



September 25, 2018

FOUNDATION INVESTIGATION REPORT

**HIGH FILL EMBANKMENT
HIGHWAY 400-89 INTERCHANGE RECONSTRUCTION
TOWN OF INNISFIL, SIMCOE COUNTY
MINISTRY OF TRANSPORTATION, ONTARIO
G.W.P. 2438-13-00**

Submitted to:

Morrison Hershfield Limited
Suite 300, 125 Commerce Valley Drive West
Markham, Ontario
L3T 7W4



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REPORT





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1.0 INTRODUCTION

Golder Associated Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the proposed reconstruction of Highway 400/89 interchange and bridge replacement. The proposed works will include high fill embankment areas along the following new road/ramp alignments:

- Realigned Highway 89 Approach Embankments east and west of Highway 400;
- Highway 89 East – Highway 400 South (Ramp E-S); and,
- Highway 89 West – Highway 400 South (Ramp W-S);
- Highway 400 North – Highway 89 East/West (Ramp N-E/W).
- Highway 89 East – Highway 400 North (Ramp E-N);
- Highway 89 East/West – Highway 400 North (Ramp E/W-N);
- Highway 400 South – Highway 89 East/West (Ramp S-E/W); and,
- Reive Boulevard north of Highway 89.

The purpose of this investigation is to establish the subsurface soil and groundwater conditions in the high fill embankment areas by borehole drilling, in situ testing and laboratory testing on selected soil samples. The investigation areas are shown in plan on Drawing 1.

The Terms of Reference (TOR) and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated November 2, 2016, which forms part of the Consultant's Assignment Number (Number 2015-E-0038) for this project and associated adjustments made to the roadway profiles as part of the detail design. The work has been carried out with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated April 25, 2017.

2.0 SITE DESCRIPTION

The Highway 400/89 interchange is located about 20 km south of the City of Barrie in the Town of Innisfil, Ontario, as shown on the Key Plan on Drawing 1. Highway 400 consists of three lanes of traffic in each northbound and southbound directions. Highway 89 is oriented in an east-west direction and consists of one lane of traffic in each direction, with turning lanes connecting to the Highway 400 on-ramps.

The northwest quadrant of the interchange consists of agricultural lands, and a closed highway service centre. All infrastructure, excluding lamp standards, has been removed from the footprint of the closed service centre. The northeast quadrant of the interchange consists of an open field containing a small area vegetated with trees and an industrial facility and yard. The southeast quadrant is occupied by a commuter parking lot and an outlet mall. The southwest quadrant is occupied by an area densely populated with trees and agricultural lands. Overhead power lines extend along the south side of Highway 89.

The ground surface of Highway 400 varies from about Elevation 229 m to Elevation 229.5 m, and the existing Highway 89 grade at the existing underpass is at about Elevation 235.4 m.



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The existing Highway 89 embankment has side slopes inclined at approximately two horizontal to one vertical (2H:1V). Based on observations of the embankment at the time of the borehole investigation, the side slopes appear to be performing adequately with no visual evidence of surficial sloughing or slope instability.

3.0 INVESTIGATION PROCEDURES

3.1 Previous Investigation

A preliminary foundation investigation for the Highway 89 underpass was carried out by Golder in 2002 during which time a total of two boreholes, designated as Boreholes B1-1 and B1-2, were advanced near the east and west abutments of the underpass. The boreholes were advanced to depths of 28 m and 37 m below ground surface and geotechnical laboratory testing was carried out on selected soil samples. The results of this investigation are contained in a report titled, "Preliminary Foundation Investigation and Design Report, Highway 89 Underpass Structure Site 30-256, Highway 400 Widening from 1 km South of Highway 89 to Highway 11, G.W.P. 30-95-00", dated January 2002 (GEOCRE No. 31D-465).

The locations of the boreholes advanced during the 2002 investigation are shown on Drawing 1, and the borehole records, including a summary of the laboratory testing results from this investigation, are presented in Appendix A. The northing and easting coordinates relative to the MTM NAD 83 (Zone 10) coordinate system, the ground surface elevations referenced to Geodetic datum and drilled depths are presented below and on the borehole records in Appendix A.

Borehole No.	Location (MTM NAD 83 Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (m) (Latitude, °)	Easting (m) (Longitude, °)		
B1-1	4,895,635.8 (44.200617)	292,452.1 (-79.654489)	228.9	28.0
B1-2	4,895,623.5 (44.200506)	292,394.6 (-79.655208)	228.4	37.0

3.2 Current Investigation

Field work for the foundation investigation was carried out between July 11 and August 15, 2017 and between January 23 and February 15, 2018 during which time 33 boreholes were drilled specifically along the high fill embankments (i.e. HF and PMT series), supplemented with 8 boreholes drilled for the realigned underpass (i.e. 89UP series). The borehole locations are shown on Drawing 1. Detailed below are the applicable soil strata drawing, station limits of the high fills and the applicable boreholes for each ramp within the interchange.

Location	Soil Strata Drawing	Station Limits	Boreholes
Highway 89 (east and west of the underpass)	2	9+820 to 10+290	HF-01 to HF-04, HF-16 to HF-18 and 89UP-01, 89UP-03, 89UP-05 and 89UP-07 and 89UP-08
Ramp E-S	3	9+912 to 10+170	HF-01, HF-10 to HF-12, HF-21, 89UP-01 and 89UP-03
Reive Boulevard	4	10+010 to 10+110	HF-14 and HF-15



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Location	Soil Strata Drawing	Station Limits	Boreholes
Ramp S-E/W Ramp E/W-N	4	10+220 to 10+380 10+040 to 10+110	HF-28 to HF-31 and PMT/VSP-02
Ramp W-N	4	10+050 to 10+110	HF-26, HF-27 and PMT-02
Ramp W-S	5	10+000 to 10+160	HF-05 to HF-09, HF-24, HF-25 and PMT/VSP-01
Ramp N-E/W	5	10+320 to 10+560	HF-12, HF-13 and HF-19 to HF-23

Boreholes were advanced to depths ranging between 5.2 m and 52.4 m below existing ground surface using a D-50 track mounted drill rig supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. The boreholes were advanced through the overburden by 203 mm outer diameter (O.D.) continuous flight hollow stem augers and wash boring methods using 'NW' casing and a tricone. Soil samples were obtained at 0.75 m, 1.5 m and 3 m intervals of depth, using 50 mm O.D. split spoon samplers driven by an automatic hammer, in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586)¹. In-situ field vane testing, using MTO standard "N"-sized vanes, was carried out in the cohesive soils where encountered, to measure the undrained shear strength of the clayey silt to silty clay deposits (ASTM D2573 Standard for Test Method for Field Vane Shear Test). Thin-walled Shelby tube samples were also taken within the cohesive deposit at selected intervals (ASTM D1587 Standard Penetration for Thin-Walled Sampling).

In addition, two boreholes were advanced in the southwest and southeast quadrant of the Highway 400 and Highway 89 interchange to carry out in-situ pressuremeter testing (PMT). The boreholes were advanced by Walker Drilling Ltd. using wash boring methods, and the PMT was carried out by In-Depth Geotechnical Inc. of Hamilton, Ontario. A detailed report summarizing the test procedures is provided in Appendix B. Upon completion of PMT, a 50 mm diameter PVC casing was installed in each borehole and the annulus between the casing and the open borehole was backfilled with a cement/bentonite mix using tremie methods. Once the grout cured, Vertical Seismic Profiling (VSP) was carried out by placing receivers (i.e., geophones) inside the casing at a specific interval of depth, generating seismic energy at the ground surface near the casing, and recording data at the geophones. The VSP was carried out by a geophysicists from Golder. A detailed report summarizing the test procedures and results is provided in Appendix C.

Groundwater conditions were observed in the open boreholes during the drilling operations. A standpipe piezometer was installed in each of Boreholes 89UP-03, 89UP-07, HF-12, HF-15, HF-22, HF-23 and HF-26 to permit monitoring of the groundwater level. The standpipe piezometers consists of a 50 mm diameter PVC pipe with a slotted screen sealed at a depth within the boreholes. Details of standpipe piezometer installations and water level readings are presented on the borehole records in Appendix B. All open boreholes were backfilled with bentonite upon completion, in accordance with Ontario Regulation 903, Wells (as amended).

Field work was observed by a member of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground utility services, observed the drilling, sampling and in situ testing operations, and logged the boreholes. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected samples, to MTO LS and/or ASTM Standards, as applicable. In addition,

¹ ASTM D1586-08a – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the soil.



four, one-dimensional consolidation (oedometer) tests were carried out on samples of the silty clay to clayey silt deposit. The results of the geotechnical laboratory testing for the current investigation are included in Appendix E.

Borehole locations and ground surface elevations were obtained using a GPS (Trimble XH 3.5G), having an accuracy of 0.1 m in the vertical and 0.1 m in the horizontal directions. The locations, given in the borehole records and shown on Drawing 1 are positioned relative to North American Datum 1983 (NAD83CSRS), Modified Transverse Mercator (MTM) northing and easting coordinates, Zone 10, and the ground surface elevations referenced the Geodetic datum. The borehole locations in MTM NAD83 and geographic coordinates, ground surface elevations and drilled depths are summarized in Table 1, following the text of this report.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The project area is located within the Peterborough Drumlin Field physiographic region, as delineated in *The Physiography of Southern Ontario (Chapman and Putman, 1894)*². The surficial soils in the Peterborough Drumlin Field consist primarily of gravelly sand till or sand and gravel deposits. Drumlins (glacially-shaped hills) are more frequent in the southern portion of the section of the Peterborough Drumlin Field traversed by Highway 400. Deposits of silt, clay or peat may be found in the low-lying areas between drumlins. The Lindsay and Verulam Formations which underlies the Peterborough Drumlin Field consists mainly of fossiliferous limestone.

4.2 Subsurface Conditions

Detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during the investigation and the results of the laboratory tests carried out on selected soil samples are presented on the borehole records provided in Appendix D. The results of the in situ field tests (i.e. SPT “N”-values and field vane) as presented on the Record of Borehole sheets and in sub-sections of Section 4.2 are uncorrected. The geotechnical laboratory testing plots are contained in Appendix E.

The stratigraphic boundaries shown on the Record of Borehole sheets and on the stratigraphic profiles on Drawings 2 to 5 are inferred from non-contiguous sampling, observations of drilling progress and the results of Standard Penetration Tests and in situ field vane tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations; however, the factual data presented in the borehole records governs any interpretation of the site conditions. It should be noted that the interpreted stratigraphy shown on Drawings 2 to 5 is a simplification of the subsurface conditions.

In general, the subsurface conditions consist of a layer of topsoil or pavement structure underlain by granular fill, in turn underlain by an upper granular deposit of silt to silt and sand to silty sand. The upper granular deposit is underlain by an upper cohesive deposit composed of varved clayey silt to clay, underlain in places by a lower non-cohesive deposit and/or layers of silt to sandy silt to silty sand. The lower granular deposit is underlain by a lower cohesive deposit comprised of clayey silt and a deposit of glacial till that varies in composition from silt and sand to sandy clayey silt. A more detailed description of the subsurface conditions encountered in the boreholes during the previous and current field investigations is provided in the following sections.

² Chapman, L.J. and Putman, D.F., 1894, *The Physiography of Southern Ontario*, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.)



4.2.1 Topsoil

A 102 mm to 685 mm thick layer of topsoil was encountered from ground surface in Boreholes HF-01 to HF-09, HF-12 to HF-18, HF-21 to HF-23, HF-26 to HF-31, PMT-01, PMT-02, 89UP-01, 89UP-03, 89UP-07, 89UP-08 and HF-02. In boreholes where the thickness of topsoil is greater than the length of the split spoon sampler, the SPT “N”-values range from 1 blow to 8 blows per 0.3 m of penetration, indicating a very loose to loose level of compactness.

4.2.2 Pavement Structure

Boreholes 89UP-02 and 89UP-06 advanced through the existing pavement structure on the westbound lane of Highway 89, Boreholes 89UP-04 and 89UP-05 advanced on the northbound lanes of Highway 400 and Boreholes HF-10, HF-11, HF-19, HF-20, HF-24 and HF-25 advanced from existing ramps penetrated the pavement structure which is comprised of asphaltic concrete ranging in thickness from approximately 102 mm to 250 mm. The asphaltic concrete is underlain by a layer of sand and gravel (granular road base material) ranging in thickness from approximately 250 mm to 2,100 mm. Within the gravelly sand fill in Borehole HF-24, asphaltic concrete was encountered between depths of 1.2 m and 1.4 m below ground surface.

4.2.3 Fill

Granular fill was encountered underlying the pavement structure and topsoil at all borehole locations advanced for the high fill embankments with the exception of Boreholes HF-02 HF-05, HF-12, HF-13 and HF-15. The fill is variable in composition and generally consists of layers of silt and sand silty sand and sand and gravel. Organic odour was noted in Borehole 89UP-05 throughout the fill layer and clayey silt pockets were encountered below a depth of 7.2 m in Borehole 89UP-06. The surface of the fill was encountered at Elevations 234.6 m and 234.8 m in Boreholes 89UP-02 and 89UP-06, respectively, both of which were advanced on Highway 89, and between Elevations 229.7 m and 225.7 m at the other borehole locations. In Boreholes 89UP-02 and 89UP-06, the fill extends to depths of 10.2 m and 9.1 m respectively, below ground surface (Elevations 225.3 m and 226.2 m), while the fill extends to depths between about 0.7 m and 3.7 m below ground surface (between Elevations 226.7 m and 224.4 m) at the other borehole locations.

The SPT “N”-values measured within the granular fill range from 3 blows to 56 blows per 0.3 m of penetration, indicating very loose to very dense levels of compactness.

The results of grain size distribution tests completed on sixteen samples of the granular fill are presented on Figures E-1, E-2A, E-2B and E-3 in Appendix E.

The water content measured on samples of various layers of the fill deposit range from 10 per cent to 23 per cent, and field observations indicate moist to wet conditions.

4.2.4 Silt to Silty Sand (Upper Granular Deposit)

Underlying the topsoil and/or fill in all boreholes and from ground surface in Borehole PMT-02, a non-cohesive deposit consisting of silt to sandy silt to silt and sand to silty sand was encountered, between about Elevations 228.4 m and 224.4 m. The thickness of the deposit ranges from about greater than 1.5 m where it was not fully penetrated to 21.3 m and the deposit extends to depths between about 20.8 m and 29.3 m (between Elevations 209.1 m and 205.3 m) below ground surface. Boreholes HF-01 to HF-06 and HF-08 to HF-31 terminated within this deposit at depths of between 5.2 m and 9.8 m (between Elevations 224.4 m and 217.7 m) below ground surface. In addition, Boreholes 89UP-01 and 89UP-08 terminated within this deposit at a depth of 8.2 m (Elevation 219.6 m) and 11.3 m (Elevation 216.3 m) respectively, below ground surface.



The SPT “N”-values recorded within the non-cohesive deposit range from 5 blows to 80 blows per 0.3 m of penetration, indicating a loose to very dense compactness condition. The SPT “N”-values recorded in the upper granular deposit between about Elevations 228 m and 214 m generally range from about 5 blows to 43 blows, and below about Elevation 214 m the SPT “N”-values range from about 14 blows to 80 blows.

The results of grain size distribution testing completed on eighty-eight samples is shown on Figures E-4A to E-4G, E-5, E-6A, E-6B and E-7A to E-7D in Appendix E. The deposit generally contains trace to some gravel and trace clay and the silt portion contains trace to some sand. At some locations, the deposit contains clayey silt to silty clay interlayers which are between about 0.1 m to 2.3 m thick as described further in Section 4.2.5.

Atterberg limits testing carried out on thirteen samples of the non-cohesive deposit measured liquid limits ranging from about 14 per cent to about 17 per cent, plastic limits ranging from about 12 per cent to about 15 per cent, and plasticity indices ranging from about 1 per cent to about 3 per cent, indicating that the portion of the silt to sandy silt layers of the deposit has slight plasticity as presented on the plasticity chart on Figures E-8A and E-8B in Appendix E.

The natural water content measured on samples of the silt to silty sand deposit ranges from about 10 per cent to 24 per cent.

4.2.5 Clayey Silt to Silty Clay (Interlayers)

Boreholes 89UP-03, 89UP-07 and 89UP-08 penetrated approximately 0.3 m to 2.3 m thick layers of clayey silt to silty clay within the upper granular deposit. The surface of the clayey silt to silty clay layers were encountered between about Elevations 226.0 m and 209.6 m. The grey clayey silt to silty clay contains trace to some sand and in Borehole 89UP-07 the lower 2.3 m thick interlayer at Elevation 218.5 m is varved.

The SPT “N”-values measured within the cohesive layer in Boreholes 89UP-07 are 8 blows and 23 blows (measured at the interface of the silty clay layer and the underlying silt deposit) per 0.3 m of penetration, suggesting a stiff to very stiff consistency. A SPT “N”-value measured at the interface of the silty clay layer and underlying silt and sand deposit in Borehole 89UP-03 is 44 blows per 0.3 m of penetration, suggesting a hard consistency. A SPT “N”-value measured at the interface of the silty clay layer and overlying silt and sand deposit in Borehole 89UP-08 is 15 blows per 0.3 m of penetration, suggesting a stiff consistency.

The natural water content measured on four samples of the clayey silt to silty clay deposit ranges from about 21 per cent to 25 per cent.

4.2.6 Clayey Silt with Sand to Clay (Upper Cohesive Deposit)

A varved cohesive deposit comprised of clayey silt with sand to clayey silt to silty clay to clay was encountered underlying the upper granular deposit in Boreholes B1-1, B1-2, 89UP-02 to 89UP-07, HF-02 and HF-07. The cohesive deposit is varved, comprised of silty clay with thin clayey silt and silt laminae, but includes homogenous zones of silty clay in places. The surface of the cohesive deposit was encountered at depths between about 20.8 m and 29.3 m (between Elevations 209.1 m and 205.3 m) below ground surface. The thickness of the varved cohesive deposit varies from about 9.6 m to 12.4 m and the deposit extended to between about Elevations 195.8 m and 194.0 m. Borehole B1-1 was terminated within this deposit at a depth of 28.0 m (Elevation 200.9 m) below ground surface.

The SPT “N”-values recorded within this deposit ranges from 0 blows (weight of hammer) to 40 blows per 0.3 m of penetration. In situ vane tests carried out within this deposit measured undrained shear strength ranging from about 11 kPa to greater than 96 kPa, but typically greater than 40 kPa. The sensitivity ranges from about 1 to 4,



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with the exception of Borehole 89UP-06 in which a sensitivity of about 7 was measured at Elevation 200.8 m. The in situ field vane tests results together with the SPT “N”-values indicate that the clayey silt to silty clay deposit predominately has a firm to very stiff consistency, with the exception of the upper zone of the silty clay deposit encountered in Borehole B1-1 which has a hard consistency based on an SPT “N”-value of 40 blows per 0.3 m of penetration recorded at about Elevation 207.0 m.

The results of grain size distribution tests completed on four samples of the cohesive deposit are shown on Figure E-9 in Appendix E. The clayey silt portion of the deposit generally contains trace to some gravel and trace sand to a sandy composition. As noted above, the cohesive deposit is generally varved with clayey silt and silt laminae, as shown on the photographs on Figure E-10.

Atterberg limits tests were carried out on twenty-two samples of the varved cohesive deposit and measured liquid limits ranging from about 15 per cent to about 53 per cent, plastic limits ranging from about 13 per cent to about 21 and plasticity indices ranging from about 5 per cent to about 33 per cent. The results of the Atterberg limits tests are shown on the plasticity charts on Figures E-11A to E-11D in Appendix E, indicate that the cohesive deposit can be classified as clayey silt of low plasticity to silty clay of intermediate plasticity to clay of high plasticity. The liquidity index of the upper varved cohesive deposit ranges from about 0.6 to 1.3.

Laboratory consolidation tests were carried out on four samples of the cohesive deposit obtained from Shelby tubes in Boreholes 89UP-03, 89UP-06, 89UP-07 and HF-07. A pre-consolidation stress ranging between about 335 kPa and 555 kPa was estimated from the void ratio versus logarithmic pressure plots and from the total work versus pressure plots. A bulk unit weight ranging between about 17.4 kN/m³ and 18.8 kN/m³ and a specific gravity between about 2.71 and 2.75 was measured on the consolidation test samples. The overconsolidation ratio (OCR) ranges from 1.0 to 2.2 and it is noted that an OCR value of 1.0 was estimated on a specimen recovered from Borehole 89UP-06 (Sample 24) which was advanced through the existing Highway 89 embankment where the vertical effective stress is higher in comparison to the other samples tested. Details of the test results are shown on Figures E-12A to E-12D, E-13A to E-13D, E-14A to E-14D and E-15A to E-15D in Appendix E, and the test results are summarized below.

Borehole and Sample No.	Sample Depth / Elevation	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	C_c	C_r	e_o	c_v^1 (cm ² /s)
89UP-03 Sample 20	24.7 m / 202.7 m	235	335	100	1.4	0.53	0.024	0.96	9.3 x 10 ⁻³ 1.7 x 10 ⁻³
89UP-06 Sample 24	36.9 m / 198.5 m	410	410	~0	1.0	0.70	0.058	1.19	2.6 x 10 ⁻³ 1.5 x 10 ⁻⁴
89UP-07 Sample 21	26.2 m / 201.0 m	250	555	305	2.2	0.52	0.022	0.91	6.0 x 10 ⁻³ 1.9 x 10 ⁻³
HF-07 Sample 22	27.7 m / 199.6 m	265	370	105	1.4	0.50	0.030	0.95	2.7 x 10 ⁻³ 1.2 x 10 ⁻³

Note:

1. Two coefficients of consolidation (c_v) have been presented for each sample. The first value (top line) is based on a stress range below the effective overburden stress (i.e., within the overconsolidated stress range). The second value (bottom line) is based on a stress range between the effective overburden stress and the final stress due to high fill embankments greater than 7.5 m in height (i.e., normally consolidated stress range).



where: σ_{vo}' is the in situ vertical effective overburden stress in kPa
 σ_p' is the preconsolidation stress in kPa
OCR is the overconsolidation ratio
 e_o is the initial void ratio
 C_c is the compression index
 C_r is the recompression index
 c_v is the coefficient of consolidation in cm^2/s

The natural water content measured on thirty-six samples of this deposit ranges from about 20 per cent to 44 per cent.

4.2.7 Silt to Silty Sand (Lower Granular Deposit)

Underlying the upper cohesive deposit in Boreholes B1-2, 89UP-02 to 89UP-07, HF-02 and HF-07, a granular deposit consisting of silt to silt and sand to silty sand was encountered between Elevations 195.8 m and 194.0 m. The thickness of the deposit ranges from about 2.3 m to 6.5 m and the deposit extended to between about Elevations 193.5 m and 189.0 m. Boreholes HF-02 and B1-2 terminated within this deposit a depth of 35.7 m and 37.0 m (at Elevations 191.8 m and 191.4 m), respectively below ground surface.

The SPT "N"-values recorded in the lower granular deposit range from 27 blows to 106 blows per 0.3 m of penetration, with some values up to 100 blows for 0.08 m penetration, indicating a compact to very dense compactness condition.

The results of grain size distribution tests completed on six samples of this deposit are shown on Figure E-16 in Appendix E. The silt layers contain trace to some clay, trace to some sand, and the silt and sand layers contain trace clay. The deposit occasionally contains clayey silt inclusions and trace gravel.

The natural water content measured on fifteen samples of this deposit ranges from about 12 per cent to 24 per cent.

4.2.8 Sandy Clayey Silt to Clayey Silt (Lower Cohesive Deposit)

A lower cohesive deposit was encountered underlying the lower granular deposit in Boreholes 89UP-02 to 89UP-07 and HF-07. The surface of the deposit was encountered between about Elevations 193.5 m to 189.0 m, the thickness of the deposit ranges from between about 3.1 m to greater than 7.9 m and the deposit extends to between about Elevations 186.3 m and 182.9 m. Boreholes 89UP-02, 89UP-06 and HF-07 were terminated within this deposit at depths of 50.8 m (Elevation 184.6 m), 52.4 m (Elevation 183.0 m) and 35.7 m (Elevation 191.6 m), respectively.

The SPT "N"-values recorded within this deposit generally range from 15 blows to 77 blows per 0.3 m of penetration, with one value of 100 blows per 0.15 m of penetration. A SPT "N"-value measured in the upper portion of the clayey silt deposit in Borehole 89UP-06 at about Elevation 189.4 m is 0 blows per 0.3 m of penetration (weight of hammer) but two in situ vane tests carried out within this deposit between about Elevations 189.0 m and 188.0 m measured undrained shear strengths greater than 96 kPa. The two field vane tests results together with the SPT "N"-values suggest that the sandy clayey silt to clayey silt deposit has a very stiff to hard consistency.

The results of grain size distribution tests completed on five samples of this deposit are shown on Figure E-17 in Appendix E. The clayey silt deposit contains trace sand to sandy and trace gravel.

Atterberg limits tests were carried out on eight samples of this deposit and measured liquid limits ranging from about 18 per cent to 24 per cent, plastic limits ranging from about 11 per cent to 16 per cent and a plasticity indices ranging from about 4 per cent to 8 per cent. The results of the Atterberg limits tests are shown on the plasticity



chart on Figure E-18 in Appendix E and indicate that the cohesive deposit can be classified as silt of slight plasticity to clayey silt of low plasticity.

The natural water content measured on ten samples of the deposit ranges from about 12 per cent to 22 per cent.

4.2.9 Silt and Sand to Silty Sand Till / Clayey Silt with Sand to Clayey Silt Till

A glacial till deposit was encountered underlying the lower cohesive deposit in Boreholes 89UP-03, 89UP-04, 89UP-05 and 89UP-07. The till deposit varies in composition from silt and sand to silty sand (i.e. granular till) to clayey silt with sand to clayey silt (i.e. cohesive till). Inferred cobbles and boulders were encountered between about Elevations 182.9 m and 182.3 m in Borehole 89UP-05. The surface of the till was encountered between Elevations 186.2 m and 182.9 m, and the boreholes were terminated within the till deposit at depths between about 49.2 m and 50.6 m (between Elevations 178.8 m and 176.6 m) below ground surface.

The SPT "N"-values measured within the granular till deposit range from 101 blows per 0.3 m of penetration to 100 blows per 0.08 m of penetration, indicating a very dense compactness condition. The SPT "N"-values measured within the cohesive till deposit range from 35 blows per 0.3 m of penetration to 100 blows per 0.05 m of penetration, suggesting a hard consistency.

Grain size distribution testing carried out on two samples of the granular till deposit are shown on Figure E-19 in Appendix E. The granular till consists of grey silt and sand to silty sand trace to some gravel, and trace clay. Grain size distribution of the three samples of the cohesive till deposit are shown on Figure E-20 in Appendix E. The cohesive till consists of grey clayey silt with sand to clayey silt, trace to some gravel.

Atterberg limit tests were carried out on three samples of the cohesive till deposit and measured liquid limits ranging from about 15 per cent to 23 per cent, plastic limits ranging from about 10 per cent to 11 per cent, and a plasticity indices ranging from about 4 per cent to 12 per cent. The results of the Atterberg limits tests shown on the plasticity chart on Figure E-21 indicate that cohesive till deposit can be classified as a clayey silt of low plasticity.

The natural water content measured in eight samples of the till deposit(s) ranges from about 7 per cent to 19 per cent.

4.2.10 Groundwater Conditions

The overburden samples obtained from the boreholes advanced during the previous and current investigations were generally moist to wet. The groundwater levels in the open boreholes or inside the drill casing were measured upon completion of drilling operations; however, the water levels in the drill casing does not necessarily reflect groundwater conditions on completion of drilling as water with drilling mud was used to advance Boreholes 89UP-02 to 89UP-07, HF-02, HF-04, HF-14 to HF-18, HF-20 to HF-22, HF-26, HF-27, HF-29 and HF-31.

Standpipe piezometers were installed in Boreholes 89UP-03, 89UP-07, HF-12, HF-15, HF-22, HF-23 and HF-26 to permit monitoring of groundwater level at this site. The piezometers in Boreholes 89UP-03, HF-12, HF-15, HF-22, HF-23, HF-26 and B1-2 are screened within the upper granular deposit and the piezometer in Borehole 89UP-07 is screened in the lower granular deposit. The measured water level in the piezometer installed in Borehole 89UP-07 is above the top of the lower granular deposit and therefore the groundwater in this deposit is artesian (but not flowing). Details of the piezometer installations and measured groundwater levels are shown on the borehole records in Appendix D. The groundwater levels recorded in open boreholes and in the piezometers (i.e. excluding water levels inside the casing in boreholes advanced using drill water/mud rotary methods) are summarized below.



FOUNDATION REPORT - HIGHWAY 400/89 HIGH FILL EMBANKMENT, G.W.P. 2483-13-00

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date (dd/mm/yyyy)	Comments
89UP-01	227.8	2.2	225.6	15/08/2017	Open borehole
89UP-03	227.4	3.3	224.1	21/07/2017	Open Borehole
		1.0	226.4	03/08/2017	Standpipe piezometer
		1.0	226.4	10/08/2017	
		1.2	226.2	15/08/2017	
		1.3	226.1	19/09/2017	
		0.7	226.7	05/03/2018	
		0.5	226.9	16/05/2018	
89UP-07	227.2	7.9	219.3	02/08/2017	Open borehole
		0.7	226.5	10/08/2017	Standpipe piezometer
		0.7	226.5	15/08/2017	
		0.9	226.3	19/09/2017	
		1.0	226.2	05/03/2018	
89UP-08	227.6	1.1	226.5	09/08/2017	Open borehole
HF-01	227.8	4.0	223.8	11/07/2017	Open borehole
HF-02	227.5	2.7	224.8	09/08/2017	Open borehole
HF-03	227.5	1.5	226.0	09/08/2017	Open borehole
HF-04	227.8	1.2	226.6	02/02/2018	Open borehole
HF-05	227.0	1.4	225.6	17/07/2017	Open borehole
HF-06	227.2	1.2	226.0	14/07/2017	Open borehole
HF-08	227.2	0.8	226.4	14/07/2017	Open borehole
HF-09	227.2	1.1	226.1	13/07/2017	Open borehole
HF-10	227.6	1.3	226.3	11/07/2017	Open borehole
HF-11	227.8	2.6	225.2	11/07/2017	Open borehole
HF-12	226.7	0.8	225.9	13/07/2017	Open borehole
		2.0	224.7	03/08/2017	Standpipe piezometer
		2.0	224.7	10/08/2017	
		2.1	224.6	15/08/2017	
		2.4	224.3	19/09/2017	
		1.4	225.3	19/09/2017	
		0.3	226.4	05/03/2018	
HF-13	226.8	1.2	225.6	13/07/2017	Open borehole
HF-19	229.6	3.4	226.2	02/02/2018	Open borehole
HF-22	226.8	0.6	226.2	05/03/2018	Standpipe piezometer
HF-23	226.9	0.7	226.2	05/03/2018	Standpipe piezometer
HF-24	229.1	3.2	225.9	15/02/2018	Open borehole
HF-25	229.8	3.1	226.7	15/02/2018	Open borehole



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Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date (dd/mm/yyyy)	Comments
HF-26	228.5	1.4	227.1	05/03/2018	Standpipe piezometer
HF-28	229.4	2.2	227.2	08/02/2018	Open borehole
HF-30	228.1	3.3	224.8	31/01/2018	Open borehole
B1-1	228.9	2.7	226.2	18/12/2000	Open borehole
B1-2	228.4	2.3	226.1	18/12/2000	Open borehole
		1.8	226.6	19/01/2001	Standpipe piezometer
		1.3	227.1	15/03/2001	

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events, and should be expected to be higher during wet periods of the year.



5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Sandra McGaghran, M.Eng., P.Eng., a senior geotechnical engineer and Associate with Golder. Mr. Jorge Costa, P.Eng, a MTO Foundations Designated Contact and Senior Consultant with Golder conducted a technical review of the report and Ms. Lisa Coyne, P.Eng., Golder's MTO Foundations Designated Contact for this project and Principal with Golder, conducted an independent quality control review of the report.

GOLDER ASSOCIATES LTD.



Sandra McGaghran, M.Eng., P.Eng.
Senior Geotechnical Engineer, Associate



Lisa Coyne, P.Eng.
Principal, MTO Foundations Designated Contact

Jorge M.A. Costa, P.Eng
MTO Foundations Designated Contact, Senior Consultant

SMM/JMAC/LCC/rb

[https://golderassociates.sharepoint.com/sites/12201g/6-deliverables/fnds/reports/high fill embankment/4-final/1668512-fir-high fill areas 2018sept21.docx](https://golderassociates.sharepoint.com/sites/12201g/6-deliverables/fnds/reports/high%20fill%20embankment/4-final/1668512-fir-high%20fill%20areas%202018sept21.docx)



FOUNDATION REPORT - HIGHWAY 400/89 HIGH FILL EMBANKMENT, G.W.P. 2483-13-00

**TABLE 1 – SUMMARY OF BOREHOLE LOCATIONS FROM 2017/2018 INVESTIGATION
HIGH FILL EMBANKMENTS, HIGHWAY 400/89 INTERCHANGE**

Borehole No.	Location (MTM NAD 83 – Zone 10)		Ground Surface Elevation (m), (Geodetic Datum)	Borehole Depth (m)
	Northing (m) (Latitude, °)	Easting (m) (Longitude, °)		
HF-01	4,895,603.0 (44.200320)	292,316.5 (-79.656185)	227.8	5.2
HF-02	4,895,665.0 (44.200881)	292,504.8 (-79.653830)	227.5	35.7
HF-03	4,895,693.1 (44.201135)	292,575.5 (-79.652946)	227.5	8.2
HF-04	4,895,694.3 (44.201156)	292,648.2 (-79.652040)	227.8	6.7
HF-05	4,895,517.7 (44.199551)	292,255.6 (-79.656945)	227.0	5.2
HF-06	4,895,503.9 (44.199427)	292,288.0 (-79.656539)	227.2	8.2
HF-07	4,895,478.1 (44.199196)	292,331.7 (-79.655992)	227.3	35.7
HF-08	4,895,469.0 (44.199114)	292,368.5 (-79.655531)	227.2	8.2
HF-09	4,895,449.3 (44.198938)	292,404.0 (-79.655086)	227.2	5.2
HF-10	4,895,613.9 (44.200417)	292,273.6 (-79.656721)	227.6	8.2
HF-11	4,895,635.6 (44.200612)	292,234.1 (-79.657216)	227.8	6.7
HF-12	4,895,670.6 (44.200927)	292,213.9 (-79.657470)	226.7	5.2
HF-13	4,895,650.6 (44.200747)	292,203.3 (-79.657603)	226.8	5.2
HF-14	4,895,742.6 (44.201590)	292,608.7 (-79.652536)	228.0	6.7
HF-15	4,895,764.4 (44.201785)	292,551.3 (-79.653255)	227.1	6.7
HF-16	4,895,581.4 (44.200133)	292,260.0 (-79.656895)	227.8	8.2
HF-17	4,895,595.0 (44.200256)	292,291.5 (-79.656500)	227.5	9.8
HF-18	4,895,703.0 (44.201235)	292,682.9 (-79.651607)	228.1	5.2
HF-19	4,895,582.4 (44.200142)	292,226.7 (-79.657311)	229.6	5.2
HF-20	4,895,608.5 (44.200377)	292,219.5 (-79.657402)	228.4	8.2
HF-21	4,895,723.3 (44.201410)	292,214.5 (-79.657468)	226.6	8.2
HF-22	4,895,770.4 (44.201834)	292,226.3 (-79.657321)	226.8	5.2



FOUNDATION REPORT - HIGHWAY 400/89 HIGH FILL EMBANKMENT, G.W.P. 2483-13-00

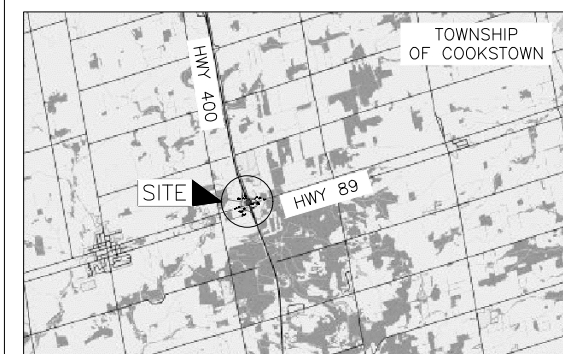
**TABLE 1 – SUMMARY OF BOREHOLE LOCATIONS FROM 2017/2018 INVESTIGATION
HIGH FILL EMBANKMENTS, HIGHWAY 400/89 INTERCHANGE**

Borehole No.	Location (MTM NAD 83 – Zone 10)		Ground Surface Elevation (m), (Geodetic Datum)	Borehole Depth (m)
	Northing (m) (Latitude, °)	Northing (m) (Latitude, °)		
HF-23	4,895,815.5 (44.202240)	292,244.4 (-79.657096)	226.9	5.2
HF-24	4,895,520.6 (44.199585)	292,191.0 (-79.657756)	229.1	6.7
HF-25	4,895,510.1 (44.199491)	292,238.8 (-79.657158)	229.8	9.8
HF-26	4,895,578.2 (44.200110)	292,615.8 (-79.652443)	228.5	5.2
HF-27	4,895,621.1 (44.200496)	292,594.5 (-79.652711)	227.6	8.2
HF-28	4,895,492.9 (44.199342)	292,593.3 (-79.652723)	229.4	5.2
HF-29	4,895,521.9 (44.199603)	292,610.6 (-79.652507)	228.2	6.7
HF-30	4,895,594.9 (44.200261)	292,627.7 (-79.652294)	228.1	5.2
HF-31	4,895,626.4 (44.200545)	292,631.5 (-79.652247)	228.0	8.2
PMT/VSP-01	4,895,473.7 (44.199165)	292,331.2 (-79.656001)	227.2	34.6
PMT/VSP-02	4,895,579.3 (44.200120)	292,616.8 (-79.652431)	228.4	22.2
89UP-01	4,895,618.4 (44.200459)	292,361.9 (-79.655616)	227.8	8.2
89UP-02	4,895,597.2 (44.200269)	292,389.9 (-79.655266)	235.4	50.8
89UP-03	4,895,628.3 (44.200549)	292,375.2 (-79.655451)	227.4	49.2
89UP-04	4,895,619.3 (44.200469)	292,430.3 (-79.654761)	229.3	50.5
89UP-05	4,895,649.6 (44.200750)	292,418.6 (-79.654912)	229.2	50.4
89UP-06	4,895,621.9 (44.200493)	292,469.4 (-79.654271)	235.4	52.4
89UP-07	4,895,660.9 (44.200843)	292,451.0 (-79.654503)	227.2	50.6
89UP-08	4,895,655.5 (44.200795)	292,478.1 (-79.654165)	227.6	11.3

CONT No.
GWP No. 2438-13-00



HIGHWAY 400/89 INTERCHANGE
HIGH FILL EMBANKMENTS
BOREHOLE LOCATIONS








KEY PLAN
SCALE



2 0 2 4 km

LEGEND

- | | |
|---|--|
|  | Borehole – Current Investigation (Golder, 2017&2018) |
|  | Borehole – Current Investigation (Golder, 2017&2018) |
|  | Pressuremeter / Vertical Seismic Profile Test
Borehole – Current Investigation (Golder, 2018) |
|  | Borehole – Previous Investigation – GEOCREST NO.
31000-465 |
|  | High Fill Area |

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE10)			
No.	ELEVATION	NORTHING	EASTING
HF-12	226.7	4895670.6	292213.9
HF-13	226.8	4895650.6	292203.3
HF-14	228.0	4895742.6	292608.7
HF-15	227.1	4895764.4	292551.3
HF-16	227.8	4895581.4	292260.0
HF-17	227.5	4895595.0	292291.5
HF-18	228.1	4895703.0	292682.9
HF-19	229.6	4895582.4	292226.7
HF-20	228.4	4895608.5	292219.5
HF-21	226.6	4895723.3	292214.5
HF-22	226.8	4895770.4	292226.3
HF-23	226.9	4895815.5	292244.4
HF-24	229.1	4895520.6	292191.0
HF-25	229.8	4895510.1	292238.8
HF-26	228.5	4895578.2	292615.8
HF-27	227.6	4895621.1	292594.5
HF-28	229.4	4895492.9	292593.3
HF-29	228.2	4895521.9	292610.6
HF-30	228.1	4895594.9	292627.7
HF-31	228.0	4895626.4	292631.5
PMT-01	227.2	4895473.7	292331.2
PMT-02	228.5	4895579.3	292616.8
B1-1	228.9	4895635.8	292452.1
B1-2	228.4	4895623.5	292394.6

No.	ELEVATION	NORTHING	EASTING
89UP-01	227.8	4895618.4	292361.9
89UP-02	235.4	4895597.2	292389.9
89UP-03	227.4	4895628.3	292375.2
89UP-04	229.3	4895619.3	292430.3
89UP-05	229.2	4895649.6	292418.6
89UP-06	235.4	4895621.9	292469.4
89UP-07	227.2	4895660.9	292451.0
89UP-08	227.6	4895655.5	292478.1
CE-01	226.9	4895834.7	292221.0
CE-02	228.5	4895835.0	292256.3
HF-01	227.8	4895603.0	292316.5
HF-02	227.5	4895665.0	292504.8
HF-03	227.5	4895693.1	292575.5
HF-04	227.8	4895694.3	292648.2
HF-05	227.0	4895517.7	292255.6
HF-06	227.2	4895503.9	292288.0
HF-07	227.3	4895478.1	292331.7
HF-08	227.2	4895469.0	292368.5
HF-09	227.2	4895449.3	292404.0
HF-10	227.6	4895613.9	292273.6
HF-11	227.8	4895635.6	292234.1

-	-	-	-	-
NO.	DATE	BY	REVISION	
Geocres No. 31D-703				
HWY. 400/89			PROJECT NO. 1668512	DIST. CENTRAL
SUBM'D. DF	CHKD. DM	DATE: 5/8/2018		SITE: 30-256
DRAWN: SMD	CHKD. SMM	APPD. JMAC/LCC		DWG. 1

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Base plans provided in digital format by Morrison Hershfield, received May 26, 2017.

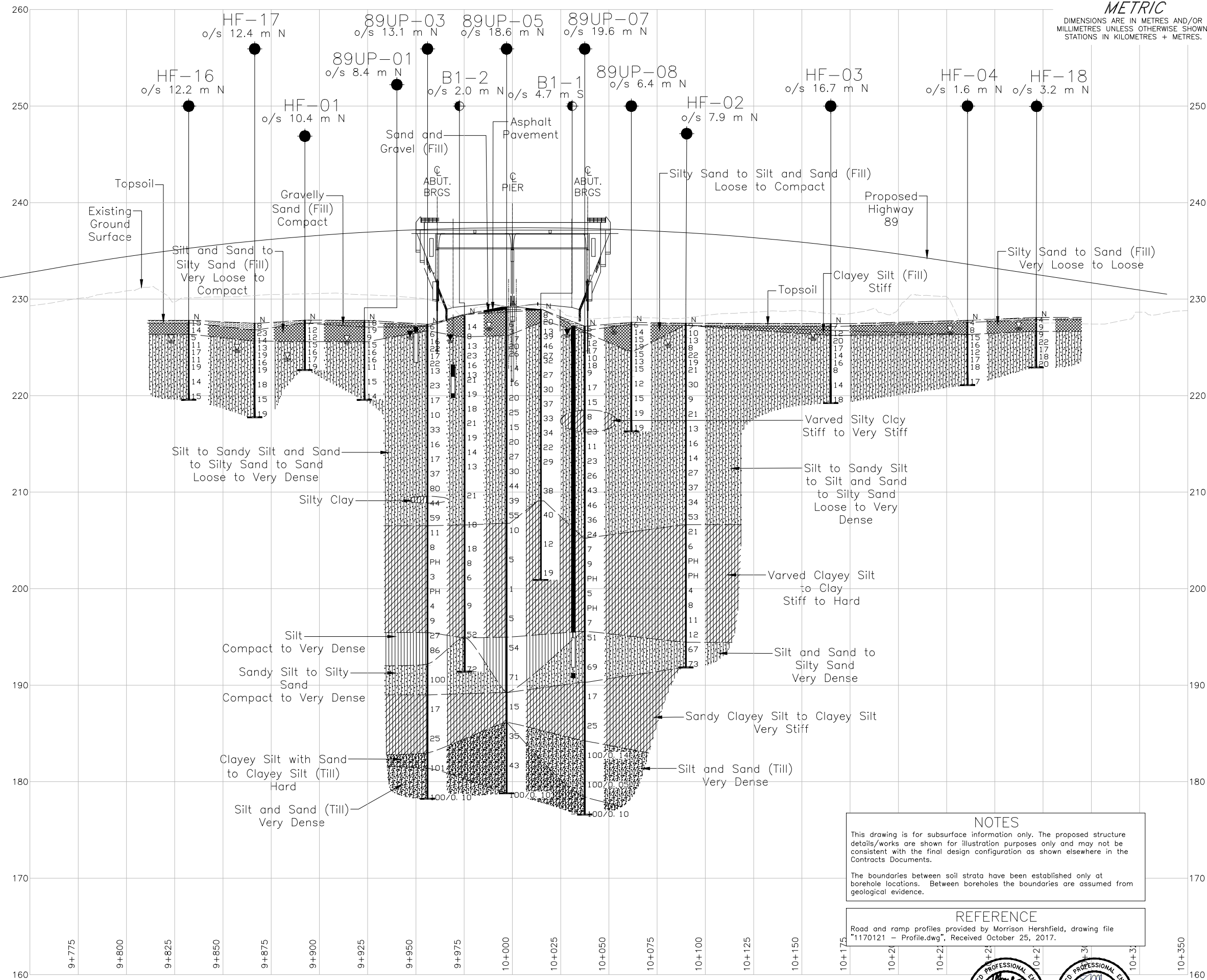
Interim design provided by Morrison Hershfield, drawing file "X1170121Design_Interim.dwg", received October 25, 2017.

Road and ramp alignments provided by Morrison Hershfield, drawing file "1170121 - Alignment.dwg", received October 25, 2017.

-EXISTING 300mm DIA.
PVC WATERMAIN



PLAN
SCALE

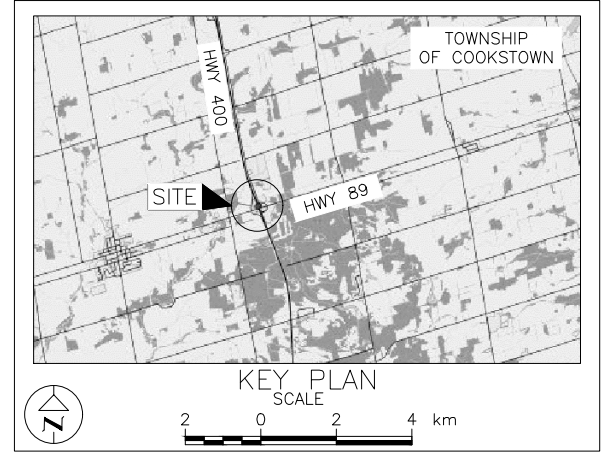


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2438-13-00

HIGHWAY 89
HIGH FILL EMBANKMENTS
SOIL STRATA

SHEET



LEGEND

- Borehole - Current Investigation (Golder, 2017 & 2018)
- Borehole - Previous Investigation (GEOCRETS NO. 31000-465)
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL in piezometer, measured on March 5, 2018 and March 15, 2001 in Borehole B1-2
- WL upon completion of drilling

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE10)			
No.	ELEVATION	NORTHING	EASTING
89UP-01	227.8	4895618.4	292361.9
89UP-03	227.4	4895628.3	292375.2
89UP-05	229.2	4895649.6	292418.6
89UP-07	227.2	4895660.9	292451.0
89UP-08	227.6	4895655.5	292478.1
HF-01	227.8	4895603.0	292316.5
HF-02	227.5	4895665.0	292504.8
HF-03	227.5	4895693.1	292575.5
HF-04	227.8	4895694.3	292648.2
HF-16	227.8	4895581.4	292260.0
HF-17	227.5	4895595.0	292291.5
HF-18	228.1	4895703.0	292682.9
B1-1	228.9	4895635.8	292452.1
B1-2	228.4	4895623.5	292394.6

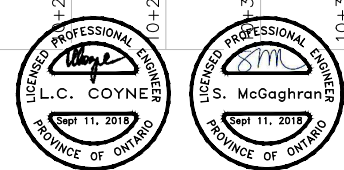
NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

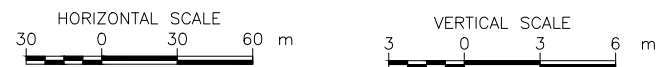
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Road and ramp profiles provided by Morrison Hershfield, drawing file "1170121 - Profile.dwg", Received October 25, 2017.



NO.	DATE	BY	REVISION
Geocres No. 31D-703			
HWY. 400/89	PROJECT NO. 1668512		DIST. CENTRAL
SUBM'D. DF	CHKD. DM	DATE: 5/8/2018	SITE: .
DRAWN: SMD	CHKD. SMM	APPD. JMAC/LCC	DWG. 2

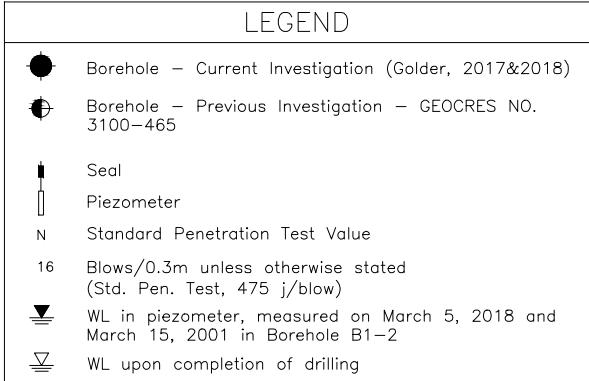


Road and ramp profiles provided by Morrison Hershfield, drawing file "1170121 - Profile.dwg", Received October 25, 2017.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

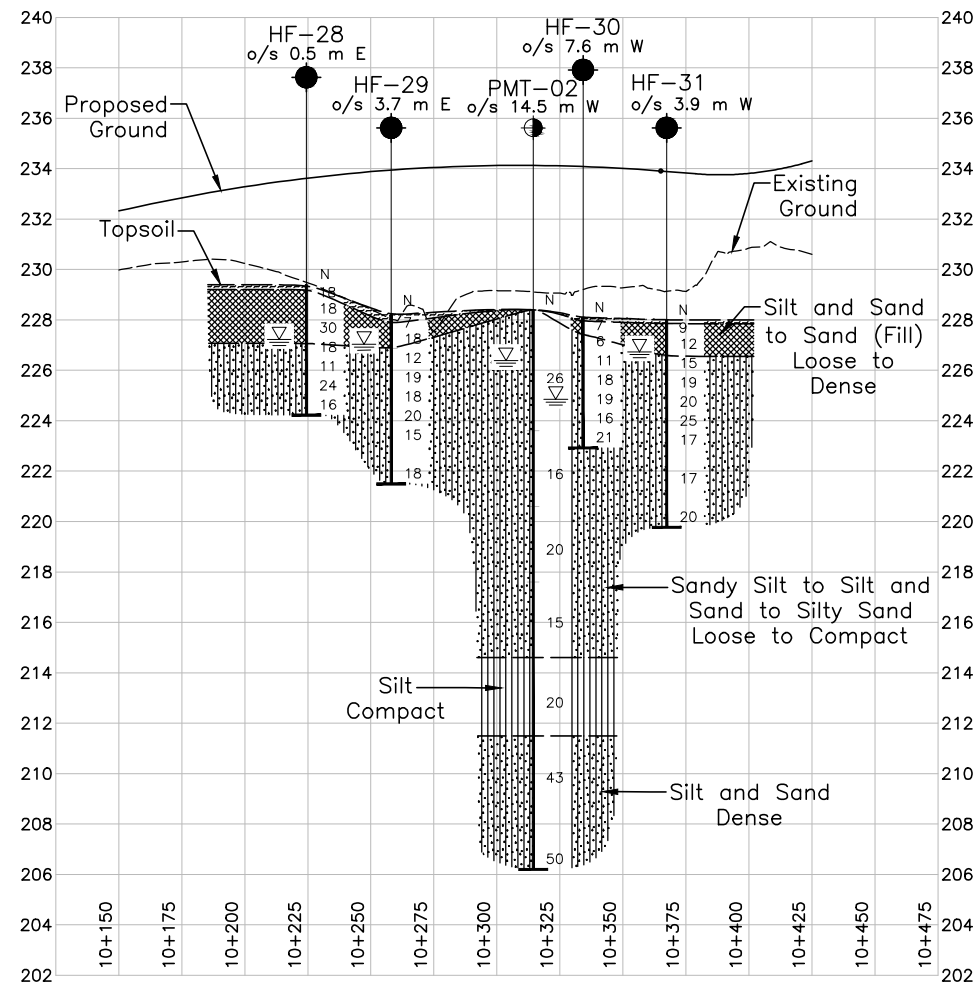
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN
STATIONS IN KILOMETRES + METRES.

HIGHWAY 400 / 89 INTERCHANGE
E-S RAMP
HIGH FILL EMBANKMENTS
SOIL STRATA

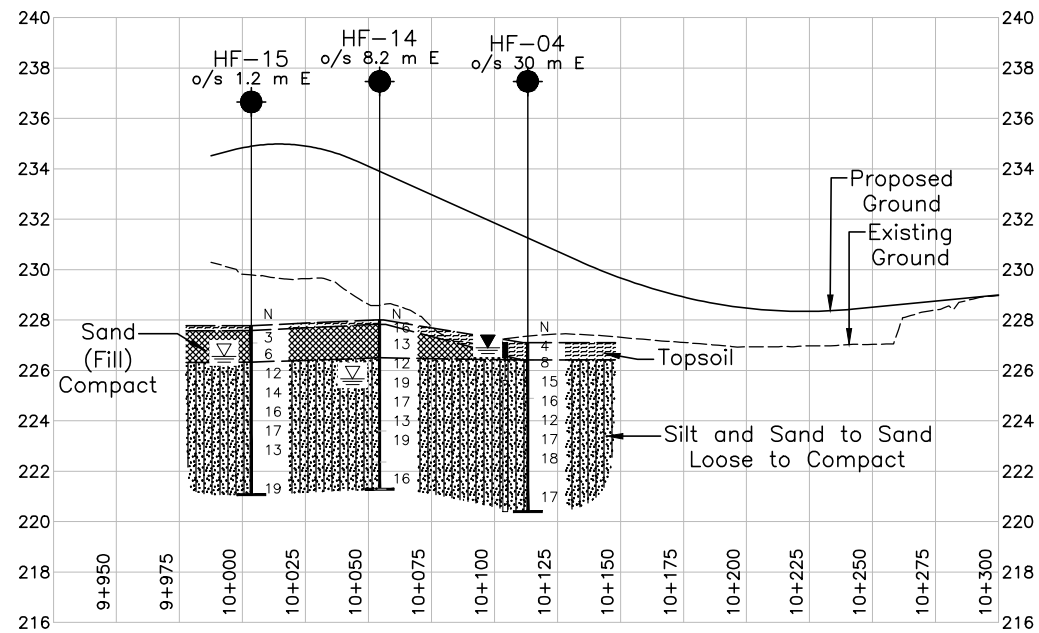
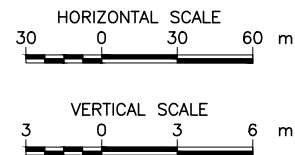


BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
89UP-01	227.8	4895618.4	292361.9
89UP-03	227.4	4895628.3	292375.2
B1-2	228.4	4895623.5	292394.6
HF-01	227.8	4895603.0	292316.5
HF-10	227.6	4895613.9	292273.6
HF-11	227.8	4895635.6	292234.1
HF-12	226.7	4895670.6	292213.9
HF-21	226.6	4895723.3	292214.5

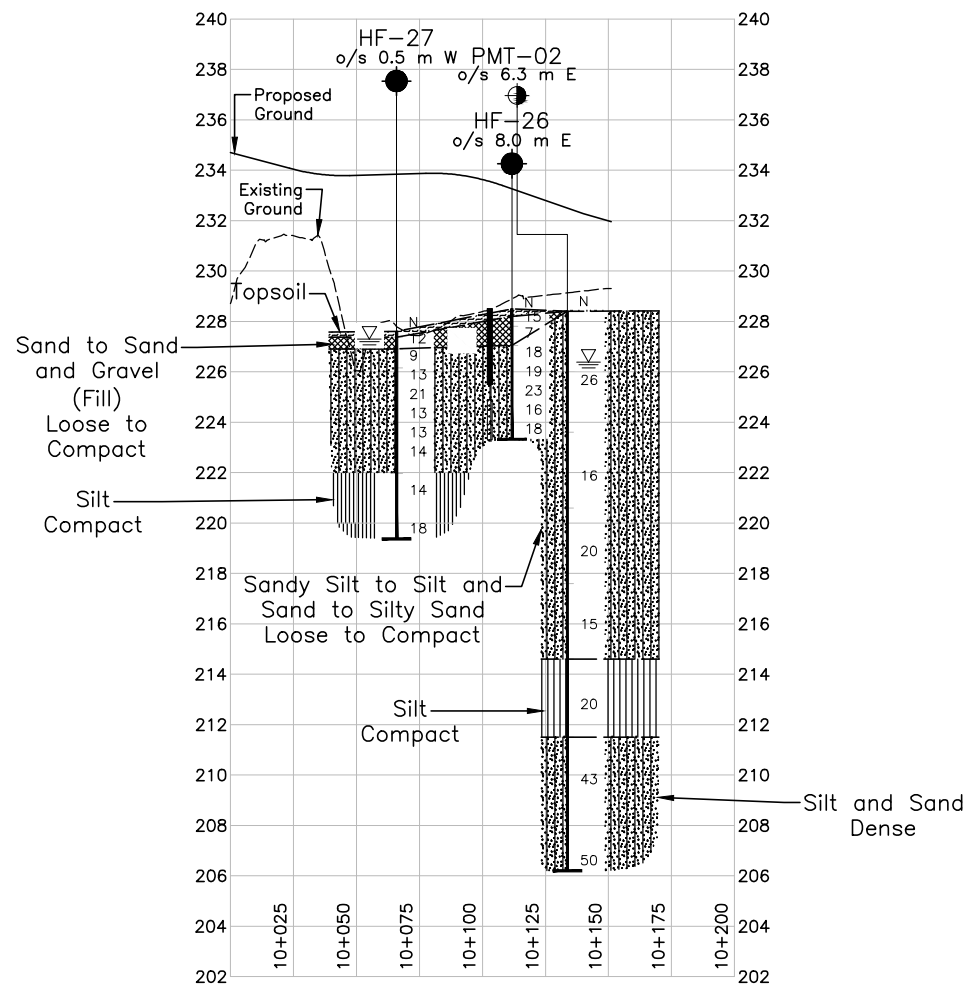
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D-D' RAMP E/W-N AND RAMP S-E/W PROFILE



C-C' REIVE BOULEVARD PROFILE



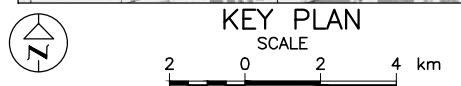
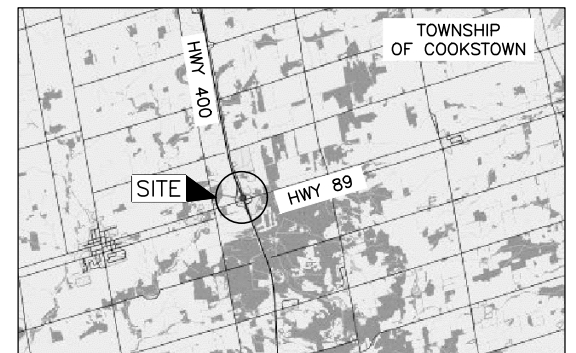
E-E' W-N RAMP PROFILE

METRIC
 DIMENSIONS ARE IN METRES AND/OR
 MILLIMETRES UNLESS OTHERWISE SHOWN.
 STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2438-13-00

HIGHWAY 400/89 INTERCHANGE
 RAMP E/W-N, S-E/W, W-N AND REIVE BOULEVARD
HIGH FILL EMBANKMENTS
SOIL STRATA

SHEET



LEGEND

- Borehole - Current Investigation (Golder, 2017&2018)
- ⊙ Pressuremeter / Vertical Seismic Profile Test Borehole - Current Investigation (Golder, 2018)
- ⊔ Seal
- ⊔ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ▽ WL in piezometer, measured on March 5, 2018
- ▽ WL upon completion of drilling

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE10)

No.	ELEVATION	NORTHING	EASTING
HF-04	227.8	4895694.3	292648.2
HF-14	228.0	4895742.6	292608.7
HF-15	227.1	4895764.4	292551.3
HF-26	228.5	4895578.2	292615.8
HF-27	227.6	4895621.1	292594.5
HF-28	229.4	4895492.9	292593.3
HF-29	228.2	4895521.9	292610.6
HF-30	228.1	4895594.9	292627.7
HF-31	228.0	4895626.4	292631.5
PMT-02	228.5	4895579.3	292616.8

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Road and ramp profiles provided by Morrison Hershfield, drawing file "1170121 - Profile.dwg", Received October 25, 2017.

NO.	DATE	BY	REVISION

Geocres No. 31D-703

HWY. 400/89	PROJECT NO. 1668512	DIST. CENTRAL
SUBM'D. DF	CHKD. DM	DATE: 5/4/2018
DRAWN: SMD/TB	CHKD. SMM	APPD. LCC/JMAC
		DWG. 4

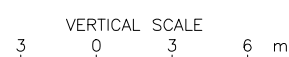


No.	ELEVATION	NORTHING	EASTING
HF-05	227.0	4895517.7	292255.6
HF-06	227.2	4895503.9	292288.0
HF-07	227.3	4895478.1	292331.7
HF-08	227.2	4895469.0	292368.5
HF-09	227.2	4895449.3	292404.0
HF-12	226.7	4895670.6	292213.9
HF-13	226.8	4895650.6	292203.3
HF-19	229.6	4895582.4	292226.7
HF-20	228.4	4895608.5	292219.5
HF-21	226.6	4895723.3	292214.5
HF-22	226.8	4895770.4	292226.3
HF-23	226.9	4895815.5	292244.4
HF-24	229.1	4895520.6	292191.0
HF-25	229.8	4895510.1	292238.8

NO.	DATE	BY	REVISION		
Geocres No. 31D-703					
HWY. 400/89		PROJECT NO. 1668512		DIST. CENTRAL	
SUBM'D. DF		CHKD. DM	DATE: 5/8/2018		SITE: .
DRAWN: SMD		CHKD. SMM	APPD. JMAC/LCC		DWG. 5

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.


Road and ramp profiles provided by Morrison Hershfield, drawing file "1170121 - Profile.dwg", Received October 25, 2017.





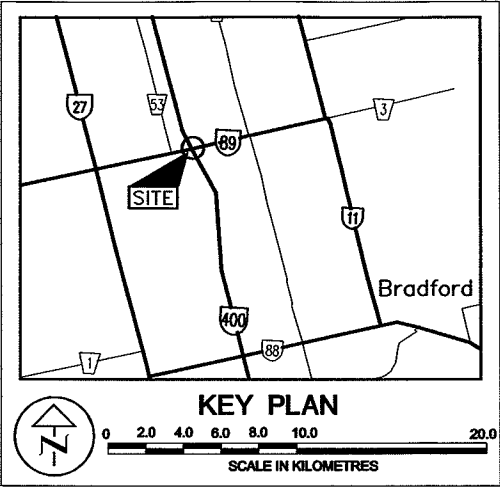
APPENDIX A



2002 Investigation – MTO GEOCRES No. 31D00-465

DIST CONT. No. GWP No. 30-95-00	HWY 400	
HIGHWAY 89 UNDERPASS HWY 400 BOREHOLE LOCATION PLAN		

**Golder Associates**

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA

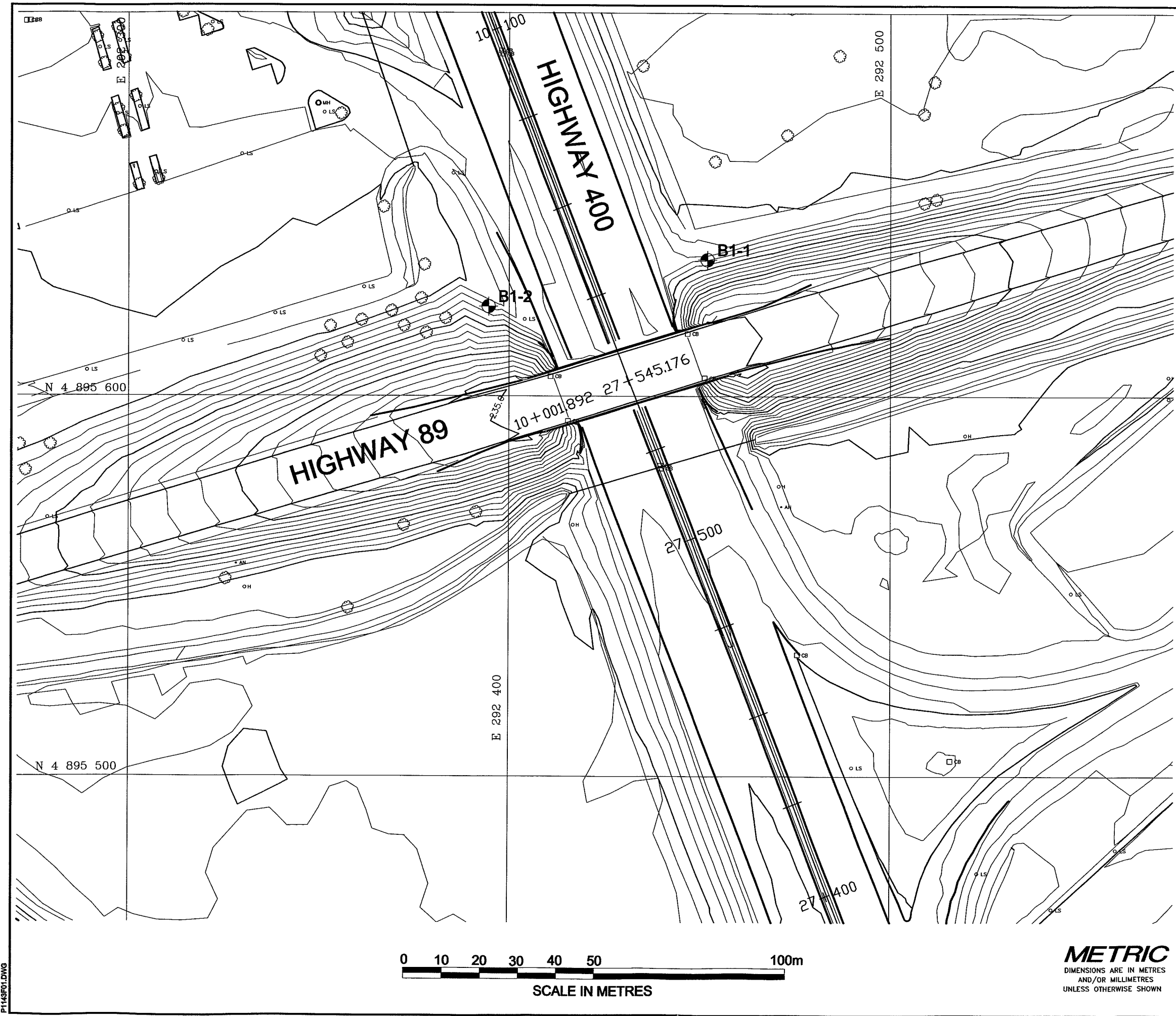


LEGEND			
	Borehole, previous investigation		
	Borehole, present investigation		
No.	ELEVATION	LOCATION	
		NORTHING	EASTING
B1-1	228.9	4,895,635.8	292,452.1
B1-2	228.4	4,895,623.5	292,394.6

REFERENCE

This drawing was created from digital file "33811.dwg" provided by URS Cole Sherman

NO.	DATE	BY	REVISION
Geocres No.			
HWY. No. 400	PROJECT NO.: 001-1143F		
SUBM'D. LCC	CHKD: ASP	DATE: JANUARY 2001	SITE 30-256
DRAWN: MHW	CHKD. LCC	APPD. ASP	DWG. 1



P1143F01.DWG

ON_MOT 0011143F.GPJ ON_MOT.GDT 14/1/02

+³, X³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

PROJECT 001-1143F			RECORD OF BOREHOLE No B1-1			2 OF 2			METRIC					
W.P. 30-95-00			LOCATION N 4895635.8; E 292452.1			ORIGINATED BY PKS								
DIST SW HWY 400			BOREHOLE TYPE 108mm DIAMETER SOLID STEM AUGERS			COMPILED BY LCC								
DATUM Geodetic			DATE Dec.14-18/2000			CHECKED BY ASP								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			ELEVATION SCALE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
	--- CONTINUED FROM PREVIOUS PAGE ---					SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED			W _p W W _L WATER CONTENT (%)			γ	GR SA SI CL	
209.1	Silty Sand to Sandy Silt, trace gravel, trace clay, containing silty clay layers Compact to dense Wet Brown to grey		14	SS	29									
			15	SS	38									
19.8	Silty Clay, trace sand Stiff to hard Wet Grey													
			16	SS	40									
			17	SS	12									
200.9			18	SS	19									
28.0	END OF BOREHOLE													
	Notes: 1. Hole terminated due to tightening of soil around augers and resulting difficulties in advancing/withdrawing augers. 2. Water level in open borehole on December 15 and 18, 2000 at 2.7m depth (Elev.226.2m)													

ON_MOT_0011143F.GPJ ON_MOT.GDT 14/1/02

PROJECT <u>001-1143F</u>		RECORD OF BOREHOLE No B1-2		1 OF 3		METRIC	
W.P. <u>30-95-00</u>		LOCATION <u>N 4895623.5; E 292394.6</u>		ORIGINATED BY <u>GPD</u>			
DIST <u>SW</u> HWY <u>400</u>		BOREHOLE TYPE <u>108mm ID HOLLOW STEM AUGERS AND CASING</u>		COMPILED BY <u>LCC</u>			
DATUM <u>Geodetic</u>		DATE <u>Dec.14-18/2000</u>		CHECKED BY <u>ASP</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL					
228.4	GROUND SURFACE														
0.0	Silty Sand, trace gravel, trace organics (Fill) Loose to compact Moist Brown		1	SS	14										
			2	SS	8										
226.1															
2.3	Silty Sand to Sandy Silt, trace clay Compact Wet Brown		3	SS	13										
			4	SS	23										0 71 29 0
			5	SS	16										
			6	SS	13										0 34 65 1
			7	SS	21										
			8	SS	19										
			9	SS	18										
			10	SS	21										
			11	SS	19										
			12	SS	14										

ON_MOT 0011143F.GPJ ON_MOT.GDT 14/1/02

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>001-1143F</u>		RECORD OF BOREHOLE No B1-2		2 OF 3	METRIC
W.P. <u>30-95-00</u>		LOCATION <u>N 4895623.5; E 292394.6</u>		ORIGINATED BY <u>GPD</u>	
DIST <u>SW</u> HWY <u>400</u>		BOREHOLE TYPE <u>108mm ID HOLLOW STEM AUGERS AND CASING</u>		COMPILED BY <u>LCC</u>	
DATUM <u>Geodetic</u>		DATE <u>Dec. 14-18/2000</u>		CHECKED BY <u>ASP</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N VALUES			SHEAR STRENGTH kPa						
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x REMOULDED					
-- CONTINUED FROM PREVIOUS PAGE --														
	Silty Sand to Sandy Silt, trace clay Compact Wet Brown		13	SS	13		213							
							212							
							211							
				14	SS	21		210						
							209							
							208							
							207							
206.6			15	SS	18		206							
21.8	Silty Clay, trace sand Firm to very stiff Moist Grey						205							
							204							
				16	SS	18		203						
							202							
							201							
				17	SS	8		200						
							199							
				18	SS	6								

Continued Next Page

+³, x³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

UN_MU1 001143F-GPJ UN_MU1.GU1 14/7/02

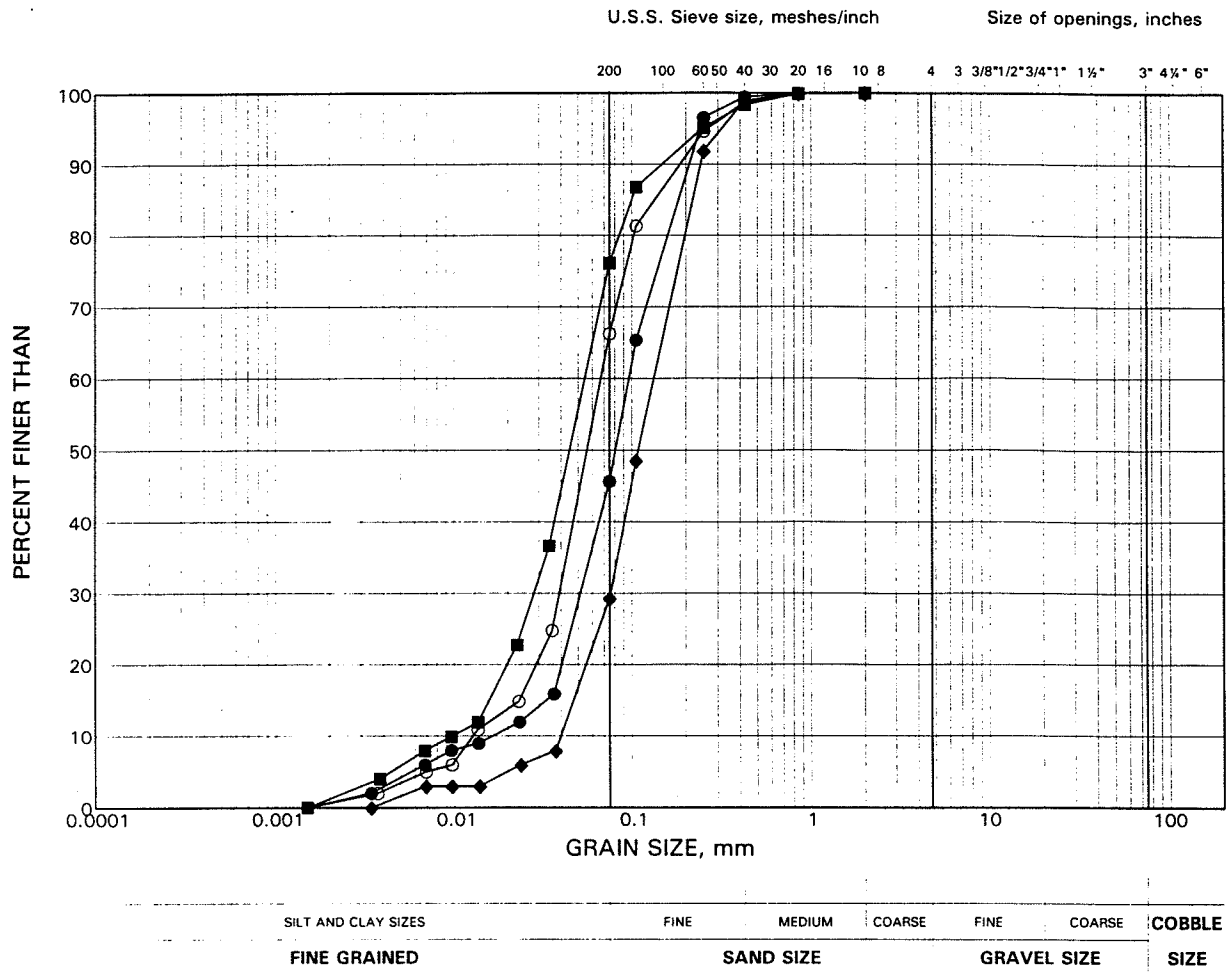
PROJECT 001-1143F			RECORD OF BOREHOLE No B1-2			3 OF 3			METRIC				
W.P. 30-95-00			LOCATION N 4895623.5; E 292394.6			ORIGINATED BY GPD							
DIST SW HWY 400			BOREHOLE TYPE 108mm ID HOLLOW STEM AUGERS AND CASING			COMPILED BY LCC							
DATUM Geodetic			DATE Dec.14-18/2000			CHECKED BY ASP							
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa	W _p	W	W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED	WATER CONTENT (%)				
									10 20 30			kN/m ³	GR SA SI CL
194.9	Silty Clay, trace sand Firm to very stiff Moist Grey		19	SS	9		198						
							197						
							196						
33.5	Silty Sand containing silty clay layers Very dense Wet Grey		20	SS	52		195						
							194						
							193						
							192						
191.4			21	SS	72								
37.0	END OF BOREHOLE												
	Notes: 1. Water level in open borehole at 2.3m depth (Elev.226.1m) on completion of drilling operations. 2. Water level in piezometer at 1.8m depth (Elev.226.6m) on January 19, 2001, and at 1.3m depth (Elev.227.1m) on March 15, 2001.												

