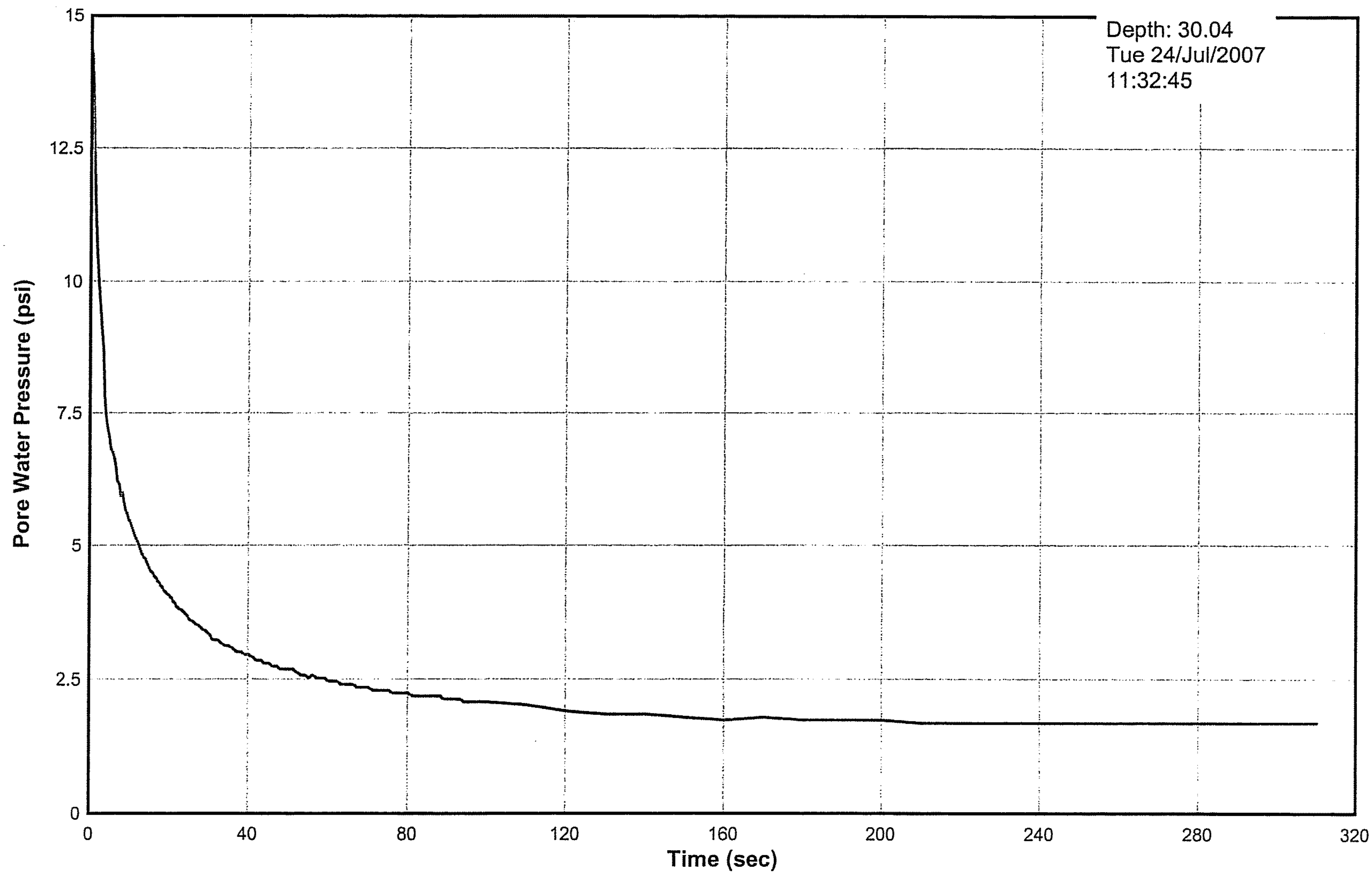
Pore Pressure Dissipation Test
Sounding 07-04B
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-05
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-05
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-05
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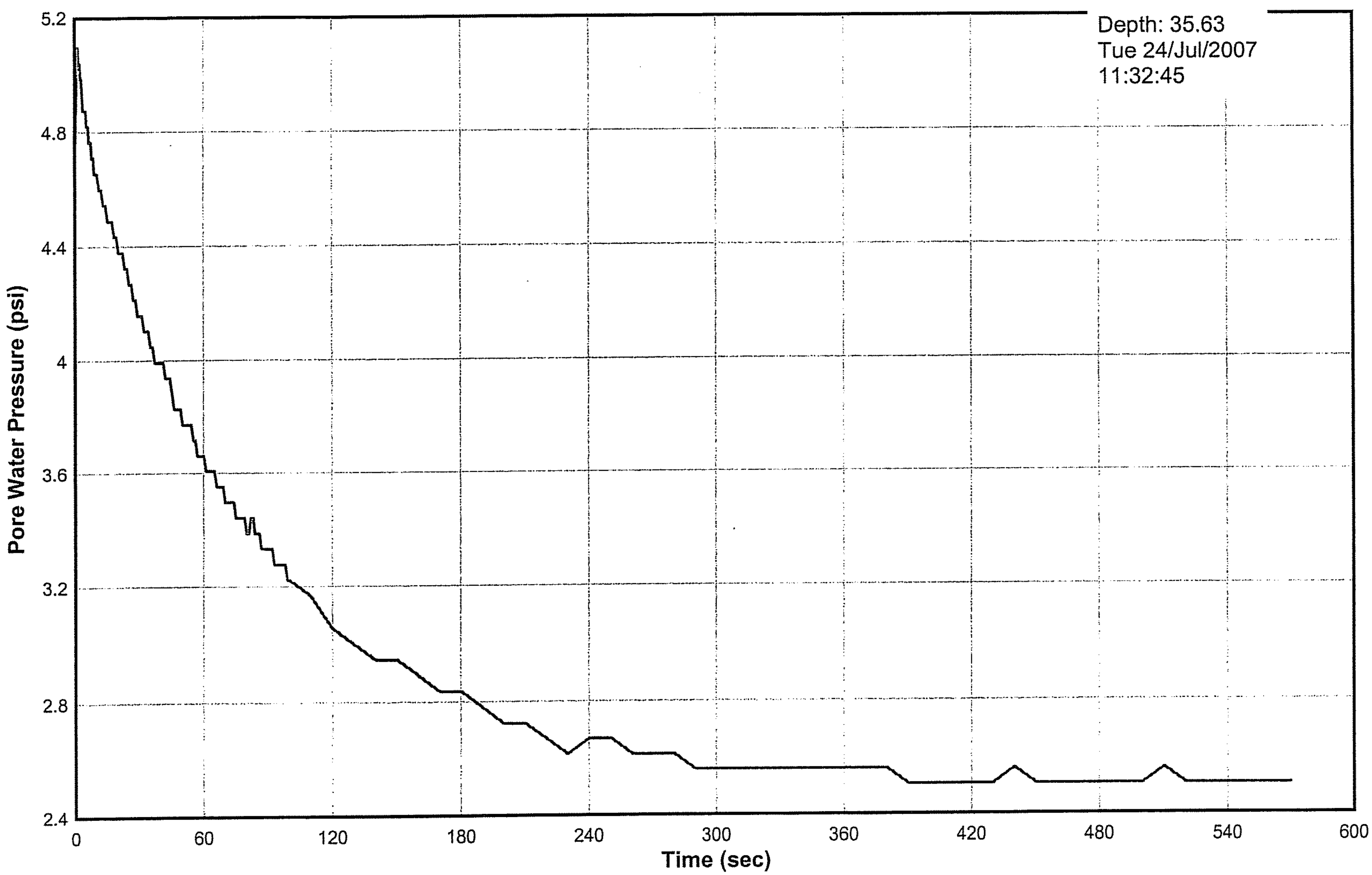

Pore Pressure Dissipation Test
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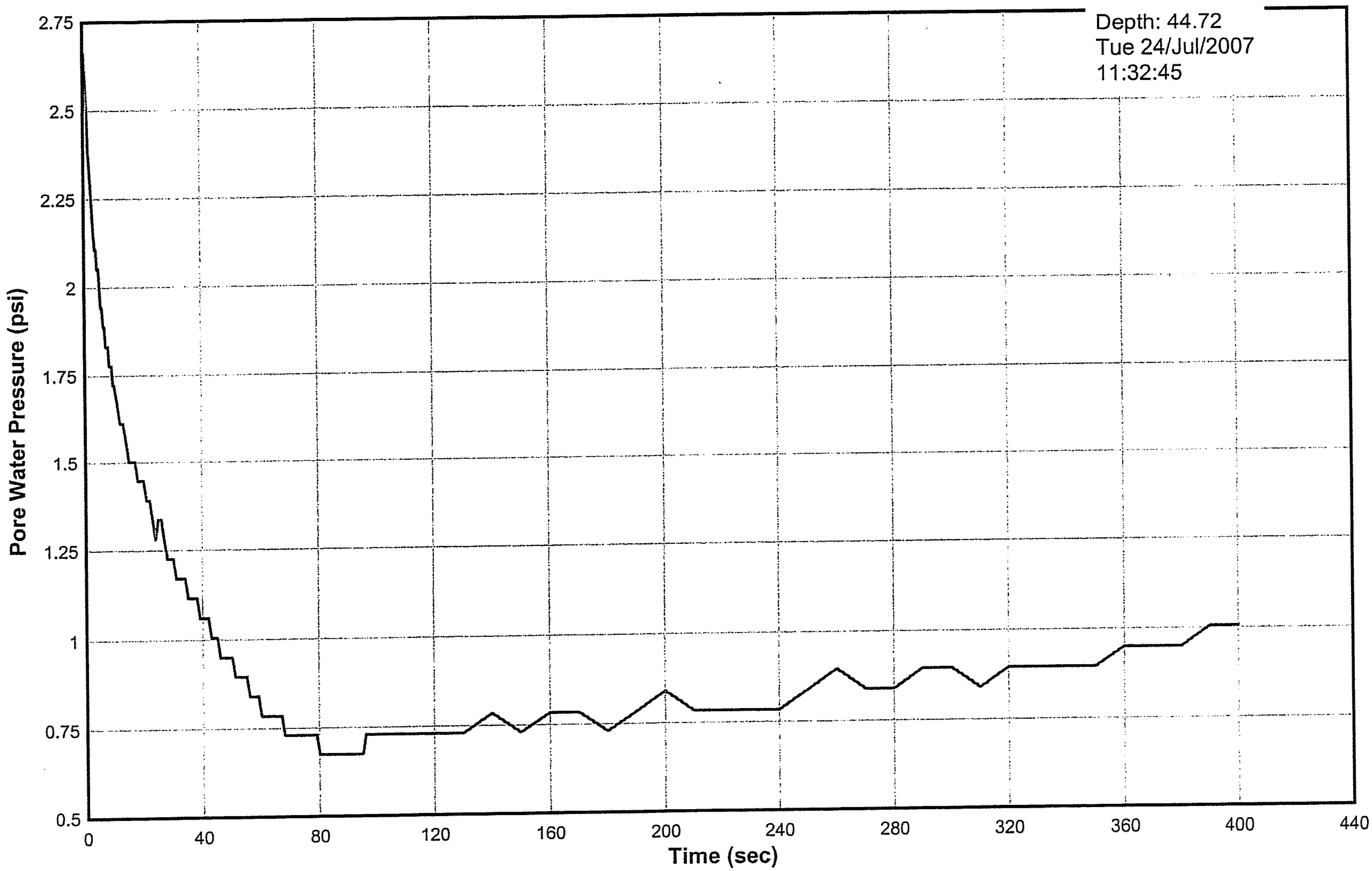

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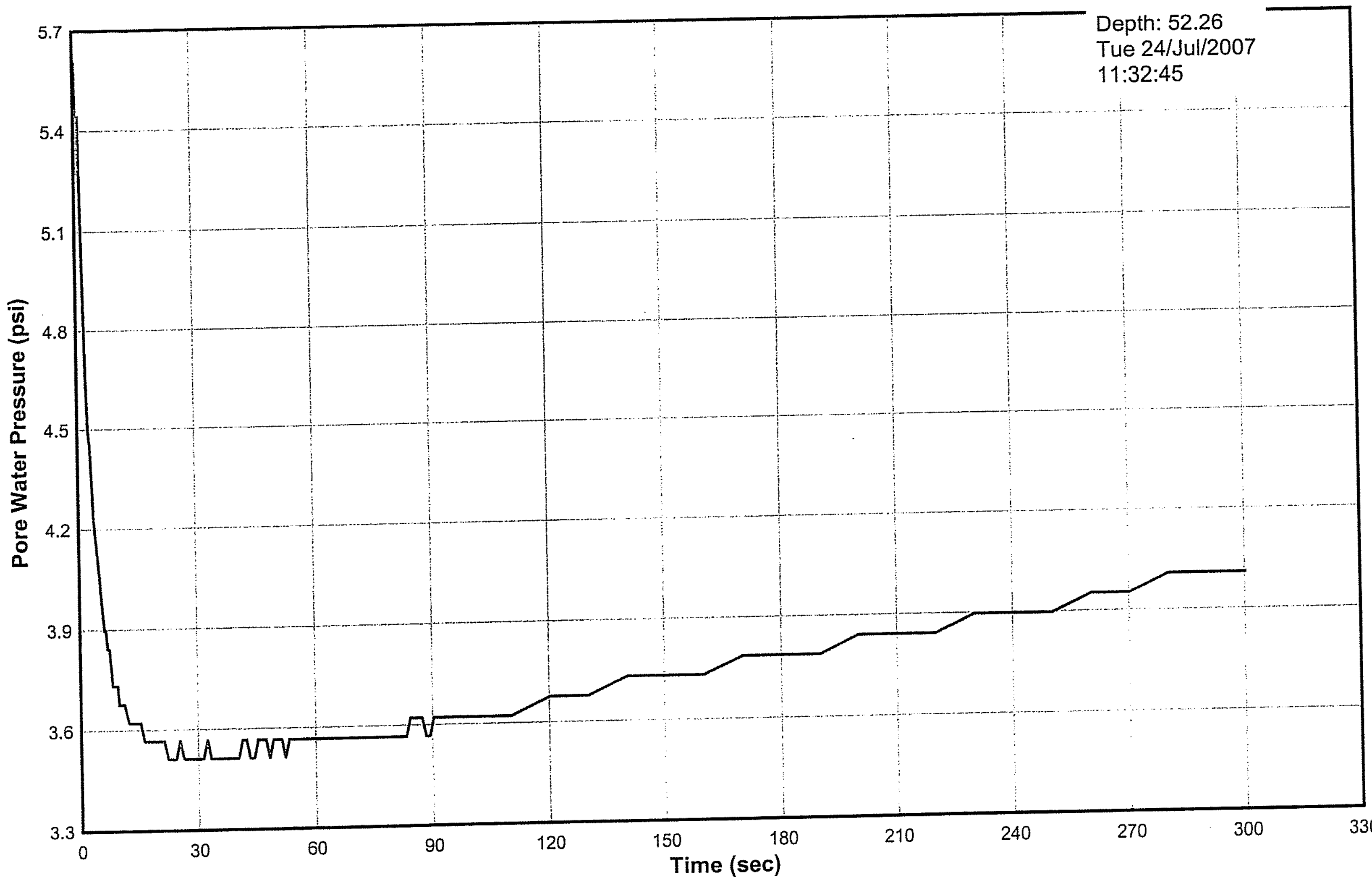

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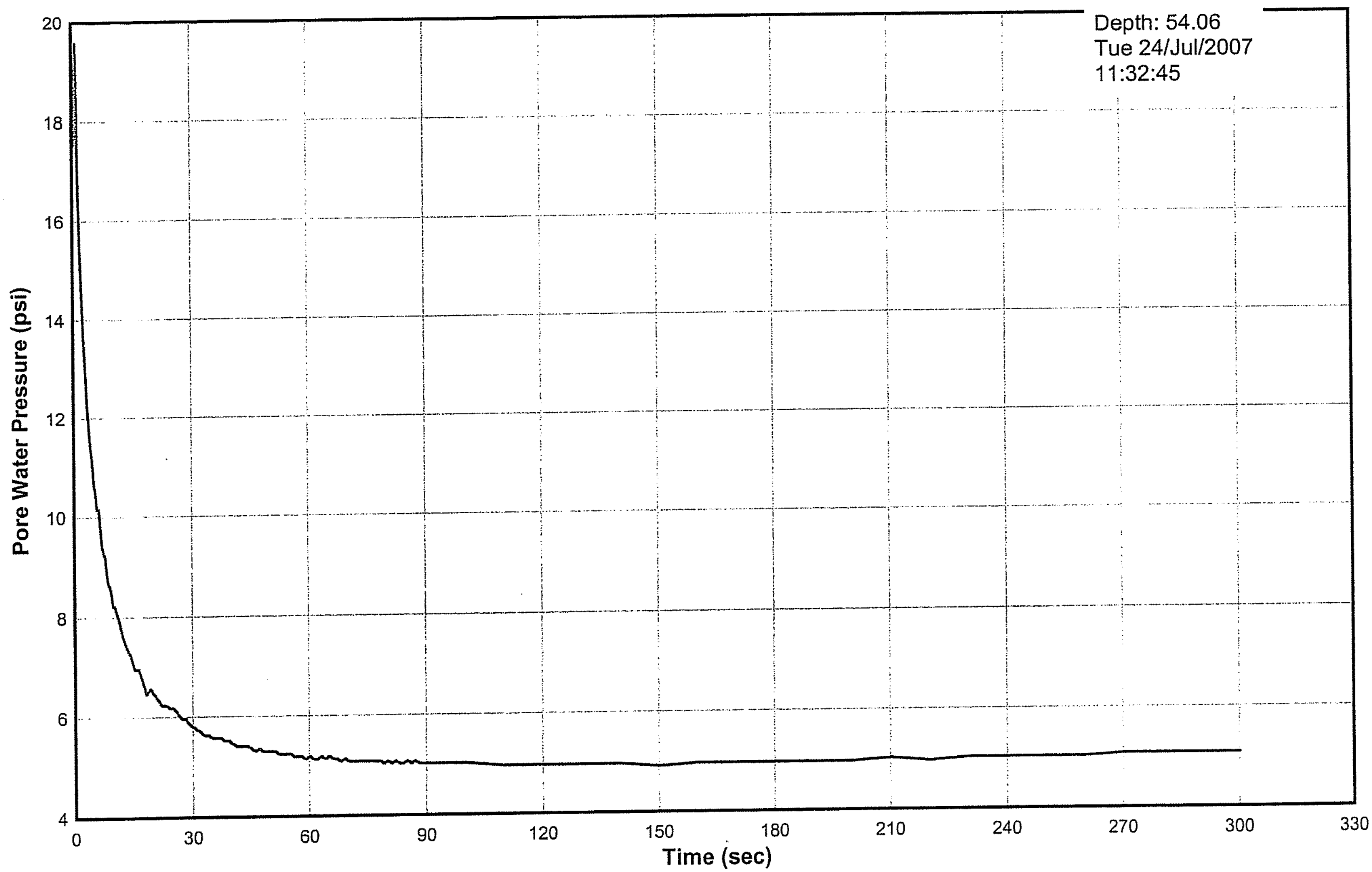

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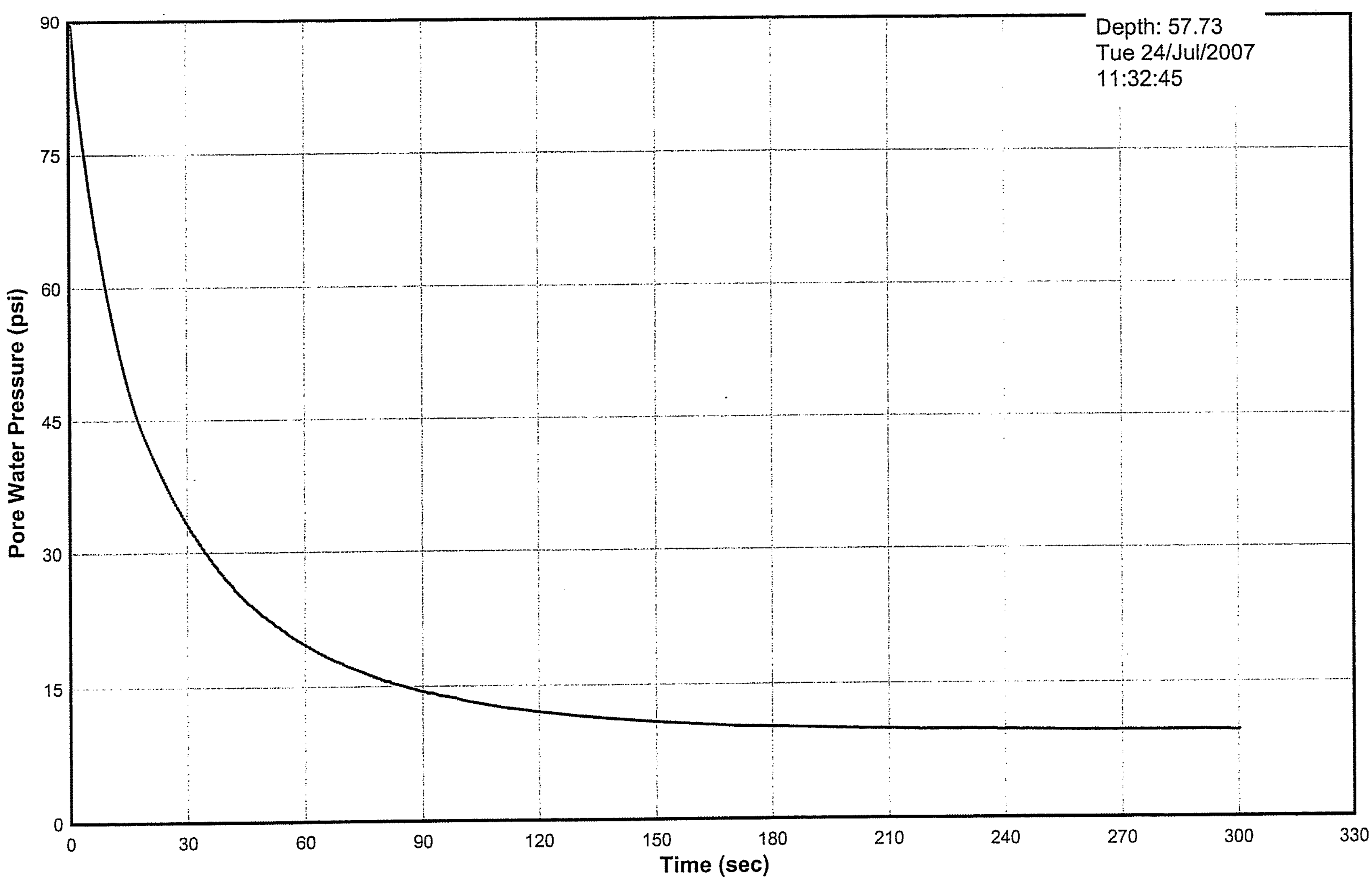
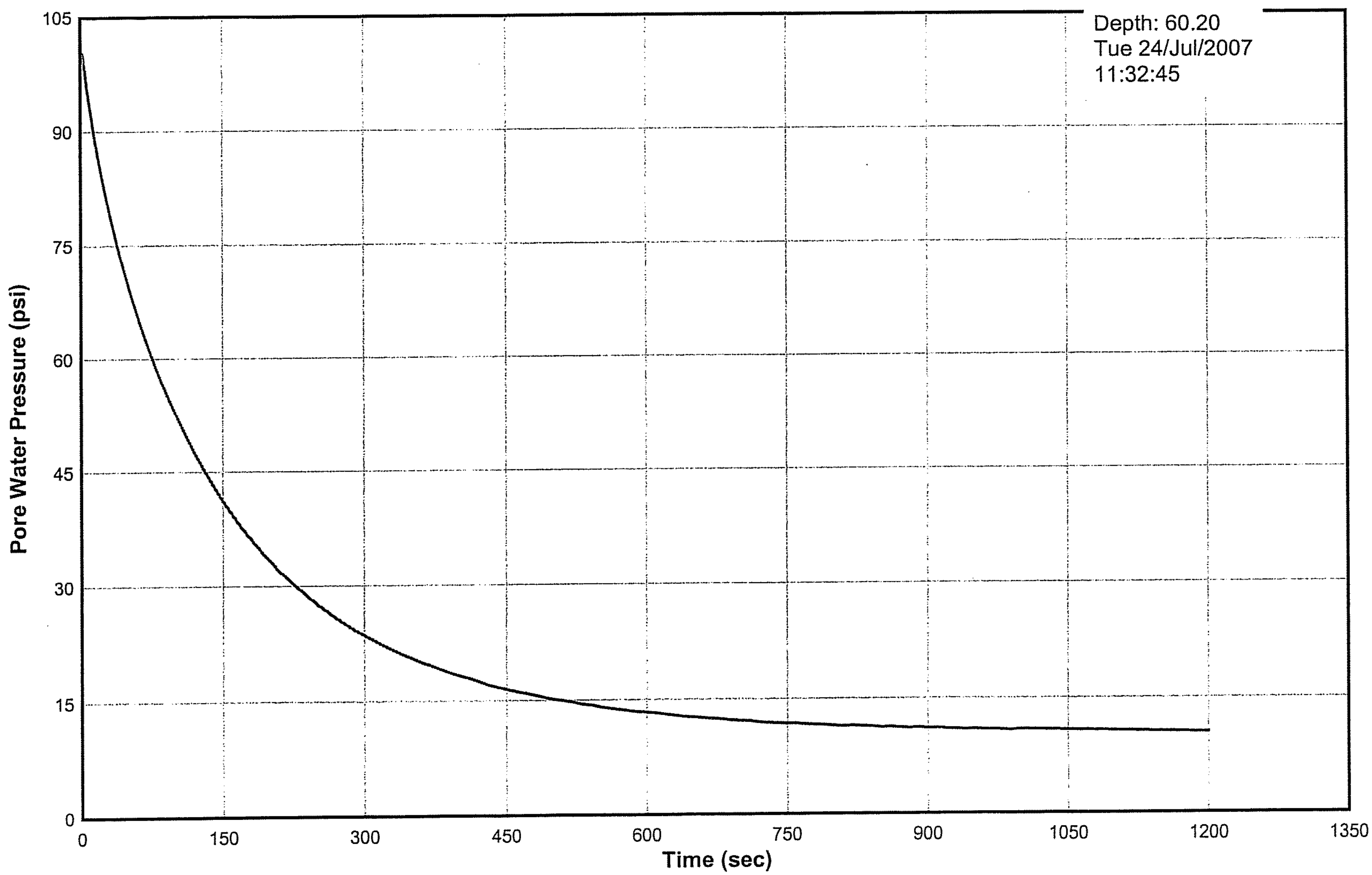
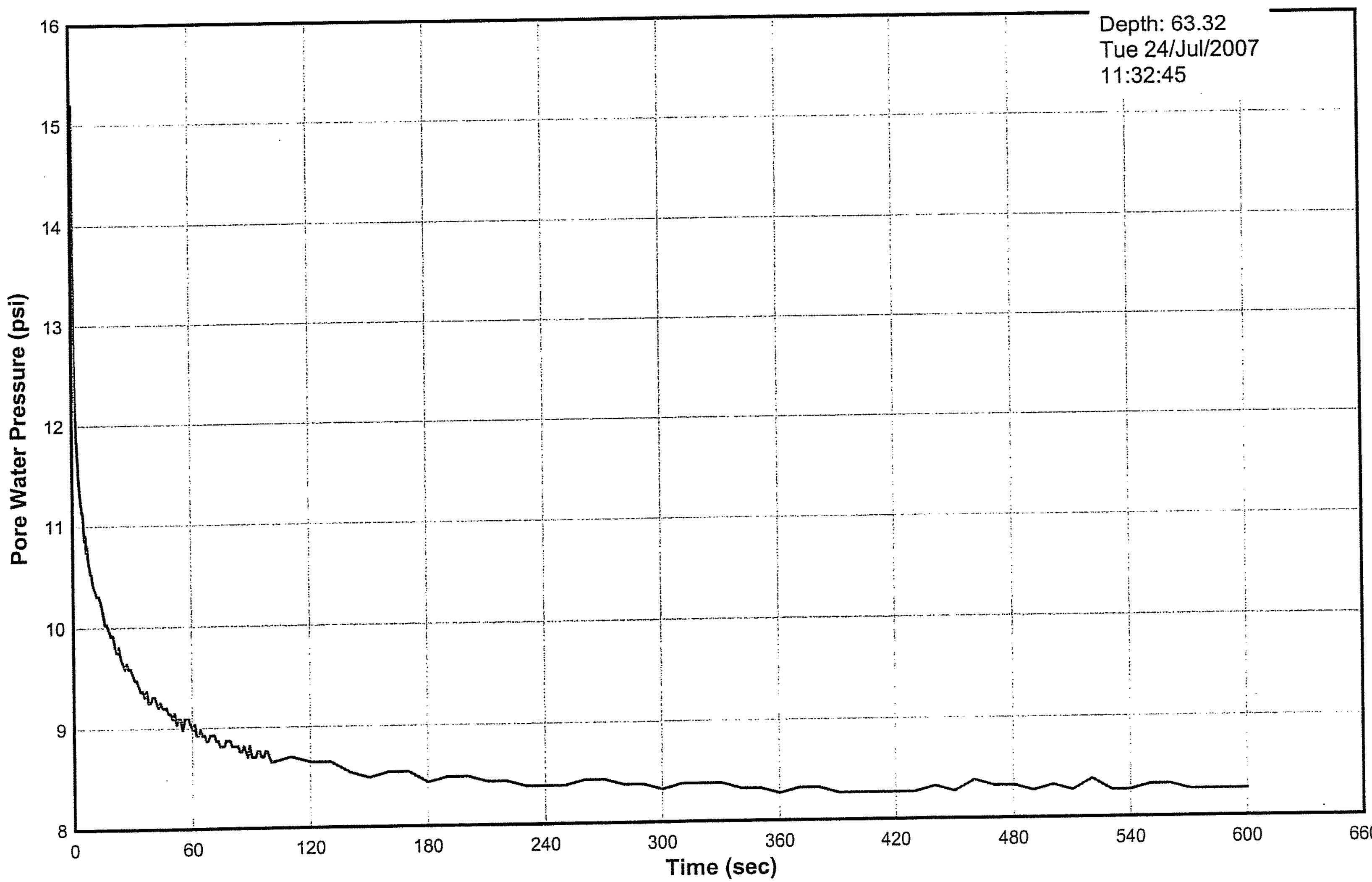
Sounding 07-05
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-05
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-05
AET #01-03612



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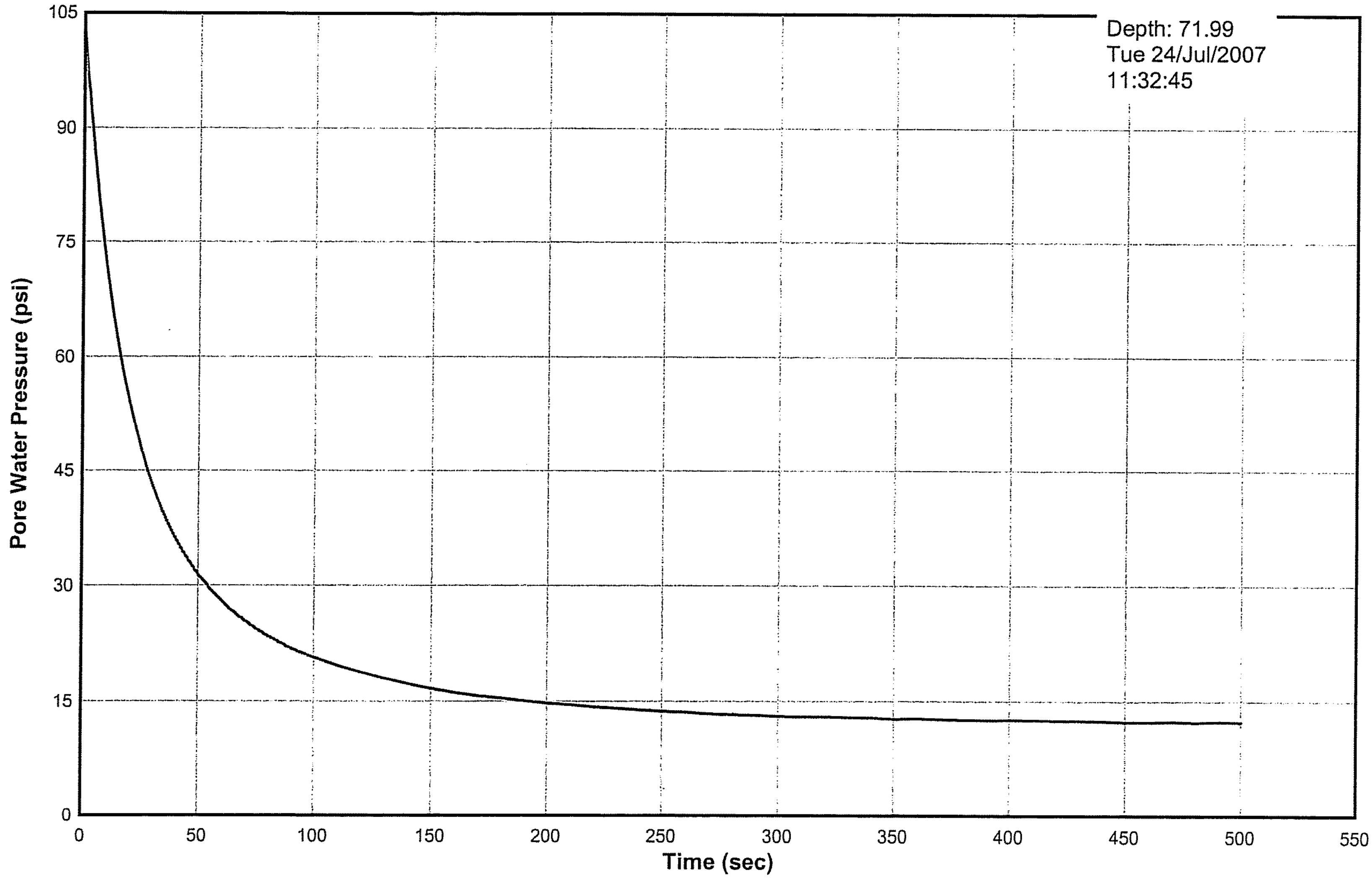
Sounding 07-05
AET #01-03612



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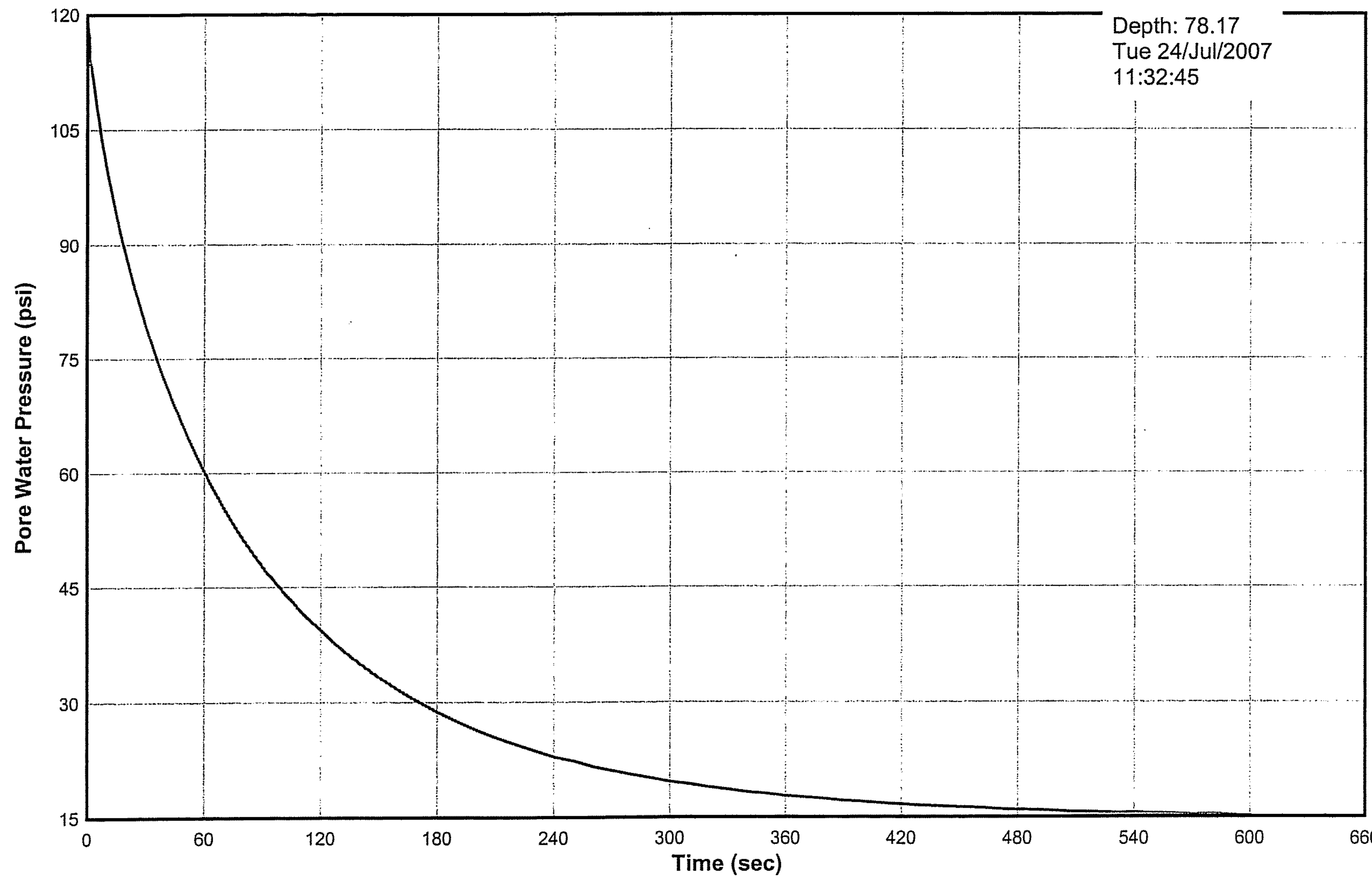
Sounding 07-05
AET #01-03612



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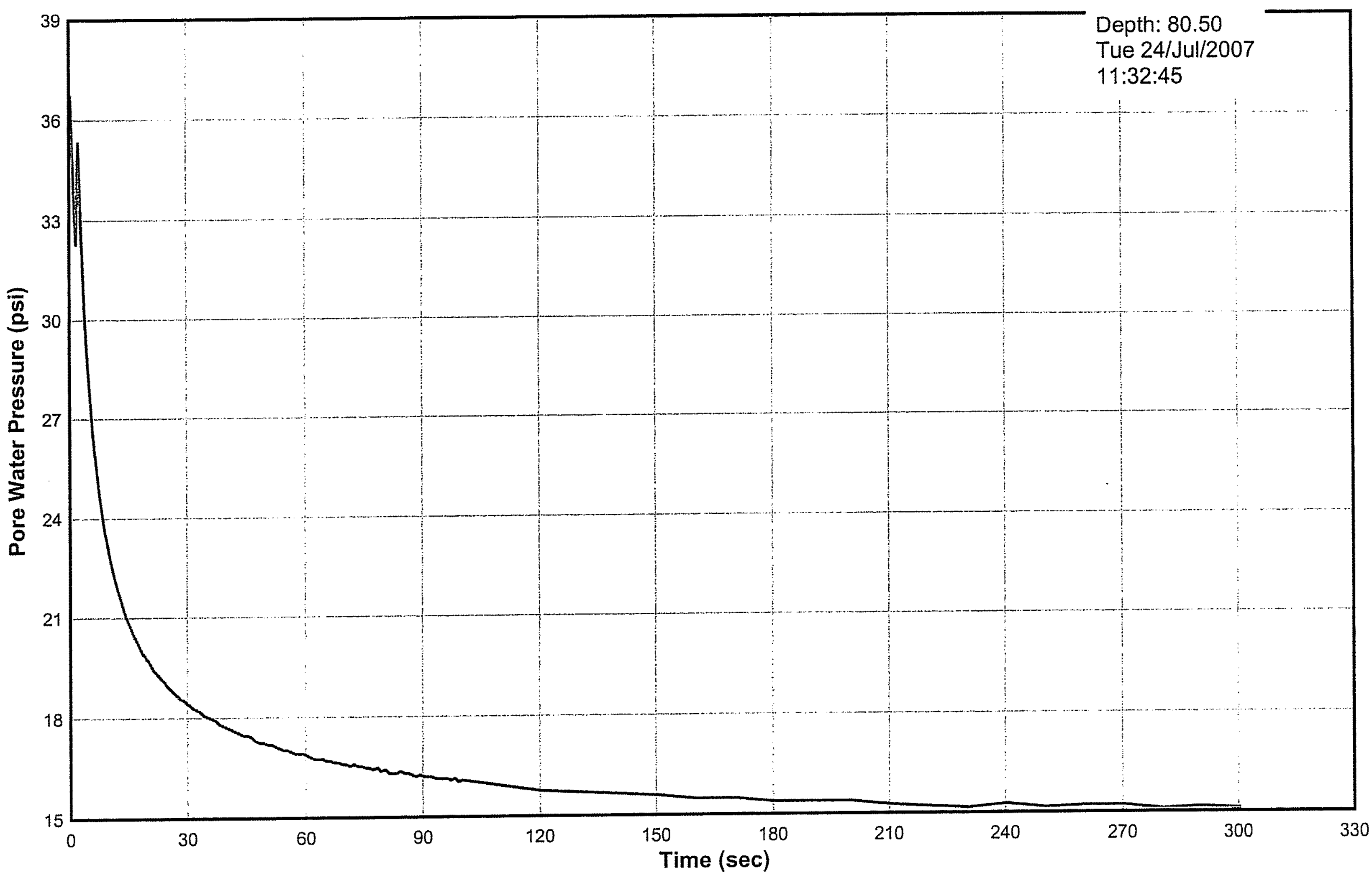
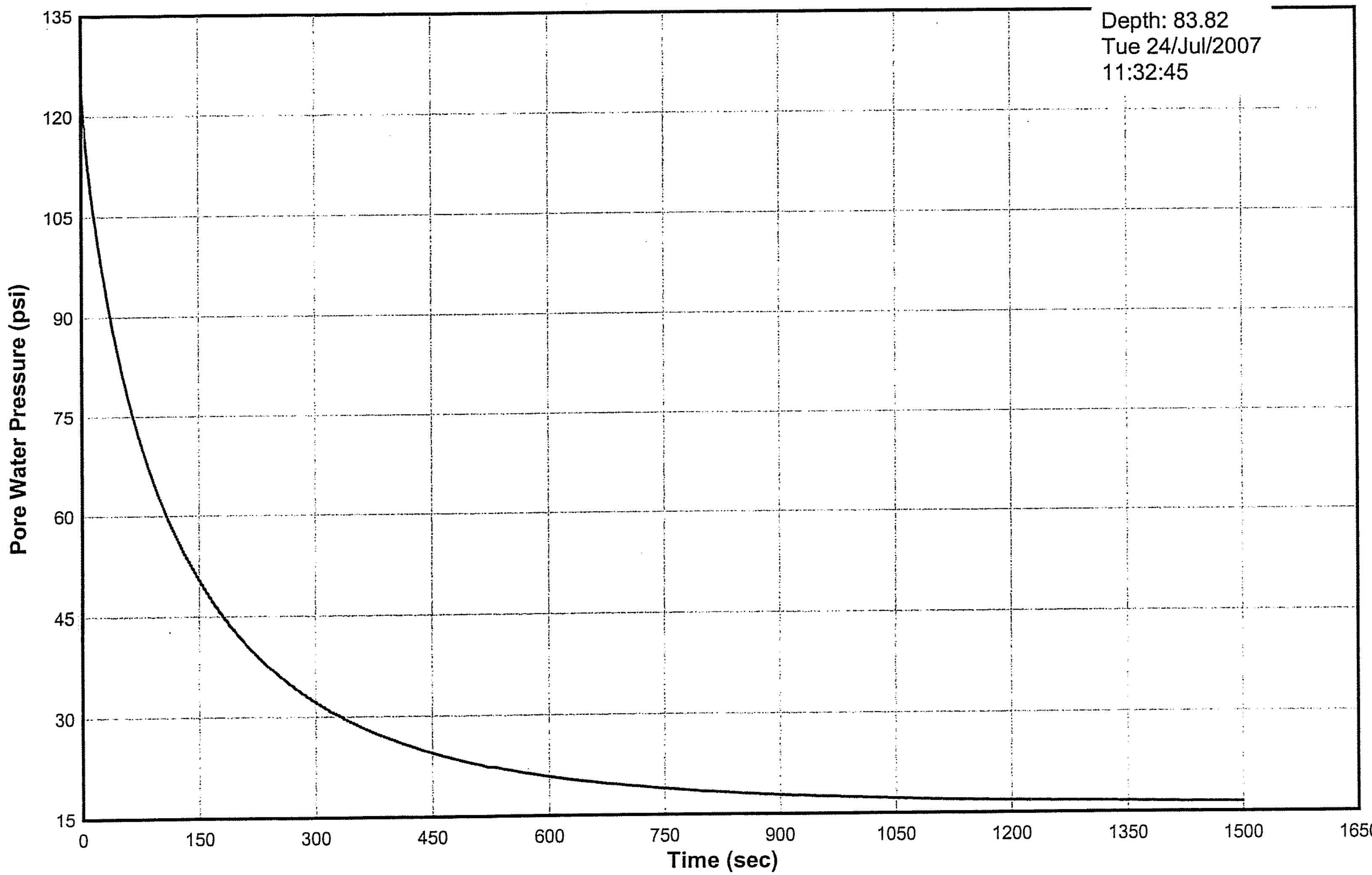
Sounding 07-05
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-05
AET #01-03612



Pore Pressure Dissipation Test
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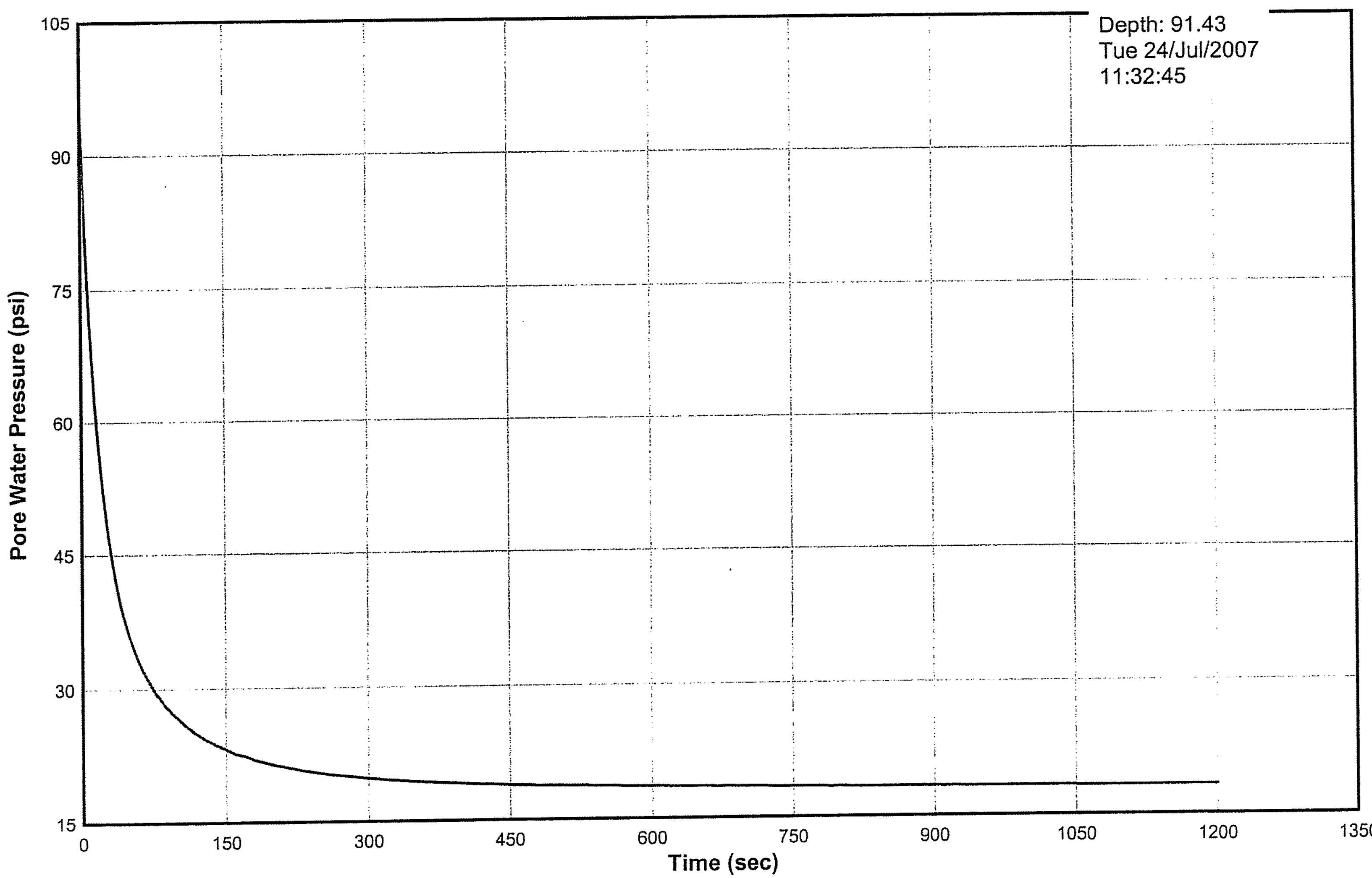
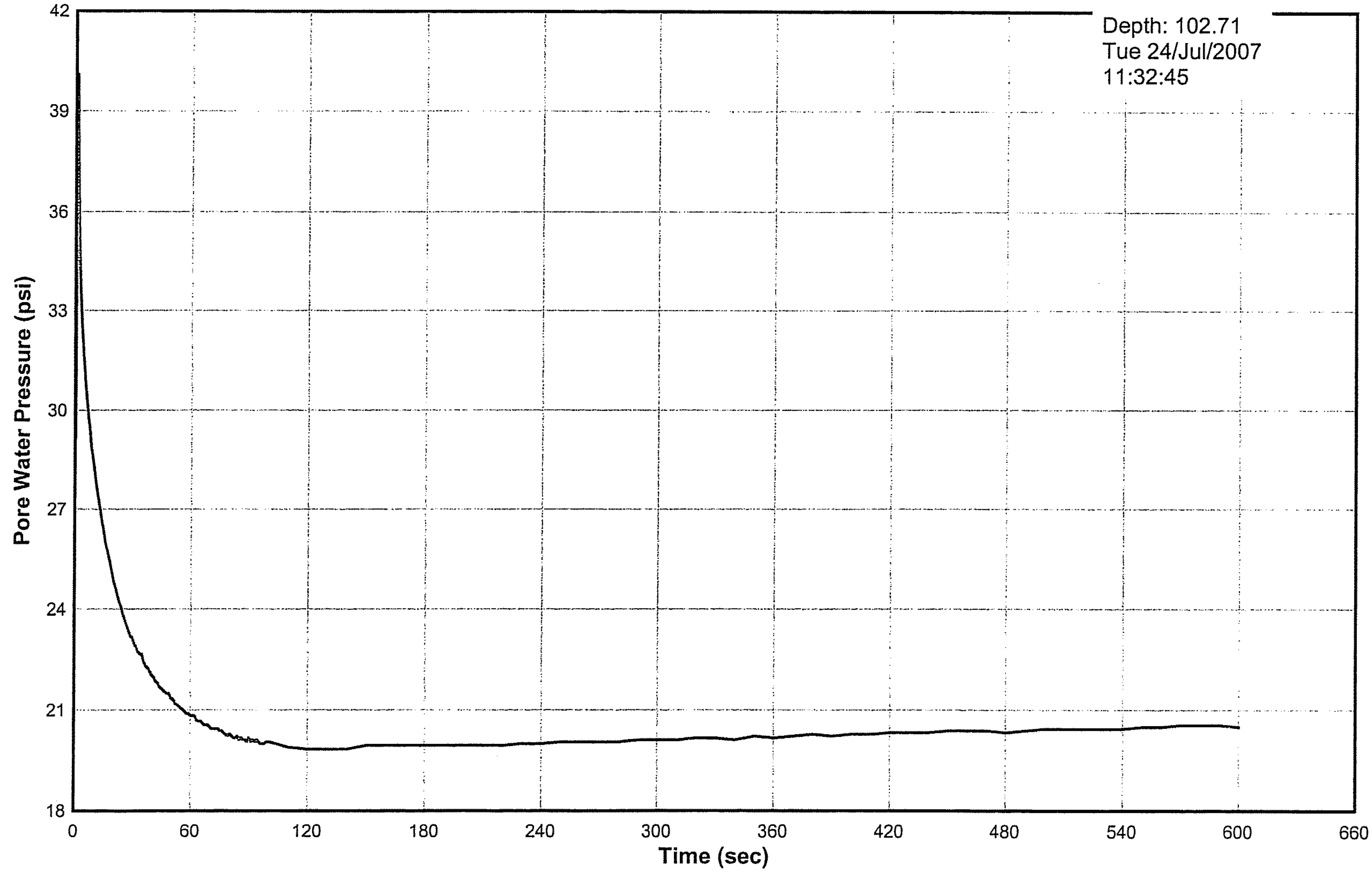
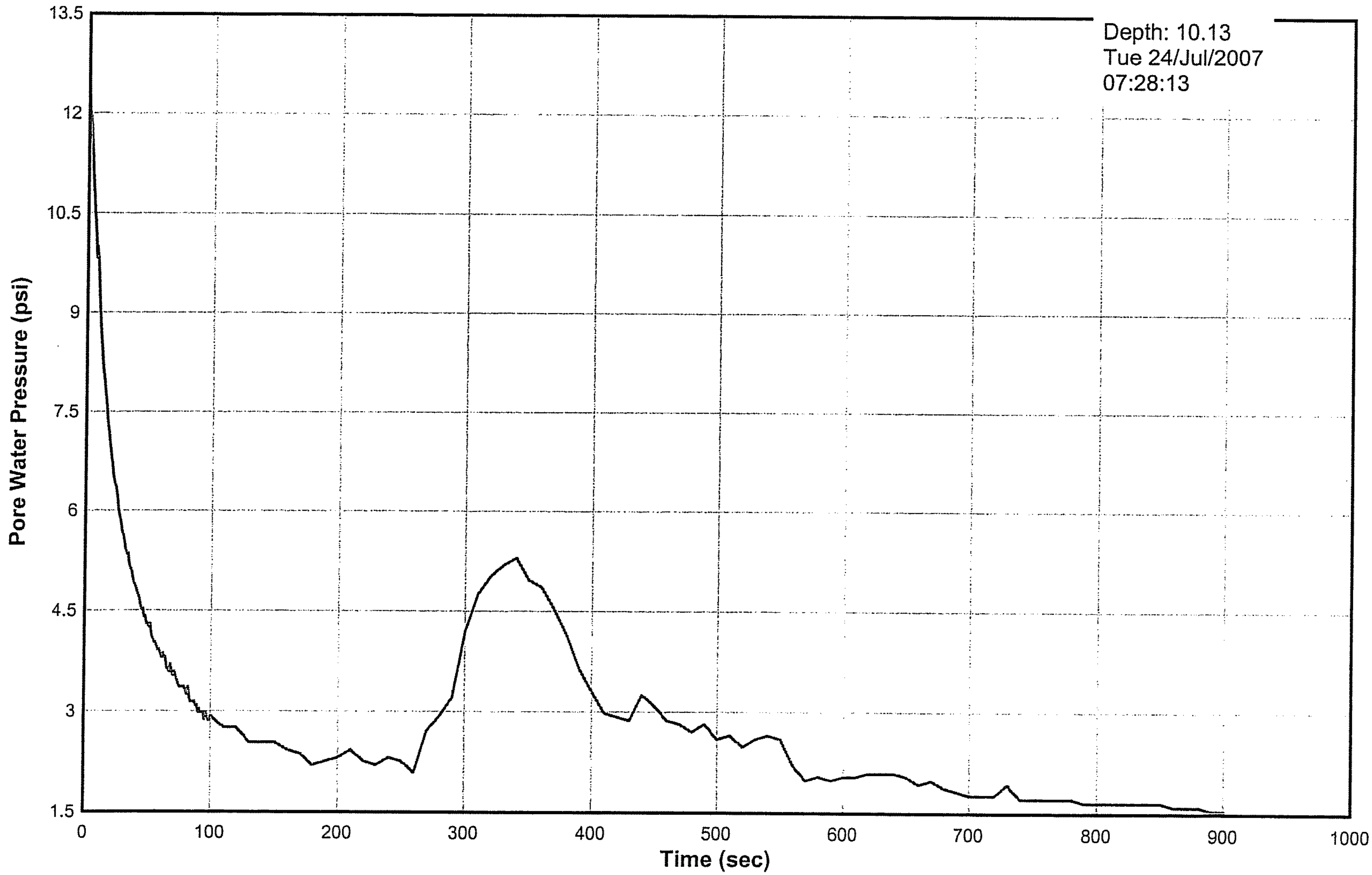
AET #01-03612



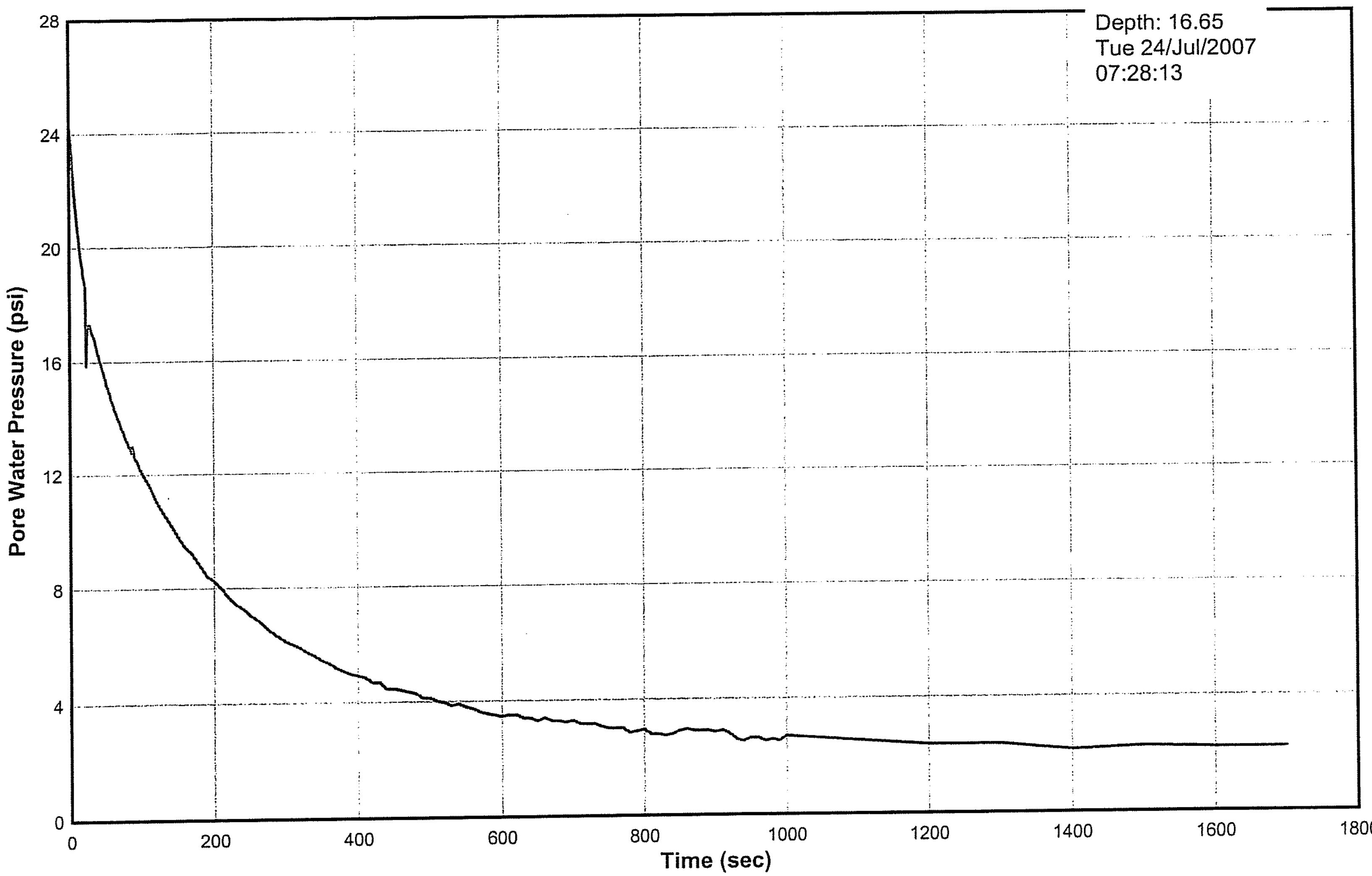
Pore Pressure Dissipation Test
Sounding 07-05
AET #01-03612



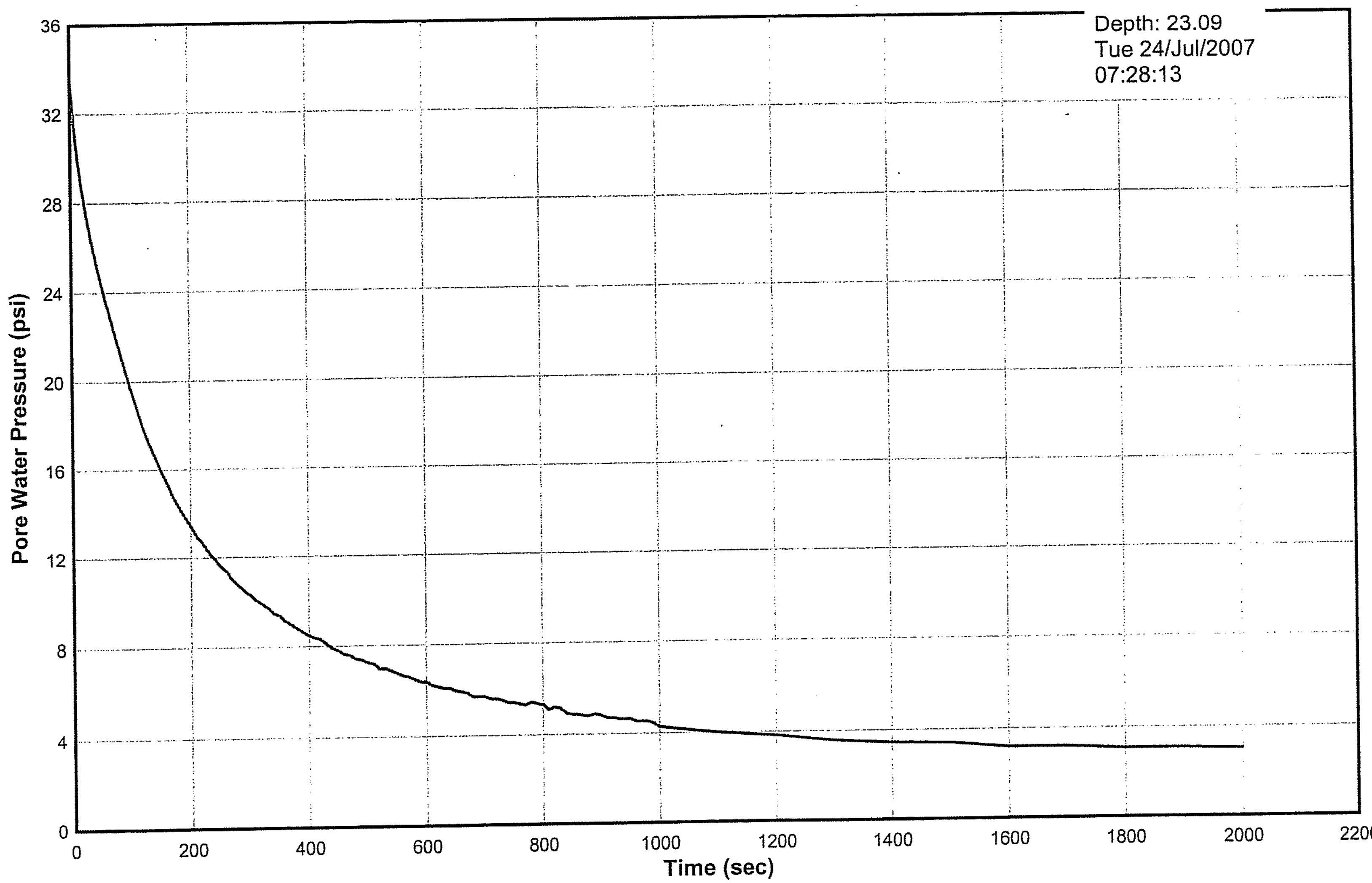
Pore Pressure Dissipation Test
Sounding 07-06
AET #01-03612

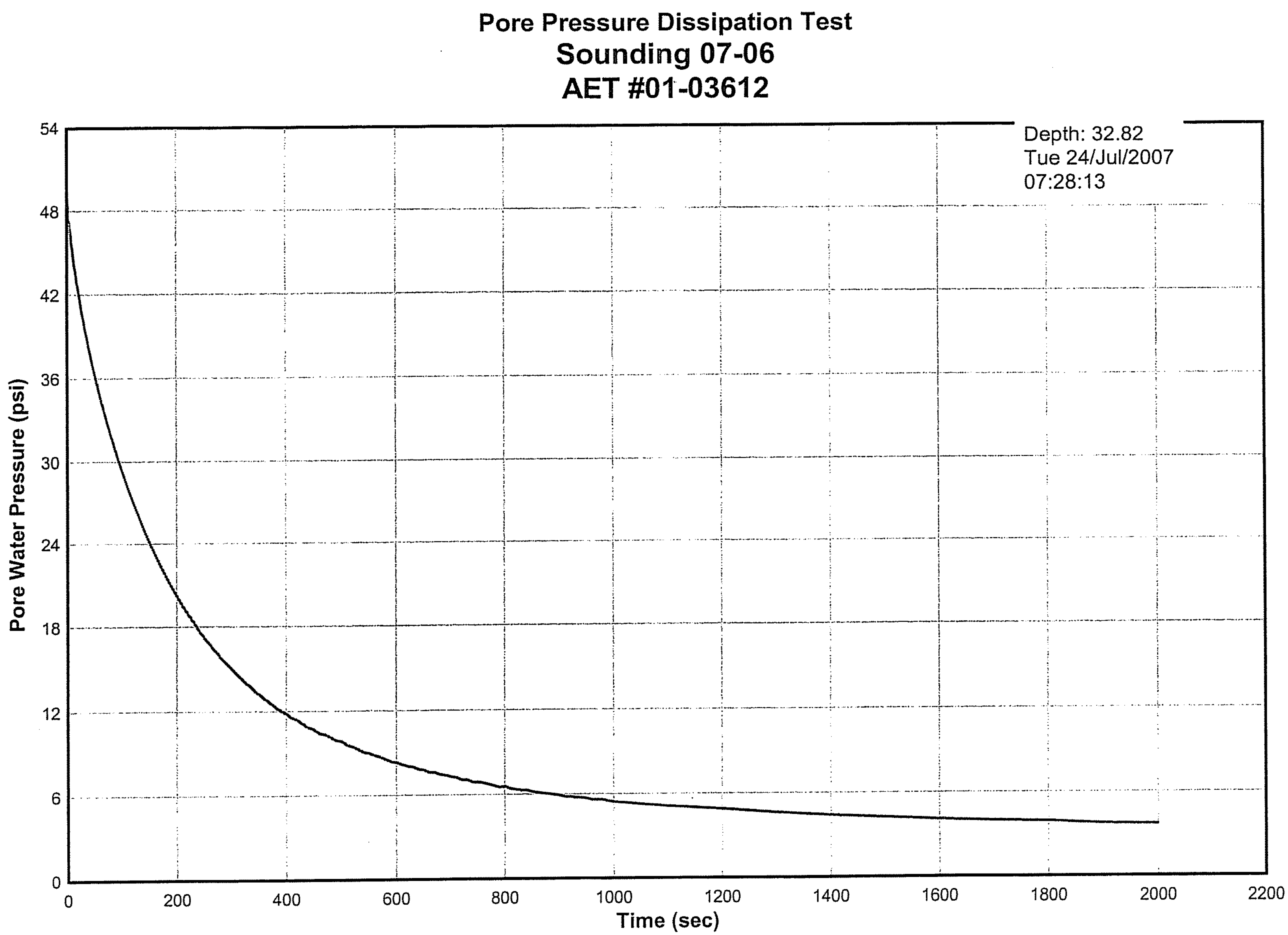


Pore Pressure Dissipation Test
Sounding 07-06
AET #01-03612

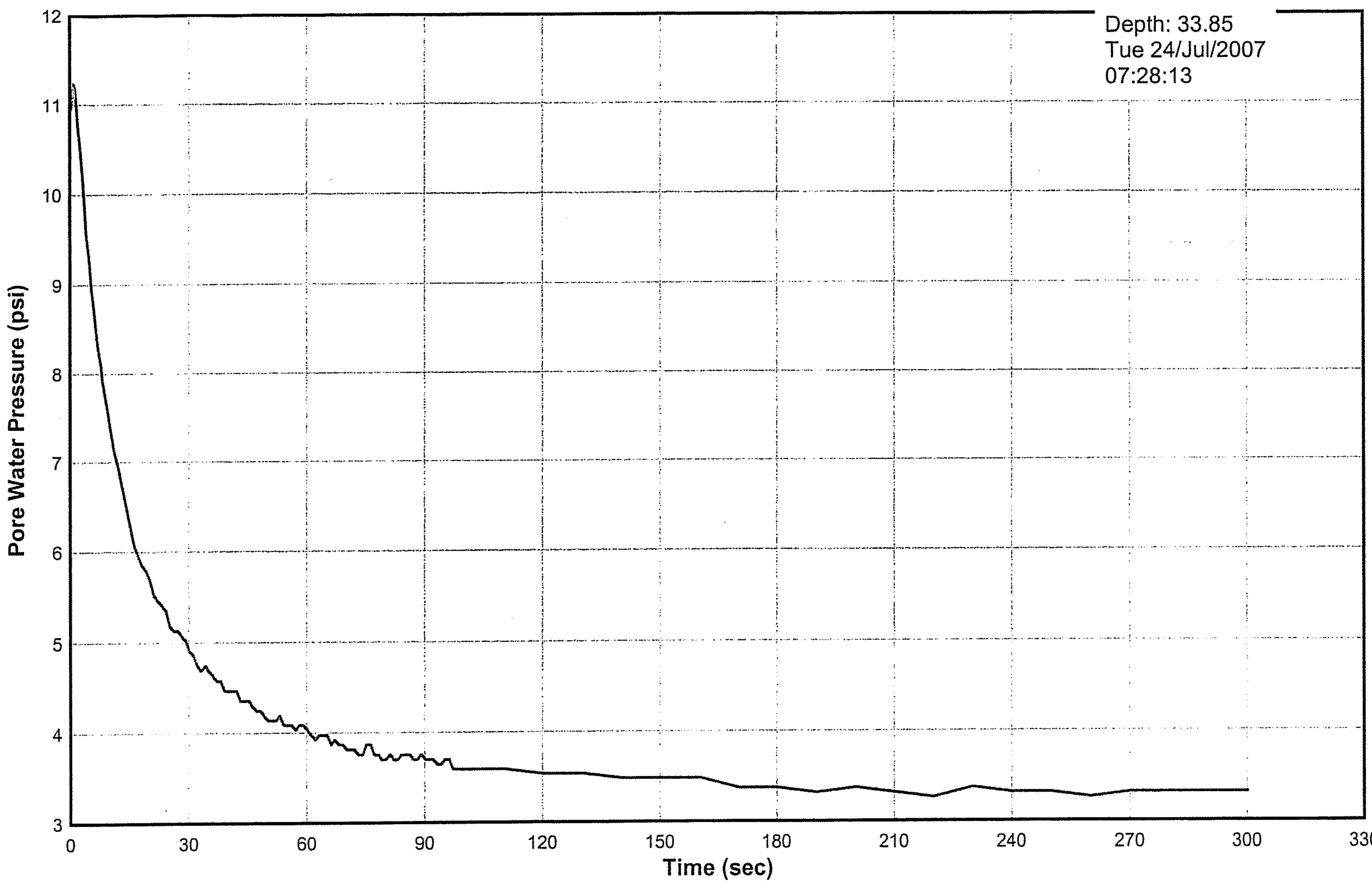


Pore Pressure Dissipation Test
Sounding 07-06
AET #01-03612

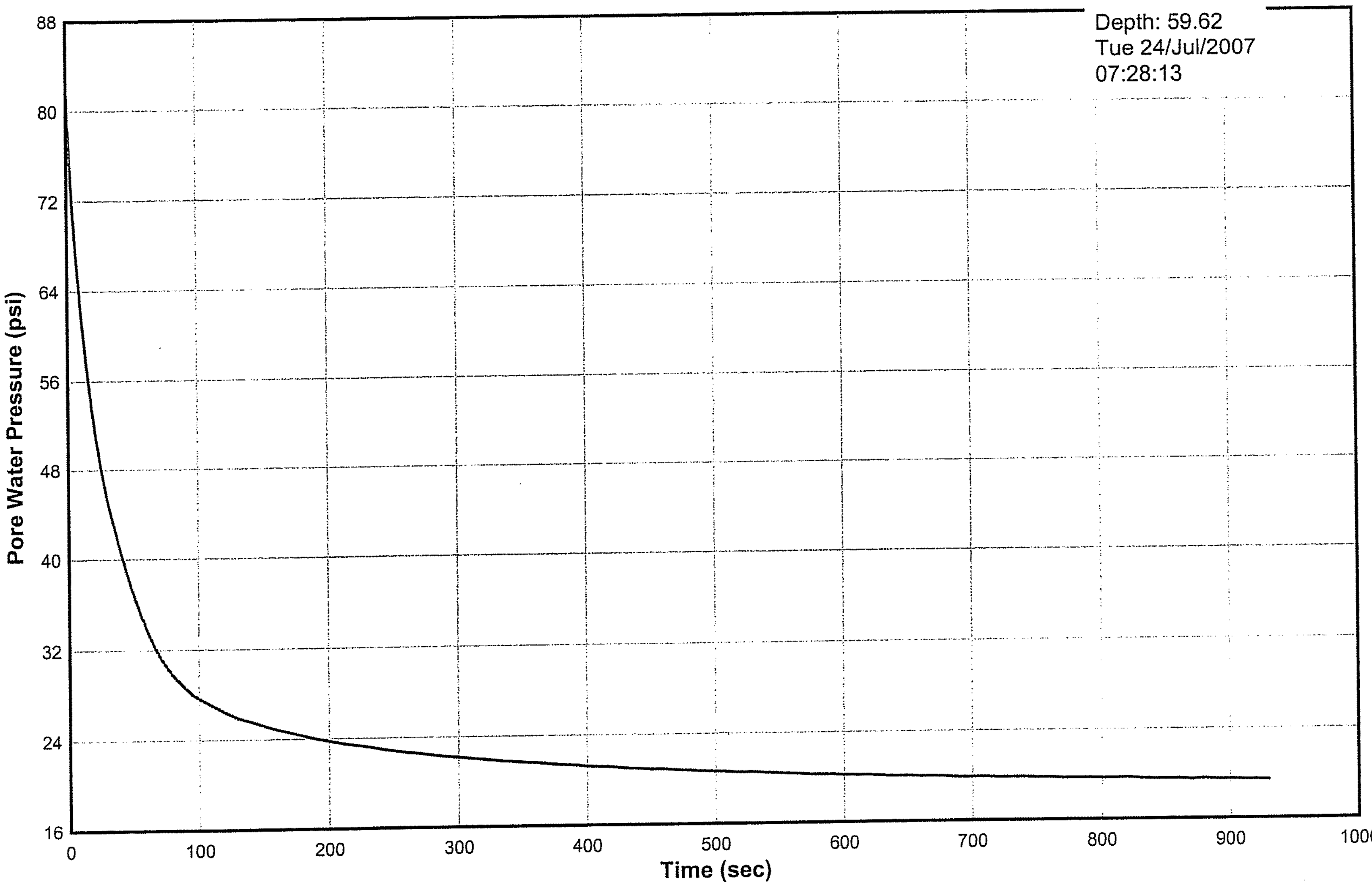



Pore Pressure Dissipation Test
Sounding 07-06
AET #01-03612
Depth: 32.82
Tue 24/Jul/2007
07:28:13
Pore Water Pressure (psi)
54
48
42
36
30
24
18
12
6
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Time (sec)

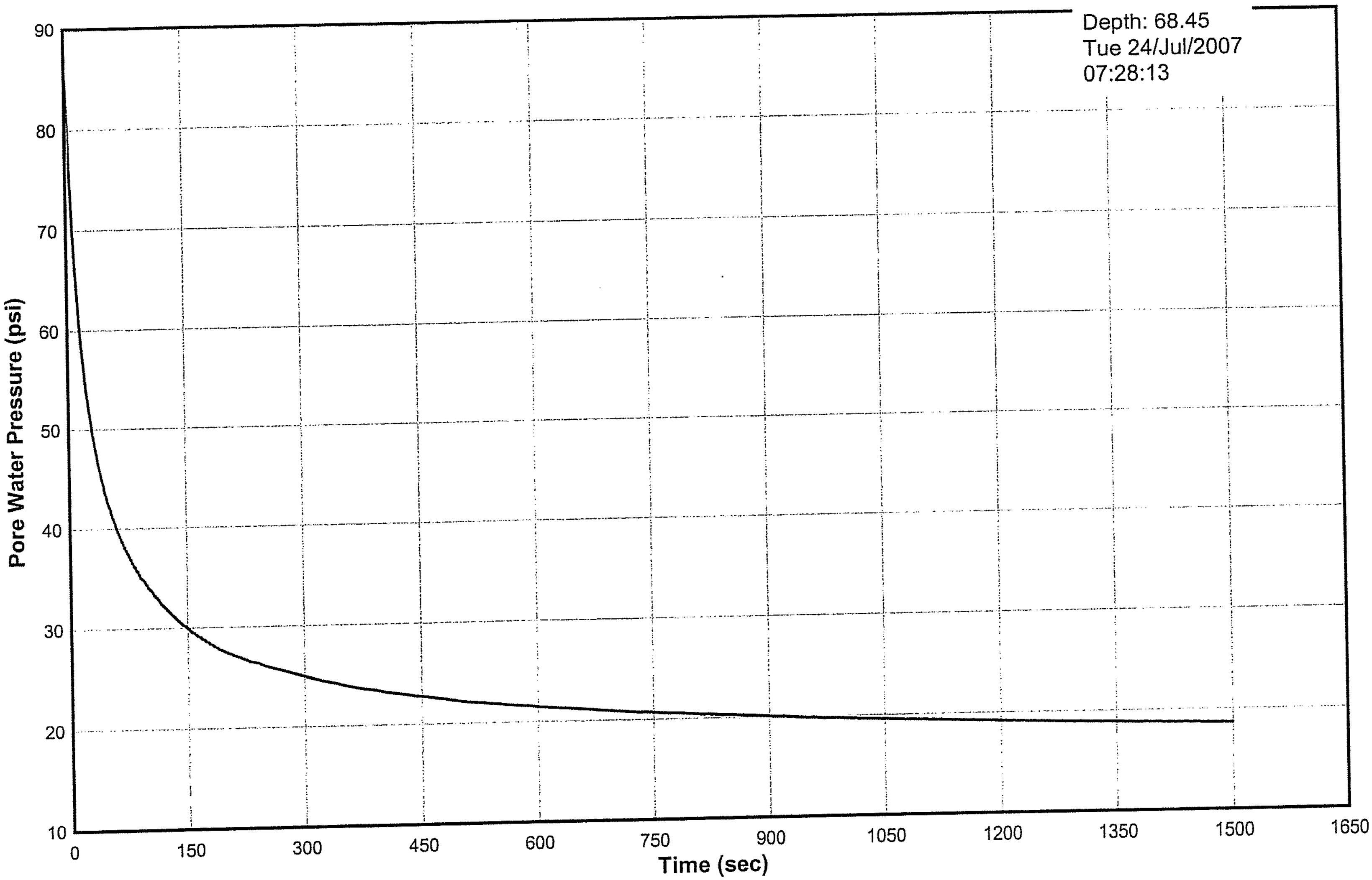
Pore Pressure Dissipation Test
Sounding 07-06
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-06
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-06
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-06
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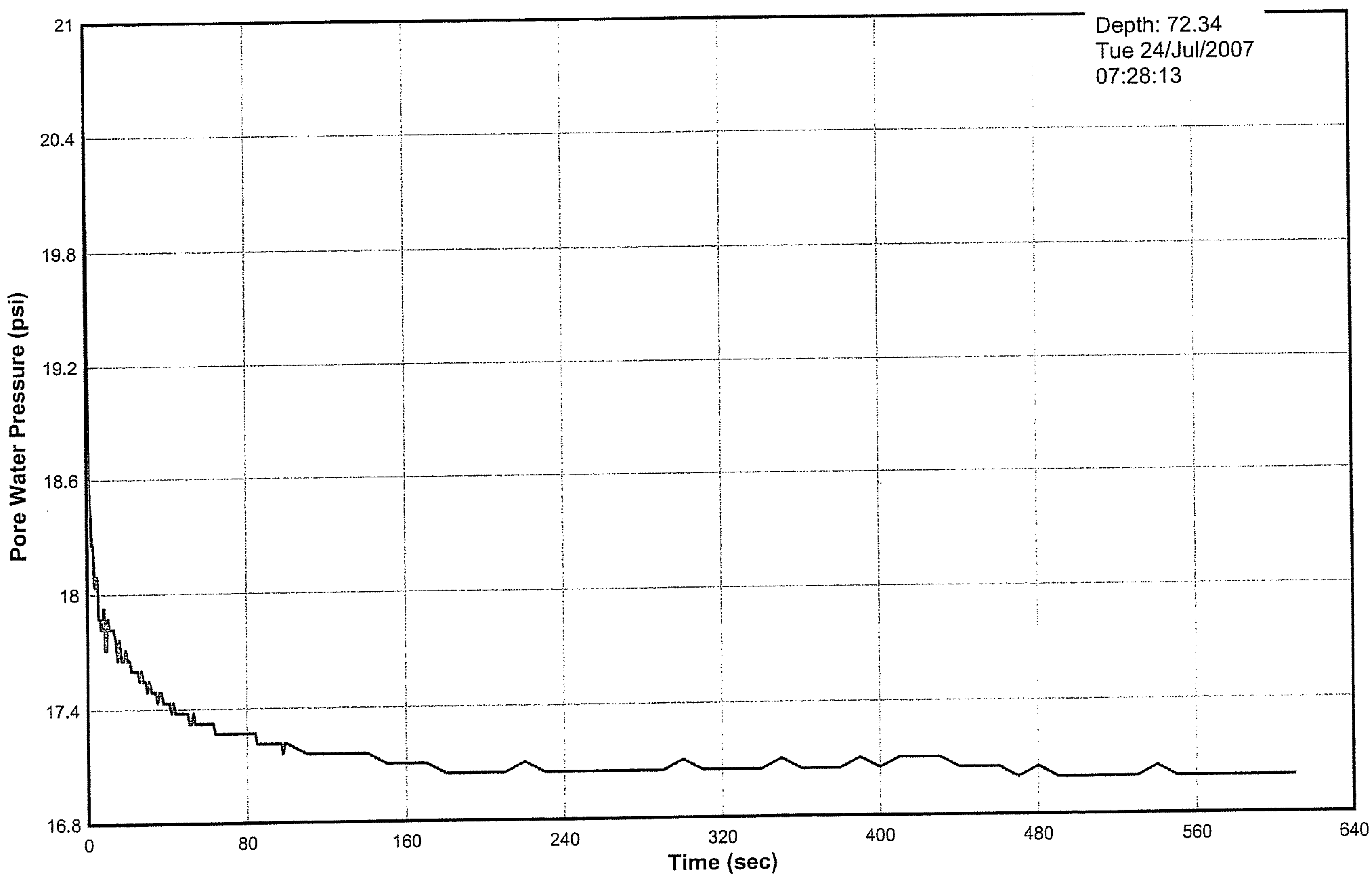
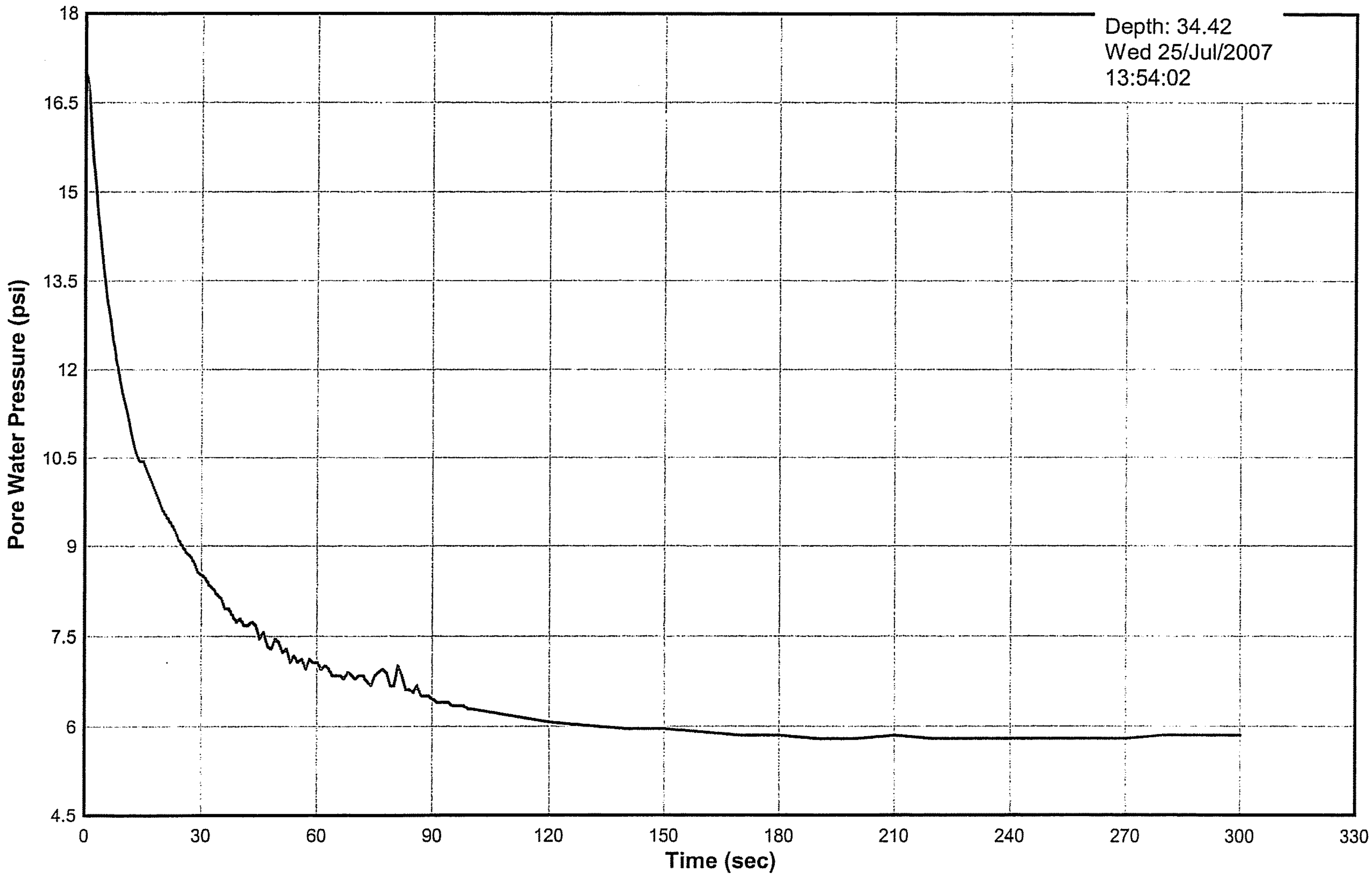
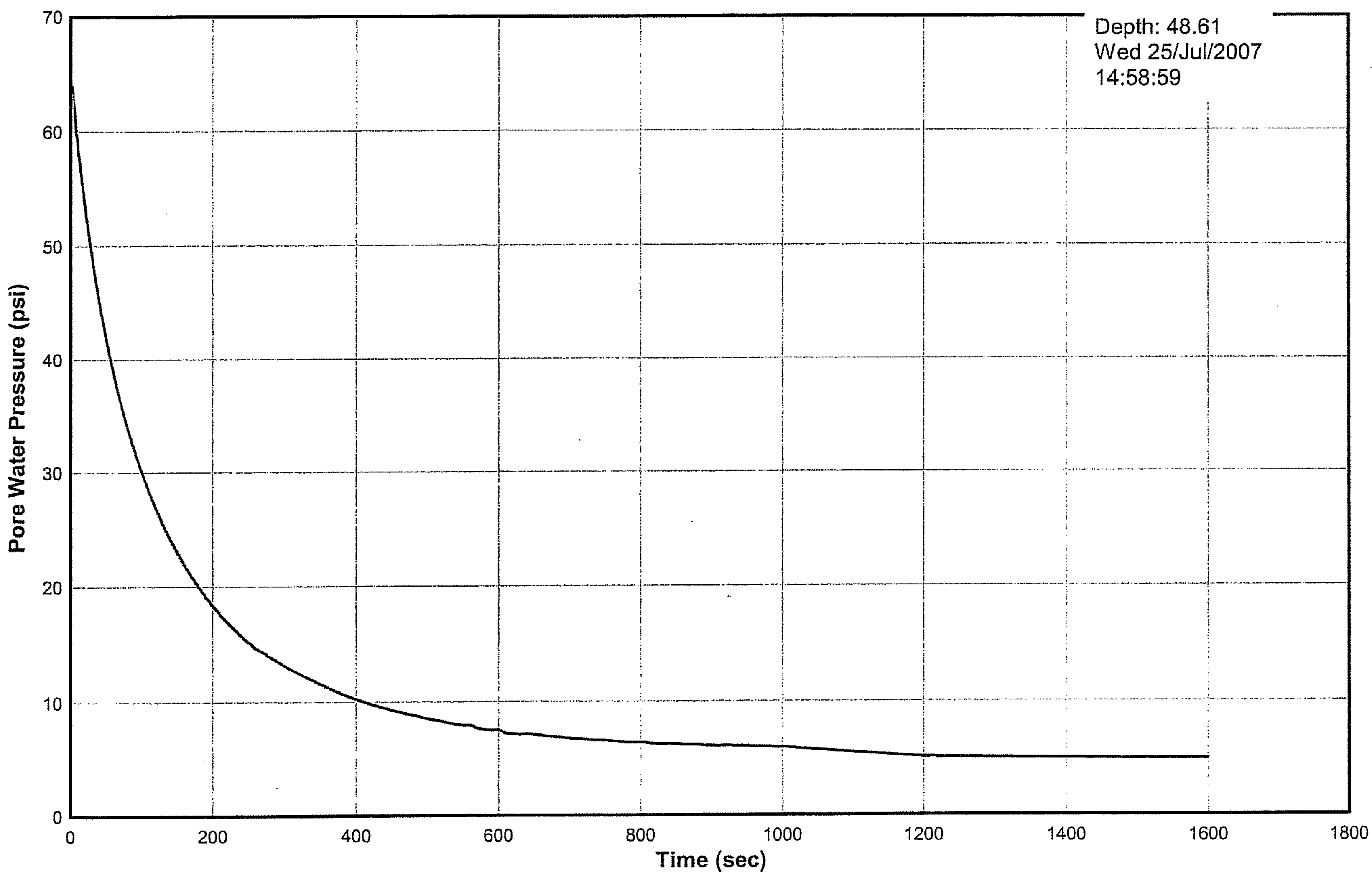


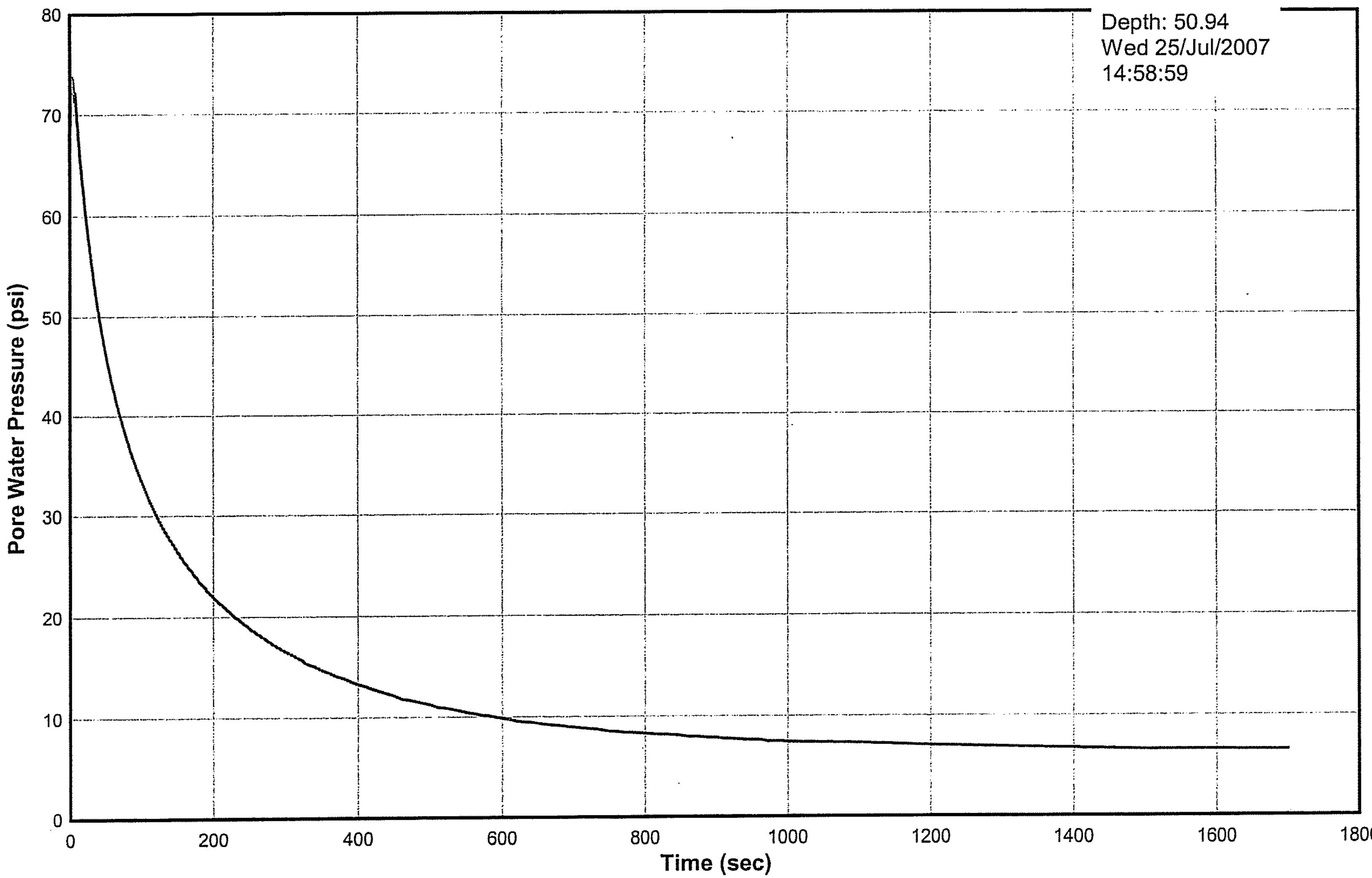
Pore Pressure Dissipation Test
Sounding 07-07B
AET #01-03612



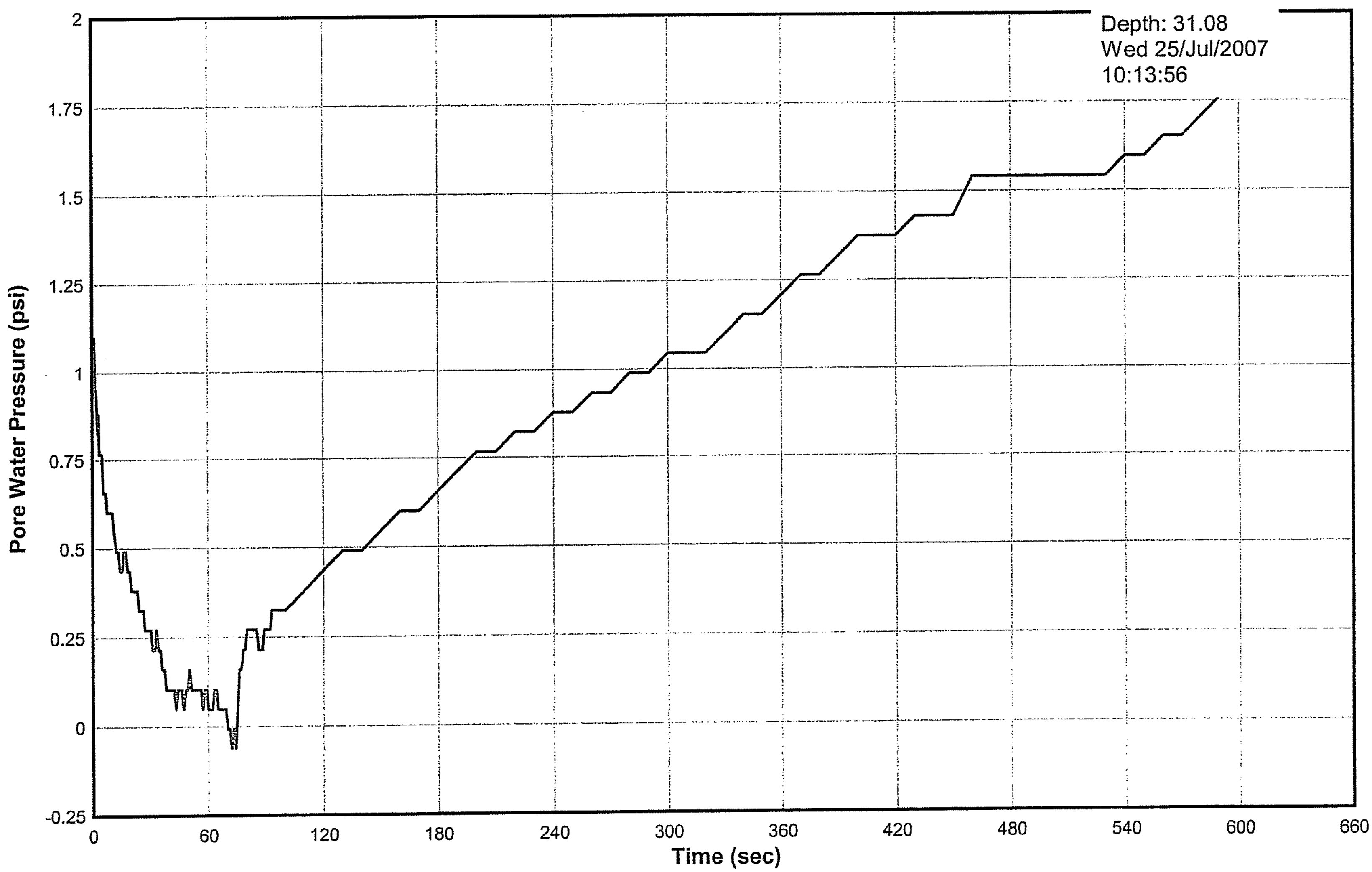
Pore Pressure Dissipation Test
Sounding 07-07C
AET #01-03612



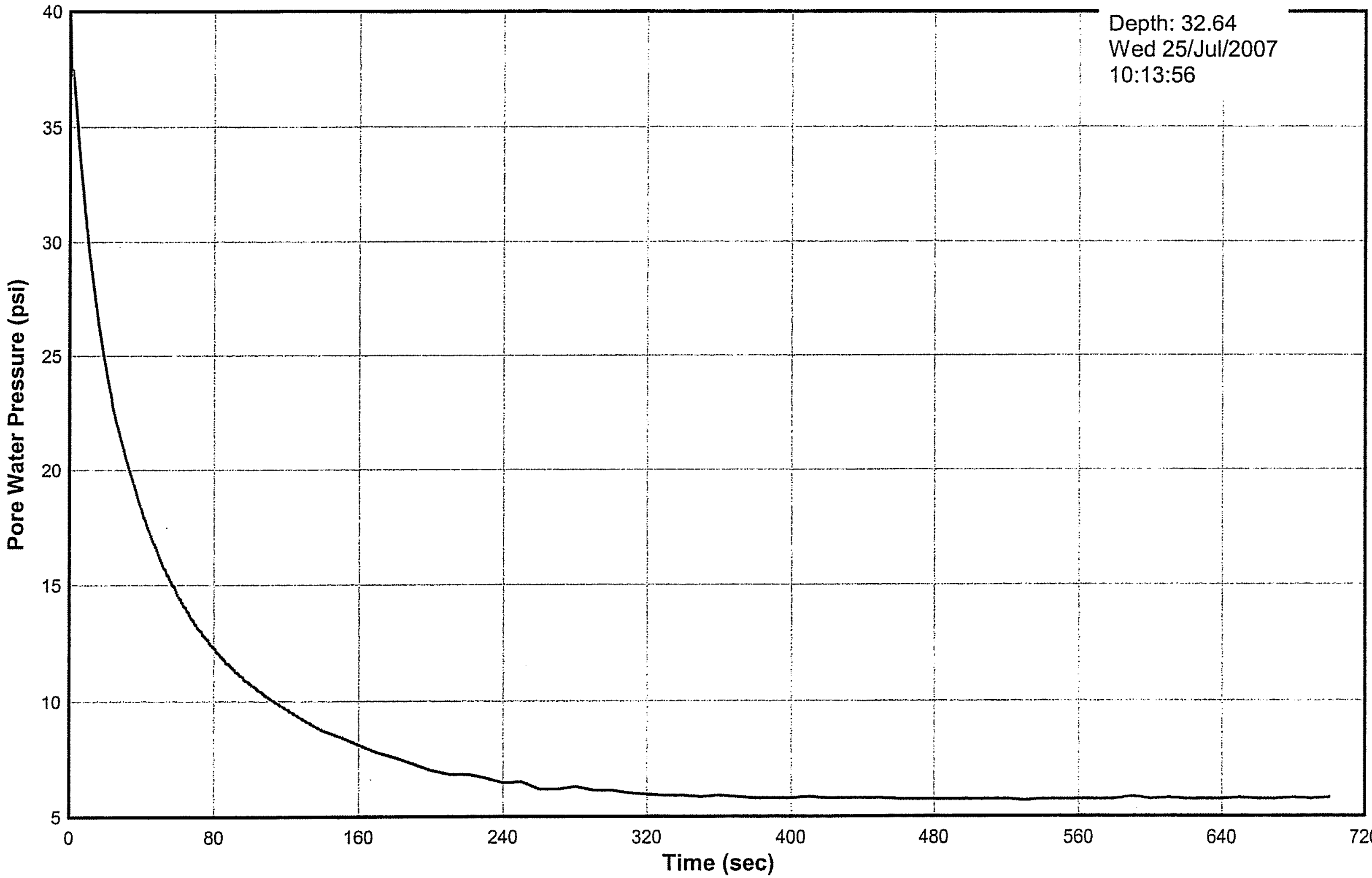
Pore Pressure Dissipation Test
Sounding 07-07C
AET #01-03612



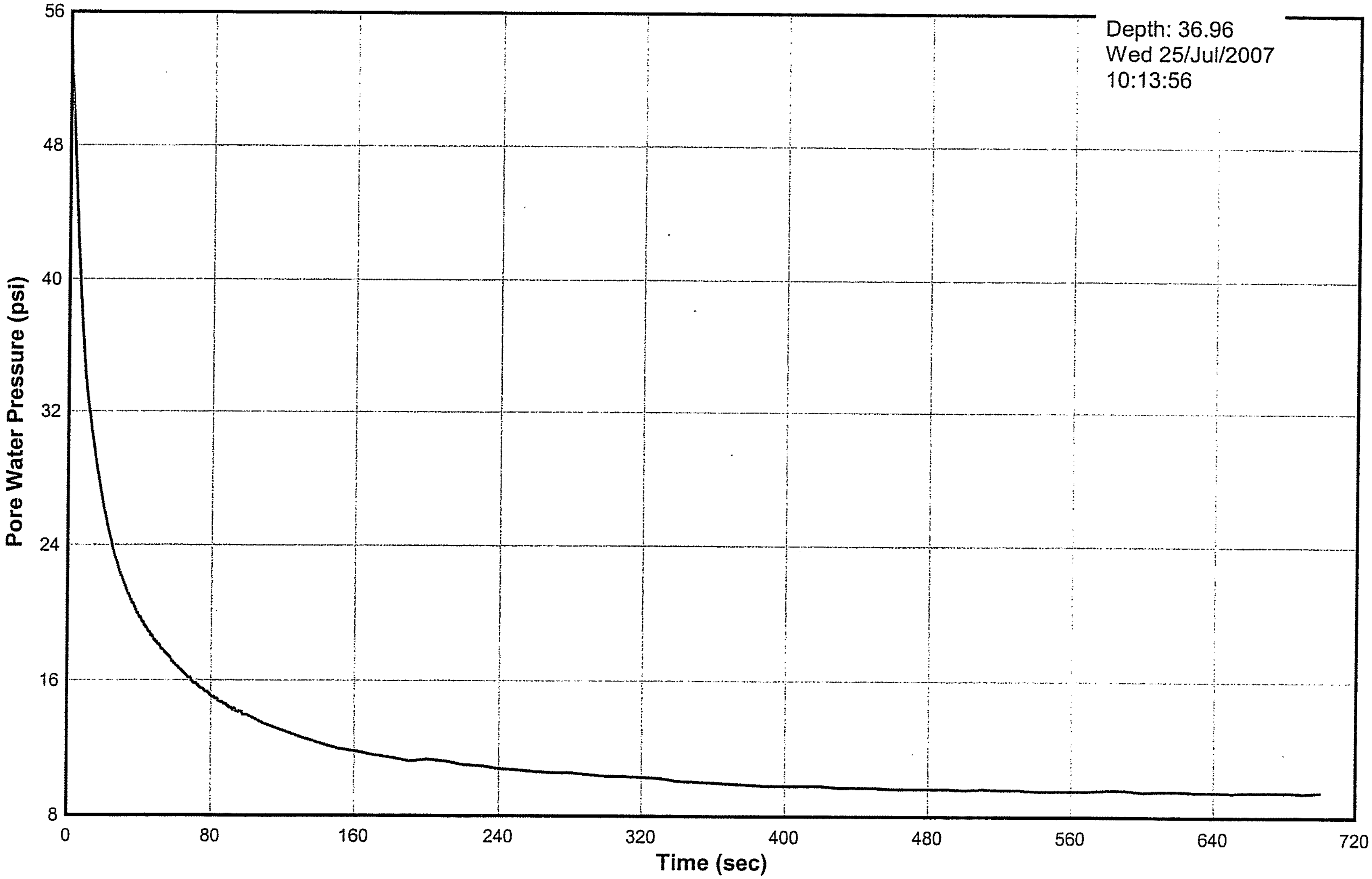
Pore Pressure Dissipation Test
Sounding 07-08
AET #01-03612



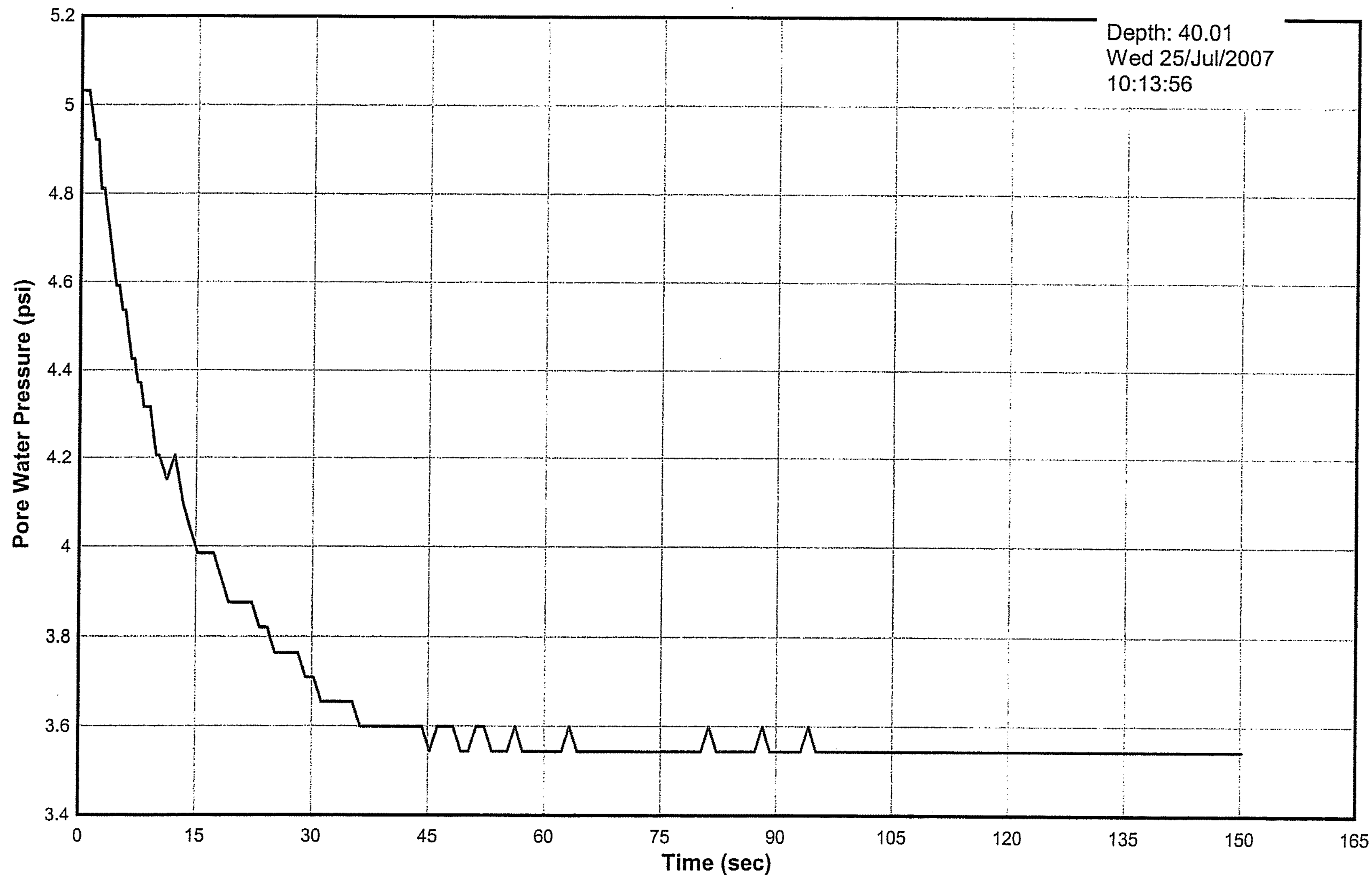
Pore Pressure Dissipation Test
Sounding 07-08
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-08
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-08
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-08
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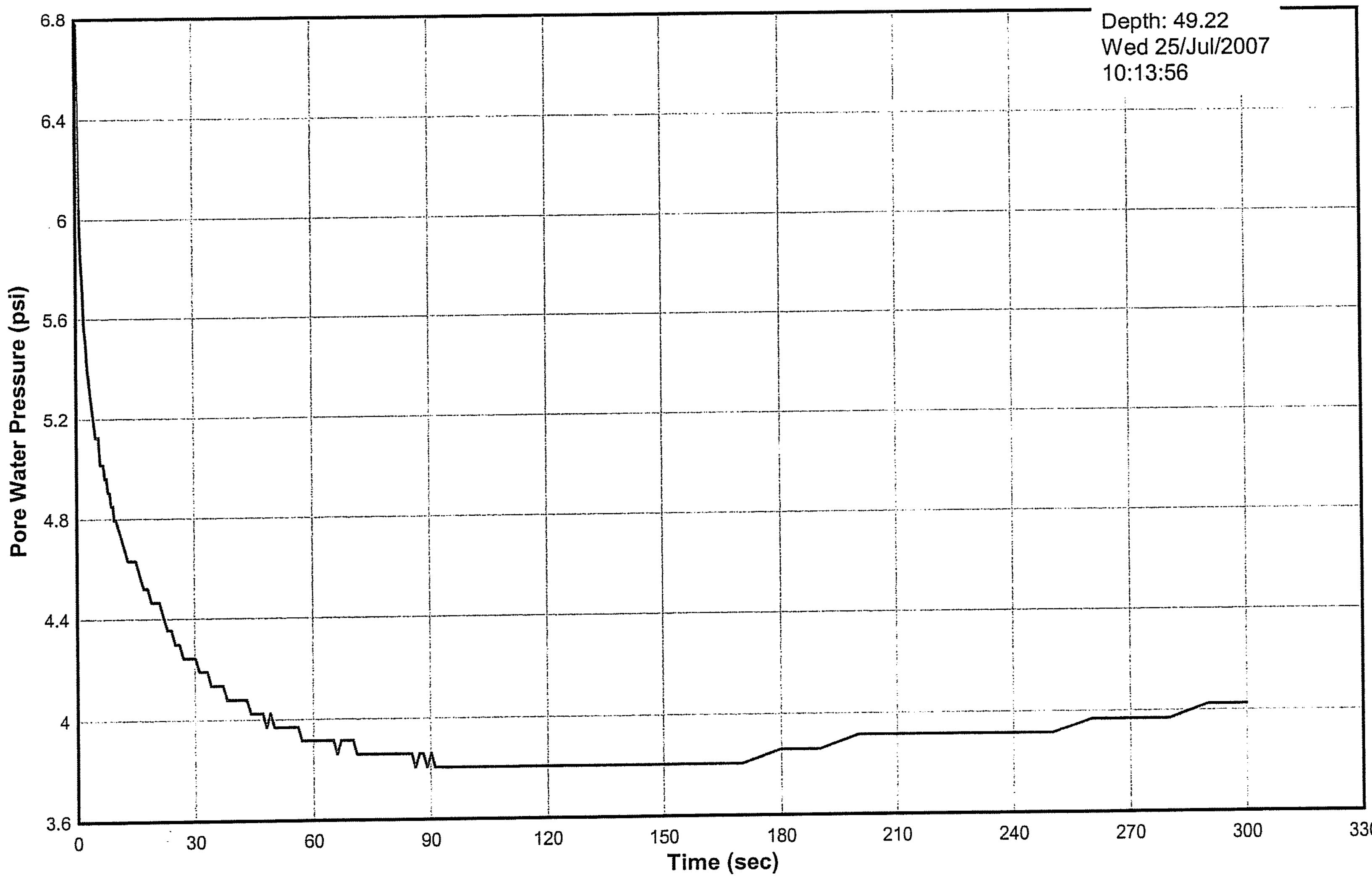
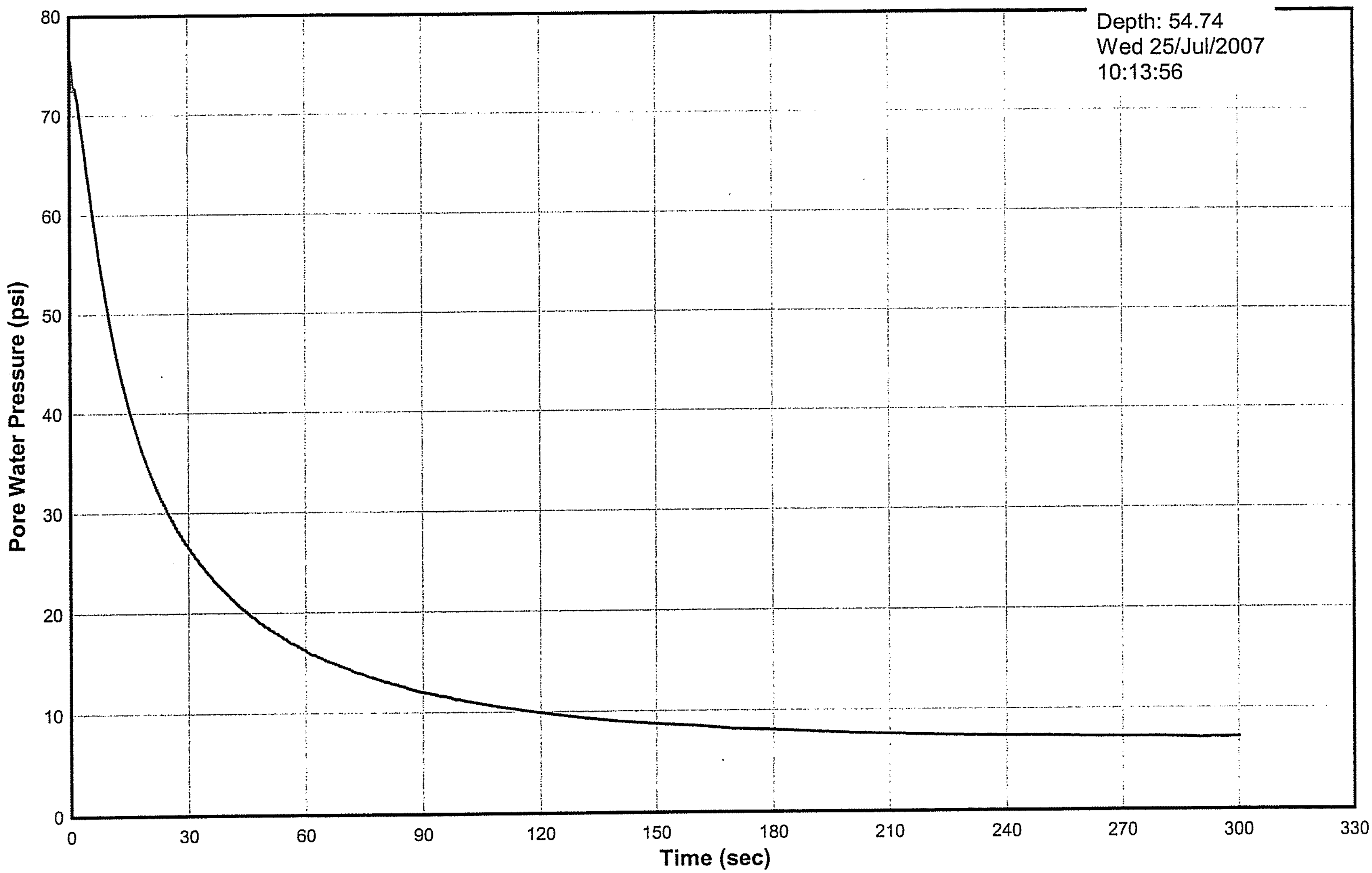
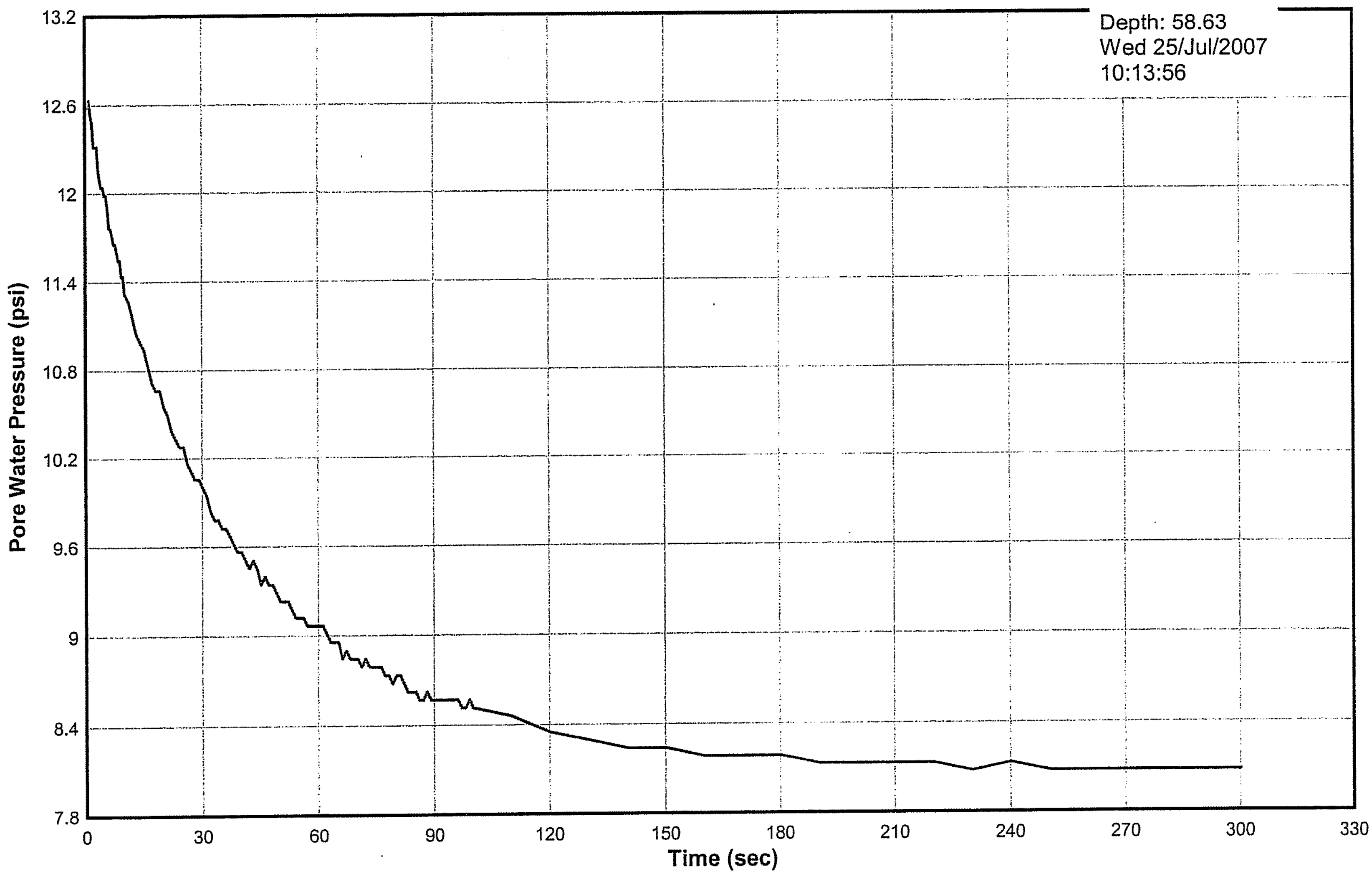


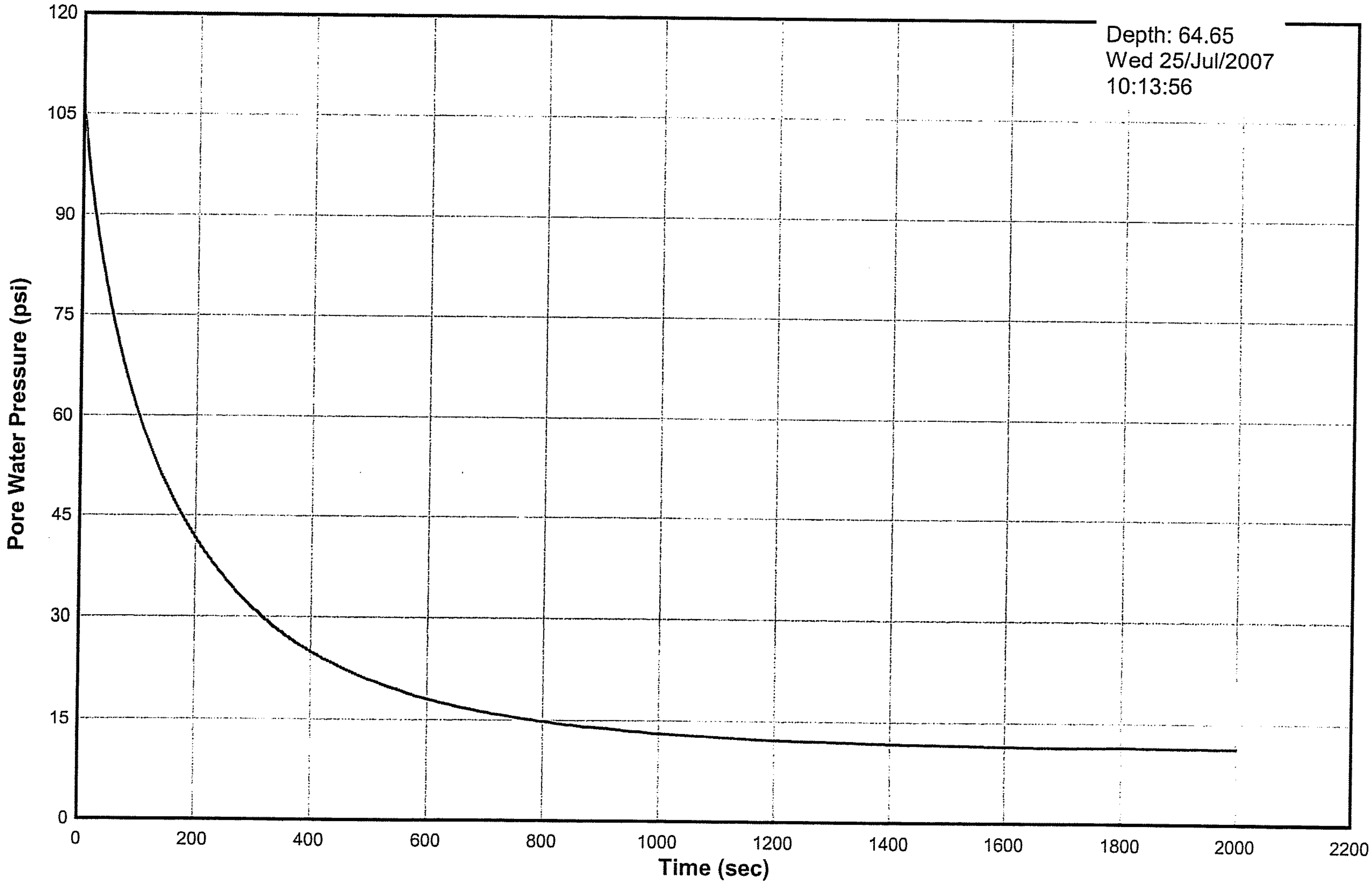
Pore Pressure Dissipation Test
Sounding 07-08
AET #01-03612



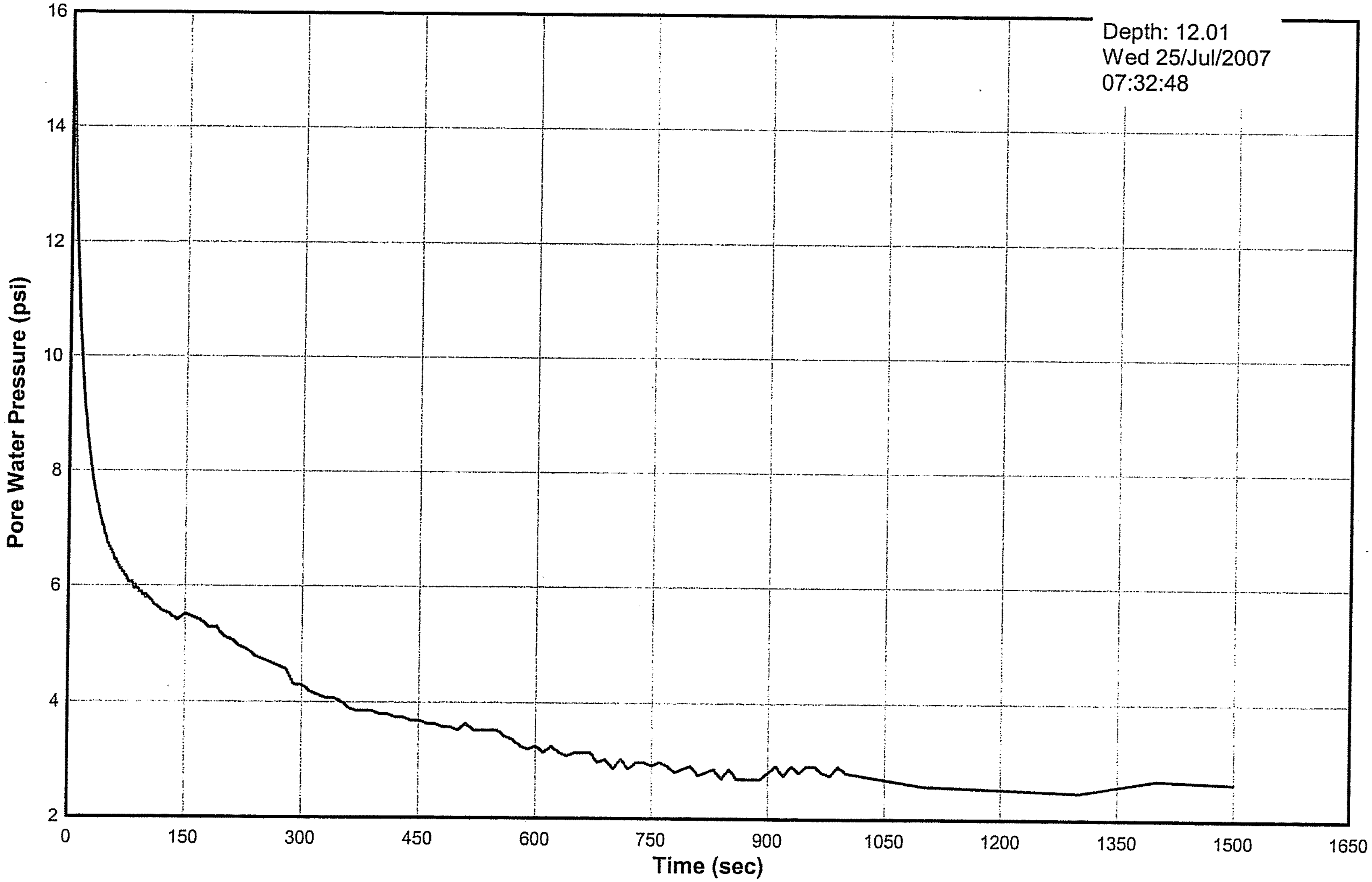
Pore Pressure Dissipation Test
Sounding 07-08
AET #01-03612

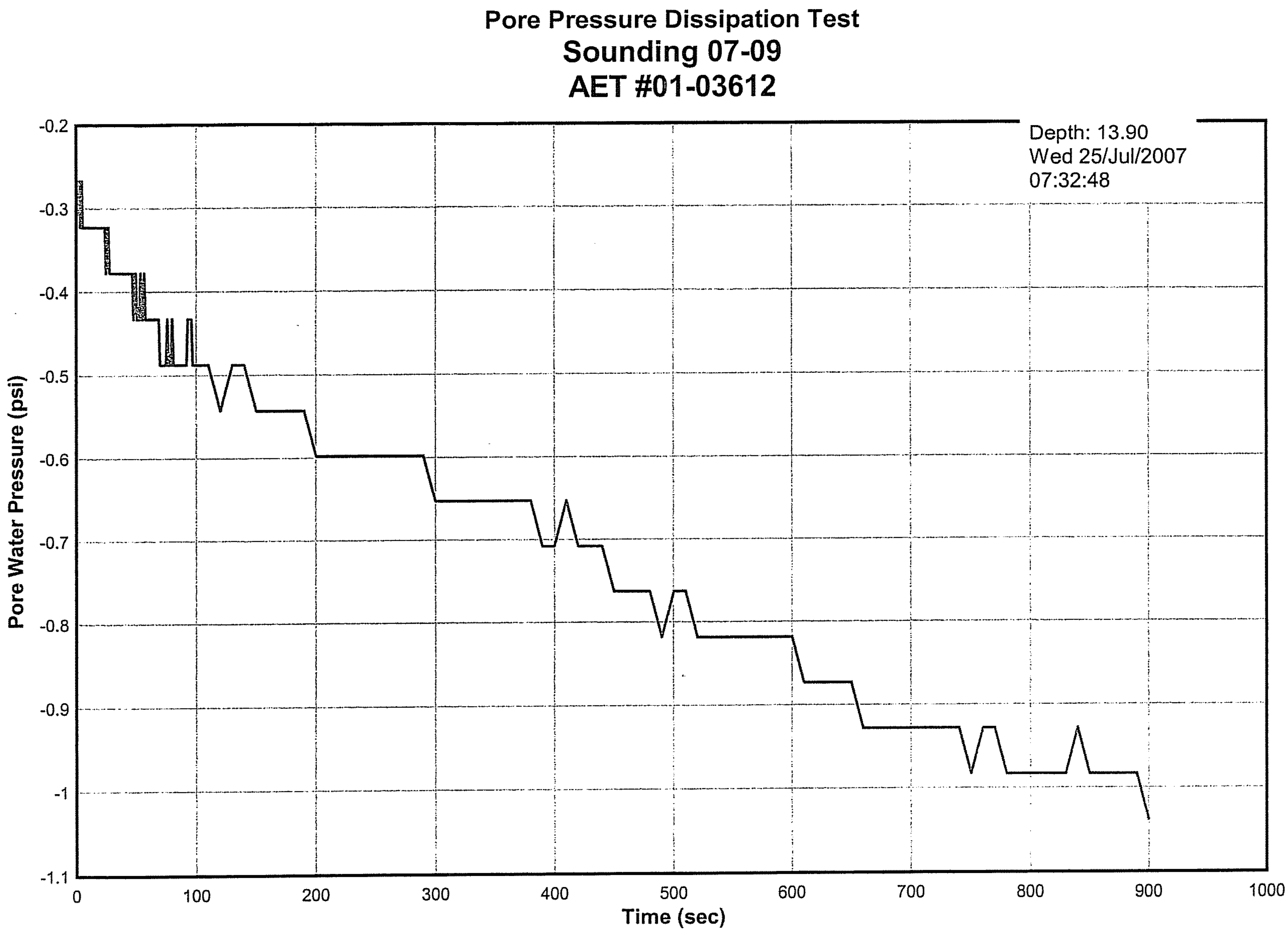


Pore Pressure Dissipation Test
Sounding 07-08
AET #01-03612

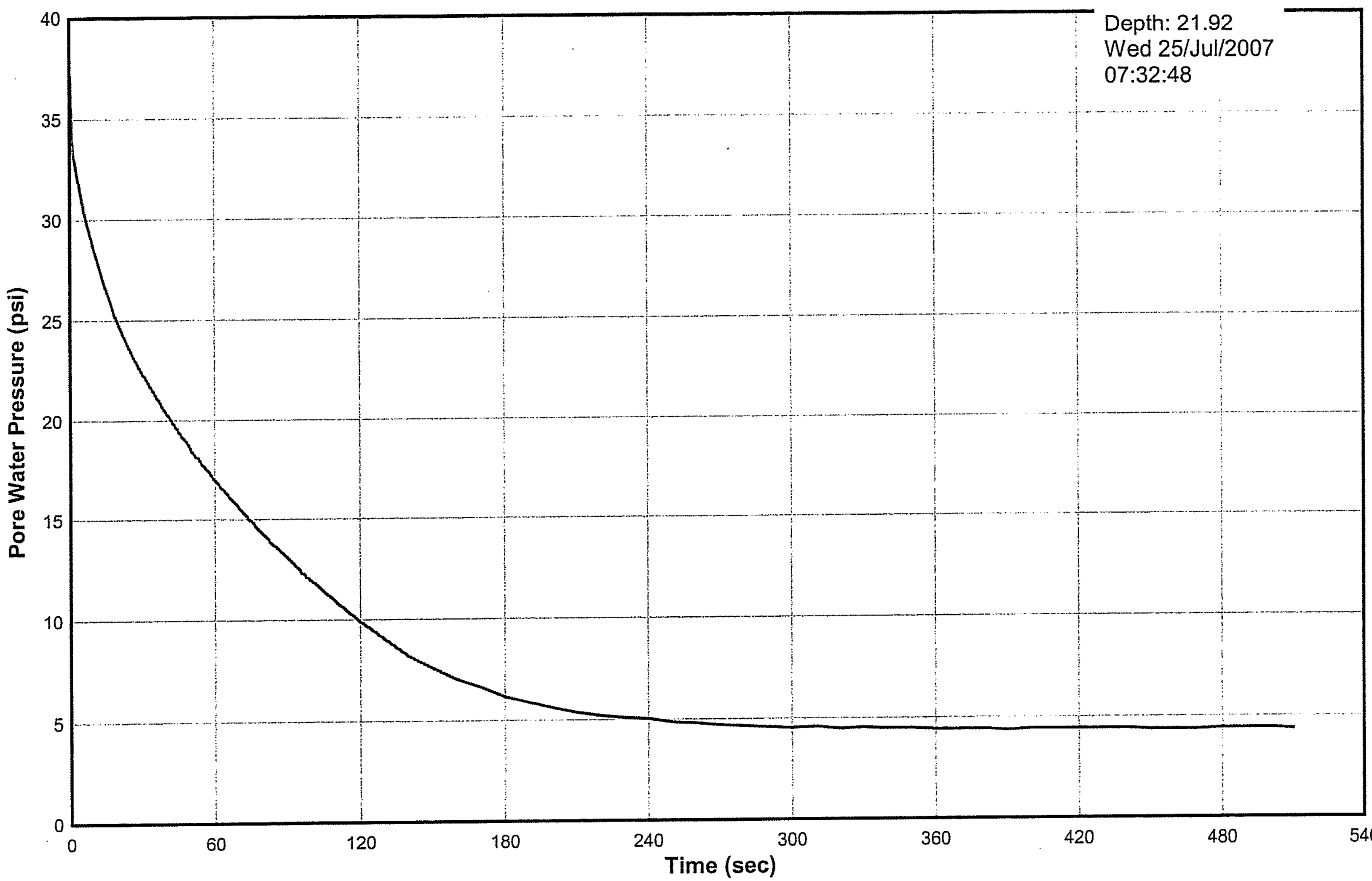


Pore Pressure Dissipation Test
Sounding 07-09
AET #01-03612

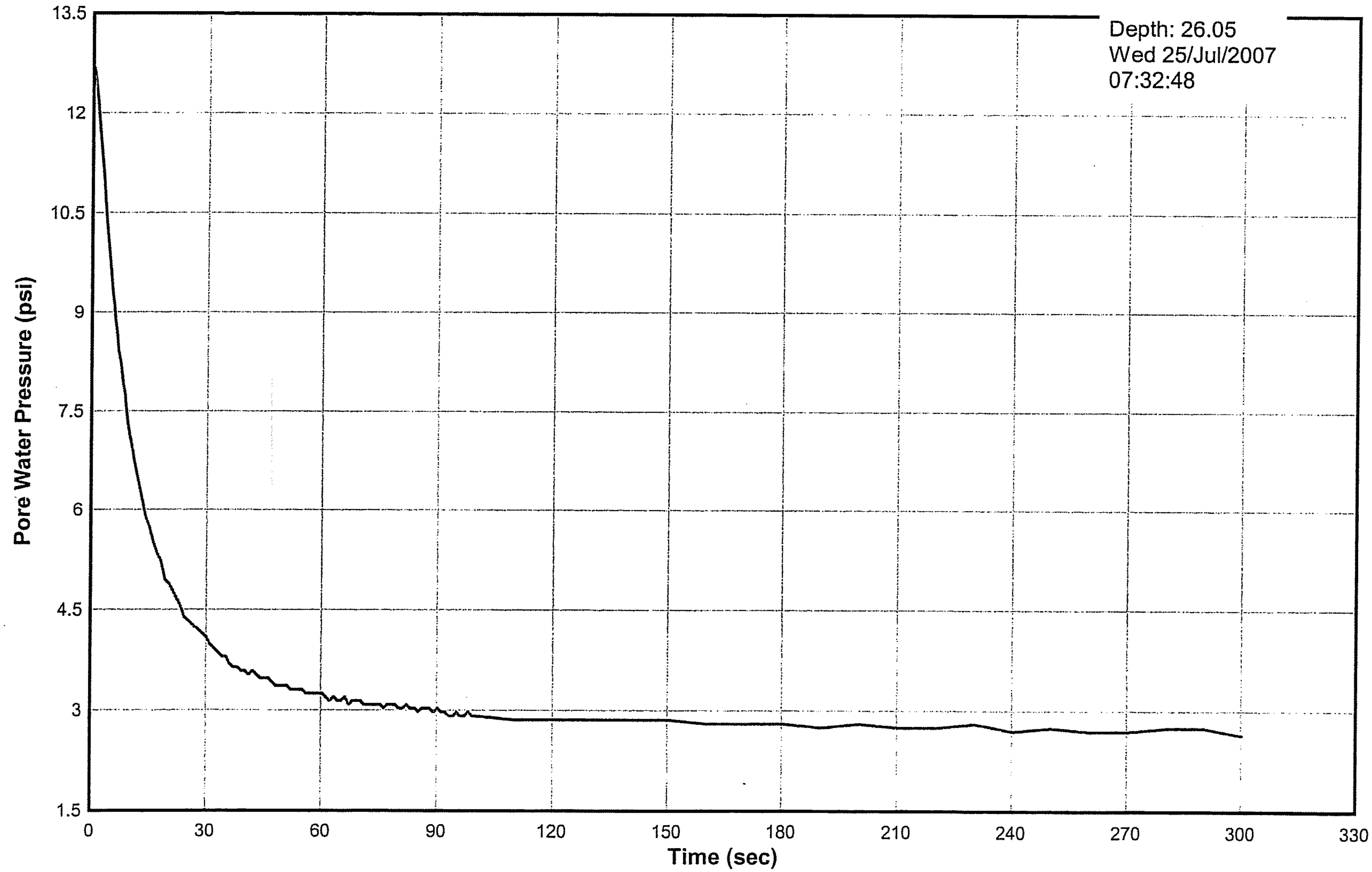



Pore Pressure Dissipation Test
Sounding 07-09
AET #01-03612
Depth: 13.90
Wed 25/Jul/2007
07:32:48
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
Pore Water Pressure (psi)
0
100
200
300
400
500
600
700
800
900
1000
Time (sec)

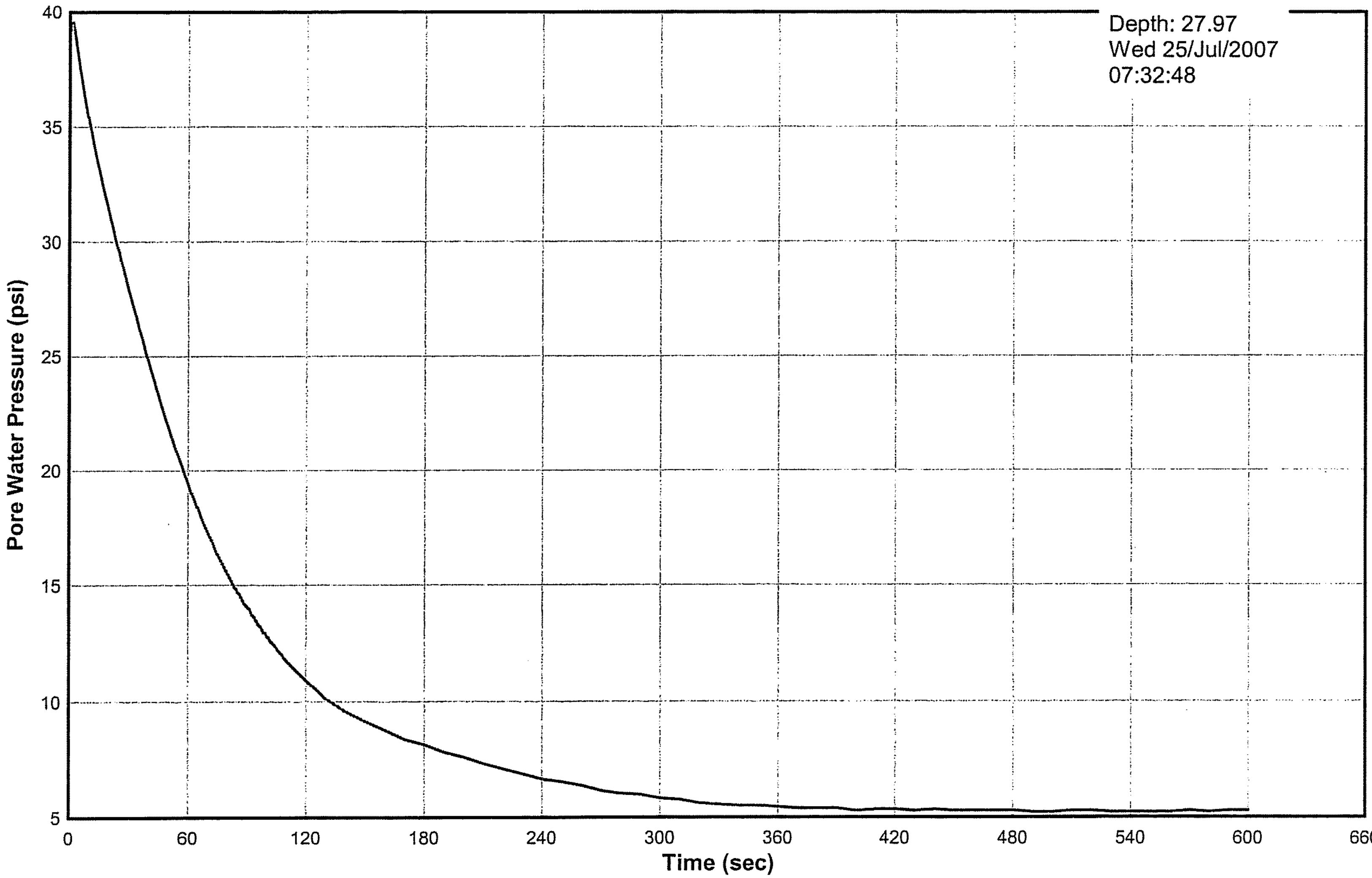
Pore Pressure Dissipation Test
Sounding 07-09
AET #01-03612



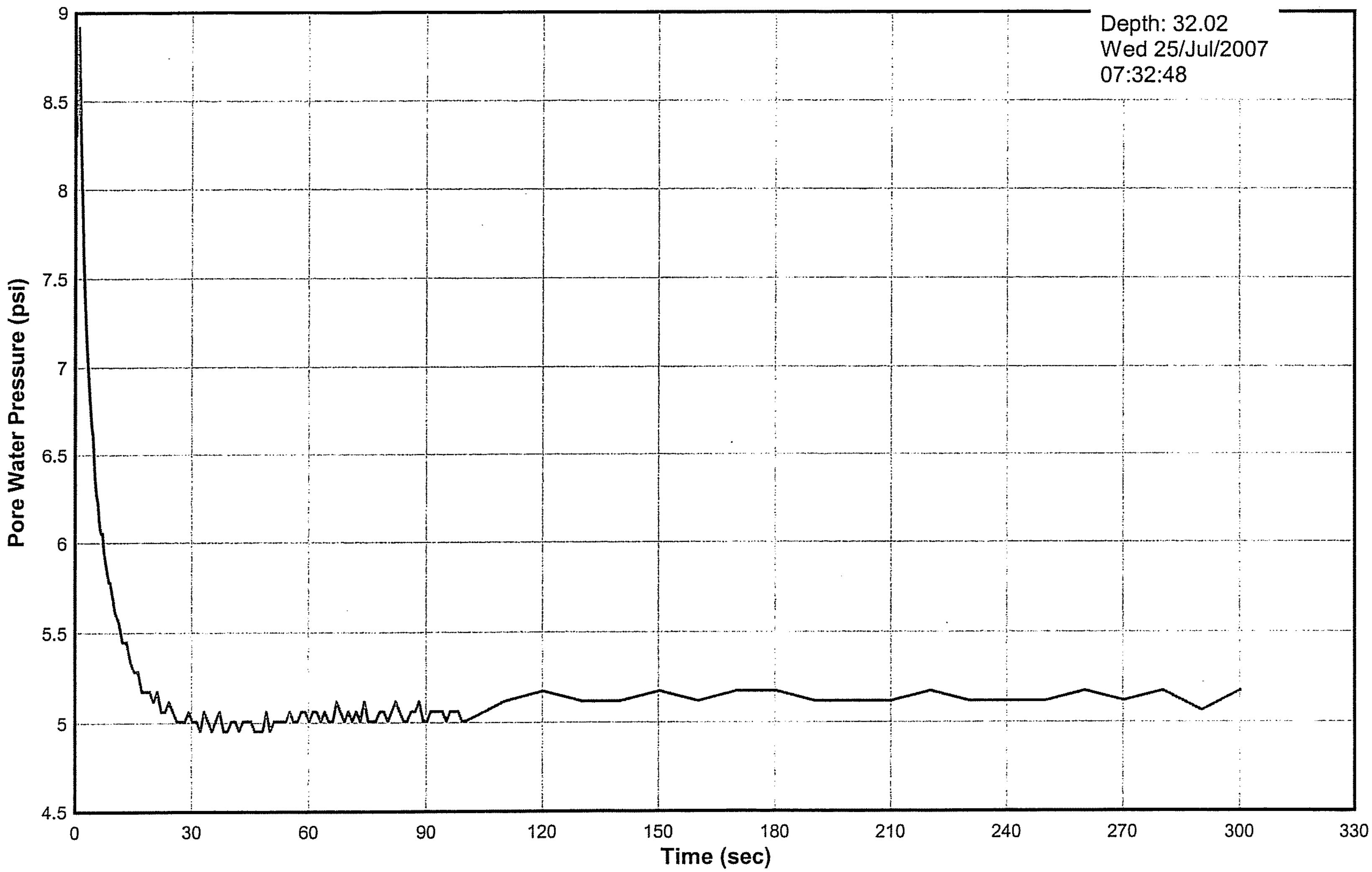
Pore Pressure Dissipation Test
Sounding 07-09
AET #01-03612



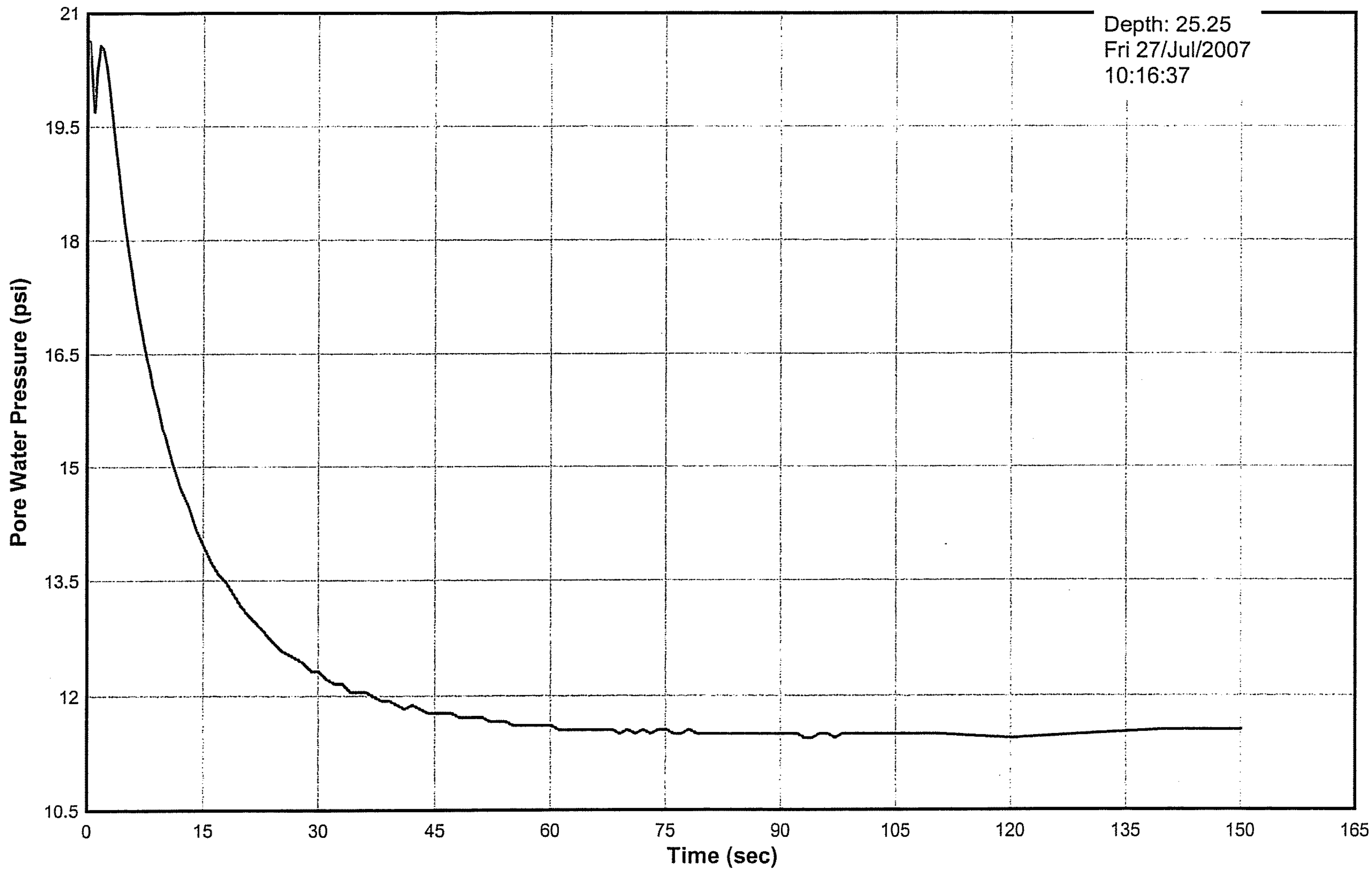
Pore Pressure Dissipation Test
Sounding 07-09
AET #01-03612



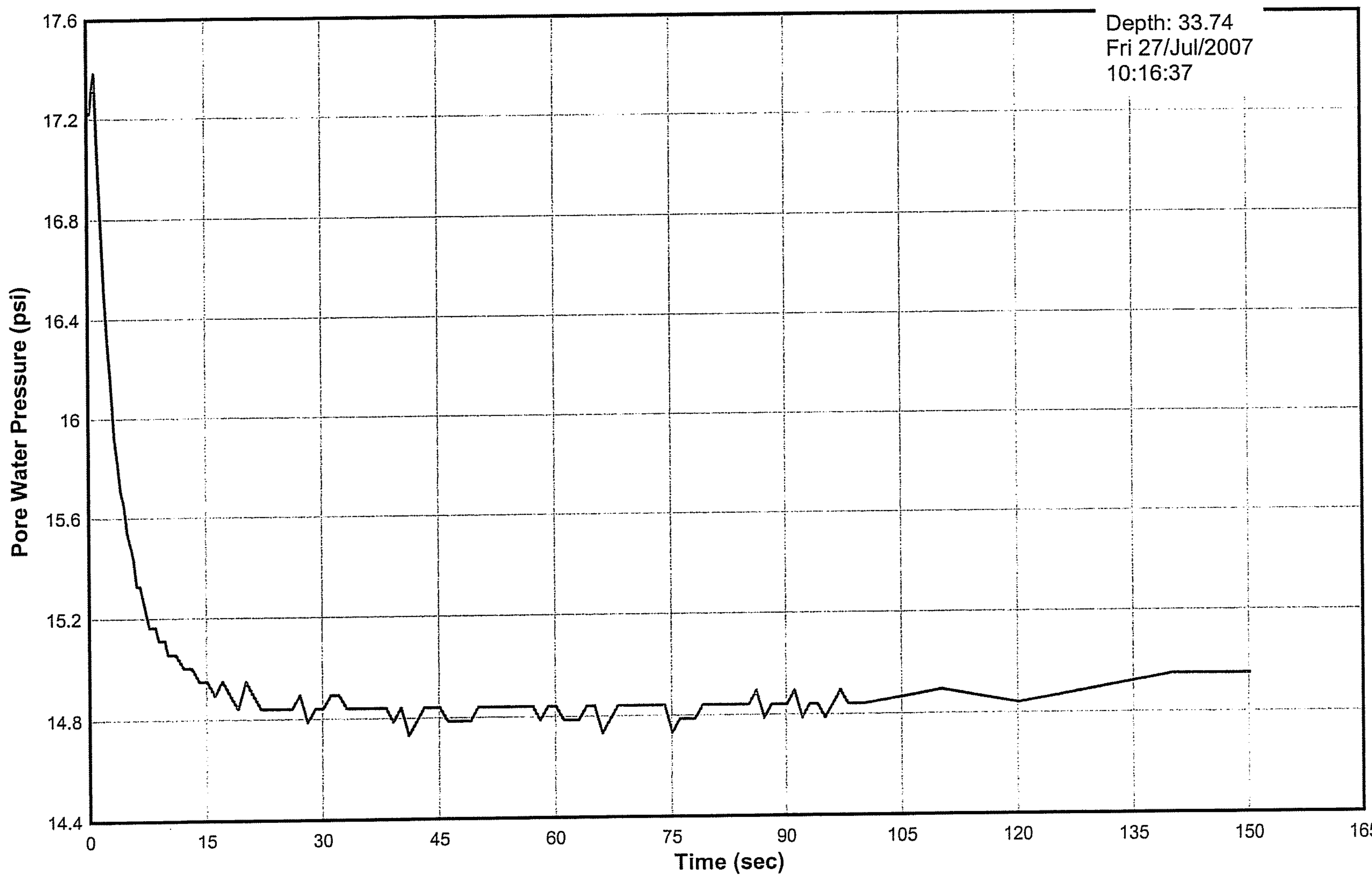
Pore Pressure Dissipation Test
Sounding 07-09
AET #01-03612



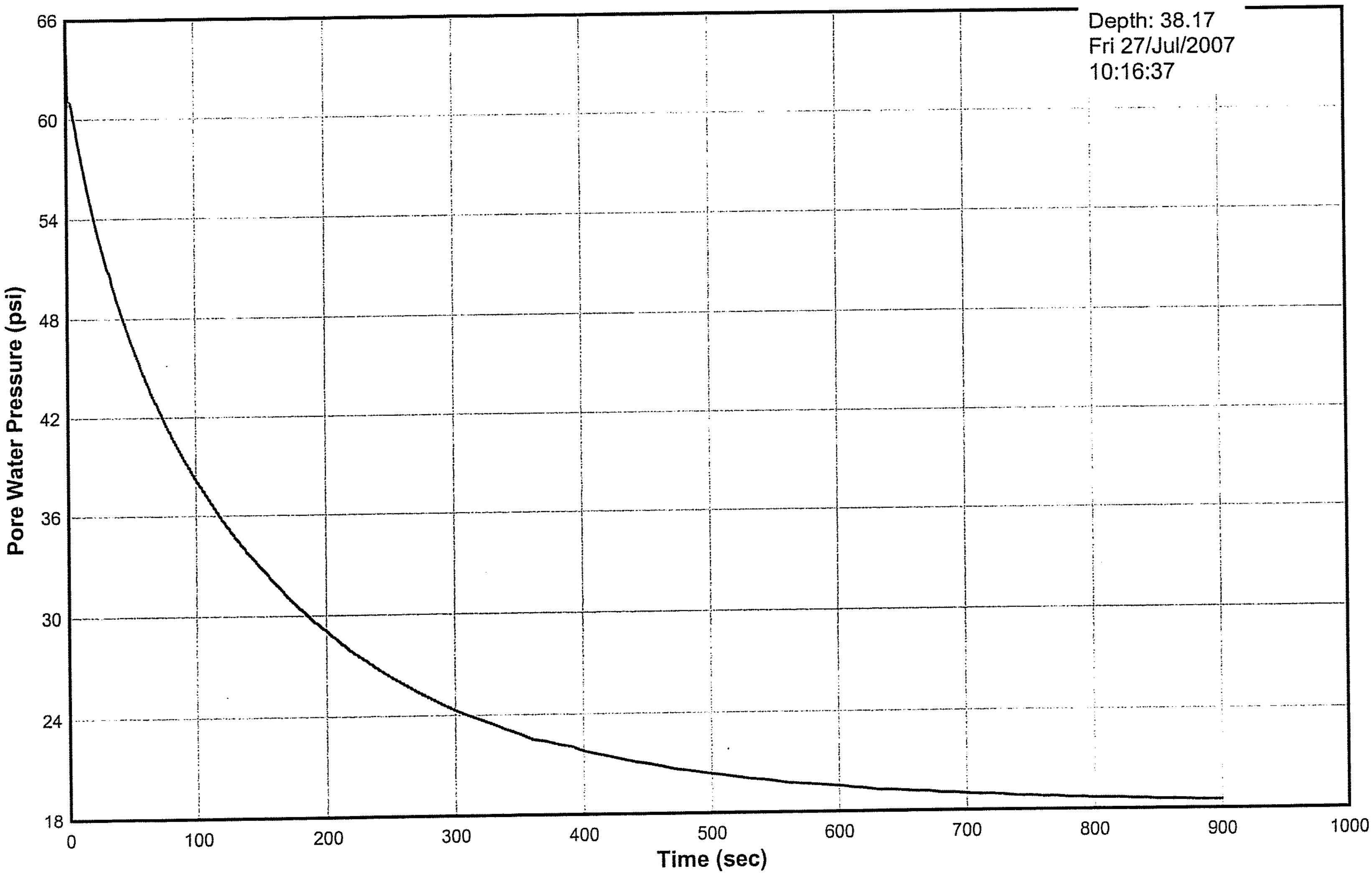
Pore Pressure Dissipation Test
Sounding 07-10
AET #01-03612



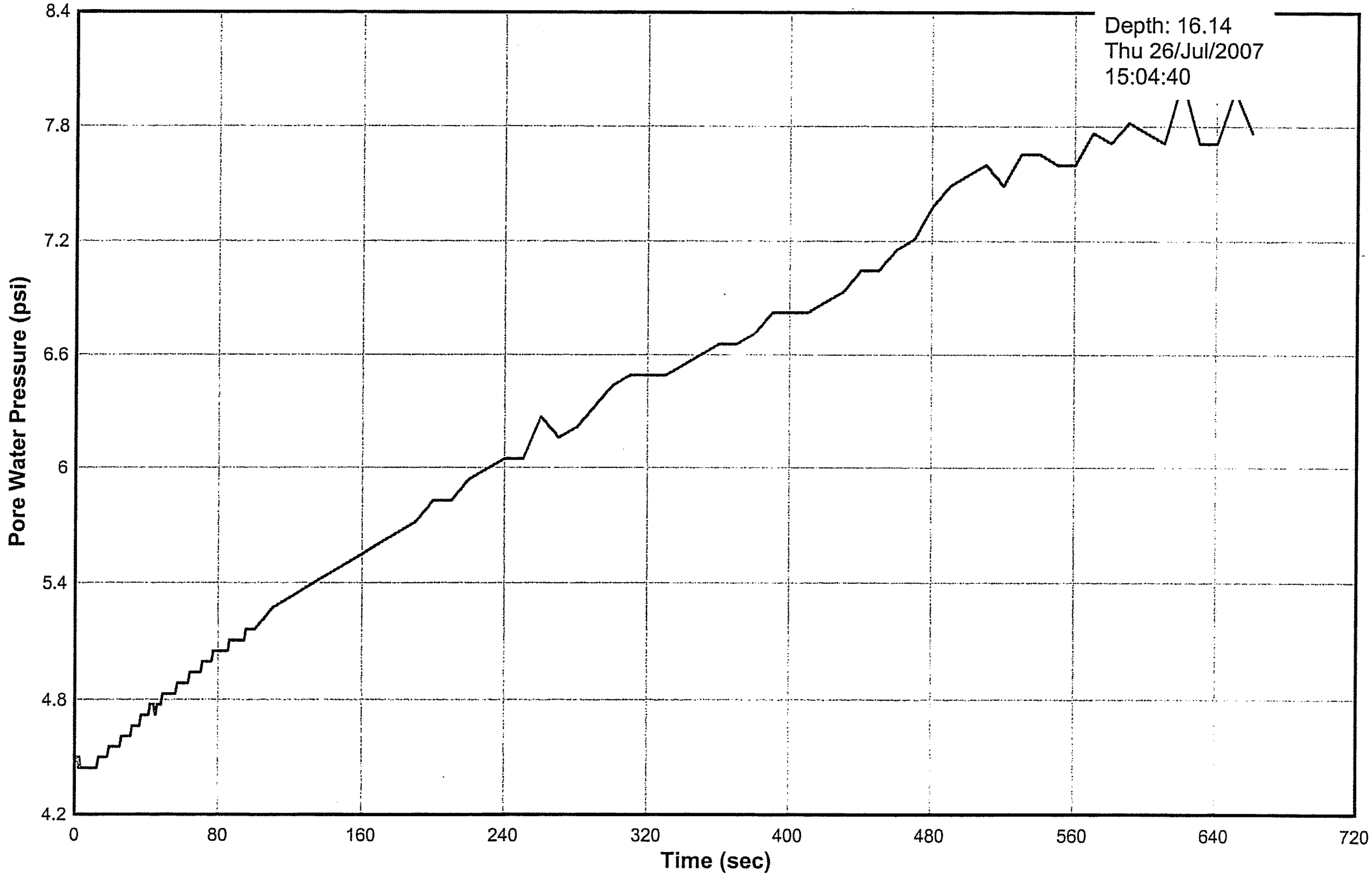
Pore Pressure Dissipation Test
Sounding 07-10
AET #01-03612



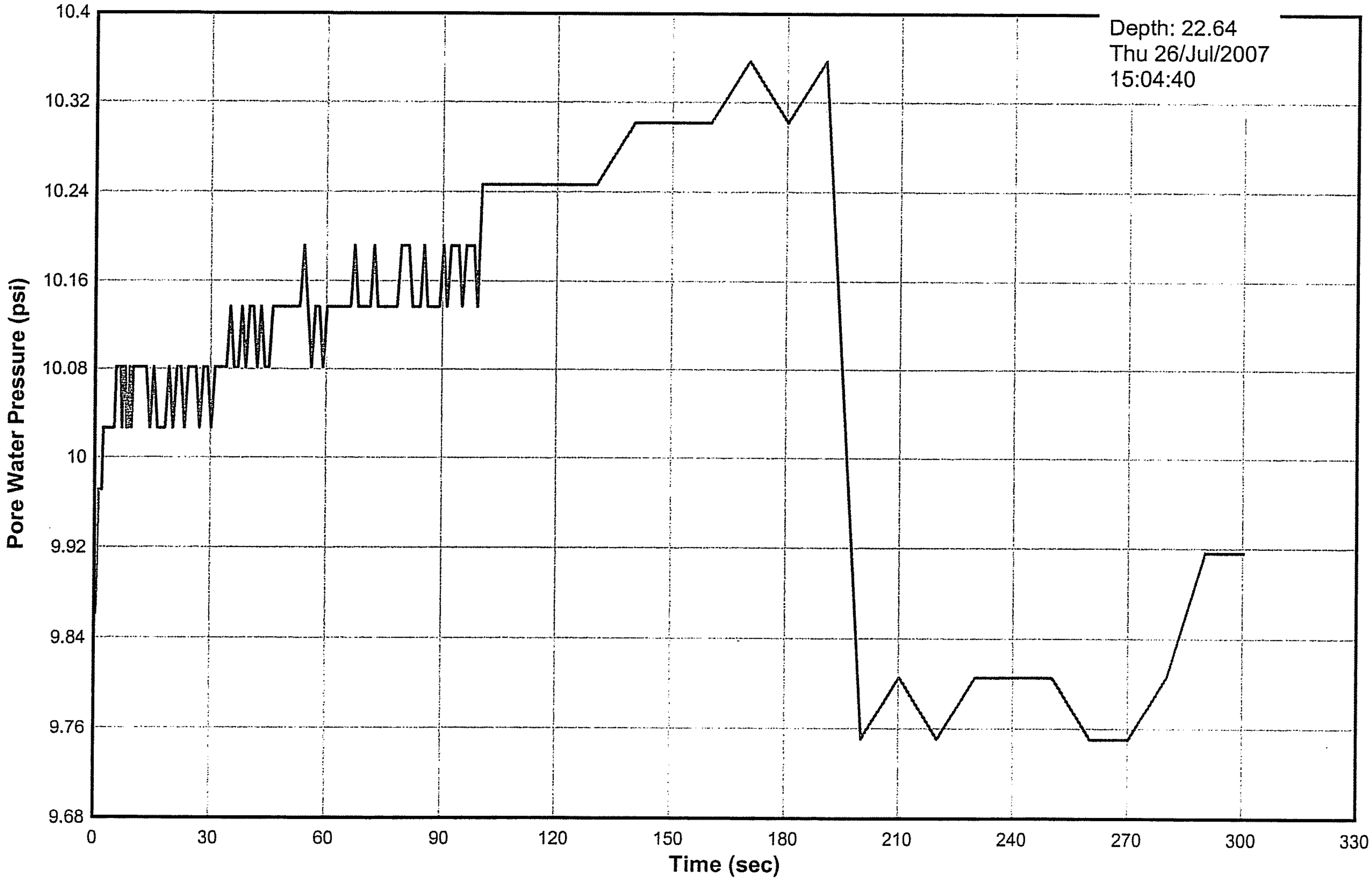
Pore Pressure Dissipation Test
Sounding 07-10
AET #01-03612



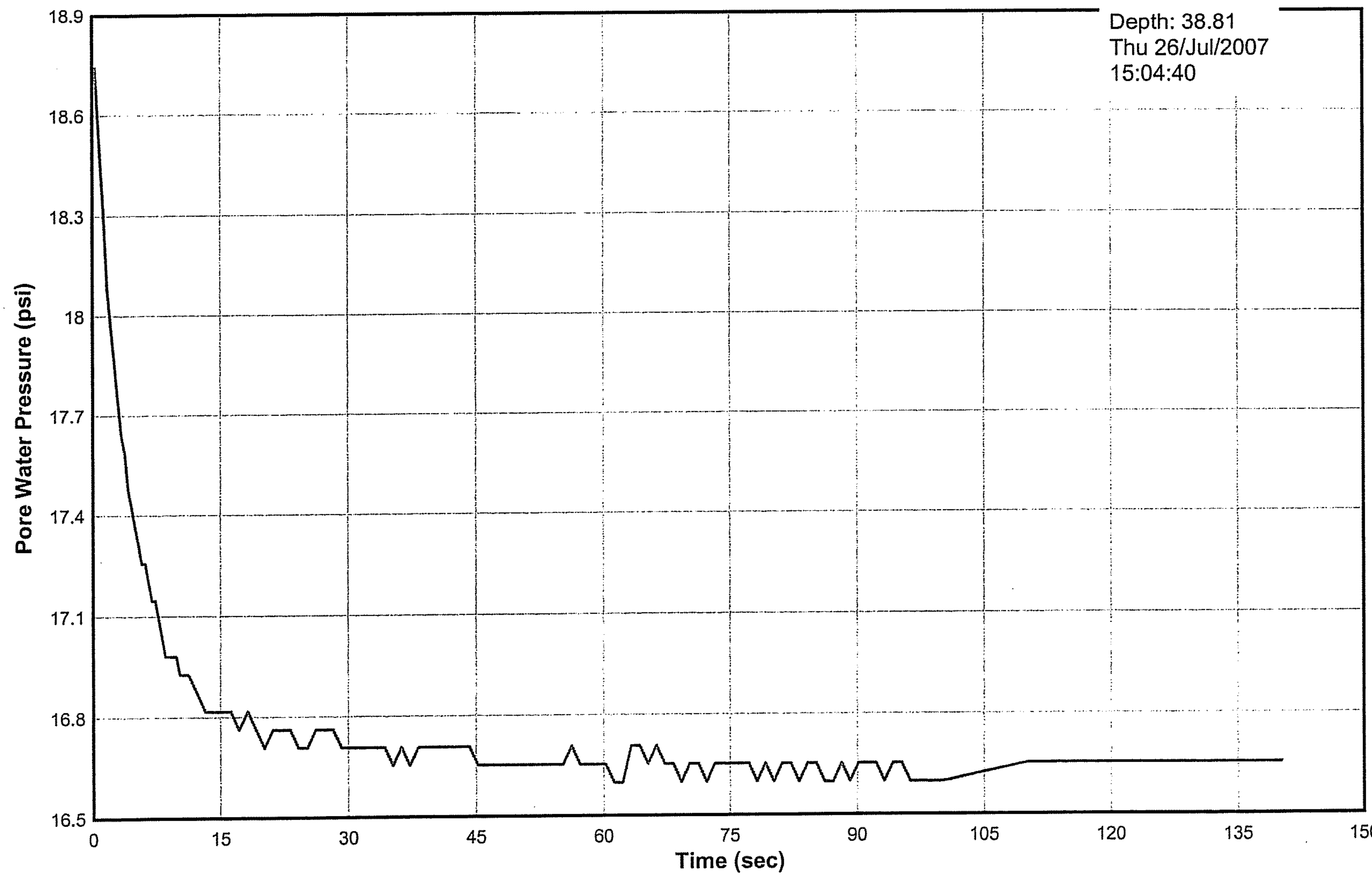
Pore Pressure Dissipation Test
Sounding 07-11
AET #01-03612



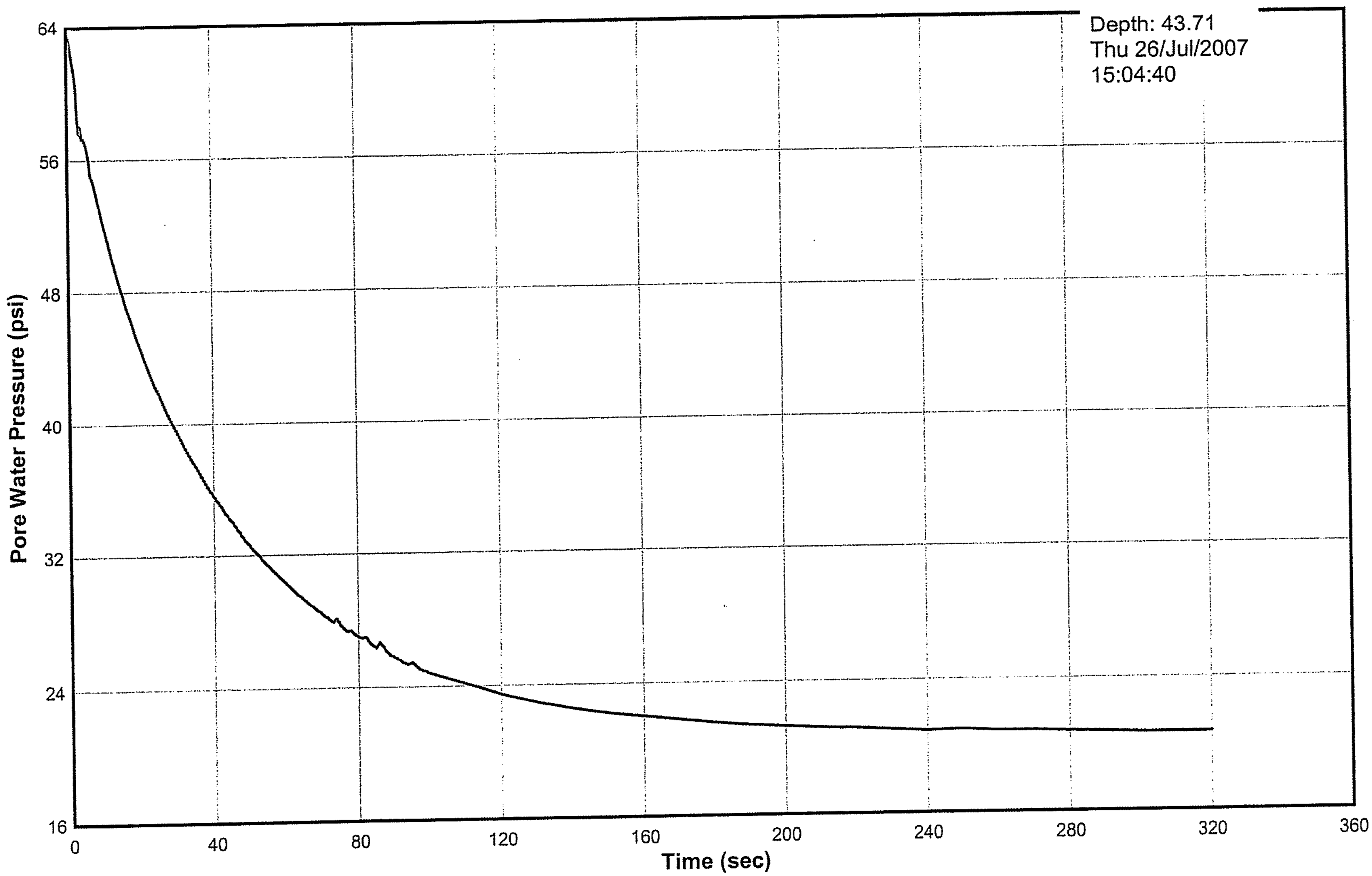
Pore Pressure Dissipation Test
Sounding 07-11
AET #01-03612



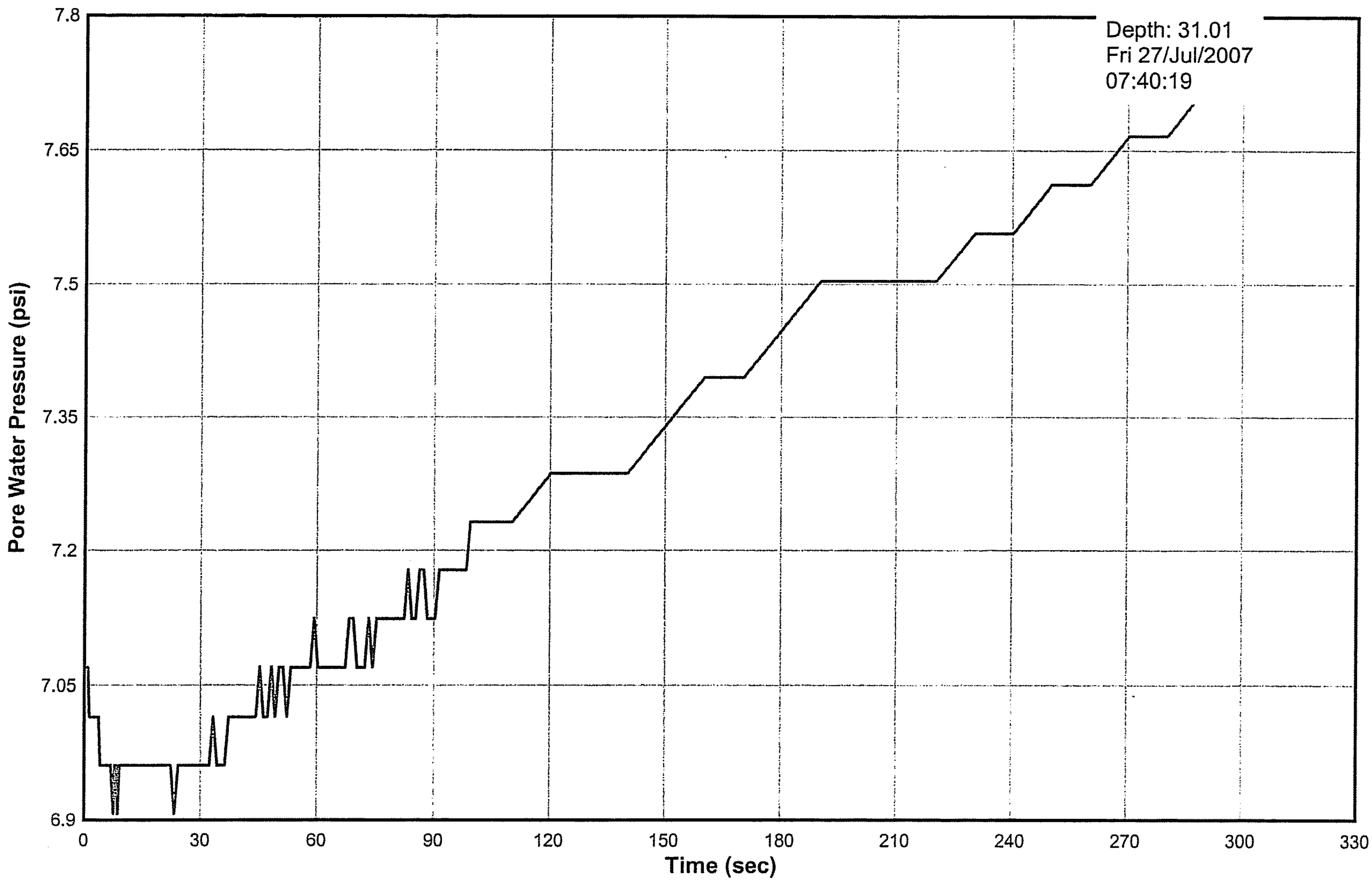
Pore Pressure Dissipation Test
Sounding 07-11
AET #01-03612



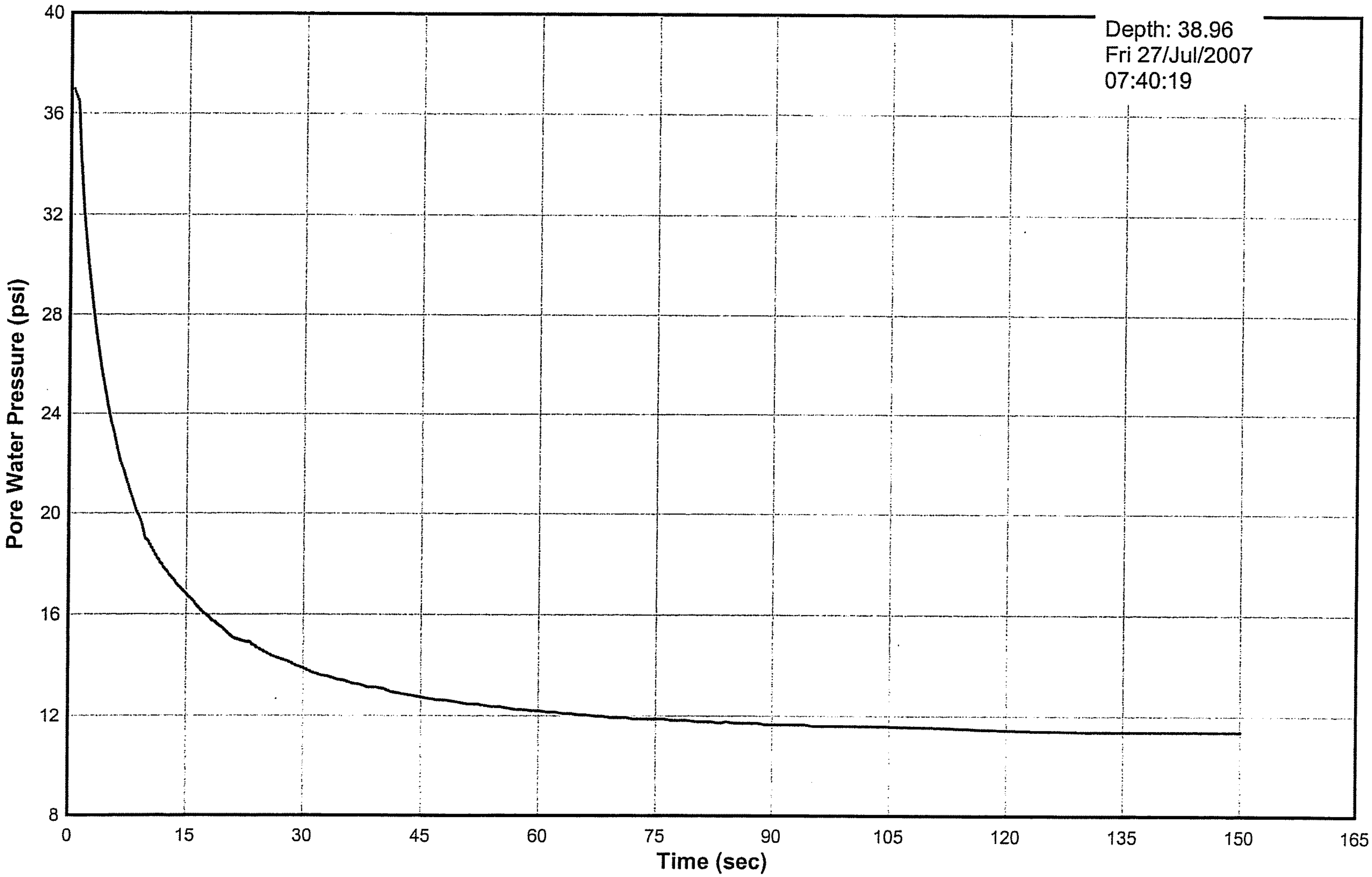
Pore Pressure Dissipation Test
Sounding 07-11
AET #01-03612



