



FINAL REPORT

FOUNDATION INVESTIGATION REPORT

**Supplementary Foundation Investigation for RFP Stage of DB Calamity Creek
Culvert Replacement, Highway 11, New Liskeard Area, Ontario**

Agreement No. 5015-E-0007

Assignment No. 8

GWP 5159-12-00

Geocres No: 31M-1216

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Ontario Ministry of Transportation

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1 FOUNDATION INVESTIGATION REPORT

1.1 Introduction

This report presents the results of a supplementary geotechnical investigation completed by **exp** Services Inc. as part of the Request for Proposal (RFP) phase for a Design-build (DB) project for Calamity Creek Culvert replacement on Highway 11, in the vicinity of New Liskeard. The work was undertaken under Agreement No. 5015-E-0007, Assignment No. 8. The terms of reference (TOR) were as presented in MTO's letter dated September 26, 2017.

The purpose of the investigation was to investigate soil conditions at the locations specified by the RFP respondents (Proponents) in order to provide additional information during the RFP stage of the DB Contract for replacement of Calamity Creek Culvert (Contract 2017-5003). Based on the supplement investigations requested by the Proponents, the field program comprised the following:

- a) Three (3) vertical boreholes to be drilled and sampled on the west side of Highway 11
- b) One (1) angled borehole to be drilled from an accessible position on the embankment slope toward the roadway centerline to assess potential presence of any obstacles along the proposed culvert alignment as shown in the Draft Structural Design Report (December 2016) prepared by MMM Group Limited
- c) Three (3) Cone Penetration Tests (CPTu) to be performed on the west side of Highway 11

This site specific geotechnical investigation consisted of visual inspections, drilling, in-situ soil testing, soil sampling, and laboratory testing. The previous foundation investigation reports from the Geocres library, which were conducted at this site by others, are listed in Section 1.3.2 below.

This foundation investigation report has been prepared specifically and solely for the project described herein. It contains a borehole location plan, records of boreholes, stratigraphic profile, in-situ test results, laboratory test results and a written description of the subsurface conditions developed based on data of this supplementary investigation and data available from previous foundation investigations performed at the site. The records obtained from a distance away are not included in the stratigraphic profile, but their borehole logs are included in Appendix E. It should be noted that accuracy and quality of the subsurface information provided in the previous reports prepared by the others are exclusively their responsibility.

1.2 Site Description and Geological Setting

1.2.1 Site Description

The existing Calamity Creek Culvert is located on Highway 11 (Sta. 17+645), about 2.9 km north of the north junction of Highway 11 and Highway 65, in the vicinity of New Liskeard, Ontario. At the site, Highway 11 is a two lane highway with a rural cross-section and gravel shoulders. Based on the Geocres reports and the drawing provided by MTO, the roadway embankment above the top of the culvert is about 16.3 m high with side slopes of about 2H:1V for the upper 6 m of embankment and

flatter below this level (~8H:1V). The elevation of highway pavement centerline at the site is about 213.7 m.

Based on the information provided by MTO, the existing culvert is a concrete box culvert with 3.05 m x 2.45 m at the inlet and approximately 236 m long having non-linear arrangement (5 bends along the alignment) with a generally northeast to southwest direction. It is also understood that the invert elevation of the new culvert will be at similar to the existing culvert, i.e. at Elev. 194.15 m and 196.77 m for outlet and inlet, respectively. Selected photographs of the site and existing culvert are presented in Appendix A. The site plan and cross-section profile are shown on Drawing 1 attached in Appendix B.

Highway 11 generally runs in a north-south direction. The terrain is generally rolling to gently undulating with some grass and shrubs and occasional stands of deciduous and coniferous trees along the banks of the creek. The Calamity Creek flows in an east to west direction through a deep V-shaped valley and drains into the Wabi River. At the time of this investigation, the water level in creek at inlet and outlet of the existing culvert were about Elev. 197.8 m and 192.7 m, respectively. Erosion and surficial slumps, likely reflecting activity during high flow and rapid drawdown of the creek water level, were noted near the inlet and outlet of the existing culvert. However, no groundwater seepage through embankment were observed at the time of this investigation.

1.2.2 Geological Setting

According the Ministry of Northern Development and Mines, Map 2555 (Quaternary Geology of Ontario, East-Central Sheet, 1991) the surface conditions in the vicinity of the project area consists of Glaciolacustrine deposits, which includes silt and clay, minor sand, basin and quiet water deposits and according to Map 2543 (Bedrock Geology of Ontario, East-Central Sheet, 1991), the bedrock within the site area consists of the Thornloe/ Earlton Formation of Middle and Lower Silurian age. The Thornloe/Earlton Formation consists of sandstone, shale, dolostone and siltstone.

1.3 Investigation Procedures

1.3.1 Site Investigation and Field Testing

The supplementary field investigation was performed between November 7, 2017 and November 24, 2017. Based on the supplemental investigations requested by the Proponents, the field program consisted of drilling three (3) sampled vertical boreholes (BH17-2 to BH17-4), one (1) non-sampled angled borehole (BH17-1) and three (3) cone penetration tests (CPT17-P1 to CPT17-P3).

The borehole and CPT locations are shown on Drawing 1 in Appendix B. In addition, Table A1-1 below summarizes the borehole and CPT locations, ground surface elevations and depths:

Table A1-1: Borehole and CPT hole information

Borehole	Location		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing	Easting		
BH17-1 (Angled)	5269370.9	404509.3	205.7	33.0 ⁽¹⁾
BH17-2 (Vertical)	5269354.7	404513.4	207.5	20.4
BH17-3 (Vertical)	5269357.9	404535.9	213.8	27.5
BH17-4 (Vertical)	5269311.5	404470.5	201.1	15.9
CPT17-P1	5269370.9	404529.4	213.6	9.3 ⁽²⁾
CPT17-P2	5269330.2	404507.3	204.9	19.4
CPT17-P3	5269298.6	404475.6	202.0	17.1

Notes:

⁽¹⁾-represents the length drilled along the angled path of the borehole

⁽²⁾-CPT17-P1 was prematurely terminated, penetration of cone was obstructed probably by a boulder or cobble

The borehole locations (referenced to the NAD83/MTM Zone 12 coordinate system) and their ground surface elevations were surveyed by **exp's** personnel, with reference to a Temporary Benchmark set at previous boreholes BH16-7 and top of pavement at centerline of Highway 11 (Elev. 204.2 and 213.9 m, respectively).

Two vertical boreholes BH17-2 (up to 7.6 m depth) and BH17-4 were advanced using a portable tripod equipped with a portable hammer and NW casing. Boreholes BH17-3 and BH17-2 (below 7.6 m depth) were advanced using a track mounted CME-55 drill rig, equipped with a hollow stem auger and diamond bit NW casing. It should be noted that cobbles and boulders were encountered at a depth of 7.6 m below ground surface during drilling BH17-2 with the portable tripod equipment, therefore the farther advancement of BH17-2 was restricted. However, the borehole was advanced again up to the desired depth using the track mounted CME-55 drill rig. One angled borehole (BH17-1) drilled at this site was advanced using a portable horizontal drill (ODR -100). AQTk drill rods were used for anchoring, as well as bentonite and liquid polymer to prevent hole caving. All vertical borehole drilling and sampling operations were performed by Landcore Drilling, while drilling of the angled borehole was performed by Grandmont Drilling Inc. The CPT soundings were performed by ConeTec Investigations Ltd.

During drilling of vertical boreholes using the portable tripod or CME-55 drill rig, soil samples were obtained using a 51 mm outside diameter (O.D.) split-spoon sampler in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586) at intervals ranging from 0.75 m to 1.5 m in depth as shown on the attached borehole logs (Appendix C). The original field (uncorrected) SPT "N" values were recorded on the borehole logs as recommended in the Canadian Foundation Engineering Manual (CFEM, pg. 40) and used to provide an assessment of in-situ relative density of non-cohesive soils. Since the conventional hammer of 140-pound (63.5 kg) weight was used for the portable tripod the

blow counts were not factored. The angled borehole BH17-1 was not sampled; only the penetration rate was recorded.

Since a wash boring technique was used to drill vertical boreholes, the ground water level was not measured in open boreholes upon completion of drilling. Monitoring wells installed during previous investigations were also damaged/discarded, so no groundwater level measurements were able to be carried out in those wells. However, ground water levels were recorded in the CPTu holes. The boreholes were decommissioned by bentonite/cement mixtures in accordance with the Ministry of the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the *Ontario Water Resources Act*).

The fieldwork was supervised by an **exp** geotechnical representative who directed drilling and sampling operations, logged borehole data in accordance with MTO and/or ASTM Standards for Soils Classification, and retrieved soil samples for subsequent laboratory testing and identification.

All recovered soil samples were placed in labelled moisture-proof bags and returned to **exp**'s Sudbury laboratory for additional visual, textual, olfactory examination and selective testing.

The cone penetration tests (CPTu) were conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd. of Richmond, British Columbia, Canada. The tests were carried out in general accordance with the current ASTM D 5778 standard. The detailed field testing procedures are presented in the CPTu report attached in Appendix F.

1.3.2 Previous Investigations

The following previous/historical investigation reports were obtained from MTO's Geocres Library:

- Foundation Investigation and Design Report for Calamity Creek Culvert Replacement on Hwy 11, 2.9 km north of north junction of Hwy 11 and Hwy 65; G.W.P. 5159-12-00; Agreement # 5013-E-0031; Site No. 47-273/C; Geocres No. 31M-119; Thurber Engineering Ltd. (Thurber); June 2017.
- Preliminary Foundation Investigation and Design Report for Calamity Creek Culvert, Hwy 11, Agreement # 5013-E-0018; Site No. 47-273/C; Geocres No. 31M-109; Terraprobe Inc. (Terraprobe); April 11, 2016.
- Exploratory Boreholes, W.P. 147-98-00, Agreement # PO5005A000062; Geocres No. 31M-66; Shaheen & Peaker Limited (S&P); December 1999.

The details of the boreholes completed by Thurber (2017), Terraprobe (2016) and S&P (1999) at the site location are outlined in Table A2-1 and the borehole locations are shown on Drawing 1 in Appendix B. The borehole logs and laboratory test results completed by Thurber, Terraprobe and S&P are included in Appendix E.

Table A2-1. Summary of boreholes completed by Thurber, Terraprobe and S&P

BH No.⁽¹⁾	Ground Elevation (m)	Borehole Depth (m)	Borehole Bottom Elevation (m)	Piezometer/ Monitoring Well
16-01 (Thurber)	194.3	8.8	185.5	Vibrating Wire Piezometer
16-02 (Thurber)	200.5	14.7	185.8	None
16-03 (Thurber)	203.2	17.3	185.9	Standpipe Piezometer
16-04 (Thurber)	213.4	26.9	186.5	None
16-05 (Thurber)	204.0	15.7	188.3	Standpipe Piezometer
16-06 (Thurber)	198.1	9.7	188.4	Vibrating Wire Piezometer
16-07 (Thurber)	204.2	18.0	186.2	Vibrating Wire Piezometer
16-08 (Thurber)	206.9	19.1	187.8	Vibrating Wire Piezometer
BH1 (Terraprobe)	201.8	16.3	185.5	25 mm dia Standpipe Piezometer
BH3 (Terraprobe)	213.7	30.3	183.5	None
BH4 (Terraprobe)	213.9	30.0	183.9	None
BH5 (Terraprobe)	203.5	20.6	183.0	None
BH6 (Terraprobe)	197.7	15.2	182.5	25 mm dia Standpipe Piezometer
DB-3 (S&P)	213.9	26.6	187.3	Standpipe Piezometer
DB-4 (S&P)	213.8	21.9	181.9	None

Note: ⁽¹⁾ BH2 (Terraprobe) and DB1, DB2, DB5 (S&P) from Geocres reports were not drilled in the vicinity of the investigation locations required by the Proponents. Hence, these boreholes are not provided in this report.

1.3.3 Laboratory Testing

All samples returned to the laboratory were subjected to visual examination and classification. The laboratory testing program included determinations of natural moisture content, particle size distribution for approximately 25% of collected soil samples. Atterberg Limits tests were carried out on selected cohesive soil samples. All laboratory tests were carried out in accordance with MTO and/or ASTM standards as appropriate.

The laboratory test results are provided on the attached borehole log sheets in Appendix C. The results of grain size analyses and Atterberg Limits tests are presented graphically in Appendix D .

1.4 Subsurface Conditions

Detailed subsurface soil conditions encountered in the vertical boreholes advanced during this investigation are presented on the borehole log sheets in Appendix C, while detailed subsurface soil and groundwater conditions encountered during CPTu are presented in the ConeTec's report attached in Appendix F. The borehole logs from the Geocres reports are presented in Appendix E. The

“Explanation of Terms Used in Report” preceding the borehole logs in Appendix C forms an integral part of and should be read in conjunction with this report, as well as the ConeTec’s report attached in Appendix F.

A borehole/CPT hole location plan and stratigraphic section at the site is provided in Appendix B. It should be noted that the stratigraphic boundaries indicated on the borehole logs and stratigraphic section are inferred from non-continuous sampling, observations of drilling progress and results of Standard Penetration Tests (SPT) and Cone Penetration Tests (CPTu). These boundaries typically represent transitions from one soil type to another and should not be regarded as exact planes of geological change. Further, subsurface conditions may vary between and beyond the borehole locations.

The geological stratigraphy noted in the boreholes conducted by Thurber, Terraprobe and S&P were in general agreement with the ground conditions encountered during the current investigation.

In general, the stratigraphic sequence at the site consists of embankment fill (consist of sand to gravelly sand fill, silty sand to clayey sand fill and silty clay/clayey silt to clay fill) overlying a deposit of predominantly varved silty clay to clay over a thin deposit of clayey sand/clayey silt till over bedrock.

A detailed description of the stratigraphy encountered is discussed further in subsequent sections. It should be noted that the following sections are based on the geotechnical investigations conducted by **exp**, Thurber, Terraprobe and S&P.

1.4.1 Asphalt

Asphalt was encountered at the surface of boreholes BH17-3, 16-4, BH-3, BH-4, DB3 and DB4. The thickness of asphalt ranges from about 0.1 m to 0.125 m. It was also encountered buried below granular fill in boreholes 16-4, BH-3 and DB3. The thickness of buried asphalt encountered below granular ranges from 0.07 m to 0.3 m. Asphalt thicknesses may further vary beyond the borehole locations.

1.4.2 Topsoil

Topsoil was encountered at the surface of all off-road boreholes i.e. BH17-2, BH17-4, 16-1 to 16-3, 16-5 to 16-8. The thickness of topsoil ranges from 0.05 m to 0.1 m. Topsoil thicknesses may further vary beyond the borehole locations.

1.4.3 FILL: Sand to Gravelly Sand

A sand to gravelly sand fill layer was encountered below asphalt in boreholes BH17-3, 16-4, BH-3, BH-4, DB-3 and DB-4. The approximate elevations of the surface and base of the fill and the thickness of fill as encountered in boreholes are summarized in Table A3-1 below:

Table A3-1. Summary of sand to gravelly sand fill layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH17-2	207.4	204.5	0.1	3.0
BH17-3	213.7	207.7	0.2	5.9
16-4	213.1/212.2 ⁽¹⁾	212.5/211.1 ⁽¹⁾	0.3/1.2 ⁽¹⁾	0.6/1.1 ⁽¹⁾
BH-3	213.4/212.6 ⁽¹⁾	212.9/212.4 ⁽¹⁾	0.3/1.1 ⁽¹⁾	0.5/0.2 ⁽¹⁾
BH-4	213.5	213.0	0.4	0.5
DB-3	213.5	213.3	0.4	0.2
DB-4	213.6	204.7	0.2	8.9

Note: ⁽¹⁾ Elevations, surface depths and thickness of alternating layers

This layer consists of sand, gravel, trace to some silt, trace clay and occasional cobbles and boulders. The material is brown in color and moist to wet. The SPT “N” values within this layer ranged from 8 to over 100 blows per 300 mm penetration, corresponding to loose to very dense, but generally compact to very dense compactness condition.

Laboratory testing performed on selected sample consisted of moisture content and grain size distribution tests. The test results are as follow:

Moisture Content: (**exp**, Thurber and Terraprobe)

- 3% to 16%

Grain Size Distribution: (**exp**)

- 26% to 49% gravel
- 37% to 68% sand
- 6% to % 14 silt and clay

The results of the moisture content and grain size distribution tests performed by **exp** are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests performed by **exp** are also provided on Figure 1 in Appendix D. The results of tests performed by Thurber and Terraprobe are shown on the borehole logs attached in Appendix E.

1.4.4 FILL: Silty Sand/Clayey Sand

A silty sand/clayey sand fill layer was encountered below sand to gravelly sand fill in boreholes BH17-3, 16-4, and BH-3, and below topsoil in boreholes BH17-2, 16-2, 16-3, 16-5, 16-7, 16-8 and BH-5. The approximate elevations of the surface and base of the fill and the thickness of fill as encountered in boreholes are summarized in Table A3-2 below:

Table A3-2. Summary of silty sand/clayey sand fill layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH17-3	207.7	204.7	6.1	3.1
CPT17-P1	213.6	204.3	-	-
CPT17-P3	202.0	200.8	0	1.2
16-2	200.4	199.6	0.1	0.8
16-3	203.1	201.7	0.1	1.4
16-4	211.1	204.3	2.3	6.8
16-5	203.9	199.6	0.1	4.3
16-7	204.1	203.0	0.1	1.1
16-8	206.8	199.6	0.1	7.2
BH-3	212.4	204.7	1.3	7.7
BH-5	203.4	201.4	0.2	1.9

This layer consists of sand, silt, trace to some gravel, some silt, trace to some clay, trace organics and occasional boulders and cobbles. The material is brown in color and moist to wet. The SPT “N” values within this layer ranged from 3 to 48 blows per 300 mm penetration, corresponding to very loose to dense, but generally compact to dense compactness condition. In borehole 16-7 SPT “N” values within this layer ranged from 58 to 109 blows per 300 mm penetration, corresponding to very dense compactness condition. The penetration of piezocone in the test hole CPT17-P1 was stopped within this layer at Elev. 204.3 m, probably because it was obstructed by a boulder or cobble.

Laboratory testing performed on selected sample consisted of moisture content, grain size distribution and Atterberg Limit tests. The test results are as follow:

Moisture Content: (**exp**, Thurber and Terraprobe)

- 8% to 33%

One sample within this layer with organics, recorded moisture content of 151%

Grain Size Distribution: (Thurber and Terraprobe)

- 4% to 30% gravel
- 35% to 54% sand
- 16% to % 37 silt
- 4% to 17% clay
- 32% to 43% silt and clay

Atterberg Limits: (Thurber and Terraprobe)

- Liquid Limit: 25% to 26%
- Plastic Limit: 14% to 16%
- Plasticity Index: 10% to 11%

The results of CPT17-P1 and CPT17-P3 performed within this layer are as follows:

- Undrained Shear Strength = 70 to 80 kPa
- Mean $N_{60} = 5$
- Cone Tip Resistance = 1 to 1.2 MPa
- Overconsolidation Ratio = 3.25 to 10

The test hole CPT17-P1 is prematurely terminated within this layer.

The results of the moisture content tests performed by **exp** are provided on the record of borehole sheets in Appendix C. The results of tests performed by Thurber and Terraprobe are shown on the borehole logs attached in Appendix E.

1.4.5 FILL: Silty Clay/Clayey Silt/Clay

A silty clay/clayey silt/clay fill layer was encountered below silty sand/clayey sand fill in boreholes BH17-2, 16-3, 16-4, 16-5, 16-7, 16-8, BH-3, below sand to gravelly sand fill in BH-4, and below asphalt in DB-3. The approximate elevations of the surface and base of the fill and the thickness of fill as encountered in boreholes are summarized in Table A3-3 below:

Table A3-3. Summary of silty clay/clayey silt/clay fill layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH17-2	204.5	201.4	3.1	3.0
16-3	201.7	199.5	1.5	2.2
16-4	201.8	200.0	11.6	1.8
16-5	199.6	197.9	4.4	1.7
16-7	203.0	196.6	1.2	6.4
16-8	199.6	198.2	7.3	1.4
BH-3	204.7	200.1	9.0	4.6
BH-4	213.0	206.4	0.9	6.6
DB-3	213.2	207.6	0.7	5.6

This layer consists of silt, clay, trace to some sand, trace gravel, trace organics, occasional wood fragments, and occasional cobbles. The material is brown to grey in color and moist to wet. The SPT "N" values within this layer ranged from 1 to 41 blows per 300 mm penetration, corresponding to very soft to hard in consistency, but generally, firm to stiff in consistency. The vane shear strength of about 32 kPa to 56 kPa was measured in-situ indicating firm to stiff consistency of this layer.

Laboratory testing performed on selected sample consisted of moisture content, grain size distribution and Atterberg Limits tests. The test results are as follow:

Moisture Content: (**exp**, Thurber and Terraprobe)

- 6.4% to 56%

Grain Size Distribution: (**exp**, Thurber and Terraprobe)

- 0% to 15% gravel
- 2% to 37% sand
- 20% to 43% silt
- 22% to 78% clay

Atterberg Limits: (**exp**, Thurber and Terraprobe)

- Liquid Limit: 26% to 66%
- Plastic Limit: 13% to 23%
- Plasticity Index: 13% to 43%

The results of the moisture content and grain size distribution tests performed by **exp** are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg Limits tests performed by **exp** are also provided on Figures 2 and 6, respectively in Appendix D. The results of tests performed by Thurber and Terraprobe are shown on the borehole logs attached in Appendix E.

1.4.6 Sandy Silt

A native sandy silt layer was encountered below silty clay fill in BH17-2. The approximate elevations of the surface and base of the sandy silt layer and the thickness of the layer as encountered in the borehole is summarized in Table A3-4 below:

Table A3-4. Summary of sandy silt layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH17-2	201.4	197.6	6.1	3.8

This layer consists of silt, sand, trace to some gravel, trace clay and occasional cobbles and boulders. The material is grey in color and moist to wet. The SPT "N" values within this layer ranged from 11 to over 77 blows per 300 mm penetration, corresponding to compact to very dense compactness condition.

Laboratory testing performed on selected sample consisted of moisture content and grain size distribution tests. The test results are as follow:

Moisture Content: (**exp**)

- 12% to 49%

Grain Size Distribution: (**exp**)

- 30% gravel
- 28% sand
- 37% silt

- 5% clay

The results of the moisture content and grain size distribution tests performed by **exp** are provided on the record of borehole sheets in Appendix C. The result of the grain size distribution test performed by **exp** is also provided on Figure 3 in Appendix D.

1.4.7 Silty Clay/Clay

A native silty clay/clay layer was encountered below silty sand/clayey sand fill in boreholes BH17-3 and 16-2; below sand to gravelly sand fill in boreholes DB-4 and BH-5; below silty clay/clayey silt/clay fill in boreholes 16-3, 16-4, 16-7, BH-3, BH-4, DB-3; and below topsoil in boreholes BH17-4, 16-1, 16-6, BH-1 and BH-6. The approximate elevations of the surface and base of the layer and the thickness of layer as encountered in boreholes are summarized in Table A3-5 below:

Table A3-5. Summary of silty clay/clay layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH17-3	204.7	200.9	9.2	3.8
BH17-4	201.0	194.2	0.1	6.8
CPT17-P2	196.8	194.4	8.1	2.4
CPT17-P3	200.8	194.6	1.2	6.2
16-1	194.2	193.2	0.1	1.0
16-2	199.6	198.8	0.9	0.8
16-3	199.5	197.0	3.7	2.5
16-4	201.8	200.0	11.6	1.8
16-6	198.0	197.2	0.1	0.8
16-7	196.6	192.0	7.6	4.6
BH-1	201.7	200.4	0.1	1.3
BH-3	200.1	199.4	13.6	0.7
BH-4	206.4	203.8	7.5	2.6
BH-5	201.4	197.9	2.1	3.5
BH-6	197.6	195.6	0.2	1.9
DB-3	207.6	202.4	6.3	5.2
DB-4	204.7	199.0	9.1	5.7

This layer consists of silt, clay, trace to some sand, trace gravel, trace organics and trace woods. The material is brown to grey in color and moist to wet. The SPT "N" values within this layer ranged from 1 to 28 blows per 300 mm penetration, corresponding to very soft to very stiff in consistency, but generally, soft to firm in consistency. The vane shear strength of about 17 kPa to 78 kPa was measured in-situ indicating soft to stiff consistency of this layer.

Laboratory testing performed on selected sample consisted of moisture content, grain size distribution and Atterberg Limits tests. The test results are as follow:

Moisture Content: (**exp**, Thurber and Terraprobe)

- 15% to 46%

Grain Size Distribution: (exp, Thurber and Terraprobe)

- 0% to 15% gravel
- 0% to 25% sand
- 21% to 43% silt
- 25% to 77% clay

Atterberg Limits: (exp, Thurber and Terraprobe)

- Liquid Limit: 23% to 66%
- Plastic Limit: 13% to 23%
- Plasticity Index: 10% to 44%

The results of CPT17-P2 and CPT17-P3 performed within this layer are as follows:

- Undrained Shear Strength = 34 to 75 kPa
- Mean N_{60} = 3 to 4
- Cone Tip Resistance = 0.5 to 1.6 MPa
- Overconsolidation Ratio = 4.5 to 4.7

The results of the moisture content and grain size distribution tests performed by **exp** are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg Limits tests performed by **exp** are also provided on Figure 4 and 7, respectively, in Appendix D. The results of tests performed by Thurber and Terraprobe are shown on the borehole logs attached in Appendix E.

