

**FOUNDATION INVESTIGATION REPORT  
SLOPE REHABILITATION ON HIGHWAY 118  
0.5 KM NORTH OF HALIBURTON COUNTY ROAD 121  
HUNTSVILLE DISTRICT  
G.W.P. 5339-11-00**

**GEOCRES No. 31E-369**

**Report**

to

**Englobe Corp.**

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**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for the proposed slope rehabilitation on Highway 118 approximately 0.5 km north of Haliburton County Road 121 in Huntsville District, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the site, and based on the data obtained, to provide a borehole location plan, record of borehole sheets, a stratigraphic profiles and sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to Englobe Corp., under the Ministry of Transportation Ontario (MTO) Agreement Number 5014-E-0004.

A preliminary foundation investigation carried out at this site for the slope rehabilitation was documented in the report titled "Foundation Investigation and Design Report, Slope Instability Hwy 118, 0.5 km North of Haliburton County Road 121, District 52, Huntsville", prepared by exp Services Inc. (exp), dated April 10, 2013 (Geocres No. 31E-326). Reference should be made to the exp report for a written description of the subsurface conditions, borehole location plan, stratigraphic profiles and sections, records of borehole sheets and laboratory test results. It should be noted that exp is solely responsible for the subsurface information provided in their Foundation Investigation and Design Report. The factual subsurface information presented in the exp report was incorporated in the current report and their borehole logs are included in Appendix E.

## **2. SITE DESCRIPTION**

The site is located on Highway 118 approximately 0.5 km north of Haliburton County Road 121 in the County of Haliburton, Ontario. The foundation investigation and design report prepared by exp indicates that some signs of instability in the embankment between Sta. 16+730 and Sta. 17+100 were noticed approximately during the last four years (2009 to 2012) and reported by MTO. The exp report has identified three areas of potentially unstable embankment sections that may require slope stabilization.

In the investigated areas, Highway 118 runs in a generally north-south direction with a mild turn to the northeast in the northerly portion. This section of highway is bordered by Head Lake to the west and bounded by wooded lands with sporadic residential properties to the east. The existing highway is a two-lane roadway with a declining grade towards the south at an approximately 1% gradient within the investigated section.

The topography in the area slopes westerly towards the lake. The existing highway platform cuts into the bedrock outcrop and intermittent bedrock cuts are evident on the east side of the highway. Vegetation consisting of frequent trees and small shrubs are present on the sloped lands adjacent to the highway.

The site is located within the physiographic region of Algonquin Highlands, as delineated in The Physiography of Southern Ontario by Chapman and Putnam (1984). This region is characterized by shallow sandy till soils overlying Precambrian bedrock.

Geological terrain mapping in the immediate vicinity of Head Lake suggests that the site is situated within a glaciolacustrine delta composed of coarse-textured glaciolacustrine deposits of sand and gravel with minor silt and clay. In the middle of the site, this undulating delta deposit of low local relief is separated by a bedrock knob of high local relief. The bedrock in this area is overlain by a thin drift veneer (OGS Map 5505).

The bedrock in the general area is mapped as tonalite, syenogranite and straight gneiss of the Dysart and Redstone Lake Gneiss Complexes (OGS Map P.3416).

Surface drainage generally flows westerly towards Head Lake. The surface water east of the roadway is collected through a shoulder swale and catch basins, and then channeled through culverts and discharged into the lake.

Photographs showing the general nature of the site are presented in Appendix C.



### 3. FIELD INVESTIGATION PROCEDURES

Three critical areas were identified in the exp report, i.e. Area 1: Sta. 16+730 to 16+830, Area 2: Sta. 16+910 to 17+040, and Area 3: 17+040 to 17+100. The current site investigation and field testing were strategically conducted between Sta. 16+730 and 17+100 as per the Contract RFP requirements. Two stages of investigations were carried out from October 26 to November 4, 2015 and from March 8 to 10, 2016, respectively. A total of eighteen (18) boreholes, denoted as 15-01 to 15-18, were advanced to depths ranging from 3.0 to 10.8 m below the ground surface. Boreholes 15-01, 15-02, 15-03, 15-05, 15-06, 15-08, 15-09, 15-11, 15-12 and 15-14 to 15-17 were advanced from the roadway pavement level. Boreholes 15-04, 15-07, 15-10, 15-13 and 15-18 were advanced at the toe of embankment slope near the shoreline of Head Lake.

The locations of the boreholes from the preliminary and current investigations are shown on the attached Borehole Location Plan Drawing included in Appendix D.

The boreholes drilled on the roadway were advanced using a CME75 truck-mounted drill rig in combination with hollow stem augers to advance the boreholes to bedrock surface. Upon encountering the bedrock, each borehole was cored a minimum 3.0 m into the bedrock using NQ coring equipment. The boreholes drilled along the edge of the water were advanced using a portable tripod drill rig in combination with steel casings to auger refusal upon probable bedrock. Samples of the overburden soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Intact rock core samples were collected in all boreholes drilled from the roadway pavement. A summary of the borehole depths and bedrock elevations are provided in Table 3.1.

**Table 3.1 – Borehole Depths and Bedrock Elevations**

Borehole	Approximate Station	Termination Depth (m)	Bedrock Level (m)		Piezometer Installation
			Depth	Elevation	
15-01	16+729	5.0	1.9	323.8	No
15-02	16+769	8.0	4.9	320.6	Yes
15-03	16+769	9.4	6.3	319.2	No
15-04	16+769	9.1	-	-	No
15-05	16+807	7.2	3.7	321.3	No
15-06	16+807	9.7	6.6	318.7	Yes
15-07	16+807	3.0	-	-	No
15-08	16+907	9.7	5.6	318.7	Yes
15-09	16+907	10.8	7.0	317.3	No

Borehole	Approximate Station	Termination Depth (m)	Bedrock Level (m)		Piezometer Installation
			Depth	Elevation	
15-10	16+907	3.4	-	-	No
15-11	16+938	10.7	7.6	316.7	No
15-12	16+938	8.7	5.6	318.0	Yes
15-13	16+938	3.8	-	-	No
15-14	16+990	8.6	5.5	318.0	Yes
15-15	17+024	7.1	3.3	319.7	Yes
15-16	17+104	7.0	4.2	318.7	No
15-17	17+104	8.6	5.5	317.0	Yes
15-18	17+104	4.1	-	-	No

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed during the drilling operations. Standpipe piezometers consisting of 19 mm diameter PVC pipe with slotted screen were installed in selected boreholes. Following the final water level reading, the piezometers were decommissioned in general accordance with MOE Regulation 903.

#### **4. LABORATORY TESTING**

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets included in Appendix A. Selected samples were also subjected to gradation analysis and Atterberg Limits tests. The results of this laboratory testing program are summarized on the Record of Borehole sheets in Appendix A and shown on the figures included in Appendix B.

The recovered intact rock core samples were photographed and examined in the laboratory for weathering conditions, fracture/joint conditions, soil infills and to verify total core recovery (TCR), solid core recovery (SCR), rock quality designation (RQD) and fracture index (FI). Selected rock cores were subjected to Point Load Test (PLT) to allow correlations with unconfined compressive strength (UCS) of the rock. The results of the point load tests and rock core photographs are included in Appendix B.

## **5. DESCRIPTION OF SUBSURFACE CONDITIONS**

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. Borehole logs from a previous foundation investigation by exp in 2013 are included in Appendix E. A borehole location plan, stratigraphic profiles and cross sections are presented on the “Borehole Locations and Soil Strata” drawings (No. 1 through 7) in Appendix D.

An overall description of the stratigraphy for each area is given in the following sections. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

The subsurface stratigraphy below the pavement structure encountered in each of the three areas generally consisted of silt to sandy silt underlain by sand to gravelly sand, occasional cobbles and boulders were encountered within the sand to gravelly sand layer or immediately above the granitic bedrock. Detailed descriptions of the individual strata for each area are presented below.

### **5.1 Area 1 (Sta. 16+730 to 16+830)**

#### **5.1.1 Asphalt**

A 150 to 250 mm thick layer of asphalt was encountered in the boreholes drilled on the roadway except in boreholes 1-4 and 15-05.

#### **5.1.2 Granular Fill**

Brown granular fill was encountered at ground surface or below the asphalt pavement in the boreholes drilled on the roadway. The granular fill consisted of sand, some gravel to gravelly, and trace silt. The fill extended to depths ranging from 0.6 to 2.4 m (elevations ranging from 324.4 to 323.1 m) with thickness ranging from 0.5 to 2.2 m.

SPT ‘N’ values recorded in the fill ranged from 7 to 45 blows per 0.3 m penetration, indicating a loose to dense relative density. The higher ‘N’ values are probably indicative of increased gravel content in the fill.

Moisture contents of the fill ranged from 2 to 10%. Grain size analyses indicated that particle size distribution of the fill can be summarized as follows:

Soil Particle	Percentage (%)
Gravel	7 - 35
Sand	60 - 89
Silt & Clay	4 - 23

The results of the laboratory tests are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses are illustrated in Figures B1 and B2 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.

### 5.1.3 Silt

A layer of brown to grey silt to sandy silt containing trace to some clay was encountered either below the granular fill in the boreholes drilled on the roadway or at the toe of slope near the edge of Head Lake. The silt below the fill extended to depths ranging from 1.2 to 5.8 m (elevations ranging from 324.5 to 319.7 m) with thickness ranging from 0.4 to 2.9 m. The silt below the lakebed extended to depths ranging from 4.7 to 6.1 m (elevations ranging from 312.7 to 310.9 m) with layer thickness ranging from 4.7 to 6.1 m. A 0.7 m thick cobble zone was encountered and cored through below the silt at 1.2 m depth. Borehole 1-2 was terminated within the silt layer upon auger refusal.

SPT 'N' values recorded in the silt below the fill ranged from 10 to 38 blows per 0.3 m penetration, indicating a compact to dense relative density. SPT 'N' values recorded in the silt below the lakebed ranged from 2 to 36 blows per 0.3 m penetration, indicating a very loose to dense relative density.

Moisture contents of the silt ranged from 17 to 29% below the fill and from 22 to 36% below the lakebed, respectively. Atterberg Limits test results showed that the silt has Liquid Limits ranging from 26 to 29% and Plastic Limits in the order of 19%, respectively, indicating a marginal to low plasticity. Grain size analyses indicated that particle size distribution of the silt can be summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 - 2
Sand	4 - 35
Silt	53 - 96
Clay	10 - 19

The results of the laboratory tests are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses and Atterberg Limits are illustrated in Figures B8 to

B12 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.

#### 5.1.4 Sand to Gravelly Sand

A layer of brown sand to gravelly sand was encountered below the existing fill, silt or lakebed and extended to depths ranging from 2.6 to 9.1 m (elevations ranging from 322.9 to 308.3 m) with thickness ranging from 0.2 to 5.8 m. A 2.1 m thick boulder was encountered and cored through within the sand at 2.9 m depth in borehole 1-8. The sand was not encountered in exp's boreholes 1-2 and 1-6, and borehole 15-01. Boreholes 1-1, 1-3, 1-4, 15-04 and 15-07 were terminated within the sand layer upon auger refusal.

SPT 'N' values recorded in the sand ranged from 3 to more than 50 blows per 0.3 m penetration, indicating a very loose to very dense relative density. The higher 'N' values are probably indicative of increased gravel content in the sand. Moisture contents of the sand ranged from 2 to 19%. Grain size analyses indicated that particle size distribution of the sand can be summarized as follows:

Soil Particle	Percentage (%)	
	Sand, some Gravel	Gravelly Sand
Gravel	5 - 20	21 - 46
Sand	60 - 91	47 - 68
Silt & Clay	3 - 30	5 - 17

The results of the laboratory test are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses are illustrated in Figures B3 to B8 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.

#### 5.1.5 Bedrock

Granitic Gneiss bedrock was encountered below the silt and sand to gravelly sand, and extended to the end of the boreholes. Where proven by coring, the bedrock depth ranged from 1.9 to 6.6 m (elevations ranging from 323.8 to 318.7 m) below the embankment and from 6.1 to 6.7 m (elevations 311.6 to 311.7 m) below the lakebed.

Generally, Total Core Recovery (TCR) in the bedrock ranged from 56 to 100%. The Rock Quality Designation (RQD) ranged typically from 48 to 98%, indicating poor to excellent rock mass quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to greater than 10. The Point Load Index ( $Is$ )<sub>50</sub> ranged from 2.0 to 8.4 MPa, which

correlates to unconfined compressive strength (UCS) ranging from 48 to 201 MPa using an assumed conversion factor of 24, indicating a medium strong to very strong rock.

The bedrock was significantly more fractured in borehole 15-05 between 3.7 m and 5.7 m depths where RQD values ranged from 18 to 25%, indicating very poor rock mass quality.

The results of the TCR, RQD and  $(I_s)_{50}$  are provided on the Record of Borehole sheets in Appendix A. Rock core photographs and point load test results are included in Appendix B.

### 5.1.6 Groundwater Conditions

Standpipe piezometers were installed in two boreholes (15-02 and 15-06) in Area 1 to monitor stabilized (long term) groundwater levels. The water levels measured in the piezometers in addition to those recorded during the exp investigation in 2013 are summarized as follows:

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
1-1	Jan. 24, 2013	4.6	320.9	Open borehole
1-2	Jan. 24, 2013	2.1	323.4	Open borehole
1-3	Jan. 24, 2013	1.8	323.7	Open borehole
1-4	Jan. 24, 2013	3.0	322.2	Open borehole
1-5	Feb. 6, 2013	5.6	319.7	Standpipe Piezometer
15-02	Mar. 15, 2016	0.6	324.9	Standpipe Piezometer
15-06	Mar. 15, 2016	2.8	322.5	Standpipe Piezometer

The water level in the Head Lake was at elevation 317.7 m during the investigations.

The water level in the Head Lake and groundwater levels are expected to fluctuate seasonally and are subject to precipitation patterns, and may vary from the levels presented above.

## **5.2 Area 2 (Sta. 16+910 to 17+040)**

### **5.2.1 Asphalt**

A 200 to 300 mm thick layer of asphalt was encountered in each borehole drilled on the roadway.

### **5.2.2 Granular Fill**

Brown sand to gravelly sand fill was encountered at ground surface or below the asphalt in the boreholes drilled within the roadway. The fill extended to depths ranging from 0.8 to 1.5 m (elevations ranging from 322.1 to 323.7 m) with thickness ranging from 0.6 to 1.3 m.

SPT 'N' values recorded in the fill ranged from 9 to 32 blows per 0.3 m penetration, indicating a loose to compact relative density.

Moisture contents of the fill ranged from 3 to 5%. Grain size analyses indicated that particle size distribution of the fill can be summarized as follows:

<b>Soil Particle</b>	<b>Percentage (%)</b>
Gravel	8 - 27
Sand	50 - 86
Silt & Clay	5 - 35

The results of the laboratory test are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses are illustrated in Figures B1 to B2 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.

### **5.2.3 Silt**

A layer of brown to grey silt to sandy silt, trace to some clay was encountered either below the granular fill in the boreholes drilled on the roadway or immediately on the lakebed. The silt below the fill extended to depths ranging from 1.4 to 4.6 m (elevations ranging from 319.0 to 321.6 m) with thickness ranging from 0.5 to 3.0 m. The silt below the lakebed extended to depths ranging from 2.1 to 2.5 m (elevations ranging from 315.6 to 315.2 m) with thickness ranging from 1.8 to 2.2 m.

SPT 'N' values recorded in the silt ranged from 2 to 31 blows per 0.3 m penetration, indicating a very loose to dense relative density.

Moisture contents of the silt ranged from 6 to 40%. Atterberg Limits testing results showed that

the Liquid Limit and Plastic Limit of the silt were in the order of 30 and 22%, respectively, indicating a marginal to low plasticity. Grain size analyses indicated that the silt consisted of the following:

Soil Particle	Percentage (%)
Gravel	0 - 2
Sand	0 - 42
Silt	63 - 93
Clay	6 - 22

The results of the laboratory test are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses and Atterberg Limits are illustrated in Figures B9 to B12 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.

#### 5.2.4 Sand to Gravelly Sand

A deposit of sand to gravelly sand was encountered below the fill, silt or lakebed, and extended to depths ranging from 2.4 to 7.6 m (elevations ranging from 320.5 to 316.7 m) with thickness ranging from 0.3 to 3.9 m. A 1.4 m thick layer of cobbles and boulders was encountered and cored through below the sand at 2.4 m depth in borehole 2-6. A 0.4 m thick cobble zone was encountered below the sand at 5.2 m depth in borehole 15-8. Boreholes 2-2, 2-3, 2-5, 15-10 and 15-13 were terminated within the sand layer upon auger refusal.

SPT 'N' values recorded in the sand to gravelly sand ranged from 5 to more than 50 blows per 0.3 m penetration, indicating a loose to very dense relative density. The higher 'N' values are probably indicative of increased gravel content in the sand.

Moisture contents of the sand to gravelly sand ranged from 2 to 29%. Grain size analyses indicated that grain size distribution of the sand to gravelly sand can be summarized as follows:

Soil Particle	Percentage (%)	
	Sand, Some Gravel	Gravelly Sand
Gravel	0 - 17	22 - 44
Sand	66 - 98	43 - 74
Silt & Clay	2 - 18	5 - 13

The results of the laboratory test are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses are illustrated in Figures B3 to B8 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.



### 5.2.5 Bedrock

Granitic Gneiss bedrock was encountered below the sand and gravelly sand, and extended to the end of the boreholes. Where proven by coring, the depth to bedrock below the roadway ranged from 3.3 to 7.6 m (elevations ranging from 319.7 to 316.7 m) whereas the depth to bedrock below the lakebed was 3.8 m (elevation 313.9 m).

Generally, Total Core Recovery (TCR) in the bedrock ranged from 29 to 100%. The Rock Quality Designation (RQD) ranged from 0 to 95%, indicating very poor to excellent rock mass quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to greater than 10. The Point Load Index  $(Is)_{50}$  ranged from 2.5 to 9.1 MPa, which correlates to unconfined compressive strength (UCS) ranging from 60 to 219 MPa using an assumed conversion factor of 24, indicating a strong to very strong rock.

The results of the TCR, RQD and  $(Is)_{50}$  are provided on the Record of Borehole sheets in Appendix A. Rock core photographs and point load test results are included in Appendix B.

### 5.2.6 Groundwater Conditions

Standpipe piezometers were installed in four boreholes (15-08, 15-12, 15-14, and 15-15) in Area 2 to monitor stabilized (long term) groundwater levels. The water levels measured in the piezometers in addition to those recorded during the exp investigation in 2013 can be summarized as follows:

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
2-1	Jan. 18, 2013	3.3	319.6	Open borehole
2-3	Jan. 30, 2013	4.7	318.6	Open borehole
2-4	Feb. 6, 2013	3.9	319.6	Standpipe Piezometer
15-08	Mar. 15, 2016	4.5	319.8	Standpipe Piezometer
15-12	Mar. 15, 2016	3.0	320.6	Standpipe Piezometer
15-14	Mar. 15, 2016	3.8	319.7	Standpipe Piezometer
15-15	Mar. 15, 2016	0.7	322.3	Standpipe Piezometer

The water level in the Head Lake was at elevation 317.7 m during the field works.

The water level in the Head Lake and groundwater levels are expected to fluctuate seasonally and are subject to precipitation patterns, and may vary from the levels presented above.

### 5.3 Area 3 (Sta. 17+040 to 17+100)

#### 5.3.1 Asphalt

A 150 mm to 275 mm thick layer of asphalt was encountered in each borehole drilled on the roadway.

#### 5.3.2 Granular Fill

Brown granular fill was encountered at ground surface or below the roadway asphalt in the boreholes drilled on the roadway. The granular fill consisted of sand, some gravel to gravelly and trace silt. The fill extended to depths ranging from 0.6 to 1.1 m (elevations ranging from 321.9 to 321.7 m) with thickness ranging from 0.4 to 0.9 m.

SPT 'N' values recorded in the fill ranged from 15 to 26 blows per 0.3 m penetration, indicating a compact relative density. Moisture contents of the fill ranged typically from 2 to 16%. Grain size analyses indicated that the fill consisted of the following:

Soil Particle	Percentage (%)
Gravel	10 - 20
Sand	53 - 82
Silt & Clay	8 - 27

The results of the laboratory test are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses are illustrated in Figure B1 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.

#### 5.3.3 Silt

Silt was encountered either below the granular fill in the boreholes drilled on the roadway or immediately at the lakebed. The silt below the fill extended to depths ranging from 1.8 to 5.2 m (elevations ranging from 321.0 to 317.3 m) with thickness ranging from 0.7 to 4.6 m. The silt below the lakebed extended to depths ranging from 2.8 to 3.7 m (elevations ranging from 315.5 to 314.0 m) with thickness ranging from 1.1 to 3.7 m.

SPT 'N' values recorded in the silt ranged from 2 to 20 blows per 0.3 m penetration, indicating a very loose to compact relative density. Moisture contents of the silt ranged from 17 to 32%.

Atterberg Limits test results showed that the silt was marginally plastic with a Liquid Limit of 23% and a Plastic Limit of 18%. Grain size analyses indicated that the silt consisted of the following:

Soil Particle	Percentage (%)
Gravel	0 - 4
Sand	1 - 26
Silt	65 - 89
Clay	4 – 16

The results of the laboratory test are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses and Atterberg Limits are illustrated in Figures B8 to B12 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.

### 5.3.4 Sand to Gravelly Sand

Sand to gravelly sand was encountered below the silt and extended to depths ranging from 3.4 to 5.5 m (elevations ranging from 317.1 to 319.4 m below the roadway and 313.3 to 313.6 m below the lakebed) with thickness ranging from 0.4 to 2.2 m. The sand becomes silty above the bedrock surface in boreholes 15-16 and 15-17. Boreholes 3-3, 3-4 and 15-18 were terminated within the sand layer upon auger refusal.

SPT 'N' values recorded in the sand ranged from 8 to greater than 50 blows per 0.3 m penetration, indicating a loose to very dense relative density. Moisture contents of the sand ranged from 4 to 21%. Grain size analyses indicated that this deposit consisted of the following:

Soil Particle	Percentage (%)	
	Sand	Silty Sand
Gravel	2 - 22	2
Sand	65 - 95	60
Silt & Clay	3 - 13	-
Silt	-	34
Clay	-	4

The results of the laboratory test are provided on the Record of Borehole sheets in Appendix A. The results of the grain size analyses are illustrated in Figures B3 to B8 in Appendix B. The laboratory test results from the exp investigation in 2013 are included in Appendix E.

### 5.3.5 Bedrock

Granitic Gneiss bedrock was encountered below the sand to gravelly sand and extended to the end of the boreholes. Where proven by coring, the depth to bedrock ranged from 4.2 to 8.1 m (elevations ranging from 318.7 to 314.6 m).

Generally, Total Core Recovery (TCR) in the bedrock was 100%. The Rock Quality Designation (RQD) ranged from 37 to 95%, indicating poor to excellent rock mass quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to greater than 10. The Point Load Index  $(Is)_{50}$  ranged from 1.6 to 7.1 MPa, which correlates to unconfined compressive strength (UCS) ranging from 39 to 170 MPa using an assumed conversion factor of 24, indicating a medium strong to very strong rock.

The results of the TCR, RQD and  $(Is)_{50}$  are provided on the Record of Borehole sheets in Appendix A. Rock core photographs and point load test results are included in Appendix B.

### 5.3.6 Groundwater Conditions

Standpipe piezometers were installed in one borehole (15-17) in Area 3 to monitor stabilized (long term) groundwater levels. The water levels measured in the piezometers in addition to those recorded during the exp investigation in 2013 can be summarized as follows:

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
3-1	Jan. 16, 2013	4.0	318.6	Open borehole
3-2	Jan. 17, 2013	3.4	319.3	Open borehole
3-3	Jan. 27, 2013	3.2	319.6	Open borehole
3-4	Jan. 31, 2013	0.6	317.7	Open borehole
15-17	Mar. 15, 2016	0.7	321.8	Standpipe Piezometer

The water level in the Head Lake was at elevation 317.7 m during the field works.