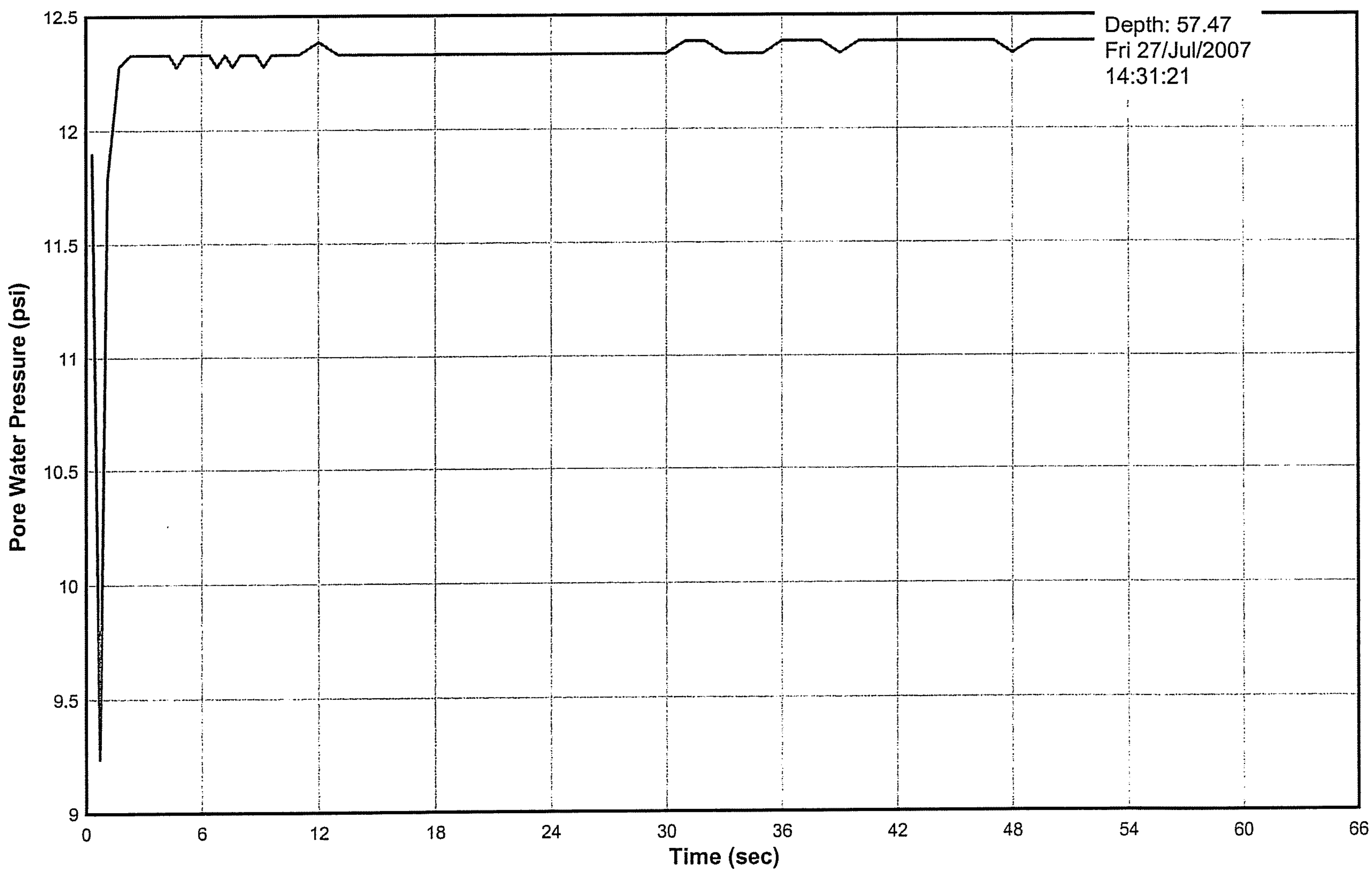
Pore Pressure Dissipation Test
Sounding 07-12
AET #01-03612



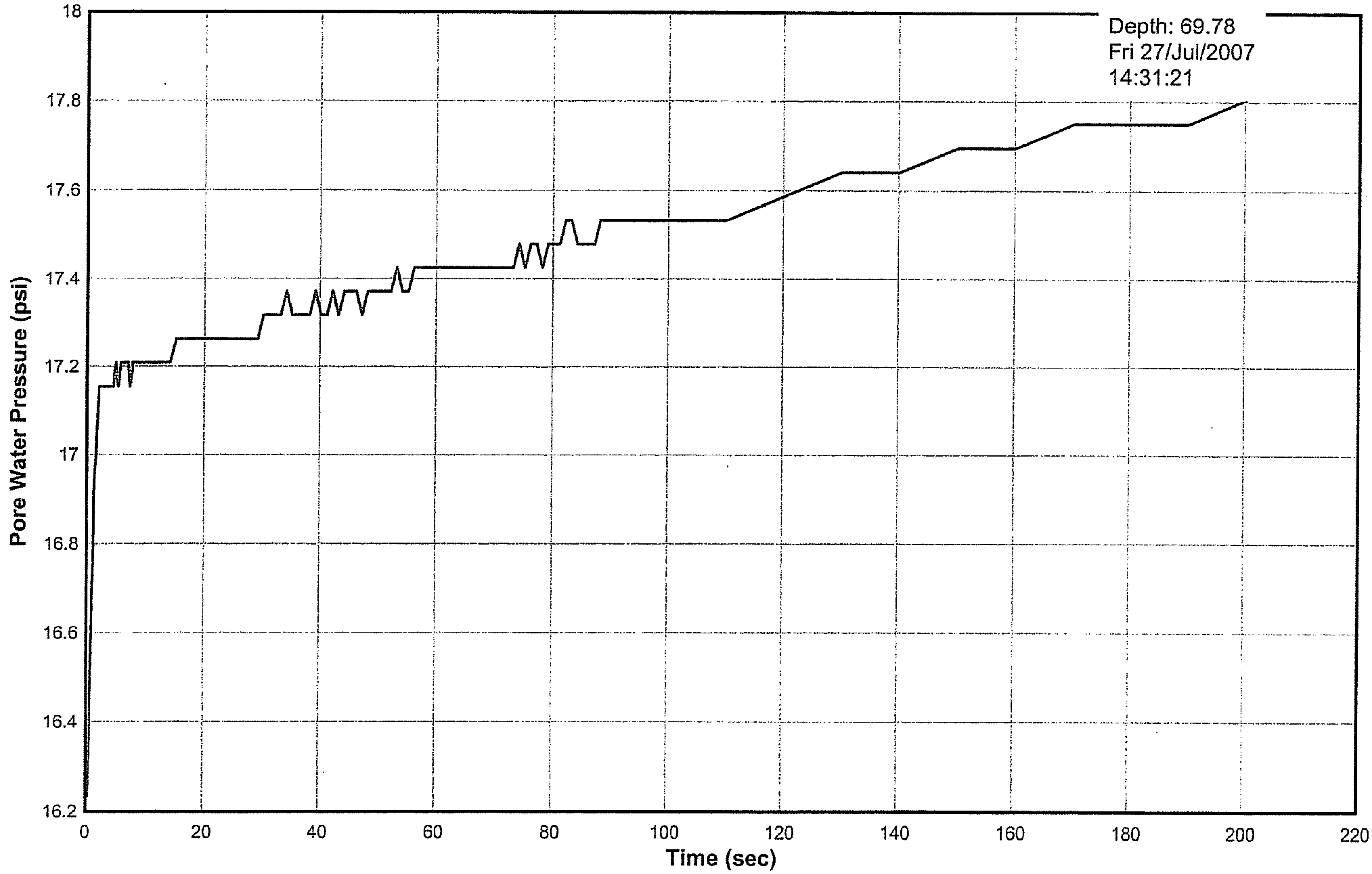
Pore Pressure Dissipation Test
Sounding 07-12
AET #01-03612



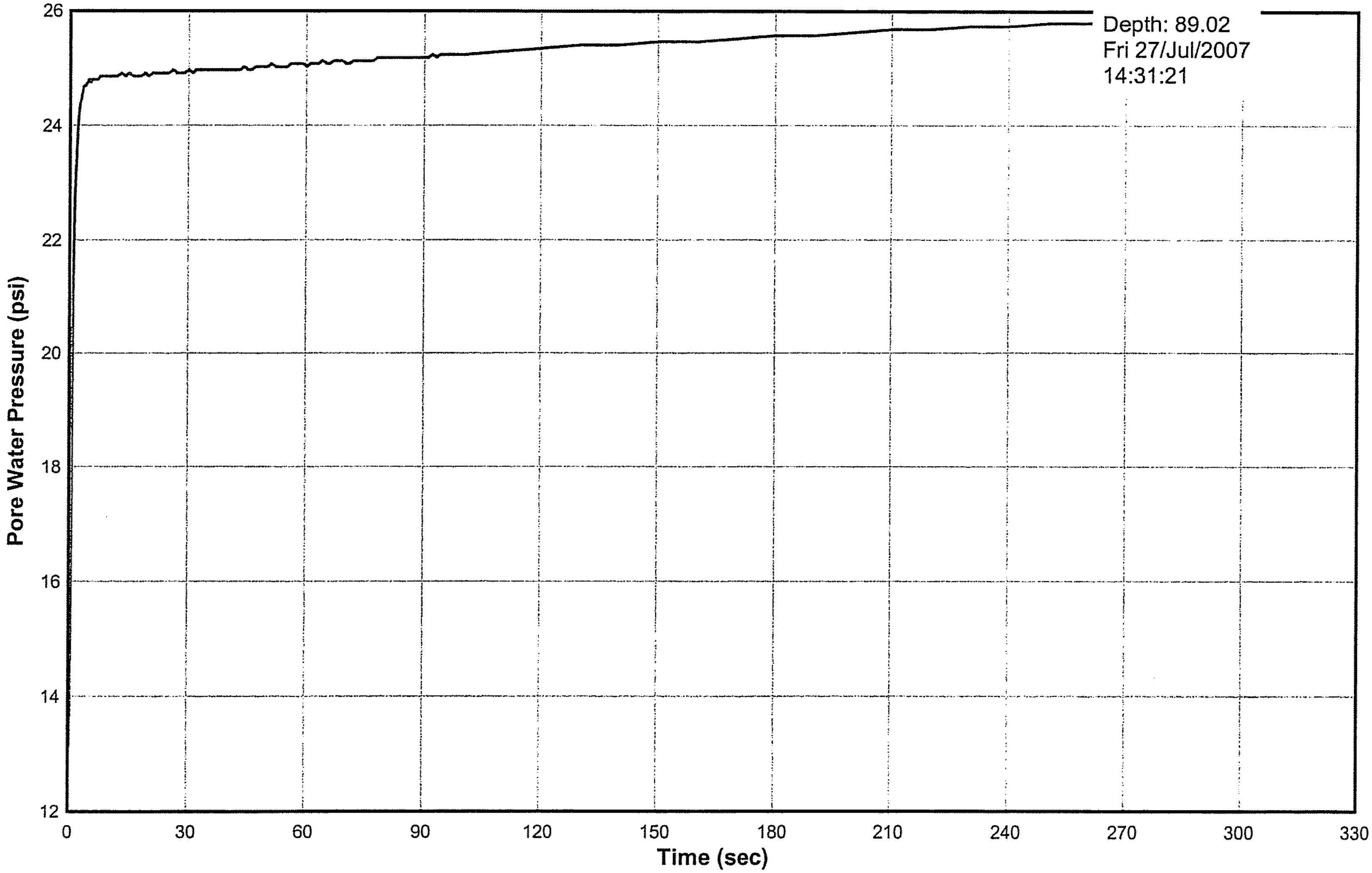
Pore Pressure Dissipation Test
Sounding 07-14
AET #01-03612



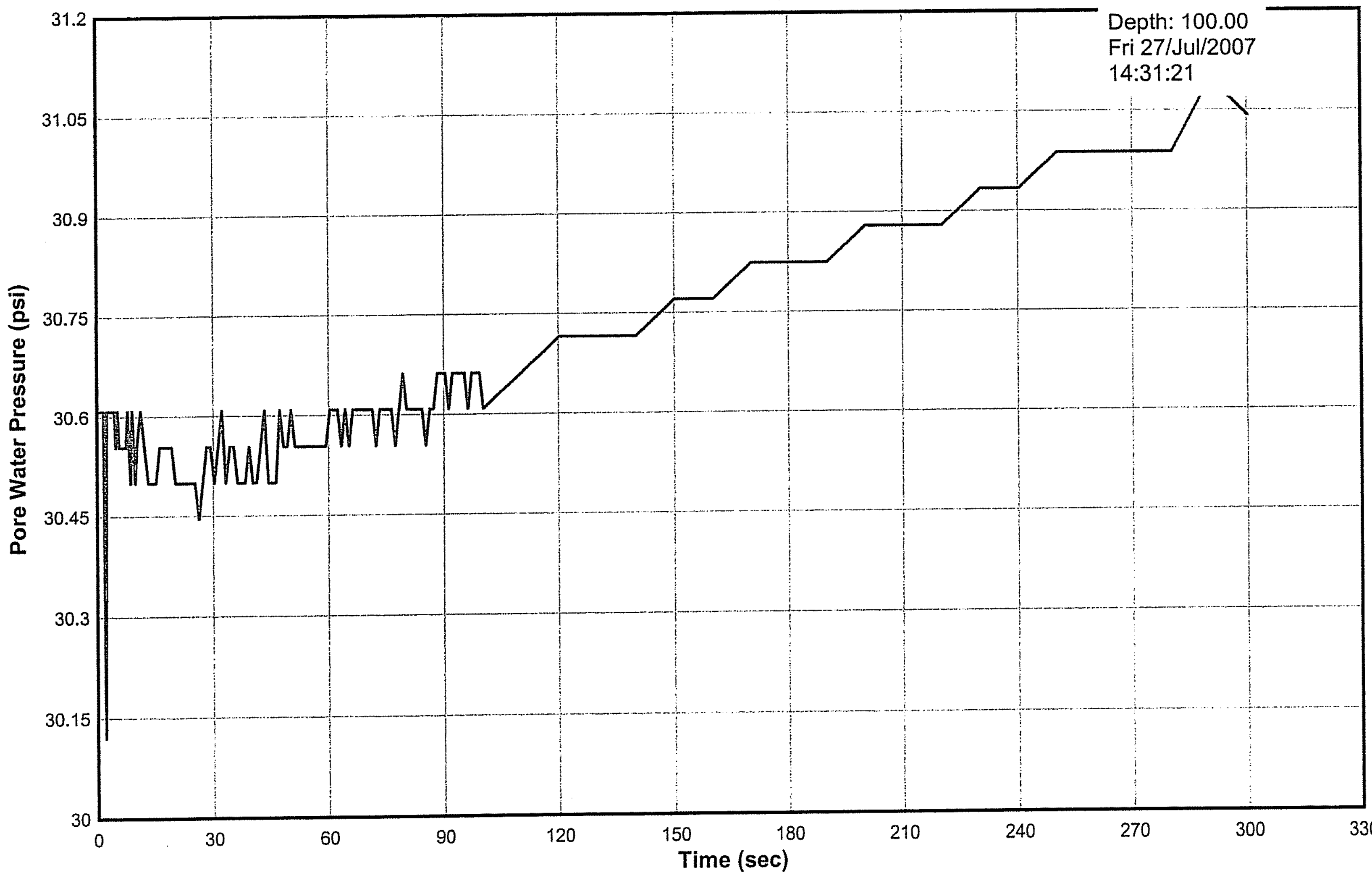
Pore Pressure Dissipation Test
Sounding 07-14
AET #01-03612



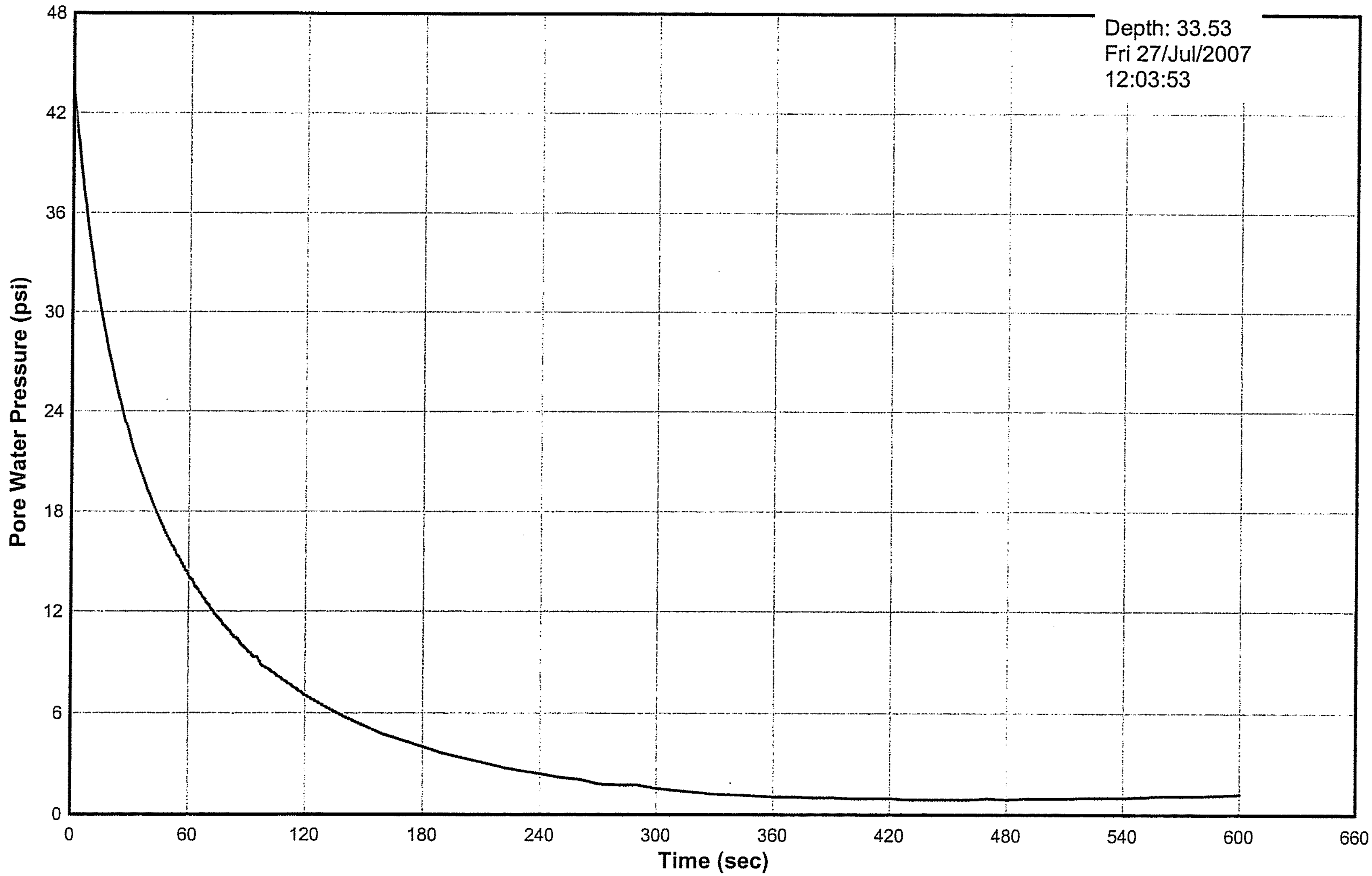
Pore Pressure Dissipation Test
Sounding 07-14
AET #01-03612



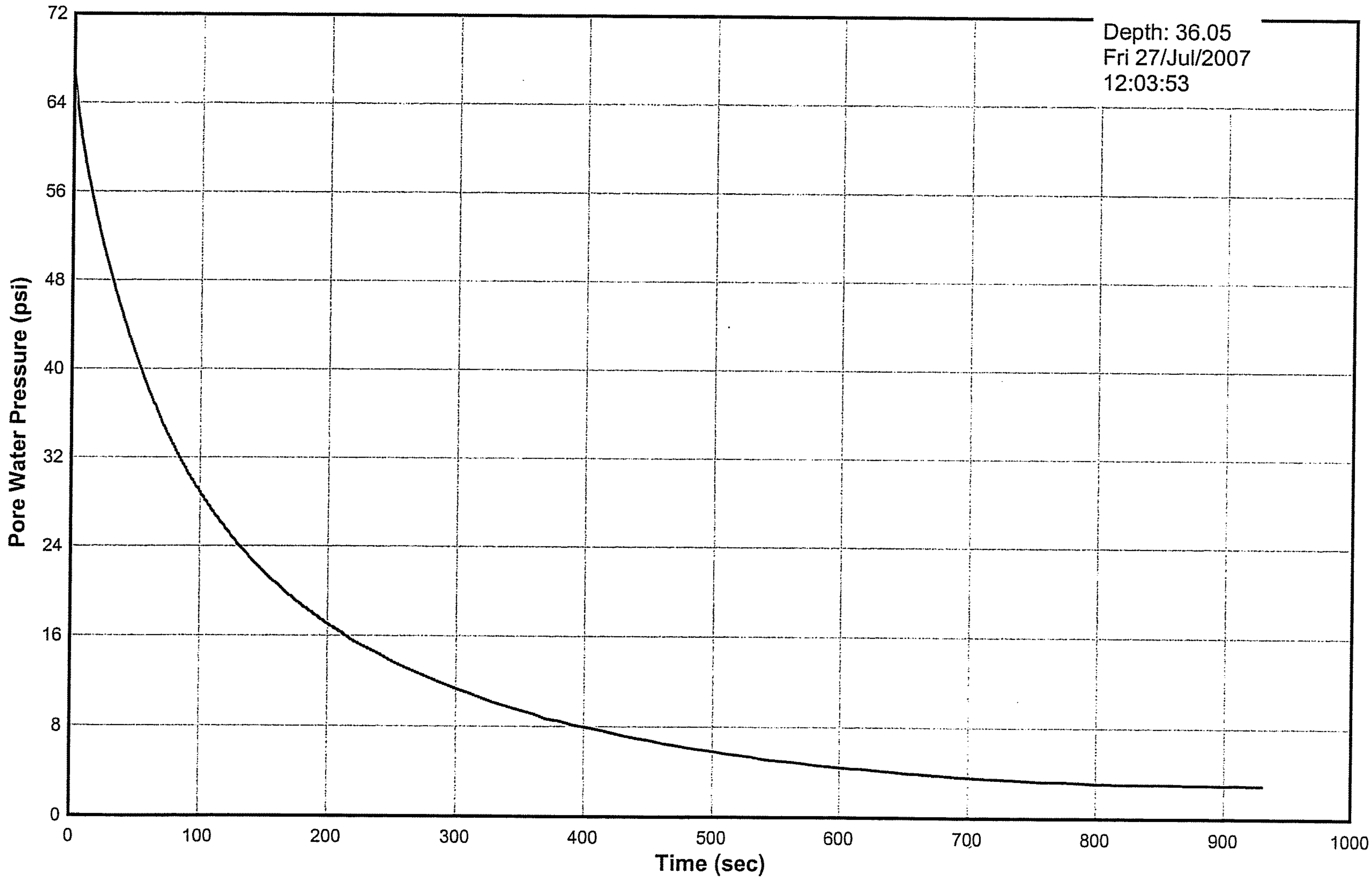
Pore Pressure Dissipation Test
Sounding 07-14
AET #01-03612



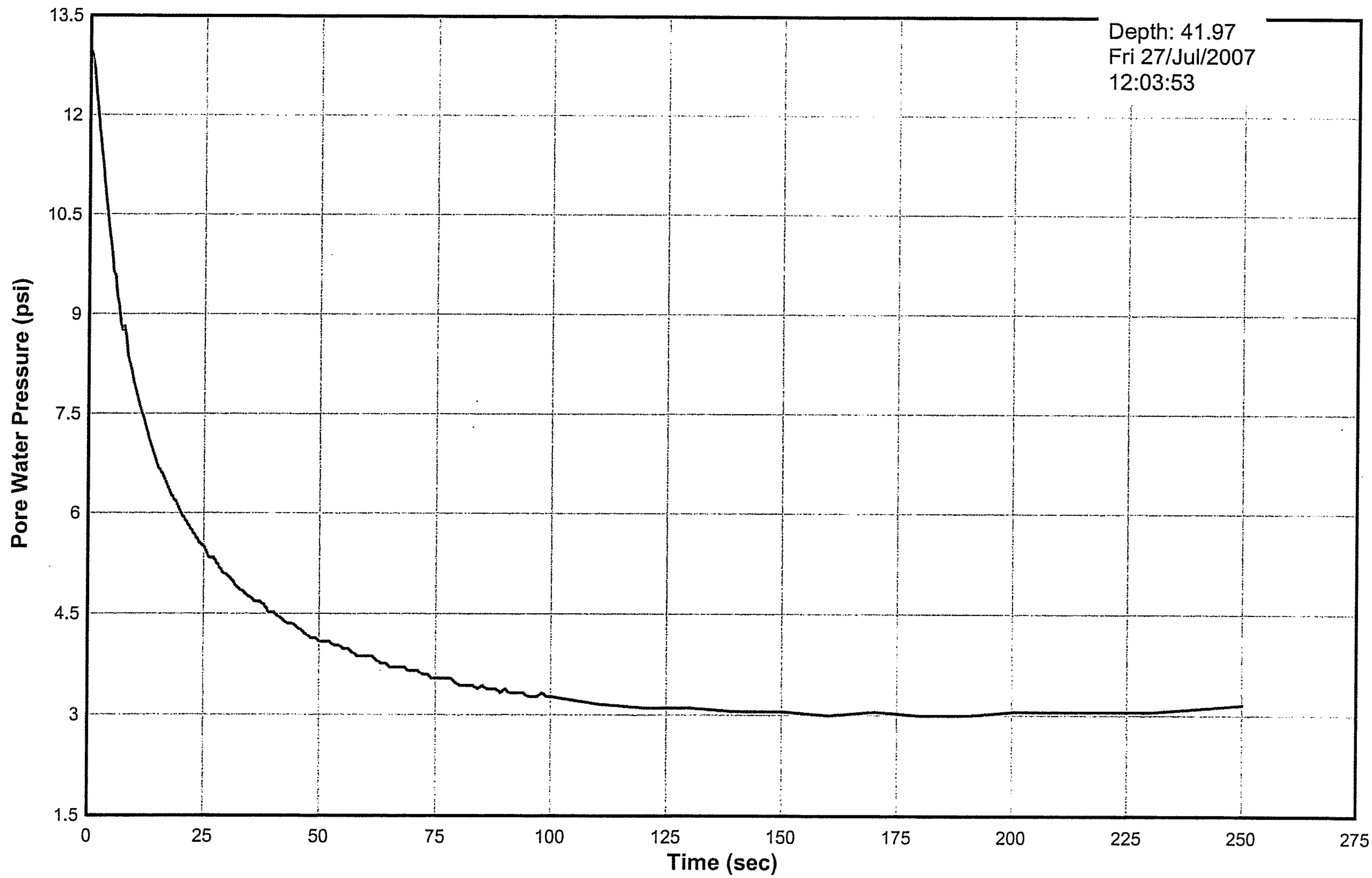
Pore Pressure Dissipation Test
Sounding 07-15
AET #01-03612



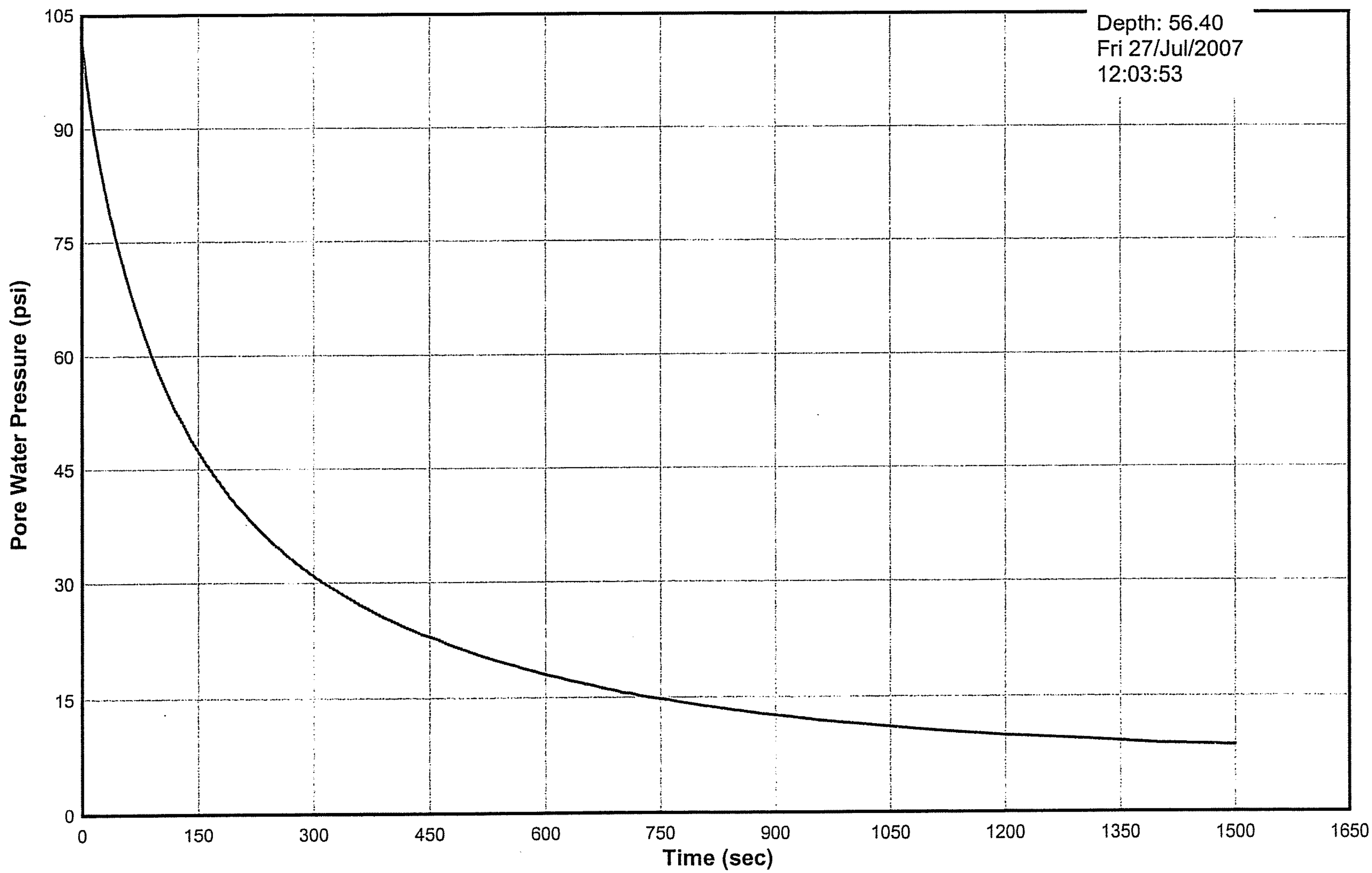
Pore Pressure Dissipation Test
Sounding 07-15
AET #01-03612



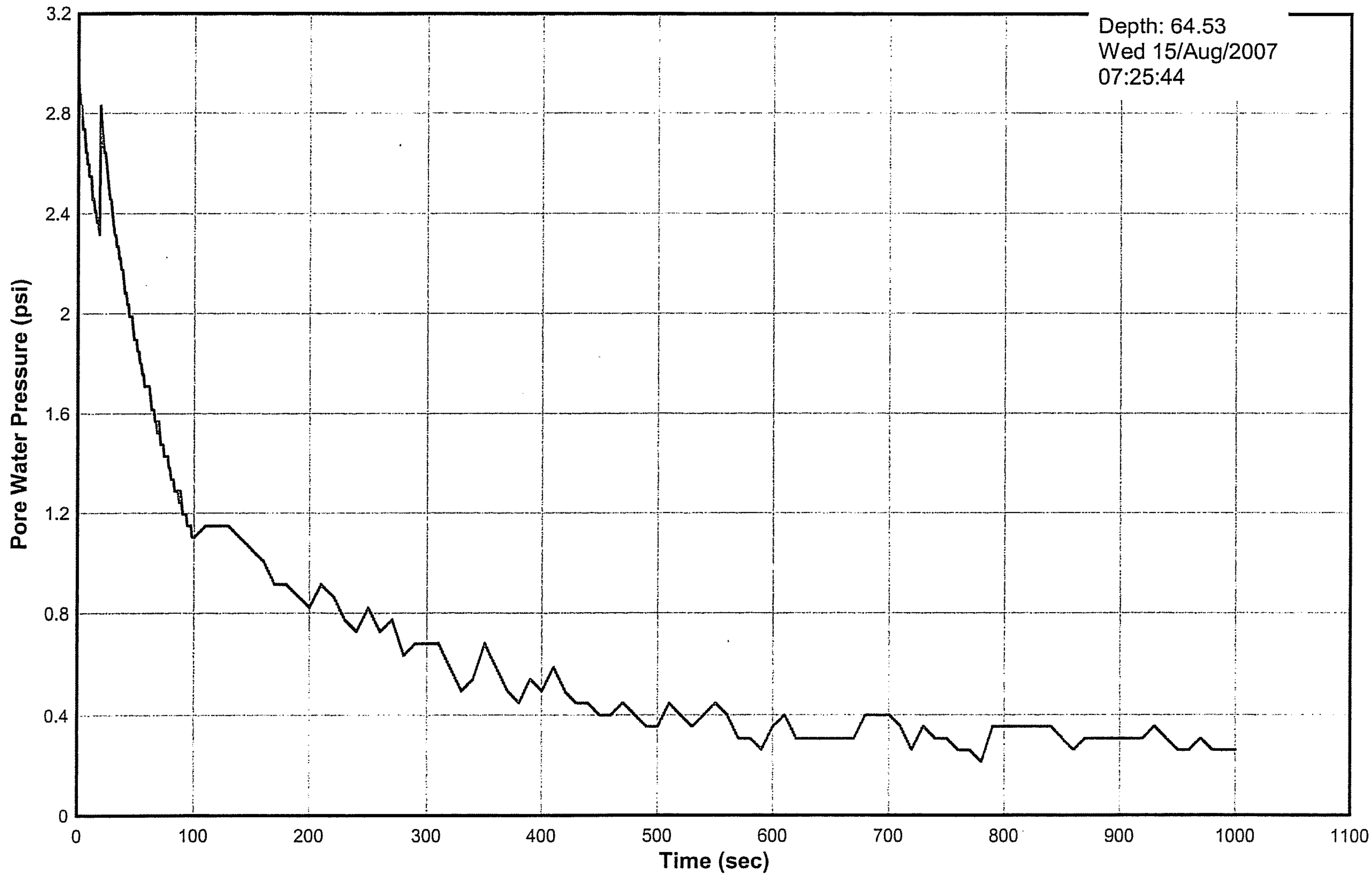
Pore Pressure Dissipation Test
Sounding 07-15
AET #01-03612



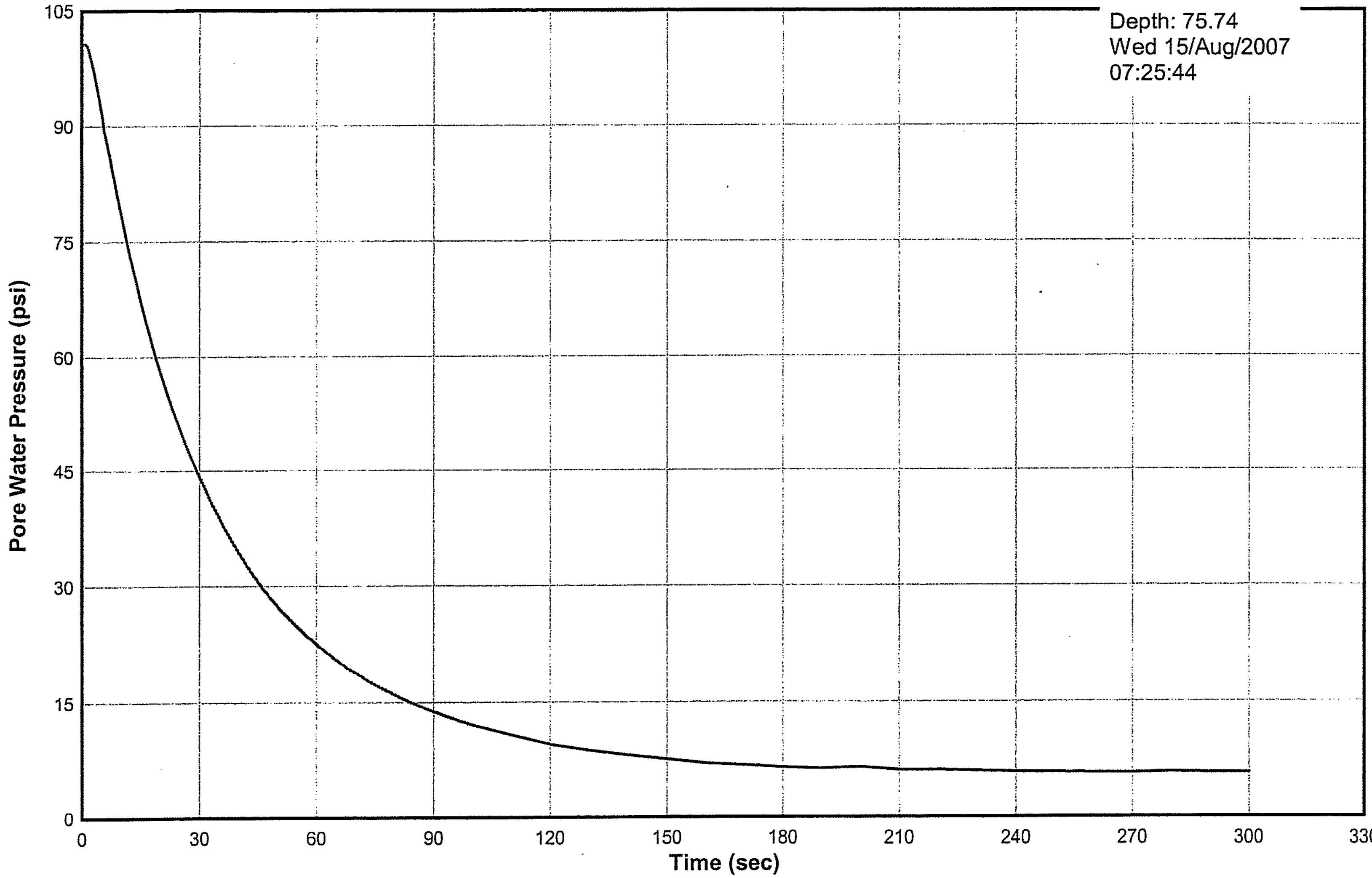
Pore Pressure Dissipation Test
Sounding 07-15
AET #01-03612



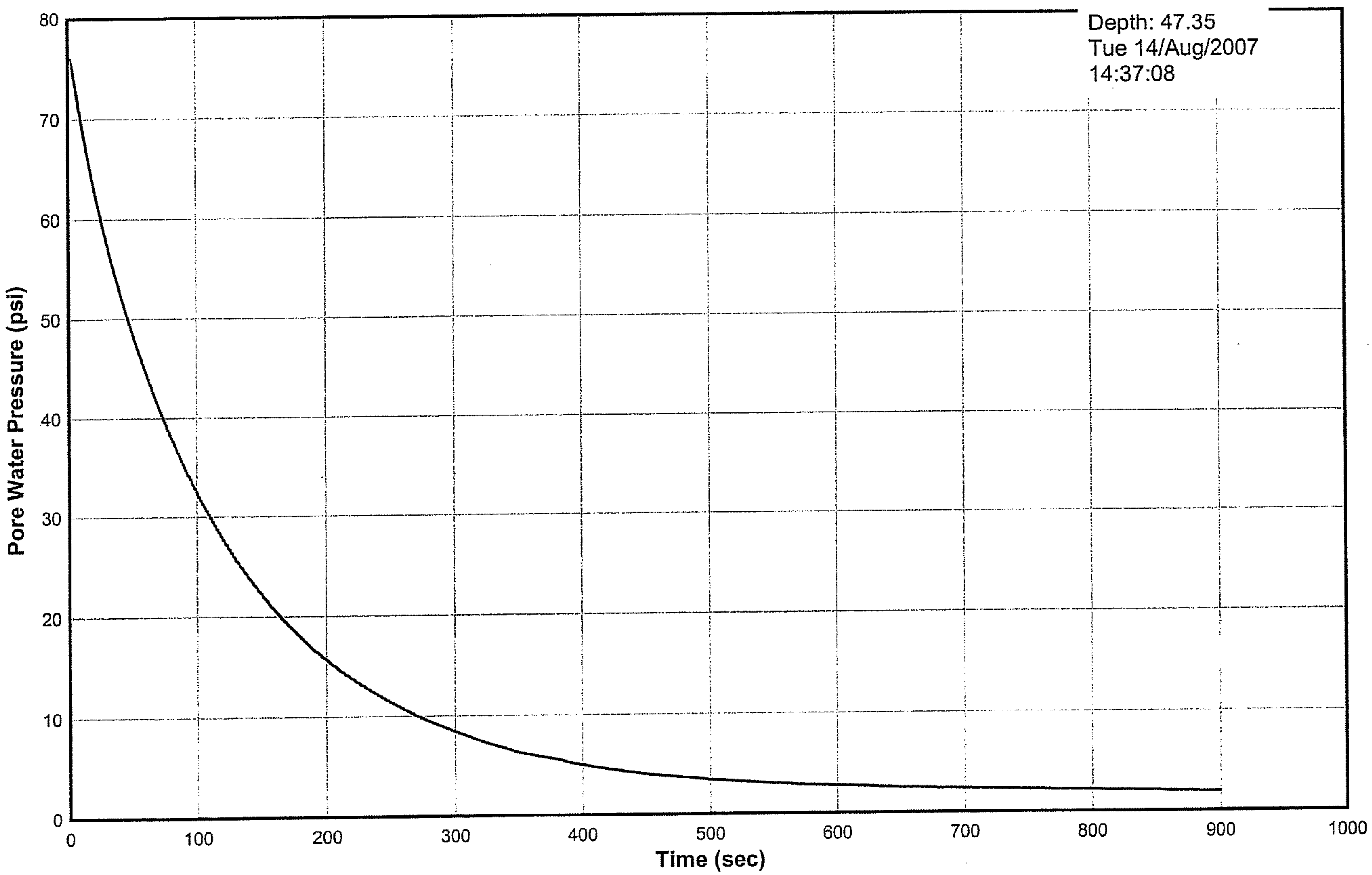
Pore Pressure Dissipation Test
Sounding 07-16
AET #01-03612



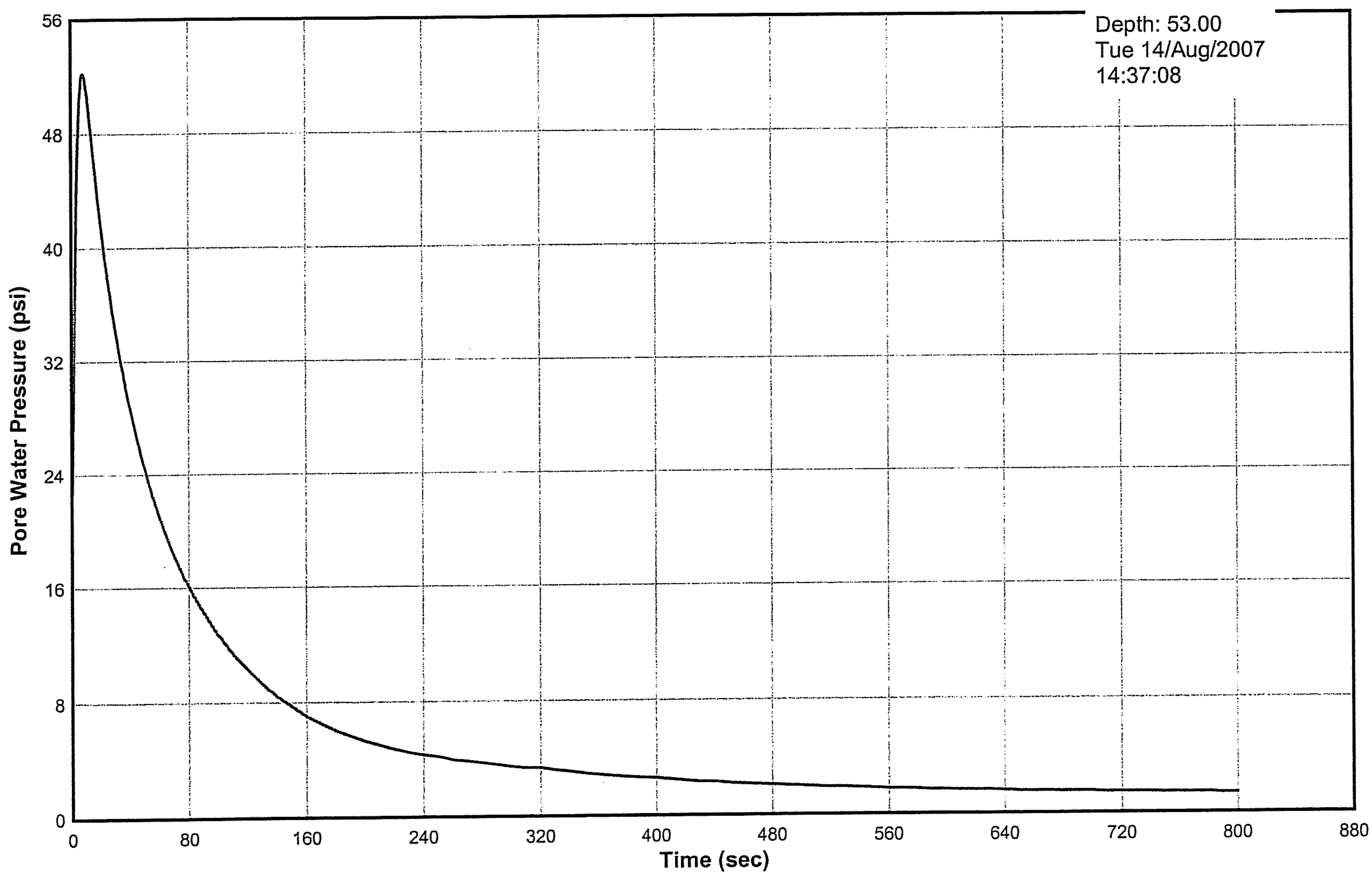
Pore Pressure Dissipation Test
Sounding 07-16
AET #01-03612



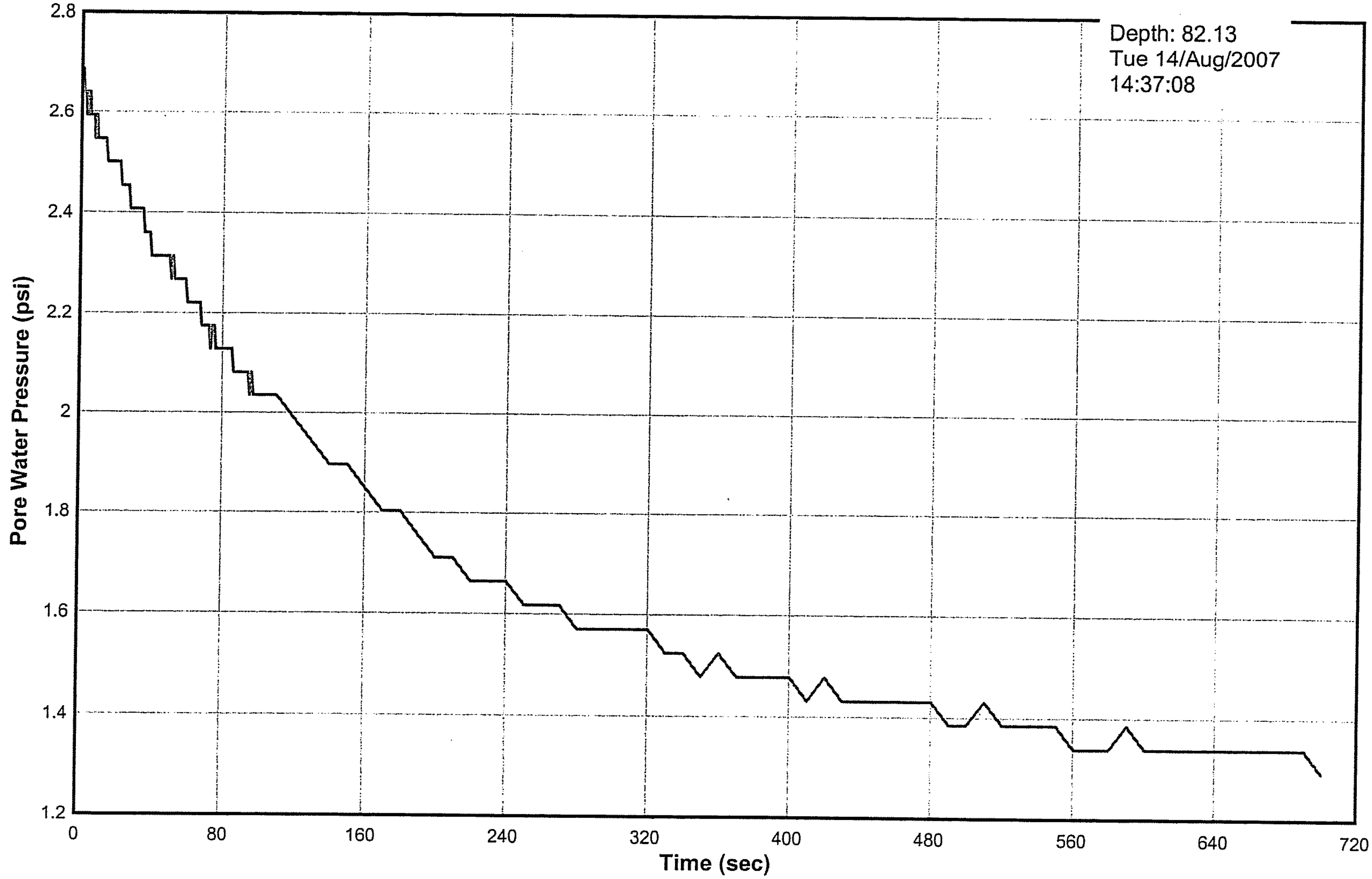
Pore Pressure Dissipation Test
Sounding 07-17
AET #01-03612



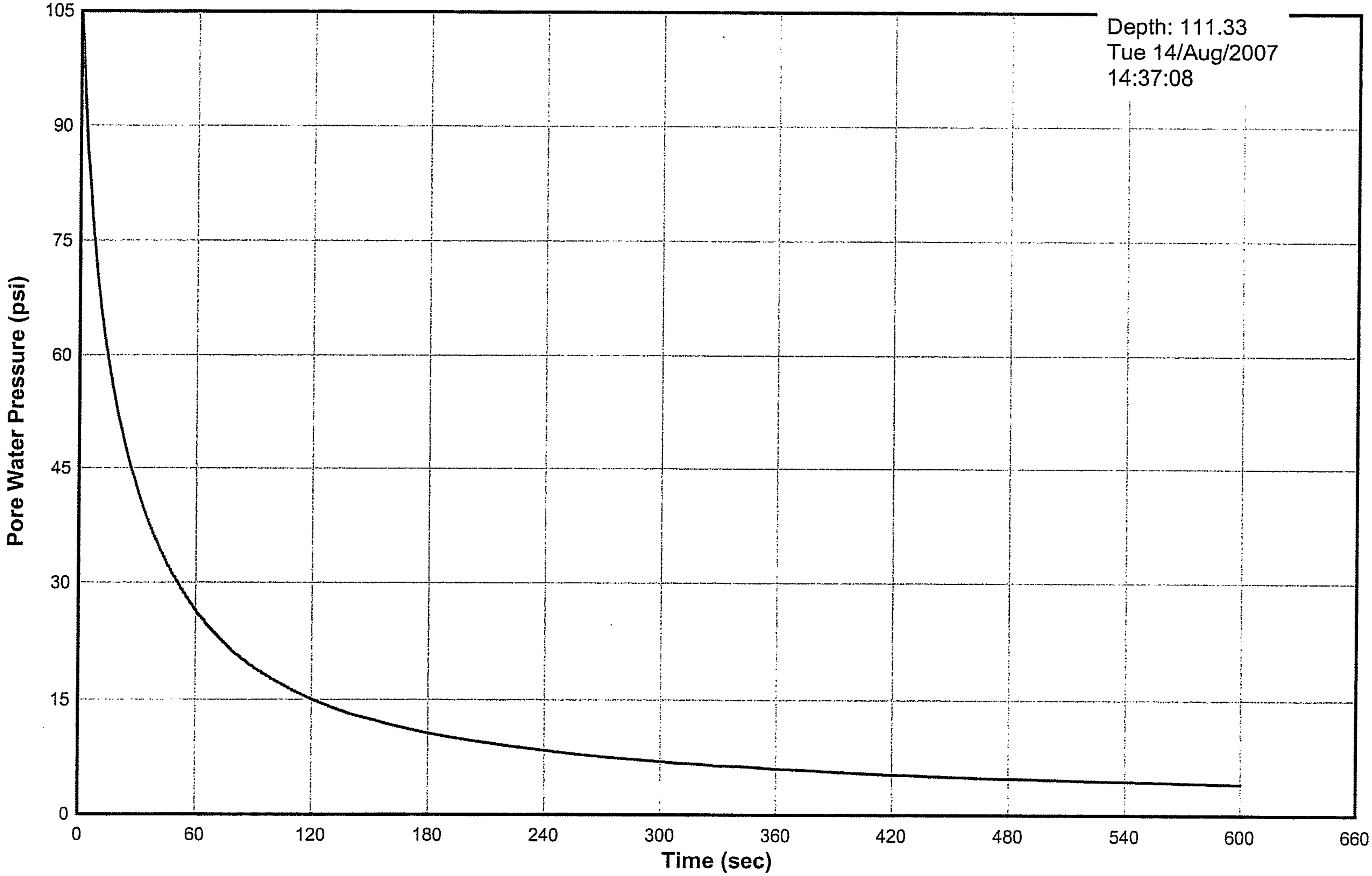
Pore Pressure Dissipation Test
Sounding 07-17
AET #01-03612



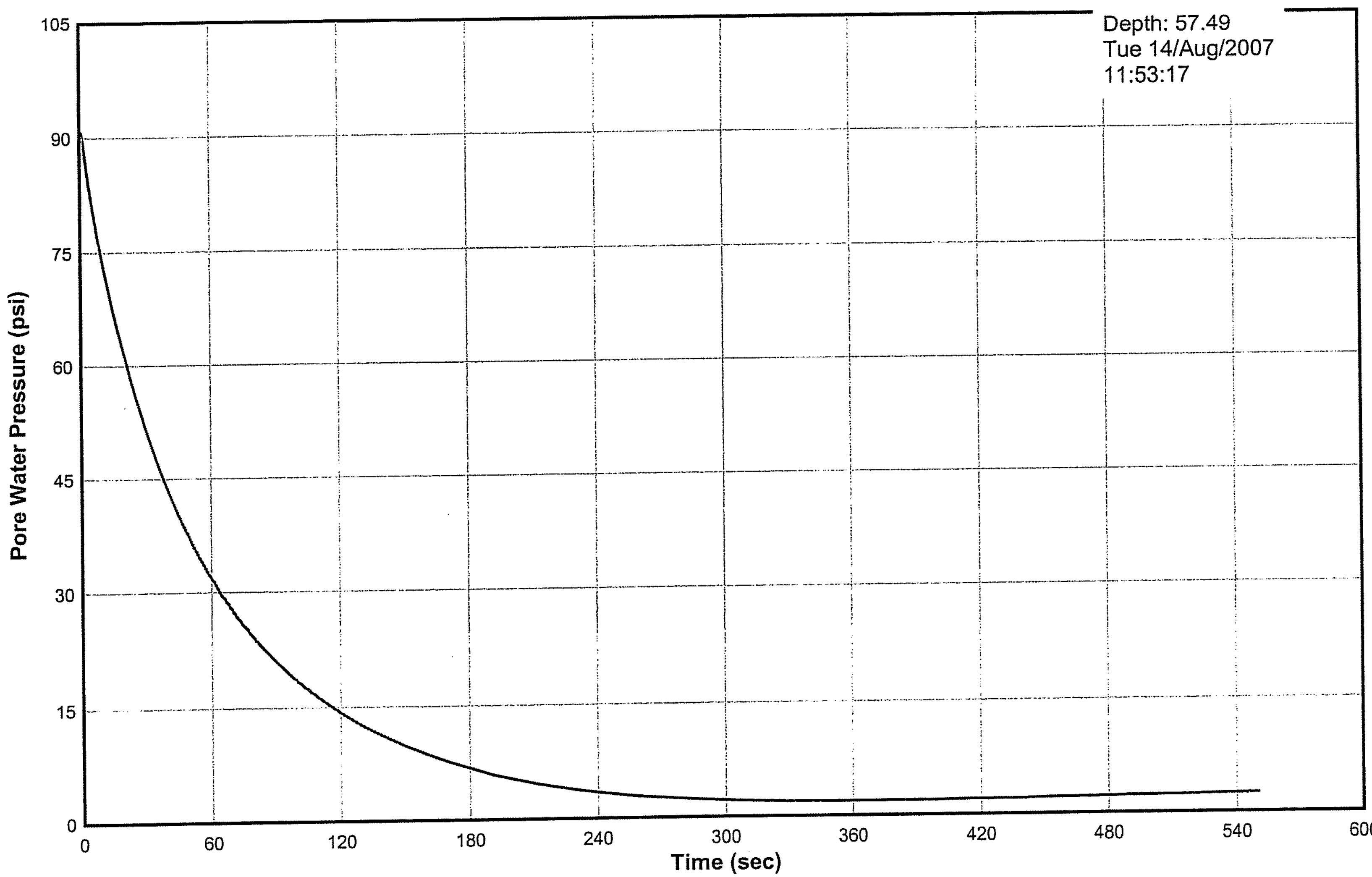
Pore Pressure Dissipation Test
Sounding 07-17
AET #01-03612



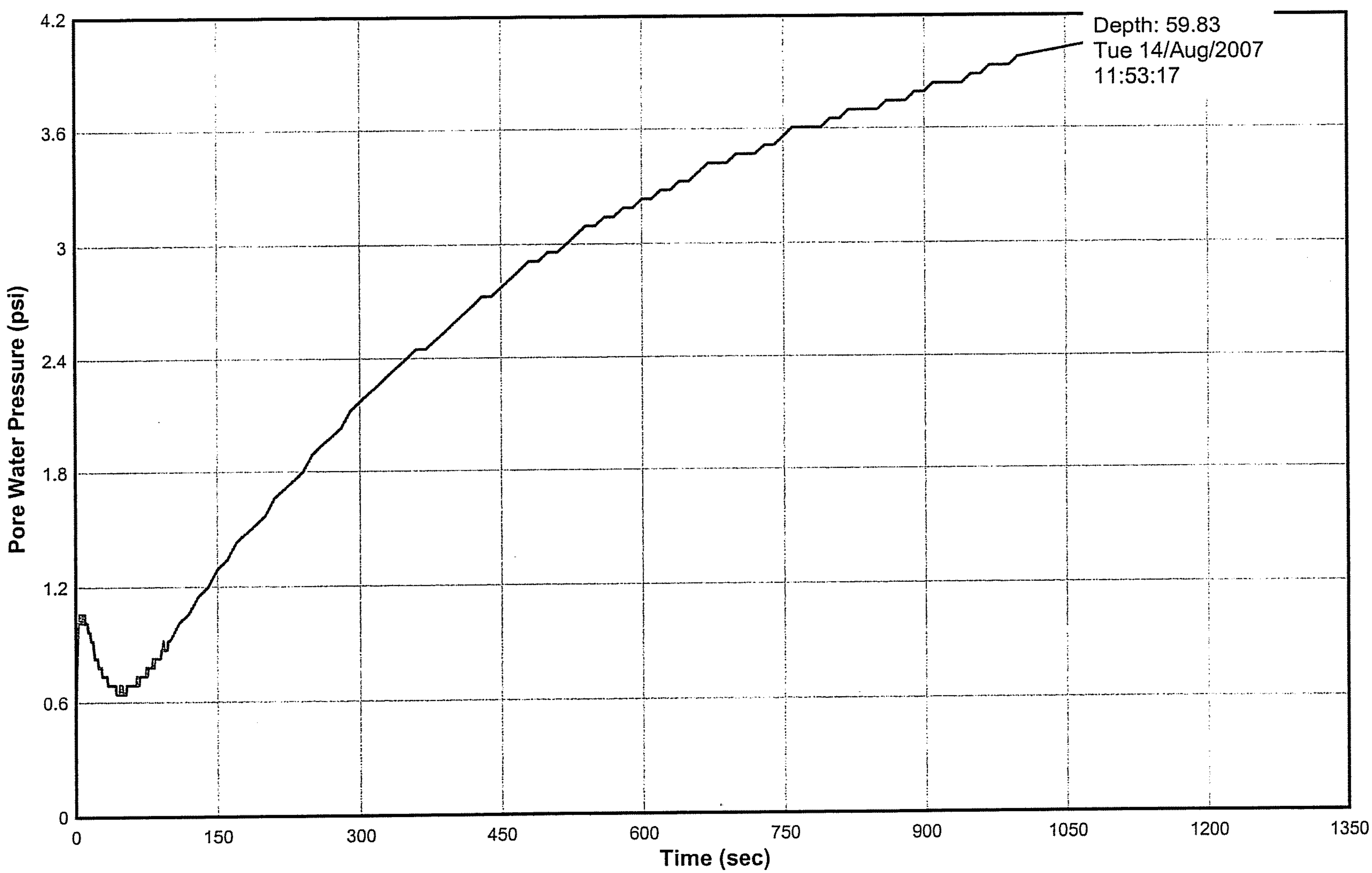
Pore Pressure Dissipation Test
Sounding 07-17
AET #01-03612



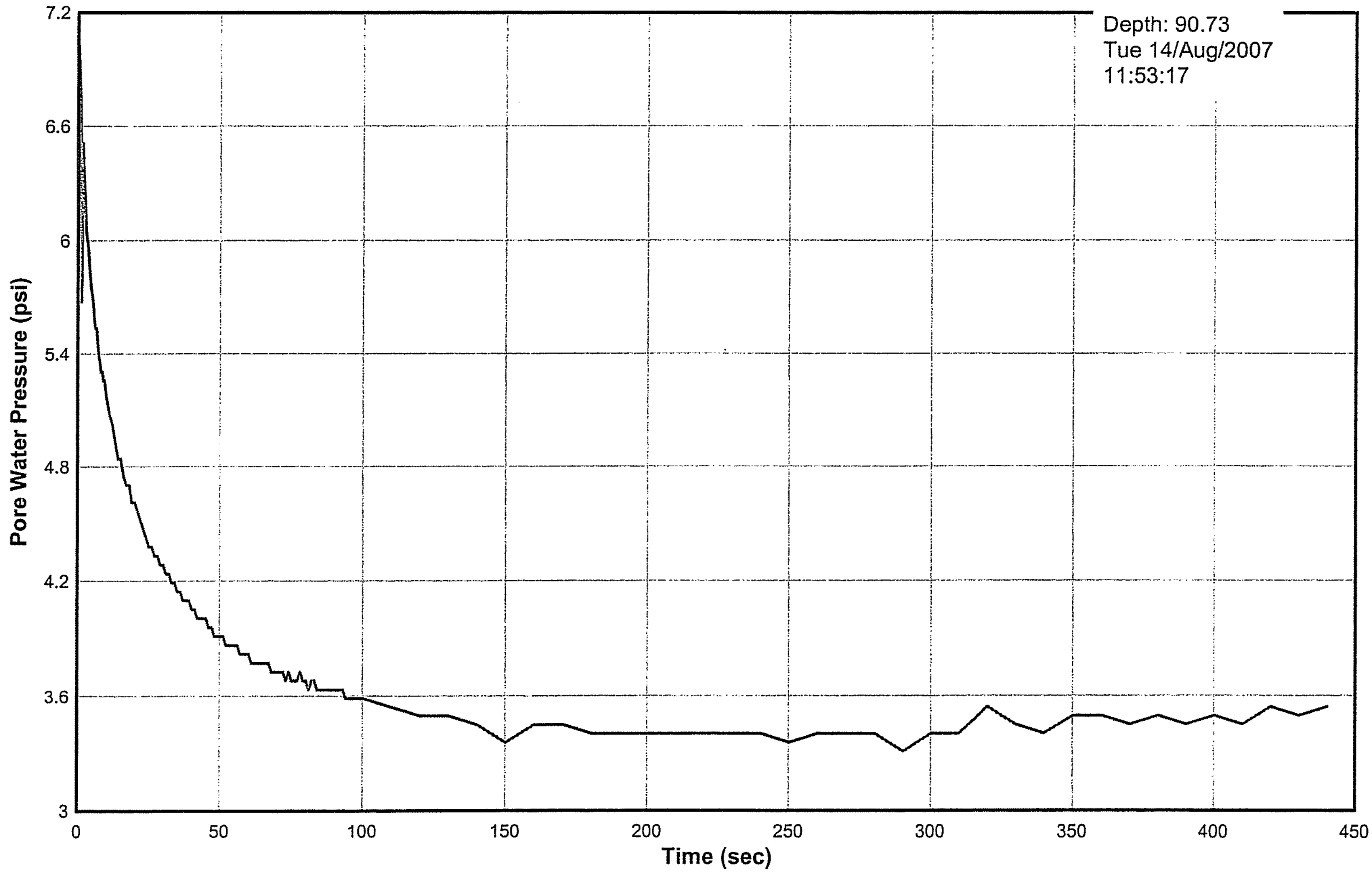
Pore Pressure Dissipation Test
Sounding 07-18
AET #01-03612



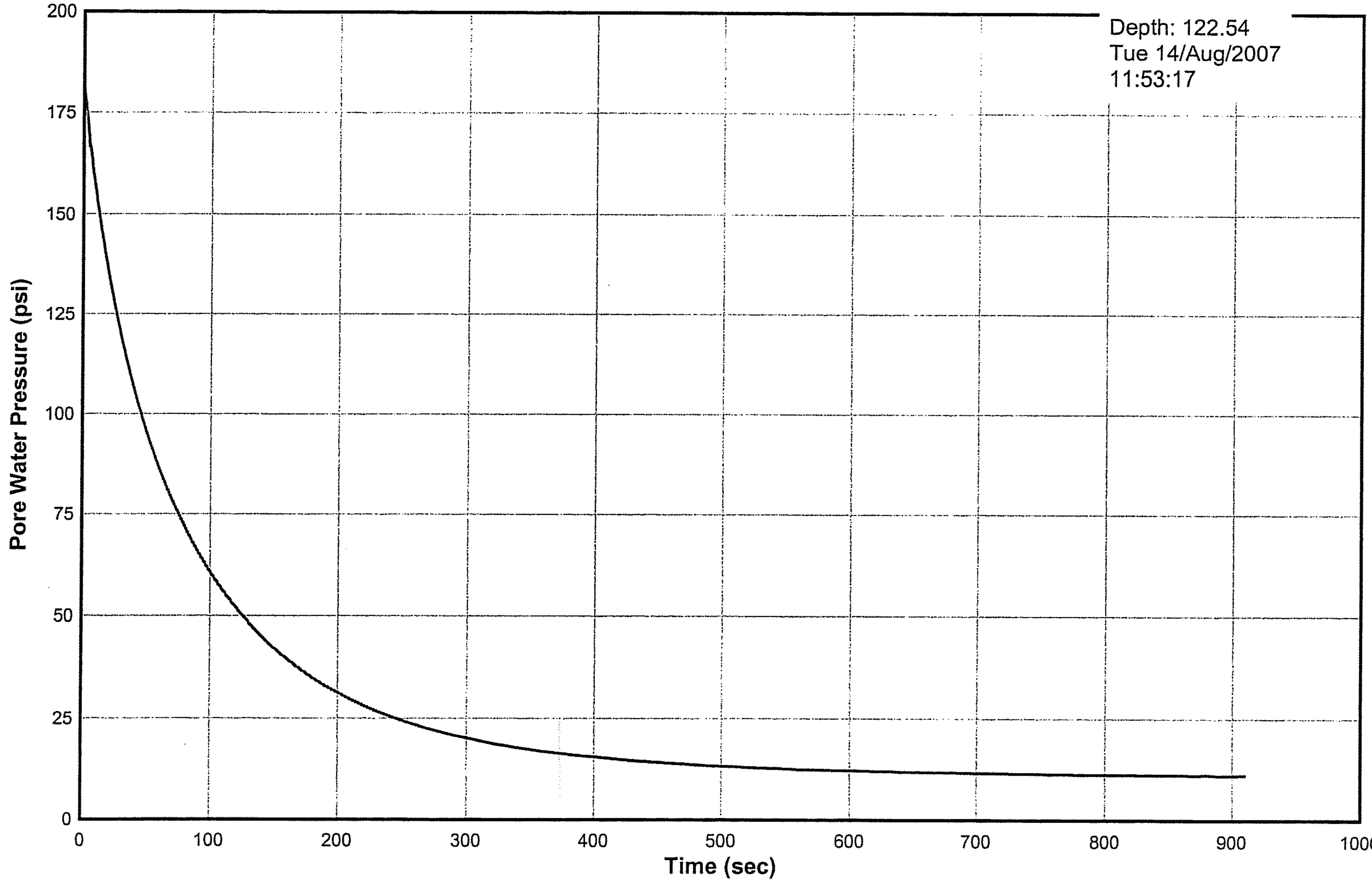
Pore Pressure Dissipation Test
Sounding 07-18
AET #01-03612



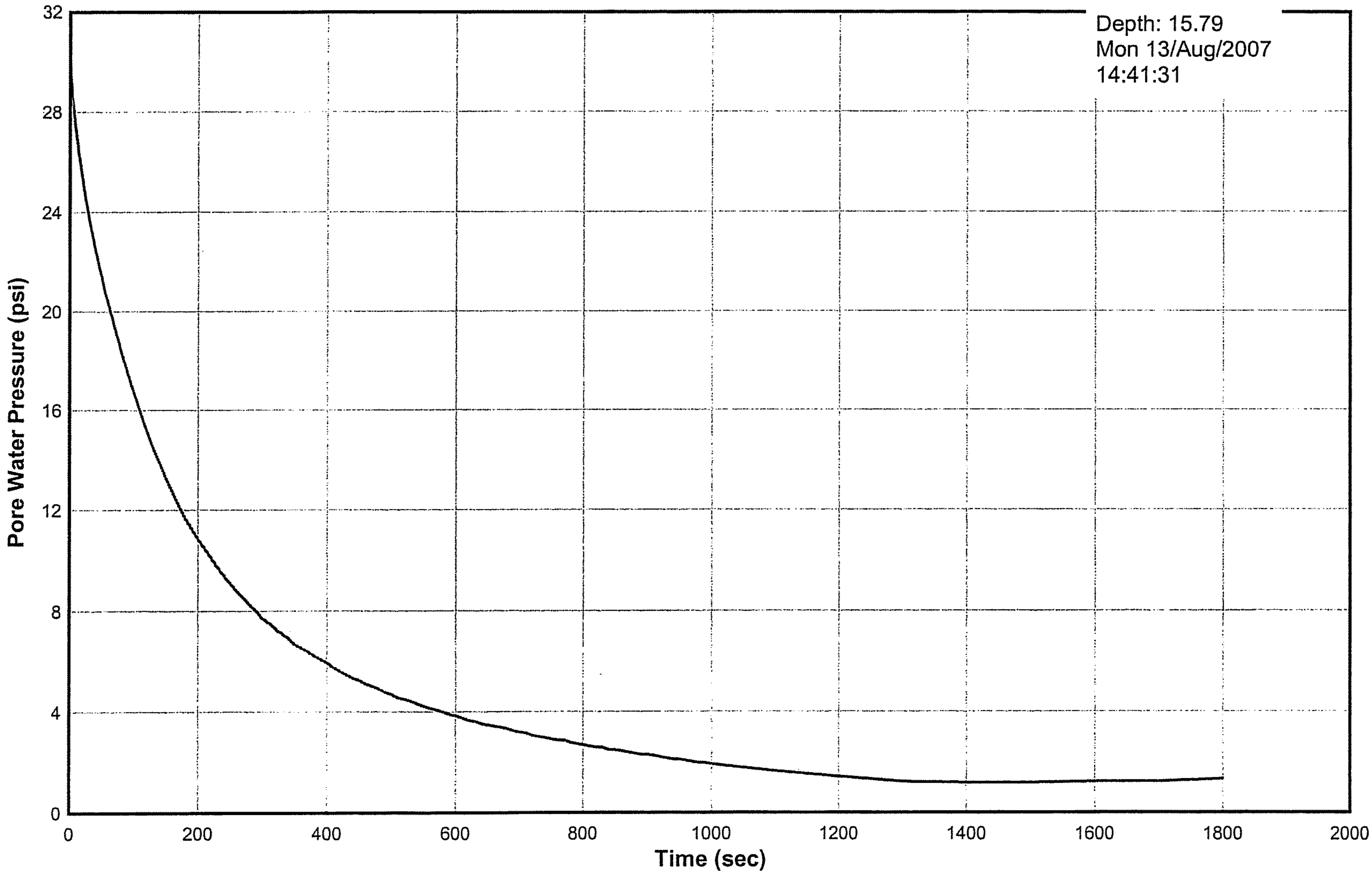
Pore Pressure Dissipation Test
Sounding 07-18
AET #01-03612



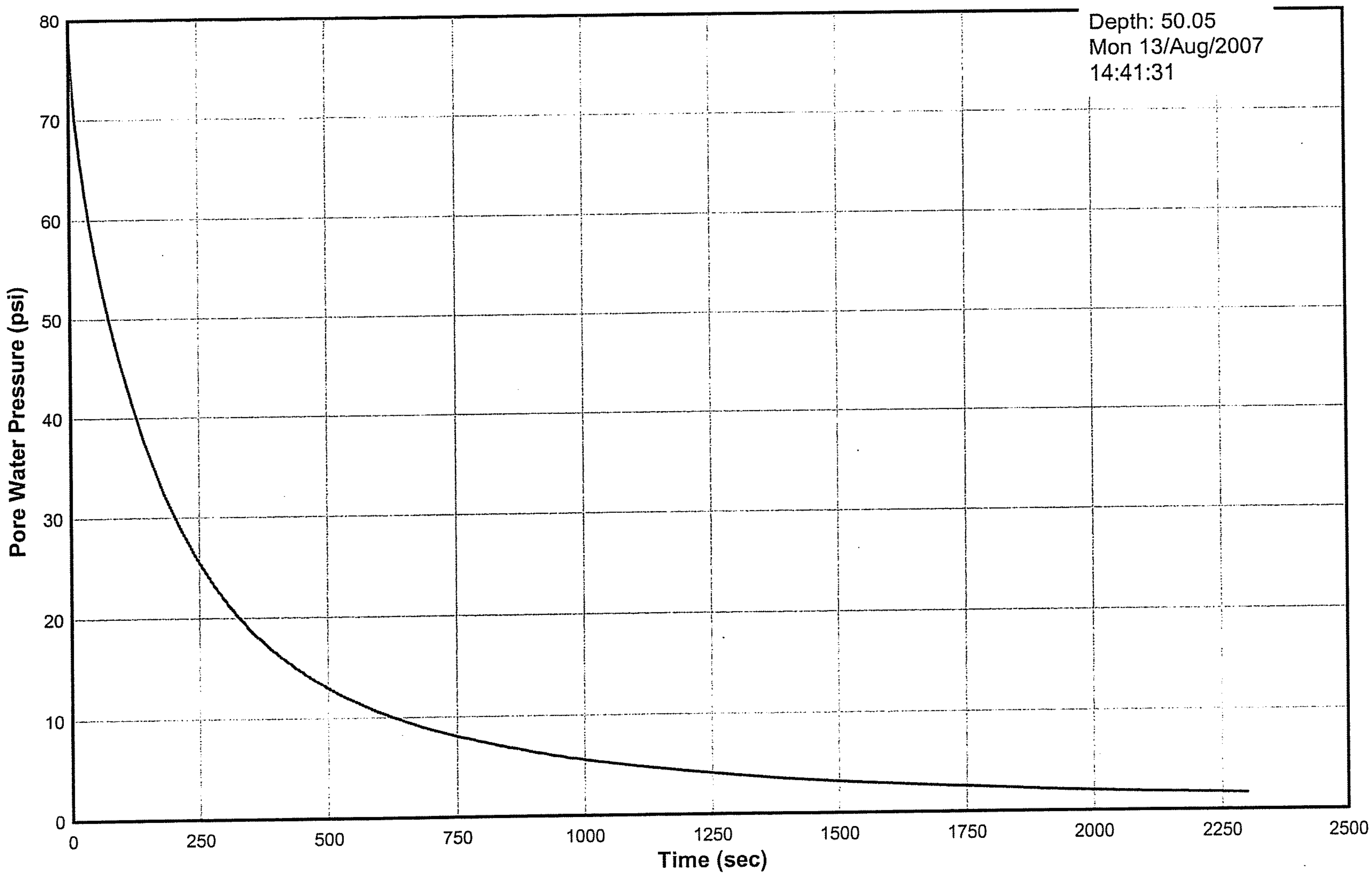
Pore Pressure Dissipation Test
Sounding 07-18
AET #01-03612



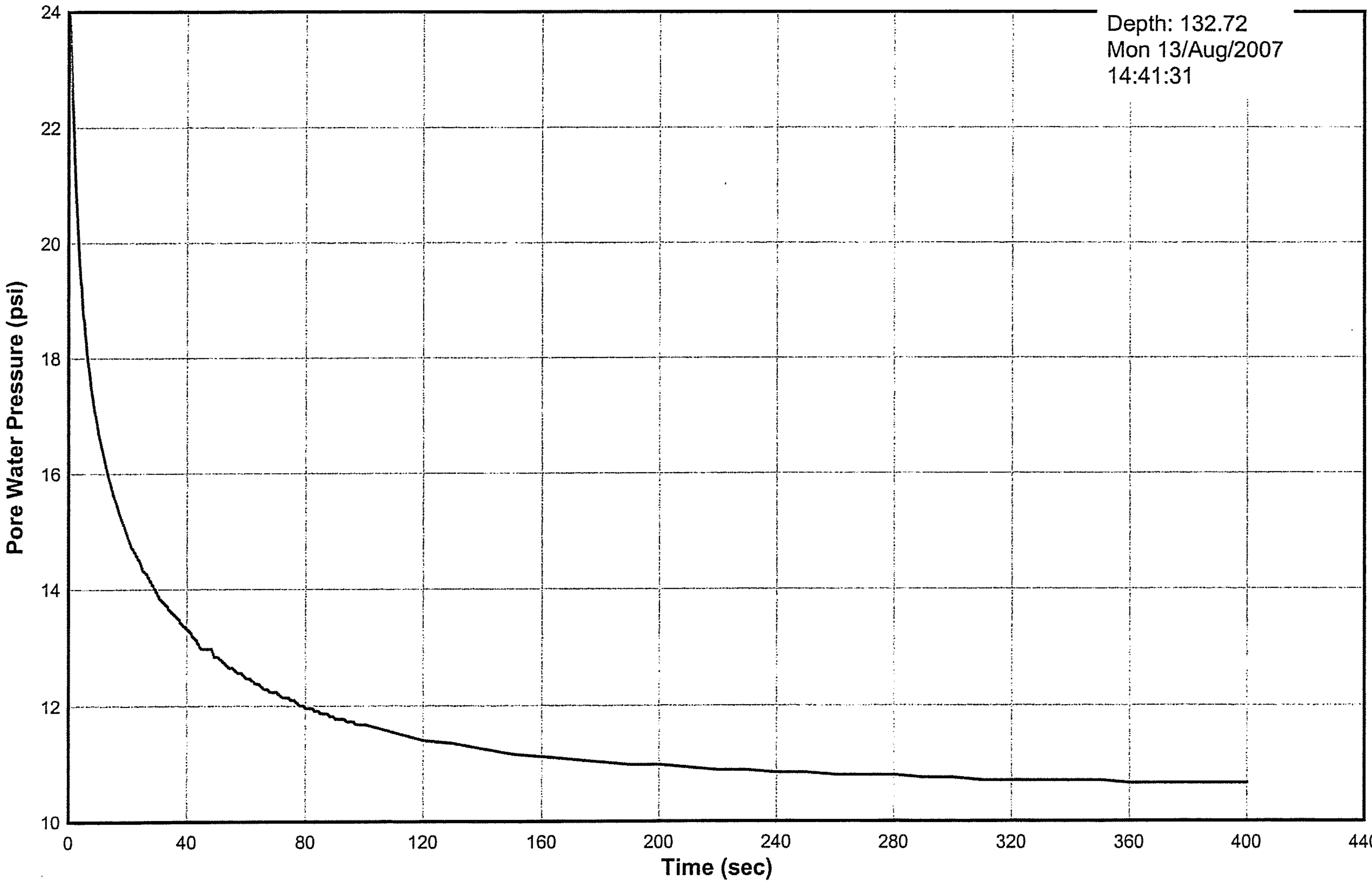
Pore Pressure Dissipation Test
Sounding 07-19
AET #01-03612



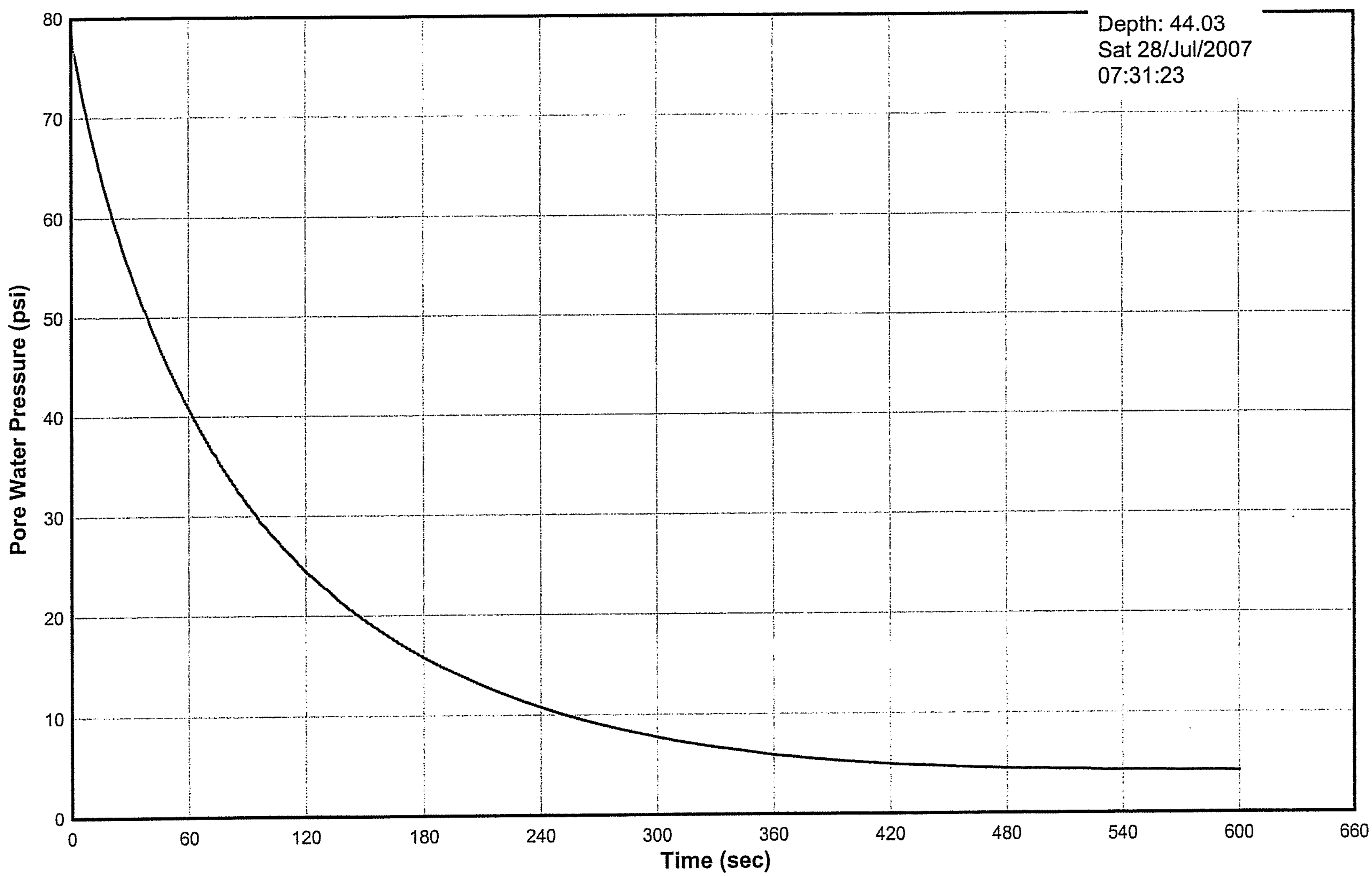
Pore Pressure Dissipation Test
Sounding 07-19
AET #01-03612



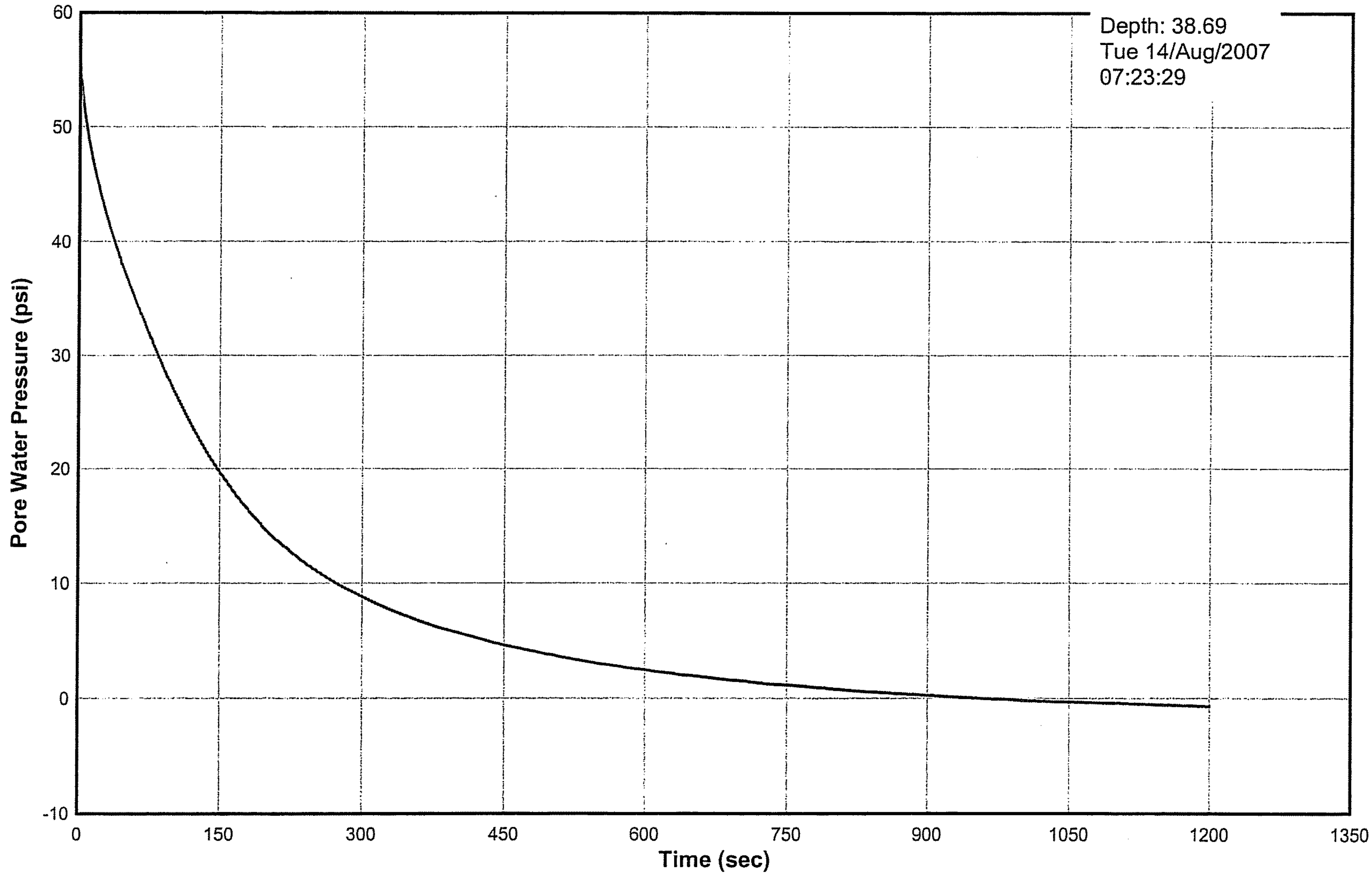
Pore Pressure Dissipation Test
Sounding 07-19
AET #01-03612



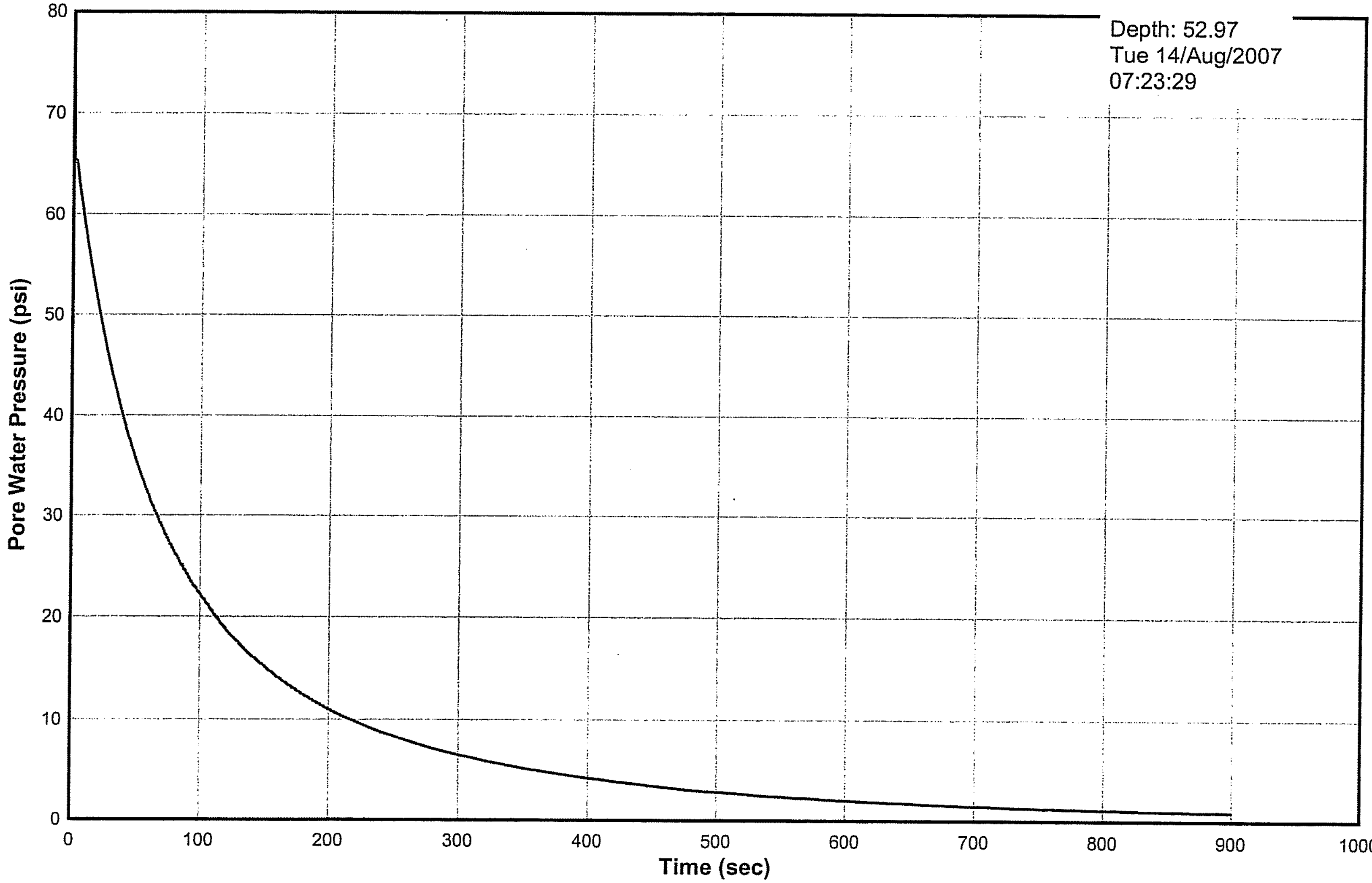
Pore Pressure Dissipation Test
Sounding 07-20
AET #01-03612



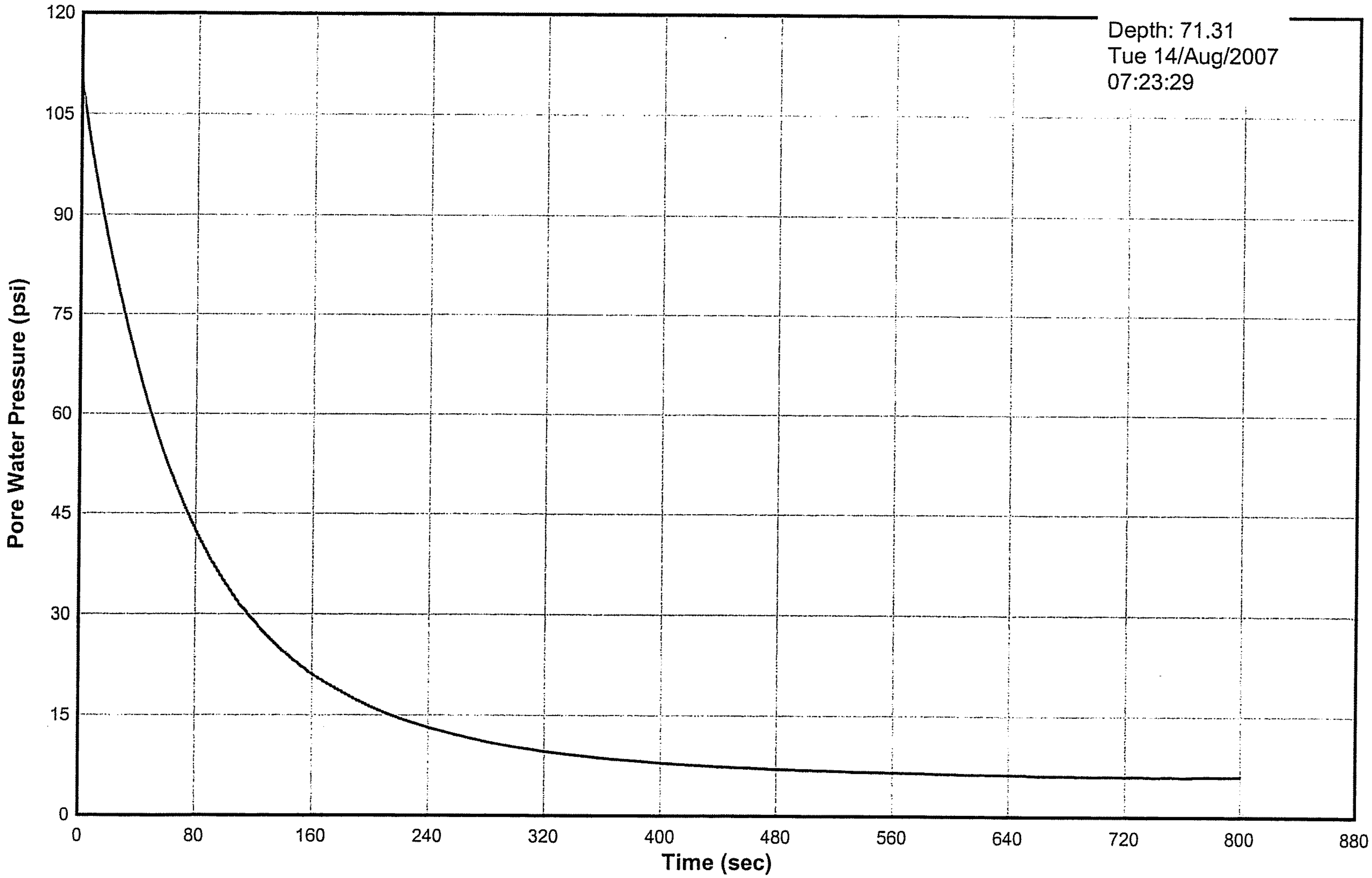
Pore Pressure Dissipation Test
Sounding 07-21
AET #01-03612



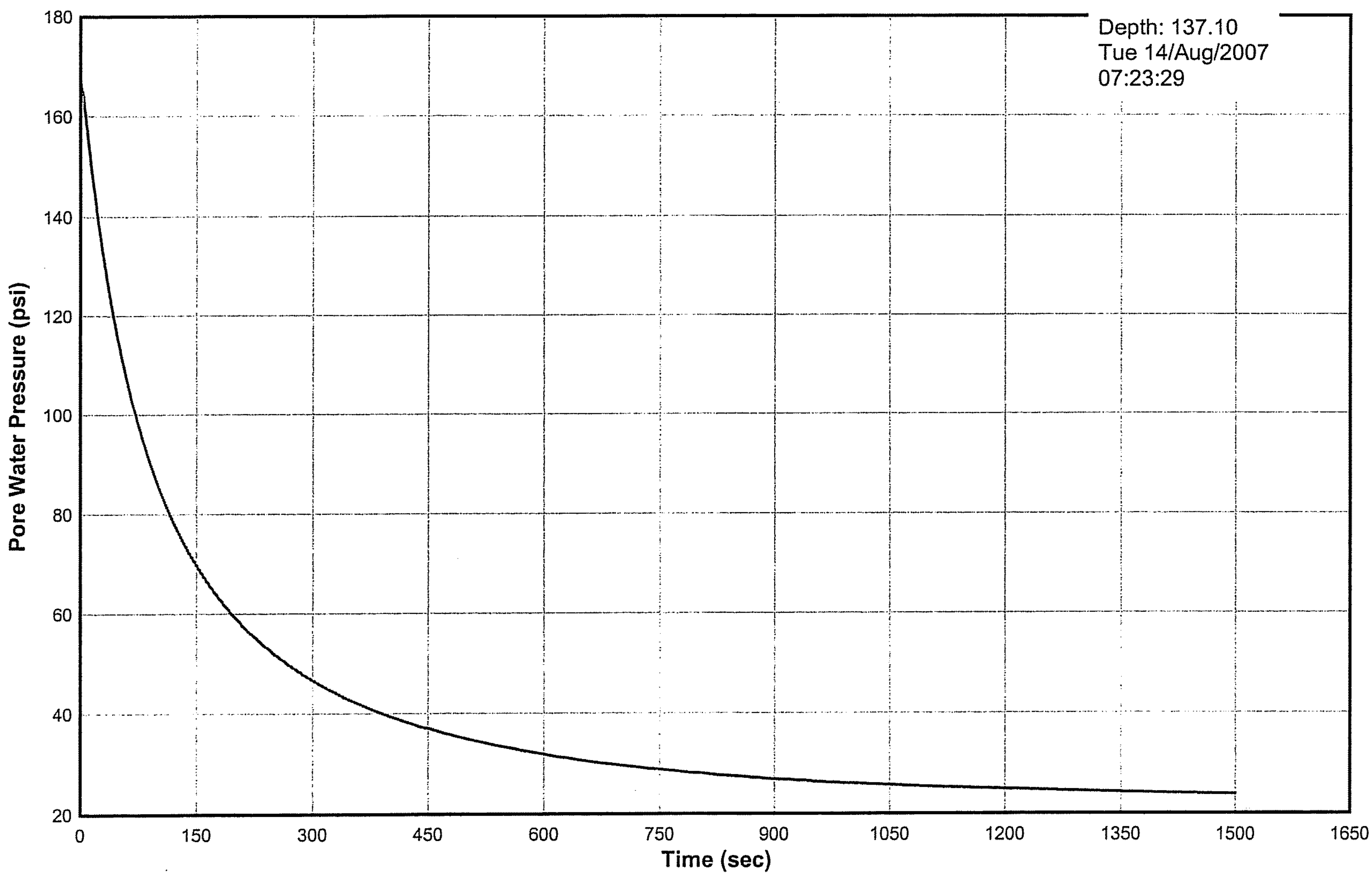
Pore Pressure Dissipation Test
Sounding 07-21
AET #01-03612



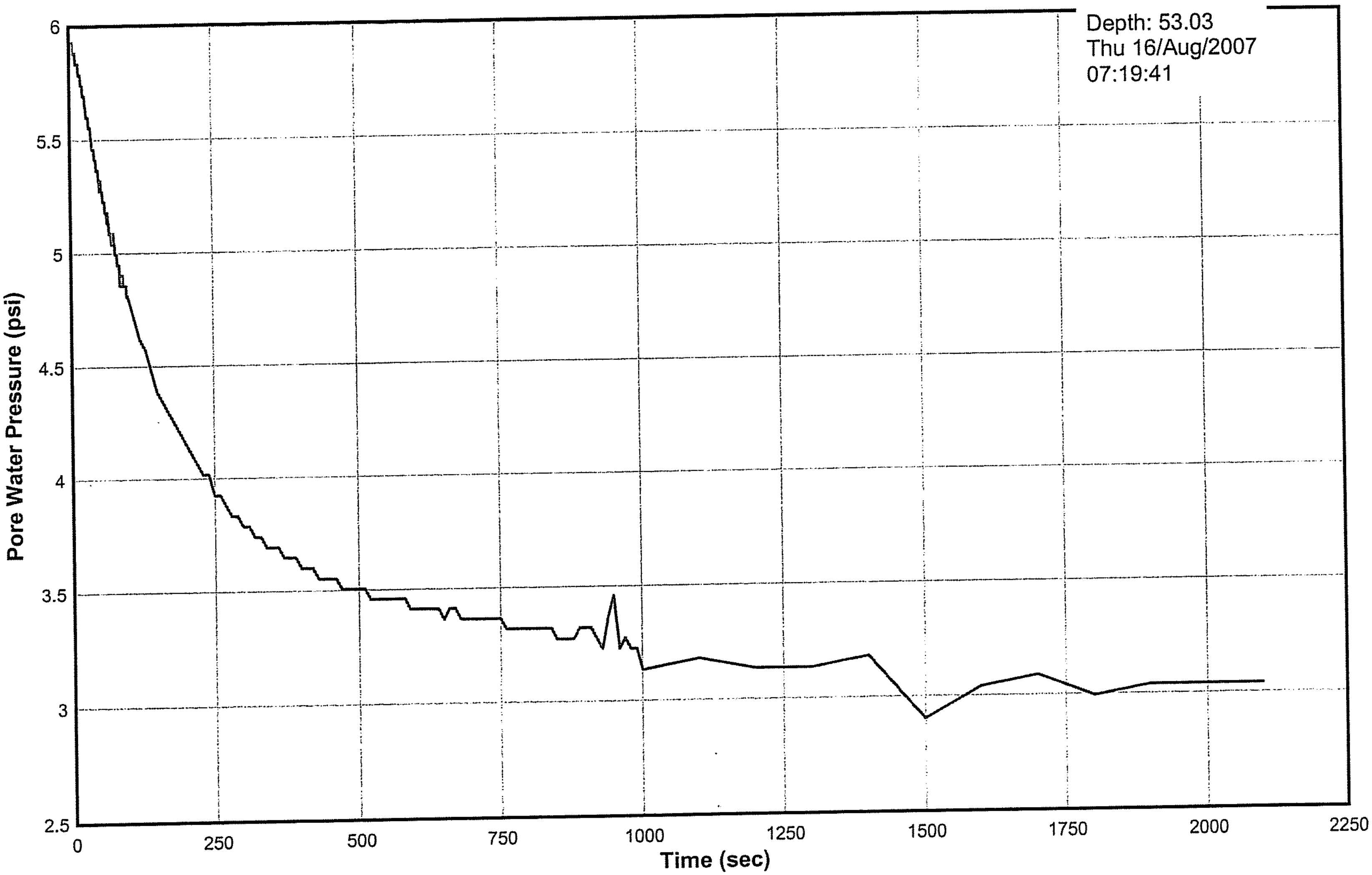
Pore Pressure Dissipation Test
Sounding 07-21
AET #01-03612



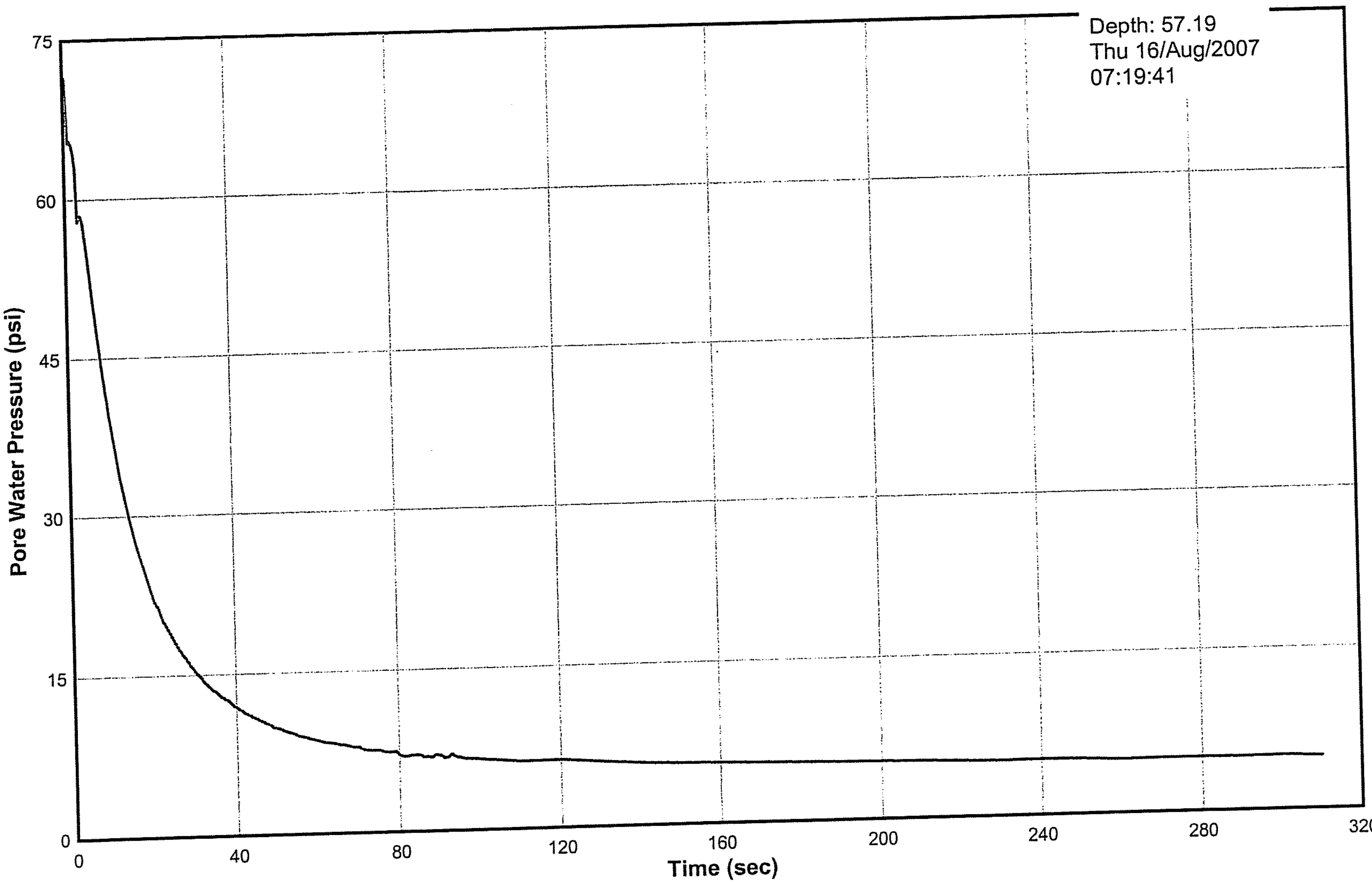
Pore Pressure Dissipation Test
Sounding 07-21
AET #01-03612



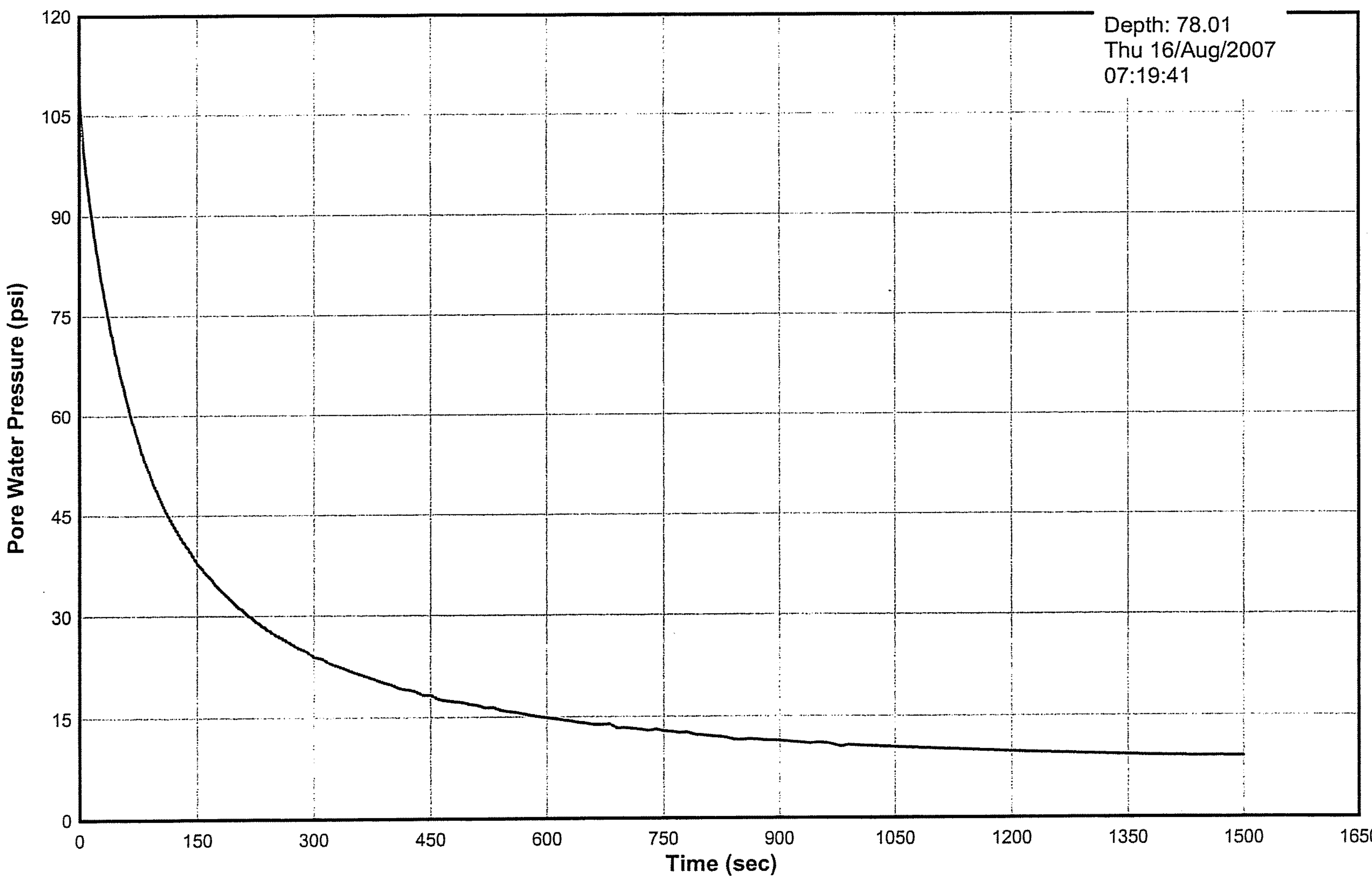
Pore Pressure Dissipation Test
Sounding 07-22
AET #01-03612



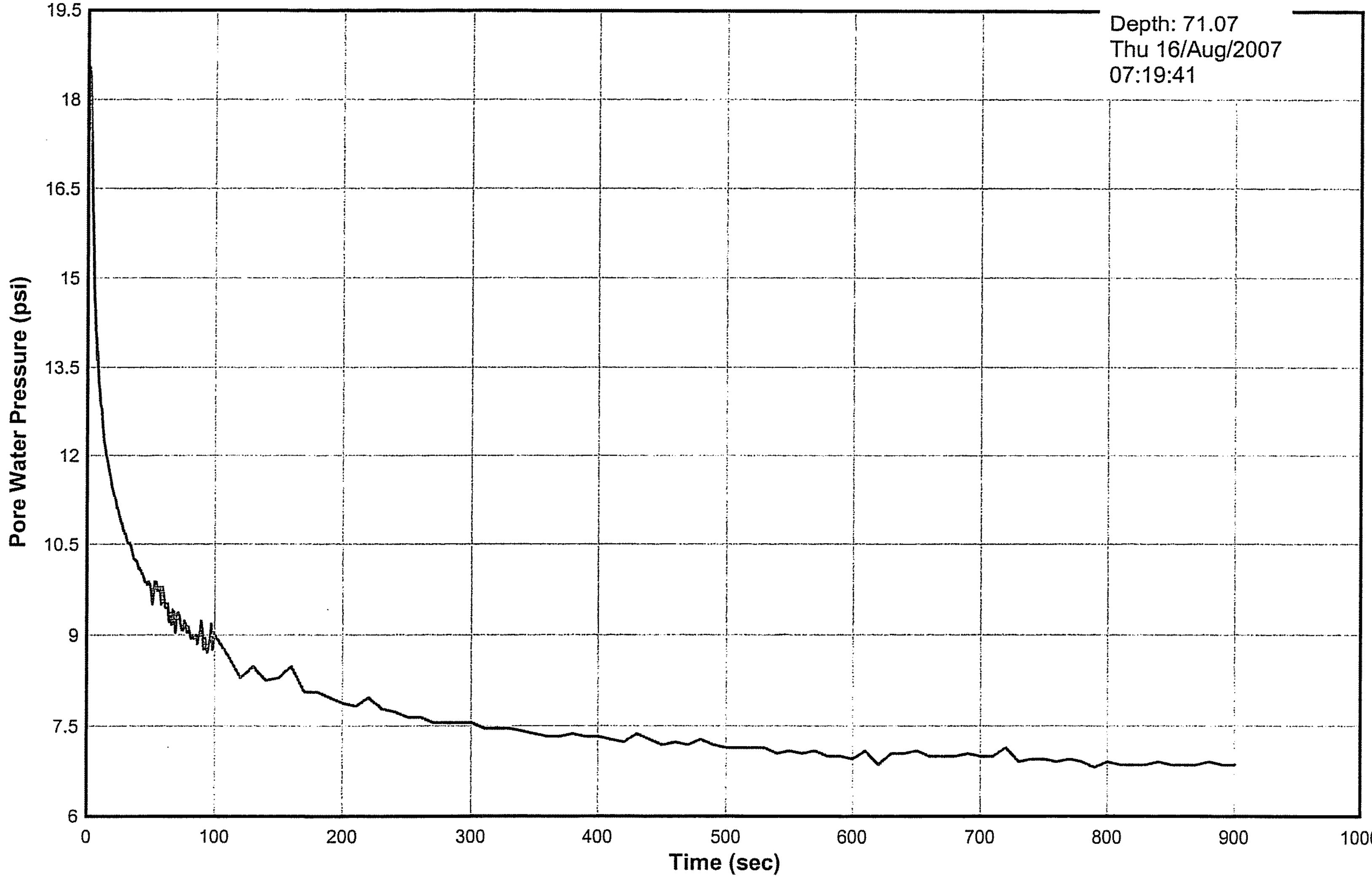
Pore Pressure Dissipation Test
Sounding 07-22
AET #01-03612



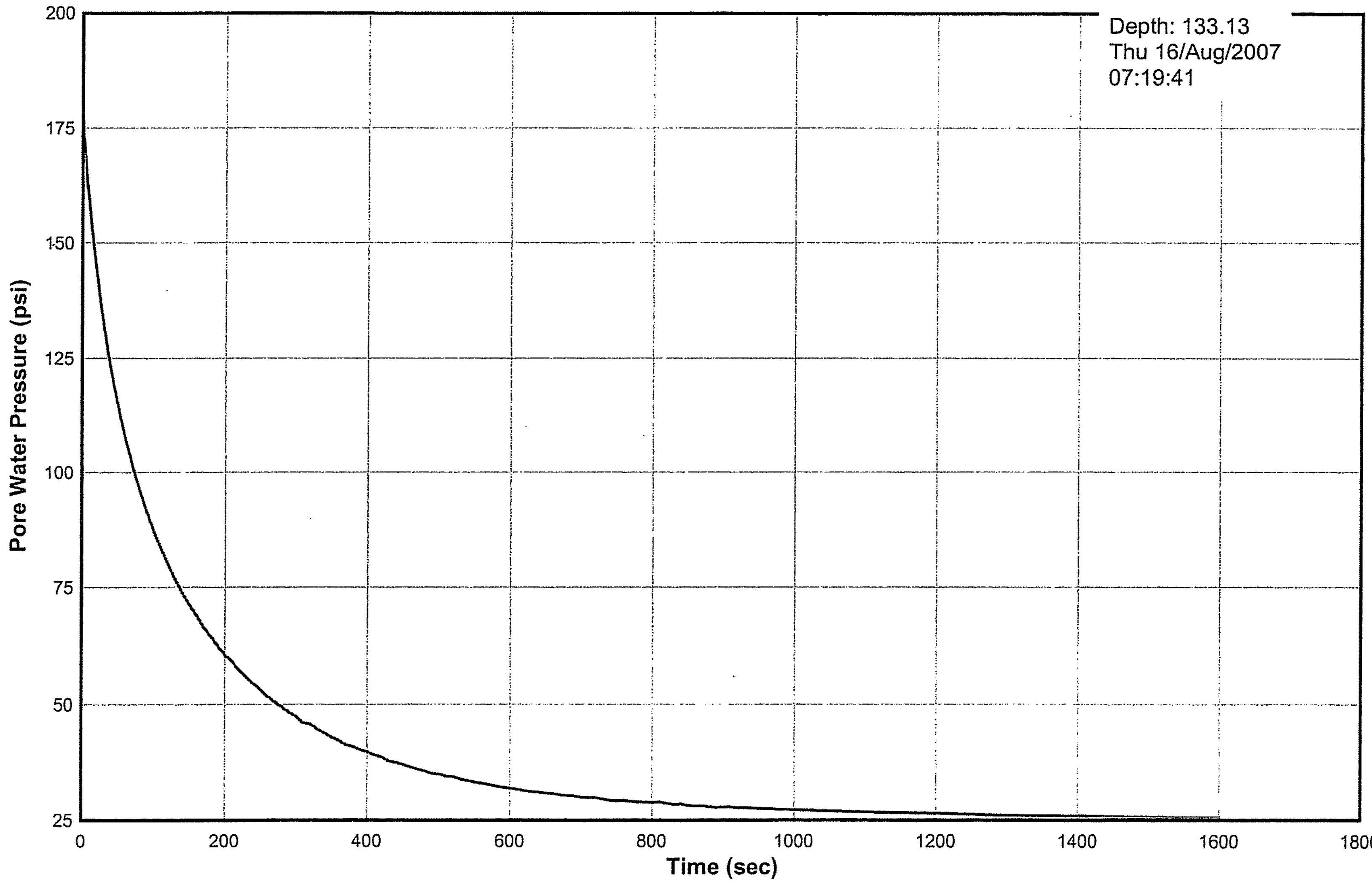
Pore Pressure Dissipation Test
Sounding 07-22
AET #01-03612



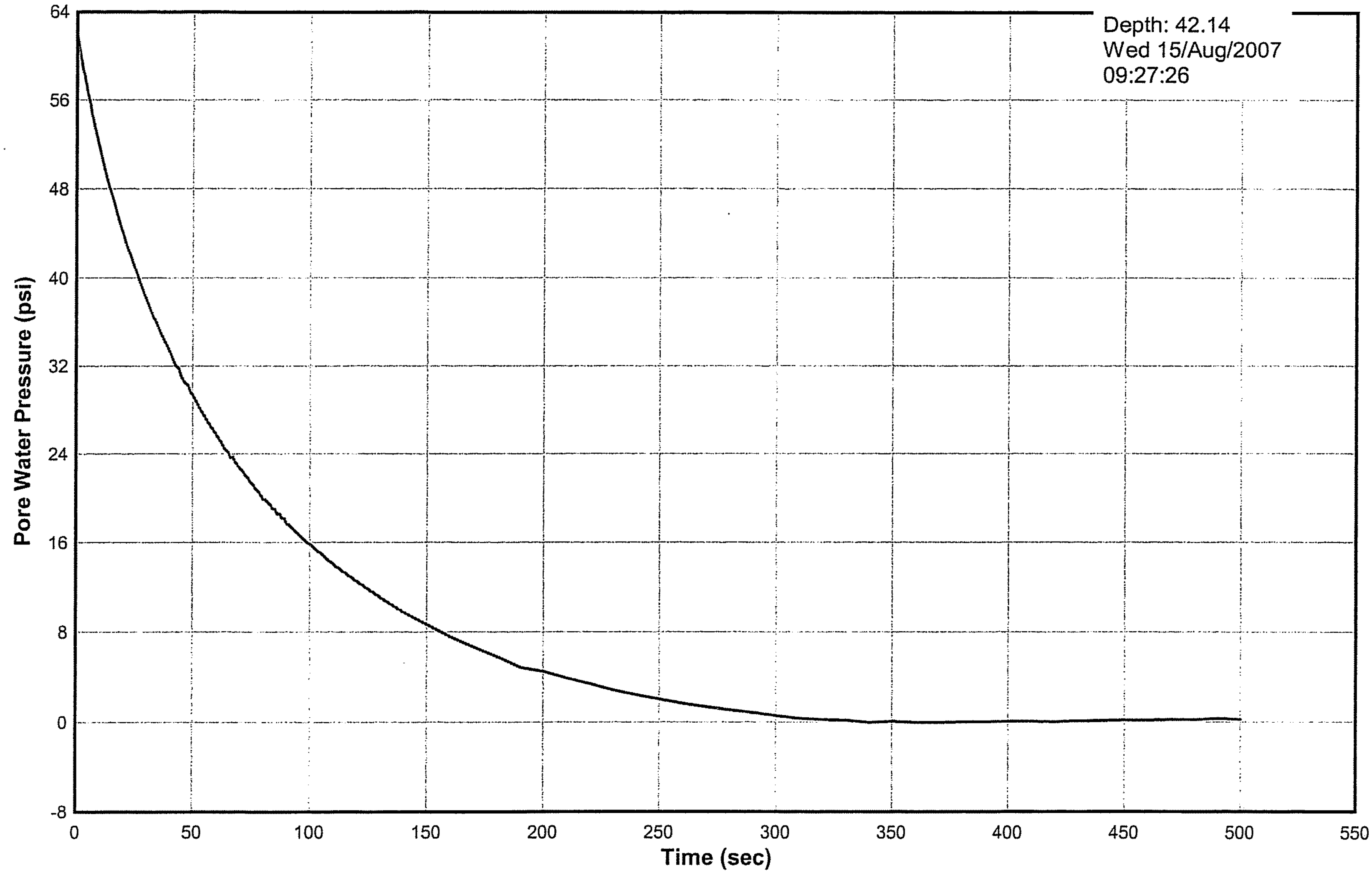
Pore Pressure Dissipation Test
Sounding 07-22
AET #01-03612



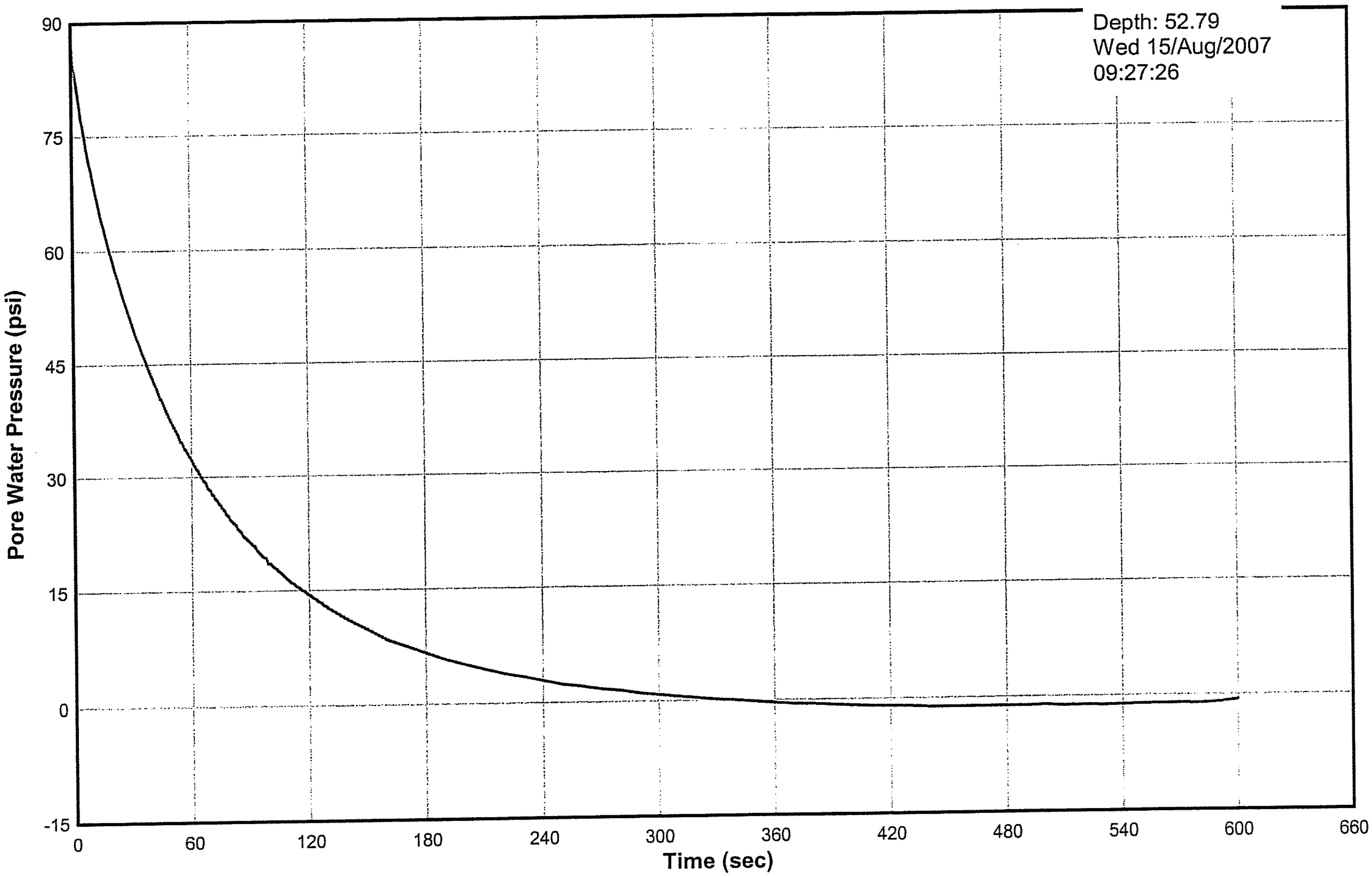
Pore Pressure Dissipation Test
Sounding 07-22
AET #01-03612



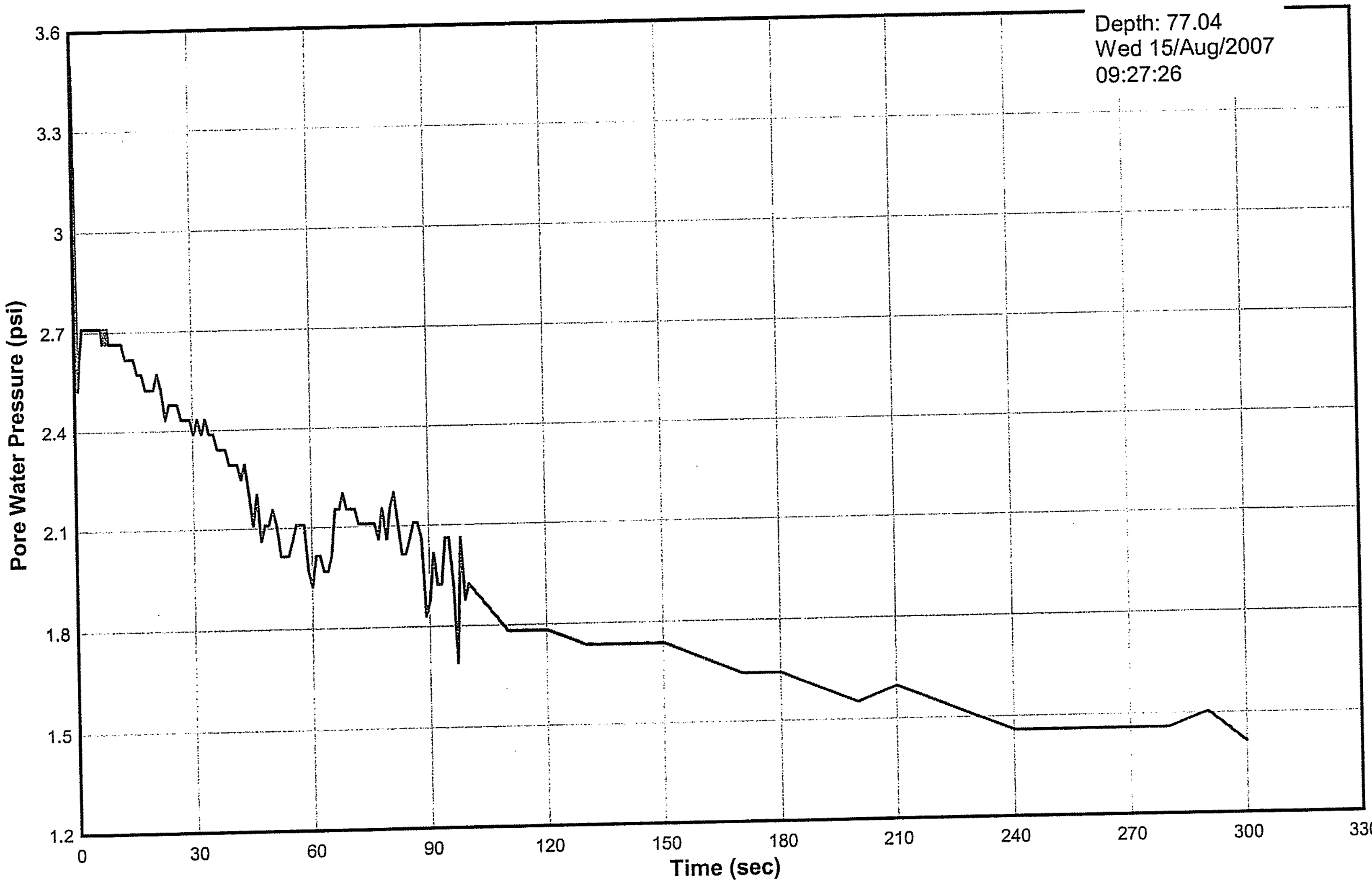
Pore Pressure Dissipation Test
Sounding 07-23
AET #01-03612



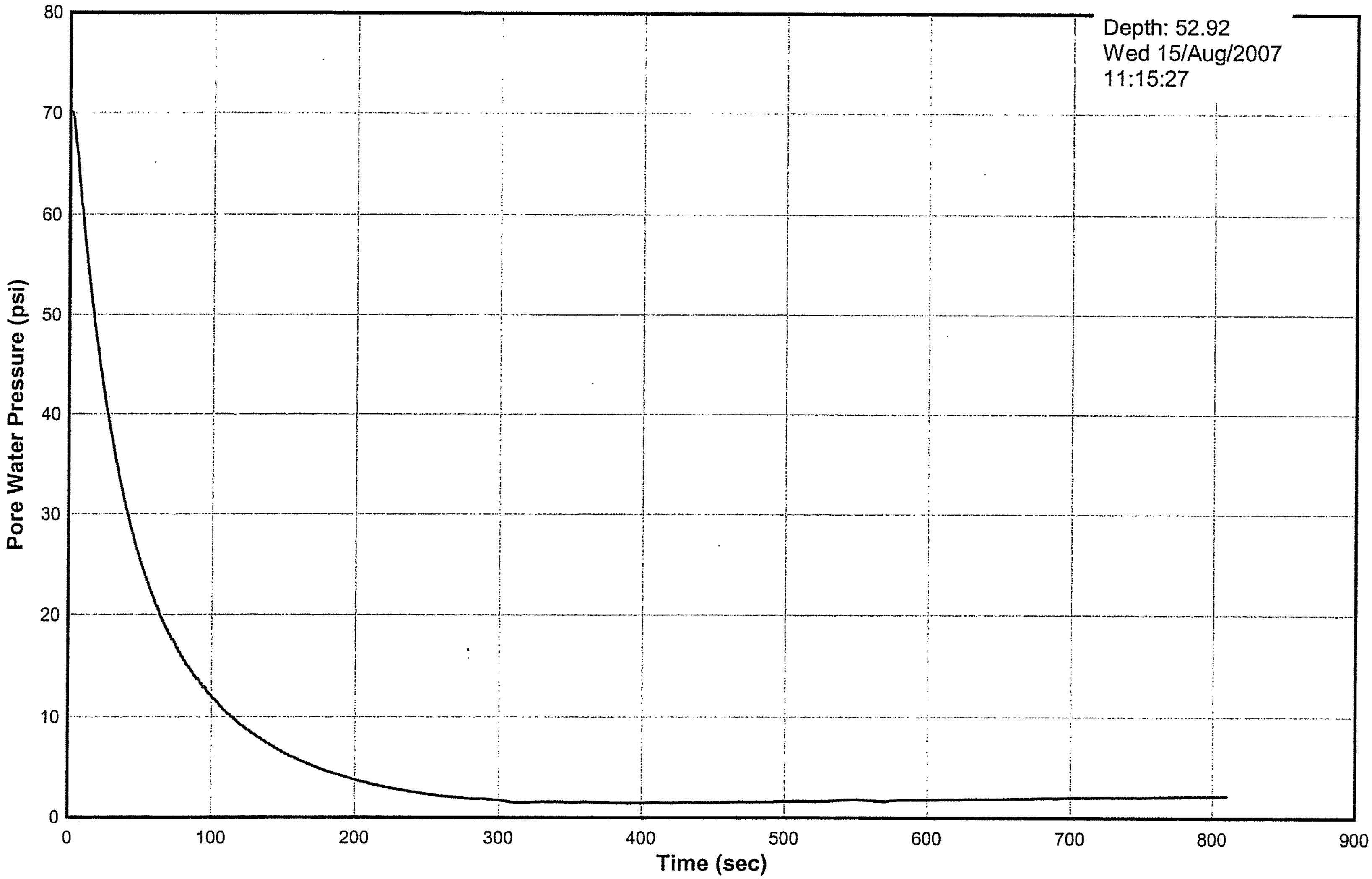
Pore Pressure Dissipation Test
Sounding 07-23
AET #01-03612



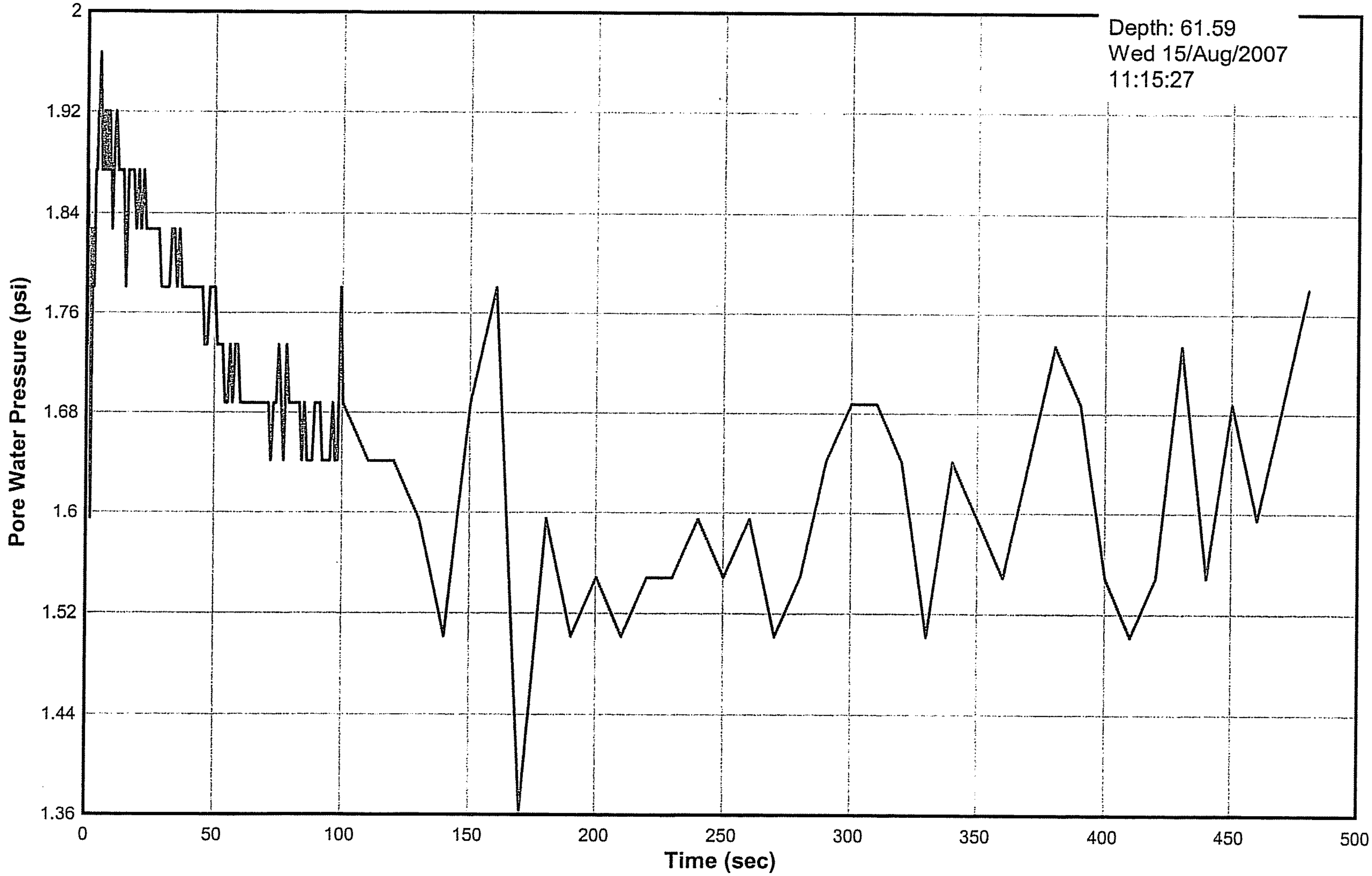
Pore Pressure Dissipation Test
Sounding 07-23
AET #01-03612



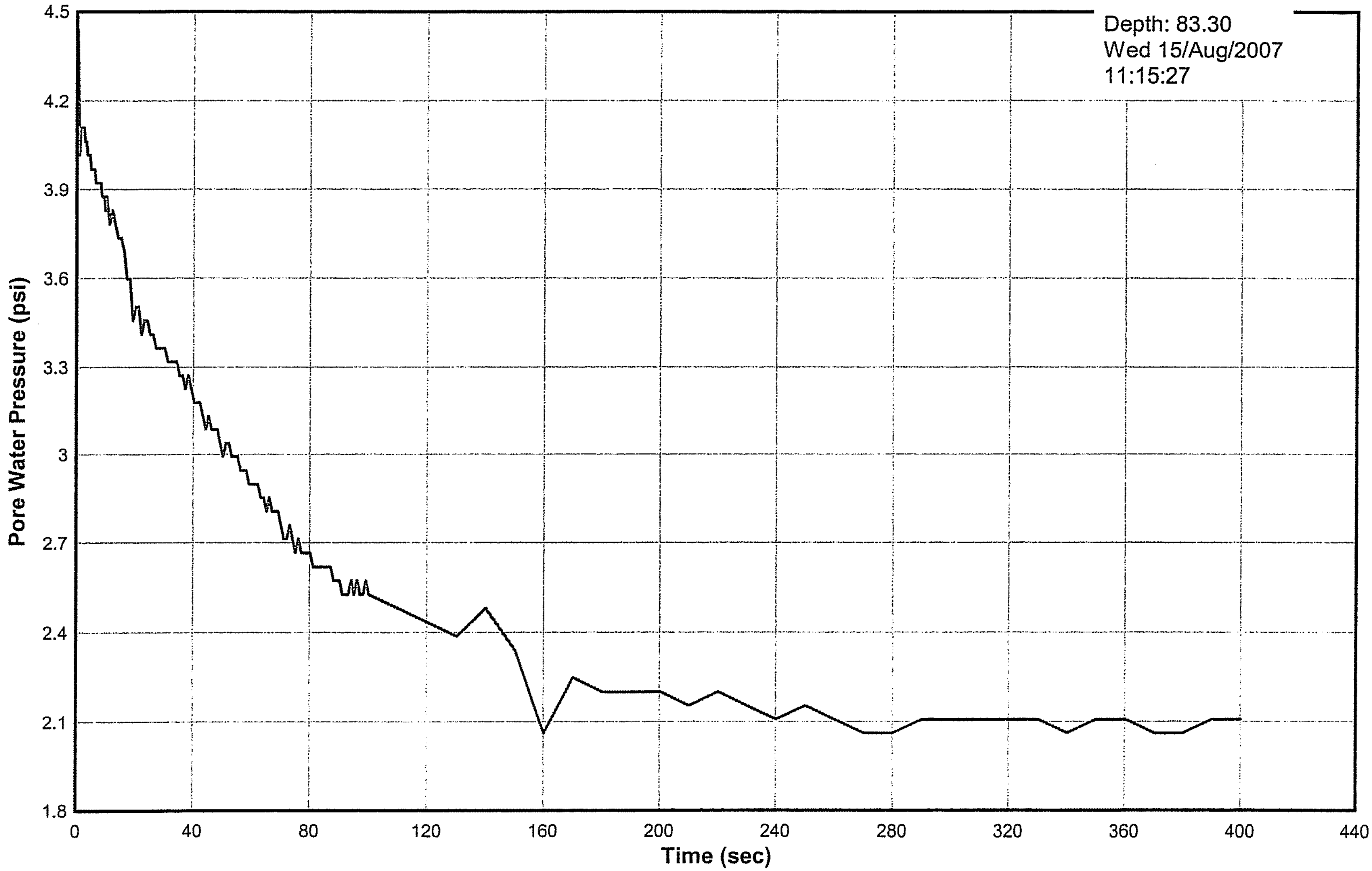
Pore Pressure Dissipation Test
Sounding 07-24
AET #01-03612



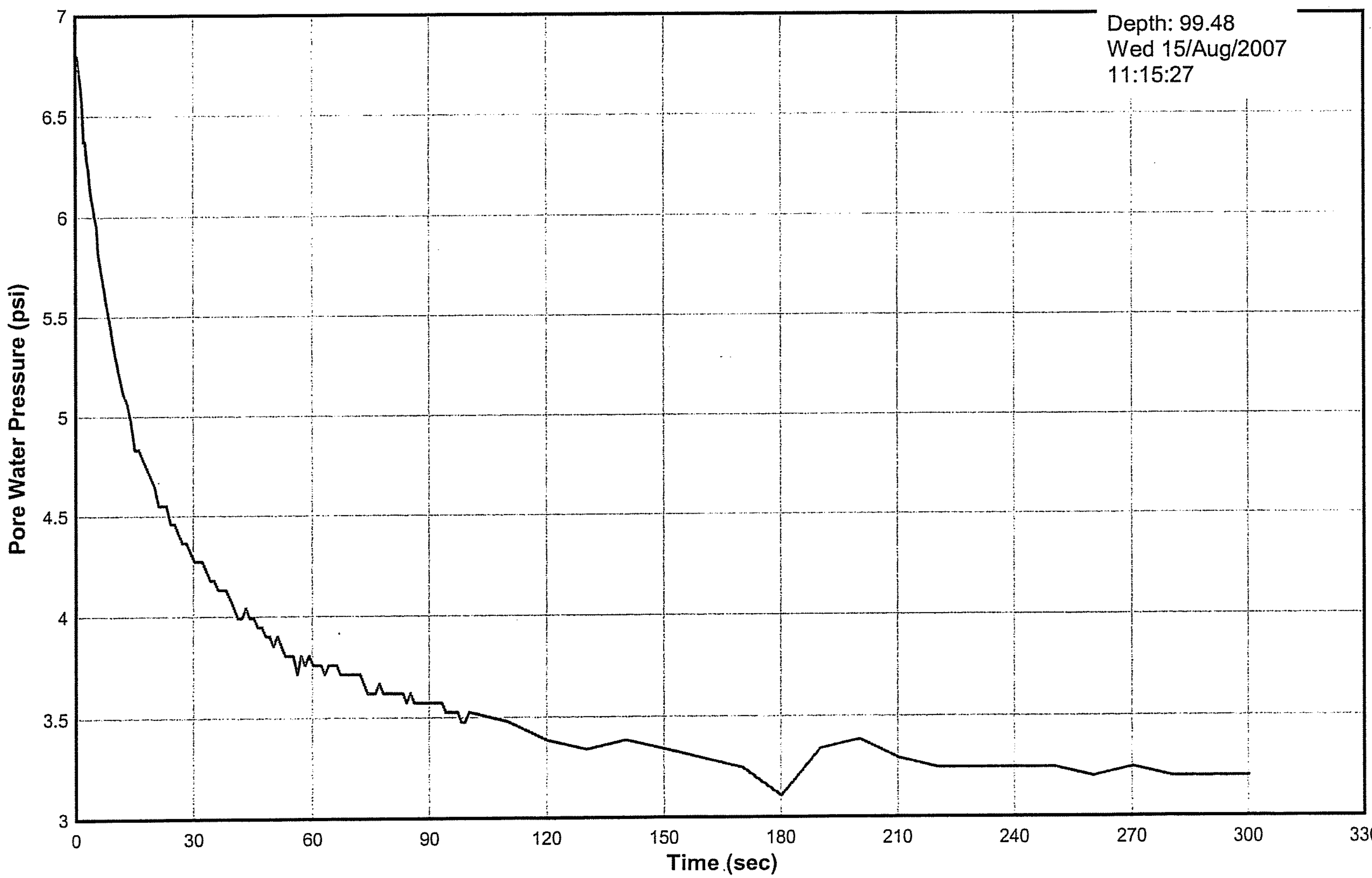
Pore Pressure Dissipation Test
Sounding 07-24
AET #01-03612



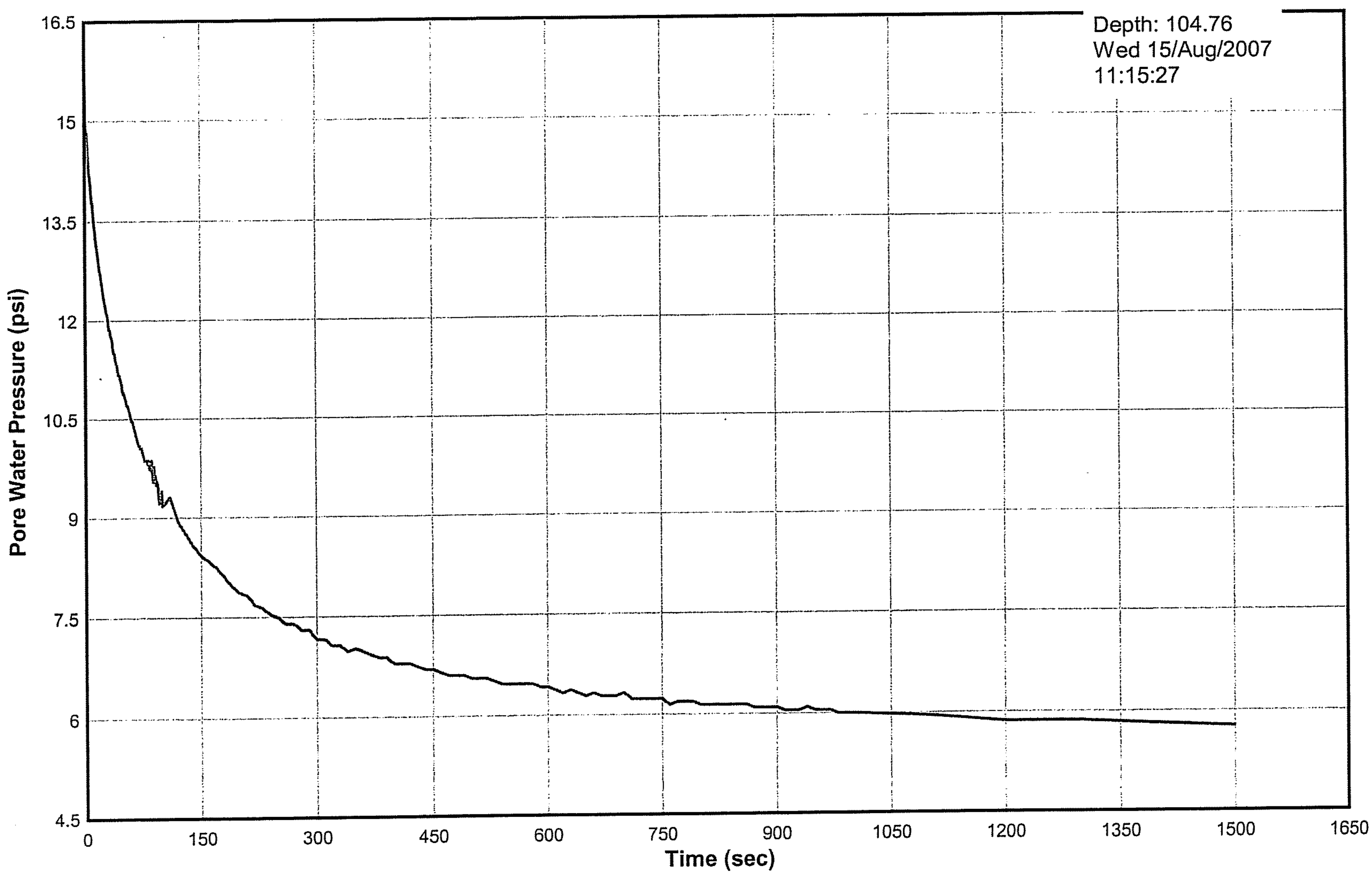
Pore Pressure Dissipation Test
Sounding 07-24
AET #01-03612



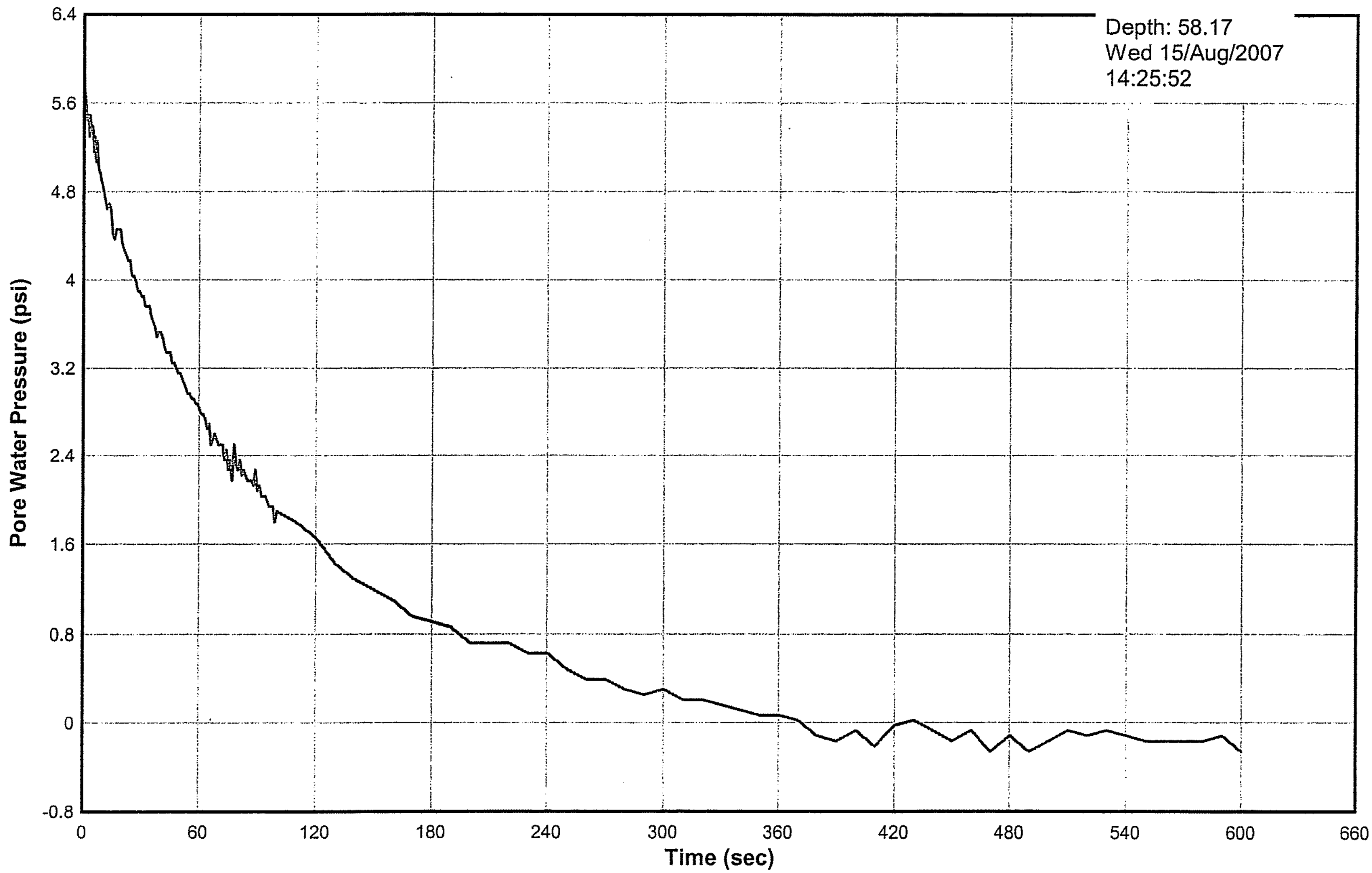
Pore Pressure Dissipation Test
Sounding 07-24
AET #01-03612

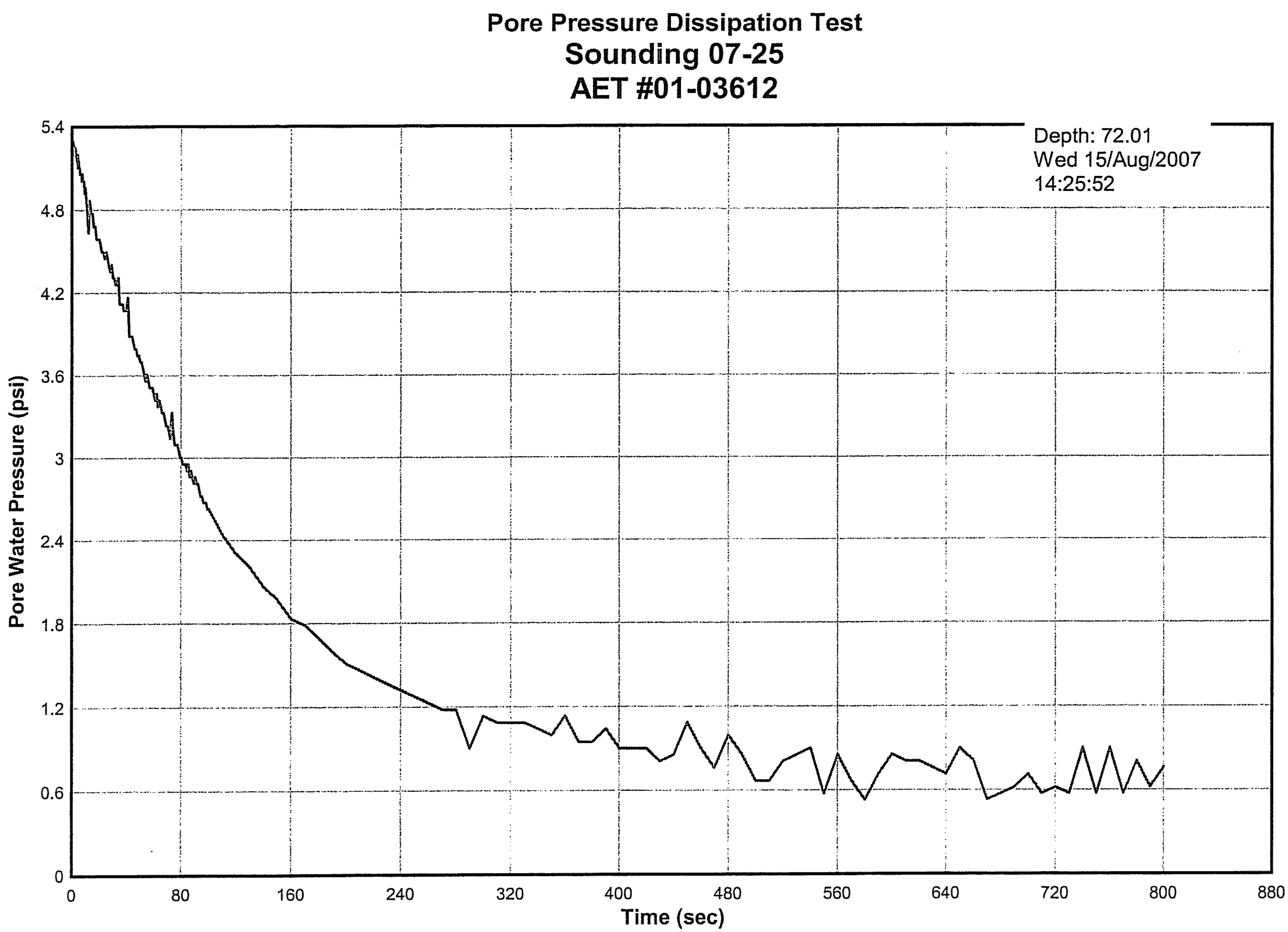


Pore Pressure Dissipation Test
Sounding 07-24
AET #01-03612

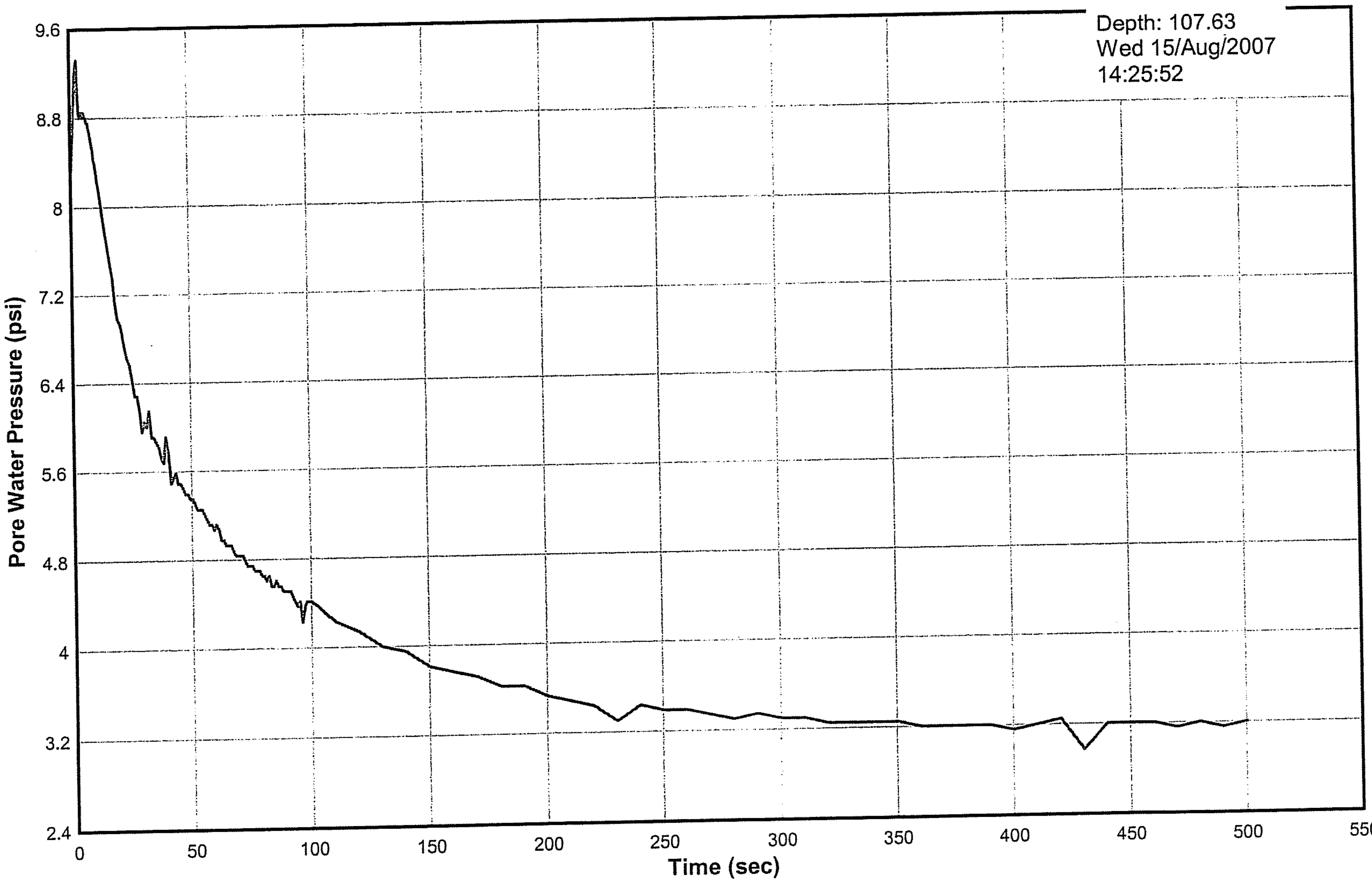


Pore Pressure Dissipation Test
Sounding 07-25
AET #01-03612

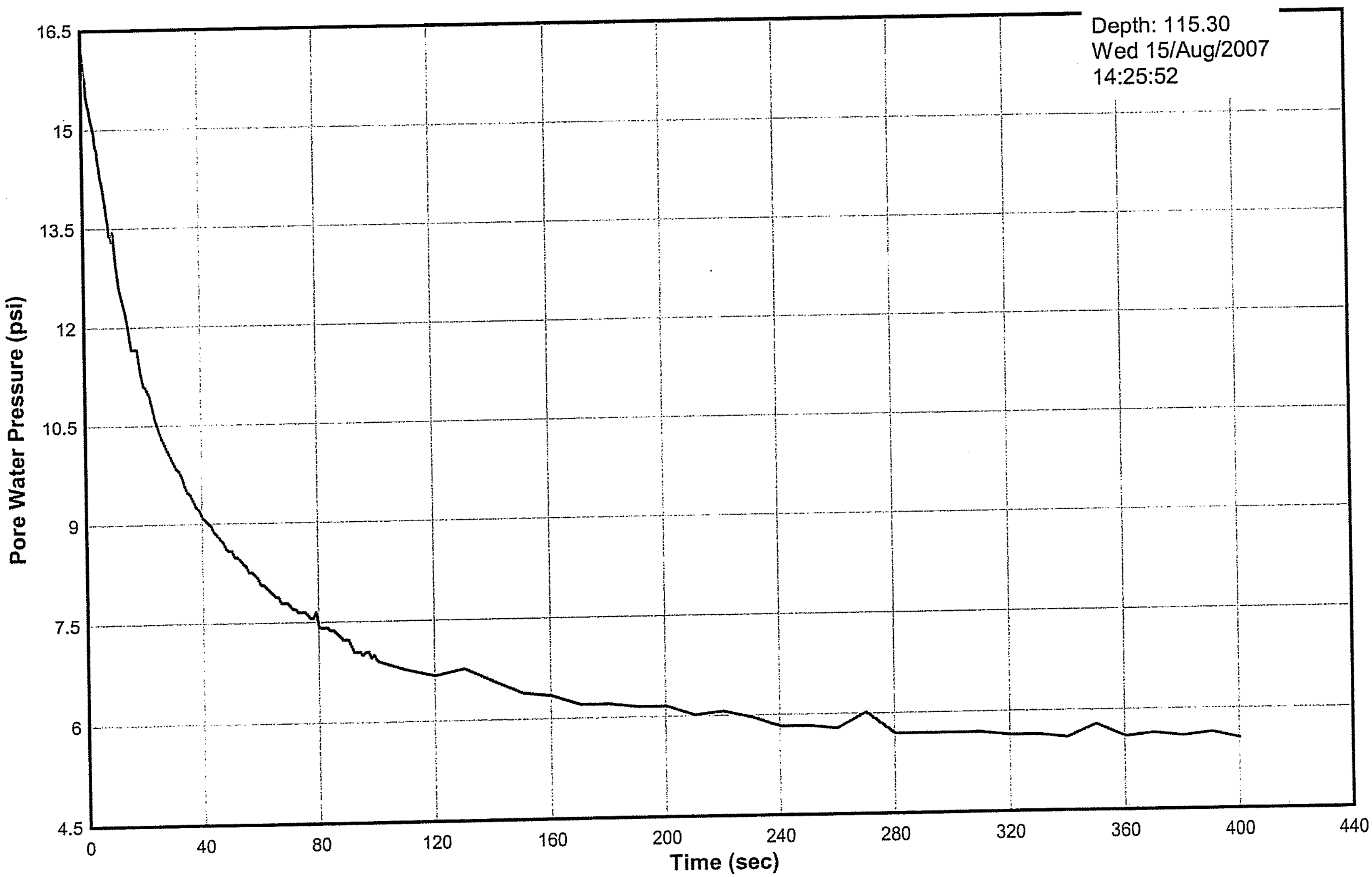



Pore Pressure Dissipation Test
Sounding 07-25
AET #01-03612
Depth: 72.01
Wed 15/Aug/2007
14:25:52
Pore Water Pressure (psi)
5.4
4.8
4.2
3.6
3
2.4
1.8
1.2
0.6
0
Time (sec)
0
80
160
240
320
400
480
560
640
720
800
880

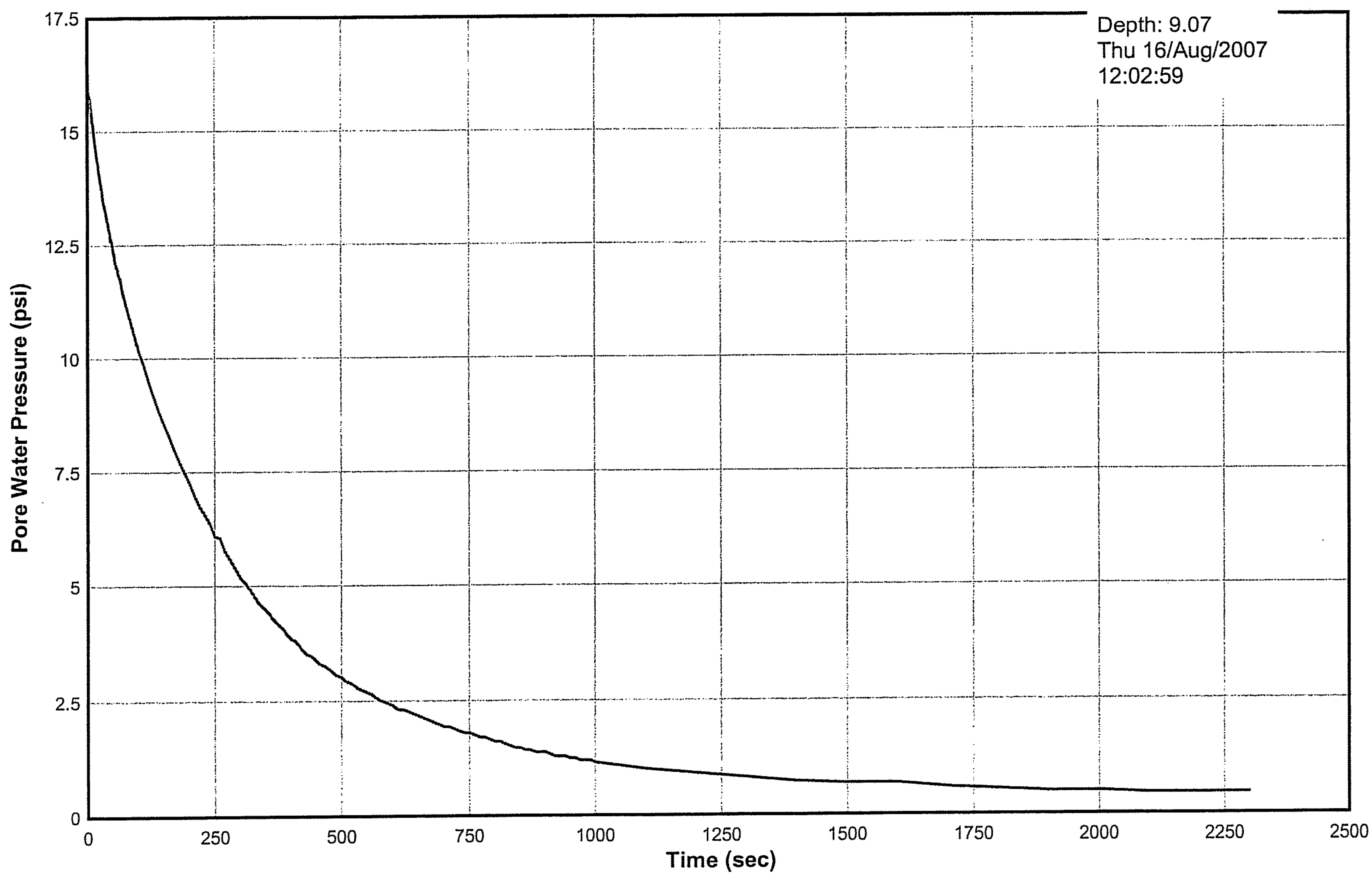
Pore Pressure Dissipation Test
Sounding 07-25
AET #01-03612



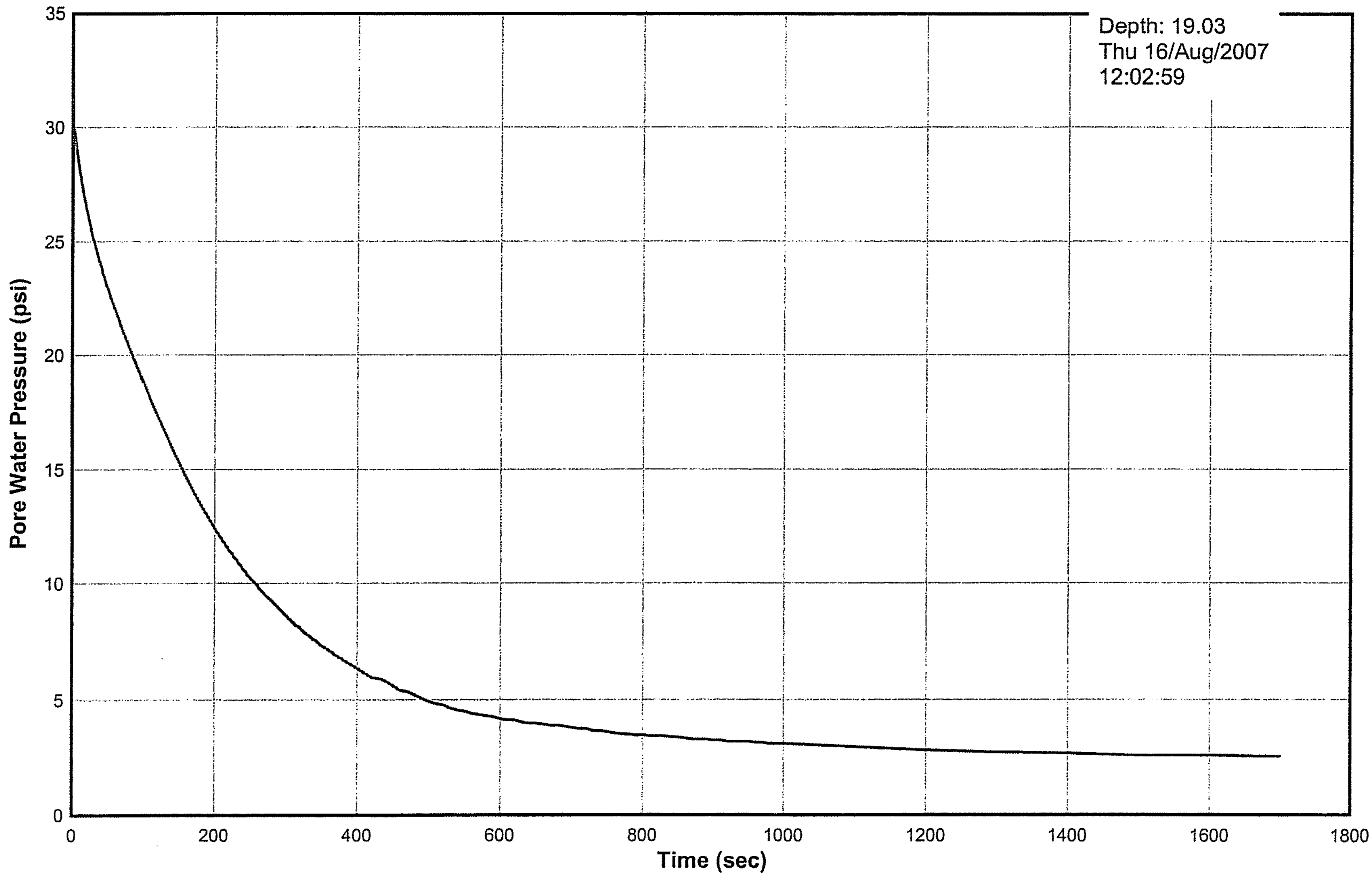
Pore Pressure Dissipation Test
Sounding 07-25
AET #01-03612



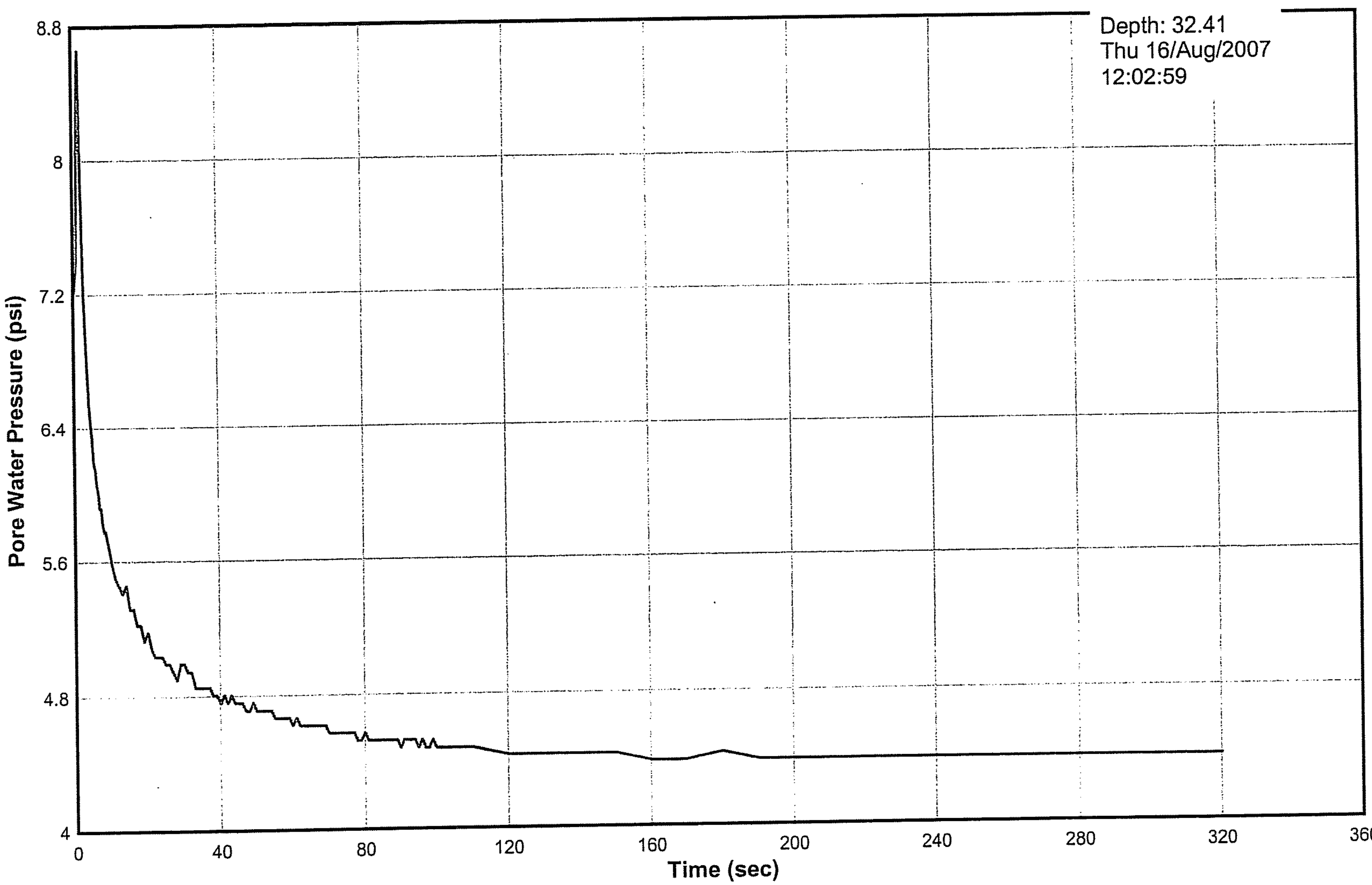
Pore Pressure Dissipation Test
Sounding 07-26
AET #01-03612



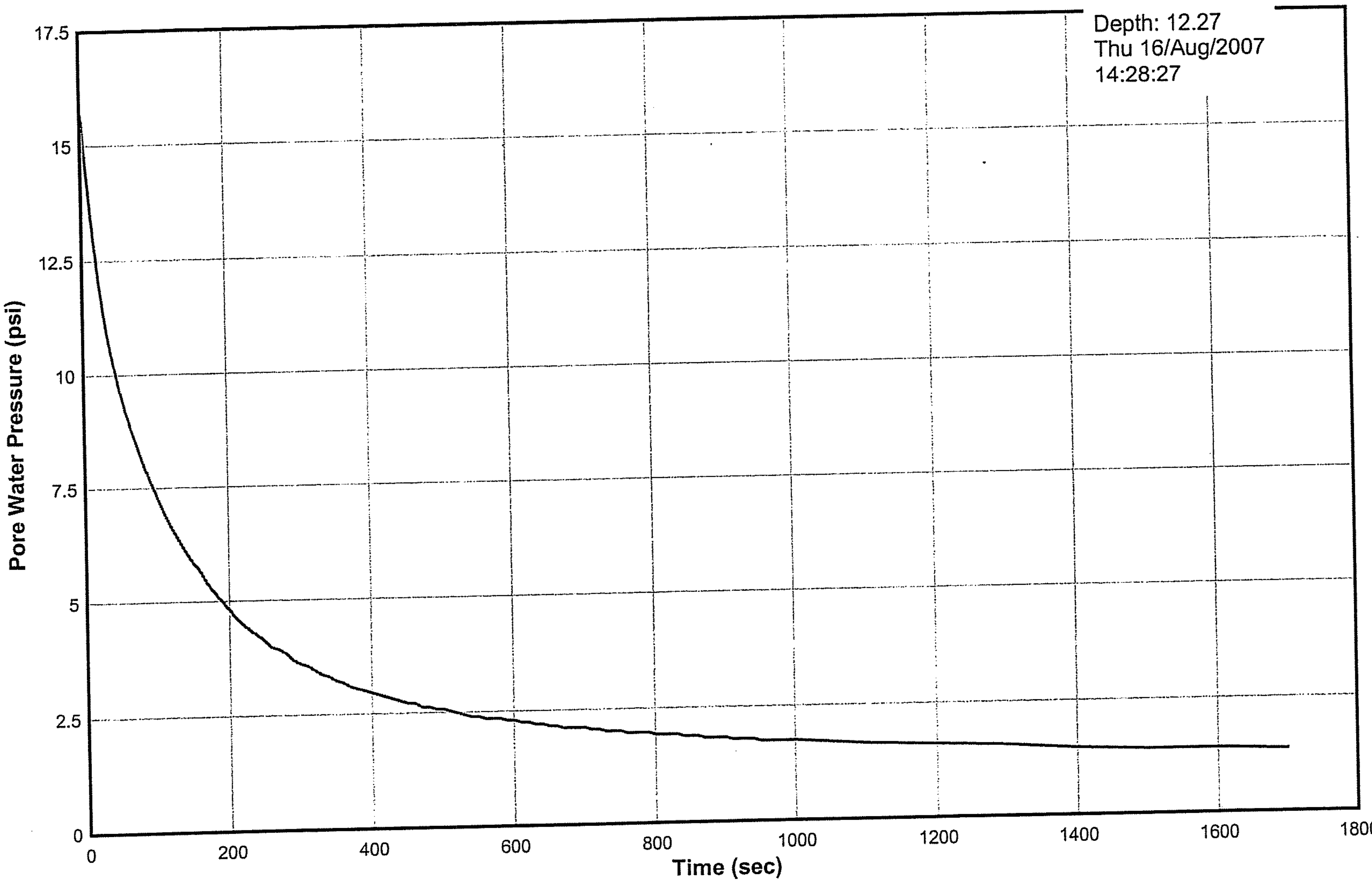
Pore Pressure Dissipation Test
Sounding 07-26
AET #01-03612



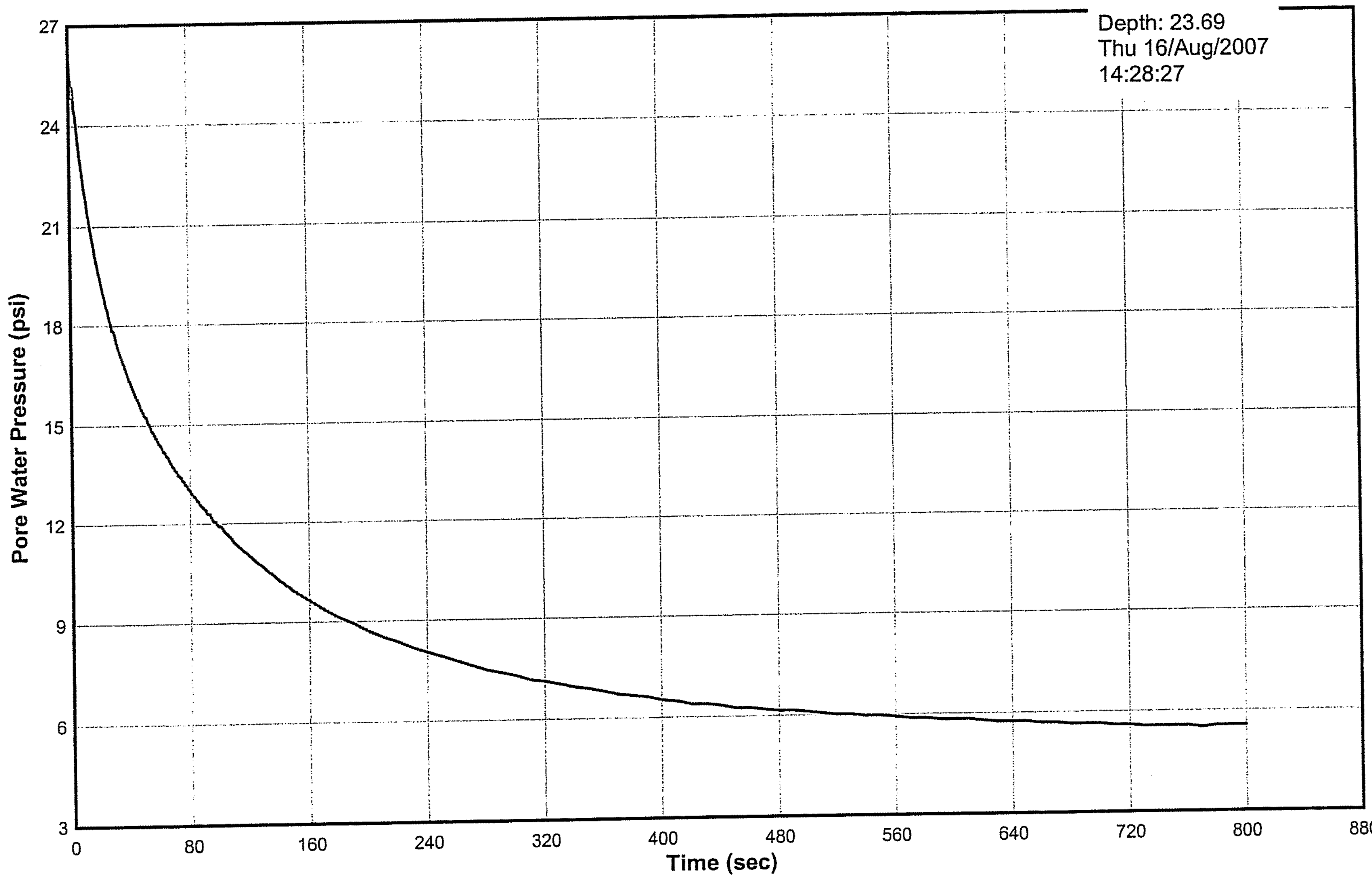
Pore Pressure Dissipation Test
Sounding 07-26
AET #01-03612