1.4.8 Varved Silty Clay/Clay

A native varved silty clay/clay layer was encountered below the silty sand layer in borehole BH17-2; below silty clay/clayey silt/clay fill in boreholes 16-5 and 16-8; and below the silty clay/clay layer in boreholes BH17-3, BH17-4, 16-3, 16-4, 16-6, 16-7, BH-1, BH-3, BH-4, BH-5, BH-6, DB-3 and DB-4. Boreholes BH17-2, BH17-3, BH17-4, 16-6 and DB-4 are terminated within this layer. The approximate elevations of the surface and base of the layer and the thickness of layer as encountered in boreholes are summarized in Table A3-6 below:

Table A3-6: Summary of varved silty clay/clay layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
BH17-2	197.6	187.1	9.9	10.5
BH17-3	200.9	186.3	13.0	14.6
BH17-4	194.2	185.3	6.9	8.9
CPT17-P2	194.4	185.5	10.5	8.9
CPT17-P3	194.6	185.0	7.4	9.6
16-1	193.2	186.5	1.1	6.7
16-2	198.8	186.5	1.7	12.3

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
16-3	197.0	186.6	6.2	10.4
16-4	200.0	186.7	13.4	13.3
16-5	197.9	188.5	6.1	9.4
16-6	197.2	188.4	0.9	8.8
16-7	192.0	186.8	12.2	5.2
16-8	198.2	188.0	8.7	10.2
BH-1	200.4	188.7	1.4	11.7
BH-3	199.4	187.2	14.3	12.2
BH-4	203.8	187.1	10.1	16.7
BH-5	197.9	186.8	5.6	11.1
BH-6	195.6	185.6	2.1	10.0
DB-3	202.4	188.4	11.5	14.0
DB-4	199.0	191.9	18.8	7.1

This layer consists of silt, clay, trace to some sand and trace gravel. The material is grey in color and wet. The SPT "N" values within this layer ranged from weight hammer to 9 blows per 300 mm penetration, corresponding to very soft to stiff in consistency, but generally, very soft to firm in consistency. The vane shear strength of about 15 kPa to 86 kPa was measured in-situ indicating soft to stiff consistency of this layer.

Laboratory testing performed on selected sample consisted of moisture content, grain size distribution, Atterberg Limits and consolidation tests. The test results are as follow:

Moisture Content: (**exp**, Thurber, Terraprobe and S&P)

- 15% to 63%

Grain Size Distribution: (**exp**, Thurber and Terraprobe)

- 0% to 6% gravel
- 0% to 17% sand
- 23% to 70% silt
- 26% to 77% clay

Atterberg Limits: (**exp**, Thurber, Terraprobe and S&P)

- Liquid Limit: 26% to 54%
- Plastic Limit: 16% to 22%
- Plasticity Index: 4% to 32%

One-dimensional consolidation tests were performed on three Shelby Tube samples of varved silty clay/clay from BH16-4 (Sample18), BH-1 (Sample 4) and BH-3 (Sample 22) by Thurber or Terraprobe. The results of these tests are summarized below:

- Moisture Content = 34 to 52.6 %
- Initial Void Ratio (e_0) = 1.02 to 1.38
- Pre-consolidation Pressure (p'_c) = 257 to 300 kPa
- Recompression Index (C_r) = 0.05 to 0.085
- Compression Index (C_c) = 0.382 to 0.472

The results of CPT17-P2 and CPT17-P3 performed within this layer are as follows:

- Undrained Shear Strength = 50 to 75 kPa
- Mean N_{60} = 5 to 7
- Cone Tip Resistance = 1.2 to 1.4 MPa
- Overconsolidation Ratio = 2.1 to 2.6

The results of the moisture content and grain size distribution tests performed by **exp** are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution and Atterberg Limit tests performed by **exp** are also provided on Figure 5 and 8, respectively in Appendix D. The results of tests performed by Thurber, Terraprobe and S&P are shown on the borehole logs attached in Appendix E.

1.4.9 Clayey Sand Till/Clayey Silt Till/Silty Clay Till

A native clayey sand till/clayey silt till/silty clay till layer was encountered below the varved silty clay/clay layer in all boreholes except BH17-2, BH17-3, BH17-4, 16-6 , BH-6 and DB-4. Boreholes 16-1, 16-2, 16-3,16-4,16-5,16-7,16-8 and DB-3 are terminated within this layer. The approximate elevations of the surface and base of the layer and the thickness of layer as encountered in boreholes are summarized in Table A3-7 below:

Table A3-7. Summary of clayey sand till/clayey silt till/silty clay till layer

Borehole	Elevation (m)		Layer Surface Depth (m)	Layer Thickness (m)
	Top	Bottom		
16-1	186.5	185.5	7.8	1.0
16-2	186.5	185.8	14.0	0.7
16-3	186.6	185.9	16.6	0.7
16-4	186.7	186.5	26.7	0.2
16-5	188.5	188.3	15.5	0.2
16-7	186.8	186.2	17.4	0.6
16-8	188.0	187.8	18.9	0.2
BH-1	188.7	188.5	13.1	0.2
BH-3	187.2	186.5	26.5	0.7
BH-5	186.8	186.0	16.7	0.8
DB-3	188.4	187.3	25.5	1.1

This layer consists of silt, clay, trace to some sand and trace to some gravel. The material is grey in color and wet. The SPT “N” values within clayey silt till/ silty clay till layer ranged from 5 per 300 mm penetration to more than 100 blows for less than 300 mm penetration, corresponding to firm to hard in consistency, but generally, stiff to very stiff in consistency and the SPT “N” values within clayey sand till layer ranged from 4 per 300 mm penetration to more than 100 blows for less than 300 mm penetration, corresponding to very loose to very dense compactness condition.

Laboratory testing performed on selected sample consisted of moisture content, grain size distribution and Atterberg Limits tests. The test results are as follow:

Moisture Content: (Thurber and Terraprobe)

- 8% to 16%

Grain Size Distribution: (Thurber and Terraprobe)

- 9% to 24% gravel
- 29% to 41% sand
- 28% to 47% silt
- 13% to 17% clay
- 39% to 50% silt and clay

Atterberg Limits: (Terraprobe)

- Liquid Limit: 17%
- Plastic Limit: 12%
- Plasticity Index: 5%

The results of tests performed by Thurber and Terraprobe are shown on the borehole logs attached in Appendix E.

1.4.10 Bedrock

Bedrock was encountered underlying the clayey sand till/clayey silt till/silty clay till layer in boreholes BH-1, BH-3 and BH-5; and underlying the varved silty clay/clay layer in boreholes BH-4 and BH-6. All Thurber's boreholes (16-1 to 16-8) and one S&P's borehole BH-3 were terminated on refusal which is probably on bedrock. In Terraprobe's boreholes BH-1 to BH-6 bedrock was confirmed by coring of 3.0 to 3.2 m long rock cores. The inferred and cored bedrock surface depths and elevations encountered at the drilled borehole locations are listed in Table A3-8.

Table A3-8. Depths and elevations of bedrock surface

Borehole	Depth Below Ground Surface (m)	Elevation (m)	Comments
16-1	8.8	185.5	Inferred Bedrock
16-2	14.7	185.8	Inferred Bedrock

Borehole	Depth Below Ground Surface (m)	Elevation (m)	Comments
16-3	17.3	185.9	Inferred Bedrock
16-4	26.9	186.5	Inferred Bedrock
16-5	15.7	188.3	Inferred Bedrock
16-6	9.7	188.4	Inferred Bedrock
16-7	18.0	186.2	Inferred Bedrock
16-8	19.1	187.8	Inferred Bedrock
BH-1	13.3	188.5	Bedrock Cored
BH-3	27.2	186.5	Bedrock Cored
BH-4	26.8	187.1	Bedrock Cored
BH-5	17.5	186.0	Bedrock Cored
BH-6	12.1	185.6	Bedrock Cored
DB-3	26.6	187.3	Inferred Bedrock

Based on the rock cores recovered, the bedrock consists of dolomitic limestone. In general, rock samples are described as grey to whitish grey, slightly to moderately weathered, thinly to thickly bedded. The Rock Quality Designation (RQD) measured on the rock core samples ranged from approximately 37% to 100%, indicating a rock mass of poor to excellent, but generally good to excellent quality.

1.4.11 Results of Drilling of Angled Borehole

The objective of drilling the angled borehole BH17-1 was to assess potential presence of buried remains of a roadway protection system used during the installation of the existing culvert, if any. BH17-1 was drilled from an accessible position at the roadway embankment slope at an angle of 18 degree to the horizontal to intersect the roadway centerline as shown on Drawing 1 in Appendix B. Considering the position of the rig and angle of drilling it was estimated that the depth of the hole to reach the roadway centerline should be approximately between 28 and 30 m. The total drilling length of the angled borehole was approximately 33 m.

During the first 7 m of drilling the penetration rate was very low (~ 1.5 hr/m) due to presence of boulders, cobbles and gravel within the surficial silty sand fill. However, the drilling in the underlying silty clay material was much faster having the penetration rate of approximately 0.5 hr/m. There was no buried obstacle encountered during drilling. The record of borehole BH17-1 is included in Appendix C.

1.4.12 Results of Cone Penetration Tests

Three cone penetration tests CPT17-P1, CPT17-P2 and CPT17-P3 were conducted at the requested locations to a depth between 9.3 m and 19.4 m. The top sand and silty sand fill layers in CPT holes were drilled out for CPT17-P1 (to a depth of 7.3 m) and CPT17-P2 (to a depth of 8.1 m) since these soil layers were too dense for cone penetration. As marked before, the penetration of the cone in hole CPT17-P1 was obstructed at a depth of 9.3 m from the ground surface, and the test was terminated at that level. In CPT17-P2 there was data loss during penetration at depths of 7.8 m and 11.2 m. The

underlying till was not penetrated to any extent. CPT17-P2 and CPT17-P3 were terminated above the till layer.

The results of three CPTu are presented on sounding logs in Appendix F. Each sounding log comprises of continuous measurements of cone tip resistance (q_t), sleeve friction (f_s), friction ratio (R_f), pore pressure (u) and soil behavior type (SBT). Based on these results and established/published correlations, the undrained shear strength, equivalent N_{60} SPT values and CPT soil index (I_c) were interpreted and their interpretation was plotted on the graphs attached in Appendix F. Interpreted geotechnical parameters are discussed in Section 1.4.

1.5 Groundwater Conditions

The groundwater levels in boreholes at the site were observed during and upon completion of their drilling, as well as in vibrating wire piezometers (VWP) and standpipe piezometers (SP) installed during the previous investigations. During exp's investigation in November 2017, the groundwater levels were not measured in the boreholes upon completion of drilling since they were filled with drilling water. However, the groundwater levels were determined with CPTu. At the time of this investigation, it was found that the previously installed SPs and VWPs were damaged or discarded, so taking any reading of groundwater levels in the piezometers was not possible. The summary of measured groundwater levels during all investigations is presented in Table A3-9.

Table A3-9. Measured groundwater levels

Location	Date	Ground Surface Elevation (m)	Groundwater Level	
			Depth (m)	Elevation (m)
CPT17-P1	11/14/2017	213.6	6.3	207.3
CPT17-P2	11/09/2017	204.9	3.5	201.4
CPT17-P3	11/10/2017	202.0	3.5	198.5
BH 16-1 (VWP)	10/16/2016	194.3	-	194.4 ⁽¹⁾
BH 16-2 (Open hole)	08/11/2016	200.5	0.4	200.1
BH 16-3 (SP)	05/16/2017	203.2	0.5	202.7
BH 16-5 (SP)	05/16/2017	204.0	2.7	201.3
BH 16-6 (VWP)	10/16/2016	198.1	-	200.7 ⁽¹⁾
BH 16-7 (VWP)	10/16/2016	204.2	-	200.1
BH 16-8 (VWP)	10/16/2016	206.9	-	200.9
BH-1 (SP)	11/24/2014	201.8	-0.6	202.4 ⁽¹⁾
BH-6 (SP)	11/24/2014	197.7	-0.4	198.1 ⁽¹⁾
DB-3 (SP)	10/14/1999	213.9	13.8	200.1

Note: ⁽¹⁾ - Groundwater level/pressures was noted to be above the existing ground surface (artesian flow conditions)

In Thurber's report it is noted that the artesian water recorded in their boreholes should be sourced from the till layer which is confined below the low permeable native clay deposits. The presence of artesian water was not noticed during drilling **exp's** boreholes.

At time of November 2017 investigation, the water levels in Calamity Creek were at Elev. 192.7 m and 197.8 m at the outlet and inlet locations, respectively.

Groundwater levels would be expected to reflect levels in the adjacent open water and to fluctuate seasonally. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.

January 9, 2018

2 CLOSURE

A subsurface investigation is a limited sampling of a site; the subsurface conditions have been established only at the test hole locations. Should conditions at the site be encountered which differ from those reported at the test locations, we require that we be notified immediately in order to assess this additional information.

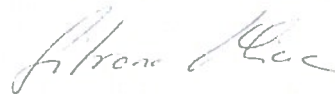
Contractors bidding on or undertaking any proposed work at this site should, relative to the subsurface conditions, decide on their own investigations, if deemed necessary, as well as their own interpretations of the factual results provided herein, so they may draw their own conclusions as to how the subsurface conditions may affect them.

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3 LIMITATIONS AND USE OF REPORT

BASIS OF REPORT

This report ("Report") is based on site conditions known or inferred by the geotechnical investigation undertaken as of the date of the Report. Should changes occur which potentially impact the geotechnical condition of the site, or if construction is implemented more than one year following the date of the Report, the recommendations of exp may require re-evaluation.

The Report is provided solely for the guidance of design engineers and on the assumption that the design will be in accordance with applicable codes and standards. Any changes in the design features which potentially impact the geotechnical analyses or issues concerning the geotechnical aspects of applicable codes and standards will necessitate a review of the design by exp. Additional field work and reporting may also be required.

Where applicable, recommended field services are the minimum necessary to ascertain that construction is being carried out in general conformity with building code guidelines, generally accepted practices and exp's recommendations. Any reduction in the level of services recommended will result in exp providing qualified opinions regarding the adequacy of the work. exp can assist design professionals or contractors retained by the Client to review applicable plans, drawings, and specifications as they relate to the Report or to conduct field reviews during construction.

Contractors contemplating work on the site are responsible for conducting an independent investigation and interpretation of the borehole results contained in the Report. The number of boreholes necessary to determine the localized underground conditions as they impact construction costs, techniques, sequencing, equipment and scheduling may be greater than those carried out for the purpose of the Report.

Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates are based on investigations performed in accordance with the standard of care set out below and require the exercise of judgment. As a result, even comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations or building envelope descriptions involve an inherent risk that some conditions will not be detected. All documents or records summarizing investigations are based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated. Some conditions are subject to change over time. The Report presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, these should be disclosed to exp to allow for additional or special investigations to be undertaken not otherwise within the scope of investigation conducted for the purpose of the Report.

RELIANCE ON INFORMATION PROVIDED

The evaluation and conclusions contained in the Report are based on conditions in evidence at the time of site inspections and information provided to exp by the Client and others. The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose as communicated by the Client. exp has relied in good faith upon such representations, information and instructions and accepts no responsibility for any deficiency, misstatement or

inaccuracy contained in the Report as a result of any misstatements, omissions, misrepresentation or fraudulent acts of persons providing information. Unless specifically stated otherwise, the applicability and reliability of the findings, recommendations, suggestions or opinions expressed in the Report are only valid to the extent that there has been no material alteration to or variation from any of the information provided to exp.

STANDARD OF CARE

The Report has been prepared in a manner consistent with the degree of care and skill exercised by engineering consultants currently practicing under similar circumstances and locale. No other warranty, expressed or implied, is made. Unless specifically stated otherwise, the Report does not contain environmental consulting advice.

COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment form part of the Report. This material includes, but is not limited to, the terms of reference given to exp by its client ("Client"), communications between exp and the Client, other reports, proposals or documents prepared by exp for the Client in connection with the site described in the Report. In order to properly understand the suggestions, recommendations and opinions expressed in the Report, reference must be made to the Report in its entirety. exp is not responsible for use by any party of portions of the Report.

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The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. No other party may use or rely upon the Report in whole or in part without the written consent of exp. Any use of the Report, or any portion of the Report, by a third party are the sole responsibility of such third party. exp is not responsible for damages suffered by any third party resulting from unauthorised use of the Report.

REPORT FORMAT

Where exp has submitted both electronic file and a hard copy of the Report, or any document forming part of the Report, only the signed and sealed hard copy shall be the original documents for record and working purposes. In the event of a dispute or discrepancy, the hard copy shall govern. Electronic files transmitted by exp have utilize specific software and hardware systems. exp makes no representation about the compatibility of these files with the Client's current or future software and hardware systems. Regardless of format, the documents described herein are exp's instruments of professional service and shall not be altered without the written consent of exp.

Appendix A – Site Photographs



Photo 1. Inlet of the existing Calamity creek culvert, facing east



Photo 2. East embankment of Hwy 11, facing north-east toward the inlet



Photo 3. East embankment of Hwy 11, facing north



Photo 4. East embankment of Hwy 11, facing south



Photo 5. Outlet of the existing culvert, facing west



Photo 6. Outlet of the existing culvert, facing east



Photo 7. West embankment of Hwy 11, facing north



Photo 8. West embankment of Hwy 11, facing south



Photo 9. Drilling angled BH17-1



Photo 10. Drilling vertical BH17-2

Appendix B – Drawings

Appendix C – Borehole Logs

Explanation of Terms Used on Borehole Records

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil: mixture of soil and humus capable of supporting good vegetative growth.

Peat: fibrous fragments of visible and invisible decayed organic matter.

Fill: where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

Till: the term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Terminology describing soil structure:

Desiccated: having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.

Stratified: alternating layers of varying material or color with the layers greater than 6 mm thick.

Laminated: alternating layers of varying material or color with the layers less than 6 mm thick.

Fissured: material breaks along plane of fracture.

Varved: composed of regular alternating layers of silt and clay.

Slickensided: fracture planes appear polished or glossy, sometimes striated.

Blocky: cohesive soil that can be broken down into small angular lumps which resist further breakdown.

Lensed: inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay; not thickness.

Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

Homogeneous: same color and appearance throughout.

Well Graded: having wide range in grain sized and substantial amounts of all predominantly on grain size.

Uniformly Graded: predominantly on grain size.

All soil sample descriptions included in this report follow generally the ASTM D2487-11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) with some modification to reflect current MTO practices. The system divides soils into three major categories: (1) coarse grained, (2) fine-grained, and (3) highly organic. The soil is then subdivided based on either gradation or plasticity characteristics. The system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification. The classification excludes particles larger than 76 mm. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually in accordance with ASTM D2488-09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems. Others may use different classification systems; one such system is the ISSMFE Soil Classification.

ISSMFE SOIL CLASSIFICATION											
CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		
<div><div>0.002</div><div>0.006</div><div>0.02</div><div>0.06</div><div>0.2</div><div>0.6</div><div>2.0</div><div>6.0</div><div>20</div><div>60</div><div>200</div></div>											
EQUIVALENT GRAIN DIAMETER IN MILLIMETRES											
CLAY (PLASTIC) TO				FINE		MEDIUM		CRS.		FINE COARSE	
SILT (NONPLASTIC)				SAND				GRAVEL			
UNIFIED SOIL CLASSIFICATION											

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present and as described below in accordance with Note 16 in ASTM D2488-09a:

Table a: Percent or Proportion of Soil, Pp

	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	$5 \leq Pp \leq 10\%$
Little	$15 \leq Pp \leq 25\%$
Some	$30 \leq Pp \leq 45\%$
Mostly	$50 \leq Pp \leq 100\%$

The standard terminology to describe cohesionless soils includes the compactness as determined by the Standard Penetration Test 'N' value:

Table b: Apparent Density of Cohesionless Soil

	'N' Value (blows/0.3 m)
Very Loose	$N < 5$
Loose	$5 \leq N < 10$
Compact	$10 \leq N < 30$
Dense	$30 \leq N < 50$
Very Dense	$50 \leq N$

The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis, Standard Penetration Test 'N' values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils:

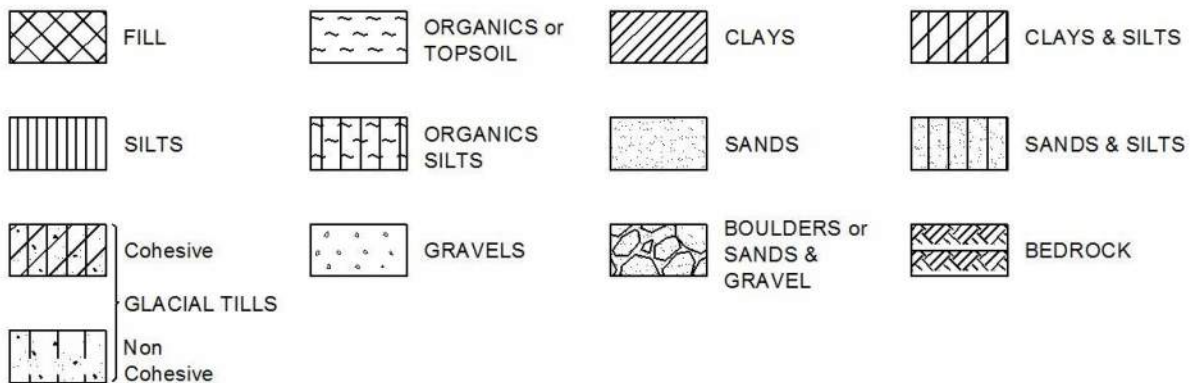
Table c: Consistency of Cohesive Soil

Consistency	Vane Shear Measurement (kPa)	'N' Value
Very Soft	<12.5	<2
Soft	12.5-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

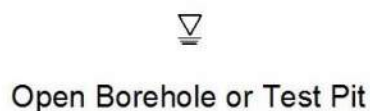
Note: 'N' Value - The Standard Penetration Test records the number of blows of a 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler 1 foot (305mm). For split spoon samples where full penetration is not achieved, the number of blows is reported over the sampler penetration in meters (e.g. 50/0.15).

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



WATER LEVEL MEASUREMENT



ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	Split spoon sample (obtained from the Standard Penetration Test)
WS	Wash sample
BS	Bulk sample
TW	Thin wall sample or Shelby tube
PS	Piston sample
AS	Auger sample
VT	Vane test
GS	Grab sample
HQ, NQ, etc.	Rock core samples obtained with the use of standard size diamond drilling bits

STRESS AND STRAIN

u_w	kPa	Pore water pressure
r_u	1	Pore pressure ratio
σ	kPa	Total normal stress
σ'	kPa	Effective normal stress
τ	kPa	Shear stress
$\sigma_1, \sigma_2, \sigma_3$	kPa	Principal stresses
ε	%	Linear strain
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	Principal strains
E	kPa	Modulus of linear deformation
G	kPa	Modulus of shear deformation
μ	1	Coefficient of friction

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	Coefficient of volume change
c_c	1	Compression index
c_s	1	Swelling index
c_r	1	Recompression index
c_v	m ² /s	Coefficient of consolidation
H	m	Drainage path
T_v	1	Time factor
U	%	Degree of consolidation
σ'_{v0}	kPa	Effective overburden pressure
σ'_p	kPa	Preconsolidation pressure
τ_f	kPa	Shear strength
c'	kPa	Effective cohesion intercept
ϕ'	—°	Effective angle of internal friction
c_u	kPa	Apparent cohesion intercept
ϕ_u	—°	Apparent angle of internal friction
τ_R	kPa	Residual shear strength
τ_r	kPa	Remoulded shear strength
S_t	1	Sensitivity = c_u/τ_r

PHYSICAL PROPERTIES OF SOIL

P_s	kg/m ³	Density of solid particles
γ_s	kN/m ³	Unit weight of solid particles
ρ_w	kg/m ³	Density of water
γ_w	kN/m ³	Unit weight of water
ρ	kg/m ³	Density of soil
γ	kN/m ³	Unit weight of soil
ρ_d	kg/m ³	Density of dry soil
γ_d	kN/m ³	Unit weight of dry soil
ρ_{sat}	kg/m ³	Density of saturated soil
γ_{sat}	kN/m ³	Unit weight of saturated soil
ρ'	kg/m ³	Density of submerged soil
γ'	kN/m ³	Unit weight of submerged soil
e	1, %	Void ratio
n	1, %	Porosity
w	1, %	Water content
S_r	%	Degree of saturation
W_L	%	Liquid limit
W_P	%	Plastic limit
W_s	%	Shrinkage limit
I_p	%	Plasticity index = $(W_L - W_P)$
I_L	%	Liquidity index = $(W - W_P)/I_p$
I_C	%	Consistency index = $(W_L - W)/I_p$
e_{max}	1, %	Void ratio in loosest state
e_{min}	1, %	Void ratio in densest state
I_D	1	Density index = $(e_{max} - e)/(e_{max} - e_{min})$
D	mm	Grain diameter
D_n	mm	N percent - diameter
C_u	1	Uniformity coefficient
h	m	Hydraulic head or potential
q	m ³ /s	Rate of discharge
v	m/s	Discharge velocity
i	1	Hydraulic gradient
k	m/s	Hydraulic conductivity
j	kN/m ³	Seepage force

Brampton, Ontario

RECORD OF BOREHOLE No BH-17-1 (angled) 1 OF 2 METRIC

W.P. GWP 5159-12-00 LOCATION Hwy 11, New Liskeard, MTM ON12 N5269370.9, E404509.3 ORIGINATED BY ST
 DIST New Liskeard HWY 11 BOREHOLE TYPE Portable Horizontal Drill (ODR-100) COMPILED BY NT
 DATUM Geodetic DATE 2017.11.21 - 2017.11.24 LATITUDE 47.5558739 LONGITUDE -79.6750559 CHECKED BY SM

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
205.7	Ground Surface													
0.0	FILL: SILTY SAND: with gravel, cobbles and boulders - Penetration rate is 1.5 hour per meter													
7.0	SILTY CLAY: - Penetration rate is 0.5 hour per meter													

Continued Next Page

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

ONTARIO MTO ASSIGNMENT#8, BH17-1.GPJ ONTARIO MTO.GDT 19/18

Brampton, Ontario

2 OF 2

W.P.	GWP 5159-12-00	LOCATION	Hwy 11, New Liskeard, MTM ON12 N5269370.9, E404509.3			ORIGINATED BY	ST		
DIST	New Liskeard	HWY	11	BOREHOLE TYPE	Portable Horizontal Drill (ODR-100)			COMPILED BY	NT
DATUM	Geodetic	DATE	2017.11.21 - 2017.11.24	LATITUDE	47.5558739	LONGITUDE	-79.6750559	CHECKED BY	SM

[illegible]

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

ONTARIO MTO ASSIGNMENT#8, BH17-1.GPJ ONTARIO MTO.GDT 1/9/18

Brampton, Ontario

RECORD OF BOREHOLE No BH-17-2

1 OF 2

METRIC

W.P. GWP 5159-12-00 LOCATION Hwy 11, New Liskeard, MTM ON12 N5269354.7, E404513.4 ORIGINATED BY ST
 DIST New Liskeard HWY 11 BOREHOLE TYPE Portable Tripod/NW Casing/ CME 55 Continuous Flight HSA COMPILED BY NT
 DATUM Geodetic DATE 2017.11.07 - 2017.11.15 LATITUDE 47.5557276 LONGITUDE -79.6750052 CHECKED BY SM