ON_MOT 0011143F.GPJ ON_MOT.GDT 14/1/02

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silty Sand to Sandy Silt Deposit

FIGURE 1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	B1-1	4	226.3
■	B1-1	7	224.0
◆	B1-2	4	225.0
○	B1-2	6	223.5



APPENDIX B

Pressuremeter Test Results



**In-Situ Pressuremeter Testing
HWY 400 and HWY 89, Innisfil, Ontario
Boring Nos. 01-PMT and 02-PMT
February 3, 2018**

Project No. IDG 180411

Prepared for:
Mr. David Marmor, E.I.T.
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
L5N 7K2

In-Depth Geotechnical Inc.

20 Ravenscliffe Avenue
Hamilton, Ontario
L8P 3M4
Phone: (905) 541 9937
Fax: (877) 624 0140

Table of Contents

1. Introduction		1
2. Field Testing Procedures		2
3. In-Situ Test Results		3
4. Closure		10
Appendix One	Pressuremeter Results – Graphic Data	One-1
Appendix Two	Pressuremeter Data Interpretation	Two-1
Appendix Three	Calibration Data	Three-1

1. Introduction

In-Depth Geotechnical Inc. was retained by Golder Associates Ltd. (Golder) to conduct Pressuremeter testing in relation to their Geotechnical Investigation at the HWY 400 and HWY 89 site, in Innisfil, Ontario.

This report presents the results of pressuremeter testing (PMT) carried out at two borehole locations with the purpose of evaluating specific parameters related to a) shear strength; and b) deformation properties of the encountered soils.

This report includes data obtained by use of a pre-bored pressuremeter system. Inferred characteristics of the data are also presented including initial contact pressure, limit pressure, secant deformation modulus values during loading, unloading and reloading cycles, and yield pressure if and when justified by the data. Multiple methods are available for interpretation of this data to estimate engineering properties of soils but such methods are not discussed or included in this report except for the characteristics of the data plots as described above.

2. Field Testing Procedures

Pressuremeter testing was performed at two borehole locations, as indicated on site by Golder representatives, namely, Boring Nos. 01-PMT and 02-PMT.

Drilling procedures were undertaken by Walker Drilling Contractor. The boreholes were advanced using mud rotary drilling technique with a rubber track-mounted Diedrich D50 drill rig.

Field work was completed between January 24 and 25, 2018 for BH 01-PMT and between January 29 and 30, 2018 for BH 02-PMT. Details of maximum depth of testing and number of PMT tests completed per borehole are:

	Maximum Depth [m]	Number PMT tests	Ground Elevation [m]
Borehole No. BH 01-PMT	34.60	11	100.00 assumed
Borehole No. BH 02-PMT	21.50	7	100.00 assumed

The test sections of the boring were drilled with a tricone bit, with a nominal diameter of 3 ¹/₁₆ inch. The bit was advanced using continuous circulation of drilling mud to flush soil cuttings, producing a controlled diameter hole for the pressuremeter probe. A positive water head was kept inside the surface casing throughout drilling and in-situ testing procedures. In general, the drilling fluid remained at the top of casing.

Pre-boring pressuremeter testing was completed using a TEXAM unit. The testing procedure was in general accordance with Procedure B, volume-controlled loading, as outlined in the ASTM D 4719-00 Standard Test Method for Pre-bored Pressuremeter Testing of Soils. The testing equipment was calibrated for pressure and volume losses as indicated in the above mentioned standard. The Record of Calibration for the PMT probe utilized in this job is attached on Appendix Three. The control unit was de-aired prior to every test. Also, checks were completed to ensure that the probe, tubing, and control unit assembly were fully saturated, and that the probe membrane was leakage-free at high pressures. Two readings were taken for each volume step, namely for time delays of 15 and 30 seconds. One unload-reload cycle was performed on each PMT test.

3. Pressuremeter Test Results

Details for each pressuremeter test results are presented in Appendix One. Summaries of pressuremeter test results for each boring are illustrated in Table Nos. 1 and 2 below.

A general guideline to interpret and infer soil properties based on available PMT test data is attached to Appendix Two. This guideline suggests accepted current procedures to estimate or infer shear strength, deformation properties, and other related soil parameters.

Undrained shear strength values for cohesive soils can be inferred using the method suggested in Appendix B. Likewise, for cohesionless soils, approximated values of the friction angles can be correlated to the estimated values of the net limit pressure whenever available. See Figure 6-86 in page Appendix Two - 5.

Based on pressuremeter test data, we have included subsoil profiles for the tested borings, plotting the distributions of the interpreted PMT parameters with depth. These profiles are included in Drawings listed in the following pages, and, as mentioned above, summarized in Table Nos. 1 and 2.

Inferred values of the Young's Modulus are included in Table No. 1. These values were inferred with the Menard's α Rheological Parameter, in accordance with the procedure suggested by Baud and Gambin using the Pressiorama Chart. This Pressiorama Chart is included in Appendix Two.

Table No. 1

Summary of Pressuremeter Test Results							Boring No.:		BH 01-PMT			
Test No.	Depth [m]	Elevation [m]	p_0 [kPa]	E_{PMT} [MPa]	$E_{Unload\ 1}$	$E_{Reload\ 1}$	p_y [kPa]	p^*_L [kPa]	E_{PMT} / p^*_L	p^*_L / p_y	α Menard's Parameter	E_{Young}
					[MPa]	[MPa]						[MPa]
1	4.11	95.89	38	21.6	84.5	51.6	441	1983	10.9	4.5	0.35	62
2	7.11	92.89	66	12.7	68.0	43.7	544	1436	8.8	2.6	0.39	32
3	10.19	89.81	113	18.2	81.6	47.1	590	1932	9.4	3.3	0.43	42
4	13.26	86.74	149	18.8	87.2	56.8	625	1788	10.5	2.9	0.50	38
5	16.31	83.69	165	26.4	141.1	82.1	967	2821	9.4	2.9	0.43	61
6	19.36	80.64	214	21.5	109.5	65.2	822	2389	9.0	2.9	0.47	46
7	22.40	77.60	262	33.3	81.2	45.3	675	1036	32.1	1.5	1.00	33
8	25.48	74.52	298	50.6	94.5	55.2	622	1194	42.4	1.9	1.00	51
9	28.52	71.48	348	43.1	75.7	56.1	579	1252	34.4	2.2	1.00	43
10	31.57	68.43	397	36.0	105.4	65.0	829	2276	15.8	2.7	0.73	49
11	34.60	65.40	442	42.6	153.2	92.1	1060	1495	28.5	1.4	1.00	43

1. E_{PMT} is the Pressuremeter modulus, indicated also as E_0 in the Pressuremeter Test Reports

2. Surface elevation at El. 100.00 [m]

3. Groundwater elevation at El. n/a [m]

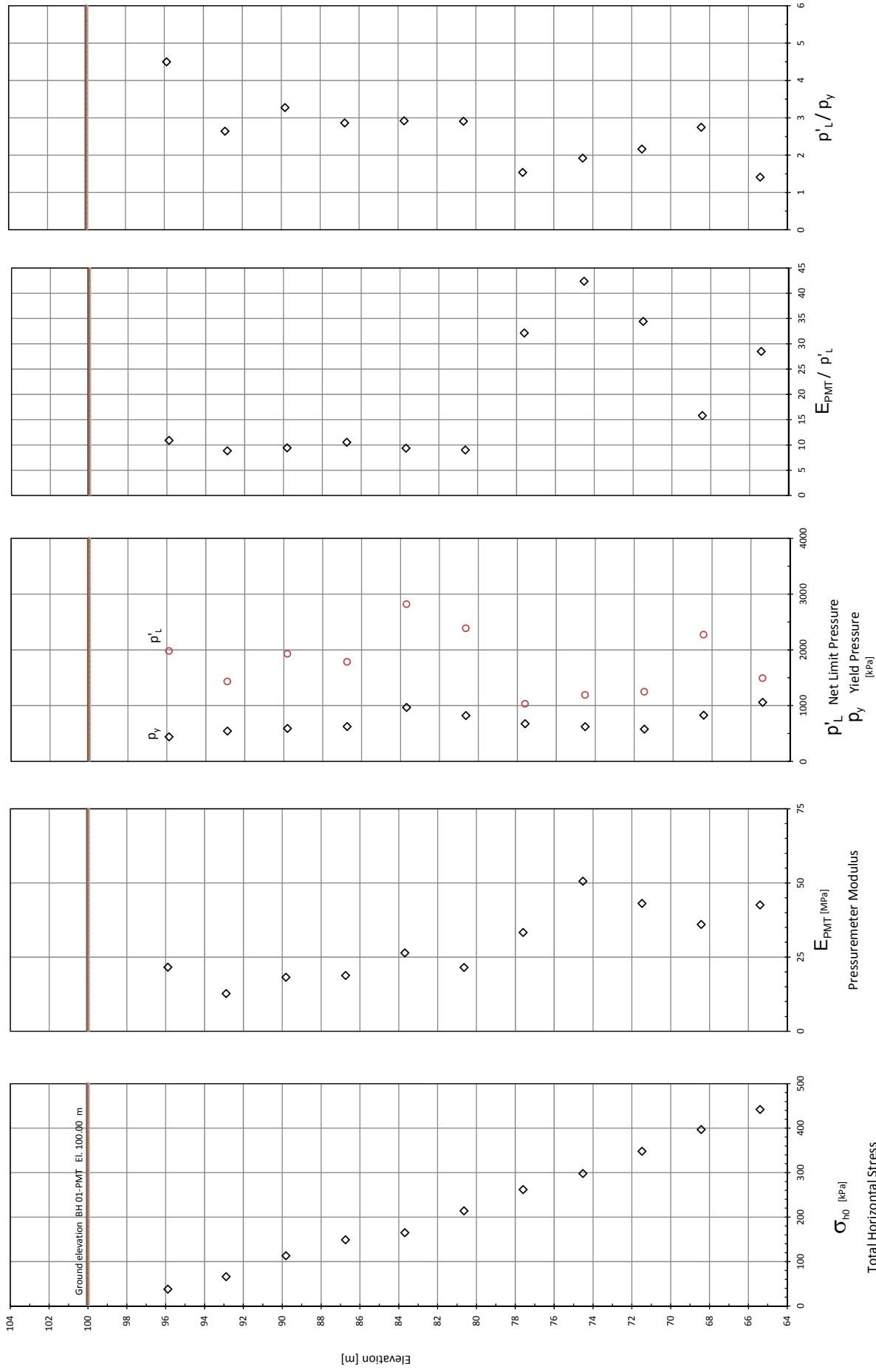
Table No. 2

Summary of Pressuremeter Test Results							Boring No.:		BH 02-PMT			
Test No.	Depth [m]	Elevation [m]	p_0 [kPa]	E_{PMT} [MPa]	$E_{Unload\ 1}$	$E_{Reload\ 1}$	p_y [kPa]	p^*_L [kPa]	E_{PMT} / p^*_L	p^*_L / p_y	α Menard's Parameter	E_{Young}
					[MPa]	[MPa]						[MPa]
1	2.11	97.89	19	4.3	19.9	14.2	152	601	7.2	4.0	0.32	13
2	5.87	94.13	60	15.2	69.8	48.2	513	1585	9.6	3.1	0.39	39
3	8.86	91.14	92	26.3	87.9	62.4	511	2311	11.4	4.5	0.43	61
4	11.76	88.24	131	22.5	97.9	64.4	658	2077	10.8	3.2	0.47	48
5	14.94	85.06	166	28.7	104.8	67.6	642	2045	14.0	3.2	0.57	50
6	17.88	82.12	205	41.0	122.9	83.4	655	3241	12.7	4.9	0.51	80
7	21.13	78.87	238	39.0	149.5	106.0	898	3165	12.3	3.5	0.53	74

1. E_{PMT} is the Pressuremeter modulus, indicated also as E_0 in the Pressuremeter Test Reports

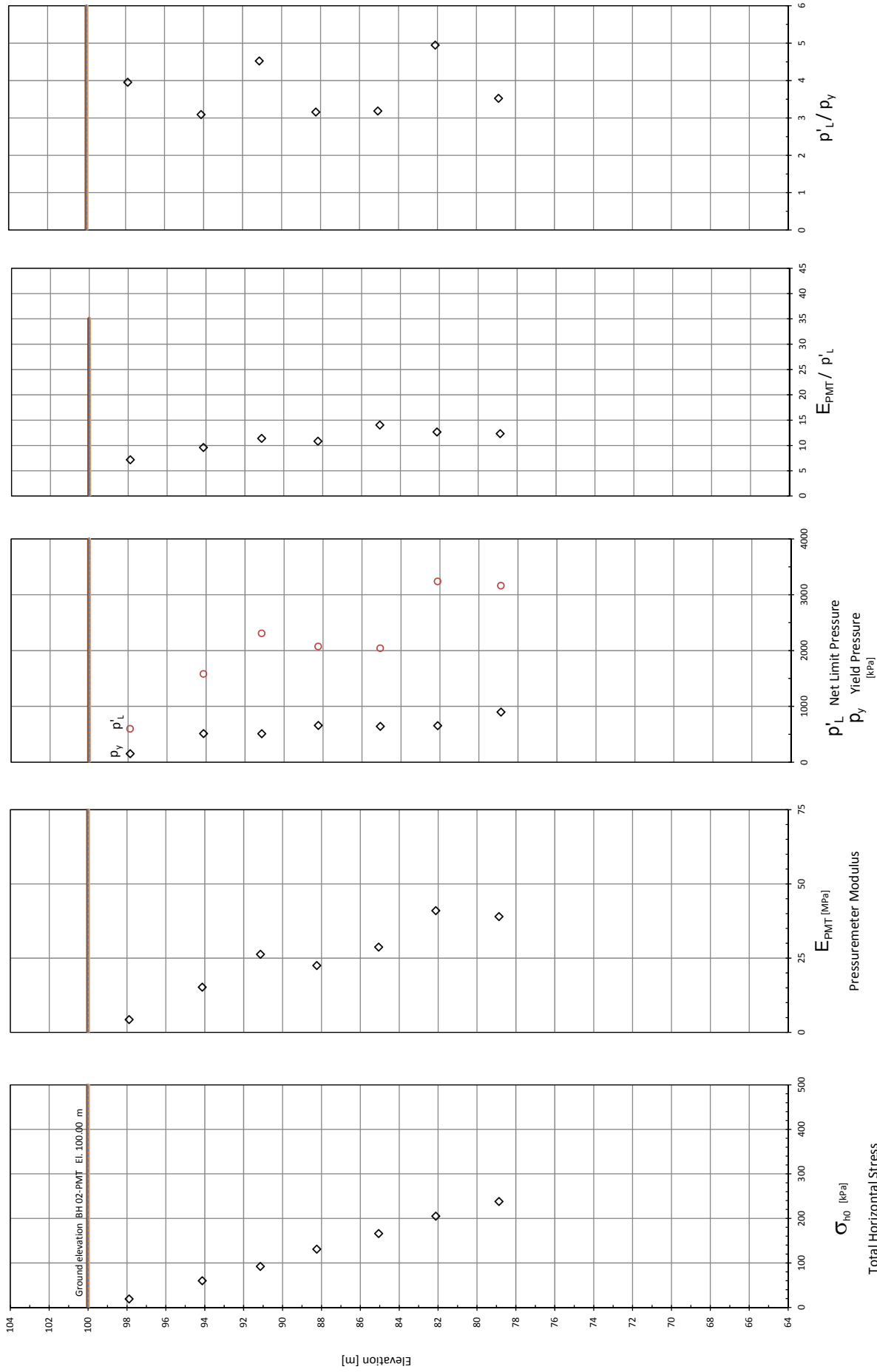
2. Surface elevation at El. 100.00 [m]

3. Groundwater elevation at El. n/a [m]



HWY 400 and HWY 89, Innisfil, Ontario		Boring No.: BH 01-PMT	
Pressuremeter Test Results		Project No.: IDG 180411	
Date: February 3, 2018			





Boring No.: BH 02-PMT

HWY 400 and HWY 89, Innisfil, Ontario

Pressuremeter Test Results

Date: February 3, 2018

Project No.: IDG 180411



4. Closure

The subsoils data presented in this report is based on in-situ PMT testing and interpretation procedures. It should be noted that soil conditions may vary within the site and interpreted data may not be entirely representative of conditions at locations away from the tested borings. Therefore care should be exercised when extrapolating or inferring subsoil conditions away from the borehole location.

We trust that the present report fulfill your requirements. Should you have any question, please feel free to contact the undersigned.

Sincerely,

In-Depth Geotechnical Inc.



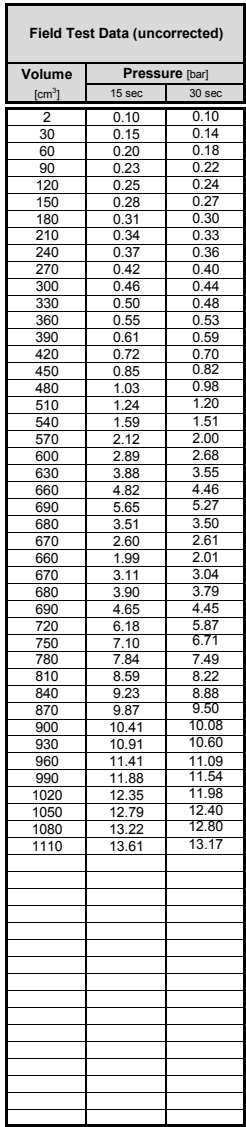
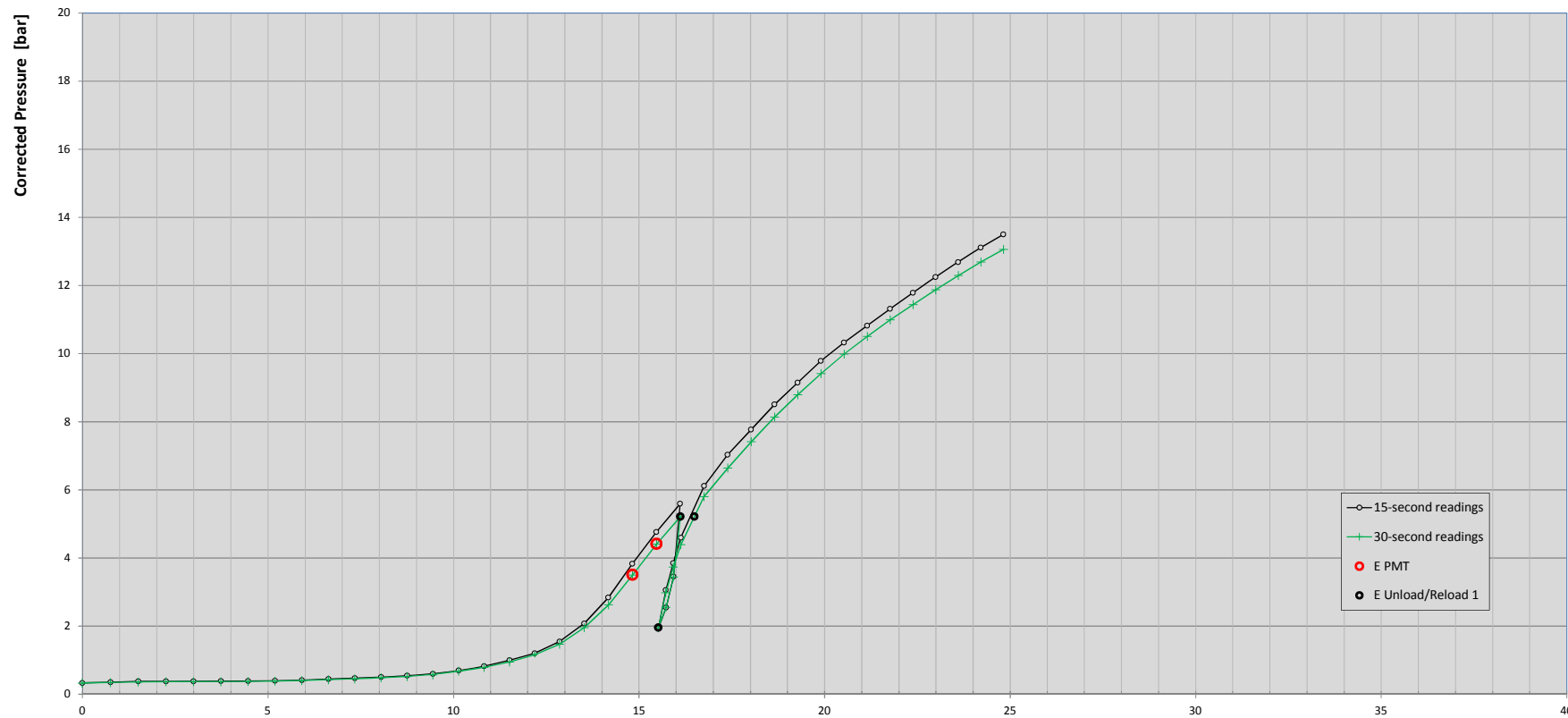
Gabriel Sedran, P.Eng., Ph.D.
President

Appendix One

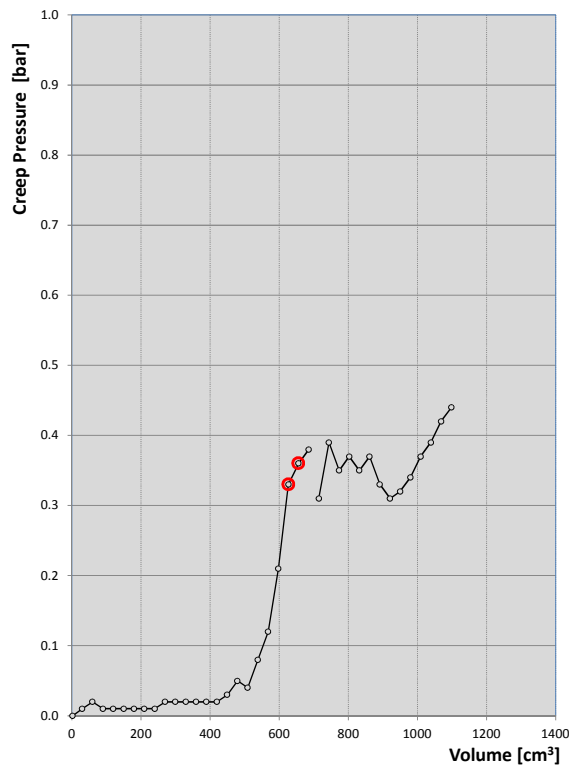
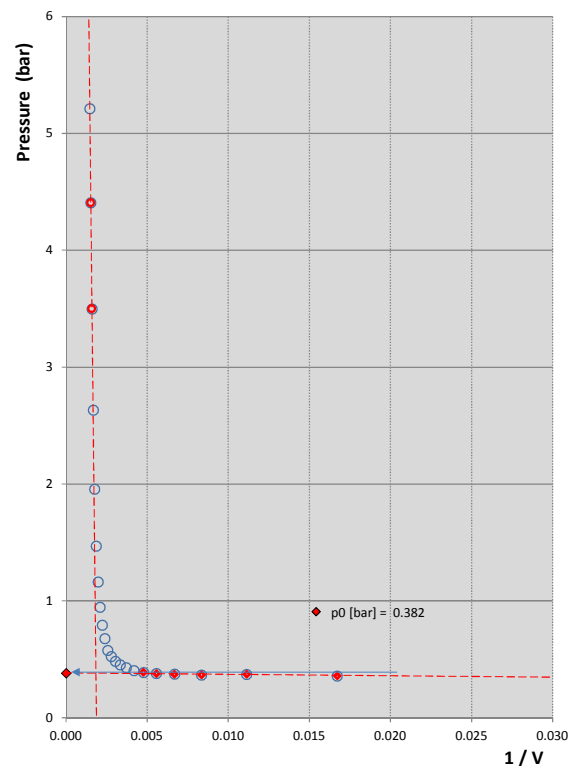
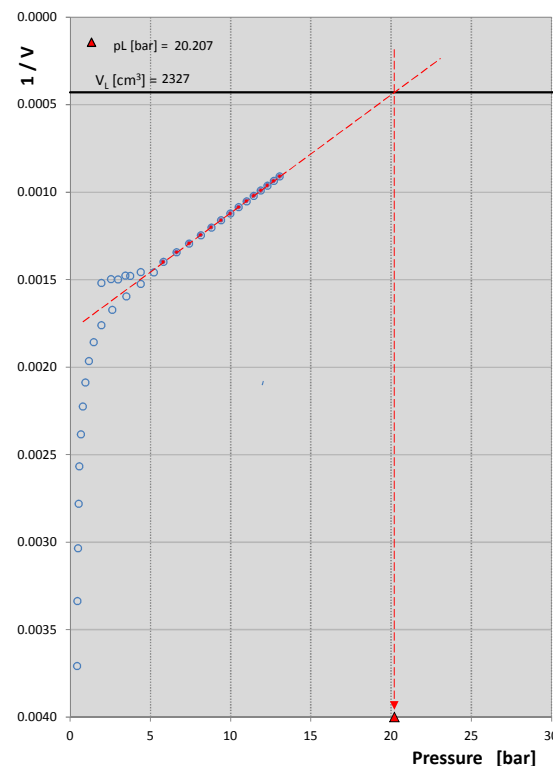
Pressuremeter Results - Data

BH 01-PMT
BH 02-PMT


Appendix One – Pages 1 to 11
Appendix One – Pages 12 to 18

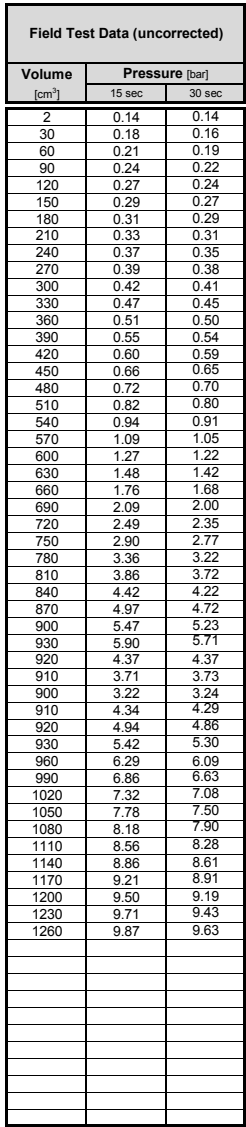
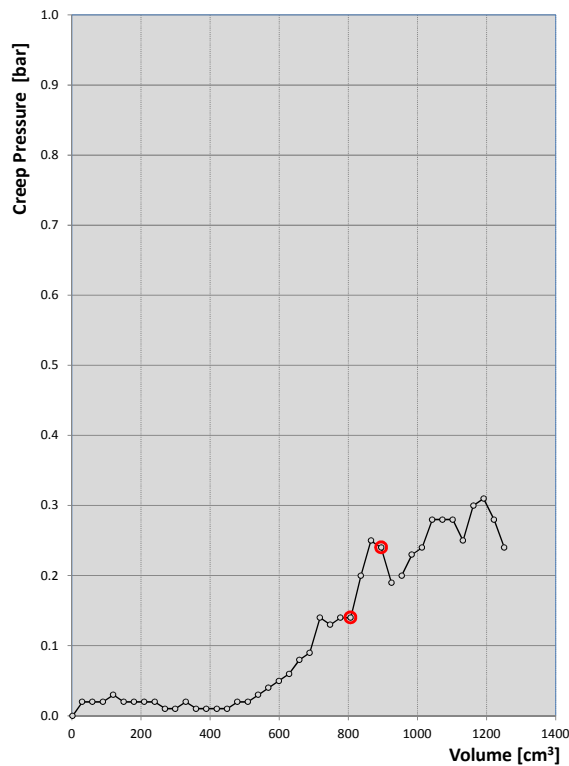
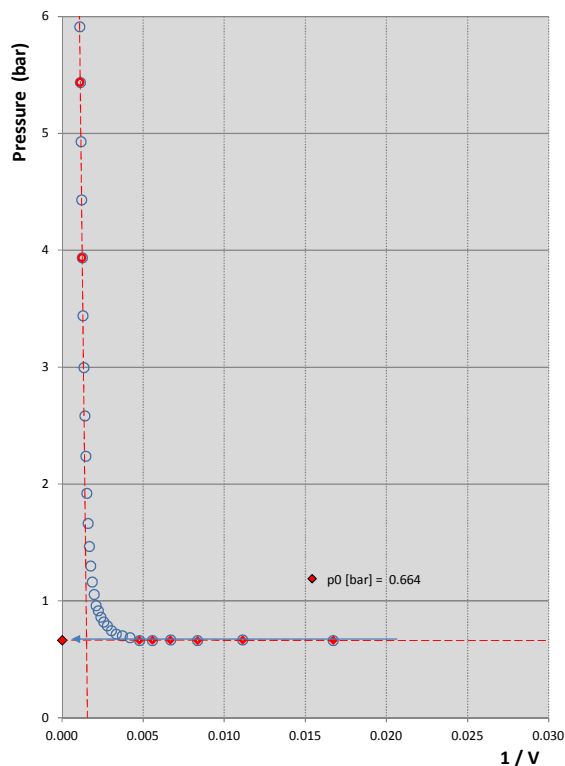
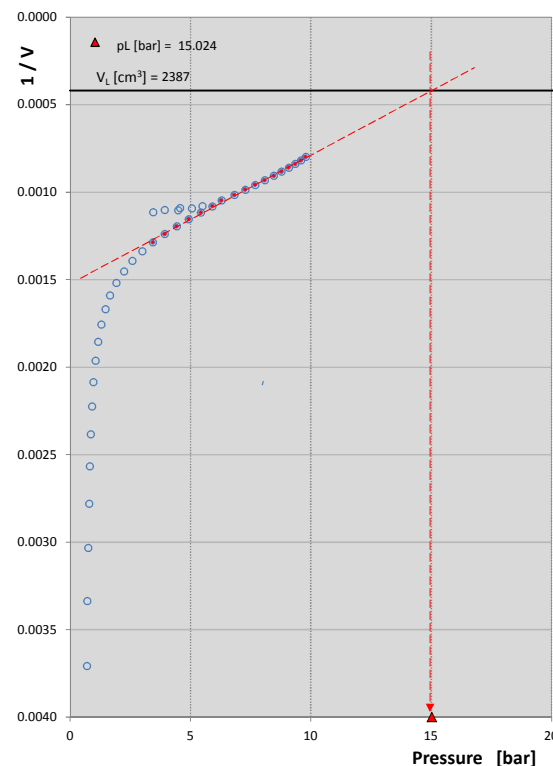
[illegible][illegible][illegible]

Pressuremeter test results [corrected data] pressure vs radial strain


Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 Determination of Limit Pressure p_L

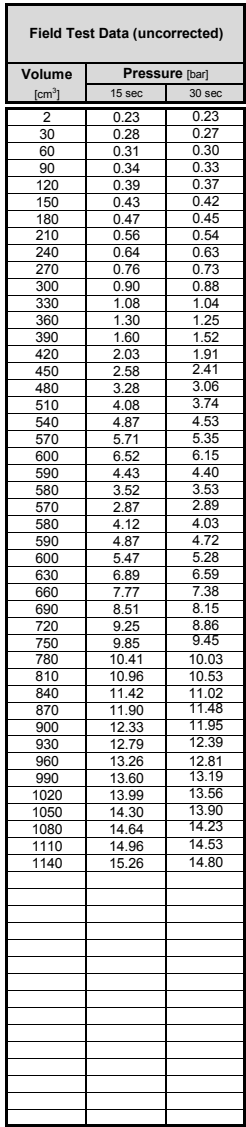
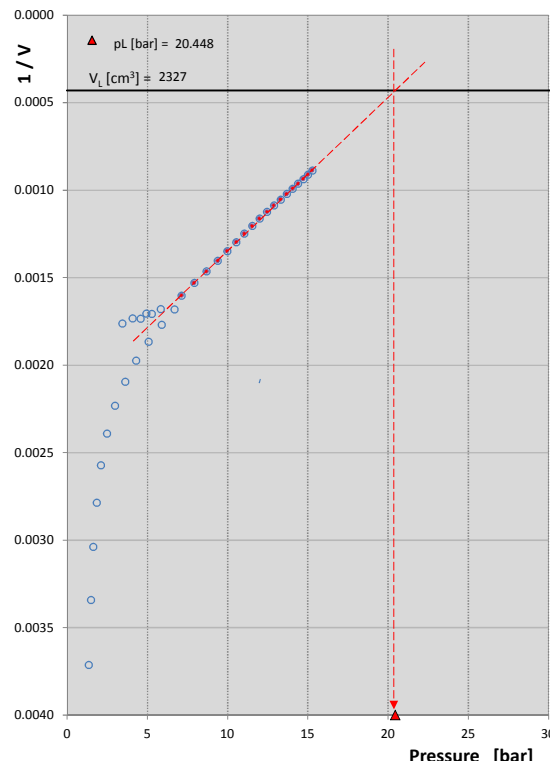
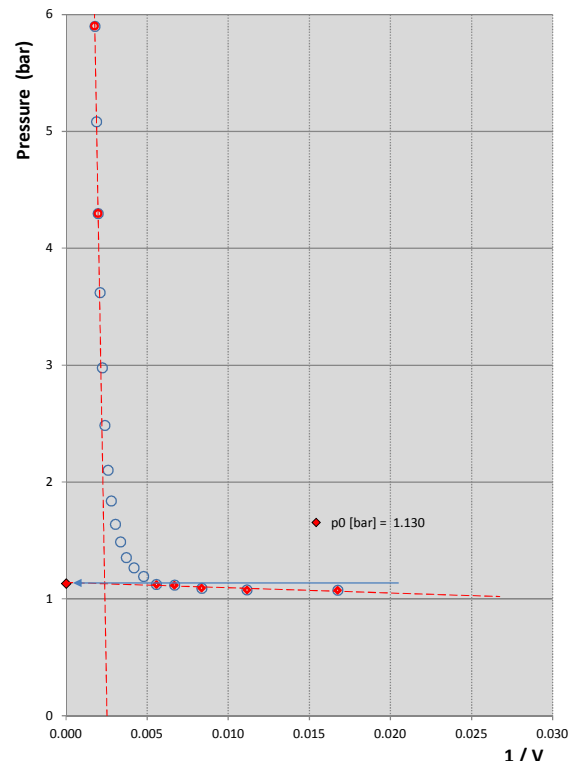
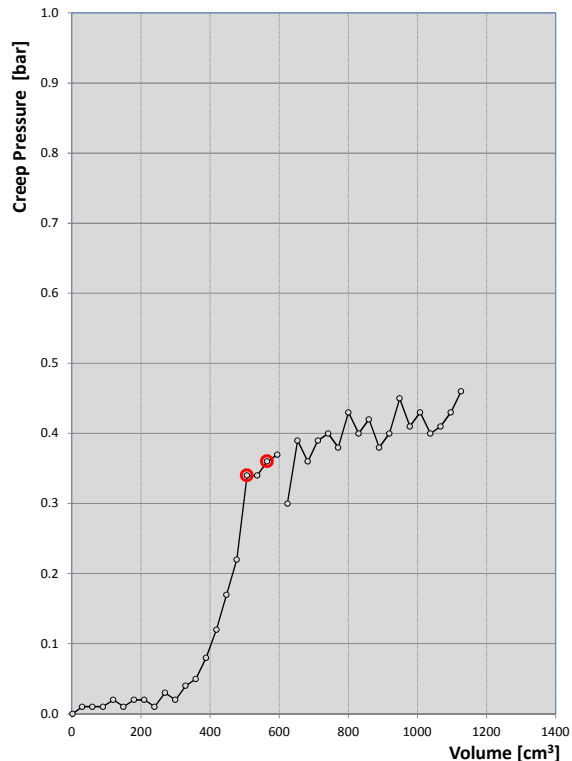
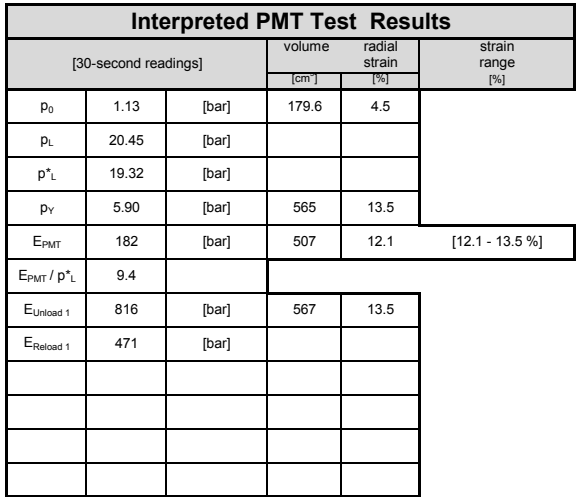
Interpreted PMT Test Results					
[30-second readings]			volume		strain range [%]
			[cm ³]	[%]	
p ₀	0.38	[bar]	179.7	4.5	
p _L	20.21	[bar]			
p [*] _L	19.83	[bar]			
p _γ	4.41	[bar]	656	15.5	
E _{PMT}	216	[bar]	627	14.8	[14.8 - 15.6 %]
E _{PMT} / p [*] _L	10.9				
E _{Unload 1}	845	[bar]	658	15.5	
E _{Reload 1}	516	[bar]			


Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 23, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 1	In-Depth Geotechnical Inc. 
Volume-controlled test as per ASTM D4719 Method B	Probe No.: E 309 Calibration Record No.: 1	Drilling Bit: Tricone Bit Time elapsed from hole drilling to testing ~ 5 minutes				
Volume increments: 40 cm³ Maximum Volume: 1400 cm³ Maximum Pressure: 100 bar	Tubing Length: 150 [ft] Probe Length: 0.46 [m] Probe Initial Volume: 1968 cm³	Engineer: Gabriel Sedran, P.Eng., Ph.D. Operator: Scott Hall	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		

[illegible][illegible][illegible]Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 Determination of Limit Pressure p_L

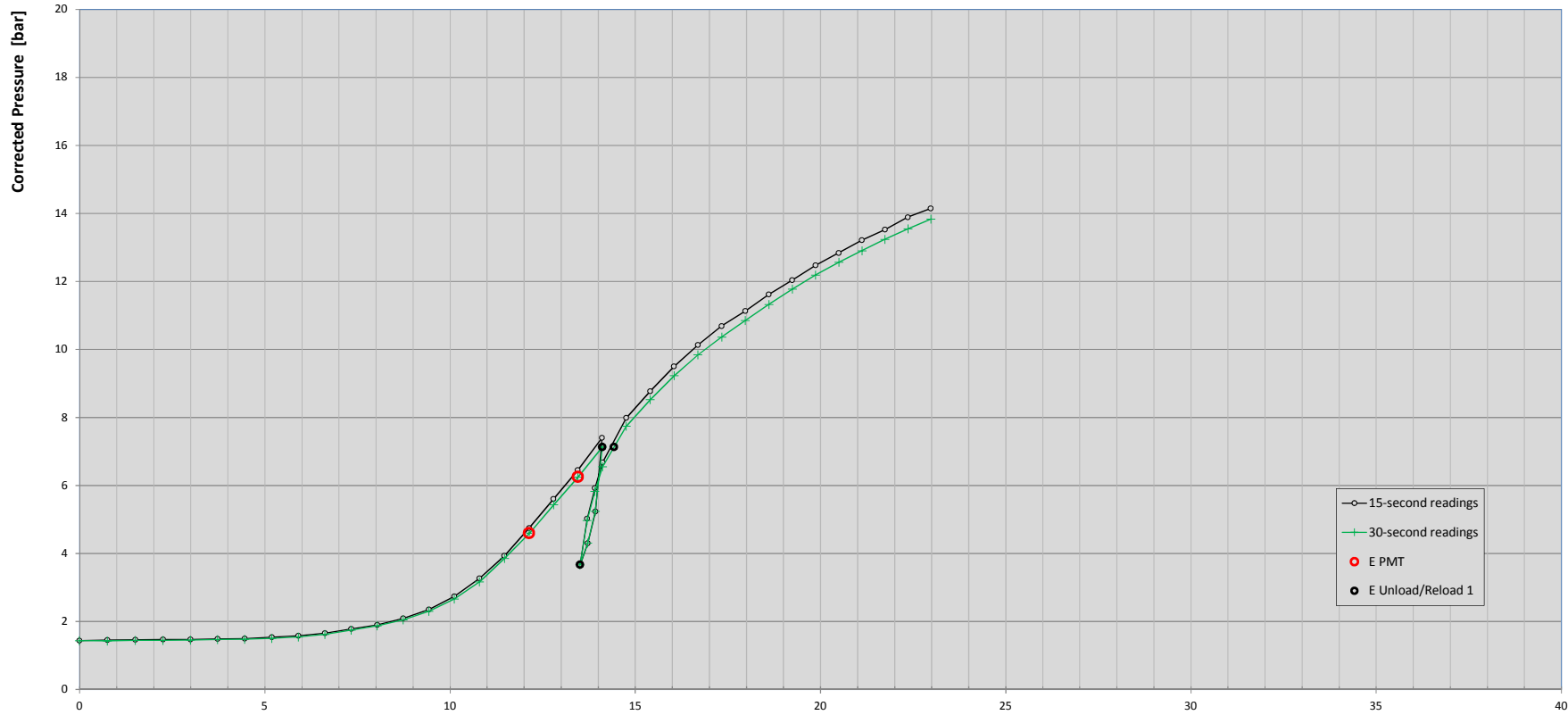
Interpreted PMT Test Results						
[30-second readings]			volume		radial strain	strain range [%]
			[cm ³]	[%]		
p ₀	0.66	[bar]	209.7	5.2		
p _L	15.02	[bar]				
p _L [*]	14.36	[bar]				
p _γ	5.44	[bar]	895	20.6		
E _{PMT}	127	[bar]	807	18.7	[18.7 - 20.6 %]	
E _{PMT} / p _L [*]	8.8					
E _{Unload 1}	680	[bar]	897	20.7		
E _{Reload 1}	437	[bar]				

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 23, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 2	In-Depth Geotechnical Inc. 
Volume-controlled test as per ASTM D4719 Method B	Probe No.: E 309 Calibration Record No.: 1	Drilling Bit: Tricone Bit Time elapsed from hole drilling to testing ~ 5 minutes				
Volume increments: 40 cm³ Maximum Volume: 1400 cm³ Maximum Pressure: 100 bar	Tubing Length: 150 [ft] Probe Length: 0.46 [m] Probe Initial Volume: 1968 cm³	Engineer: Gabriel Sedran, P.Eng., Ph.D. Operator: Scott Hall	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411	Borehole No.: BH 01-PMT	

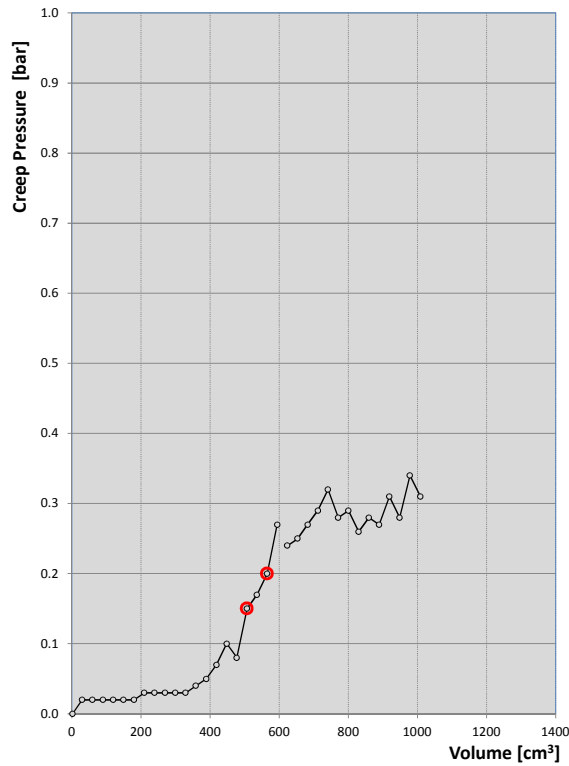
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Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 23, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 3	In-Depth Geotechnical Inc. 
Volume-controlled test as per ASTM D4719 Method B	Probe No.: E 309 Calibration Record No.: 1	Drilling Bit: Tricone Bit Time elapsed from hole drilling to testing ~ 5 minutes				
Volume increments: 40 cm³ Maximum Volume: 1400 cm³ Maximum Pressure: 100 bar	Tubing Length: 150 [ft] Probe Length: 0.46 [m] Probe Initial Volume: 1968 cm³	Engineer: Gabriel Sedran, P.Eng., Ph.D. Operator: Scott Hall	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411	Borehole No.: BH 01-PMT	

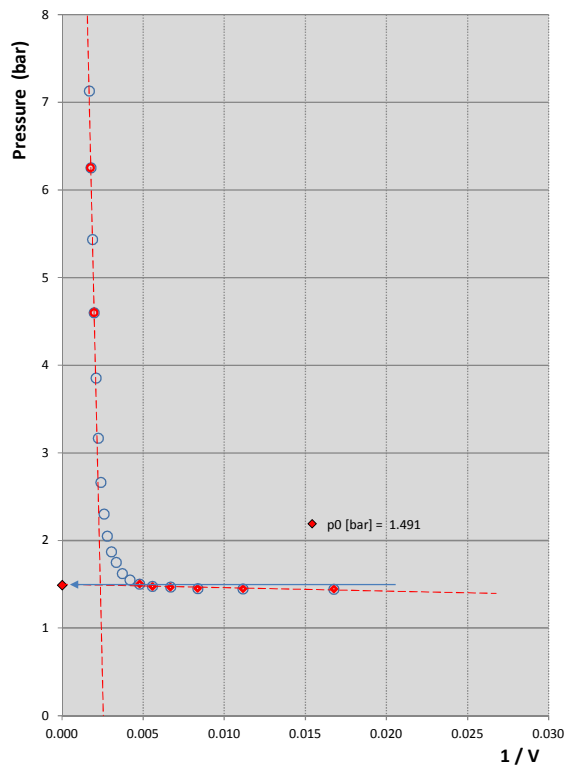
Field Test Data (uncorrected)			Corrected Test data						Creep		Auxiliary Data	
Volume [cm ³]	Pressure [bar]		15-second readings			30-second readings			Volume [cm ³]	Δp_{30-15} [bar]	30 sec	
	15 sec	30 sec	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]			Pressure [bar]	1 / V
2	0.31	0.31	1.44	2	0.00	1.44	2	0.00	2	0.00	1.44	0.58089
30	0.35	0.33	1.45	29.7	0.75	1.43	29.7	0.75	29.7	0.02	1.43	0.03367
60	0.39	0.37	1.47	59.6	1.50	1.45	59.7	1.50	59.7	0.02	1.45	0.01676
90	0.42	0.40	1.47	89.6	2.25	1.45	89.6	2.25	89.6	0.02	1.45	0.01116
120	0.45	0.43	1.47	119.6	2.99	1.45	119.6	2.99	119.6	0.02	1.45	0.00836
150	0.49	0.47	1.49	149.6	3.73	1.47	149.6	3.73	149.6	0.02	1.47	0.00669
180	0.52	0.50	1.50	179.5	4.46	1.48	179.6	4.46	179.6	0.02	1.48	0.00557
210	0.58	0.55	1.53	209.5	5.19	1.50	209.5	5.19	209.5	0.03	1.50	0.00477
240	0.64	0.61	1.58	239.4	5.91	1.55	239.5	5.91	239.5	0.03	1.55	0.00418
270	0.73	0.70	1.65	269.3	6.62	1.62	269.4	6.63	269.4	0.03	1.62	0.00371
300	0.87	0.84	1.78	299.2	7.33	1.75	299.2	7.33	299.2	0.03	1.75	0.00334
330	1.00	0.97	1.90	329.1	8.04	1.87	329.1	8.04	329.1	0.03	1.87	0.00304
360	1.20	1.16	2.09	358.9	8.74	2.05	359.0	8.74	359.0	0.04	2.05	0.00279
390	1.47	1.42	2.35	388.7	9.43	2.30	388.7	9.43	388.7	0.05	2.30	0.00257
420	1.86	1.79	2.74	418.3	10.12	2.67	418.4	10.12	418.4	0.07	2.67	0.00239
450	2.40	2.30	3.27	447.8	10.80	3.17	447.9	10.80	447.9	0.10	3.17	0.00223
480	3.07	2.99	3.93	477.2	11.47	3.85	477.3	11.47	477.3	0.08	3.85	0.00210
510	3.89	3.74	4.75	506.5	12.13	4.60	506.6	12.14	506.6	0.15	4.60	0.00197
540	4.75	4.58	5.61	535.7	12.79	5.44	535.9	12.80	535.9	0.17	5.44	0.00187
570	5.60	5.40	6.45	565.0	13.45	6.25	565.1	13.46	565.1	0.20	6.25	0.00177
600	6.55	6.28	7.40	594.1	14.10	7.13	594.4	14.11	594.4	0.27	7.13	0.00168
590	4.38	4.39	5.23	586.1	13.92	5.24	586.1	13.92			5.24	0.00171
580	3.45	3.46	4.30	576.9	13.72	4.31	576.9	13.72			4.31	0.00173
570	2.80	2.82	3.65	567.5	13.51	3.67	567.5	13.51			3.67	0.00176
580	4.17	4.12	5.02	576.3	13.70	4.97	576.3	13.70			4.97	0.00174
590	5.07	4.98	5.92	585.4	13.91	5.83	585.5	13.91			5.83	0.00171
600	5.83	5.70	6.68	594.8	14.12	6.55	594.9	14.12			6.55	0.00168
630	7.14	6.90	7.99	623.6	14.76	7.75	623.8	14.76	623.8	0.24	7.75	0.00160
660	7.93	7.68	8.77	652.9	15.40	8.52	653.1	15.41	653.1	0.25	8.52	0.00153
690	8.66	8.39	9.50	682.2	16.05	9.23	682.5	16.05	682.5	0.27	9.23	0.00147
720	9.30	9.01	10.14	711.6	16.69	9.85	711.9	16.70	711.9	0.29	9.85	0.00140
750	9.86	9.54	10.69	741.1	17.33	10.37	741.4	17.34	741.4	0.32	10.37	0.00135
780	10.31	10.03	11.13	770.7	17.97	10.85	771.0	17.98	771.0	0.28	10.85	0.00130
810	10.80	10.51	11.62	800.3	18.61	11.33	800.6	18.61	800.6	0.29	11.33	0.00125
840	11.22	10.96	12.04	829.9	19.24	11.78	830.2	19.24	830.2	0.26	11.78	0.00120
870	11.66	11.38	12.47	859.5	19.87	12.19	859.8	19.87	859.8	0.28	12.19	0.00116
900	12.03	11.76	12.84	889.2	20.49	12.57	889.4	20.50	889.4	0.27	12.57	0.00112
930	12.41	12.10	13.22	918.9	21.12	12.91	919.1	21.12	919.1	0.31	12.91	0.00109
960	12.72	12.44	13.52	948.6	21.74	13.24	948.8	21.75	948.8	0.28	13.24	0.00105
990	13.09	12.75	13.89	978.2	22.36	13.55	978.5	22.36	978.5	0.34	13.55	0.00102
1020	13.35	13.04	14.15	1008.0	22.97	13.84	1008.3	22.98	1008.3	0.31	13.84	0.00099



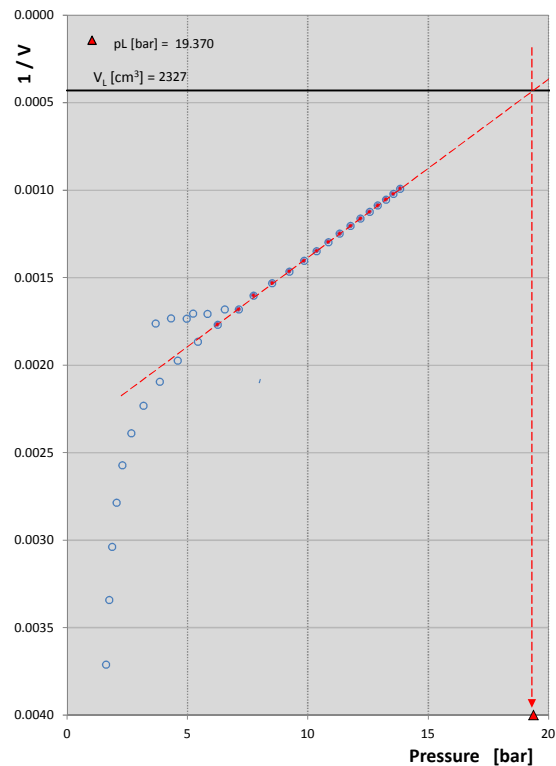
Pressuremeter test results [corrected data] pressure vs radial strain



Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$




Determination of total contact pressure p_0



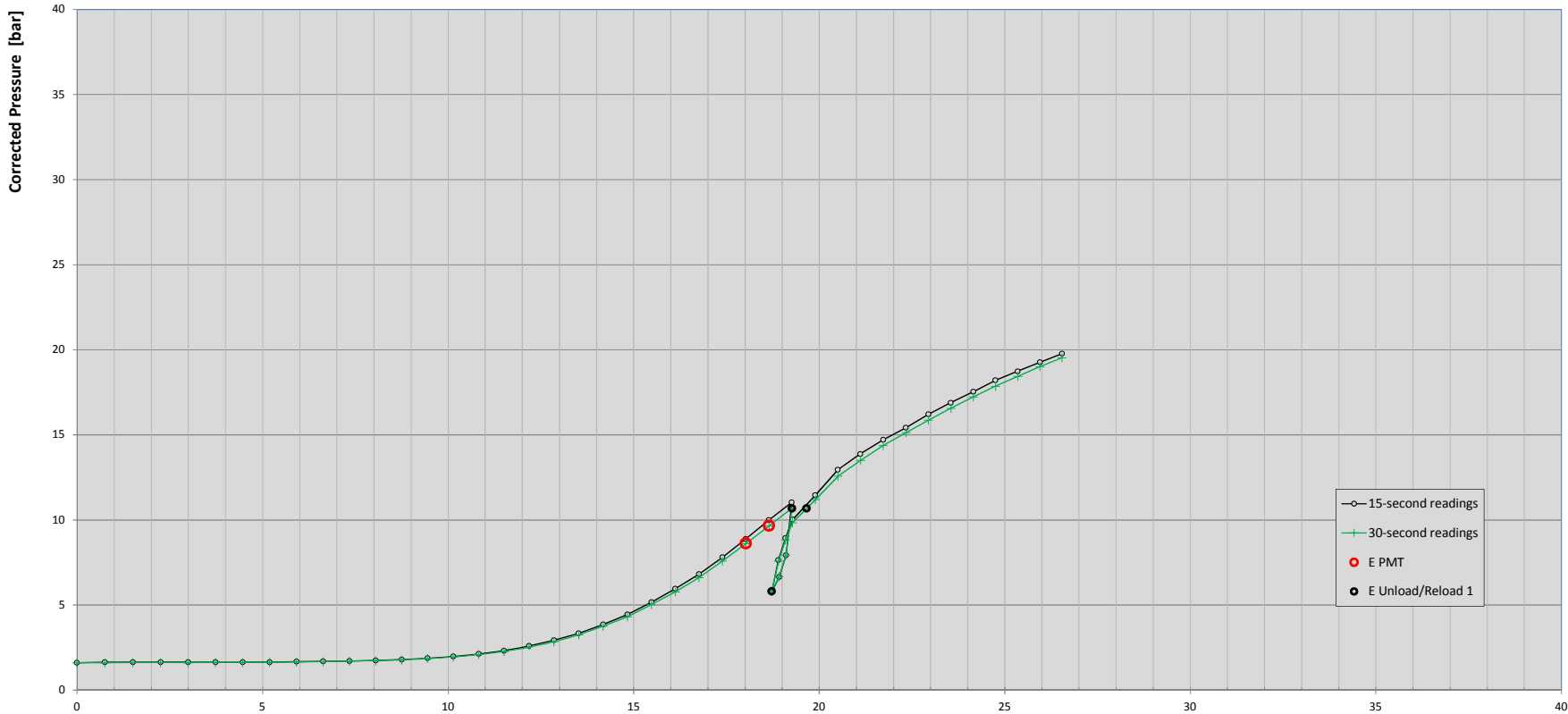
Determination of Limit Pressure p_L

Interpreted PMT Test Results					
[30-second readings]			volume		strain range [%]
			radial strain [cm]	range [%]	
p_0	1.49	[bar]	179.6	4.5	
p_L	19.37	[bar]			
p^*_L	17.88	[bar]			
p_V	6.25	[bar]	565	13.5	
E_{PMT}	188	[bar]	507	12.1	[12.1 - 13.5 %]
E_{PMT} / p^*_L	10.5				
$E_{Unload 1}$	872	[bar]	567	13.5	
$E_{Reload 1}$	568	[bar]			

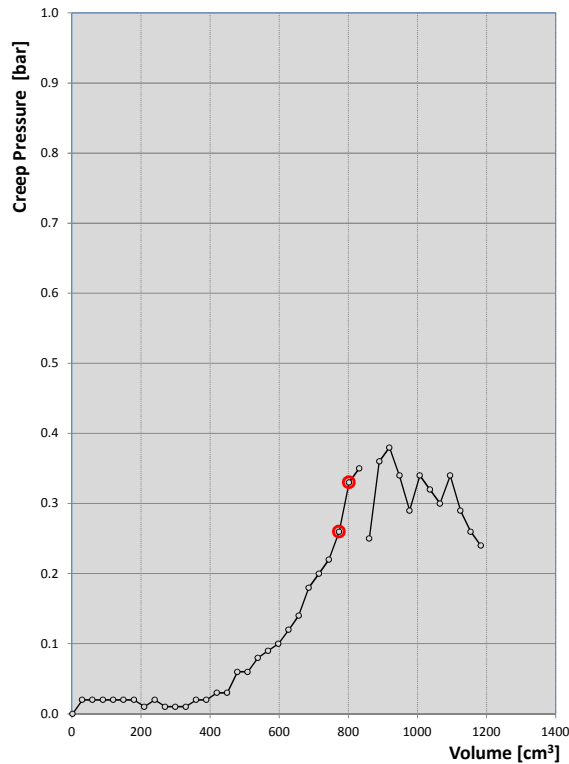
Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 23, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 4	
Volume-controlled test as per ASTM D4719	Probe No.: E 309	Drilling Bit: Tricone Bit	Test Depth [m]: 13.26 (center of the probe)	Client: Golder Associates	Borehole No.: BH 01-PMT	
Method B	Calibration Record No.: 4	Time elapsed from hole drilling to testing ~ 5 minutes	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		
Volume increments: 40 cm ³	Tubing Length: 150 [ft]	Engineer: Gabriel Sedran, P.Eng., Ph.D.				
Maximum Volume: 1400 cm ³	Probe Length: 0.46 [m]	Operator: Scott Hall				
Maximum Pressure: 100 bar	Probe Initial Volume: 1968 cm ³					

Field Test Data (uncorrected)			Corrected Test data						Creep		Auxiliary Data	
Volume [cm ³]	Pressure [bar]		15-second readings			30-second readings			Volume [cm ³]	$\Delta\rho_{30-15}$ [bar]	30 sec	
	15 sec	30 sec	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]			Pressure [bar]	1 / V
2	0.19	0.19	1.62	2	0.00	1.62	2	0.00	2	0.00	1.62	0.54666
30	0.24	0.22	1.64	29.8	0.75	1.62	29.8	0.75	29.8	0.02	1.62	0.03355
60	0.27	0.25	1.64	59.8	1.51	1.62	59.8	1.51	59.8	0.02	1.62	0.01673
90	0.30	0.28	1.65	89.7	2.25	1.63	89.7	2.26	89.7	0.02	1.63	0.01114
120	0.32	0.30	1.64	119.7	3.00	1.62	119.7	3.00	119.7	0.02	1.62	0.00835
150	0.35	0.33	1.65	149.7	3.73	1.63	149.7	3.73	149.7	0.02	1.63	0.00668
180	0.38	0.36	1.65	179.7	4.47	1.63	179.7	4.47	179.7	0.02	1.63	0.00557
210	0.40	0.39	1.65	209.6	5.19	1.64	209.6	5.19	209.6	0.01	1.64	0.00477
240	0.44	0.42	1.68	239.6	5.91	1.66	239.6	5.91	239.6	0.02	1.66	0.00417
270	0.47	0.46	1.69	269.6	6.63	1.68	269.6	6.63	269.6	0.01	1.68	0.00371
300	0.51	0.50	1.72	299.5	7.34	1.71	299.6	7.34	299.6	0.01	1.71	0.00334
330	0.55	0.54	1.75	329.5	8.05	1.74	329.5	8.05	329.5	0.01	1.74	0.00303
360	0.61	0.59	1.80	359.5	8.75	1.78	359.5	8.75	359.5	0.02	1.78	0.00278
390	0.70	0.68	1.88	389.4	9.45	1.86	389.4	9.45	389.4	0.02	1.86	0.00257
420	0.81	0.78	1.98	419.3	10.14	1.95	419.3	10.14	419.3	0.03	1.95	0.00238
450	0.96	0.93	2.13	449.1	10.83	2.10	449.2	10.83	449.2	0.03	2.10	0.00223
480	1.16	1.10	2.32	479.0	11.51	2.26	479.0	11.51	479.0	0.06	2.26	0.00208
510	1.44	1.38	2.60	508.7	12.18	2.54	508.8	12.19	508.8	0.06	2.54	0.00197
540	1.78	1.70	2.93	538.4	12.85	2.85	538.5	12.86	538.5	0.08	2.85	0.00186
570	2.20	2.11	3.35	568.0	13.52	3.26	568.1	13.52	568.1	0.09	3.26	0.00176
600	2.71	2.61	3.86	597.6	14.18	3.76	597.7	14.18	597.7	0.10	3.76	0.00167
630	3.30	3.18	4.44	627.0	14.83	4.32	627.1	14.84	627.1	0.12	4.32	0.00159
660	4.04	3.90	5.18	656.4	15.48	5.04	656.5	15.48	656.5	0.14	5.04	0.00152
690	4.82	4.64	5.96	685.7	16.12	5.78	685.8	16.13	685.8	0.18	5.78	0.00146
720	5.68	5.48	6.81	714.9	16.76	6.61	715.1	16.76	715.1	0.20	6.61	0.00140
750	6.68	6.46	7.81	744.0	17.39	7.59	744.2	17.40	744.2	0.22	7.59	0.00134
780	7.76	7.50	8.88	773.0	18.02	8.62	773.3	18.02	773.3	0.26	8.62	0.00129
810	8.88	8.55	10.00	802.0	18.64	9.67	802.3	18.65	802.3	0.33	9.67	0.00125
840	9.93	9.58	11.04	831.1	19.26	10.69	831.4	19.27	831.4	0.35	10.69	0.00120
830	6.81	6.83	7.92	823.9	19.11	7.94	823.9	19.11			7.94	0.00121
820	5.53	5.56	6.65	815.0	18.92	6.68	815.0	18.92			6.68	0.00123
810	4.67	4.70	5.79	805.8	18.72	5.82	805.8	18.72			5.82	0.00124
820	6.53	6.48	7.65	814.1	18.90	7.60	814.2	18.90			7.60	0.00123
830	7.83	7.72	8.94	823.0	19.09	8.83	823.1	19.09			8.83	0.00121
840	8.91	8.74	10.02	832.0	19.28	9.85	832.1	19.29			9.85	0.00120
870	10.35	10.10	11.46	860.7	19.89	11.21	860.9	19.90			11.21	0.00116
900	11.84	11.48	12.95	889.4	20.50	12.59	889.7	20.50			12.59	0.00112
930	12.78	12.40	13.88	918.5	21.11	13.50	918.9	21.12			13.50	0.00109
960	13.62	13.28	14.72	947.8	21.72	14.38	948.1	21.73			14.38	0.00105
990	14.33	14.04	15.43	977.1	22.33	15.14	977.4	22.34			15.14	0.00102
1020	15.12	14.78	16.22	1006.4	22.94	15.88	1006.7	22.95			15.88	0.00099
1050	15.80	15.48	16.89	1035.8	23.55	16.57	1036.1	23.55			16.57	0.00097
1080	16.45	16.15	17.54	1065.2	24.15	17.24	1065.5	24.16			17.24	0.00094
1110	17.12	16.78	18.21	1094.6	24.75	17.87	1094.9	24.76			17.87	0.00091
1140	17.66	17.37	18.74	1124.1	25.35	18.45	1124.4	25.36			18.45	0.00089
1170	18.20	17.94	19.27	1153.6	25.95	19.01	1153.9	25.95			19.01	0.00087
1200	18.71	18.47	19.78	1183.2	26.54	19.54	1183.4	26.55			19.54	0.00085

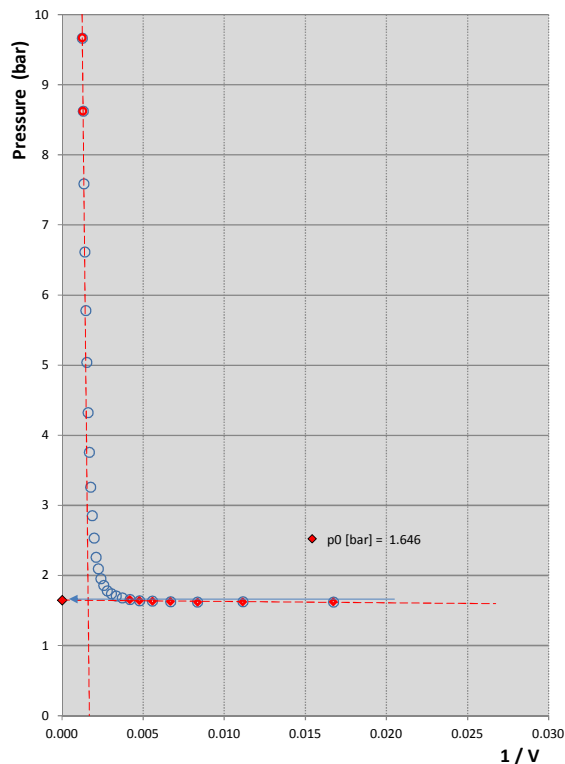
Interpreted PMT Test Results					
[30-second readings]			volume	radial strain	strain range [%]
			[cm ³]	[%]	
p_0	1.65	[bar]	209.6	5.2	[18.0 - 18.7 %]
p_L	29.86	[bar]			
p^*_L	28.21	[bar]			
p_V	9.67	[bar]	802	18.6	
E_{PMT}	264	[bar]	773	18.0	
E_{PMT} / p^*_L	9.3				
$E_{Unload\ 1}$	1411	[bar]	806	18.7	
$E_{Reload\ 1}$	821	[bar]			