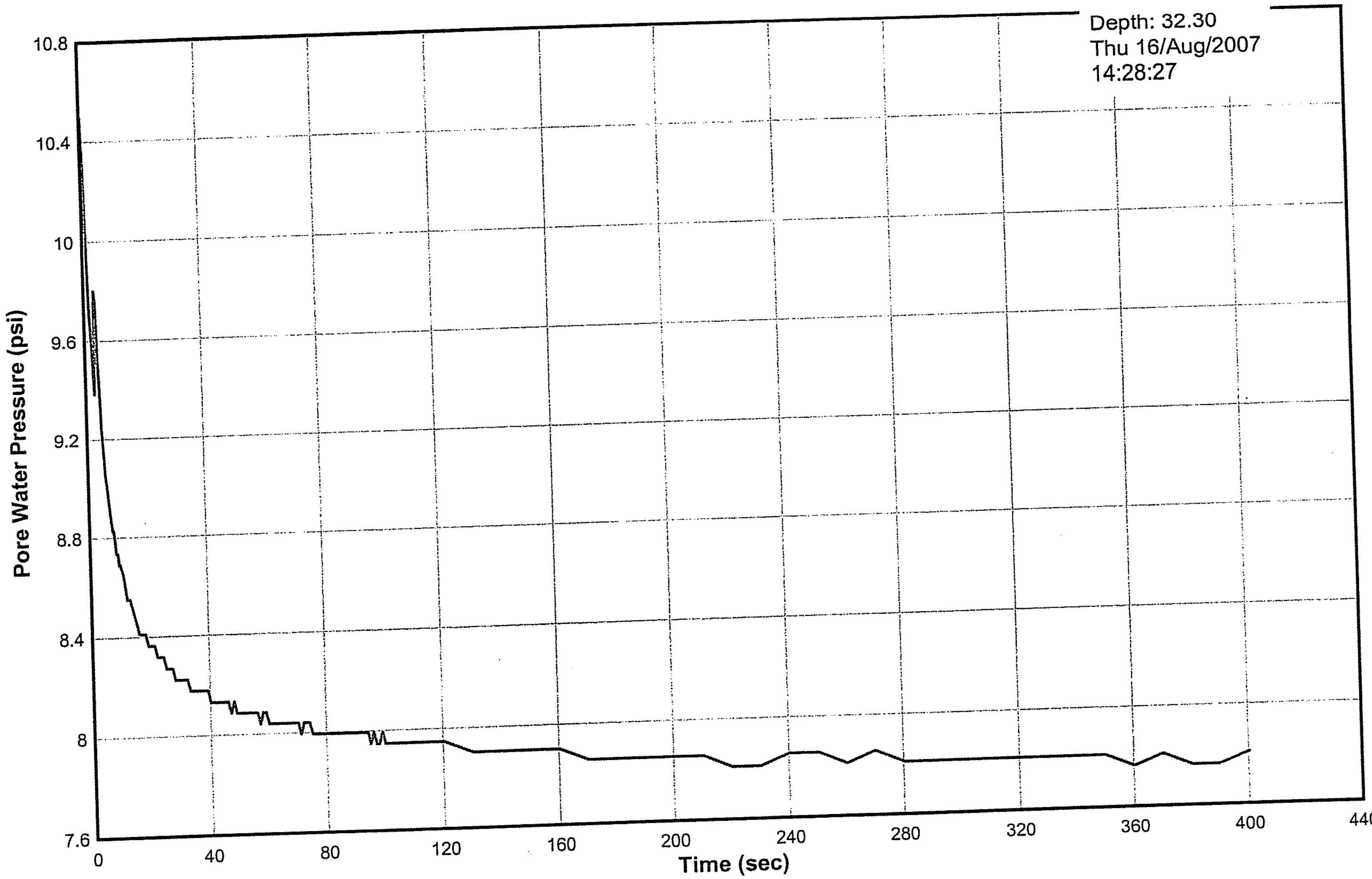
Pore Pressure Dissipation Test
Sounding 07-27
AET #01-03612



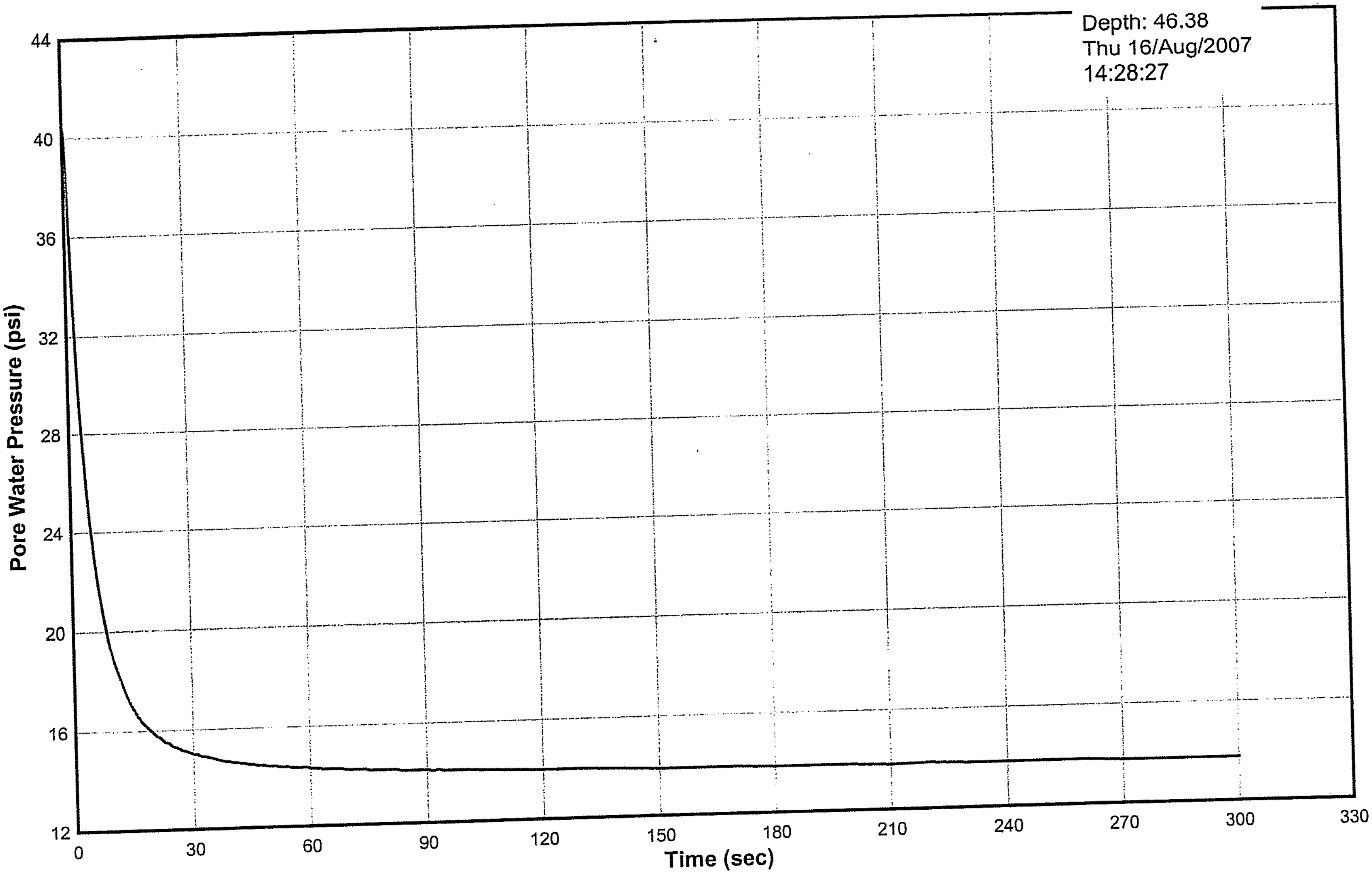
Pore Pressure Dissipation Test
Sounding 07-27
AET #01-03612



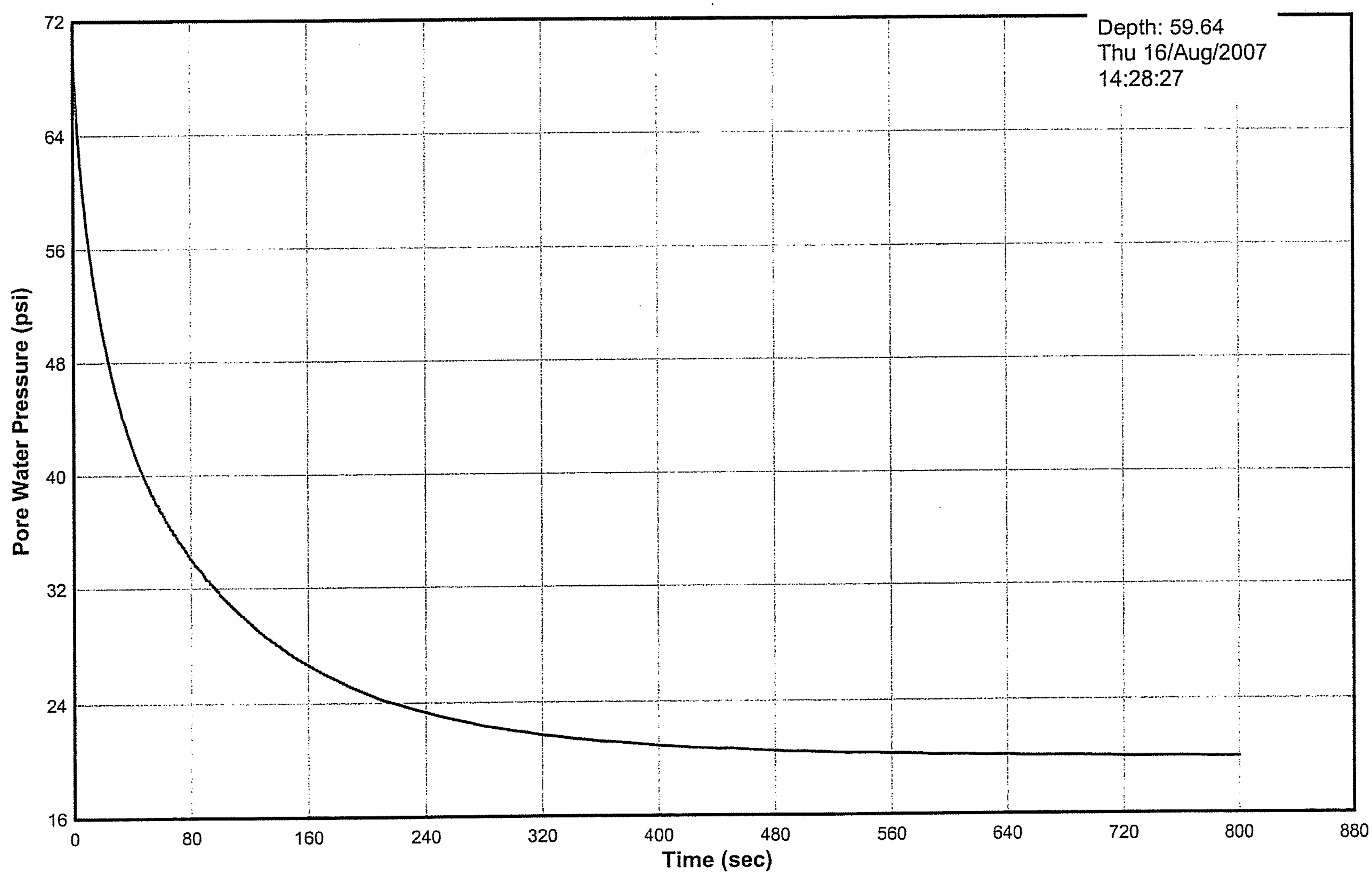
Pore Pressure Dissipation Test
Sounding 07-27
AET #01-03612



Pore Pressure Dissipation Test
Sounding 07-27
AET #01-03612

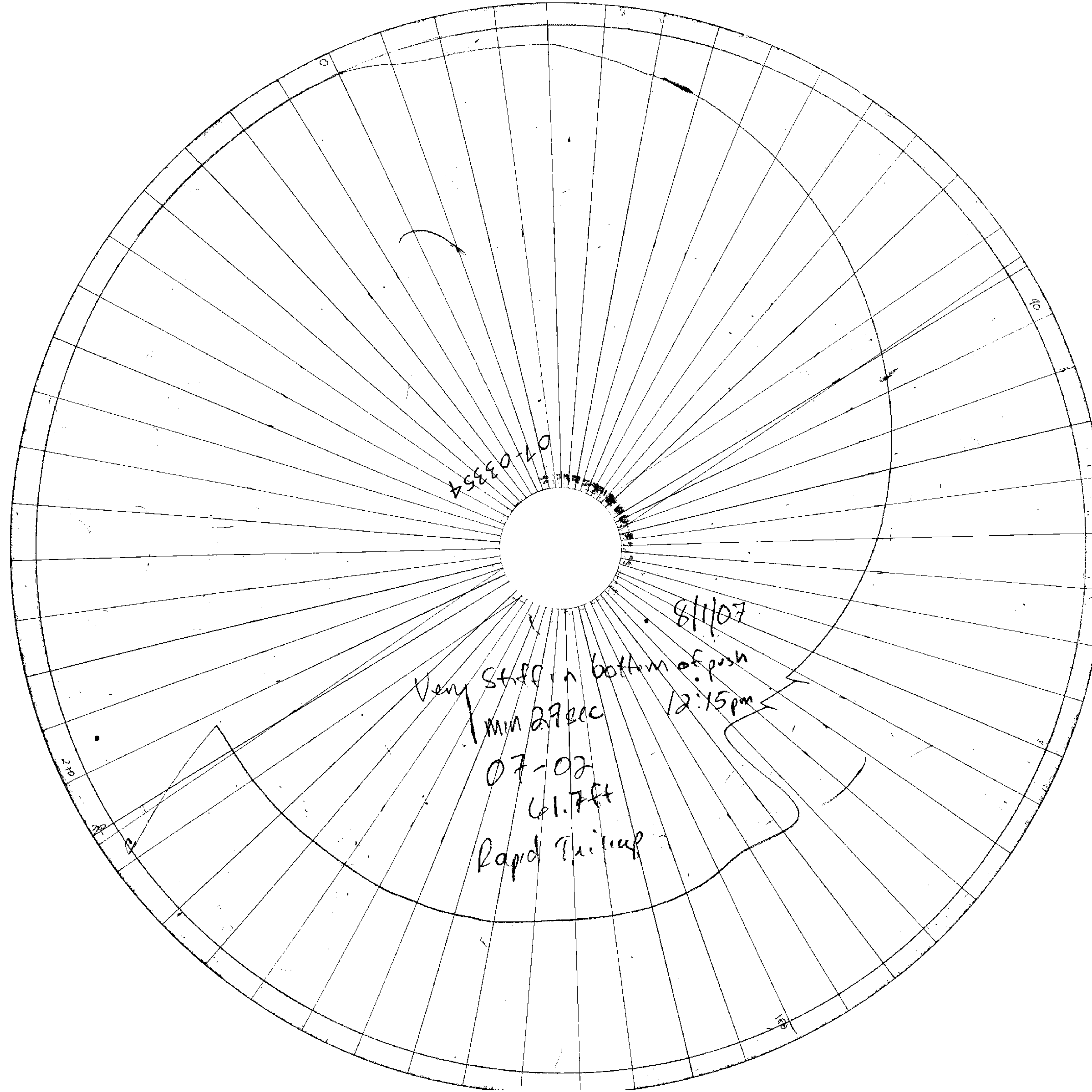


Pore Pressure Dissipation Test
Sounding 07-27
AET #01-03612



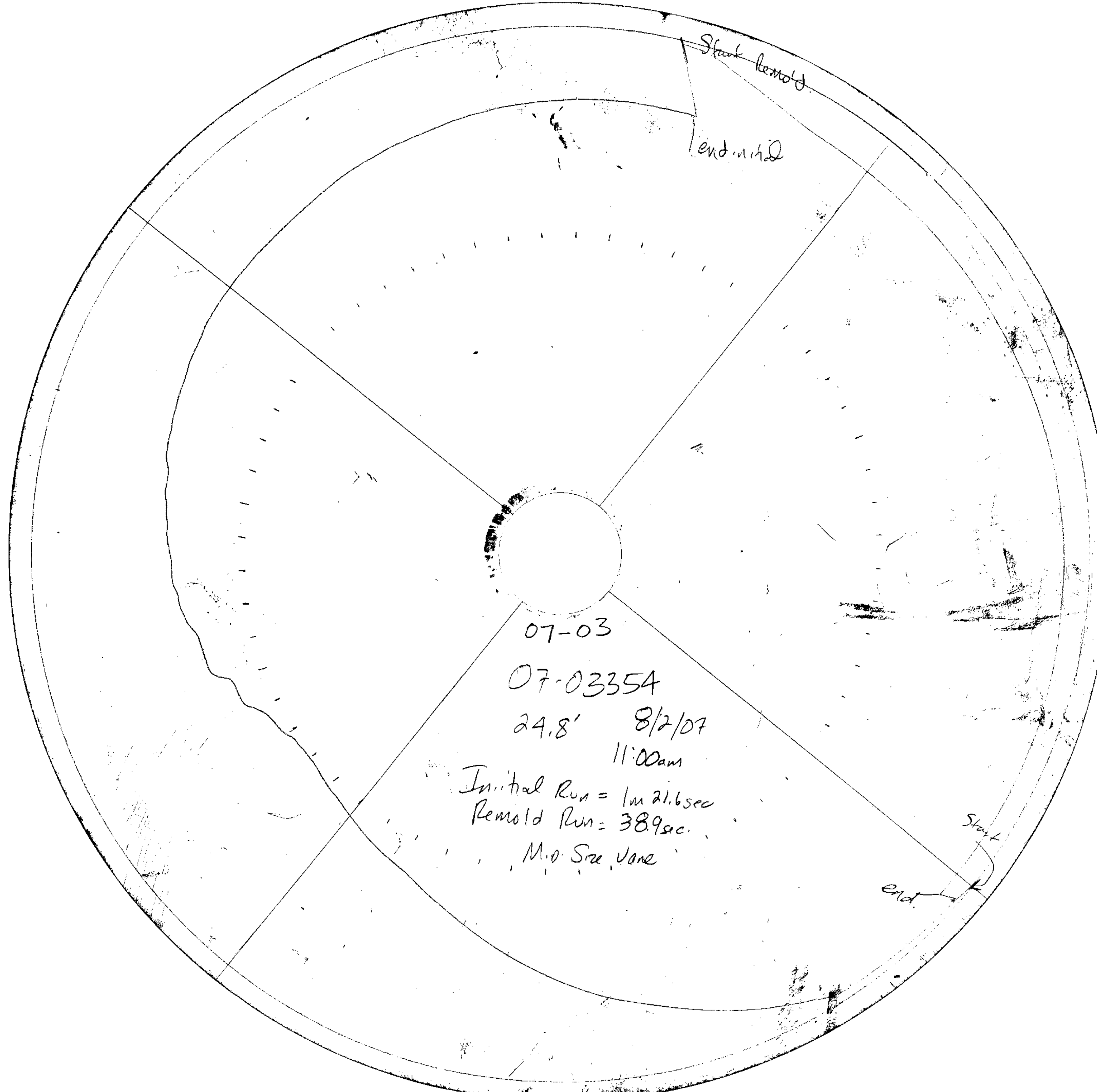
Boring: 07-02

Depth: 61.7 ft



Boring: 07-03

Depth: 24.8 ft

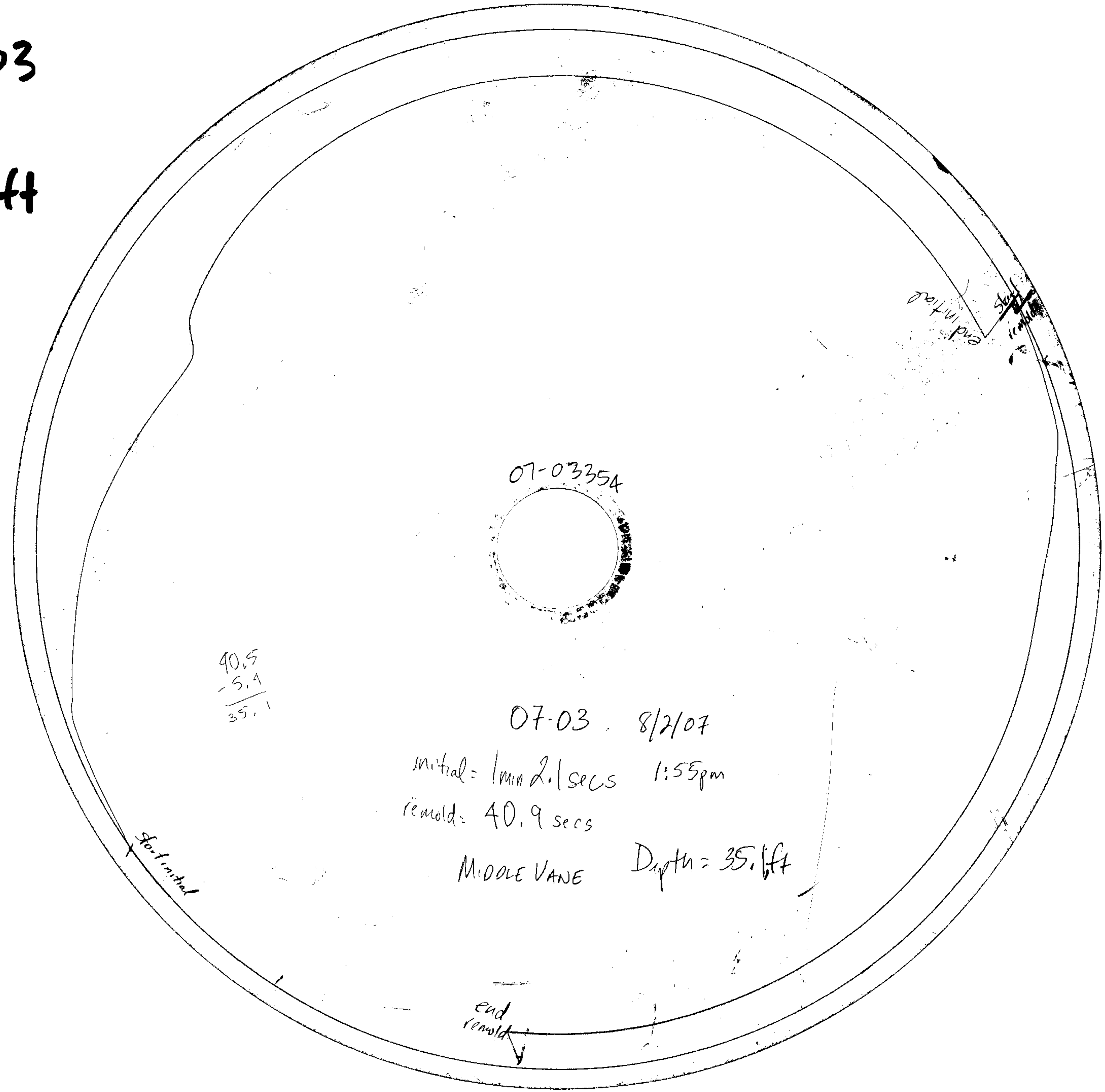


Boring: 07-03

Depth: 25.2 ft

Boring: 07-03

Depth: 35.1 ft

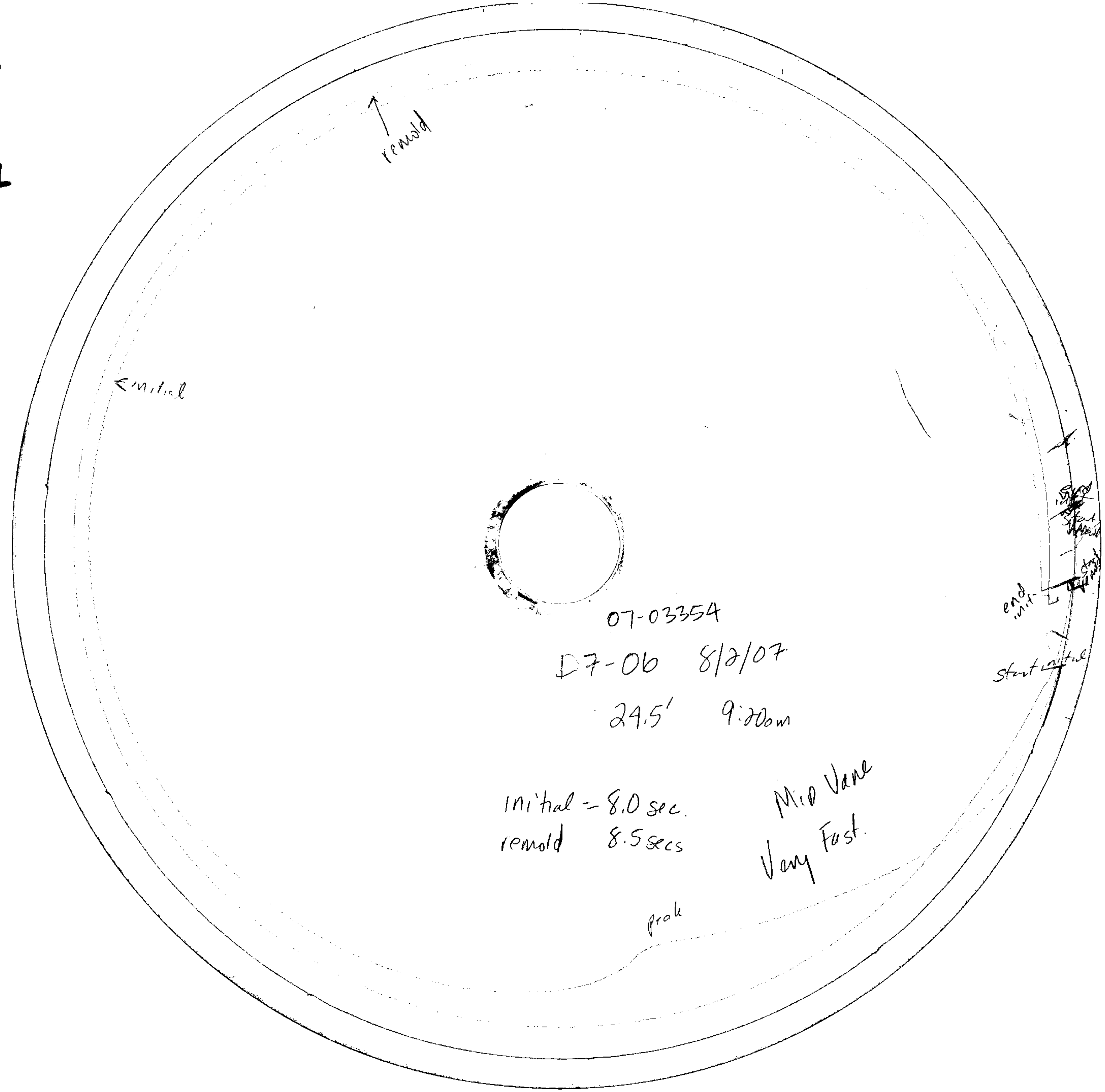


Boring : 07-06

Depth: 23.5 ft

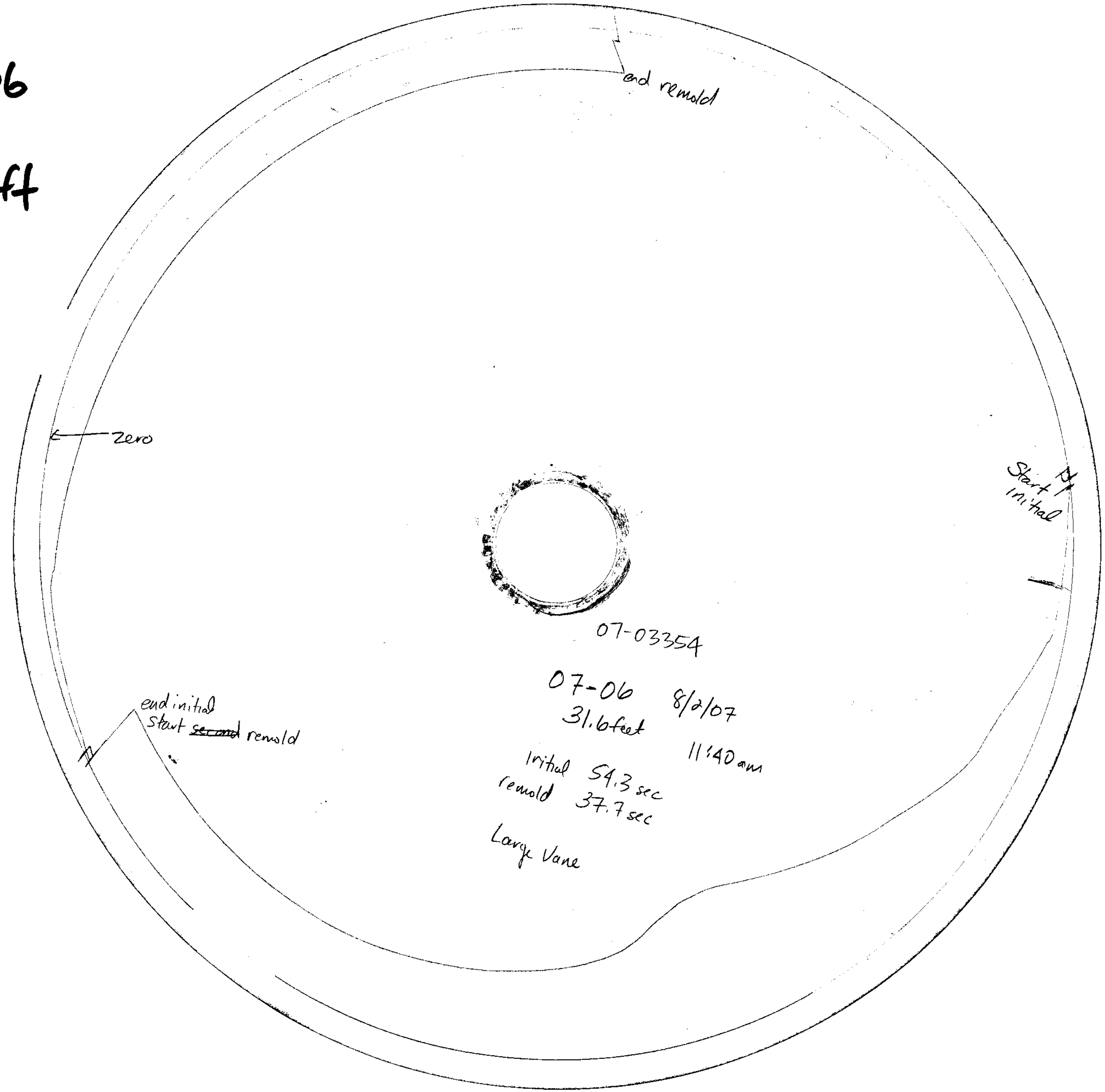
Boring: 07-06

Depth: 24.5 ft



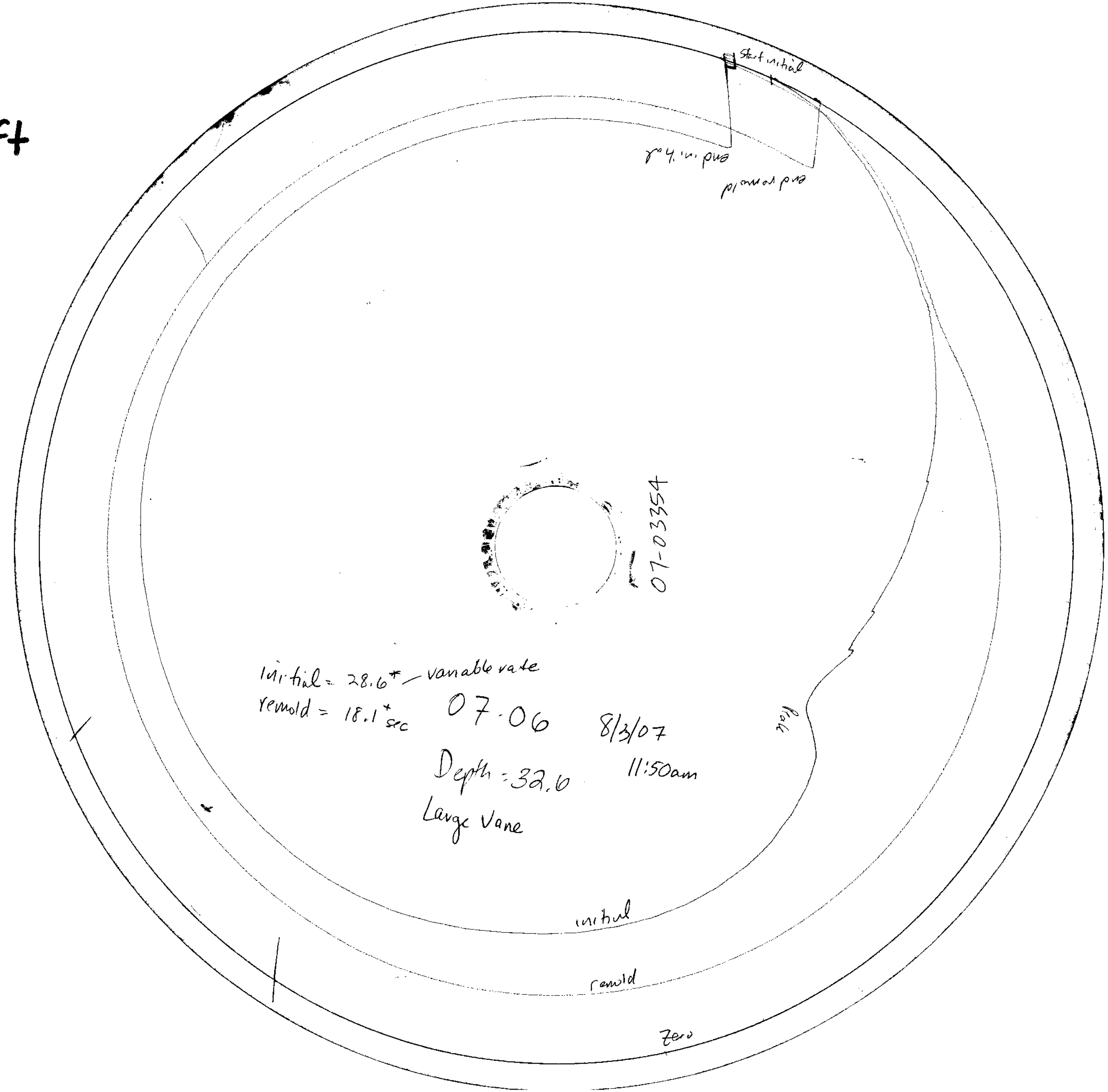
Boring : 07-06

Depth : 31.6 ft



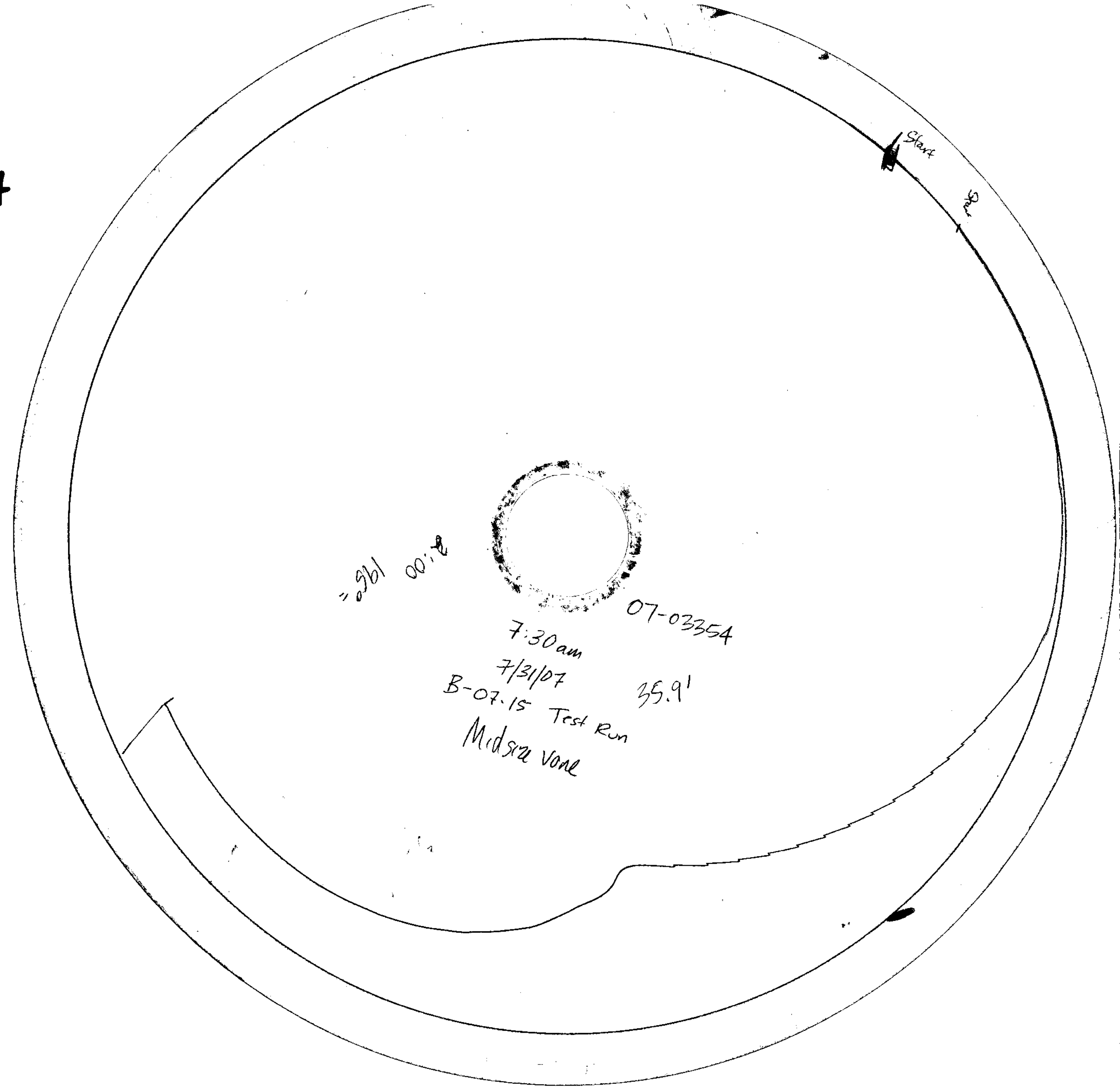
Boring : 07-06

Depth : 32.6 ft



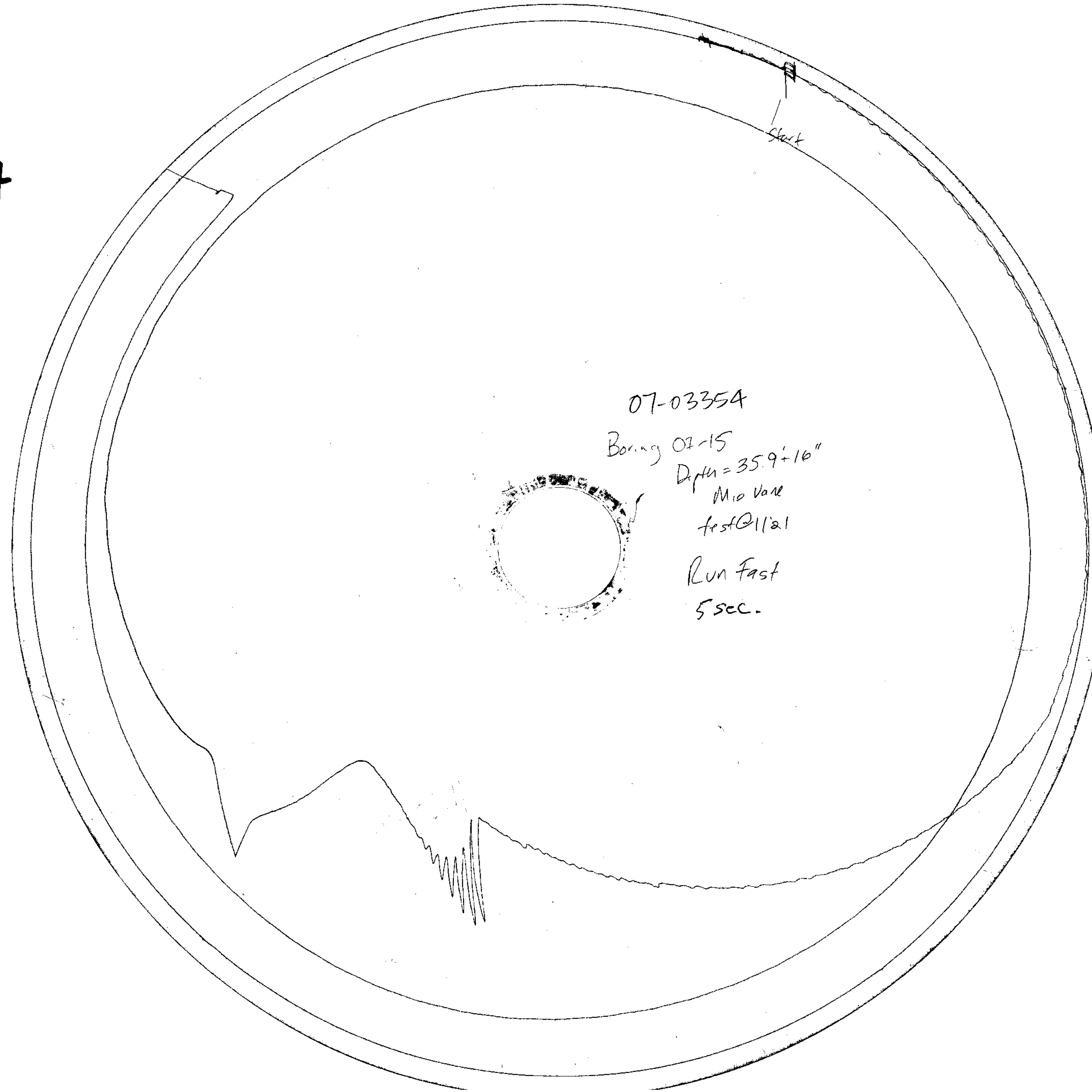
Boring: 07-15

Depth: 35.9 ft



Boring: 07-15

Depth: 37.2 ft

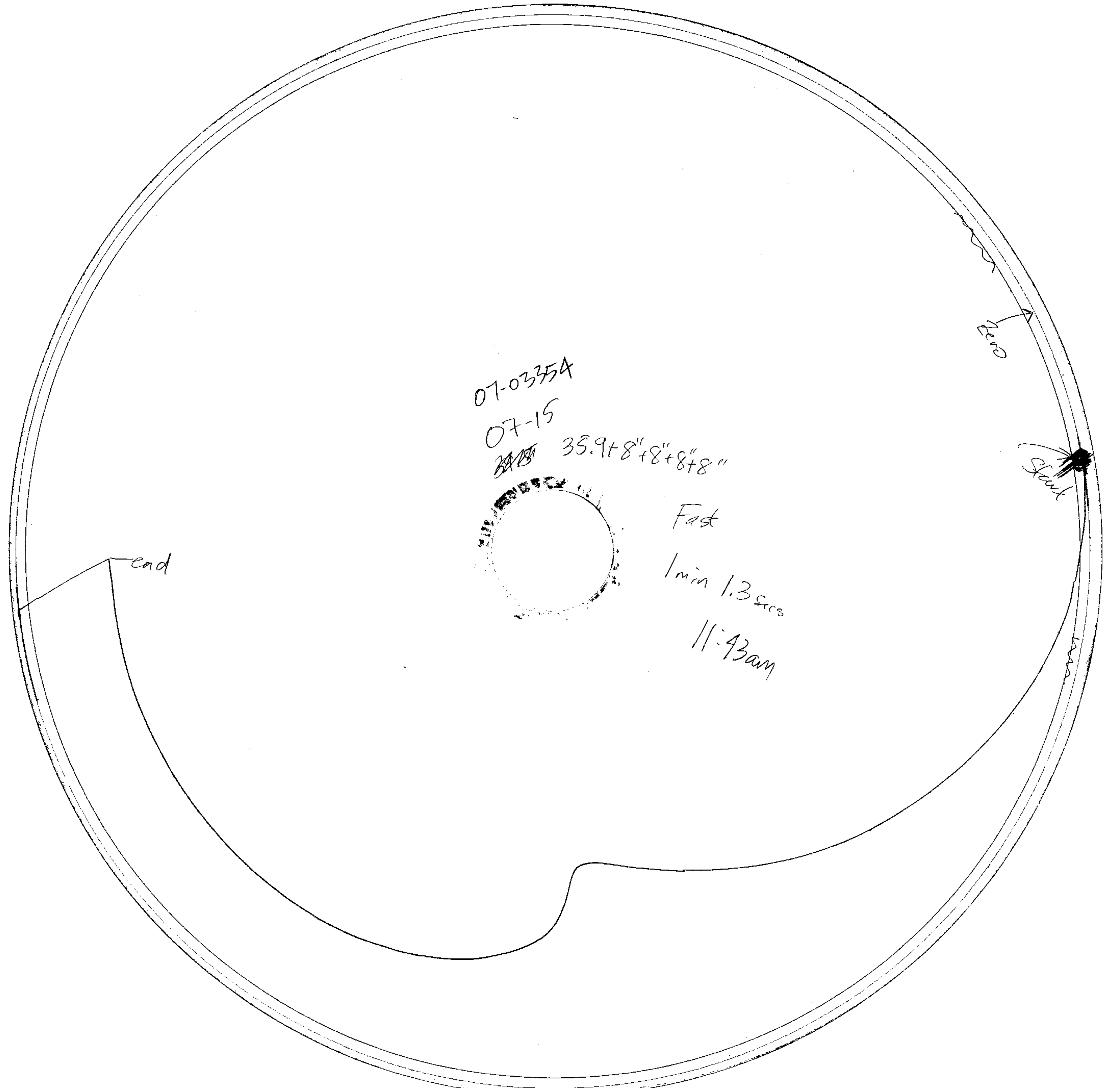


Boring: 07-15

Depth: 37.9 ft

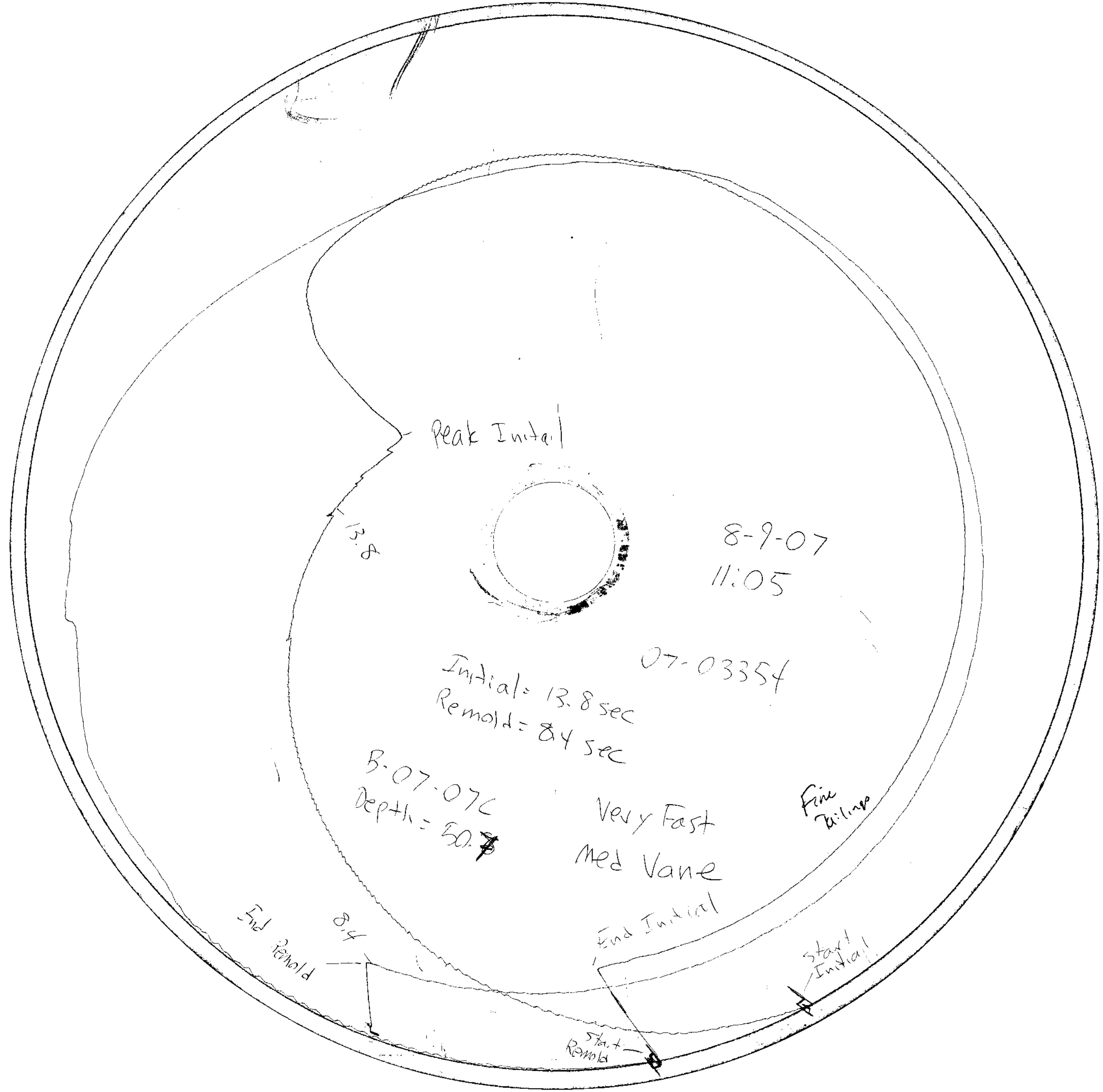
Boring: 07-15

Depth: 38.6 ft



Boring: 07-07C

Depth: 50.7 ft.



Boring: 07-07C

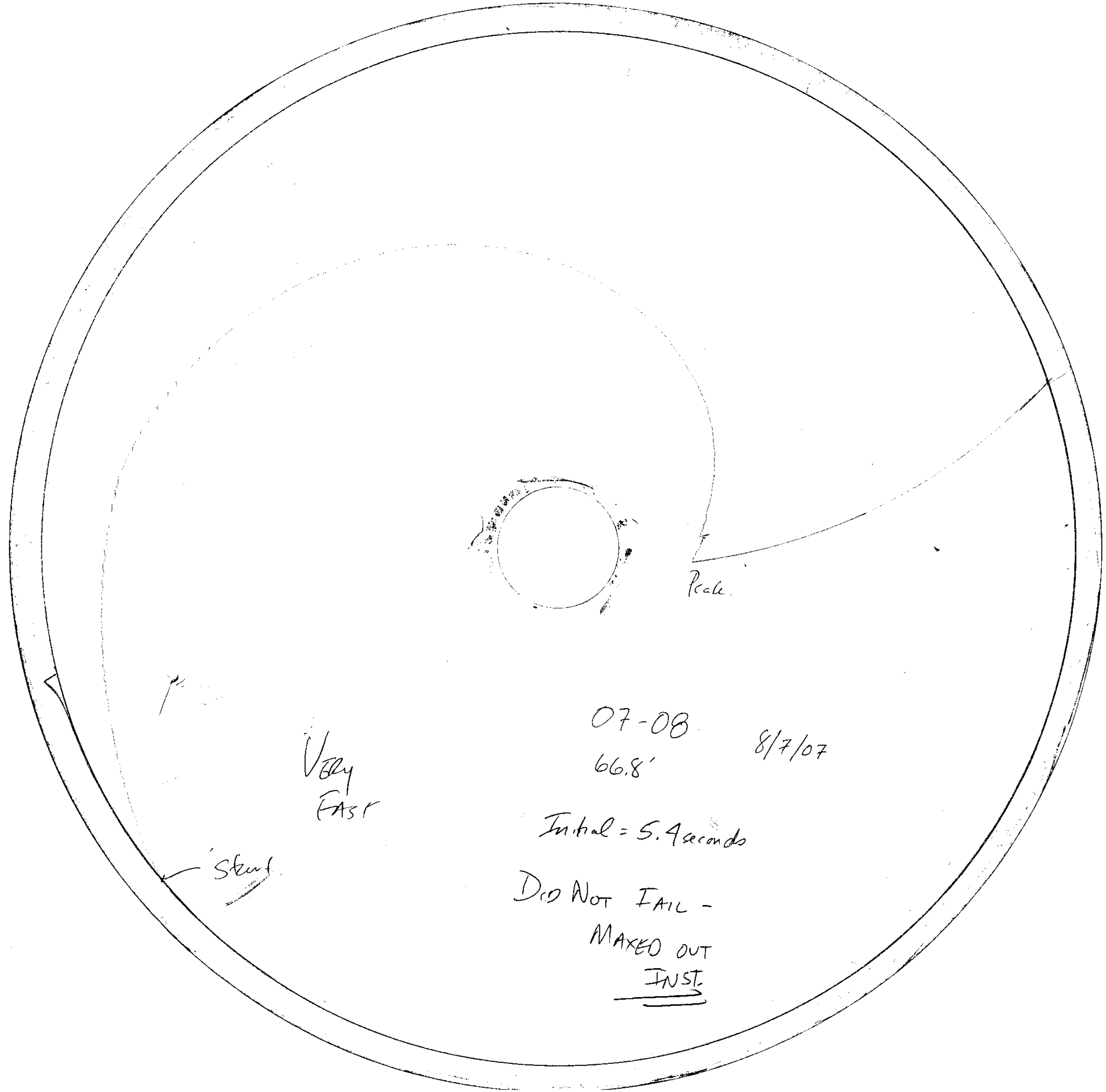
Depth: 51.4 ft.

Boring: 07-07C

Depth: 52.2 ft.

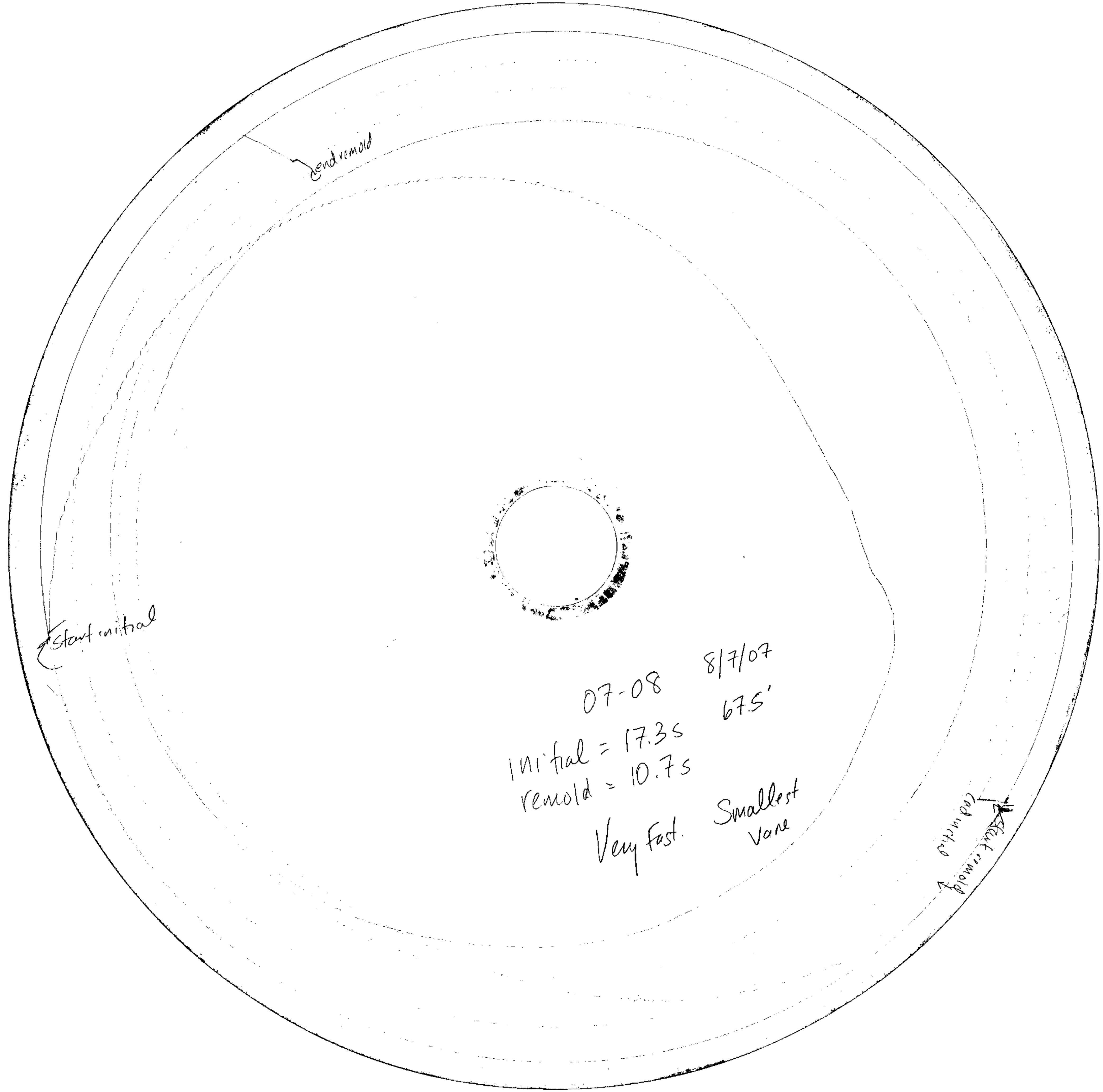
Boring : 07-08

Depth : 66.8 ft.



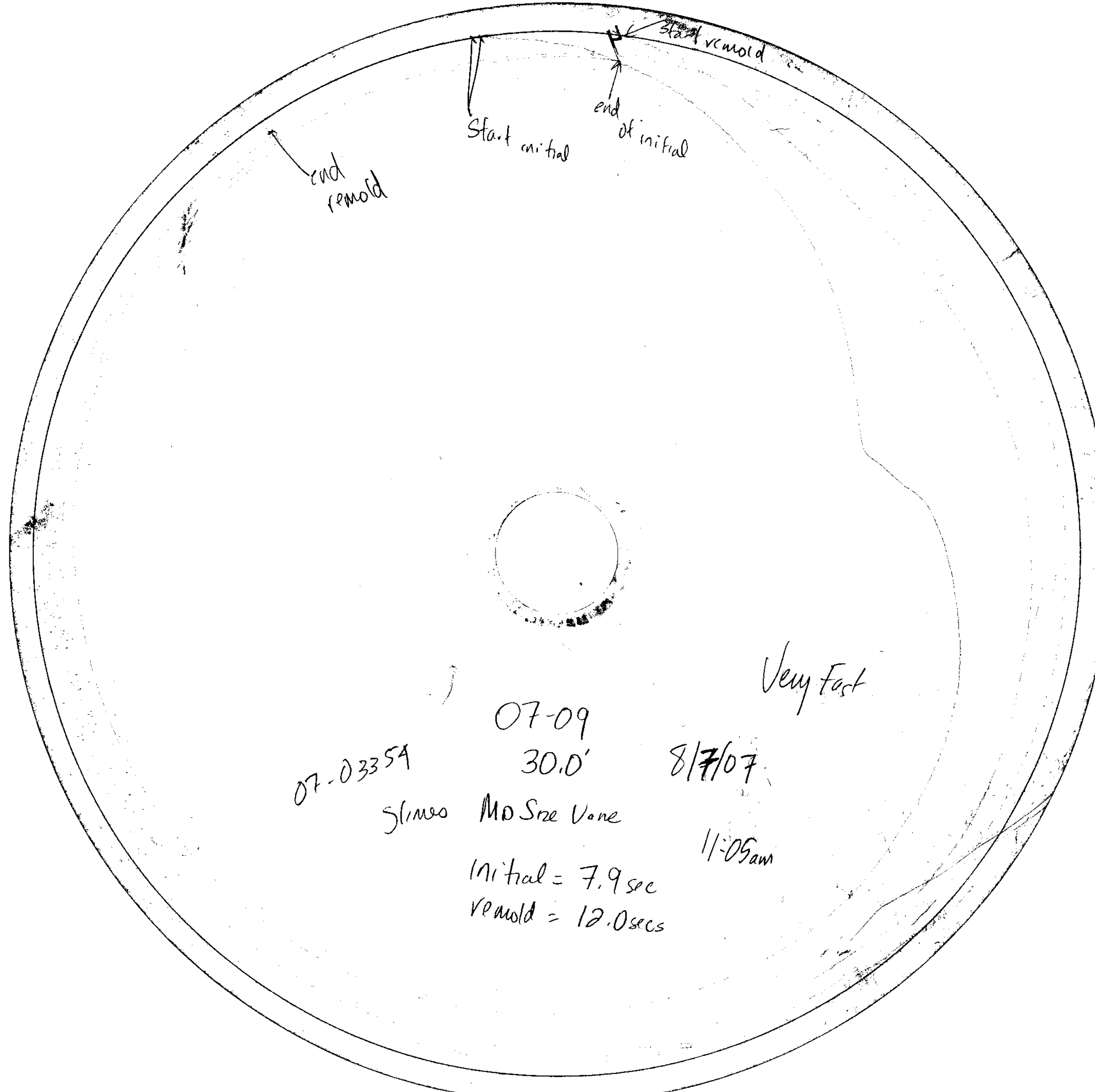
Boring : 07-08

Depth : 67.5 ft.



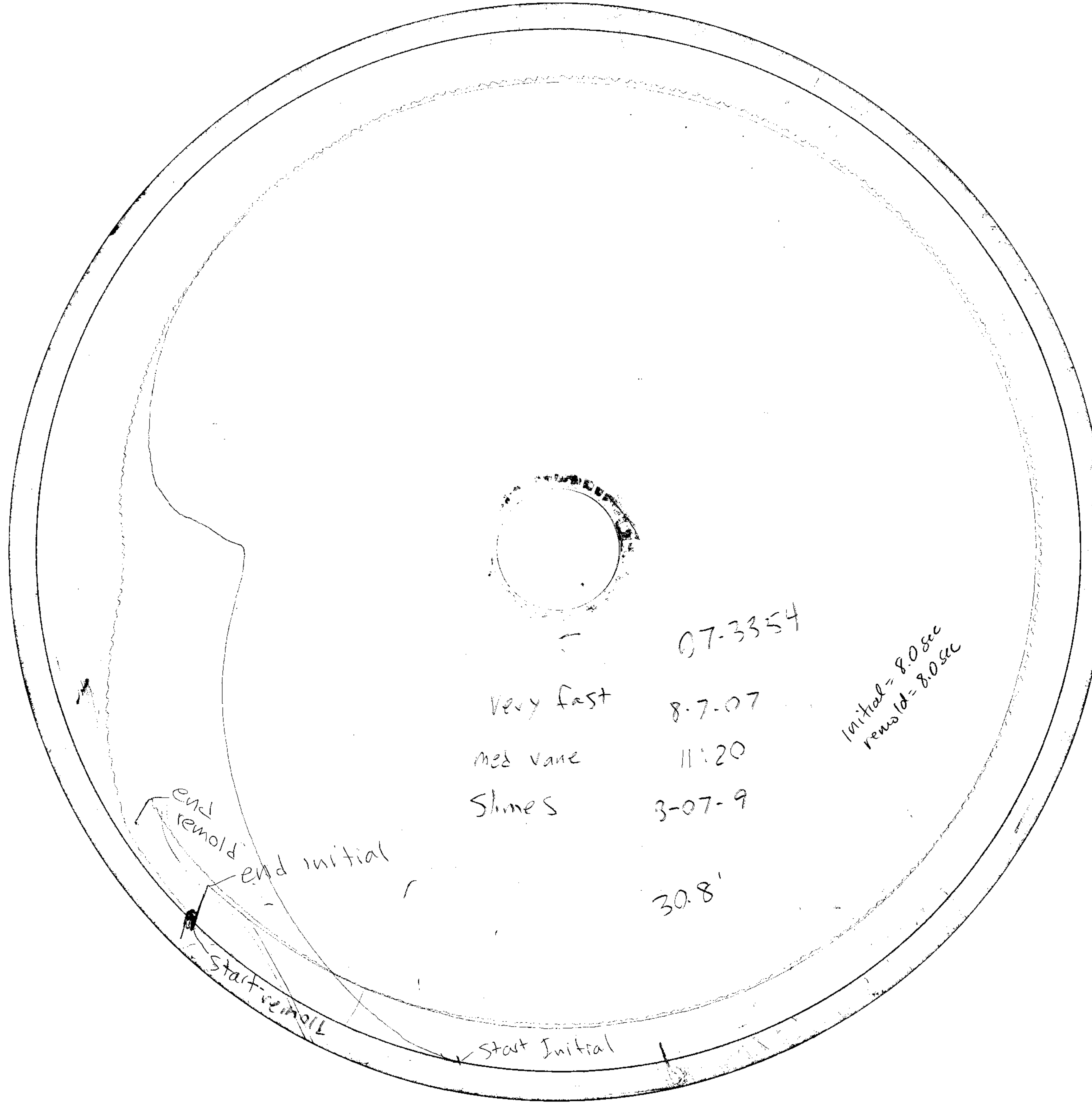
Boring: 07-09

Depth: 30.0 ft.



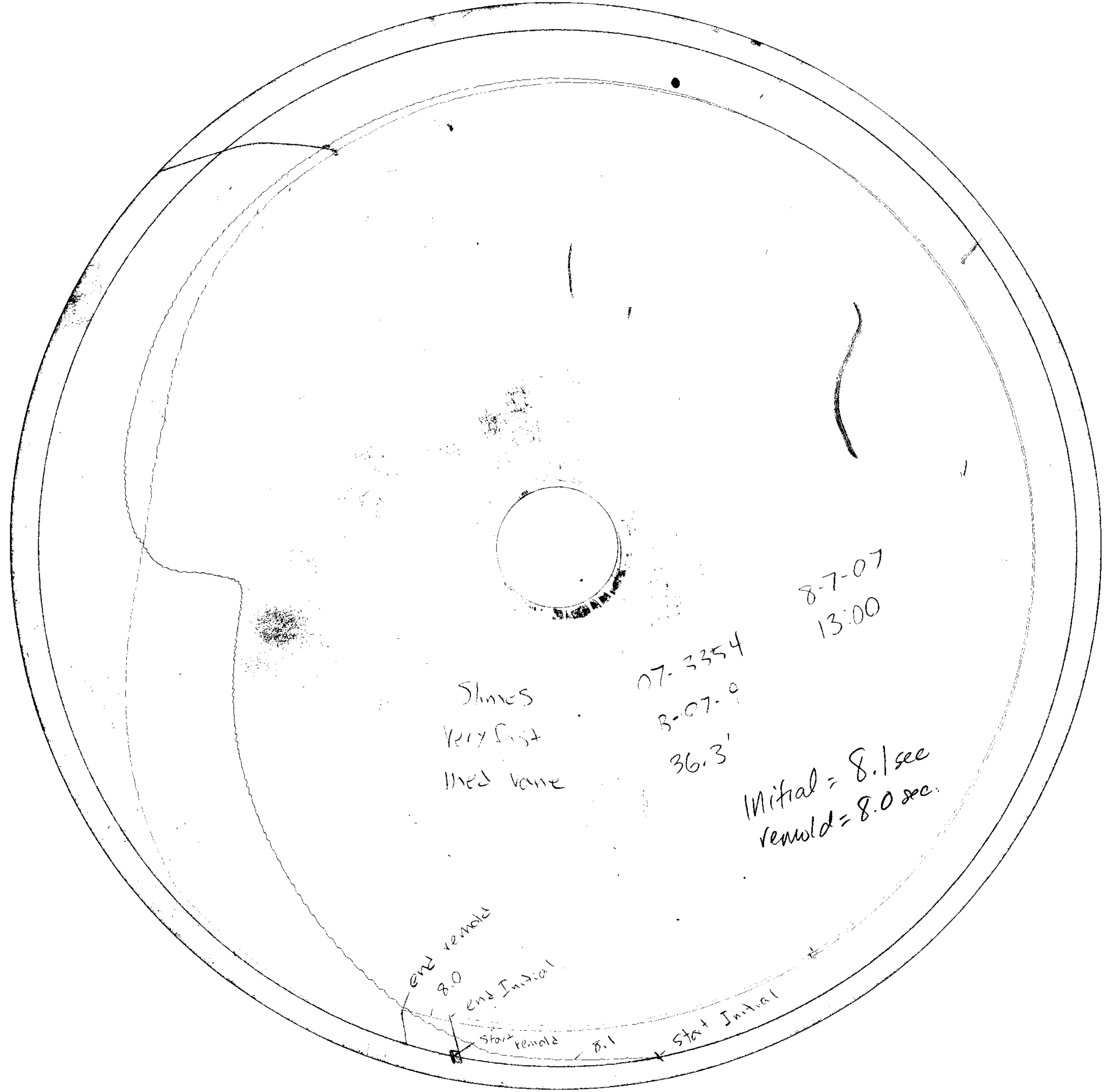
Boring: 07-09

Depth: 30.8 ft.



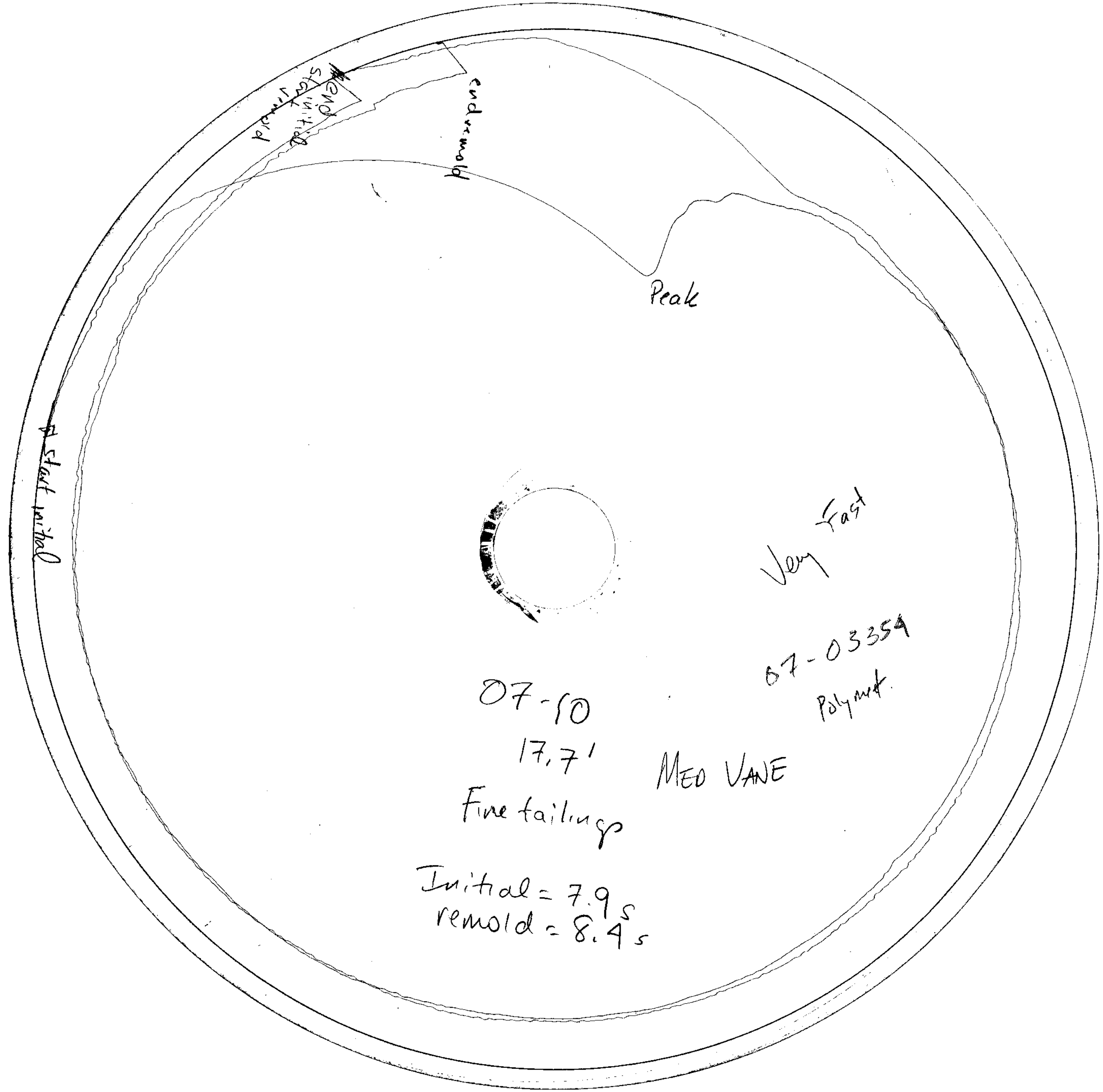
Boring: 07-09

Depth: 36.3 ft.



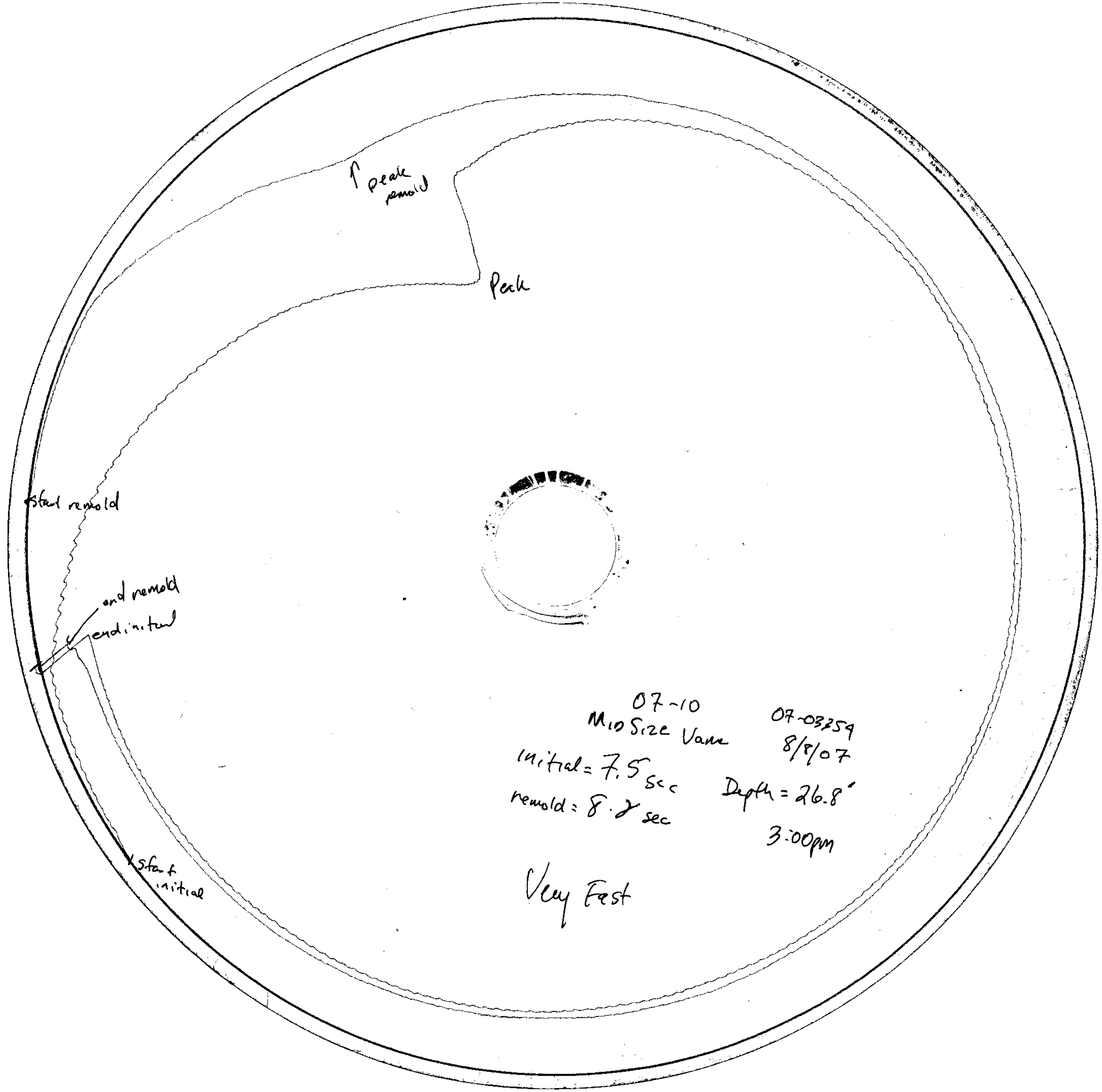
Boring : 07-10

Depth : 17.7 ft.



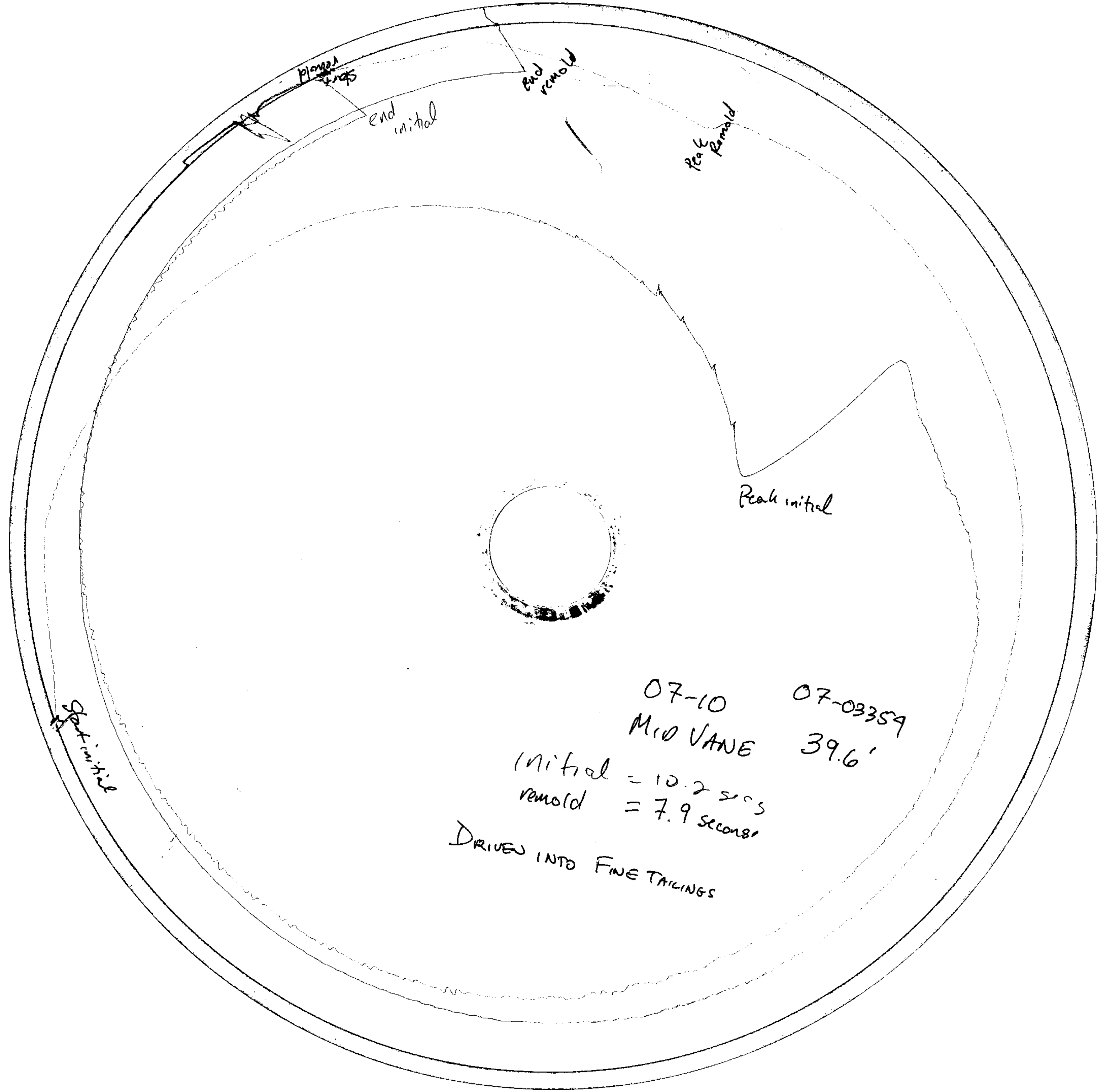
Boring : 07-10

Depth : 26.8 ft.



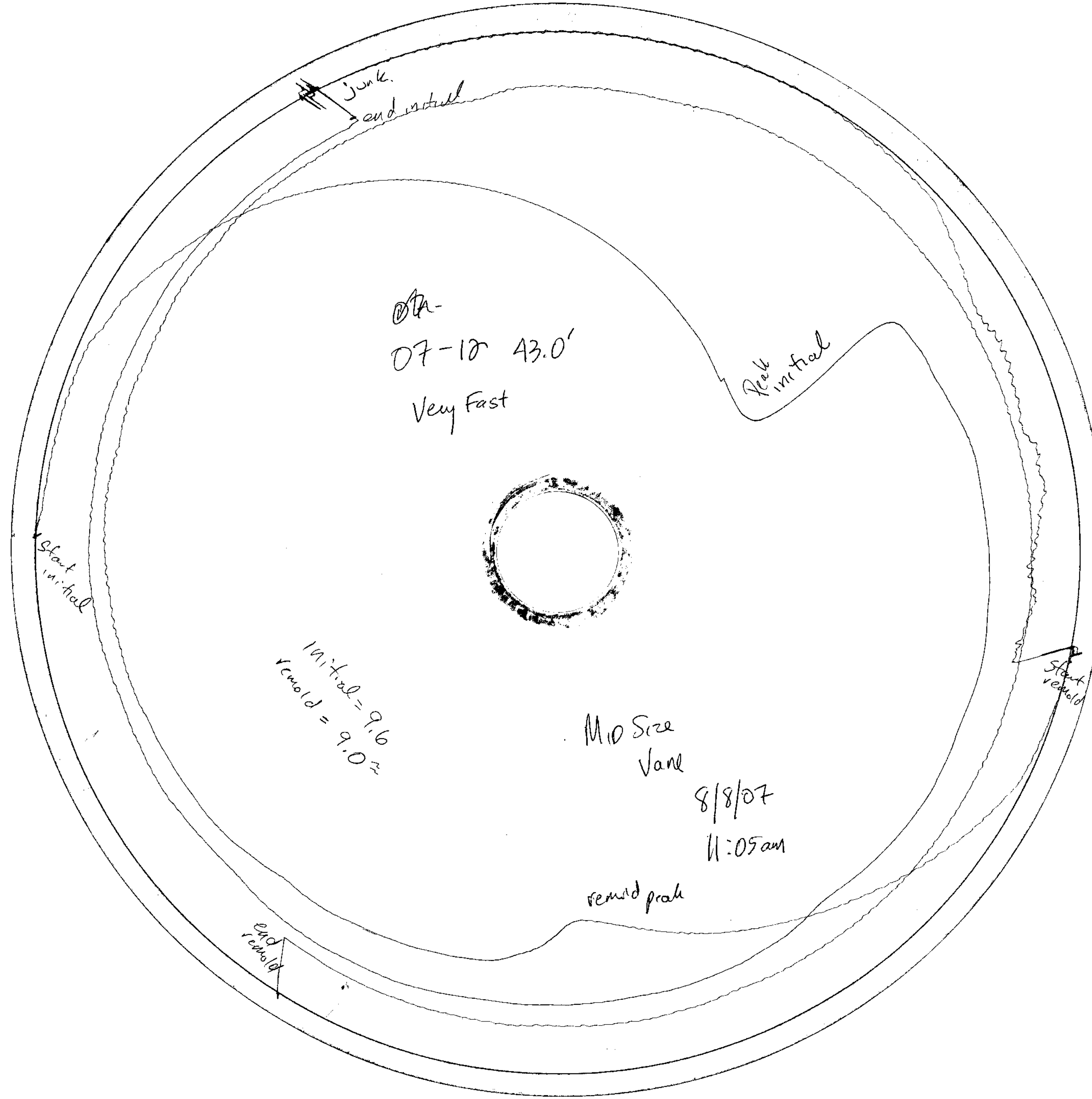
Boring: 07-10

Depth: 39.6 ft.



Boring : 07-12

Depth : 43.0 ft.



Attachment I

2007 Geotechnical Investigation Dilatometer Test Results

DMT 07-02
Date: 7/24/2007
Total Depth (ft): 75

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	4.7	18		0.1	0.2	10	0.05	0.1	0	4.1	17.7	0	0	2	21.126	0.19	3.31		472									401	SAND
3.05	-3.05	0	6	17.2		0.1	0.2	10	0.05	0.1	0	5.51	16.9	0	0	2	21.426	0.26	2.07		395									336	SILTY SAND
4.57	-4.57	0	6	19.6		0.1	0.2	10	0.05	0.1	0	5.39	19.3	0	0	2	21.724	0.25	2.58		483									410	SILTY SAND
6.1	-6.1	0	6.7	19		0.1	0.2	10	0.05	0.1	0	6.15	18.7	0	0	2	22.025	0.28	2.04		435									370	SILTY SAND
7.62	-7.62	0	3.5	4.2		0.1	0.2	10	0.05	0.1	0	3.53	3.95	0	0	1.6	22.293	0.16	0.12		15		0.21					0.43		12	CLAY
9.14	-9.14	0	3.1	8.1		0.1	0.2	10	0.05	0.1	0	2.92	7.85	0	0	1.8	22.547	0.13	1.69		171									146	SANDY SILT
10.67	-10.67	0	3.6	4.1		0.1	0.2	10	0.05	0.1	0	3.64	3.85	0	0.06	1.5	22.735	0.16	0.06		7		0.21					0.43		6	MUD
12.19	-12.19	0	3.7	4.7	0.2	0.1	0.2	10	0.05	0.1	0	3.72	4.45	0.25	0.209	1.7	22.824	0.15	0.21	0.01	26		0.2					0.42		22	CLAY
13.72	-13.72	0	4.5	13.8		0.1	0.2	10	0.05	0.1	0	4.1	13.5	0	0.359	1.9	22.944	0.16	2.51		326									277	SILTY SAND
15.24	-15.24	0	3.8	4.5	0.05	0.1	0.2	10	0.05	0.1	0	3.83	4.25	0.1	0.508	1.6	23.056	0.14	0.13	-0.12	15		0.19					0.38		12	CLAY
16.76	-16.76	0	4.6	5.3	0.7	0.1	0.2	10	0.05	0.1	0	4.63	5.05	0.75	0.658	1.6	23.146	0.17	0.11	0.02	15		0.24					0.5		12	CLAY
18.29	-18.29	0	5.1	14.8		0.1	0.2	10	0.05	0.1	0	4.68	14.5	0	0.808	1.9	23.258	0.17	2.53		341									290	SILTY SAND
19.81	-19.81	0	6.9	7.8	1	0.1	0.2	10	0.05	0.1	0	6.92	7.55	1.05	0.957	1.7	23.378	0.26	0.11	0.02	22		0.39					0.94		19	CLAY
21.34	-21.34	0	8.3	20.2		0.1	0.2	10	0.05	0.1	0	7.77	19.9	0	1.107	2	23.505	0.28	1.82		421									358	SILTY SAND
22.86	-22.86	0	5.8	6.4	0.05	0.1	0.2	10	0.05	0.1	0	5.84	6.15	0.1	1.256	1.5	23.617	0.19	0.07	-0.25	11		0.28					0.62		9	MUD

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	4.91	18.79		0.1	0.21	10.44	0.05	0.1	0	4.28	18.48		0	124.8	22.056	0.19	3.31		493									419	SAND
10	-10	0	6.26	17.96		0.1	0.21	10.44	0.05	0.1	0	5.75	17.64		0	124.8	22.369	0.26	2.07		412									351	SILTY SAND
15	-15	0	6.26	20.46		0.1	0.21	10.44	0.05	0.1	0	5.63	20.15		0	124.8	22.68	0.25	2.58		504									428	SILTY SAND
20	-20	0	6.99	19.84		0.1	0.21	10.44	0.05	0.1	0	6.42	19.52		0	124.8	22.994	0.28	2.04		454									386	SILTY SAND
25	-25	0	3.65	4.38		0.1	0.21	10.44	0.05	0.1	0	3.69	4.12		0	99.8	23.274	0.16	0.12		16		0.22					0.45		13	CLAY
30	-30	0	3.24	8.46		0.1	0.21	10.44	0.05	0.1	0	3.05	8.2		0	112.3	23.539	0.13	1.69		179									152	SANDY SILT
35	-35	0	3.76	4.28		0.1	0.21	10.44	0.05	0.1	0	3.8	4.02		0.063	93.6	23.735	0.16	0.06		7		0.22					0.45		6	MUD
40	-40	0	3.86	4.91	0.21	0.1	0.21	10.44	0.05	0.1	0	3.88	4.65	0.26	0.218	106.1	23.828	0.15	0.21	0.01	27		0.21					0.44		23	CLAY
45	-45	0	4.7	14.41		0.1	0.21	10.44	0.05	0.1	0	4.28	14.09		0.375	118.6	23.954	0.16	2.51		340									289	SILTY SAND
50	-50	0	3.97	4.7	0.05	0.1	0.21	10.44	0.05	0.1	0	4	4.44	0.1	0.53	99.8	24.07	0.14	0.13	-0.12	16		0.2					0.4		13	CLAY
55	-55	0	4.8	5.53	0.73	0.1	0.21	10.44	0.05	0.1	0	4.83	5.27	0.78	0.687	99.8	24.164	0.17	0.11	0.02	16		0.25					0.52		13	CLAY
60	-60	0	5.32	15.45		0.1	0.21	10.44	0.05	0.1	0	4.89	15.14		0.844	118.6	24.281	0.17	2.53		356									303	SILTY SAND
65	-65	0	7.2	8.14	1.04	0.1	0.21	10.44	0.05	0.1	0	7.22	7.88	1.1	0.999	106.1	24.407	0.26	0.11	0.02	23		0.41					0.98		20	CLAY
70	-70	0	8.67	21.09		0.1	0.21	10.44	0.05	0.1	0	8.11	20.78		1.156	124.8	24.539	0.28	1.82		440									374	SILTY SAND
75	-75	0	6.06	6.68	0.05	0.1	0.21	10.44	0.05	0.1	0	6.1	6.42	0.1	1.311	93.6	24.656	0.19	0.07	-0.25	11		0.29					0.65		9	MUD

	K_D	K_O
AVERAGE	0.20	-0.22
ST DEV	0.05	-0.39
MIN	0.13	-0.28
MAX	0.28	-0.15

DMT 07-03

Date: 7/23/2007

Total Depth (ft): 65

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
3.05	-3.05	0	2.6	6.1		0.1	0.2	0	0	0	0	2.54	5.9	0	0	1.7	12.69	0.2	1.32		117									99	SANDY SILT
4.57	-4.57	0	1.9	4.5		0.1	0.2	0	0	0	0	1.89	4.3	0	0	1.7	12.944	0.15	1.28		84									71	SANDY SILT
7.62	-7.62	0	1.9	3.1	0.1	0.1	0.2	0	0	0	0	1.96	2.9	0.2	0.19	1.6	13.247	0.13	0.54	0.01	33		0.1					0.19		28	SILTY CLAY
9.14	-9.14	0	3.4	4	0.5	0.1	0.2	0	0	0	0	3.49	3.8	0.6	0.23	1.5	13.439	0.24	0.1	0.11	11		0.21					0.5		9	MUD
10.67	-10.67	0	2.8	3.5		0.1	0.2	0	0	0	0	2.88	3.3	0	0.24	1.6	13.661	0.19	0.16		15		0.16					0.36		12	CLAY
12.19	-12.19	0	3.7	4.1	0.5	0.1	0.2	0	0	0	0	3.8	3.9	0.6	0.31	1.5	13.823	0.25	0.03	0.08	4		0.23					0.55		3	MUD
13.72	-13.72	0	3.3	10		0.1	0.2	0	0	0	0	3.08	9.8	0	0.47	1.9	13.918	0.19	2.57		233									198	SILTY SAND
15.24	-15.24	0	4.5	5.2	0.2	0.1	0.2	0	0	0	0	4.58	5	0.3	0.68	1.6	13.969	0.28	0.11	-0.1	15		0.26					0.65		12	CLAY
16.76	-16.76	0	7	13.6		0.1	0.2	0	0	0	0	6.79	13.4	0	1.14	1.95	13.774	0.41	1.17		230							1.16	0.1	195	SILT
18.29	-18.29	0	5.5	12.2		0.1	0.2	0	0	0	0	5.28	12	0	1.71	1.9	13.493	0.26	1.88		233									198	SILTY SAND
19.81	-19.81	0	6	6.8	1.3	0.1	0.2	0	0	0	0	6.08	6.6	1.4	0.69	1.7	14.781	0.36	0.1	0.13	18		0.39					1.04	0.1	15	CLAY?

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
10	-10	0	2.71	6.37		0.1	0.21	0	0	0	0	2.65	6.16		0	106.1	13.248	0.2	1.32		122									103	SANDY SILT
15	-15	0	1.98	4.7		0.1	0.21	0	0	0	0	1.97	4.49		0	106.1	13.514	0.15	1.28		88									74	SANDY SILT
25	-25	0	1.98	3.24	0.1	0.1	0.21	0	0	0	0	2.05	3.03	0.21	0.198	99.8	13.83	0.13	0.54	0.01	34		0.1					0.2		29	SILTY CLAY
30	-30	0	3.55	4.18	0.52	0.1	0.21	0	0	0	0	3.64	3.97	0.63	0.24	93.6	14.03	0.24	0.1	0.11	11		0.22					0.52		9	MUD
35	-35	0	2.92	3.65		0.1	0.21	0	0	0	0	3.01	3.45		0.251	99.8	14.262	0.19	0.16		16		0.17					0.38		13	CLAY
40	-40	0	3.86	4.28	0.52	0.1	0.21	0	0	0	0	3.97	4.07	0.63	0.324	93.6	14.431	0.25	0.03	0.08	4		0.24					0.57		3	MUD
45	-45	0	3.45	10.44		0.1	0.21	0	0	0	0	3.22	10.23		0.491	118.6	14.53	0.19	2.57		243									207	SILTY SAND
50	-50	0	4.7	5.43	0.21	0.1	0.21	0	0	0	0	4.78	5.22	0.31	0.71	99.8	14.584	0.28	0.11	-0.1	16		0.27					0.68		13	CLAY
55	-55	0	7.31	14.2		0.1	0.21	0	0	0	0	7.09	13.99		1.19	121.7	14.38	0.41	1.17		240							1.21	0.1	204	SILT
60	-60	0	5.74	12.74		0.1	0.21	0	0	0	0	5.51	12.53		1.785	118.6	14.087	0.26	1.88		243									207	SILTY SAND
65	-65	0	6.26	7.1	1.36	0.1	0.21	0	0	0	0	6.35	6.89	1.46	0.72	106.1	15.431	0.36	0.1	0.13	19		0.41					1.09	0.1	16	CLAY?

	K_D	K_O
AVERAGE	0.24	-0.18
ST DEV	0.08	-0.34
MIN	0.13	-0.28
MAX	0.41	-0.06

DMT 07-05

Date: 7/24/2007

Total Depth (ft): 104

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	5.1	17.8		0.15	0.35	0	0	0	0	4.64	17.45	0	0	2	24.873	0.19	2.76		445									378	SILTY SAND
3.05	-3.05	0	6.5	22		0.15	0.35	0	0	0	0	5.9	21.65	0	0	2	25.173	0.23	2.67		547									465	SILTY SAND
4.57	-4.57	0	6.1	18		0.15	0.35	0	0	0	0	5.68	17.65	0	0	2	25.472	0.22	2.11		415									353	SILTY SAND
6.1	-6.1	0	8.1	27		0.15	0.35	0	0	0	0	7.33	26.65	0	0	2	25.772	0.28	2.64		670									570	SILTY SAND
7.62	-7.62	0	4.3	10		0.15	0.35	0	0	0	0	4.19	9.65	0	0.029	1.8	26.026	0.16	1.31		189									161	SANDY SILT
9.14	-9.14	0	6.6	18.8		0.15	0.35	0	0	0	0	6.17	18.45	0	0.179	2	26.16	0.23	2.05		426									362	SILTY SAND
10.67	-10.67	0	6.1	15		0.15	0.35	0	0	0	0	5.83	14.65	0	0.329	1.95	26.307	0.21	1.6		306									260	SANDY SILT
12.19	-12.19	0	5.7	18.6		0.15	0.35	0	0	0	0	5.23	18.25	0	0.478	2	26.452	0.18	2.74		452									384	SILTY SAND
13.72	-13.72	0	8	28.2		0.15	0.35	0	0	0	0	7.17	27.85	0	0.628	2	26.602	0.25	3.16		718									610	SILTY SAND
15.24	-15.24	0	7.2	26		0.15	0.35	0	0	0	0	6.44	25.65	0	0.777	2	26.751	0.21	3.4		667									567	SAND
16.76	-16.76	0	6.5	16.8		0.15	0.35	0	0	0	0	6.16	16.45	0	0.926	2	26.901	0.19	1.97		357									304	SILTY SAND
18.29	-18.29	0	4.9	5.7	0.6	0.15	0.35	0	0	0	0	5.04	5.35	0.75	1.077	1.5	27.013	0.15	0.08	-0.08	11		0.23					0.46		9	MUD
19.81	-19.81	0	4.7	8		0.15	0.35	0	0	0	0	4.71	7.65	0	1.226	1.8	27.11	0.13	0.84		102							0.37		87	CLAYEY SILT
21.34	-21.34	0	5.9	6.7	0.9	0.15	0.35	0	0	0	0	6.04	6.35	1.05	1.376	1.5	27.208	0.17	0.07	-0.07	11		0.28					0.59		9	MUD
22.86	-22.86	0	6.5	7.3	1.2	0.15	0.35	0	0	0	0	6.64	6.95	1.35	1.525	1.7	27.297	0.19	0.06	-0.03	11		0.31					0.68		9	MUD
24.38	-24.38	0	6.8	7.7	1.3	0.15	0.35	0	0	0	0	6.93	7.35	1.45	1.674	1.7	27.402	0.19	0.08	-0.04	15		0.32					0.71		12	CLAY?
25.91	-25.91	0	5.9	8	3	0.15	0.35	0	0	0	0	5.97	7.65	3.15	1.824	1.7	27.507	0.15	0.41	0.32	58		0.24					0.49		50	SILTY CLAY
27.43	-27.43	0	8.4	17.8		0.15	0.35	0	0	0	0	8.11	17.45	0	1.974	1.95	27.63	0.22	1.52		324									276	SANDY SILT
28.96	-28.96	0	6.2	9.2		0.15	0.35	0	0	0	0	6.23	8.85	0	2.124	1.8	27.761	0.15	0.64		91							0.48		77	CLAYEY SILT
30.48	-30.48	0	18.2	24	2.3	0.15	0.35	0	0	0	0	18.09	23.65	2.45	2.273	2.05	27.899	0.57	0.35	0.01	193	0.03	1.27					3.9	0.1	164	SILTY CLAY
31.58	-31.58	0	9.6	34.2		0.15	0.35	0	0	0	0	8.55	33.85	0	2.381	2	28.01	0.22	4.11		878									746	SAND

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	5.32	18.58		0.16	0.37	0	0	0	0	4.84	18.22		0	124.8	25.967	0.19	2.76		465									395	SILTY SAND
10	-10	0	6.79	22.97		0.16	0.37	0	0	0	0	6.16	22.6		0	124.8	26.281	0.23	2.67		571									485	SILTY SAND
15	-15	0	6.37	18.79		0.16	0.37	0	0	0	0	5.93	18.43		0	124.8	26.593	0.22	2.11		433									369	SILTY SAND
20	-20	0	8.46	28.19		0.16	0.37	0	0	0	0	7.65	27.82		0	124.8	26.906	0.28	2.64		699									595	SILTY SAND
25	-25	0	4.49	10.44		0.16	0.37	0	0	0	0	4.37	10.07		0.03	112.3	27.171	0.16	1.31		197									168	SANDY SILT
30	-30	0	6.89	19.63		0.16	0.37	0	0	0	0	6.44	19.26		0.187	124.8	27.311	0.23	2.05		445									378	SILTY SAND
35	-35	0	6.37	15.66		0.16	0.37	0	0	0	0	6.09	15.29		0.343	121.7	27.465	0.21	1.6		319									271	SANDY SILT
40	-40	0	5.95	19.42		0.16	0.37	0	0	0	0	5.46	19.05		0.499	124.8	27.616	0.18	2.74		472									401	SILTY SAND
45	-45	0	8.35	29.44		0.16	0.37	0	0	0	0	7.49	29.08		0.656	124.8	27.772	0.25	3.16		750									637	SILTY SAND
50	-50	0	7.52	27.14		0.16	0.37	0	0	0	0	6.72	26.78		0.811	124.8	27.928	0.21	3.4		696									592	SAND
55	-55	0	6.79	17.54		0.16	0.37	0	0	0	0	6.43	17.17		0.967	124.8	28.085	0.19	1.97		373									317	SILTY SAND
60	-60	0	5.12	5.95	0.63	0.16	0.37	0	0	0	0	5.26	5.59	0.78	1.124	93.6	28.202	0.15	0.08	-0.08	11		0.24					0.48		9	MUD
65	-65	0	4.91	8.35		0.16	0.37	0	0	0	0	4.92	7.99		1.28	112.3	28.303	0.13	0.84		106							0.39		91	CLAYEY SILT
70	-70	0	6.16	6.99	0.94	0.16	0.37	0	0	0	0	6.31	6.63	1.1	1.437	93.6	28.405	0.17	0.07	-0.07	11		0.29					0.62		9	MUD
75	-75	0	6.79	7.62	1.25	0.16	0.37	0	0	0	0	6.93	7.26	1.41	1.592	106.1	28.498	0.19	0.06	-0.03	11		0.32					0.71		9	MUD
80	-80	0	7.1	8.04	1.36	0.16	0.37	0	0	0	0	7.23	7.67	1.51	1.748	106.1	28.608	0.19	0.08	-0.04	16		0.33					0.74		13	CLAY?
85	-85	0	6.16	8.35	3.13	0.16	0.37	0	0	0	0	6.23	7.99	3.29	1.904	106.1	28.717	0.15	0.41	0.32	61		0.25					0.51		52	SILTY CLAY
90	-90	0	8.77	18.58		0.16	0.37	0	0	0	0	8.47	18.22		2.061	121.7	28.846	0.22	1.52		338									288	SANDY SILT
95	-95	0	6.47	9.6		0.16	0.37	0	0	0	0	6.5	9.24		2.217	112.3	28.982	0.15	0.64		95							0.5		80	CLAYEY SILT
100	-100	0	19	25.06	2.4	0.16	0.37	0	0	0	0	18.89	24.69	2.56	2.373	127.9	29.127	0.57	0.35	0.01	201	0.03	1.33					4.07	0.1	171	SILTY CLAY
103.6	-103.6	0	10.02	35.7		0.16	0.37	0	0	0	0	8.93	35.34		2.486	124.8	29.242	0.22	4.11		917									779	SAND

	K_D	K_O
AVERAGE	0.21	-0.20
ST DEV	0.09	-0.33
MIN	0.13	-0.28
MAX	0.57	0.03

DMT 07-06
Date: 7/24/2007
Total Depth (ft): 70

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	2.7	6		0.15	0.35	0	0.05	0	0.05	2.76	5.7	0	0	1.7	9.473	0.29	1.07		102							0.47		87	SILT
3.05	-3.05	0	1.1	1.7		0.15	0.35	0	0.05	0	0.05	1.3	1.4	0	0.1	1.5	9.613	0.12	0.09		4		0.07					0.13		3	MUD
4.57	-4.57	0	3.3	5.9		0.15	0.35	0	0.05	0	0.05	3.4	5.6	0	0.14	1.7	9.812	0.33	0.68		77							0.6	0.1	65	CLAYEY SILT
6.1	-6.1	0	3.2	4	0.05	0.15	0.35	0	0.05	0	0.05	3.39	3.7	0.25	0.18	1.5	10.012	0.32	0.1	0.02	11		0.22					0.57	0.1	9	MUD
10.67	-10.67	0	4.8	12.4		0.15	0.35	0	0.05	0	0.05	4.65	12.1	0	0.3	1.8	10.632	0.41	1.72		259									220	SANDY SILT
12.19	-12.19	0	4.3	7.8		0.15	0.35	0	0.05	0	0.05	4.35	7.5	0	0.54	1.8	10.661	0.36	0.83		109							0.73	0.1	93	CLAYEY SILT
13.72	-13.72	0	3.5	6.1		0.15	0.35	0	0.05	0	0.05	3.6	5.8	0	0.72	1.7	10.744	0.27	0.77		77							0.47		65	CLAYEY SILT
15.24	-15.24	0	4.7	8.3		0.15	0.35	0	0.05	0	0.05	4.75	8	0	1.06	1.8	10.665	0.35	0.88		113							0.69	0.1	96	CLAYEY SILT
18.29	-18.29	0	4.3	5.1	0.15	0.15	0.35	0	0.05	0	0.05	4.49	4.8	0.35	1.33	1.5	10.888	0.29	0.1	-0.31	11		0.21					0.53		9	MUD
19.81	-19.81	0	5.1	5.8	1	0.15	0.35	0	0.05	0	0.05	5.29	5.5	1.2	1.31	1.5	11.132	0.36	0.05	-0.03	7		0.28					0.76	0.1	6	MUD
21.34	-21.34	0	7.9	10.2	1	0.15	0.35	0	0.05	0	0.05	8.01	9.9	1.2	0.77	1.8	11.92	0.61	0.26	0.06	66	0.05	0.59					1.86	0.2	56	CLAY

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	2.82	6.26		0.16	0.37	0	0.05	0	0.05	2.88	5.95		0	106.1	9.89	0.29	1.07		106							0.49		91	SILT
10	-10	0	1.15	1.77		0.16	0.37	0	0.05	0	0.05	1.36	1.46		0.104	93.6	10.036	0.12	0.09		4		0.07					0.14		3	MUD
15	-15	0	3.45	6.16		0.16	0.37	0	0.05	0	0.05	3.55	5.85		0.146	106.1	10.244	0.33	0.68		80							0.63	0.1	68	CLAYEY SILT
20	-20	0	3.34	4.18	0.05	0.16	0.37	0	0.05	0	0.05	3.54	3.86	0.26	0.188	93.6	10.453	0.32	0.1	0.02	11		0.23					0.6	0.1	9	MUD
35	-35	0	5.01	12.95		0.16	0.37	0	0.05	0	0.05	4.85	12.63		0.313	112.3	11.1	0.41	1.72		270									230	SANDY SILT
40	-40	0	4.49	8.14		0.16	0.37	0	0.05	0	0.05	4.54	7.83		0.564	112.3	11.13	0.36	0.83		114							0.76	0.1	97	CLAYEY SILT
45	-45	0	3.65	6.37		0.16	0.37	0	0.05	0	0.05	3.76	6.06		0.752	106.1	11.217	0.27	0.77		80							0.49		68	CLAYEY SILT
50	-50	0	4.91	8.67		0.16	0.37	0	0.05	0	0.05	4.96	8.35		1.107	112.3	11.134	0.35	0.88		118							0.72	0.1	100	CLAYEY SILT
60	-60	0	4.49	5.32	0.16	0.16	0.37	0	0.05	0	0.05	4.69	5.01	0.37	1.389	93.6	11.367	0.29	0.1	-0.31	11		0.22					0.55		9	MUD
65	-65	0	5.32	6.06	1.04	0.16	0.37	0	0.05	0	0.05	5.52	5.74	1.25	1.368	93.6	11.622	0.36	0.05	-0.03	7		0.29					0.79	0.1	6	MUD
70	-70	0	8.25	10.65	1.04	0.16	0.37	0	0.05	0	0.05	8.36	10.34	1.25	0.804	112.3	12.444	0.61	0.26	0.06	69	0.05	0.62					1.94	0.2	58	CLAY

	K_D	K_O
AVERAGE	0.34	-0.10
ST DEV	0.12	-0.30
MIN	0.12	-0.29
MAX	0.61	0.06

DMT 07-08
Date: 7/25/2007
Total Depth (ft): 70

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	5.1	18.2		0.05	0.6	0	0	0	0	4.53	17.6	0	0	2	30.391	0.15	2.89		454									386	SILTY SAND
3.05	-3.05	0	5.2	17.6		0.05	0.6	0	0	0	0	4.66	17	0	0	2	30.691	0.15	2.65		428									364	SILTY SAND
4.57	-4.57	0	6.8	20.6		0.05	0.6	0	0	0	0	6.19	20	0	0	2	30.989	0.2	2.23		479									407	SILTY SAND
6.1	-6.1	0	7.3	23.2		0.05	0.6	0	0	0	0	6.59	22.6	0	0	2	31.29	0.21	2.43		556									472	SILTY SAND
7.62	-7.62	0	6.6	21.8		0.05	0.6	0	0	0	0	5.92	21.2	0	0	2	31.588	0.19	2.58		530									451	SILTY SAND
9.14	-9.14	0	6.7	16.8		0.05	0.6	0	0	0	0	6.28	16.2	0	0	1.95	31.882	0.2	1.58		344									293	SANDY SILT
10.67	-10.67	0	4.7	10		0.05	0.6	0	0	0	0	4.52	9.4	0	0	1.8	32.164	0.14	1.08		169							0.51		144	SILT
12.19	-12.19	0	6.4	19.2		0.05	0.6	0	0	0	0	5.84	18.6	0	0	2	32.447	0.18	2.18		443									376	SILTY SAND
13.72	-13.72	0	8	22.4		0.05	0.6	0	0	0	0	7.36	21.8	0	0	2	32.748	0.22	1.96		501									426	SILTY SAND
15.24	-15.24	0	6.4	16.2		0.05	0.6	0	0	0	0	5.99	15.6	0	0.089	1.95	32.953	0.18	1.63		333									283	SANDY SILT
16.76	-16.76	0	5.1	8.8		0.05	0.6	0	0	0	0	5	8.2	0	0.238	1.8	33.084	0.14	0.67		111							0.54		94	CLAYEY SILT
18.29	-18.29	0	5.6	13		0.05	0.6	0	0	0	0	5.31	12.4	0	0.389	1.8	33.204	0.15	1.44		246									209	SANDY SILT
19.81	-19.81	0	6	9		0.05	0.6	0	0	0	0	5.93	8.4	0	0.538	1.8	33.323	0.16	0.46		86		0.32					0.66		73	SILTY CLAY
21.34	-21.34	0	7.5	8.4	1.3	0.05	0.6	0	0	0	0	7.54	7.8	1.35	0.688	1.7	33.436	0.2	0.04	0.1	9		0.43					0.96		8	MUD

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	5.32	19		0.05	0.63	0	0	0	0	4.73	18.37		0	124.8	31.728	0.15	2.89		474									403	SILTY SAND
10	-10	0	5.43	18.37		0.05	0.63	0	0	0	0	4.87	17.75		0	124.8	32.041	0.15	2.65		447									380	SILTY SAND
15	-15	0	7.1	21.51		0.05	0.63	0	0	0	0	6.46	20.88		0	124.8	32.353	0.2	2.23		500									425	SILTY SAND
20	-20	0	7.62	24.22		0.05	0.63	0	0	0	0	6.88	23.59		0	124.8	32.667	0.21	2.43		580									493	SILTY SAND
25	-25	0	6.89	22.76		0.05	0.63	0	0	0	0	6.18	22.13		0	124.8	32.978	0.19	2.58		553									471	SILTY SAND
30	-30	0	6.99	17.54		0.05	0.63	0	0	0	0	6.56	16.91		0	121.7	33.285	0.2	1.58		359									306	SANDY SILT
35	-35	0	4.91	10.44		0.05	0.63	0	0	0	0	4.72	9.81		0	112.3	33.579	0.14	1.08		176							0.53		150	SILT
40	-40	0	6.68	20.04		0.05	0.63	0	0	0	0	6.1	19.42		0	124.8	33.875	0.18	2.18		462									393	SILTY SAND
45	-45	0	8.35	23.39		0.05	0.63	0	0	0	0	7.68	22.76		0	124.8	34.189	0.22	1.96		523									445	SILTY SAND
50	-50	0	6.68	16.91		0.05	0.63	0	0	0	0	6.25	16.29		0.093	121.7	34.403	0.18	1.63		348									295	SANDY SILT
55	-55	0	5.32	9.19		0.05	0.63	0	0	0	0	5.22	8.56		0.248	112.3	34.54	0.14	0.67		116							0.56		98	CLAYEY SILT
60	-60	0	5.85	13.57		0.05	0.63	0	0	0	0	5.54	12.95		0.406	112.3	34.665	0.15	1.44		257									218	SANDY SILT
65	-65	0	6.26	9.4		0.05	0.63	0	0	0	0	6.19	8.77		0.562	112.3	34.789	0.16	0.46		90		0.33					0.69		76	SILTY CLAY
70	-70	0	7.83	8.77	1.36	0.05	0.63	0	0	0	0	7.87	8.14	1.41	0.718	106.1	34.907	0.2	0.04	0.1	9		0.45					1		8	MUD

	K_D	K_O
AVERAGE	0.18	-0.23
ST DEV	0.03	-0.45
MIN	0.14	-0.27
MAX	0.22	-0.19

DMT 07-09
Date: 7/25/2007
Total Depth (ft): 40

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	2.5	7.3		0.1	0.3	0	0	0	0	2.38	7	0	0	1.9	15.471	0.15	1.94		160									136	SILTY SAND
3.05	-3.05	0	2.2	4.3		0.1	0.3	0	0	0	0	2.22	4	0	0	1.7	15.741	0.14	0.81		62							0.25		53	CLAYEY SILT
4.57	-4.57	0	3.2	9.8		0.1	0.3	0	0	0	0	2.99	9.5	0	0	1.9	16.01	0.19	2.18		226									192	SILTY SAND
6.1	-6.1	0	2.5	4.2		0.1	0.3	0	0	0	0	2.54	3.9	0	0	1.7	16.28	0.16	0.54		47		0.15					0.3		40	SILTY CLAY
7.62	-7.62	0	5.6	15.2		0.1	0.3	0	0	0	0	5.24	14.9	0	0	2	16.556	0.32	1.84		335									285	SILTY SAND
9.14	-9.14	0	3	9.2		0.1	0.3	0	0	0	0	2.81	8.9	0	0.36	1.9	16.487	0.15	2.49		211									180	SILTY SAND
10.67	-10.67	0	4.1	4.8		0.1	0.3	0	0	0	0	4.19	4.5	0	0.62	1.5	16.482	0.22	0.09		11		0.22					0.51		9	MUD
12.19	-12.19	0	3.2	5.5		0.1	0.3	0	0	0	0	3.21	5.2	0	0.41	1.7	16.931	0.17	0.71		69							0.35		59	CLAYEY SILT

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	2.61	7.62		0.1	0.31	0	0	0	0	2.48	7.31		0	118.6	16.152	0.15	1.94		167									142	SILTY SAND
10	-10	0	2.3	4.49		0.1	0.31	0	0	0	0	2.32	4.18		0	106.1	16.434	0.14	0.81		65							0.26		55	CLAYEY SILT
15	-15	0	3.34	10.23		0.1	0.31	0	0	0	0	3.12	9.92		0	118.6	16.714	0.19	2.18		236									200	SILTY SAND
20	-20	0	2.61	4.38		0.1	0.31	0	0	0	0	2.65	4.07		0	106.1	16.996	0.16	0.54		49		0.16					0.31		42	SILTY CLAY
25	-25	0	5.85	15.87		0.1	0.31	0	0	0	0	5.47	15.56		0	124.8	17.284	0.32	1.84		350									298	SILTY SAND
30	-30	0	3.13	9.6		0.1	0.31	0	0	0	0	2.93	9.29		0.376	118.6	17.212	0.15	2.49		220									188	SILTY SAND
35	-35	0	4.28	5.01		0.1	0.31	0	0	0	0	4.37	4.7		0.647	93.6	17.207	0.22	0.09		11		0.23					0.53		9	MUD
40	-40	0	3.34	5.74		0.1	0.31	0	0	0	0	3.35	5.43		0.428	106.1	17.676	0.17	0.71		72							0.37		62	CLAYEY SILT

	K_D	K_O
AVERAGE	0.19	-0.22
ST DEV	0.06	-0.38
MIN	0.14	-0.27
MAX	0.32	-0.12

DMT 07-10

Date: 7/27/2007
Total Depth (ft): 35

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	3.5	5.4		0.15	0.25	0	0	0	0	3.58	5.15	0	0.029	1.7	34.094	0.1	0.44		55		0.19					0.34		46	SILTY CLAY
3.05	-3.05	0	4	7		0.15	0.25	0	0	0	0	4.02	6.75	0	0.18	1.8	34.207	0.11	0.71		95							0.38		81	CLAYEY SILT
4.57	-4.57	0	1.9	3		0.15	0.25	0	0	0	0	2.02	2.75	0	0.329	1.6	34.311	0.05	0.44		26		0.07					0.11		22	SILTY CLAY
6.1	-6.1	0	2.4	4.3		0.15	0.25	0	0	0	0	2.48	4.05	0	0.479	1.7	34.409	0.06	0.79		55							0.14		46	CLAYEY SILT
7.62	-7.62	0	2.2	5	0.05	0.15	0.25	0	0	0	0	2.23	4.75	0.2	0.628	1.7	34.513	0.05	1.57	-0.27	87									74	SANDY SILT
9.14	-9.14	0	3.6	6.6		0.15	0.25	0	0	0	0	3.62	6.35	0	0.777	1.7	34.618	0.08	0.96		95							0.24		81	SILT
10.67	-10.67	0	4.7	10.2	0.1	0.15	0.25	0	0	0	0	4.6	9.95	0.25	0.927	1.8	34.73	0.11	1.46	-0.18	186									158	SANDY SILT

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	3.65	5.64		0.16	0.26	0	0	0	0	3.74	5.38		0.03	106.1	35.594	0.1	0.44		57		0.2					0.35		48	SILTY CLAY
10	-10	0	4.18	7.31		0.16	0.26	0	0	0	0	4.2	7.05		0.188	112.3	35.712	0.11	0.71		99							0.4		85	CLAYEY SILT
15	-15	0	1.98	3.13		0.16	0.26	0	0	0	0	2.11	2.87		0.343	99.8	35.821	0.05	0.44		27		0.07					0.11		23	SILTY CLAY
20	-20	0	2.51	4.49		0.16	0.26	0	0	0	0	2.59	4.23		0.5	106.1	35.923	0.06	0.79		57							0.15		48	CLAYEY SILT
25	-25	0	2.3	5.22	0.05	0.16	0.26	0	0	0	0	2.33	4.96	0.21	0.656	106.1	36.032	0.05	1.57	-0.27	91									77	SANDY SILT
30	-30	0	3.76	6.89		0.16	0.26	0	0	0	0	3.78	6.63		0.811	106.1	36.141	0.08	0.96		99							0.25		85	SILT
35	-35	0	4.91	10.65	0.1	0.16	0.26	0	0	0	0	4.8	10.39	0.26	0.968	112.3	36.258	0.11	1.46	-0.18	194									165	SANDY SILT

	K_D	K_O
AVERAGE	0.08	-0.35
ST DEV	0.03	-0.45
MIN	0.05	-0.40
MAX	0.11	-0.31

DMT 07-11

Date: 7/26/2007
Total Depth (ft): 40

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	9.5	33		0.15	0.25	0	0	0	0	8.5	32.75	0	0	2.15	35.658	0.24	2.86		842									715	SILTY SAND
3.05	-3.05	0	6.8	15		0.15	0.25	0	0	0	0	6.56	14.75	0	0.03	1.95	35.935	0.18	1.25		284									242	SANDY SILT
4.57	-4.57	0	3.7	8.5		0.15	0.25	0	0	0	0	3.63	8.25	0	0.18	1.8	36.065	0.1	1.34		160									136	SANDY SILT
6.1	-6.1	0	3.7	8.2		0.15	0.25	0	0	0	0	3.65	7.95	0	0.33	1.8	36.186	0.09	1.3		149									127	SANDY SILT
7.62	-7.62	0	4.5	10.6		0.15	0.25	0	0	0	0	4.37	10.35	0	0.479	1.8	36.305	0.11	1.54		208									177	SANDY SILT
9.14	-9.14	0	5.9	13.8		0.15	0.25	0	0	0	0	5.68	13.55	0	0.628	1.95	36.435	0.14	1.56		273									232	SANDY SILT
10.67	-10.67	0	5.3	10		0.15	0.25	0	0	0	0	5.24	9.75	0	0.778	1.8	36.567	0.12	1.01		157							0.47		133	SILT
12.19	-12.19	0	5.1	9.6		0.15	0.25	0	0	0	0	5.05	9.35	0	0.927	1.8	36.686	0.11	1.05		149							0.41		127	SILT

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	9.92	34.45		0.16	0.26	0	0	0	0	8.87	34.19		0	134.2	37.227	0.24	2.86		879									746	SILTY SAND
10	-10	0	7.1	15.66		0.16	0.26	0	0	0	0	6.85	15.4		0.031	121.7	37.516	0.18	1.25		296									253	SANDY SILT
15	-15	0	3.86	8.87		0.16	0.26	0	0	0	0	3.79	8.61		0.188	112.3	37.652	0.1	1.34		167									142	SANDY SILT
20	-20	0	3.86	8.56		0.16	0.26	0	0	0	0	3.81	8.3		0.345	112.3	37.778	0.09	1.3		156									133	SANDY SILT
25	-25	0	4.7	11.07		0.16	0.26	0	0	0	0	4.56	10.81		0.5	112.3	37.902	0.11	1.54		217									185	SANDY SILT
30	-30	0	6.16	14.41		0.16	0.26	0	0	0	0	5.93	14.15		0.656	121.7	38.038	0.14	1.56		285									242	SANDY SILT
35	-35	0	5.53	10.44		0.16	0.26	0	0	0	0	5.47	10.18		0.812	112.3	38.176	0.12	1.01		164							0.49		139	SILT
40	-40	0	5.32	10.02		0.16	0.26	0	0	0	0	5.27	9.76		0.968	112.3	38.3	0.11	1.05		156							0.43		133	SILT

	K_D	K_O
AVERAGE	0.14	-0.28
ST DEV	0.05	-0.40
MIN	0.09	-0.33
MAX	0.24	-0.18

DMT 07-12

Date: 7/27/2007
Total Depth (ft): 39

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	5	12.2		0.1	0.2	0	0	0	0	4.76	12	0	0	1.8	37.613	0.13	1.52		251									214	SANDY SILT
3.05	-3.05	0	7.7	18.2		0.1	0.2	0	0	0	0	7.29	18	0	0	1.95	37.895	0.19	1.47		372									316	SANDY SILT
4.57	-4.57	0	7.5	24.6		0.1	0.2	0	0	0	0	6.76	24.4	0	0	2	38.19	0.18	2.61		612									520	SILTY SAND
6.1	-6.1	0	5.2	10.8		0.1	0.2	0	0	0	0	5.04	10.6	0	0.06	1.8	38.415	0.13	1.12		193							0.54		164	SILT
7.62	-7.62	0	3.5	9.2		0.1	0.2	0	0	0	0	3.33	9	0	0.209	1.9	38.542	0.08	1.82		197									167	SILTY SAND
9.14	-9.14	0	6.2	18.6		0.1	0.2	0	0	0	0	5.7	18.4	0	0.358	2	38.684	0.14	2.38		441									375	SILTY SAND
10.67	-10.67	0	6.3	10		0.1	0.2	0	0	0	0	6.23	9.8	0	0.508	1.8	38.819	0.15	0.62		124							0.66		105	CLAYEY SILT
11.73	-11.73	0	2.5	3.4	0.05	0.1	0.2	0	0	0	0	2.57	3.2	0.15	0.612	1.6	38.891	0.05	0.32	-0.24	22		0.09					0.12		19	CLAY

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	5.22	12.74		0.1	0.21	0	0	0	0	4.97	12.53		0	112.3	39.268	0.13	1.52		262									223	SANDY SILT
10	-10	0	8.04	19		0.1	0.21	0	0	0	0	7.61	18.79		0	121.7	39.562	0.19	1.47		388									330	SANDY SILT
15	-15	0	7.83	25.68		0.1	0.21	0	0	0	0	7.06	25.47		0	124.8	39.87	0.18	2.61		639									543	SILTY SAND
20	-20	0	5.43	11.28		0.1	0.21	0	0	0	0	5.26	11.07		0.063	112.3	40.105	0.13	1.12		201							0.56		171	SILT
25	-25	0	3.65	9.6		0.1	0.21	0	0	0	0	3.48	9.4		0.218	118.6	40.238	0.08	1.82		206									174	SILTY SAND
30	-30	0	6.47	19.42		0.1	0.21	0	0	0	0	5.95	19.21		0.374	124.8	40.386	0.14	2.38		460									392	SILTY SAND
35	-35	0	6.58	10.44		0.1	0.21	0	0	0	0	6.5	10.23		0.53	112.3	40.527	0.15	0.62		129							0.69		110	CLAYEY SILT
38.5	-38.5	0	2.61	3.55	0.05	0.1	0.21	0	0	0	0	2.68	3.34	0.16	0.639	99.8	40.602	0.05	0.32	-0.24	23		0.09					0.13		20	CLAY

	K_D	K_O
AVERAGE	0.13	-0.28
ST DEV	0.05	-0.40
MIN	0.05	-0.40
MAX	0.19	-0.22

DMT 07-13D
Date: 7/27/2007
Total Depth (ft): 5

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	8	20.2		0.1	0.2	0	0	0	0	7.51	20	0	0	1.95	39.504	0.19	1.66		434									369	SANDY SILT

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	8.35	21.09		0.1	0.21	0	0	0	0	7.84	20.88		0	121.7	41.242	0.19	1.66		453									385	SANDY SILT

DMT 07-14
Date: 7/27/2007
Total Depth (ft): 75

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	6	19		0.15	0.25	0	0	0	0	5.52	18.75	0	0	2	39.504	0.14	2.4		459									390	SILTY SAND
3.05	-3.05	0	5.4	24.2		0.15	0.25	0	0	0	0	4.63	23.95	0	0	2	39.804	0.12	4.17		670									570	SAND
4.57	-4.57	0	3.7	9.2		0.15	0.25	0	0	0	0	3.6	8.95	0	0	1.8	40.088	0.09	1.49		186									158	SANDY SILT
6.1	-6.1	0	3.8	9.2		0.15	0.25	0	0	0	0	3.7	8.95	0	0	1.8	40.358	0.09	1.42		182									155	SANDY SILT
7.62	-7.62	0	7.4	25		0.15	0.25	0	0	0	0	6.69	24.75	0	0	2	40.641	0.16	2.7		627									533	SILTY SAND
9.14	-9.14	0	3	7.8		0.15	0.25	0	0	0	0	2.93	7.55	0	0.06	1.8	40.865	0.07	1.61		160									136	SANDY SILT
10.67	-10.67	0	3.2	8.8		0.15	0.25	0	0	0	0	3.09	8.55	0	0.21	1.9	40.992	0.07	1.9		189									161	SILTY SAND
12.19	-12.19	0	6.5	20.8		0.15	0.25	0	0	0	0	5.96	20.55	0	0.359	2	41.134	0.14	2.61		506									430	SILTY SAND
13.72	-13.72	0	8.7	30.2		0.15	0.25	0	0	0	0	7.8	29.95	0	0.509	2	41.284	0.18	3.04		769									653	SILTY SAND
15.24	-15.24	0	11.2	43.2		0.15	0.25	0	0	0	0	9.77	42.95	0	0.658	2.15	41.445	0.22	3.64		1151									979	SAND
16.76	-16.76	0	12.8	39.2		0.15	0.25	0	0	0	0	11.65	38.95	0	0.808	2.15	41.616	0.26	2.52		947									805	SILTY SAND
18.29	-18.29	0	9.4	27		0.15	0.25	0	0	0	0	8.69	26.75	0	0.958	2	41.778	0.19	2.34		627									533	SILTY SAND
19.81	-19.81	0	14.8	42.2		0.15	0.25	0	0	0	0	13.6	41.95	0	1.107	2.15	41.938	0.3	2.27		984									836	SILTY SAND
21.34	-21.34	0	16.8	44		0.15	0.25	0	0	0	0	15.61	43.75	0	1.257	2.15	42.111	0.34	1.96		976									830	SILTY SAND
22.86	-22.86	0	17.2	51		0.15	0.25	0	0	0	0	15.68	50.75	0	1.406	2.15	42.282	0.34	2.46		1217									1034	SILTY SAND

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	6.26	19.84		0.16	0.26	0	0	0	0	5.76	19.58		0	124.8	41.242	0.14	2.4		479									407	SILTY SAND
10	-10	0	5.64	25.26		0.16	0.26	0	0	0	0	4.83	25		0	124.8	41.555	0.12	4.17		699									595	SAND
15	-15	0	3.86	9.6		0.16	0.26	0	0	0	0	3.76	9.34		0	112.3	41.852	0.09	1.49		194									165	SANDY SILT
20	-20	0	3.97	9.6		0.16	0.26	0	0	0	0	3.86	9.34		0	112.3	42.134	0.09	1.42		190									162	SANDY SILT
25	-25	0	7.73	26.1		0.16	0.26	0	0	0	0	6.98	25.84		0	124.8	42.429	0.16	2.7		655									556	SILTY SAND
30	-30	0	3.13	8.14		0.16	0.26	0	0	0	0	3.06	7.88		0.063	112.3	42.663	0.07	1.61		167									142	SANDY SILT
35	-35	0	3.34	9.19		0.16	0.26	0	0	0	0	3.23	8.93		0.219	118.6	42.796	0.07	1.9		197									168	SILTY SAND
40	-40	0	6.79	21.72		0.16	0.26	0	0	0	0	6.22	21.45		0.375	124.8	42.944	0.14	2.61		528									449	SILTY SAND
45	-45	0	9.08	31.53		0.16	0.26	0	0	0	0	8.14	31.27		0.531	124.8	43.1	0.18	3.04		803									682	SILTY SAND
50	-50	0	11.69	45.1		0.16	0.26	0	0	0	0	10.2	44.84		0.687	134.2	43.269	0.22	3.64		1202									1022	SAND
55	-55	0	13.36	40.92		0.16	0.26	0	0	0	0	12.16	40.66		0.844	134.2	43.447	0.26	2.52		989									840	SILTY SAND
60	-60	0	9.81	28.19		0.16	0.26	0	0	0	0	9.07	27.93		1	124.8	43.616	0.19	2.34		655									556	SILTY SAND
65	-65	0	15.45	44.06		0.16	0.26	0	0	0	0	14.2	43.8		1.156	134.2	43.783	0.3	2.27		1027									873	SILTY SAND
70	-70	0	17.54	45.94		0.16	0.26	0	0	0	0	16.3	45.68		1.312	134.2	43.964	0.34	1.96		1019									867	SILTY SAND
75	-75	0	17.96	53.24		0.16	0.26	0	0	0	0	16.37	52.98		1.468	134.2	44.142	0.34	2.46		1271									1079	SILTY SAND

	K_D	K_O
AVERAGE	0.18	-0.23
ST DEV	0.09	-0.33
MIN	0.07	-0.36
MAX	0.34	-0.10

DMT 07-16
Date: 8/14/2007
Total Depth (ft): 34

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	7.9	25.8		0.1	0.3	0	0	0	0	7.13	25.5	0	0	2	1.686	4.23	2.58		638									1102	SILTY SAND
3.05	-3.05	0	6.5	20.8		0.1	0.3	0	0	0	0	5.91	20.5	0	0	2	1.987	2.97	2.47		506									711	SILTY SAND
4.57	-4.57	0	1.4	2.5		0.1	0.3	0	0	0	0	1.47	2.2	0	0	1.6	2.255	0.65	0.5		26	0.07	0.12					0.39	0.2	22	SILTY CLAY
6.1	-6.1	0	11	35.8		0.1	0.3	0	0	0	0	9.88	35.5	0	0	2.15	2.537	3.9	2.59		889									1472	SILTY SAND
7.62	-7.62	0	6.7	20.2		0.1	0.3	0	0	0	0	6.15	19.9	0	0	2	2.846	2.16	2.24		477									521	SILTY SAND
9.14	-9.14	0	9.8	27		0.1	0.3	0	0	0	0	9.06	26.7	0	0	2.15	3.156	2.87	1.95		612									814	SILTY SAND
10.26	-10.26	0	10	37		0.1	0.3	0	0	0	0	8.77	36.7	0	0	2.15	3.392	2.59	3.18		969									1284	SILTY SAND

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	8.25	26.94		0.1	0.31	0	0	0	0	7.44	26.62		0	124.8	1.76	4.23	2.58		666									1150	SILTY SAND
10	-10	0	6.79	21.72		0.1	0.31	0	0	0	0	6.17	21.4		0	124.8	2.074	2.97	2.47		528									742	SILTY SAND
15	-15	0	1.46	2.61		0.1	0.31	0	0	0	0	1.53	2.3		0	99.8	2.354	0.65	0.5		27	0.07	0.13					0.41	0.2	23	SILTY CLAY
20	-20	0	11.48	37.38		0.1	0.31	0	0	0	0	10.31	37.06		0	134.2	2.649	3.9	2.59		928									1537	SILTY SAND
25	-25	0	6.99	21.09		0.1	0.31	0	0	0	0	6.42	20.78		0	124.8	2.971	2.16	2.24		498									544	SILTY SAND
30	-30	0	10.23	28.19		0.1	0.31	0	0	0	0	9.46	27.87		0	134.2	3.295	2.87	1.95		639									850	SILTY SAND
33.7	-33.7	0	10.44	38.63		0.1	0.31	0	0	0	0	9.16	38.31		0	134.2	3.541	2.59	3.18		1012									1340	SILTY SAND

	K_D	K_O
AVERAGE	2.77	0.73
ST DEV	1.18	0.29
MIN	0.65	0.08
MAX	4.23	1.03

DMT 07-17
Date: 8/14/2007
Total Depth (ft): 125

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	0.7	1.2		0.1	0.35	0	0	0	0	0.8	0.85	0	0	1.5	3.392	0.24	0.07		2		0.05					0.12		2	MUD
3.05	-3.05	0	3	10		0.1	0.35	0	0	0	0	2.77	9.65	0	0	1.9	3.647	0.76	2.48		239									203	SILTY SAND
4.57	-4.57	0	3.5	11		0.1	0.35	0	0	0	0	3.25	10.65	0	0	1.9	3.931	0.83	2.28		257									218	SILTY SAND
6.1	-6.1	0	1.4	3.6		0.1	0.35	0	0	0	0	1.41	3.25	0	0	1.7	4.201	0.34	1.3		64									54	SANDY SILT
7.62	-7.62	0	2.3	6.7		0.1	0.35	0	0	0	0	2.2	6.35	0	0	1.8	4.462	0.49	1.88		144									122	SILTY SAND
9.14	-9.14	0	5.7	15		0.1	0.35	0	0	0	0	5.36	14.65	0	0	1.95	4.742	1.13	1.73		322									274	SANDY SILT
10.67	-10.67	0	3	3.6		0.1	0.35	0	0	0	0	3.09	3.25	0	0	1.5	5.001	0.62	0.05		5	0.06	0.25					0.8	0.2	5	MUD
12.19	-12.19	0	4.5	11.4		0.1	0.35	0	0	0	0	4.28	11.05	0	0	1.8	5.247	0.82	1.58		235									200	SANDY SILT
13.72	-13.72	0	5.8	15.6		0.1	0.35	0	0	0	0	5.43	15.25	0	0	2	5.532	0.98	1.81		341									290	SILTY SAND
15.24	-15.24	0	4.3	4.8	0.15	0.1	0.35	0	0	0	0	4.4	4.45	0.25	0	1.5	5.793	0.76	0.01	0.06	2	0.13	0.38					1.28	0.2	2	MUD
16.76	-16.76	0	6.3	9		0.1	0.35	0	0	0	0	6.29	8.65	0	0	1.8	6.039	1.04	0.38		82	0.24	0.59					2.18	0.4	70	SILTY CLAY
18.29	-18.29	0	5.5	6	0.6	0.1	0.35	0	0	0	0	5.6	5.65	0.7	0	1.5	6.287	0.89	0.01	0.13	2	0.18	0.5					1.78	0.3	2	MUD
19.81	-19.81	0	7	16.2		0.1	0.35	0	0	0	0	6.66	15.85	0	0	1.95	6.544	1.02	1.38		319									271	SANDY SILT
21.34	-21.34	0	10	22.2		0.1	0.35	0	0	0	0	9.51	21.85	0	0	1.95	6.837	1.39	1.3		428									364	SANDY SILT
22.86	-22.86	0	4.7	6.4	0.15	0.1	0.35	0	0	0	0	4.74	6.05	0.25	0	1.7	7.109	0.67	0.28	0.05	46	0.08	0.4					1.28	0.2	39	CLAY
24.38	-24.38	0	8.6	21.8		0.1	0.35	0	0	0	0	8.06	21.45	0	0	1.95	7.381	1.09	1.66		465									395	SANDY SILT
25.91	-25.91	0	10.2	28.8		0.1	0.35	0	0	0	0	9.39	28.45	0	0	2.15	7.689	1.22	2.03		661									562	SILTY SAND
27.43	-27.43	0	12	32.2		0.1	0.35	0	0	0	0	11.11	31.85	0	0	2.15	8.01	1.39	1.87		720									612	SILTY SAND
28.96	-28.96	0	8.3	22.4		0.1	0.35	0	0	0	0	7.72	22.05	0	0.15	2	8.171	0.93	1.89		497									423	SILTY SAND
30.48	-30.48	0	5.5	11.2		0.1	0.35	0	0	0	0	5.34	10.85	0	0.299	1.8	8.306	0.61	1.09		191	0.05						1.29	0.2	163	SILT
32	-32	0	22	35		0.1	0.35	0	0	0	0	21.47	34.65	0	0.448	2.1	8.447	2.49	0.63		457	0.67						11.88	1.4	492	CLAYEY SILT
33.53	-33.53	0	10	11	1.6	0.1	0.35	0	0	0	0	10.07	10.65	1.7	0.599	1.8	8.59	1.1	0.06	0.12	20	0.27	0.9					3.39	0.4	17	CLAY?
35.05	-35.05	0	12	22		0.1	0.35	0	0	0	0	11.62	21.65	0	0.748	2.1	8.732	1.25	0.92		348	0.32						4.17	0.5	296	SILT
36.58	-36.58	0	22	26.5		0.1	0.35	0	0	0	0	21.9	26.15	0	0.898	2.05	8.893	2.36	0.2		148	0.64	2.41					11.52	1.3	151	CLAY
38.1	-38.1	0	16	20		0.1	0.35	0	0	0	0	15.92	19.65	0	1.047	1.9	9.038	1.65	0.25		129	0.44	1.56					6.67	0.7	110	CLAY

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	0.73	1.25		0.1	0.37	0	0	0	0	0.84	0.89		0	93.6	3.541	0.24	0.07		2		0.05					0.13		2	MUD
10	-10	0	3.13	10.44		0.1	0.37	0	0	0	0	2.89	10.07		0	118.6	3.807	0.76	2.48		250									212	SILTY SAND
15	-15	0	3.65	11.48		0.1	0.37	0	0	0	0	3.39	11.12		0	118.6	4.104	0.83	2.28		268									228	SILTY SAND
20	-20	0	1.46	3.76		0.1	0.37	0	0	0	0	1.47	3.39		0	106.1	4.386	0.34	1.3		67									56	SANDY SILT
25	-25	0	2.4	6.99		0.1	0.37	0	0	0	0	2.3	6.63		0	112.3	4.658	0.49	1.88		150									127	SILTY SAND
30	-30	0	5.95	15.66		0.1	0.37	0	0	0	0	5.6	15.29		0	121.7	4.951	1.13	1.73		336									286	SANDY SILT
35	-35	0	3.13	3.76		0.1	0.37	0	0	0	0	3.23	3.39		0	93.6	5.221	0.62	0.05		5	0.06	0.26					0.84	0.2	5	MUD
40	-40	0	4.7	11.9		0.1	0.37	0	0	0	0	4.47	11.54		0	112.3	5.478	0.82	1.58		245									209	SANDY SILT
45	-45	0	6.06	16.29		0.1	0.37	0	0	0	0	5.67	15.92		0	124.8	5.775	0.98	1.81		356									303	SILTY SAND
50	-50	0	4.49	5.01	0.16	0.1	0.37	0	0	0	0	4.59	4.65	0.26	0	93.6	6.048	0.76	0.01	0.06	2	0.13	0.4					1.34	0.2	2	MUD
55	-55	0	6.58	9.4		0.1	0.37	0	0	0	0	6.57	9.03		0	112.3	6.305	1.04	0.38		86	0.24	0.62					2.28	0.4	73	SILTY CLAY
60	-60	0	5.74	6.26	0.63	0.1	0.37	0	0	0	0	5.85	5.9	0.73	0	93.6	6.564	0.89	0.01	0.13	2	0.18	0.52					1.86	0.3	2	MUD
65	-65	0	7.31	16.91		0.1	0.37	0	0	0	0	6.95	16.55		0	121.7	6.832	1.02	1.38		333									283	SANDY SILT
70	-70	0	10.44	23.18		0.1	0.37	0	0	0	0	9.93	22.81		0	121.7	7.138	1.39	1.3		447									380	SANDY SILT
75	-75	0	4.91	6.68	0.16	0.1	0.37	0	0	0	0	4.95	6.32	0.26	0	106.1	7.422	0.67	0.28	0.05	48	0.08	0.42					1.34	0.2	41	CLAY
80	-80	0	8.98	22.76		0.1	0.37	0	0	0	0	8.41	22.39		0	121.7	7.706	1.09	1.66		485									412	SANDY SILT
85	-85	0	10.65	30.07		0.1	0.37	0	0	0	0	9.8	29.7		0	134.2	8.027	1.22	2.03		690									587	SILTY SAND
90	-90	0	12.53	33.62		0.1	0.37	0	0	0	0	11.6	33.25		0	134.2	8.362	1.39	1.87		752									639	SILTY SAND
95	-95	0	8.67	23.39		0.1	0.37	0	0	0	0	8.06	23.02		0.157	124.8	8.531	0.93	1.89		519									442	SILTY SAND
100	-100	0	5.74	11.69		0.1	0.37	0	0	0	0	5.57	11.33		0.312	112.3	8.671	0.61	1.09		199	0.05						1.35	0.2	170	SILT
105	-105	0	22.97	36.54		0.1	0.37	0	0	0	0	22.41	36.17		0.468	131	8.819	2.49	0.63		477	0.67						12.4	1.4	514	CLAYEY SILT
110	-110	0	10.44	11.48	1.67	0.1	0.37	0	0	0	0	10.51	11.12	1.77	0.625	112.3	8.968	1.1	0.06	0.12	21	0.27	0.94					3.54	0.4	18	CLAY?
115	-115	0	12.53	22.97		0.1	0.37	0	0	0	0	12.13	22.6		0.781	131	9.116	1.25	0.92		363	0.32						4.35	0.5	309	SILT
120	-120	0	22.97	27.67		0.1	0.37	0	0	0	0	22.86	27.3		0.938	127.9	9.284	2.36	0.2		155	0.64	2.52					12.03	1.3	158	CLAY
125	-125	0	16.7	20.88		0.1	0.37	0	0	0	0	16.62	20.51		1.093	118.6	9.436	1.65	0.25		135	0.44	1.63					6.96	0.7	115	CLAY

	K_D	K_O
AVERAGE	1.08	0.26
ST DEV	0.51	0.01
MIN	0.34	-0.10
MAX	2.49	0.67

DMT 07-18
Date: 8/14/2007
Total Depth (ft): 125

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
3.05	-3.05	0	1.3	2	0.05	0.15	0.3	0	0	0	0	1.44	1.7	0.2	0	1.5	10.086	0.14	0.18	0.14	9		0.08					0.16		8	MUD
6.1	-6.1	0	3.2	8.5		0.15	0.3	0	0	0	0	3.11	8.2	0	0	1.8	10.579	0.29	1.64		177									150	SANDY SILT
7.62	-7.62	0	2.5	3.8	0.05	0.15	0.3	0	0	0	0	2.61	3.5	0.2	0	1.7	10.841	0.24	0.34	0.08	31		0.17					0.4		26	CLAY
9.14	-9.14	0	3	3.5	0.15	0.15	0.3	0	0	0	0	3.15	3.2	0.3	0	1.5	11.079	0.28	0.02	0.1	2		0.21					0.53		2	MUD
10.67	-10.67	0	4	10.2		0.15	0.3	0	0	0	0	3.86	9.9	0	0	1.8	11.327	0.34	1.56		210									178	SANDY SILT
12.19	-12.19	0	4	4.6	0.2	0.15	0.3	0	0	0	0	4.14	4.3	0.35	0	1.5	11.573	0.36	0.04	0.08	5		0.3					0.79	0.1	5	MUD
13.72	-13.72	0	5.5	19.2		0.15	0.3	0	0	0	0	4.99	18.9	0	0	2	11.836	0.42	2.79		483									410	SILTY SAND
15.24	-15.24	0	3.9	5.2		0.15	0.3	0	0	0	0	4.01	4.9	0	0	1.7	12.112	0.33	0.22		31		0.28					0.73	0.1	26	CLAY
16.76	-16.76	0	5	15		0.15	0.3	0	0	0	0	4.67	14.7	0	0	2	12.388	0.38	2.15		348									296	SILTY SAND
18.29	-18.29	0	4.7	7.3		0.15	0.3	0	0	0	0	4.74	7	0	0	1.8	12.673	0.37	0.48		78		0.34					0.93	0.1	67	SILTY CLAY
19.81	-19.81	0	4.5	12.2		0.15	0.3	0	0	0	0	4.29	11.9	0	0	1.8	12.941	0.33	1.78		264									225	SANDY SILT
21.34	-21.34	0	7	12.8		0.15	0.3	0	0	0	0	6.88	12.5	0	0	1.95	13.223	0.52	0.82		195	0.01						1.62	0.1	166	CLAYEY SILT
22.86	-22.86	0	6	17.8		0.15	0.3	0	0	0	0	5.58	17.5	0	0	2	13.518	0.41	2.13		414									352	SILTY SAND
24.38	-24.38	0	5.1	10.8		0.15	0.3	0	0	0	0	4.99	10.5	0	0	1.8	13.801	0.36	1.11		191							0.96	0.1	163	SILT
25.91	-25.91	0	7.4	19		0.15	0.3	0	0	0	0	6.99	18.7	0	0.15	1.95	13.932	0.49	1.71		406									345	SANDY SILT
27.43	-27.43	0	9.2	22.2		0.15	0.3	0	0	0	0	8.72	21.9	0	0.299	1.95	14.074	0.6	1.56		457									389	SANDY SILT
28.96	-28.96	0	8.8	20		0.15	0.3	0	0	0	0	8.41	19.7	0	0.449	1.95	14.217	0.56	1.42		392									333	SANDY SILT
30.48	-30.48	0	9.6	24.8		0.15	0.3	0	0	0	0	9.01	24.5	0	0.599	2	14.362	0.59	1.84		537									457	SILTY SAND
32	-32	0	8.5	21.6		0.15	0.3	0	0	0	0	8.02	21.3	0	0.748	2	14.511	0.5	1.83		461									392	SILTY SAND
33.53	-33.53	0	10	21		0.15	0.3	0	0	0	0	9.62	20.7	0	0.898	1.95	14.658	0.6	1.27		384									327	SANDY SILT
35.05	-35.05	0	8.5	12.8		0.15	0.3	0	0	0	0	8.46	12.5	0	1.047	1.9	14.796	0.5	0.55		140		0.58					1.71	0.1	119	SILTY CLAY
36.58	-36.58	0	19.2	44		0.15	0.3	0	0	0	0	18.13	43.7	0	1.197	2.1	14.946	1.13	1.51		887									754	SANDY SILT
38.1	-38.1	0	10.2	15.8		0.15	0.3	0	0	0	0	10.09	15.5	0	1.346	1.95	15.099	0.58	0.62		188	0.04						2.18	0.1	159	CLAYEY SILT

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
10	-10	0	1.36	2.09	0.05	0.16	0.31	0	0	0	0	1.5	1.77	0.21	0	93.6	10.53	0.14	0.18	0.14	9		0.08					0.17		8	MUD
20	-20	0	3.34	8.87		0.16	0.31	0	0	0	0	3.25	8.56		0	112.3	11.044	0.29	1.64		185									157	SANDY SILT
25	-25	0	2.61	3.97	0.05	0.16	0.31	0	0	0	0	2.72	3.65	0.21	0	106.1	11.318	0.24	0.34	0.08	32		0.18					0.42		27	CLAY
30	-30	0	3.13	3.65	0.16	0.16	0.31	0	0	0	0	3.29	3.34	0.31	0	93.6	11.566	0.28	0.02	0.1	2		0.22					0.55		2	MUD
35	-35	0	4.18	10.65		0.16	0.31	0	0	0	0	4.03	10.34		0	112.3	11.825	0.34	1.56		219									186	SANDY SILT
40	-40	0	4.18	4.8	0.21	0.16	0.31	0	0	0	0	4.32	4.49	0.37	0	93.6	12.082	0.36	0.04	0.08	5		0.31					0.82	0.1	5	MUD
45	-45	0	5.74	20.04		0.16	0.31	0	0	0	0	5.21	19.73		0	124.8	12.357	0.42	2.79		504									428	SILTY SAND
50	-50	0	4.07	5.43		0.16	0.31	0	0	0	0	4.19	5.12		0	106.1	12.645	0.33	0.22		32		0.29					0.76	0.1	27	CLAY
55	-55	0	5.22	15.66		0.16	0.31	0	0	0	0	4.88	15.35		0	124.8	12.933	0.38	2.15		363									309	SILTY SAND
60	-60	0	4.91	7.62		0.16	0.31	0	0	0	0	4.95	7.31		0	112.3	13.231	0.37	0.48		81		0.35					0.97	0.1	70	SILTY CLAY
65	-65	0	4.7	12.74		0.16	0.31	0	0	0	0	4.48	12.42		0	112.3	13.51	0.33	1.78		276									235	SANDY SILT
70	-70	0	7.31	13.36		0.16	0.31	0	0	0	0	7.18	13.05		0	121.7	13.805	0.52	0.82		204	0.01						1.69	0.1	173	CLAYEY SILT
75	-75	0	6.26	18.58		0.16	0.31	0	0	0	0	5.83	18.27		0	124.8	14.113	0.41	2.13		432									367	SILTY SAND
80	-80	0	5.32	11.28		0.16	0.31	0	0	0	0	5.21	10.96		0	112.3	14.408	0.36	1.11		199							1	0.1	170	SILT
85	-85	0	7.73	19.84		0.16	0.31	0	0	0	0	7.3	19.52		0.157	121.7	14.545	0.49	1.71		424									360	SANDY SILT
90	-90	0	9.6	23.18		0.16	0.31	0	0	0	0	9.1	22.86		0.312	121.7	14.693	0.6	1.56		477									406	SANDY SILT
95	-95	0	9.19	20.88		0.16	0.31	0	0	0	0	8.78	20.57		0.469	121.7	14.843	0.56	1.42		409									348	SANDY SILT
100	-100	0	10.02	25.89		0.16	0.31	0	0	0	0	9.41	25.58		0.625	124.8	14.994	0.59	1.84		561									477	SILTY SAND
105	-105	0	8.87	22.55		0.16	0.31	0	0	0	0	8.37	22.24		0.781	124.8	15.149	0.5	1.83		481									409	SILTY SAND
110	-110	0	10.44	21.92		0.16	0.31	0	0	0	0	10.04	21.61		0.938	121.7	15.303	0.6	1.27		401									341	SANDY SILT
115	-115	0	8.87	13.36		0.16	0.31	0	0	0	0	8.83	13.05		1.093	118.6	15.447	0.5	0.55		146		0.61					1.79	0.1	124	SILTY CLAY
120	-120	0	20.04	45.94		0.16	0.31	0	0	0	0	18.93	45.62		1.25	131	15.604	1.13	1.51		926									787	SANDY SILT
125	-125	0	10.65	16.5		0.16	0.31	0	0	0	0	10.53	16.18		1.405	121.7	15.763	0.58	0.62		196	0.04						2.28	0.1	166	CLAYEY SILT

	K_D	K_0
AVERAGE	0.45	-0.03
ST DEV	0.19	-0.22
MIN	0.14	-0.27
MAX	1.13	0.28

DMT 07-19
Date: 8/13/2007
Total Depth (ft): 125

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	0.9	1.4		0.15	0.3	0	0	0	0	1.05	1.1	0	0	1.5	16.445	0.06	0.05		2		0.05					0.08		2	MUD
3.05	-3.05	0	1.3	5		0.15	0.3	0	0	0	0	1.29	4.7	0	0	1.8	16.693	0.08	2.65		118									101	SILTY SAND
4.57	-4.57	0	1.3	2.2	0.05	0.15	0.3	0	0	0	0	1.43	1.9	0.2	0	1.6	16.947	0.08	0.33	0.14	16		0.07					0.12		14	CLAY
6.1	-6.1	0	2.4	2.9	0.1	0.15	0.3	0	0	0	0	2.55	2.6	0.25	0	1.5	17.179	0.15	0.02	0.1	2		0.15					0.3		2	MUD
7.62	-7.62	0	2.1	2.6	0.1	0.15	0.3	0	0	0	0	2.25	2.3	0.25	0	1.5	17.403	0.13	0.02	0.11	2		0.12					0.24		2	MUD
9.14	-9.14	0	3	3.5	0.3	0.15	0.3	0	0	0	0	3.15	3.2	0.45	0	1.5	17.627	0.18	0.02	0.14	2		0.19					0.41		2	MUD
10.67	-10.67	0	3.3	4	0.35	0.15	0.3	0	0	0	0	3.44	3.7	0.5	0	1.5	17.852	0.19	0.08	0.15	9		0.21					0.46		8	MUD
12.19	-12.19	0	3.3	4.4	0.5	0.15	0.3	0	0	0	0	3.42	4.1	0.65	0	1.7	18.091	0.19	0.2	0.19	24		0.21					0.46		20	CLAY
13.72	-13.72	0	4.3	4.9	0.7	0.15	0.3	0	0	0	0	4.44	4.6	0.85	0	1.5	18.331	0.24	0.04	0.19	5		0.29					0.68		5	MUD
15.24	-15.24	0	4.7	5.4	1.2	0.15	0.3	0	0	0	0	4.84	5.1	1.35	0	1.5	18.555	0.26	0.05	0.28	9		0.32					0.77		8	MUD
16.76	-16.76	0	5.5	24		0.15	0.3	0	0	0	0	4.75	23.7	0	0.149	2	18.666	0.25	4.12		658									559	SAND
18.29	-18.29	0	6	6.8	0.9	0.15	0.3	0	0	0	0	6.13	6.5	1.05	0.299	1.7	18.794	0.31	0.06	0.13	13		0.4					1.03	0.1	11	CLAY?
19.81	-19.81	0	4.8	5.4	0.9	0.15	0.3	0	0	0	0	4.94	5.1	1.05	0.448	1.5	18.884	0.24	0.04	0.13	5		0.29					0.68		5	MUD
21.34	-21.34	0	5.5	6.2	1.5	0.15	0.3	0	0	0	0	5.64	5.9	1.65	0.599	1.5	18.959	0.27	0.05	0.21	9		0.33					0.81		8	MUD
22.86	-22.86	0	5.4	6.2	0.5	0.15	0.3	0	0	0	0	5.53	5.9	0.65	0.748	1.7	19.048	0.25	0.08	-0.02	13		0.31					0.75		11	CLAY?
24.38	-24.38	0	6.5	7.3	1.9	0.15	0.3	0	0	0	0	6.63	7	2.05	0.897	1.7	19.153	0.3	0.06	0.2	13		0.39					0.99	0.1	11	CLAY?
25.91	-25.91	0	7.3	8.4	3.4	0.15	0.3	0	0	0	0	7.42	8.1	3.55	1.047	1.7	19.258	0.33	0.11	0.39	24		0.45					1.16	0.1	20	CLAY
27.43	-27.43	0	7.5	8.6	3.5	0.15	0.3	0	0	0	0	7.62	8.3	3.65	1.196	1.7	19.362	0.33	0.11	0.38	24		0.45					1.17	0.1	20	CLAY
28.96	-28.96	0	8.4	10	2.6	0.15	0.3	0	0	0	0	8.49	9.7	2.75	1.346	1.8	19.475	0.37	0.17	0.2	42		0.51					1.38	0.1	36	CLAY
30.48	-30.48	0	8.9	10	1.7	0.15	0.3	0	0	0	0	9.02	9.7	1.85	1.496	1.8	19.594	0.38	0.09	0.05	24		0.55					1.49	0.1	20	CLAY?
32	-32	0	9.1	10.3	3.1	0.15	0.3	0	0	0	0	9.21	10	3.25	1.645	1.8	19.713	0.38	0.1	0.21	27		0.55					1.5	0.1	23	CLAY
33.53	-33.53	0	9	10.6	4.5	0.15	0.3	0	0	0	0	9.09	10.3	4.65	1.795	1.8	19.834	0.37	0.17	0.39	42		0.53					1.41	0.1	36	CLAY
35.05	-35.05	0	8	18.6		0.15	0.3	0	0	0	0	7.64	18.3	0	1.944	2	19.968	0.29	1.87		370									314	SILTY SAND
36.58	-36.58	0	8	12.2		0.15	0.3	0	0	0	0	7.96	11.9	0	2.094	1.8	20.103	0.29	0.67		137							1		116	CLAYEY SILT
38.1	-38.1	0	12.2	30.6		0.15	0.3	0	0	0	0	11.45	30.3	0	2.243	2.15	20.248	0.45	2.05		654									556	SILTY SAND

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	0.94	1.46		0.16	0.31	0	0	0	0	1.1	1.15		0	93.6	17.169	0.06	0.05		2		0.05					0.08		2	MUD
10	-10	0	1.36	5.22		0.16	0.31	0	0	0	0	1.35	4.91		0	112.3	17.427	0.08	2.65		123									105	SILTY SAND
15	-15	0	1.36	2.3	0.05	0.16	0.31	0	0	0	0	1.49	1.98	0.21	0	99.8	17.693	0.08	0.33	0.14	17		0.07					0.13		15	CLAY
20	-20	0	2.51	3.03	0.1	0.16	0.31	0	0	0	0	2.66	2.71	0.26	0	93.6	17.935	0.15	0.02	0.1	2		0.16					0.31		2	MUD
25	-25	0	2.19	2.71	0.1	0.16	0.31	0	0	0	0	2.35	2.4	0.26	0	93.6	18.169	0.13	0.02	0.11	2		0.13					0.25		2	MUD
30	-30	0	3.13	3.65	0.31	0.16	0.31	0	0	0	0	3.29	3.34	0.47	0	93.6	18.403	0.18	0.02	0.14	2		0.2					0.43		2	MUD
35	-35	0	3.45	4.18	0.37	0.16	0.31	0	0	0	0	3.59	3.86	0.52	0	93.6	18.637	0.19	0.08	0.15	9		0.22					0.48		8	MUD
40	-40	0	3.45	4.59	0.52	0.16	0.31	0	0	0	0	3.57	4.28	0.68	0	106.1	18.887	0.19	0.2	0.19	25		0.22					0.48		21	CLAY
45	-45	0	4.49	5.12	0.73	0.16	0.31	0	0	0	0	4.64	4.8	0.89	0	93.6	19.138	0.24	0.04	0.19	5		0.3					0.71		5	MUD
50	-50	0	4.91	5.64	1.25	0.16	0.31	0	0	0	0	5.05	5.32	1.41	0	93.6	19.371	0.26	0.05	0.28	9		0.33					0.8		8	MUD
55	-55	0	5.74	25.06		0.16	0.31	0	0	0	0	4.96	24.74		0.156	124.8	19.487	0.25	4.12		687									584	SAND
60	-60	0	6.26	7.1	0.94	0.16	0.31	0	0	0	0	6.4	6.79	1.1	0.312	106.1	19.621	0.31	0.06	0.13	14		0.42					1.08	0.1	11	CLAY?
65	-65	0	5.01	5.64	0.94	0.16	0.31	0	0	0	0	5.16	5.32	1.1	0.468	93.6	19.715	0.24	0.04	0.13	5		0.3					0.71		5	MUD
70	-70	0	5.74	6.47	1.57	0.16	0.31	0	0	0	0	5.89	6.16	1.72	0.625	93.6	19.793	0.27	0.05	0.21	9		0.34					0.85		8	MUD
75	-75	0	5.64	6.47	0.52	0.16	0.31	0	0	0	0	5.77	6.16	0.68	0.781	106.1	19.886	0.25	0.08	-0.02	14		0.32					0.78		11	CLAY?
80	-80	0	6.79	7.62	1.98	0.16	0.31	0	0	0	0	6.92	7.31	2.14	0.936	106.1	19.996	0.3	0.06	0.2	14		0.41					1.03	0.1	11	CLAY?
85	-85	0	7.62	8.77	3.55	0.16	0.31	0	0	0	0	7.75	8.46	3.71	1.093	106.1	20.105	0.33	0.11	0.39	25		0.47					1.21	0.1	21	CLAY
90	-90	0	7.83	8.98	3.65	0.16	0.31	0	0	0	0	7.96	8.67	3.81	1.249	106.1	20.214	0.33	0.11	0.38	25		0.47					1.22	0.1	21	CLAY
95	-95	0	8.77	10.44	2.71	0.16	0.31	0	0	0	0	8.86	10.13	2.87	1.405	112.3	20.332	0.37	0.17	0.2	44		0.53					1.44	0.1	38	CLAY
100	-100	0	9.29	10.44	1.77	0.16	0.31	0	0	0	0	9.42	10.13	1.93	1.562	112.3	20.456	0.38	0.09	0.05	25		0.57					1.56	0.1	21	CLAY?
105	-105	0	9.5	10.75	3.24	0.16	0.31	0	0	0	0	9.62	10.44	3.39	1.717	112.3	20.58	0.38	0.1	0.21	28		0.57					1.57	0.1	24	CLAY
110	-110	0	9.4	11.07	4.7	0.16	0.31	0	0	0	0	9.49	10.75	4.85	1.874	112.3	20.707	0.37	0.17	0.39	44		0.55					1.47	0.1	38	CLAY
115	-115	0	8.35	19.42		0.16	0.31	0	0	0	0	7.98	19.11		2.03	124.8	20.847	0.29	1.87		386									328	SILTY SAND
120	-120	0	8.35	12.74		0.16	0.31	0	0	0	0	8.31	12.42		2.186	112.3	20.988	0.29	0.67		143							1.04		121	CLAYEY SILT
125	-125	0	12.74	31.95		0.16	0.31	0	0	0	0	11.95	31.63		2.342	134.2	21.139	0.45	2.05		683									580	SILTY SAND

	K_D	K_D
AVERAGE	0.28	-0.16
ST DEV	0.08	-0.35
MIN	0.13	-0.29
MAX	0.45	-0.05

DMT 07-20
Date: 7/28/2007
Total Depth (ft): 50

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	3.3	10		0.15	0.4	0	0	0	0	3.14	9.6	0	0	1.9	22.492	0.14	2.05		224									190	SILTY SAND
3.05	-3.05	0	2.7	8.9		0.15	0.4	0	0	0	0	2.57	8.5	0	0	1.9	22.777	0.11	2.31		206									175	SILTY SAND
4.57	-4.57	0	3.3	8.3		0.15	0.4	0	0	0	0	3.23	7.9	0	0	1.8	23.053	0.14	1.45		162									138	SANDY SILT
7.62	-7.62	0	3.6	4.3	0.1	0.15	0.4	0	0	0	0	3.74	3.9	0.25	0	1.5	23.547	0.16	0.04	0.07	5		0.22					0.45		5	MUD
10.67	-10.67	0	5.4	14.8		0.15	0.4	0	0	0	0	5.11	14.4	0	0	2	24.071	0.21	1.82		322									274	SILTY SAND
12.19	-12.19	0	5.3	6	0.3	0.15	0.4	0	0	0	0	5.44	5.6	0.45	0	1.5	24.332	0.22	0.03	0.08	5		0.35					0.8		5	MUD
13.72	-13.72	0	4.5	5.2	0.5	0.15	0.4	0	0	0	0	4.64	4.8	0.65	0	1.5	24.557	0.19	0.03	0.14	5		0.28					0.62		5	MUD
15.24	-15.24	0	7.8	26.2		0.15	0.4	0	0	0	0	7.06	25.8	0	0	2	24.818	0.28	2.66		650									553	SILTY SAND

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	3.45	10.44		0.16	0.42	0	0	0	0	3.28	10.02		0	118.6	23.482	0.14	2.05		234									198	SILTY SAND
10	-10	0	2.82	9.29		0.16	0.42	0	0	0	0	2.68	8.87		0	118.6	23.779	0.11	2.31		215									183	SILTY SAND
15	-15	0	3.45	8.67		0.16	0.42	0	0	0	0	3.37	8.25		0	112.3	24.067	0.14	1.45		169									144	SANDY SILT
25	-25	0	3.76	4.49	0.1	0.16	0.42	0	0	0	0	3.9	4.07	0.26	0	93.6	24.583	0.16	0.04	0.07	5		0.23					0.47		5	MUD
35	-35	0	5.64	15.45		0.16	0.42	0	0	0	0	5.33	15.03		0	124.8	25.13	0.21	1.82		336									286	SILTY SAND
40	-40	0	5.53	6.26	0.31	0.16	0.42	0	0	0	0	5.68	5.85	0.47	0	93.6	25.403	0.22	0.03	0.08	5		0.37					0.84		5	MUD
45	-45	0	4.7	5.43	0.52	0.16	0.42	0	0	0	0	4.84	5.01	0.68	0	93.6	25.638	0.19	0.03	0.14	5		0.29					0.65		5	MUD
50	-50	0	8.14	27.35		0.16	0.42	0	0	0	0	7.37	26.94		0	124.8	25.91	0.28	2.66		679									577	SILTY SAND

	K_D	K_O
AVERAGE	0.18	-0.23
ST DEV	0.05	-0.39
MIN	0.11	-0.31
MAX	0.28	-0.15

DMT 07-24
Date: 8/15/2007
Total Depth (ft): 125

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	1.8	6.1		0.15	0.35	0	0	0	0	1.76	5.75	0	0.149	1.8	23.806	0.07	2.48		138									118	SILTY SAND
3.05	-3.05	0	2.4	7.1		0.15	0.35	0	0	0	0	2.34	6.75	0	0.299	1.8	23.926	0.09	2.16		153									130	SILTY SAND
4.57	-4.57	0	2.8	5.3		0.15	0.35	0	0	0	0	2.85	4.95	0	0.448	1.7	24.038	0.1	0.87		73							0.22		62	CLAYEY SILT
6.1	-6.1	0	2.75	8		0.15	0.35	0	0	0	0	2.66	7.65	0	0.599	1.8	24.15	0.09	2.42		173									147	SILTY SAND
7.62	-7.62	0	3.4	6.4		0.15	0.35	0	0	0	0	3.43	6.05	0	0.748	1.7	24.262	0.11	0.98		91							0.26		77	SILT
9.14	-9.14	0	3.8	7.9		0.15	0.35	0	0	0	0	3.77	7.55	0	0.897	1.8	24.374	0.12	1.32		131									111	SANDY SILT
10.67	-10.67	0	3.05	3.8		0.15	0.35	0	0	0	0	3.19	3.45	0	1.047	1.5	24.472	0.09	0.12		9		0.11					0.19		8	MUD
12.19	-12.19	0	7.15	23		0.15	0.35	0	0	0	0	6.53	22.65	0	1.196	2	24.583	0.22	3.02		559									475	SILTY SAND
13.72	-13.72	0	3.7	8.8		0.15	0.35	0	0	0	0	3.62	8.45	0	1.346	1.9	24.726	0.09	2.12		168									142	SILTY SAND
15.24	-15.24	0	6.5	15.8		0.15	0.35	0	0	0	0	6.21	15.45	0	1.496	2	24.868	0.19	1.96		321									273	SILTY SAND
16.76	-16.76	0	5.3	11.2		0.15	0.35	0	0	0	0	5.18	10.85	0	1.645	1.8	25.002	0.14	1.6		197									167	SANDY SILT
18.29	-18.29	0	8	20.4		0.15	0.35	0	0	0	0	7.56	20.05	0	1.795	2	25.137	0.23	2.17		434									369	SILTY SAND
19.81	-19.81	0	10.4	24.2		0.15	0.35	0	0	0	0	9.89	23.85	0	1.944	1.95	25.283	0.31	1.76		485									412	SANDY SILT
21.34	-21.34	0	9.2	27.2		0.15	0.35	0	0	0	0	8.48	26.85	0	2.094	2	25.429	0.25	2.88		638									542	SILTY SAND
22.86	-22.86	0	9	24.2		0.15	0.35	0	0	0	0	8.42	23.85	0	2.243	2	25.578	0.24	2.5		536									455	SILTY SAND
24.38	-24.38	0	6.5	10.4		0.15	0.35	0	0	0	0	6.48	10.05	0	2.393	1.8	25.712	0.16	0.87		124							0.49		105	CLAYEY SILT
25.91	-25.91	0	7.9	24.2		0.15	0.35	0	0	0	0	7.26	23.85	0	2.543	2	25.848	0.18	3.52		576									489	SAND
27.43	-27.43	0	10.2	26.8		0.15	0.35	0	0	0	0	9.55	26.45	0	2.692	2	25.997	0.26	2.47		587									499	SILTY SAND
28.96	-28.96	0	11	23.6		0.15	0.35	0	0	0	0	10.55	23.25	0	2.842	1.95	26.143	0.29	1.65		441									375	SANDY SILT
30.48	-30.48	0	7.5	22		0.15	0.35	0	0	0	0	6.95	21.65	0	2.991	2	26.289	0.15	3.71		510									434	SAND
32	-32	0	9.6	20.4		0.15	0.35	0	0	0	0	9.24	20.05	0	3.14	1.95	26.434	0.23	1.77		375									319	SANDY SILT
33.53	-33.53	0	11	30.2		0.15	0.35	0	0	0	0	10.22	29.85	0	3.29	2	26.58	0.26	2.84		681									579	SILTY SAND
35.05	-35.05	0	7.5	17.8		0.15	0.35	0	0	0	0	7.16	17.45	0	3.44	1.9	26.722	0.14	2.77		357									304	SILTY SAND
36.58	-36.58	0	12	23		0.15	0.35	0	0	0	0	11.63	22.65	0	3.59	1.95	26.861	0.3	1.37		383									325	SANDY SILT
38.1	-38.1	0	8	25.6		0.15	0.35	0	0	0	0	7.3	25.25	0	3.739	2	27.006	0.13	5.05		623									530	SAND

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	1.88	6.37		0.16	0.37	0	0	0	0	1.84	6		0.156	112.3	24.853	0.07	2.48		144									123	SILTY SAND
10	-10	0	2.51	7.41		0.16	0.37	0	0	0	0	2.44	7.05		0.312	112.3	24.979	0.09	2.16		160									136	SILTY SAND
15	-15	0	2.92	5.53		0.16	0.37	0	0	0	0	2.98	5.17		0.468	106.1	25.096	0.1	0.87		76							0.23		65	CLAYEY SILT
20	-20	0	2.87	8.35		0.16	0.37	0	0	0	0	2.78	7.99		0.625	112.3	25.213	0.09	2.42		181									153	SILTY SAND
25	-25	0	3.55	6.68		0.16	0.37	0	0	0	0	3.58	6.32		0.781	106.1	25.33	0.11	0.98		95							0.27		80	SILT
30	-30	0	3.97	8.25		0.16	0.37	0	0	0	0	3.94	7.88		0.936	112.3	25.446	0.12	1.32		137									116	SANDY SILT
35	-35	0	3.18	3.97		0.16	0.37	0	0	0	0	3.33	3.6		1.093	93.6	25.549	0.09	0.12		9		0.11					0.2		8	MUD
40	-40	0	7.46	24.01		0.16	0.37	0	0	0	0	6.82	23.65		1.249	124.8	25.665	0.22	3.02		584									496	SILTY SAND
45	-45	0	3.86	9.19		0.16	0.37	0	0	0	0	3.78	8.82		1.405	118.6	25.814	0.09	2.12		175									148	SILTY SAND
50	-50	0	6.79	16.5		0.16	0.37	0	0	0	0	6.48	16.13		1.562	124.8	25.962	0.19	1.96		335									285	SILTY SAND
55	-55	0	5.53	11.69		0.16	0.37	0	0	0	0	5.41	11.33		1.717	112.3	26.102	0.14	1.6		206									174	SANDY SILT
60	-60	0	8.35	21.3		0.16	0.37	0	0	0	0	7.89	20.93		1.874	124.8	26.243	0.23	2.17		453									385	SILTY SAND
65	-65	0	10.86	25.26		0.16	0.37	0	0	0	0	10.33	24.9		2.03	121.7	26.395	0.31	1.76		506									430	SANDY SILT
70	-70	0	9.6	28.4		0.16	0.37	0	0	0	0	8.85	28.03		2.186	124.8	26.548	0.25	2.88		666									566	SILTY SAND
75	-75	0	9.4	25.26		0.16	0.37	0	0	0	0	8.79	24.9		2.342	124.8	26.703	0.24	2.5		560									475	SILTY SAND
80	-80	0	6.79	10.86		0.16	0.37	0	0	0	0	6.77	10.49		2.498	112.3	26.843	0.16	0.87		129							0.51		110	CLAYEY SILT
85	-85	0	8.25	25.26		0.16	0.37	0	0	0	0	7.58	24.9		2.655	124.8	26.985	0.18	3.52		601									511	SAND
90	-90	0	10.65	27.98		0.16	0.37	0	0	0	0	9.97	27.61		2.81	124.8	27.141	0.26	2.47		613									521	SILTY SAND
95	-95	0	11.48	24.64		0.16	0.37	0	0	0	0	11.01	24.27		2.967	121.7	27.293	0.29	1.65		460									392	SANDY SILT
100	-100	0	7.83	22.97		0.16	0.37	0	0	0	0	7.26	22.6		3.123	124.8	27.446	0.15	3.71		532									453	SAND
105	-105	0	10.02	21.3		0.16	0.37	0	0	0	0	9.65	20.93		3.278	121.7	27.597	0.23	1.77		392									333	SANDY SILT
110	-110	0	11.48	31.53		0.16	0.37	0	0	0	0	10.67	31.16		3.435	124.8	27.75	0.26	2.84		711									604	SILTY SAND
115	-115	0	7.83	18.58		0.16	0.37	0	0	0	0	7.48	18.22		3.591	118.6	27.898	0.14	2.77		373									317	SILTY SAND
120	-120	0	12.53	24.01		0.16	0.37	0	0	0	0	12.14	23.65		3.748	121.7	28.043	0.3	1.37		400									339	SANDY SILT
125	-125	0	8.35	26.73		0.16	0.37	0	0	0	0	7.62	26.36		3.904	124.8	28.194	0.13	5.05		650									553	SAND

	K_D	K_O
AVERAGE	0.22	-0.21
ST DEV	0.06	-0.38
MIN	0.13	-0.29
MAX	0.31	-0.14

DMT 07-25
Date: 8/15/2007
Total Depth (ft): 10

Metric Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(M)	(M)	(KGF)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(BAR)	(T/M3)	(BAR)				(BAR)		(BAR)	(BAR)	(DEG)	(BAR)	(DEG)	(BAR)		(BAR)	
1.52	-1.52	0	9.8	27.2		0.1	0.2	0	0	0	0	9.05	27	0	0.149	2.15	30.596	0.29	2.02		623									530	SILTY SAND
3.05	-3.05	0	15.2	42		0.1	0.2	0	0	0	0	13.98	41.8	0	0.299	2.15	30.769	0.44	2.03		966									821	SILTY SAND

Imperial Units

Z	ELEV	THRUST	A	B	C	DA	DB	ZMRNG	ZMLO	ZMHI	ZMCAL	P0	P1	P2	U0	GAMMA	SVP	KD	ID	UD	ED	K0	SU	QD	PHI	SIGFF	PHI0	PC	OCR	M	SOIL TYPE
(FT)	(FT)	(LBF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(TSF)	(PCF)	(TSF)				(TSF)		(TSF)	(TSF)	(DEG)	(TSF)	(DEG)	(TSF)		(TSF)	
5	-5	0	10.23	28.4		0.1	0.21	0	0	0	0	9.45	28.19		0.156	134.2	31.942	0.29	2.02		650									553	SILTY SAND
10	-10	0	15.87	43.85		0.1	0.21	0	0	0	0	14.6	43.64		0.312	134.2	32.123	0.44	2.03		1009									857	SILTY SAND

	K_D	K_O
AVERAGE	0.37	-0.10
ST DEV	0.11	-0.32
MIN	0.29	-0.15
MAX	0.44	-0.05

Attachment J

2007 Geotechnical Investigation SPT Boring Logs

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-01 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–28	FILL, silty sand, fine to medium grained, dark gray to dark grayish brown (coarse tailings)	FILL/ TAILINGS									
5			69	M	SS	24					
10			7	M	SS	13					
15			33	M	SS	15					
20			31	M	SS	16					
25			26	M	SS	16					
28–34	FILL, silty sand, fine to medium grained, lenses of silt, dark grayish brown (coarse tailings)										
30			31	M/W	SS	20	20				
34–38	FILL, silt, lenses of silty sand (fine tailings)										
35			33	M/W	SS	23	17				
38–44	FILL, silt, dark grayish brown, lenses of fine to medium grained silty sand (slimes)										
40			27	W	SS	19	23				
44–46	FILL, silt, brown to dark gray, lenses of sandy silt (slimes)										
45			16	W	SS	21	25				
46–48	SILT, slightly organic, trace roots, gray (ML) 3 inch thinwall sample from 46.0 to 48.0 feet	FINE ALLUVIUM		M	TW	24					
48–49.7	SILTY SAND, a little gravel, apparent cobbles, brown, moist, a little peat above about 49 feet (SM)	TILL	24	M	SS	23	12				
	END OF BORING AT 49.7 FEET Borehole backfilled with bentonite grout										

DEPTH:	DRILLING METHOD
0-9'	**4.25" HSA**
9-46'	**RD w/DM**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/6/07		**11.0**	**9.0**	**11.0**	**---**	**None**

BORING COMPLETED: **8/6/07**

DR: **JU** LG: **TDD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-02 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1566.4**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)			M	SU						
6			8	M	SS	14					
11			11	M	SS	20					
16			16	M	SS	20					
21			12	M	SS	20					
23	FILL, silt, dark grayish brown (slimes)	FILL/ TAILINGS									
25				▽							
26			3	W	SS	20	33				
28	FILL, sandy silt, dark gray (slimes)										
31			6	W	SS	7	27				
33	FILL, silt, dark grayish brown (slimes)										
36			2	W	SS	24	36				
41			<1	W	SS	24	40				
43	FILL, sandy silt with lenses of silt, dark gray and dark grayish brown (slimes)										
46			1	W	SS	24	31				

DEPTH:	DRILLING METHOD
0-25'	4.25" HSA
25-77'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/31/07	16:30	27.0	25.0	25.4	---	25.0
7/31/07	17:05	---	---	---	---	None

BORING COMPLETED: **8/1/07**

DR: **LA** LG: **MC** Rig: **51**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**

LOG OF BORING NO. **07-02 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
51	FILL, sandy silt with lenses of silt, dark gray and dark grayish brown (slimes)*(continued)*		2	W	SS	24	32				
52											
53	3 inch thinwall sample from 52.0 to 54.0 feet				TW	0					
54	FILL, silt, lenses of silty clay, grayish brown (slimes)										
55					TW	26					
56	3 inch thinwall sample from 54.0 to 56.0 feet										
57			<1	W	SS	24	39				
58											
59											
60	3 inch thinwall sample from 59.0 to 61.0 feet				TW	23					
61		FILL/ TAILINGS									
62	Vane shear test-tip of vane 61.7 feet				VANE						
63											
64											
65			<1	M	SS	24	34				
66											
67											
68											
69											
70											
71	3 inch thinwall sample from 70.5 to 72.5 feet				TW	0					
72											
73											
74											
75	3 inch Osterberg piston thinwall sample from 75.0 to 77.0 feet										
76		TILL			PS	21.5					
77	**END OF BORING AT 77.0 FEET.** Borehole backfilled with bentonite grout.		50/0.0		SS	0					

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-03 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1559.9**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–19	FILL, silty sand, fine grained, dark gray, lenses and laminations of sandy silt (fine tailings)	FILL / TAILINGS									
5–6			4	M	SS	15					
10–11			4	M	SS	16	22				78
15–16			3	W	SS	14					
20	FILL, silt, dark gray (slimes)										
21	3 inch thinwall sample from 19.5 to 21.5 feet				TW	8					
25	Vane shear test-tip of vane at 24.8 feet				VANE						
26	Vane shear test-tip of vane at 25.2 feet				VANE						
29	3 inch thinwall sample from 28.5 to 30.5 feet				TW	0					
30	FILL, silt, dark gray, lenses of dark grayish brown silty clay (slimes)										
32	3 inch Osterberg piston thinwall sample from 30.7 to 32.7 feet				PS	24					
35	Vane shear test-tip of vane at 35.1 feet			W	VANE SS	24	36		25	22	77
37	FILL, silt, dark gray to dark grayish brown, lenses of fine grained dark gray silty sand (fine tailings)										
40–41			4	W	SS	10	29				
44	FILL, silt, dark gray (slimes)										
45–46			3	W	SS	22	42		24	22	91

DEPTH:	DRILLING METHOD
0-9½'	6.625" HSA
9½-32½'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/3/07	11:00	78.8	9.5	78.8	4.0	None

BORING COMPLETED: **8/3/07**

DR: **JU** LG: **MD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-03 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
49–52	FILL, silt, dark gray (slimes) *(continued)*	FILL / TAILINGS	8	W	SS	2	35				
52–57	FILL, silt, dark gray to dark grayish brown (fine tailings)		2	W	SS	11	31				
57–67	FILL, silt, dark gray to dark grayish brown, lenses of fine grained dark gray silty sand (slimes)		3	W	SS	24	33				95
			<1	W	SS	6	34				
67–70	PEAT, hemic, black, lenses of sand with silt (PT)	SWAMP DEPOSIT									
70–71.5	SAND WITH SILT, fine to coarse grained, brown, moist, medium dense (SP-SM)	COARSE ALLUVIUM	27	M	SS	11					
71.5–76	SILTY SAND, a little gravel, dark grayish brown, moist (SM) Pitcher sample from 72.0 to 75.0 feet Pitcher sample from 75.0 to 77.7 feet	TILL			TW	29					
					TW	7.5					
76–78.8	SILTY SAND WITH GRAVEL, brown, moist (SM)		70/0.6	M	SS	7					

END OF BORING AT 78.8 FEET.
Borehole backfilled with bentonite grout.