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 (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × P. PENETROMETER												
207.5	Ground Surface							20	40	60	80	100								
207.4	TOPSOIL 76 mm Topsoil		1	SS	4		207													
	FILL: SAND TO GRAVELLY SAND: trace to some silt, brown, moist very loose to loose																			
			2	SS	5		206													
							205													
204.5	FILL: CLAYEY SILT: some sand, some gravel, occassional cobbles, brown to grey, wet, soft to very stiff		3	SS	2		204													
	- Vane attempted no shear @ 3.81 m			VANE																
			4	SS	19		203													
							202													
201.4	SANDY SILT : trace to some gravel, trace clay, cobbles and boulders, grey, wet, compact to very dense		5	SS	11		201													
							200													
	- Refusal @ 7.6 m depth on cobbles/boulder with portable tripod. switch to CME-55 drill rig to advance below 7.6 m depth		6	SS	38															
			7	SS	77		199													
			8	SS	32		198													
197.6	VARVED SILTY CLAY: trace sand, brown to grey, wet, very stiff to very soft		9	SS	17		197													
			10	SS	6															
			11	SS	5		196													

Continued Next Page

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

ONTARIO MTO ASSIGNMENT#8, NER, GPJ, ONTARIO MTO, GDT, 12/18

2 OF 2

METRIC

[illegible]

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

Brampton, Ontario

RECORD OF BOREHOLE No BH-17-3

1 OF 3

METRIC

W.P. GWP 5159-12-00 LOCATION Hwy 11, New Liskeard, MTM ON12 N5269357.96, 404535.9 ORIGINATED BY ST
 DIST New Liskeard HWY 11 BOREHOLE TYPE CME 55/ NW Casing/ Wash Boring COMPILED BY NT
 DATUM Geodetic DATE 2017.11.14 - 2017.11.14 LATITUDE 47.5557529 LONGITUDE -79.6747055 CHECKED BY SM

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 (%)	
								20 40 60 80 100	20 40 60							
213.8	Ground Surface															
219.6	ASPHALT 152 mm															
0.2	FILL: SAND TO GRAVELLY SAND: some gravel, trace silt, brown, moist, dense		1	AS			213									
	-becoming gravelly sand, some silt, brown, moist		2	SS	40		212							35 54 (11)		
			3	SS	5		211									
			4	SS	10		209							49 37 (14)		
							208									
207.7	FILL: SILTY SAND: some gravel, some clay, brown, moist to wet, loose to compact		5	SS	19		207									
6.1	-becoming silty sand, some organics, brown to black		6	SS	11		206						151			
204.7	SILTY CLAY: some sand, trace gravel, occasional wood, grey, wet, firm to very stiff		7	SS	7		204							10 25 40 25		
9.2			8	SS	13		203									
							202									

Continued Next Page

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

ONTARIO MTO ASSIGNMENT#8, NER_GPJ ONTARIO MTO.GDT 12/18

Brampton, Ontario

RECORD OF BOREHOLE No BH-17-3

2 OF 3

METRIC

W.P. GWP 5159-12-00 LOCATION Hwy 11, New Liskeard, MTM ON12 N5269357.96, 404535.9 ORIGINATED BY ST
 DIST New Liskeard HWY 11 BOREHOLE TYPE CME 55/ NW Casing/ Wash Boring COMPILED BY NT
 DATUM Geodetic DATE 2017.11.14 - 2017.11.14 LATITUDE 47.5557529 LONGITUDE -79.6747055 CHECKED BY SM

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 (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × P. PENETROMETER												
								20	40	60	80	100		20	40	60				
200.9	SILTY CLAY: some sand, trace gravel, occassional wood, grey, wet, firm to very stiff (continued)		9	SS	28		201								○					
13.0	VARVED SILTY CLAY: trace sand, trace gravel, grey, wet, very soft to firm		10	SS	5											○				
			11	SS	3											○				
			12	SS	4											○				
			13	SS	2											○				
			14	SS	2											○				
			15	SS	4											○				
			16	SS	5											○				
			17	SS	2											○				
			18	SS	3											○				
			19	SS	1											○				
			20	SS	5											○				
21	SS	3											○							

Continued Next Page

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

ONTARIO MTO ASSIGNMENT#8, NER_GPJ ONTARIO MTO.GDT 12/18

Brampton, Ontario

3 OF 3

METRIC[illegible]

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

Brampton, Ontario

RECORD OF BOREHOLE No BH-17-4

1 OF 2

METRIC

W.P. GWP 5159-12-00 LOCATION Hwy 11, New Liskeard, MTM ON12 N5269311.55, 40470.52 ORIGINATED BY ST
 DIST New Liskeard HWY 11 BOREHOLE TYPE Portable Tripod/NW Casing/Wash Boring COMPILED BY NT
 DATUM Geodetic DATE 2017.11.08 - 2017.11.09 LATITUDE 47.5553457 LONGITUDE -79.6755848 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
201.1	Ground Surface													
200.4	TOPSOIL 50 mm SILTY CLAY: trace to some sand, brown to grey, moist to wet, very soft to firm		1	SS	7		201							
			2	SS	5		200							
			3	SS	1		199							0 0 42 58
			4	SS	2		198							
				VANE			198							
			5	SS	2		197							
				VANE			196							
			6	SS	3		195							
				VANE			194							0 0 52 48
194.2	VARVED SILTY CLAY: trace to some sand, grey, wet, very soft to firm		7	SS	2		193							
6.9				VANE			192							
			8	SS	WH		191							
				VANE			190							
			9	SS	WH									
				VANE										

Continued Next Page

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

ONTARIO MTO ASSIGNMENT#8, NER_GRP ONTARIO MTO.GDT 12/18

Brampton, Ontario

RECORD OF BOREHOLE No BH-17-4

2 OF 2

METRIC

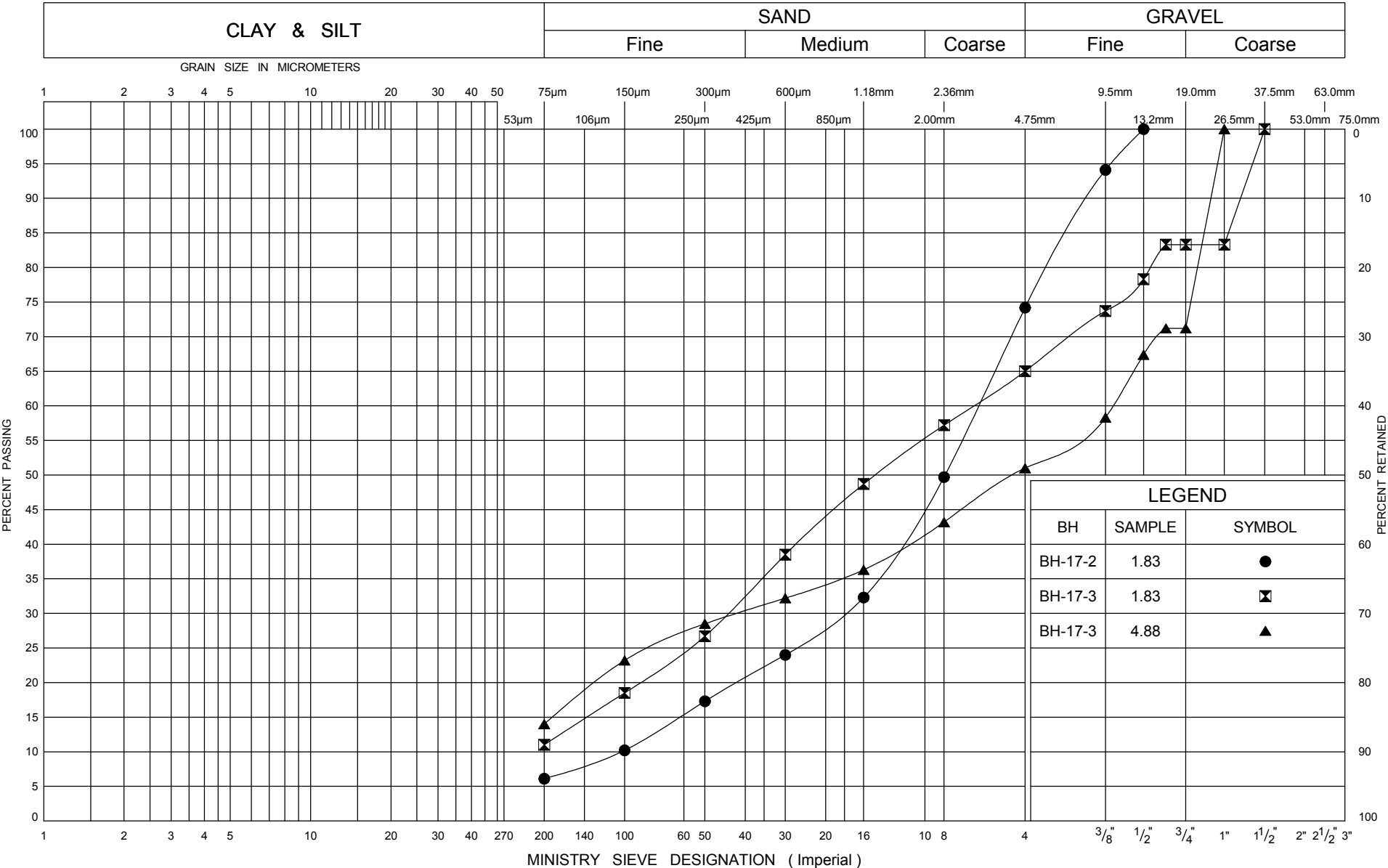
W.P. GWP 5159-12-00 LOCATION Hwy 11, New Liskeard, MTM ON12 N5269311.55, 40470.52 ORIGINATED BY ST
 DIST New Liskeard HWY 11 BOREHOLE TYPE Portable Tripod/NW Casing/Wash Boring COMPILED BY NT
 DATUM Geodetic DATE 2017.11.08 - 2017.11.09 LATITUDE 47.5553457 LONGITUDE -79.6755848 CHECKED BY SM

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × P. PENETROMETER		WATER CONTENT (%) W _P W W _L				GR	SA	SI	CL		
	VARVED SILTY CLAY: trace to some sand, grey, wet, very soft to firm (continued)						189												
			10	SS	1														
			11	SS	WH														
							187												
							186												
185.3			12	SS	6														
15.9	End of borehole at 15.85 m depth.																		
<div>Notes: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Since wash boring technique was used, groundwater level was not measured in open hole upon completion of drilling.</div>																			

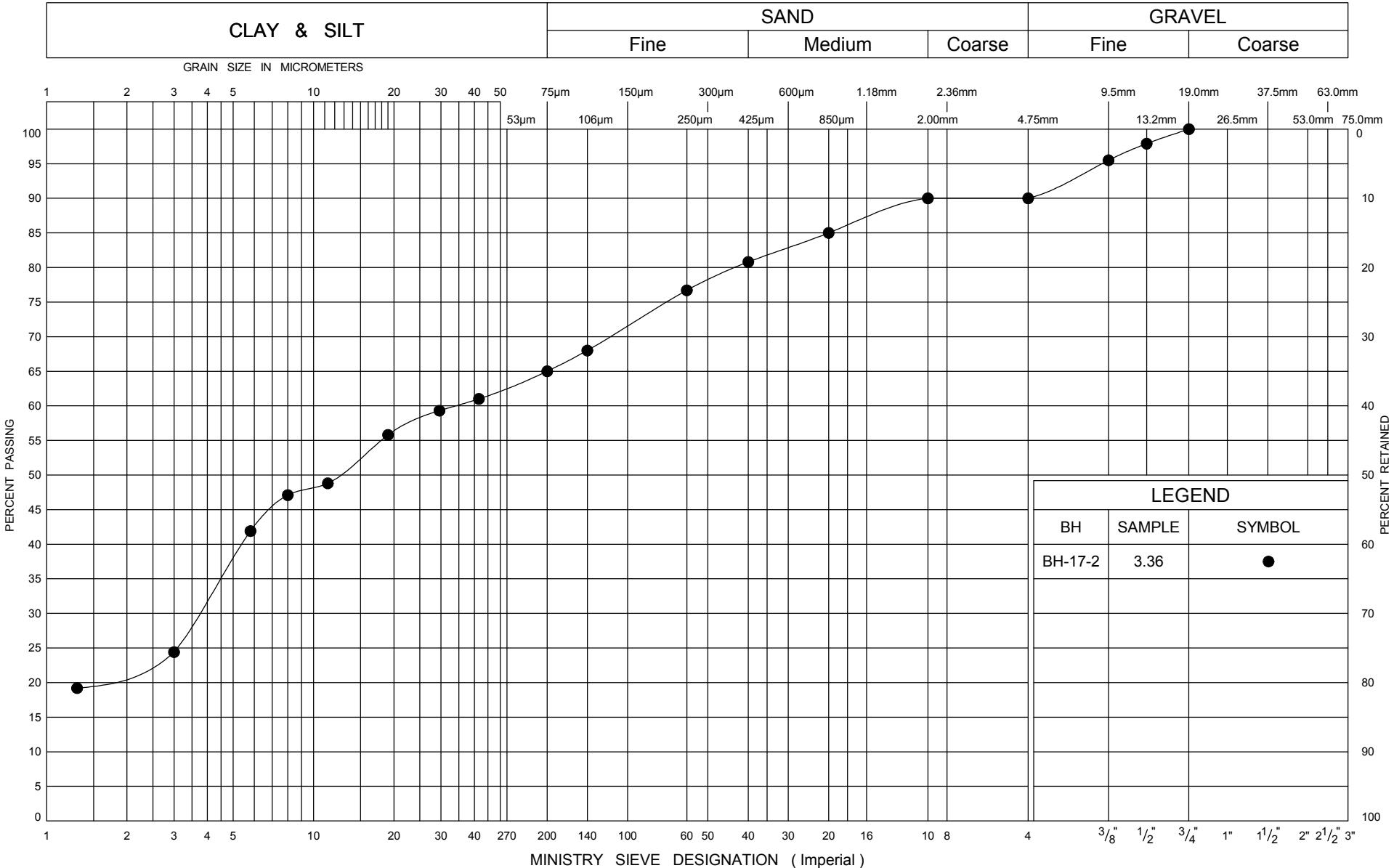
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Appendix D – Laboratory Data

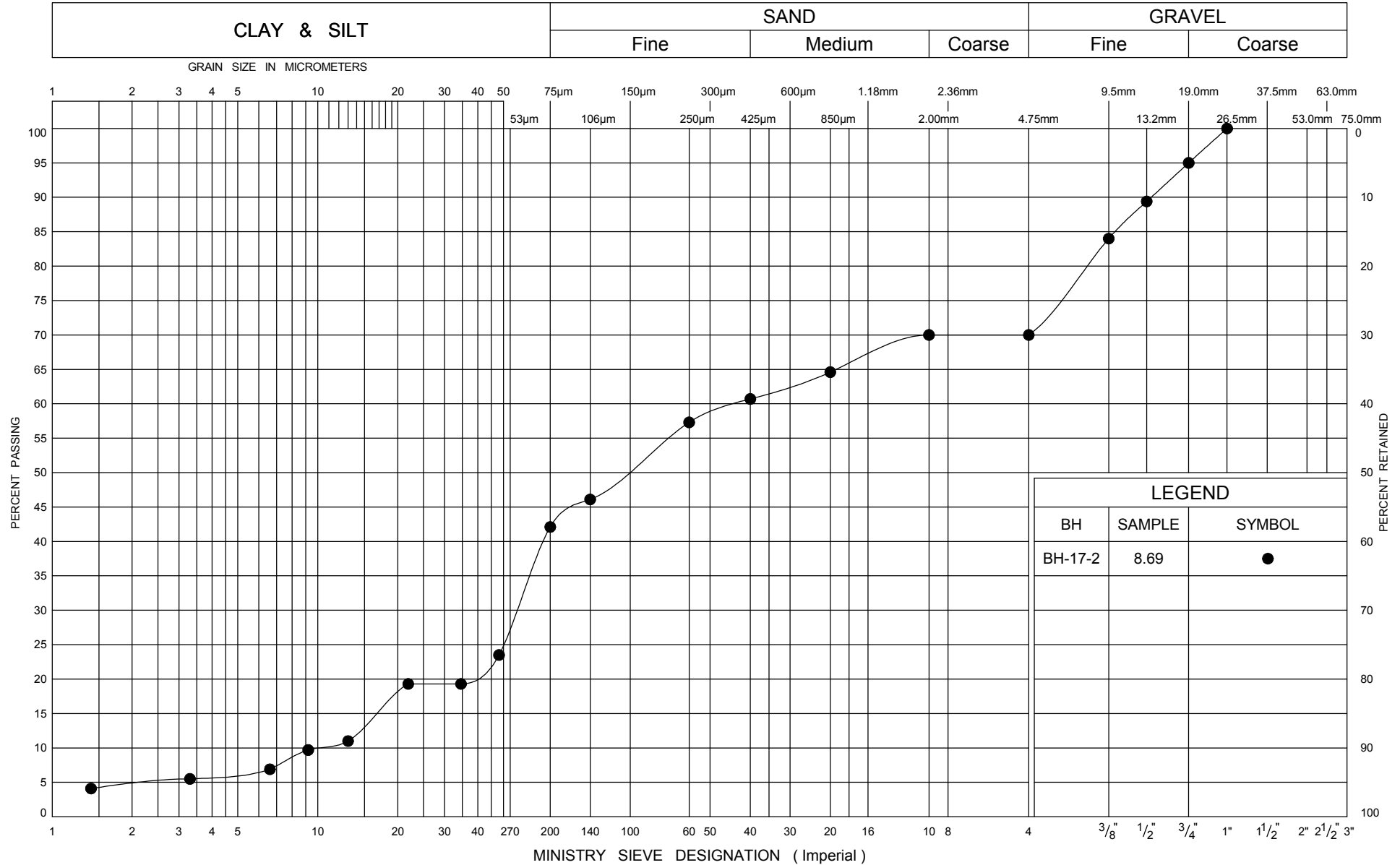
UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