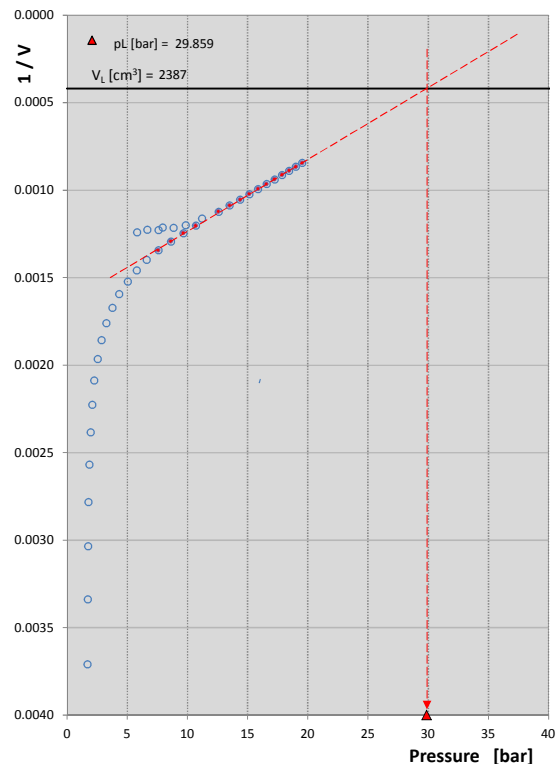
Pressuremeter test results [corrected data] pressure vs radial strain




Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30\ sec]}$

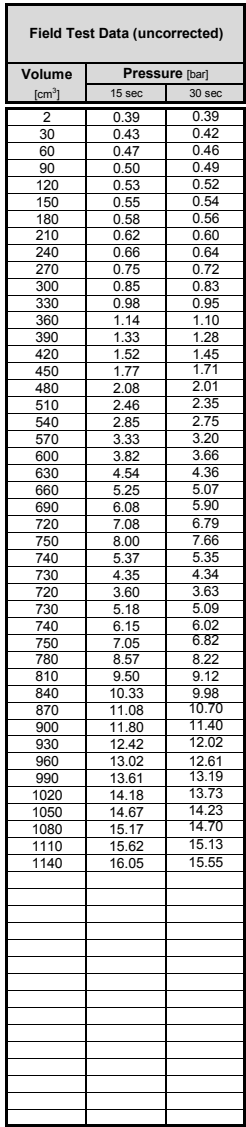
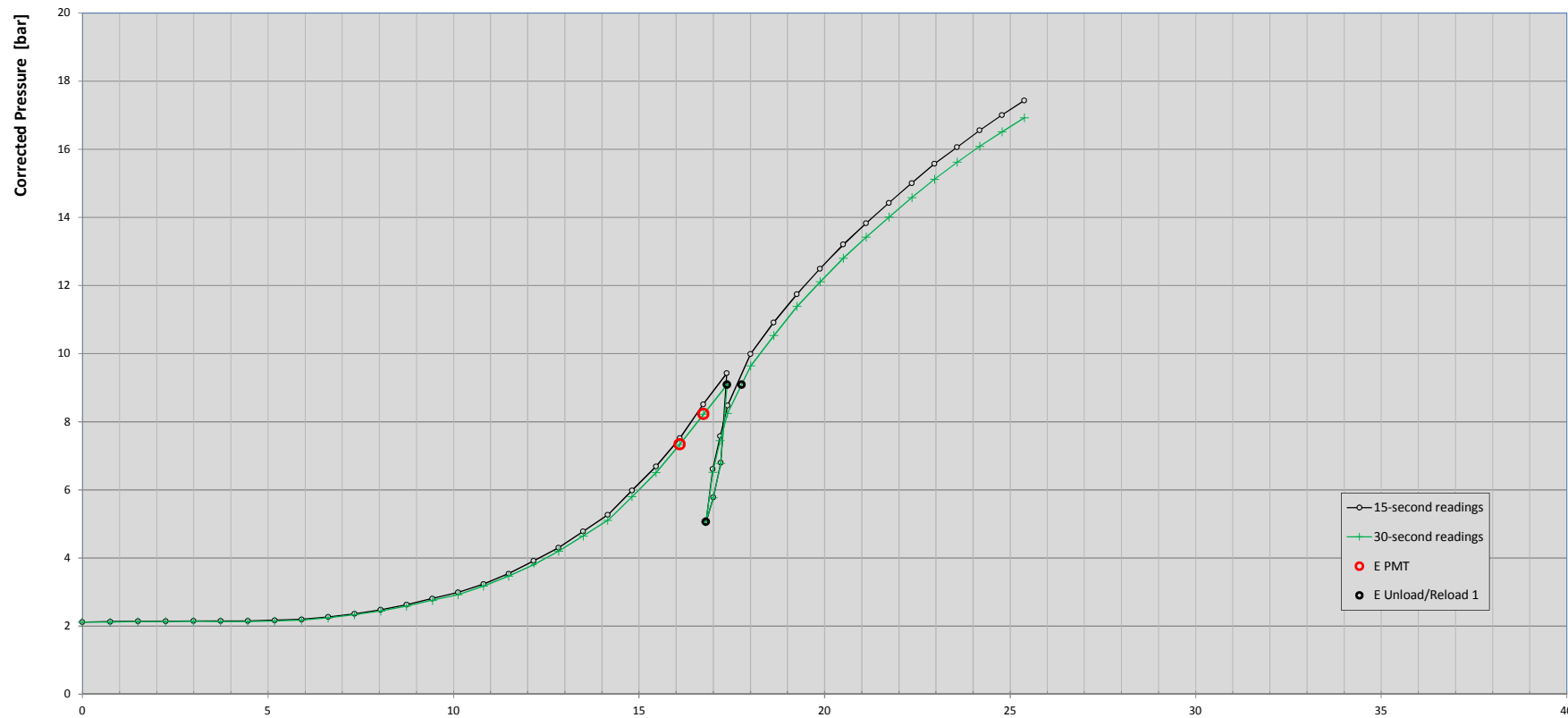


Determination of total contact pressure p_0

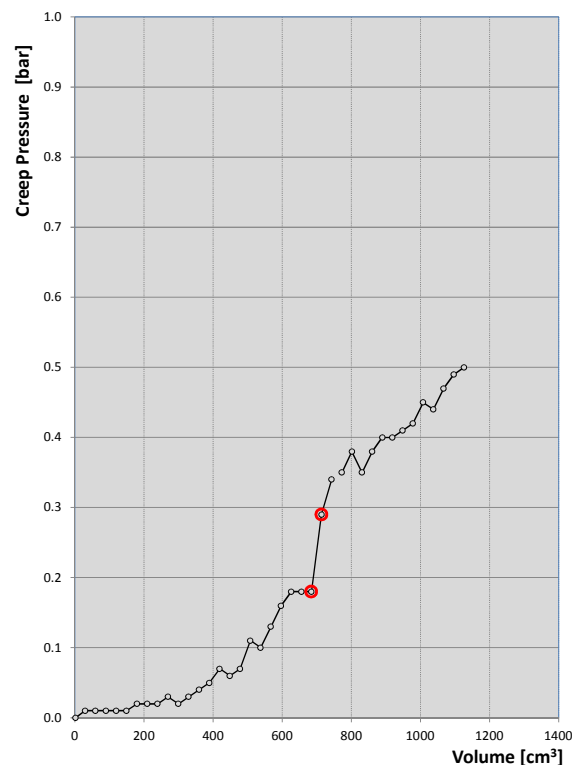
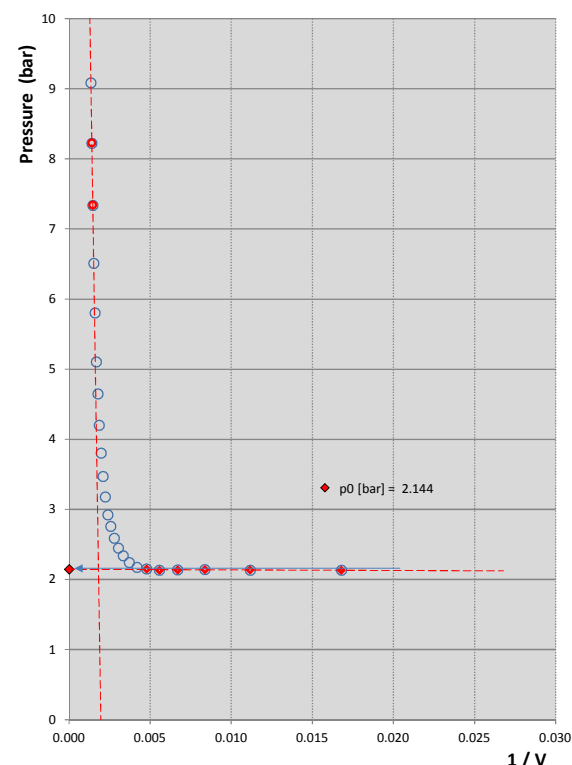
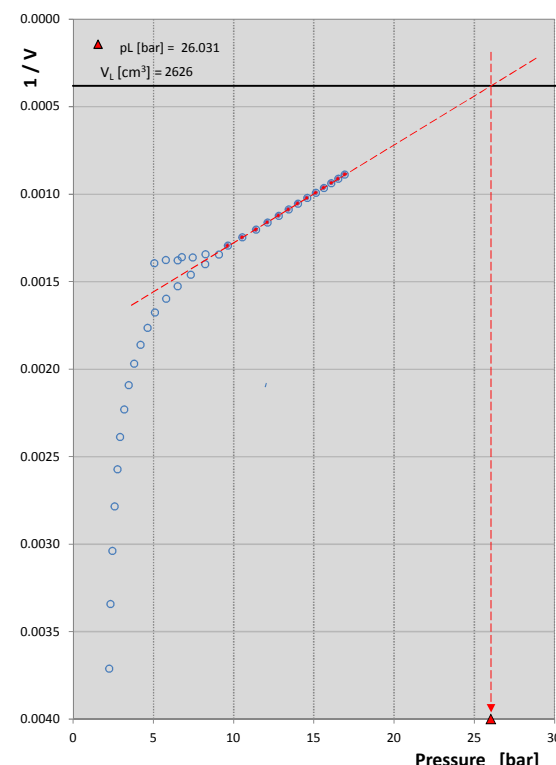


Determination of Limit Pressure p_L

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 24, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 5	
Volume-controlled test as per ASTM D4719	Probe No.: E 309	Drilling Bit: Tricone Bit	Test Depth [m]: 16.31 (center of the probe)	Client: Golder Associates	Borehole No.: BH 01-PMT	
Method B	Calibration Record No.: 4	Time elapsed from hole drilling to testing ~ 5 minutes	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		
Volume Increments: 40 cm ³	Tubing Length: 150 [ft]	Engineer: Gabriel Sedran, P.Eng., Ph.D.				
Maximum Volume: 1400 cm ³	Probe Length: 0.46 [m]	Operator: Scott Hall				
Maximum Pressure: 100 bar	Probe Initial Volume: 1968 cm ³					

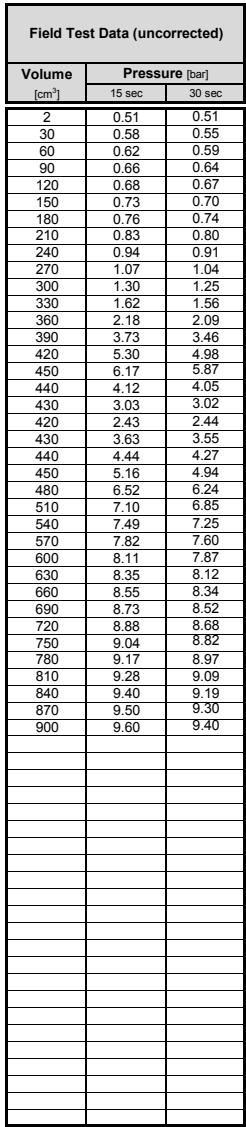
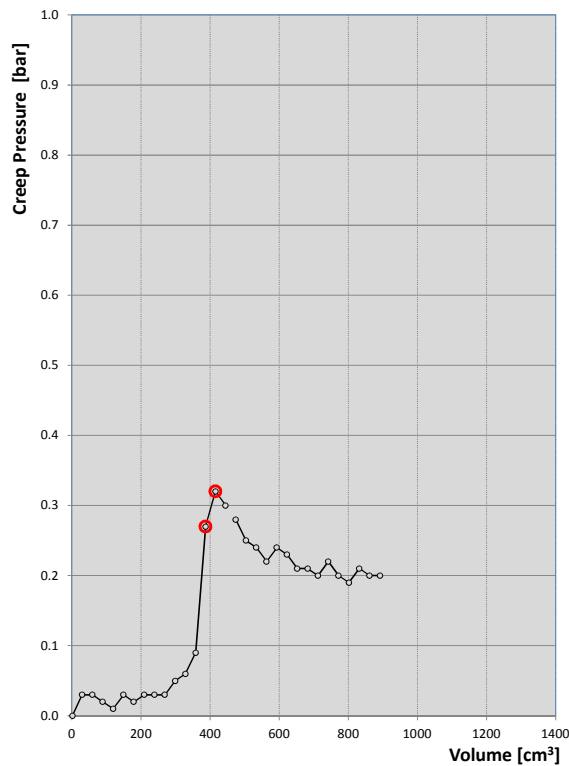
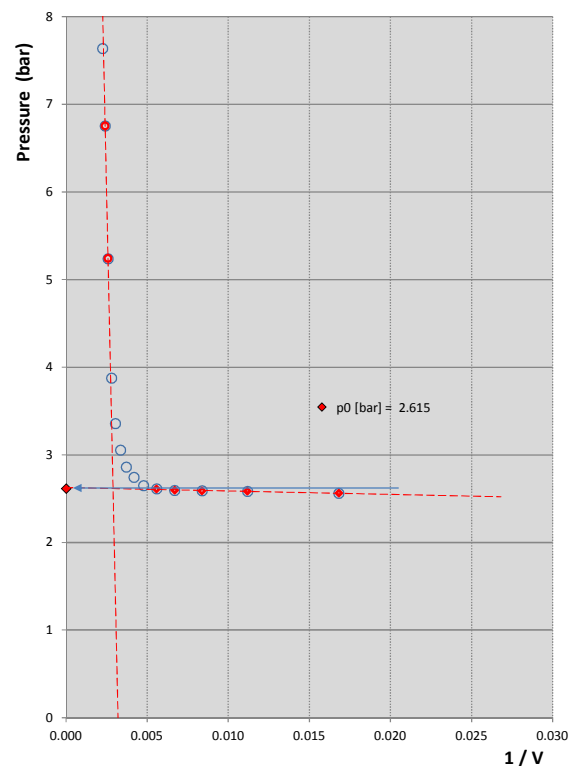
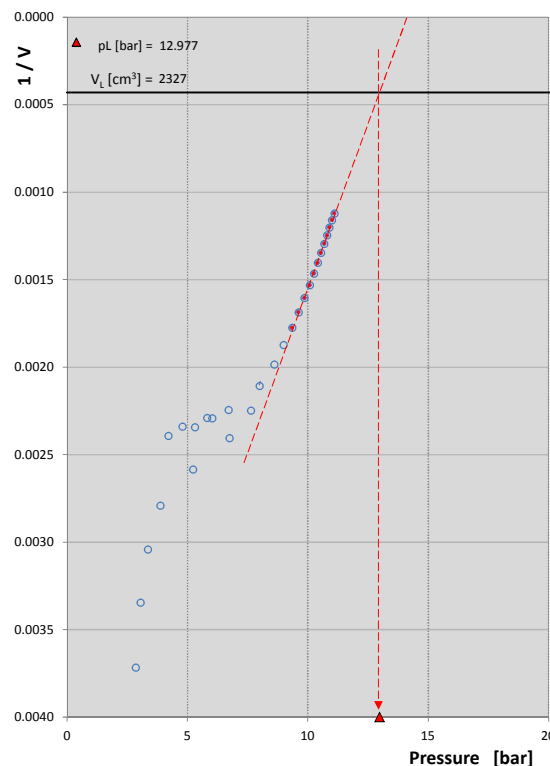
[illegible][illegible][illegible]

Pressuremeter test results [corrected data] pressure vs radial strain

Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 Determination of Limit Pressure p_L


Interpreted PMT Test Results					
[30-second readings]			volume	radial strain	strain range [%]
			[cm ³]	[%]	
p ₀	2.14	[bar]	329.1	8.0	
p _L	26.03	[bar]			
p [*] _L	23.89	[bar]			
p _Y	8.22	[bar]	714	16.7	
E _{PMT}	215	[bar]	685	16.1	[16.1 - 16.7 %]
E _{PMT} / p [*] _L	9.0				
E _{Unload 1}	1095	[bar]	717	16.8	
E _{Reload 1}	652	[bar]			

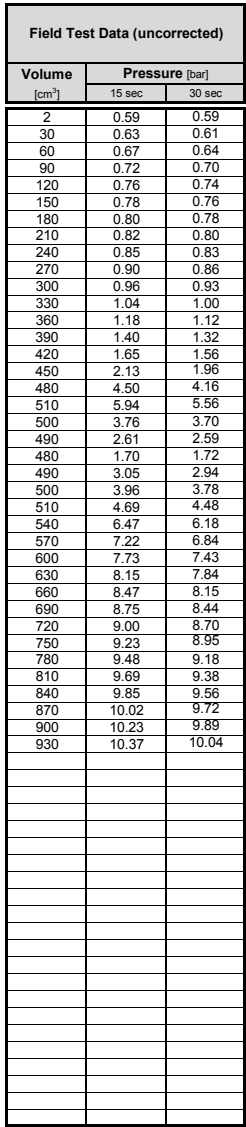
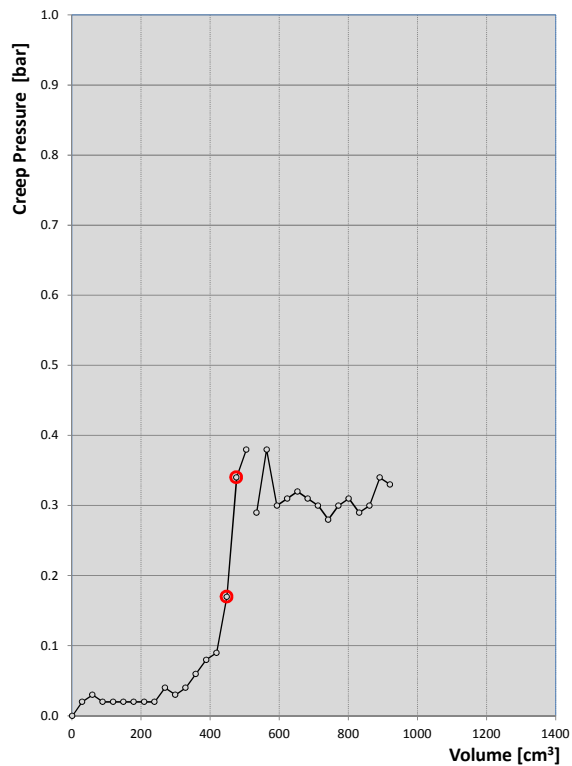
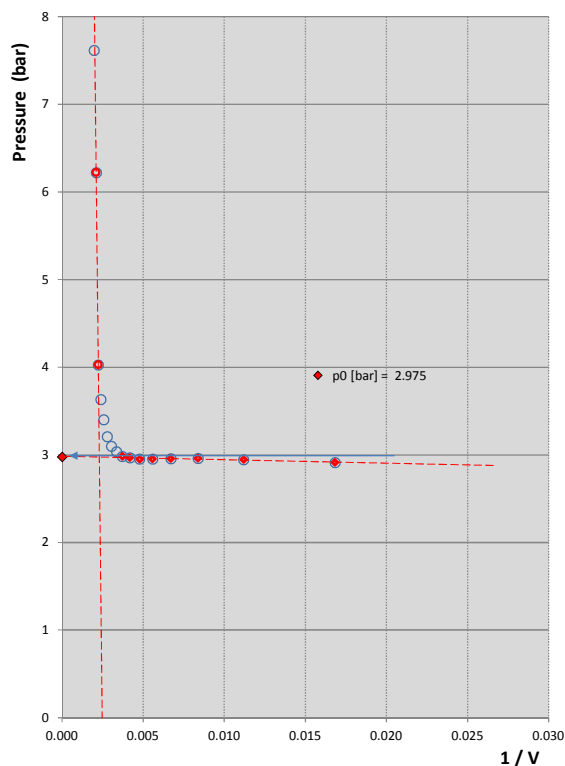
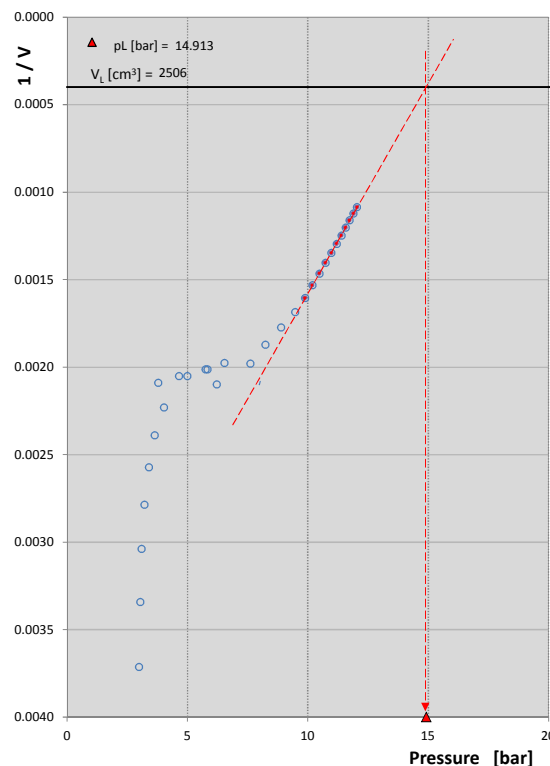
Appendix One - Page 6

[illegible][illegible][illegible]Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 

Determination of Limit Pressure p_L

Interpreted PMT Test Results						
[30-second readings]			volume		radial strain	strain range [%]
			[cm ³]	[%]		
p ₀	2.62	[bar]	179.3	4.5		
p _L	12.98	[bar]				
p [*] _L	10.36	[bar]				
p _γ	6.75	[bar]	416	10.1		
E _{PMT}	333	[bar]	387	9.4	[9.4 - 10.1 %]	
E _{PMT} / p [*] _L	32.1					
E _{Unload 1}	812	[bar]	418	10.1		
E _{Reload 1}	453	[bar]				

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 24, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 7	In-Depth Geotechnical Inc. 
Volume-controlled test as per ASTM D4719 Method B	Probe No.: E 309 Calibration Record No.: 1	Drilling Bit: Tricone Bit Time elapsed from hole drilling to testing ~ 5 minutes				
Volume increments: 40 cm³ Maximum Volume: 1400 cm³ Maximum Pressure: 100 bar	Tubing Length: 150 [ft] Probe Length: 0.46 [m] Probe Initial Volume: 1968 cm³	Engineer: Gabriel Sedran, P.Eng., Ph.D. Operator: Scott Hall	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411	Borehole No.: BH 01-PMT	

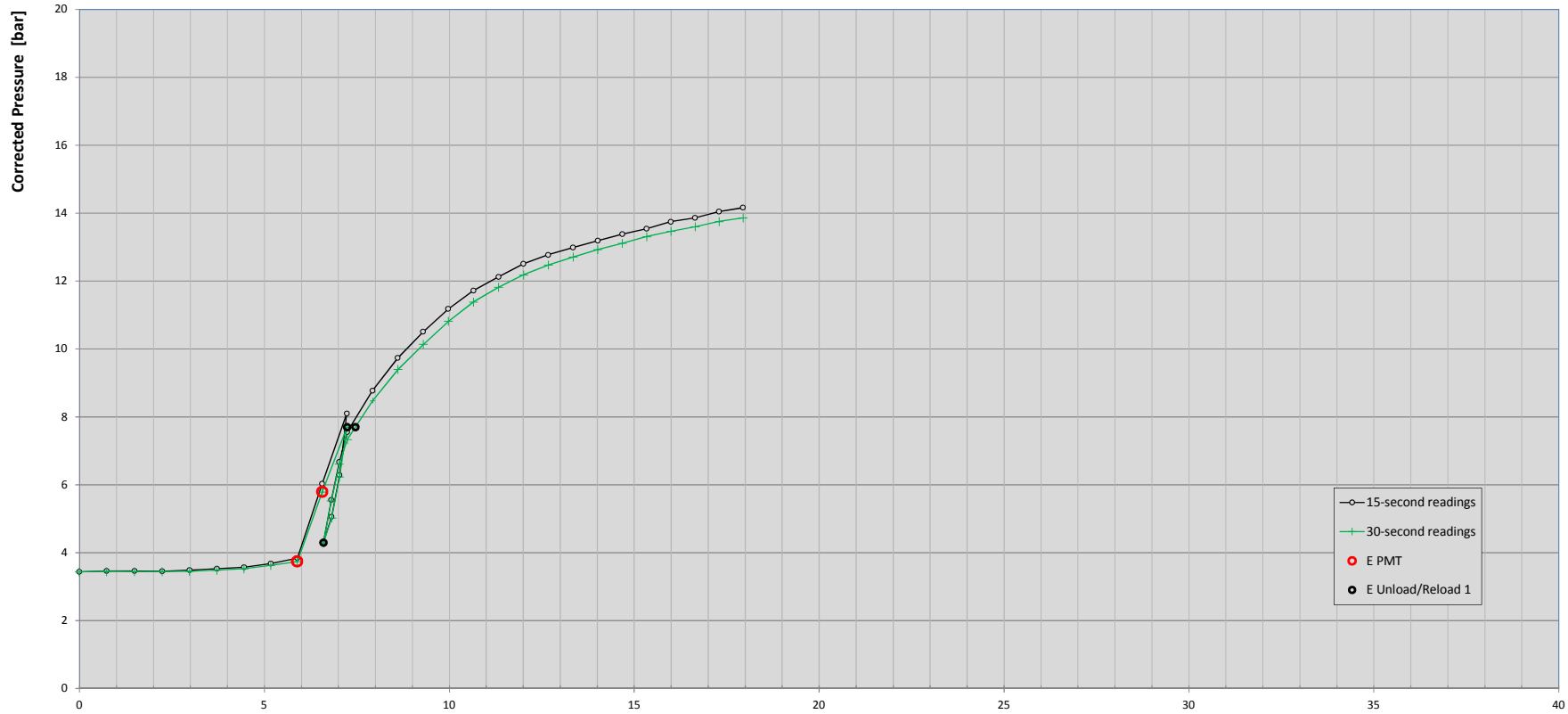
[illegible][illegible][illegible]Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 

Determination of Limit Pressure p_L

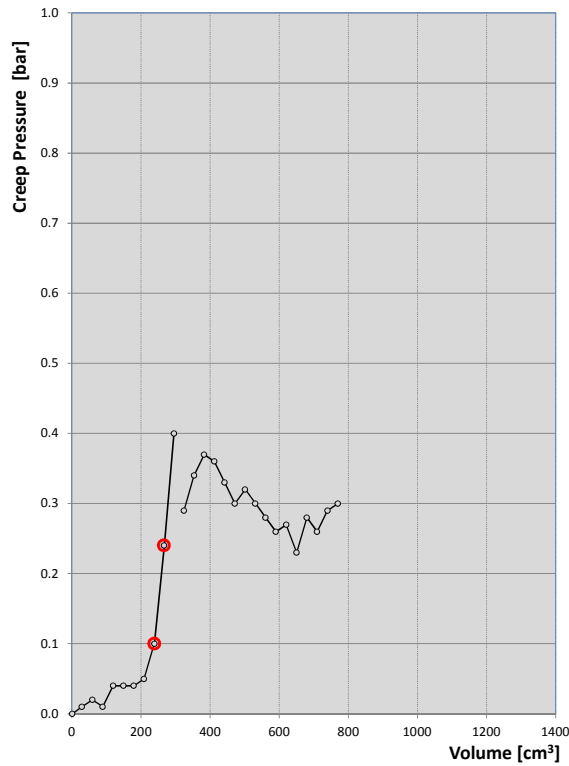
Interpreted PMT Test Results						
[30-second readings]			volume		radial strain	strain range [%]
			[cm]	[°]		
p ₀	2.98	[bar]	269.2	6.6		
p _L	14.91	[bar]				
p [*] _L	11.94	[bar]				
p _Y	6.22	[bar]	476	11.4		
E _{PMT}	506	[bar]	448	10.8	[10.8 - 11.5 %]	
E _{PMT} / p [*] _L	22.4					
E _{Unload 1}	945	[bar]	478	11.5		
E _{Reload 1}	552	[bar]				

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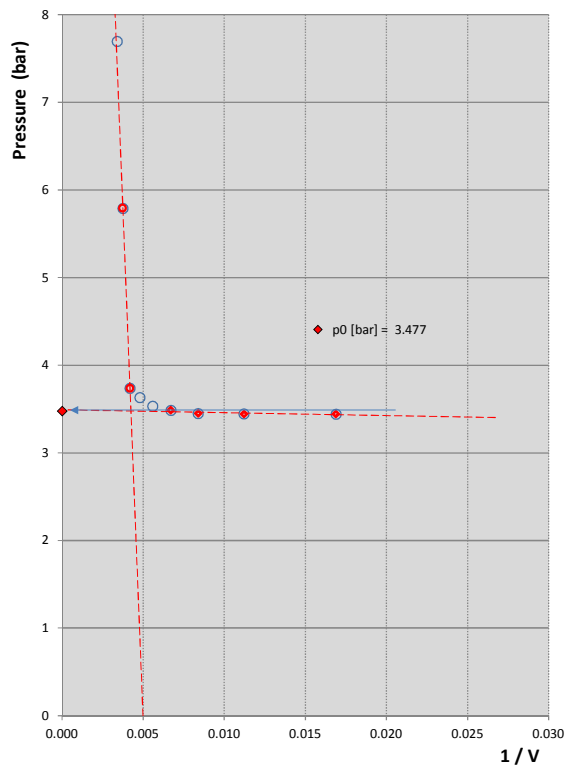
Field Test Data (uncorrected)			Corrected Test data						Creep		Auxiliary Data	
Volume [cm³]	Pressure [bar]		15-second readings			30-second readings			Volume [cm³]	Δp_{30-15} [bar]	30 sec	
	15 sec	30 sec	Pressure [bar]	Volume [cm³]	$\Delta r/r_0$ [%]	Pressure [bar]	Volume [cm³]	$\Delta r/r_0$ [%]			Pressure [bar]	1 / V
2	0.81	0.81	3.43	1	0.00	3.43	1	0.00	1	0.00	3.43	0.78598
30	0.86	0.85	3.46	29.2	0.74	3.45	29.2	0.74	29.2	0.01	3.45	0.03420
60	0.89	0.87	3.46	59.2	1.49	3.44	59.2	1.49	59.2	0.02	3.44	0.01689
90	0.91	0.90	3.45	89.2	2.24	3.44	89.2	2.24	89.2	0.01	3.44	0.01121
120	0.97	0.93	3.49	119.1	2.98	3.45	119.2	2.98	119.2	0.04	3.45	0.00839
150	1.03	0.99	3.53	149.1	3.72	3.49	149.1	3.72	149.1	0.04	3.49	0.00671
180	1.10	1.06	3.57	179.0	4.45	3.53	179.0	4.45	179.0	0.04	3.53	0.00559
210	1.23	1.18	3.68	208.9	5.17	3.63	208.9	5.18	208.9	0.05	3.63	0.00479
240	1.40	1.30	3.84	238.7	5.89	3.74	238.8	5.90	238.8	0.10	3.74	0.00419
270	3.61	3.37	6.03	266.8	6.56	5.79	267.0	6.57	267.0	0.24	5.79	0.00375
300	5.69	5.29	8.10	294.9	7.23	7.70	295.2	7.24	295.2	0.40	7.70	0.00339
290	3.87	3.82	6.28	286.5	7.03	6.23	286.6	7.03	6.23		6.23	0.00349
280	2.64	2.61	5.06	277.6	6.82	5.03	277.7	6.82	5.03		5.03	0.00360
270	1.88	1.87	4.30	268.3	6.60	4.29	268.3	6.60	4.29		4.29	0.00373
280	3.14	3.11	5.56	277.2	6.81	5.53	277.2	6.81	5.53		5.53	0.00361
290	4.26	4.20	6.67	286.2	7.02	6.61	286.2	7.03	6.61		6.61	0.00349
300	5.15	4.93	7.56	295.4	7.24	7.34	295.6	7.25	7.34		7.34	0.00338
330	6.37	6.08	8.77	324.3	7.93	8.48	324.5	7.93	8.48		8.48	0.00308
360	7.35	7.01	9.74	353.4	8.61	9.40	353.7	8.62	9.40		9.40	0.00283
390	8.13	7.76	10.51	382.7	9.29	10.14	383.0	9.30	10.14		10.14	0.00261
420	8.81	8.45	11.18	412.1	9.97	10.82	412.4	9.98	10.82		10.82	0.00242
450	9.35	9.02	11.72	441.6	10.65	11.39	441.9	10.66	11.39		11.39	0.00226
480	9.76	9.46	12.12	471.2	11.33	11.82	471.5	11.34	11.82		11.82	0.00212
510	10.15	9.83	12.50	500.9	12.01	12.18	501.2	12.01	12.18		12.18	0.00200
540	10.42	10.12	12.77	530.6	12.68	12.47	530.9	12.69	12.47		12.47	0.00188
570	10.64	10.36	12.99	560.4	13.35	12.71	560.7	13.36	12.71		12.71	0.00178
600	10.84	10.58	13.19	590.3	14.02	12.93	590.5	14.02	12.93		12.93	0.00169
630	11.04	10.77	13.38	620.1	14.68	13.11	620.3	14.68	13.11		13.11	0.00161
660	11.20	10.97	13.54	649.9	15.34	13.31	650.1	15.34	13.31		13.31	0.00154
690	11.41	11.13	13.75	679.7	15.99	13.47	680.0	16.00	13.47		13.47	0.00147
720	11.53	11.27	13.86	709.6	16.65	13.60	709.9	16.65	13.60		13.60	0.00141
750	11.72	11.43	14.05	739.5	17.29	13.76	739.7	17.30	13.76		13.76	0.00135
780	11.84	11.54	14.16	769.4	17.94	13.86	769.6	17.95	13.86		13.86	0.00130



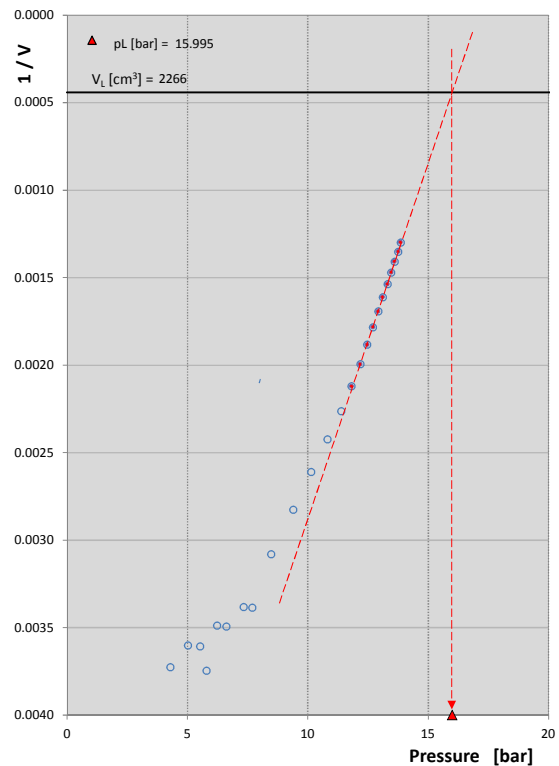
Pressuremeter test results [corrected data] pressure vs radial strain



Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$




Determination of total contact pressure p_0

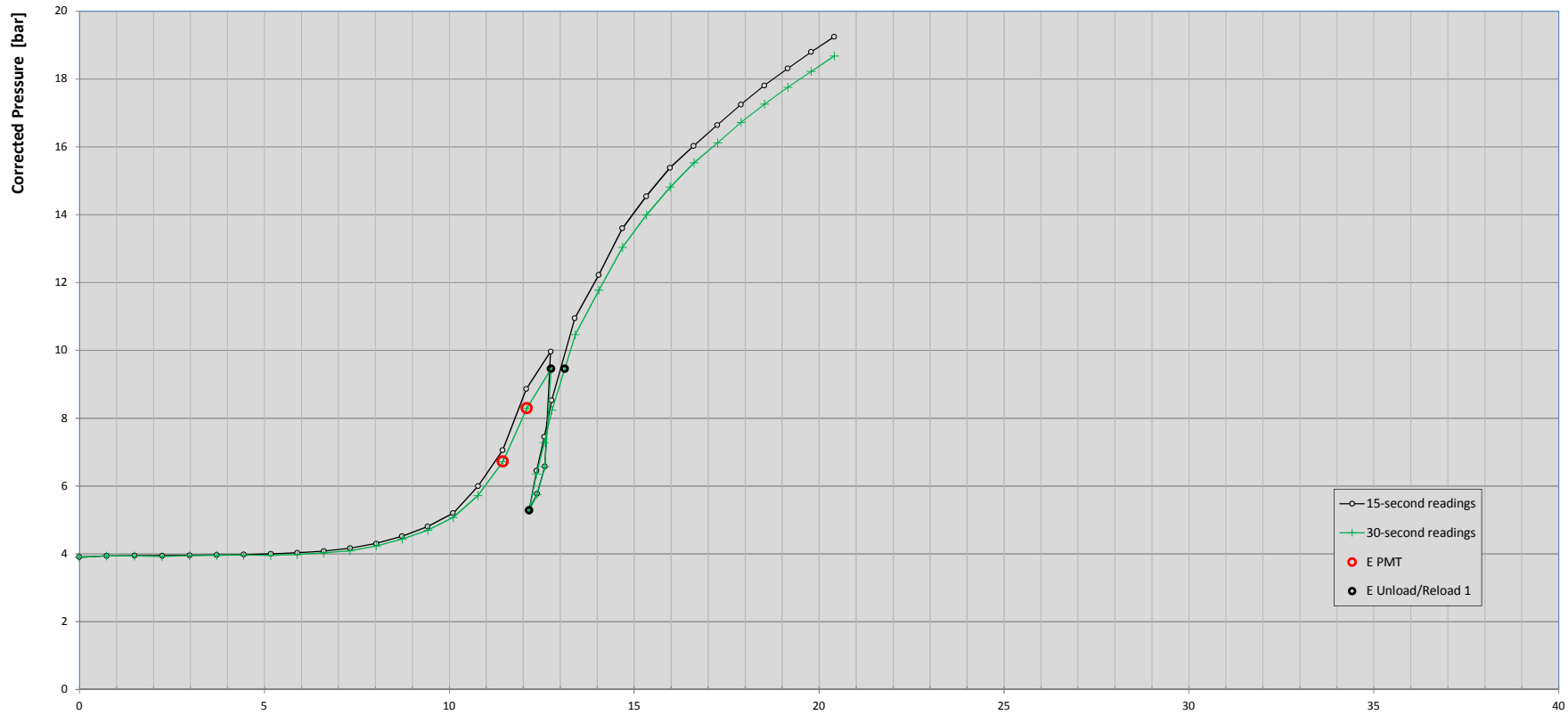


Determination of Limit Pressure p_L

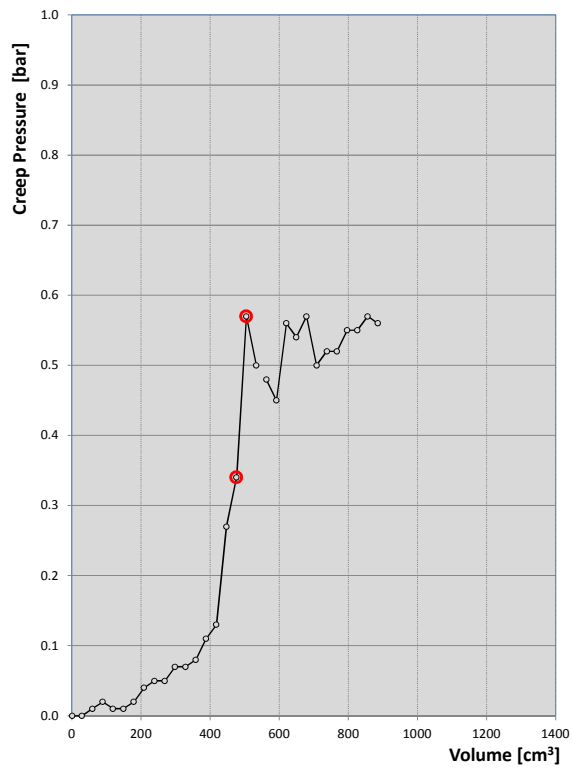
Interpreted PMT Test Results					
[30-second readings]			volume	radial strain	strain range [%]
			[cm³]	[%]	
p_0	3.48	[bar]	149.1	3.7	[5.9 - 6.6 %]
p_L	15.99	[bar]			
p^*_L	12.52	[bar]			
p_V	5.79	[bar]	267	6.6	
E_{PMT}	431	[bar]	239	5.9	[5.9 - 6.6 %]
E_{PMT} / p^*_L	34.5				
$E_{Unload 1}$	757	[bar]	268	6.6	
$E_{Reload 1}$	561	[bar]			

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 24, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 9	
Volume-controlled test as per ASTM D4719	Probe No.: E 309	Drilling Bit: Tricone Bit	Test Depth [m]: 28.52 (center of the probe)	Client: Golder Associates	Borehole No.: BH 01-PMT	
Method B	Calibration Record No.: 4	Time elapsed from hole drilling to testing ~ 5 minutes	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		
Volume Increments: 40 cm³	Tubing Length: 150 [ft]	Engineer: Gabriel Sedran, P.Eng., Ph.D.				
Maximum Volume: 1400 cm³	Probe Length: 0.46 [m]	Operator: Scott Hall				
Maximum Pressure: 100 bar	Probe Initial Volume: 1968 cm³					

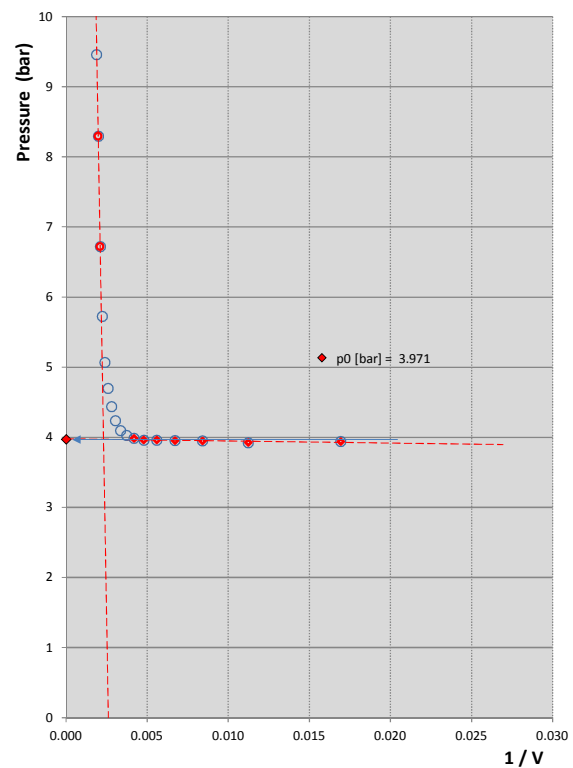
Field Test Data (uncorrected)			Corrected Test data						Creep		Auxiliary Data	
Volume [cm ³]	Pressure [bar]		15-second readings			30-second readings			Volume [cm ³]	Δp_{30-15} [bar]	30 sec	
	15 sec	30 sec	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]			Pressure [bar]	1 / V
2	0.98	0.98	3.90	1	0.00	3.90	1	0.00	1	0.00	3.90	0.89320
30	1.04	1.04	3.94	29.1	0.74	3.94	29.1	0.74	29.1	0.00	3.94	0.03440
60	1.08	1.07	3.95	59.0	1.49	3.94	59.0	1.49	59.0	0.01	3.94	0.01894
90	1.10	1.08	3.94	89.0	2.24	3.92	89.0	2.24	89.0	0.02	3.92	0.01123
120	1.14	1.13	3.96	119.0	2.98	3.95	119.0	2.98	119.0	0.01	3.95	0.00840
150	1.17	1.16	3.96	148.9	3.72	3.95	149.0	3.72	149.0	0.01	3.95	0.00671
180	1.21	1.19	3.98	178.9	4.45	3.96	178.9	4.45	178.9	0.02	3.96	0.00559
210	1.25	1.21	4.00	208.9	5.17	3.96	208.9	5.17	208.9	0.04	3.96	0.00479
240	1.30	1.25	4.03	238.8	5.90	3.98	238.9	5.90	238.9	0.05	3.98	0.00419
270	1.36	1.31	4.08	268.8	6.61	4.03	268.8	6.61	268.8	0.05	4.03	0.00372
300	1.46	1.39	4.16	298.7	7.32	4.09	298.8	7.32	298.8	0.07	4.09	0.00335
330	1.61	1.54	4.31	328.6	8.03	4.24	328.6	8.03	328.6	0.07	4.24	0.00304
360	1.83	1.75	4.52	358.4	8.73	4.44	358.4	8.73	358.4	0.08	4.44	0.00279
390	2.13	2.02	4.81	388.1	9.42	4.70	388.2	9.42	388.2	0.11	4.70	0.00258
420	2.53	2.40	5.20	417.7	10.10	5.07	417.8	10.11	417.8	0.13	5.07	0.00239
450	3.33	3.06	5.99	447.0	10.78	5.72	447.3	10.78	447.3	0.27	5.72	0.00224
480	4.40	4.06	7.06	476.0	11.44	6.72	476.4	11.45	476.4	0.34	6.72	0.00210
510	6.21	5.64	8.86	504.4	12.09	8.29	504.9	12.10	504.9	0.57	8.29	0.00198
540	7.31	6.81	9.96	533.4	12.74	9.46	533.9	12.75	533.9	0.50	9.46	0.00187
530	3.93	3.92	6.58	526.5	12.59	6.57	526.5	12.59	530		6.57	0.00190
520	3.12	3.10	5.77	517.2	12.38	5.75	517.2	12.38	520		5.75	0.00193
510	2.65	2.63	5.30	507.6	12.16	5.28	507.6	12.16	510		5.28	0.00197
520	3.80	3.71	6.45	516.6	12.36	6.36	516.7	12.36	520		6.36	0.00194
530	4.80	4.63	7.45	525.7	12.57	7.28	525.8	12.57	530		7.28	0.00190
540	5.88	5.59	8.53	534.7	12.77	8.24	535.0	12.78	540		8.24	0.00187
570	8.30	7.82	10.95	562.5	13.40	10.47	563.0	13.41	570		10.47	0.00178
600	9.58	9.13	12.22	591.4	14.04	11.77	591.8	14.05	600		11.77	0.00169
630	10.96	10.40	13.60	620.2	14.68	13.04	620.7	14.69	630		13.04	0.00161
660	11.90	11.36	14.54	649.3	15.32	14.00	649.8	15.34	660		14.00	0.00154
690	12.75	12.18	15.39	678.5	15.97	14.82	679.1	15.98	690		14.82	0.00147
720	13.40	12.90	16.03	708.0	16.61	15.53	708.4	16.62	720		15.53	0.00141
750	14.02	13.50	16.64	737.4	17.25	16.12	737.9	17.26	750		16.12	0.00136
780	14.63	14.11	17.25	766.9	17.89	16.73	767.3	17.90	780		16.73	0.00130
810	15.20	14.65	17.81	796.3	18.52	17.26	796.8	18.53	810		17.26	0.00125
840	15.70	15.15	18.31	825.9	19.15	17.76	826.4	19.16	840		17.76	0.00121
870	16.19	15.62	18.80	855.5	19.78	18.23	856.0	19.79	870		18.23	0.00117
900	16.64	16.08	19.24	885.1	20.41	18.68	885.6	20.42	900		18.68	0.00113



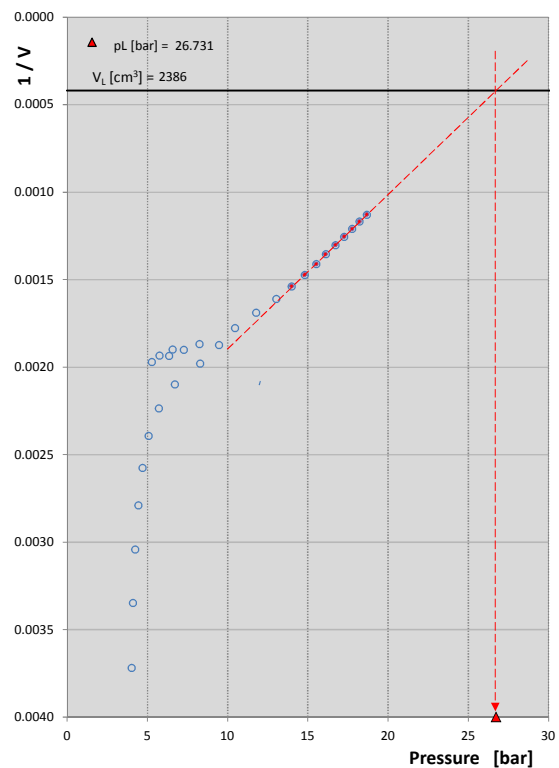
Pressuremeter test results [corrected data] pressure vs radial strain



Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$




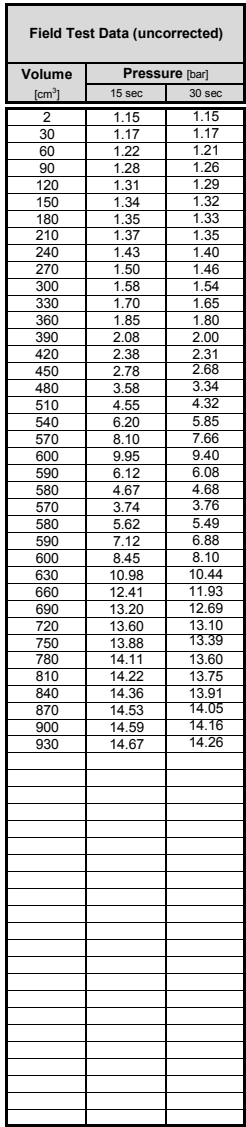
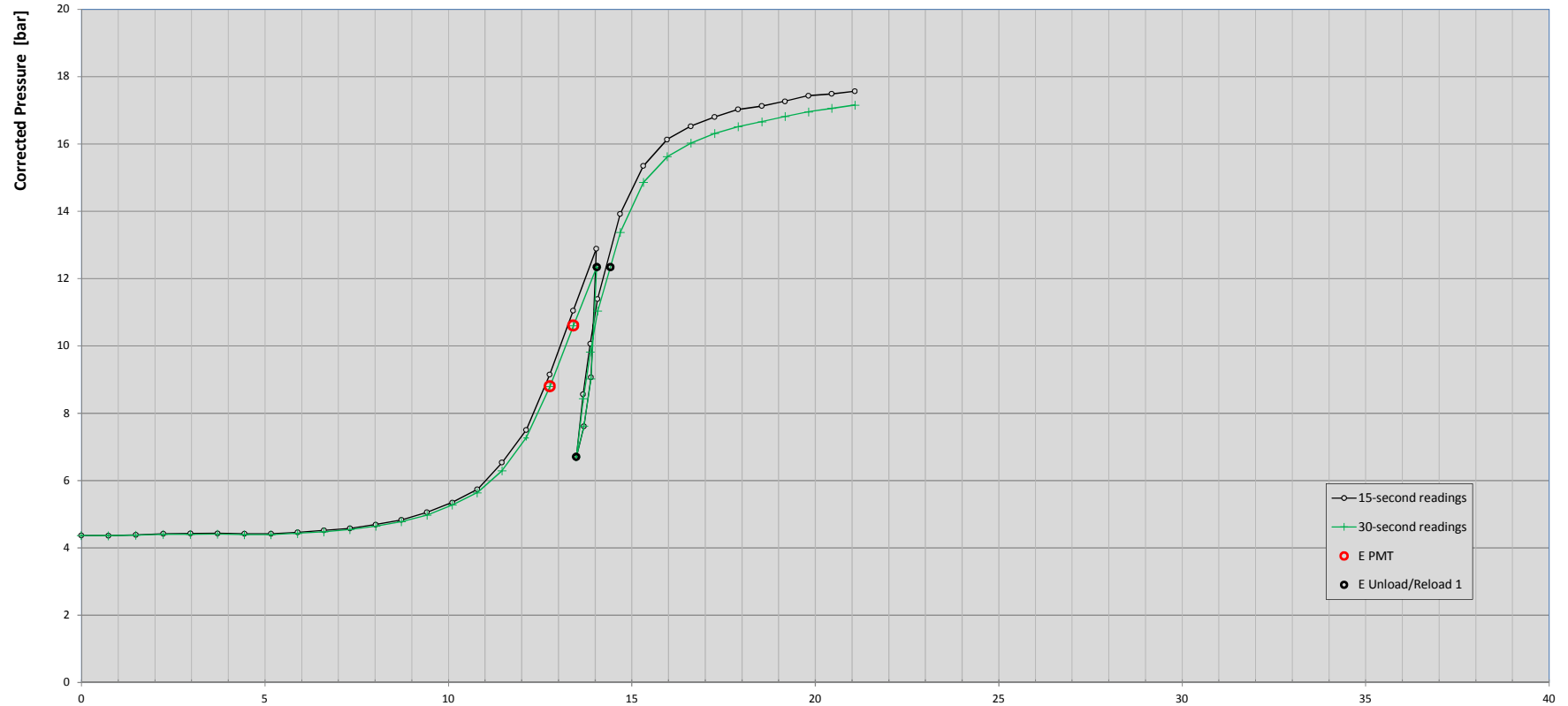
Determination of total contact pressure p_0



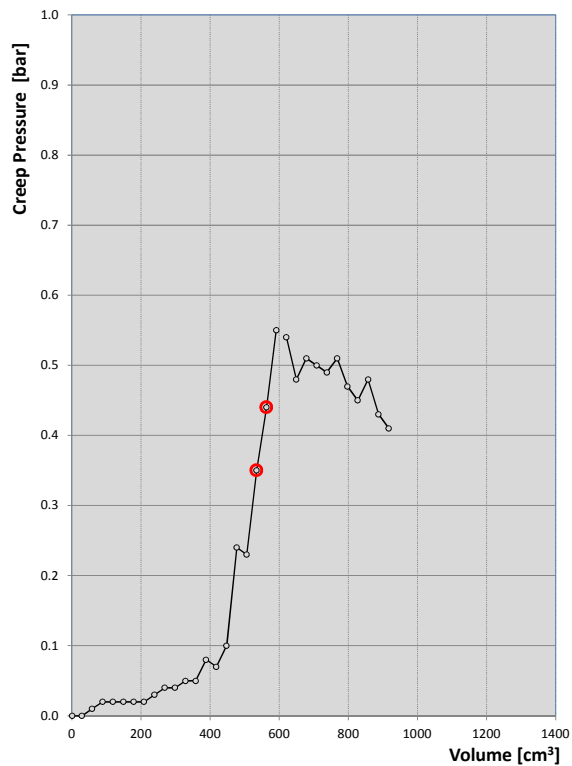
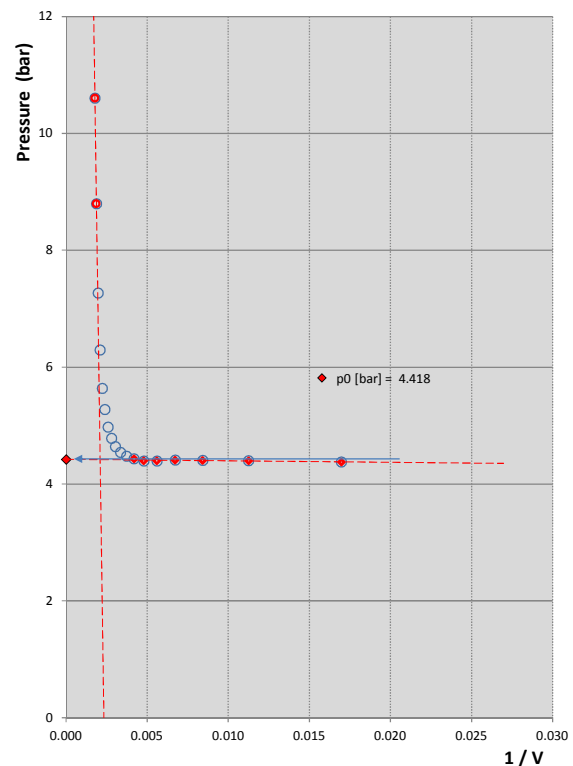
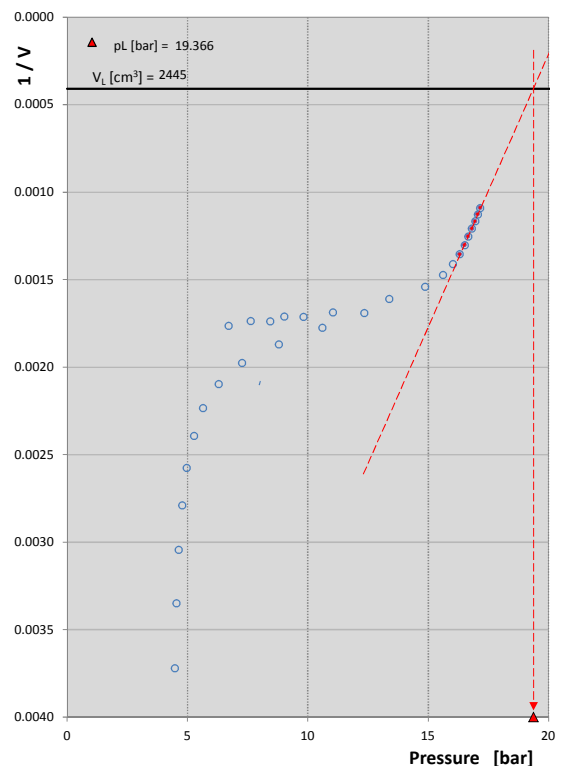
Determination of Limit Pressure p_L

Interpreted PMT Test Results					
[30-second readings]			volume		strain range [%]
			[cm ³]	radial strain [%]	
p_0	3.97	[bar]	208.9	5.2	[11.5 - 12.1 %]
p_L	26.73	[bar]			
p^*_L	22.76	[bar]			
p_V	8.29	[bar]	505	12.1	
E_{PMT}	360	[bar]	476	11.4	
E_{PMT} / p^*_L	15.8				
$E_{Unload 1}$	1054	[bar]	508	12.2	
$E_{Reload 1}$	650	[bar]			


Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 24, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 10	
Volume-controlled test as per ASTM D4719	Probe No.: E 309	Drilling Bit: Tricone Bit	Test Depth [m]: 31.57 (center of the probe)	Client: Golder Associates	Borehole No.: BH 01-PMT	
Method B	Calibration Record No.: 4	Time elapsed from hole drilling to testing ~ 5 minutes	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		
Volume increments: 40 cm ³	Tubing Length: 150 [ft]	Engineer: Gabriel Sedran, P.Eng., Ph.D.				
Maximum Volume: 1400 cm ³	Probe Length: 0.46 [m]	Operator: Scott Hall				
Maximum Pressure: 100 bar	Probe Initial Volume: 1968 cm ³					

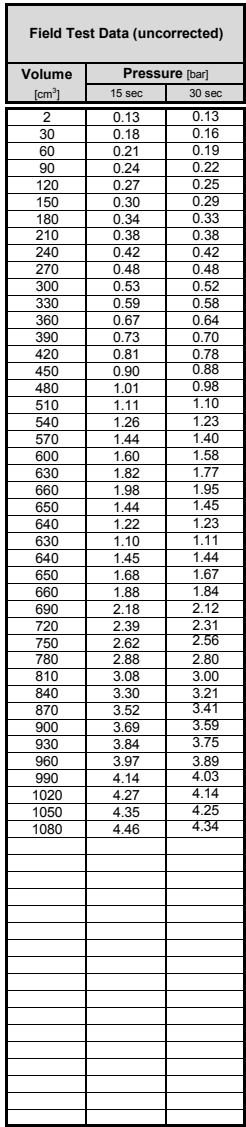
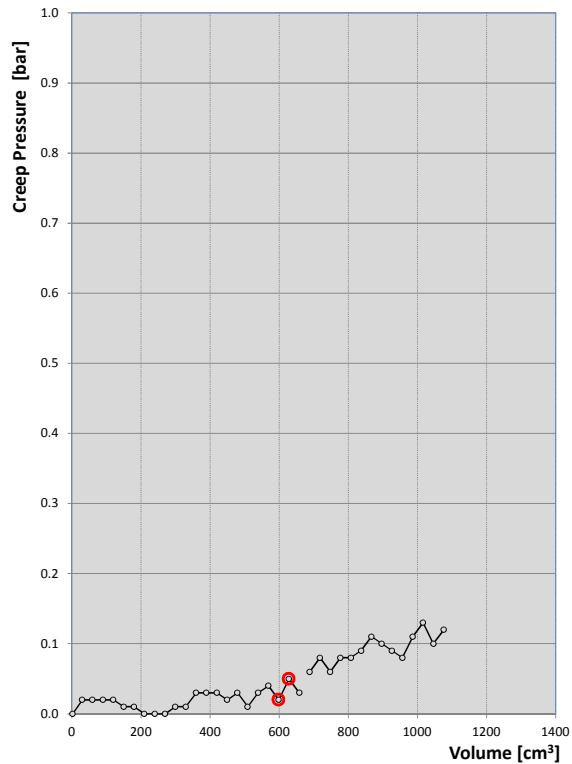
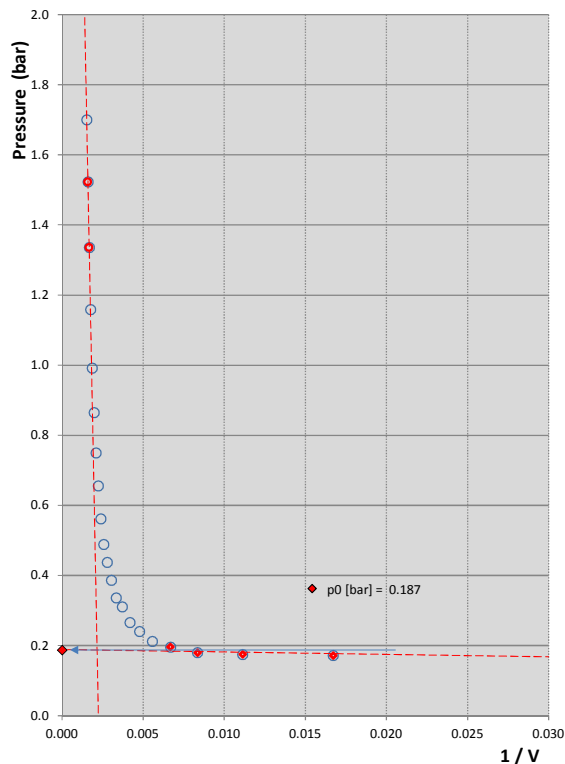
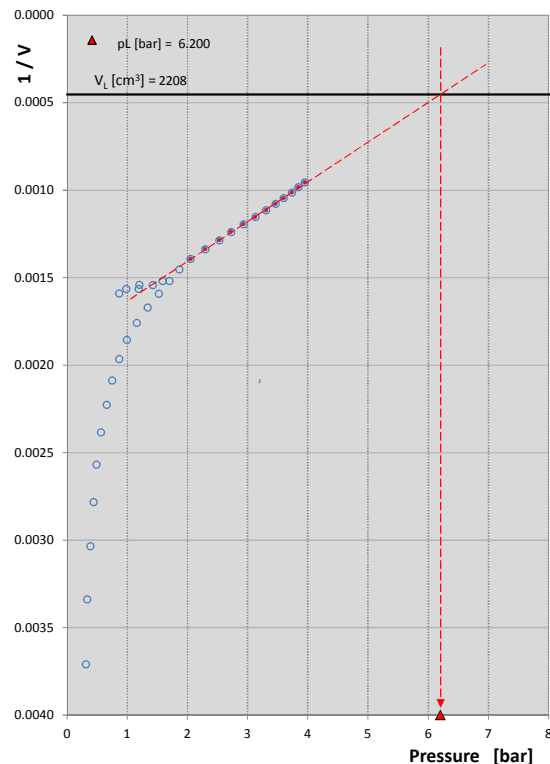
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Pressuremeter test results [corrected data] pressure vs radial strain


Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 

Determination of Limit Pressure p_L

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 24, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 11	<div>In-Depth Geotechnical Inc.</div> 
		Drilling Bit: Tricone Bit				
Volume-controlled test as per ASTM D4719 Method B	Probe No.: E 309 Calibration Record No.: 1	Time elapsed from hole drilling to testing ~ 5 minutes	Test Depth [m]: 34.60 (center of the probe)	Client: Golder Associates	Borehole No.: BH 01-PMT	
Volume increments: 40 cm³ Maximum Volume: 1400 cm³ Maximum Pressure: 100 bar	Tubing Length: 150 [ft] Probe Length: 0.46 [m] Probe Initial Volume: 1968 cm³	Engineer: Gabriel Sedran, P.Eng., Ph.D. Operator: Scott Hall				
		Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411			

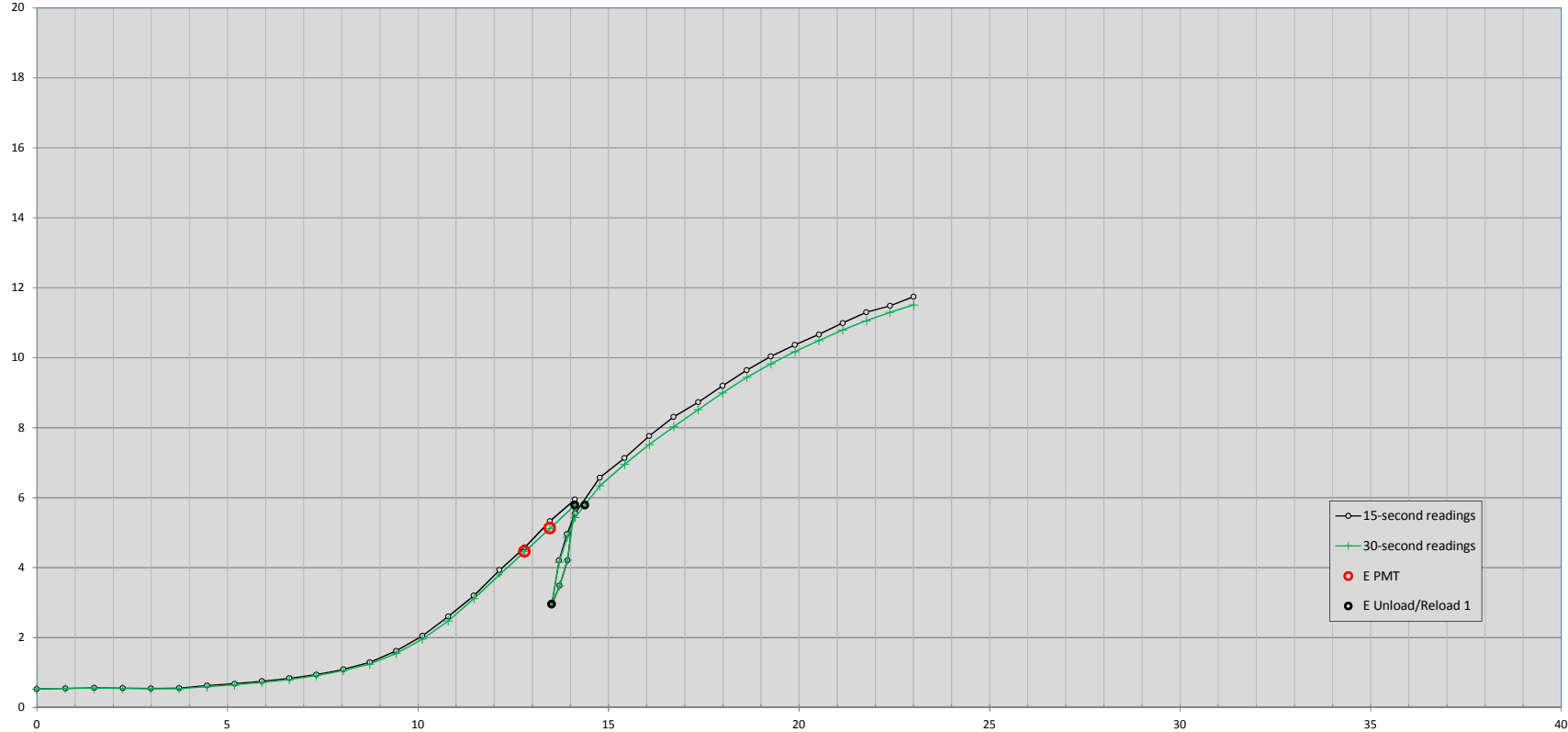
[illegible][illegible][illegible]Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 Determination of Limit Pressure p_L

Interpreted PMT Test Results					
[30-second readings]			volume		strain range [%]
			[cm ³]	[%]	
p ₀	0.19	[bar]	119.8	3.0	
p _L	6.20	[bar]			
p [*] _L	6.01	[bar]			
p _γ	1.52	[bar]	628	14.9	
E _{PMT}	43	[bar]	599	14.2	[14.2 - 14.8 %]
E _{PMT} / p [*] _L	7.2				
E _{Unload 1}	199	[bar]	629	14.9	
E _{Reload 1}	142	[bar]			

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 29, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 1	In-Depth Geotechnical Inc. 
		Drilling Bit: Tricone Bit				
Volume-controlled test as per ASTM D4719	Probe No.: E 309	Time elapsed from hole drilling to testing	Test Depth [m]: 2.11 (center of the probe)	Client: Golder Associates	Borehole No.: BH 02-PMT	
Method B	Calibration Record No.: 1	~ 5 minutes				
Volume increments: 40 cm³	Tubing Length: 150 [ft]	Engineer: Gabriel Sedran, P.Eng., Ph.D.	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		
Maximum Volume: 1400 cm³	Probe Length: 0.46 [m]	Operator: Scott Hall				
Maximum Pressure: 100 bar	Probe Initial Volume: 1968 cm³					