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-04B (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–2	FILL, silty sand, fine to medium grained, brown, trace roots (coarse tailings)	FILL/ TAILINGS		D	SU						
3–21	FILL, silty sand, fine to medium grained, dark grayish brown (coarse tailings)		8	M	SS	14					
			2	M	SS	15					
			30	M	SS	18					
			13	M	SS	16					
21–27	FILL, silty sand, fine grained, dark gray (fine tailings)		35	M	SS	21					
27–34	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)		27	M	SS	16					
34–37.5	FILL, silty sand, fine to coarse grained, dark gray (coarse tailings)		36	M	SS	17					
			32	M	SS	19					
37.5–39	FILL, silt, dark grayish brown (fine tailings)										
39–43	FILL, silty sand, fine grained, dark grayish brown, lenses of sandy silt (coarse to fine tailings)		27	M/W	SS	24	19				
43–48	FILL, silt, dark gray, lenses of fine grained silty sand and sandy silt (fine tailings)		34	W	SS	19	21				
48–53	FILL, silty sand, fine to medium grained, dark grayish brown (coarse tailings)		40	W	SS	18	16				
53–55	FILL, silt, dark gray (slimes)		51	W	SS	24	38 224				
55–60.5	PEAT, hemic, dark brown (PT) 3 inch split-spoon sample from 56.0 to 58.0 feet	SWAMP DEPOSIT	96	W	3SS	17	222				
60.5–61.5	SAND WITH SILT AND GRAVEL, dark brown, wet (SP-SM)	COARSE ALLUVIUM	83	W	SS	14					
61.5–62	SILTY SAND, dark grayish brown, wet, very dense (SM)	TILL									

END OF BORING AT 62.0 FEET
Borehole backfilled with bentonite grout

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9'	**4.25" HSA**							
9-60'	**RD w/DM**	**8/8/07**	**7:15**	**11.0**	**9.0**	**9.0**	**---**	**None**

BORING COMPLETED: **8/8/07**

DR: **JU** LG: **TDD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-05 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: ______

MATERIAL DESCRIPTION	GEOLOGY
FILL, silty sand, fine to medium grained, dark gray (coarse tailings)	FILL / TAILINGS
FILL, silty sand, fine to medium grained, dark gray (fine tailings)	
FILL, silt, dark gray (slimes)	
FILL, silty sand, fine grained, dark gray (fine tailings)	
FILL, silty sand, fine to medium grained, dark gray (coarse tailings)	
FILL, silty sand, fine to medium grained (fine tailings)	
FILL, silt, dark grayish brown (slimes)	
FILL, silt, dark gray to dark grayish brown, lenses of dark gray sandy silt (slimes)	

N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
		SU						
20	M	SS	18					
16	M	SS	20					
20	M	SS	20					
18	M	SS	20					
2	W	SS	20	34				
19	W	SS	18	24				
28	W	SS	24	18				
19	W	SS	24	24				
3	W	SS	24	25				
1	W	SS	24	38				
4	W	SS	24	35				
2	W	SS	20	34				
2	W	SS	24	36				

DEPTH	DRILLING METHOD
0-20'	4.25" HSA
20-102'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/2/07	9:20	22.0	20.0	21.6	---	None

BORING COMPLETED: **8/2/07**

DR: **LA** LG: **MC** Rig: **51**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-05 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81	FILL, silt, dark gray to dark grayish brown, lenses of dark gray sandy silt (slimes) *(continued)*	FILL / TAILINGS	2	W	SS	24	32				
86			<1	W	SS	24	32				
91			3	W	SS	24	30				
93–96	PEAT, sapric, dark brown, with some wood (PT)	SWAMP DEPOSIT	29	M	SS	24	147				
98	3 inch split-spoon sample from 97.0 to 99.0 feet		49	M	3SS	16	199				
102–104	SILTY SAND, a little gravel, fine to medium grained, dark grayish brown, wet, dense (SM)	COARSE ALLUVIUM	35	W	SS	16	14				

END OF BORING AT 104.0 FEET.
Borehole backfilled with bentonite grout.

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-06 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

MATERIAL DESCRIPTION (SURFACE ELEVATION: ____)	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
FILL, sandy silt, dark grayish brown, trace roots (slimes)	FILL/ TAILINGS			SU						
FILL, silty sand, fine grained, dark gray, lenses of grayish brown sandy silt and silt (fine tailings)		4	M	SS						
FILL, silt, lenses of silt with sand, dark grayish brown (slimes)		<1	W	SS	14	33				
FILL, sandy silt, dark gray (fine tailings)		2	W	SS		28				
FILL, silt, dark grayish brown (slimes)		1	W	SS	18	37				98
				VANE		33				
Vane shear test-tip of vane at 23.5 feet		<1		SS	16					
Vane shear test-tip of vane at 24.5 feet				VANE	0					
3 inch Osterberg piston thinwall sample from 25.5 to 27.5 feet				PS	25					
3 inch Osterberg piston thinwall sample from 27.5 to 29.5 feet				PS						
Vane shear test-tip of vane at 31.6 feet				VANE		39				
Vane shear test-tip of vane at 32.6 feet				VANE						
		6	W	SS	24	35				
FILL, sandy silt, dark grayish brown (fine tailings)		2	W	SS	24	33				
FILL, sandy silt, dark grayish brown, lenses of fine grained silty sand (fine tailings/slimes)		6	W	SS	24	33				86
		2	W	SS	24	35				
FILL, silt, dark grayish brown, lenses of sandy silt (fine tailings/slimes)		3	W	SS	20	36				86
		2	W	SS	24	29				
FILL, silt, dark grayish brown (slimes)		<1	W	SS	24	31				
PEAT WITH WOOD (PT)	SWAMP DEPOSIT			WS						
Obstruction at 69.0 feet	TILL OR WEATHERED ROCK	50/0		SS	0					
END OF BORING AT 70.0 FEET										
Borehole backfilled with bentonite grout										

DEPTH:	DRILLING METHOD
0-25'	**4.25" HSA**
25-70'	**RD w/DM**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/3/07	**9:30**	**22.0**	**20.0**	**21.0**	**---**	**None**

BORING COMPLETED: **8/6/07**

DR: **LA** LG: **MC** Rig: **58**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**　　LOG OF BORING NO. **07-07C (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: ____________

MATERIAL DESCRIPTION	GEOLOGY
FILL, silty sand, fine to medium grained, trace roots, brown (coarse tailings)	FILL/ TAILINGS
FILL, silty sand, fine to medium grained, dark gray to dark grayish brown (coarse tailings)	FILL/ TAILINGS
FILL, silt, dark grayish brown to dark gray (slimes) 3 inch Osterberg piston thinwall sample from 48.0 to 50.0 feet 3 inch split-spoon sample from 50 to 51.8 feet Vane shear test-tip of vane at 50.7 feet Vane shear test-tip of vane at 51.4 feet Vane shear test-tip of vane at 52.2 feet	FILL/ TAILINGS
SILTY SAND, a little gravel, brown (SM) Pitcher sample from 52.2 to 55.2 feet Pitcher sample from 55.2 to 58.0 feet	TILL

END OF BORING AT 58.5 FEET.
Borehole backfilled with bentonite grout.

N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
	M							
5	M	SS	15					
19	M	SS	17					
21	M	SS	18					
23	M	SS	17					
31	M	SS	17					
56	M	SS	20					
35	M	SS	21	10				
29	W	SS	21	14				
9	W	SS	15	23				
				28				
		PS	24					
		VANE	20	27				
		VANE						
		VANE	27					
		TW						
		TW	11					
		WS						

DEPTH	DRILLING METHOD
0-9'	6.25" HSA
9-58.5'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/8/07	14:00	11.0	9.0	11.0	---	None

BORING COMPLETED: **8/9/07**

DR: **JU**　LG: **TDD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-08 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0-5	FILL, silty sand, fine to medium grained, dark gray (fine tailings)	FILL/ TAILINGS		M	SU						
5-19	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)		20	M	SS	20					
			18	M	SS	20					
			15	M	SS	20					
19-24	FILL, sand with silt, fine to coarse grained, dark gray (coarse tailings)		18	M	SS	24					
24-29	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)		20	M	SS	18					
29-34	FILL, silty sand, fine to medium grained, dark gray, lenses of silt (fine tailings)		6	W	SS	14	22				
34-	FILL, silt, dark gray to dark grayish brown, lenses of silt with sand (slimes)		10	M	SS	14	23				
38	3 inch Osterberg piston thinwall sample from 37.0 to 39.0 feet				PS	0					

DEPTH:	DRILLING METHOD
0-20'	**4.25" HSA**
20-71.6'	**RD w/DM**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/6/07	**16:00**	**47.0**	**20.0**	**---**	**---**	**44.0**

BORING COMPLETED: **8/7/07**

DR: **LA** LG: **MC** Rig: **58**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-08 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
41–44	FILL, silt, dark gray to dark grayish brown, lenses of silt with sand (slimes)*(continued)*	FILL/ TAILINGS									
44–51	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)										
46			15	W	SS	16	17				
51–52	FILL, silt, dark gray to dark grayish brown (slimes)		3	W	SS	24	30				
52–65	FILL, silt, dark gray to dark grayish brown, lenses of silt with sand and sandy silt (fine tailings) 3 inch Osterberg piston thinwall sample from 52.0 to 54.0 feet										
53					PS	15					
56			7	W	SS	24	33				
61			11	W	SS	18	26				
63			5	W	SS	24	28				
65	3 inch Osterberg piston thinwall sample from 64.0 to 66.0 feet				PS	2					
66–70.8	FILL, silt, dark grayish brown (fine tailings to slimes) Vane shear test-tip of vane at 66.8 feet Vane shear test-tip of vane at 67.5 feet 3 inch Osterberg piston thinwall sample from 68.0 to 70.0 feet				VANE VANE						
69					PS	24					
70.8–71.6	Obstruction at 70.8 feet	TILL OR WEATHERED ROCK									
	END OF BORING AT 71.6 FEET Borehole backfilled with bentonite grout										

Water level symbol shown at approximately 44 feet.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-09 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: ____________

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–4	FILL, silty sand, fine to medium grained, grayish brown, trace roots above about 1 foot (fine tailings)	FILL / TAILINGS		D	SU						
5–11	FILL, silt with sand, dark gray (fine tailings)		3	M	SS	11					
			3	M	SS	17	21				77
12–14	FILL, lean clay (slimes) 3 inch Osterberg piston thinwall sample from 12.0 to 14.0 feet				PS	23					
15–22	FILL, silty sand, fine grained, dark gray, lenses of silt (fine tailings)		3	W	SS	8	23				54
			7	W	SS	15	25				
22–25	FILL, sandy silt, dark gray (fine tailings)		8	W	SS	12	28				53
26–28	3 inch Osterberg piston thinwall sample from 25.0 to 27.0 feet (2 inch split-spoon advanced through Osterberg sample zone)				PS	1	35				
				W	SS	24					
29–33	FILL, silt, gray (slimes) 3 inch Osterberg piston thinwall sample from 27.5 to 29.5 feet Vane shear test-tip of vane at 30.0 feet Vane shear test-tip of vane at 30.8 feet				PS	24					
					VANE						
					VANE						
34–42	FILL, silt, dark grayish brown to brown, lenses and laminations of sandy silt, trace roots below about 39 feet (slimes) Vane shear test-tip of vane at 36.3 feet 3 inch Osterberg piston thinwall sample from 36.5 to 38.5 feet		<1	W	SS	24	38				
					VANE						
					PS	23					
			<1		SS	15	40				86
42	Pitcher sample from 41.5 to 42.8 feet				TW	0					
	END OF BORING AT 42.8 FEET Borehole backfilled with bentonite grout										

DEPTH:	DRILLING METHOD
0-9'	**6.25" HSA**
9-41.5'	**RD w/DM**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/6/07	**17:15**	**11.0**	**9.0**	**9.0**	**---**	**None**

BORING COMPLETED: **8/7/07**

DR: **JU** LG: **TDD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **07-10 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–3	FILL, silty sand, fine to medium grained, dark grayish brown (coarse tailings)	FILL/ TAILINGS		M	SU						
3–8	FILL, sand with silt, fine to medium grained, dark grayish brown (coarse tailings)		5	W	SS	16	17				
8–16	FILL, silty sand, fine to medium grained, dark grayish brown (coarse tailings)		2	W	SS	18	17				
			<1	W	SS	18	29				
16–23	FILL, silt, dark grayish brown, lenses of sandy silt and fine grained silty sand (fine tailings) Vane shear test-tip of vane at 17.7 feet				VANE						
			6	W	SS	20	30				
23–40	FILL, silt, dark gray, lenses of sandy silt (fine tailings)		<1	W	SS	20	25				
							27				
	Vane shear test-tip of vane at 26.8 feet				VANE						
				W	SS	24					
			<1	W	SS	24	34				
	3 inch Osterberg piston thinwall sample from 32.0 to 34.0 feet				PS	11					
			<1	W	SS	17	34				
	3 inch Osterberg piston thinwall sample from 37.0 to 39.0 feet				PS	24					
	Vane shear test-tip of vane at 39.6 feet				VANE						
40–43	SILTY SAND, fine grained, brown, wet, medium dense	COARSE ALLUVIUM	19	W	SS	24	20				
			77/.7	W	SS	0					

END OF BORING AT 43.2 FEET
Borehole backfilled with bentonite grout

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9.5'	**4.25" HSA**							
9.5-43.2'	**RD w/DM**	**8/8/07**	**13:05**	**7.0**	**5.0**	**5.4**	**---**	**3.6**

BORING COMPLETED: **8/8/07**

DR: **MC** LG: **LA** Rig: **58**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-11 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0–9	FILL, silty sand, fine to coarse grained, dark grayish brown, trace roots above about 1 foot (coarse tailings)	FILL/ TAILINGS		M							
5			40	M	SS	24					
9–18	FILL, sand with silt, fine to medium grained, dark gray (coarse tailings)		13	W	SS	20	15				
14			12	W	SS	12	15				
18–33	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)		6	W	SS	12	18				
24			9	W	SS	14	17				
29			15	W	SS	15	17				
33–46	FILL, sandy silt, dark grayish brown, lenses of silt (fine tailings)		4	W	SS	17	28				
36	3 inch Osterberg piston thinwall sample from 35.0 to 37.0 feet			W	PS	22					
42			1	W	SS	24	34				
45	3 inch Osterberg piston thinwall sample from 44.0 to 46.0 feet			W	PS	24					
46–47	PEAT, fibric to hemic, dark grayish brown to brown, with some sand below about 46.5 feet (PT)	SWAMP DEPOSIT	10	W	SS	14	115				
47–48	SILTY SAND, a little gravel, brown, wet	TILL									

END OF BORING AT 48.0 FEET.
Borehole backfilled with bentonite grout.

(Water level symbol at 9.7 ft.)

DEPTH:	DRILLING METHOD
0-9'	6.25" HSA
9-47'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/10/07	8:10	11.0	9.0	10.3	---	9.7

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

BORING COMPLETED: **8/10/07**

DR: **JU** LG: **TDD** Rig: **85**

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-12 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: ____________

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1	FILL, silty sand, fine to medium grained, dark grayish brown (coarse tailings)	FILL/ TAILINGS									
3				M	SU						
6			20	M	SS	18					
11			36	M	SS	24					
16			14	W	SS	20	13				
17	FILL, sand with silt, fine to medium grained, dark gray (coarse tailings)										
21			6	W	SS	24	15				
26			14	W	SS	14	15				
28	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)										
31			13	W	SS	14	13				
36			7	W	SS	14	25				
37	FILL, silt, grayish brown (fine tailings/slimes)										
38	FILL, silt, trace roots, brown, lenses of fine grained silty sand (fine tailings)										
41			<1	W	SS	24	23				
43					VANE						
44	Vane shear test-tip of vane at 43.0 feet		20	W	SS	18	13				
45	SILTY SAND WITH GRAVEL, brown, wet (SM)	TILL									

END OF BORING AT 45.5 FEET
Borehole backfilled with bentonite grout

DEPTH:	DRILLING METHOD
0-20'	4.25" HSA
20-45.5'	RD w/DM

BORING COMPLETED: **8/8/07**

DR: **LA** LG: **MC** Rig: **58**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/7/07	17:20	22.0	20.0	20.6	---	18.1
8/8/07	8:15	22.0	20.0	20.2	---	15.4

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-13D (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0–13	FILL, silty sand, fine to medium grained, dark grayish brown, trace roots above about 2 feet (may be organic below about 11 feet) (coarse tailings)	FILL/ TAILINGS									
2.5				M	SU						
6			53	M	SS	20					
10			20	M	SS	20	11				
11–12.3	3 inch thinwall sample from 11.0 to 12.3 feet			▽	TW	9					
13–14.6	Obstruction at 13.0 feet - probable weathered bedrock, dark gray	TILL OR WEATHERED ROCK	66	W	SS	14					
	END OF BORING AT 14.6 FEET Borehole backfilled with bentonite grout										

DEPTH:	DRILLING METHOD
0-14.6'	4.25" HSA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/7/07	15:35	14.5	13.0	13.0	---	12.0
8/7/07	15:55	14.5	None	7.5	---	None

BORING COMPLETED: **8/7/07**

DR: **LA** LG: **MC** Rig: **58**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-14 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1655.2**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–4	FILL, silty sand, fine to medium grained, dark grayish brown (fine tailings)	FILL / TAILINGS		M	SU						
4–8	FILL, silty sand, fine to medium grained, dark grayish brown, lenses of silt (fine tailings)		11	M	SS	18					
8–79	FILL, silty sand, fine to medium grained, dark grayish brown to dark gray (coarse tailings)		28	M	SS	20					
			12	M	SS	24					
			3	M	SS	20					
			18	M	SS	20					
			22	▼	SS	18					
			7	W	SS	14	14				
			15	W	SS	14	14				
			17	W	SS	14	11				
			20	W	SS	16	14				
			41	W	SS	20	16				
			24	W	SS	18	12				
			27	W	SS	18	16				

DEPTH:	DRILLING METHOD
0-20'	4.25" HSA
20-125'	RD w/DM

BORING COMPLETED: **8/10/07**

DR: **LA** LG: **MC** Rig: **58**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/9/07	10:15	30.5	20.0	---	---	27.0

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-14 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81–86	FILL, silty sand, fine to medium grained, dark grayish brown to dark gray (coarse tailings) *(continued)*	FILL / TAILINGS	36	W	SS	20	14				
86–116	FILL, silty sand, fine to coarse grained, dark gray (coarse tailings)		35	W	SS	24	12				
			24	W	SS	20	19				
			24	W	SS	20	22				
116–121	FILL, silty sand, fine grained, dark gray (fine tailings)		19	W	SS	24	120				
121–122	PEAT, fibric, dark brown (PT)	SWAMP DEPOSIT	32	W	3SS	19					
122–125	SILTY SAND, a little gravel, brown, wet (SM)	TILL	21/0.5 141/0.5	W	3SS						

3 inch split spoon sample from 122 to 124 feet
3 inch split spoon sample from 124 to 125 feet
END OF BORING AT 125.0 FEET.
Borehole backfilled with bentonite grout.

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-15 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–23	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)	FILL/ TAILINGS	26	M	SS	20					
			26	M	SS	20					
			26	M	SS	18					
			30	M	SS	19					
23–28	FILL, silty sand, fine to medium grained, dark gray, lenses of sandy silt (coarse tailings)		23	W	SS	13	13				
28–34	FILL, silty sand, fine grained, dark gray (fine tailings)		15	W	SS	14	23				
34–44.5	FILL, silty clay to lean clay, dark grayish brown (slimes) 3 inch thinwall sample from 34.0 to 36.0 feet Vane shear test-tip of vane at 36.2 feet Vane shear test-tip of vane at 37.2 feet Vane shear test-tip of vane at 37.9 feet Vane shear test-tip of vane at 38.6 feet				TW	24					
					VANE						
					VANE						
					VANE						
			7	W	VANE	23	36				
					SS						
44.5–53	FILL, silt, dark grayish brown, lenses of silt with sand (fine tailings)		5	W	SS	18	36				
			7	W	SS	18	35				
53–68	FILL, silt, dark grayish brown (slimes) 3 inch thinwall sample from 56.5 to 58.5 feet		4	W	SS	24	28				
					TW	27					
			3	W	SS	24	35				
			6	W	SS	18	39				
68–79	FILL, silt, lenses of silt with sand, dark gray to dark grayish brown (fine tailings)		7	W	SS	15	35				
			6	W	SS	14	33				

Water level symbol (▽) shown at approximately 25.5 feet.

DEPTH:	DRILLING METHOD
0-9½'	6.625" HSA
9½-144½'	RD w/DM

BORING COMPLETED: 7/30/07

DR: JU LG: MD Rig: 85

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/30/07	16:45	26.5	9.5	26.5	4.0	25.5
7/31/07	17:30	146.5	9.5	146.5	4.0	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**

LOG OF BORING NO. **07-15 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81	3 inch thinwall sample from 79.5 to 81.5 feet FILL, silt, lenses of silt with sand, dark gray to dark grayish brown (fine tailings)*(continued)*				TW	0					
86			19	W	SS	12	34				
91			8	W	SS	16	33				
94	FILL, sandy silt, dark gray, lenses of fine grained silty sand (fine tailings)		10	W	SS	12	30				
99	FILL, silt, lenses of silt with sand, dark gray (fine tailings)		11	W	SS	18	34				
105	FILL, silty sand, fine grained, dark gray (fine tailings)		15	W	SS	15	31				
111		FILL/ TAILINGS	24	W	SS	9	38				
112	FILL, organic silt, dark grayish brown										
114	FILL, silt, dark grayish brown (slimes) 3 inch thinwall sample from 114.5 to 116.5 feet				TW	17					
121			10	W	SS	23	31				
123	FILL, sand with silt, fine to medium grained, dark gray, lenses of fine to medium grained silty sand (coarse tailings)		22	W	SS	15	16				
131			38	W	SS	12	10				
136			31	W	SS	14	16				
138	FILL, silty sand, fine to coarse grained, dark grayish brown (coarse tailings)		38	W	SS	17	13				
143	SANDY LEAN CLAY, trace roots, apparent cobbles, dark gray, hard, laminations of brown silty sand and dark brown organic silt (CL)	FINE ALLUVIUM	61	M	SS	12	31				
	END OF BORING AT 146.5 FEET. Borehole backfilled with bentonite grout.										

FIELD & LABORATORY TESTS: WC, DD, LL, PL, %-#200

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-16 (p. 1 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1721.8**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1	Root Mass	FILL / TAILINGS		D/M	SU						
3	FILL, silty sand, fine to medium grained, grayish brown (coarse tailings)										
5			31	M	SS	21					
6	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)										
10			14	M	SS	20					
14			12	M/W	SS	14	14				
17	3 inch Osterberg piston thinwall sample from 16.0 to 18.0 feet				PS	20					
19			28	M	SS	17	11				
24			23	M	SS	15	11				
29			25	W	SS	17	13				
34			35	W	SS	18	14				
39			26	W	SS	17	12				
42	FILL, sand with silt, fine to coarse grained, dark gray (coarse tailings)										
44			39	W	SS	18	11				
49			39	W	SS	18	10				
52	FILL, silty sand, fine to coarse grained, dark gray, dark grayish brown lenses of silt (coarse to fine tailings)										
59			32	W	SS	17	13				
67	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)										
69			42	W	SS	20	15				
79			48	W	SS	20	15				

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9'	**4.25" HSA**							
9-203'	**RD w/DM**	**8/20/07**	**16:00**	**11.0**	**9.0**	**9.0**	**---**	**None**

BORING COMPLETED: **8/22/07**

DR: **JU** LG: **TDD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-16 (p. 2 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
81	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)*(continued)*										
89	FILL, silty sand, fine grained, dark grayish brown, lenses of dark brown silt (fine tailings)		30	M	SS	15	23				
97	FILL, silty sand, fine to coarse grained, dark grayish brown, lenses of silt (coarse tailings)										
99			53	M	SS	17	13				
116	FILL, silt, dark gray to dark grayish brown, lenses of sandy silt (fine tailings)	FILL / TAILINGS									
119			50	M	SS	15	22				
139			29	M	SS	20	28				
159			45	W	SS	17	28				
174											

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-16 (p. 3 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
176–187	FILL, silt, dark gray to dark grayish brown, lenses of sandy silt (fine tailings)*(continued)*	FILL / TAILINGS	40	W	SS	15	30				
187–200	FILL, silt, dark grayish brown, lenses of silty clay (slimes)		6/0.5 16/0.5 50/0.3		SS	15	33				
200–203	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)										
	END OF BORING AT 203.0 FEET Borehole backfilled with bentonite grout.										

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-17 (p. 1 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: ____________

MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
FILL, silt, grayish brown to dark grayish brown, trace roots above about 1.5 feet (fine tailings)	FILL / TAILINGS		D/M	SU						
FILL, silt, dark gray to dark grayish brown, lenses of silt with sand (fine tailings)		2	M/W	SS	10					
FILL, sandy silt, dark gray, lenses of silt (fine tailings)		7	M	SS	12					
FILL, silt, dark grayish brown, lenses of sand with silt (fine tailings)		3	M/W	SS	10	27				
3 inch mechanical piston thinwall sample from 15.0 to 17.0 feet				PS	14					
FILL, silt, dark grayish brown to brown (slimes)		4	W	SS	14	41				
		3	W	SS	14	40				
FILL, silty sand, fine grained, dark gray (fine tailings)		14	W	SS	17	14				
FILL, silt, dark gray to dark grayish brown, lenses of dark gray sandy silt and silty clay (fine tailings)		7	W	SS	14	25				
		7	W	SS	16	20				
		8	W	SS	21	34				
FILL, sandy silt, dark gray, lenses of dark grayish brown silt (fine tailings)		10	W	SS	16	26				
		22	W	SS	12	25				
FILL, silt, lenses of sandy silt and silty clay, dark grayish brown (fine tailings/slimes)		7	W	SS	17	36				
3 inch mechanical piston thinwall sample from 72.0 to 74.0 feet				PS	20					
FILL, silty sand, fine grained, dark gray, lenses of sandy silt and silt (fine tailings)		29	W	SS	16	22				

DEPTH:	DRILLING METHOD
0-9'	4.25" HSA
9-226'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/23/07	9:00	11.0	9.0	9.0	---	None

BORING COMPLETED: **8/27/07**

DR: **JU** LG: **TDD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-17 (p. 2 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81	FILL, silty sand, fine grained, dark gray, lenses of sandy silt and silt (fine tailings)*(continued)*	FILL / TAILINGS									
89			23	W	SS	17	22				
99			21	W	SS	17	27				
110	FILL, sandy silt, dark gray, lenses of dark grayish brown silt (fine tailings)										
119			18	W	SS	18	32				
125	3 inch mechanical piston thinwall sample from 124.0 to 126.0 feet				PS	24					
135	FILL, silt, dark gray to dark grayish brown, lenses of silt with sand (slimes)										
139			33	W	SS	8	29				
159	FILL, silty clay, brown (slimes)		27	W	SS	19	36				
174											

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**

LOG OF BORING NO. **07-17 (p. 3 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
176–188	FILL, silty clay, brown (slimes) *(continued)*	FILL / TAILINGS									
189	FILL, silty sand, fine grained, dark gray (fine tailings)		47	W	SS	17	25				
201	FILL, silty sand, fine to medium grained, dark gray, lenses of brown silt (coarse to fine tailings)										
219			52	W	SS	15	17				
224–226	Apparent gravel and cobbles	TILL									

AUGER REFUSAL AT 226.0 FEET
Borehole backfilled with bentonite grout

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-18 (p. 1 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0–12	FILL, silt, dark grayish brown to dark gray, with roots above about 0.5 feet (fine tailings)	FILL / TAILINGS		M	SU						
			3	M	SS	6					
			4	W	SS	6					
12–28	FILL, silt, dark grayish brown to dark gray (slimes)		<1	W	SS	16	33				
			1	W	SS	16	32				
			4	M	SS	16	42				
28–30	3 inch mechanical piston thinwall sample from 28.0 to 30.0 feet				PS	12					
30–47	FILL, silt, dark gray (fine tailings)		8	W	SS	18	25				
			8	W	SS	3	25				
			10	W	SS	16	27				
47–65	FILL, silty clay, dark grayish brown to dark gray, lenses of silt (slimes)		2	M/W	SS	16	37				
	3 inch mechanical piston thinwall sample from 58.0 to 60.0 feet			M	PS	0	34				
					SS	18					
65–79	FILL, silt with sand, dark gray (fine tailings)		22	M/W	SS	16	24				
			17	M/W	SS	16	27				

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9'	**4.25" HSA**							
9-203.5'	**RD w/DM**	**8/28/07**		**11.0**	**9.0**	**9.0**	**---**	**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **8/28/07**

DR: **JU** LG: **DB** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-18 (p. 2 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81	FILL, silt with sand, dark gray (fine tailings) *(continued)*	FILL / TAILINGS									
89			28	M/W	SS	16	33				
94	FILL, silty clay, dark brown, lenses of dark grayish brown silt (slimes)										
99			8	M/W	SS	14	36				
108.5	FILL, sandy silt, lenses of silt, dark gray (fine tailings)										
119			34	M/W	SS	16	26				
124	3 inch mechanical piston thinwall sample from 123.0 to 125.0 feet				PS	24					
132	FILL, silt, dark grayish brown (slimes)										
139			27	M/W	SS	12	33				
150	FILL, silty clay, dark brown, lenses of dark grayish brown silt (slimes)										
159			15	M/W	SS	22	34				
174											

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-18 (p. 3 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
176–190	FILL, silty clay, dark brown, lenses of dark grayish brown silt (slimes)*(continued)*	FILL / TAILINGS	7	M/W	SS	24	33				
190–200	FILL, silty sand, fine grained, dark gray, lenses of sandy silt (fine tailings)		51	M/W	SS	10	21				
200–203	Apparent gravel and cobbles	TILL									

END OF BORING AT 203.5 FEET
Borehole backfilled with bentonite grout

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**

LOG OF BORING NO. **07-19 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1716.4**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–13	FILL, silt, dark gray, trace roots above about 2 feet (slimes)	FILL / TAILINGS		M	SU						
6			1	M/W	SS	12	38				
11			0	W	SS	21	33				
13–79	FILL, silt, dark gray, lenses of dark grayish brown silty clay (fine tailings/slimes)										
16			0	W	SS	24	41				
21			0	W	SS	22	34				
26			0	W	SS	24	42				
31			0	W	SS	24	37				
36			0	W	SS	24	38				
41			0	W	SS	24	42				
46			0	W	SS	24	30				
51			0	W	SS	24	34				
61			0	W	SS	24	40				
71			0	W	SS	24	31				

DEPTH:	DRILLING METHOD
0-30'	4.25" HSA
30-148'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/15/07	13:30	32.0	30.0	30.0	---	None

BORING COMPLETED: **8/17/07**

DR: **LA** LG: **TDD** Rig: **51**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-19 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81–91	FILL, silt, dark gray, lenses of dark grayish brown silty clay (fine tailings/slimes) *(continued)*	FILL / TAILINGS	0	W	SS	24	38				
91–100	FILL, sandy silt, dark gray (fine tailings)		5	W	SS	24	31				
100–130	FILL, silt, dark grayish brown (slimes)		2	W	SS	24	33				
			17	W	SS	12	31				
130–145.5	FILL, silt, dark grayish brown, lenses of silty clay (slimes)		9	W	SS	24	30				
145.5–146.5	Apparent gravel and cobbles	TILL									
146.5–148	Obstruction at 146.5 feet	TILL OR WEATHERED ROCK									

END OF BORING AT 148.0 FEET.
Borehole backfilled with bentonite grout.

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-20 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION:

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–13	FILL, silty sand, fine to medium grained, dark gray (fine tailings)	FILL / TAILINGS		M	SU						
			11	M	SS	20					
			7	M	SS	20					
13–33	FILL, silt, gray to grayish brown, lenses of silty clay (slimes)		1	W	SS	24	40				
			2	W	SS	18	40				
			1	W (▼)	SS	24	31				
			1	W	SS	24	46				
33–41	FILL, silty sand, fine grained, dark gray, lenses of sandy silt (fine tailings)		11	W	SS	24	22				
41–47	FILL, silt, gray to grayish brown, lenses of silty clay (slimes)		2	W	SS	24	33				
			0	W	SS	24	31				
47–58	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)		60	W	SS	18	13				
			16	W	SS	24	13				
58–63	FILL, silty sand, fine to coarse grained, dark gray (coarse tailings)		116	W	SS	18	10				
63–69	FILL, silty sand, fine grained, trace roots, dark gray, lenses of dark grayish brown silt (fine tailings)		32	W	SS	18	24				
69–84	FILL, silty sand, fine to coarse grained, dark grayish brown (coarse tailings)		65	W	SS	20	14				
			51	W	SS	24	16				
			57	W	SS	20	10				
84–87	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)		78	W	SS	20	13				

DEPTH:	DRILLING METHOD
0-25'	4.25" HSA
25-177'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/13/07	16:05	27.0	25.0	25.9	---	24.9

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

BORING COMPLETED: **8/15/07**

DR: **LA** LG: **MC** Rig: **51**

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**　　LOG OF BORING NO. **07-20 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
89–94	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)*(continued)*	FILL / TAILINGS	61	W	SS	20	17				
94–99	FILL, silty sand, fine to medium grained, dark gray, lenses of dark grayish brown silt (coarse to fine tailings)		21	W	SS	24	18				
99–151	FILL, silty sand, fine to medium grained, dark grayish brown to dark gray (coarse tailings)		52	W	SS	20	12				
			61	W	SS	20	12				
			50	W	SS	20	14				
151–168	FILL, silty sand, fine grained, dark grayish brown, lenses of sandy silt (fine tailings)		38	W	SS	20	25				
168–177	SILTY SAND WITH GRAVEL, brown, moist, very dense (SM)	TILL	85	M	SS	5					

END OF BORING AT 177.0 FEET.
Borehole backfilled with bentonite grout.

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-21 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1720.5**

MATERIAL DESCRIPTION	GEOLOGY
FILL, silt, dark grayish brown, lenses of silt with sand, trace roots above about 2 feet (slimes)	FILL / TAILINGS
FILL, silty sand, fine grained, dark gray, lenses of dark grayish brown silt (fine tailings)	
FILL, silt with sand, dark gray, lenses of silt (fine tailings)	
FILL, sandy silt, dark gray, lenses of silt and grayish brown silty clay (slimes)	
FILL, sandy silt, dark gray, lenses of silt (fine tailings)	
FILL, silt, dark grayish brown, lenses of silty clay (slimes) 3 inch Osterberg piston thinwall sample from 38.0 to 40.0 feet	
FILL, silty sand, fine grained lenses of sandy silt and silt (fine tailings)	
FILL, silty clay, brown (slimes)	
FILL, silt with sand, dark grayish brown (slimes) 3 inch mechanical piston thinwall sample from 82.0 to 84.0 feet	

N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
	M	SU						
4	M	SS	12					
3	M/W	SS	16	27				
6	M/W	SS	18	16				
4	M/W	SS	14	29				
5	W	SS	18	30				
8	W	SS	14	26				
6	W	SS	18	34				
		PS	24					
2	W	SS	24	35				
2	W	SS	24	40				
1	W	SS	24	36				
8	W	SS	14	27				
4	W	SS	24	31				
5	W	SS	24	36				
		PS	11					

DEPTH:	DRILLING METHOD
0-20'	4.25" HSA
20-175'	RD w/DM

BORING COMPLETED: **8/21/07**

DR: **LA** LG: **JN** Rig: **51**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/20/07	17:00	32.0	20.0	21.0	3.0	N/A
8/21/07	17:12	176.0	20.0	---	2.0	N/A

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-21 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
89–120	FILL, silt with sand, dark grayish brown (fine tailings)	FILL / TAILINGS	2	W	SS	18	30				
			12	W	SS	14	28				
120–160	FILL, silt, brown and dark grayish brown, lenses of silty clay and silt with sand (fine tailings)		7	W	SS	24	39				
	3 inch mechanical piston thinwall sample from 134.0 to 136.0 feet				PS	21					
160–175	FILL, silt, dark gray and dark grayish brown, lenses of sandy silt (fine tailings)		41	W	SS	16	27				
175–176.5	SILTY SAND, a little gravel, grayish brown, very dense (SM)	TILL	10/0.5 24/0.5 41/0.5 10/0.0	W	SS	18	15				

END OF BORING AT 176.5 FEET
Borehole backfilled with auger cuttings.

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-22 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1722.2**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1	FILL, silt, dark gray, lenses of dark grayish brown fine grained silty sand, trace roots above about 1 foot (fine tailings)			M	SU						
6			2	M	SS	8					
9	FILL, sandy silt, dark gray, lenses of silt with sand (fine tailings)										
11			6	M	SS	16					
16			4	M	SS	14					
21			6	M	SS	14	23				
22	FILL, silt with sand, dark gray to dark grayish brown, lenses of silt (fine tailings)										
26	FILL, silty sand, fine grained, dark gray, lenses of dark grayish brown silt (fine tailings)		9	W	SS	18	27				
31	FILL, silt, dark grayish brown, lenses of silt with sand and fine grained silty sand (fine tailings)	FILL / TAILINGS	6	W	SS	12	30				
36			8	W	SS	16	31				
41			8	W	SS	18	27				
46			7	W	SS	14	28				
50	FILL, silty sand, fine grained, dark gray (fine tailings)										
51			14	W	SS	18	16				
57	FILL, silt, gray, lenses of dark gray silt with sand and sandy silt (fine tailings)										
61			7	W	SS	16	28				
66	FILL, silty sand, fine grained, dark gray (fine tailings)										
71			9	W	SS	16	23				
74	FILL, silt, brown, lenses of silty clay (slimes) 3 inch mechanical piston thinwall sample from 74.0 to 76.0 feet										
75					PS	0					

DEPTH:	DRILLING METHOD
0-15'	4.25" HSA
15-159.5	RD w/DM

BORING COMPLETED: **8/22/07**

DR: **LA** LG: **JN** Rig: **51**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/22/07	17:00	161.5	15.0	17.0	3.0	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-22 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81	FILL, silt, brown, lenses of silty clay (slimes) *(continued)*		9	W	SS	24	32				
89	FILL, silt, brown, lenses of dark gray fine grained silty sand (fine tailings)		6	M	SS	18	32				
97	FILL, silt, dark brown to dark grayish brown (slimes)		3	M	SS	24	33				
117	3 inch mechanical piston thinwall sample from 116.0 to 118.0 feet	FILL / TAILINGS		M	PS	24					
119			12	M	SS	24	27				
139	3 inch mechanical piston thinwall sample from 138.0 to 140.0 feet				PS	24					
160	Wood	TILL	21	W	SS	20					
161	SILTY SAND WITH GRAVEL, brown, wet, medium dense (SM)										
	END OF BORING AT 161.5 FEET Borehole backfilled with auger cuttings										

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-23 (p. 1 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1721.5**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0-3	FILL, sandy silt, grayish brown, trace roots (fine tailings)	FILL / TAILINGS		M	SU						
3-18	FILL, silt, dark grayish brown to dark gray, lenses of silt with sand (fine tailings)		5	M	SS	10					
			7	M	SS	14					
			5	M	SS	16					
18-26	FILL, silt, dark gray, lenses of fine grained silty sand (fine tailings)		10	W	SS	18	27				
26-31	FILL, silty clay, dark brown, lenses ofdark grayish brown silt with sand (fine tailings) 3 inch mechanical piston thinwall sample from 26.0 to 28.0 feet				PS	24					
			5	W	SS	20	29				
31-36	FILL, silt, dark grayish brown, lenses of fine grained silty sand (fine tailings)		8	W	SS	18	26				
36-44	FILL, sandy silt, dark gray (fine tailings)		13	W	SS	18	21				
44-55	FILL, sandy silt, dark gray, lenses of silt (fine tailings)		9	W	SS	16	23				
			9	W	SS	18	24				
55-76	FILL, silt, dark grayish brown, lenses of brown silty clay and dark gray sandy silt (fine tailings/slimes) 3 inch mechanical piston thinwall sample from 56.0 to 58.0 feet				PS	20					
			11	W	SS	18	31				
76-87	FILL, silty sand, fine to medium grained, dark grayish brown (coarse tailings)		22	W	SS	20	17				

DEPTH	DRILLING METHOD
0-15'	4.25" HSA
15-173'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/23/07	17:12	162.0	15.0	16.0	3.0	N/A

BORING COMPLETED: **8/23/07**

DR: **LA** LG: **JN** Rig: **51**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**

LOG OF BORING NO. **07-23 (p. 2 of 2)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
89	FILL, silt with sand, dark grayish brown, lenses of brown silt (fine tailings)	FILL / TAILINGS	16	M	SS	18	31				
98	FILL, silty sand, fine to medium grained, dark gray, lenses of silt (coarse tailings)		36	M	SS	20	20				
119	FILL, silt, dark grayish brown (fine tailings)		9	M	SS	18	33				
121	FILL, silty sand, fine grained, dark gray (coarse tailings)										
135	FILL, silty sand, fine to coarse grained, dark gray (coarse tailings)		28	M	SS	20	13				
			42	M	SS	20	15				
170–173	Apparent gravel and cobbles (possible peat lens at about 170.0 feet)	TILL									

AUGER REFUSAL AT 173.0 FEET
Borehole backfilled with bentonite grout

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-24 (p. 1 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: **1722.6**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1	FILL, sandy silt, dark gray, trace roots above about 2 feet (slimes)	FILL / TAILINGS		M	SU						
6	FILL, sandy silt, dark gray, lenses of fine grained silty sand (fine tailings)		5	M	SS	12					
9.5	FILL, silt, dark gray (fine tailings)		3	M	SS	12					
13.5	FILL, silty sand, fine grained, dark gray, lenses of silt and sandy silt (coarse to fine tailings)		5	M	SS	18					
			7	W	SS	18	28				
24	FILL, silt, dark grayish brown to dark brown, lenses of silty clay and sandy silt (slimes)		3	W	SS	18	45				
	3 inch mechanical piston thinwall sample from 28.0 to 30.0 feet				PS	13					
32	FILL, silty sand, fine grained, dark gray (fine tailings)		5	M/W	SS	14	25				
			11	M/W	SS	18	25				
43.5	FILL, silty sand, fine grained, dark gray, lenses of silt (fine tailings)		6	M/W	SS	16	20				
48.5	FILL, silty sand, fine grained, dark gray (fine tailings)		9	M/W	SS	18	13				
			13	M/W	SS	18	22				
			19	W	SS	18	24				
77											

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-15'	**4.25" HSA**							
15-213.5'	**RD w/DM**	**8/24/07**	**12:00**	**82.0**	**15.0**	**16.0**	**3.0**	**None**

BORING COMPLETED: **8/24/07**

DR: **LA** LG: **JN** Rig: **51**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **07-24 (p. 2 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81	FILL, silty sand, fine grained, dark gray, lenses of dark grayish brown silt (fine tailings) *(continued)*	FILL / TAILINGS	14	W	SS	18	23				
86	FILL, silty sand, fine grained, dark gray (fine tailings)										
91			24	W	SS	18	18				
103	3 inch mechanical piston thinwall sample from 102.0 to 104.0 feet				PS	16					
121			27	W	SS	18	28				
131	FILL, sandy silt, dark gray, lenses of dark gray to dark grayish brown silt (fine tailings)										
141			23	W	SS	16	29				
155	FILL, silty clay, dark brown, lenses of silt (slimes)										
161			13	W	SS	20	41				
174											

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**

LOG OF BORING NO. **07-24 (p. 3 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
176–180	FILL, silty clay, dark brown, lenses of silt (slimes) *(continued)*	FILL / TAILINGS									
181			9	W	SS	24	32				
201			7	W	SS	24	31				
213	Apparent gravel and cobbles	TILL									
	END OF BORING AT 213.5 FEET Borehole backfilled with bentonite grout										

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **07-25 (p. 1 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

SURFACE ELEVATION: ____________

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1	FILL, silty sand, fine to medium grained, dark grayish brown to dark gray (coarse tailings)			M	SU						
6			23	M	SS	16					
8	FILL, sand with silt, fine to coarse grained, dark gray (coarse tailings)										
11			50	M	SS	18					
16			26	M/W	SS	14	11				
19	FILL, silty sand, fine to coarse grained, dark gray (coarse tailings)										
21			20	M/W	SS	14	13				
26			25	M/W	SS	16	13				
29	3 inch mechanical piston thinwall sample from 28.0 to 30.0 feet				PS	6.5					
33	FILL, sand with silt, fine to coarse grained (coarse tailings)	TILL / TAILINGS									
36			21	W	SS	16	12				
41			26	W	SS	16	14				
46			29	W	SS	16	12				
51			24	W	SS	20	12				
56	FILL, silt, dark gray, lenses of sandy silt (fine tailings)										
61			7	W	SS	16	23				
68	FILL, silty sand, fine to coarse grained, dark gray (coarse tailings)										
71			29	W	SS	18	14				
76	FILL, silty sand, fine to medium grained, dark gray (fine tailings)										

DEPTH:	DRILLING METHOD
0-10'	4.25" HSA
10-214'	RD w/DM

BORING COMPLETED: **8/29/07**

DR: **LA** LG: **JN** Rig: **51**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
8/28/07	17:30	140.0	10.0	11.0	3.0	N/A
8/29/07	13:00	215.5	10.0	11.0	3.0	N/A

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **07-25 (p. 2 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
81	FILL, silty sand, fine to medium grained, dark gray (fine tailings)*(continued)*	TILL / TAILINGS	29	W	SS	20	15				
91			25	W	SS	20	18				
94	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)										
101			32	W	SS	20	20				
111	FILL, silt, dark gray (fine tailings)										
121			20	W	SS	16	29				
131	FILL, silty sand, fine to medium grained, dark gray (fine tailings)										
141			64	W	SS	18	15				
151	FILL, sandy silt, dark grayish brown, lenses of fine grained silty sand (fine tailings)										
161			24	W	SS	20	19				
171	FILL, silty clay, lenses of silt, dark grayish brown (slimes)										
174											

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **07-25 (p. 3 of 3)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
176–191	FILL, silty clay, lenses of silt, dark grayish brown (slimes) *(continued)*	TILL / TAILINGS									
181			21	W	SS	20	36				
191–214	FILL, silt with sand, dark grayish brown (fine tailings)										
201			23	W	SS	18	30				
214–215.5	SILTY SAND WITH GRAVEL, apparent cobbles, brown (SM)	TILL	87	W	SS	16	14				
	END OF BORING AT 215.5 FEET Borehole backfilled with bentonite grout										

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **A-1 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
1–25	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU		6				19
				M	SU						
25–30	FILL, sandy silt, dark gray (fine tailings)			M/W	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/26/07	12:40	---	---	---	---	None

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

SUBSURFACE TEST BORING LOG

AMERICAN ENGINEERING TESTING, INC.

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **A-2 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ______ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
				M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-30'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/26/07	**13:15**	**---**	**---**	**---**	**---**	**None**	

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **A-3 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
1–10	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
10–25	FILL, silty sand, fine to coarse grained, dark gray, (coarse tailings)			M	SU						
25–30	FILL, silty sand, fine grained, dark gray, (coarse tailings)			M/W	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/26/07	13:45	---	---	---	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **A-4 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ________ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0–20	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
20–25	FILL, silty sand, fine to medium grained, dark gray, lenses of fine grained sand (fine tailings)			M/W	SU						
25–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-30'	**6" FA**	**7/26/07**	**14:05**	**---**	**---**	**---**	**---**	**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **A-5 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0–20	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
20–25	FILL, silty sand, fine to medium grained, dark gray, lenses of fine grained silty sand (fine tailings)			M/W	SU						
25–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)			M	SU						
	END OF BORING AT 30.0 FEET. Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/26/07	15:35	---	---	---	---	None

BORING COMPLETED: 7/26/07

DR: LA LG: DH Rig: 85

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **A-6 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ___ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–20	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
				M	SU						
20–23	FILL, sandy silt, dark gray, lenses of silt (fine tailings)			W	SU						
23–30	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-30'	**6" FA**	**7/26/07**	**16:30**	**---**	**---**	**---**	**---**	**None**

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **B-1 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ___ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS: WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS: DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-30'	**6" FA**	**7/27/07**	**7:30**	**---**	**---**	**25.0**	**---**	**None**

BORING COMPLETED: **7/27/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **B-2 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
				M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/27/07	8:45	---	---	25.0	---	None

BORING COMPLETED: **7/27/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **B-3 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0-5	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
5-20	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)			M	SU						
20-30	FILL, silty sand, fine to medium grained, dark gray (fine tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/27/07	9:20	---	---	23.0	---	None

BORING COMPLETED: 7/27/07

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **B-4 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/27/07	9:40	---	---	25.0	---	None

BORING COMPLETED: **7/27/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **B-5 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0–5	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
5–15	FILL, sand with silt, fine to coarse grained, dark gray (coarse tailings)			M	SU		5				11
15–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

BORING COMPLETED: **7/27/07**

DR: **LA** LG: **DH** Rig: **85**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/27/07	10:25	---	---	25.0	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **B-6 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0-15	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
15-30	FILL, silty sand, fine to coarse grained, dark gray, (coarse tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-30'	**6" FA**	**7/27/07**	**10:45**	**---**	**---**	**24.0**	**---**	**None**

BORING COMPLETED: **7/27/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **H-1 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-30'	**6" FA**	**7/25/07**	**16:00**	**---**	**---**	**30.0**	**---**	**None**

BORING COMPLETED: **7/25/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **H-2 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0-10	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
10-15	FILL, silty sand, fine to coarse grained, dark gray, (coarse tailings)			M	SU						
15-30	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/25/07	16:35	---	---	30.0	---	None

BORING COMPLETED: **7/25/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

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AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **H-3 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–7	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
7–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-30'	**6" FA**	**7/25/07**	**17:05**	**---**	**---**	**30.0**	**---**	**None**

WATER LEVEL MEASUREMENTS

BORING COMPLETED: **7/25/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **H-4 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–5	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
5–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

BORING COMPLETED: **7/25/07**

DR: **LA** LG: **DH** Rig: **85**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/25/07	17:45	---	---	26.0	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **H-5 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
0-30'	6" FA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
		7/26/07	7:45	---	---	24.0	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **H-6 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–12	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)			D	SU						
				M	SU						
12–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS									
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-30'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/26/07	**8:20**	**---**	**---**	**22.0**	**---**	**None**	
BORING COMPLETED: **7/26/07**									
DR: **LA** LG: **DH** Rig: **85**									

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AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **I-1 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–29	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS									
8				M	SU						
18				M	SU		5				15
25				M	SU						
29	**END OF BORING AT 29.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-29'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/25/07	12:10	---	---	29.0	---	None

BORING COMPLETED: **7/25/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **I-2 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–29	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
29	**END OF BORING AT 29.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-29'	**6" FA**

BORING COMPLETED: **7/25/07**

DR: **LA** LG: **DH** Rig: **85**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/25/07	**13:00**	**---**	**---**	**29.0**	**---**	**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

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AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **I-3 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-30'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/25/07	**13:15**	**---**	**---**	**30.0**	**---**	**None**	
BORING COMPLETED: **7/25/07**									
DR: **LA** LG: **DH** Rig: **85**									

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **I-4 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–29	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
29	**END OF BORING AT 29.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-29'	6" FA

BORING COMPLETED: 7/25/07

DR: **LA** LG: **DH** Rig: **85**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/25/07	13:50	---	---	29.0	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **I-5 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–27	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
				M	SU						
28–29	FILL, silty sand, fine grained, dark gray, (fine tailings)			W	SU						
	END OF BORING AT 30.0 FEET. Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-30'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/25/07	**14:30**	**---**	**---**	**30.0**	**---**	**27.0**	
BORING COMPLETED: **7/25/07**									
DR: **LA** LG: **DH** Rig: **85**									

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AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **I-6 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ________ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0-10	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
				M	SU						
10-15	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)			M	SU						
15-26	FILL, mostly silty sand, fine to medium grained, some sandy silt, dark gray, (fine tailings)			M	SU						
26-30	FILL, silty sand, fine grained, dark gray, (fine tailings)			W	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/25/07	15:15	---	---	30.0	---	26.0

BORING COMPLETED: 7/25/07

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **N-1 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
1–15	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
15–30	FILL, silty sand, fine to coarse grained, dark gray, (coarse tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-30'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/27/07	**11:20**	**---**	**---**	**25.0**	**---**	**None**	
BORING COMPLETED: **7/27/07**									
DR: **LA** LG: **DH** Rig: **85**									

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AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**

LOG OF BORING NO. **N-2 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–15	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
15–30	FILL, silty sand, fine to coarse grained, dark gray, (coarse tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/27/07	11:45	---	---	26.0	---	None

BORING COMPLETED: **7/27/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **N-3 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ___ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–5	FILL, silty sand, fine to medium grained, dark gray, (fine tailings)	FILL / TAILINGS		M	SU						
5–30	FILL, silty sand, fine to coarse grained, dark gray, (coarse tailings)			M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

BORING COMPLETED: 7/27/07

DR: **LA** LG: **DH** Rig: **85**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/27/07	12:10	---	---	26.0	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **N-4 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–5	FILL, silty sand, fine to medium grained, dark gray (fine tailings)	FILL / TAILINGS		M							
5–30	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)			M							
				M							
				M							
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

BORING COMPLETED: **7/31/07**

DR: **LA** LG: **MC** Rig: **51**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/31/07	---	---	---	24.0	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **N-5 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
0–5	FILL, silty sand, fine to medium grained, dark gray (fine tailings)	FILL / TAILINGS		M							
5–25	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)			M							
25–30	FILL, sandy silt, dark gray (fine tailings)			W							
	END OF BORING AT 30.0 FEET. Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

BORING COMPLETED: **7/31/07**

DR: **LA** LG: **MC** Rig: **51**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/31/07	---	---	---	24.1	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **N-6 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
1–22	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)	FILL / TAILINGS		M							
				M							
22–30	FILL, sandy silt, dark gray (slimes)			W							
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-30'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/31/07	**13:03**	**---**	**---**	**23.6**	**---**	**None**	
BORING COMPLETED: **7/31/07**									
DR: **LA** LG: **MC** Rig: **51**									

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **N-7 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DD	LL	PL	%-#200
1–20	FILL, silty sand, fine to medium grained, dark gray (coarse tailings)	FILL / TAILINGS		M							
				M							
20–30	FILL, sandy silt, dark gray (slimes)			M/W							
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

BORING COMPLETED: **7/31/07**

DR: **LA** LG: **MC** Rig: **51**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/31/07	11:51	---	---	24.8	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **O-1 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: ______ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-30'	**6" FA**	**7/26/07**	**9:00**	**---**	**---**	**25.0**	**---**	**None**

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **O-2 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS									
5				M	SU						
20				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/26/07	9:35	---	---	25.0	---	None

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **O-3 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS									
5				M	SU						
20				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-30'	**6" FA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/26/07	**10:15**	**---**	**---**	**26.0**	**---**	**None**	
BORING COMPLETED: **7/26/07**									
DR: **LA** LG: **DH** Rig: **85**									

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **O-4 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–7	FILL, silty sand, fine to coarse grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
7–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)			M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/26/07	10:45	---	---	26.0	---	None

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **O-5 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-30'	**6" FA**	**7/26/07**	**11:15**	**---**	**---**	**26.0**	**---**	**None**

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **O-6 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–30	FILL, silty sand, fine to medium grained, dark gray, (coarse tailings)	FILL / TAILINGS		M	SU						
				M	SU						
				M	SU						
30	**END OF BORING AT 30.0 FEET.** Borehole backfilled with auger cuttings.										

DEPTH:	DRILLING METHOD
0-30'	6" FA

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/26/07	11:40	---	---	26.0	---	None

BORING COMPLETED: **7/26/07**

DR: **LA** LG: **DH** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**

LOG OF BORING NO. **PZ-07-01 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS: WC	DD	LL	PL	%-#200
1–53	No samples taken See boring 07-01										
53	**END OF BORING AT 53.0 FEET** Piezometer PZ-07-01 installed at 53.0 feet (Two unsuccessful attempts at drilling and installing this piezometer were made on 08/14/07.)										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-53'	4.25" HSA							

BORING COMPLETED: **8/15/07**

DR: **JU** LG: **TAD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

06/06

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **PZ-07-07C (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
1–58	No samples taken See boring 07-07C										
	END OF BORING AT 58.3 FEET Piezometer PZ-07-07C installed at 58.3 feet										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-58.3'	**4.25" HSA**							
BORING COMPLETED: **8/13/07**								
DR: **JU** LG: **TAD** Rig: **85**								

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354**   LOG OF BORING NO. **PZ-07-10 (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DD	LL	PL	%-#200
1–42	No samples taken See boring 07-10										
	AUGER REFUSAL AT 42.1 FEET Installed piezometer PZ-07-10 at 41.7 feet (First attempt encountered auger refusal at 43.0 feet)										

DEPTH:	DRILLING METHOD
0-42.1	**4.25" HSA**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL

BORING COMPLETED: **8/16/07**

DR: **JU** LG: **TAD** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE TEST BORING LOG

BARR JOB NO: 23/69-862

AET JOB NO: **07-03354** LOG OF BORING NO. **PZ-07-13D (p. 1 of 1)**

PROJECT: **PolyMet Tailings Basin; Hoyt Lakes, MN**

DEPTH IN FEET	SURFACE ELEVATION: MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DD	LL	PL	%-#200
1–14	No samples taken See boring 07-013D										
14–22	MICA SCHIST, whitish gray, fresh to slightly weathered, moderately to very fractured, hard, foliated 65-70° from horizontal	BEDROCK			NQ NQ NQ NQ	8 13 48 16					

END OF BORING AT 22.2 FEET
Piezometer PZ-07-13D installed at 21.8 feet

Coring information:

Depth(ft)	RQD%	CWR%	Recovery%
14-15.2'	0	100	56
15.2-16.8'	0	100	68
16.8-20.8'	8	100	100
20.8-22.2'	47	100	95

RQD = Rock Quality Description
CWR = Core Water Recovery

DEPTH:	DRILLING METHOD
0-14'	4.25" HSA
14-22.2'	NQ Core

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL

BORING COMPLETED: **8/17/07**

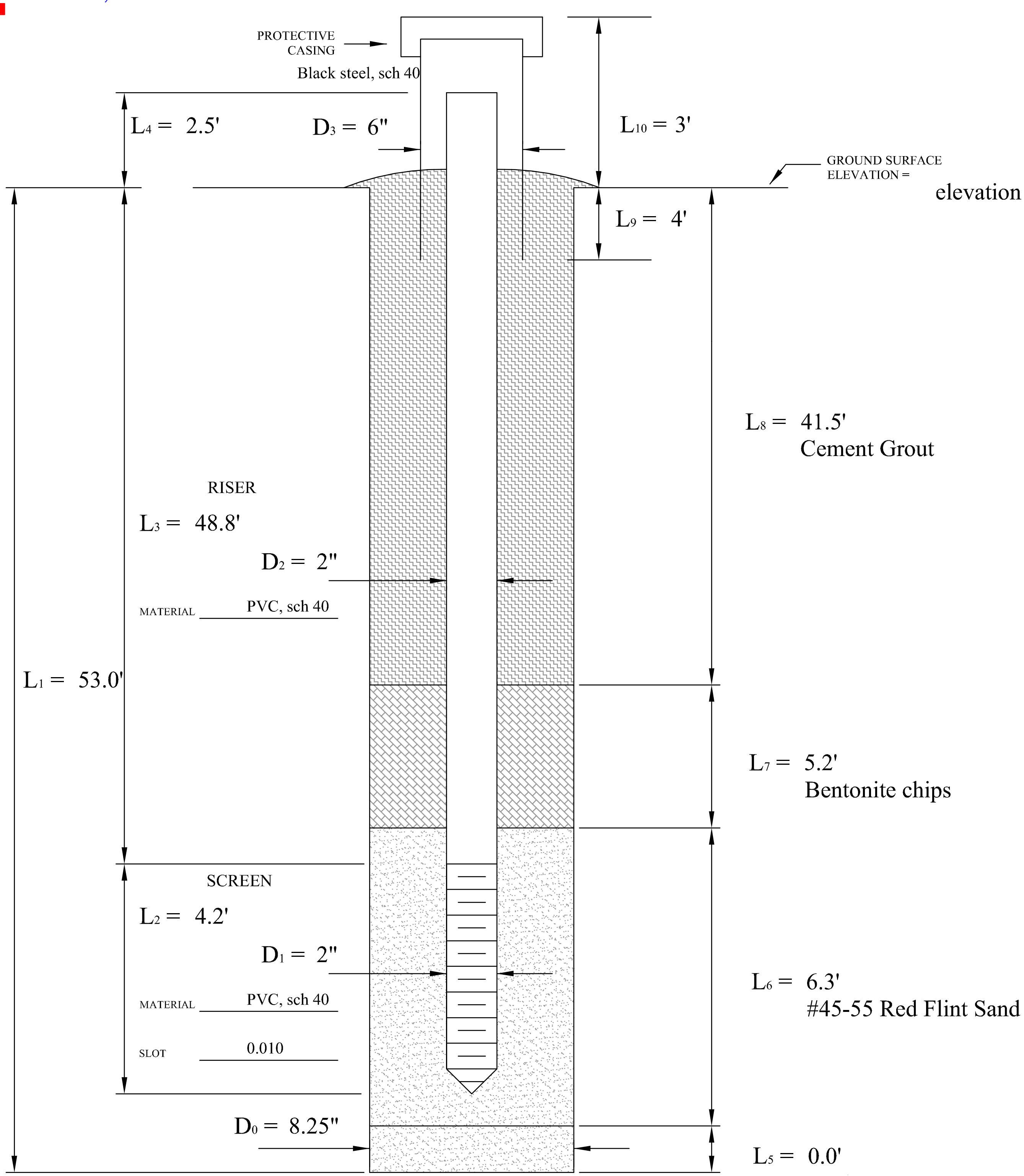
DR: **MC** LG: **JU** Rig: **85**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

MONITORING WELL / PIEZOMETER LOG

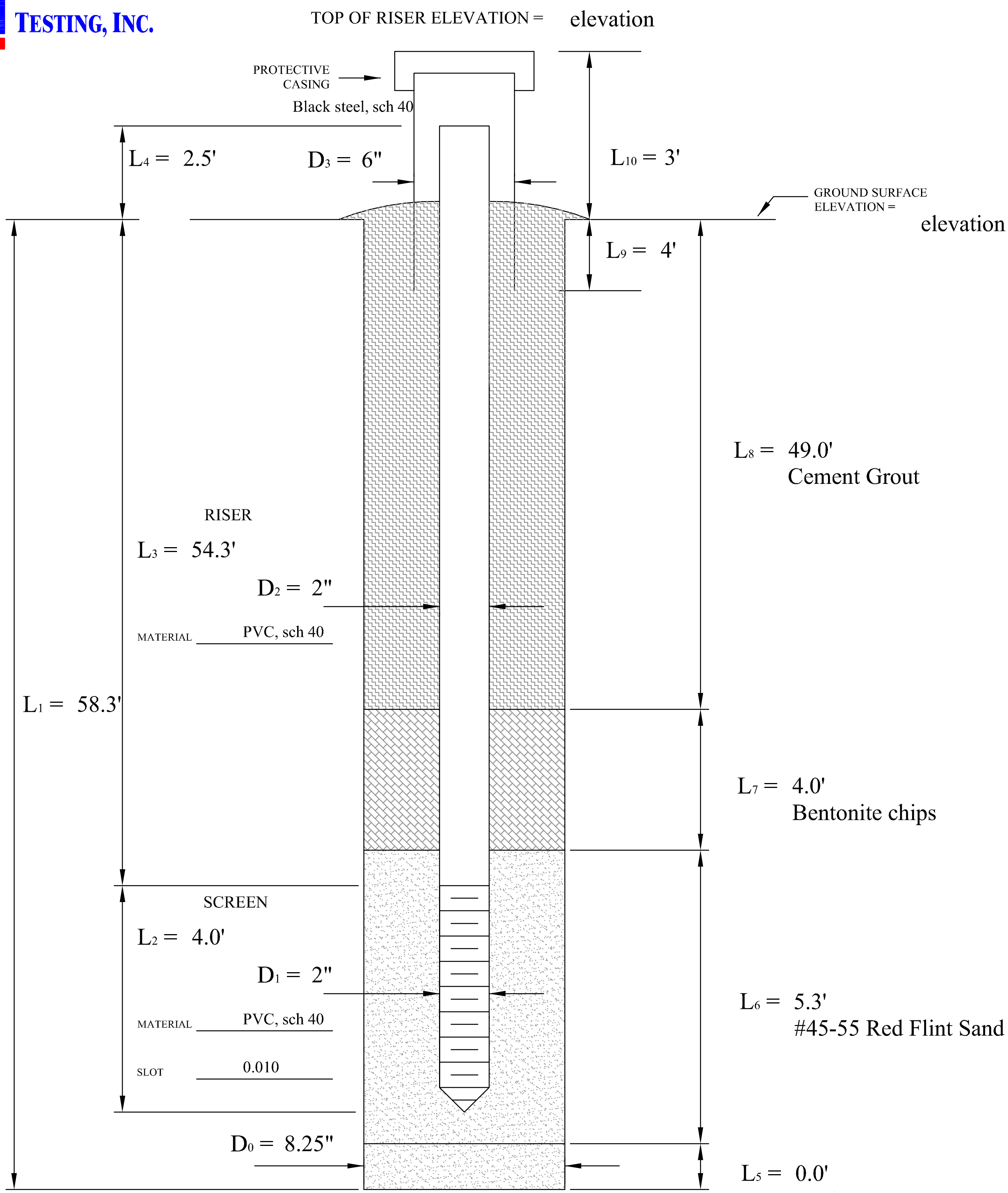
TOP OF RISER ELEVATION = elevation



PROTECTIVE CASING MATERIAL Black steel, sch 40	UNIQUE WELL NO.: NA	WELL NO.: PZ-07-01
	DATE INSTALLED: 08/15/07	JOB NO.: 07-03354
PROTECTIVE POSTS NUMBER INSTALLED NA MATERIAL NA	REMARKS Barr Project No. : 23/69-862	PROJECT NAME: PolyMet Tailings Basin

AMERICAN ENGINEERING TESTING, INC.

MONITORING WELL / PIEZOMETER LOG

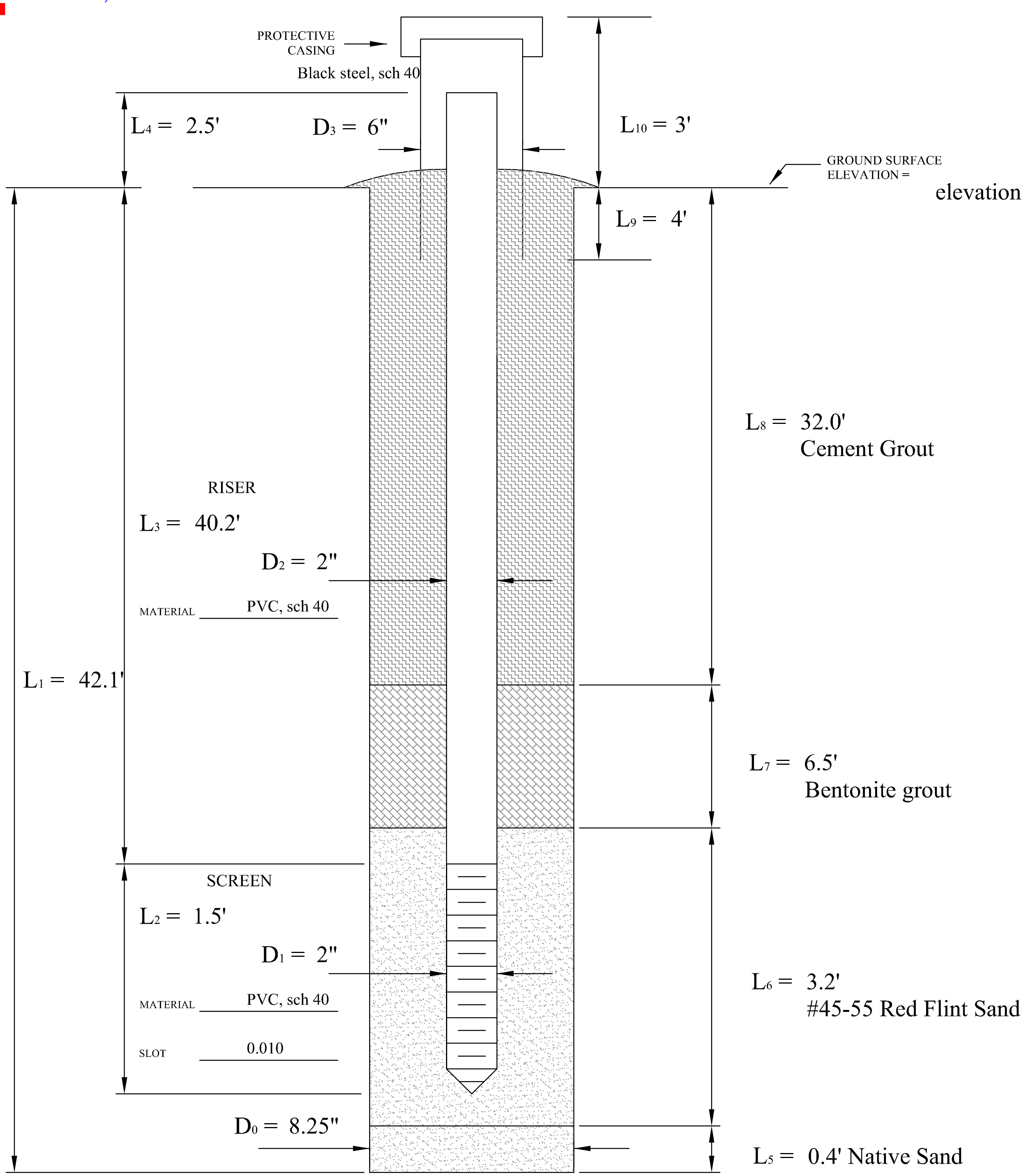


PROTECTIVE CASING MATERIAL Black steel, sch 40	UNIQUE WELL NO.: NA	WELL NO.: PZ-07-07C
	DATE INSTALLED: 08/13/07	JOB NO.: 07-03354
PROTECTIVE POSTS NUMBER INSTALLED NA MATERIAL NA	REMARKS Barr Project No. : 23/69-862	PROJECT NAME: PolyMet Tailings Basin

AMERICAN ENGINEERING TESTING, INC.

MONITORING WELL / PIEZOMETER LOG

TOP OF RISER ELEVATION = elevation

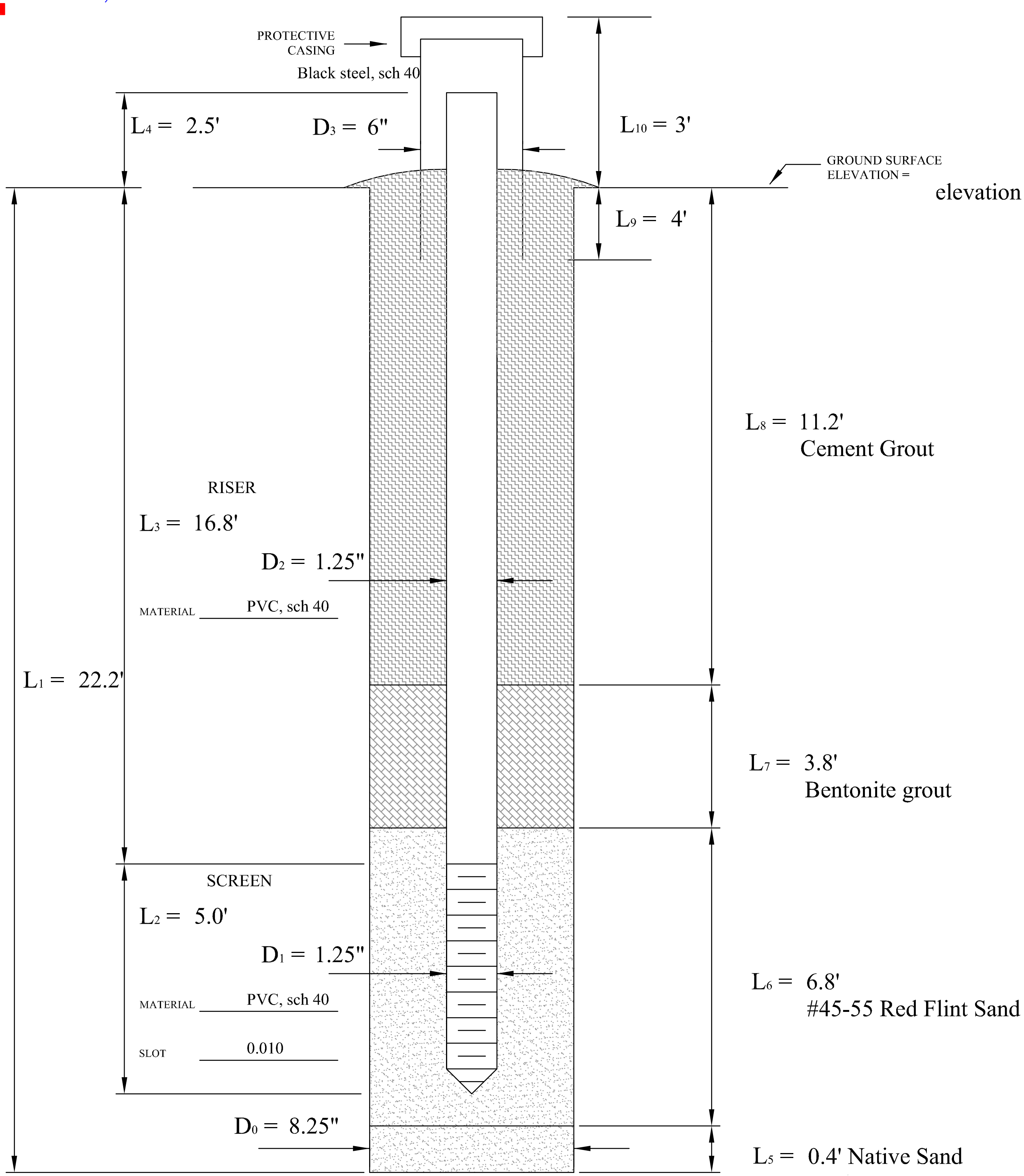


PROTECTIVE CASING MATERIAL Black steel, sch 40	UNIQUE WELL NO.: NA	WELL NO.: PZ-07-10
	DATE INSTALLED: 08/16/07	JOB NO.: 07-03354
PROTECTIVE POSTS NUMBER INSTALLED NA MATERIAL NA	REMARKS Barr Project No. : 23/69-862	PROJECT NAME: PolyMet Tailings Basin

MONITORING WELL / PIEZOMETER LOG

AMERICAN ENGINEERING TESTING, INC.

TOP OF RISER ELEVATION = elevation



PROTECTIVE CASING MATERIAL: Black steel, sch 40	UNIQUE WELL NO.: NA	WELL NO.: PZ-07-13D
	DATE INSTALLED: 08/17/07	JOB NO.: 07-03354
PROTECTIVE POSTS NUMBER INSTALLED: NA MATERIAL: NA	REMARKS Barr Project No. : 23/69-862	PROJECT NAME: PolyMet Tailings Basin

Attachment K

Tailings Mineralogy and Shape Memorandum

Report of Results

Scanning Electron Microscopy Tailings

Prepared For:

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Respectfully Submitted By:

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17 October 2012

UNIVERSITY OF MINNESOTA DULUTH

Introduction

Three (3) samples of tailings were delivered to the UMD Research Instrumentation Laboratory by Tamara Diedrich on 11 October 2012. The samples were contained in ziplock plastic bags and were composed of light to dark grey granular material. The sample identifications are listed below:

PolyMet float tailings, 5/9/05, Pail #2
LTV slimes, TP#2, 15', Pail #4
LTV fines, TP#3, 10', #11, 4/6/06

I was asked to collect images using scanning electron microscope (SEM) in order to show the overall morphology of particles and to use energy dispersive x-ray spectroscopy (EDS) to obtain qualitative chemical data from representative particles.

Methods and Materials

I was asked to combine the two LTV samples into one subsample at a ratio of 1:1 by weight. Both samples were moist upon receipt, and prior to mixing were dried for at least 2 hours in a 90° C oven.

All samples were prepared for SEM following the procedure described in Bern et al. (2009). Each sample was suspended in isopropanol at a concentration of approximately 10mg/ml and briefly placed in an ultrasonic bath to thoroughly mix the sample. A 10 µL drop of the resulting suspension was placed on a 0.2 µm porsize polycarbonate membrane filter affixed to an aluminum SEM sample stub. The drop was allowed to dry and the resulting particulate dispersion was coated with a conductive carbon film approximately 20 nm thick in order to make the sample electrically conductive.

The samples were examined using a JEOL model JSM-6490LV scanning electron microscope equipped with a solid state backscattered electron detector. Compositional information from representative particles was collected using an Oxford Instruments xAct silicon drift energy dispersive x-ray spectrometer. Imaging and chemical analysis were performed using 15 kV accelerating voltage and probe currents from 2-4 nA.

Results

Backscattered electron images were collected at 100x, 500x, and 2000x magnifications from both the PolyMet and LTV samples. Access to digital image files has been provided online.

Several representative particles were analyzed from each sample. The PolyMet sample was found to contain particles with compositions consistent with plagioclase feldspar, iron-magnesium silicates of varying compositions and iron + titanium oxide (pos. ilmenite). The LTV sample was found to contain particles with compositions consistent with quartz, iron-magnesium silicates of varying compositions, iron oxide and magnesium carbonate. Images and representative EDS spectra from observed phases are contained in the documents provided online.

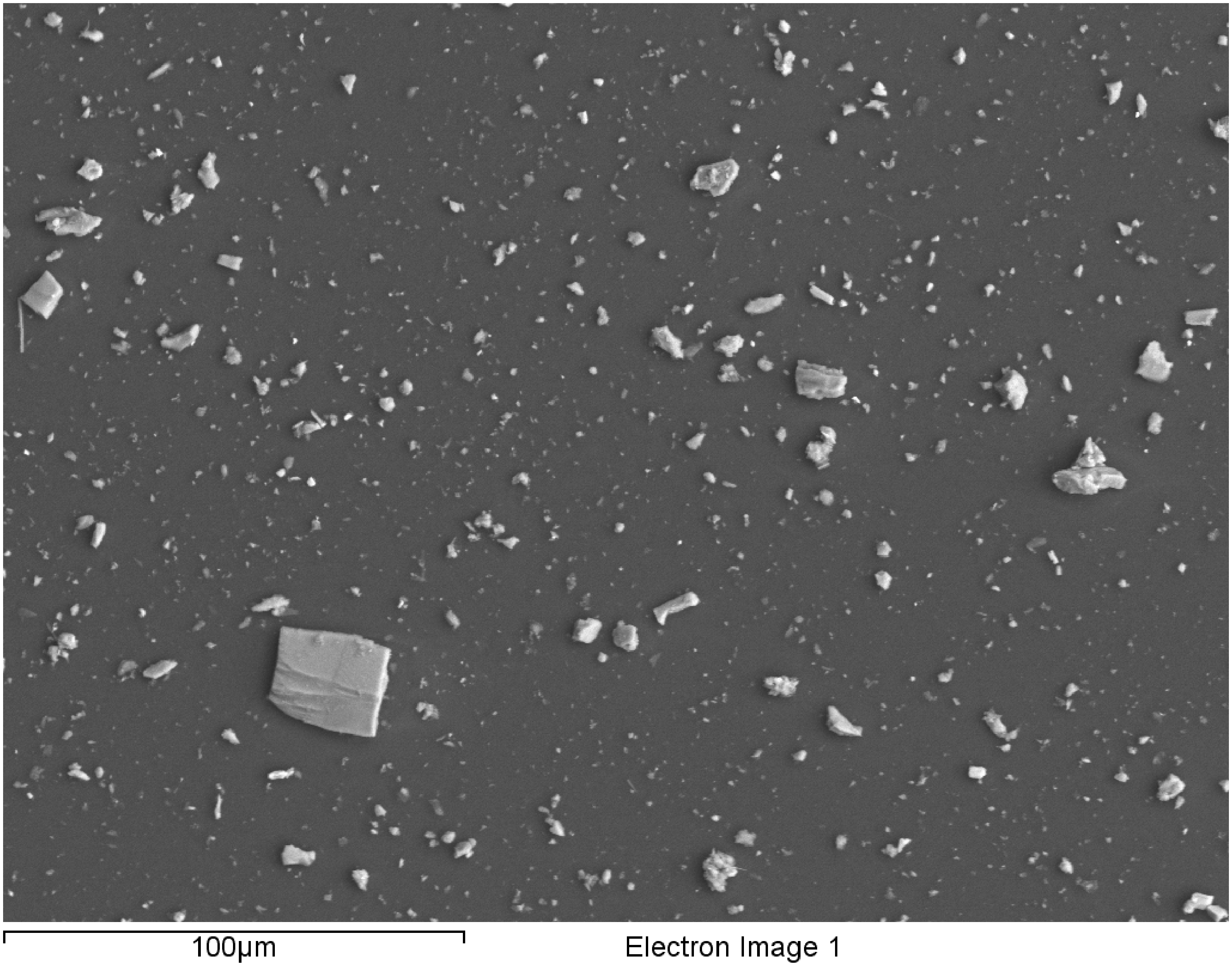
Reference Cited

Bern, A.M., Lowers, H.A., Meeker, G.P. and Rosati, J.A. (2009) Method Development for Analysys of Urban Dust Using Scanning Electron Microscopy with Energy Dispersive X-ray Spectrometry to Detect the Possible Presence of World Trade Center Dust Constituents. Environmental Science and Technology, 43, 1449-1454.

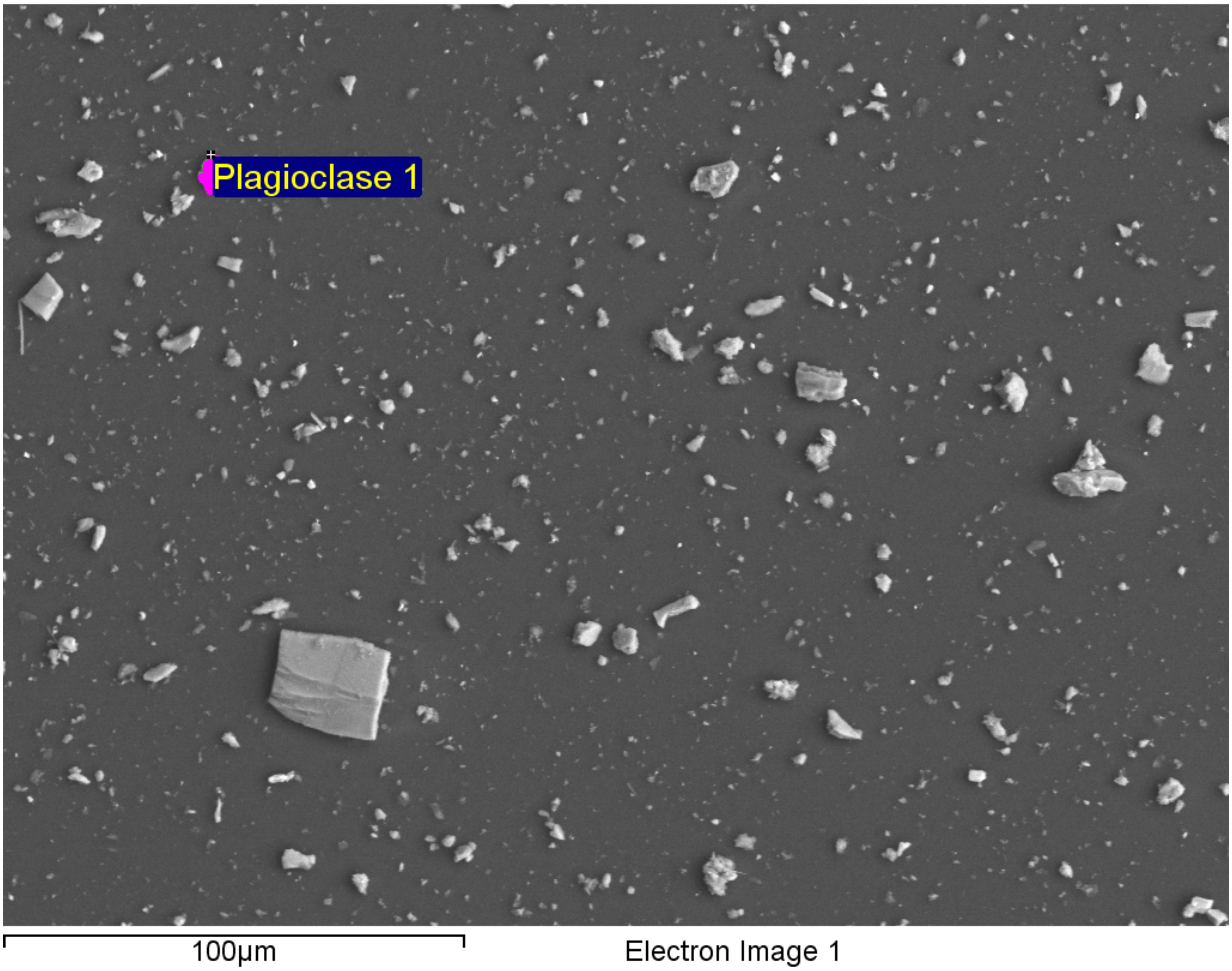
Exhibit 1

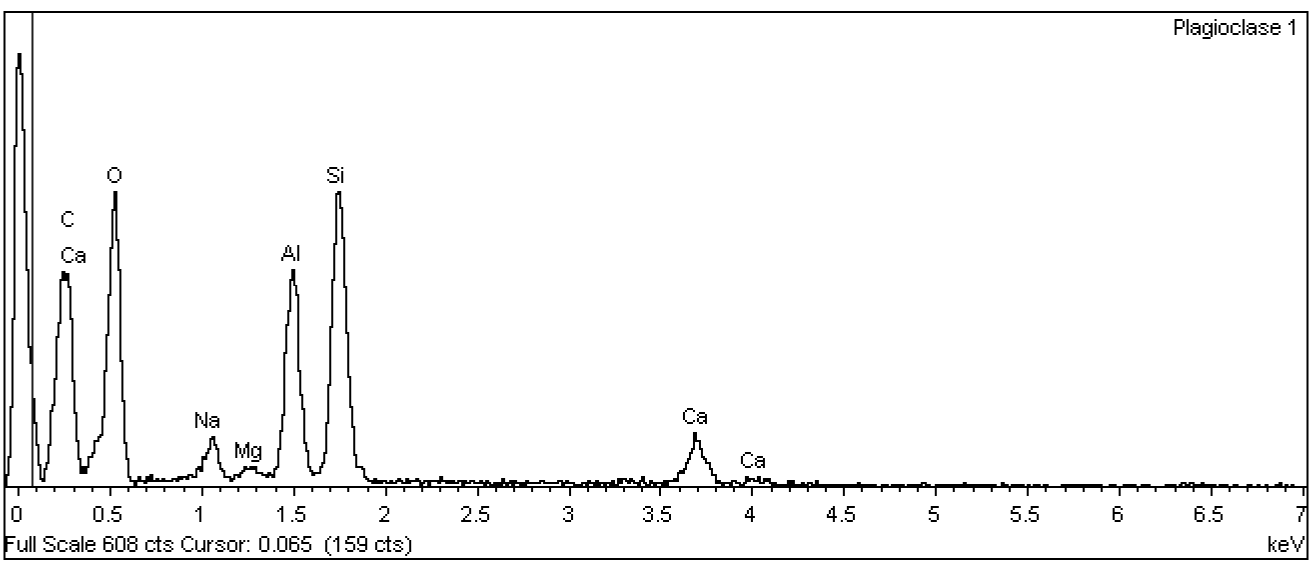
NorthMet Flotation Tailings

Representative Particle Compositions



Comment:

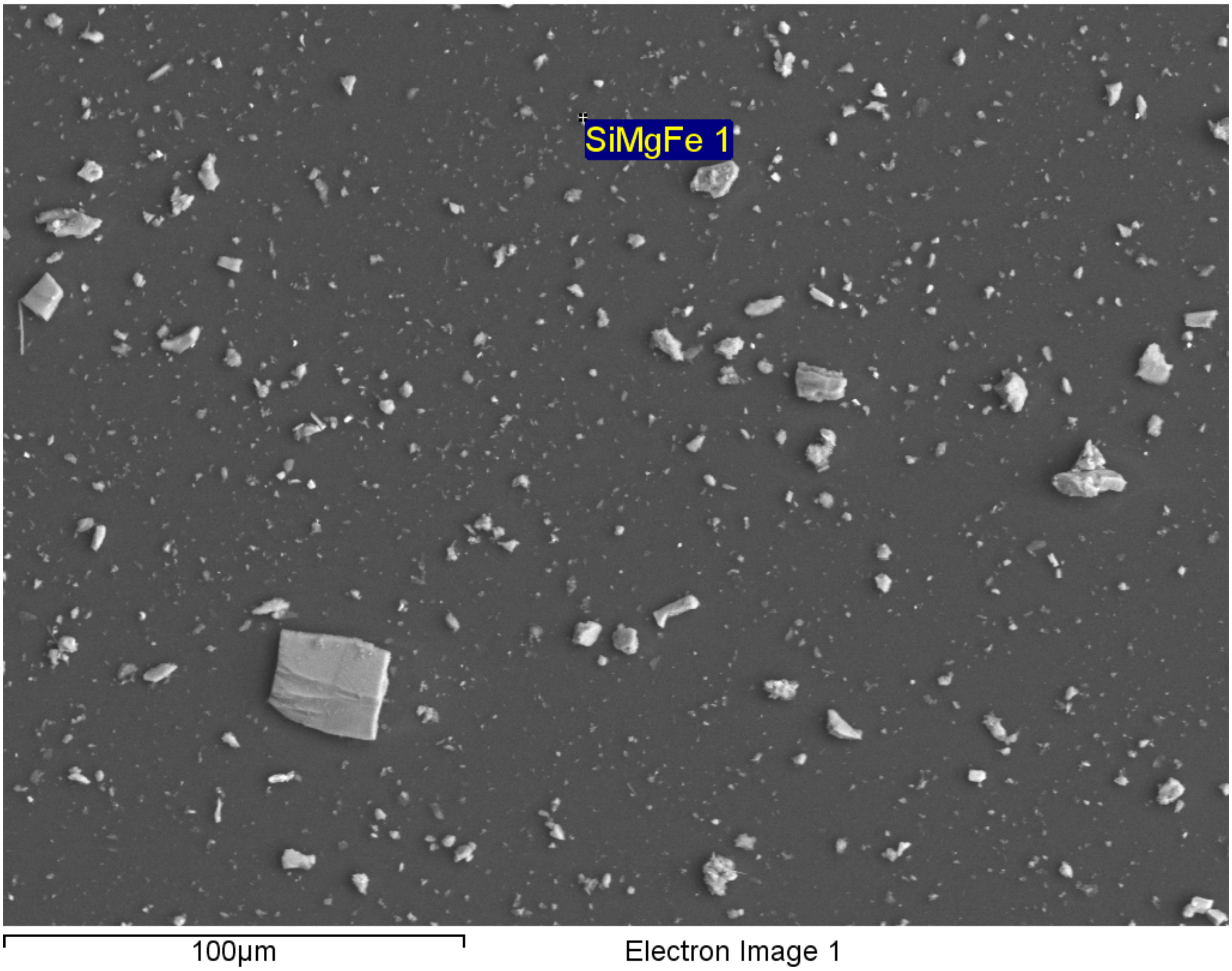




Sample: PolyMet	Project: Barr 101712
Type: Default	Owner: Inca User
ID:	Site: PolyMet

Barr 101712 - NorthMet

10/17/2012 10:13:00 AM



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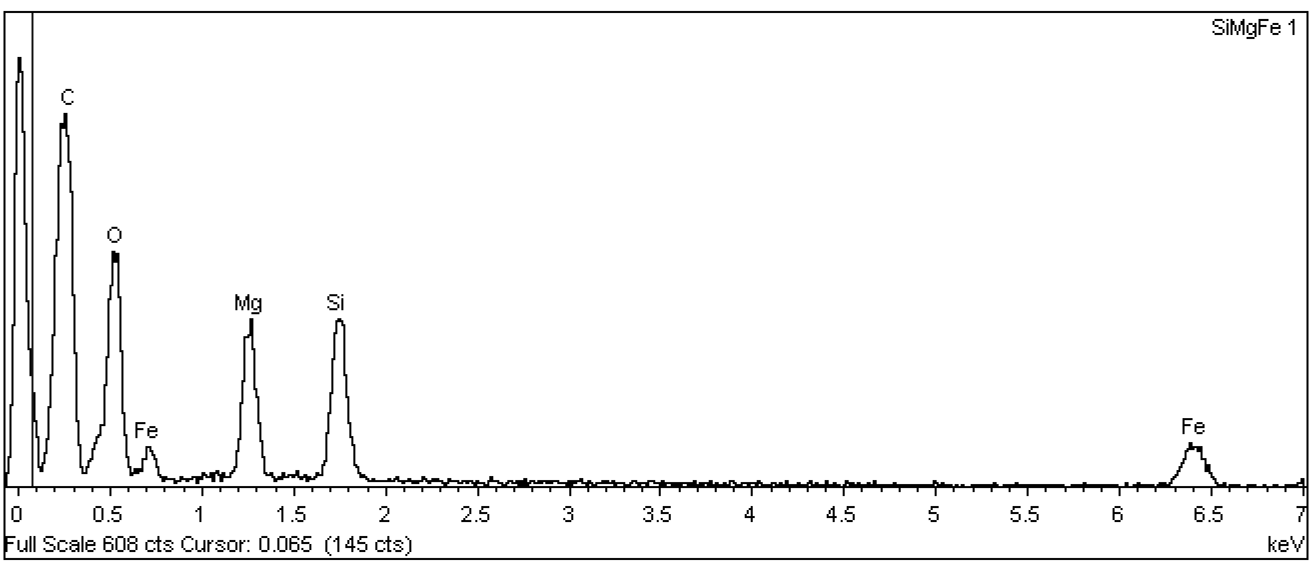

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Type: Default

ID:

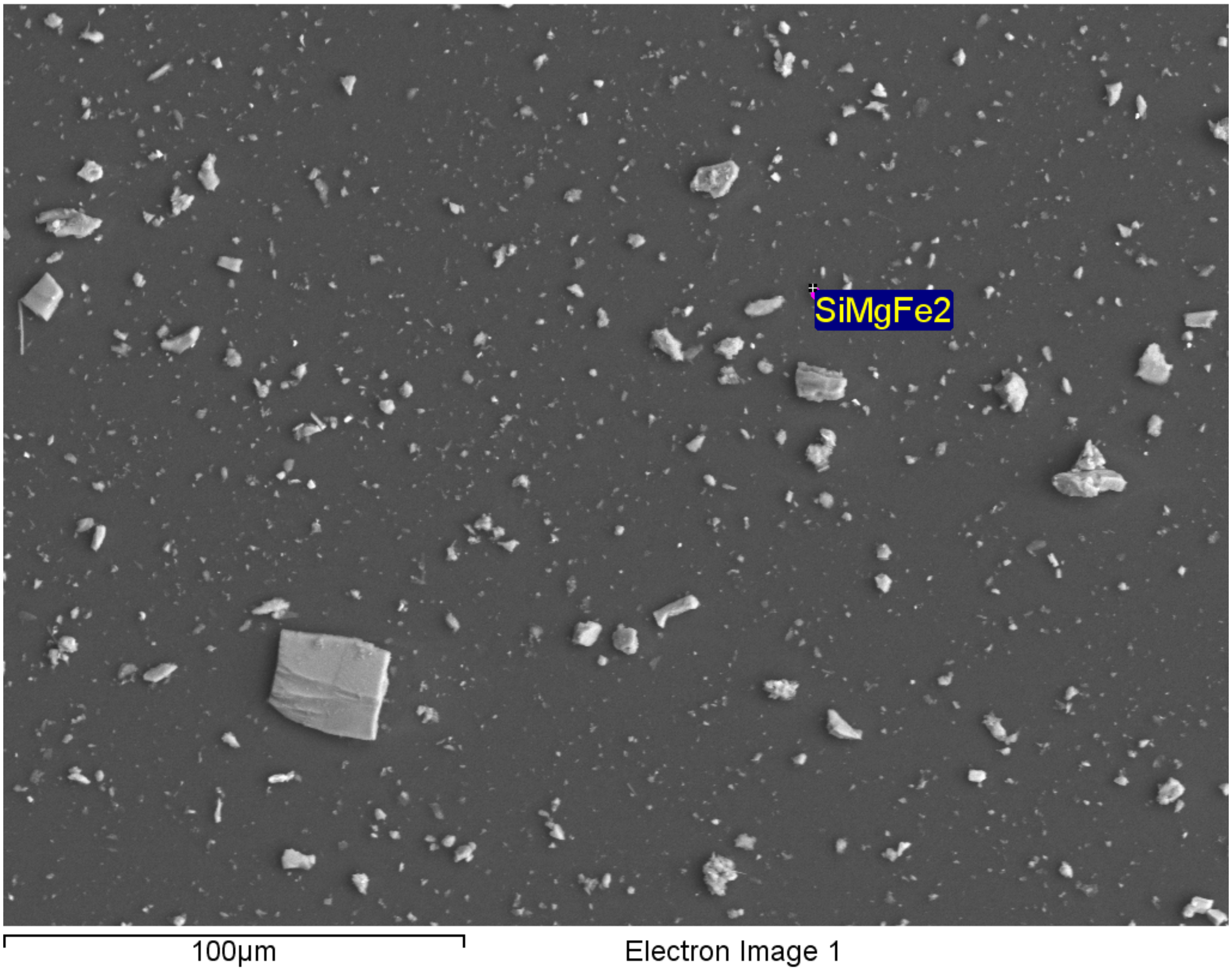
Project: Barr 101712

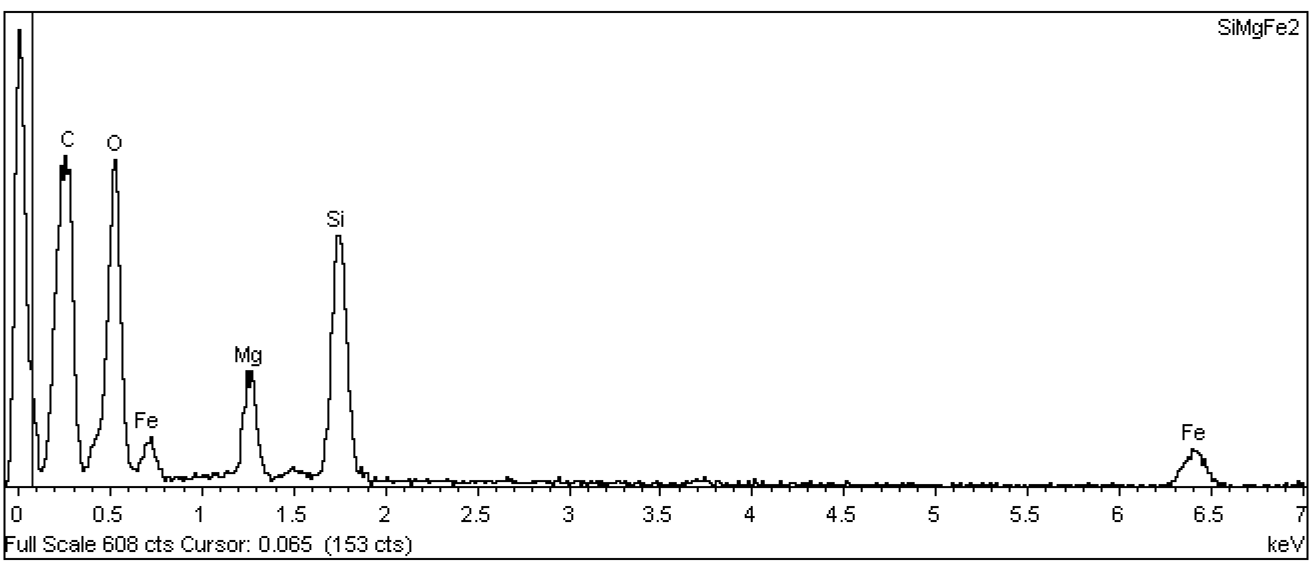
Owner: Inca User

Site: PolyMet

Barr 101712 - NorthMet

10/17/2012 10:13:08 AM





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Site: PolyMet

Barr 101712 - NorthMet

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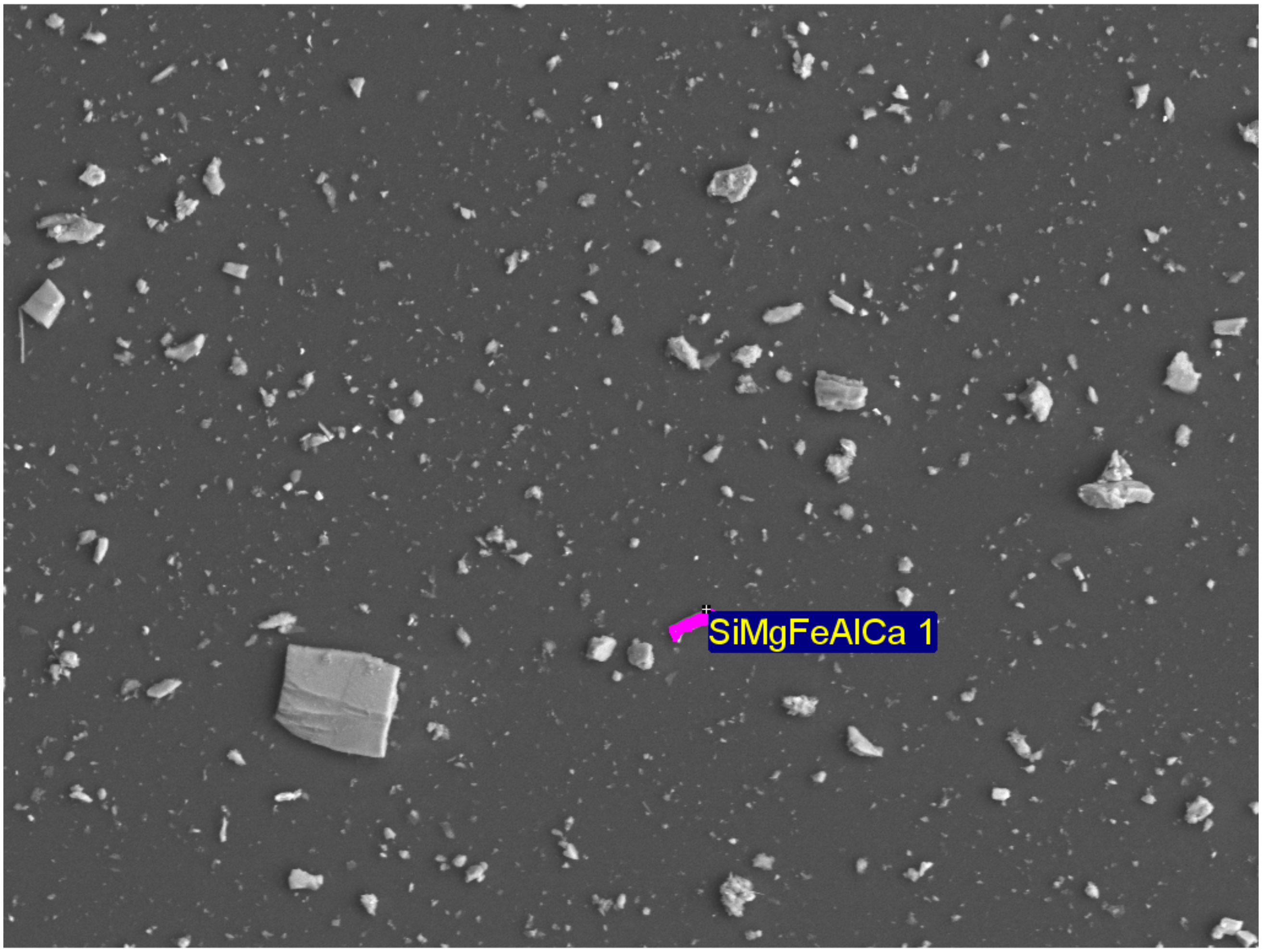

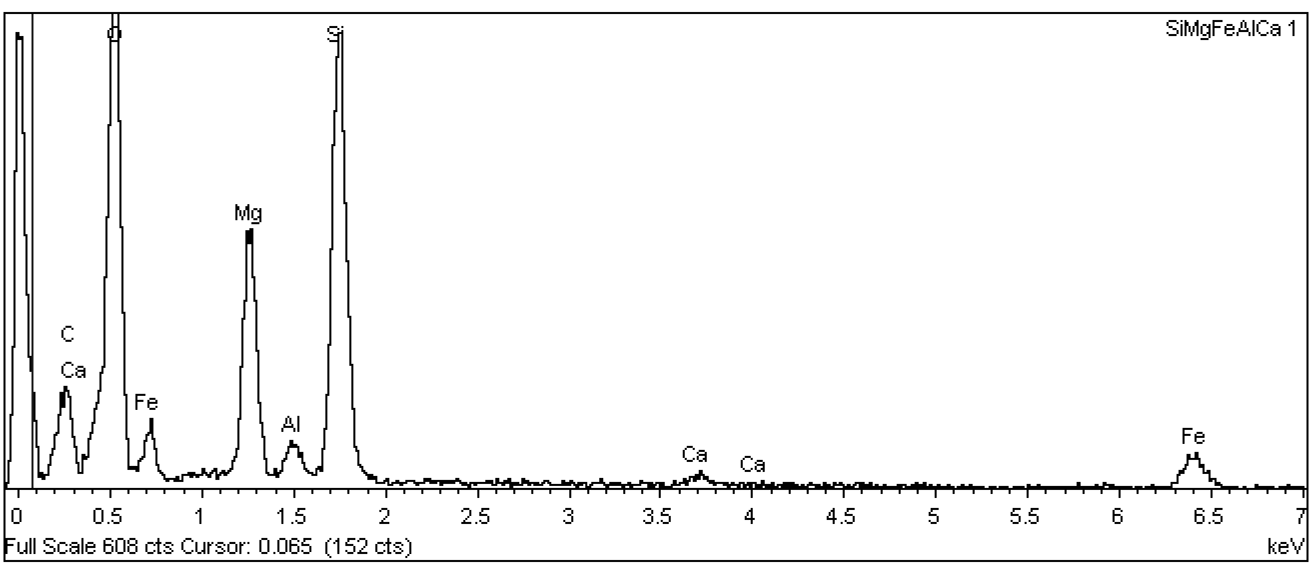

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Type: Default

ID:

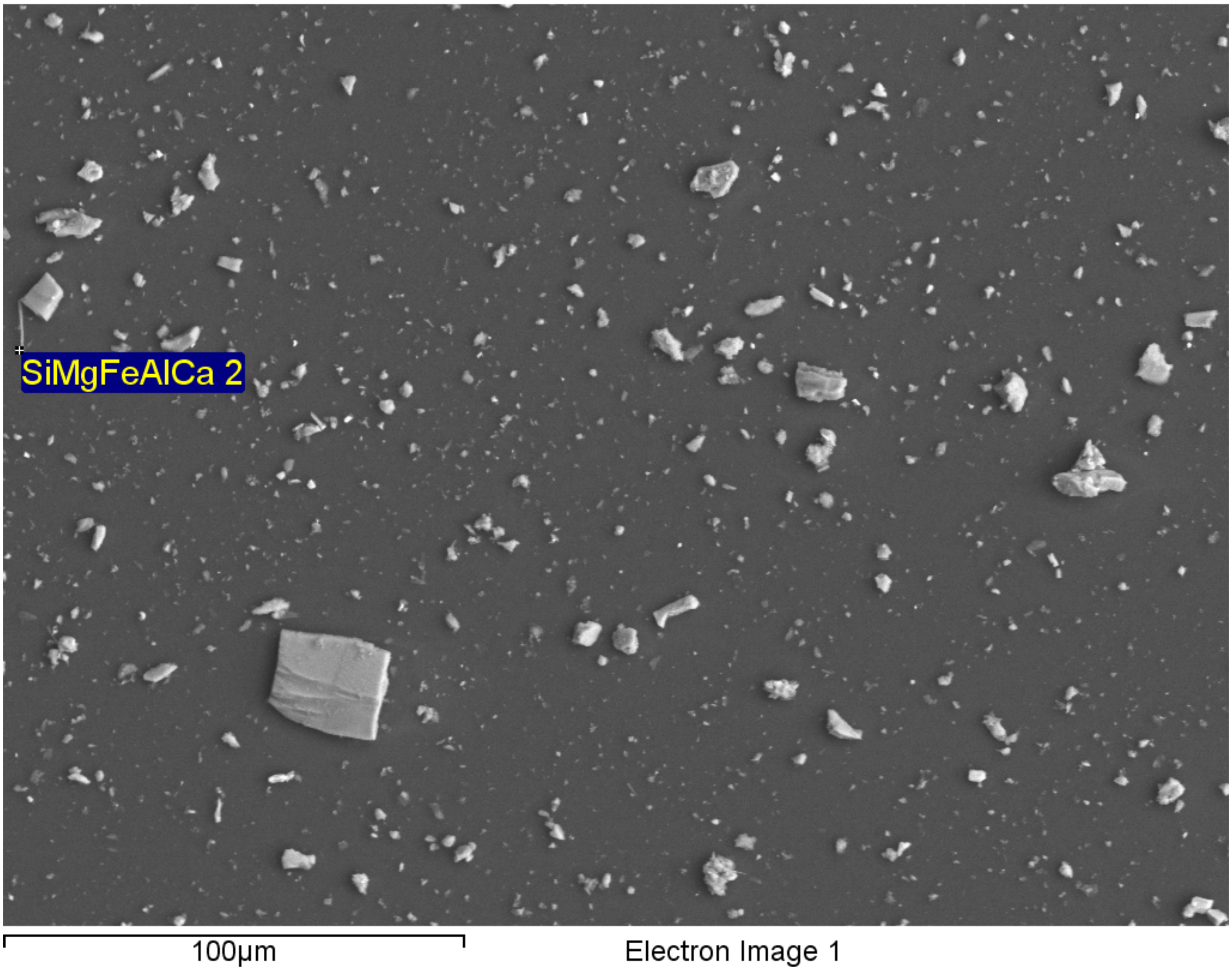
Project: Barr 101712

Owner: Inca User

Site: PolyMet

Barr 101712 - NorthMet

10/17/2012 10:14:03 AM



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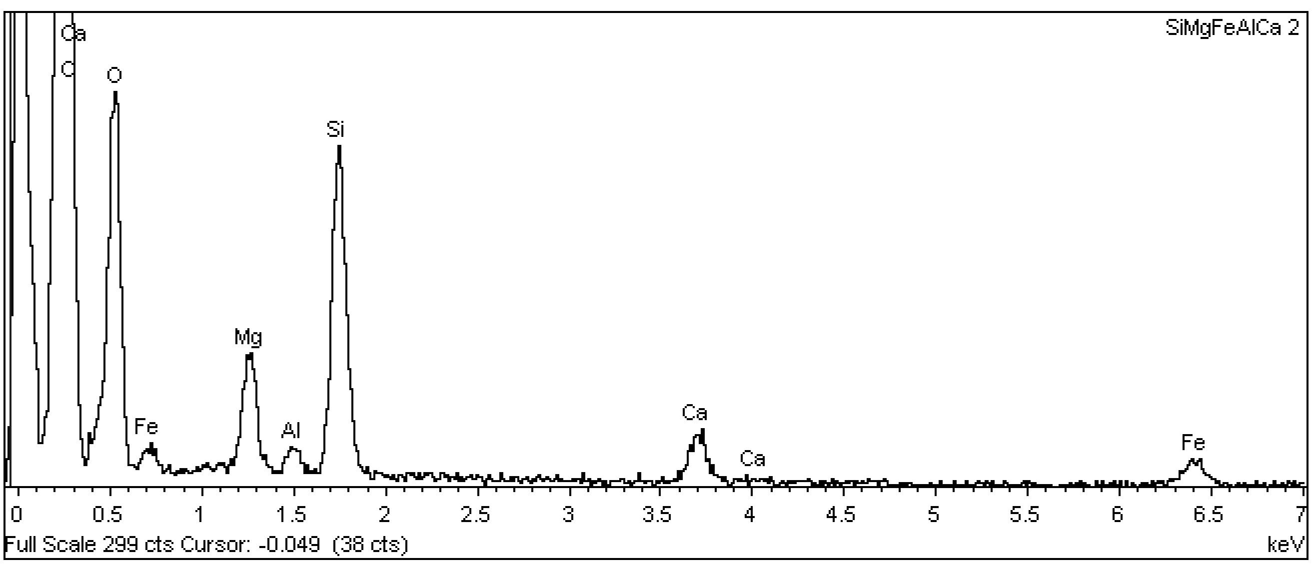

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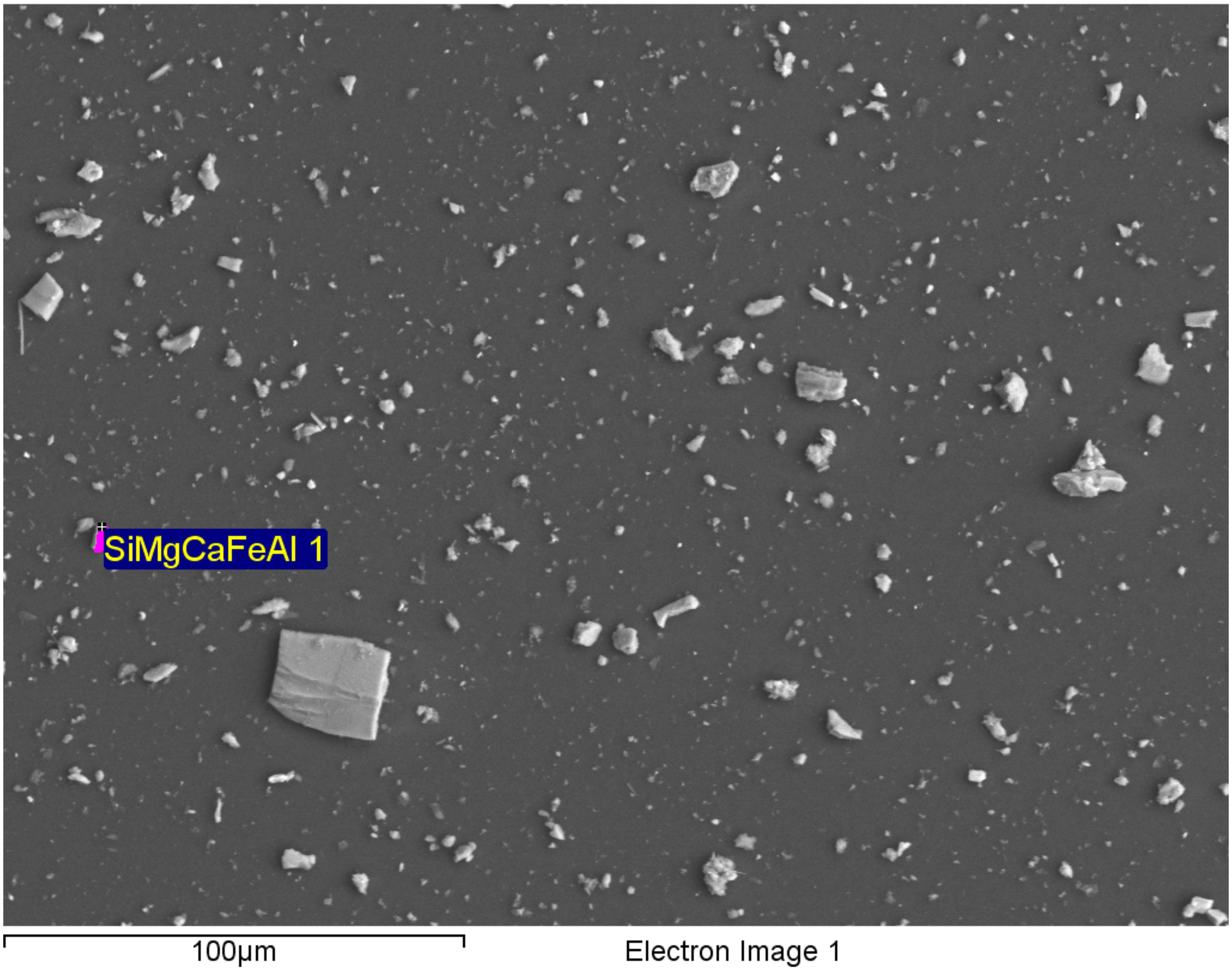
Type: Default	Owner: Inca User
ID:	Site: PolyMet



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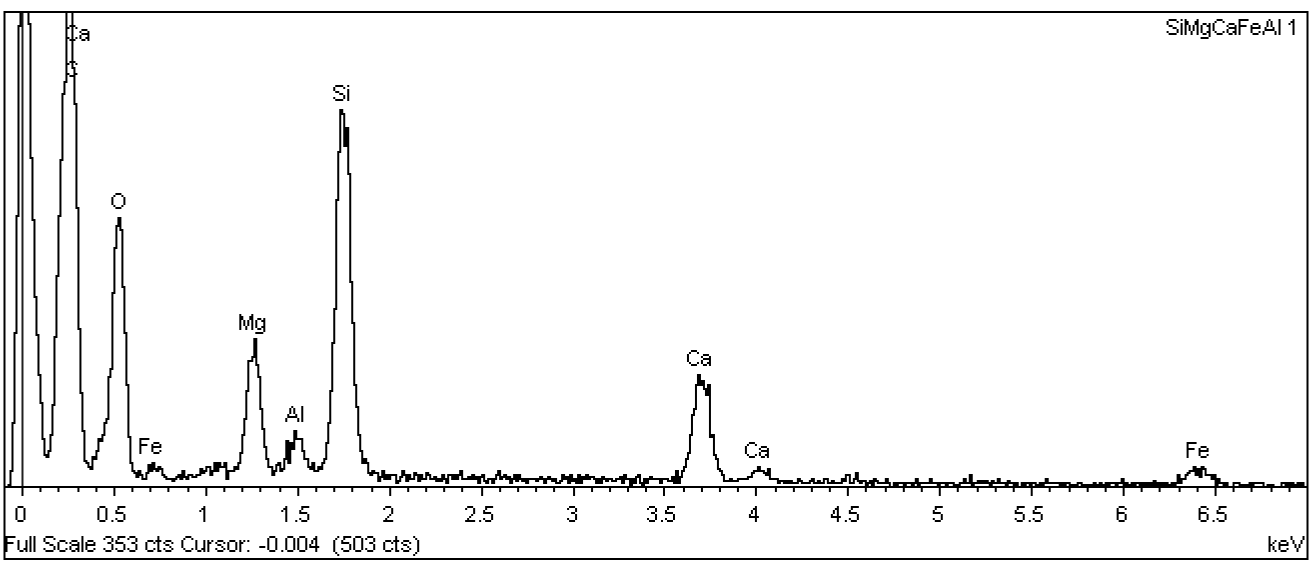

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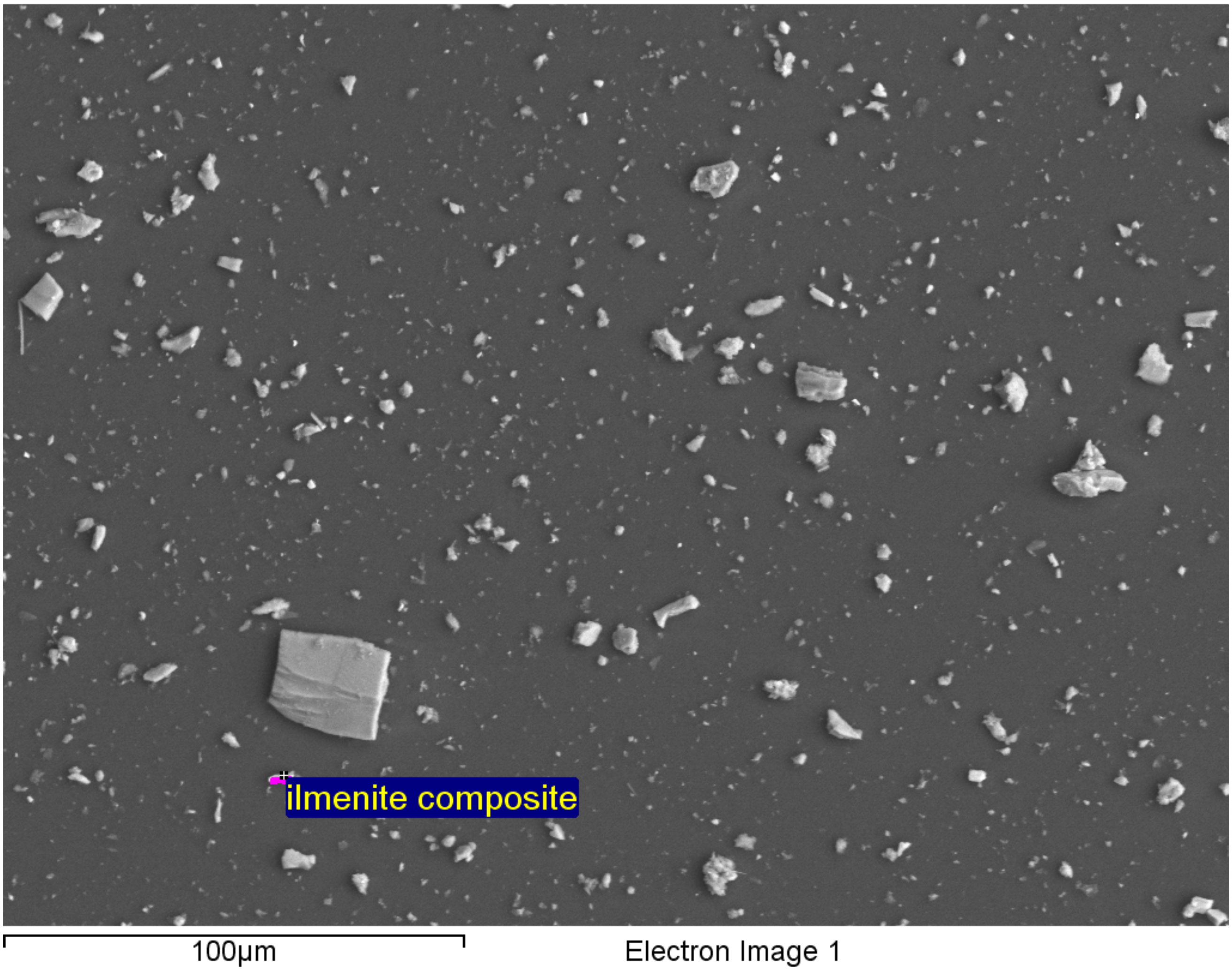
Type: Default	Owner: Inca User
ID:	Site: PolyMet

Barr 101712 - NorthMet

10/17/2012 10:14:58 AM



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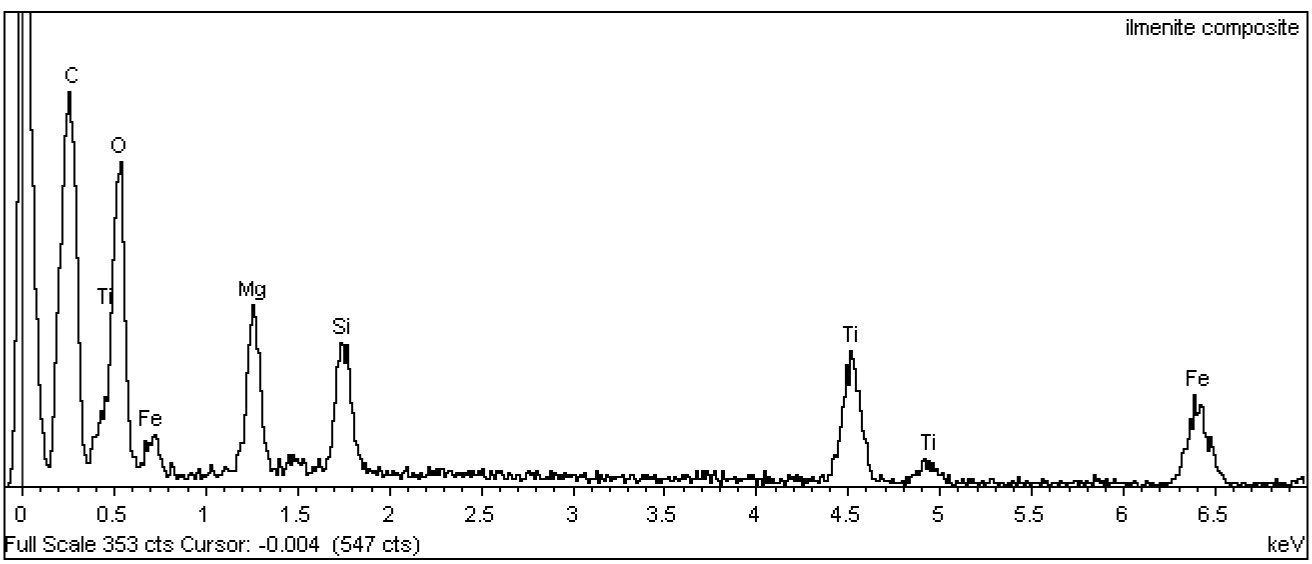
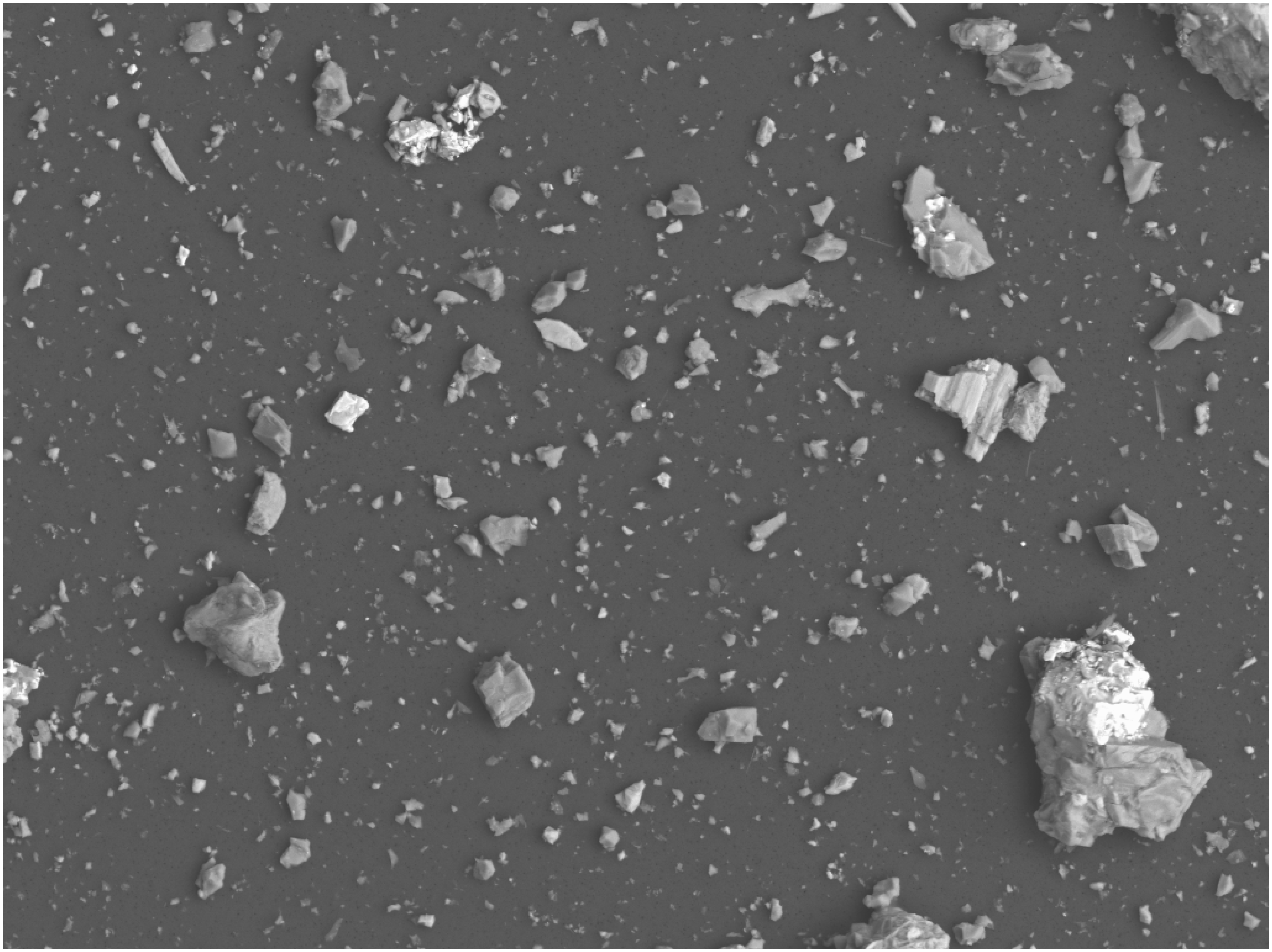


Sample: PolyMet	Project: Barr 101712
Type: Default	Owner: Inca User
ID:	Site: PolyMet

Exhibit 2

LTVSMC Tailings

Representative Particle Compositions



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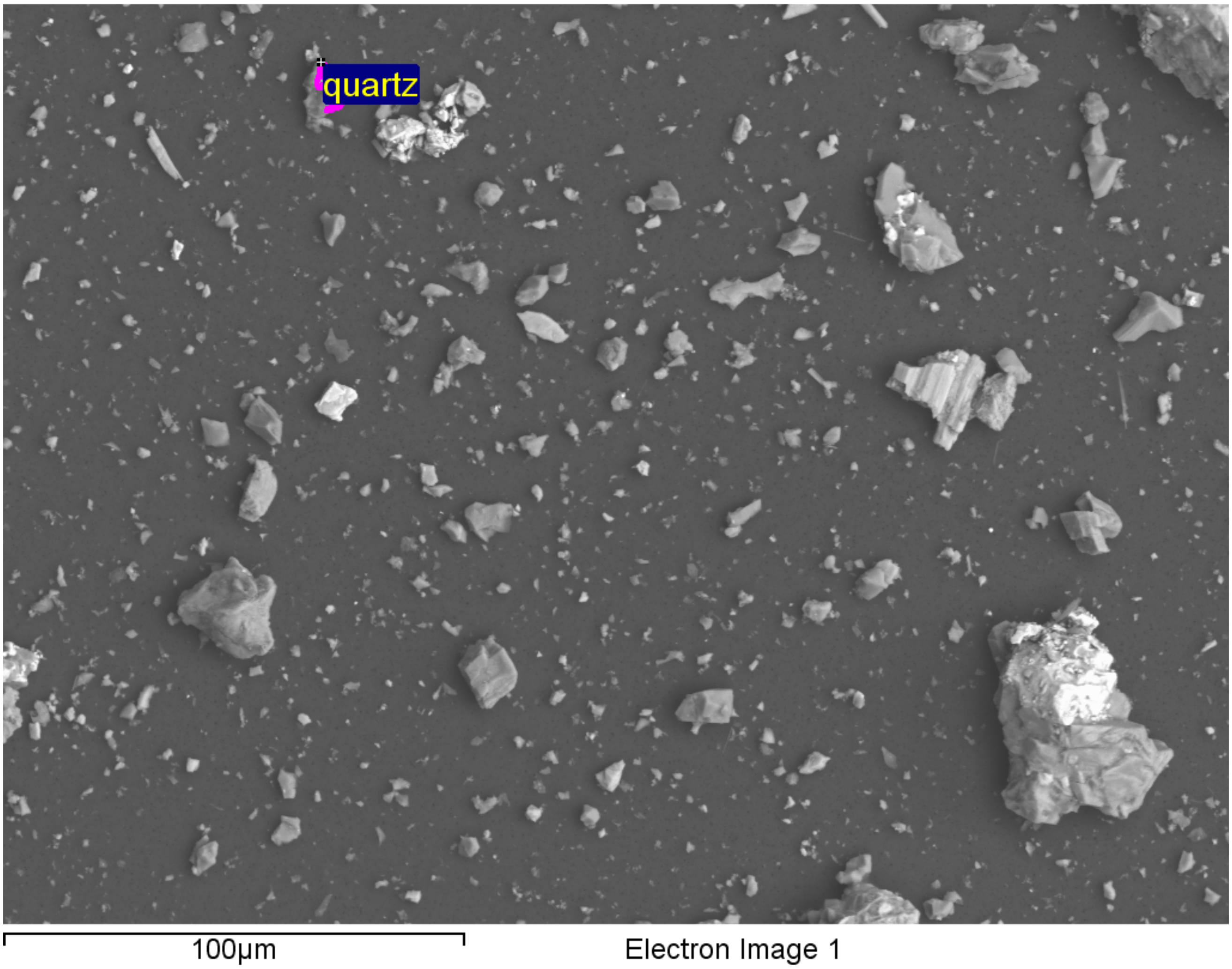
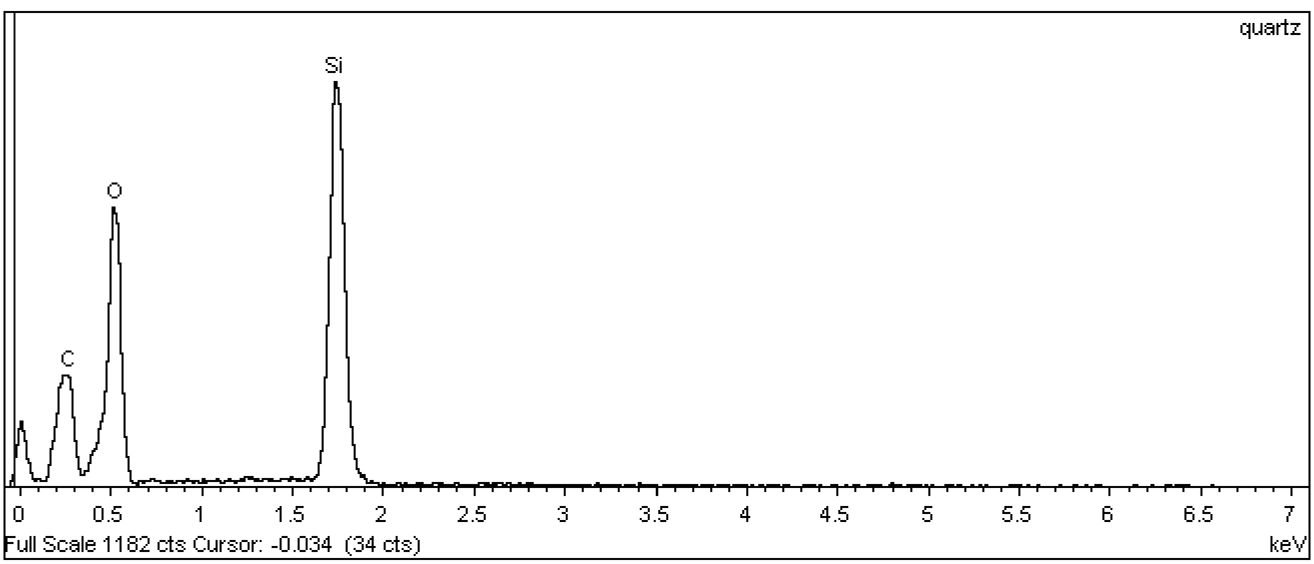
Electron Image 1

Comment:

Barr 101712 - LTVSMC

10/17/2012 10:57:52 AM





Sample: LTV

Type: Default

ID:

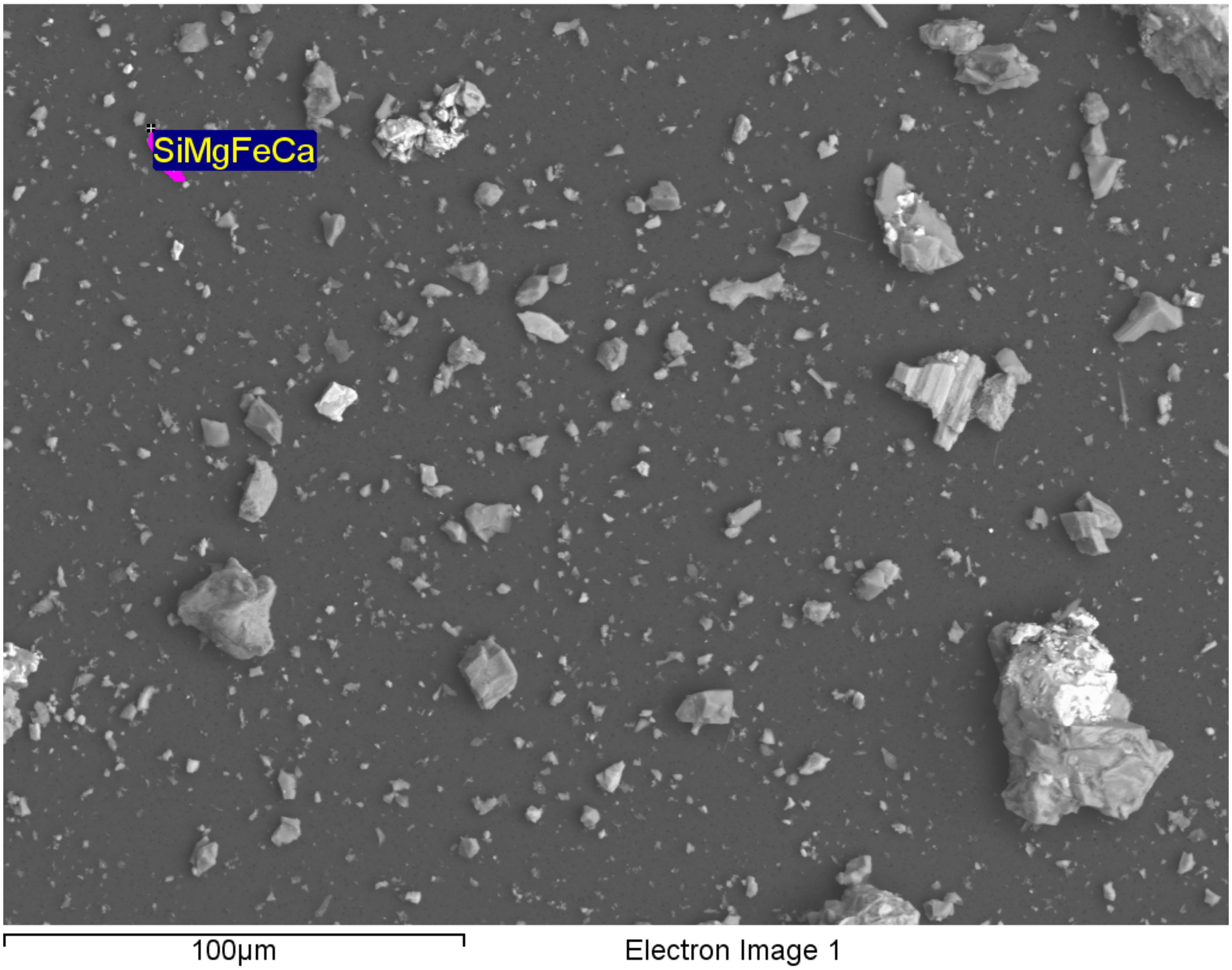
Project: Barr 101712

Owner: Inca User

Site: Site of Interest 1

Barr 101712 - LTVSMC

10/17/2012 10:58:05 AM



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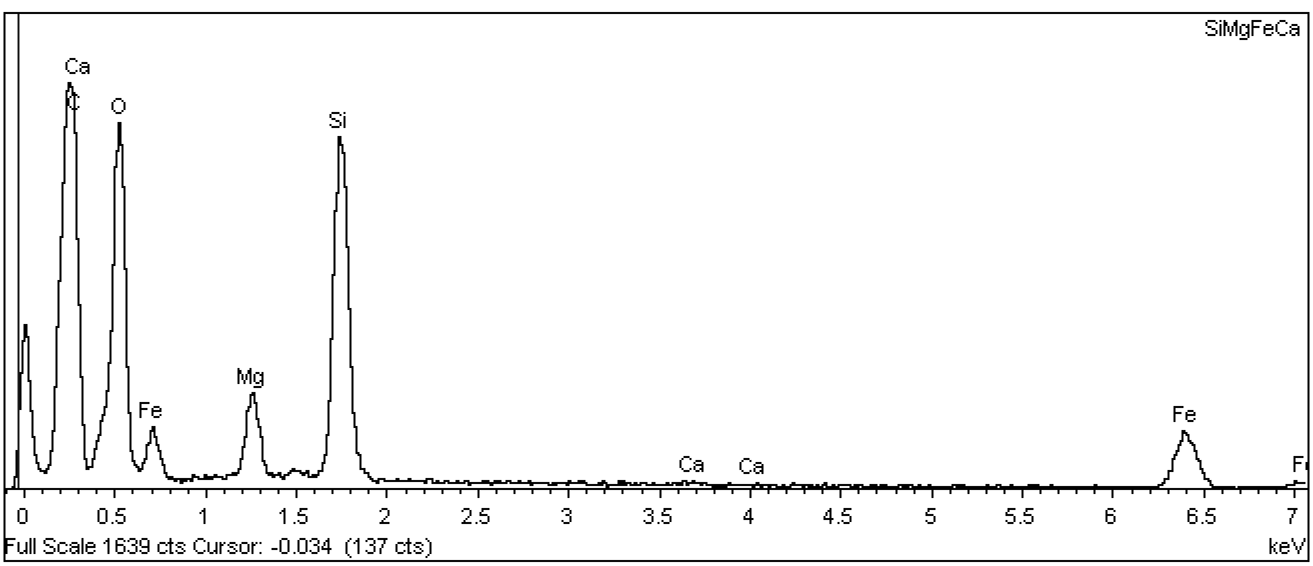

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Type: Default	Owner: Inca User
ID:	Site: Site of Interest 1

Barr 101712 - LTVSMC

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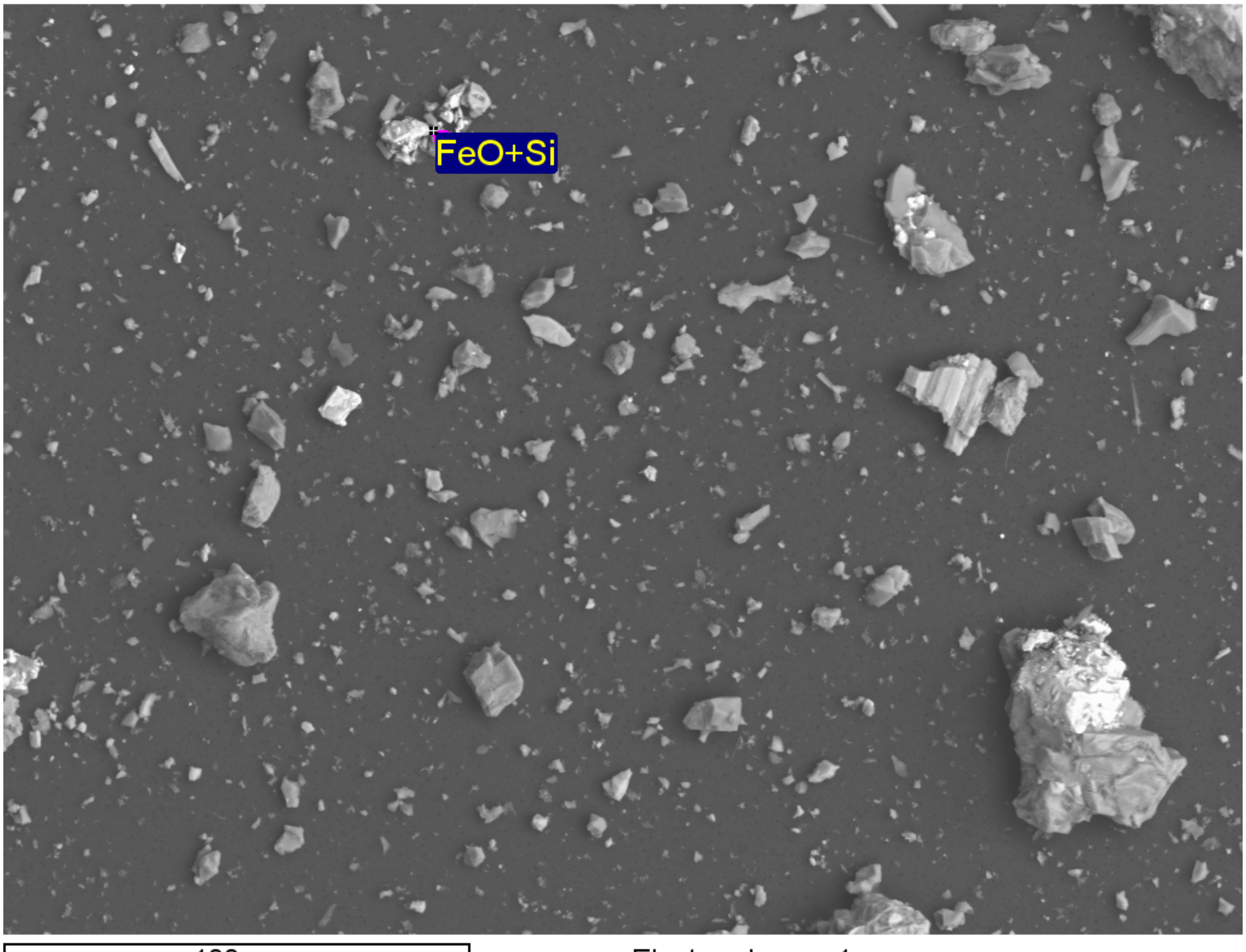

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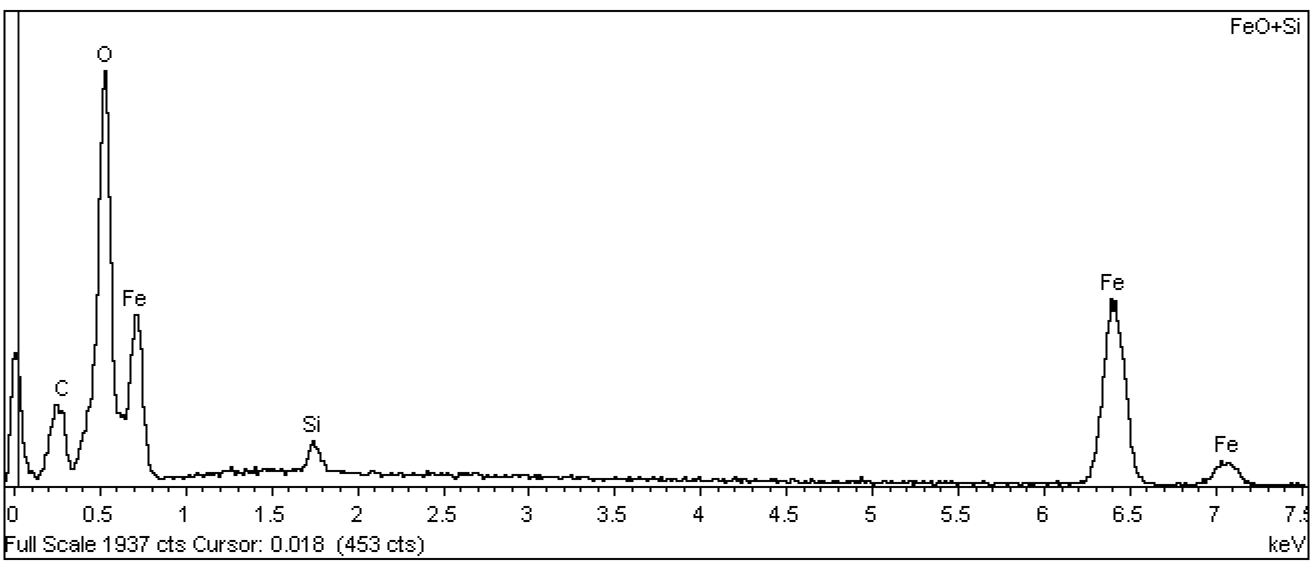

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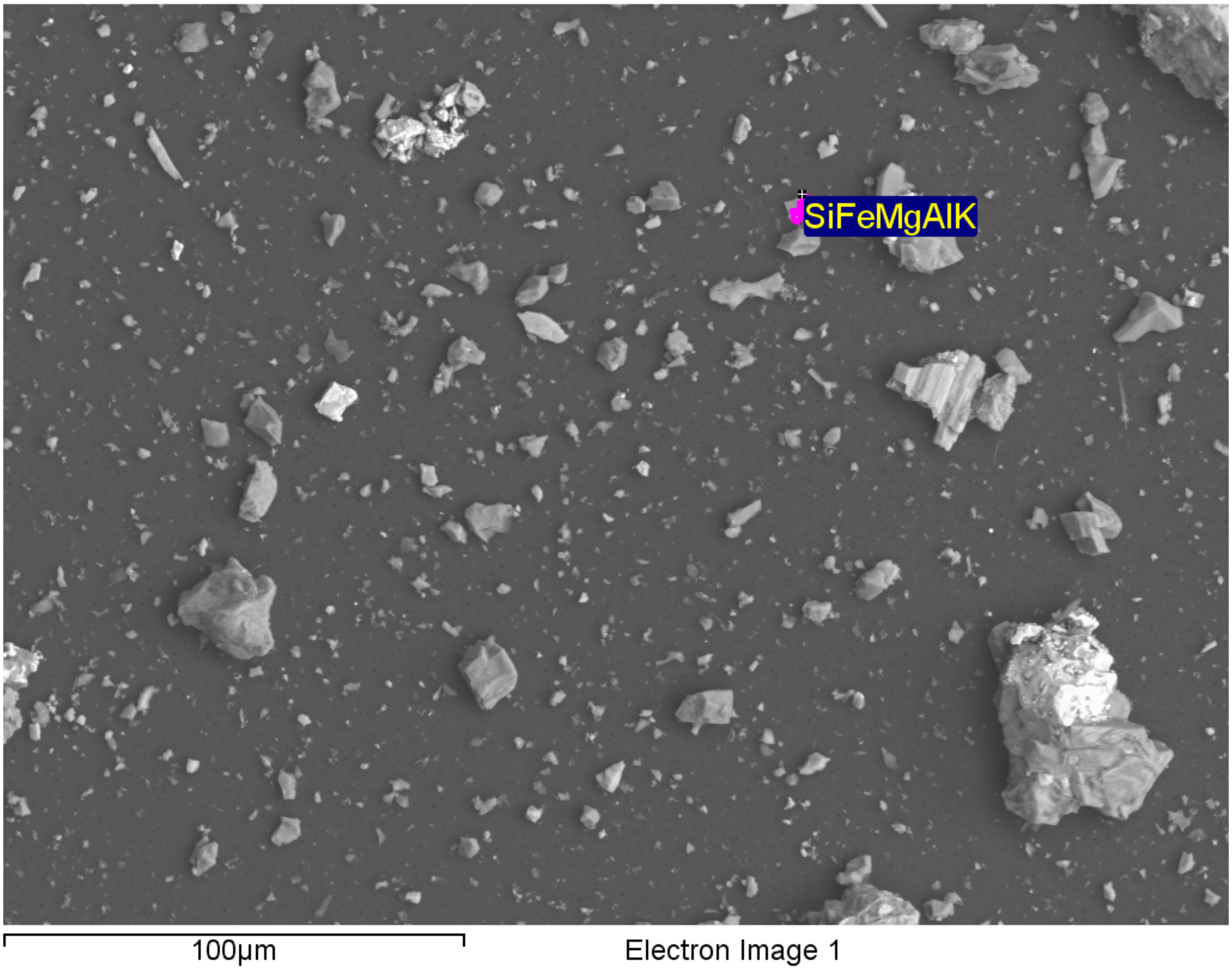
ID:	Site: Site of Interest 1

Barr 101712 - LTVSMC

10/17/2012 10:58:32 AM



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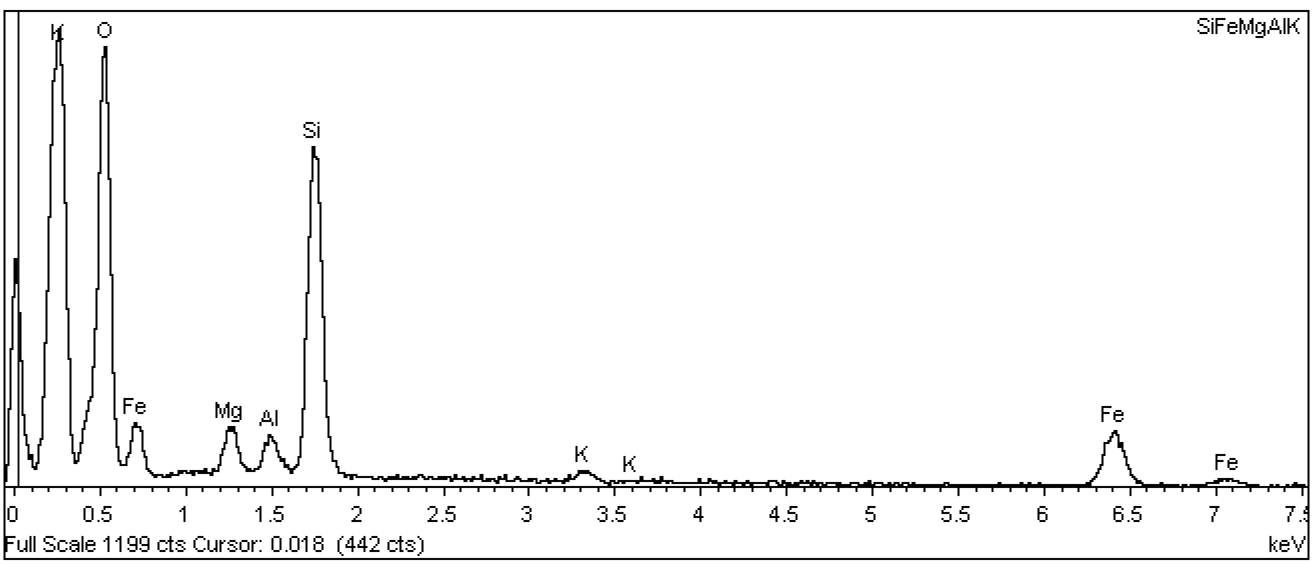

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ID:	Site: Site of Interest 1

Barr 101712 - LTVSMC

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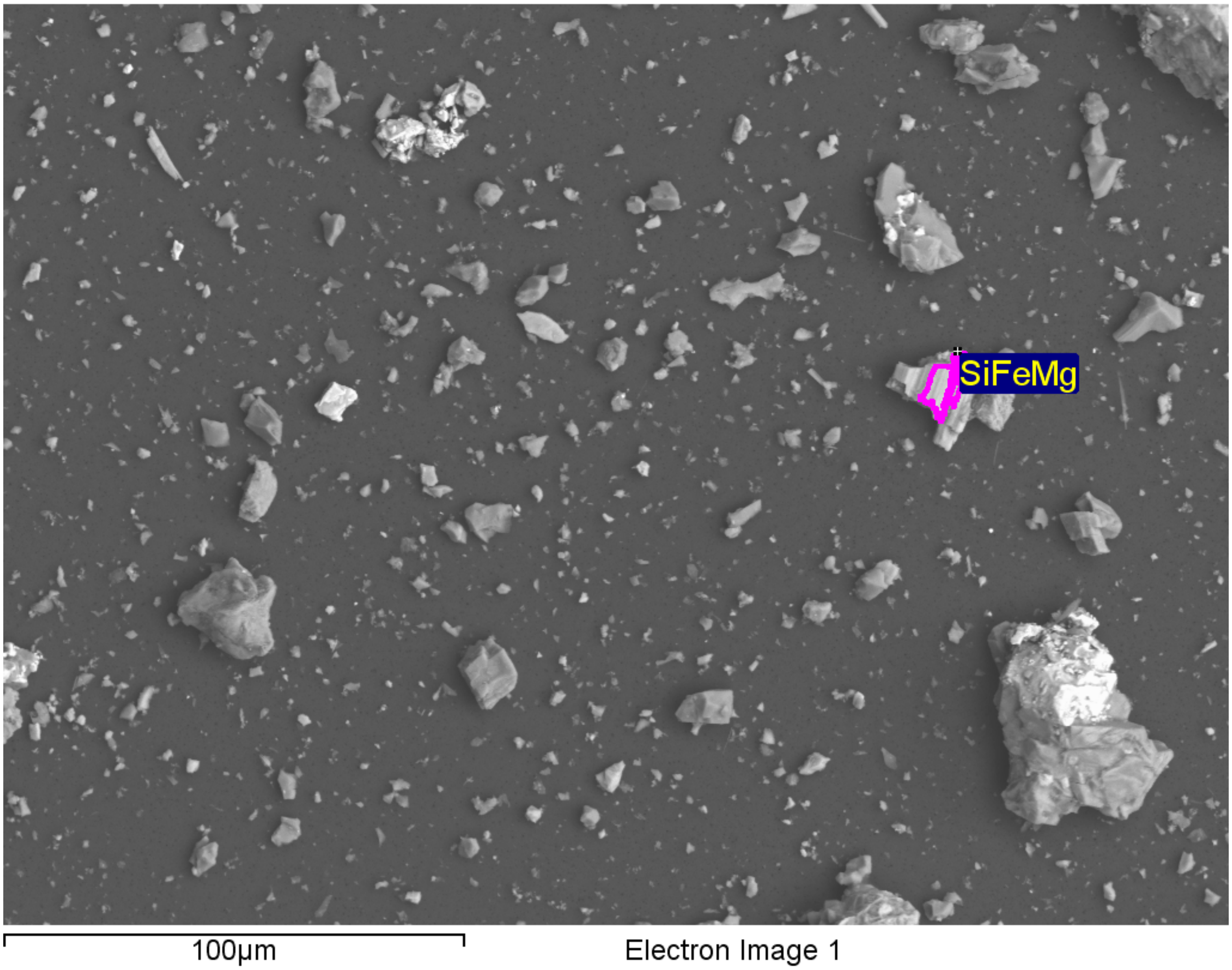

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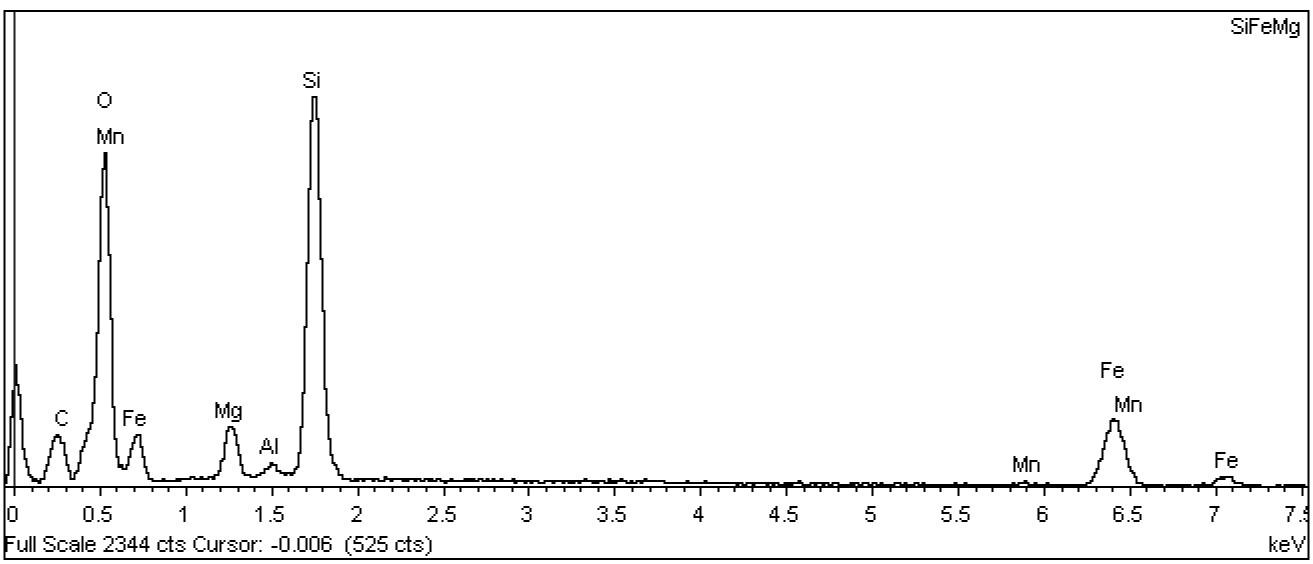

Sample: LTV

Type: Default

ID:

Project: Barr 101712

Owner: Inca User

Site: Site of Interest 1

Barr 101712 - LTVSMC

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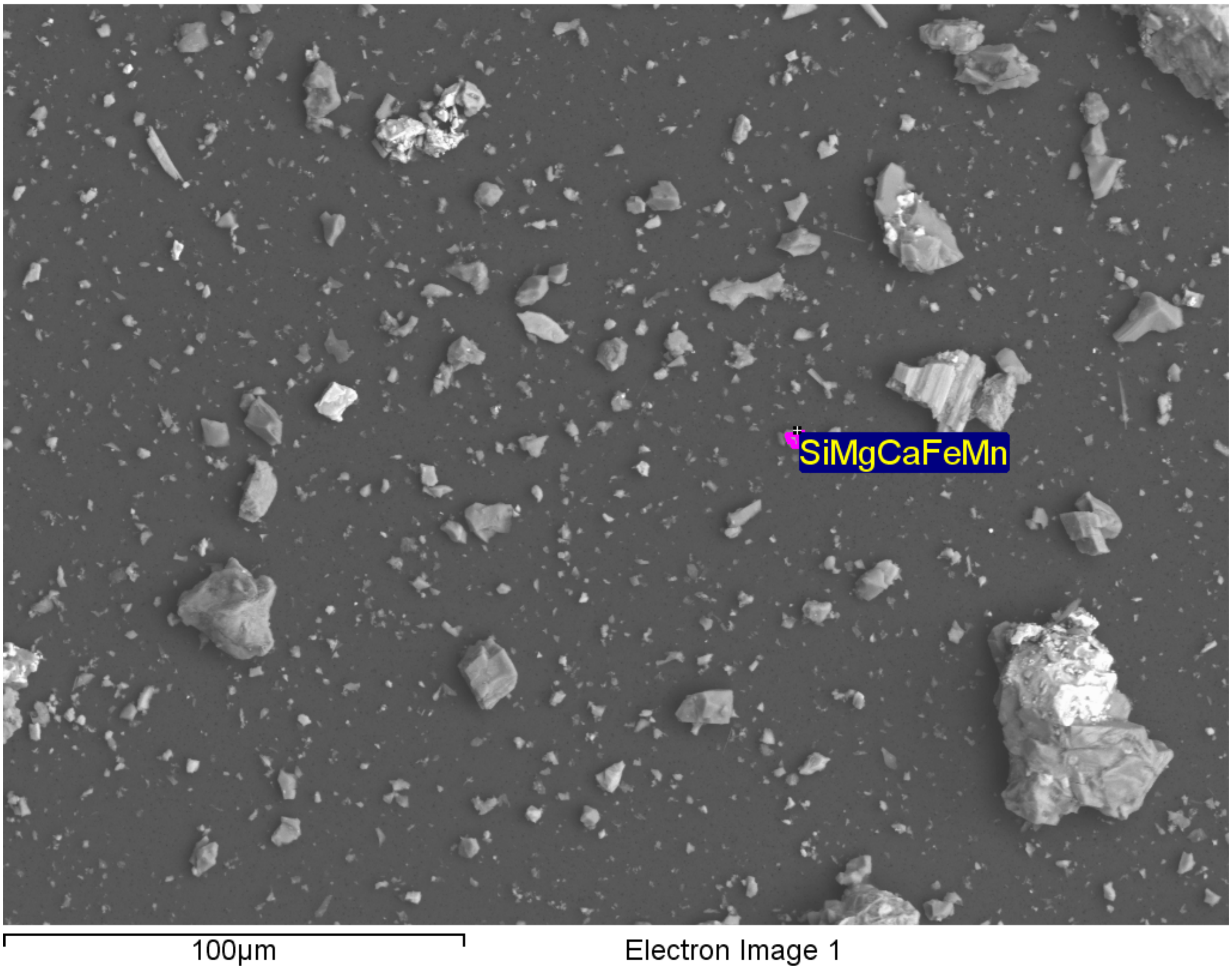

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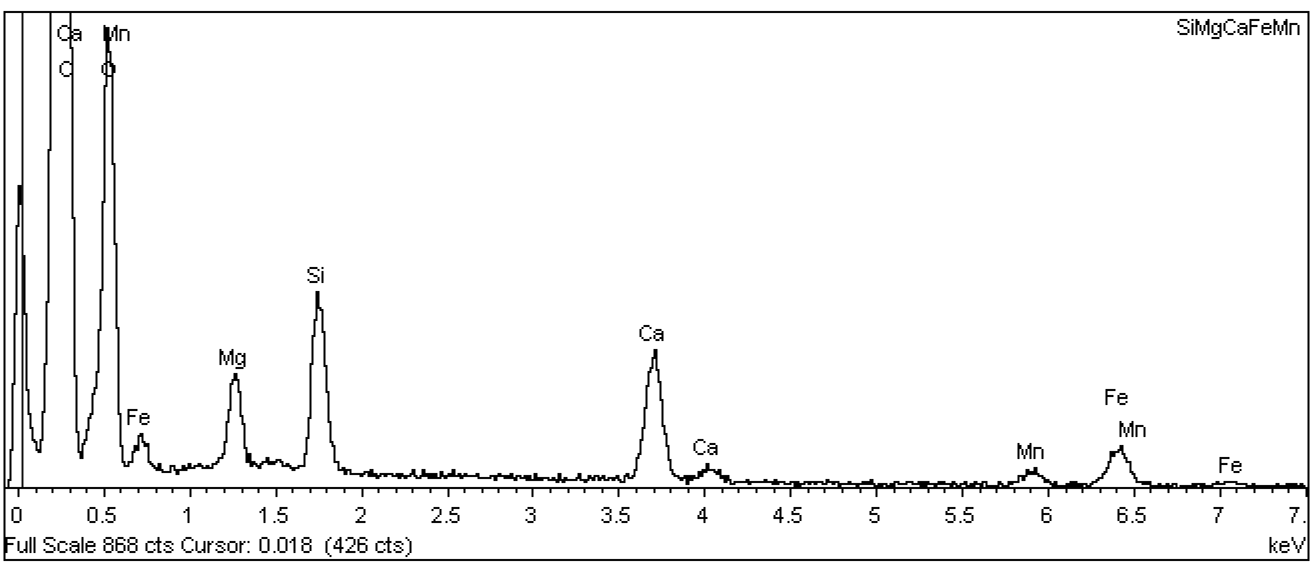

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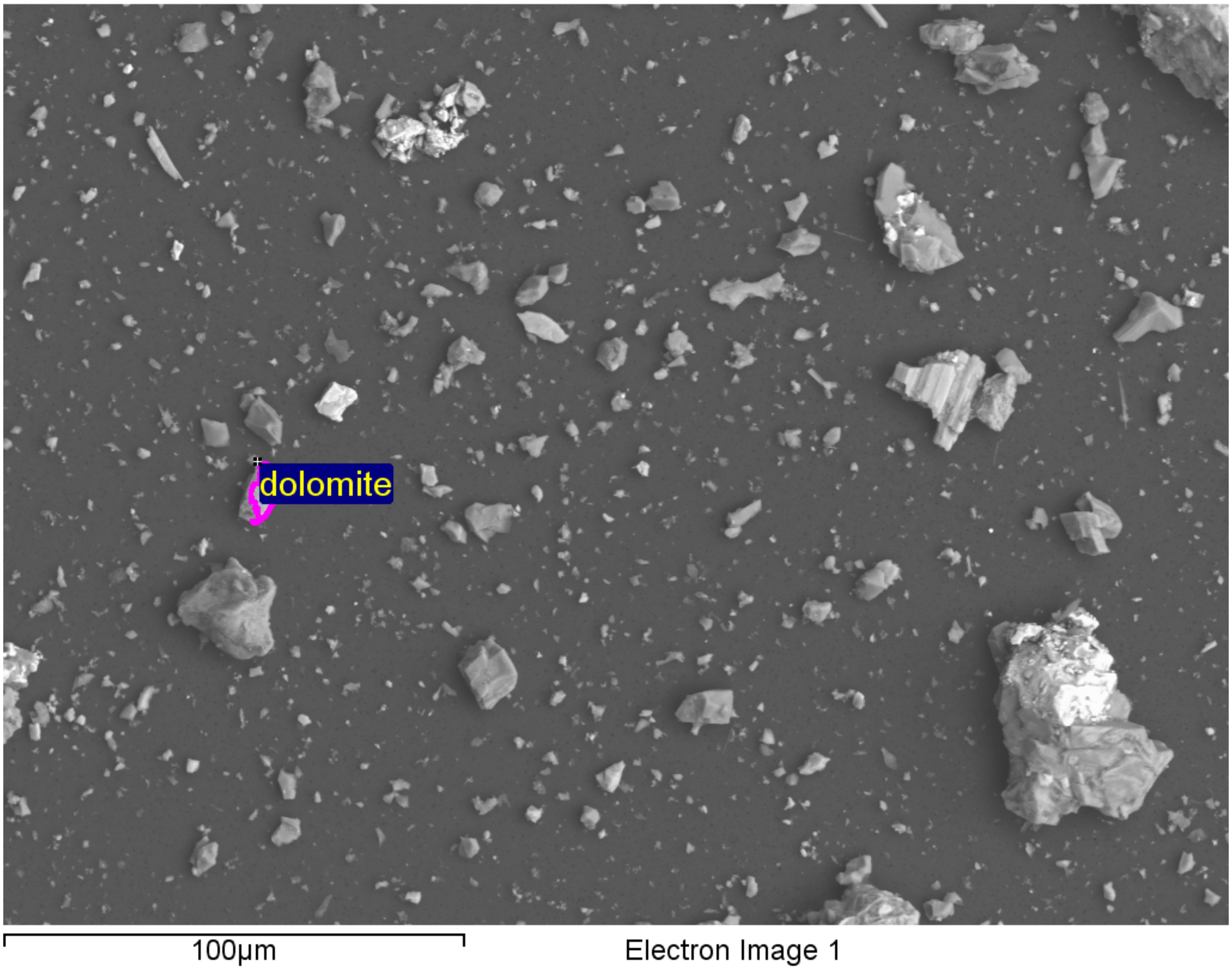

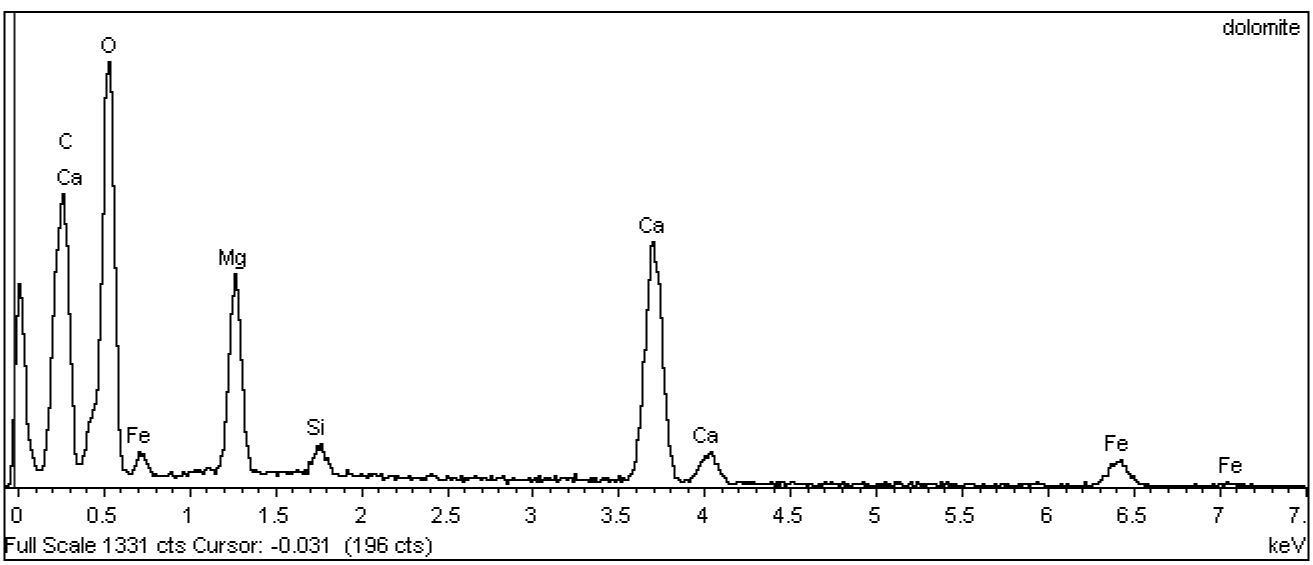

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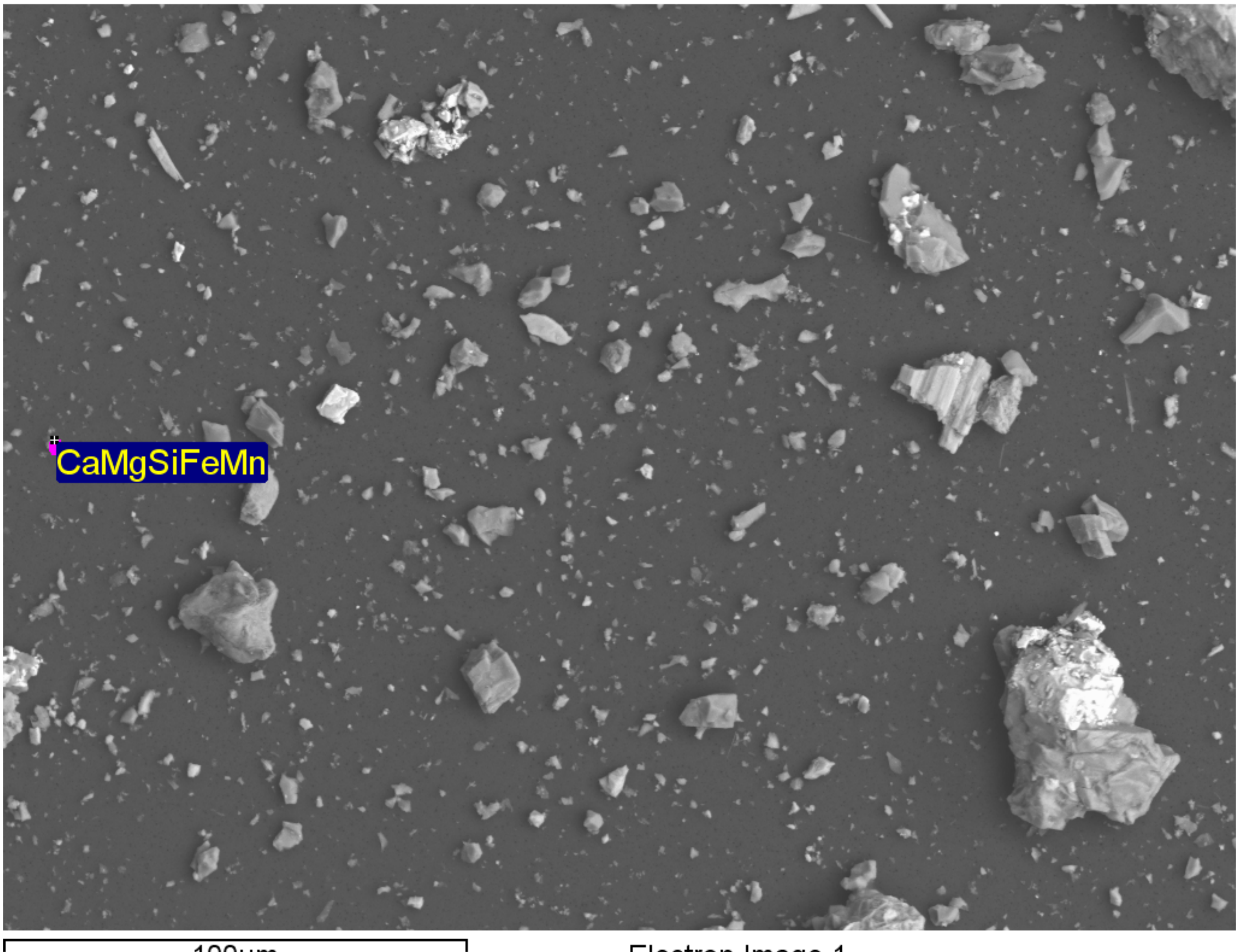

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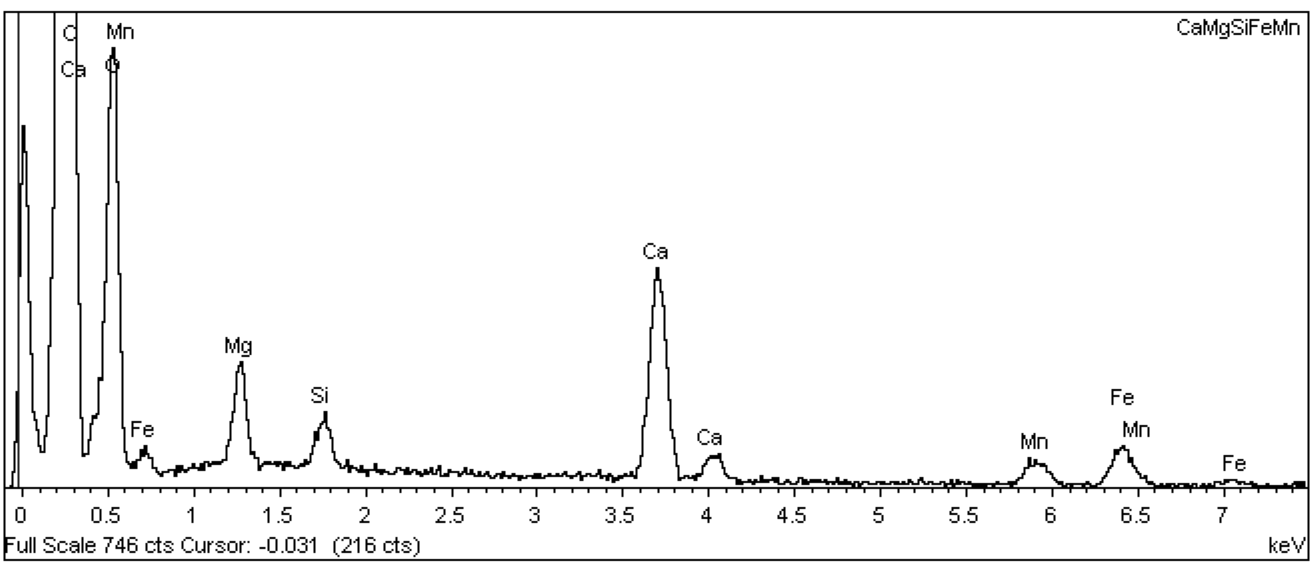

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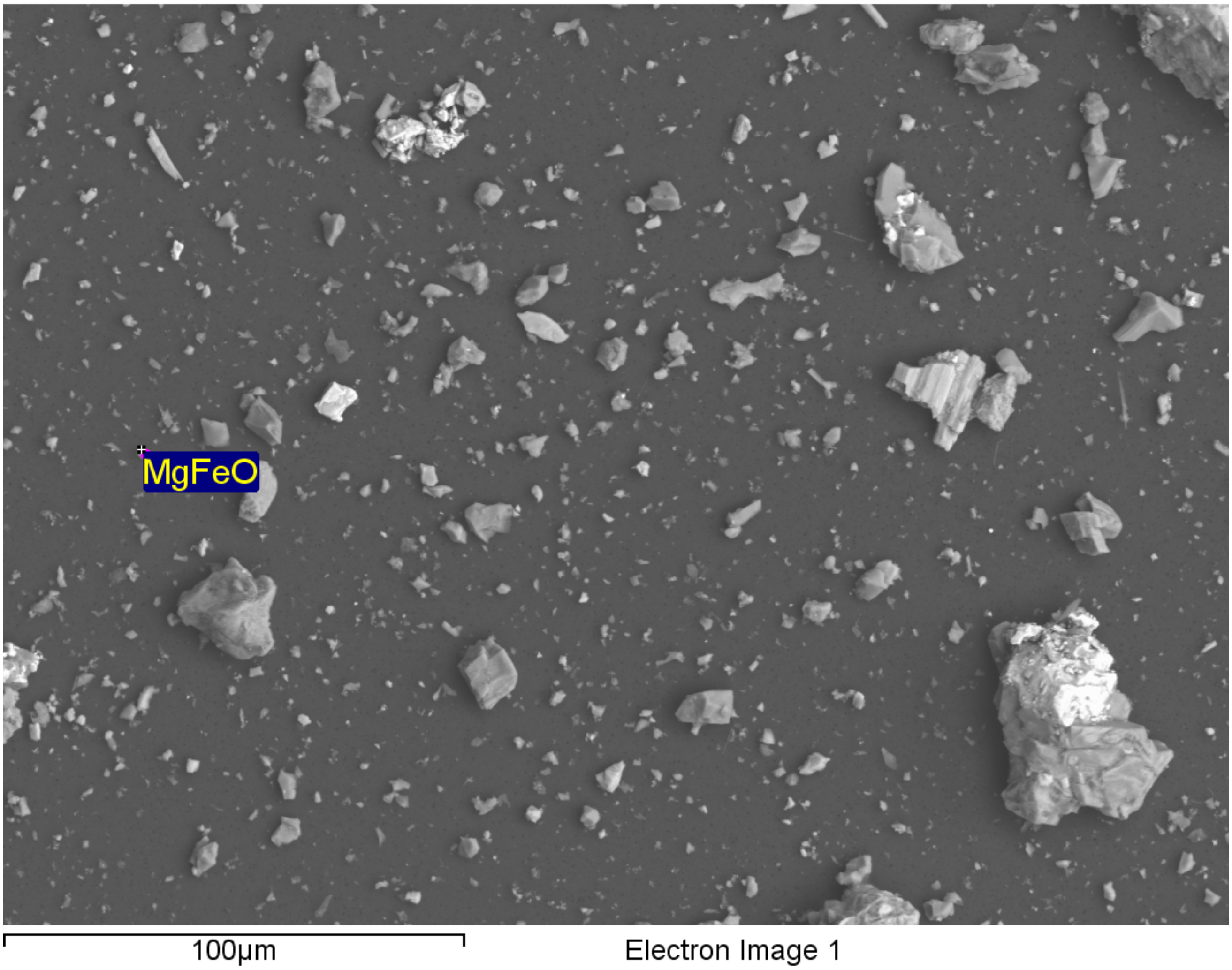