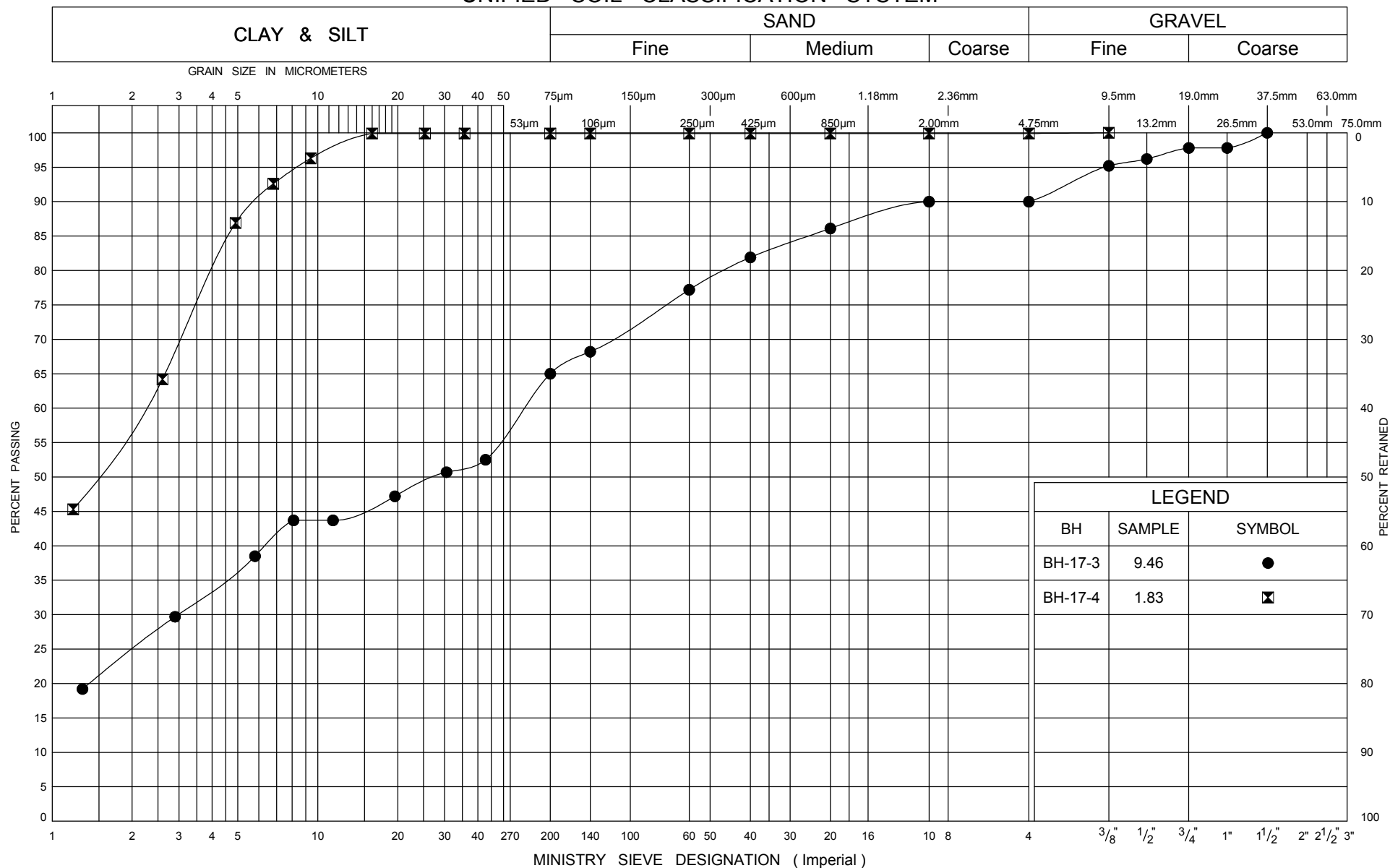
GRAIN SIZE DISTRIBUTION SANDY SILT

FIG No 3

W PGWP 5159-12-00

5015-E-0007, Assignment 8

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND

BH	SAMPLE	SYMBOL
BH-17-3	9.46	●
BH-17-4	1.83	☒

GRAIN SIZE DISTRIBUTION
SILTY CLAY/CLAY

FIG No 4

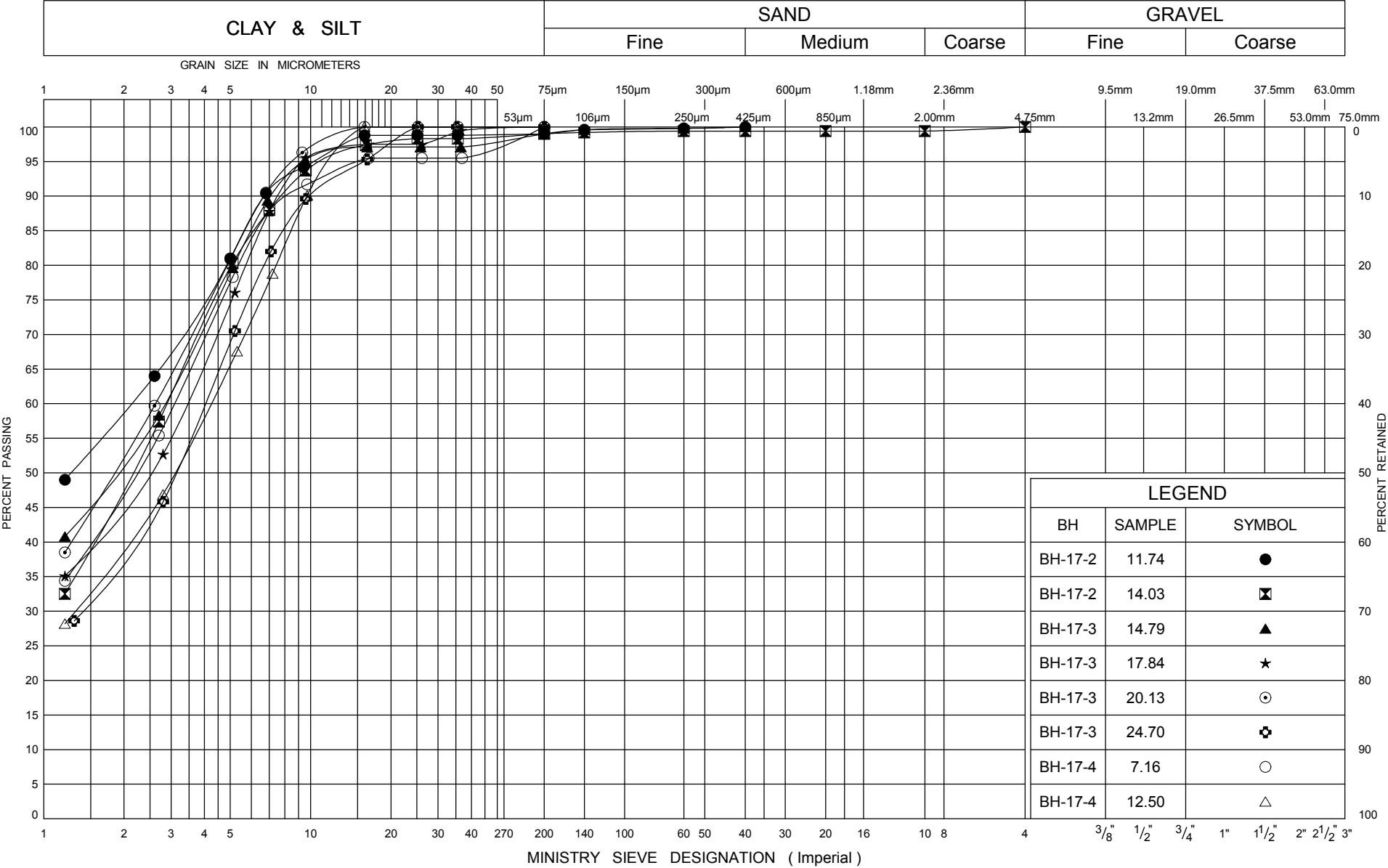
W PGWP 5159-12-00

5015-E-0007, Assignment 8

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Transportation

Ontario

UNIFIED SOIL CLASSIFICATION SYSTEM



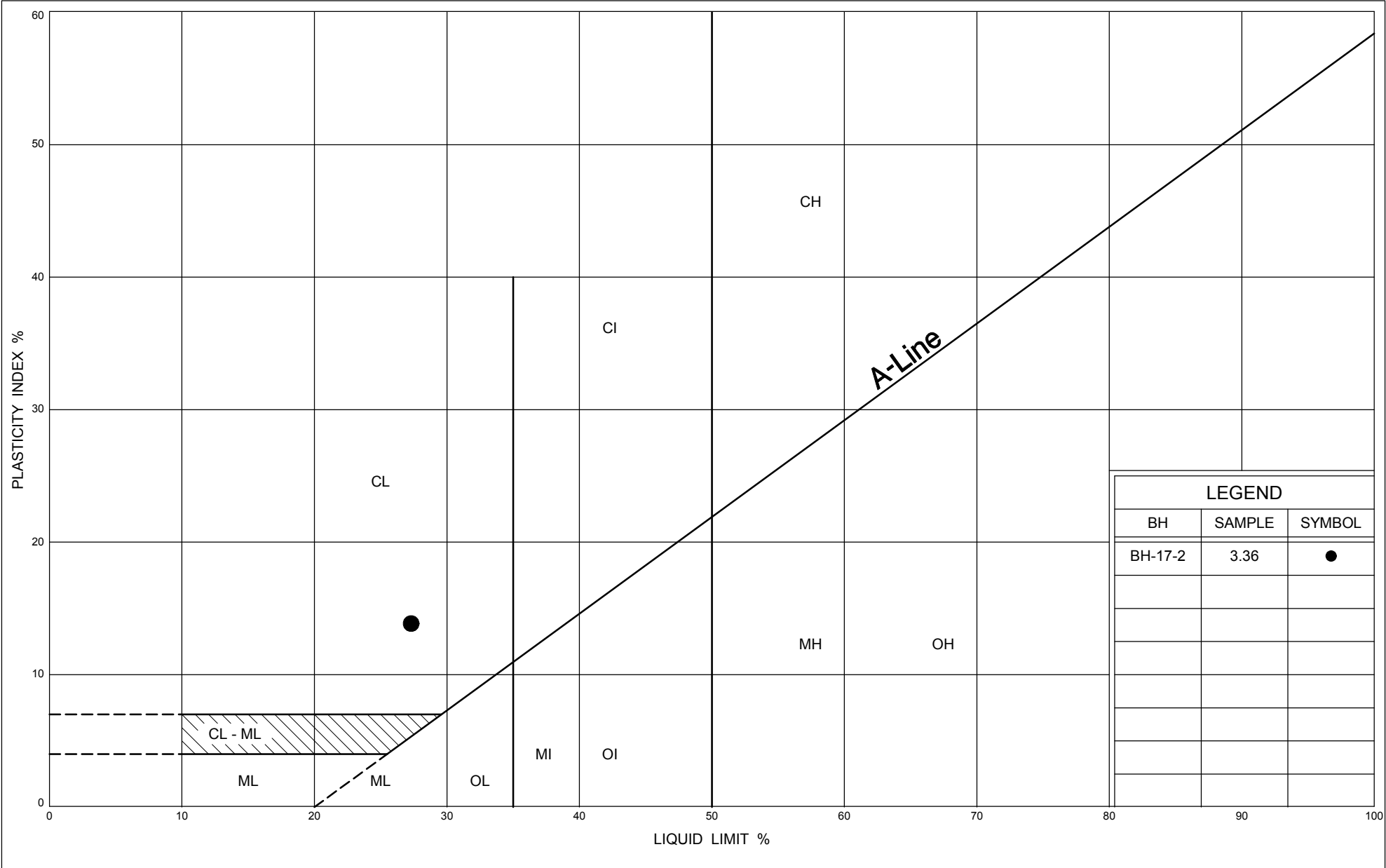
Ministry of
Transportation

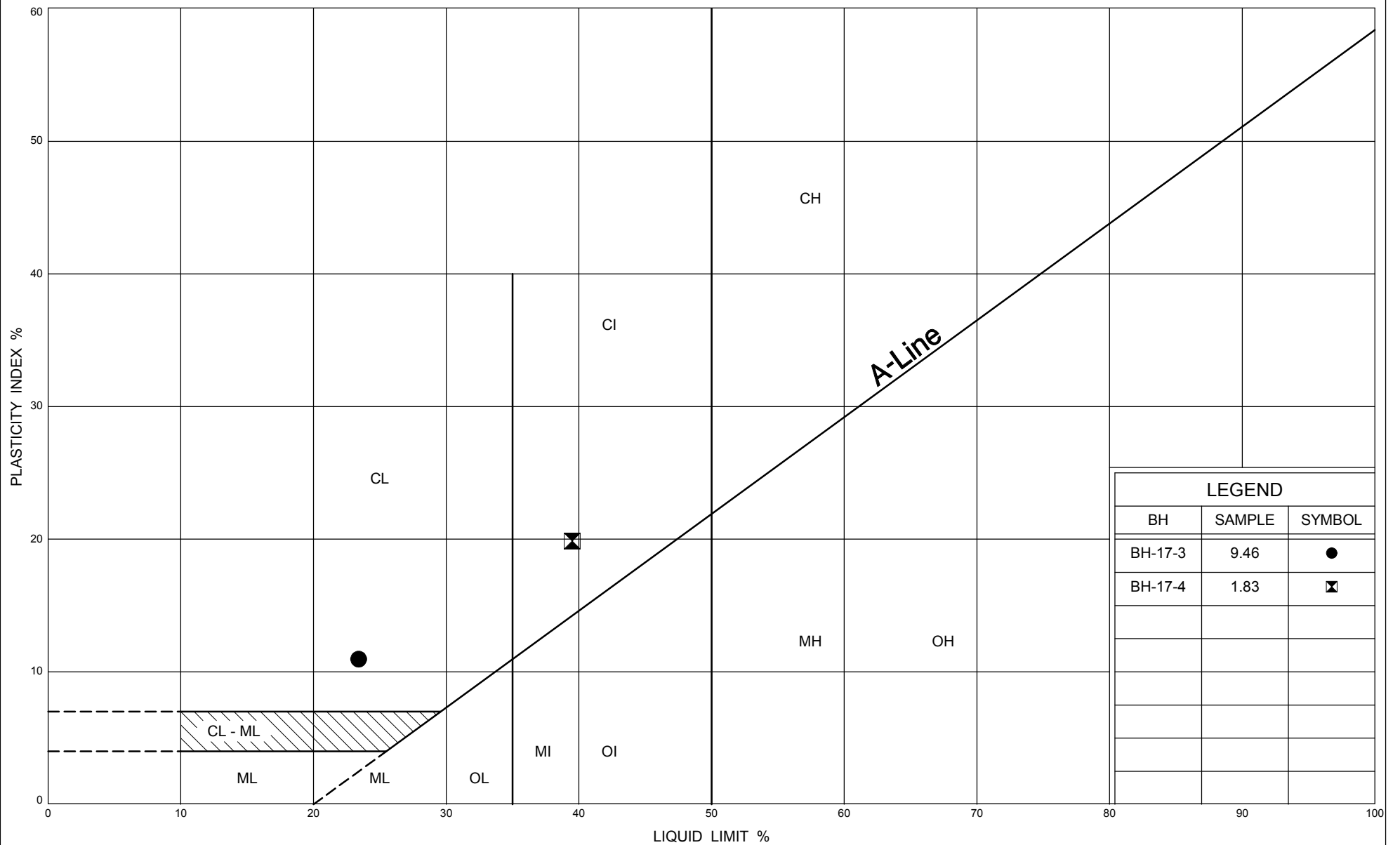
GRAIN SIZE DISTRIBUTION
VARVED SILTY CLAY/CLAY

FIG No 5

W PGWP 5159-12-00

5015-E-0007, Assignment 8





LEGEND		
BH	SAMPLE	SYMBOL
BH-17-3	9.46	●
BH-17-4	1.83	☒



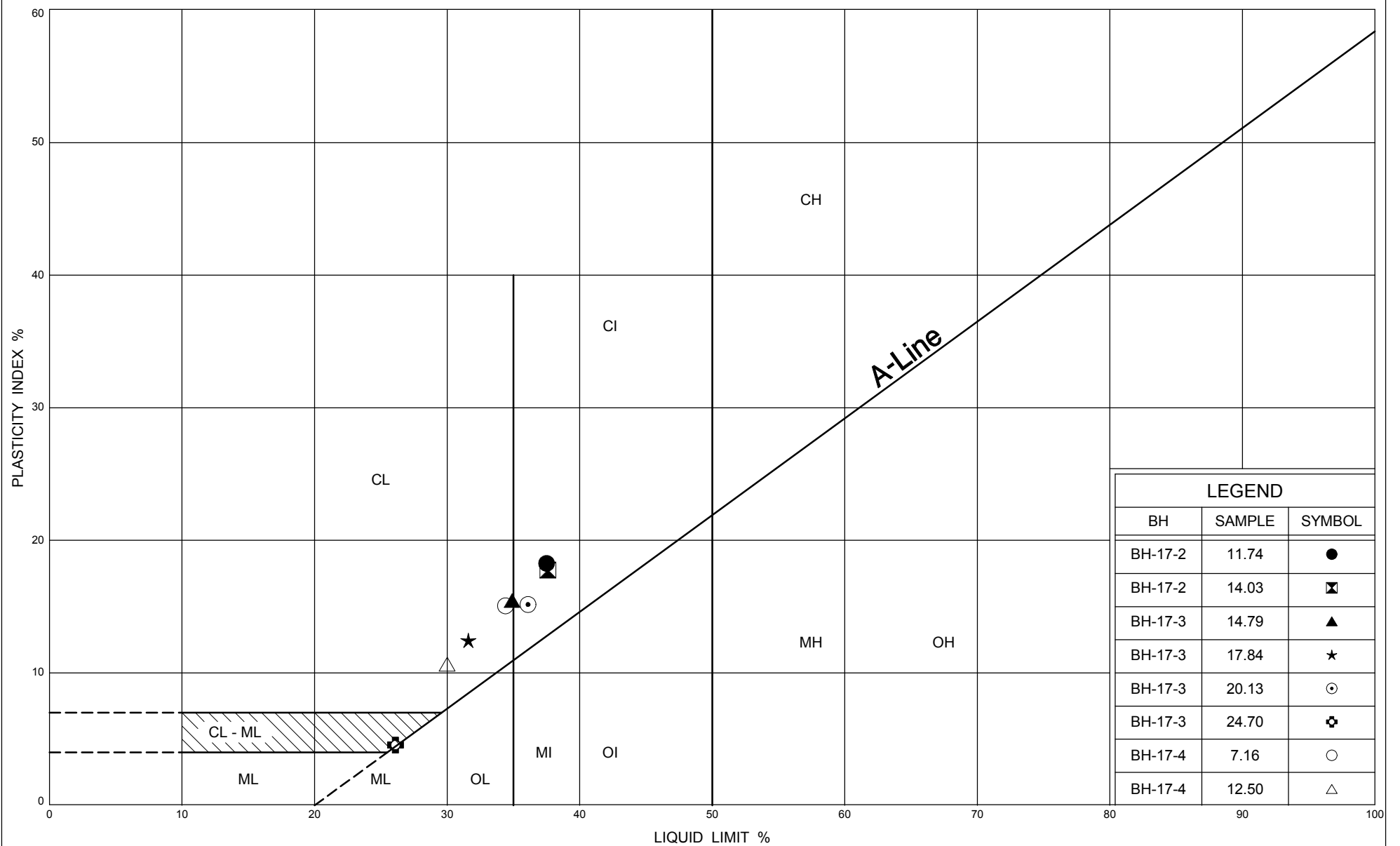
Ministry of
Transportation

PLASTICITY CHART SILTY CLAY/CLAY

FIG No 7

W P GWP 5159-12-00

5015-E-0007, Assignment 8









Appendix E – Borehole Logs from GEOCREES Reports

RECORD OF BOREHOLE No 16-1

1 OF 1

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 287.6 E 404 445.1 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.11 - 2016.08.11 CHECKED BY SP

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						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%)						
194.3								20	40	60	80	100					
0.0																	
0.1	TOPSOIL (100 mm)																
	CLAY stiff brown		1	SS	7		194										
			2	SS	16												
193.2																	
1.1	CLAY, varved firm to stiff grey						193										
			3	SS	1												
							192										
								10.0 +									
								7.2 +									
			4	SS	1		191										
								14.7 +									
							190										
								8.3 +									
			5	SS	1												
							189										
								9.0 +									
								6.0 +									
			6	SS	2		188										
								16.7 +									
							187										
								9.7 +									
186.5																	
7.8	Clayey SAND with gravel loose grey		7	SS	9												
185.5																	
8.8	Borehole terminated on inferred bedrock at 8.8 m Ground water level measured in VWP at: 0.1 m above ground surface (Elev. 194.4 m) on 2016/10/16 0.3 m above ground surface (Elev. 194.6 m) on 2016/09/23		8	SS	100/25 mm												

+³, ×³: Numbers refer to Sensitivity
 20
15
10
5
0
5
10
(%) STRAIN AT FAILURE

METRIC

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 16-2

2 OF 2

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 303.9 E 404 471.5 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.10 - 2016.08.10 CHECKED BY SP

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 × LAB VANE												
						20 40 60 80 100				20 40 60								
	Continued From Previous Page																	
	CLAY, varved firm to stiff grey						190											
			9	SS	1											0 0 61 39		
								189										
			10	SS	4													
186.5																		
14.0	Clayey SAND loose grey TILL		11	SS	4										14 41 28 17			
185.8			12	SS	100/ 250mm													
14.7	Borehole terminated on inferred bedrock at 14.7 m Borehole open upon completion Ground water level at 0.4 m BGS (Elev. 200.1 m) on completion of drilling																	

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16-3

1 OF 2

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 323.0 E 404 488.4 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.11 - 2016.08.12 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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					
								20 40 60 80 100					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
						WATER CONTENT (%) 20 40 60							
						PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L							
203.2													
0.0	TOPSOIL (100 mm)												
0.1	Clayey SAND compact brown FILL		1	SS	24		203						
			2	SS	21		202						
201.7													
1.5	CLAY firm brown FILL		3	SS	2		201						
			4	SS	2		200						
199.5													
3.7	CLAY stiff brown						199						
			5	SS	4		198						
										</			

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10



(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16-3

2 OF 2

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 323.0 E 404 488.4 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.11 - 2016.08.12 CHECKED BY SP

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			WATER CONTENT (%)					
								20 40 60 80 100	W _p W W _L							
Continued From Previous Page																
	CLAY, varved firm to stiff grey						193									
			9	SS	2											
			10	SS	3											
			11	SS	4											
														</		

+³, ×³: Numbers refer to
Sensitivity 20
15 10 5
(%) STRAIN AT FAILURE


















ONTMT4S 19-5161-208 CALAMITY CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 14/6/17

RECORD OF BOREHOLE No 16-4

1 OF 3

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 372.9 E 404 540.7 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.08 - 2016.08.09 CHECKED BY SP

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 × LAB VANE									WATER CONTENT (%)
213.4 0.0 213.1	ASPHALT (260 mm)							20	40	60	80	100					
0.3 212.5	SAND with silt and gravel brown FILL		1	AS			213							○			
0.9 212.2	ASPHALT (280 mm)		2	SS	100												
1.2 211.1	SAND with silt and gravel, occasional cobbles and boulders loose FILL -280 mm diameter boulder at 1.8 m		3	SS	100/ 180 mm		212							○			
2.3 211.1	Clayey SAND with gravel brown loose FILL		4	SS	4		211							○			
			5	SS	5		210							○			14 43 26 17
			6	SS	4												
			7	SS	4		209										
														○			
							208										
																	
			8	SS	7		207							○			30 35 25 10
																	
							206										
																	
							205										
204.3 9.1	Clay firm brown to grey FILL -25 mm fine fibrous organic layer at 9.6 m		10	SS	7		204							○			

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16-4

2 OF 3

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 372.9 E 404 540.7 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.08 - 2016.08.09 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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				
								20 40 60 80 100				
								20 40 60 80 100				
	Continued From Previous Page											
201.8	Clay firm brown to grey FILL -150 mm diameter cobble at 10.7 m -trace wood pieces		11	SS	10							
11.6	CLAY, trace roots/wood stiff greyish brown		12	SS	11							
200.0												
13.4	CLAY, varved firm to stiff grey		13	SS	WH							
			14	ST	PUSH							
			15	SS	WH							
			16	SS	1							

Continued Next Page

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

METRIC

ELEV. DEPTH	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 (%)
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L	WATER CONTENT (%) 20 40 60			
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					GR SA SI CL

[illegible]

+³, ×³: Numbers refer to Sensitivity

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

ONTMT4S 19-5161-208 CALAMITY CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 14/6/17

METRIC

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W P W W L	WATER CONTENT (%)			
	Continued From Previous Page												
	CLAY , varved firm to stiff grey												
			12	SS	2								
			13	SS	7								
			14	SS	5								
188.5													
186.5													
15.7	Clayey SAND compact grey TILL Borehole terminated on inferred bedrock at 17.3 m Ground water level measured in standpipe piezometer at: 2.7 m BGS (Elev. 201.3 m) on 2017/05/16 3.6 m BGS (Elev. 200.4 m) on 2016/09/22		15	SS	11								

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 16-6

1 OF 2

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 437.6 E 404 603.8 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.14 - 2016.08.14 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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 (%)					
198.1							20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L			
0.0	TOPSOIL (50 mm)							○ UNCONFINED + FIELD VANE					
197.2	CLAY stiff brown		1	SS	25			● QUICK TRIAXIAL × LAB VANE					
0.9	CLAY, varved firm to stiff grey		2	SS	9								
			3	SS	1								
			4	SS	WH								
			5	SS	1								
			6	SS	1								
			7	SS	4								
			8	SS	9								
188.4	Borehole terminated on inferred bedrock at 9.7 m												
9.7													

ONTMT4S 19-5161-208 CALAMITY CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 14/6/17

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16-6

2 OF 2

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 437.6 E 404 603.8 ORIGINATED BY JG
HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
DATUM Geodetic DATE 2016.08.14 - 2016.08.14 CHECKED BY SP

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																
	Ground water level measured in VWP at: 2.6 m above ground surface (Elev. 200.7 m) on 2016/10/16 2.5 m above ground surface (Elev. 200.6 m) on 2016/09/23																

ONTMT4S 19-5161-208 CALAMITY CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 14/6/17

RECORD OF BOREHOLE No 16-7

1 OF 2

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 343.6 E 404 499.5 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.12 - 2016.08.13 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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 × LAB VANE							
								WATER CONTENT (%) PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L							
204.2							20	40	60	80	100	20	40	60	
0.0	TOPSOIL (100 mm)														
0.1	Clayey SAND with gravel, occasional cobbles very dense brown FILL		1	SS	58										20 44 36 (SI+CL)
			2	SS	109							○			
203.0															
1.2	Clay firm brown to grey FILL		3	SS	7								○		
			4	SS	2								○		
			5	SS	1								○		
			6	SS	2										5 18 36 41
			7	SS	4									○	
196.6			8	SS	6									○	
7.6	CLAY stiff brown														
			9	SS	15										15 23 29 33

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

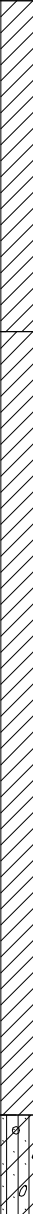


ONTMT4S 19-5161-208 CALAMITY CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 14/6/17

RECORD OF BOREHOLE No 16-7

2 OF 2

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 343.6 E 404 499.5 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.12 - 2016.08.13 CHECKED BY SP

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 × LAB VANE											
	Continued From Previous Page						20	40	60	80	100	20	40	60					
192.0 12.2	CLAY with sand, varved firm to stiff grey					194										6 17 39 38			
			10	SS	5	193													
						192													
						191													
						190													
186.8 17.4	Clayey SAND compact brownish-grey TILL					189													
			13	SS	6	188													
186.2 18.0	Borehole terminated on inferred bedrock at 18.0 m Borehole open to 15.8 m upon completion Vibrating Wire Piezometer installed at 14.9 m Ground water level measured in VWP at: 3.2 m BGS (Elev. 201.0 m) on 2016/10/16 3.0 m BGS (Elev. 201.2 m) on 2016/09/23					187													
			14	SS	8														

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16-8

1 OF 3

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 397.6 E 404 565.3 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.15 - 2016.08.16 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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 × LAB VANE								
206.9						20 40 60 80 100				PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W L				
0.0	TOPSOIL (50 mm)					20 40 60 80 100				WATER CONTENT (%)						
0.1	Clayey SAND with gravel, occasional cobbles loose to dense brown FILL		1	SS	32								○			
			2	SS	19		206						○			
			3	SS	19		205						○			
			4	SS	9		204						○			14 47 30 9
			5	SS	12		203						○			
			6	SS	16		202						○			
							▼ 201									
			7	SS	17		200						● —			21 42 23 14
199.6																
7.3	Clay firm brown to grey FILL		8	SS	41		199						● —			0 2 33 65
198.2																
8.7	CLAY , varved firm to stiff grey		9	SS	8		198							○		
							197									

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
15
10
(%) STRAIN AT FAILURE

ONTMT4S 19-5161-208 CALAMITY CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 14/6/17

RECORD OF BOREHOLE No 16-8

2 OF 3

METRIC

GWP# 5013-E-0031 LOCATION Calamity Creek Culvert, MTM Z12: N 5 269 397.6 E 404 565.3 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE NW casing COMPILED BY JG
 DATUM Geodetic DATE 2016.08.15 - 2016.08.16 CHECKED BY SP

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 (%)		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE									
	Continued From Previous Page							20 40 60 80 100	20 40 60									
	CLAY, varved firm to stiff grey																	
		10	SS	3				14.4 +										
								5.3 +										
								8.7 +										
		11	SS	3										0 0 54 46				
								8.0 +										
								7.5 +										
		12	SS	WH														
								5.6 +										
								4.7 +										
			13	SS	5													
								6.6 +										
								4.0 +										
			14	SS	8													
	-silty		15	SS	8								1 3 70 26					
188.0							188											
187.8	Clayey SAND		16	SS	100/													
19.1	TILL				50 mm													
	Borehole terminated on inferred bedrock at 19.1 m Vibrating Wire Piezometer installed at 17.5 m Ground water level measured in VWP																	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

ONTMT4S 19-5161-208 CALAMITY CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 14/6/17

METRIC

[illegible]

Previous Investigation
(GEOCRES 31M-109)

RECORD OF BOREHOLE No 1

1 of 2

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404593.1 N:5269457.4 ORIGINATED BY S.M
DIST HWY 11 BOREHOLE TYPE CASING AND WASH BORING/NQ CORING COMPILED BY A.A
DATUM GEODETIC DATE 2014-9-4 CHECKED BY R.A

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 (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)		W _p	W	W _L		
								20 40 60 80 100						
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE					
201.8	GROUND SURFACE													
	100mm TOPSOIL		1	SS	5									
	SILTY CLAY , trace sand, trace gravel, firm, brown, wet		2	SS	5								0 0 27 73	
200.4			3	SS	3									
1.4			4	TW	PH								0 0 63 37 0 0 23 77	
	SILTY CLAY (Varved), containing 5mm to 20mm thick silt layers, stiff, grey, wet		5	SS	0*								0 0 27 73	
			6	TW	PH									
			7	SS	0*								0 0 37 63	
			8	SS	1									
			9	SS	0*								0 0 56 44	
			10	SS	0*									
188.7			11	SS	100 / 75mm									
13.1	CLAYEY SILT , sandy, trace gravel, hard, grey, moist (GLACIAL TILL)		1	RUN	NQ								NQ Coring RUN# 1 TCR=100% SCR=100% RQD=86%	
188.5	BEDROCK-LIMESTONE , (Dolomitic), slightly weathered (13.3m-14.9m) to moderately weathered (14.9m-16.3m) medium to thickly bedded, grey to whitish grey, medium to high strength, vuggy (frequent vugs at 15.2m-16.3m)		2	RUN	NQ								RUN# 2	
13.3														

Continued Next Page

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

RECORD OF BOREHOLE No 1

2 of 2

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404593.1 N:5269457.4 ORIGINATED BY S.M
 DIST HWY 11 BOREHOLE TYPE CASING AND WASH BORING/NQ CORING COMPILED BY A.A
 DATUM GEODETIC DATE 2014-9-4 CHECKED BY R.A

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 (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)										WATER CONTENT (%)		
								20	40	60	80	100						○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE	
	(continued)						20	40	60	80	100				kn/m ³					
185.5	BEDROCK-LIMESTONE, (Dolomitic), slightly weathered (13.3m-14.9m) to moderately weathered (14.9m-16.3m) medium to thickly bedded, grey to whitish grey, medium to high strength, vuggy (frequent vugs at 15.2m-16.3m)		2	RUN	NQ											TCR=100% SCR=92% RQD=37%				

END OF BOREHOLE

Borehole filled with drill water upon completion of drilling.

*Sampler sinking under weight of hammer and/ or rods.

Consolidation test performed on TW4.

Piezometer installation consists of a 25mm diameter schedule 40PVC pipe with a 3.0m slotted screen.

*(ag) - above ground.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 17, 2014	-0.1 (ag)*	n/a
Oct 28, 2014	-0.5 (ag)*	n/a
Nov 24, 2014	-0.6 (ag)*	n/a

RECORD OF BOREHOLE No 3

1 of 3

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404536.5 N:5269374.3 ORIGINATED BY S.M
DIST HWY 11 BOREHOLE TYPE HOLLOW STEM AUGERS / CASING AND WASH BORING/NQ CORING COMPILED BY A.A
DATUM GEODETIC DATE 2014-8-27 - 2014-8-28 CHECKED BY R.A

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			20 40 60 80 100							
								SHEAR STRENGTH (kPa)							
								○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE							
PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _P															

Continued Next Page

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

RECORD OF BOREHOLE No 3

2 of 3

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404536.5 N:5269374.3 ORIGINATED BY S.M
DIST HWY 11 BOREHOLE TYPE HOLLOW STEM AUGERS / CASING AND WASH BORING/NQ CORING COMPILED BY A.A
DATUM GEODETIC DATE 2014-8-27 - 2014-8-28 CHECKED BY R.A

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 (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)							WATER CONTENT (%)		
								20	40	60	80	100			W _p	W	W _L
(continued)																	
187.2 26.5 186.5 27.2	SILTY CLAY (Varved), containing 10mm to 30mm thick silt layers, stiff, grey, wet		21	SS	0*					4.2				44	0 0 38 62		
			22	TW	PH						3.8				50	0 0 45 55	
			23	SS	0*										44	August 27, 2014 August 28, 2014 0 0 43 57	
			24	TW	PH												
			25	SS	0*											42	0 0 43 57

Continued Next Page



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

RECORD OF BOREHOLE No 3

3 of 3

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404536.5 N:5269374.3 ORIGINATED BY S.M
 DIST HWY 11 BOREHOLE TYPE HOLLOW STEM AUGERS / CASING AND WASH BORING/NQ CORING COMPILED BY A.A
 DATUM GEODETIC DATE 2014-8-27 - 2014-8-28 CHECKED BY R.A

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 WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
183.5 30.3	(continued)		2	RUN	NQ					

END OF BOREHOLE

Borehole filled with drill water upon completion of drilling.