The water level in the Head Lake and groundwater levels are expected to fluctuate seasonally and are subject to precipitation patterns, and may vary from the levels presented above.

## 6. MISCELLANEOUS

The borehole locations were staked and/or marked in the field and utility clearances obtained prior to drilling. Thurber obtained the northing and easting coordinates (MTM) and ground surface elevations of all boreholes from a digital terrain model (DTM) provided by Callon Dietz.

Downing Drilling Ltd. of Hawkesbury, Ontario supplied and operated a truck-mounted CME75 drill rig for the first phase of the field investigation. OGS Drilling Inc. of Almonte, Ontario supplied and operated a portable tripod drill for the second phase of the investigation.

Fowler Construction of Huntsville, Ontario provided traffic control services during the field investigations.

The drilling and sampling operations in the field were supervised on a full time basis by an experienced Thurber drilling supervisor. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory. Overall supervision of the field program was carried out by Mr. Stephane Loranger, CET.

Dr. Tamer Elkateb and Mr. Keli Shi, P.Eng., interpreted the data and prepared the report. The report was reviewed by Mr. Jason Lee, P.Eng., and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.



Keli Shi, P.Eng.  
Foundations Engineer



Jason Lee, P.Eng.  
Principal, Senior Geotechnical Engineer



Dr. P.K. Chatterji, P.Eng.  
Review Principal, Designated MTO Contact



## **Appendix A**

### **Record of Borehole Sheets**

## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

### 2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

### 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level  
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value      Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT      Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

# UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS W <sub>L</sub> < 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. (W <sub>L</sub> < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W <sub>L</sub> < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W <sub>L</sub> > 50%	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			



## EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
<b>Fresh (FR)</b>	No visible signs of weathering.		
<b>Fresh Jointed (FJ)</b>	Weathering limited to the surface of major discontinuities.		CLAYSTONE
<b>Slightly Weathered (SW)</b>	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
<b>Moderately Weathered (MW)</b>	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
<b>Highly Weathered (HW)</b>	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
<b>Completely Weathered (CW)</b>	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
<u>TERMS</u>		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.				
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

# RECORD OF BOREHOLE No 15-01

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+729 N 4 990 897.1 E 382 437.9 ORIGINATED BY AHF  
HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
DATUM Geodetic DATE 2015.11.02 - 2015.11.02 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
325.7	GROUND SURFACE													
0.0	ASPHALT: (225mm)													
0.2	SAND, some gravel, trace silt Compact Brown Moist		1	SS	15									
324.9	(FILL)		2	SS	11									
0.8	Sandy SILT, some clay Compact Grey Moist													
324.5														
1.2														
323.8	Cobble zone Start coring at 1.9m													
1.9	GRANITIC GNEISS, slightly weathered to fresh, strong to very strong, dark grey/pink		1	RUN										
	Horizontal joints at 2.0m, 2.5m, 3.0m and 3.3m													
	Highly broken zone 125mm at 2.1m													
	Sub-veritcal joint 250mm at 3.7m, 125mm at 3.9m, 275mm at 4.1m and 125mm at 4.6m		2	RUN										
	Sub-horizontal joint 50mm at 4.5m													
320.7														
5.0	END OF BOREHOLE AT 5.0m. BOREHOLE BACKFILLED WITH BENTONITE/CUTTINGS TO 0.6m, THEN WITH SAND TO 0.3m AND COLD PATCH ASPHALT TO SURFACE.													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 15-02

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+769 N 4 990 862.4 E 382 420.2 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.11.02 - 2015.11.02 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
325.5	GROUND SURFACE												
0.0	ASPHALT: (250mm)												
0.3	SAND, trace silt, trace gravel Compact Brown Moist (FILL)		1	SS	10								7 89 4 (SI+CL)
324.7			2	SS	9								0 35 53 12
0.8	Sandy SILT, some clay Loose to Compact Grey Moist												
			3	SS	27								
323.3													
2.2	SAND, some silt, trace to some gravel Compact to Dense Brown Moist to Wet		4	SS	30								7 76 17 (SI+CL)
	Becoming gravelly		5	SS	21								
			6	SS	27								20 60 17 3
320.6			7	SS	70/ 0.300								
4.9	GRANITIC GNEISS, moderately weathered to fresh jointed, medium strong to very strong, dark grey												
	Sub-vertical joint 25mm at 5.0m, 5.2m and 75mm at 5.4m		1	RUN									RUN #1 TCR=100% SCR=63% RQD=48% Is50 (A)=6.0 MPa Is50 (D)=3.5 MPa
	Horizontal joint at 5.5m, 5.6m, 5.8m, 5.9m and 6.0m												
	50mm highly broken zone at 6.3m												
	Horizontal joints at 6.9m, 7.0m, 7.1m, 7.2m and 7.6m												RUN #2 TCR=100% SCR=77% RQD=78% Is50 (A)=8.4 MPa Is50 (D)=5.3 MPa
	Subhorizontal joints 50mm at 7.0m and 75mm at 7.4m		2	RUN									
317.5													
8.0	END OF BOREHOLE AT 8.0m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.												
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2016.03.15 0.6 324.9												

ONTMT4S 8870.GPJ 2017TEMPLATE(MTO).GDT 9/29/17

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

# RECORD OF BOREHOLE No 15-03

1 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+769 N 4 990 864.0 E 382 414.4 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.11.03 - 2015.11.03 CHECKED BY KS

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					GR	SA	SI	CL	
325.5	GROUND SURFACE																				
0.0	ASPHALT: (200mm)																				
0.2	SAND, some gravel, some silt, trace clay Dense to Loose Brown Moist (FILL)		1	SS	28		325														
			2	SS	45																
			3	SS	7		324										10	67	19	4	
			4	SS	11																
323.1																					
2.4	Sandy SILT, some clay Compact to Dense Brown Moist		5	SS	20		323											0	24	66	10
			6	SS	38																
							322														
			7	SS	22																
320.9							321														
4.6	SAND, some gravel, occasional rock fragments Compact to Very Dense Brown Moist		8	SS	14													21	62	17	(SI+CL)
			9	SS	33		320														
319.2			10	SS	50/																
6.3	GRANITIC GNEISS, slightly weathered to fresh, strong to very strong, dark grey				0.050		319														
	Horizontal joint at 6.7m, 6.8m, 7.2m, 7.3m, 7.5m and 7.7m		1	RUN																	
	Horizontal joint from 8.1m to 8.5m						318														
			2	RUN																	
	Horizontal joints at 8.8m and from 9.0m to 9.3m		3	RUN			317														
316.1																					
9.4	END OF BOREHOLE AT 9.4m. BOREHOLE BACKFILLED WITH BENTONITE/CUTTINGS TO 0.6m, THEN WITH SAND TO 0.3m AND																				

Continued Next Page

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

# RECORD OF BOREHOLE No 15-03

2 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+769 N 4 990 864.0 E 382 414.4 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.11.03 - 2015.11.03 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
	Continued From Previous Page																
	COLD PATCH ASPHALT TO SURFACE.																

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# RECORD OF BOREHOLE No 15-04

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+769 N 4 990 871.8 E 382 401.0 ORIGINATED BY TM  
 HWY 118 BOREHOLE TYPE Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2016.03.08 - 2016.03.08 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)				
								<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>							<div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div><div>W P                  W                  W L</div></div>				
317.4	GROUND SURFACE																		
0.0	Sandy <b>SILT</b> , trace clay, trace to some organics, decayed wood		1	SS	2		317												
316.8	Loose Grey Wet		2	SS	10		316												
0.6	<b>SILT</b> , some clay, trace to some sand Loose to Compact Grey Moist to Wet		3	SS	15		315												
			4	SS	7		314												
			5	SS	6		313												
			6	SS	10		312												
			7	SS	19		311												
			8	SS	13		310												
312.7	Trace gravel																		
4.7	<b>SAND</b> , some gravel Compact to Very Dense Brown Wet		9	SS	16														
	Becoming gravelly	10	SS	14		312													
		11	SS	10		311													
		12	SS	52		310													
		13	SS	67		309													
		14	SS	60															
		15	SS	88/ 0.275															
308.3																			
9.1	END OF BOREHOLE AT 9.1m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																		

ONTMT4S 8870.GPJ 2017TEMPLATE(MTO).GDT 9/29/17

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

# RECORD OF BOREHOLE No 15-05

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+807 N 4 990 827.8 E 382 409.1 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.10.29 - 2015.10.29 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
325.0	GROUND SURFACE							20 40 60 80 100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
0.0	<b>SAND</b> , some gravel, trace silt, trace organics Compact Brown Moist (FILL)  <b>SAND</b> , some gravel, trace silt, occasional cobbles Compact to Dense Brown Moist		1	SS	10	324																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	</



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

# RECORD OF BOREHOLE No 15-06

1 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+807 N 4 990 835.4 E 382 402.9 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.11.04 - 2015.11.04 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
325.3	GROUND SURFACE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.0	ASPHALT: (175mm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
0.2	SAND, gravelly to some gravel, trace silt Compact Brown Moist (FILL)		1	SS	26		325																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 15-06

2 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+807 N 4 990 835.4 E 382 402.9 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.11.04 - 2015.11.04 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
	Continued From Previous Page																
	19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2016.03.15 2.8 322.5																

ONTMT4S 8870.GPJ 2017TEMPLATE(MTO).GDT 9/29/17

# RECORD OF BOREHOLE No 15-07

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+807 N 4 990 834.4 E 382 389.2 ORIGINATED BY TM  
 HWY 118 BOREHOLE TYPE Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2016.03.09 - 2016.03.09 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
317.7	GROUND SURFACE													
0.0	ICE: (200mm)													
0.2	WATER													
317.2														
0.5	SAND, trace to some gravel, trace rootlets Loose to Dense Brown Wet		1	SS	8		317							
			2	SS	32									
			3	SS	24		316							
	Becoming silty		4	SS	13									
			5	SS	50/		315							
314.7														
3.0	END OF BOREHOLE AT 3.0m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.  TWO ADDITIONAL BOREHOLES WERE DRILLED WITH IN 5.0m OF THIS BOREHOLE. THE TWO ADDITIONAL BOREHOLES ALSO ENCOUNTERED REFUSAL AT A DEPTH OF 2.5m BELOW LAKEBED.				0.100									

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

# RECORD OF BOREHOLE No 15-08

1 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+907 N 4 990 731.5 E 382 404.9 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.10.27 - 2015.10.27 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
324.3	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (200mm)							20	40	60	80	100							
0.2	SAND, some gravel Compact Brown Moist (FILL)		1	SS	16		324												
323.4			2	SS	14														
0.9	SILT, some clay, trace to some sand Compact Brown/Grey Moist						323												
			3	SS	11														
322.1							322												
2.2	SAND, gravelly to some gravel, trace silt, occasional rock fragments Compact to Very Dense Brown Moist		4	SS	25														
			5	SS	16		321												
			6	SS	23		320												
	Granitic rock pieces		7	SS	64														
319.1							319												
5.2	Cobble zone		1	RUN															
318.7							318												
5.6	GRANITIC GNEISS, moderately to slightly weathered, strong to very strong, grey  Horizontal joints at 6.4m, 6.5m and 6.6m  Horizontal joint at 7.1m  Sub-horizontal joints 75mm at 7.7m and 50mm at 8.1m  Horizontal joints at 8.0m, 8.2m and 8.5m  Highly broken zones 100mm at 7.6m, 75mm at 8.7m and 300mm at 9.4m  Horizontal joints (7) from 8.8m to 9.3m		2	RUN															
			3	RUN			317												
			4	RUN			316												
			5	RUN			315												
314.6																			
9.7	END OF BOREHOLE AT 9.7m. Piezometer installation consists of																		

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 15-08

2 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+907 N 4 990 731.5 E 382 404.9 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.10.27 - 2015.10.27 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
	Continued From Previous Page																
	19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2016.03.15 4.5 319.8																

ONTMT4S 8870.GPJ 2017TEMPLATE(MTO).GDT 9/29/17

# RECORD OF BOREHOLE No 15-09

1 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+907 N 4 990 730.3 E 382 398.6 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.11.03 - 2015.11.03 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
324.3	GROUND SURFACE													
0.0	ASPHALT: (225mm)													
0.2	Gravelly <b>SAND</b> , trace silt Compact Brown Moist (FILL)		1	SS	11		324							27 68 5 (SI+CL)
323.4			2	SS	14									
0.9	Sandy <b>SILT</b> , some clay Compact Brown/Grey Moist						323							
			3	SS	9									0 22 63 15
			4	SS	12		322							
321.4														
2.9	<b>SILT</b> , trace to some clay, occasional rock fragments Loose to Compact Grey Wet		5	SS	50/ 0.025		321							0 0 90 10
320.5														
3.8	Gravelly <b>SAND</b> , trace silt Compact to Dense Brown Moist		6	SS	19		320							
			7	SS	34									
			8	SS	31		319							
			9	SS	45		318							34 61 5 (SI+CL)
317.3	Becoming silty		10	SS	55/ 0.200									
7.0	<b>GRANITIC GNEISS</b> , slightly weathered to fresh, strong to very strong, mottled grey/pink  50mm sub-horizontal joint at 7.0m  75mm highly broken zone at 7.4m and 8.0m  Horizontal joints at 7.6m and 7.9m  Horizontal joints at 8.4m, 8.5m, 8.6m, 8.8m and 9.2m  Sub-horizontal joints 25mm at 8.6m and 75mm at 8.7m		1	RUN			317							RUN #1 TCR=78% SCR=52% RQD=52% Is50 (A)=6.9 MPa Is50 (D)=5.0 MPa
			2	RUN			316							RUN #2 TCR=98% SCR=71% RQD=71% Is50 (A)=8.1 MPa Is50 (D)=4.1 MPa
							315							

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 15-09

2 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+907 N 4 990 730.3 E 382 398.6 ORIGINATED BY AHF  
HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
DATUM Geodetic DATE 2015.11.03 - 2015.11.03 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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									
	Continued From Previous Page																
313.5	Horizontal joints (12) from 9.4m to 10.3m		3	RUN			314									4	RUN #3 TCR=74% SCR=50% RQD=44% Is50 (A)=8.0 MPa Is50 (D)=3.9 MPa
10.8	END OF BOREHOLE AT 10.8m.															1	

# RECORD OF BOREHOLE No 15-10

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+907 N 4 990 728.2 E 382 390.4 ORIGINATED BY TM  
 HWY 118 BOREHOLE TYPE Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2016.03.09 - 2016.03.09 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT							UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																	
317.7	GROUND SURFACE							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>							<div>PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT</div> <div>W<sub>P</sub>                      W                      W<sub>L</sub></div> <div>WATER CONTENT (%)</div> <div>102030</div>										
0.0	ICE: (200mm)																								
0.2	WATER																								
317.2																									
0.5	SAND, some gravel Compact to Very Dense Brown Wet		1	SS	24		317																		
			2	SS	18																				
			3	SS	60		316																		
			4	SS	38																				
			5	SS	73/ 0.250		315																		
314.3																									
3.4	END OF BOREHOLE AT 3.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.  TWO ADDITIONAL BOREHOLES WERE DRILLED WITH IN 5.0m OF THIS BOREHOLE. THE TWO ADDITIONAL BOREHOLES ALSO ENCOUNTERED REFUSAL AT A DEPTH OF 2.8m BELOW LAKEBED.																								

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 15-11

1 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+938 N 4 990 701.6 E 382 410.2 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.10.27 - 2015.10.27 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
324.3	GROUND SURFACE							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>20406080100</div>					GR SA SI CL
0.0	ASPHALT: (300mm)							<div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div> <div>w P w w L</div> <div>WATER CONTENT (%)</div> <div>102030</div>					
324.0							324						
0.3	SAND, some gravel, trace silt Compact Brown Moist (FILL)		1	SS	18								18 76 6 (SI+CL)
			2	SS	21								
323.1													
1.2	Sandy SILT, trace to some clay, occasional rock fragments Loose to Compact Brown/Grey Moist to Wet		3	SS	12		323						
			4	SS	6		322						
			5	SS	31		321						0 29 65 6
320.6													
3.7	SAND, gravelly to some gravel, trace to some silt, occasional rock fragments Compact to Very Dense Brown Moist		6	SS	56		320						
			7	SS	28								
							319						32 57 11 (SI+CL)
			8	SS	41								
			9	SS	44		318						
			10	SS	41		317						
316.7												FI	
7.6	GRANITIC GNEISS, slightly weathered to fresh, strong to very strong, grey  Highly broken zones 100mm at 7.6m and 25mm at 8.4m  Sub-horizontal joints 25mm at 7.8m and 7.9m  Horizontal joint at 9.2m  Sub-horizontal joints 25mm at 9.4m, 9.7m, 10.0m and 10.2m		1	RUN			316					>10	RUN #1 TCR=97% SCR=82% RQD=82% Is50 (A)=5.2 MPa Is50 (D)=3.7 MPa
												1	
												5	
												6	
												2	RUN #2 TCR=100% SCR=93% RQD=95% Is50 (A)=6.4 MPa Is50 (D)=3.4 MPa
			2	RUN			315						

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 15-11

2 OF 2

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+938 N 4 990 701.6 E 382 410.2 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.10.27 - 2015.10.27 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
	Continued From Previous Page																
313.6							314										
10.7	END OF BOREHOLE AT 10.7m. BOREHOLE BACKFILLED WITH BENTONITE/CUTTINGS TO 0.6m, THEN WITH SAND TO 0.3m AND COLD PATCH ASPHALT TO SURFACE.																

# RECORD OF BOREHOLE No 15-12

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+938 N 4 990 696.4 E 382 403.9 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.11.04 - 2015.11.04 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
323.6	GROUND SURFACE														
0.0	ASPHALT: (200mm)														
0.2	SAND, trace silt, trace gravel Loose Brown Moist (FILL)		1	SS	9		323							9 86 5 (SI+CL)	
322.7			2	SS	8										
0.9	SILT, trace to some clay, trace to some sand, occasional sand seams Compact Brown/Grey Moist						322								
			3	SS	7									0 6 76 18	
				4	SS	12		321							0 0 90 10
				5	SS	12									
							320								
			6	SS	10									0 0 93 7	
319.0							319								
4.6	SAND, some gravel, some silt, occasional rock fragments Dense Brown Moist		7	SS	42									16 66 18 (SI+CL)	
318.0															
5.6	GRANITIC GNEISS, fresh jointed to fresh, strong to very strong, mottled grey/pink  75mm sub-horizontal joint at 5.6m  Horizontal joints at 5.9m, 6.1m, 6.6m, 6.9m and 7.1m  Horizontal joints at 7.2m, 7.6m, 7.7m, 7.8m, 7.9m and 8.2m		1	RUN			318								
								317							
								316							
				2	RUN										
314.9							315								
8.7	END OF BOREHOLE AT 8.7m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2016.03.15 3.0 320.6														

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 15-13

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 16+938 N 4 990 696.6 E 382 394.0 ORIGINATED BY TM  
 HWY 118 BOREHOLE TYPE Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2016.03.10 - 2016.03.10 CHECKED BY KS

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>				GR	SA	SI	CL
317.7	GROUND SURFACE							20	40	60	80	100								
0.0	ICE: (200mm)							20	40	60	80	100								
0.2	<b>WATER</b>																			
0.2	<b>SAND</b> , some gravel, trace silt Loose to Dense Brown Wet		1	SS	5		317													
			2	SS	40															
			3	SS	48		316													
	Becoming gravelly		4	SS	17															
			5	SS	41		315													
			6	SS	66															
			7	SS	50/		314													
313.7																				
4.0	END OF BOREHOLE AT 4.0m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.				0.125															

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

## METRIC

SOIL PROFILE			SAMPLES			<div>DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE WATER CONTENT (%) </div>	UNIT WEIGHT  γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				GROUND WATER CONDITIONS	ELEVATION SCALE	
323.5	GROUND SURFACE										
0.0	ASPHALT: (200mm)										
0.2	SAND, some gravel, trace silt Compact Brown Moist (FILL)		1	SS	14						
322.3			2	SS	20						
1.2	SILT, trace to some clay Compact Grey Wet		3	SS	11						
320.9											
2.6	SAND, trace silt, occasional rock fragments Compact Brown Moist		4	SS	27						
			5	SS	19						
			6	SS	21						
			7	SS	14						
318.0											
5.5	GRANITIC GNEISS, slightly weathered to fresh jointed, medium strong to very strong, grey  Horizontal joints 25mm at 5.9m, 6.0m, 6.2m and 6.3m  Sub-horizontal joints 25mm at 5.6m, 5.7m, 5.9m, 6.1m and 6.7m  Horizontal joints from 7.2m to 7.5m, 7.7m to 7.9m, 8.2m and 8.4m  Sub-horizontal joints 25mm at 7.0m, 7.5m, 7.7m, 7.8m, 8.0m and 8.3m		1	RUN							
			2	RUN							
314.9											
8.6	END OF BOREHOLE AT 8.6m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) 2016.03.15      3.8      319.7										

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 15-15

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 17+024 N 4 990 615.8 E 382 427.4 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.10.27 - 2015.10.27 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
323.0	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (200mm)																	
0.2	SAND, trace silt, trace to some gravel Dense Brown Moist (FILL)		1	SS	32													
322.1			2	SS	26													8 81 11 (SI+CL)
0.9	Sandy SILT, trace to some clay Compact Brown Moist																	
321.6																		
1.4																		
	SAND, trace silt, trace gravel, occasional rock fragments Compact to Dense Brown/Grey Moist		3	SS	16													
			4	SS	22													1 94 5 (SI+CL)
			5	SS	59/													
319.7																		
3.3	GRANITIC GNEISS, moderately weathered to fresh, strong to very strong, grey/pink		1	RUN														RUN #1 TCR=36% SCR=12% RQD=12% Is50 (A)=4.3 MPa Is50 (D)=4.2 MPa
	Highly broken zones 75mm at 3.3m and 4.0m																	
	Highly broken zones 50mm at 4.2m, 150mm at 4.3m, 50mm at 4.7m and 275mm at 4.8m		2	RUN														RUN #2 TCR=95% SCR=25% RQD=0%
	Horizontal joints at 4.2m, 4.3m, 4.5m, 4.6m, 4.7m and 4.8m																	
	Sub-horizontal joint 25mm at 4.5m		3	RUN														RUN #3 TCR=83% SCR=50% RQD=44% Is50 (A)=9.1 MPa Is50 (D)=4.4 MPa
	Horizontal joint at 5.4m																	
	Sub-vertical joint 75mm at 5.4m																	
	Horizontal joints at 5.7m and 6.9m		4	RUN														RUN #4 TCR=100% SCR=92% RQD=90% Is50 (A)=6.2 MPa Is50 (D)=2.7 MPa
	Sub-horizontal joints 25mm at 5.7m and 6.1m																	
315.9																		
7.1	END OF BOREHOLE AT 7.1m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																	
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2016.03.15 0.7 322.3																	

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 15-16

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 17+104 N 4 990 538.1 E 382 442.1 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.10.26 - 2015.10.26 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT							UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
322.9	GROUND SURFACE							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>20406080100</div>							<div>PLASTIC LIMIT</div> <div>NATURAL MOISTURE CONTENT</div> <div>LIQUID LIMIT</div> <div>W P W L</div>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

ONTMT4S 8870.GPJ 2017TEMPLATE(MTO).GDT 9/29/17

# RECORD OF BOREHOLE No 15-17

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 17+104 N 4 990 536.3 E 382 432.5 ORIGINATED BY AHF  
 HWY 118 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2015.11.04 - 2015.11.04 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	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						
322.5	GROUND SURFACE													
0.0	ASPHALT: (200mm)													
0.2	SAND, some gravel, trace silt Compact		1	SS	20									
321.9	Brown Moist (FILL)		2	SS	19									
0.6	SILT, trace to some sand, trace to some clay Very Loose to Compact Grey Moist													
			3	SS	7									
			4	SS	2									
			5	SS	5									
			6	SS	4									
			7	SS	3									
317.3														
5.2	Silty SAND, trace gravel		8	SS	50/									
317.0	Brown Wet				0.125									
5.5	GRANITIC GNEISS, fresh jointed to fresh, strong to very strong, grey/pink		1	RUN										
	Horizontal joints (7) from 5.7m to 6.3m and 6.9m													
	Horizontal joints at 7.3m, 7.9m, 7.1m and 8.3m		2	RUN										
313.9														
8.6	END OF BOREHOLE AT 8.6m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													
	WATER LEVEL READINGS: DATE          DEPTH (m)          ELEV. (m) 2016.03.15      0.7                      321.8													