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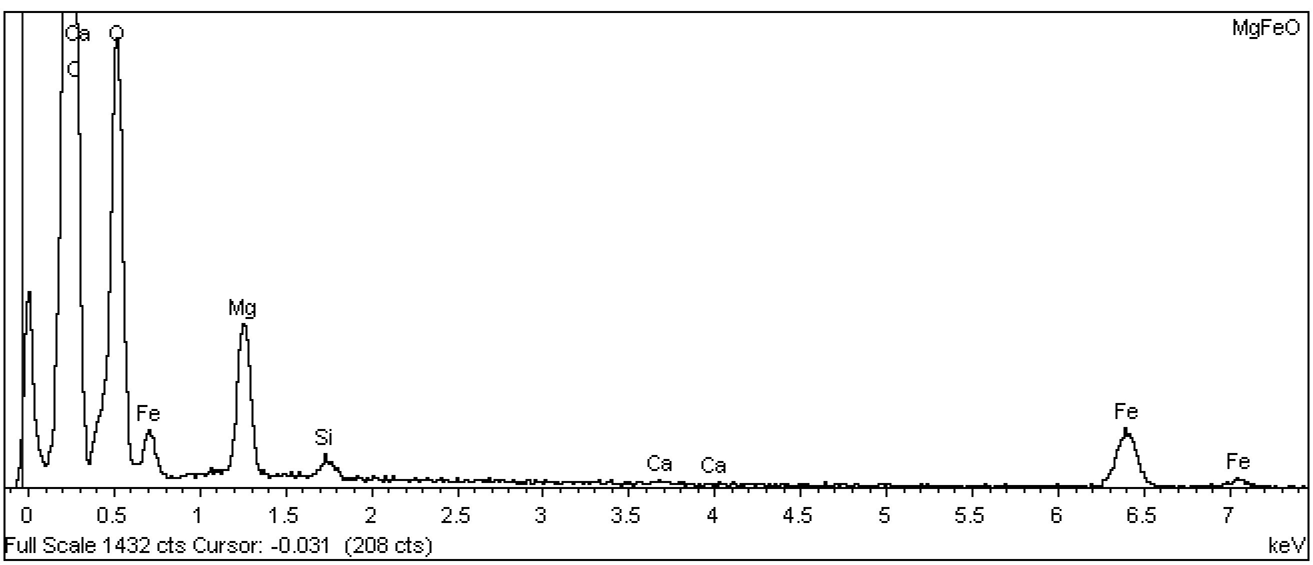

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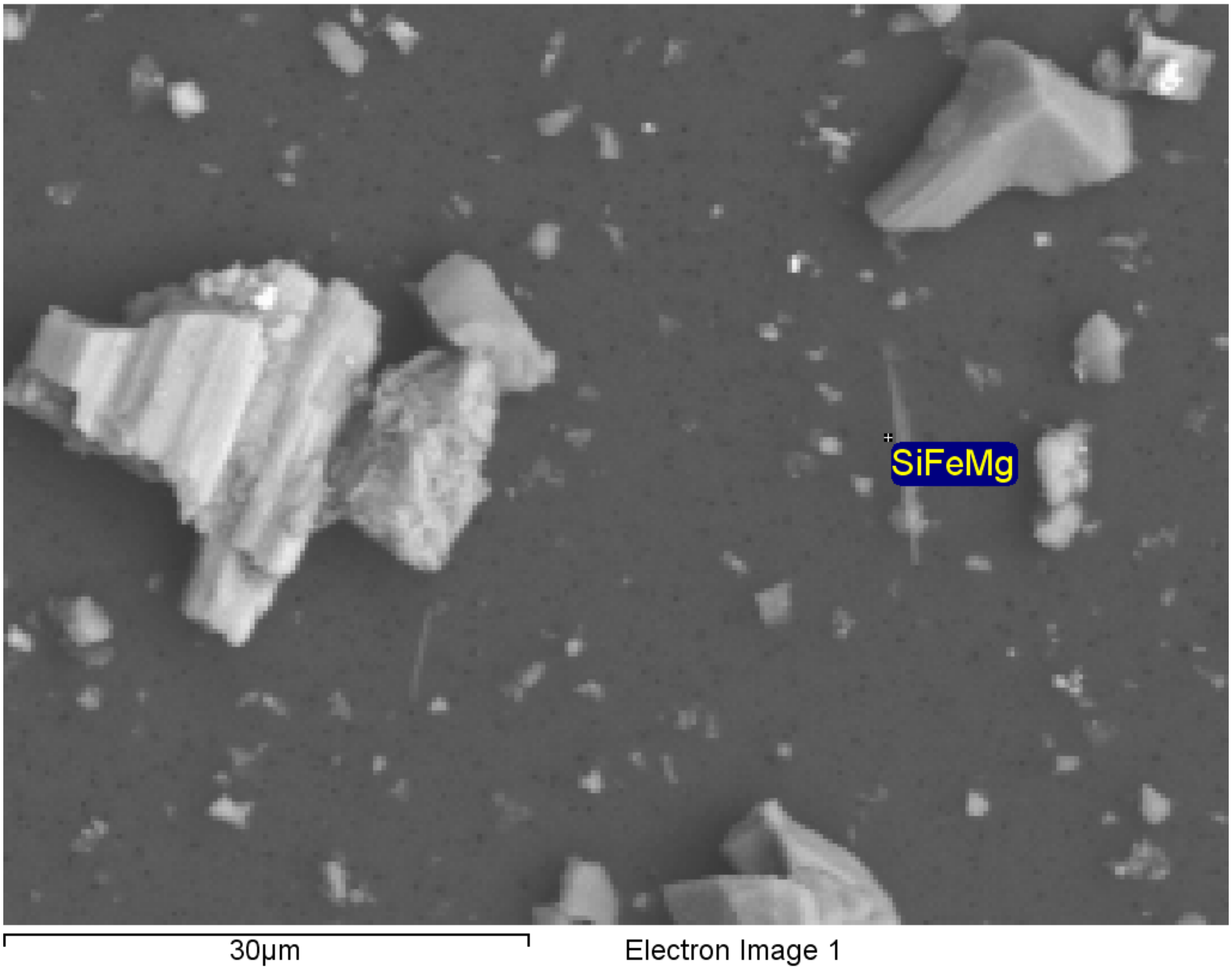
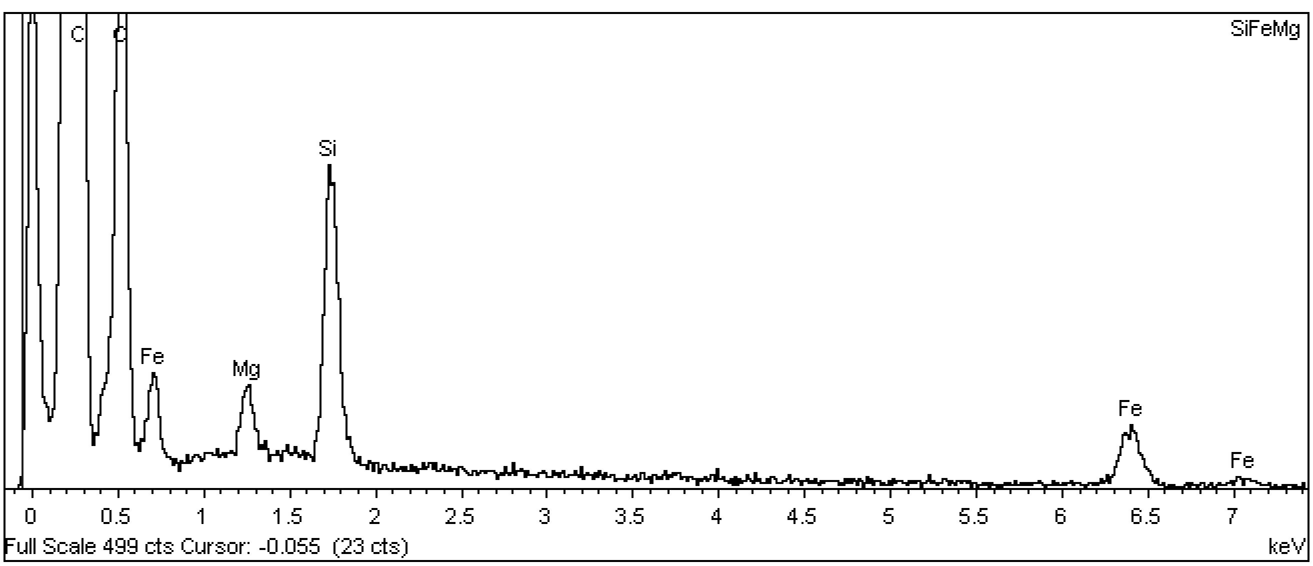
ID:	Site: Site of Interest 1

Barr 101712 - LTVSMC

10/17/2012 11:00:47 AM





Sample: LTV

Type: Default

ID:

Project: Barr 101712

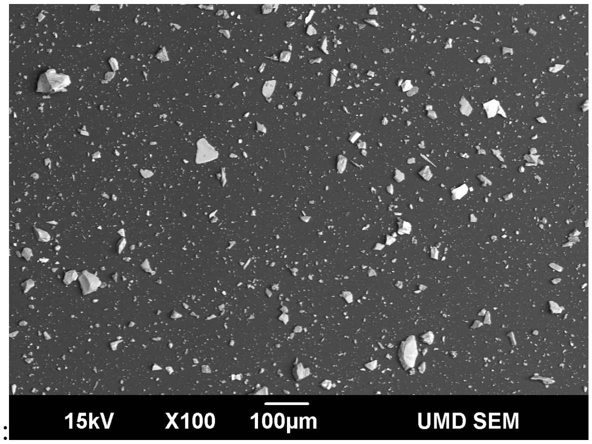
Owner: Inca User

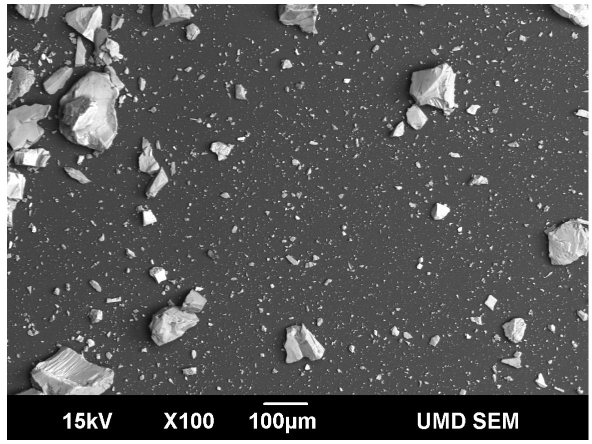
Site: Site of Interest 1

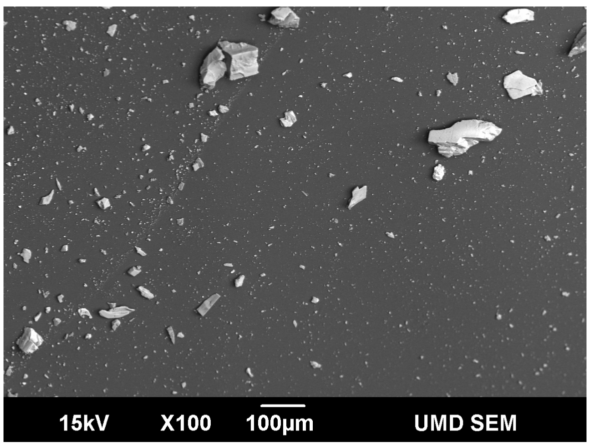
Exhibit 3

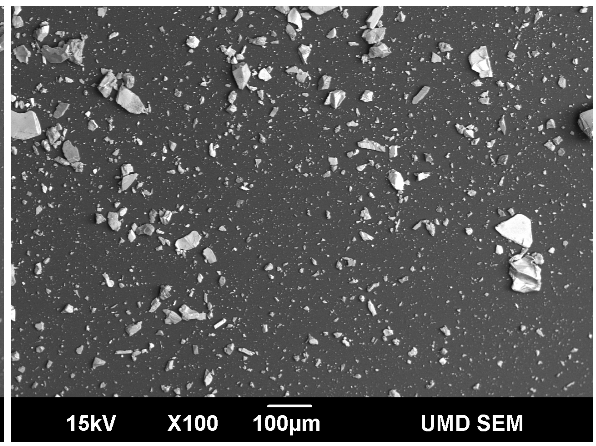
Comparison SEM Images

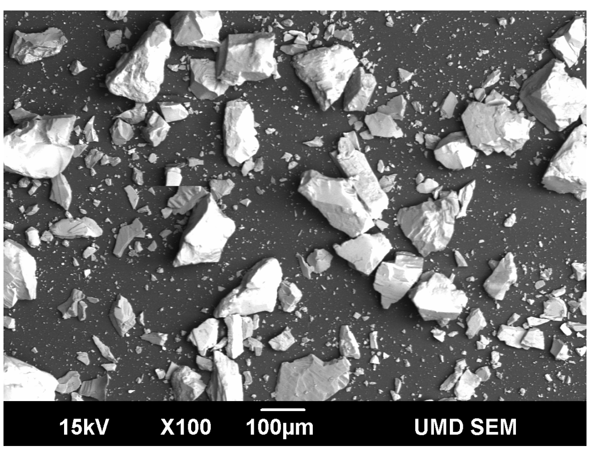
SEM Images of NorthMet Flotation Tailings

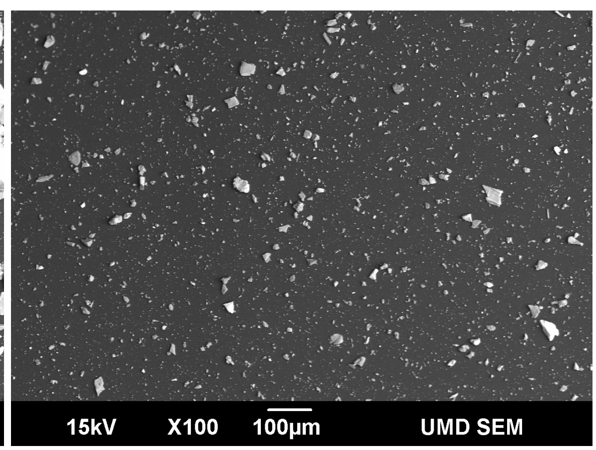




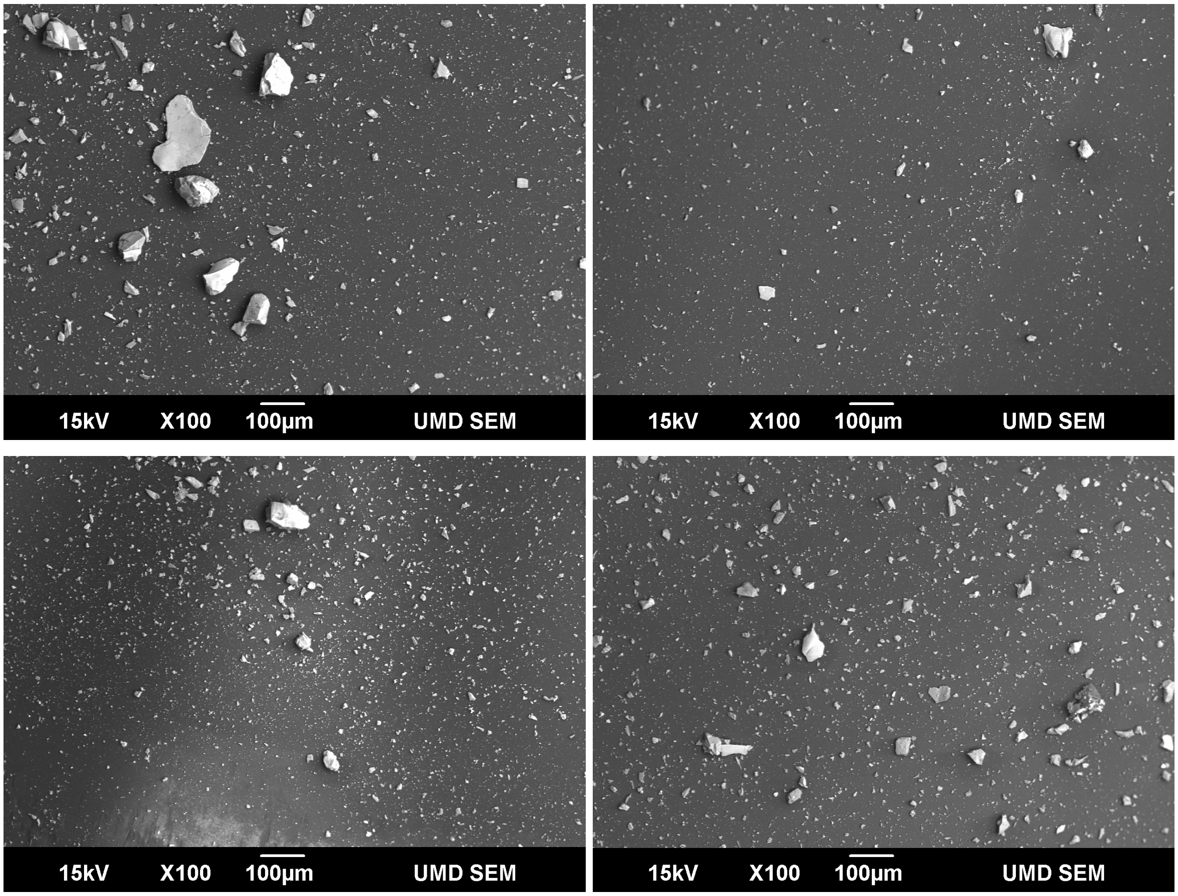




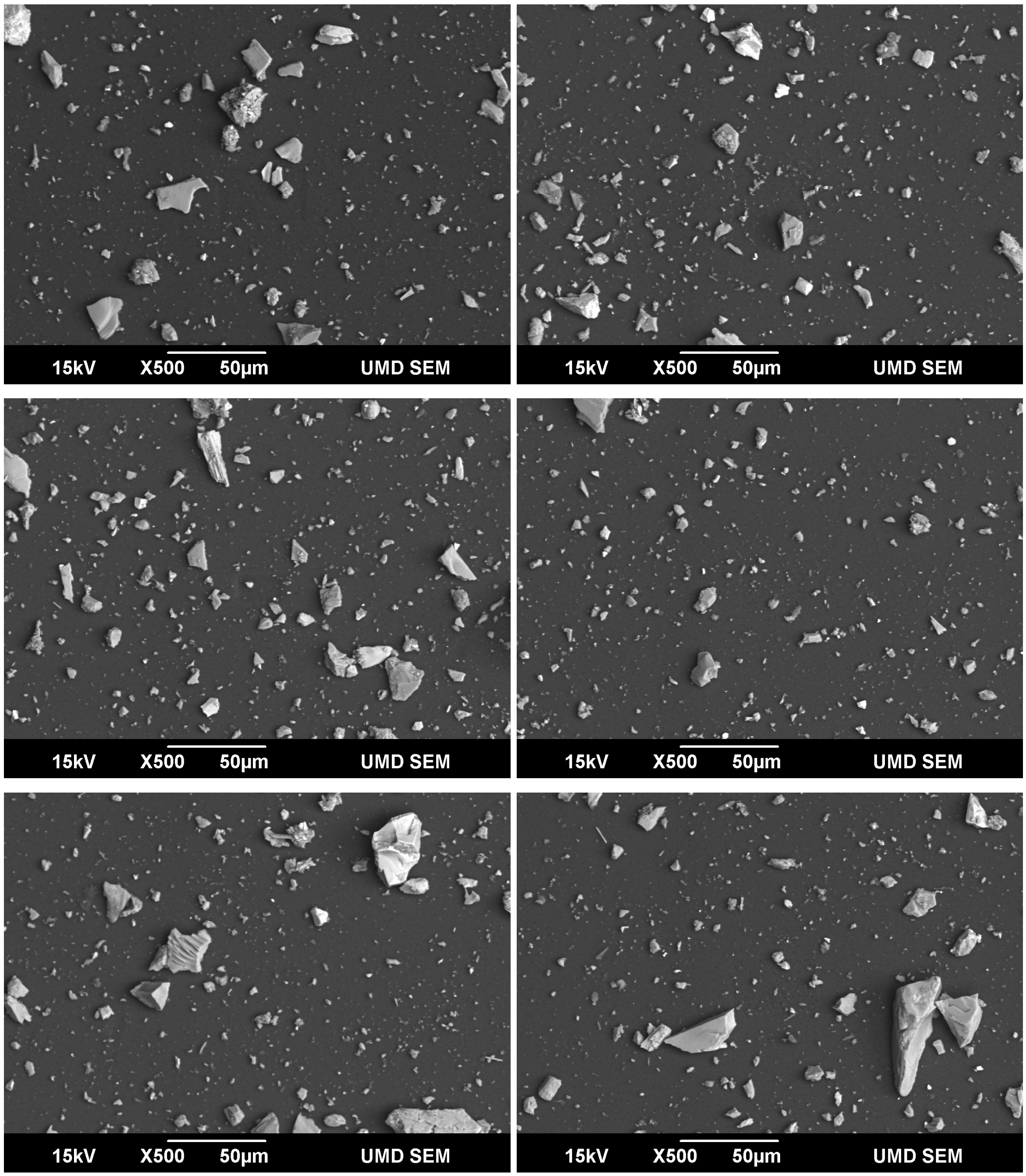




SEM Images of NorthMet Flotation Tailings



SEM Images of NorthMet Flotation Tailings



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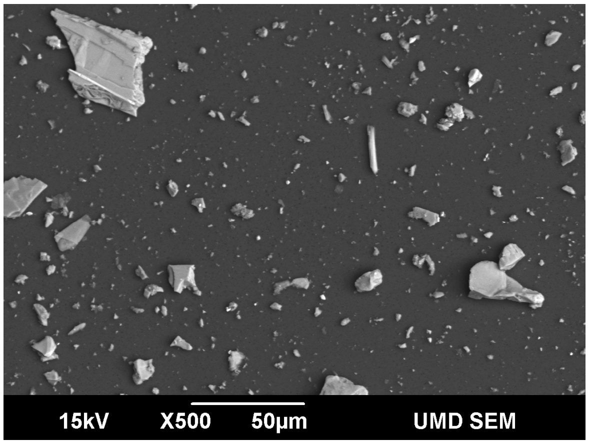
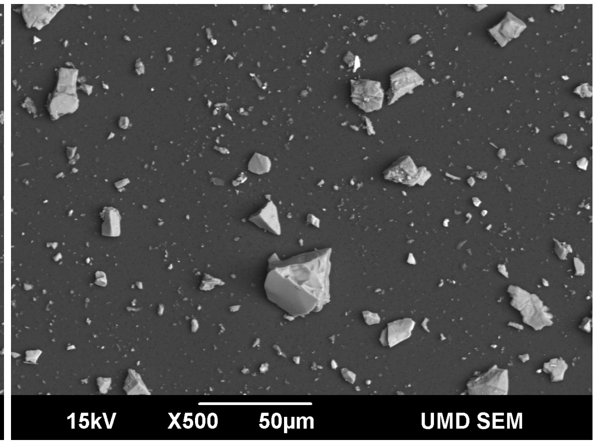
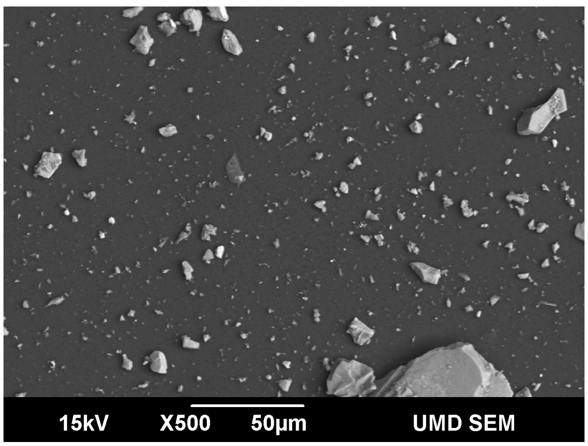
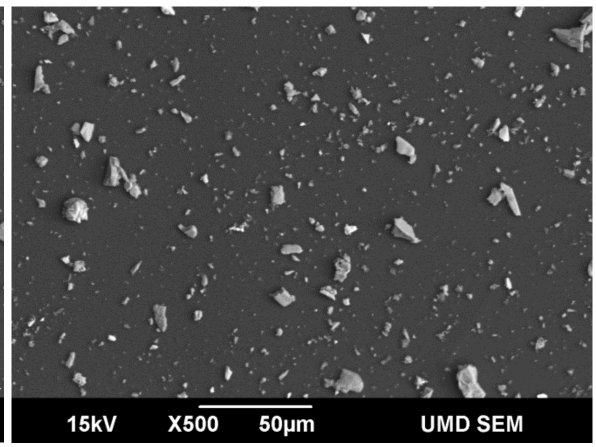
SEM Images of NorthMet Flotation Tailings

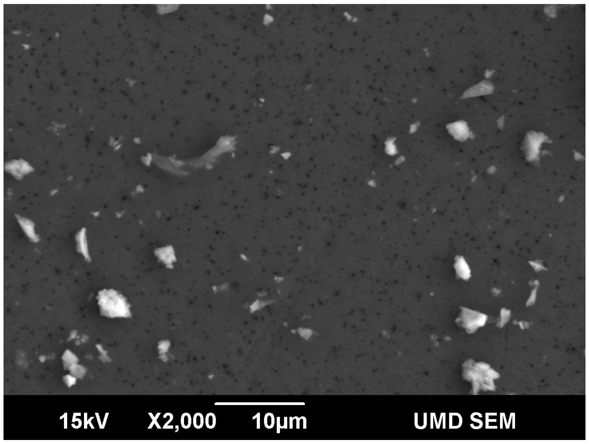


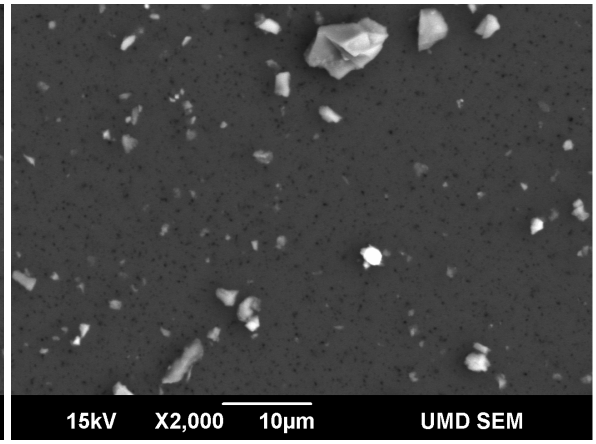


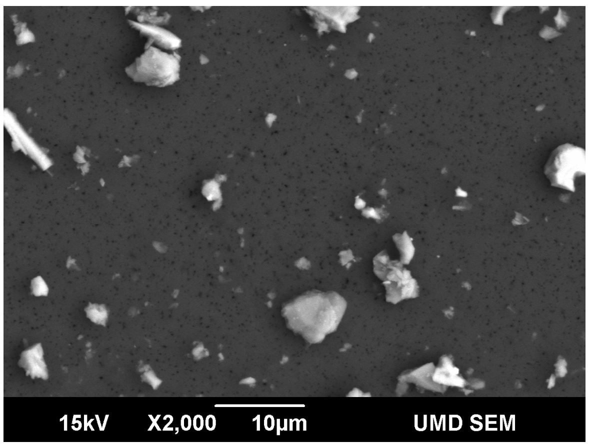


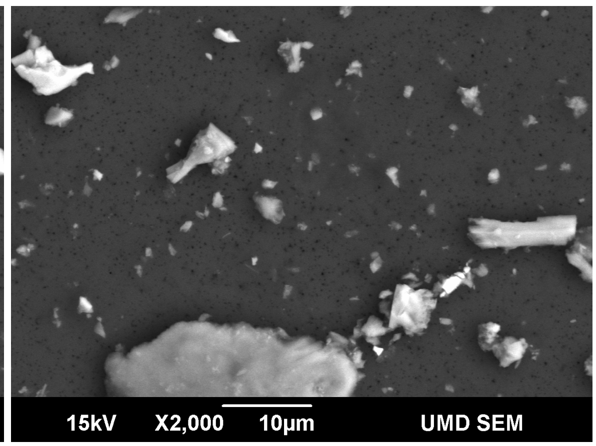


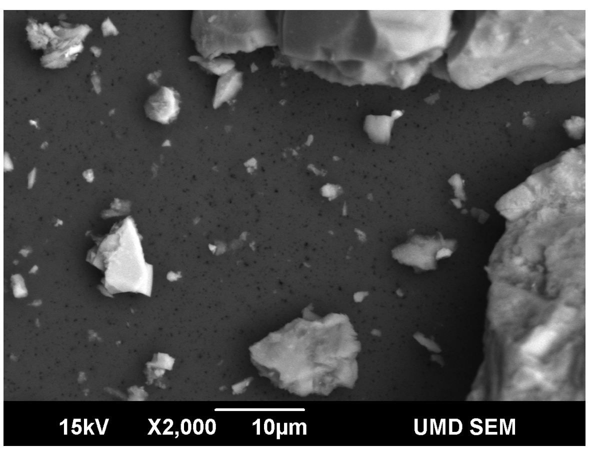
SEM Images of NorthMet Flotation Tailings

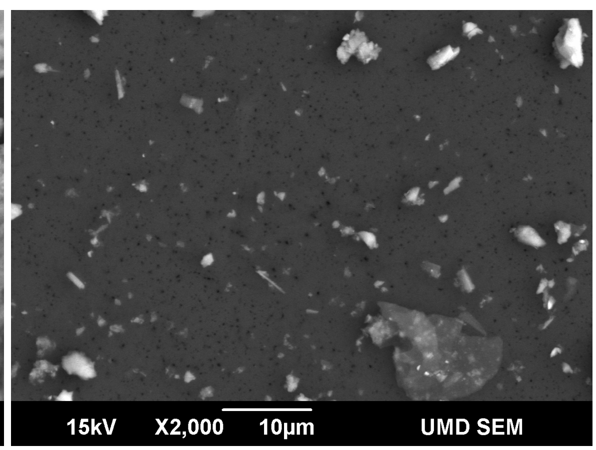












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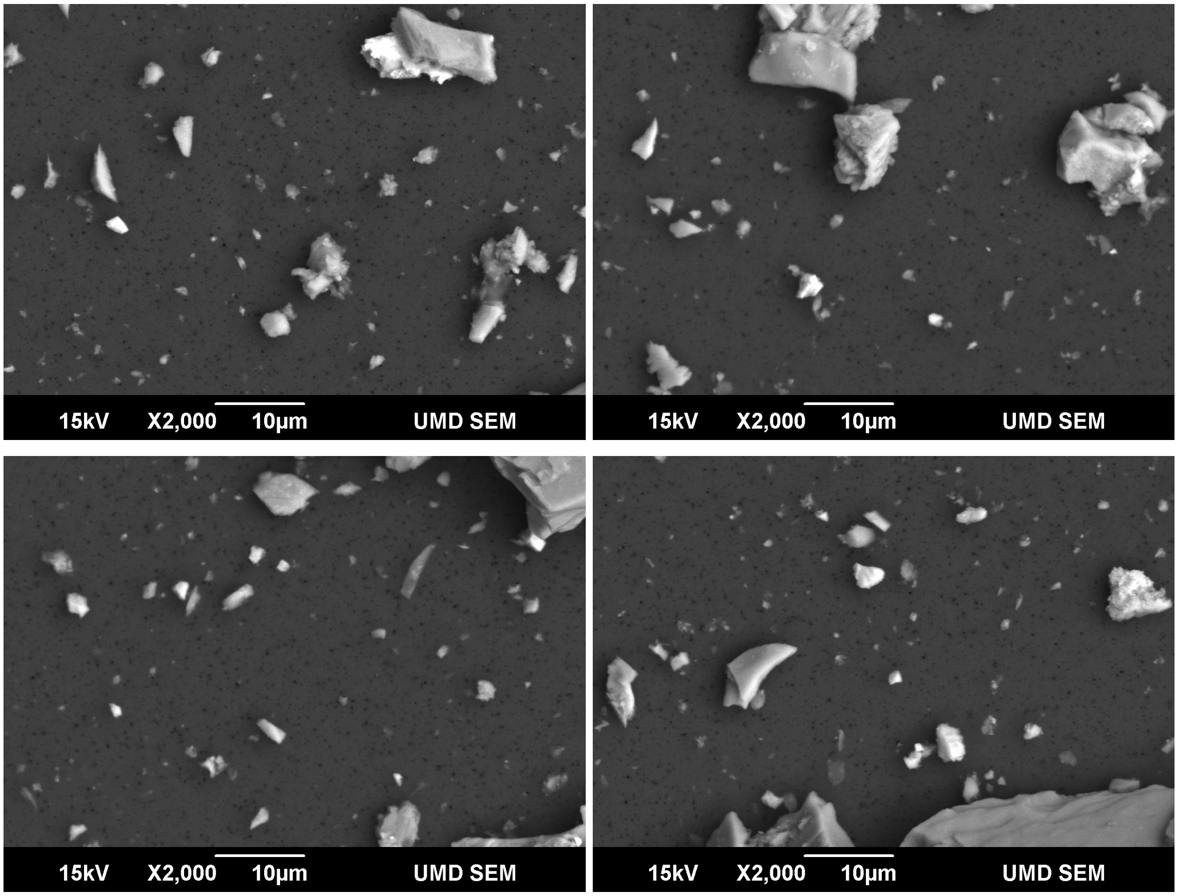
SEM Images of NorthMet Flotation Tailings



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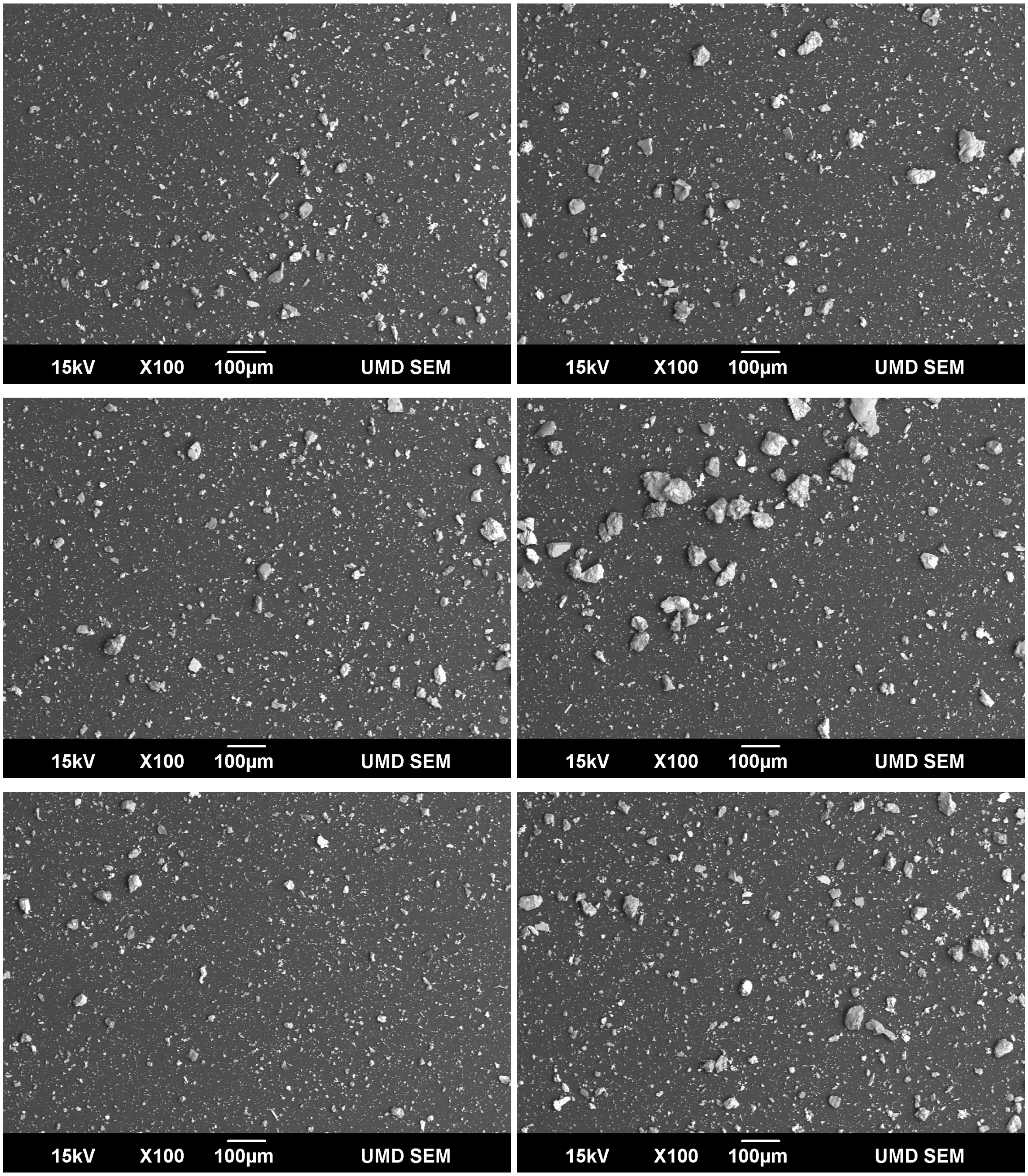
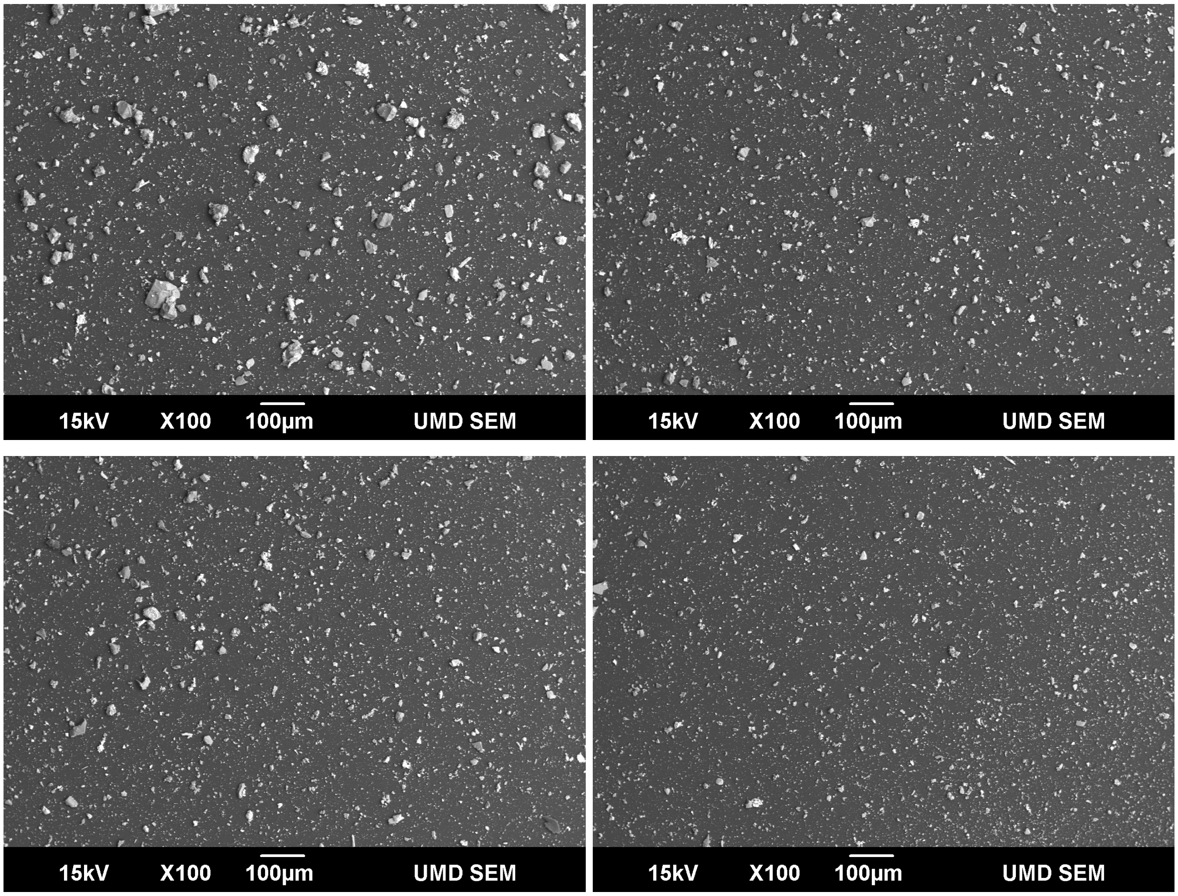
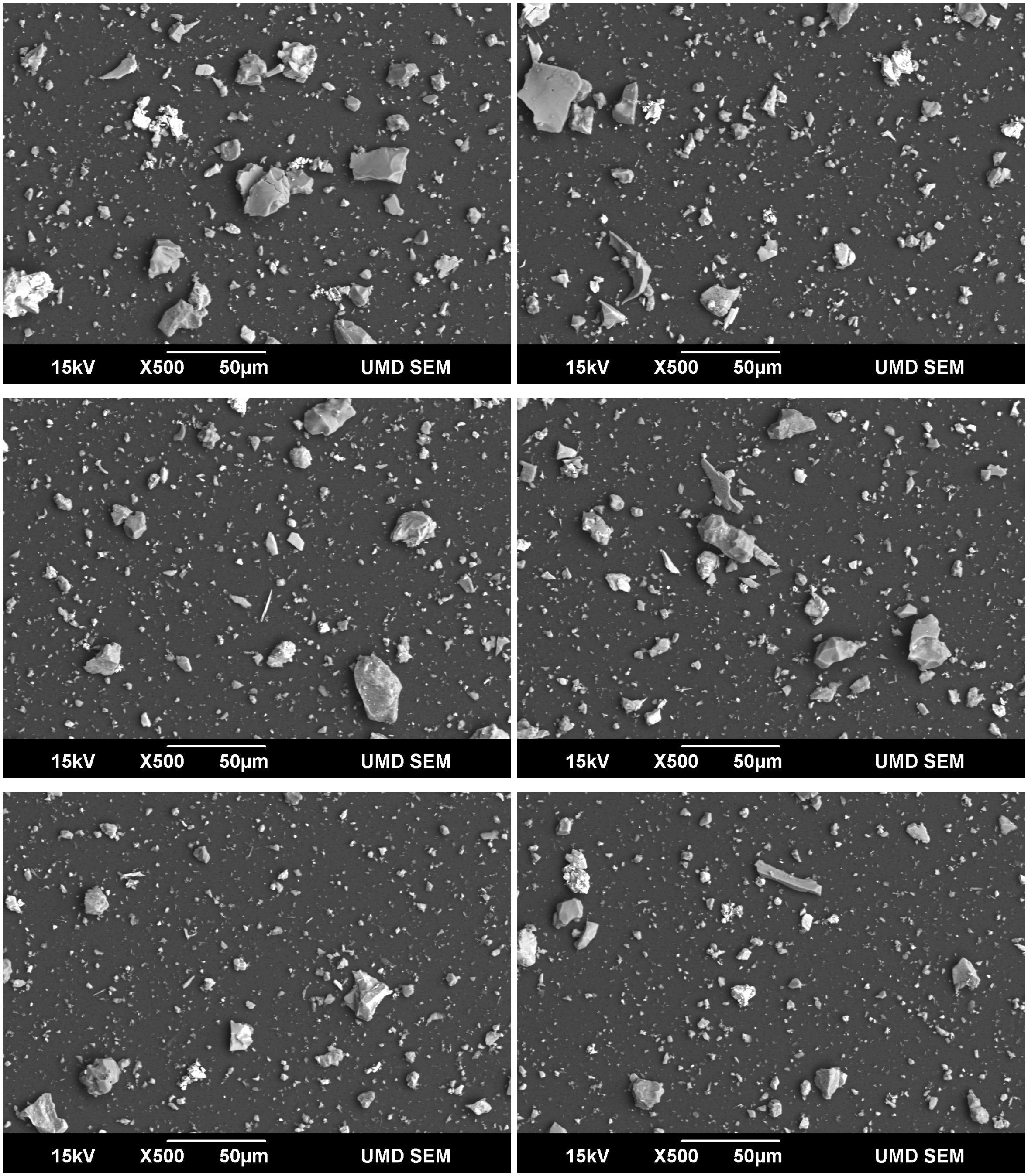
SEM Images of LTVSMC Tailings



SEM Images of LTVSMC Tailings



SEM Images of LTVSMC Tailings



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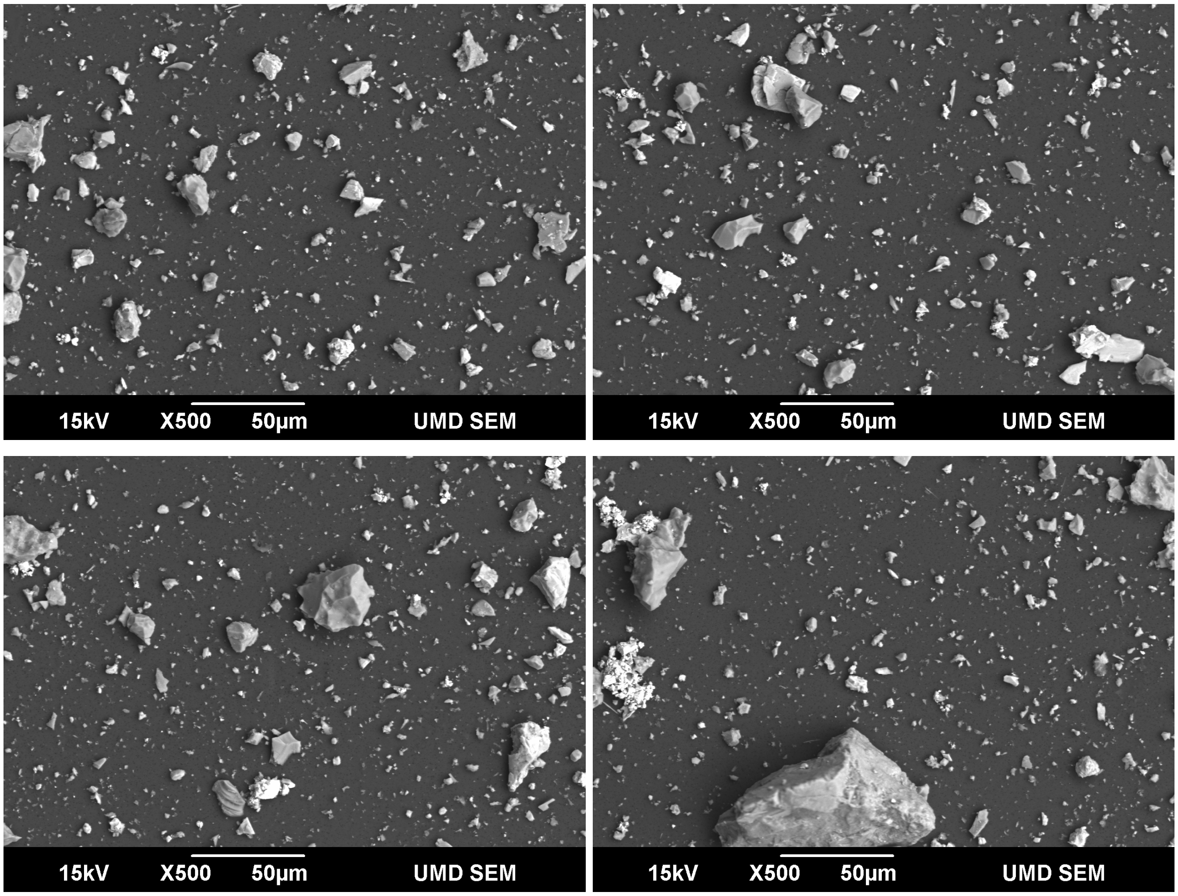
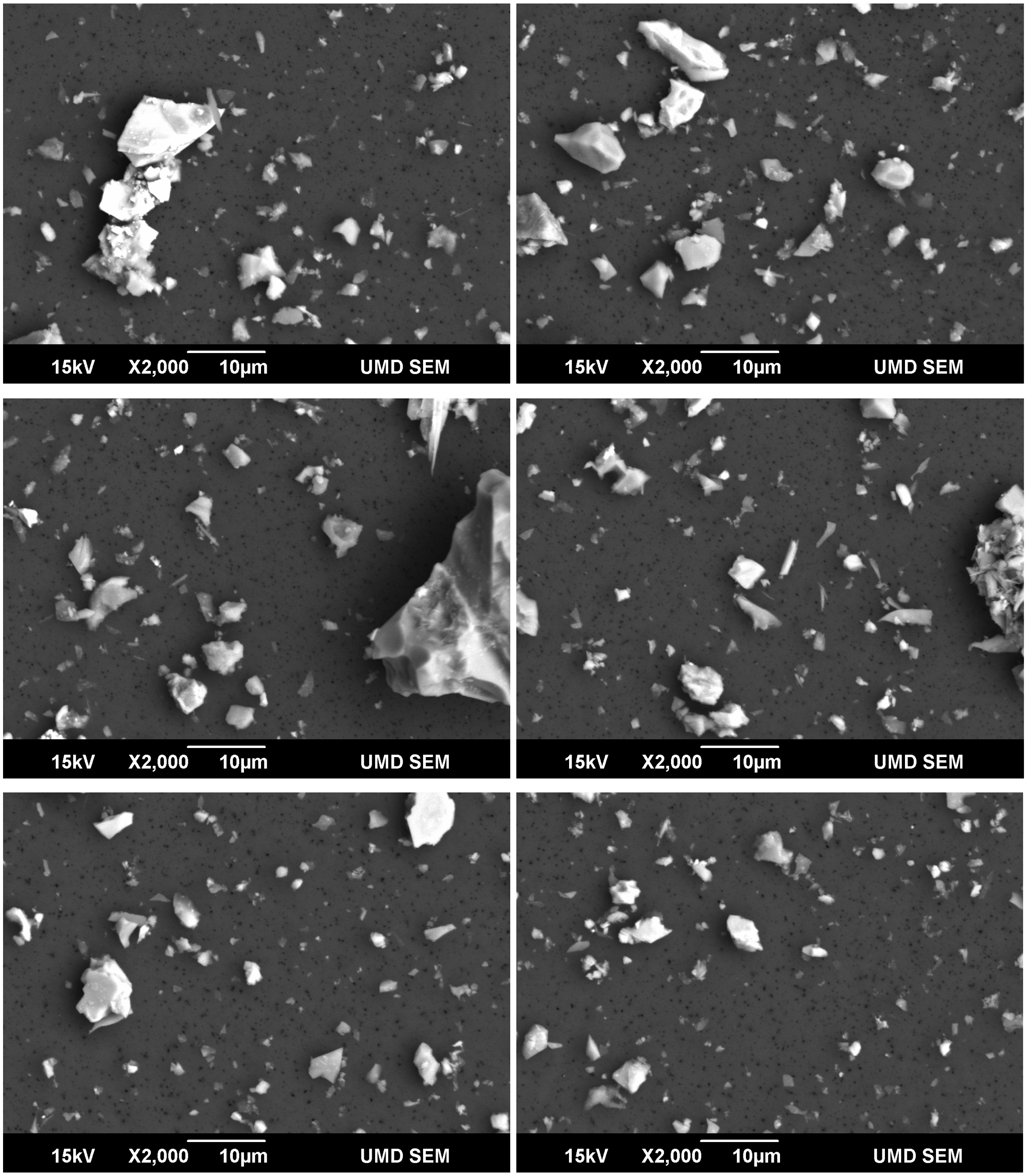
SEM Images of LTVSMC Tailings



SEM Images of LTVSMC Tailings



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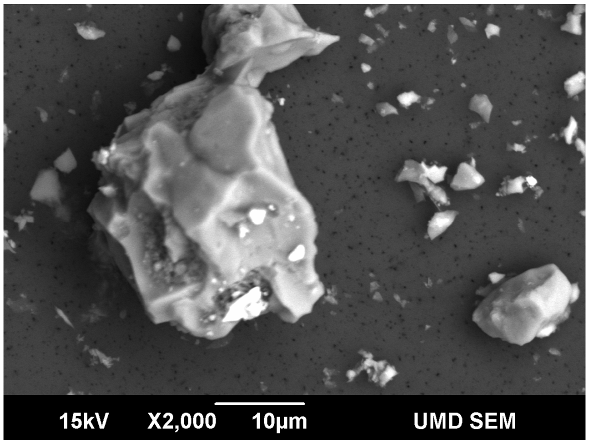
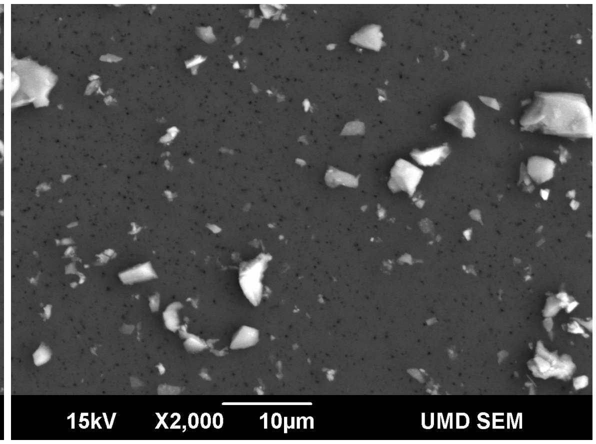
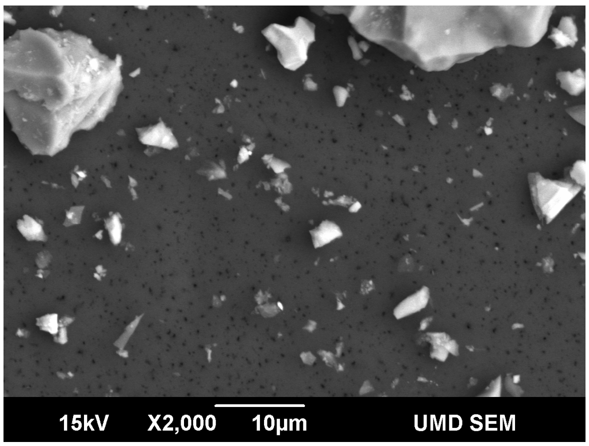
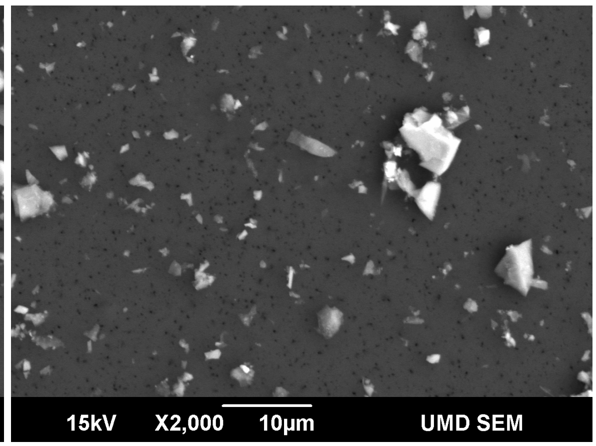
SEM Images of LTVSMC Tailings









Attachment L

NorthMet Tailings Weathering Memorandum

Technical Memorandum

To: Tom Radue, Bethany Erfourth
From: Tamara Diedrich, Mehgan Blair
Cc: Stephen Day, SRK
Subject: Weathering of NorthMet Flotation Tailings
Date: April 4, 2013
Project: NorthMet Project – 23690862.00-037

Problem Statement

Flotation Tailings produced by a future NorthMet Mine during beneficiation of ore would be comprised of minerals typical of rock from the Duluth Complex (geologic source of NorthMet ore). In geologic time, these minerals can be expected to weather when exposed to surficial conditions, resulting in alteration of the original mineral assemblage through oxidation, hydrolysis, dissolution, leaching, and precipitation of secondary minerals. This process is consistent with the weathering that generally occurs to igneous rock exposed to conditions on the Earth's surface over geologic time.

This memo presents results of a qualitative evaluation of the likely extent of weathering to occur in NorthMet Flotation Tailings over approximately 2,000 years using existing data on mineral, chemical, and physical characteristics of the Flotation Tailings as produced from the NorthMet pilot plant; along with peer-reviewed scientific literature values on weathering rates. Alteration of NorthMet Flotation Tailings due to weathering may, or may not, be consequential with respect to the geotechnical properties of the NorthMet Flotation Tailings; the geotechnical implications of weathering are not addressed in this memo.

Background

Petrographic analysis[1] indicates that NorthMet Flotation Tailings will be comprised of the following minerals:

Table 1. Mineralogy of Flotation Tailings Samples, as Identified by Optical Petrography

Sample ID	P1S	P1SA	P1SOLID	P2S	P3S
Plagioclase (%)	80	75	60	50	60
Olivine (%)	12	15	15	10	10
Clinopyroxene (%)	4	5	5	4	5
Orthopyroxene (%)	1	2	1		1
Pyrite (%)	rare	rare	rare	rare	rare
Pyrrhotite (%)	0.25	0.25	0.25	0.5	0.25
Chalcopyrite (%)	rare	rare	rare	rare	rare
Biotite (%)	1	1	1	1	1
Chlorite (%)	0.5	0.25	1	1.5	1
Serpentine (%)					0.25
Sericite/Muscovite (%)	0.25	0.5	1	2	1
Sphalerite (%)	rare	rare	rare		rare
Galena (%)	rare	rare	rare	rare	rare
Ilmenite (%)	1	1	0.75	1	0.5
Clay/unidentified (%)			15	30	20

Plagioclase (representing 50-80% by volume) makes up the bulk of the tailings. Electron microprobe analysis of selected individual plagioclase crystals in NorthMet ore and waste rock indicates that the plagioclase has an intermediate composition between anorthite (with an idealized formula of $CaAl_2Si_2O_8$) and albite (idealized formula of $NaAlSi_3O_8$). The average NorthMet plagioclase composition is 59% anorthite, and 41% albite (i.e. $An_{59}Ab_{41}$)[2]. This composition of plagioclase is also referred to as labradorite, and has a generalized chemical formula of $Ca_{0.59}Na_{0.61}(Al, Si)_4O_8$.

Plagioclase is susceptible to the primary agents of chemical weathering: water, oxygen, and carbonic acid (produced from the interaction of rainwater with atmospheric CO_2). The

[1] Tailings Petrographic Description, Appendix B.1 in: SRK Consulting, RS54/RS46- Waste Water Modeling-Tailings NorthMet Project- DRAFT 01, July 20, 2007. Report Prepared for PolyMet Mining Inc.
[2] Results of Microprobe Analysis, Appendix D.3 in SRK Consulting, RS53/RS42- Waste Rock Characteristics/Waste Water Quality Modeling-Waste Rock and Lean Ore- DRAFT 01, March 9, 2007. Report prepared for PolyMet Mining, Inc.

weathering process takes place at the surface of minerals, and results in the *in-situ* formation of new, stable minerals, and leached ions such as silica, potassium, hydrogen, sodium, and calcium in solution, through reaction such as:

$$CaAl_2Si_2O_{8\ (Anorthite)} + H_2CO_3 + H_2O \rightarrow CaCO_{3(Calcite)} + Al_2Si_2O_5(OH)_{4\ (Kaolinite)} \quad (1)$$

Due to the predominance of plagioclase in the NorthMet Flotation Tailings, as well as the likelihood that it will weather to some extent over the timeframe of 2,000 years, the focus of the following evaluation will be on plagioclase weathering.

It is notable, that while making up a small fraction of the volume of the original tailings, iron sulfide minerals (pyrite, pyrrhotite, chalcopyrite, ± sphalerite) and less predominant iron- and magnesium-bearing minerals, such as olivine [$(Mg, Fe)_2SiO_4$] and clinopyroxene [$(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$], will also be undergoing weathering. The release of iron, (as Fe^{2+}) from these phases, followed by almost immediate precipitation of iron as Fe^{3+}-oxyhydroxides (in an oxygen-rich system) will result in the accumulation of iron oxide coating on mineral surfaces and cements[3].

Plagioclase Weathering Evaluation

The rate of plagioclase weathering per mass plagioclase at any given time can be represented by:

$$Q = R * S * t \quad (2)$$

Where Q (mol/kg) is the number of moles of plagioclase reacted per kg original plagioclase, S (m^2/kg) is the specific surface area, t (sec) is time, and R (mol $m^{-2}s^{-1}$) is the weathering rate constant for plagioclase.

For the following evaluation of the extent of plagioclase weathering, estimates of S and R were required.

[3]Iron oxyhydroxide coatings have been shown to increase residual strength, dilatancy and friction angle of sand: Larrahondo, J.M., Zhao, Q., and Burns, S.E., 2010, Effects of ferric oxyhydroxide coatings on sand shear response: a laboratory approach to chemical weathering, *in* Characterization and Behavior of Interfaces: Proceedings of Research Symposium on Characterization and Behavior of Interfaces, 21 September, 2008, Atlanta, Georgia.

Specific Surface Area

In previous investigations[4], Flotation Tailings were separated into particle size fractions representing a fine end member (-200 mesh) and two coarser fractions (+200 to -100 mesh; and +100 mesh). Consistent with equation (2), the extent of weathering will be directly related to the amount of surface area available for reaction. As a simplifying assumption, the Flotation Tailings were assumed to have a size distribution represented by the existing "fine" fraction. This assumption may result in an overestimate of the amount of plagioclase weathered because the fine fraction will have a greater specific surface area than the coarse fraction. In a future NorthMet tailings basin, the actual size distribution of tailings will be intermediate between the fine and coarse fragments and will be dependent at any given location on physics of the depositional environment. Generally, specific surface area is equal to:

$$S = surface\ area/mass \tag{3}$$

Assuming cubic particles with edge length D (m), equation (3) is equivalent to:

$$S = 6D^{-1}\rho^{-1} \tag{4}$$

where ρ (kg/m^3) is the bulk density. Assuming a uniform particle edge length of 0.0375 mm (midpoint of -200 mesh fragment) and an average bulk density[5] of 3,000 kg/m^3, the specific surface area of the fine fraction would be approximately 53 m^2/kg tailings. If 80% of the fine fraction is plagioclase (Table 1), and the plagioclase is uniformly distributed in the tailings (consistent with petrographic observations), this implies that 53 m^2/kg tailings $\times 0.8 = 42.4$ m^2/kg tailings surface area can be attributed to plagioclase.

Weathering Rates

Extrapolating weathering rates over multiple orders of magnitude presents a challenge because weathering rates of silicate minerals are dependent on time due to complex interplay of competing factors[6].

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[4] Laboratory Report for Barr Engineering Company (Tailings Samples), Attachment D, Barr Engineering Company, NorthMet Project Waste Characterization Data Package, Version 10, Issue Date, March 7, 2013.

[5] Laboratory Report for Barr Engineering Company (Tailings Samples), Attachment D, Barr Engineering Company, NorthMet Project Waste Characterization Data Package, Version 10, Issue Date, March 7, 2013.

[6] As described in: White, A. F., and Brantley, S.L., 2003. The effect of time on the weathering of silicate minerals: why do weathering rates differ in the laboratory and field? Chemical Geology, v. 202, p. 479-506, time-dependent silicate weathering rates reflect effect of *intrinsic* factors (having to do with changes in reactive surface area and availability with time) and *extrinsic* factors (changes in the chemical environment with time that decrease energetic driver for dissolution, i.e. thermodynamic systems approaching equilibrium).

Published labradorite weathering rates[7,8] (specific to field-based, geometric surface area-normalized studies) were used to calculate the mass of plagioclase that might be expected to weather over periods of 20, 200, and 2,000 years in NorthMet Flotation Tailings. Table 2 summarizes these calculations.

Table 2. Labradorite weathering rates applied to NorthMet Flotation Tailings.

Weathering Duration (yrs)	Specific surface area (m^2/kg)	Labradorite surface area (m^2/kg tailings)	Log R	Labradorite weathered (mols/kg tailings)	Labradorite weathered (g/kg tailings)	Labradorite weathered (% of original rock, by mass)
20	53	42.4	*-13.7*[1]	*0.001*	*0.14*	*0.0%*
	53	42.4	**-12.9**[2]	**0.003**	**0.91**	**0.1%**
200	53	42.4	*-13.7*	*0.005*	*1.45*	*0.1%*
	53	42.4	**-12.9**	**0.034**	**9.15**	**0.9%**
2000	53	42.4	*-13.7*	*0.053*	*14.50*	*1.4%*
	53	42.4	**-12.9**	**0.337**	**91.47**	**9.1%**

[1] *Italicized* values in Table 1 are from Kenoyer and Bowser, 1992.
[2] **Bold** values in Table 1 are from Benedetti et al., 1994.

Results-Extent of Plagioclase Weathering

The amount of labradorite weathered (as a percent of the original tailings mass) ranges from 0.0-0.1% when weathered for 20 years, from 0.1-0.9% when weathered for 200 years, and from 1.4-9.1% when weathered for 2,000 years.

[7] Kenoyer, G.J., Bowser, C.J., 1992. Groundwater chemical evolution in a sandy silicate aquifer in Northern Wisconsin: 2. Reaction modeling. Water Resources Research, v. 28, p. 591-600.

[8] Benedetti, M.F., Menard, O., Noack, Y., Caralho, A., Nahon, D., 1994. Water-rock interactions in tropical catchments: field rates of weathering and biomass impact. Chemical Geology, v. 188, p. 203-220.

Attachment M

Material Strength Characterization Review by Scott Olson

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REVIEW MEMORANDUM

To: Mr. Thomas Radue, PE
From: Scott Olson
Date: April 10, 2013
RE: Comments on static and seismic liquefaction issues
NorthMet Project – Flotation Tailings Basin

This memorandum provides my comments on your stability and liquefaction assessment for the Flotation Tailings Basin (FTB) for the NorthMet Project. Specifically, my review involved the following items.

1. Strength estimates for use in slope stability analysis (drained, undrained, and liquefied).
2. Static and seismic liquefaction triggering analyses.
3. Slope stability analyses, particularly for liquefied conditions.

As part of my analysis, I reviewed the project documents listed below, and met with Barr Engineering, Inc. (Barr) personnel on July 19 and July 30, 2012 to discuss their analyses performed to date. The documents included:

1. NorthMet Project – Flotation Tailings Management Plan, Version 1; dated 10/31/2011. <*filename: Flotation Tailings Management Plan – v1 OCT2011.pdf*>
2. NorthMet Geotechnical Modeling Work Plan, Version 2; dated 3/08/2012. <*filename: 2012 0308 Revised Geotechnical Modeling Workplan FINAL.pdf*>
3. NorthMet Project, Geotechnical Data Package, Volume 1 – Flotation Tailings Basin, Version 2; dated 7/13/2012. Document includes Attachments A through L. <*filename: NorthMet Data Package – Geotechnical Vol 1 v2 – rev 2.docx*>
4. NorthMet Project, Geotechnical Data Package – Volume 1 – Version 2, Attachment X – Material Strength Characterization (Draft Version 2); dated 8/2012. Document includes Appendices A through D. <*filename: Material Strength Characterization_8-6-12.docx*>
5. NorthMet Project, Geotechnical Data Package, Volume 1 – Flotation Tailings Basin, Version 3; dated 11/7/2012. <*filename: NorthMet Data Package – Geotechnical Vol 1 Ver3 – 11_02_2012.docx*>
6. NorthMet Project, Geotechnical Data Package – Volume 1 – Version 2, Attachment E – Material Strength Characterization; dated 8/2012. Document includes Appendices A through D. <*filename: Material Strength Characterization_08_06_2012.docx*>
7. GeoSlope software analyses for “Eroded,” “Liquefied,” “Static PMP,” and “Triggering Analysis” conditions for Section F of Cell 1E.
8. Site aerial and surface photographs taken by Barr personnel.

In addition, I have reviewed new versions, Minnesota Department of Natural Resources (MDNR) comments, and response to comments from Barr following the February and March 2013 project workshops. The comments in this memorandum related to strength characterization are chiefly focused on the latest versions of Barr's submittals, i.e., Version 4 of documents 5 and 6 above, and address comments and discussions that occurred during and following the February and March 2013 workshops.

Strength Estimates for Use in Slope Stability Analyses

Using the data available in the documents listed above, I evaluated Barr's interpretation of strengths for drained, undrained (peak or yield), and liquefied conditions for use in slope stability analyses. The materials involved at the site include coarse tailings, fine tailings, tailings slimes, composite material (combined fine tailings and tailings slimes), flotation tailings, foundation peat, and foundation till. These strengths and my additional comments and recommendations are provided below.

In general, I recommend that a consistent statistical metric be employed to estimate the shear strengths for each material. Specifically, I recommend that the 33rd percentile values be utilized for the drained and peak (or yield) undrained shear strengths. The 33rd percentile values correspond to values where 1/3 of the data are less than and 2/3 of the data are greater than the selected value. This approach, widely used in practice, yields strength values that are relatively conservative, yet not overly conservative. In contrast, I recommend that the average values be selected for the liquefied shear strengths. The rationale for utilizing an average value, rather than a 33rd percentile value, is: (1) the liquefied shear strength is the lowest shear strength available to contractive soils during undrained loading; (2) the required factor of safety for liquefied conditions (FS $\geq$ 1.1) is larger than typically required for liquefaction flow failure stability analyses, and therefore, a strength higher than the 33rd percentile is justified; and (3) a significant portion of the tailings materials were predicted to dilate during shear and were discounted from the liquefied shear strength estimates. Incorporating these dilative zones into the liquefied shear strength estimates would significantly increase the overall post-triggering strength of the tailings materials.

Strengths can be estimated from direct measurement in-situ (e.g., field vane shear test), direct measurement in the laboratory, and indirectly using correlations with in-situ tests (e.g., SPT and CPT). Each method has distinct advantages and disadvantages. Field vane shear tests provide direct measurements of in-situ strength; however, the drainage conditions must be known to properly interpret the measured strengths. Furthermore, the mode of shear differs from that typically encountered in failures. Nevertheless, where drainage conditions can be reasonably interpreted (and at least six to ten tests are available), field vane shear test results can provide reasonable strength estimates.

Laboratory tests also directly measure material strength, methods for reconstituting specimens can reasonably mimic some man-made artificial fills, and, most importantly, the site-specific materials are tested. Therefore, where available, laboratory tests can provide reasonable strength estimates when the appropriate stress-strain behavior is observed. That is, strengths for materials that are predicted to be contractive should be estimated from laboratory tests where contractive stress-strain response is observed.

Correlations between strength and penetration resistance also are valuable, particularly where contractive, nonplastic specimens are difficult to retrieve or reconstitute. Furthermore, strength correlations utilize in-situ penetration tests (which indicate soil state) and experience from field observations of failures. However, these correlations are not based on site-specific materials and behavior. Therefore, where reliable laboratory results are available, I recommend that laboratory-measured strengths be weighted equally with estimates from field tests (i.e., ½ lab and ½ field). The field tests can be combined in two ways. First, strengths estimated from SPT and CPT correlations can be weighted equally (i.e., ½ SPT and ½ CPT). Then, where a statistically-significant number of reliable FVST are available, these strengths should be weighted equally with the average strength estimate from SPT and CPT correlations (i.e, ½ SPT-CPT average and ½ FVST). Alternately, where the number of FVST is not statistically-significant or the drainage conditions for the tests are uncertain, these tests can be considered with the SPT-based and CPT-based correlations individually (i.e., 1/3 SPT, 1/3 CPT, and 1/3 FVST).

Drained Strength – Coarse Tailings. The coarse tailings consist chiefly of nonplastic silty sand-sized particles with fines contents (FC; percent by weight passing the No. 200 sieve) ranging from about 0 to 25%. The drained strength of the coarse tailings was measured in consolidated drained (CD) triaxial compression (TC) tests, drained direct shear (DS) tests, correlations with standard penetration tests (SPT) via Schmertmann (1975), and correlations with piezocone penetration tests (CPTu) via Robertson and Campanella (1983). Based on these tests and correlations, Barr estimated an effective stress friction angle (ϕ') of 38.5°. Considering the density and angularity of the coarse tailings, this value appears to be reasonable. And based on permeability tests performed during oedometer testing, as well as correlations with piezocone dissipation tests, I agree with Barr's assessment that the coarse tailings will be drained during all loading conditions.

Drained Strength – Fine Tailings. The fine tailings consist chiefly of low plasticity (average PI = 4) silty sand to sandy silt with FC ~ 25 to 95%. The drained strength of the fine tailings was measured in CD TC tests and isotropically-consolidated undrained with porewater pressure (PWP) measurements (CIU-bar) TC tests. Empirical correlations with SPT and CPTu results were not employed because of the high FC of the fine tailings. Based on these tests, Barr estimated $\phi' = 33°$. This value appears to be reasonable. Based on permeability testing, I agree with Barr's evaluation that the fine tailings will be undrained during rapid loading and will be drained during long-term loading.

Drained Strength – Slimes. The tailings slimes (or simply, slimes) consist chiefly of low plasticity (average PI = 10) silt and clay-sized particles with FC > 95%. The drained strength of the fine tailings was measured in CD-TC tests and drained DS tests. Again, empirical correlations with SPT and CPTu results were not employed because of the high FC of the slimes. Based on these tests, Barr estimated $\phi' = 33°$. This value appears to be reasonable. Based on permeability testing, I agree with Barr's evaluation that the slimes will be undrained during rapid loading and will be drained during long-term loading.

Drained Strength – Composite Fine Tailings and Slimes. Owing to the difficulty of differentiating the fine tailings and slimes in the interior portion of the tailings pond, Professor P. Robertson suggested that these materials could be combined for stability analyses. I agree this recommendation. Several sets of composite materials were tested in CD TC, CIU-bar TC, and DS. Based on these tests, Barr estimated $\phi' = 33°$. This value appears reasonable, and it is quite realistic that the fine tailings, slimes, and composite fine tailings/slimes have the same effective stress friction angle. Based on permeability testing, I agree with Barr's evaluation that the composite material will be undrained during rapid loading and will be drained during long-term loading.

<u>Drained Strength – Bulk Tailings.</u> The bulk tailings consist of a mixture of coarse tailings (chief constituent), fine tailings, and slimes. Several sets of bulk tailings were tested in CIU-bar TC. Based on this tests, Barr estimated $\phi' = 38.5°$. This value appears reasonable, and is identical to the friction angle of the chief component material, the coarse tailings. Because this material will consist chiefly of coarse tailings and will be well-compacted, I agree with Barr's assessment that the bulk tailings will be drained during all loading conditions.

<u>Drained Strength – Flotation Tailings.</u> The flotation tailings will have a gradation similar to the fine tailings. The flotation tailings were tested in CIU-bar TC. Based on reinterpretation of these tests, Barr estimated Barr estimated $\phi' = 33°$. This value appears reasonable. Based on permeability testing, I agree with Barr's evaluation that the flotation tailings will be undrained during rapid loading and will be drained during long-term loading.

<u>Drained Strength – Foundation Peat.</u> Peat was encountered in the foundation for the existing tailings near the critical cross-section for slope stability. It is not known whether the peat is fibrous or amorphous; however, based on the photos taken at the site by Barr personnel, I suspect that the peat may be fibrous. Drained strengths were measured in TC and DS. In general, the DS results are more consistent, and I recommend that these values be preferred. Based on the DS tests, Barr recommended a nonlinear failure envelope with a value of $\phi' \cong 27°$ in the linear portion of the envelope. The nonlinear failure envelope appears reasonable.

<u>Drained Strength – Foundation Till.</u> Coarse-grained till is widely present in the foundation of the tailings basin. One strength value was measured in TC, yielding $\phi' = 35°$. SPT-based correlations (Schmertmann 1975) suggested a friction angle near 38°. Based on these data, Barr selected $\phi' = 36.5°$ for design. This value is conservative, but reasonable for the till.

<u>Drained Strength – Other Comments.</u> Some additional observations regarding Barr's evaluation of drained strengths follow.

1. Barr's approach of plotting strengths from each individual test and determining an average is reasonable and widely-used in practice.
2. The angular particle shapes reported for the tailings materials further justifies the effective stress friction angles recommended by Barr.

<u>Yield (Undrained Peak) Strength – Fine Tailings.</u> Barr evaluated yield shear strengths using only empirical correlations based on in-situ penetration test results. The empirical correlation included CPT- and SPT-based yield strength ratios, $s_u(\text{yield})/\sigma'_{vo}$, proposed by Olson and Stark (2003).

Field vane shear tests were also performed in the fine tailings. Field vane tests directly measure shear resistance, and therefore, drainage conditions must be known to properly interpret the test results. However, in layered soils such as the tailings under investigation, it is difficult to reliably assess drainage conditions. As a result, FVST may exhibit considerable variation in layered soils. Furthermore, FVSTs may be performed in dilative soils, resulting in a higher shear resistance than in adjacent contractive soils, which would further contribute to observed strength variations. In contrast, the empirical SPT- and CPT-based correlations do not depend on the drainage conditions during penetration. Therefore, it is not necessary to know the drainage conditions during penetration in the tailings to employ these empirical correlations. Field vane shear tests performed in the fine tailings were discounted because the drainage conditions were not certain. I agree with Barr's choice to discount these data.

A very limited number of laboratory tests were performed on the fine tailings, and of these tests, only three specimens exhibited contractive behavior. Because of the limited number of data, Barr opted not to incorporate these data in the strength interpretation. This is a reasonable approach.

The use of strength ratios for evaluating yield shear strengths (as well as liquefied shear strengths) is supported by laboratory-measured compressibility and critical state lines. Oedometer-measured values of compressibility (C_c) for the fine tailings and slimes averaged 0.11 (range of 0.025 to 0.179) and the critical state line slope (λ_{cs}) was approximately 0.109. As discussed by Olson and Stark (2002), the strength ratio approach is valid when these lines are approximately parallel.

The SPT- and CPT-based correlations relate $s_u(\text{yield})/\sigma'_{vo}$ to overburden stress-normalized SPT blow count [$(N_1)_{60}$] and CPTu tip resistance, q_{c1}. For CPTu data in all tailings materials, I recommend that the yield strength ratios be estimated using q_{T1} (tip resistance corrected for unequal end area effects) rather than q_{c1}. As discussed by Olson and Stark (2003) and Olson (2009), yield strength ratio correlations developed by Olson and Stark (2003) apply only to contractive soils. Contractive or dilative conditions can be evaluated using penetration resistance as proposed by Olson (2009). This is described in more detail later. As a result, estimates of undrained strengths for stability analysis will be conservative, as these estimates do not incorporate the impact of dilative zones.

The SPT- and CPT-based empirical correlations yielded an average $s_u(\text{yield})/\sigma'_{vo}$ of 0.25. This value is reasonable for the contractive fine tailings.

Yield (Undrained Peak) Strength – Slimes. Undrained peak shear strengths for the slimes were measured in CIU-bar TC tests, estimated from SPT- and CPT-based correlations (Olson and Stark 2003), and measured using FVST. Field vane tests utilized in Barr's assessment were performed where adjacent soundings and/or borings were available to confirm material type and state (i.e., contractive/dilative response). As recommended earlier, Barr equally weighted the 33rd percentile values of the field results (i.e., 1/3 CPT, 1/3 SPT, and 1/3 FVST). Again, as recommended earlier, this field value was then averaged with the 33rd percentile strength from the laboratory TC tests. From this exercise, Barr estimated $s_u(\text{yield})/\sigma'_{vo} = 0.22$. This value is reasonable for the contractive slimes.

Yield (Undrained Peak) Strength – Composite Fine Tailings and Slimes. Undrained peak shear strengths for the undifferentiated fine tailings and slimes in the interior portion of the pond were estimated using SPT- and CPT-based correlations (Olson and Stark 2003) and FVST performed in the interior portion of the pond. Again, the FVST were performed where an adjacent sounding and/or boring were available to confirm material type and state. The 33rd percentile values of the CPT, SPT, and FVST strengths were equally weighted to obtain $s_u(yield)/\sigma'_{vo}$ = 0.24. This value is reasonable for the contractive fine tailings/slimes mixture.

Yield (Undrained Peak) Strength – Flotation Tailings. Undrained peak shear strengths for the flotation tailings were measured in CIU-bar TC tests. Fourteen specimens exhibited contractive behavior, with $s_u(yield)/\sigma'_{vo}$ = 0.26. This value appears reasonable for the flotation tailings.

Yield (Undrained Peak) Strength – Peat. Undrained strengths were estimated from CIU-bar TC tests. Based on these tests, Barr estimated $s_u(yield)/\sigma'_{vo}$ = 0.23. This value appears reasonable for the peat.

Liquefied Strength - Coarse Tailings. Prior to assigning a liquefied shear strength, a soil should be evaluated to determine whether it is contractive. Barr used the medium compressibility boundary proposed by Olson (2009) for this evaluation (among other methods). Based on the measured compressibility of the tailings, the use of the medium compressibility contractive-dilative boundary is reasonable for the tailings at the site. Based on this evaluation, Barr concluded that the coarse tailings generally are dilative. As a result, a liquefied shear strength was not assigned to this material. I agree with this assessment.

Liquefied Strength – Fine Tailings, Slimes, and Composite Fine Tailings/Slimes. Because of the limited number of laboratory tests that exhibited contractive behavior (quasi-critical state and critical state strengths), Barr opted to evaluate the liquefied shear strengths of these materials together. As most of the available laboratory data corresponded to the slimes, I believe that this combined interpretation is conservative and defensible. Barr evaluated the state of the tailings using the Olson (2009) medium compressibility boundary, and concluded that approximately 2/3 of the fine tailings are contractive, while nearly all of the slimes are contractive. I agree with this assessment. Furthermore, the composite fine tailings/slimes are likely to be largely contractive given that their component materials are contractive. Therefore, it is appropriate to select liquefied shear strengths for these materials.

Using the results of CIU-bar TC tests (for only contractive specimens that exhibited quasi-critical state or critical state strengths), SPT- and CPT-based correlations for $s_u(liq)/\sigma'_{vo}$, and large-displacement FVST results, Barr recommended $s_u(liq)/\sigma'_{vo}$ = 0.10 for the fine tailings, slimes, and composite fine tailings/slimes.. My understanding is that the laboratory specimens were prepared by moist tamping at their loosest possible void ratio. Based on my experience with similar materials, this depositional method (when successfully achieving contractive specimens) yields reasonable liquefied strength ratios. As I noted above, I recommend that the laboratory tests results be weighted equally with the empirical correlations for evaluating the liquefied shear strength. Based on this recommendation, I find the design value of $s_u(liq)/\sigma'_{vo}$ = 0.10 to be a reasonable interpretation of the available data.

Liquefied Strength – Flotation Tailings. Liquefied shear strengths for the flotation tailings were measured in CIU-bar TC tests. A limited number of specimens exhibited contractive behavior (quasi-critical state or critical state) throughout shearing, with $s_u(liq)/\sigma'_{vo} \sim 0.12$. This value appears reasonable.

Liquefied Strength – General Comments. Some additional observations regarding Barr's evaluation of liquefied shear strengths follow.

1. Again, where appropriate, laboratory tests should be equally weighted with the empirical correlations for liquefied strength ratio. Empirical correlations suggest that $s_u(liq)/\sigma'_{vo}$ can vary by about 0.06 for a given value of q_{c1} (or q_{T1}) and $(N_1)_{60}$. As a result, the empirical correlations should not supersede laboratory measurements of liquefied shear strength where the appropriate response is observed (i.e., quasi-critical state or critical state response for materials predicted to be contractive).
2. As the density of the tailings materials varies with depth, it is not unusual for the FVST results to vary with depth. Therefore, Barr appropriately interpreted the FVST results with respect to the CPT strength and state profiles to assess whether the FVST results follow identifiable patterns.

Static and Seismic Liquefaction Triggering Analyses

Numerous mechanisms have triggered static liquefaction at tailings retention facilities worldwide, including overtopping, rapid tailings placement, starter dike erosion, drainage system failure, among others. It is good engineering practice to evaluate triggering mechanisms that are considered plausible. However, as a result of the multitude of potential static triggering mechanisms, the state-of-practice in tailings facility design is to assume that liquefaction may be triggered in contractive tailings and to evaluate the "lower bound" factor of safety against potential flow failure. Contractive soils are assigned liquefied shear strengths for this analysis. The failure surfaces evaluated by Barr for all of the the static and seismic stability analyses described below appear reasonable.

Specifically, Barr evaluated static triggering mechanisms involving: (1) an elevated phreatic surface as a result of an ineffective drain; (2) rapid fill placement during Lift 1; (3) local erosion/scour (oversteepening of the exterior slope) resulting from pipe break; and (4) an elevated phreatic surface resulting from an ineffective drain with a high pond level (from PMP event. rapid rise during Lift 1. Each of these analyses indicated that liquefaction was unlikely to be triggered in the contractive tailings. And each analysis was performed in consultation with the author, and I believe that the results are reasonable.

In addition to these plausible static triggering mechanisms, it is standard practice (and I agree with Barr's approach) to assume that some static event (either one of the events analyzed by Barr, or an unknown event) could trigger liquefaction within the contractive soils, and evaluating the post-triggering factor of safety. While I maintain that a $FS_{flow} \geq 1.0$ is appropriate for an unknown triggering event[1] (that has a very low likelihood of occurrence) combined with the assumption that all tailings simultaneously liquefy, Barr computed FS_{flow} >

[1] A factor of safety (FS) against seismic liquefaction of 1.2 is required by some regulatory agencies. This is the FS against the triggering of liquefaction ($FS_{triggering}$) by seismic shaking. Barr used $FS_{triggering} \geq 1.2$ for the seismic case and $FS_{triggering} \geq 1.1$ for non-seismic triggering cases per the recommendations of Olson and Stark (2003). This $FS_{triggering}$ differs from the factor of safety against flow failure (FS_{flow}). In a flow failure/post-triggering stability analysis, any slice that $FS_{triggering} \leq 1.1$ was assigned its liquefied shear strength for the stability analysis. The post-triggering stability analysis (utilizing the liquefied shear strength in slices triggered to liquefy) is performed to compute FS_{flow}. Based on my experience, many regulatory agencies (e.g., USACOE) allow FS(flow) ≥ 1.0.

1.1 for this case when the external berm was raised by 4 ft (to El. 1538). I believe that this result is reasonable and defensible.

Barr also considered an unknown trigger causing liquefaction after closure of the facility (up to 2000 years after closure). This analysis incorporated potential weathering of the tailings materials (thereby decreasing the liquefied shear strengths of the tailings materials) as well as secondary compression (which increases the liquefied shear strengths of the tailings). As the beneficial effects of secondary compression outweigh the detrimental effects of weathering, and because the closure plan will promote long-term dewatering of the tailings (below the surficially-maintained pond), it is reasonable that Barr was computing that the FS_{flow} increases with time after closure.

Lastly, in addition to static triggering mechanisms, earthquake shaking has caused numerous liquefaction-induced failures of tailings facilities. As part of the seismic analysis, Barr performed a probabilistic seismic hazard analysis (PSHA) for the site. In my experience, the number of individual "sources" that were used (and then combined) for the New Madrid seismic zone (NMSZ) is unusually high. This potentially overestimates the hazard from the NMSZ. And although it is unusual to use multiple uniform hazard spectra for a given site, the bi-modal hazard presented at this site from the near-field and far-field sources warrants this analysis approach. It appears that the seismic triggering analysis performed by Barr is reasonable and correct, although I did not perform a detailed review of the spreadsheet calculations. The seismic triggering analysis was performed using updated version of the cyclic stress method endorsed by Youd et al. (2001), as well as the version proposed by Idriss and Boulanger (2008). Both methods predicted that seismic liquefaction of the tailings is highly unlikely.

I look forward to discussing these comments and recommendations with your project team.

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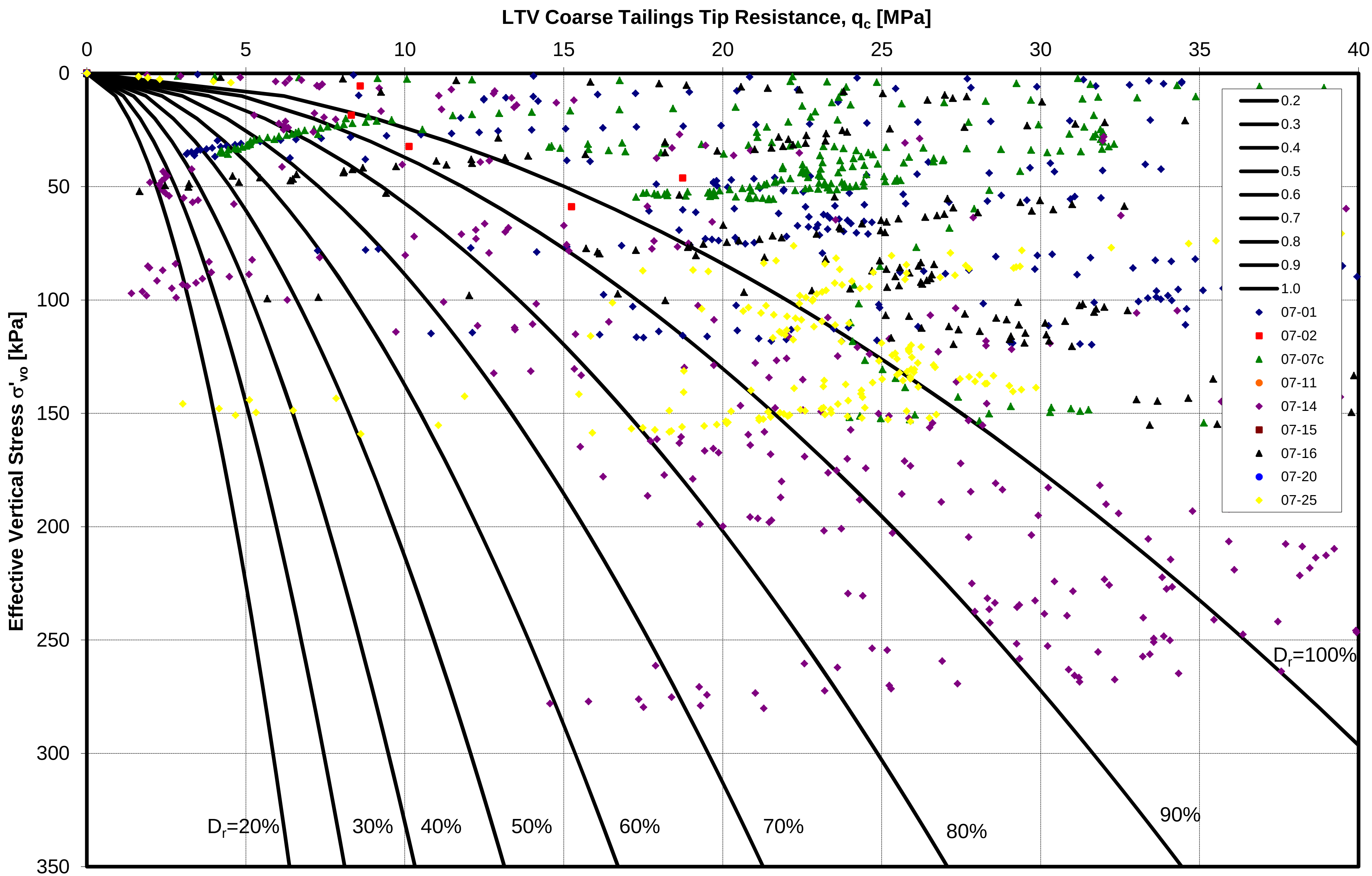
Attachment N

Processed CPT Results



Relative Density Relationship for CPT Data from LTV Coarse Tailings (Baldi et *al.*, 1986)

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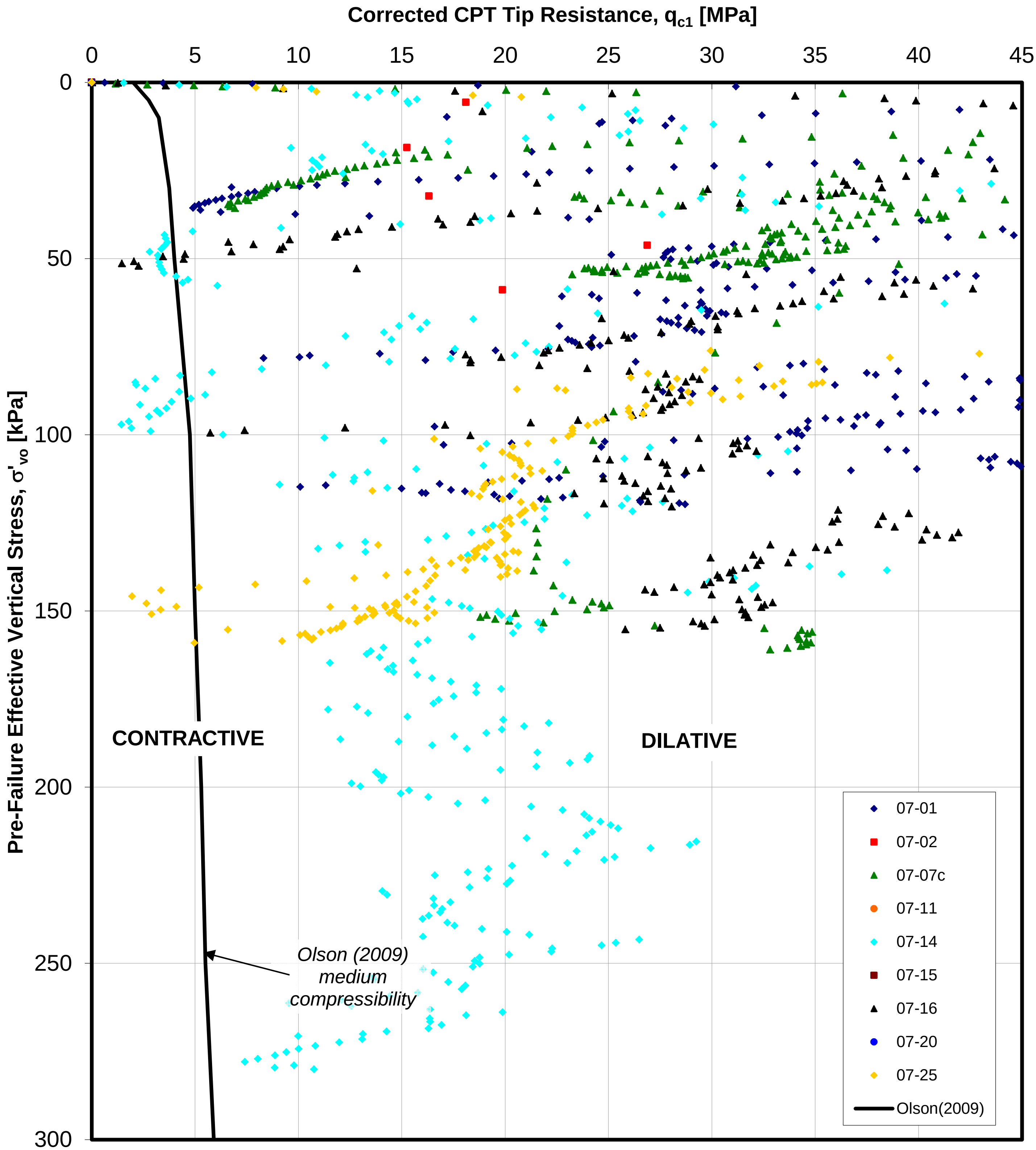

LTVSMC Coarse Tailings Contractive/Dilative Behavior based on CPT data (Fear and Robertson, 1995)

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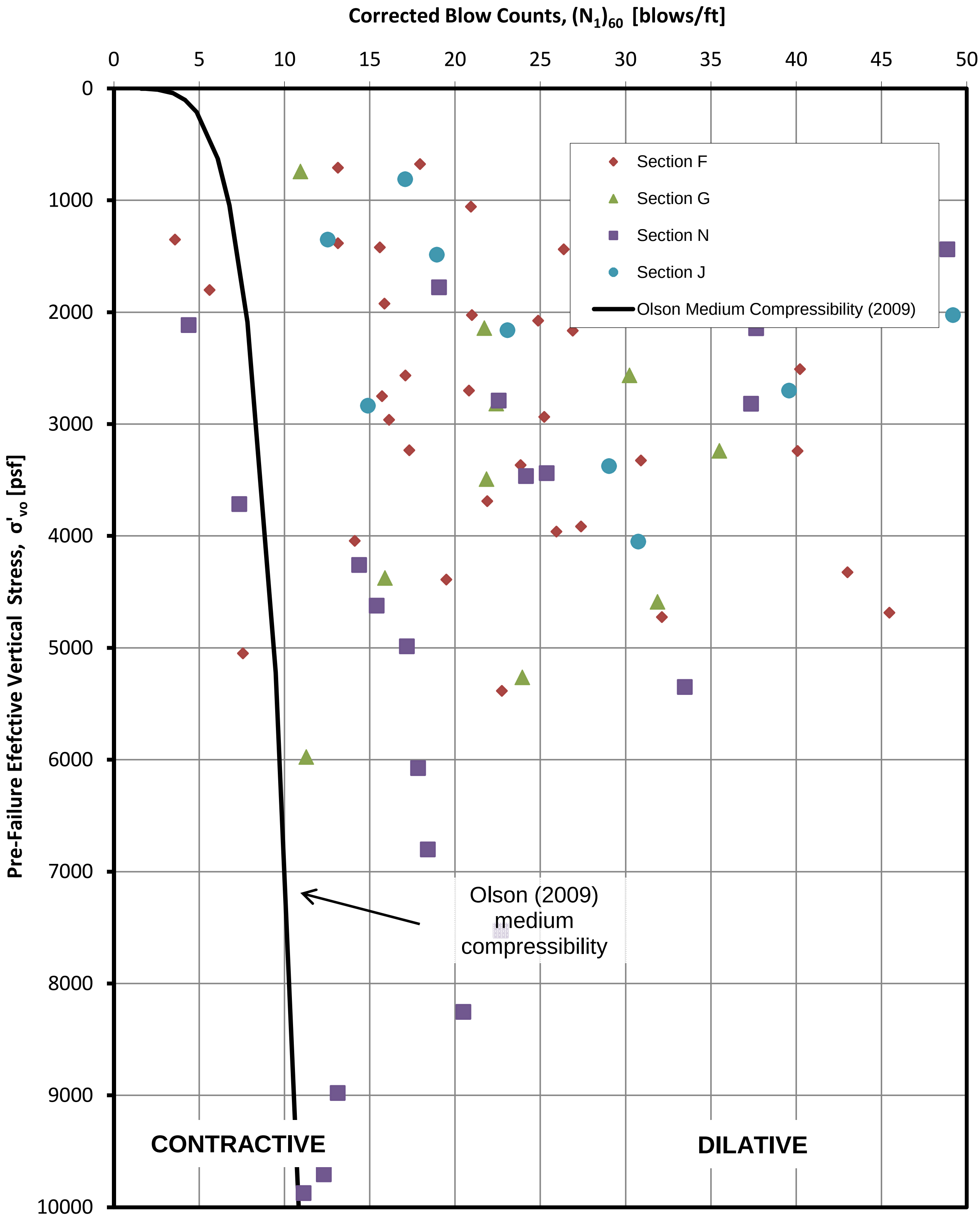
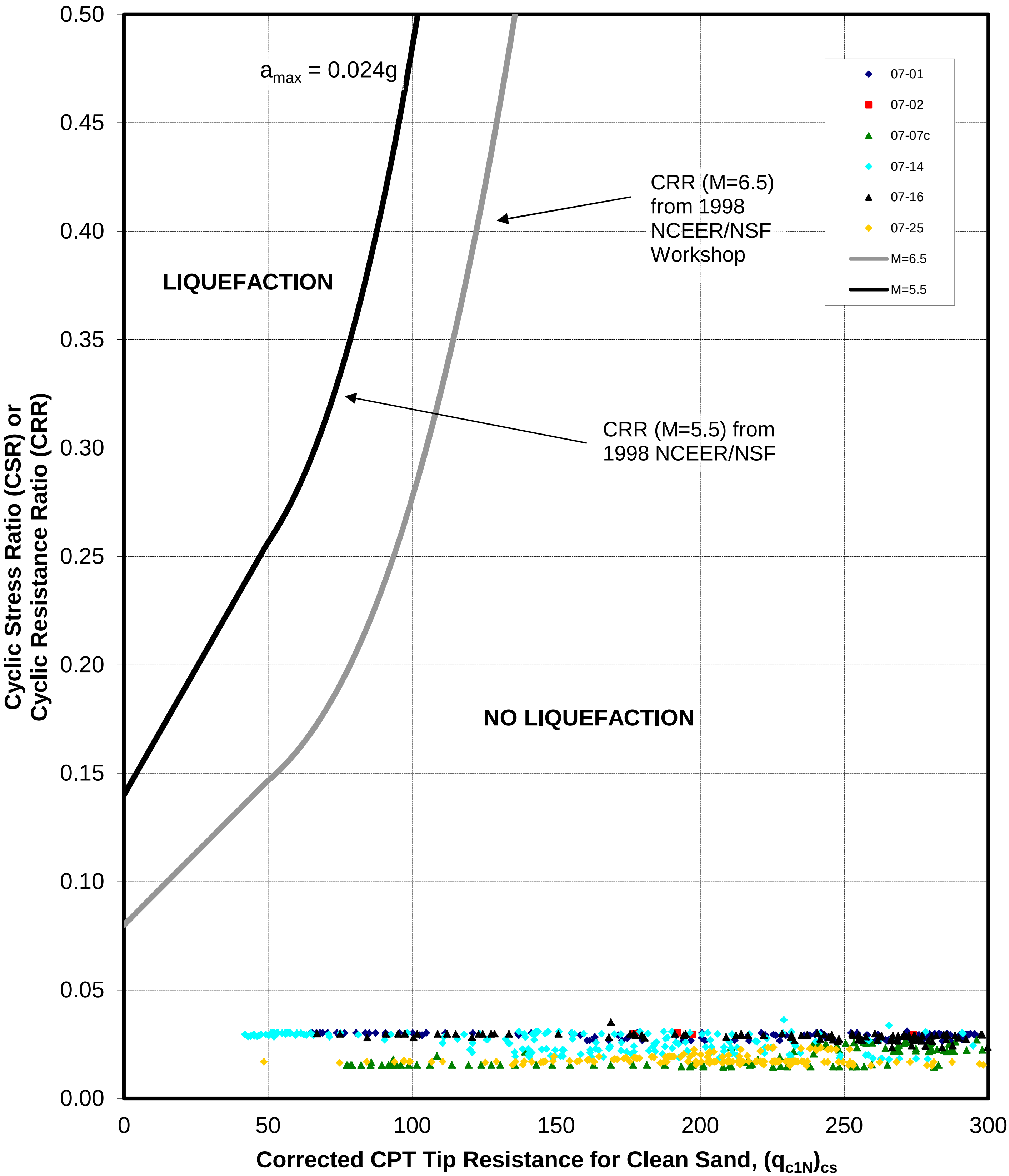


LTVSMC Coarse Tailings Contractive/Dilative Behavior based on SPT data (Fear and Robertson, 1995)



Liquefaction Potential for LTV Coarse Tailings based on CPT data (after NCEER, 1996)

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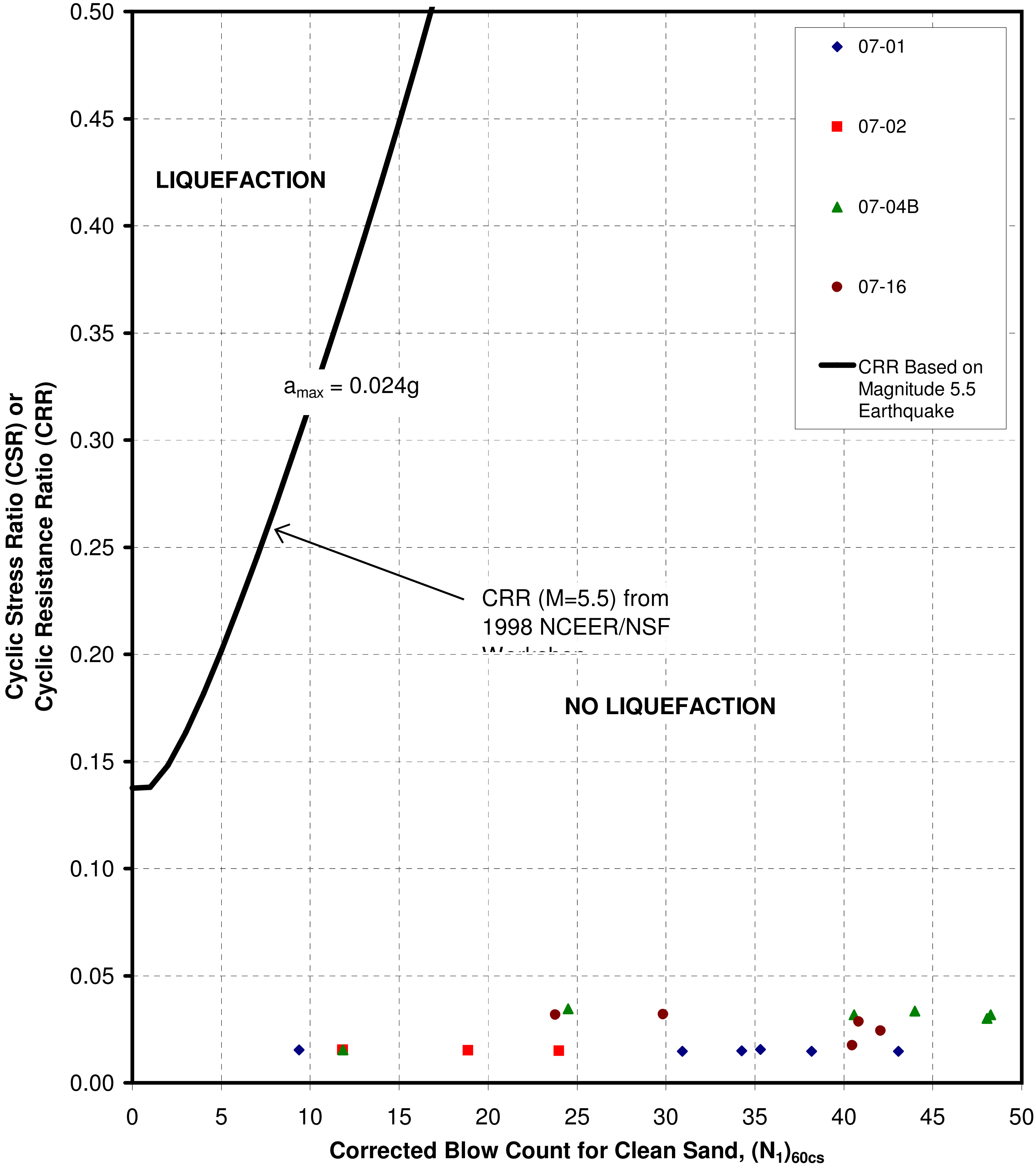

LTVSMC Coarse Tailings Liquefaction Potential based on SPT data (after NCEER, 1996)

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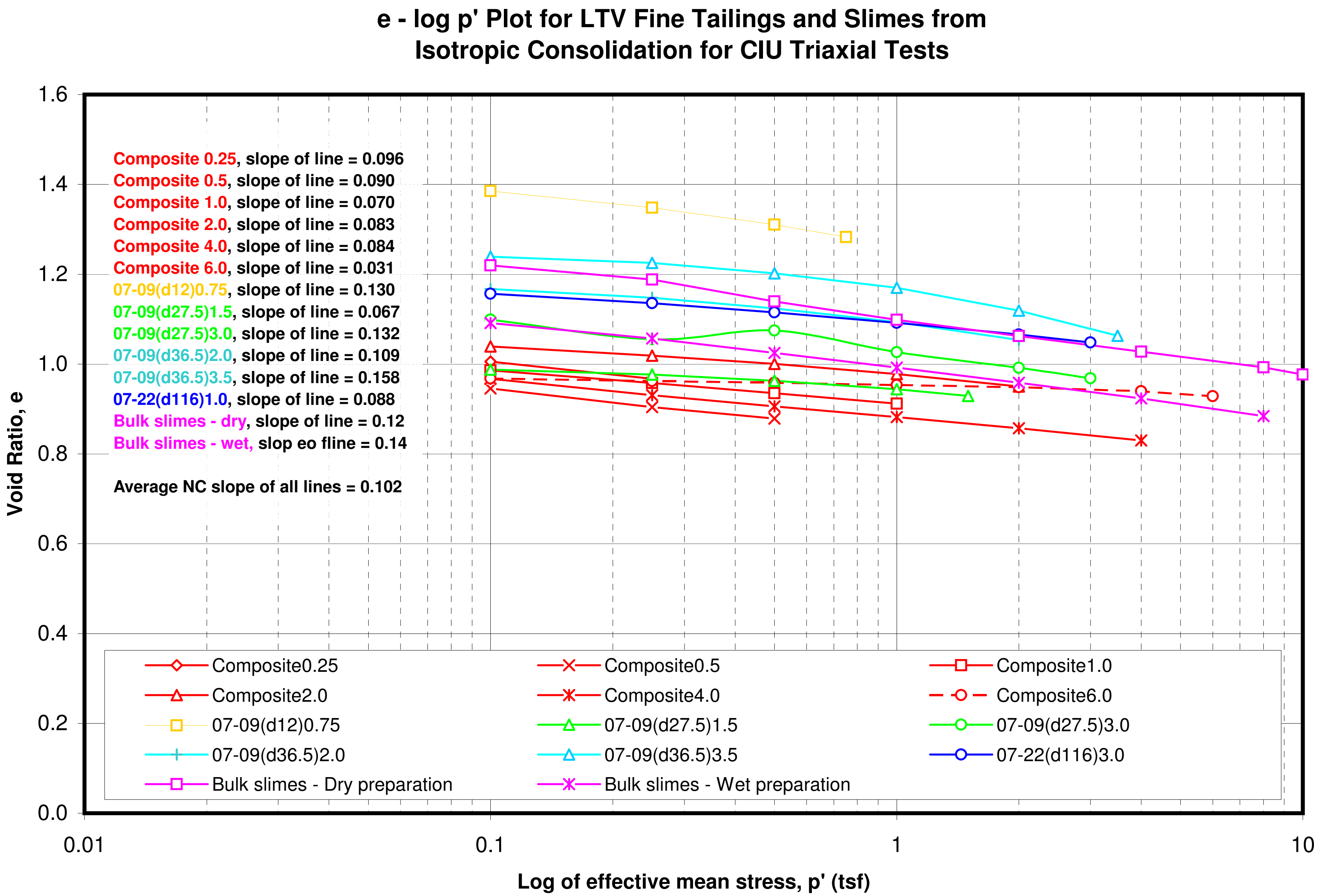

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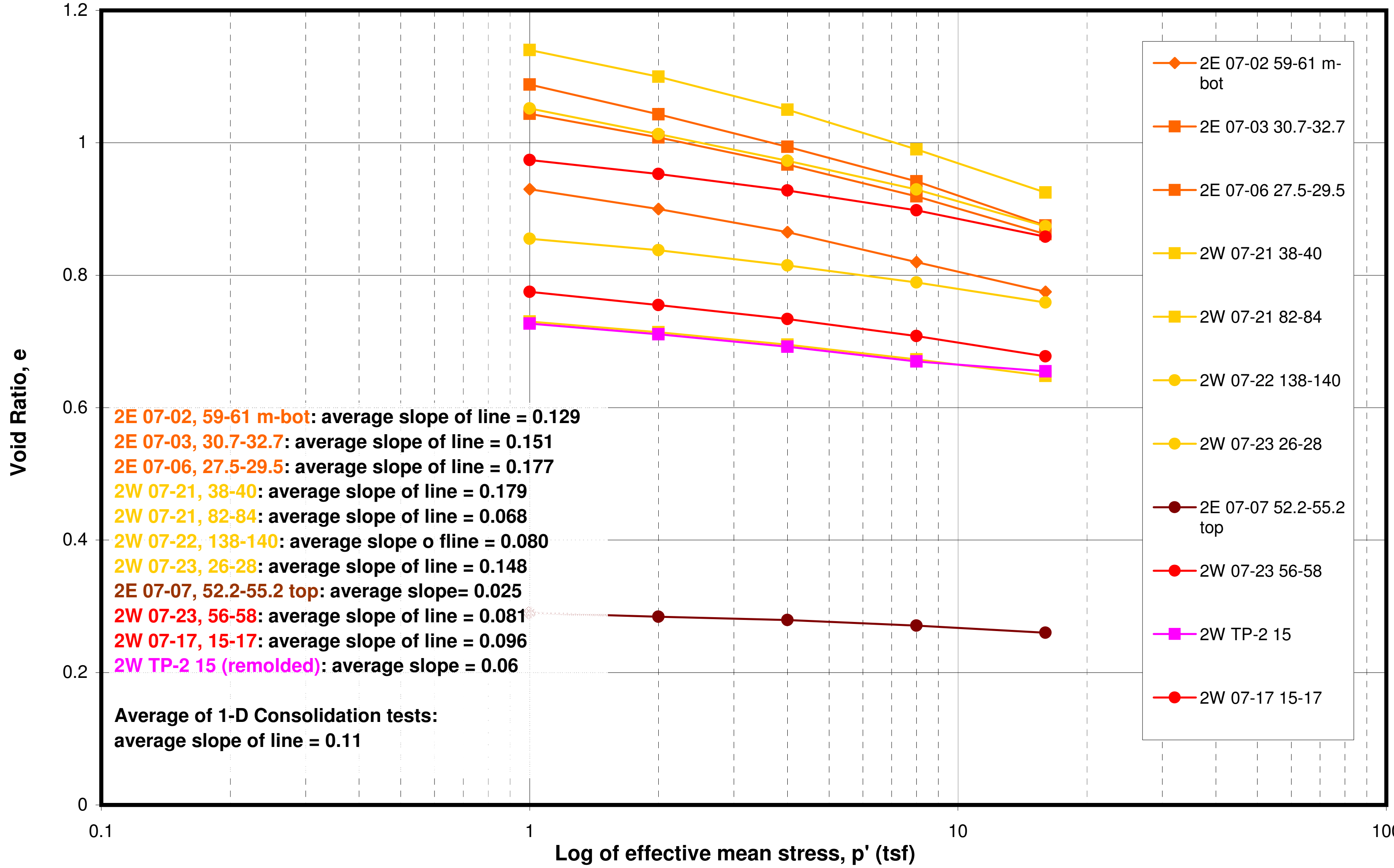
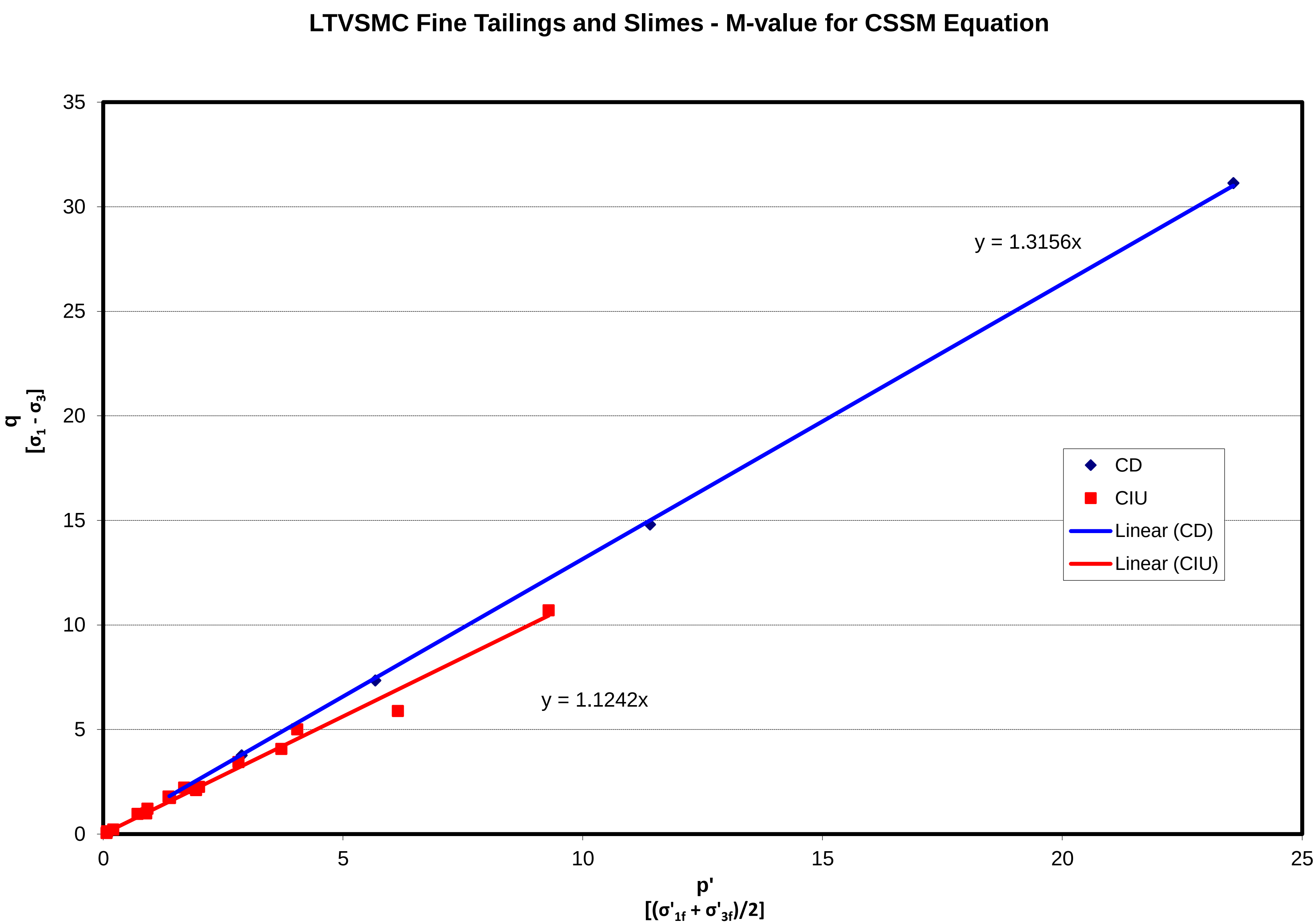
Consolidation Curves for Oedometer Test Samples

LTV Fine Tailings and Slimes





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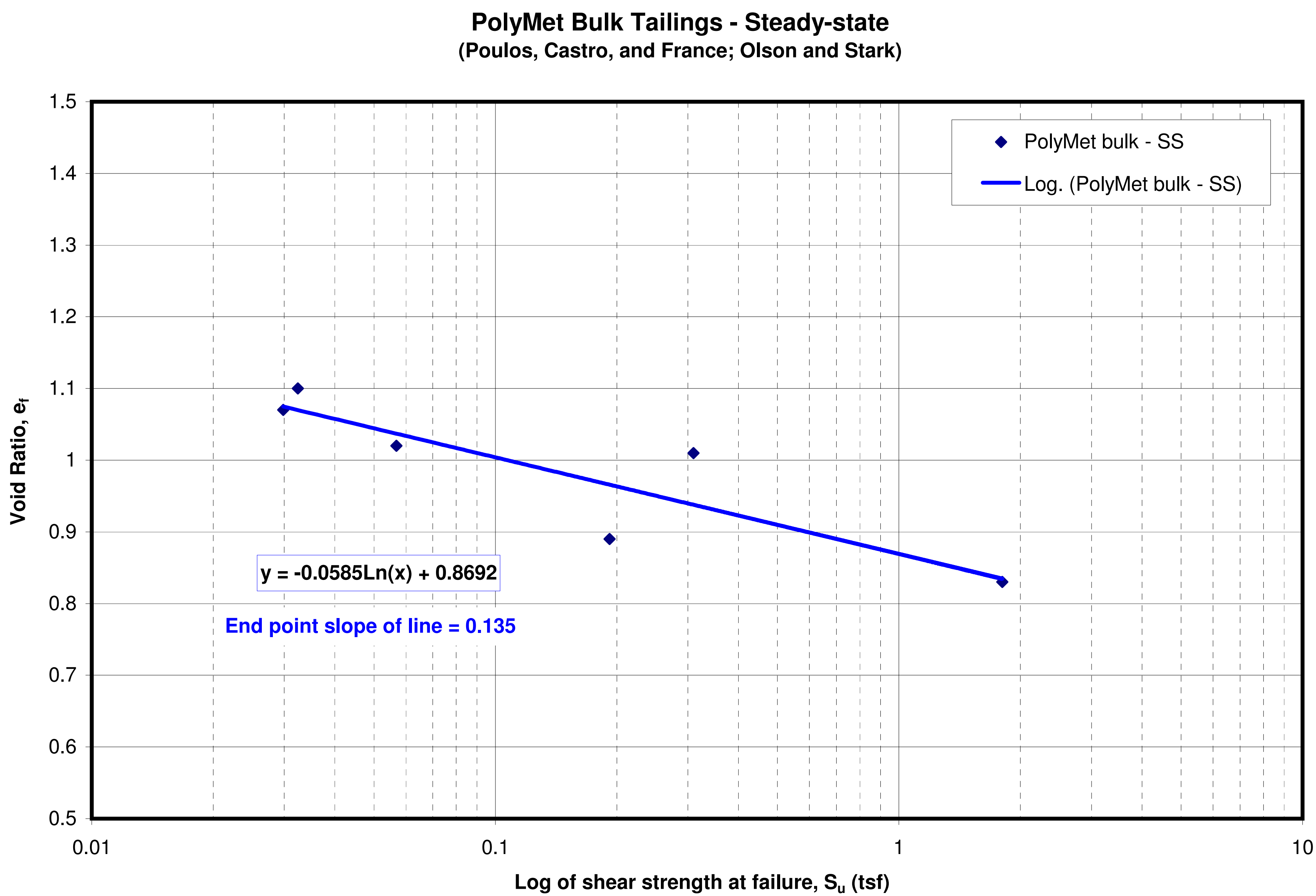
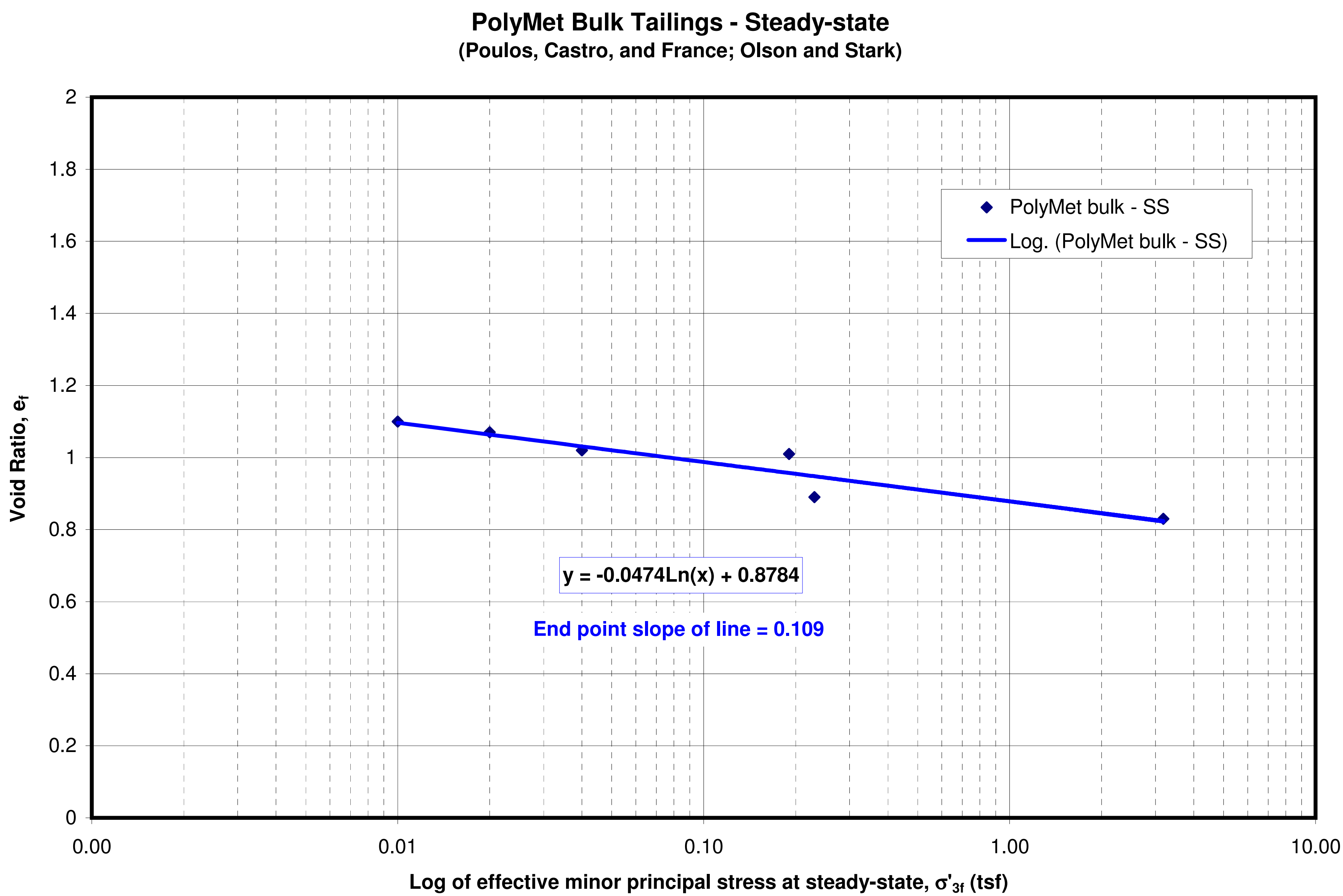

PolyMet Bulk Tailings - Steady-state
(Poulos, Castro, and France; Olson and Stark)
PolyMet bulk - SS
Log. (PolyMet bulk - SS)
y = -0.0585Ln(x) + 0.8692
End point slope of line = 0.135
Void Ratio, e_f
Log of shear strength at failure, S_u (tsf)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.01
0.1
1
10



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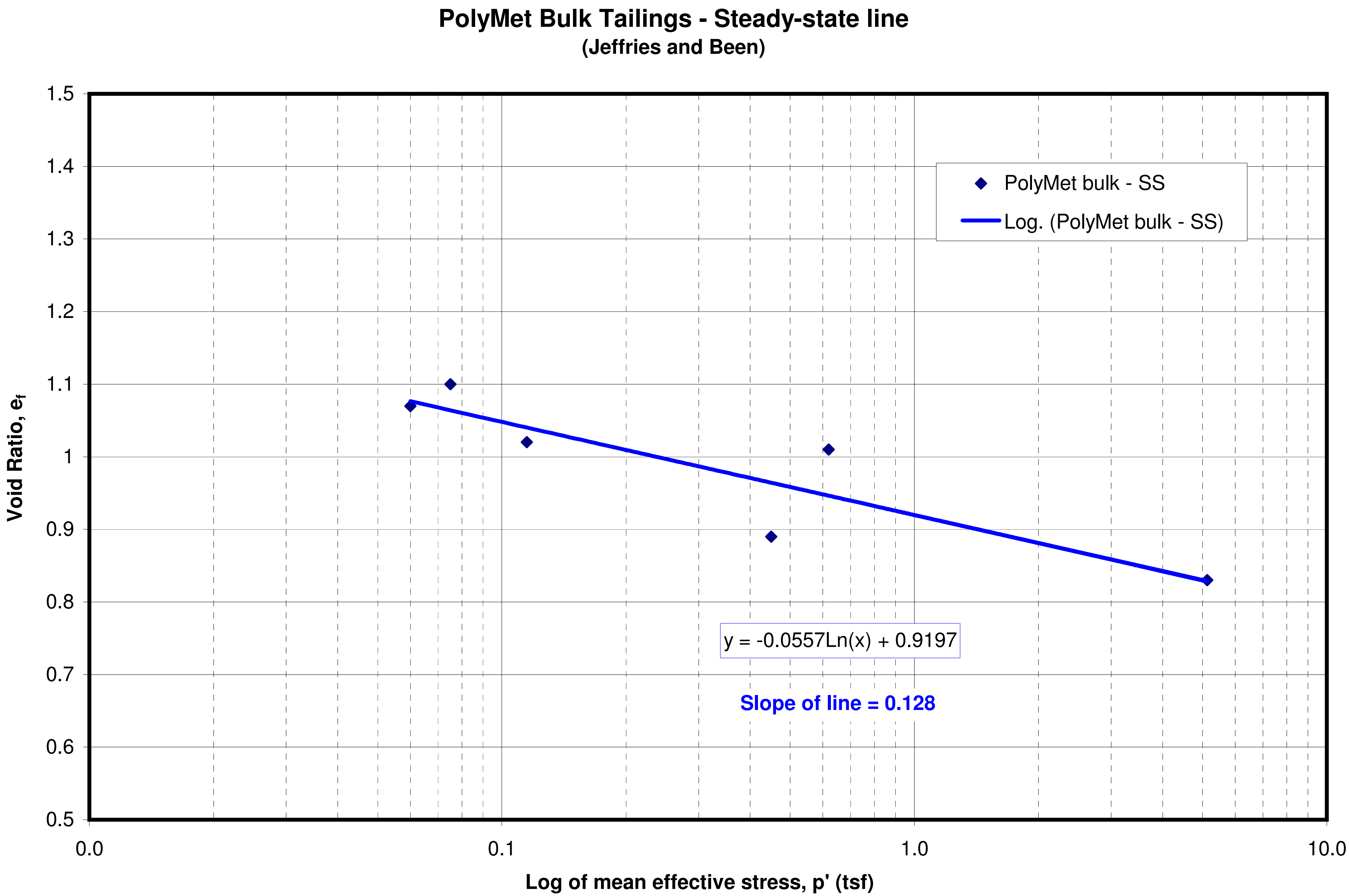

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PolyMet Tailings Basin
2011 Re-analysis
Index Properties
LTVSMC Coarse Tailings

Boring	Year	Depth	lassificatic	WC	LL	PL	PI	SG	p200	CF
	1992, SET	17.5								
		7.2							13.9	
									11.4	
	2007, set J	5.1							12.1	5.5
DH-1	1974	2.5		4.3						
DH-1	1974	5		6.4						
DH-1	1974	7.5		5.2						
DH-1	1974	10		5.9						
DH-2	1974	2.5		7.1						
DH-2	1974	5		6.1						
DH-2	1974	7.5		5.2						
DH-2	1974	10		5.5						
DH-2	1974	15		7.5						
DH-3	1974	2.5		6.8						
DH-3	1974	5		6.6						
DH-3	1974	7.5		5.3						
DH-3	1974	10		4.6						
DH-3	1974	15		5.6						
DH-4	1974	2.5		5.4						
DH-4	1974	5		5.2						
DH-4	1974	7.5		4.4						
DH-4	1974	10		6.4						
DH-4	1974	15		6.2						
DH-5	1974	2.5		6.9						
DH-5	1974	5		5.4						
DH-6	1974	5		8.9						
DH-6	1974	10		12.8						
DH-6	1974	15		4.9						
DH-6	1974	20		4.7						
DH-6	1974	25		4.2						
ST-4	1973	5		5						
ST-4	1973	10		6.6						
TP-1	2007, buck	5		4.5					14.7	
TP-2	2007, buck	12		5.2				2.93	8.6	
bucket 17	2007	1-3		2.2					8.9	
F-1		15-16							18.4	
F-1		25-26							16	
F-1		35-36							13.9	
F-2		10-11							18.8	
F-3		15-16							13	
G-1		20-21							13.5	
G-1		40-41							17.5	
G-1		50-51							19	
G-2		15-16							11	
G-2		20-21							14	
G-2		25-26							15.5	
G-3		10-11							9.5	
ST-1		4-5							3	
ST-1		9-10							13.5	
ST-4		9-10							8.5	
ST-4		19-20							10.5	
ST-5		9-10							13.7	
ST-6		4-5							7.8	
ST-6		39-40							7.8	
ST-7		24-25							13	
ST-7		29-30							17.5	2.5
ST-7		34-35							8.5	
ST-8		14-15							18.2	
ST-8		29-30							11.5	
A-3		4-10							15	
A-3		24-30							17	
DH-5	1974	30		14.9				2.69	6.8	
N76-05									12	
F-1	1990	#4							11	
F-1	1990	#6							14	
F-1	1990	#8							12	
F-2	1990	#2							19	
F-3	1990	#4							11	
G-1	1990	#3							16	
G-2	1990	#5							10	

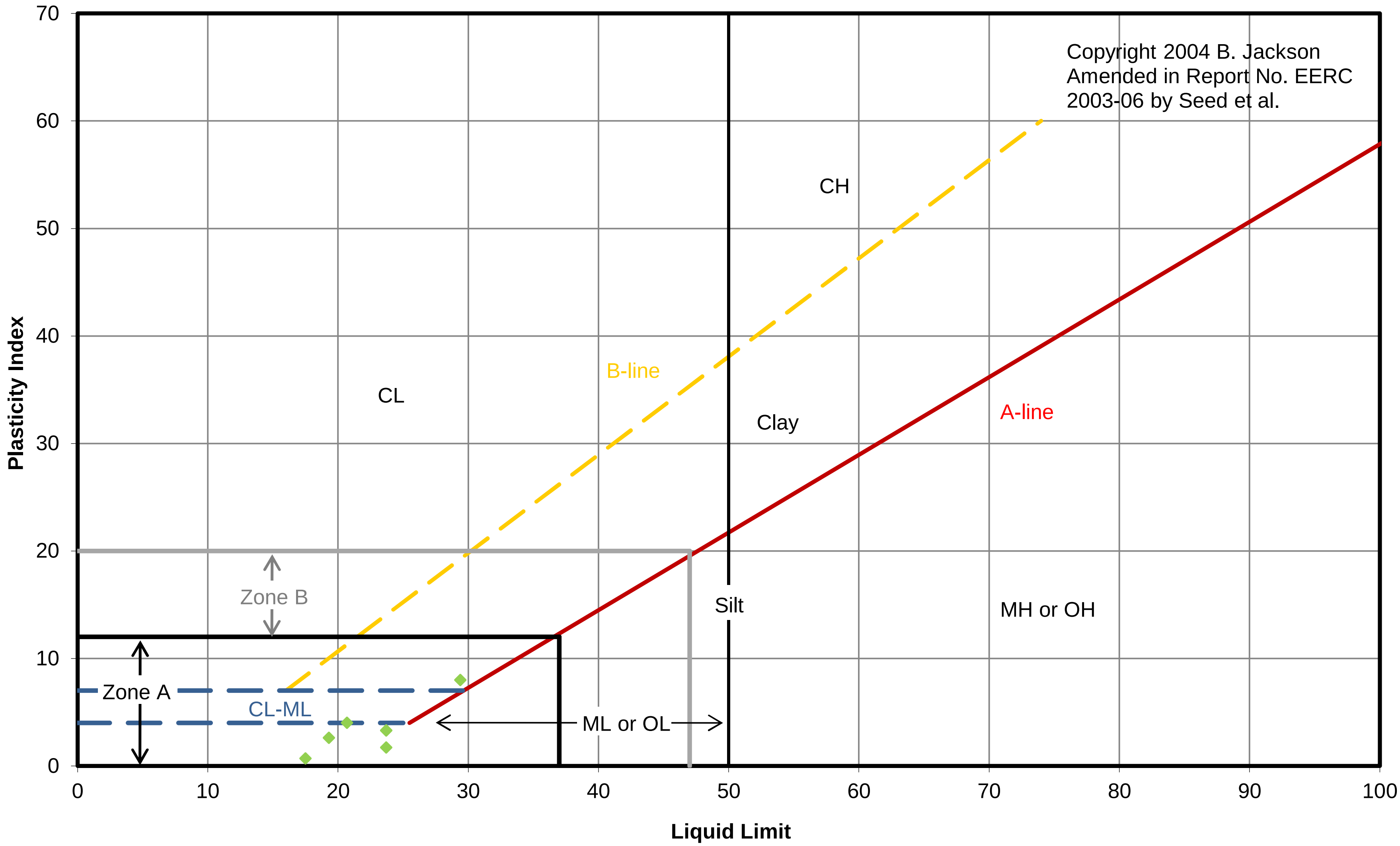
		WC	LL	PL	PI	SG	p200	CF
mean		**6.1**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**2.8**	**12.9**	**4.0**
min		2.2	0.0	0.0	0.0	2.7	3.0	2.5
max		14.9	0.0	0.0	0.0	2.9	19.0	5.5
stdev		*2.37*	*#DIV/0!*	*#DIV/0!*	*#DIV/0!*	*0.17*	*3.77*	*2.12*
# of tests		32	0	0	0	2	41	2

PolyMet Tailings Basin
2011 Re-analysis
Index Properties
LTVSMC Fine Tailings

Boring	Year	Depth	Classification	WC	LL	PL	PI	SG	p200	CF
07-02		59-61	FT (ML w/sand)		23.7	22	1.7			
07-02		59-61	FT (ML w/sand)		23.7	20.4	3.3			
07-02		60-61			23.7	20.4	3.3	2.95	74.8	2
07-10		37-39			NP	NP	NP	2.93	70.3	6
07-15		114.5-115.8	FT (ML w/sand)							
07-17		72-74	FT (ML w/sand)		29.4	21.4	8			
Bucket #11									17.9	
Bulk		Composite	Slimes (ML)* BSE reclassified a		20.7	16.7	4			
Cell-2E		Pail 1							84.7	4.0
Cell-2E		Pail 2							53.9	3.5
Cell-2E		Pail 3							51.0	1.5
DH-5	1974	7.5		17.5						
DH-5	1974	10		12.9					16.6	
DH-5	1974	15		13.7					32	
DH-5	1974	20		11.8						
DH-5	1974	25		17.7						
DH96-19		190		22.4	19.3	16.7	2.6		89.4	12
DH96-39		30		26.8					85.9	1.0
DH96-39		50								
DH96-40		15		21.6					77.2	2.5
DH96-40		25		27					69.9	3.5
DH96-40		45		25.9					87.5	
DH96-40		40								
DH96-40		50							91.1	7.5
DH96-40		55							95.7	3.5
DH96-49		4		24.9					78.6	5.0
DH96-49		25		22.6					49.0	2.0
DH96-49		40.3		24.6					52.6	1.5
DH96-49		65		30.5					88.1	3.0
DH96-49		45								
DH96-49		65								
DH96-49		45								
DH96-49		65								
DH96-49		65								
DH96-49		55							94.6	3.0
DH96-49		85							92.1	2.5
DH96-54		45		23					46.2	
DH96-54		45							46.2	1.5
DH96-60		57.5							89.0	4.0
F-1		45-46							62.1	
F-2		55-56			NP	NP	NP			
F-2		45-46							72.8	
F-2		50-51							88.5	
F-3-A		15-16							13.2	
F-3-A		27-28			NP	NP	NP			
F-3-A		34-36			NP	NP	NP			
I-1		69.5-71.5		21.9	17.5	16.8	0.7		70.6	2.5
Parcel 3	2005	1-pail		24	NP				66.7	1
Parcel 3	2005	2-pail		23.8	NP				68.2	1
PP-10060								2.98	65.4	21
PP-10061								3.03	52	14
PP-10062								3	58.8	17.5
ST-1	1971	5		3.6						
ST-1	1971	10		5.5				2.94		
ST-1	1973	5		3.9						
ST-1	1973	10		5.7				2.98		
ST-1	1973	15		12						
ST-1	1973	20		16.4						
ST-2	1971	5		23.7	np			2.89		
ST-2	1971	35						2.89		
ST-2	1971	50		23.4						
ST-2		4-5							36	2
ST-3	1971	5		12.9						
ST-3	1971	10						2.94		
ST-3	1971	15		10.6	np					
ST-3		9-10							28	2
ST-4	1971	10		13.8				2.63		
ST-4	1973	15		12.1						
ST-4	1973	20		15.3						
ST-4	1973	25		13.3						
ST-4	1973	30		17.5				2.99		
ST-5	1971	5		3.7						
ST-5	1971	10		8.7				2.91		
ST-5	1973	10		5.5						
ST-5	1973	15		11.1						
ST-5	1973	20		15.4						
ST-5	1973	35		15.7						
ST-5	1973	45		23.4						
ST-6	1971	5		11.4				2.93		
ST-6	1971	30						2.91		
ST-6	1971	40		13						
ST-7	1971	5		7.2						
ST-7	1971	10		6.3						
ST-7	1971	15		7.1						
ST-7	1971	20		7.5						
ST-7	1971	25		6.9						
ST-7	1971	30		10.9						
ST-7	1971	35						2.88		
ST-7	1971	70		22.5				2.94		
ST-8	1971	5		3.7						
ST-8	1971	10		5.5						
ST-8	1971	15		5.1						
ST-8	1971	30						2.93		
F-1	1990	#10							61	
F-2	1990	#9							74	
F-2	1990	#10							88	
DH96-60		57.5	ML	24.8					89	4

	WC	LL	PL	PI	SG	p200	CF
mean	**15.1**	**22.6**	**19.2**	**3.4**	**2.9**	**65.7**	**4.8**
min	3.6	17.5	16.7	0.7	2.6	13.2	1.0
max	30.5	29.4	22.0	8.0	3.0	95.7	21.0
stdev	*7.70*	*3.88*	*2.37*	*2.32*	*0.08*	*23.09*	*5.11*
# of tests	53	7	7	7	18	40	28

LTV Fine Tailings - Atterberg Limits

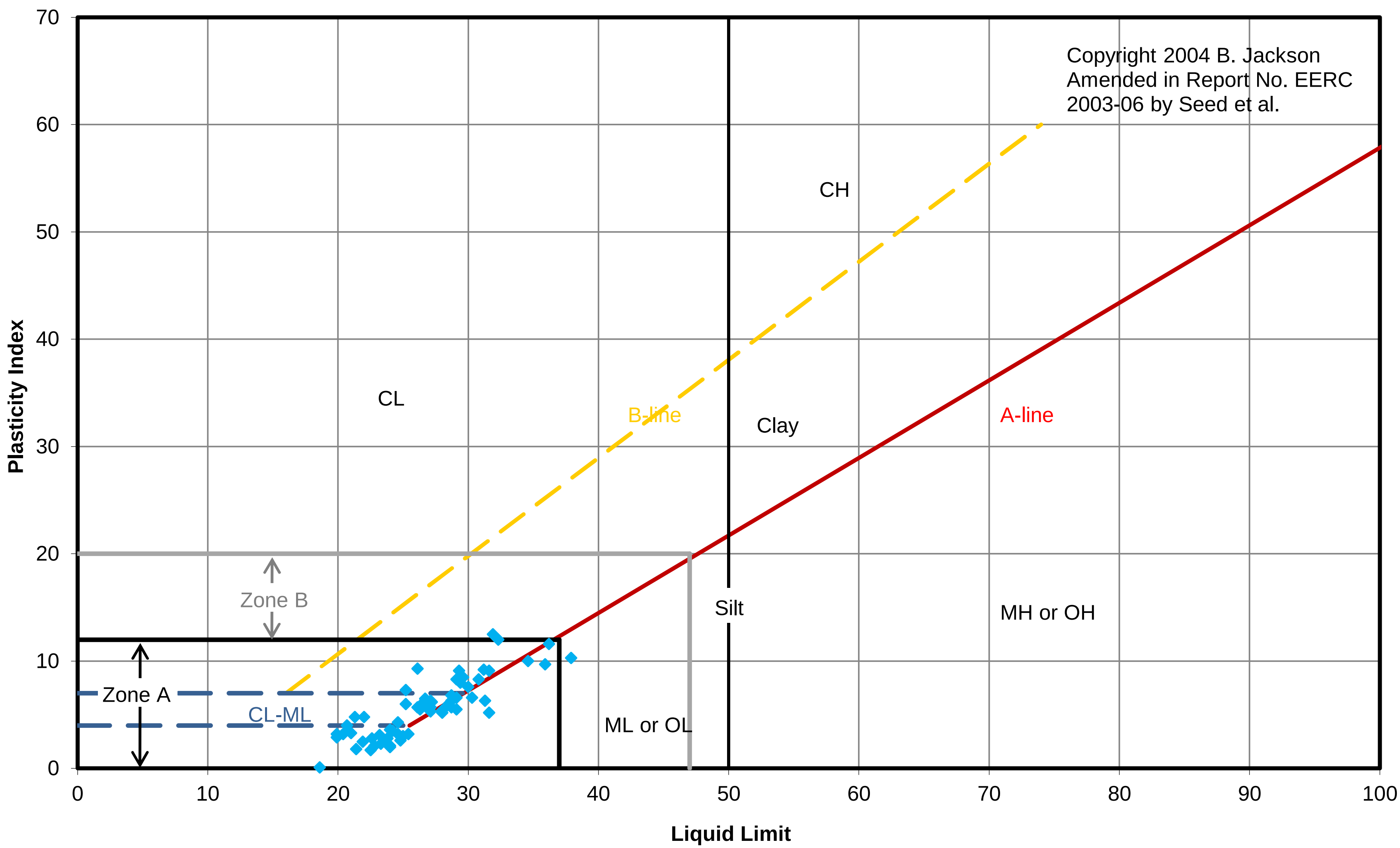


PolyMet Tailings Basin
2011 Re-analysis
Index Properties
LTV Slimes

Boring	Year	Depth	Classification	WC	LL	PL	PI	SG	p200	CF
9C	1996	pail-9C			24.2	20.7	3.5		97.7	8.0
9B	1996	pail-9B			24.6	21.4	3.2		98.6	10.0
9A	1996	pail-9A			24.8	22.2	2.6		98.2	10.0
07-02		59-61	Slimes (ML)		20.4	17.2	3.2			
07-02		59-61	Slimes (ML)	37.4	22	17.2	4.8	2.93	99.4	8
07-03		44.5			24	22	2			
07-03		34			25	22	3			
07-03		30.7-32.7	Slimes (ML)	40.9	31.6	26.4	5.2	2.94	99.8	17
07-06		27.5-29.5	Slimes (ML)	41.1	29.1	23.6	5.5	2.96	99.9	20
07-07C		48-50	Slimes (ML)		22.5	20.8	1.7	2.97	99.4	14
07-09		27.5-29.5	Slimes (ML)		21.3	16.5	4.8	2.96	97.5	12
07-09		36.5-38.5	Slimes (ML)		28	22.6	5.4	2.96	99.5	22
07-09		12-14	Slimes (ML)		31.9	19.4	12.5	2.98	99.6	29
07-15		34-36	Slimes (CL/CL-ML)	33.6	25.2	17.9	7.3		99.4	13
07-15		56.5-58.5	Slimes (CL)	32.3	32.3	20.3	12		99.5	18
07-17		72-74		34.4	29.4	21.4	8			
07-21		38-40	Slimes (ML)		31.3	25	6.3			
07-23		56-58	Slimes (ML)		29.3	20.2	9.1			
07-23		26-28	Slimes (ML)	38.4	37.9	27.6	10.3			
A-9		186.5			26.1	16.8	9.3			
A-9		210			36.2	24.6	11.6			
Bulk Sample		-			20.7	16.7	4	2.99	97.1	4
Cell-1E		Pail 8							95.0	6.0
composite		07-09@36.5 +	Slimes (ML)		30.3	23.7	6.6			
DH-5	1974	27-27.8		32.2	31.6	22.5	9.1		99	20
DH-5	1974			20.7						
DH-6	1974	35		29.5						
DH-6	1974	55		25.5						
DH-6	1974	90-100		17				2.89	91.2	14.5
DH96-12		170		27.2	29.1	20.8	8.3		99.7	20
DH96-12		175		30.5	29.6	21.1	8.5		97.2	20
DH96-12		200		37.5	35.9	26.2	9.7		96.4	18
DH96-13		150		29.2	26.6	20.4	6.2		99.6	18
DH96-13		165.5		58.2	27.2	21	6.2		98.1	20
DH96-13		181		30.8	28	22.8	5.2		97	19
DH96-13		155		35.1	28.7	21.9	6.8		98.7	18
DH96-16		225		32.2	26.4	20.7	5.7		99.8	17
DH96-16		75		29.5	27.1	20.8	6.3		98.9	14
DH96-19		220		29.6	30	22.4	7.6		98.3	19
DH96-19		225		27.7	30.8	22.5	8.3		98.5	17
DH96-23		155		31.9	26.7	20.2	6.5		99.3	18
DH96-23		100		30.3	28.5	22.5	6		99.7	21
DH96-23		220		33	29.1	22.5	6.6		98.3	16
DH96-26		205		32	24.6	20.3	4.3		98.6	10
DH96-26		170		30.9	28.7	22.4	6.3		99.5	18
DH96-26		200		27.8	31.2	22	9.2		99.2	16
DH96-28		55		25.5					96.1	4
DH96-32		195		29.4	26.3	20.6	5.7		99.6	14
DH96-32		200.5		32.4	26.3	20.8	5.5		99.3	17
DH96-39		35		37.9	24	21.9	2.1		98.8	17.0
DH96-40		50		37	18.6	18.5	0.1		91.1	
DH96-40		30		31.5	21.4	19.6	1.8		93.1	8.0
DH96-40		35		41.8					96.0	10.5
DH96-40		40		28.9					99.5	16.5
DH96-40		45							87.5	8.0
DH96-49		85		31.8	19.9	17	2.9		92.1	
DH96-49		60		26.9	24	20.4	3.6		98.8	12.5
DH96-49		55		31.6					95.7	
DH96-49		45		34.9					96.5	8.5
DH96-49		55		32.1					94.6	
DH96-49		65.5		23.2					99.3	12.5
DH96-49		30							87.8	14.0
DH96-49		35							98.4	31.5
DH96-49		40							98.1	22.0
DH96-52		50		29.3	22.8	20.7	2.1		96.2	13.0
DH96-52		40		30.4					96.0	15.0
DH96-52		55		30.2					98.8	14.0
DH96-54		40		36.3	26.1	20.4	5.7		92.4	16.0
DH96-9		50		33.8	21	17.7	3.3		90.4	9
DH96-9		45		31.1	21.9	19.4	2.5		92.4	9
DH96-9		45							97.6	8.5
F-2		50-51							88.4	
F-2		55-56							99.9	25.6
F-3		35-36	ML		34.6	24.6	10		99.8	57.7
F-3		40-41							90.5	
F-3		50-51							95	48.5
F-3-A		50-52		34.7	27.1	21.4	5.7			
F-3-A		50-52		29.5						
F-3-A		50-52		29.3						
F-3-A		34-36		41.2						
F-3-A		34-36		37.4						
F-3-A		34-36		39.3						
G-2		40-41	Slimes (ML)		27.1	21.8	5.3		94.9	17.3
I-1		74.5-76.5		31.4	19.9	16.7	3.2		98.2	7.0
I-1		82.0-84.0		31.8	22.6	19.8	2.8		98.9	7.0
I-1		84.5-86.5							90.6	2.0
I-1H-99		77-79		37.2	25.2	19.2	6		100.0	21.0
I-1H-99		89-91		32	25.4	22.2	3.2	2.98	99.4	16.0
ST-2		34-35							92.0	7.4
ST-2		59-60							95.5	5.0
ST-6		29-30							98.8	14.0
ST-6		69-70							96.8	3.0
ST-7		59-60							100	16
A-7	1977	A-7-B-1-3						2.96		
A-7	1977	A-7-1-3						2.99		
A-7	1977	A-7-1-4						3.02		
F-2	1990	#11							100	8
F-2-A	1990	T-2							100	18
F-3	1990	#8							100	24
F-3	1990	A-3							100	11
F-3	1990	#11							96	6
DH96-61		130	ML	24.9	23.8	21	2.8		99	10
DH96-61		135	CL-ML	32	28.7	23	5.7		98.7	7
DH96-61		65	ML/CL-ML	32.9	23.2	20.1	3.1		93.7	19
DH96-61		125	ML	29.3	23.3	21	2.3		99	16
DH96-60		45	ML/CL-ML	27.2					97.6	9

	WC	LL	PL	PI	SG	p200	CF
mean	**32.5**	**26.7**	**21.1**	**5.6**	**3.0**	**97.1**	**15.1**
min	20.7	18.6	16.5	0.1	2.9	87.5	2.0
max	58.2	37.9	27.6	12.5	3.0	100.0	57.7
stdev	*5.50*	*4.23*	*2.38*	*2.79*	*0.03*	*3.19*	*8.62*
# of tests	63	63	63	63	13	84	78

LTV Slimes - Atterberg Limits



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PolyMet Tailings Basin
2011 Re-analysis
Index Properties
Peat

Boring	Year	Depth	lassificatic	WC	LL	PL	PI	SG	p200	CF	OC
DH96-1A		25.5-28	OL	120				2.53			7.4
DH96-1A		25.5-28	OL	53				2.63			3.2
DH96-1		22-24.5	OL	128.3				2.47			5.6
DH96-1A		25.5-28	OL	48.3							3
DH96-1A		25.5-28	OL	48.1							2.9
DH96-1A		25.5-28	OL	44.9							2.9
27	1981	4	PEAT	300					40	13	
F-1		56.5-58.7	PT (fibrous	89.2							
F-1		56.5-58.7	PT (fibrous	173.3							
F-1		56.5-58.7	PT (fibrous	194.8							
DH96-1A		20.5-23	PT (fibrous)	373				1.59			39.9
DH96-1A		20.4-23	PT (fibrous)	377				1.7			41.1
DH96-4		8-10.5	PT (fibrous)	436.4				1.61			83.9
DH96-1A		20.5-23	PT (fibrous)	450.1							46.8
DH96-1A		20.5-23	PT (fibrous)	189.2							28.3
DH96-1A		20.5-23	PT (fibrous)	154.9							19.7
DH96-1A		20.5-23	PT (fibrous)	74.7							9.3
DH96-1A		18-20.5	PT (fibrous)	384.7							70.3
DH96-1A		18-20.5	PT (fibrous)	335.6							57.7
DH96-4		8-10.5	PT (fibrous)	261.8							87.7
DH96-4		8-10.5	PT (fibrous)	222							83.3
F-3-A		69.5-71.5	PT (sapric)	217.9							
F-3-A		69.5-71.5	PT (sapric)	226.7							
F-3-A		69.5-71.5	PT (sapric)	206.8							
F-3-A		65.5-68		188							
E-27									40		
ST-1	1970			350							
ST-14	1970			42							
ST-15	1970			91.5							
ST-2	1971			135							
ST-5	1971			53.6							
ST-6	1971			73.2							
ST-8	1971			219.3							
ST-2	1976			528							
ST-2	1976			365							
DH96-1				313	108						
				149							
DH96-2				269	124						
				359							
				339							
				106							
DH 96-5				285							
E-12		5-7		257.8				1.5			
E-12		10-12		187.8				1.65			
E-12		15-17		271.4				1.45			
E-12		14.5-16.5		273				1.42			
E-16		8-10		409.2				1.52			
				408							
ST-7	1971			115.7							

		WC	LL	PL	PI	SG	P200	CF	OC
mean		**249.0**	**116.0**	**#DIV/0!**	**#DIV/0!**	**1.6**	**40.0**	**13.0**	**51.6**
min		42.0	108.0	0.0	0.0	1.4	40.0	13.0	9.3
max		528.0	124.0	0.0	0.0	1.7	40.0	13.0	87.7
stdev		*121.26*	*11.31*	*#DIV/0!*	*#DIV/0!*	*0.10*	*0.00*	*#DIV/0!*	*27.13*
# of tests		42	2	0	0	8	2	1	11

PolyMet Tailings Basin
2011 Re-analysis
Index Properties
Till

Boring	Year	Depth	lassificatic	WC	LL	PL	PI	SG	p200	CF
07-07		52.2-55.2		7.5					40.2	4
E-2		14-16							29.3	
E-3		9-11							29.3	
E-6		4-6							16.5	
E-7		14-16							20.6	
E-9		9-11							60.8	
E-10		19-21							21.1	
E-12		19-21							9.7	
E-13		19-21							0.6	
E-14		14-16							8.1	
E-15		19-21							39	
ST-2A	1970			11.6						
ST-6	1970			28	36	23	13			
ST-11	1970			18.8						
ST-12	1970				12	11	1			
ST-15	1970			6.6	11	11	0			
ST-16A	1970							2.66		
ST-17	1970			8	13	11	2			
ST-1	1971			6.7						
ST-1	1971			7						
ST-1	1971			7.8						
ST-1	1974			29.8						
ST-1	1976								39	
ST-2									15	
ST-3									37	
ST-7									26	
ST-8									7	

		WC	LL	PL	PI	SG	p200	CF
mean		**13.2**	**18.0**	**14.0**	**4.0**	**2.7**	**25.0**	**4.0**
min		6.6	11.0	11.0	0.0	2.7	0.6	4.0
max		29.8	36.0	23.0	13.0	2.7	60.8	4.0
stdev		*9.08*	*12.03*	*6.00*	*6.06*	*#DIV/0!*	*15.77*	*#DIV/0!*
# of tests		10	4	4	4	1	16	1

Attachment O

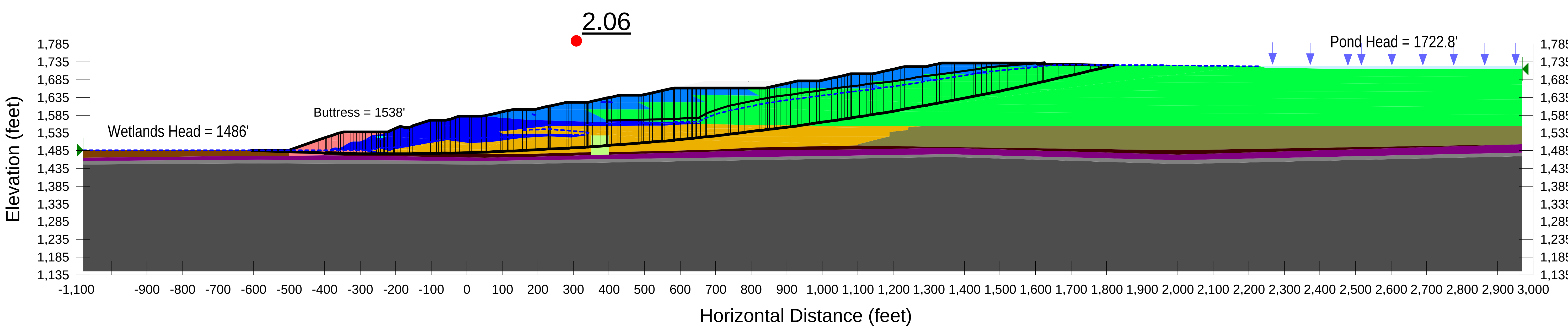
Static Liquefaction Triggering Plots

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/11/2014
File Name: Triggering-Baseline-SecF_Lift8_LIQ_CDSM_USSA.gsz

1.0 Lift 8 -USSA (FSFS)
USSA FSFS

Factor of Safety: 2.06

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC FT/Slimes Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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Project #23690862-037

Attachment O - Static Triggering Outputs
Baseline Case

PolyMet Flotation Tailings Basin Design
v5 Submittal

Liquefaction Triggering Analysis

Baseline

Saturated Zones	
Distance (feet)	
Toe	Crest
0	0
0	0

Post-liquefaction FSFS FS= ***N/A***

Computing the FStriggering based on the shear mobilized of the pre-con model versus the shear resistance/strength of the post-con model

Baseline-SecF_Lift8_LIQ_CDSM_USSA
\# of slices 193
USSA $_{liq}$ ***FS= 1.1***
USSA $_{yield}$ ***FS= 2.06***
Lift8-FSFS

Saturated slices	*FS*	
min	*2.06*	@x=
max	*2.06*	2007.8
ave	*2.06*	1983.8

Legend

- (grey) *Added & interpolated to to maintain distances for FS computation*
- (orange) *Indicates unsaturated soil (above phreatic), not subject to liquefaction*

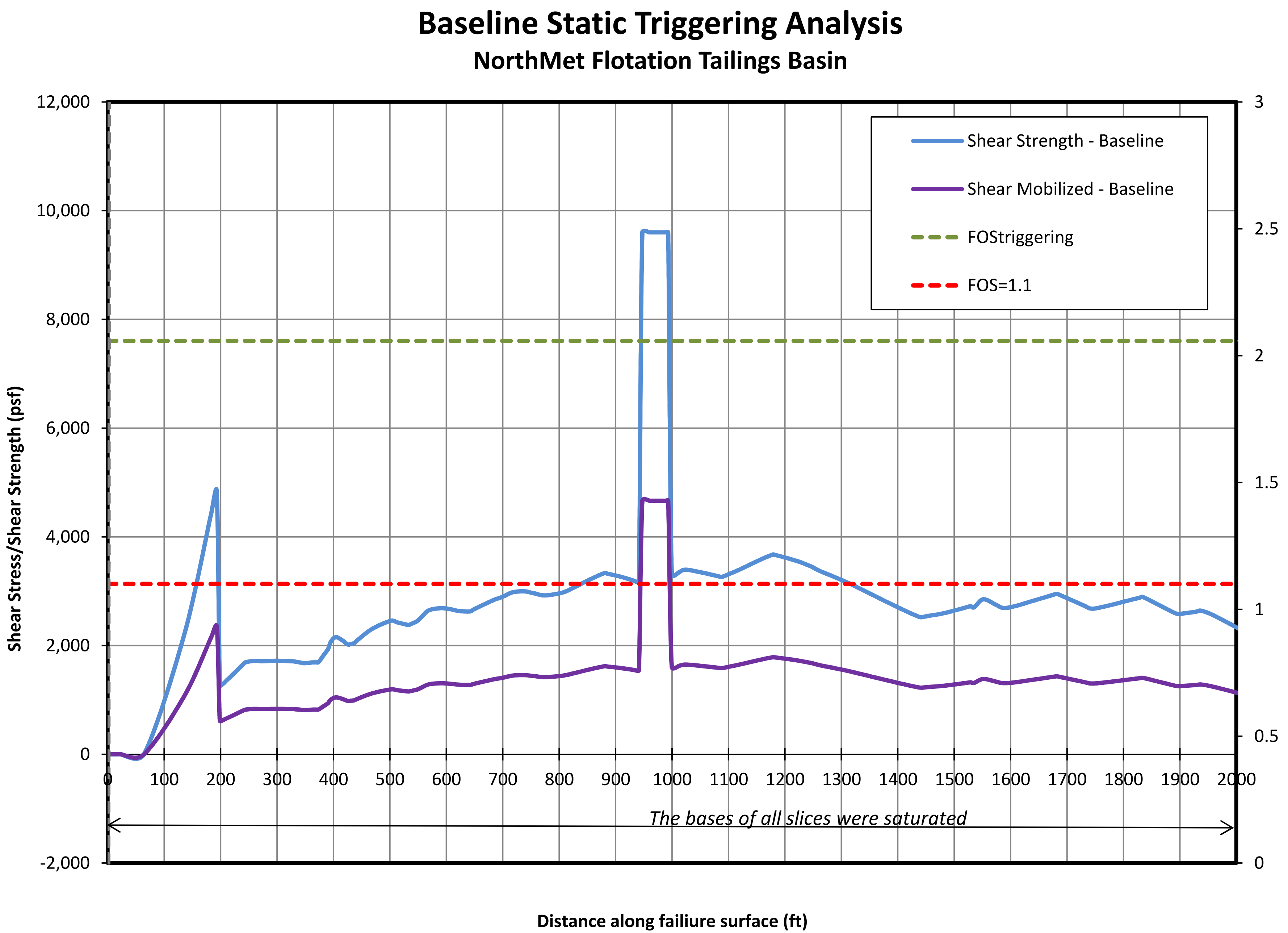
$FS_{triggering}$ shading scale
- min
- 1.1
- max

- (yellow) *Liquefaction is triggered (FS<1.1)*

Slice #	X (ft)	Pore-Water Pressure - Pore-Wate	Distance (f	Shear Mobilized - Bas Shear Mob	Distance (f	Shear Strength - Baseline Shear Resistance (psf)	Strength/ Mob $FOS_{triggering}$	Distance (ft)
1	-594.905	28.22741	0	0.38272	0	0.787696	2.0581511	0
2	-573	90.6576	21.92758	1.228653	21.92758	2.528753	2.0581511	26.27852
3	-530.5	187.2949	64.45575	2.537311	64.45575	5.22217	2.0581511	40.39972
4	-459.213	330.4381	135.7795	1072.285	135.7795	2206.924	2.0581511	47.91643
5	-411.713	424.4736	183.3031	2149.789	183.3031	4424.591	2.0581511	56.25987
6	-401.683	442.0055	193.3375	2343.854	193.3375	4824.007	2.0581511	66.54857
7	-396.307	454.5081	198.7138	616.9126	198.7138	1269.699	2.0581511	86.82644
8	-391.125	475.148	203.8974	627.0591	203.8974	1290.582	2.0581511	107.0142
9	-384	503.1627	211.0237	662.0582	211.0237	1362.616	2.0581511	114.9157
10	-375.5	541.6942	219.5255	702.9702	219.5255	1446.819	2.0581511	123.9435
11	-366.106	591.8872	228.9217	749.1099	228.9217	1541.781	2.0581511	130.9523
12	-358.606	615.9958	236.4233	787.2512	236.4233	1620.282	2.0581511	136.4665
13	-355.5	625.927	239.5297	802.2428	239.5297	1651.137	2.0581511	144.3561
14	-351.379	639.5543	243.6519	820.8332	243.6519	1689.399	2.0581511	150.849
15	-336.879	686.3897	258.1555	834.5196	258.1555	1717.567	2.0581511	162.8939
16	-323	729.7272	272.0377	832.1742	272.0377	1712.74	2.0581511	187.6069
17	-315.5	752.4909	279.5395	832.7772	279.5395	1713.981	2.0581511	205.8557
18	-306	767.3789	289.0401	834.398	289.0401	1717.317	2.0581511	219.9328
19	-297	767.3301	298.0401	835.6373	298.0401	1719.868	2.0581511	236.5743
20	-289	764.1763	306.0401	835.1785	306.0401	1718.924	2.0581511	248.0447
21	-276.5	752.8867	318.5401	833.3216	318.5401	1715.102	2.0581511	254.1605
22	-266	742.4752	329.0401	830.535	329.0401	1709.367	2.0581511	269.416
23	-261	752.6844	334.0401	826.3348	334.0401	1700.722	2.0581511	288.346
24	-256	762.4622	339.0401	822.0231	339.0401	1691.848	2.0581511	303.4913
25	-251.5	770.8817	343.5401	817.1793	343.5401	1681.879	2.0581511	316.3712
26	-248.5	776.2889	346.5401	814.1202	346.5401	1675.582	2.0581511	318.8981
27	-245.5	781.5177	349.5401	813.8875	349.5401	1675.103	2.0581511	321.4472
28	-238.501	792.9927	356.5393	817.3018	356.5393	1682.131	2.0581511	325.8056
29	-233.001	801.3157	362.0393	820.9957	362.0393	1689.733	2.0581511	335.8439
30	-229.5	806.2837	365.5401	821.7008	365.5401	1691.185	2.0581511	348.2501
31	-225	811.7003	370.0401	821.6475	370.0401	1691.075	2.0581511	359.1566
32	-222.222	811.0395	372.8179	821.4368	372.8179	1690.641	2.0581511	369.1041
33	-218.651	809.7942	376.3887	841.6323	376.3887	1732.206	2.0581511	373.2149
34	-210.929	805.5288	384.1109	895.3678	384.1109	1842.802	2.0581511	375.0665
35	-205.558	801.2448	389.4822	931.8723	389.4822	1917.934	2.0581511	389.9058
36	-204.558	800.3241	390.4822	938.7769	390.4822	1932.145	2.0581511	409.6119
37	-199	876.1137	396.0401	1010.962	396.0401	2080.713	2.0581511	424.7539
38	-190.5	1005.849	404.5401	1047.022	404.5401	2154.93	2.0581511	444.3214
39	-179	1171.577	416.0401	1017.338	416.0401	2093.836	2.0581511	462.0928
40	-169.418	1300.316	425.6218	981.0346	425.6218	2019.117	2.0581511	472.7525
41	-164.459	1366.274	430.5814	986.0276	430.5814	2029.394	2.0581511	477.515
42	-157.54	1446.81	437.4997	994.3162	437.4997	2046.453	2.0581511	479.8893
43	-152.5	1504.215	442.5401	1019.654	442.5401	2098.602	2.0581511	485.8509
44	-126.5	1761.475	468.5425	1120.429	468.5425	2306.011	2.0581511	490.9837
45	-93.5	2029.419	501.5455	1193.407	501.5455	2456.213	2.0581511	491.8484
46	-82.5	2108.896	512.5465	1179.525	512.5465	2427.641	2.0581511	492.843
47	-75.4238	2153.936	519.6239	1170.816	519.6239	2409.717	2.0581511	498.5665
48	-70.4238	2184.988	524.625	1164.565	524.625	2396.85	2.0581511	518.2594
49	-66	2211.163	529.0497	1159.184	529.0497	2385.777	2.0581511	543.742
50	-61.5	2234.588	533.5507	1155.643	533.5507	2378.489	2.0581511	569.0621
51	-60	2242.4	535.051	1158.618	535.051	2384.612	2.0581511	586.0979
52	-53.4541	2276.516	541.5984	1173.701	541.5984	2415.655	2.0581511	592.1249
53	-47.3781	2307.879	547.6757	1188.089	547.6757	2445.267	2.0581511	614.5424
54	-39.424	2341.36	555.6315	1224.456	555.6315	2520.116	2.0581511	638.5205
55	-26.5	2393.676	568.5586	1285.549	568.5586	2645.854	2.0581511	646.477
56	-6.5	2455.828	588.5638	1305.552	588.5638	2687.024	2.0581511	652.508
57	10.5	2497.842	605.5683	1298.673	605.5683	2672.865	2.0581511	657.7583
58	27.5	2532.497	622.5728	1280.414	622.5728	2635.286	2.0581511	680.8007
59	46.7361	2568.048	641.814	1276.604	641.814	2627.445	2.0581511	705.5828
60	53.2361	2580.088	648.3157	1294.138	648.3157	2663.532	2.0581511	713.3882
61	63	2579.312	658.0946	1318.085	658.0946	2712.818	2.0581511	717.9226
62	81	2583.153	676.1204	1361.037	676.1204	2801.219	2.0581511	721.9061
63	92.5	2592.812	687.6329	1386.932	687.6329	2854.516	2.0581511	729.3915
64	97	2597.864	692.1377	1393.349	692.1377	2867.724	2.0581511	740.6194
65	106.9218	2609.187	702.0702	1412.858	702.0702	2907.876	2.0581511	750.8074
66	122.8918	2623.544	718.0575	1448.464	718.0575	2981.158	2.0581511	758.1759
67	143.47	2637.178	738.658	1456.298	738.658	2997.28	2.0581511	765.872
68	156	2642.119	751.2015	1443.087	751.2015	2970.091	2.0581511	776.4268
69	162.2414	2642.856	757.4506	1436.848	757.4506	2957.251	2.0581511	788.5496
70	179.7114	2642.09	774.943	1419.89	774.943	2922.349	2.0581511	808.5429
71	209.97	2703.865	805.2404	1444.154	805.2404	2972.287	2.0581511	830.827
72	229	2736.034	824.2948	1486.1	824.2948	3058.619	2.0581511	839.0338
73	230.4999	2738.331	825.7966	1489.499	825.7966	3065.614	2.0581511	846.3362
74	231.2622	2739.283	826.5599	1491.318	826.5599	3069.358	2.0581511	855.8749
75	232.7624	2740.727	828.062	1495.133	828.062	3077.211	2.0581511	865.8304
76	235	2742.881	830.3025	1500.84	830.3025	3088.955	2.0581511	878.2902
77	258.97	2758.03	854.3045	1561.944	854.3045	3214.717	2.0581511	903.6186
78	284.5264	2771.556	879.8951	1618.668	879.8951	3331.464	2.0581511	925.8288
79	290.5564	2775.932	885.9331	1613.657	885.9331	3321.149	2.0581511	931.3706
80	312.97	2821.932	908.3728	1587.912	908.3728	3268.163	2.0581511	934.9032
81	333.97	2918.395	929.3966	1556.362	929.3966	3203.229	2.0581511	942.1313
82	337.9993	2935.284	933.4337	1548.591	933.4337	3187.234	2.0581511	951.5881
83	340.9693	2944.489	936.4124	1542.817	936.4124	3175.35	2.0581511	955.1205
84	345.97	2960.262	941.4279	1547.384	941.4279	3184.749	2.0581511	957.8736
85	352	2994.158	947.4757	4664.381	947.4757	9600	2.0581511	967.1293
86	364.5	3129.032	960.0126	4664.381	960.0126	9600	2.0581511	985.041
87	384	3323.605	979.5724	4664.381	979.5724	9600	2.0581511	998.3389
88	394.1251	3409.805	989.7298	4664.381	989.7298	9600	2.0581511	1001.819
89	397.6251	3440.174	993.241	4664.381	993.241	9600	2.0581511	1008.623
90	403.9522	3473.329	999.5883	1603.2	999.5883	3299.628	2.0581511	1029.414

91	416.4522	3514.122	1012.128	1626.669	1012.128	3347.931	2.0581511	1046.187
92	428.47	3538.606	1024.185	1649.931	1024.185	3395.807	2.0581511	1066.353
93	456.94	3564.916	1052.747	1624.31	1052.747	3343.074	2.0581511	1087.544
94	484.47	3540.68	1080.366	1593.286	1080.366	3279.224	2.0581511	1095.901
95	489.47	3532.916	1085.382	1586.714	1085.382	3265.697	2.0581511	1108.254
96	494.47	3525.201	1090.398	1588.706	1090.398	3269.796	2.0581511	1119.908
97	505	3508.333	1100.961	1610.529	1100.961	3314.711	2.0581511	1130.256
98	517.4583	3484.707	1113.459	1636.788	1113.459	3368.757	2.0581511	1140.257
99	534.9583	3449.215	1131.014	1677.888	1131.014	3453.347	2.0581511	1145.723
100	549	3418.899	1145.1	1712.162	1145.1	3523.889	2.0581511	1150.258
101	550.5	3415.83	1146.605	1715.757	1146.605	3531.288	2.0581511	1158.066
102	554	3407.637	1150.117	1724.051	1150.117	3548.357	2.0581511	1164.674
103	569.47	3371.899	1165.644	1759.578	1165.644	3621.478	2.0581511	1169.853
104	582.97	3347.807	1179.194	1786.059	1179.194	3675.98	2.0581511	1183.219
105	584.5	3345.032	1180.729	1784.328	1180.729	3672.417	2.0581511	1199.252
106	592.7891	3328.072	1189.059	1773.816	1189.059	3650.781	2.0581511	1219.775
107	610.7655	3305.812	1207.125	1749.098	1207.125	3599.909	2.0581511	1240.796
108	621.9765	3307.553	1218.392	1731.862	1218.392	3564.433	2.0581511	1247.257
109	627.47	3308.871	1223.913	1723.361	1223.913	3546.938	2.0581511	1247.639
110	633.47	3316.829	1229.943	1712.882	1229.943	3525.37	2.0581511	1247.744
111	639.2	3324.335	1235.706	1701.046	1235.706	3501.01	2.0581511	1264.773
112	644.8878	3331.113	1241.429	1689.178	1241.429	3476.584	2.0581511	1286.52
113	649.6322	3337.056	1246.203	1679.382	1246.203	3456.422	2.0581511	1292.959
114	653.1606	3345.057	1249.753	1671.68	1249.753	3440.569	2.0581511	1313.981
115	655.4008	3351.17	1252.007	1663.753	1252.007	3424.256	2.0581511	1344.769
116	664.6461	3377.005	1261.309	1640.17	1261.309	3375.718	2.0581511	1361.61
117	673.2551	3402.873	1269.971	1620.956	1269.971	3336.172	2.0581511	1376.203
118	676.7937	3414.387	1273.531	1613.893	1273.531	3321.637	2.0581511	1402.676
119	688.5	3455.745	1285.31	1590.149	1285.31	3272.767	2.0581511	1425.75
120	717	3573.59	1314.007	1527.544	1314.007	3143.916	2.0581511	1434.088
121	738.8203	3707.082	1335.987	1473.494	1335.987	3032.674	2.0581511	1441.595
122	752.8203	3799.922	1350.089	1437.978	1350.089	2959.576	2.0581511	1454.684
123	772.9711	3936.847	1370.384	1386.939	1370.384	2854.53	2.0581511	1464.089
124	782.2033	4001.698	1379.68	1363.575	1379.68	2806.443	2.0581511	1471.132
125	785.2033	4016.092	1382.7	1356.761	1382.7	2792.42	2.0581511	1479.532
126	804.9422	4099.201	1402.575	1308.022	1402.575	2692.107	2.0581511	1494.466
127	826.0997	4173.749	1423.879	1257.84	1423.879	2588.824	2.0581511	1512.678
128	833.1712	4195.653	1430.999	1243.159	1430.999	2558.609	2.0581511	1528.897
129	839.0126	4223.121	1436.881	1229.939	1436.881	2531.4	2.0581511	1540.579
130	843.9843	4253.029	1441.887	1224.818	1441.887	2520.861	2.0581511	1554.333
131	848.5183	4280.025	1446.452	1229.182	1446.452	2529.842	2.0581511	1570.72
132	857.6152	4335.432	1455.612	1237.793	1455.612	2547.564	2.0581511	1583.126
133	865.1112	4380.564	1463.159	1244.693	1463.159	2561.766	2.0581511	1596.903
134	868.1142	4397.819	1466.185	1246.562	1466.185	2565.613	2.0581511	1605.677
135	876.1142	4443.946	1474.247	1252.983	1474.247	2578.829	2.0581511	1622.05
136	890.0099	4490.864	1488.254	1268.767	1488.254	2611.314	2.0581511	1643.303
137	904.2703	4513.841	1502.63	1287.666	1502.63	2650.211	2.0581511	1654.241
138	919.7604	4534.67	1518.246	1308.676	1518.246	2693.453	2.0581511	1660.109
139	930.4961	4547.004	1529.071	1323.151	1529.071	2723.245	2.0581511	1669.574
140	936.5663	4567.577	1535.203	1313.137	1535.203	2702.635	2.0581511	1682.238
141	952.5702	4576.306	1551.369	1385.273	1551.369	2851.102	2.0581511	1689.664
142	974	4551.331	1573.027	1338.841	1573.027	2755.538	2.0581511	1703.137
143	987.97	4534.161	1587.151	1308.074	1587.151	2692.214	2.0581511	1724.913
144	1008.47	4510.329	1607.87	1324.057	1607.87	2725.109	2.0581511	1741.318
145	1034.124	4478.542	1633.796	1362.605	1633.796	2804.446	2.0581511	1751.812
146	1048.284	4460.515	1648.104	1384.069	1648.104	2848.623	2.0581511	1762.619
147	1058.488	4447.272	1658.417	1399.571	1658.417	2880.528	2.0581511	1778.828
148	1067.329	4435.649	1667.35	1413.019	1667.35	2908.206	2.0581511	1793.674
149	1075.5	4424.852	1675.607	1425.455	1675.607	2933.802	2.0581511	1809.823
150	1080.97	4416.736	1681.137	1433.684	1681.137	2950.738	2.0581511	1837.049
151	1082.983	4412.396	1683.175	1432.721	1683.175	2948.756	2.0581511	1862.77
152	1094.573	4387.402	1694.911	1406.774	1694.911	2895.354	2.0581511	1873.433
153	1114.56	4344.24	1715.149	1362.035	1715.149	2803.275	2.0581511	1894.189
154	1127.97	4313.506	1728.732	1331.769	1728.732	2740.981	2.0581511	1916.57
155	1133.97	4297.897	1734.815	1317.278	1734.815	2711.157	2.0581511	1930.566
156	1138.97	4285.471	1739.883	1304.151	1739.883	2684.141	2.0581511	1941.172
157	1147.968	4263.732	1749.001	1302.607	1749.001	2680.963	2.0581511	1943.026
158	1162.686	4228.525	1763.915	1317.84	1763.915	2712.313	2.0581511	1945.941
159	1184.188	4178.102	1785.704	1344.277	1785.704	2766.725	2.0581511	1955.592
160	1197.677	4147.189	1799.374	1362.493	1799.374	2804.217	2.0581511	1975.827
161	1209.672	4115.524	1811.544	1377.872	1811.544	2835.868	2.0581511	1976.827
162	1226.466	4073.748	1828.583	1399.05	1828.583	2879.456	2.0581511	1977.827
163	1231.97	4060.309	1834.167	1405.83	1834.167	2893.411	2.0581511	1978.827
164	1256.97	3990.479	1859.577	1342.9	1859.577	2763.892	2.0581511	1979.827
165	1286.94	3917.525	1890.039	1264.544	1890.039	2602.623	2.0581511	1980.827
166	1294.97	3899.351	1898.2	1252.511	1898.2	2577.857	2.0581511	1981.827
167	1299.014	3890.067	1902.311	1255.692	1902.311	2584.403	2.0581511	1982.827
168	1310.326	3862.083	1913.821	1263.656	1913.821	2600.795	2.0581511	1983.827
169	1321.27	3835.658	1924.956	1271.238	1924.956	2616.4	2.0581511	1984.827
170	1325.957	3824.586	1929.724	1275.868	1929.724	2625.93	2.0581511	1985.827
171	1333.455	3807.074	1937.353	1283.61	1937.353	2641.863	2.0581511	1986.827
172	1349.455	3770.342	1953.632	1255.665	1953.632	2584.348	2.0581511	1987.827
173	1367.432	3728.28	1971.927	1210.209	1971.927	2490.792	2.0581511	1988.827
174	1399.055	3650.849	2004.134	1124.032	2004.134	2313.428	2.0581511	1989.827
175	1428.594	3580.475	2034.217	1042.345	2034.217	2145.304	2.0581511	1990.827
176	1439.976	3551.724	2045.81	1008.645	2045.81	2075.944	2.0581511	1991.827
177	1454.813	3512.07	2060.921	963.442	2060.921	1982.909	2.0581511	1992.827
178	1466.799	3478.304	2073.128	926.9196	2073.128	1907.741	2.0581511	1993.827
179	1473.992	3454.914	2080.454	906.0748	2080.454	1864.839	2.0581511	1994.827
180	1487.504	3395.865	2094.265	868.0763	2094.265	1786.632	2.0581511	1995.827
181	1510.503	3278.715	2117.792	804.2041	2117.792	1655.174	2.0581511	1996.827
182	1523.44	3208.769	2131.026	768.7386	2131.026	1582.18	2.0581511	1997.827
183	1550.213	3057.263	2158.411	696.2002	2158.411	1432.885	2.0581511	1998.827
184	1588.266	2835.519	2197.336	593.9023	2197.336	1222.341	2.0581511	1999.827
185	1603.822	2743.418	2213.249	527.6727	2213.249	1086.03	2.0581511	2000.827
186	1613.328	2685.316	2222.972	474.3333	2222.972	976.2497	2.0581511	2001.827
187	1620.953	2638.051	2230.775	449.9727	2230.775	926.1119	2.0581511	2002.827
188	1642.953	2451.302	2253.336	389.4461	2253.336	801.5389	2.0581511	2003.827
189	1687.241	1972.708	2298.802	277.7564	2298.802	571.6646	2.0581511	2004.827
190	1722.422	1499.037	2334.955	198.3585	2334.955	408.2517	2.0581511	2005.827
191	1744.681	1166.866	2357.829	151.2927	2357.829	311.3833	2.0581511	2006.827
192	1765.954	846.5193	2379.69	108.367	2379.69	223.0358	2.0581511	2007.827
193	1799.928	340.3681	2414.602	43.8446	2414.602	90.23882	2.0581511	2008.827

Attachment O - Static Triggering Outputs
Baseline Case



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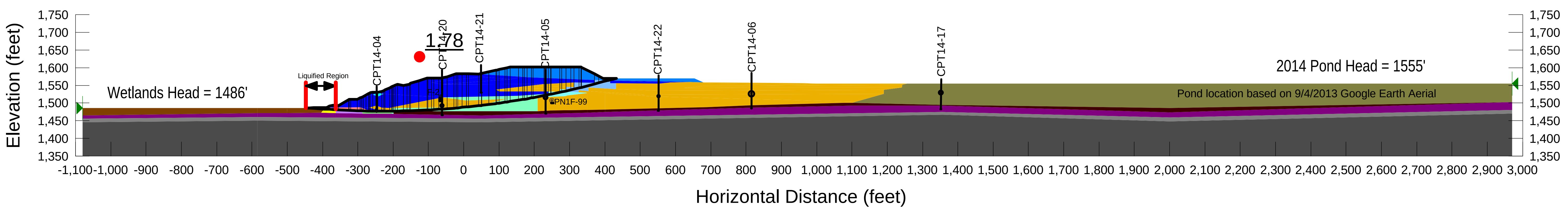
PolyMet Flotation Tailings Basin
Date Last Saved: 12/23/2014
File Name: RapidLoad_SectionF_L1_sliced_post_loading.gsz

Case: L1 - sliced- USSA (FSFS) (post loading)
Yield USSA strengths
w/ liquified zone
Post Loading

Factor of Safety: 1.78

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf
Name: LTVSMC FT/Slimes Model: S=f(overburden) Unit Weight: 125 pcf
Name: LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Slice #3 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,440 psf
Name: Slice #4 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,090 psf
Name: Slice #5 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 4,000 psf
Name: Slice #6 Model: Undrained (Phi=0) Unit Weight: 135 pcf Cohesion': 550 psf
Name: Slice #2 Model: Undrained (Phi=0) Unit Weight: 90 pcf Cohesion': 645 psf