Field Test Data (uncorrected)			Corrected Test data						Creep		Auxiliary Data	
Volume [cm ³]	Pressure [bar]		15-second readings			30-second readings			Volume [cm ³]	Δp_{30-15} [bar]	30 sec	
	15 sec	30 sec	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]			Pressure [bar]	1 / V
2	0.13	0.13	0.53	2	0.00	0.53	2	0.00	2	0.00	0.53	0.53101
30	0.17	0.17	0.55	29.8	0.76	0.55	29.8	0.76	29.8	0.00	0.55	0.03350
60	0.21	0.20	0.56	59.8	1.51	0.55	59.8	1.51	59.8	0.01	0.55	0.01672
90	0.23	0.22	0.55	89.8	2.26	0.54	89.8	2.26	89.8	0.01	0.54	0.01114
120	0.25	0.24	0.55	119.8	3.00	0.54	119.8	3.00	119.8	0.01	0.54	0.00835
150	0.28	0.26	0.55	149.7	3.74	0.53	149.8	3.74	149.8	0.02	0.53	0.00668
180	0.38	0.35	0.63	179.7	4.47	0.60	179.7	4.47	179.7	0.03	0.60	0.00557
210	0.45	0.42	0.68	209.6	5.19	0.65	209.6	5.19	209.6	0.03	0.65	0.00477
240	0.54	0.51	0.75	239.5	5.91	0.72	239.5	5.91	239.5	0.03	0.72	0.00417
270	0.64	0.60	0.84	269.4	6.63	0.80	269.5	6.63	269.5	0.04	0.80	0.00371
300	0.76	0.73	0.94	299.3	7.34	0.91	299.3	7.34	299.3	0.03	0.91	0.00334
330	0.92	0.88	1.10	329.2	8.04	1.06	329.2	8.04	329.2	0.04	1.06	0.00304
360	1.13	1.08	1.30	359.0	8.74	1.25	359.0	8.74	359.0	0.05	1.25	0.00279
390	1.46	1.39	1.62	388.7	9.43	1.55	388.8	9.43	388.8	0.07	1.55	0.00257
420	1.90	1.81	2.05	418.3	10.12	1.96	418.4	10.12	418.4	0.09	1.96	0.00239
450	2.46	2.33	2.60	447.8	10.80	2.47	447.9	10.80	447.9	0.13	2.47	0.00223
480	3.06	2.98	3.20	477.3	11.47	3.12	477.3	11.47	477.3	0.08	3.12	0.00210
510	3.80	3.66	3.93	506.6	12.14	3.79	506.7	12.14	506.7	0.14	3.79	0.00197
540	4.45	4.33	4.58	536.0	12.80	4.46	536.1	12.80	536.1	0.12	4.46	0.00187
570	5.20	5.00	5.33	565.3	13.46	5.13	565.5	13.46	565.5	0.20	5.13	0.00177
600	5.82	5.66	5.94	594.8	14.12	5.78	594.9	14.12	594.9	0.16	5.78	0.00168
590	4.08	4.09	4.21	586.3	13.93	4.22	586.3	13.93			4.22	0.00171
580	3.36	3.36	3.49	577.0	13.72	3.49	577.0	13.72			3.49	0.00173
570	2.80	2.83	2.93	567.5	13.51	2.96	567.5	13.51			2.96	0.00176
580	4.08	4.03	4.21	576.3	13.71	4.16	576.4	13.71			4.16	0.00173
590	4.83	4.75	4.96	585.7	13.91	4.88	585.7	13.92			4.88	0.00171
600	5.43	5.31	5.55	595.1	14.12	5.43	595.2	14.13			5.43	0.00168
630	6.45	6.22	6.57	624.2	14.77	6.34	624.4	14.77	624.4	0.23	6.34	0.00160
660	7.01	6.84	7.13	653.7	15.42	6.96	653.9	15.42	653.9	0.17	6.96	0.00153
690	7.65	7.40	7.77	683.1	16.07	7.52	683.4	16.07	683.4	0.25	7.52	0.00146
720	8.20	7.92	8.31	712.6	16.71	8.03	712.9	16.72	712.9	0.28	8.03	0.00140
750	8.62	8.41	8.72	742.3	17.35	8.51	742.4	17.36	742.4	0.21	8.51	0.00135
780	9.10	8.90	9.20	771.8	17.99	9.00	772.0	18.00	772.0	0.20	9.00	0.00130
810	9.55	9.35	9.64	801.4	18.63	9.44	801.6	18.63	801.6	0.20	9.44	0.00125
840	9.95	9.74	10.04	831.1	19.26	9.83	831.2	19.27	831.2	0.21	9.83	0.00120
870	10.28	10.09	10.37	860.8	19.89	10.18	860.9	19.90	860.9	0.19	10.18	0.00116
900	10.58	10.41	10.66	890.5	20.52	10.49	890.6	20.53	890.6	0.17	10.49	0.00112
930	10.91	10.71	10.99	920.2	21.15	10.79	920.4	21.15	920.4	0.20	10.79	0.00109
960	11.22	10.98	11.30	949.9	21.77	11.06	950.1	21.77	950.1	0.24	11.06	0.00105
990	11.41	11.22	11.49	979.7	22.39	11.30	979.9	22.39	979.9	0.19	11.30	0.00102
1020	11.67	11.44	11.74	1009.5	23.01	11.51	1009.7	23.01	1009.7	0.23	11.51	0.00099

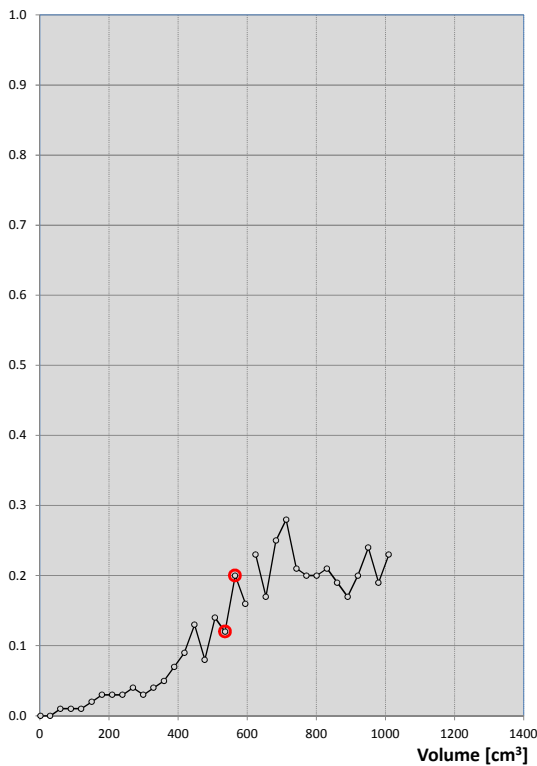
Corrected Pressure [bar]



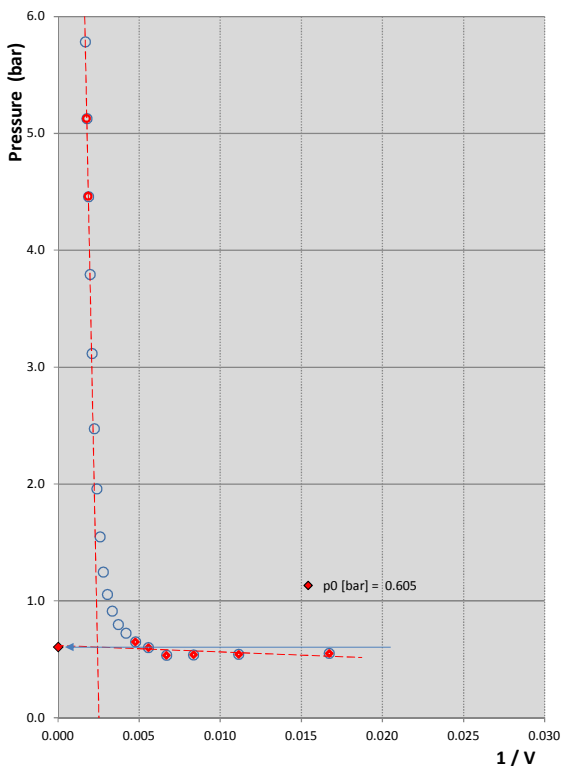
Pressuremeter test results [corrected data] pressure vs radial strain

Radial Strain [%]

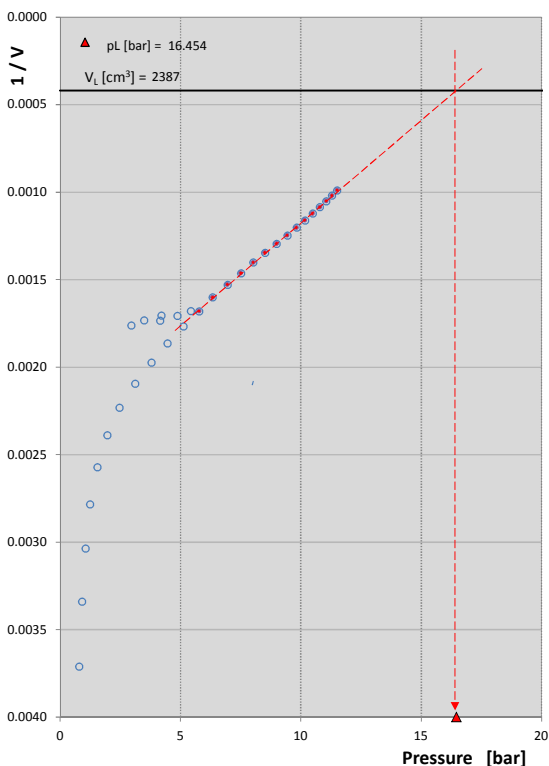
Creep Pressure [bar]

Pressure difference from 15 to 30 sec. readings $\Delta p_{15-30 \text{ sec}}$


Pressure (bar)

Determination of total contact pressure p_0

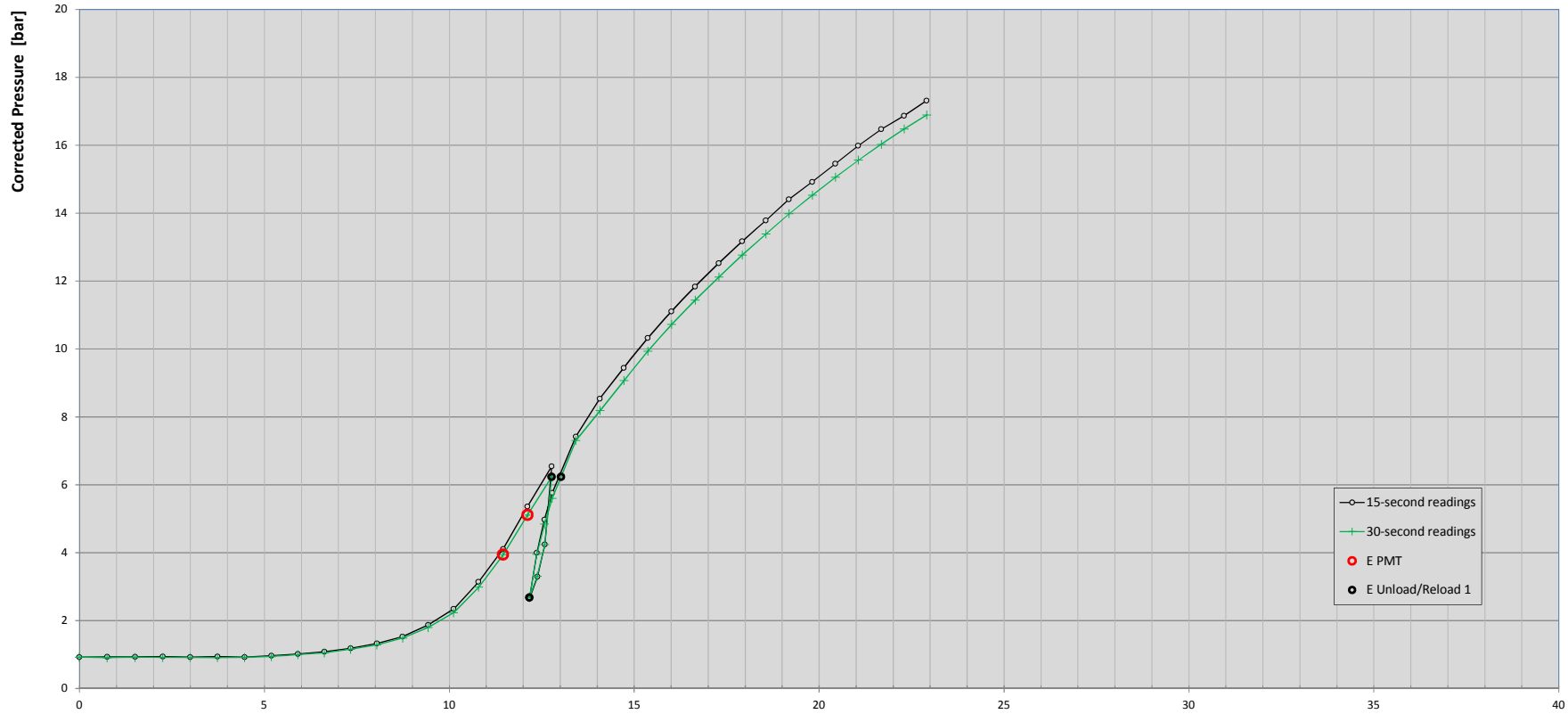
1 / V

Determination of Limit Pressure p_L

Interpreted PMT Test Results					
[30-second readings]			volume	radial strain	strain range [%]
			[cm ³]	[%]	
p_0	0.60	[bar]	209.6	5.2	
p_L	16.45	[bar]			
p^*_L	15.85	[bar]			
p_V	5.13	[bar]	566	13.5	
E_{PMT}	152	[bar]	536	12.8	[12.8- 13.5 %]
E_{PMT} / p^*_L	9.6				
$E_{Unload 1}$	698	[bar]	567	13.5	
$E_{Reload 1}$	492	[bar]			

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 29, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 2	
Volume-controlled test as per ASTM D4719	Probe No.: E 309	Drilling Bit: Tricone Bit	Test Depth [m]: 5.87 (center of the probe)	Client: Golder Associates	Borehole No.: BH 02-PMT	
Method B	Calibration Record No.: 4	Time elapsed from hole drilling to testing ~ 5 minutes	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		
Volume increments: 40 cm ³	Tubing Length: 150 [ft]	Engineer: Gabriel Sedran, P.Eng., Ph.D.				
Maximum Volume: 1400 cm ³	Probe Length: 0.46 [m]	Operator: Scott Hall				
Maximum Pressure: 100 bar	Probe Initial Volume: 1968 cm ³					

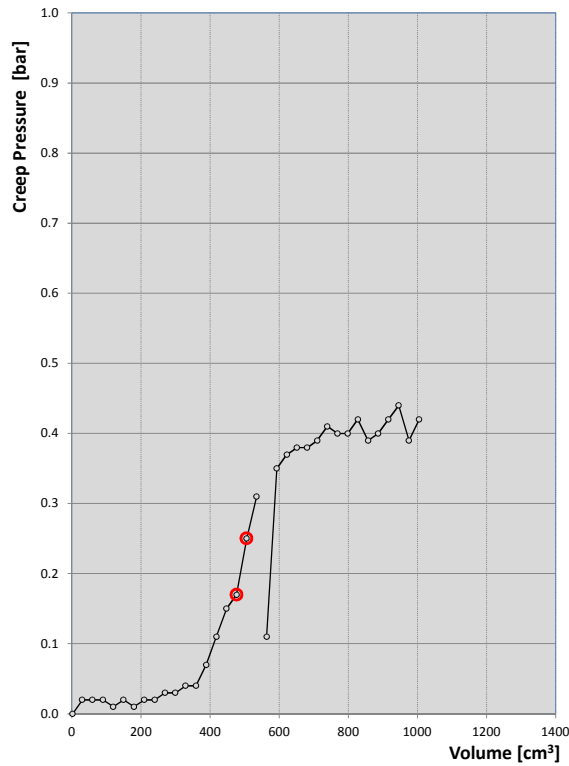
Field Test Data (uncorrected)			Corrected Test data						Creep		Auxiliary Data	
Volume [cm ³]	Pressure [bar]		15-second readings			30-second readings			Volume [cm ³]	Δp_{30-15} [bar]	30 sec	
	15 sec	30 sec	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]	Pressure [bar]	Volume [cm ³]	$\Delta r/r_0$ [%]			Pressure [bar]	1 / V
2	0.23	0.23	0.93	2	0.00	0.93	2	0.00	2	0.00	0.93	0.55761
30	0.26	0.24	0.93	29.8	0.75	0.91	29.8	0.75	29.8	0.02	0.91	0.03357
60	0.29	0.27	0.93	59.7	1.51	0.91	59.8	1.51	59.8	0.02	0.91	0.01673
90	0.32	0.30	0.94	89.7	2.25	0.92	89.7	2.25	89.7	0.02	0.92	0.01114
120	0.33	0.32	0.92	119.7	3.00	0.91	119.7	3.00	119.7	0.01	0.91	0.00835
150	0.37	0.35	0.94	149.7	3.73	0.92	149.7	3.73	149.7	0.02	0.92	0.00668
180	0.38	0.37	0.92	179.7	4.47	0.91	179.7	4.47	179.7	0.01	0.91	0.00557
210	0.44	0.42	0.96	209.6	5.19	0.94	209.6	5.19	209.6	0.02	0.94	0.00477
240	0.51	0.49	1.02	239.5	5.91	1.00	239.6	5.91	239.6	0.02	1.00	0.00417
270	0.59	0.56	1.08	269.5	6.63	1.05	269.5	6.63	269.5	0.03	1.05	0.00371
300	0.71	0.68	1.19	299.4	7.34	1.16	299.4	7.34	299.4	0.03	1.16	0.00334
330	0.86	0.82	1.33	329.2	8.04	1.29	329.3	8.04	329.3	0.04	1.29	0.00304
360	1.07	1.03	1.53	359.0	8.74	1.49	359.1	8.74	359.1	0.04	1.49	0.00278
390	1.42	1.35	1.87	388.7	9.43	1.80	388.8	9.43	388.8	0.07	1.80	0.00257
420	1.90	1.79	2.34	418.3	10.12	2.23	418.4	10.12	418.4	0.11	2.23	0.00239
450	2.70	2.55	3.14	447.6	10.79	2.99	447.7	10.79	447.7	0.15	2.99	0.00223
480	3.68	3.51	4.11	476.7	11.46	3.94	476.8	11.46	476.8	0.17	3.94	0.00210
510	4.93	4.68	5.36	505.6	12.11	5.11	505.8	12.12	505.8	0.25	5.11	0.00198
540	6.12	5.81	6.54	534.5	12.77	6.23	534.8	12.77	534.8	0.31	6.23	0.00187
530	3.82	3.82	4.25	526.6	12.59	4.25	526.6	12.59	4.25		4.25	0.00190
520	2.87	2.86	3.30	517.4	12.38	3.31	517.4	12.38	3.31		3.31	0.00193
510	2.22	2.25	2.65	508.0	12.17	2.68	508.0	12.17	2.68		2.68	0.00197
520	3.57	3.53	4.00	516.8	12.37	3.96	516.8	12.37	3.96		3.96	0.00193
530	4.55	4.42	4.98	525.9	12.57	4.85	526.0	12.58	4.85		4.85	0.00190
540	5.34	5.18	5.76	535.2	12.78	5.60	535.3	12.79	5.60		5.60	0.00187
570	7.00	6.89	7.42	563.7	13.42	7.31	563.8	13.43	7.31		7.31	0.00177
600	8.12	7.77	8.54	592.7	14.07	8.19	593.0	14.08	8.19		8.19	0.00169
630	9.03	8.66	9.45	621.9	14.72	9.08	622.2	14.73	9.08		9.08	0.00161
660	9.91	9.53	10.32	651.1	15.36	9.94	651.4	15.37	9.94		9.94	0.00154
690	10.70	10.32	11.11	680.4	16.01	10.73	680.7	16.02	10.73		10.73	0.00147
720	11.43	11.04	11.83	709.7	16.65	11.44	710.1	16.66	11.44		11.44	0.00141
750	12.13	11.72	12.53	739.1	17.29	12.12	739.5	17.29	12.12		12.12	0.00135
780	12.78	12.38	13.17	768.5	17.92	12.77	768.9	17.93	12.77		12.77	0.00130
810	13.40	13.00	13.79	798.0	18.55	13.39	798.3	18.56	13.39		13.39	0.00125
840	14.02	13.60	14.40	827.4	19.18	13.98	827.8	19.19	13.98		13.98	0.00121
870	14.54	14.15	14.92	856.9	19.81	14.53	857.3	19.82	14.53		14.53	0.00117
900	15.08	14.68	15.46	886.5	20.44	15.06	886.8	20.44	15.06		15.06	0.00113
930	15.61	15.19	15.99	916.0	21.06	15.57	916.4	21.07	15.57		15.57	0.00109
960	16.10	15.66	16.47	945.5	21.68	16.03	945.9	21.69	16.03		16.03	0.00106
990	16.50	16.11	16.87	975.2	22.29	16.48	975.5	22.30	16.48		16.48	0.00103
1020	16.95	16.53	17.32	1004.8	22.91	16.90	1005.1	22.92	16.90		16.90	0.00099



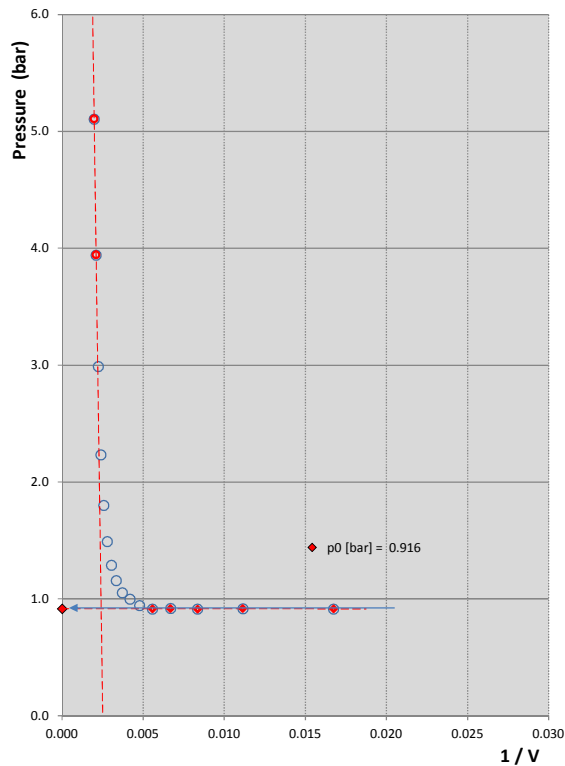
Pressuremeter test results [corrected data] pressure vs radial strain

Radial Strain [%]

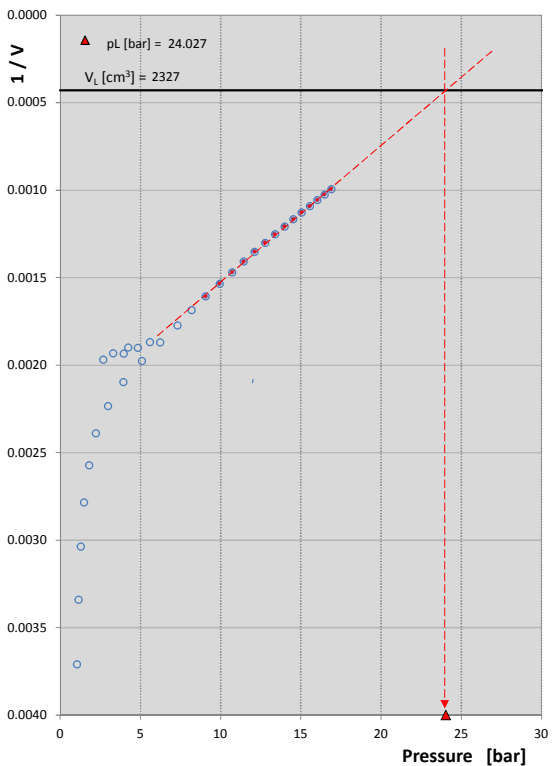
Interpreted PMT Test Results					
[30-second readings]			volume	radial strain	strain range [%]
			[cm ³]	[%]	
p_0	0.92	[bar]	179.7	4.5	
p_L	24.03	[bar]			
p^*_L	23.11	[bar]			
p_V	5.11	[bar]	506	12.1	
E_{PMT}	263	[bar]	477	11.5	[11.5- 12.1 %]
E_{PMT} / p^*_L	11.4				
$E_{Unload\ 1}$	879	[bar]	508	12.2	
$E_{Reload\ 1}$	624	[bar]			




Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30\ sec]}$

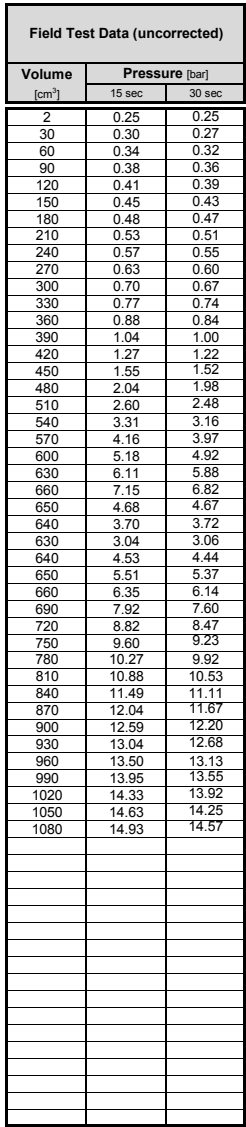
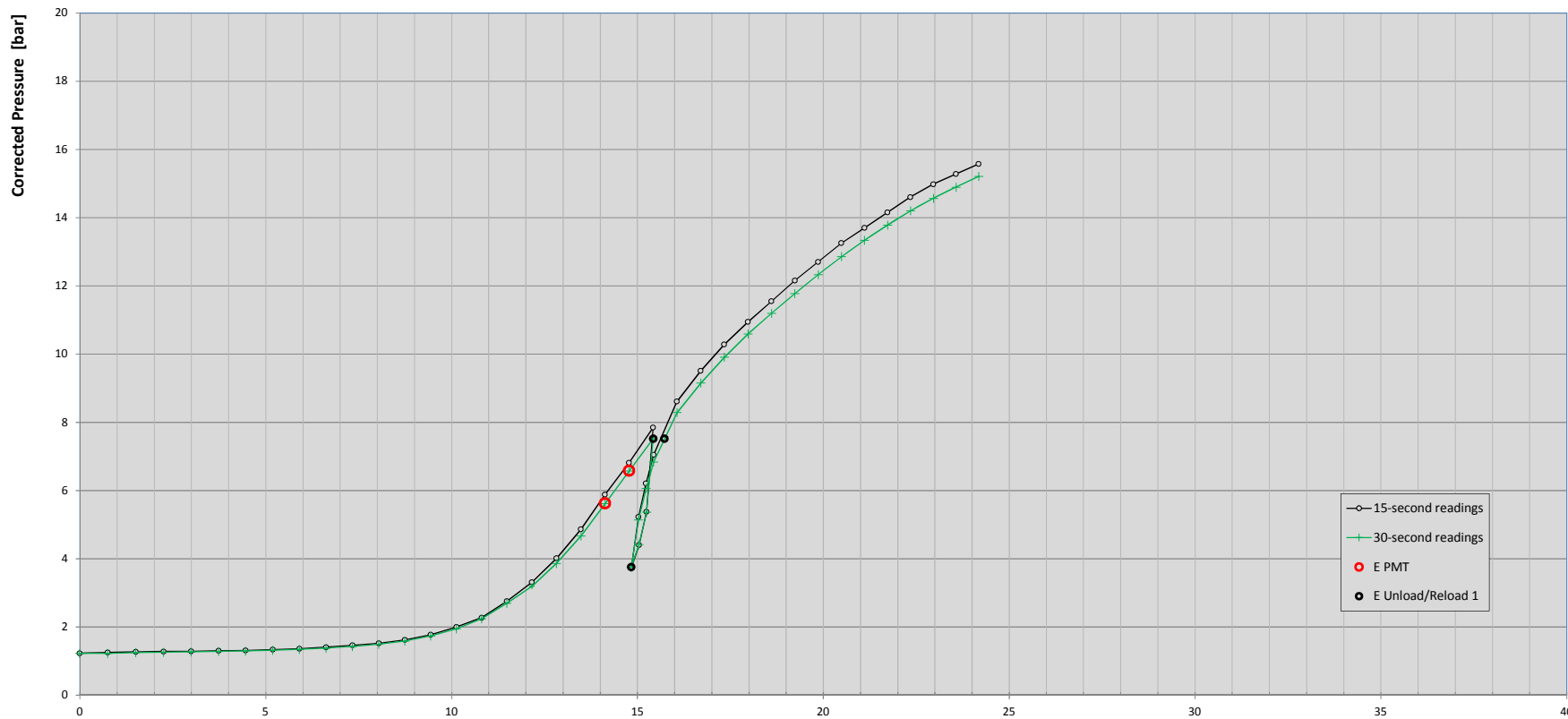


Determination of total contact pressure p_0

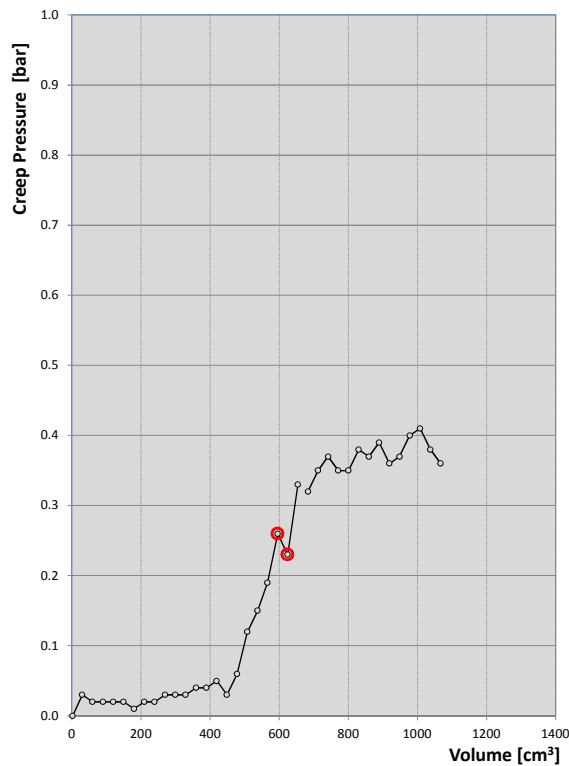
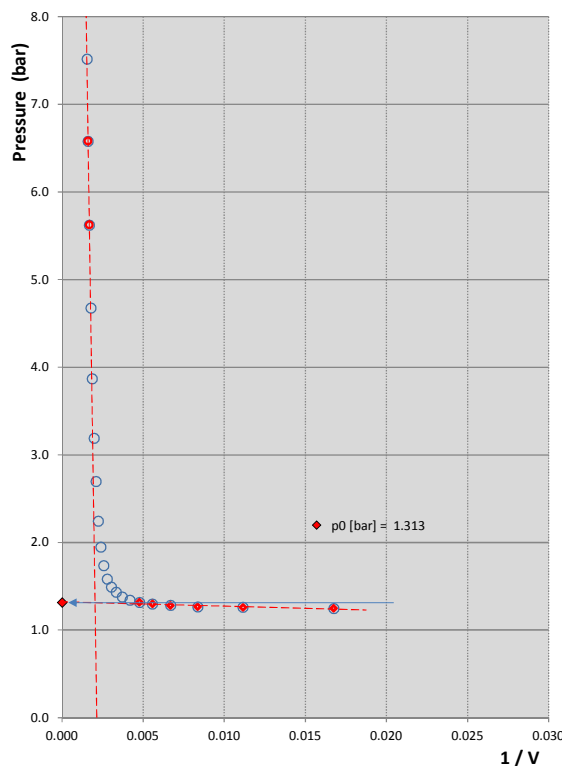
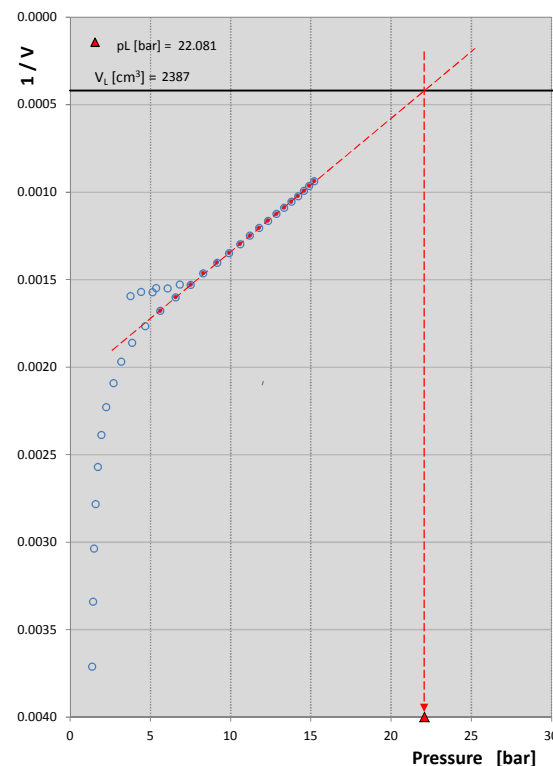


Determination of Limit Pressure p_L


Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 29, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 3	
Volume-controlled test as per ASTM D4719	Probe No.: E 309	Drilling Bit: Tricone Bit	Test Depth [m]: 8.86 (center of the probe)	Client: Golder Associates	Borehole No.: BH 02-PMT	
Method B	Calibration Record No.: 1	Time elapsed from hole drilling to testing ~ 5 minutes	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		
Volume increments: 40 cm³	Tubing Length: 150 [ft]	Engineer: Gabriel Sedran, P.Eng., Ph.D.				
Maximum Volume: 1400 cm³	Probe Length: 0.46 [m]	Operator: Scott Hall				
Maximum Pressure: 100 bar	Probe Initial Volume: 1968 cm³					

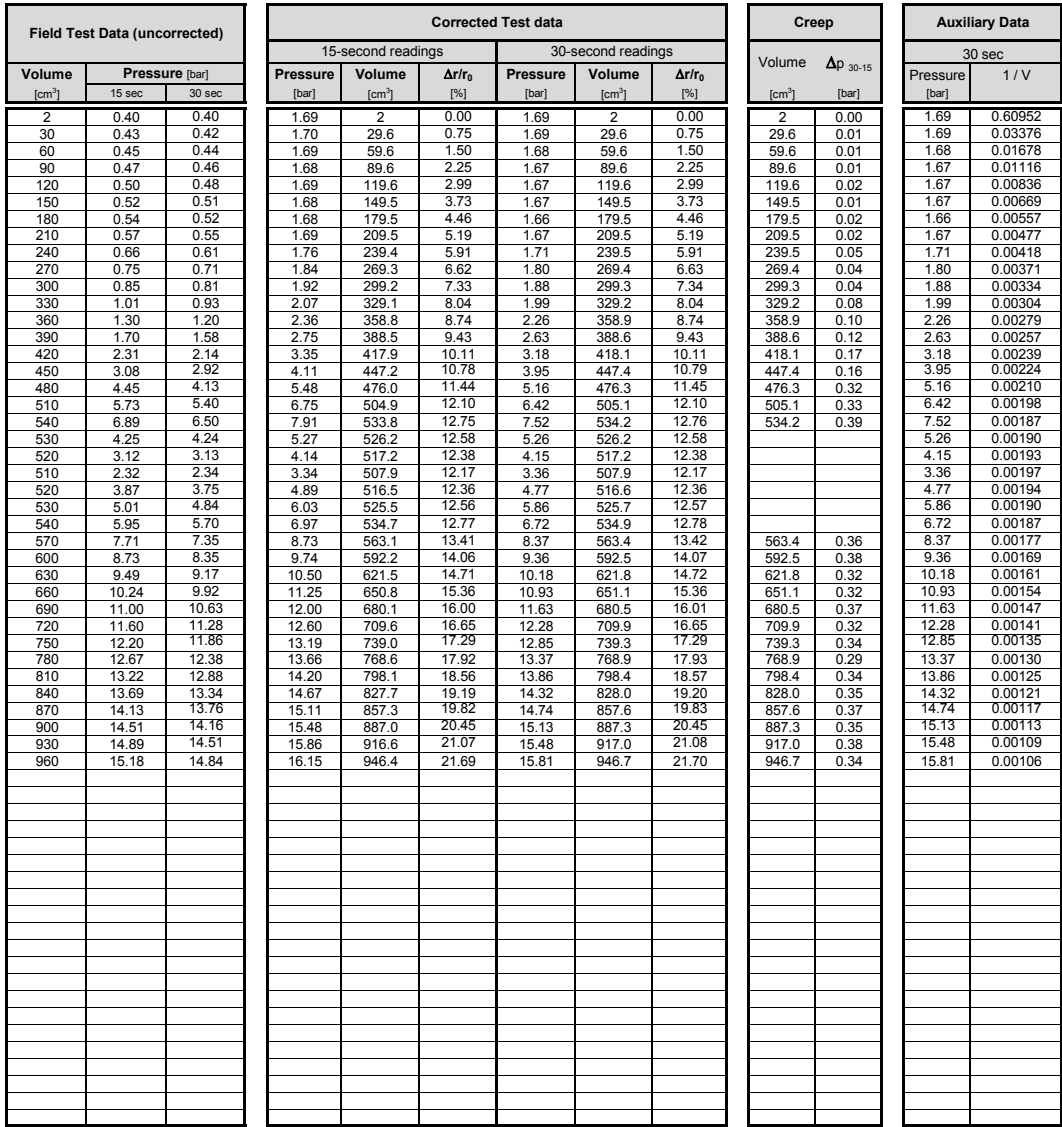
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Pressuremeter test results [corrected data] pressure vs radial strain

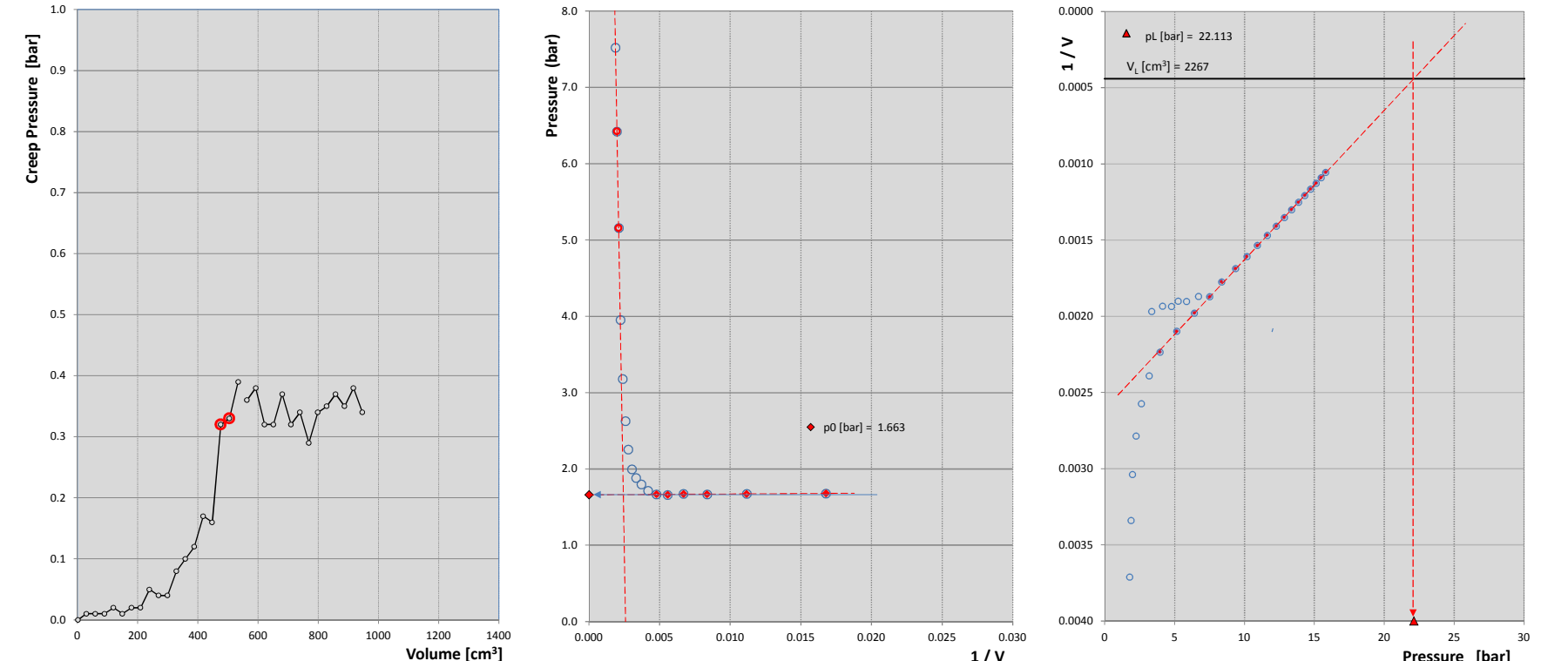
Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 Determination of Limit Pressure p_L

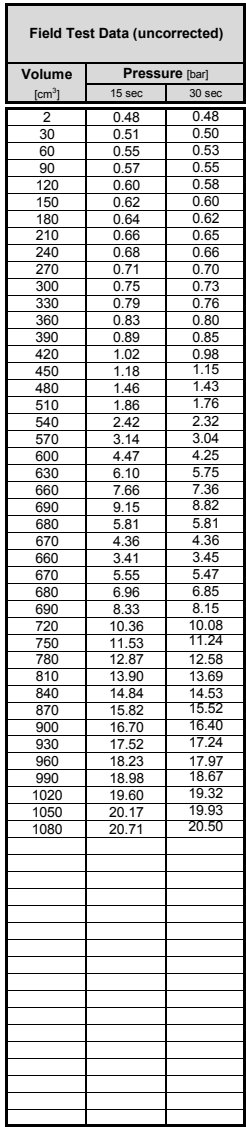
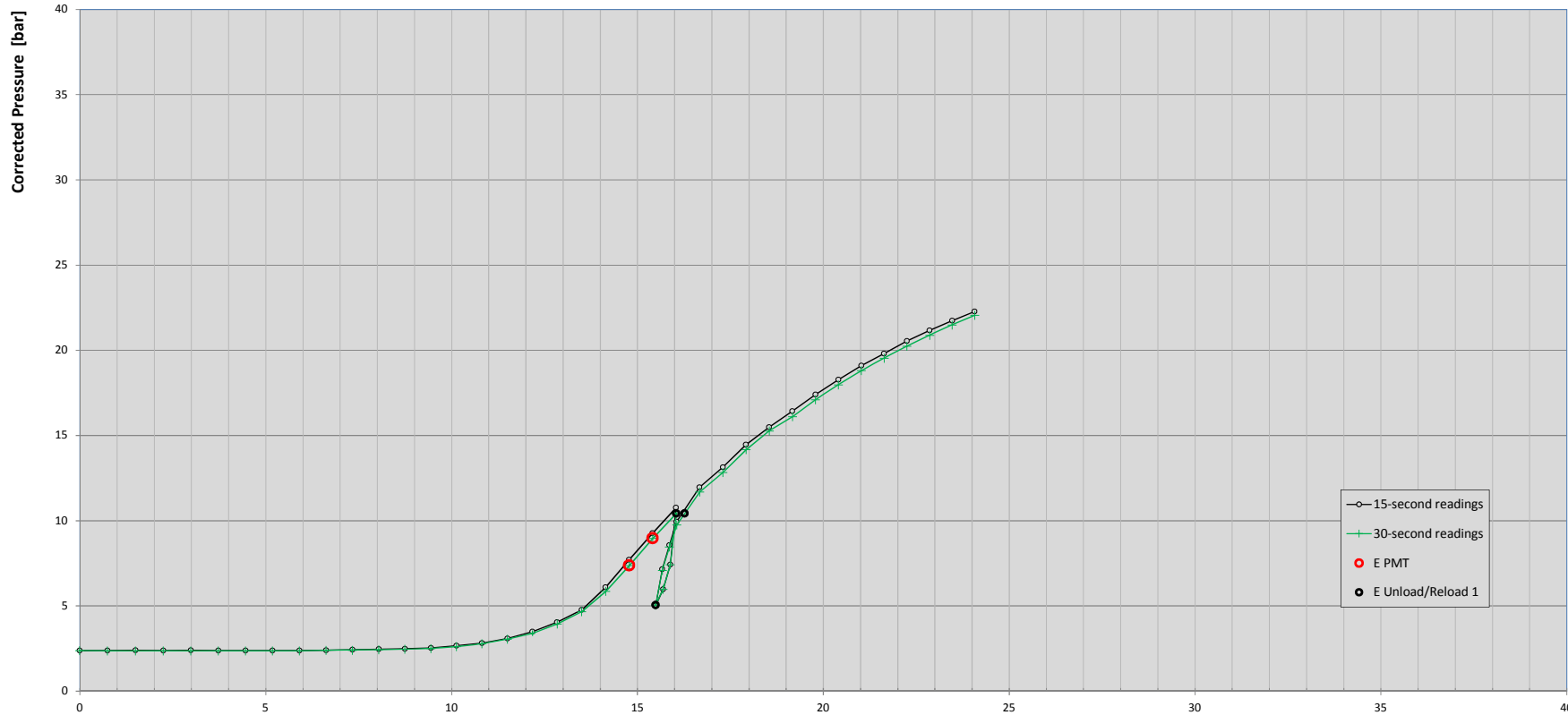
Interpreted PMT Test Results					
[30-second readings]			volume		strain range [%]
			[cm ³]	[%]	
p ₀	1.31	[bar]	209.5	5.2	
p _L	22.08	[bar]			
p _L [*]	20.77	[bar]			
p _Y	6.58	[bar]	625	14.8	
E _{PMT}	225	[bar]	596	14.1	[14.1- 14.8 %]
E _{PMT} / p _L [*]	10.8				
E _{Unload 1}	979	[bar]	627	14.8	
E _{Reload 1}	644	[bar]			

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 29, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 4	In-Depth Geotechnical Inc. 
Volume-controlled test as per ASTM D4719 Method B	Probe No.: E 309 Calibration Record No.: 1	Drilling Bit: Tricone Bit Time elapsed from hole drilling to testing ~ 5 minutes				
Volume increments: 40 cm³ Maximum Volume: 1400 cm³ Maximum Pressure: 100 bar	Tubing Length: 150 [ft] Probe Length: 0.46 [m] Probe Initial Volume: 1968 cm³	Engineer: Gabriel Sedran, P.Eng., Ph.D. Operator: Scott Hall	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		

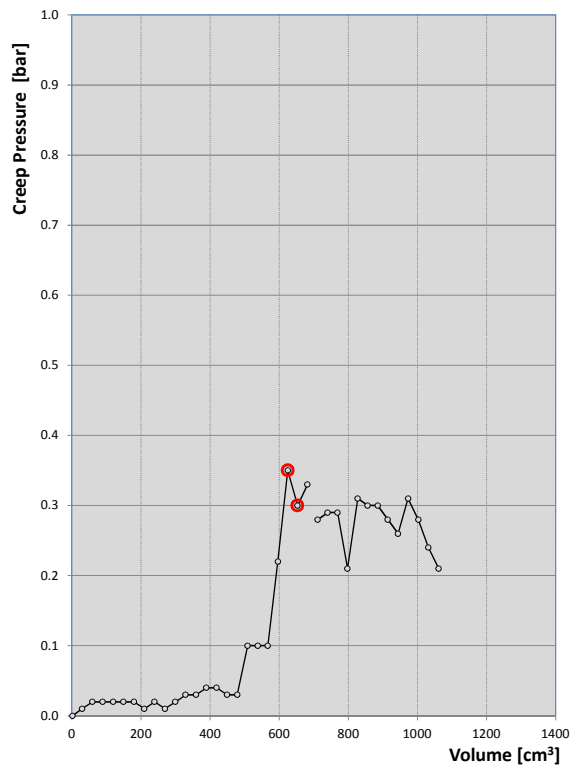
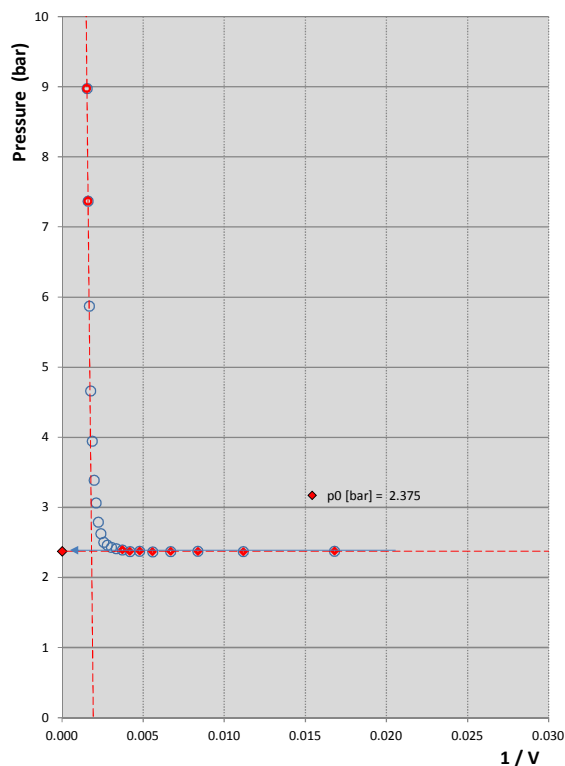
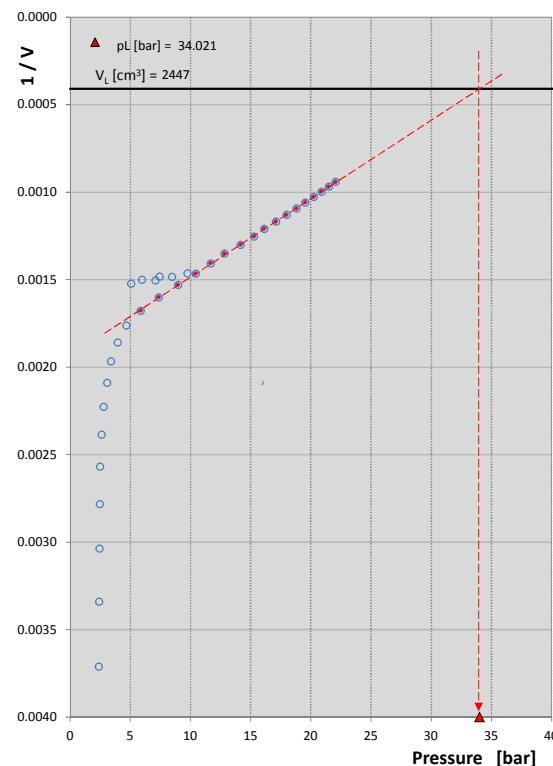


Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 29, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 5	In-Depth Geotechnical Inc. 
Volume-controlled test as per ASTM D4719 Method B	Probe No.: E 309 Calibration Record No.: 1	Drilling Bit: Tricone Bit Time elapsed from hole drilling to testing ~ 5 minutes				
Volume increments: 40 cm³ Maximum Volume: 1400 cm³ Maximum Pressure: 100 bar	Tubing Length: 150 [ft] Probe Length: 0.46 [m] Probe Initial Volume: 1968 cm³	Engineer: Gabriel Sedran, P.Eng., Ph.D. Operator: Scott Hall	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411	Borehole No.: BH 02-PMT	




[illegible][illegible][illegible]

Pressuremeter test results [corrected data] pressure vs radial strain

Pressure difference from 15 to 30 sec. readings $\Delta p_{[15-30 \text{ sec}]}$ Determination of total contact pressure p_0 Determination of Limit Pressure p_L

Interpreted PMT Test Results					
[30-second readings]			volume		strain range [%]
			[cm ³]	[%]	
p ₀	2.38	[bar]	239.4	5.9	
p _L	34.02	[bar]			
p [*] _L	31.65	[bar]			
p _γ	8.98	[bar]	653	15.4	
E _{PMT}	390	[bar]	625	14.8	[14.8 - 15.4 %]
E _{PMT} / p [*] _L	12.3				
E _{Unload 1}	1495	[bar]	657	15.5	
E _{Reload 1}	1060	[bar]			

Pressuremeter Equipment: TEXAM Model	Probe Designation : NX Probe (76 mm OD)	Drilling Method: Mud Rotary Drilling	Test Date: January 30, 2018	Project: HWY 400 and HWY 89	PMT TEST No.: 7	In-Depth Geotechnical Inc. 
Volume-controlled test as per ASTM D4719 Method B	Probe No.: E 309 Calibration Record No.: 1	Drilling Bit: Tricone Bit Time elapsed from hole drilling to testing ~ 5 minutes				
Volume increments: 40 cm³ Maximum Volume: 1400 cm³ Maximum Pressure: 100 bar	Tubing Length: 150 [ft] Probe Length: 0.46 [m] Probe Initial Volume: 1968 cm³	Engineer: Gabriel Sedran, P.Eng., Ph.D. Operator: Scott Hall	Drilling Company: Walker Drilling	In-Depth Geotechnical Project No.: IDG 180411		

Appendix Two

Pressuremeter Data Interpretation

Interpretation of Pressuremeter Test Results

Prebored pressuremeter test results are expressed in terms of applied pressure versus radial strain. Both pressure and strain measurements must be corrected for pressure and volume losses using the corresponding probe and system calibration curves.

The typical pressure versus radial strain curve features up to four distinctive portions which characterize the stress-strain behaviour of the soil, namely:

- The linear pseudo-elastic stress-strain portion of the deformation curve;
- The departure from linear elastic conditions starting at the yield pressure p_y ;
- The unload-reload portion of the test (usually two cycles are performed); and
- The development of soil failure, which is represented by the net limit pressure p^*_L .

Based on these test features the following soil parameters are determined or estimated:

1. Total Horizontal Stress σ_{ho} or p_o :

When using the prebored TEXAM unit, the initial contact pressure is taken as the pressure at the intersection of the two lines representing the pseudo elastic and the initial expansion portions of the pressure vs. $1/V$ plot, as shown in the PMT data sheets, in Appendix One. In the context of this report, σ_{ho} is also equivalent to the total contact pressure p_o .

2. Pressuremeter modulus E_{PMT} :

The pressuremeter modulus is represented by the slope of the pressure versus radial strain curve along its linear portion, and may be calculated as follows:

$$E_{PMT} = (1 + \nu)(p_2 - p_1) \frac{\left(1 + \left(\frac{\Delta R}{R_o}\right)_2\right)^2 + \left(1 + \left(\frac{\Delta R}{R_o}\right)_1\right)^2}{\left(1 + \left(\frac{\Delta R}{R_o}\right)_2\right)^2 - \left(1 + \left(\frac{\Delta R}{R_o}\right)_1\right)^2}$$

where the sub-indices 1 and 2 indicate the beginning and the end of the linear portion of the curve, respectively. These two points are shown in pressuremeter curves with two red oversized circles. For the self-boring probe, the linear portion of the stress-strain response occurs between the very first data point (zero volume increase) and the subsequent two or three data points.

In this determination a value of the Poisson's ratio, typically $\nu = 0.33$ for most soils, must be assumed. For saturated clays a value of $\nu = 0.45$ is suggested.

The Pressuremeter modulus E_{PMT} corresponds to large strains, namely for radial strains in the 2 to 5 % range, and it is therefore considered to be a relatively low value of the elastic modulus.

In practice, the Young's modulus E can be inferred from Pressuremeter testing using the Menard α factor:

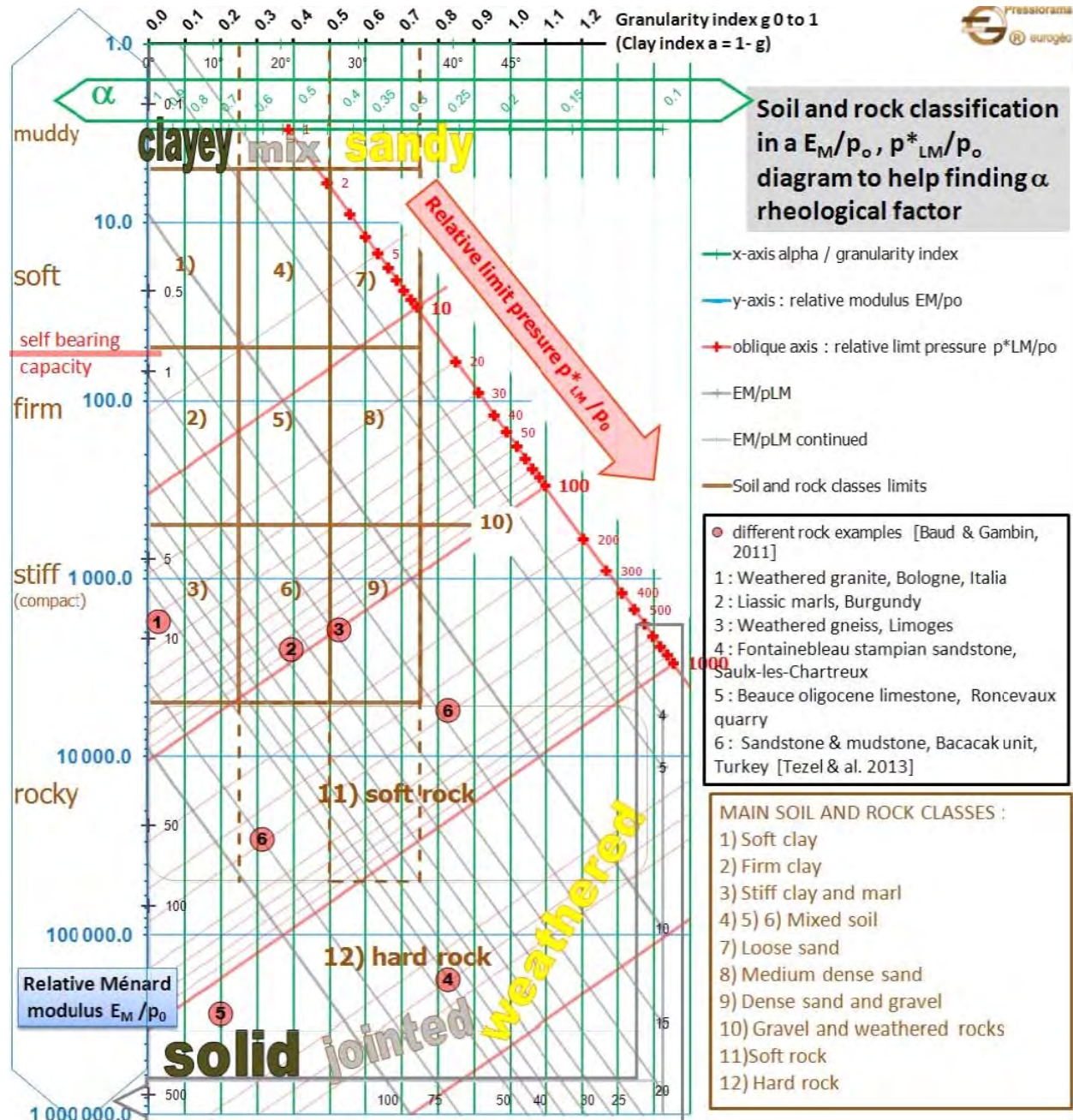
$$E = E_{PMT} / \alpha$$

Typical values of the Menard α factor are suggested in the following Table:

Soil type	Peat		Clay		Silt		Sand		Sand and gravel	
	E/p_L^*	α	E/p_L^*	α	E/p_L^*	α	E/p_L^*	α	E/p_L^*	α
Over consolidated		1	> 16	1	> 14	2/3	> 12	1/2	> 10	1/3
Normally consolidated	For all values	1	9-16	2/3	8-14	1/2	7-12	1/3	6-10	1/4
Weathered and/or remoulded		1	7-9	1/2		1/2		1/3		1/4
Rock	Extremely fractured		Other				Slightly fractured or extremely weathered			
	$\alpha = 1/3$		$\alpha = 1/2$				$\alpha = 2/3$			

(from 'The Pressuremeter', J.L. Briaud. Balkema, 1992)

Alternatively, better-defined values of the Menard α parameter can be obtained from the Pressiorama chart introduced by Baud et.al., as illustrated below.



Baud J.P., and Gambin M. 2013. “Détermination du coefficient rhéologique α de Ménard dans le diagramme Pressiorama”. Proceedings of the 18th International Conference on Soil Mechanics and Geotechnical Engineering, Paris, 2013, Parallel Session ISP 6, International Symposium on the Pressuremeter.

3. Yield Pressure p_y :

The yield pressure indicates the end of the linear pseudo-elastic deformations and the onset of plasticity. This yield pressure is useful in indicating beyond which pressure significant creep deformations may occur.

4. Unload-Reload Modulus E_R :

The reload modulus is represented by the slope of the unload-reload loop, and may be used to determine elastic soil deformations upon unloading conditions such as those typically encountered during excavations.

5. Net Limit Pressure p_L^* :

The net limit pressure is a measure of the strength of the soil (either under undrained conditions for cohesive soils, or drained conditions for non-cohesive soils). This parameter is defined as the pressure reached when the soil cavity has been extended to twice its original soil cavity volume V_c (minus the initial total contact pressure p_o).

The limit pressure is not always attained during testing. In such cases, the value of p_L is inferred by plotting pressure versus $1/V$ for the plastic phase of the deformations. This method of inferring p_L , known as the “upside down curve” method, is described in “*The Pressuremeter and Foundation Engineering*” textbook, by F. Baguelin, J.F. Jezequel, and D.H. Shields, published in 1978 by Trans Tech Publications, Section: Methods of extrapolating pressuremeter curves to p_L . See also ASTM D4719-00, Section 10.6.

It should be noted that radial strains are calculated from the volume of fluid (typically tap water) injected into the probe. In this regard, the radial strains shown in the results are related to the probe expansion, not the cavity’s expansion. The cavity initial volume, V_c , is calculate by adding the probe initial volume, V_o , plus the volume of water injected into the probe at the initial contact pressure p_o . For the self-boring PMT probe,

6. Some Additional Parameters

In addition, two useful ratios, (E_{PMT} / p_L^*) and (p_L^* / p_y) , may be used as a general guideline for soil identification, as follows:

for sands $7 < E_{PMT} / p_L^* < 12$

for clays $12 < E_{PMT} / p_L^*$

Also, as presented in the Canadian Foundation Engineering Manual (4th Edition, 2006)

TABLE 4.7 *Typical Menard Pressuremeter Values*

Type Of Soil	Limit Pressure (kPa)	E_{vt} / p_t
Soft clay	50 – 300	10
Firm clay	300 – 800	10
Stiff clay	600 - 2500	15
Loose silty sand	100 – 500	5
Silt	200 - 1500	8
Sand and gravel	1200 – 5000	7
Till	1000 – 5000	8
Old fill	400 – 1000	12
Recent fill	50 - 300	12

For most soil types the ratio between the limit and the yield pressures may be expressed as:

$$1.3 < (p_L^* / p_y) < 2.0$$

Also as a general guideline, clayey and sandy soils may have the following parameters:

Table 10. Approximate common values for the pressuremeter parameters.

CLAY					
Soil type	Soft	Medium	Stiff	Very stiff	Hard
p_L^* (kPa)	0 - 200	200 - 400	400 - 800	800 - 1600	>1600
E_o (kPa)	0 - 2500	2500 - 5000	5000 - 12000	12000 - 25000	>25000

SAND				
Soil type	Loose	Compact	Dense	Very dense
p_L^* (kPa)	0 - 500	500 - 1500	1500 - 2500	> 2500
E_o (kPa)	0 - 3500	3500 - 12000	12000 - 22500	> 22500

Note: 100 kPa = 1.04 tsf

(from 'The Pressuremeter', J.L. Briaud. Balkema, 1992)

Inferred Shear Strength Parameters

The undrained shear strength of cohesive soils may be estimated as:

$$\frac{S_u}{p_a} = 0.21 \left(\frac{p_L^*}{p_a} \right)^{0.75}$$

where p_a represents a reference pressure (i.e., atmospheric pressure = 100 kPa), after J.L. Briaud ('The Pressuremeter', Balkema, 1992).

The drained friction angle of cohesionless soils ($c' = 0$) may be estimated using the empirical correlations illustrated in the graph shown below. This approach is outlined by Baguelin et.al. in "*The Pressuremeter and Foundation Engineering*" (F. Baguelin; J.F. Jézéquel; and D.H. Shields. TransTech Publications. 1978), and it requires some knowledge on the state or conditions of the cohesionless material. This approach only provides a likely range of friction angles from interpreted limit pressure values.

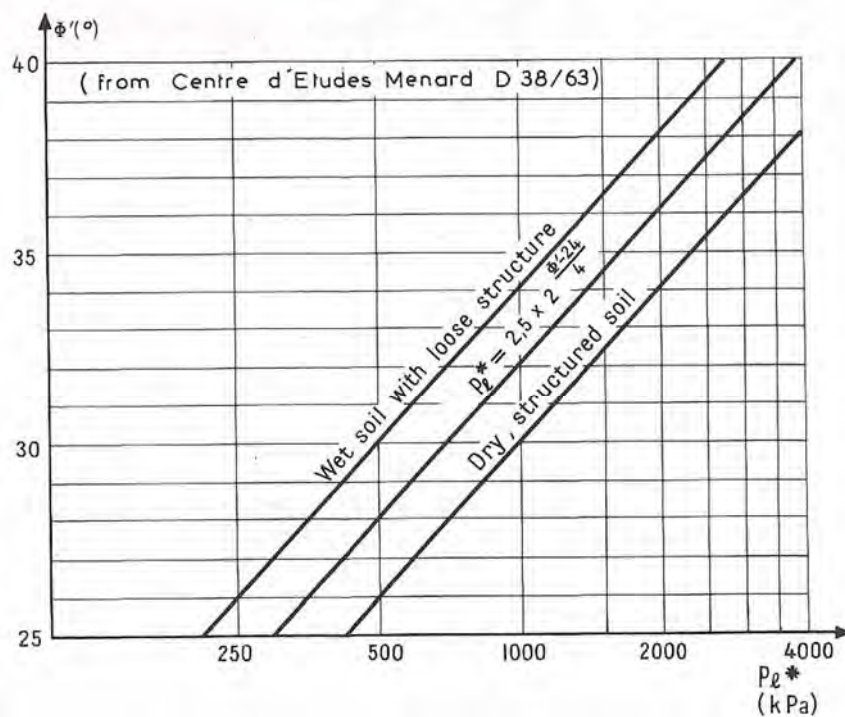


Fig. 6-86: MÉNARD's graph to determine ϕ' from p_L^* .

Conservative estimates (lower-bound estimates) of strength parameters can also be inferred from the following table:

Table 8. Guidelines for estimating the limit pressure of the soil.

Soils		Pressuremeter p_L (kPa)	SPT blow count N (blows/30 cm)	Undrained shear strength S_u (kPa)
Sand	loose	0 - 500	0 - 10	
	medium	500 - 1500	10 - 30	
	dense	1500 - 2500	30 - 50	
	very dense	> 2500	> 50	
Clay	soft	0 - 200		0 - 25
	firm	200 - 400		25 - 50
	stiff	400 - 800		50 - 100
	very stiff	800 - 1600		100 - 200
	hard	> 1600		> 200
Note: 100 kPa = 1.044 tsf; 1 cm = 0.033 ft				

(From 'The Pressuremeter', J.L. Briaud. Balkema, 1992)

Appendix Three

Calibration Data

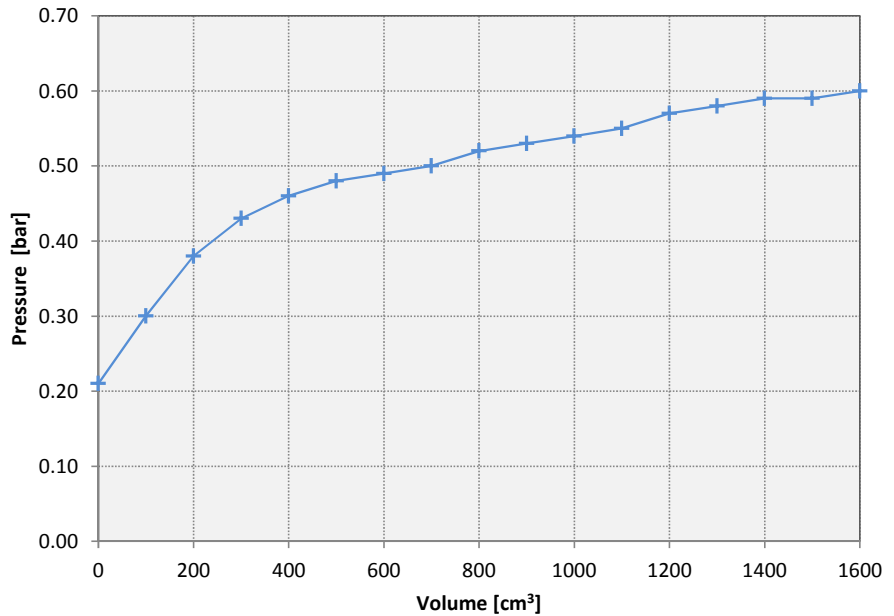
Calibration Date: December 13, 2017
 Probe Designation: E 309
 Calibration Record No.: 1
 Length of Tubing: 150 feet
 Calibrated by: T.H.



Membrane stiffness calibration

Pressure [bar]	Volume cm ³
0.21	0
0.30	100
0.38	200
0.43	300
0.46	400
0.48	500
0.49	600
0.50	700
0.52	800
0.53	900
0.54	1000
0.55	1100
0.57	1200
0.58	1300
0.59	1400
0.59	1500
0.60	1600

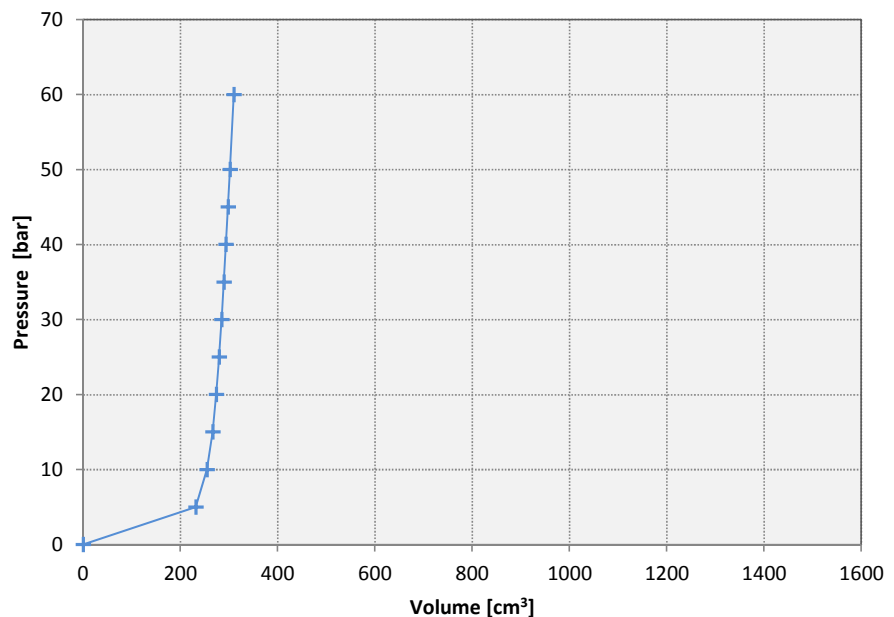
Membrane Stiffness (Air Calibration)



Volume calibration

Pressure [bar]	Volume cm ³
0	0.0
5	231.9
10	254.8
15	266.6
20	273.6
25	279.5
30	284.6
35	289.3
40	293.7
45	297.9
50	302.0
60	309.9
Reload Cal. Data	
25	280.8
50	302.4

System Stiffness (Compliance Calibration)





APPENDIX C

Vertical Seismic Profile Test Results

DATE February 16, 2018**PROJECT No.** 1668512/1000/1005**TO** David Marmor
Golder Associates**FROM** Stephane Sol, Christopher Phillips**EMAIL** ssol@golder.com, cphillips@golder.com**VERTICAL SEISMIC PROFILING TEST RESULTS
HWY400 AND HWY89, INNISFIL, ONTARIO**

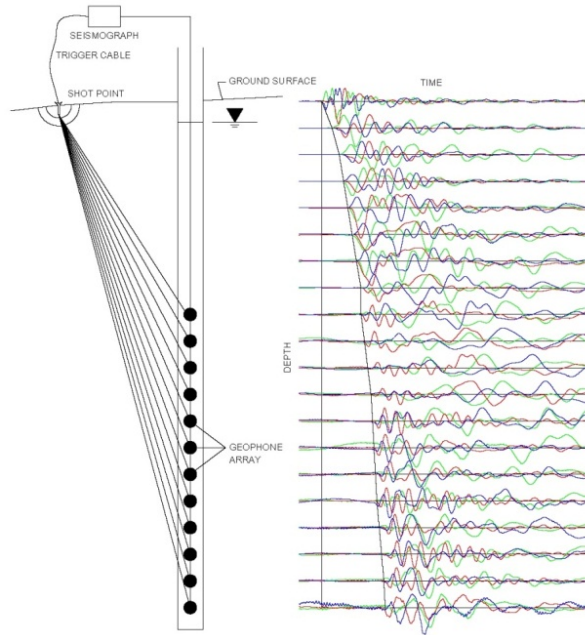
This memorandum presents the results of two Vertical Seismic Profiling (VSP) testing carried out at a site located at the intersection of HWY400 and HWY89 south of Innisfil. VSP testing was carried out on February 12 2018. Borehole PMT-01, located in the SW quadrant of the intersection, was drilled to an approximate depth of 35.7 m below the existing ground surface and then cased with a 2 inch PVC pipe grouted in place. The borehole consisted of approximately 1.5 m of silty sand fill, 10.2 m of silt and sand, 9.1 m of silt, 10.7 m of clayey silt, 2.3 m of silty sand and clayey silt to bottom of the borehole. Borehole PMT-02, located in the SE quadrant of the intersection, was drilled to an approximate depth of 22 m below the existing ground surface and then cased with a 2 inch PVC pipe grouted in place. The borehole consisted of variations of silty sand, sand, and sandy silt.