*Sampler sinking under weight of hammer and/ or rods.

Consolidation test performed on TW22

RECORD OF BOREHOLE No 4

1 of 3

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404541 N:5269354.3 ORIGINATED BY S.M
 DIST HWY 11 BOREHOLE TYPE CASING AND WASH BORING/NQ CORING COMPILED BY A.A
 DATUM GEODETIC DATE 2014-8-26 - 2014-8-27 CHECKED BY R.A

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 (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)										WATER CONTENT (%)		
								20	40	60	80	100						W _p	w	W _L

213.9	GROUND SURFACE																
213.5	360mm ASPHALTIC CONCRETE																
0.4	540mm FILL, SAND, some silt, some gravel, trace clay, very dense, brown, drv		1	SS	50 / 100mm		213										
213.0	FILL, silty clay, trace sand to sandy, trace gravel, trace organics below 6.9m, occasional cobbles, firm to very stiff, brown, moist to wet		2	SS	7		212										
0.9			3	SS	9		211										6 34 34 26
			4	SS	13		210										
			5	SS	30		209										
			6	SS	8		208										
			7	SS	6		207										
			8	SS	3		206										
			9	SS	7		205										
206.4	SILTY CLAY, trace sand, trace organics, firm, brown to grey, wet		10	SS	7		204										0 2 21 77
7.5			11	SS	4		203										
			12	SS	5		202										0 1 47 52
							201										
203.8	SILTY CLAY (Varved), containing 10mm to 20mm thick silt layers, stiff, grey, wet		13	SS	0*		200										
10.1			14	TW	PH		199										
			15	SS	0												

Continued Next Page

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

August 26, 2014
August 27, 2014

RECORD OF BOREHOLE No 4

2 of 3

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404541 N:5269354.3 ORIGINATED BY S.M
DIST HWY 11 BOREHOLE TYPE CASING AND WASH BORING/NQ CORING COMPILED BY A.A
DATUM GEODETIC DATE 2014-8-26 - 2014-8-27 CHECKED BY R.A

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 (%)			
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)							WATER CONTENT (%)		
								20 40 60 80 100							w _p w w _L		
(continued)								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
	SILTY CLAY (Varved). containing 10mm to 20mm thick silt layers, stiff, grey, wet																
			16	TW	PH												

Continued Next Page

END OF BOREHOLE

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

library: library - terraprobe gint.gdb report: mto-terraprobe soil file: 11-14-4086 (47-273c) calanity creek.gpj

RECORD OF BOREHOLE No 4

3 of 3

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404541 N:5269354.3 ORIGINATED BY S.M
DIST HWY 11 BOREHOLE TYPE CASING AND WASH BORING/NQ CORING COMPILED BY A.A
DATUM GEODETIC DATE 2014-8-26 - 2014-8-27 CHECKED BY R.A

SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT NUMBER	TYPE			SHEAR STRENGTH (kPa)		W _p	W	W _L	γ	
						20 40 60 80 100		10 20 30			kN/m ³	GR SA SI CL

(continued)

30.0

Borehole filled with drill water
upon completion of drilling.

*Sampler sinking under weight of
hammer and/ or rods




Insufficient sample available for
Atterberg limits test at SS12

RECORD OF BOREHOLE No 5

1 of 2

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404496.3 N:5269354.8 ORIGINATED BY S.M
DIST HWY 11 BOREHOLE TYPE HOLLOW STEM AUGERS/CASING AND WASH BORING/NQ CORING COMPILED BY A.A
DATUM GEODETIC DATE 2014-8-29 - 2014-9-3 CHECKED BY R.A

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 (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)							WATER CONTENT (%)		
								20 40 60 80 100							W _p W W _L		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							WATER CONTENT (%)		
203.5	GROUND SURFACE						20	40	60	80	100	10	20	30	GR SA SI CL		
203.4 0.2	150mm TOPSOIL		1	SS	7	203									4 45 37 14		
	FILL, sand and silt, some clay, trace gravel, very loose to compact, brown, wet		2	SS	12	202											
			3	SS	2	201											
201.4 2.1	SILTY CLAY, trace sand, trace gravel, soft to stiff, brown, wet		4	SS	2	200									0 1 33 66		
	...		5	SS	4	199											
	containing organics		6	SS	13	198											
197.9 5.6	SILTY CLAY (Varved), containing 10mm to 20mm thick silt layers, firm to stiff, grey, wet					197									Aug. 29, 2014 Sept. 2, 2014 commence casing and washboring		
			7	TW	PH	196											
			8	SS	0*	195											
			9	TW	PH	194											
			10	SS	0*	193											
			11	SS	0*	192											
			12	SS	0*	191											
						190									0 0 29 71		
						189											
																0 0 43 57	
																0 0 51 49	

Continued Next Page

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

RECORD OF BOREHOLE No 5

2 of 2

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404496.3 N:5269354.8 ORIGINATED BY S.M
 DIST HWY 11 BOREHOLE TYPE HOLLOW STEM AUGERS/CASING AND WASH BORING/NQ CORING COMPILED BY A.A
 DATUM GEODETIC DATE 2014-8-29 - 2014-9-3 CHECKED BY R.A

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 (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)							WATER CONTENT (%)		
	(continued)							20 40 60 80 100									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
								20 40 60 80 100				10 20 30					

END OF BOREHOLE

Borehole filled with drill water upon
completion of drilling.

*Sampler sinking under weight of
hammer and/ or rods.

Insufficient sample available for
Atterberg limits test at SS6

RECORD OF BOREHOLE No 6

1 of 2

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404454.7 N:5269290.3 ORIGINATED BY S.M
DIST HWY 11 BOREHOLE TYPE HOLLOW STEM AUGERS/CASING AND WASH BORING/NQ CORING COMPILED BY A.A
DATUM GEODETIC DATE 2014-9-3 CHECKED BY R.A

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			20 40 60 80 100						
								SHEAR STRENGTH (kPa)						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W _L WATER CONTENT (%)														
197.7	GROUND SURFACE													
197.6 0.2	150mm TOPSOIL		1	SS	3		197						○	
	SILTY CLAY, trace sand, trace organics, soft to firm, brown, wet		2	SS	4									
			3	SS	2		196						41 ○	commence casing and washboring 0 1 43 56
195.6 2.1														
	SILTY CLAY (Varved), containing 5mm to 20mm thick silt layers, firm to stiff, grey, wet		4	TW	PH		195		3.7 +					
							194		3.7 +					
							193		8.0 +				43 ○	0 0 53 47
			5	SS	0*				5.1 +					
							192		7.4 +					
			6	TW	PH				3.6 +					
							191		5.6 +					
							190		5.8 +				47 ○	0 0 40 60
			7	SS	0*									
							189		7.5 +					
									5.0 +					
							188							
									7.3 +					
									5.6 +					
			9	SS	0*		187						○	0 1 69 30
							186		5.2 +					
185.6 12.1	BEDROCK-LIMESTONE, (Dolomitic), slightly weathered, medium to thickly bedded, grey to whitish grey, high strength, vuggy		10	SS	100 / 50mm		185							NQ Coring
			1	RUN	NQ									RUN #1 TCR=100% SCR=97% RQD=88%
							184							
			2	RUN	NQ									RUN #2 TCR=100% SCR=100% RQD=95%
							183							

Continued Next Page

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


library: library - terraprobe gint - md.gib report: mto-terraprobe soil file: 11-14-4086 (47-273c) calanity creek.gpj

RECORD OF BOREHOLE No 6

2 of 2

METRIC

G.W.P. 5159-12-00 LOCATION Coords: E:404454.7 N:5269290.3 ORIGINATED BY S.M
 DIST HWY 11 BOREHOLE TYPE HOLLOW STEM AUGERS/CASING AND WASH BORING/NQ CORING COMPILED BY A.A
 DATUM GEODETIC DATE 2014-9-3 CHECKED BY R.A

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 (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
182.5 15.2	(continued)		2	RUN	NQ							
							SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
							20 40 60 80 100 20 40 60 80 100					

END OF BOREHOLE

Borehole filled with drill water upon completion of drilling.

*Sampler sinking under weight of hammer and/ or rods.

Piezometer installation consists of a 25mm diameter schedule 40PVC pipe with a 3.0m slotted screen.

*(ag) - above ground.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 17, 2014	-0.3 (ag)*	n/a
Oct 28, 2014	-0.4 (ag)*	n/a
Nov 24, 2014	-0.4 (ag)*	n/a

**Previous Investigation
(*GEOCRES 31M-66*)**

RECORD OF BOREHOLE No DB3

1 OF 2

W.P. WP147-98-00 LOCATION Hwy 11 Dymond Twp Stn 17 + 630 O/S 3.1 m Rt.
 DIST Northern HWY Hwy 11 BOREHOLE TYPE Solid Stem Augers
 DATUM _____ DATE 10.05.99 & 10.05.99

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT		NATURAL MOISTURE CONTENT	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W		
213.9	Ground Surface															
0.0	220 mm Asphalt															
0.2	50 mm Sand and gravel, brown, moist															
0.3																
0.4	70 mm Asphalt															
0.6	170 mm Sand and gravel															
0.7	70 mm Asphalt, over Sand and gravel		1	SPT	19											
	FILL: clayey silt with trace organics and some gravel sizes, grey, moist, very stiff, over (possible fill) grey, moist clayey silt with trace organics 25 mm thick layer of topsoil		2	SPT	32											
			3	SPT	20											
207.6			4	SPT	6											
6.3	SILTY CLAY: greenish, moist, stiff very soft		5	SPT	11											
			6	SPT	21											
			7	SPT	19											
			8	SPT	10											
			9	SPT	7											
	with layers of organics becoming brown, very stiff fissured, stiff		10	SPT	3											
202.4	becoming wet at 10.7 m		11	SPT	4											
11.5	VARVED CLAY: rhythmic layers of dark grey silty clay to clay and light grey clayey silt to silt.		12	SHELBY												
			13	SPT	5											

Continued Next Page

3, X 3

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No DB3

2 OF 2

M

W.P. WP147-98-00 LOCATION Hwy 11 Dymond Twp Str 17 + 630 O/S 3.1 m Rt. O
 DIST Northern HWY Hwy 11 BOREHOLE TYPE Solid Stem Augers C
 DATUM DATE 10.05.99 & 10.05.99 C

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIMIT MOISTURE CONTENT		L _u
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	W _p	W	
			14	SHELBY										
			15	SHELBY										
			16	SPT	1									
			17	SHELBY										
			18	SPT	5									
			19	SHELBY										
			20	SPT	5									
188.4			21	SHELBY										
25.5	SILTY CLAY TILL: gray, moist		22	SPT 50/8 cm										
189.3														
26.6	End of borehole Refusal to further augering at 26.6 m Notes Borehole dry on completion: Water on piezometer at 13.8 m on 10.13.99 and on 10.14.99													

+ 3, x 3; Numbers refer to 20
Sensitivity 15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No DB4

1 OF 2

W.P. WP147-98-00

LOCATION Hwy 11 Dymond Twp Stn 17+679 O/S 2.9 m Lt.

DIST Northern HWY Hwy 11

BOREHOLE TYPE Solid Stem Augers

DATUM

DATE 10.05.99 & 10.05.99

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	W _p	W	
313.8	Ground Surface													
0.0	195 mm Asphalt													
0.2	FILL: sand and gravel, moist													
			1	SPT	27									
			2	SPT	11									
			3	SPT	27									
	with trace clay		4	SPT	10									
			5	SPT	8									
304.7	CLAYEY SILT: with some sand and gravel, brown		6	SPT	15									
303.2	with some organics													
302.2	CLAYEY SILT: with some gravel and organics, brown, moist		7	SPT	14									
			8	SPT	20									
301.0	SILTY CLAY: grey, organics		9	SPT	27									
			10	SPT	19									
199.0	becoming brown with trace		11	SPT	9									

Continued Next Page

+ 3, x 3, Numbers refer to 20
Sensitivity 15-25 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No DB4

2 OF 2

M

W.P. WP147-98-00 LOCATION Hwy 11 Dymond Twp Stn 17 + 679 O/S 2.9 m Lt. DIST Northern HWY Hwy 11 BOREHOLE TYPE Solid Stem Augers DATUM DATE 10.05.99 & 10.05.99

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	L _k
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100			
14.8	organics VARVED CLAY: rhythmic layers of dark grey silty clay to clay and light grey clayey silt to silt. Clay layers are approximately 25 mm thick with 12 mm thick silt layers, firm but readily separates on horizontal planes		12	SPT	9									
			13	SHELBY										
			14	SHELBY										
			15	SPT	3									
			16	SHELBY										
			17	SHELBY										
			18	SPT	3									
21.9	End of borehole Note: Borehole dry on completion													

Appendix F – Results of CPTu

PRESENTATION OF SITE INVESTIGATION RESULTS

Calamity Creek Culvert

Prepared for:

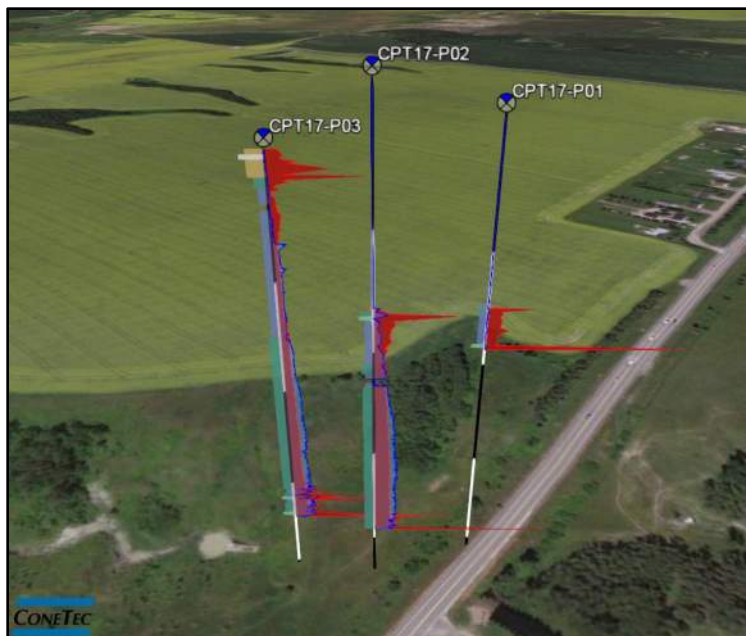
exp Services Inc.

ConeTec Job No: 17-05064

Project Start Date: 09-Nov-2017

Project End Date: 14-Nov-2017

Report Date: 20-Nov-2017



Prepared by:

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www.conetecdataservices.com



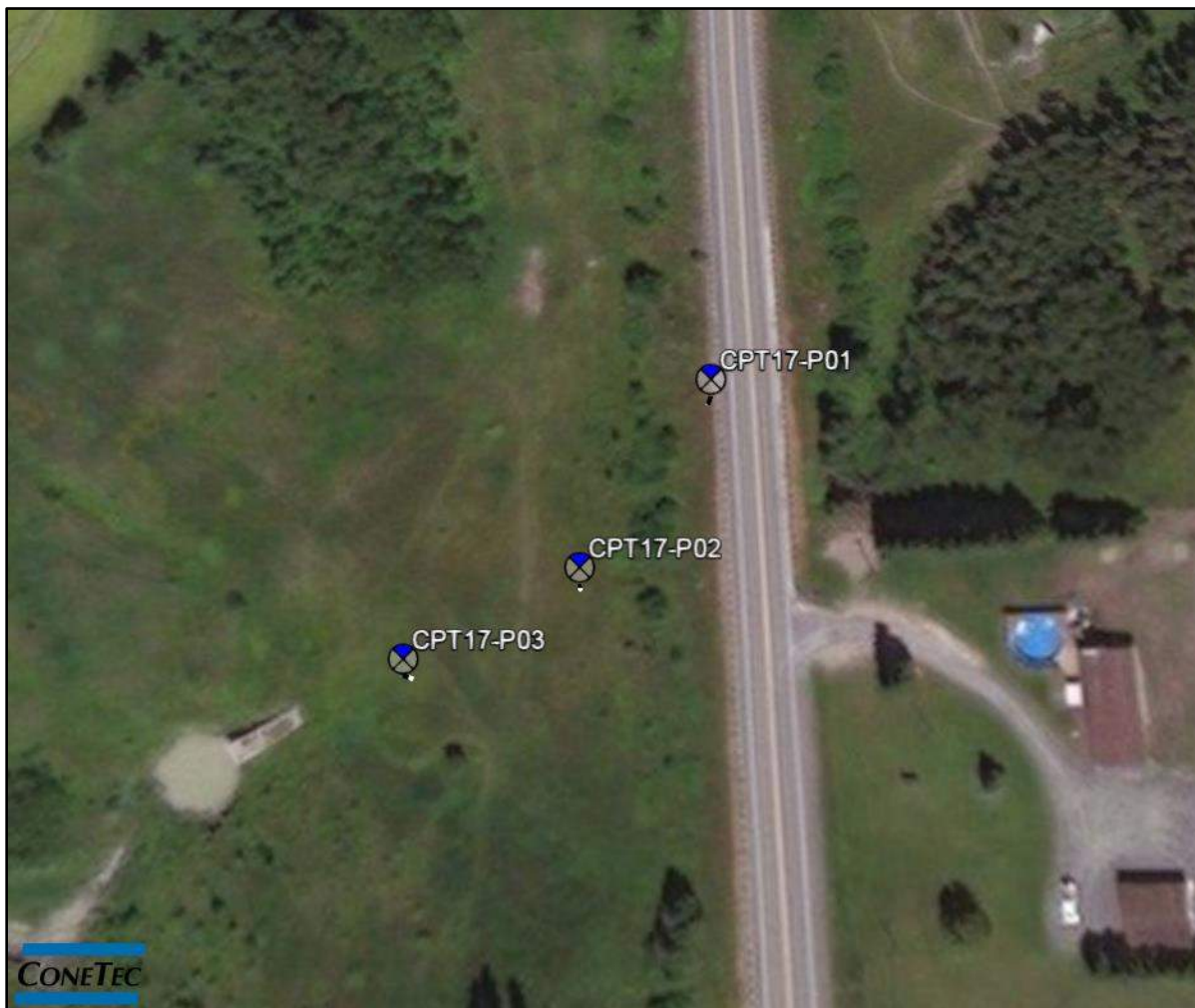
Introduction

The enclosed report presents the results of the site investigation program conducted by ConeTec Investigations Ltd. for exp Services Inc. in Temiskaming Shores, ON. The program consisted of three cone penetration tests (CPT).

Project Information

Project	
Client	exp Services Inc.
Project	Calamity Creek Culvert
ConeTec project number	17-05064

An overview map displaying the CPT test locations is presented below.



Rig Description	Deployment System	Test Type
CPT track rig (M5TII)	14 ton rig cylinder	CPT

Coordinates		
Test Type	Collection Method	EPSG Number
CPT	Consumer grade GPS	32617

Cone Penetration Test (CPT)	
Depth reference	Depths are referenced to the existing ground surface at the time of each test.
Tip and sleeve data offset	0.1 meter This has been accounted for in the CPT data files.
Additional plots	Advanced plots displaying I_c , $S_u(Nkt)$, and $N1(60)I_c$, along with soil behaviour type (SBT) scatter plots are provided in the data release package.

Cone Penetrometers Used for this Project						
Cone Description	Cone Number	Cross Sectional Area (cm ²)	Sleeve Area (cm ²)	Tip Capacity (bar)	Sleeve Capacity (bar)	Pore Pressure Capacity (psi)
322:T1500F15U500	322	15	225	1500	15	500
Cone 322 was used for all CPT soundings.						

Calculated Geotechnical Parameter Tables	
Additional information	<p>The Normalized Soil Behaviour Type Chart based on Q_{tn} (SBT Q_{tn}) (Robertson, 2009) was used to classify the soil for this project. A detailed set of calculated CPT parameters have been generated and are provided in Excel format files in the release folder. The CPT parameter calculations are based on values of corrected tip resistance (q_t) sleeve friction (f_s) and pore pressure (u_2).</p> <p>Soils were classified as either drained or undrained based on the Normalized Soil Behaviour Type Chart (SBT Q_{tn}) (Robertson, 2009). Calculations for both drained and undrained parameters were included for materials that classified as silt mixtures – clayey silt to silty clay (zone 4). Materials classifying as undefined (zone 0) were treated as undrained.</p>

Limitations

This report has been prepared for the exclusive use of exp Services Inc. (Client) for the project titled “Calamity Creek Culvert”. The report’s contents may not be relied upon by any other party without the express written permission of ConeTec Investigations Ltd. (ConeTec). ConeTec has provided site investigation services, prepared the factual data reporting and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to ConeTec by the Client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

The cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd. of Richmond, British Columbia, Canada.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and a geophone sensor for recording seismic signals. All signals are amplified down hole within the cone body and the analog signals are sent to the surface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm² and 15 cm² tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table presented in the first Appendix. The 15 cm² penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm² piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 mm diameter over a length of 32 mm with tapered leading and trailing edges) located at a distance of 585 mm above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u₂" position (ASTM Type 2). The filter is 6 mm thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meets or exceeds those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.



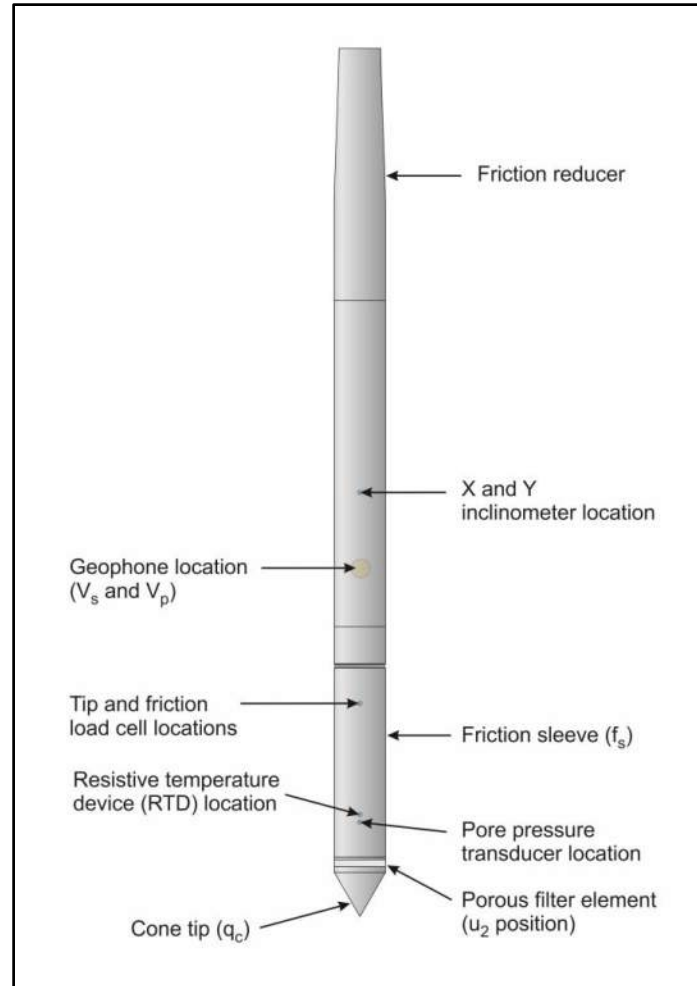


Figure CPTu. Piezocone Penetrometer (15 cm²)

The ConeTec data acquisition systems consist of a Windows based computer and a signal conditioner and power supply interface box with a 16 bit (or greater) analog to digital (A/D) converter. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording intervals are either 2.5 cm or 5.0 cm depending on project requirements; custom recording intervals are possible. The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPT operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with either glycerine or silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of 2 cm/s, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil or glycerine under vacuum pressure prior to use
- Recorded baselines are checked with an independent multi-meter
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson (1990) and Robertson (2009). It should be noted that it is not always possible to accurately identify a soil type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behaviour type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al, 1986:

$$q_t = q_c + (1-a) \cdot u_2$$

where: q_t is the corrected tip resistance

q_c is the recorded tip resistance

u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)

a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (R_f) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high



friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of interpretation files were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the interpretation methods used is also included in the data release folder.

For additional information on CPTu interpretations, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

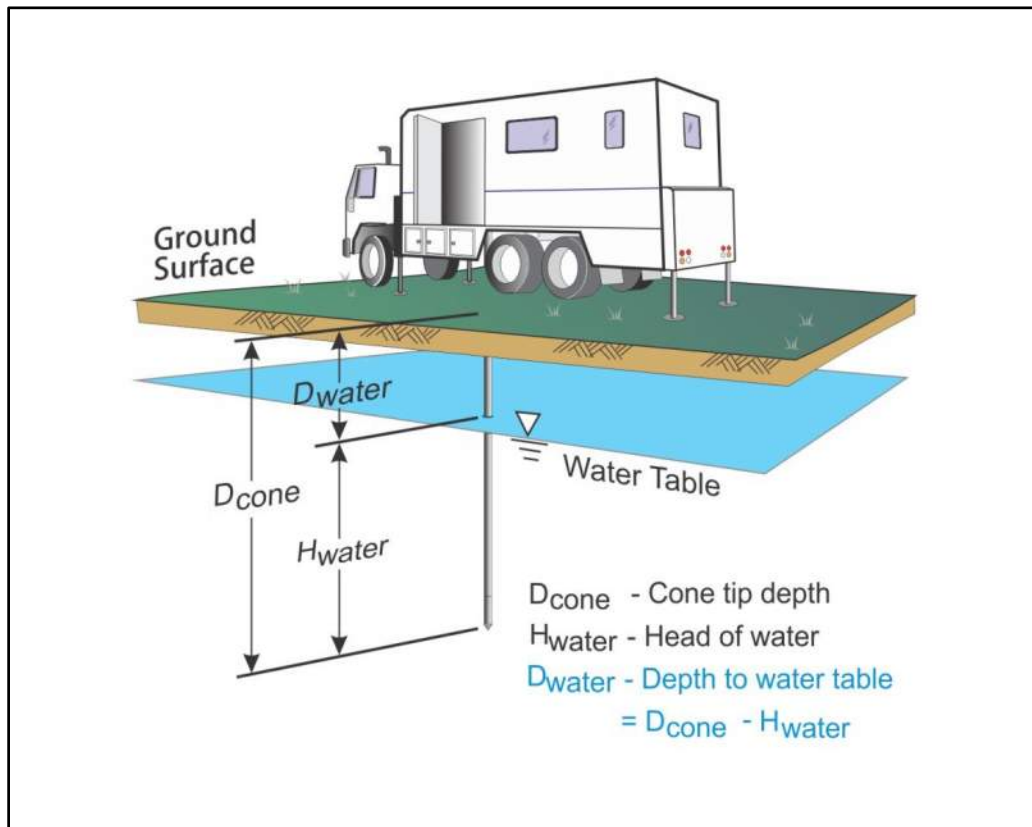


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behaviour.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

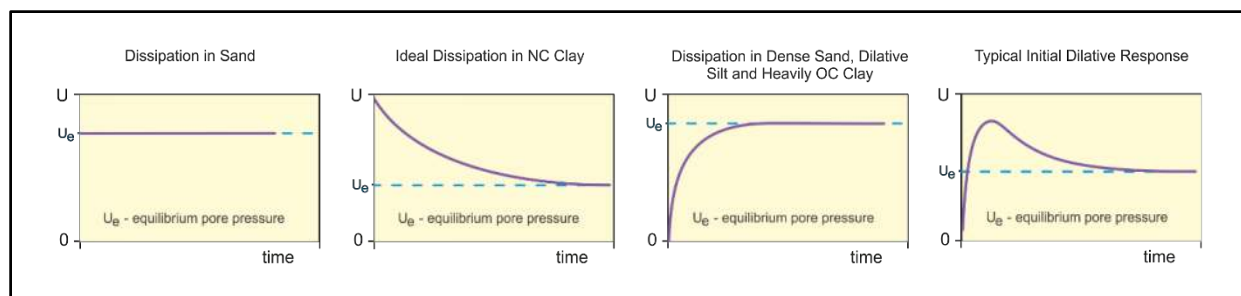


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve of Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100} . In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100} . A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T^*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:

- T^* is the dimensionless time factor (Table Time Factor)
- a is the radius of the cone
- I_r is the rigidity index
- t is the time at the degree of consolidation

Table Time Factor. T^* versus degree of dissipation (Teh and Houlsby, 1991)

Degree of Dissipation (%)	20	30	40	50	60	70	80
$T^* (u_2)$	0.038	0.078	0.142	0.245	0.439	0.804	1.60

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50} , dissipation tests must be taken to a pressure less than u_{50} . The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100} . To estimate u_{50} , both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby, 1991), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50} . In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r , the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50} , other methods should be applied to confirm the results for c_h .