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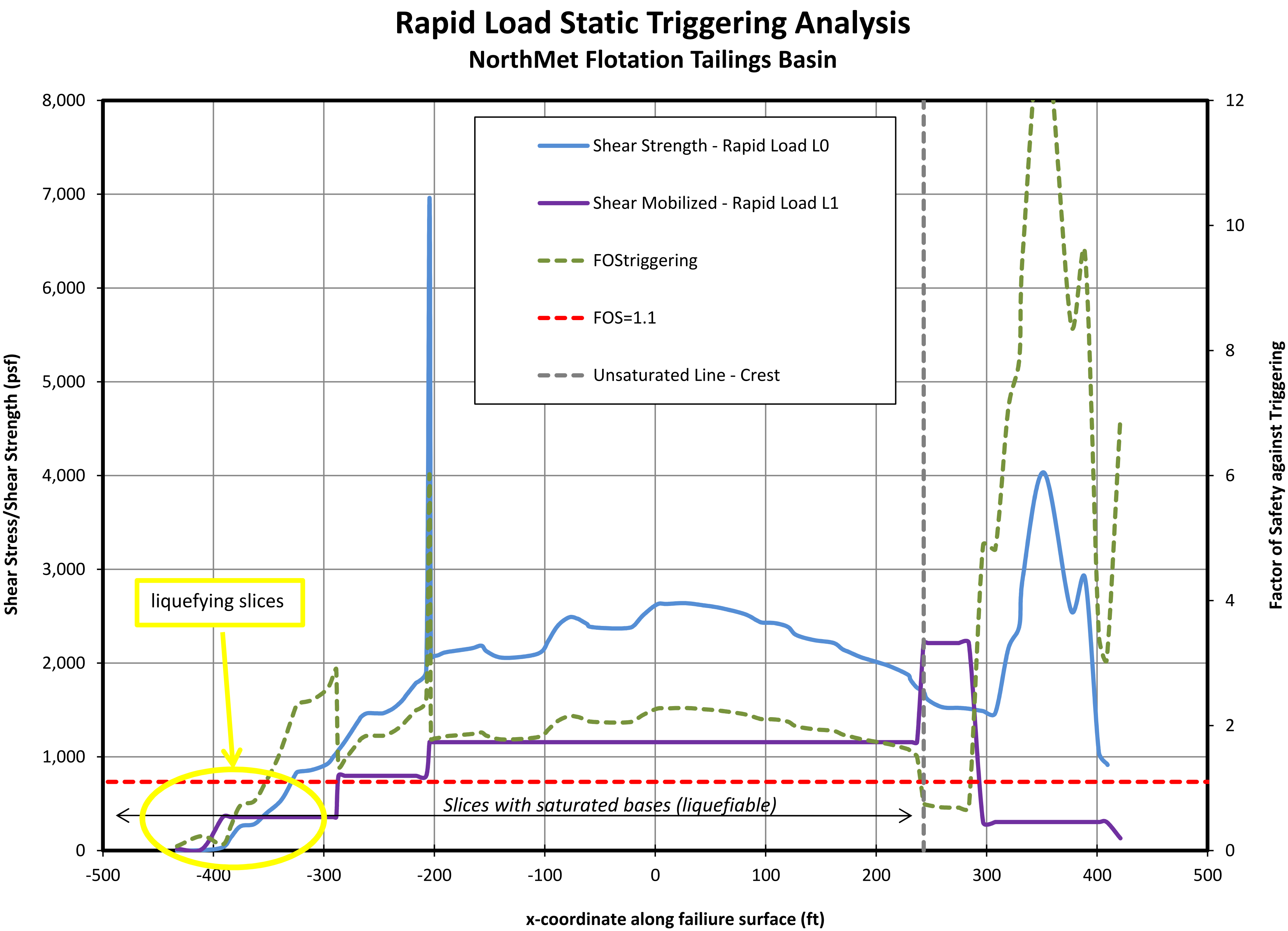
Project #23690862-037

Attachment O - Static Triggering Outputs
Rapid Load Case



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Attachment O - Static Triggering Outputs
Rapid Load Case

PolyMet Flotation Tailings Basin Design
v5 Submittal

Liquefaction Triggering Analysis

Saturated Zones	
x-coord (feet)	
Toe	Crest
0	243
0	243

Post-liquefaction FSFS FS= ***1.78***

Rapid Load

Computing the Fstriggering based on the shear mobilized of the pre-con model versus the shear resistance/strength of the post-con mode

RapidLoad-SectionF-L1_sliced (pre-trigger)
1.0 L0 - sliced- USSA (FSFS)
\# of slices 90 USSA (FSFS)
USSA** $_{liq}$ **FS= 1.67
USSA** $_{yield}$ **FS= 2.52
Lift0-FSFS

RapidLoad-SectionF-L1_sliced (pre-trigger)
2.0 L1 - sliced- USSA (FSFS) (2)
\# of slices 91 USSA (FSFS)
USSA** $_{liq}$ **FS= 1.72
USSA** $_{yield}$ **FS= 1.81
Lift1-FSFS

Saturated slices	FS	Distance (ft)	X (ft)
min	0.07	0.0	-432.9
max	6.02	228.8	-204.3
ave	1.90		

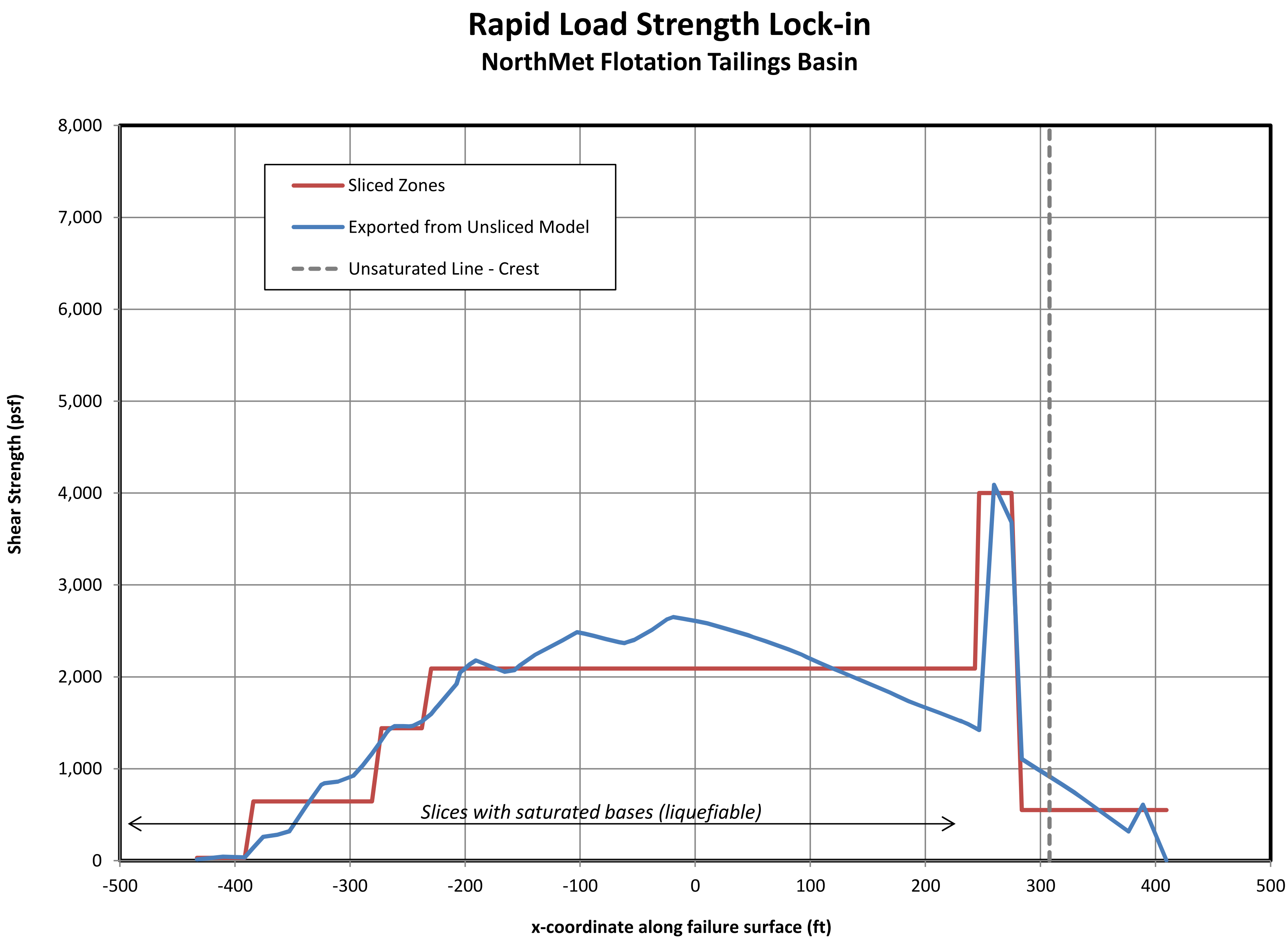
Legend

- (grey) *Added & interpolated to to maintain distances for FS computation*
- (orange) *Indicates unsaturated soil (above phreatic), not subject to liquefaction*

$FS_{triggering}$ shading scale
- min
- 1.1
- max

- (yellow) *Liquefaction is triggered (FS<1.1)*

Slice #	X (ft)	Pore-Water Pressure (psf)	Distance (ft)	Shear Mobilized - Rapid Load (psf)	X (ft)	Shear Strength - Rapid Load L0 / Shear Resistance (psf)	Difference	Slice #	X (ft)	Slip 1 Pore-Water Pressure (psf)	Distance (ft)	Slip 1 Shear Mobilized (psf)	Distance (ft)	Slip 1 Shear Resistance (psf)	**Strength/ Mob** FOS$_{triggering}$	Distance (ft)	X (ft)
1	-432.899	0	0	355.4176	-432.899	1.176516	0	1	-432.899	0	0	16.60239	0	30	0.070864271	0	-432.899
2	-410.249	0	22.71162	355.4176	-410.249	3.853813	0	2	-410.249	0	22.71162	16.60239	22.71162	30	0.232124033	22.71162	-410.249
3	-391.496	255.6888	41.49722	355.4176	-391.496	34.95286	0	3	-391.496	255.9169	41.49722	356.9513	41.49722	645	0.09792051	41.49722	-391.496
4	-384	285.2076	49.00657	355.4176	-384	143.1295	0	4	-384	285.5408	49.00657	356.9513	49.00657	645	0.400977739	49.00657	-384
5	-375.501	319.0608	57.52008	355.4176	-375.501	258.2974	0	5	-375.501	319.5439	57.52008	356.9513	57.52008	645	0.723620655	57.52008	-375.501
6	-362.997	369.6963	70.04652	355.4176	-362.997	282.5283	0	6	-362.997	370.4688	70.04652	356.9513	70.04652	645	0.791503577	70.04652	-362.997
7	-352.498	413.0246	80.56364	355.4176	-352.498	393.5921	0		-352.498		80.56364	356.9513		645	1.102649063	80.56364	-352.498
8	-338.007	475.0424	95.08071	355.4176	-338.007	546.8965	2.4982	7	-340.505	465.0469	92.57813	356.9513	92.57813	645	1.532131901	92.57813	-340.505
9	-325.132	532.0724	107.9783	355.4176	-325.132	825.483	0	8	-325.132	532.2302	107.9783	356.9513	107.9783	645	2.312592432	107.9783	-325.132
10	-322.121	540.9932	110.9911	355.4176	-322.121	842.8431	0	9	-322.121	540.9277	110.9911	356.9513	110.9911	645	2.361226989	110.9911	-322.121
11	-310.492	567.9574	122.626	355.4176	-310.492	860.8241	0	10	-310.492	566.8645	122.626	356.9513	122.626	645	2.411600578	122.626	-310.492
12	-296.996	599.1316	136.1288	355.4176	-296.996	923.3563	0	11	-296.996	596.6603	136.1288	356.9513	136.1288	645	2.586784934	136.1288	-296.996
	-291				-291	1007.298	0	12	-291	609.7724	142.1277	356.9513	142.1277	645	2.821947718	142.1277	-291
13	-289	617.5181	144.1283	355.4176	-289	1035.292	-0.2360419	13	-288.764	614.6401	144.3645	356.9513	144.3645	645	2.900373226	144.3645	-288.764
	-286.765				-286.765	1070.808	0	14	-286.765	619.4672	146.3651	796.9146	146.3651	1440	1.343692665	146.3651	-286.765
14	-280.875	636.1569	152.2574	355.4176	-280.875	1164.369	0	15	-280.875	633.9315	152.2574	796.9146	152.2574	1440	1.46109606	152.2574	-280.875
15	-272.639	646.5466	160.4956	355.4176	-272.639	1312.094	0	16	-272.639	645.8687	160.4956	796.9146	160.4956	1440	1.646467112	160.4956	-272.639
16	-268.265	647.2819	164.87	355.4176	-268.265	1390.741	0	17	-268.265	647.5541	164.87	796.9146	164.87	1440	1.745156355	164.87	-268.265
17	-266	649.6172	167.1345	355.4176	-266	1429.097	0	18	-266	649.7652	167.1345	796.9146	167.1345	1440	1.793287108	167.1345	-266
18	-261	654.6543	172.1351	355.4176	-261	1463.999	0	19	-261	654.7857	172.1351	796.9146	172.1351	1440	1.837084397	172.1351	-261
19	-253.5	661.8879	179.635	355.4176	-253.5	1464.104	0	20	-253.5	661.9948	179.635	796.9146	179.635	1440	1.837215904	179.635	-253.5
20	-248.493	666.4946	184.643	355.4176	-248.493	1462.989	0	21	-248.493	666.5857	184.643	796.9146	184.643	1440	1.835817009	184.643	-248.493
21	-245.489	669.3551	187.6465	355.4176	-245.489	1467.825	0	22	-245.489	669.4281	187.6465	796.9146	187.6465	1440	1.841885413	187.6465	-245.489
22	-237.493	677.0341	195.643	355.4176	-237.493	1514.091	0	23	-237.493	677.0873	195.643	796.9146	195.643	1440	1.899941571	195.643	-237.493
23	-229.497	684.2327	203.6399	355.4176	-229.497	1594.656	0	24	-229.497	684.2679	203.6399	796.9146	203.6399	1440	2.00103722	203.6399	-229.497
24	-225.35	687.6966	207.7865	355.4176	-225.35	1658.095	0	25	-225.35	687.726	207.7865	796.9146	207.7865	1440	2.080643741	207.7865	-225.35
25	-223.35	688.8169	209.7867	355.4176	-223.35	1687.846	0	26	-223.35	688.8423	209.7867	796.9146	209.7867	1440	2.117976348	209.7867	-223.35
26	-216.499	686.8106	216.6378	355.4176	-216.499	1788.847	0	27	-216.499	686.8223	216.6378	796.9146	216.6378	1440	2.244715648	216.6378	-216.499
27	-207.341	683.0976	225.7958	355.4176	-207.341	1915.681	0	28	-207.341	683.0987	225.7958	796.9146	225.7958	1440	2.403872724	225.7958	-207.341
28	-204.342	694.0405	228.7947	2750.537	-204.342	6960.738	0	29	-204.342	694.0405	228.7947	1156.633	228.7947	2090	6.01810403	228.7947	-204.342
29	-202.997	717.4412	230.1401	2750.537	-202.997	2063.314	0	30	-202.997	717.4413	230.1401	1156.633	230.1401	2090	1.783896513	230.1401	-202.997
30	-200.347	758.7565	232.791	2750.537	-200.347	2073.811	0	31	-200.347	758.7568	232.791	1156.633	232.791	2090	1.792972141	232.791	-200.347
31	-196.35	808.6972	236.789	789.8169	-196.35	2084.058	0	32	-196.35	808.6979	236.789	1156.633	236.789	2090	1.801831898	236.789	-196.35
32	-190.503	870.5323	242.6378	789.8169	-190.503	2112.804	0	33	-190.503	870.5349	242.6378	1156.633	242.6378	2090	1.826684502	242.6378	-190.503
33	-179.008	991.83	254.1364	789.8169	-179.008	2133.884	0	34	-179.008	991.8363	254.1364	1156.633	254.1364	2090	1.84491035	254.1364	-179.008
34	-165.705	1118.255	267.4438	789.8169	-165.705	2158.281	0	35	-165.705	1118.266	267.4438	1156.633	267.4438	2090	1.866003023	267.4438	-165.705
35	-157.201	1196.64	275.9512	789.8169	-157.201	2184.827	0	36	-157.201	1196.653	275.9512	1156.633	275.9512	2090	1.888954469	275.9512	-157.201
36	-152.499	1239.134	280.6553	789.8169	-152.499	2123.961	0	37	-152.499	1239.149	280.6553	1156.633	280.6553	2090	1.836331209	280.6553	-152.499
37	-139.073	1360.985	294.0895	789.8169	-139.073	2057.352	0	38	-139.073	1361.003	294.0895	1156.633	294.0895	2090	1.778742156	294.0895	-139.073
38	-115.224	1544.374	317.9512	789.8169	-115.224	2074.76	0	39	-115.224	1544.393	317.9512	1156.633	317.9512	2090	1.793792392	317.9512	-115.224
39	-102.651	1615.926	330.5319	789.8169	-102.651	2124.348	0	40	-102.651	1615.945	330.5319	1156.633	330.5319	2090	1.836665282	330.5319	-102.651
40	-96.5231	1636.777	336.6759	789.8169	-96.5231	2243.069	0	41	-96.5231	1636.795	336.6759	1156.633	336.6759	2090	1.939308816	336.6759	-96.5231
41	-88.0218	1658.051	345.1991	789.8169	-88.0218	2400.543	0	42	-88.0218	1658.071	345.1991	1156.633	345.1991	2090	2.075458137	345.1991	-88.0218
42	-77.9238	1678.728	355.3231	789.8169	-77.9238	2487.48	0	43	-77.9238	1678.749	355.3231	1156.633	355.3231	2090	2.150621996	355.3231	-77.9238
43	-70.4155	1691.836	362.8508	789.8169	-70.4155	2473.384	0	44	-70.4155	1691.857	362.8508	1156.633	362.8508	2090	2.138434725	362.8508	-70.4155
44	-65.9917	1695.699	367.2859	789.8169	-65.9917	2444.88	0	45	-65.9917	1695.72	367.2859	1156.633	367.2859	2090	2.113790175	367.2859	-65.9917
45	-61.4812	1699.607	371.808	789.8169	-61.4812	2413.861	0	46	-61.4812	1699.628	371.808	1156.633	371.808	2090	2.086972334	371.808	-61.4812
46	-59.9812	1700.9	373.3119	789.8169	-59.9812	2390.725	0	47	-59.9812	1700.921	373.3119	1156.633	373.3119	2090	2.066969101	373.3119	-59.9812
47	-52.924	1706.901	380.3873	789.8169	-52.924	2377.952	0	48	-52.924	1706.922	380.3873	1156.633	380.3873	2090	2.055926445	380.3873	-52.924
48	-37.474	1705.388	395.877	789.8169	-37.474	2368.668	0	49	-37.474	1705.413	395.877	1156.633	395.877	2090	2.047899699	395.877	-37.474
49	-24.5483	1690.311	408.8434	789.8169	-24.5483	2374.206	0	50	-24.5483	1690.337	408.8434	1156.633	408.8434	2090	2.052687043	408.8434	-24.5483
50	-18.9983	1676.193	414.4206	789.8169	-18.9983	2402.754	0	51	-18.9983	1676.219	414.4206	1156.633	414.4206	2090	2.077369547	414.4206	-18.9983
51	-10.8506	1650.391	422.6081	789.8169	-10.8506	2511.428	0	52	-10.8506	1650.418	422.6081	1156.633	422.6081	2090	2.171326316	422.6081	-10.8506
52	1.644344	1624.699	435.1643	789.8169	1.644344	2625.622	0	53	1.644344	1624.728	435.1643	1156.633	435.1643	2090	2.270056508	435.1643	1.644344
53	10.49495	1613.415	444.0582	789.8169	10.49495	2630.064	0	54	10.49495	1613.442	444.0582	1156.633	444.0582	2090	2.273897082	444.0582	10.49495
54	27.5	1583.448	461.1466	789.8169	27.5	2638.599	0	55	27.5	1583.47	461.1466	1156.633	461.1466	2090	2.281276143	461.1466	27.5
55	45.8	1540.597	479.5362	789.8169	45.8	2611.967	0	56	45.8	1540.613	479.5362	1156.633	479.5362	2090	2.258250424	479.5362	45.8
56	50.35	1529.724	484.1113	789.8169	50.35	2605.345	0	57	50.35	1529.739	484.1113	1156.633	484.1113	2090	2.25252545	484.1113	50.35
57	61.05	1440.039	494.91	789.8169	61.05	2582.316	0	58	61.05	1440.055	494.91	1156.633	494.91	2090	2.232614727	494.91	61.05
58	80.9868	1290.279	515.0305	789.8169	80.9868	2522.143	0	59	80.9868	1290.297	515.0305	1156.633	515.0305	2090	2.18059036	515.0305	80.9868
59	92.5022	1210.881	526.6521	789.8169	92.5022	2451.569	0	60	92.5022	1210.901	526.6521	1156.633	526.6521	2090	2.119573686	526.6521	92.5022
60	96.9989	1184.285	531.1902	789.8169	96.9989	2431.15	0	61	96.9989	1184.305	531.1902	1156.633	531.1902	2090	2.101919945	531.1902	96.9989
61	108.5835	1120.445	542.8816	789.8169	108.5835	2425.607	0	62	108.5835	1120.463	542.8816	1156.633	542.8816	2090	2.097127759	542.8816	108.5835
62	120.15	1054.105	554.5624	789.8169	120.15	2384.936	0	63	120.15	1054.121	554.5624	1156.633	554.5624	2090	2.061963969	554.5624	120.15
63	127.52	1002.527	562.0204	789.8169	127.52	2300.012	0	64	127.52	1002.542	562.0204	1156.633	562.0204	2090	1.98854094	562.0204	127.52
64	143.4832	881.9654	578.1741	789.8169	143.4832	2245.389	0	65	143.4832	881.9782	578.1741	1156.633	578.1741	2090	1.941315243	578.1741	143.4832
65	161.2545	742.987	596.1576	789.8169	161.2545	2214.855	0	66	161.2545	743.0024	596.1576	1156.633	596.1576	2090	1.914915685	596.1576	161.2545
66	169.4414	677.6079	604.4422	789.8169	169.4414	2148.158	0	67	169.4414	677.6248	604.4422	1156.633	604.4422	2090	1.857250722	604.4422	169.4414
67	175.1941	624.3305	610.2839	789.8169	175.1941	2118.502	0	68	175.1941	624.348	610.2839	1156.633	610.2839	2090	1.831610868	610.2839	175.1941
68	185.4641	522.5334	620.7332	789.8169	185.4641	2065.559	0	69	185.4641	522.5524	620.7332	1156.633	620.7332	2090	1.785837751	620.7332	185.4641
69	194.2168	437.7714	629.6387	789.8169	194.2168	2033.086	0	70	194.2168	437.792	629.6387	1156.633	629.6387	2090	1.757762131	629.6387	194.2168
70	212.244	236.532	647.9807	789.8169	212.244	1966.204	0	71	212.244	236.5573	647.9807	1156.633	647.9807	2090	1.699837384	647.9807	212.244
71	228.9972	64.17601	665.0263	789.8169	228.9972	1874.038	0	72	228.9972	64.20357	665.0263	1156.633	665.0263	2090	1.620252472	665.0263	228.9972
72	230.7624	46.04123	666.8222	789.8169	230.7624	1829.835	0	73	230.7624	46.06889	666.8222	1156.633	666.8222	2090	1.582036288	666.8222	230.7624
73	232.7557	26.51005	668.8503	789.8169	232.7557	1793.45	0	74	232.7557	26.53808	668.8503	1156.633	668.8503	2090	1.550578601	668.8503	232.7557
74	236.9933	-13.4367	673.162	789.8169	236.9933	1737.001	0	75	236.9933	-13.4071	673.162	1156.633	673.162	2090	1.501773406	673.162	236.9933
75	243	-66.6711	679.2735	1591.481	243	1693.913	0	76	243	-66.6401	679.2735	2213.652	679.2735	4000	0.765212025	679.2735	243
76	246.645	-96.9482	682.9861	1591.481	246.645	1610.784	0	77	246.645	-96.9171	682.9861	2213.652	682.9861	4000	0.727659279	682.9861	246.645
77	259.745	-227.926	696.4006	1591.481	259.745	1529.984	0	78	259.745	-227.906	696.4006	2213.652	696.4006	4000	0.691158595	696.4006	259.745
78	274.97	-432.724	711.9912	1591.481	274.97	1521.616	0	79	274.97	-432.706	711.9912	2213.652	711.9912	4000	0.6873781	711.9912	274.97
79	283.87	-550.944	721.1049	1591.481	283.87	1512.361	0	80	283.87	-550.929	721.1049	2213.652	721.1049	4000	0.683197361	721.1049	283.87
80	296.8052	-721.379	734.3507	195.4797	296.8052	1487.617	0	81	296.8052	-721.363	734.3507	304.3771	734.3507	550	4.88741373	734.3507	296.8052
81	307.8052	-784.137	745.6148	195.4797	307.8052	1466.575	0	82	307.8052	-784.126	745.6148	304.3771	745.6148	550	4.818281524	745.6148	307.8052
82	319.6	-720.199	757.6927	195.4797	319.6	2151.537	0	83	319.6	-720.196	757.6927	304.3771	757.6927	550	7.068656648	757.6927	319.6
83	329.57	-690.598	767.923	195.4797	329.57	2392.941	0	84	329.57	-690.597	767.923	304.3771	767.923	550	7.861764615	767.923	329.57
84	332.9357	-685.332	771.401	195.4797	332.9357	2925.988	0	85	332.9357	-685.332	771.401	304.3771	771.401	550	9.613034258	771.401	332.9357
85	351.9657	-1010.25	791.0662	195.4797	351.9657	4031.125	0	86	351.9657	-1010.25	791.0662	304.3771	791.0662	550	13.24385042	791.0662	351.9657
86	376.4812	-1439.77	816.3999	195.4797	376.4812	2558.239	0	87	376.4812	-1439.77	816.3999	304.3771	816.3999	550	8.404835186	816.3999	376.4812
87	389.1063	-1553.42	829.4465	195.4797	389.1063	2902.367	0	88	389.1063	-1553.42	829.4465	304.3771	829.4465	550	9.535432032	829.4465	389.1063
88	401.5773	-1593.99	842.3337	195.4797	401.5773	1050.469	0	89	401.5773	-1593.99	842.3337	304.3771	842.3337	550	3.451208286	842.3337	401.5773
89	408.6889	-1650.57	849.6827	195.4797	408.6889	928.2366	0	90	408.6889	-1650.57	849.6827	304.3771	849.6827	550	3.049626722	849.6827	408.6889
90	409.5212	-1651.79	850.5428	0.522232	409.5212	913.9312	-11.636289	91	421.1575	0	862.5675	131.5107	862.5675	237.6359	6.94947993	862.5675	421.1575

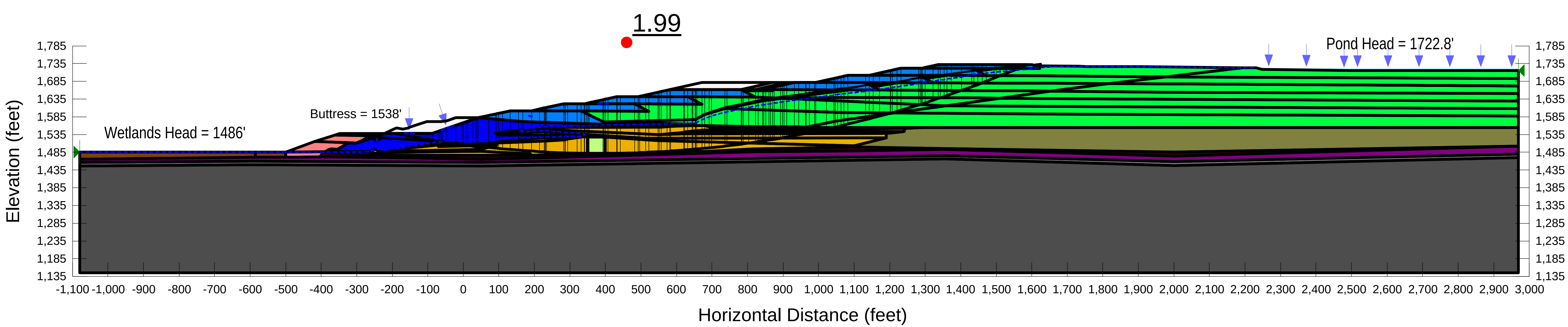

Rapid Load Strength Lock-in
NorthMet Flotation Tailings Basin
Sliced Zones
Exported from Unsliced Model
Unsaturated Line - Crest
Shear Strength (psf)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Slices with saturated bases (liquefiable)
-500
-400
-300
-200
-100
0
100
200
300
400
500
x-coordinate along failure surface (ft)

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/16/2014
File Name: ErosionC-SecF_Lift8_USSA_Sliced.gsz

1.0 Lift 8- Eroded - USSA (FSFS Erosion C)
USSA strengths, FSFS from Erosion C model

Factor of Safety: 1.99

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC FT/Slimes Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Slice 1 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf



P:\Mpls\23 MN\69\2369862\WorkFiles\022A GeoStudio models\2014\Section F\Triggering_04_Erosion

Project #23690862-037

PolyMet

v5 Submittal

Progressive Erosion cases

Saturated Zones	
Distance (feet)	
Toe	Crest
130.5228	1783.273
130.5228	1783.273

Note: Su were set along the fully specified failure surface based on Baseline strengths within the LTVSMC FT/slimes zone below the eroded area.

Post-liquefaction FSFS FS= N/A

Computing the Fstriggering based on the shear mobilized of the baseline (pre-erosion) model versus the shear resistance/strength of the eroded model

ErosionB case

2nd progressive erosion case

Baseline-SecF_Lift8_USSA_FSFSErosionC
# of slices 147
USSA liq FS= 1.1
USSA yield FS= 2.22

ErosionC-SecF_Lift8_USSA_Sliced
# of slices 0
USSA liq FS= 1
USSA yield FS= 1.99

Saturated Slices	FS	@dist
ave	*1.99*	
min	*1.81*	157.4
max	*2.03*	232.2

Legend

Added & interpolated to to maintain distances for FS computation

Indicates unsaturated soil (above phreatic), not subject to liquefaction

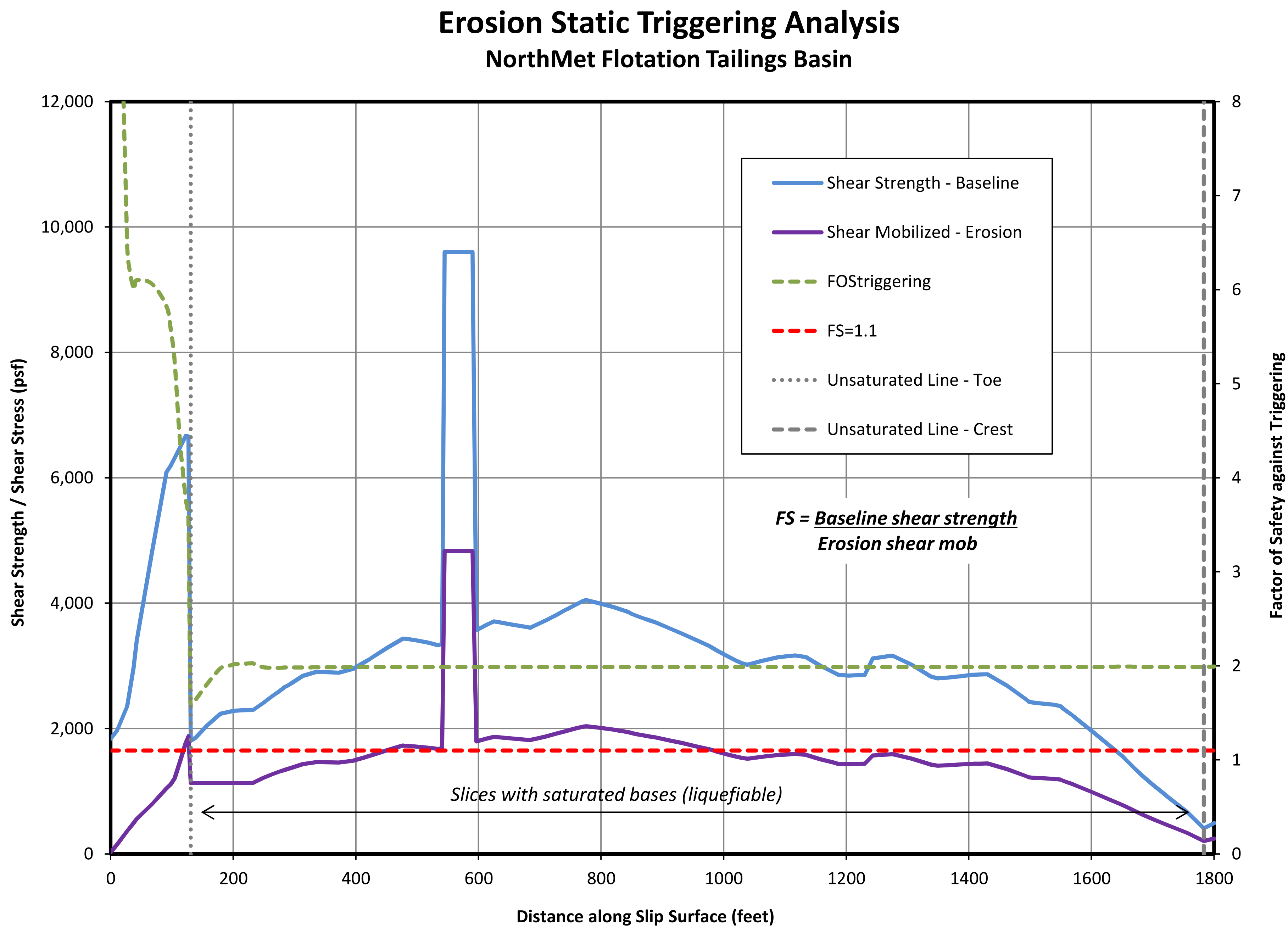
$FS_{triggering}$ shading scale
- min
- 1.1
- max

Liquefaction is triggered (FS<1.1)

Baseline-FSFS_B						***ErosionB-FSFS***					ErosionB
			PWP		Shear Strength - Baseline				Shear Mobilized - Erosion		
Slice #	Distance (ft)	Slice #	Pore-Water P	X (ft)	Shear Resistance (psf)	Slice #	Distance (ft)	X (ft)	Shear Mobilized (psf)	$FOS_{triggering}$	Distance (ft)
1	0	1	-290.047	-203.389	773.63499						
2	10.96589	2	-464.07	-192.617	1628.9754	Slice #	Distance (f	X (ft)	ear Mobilized (psf)		
3	14.52886	3	-492.698	-189.117	1835.7531	1	0	-189.117	25.70131322	71.42643197	0
4	24.82789	4	-386.112	-179	1963.8427	2	10.29904	-179	148.5251758	13.22228834	10.299037
5	41.62475	5	-266.81	-162.5	2353.8452	3	27.09589	-162.5	364.4400826	6.458798887	27.095888
6	51.80466	6	-420.273	-152.5	2962.3599	4	37.2758	-152.5	492.9944638	6.008911088	37.275799
7	56.89461	7	-506.958	-147.5	3399.5277	5	42.36575	-147.5	557.2716569	6.100306121	42.365754
8	81.76229	8	-539.316	-123	4805.5455	6	67.23344	-123	792.6480733	6.062647046	67.233436
9	105.4771	9	-450.342	-99.625	6085.1309	7	90.94821	-99.625	1044.410609	5.826377911	90.948213
10	112.5713	10	-392.252	-92.625	6192.3949	8	98.04244	-92.625	1110.106299	5.578199949	98.042435
11	118.7755	11	-333.386	-86.5	6312.9461	9	104.2466	-86.5	1203.663942	5.244774627	104.24659
12	127.6433	12	-271.705	-77.7453	6485.2549	10	113.1145	-77.7453	1477.355468	4.389772835	113.11445
13	137.1395	13	-97.5165	-68.3703	6669.772	11	122.6106	-68.3703	1770.438441	3.767299582	122.61061
14	141.4318	14	-14.2699	-64.125	6658.4285	12	126.8618	-64.167	1875.786224	3.54967342	126.86178
15	145.0909	15	52.88433	-60.5	1803.3195	13	130.5228	-60.542	1132.225353	1.592721357	130.52275
16	152.7381	16	182.5181	-52.924	1853.3086	14	138.2163	-52.924	1132.225353	1.63687255	138.21632
17	171.9166	17	486.4711	-33.924	2046.3434	15	157.4049	-33.924	1132.225353	1.807364051	157.40485
18	194.506	18	720.245	-11.5448	2234.119	16	179.0014	-12.5397	1132.225353	1.97321054	179.00137
19	204.7262	19	820.2953	-1.41984	2257.0959	17	189.2268	-2.41467	1132.225353	1.993504115	189.22683
20	206.5245	20	837.051	0.36325	2261.0152	18	191.3069	-0.35399	1132.225353	1.996965705	191.30686
21	210.9349	21	873.5209	4.73825	2271.2517	19	195.7138	4.02101	1132.225353	2.00600675	195.71378
22	216.2391	22	918.2918	10	2282.4867	20	201.7364	10	1132.225353	2.015929686	201.73639
23	226.1451	23	1007.826	19.82651	2289.4441	21	211.3951	19.58878	1132.225353	2.022074576	211.39513
	intermediary point			30.96378	2292.378539	22	222.8531	30.96378	1132.225353	2.02466632	222.85312
24	239.5021	24	1138.753	33.07651	2292.9352		224.9813	33.07651	1132.225353	2.025157973	224.98127
	intermediary point			36.625	2293.457272	23	228.5557	36.625	1132.225353	2.025619075	228.55565
25	246.7271	25	1206.515	40.25	2293.9906	24	232.2037	40.25	1132.225353	2.026090119	232.20367
26	263.0537	26	1335.885	56.5	2405.2583	25	248.5416	56.5	1211.307167	1.985671649	248.5416
	intermediary point			72	2520.411216	26	264.1255	72	1272.175552	1.981181931	264.12546
27	287.6693	27	1548.843	81	2587.2742	27	274.1796	82	1307.560966	1.978702537	274.17957
28	299.2235	28	1665.966	92.5	2664.459	28	284.7364	92.5	1343.369178	1.983415315	284.73638
29	303.7447	29	1712.075	97	2687.2173	29	289.2607	97	1355.03593	1.983133614	289.26073
30	312.0336	30	1797.056	105.25	2737.2333	30	297.5554	105.25	1380.596647	1.98264519	297.55537
31	328.0615	31	1944.822	121.22	2841.6056	31	313.582	121.22	1432.991759	1.982988097	313.58197
32	350.3814	32	2145.987	143.47	2904.7494	32	335.8937	143.47	1463.986805	1.984136326	335.89366
33	368.2085	33	2304.708	161.2414	2897.6521	33	353.7143	161.2414	1459.825248	1.984930802	353.71429
34	386.7366	34	2473.953	179.7114	2891.9098	34	372.2355	179.7114	1456.359682	1.985711247	372.2355
35	410.3191	35	2732.856	203.22	2952.8312	35	395.8093	203.22	1486.242984	1.986775535	395.80933
36	428.3891	36	2929.307	221.25	3058.262	36	413.8759	221.25	1538.951898	1.9872369	413.87587
37	436.1472	37	2999.061	229	3102.2018	37	421.6339	229	1561.062901	1.9872369	421.63393
38	437.6486	38	3012.588	230.4999	3110.8325	38	423.1353	230.4999	1565.405966	1.9872369	423.13534
39	438.4117	39	3019.467	231.2622	3115.3544	39	423.8985	231.2622	1567.681437	1.9872369	423.89848
40	439.9135	40	3031.772	232.7624	3124.9325	40	425.4002	232.7624	1572.501245	1.9872369	425.40019
41	465.1473	41	3239.766	257.97	3284.7797	41	450.6341	257.97	1652.938157	1.9872369	450.63405
42	491.0492	42	3458.934	283.845	3434.1759	42	476.536	283.845	1728.116009	1.9872369	476.53596
43	493.6378	43	3480.841	286.4314	3432.1572	43	479.1246	286.4314	1727.100176	1.9872369	479.12455
44	497.7605	44	3511.964	290.5524	3428.3342	44	483.2472	290.5524	1725.176399	1.9872369	483.24724
45	514.3361	45	3649.936	307.121	3403.0703	45	499.8228	307.121	1712.46332	1.9872369	499.82279
46	533.3151	46	3816.658	326.095	3366.622	46	518.8019	326.095	1694.122125	1.9872369	518.80188
47	543.1899	47	3899.101	335.9693	3342.3409	47	528.6766	335.9693	1681.903602	1.9872369	528.67665
48	548.1901	48	3942.78	340.9693	3328.2622	48	533.6769	340.9693	1674.819041	1.9872369	533.67688
49	551.191	49	3968.943	343.97	3335.0018	49	536.6777	343.97	1678.210484	1.9872369	536.67773
50	555.2212	50	4003.959	348	3353.097	50	540.7079	348	1687.316193	1.9872369	540.70791
51	559.2213	51	4047.074	352	9600	51	544.7081	352	4830.828172	1.9872369	544.70808
52	580.7223	52	4321.792	373.5	9600	52	566.209	373.5	4830.828172	1.9872369	566.20901
53	601.3483	53	4573.775	394.1251	9600	53	586.835	394.1251	4830.828172	1.9872369	586.835
54	604.7234	54	4613.807	397.5001	9600	54	590.2101	397.5001	4830.828172	1.9872369	590.21015
55	611.0507	55	4665.58	403.8272	3567.4607	55	596.5375	403.8272	1795.186422	1.9872369	596.53745
56	627.1482	56	4760.418	419.9222	3649.056	56	612.6349	419.9222	1836.246096	1.9872369	612.63493
57	639.6979	57	4823.3	432.47	3709.9925	57	625.1847	432.47	1866.91003	1.9872369	625.18466
58	644.9787	58	4849.508	437.75	3700.6328	58	630.4655	437.75	1862.200123	1.9872369	630.46547
59	669.4557	59	4942.798	462.22	3659.38	59	654.9424	462.22	1841.441249	1.9872369	654.94244
60	694.0886	60	5015.307	486.845	3618.8175	60	679.5754	486.845	1821.029742	1.9872369	679.57537
61	699.0903	61	5028.422	491.845	3608.4157	61	684.577	491.845	1815.795439	1.9872369	684.57703
62	701.7181	62	5031.949	494.47	3619.7191	62	687.2048	494.47	1821.483438	1.9872369	687.20479
63	712.2591	63	5045.597	505	3667.891	63	697.7459	505	1845.724081	1.9872369	697.74586
64	724.7305	64	5059.54	517.4583	3725.4381	64	710.2172	517.4583	1874.68243	1.9872369	710.21721
65	742.2489	65	5078.098	534.9583	3814.6401	65	727.7356	534.9583	1919.569881	1.9872369	727.73561
66	756.8059	66	5093.324	549.5	3891.1161	66	742.2927	549.5	1958.053466	1.9872369	742.29265
67	761.3106	67	5098.243	554	3914.7322	67	746.7974	554	1969.937354	1.9872369	746.79738
68	772.5725	68	5110.532	565.25	3972.312	68	758.0592	565.25	1998.912158	1.9872369	758.05921
69	785.0641	69	5116.398	577.72	4032.5319	69	770.5508	577.72	2029.21549	1.9872369	770.55083
70	790.3328	70	5109.958	582.97	4048.8686	70	775.8195	582.97	2037.436302	1.9872369	775.81949
71	809.9085	71	5093.331	602.4765	4000.8963	71	795.3953	602.4765	2013.2961	1.9872369	795.39527
72	829.4778	72	5087.29	621.9765	3950.5003	72	814.9646	621.9765	1987.936265	1.9872369	814.96458
73	835.021	73	5087.375	627.5	3935.7982	73	820.5078	627.5	1980.538002	1.9872369	820.50777
74	845.2573	74	5094.962	637.7	3903.5724	74	830.744	637.7	1964.321617	1.9872369	830.74402
75	852.4706	75	5099.843	644.8878	3879.3193	75	837.9573	644.8878	1952.117183	1.9872369	837.95732
76	857.2319	76	5105.509	649.6322	3863.0279	76	842.7186	649.6322	1943.919167	1.9872369	842.71863
77	860.7728	77	5111.276	653.1606	3850.5393	77	846.2596	653.1606	1937.634763	1.9872369	846.25957
78	863.021	78	5115.041	655.4008	3836.5857	78	848.5077	655.4008	1930.613154	1.9872369	848.50769
79	872.2991	79	5131.451	664.6461	3797.722	79	857.7858	664.6461	1911.056503	1.9872369	857.78585
80	883.153	80	5158.175	675.4615	3759.3008	80	868.6397	675.4615	1891.722522	1.9872369	868.63969
81	893.2272	81	5186.792	685.5	3727.0848	81	878.7139	685.5	1875.511068	1.9872369	878.71392
82	903.0152	82	5215.113	695.2443	3692.6155	82	888.502	695.2443	1858.165727	1.9872369	888.50198
83	925.1625	83	5266.731	717.2443	3603.8763	83	910.6493	717.2443	1813.511162	1.9872369	910.64926
84	946.8829	84	5336.405	738.8203	3512.2753	84	932.3696	738.8203	1767.416507	1.9872369	932.36965
85	970.0078	85	5427.341	761.7914	3410.7295	85	955.4945	761.7914	1716.317516	1.9872369	955.49452
86	991.7068	86	5525.565	783.3461	3312.3502	86	977.1936	783.3461	1666.811944	1.9872369	977.19357
87	994.7338	87	5538.124	786.3461	3297.2718	87	980.2205	786.3461	1659.224323	1.9872369	980.22049
88	1003.991	88	5570.977	795.5003	3243.324	88	989.4777	795.5003	1632.077182	1.9872369	989.47768
89	1021.182	89	5598.066	812.5003	3149.392	89	1006.669	812.5003	1584.809541	1.9872369	1006.6689
90	1034.935	90	5597.005	826.0997	3082.3263	90	1020.421	826.0997	1551.061325	1.9872369	1020.4213
91	1045.046	91	5592.31	836.0986	3038.3326	91	1030.533	836.0986	1528.9232	1.9872369	1030.5327
92	1053.02	92	5588.493	843.9843	3017.8502	92	1038.507	843.9843	1518.616225	1.9872369	1038.5071
93	1057.605	93	5586.015	848.5183	3029.4481	93	1043.092	848.5183	1524.452419	1.9872369	1043.0921
94	1064.604	94	5580.196	855.4394	3047.6406	94	1050.091	855.4394	1533.60709	1.9872369	1050.0911

95	1071.286	95	5574.584	862.0466	3065.022	95	1056.773	862.0466	1542.353607	1.9872369	1056.7726
96	1076.671	96	5570.021	867.3716	3077.2553	96	1062.157	867.3716	1548.509541	1.9872369	1062.1575
97	1081.867	97	5564.603	872.5104	3089.2527	97	1067.354	872.5104	1554.546768	1.9872369	1067.3541
98	1092.971	98	5536.531	883.4519	3115.2026	98	1078.458	883.4519	1567.60505	1.9872369	1078.458
99	1104.916	99	5515.466	895.2118	3139.1416	99	1090.403	895.2118	1579.651425	1.9872369	1090.4027
100	1109.937	100	5525.14	900.1549	3144.7571	100	1095.423	900.1549	1582.477207	1.9872369	1095.4233
101	1116.285	101	5538.614	906.4054	3151.56	101	1101.772	906.4054	1585.900503	1.9872369	1101.772
102	1131.37	102	5572.122	921.2566	3167.3655	102	1116.857	921.2566	1593.854009	1.9872369	1116.8565
103	1148.474	103	5614.614	938.0962	3141.7584	103	1133.961	938.0962	1580.968228	1.9872369	1133.9607
104	1164.188	104	5657.517	953.5676	3048.7101	104	1149.675	953.5676	1534.145275	1.9872369	1149.6751
105	1174.752	105	5682.158	963.9675	2987.1702	105	1160.238	963.9675	1503.177704	1.9872369	1160.2384
106	1180.498	106	5663.688	969.625	2961.3428	106	1165.985	969.625	1490.181065	1.9872369	1165.9848
107	1192.537	107	5604.633	981.4175	2902.6745	107	1178.024	981.4175	1460.658515	1.9872369	1178.0238
108	1201.6	108	5548.409	990.2625	2856.8062	108	1187.087	990.2625	1437.57707	1.9872369	1187.0868
109	1218.533	109	5567.643	1006.789	2844.4526	109	1204.02	1006.789	1431.360599	1.9872369	1204.0202
110	1245.022	110	5538.167	1032.64	2857.6535	110	1230.508	1032.64	1438.003441	1.9872369	1230.5084
111	1258.016	111	5461.844	1045.321	3118.8919	111	1243.502	1045.321	1569.461547	1.9872369	1243.5023
112	1262.992	112	5427.71	1050.159	3126.2745	112	1248.479	1050.159	1573.176555	1.9872369	1248.4788
113	1271.577	113	5363.857	1058.488	3137.8062	113	1257.064	1058.488	1578.979436	1.9872369	1257.0641
114	1280.69	114	5296.206	1067.329	3150.0137	114	1266.177	1067.329	1585.122388	1.9872369	1266.1768
115	1290.112	115	5226.108	1076.47	3162.6745	115	1275.599	1076.47	1591.493445	1.9872369	1275.5991
116	1321.52	116	4992.471	1106.94	3017.0257	116	1307.007	1106.94	1518.201328	1.9872369	1307.0069
117	1352.443	117	4763.016	1136.94	2829.5565	117	1337.93	1136.94	1423.864714	1.9872369	1337.9301
118	1363.811	118	4679.092	1147.968	2799.4926	118	1349.298	1147.968	1408.736221	1.9872369	1349.2978
119	1378.982	119	4567.704	1162.686	2809.4823	119	1364.469	1162.686	1413.76315	1.9872369	1364.4686
120	1403.722	120	4387.799	1186.688	2835.9125	120	1389.209	1186.688	1427.063125	1.9872369	1389.2091
121	1420.16	121	4268.408	1202.627	2856.3287	121	1405.65	1202.63	1437.342171	1.987229456	1405.6499
122	1423.052	122	4239.754	1205.397	2857.5105	122	1408.55	1205.408	1437.958907	1.987198999	1408.5497
123	1432.314	123	4148.731	1214.265	2861.1051	123	1417.806	1214.273	1439.832262	1.98711001	1417.806
124	1445.056	124	4025.63	1226.466	2865.4397	124	1430.536	1226.466	1442.10255	1.986987473	1430.5365
125	1476.882	125	3727.781	1256.94	2685.7992	125	1462.355	1256.94	1351.933733	1.986635243	1462.3553
126	1505.084	126	3477.563	1283.944	2485.3343	126	1490.659	1284.048	1250.842011	1.986929027	1490.6591
127	1509.293	127	3441.232	1287.974	2452.7738	127	1494.997	1288.203	1233.980206	1.987692985	1494.9974
128	1512.431	128	3412.575	1290.97	2427.9403	128	1498.026	1291.095	1221.94928	1.986940325	1498.0258
129	1517.718	129	3358.288	1295.984	2415.1205	129	1503.183	1295.984	1215.987636	1.986139027	1503.1829
130	1533.522	130	3197.078	1310.971	2397.6627	130	1518.994	1310.971	1207.02645	1.986421011	1518.9935
131	1552.969	131	3000.584	1329.412	2380.6663	131	1538.448	1329.412	1198.255578	1.986776731	1538.448
132	1563.543	132	2894.471	1339.44	2357.0924	132	1549.049	1339.461	1186.18988	1.987112215	1549.0492
133	1571.895	133	2811.189	1347.36	2295.2136	133	1557.404	1347.381	1154.957419	1.987271187	1557.4044
134	1581.936	134	2709.914	1356.871	2220.0865	134	1567.429	1356.871	1117.063748	1.987430443	1567.4292
135	1592.569	135	2600.886	1366.928	2139.6672	135	1578.072	1366.928	1076.329702	1.98792916	1578.0715
136	1614.599	136	2378.996	1387.766	1966.3997	136	1599.901	1387.557	989.4790098	1.98730815	1599.9014
137	1645.829	137	2074.8	1417.304	1714.8663	137	1631.159	1417.095	862.1153321	1.989137922	1631.1592
138	1664.11	138	1902.355	1434.595	1564.5128	138	1649.678	1434.595	785.0621131	1.992852252	1649.6777
139	1672.719	139	1805.295	1442.631	1484.0882	139	1658.281	1442.631	744.7315919	1.992782656	1658.281
140	1685.169	140	1649.162	1454.173	1364.907	140	1670.515	1453.991	686.1696761	1.989168346	1670.5152
141	1698.098	141	1471.65	1466.159	1244.7405	141	1683.424	1465.976	626.190818	1.987797432	1683.4242
142	1715.986	142	1196.423	1482.742	1093.6742	142	1701.482	1482.742	549.936145	1.988729437	1701.4815
143	1730.559	143	955.5887	1496.254	978.39226	143	1716.036	1496.254	492.3380096	1.9872369	1716.0364
144	1739.856	144	801.8056	1504.879	905.17555	144	1725.334	1504.879	455.4945362	1.9872369	1725.334
145	1770.708	145	269.1604	1533.5	667.89218	145	1756.186	1533.5	336.0908707	1.9872369	1756.1856
146	1797.717	146	-212.273	1558.537	407.30381	146	1783.273	1558.621	204.9586841	1.987248366	1783.2728
147	1814.281	147	-251.34	1573.768	490.78144	147	1800.355	1574.415	246.2340046	1.993150543	1800.3552

Attachment O - Static Triggering Outputs
Erosion Case

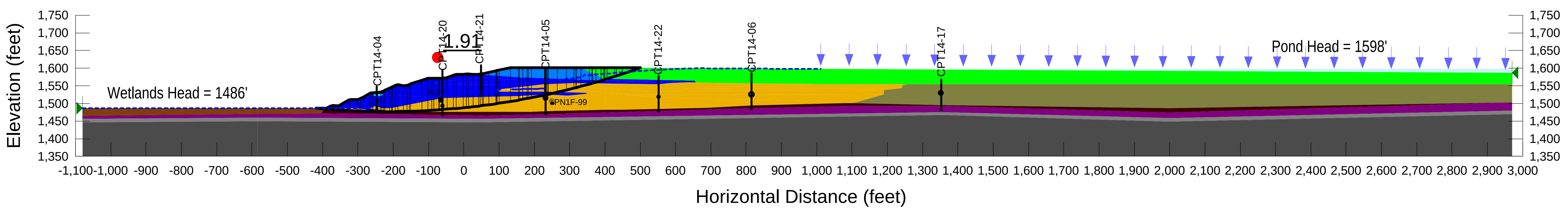


PolyMet Flotation Tailings Basin
Date Last Saved: 12/23/2014
File Name: PLUGGED_SectionF_2014 L1_USSA.gsz

Case: 1.0 L1 - USSA (FSFS)
USSA strengths
FSFS

Factor of Safety: 1.91

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: LTVSMC FT/Slimes Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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Project #23690862-037

Attachment O - Static Triggering Outputs
Plugged Lift 1

PolyMet

v5 Submittal

Post-liquefaction FSFS FS= ***N/A***

PluggedL1

Computing the Fstriggering based on the shear mobilized versus the shear resistance/strength of the plugged steady-state model
Using v3 buttress

# of slices	98			
USSA $_{liq}$ ***FS= 1***				
USSA $_{yield}$ ***FS= 1.91***				
		Saturated slices	*FS*	
		min	*1.91*	@x=
		max	*1.91*	227.5
		ave	*1.91*	#N/A

Lift1-FSFS

Legend

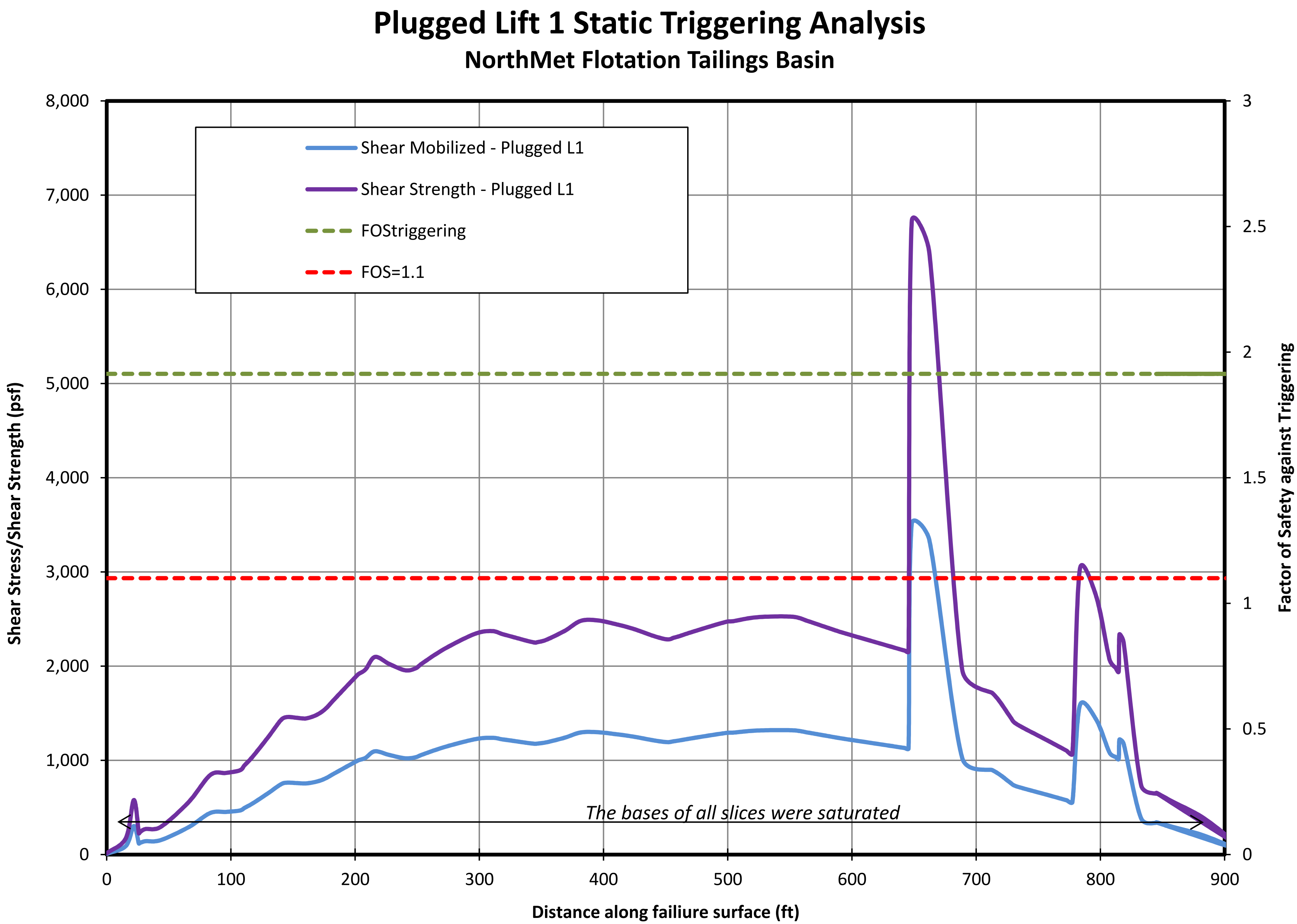
Added & interpolated to to maintain distances for FS computation (grey)

Indicates unsaturated soil (above phreatic), not subject to liquefaction (orange)

FS$_{triggering}$ shading scale
- min (red)
- 1.1 (yellow)
- max (green)

Slice #	Pore-Water Pressure: Distance (f	Pore-Wate	Shear Strength - Plugg: Distance (f	Shear Resi:	Shear Mobilized - Plugged L1: Distance (f	Shear Mobilized (psf)	Strength/ Mob FOS$_{triggering}$	Distance (f
1	0	26.18202	0	13.31107	0	6.955865	1.9136468	0
2	15.42686	105.7758	15.42686	173.884	15.42686	90.86527	1.9136468	15.42686
3	21.87774	140.9299	21.87774	578.6424	21.87774	302.3768	1.9136468	21.87774
4	25.88742	162.9514	25.88742	225.351	25.88742	117.76	1.9136468	25.88742
5	26.66525	167.5254	26.66525	236.6354	26.66525	123.6568	1.9136468	26.66525
6	31.17793	186.3268	31.17793	271.0972	31.17793	141.6652	1.9136468	31.17793
7	43.35156	239.2323	43.35156	292.5541	43.35156	152.8778	1.9136468	43.35156
8	65.88413	341.0208	65.88413	555.3641	65.88413	290.2124	1.9136468	65.88413
9	83.41763	426.2051	83.41763	844.5332	83.41763	441.3214	1.9136468	83.41763
10	95.95076	490.885	95.95076	866.2887	95.95076	452.69	1.9136468	95.95076
11	107.167	551.8629	107.167	894.2417	107.167	467.2972	1.9136468	107.167
12	111.1661	565.365	111.1661	950.6623	111.1661	496.7804	1.9136468	111.1661
13	117.4676	576.0235	117.4676	1038.524	117.4676	542.6938	1.9136468	117.4676
14	129.9707	596.0486	129.9707	1246.254	129.9707	651.2453	1.9136468	129.9707
15	140.4748	622.0688	140.4748	1430.659	140.4748	747.6086	1.9136468	140.4748
16	145.4767	657.988	145.4767	1460.006	145.4767	762.9445	1.9136468	145.4767
17	152.9786	711.9118	152.9786	1451.703	152.9786	758.6052	1.9136468	152.9786
18	157.9879	747.9558	157.9879	1444.92	157.9879	755.0609	1.9136468	157.9879
19	160.9922	769.3199	160.9922	1446.429	160.9922	755.8493	1.9136468	160.9922
20	166.3865	806.8935	166.3865	1467.261	166.3865	766.7356	1.9136468	166.3865
21	171.8873	838.4878	171.8873	1503.453	171.8873	785.6481	1.9136468	171.8873
22	176.9872	860.9719	176.9872	1557.405	176.9872	813.8416	1.9136468	176.9872
23	181.4836	880.4174	181.4836	1621.984	181.4836	847.5878	1.9136468	181.4836
24	189.9849	905.9357	189.9849	1741.906	189.9849	910.2548	1.9136468	189.9849
25	199.335	933.7896	199.335	1871.475	199.335	977.9628	1.9136468	199.335
26	202.3369	942.3299	202.3369	1911.708	202.3369	998.9868	1.9136468	202.3369
27	203.4902	964.4311	203.4902	1922.555	203.4902	1004.655	1.9136468	203.4902
28	208.4878	1074.986	208.4878	1966.74	208.4878	1027.744	1.9136468	208.4878
29	215.9825	1248.153	215.9825	2097.891	215.9825	1096.279	1.9136468	215.9825
30	227.4791	1445.699	227.4791	2023.295	227.4791	1057.298	1.9136468	227.4791
31	240.2339	1585.027	240.2339	1956.11	240.2339	1022.189	1.9136468	240.2339
32	248.7405	1656.998	248.7405	1976.986	248.7405	1033.099	1.9136468	248.7405
33	253.9952	1696.244	253.9952	2029.674	253.9952	1060.632	1.9136468	253.9952
34	271.7569	1822.919	271.7569	2182.194	271.7569	1140.333	1.9136468	271.7569
35	296.2797	1981.086	296.2797	2342.024	296.2797	1223.854	1.9136468	296.2797
36	310.0388	2053.116	310.0388	2372.42	310.0388	1239.737	1.9136468	310.0388
37	318.5592	2097.915	318.5592	2340.507	318.5592	1223.061	1.9136468	318.5592
38	328.6798	2145.247	328.6798	2303.997	328.6798	1203.982	1.9136468	328.6798
39	336.205	2180.713	336.205	2276.78	336.205	1189.76	1.9136468	336.205
40	340.6387	2198.621	340.6387	2261.48	340.6387	1181.764	1.9136468	340.6387
41	345.1593	2215.346	345.1593	2249.579	345.1593	1175.546	1.9136468	345.1593
42	346.6626	2220.92	346.6626	2254.247	346.6626	1177.985	1.9136468	346.6626
43	353.7357	2247.22	353.7357	2278.701	353.7357	1190.763	1.9136468	353.7357
44	368.7694	2292.087	368.7694	2374.644	368.7694	1240.9	1.9136468	368.7694
45	381.7333	2315.862	381.7333	2480.778	381.7333	1296.362	1.9136468	381.7333
46	395.7179	2314.403	395.7179	2484.918	395.7179	1298.525	1.9136468	395.7179
47	410.2821	2312.518	410.2821	2444.178	410.2821	1277.236	1.9136468	410.2821
48	417.4004	2324.375	417.4004	2421.199	417.4004	1265.228	1.9136468	417.4004
49	426.7008	2331.578	426.7008	2384.358	426.7008	1245.976	1.9136468	426.7008
50	441.2997	2333.672	441.2997	2315.939	441.2997	1210.223	1.9136468	441.2997
51	451.39	2326.11	451.39	2284.101	451.39	1193.585	1.9136468	451.39
52	456.4338	2313.079	456.4338	2301.143	456.4338	1202.491	1.9136468	456.4338
53	460.7263	2295.494	460.7263	2317.206	460.7263	1210.885	1.9136468	460.7263
54	470.3094	2232.424	470.3094	2358.782	470.3094	1232.611	1.9136468	470.3094
55	488.4454	2134.716	488.4454	2432.268	488.4454	1271.012	1.9136468	488.4454
56	499.2895	2085.966	499.2895	2472.46	499.2895	1292.015	1.9136468	499.2895
57	500.8344	2078.184	500.8344	2475.093	500.8344	1293.391	1.9136468	500.8344
58	504.6154	2067.314	504.6154	2478.028	504.6154	1294.925	1.9136468	504.6154
59	523.8116	2007.773	523.8116	2519.537	523.8116	1316.615	1.9136468	523.8116
60	551.6921	1846.118	551.6921	2524.981	551.6921	1319.46	1.9136468	551.6921
61	564.1286	1768.275	564.1286	2479.866	564.1286	1295.885	1.9136468	564.1286
62	570.4744	1718.48	570.4744	2452.196	570.4744	1281.426	1.9136468	570.4744
63	581.9412	1625.442	581.9412	2401.244	581.9412	1254.8	1.9136468	581.9412
64	589.8775	1560.131	589.8775	2366.211	589.8775	1236.493	1.9136468	589.8775
65	596.4817	1494.391	596.4817	2340.07	596.4817	1222.833	1.9136468	596.4817
66	619.4004	1250.005	619.4004	2252.767	619.4004	1177.211	1.9136468	619.4004
67	638.8073	1044.28	638.8073	2178.447	638.8073	1138.375	1.9136468	638.8073
68	640.6074	1025.213	640.6074	2171.681	640.6074	1134.839	1.9136468	640.6074
69	642.6401	1003.635	642.6401	2164.622	642.6401	1131.15	1.9136468	642.6401
70	645.5241	972.9701	645.5241	2154.845	645.5241	1126.041	1.9136468	645.5241
71	648.0805	945.6192	648.0805	6714.978	648.0805	3508.996	1.9136468	648.0805
72	662.2149	764.3429	662.2149	6394.677	662.2149	3341.618	1.9136468	662.2149
73	688.7332	442.8057	688.7332	1962.788	688.7332	1025.679	1.9136468	688.7332
74	713.0221	759.9281	713.0221	1714.902	713.0221	896.1436	1.9136468	713.0221
75	726.7073	1361.08	726.7073	1474.188	726.7073	770.3551	1.9136468	726.7073
76	730.4182	1535.609	730.4182	1405.52	730.4182	734.4721	1.9136468	730.4182
77	738.0635	1539.621	738.0635	1343.789	738.0635	702.2138	1.9136468	738.0635
78	756.8857	1417.697	756.8857	1214.965	756.8857	634.8953	1.9136468	756.8857
79	772.9538	1313.305	772.9538	1101.12	772.9538	575.4039	1.9136468	772.9538
80	777.4697	1281.092	777.4697	1069.413	777.4697	558.8352	1.9136468	777.4697
81	783.4685	1219.362	783.4685	3029.765	783.4685	1583.241	1.9136468	783.4685
82	796.5472	1078.021	796.5472	2744.275	796.5472	1434.055	1.9136468	796.5472
83	807.3711	969.6261	807.3711	2069.672	807.3711	1081.533	1.9136468	807.3711
84	812.312	930.7386	812.312	1981.234	812.312	1035.318	1.9136468	812.312
85	814.702	911.9277	814.702	1942.469	814.702	1015.061	1.9136468	814.702
86	815.3541	906.4923	815.3541	2338.441	815.3541	1221.981	1.9136468	815.3541
87	818.6687	866.405	818.6687	2252.811	818.6687	1177.234	1.9136468	818.6687
88	832.8125	693.2659	832.8125	734.6387	832.8125	383.8946	1.9136468	832.8125
89	846.3485	532.6905	846.3485	643.0944	846.3485	336.057	1.9136468	846.3485
90	857.9334	380.6749	857.9334	562.7257	857.9334	294.0593	1.9136468	857.9334
91	880.8762	54.83158	880.8762	406.6588	880.8762	212.5046	1.9136468	880.8762
92	900.2589	-211.863	900.2589	217.4922	900.2589	113.6532	1.9136468	900.2589
93	913.2922	-400.013	913.2922	80.3776	913.2922	42.00232	1.9136468	913.2922
94	429.5	532.6905	846.3549	643.0944	846.3549	336.1037	1.9133809	846.3549
95	440.5	375.8806	857.9657	561.3106	857.9657	293.3606	1.9133809	857.9657
96	462.25	37.66445	880.9761	401.6501	880.9761	209.9164	1.9133809	880.9761
97	480.625	-238.762	900.4158	202.2663	900.4158	105.7115	1.9133809	900.4158
98	492.0464	-418.942	912.499	71.9623	912.499	37.61002	1.9133809	912.499

Attachment O - Static Triggering Outputs
Plugged Lift 1



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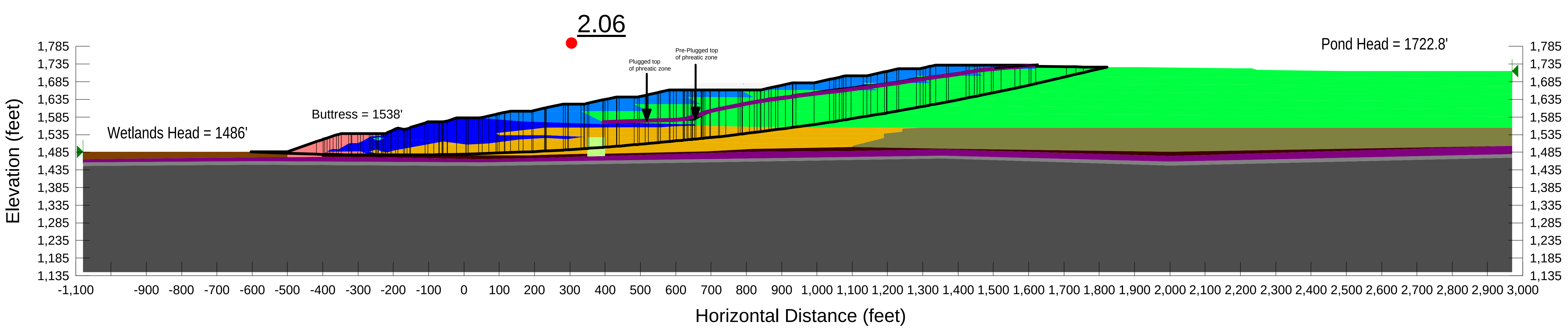
PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/23/2014
File Name: Triggering-PLUGGED-SecF_Lift8_LIQ_CDSM_USSA.gsz

1.0 Lift 8 - USSA (FSFS)
USSA (FSFS)

Factor of Safety: 2.06

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC FT/Slimes Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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Project #23690862-037

Attachment O - Static Triggering Outputs

Plugged Lift 8 Case

PolyMet

v5 Submittal

Saturated Zones

0	0
0	0

Post-liquefaction FSFS FS= ***N/A***

Computing the Fstriggering based on the shear mobilized of the pre-con model versus the shear resistance/strength of the post-con model

PLUGGED-SecF_Lift8_LIQ_CDSM_USSA

# of slices 186

USSA $_{liq}$ ***FS= 1.1***

USSA $_{yield}$ ***FS= 2.06***

Lift8-FSFS

Saturated slices	*FS*	@x=
min	*2.06*	415.2
max	*2.06*	
ave	*2.06*	394.8

Legend

- (grey) *Added & interpolated to to maintain distances for FS computation*
- (orange) *Indicates unsaturated soil (above phreatic), not subject to liquefaction*

$FS_{triggering}$ shading scale

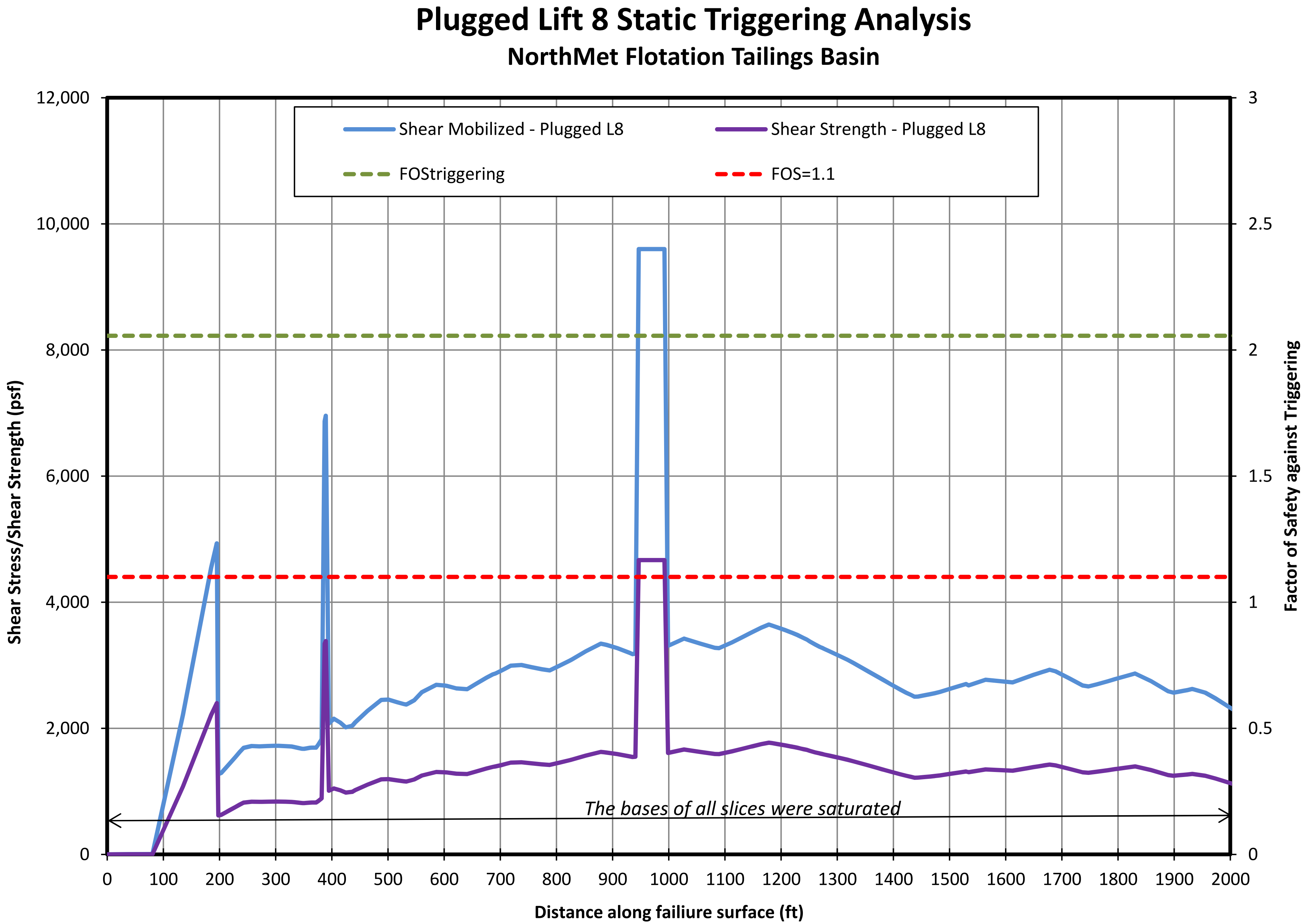
- (red) min
- (yellow) 1.1
- (green) max

- (yellow) *Liquefaction is triggered (FS<1.1)*

		Pore-Water Pressure	**Shear Strength - Plugg**		**Shear Mobilized - Plugged L8**		**Strength/ Mob**	
Slice #	X (ft)	Pore-Wate	**Distance (f**	**Shear Mob**	**Distance (f**	**Shear Resistance (psf)**	**$FOS_{triggering}$**	**Distance (ft)**
1	-594.071	24.17116	0	0.327988	0	0.674474	2.0563971	0
2	-556	125.6234	38.10609	1.703446	38.10609	3.502961	2.0563971	38.10609
3	-513.5	229.3143	80.63855	3.112981	80.63855	6.401526	2.0563971	80.63855
4	-459.213	335.9673	134.9523	1076.127	134.9523	2212.944	2.0563971	134.9523
5	-408.963	434.7988	185.227	2211.822	185.227	4548.384	2.0563971	185.227
6	-398.985	453.8872	195.2099	2398.686	195.2099	4932.652	2.0563971	195.2099
7	-396.36	462.2978	197.8354	617.8468	197.8354	1270.538	2.0563971	197.8354
8	-391.125	481.6845	203.0707	627.7613	203.0707	1290.927	2.0563971	203.0707
9	-384	507.4667	210.1964	662.6901	210.1964	1362.754	2.0563971	210.1964
10	-375.5	542.9836	218.6974	703.5569	218.6974	1446.792	2.0563971	218.6974
11	-366.106	589.3389	228.0928	749.704	228.0928	1541.689	2.0563971	228.0928
12	-358.106	611.3434	236.0937	790.3134	236.0937	1625.198	2.0563971	236.0937
13	-351.379	629.1564	242.8214	821.5636	242.8214	1689.461	2.0563971	242.8214
14	-336.879	665.0452	257.3231	835.5241	257.3231	1718.169	2.0563971	257.3231
15	-323	696.1044	271.2035	833.6292	271.2035	1714.273	2.0563971	271.2035
16	-318.75	704.9166	275.454	834.0252	275.454	1715.087	2.0563971	275.454
17	-309.25	715.1217	284.9543	835.9315	284.9543	1719.007	2.0563971	284.9543
18	-297	722.3009	297.2045	837.9498	297.2045	1723.158	2.0563971	297.2045
19	-289	724.011	305.2047	837.4604	305.2047	1722.151	2.0563971	305.2047
20	-276.5	721.5294	317.705	835.4198	317.705	1717.955	2.0563971	317.705
21	-266	720.1256	328.2052	832.2978	328.2052	1711.535	2.0563971	328.2052
22	-261	734.8603	333.2054	827.909	333.2054	1702.51	2.0563971	333.2054
23	-253.5	756.3241	340.7055	820.5983	340.7055	1687.476	2.0563971	340.7055
24	-248.5	770.1911	345.7056	815.1754	345.7056	1676.324	2.0563971	345.7056
25	-245.75	777.6607	348.4557	814.8046	348.4557	1675.562	2.0563971	348.4557
26	-243.25	783.9205	350.9557	814.878	350.9557	1675.713	2.0563971	350.9557
27	-238.501	788.1119	355.705	818.3487	355.705	1682.85	2.0563971	355.705
28	-233.001	792.2867	361.2051	822.2939	361.2051	1690.963	2.0563971	361.2051
29	-229.5	794.5527	364.7059	823.1644	364.7059	1692.753	2.0563971	364.7059
30	-225	796.4124	369.2059	823.3323	369.2059	1693.098	2.0563971	369.2059
31	-222.222	793.5544	371.9837	823.2581	371.9837	1692.946	2.0563971	371.9837
32	-218.651	789.4202	375.5546	843.6538	375.5546	1734.887	2.0563971	375.5546
33	-212.249	780.6739	381.9566	888.8231	381.9566	1827.773	2.0563971	381.9566
34	-206.878	779.0142	387.328	3339.412	387.328	6867.158	2.0563971	387.328
35	-204.938	783.4724	389.2684	3383.119	389.2684	6957.036	2.0563971	389.2684
36	-199.38	854.5671	394.8263	1008.875	394.8263	2074.648	2.0563971	394.8263
37	-190.5	987.2229	403.7062	1046.898	403.7062	2152.837	2.0563971	403.7062
38	-179	1150.213	415.2063	1016.816	415.2063	2090.977	2.0563971	415.2063
39	-169.418	1276.748	424.7881	980.1611	424.7881	2015.601	2.0563971	424.7881
40	-164.459	1340.963	429.7477	985.0631	429.7477	2025.681	2.0563971	429.7477
41	-157.54	1420.501	436.6661	993.0587	436.6661	2042.123	2.0563971	436.6661
42	-152.5	1478.471	441.7065	1018.344	441.7065	2094.12	2.0563971	441.7065
43	-130.625	1710.938	463.5817	1106.93	463.5817	2276.288	2.0563971	463.5817
44	-106.125	1933.76	488.0822	1191.256	488.0822	2449.695	2.0563971	488.0822
45	-93.5	2025.238	500.7096	1194.132	500.7096	2455.609	2.0563971	500.7096
46	-77.9238	2129.634	516.2887	1174.122	516.2887	2414.462	2.0563971	516.2887
47	-70.4238	2176.928	523.7901	1164.835	523.7901	2395.363	2.0563971	523.7901
48	-66	2203.477	528.2146	1159.514	528.2146	2384.421	2.0563971	528.2146
49	-61.5	2227.302	532.7154	1156.032	532.7154	2377.261	2.0563971	532.7154
50	-60	2235.248	534.2157	1159.03	534.2157	2383.427	2.0563971	534.2157
51	-53.4541	2269.942	540.7628	1174.217	540.7628	2414.657	2.0563971	540.7628
52	-47.3781	2301.815	546.8399	1188.705	546.8399	2444.449	2.0563971	546.8399
53	-33.924	2359.609	560.2965	1251.285	560.2965	2573.138	2.0563971	560.2965
54	-8.25	2451.932	585.9752	1307.861	585.9752	2689.481	2.0563971	585.9752
55	6.25	2489.081	600.4785	1302.639	600.4785	2678.743	2.0563971	600.4785
56	10.5	2495.881	604.7314	1300.109	604.7314	2673.54	2.0563971	604.7314
57	27.5	2515.79	621.7428	1280.156	621.7428	2632.509	2.0563971	621.7428
58	46.7361	2534.692	640.9919	1274.439	640.9919	2620.752	2.0563971	640.9919
59	61.2361	2549.9	655.5016	1312.059	655.5016	2698.115	2.0563971	655.5016
60	81	2574.942	675.2788	1361.81	675.2788	2800.423	2.0563971	675.2788
61	92.5	2591.803	686.7866	1388.534	686.7866	2855.377	2.0563971	686.7866
62	97	2599.677	691.2896	1395.272	691.2896	2869.233	2.0563971	691.2896
63	107.2412	2617.777	701.5377	1416.219	701.5377	2912.308	2.0563971	701.5377
64	115.5209	2632.608	709.8229	1435.018	709.8229	2950.967	2.0563971	709.8229
65	124.2497	2645.31	718.5576	1455.179	718.5576	2992.426	2.0563971	718.5576
66	143.47	2670.814	737.7909	1461.213	737.7909	3004.834	2.0563971	737.7909
67	161.2414	2689.967	755.5742	1443.97	755.5742	2969.376	2.0563971	755.5742
68	179.7114	2706.536	774.0566	1427.733	774.0566	2935.987	2.0563971	774.0566
69	193.595	2735.431	787.9496	1419.322	787.9496	2918.689	2.0563971	787.9496
70	211.625	2786.561	806.0049	1456.079	806.0049	2994.276	2.0563971	806.0049
71	229	2811.338	823.4057	1493.943	823.4057	3072.14	2.0563971	823.4057
72	230.4999	2813.312	824.9078	1497.296	824.9078	3079.035	2.0563971	824.9078
73	231.2622	2814.139	825.6713	1499.087	825.6713	3082.718	2.0563971	825.6713
74	232.7624	2815.152	827.1737	1502.869	827.1737	3090.496	2.0563971	827.1737
75	257.97	2827.779	852.4189	1566.552	852.4189	3221.454	2.0563971	852.4189
76	284.5264	2837.869	879.0148	1625.24	879.0148	3342.139	2.0563971	879.0148
77	290.5524	2841.348	885.0497	1620.08	885.0497	3331.528	2.0563971	885.0497
78	294.996	2847.364	889.5	1615.619	889.5	3322.354	2.0563971	889.5
79	313.97	2861.102	908.518	1590.515	908.518	3270.731	2.0563971	908.518
80	335.9693	2927.326	930.5694	1554.13	930.5694	3195.908	2.0563971	930.5694
81	340.9693	2945.926	935.5812	1544.479	935.5812	3176.062	2.0563971	935.5812
82	345.97	2964.836	940.5938	1549.271	940.5938	3185.917	2.0563971	940.5938
83	352	3002.464	946.6381	4668.359	946.6381	9600	2.0563971	946.6381
84	373.5	3240.844	968.189	4668.359	968.189	9600	2.0563971	968.189
85	394.1251	3444.831	988.8629	4668.359	988.8629	9600	2.0563971	988.8629
86	397.6251	3477.613	992.3712	4668.359	992.3712	9600	2.0563971	992.3712
87	403.9522	3515.185	998.7133	1608.896	998.7133	3308.529	2.0563971	998.7133
88	419.9222	3578.795	1014.721	1639.872	1014.721	3372.228	2.0563971	1014.721
89	432.47	3607.235	1027.299	1664.129	1027.299	3422.11	2.0563971	1027.299
90	436.375	3617.675	1031.213	1658.883	1031.213	3411.321	2.0563971	1031.213

91	460.845	3615.538	1055.784	1626.042	1055.784	3343.788	2.0563971	1055.784
92	486.94	3570.914	1081.995	1593.109	1081.995	3276.064	2.0563971	1081.995
93	494.47	3554.513	1089.558	1590.704	1089.558	3271.119	2.0563971	1089.558
94	505	3530.917	1100.135	1611.025	1100.135	3312.907	2.0563971	1100.135
95	517.4583	3501.103	1112.649	1635.301	1112.649	3362.827	2.0563971	1112.649
96	534.9583	3458.507	1130.226	1673.432	1130.226	3441.241	2.0563971	1130.226
97	549.5	3423.194	1144.833	1706.23	1144.833	3508.687	2.0563971	1144.833
98	554	3414.158	1149.353	1716.159	1149.353	3529.104	2.0563971	1149.353
99	569.47	3384.561	1164.891	1749.045	1164.891	3596.731	2.0563971	1164.891
100	582.97	3369.951	1178.451	1772.736	1178.451	3645.449	2.0563971	1178.451
101	589.1262	3365.673	1184.635	1764.33	1184.635	3628.163	2.0563971	1184.635
102	598.1262	3369.217	1193.675	1750.969	1193.675	3600.687	2.0563971	1193.675
103	611.4765	3382.493	1207.085	1730.213	1207.085	3558.005	2.0563971	1207.085
104	621.9765	3404.901	1217.631	1712.492	1217.631	3521.565	2.0563971	1217.631
105	624.25	3409.901	1219.915	1708.638	1219.915	3513.638	2.0563971	1219.915
106	628.72	3419.879	1224.405	1701.043	1224.405	3498.02	2.0563971	1224.405
107	633.595	3435.705	1229.301	1691.713	1229.301	3478.833	2.0563971	1229.301
108	639.325	3455.939	1235.057	1679.532	1235.057	3453.785	2.0563971	1235.057
109	644.8878	3475.868	1240.644	1667.722	1240.644	3429.499	2.0563971	1240.644
110	646.8128	3482.827	1242.578	1663.683	1242.578	3421.194	2.0563971	1242.578
111	650.3412	3495.664	1246.122	1656.271	1246.122	3405.951	2.0563971	1246.122
112	655.4008	3518.011	1251.204	1642.265	1251.204	3377.148	2.0563971	1251.204
113	664.6461	3560.175	1260.49	1619.013	1260.49	3329.333	2.0563971	1260.49
114	672.7115	3597.55	1268.592	1601.288	1268.592	3292.883	2.0563971	1268.592
115	674.5092	3606.394	1270.397	1597.786	1270.397	3285.683	2.0563971	1270.397
116	677.2592	3620.067	1273.16	1592.413	1273.16	3274.633	2.0563971	1273.16
117	681.25	3640.614	1277.168	1584.533	1277.168	3258.429	2.0563971	1277.168
118	689.75	3687.115	1285.706	1567.43	1285.706	3223.259	2.0563971	1285.706
119	697.2443	3728.932	1293.233	1552.256	1293.233	3192.054	2.0563971	1293.233
120	709.4943	3794.706	1305.538	1527.752	1305.538	3141.666	2.0563971	1305.538
121	722.375	3875.349	1318.476	1500.647	1318.476	3085.927	2.0563971	1318.476
122	732.9453	3931.048	1329.123	1475.572	1329.123	3034.363	2.0563971	1329.123
123	758.9453	4069.813	1355.329	1411.538	1355.329	2902.682	2.0563971	1355.329
124	779.0961	4181.923	1375.641	1361.376	1375.641	2799.53	2.0563971	1375.641
125	784.9422	4215.583	1381.533	1346.691	1381.533	2769.332	2.0563971	1381.533
126	788.4826	4234.62	1385.102	1337.788	1385.102	2751.023	2.0563971	1385.102
127	798.8865	4265.85	1395.588	1311.777	1395.588	2697.534	2.0563971	1395.588
128	815.3461	4306.952	1412.179	1271.596	1412.179	2614.906	2.0563971	1412.179
129	826.0997	4330.791	1423.018	1246.97	1423.018	2564.266	2.0563971	1423.018
130	834.5888	4347.313	1431.574	1229.395	1431.574	2528.124	2.0563971	1431.574
131	840.4302	4364.1	1437.462	1216.669	1437.462	2501.955	2.0563971	1437.462
132	846.595	4395.707	1443.676	1217.326	1443.676	2503.305	2.0563971	1443.676
133	857.7362	4454.807	1454.906	1227.489	1454.906	2524.205	2.0563971	1454.906
134	867.3716	4505.717	1464.618	1235.435	1464.618	2540.545	2.0563971	1464.618
135	876.4172	4553.835	1473.735	1242.818	1473.735	2555.728	2.0563971	1473.735
136	885.7818	4590.527	1483.174	1252.899	1483.174	2576.457	2.0563971	1483.174
137	899.75	4609.013	1497.254	1272.165	1497.254	2616.076	2.0563971	1497.254
138	920.5757	4623.813	1518.264	1300.245	1518.264	2673.819	2.0563971	1518.264
139	931.4468	4627.999	1529.242	1314.182	1529.242	2702.481	2.0563971	1529.242
140	936.1951	4647.762	1534.037	1303.964	1534.037	2681.467	2.0563971	1534.037
141	966.1689	4636.404	1564.305	1347.341	1564.305	2770.667	2.0563971	1564.305
142	1013.676	4589.749	1612.279	1327.052	1612.279	2728.947	2.0563971	1612.279
143	1041.331	4558.743	1640.206	1370.643	1640.206	2818.586	2.0563971	1640.206
144	1050.284	4544.242	1649.256	1384.245	1649.256	2846.557	2.0563971	1649.256
145	1058.488	4523.474	1657.568	1395.735	1657.568	2870.185	2.0563971	1657.568
146	1067.329	4501.017	1666.526	1408.126	1666.526	2895.666	2.0563971	1666.526
147	1073.375	4485.664	1672.651	1416.599	1672.651	2913.091	2.0563971	1672.651
148	1078.845	4471.683	1678.193	1424.272	1678.193	2928.869	2.0563971	1678.193
149	1089.305	4444.967	1688.792	1412.032	1688.792	2903.698	2.0563971	1688.792
150	1114.305	4381.199	1714.121	1355.749	1714.121	2787.959	2.0563971	1714.121
151	1136.94	4323.793	1737.054	1303.089	1737.054	2679.668	2.0563971	1737.054
152	1147.095	4298.312	1747.343	1295.627	1747.343	2664.324	2.0563971	1747.343
153	1161.813	4261.759	1762.255	1311.263	1762.255	2696.478	2.0563971	1762.255
154	1181.438	4213.937	1782.139	1335.381	1782.139	2746.073	2.0563971	1782.139
155	1194.249	4180.717	1795.126	1352.706	1795.126	2781.701	2.0563971	1795.126
156	1197.749	4169.04	1798.683	1357.011	1798.683	2790.554	2.0563971	1798.683
157	1212.25	4121.319	1813.418	1374.765	1813.418	2827.062	2.0563971	1813.418
158	1228.97	4069.419	1830.408	1394.825	1830.408	2868.314	2.0563971	1830.408
159	1256.94	3989.848	1858.829	1336.038	1858.829	2747.424	2.0563971	1858.829
160	1286.94	3916.045	1889.313	1258.364	1889.313	2587.696	2.0563971	1889.313
161	1296.22	3894.81	1898.743	1247.623	1898.743	2565.609	2.0563971	1898.743
162	1304.375	3876.821	1907.029	1254.184	1907.029	2579.1	2.0563971	1907.029
163	1313.807	3856.447	1916.614	1261.482	1916.614	2594.107	2.0563971	1916.614
164	1320.64	3842.046	1923.556	1266.723	1923.556	2604.885	2.0563971	1923.556
165	1329.412	3823.981	1932.47	1276.021	1932.47	2624.007	2.0563971	1932.47
166	1351.955	3778.981	1955.377	1247.607	1955.377	2565.575	2.0563971	1955.377
167	1369.932	3740.61	1973.655	1203.124	1973.655	2474.1	2.0563971	1973.655
168	1397.955	3656.007	2002.243	1124.447	2002.243	2312.309	2.0563971	2002.243
169	1427.493	3569.231	2032.376	1040.636	2032.376	2139.961	2.0563971	2032.376
170	1438.845	3534.234	2043.957	1006.522	2043.957	2069.808	2.0563971	2043.957
171	1449.625	3500.479	2054.954	972.7984	2054.954	2000.46	2.0563971	2054.954
172	1457.557	3473.907	2063.046	948.0739	2063.046	1949.616	2.0563971	2063.046
173	1467.057	3441.707	2072.738	918.5922	2072.738	1888.99	2.0563971	2072.738
174	1483	3381.706	2089.002	873.323	2089.002	1795.899	2.0563971	2089.002
175	1496.254	3326.111	2102.523	837.8517	2102.523	1722.956	2.0563971	2102.523
176	1510.503	3261.751	2117.06	800.2058	2117.06	1645.541	2.0563971	2117.06
177	1541.375	3112.697	2148.554	719.8192	2148.554	1480.234	2.0563971	2148.554
178	1568.147	2964.027	2175.911	649.0057	2175.911	1334.614	2.0563971	2175.911
179	1588.266	2827.078	2196.566	591.9815	2196.566	1217.349	2.0563971	2196.566
180	1603.822	2720.188	2212.536	523.4025	2212.536	1076.323	2.0563971	2212.536
181	1613.446	2652.243	2222.415	468.221	2222.415	962.8483	2.0563971	2222.415
182	1663.725	2193.471	2274.032	327.7911	2274.032	674.0686	2.0563971	2274.032
183	1720.788	1479.562	2332.613	196.0599	2332.613	403.1769	2.0563971	2332.613
184	1744.681	1129.067	2357.142	146.4896	2357.142	301.2407	2.0563971	2357.142
185	1765.954	814.4595	2378.982	104.3067	2378.982	214.496	2.0563971	2378.982
186	1799.365	325.8306	2413.281	42.00442	2413.281	86.37777	2.0563971	2413.281

Attachment O - Static Triggering Outputs
Plugged Lift 8 Case



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Example Computation for Olson and Stark's Triggering Analysis

Example for Slice #1, located at the toe of the slope

The Olson and Stark (Reference (1) (2)) procedure can generally be summarized in the following steps:

Step 1 – Perform a limit equilibrium analysis (SLOPE/W) to determine $\tau_{driving}$ and σ'_{vo} for each slice along the critical failure surface.

From back-calculated model where FOS = 1.0, the Shear Mobilized is equal to $\tau_{driving}$. Therefore, this value is obtained from SLOPE/W output for each slice.

Slice #1: $\boldsymbol{\tau_{driving}}$ **= 400 psf**

The effective vertical stress ($\sigma'_{vo,\,ave}$) is calculated by the following equation:

$$\sigma'_{vo,ave}(psf) = \sigma'_{normal} * \cos(\alpha) = 1050\ psf * 0.94 = 987\ psf$$

Where:
$\sigma'_{vo,\,ave}$ = effective vertical stress
σ'_{normal} = effective normal stress, obtained from SLOPE/W output for each slice
Slice #1: $\sigma'_{normal} = 1050\ psf$
α = base angle, obtained from SLOPE/W output for each slice
Slice #1: $\alpha = -20°$, *therefore* $\cos(20°) = 0.94$

Slice #1: $\boldsymbol{\sigma'_{vo,\,ave}}$ **= 987 psf**

Step 2 – Calculate the average static shear stress ratio $\tau_{driving} / \sigma'_{vo,\,ave}$ for each slice using the limit equilibrium results.

$$\text{Average Shear Stress Ratio} = \tau_{driving} / \sigma'_{vo,\,ave}$$
$$= 400\ psf / 987\ psf$$
$$= 0.405$$

Slice #1: $\boldsymbol{\tau_{driving}/\sigma'_{vo,\,ave}}$ **= 0.405**

Step 3 – Estimate the average seismic shear stress $\tau_{seismic,ave}$ either using published relationships or using a deformation site response analysis model.

Published relationships were used to estimate $\tau_{seismic,ave}$:

$$\tau_{seismic,ave} = \frac{0.65 * \frac{a_{max}}{g} * \frac{\sigma_{vo}}{\sigma'_{vo}} * rd}{MSF} = \frac{0.65 * 0.02 * 987 psf * 0.988}{2.82354} = 4.5\ psf$$

Where:

0.65 = reduction factor to produce a *CSR* representative of the most significant cycles over the full loading duration
a_{max} = peak horizontal ground acceleration at the ground surface due to the design earthquake (2,475-year return period) = 0.02g
g = acceleration due to gravity
Total Stress (psf), $\frac{\sigma_{vo}}{\sigma'_{vo}}$ = σ'$_{normal}$ * cos(α) = $\sigma'_{vo,\ ave}$ = 987 psf *[Calculated in Step 1]*
r_d = stress reduction coefficient, which accounts for flexibility of the soil profile

$$r_d = \frac{1.000 - 0.4113z^{0.5} + 0.04052\,z + 0.001753\,z^{1.5}}{1.000 - 0.4177z^{0.5} + 0.05792z - 0.006205z^{1.5} + 0.001210z^2} = 0.988$$

The Magnitude Scaling Factor (*MSF*) has the following relationship based on PSHA:

$$MSF = \left(\frac{M_w}{7.5}\right)^{-2.56} = 2.82354$$

M_w = 5, based on maximum earthquake in MN

Slice #1: **$\tau_{seismic,ave}$ = 4.5 psf**

Step 4 – Compute $s_{u(yield)}$ / σ'_v using corrected mean CPT and SPT penetration resistance.
For granular soils, $s_{u(yield)}/\sigma'_{vo} = \tan^{-1}(\varphi')$
For cohesive soils, $s_{u(yield)}/\sigma'_{vo}$ = cohesion (s_u, psf)/σ'_{vo}

Slice #1: φ' = 40°
Slice #1: $\sigma'_{vo} = \tan^{-1}(\varphi')$
$= \tan^{-1}(40)$
= 0.839

Slice #1: **$s_{u(yield)}/\sigma'_{vo}$ = 0.839**

Step 5 – Determine the values of $s_{u(yield)}$ and $\tau_{driving}$ along the base of each slice.

$\tau_{driving}$ = 400 psf *[Calculated in Step 1]*

*$s_{u(yield)}$ = $[s_{u(yield)}/\sigma'_{vo}]$ * $[\sigma'_{vo,\ ave}]$*
*= 0.839 [Calculated in Step 4] * 987psf [Calculated in Step 1]*
= 828.1 psf

Slice #1: **$s_{u(yield)}$ = 828.1 psf**

Step 6 – Calculate the factor of safety against liquefaction triggering as:

$$FOS_{triggering} = \frac{S_{u(yield)}}{\tau_{driving} + \tau_{seismic,ave} + \tau_{other}} = \frac{828.1\,psf}{400psf + 4.5psf + 0} = 2.05$$

Note: τ_{other} relates to external driving stresses, such as surcharges, are not included within the static driving shear stress.

Slice #1: **$FOS_{triggering}$ = 2.05**

$FOS_{triggering}$ > 1.1 so slice is assumed to not liquefy

References

1. *Yield Strength Ratio and Liquefaction Analysis of Slopes and Embankments.* **Olson, Scott M and Stark, Timothy D.** 8, s.l. : ASCE, August 2003, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 129, pp. 727-737.

2. *Strength Ratio Approach for Liquefaction Analysis of Tailings Dams.* **Olson, Scott M., Kwong Labuz, J. F. and Kwong Labuz, K. H.** Minneapolis : Proceedings of the UMN 57th Annual Geotechnical Engineering Conference, 2009. pp. 37-46.

Attachment P

NorthMet Probabilistic Seismic Hazard Assessment (PSHA)

(previously presented as Attachment N in Geotechnical Data Package – Volume 1 – Version 4; relocated to Attachment P and retained without further edits for Geotechnical Data Package – Volume 1 – Versions 5 and 6)

POLYMET
MINING

NorthMet Project

Geotechnical Data Package
Volume 1 – Flotation Tailings Basin

Attachment N – Probabilistic Seismic Hazard Analysis

Version 1

Issue Date: September 23, 2011

Table of Contents

1.0 Introduction

This document presents the seismic hazard data used in the Flotation Tailings Basin design. In cases where a supporting document is referenced, a general description of the supporting document is provided. In this document, Tailings Basin is the existing former LTVSMC tailings basin and Flotation Tailings are the NorthMet bulk flotation tailings. In addition, Flotation Tailings Basin is designated FTB.

This attachment describes the site-specific probabilistic seismic hazard analysis (PSHA) prepared for PolyMet. A PSHA is a quantitative estimate of the hazards for ground-shaking at the site analyzed probabilistically to consider uncertainties in earthquake location, size, and time of occurrence. The PSHA was used to develop acceleration-time histories for dynamic stability analyses for the FTB.

1.1 Outline

The outline of this document is:

Section 2 Discussion of seismicity and the general PSHA procedure and inputs

Section 3 Results of the PSHA

Section 4 Discussion of using the results in stability modeling

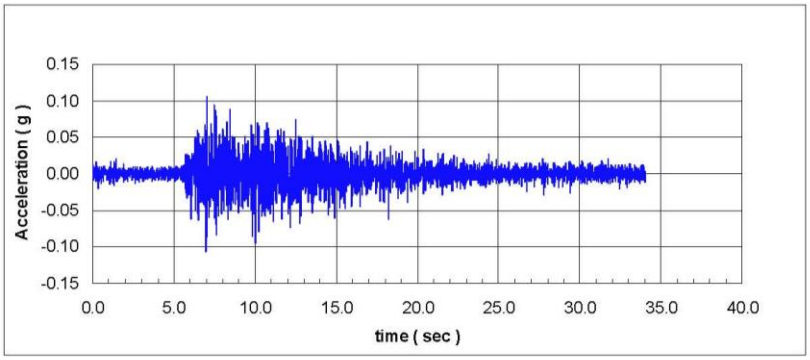
2.0 Analyzing Seismic Hazards

The goal of PSHA is to quantify the probability of exceeding various ground-motion levels at a site given all possible earthquakes. The PSHA has become one of the most effective ways to analyze and describe seismic hazards at a site. The results of a PSHA are useful for geotechnical and structural design to verify that the stability of structures will be maintained during seismic shaking events.

2.1 Seismicity

A time history is the most common way to describe ground motions. For dynamic stability analyses, acceleration (rather than velocity or displacement) induced at the top of bedrock is plotted against time. This record is also known as an accelerogram. The largest absolute acceleration value in the record is known as the peak ground acceleration (PGA). In general, the PGA can be correlated to the earthquake intensity, and ground motions with a higher PGA are usually more destructive than those with a lower PGA.

The duration of shaking also impacts how destructive an event may be. For example, very high PGAs with high frequencies lasting only a very short time may cause little damage, while an event with a moderate PGA and dominated by long period ground motions may cause substantial damage. Two different example earthquake records are shown in Figure 1 illustrating two of the different types of earthquakes – shaking can be high frequency and long duration (top) or low frequency and short duration (bottom).



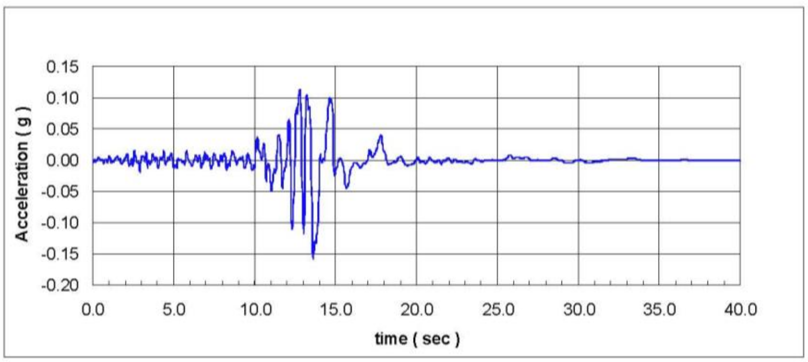


Figure 1. Example acceleration-time histories (source: GEO-SLOPE International, Ltd.)

Traditionally, PGA has been used to quantify ground motion in a PSHA to define lateral forces and shear stresses in the equivalent-static-force procedures of some building codes, and in liquefaction analyses. While this still presents a quick way to assess and, when using a pseudo-static preliminary analysis, to evaluate earthquake motion, more sophisticated methods are available and used now.

Currently, the preferred parameter is Response Spectral Acceleration (SA), which gives the maximum acceleration experienced by a damped, single-degree-of-freedom oscillator (a crude representation of building response). The oscillator period is chosen in accordance with the natural period of the structure (roughly number of stories/10 in seconds), and damping values are typically set at 5% of critical damping.

2.2 General PSHA Procedure

The basic elements of a PSHA were established almost four decades ago and the PSHA has now become the most widely used approach for estimating seismic-design loads.

The PSHA was performed using EZ-Frisk™ software Version 7.50 created by Risk Engineering, Inc. EZ-Frisk allows the user to calculate the probability of an earthquake shaking the bedrock beneath a site based on the surrounding fault and area sources. To accomplish this, the following steps are taken:

- Enter the site's latitude and longitude, as well as other site conditions and analysis choices.
- Select the relevant seismic sources from multiple databases containing various sources (e.g. fault sources, area sources, and/or gridded sources).
- Select attenuation equations from a database with over 55 equations containing coefficients for over 240 specific relationships with world-wide applicability.
- Create a uniform hazard spectrum for the site based on the selected (and, if applicable, weighted) seismic sources and attenuation relationships.
- Adjust acceleration-time histories with spectral matching to obtain accelerograms for use in design.

2.2.1 Site Location and Analysis Choices

The location input for the PolyMet site was latitude 47.6187 and longitude -92.1281, which corresponds to the center of the existing LTV tailings basin.

Minnesota has one of the lowest levels of earthquake occurrence in the United States. However, some minor seismic activity occurs within the state infrequently. This activity is referred as nearfield events because the seismic source is relatively close to the site. Because it is closer to the PolyMet site, within a distance of a few hundred miles, the uniform hazard spectrum for such an event would have a relatively sharp peak in the low-period range (though the peak from a local source would still have a relatively small PGA) and a shorter duration.

The nearest significant fault system is the New Madrid Seismic Zone, which spans Missouri, Tennessee, Kentucky, Illinois, and Arkansas. Locally, this seismic zone is known to be as seismically hazardous as parts of California. However, shaking occurring in the New Madrid Seismic Zone must travel 920 miles to reach the PolyMet site. As this is relatively far from the site, this is referred to as a farfield event. As the seismic waves move through the bedrock, the amplitude of the waves will attenuate and the high-frequency waves will dissipate more quickly. Because the high-frequency waves are filtered out more quickly, this yields a uniform hazard spectrum with a more rounded peak in the longer period range.

The effects of both nearfield and farfield events were assessed by deaggregating the combined uniform hazard spectrum. In total, three PSHAs were performed – one for the aggregate event, one for the nearfield, and one for the farfield– to assess how the different results would affect the site.

2.2.2 Source Characterization

As discussed, both nearfield and farfield seismic sources were reviewed for the PolyMet PSHA. EZ-Frisk recommends using a minimum of three sources.

The dominant fault system is the New Madrid seismic zone (NMSZ), part of the Iapetan Continental Rifts source zone (ICR), which represents an interconnected system of partially developed and failed continental rifts that lie within the mid-continental region of the United States. The New Madrid Fault Line is a source of intraplate earthquakes, those that occur in the interior of a tectonic plate. It is a 150-mile long fault system extending into five states. Most seismic activity is located between 3 to 15 miles beneath Earth's surface. This seismic zone is made up of reactivated faults formed when North America began to split or rift apart during the breakup of the supercontinent Rodinia during the Neoproterozoic Era. A scar, or zone of weakness, from the rift is deep underground. This weak area, combined with focusing effects from surrounding stronger igneous rocks, allows small east-west compressive forces to reactivate old faults, the cause of seismic activity. However, large earthquakes in this area are rare with only three Magnitude 8 earthquakes recorded in the last 2000 years, with the last major earthquake occurring in the year 1812.

The greatest seismic impact region for northern Minnesota consists of the Midcontinent Rift System (MRS) or Keweenawan Rift, a 1,243 mile long geological rift in the center of North America. The rift began to split apart during the Mesoproterozoic era but failed and healed, leaving behind Lake Superior basin and rock buried beneath layers of sediments. The northern reaches of the rift have exposed rock of gabbro and granites from magma and basalts seen on the North Shore Minnesota, northwest Wisconsin, and the Upper Michigan Peninsula.

2.2.2.1 Earthquake Magnitude

Inconsistent use of terminology is a cause of confusion in many PSHA reports. In listing the fault and source zone parameters, the term "maximum magnitude" is often used for both the true maximum magnitude and for the mean magnitude from full rupture of a fault.

For area sources, the maximum magnitude is the largest magnitude that can occur in the area source. If an exponential distribution is used for the magnitudes (e.g. Gutenberg-Richter model), then the maximum magnitude is the magnitude at which the exponential distribution is truncated. For fault sources, the dimension of the fault (length or area) is typically used to estimate the mean magnitude for full rupture of the fault. This mean magnitude is better described as the "mean characteristic magnitude" and not as the maximum magnitude because the PSHA will typically consider a range of values about this mean magnitude to account for the variability of the magnitude for a given rupture dimension. For example, the widely used Youngs and Coppersmith (1985) model for the magnitude distribution has the characteristic part of the model centered on the mean characteristic magnitude and the maximum magnitude is 0.25 units larger.

2.2.3 Attenuation Relations

In most cases, the attenuation relations are selected from existing models for the appropriate tectonic regime (shallow crustal earthquakes in active tectonic regions, shallow crustal earthquakes in stable continental regions, or subduction zone earthquakes). The PolyMet PSHA used these three attenuation relationships:

- Silva et al (2002) USGS 2008 MbLg - AB MRC
- Toro (1999) Midcontinent - USGS 2008 MbLg MRC
- Campbell (2003) USGS 2008 MbLg - AB MRC

No fewer than three NGA relations should be utilized and these certain attenuation relations were chosen from a database with over 55 equations containing coefficients for over 240 specific relationships with world-wide applicability. All three equations include MbLg or earthquake magnitudes determined from 1.0 hertz S-waves. These are applicable because of much better data on Lg for calibration in the eastern and central United States.

2.3 Probabilistic Hazard Calculations

The basic result of a PSHA is a series of hazard curves showing the probability of exceeding a ground motion for a range of ground motion values. As it is a probabilistic analysis, there are a range of results that can be supplied for varying probabilities. At a minimum, the hazard should be shown for a least two spectral periods: one short period, such as PGA, and one long period, such as T=2 sec. The selection of the spectral periods should consider the period of the structure.

2.4 Spectral Matching

A uniform hazard spectrum from the 2745-year return period, or 2-percent probability of exceedance in 50 years, is obtained from EZ-FRISK™ for each nearfield, farfield, and combined event. It can then be entered into the PEER Ground Motion Database as a target spectrum. This tool plots the target hazard spectrum and searches for an existing earthquake hazard spectrum that matches the inputs provided by the EZ-FRISK™ analysis. The target hazard spectrum is unique for each nearfield, farfield, and combined analysis. Criteria inputs obtained from the EZ-FRISK™ analysis include magnitude, fault type, rupture distance, duration, and factor limits.

For the PEER search criteria, a mean and range of magnitudes was identified for each PSHA performed. The nearfield was given a mean magnitude of 5.62 with a range from 5.0 to 6.5 and did not include records below a magnitude of 5.0. The farfield was given a mean magnitude of 7.73 with a range from 7.0 to 8.0 and did not include records below a magnitude of 5.0. The combined PSHA was given a mean magnitude of 5.92 with a range from 5.0 to 8.0 and did not include records below a magnitude of 5.0. The source gridding by the USGS in 2008 was utilized because it is the most recent mapping exercise by USGS. MRC, or maximum rotated component, was chosen because it is considered to be the most conservative attenuation equation for predicting the horizontal geomean component of spectral response at 5% damping. A VS30 of 760 m/s was chosen because it gives Site Classes A or B (according to ASCE 7), which are Hard Rock and Rock, respectively.

The PEER spectral matching provides 30 acceleration-time histories from measured earthquakes that best match the target hazard spectrum. The 30 matching records each include a fault normal and fault parallel event (horizontal records rotated to match the normal and parallel directions to the source fault) and they are ordered from most to least similar. For the PolyMet PEER analysis, the best matching event to the EZ-FRISK™ input was the NGA_2996CHICHI05.HWA003 earthquake record providing a fault normal, fault parallel, and vertical shaking record. For the GeoStudio 2007 QUAKE model, the worst case, or highest peak, acceleration record was chosen to run in the program. The QUAKE input acceleration records are shown in Figures 9 and 10. Due to similar acceleration records, the combined and nearfield events are shown in Figure 9 and the farfield event is shown in Figure 10.

3.0 Results

For each nearfield, farfield, and combined PSHA performed, eight figures were produced showing seismic hazard results. Figures 1-8 are shown as combined (C1-C8), nearfield (N1-N8), and farfield (F1-F8) events. Each figure is based on the spectral response at 5% damping – MRC (maximum rotated component). The first figure provided plots the total mean hazard for each source, or annual peak frequency of exceedance, versus peak ground acceleration. The second figure plots the uniform hazard spectral response versus spectral period for a mean return period of 475, 975, and 2475 years or an occurrence of 2%, 5%, and 10% in 50 years, respectively. The third figure shows the seismic hazard for each fault location while the fourth figure plots the seismic hazard for each fault. The fifth plot displays distance deaggregation plotting probability density versus distance. The magnitude deaggregation or probability density versus magnitude is plotted in the sixth figure and the seventh figure combines the magnitude and distance deaggragation onto one three-dimensional plot. The final figure eight plots the activity rate by seismic source or annual rate of events versus magnitude. Also included for each analysis is an ECHO report, an analysis log, and an area map showing the influential fault and area sources.

3.1 Nearfield Event

The EZ-FRISK™ software identifies the seismic sources within 500 miles of PolyMet as CEUS Gridded – AB and CEUS Gridded – J (CEUS standing for Central and Eastern United States). For the nearfield analysis, the deaggregated seismic hazard is also used because the important earthquake frequencies must be determined and characterized.

For the nearfield event, Figures N-1, N-3, and N-4 show the annual frequency of exceedance versus the PGA.

Figure N-2 shows the variation in spectral acceleration for the 2475-, 975-, and 475-year return periods. The nearfield event had a peak acceleration of 0.055g occurring around a period of 0.1 seconds for the 2475-year return period. The peak nearfield accelerations are 0.025g and 0.013g for the 975- and 475-year return periods, respectively

Figure N-5 displays the mean hazard probability density over a given distance for an acceleration of 0.2g. Figure N-6 provides the probability density of earthquake magnitude. The nearfield event has a mean magnitude of 5.62.

3.2 Farfield Event

The nearest significant fault system, about 920 miles away from the site, is the New Madrid Seismic Zone, which spans Missouri, Tennessee, Kentucky, Illinois, and Arkansas. A farfield event for this site includes seismic faults located a distance greater than about 500 miles from the site. As the seismic waves move through the bedrock, the amplitude of the waves will attenuate and the high-frequency waves will dissipate more quickly. Because the high-frequency waves are filtered out more quickly, this yields a uniform hazard spectrum with a more rounded peak in the longer period range. The EZ-FRISK™ software identifies these seismic sources greater than 500 miles of PolyMet as the New Madrid – Composite or the USGS 2008 New Madrid Reverse Fault.

For the nearfield event, Figures F-1, F-3, and F-4 show the annual frequency of exceedance versus the PGA.

Figure F-2 shows the variation in spectral acceleration for the 2475-, 975-, and 475-year return periods. The farfield event had a peak acceleration of 0.016g occurring around a period of 2.0 seconds for the 2475-year return period. The peak farfield accelerations are 0.006g and almost zero for the 975- and 475-year return periods, respectively

Figure F-5 displays the mean hazard probability density over a given distance for an acceleration of 0.2g. Figure N-6 provides the probability density of earthquake magnitude. The nearfield event has a mean magnitude of 7.73.

3.3 Combined Event

The nearfield analysis analyzes seismic activity within a distance of 500 miles. The farfield events excluded the nearfield influence and analyze seismic activity greater than a distance of 500 miles and less than 1242 miles. The effect of both nearfield and farfield events can also be combined, or aggregated, for a given site. The EZ-FRISK™ software identifies all seismic sources within a 1242 mile range of the PolyMet site. These sources include the nearfield events of CEUS Gridded – AB and CEUS Gridded – J as well as farfield events such as the New Madrid – Composite or the USGS 2008 New Madrid Reverse Fault.

For the nearfield event, Figures C-1, C-3, and C-4 show the annual frequency of exceedance versus the PGA.

Figure C-2 shows the variation in spectral acceleration for the 2475-, 975-, and 475-year return periods. The combined event had a peak acceleration of 0.061g occurring around a period of 0.1 seconds for the 2475-year return period. The peak combined accelerations are 0.030g and 0.017g for the 975- and 475-year return periods, respectively

Figure C-5 displays the mean hazard probability density over a given distance for an acceleration of 0.2g. Figure C-6 provides the probability density of earthquake magnitude. The combined event has a mean magnitude of 5.92.

3.4 Deaggregation Comparison

Figures labeled N-2, F-2, and C-2 show the variation in spectral acceleration for the 2475-, 975-, and 475-year return periods. It can be seen that the nearfield event had a peak acceleration of 0.055g occurring around a period of 0.1 seconds for the 2475-year return period. For the same return period, the farfield spectrum had a spectral peak acceleration much less, with a value of 0.016g at a period of 2.0 seconds. The peak nearfield accelerations are 0.025g and 0.013g for the 975- and 475-year return periods, respectively, and the peak farfield accelerations are 0.006g and almost zero for the 975- and 475-year return periods, respectively. The combined peak acceleration is slightly higher than the nearfield peak acceleration for each return period indicating that the highest amplitude shaking would result from the nearfield seismic events. The combined peak accelerations are 0.061g, 0.030g, and 0.017g for the 2475-, 975-, and 475-year return periods, respectively.

Figures labeled N-5, F-5, and C-5 display the mean hazard probability density over a given distance. The nearfield event has the highest probability (about twice as high as the farfield probability when compared on the combined plot) within a distance of 200 miles from the PolyMet site. The farfield probability is greatest at a distance of 750 miles from the PolyMet site but it is about half the probability when compared to the nearfield probability indicating that closer seismic events are much more likely to produce higher accelerations at the site.

Figures N-6, F-6, and C-6 provide the probability density of earthquake magnitude. The nearfield event has a mean magnitude of 5.62, while the farfield and combined analysis show mean magnitudes of 7.73 and 5.92, respectively.

3.5 Validation of Results

A comparison of uniform hazard spectra was used to verify the results of the PSHAs. The results of the combined PSHA were compared to the hazard spectrum coming from the USGS website which uses latitude and longitude as the input. The 2475-year return period results were almost identical, as shown in Figure 11.

Table 1. Summary of PSHA results

				Nearfield	Farfield	Combined
Figure 2	**2475-year Return Period**	**Spectral Acceleration**	g	0.055	0.016	0.061
		Peak Period	seconds	0.1	2.0	0.1
	975-year Return Period	**Spectral Acceleration**	g	0.025	0.006	0.030
		Peak Period	seconds	0.2	1.0	0.1
	475-year Return Period	**Spectral Acceleration**	g	0.013	0.000	0.017
		Peak Period	seconds	0.2	N/A	0.2
Figure 5		**Hazard (probability)**		0.0005254	8.13349E-05	0.000617235
		Mean Distance	miles	100	763	200
Figure 6		**Mean Magnitude**	M	5.62	7.73	5.92

4.0 References

Barr Engineering Company. (2008, September). *Streamflow and Lake Level Changes, Model Calibration Report for the PolyMet NorthMet Mine Site* .

Edward H. Field. (2005, 02 24). *Probabilistic Seismic Hazard Analysis (PSHA): A Primer*. Retrieved June 29, 2011, from OpenSHA: http://www.opensha.org/sites/opensha.org/files/PSHA_Primer_v2_0.pdf

5.0 List of Tables

6.0 List of Figures

7.0 List of Attached Figures

Figures

Figure C1 - Combined Total Hazard Spectrum

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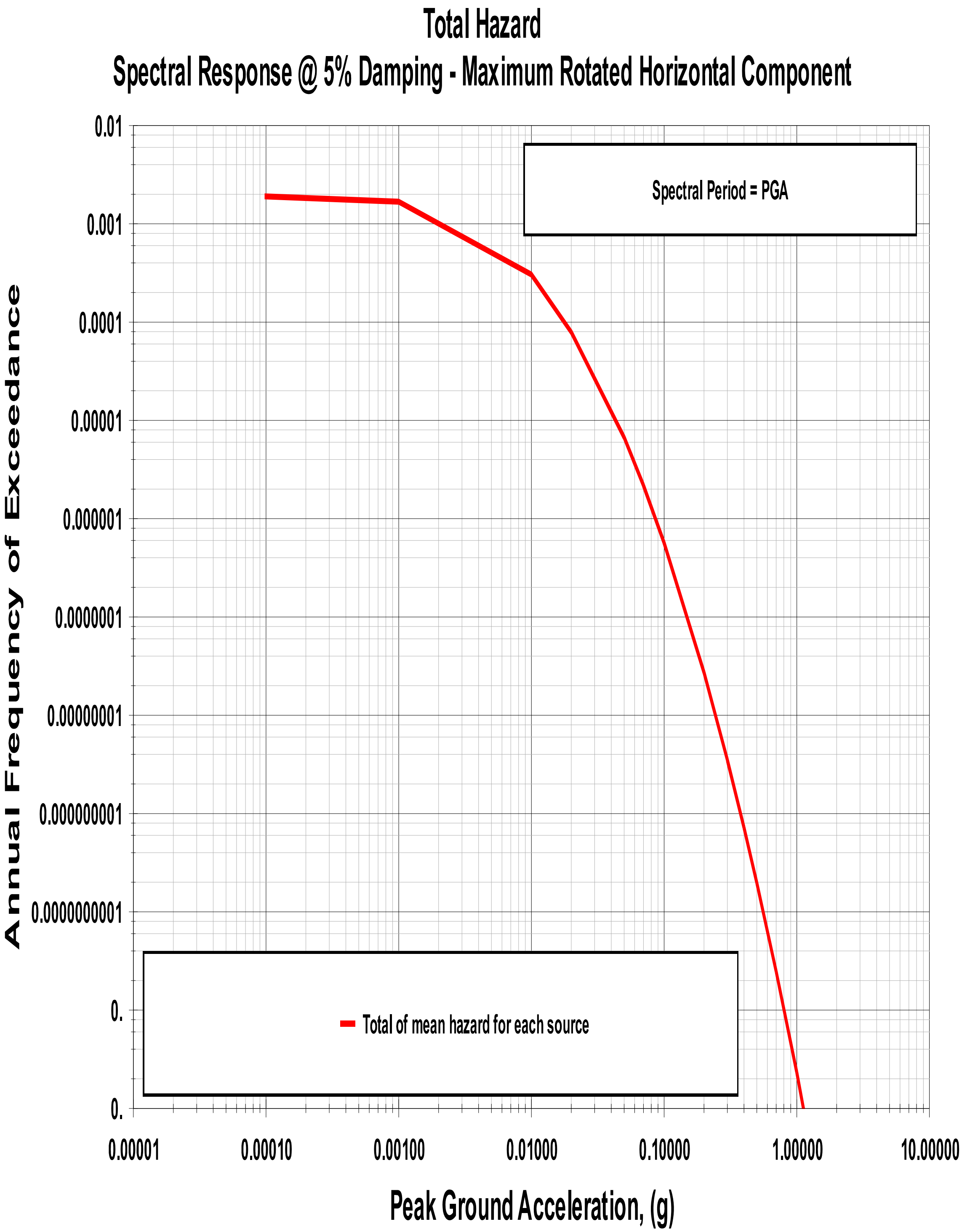

Figure C2 - Combined Uniform Hazard Spectrum

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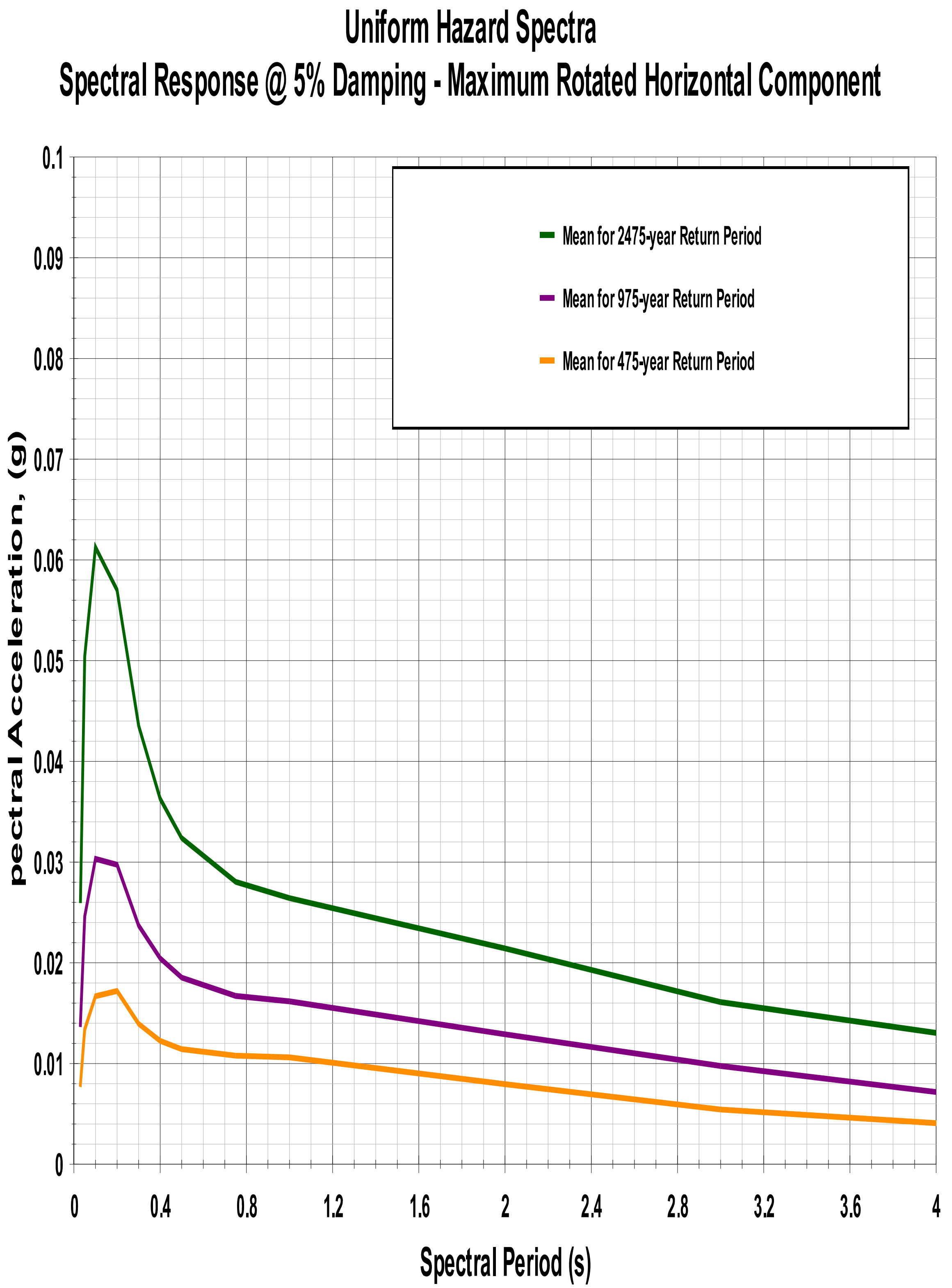

Figure C3 - Combined Hazard by Seismic Source

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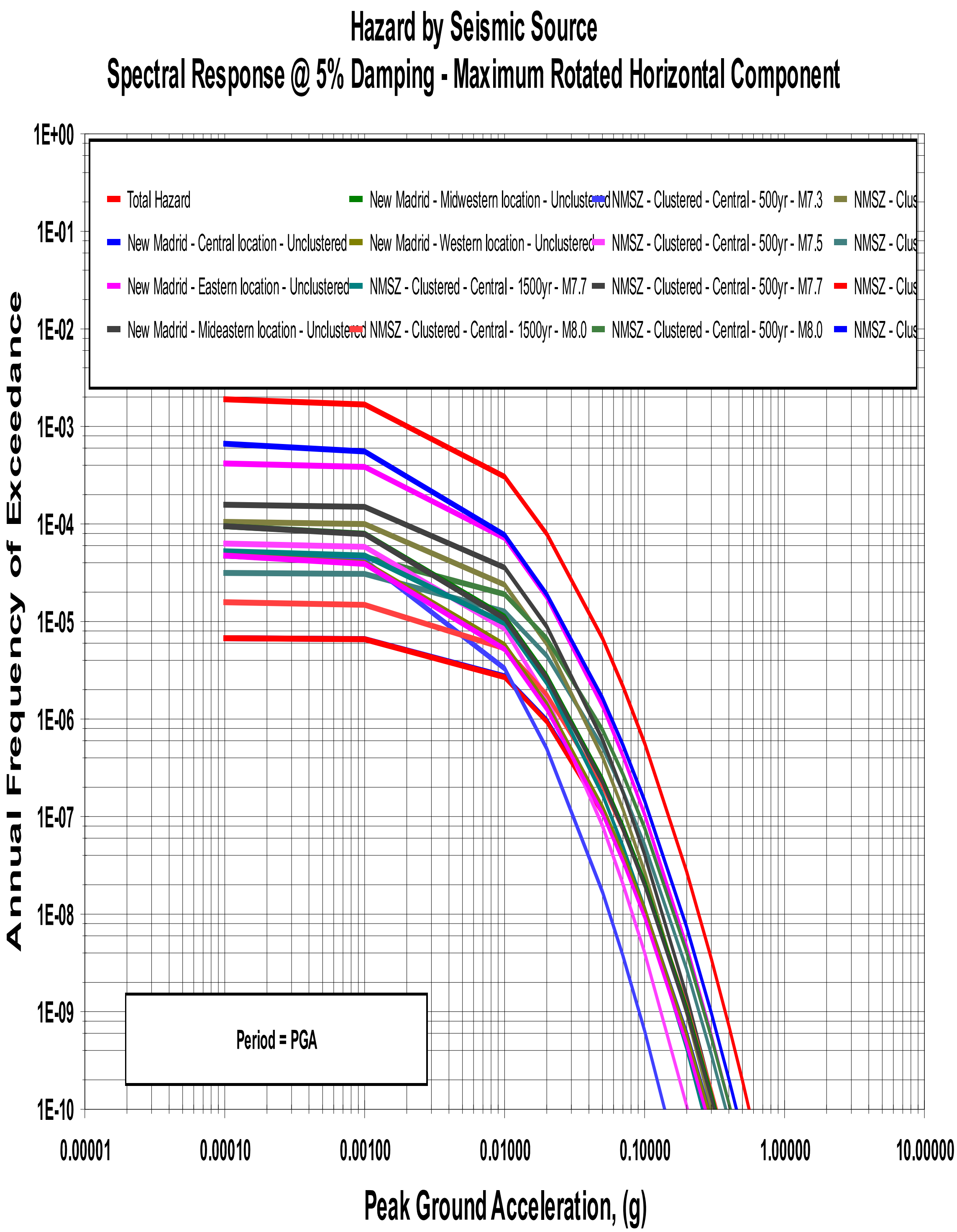

Figure C4 - Combined Hazard-Spectral Response

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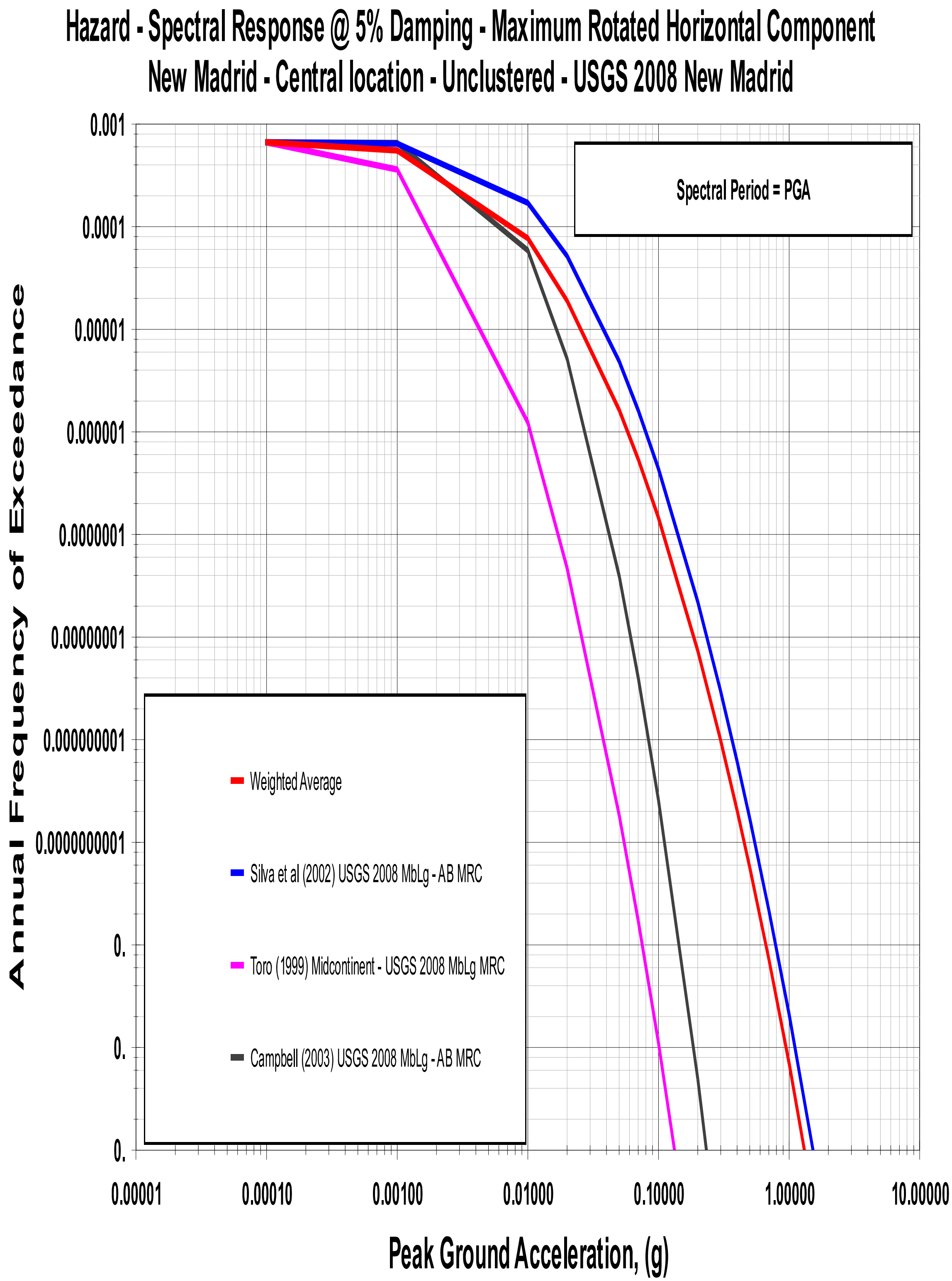

Figure C5 - Combined Distance Deaggregation

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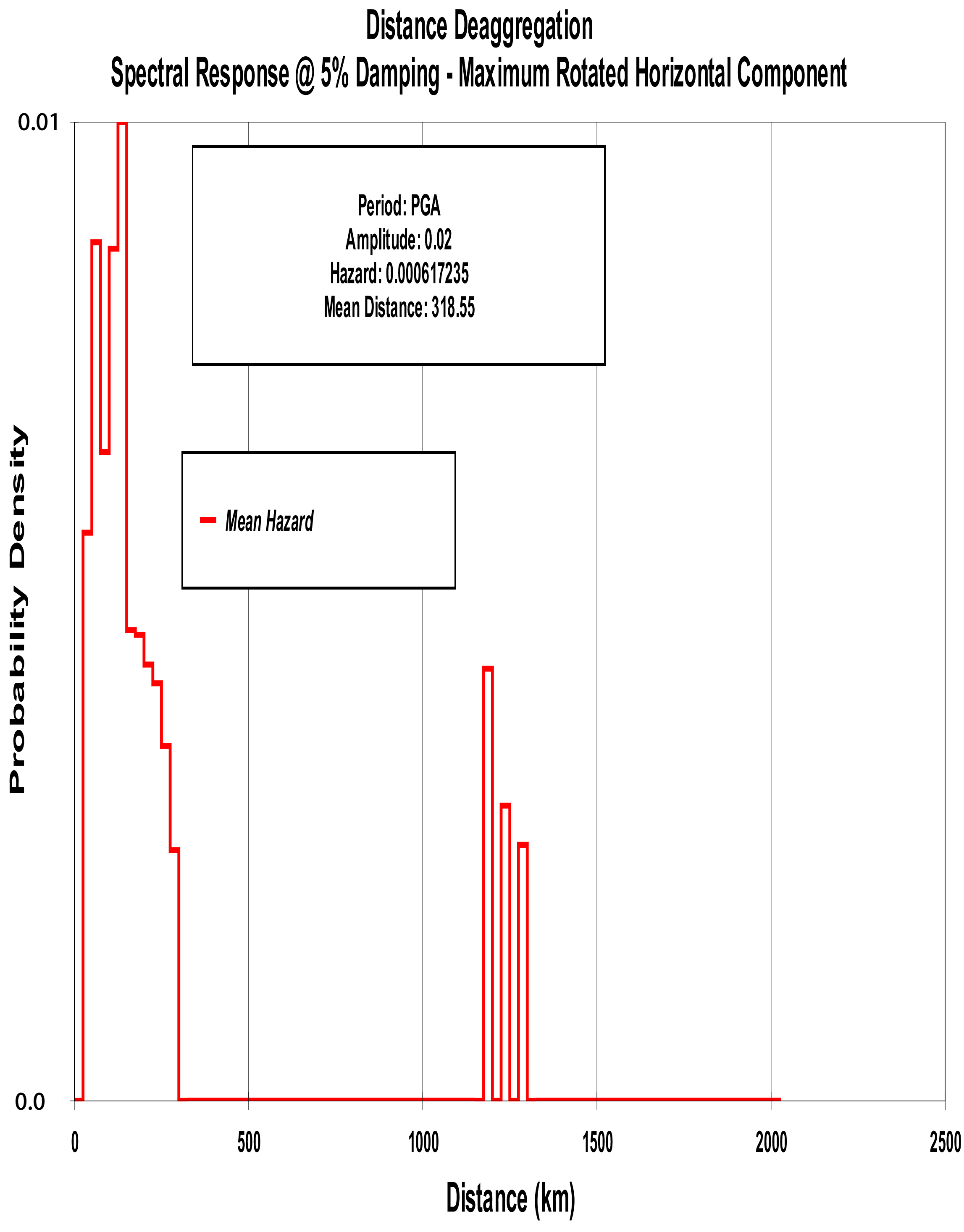

Figure C6 - Combined Magnitude Deaggregation

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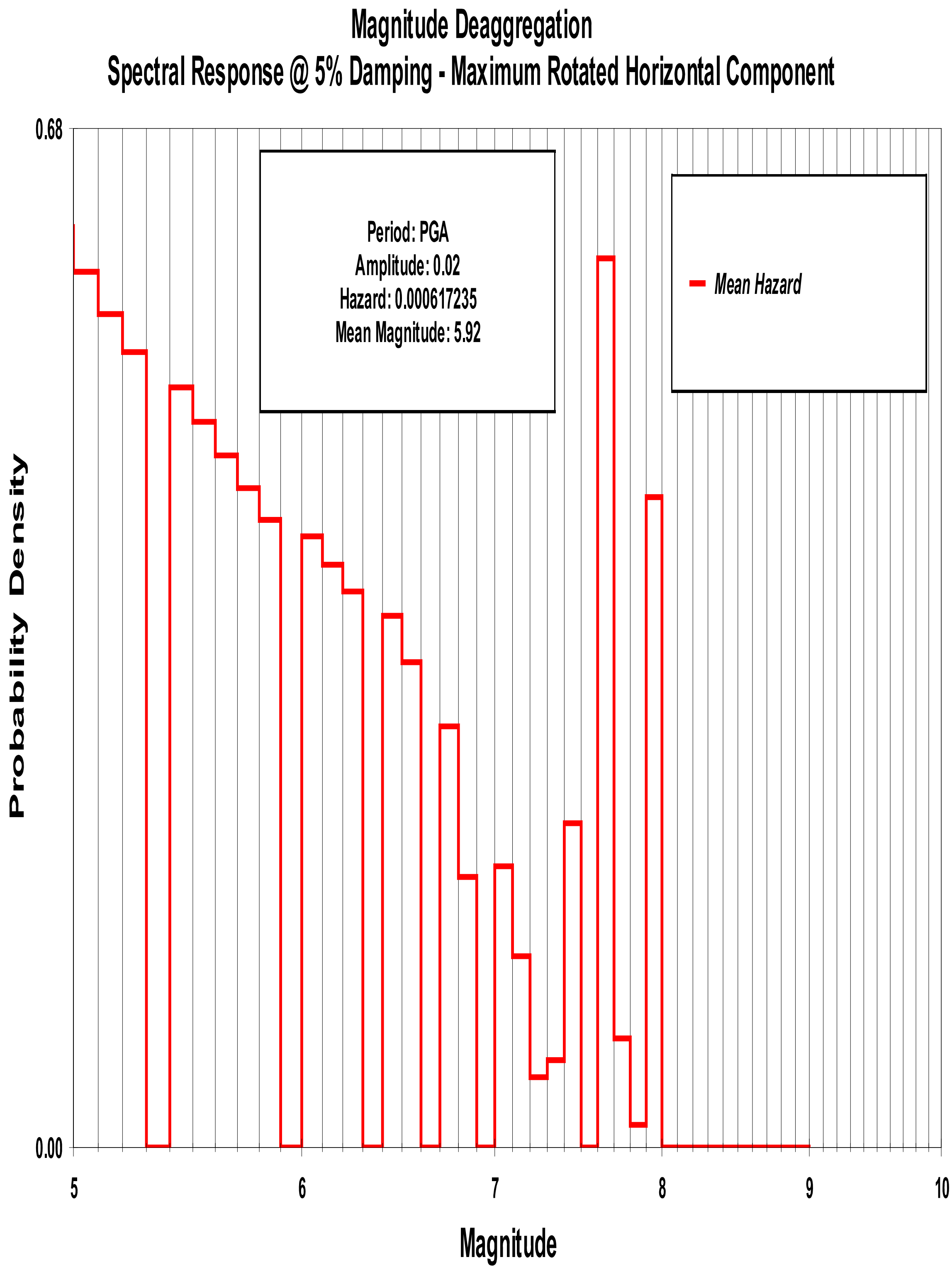

Figure C7 - Combined Magnitude-Distance Deaggregation

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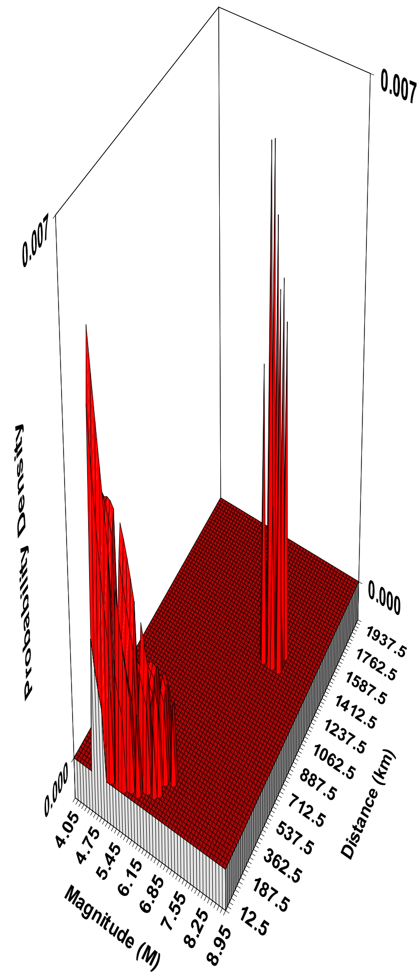
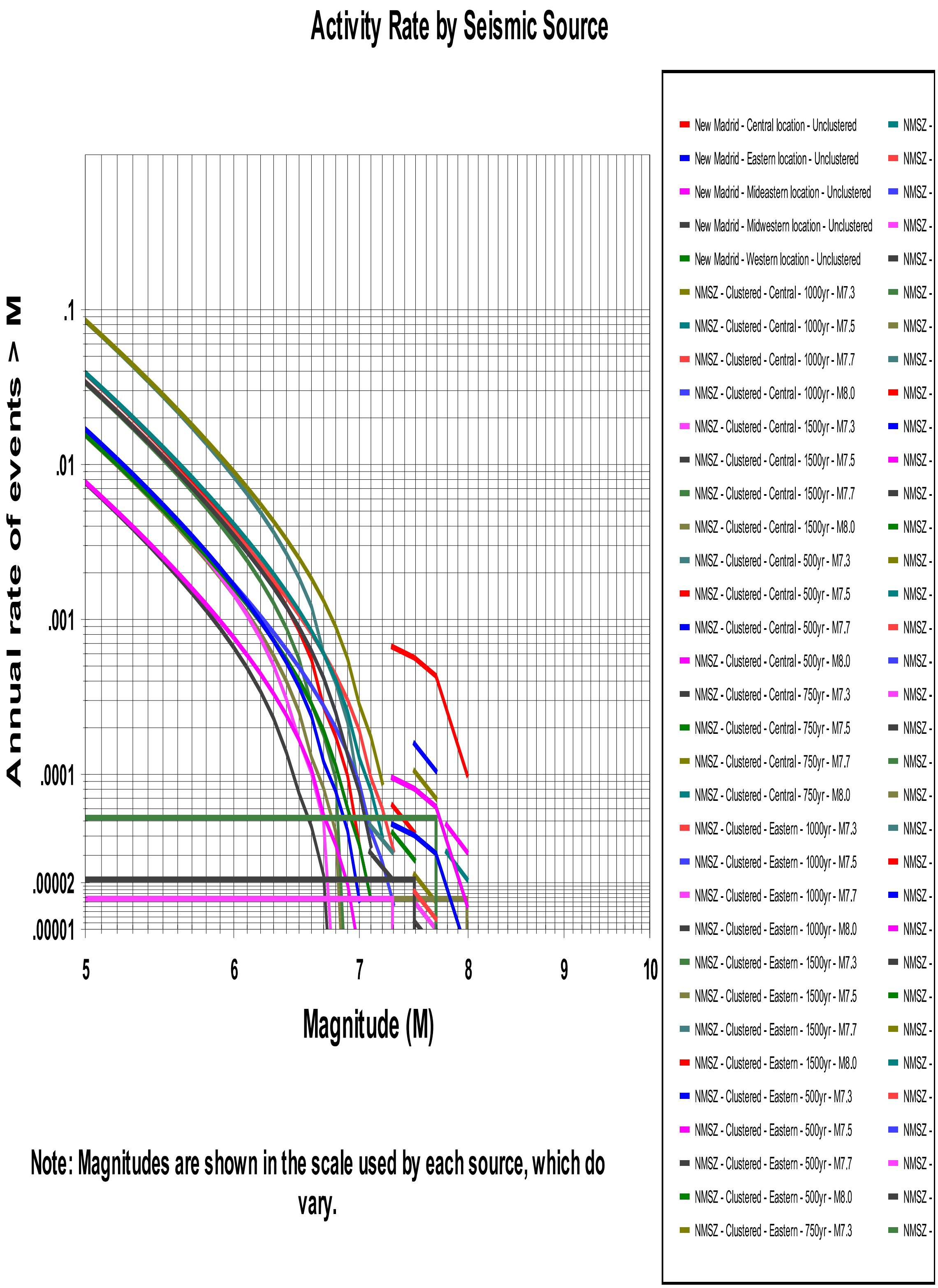
Magnitude-Distance Deaggregation
Spectral Response @ 5% Damping - Maximum Rotated Horizontal Component



Period: PGA
Amplitude: 0.02
Hazard: 0.000617235
Mean Magnitude: 5.92
Mean Distance: 318.55



Activity Rate by Seismic Source
Annual rate of events > M
.1
.01
.001
.0001
.00002
.00001
5
6
7
8
9
10
Magnitude (M)
Note: Magnitudes are shown in the scale used by each source, which do vary.
New Madrid - Central location - Unclustered
New Madrid - Eastern location - Unclustered
New Madrid - Mideastern location - Unclustered
New Madrid - Midwestern location - Unclustered
New Madrid - Western location - Unclustered
NMSZ - Clustered - Central - 1000yr - M7.3
NMSZ - Clustered - Central - 1000yr - M7.5
NMSZ - Clustered - Central - 1000yr - M7.7
NMSZ - Clustered - Central - 1000yr - M8.0
NMSZ - Clustered - Central - 1500yr - M7.3
NMSZ - Clustered - Central - 1500yr - M7.5
NMSZ - Clustered - Central - 1500yr - M7.7
NMSZ - Clustered - Central - 1500yr - M8.0
NMSZ - Clustered - Central - 500yr - M7.3
NMSZ - Clustered - Central - 500yr - M7.5
NMSZ - Clustered - Central - 500yr - M7.7
NMSZ - Clustered - Central - 500yr - M8.0
NMSZ - Clustered - Central - 750yr - M7.3
NMSZ - Clustered - Central - 750yr - M7.5
NMSZ - Clustered - Central - 750yr - M7.7
NMSZ - Clustered - Central - 750yr - M8.0
NMSZ - Clustered - Eastern - 1000yr - M7.3
NMSZ - Clustered - Eastern - 1000yr - M7.5
NMSZ - Clustered - Eastern - 1000yr - M7.7
NMSZ - Clustered - Eastern - 1000yr - M8.0
NMSZ - Clustered - Eastern - 1500yr - M7.3
NMSZ - Clustered - Eastern - 1500yr - M7.5
NMSZ - Clustered - Eastern - 1500yr - M7.7
NMSZ - Clustered - Eastern - 1500yr - M8.0
NMSZ - Clustered - Eastern - 500yr - M7.3
NMSZ - Clustered - Eastern - 500yr - M7.5
NMSZ - Clustered - Eastern - 500yr - M7.7
NMSZ - Clustered - Eastern - 500yr - M8.0
NMSZ - Clustered - Eastern - 750yr - M7.3

Combined Map

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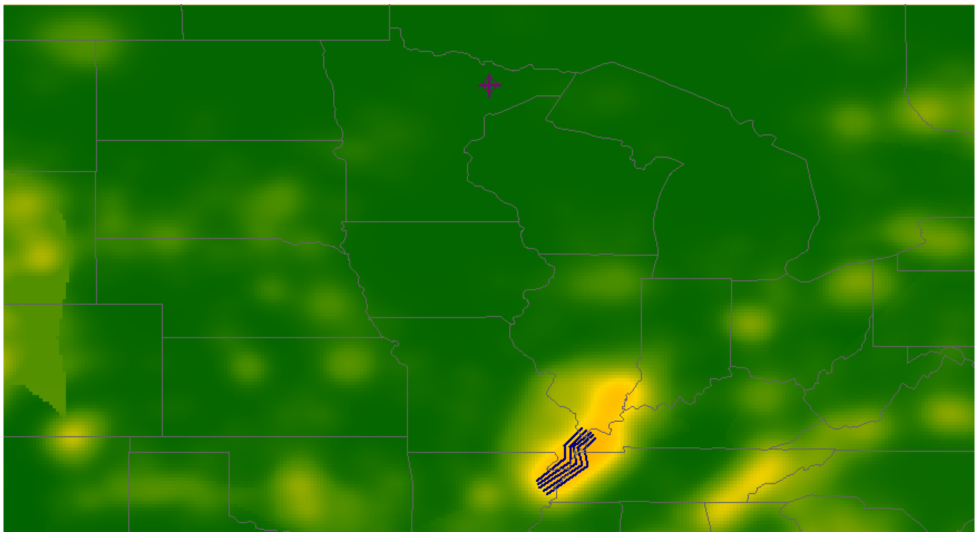

MAP LEGEND

Site

Faults

Included

Not included

Activity Rate

(rate of M>5

0.0e+000

1.0e-005

5.0e-005

1.0e-004

5.0e-004

1.0e+000

Figure F1 - Farfield Total Hazard Spectrum

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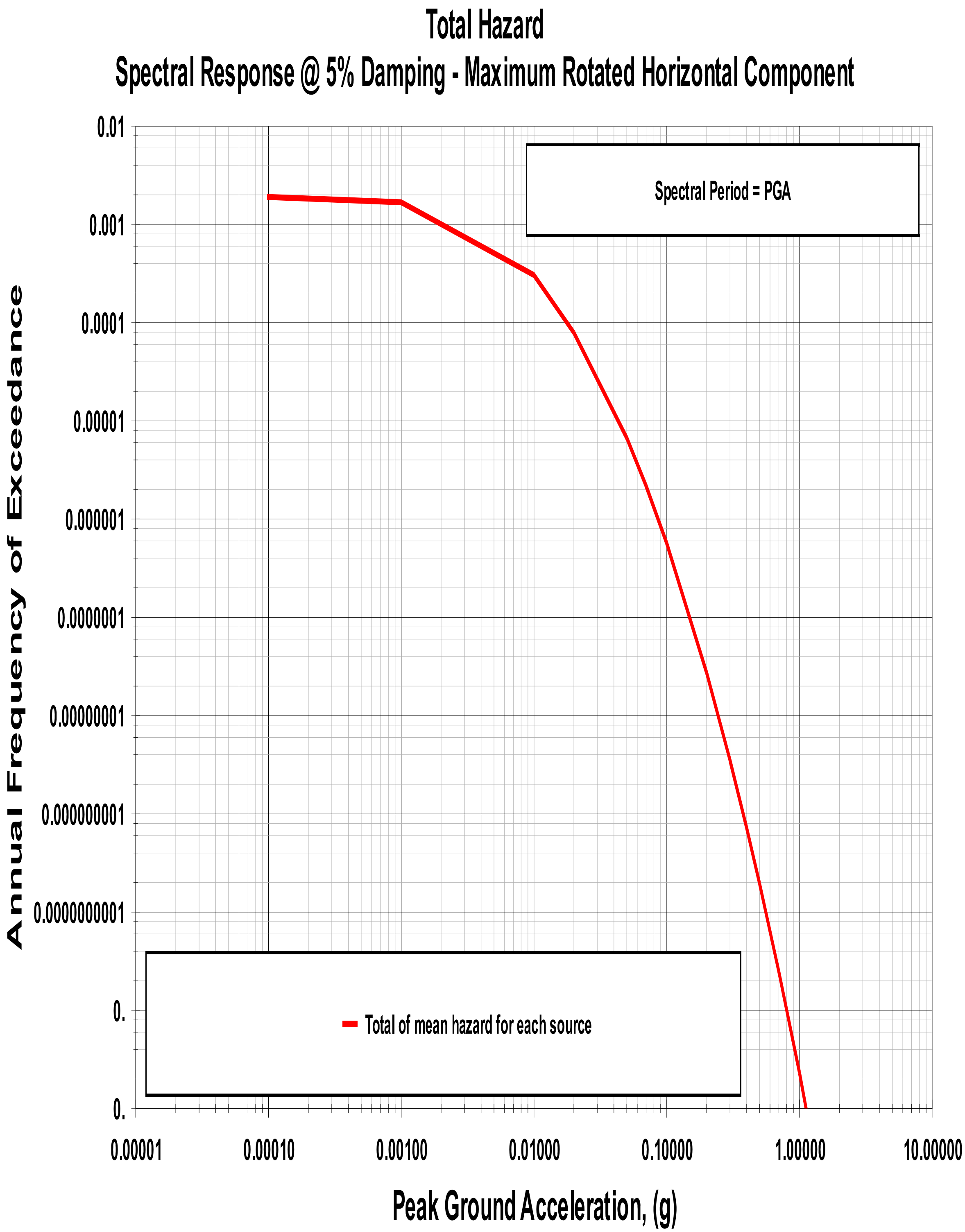

Figure F2 - Farfield Uniform Hazard Spectra

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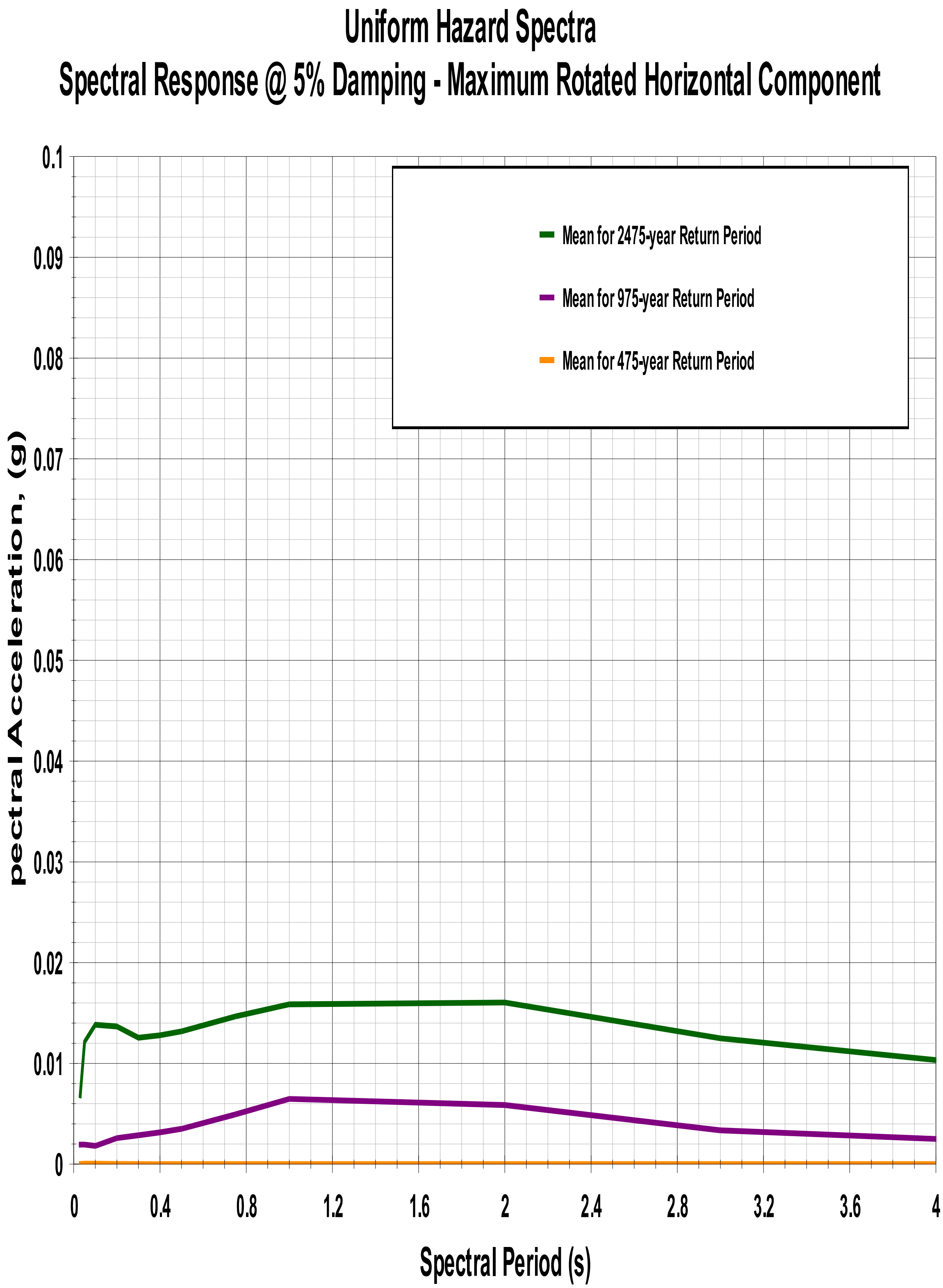

Figure F3 - Farfield Hazard by Seismic Source

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Date Modified: 06/11/2011 11:05:37 PM

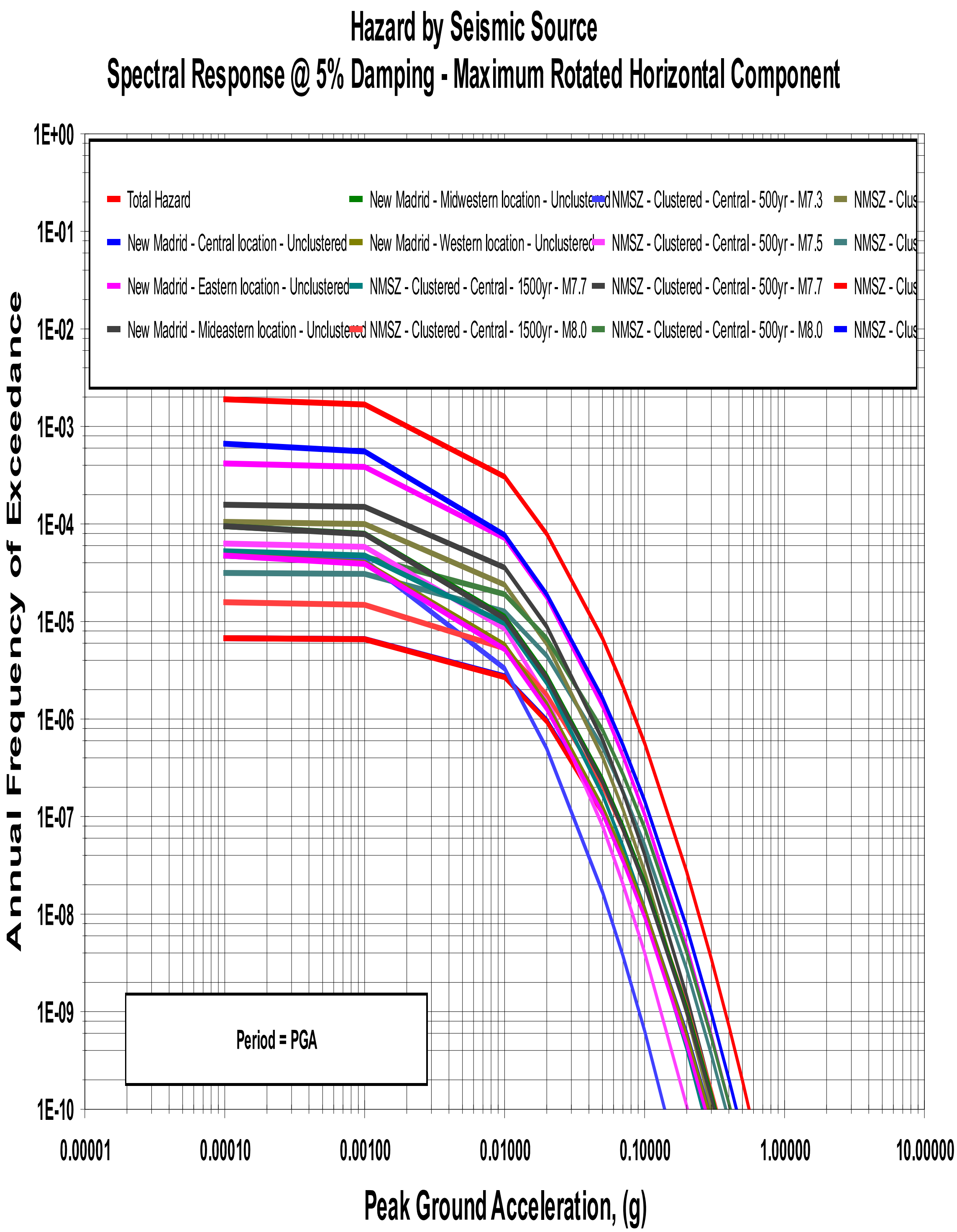

Figure F4 - Farfield Hazard Spectral Response

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Date Modified: 06/11/2011 11:06:57 PM

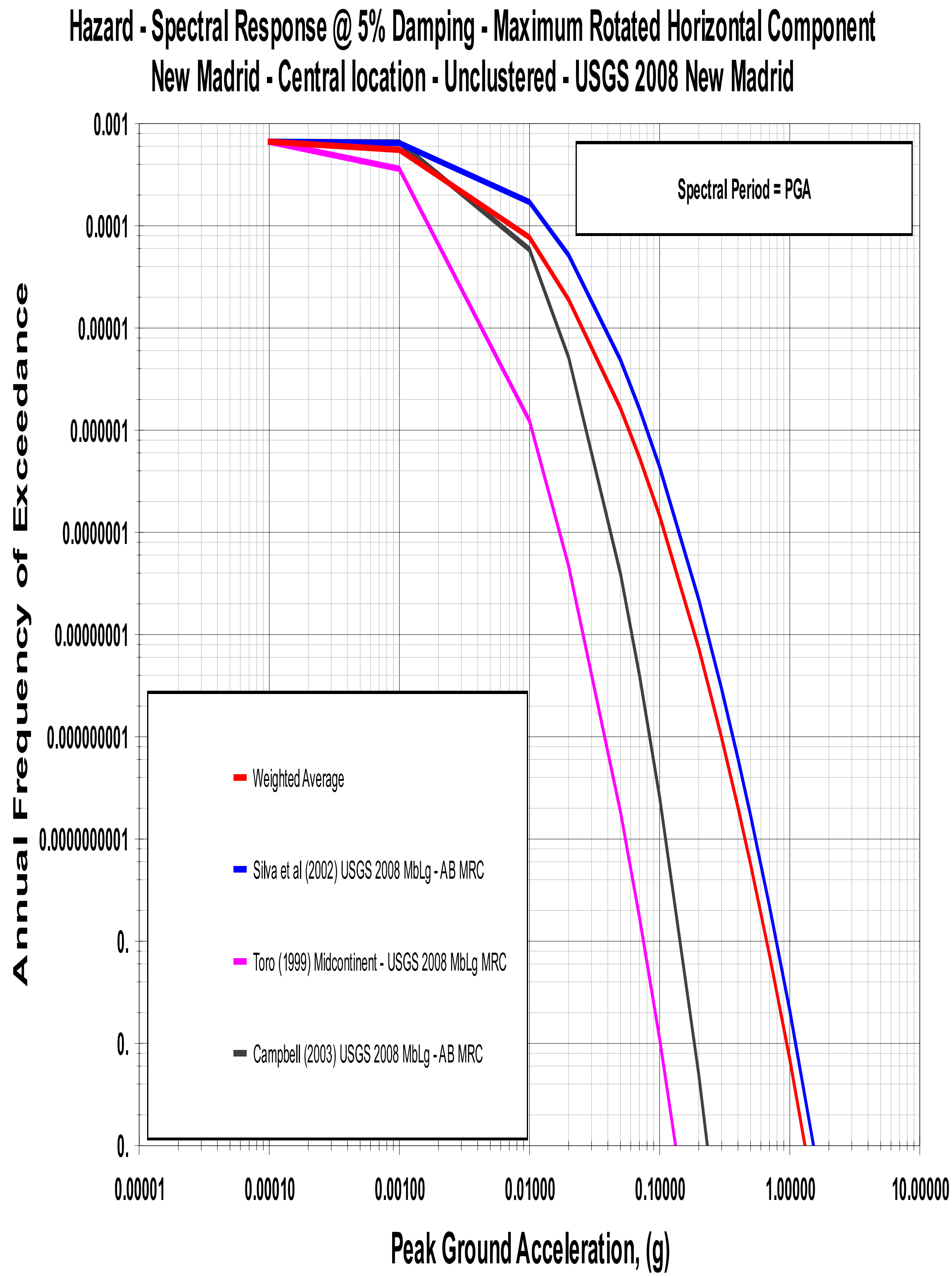

Figure F5 - Farfield Distance Deaggregation

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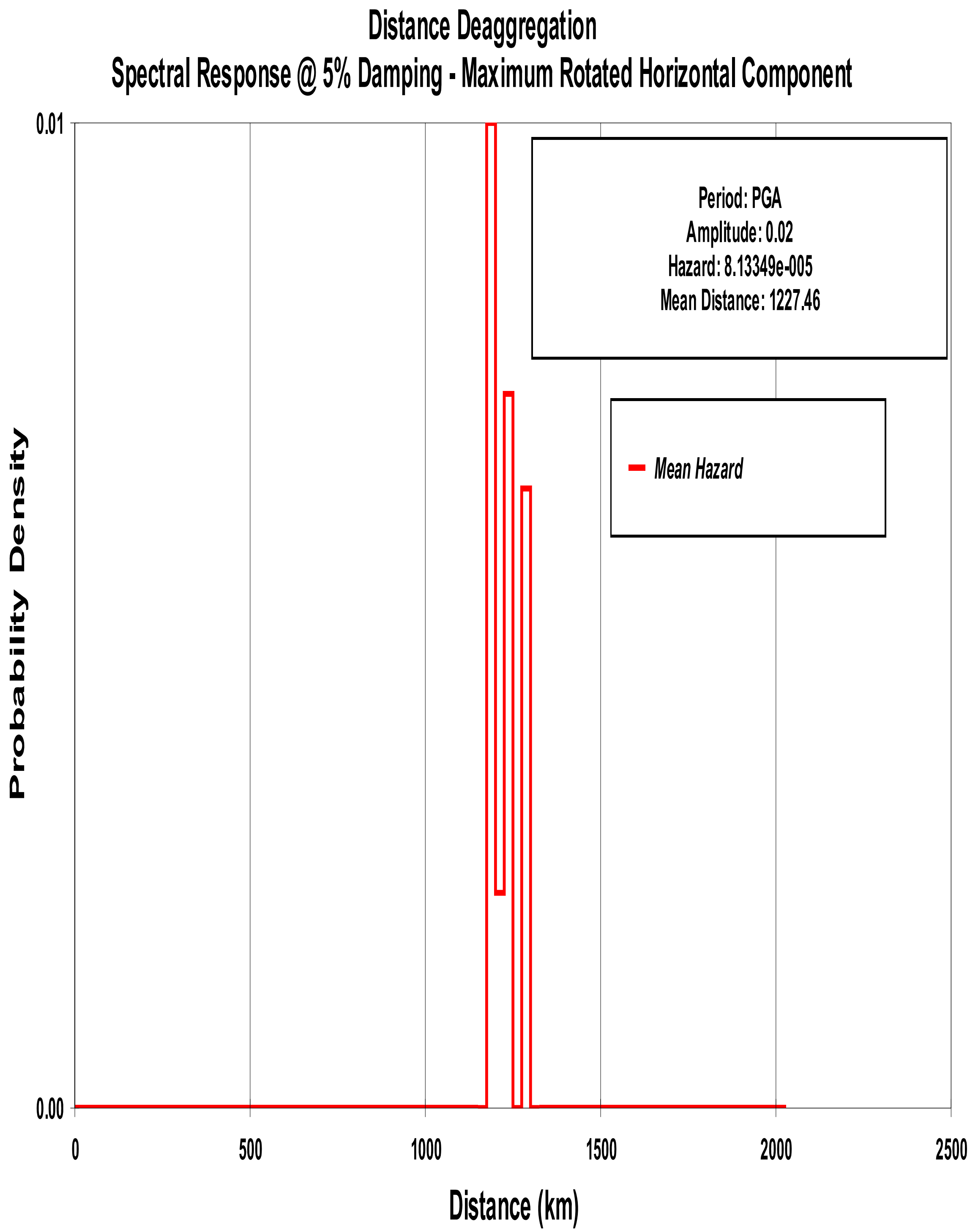

Figure F6 - Farfield Magnitude Deaggregation

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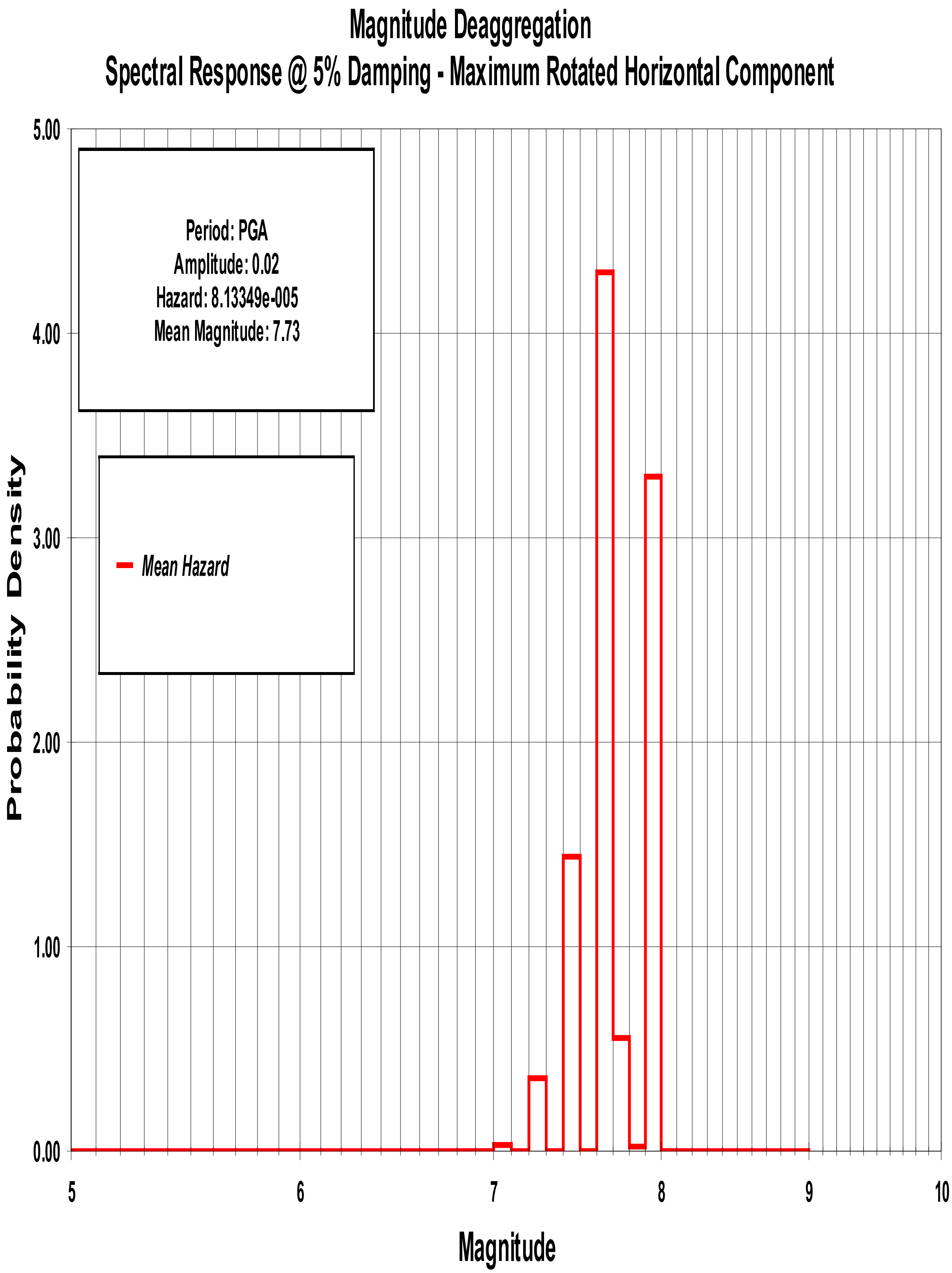
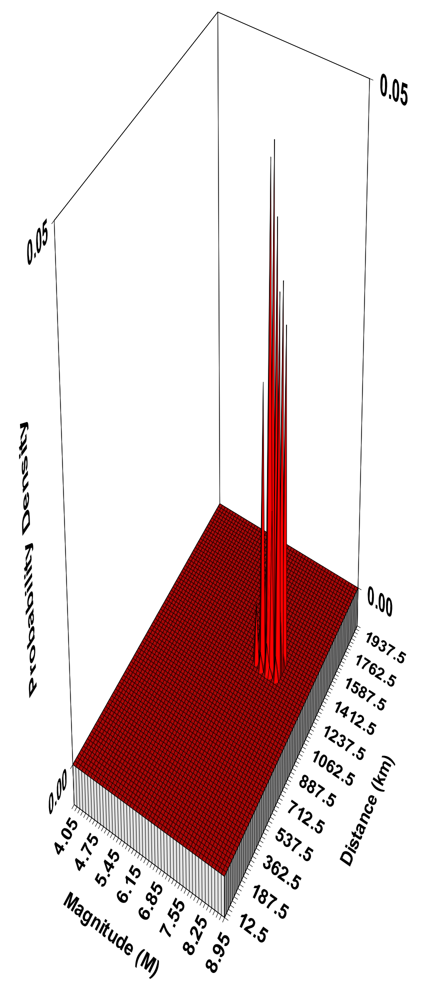


Figure F7 - Farfield Magnitude-Distance Deaggregation

Magnitude-Distance Deaggregation
Spectral Response @ 5% Damping - Maximum Rotated Horizontal Component



Period: PGA
Amplitude: 0.02
Hazard: 8.13349e-005
Mean Magnitude: 7.73
Mean Distance: 1227.46

Figure F8 - Farfield Activity Rate

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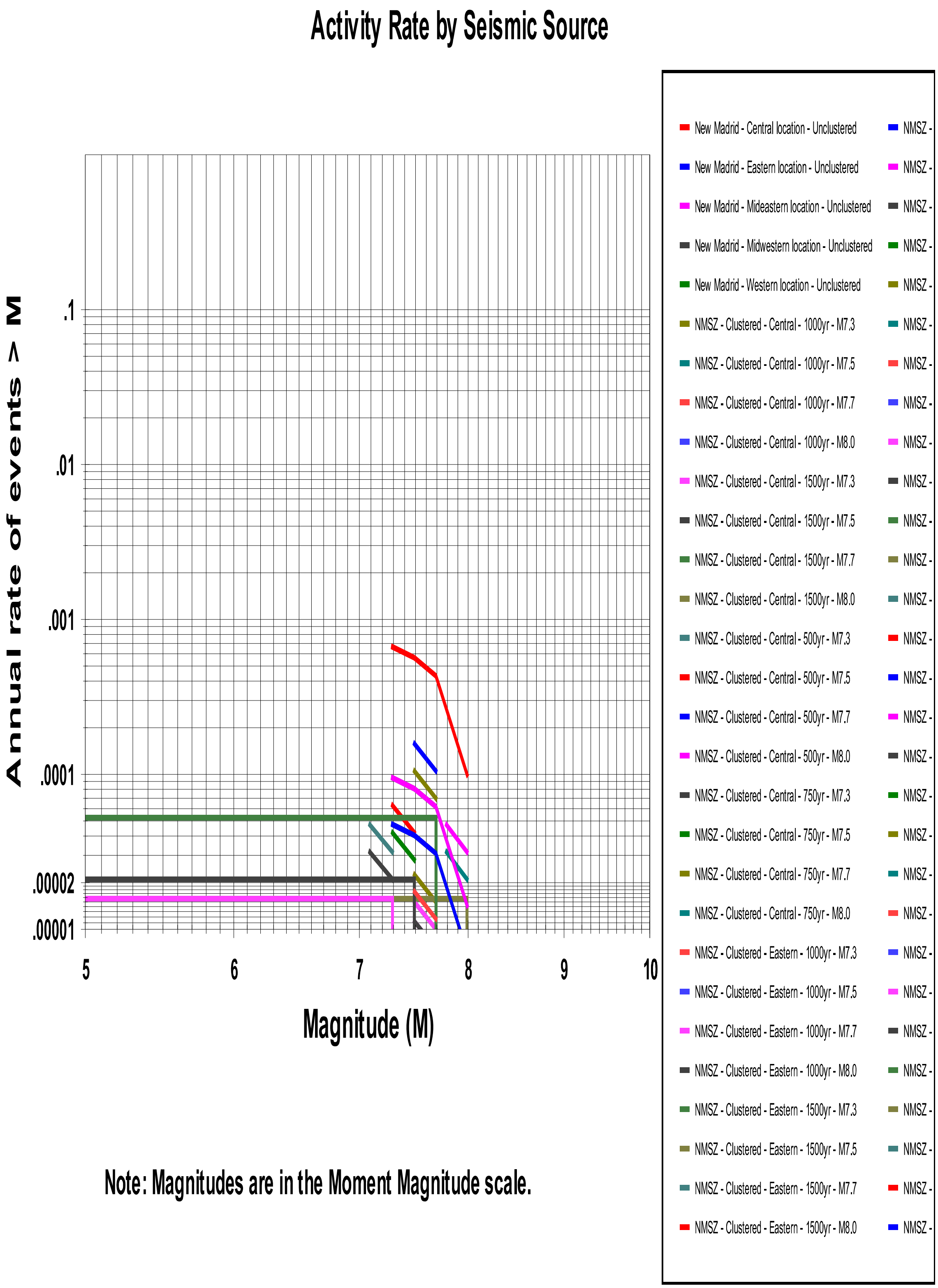
Date Modified: 06/11/2011 11:09:24 PM



Farfield Map

File: C:\Documents and Settings\jdg\Desktop\EZ-FRISK\PolyMet\Deaggregated_6-11-11\Farfield\~_PolyMet Probal

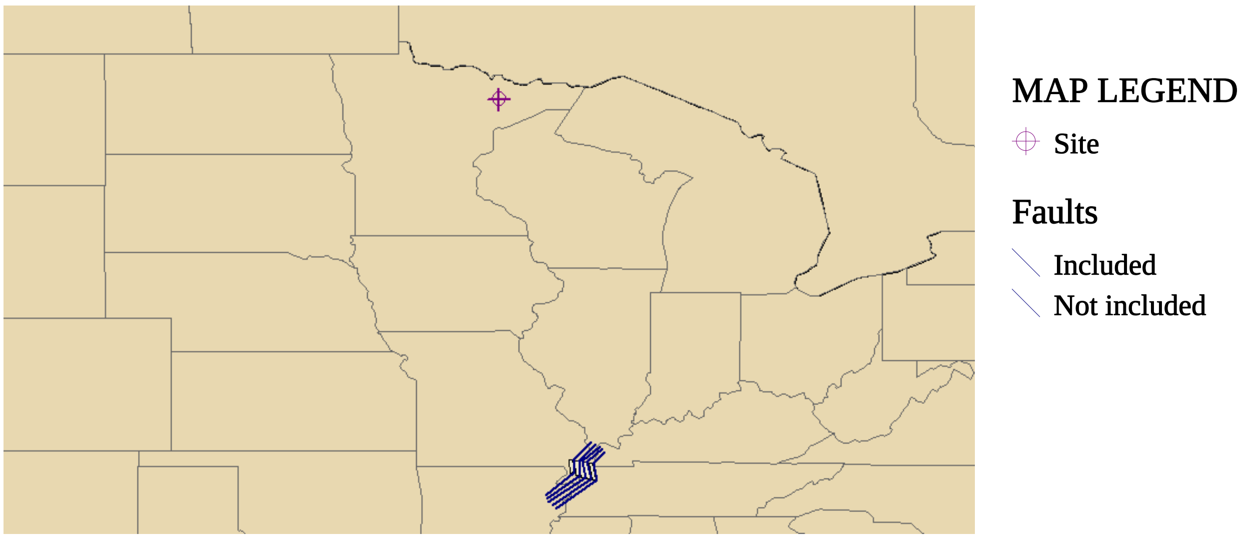


Figure N1 - Nearfield Total Hazard Spectrum

File: C:\Documents and Settings\jdg\Desktop\EZ-FRISK\PolyMet\Deaggregated_6-11-11\Nearfield\~_PolyMet Prob
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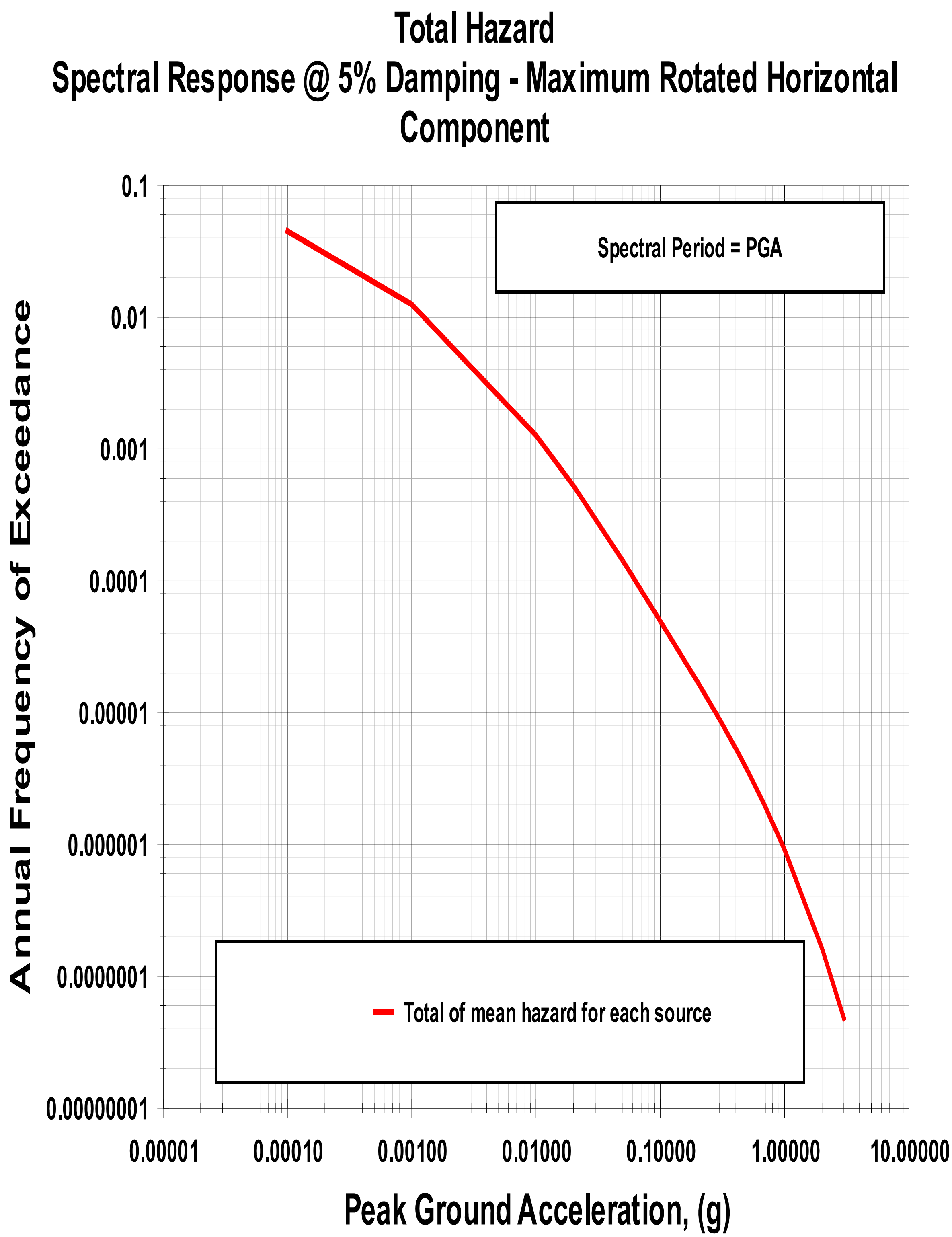

Figure N2 - Nearfield Uniform Hazard Spectra

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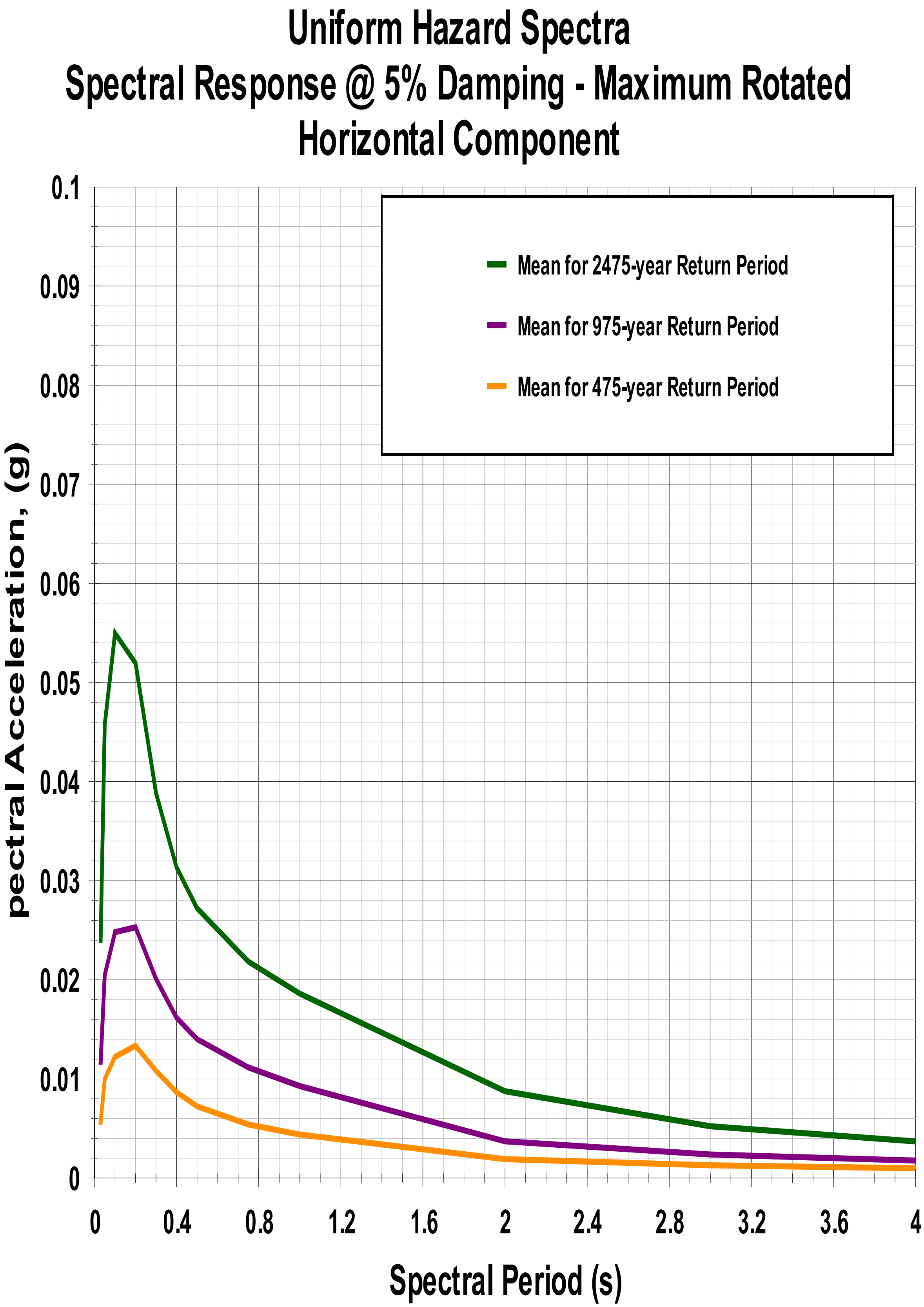

RISK ENGINEERING, INC.