Methodology

For the VSP method, seismic energy is generated at the ground surface by an active seismic source and recorded by a geophone located in a nearby borehole at a known depth. The active seismic source can be either compression or shear wave. The time required for the energy to travel from the source to the receiver (geophone) provides a measurement of the average compression or shear-wave seismic velocity of the medium between the source and the receiver. Data obtained from different geophone depths are used to calculate a detailed vertical seismic velocity profile of the subsurface in the immediate vicinity of the test borehole.

The high resolution results of a VSP survey are often used for earthquake engineering site classification, as per the 2015 National Building Code of Canada.





Example 1: Layout and resulting time traces from a VSP survey.

Fieldwork

The fieldwork was carried out on February 12, 2018, by personnel from the Golder Mississauga offices.

At PMT-01, the compression and shear-wave seismic sources were used and they were located 2 m, and 1.95 m from the borehole. The seismic source for the compression wave test consisted of a 9.9 kilogram sledge hammer vertically impacted on a metal plate. The seismic source for the shear-wave test consisted of a 1 metre long aluminium plate, hammer into the ground and horizontally struck with a 9.9 kilogram sledge hammer on alternate ends of the beam to induce polarized shear waves. Test measurements started at ground surface and were recorded in the borehole with a 3-component receiver spaced mostly at 1-metre intervals below the ground surface to a maximum depth of the casing (33.8 m).

At PMT-02, the compression and shear-wave seismic sources were used and they were located 2 m, and 2.27 m from the borehole. The seismic source for the shear-wave test consisted of a 2.4 metre long, 150 millimetre by 150 millimetre wooden beam, weighted by a vehicle and horizontally struck with a 9.9 kilogram sledge hammer on alternate ends of the beam to induce polarized shear waves. The shear source was coupled to the ground surface by parking a vehicle on top of it. Test measurements started at ground surface and were recorded in the borehole with a 3-component receiver spaced mostly at 1-metre intervals below the ground surface to a maximum depth of the casing (20.7 m).

The seismic records collected for each source location were stacked a minimum of five times to minimize the effects of ambient background seismic noise on the collected data. The data was sampled at 0.020833 millisecond intervals and a total time window of 0.341 seconds was collected for each seismic shot.

Data Processing

Processing of the VSP test results consisted of the following main steps:

- 1) Combination of seismic records to present seismic traces for all depth intervals on a single plot for each seismic source and for each component;
- 2) Low Pass Filtering of data to remove spurious high frequency noise;
- 3) First break picking of the compression and shear-wave arrivals; and,
- 4) Calculation of the average compression and shear-wave velocity to each tested depth interval.

Processing of the VSP data was completed using the SeisImager/SW software package (Geometrics Inc.). The seismic records at PMT-01 are presented on the following two plots and show the first break picks of the compression wave (Figure 1) and shear wave arrivals (Figure 2) overlaid on the seismic waveform traces recorded at the different geophone depths. The arrivals were picked on the vertical component for the compression source and on the two horizontal components for the shear source.

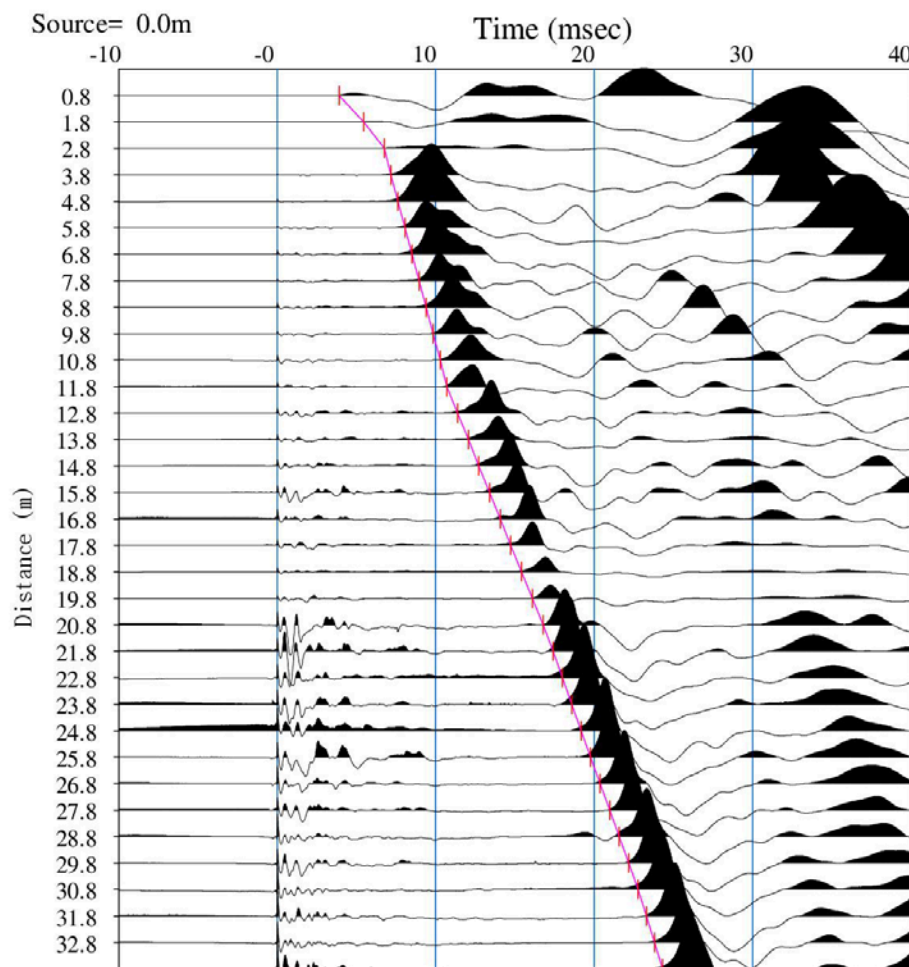


Figure 1: First break picking of compression wave arrivals (red) along the seismic traces recorded at each receiver depth of Borehole PMT-01.

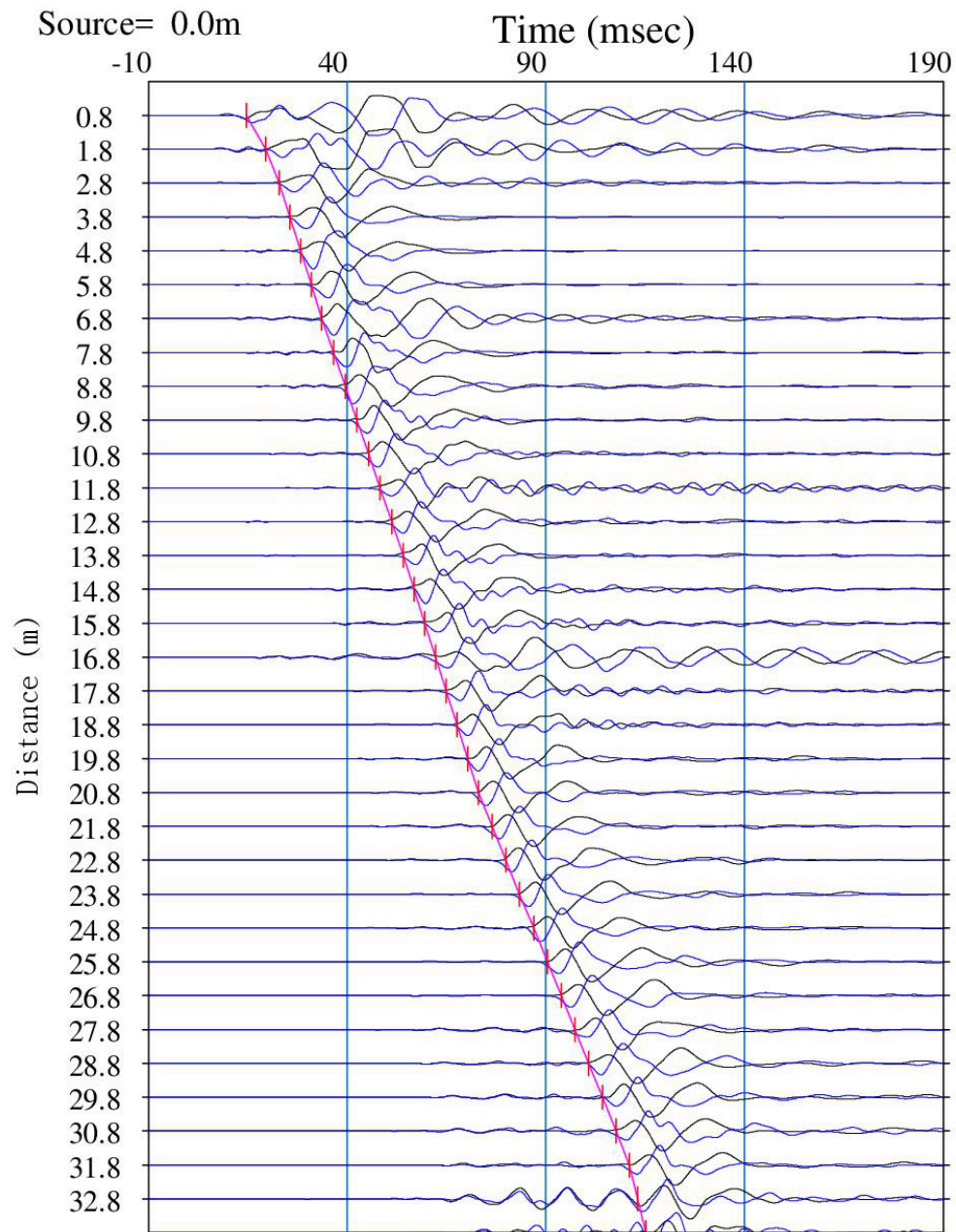


Figure 2: First break picking of shear wave arrivals (red) along the seismic traces recorded at each receiver depth of Borehole PMT-01.

The seismic records at PMT-02 are presented on the following two plots and show the first break picks of the compression wave (Figure 3) and shear wave arrivals (Figure 4) overlaid on the seismic waveform traces recorded at the different geophone depths. The arrivals were picked on the vertical component for the compression source and on the two horizontal components for the shear source.

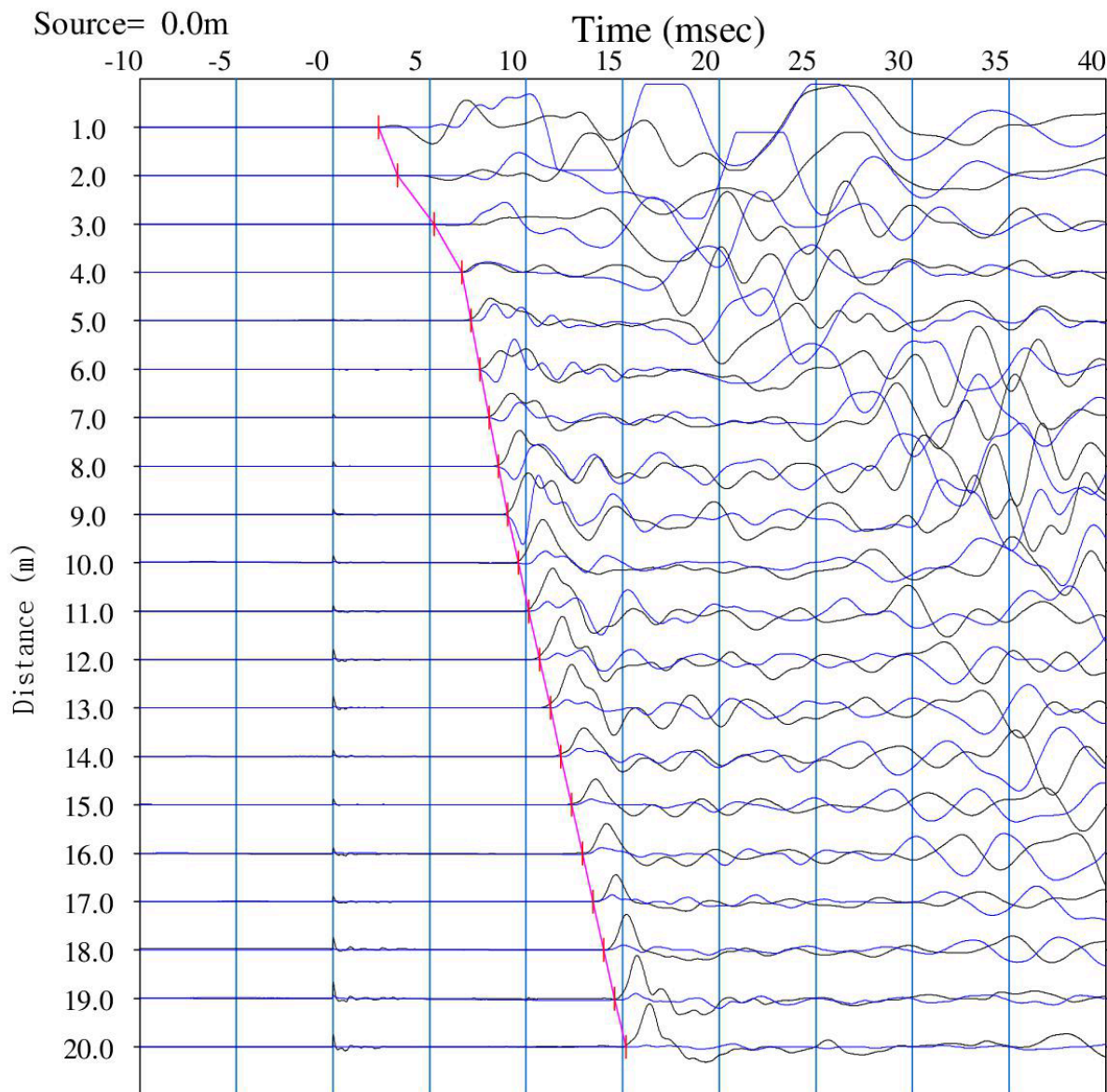


Figure 3: First break picking of compression wave arrivals (red) along the seismic traces recorded at each receiver depth of Borehole PMT-02.

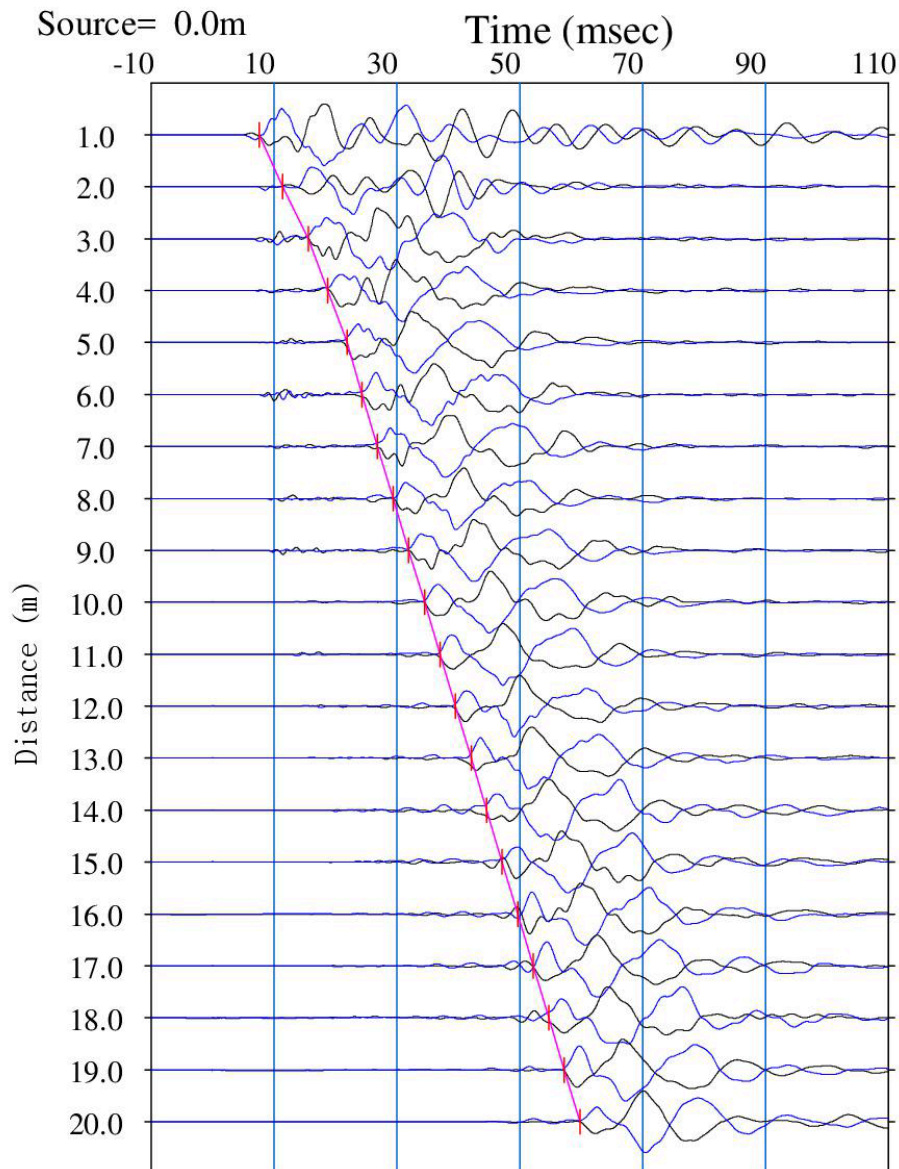


Figure 4: First break picking of shear wave arrivals (red) along the seismic traces recorded at each receiver depth of Borehole PMT-02.

Results

The VSP results at PMT-01 and PMT-02 are summarized in Tables 1, and Table 2, respectively. The shear wave and compression wave layer velocities were calculated by best fitting a theoretical travel time model to the field data. The depths presented on the table are relative to ground surface.

The estimated dynamic engineering moduli, based on the calculated wave velocities, are also presented in Tables 1 and 2. The engineering moduli were calculated using an estimated bulk density, based on the borehole log. At borehole PMT-01, an estimated bulk density of 2000 kg/m^3 was used for the sand and silt layers and an estimated

bulk density of 1,850 kg/m³ was used for the clay layers. At borehole PMT-02, an estimated bulk density of 2000 kg/m³ was used for the sand and silt layer.

At borehole PMT-01, the average shear wave velocity from ground surface to a depth of 30 metres was measured to be 286 metres per second. At borehole PMT-02, the average shear wave velocity from ground surface to a depth of 30 metres was measured to be 352 metres per second. The average velocity at PMT-02 was calculated assuming that the velocity from 20.7 metres to a depth of 30 metres was constant with an average shear-wave velocity value of 390m/s which is equal to the velocity at the bottom of the borehole.

Limitations

This technical memorandum, which specifically includes all tables, figures and attachments, is based on data and information collected by Golder Associates Ltd. and is based solely on the conditions of the properties at the time of the work, supplemented by historical information and data obtained by Golder Associates Ltd. as described in this memo.

Golder Associates Ltd. has relied in good faith on all information provided and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the reports as a result of omissions, misinterpretation, or fraudulent acts of the persons contacted or errors or omissions in the reviewed documentation.

The services performed, as described in this memo, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this memo, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this memo.

The findings and conclusions of this memo are valid only as of the date of this memo. If new information is discovered in future work, including excavations, borings, or other studies, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this memo, and to provide amendments as required.

Closure

We trust that these results meet your current needs. If you have any questions or require clarification, please contact the undersigned at your convenience.

GOLDER ASSOCIATES LTD.



Stephane Sol, Ph.D., P.Geo
Senior Geophysicist



Christopher Phillips, M.Sc., P.Geo
Principal, Senior Geophysicist

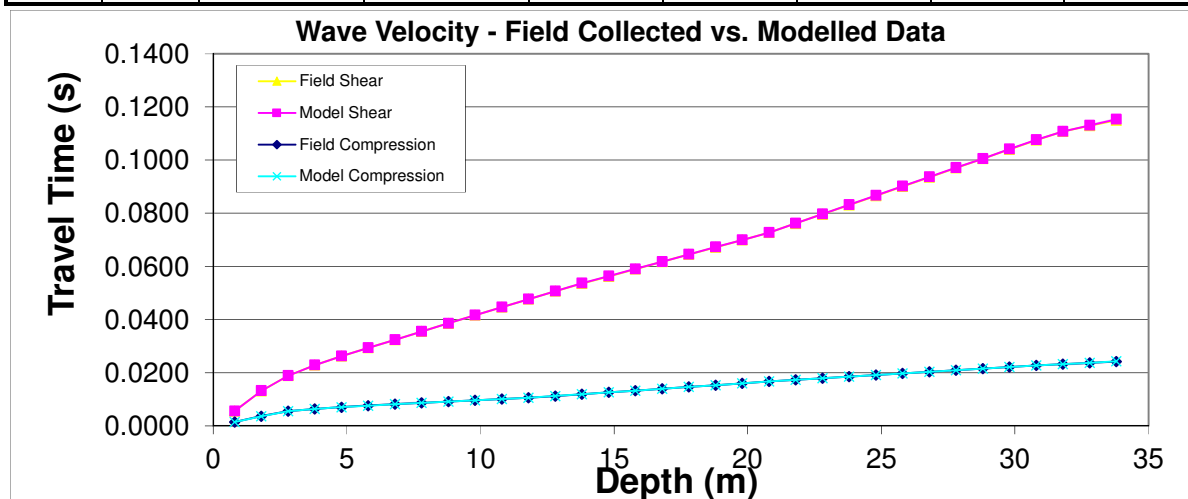
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https://golderassociates.sharepoint.com/sites/12201g/5 - technical work/field work/geophysics/report/1668512_1000_1005 tech memovsp_innisfil.docx

Attachment: Table 1 – Compression and Shear Wave Velocity Profiles at Borehole PMT-01
 Table 2 – Compression and Shear Wave Velocity Profiles at Borehole PMT-02

TABLE 1
SHEAR WAVE VELOCITY PROFILE AT BOREHOLE PMT-01

Layer Depth (m)		Velocities (m/s)		Estimated Bulk Density (kg/m ³)	Dynamic Engineering Properties			
Top	Bottom	Compressional Wave	Shear Wave		Poissons Ratio	Shear Modulus (MPa)	Deformation Modulus (MPa)	Bulk Modulus (MPa)
0.0	0.8	550	144	2000	0.46	41	121	550
0.8	1.8	460	130	2000	0.46	34	98	378
1.8	2.8	545	179	2000	0.44	64	184	509
2.8	3.8	1140	252	2000	0.47	127	374	2430
3.8	4.8	1480	293	2000	0.48	172	508	4152
4.8	5.8	1700	320	2000	0.48	205	607	5507
5.8	6.8	1840	330	2000	0.48	218	646	6481
6.8	7.8	1960	320	2000	0.49	205	609	7410
7.8	8.8	2090	325	2000	0.49	211	629	8455
8.8	9.8	2100	325	2000	0.49	211	629	8538
9.8	10.8	2100	330	2000	0.49	218	648	8530
10.8	11.8	2240	335	2000	0.49	224	668	9736
11.8	12.8	1450	335	2000	0.47	224	661	3906
12.8	13.8	1470	335	2000	0.47	224	661	4023
13.8	14.8	1470	375	2000	0.47	281	824	3947
14.8	15.8	1470	365	2000	0.47	266	782	3967
15.8	16.8	1490	365	2000	0.47	266	782	4085
16.8	17.8	1470	365	2000	0.47	266	782	3967
17.8	18.8	1470	365	2000	0.47	266	782	3967
18.8	19.8	1470	365	2000	0.47	266	782	3967
19.8	20.8	1430	370	2000	0.46	274	802	3725
20.8	21.8	1630	285	1850	0.48	150	446	4715
21.8	22.8	1660	290	1850	0.48	156	462	4890
22.8	23.8	1660	285	1850	0.48	150	446	4898
23.8	24.8	1660	285	1850	0.48	150	446	4898
24.8	25.8	1670	290	1850	0.48	156	462	4952
25.8	26.8	1670	285	1850	0.49	150	446	4959
26.8	27.8	1660	285	1850	0.48	150	446	4898
27.8	28.8	1670	290	1850	0.48	156	462	4952
28.8	29.8	1670	285	1850	0.49	150	446	4959
29.8	30.8	1670	285	1850	0.49	150	446	4959
30.8	31.8	1850	320	1850	0.48	189	562	6079
31.8	32.8	1950	430	1850	0.47	342	1009	6579
32.8	33.8	1950	430	1850	0.47	342	1009	6579

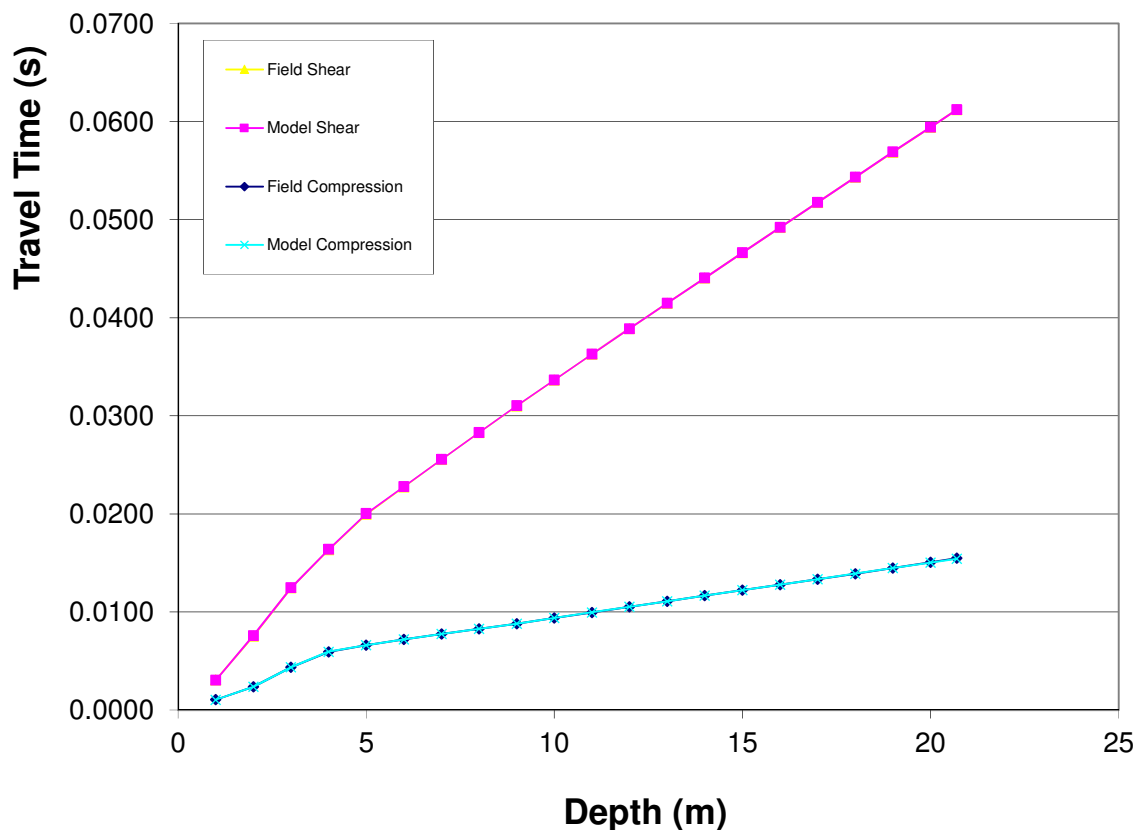
**Notes**

1. Depth Presented relative to ground surface.
2. This Table to be analyzed in conjunction with the accompanying report.

TABLE 2
SHEAR WAVE VELOCITY PROFILE AT BOREHOLE PMT-02

Layer Depth (m)		Velocities (m/s)		Estimated Bulk Density (kg/m ³)	Dynamic Engineering Properties			
Top	Bottom	Compressional Wave	Shear Wave		Poissons Ratio	Shear Modulus (MPa)	Deformation Modulus (MPa)	Bulk Modulus (MPa)
0.0	1.0	950	330	2000	0.43	218	624	1515
1.0	2.0	765	220	2000	0.45	97	282	1041
2.0	3.0	500	205	2000	0.40	84	235	388
3.0	4.0	630	255	2000	0.40	130	365	620
4.0	5.0	1500	275	2000	0.48	151	448	4298
5.0	6.0	1700	365	2000	0.48	266	786	5425
6.0	7.0	1800	360	2000	0.48	259	767	6134
7.0	8.0	1880	365	2000	0.48	266	789	6714
8.0	9.0	1970	365	2000	0.48	266	790	7407
9.0	10.0	1720	380	2000	0.47	289	852	5532
10.0	11.0	1730	380	2000	0.47	289	852	5601
11.0	12.0	1750	385	2000	0.47	296	874	5730
12.0	13.0	1760	385	2000	0.47	296	874	5800
13.0	14.0	1780	390	2000	0.47	304	897	5931
14.0	15.0	1780	385	2000	0.48	296	875	5942
15.0	16.0	1780	390	2000	0.47	304	897	5931
16.0	17.0	1780	390	2000	0.47	304	897	5931
17.0	18.0	1780	390	2000	0.47	304	897	5931
18.0	19.0	1780	390	2000	0.47	304	897	5931
19.0	20.0	1780	395	2000	0.47	312	920	5921
20.0	20.7	1780	390	2000	0.47	304	897	5931

Wave Velocity - Field Collected vs. Modelled Data



Notes

1. Depth Presented relative to ground surface.
2. This Table to be analyzed in conjunction with the accompanying report.



APPENDIX D

Borehole Records - Current Investigation



LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a)	Index Properties
$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_c	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$



LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

Condition	N Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils Consistency

	c_u, s_u kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand

PROJECT		1668512		RECORD OF BOREHOLE No 89UP-01		SHEET 1 OF 1		METRIC									
G.W.P.		2438-13-00		LOCATION		N 4895618.4; E 292361.9 MTM NAD 83 ZONE 10 (LAT. 44.200459; LONG. -79.655616)		ORIGINATED BY									
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track Mount, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY									
DATUM		Geodetic		DATE		August 15, 2017		CHECKED BY									
								SMM/TZ									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
227.8	GROUND SURFACE																
0.0	TOPSOIL (200 mm)																
0.2	Gravelly sand, trace silt, trace organics (FILL)		1	SS	18												
227.1	Compact Brown Moist		2	SS	19												
0.7	Silty sand, trace gravel (FILL)																
	Loose to compact Brown mottled with oxidation staining Moist		3	SS	9												
225.6																	
2.2	SILT and SAND, trace to some clay		4	SS	15												
	Compact Grey Wet		5	SS	16												
			6	SS	16												
			7	SS	11												
			8	SS	15												
			9	SS	14												
219.6																	
8.2	END OF BOREHOLE																
NOTE:																	
1. Water level measured in open borehole at a depth of about 2.2 m below ground surface (Elev. 225.6 m) upon completion of drilling.																	

PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-02		SHEET 1 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895597.2; E 292389.9 MTM NAD 83 ZONE 10 (LAT. 44.200269; LONG. -79.655266)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DM</u>			
DATUM <u>Geodetic</u>		DATE <u>June 11 to 15, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL
								20	40	60	80	100	W _p	W	W _L					
235.4	GROUND SURFACE																			
0.0	ASPHALT (165 mm)																			
0.2	Sand and gravel (FILL) (600 mm)																			
234.6							235													
0.8	Silt and sand, trace to some clay (FILL) Compact to dense Brown Moist						234													
			1	SS	18															
			2	SS	17		233							○			0	56	40	4
			3	SS	19		232													
			4	SS	26		231													
			5	SS	20		230													
			6	SS	45		229							○			0	51	45	4
			7	SS	33		228							○			0	63	30	7
							227													
			8	SS	23		226							○			0	58	35	7
225.2							225													
10.2	Sandy SILT to SILT and SAND, trace clay Dense Brown to grey Moist to wet - Grey below a depth of about 11.2 m		9A	SS	40		224							○						
			9B																	
			10A				223								○					
			10B	SS	41									○			0	59	39	2
							222													
			11A				221													
221.4			11B	SS	28															
14.0	SILT, some clay, trace to some sand Compact Grey Moist													H ○			0	8	78	14

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+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-02		SHEET 2 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895597.2; E 292389.9 MTM NAD 83 ZONE 10 (LAT. 44.200269; LONG. -79.655266)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DM</u>			
DATUM <u>Geodetic</u>		DATE <u>June 11 to 15, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION --- CONTINUED FROM PREVIOUS PAGE ---	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		GR	SA	SI	CL				
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	WATER CONTENT (%)												
								20	40	60	80	100									10	20	30	
220.0																								
15.4	SILT and SAND, trace clay Compact to dense Grey Moist		12A 12B	SS	23													0	42	56	2			
			13A 13B	SS	34																			
217.6																								
17.8	SILT, trace to some sand, trace clay Compact to very dense Grey Moist to wet																							
			14	SS	17																			
			15	SS	27																			
			16	SS	26																			
			17	SS	41																			
			18	SS	43																			
			19	SS	62																			
			20	SS	61																			
206.9																								
28.5	Varved SILTY CLAY, with silt and clay laminae Firm to Stiff Grey Moist																							
			21	SS	21																			

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-02		SHEET 3 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895597.2; E 292389.9 MTM NAD 83 ZONE 10 (LAT. 44.200269; LONG. -79.655266)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DM</u>			
DATUM <u>Geodetic</u>		DATE <u>June 11 to 15, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L		
								○ UNCONFINED + FIELD VANE	WATER CONTENT (%)					
								● QUICK TRIAXIAL × REMOULDED						
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100						
	Varved SILTY CLAY, with silt and clay laminae Firm to Stiff Grey Moist		22	SS	3		205							
							204		3 +					
			23	TO	PH		203							
							202		3 +					
			24	SS	WH		201							
							200							
			25	SS	WH		199							
							198		2 + 1					
197.4	CLAYEY SILT, trace sand Soft to firm Grey Wet		26	SS	WH		197							
38.0							196		1 +					
			27	SS	WH		195							
194.5	SILT, trace to some sand, trace clay Very dense Grey Moist		28	SS	81		194							
40.9							193							
							192							
			29	SS	55		191							

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT		1668512		RECORD OF BOREHOLE No 89UP-02		SHEET 4 OF 4		METRIC									
G.W.P.		2438-13-00		LOCATION		N 4895597.2; E 292389.9 MTM NAD 83 ZONE 10 (LAT. 44.200269; LONG. -79.655266)		ORIGINATED BY									
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track Mount, NW Casing and Wash Boring with Drilling Mud		COMPILED BY									
DATUM		Geodetic		DATE		June 11 to 15, 2017		CHECKED BY									
								SMM/TZ									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
189.4	SILT, trace to some sand, trace clay Very dense Grey Moist						190										
46.0	CLAYEY SILT, trace sand Hard Grey Moist						189										
			30	SS	77		188										0 2 75 23
							187										
							186										
184.6			31	SS	100/0.15		185										
50.8	END OF BOREHOLE																
	NOTE: 1. Water level measurements in the casing at the beginning of each work shift: Date Depth (m) Elev. (m) 12/06/17 11.3 224.1 13/06/17 9.3 226.1 14/06/17 5.0 230.4 15/06/17 2.0 233.4 The water level measurements are not considered to be representative of the groundwater level due to introduction of water/drilling mud during wash boring operations.																

PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-03		SHEET 1 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895628.3; E 292375.2 MTM NAD 83 ZONE 10 (LAT. 44.200549; LONG. -79.655451)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DH</u>			
DATUM <u>Geodetic</u>		DATE <u>July 17 to 21, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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227.4	GROUND SURFACE							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														

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PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-03		SHEET 2 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895628.3; E 292375.2 MTM NAD 83 ZONE 10 (LAT. 44.200549; LONG. -79.655451)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DH</u>			
DATUM <u>Geodetic</u>		DATE <u>July 17 to 21, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											WATER CONTENT (%)		
								20	40	60	80	100							W _p	W	W _L
	--- CONTINUED FROM PREVIOUS PAGE ---																				
		SILT, trace to some sand to SILT and SAND, trace to some clay Loose to very dense Grey Wet		14	SS	37															
				15	SS	80															
209.6																					
17.8		SILTY CLAY, trace sand Grey Moist																			
208.9				16A																	
18.5		SILT and SAND Dense to very dense Grey Wet		16B	SS	44															
				17	SS	59															
206.5																					
20.9		Varved CLAYEY SILT to SILTY CLAY with silt and clay laminae Stiff to very stiff Grey Moist - Sand inclusions from 20.9 m to 22.4 m		18	SS	11															
				19	SS	8															
				20	TO	PH															
				21	SS	3															
				22	TO	PH															
				23	SS	4															

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-03		SHEET 3 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895628.3; E 292375.2 MTM NAD 83 ZONE 10 (LAT. 44.200549; LONG. -79.655451)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DH</u>			
DATUM <u>Geodetic</u>		DATE <u>July 17 to 21, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE											w _p w w _L		
								● QUICK TRIAXIAL × REMOULDED													
		--- CONTINUED FROM PREVIOUS PAGE ---					20	40	60	80	100		10	20	30						
		Varved CLAYEY SILT to SILTY CLAY with silt and clay laminae Stiff to very stiff Grey Moist																			
195.5			24	SS	9																
31.9		SILT, some sand, trace clay Compact to very dense Grey Wet - Clayey silt inclusions encountered between depths of about 32.0 m and 32.6 m	25	SS	27																
			26	SS	86																
192.0																					
35.4		Sandy SILT, trace clay Very dense Grey Wet																			
			27A	SS	100																
			27B																		
189.0																					
38.4		CLAYEY SILT, some sand Very stiff Grey Moist																			
			28	SS	17																

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PROJECT		1668512		RECORD OF BOREHOLE No 89UP-03				SHEET 4 OF 4		METRIC											
G.W.P.		2438-13-00		LOCATION		N 4895628.3; E 292375.2 MTM NAD 83 ZONE 10 (LAT. 44.200549; LONG. -79.655451)				ORIGINATED BY		DF									
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track Mount, NW Casing and Wash Boring with Drilling Mud				COMPILED BY		DH									
DATUM		Geodetic		DATE		July 17 to 21, 2017				CHECKED BY		SMM/TZ									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100									
181.4	CLAYEY SILT (TILL) Grey Moist		30A	SS	101		182														
46.0	SILT and SAND, trace gravel, trace clay (TILL) Very dense Grey Wet		30B				181														
				180																	
				179																	
178.2			31	SS	100/0.10																
49.2	END OF BOREHOLE																				
NOTES: 1. Water level measurements in the casing at the beginning of each work shift: Date Depth (m) Elev. (m) 18/07/17 0.7 226.7 19/07/17 1.6 225.8 20/07/17 0.0 227.4 21/07/17 3.3 224.1 2. A borehole was advanced to a depth of about 4.0 m immediately next to borehole 89UP-03 in order to install a standpipe piezometer. 3. Water level measurements in standpipe piezometer: Date Depth (m) Elev. (m) 03/08/17 1.0 226.4 10/08/17 1.0 226.4 15/08/17 1.2 226.2 19/09/17 1.3 226.1 05/03/18 0.7 226.7 16/05/18 0.5 226.9																					

PROJECT 1668512		RECORD OF BOREHOLE No 89UP-04				SHEET 1 OF 4		METRIC						
G.W.P. 2438-13-00		LOCATION N 4895619.3; E 292430.3 MTM NAD 83 ZONE 10 (LAT. 44.200469; LONG. -79.654761)				ORIGINATED BY DF								
DIST Central HWY 400		BOREHOLE TYPE D50 Track Mount, NW Casing and Wash Boring with Drilling Mud				COMPILED BY DH								
DATUM Geodetic		DATE July 4, 5, 24 and 25, 2017				CHECKED BY SMM/TZ								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
229.3	GROUND SURFACE													
0.0	ASPHALT (250 mm)													
228.8	Sand and gravel (FILL) (280 mm)													
0.5	Silt and sand, trace clay, trace organics (FILL) Compact Brown to grey Moist													
			1	SS	15									0 67 31 2
			2	SS	12									
226.3	SILT and SAND, trace clay Compact to dense Grey Moist to wet													
3.0			3	SS	16									
			4	SS	38									
			5	SS	22									
			6	SS	26									0 53 42 5
			7	SS	19									
			8	SS	19									
			9	SS	15									
217.6	SILT, trace to some sand, trace to some clay Compact Grey Wet													
11.7			10	SS	18									
			11	SS	20									0 8 84 8

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PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-04		SHEET 3 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895619.3; E 292430.3 MTM NAD 83 ZONE 10 (LAT. 44.200469; LONG. -79.654761)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DH</u>			
DATUM <u>Geodetic</u>		DATE <u>July 4, 5, 24 and 25, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	W _p	W	W _L		
	--- CONTINUED FROM PREVIOUS PAGE ---																
	Varved SILTY CLAY, with silt and clay laminae Very stiff to hard Grey Moist						199										
							198										
			19	SS	10		197									43	
							196										
195.5 33.8	SILT, trace sand, trace clay Dense to very dense Grey Wet						195										
			20	SS	33		194										
							193										
							192										
			21	SS	94		191									0 5 93 2	
							190										
190.0 39.3	Sandy CLAYEY SILT, some sand Very stiff Grey Moist						189										
			22	SS	18		188									1 20 59 20	
							187										
186.3 43.0	SILT, trace to some clay, trace sand Very dense Grey Moist						186										
			23	SS	106		185										

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PROJECT		1668512		RECORD OF BOREHOLE No 89UP-04				SHEET 4 OF 4		METRIC																							
G.W.P.		2438-13-00		LOCATION		N 4895619.3; E 292430.3 MTM NAD 83 ZONE 10 (LAT. 44.200469; LONG. -79.654761)				ORIGINATED BY		DF																					
DIST		Central		HWY		400		BOREHOLE TYPE		D50 Track Mount, NW Casing and Wash Boring with Drilling Mud				COMPILED BY		DH																	
DATUM		Geodetic		DATE		July 4, 5, 24 and 25, 2017				CHECKED BY		SMM/TZ																					
SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)															
ELEV DEPTH	DESCRIPTION		STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		GR	SA	SI	CL												
	--- CONTINUED FROM PREVIOUS PAGE ---								20	40	60	80	100																				
183.3	SILT, trace to some clay, trace sand Very dense Grey Moist							184																									
46.0	Silty SAND, trace to some gravel, trace clay (TILL) Very dense Grey Moist							183																									
				24	SS	100/0.08		182																									
								181																									
180.3	CLAYEY SILT with SAND, trace gravel (TILL) Hard Grey Moist							180																									
49.0								179																									
178.8				25	SS	100/0.09																											
50.5	END OF BOREHOLE																																
NOTE: 1. Water level measurements in the casing at the beginning of each work shift: <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev. (m)</th> </tr> </thead> <tbody> <tr> <td>05/07/17</td> <td>0.8</td> <td>228.5</td> </tr> <tr> <td>24/07/17</td> <td>3.8</td> <td>225.5</td> </tr> <tr> <td>25/07/17</td> <td>8.2</td> <td>221.1</td> </tr> </tbody> </table> The water level measurements are not considered to be representative of the groundwater level due to introduction of water/drilling mud during wash boring operations.																						Date	Depth (m)	Elev. (m)	05/07/17	0.8	228.5	24/07/17	3.8	225.5	25/07/17	8.2	221.1
Date	Depth (m)	Elev. (m)																															
05/07/17	0.8	228.5																															
24/07/17	3.8	225.5																															
25/07/17	8.2	221.1																															

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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-05		SHEET 2 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895649.6; E 292418.6 MTM NAD 83 ZONE 10 (LAT. 44.200750; LONG. -79.654912)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DM</u>			
DATUM <u>Geodetic</u>		DATE <u>June 26 to 29 and July 3, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	○ UNCONFINED	+ FIELD VANE			○ UNCONFINED	+ FIELD VANE	
--- CONTINUED FROM PREVIOUS PAGE ---																	
	SILT to Sandy SILT, trace clay with clayey silt pockets Compact to very dense Grey Wet		12	SS	27		214									0 10 87 3	
							213										
							212										
							211										
							210										
							209										
							208										
							207										
							206										
							205										
206.8	Varved CLAYEY SILT, with silt and clay laminae Stiff to very stiff Grey Wet		17	SS	10		206								0 0 62 38		
					205												
					204												
204.1	Varved SILTY CLAY, with silt and clay laminae Stiff to very stiff Grey Wet		18	SS	5		203										
25.1							202										
							201										
							200										

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PROJECT 1668512		RECORD OF BOREHOLE No 89UP-05				SHEET 4 OF 4		METRIC											
G.W.P. 2438-13-00		LOCATION N 4895649.6; E 292418.6 MTM NAD 83 ZONE 10 (LAT. 44.200750; LONG. -79.654912)				ORIGINATED BY DF													
DIST Central HWY 400		BOREHOLE TYPE D50 Track Mount, NW Casing and Wash Boring with Drilling Mud				COMPILED BY DM													
DATUM Geodetic		DATE June 26 to 29 and July 3, 2017				CHECKED BY SMM/TZ													
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)						
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L 10 20 30							
178.8	Sandy CLAYEY SILT, some gravel (TILL) Hard Grey Wet					184													
	- Inferred cobbles/boulders encountered between depths of about 46.3 m and 46.9 m					183													
			25	SS	43	182													
						181													
						180													
179	END OF BOREHOLE		26	SS	100/70 10														
50.4	NOTE: 1. Water level measurements in the casing at the beginning of each work shift: Date Depth (m) Elev. (m) 27/06/17 1.1 228.1 28/06/17 4.3 224.9 29/06/17 1.1 228.1 03/07/17 9.0 220.2 The water level measurements are not considered to be representative of the groundwater level due to introduction of water/drilling mud during wash boring operations.																		

PROJECT 1668512		RECORD OF BOREHOLE No 89UP-06				SHEET 1 OF 4		METRIC						
G.W.P. 2438-13-00		LOCATION N 4895621.9; E 292469.4 MTM NAD 83 ZONE 10 (LAT. 44.200493; LONG. -79.654271)				ORIGINATED BY DF								
DIST Central HWY 400		BOREHOLE TYPE D50 Track Mount, NW Casing and Wash Boring with Drilling Mud				COMPILED BY DM								
DATUM Geodetic		DATE June 18 to 21, 2017				CHECKED BY SMM/TZ								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
235.4	GROUND SURFACE													
0.0	ASPHALT (200 mm)													
0.2	Sand and gravel (FILL) (430 mm)													
234.8							235							
0.6	Silt and sand, trace to some clay (FILL) Compact to very dense Brown Moist						234							
			1	SS	14									
			2	SS	34		233							
			3	SS	33		232							0 52 45 3
			4	SS	31		231							
			5	SS	47		230							
	- Oxidation staining encountered below a depth of about 4.9 m		6	SS	36		229							
			7	SS	56									
			8	SS	30		228							0 47 43 10
	- Clayey silt pockets encountered below a depth of about 7.2 m		9	SS	20		227							
			10	SS	26									
226.3							226							
9.1	SILT and SAND, trace clay Compact to dense Grey Wet		11	SS	38		225							
			12	SS	28		224							0 57 41 2
							223							
	- Grey below a depth of about 12.2 m		13	SS	26		222							
							221							
			14	SS	25									

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PROJECT 1668512		RECORD OF BOREHOLE No 89UP-06				SHEET 2 OF 4		METRIC								
G.W.P. 2438-13-00		LOCATION N 4895621.9; E 292469.4 MTM NAD 83 ZONE 10 (LAT. 44.200493; LONG. -79.654271)				ORIGINATED BY DF										
DIST Central HWY 400		BOREHOLE TYPE D50 Track Mount, NW Casing and Wash Boring with Drilling Mud				COMPILED BY DM										
DATUM Geodetic		DATE June 18 to 21, 2017				CHECKED BY SMM/TZ										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---															
217.9	SILT and SAND, trace clay Compact to dense Grey Wet		15	SS	23		220									0 40 58 2
							219									
17.5	Sandy SILT, trace to some clay Compact to dense Grey Wet		16	SS	39		218									
							217									0 29 59 12
							216									
			18	SS	24		215									
							214									0 23 70 7
							213									
							212									
			20	SS	37		211									
							210									
							209									
							208									
			21	SS	43		207									
							206									
206.1 29.3																

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PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-06		SHEET 3 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895621.9; E 292469.4 MTM NAD 83 ZONE 10 (LAT. 44.200493; LONG. -79.654271)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DM</u>			
DATUM <u>Geodetic</u>		DATE <u>June 18 to 21, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	○ UNCONFINED + FIELD VANE	○ UNCONFINED + FIELD VANE	○ UNCONFINED + FIELD VANE			○ UNCONFINED + FIELD VANE		
--- CONTINUED FROM PREVIOUS PAGE ---																	
	Varved CLAYEY SILT to SILTY CLAY with silt and clay laminae Stiff Grey Wet		22	SS	2		205								0 0 54 46		
							204										
							203										
				23	SS	5		202									
							201										
						200											
						199											
			24	TO	PH		198										
							197										
							196										
195.5 39.9	Sandy CLAYEY SILT, trace to some gravel Firm Grey Wet		25A 25B	SS	6		195							6 29 51 14			
193.9 41.5	SILT, trace sand Very dense Grey Wet						194										
								193									
				26	SS	65		192									
190.9 44.5							191										

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+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

PROJECT		1668512		RECORD OF BOREHOLE No 89UP-07		SHEET 1 OF 4		METRIC						
G.W.P.		2438-13-00		LOCATION		N 4895660.9; E 292451.0 MTM NAD 83 ZONE 10 (LAT. 44.200843; LONG. -79.654503)		ORIGINATED BY DM						
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track Mount, NW Casing and Wash Boring with Drilling Mud		COMPILED BY DH						
DATUM		Geodetic		DATE		July 28 and 31 and August 1 and 2, 2017		CHECKED BY SMM/TZ						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
227.2	GROUND SURFACE													
0.0	TOPSOIL (460 mm)													
226.7	Loose		1	SS	6									
0.7	Silty sand, trace organics (FILL)													
226.0	Loose Brown Moist		2A	SS	8									
1.5	Silty SAND		2B											
	Loose Grey to brown Wet		3	SS	12									
	CLAYEY SILT, some sand Grey Wet		4	SS	17									
	SILT and SAND, trace clay Loose to compact Grey Wet		5	SS	10									
			6	SS	18									
			7	SS	9									
			8	SS	17									
			9	SS	15									
218.5	Varved SILTY CLAY, trace sand, with silt and clay laminae Stiff to very stiff Grey Moist		10	SS	8									
8.7														
			11A	SS	23									
216.2	SILT, some sand, trace to some clay Compact to dense Grey Wet		11B											
11.0														
			12	SS	11									
			13	SS	23									

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-07		SHEET 2 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895660.9; E 292451.0 MTM NAD 83 ZONE 10 (LAT. 44.200843; LONG. -79.654503)</u>		ORIGINATED BY <u>DM</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DH</u>			
DATUM <u>Geodetic</u>		DATE <u>July 28 and 31 and August 1 and 2, 2017</u>		CHECKED BY <u>SMM/TZ</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	w _p		
	--- CONTINUED FROM PREVIOUS PAGE ---													
	SILT, some sand, trace to some clay Compact to dense Grey Wet		14	SS	26									
			15	SS	43							○		
			16	SS	46							○		
			17	SS	36							○		
			18A									○		
			18B	SS	24							○		
205.2														
22.0	Varved SILTY CLAY, with silt and clay laminae Soft to stiff Grey Moist													
			19	SS	7							┌───○───┐		
			20	SS	9								○	
			21	TO	PH									
			22	SS	5							┌───○───┐	48	
			23	TO	PH									

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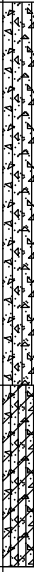

PROJECT <u>1668512</u>		RECORD OF BOREHOLE No 89UP-07		SHEET 3 OF 4		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895660.9; E 292451.0 MTM NAD 83 ZONE 10 (LAT. 44.200843; LONG. -79.654503)</u>		ORIGINATED BY <u>DM</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track Mount, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DH</u>			
DATUM <u>Geodetic</u>		DATE <u>July 28 and 31 and August 1 and 2, 2017</u>		CHECKED BY <u>SMM/TZ</u>			


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED						
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100		20 40 60 80 100	w _p	w	w _L		
	Varved SILTY CLAY, with silt and clay laminae Soft to stiff Grey Moist		24	SS	7							○		
195.6														
31.6	SILT and SAND, some gravel, trace clay Very dense Grey Wet		25	SS	51					○				20 38 39 3
			26	SS	69									
190.3														
36.9	Sandy CLAYEY SILT, trace gravel Very stiff Grey Moist													
			27	SS	17					┌─┐				4 22 56 18
			28	SS	25					○				
184.2														
43.0	SILT and SAND, trace clay (TILL) Very dense Grey Wet													
			29	SS	100/0.1					○				0 40 58 2

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT		1668512		RECORD OF BOREHOLE No 89UP-07				SHEET 4 OF 4		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895660.9; E 292451.0 MTM NAD 83 ZONE 10 (LAT. 44.200843; LONG. -79.654503)				ORIGINATED BY DM							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track Mount, NW Casing and Wash Boring with Drilling Mud				COMPILED BY DH							
DATUM		Geodetic		DATE		July 28 and 31 and August 1 and 2, 2017				CHECKED BY SMM/TZ							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
--- CONTINUED FROM PREVIOUS PAGE ---								20	40	60	80	100	W _p	W	W _L		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
								20	40	60	80	100	10	20	30		
178.4	SILT and SAND, trace clay (TILL) Very dense Grey Wet						182										
							181										
							180										
							179										
48.8	CLAYEY SILT with SAND, trace gravel (TILL) Hard Grey Moist						178										
176.6							177										
50.6	END OF BOREHOLE		31	SS	100/0.10												1 31 44 24
NOTE: 1. Water level measurements in the casing at the begining of each work shift: Date Depth (m) Elev. (m) 31/07/17 6.2 221.0 01/08/17 5.9 221.3 02/08/17 7.9 219.3 2. Water level measurements in standpipe piezometer: Date Depth (m) Elev. (m) 10/08/17 0.7 226.5 15/08/17 0.7 226.5 19/08/17 0.9 226.3 05/03/18 1.0 226.2																	

PROJECT		1668512		RECORD OF BOREHOLE No 89UP-08		SHEET 1 OF 1		METRIC						
G.W.P.		2438-13-00		LOCATION		N 4895655.5; E 292478.1 MTM NAD 83 ZONE 10 (LAT. 44.200795; LONG. -79.654165)		ORIGINATED BY						
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track Mount, NW Casing and Wash Boring with Drilling Mud		COMPILED BY						
DATUM		Geodetic		DATE		August 9, 2017		CHECKED BY						
								SMM/TZ						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
227.6	GROUND SURFACE													
0.0	TOPSOIL (250 mm)													
0.3	Silt and sand to silty sand to sand and silt, trace clay (FILL) Loose to compact Brown mottled with oxidation staining Moist		1	SS	6		227							
			2A				226							
			2B	SS	14		225							
			3	SS	15		224							
			4	SS	19		223							
224.6							222							
3.0	SILT and SAND Compact Brown Wet		5	SS	15		221							
			6	SS	13		220							
			7A	SS	15		219							
			7B				218							
222.6							217							
5.0	SILTY CLAY Stiff Grey Moist													
222.0														
5.6	SILT and SAND, trace to some clay Compact Grey Wet		8	SS	12									
			9	SS	15									
			10	SS	19									
			11	SS	19									
216.3														
11.3	END OF BOREHOLE													
	NOTE: 1. Water level measured in open borehole at a depth of about 1.1 m (Elev. 226.5 m) below ground surface upon completion of drilling.													

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PROJECT 1668512		RECORD OF BOREHOLE No HF-01				SHEET 1 OF 1		METRIC									
G.W.P. 2438-13-00		LOCATION N 4895603.0; E 292316.5 MTM NAD 83 ZONE 10 (LAT. 44.200320; LONG. -79.656185)				ORIGINATED BY DF											
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers				COMPILED BY DH											
DATUM Geodetic		DATE July 11, 2017				CHECKED BY SMM											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
227.8	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL (300 mm)		1	SS	7												
0.3	Silt and sand, trace clay, trace rootlets (FILL) Loose to compact Brown Moist		2	SS	12												
			3	SS	12												
225.6																	
2.2	SILT and SAND, trace clay Compact Grey Moist to wet		4	SS	15												
			5	SS	16												
			6	SS	17												
			7	SS	19												
222.6																	
5.2	END OF BOREHOLE																
	NOTE: 1. Water level measured in open borehole at a depth of about 4.0 m below ground surface (Elev. 228.8 m) upon completion of drilling.																


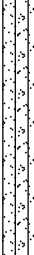
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PROJECT 1668512		RECORD OF BOREHOLE No HF-02		SHEET 2 OF 3		METRIC							
G.W.P. 2438-13-00		LOCATION N 4895665.0; E 292504.8 MTM NAD 83 ZONE 10 (LAT. 44.200881; LONG. -79.653830)		ORIGINATED BY DF									
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud		COMPILED BY DH									
DATUM Geodetic		DATE August 4, 8 and 9, 2017		CHECKED BY SMM/TZ									
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		W _p			W
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	20 40 60 80 100 WATER CONTENT (%)		10 20 30			
206.6	SILT, trace to some sand to SILT and SAND, trace clay Loose to very dense Grey Wet		14	SS	27	212							
						211							
			15	SS	37	210							0 8 88 4
						209							
			16	SS	34	208							
						207							
			17	SS	53	206							
20.9	Varved CLAYEY SILT to CLAY, with silt and clay laminae Stiff to very stiff Grey Moist		18	SS	21	205							
						204							
			19	SS	6	203							
						202							
			20	TO	PH	201							
						200							
			21	TO	PH	199							
						198							
			22	SS	4								
			23	SS	8								

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT		1668512		RECORD OF BOREHOLE No HF-02				SHEET 3 OF 3		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895665.0; E 292504.8 MTM NAD 83 ZONE 10 (LAT. 44.200881; LONG. -79.653830)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud		COMPILED BY		DH							
DATUM		Geodetic		DATE		August 4, 8 and 9, 2017		CHECKED BY		SMM/TZ							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
--- CONTINUED FROM PREVIOUS PAGE ---																	
194.4	Varved CLAYEY SILT to CLAY, with silt and clay laminae Stiff to very stiff Grey Moist		24	SS	11												
33.1	Silty SAND, trace clay Very dense Grey Wet		26A	SS	67												
			26B														
191.8			27	SS	73												
35.7	END OF BOREHOLE																
NOTE: 1. Water level measurements in the casing at the beginning of each work shift: Date Depth (m) Elev. (m) 08/08/17 1.3 226.2 09/08/17 2.7 224.8 The water level measurements are not considered to be representative of the groundwater level due to introduction of water/drilling mud during wash boring operations.																	

PROJECT 1668512		RECORD OF BOREHOLE No HF-03				SHEET 1 OF 1		METRIC										
G.W.P. 2438-13-00		LOCATION N 4895693.1; E 292575.5 MTM NAD 83 ZONE 10 (LAT. 44.201135; LONG. -79.652946)				ORIGINATED BY DF												
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud				COMPILED BY DH												
DATUM Geodetic		DATE August 9, 2017				CHECKED BY SMM												
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
227.5	GROUND SURFACE																	
0.0	TOPSOIL (300 mm)																	
227.2			1	SS	7	▽												
226.8	Silty sand, trace rootlets (FILL) Loose Brown, mottled Moist		2A	SS	12													
226.3	Clayey silt, trace sand (FILL) Stiff Brown, mottled Moist		2B															
225.2	SILT, some sand, trace clay Compact Brown, varved Moist to wet		3A	SS	20													0 19 76 5
225.2			3B															
225.2			4A	SS	17													
225.2			4B															
223.8	SILT and SAND, trace clay Compact Brown Wet		5	SS	14													0 49 49 2
223.8			6	SS	16													
223.8			7	SS	8													0 25 74 1
223.8			8A	SS	14													
223.8			8B															
223.8			9	SS	18													
219.3	END OF BOREHOLE																	
8.2	NOTE: 1. Water level measured in open borehole at a depth of 1.5 m below ground surface (Elev. 226.0 m) upon completion of drilling.																	

PROJECT		1668512		RECORD OF BOREHOLE		No HF-04		SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895694.3; E 292648.2 MTM NAD 83 ZONE 10 (LAT. 44.201156; LONG. -79.652040)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud		COMPILED BY		EG							
DATUM		Geodetic		DATE		February 2, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
227.8	GROUND SURFACE																
0.0	TOPSOIL (200 mm)		1A	SS	4												
0.2	Sand, some to trace silt (FILL)		1B														
227.1	Very loose																
0.7	Light brown																
	Moist																
	Sandy silt, some clay (FILL)		2	SS	8												
226.4	Loose																
1.5	Brown/grey, mottled																
	Moist																
	SILT and SAND, trace clay		3	SS	15												
	Compact																
	Light brown, stratified		4	SS	16												
	Wet																
	- Silt inclusions at a depth of about 4.1 m		5	SS	12												
			6	SS	17												
			7	SS	18												
			8	SS	17												
221.1	END OF BOREHOLE																
6.7	NOTES:																
	1. Water level measured in open borehole at a depth of about 1.2 m below ground surface (Elev. 226.6 m) upon completion of drilling.																
	2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																

PROJECT		1668512		RECORD OF BOREHOLE		No HF-05		SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895517.7; E 292255.6 MTM NAD 83 ZONE 10 (LAT. 44.199551; LONG. -79.656945)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		DH							
DATUM		Geodetic		DATE		July 17, 2017		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
227.0	GROUND SURFACE																
0.0	TOPSOIL (610 mm)		1	SS	1												
226.4																	
0.6	Silty SAND, trace clay Compact Brown to grey Wet		2	SS	16												
			3	SS	18												
	- Grey below a depth of about 2.3 m (Elev. 224.7 m)		4	SS	16												
			5	SS	14												
223.3																	
3.7	SILT, some sand, trace clay Compact Grey Wet		6	SS	18												
222.5																	
4.5	Silty SAND Compact Grey Wet		7	SS	14												
221.8																	
5.2	END OF BOREHOLE																
NOTE:																	
1. Water level measured in open borehole at a depth of about 1.4 m below ground surface (Elev. 225.6 m) upon completion of drilling.																	

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PROJECT		1668512		RECORD OF BOREHOLE No HF-06				SHEET 1 OF 1		METRIC										
G.W.P.		2438-13-00		LOCATION		N 4895503.9; E 292288.0 MTM NAD 83 ZONE 10 (LAT. 44.199427; LONG. -79.656539)		ORIGINATED BY		DF										
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		DH										
DATUM		Geodetic		DATE		July 14, 2017		CHECKED BY		SMM										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
227.2	GROUND SURFACE																			
0.0	TOPSOIL (250 mm)																			
0.3	Silt and sand, trace to some clay (FILL) Very loose to loose Brown Moist to wet		1	SS	2	▽	227													
			2	SS	9		226													
225.5			3A																	
1.7	SILT and SAND, trace clay Loose to compact Grey Wet		3B	SS	16		225													
			4	SS	17															
			5	SS	9		224													
			6	SS	13		223													
222.7																				
4.5	SILT, some sand, trace clay Compact Grey Wet		7	SS	14		222													
			8	SS	13	221														
220.0																				
7.2	Silty SAND with clayey silt laminae Compact Grey Wet						220													
			9	SS	11															
219.0																				
8.2	END OF BOREHOLE						219													
NOTE:																				
1. Water level measured in open borehole at a depth of about 1.2 m below ground surface (Elev. 226.0 m) upon completion of drilling.																				




PROJECT 1668512		RECORD OF BOREHOLE No HF-07		SHEET 1 OF 3	METRIC
G.W.P. 2438-13-00		LOCATION N 4895478.1; E 292331.7 MTM NAD 83 ZONE 10 (LAT. 44.199196; LONG. -79.655992)		ORIGINATED BY DF	
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud		COMPILED BY DH	
DATUM Geodetic		DATE August 11, 14 and 15, 2017		CHECKED BY SMM	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>						<div><div></div><div></div></div>
227.3	GROUND SURFACE					▽															
0.0	TOPSOIL (280 mm)																				
227.0	Silty sand (FILL) Loose to compact Brown, mottled Moist		1	SS	7		227														
0.3			2	SS	10		226														
225.9	Sandy SILT to SILT and SAND, trace clay Loose to compact Grey Wet		3	SS	16		225												0 47 51 2		
1.5			4	SS	8		224														
			5	SS	16		223														
			6	SS	21		222														
			7	SS	12		221													0 21 75 4	
			8	SS	17		220														
			9	SS	15		219													0 31 67 2	
			10A 10B	SS	16		218														
			11	SS	19		217														
						216															
215.6	SILT, trace sand to sandy, trace to some clay Compact to dense Grey Wet		12	SS	14	215												0 7 82 11			
11.7						214															
			13	SS	22	213															

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

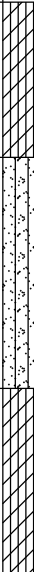

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PROJECT 1668512		RECORD OF BOREHOLE No HF-07				SHEET 2 OF 3		METRIC											
G.W.P. 2438-13-00		LOCATION N 4895478.1; E 292331.7 MTM NAD 83 ZONE 10 (LAT. 44.199196; LONG. -79.655992)				ORIGINATED BY DF													
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud				COMPILED BY DH													
DATUM Geodetic		DATE August 11, 14 and 15, 2017				CHECKED BY SMM													
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									20 40 60 80 100 20 40 60 80 100		10 20 30
--- CONTINUED FROM PREVIOUS PAGE ---																			
206.5 20.8	SILT, trace sand to sandy, trace to some clay Compact to dense Grey Wet		14	SS	23		212										0 18 79 3		
								211											
								210											
								209											
								208											
								207											
								206											
								205											
								204											
								203											
								202											
								201											
								200											
200 18.6 (C)	Varved CLAYEY SILT to SILTY CLAY, silt and clay laminae Stiff Grey Wet		18	SS	11		206												
								205											
								204											
								203											
								202											
200 18.6 (C)	Varved CLAYEY SILT to SILTY CLAY, silt and clay laminae Stiff Grey Wet		19	TO	PH		206												
								205											
								204											
								203											
								202											
200 18.6 (C)	Varved CLAYEY SILT to SILTY CLAY, silt and clay laminae Stiff Grey Wet		20	SS	9		206												
								205											
								204											
								203											
								202											
200 18.6 (C)	Varved CLAYEY SILT to SILTY CLAY, silt and clay laminae Stiff Grey Wet		21	SS	7		206												
								205											
								204											
								203											
								202											
200 18.6 (C)	Varved CLAYEY SILT to SILTY CLAY, silt and clay laminae Stiff Grey Wet		22	TO	PH		206												
								205											
								204											
								203											
								202											
200 18.6 (C)	Varved CLAYEY SILT to SILTY CLAY, silt and clay laminae Stiff Grey Wet		23	SS	11		206												
								205											
								204											
								203											
								202											

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT		1668512		RECORD OF BOREHOLE No HF-07				SHEET 3 OF 3		METRIC															
G.W.P.		2438-13-00		LOCATION		N 4895478.1; E 292331.7 MTM NAD 83 ZONE 10 (LAT. 44.199196; LONG. -79.655992)		ORIGINATED BY		DF															
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud		COMPILED BY		DH															
DATUM		Geodetic		DATE		August 11, 14 and 15, 2017		CHECKED BY		SMM															
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)							
--- CONTINUED FROM PREVIOUS PAGE ---																									
195.8	Varved CLAYEY SILT to SILTY CLAY, silt and clay laminae Stiff Grey Wet		24	SS	11		197										0 5 72 23								
31.5	Silty SAND Dense Grey Wet		25	SS	62		196																		
							195																		
							194																		
193.5	CLAYEY SILT, trace sand, trace gravel Hard Grey Moist						193																		
191.6	END OF BOREHOLE		26	SS	35		192																		
35.7	NOTES: 1. Water level measurements in the NW casing at the beginning of each work shift: <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev. (m)</th> </tr> </thead> <tbody> <tr> <td>14/08/17</td> <td>1.6</td> <td>225.7</td> </tr> <tr> <td>15/08/17</td> <td>1.7</td> <td>225.6</td> </tr> </tbody> </table> 2. The water level measurements are not considered to be representative of the groundwater level due to introduction of water/drilling mud during washboring operations.																Date	Depth (m)	Elev. (m)	14/08/17	1.6	225.7	15/08/17	1.7	225.6
Date	Depth (m)	Elev. (m)																							
14/08/17	1.6	225.7																							
15/08/17	1.7	225.6																							

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PROJECT		1668512		RECORD OF BOREHOLE		No HF-08		SHEET 1 OF 1		METRIC								
G.W.P.		2438-13-00		LOCATION		N 4895469.0; E 292368.5 MTM NAD 83 ZONE 10 (LAT. 44.199114; LONG. -79.655531)		ORIGINATED BY		DF								
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		DH								
DATUM		Geodetic		DATE		July 14, 2017		CHECKED BY		SMM								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
227.2	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL (180 mm)																	
0.2	Silty sand (FILL) Very loose to compact Grey to brown Wet		1	SS	2	▽	227											
			2A	SS	16		226											
226.1	SILT and SAND, trace clay Loose to compact Brown to grey Wet		3	SS	16		225											
1.1			4	SS	15		224											
			5	SS	9		223											
			6	SS	16		222											
			7	SS	15		221											
			8	SS	14		220											
			9	SS	15		219											
219.0	END OF BOREHOLE																	
8.2	NOTE: 1. Water level measured in open borehole at a depth of about 0.8 m below ground surface (Elev. 226.4 m) upon completion of drilling.																	