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

# RECORD OF BOREHOLE No 15-18

1 OF 1

METRIC

W.P. 5339-11-00 LOCATION Sta. 17+104 N 4 990 534.4 E 382 422.6 ORIGINATED BY TM  
 HWY 118 BOREHOLE TYPE Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2016.03.10 - 2016.03.10 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
317.7	GROUND SURFACE													
0.0	ICE: (325mm)													
317.4														
319.3	WATER													
0.5	SILT, trace sand, trace clay, some organics, decayed wood, rootlets Very Loose to Compact Grey Wet		1	SS	18		317							
			2	SS	14									0 6 87 7
			3	SS	3		316							
			4	SS	6									
			5	SS	10		315							0 5 89 6
	Trace gravel		6	SS	75		314							
313.6														
4.1	Gravelly SAND, some silt Very Dense		7	SS	98/ 0.250									22 65 13 (SI+CL)
313.2	Brown													
4.5	Wet													
	END OF BOREHOLE AT 4.5m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE





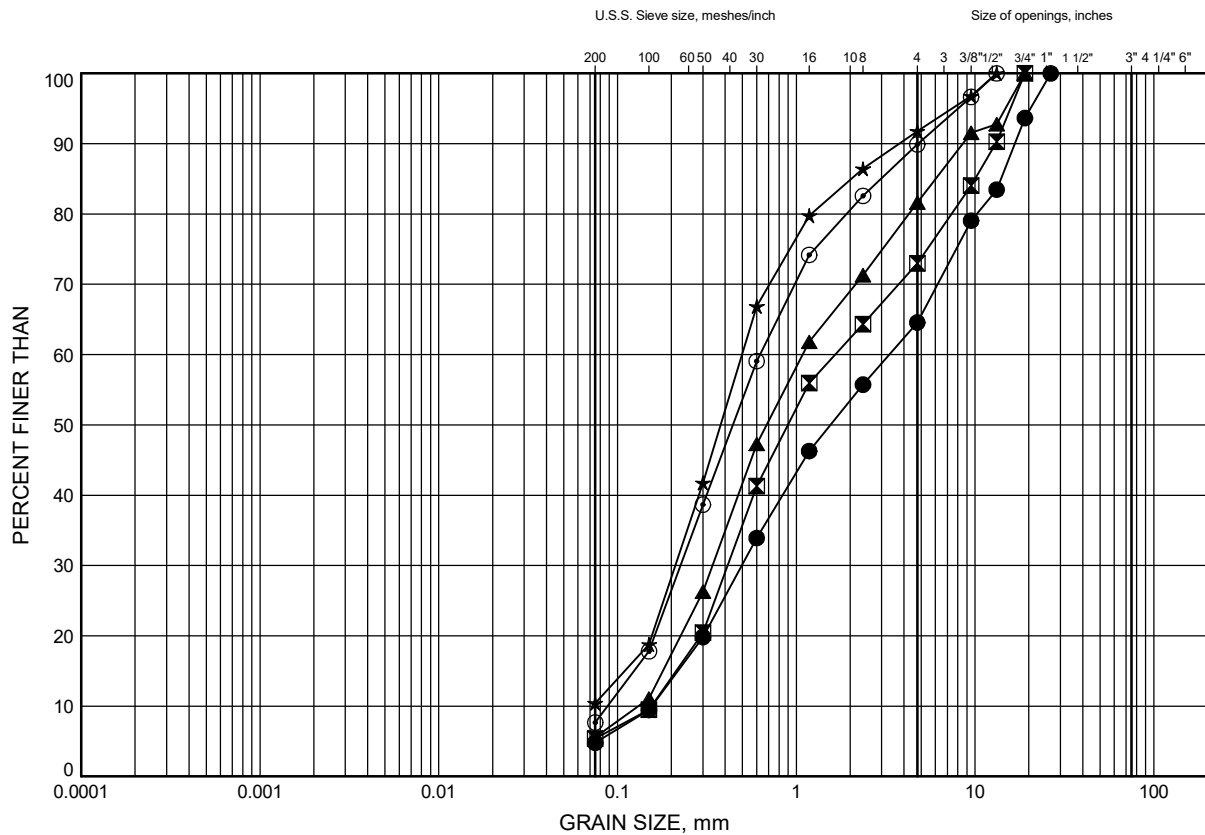
## **Appendix B**

### **Laboratory Test Results and Rock Core Photographs**

# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B1

## SAND, Gravelly to Some Gravel FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-06	0.5	324.8
⊠	15-09	0.5	323.8
▲	15-11	0.9	323.4
★	15-15	0.7	322.3
⊙	15-16	0.5	322.4

Date September 2017  
W.P. 5339-11-00

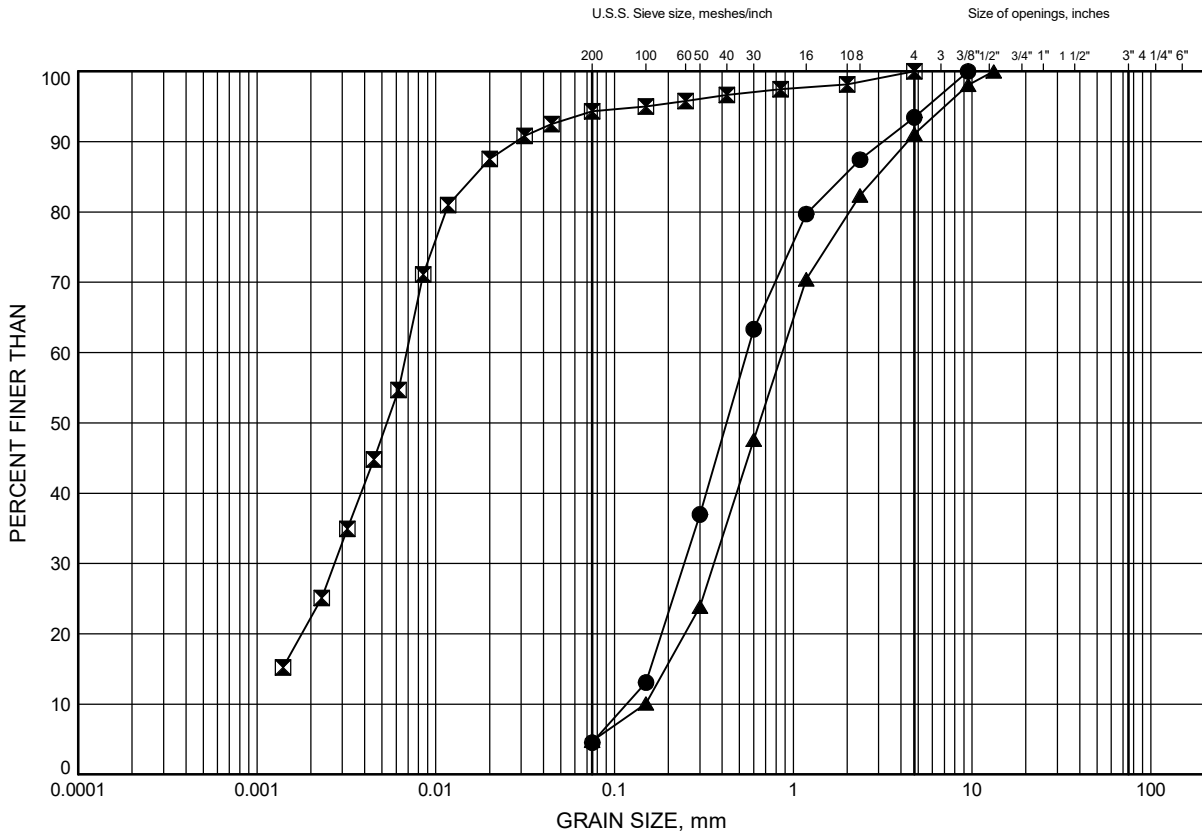


Prep'd MFA  
Chkd. KS

# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B2

## SAND FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-02	0.5	325.0
⊠	15-08	1.1	323.2
▲	15-12	0.5	323.1

Date September 2017  
W.P. 5339-11-00



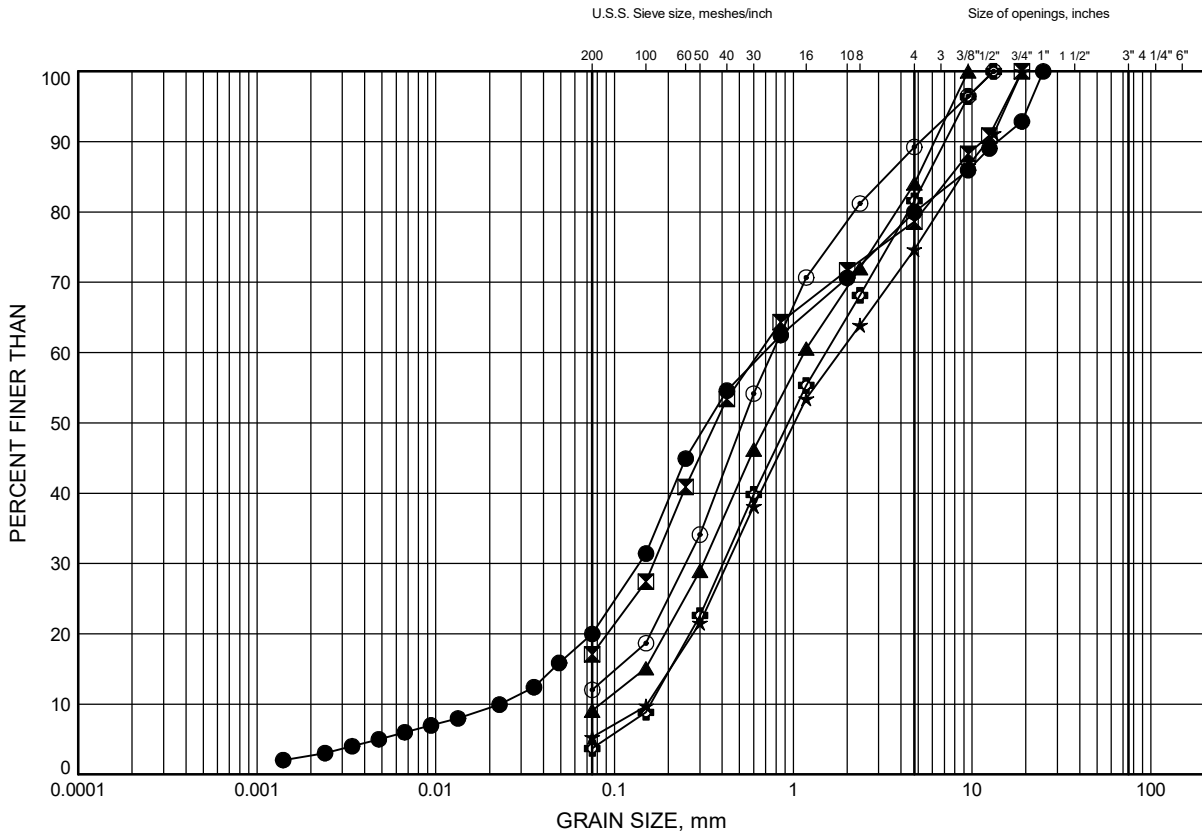
Prep'd MFA  
Chkd. KS

# Hwy 118 Soil Nailing

## GRAIN SIZE DISTRIBUTION

FIGURE B3

### SAND, Gravelly to Some Gravel



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-02	4.1	321.4
⊠	15-03	4.9	320.6
▲	15-04	5.2	312.2
★	15-04	7.0	310.4
⊙	15-05	0.9	324.1
⊕	15-05	2.6	322.4

Date September 2017  
W.P. 5339-11-00

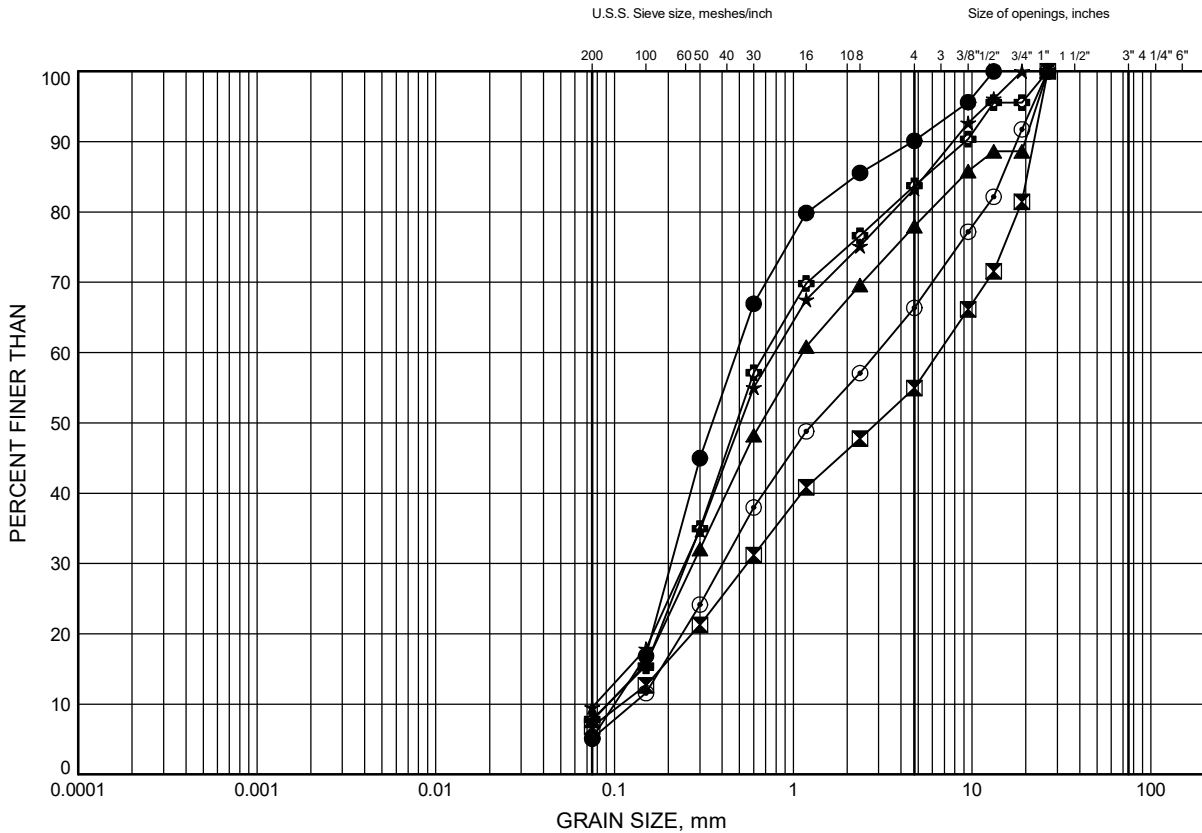


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# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B4

## SAND, Gravelly to Some Gravel



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-06	1.5	323.8
⊠	15-06	5.6	319.7
▲	15-08	2.6	321.7
★	15-08	4.9	319.4
⊙	15-09	6.4	317.9
⊕	15-10	2.0	315.7

Date September 2017  
W.P. 5339-11-00

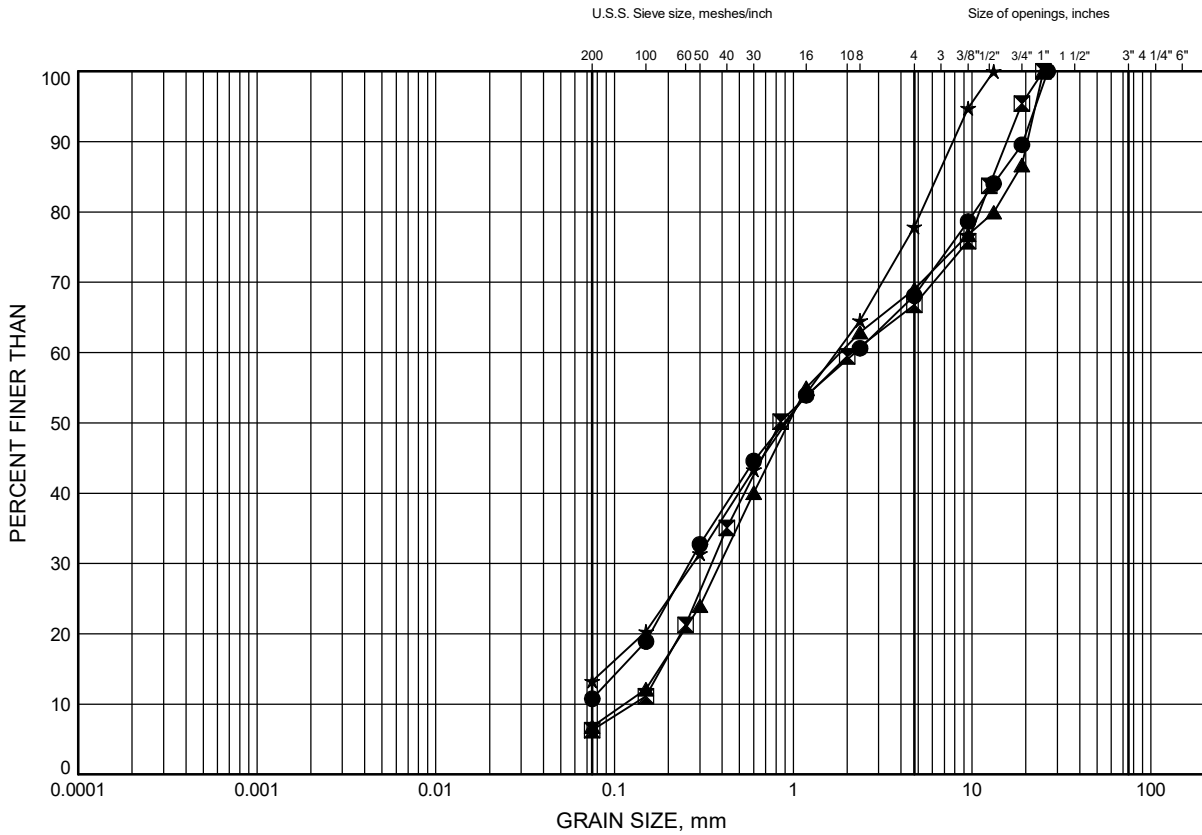


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Chkd. KS

# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B5

## Gravelly SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-11	5.6	318.7
⊠	15-13	2.4	315.3
▲	15-13	4.0	313.7
★	15-18	4.3	313.4

Date September 2017  
W.P. 5339-11-00



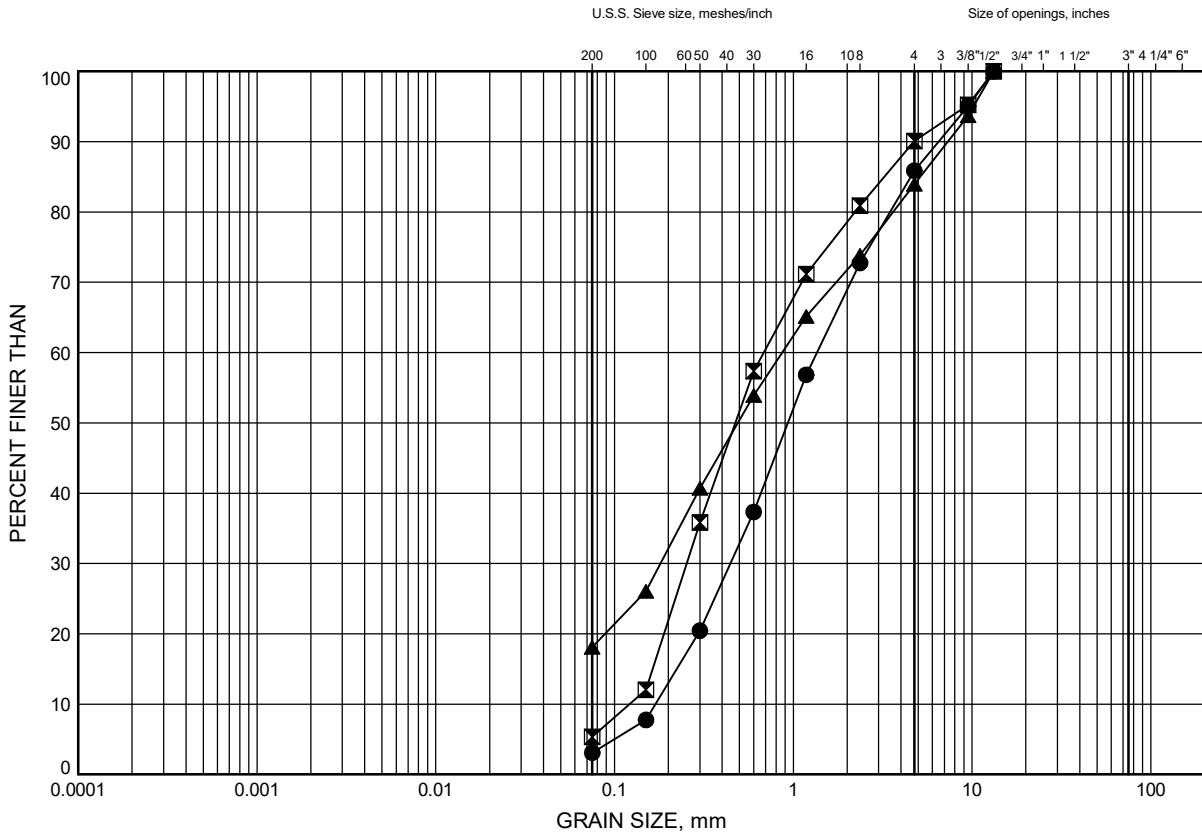
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Chkd. KS

# Hwy 118 Soil Nailing

## GRAIN SIZE DISTRIBUTION

FIGURE B6

### SAND, Some Gravel



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-06	3.4	321.9
⊠	15-07	1.4	316.3
▲	15-12	4.9	318.7