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

REFERENCES

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- Sully, J.P., Robertson, P.K., Campanella, R.G. and Woeller, D.J., 1999, "An approach to evaluation of field CPTU dissipation data in overconsolidated fine-grained soils", *Canadian Geotechnical Journal*, 36(2): 369-381.
- Teh, C.I., and Houlsby, G.T., 1991, "An analytical study of the cone penetration test in clay", *Geotechnique*, 41(1): 17-34.

The appendices listed below are included in the report:

- Cone Penetration Test Summary and Standard Cone Penetration Test Plots
- Advanced Cone Penetration Test Plots displaying I_c , $S_u(N_{kt})$, and $N1(60)I_c$
- Soil Behaviour Type (SBT) Scatter Plots
- Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Cone Penetration Test Summary and Standard Cone Penetration Test Plots



Job No: 17-05064
Client: exp Services Inc.
Project: Calamity Creek Culvert
Start Date: 09-Nov-2017
End Date: 14-Nov-2017

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface ¹ (m)	Final Depth (m)	Northing ² (m)	Easting (m)	Refer to Notation Number
CPT17-P01	17-05064_CP01	14-Nov-2017	322:T1500F15U500	6.3	9.275	5267779	599704	
CPT17-P02	17-05064_CP02	09-Nov-2017	322:T1500F15U500	3.5	19.425	5267744	599681	3
CPT17-P03	17-05064_CP03	10-Nov-2017	322:T1500F15U500	3.5	17.050	5267728	599651	3

1. The assumed phreatic surface was based on pore pressure dissipation tests, unless otherwise noted. Hydrostatic conditions were assumed for the calculated parameters.
2. Coordinates were collected with a consumer grade GPS device in datum WGS84/UTM Zone 17 North.
3. The assumed phreatic surface was based on dynamic pore pressure response.



exp Services Inc.

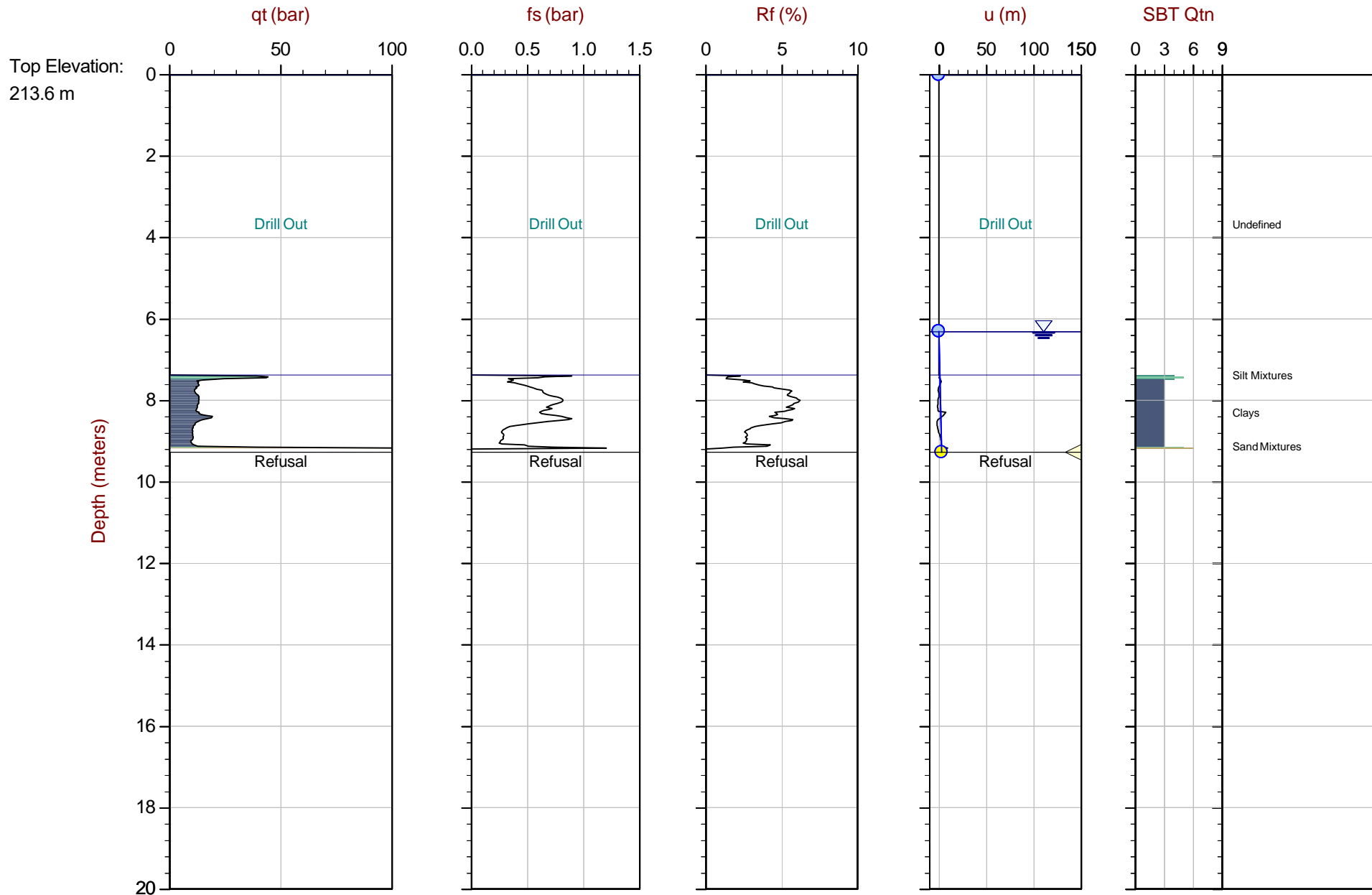
Job No: 17-05064

Date: 2017-11-14 10:31

Site: Calamity Creek Culvert

Sounding: CPT17-P01

Cone: 322:T1500F15U500



Max Depth: 9.275 m / 30.43 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: Every Point

File: 17-05064_CP01.COR

Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010

Coords: UTM17N N: 5267779m E: 599704m

Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq)

● Assumed Ueq

◀ Dissipation, Ueq achieved

◀ Dissipation, Ueq not achieved

— Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



exp Services Inc.

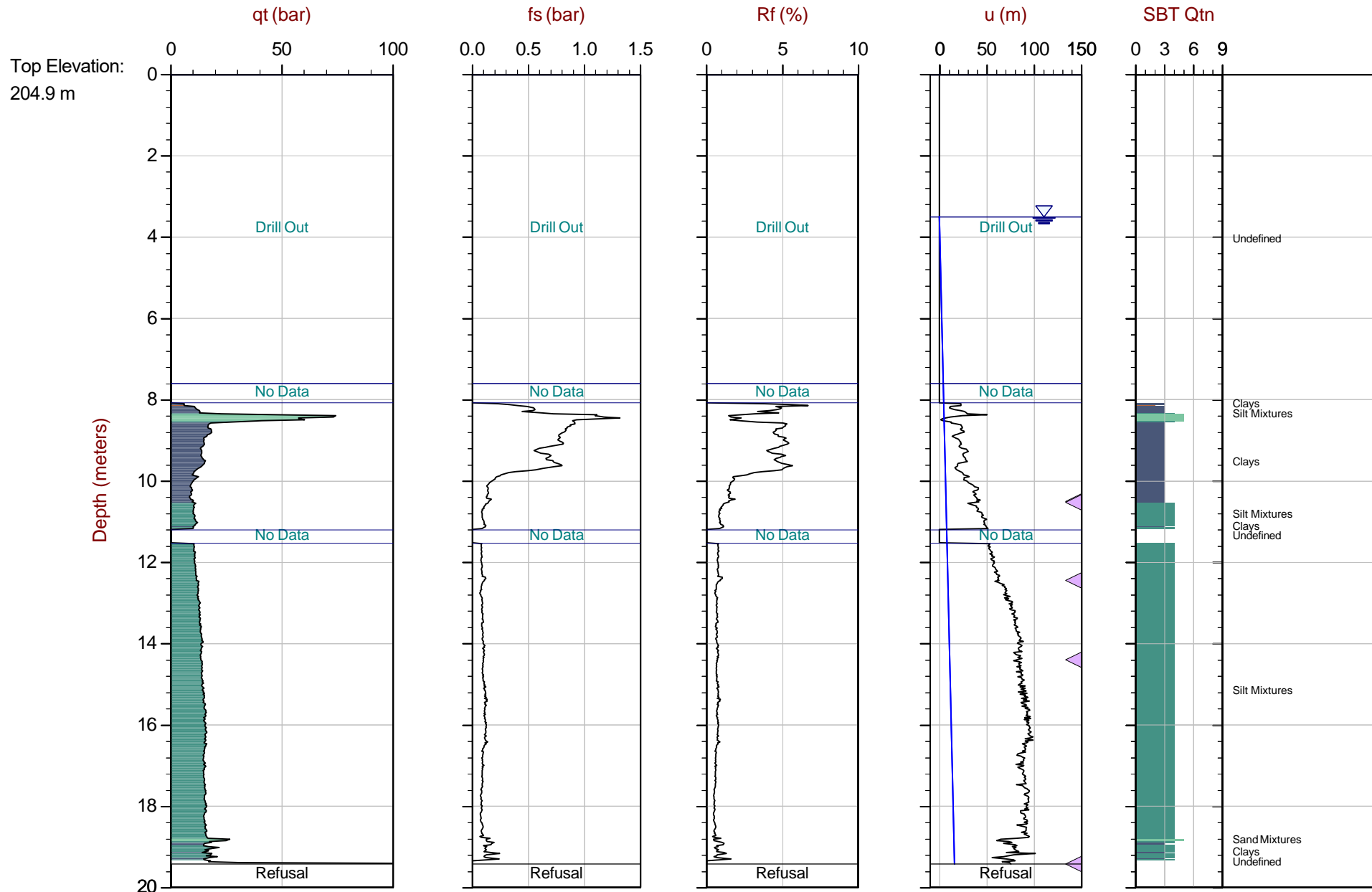
Job No: 17-05064

Date: 2017-11-09 11:44

Site: Calamity Creek Culvert

Sounding: CPT17-P02

Cone: 322:T1500F15U500



Max Depth: 19.425 m / 63.73 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: Every Point

File: 17-05064_CP02.COR

Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010

Coords: UTM17N: 5267744m E: 599681m

Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq) ● Assumed Ueq ▲ Dissipation, Ueq achieved ▼ Dissipation, Ueq not achieved — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



exp Services Inc.

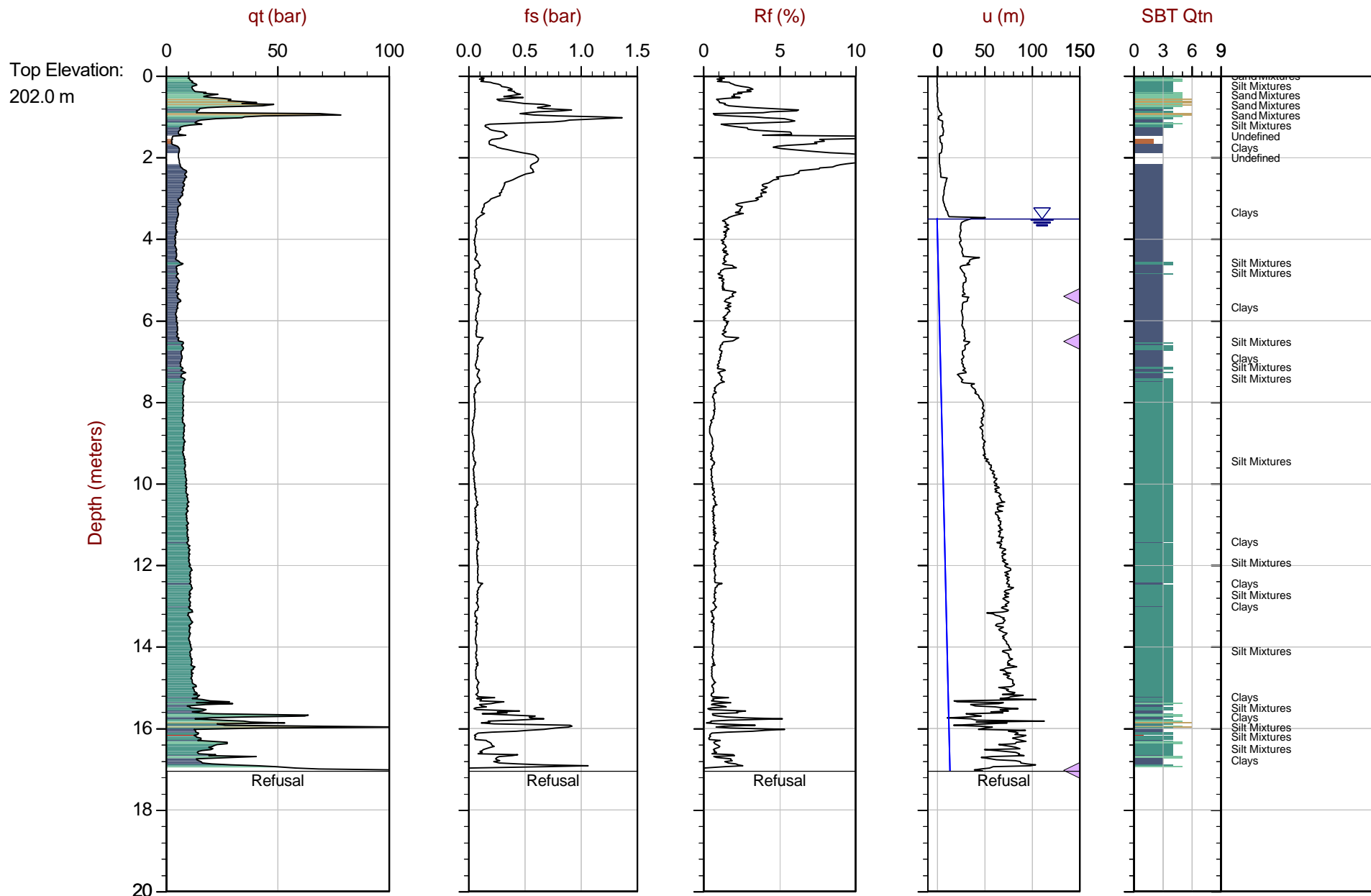
Job No: 17-05064

Date: 2017-11-10 08:50

Site: Calamity Creek Culvert

Sounding: CPT17-P03

Cone: 322:T1500F15U500



Max Depth: 17.050 m / 55.94 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: Every Point

File: 17-05064_CP03.COR

Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010

Coords: UTM17N:5267728mE:599651m

SheetNo: 1 of 1

● Equilibrium Pore Pressure (Ueq)

● Assumed Ueq

◀ Dissipation, Ueq achieved

◀ Dissipation, Ueq not achieved

— Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Advanced Cone Penetration Test Plots with I_c , $S_u(N_{kt})$, and $N_{1(60)}I_c$



exp Services Inc.

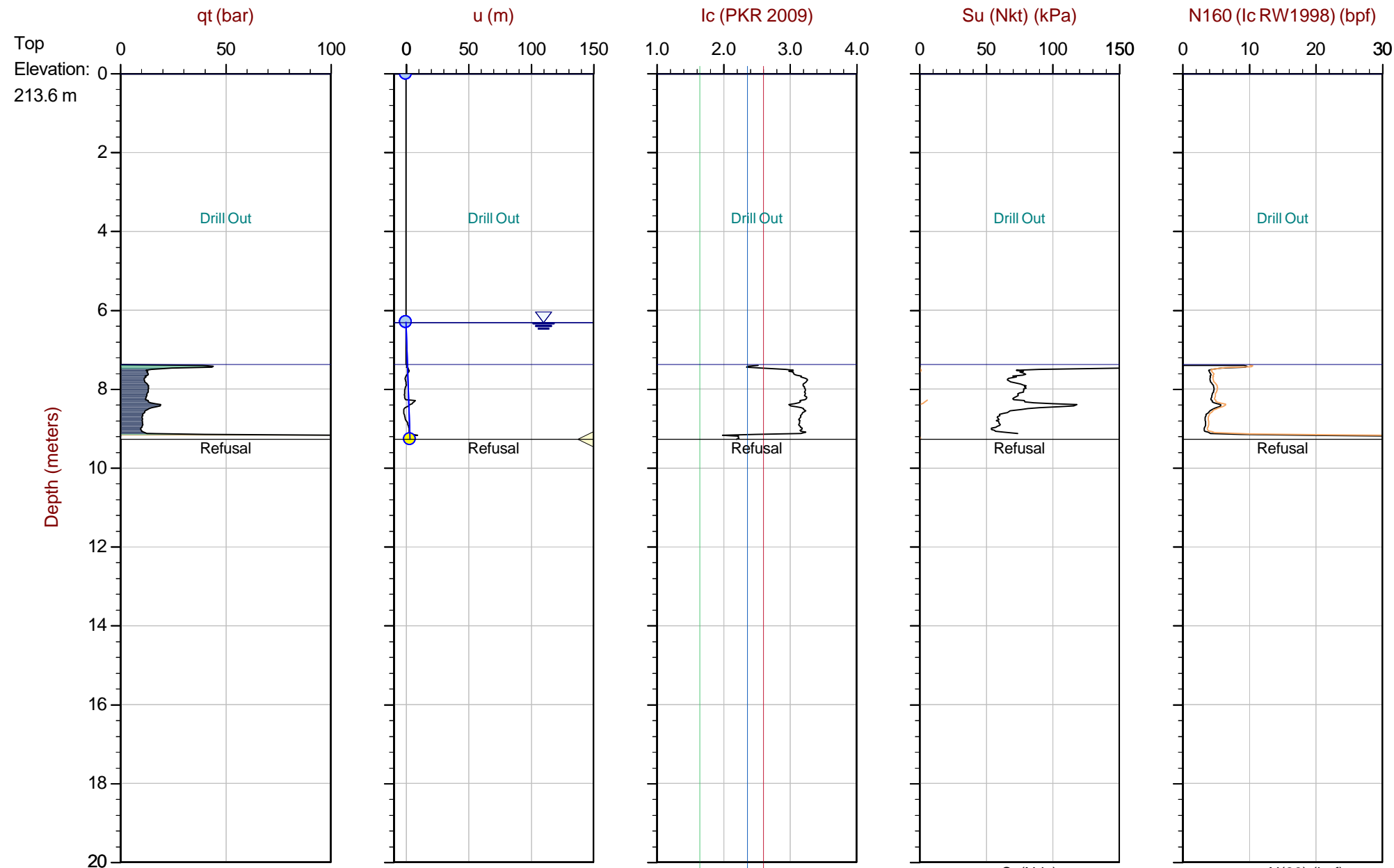
Job No: 17-05064

Date: 2017-11-14 10:31

Site: Calamity Creek Culvert

Sounding: CPT17-P01

Cone: 322:T1500F15U500



Max Depth: 9.275 m / 30.43 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: Every Point

File: 17-05064_CP01.COR

Unit Wt: SBTQtn (PKR2009)

Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010

Coords: UTM 17N N: 5267779m E: 599704m

Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq)

● Assumed Ueq

◀ Dissipation, Ueq achieved

◀ Dissipation, Ueq not achieved

— Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



exp Services Inc.

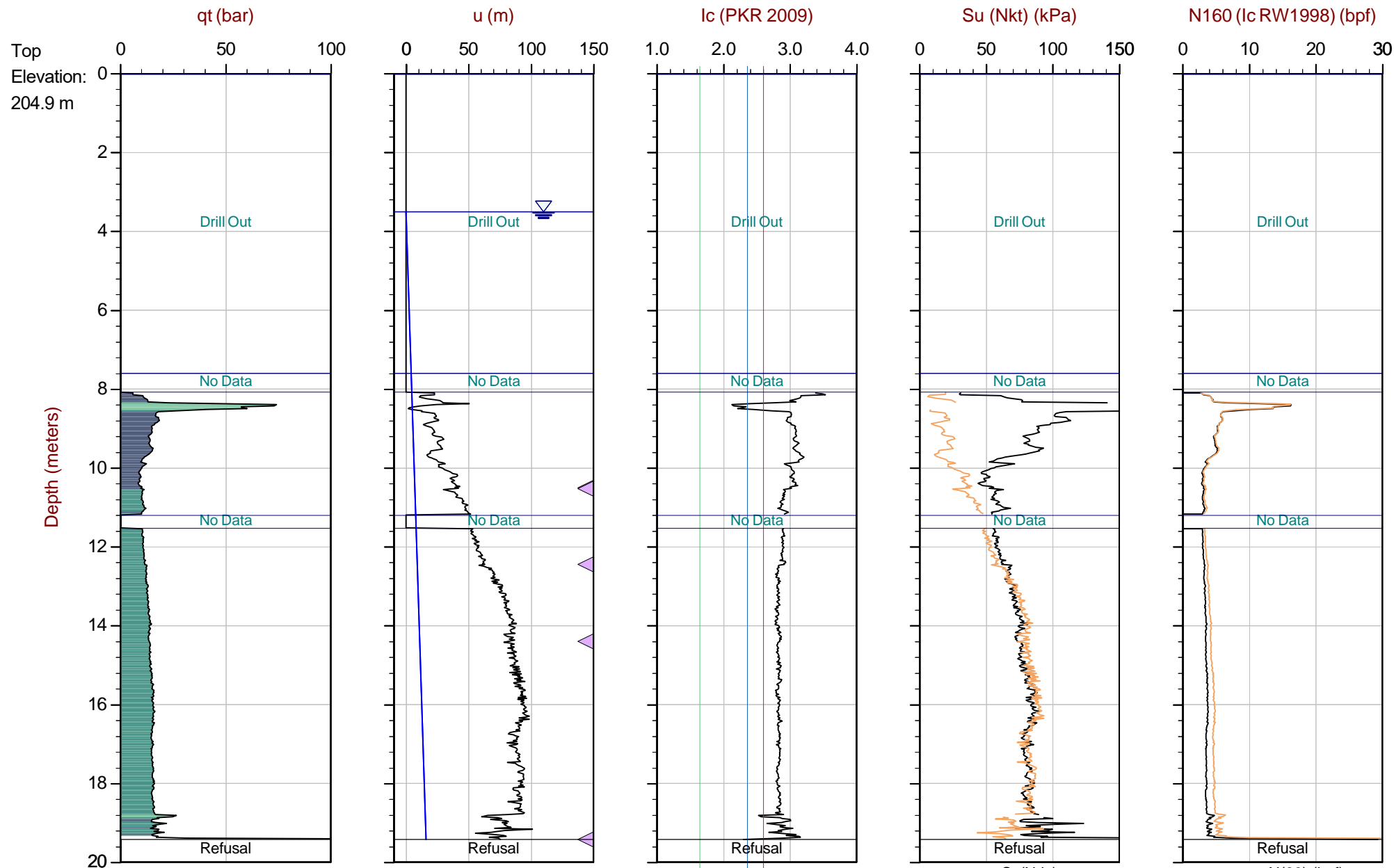
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Date: 2017-11-09 11:44

Site: Calamity Creek Culvert

Sounding: CPT17-P02

Cone: 322:T1500F15U500



Max Depth: 19.425 m / 63.73 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: Every Point

File: 17-05064_CP02.COR

Unit Wt: SBTQtn(PKR2009)

SuNkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010

Coords: UTM17N: 5267744mE: 599681m

Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq)

● Assumed Ueq

◀ Dissipation, Ueq achieved

◀ Dissipation, Ueq not achieved

— Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



exp Services Inc.