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PROJECT 1668512		RECORD OF BOREHOLE No HF-09		SHEET 1 OF 1		METRIC	
G.W.P. 2438-13-00		LOCATION N 4895449.3; E 292404.0 MTM NAD 83 ZONE 10 (LAT. 44.198938; LONG. -79.655086)		ORIGINATED BY DF			
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY DH			
DATUM Geodetic		DATE July 13, 2017		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								20	40	60	80	100	W _p	W	W _L						
227.2	GROUND SURFACE																				
0.0	TOPSOIL (130 mm)																				
0.1	Silt and sand, with rootlets (FILL) Loose to compact Grey to brown, mottled Moist to wet		1	SS	7		227														
226.1			2A	SS	11		226														
1.1	SILT and SAND, trace clay Compact Brown to grey Wet		2B				226														
			3	SS	14		225														
			4	SS	15		225														
			5	SS	18		224														
			6	SS	12		224														
			7	SS	16		223														
222.0	END OF BOREHOLE																				
5.2	NOTE: 1. Water level measured in open borehole at a depth of about 1.1 m below ground surface (Elev. 226.1 m) upon completion of drilling.																				

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PROJECT 1668512		RECORD OF BOREHOLE No HF-10		SHEET 1 OF 1		METRIC	
G.W.P. 2438-13-00		LOCATION N 4895613.9; E 292273.6 MTM NAD 83 ZONE 10 (LAT. 44.200417; LONG. -79.656721)		ORIGINATED BY DF			
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY DH			
DATUM Geodetic		DATE July 11, 2017		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								20	40	60	80	100	W _p	W	W _L						
227.6	GROUND SURFACE																				
0.0	ASPHALT (130 mm)																				
0.1	Sand, some gravel, trace silt (FILL)		1	SS	18	▽	227											0	78	21	1
227.0	Compact Brown Moist		2	SS	14		226														
0.6	Silty sand, trace clay (FILL)		3	SS	12		225														
225.4	Compact Brown with oxidation staining						224														
224.5	Moist to wet						223														
2.2	Silty SAND		4	SS	10		222														
224.5	Compact Grey Wet						221														
3.1	SILT, some sand, trace clay		5	SS	15		220														
223.9	Compact Grey Wet																				
3.7	Silty SAND, trace clay		6	SS	15																
	Loose to compact Grey Wet		7	SS	13																
			8A																		
			8B	SS	7																
220.4																					
7.2	SILT, some clay with sand inclusions																				
	Compact Grey Moist		9	SS	14																
219.4																					
8.2	END OF BOREHOLE																				
	NOTE: 1. Water level measured in open borehole at a depth of about 1.3 m below ground surface (Elev.226.3 m) upon completion of drilling.																				

PROJECT		1668512		RECORD OF BOREHOLE		No HF-11		SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895635.6; E 292234.1 MTM NAD 83 ZONE 10 (LAT. 44.200612; LONG. -79.657216)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		DH							
DATUM		Geodetic		DATE		July 11, 2017		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
227.8	GROUND SURFACE																
0.0	ASPHALT (115 mm)		1A	SS	15												
227.3	Gravelly sand, trace to some silt (FILL)		1B														
0.5	Compact Brown Moist		2	SS	8												
	Silty sand (FILL)																
	Loose Brown to black to grey, mottled Moist		3	SS	6												
225.6	SILT and SAND, trace clay																
2.2	Loose to compact Grey Moist to wet		4	SS	18												0 34 65 1
			5	SS	10												
			6	SS	10												
			7	SS	18												0 31 67 2
			8	SS	5												
			9	SS	17												
221.1	END OF BOREHOLE																
6.7	NOTE: 1. Water level measured in open borehole at a depth of about 2.6 m below ground (Elev. 225.2 m) surface upon completion of drilling.																

PROJECT		1668512		RECORD OF BOREHOLE		No HF-12		SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895670.6; E 292213.9 MTM NAD 83 ZONE 10 (LAT. 44.200927; LONG. -79.657470)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		DH							
DATUM		Geodetic		DATE		July 13, 2017		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
226.7	GROUND SURFACE																
0.0	TOPSOIL (150 mm)																
0.2	Silty SAND, trace rootlets Loose to compact Brown Moist to wet		1	SS	5												
225.6			2A	SS	16												
1.1	SILT and SAND, trace clay Compact Brown to grey Wet		2B														
			3	SS	18												
			4	SS	13												
			5	SS	21												
223.0																	
3.7	Sandy SILT, trace to some clay Compact Grey Wet		6	SS	20												
			7	SS	21												
221.5																	
5.2	END OF BOREHOLE																
NOTES: 1. Water level measured at a depth of about 0.8 m below ground surface (Elev. 225.9 m) upon completion of drilling. 2. Groundwater level measurements in piezometer: Date Depth (m) Elev. (m) 03/08/17 2.0 224.7 10/08/17 2.0 224.7 15/08/17 2.1 224.6 19/09/17 2.4 224.3 19/09/17 1.4 225.3 05/03/18 0.3 226.4																	

PROJECT 1668512		RECORD OF BOREHOLE No HF-13		SHEET 1 OF 1		METRIC	
G.W.P. 2438-13-00		LOCATION N 4895650.6; E 292203.3 MTM NAD 83 ZONE 10 (LAT. 44.200747; LONG. -79.657603)		ORIGINATED BY DF			
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY DH			
DATUM Geodetic		DATE July 13, 2017		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								20	40	60	80	100	W _p	W	W _L			GR	SA	SI
226.8	GROUND SURFACE																			
0.0	TOPSOIL (130 mm)																			
0.1	SILT and SAND, trace to some clay Loose to compact Brown to grey Moist to wet		1	SS	7	▽											0	55	39	6
			2	SS	12								○							
			3	SS	17								○							
			4	SS	13															
			5	SS	11								○							
223.1																				
3.7	SILT, trace to some clay, trace to some sand Compact Grey Wet		6	SS	13		223						○					0	11	77
			7	SS	11	222														
221.6	END OF BOREHOLE																			
5.2	NOTE: 1. Water level measured in open borehole at a depth of about 1.2 m below ground surface (Elev. 225.6 m) upon completion of drilling.																			

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PROJECT		1668512		RECORD OF BOREHOLE		No HF-14		SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895742.6; E 292608.7 MTM NAD 83 ZONE 10 (LAT. 44.201590; LONG. -79.652536)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		EG							
DATUM		Geodetic		DATE		February 2, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
228.0	GROUND SURFACE																
0.0	TOPSOIL (180 mm)		1A	SS	16												
0.2	Sand, trace gravel, trace silt (FILL) Compact Brown Moist		1B														
			2	SS	13												
226.5																	
1.5	SILT and SAND, trace to some clay Compact Light brown to brown/grey, mottled Moist to wet		3	SS	12												
			4	SS	19												
			5	SS	17												
			6	SS	13												
223.6																	
4.4	SILT, some sand, trace to some clay Compact Brown/grey Moist to wet		7	SS	19												
222.4																	
5.6	SAND, trace silt, trace clay Compact Brown/grey, mottled Wet		8	SS	16												
221.3																	
6.7	END OF BOREHOLE																
NOTES:																	
1. Water level measured in open borehole at a depth of about 2.3 m below ground surface (Elev. 225.7 m) upon completion of drilling.																	
2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																	

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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

PROJECT 1668512		RECORD OF BOREHOLE No HF-16				SHEET 1 OF 1		METRIC									
G.W.P. 2438-13-00		LOCATION N 4895581.4; E 292260.0 MTM NAD 83 ZONE 10 (LAT. 44.200133; LONG. -79.656895)				ORIGINATED BY PFP											
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers				COMPILED BY EG											
DATUM Geodetic		DATE February 8, 2018				CHECKED BY SMM											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
227.8	GROUND SURFACE																
0.0	TOPSOIL (280 mm)																
0.3	Sand, trace to some silt, trace gravel, trace organics (FILL) Compact Brown with black staining Moist		1	SS	15	∇	227										
			2	SS	14		226										
226.3							225										
1.5	Sandy SILT, trace to some clay Loose to compact Brown to grey Moist to wet		3	SS	5		224										
			4	SS	11		223										
			5	SS	17		222										
			6	SS	11		221										
			7	SS	19		220										
			8	SS	14												
			9	SS	15												
219.6	END OF BOREHOLE																
8.2	NOTES: 1. Water level measured in open borehole at a depth of about 2.1 m below ground surface (Elev. 225.7 m) upon completion of drilling. 2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																

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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

PROJECT 1668512		RECORD OF BOREHOLE No HF-18				SHEET 1 OF 1		METRIC								
G.W.P. 2438-13-00		LOCATION N 4895703.0; E 292682.9 MTM NAD 83 ZONE 10 (LAT. 44.201235; LONG. -79.651607)				ORIGINATED BY DF										
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers				COMPILED BY EG										
DATUM Geodetic		DATE February 2, 2018				CHECKED BY SMM										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
228.1	GROUND SURFACE															
0.0	TOPSOIL (230 mm)		1A	SS	4											
0.2	Silty sand (FILL) Very loose to loose Brown, mottled Moist		1B													
			2	SS	9											
226.6																
1.5	SILT and SAND to Silty SAND, trace clay Loose to compact Brown, stratified Wet		3	SS	9											
			4	SS	22											
	- Silt inclusions between depths of about 2.3 m and 2.9 m		5	SS	17											
			6	SS	18											
			7	SS	20											
222.9																
5.2	END OF BOREHOLE															
NOTES: 1. Water level measured in open borehole at a depth of about 1.1 m below ground surface (Elev. 227.0 m) upon completion of drilling. 2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																

PROJECT		1668512		RECORD OF BOREHOLE		No HF-19		SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895582.4; E 292226.7 MTM NAD 83 ZONE 10 (LAT. 44.200142; LONG. -79.657311)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		EG							
DATUM		Geodetic		DATE		February 2, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
229.6	GROUND SURFACE																
0.0	ASPHALT (102 mm)		1A	SS	20												
0.1	Sand and gravel, trace silt (FILL) Compact Brown Moist		1B														
			2	SS	16												
228.1																	
1.5	Silty sand, some gravel, some to trace clay (FILL) Compact Grey/brown Moist		3	SS	10												
227.4																	
2.2	Sand and gravel, trace to some silt, trace clay (FILL) Compact Black to brown Moist		4	SS	14												
			5	SS	10												
225.9																	
3.7	SILT and SAND, trace to some clay Compact Grey Wet		6	SS	14												
			7	SS	15												
224.4																	
5.2	END OF BOREHOLE																
NOTES:																	
1. Water level measured in open borehole at a depth of about 3.4 m below ground surface (Elev. 226.2 m) upon completion of drilling.																	

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PROJECT		1668512		RECORD OF BOREHOLE No HF-20				SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895608.5; E 292219.5 MTM NAD 83 ZONE 10 (LAT. 44.200377; LONG. -79.657402)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		EG							
DATUM		Geodetic		DATE		February 5, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
228.4	GROUND SURFACE																
0.0	ASPHALT (152 mm)																
0.2	Sand and gravel, trace silt (FILL) Compact to dense Brown Moist		1	SS	17												
			2	SS	42												
227.0																	
1.5	Sand, trace silt (FILL) Compact Brown, mottled Moist		3	SS	20												
226.2																	
2.2	Sandy silt, some to trace clay (FILL) Loose Brown, mottled Moist		4	SS	9												
225.4																	
3.0	SILT and SAND, trace to some clay, trace gravel Compact Brown to grey Wet		5	SS	15												
			6	SS	16												
			7	SS	11												
222.8																	
5.6	SILT, some sand, some clay Compact Grey, stratified Wet		8	SS	14												
			9	SS	15												
220.2																	
8.2	END OF BOREHOLE																
NOTES:																	
1. Water level measured in open borehole at a depth of about 1.7 m below ground surface (Elev. 226.7 m) upon completion of drilling.																	
2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																	

PROJECT		1668512		RECORD OF BOREHOLE		No HF-21		SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895723.3; E 292214.5 MTM NAD 83 ZONE 10 (LAT. 44.201410; LONG. -79.657468)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		EG							
DATUM		Geodetic		DATE		February 6, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
226.6	GROUND SURFACE																
0.0	TOPSOIL (405 mm)		1A	SS	12												
226.2			1B														
0.4	Sand, some silt, trace clay (FILL) Compact Brown, mottled Moist		2	SS	15												
			3	SS	15												
224.4																	
2.2	Sandy SILT to SILT and SAND, trace to some clay Compact Grey Wet		4	SS	15												
			5	SS	17												
			6	SS	16												
			7	SS	13												
			8	SS	14												
			9	SS	22												
218.4	END OF BOREHOLE																
8.2	NOTES: 1. Water level measured in open borehole at a depth of about 1.6 m below ground surface (Elev. 225.0 m) upon completion of drilling. 2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																

PROJECT 1668512		RECORD OF BOREHOLE No HF-22		SHEET 1 OF 1		METRIC							
G.W.P. 2438-13-00		LOCATION N 4895770.4; E 292226.3 MTM NAD 83 ZONE 10 (LAT. 44.201834; LONG. -79.657321)		ORIGINATED BY DF									
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY EG									
DATUM Geodetic		DATE February 6, 2018		CHECKED BY SMM									
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	γ	GR SA SI CL	
226.8	GROUND SURFACE												
0.0	TOPSOIL (102 mm)		1A	SS	5								
226.1	Silty sand, trace clay (FILL)		1B										
0.7	Loose Brown, mottled Moist		2	SS	15								
	Sandy SILT, trace to some clay Compact Brown to grey, stratified Moist to wet		3	SS	11							0 29 64 7	
			4	SS	14								
			5	SS	15								
			6	SS	11								
			7	SS	20							0 26 67 7	
221.6	END OF BOREHOLE												
5.2	NOTES:												
	1. Water level measured in open borehole at a depth of about 1.5 m below ground surface (Elev. 225.3 m) upon completion of drilling.												
	2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.												
	3. A borehole was advanced to a depth of 2.4 m immediately next to borehole HF-22 in order to install a standpipe piezometer.												
	4. Groundwater level measurements in piezometer:												
	Date Depth (m) Elev. (m)												
	05/03/18 0.6 226.2												

PROJECT 1668512		RECORD OF BOREHOLE No HF-23		SHEET 1 OF 1		METRIC															
G.W.P. 2438-13-00		LOCATION N 4895815.5; E 292244.4 MTM NAD 83 ZONE 10 (LAT. 44.202240; LONG. -79.657096)		ORIGINATED BY DF																	
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY EG																	
DATUM Geodetic		DATE February 6, 2018		CHECKED BY SMM																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
226.9 0.0	GROUND SURFACE TOPSOIL (685 mm) Loose		1	SS	5			20 40 60 80 100	○ UNCONFINED + FIELD VANE	20 40 60 80 100	10 20 30										
226.2 0.7	Sandy silt, trace clay (FILL) Loose Brown, mottled Moist		2	SS	6		226		● QUICK TRIAXIAL × REMOULDED												
225.4 1.5	SILT and SAND, some sand, trace to some clay Compact Brown to grey, stratified Wet		3	SS	14		225														
223.9 3.0	SILT, some sand, some clay Compact Brown to grey Wet		4	SS	16		224														
			5	SS	11		223														
			6	SS	19		222														
			7	SS	16																
221.7 5.2	END OF BOREHOLE																				
NOTES: 1. Water level measured in open borehole at a depth of about 1.6 m below ground surface (Elev. 225.3 m) upon completion of drilling. 2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud. 3. A borehole was advanced to a depth of 2.3 m immediately next to borehole HF-23 in order to install a standpipe piezometer. 2. Groundwater level measurements in piezometer: Date Depth (m) Elev. (m) 05/03/18 0.7 226.2																					

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE



+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

PROJECT 1668512		RECORD OF BOREHOLE No HF-26		SHEET 1 OF 1		METRIC	
G.W.P. 2438-13-00		LOCATION N 4895578.2; E 292615.8 MTM NAD 83 ZONE 10 (LAT. 44.200110; LONG. -79.652443)		ORIGINATED BY DF			
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY EG			
DATUM Geodetic		DATE January 31, 2018		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)						
								20 40 60 80 100					w _p w w _L						
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED													
228.5	GROUND SURFACE																		
0.0	TOPSOIL (305 mm)																		
228.2			1A	SS	15														
227.8	Sand and gravel, trace silt (FILL) Compact Brown Moist		1B																
0.7			2	SS	7														
	Sand, trace silt (FILL) Loose Brown mottled with oxidation stains Moist																		
227.0			3	SS	18														
1.5																			
	SILT and SAND, trace to some clay Compact Light brown, laminated Wet - Silty sand layer with clay inclusions between depths of about 2.3 m and 2.9 m		4	SS	19														
			5	SS	23														
			6	SS	16														
			7	SS	18														
223.3	END OF BOREHOLE																		
5.2	NOTES: 1. Water level measured in open borehole at a depth of about 3.1 m below ground surface (Elev. 225.4 m) upon completion of drilling. 2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud. 3. Groundwater level measurements in piezometer: Date Depth (m) Elev. (m) 05/03/18 1.4 227.1																		

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PROJECT 1668512		RECORD OF BOREHOLE No HF-27		SHEET 1 OF 1		METRIC	
G.W.P. 2438-13-00		LOCATION N 4895621.1; E 292594.5 MTM NAD 83 ZONE 10 (LAT. 44.200496; LONG. -79.652711)		ORIGINATED BY DF			
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY EG			
DATUM Geodetic		DATE January 31, 2018		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p	W	W _L		GR	SA	SI	CL
227.6	GROUND SURFACE																			
0.0	TOPSOIL (230 mm)		1A	SS	12															
0.2	Sand and gravel, trace silt (FILL)		1B	SS																
226.9	Compact Brown/grey Moist																			
0.7	Sandy SILT, some to trace clay Loose Light brown Wet		2	SS	9															
226.1																				
1.5	SILT and SAND, trace to some clay Compact Light brown, stratified Wet			3	SS		13													
				4	SS		21													
				5	SS		13													
			6	SS	13															
	- Silt inclusions between depths of about 4.6 m and 5.2 m		7	SS	14															
222.0																				
5.6	SILT, some sand, trace to some clay Compact Light brown Wet		8	SS	14															
			9	SS	18															
219.4																				
8.2	END OF BOREHOLE																			
	NOTES: 1. Water level measured in open borehole at a depth of about 0.3 m below ground surface (Elev. 227.3 m) upon completion of drilling. 2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																			

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PROJECT 1668512		RECORD OF BOREHOLE No HF-28				SHEET 1 OF 1		METRIC									
G.W.P. 2438-13-00		LOCATION N 4895492.9; E 292593.3 MTM NAD 83 ZONE 10 (LAT. 44.199342; LONG. -79.652723)				ORIGINATED BY DF											
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers				COMPILED BY EG											
DATUM Geodetic		DATE February 8, 2018				CHECKED BY SMM											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
229.4	GROUND SURFACE																
0.0	TOPSOIL (203 mm)		1	SS	18												
0.2	Silty sand, trace to some clay (FILL) Compact to dense Brown to grey, mottled Moist		2	SS	18												2 67 26 5
			3	SS	30												
227.1	- Asphalt structure between depths of about 1.9 m and 2.1 m																
2.3	SILT and SAND, trace to some clay Compact Light brown Moist to wet		4	SS	18												
			5	SS	11												0 44 47 9
			6	SS	24												
			7	SS	16												
224.2	END OF BOREHOLE																
5.2	NOTES: 1. Water level measured in open borehole at a depth of about 2.2 m below ground surface (Elev. 227.2 m) upon completion of drilling.																

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PROJECT		1668512		RECORD OF BOREHOLE		No HF-29		SHEET 1 OF 1		METRIC							
G.W.P.		2438-13-00		LOCATION		N 4895521.9; E 292610.6 MTM NAD 83 ZONE 10 (LAT. 44.199603; LONG. -79.652507)		ORIGINATED BY		DF							
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY		EG							
DATUM		Geodetic		DATE		February 8, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
228.2	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL (305 mm)		1	SS	7												
227.9																	
0.3	Silt and sand, trace clay (FILL) Loose to compact Brown/mottled Moist		2	SS	18												
226.9																	
1.3	SILT and SAND, trace clay, inclusions of silt, inclusions of clay Compact Brown to grey, mottled Wet		3	SS	12												
			4	SS	19												
			5	SS	18												
			6	SS	20												
			7	SS	15												
			8	SS	18												
221.5																	
6.7	END OF BOREHOLE																
NOTES:																	
1. Water level measured in open borehole at a depth of about 1.2 m below ground surface (Elev. 227.0 m) upon completion of drilling.																	
2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																	

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PROJECT		1668512		RECORD OF BOREHOLE No HF-30		SHEET 1 OF 1		METRIC								
G.W.P.		2438-13-00		LOCATION		N 4895594.9; E 292627.7 MTM NAD 83 ZONE 10 (LAT. 44.200261; LONG. -79.652294)		ORIGINATED BY								
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY								
DATUM		Geodetic		DATE		January 31, 2018		CHECKED BY								
								SMM								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
228.1	GROUND SURFACE															
0.0	TOPSOIL (152 mm)		1A	SS	7											
0.2	Sand, trace silt (FILL)		1B													
227.4	Loose Brown, mottled Moist															
0.7	SILT and SAND, trace to some clay		2	SS	6											
	Loose to compact															
	Light brown		3	SS	11											
	Wet															
	- Silty sand layers between depths of about 3.1 m and 3.7 m		4	SS	18											
			5	SS	19											0 43 52 5
			6	SS	16											
			7	SS	21											0 57 38 5
222.9	END OF BOREHOLE															
5.2	NOTES:															
	1. Water level measured in open borehole at a depth of about 3.3 m below ground surface (Elev. 224.8 m) upon completion of drilling.															

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PROJECT 1668512		RECORD OF BOREHOLE No HF-31				SHEET 1 OF 1		METRIC									
G.W.P. 2438-13-00		LOCATION N 4895626.4; E 292631.5 MTM NAD 83 ZONE 10 (LAT. 44.200545; LONG. -79.652247)				ORIGINATED BY DF											
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers				COMPILED BY EG											
DATUM Geodetic		DATE February 1, 2018				CHECKED BY SMM											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
228.0	GROUND SURFACE																
0.0	TOPSOIL (152 mm)		1A	SS	9												
0.2	Silt and sand, trace clay (FILL) Loose to compact Brown, mottled Moist to wet		1B	SS													
			2	SS	12												
226.5																	
1.5	SILT and SAND, trace clay Compact Brown/grey, mottled Wet		3	SS	15												
			4	SS	19												
			5	SS	20												
			6	SS	25												
			7	SS	17												
			8	SS	17												
			9	SS	20												
219.8	END OF BOREHOLE																
8.2	NOTES: 1. Water level measured in open borehole at a depth of about 1.3 m below ground surface (Elev. 226.7 m) upon completion of drilling. 2. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.																

GTA-MTO 001 S:\CLIENTS\TOHWY_400_AND_HWY_89_INTERCHANGE\GPJ_GAL-GTA.GDT 09/12/18



+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>1668512</u>		RECORD OF BOREHOLE No PMT-01		SHEET 2 OF 3		METRIC	
G.W.P. <u>2438-13-00</u>		LOCATION <u>N 4895473.7; E 292331.2 MTM NAD 83 ZONE 10 (LAT. 44.199165; LONG. -79.656001)</u>		ORIGINATED BY <u>DF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud</u>		COMPILED BY <u>DM</u>			
DATUM <u>Geodetic</u>		DATE <u>January 23 to 25, 2018</u>		CHECKED BY <u>SMM</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED		w _p	w	w _L						
	--- CONTINUED FROM PREVIOUS PAGE ---																				
	SILT, trace sand to sandy, trace to some clay Grey Wet																				
															</						

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\TOHWY_400_AND_HWY_89_INTERCHANGE02_DATA\GINT\HWY_400_AND_HWY_89_INTERCHANGE.GPJ GAL-GTA.GDT 09/12/18

PROJECT		1668512		RECORD OF BOREHOLE		No PMT-01		SHEET 3 OF 3		METRIC								
G.W.P.		2438-13-00		LOCATION		N 4895473.7; E 292331.2 MTM NAD 83 ZONE 10 (LAT. 44.199165; LONG. -79.656001)		ORIGINATED BY		DF								
DIST		Central HWY 400		BOREHOLE TYPE		D50 Track-Mounted, NW Casing and Wash Boring with Drilling Mud		COMPILED BY		DM								
DATUM		Geodetic		DATE		January 23 to 25, 2018		CHECKED BY		SMM								
SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa												
--- CONTINUED FROM PREVIOUS PAGE ---																		
195.7	Varved CLAYEY SILT to SILTY CLAY, trace to some sand, with silt and clay laminae Grey Wet																	
31.5	Silty SAND Grey Wet																	
193.4	CLAYEY SILT, trace sand, trace gravel Grey Moist																	
33.8																		
192.6	END OF BOREHOLE																	
34.6	NOTES: 1. In-situ pressuremeter testing carried out in open borehole at selected depth intervals. 2. A 50 mm diameter PVC Casing was installed upon completion of pressuremeter testing to carry out vertical seismic profiling. 3. Water level measurements in the NW casing at the beginning of each work shift. 4. The water level measurements are not considered to be representative of the groundwater level due to introduction of water/drilling mud during washboring operations. Date Depth (m) Elev. (m) 24/01/18 1.4 225.8 25/01/18 1.2 226.0																	

GTA-MTO 001 S:\CLIENTS\TOHWY_400_AND_HWY_89_INTERCHANGE\02_DATA\GINT\HWY_400_AND_HWY_89_INTERCHANGE.GPJ GAL-GTA.GDT 09/12/18

PROJECT 1668512		RECORD OF BOREHOLE No PMT-02		SHEET 1 OF 2		METRIC	
G.W.P. 2438-13-00		LOCATION N 4895579.3; E 292616.8 MTM NAD 83 ZONE 10 (LAT. 44.200120; LONG. -79.652431)		ORIGINATED BY DF			
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers		COMPILED BY EG			
DATUM Geodetic		DATE January 29-30, 2018		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE	20	40	60	80			100	w _p	w
228.4	GROUND SURFACE						● QUICK TRIAXIAL × REMOULDED	20	40	60	80	100	10	20	30		
0.0	Silty SAND Compact Grey/brown, laminated Wet																
															</		

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+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\TOHWY_400_AND_HWY_89_INTERCHANGE\02_DATA\GINT\HWY_400_AND_HWY_89_INTERCHANGE.GPJ GAL-GTA.GDT 09/12/18

PROJECT 1668512		RECORD OF BOREHOLE No PMT-02				SHEET 2 OF 2		METRIC				
G.W.P. 2438-13-00		LOCATION N 4895579.3; E 292616.8 MTM NAD 83 ZONE 10 (LAT. 44.200120; LONG. -79.652431)				ORIGINATED BY DF						
DIST Central HWY 400		BOREHOLE TYPE D50 Track-Mounted, 203mm O.D. Continuous Flight Hollow Stem Augers				COMPILED BY EG						
DATUM Geodetic		DATE January 29-30, 2018				CHECKED BY SMM						
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L			
--- CONTINUED FROM PREVIOUS PAGE ---												
211.5	SILT, some sand, trace to some clay Compact Grey Wet		5	SS	20		213					0 14 74 12
16.9	SILT and SAND Dense Grey, laminated Wet		6	SS	43		212					
							211					
							210					
							209					
							208					
							207					
206.2	END OF BOREHOLE		7	SS	50							
22.2	NOTES: 1. In-situ pressuremeter testing carried out in open borehole at selected depth intervals. 2. A 50 mm diameter PVC Casing was installed upon completion of pressuremeter testing to carry out vertical seismic profiling. 3. Water level measured in open borehole at a depth of about 2.0 m below ground surface (Elev. 226.4 m) upon completion of drilling. 4. The water level measurement is not considered to be representative of the groundwater level due to introduction of water/drilling mud.											

GTA-MTO 001 S:\CLIENTS\TOHWY_400_AND_HWY_89_INTERCHANGE\02_DATA\GINT\HWY_400_AND_HWY_89_INTERCHANGE.GPJ GAL-GTA.GDT 09/12/18



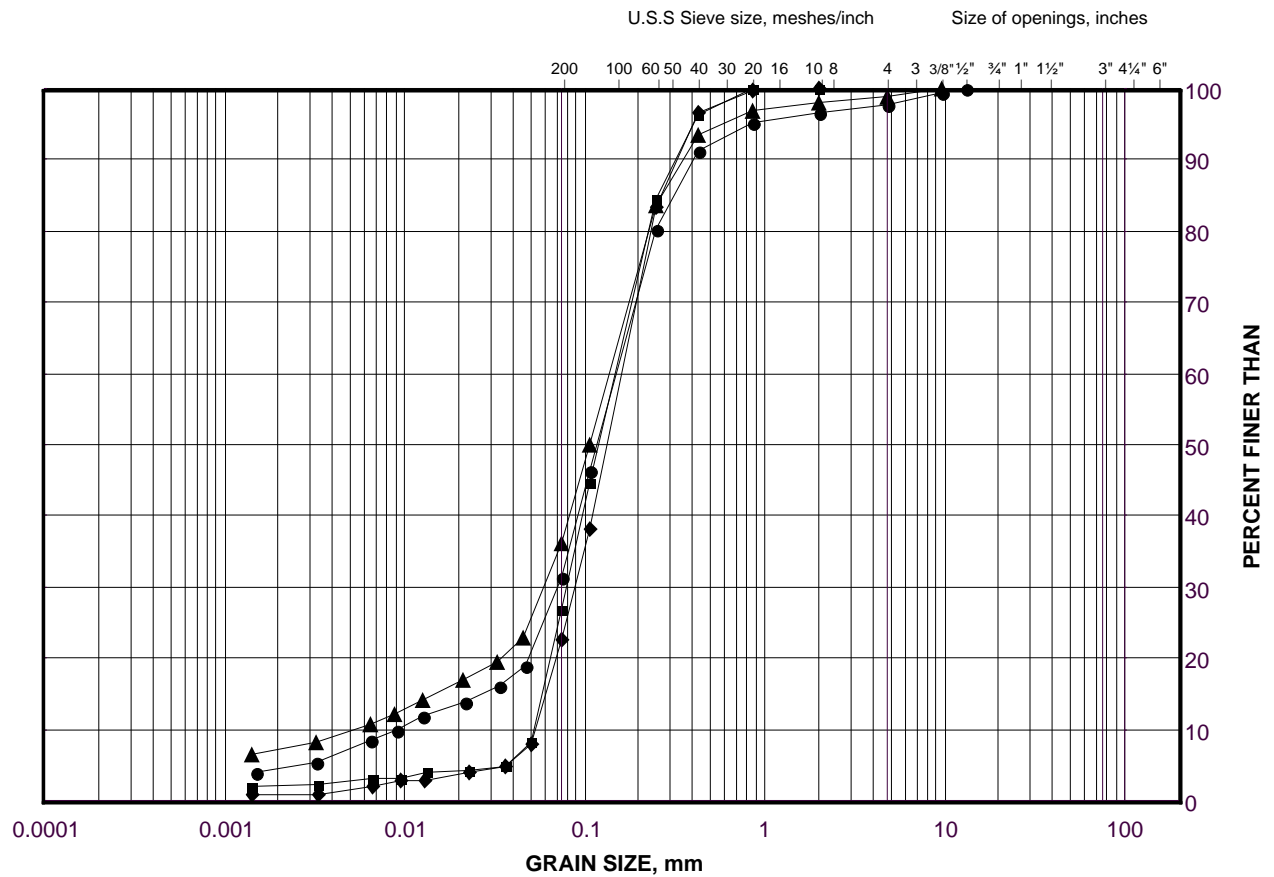
APPENDIX E

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Silty Sand (FILL)

FIGURE E-1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-28	2	228.3
■	HF-18	2	227.1
◆	HF-10	2	226.5
▲	HF-24	4	226.5

Project Number: 1668512

Checked By: SMM

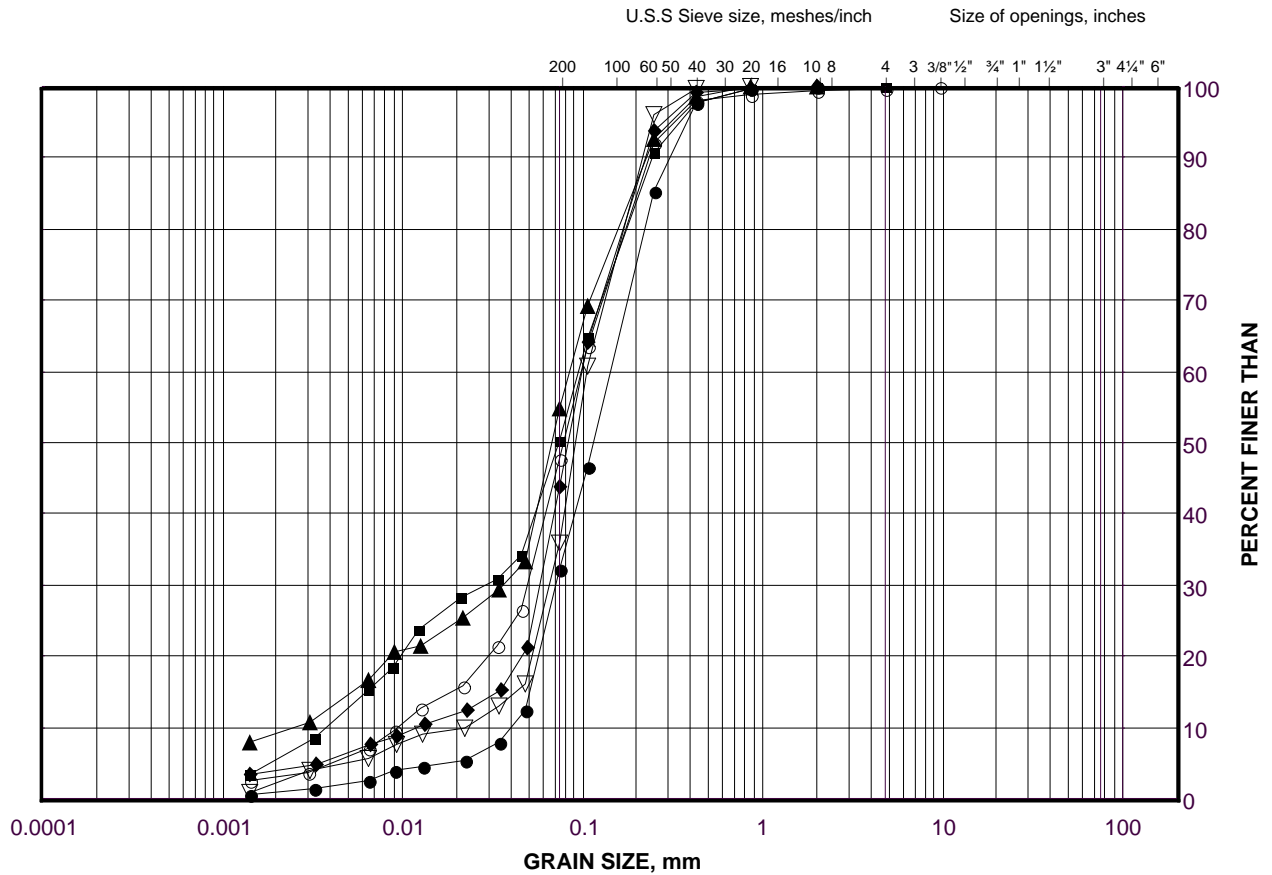
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (FILL)

FIGURE E-2A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-04	1	227.5
■	HF-06	2	226.2
◆	89UP-02	2	232.8
▲	89UP-05	2	226.6
▽	89UP-08	3	225.8
○	89UP-06	3	232.0

Project Number: 1668512

Checked By: SMM

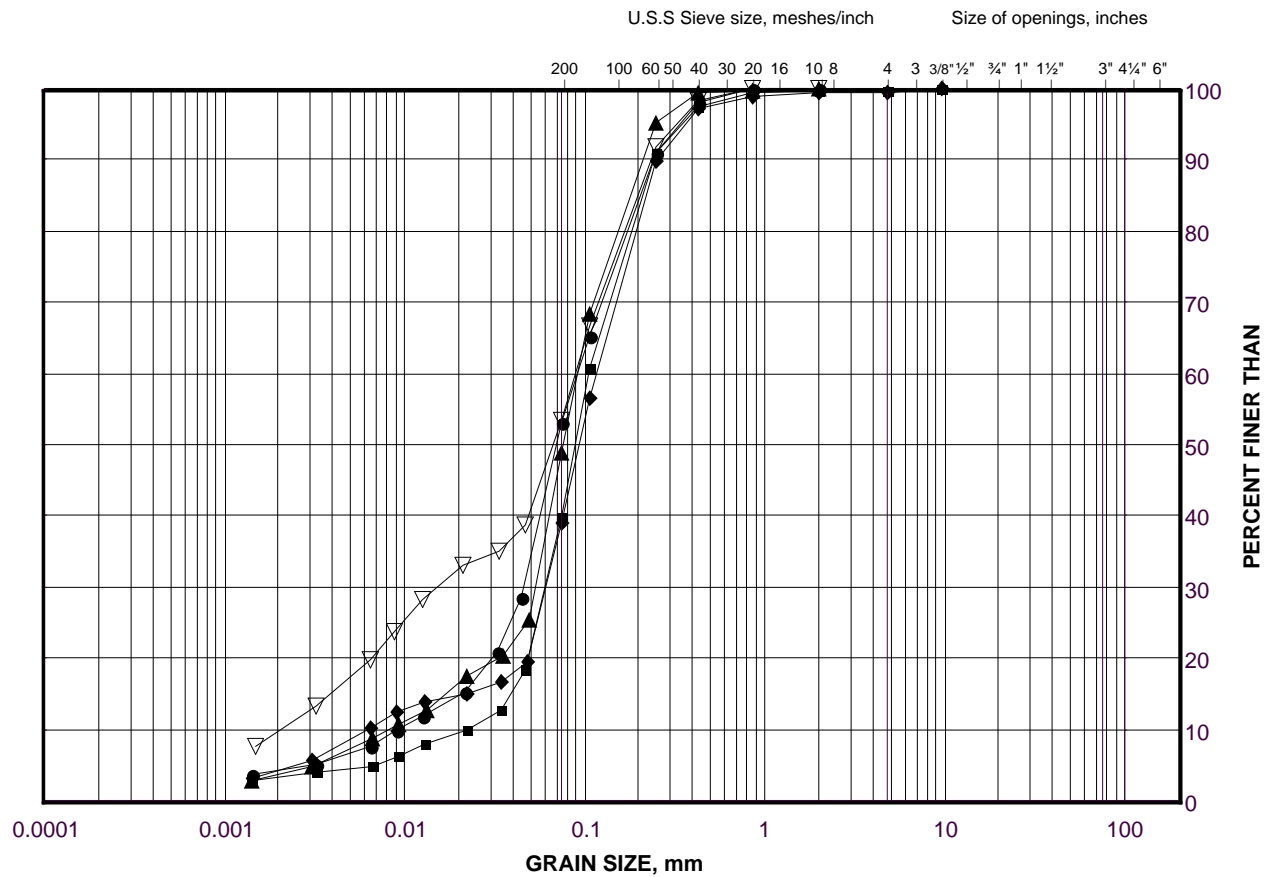
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (FILL)

FIGURE E-2B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-31	2	226.9
■	HF-29	2	227.1
◆	HF-01	3	226.0
▲	89UP-02	6	229.0
▽	89UP-06	8	228.2

Project Number: 1668512

Checked By: SMM

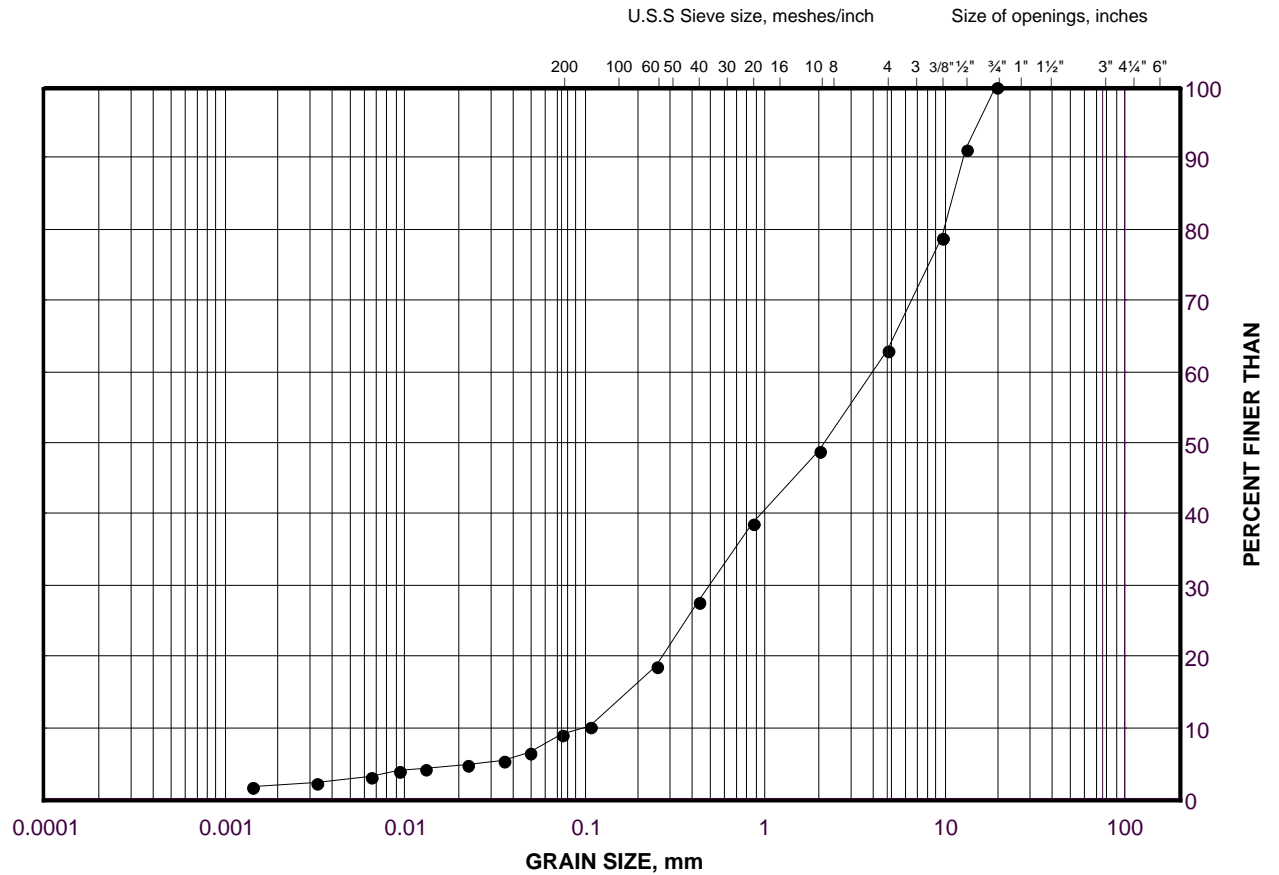
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Sand and Gravel (FILL)

FIGURE E-3



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	HF-19	4	227.0

Project Number: 1668512

Checked By: SMM

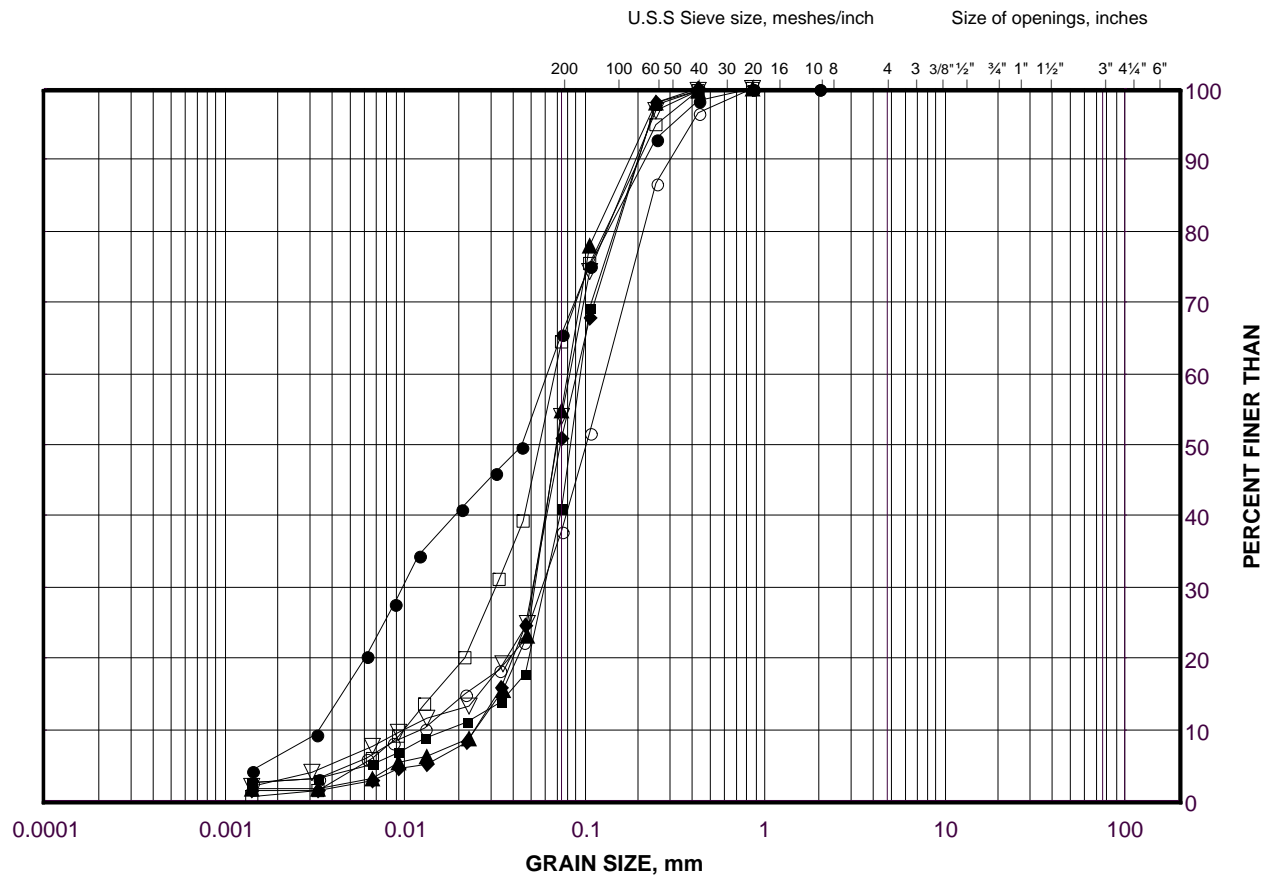
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (Upper Granular Deposit)

FIGURE E-4A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-02	2	226.4
■	HF-04	3	225.9
◆	HF-03	5	224.1
▲	HF-06	5	223.9
▽	HF-01	5	224.5
○	HF-04	7	222.9
□	HF-02	9	219.6

Project Number: 1668512

Checked By: SMM

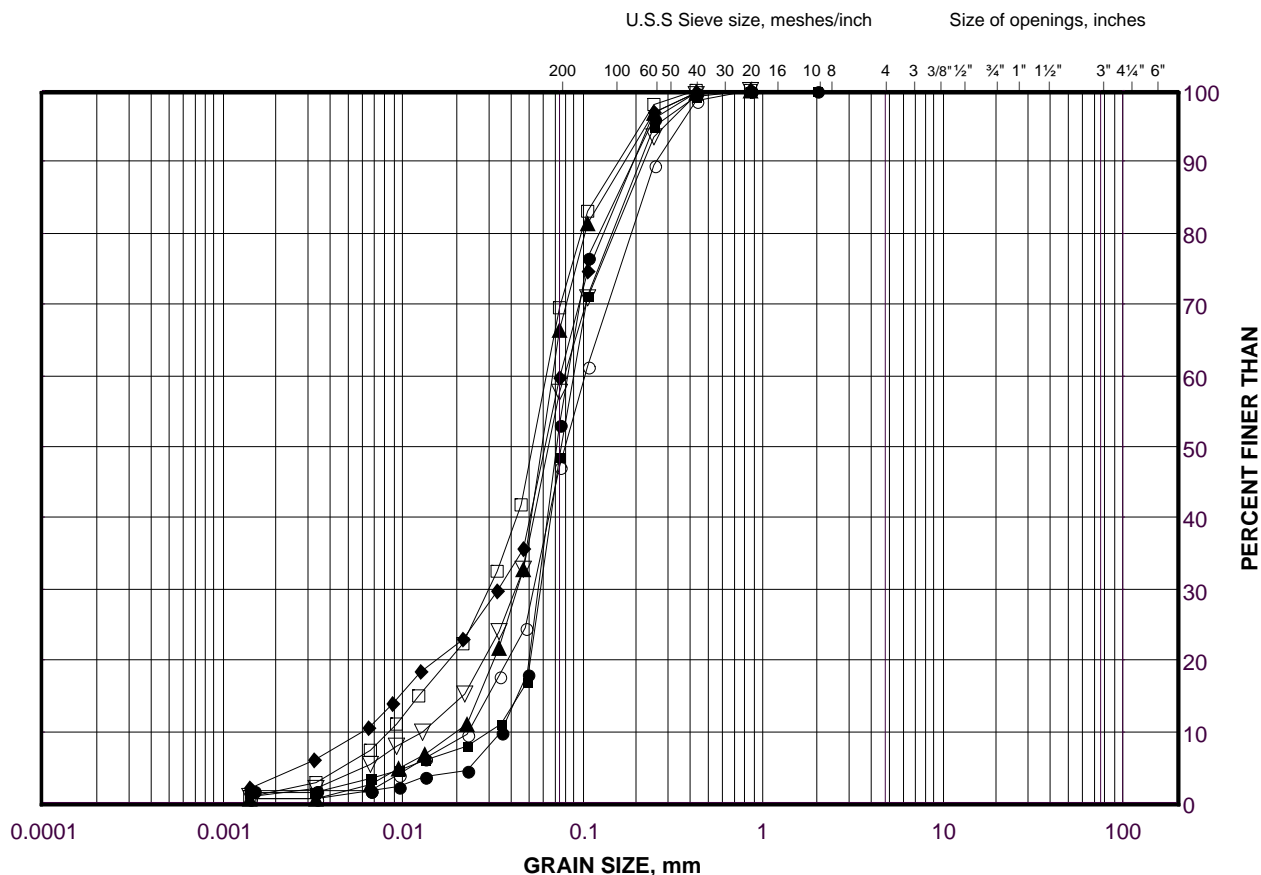
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (Upper Granular Deposit)

FIGURE E-4B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-07	3	225.4
■	HF-08	3	225.4
◆	HF-09	3	225.4
▲	HF-11	4	225.2
▽	HF-09	5	223.9
○	HF-08	7	222.3
□	HF-07	9	219.4

Project Number: 1668512

Checked By: SMM

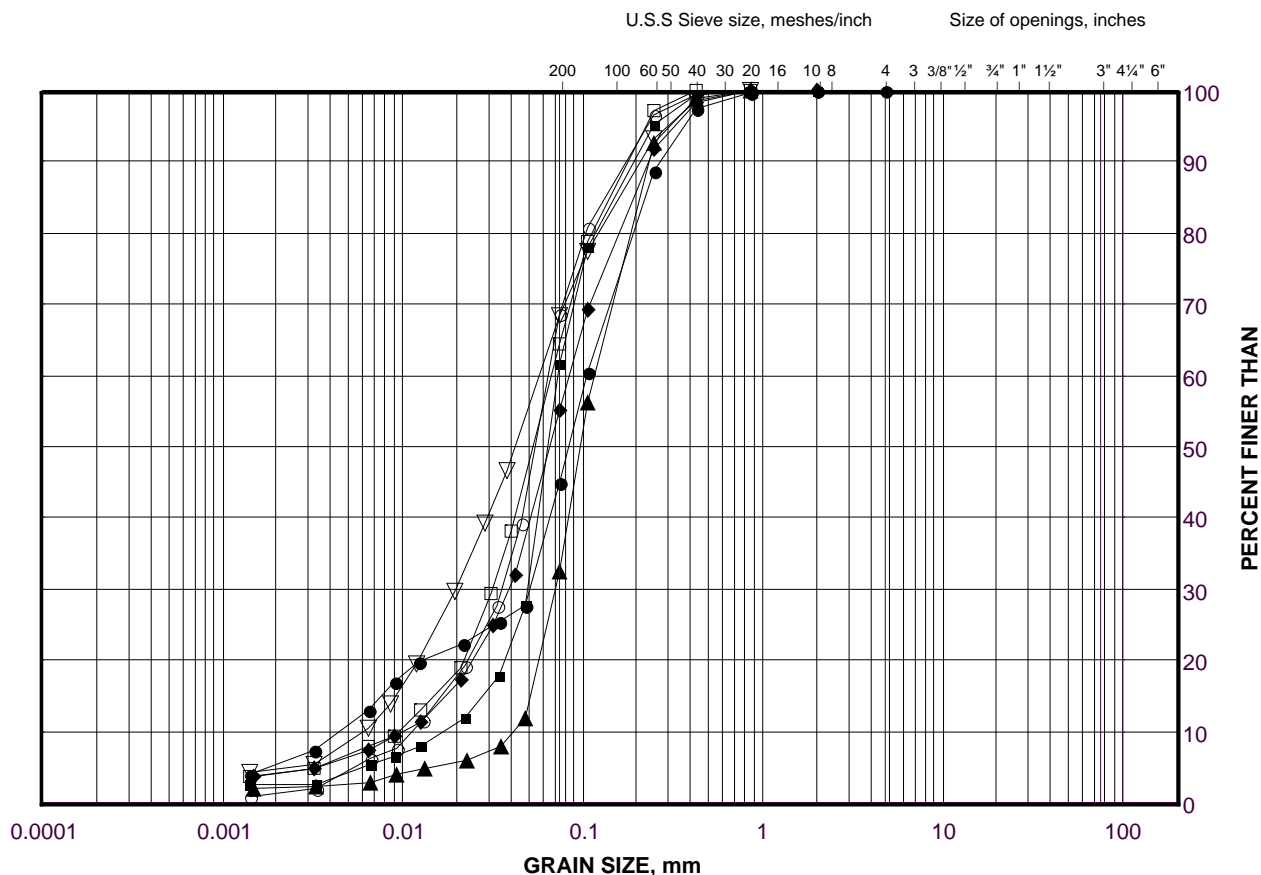
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (Upper Granular Deposit)

FIGURE E-4C



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-13	2	225.7
■	HF-12	3	224.9
◆	HF-15	4	224.5
▲	HF-14	5	224.7
▽	HF-15	6	223.0
○	HF-11	7	222.9
□	HF-17	7	222.6

Project Number: 1668512

Checked By: SMM

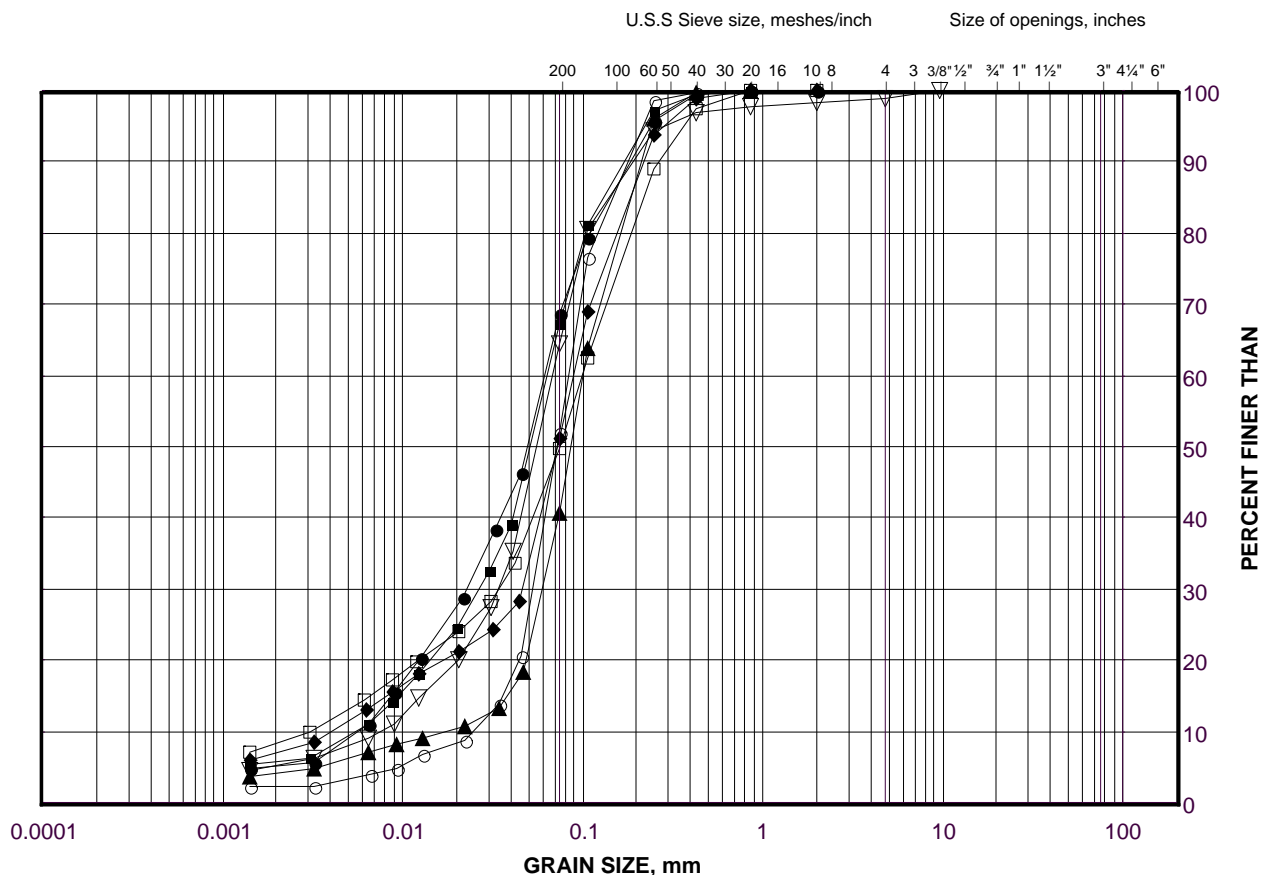
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (Upper Granular Deposit)

FIGURE E-4D



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-25	10	220.4
■	HF-23	3	225.1
◆	HF-21	4	224.0
▲	HF-18	5	224.7
▽	HF-20	5	225.1
○	HF-25	6	225.7
□	HF-19	6	225.5

Project Number: 1668512

Checked By: SMM

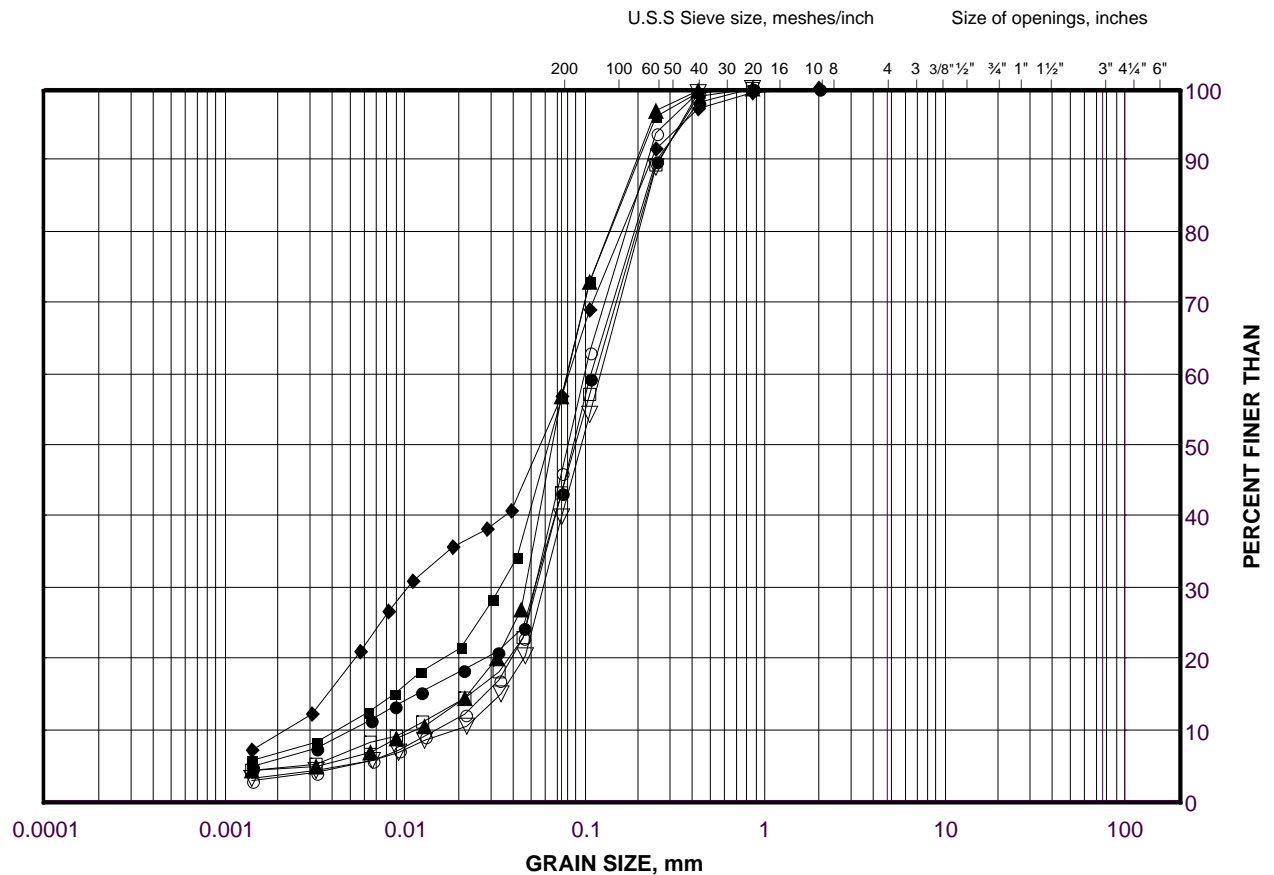
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (Upper Granular Deposit)

FIGURE E-4E



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-27	3	225.8
■	HF-26	4	225.9
◆	HF-28	5	226.1
▲	HF-30	5	224.7
▽	HF-26	6	224.4
○	HF-29	6	224.1
□	HF-30	7	223.2

Project Number: 1668512

Checked By: SMM

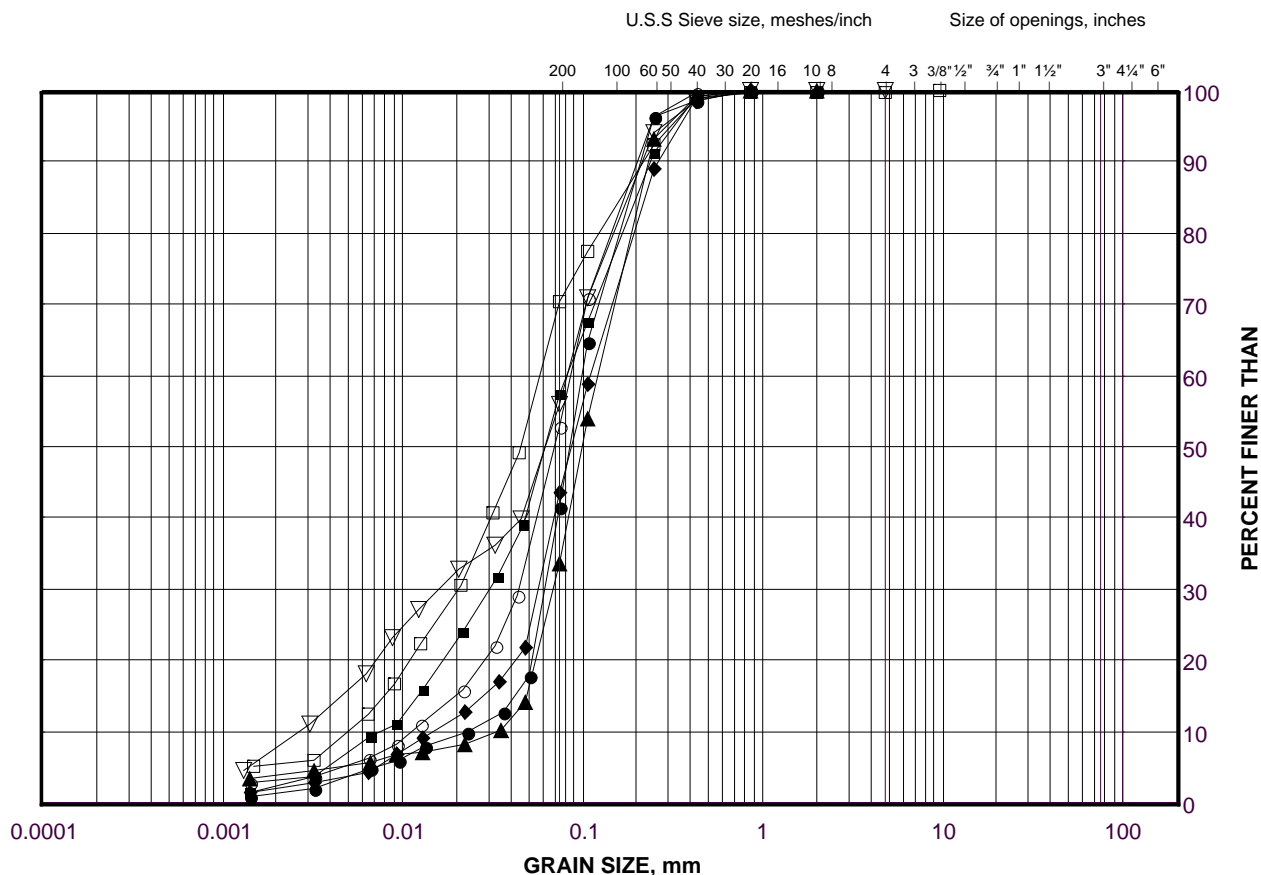
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (Upper Granular Deposit)

FIGURE E-4F



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-02	10B	222.9
■	89UP-02	12B	219.8
◆	89UP-01	5	224.4
▲	HF-31	5	224.7
▽	89UP-03	5	224.1
○	HF-31	8	221.6
□	89UP-01	9	219.9

Project Number: 1668512

Checked By: SMM

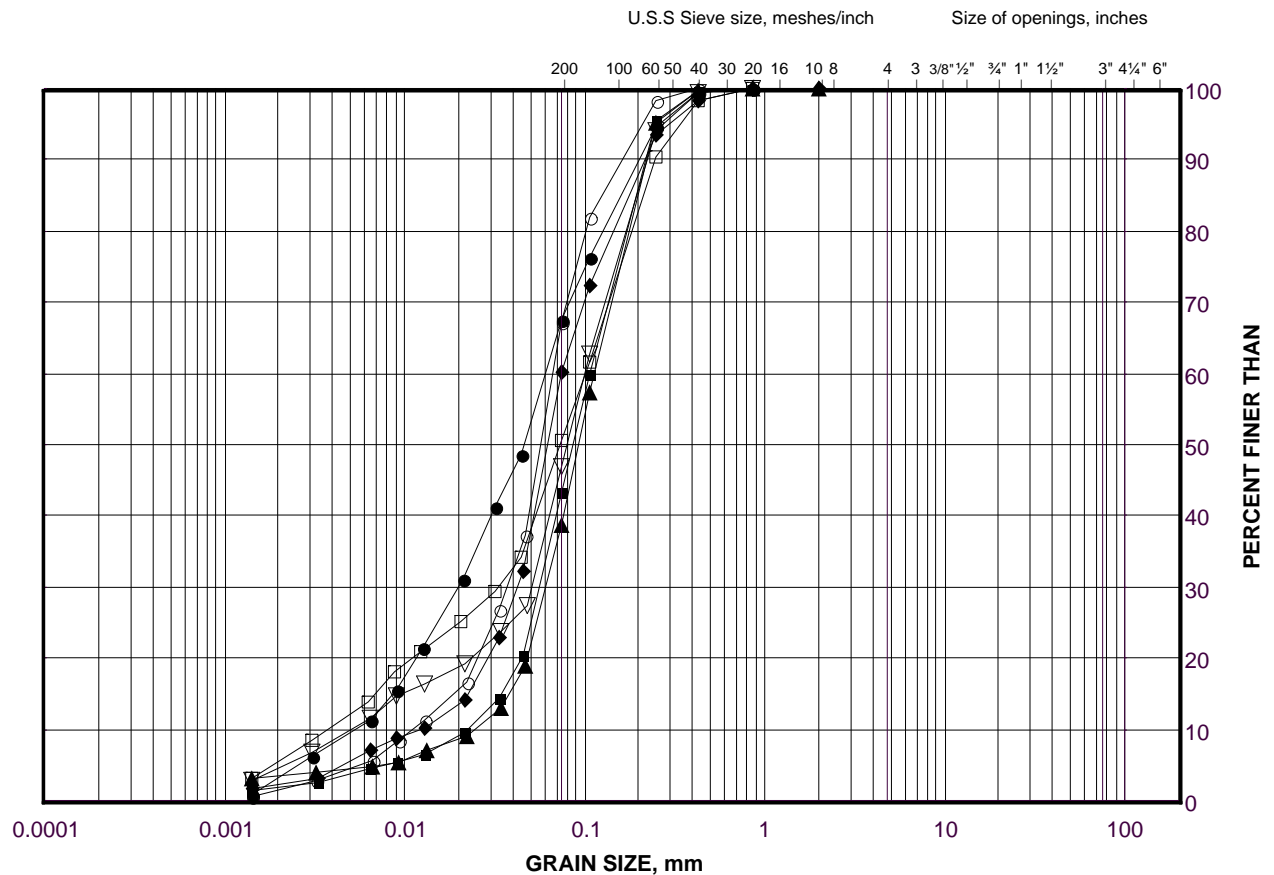
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt and Sand (Upper Granular Deposit)

FIGURE E-4G



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-08	11	216.6
■	89UP-06	12	224.4
◆	89UP-06	15	219.9
▲	PMT-02	3	218.8
▽	89UP-04	6	222.9
○	89UP-07	6	223.1
□	89UP-08	9	219.7