Date September 2017  
W.P. 5339-11-00

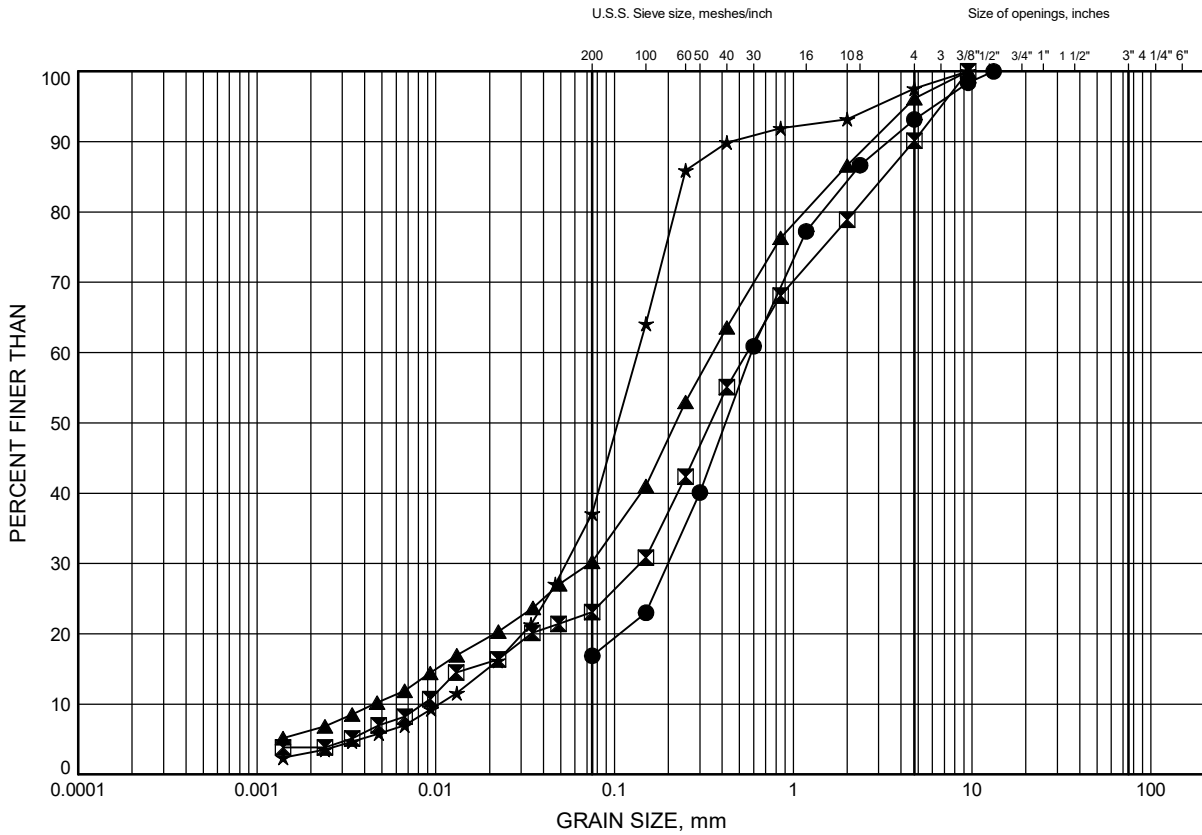


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Chkd. KS

# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B7

## SAND, Silty to Some Silt



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-02	2.6	322.9
⊠	15-03	1.5	324.0
▲	15-07	3.0	314.7
★	15-16	4.1	318.8

Date September 2017  
W.P. 5339-11-00

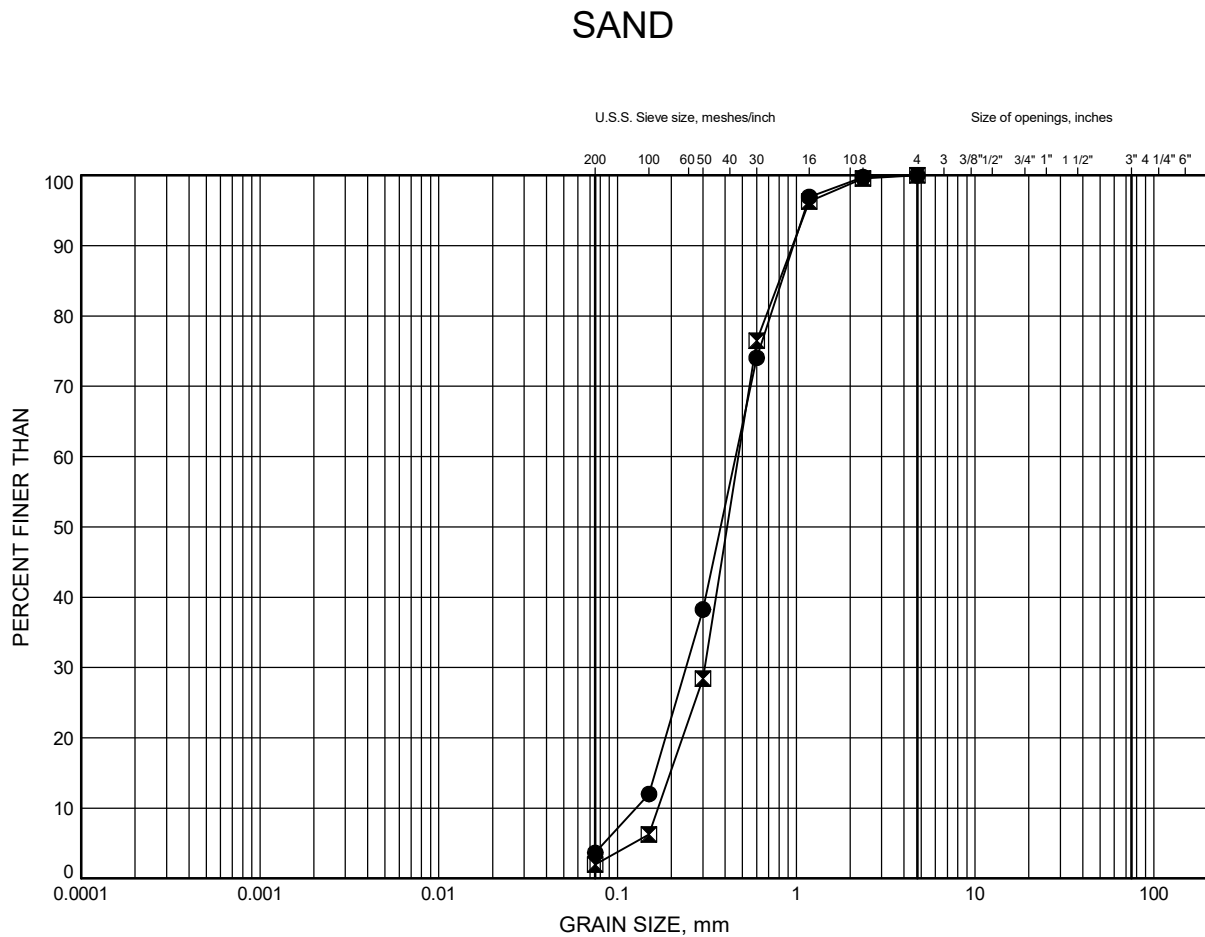


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Chkd. KS



# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B8



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-14	3.4	320.1
⊠	15-14	4.9	318.6

Date September 2017  
W.P. 5339-11-00

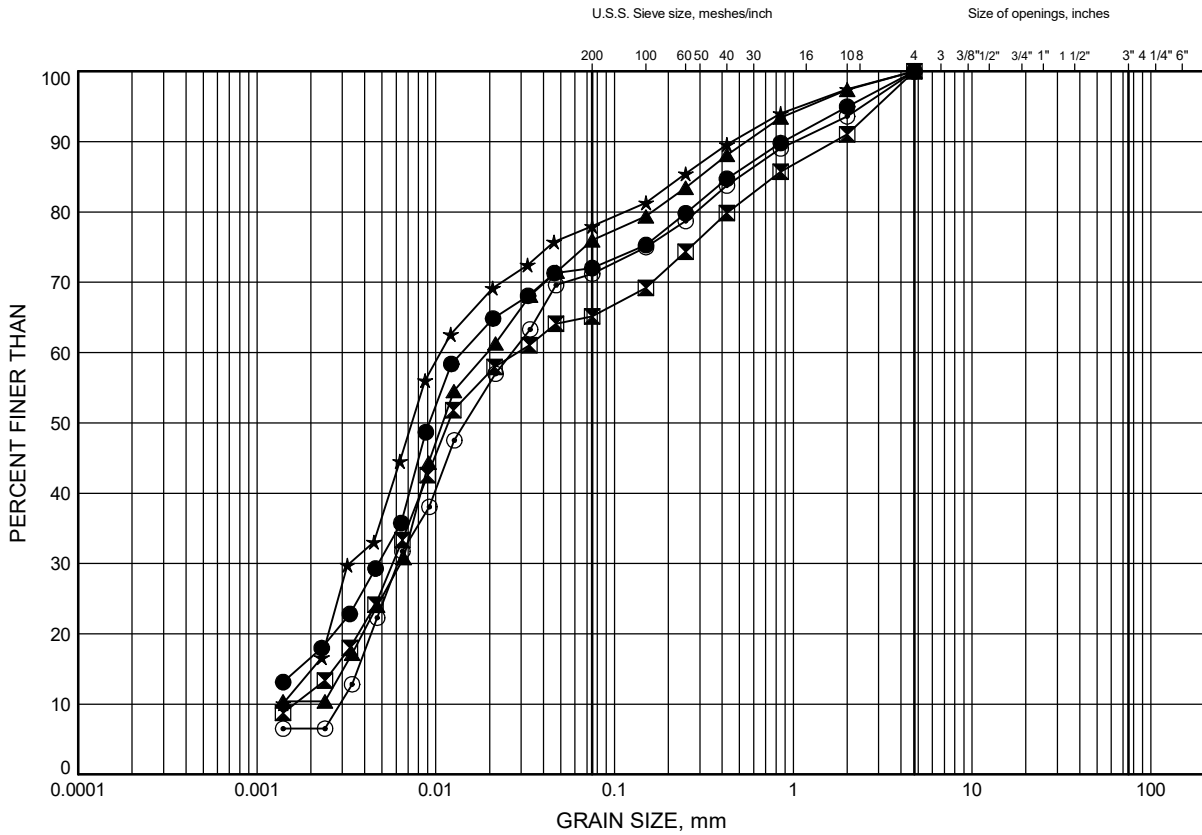


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Chkd. KS

# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B9

## Sandy SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-01	0.9	324.8
⊠	15-02	0.9	324.6
▲	15-03	2.7	322.8
★	15-09	1.8	322.5
⊙	15-11	3.4	320.9

Date September 2017

W.P. 5339-11-00



Prep'd MFA

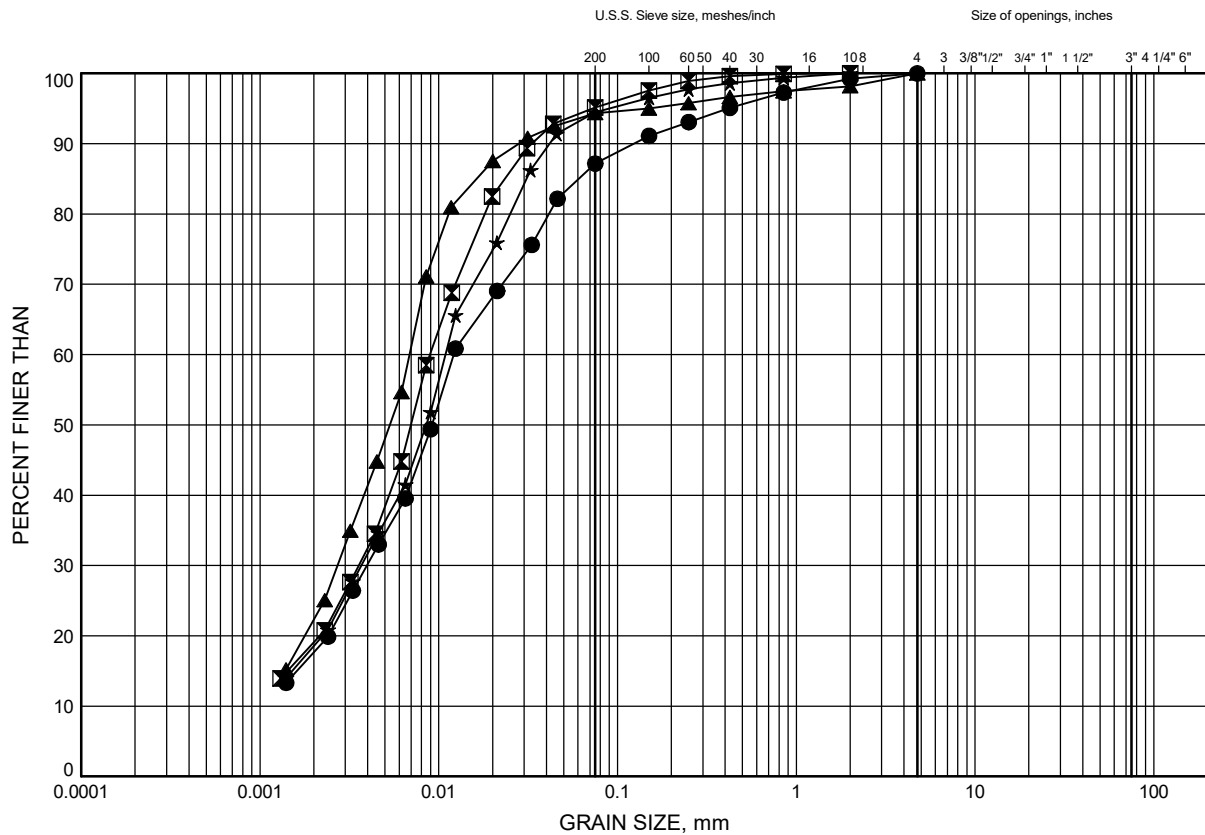
Chkd. KS

# Hwy 118 Soil Nailing

## GRAIN SIZE DISTRIBUTION

FIGURE B10

### SILT, Some Clay



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-04	0.9	316.5
⊠	15-04	4.0	313.4
▲	15-08	1.1	323.2
★	15-12	1.8	321.8

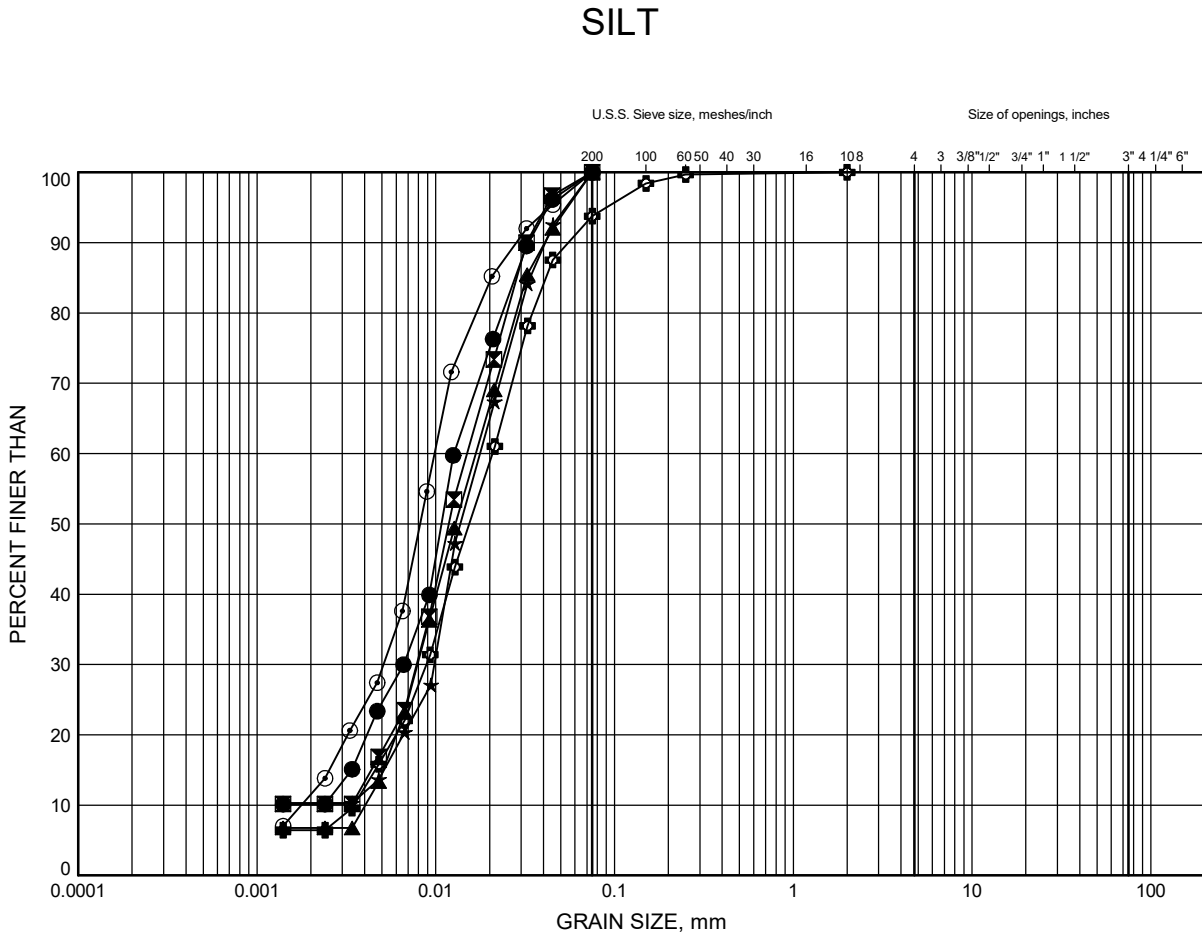
Date September 2017  
W.P. 5339-11-00



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Chkd. KS

# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B11



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-09	3.2	321.1
⊠	15-12	2.6	321.0
▲	15-12	4.1	319.5
★	15-14	1.5	322.0
⊙	15-17	4.9	317.6
⊕	15-18	1.4	316.3

Date September 2017

W.P. 5339-11-00



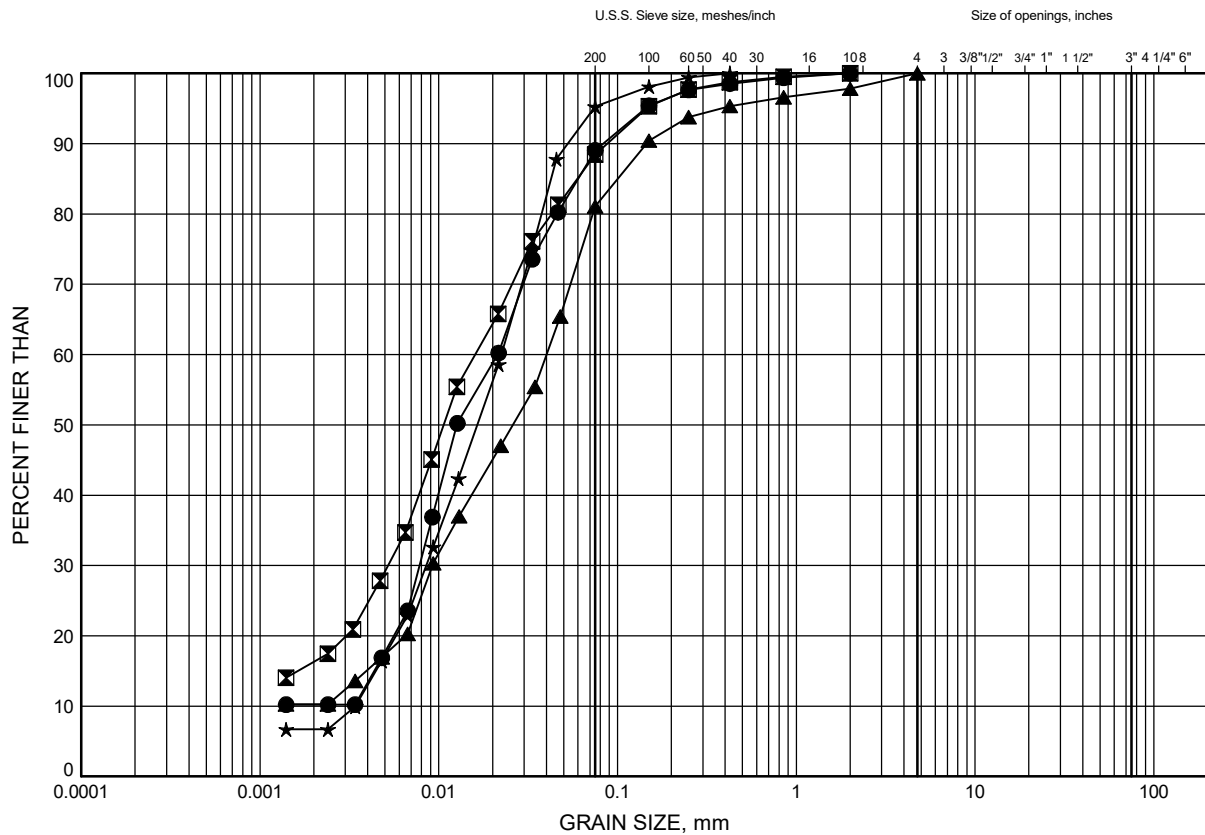
Prep'd MFA

Chkd. KS

# Hwy 118 Soil Nailing GRAIN SIZE DISTRIBUTION

FIGURE B12

## SILT, Some Sand



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-16	1.8	321.1
⊠	15-17	0.9	321.6
▲	15-17	2.6	319.9
★	15-18	3.2	314.5

Date September 2017

W.P. 5339-11-00



Prep'd MFA

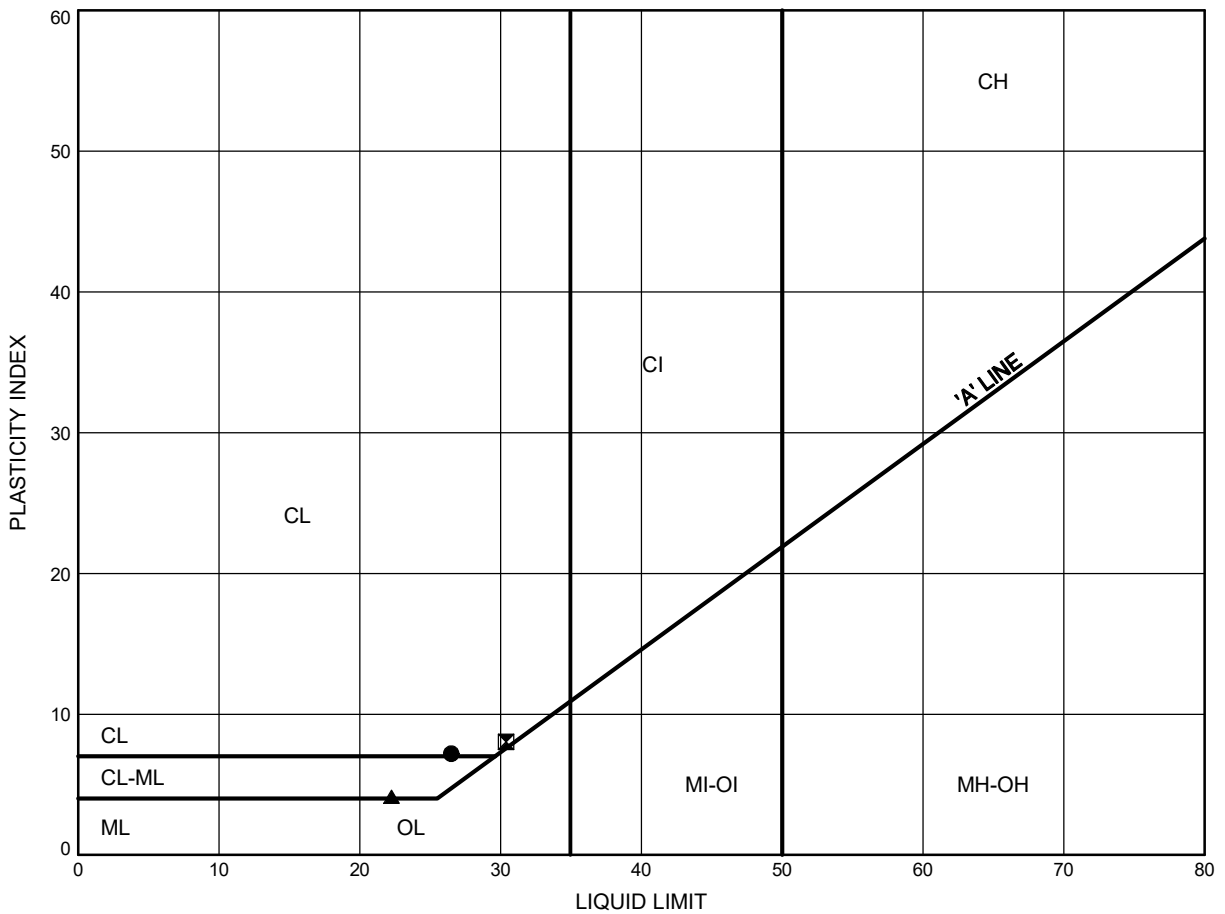
Chkd. KS

# Hwy 118 Soil Nailing

## ATTERBERG LIMITS TEST RESULTS

FIGURE B13

SILT, Some Clay



### LEGEND

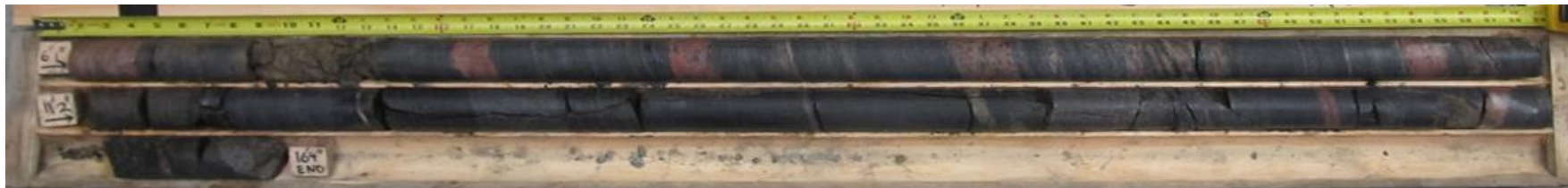
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-04	2.7	314.7
⊠	15-12	1.8	321.8
▲	15-17	1.8	320.7