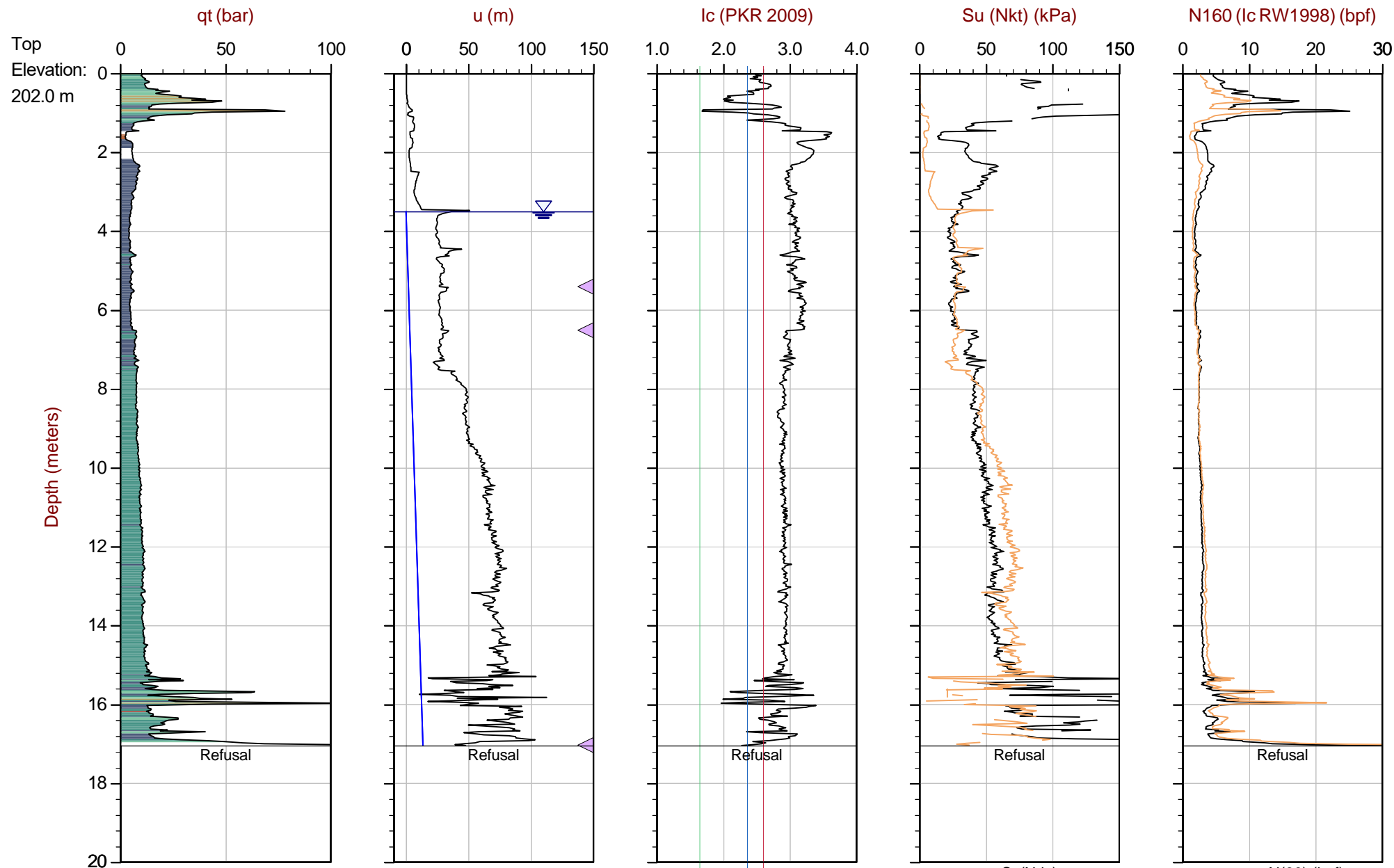
Job No: 17-05064

Date: 2017-11-10 08:50

Site: Calamity Creek Culvert

Sounding: CPT17-P03

Cone: 322:T1500F15U500



Max Depth: 17.050 m / 55.94 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

File: 17-05064_CP03.COR

Unit Wt: SBTQtn(PKR2009)

SuNkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010

Coords: UTM17N: 5267728mE: 599651m

Sheet No: 1 of 1

● Equilibrium Pore Pressure (Ueq)

● Assumed Ueq

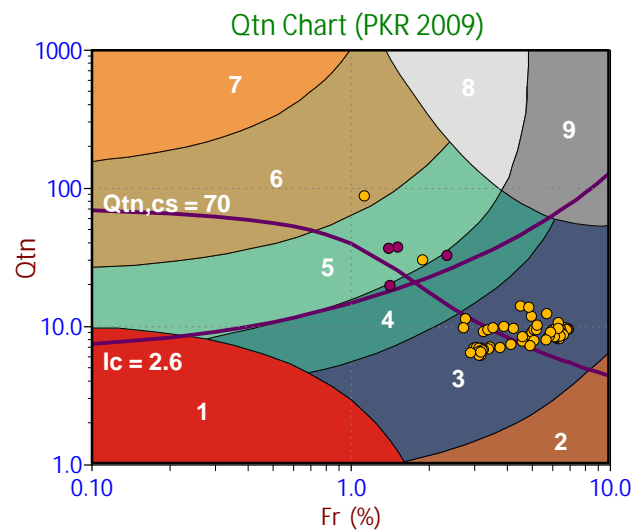
◀ Dissipation, Ueq achieved

◀ Dissipation, Ueq not achieved

— Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Soil Behaviour Type (SBT) Scatter Plots

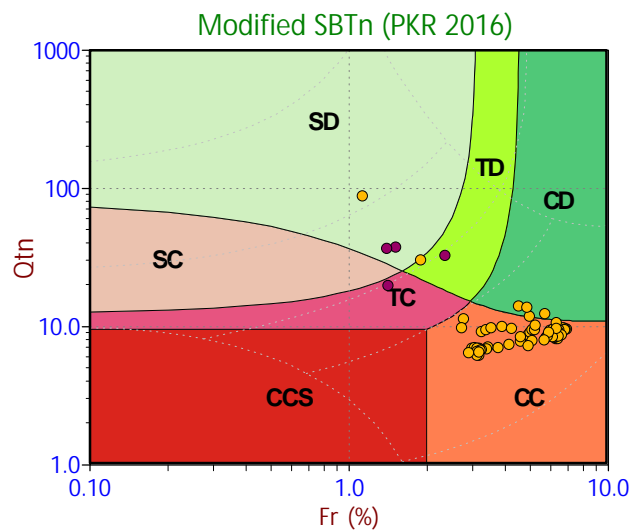


Depth Ranges

- >0.0 to 2.5 m
- >2.5 to 5.0 m
- >5.0 to 7.5 m
- >7.5 to 10.0 m
- >10.0 to 12.5 m
- >12.5 to 15.0 m
- >15.0 to 17.5 m
- >17.5 to 20.0 m

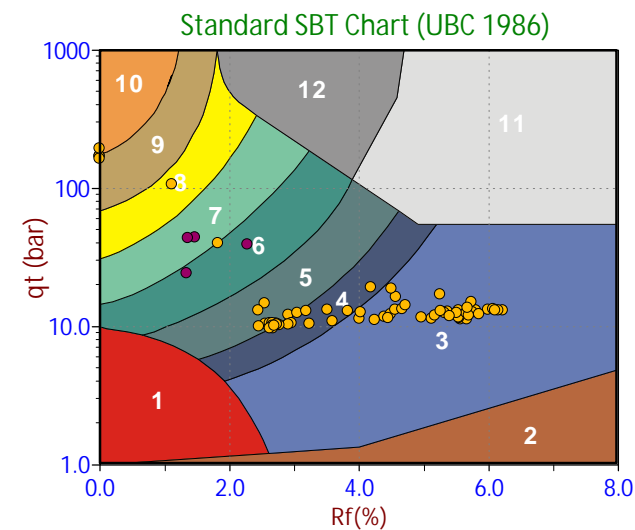
Legend

- Fines
- Fines
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained



Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand



exp Services Inc.

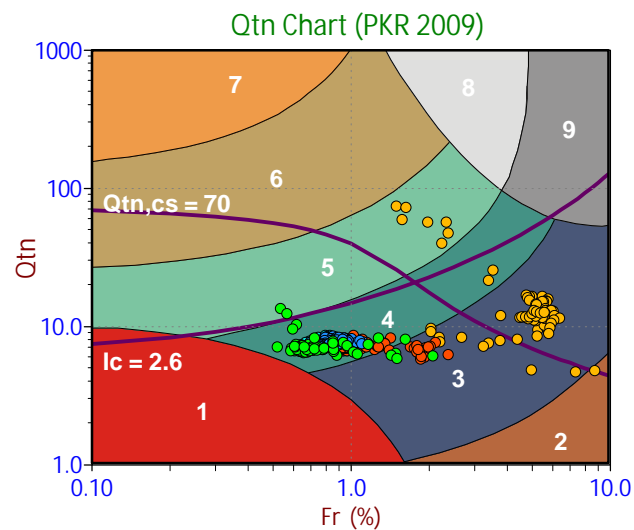
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Date: 2017-11-09 11:44

Site: Calamity Creek Culvert

Sounding: CPT17-P02

Cone: 322:T1500F15U500

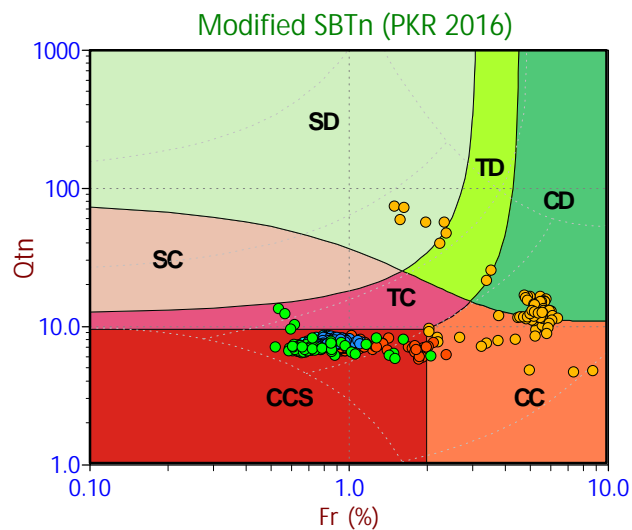


Depth Ranges

- >0.0 to 2.5 m
- >2.5 to 5.0 m
- >5.0 to 7.5 m
- >7.5 to 10.0 m
- >10.0 to 12.5 m
- >12.5 to 15.0 m
- >15.0 to 17.5 m
- >17.5 to 20.0 m

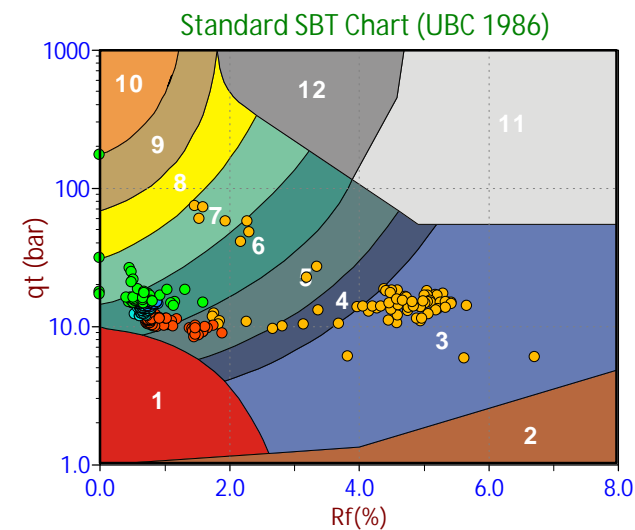
Legend

- Fines
- Fines
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained



Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand



exp Services Inc.

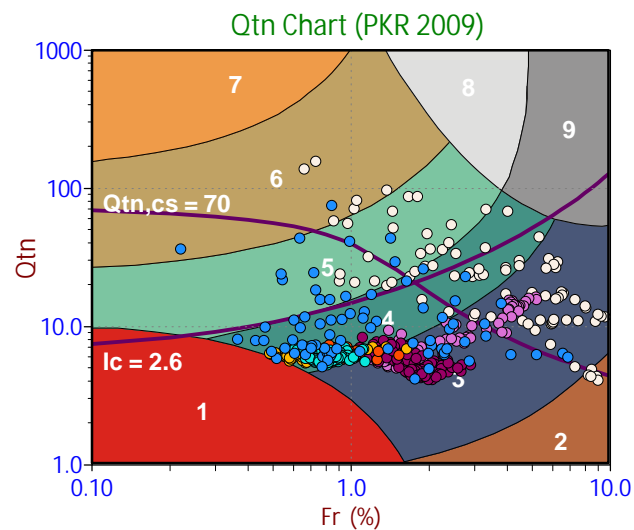
Job No: 17-05064

Date: 2017-11-10 08:50

Site: Calamity Creek Culvert

Sounding: CPT17-P03

Cone: 322:T1500F15U500

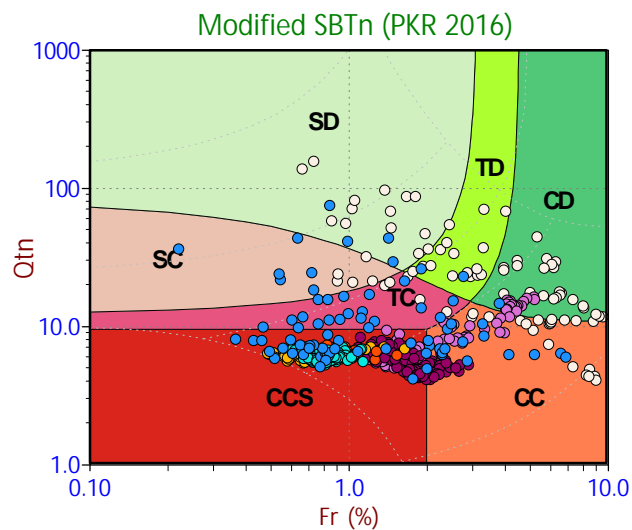


Depth Ranges

- >0.0 to 2.5 m
- >2.5 to 5.0 m
- >5.0 to 7.5 m
- >7.5 to 10.0 m
- >10.0 to 12.5 m
- >12.5 to 15.0 m
- >15.0 to 17.5 m
- >17.5 to 20.0 m

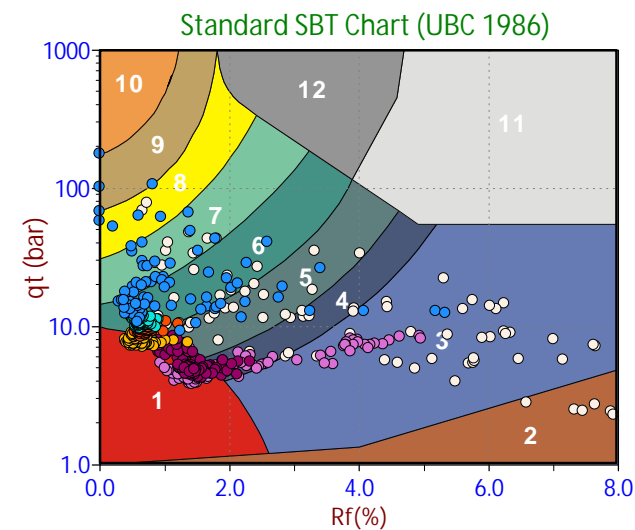
Legend

- Fines
- Fines
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained



Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots



Job No: 17-05064
Client: exp Services Inc.
Project: Calamity Creek Culvert
Start Date: 09-Nov-2017
End Date: 14-Nov-2017

CPT_u PORE PRESSURE DISSIPATION SUMMARY

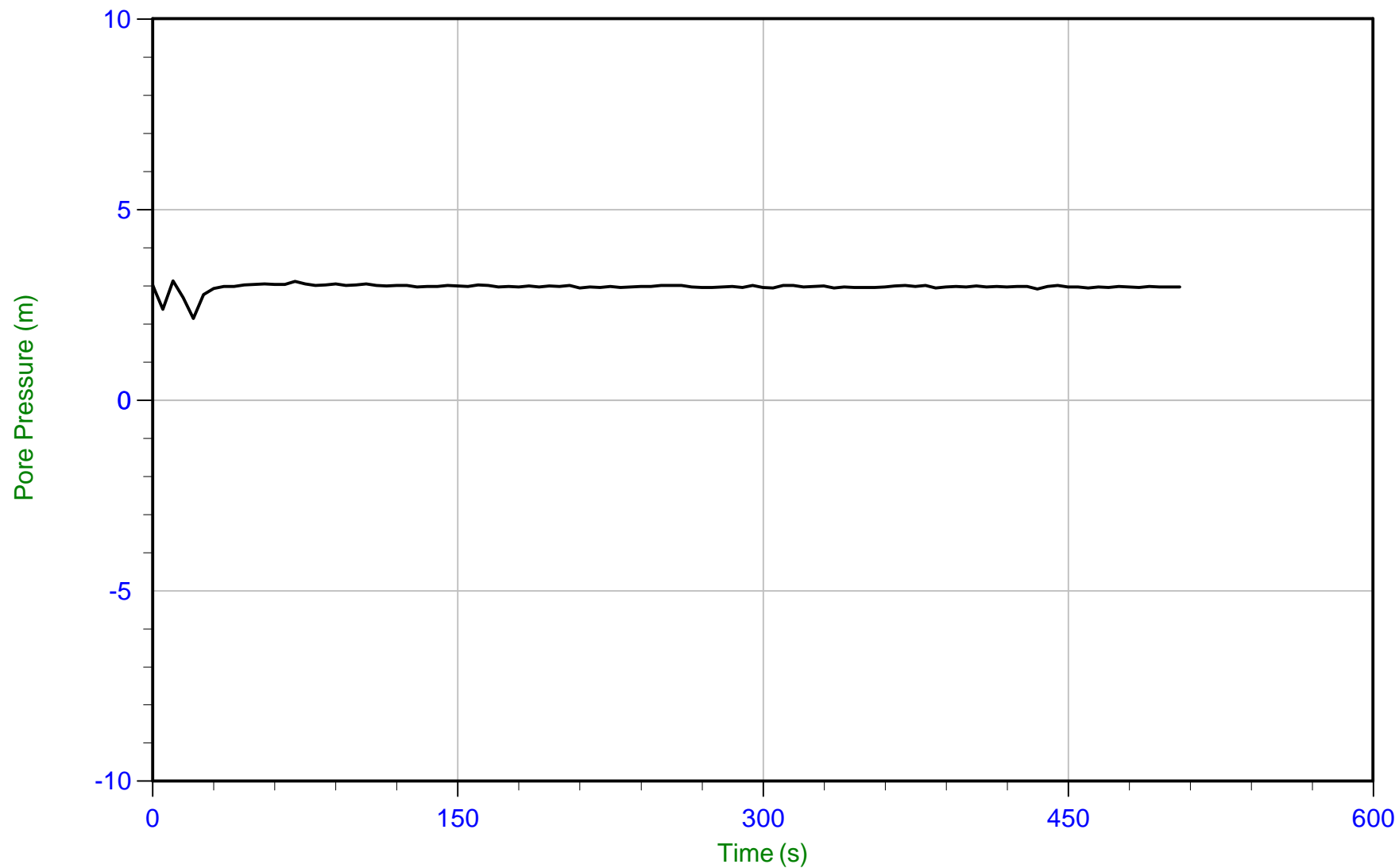
Sounding ID	File Name	Cone Area (cm ²)	Duration (s)	Test Depth (m)	Estimated Equilibrium Pore Pressure U _{eq} (m)	Calculated Phreatic Surface (m)
CPT17-P01	17-05064_CP01	15	505	9.275	3.0	6.3
CPT17-P02	17-05064_CP02	15	105	10.500	Not Achieved	
CPT17-P02	17-05064_CP02	15	785	10.525	Not Achieved	
CPT17-P02	17-05064_CP02	15	110	12.450	Not Achieved	
CPT17-P02	17-05064_CP02	15	95	14.400	Not Achieved	
CPT17-P02	17-05064_CP02	15	355	19.425	Not Achieved	
CPT17-P03	17-05064_CP03	15	130	5.400	Not Achieved	
CPT17-P03	17-05064_CP03	15	590	6.500	Not Achieved	
CPT17-P03	17-05064_CP03	15	170	17.025	Not Achieved	



exp Services Inc.

Job No: 17-05064
Date: 11/14/2017 10:31
Site: Calamity Creek Culvert

Sounding: CPT17-P01
Cone: 322:T1500F15U500 Area=15 cm²



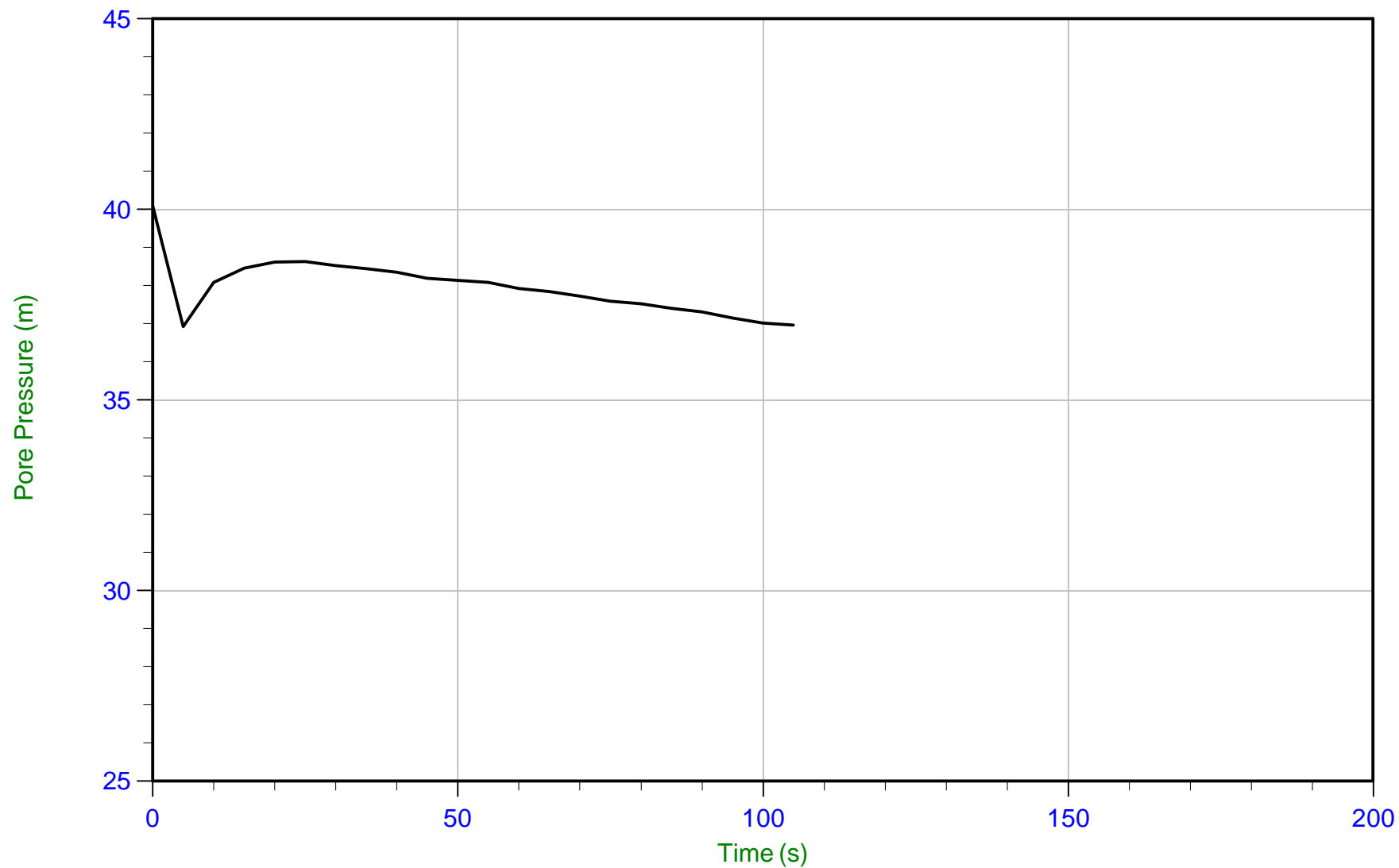
Trace Summary:	Filename: 17-05064_CP01.PPF	U Min: 2.1 m	WT: 6.309 m / 20.699 ft
	Depth: 9.275 m / 30.429 ft	U Max: 3.1 m	Ueq: 3.0 m
	Duration: 505.0 s		



exp Services Inc.

Job No: 17-05064
Date: 11/09/2017 11:44
Site: Calamity Creek Culvert

Sounding: CPT17-P02
Cone: 322:T1500F15U500 Area=15 cm²



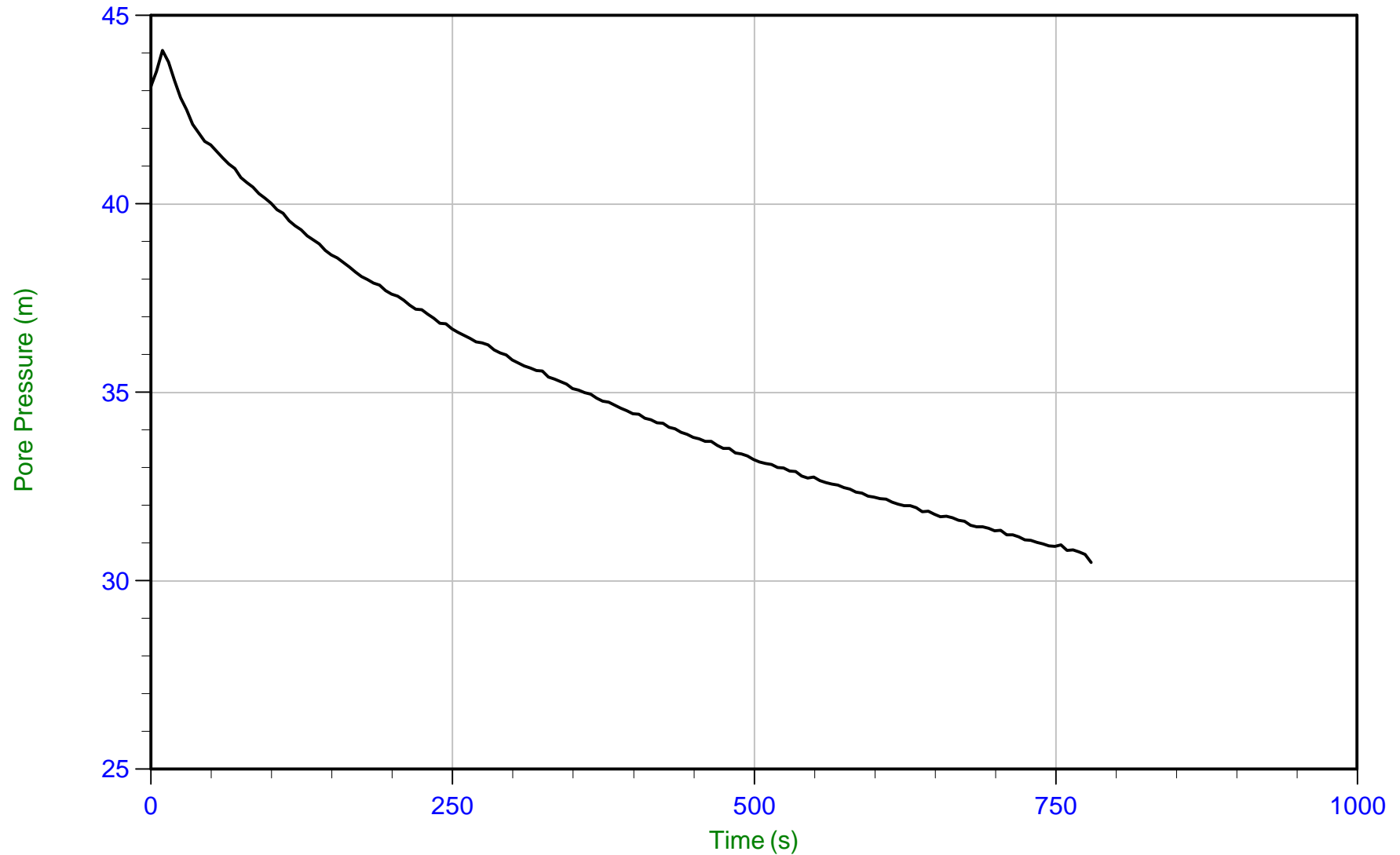
Trace Summary: Filename: 17-05064_CP02.PPF U Min: 36.9 m
Depth: 10.500 m / 34.448 ft U Max: 40.1 m
Duration: 105.0 s



exp Services Inc.