EZ-FRISK 7.60 Build 001

Figure N3 - Nearfield Hazard by Seismic Source

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Date Modified: 06/11/2011 09:08:51 PM

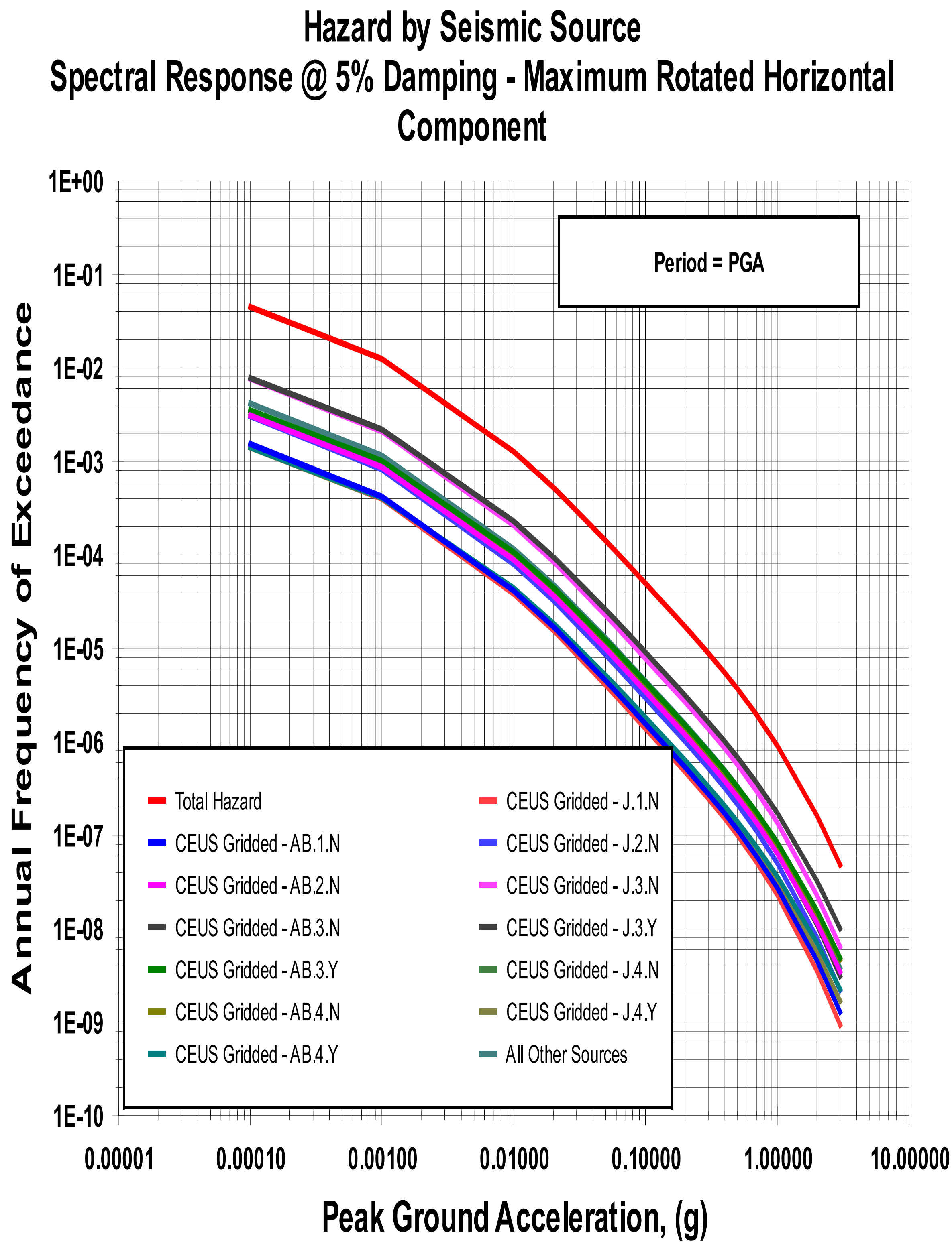

Figure N4 - Neafield Hazard Spectral Response

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Date Modified: 06/11/2011 09:09:39 PM

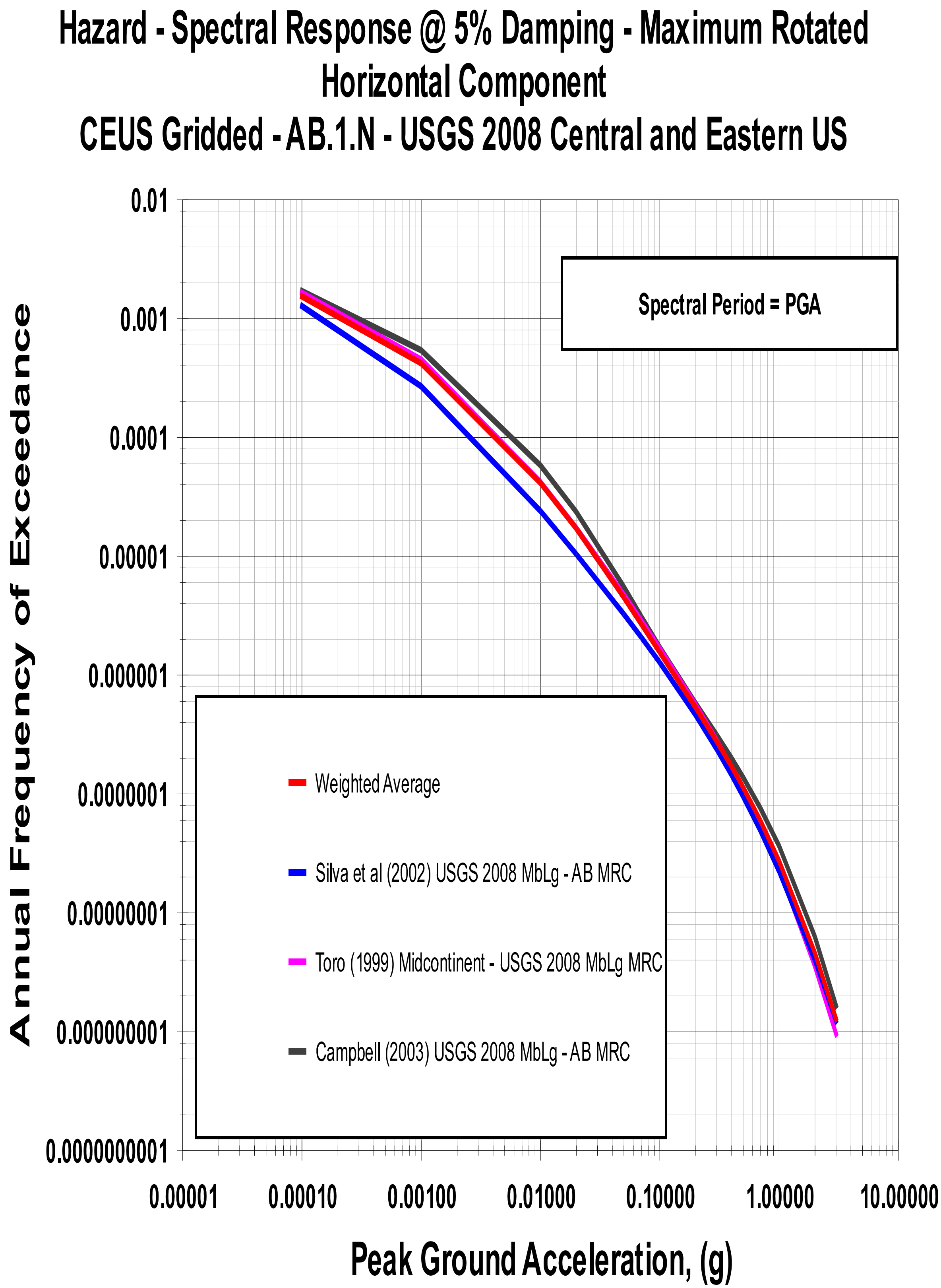

Figure N5 - Nearfield Distance Deaggregation

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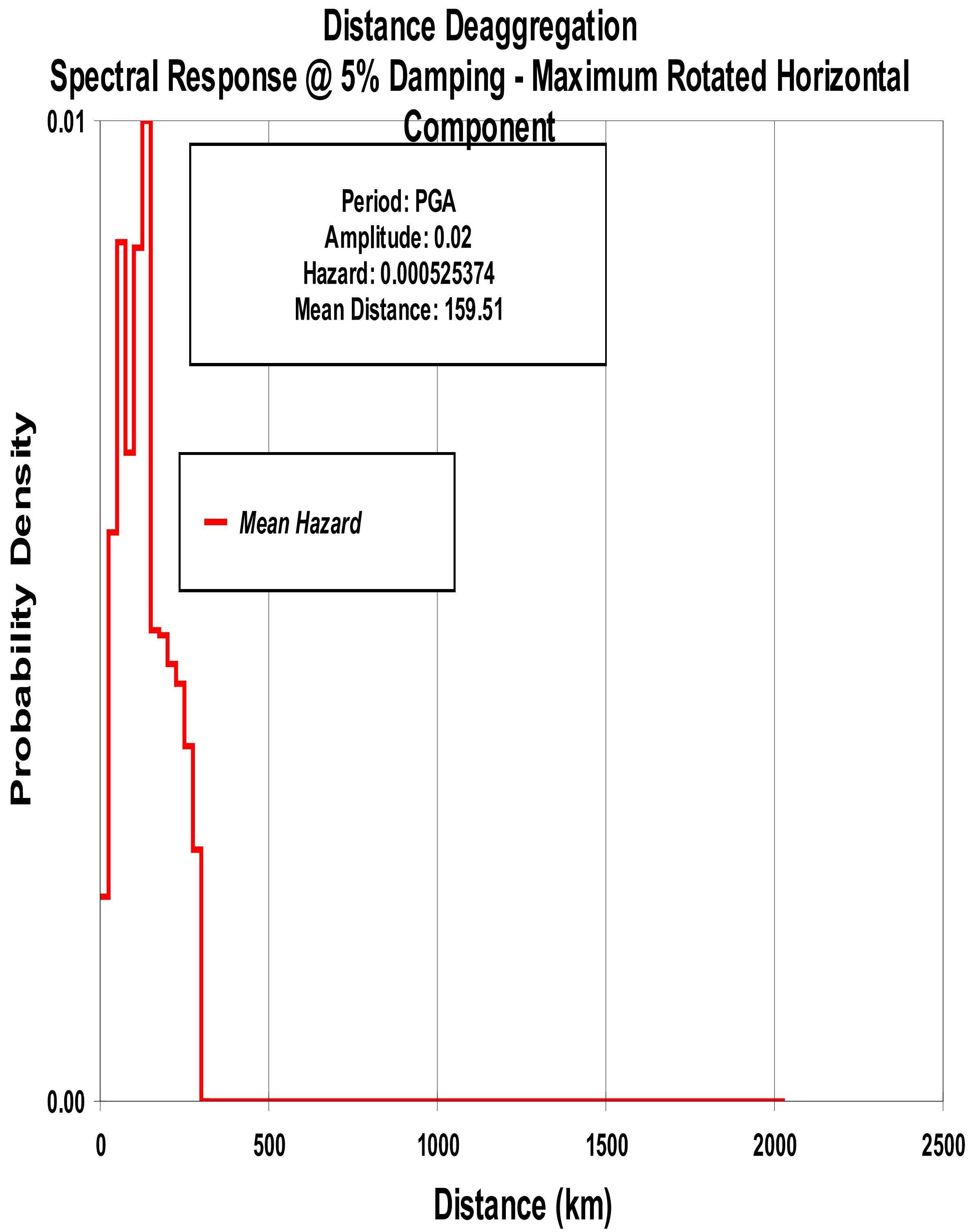

Figure N6 - Nearfield Magnitude Deaggregation

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Date Modified: 06/11/2011 09:53:32 PM

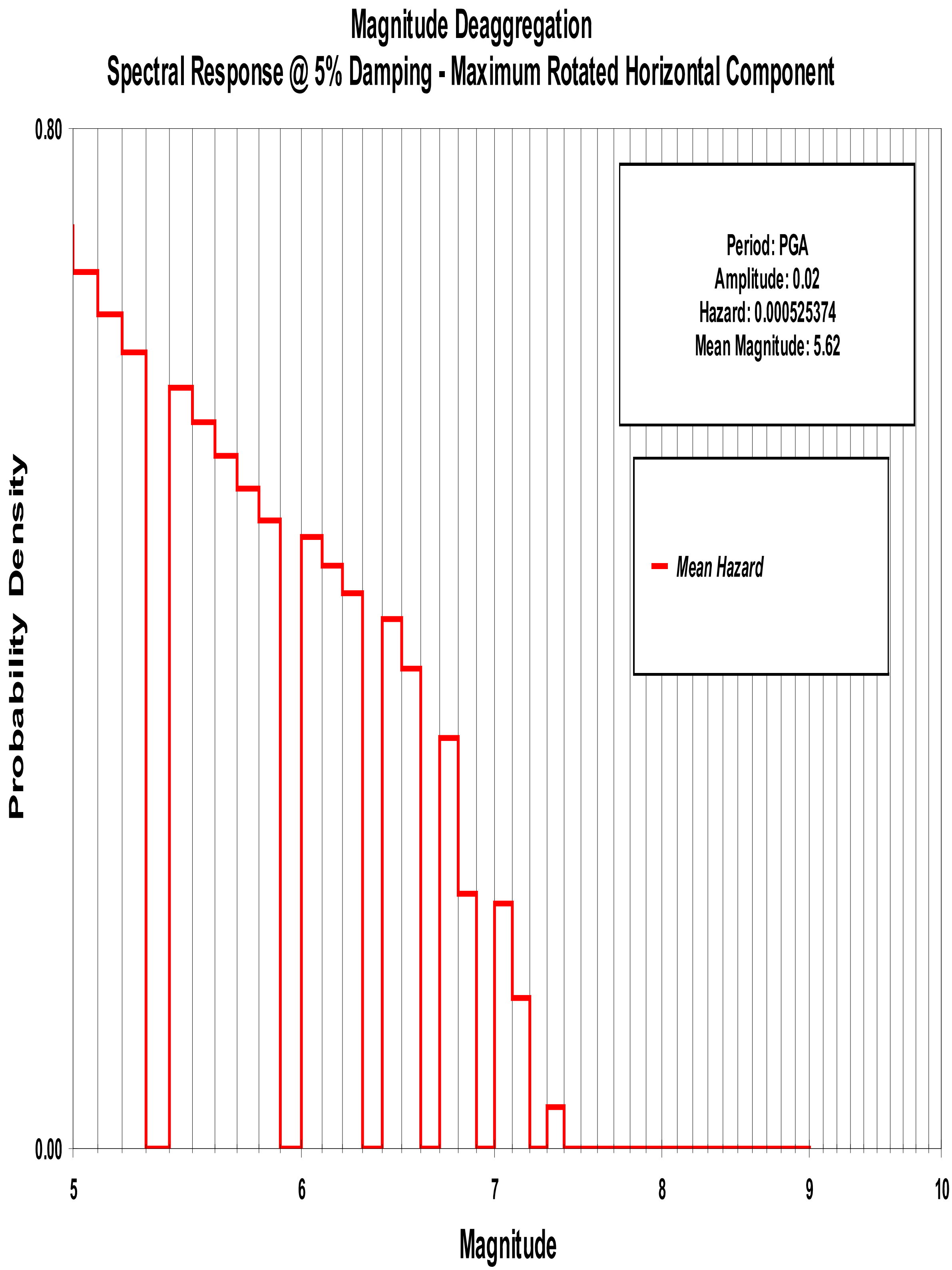
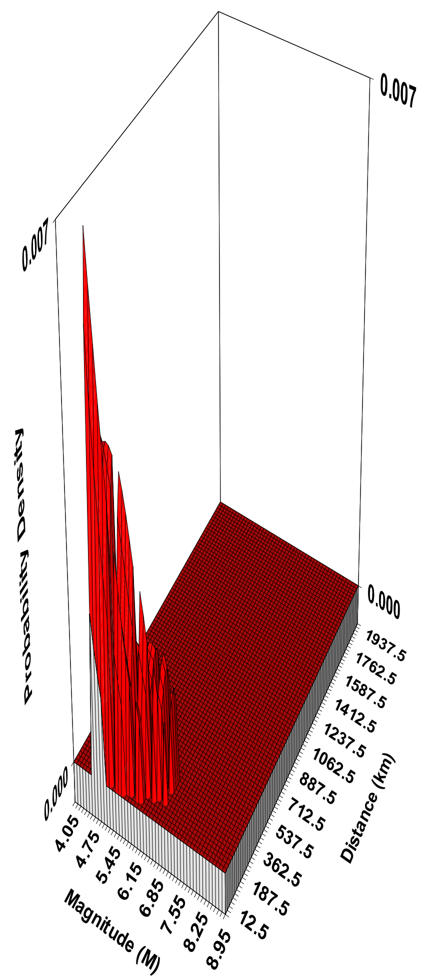


Figure N7 - Neafield Magnitude-Distance Deaggregation

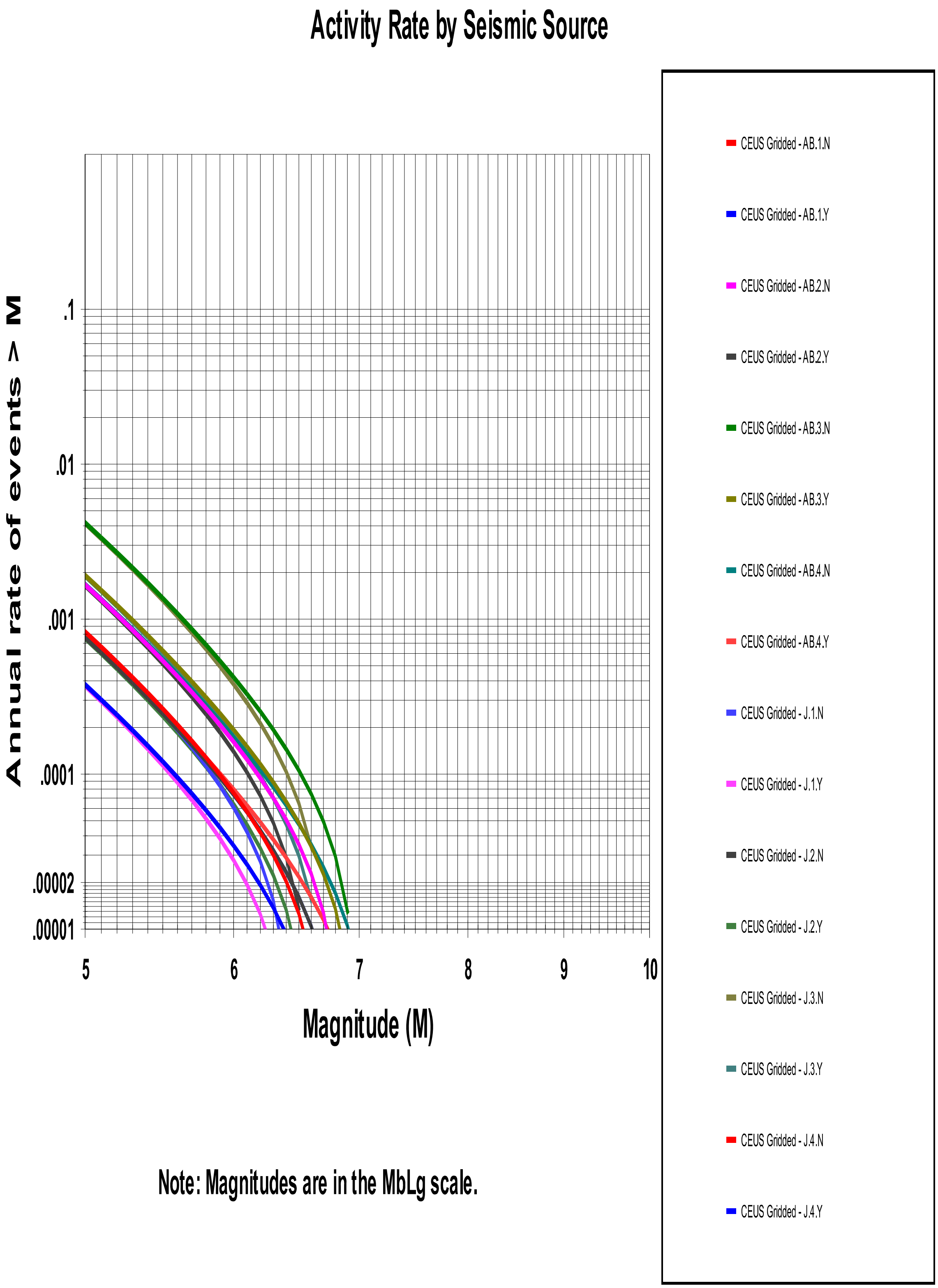
File: C:\Documents and Settings\jdg\Desktop\EZ-FRISK\PolyMet\Deaggregated_6-11-11\Nearfield\~_PolyMet Prob
Date Modified: 06/11/2011 09:53:46 PM

Magnitude-Distance Deaggregation
Spectral Response @ 5% Damping - Maximum Rotated Horizontal Component



Period: PGA
Amplitude: 0.02
Hazard: 0.000525374
Mean Magnitude: 5.62
Mean Distance: 159.51

Figure N8 - Nearfield Activity Rate



Nearfield Map

File: C:\Documents and Settings\jdg\Desktop\EZ-FRISK\PolyMet\Deaggregated_6-11-11\Nearfield\~_PolyMet Prob

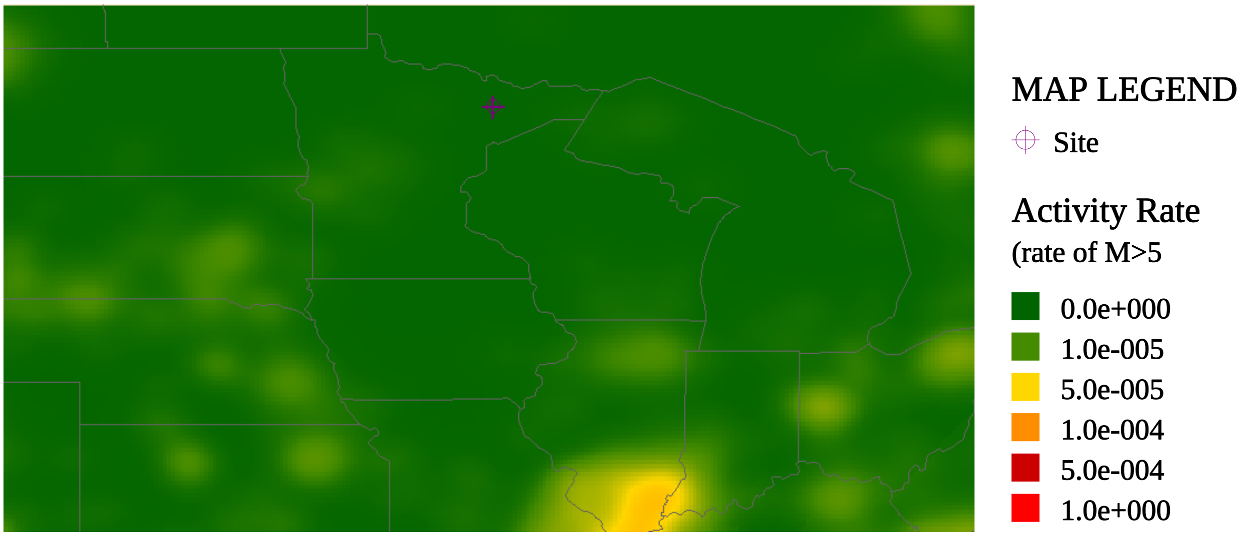
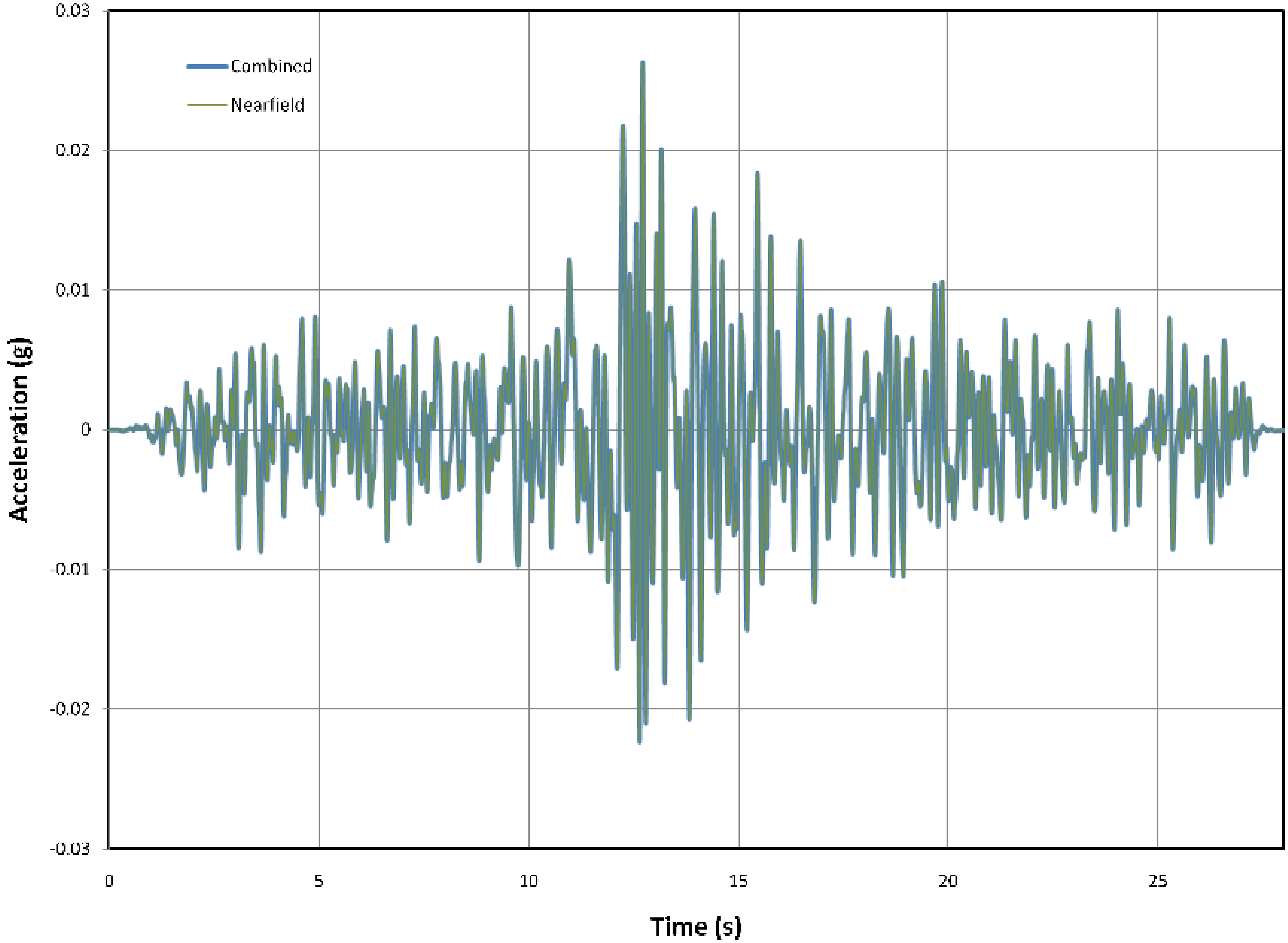


Figure 9 - Combined and Nearfield (fault parallel)



P:\Mpls\23 MN\69\2369862\WorkFiles\WO 022A Tailings Basin Permitting\2011 re-analysis\2011 Section F report\Att E - PSHA report\Quake acceleration records.xlsx

Figure 10 - Farfield (fault normal)

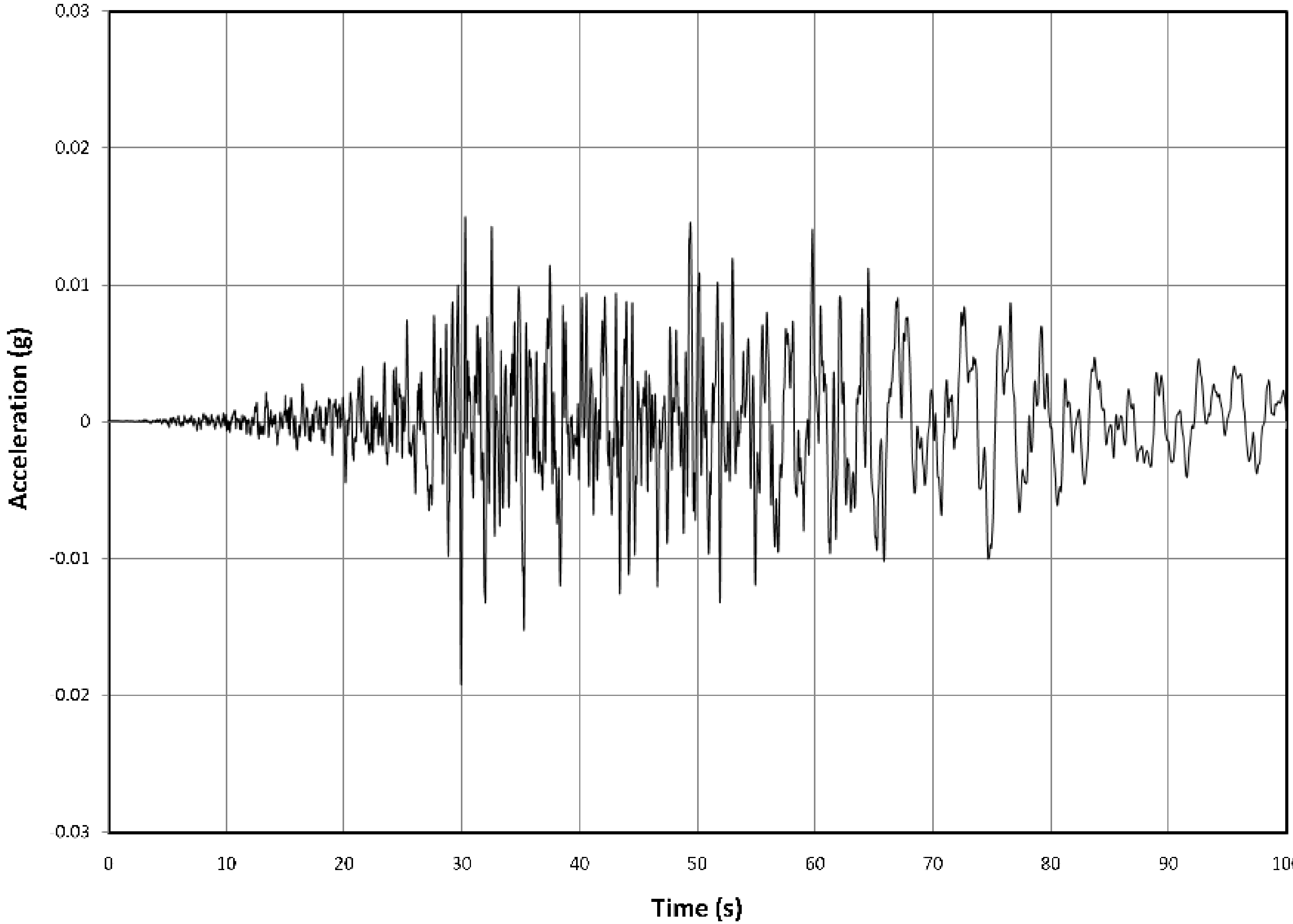


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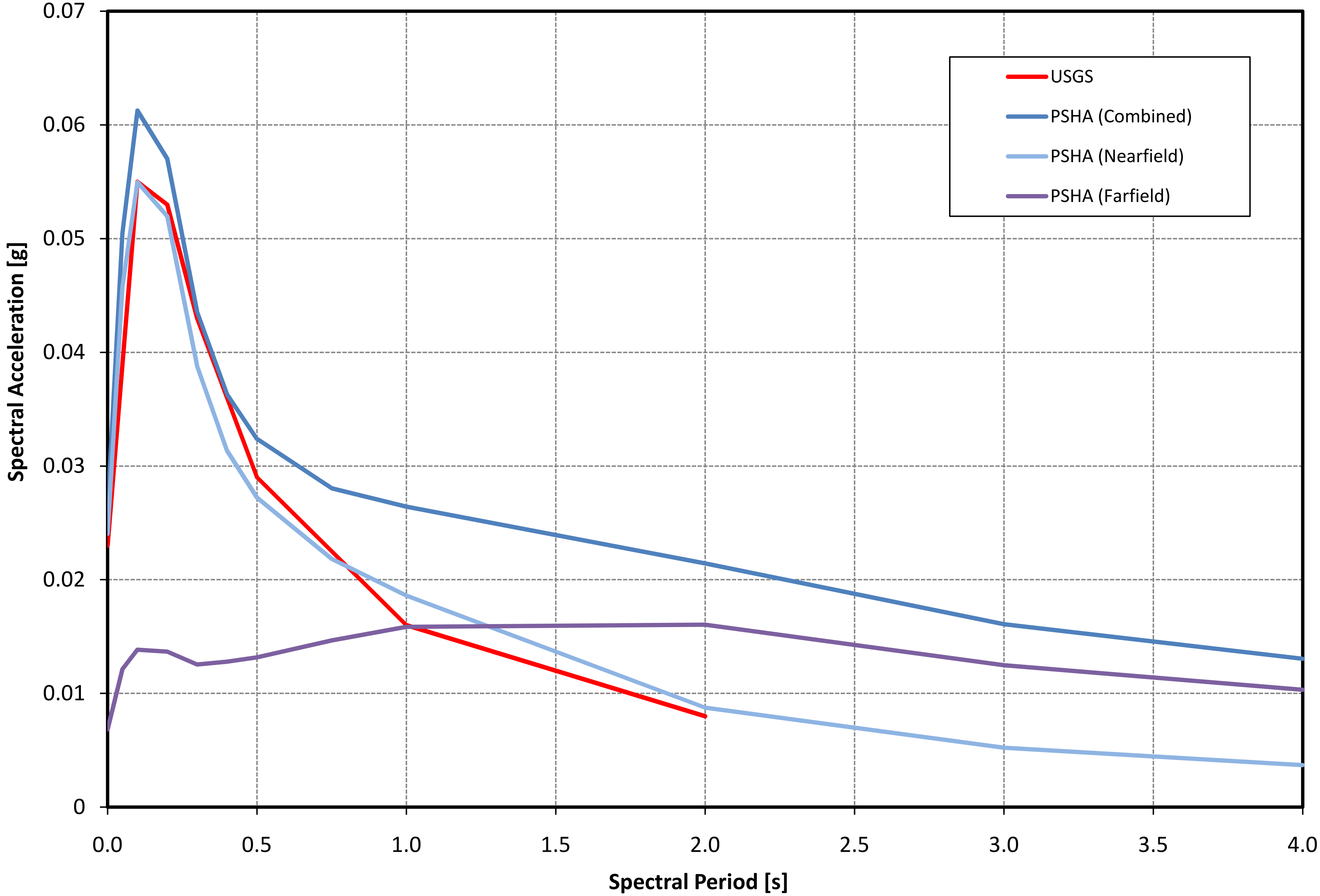
Figure 11 - PolyMet: Uniform Hazard Spectrum, 2% Exceedance in 50 Years



G:\KNA\EZ-FRISK_New\PolyMet\Spectral_Comparison.xlsx

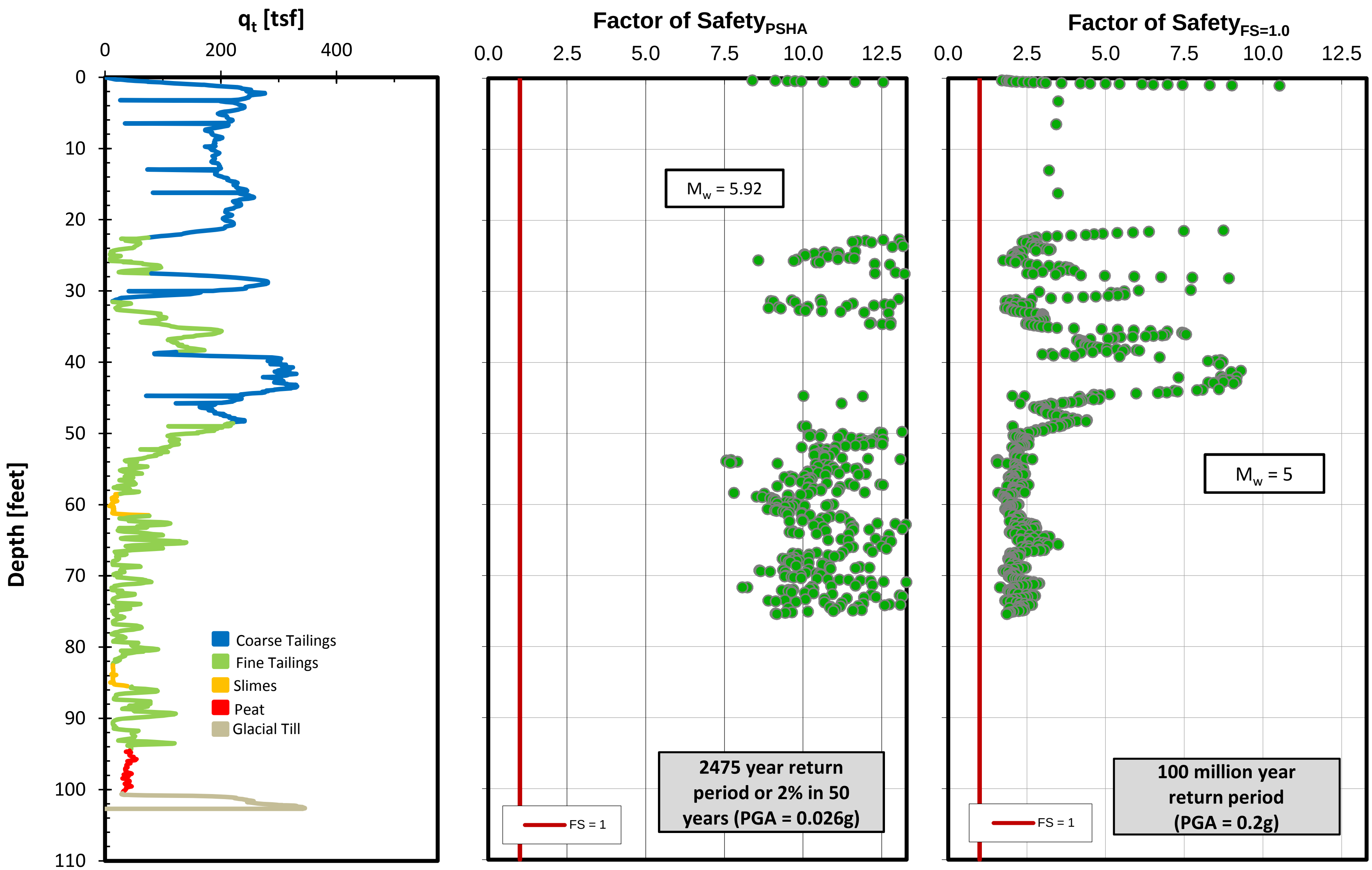
Attachment Q

Seismic Liquefaction Triggering Plots

Sounding 07-05 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

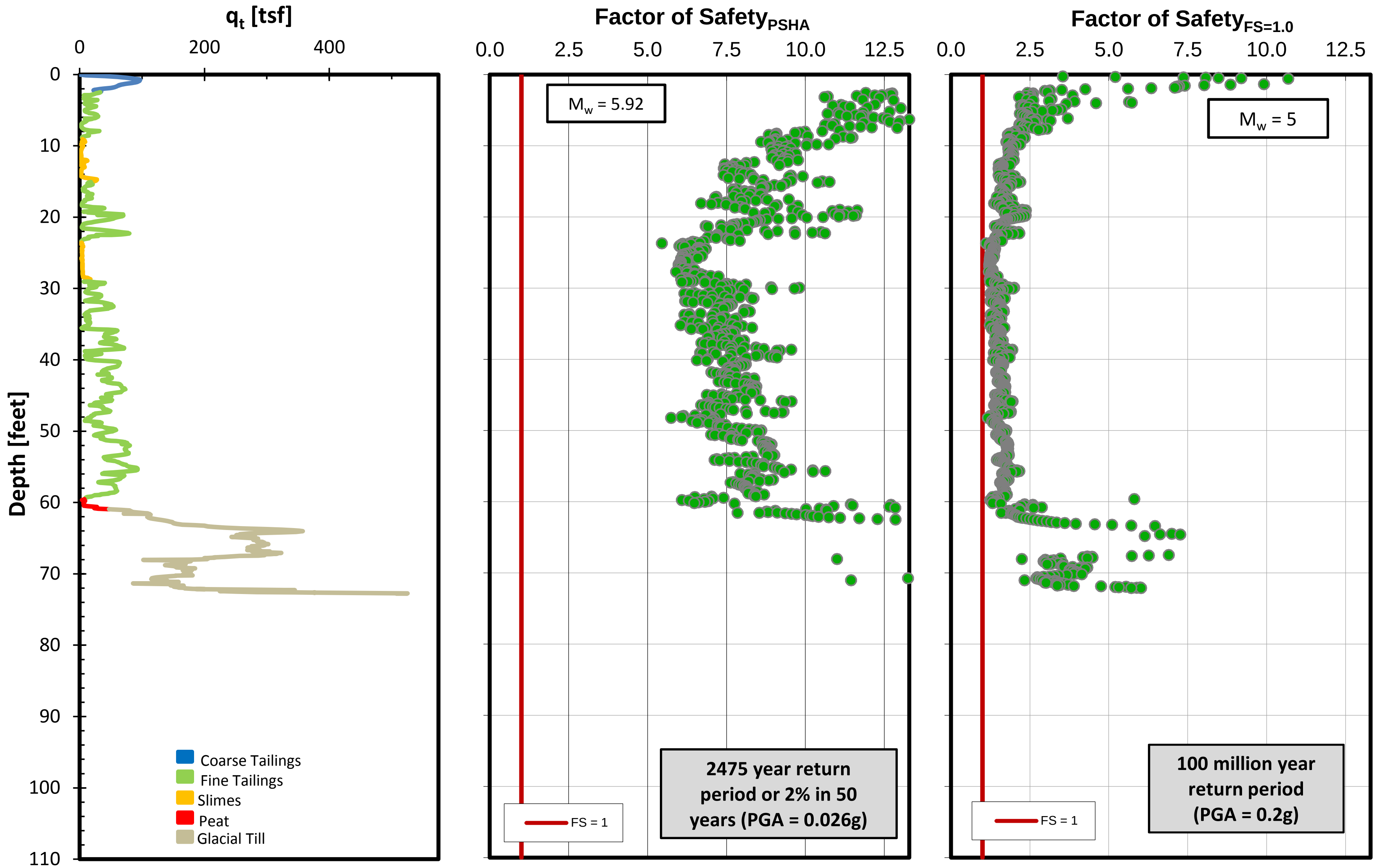
NorthMet Flotation Tailings Basin



Sounding 07-27 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

NorthMet Flotation Tailings Basin



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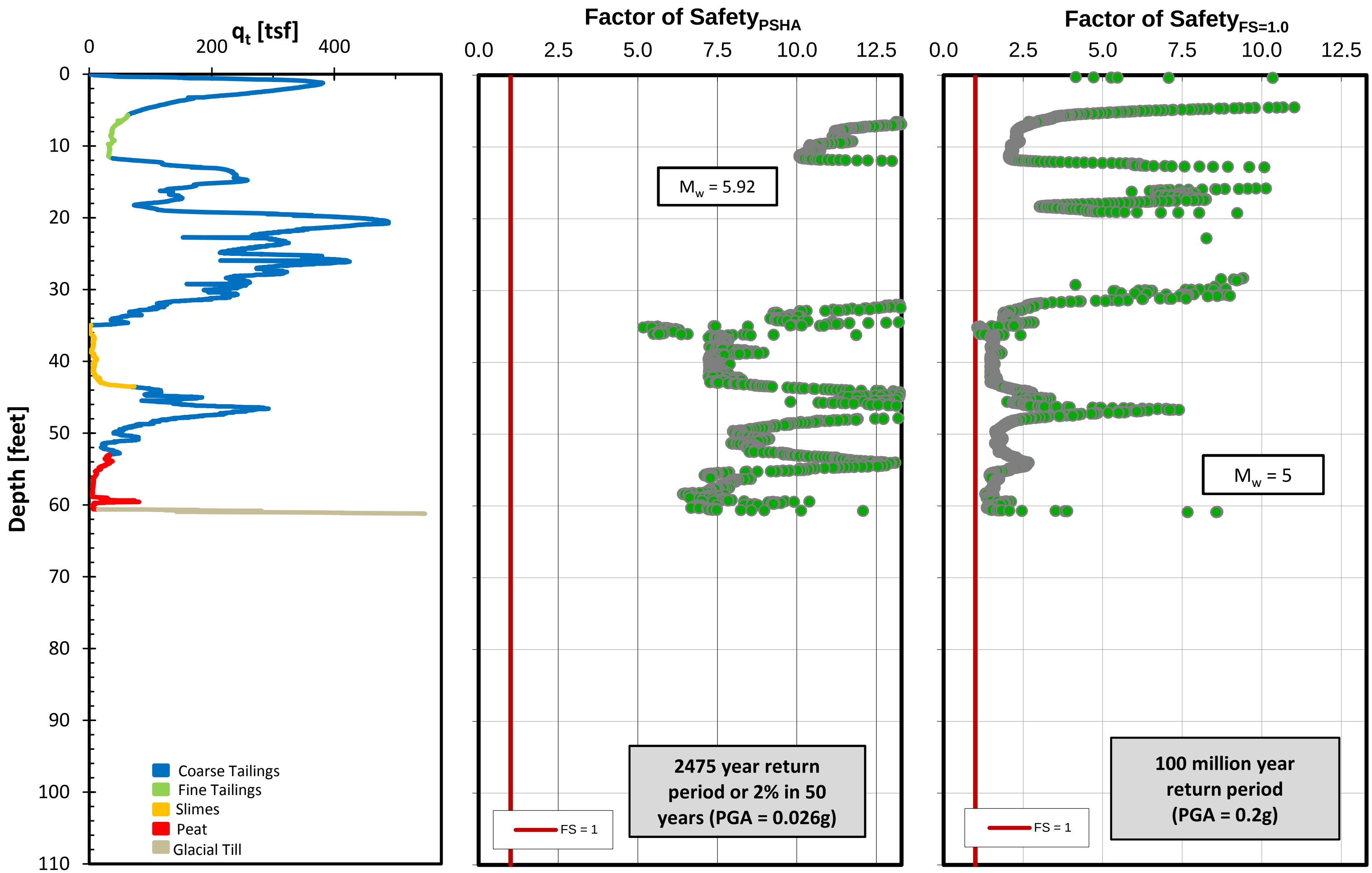
Sounding 07-04B Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

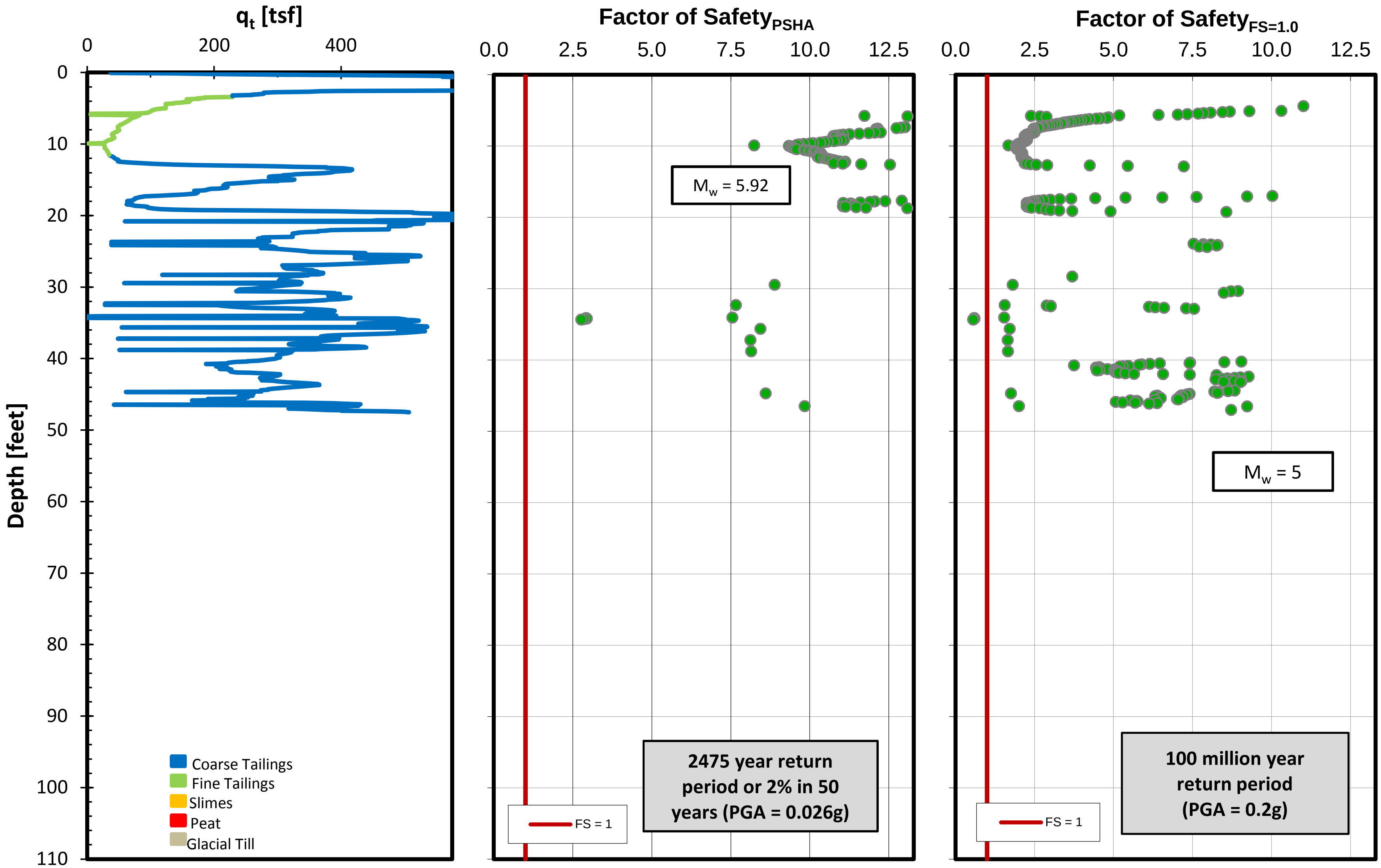
NorthMet Flotation Tailings Basin



Sounding CPT14-04 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

NorthMet Flotation Tailings Basin



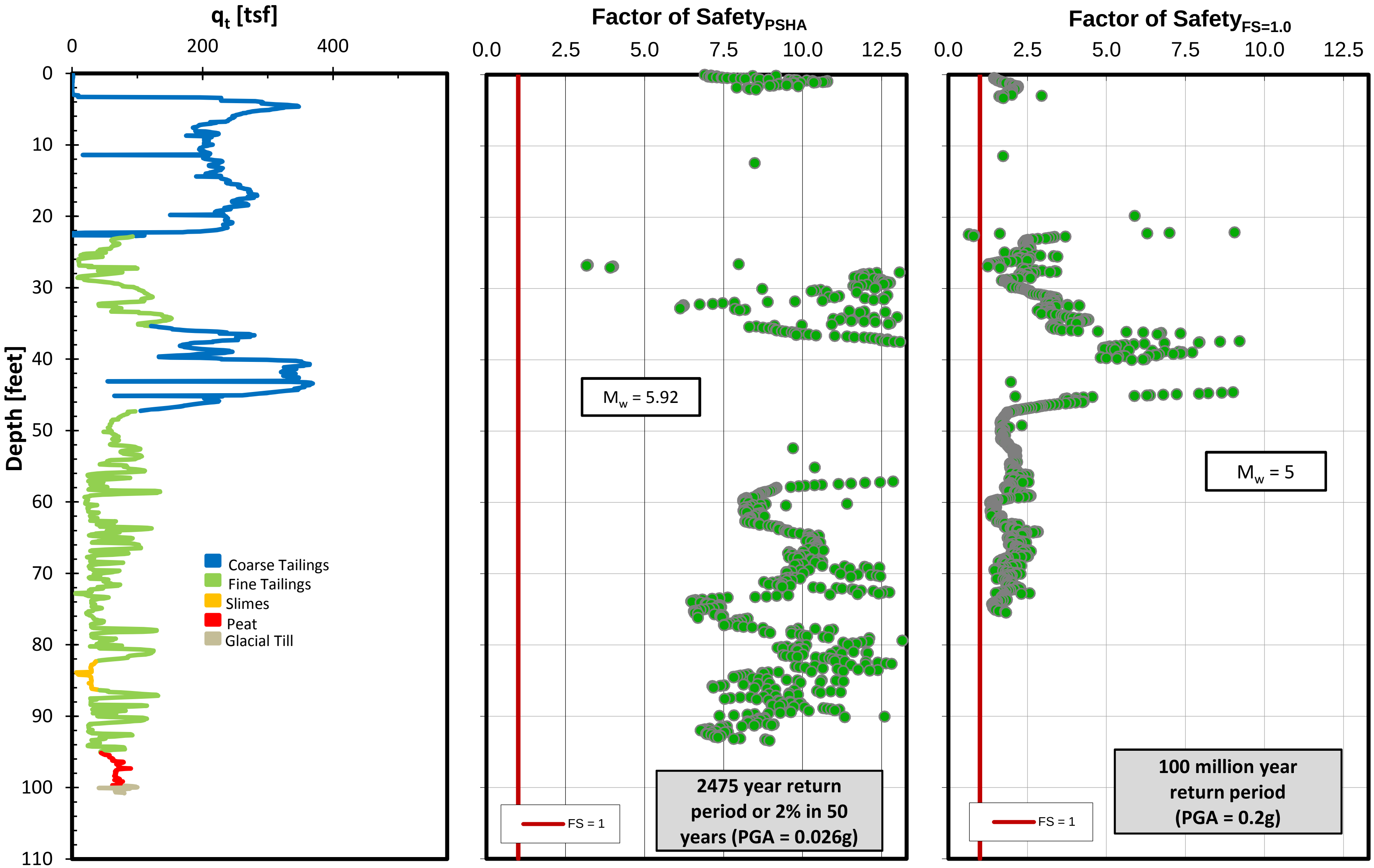
P:\Mpls\23 MN\69\2369C29 PolyMet NorthMet Engineering\Work Authorization 13\Other Costs\Soil Borings\Geotech Investigations\Winter Geotechnical Explorations 2013_2014\SOW 14_Part 1_CPT\processed results\Section F\CPT_07-04B & 14-04.xlsm

11/20/2014

Sounding CPT14-05 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

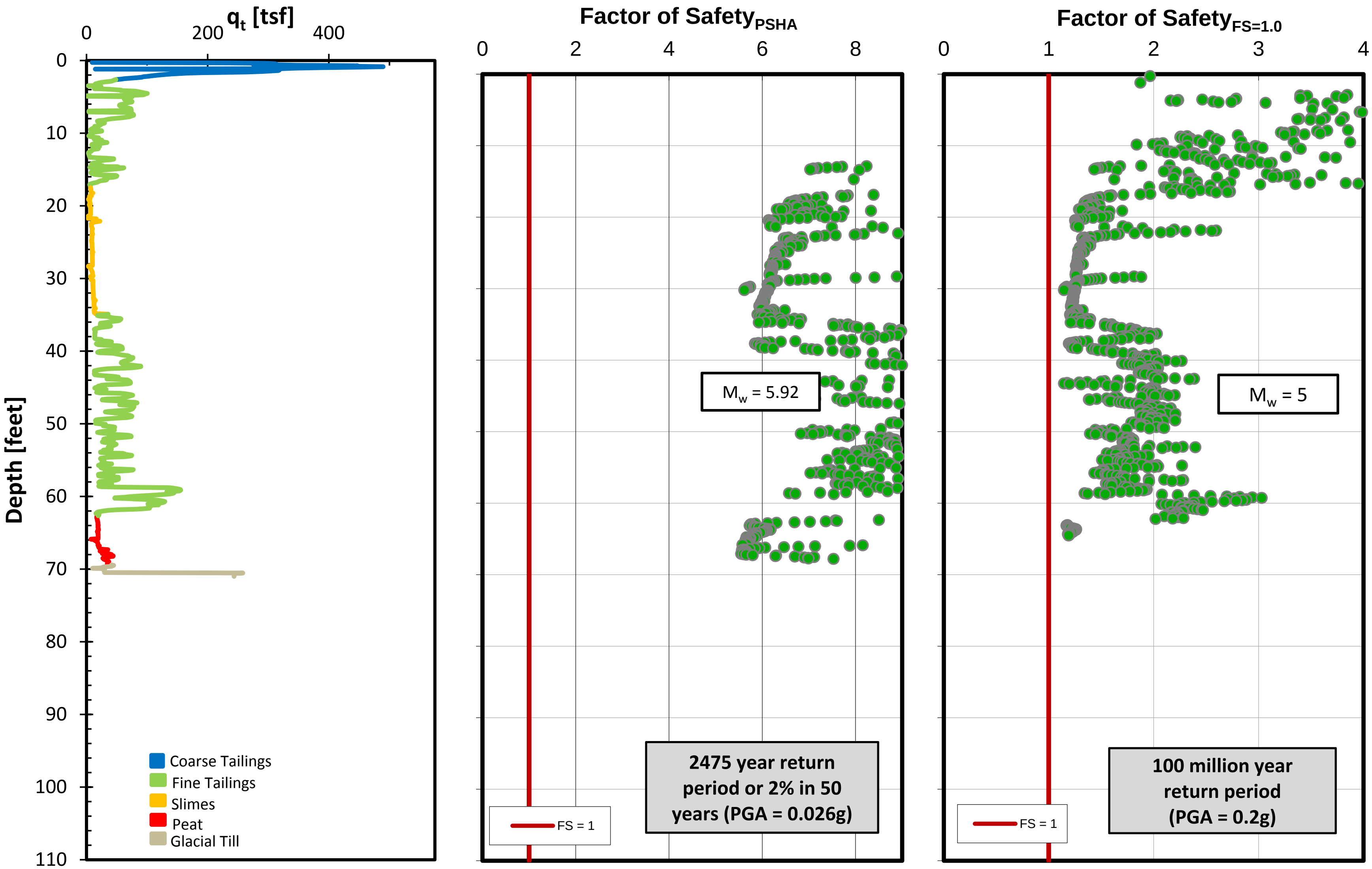
NorthMet Flotation Tailings Basin



Sounding CPT14-06 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

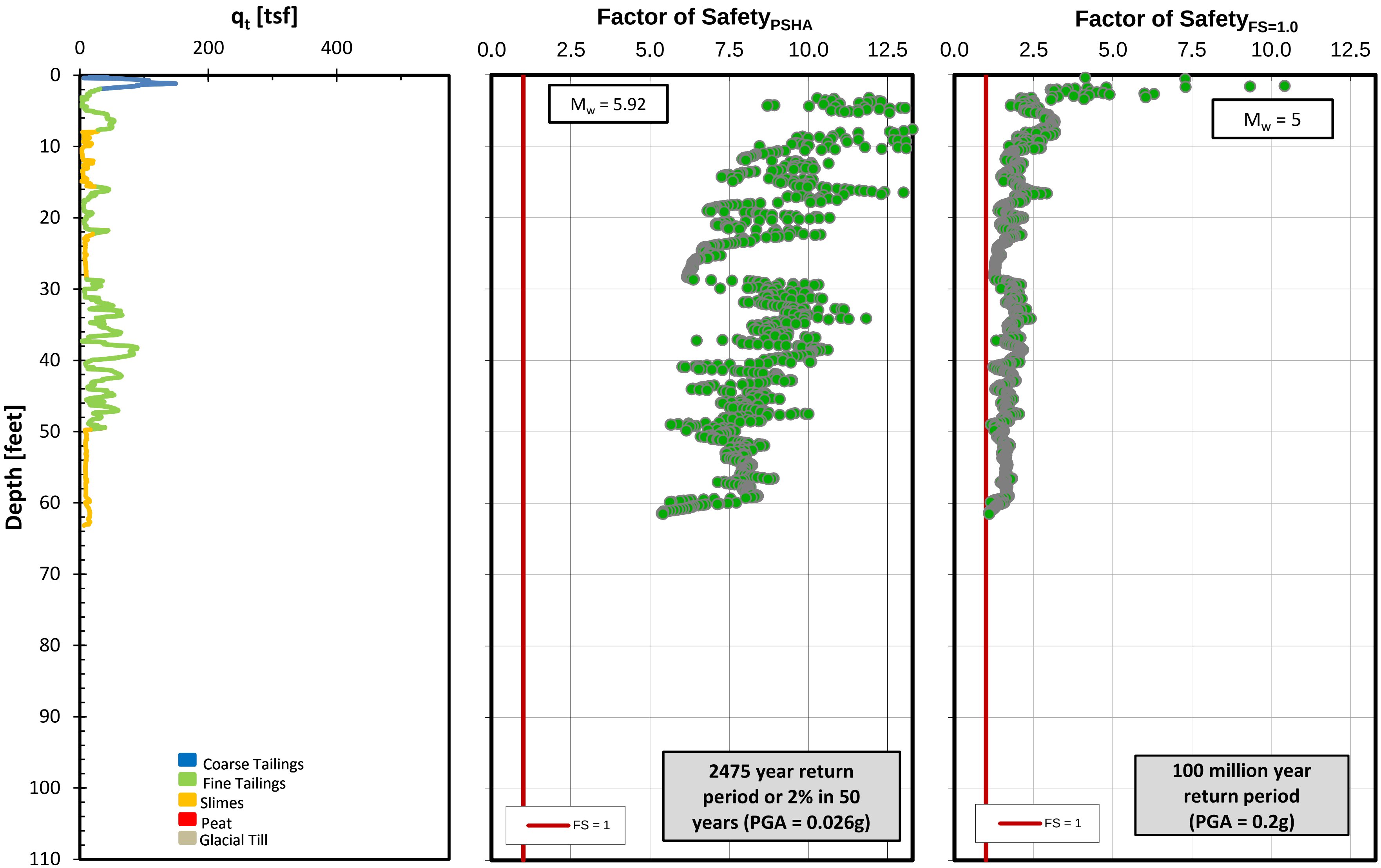
NorthMet Flotation Tailings Basin



Sounding CPT14-17 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

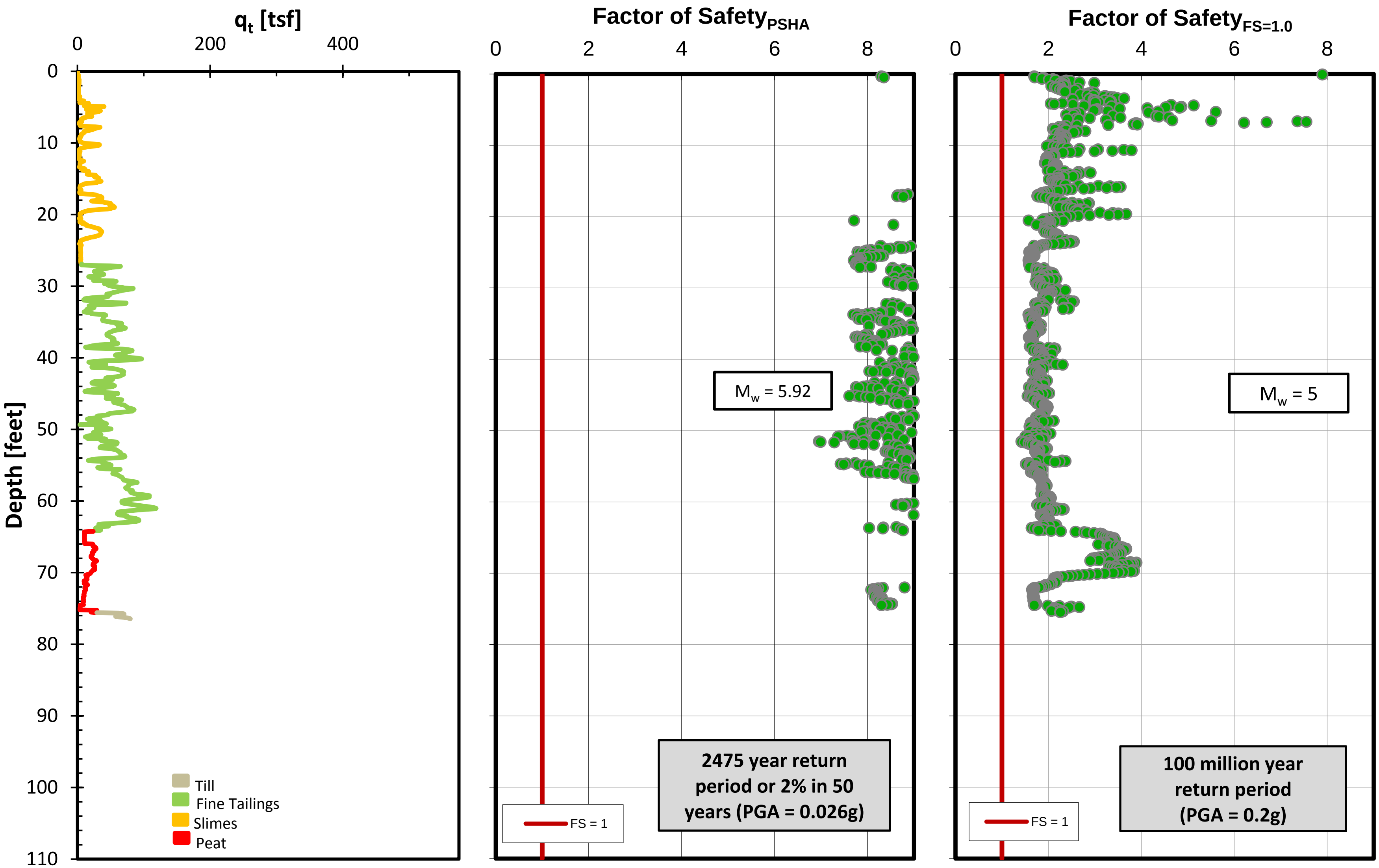
NorthMet Flotation Tailings Basin



Sounding CPT14-18 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

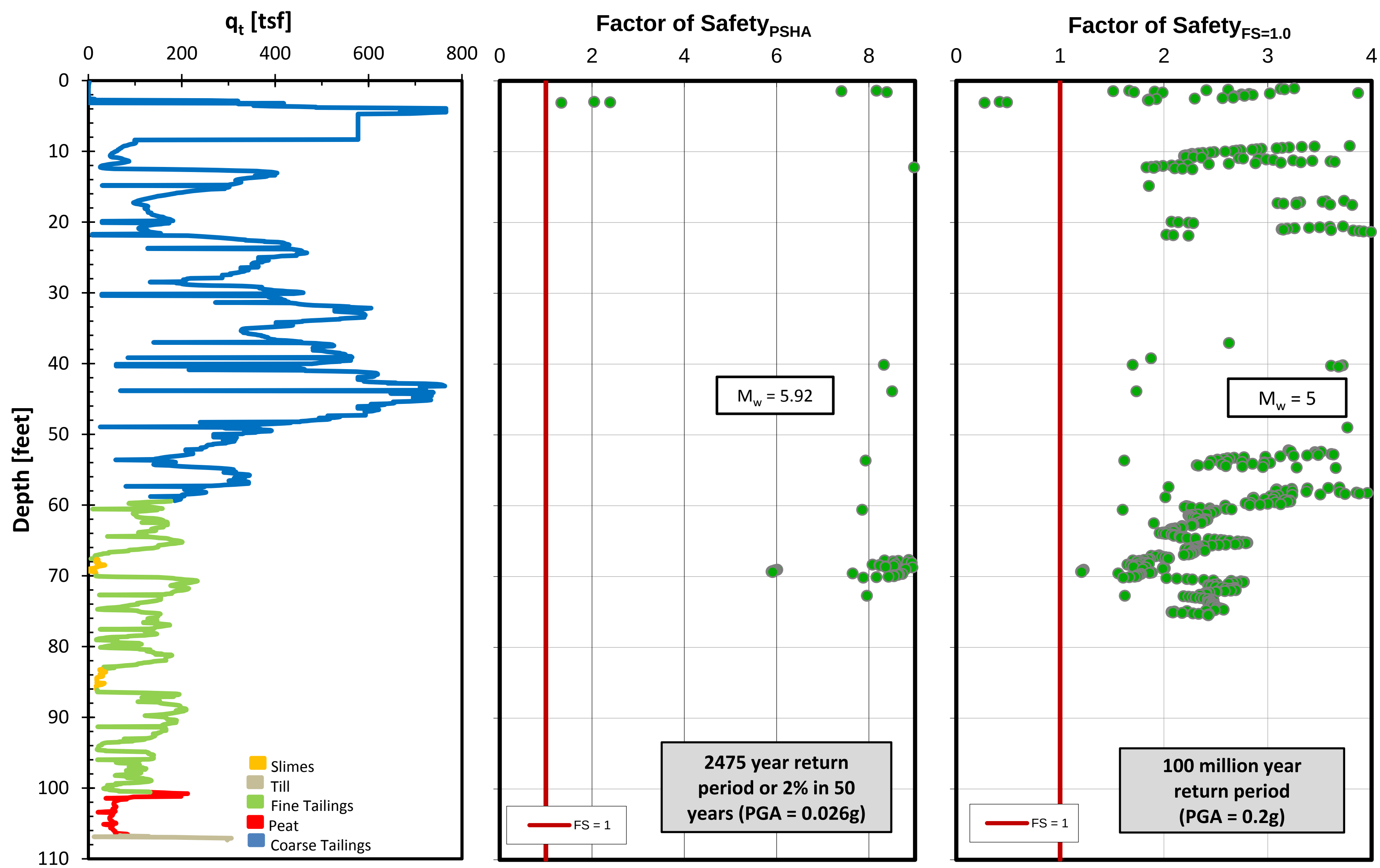
NorthMet Flotation Tailings Basin



Sounding CPT14-20 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

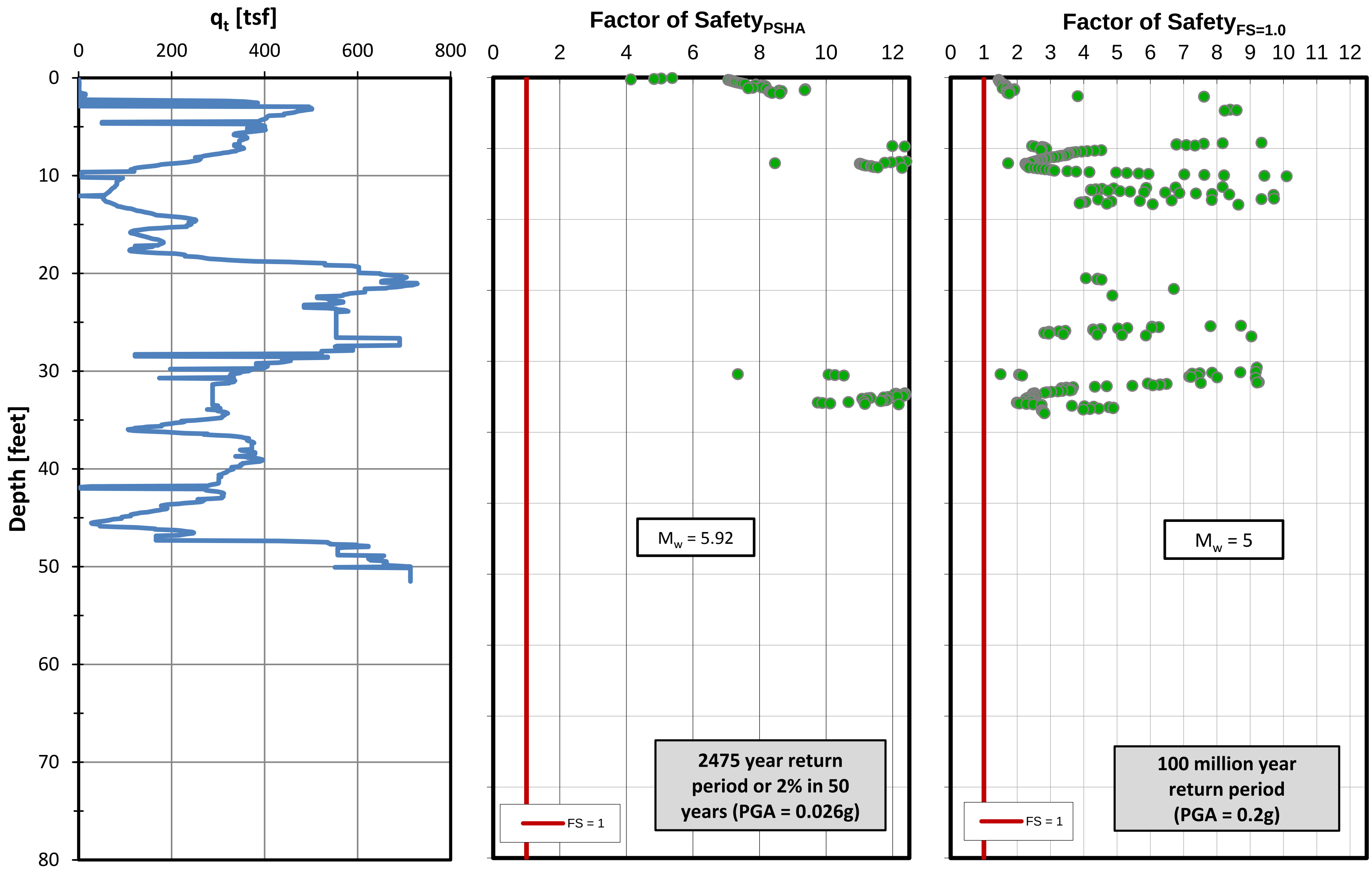
NorthMet Flotation Tailings Basin



Sounding CPT14-21 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

NorthMet Flotation Tailings Basin



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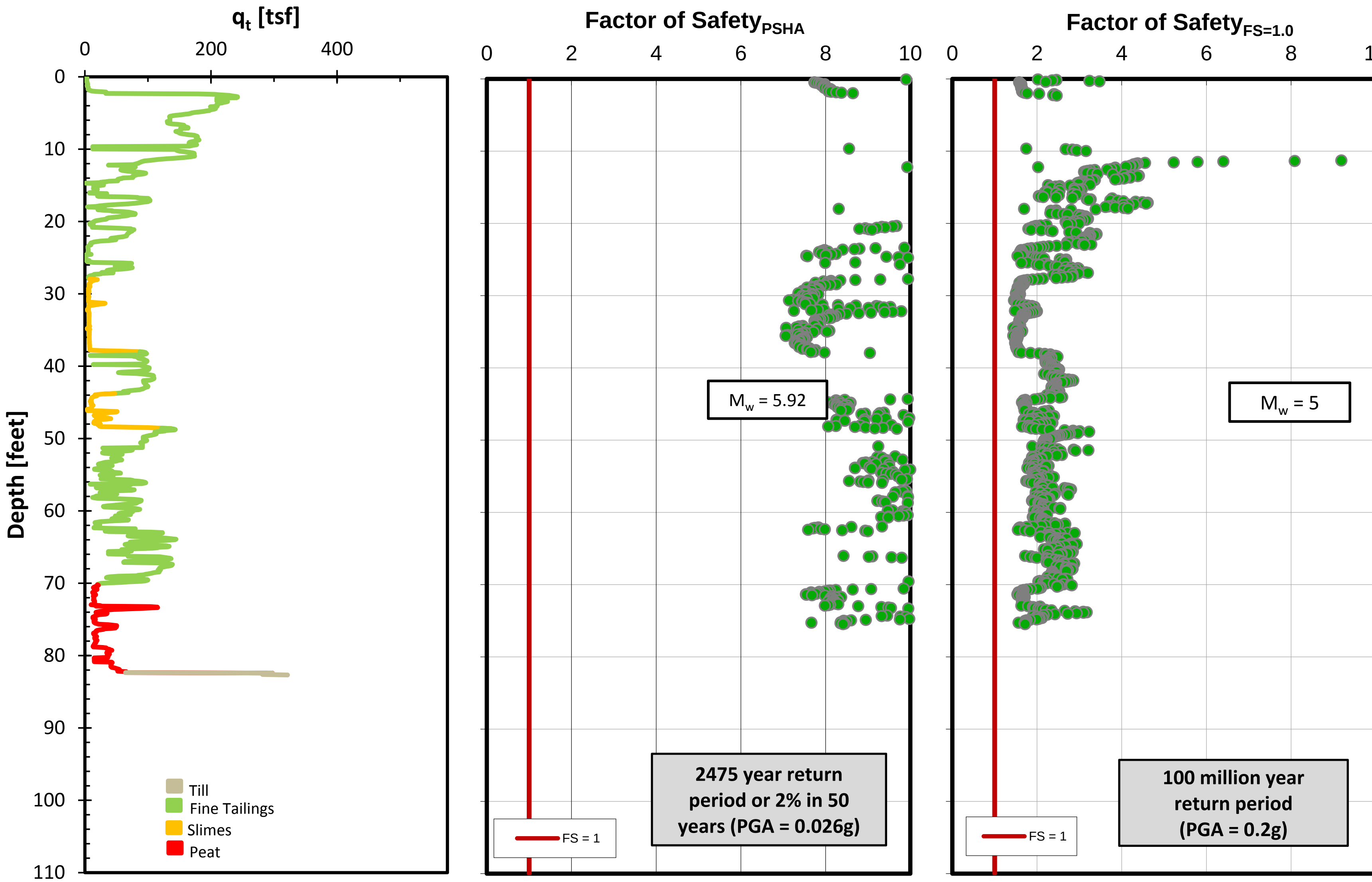
11/20/2014

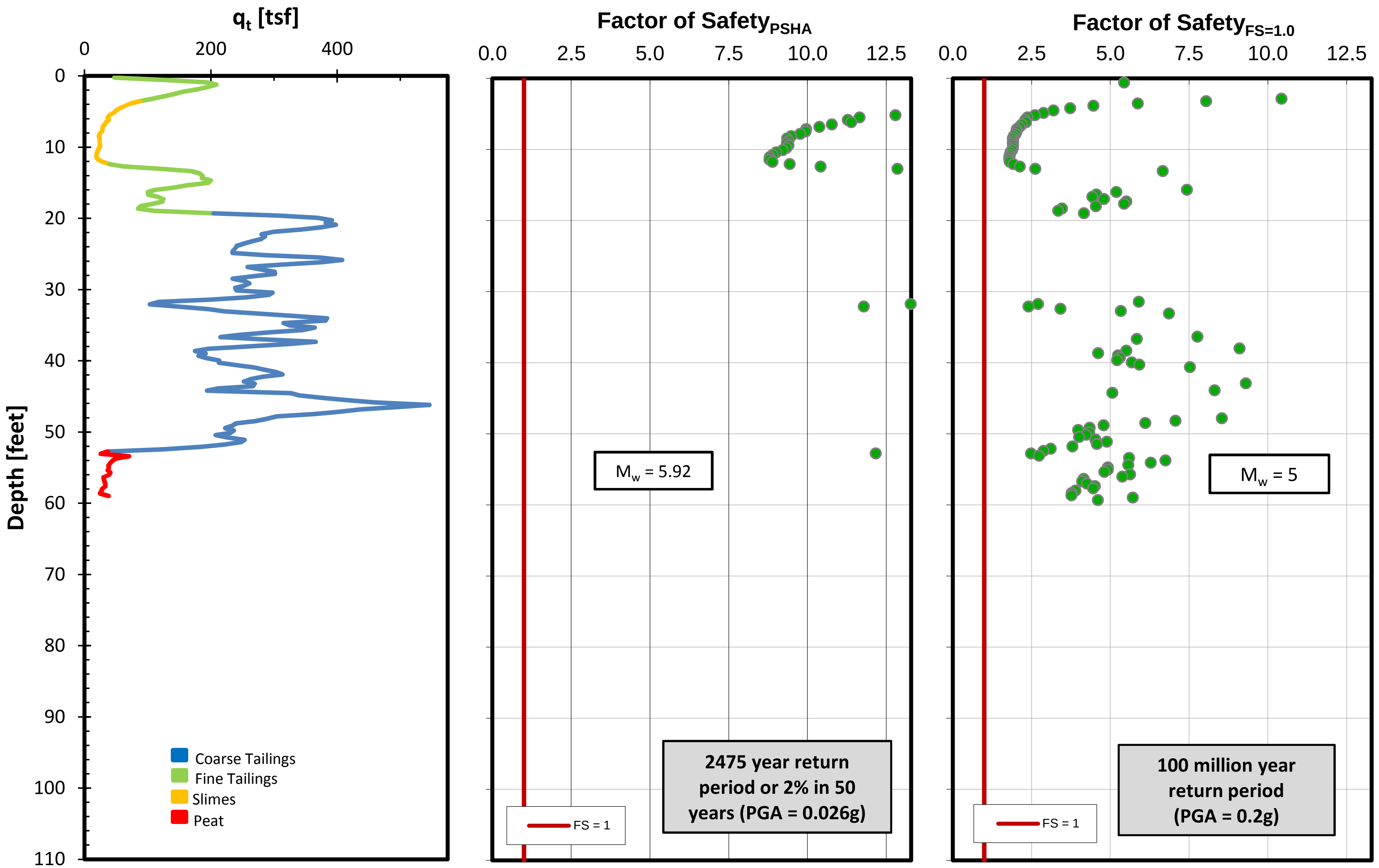
Sounding CPT14-22 Triggering Potential
Based on CPT Data (Boulanger and Idriss, 2004)
NorthMet Flotation Tailings Basin



Sounding DH96-46 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

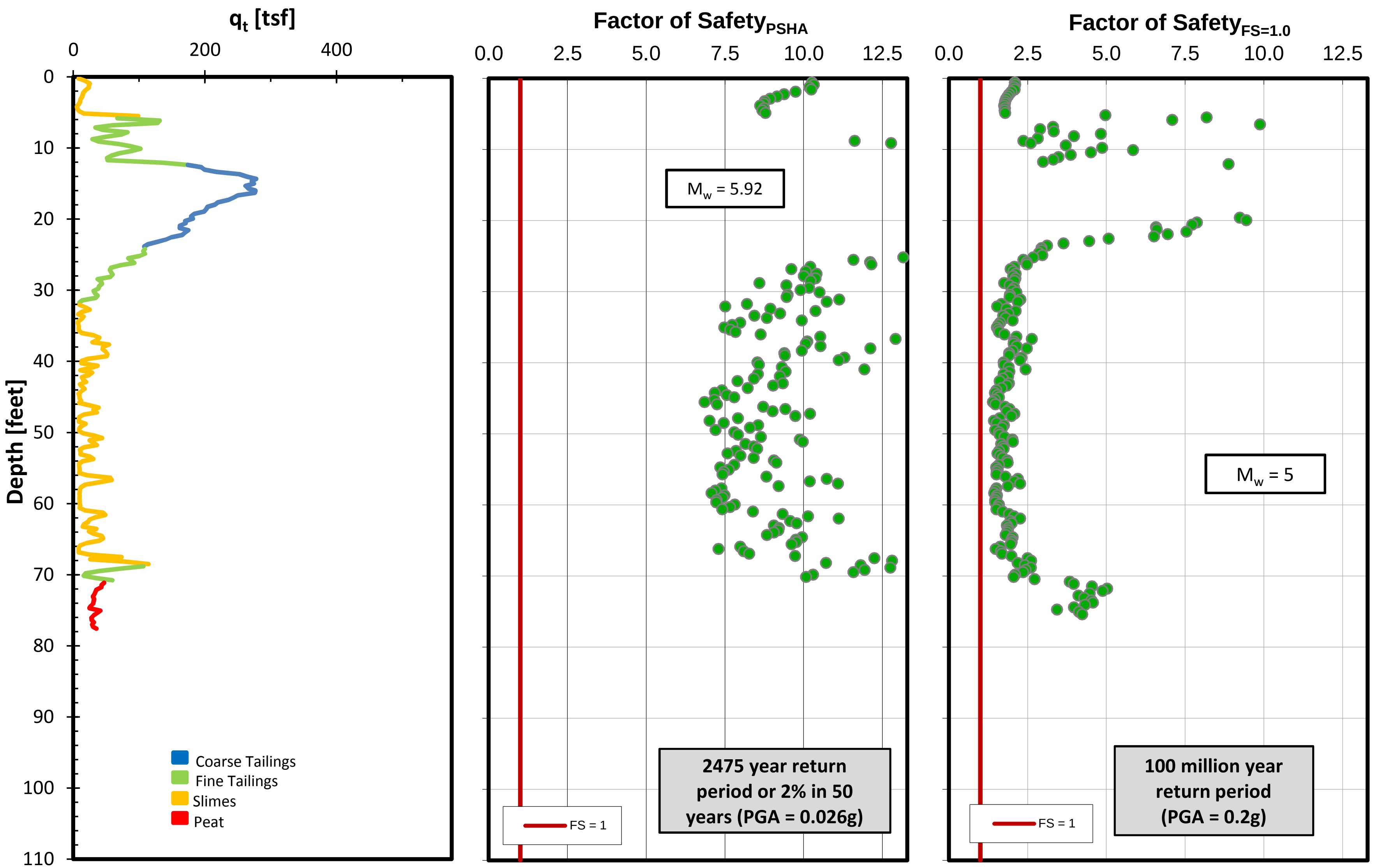
NorthMet Flotation Tailings Basin



Sounding DH96-48 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

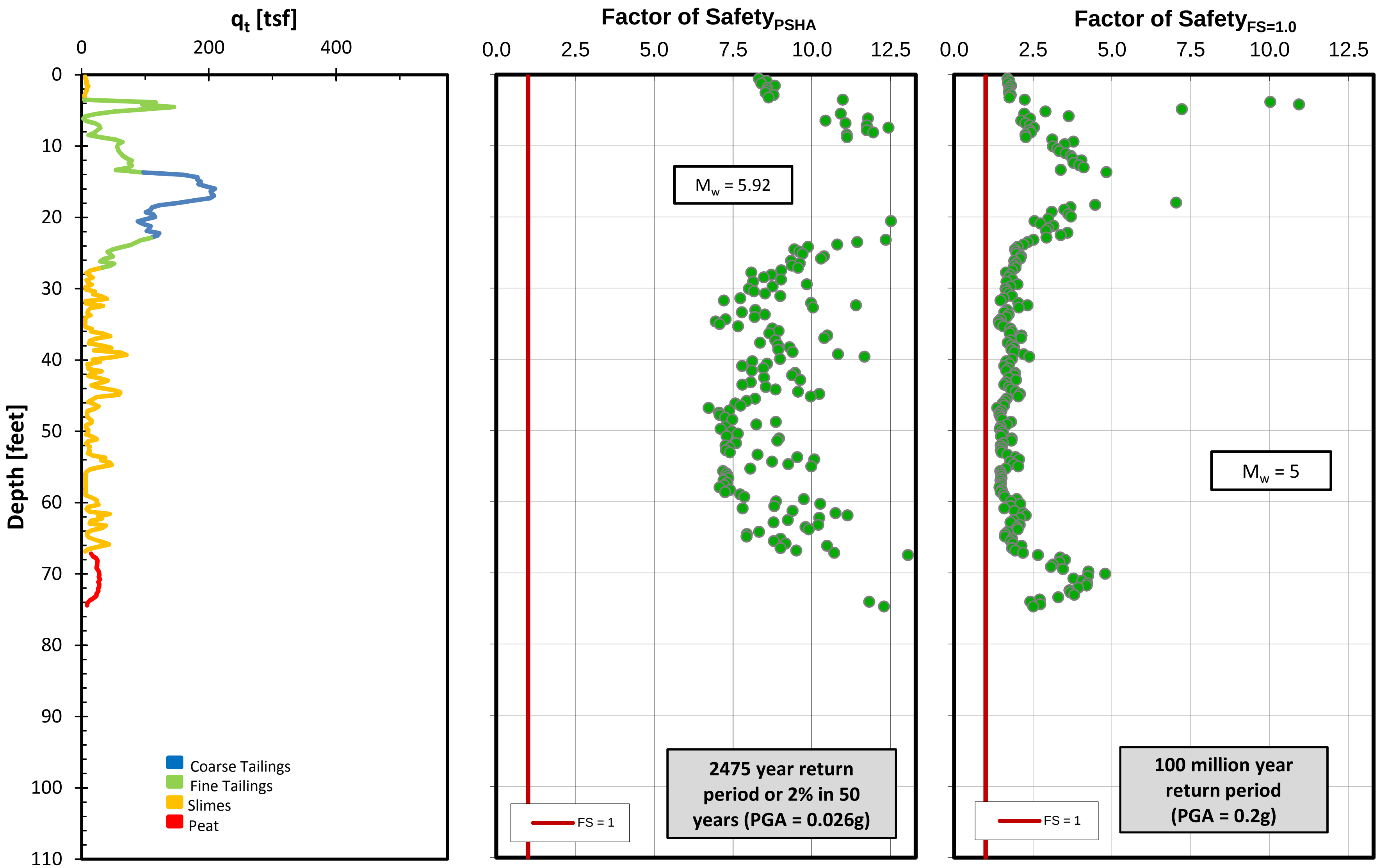
NorthMet Flotation Tailings Basin



Sounding DH96-49 Triggering Potential

Based on CPT Data (Boulanger and Idriss, 2004)

NorthMet Flotation Tailings Basin



Attachment R

Sensitivity Analysis Plots

Table 1

Critical Slip Surface Segment Lengths in the Existing Tailings Basin for Cross-Section F

									Statistics:	*MIN*	*MAX*	*AVERAGE*	*MEDIAN*
Slip Surface Segment Lengths [feet]	234	226	157	80	138	54	37	55	28	***28***	***234***	***112***	***80***
Material	fine tailings	slimes	slimes	fine tailings	slimes	fine tailings	slimes	fine tailings	slimes	slimes	slimes		

Note: Estimate of Critical Slip Surface Length in Flotation Tailings for Cross-Section F

It is reasonable to assume that at least every five-year zone of Flotation Tailings will exhibit a strength difference due to consolidation over time. In five years, two lifts will be constructed, each having a height of 20 feet. The length of the critical slip surface through a 40-foot thick deposit of Flotation Tailings will be approximately 210 feet.

FIGURE 1

LTVSMC Fine Tailings/Slimes

Yield Strength Probability Distribution

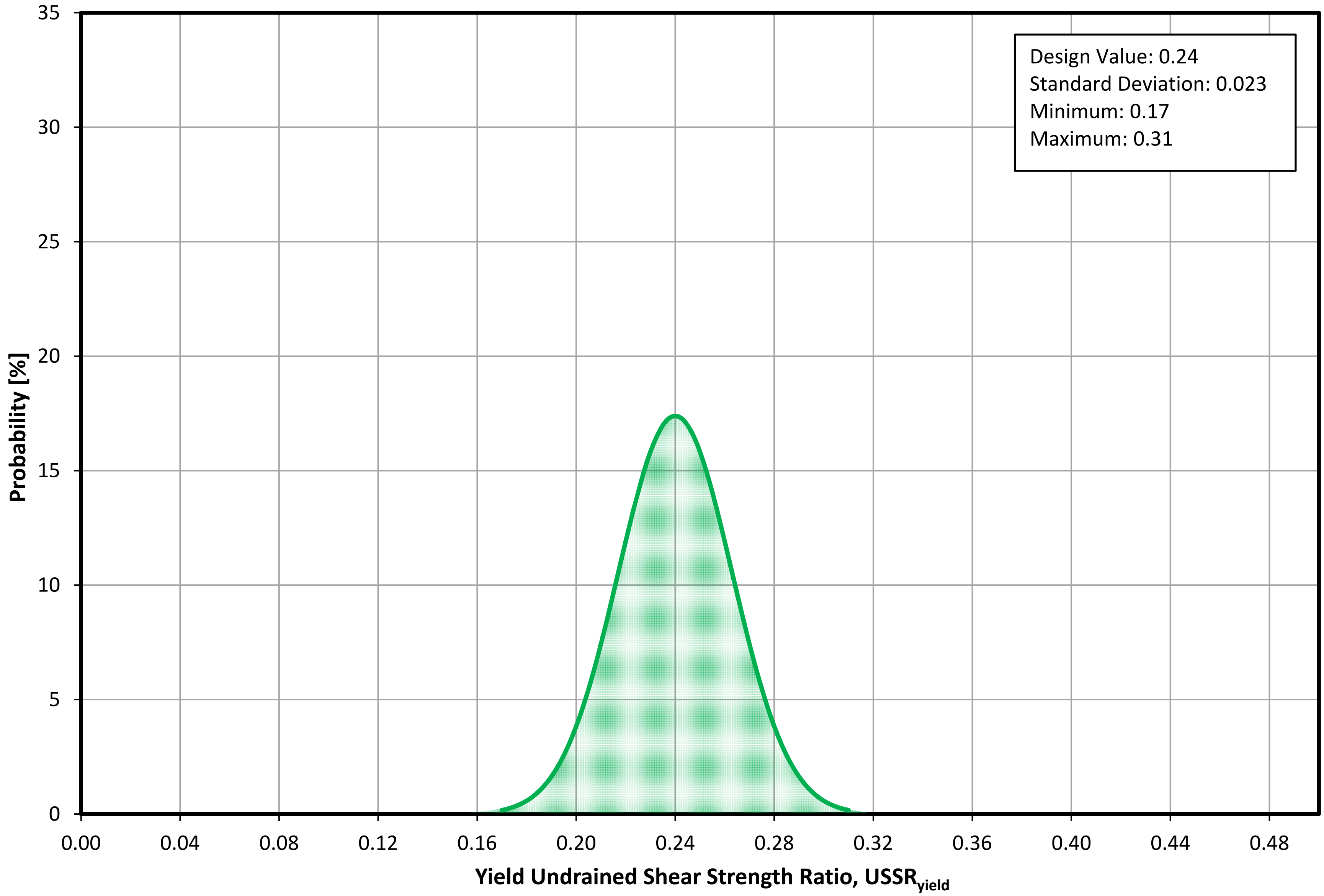
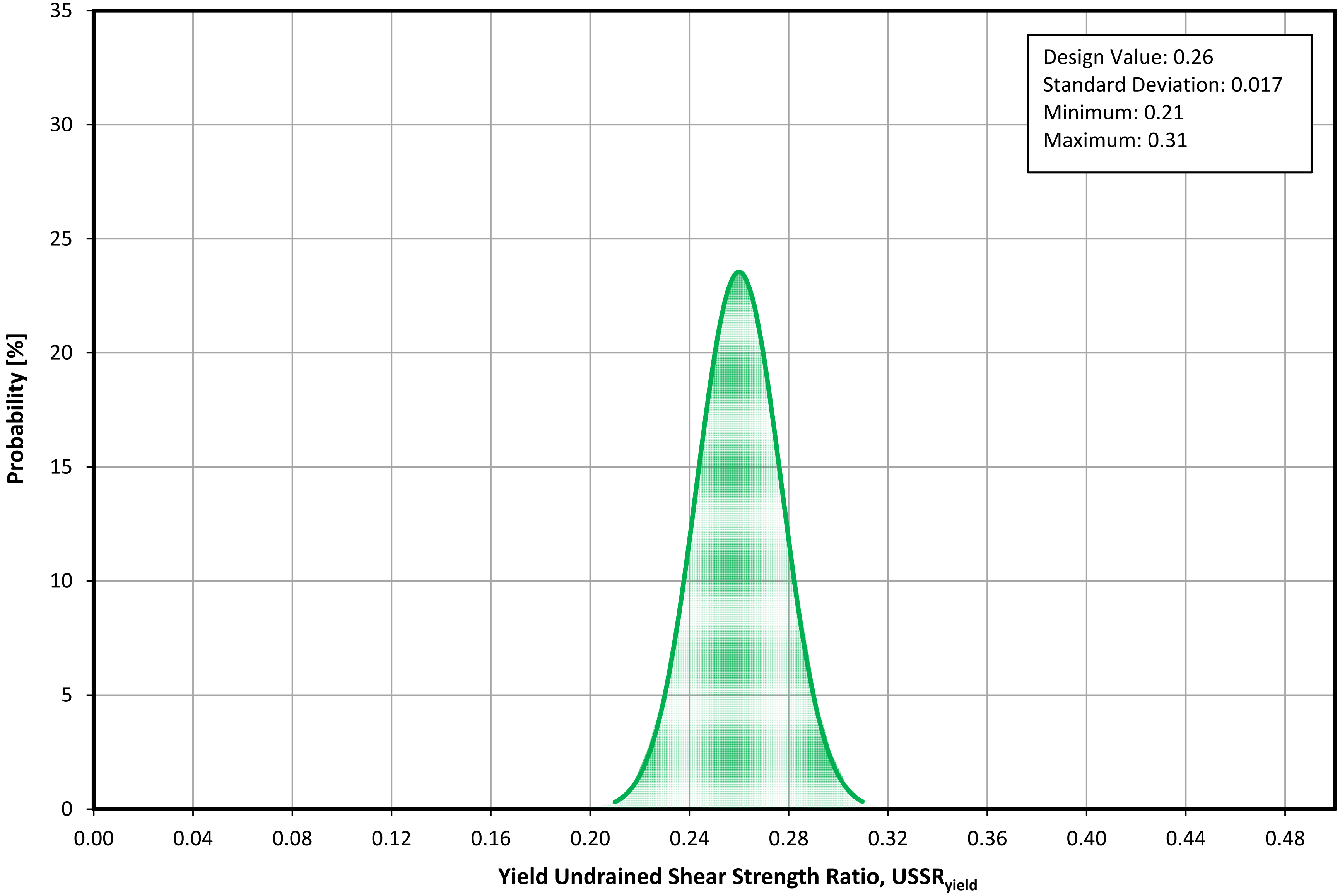


FIGURE 2

NorthMet Flotation Tailings

Yield Strength Probability Distribution



P:\Mpls\23 MN\69\2369862\WorkFiles\022A GeoStudio models\2014\Section F Sensitivity Analysis\Sensitivity Results\Version 5_PolyMet Sensitivity results_12-17-2014.xlsx 12/19/2014

FIGURE 3

Compressed and Virgin Peat

Yield Strength Probability Distribution

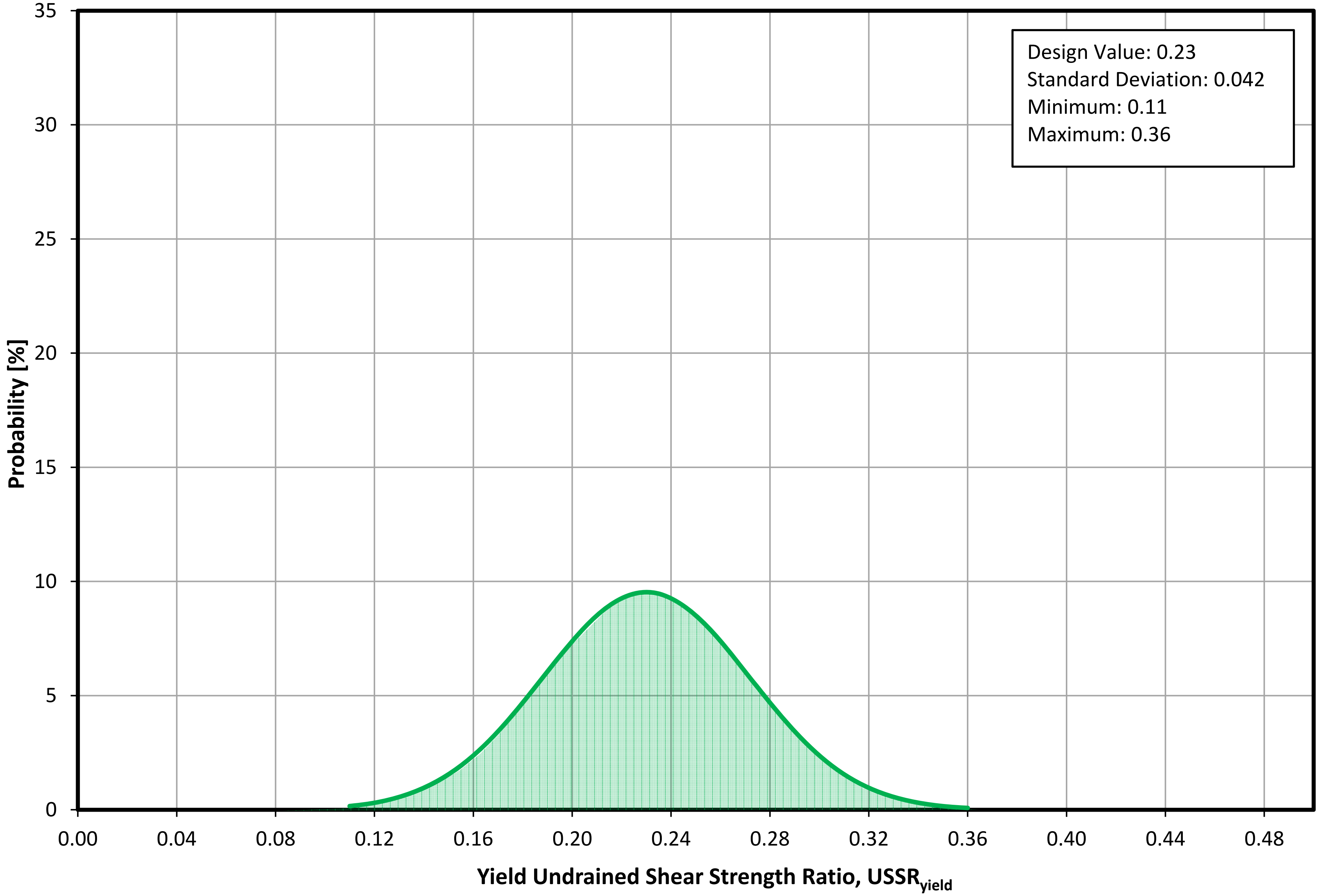


FIGURE 4

LTVSMC Fine Tailings/Slimes

Liquefied Strength Probability Distribution

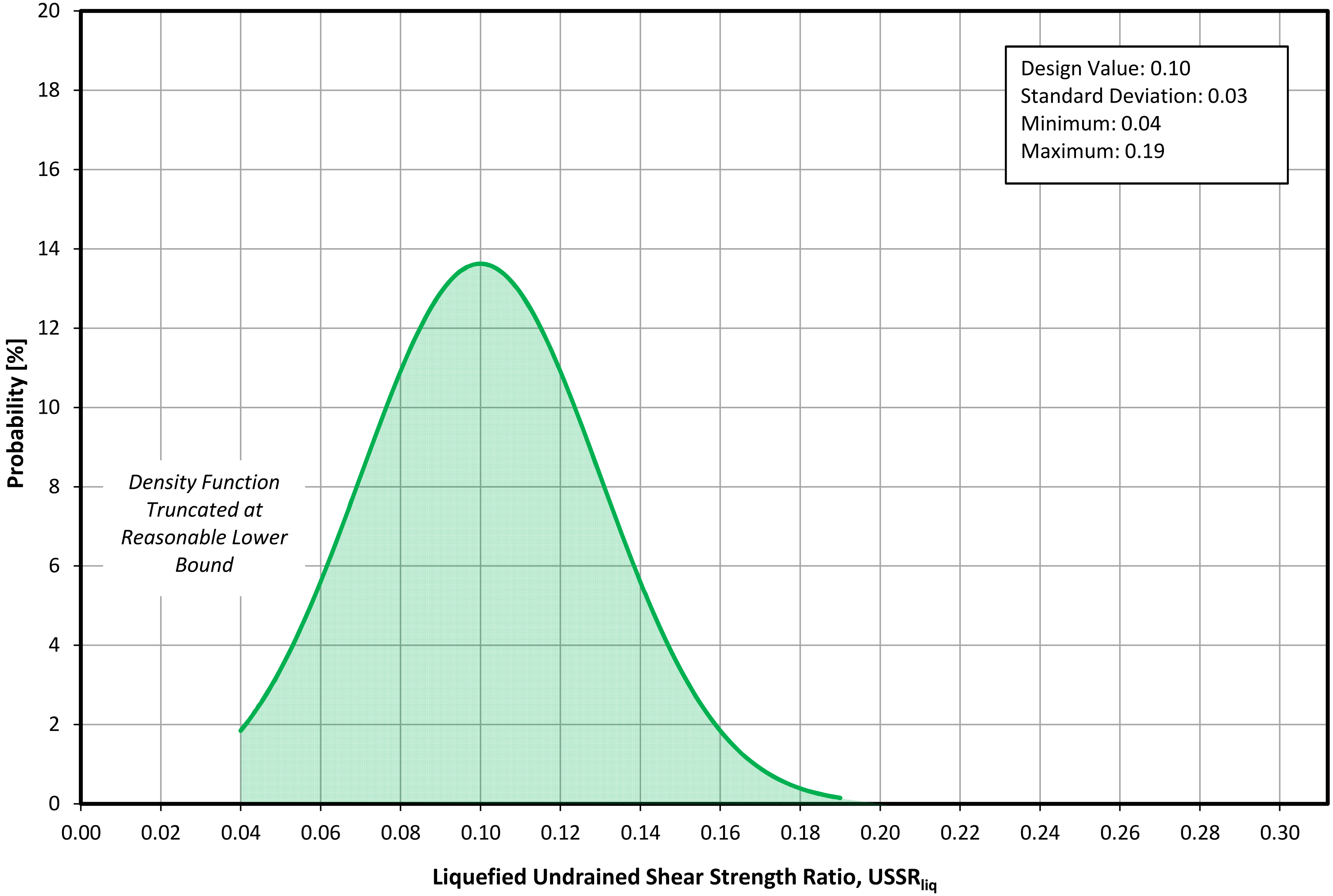


FIGURE 5

NorthMet Flotation Tailings

Liquefied Strength Probability Distribution

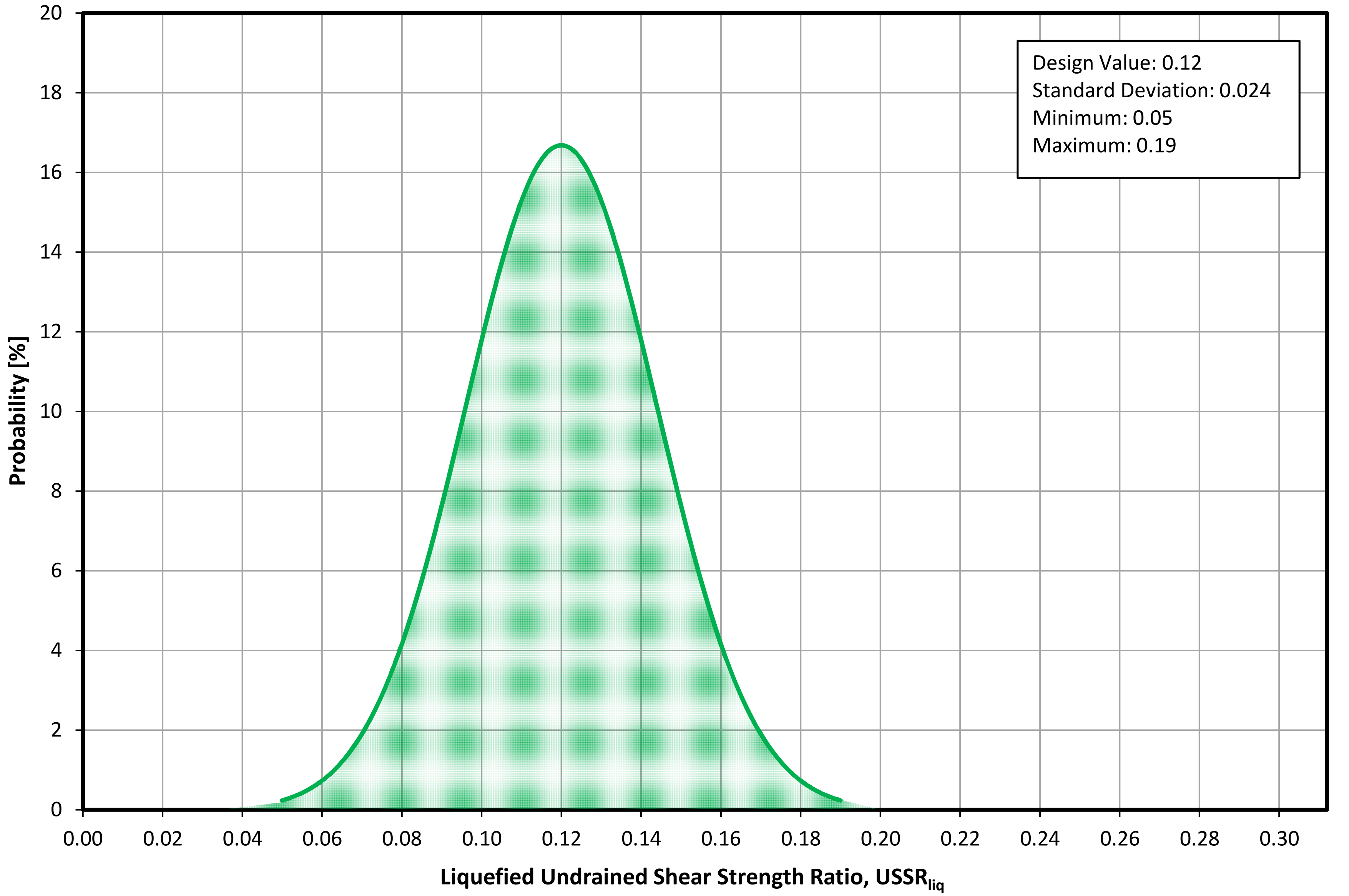


Figure 6. Cross-Section F Sensitivity Analysis 2 Critical Slip Surface

Measured Segment Lengths Along the Slip Surface

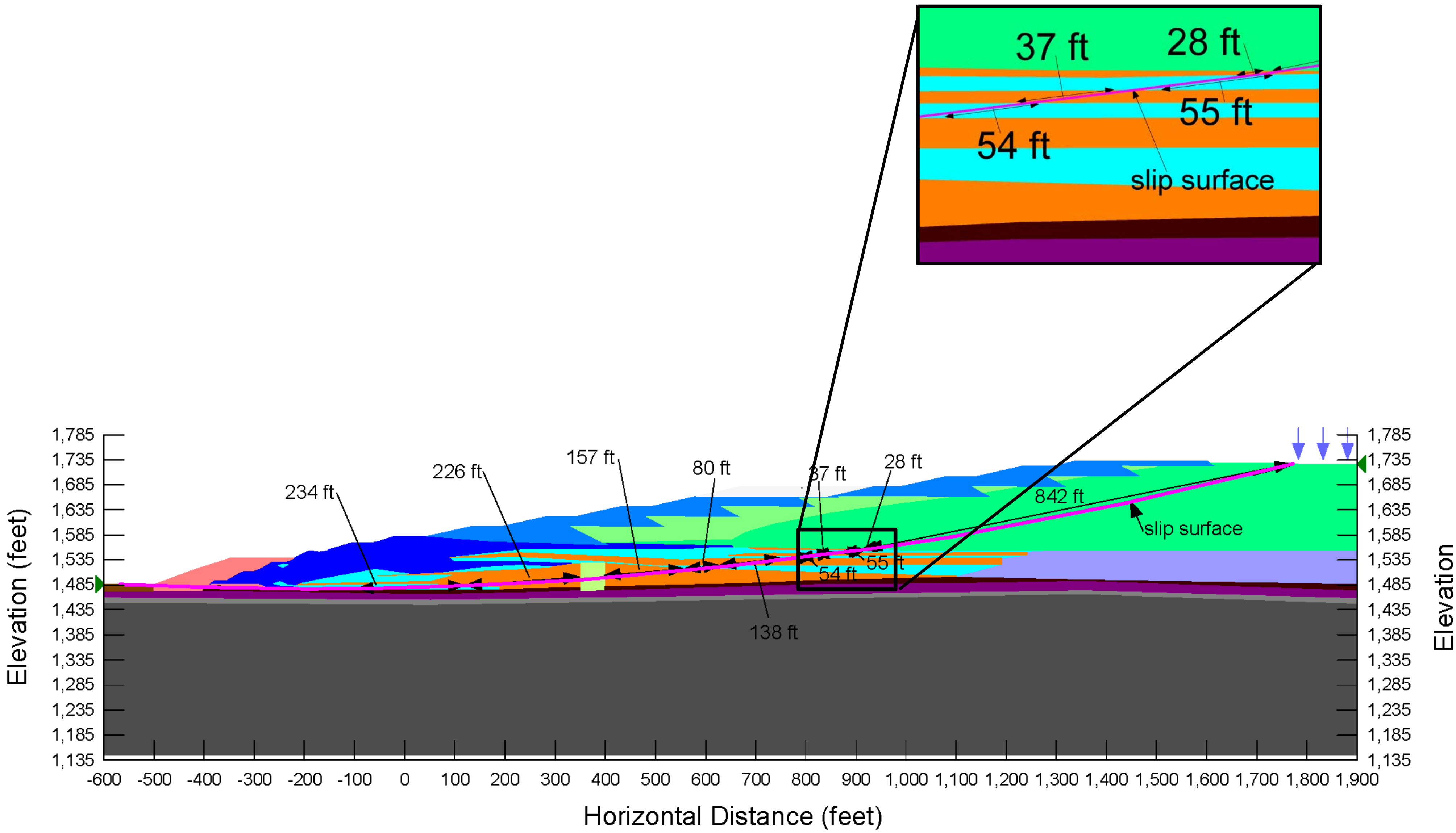


FIGURE 7

Cumulative Distribution Function for Factor of Safety Under Normal Pool Conditions

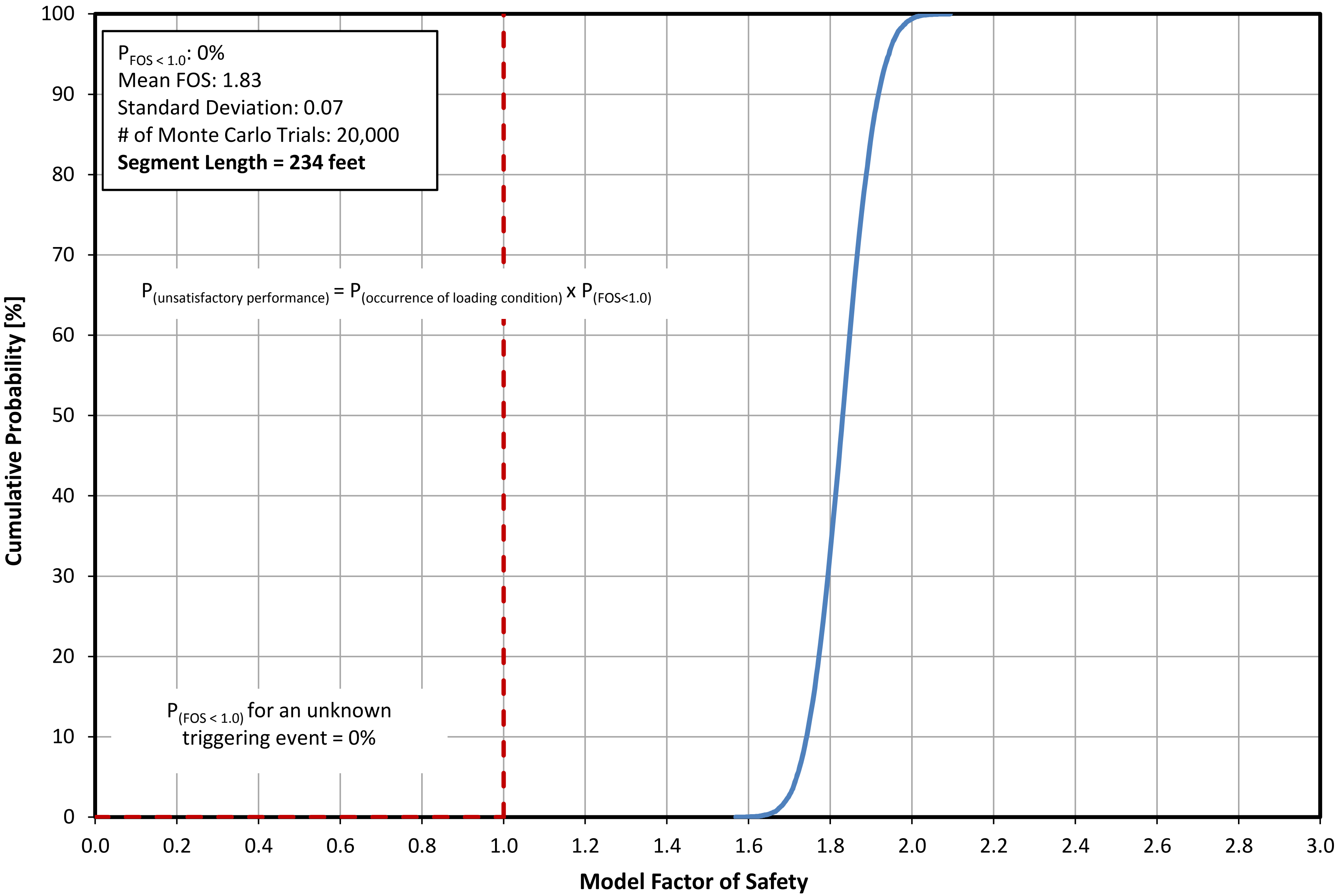


FIGURE 8

Cumulative Distribution Function for Factor of Safety Under Normal Pool Conditions: Sensitivity Analysis of Variable Inputs

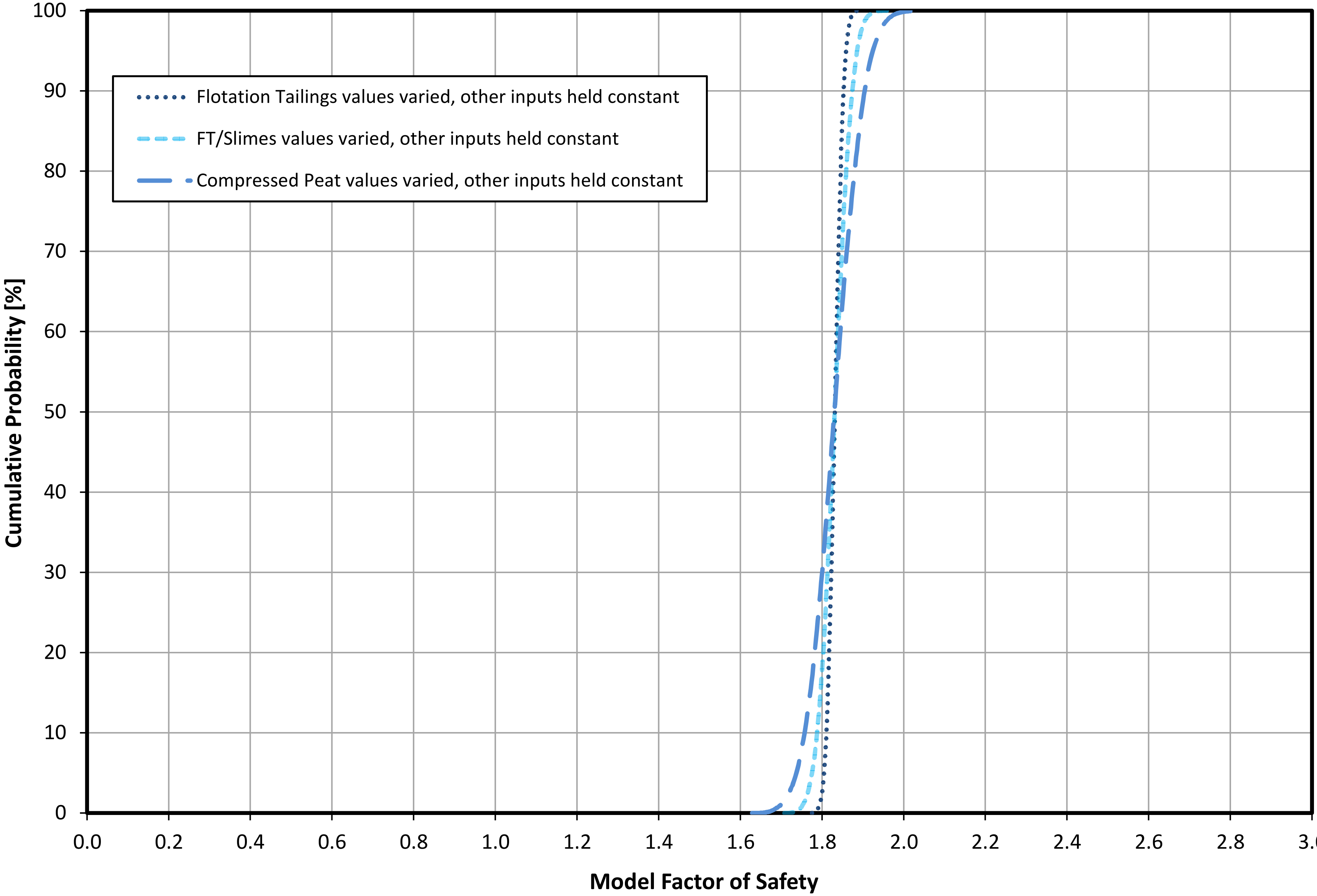


FIGURE 9

Cumulative Distribution Function for Factor of Safety given the Occurence of an Unknown Triggering Event

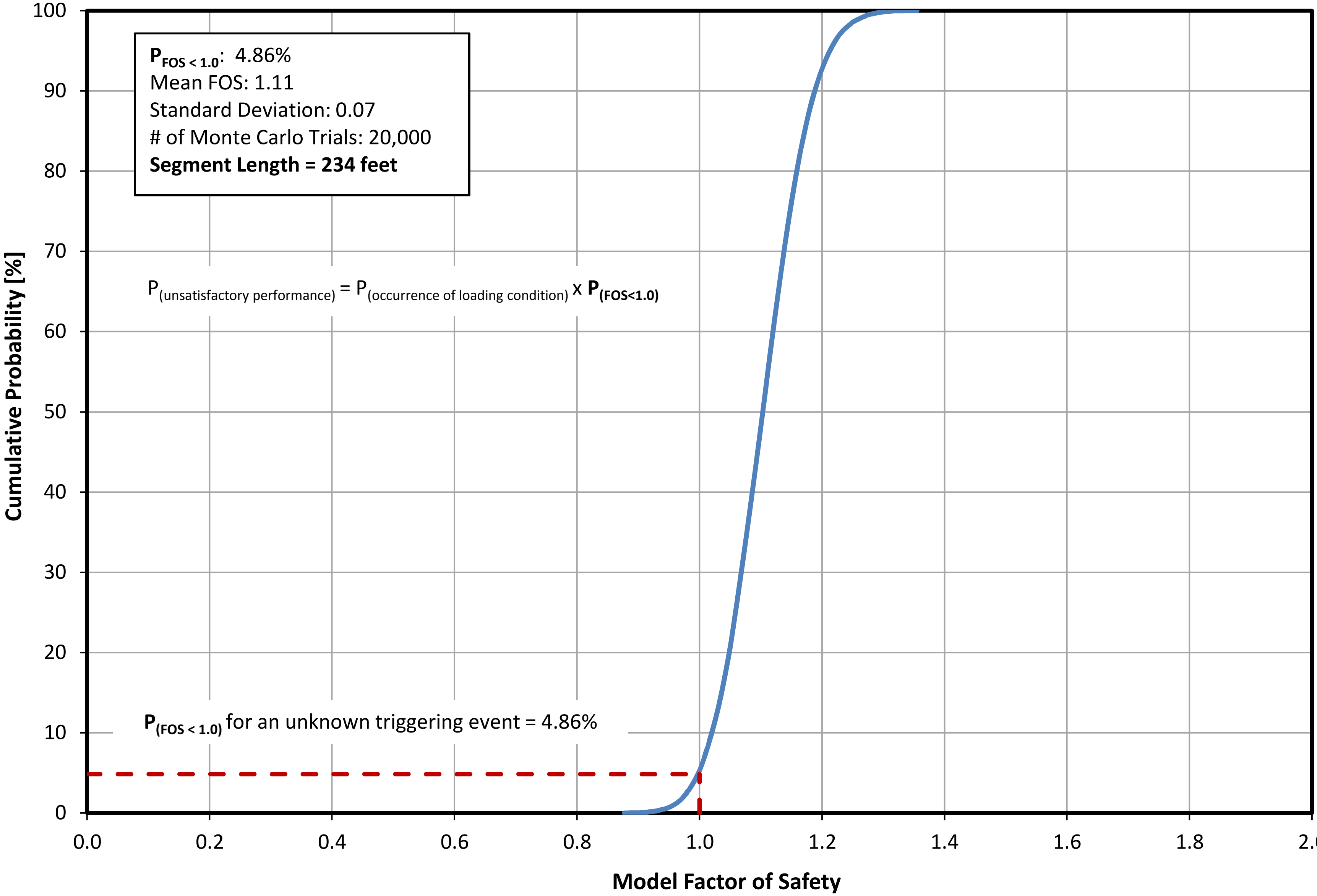
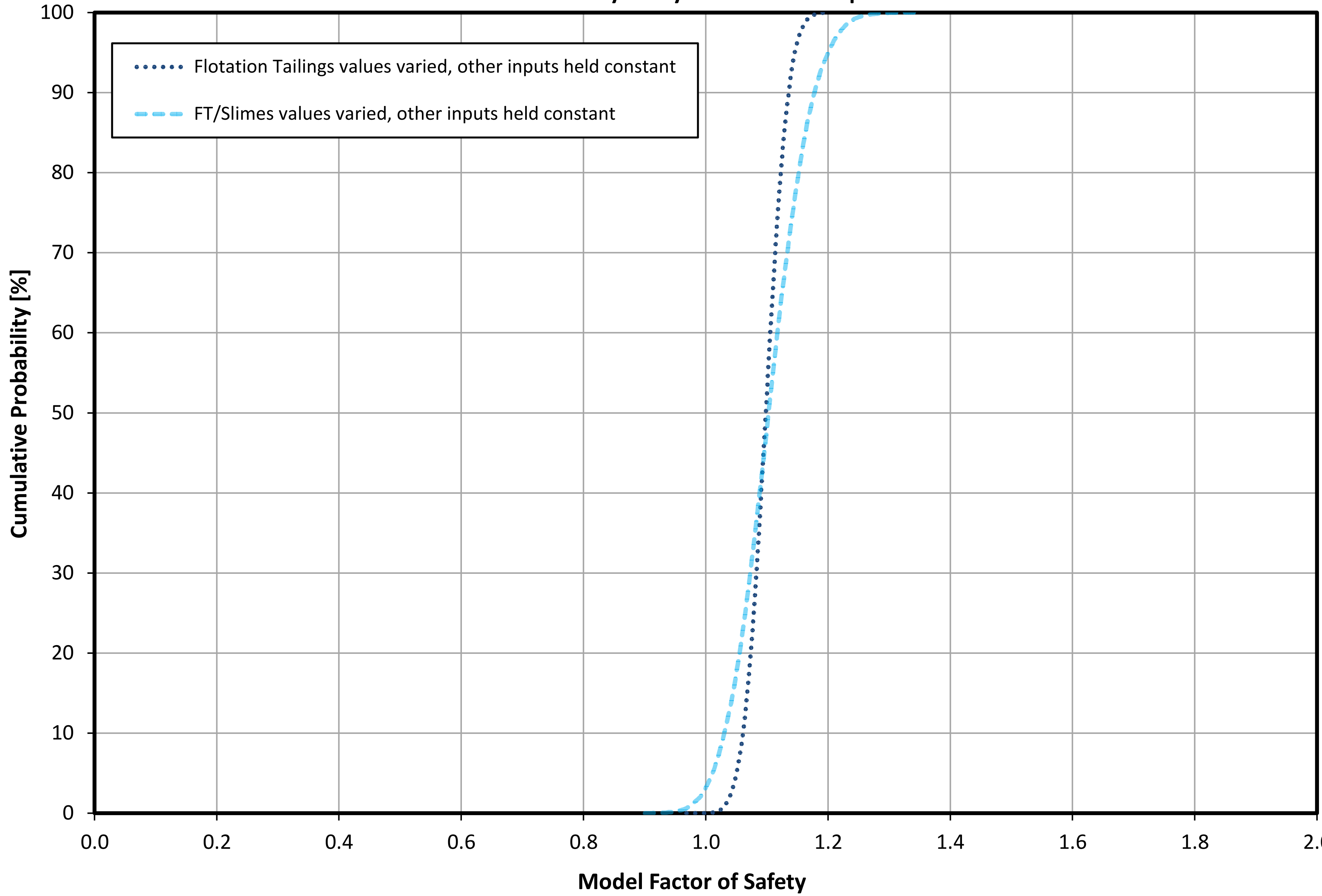


FIGURE 10

Cumulative Distribution Function for Factor of Safety given the Occurence of an Unknown Triggering Event: Sensitivity Analysis of Variable Inputs



Attachment S

SEEP/W Output Figures

Existing Conditions

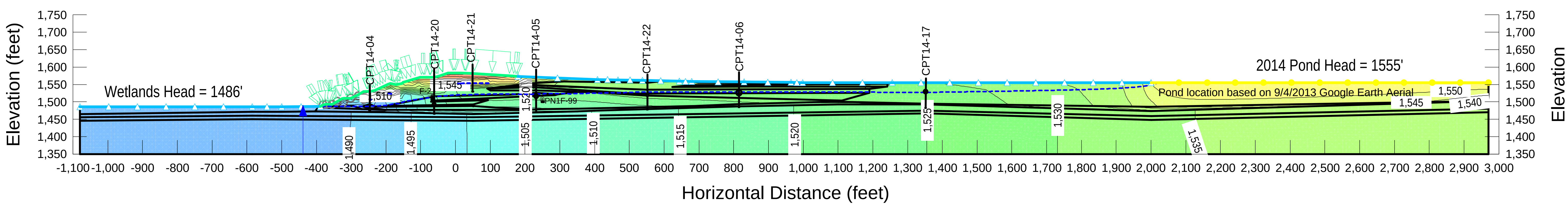
Sections F, G and N

PolyMet Flotation Tailings Basin
Section F 2014 Verification
Date Last Saved: 12/8/2014
File Name: SectionF_2014 verification.gsz

No Lifts - steady-state
2014 Basin Conditions

Name: Glacial Till   Model: Saturated / Unsaturated   K-Function: Glacial Till, ksat=5.1x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA)   Model: Saturated / Unsaturated   K-Function: Compressed Peat, ksat=1.18x10-7 ft/s   Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA)   Model: Saturated / Unsaturated   K-Function: Virgin Peat, ksat=3.3x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: Rock Dam   Model: Saturated / Unsaturated   K-Function: Rock Dam, ksat=5.0x10-2 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings   Model: Saturated / Unsaturated   K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA)   Model: Saturated / Unsaturated   K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA)   Model: Saturated / Unsaturated   K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s   Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA)   Model: Saturated / Unsaturated   K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s   Ky'/Kx' Ratio: 1
Name: Bedrock   Model: Saturated Only   K-Sat: 6.3e-007 ft/sec   Ky'/Kx' Ratio: 1   Mv: 4.79e-007 /psf
Name: Fractured Bedrock   Model: Saturated Only   K-Sat: 2.36e-005 ft/sec   Ky'/Kx' Ratio: 1   Mv: 4.79e-007 /psf

Total Head contours shown (feet)



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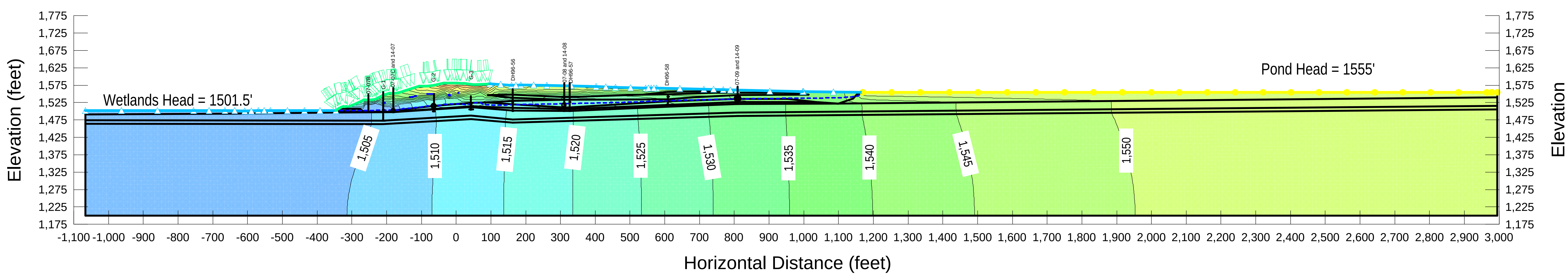
Project #23690862-037

PolyMet Flotation Tailings Basin
Section G 2014 Verification
Date Last Saved: 12/9/2014
File Name: Section G_2014 verification.gsz

No Lifts - steady-state
2014 Basin Conditions

Name: Glacial Till   Model: Saturated / Unsaturated   K-Function: Glacial Till, ksat=5.1x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA)   Model: Saturated / Unsaturated   K-Function: Compressed Peat, ksat=1.18x10-7 ft/s   Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA)   Model: Saturated / Unsaturated   K-Function: Virgin Peat, ksat=3.3x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: Rock Dam   Model: Saturated / Unsaturated   K-Function: Rock Dam, ksat=5.0x10-2 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings   Model: Saturated / Unsaturated   K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA)   Model: Saturated / Unsaturated   K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA)   Model: Saturated / Unsaturated   K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s   Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA)   Model: Saturated / Unsaturated   K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s   Ky'/Kx' Ratio: 1
Name: Bedrock   Model: Saturated Only   K-Sat: 6.3e-007 ft/sec   Ky'/Kx' Ratio: 1   Mv: 4.79e-007 /psf
Name: Fractured Bedrock   Model: Saturated Only   K-Sat: 2.36e-005 ft/sec   Ky'/Kx' Ratio: 1   Mv: 4.79e-007 /psf

Total Head countours shown (feet)



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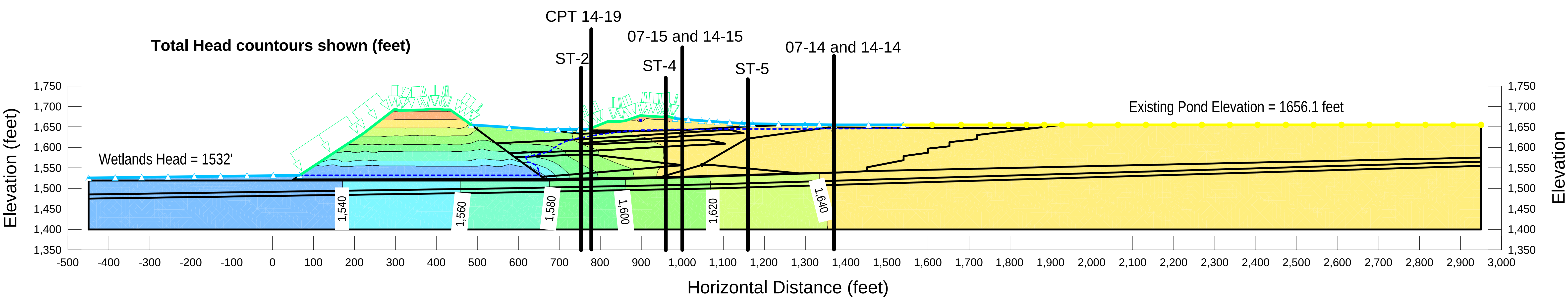
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N 2014 Verification
Date Last Saved: 12/12/2014
File Name: Verification 2014_SectionN.gsz

No Lifts - steady state
2014 Basin Conditions

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat= 5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTV slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Rail Grade Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1



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Project #23690862-037

Interim Lifts

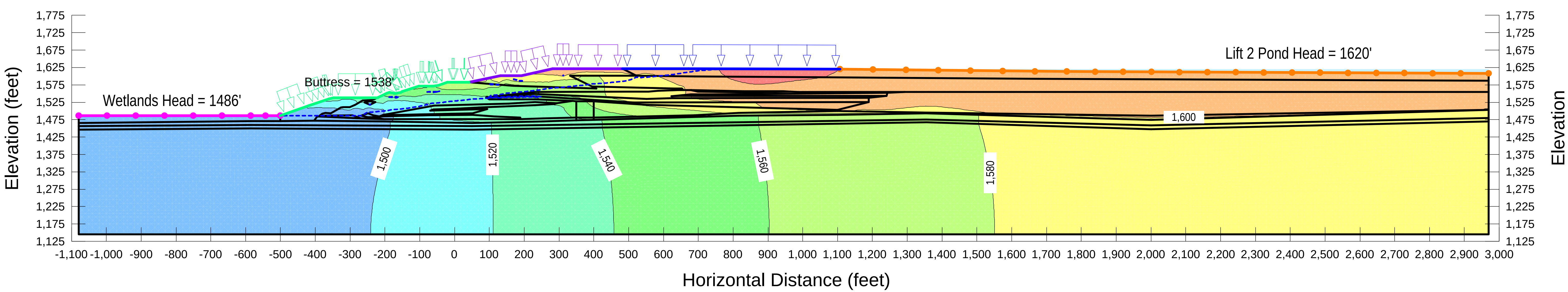
Section F – Lifts 2, 4 and 6

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/10/2014
File Name: SecF_Interim Lift 2.gsz

Lift 2 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (ESSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)

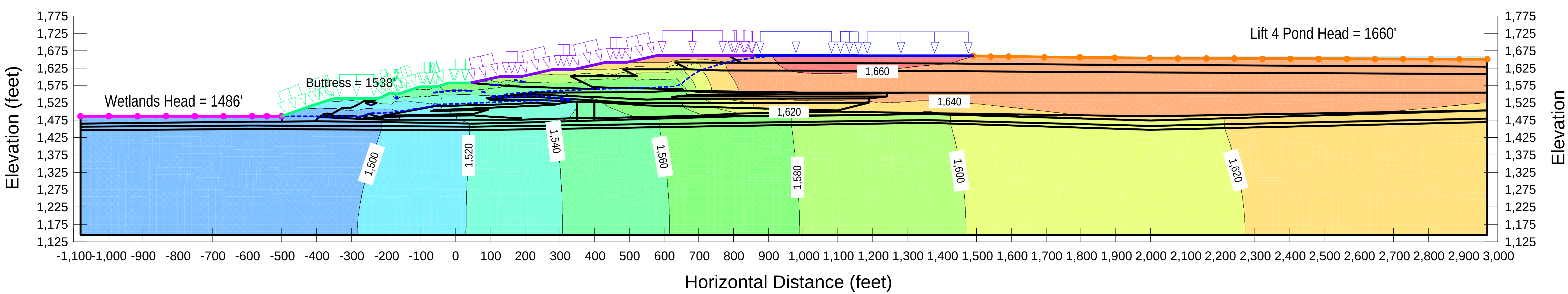


PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/10/2014
File Name: SecF_Interim Lift 4.gsz

Lift 4 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (ESSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)



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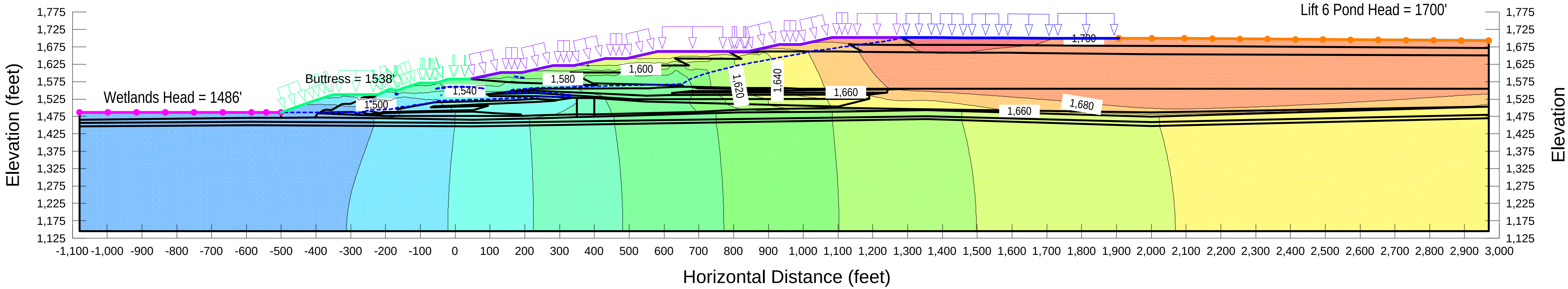
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/9/2014
File Name: SecF_Interim Lift 6.gsz

Lift 6 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (ESSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)



Interim Lifts

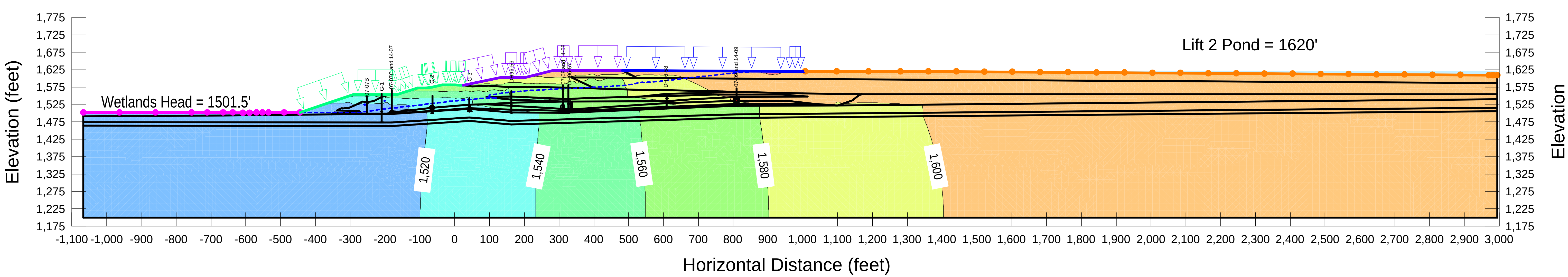
Section G – Lifts 2, 4 and 6

PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/9/2014
File Name: SecG_Interim Lift 2.gsz

Lift 2 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1

Total Head contours shown (feet)



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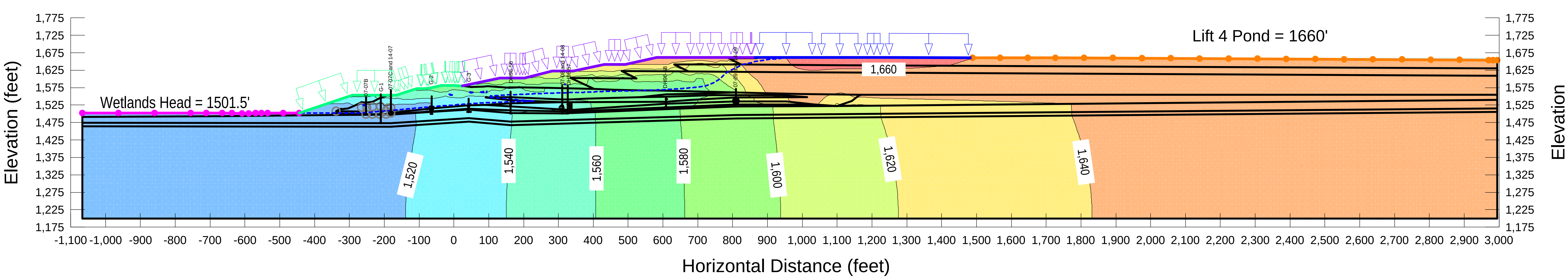
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/9/2014
File Name: SecG_Interim Lift 4.gsz

Lift 4 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1

Total Head contours shown (feet)



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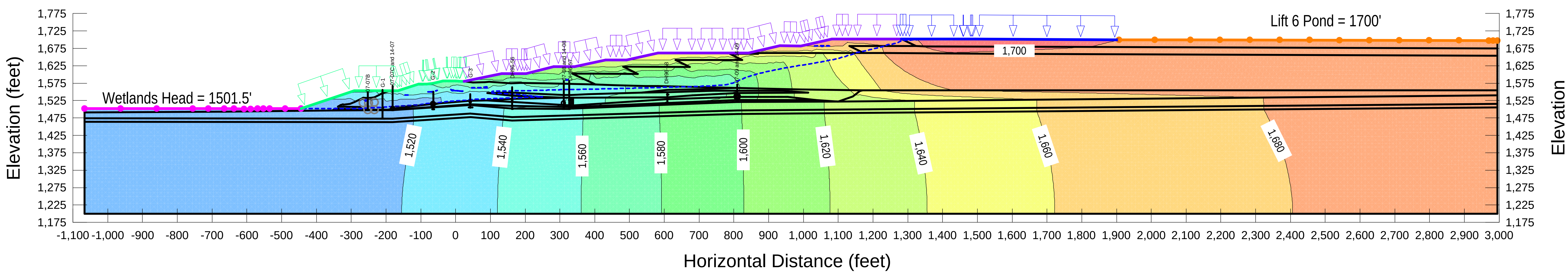
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/9/2014
File Name: SecG_Interim Lift 6.gsz

Lift 6 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1

Total Head contours shown (feet)



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Project #23690862-037

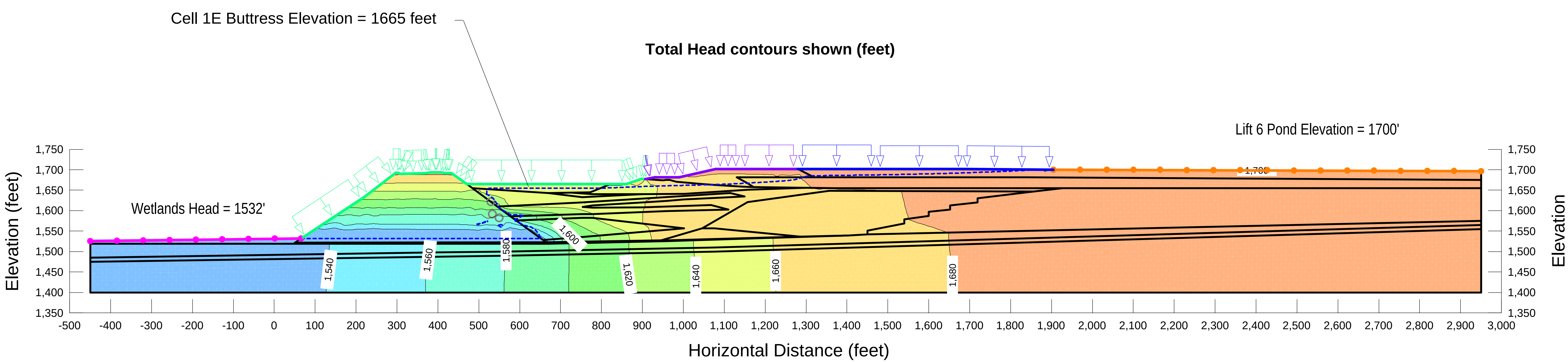
Interim Lifts

Section N – Lift 6

PolyMet Flotation Tailings Basin
Cross-Section N
Date Last Saved: 12/15/2014
File Name: Section N_Interim Lift 6.gsz

Case: Lift 6 - steady state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat= 5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTV slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Rail Grade Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1



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Project #23690862-037

Normal Pool Conditions

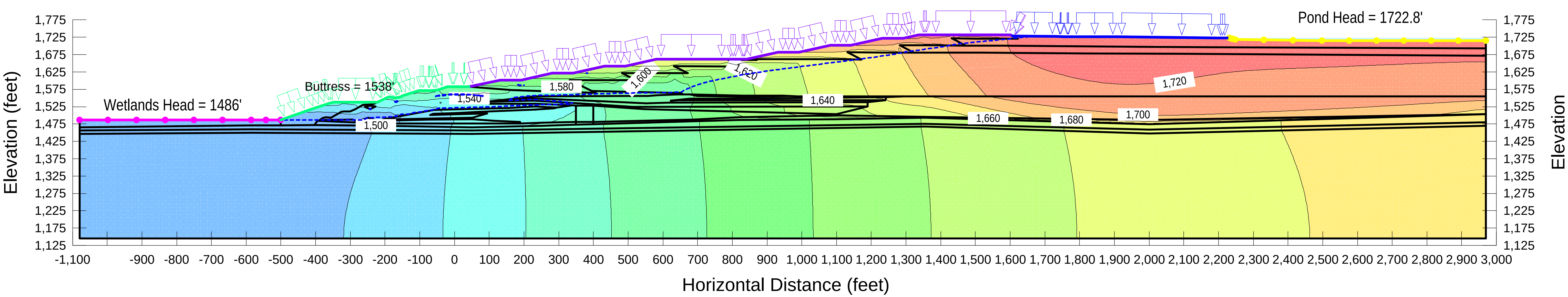
Sections F, G and N – Lift 8

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 11/13/2014
File Name: SecF_Lift8_Normal Pool.gsz

Lift 8 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (ESSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)



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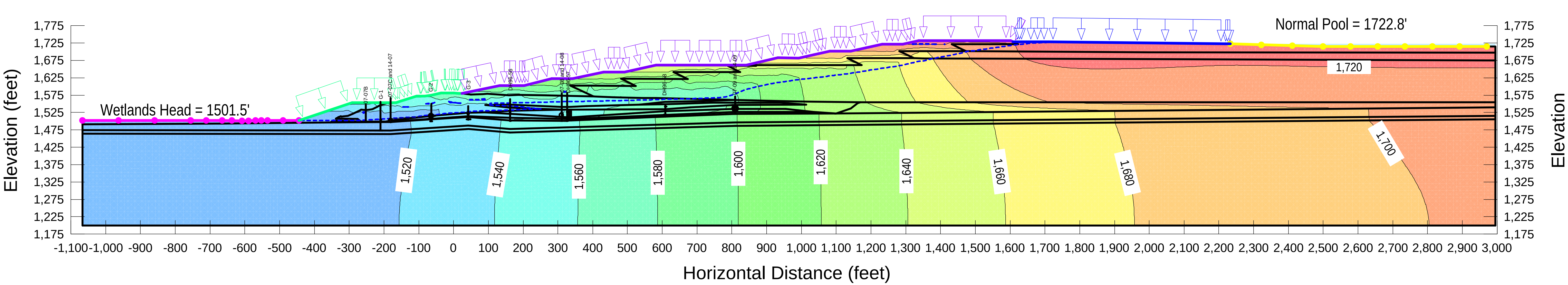
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/9/2014
File Name: SecG_Lift8_Normal Pool.gsz

Lift 8 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1

Total Head contours shown (feet)



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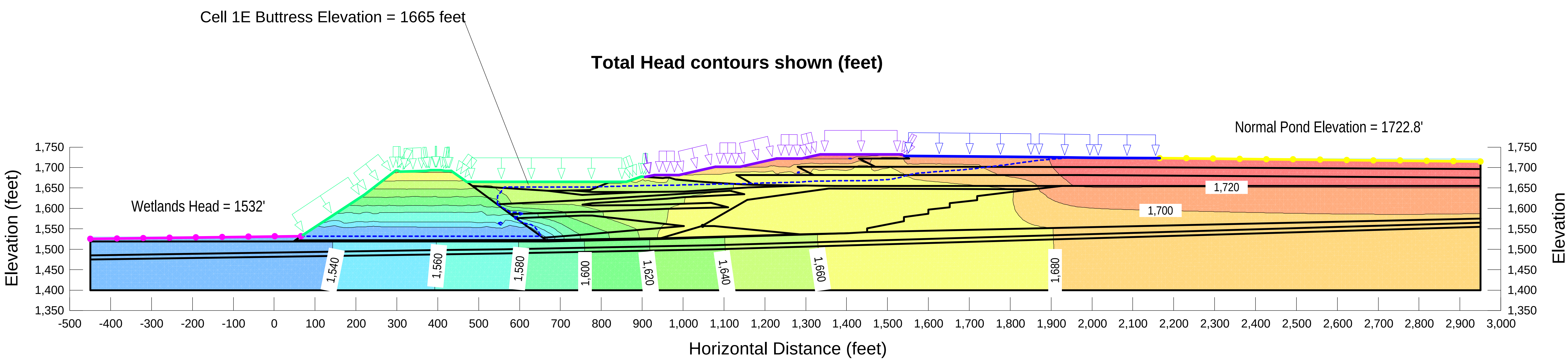
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_Normal Pool.gsz

Case: Lift 8 - steady state
POM slopes covered in bentonite

Name: Glacial Till   Model: Saturated / Unsaturated   K-Function: Glacial Till, ksat= 5.1x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA)   Model: Saturated / Unsaturated   K-Function: Compressed Peat, ksat=1.18x10-7 ft/s   Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA)   Model: Saturated / Unsaturated   K-Function: Virgin Peat, ksat=3.3x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: Rock Dam   Model: Saturated / Unsaturated   K-Function: Rock Dam, ksat=5.0x10-2 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings   Model: Saturated / Unsaturated   K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA)   Model: Saturated / Unsaturated   K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC FT/Slimes (USSA)   Model: Saturated / Unsaturated   K-Function: LTV slimes, ksat=3.16x10-8 ft/s   Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings   Model: Saturated / Unsaturated   K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s   Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA)   Model: Saturated / Unsaturated   K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s   Ky'/Kx' Ratio: 1
Name: Fractured Bedrock   Model: Saturated Only   K-Sat: 2.36e-005 ft/sec   Ky'/Kx' Ratio: 1   Mv: 4.79e-007 /psf
Name: Bedrock   Model: Saturated Only   K-Sat: 6.3e-007 ft/sec   Ky'/Kx' Ratio: 1   Mv: 4.79e-007 /psf
Name: Flotation - high k   Model: Saturated / Unsaturated   K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s   Ky'/Kx' Ratio: 1
Name: Flotation - med k   Model: Saturated / Unsaturated   K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s   Ky'/Kx' Ratio: 1
Name: Flotation - low k   Model: Saturated / Unsaturated   K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s   Ky'/Kx' Ratio: 1
Name: Rail Grade   Model: Saturated / Unsaturated   K-Function: Rock Dam, ksat=5.0x10-2 ft/s   Ky'/Kx' Ratio: 1



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Project #23690862-037

PMP Conditions

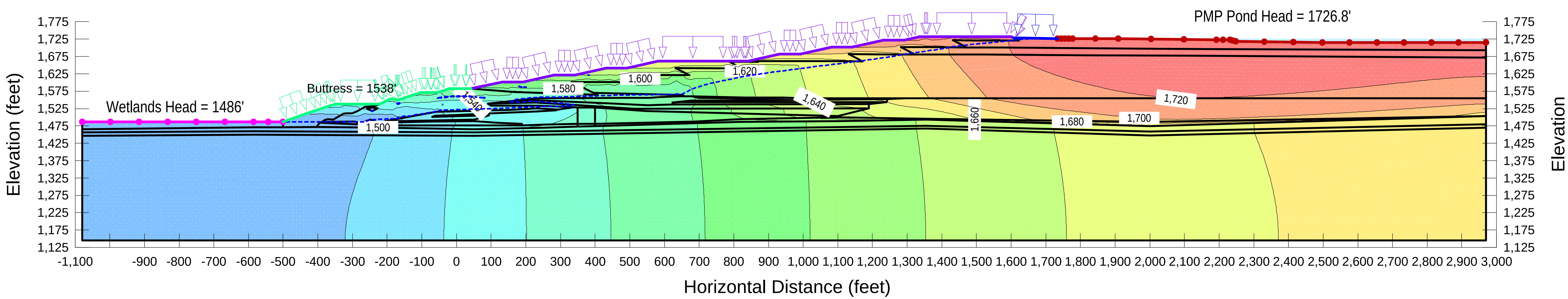
Sections F, G and N – Lift 8

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 11/25/2014
File Name: SecF_Lift8_PMP.gsz

Lift 8 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (ESSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)



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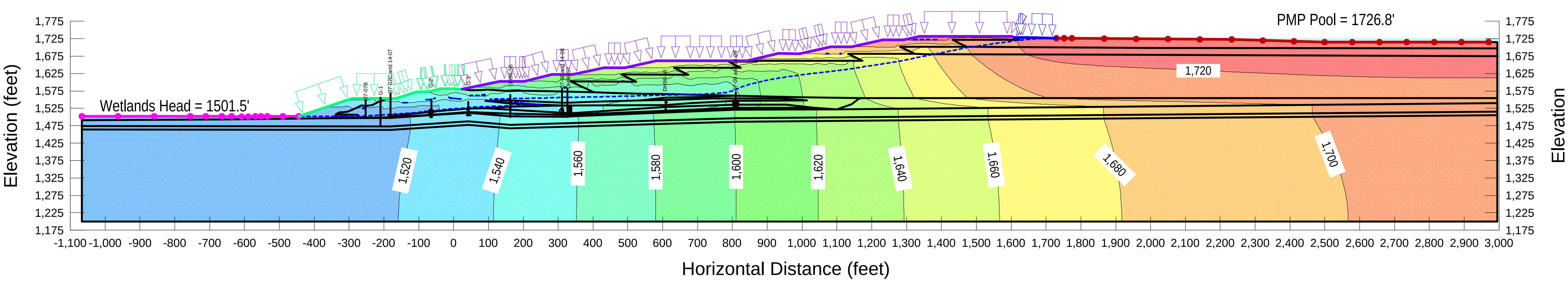
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: SecG_Lift8_PMP.gsz

Lift 8 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1

Total Head contours shown (feet)



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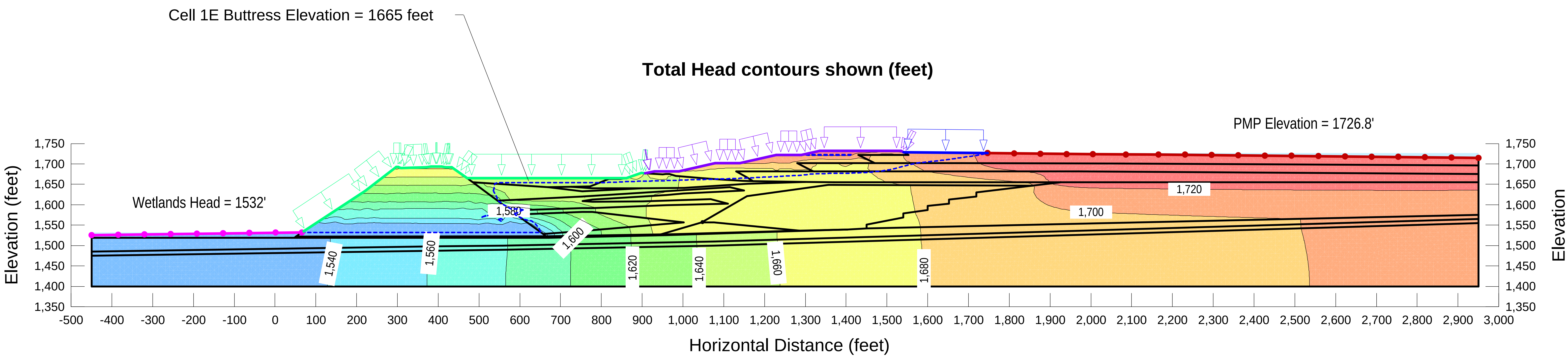
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_PMP.gsz

Case: Lift 8 - steady state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat= 5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTV slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Rail Grade Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1



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Project #23690862-037

Fully Liquefied Conditions

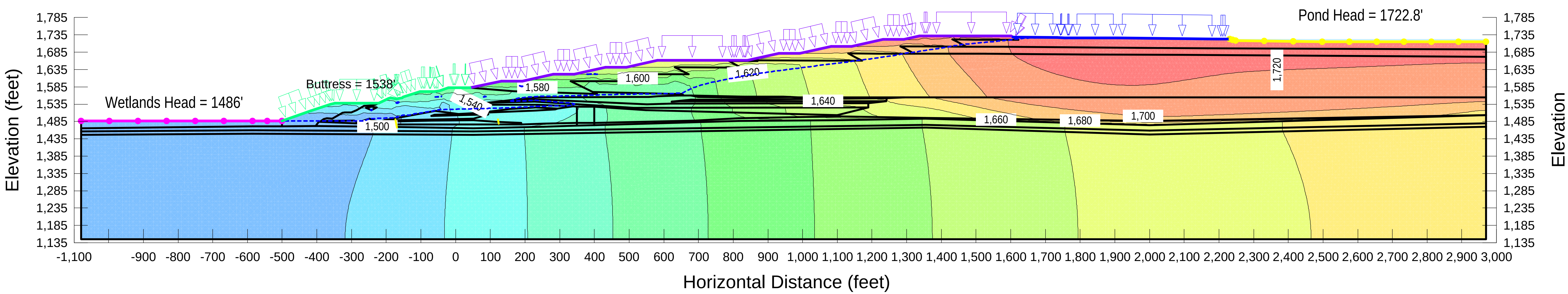
Sections F, G and N – Lift 8

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 11/28/2014
File Name: Baseline-SecF_Lift8_LIQ_CDSM.gsz

Lift 8 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.10x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)



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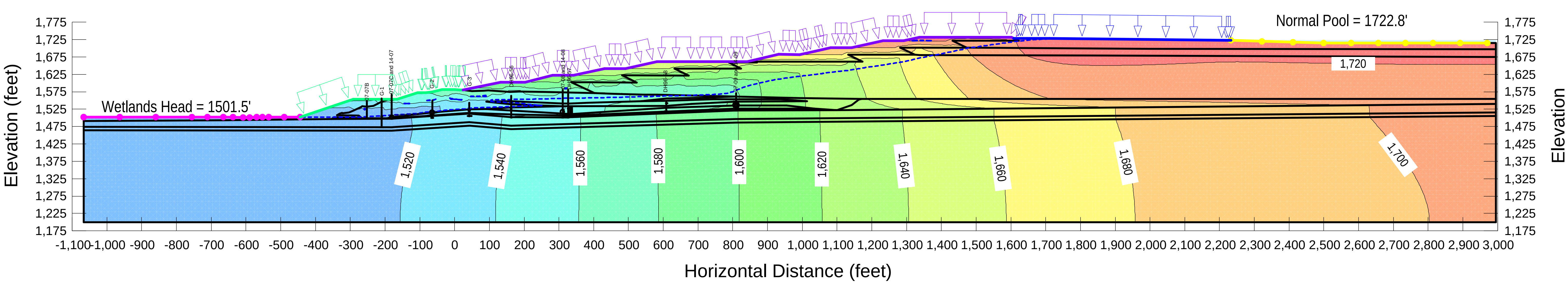
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/8/2014
File Name: 2014 Baseline-SecG_Lift8_LIQ_5-ft CDSM.gsz

Lift 8 - steady-state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1

Total Head contours shown (feet)



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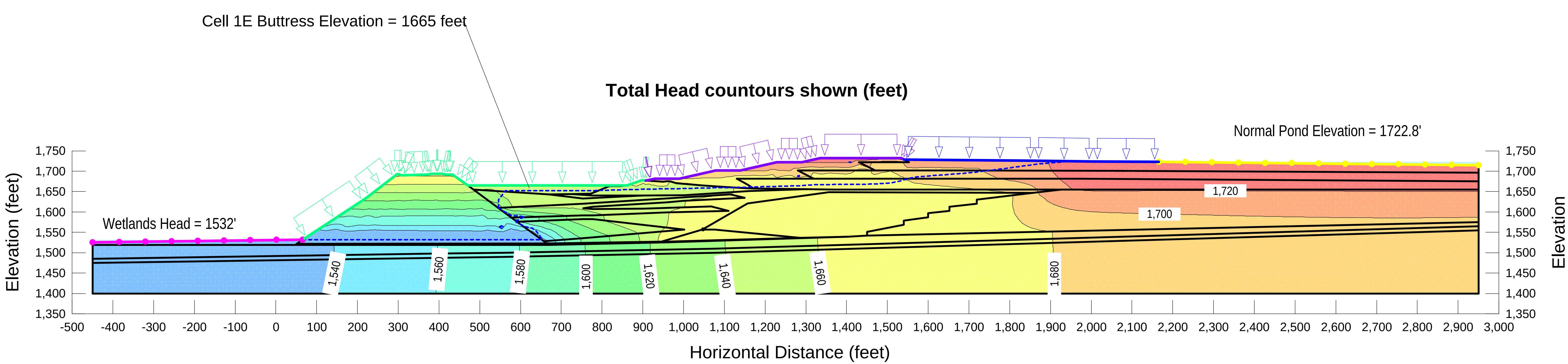
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section N
Date Last Saved: 12/12/2014
File Name: Baseline-SecN_Lift8_LIQ.gsz

Lift 8 - steady state
POM slopes covered in bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat= 5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat (USSA) Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat (USSA) Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTV slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Rail Grade Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1



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Project #23690862-037

Long – Term Conditions

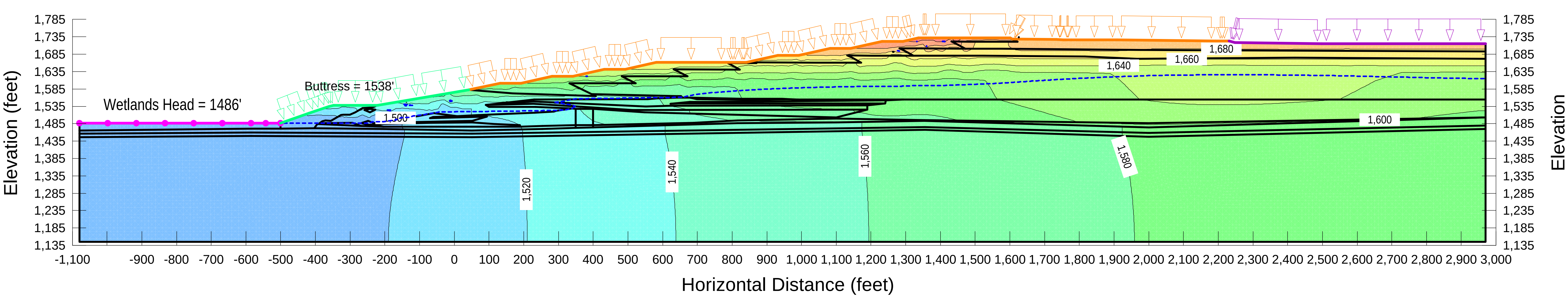
Section F

PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/20/2014
File Name: SecF_Lift8_long-term with erosion.gsz

Lift 8 - steady-state_20 years
POM slopes covered in Amended Bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)



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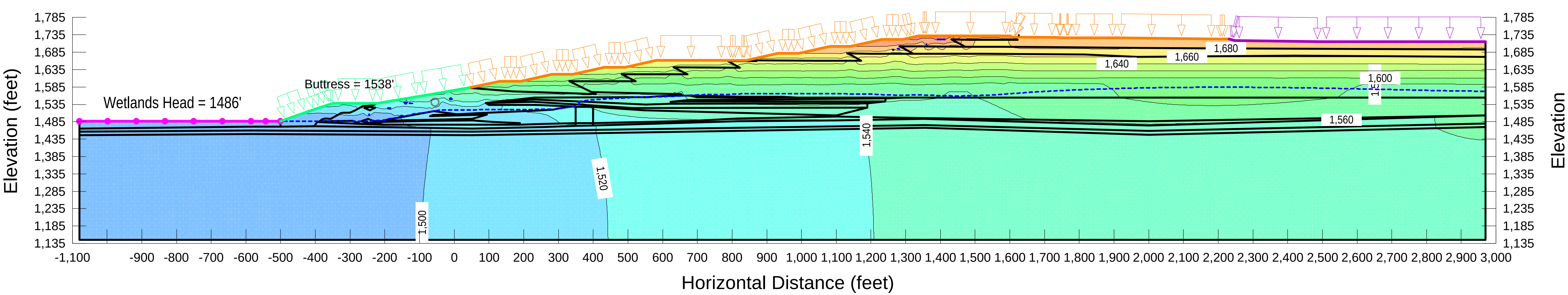
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/20/2014
File Name: SecF_Lift8_long-term with erosion.gsz

Lift 8 - steady-state_200 years
POM slopes covered in Amended Bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)



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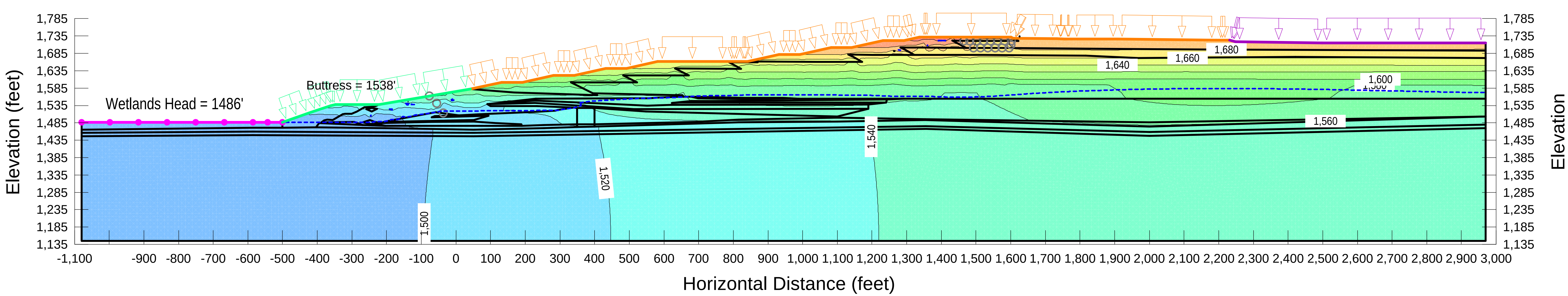
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/20/2014
File Name: SecF_Lift8_long-term with erosion.gsz

Lift 8 - steady-state_2000 years
POM slopes covered in Amended Bentonite

Name: Glacial Till Model: Saturated / Unsaturated K-Function: Glacial Till, ksat=5.1x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Compressed Peat Model: Saturated / Unsaturated K-Function: Compressed Peat, ksat=1.18x10-7 ft/s Ky'/Kx' Ratio: 0.067
Name: Virgin Peat Model: Saturated / Unsaturated K-Function: Virgin Peat, ksat=3.3x10-5 ft/s Ky'/Kx' Ratio: 1
Name: Rock Dam Model: Saturated / Unsaturated K-Function: Rock Dam, ksat=5.0x10-2 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Coarse Tailings Model: Saturated / Unsaturated K-Function: LTVSMC CT, ksat=8.0x10-5 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Fine Tailings Model: Saturated / Unsaturated K-Function: LTVSMC FT, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Bulk Tailings Model: Saturated / Unsaturated K-Function: LTVSMC bulk, ksat=2.63x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - high k Model: Saturated / Unsaturated K-Function: Flot Tailings 0.45tsf, ksat=6.23x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - med k Model: Saturated / Unsaturated K-Function: Flot Tailings 1.35tsf, ksat=1.84x10-6 ft/s Ky'/Kx' Ratio: 1
Name: Flotation - low k Model: Saturated / Unsaturated K-Function: Flot Tailings 2.29tsf, ksat=6.56x10-7 ft/s Ky'/Kx' Ratio: 1
Name: Interior LTVSMC FT/Slimes Model: Saturated / Unsaturated K-Function: LTVSMC FT/Slimes, ksat=1.0x10-7 ft/s Ky'/Kx' Ratio: 1
Name: LTVSMC Slimes (USSA) Model: Saturated / Unsaturated K-Function: LTVSMC slimes, ksat=3.16x10-8 ft/s Ky'/Kx' Ratio: 1
Name: Bedrock Model: Saturated Only K-Sat: 6.3e-007 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: Fractured Bedrock Model: Saturated Only K-Sat: 2.36e-005 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.79e-007 /psf
Name: LTVSMC Slimes CDSM Model: Saturated Only K-Sat: 2.31e-008 ft/sec Ky'/Kx' Ratio: 1 Mv: 4.8e-007 /psf
Name: Compressed Peat CDSM Model: Saturated Only K-Sat: 8.36e-008 ft/sec Ky'/Kx' Ratio: 0.067 Mv: 9.6e-006 /psf

Total Head contours shown (feet)



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Project #23690862-037

Attachment T

SLOPE/W Output Figures

Existing Conditions (Table 7-5)

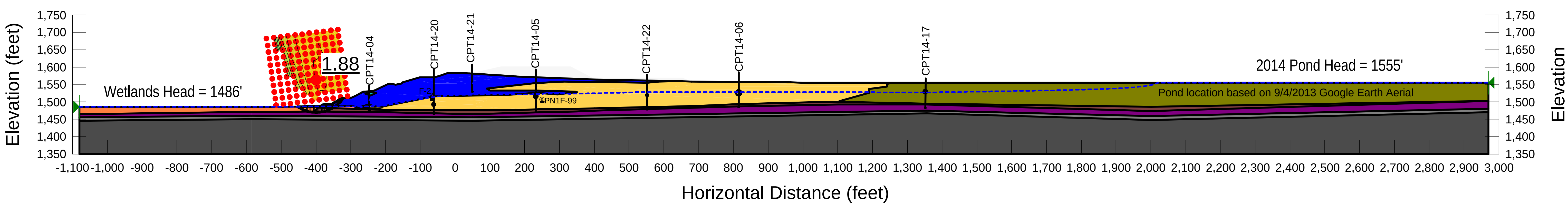
Sections F, G and N – ESSA

PolyMet Flotation Tailings Basin
Section F 2014 Verification
Date Last Saved: 12/19/2014
File Name: SectionF_2014 verification.gsz

Case: 1.0 No Lifts - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 1.88

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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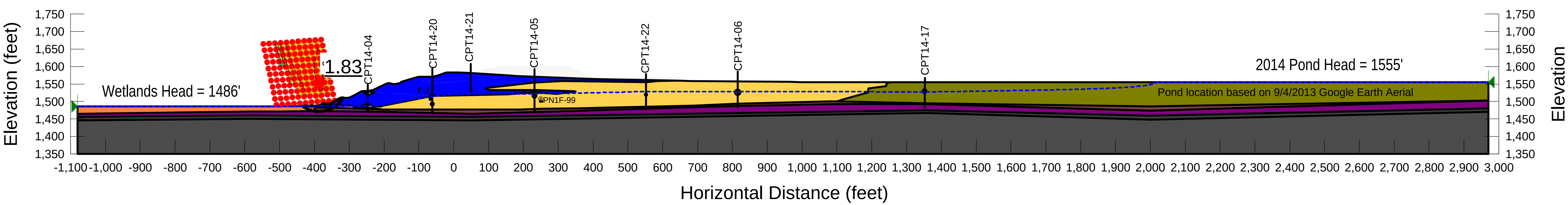
Project #23690862-037

PolyMet Flotation Tailings Basin
Section F 2014 Verification
Date Last Saved: 12/19/2014
File Name: SectionF_2014 verification.gsz

Case: 1.1 No Lifts - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.83

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)