Date September 2017  
W.P. 5339-11-00



Prep'd MFA  
Chkd. KS

BOREHOLE: 15-01  
CORE RUN #1: 6' 1" – 11' 2"  
CORE RUN #2: 11' 2" – 16' 4"



BOREHOLE: 15-02  
CORE RUN #1: 16' 2" – 21' 4"  
CORE RUN #2: 21' 4" – 26' 4"



BOREHOLE:               **15-03**  
CORE RUN #1:         20' 7" – 25' 8"  
CORE RUN #2:         25' 8" – 29'  
CORE RUN #3:         29' – 30' 11"



**HIGHWAY 118 SLOPE STABILIZATION**  
**0.5 km NORTH OF HALIBURTON COUNTY ROAD 21**  
**HALIBURTON, ON**



BOREHOLE:               **15-05**  
CORE RUN #1:       12' 2" – 15'  
CORE RUN #2:       15' – 18' 6"  
CORE RUN #3:       18' 6" – 23' 7"



BOREHOLE:               **15-06**  
CORE RUN #1:       21' 6" – 26' 6"  
CORE RUN #2:       26' 6" – 31' 8"



BOREHOLE: **15-08**  
CORE RUN #1: 17' – 18' 6"  
CORE RUN #2: 18' 6" – 23'  
CORE RUN #3: 23' – 25'  
CORE RUN #4: 25' – 28' 9"  
CORE RUN #5: 28' 9" – 31' 9"



BOREHOLE: **15-09**  
CORE RUN #1: 23' 1" – 27' 7"  
CORE RUN #2: 27' 7" – 31' 1"  
CORE RUN #3: 31' 1" – 35' 7"



BOREHOLE: 15-11  
CORE RUN #1: 24' 10" – 29' 10"  
CORE RUN #2: 29' 10" – 35'



BOREHOLE: 15-12  
CORE RUN #1: 18' 5" – 23' 5"  
CORE RUN #2: 23' 5" – 28' 7"



HIGHWAY 118 SLOPE STABILIZATION  
0.5 km NORTH OF HALIBURTON COUNTY ROAD 21  
HALIBURTON, ON

BOREHOLE:               **15-14**  
CORE RUN #1:       18' – 23' 1"  
CORE RUN #2:       23' 1" – 28' 1"



BOREHOLE:               **15-15**  
CORE RUN #1:       10' 11" – 13' 8"  
CORE RUN #2:       13' 8" – 17'  
CORE RUN #3:       17' – 18' 6"  
CORE RUN #4:       18' 6" – 23' 5"





BOREHOLE: **15-16**  
CORE RUN #1: 13' 10" – 18'  
CORE RUN #2: 18' – 23' 1"



BOREHOLE: **15-17**  
CORE RUN #1: 18' – 23' 2"  
CORE RUN #2: 23' 2" – 28' 3"



**THURBER** ENGINEERING LTD.**POINT LOAD TEST SHEET**

Job No : 19-6887-0

Client : LVM-Merlex Division of EnGlobe Corp.

Project Name : Hwy 118 Soil Nailing

Date Drilled 02-Nov-15

Core Size : NQ BH No : BH 15-01

Date Tested 06-Nov-15

Tester : BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	1	1.9	D	9.5	47.2	84.1	3.9	Granitic Gneiss	Strong
2	1	1.9	A	19.7	47.2	48.5	6.6	Granitic Gneiss	Very Strong
3	1	1.9	D	12.9	47.3	95.7	5.3	Granitic Gneiss	Very Strong
4	1	1.8	A	22.0	47.3	48.1	7.4	Granitic Gneiss	Very Strong
5	1	2.6	D	11.0	47.3	117.7	4.6	Granitic Gneiss	Strong
6	1	2.5	A	22.8	47.3	43.7	8.3	Granitic Gneiss	Very Strong
7	2	4.6	D	7.9	47.3	106.9	3.3	Granitic Gneiss	Strong
8	2	4.6	A	24.5	47.3	51.5	7.9	Granitic Gneiss	Very Strong
9									
10									
11									
12									
13									
14									
15									
16									
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31									
32									
33									

\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER ENGINEERING LTD.****POINT LOAD TEST SHEET****Job No :** 19-6887-0**Client :** LVM-Merlex Division of EnGlobe Corp.**Project Name :** Hwy 118 Soil Nailing**Date Drilled** 02-Nov-15**Core Size :** NQ **BH No :** BH 15-02**Date Tested** 06-Nov-15**Tester :** BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	1	5.3	D	5.6	47.1	86.5	2.3	Granitic Gneiss	Medium Strong
2	1	5.3	A	12.6	47.1	46.6	4.4	Granitic Gneiss	Strong
3	1	6.0	D	11.4	47.2	80.0	4.7	Granitic Gneiss	Strong
4	1	6.0	A	23.8	47.2	51.2	7.7	Granitic Gneiss	Very Strong
5	2	6.9	D	12.5	47.3	90.2	5.2	Granitic Gneiss	Very Strong
6	2	6.9	A	25.0	47.3	44.3	9.0	Granitic Gneiss	Very Strong
7	2	7.7	D	13.1	47.3	94.0	5.4	Granitic Gneiss	Very Strong
8	2	7.7	A	22.6	47.3	47.0	7.8	Granitic Gneiss	Very Strong
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									

\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER** ENGINEERING LTD.**POINT LOAD TEST SHEET**

Job No : 19-6887-0

Client : LVM-Merlex Division of EnGlobe Corp.

Project Name : Hwy 118 Soil Nailing

Date Drilled 03-Nov-15

Core Size : NQ BH No : BH 15-03

Date Tested 05-Nov-15

Tester : BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	1	6.3	D	8.8	47.0	86.3	3.7	Granitic Gneiss	Strong
2	1	6.4	A	9.4	47.0	45.7	3.3	Granitic Gneiss	Strong
3	1	6.9	D	8.8	47.3	84.4	3.6	Granitic Gneiss	Strong
4	1	6.9	A	23.0	47.3	49.8	7.6	Granitic Gneiss	Very Strong
5	1	7.5	D	7.0	47.3	87.1	2.9	Granitic Gneiss	Strong
6	1	7.6	A	21.1	47.3	45.7	7.4	Granitic Gneiss	Very Strong
7	2	8.4	D	8.7	47.3	89.1	3.6	Granitic Gneiss	Strong
8	2	8.5	A	16.4	47.3	43.9	6.0	Granitic Gneiss	Very Strong
9	3	9.2	D	11.1	47.3	82.0	4.6	Granitic Gneiss	Strong
10	3	9.2	A	20.5	47.3	43.3	7.5	Granitic Gneiss	Very Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.



**THURBER ENGINEERING LTD.****POINT LOAD TEST SHEET****Job No :** 19-6887-0**Client :** LVM-Merlex Division of EnGlobe Corp.**Project Name :** Hwy 118 Soil Nailing**Date Drilled** 30-Oct-15**Core Size :** NQ **BH No :** BH 15-05**Date Tested** 02-Nov-15**Tester :** RMT/WHW

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	1	3.9	A	19.0	47.4	49.3	6.3	Granitic Gneiss	Very Strong
2	1	3.9	D	4.8	47.3	87.9	2.0	Granitic Gneiss	Medium Strong
3	2	4.8	A	8.6	47.3	48.0	2.9	Granitic Gneiss	Strong
4	2	4.8	D	11.1	47.4	118.5	4.6	Granitic Gneiss	Strong
5	3	5.7	A	20.7	47.4	39.7	8.1	Granitic Gneiss	Very Strong
6	3	5.7	D	10.9	47.4	105.7	4.5	Granitic Gneiss	Strong
7	3	6.2	A	18.4	47.3	44.7	6.6	Granitic Gneiss	Very Strong
8	3	6.3	D	8.3	47.4	92.9	3.4	Granitic Gneiss	Strong
9	3	6.9	A	21.2	47.3	48.4	7.1	Granitic Gneiss	Very Strong
10	3	6.9	D	9.1	47.4	99.4	3.7	Granitic Gneiss	Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER** ENGINEERING LTD.**POINT LOAD TEST SHEET**

Job No : 19-6887-0

Client : LVM-Merlex Division of EnGlobe Corp.

Date Drilled 04-Nov-15

Project Name : Hwy 118 Soil Nailing

Date Tested 06-Nov-15

Core Size : NQ BH No : BH 15-06

Tester : BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>S(50)</sub> (MPa)	Rock Type	Notes
1	1	6.9	D	9.0	47.3	109.6	3.7	Granitic Gneiss	Strong
2	1	6.9	A	21.3	47.3	50.8	6.9	Granitic Gneiss	Very Strong
3	1	7.5	D	8.4	47.3	114.3	3.5	Granitic Gneiss	Strong
4	1	7.5	A	8.6	47.3	51.5	2.8	Granitic Gneiss	Strong
5	2	8.1	D	9.4	47.3	95.1	3.9	Granitic Gneiss	Strong
6	2	8.1	A	24.1	47.3	43.9	8.8	Granitic Gneiss	Very Strong
7	2	8.8	D	10.8	47.3	91.9	4.4	Granitic Gneiss	Strong
8	2	8.8	A	19.3	47.3	53.0	6.1	Granitic Gneiss	Very Strong
9	2	9.6	D	7.1	47.2	79.2	3.0	Granitic Gneiss	Strong
10	2	9.6	A	21.3	47.3	45.3	7.6	Granitic Gneiss	Very Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.



**THURBER** ENGINEERING LTD.

## POINT LOAD TEST SHEET

Job No : 19-6887-0

Client : LVM-Merlex Division of EnGlobe Corp.

Project Name : Hwy 118 Soil Nailing

Date Drilled 29-Oct-15

Core Size : NQ-HQ BH No : BH 15-08

Date Tested 02-Nov-15

Tester : RMT/WHW

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	3	7.1	A	19.1	47.5	57.0	5.6	Granitic Gneiss	Very Strong
2	4	8.0	A	33.3	62.9	54.9	8.1	Granitic Gneiss	Very Strong
3	4	8.1	A	35.0	62.9	52.4	8.9	Granitic Gneiss	Very Strong
4	5	8.9	A	35.0	62.9	61.0	7.9	Granitic Gneiss	Very Strong
5	5	9.1	A	29.3	62.8	46.3	8.2	Granitic Gneiss	Very Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER ENGINEERING LTD.****POINT LOAD TEST SHEET****Job No :** 19-6887-0**Client :** LVM-Merlex Division of EnGlobe Corp.**Project Name :** Hwy 118 Soil Nailing**Date Drilled** 03-Nov-15**Core Size :** NQ **BH No :** BH 15-09**Date Tested** 05-Nov-15**Tester :** BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	1	7.2	D	8.4	47.1	115.0	3.5	Granitic Gneiss	Strong
2	1	7.2	A	20.7	47.1	53.4	6.5	Granitic Gneiss	Very Strong
3	1	7.8	D	15.7	47.3	106.5	6.5	Granitic Gneiss	Very Strong
4	1	7.8	A	22.4	47.3	51.0	7.2	Granitic Gneiss	Very Strong
5	2	8.7	D	13.6	47.3	115.2	5.6	Granitic Gneiss	Very Strong
6	2	8.8	A	22.8	47.3	41.1	8.7	Granitic Gneiss	Very Strong
7	2	9.3	D	6.2	47.3	89.0	2.6	Granitic Gneiss	Strong
8	2	9.4	A	20.6	47.3	44.5	7.4	Granitic Gneiss	Very Strong
9	3	10.0	D	9.5	47.4	89.4	3.9	Granitic Gneiss	Strong
10	3	10.0	A	21.6	47.4	43.0	8.0	Granitic Gneiss	Very Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.



**THURBER** ENGINEERING LTD.

## POINT LOAD TEST SHEET

**Job No :** 19-6887-0 **Client :** LVM-Merlex Division of EnGlobe Corp.  
**Date Drilled** 27-Oct-15  
**Project Name :** Hwy 118 Soil Nailing **Date Tested** 02-Nov-15  
**Core Size :** NQ **BH No :** BH 15-11 **Tester :** RMT/WHW

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	1	7.8	A	13.6	47.5	47.6	4.6	Granitic Gneiss	Strong
2	1	7.8	D	8.8	47.5	80.1	3.6	Granitic Gneiss	Strong
3	1	8.6	A	15.8	47.6	43.7	5.7	Granitic Gneiss	Very Strong
4	1	8.7	D	9.2	47.7	60.9	3.7	Granitic Gneiss	Strong
5	2	9.6	A	12.5	47.6	41.4	4.7	Granitic Gneiss	Strong
6	2	9.7	D	8.3	47.6	65.8	3.4	Granitic Gneiss	Strong
7	2	10.1	D	9.2	47.5	91.9	3.8	Granitic Gneiss	Strong
8	2	10.2	A	20.0	47.5	48.7	6.7	Granitic Gneiss	Very Strong
9	2	10.5	A	22.2	47.6	45.5	7.8	Granitic Gneiss	Very Strong
10	2	10.6	D	7.2	47.5	77.8	2.9	Granitic Gneiss	Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER** ENGINEERING LTD.**POINT LOAD TEST SHEET**

Job No : 19-6887-0

Client : LVM-Merlex Division of EnGlobe Corp.

Project Name : Hwy 118 Soil Nailing

Date Drilled 04-Nov-15

Core Size : NQ BH No : BH 15-12

Date Tested 06-Nov-15

Tester : BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	1	5.9	D	9.8	47.3	75.1	4.1	Granitic Gneiss	Strong
2	1	5.8	A	19.0	47.3	44.7	6.8	Granitic Gneiss	Very Strong
3	1	6.4	D	10.5	47.3	117.8	4.4	Granitic Gneiss	Strong
4	1	6.4	A	15.3	47.3	46.3	5.3	Granitic Gneiss	Very Strong
5	2	7.2	D	8.2	47.3	61.5	3.4	Granitic Gneiss	Strong
6	2	7.2	A	18.6	47.3	41.8	7.0	Granitic Gneiss	Very Strong
7	2	7.8	D	9.0	47.4	80.8	3.7	Granitic Gneiss	Strong
8	2	7.8	A	16.9	47.4	47.1	5.8	Granitic Gneiss	Very Strong
9	2	8.7	D	10.0	47.3	103.4	4.1	Granitic Gneiss	Strong
10	2	8.6	A	18.3	47.3	50.1	6.0	Granitic Gneiss	Very Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER ENGINEERING LTD.****POINT LOAD TEST SHEET****Job No :** 19-6887-0**Client :** LVM-Merlex Division of EnGlobe Corp.**Project Name :** Hwy 118 Soil Nailing**Date Drilled** 27-Oct-15**Core Size :** NQ **BH No :** BH 15-14**Date Tested** 02-Nov-15**Tester :** RMT/WHW

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>S(50)</sub> (MPa)	Rock Type	Notes
1	1	5.8	A	13.5	47.4	40.3	5.2	Granitic Gneiss	Very Strong
2	1	5.9	D	11.6	47.4	103.5	4.8	Granitic Gneiss	Strong
3	1	6.7	D	9.3	47.4	70.8	3.8	Granitic Gneiss	Strong
4	1	6.8	A	2.5	47.4	32.1	1.2	Granitic Gneiss	Weak
5	2	7.2	D	1.9	47.4	69.2	0.8	Granitic Gneiss	Weak
6	2	7.2	A	15.1	47.4	52.2	4.8	Granitic Gneiss	Strong
7	2	8.1	D	10.3	47.4	86.1	4.3	Granitic Gneiss	Strong
8	2	8.2	A	19.3	47.4	52.6	6.1	Granitic Gneiss	Very Strong
9	2	8.4	D	5.9	47.4	95.6	2.4	Granitic Gneiss	Medium Strong
10	2	8.5	A	17.0	47.4	47.3	5.8	Granitic Gneiss	Very Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER** ENGINEERING LTD.**POINT LOAD TEST SHEET**

Job No : 19-6887-0

Client : LVM-Merlex Division of EnGlobe Corp.

Project Name : Hwy 118 Soil Nailing

Date Drilled 27-Oct-15

Core Size : NQ BH No : BH 15-15

Date Tested 02-Nov-15

Tester : RMT/WHW

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	Rock Type	Notes
1	1	3.4	D	10.2	47.5	54.6	4.2	Granitic Gneiss	Strong
2	1	3.5	A	9.4	47.6	32.5	4.3	Granitic Gneiss	Strong
3	3	5.3	D	10.8	47.5	57.9	4.4	Granitic Gneiss	Strong
4	3	5.3	A	23.1	47.6	39.1	9.1	Granitic Gneiss	Very Strong
5	4	6.5	A	22.2	47.8	51.1	7.1	Granitic Gneiss	Very Strong
6	4	6.5	D	10.5	47.5	76.6	4.3	Granitic Gneiss	Strong
7	4	7.0	A	19.3	47.4	63.6	5.3	Granitic Gneiss	Very Strong
8	4	7.1	D	2.8	47.5	54.9	1.1	Granitic Gneiss	Weak
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.



**THURBER ENGINEERING LTD.****POINT LOAD TEST SHEET****Job No :** 19-6887-0**Client :** LVM-Merlex Division of EnGlobe Corp.**Project Name :** Hwy 118 Soil Nailing**Date Drilled** 26-Oct-15**Core Size :** NQ **BH No :** BH 15-16**Date Tested** 02-Nov-15**Tester :** RMT/WHW

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>S(50)</sub> (MPa)	Rock Type	Notes
1	1	5.4	D	4.0	47.6	60.4	1.6	Granitic Gneiss	Medium Strong
2	1	5.5	A	10.8	47.6	48.2	3.6	Granitic Gneiss	Strong
3	2	5.7	D	14.7	47.6	68.9	6.0	Granitic Gneiss	Very Strong
4	2	5.8	A	23.3	47.6	47.0	8.0	Granitic Gneiss	Very Strong
5	2	6.4	D	11.6	47.6	56.9	4.7	Granitic Gneiss	Strong
6	2	6.5	A	21.2	47.6	51.0	6.8	Granitic Gneiss	Very Strong
7	2	6.7	D	17.8	47.6	71.6	7.3	Granitic Gneiss	Very Strong
8	2	6.8	A	23.7	47.6	48.8	7.9	Granitic Gneiss	Very Strong
9	2	6.9	D	11.1	47.6	44.7	4.5	Granitic Gneiss	Strong
10	2	7.0	A	12.6	47.6	39.7	4.9	Granitic Gneiss	Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER** ENGINEERING LTD.**POINT LOAD TEST SHEET**

Job No : 19-6887-0

Client : LVM-Merlex Division of EnGlobe Corp.

Project Name : Hwy 118 Soil Nailing

Date Drilled 04-Nov-15

Core Size : NQ BH No : BH 15-17

Date Tested 06-Nov-15

Tester : BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I <sub>s(50)</sub> (MPa)	Rock Type	Notes
1	1	5.5	D	8.4	47.3	103.8	3.5	Granitic Gneiss	Strong
2	1	5.5	A	20.8	47.3	47.4	7.1	Granitic Gneiss	Very Strong
3	1	6.1	D	6.8	47.4	93.0	2.8	Granitic Gneiss	Strong
4	1	6.1	A	22.8	47.4	47.0	7.8	Granitic Gneiss	Very Strong
5	1	6.8	D	14.4	47.3	96.8	6.0	Granitic Gneiss	Very Strong
6	1	6.7	A	18.7	47.3	47.2	6.4	Granitic Gneiss	Very Strong
7	2	7.5	D	11.9	47.4	103.9	4.9	Granitic Gneiss	Strong
8	2	7.5	A	25.3	47.4	51.3	8.1	Granitic Gneiss	Very Strong
9	2	8.1	D	11.3	47.3	74.5	4.7	Granitic Gneiss	Strong
10	2	8.1	A	15.0	47.3	40.3	5.8	Granitic Gneiss	Very Strong
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\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$ 

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

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## **Appendix C**

### **Selected Site Photographs**



**Photo 1: Area 1 – Highway 118 Looking North  
Significant Tension Cracks traversing entire roadway (April 2014)  
(Courtesy of AECOM)**





**Photo 2: Area 1 – Highway 118 Looking North**



**Photo 3: Area 1 – Looking East – Transverse Cracks (Rock Cut in Background)**



**Photo 4: Area 1 – Highway 118 Looking South – Longitudinal Cracks on Shoulder**



**Photo 5: Area 2 – Looking South – Longitudinal Crack and Sagging Guardrail**





**Photo 6: Area 2 – Highway 118 Looking North – Steep West Slope (Lakeside)**



**Photo 7: Area 2/3 – Highway 118 Looking North - Tilted Hydro Pole on Slope**



**Photo 8: Area 3 – Looking North – West Slope**



**Photo 9: Area 3 – Looking South – West Slope**





## **Appendix D**

### **Borehole Locations and Soil Strata Drawings**

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No 5014-E-0004  
WP No 5339-11-00



HIGHWAY 118  
SLOPE REHABILITATION  
BOREHOLE LOCATIONS PLAN

SHEET



KEYPLAN

LEGEND

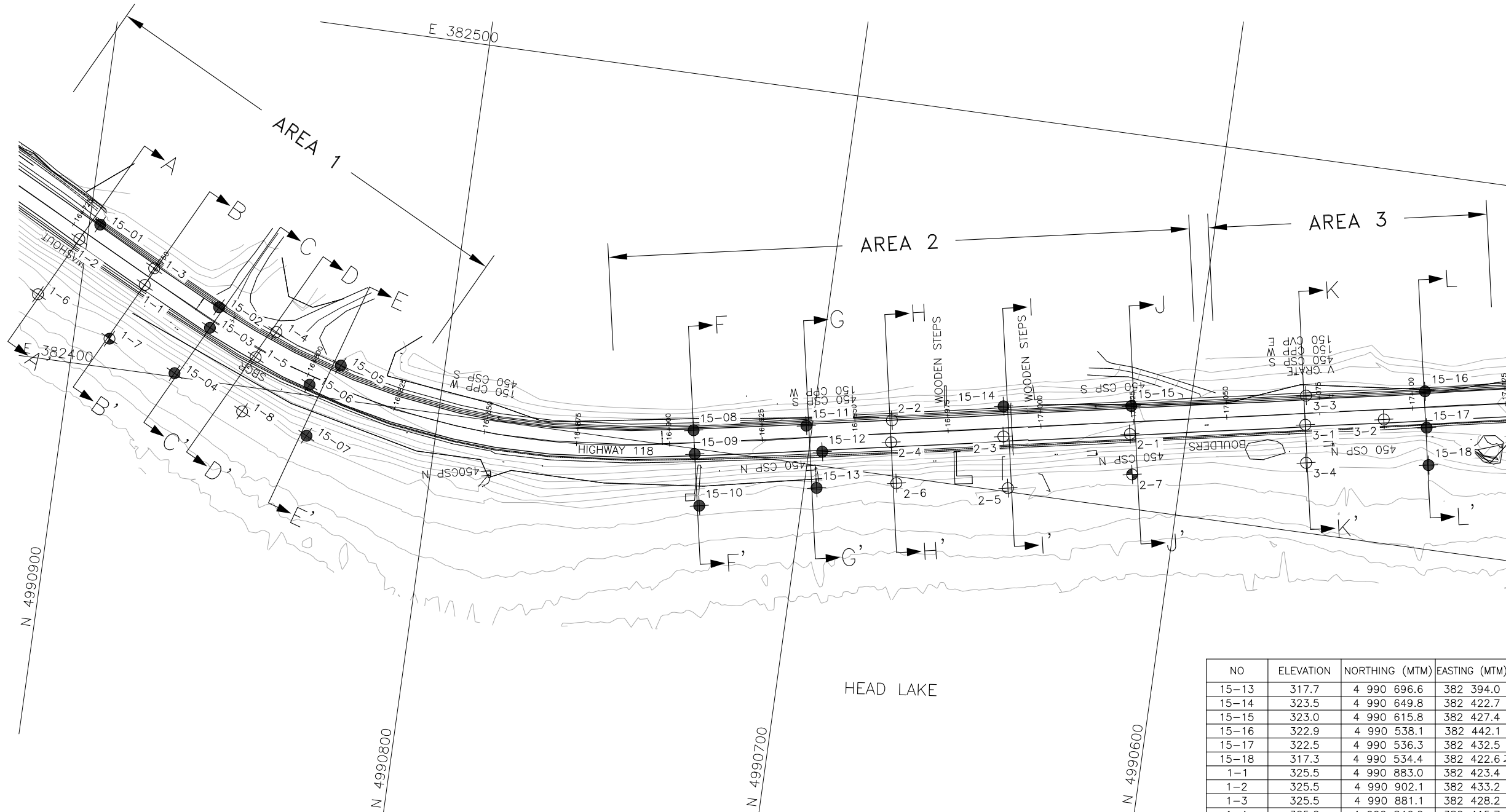
- Borehole by Thurber
- Borehole by Others
- DCPT by Others
- Blows /0.3m (Std Pen Test, 475J/blow)
- Blows /0.3m (60' Cone, 475J/blow)
- Water Level During Drilling
- Water Level In
- Piezometer
- 90% Rock Quality Designation (RQD)
- Auger Refusal

NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
15-01	325.7	4 990 897.1	382 437.9
15-02	325.5	4 990 862.4	382 420.2
15-03	325.5	4 990 864.0	382 414.4
15-04	317.7	4 990 871.8	382 401.0
15-05	325.0	4 990 827.8	382 409.1
15-06	325.3	4 990 835.4	382 402.9
15-07	317.7	4 990 834.4	382 389.2
15-08	324.3	4 990 731.5	382 404.9
15-09	324.3	4 990 730.3	382 398.6
15-10	317.7	4 990 727.2	382 385.0
15-11	324.3	4 990 701.6	382 410.2
15-12	323.6	4 990 696.4	382 403.9

NOTES

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31E-369



PLAN



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	ME	CHK KS	CODE
DRAWN	MFA	CHK ME	SITE
			LOAD
			STRUCT
			FIGURE D1
			DATE DEC 2017

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No 5014-E-0004  
WP No 5339-11-00

HIGHWAY 118  
SLOPE REHABILITATION  
SECTIONS - AREA 1  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

- Borehole by Thurber
- Borehole by Others
- DCPT by Others
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- Water Level During Drilling
- Water Level In
- Piezometer
- 90% Rock Quality Designation (RQD)
- Auger Refusal

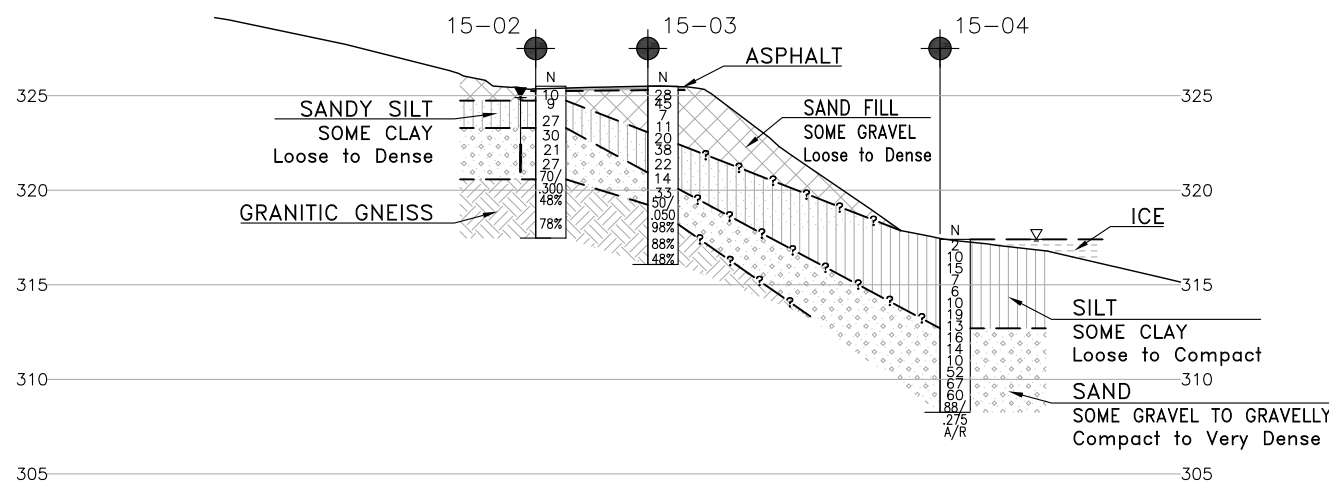
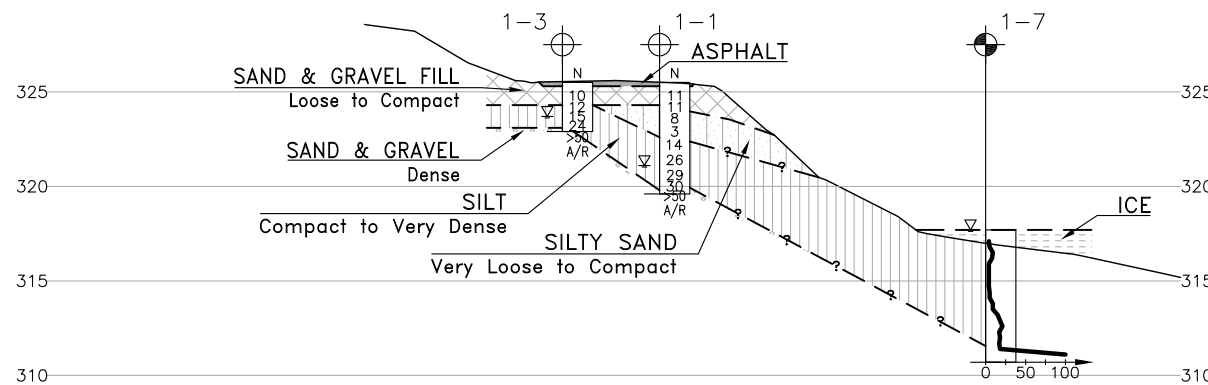
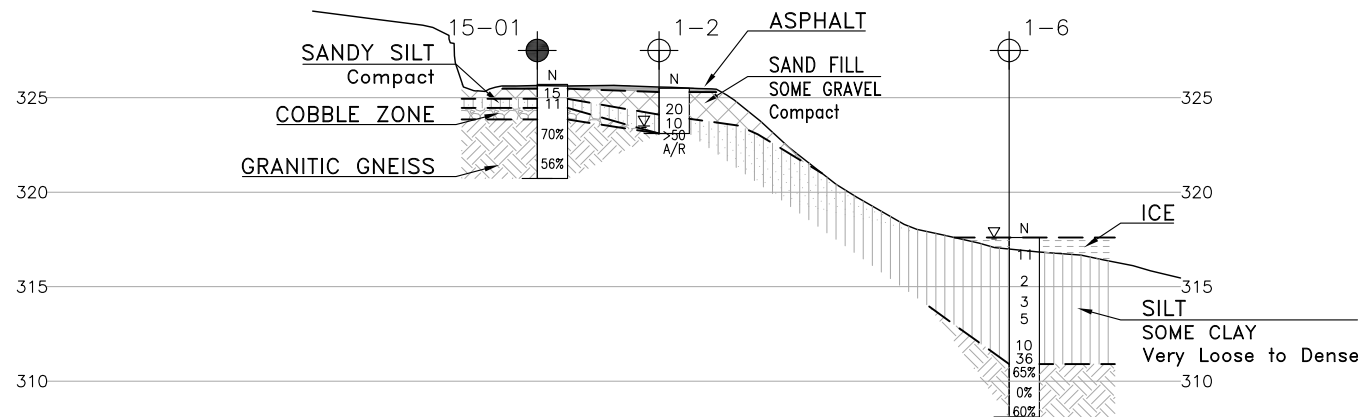
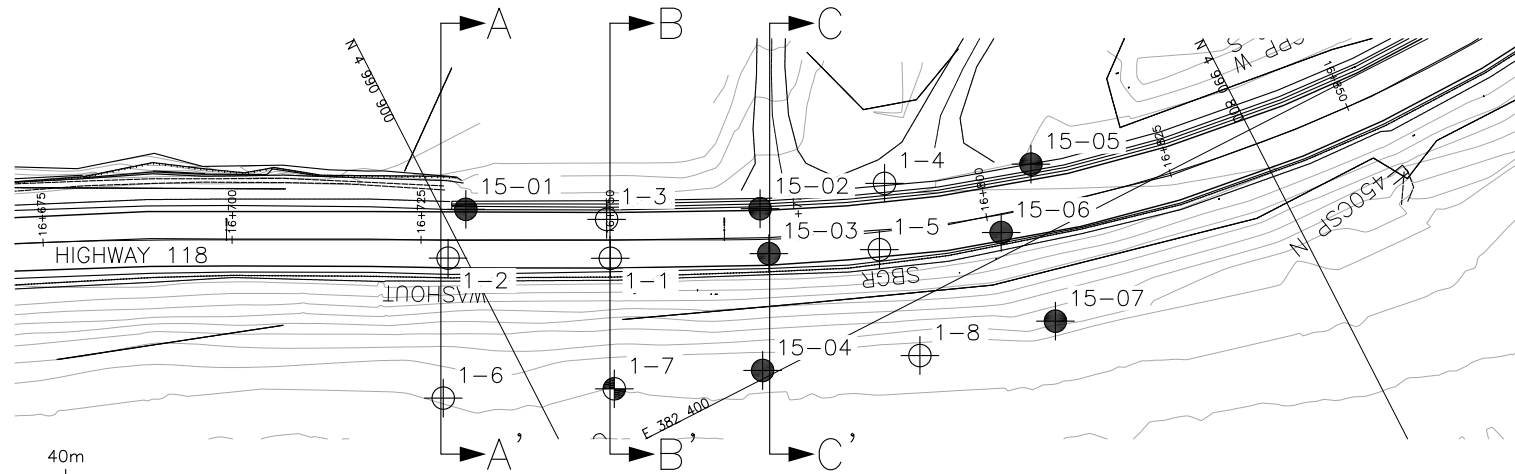
NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
15-01	325.7	4 990 897.1	382 437.9
15-02	325.5	4 990 862.4	382 420.2
15-03	325.5	4 990 864.0	382 414.4
15-04	317.7	4 990 871.8	382 401.0
15-05	325.0	4 990 827.8	382 409.1
15-06	325.3	4 990 835.4	382 402.9
15-07	317.7	4 990 834.4	382 389.2
1-1	325.5	4 990 883.0	382 423.4
1-2	325.5	4 990 902.1	382 433.2
1-3	325.5	4 990 881.1	382 428.2
1-4	325.2	4 990 846.2	382 415.7
1-5	325.3	4 990 850.8	382 408.2

-NOTES-

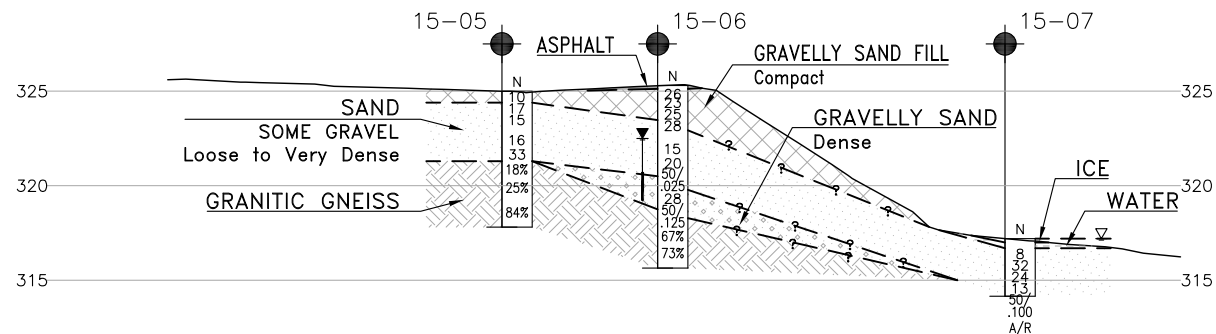
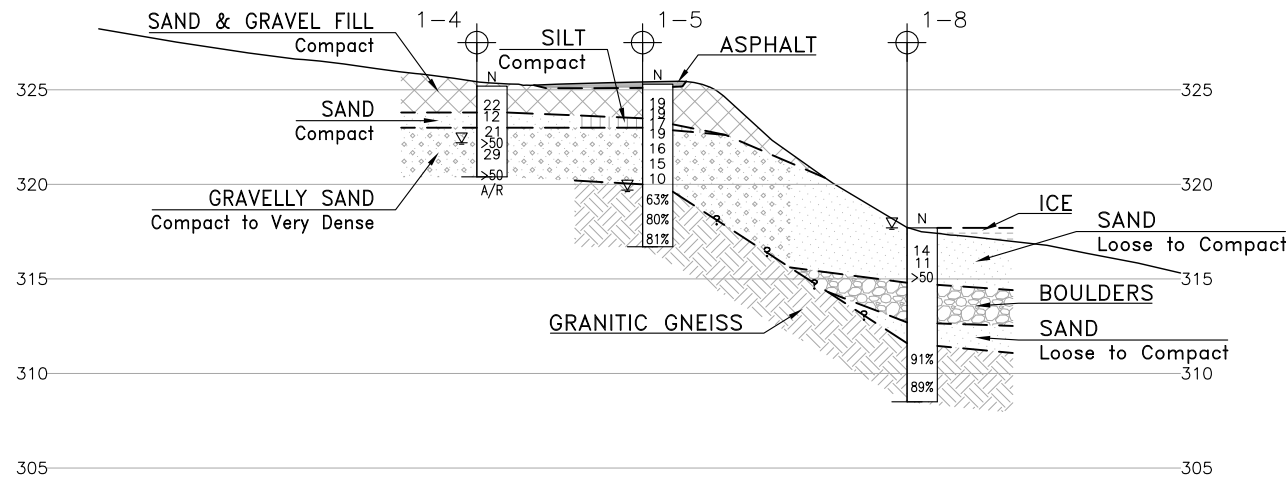
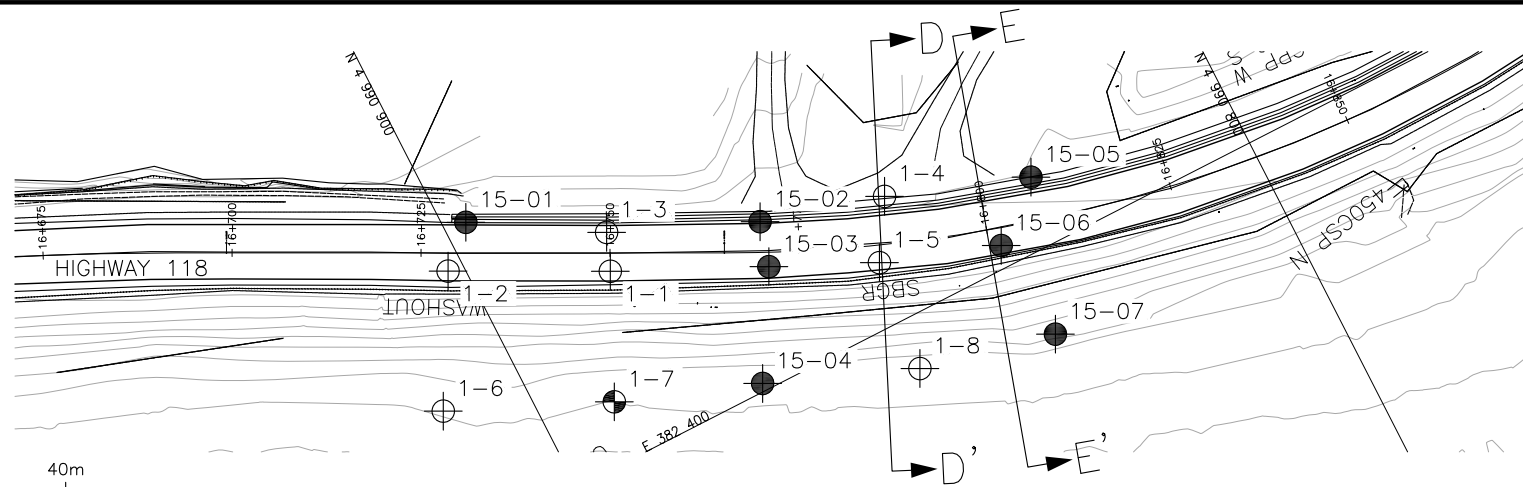
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GEOCRES No. 31E-369

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	ME	CHK KS	CODE LOAD DATE DEC 2017
DRAWN	MFA	CHK ME	SITE STRUCTURE FIGURE D2







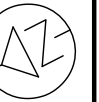
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1-6	317.6	4 990 911.1	382 417.0
1-7	317.7	4 990 890.4	382 407.8
1-8	317.7	4 990 852.4	382 393.3

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
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CONT No 5014-E-0004  
WP No 5339-11-00

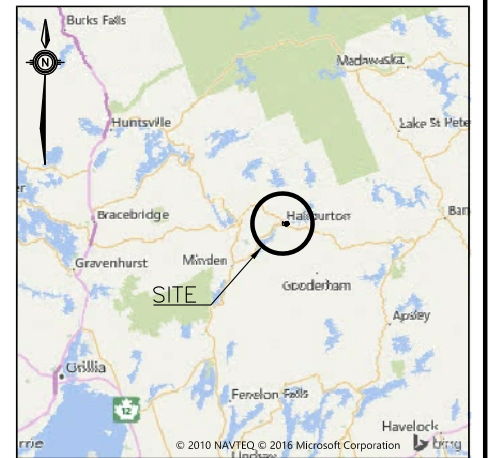
HIGHWAY 118  
SLOPE REHABILITATION  
SECTIONS - AREA 1  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

	Borehole by Thurber
	Borehole by Others
	DCPT by Others
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
	Water Level During Drilling
	Water Level In Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
15-01	325.7	4 990 897.1	382 437.9
15-02	325.5	4 990 862.4	382 420.2
15-03	325.5	4 990 864.0	382 414.4
15-04	317.7	4 990 871.8	382 401.0
15-05	325.0	4 990 827.8	382 409.1
15-06	325.3	4 990 835.4	382 402.9
15-07	317.7	4 990 834.4	382 389.2
1-1	325.5	4 990 883.0	382 423.4
1-2	325.5	4 990 902.1	382 433.2
1-3	325.5	4 990 881.1	382 428.2
1-4	325.2	4 990 846.2	382 415.7
1-5	325.3	4 990 850.8	382 408.2

-NOTES-

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GEOCRES No. 31E-369

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	ME	CHK KS	CODE
DRAWN	MFA	CHK ME	SITE
			LOAD
			STRUCT
			FIGURE D3
			DATE DEC 2017

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
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CONT No 5014-E-0004  
WP No 5339-11-00

HIGHWAY 118  
SLOPE REHABILITATION  
SECTIONS - AREA 2  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

- Borehole by Thurber
- Borehole by Others
- DCPT by Others
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- Water Level During Drilling
- Water Level In
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

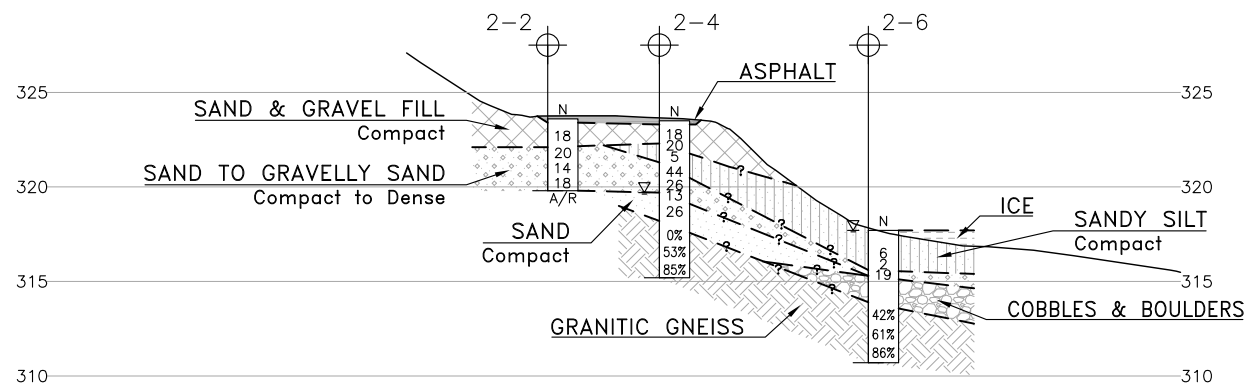
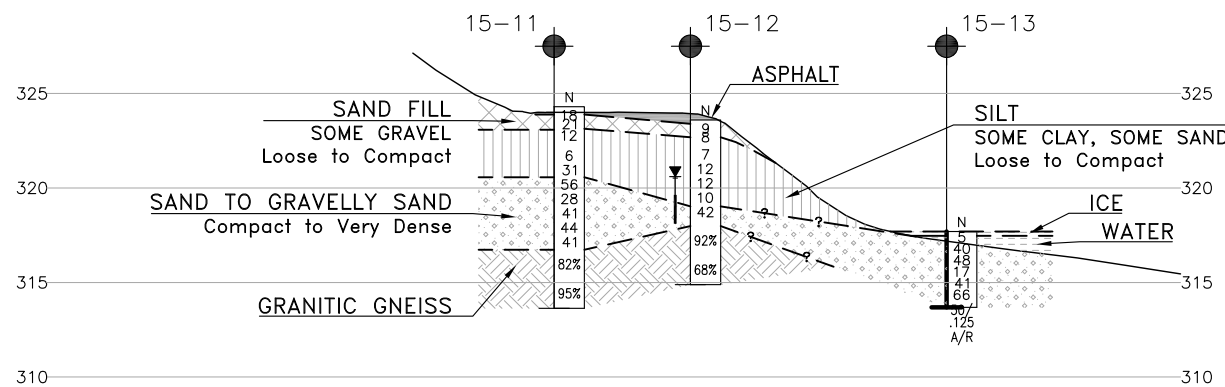
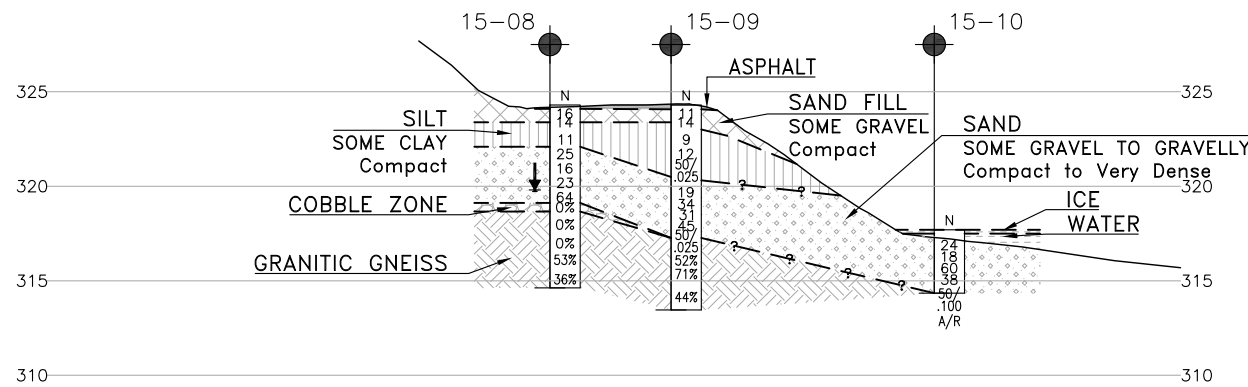
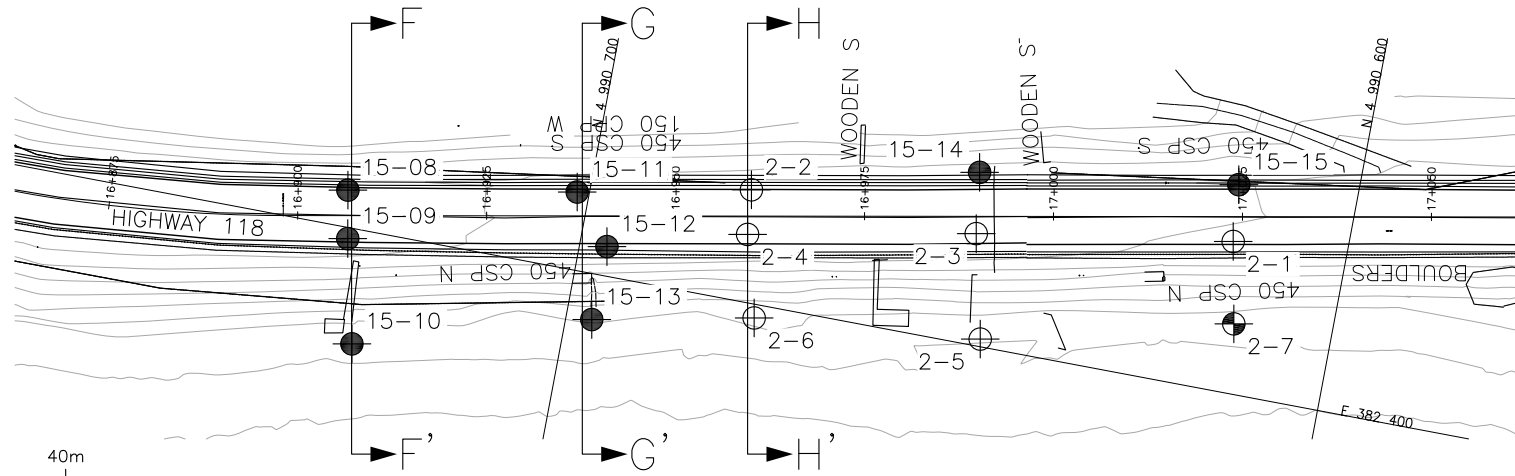
NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
15-08	324.3	4 990 731.5	382 404.9
15-09	324.3	4 990 730.3	382 398.6
15-10	317.7	4 990 727.2	382 385.0
15-11	324.3	4 990 701.6	382 410.2
15-12	323.6	4 990 696.4	382 403.9
15-13	317.7	4 990 696.6	382 394.0
15-14	323.5	4 990 649.8	382 422.7
15-15	323.0	4 990 615.8	382 427.4
2-1	322.9	4 990 615.1	382 419.9
2-2	323.6	4 990 679.0	382 414.8
2-3	323.3	4 990 648.7	382 414.6
2-4	323.5	4 990 678.4	382 408.9