Project Number: 1668512

Checked By: SMM

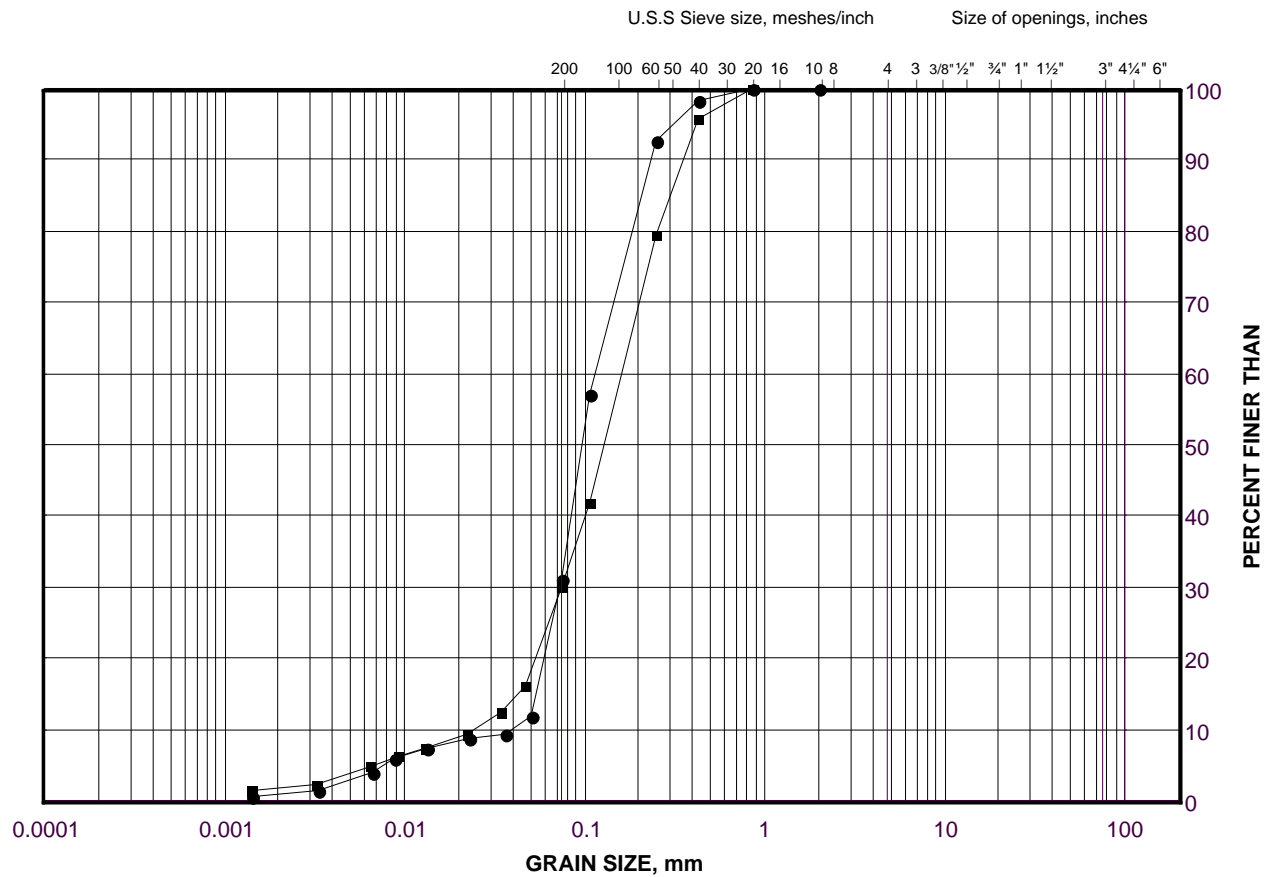
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silty Sand (Upper Granular Deposit)

FIGURE E-5



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-05	2	225.9
■	HF-02	6	223.4

Project Number: 1668512

Checked By: SMM

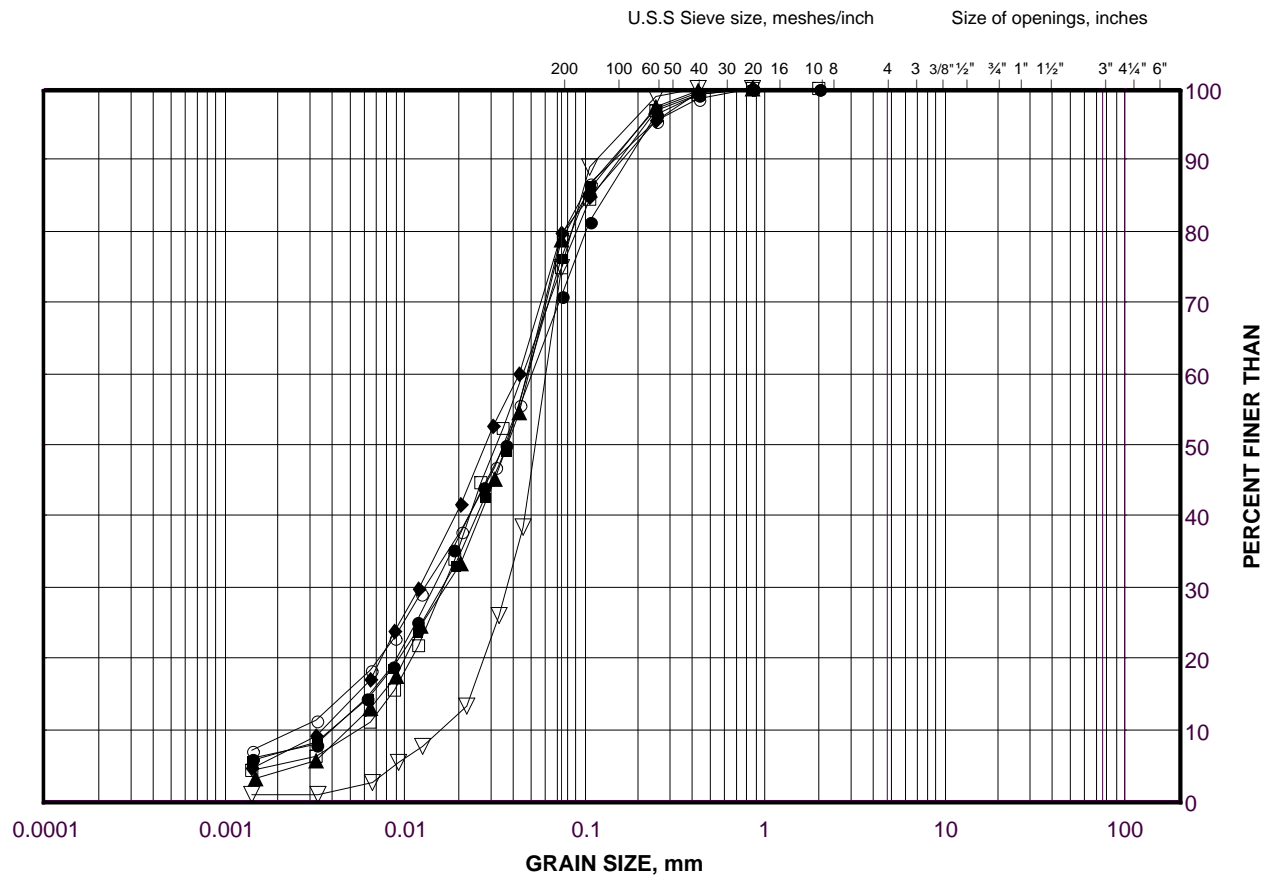
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Sandy Silt (Upper Granular Deposit)

FIGURE E-6A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-22	3	225.0
■	HF-16	6	223.7
◆	HF-12	7	221.8
▲	HF-07	7	222.4
▽	HF-03	7	222.6
○	HF-21	8	220.2
□	HF-16	8	221.4

Project Number: 1668512

Checked By: SMM

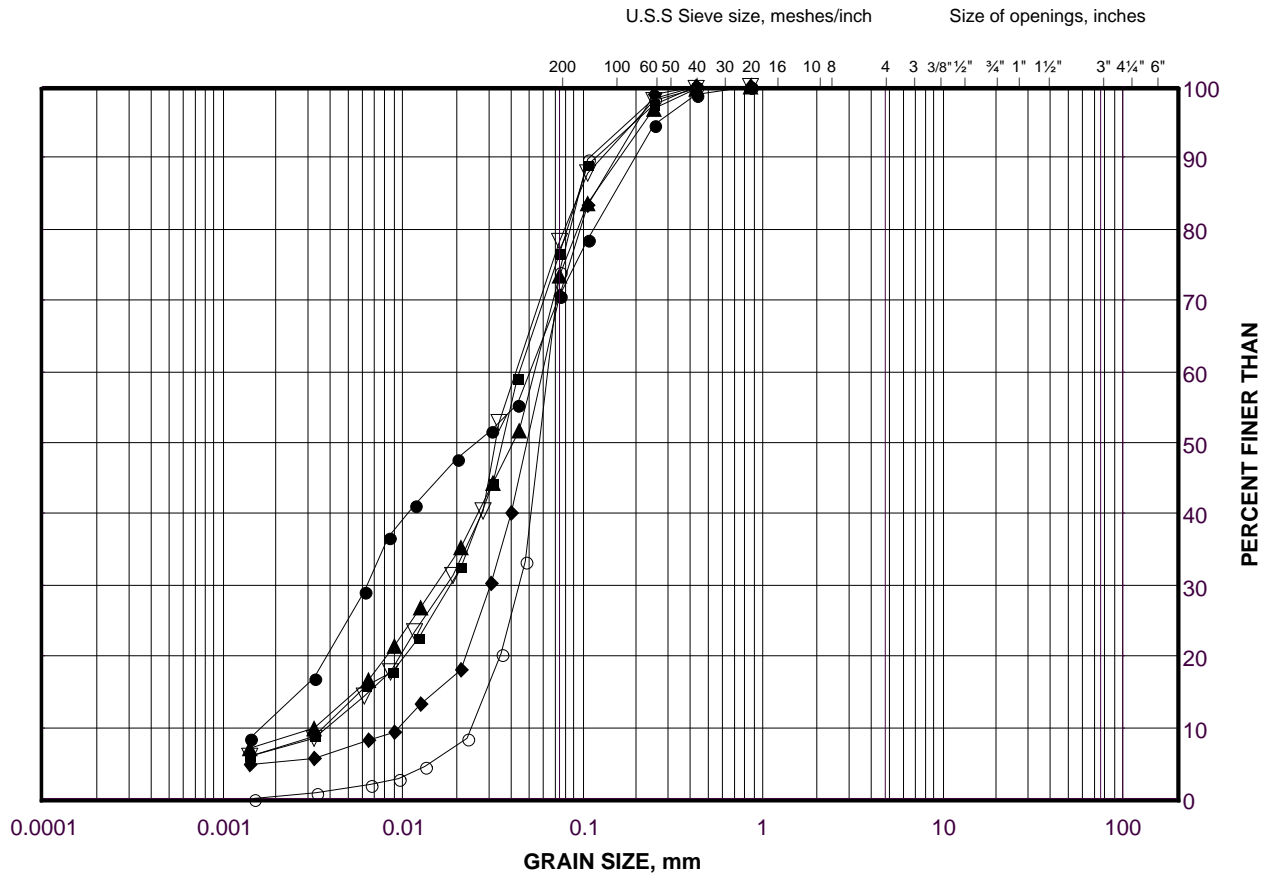
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Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Sandy Silt (Upper Granular Deposit)

FIGURE E-6B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-06	17	216.8
■	89UP-06	19	213.8
◆	PMT-02	4	215.9
▲	HF-22	6	222.7
▽	HF-24	7	224.2
○	89UP-05	8	219.8

Project Number: 1668512

Checked By: SMM

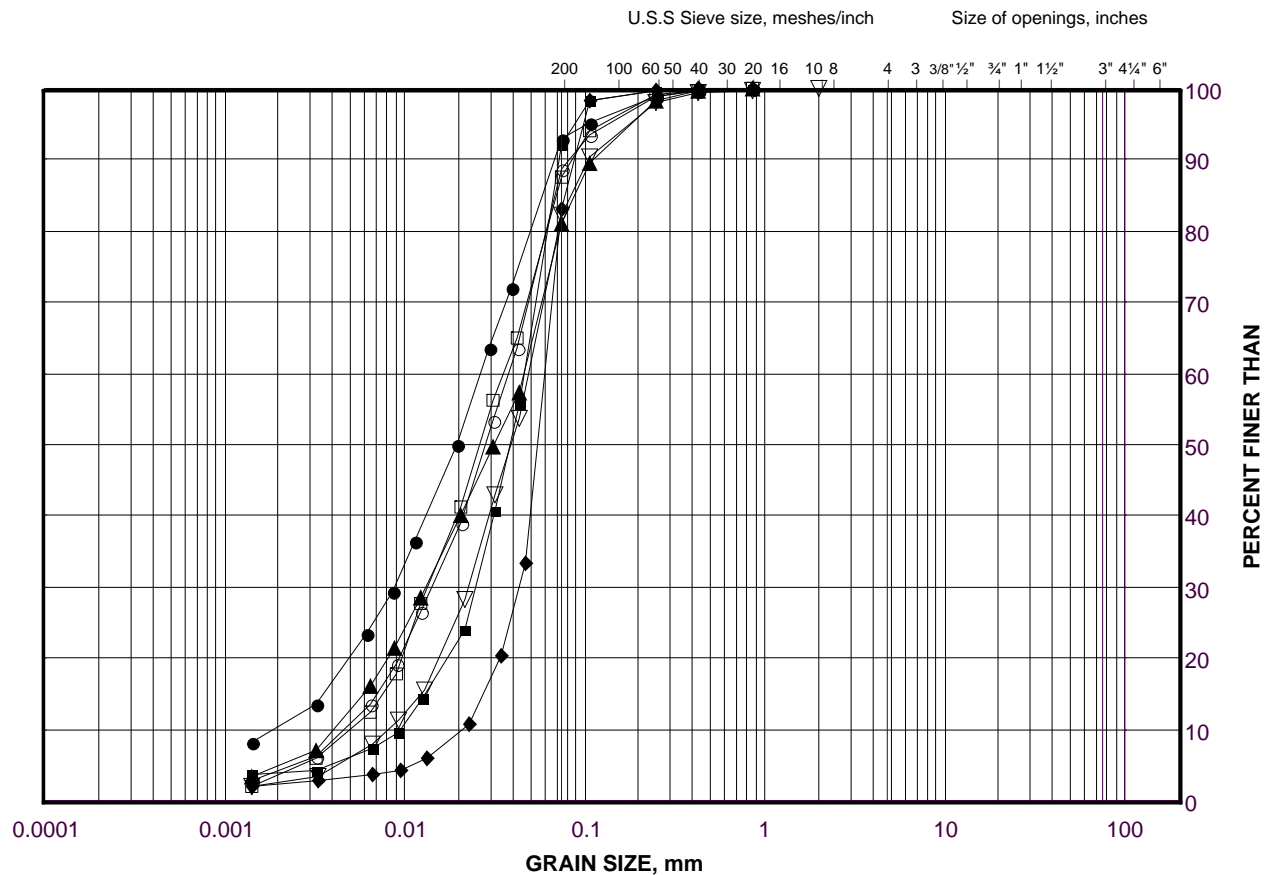
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt (Upper Granular Deposit)

FIGURE E-7A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-07	12	214.8
■	HF-02	15	210.4
◆	HF-07	17	207.2
▲	HF-03	3A	225.8
▽	HF-10	5	224.2
○	HF-05	6	222.9
□	HF-06	7	222.3

Project Number: 1668512

Checked By: SMM

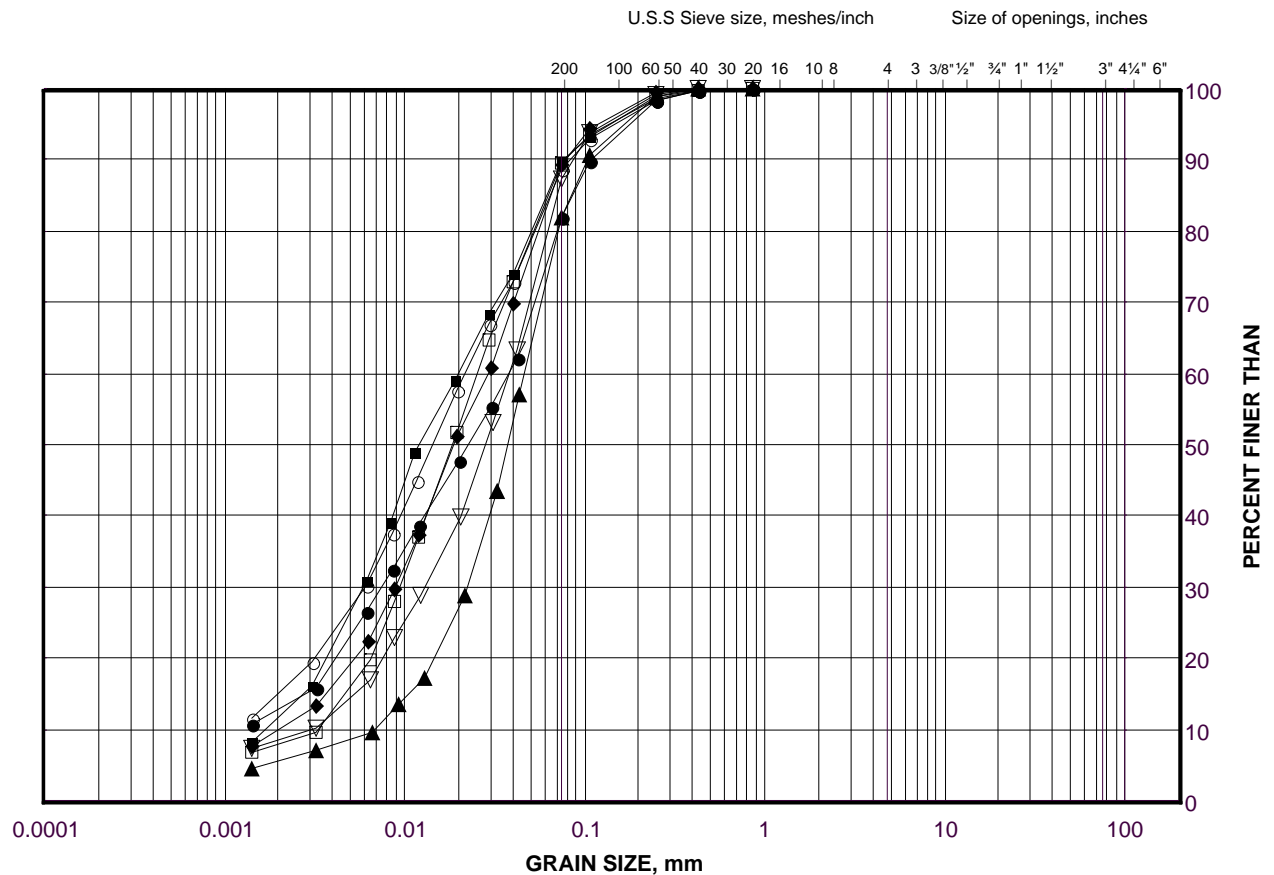
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt (Upper Granular Deposit)

FIGURE E-7B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-23	5	223.5
■	HF-13	6	222.7
◆	HF-17	6	223.4
▲	HF-14	7	223.1
▽	HF-27	8	221.2
○	HF-20	8	222.0
□	HF-17	9	219.6

Project Number: 1668512

Checked By: SMM

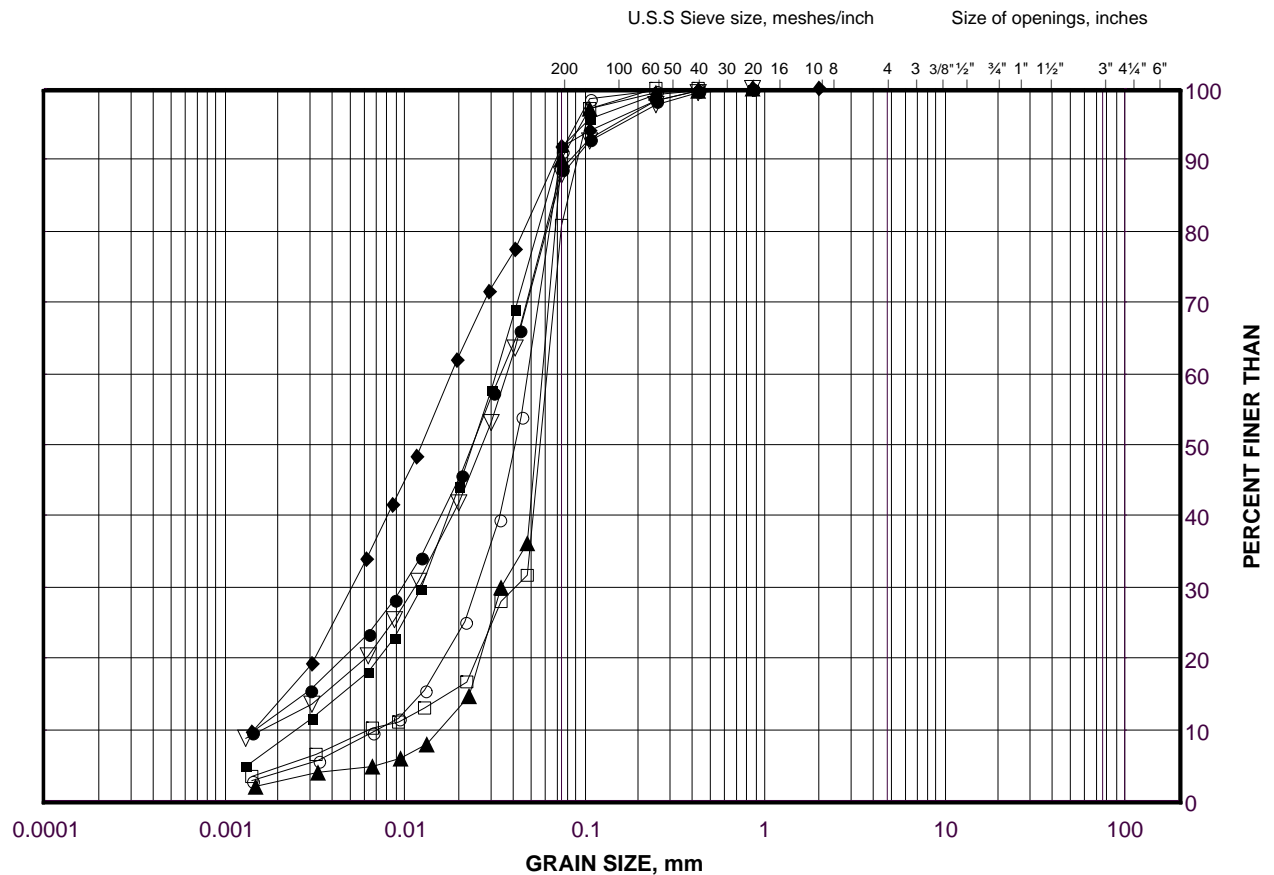
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt (Upper Granular Deposit)

FIGURE E-7C



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-05	11	215.1
■	89UP-04	11	215.3
◆	89UP-02	11B	221.2
▲	89UP-05	12	213.7
▽	89UP-03	13	213.4
○	89UP-02	17	212.2
□	89UP-02	20	207.7

Project Number: 1668512

Checked By: SMM

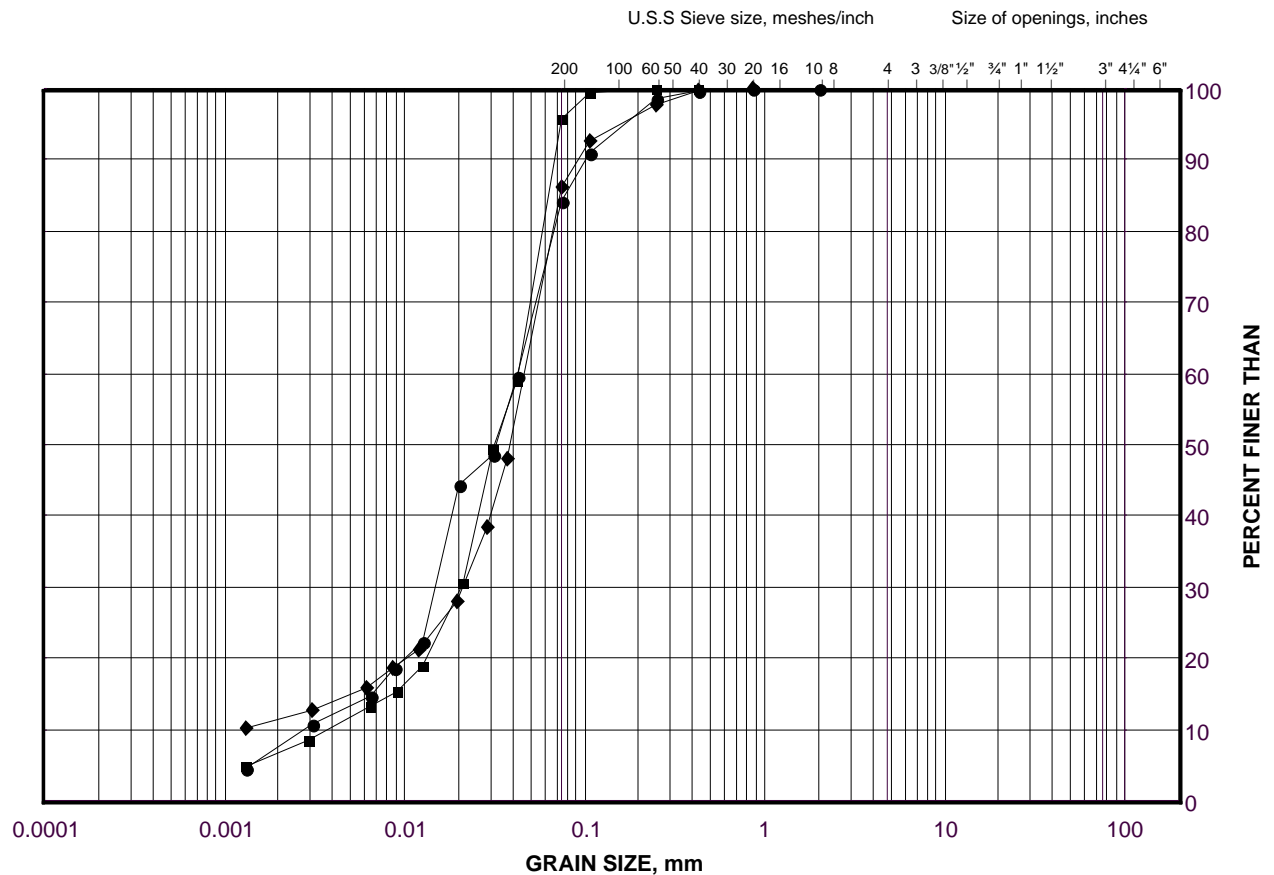
Golder Associates

Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Silt (Upper Granular Deposit)

FIGURE E-7D



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

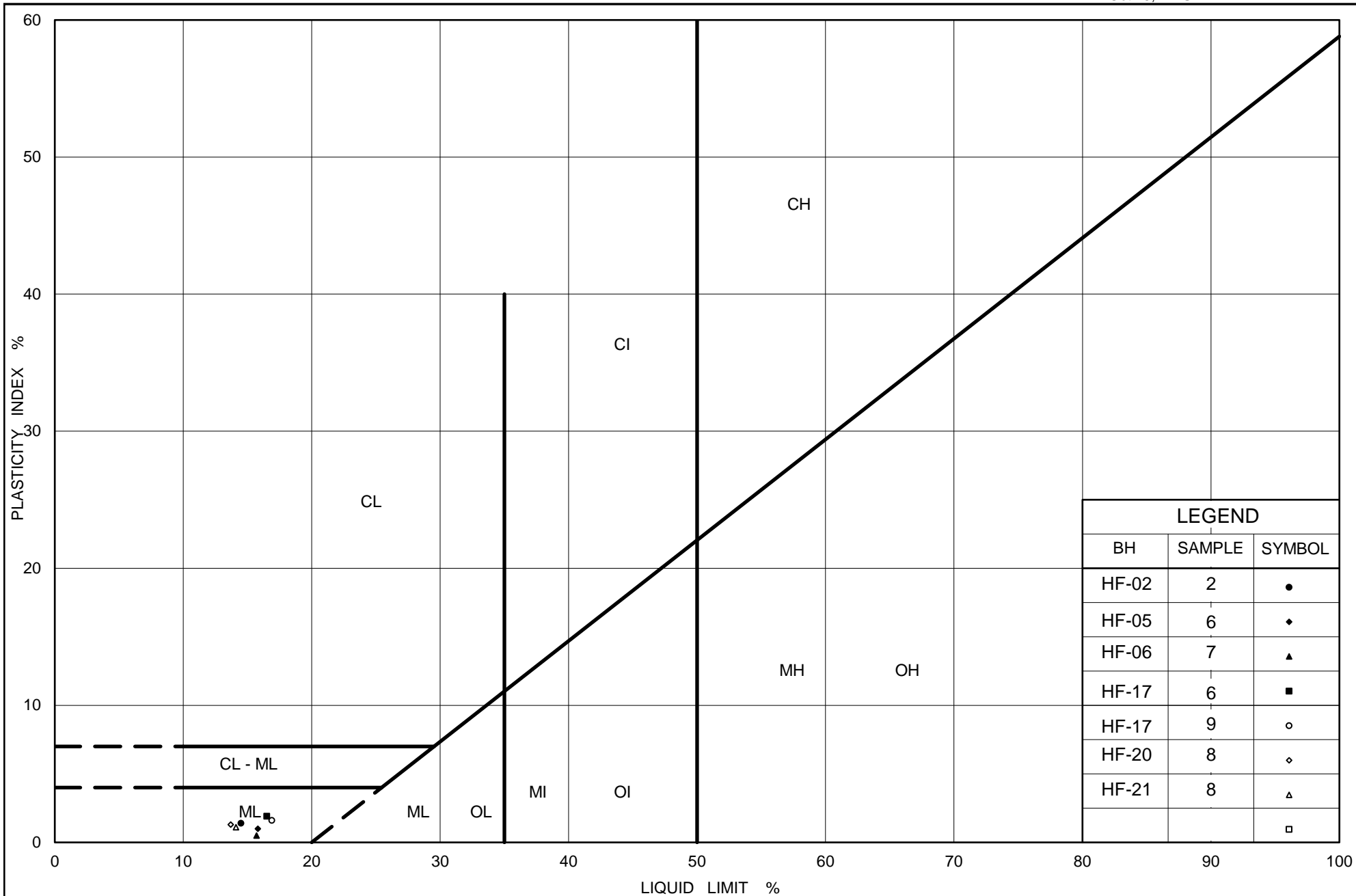
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-07	12	214.7
■	89UP-07	17	207.1
◆	PMT-02	5	212.7

Project Number: 1668512

Checked By: SMM

Golder Associates

Date: 24-Apr-18



Ministry of Transportation

Ontario

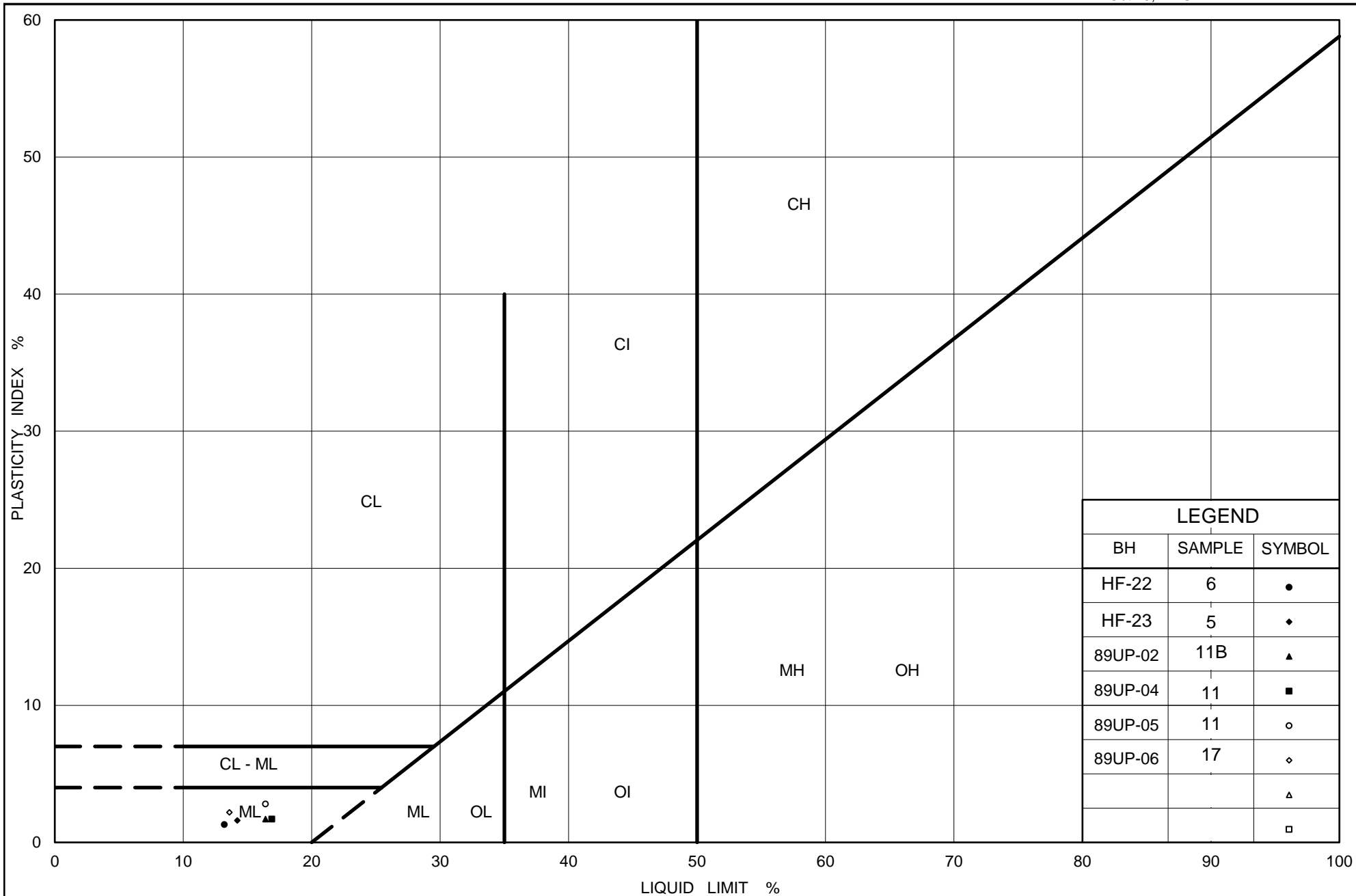
PLASTICITY CHART

Silt to Sandy Silt to Silt and Sand (Upper Granular Deposit)

Figure No. E-8A

Project No. 1668512

Checked By: SMM



Ministry of Transportation

Ontario

PLASTICITY CHART

Silt to Sandy Silt to Silt and Sand (Upper Granular Deposit)

Figure No. E-8B

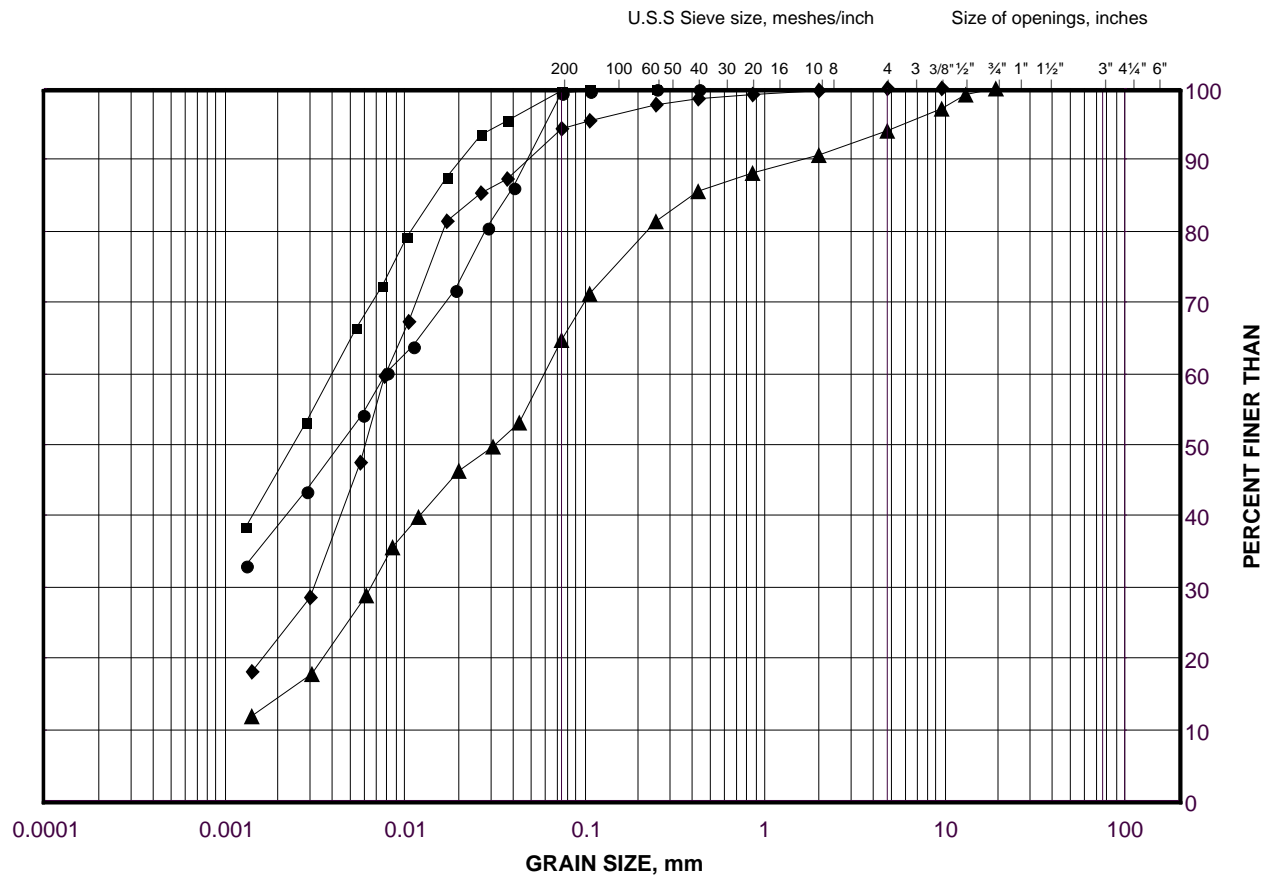
Project No. 1668512

Checked By: SMM

GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Clayey Silt (Upper Cohesive Deposit)

FIGURE E-9



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-05	17	206.0
■	89UP-06	22	204.6
◆	HF-07	24	196.5
▲	89UP-06	25B	195.3

Project Number: 1668512

Checked By: SMM

Golder Associates

Date: 24-Apr-18



Highway 400 / 89 High Fill Embankment Upper Cohesive Deposit – Varved Soil Matrix

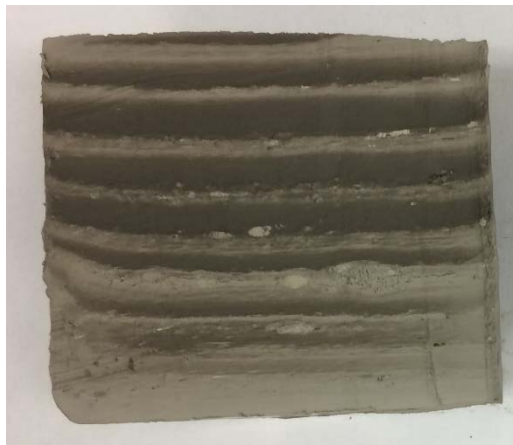
Figure E-10



Photograph 1: Soil Sample from Borehole 89UP-03 Sample 20
(Location of Proposed West Abutment)



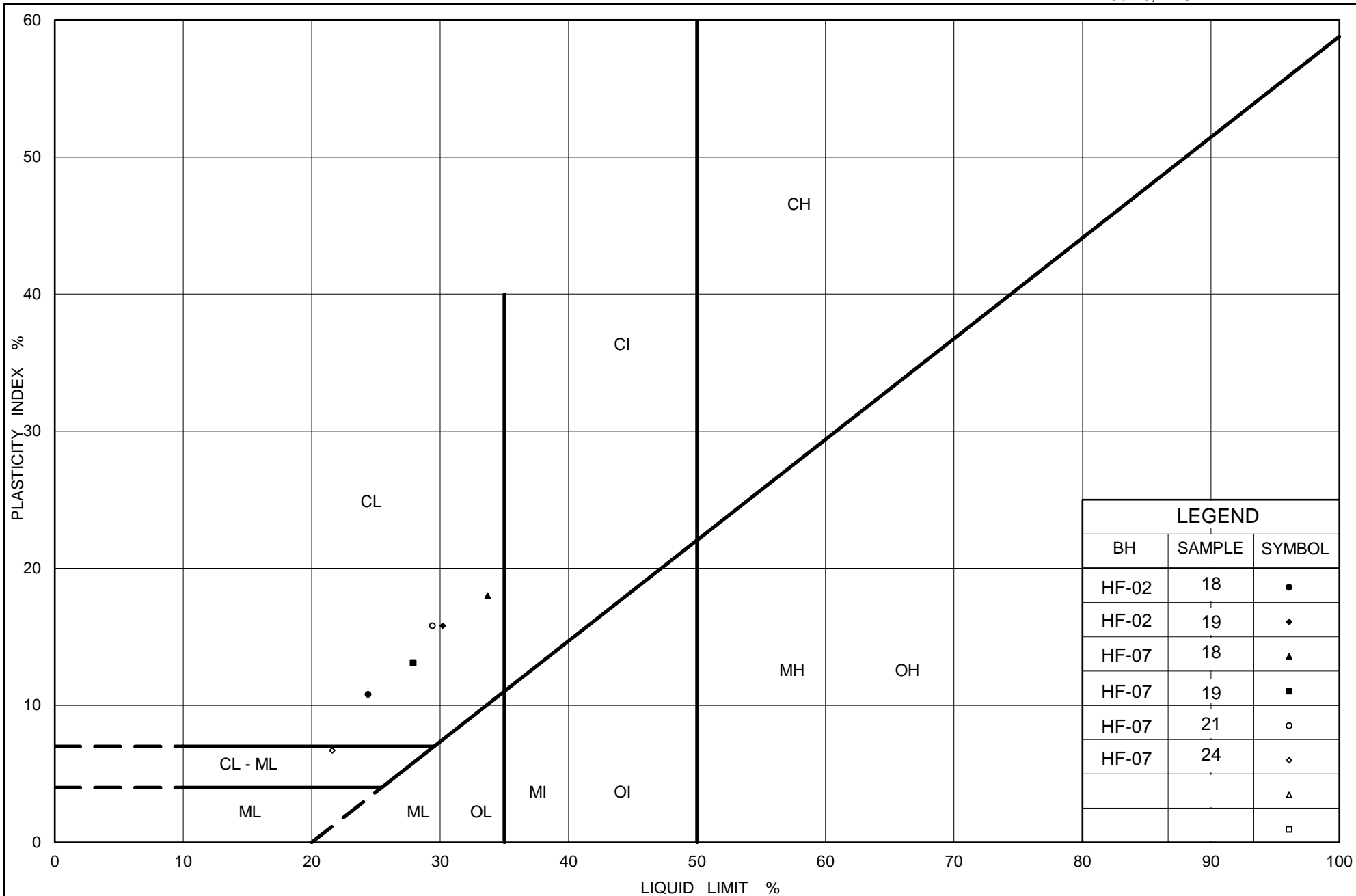
Photograph 2: Soil Sample from Borehole 89UP-07 Sample 21
(Location of Proposed East Abutment)



Photograph 3: Soil Sample from Borehole 89UP-06
Sample 24 (Location of Proposed East Abutment)

Notes:

1. The dark bands (i.e., laminae) represent the silty clay of intermediate plasticity to clay of high plasticity, while the lighter varves represent the clayey silt of low plasticity and/or silt.
2. The soil samples were extracted from Shelby tubes and dried to illustrate the distinctions between the various varves.



Ministry of Transportation

Ontario

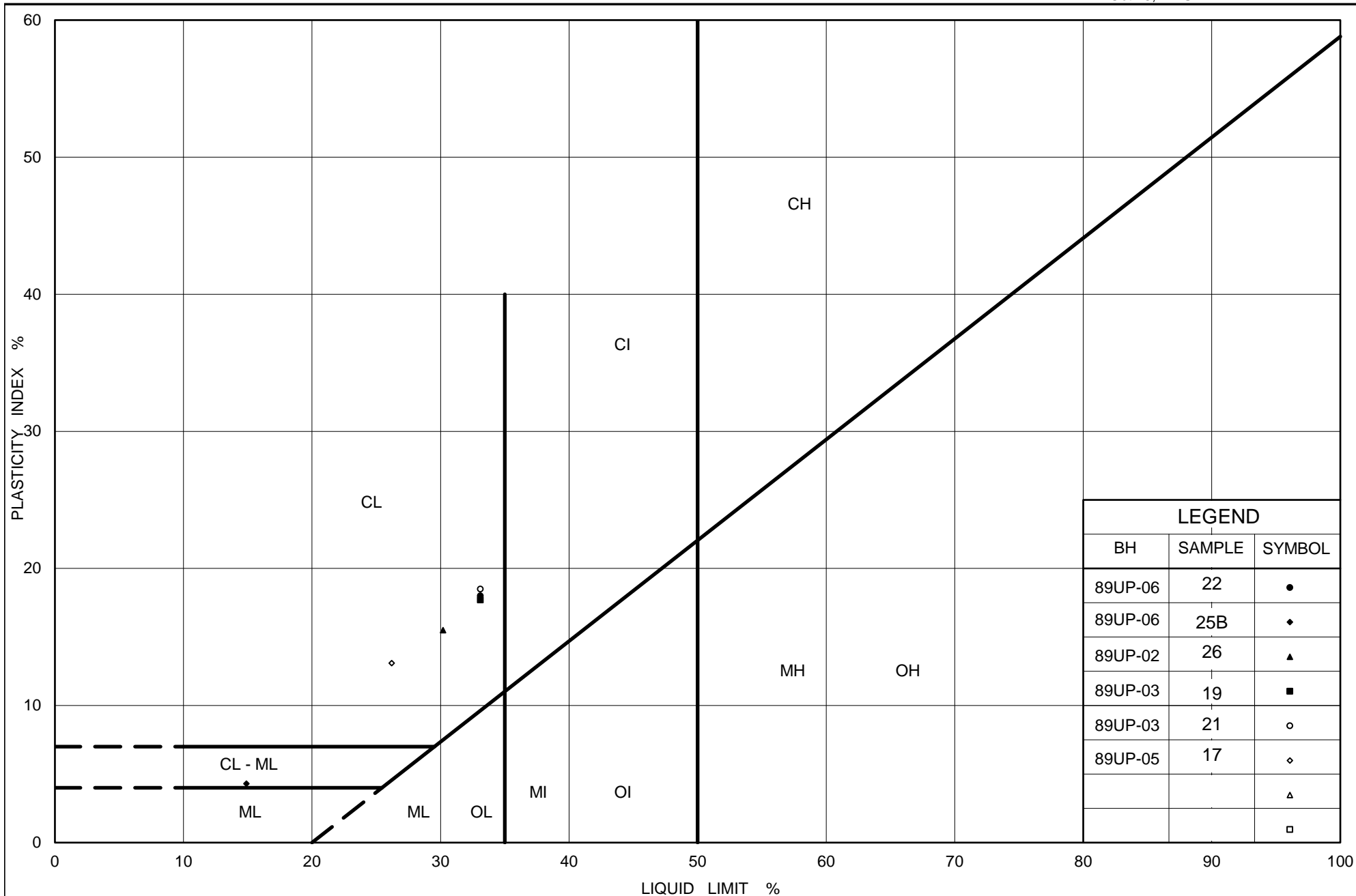
PLASTICITY CHART

Sandy Clayey Silt to Clayey Silt (Upper Cohesive Deposit)

Figure No. E-11A

Project No. 1668512

Checked By: SMM



Ministry of Transportation

Ontario

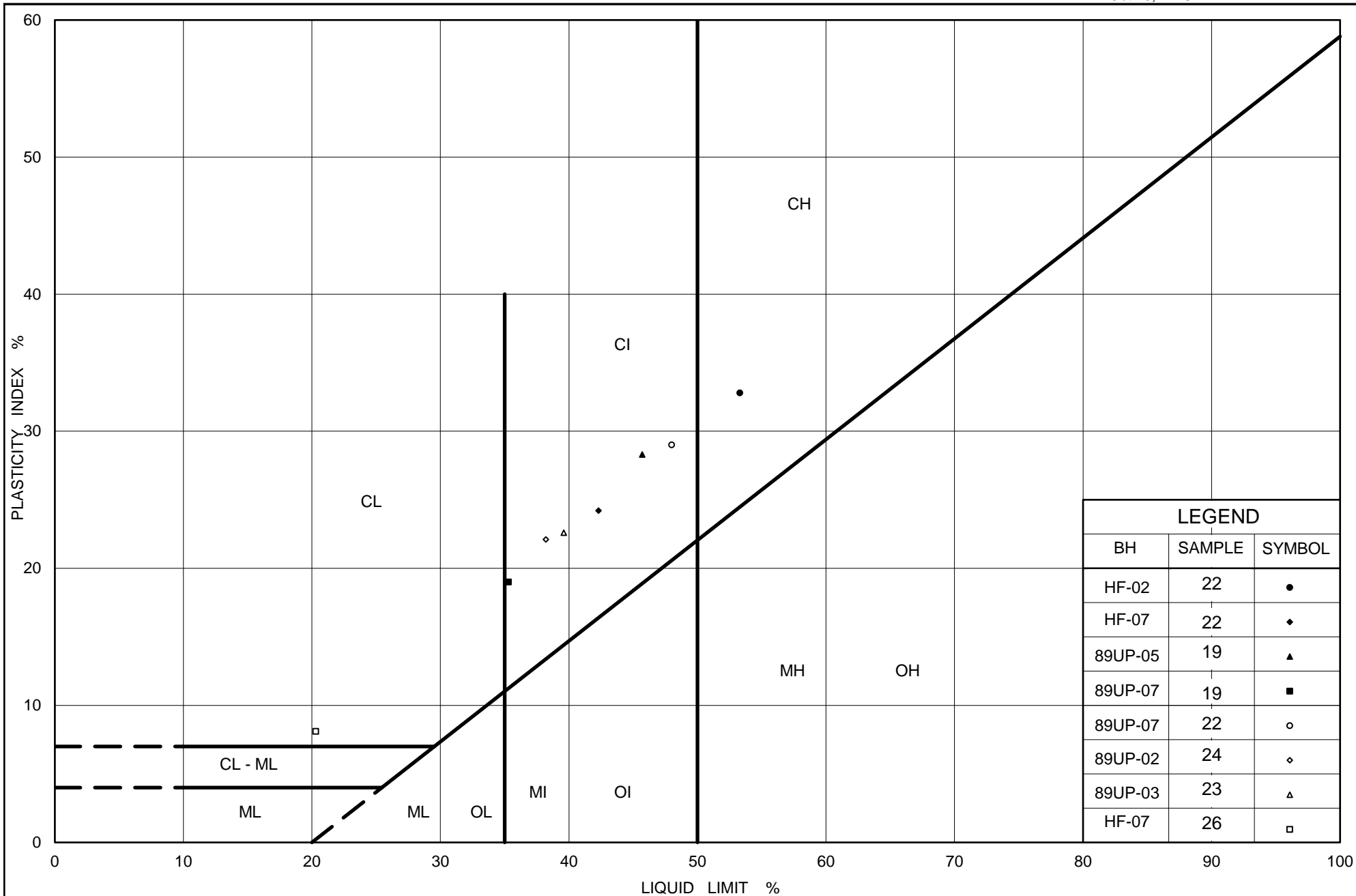
PLASTICITY CHART

Sandy Clayey Silt to Clayey Silt (Upper Cohesive Deposit)

Figure No. E-11B

Project No. 1668512

Checked By: SMM



Ministry of Transportation

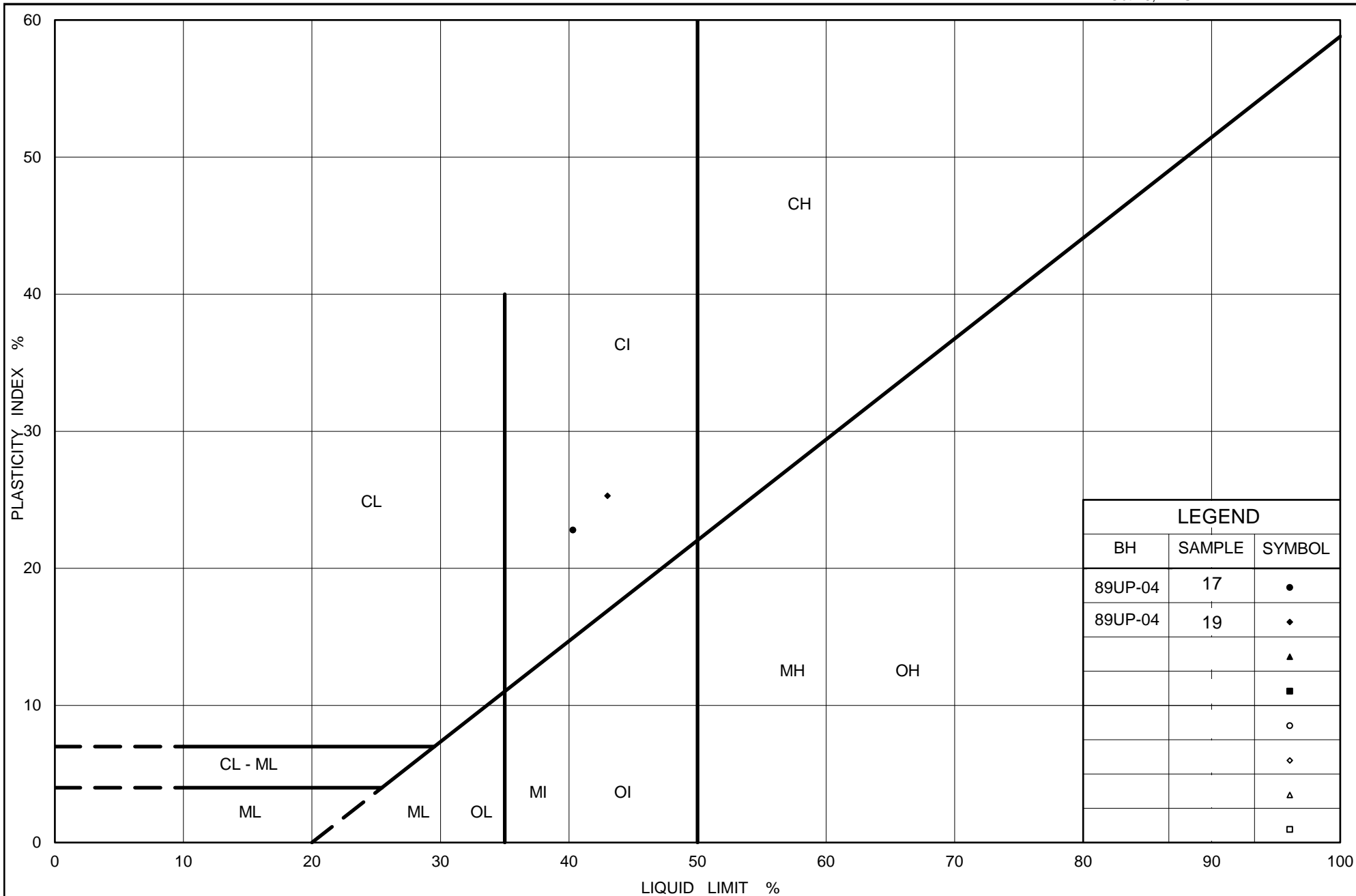
Ontario

PLASTICITY CHART Silty Clay to Clay (Upper Cohesive Deposit)

Figure No. E-11C

Project No. 1668512

Checked By: SMM



Ministry of Transportation

Ontario

PLASTICITY CHART

Silty Clay (Upper Cohesive Deposit)

Figure No. E-11D

Project No. 1668512

Checked By: SMM

CONSOLIDATION TEST SUMMARY**FIGURE E-12A****ASTM D2435/D2435M****SAMPLE IDENTIFICATION**

Project Number	1668512(1000)	Sample Number	TO 20
Borehole Number	89UP-03	Sample Depth, m	24.39-25.00

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	2		
Date Started	7/27/2017		
Date Completed	8/15/2017		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.53	Unit Weight, kN/m ³	18.46
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	13.67
Area, cm ²	31.57	Specific Gravity, measured	2.73
Volume, cm ³	80.00	Solids Height, cm	1.294
Water Content, %	35.04	Volume of Solids, cm ³	40.85
Wet Mass, g	150.60	Volume of Voids, cm ³	39.15
Dry Mass, g	111.52	Degree of Saturation, %	99.8

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
0.00	2.534	0.958	2.534				
5.90	2.534	0.958	2.534				
10.75	2.534	0.958	2.534				
20.53	2.532	0.957	2.532	60	2.27E-02	7.67E-05	1.70E-07
40.00	2.525	0.952	2.525	145	9.32E-03	1.36E-04	1.24E-07
78.82	2.507	0.937	2.507	211	6.31E-03	1.89E-04	1.17E-07
156.26	2.485	0.920	2.485	140	9.35E-03	1.13E-04	1.04E-07
226.14	2.465	0.905	2.465	118	1.09E-02	1.12E-04	1.20E-07
78.82	2.482	0.918	2.482				
40.00	2.488	0.923	2.488				
78.82	2.479	0.916	2.479	109	1.20E-02	9.15E-05	1.07E-07
226.11	2.461	0.902	2.461	113	1.14E-02	4.85E-05	5.40E-08
312.48	2.441	0.886	2.441	231	5.47E-03	9.05E-05	4.85E-08
441.12	2.388	0.845	2.388	409	2.96E-03	1.62E-04	4.70E-08
620.45	2.292	0.772	2.292	2196	5.07E-04	2.11E-04	1.05E-08
1241.20	2.109	0.630	2.109	778	1.21E-03	1.17E-04	1.39E-08
2481.08	1.981	0.531	1.981	470	1.77E-03	4.06E-05	7.05E-09
441.14	2.026	0.566	2.026				
224.46	2.052	0.586	2.052				
78.82	2.096	0.620	2.096				
20.53	2.149	0.660	2.149				
5.90	2.184	0.688	2.184				

Note:

Consolidation loading and unloading schedule assigned by the client.

cv and k are approximate only based on t₉₀ estimated from Square Root of Time Method (ASTMD2435/2435M)

Specimen taken 48-56cm from top of the tube.

Specimen swelled under 10.75 kPa.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.18	Unit Weight, kN/m ³	20.11
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	15.86
Area, cm ²	31.57	Specific Gravity, measured	2.73
Volume, cm ³	68.94	Solids Height, cm	1.294
Water Content, %	26.78	Volume of Solids, cm ³	40.85
Wet Mass, g	141.39	Volume of Voids, cm ³	28.09
Dry Mass, g	111.52		

Prepared By: LH

Golder Associates

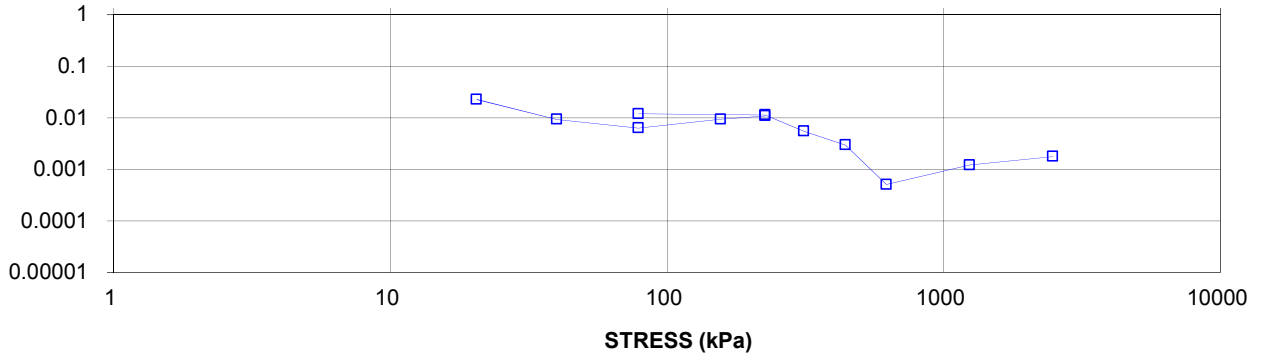
Checked By: TZ

CONSOLIDATION TEST SUMMARY

FIGURE E-12B

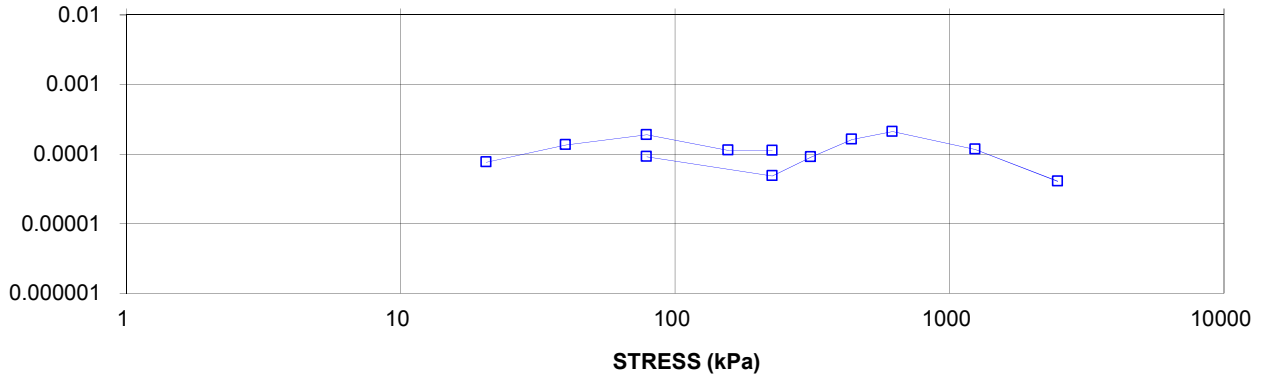
COEFFICIENT OF CONSOLIDATION,
cm²/s

CONSOLIDATION TEST
CV cm²/s VS STRESS (kPa)
BH 89UP-03 TO 20



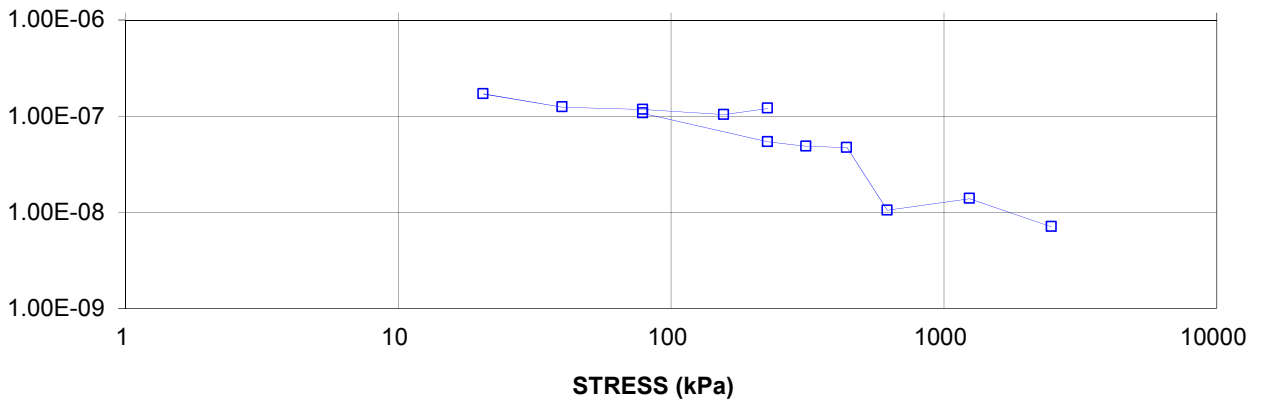
VOLUME COMPRESSIBILITY, m²/kN

CONSOLIDATION TEST
MV m²/kN vs STRESS (kPa)
BH 89UP-03 TO 20



HYDRAULIC CONDUCTIVITY,
cm/s

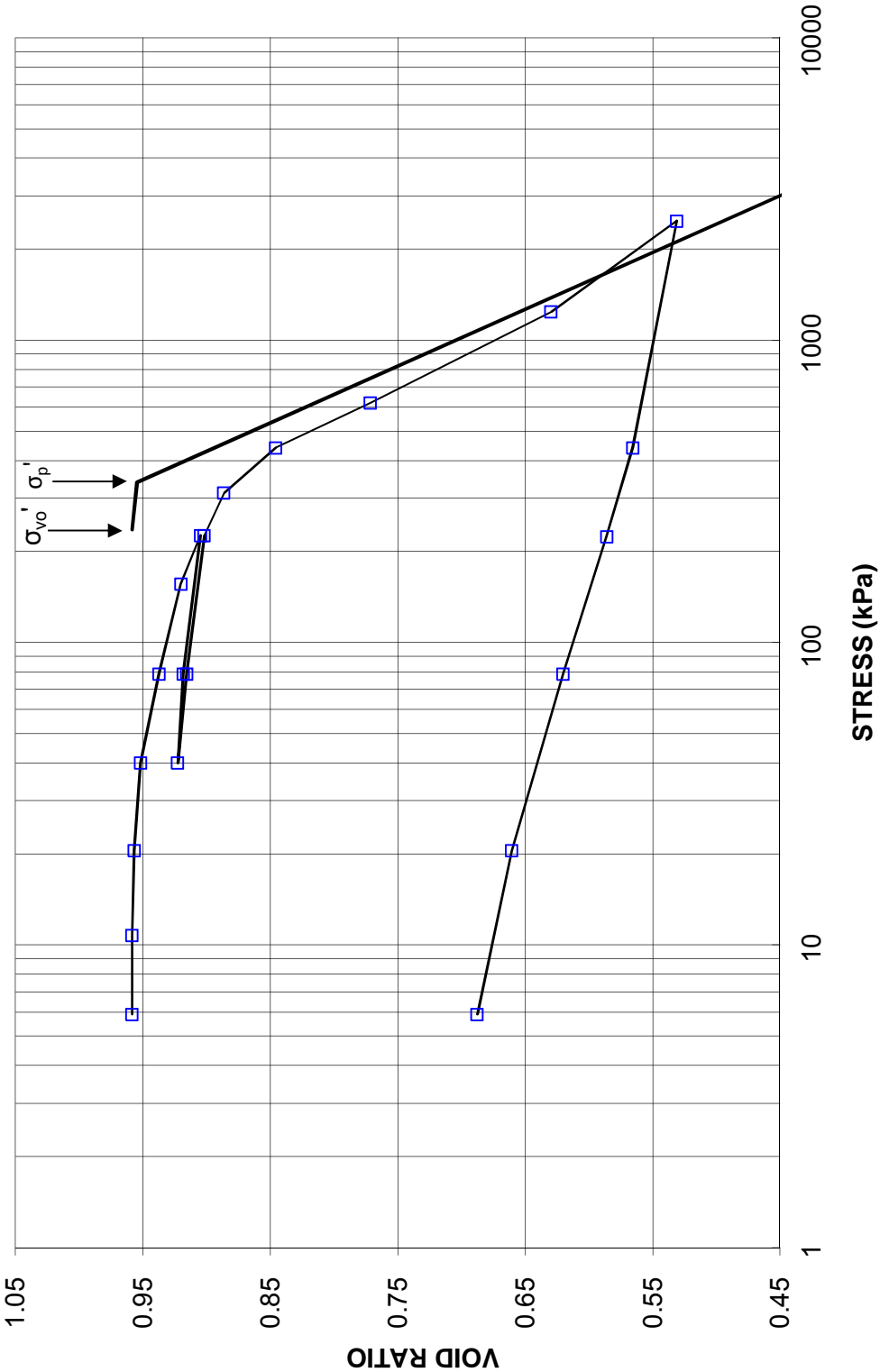
CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH 89UP-03 TO 20



CONSOLIDATION TEST
VOID RATIO VS LOG STRESS

FIGURE E-12C

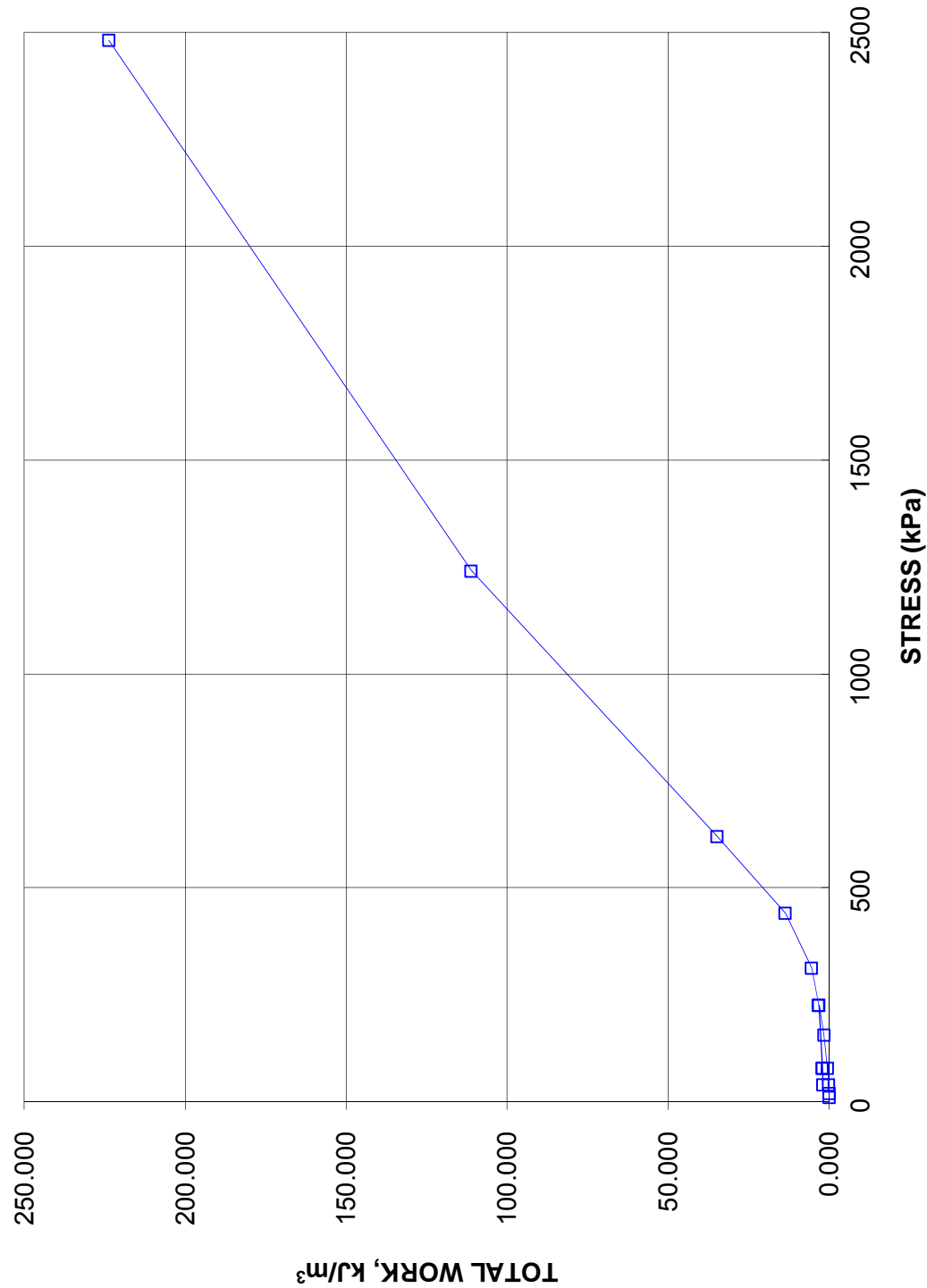
CONSOLIDATION TEST
VOID RATIO vs STRESS
BH 89UP-03 TO 20