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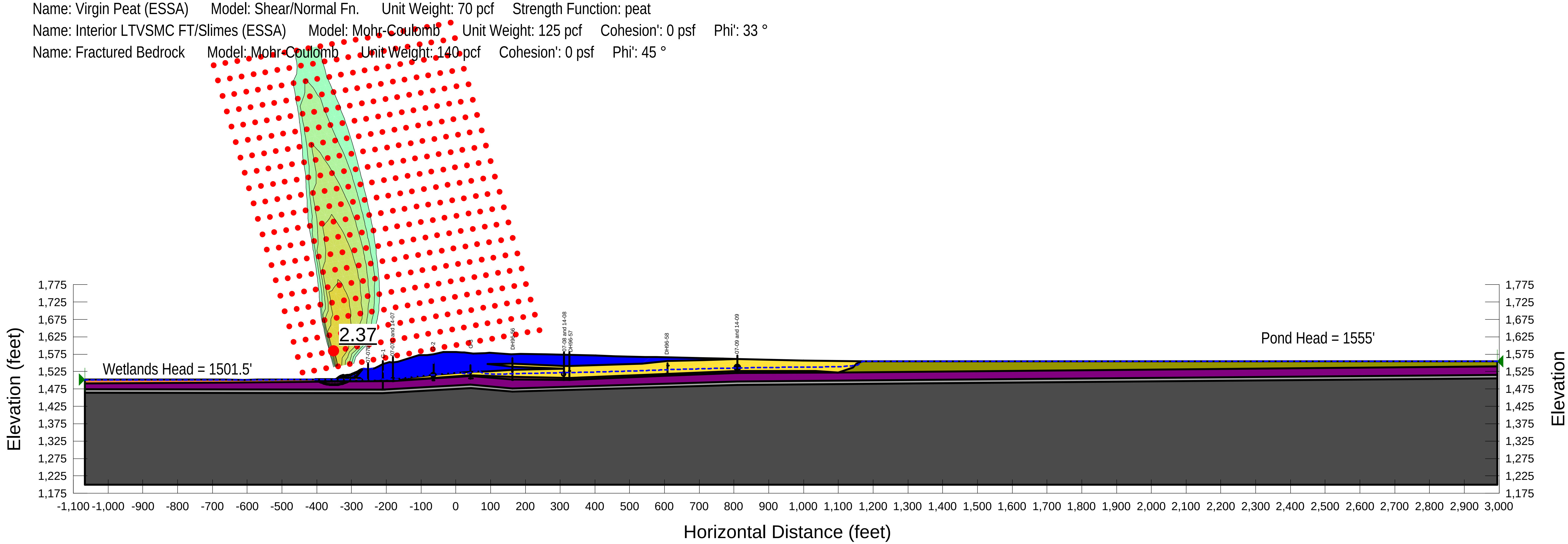
Project #23690862-037

PolyMet Flotation Tailings Basin
Section G 2014 Verification
Date Last Saved: 12/9/2014
File Name: Section G_2014 verification.gsz

1.0 No Lifts - ESSA (Circular)
ESSA Strengths
Grid & Radius, Circular

Factor of Safety: 2.37

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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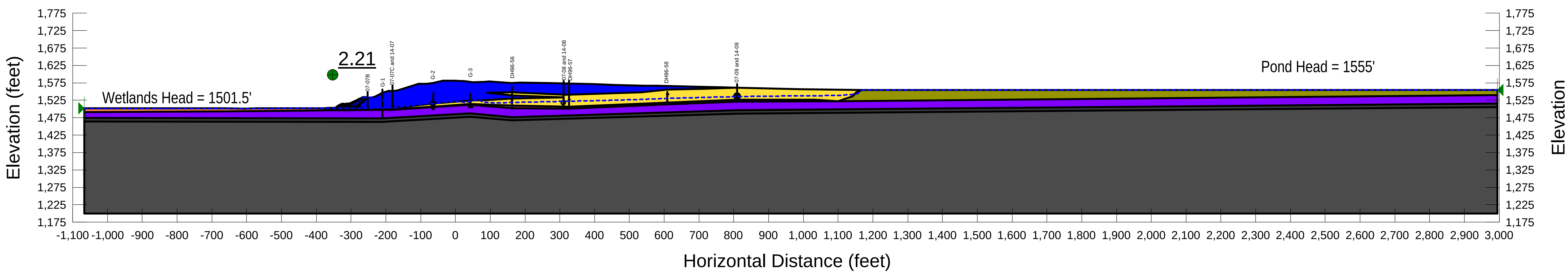
Project #23690862-037

PolyMet Flotation Tailings Basin
Section G 2014 Verification
Date Last Saved: 12/9/2014
File Name: Section G_2014 verification.gsz

1.2.1 No Lifts - ESSA_till wedge (Optimized)
ESSA Strengths
Grid & Radius, Optimized
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 2.21

Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Glacial Till -Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)



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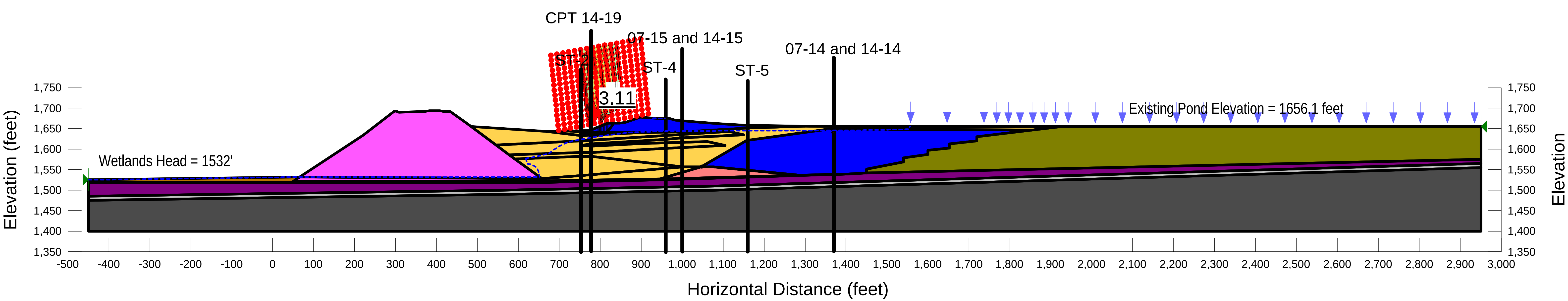
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N 2014 Verification
Date Last Saved: 12/12/2014
File Name: Verification 2014_SectionN.gsz

1.0 No Lifts - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 3.11

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °

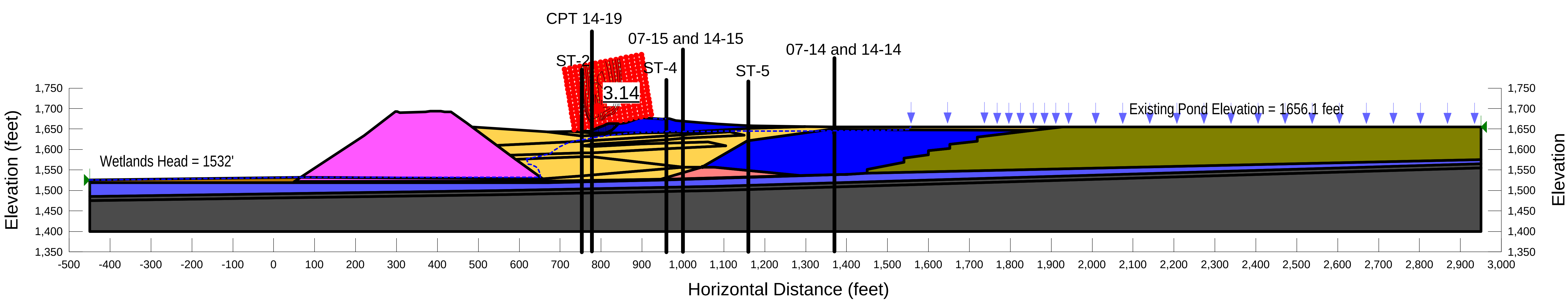


PolyMet Flotation Tailings Basin
Section N 2014 Verification
Date Last Saved: 12/12/2014
File Name: Verification 2014_SectionN.gsz

1.2 No Lifts - ESSA_till wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.14

Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Glacial Till (Impenetrable) Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



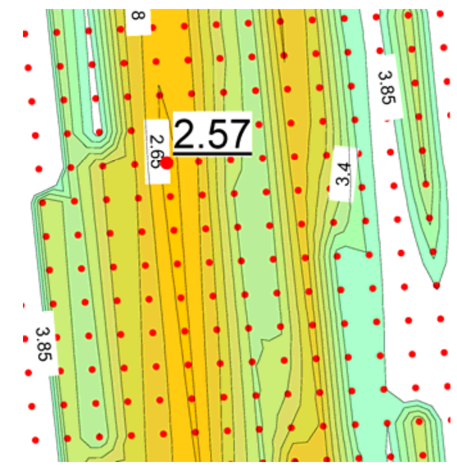
Interim Lifts – Lift 2 (Table 7-6)

Sections F and G – $USSA_{yield}$ and ESSA

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/10/2014
File Name: SecF_Interim Lift 2.gsz

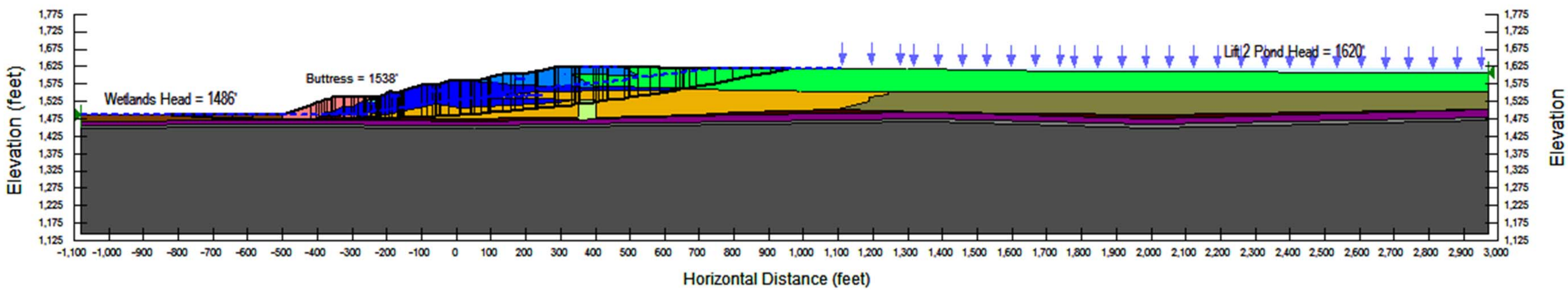
2.0 Lift 2 - USSA (Circular)
Yield USSA strength
Grid & Radius, Circular

Factor of Safety: 2.57



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25



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Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section F
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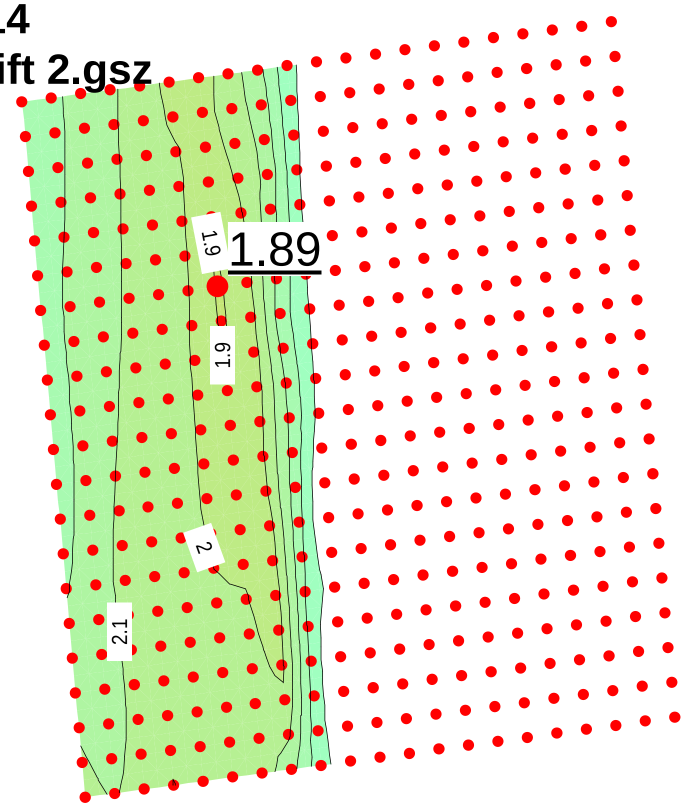
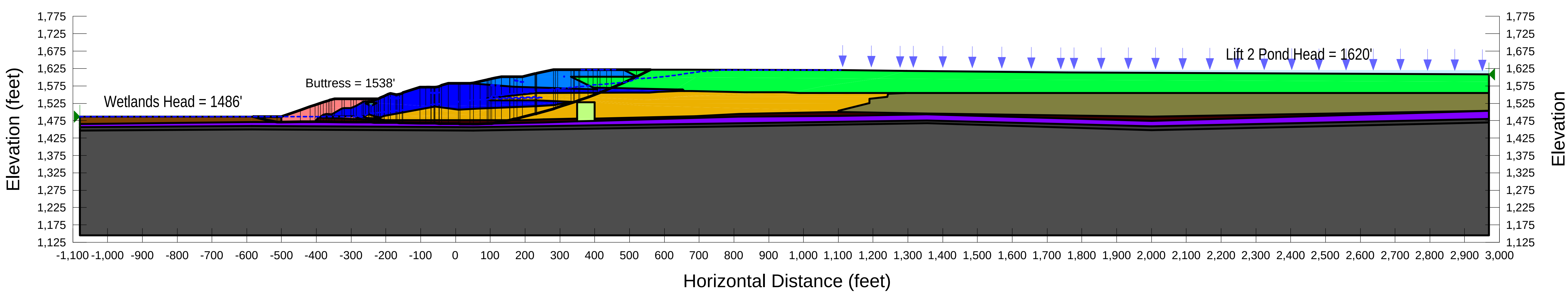
File Name: SecF_Interim Lift 2.gsz

Factor of Safety: 1.89

2.2 Lift 2 - USSA_till wedge (Circular)
Yield USSA strength
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable



Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)

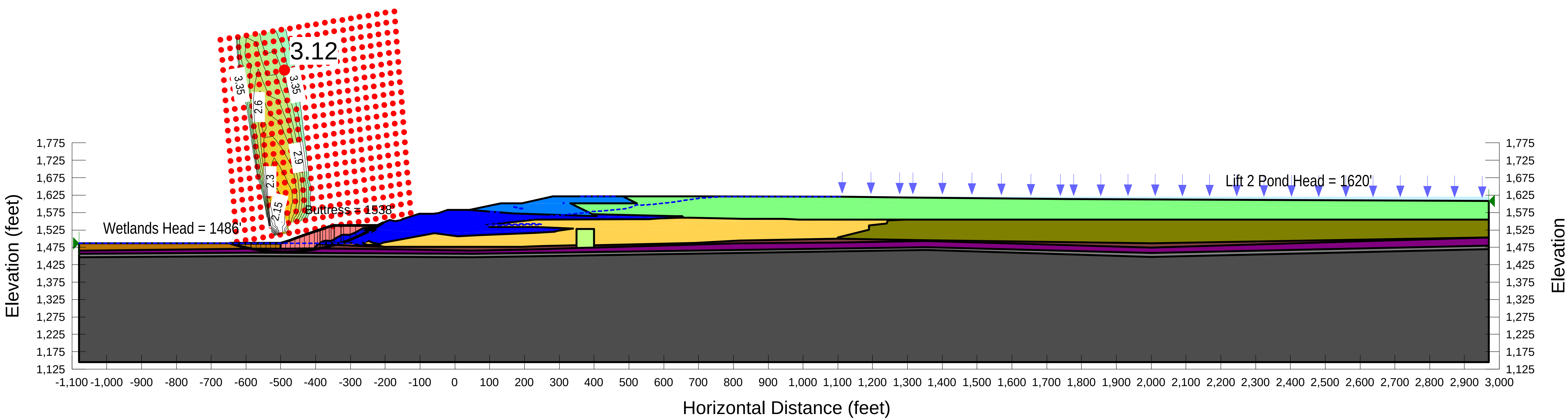


PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/10/2014
File Name: SecF_Interim Lift 2.gsz

1.0 Lift 2 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 3.12

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °



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PolyMet Flotation Tailings Basin
Cross-Section F
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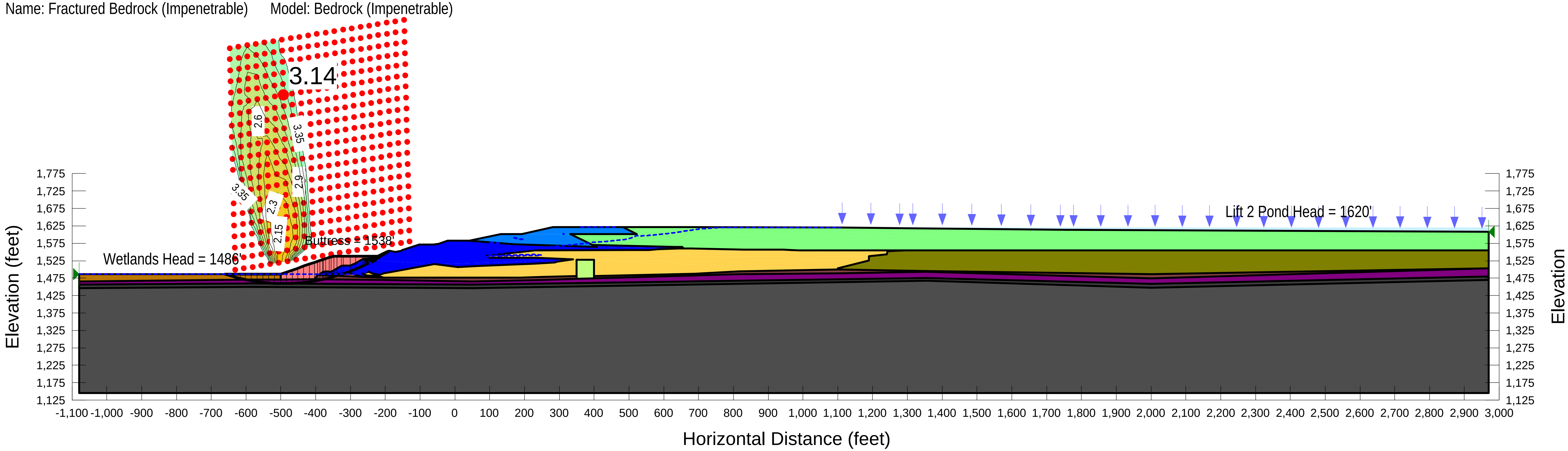
File Name: SecF_Interim Lift 2.gsz

1.1 Lift 2 - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.14

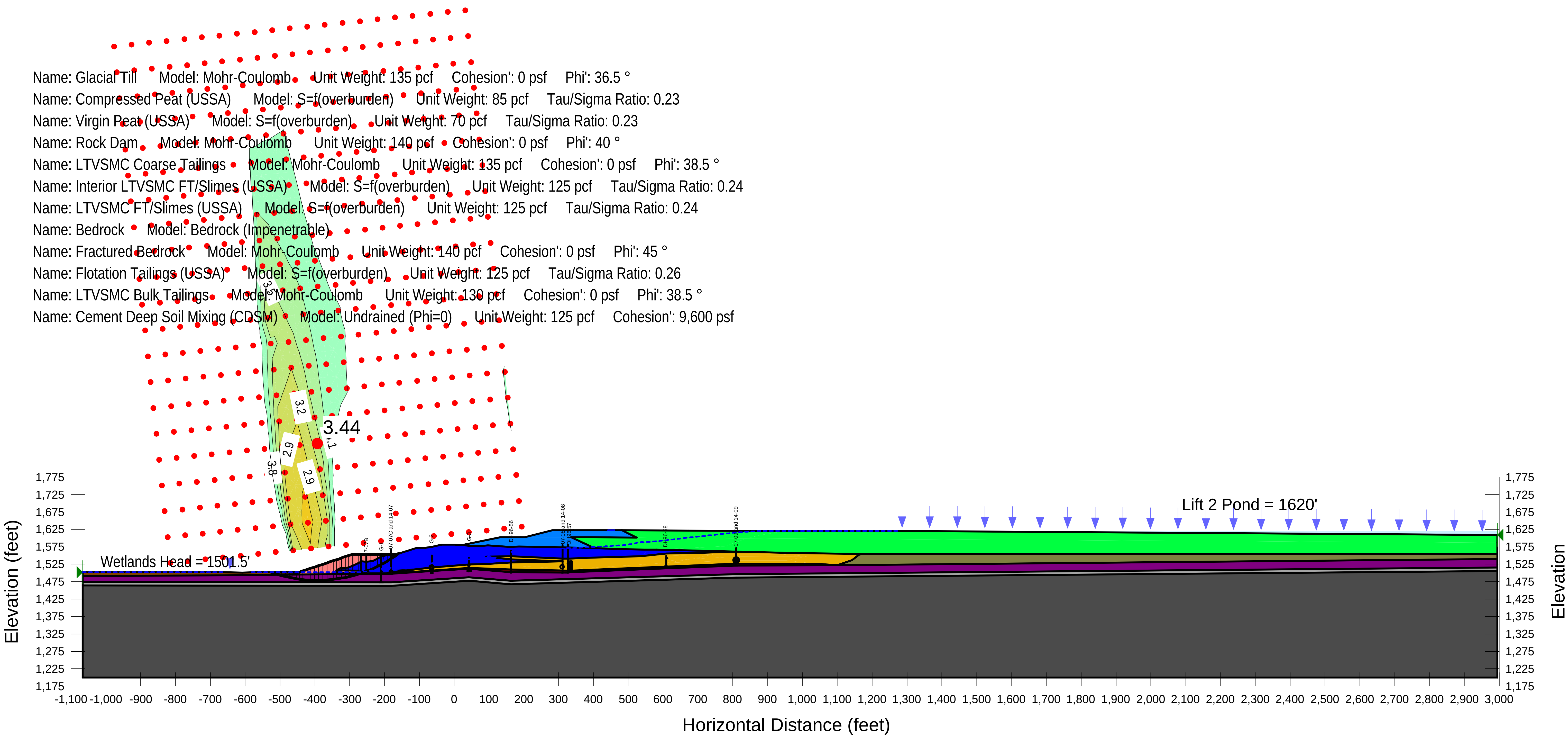
Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)



PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/9/2014
File Name: SecG_Interim Lift 2.gsz

2.0 Lift 2 - USSA (Circular)
USSA Strengths
Grid & Radius, Circular

Factor of Safety: 3.44



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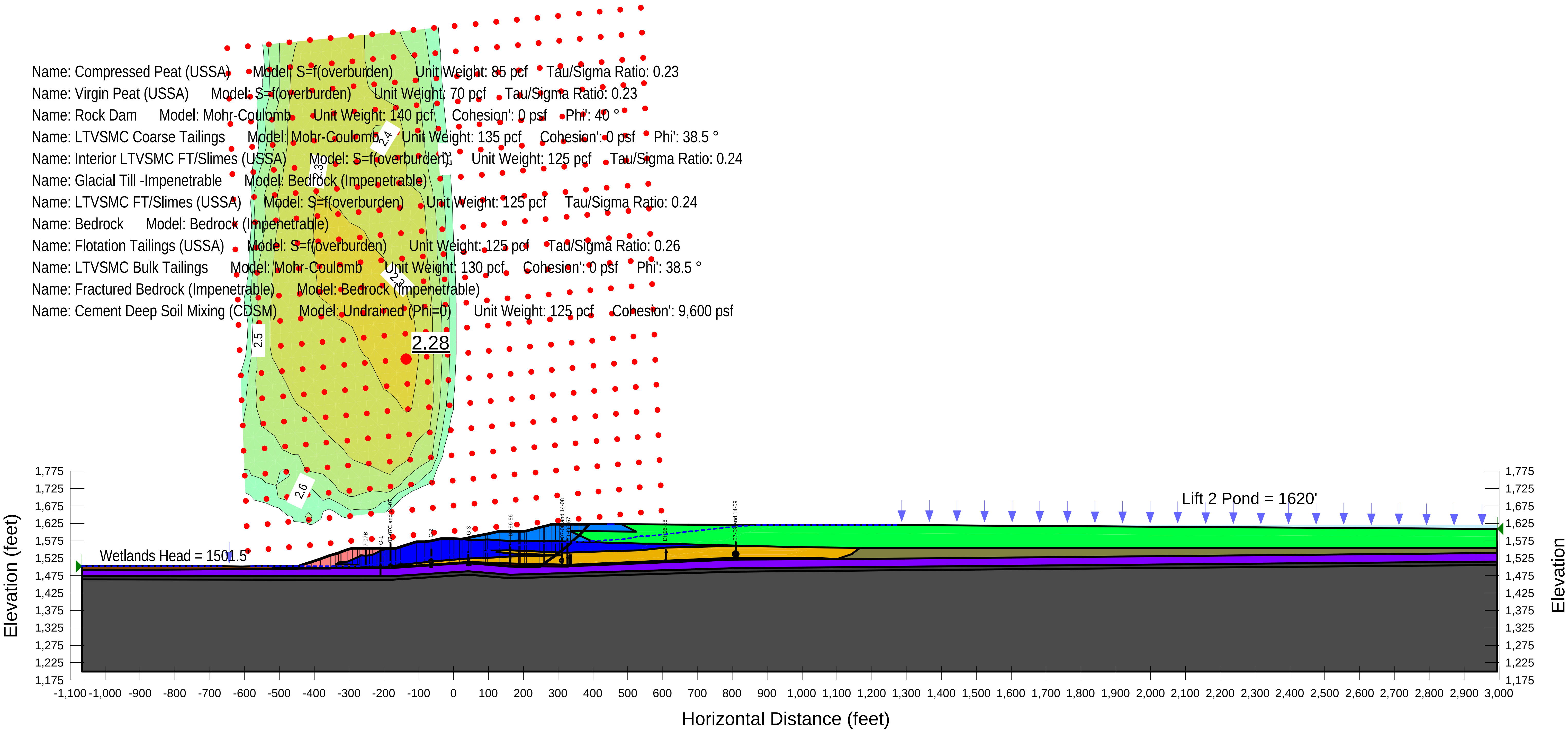
PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/9/2014
File Name: SecG_Interim Lift 2.gsz

2.2 Lift 2 - USSA_till wedge (Circular)
USSA Strengths
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 2.28



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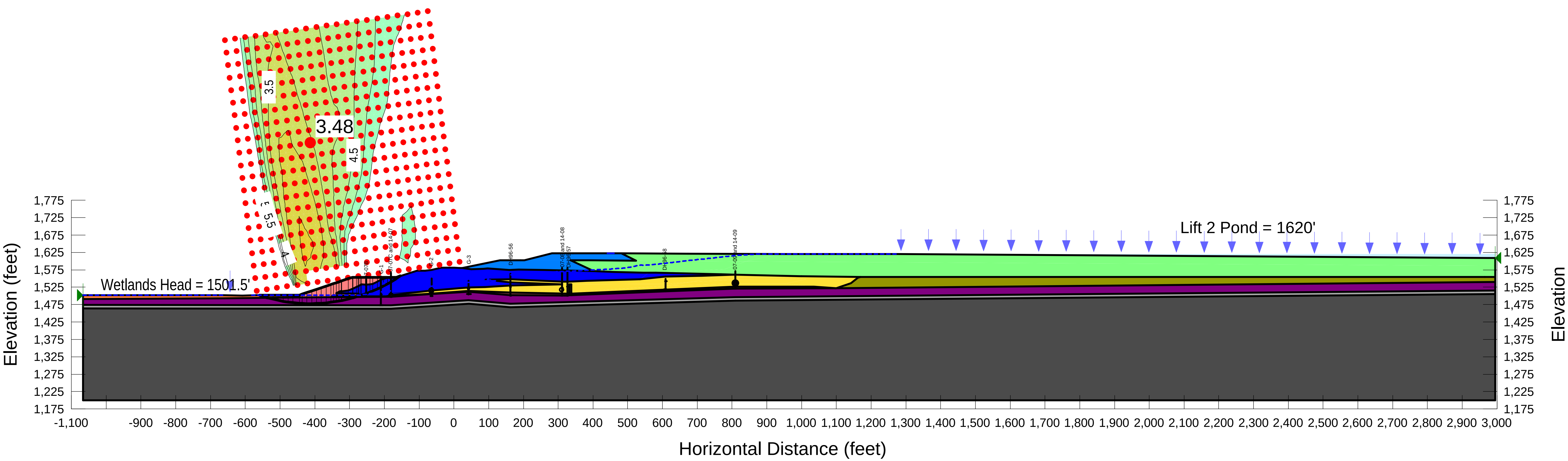
PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: SecG_Interim Lift 2.gsz

1.0 Lift 2 - ESSA (Circular)
ESSA Strengths
Grid & Radius, Circular

Factor of Safety: 3.48

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf

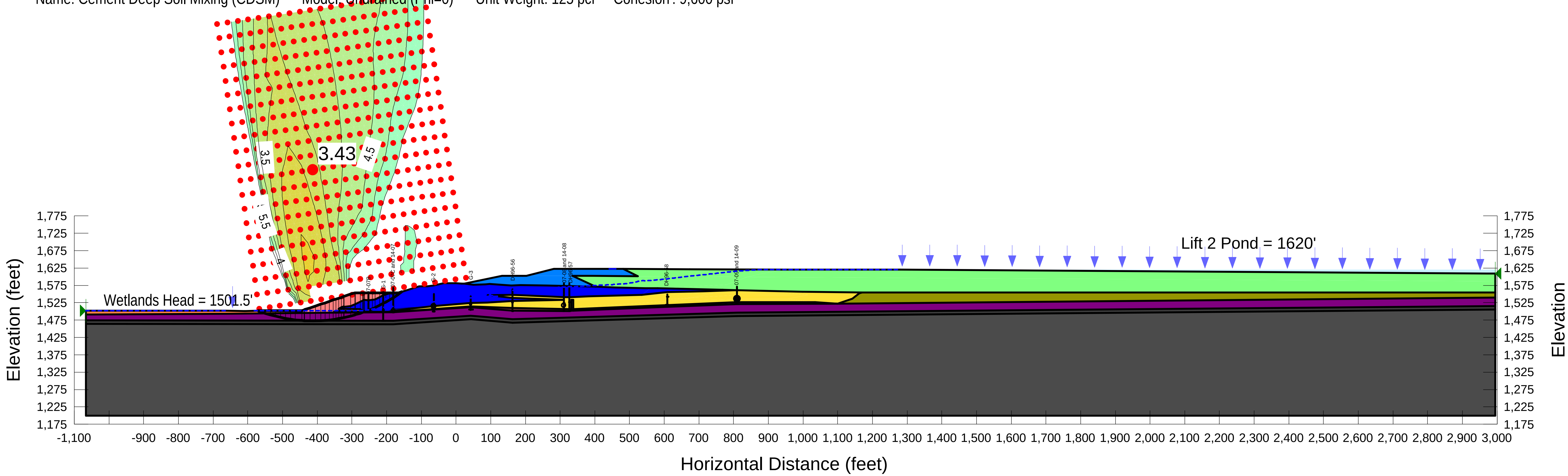


PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: SecG_Interim Lift 2.gsz

1.1 Lift 2 - ESSA_bedrock wedge (Circular)
ESSA Strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.43

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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Interim Lifts – Lift 4 (Table 7-6)

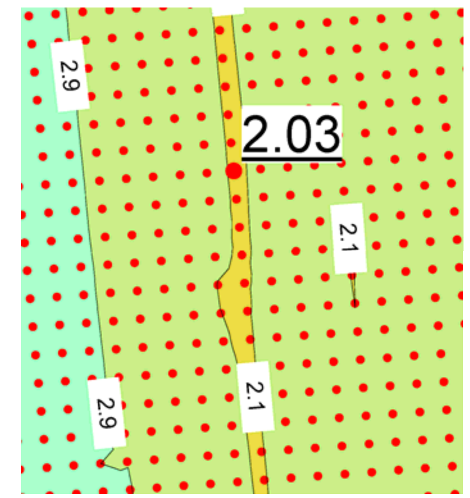
Sections F and G – $USSA_{yield}$ and ESSA

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/10/2014
File Name: SecF_Interim Lift 4.gsz

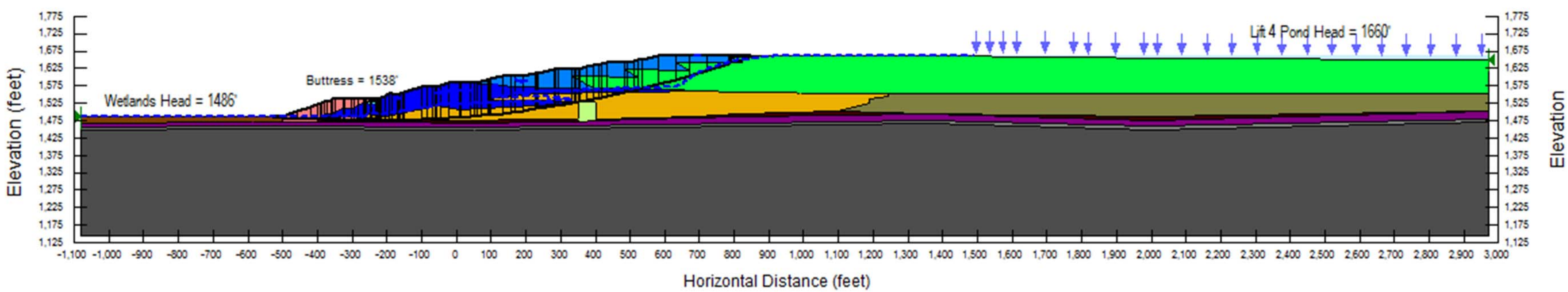
2.0 Lift 4 - USSA (Circular)
Yield USSA strength
Grid & Radius, Circular

Factor of Safety: 2.03

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.

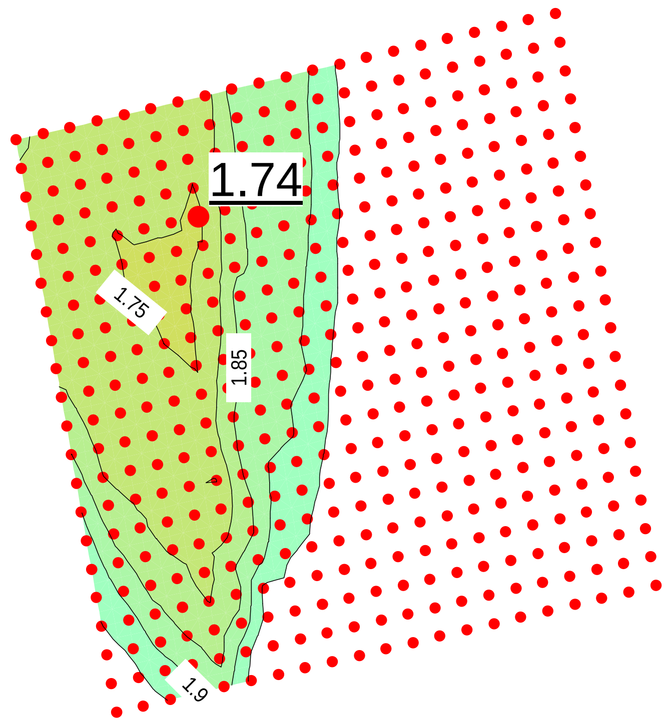


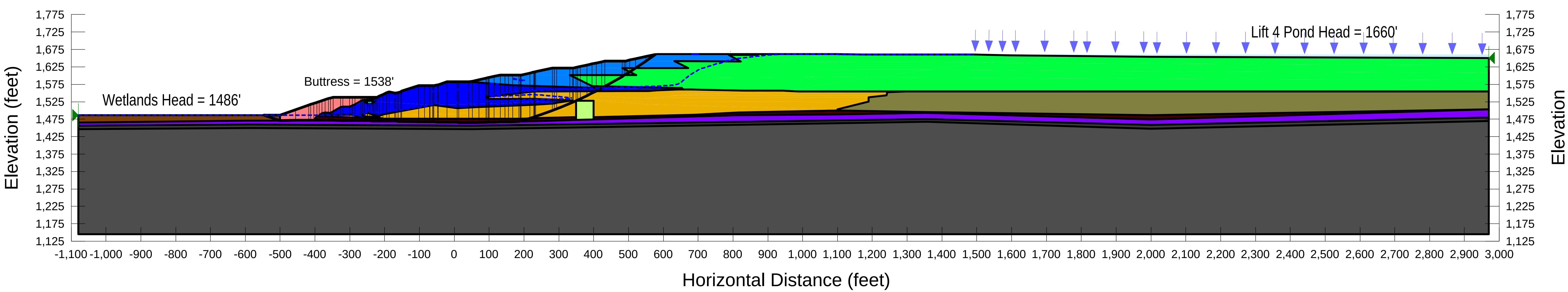
PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/10/2014
File Name: SecF_Interim Lift 4.gsz

2.2 Lift 4 - USSA_till wedge (Circular)
Yield USSA strength
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.74

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)



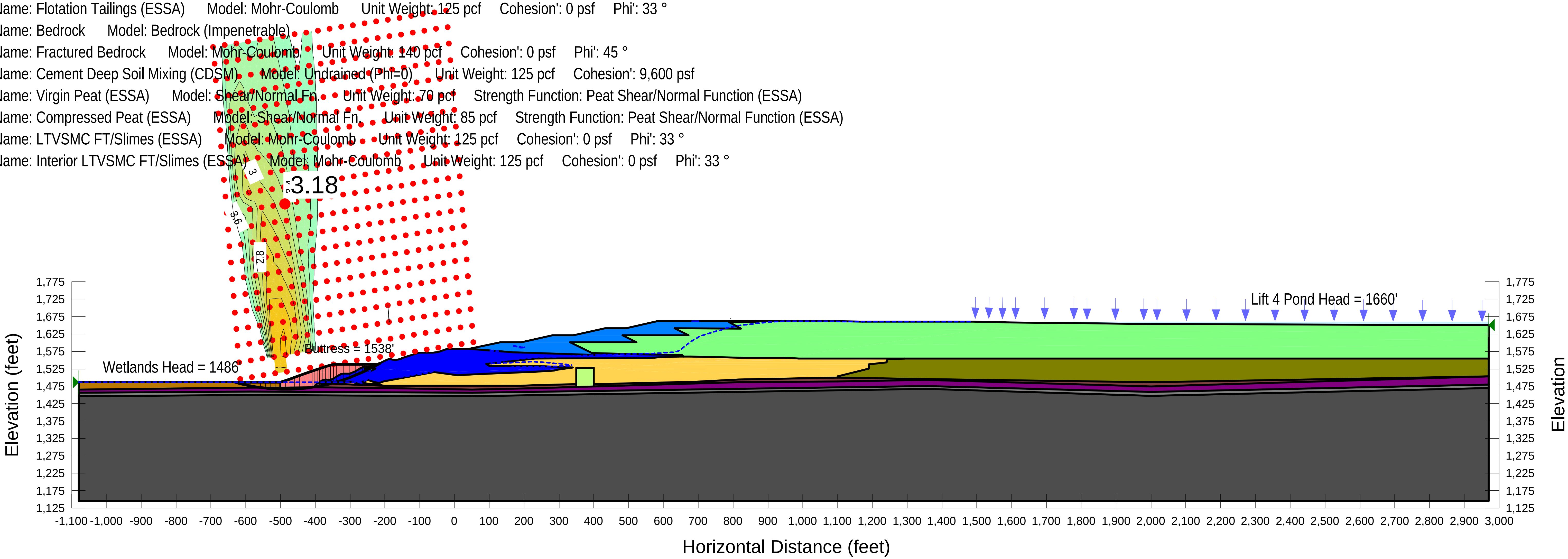


PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/10/2014
File Name: SecF_Interim Lift 4.gsz

1.0 Lift 4 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 3.18

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °



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PolyMet Flotation Tailings Basin
Cross-Section F
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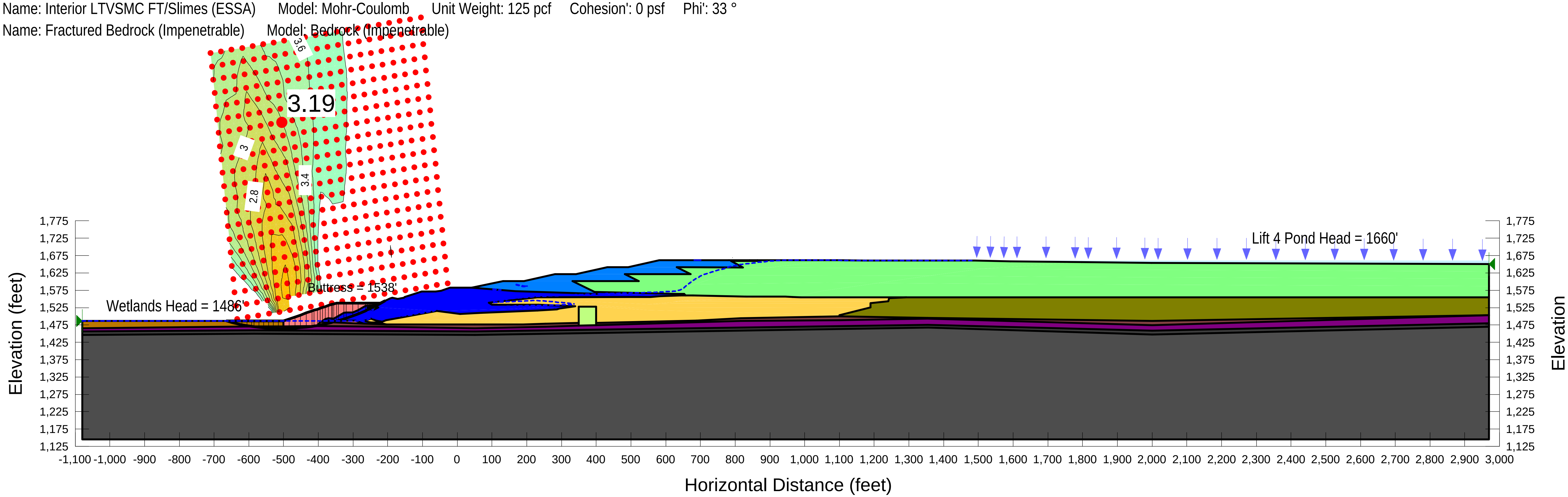
File Name: SecF_Interim Lift 4.gsz

1.1 Lift 4 - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.19

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)



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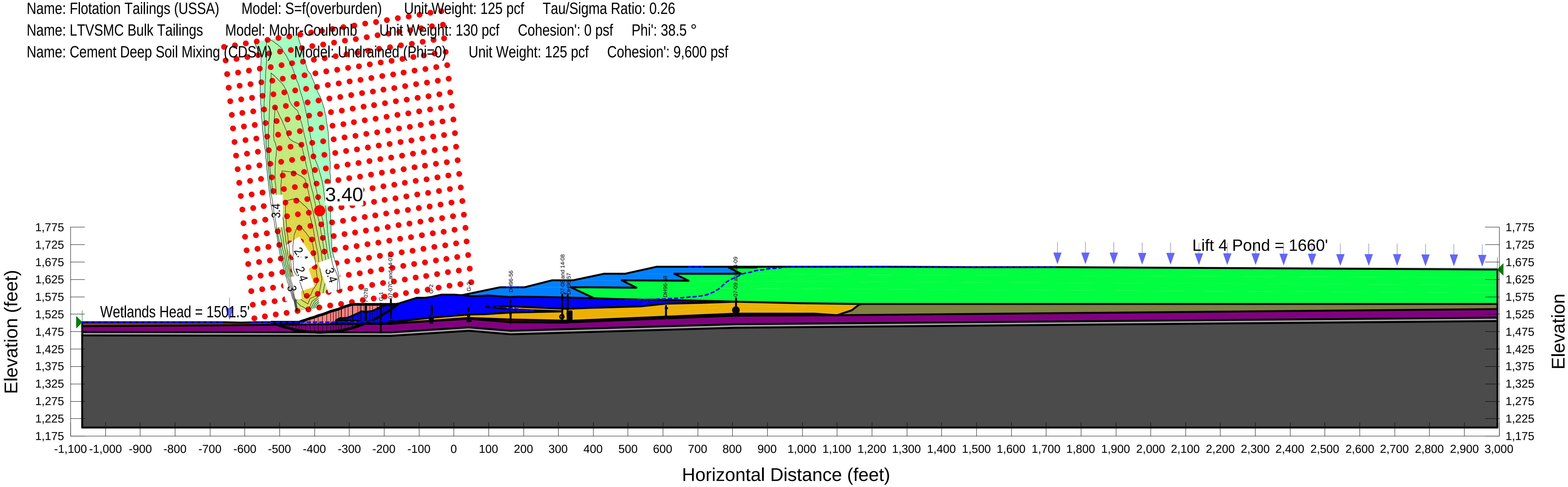
PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: SecG_Interim Lift 4.gsz

2.0 Lift 4 - USSA (Circular)
USSA Strengths
Grid & Radius, Circular

Factor of Safety: 3.40

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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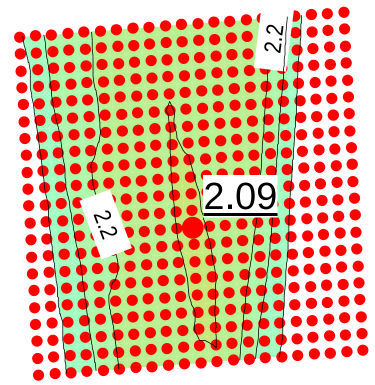
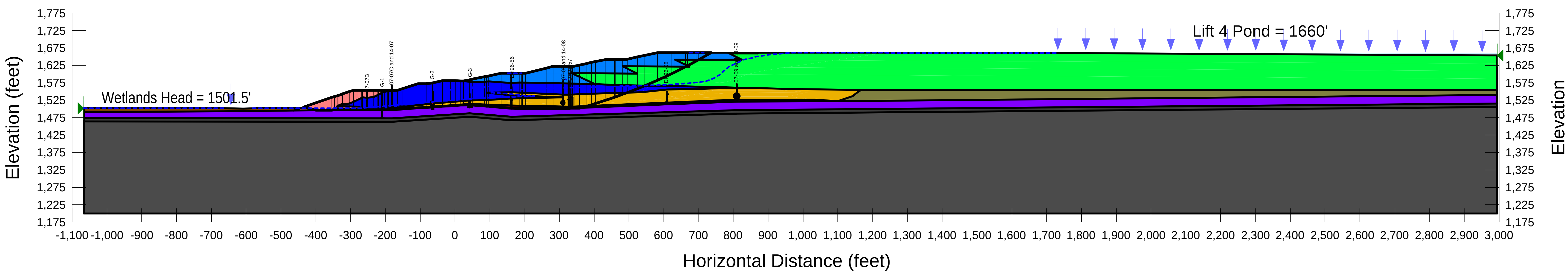
2.2 Lift 4 - USSA_till wedge (Circular)
USSA Strengths
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 2.09



Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Glacial Till -Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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PolyMet Flotation Tailings Basin
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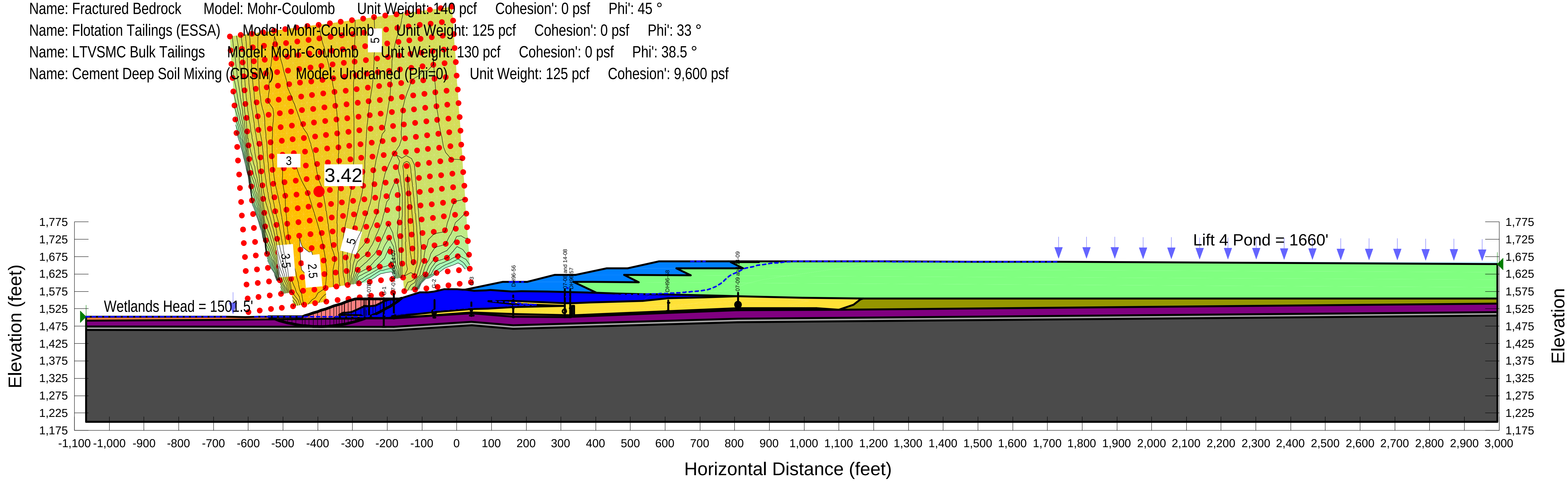
File Name: SecG_Interim Lift 4.gsz

1.0 Lift 4 - ESSA (Circular)
ESSA Strengths
Grid & Radius, Circular

Factor of Safety: 3.42

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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Cross-Section G
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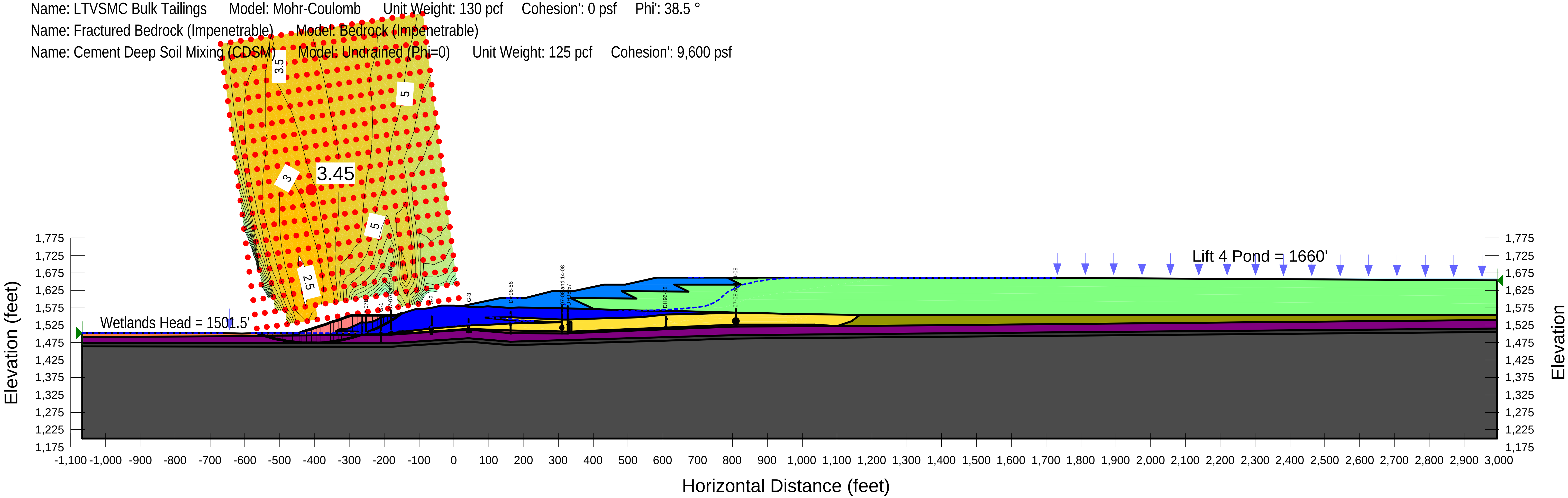
1.1 Lift 4 - ESSA_bedrock wedge (Circular)
ESSA Strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.45

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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Interim Lifts – Lift 6 (Table 7-6)

Sections F, G and N – $USSA_{yield}$ and ESSA

PolyMet Flotation Tailings Basin
Cross-Section F
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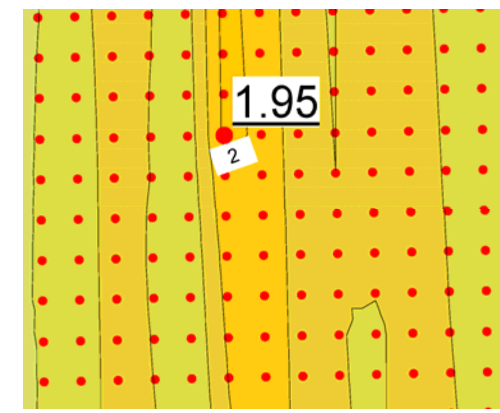
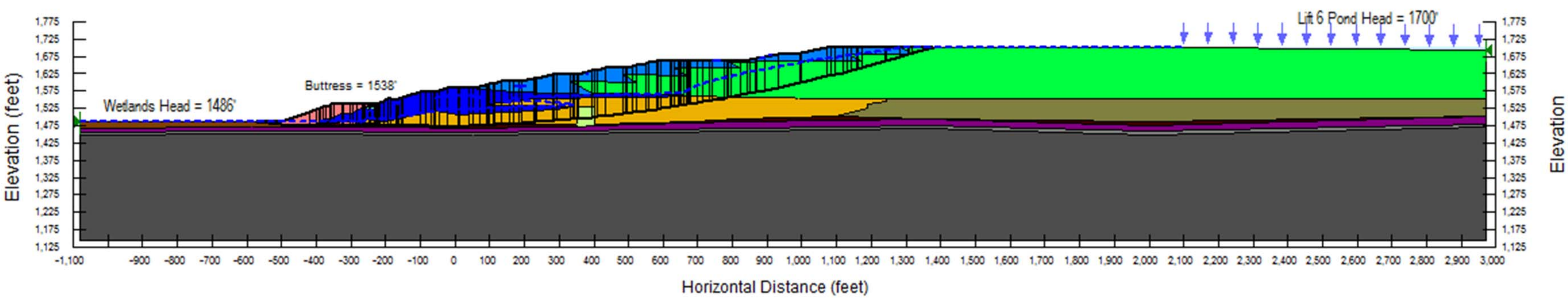
2.0 Lift 6 - USSA (Circular)
Yield USSA strength
Grid & Radius, Circular

Factor of Safety: 1.95

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.



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PolyMet Flotation Tailings Basin
Cross-Section F
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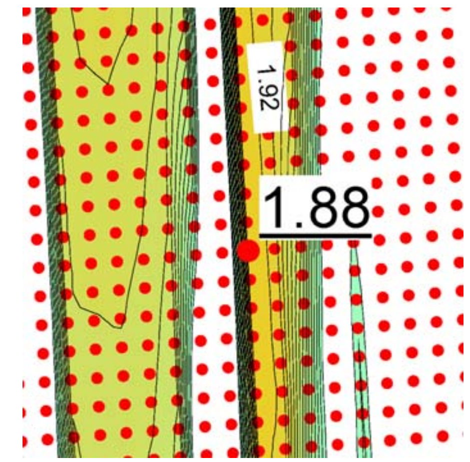
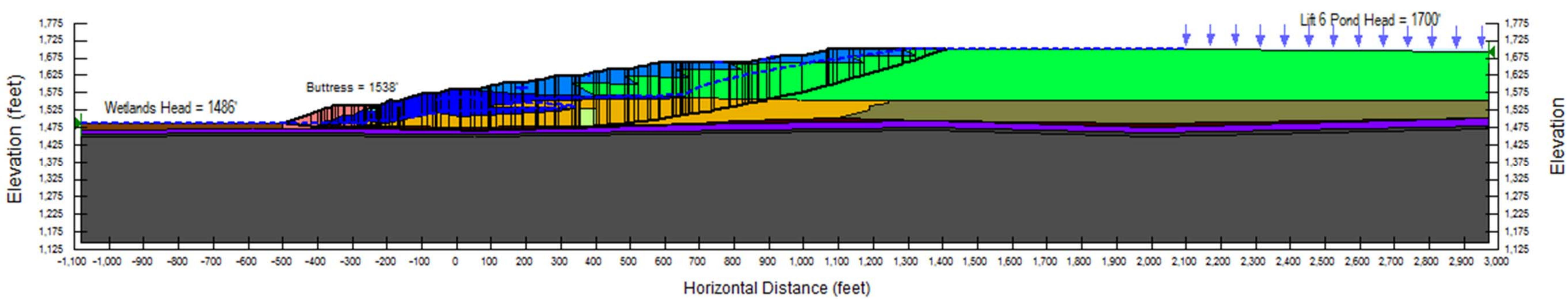
2.2 Lift 6 - USSA_till wedge (Circular)
Yield USSA strength
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.88

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25
Name: Fractured Bedrock (Impenetrable) Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.



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PolyMet Flotation Tailings Basin
Cross-Section F
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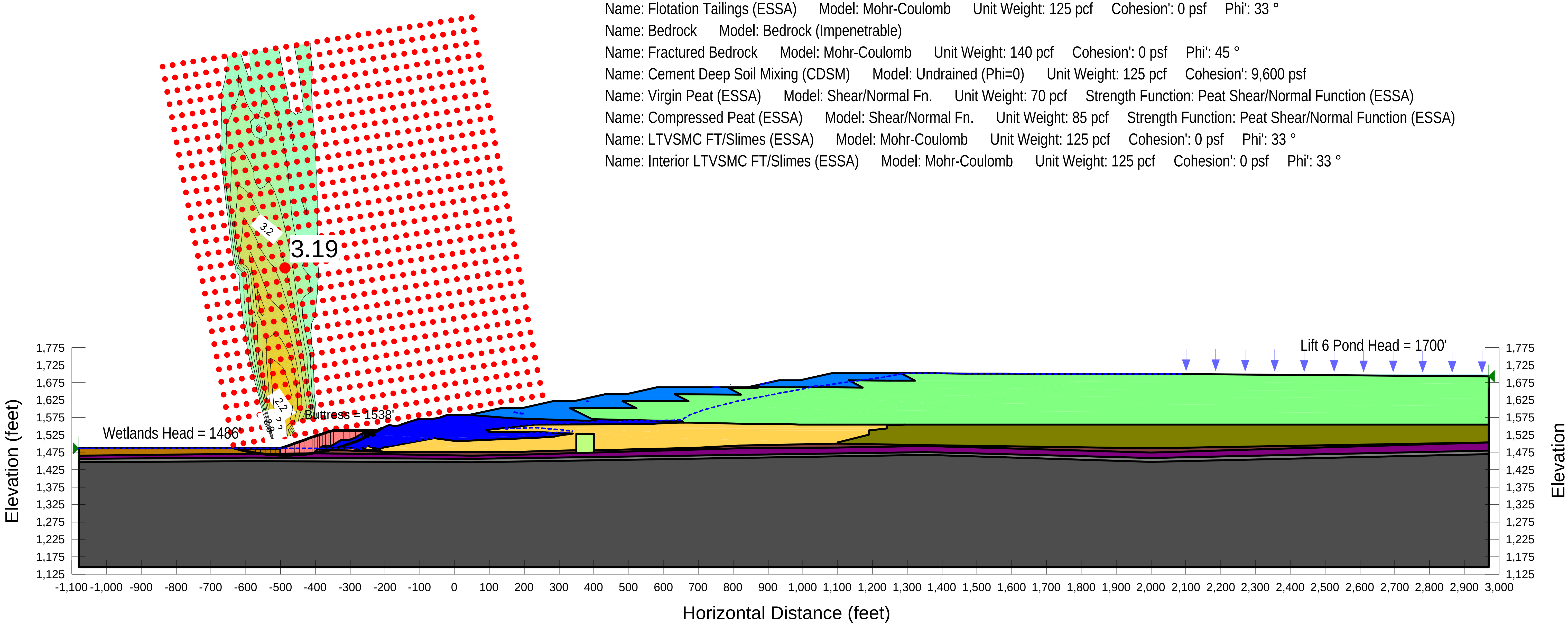
File Name: SecF_Interim Lift 6.gsz

1.0 Lift 6 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 3.19

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °

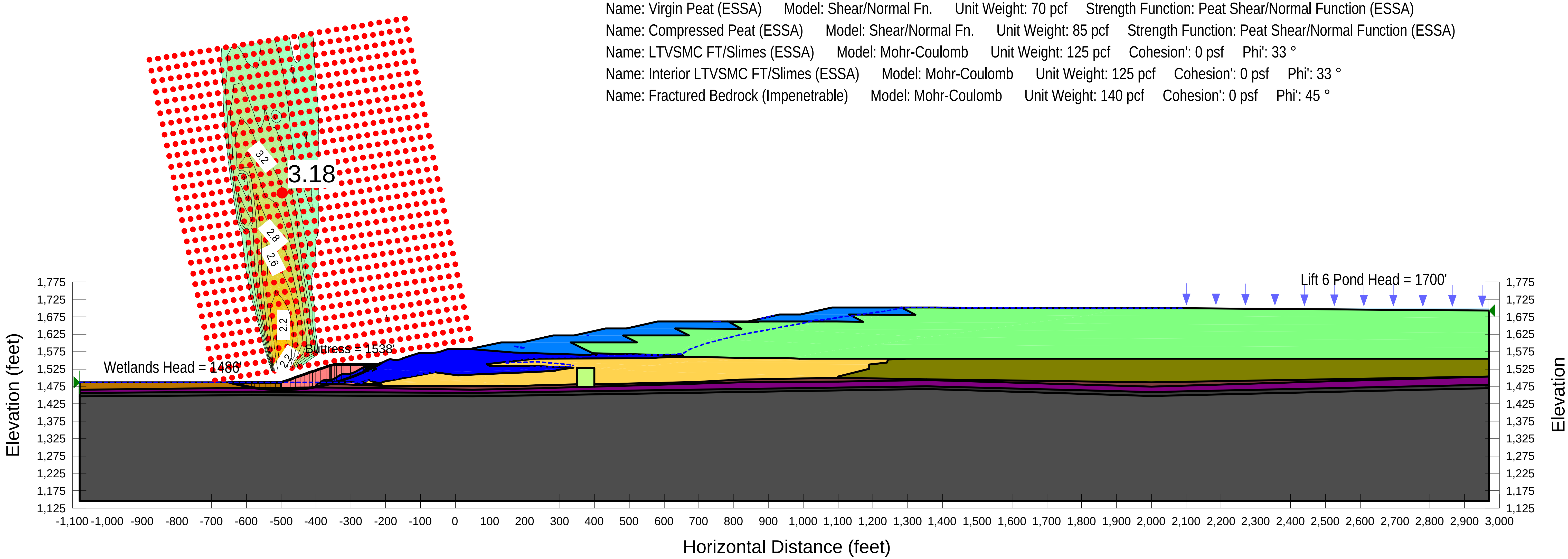


PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/9/2014
File Name: SecF_Interim Lift 6.gsz

1.1 Lift 6 - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.18

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock (Impenetrable) Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °

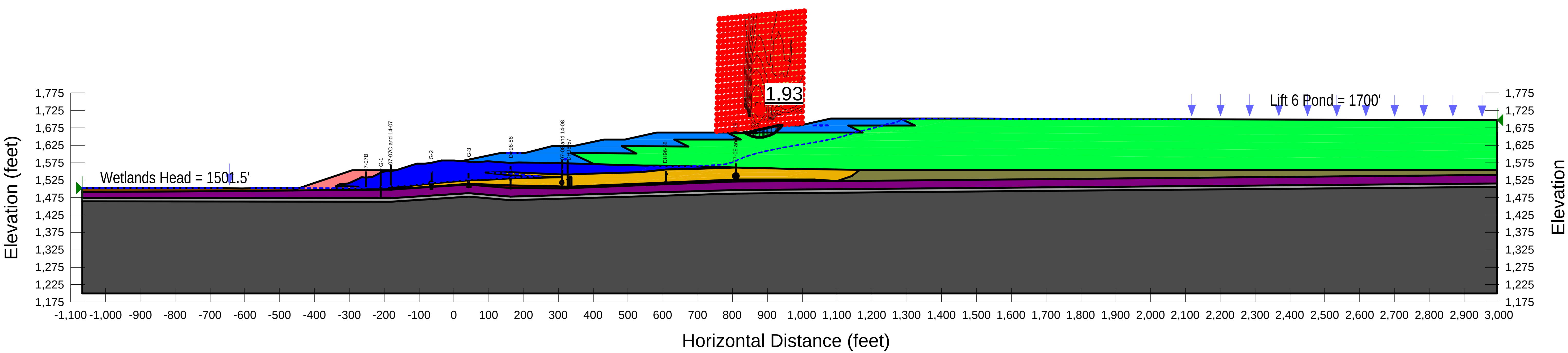


PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: SecG_Interim Lift 6.gsz

2.0 Lift 6 - USSA (Circular)
USSA Strengths
Grid & Radius, Circular

Factor of Safety: 1.93

Name: Glacial Till   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 36.5 °
Name: Compressed Peat (USSA)   Model: S=f(overburden)   Unit Weight: 85 pcf   Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA)   Model: S=f(overburden)   Unit Weight: 70 pcf   Tau/Sigma Ratio: 0.23
Name: Rock Dam   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 40 °
Name: LTVSMC Coarse Tailings   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.24
Name: LTVSMC FT/Slimes (USSA)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.24
Name: Bedrock   Model: Bedrock (Impenetrable)
Name: Fractured Bedrock   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 45 °
Name: Flotation Tailings (USSA)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.26
Name: LTVSMC Bulk Tailings   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM)   Model: Undrained (Phi=0)   Unit Weight: 125 pcf   Cohesion': 9,600 psf



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Cross-Section G
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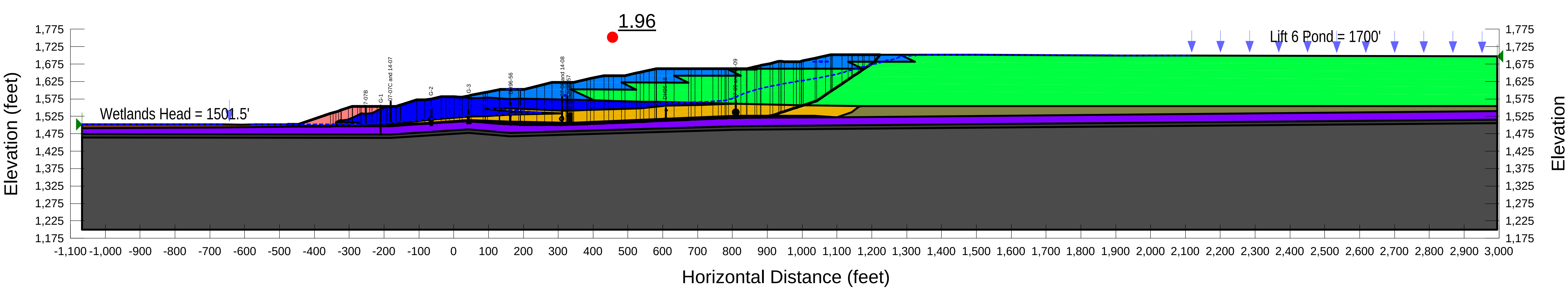
2.2.1 Lift 6 - USSA_till wedge (Optimized)
USSA Strengths
Grid & Radius, Optimized
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.96

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Glacial Till -Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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PolyMet Flotation Tailings Basin
Cross-Section G
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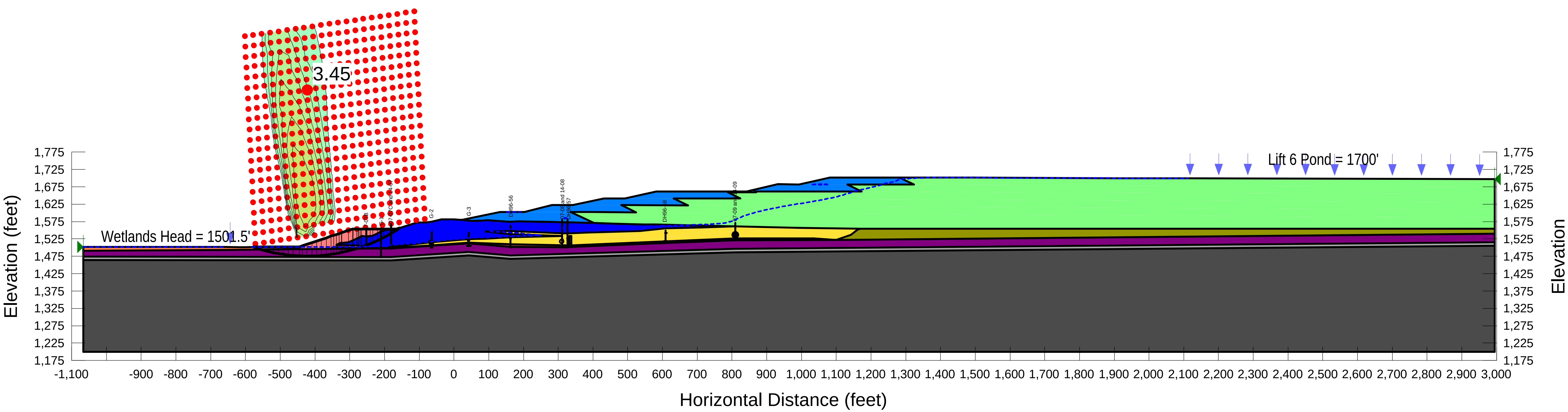
File Name: SecG_Interim Lift 6.gsz

1.0 Lift 6 - ESSA (Circular)
ESSA Strengths
Grid & Radius, Circular

Factor of Safety: 3.45

Name: Glacial Till   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 36.5 °
Name: Rock Dam   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 40 °
Name: LTVSMC Coarse Tailings   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Compressed Peat (ESSA)   Model: Shear/Normal Fn.   Unit Weight: 85 pcf   Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: Bedrock   Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA)   Model: Shear/Normal Fn.   Unit Weight: 70 pcf   Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: Fractured Bedrock   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 45 °
Name: Flotation Tailings (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: LTVSMC Bulk Tailings   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM)   Model: Undrained (Phi=0)   Unit Weight: 125 pcf   Cohesion': 9,600 psf



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PolyMet Flotation Tailings Basin
Cross-Section G
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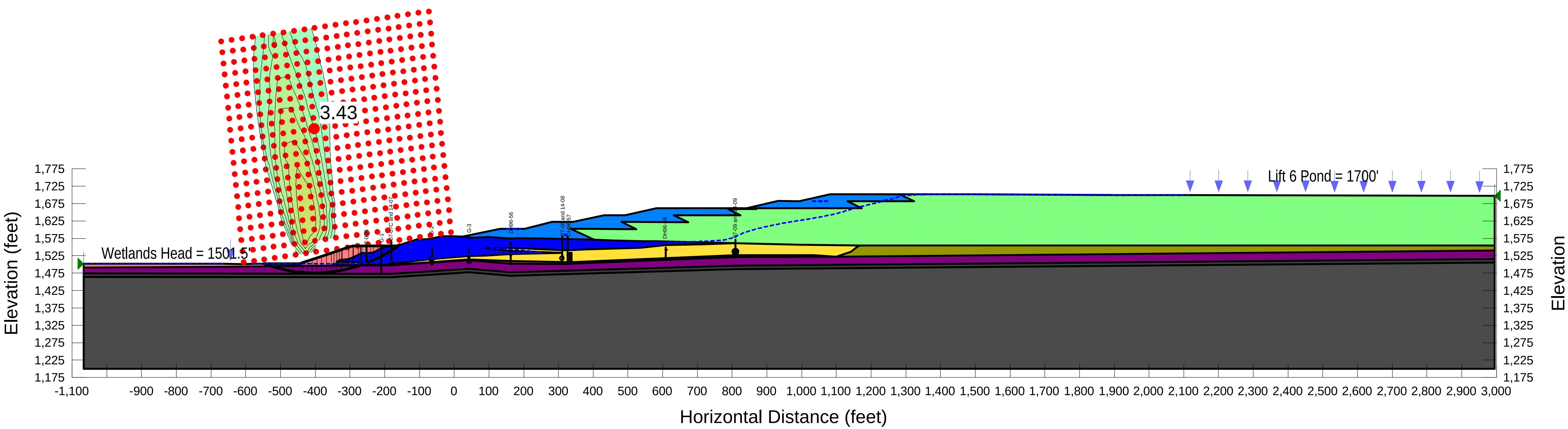
1.1 Lift 6 - ESSA_bedrock wedge (Circular)
ESSA Strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.43

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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PolyMet Flotation Tailings Basin
Section N
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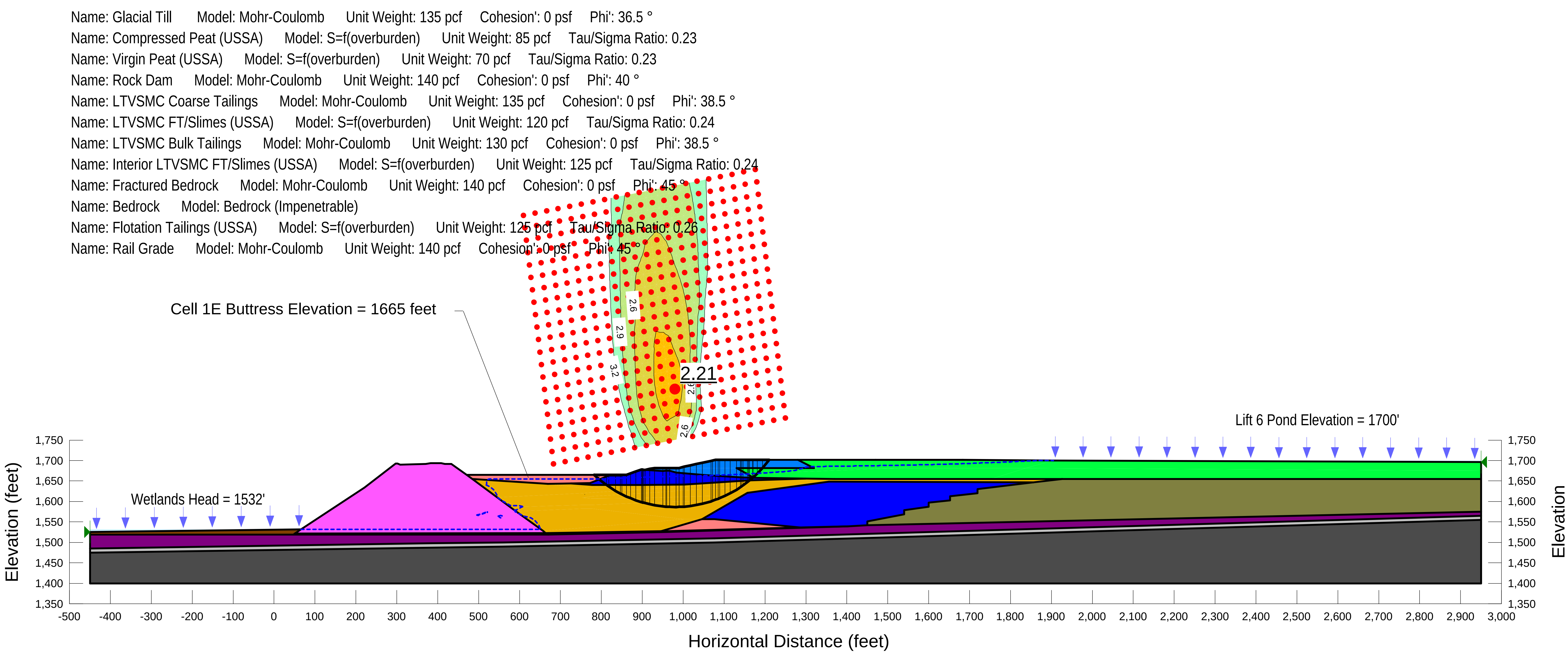
File Name: Section N_Interim Lift 6.gsz

Case: 2.0 Lift 6 - USSA (Circular)
Yield USSA strengths
Grid & Radius, Circular

Factor of Safety: 2.21



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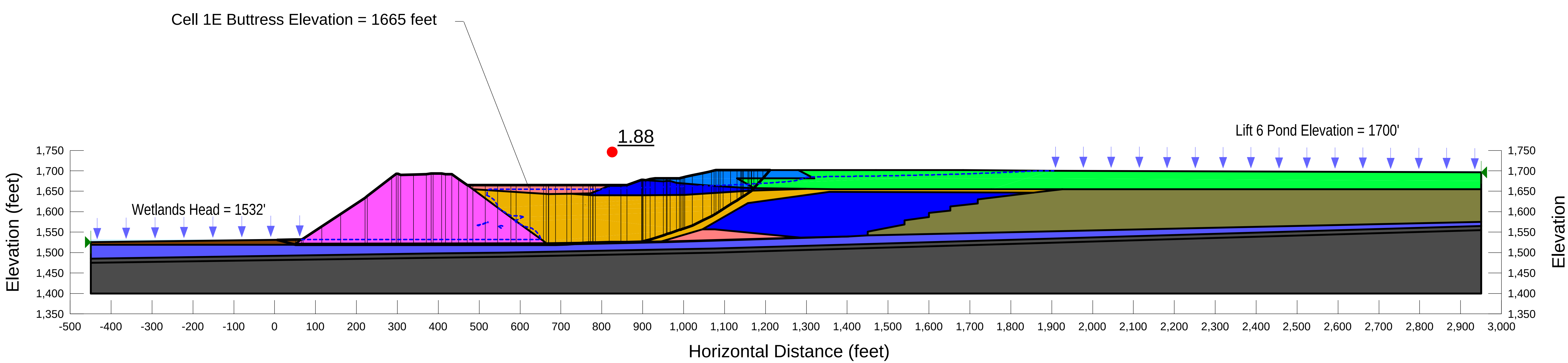
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/15/2014
File Name: Section N_Interim Lift 6.gsz

Case: 2.2.1 Lift 6 - USSA_till wedge (Optimized)
Yield USSA strengths
Grid & Radius, Optimized
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.88

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 120 pcf Tau/Sigma Ratio: 0.24
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Glacial Till (Impenetrable) Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °

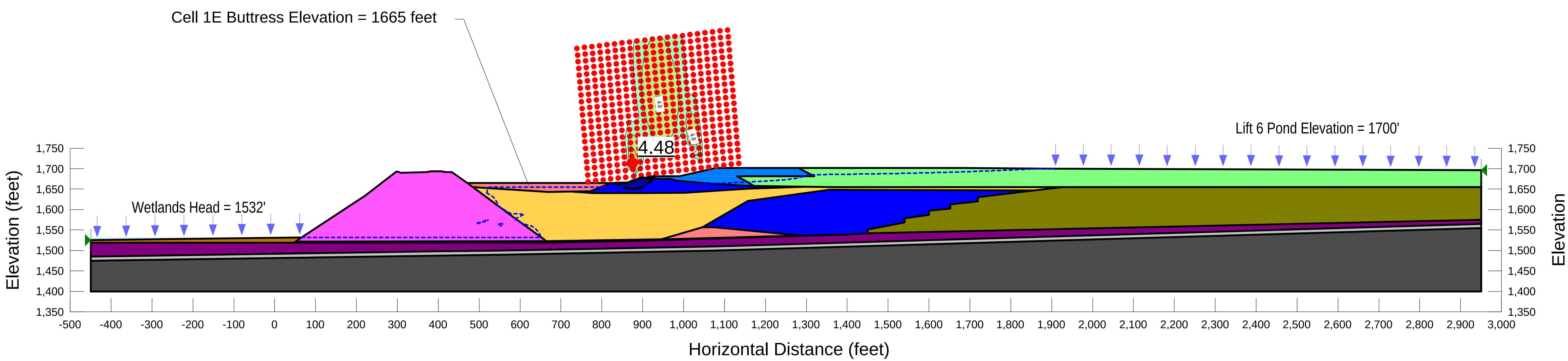


PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/15/2014
File Name: Section N_Interim Lift 6.gsz

Case: 1.0 Lift 6 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 4.48

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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PolyMet Flotation Tailings Basin
Section N
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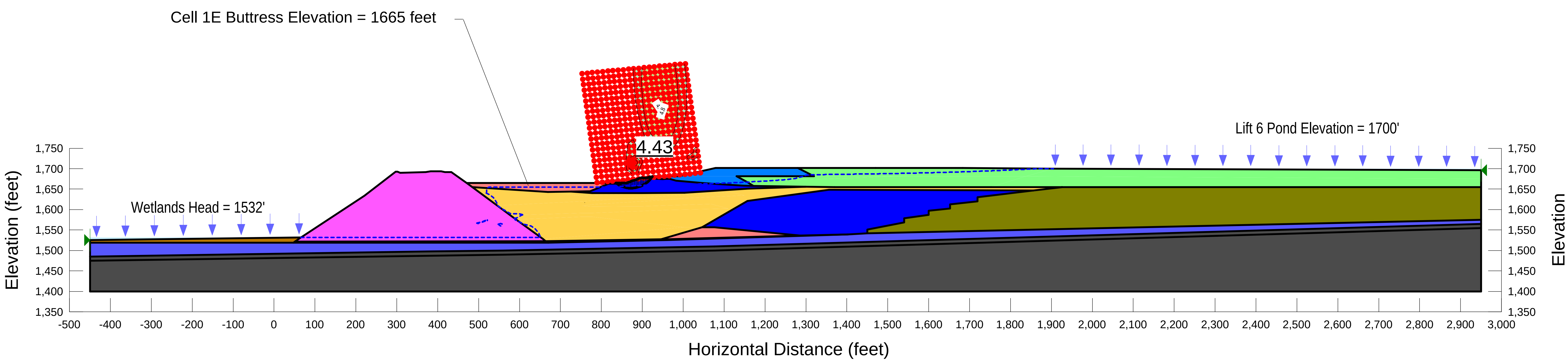
Case: 1.3 Lift 6 - ESSA_peat wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Peat, Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 4.43

Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Glacial Till (Impenetrable) Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Compressed Peat (Impenetrable) Model: Bedrock (Impenetrable)
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



Maximum Dam Height with Normal Pool – Lift 8 (Table 7-7)

Sections F, G and N – $USSA_{yield}$ and ESSA

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/8/2014
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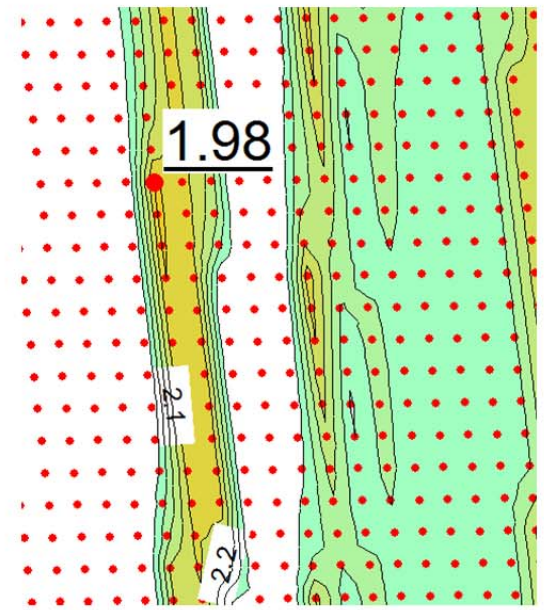
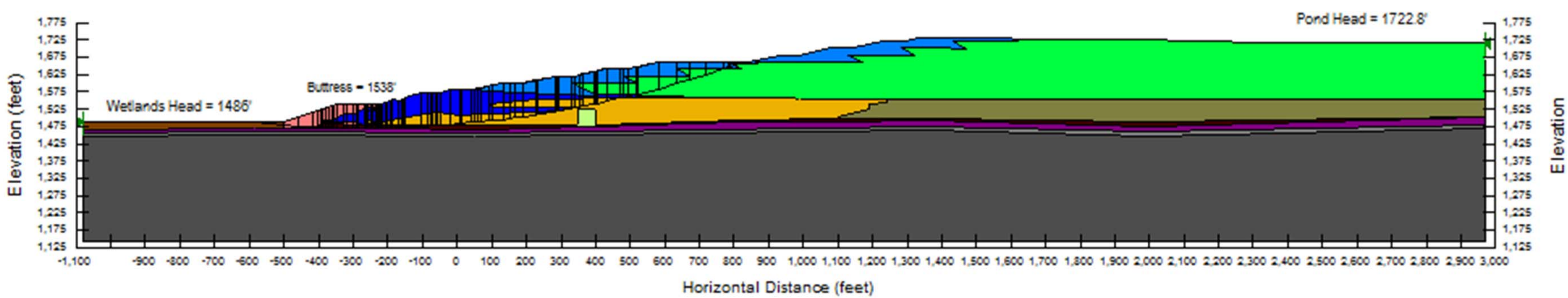
2.0 Lift 8 - USSA (Circular)
Yield USSA strength
Grid & Radius, Circular

Factor of Safety: 1.98

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.



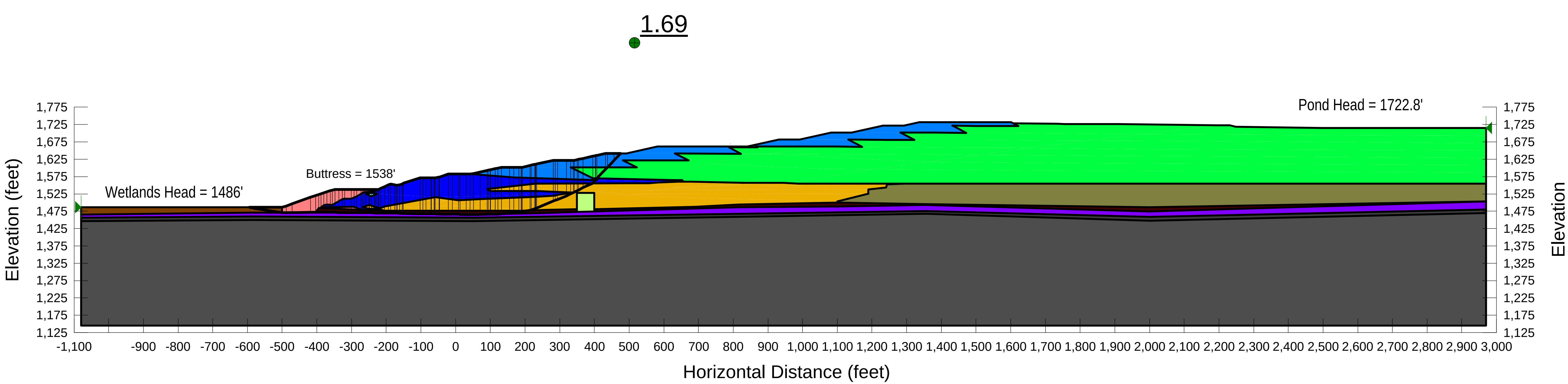
PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/8/2014
File Name: SecF_Lift8_Normal Pool.gsz

2.2.1 Lift 8 - USSA_till wedge (Optimized)
Yield USSA strength
Grid & Radius, Optimized
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.69

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)

Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.



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PolyMet Flotation Tailings Basin
Cross-Section F
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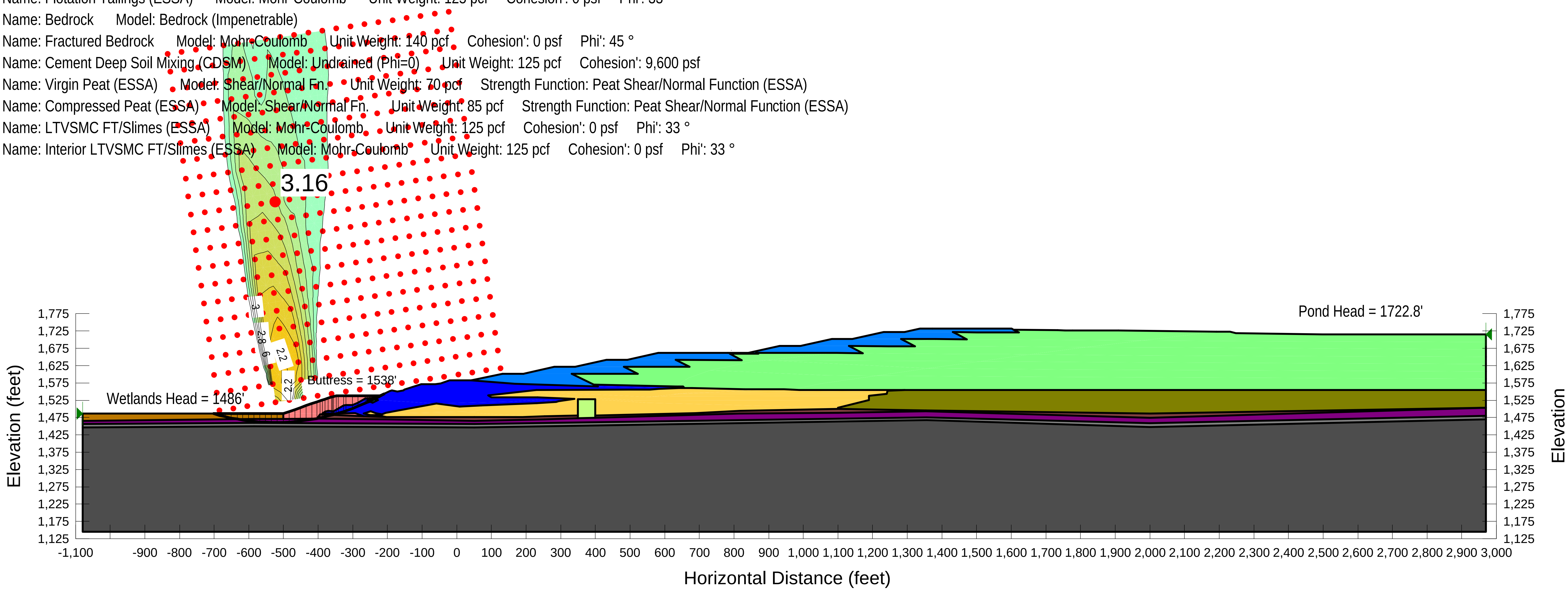
1.0 Lift 8 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 3.16

Name: Glacial Till   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 36.5 °
Name: Rock Dam   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 40 °
Name: LTVSMC Coarse Tailings   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA)   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 33 °
Name: LTVSMC Bulk Tailings   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Flotation Tailings (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: Bedrock   Model: Bedrock (Impenetrable)
Name: Fractured Bedrock   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM)   Model: Undrained (Phi=0)   Unit Weight: 125 pcf   Cohesion': 9,600 psf
Name: Virgin Peat (ESSA)   Model: Shear/Normal Fn.   Unit Weight: 70 pcf   Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA)   Model: Shear/Normal Fn.   Unit Weight: 85 pcf   Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °



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PolyMet Flotation Tailings Basin
Cross-Section F
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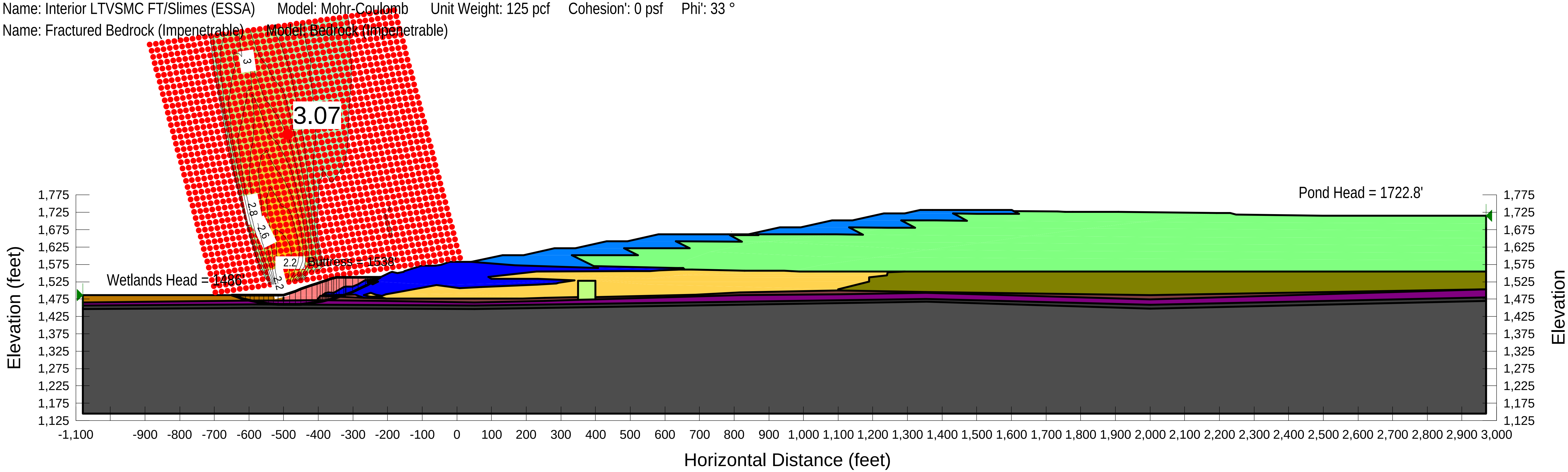
1.1 Lift 8 - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.07

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)



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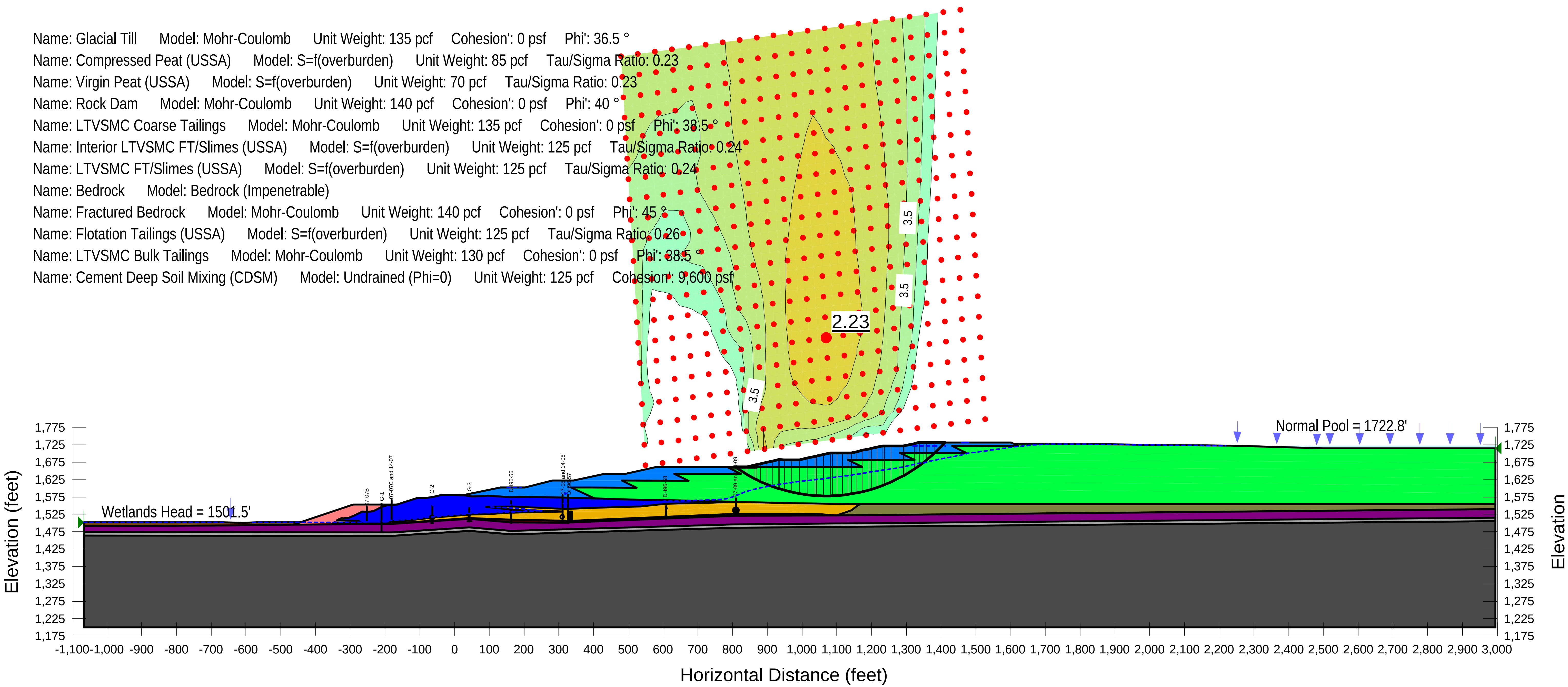
PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: SecG_Lift8_Normal Pool.gsz

2.0 Lift 8 - USSA (Circular)
USSA Strengths
Grid & Radius, Circular

Factor of Safety: 2.23

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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Cross-Section G
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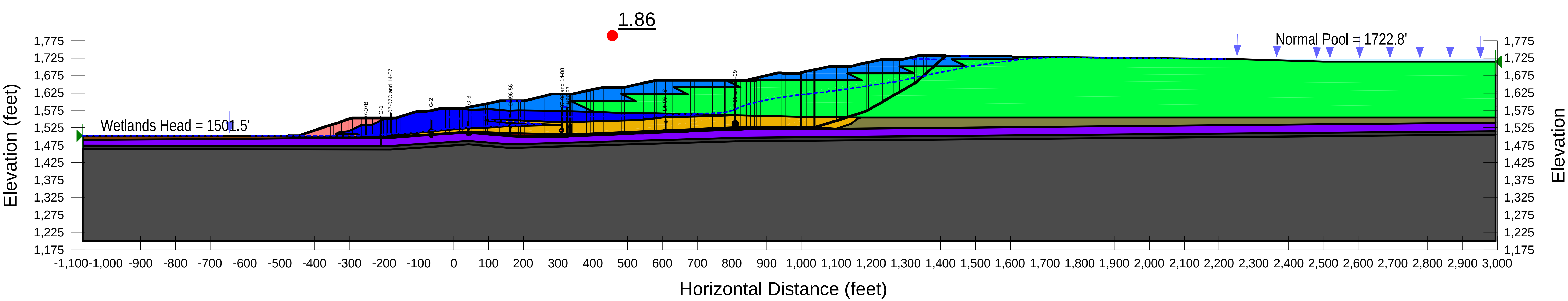
File Name: SecG_Lift8_Normal Pool.gsz

2.2.1 Lift 8 - USSA_till wedge (Optimized)
USSA Strengths
Grid & Radius, Optimized
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.86

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Glacial Till -Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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Cross-Section G
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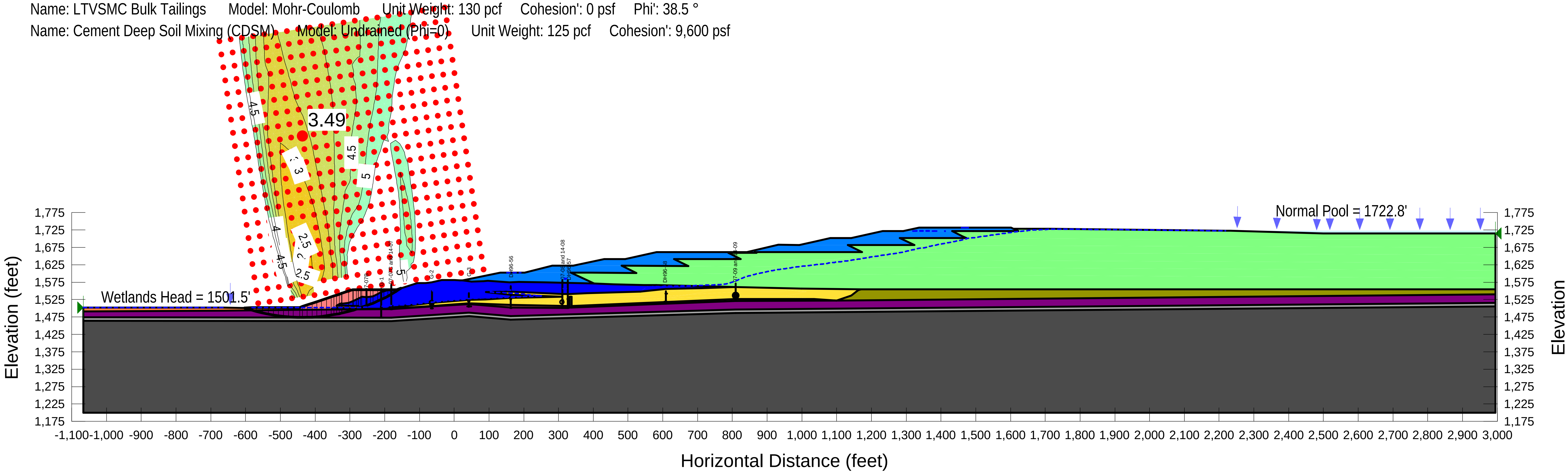
1.0 Lift 8 - ESSA (Circular)
ESSA Strengths
Grid & Radius, Circular

Factor of Safety: 3.49

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion: 9,600 psf



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PolyMet Flotation Tailings Basin
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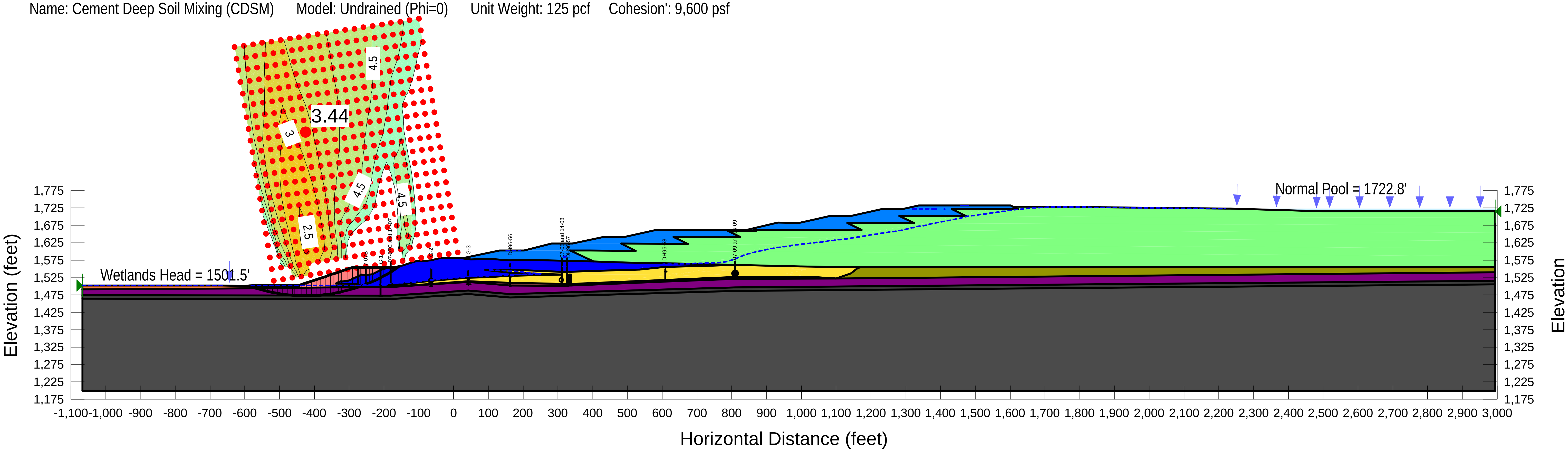
1.1 Lift 8 - ESSA_bedrock wedge (Circular)
ESSA Strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.44

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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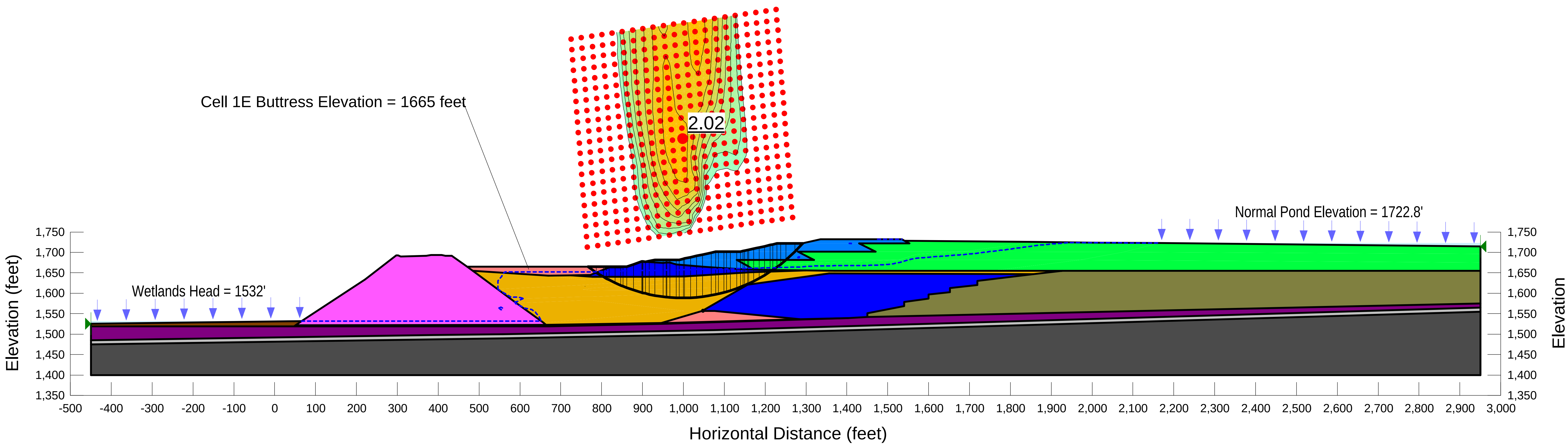
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_Normal Pool.gsz

Case: 2.0 Lift 8 - USSA (Circular)
Yield USSA strengths
Grid & Radius, Circular

Factor of Safety: 2.02

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 120 pcf Tau/Sigma Ratio: 0.24
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °

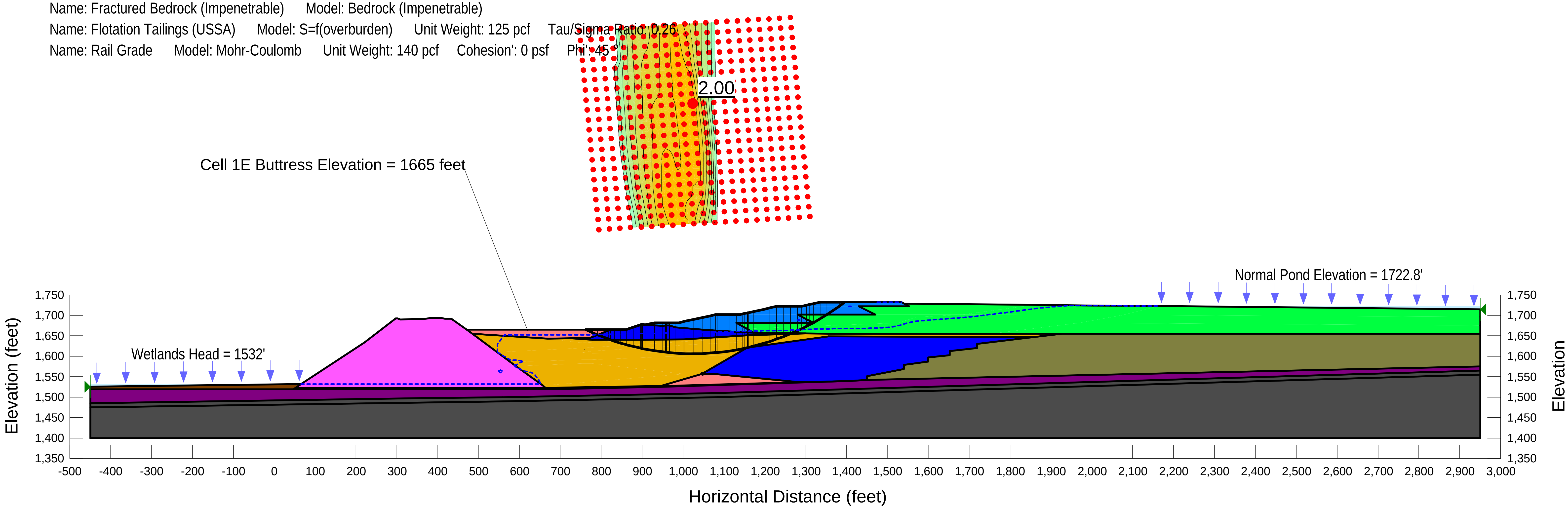


PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_Normal Pool.gsz

Case: 2.1 Lift 8 - USSA_bedrock wedge (Circular)
Yield USSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 2.00

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 120 pcf Tau/Sigma Ratio: 0.24
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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PolyMet Flotation Tailings Basin
Section N
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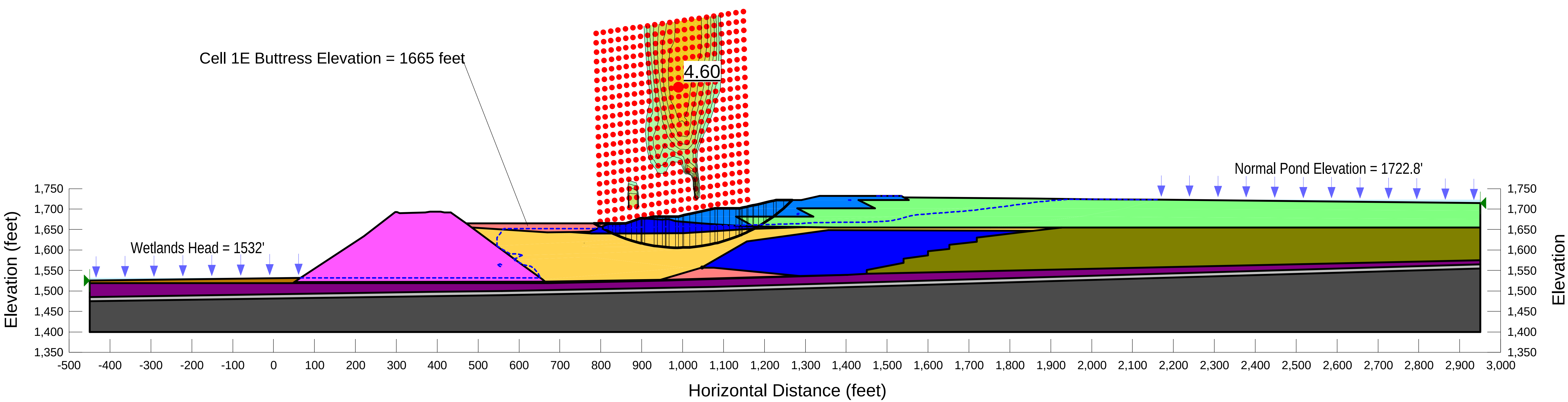
File Name: Section N_Lift8_Normal Pool.gsz

Case: 1.0 Lift 8 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 4.60

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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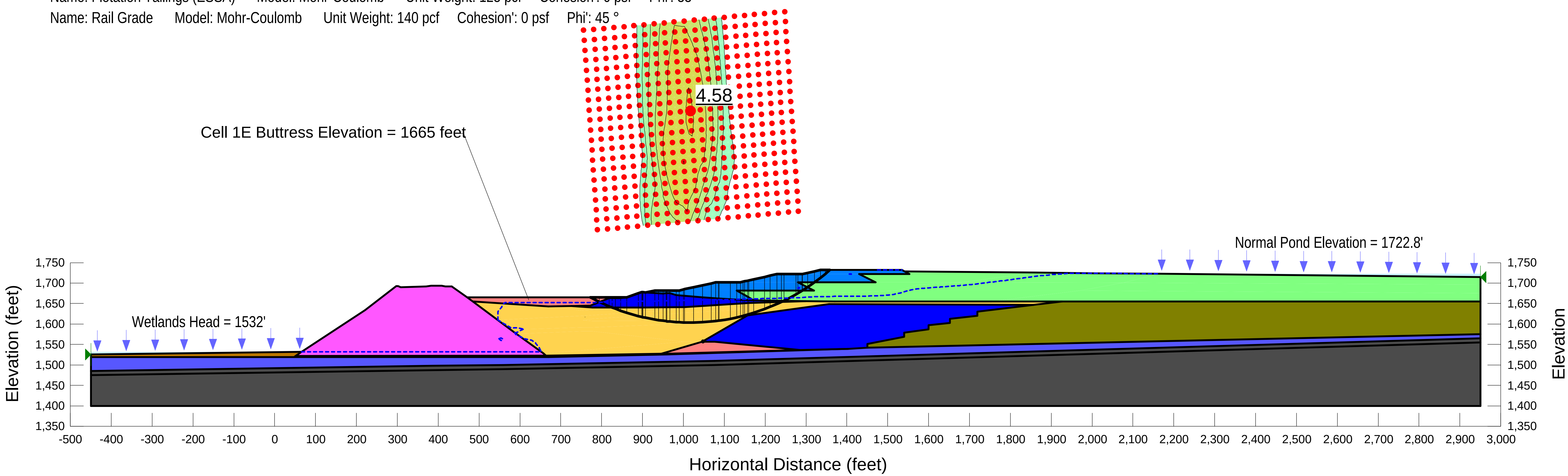
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_Normal Pool.gsz

Case: 1.2 Lift 8 - ESSA_till wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 4.58

Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Glacial Till (Impenetrable) Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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Maximum Dam Height with PMP – Lift 8 (Table 7-8)

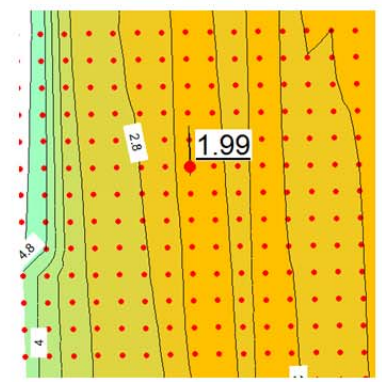
Sections F, G and N – $USSA_{yield}$ and ESSA

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/7/2014
File Name: SecF_Lift8_PMP.gsz

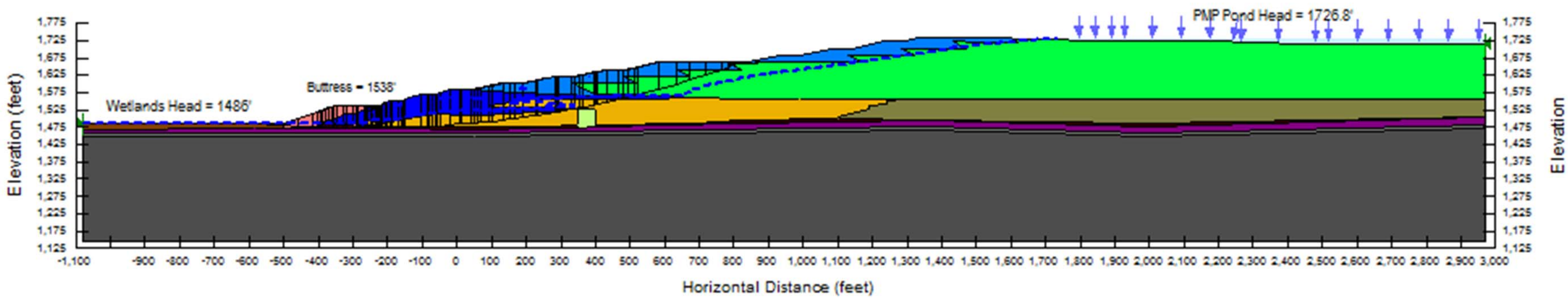
2.0 Lift 8 - USSA (Circular)
Yield USSA strength
Grid & Radius, Circular

Factor of Safety: 1.99

Name: Glacial Till   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 36.5 °
Name: Compressed Peat (USSA)   Model: S=f(overburden)   Unit Weight: 85 pcf   Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA)   Model: S=f(overburden)   Unit Weight: 70 pcf   Tau/Sigma Ratio: 0.23
Name: Rock Dam   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 40 °
Name: LTVSMC Coarse Tailings   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: LTVSMC Bulk Tailings   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.26
Name: LTVSMC FT/Slimes (USSA)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.24
Name: Bedrock   Model: Bedrock (Impenetrable)
Name: Fractured Bedrock   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM)   Model: Undrained (Phi=0)   Unit Weight: 125 pcf   Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA)   Model: S=f(overburden)   Unit Weight: 130 pcf   Tau/Sigma Ratio: 0.25



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.



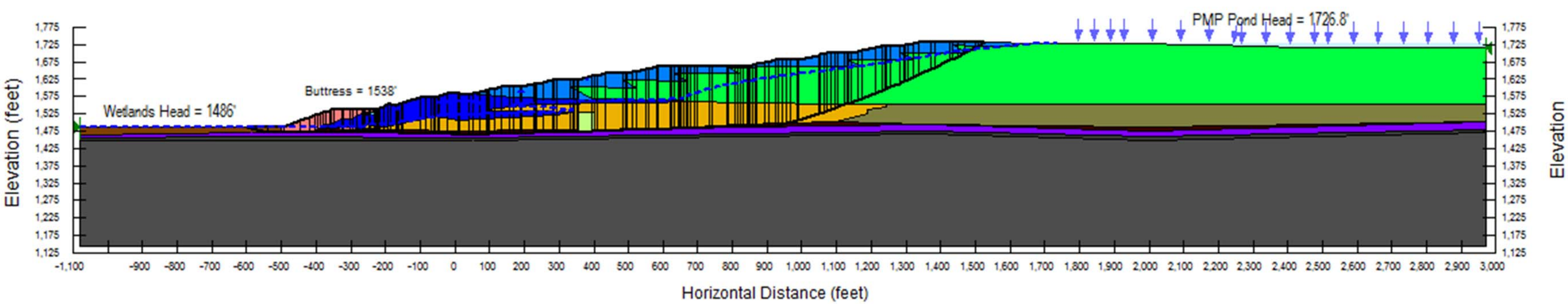
PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/8/2014
File Name: SecF_Lift8_PMP.gsz

2.2 Lift 8 - USSA_till wedge (Circular)
Yield USSA strength
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.77

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: LTVSMC Fine Tailings (USSA) Model: S=f(overburden) Unit Weight: 130 pcf Tau/Sigma Ratio: 0.25
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)

Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.



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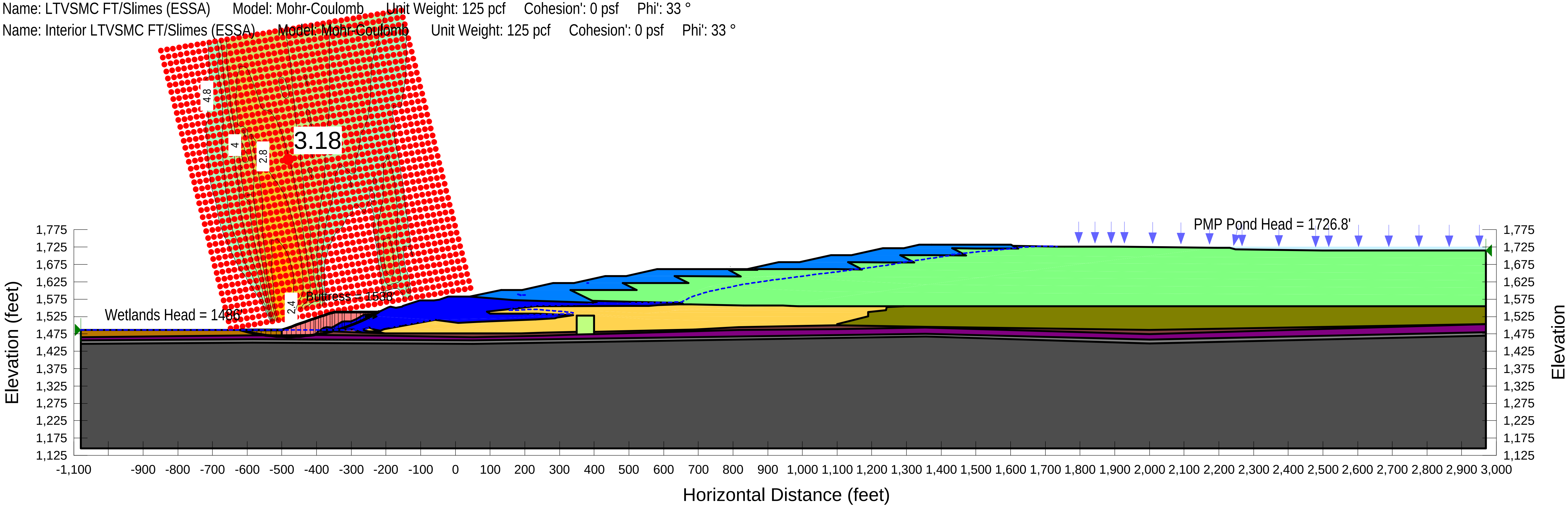
PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/8/2014
File Name: SecF_Lift8_PMP.gsz

1.0 Lift 8 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 3.18

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °

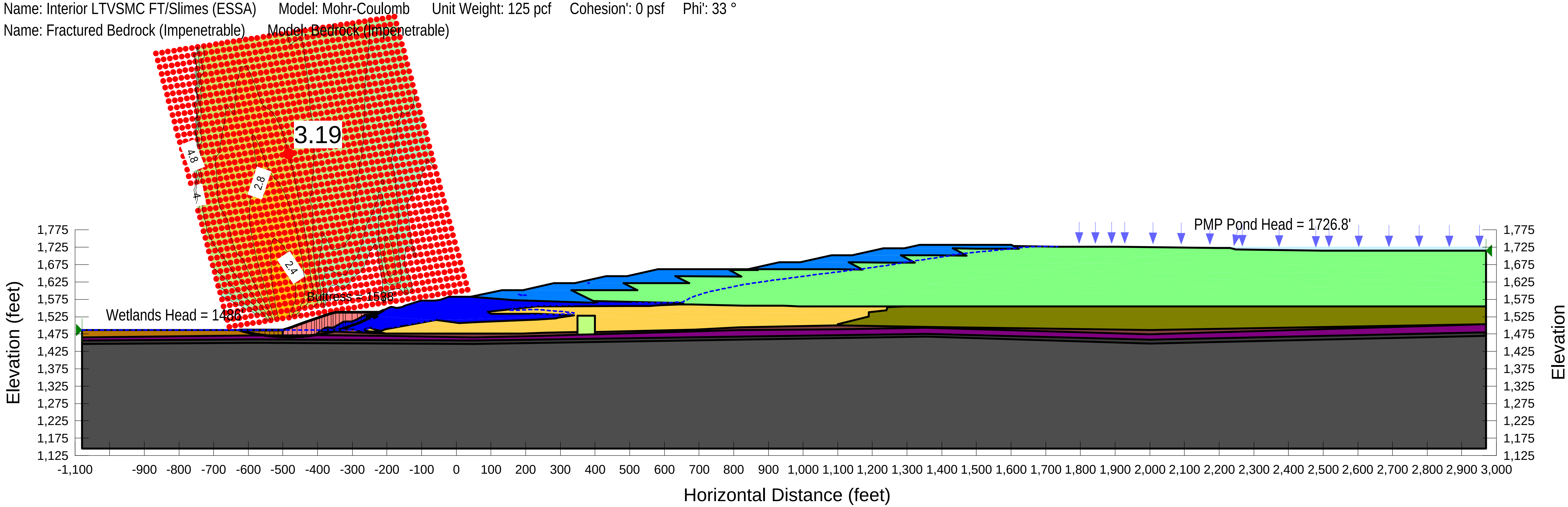


PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/8/2014
File Name: SecF_Lift8_PMP.gsz

1.1 Lift 8 - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.19

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)

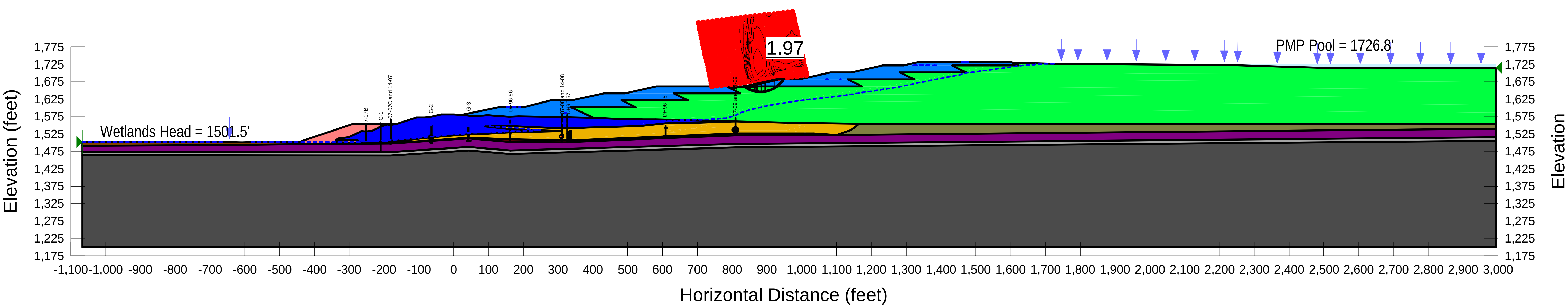


PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: SecG_Lift8_PMP.gsz

2.0 Lift 8 - USSA (Circular)
USSA Strengths
Grid & Radius, Circular

Factor of Safety: 1.97

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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PolyMet Flotation Tailings Basin
Cross-Section G
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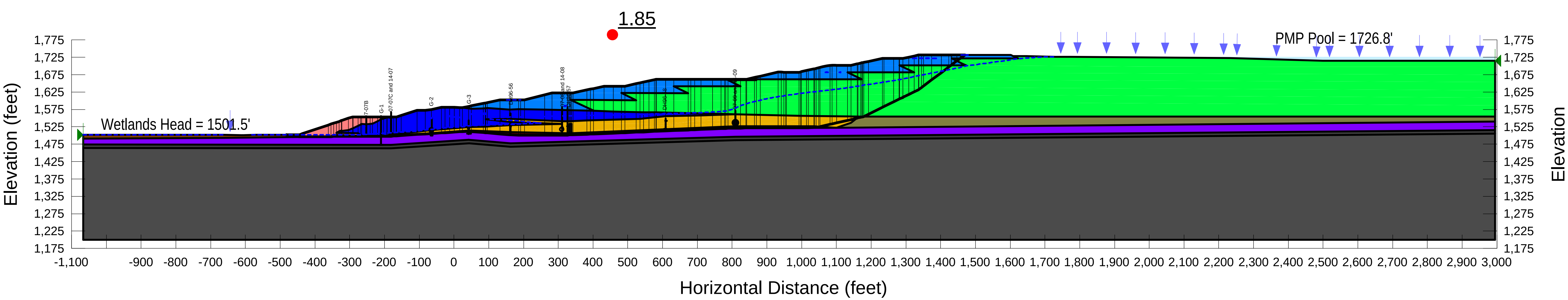
2.2.1 Lift 8 - USSA_till wedge (Optimized)
USSA Strengths
Grid & Radius, Optimized
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.85

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Glacial Till -Impenetrable Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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PolyMet Flotation Tailings Basin
Cross-Section G
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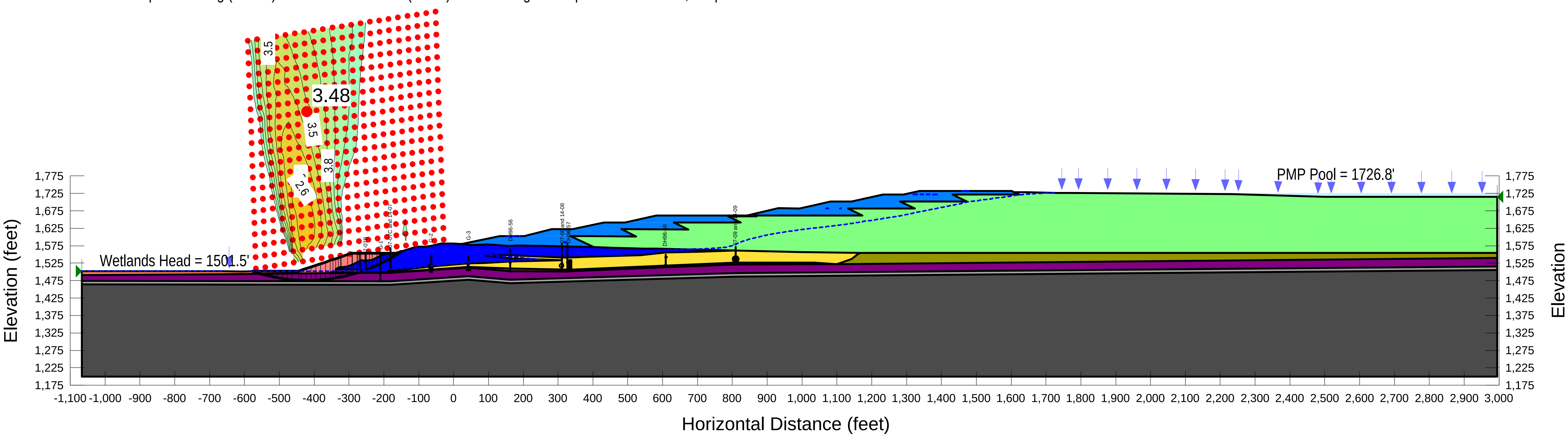
File Name: SecG_Lift8_PMP.gsz

1.0 Lift 8 - ESSA (Circular)
ESSA Strengths
Grid & Radius, Circular

Factor of Safety: 3.48

Name: Glacial Till   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 36.5 °
Name: Rock Dam   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 40 °
Name: LTVSMC Coarse Tailings   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Compressed Peat (ESSA)   Model: Shear/Normal Fn.   Unit Weight: 85 pcf   Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: Bedrock   Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA)   Model: Shear/Normal Fn.   Unit Weight: 70 pcf   Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: Fractured Bedrock   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 45 °
Name: Flotation Tailings (ESSA)   Model: Mohr-Coulomb   Unit Weight: 125 pcf   Cohesion': 0 psf   Phi': 33 °
Name: LTVSMC Bulk Tailings   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM)   Model: Undrained (Phi=0)   Unit Weight: 125 pcf   Cohesion': 9,600 psf



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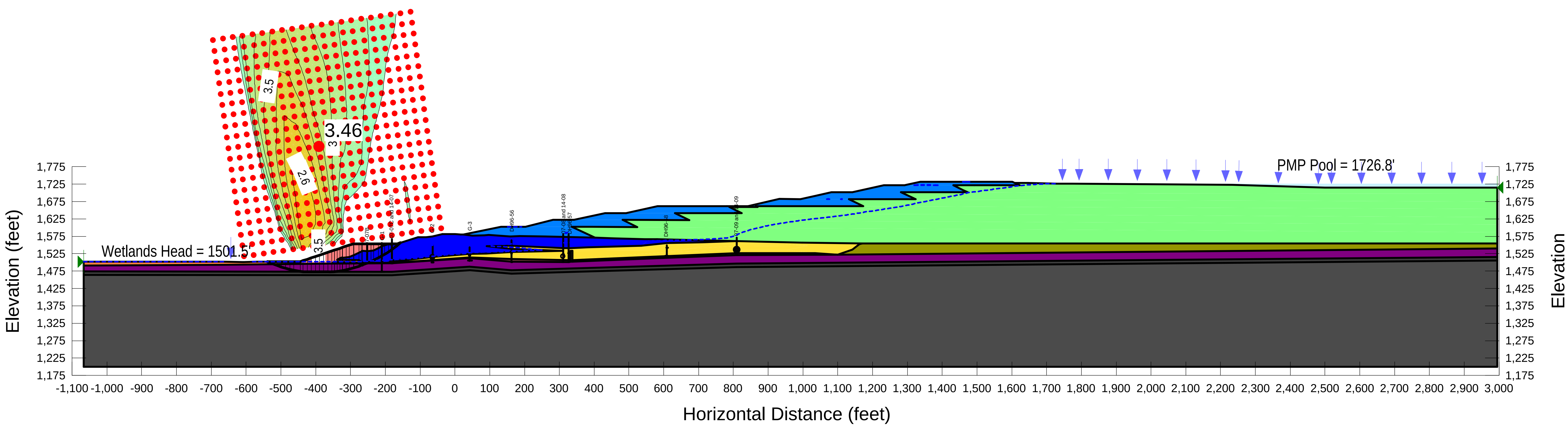
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: SecG_Lift8_PMP.gsz

1.1 Lift 8 - ESSA_bedrock wedge (Circular)
ESSA Strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.46

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf

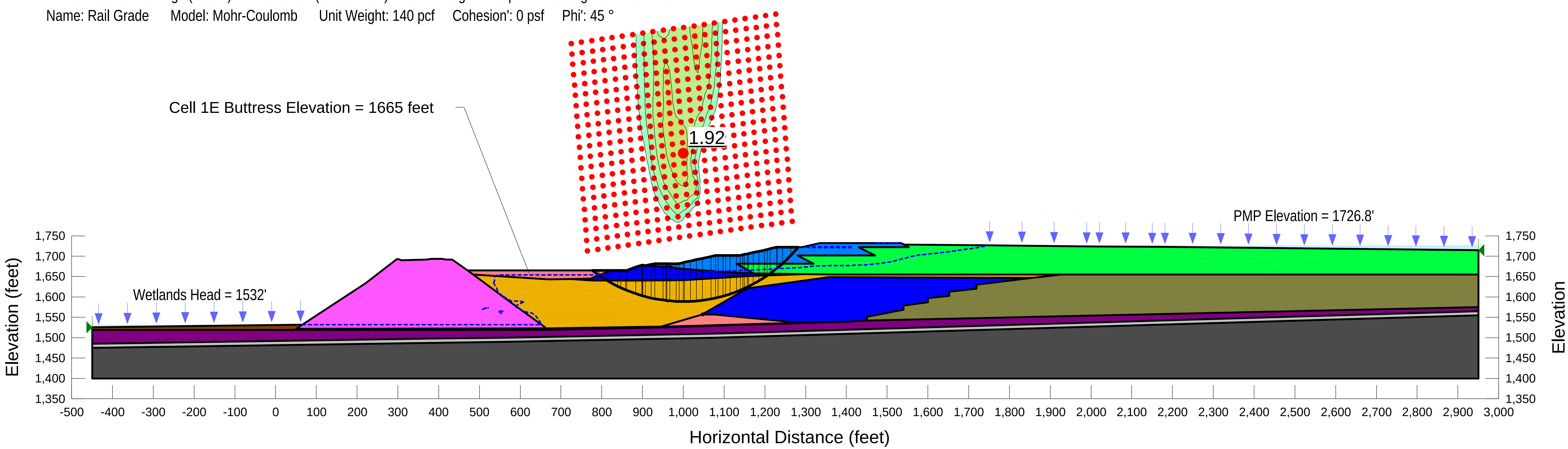


PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_PMP.gsz

Case: 2.0 Lift 8 - USSA (Circular)
Yield USSA strengths
Grid & Radius, Circular

Factor of Safety: 1.92

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 120 pcf Tau/Sigma Ratio: 0.24
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.26
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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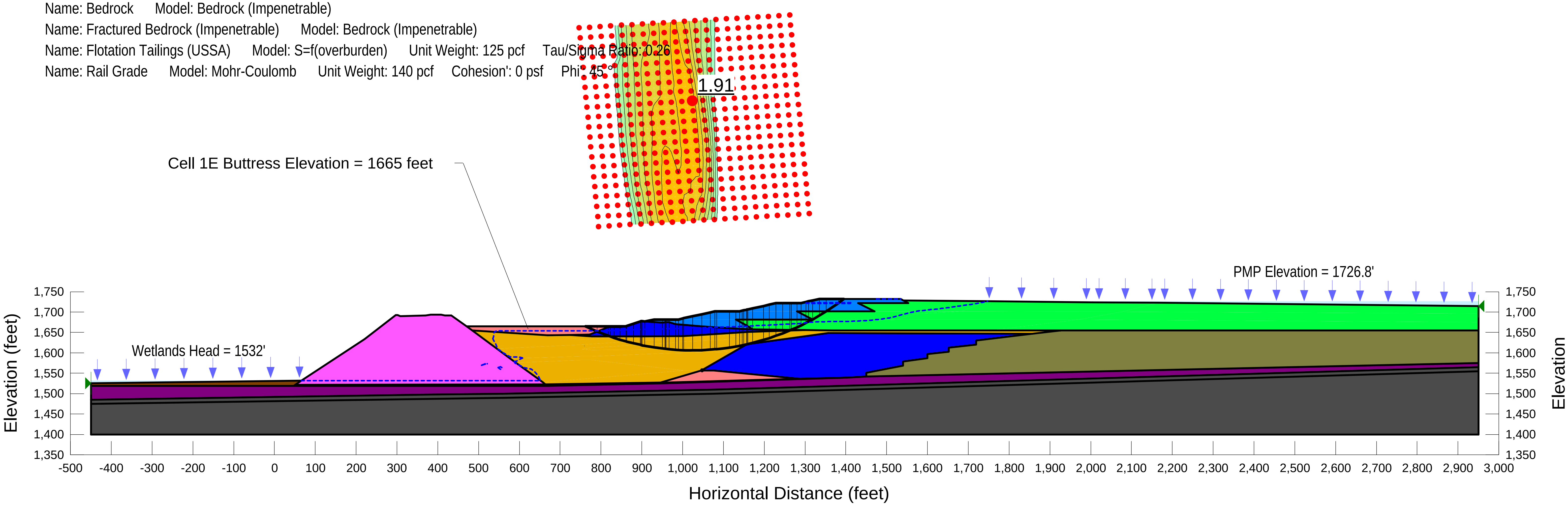
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_PMP.gsz

Case: 2.1 Lift 8 - USSA_bedrock wedge (Circular)
Yield USSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.91

Name: Glacial Till   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 36.5 °
Name: Compressed Peat (USSA)   Model: S=f(overburden)   Unit Weight: 85 pcf   Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA)   Model: S=f(overburden)   Unit Weight: 70 pcf   Tau/Sigma Ratio: 0.23
Name: Rock Dam   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 40 °
Name: LTVSMC Coarse Tailings   Model: Mohr-Coulomb   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: LTVSMC FT/Slimes (USSA)   Model: S=f(overburden)   Unit Weight: 120 pcf   Tau/Sigma Ratio: 0.24
Name: LTVSMC Bulk Tailings   Model: Mohr-Coulomb   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (USSA)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.24
Name: Bedrock   Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable)   Model: Bedrock (Impenetrable)
Name: Flotation Tailings (USSA)   Model: S=f(overburden)   Unit Weight: 125 pcf   Tau/Sigma Ratio: 0.26
Name: Rail Grade   Model: Mohr-Coulomb   Unit Weight: 140 pcf   Cohesion': 0 psf   Phi': 45 °



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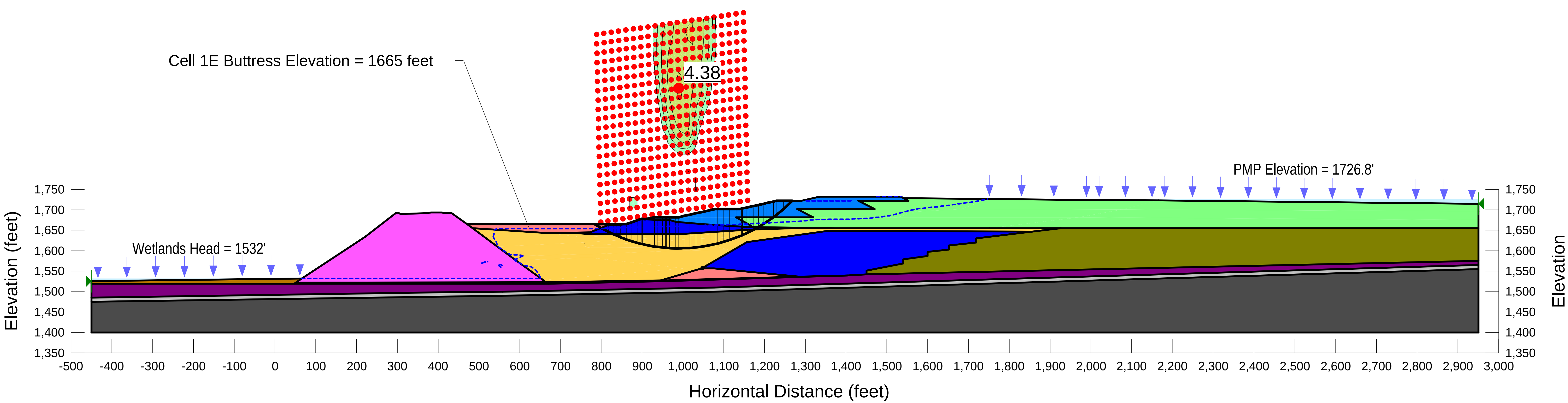
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_PMP.gsz

Case: 1.0 Lift 8 - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 4.38

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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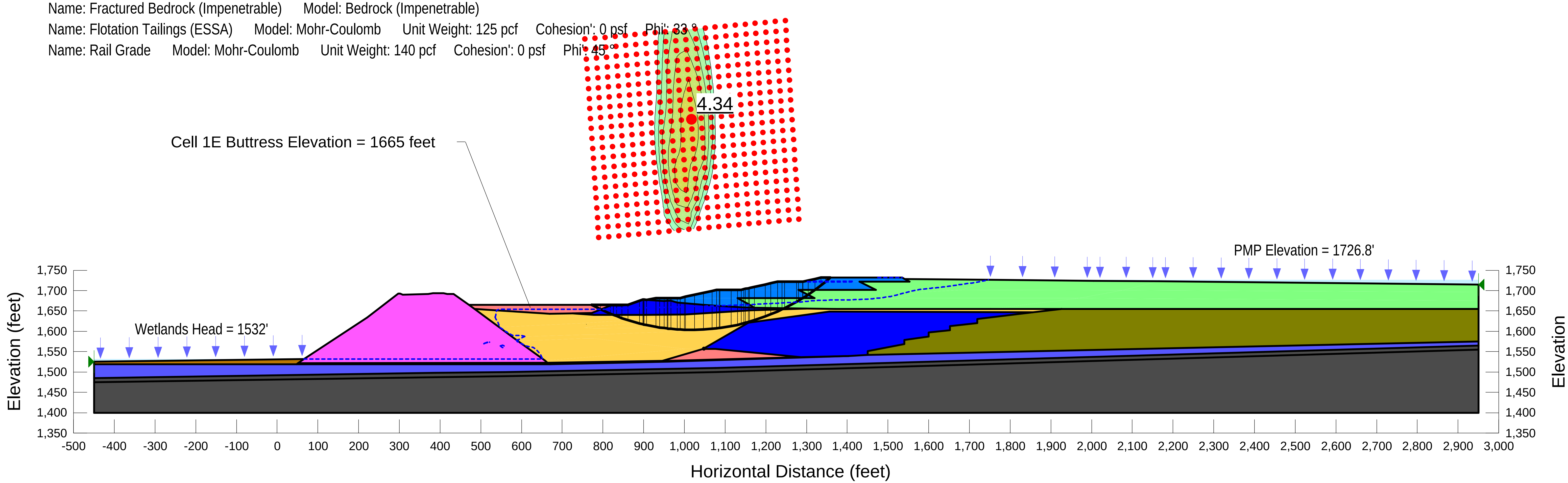
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Section N_Lift8_PMP.gsz

Case: 1.2 Lift 8 - ESSA_till wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 4.34

Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: peat
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: peat
Name: Glacial Till (Impenetrable) Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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Project #23690862-037

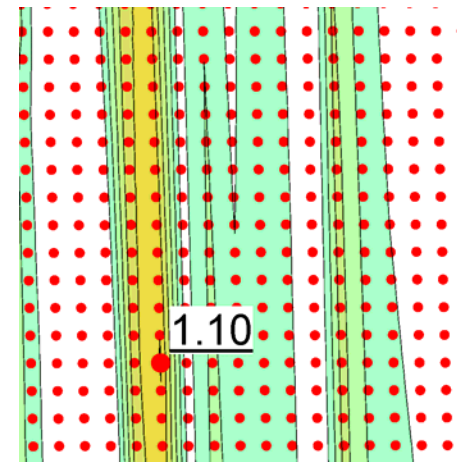
Worst Case Flow Liquefaction Conditions – Lift 8 (Table 7-10)

Sections F, G and N

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/7/2014
File Name: Baseline-SecF_Lift8_LIQ_CDSM.gsz

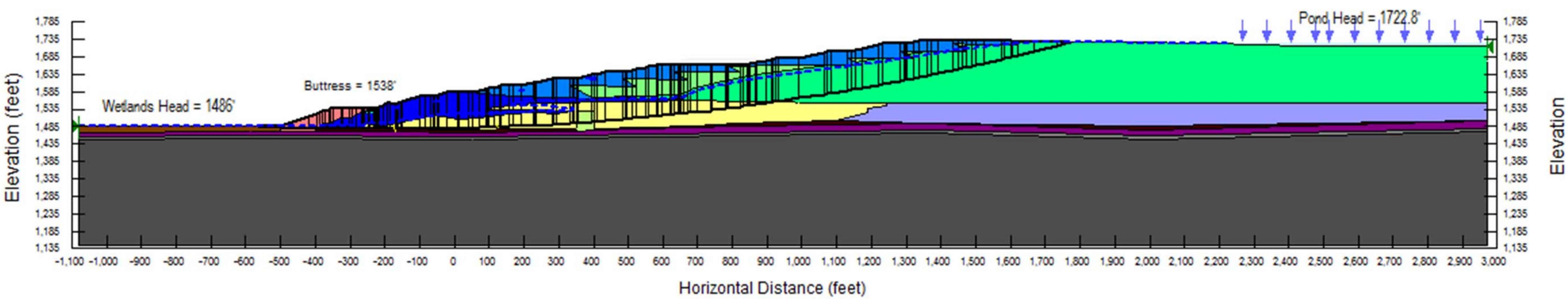
1.0 Lift 8 - LIQ (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular

Factor of Safety: 1.10



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.12
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: LTVSMC FT/Slimes (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf

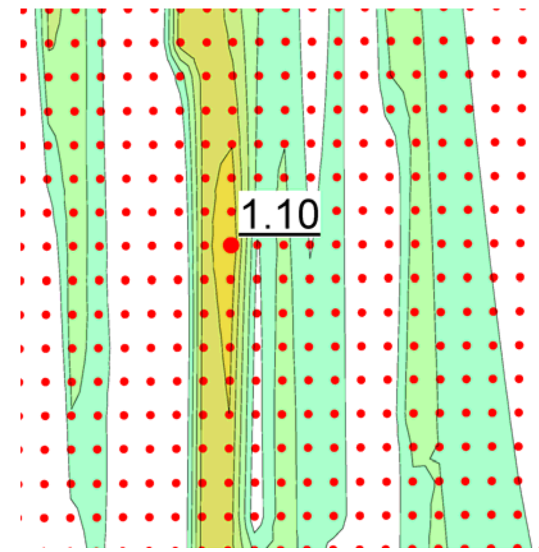


PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 11/28/2014
File Name: Baseline-SecF_Lift8_LIQ_CDSM.gsz

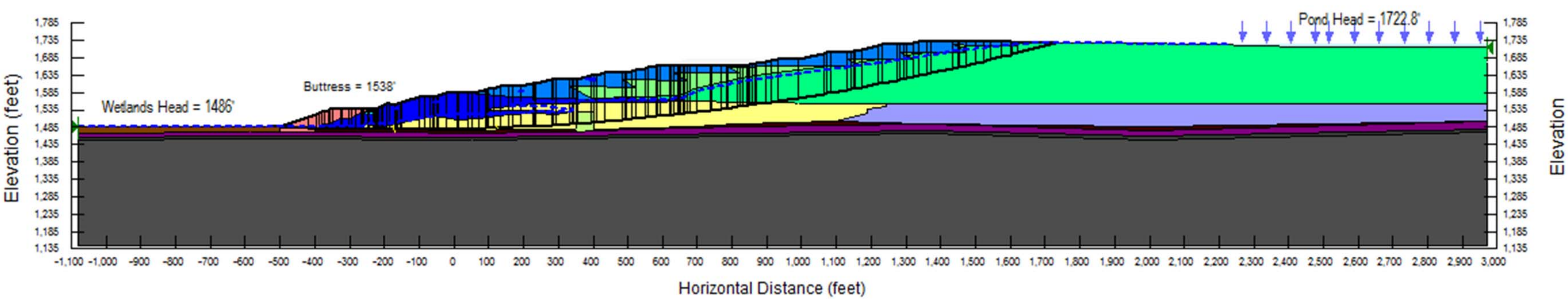
1.1 Lift 8 - LIQ_bedrock wedge (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.10

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.12
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: LTVSMC FT/Slimes (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Fractured Bedrock -Impenetrable Model: Bedrock (Impenetrable)



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.

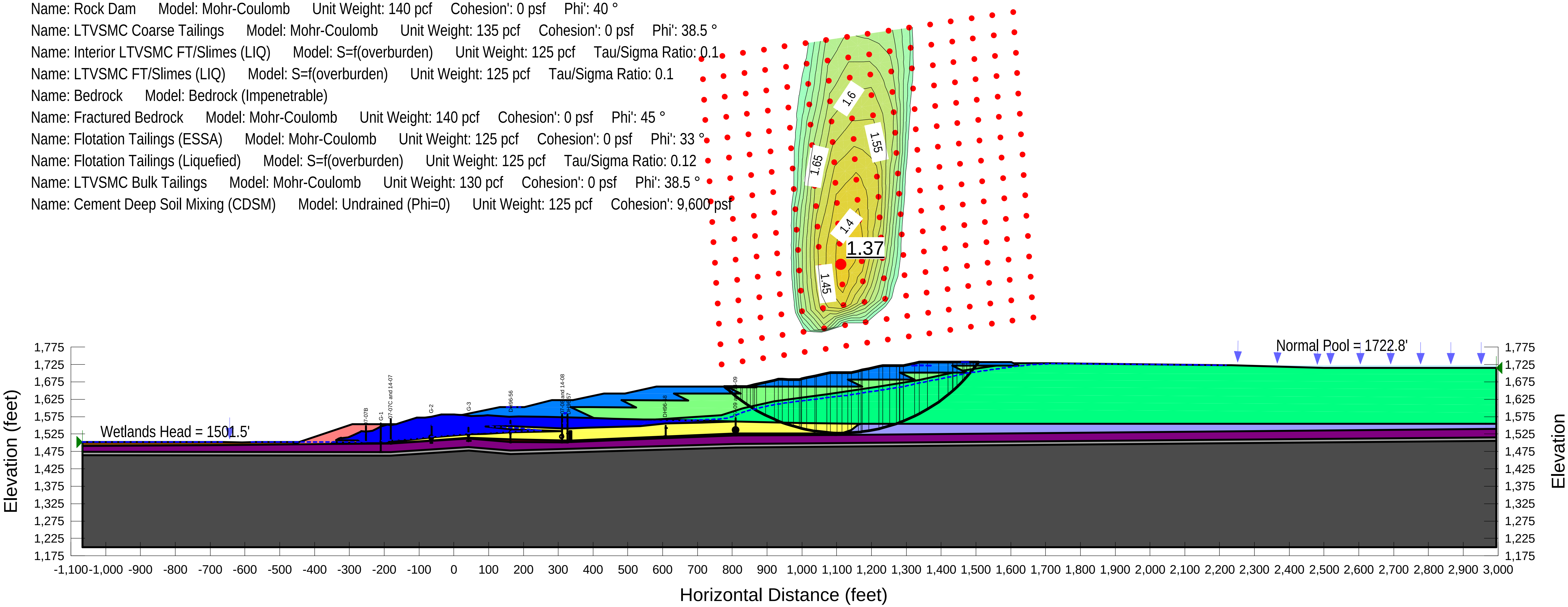


PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: 2014 Baseline-SecG_Lift8_LIQ_5-ft CDSM.gsz

1.0 Lift 8 - LIQ (Circular)
Liquified / Yield USSA Strengths
Grid & Radius, Circular

Factor of Safety: 1.37

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Interior LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.12
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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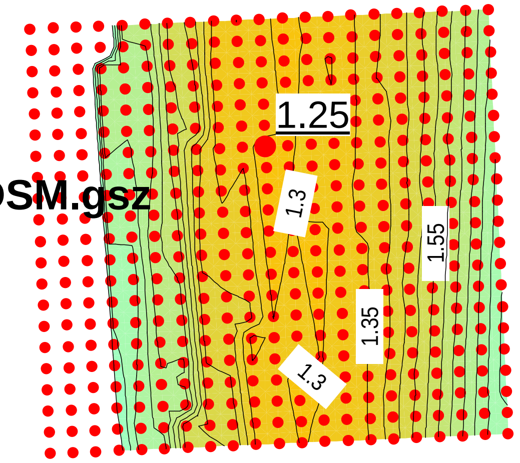
Project #23690862-037

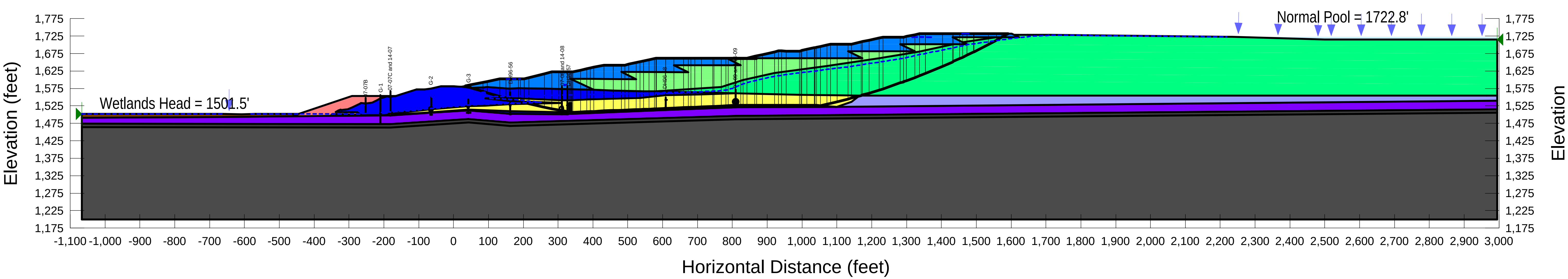
PolyMet Flotation Tailings Basin
Cross-Section G
Date Last Saved: 12/11/2014
File Name: 2014 Baseline-SecG_Lift8_LIQ_5-ft CDSM.gsz

Factor of Safety: 1.25

1.3 Lift 8 - LIQ_peat wedge (Circular)
Liquified / Yield USSA Strengths
Grid & Radius, Circular
Peat, Till, Fractured Bedrock and Bedrock Impenetrable



Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Glacial Till -Impenetrable Model: Bedrock (Impenetrable)
Name: Interior LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.12
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Compressed Peat_Impenetrable Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



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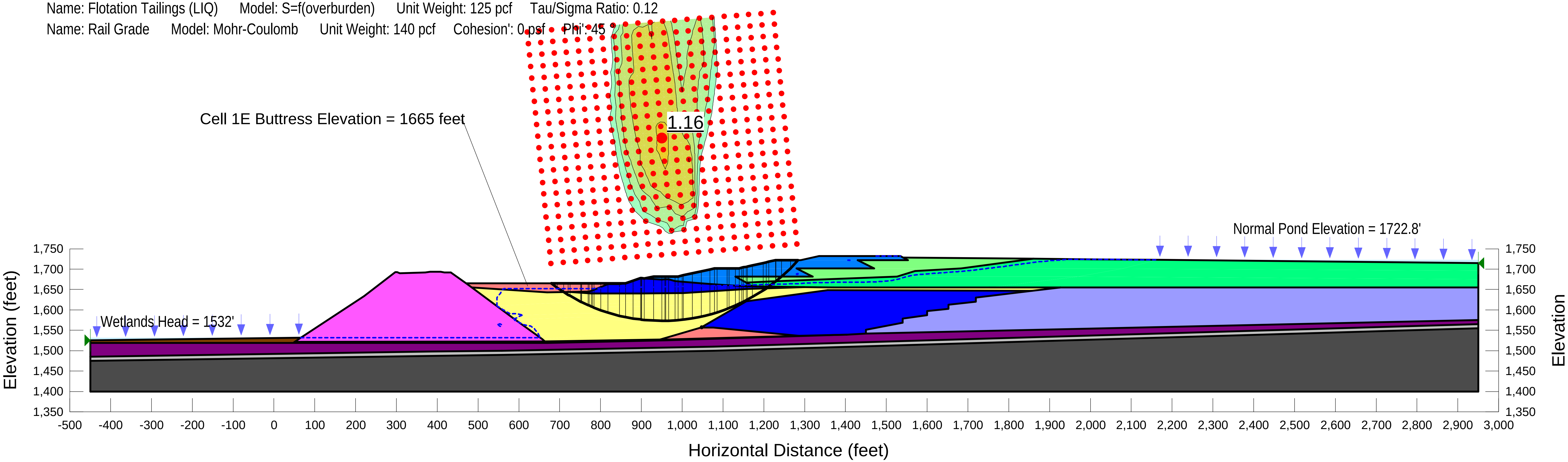
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Baseline-SecN_Lift8_LIQ.gsz

Case: 1.0 Lift 8 - LIQ (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular

Factor of Safety: 1.16

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Interior LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.12
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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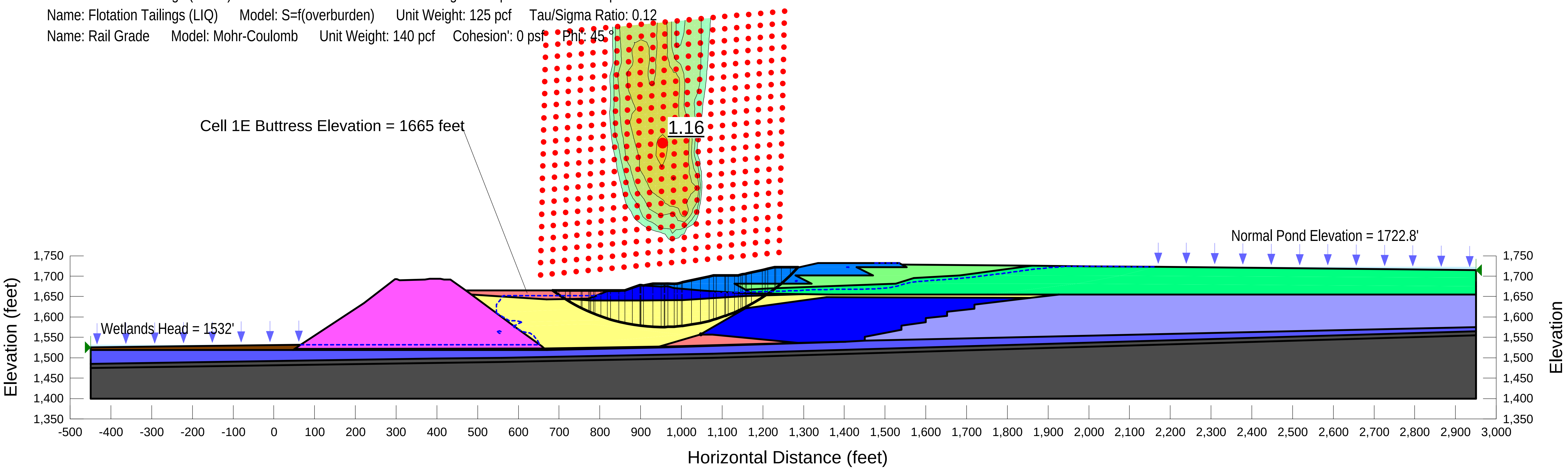
Project #23690862-037

PolyMet Flotation Tailings Basin
Section N
Date Last Saved: 12/12/2014
File Name: Baseline-SecN_Lift8_LIQ.gsz

Case: 1.2 Lift 8 - LIQ_till wedge (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular
Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.16

Name: Compressed Peat (USSA) Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat (USSA) Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Interior LTVSMC FT/Slimes (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Glacial Till (Impenetrable) Model: Bedrock (Impenetrable)
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Flotation Tailings (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.12
Name: Rail Grade Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °



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Project #23690862-037

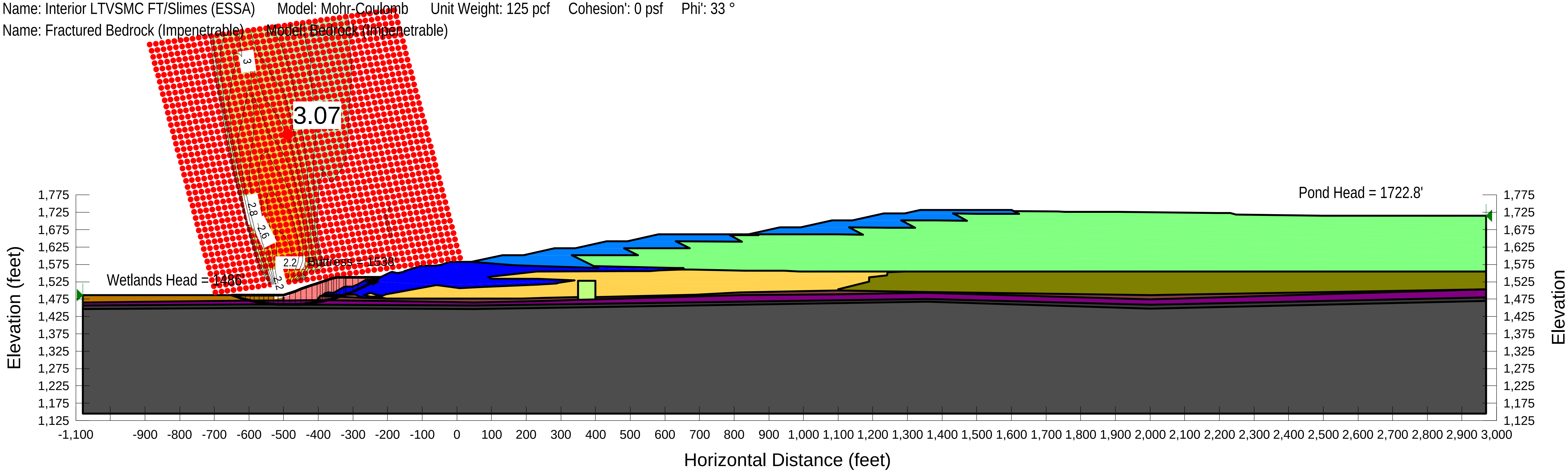
Long – Term Closure Conditions (Table 7-11)

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/8/2014
File Name: SecF_Lift8_Normal Pool.gsz

1.1 Lift 8 - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.07

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat Shear/Normal Function (ESSA)
Name: LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)



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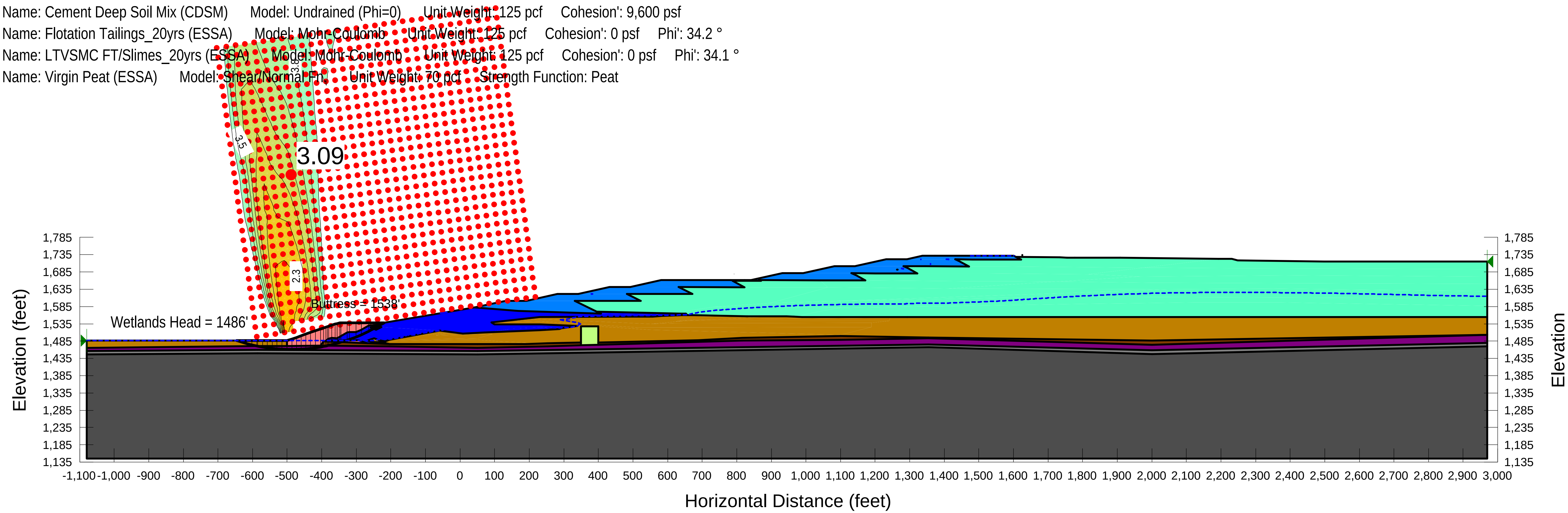
PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/20/2014
File Name: SecF_Lift8_long-term with erosion.gsz

1.0 Lift 8 - 20yr - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 3.09

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat
Name: Cement Deep Soil Mix (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Flotation Tailings_20yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34.2 °
Name: LTVSMC FT/Slimes_20yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34.1 °
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat



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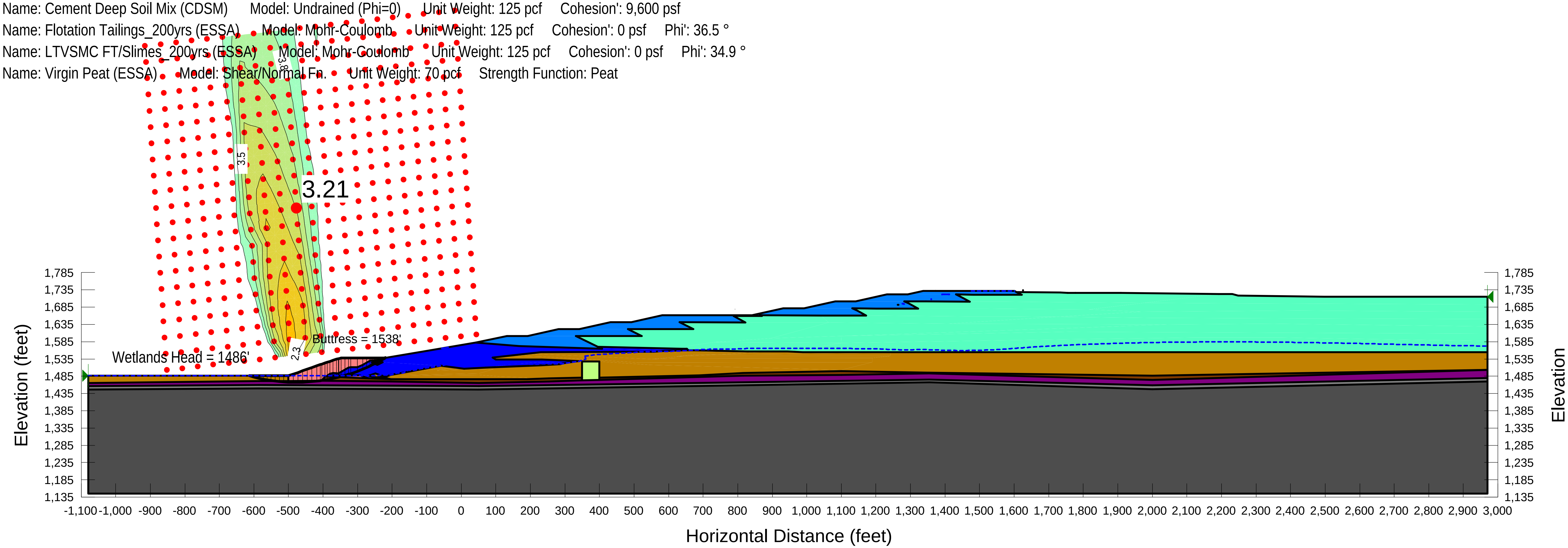
Project #23690862-037

PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/20/2014
File Name: SecF_Lift8_long-term with erosion.gsz

3.0 Lift 8 - 200yr - ESSA (Circular)
ESSA strengths
Grid & Radius, Circular

Factor of Safety: 3.21

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat
Name: Cement Deep Soil Mix (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Flotation Tailings_200yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 36.5 °
Name: LTVSMC FT/Slimes_200yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34.9 °
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat



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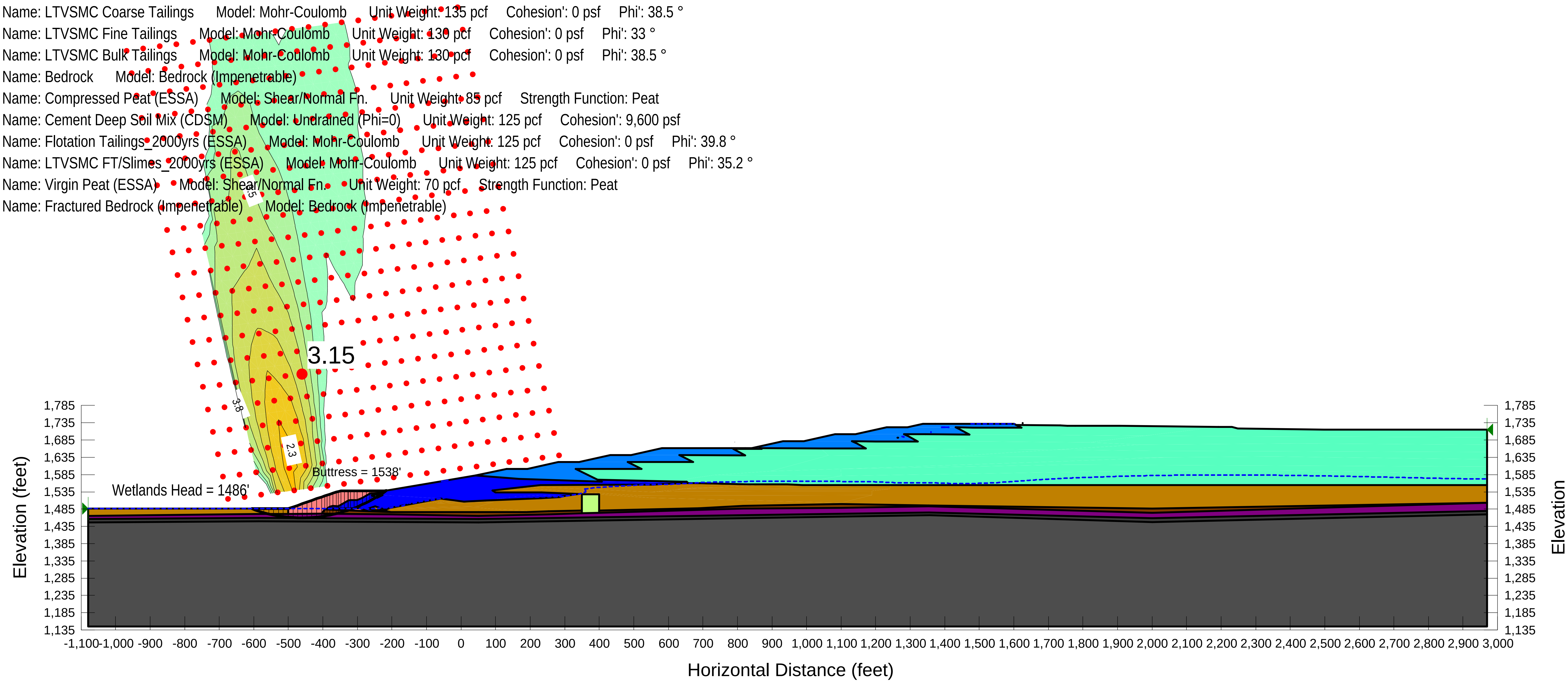
PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/20/2014
File Name: SecF_Lift8_long-term with erosion.gsz

5.1 Lift 8 - 2000yr - ESSA_bedrock wedge (Circular)
ESSA strengths
Grid & Radius, Circular
Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 3.15

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Compressed Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 85 pcf Strength Function: Peat
Name: Cement Deep Soil Mix (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion: 9,600 psf
Name: Flotation Tailings_2000yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 39.8 °
Name: LTVSMC FT/Slimes_2000yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 35.2 °
Name: Virgin Peat (ESSA) Model: Shear/Normal Fn. Unit Weight: 70 pcf Strength Function: Peat
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)



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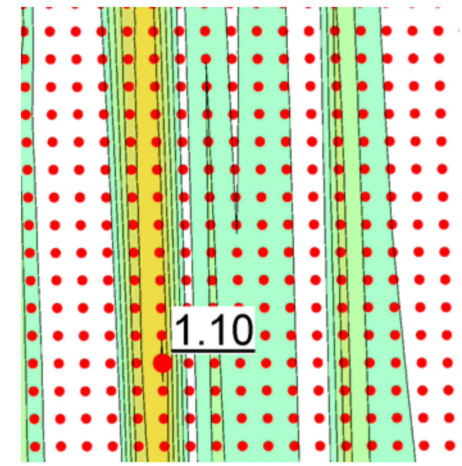
Fully Liquefied Long – Term Closure Conditions (Table 7-12)

PolyMet Flotation Tailings Basin
Cross-Section F
Date Last Saved: 12/7/2014
File Name: Baseline-SecF_Lift8_LIQ_CDSM.gsz

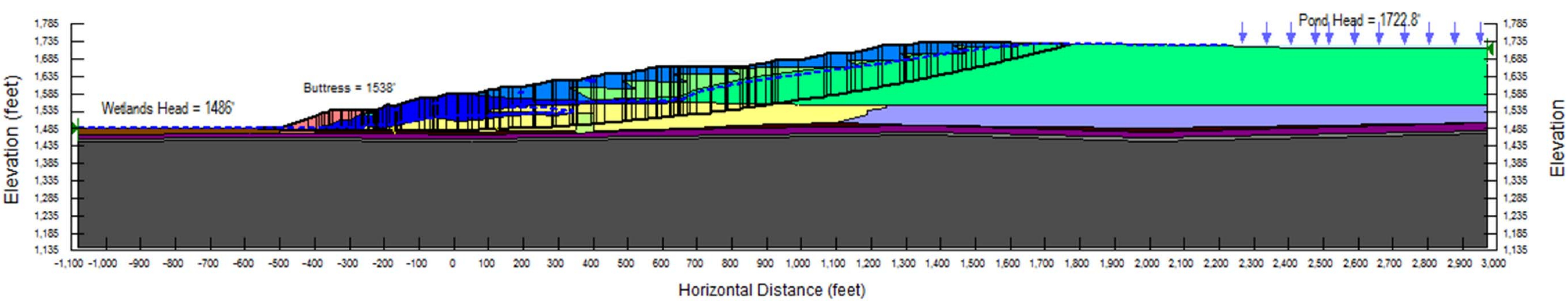
1.0 Lift 8 - LIQ (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular

Factor of Safety: 1.10



Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.

Name: Glacial Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 36.5 °
Name: Compressed Peat Model: S=f(overburden) Unit Weight: 85 pcf Tau/Sigma Ratio: 0.23
Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Flotation Tailings (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.12
Name: Flotation Tailings (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 33 °
Name: Interior LTVSMC FT/Slimes (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: LTVSMC FT/Slimes (Liquefied) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.1
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Fractured Bedrock Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 45 °
Name: Cement Deep Soil Mixing (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf



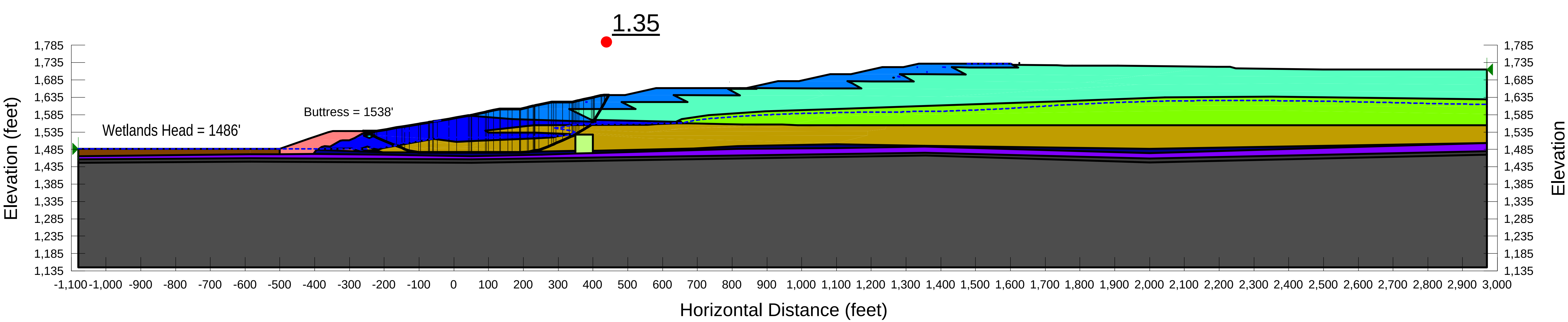
PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/22/2014
File Name: SecF_Lift8_long-term with erosion.gsz

2.3.1 Lift 8 - 20yr - LIQ_peat wedge (Optimized)
Liquefied / Yield USSA strengths
Grid & Radius, Optimized
Peat, Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.35

Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mix (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Flotation Tailings_20yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34.2 °
Name: LTVSMC FT/Slimes_20yrs (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.108
Name: Flotation Tailings_20yrs (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.129
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Compressed Peat (Impenetrable) Model: Bedrock (Impenetrable)

Note – Due to page size and data format constraints the slope stability analysis failure surface search radius grid and circle center mark have been relocated.



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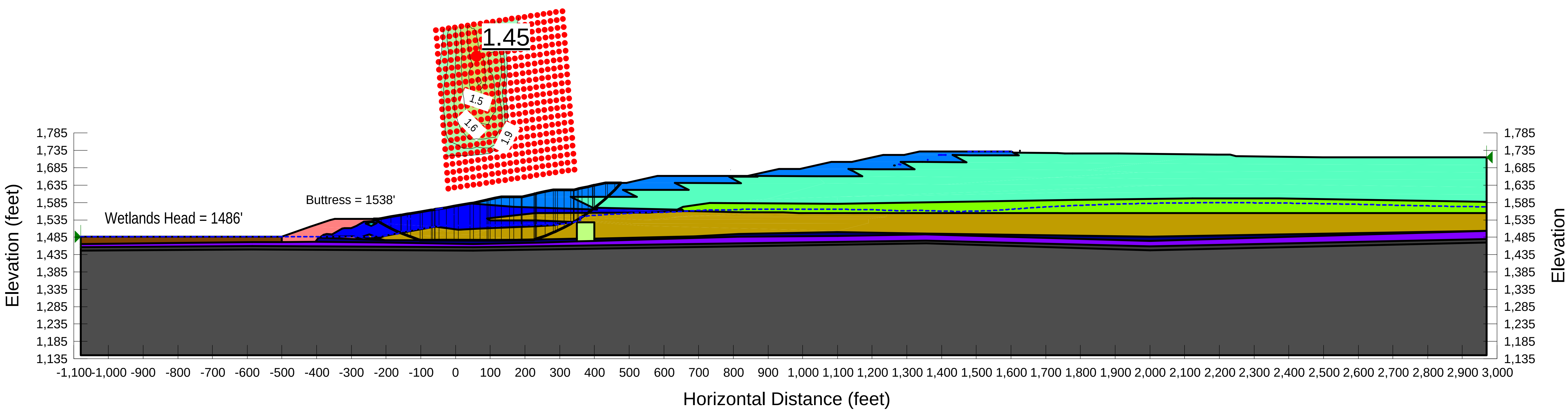
PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/20/2014
File Name: SecF_Lift8_long-term with erosion.gsz

4.3 Lift 8 - 200yr - LIQ_peat wedge (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular
Peat, Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.45

Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mix (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Flotation Tailings_200yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 36.5 °
Name: LTVSMC FT/Slimes_200yrs (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.114
Name: Flotation Tailings_200yrs (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.148
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Compressed Peat (Impenetrable) Model: Bedrock (Impenetrable)

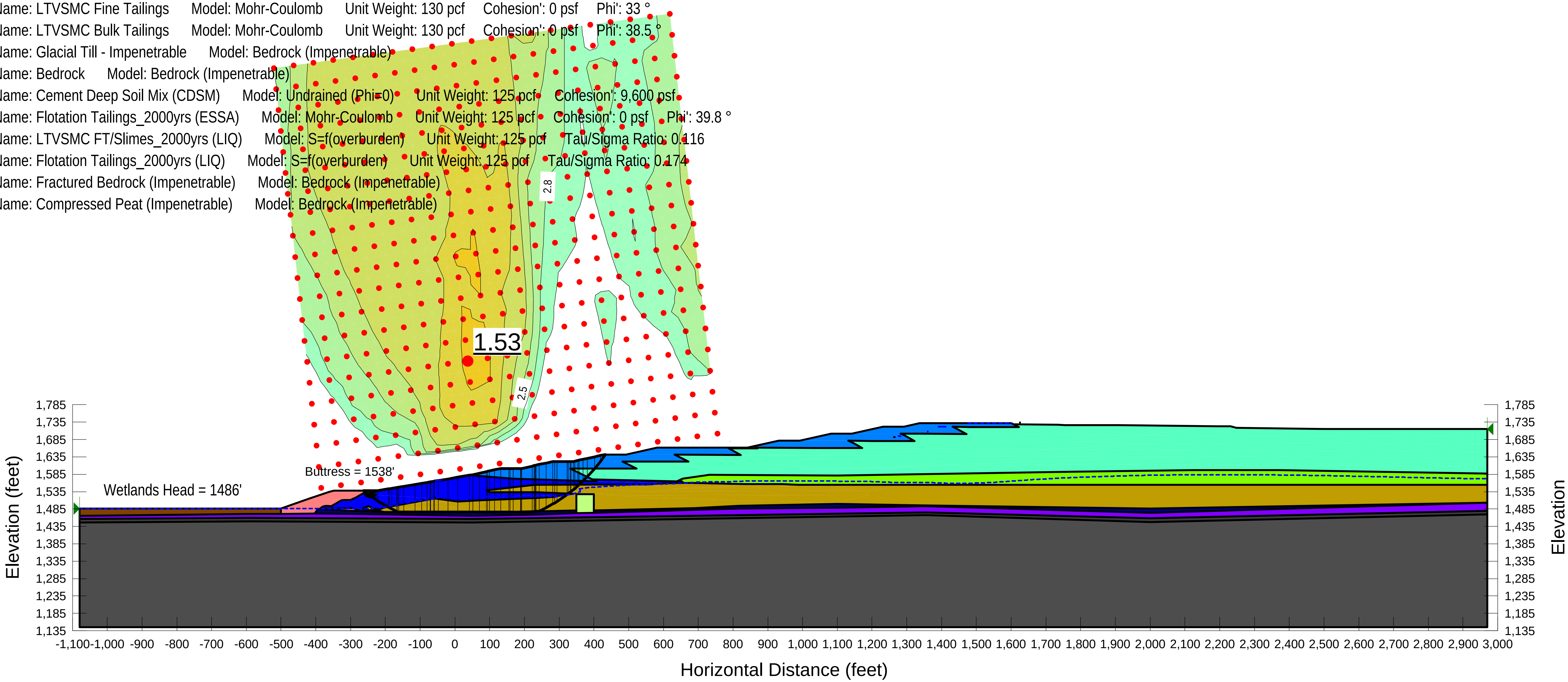


PolyMet Flotation Tailings Basin
Cross-Section F Long-term Conditions
Date Last Saved: 12/20/2014
File Name: SecF_Lift8_long-term with erosion.gsz

6.3 Lift 8 - 2000yr - LIQ_peat wedge (Circular)
Liquefied / Yield USSA strengths
Grid & Radius, Circular
Peat, Till, Fractured Bedrock and Bedrock Impenetrable

Factor of Safety: 1.53

Name: Virgin Peat Model: S=f(overburden) Unit Weight: 70 pcf Tau/Sigma Ratio: 0.23
Name: Rock Dam Model: Mohr-Coulomb Unit Weight: 140 pcf Cohesion': 0 psf Phi': 40 °
Name: LTVSMC Coarse Tailings Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38.5 °
Name: LTVSMC Fine Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: LTVSMC Bulk Tailings Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38.5 °
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable)
Name: Bedrock Model: Bedrock (Impenetrable)
Name: Cement Deep Soil Mix (CDSM) Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 9,600 psf
Name: Flotation Tailings_2000yrs (ESSA) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 39.8 °
Name: LTVSMC FT/Slimes_2000yrs (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.116
Name: Flotation Tailings_2000yrs (LIQ) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.174
Name: Fractured Bedrock (Impenetrable) Model: Bedrock (Impenetrable)
Name: Compressed Peat (Impenetrable) Model: Bedrock (Impenetrable)



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