-NOTES-

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GEOCRES No. 31E-369

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	ME	CHK KS	CODE LOAD DATE DEC 2017
DRAWN	MFA	CHK ME	SITE STRUCTURE FIGURE D4



NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
2-5	317.7	4 990 645.6	382 401.0
2-6	317.7	4 990 675.5	382 398.2
2-7	317.7	4 990 613.0	382 409.2

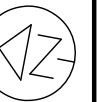


METRIC  
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AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No 5014-E-0004  
WP No 5339-11-00

HIGHWAY 118  
SLOPE REHABILITATION  
SECTIONS - AREA 2  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

- Borehole by Thurber
- Borehole by Others
- DCPT by Others
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- Water Level During Drilling
- Water Level In Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

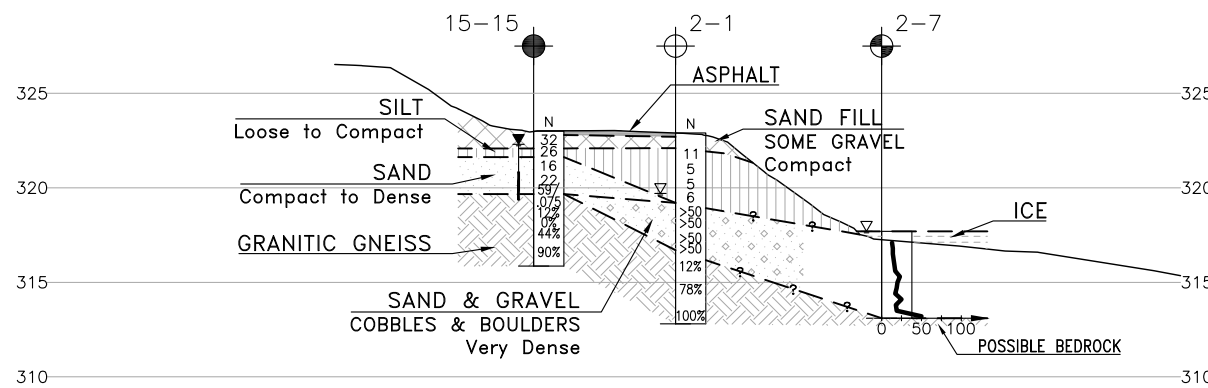
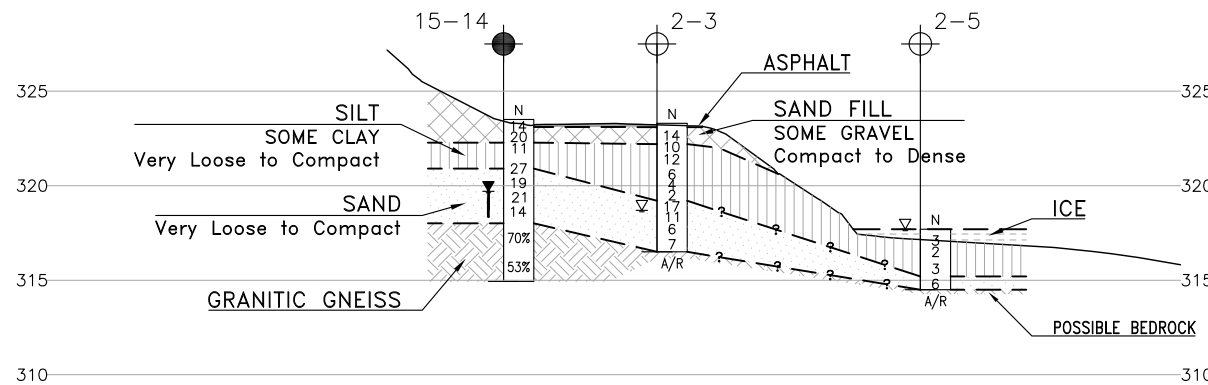
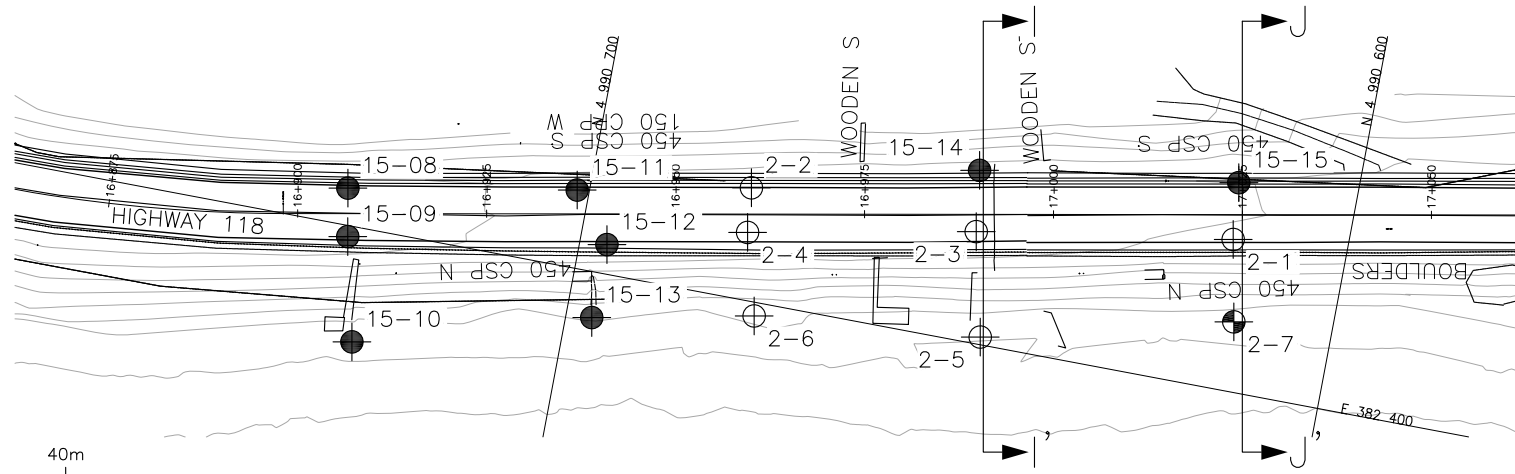
NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
15-08	324.3	4 990 731.5	382 404.9
15-09	324.3	4 990 730.3	382 398.6
15-10	317.7	4 990 727.2	382 385.0
15-11	324.3	4 990 701.6	382 410.2
15-12	323.6	4 990 696.4	382 403.9
15-13	317.7	4 990 696.6	382 394.0
15-14	323.5	4 990 649.8	382 422.7
15-15	323.0	4 990 615.8	382 427.4
2-1	322.9	4 990 615.1	382 419.9
2-2	323.6	4 990 679.0	382 414.8
2-3	323.3	4 990 648.7	382 414.6
2-4	323.5	4 990 678.4	382 408.9

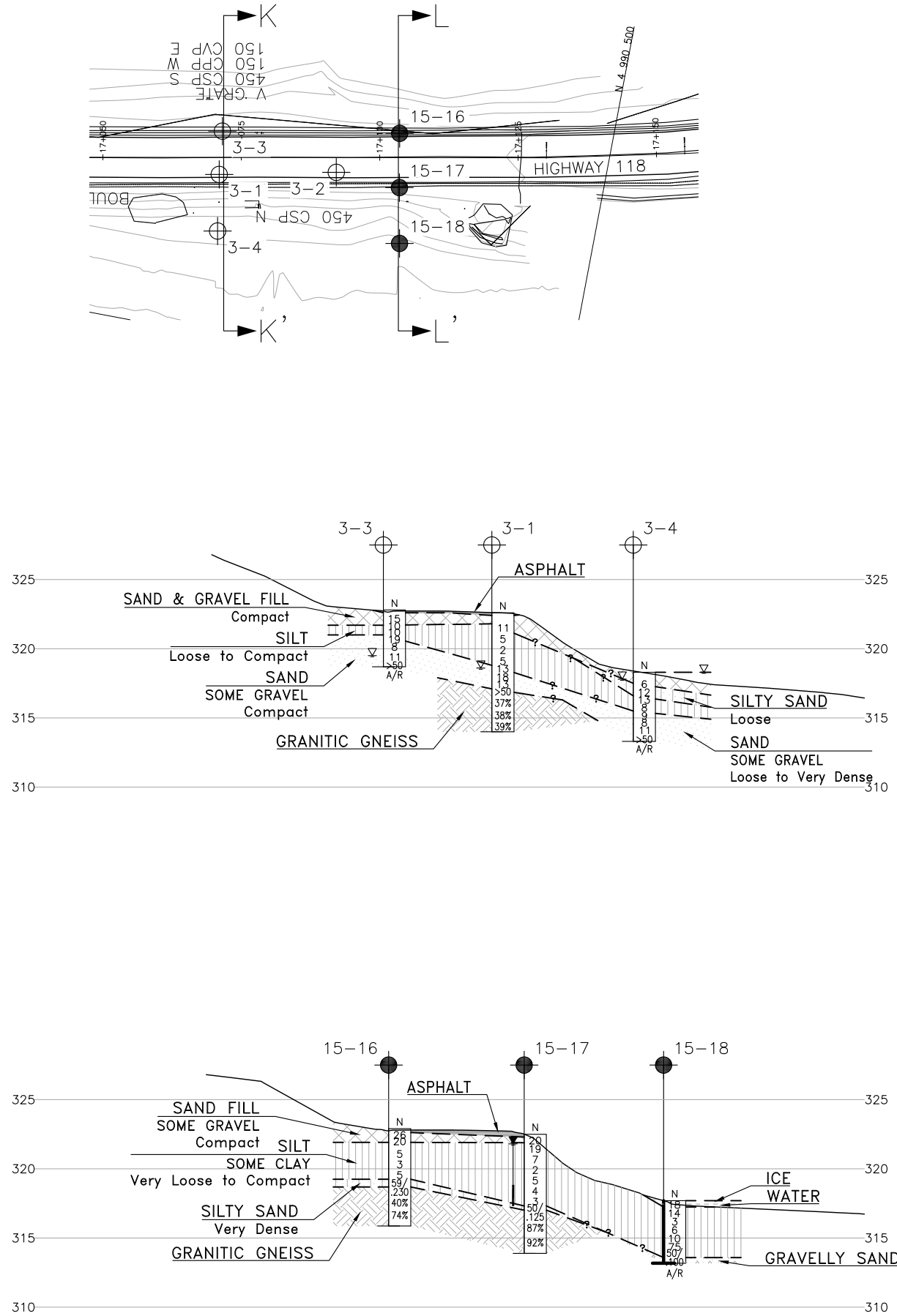
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GEOCRES No. 31E-369

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	ME	CHK KS	CODE LOAD DATE DEC 2017
DRAWN	MFA	CHK ME	SITE STRUCTURE FIGURE D5





METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No 5014-E-0004  
WP No 5339-11-00

HIGHWAY 118  
SLOPE REHABILITATION  
SECTIONS - AREA 3  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

- Borehole by Thurber
- Borehole by Others
- DCPT by Others
- Blows /0.3m (Std Pen Test, 475J/blow)
- Blows /0.3m (60' Cone, 475J/blow)
- Water Level During Drilling
- Water Level In Piezometer
- Rock Quality Designation (RQD)
- Auger Refusal

NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
15-16	322.9	4 990 538.1	382 442.1
15-17	322.5	4 990 536.3	382 432.5
15-18	317.3	4 990 534.4	382 422.6
3-1	322.6	4 990 568.7	382 428.8
3-2	322.7	4 990 548.0	382 433.1
3-3	322.8	4 990 569.6	382 436.6
3-4	318.3	4 990 567.1	382 418.7

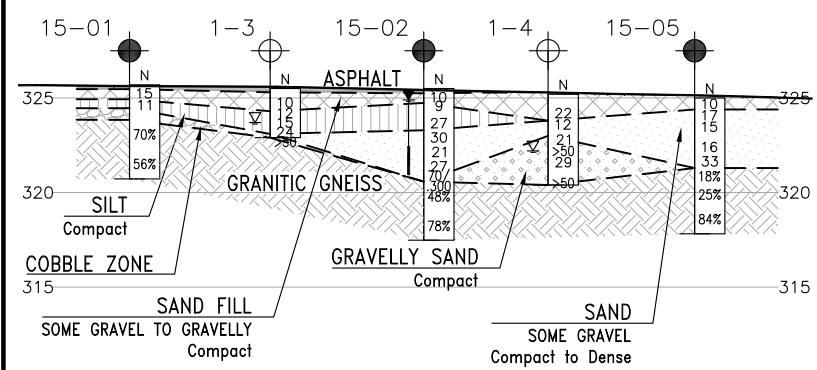
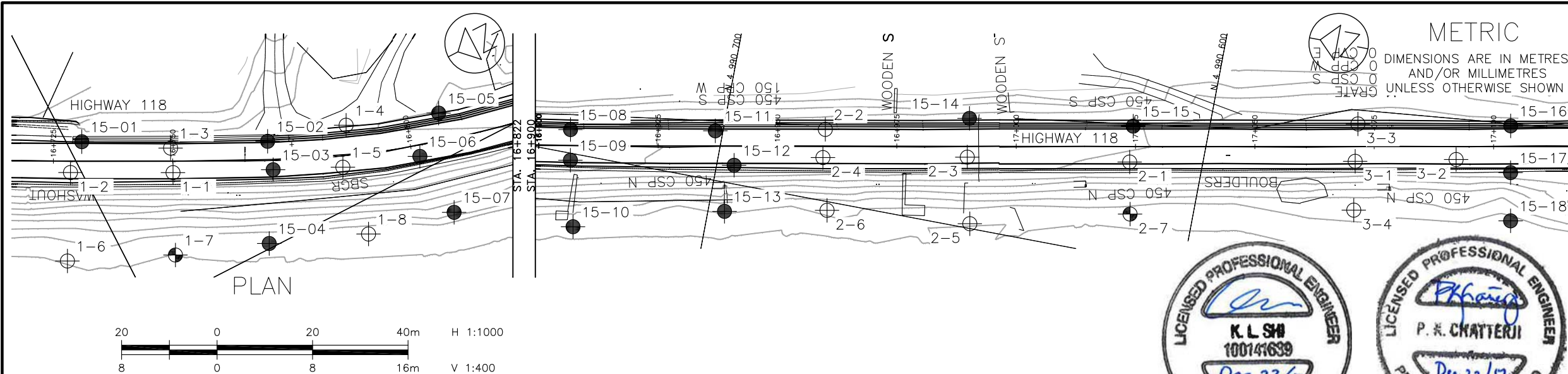
-NOTES-

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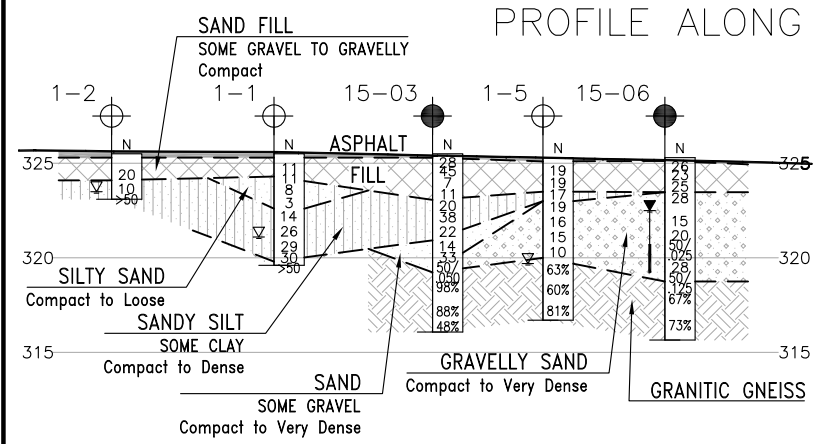
GEOCRES No. 31E-369

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	ME	CHK KS	CODE
DRAWN	MFA	CHK ME	SITE
			LOAD
			STRUCT
			FIGURE D6
			DATE DEC 2017

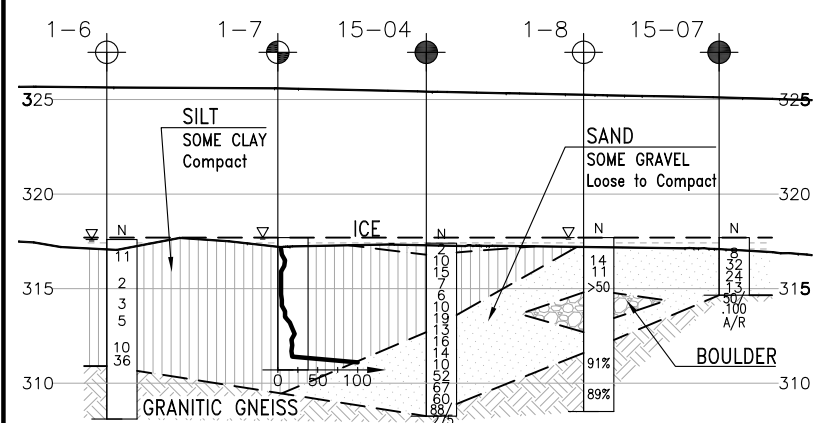




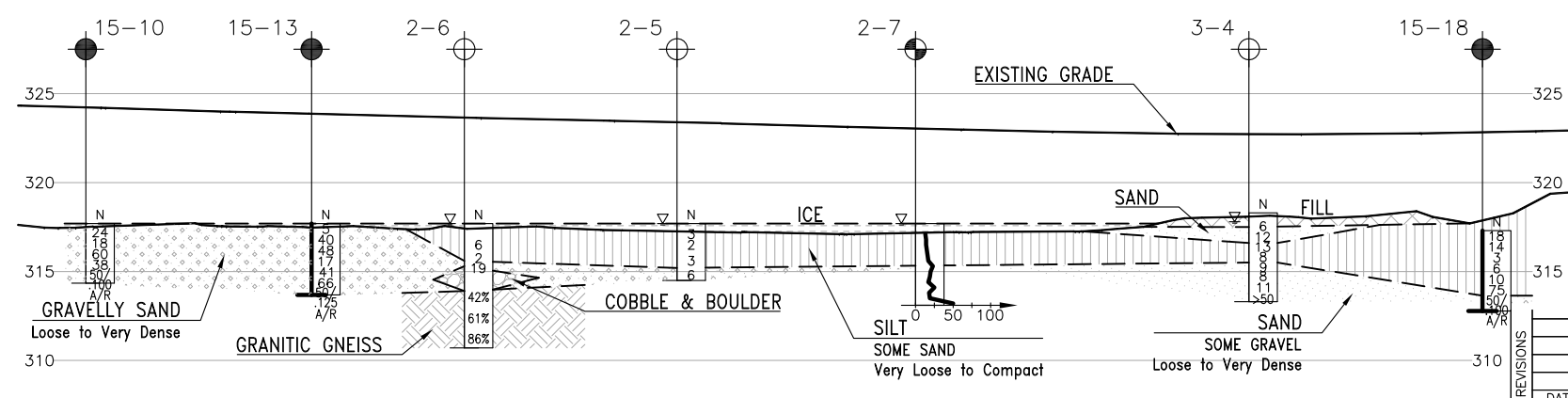
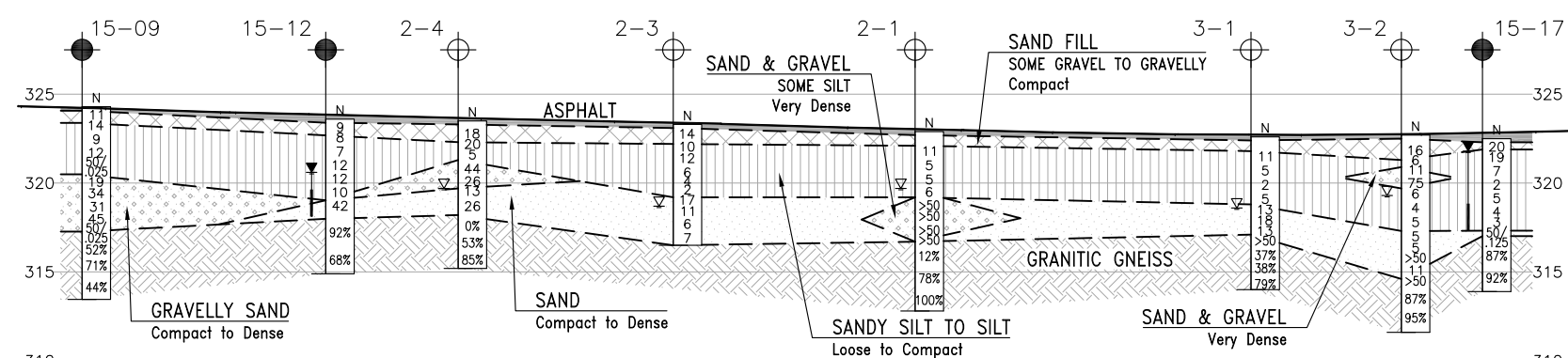
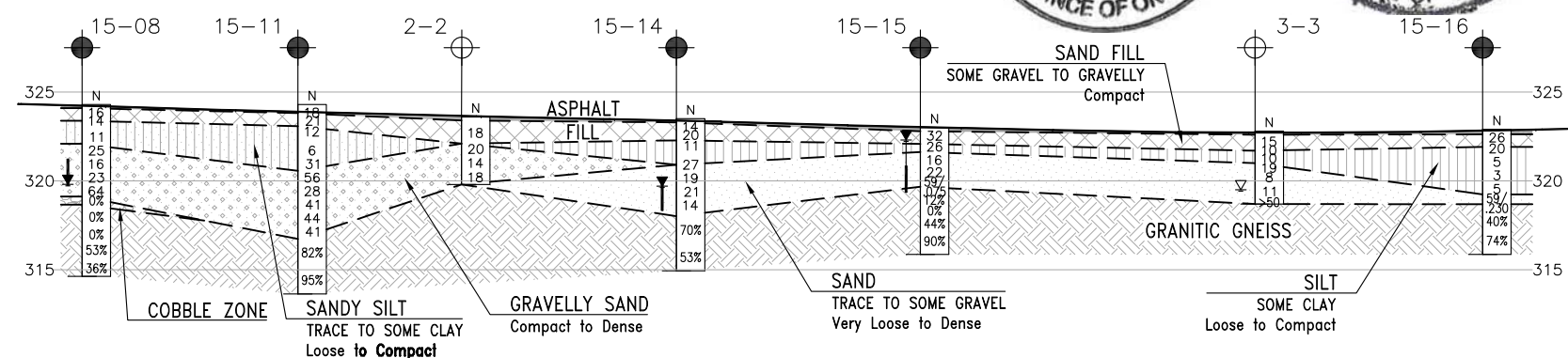
PROFILE ALONG EAST SHOULDER



PROFILE ALONG WEST SHOULDER



PROFILE ALONG TOE OF SLOPE



CONT No 5014-E-0004  
WP No 5339-11-00

HIGHWAY 118  
SLOPE REHABILITATION  
PROFILES  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND

●	Borehole by Thurber
⊕	Borehole by Others
⊙	DCPT by Others
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
▽	Water Level During Drilling
▽	Water Level In
—	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
15-01	325.7	4 990 897.1	382 437.9
15-02	325.5	4 990 862.4	382 420.2
15-03	325.5	4 990 864.0	382 414.4
15-04	317.7	4 990 871.8	382 401.0
15-05	325.0	4 990 827.8	382 409.1
15-06	325.3	4 990 835.4	382 402.9
15-07	317.7	4 990 834.4	382 389.2
15-08	324.3	4 990 731.5	382 404.9
15-09	324.3	4 990 730.3	382 398.6
15-10	317.7	4 990 727.2	382 385.0
15-11	324.3	4 990 701.6	382 410.2
15-12	323.6	4 990 696.4	382 403.9

NOTES

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31E-369

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	ME	CHK KS	CODE
DRAWN	MFA	CHK ME	SITE
			LOAD
			STRUCT
			FIGURE D7
			DATE DEC 2017





## **Appendix E**

**Factual Data from Previous Investigation  
exp. Report, Geocres No. 31E-326**

## EXPLANATION OF TERMS USED IN REPORT

**N-VALUE:** THE STANDARD PENETRATION TEST (SPT) N-VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N-VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N-VALUE IS DENOTED THUS  $\bar{N}$ .