CONSOLIDATION TEST
TOTAL WORK VS STRESS

FIGURE E-12D

CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs STRESS
BH 89UP-03 TO 20



CONSOLIDATION TEST SUMMARY**FIGURE E-13A****ASTM D2435/D2435M****SAMPLE IDENTIFICATION**

Project Number	1668512(1000)	Sample Number	24
Borehole Number	89UP-06	Sample Depth, m	36.93-36.88

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	8		
Date Started	8/23/2017		
Date Completed	9/13/2017		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m ³	17.44
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m ³	12.11
Area, cm ²	31.50	Specific Gravity, measured	2.71
Volume, cm ³	59.94	Solids Height, cm	0.867
Water Content, %	44.00	Volume of Solids, cm ³	27.32
Wet Mass, g	106.62	Volume of Voids, cm ³	32.62
Dry Mass, g	74.04	Degree of Saturation, %	99.9

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
0.00	1.903	1.194	1.903				
6.36	1.905	1.196	1.905				
11.22	1.907	1.199	1.907				
21.02	1.904	1.196	1.904	135	5.70E-03	1.37E-04	7.63E-08
40.53	1.892	1.182	1.892	392	1.94E-03	3.23E-04	6.14E-08
79.44	1.872	1.158	1.872	372	2.00E-03	2.82E-04	5.52E-08
157.05	1.851	1.134	1.851	296	2.45E-03	1.41E-04	3.40E-08
312.54	1.817	1.095	1.817	234	2.99E-03	1.12E-04	3.29E-08
410.46	1.793	1.068	1.793	265	2.57E-03	1.29E-04	3.26E-08
157.05	1.808	1.084	1.808				
40.53	1.840	1.121	1.840				
11.22	1.865	1.150	1.865				
40.48	1.857	1.141	1.857	360	2.03E-03	1.47E-04	2.93E-08
157.05	1.823	1.101	1.823	317	2.22E-03	1.55E-04	3.37E-08
410.34	1.781	1.054	1.781	267	2.52E-03	8.56E-05	2.11E-08
500.09	1.760	1.030	1.760	2579	2.55E-04	1.23E-04	3.07E-09
589.77	1.727	0.992	1.727	14789	4.28E-05	1.94E-04	8.12E-10
1197.85	1.564	0.803	1.564	1058	4.90E-04	1.41E-04	6.78E-09
2394.07	1.451	0.673	1.451	614	7.27E-04	4.97E-05	3.54E-09
589.78	1.490	0.717	1.490				
157.05	1.548	0.785	1.548				
40.53	1.615	0.862	1.615				
11.22	1.669	0.925	1.669				

Note:

Consolidation loading and unloading schedule assigned by the client.

cv and k are approximate only based on t₉₀ estimated from Square Root of Time Method (ASTMD2435/2435M)

Specimen swelled under 11.22 kPa.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.67	Unit Weight, kN/m ³	18.76
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m ³	13.81
Area, cm ²	31.50	Specific Gravity, measured	2.71
Volume, cm ³	52.58	Solids Height, cm	0.867
Water Content, %	35.87	Volume of Solids, cm ³	27.32
Wet Mass, g	100.60	Volume of Voids, cm ³	25.26
Dry Mass, g	74.04		

Prepared By: LH

Golder Associates

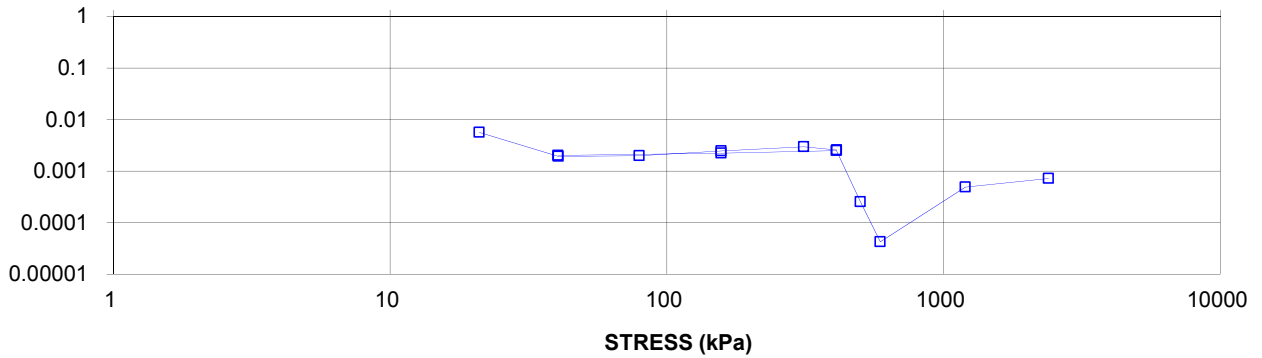
Checked By: TZ

CONSOLIDATION TEST SUMMARY

FIGURE E-13B

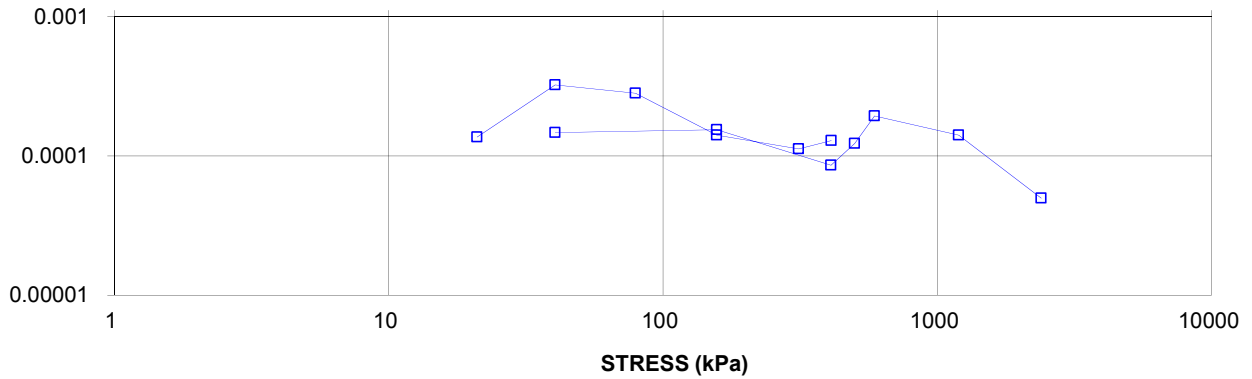
COEFFICIENT OF CONSOLIDATION,
cm²/s

CONSOLIDATION TEST
CV cm²/s VS STRESS (kPa)
BH 89UP-06 TO 24



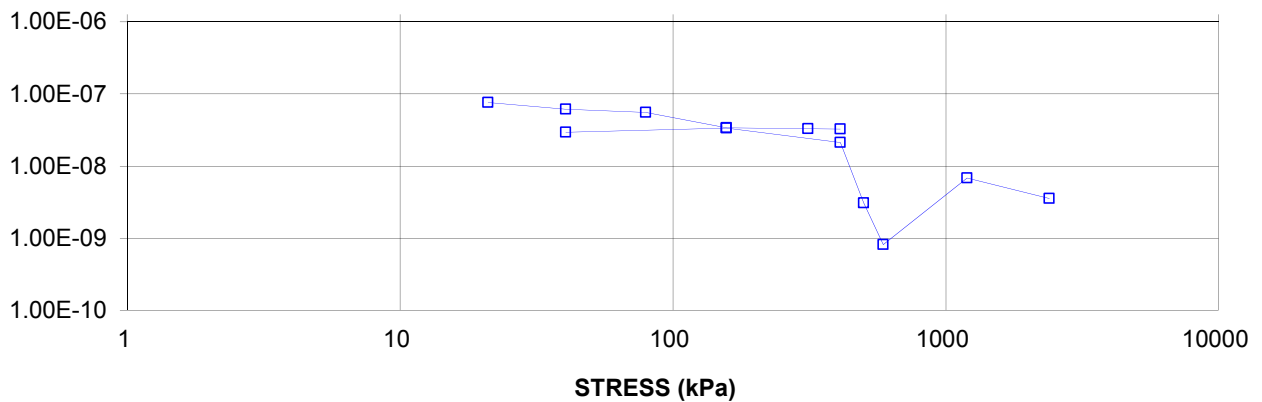
VOLUME COMPRESSIBILITY, m²/kN

CONSOLIDATION TEST
MV m²/kN vs STRESS (kPa)
BH 89UP-06 TO 24



HYDRAULIC CONDUCTIVITY,
cm/s

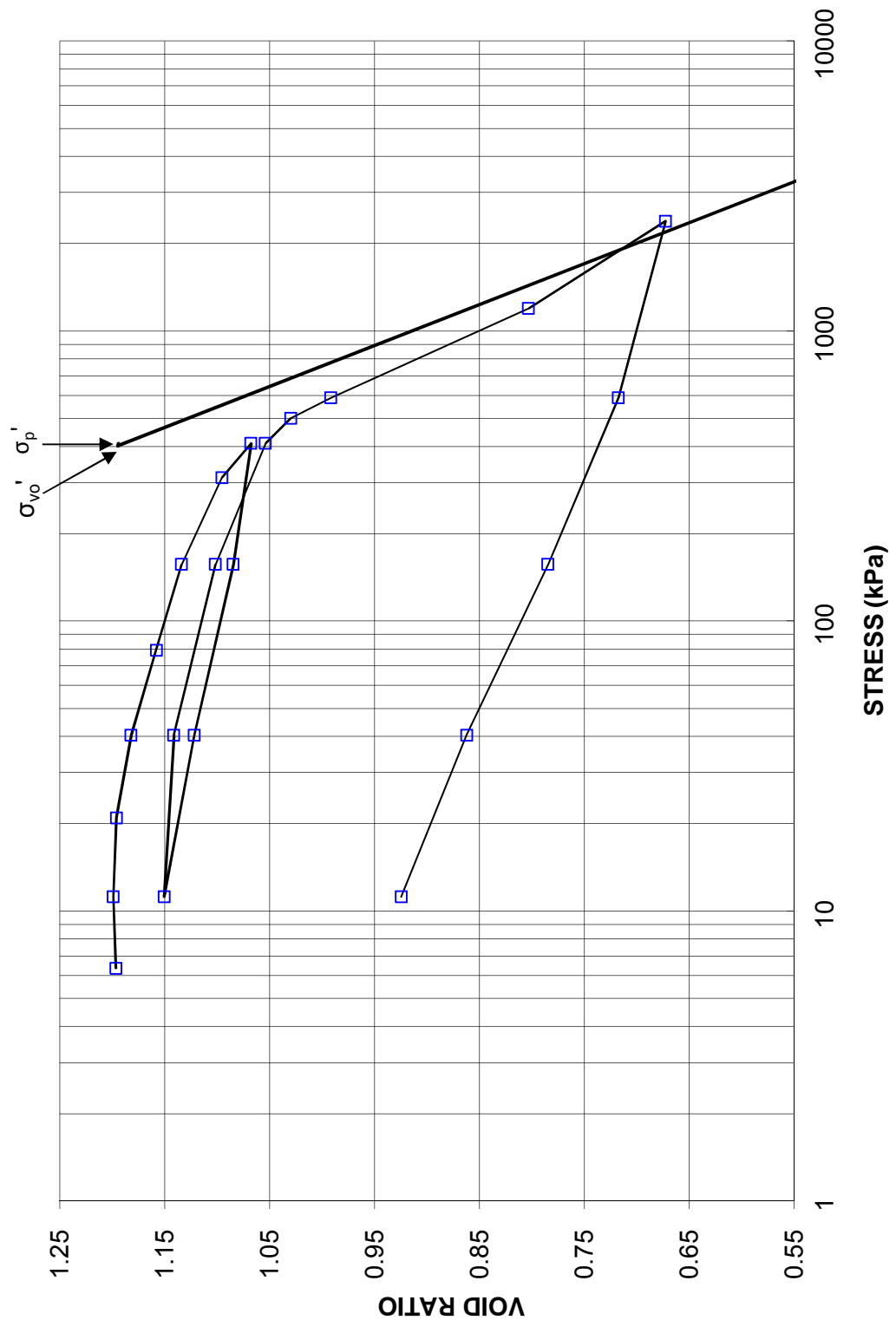
CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH 89UP-06 TO 24



**CONSOLIDATION TEST
VOID RATIO VS LOG STRESS**

FIGURE E-13C

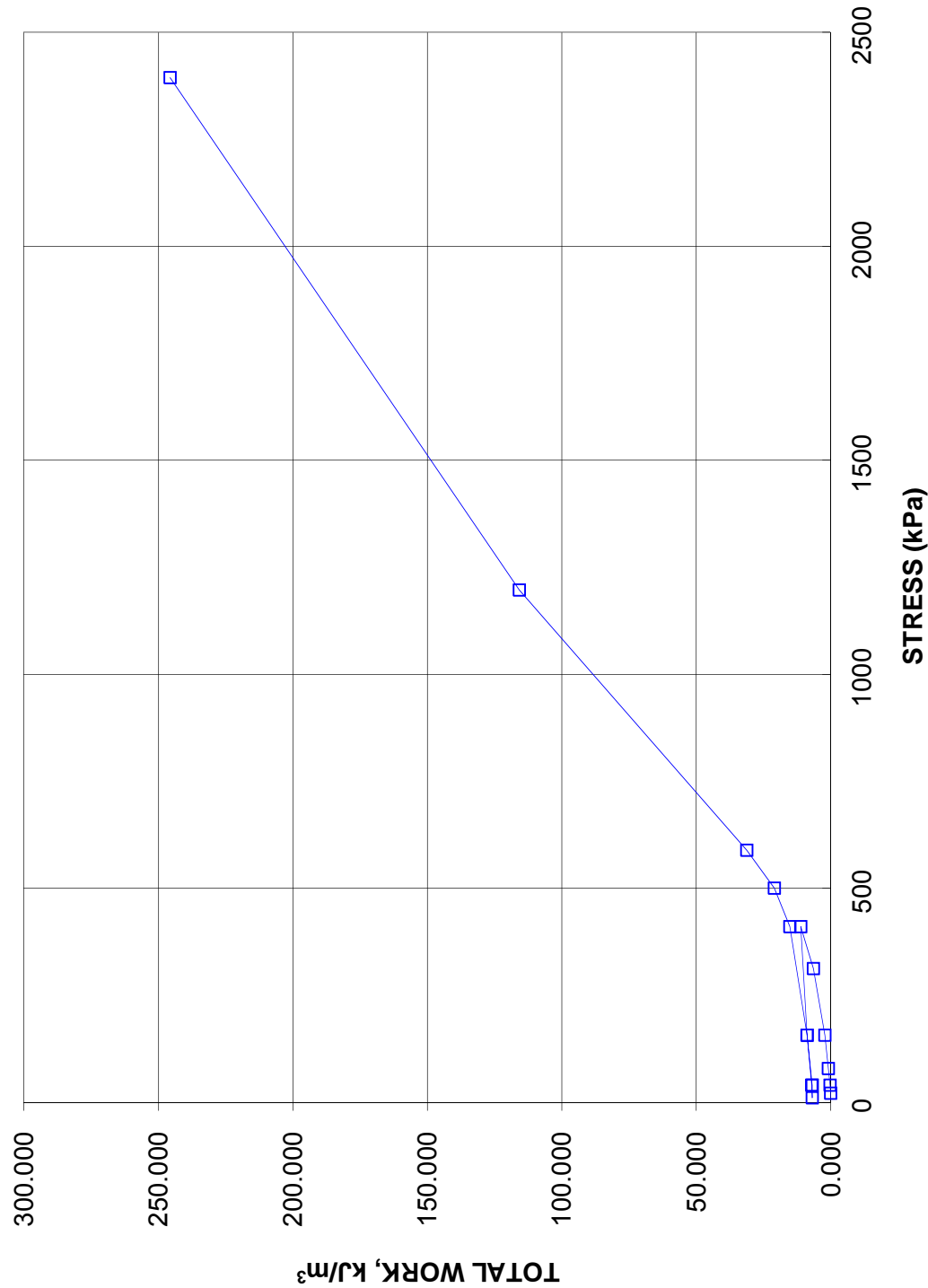
**CONSOLIDATION TEST
VOID RATIO vs STRESS
BH 89UP-06 TO 24**



CONSOLIDATION TEST
TOTAL WORK VS STRESS

FIGURE E-13D

CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs STRESS
BH 89UP-06 TO 24



CONSOLIDATION TEST SUMMARY**FIGURE E-14A****ASTM D2435/D2435M****SAMPLE IDENTIFICATION**

Project Number	1668512(1000)	Sample Number	21
Borehole Number	89UP-07	Sample Depth, m	25.91-26.52

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	1		
Date Started	8/10/2017		
Date Completed			

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.52	Unit Weight, kN/m ³	18.81
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	14.14
Area, cm ²	31.53	Specific Gravity, measured	2.75
Volume, cm ³	79.52	Solids Height, cm	1.322
Water Content, %	33.08	Volume of Solids, cm ³	41.68
Wet Mass, g	152.54	Volume of Voids, cm ³	37.84
Dry Mass, g	114.62	Degree of Saturation, %	100.2

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
0.00	2.522	0.908	2.522				
6.13	2.522	0.908	2.522				
10.99	2.522	0.908	2.522				
20.78	2.518	0.905	2.518	94	1.43E-02	1.46E-04	2.04E-07
40.27	2.508	0.898	2.508	83	1.61E-02	2.03E-04	3.20E-07
79.18	2.494	0.886	2.494	85	1.55E-02	1.49E-04	2.26E-07
156.72	2.471	0.869	2.471	144	8.99E-03	1.19E-04	1.04E-07
251.41	2.447	0.851	2.447	240	5.29E-03	1.01E-04	5.23E-08
79.18	2.462	0.863	2.462				
20.78	2.478	0.874	2.478				
79.18	2.467	0.866	2.467	126	1.02E-02	7.40E-05	7.43E-08
201.81	2.450	0.853	2.450	135	9.43E-03	5.43E-05	5.02E-08
401.46	2.419	0.830	2.419	154	8.06E-03	6.10E-05	4.81E-08
696.30	2.368	0.791	2.368	390	3.05E-03	6.93E-05	2.07E-08
1391.19	2.188	0.655	2.188	821	1.24E-03	1.03E-04	1.24E-08
2780.90	2.061	0.559	2.061	694	1.30E-03	3.61E-05	4.60E-09
695.70	2.093	0.583	2.093				
201.83	2.137	0.616	2.137				
79.18	2.169	0.641	2.169				

Note:

Consolidation loading and unloading schedule assigned by the client.

cv and k are approximate only based on t₉₀ estimated from Square Root of Time Method (ASTMD2435/2435M)

Specimen taken 18-22cm from bottom of the tube.

Specimen swelled under 10.99 kPa.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.17	Unit Weight, kN/m ³	20.98
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	16.44
Area, cm ²	31.53	Specific Gravity, measured	2.75
Volume, cm ³	68.39	Solids Height, cm	1.322
Water Content, %	27.65	Volume of Solids, cm ³	41.68
Wet Mass, g	146.31	Volume of Voids, cm ³	26.71
Dry Mass, g	114.62		

Prepared By: LH

Golder Associates

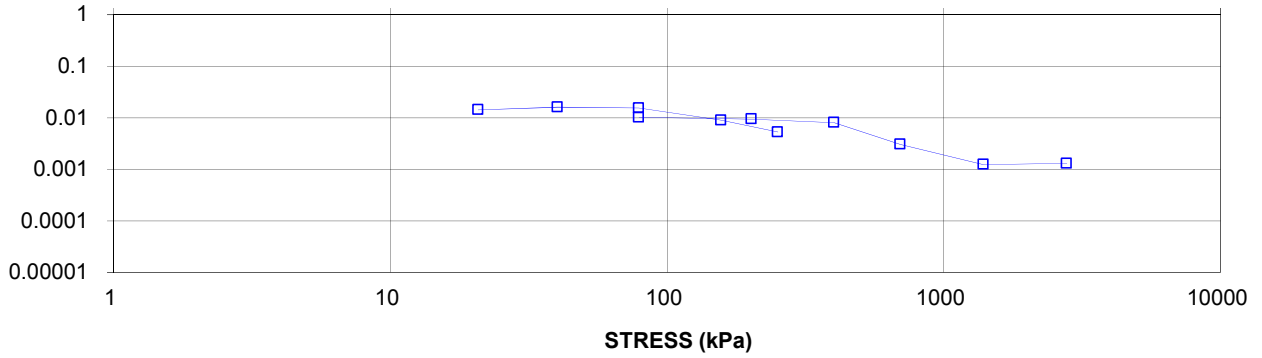
Checked By: TZ

CONSOLIDATION TEST SUMMARY

FIGURE E-14B

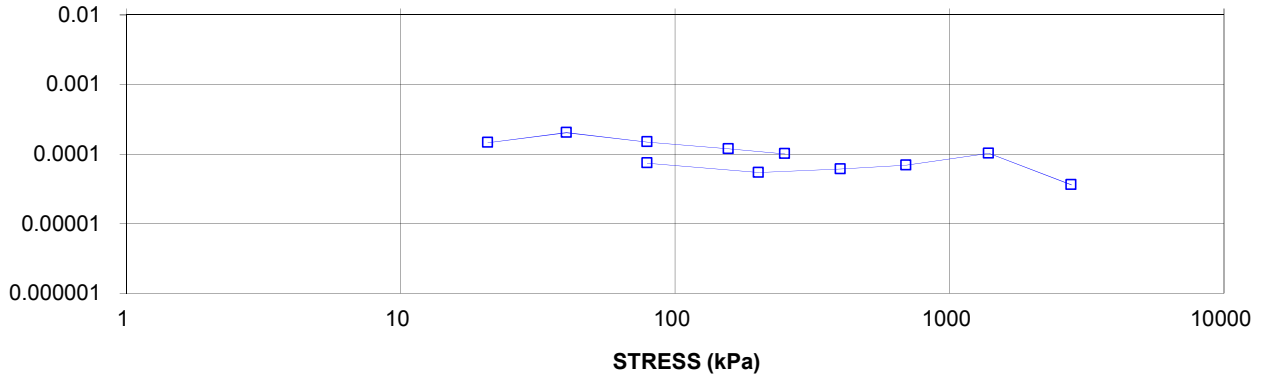
COEFFICIENT OF CONSOLIDATION,
cm²/s

CONSOLIDATION TEST
CV cm²/s VS STRESS (kPa)
BH 89UP-07 TO 21



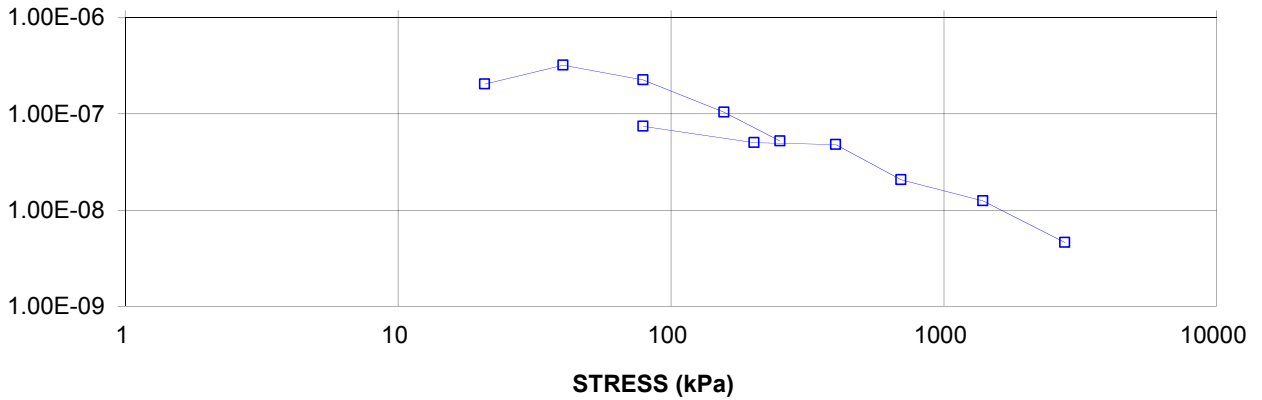
VOLUME COMPRESSIBILITY, m²/kN

CONSOLIDATION TEST
MV m²/kN vs STRESS (kPa)
BH 89UP-07 TO 21



HYDRAULIC CONDUCTIVITY,
cm/s

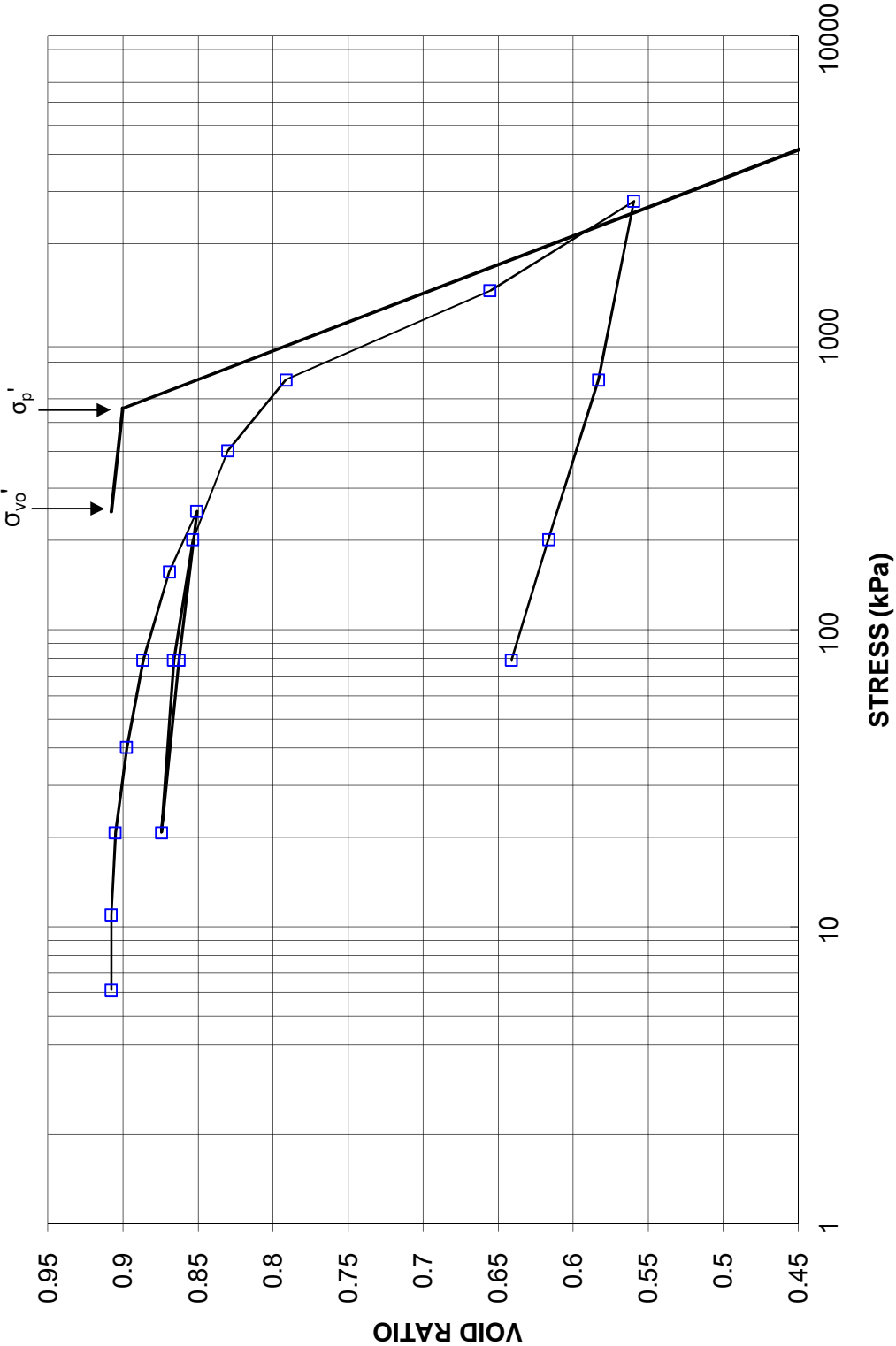
CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH 89UP-07 TO 21



CONSOLIDATION TEST
VOID RATIO VS LOG STRESS

FIGURE E-14C

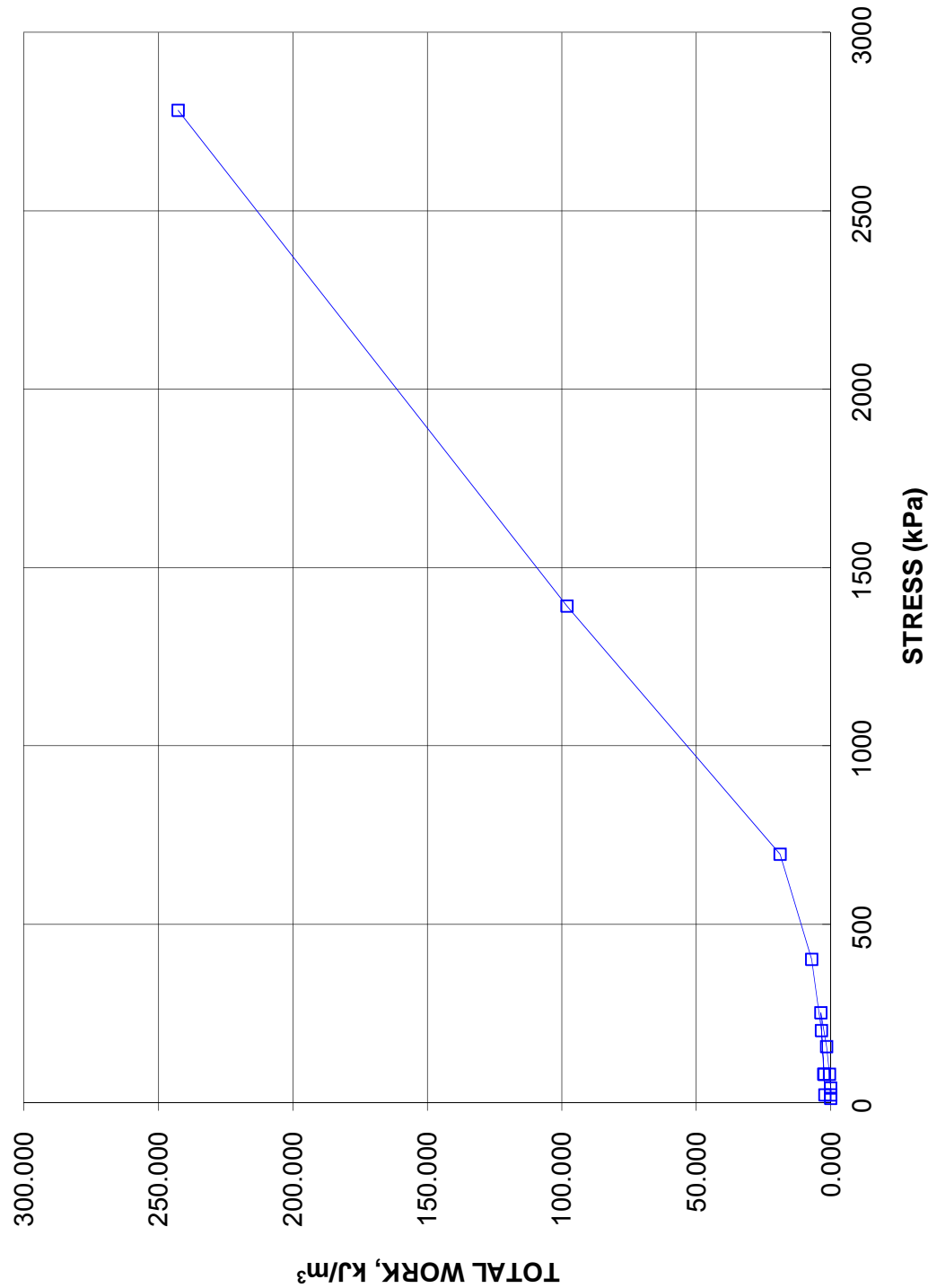
CONSOLIDATION TEST
VOID RATIO vs STRESS
BH 89UP-07 TO 21



CONSOLIDATION TEST
TOTAL WORK VS STRESS

FIGURE E-14D

CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs STRESS
BH 89UP-07 TO 21



CONSOLIDATION TEST SUMMARY**ASTM D2435/D2435M****FIGURE E-15A****SAMPLE IDENTIFICATION**

Project Number	1668512(1000)	Sample Number	22
Borehole Number	HF-07	Sample Depth, m	27.68-27.86

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	7		
Date Started	8/24/2017		
Date Completed	9/15/2017		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.89	Unit Weight, kN/m ³	18.57
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m ³	13.80
Area, cm ²	31.50	Specific Gravity, measured	2.74
Volume, cm ³	59.53	Solids Height, cm	0.971
Water Content, %	34.54	Volume of Solids, cm ³	30.58
Wet Mass, g	112.73	Volume of Voids, cm ³	28.95
Dry Mass, g	83.79	Degree of Saturation, %	100.0

Stress	Corr. Height	Void Ratio	Average Height	t ₉₀	cv.	mv	k
kPa	cm		cm	sec	cm ² /s	m ² /kN	cm/s
0.00	1.890	0.947	1.890				
5.89	1.889	0.946	1.889				
10.76	1.890	0.947	1.890				
20.56	1.887	0.944	1.887	148	5.10E-03	1.57E-04	7.83E-08
40.07	1.880	0.937	1.880	296	2.53E-03	1.84E-04	4.58E-08
78.97	1.865	0.921	1.865	358	2.06E-03	2.08E-04	4.20E-08
156.69	1.844	0.899	1.844	279	2.58E-03	1.46E-04	3.70E-08
250.94	1.819	0.873	1.819	420	1.67E-03	1.40E-04	2.30E-08
78.97	1.833	0.888	1.833				
20.68	1.850	0.905	1.850				
78.98	1.836	0.891	1.836	231	3.09E-03	1.25E-04	3.80E-08
156.69	1.827	0.881	1.827	208	3.40E-03	6.47E-05	2.16E-08
320.97	1.804	0.858	1.804	148	4.66E-03	7.25E-05	3.31E-08
450.98	1.783	0.837	1.783	427	1.58E-03	8.55E-05	1.32E-08
900.82	1.656	0.706	1.656	667	8.72E-04	1.49E-04	1.27E-08
1999.97	1.544	0.590	1.544	390	1.30E-03	5.42E-05	6.87E-09
450.88	1.573	0.621	1.573				
78.97	1.621	0.670	1.621				
10.76	1.690	0.740	1.690				

Note:

Consolidation loading and unloading schedule assigned by the client.

cv and k are approximate only based on t₉₀ estimated from Square Root of Time Method (ASTMD2435/2435M)

Specimen swelled under 10.99 kPa.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.69	Unit Weight, kN/m ³	19.70
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m ³	15.44
Area, cm ²	31.50	Specific Gravity, measured	2.74
Volume, cm ³	53.22	Solids Height, cm	0.971
Water Content, %	27.62	Volume of Solids, cm ³	30.58
Wet Mass, g	106.93	Volume of Voids, cm ³	22.64
Dry Mass, g	83.79		

Prepared By: LH

Golder Associates

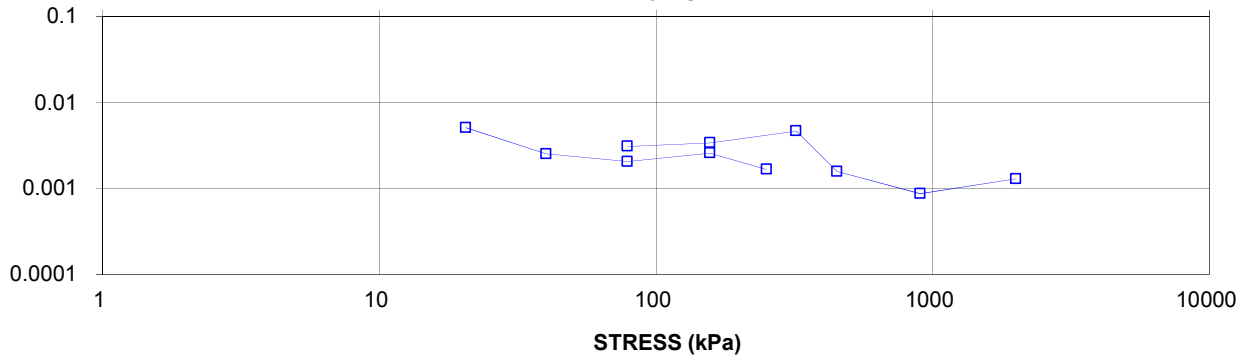
Checked By: TZ

CONSOLIDATION TEST SUMMARY

FIGURE E-15B

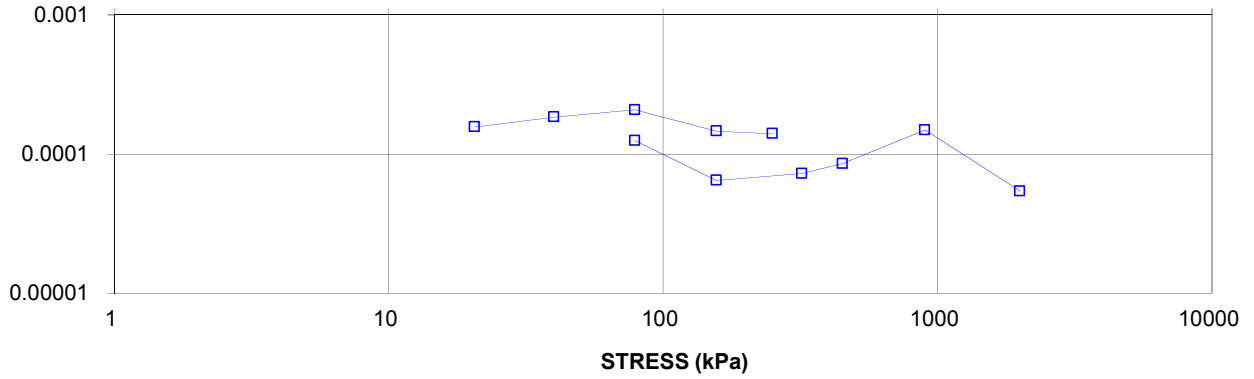
COEFFICIENT OF CONSOLIDATION,
cm²/s

CONSOLIDATION TEST
CV cm²/s VS STRESS (kPa)
BH HF-07 SA 22



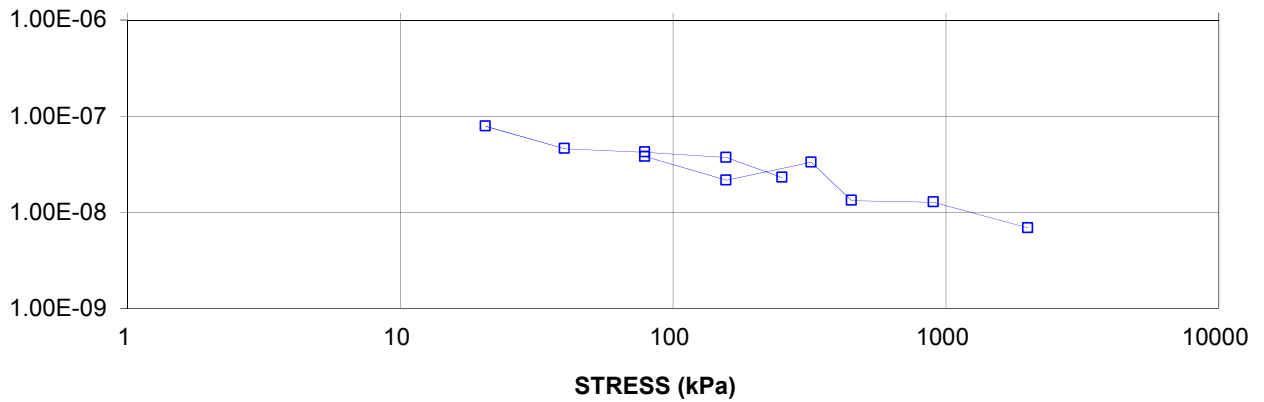
VOLUME COMPRESSIBILITY, m²/kN

CONSOLIDATION TEST
MV m²/kN vs STRESS (kPa)
BH HF-07 SA 22



HYDRAULIC CONDUCTIVITY,
cm/s

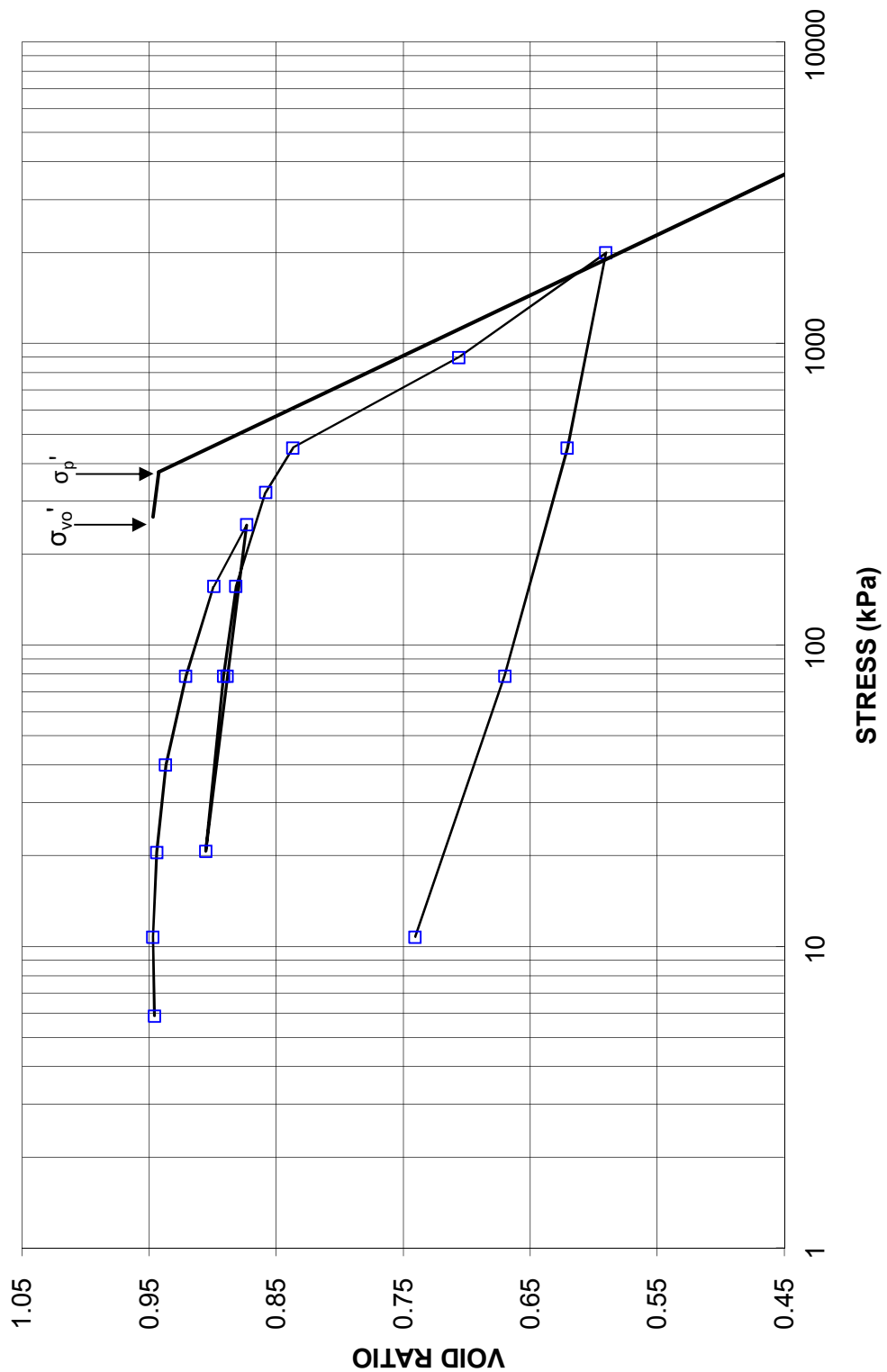
CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH HF-07 SA 22



CONSOLIDATION TEST
VOID RATIO VS LOG STRESS

FIGURE E-15C

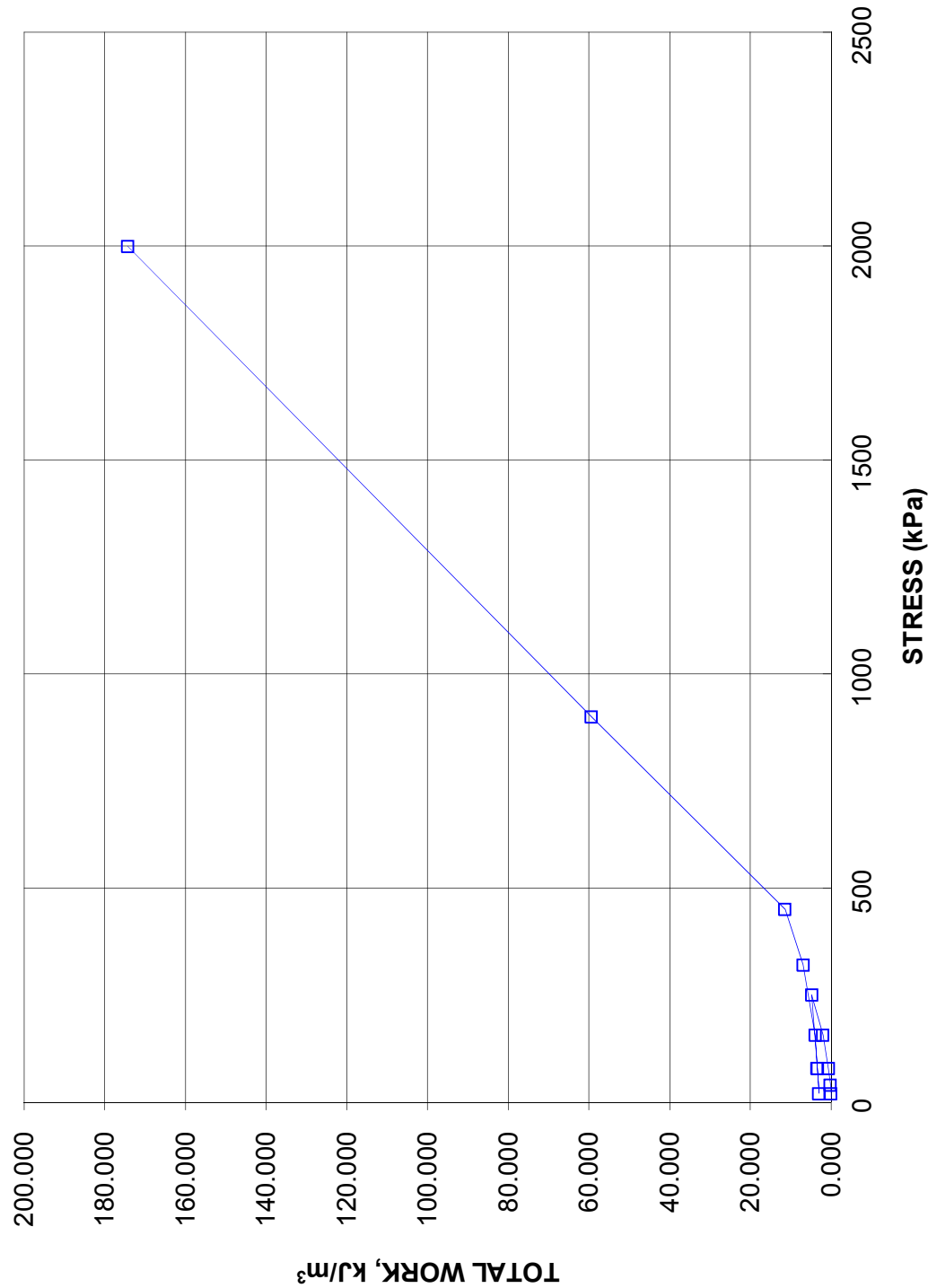
CONSOLIDATION TEST
VOID RATIO vs STRESS
BH HF-07 SA 22



CONSOLIDATION TEST
TOTAL WORK VS STRESS

FIGURE E-15D

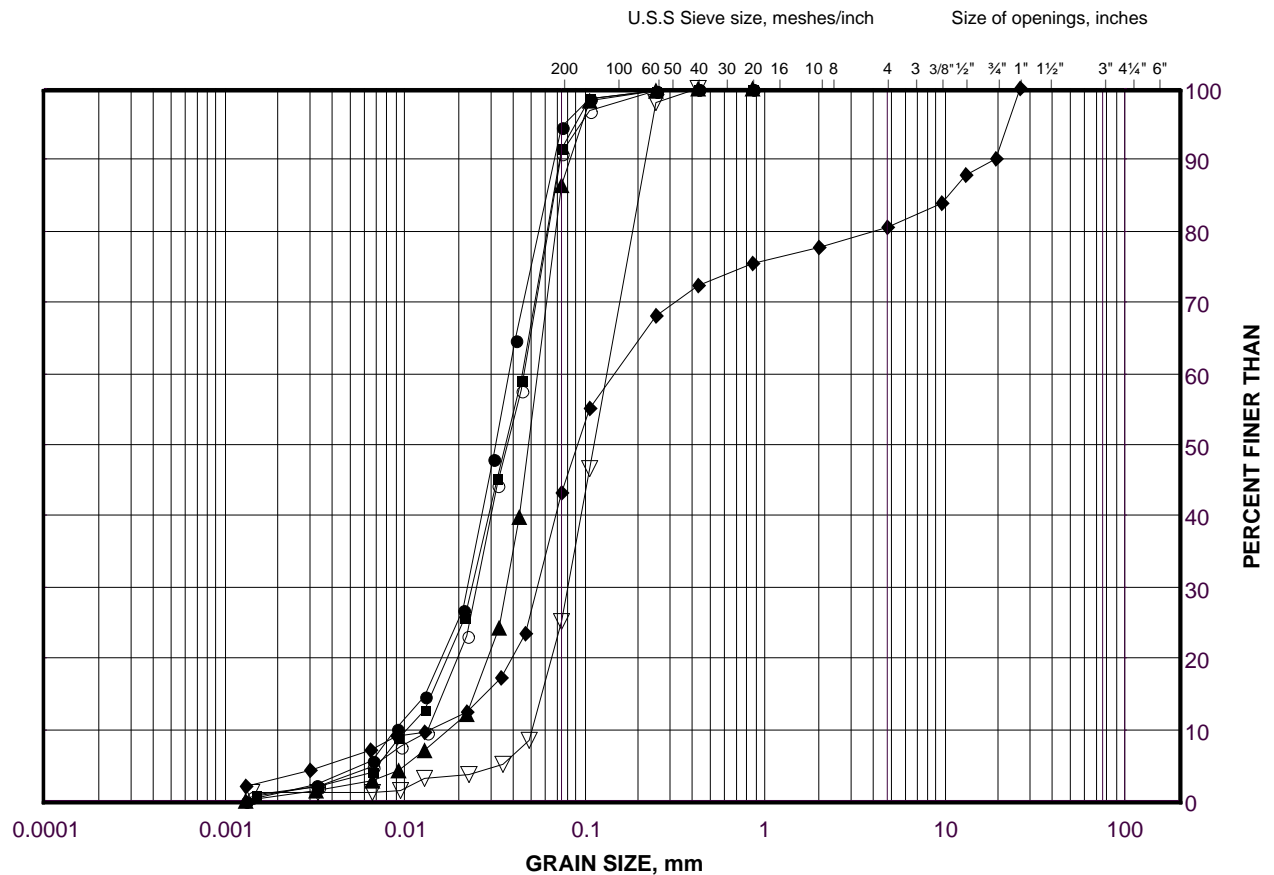
CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs STRESS
BH HF-07 SA 22



GRAIN SIZE DISTRIBUTION

Silt to Silt and Sand to Silty Sand (Lower Granular Deposit)

FIGURE E-16



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-04	21	190.9
■	89UP-05	21	193.8
◆	89UP-07	25	194.9
▲	89UP-03	26	193.6
▽	HF-02	27	192.1
○	89UP-02	29	190.9

Project Number: 1668512

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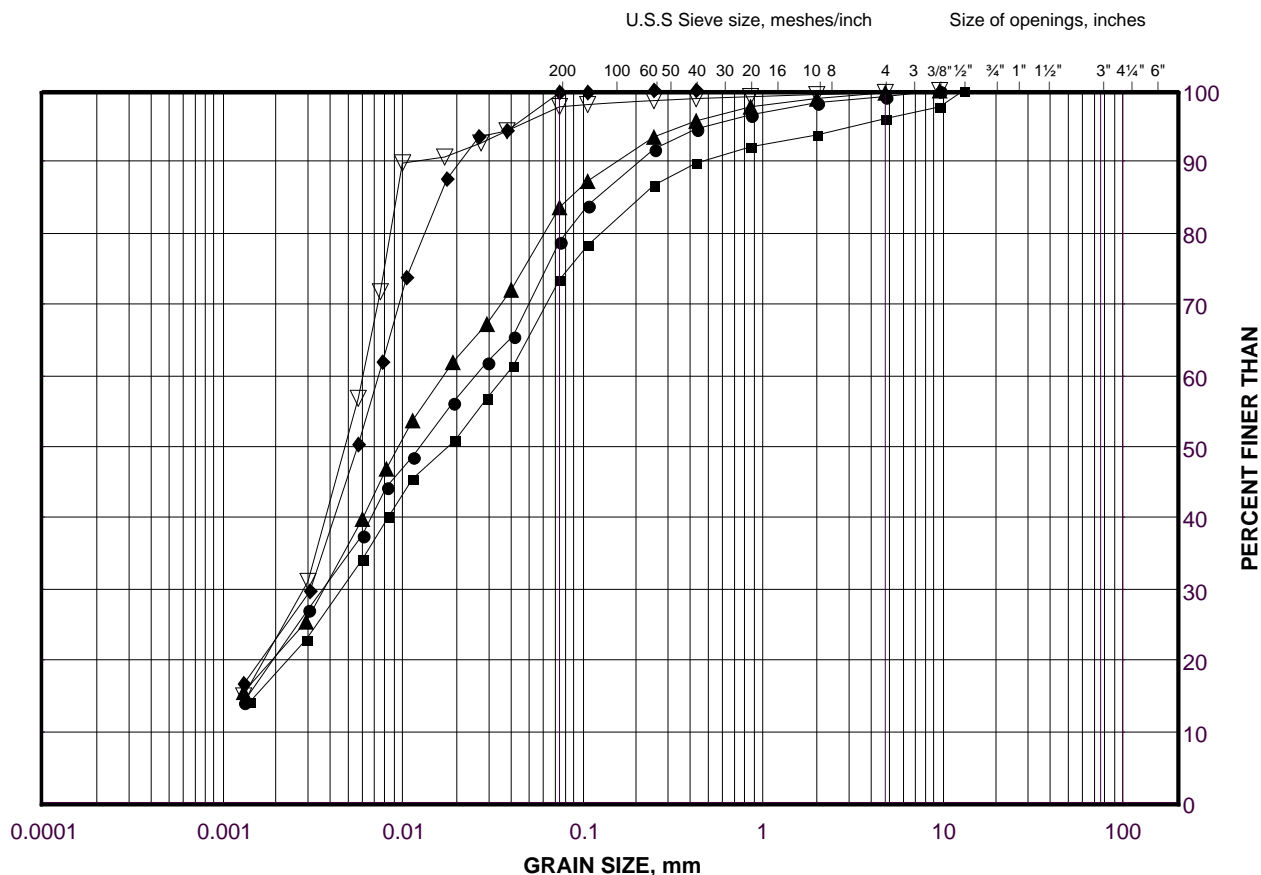
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Date: 24-Apr-18

GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Clayey Silt (Lower Cohesive Deposit)

FIGURE E-17



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

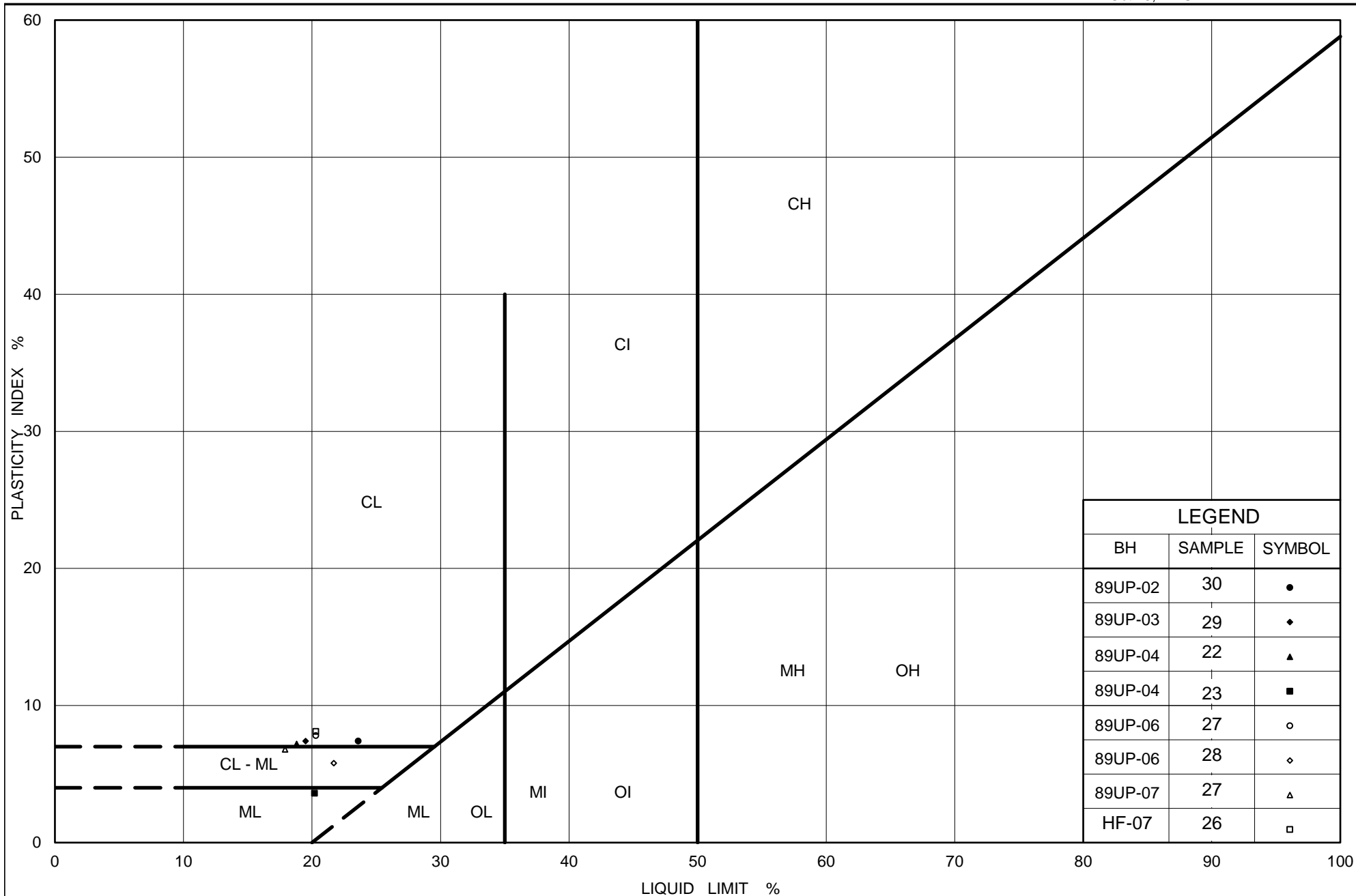
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-04	22	187.8
■	89UP-07	27	188.8
◆	89UP-06	28	186.3
▲	89UP-03	29	184.4
▽	89UP-02	30	187.9

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PLASTICITY CHART Silt to Sandy Clayey Silt to Clayey Silt (Lower Cohesive Deposit)

Figure No. E-18

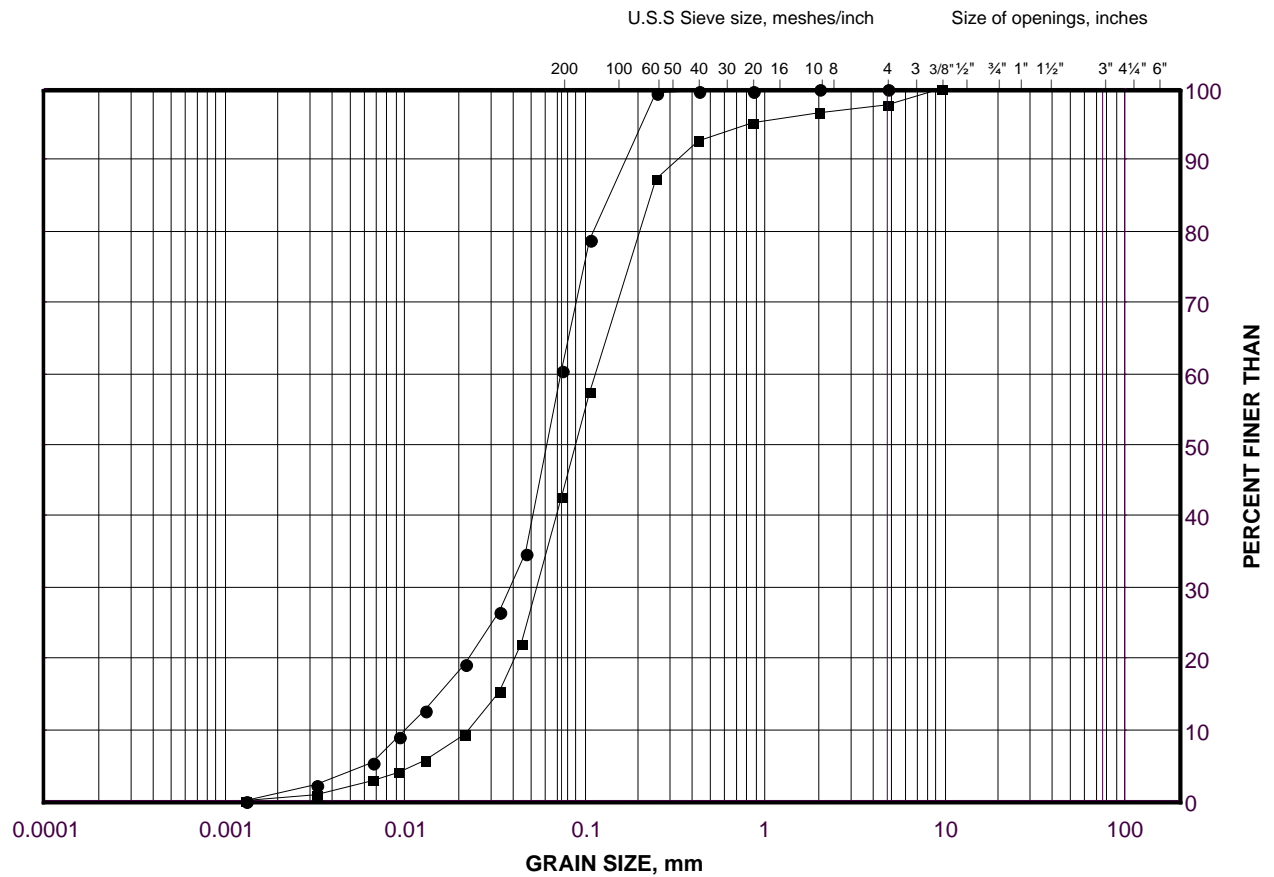
Project No. 1668512

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GRAIN SIZE DISTRIBUTION

Silt and Sand (Till)

FIGURE E-19



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-07	29	182.9
■	89UP-03	31	178.3

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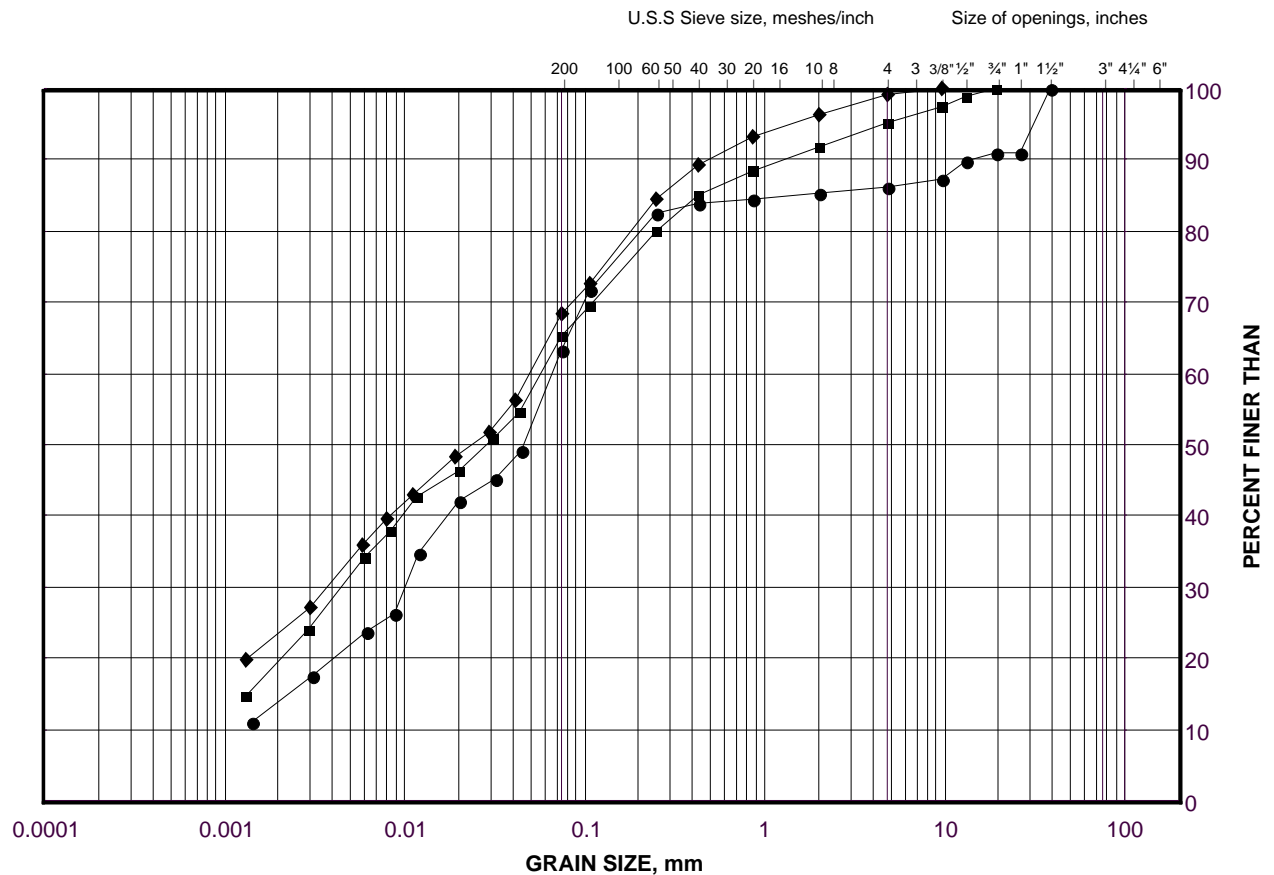
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GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand (Till)

FIGURE E-20



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

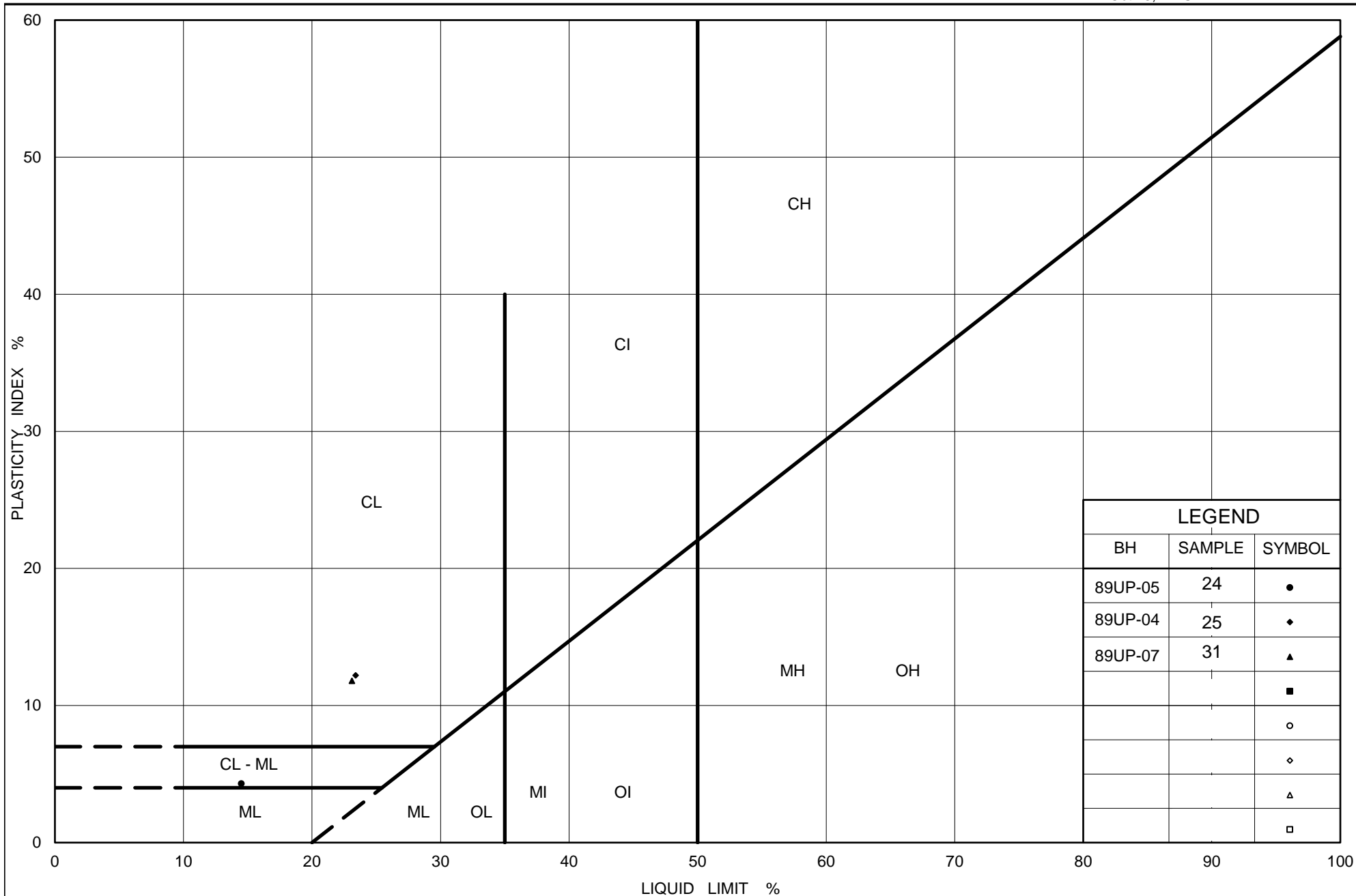
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	89UP-05	24	184.7
■	89UP-04	25	178.9
◆	89UP-07	31	176.8

Project Number: 1668512

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Date: 24-Apr-18



Ministry of Transportation

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PLASTICITY CHART

Clayey Silt with Sand (Till)

Figure No. E-21

Project No. 1668512

Checked By: SMM

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For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario, L5N 7K2
Canada
T: +1 (905) 567 4444