Job No: 17-05064
Date: 11/09/2017 11:44
Site: Calamity Creek Culvert

Sounding: CPT17-P02
Cone: 322:T1500F15U500 Area=15 cm²



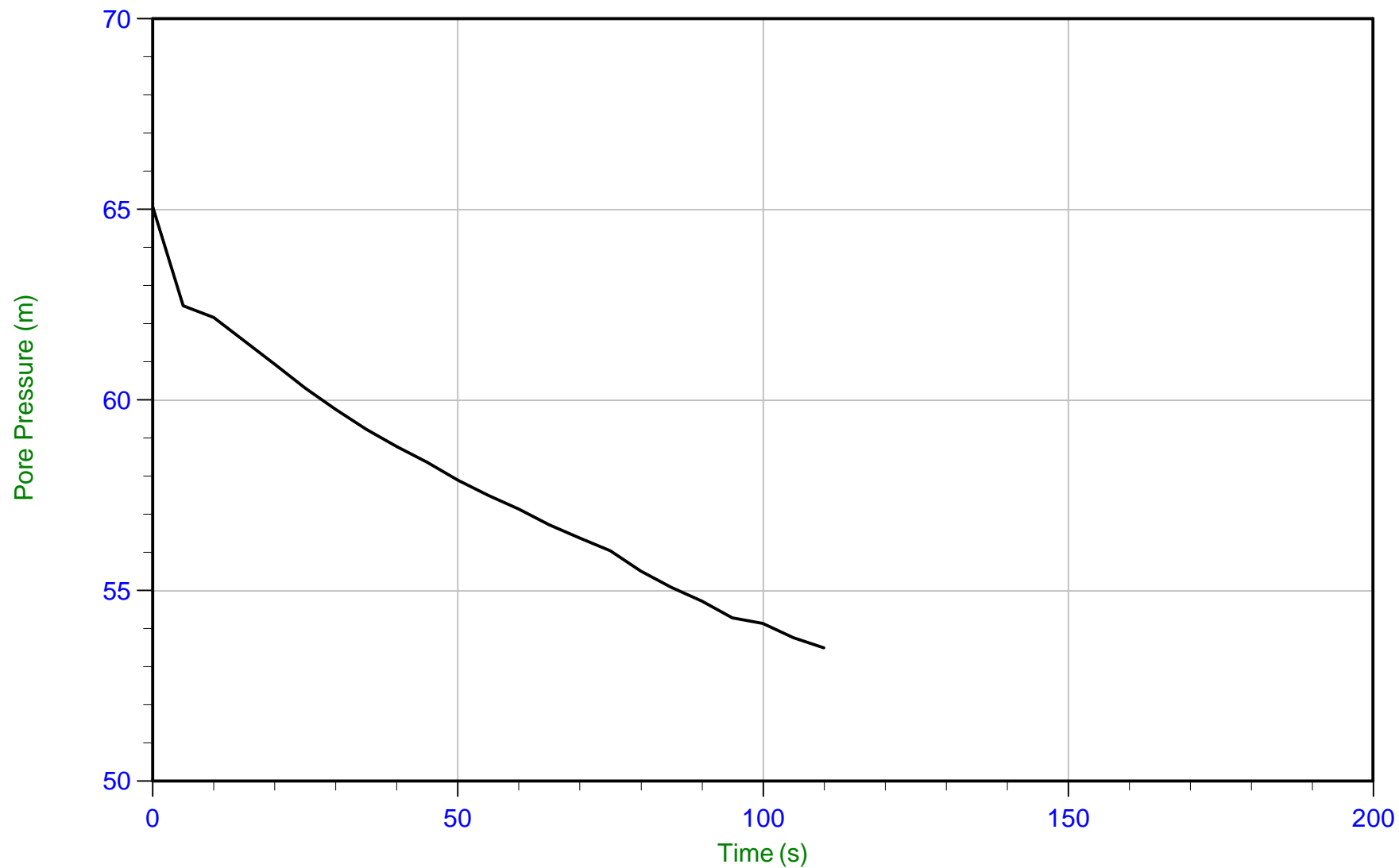
Trace Summary: Filename: 17-05064_CP02.PPF U Min: 30.5 m
Depth: 10.525 m / 34.530 ft U Max: 44.1 m
Duration: 780.0 s



exp Services Inc.

Job No: 17-05064
Date: 11/09/2017 11:44
Site: Calamity Creek Culvert

Sounding: CPT17-P02
Cone: 322:T1500F15U500 Area=15 cm²



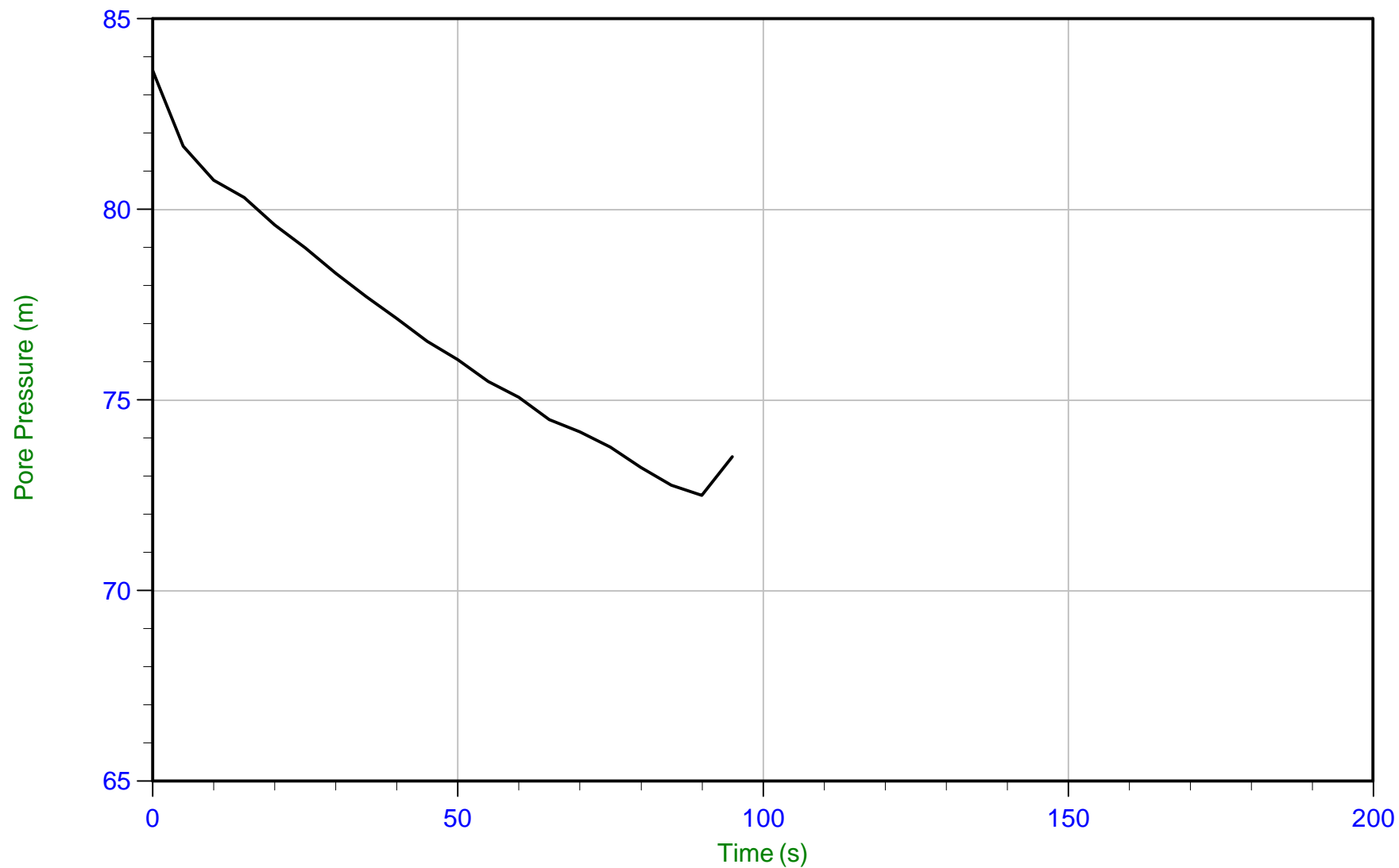
Trace Summary: Filename: 17-05064_CP02.PPF U Min: 53.5 m
Depth: 12.450 m / 40.846 ft U Max: 65.1 m
Duration: 110.0 s



exp Services Inc.

Job No: 17-05064
Date: 11/09/2017 11:44
Site: Calamity Creek Culvert

Sounding: CPT17-P02
Cone: 322:T1500F15U500 Area=15 cm²



Trace Summary: Filename: 17-05064_CP02.PPF U Min: 72.5 m
Depth: 14.400 m / 47.244 ft U Max: 83.6 m
Duration: 95.0 s



exp Services Inc.

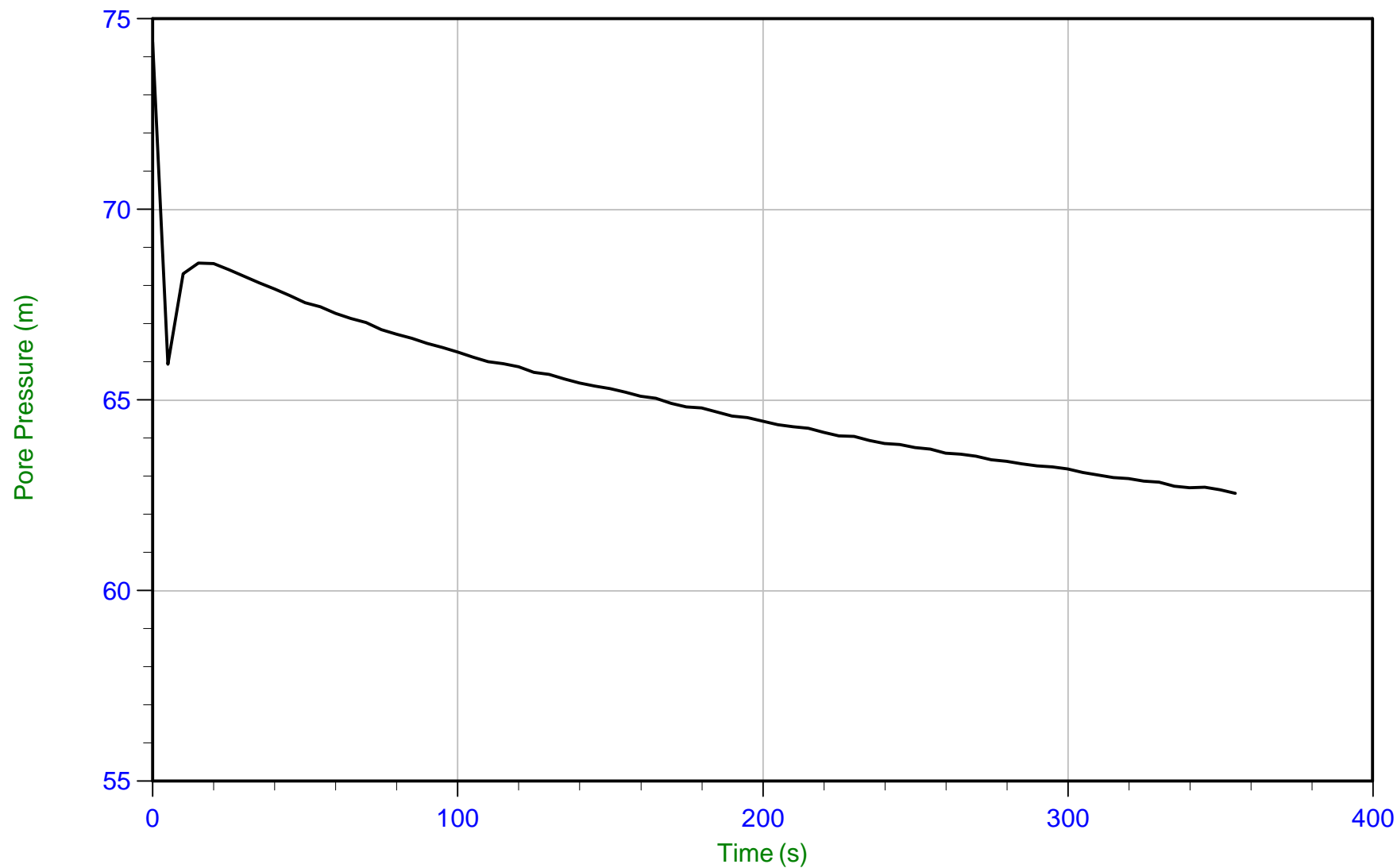
Job No: 17-05064

Date: 11/09/2017 11:44

Site: Calamity Creek Culvert

Sounding: CPT17-P02

Cone: 322:T1500F15U500 Area=15 cm²



Trace Summary:

Filename: 17-05064_CP02.PPF

Depth: 19.425 m / 63.730 ft

Duration: 355.0 s

U Min: 62.5 m

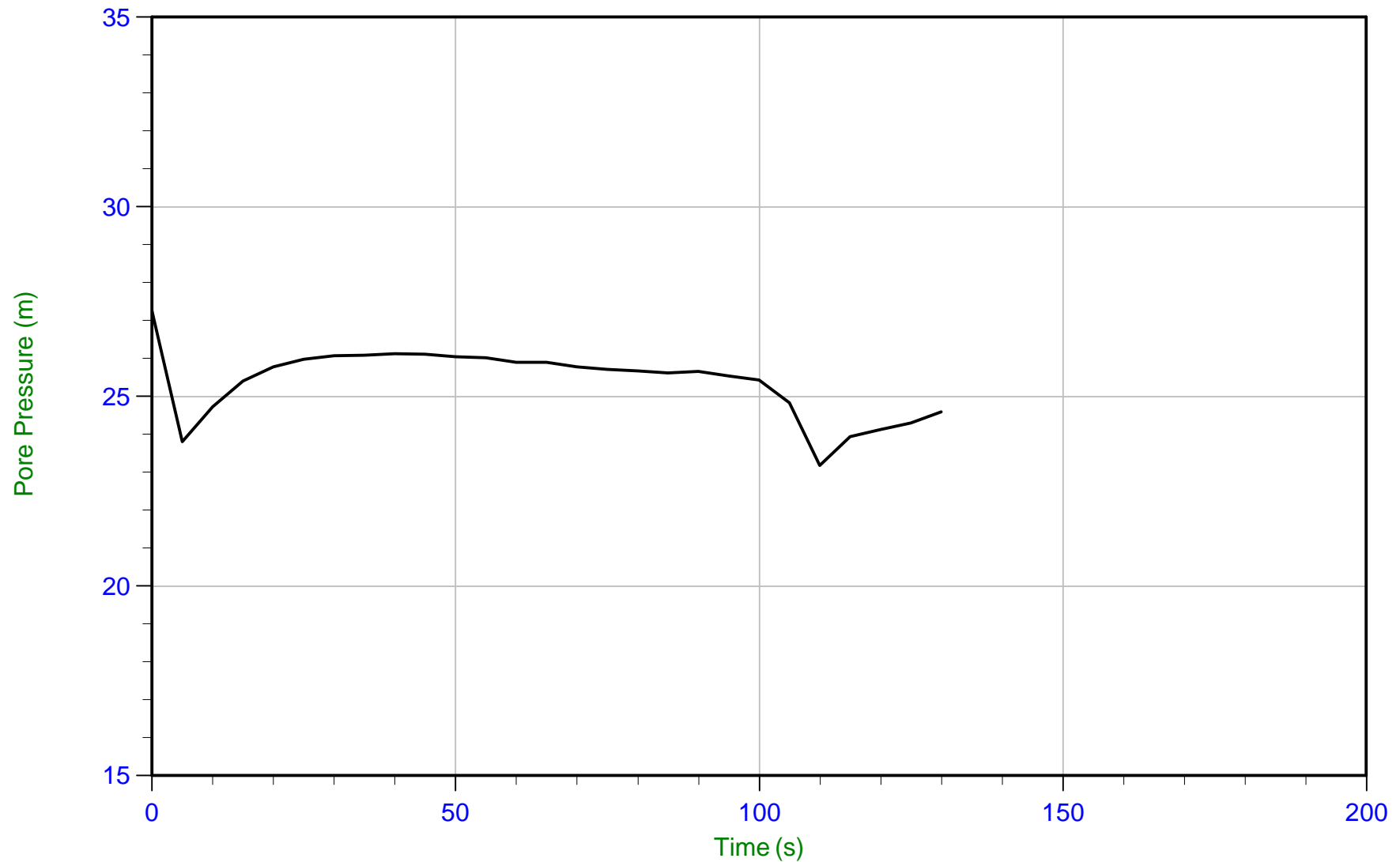
U Max: 74.4 m



exp Services Inc.

Job No: 17-05064
Date: 11/10/2017 08:50
Site: Calamity Creek Culvert

Sounding: CPT17-P03
Cone: 322:T1500F15U500 Area=15 cm²



Trace Summary: Filename: 17-05064_CP03.PPF U Min: 23.2 m
Depth: 5.400 m / 17.716 ft U Max: 27.3 m
Duration: 130.0 s



exp Services Inc.

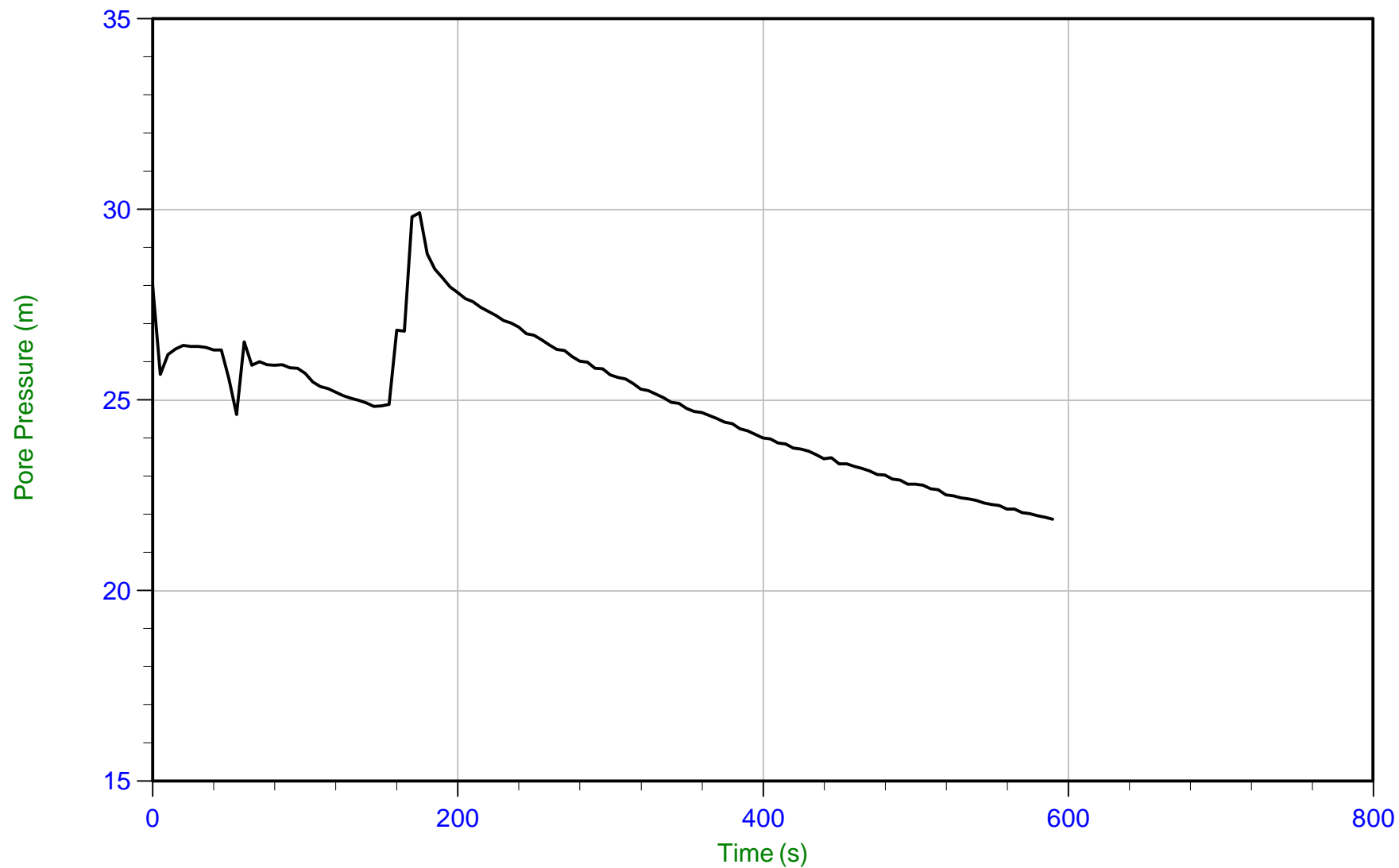
Job No: 17-05064

Date: 11/10/2017 08:50

Site: Calamity Creek Culvert

Sounding: CPT17-P03

Cone: 322:T1500F15U500 Area=15 cm²



Trace Summary: Filename: 17-05064_CP03.PPF
Depth: 6.500 m / 21.325 ft
Duration: 590.0 s

U Min: 21.9 m
U Max: 29.9 m



exp Services Inc.

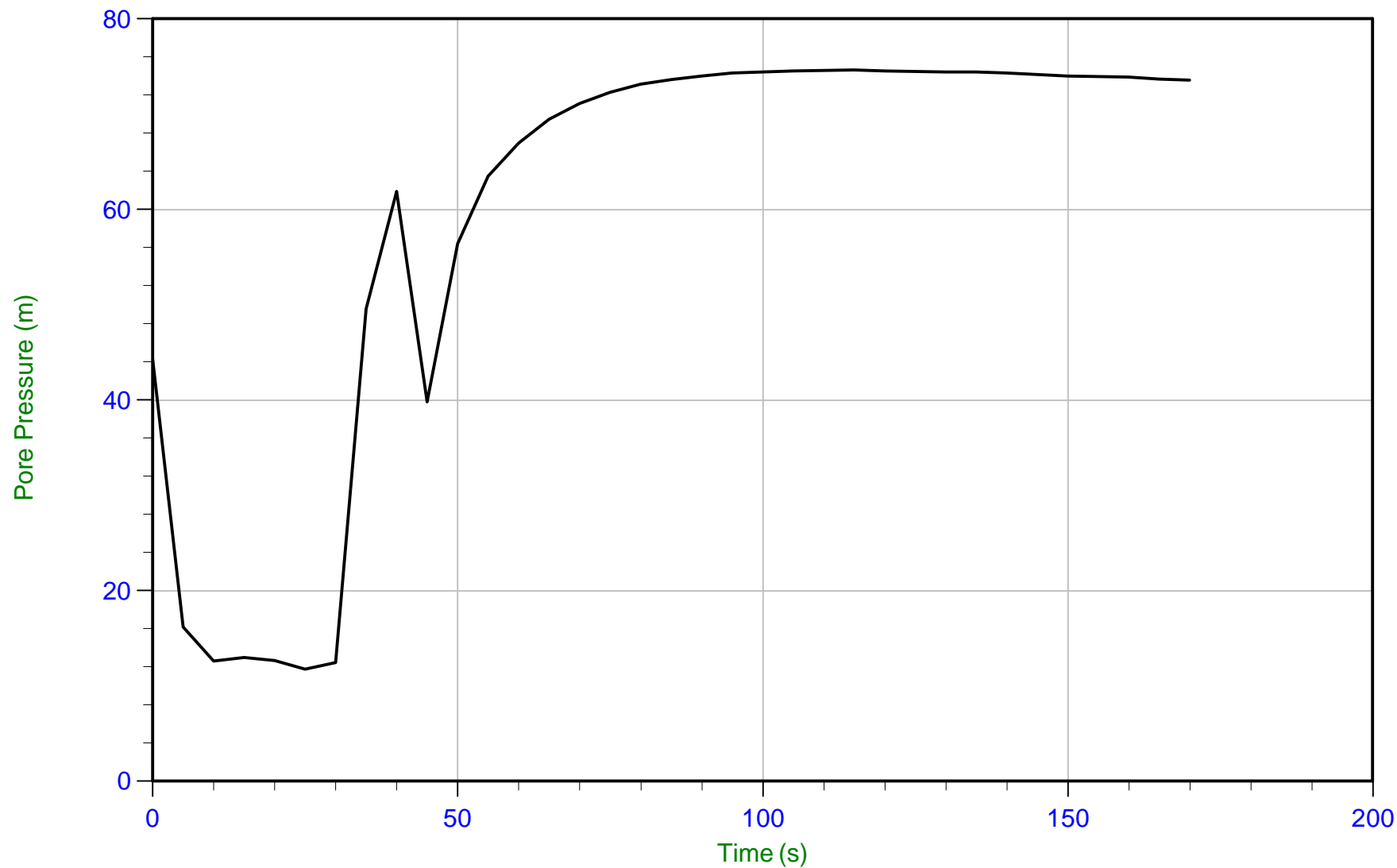
Job No: 17-05064

Date: 11/10/2017 08:50

Site: Calamity Creek Culvert

Sounding: CPT17-P03

Cone: 322:T1500F15U500 Area=15 cm²



Trace Summary:

Filename: 17-05064_CP03.PPF

Depth: 17.025 m / 55.856 ft

Duration: 170.0 s

U Min: 11.8 m

U Max: 74.6 m