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**CONSISTENCY:** COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH ( $c_u$ ) AS FOLLOWS:

$C_u$ (kPa)	0 – 12	12 – 25	25 – 50	50 – 100	100 – 200	>200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

**DENSENESS:** COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 – 5	5 – 10	10 – 30	30 – 50	>50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

**RECOVERY:** SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

**MODIFIED RECOVERY:** SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY IS:

RQD (%)	0 – 25	25 – 50	50 – 75	75 – 90	90 – 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

**JOINT AND BEDDING:**

SPACING	50mm	50 – 300mm	0.3m – 1m	1m – 3m	>3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$c_c$	1	COMPRESSION INDEX
$c_s$	1	SWELLING INDEX
$c_a$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_i$	1	SENSITIVITY = $c_u / \tau_r$

### PHYSICAL PROPERTIES OF SOIL

$P_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	$e$	1, %	VOID RATIO	$e_{\text{min}}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	$n$	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{\text{max}} - e}{e_{\text{max}} - e_{\text{min}}}$
$P_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	$w$	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF WATER	$s_r$	%	DEGREE OF SATURATION	$D_n$	mm	N PERCENT – DIAMETER
$P$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$P_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $(w_L - w_p)$	v	$\text{m}/\text{s}$	DISCHARGE VELOCITY
$P_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $(w - w_p) / I_p$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $(w_L - w) / I_p$	k	$\text{m}/\text{s}$	HYDRAULIC CONDUCTIVITY
$P'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{\text{max}}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{kN}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

Brampton, Ontario

## RECORD OF BOREHOLE No 1-1

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990883.0, 382423.4; Area 1 Sta. 16+750 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.24.13 - 1.24.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
325.5	Ground Surface						20	40	60	80	100						
0.0325.3	150 mm Asphalt Pavement																
0.2	FILL: GRAVELLY SAND (SW) occasional cobble, frozen, brown, loose to compact		1	AS													
			2	AS													
324.3			3A	SS	11												27 63 (10)
1.2	SILTY SAND (SM) trace gravel, grey to brown, moist, compact to loose - becoming more sand		3B	SS	11												
			4	SS	8												
	- becoming very loose																
			5	SS	3												
322.6																	
2.9	SILT (ML) some sand, moist, brown with oxidation, compact to dense		6	SS	14												8 63 (29)
	- cobble or boulder at 3.96-4.27 m																
	- becoming wet		7	SS	26												
			8	SS	29												
			9A	SS	30												
319.7																	
5.8319.6	SAND AND GRAVEL (SW) , brown, wet, dense		9B	SS	>50												0 16 (84)
5.9	Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE																
<b>NOTES:</b>  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																	

+ <sup>3</sup>, × <sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13



Brampton, Ontario

## RECORD OF BOREHOLE No 1-2

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990902.1, 382433.2; Area 1 Sta. 16+729 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.24.13 - 1.24.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	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												
325.5	Ground Surface							20	40	60	80	100								
0.0	200 mm Asphalt Pavement																			
0.2	FILL: SAND AND GRAVEL (SW) occasional cobble, frozen, brown, loose to compact		1	AS		325								○						
324.2		2	SS	20											○					
1.4	SANDY SILT (ML) trace gravel, trace peat, and trace organics, moist, grey and brown, loose						324											○	2 33 (65)	
	- becoming wet, brown, dense		3	SS	10												○			
323.1			4	SS	>50										○					
2.4	Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE																			
NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																				

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 1-3

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990881.1, 382428.2; Area 1 Sta. 16+750 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.24.13 - 1.24.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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		
325.5	Ground Surface					20	40	60	80	100	10	20	30							
0.0	200 mm Asphalt Pavement																			
0.2	FILL: SAND AND GRAVEL (SW) crushed, frozen, brown, loose		1	AS																
324.3			2A	SS	10															
1.2	SILT (ML) trace sand, trace organics, moist, greyish brown with oxidation, compact -becoming wet		2B	SS	12															
			3	SS	15															
323.1			4A	SS	24															
2.4	SAND AND GRAVEL (SW) trace silt, greyish brown, wet, very dense		4B	SS	>50															
2.6	Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE																			
<div>NOTES:</div> <div>1. This drawing is to be read with the subject report and project numbers as presented above.</div> <div>2. Interpretation assistance by exp is required before use by others.</div> <div>3. Groundwater level was measured in open borehole.</div>																				

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 1-4

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990846.2, 382415.7; Area 1 Sta. 16+787 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.24.13 - 1.24.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT  w <sub>p</sub>	NATURAL MOISTURE CONTENT  w	LIQUID LIMIT  w <sub>L</sub>	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		
325.2	Ground Surface						20	40	60	80	100						GR SA SI CL			
0.0	FILL: SAND (SW) to SAND AND GRAVEL (SW) occasional cobble, frozen, brown, loose to compact		1	AS																
			2	AS																
323.8			3	SS	22															
1.4	SAND (SW-SM) fine grain, trace gravel, trace silt, damp, brown , compact		4	SS	12											6 88 (6)				
323.0																				
2.2	SAND AND GRAVEL (SW) trace to some silt, damp, brown, compact		5	SS	21											25 70 (5)				
	- becoming very dense, wet																			
	-Split-spoon Refusal at 3.20 m (possibly cobble or boulder) past by auger to 3.66 m		6	SS	>50															
	- becoming more silt, wet, greyish brown, very dense		7	SS	29											30 55 (15)				
320.3			8	SS	>50															
4.8	Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE																			
	NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																			

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 1-5

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990850.8, 382408.2; Area 1 Sta. 16+786 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.25.13 - 1.25.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
325.3	Ground Surface																
0.0325.2	150 mm Asphalt Pavement																
0.2	FILL: SAND (SW) TO SAND AND GRAVEL (SW) trace silt, frozen, brown, compact		1	AS													
			2	SS	19												
323.5			3A	SS	19												
1.8	SILT (ML) trace sand, moist, greyish brown, compact		3B	SS	17												
323.0																	
2.3	SAND AND GRAVEL (SW) damp, brown, compact		4	SS	19												
			5	SS	16												
			6	SS	15												
	-becoming more sand fine grain, loose		7	SS	10												
320.0																	
5.3	Split-Spoon and Auger Refusal NQ Coring		8	NQ													
	BEDROCK Granitic layering (Gneiss), light grey/pink																
	Length (m) RQD (%)																
	Run 1 0.45 63																
	Run 2 1.52 60		9	NQ													
	Run 3 0.95 81																
			10	NQ													
316.7																	
8.6	END OF BOREHOLE																
	NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. 2" I.D. Standpipe piezometer was installed on 25/01/2013. Groundwater level measured at 5.59 m on 06/02/2013. The piezometer was decommissioned because of safety issue.																

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 1-6

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990911.1, 382417.0; Area 1 Sta. 16+728 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 2.5.13 - 2.5.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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									
317.6	Top of Ice<B>>						20	40	60	80	100						
0.0	610 mm thick ice	△		ICE													
317.0		△															
0.6	SILT (CL-ML) some clay, trace sand, some organics, moist, grey, compact		1	SS	11												
			2	VANE													
	- becoming wet, very loose		3	SS	2											0 5 77 18	
			4	VANE													
			5	SS	3												
			6	VANE													
	- becoming loose		7	SS	5											2 1 91 6	
			8	VANE													
			9	SS	10												
	- becoming some sand, loose to compact																
311.0			10	SS	36												
6.7	Split-Spoon and Auger Refusal NQ Coring BEDROCK Granitic layering (Gneiss), light grey/pink		11	NQ													
	Length (m) RQD (%) Run 1 1.37 65 Run 2 0.34 0 Run 3 1.09 60		12	NQ													
			13	NQ													
308.2																	
9.5	END OF BOREHOLE																
	NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13




Brampton, Ontario

## RECORD OF BOREHOLE No 1-7

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990890.4, 382407.8; Area 1 Sta. 16+751 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 2.5.13 - 2.5.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30 UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				
317.7	<b>Top of Ice&lt;B&gt;&gt;</b>								
0.0	300 mm thick Ice	△							
317.4									
0.3	No Samples Cone Test was done in every 0.3 m								
317									
316									
315									
314									
313									
312									
311									
310.7									
7.0	<b>Cone Refusal on Possible Bedrock END OF BOREHOLE</b>								
	<b>NOTES:</b> 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before use by others.								




Brampton, Ontario

## RECORD OF BOREHOLE No 1-8

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990852.4, 382393.3; Area 1 Sta. 16+790 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 2.6.13 - 2.6.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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													
317.7	Top of Ice<B>>						20	40	60	80	100	10	20	30						
0.0	300 mm thick Ice	△																		
317.4																				
0.3	SAND (SW) fine grains, trace silt, trace gravel, trace organics, wet, brown, loose to compact		1	AS											○					
			2	SS	14											○				
			3	SS	11											○				
			4	SS	>50											○				
314.8																				
2.9	NQ Coring		5	NQ																
	Boulder																			
	Length (m) Run 1 0.11 Run 2 1.57 Run 3 0.43		6	NQ																
			7-A	NQ																
312.7																				
5.0	SAND (SW) same as above																			
			7-B	NQ																
311.6																				
6.1	Split-Spoon and Auger Refusal NQ Coring BEDROCK Granitic layering (Gneiss), light grey/pink																			
	Length (m) RQD (%) Run 1 1.52 91 Run 2 1.51 89		8	NQ																
			9	NQ																
308.5																				
9.2																				

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 2-1

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990615.1, 382419.9; Area 2 Sta. 17+024 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.18.13 - 1.18.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	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								
322.9	Ground Surface							20	40	60	80	100							
0.0	200 mm Asphalt Pavement		1	AS															
0.2	FILL: SAND (SW) TO SAND AND GRAVEL (SW) occasional cobble, frozen, brown		2	AS															
322.1																			
0.8		SANDY SILT (ML) trace peat, trace rootlets, moist, brown, compact		3	SS	11													
				4	SS	5													
			5	SS	5														
			6	SS	6														
319.2																			
3.7	SAND AND GRAVEL (GW-GM) some silt, wet, brown, very dense  - Split-spoon Refusal at 4.11 m (possibly cobble or boulder) past by auger to 4.42 m  - Split-spoon refusal at 4.65 m and auger refusal at 4.72 m (possible cobble or boulder) ran HWT casing to 5.33 m  - Broken up bits at 6.15 m (possible bedrock) ran HWT casing to 6.48 m		7	SS	>50														
			8	SS	>50														
			9	SS	>50														
316.7			10	SS	>50														
6.2	Split-Spoon and Auger Refusal NQ Coring BEDROCK Granitic layering (Gneiss), light grey/pink  Length (m) RQD (%) Run 1 1.50 12 Run 2 1.52 78 Run 3 0.91 100		11	NQ															
			12	NQ															
			13	NQ															
312.8																			
0.1	END OF BOREHOLE																		
	NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																		

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13


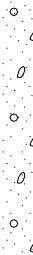
Brampton, Ontario

## RECORD OF BOREHOLE No 2-2

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990679.0, 382414.8; Area 2 Sta. 16+960 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.27.13 - 1.27.13 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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>		GR	SA	SI	CL
								○ UNCONFINED	● QUICK TRIAXIAL	+	×	FIELD VANE								
323.6	Ground Surface							20	40	60	80	100								
0.0 323.4	200 mm Asphalt Pavement																			
0.2	FILL: SAND (SW) to SAND AND GRAVEL (SW) frozen, brown, compact  - becoming damp		1	AS			323							○						
			2	SS	18									○						
322.1																				
1.5	SAND AND GRAVEL (SW) trace silt, moist, brown, compact		3	SS	20		322							○						
			4	SS	14									○						
			5	SS	18									○						
319.9							320													
3.8	Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE  NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. No groundwater was observed.																			

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 2-3

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990648.7, 382414.6; Area 2 Sta. 16+990 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.27.13 - 1.27.13 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 $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV/DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
323.3	Ground Surface															
0.0 323.1	200 mm Asphalt Pavement															
0.2	FILL: SAND AND GRAVEL (SW) frozen, brown, compact		1	AS		323										
	- becoming damp		2A	SS												
322.2																
1.1	SILT (ML) trace sand, greyish brown, moist, compact		2B	SS		322										
			3	SS												0 12 (88)
	- becoming trace clay, wet, loose		4	SS		321										0 2 87 11
			5	SS		320										0 2 (98)
	- becoming, very loose															
319.2			6A	SS												
4.1	SAND (SW) fine grain, trace silt, damp, brown, compact		6B	SS		319										
			7	SS												
	- becoming wet, loose					318										0 94 (6)
			8	SS												
			9	SS		317										
316.5																
6.8	Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE															
	NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.															

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13



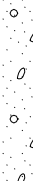


Brampton, Ontario

## RECORD OF BOREHOLE No 2-4

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990678.4, 382408.9; Area 2 Sta. 16+960 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.30.13 - 1.30.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								20 40 60 80 100									10 20 30		
323.5	Ground Surface																		
0.0	200 mm Asphalt Pavement																		
0.2	FILL: SAND AND GRAVEL (SW) frozen, brown, compact - becoming damp		1	AS															
			2	AS															
322.3			3A	SS	18														
1.2	SANDY SILT (ML) greyish brown, moist, compact  - becoming loose		3B	SS	20														
			4	SS	5														
321.3																			
2.2	SAND AND GRAVEL (SW) damp, brown, dense to compact		5	SS	44														
			6	SS	26														
319.7																			
3.8	SAND (SW) trace gravel, trace silt, moist , brown, compact  - becoming fine sand, greyish brown		7	SS	13														
			8	SS	26														
318.3																			
5.3	Split-Spoon and Auger Refusal NQ Coring BEDROCK Granitic layering (Gneiss), light grey/pink  Length (m) RQD (%) Run 1 0.53 0 Run 2 1.58 53 Run 3 0.94 85		9	NQ															
			10	NQ															
			11	NQ															
315.2																			
8.3	END OF BOREHOLE																		
	NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. 2" I.D. Standpipe piezometer was installed on 30/01/2013. Groundwater level measured at 3.85 m on 06/02/2013. The piezometer was decommissioned because of safety issue.																		

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 2-5

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990645.6, 382401.0; Area 2 Sta. 16+990 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 2.4.13 - 2.4.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED	● QUICK TRIAXIAL	+	×	FIELD VANE	LAB VANE											
317.7	Top of Ice<B>>																							
0.0	300 mm thick Ice	△																						
317.4																								
0.3	<b>SILT (CL-ML)</b> some sand, some organics, trace clay, greyish brown, wet, very loose  -becoming trace sand		1	SS	3																			
			2	SS	2														non plastic					
			3	VANE																				
			4	SS	3														0 6 (94)					
315.1																								
2.5	<b>SAND (SW)</b> trace gravel, wet, brown, loose																							
314.5			5	SS	6																			
3.2	<b>Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE</b>  <b>NOTES:</b>  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																							

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 2-6

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990675.5, 382398.2; Area 2 Sta. 16+960 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 2.4.13 - 2.4.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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 (%)						
317.7	Top of Ice						20	40	60	80	100	10	20	30				
0.0	300 mm thick Ice	△																
317.4																		
0.3	SANDY SILT (ML) some organics, greyish brown, wet, loose		1	AS		317										40.2	1 41 (58)	
			2	SS	6													
315.6			3A	SS	2													
2.1	SAND AND GRAVEL some cobble and boulder, wet, brown, compact	○	3B	SS	19													
315.3																		
2.4	Split-Spoon and Auger Refusal NQ Coring COBBLE AND BOULDER length of 1.07 m		4	NQ		315												
313.9																		
3.8	BEDROCK Granitic layering (Gneiss), light grey/pink		5	NQ		314												
	Length (m) RQD (%) Run 1 1.27 42 Run 2 0.45 61 Run 3 1.49 86		6	NQ		313												
			7	NQ		312												
310.7																		
7.0	END OF BOREHOLE																	
	NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																	

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13



Brampton, Ontario

## RECORD OF BOREHOLE No 2-7

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990613.0, 382409.2; Area 2 Sta. 17+024 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 2.6.13 - 2.6.13 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W <sub>p</sub> — W — W <sub>L</sub> 10 20 30					
317.7	Top of Ice															
0.0	300 mm thick Ice	△														
317.4																
0.3	No Samples Cone Test was done in every 0.3 m															
317																
316																
315																
314																
313.0																
4.6	Cone Refusal on Possible Bedrock END OF BOREHOLE															
	NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before use by others. 3. Groundwater level was measured in open borehole.															

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 3-1

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990568.7, 382428.8; Area 3 Sta. 17+071 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.16.13 - 1.16.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	20					40	60	80				
322.6	Ground Surface																						
0.0322.5	150 mm Asphalt Pavement																						
0.2	FILL: SAND AND GRAVEL (SW) occasional cobble, frozen, brown, loose to compact		1	AS									○										
321.8			2	AS									○										
0.8		SILT (ML) some fine sand, trace peat, moist to wet, brown, very loose to compact  - becoming more sand		3	SS	11									○				0 11 (89)				
				4	SS	5										○							
			5	SS	2										○				4 26 65 5				
			6	SS	5										○				0 22 (78)				
318.8																							
3.8	SAND(SW) trace gravel, moist to wet, brown, compact  -becoming some gravel, trace silt, wet, brown, compact to dense		7	SS	13										○								
			8A	SS	18											○							
			8B	SS	13											○							
317.1			9	SS	>50										○								
5.5	Split-Spoon and Auger Refusal NQ Coring BEDROCK Granitic layering (Gneiss), light grey/pink  Length (m) RQD (%) Run 1 0.53 37 Run 2 1.55 38 Run 3 0.97 79		10	NQ																			
			11	NQ																			
			12	NQ																			
314.0																							
8.6	END OF BOREHOLE																						
	NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																						

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

## 1 OF 1

METRIC

W.P.	ADM-00210117-A0	LOCATION	Highway 118, Haliburton ON, MTM 17T 4990548.0, 382433.1; Area 3 Sta. 17+092	ORIGINATED BY	EF
DIST	Huntsville 52 HWY 118	BOREHOLE TYPE	CME-850 Track, Continuous hollow stem augering	COMPILED BY	TSA
DATUM	GBM 778012 Elev. 322.366 m	DATE	1.17.13 - 1.17.13	CHECKED BY	SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	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									
322.7	Ground Surface																
0.0 322.5	200 mm Asphalt Pavement																
0.2	FILL: GRAVELLY SAND (SW) occasional cobble, frozen, brown, compact  -becoming moist, trace asphalt		1	AS													
			2	AS													
			3	SS	16												
321.3																	
1.4	SILT (ML) some sand, trace gravel, moist, brown, loose		4A	SS	6												
320.9																	
1.8	SAND AND GRAVEL (SW) damp, brown, compact  - becoming very dense		4B	SS	11												
			5	SS	75												
319.7																	
3.0	SILT() (ML) trace sand, trace clay, wet, brown, loose to very loose		6	SS	6												
			7	SS	4												
			8	SS	5												
317.4																	
5.4	SAND (SW) fine grain, trace silt, wet, brown, loose  -Split-Spoon refusal at a 6.48 m (very dense gravel) past by auger  - becoming some gravel, compact to very dense  - cobble and boulder encountered depth from 6.86 to 8.08		9	SS	5												
			10A	SS	5												
			10B	SS	>50												
			11	SS	11												
			12	SS	>50												
314.6																	
8.1	Split-Spoon and Auger Refusal NQ Coring BEDROCK Granitic layering (Gneiss), light grey/pink  Length (m) RQD (%) Run 1 1.52 87 Run 2 1.53 95		13	NQ													
			14	NQ													
311.6																	
1.1	END OF BOREHOLE NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																

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

MTD\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 3-3

1 OF 1

METRIC

W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990569.6, 382435.6; Area 3 Sta. 17+071 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.27.13 - 1.27.13 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	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												
322.8	Ground Surface							20	40	60	80	100								
0.0/322.6	200 mm Asphalt Pavement																			
0.2	FILL: SAND AND GRAVEL (SW) frozen, brown  - becoming damp, compact		1	AS			322							○						
			2A	SS	15									○						
321.7	SILT (ML) trace sand, trace gravel, moist to wet, greyish brown, loose to compact		2B	SS	10										○					
320.9			3A	SS	10		321								○					
1.8	SAND (SW) some gravel, trace silt, greyish brown, damp, loose  - becoming more sand, fine grain, loose  - fine to coarse grains, compact  - becoming more gravel, compact to very dense		3B	SS	19									○						
			4	SS	8		320							○			2 95 (3)			
			5	SS	11									○						
							319													
318.7			6	SS	>50										○					
4.1	Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE  NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open hole.																			

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

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

Brampton, Ontario

## RECORD OF BOREHOLE No 3-4

1 OF 1

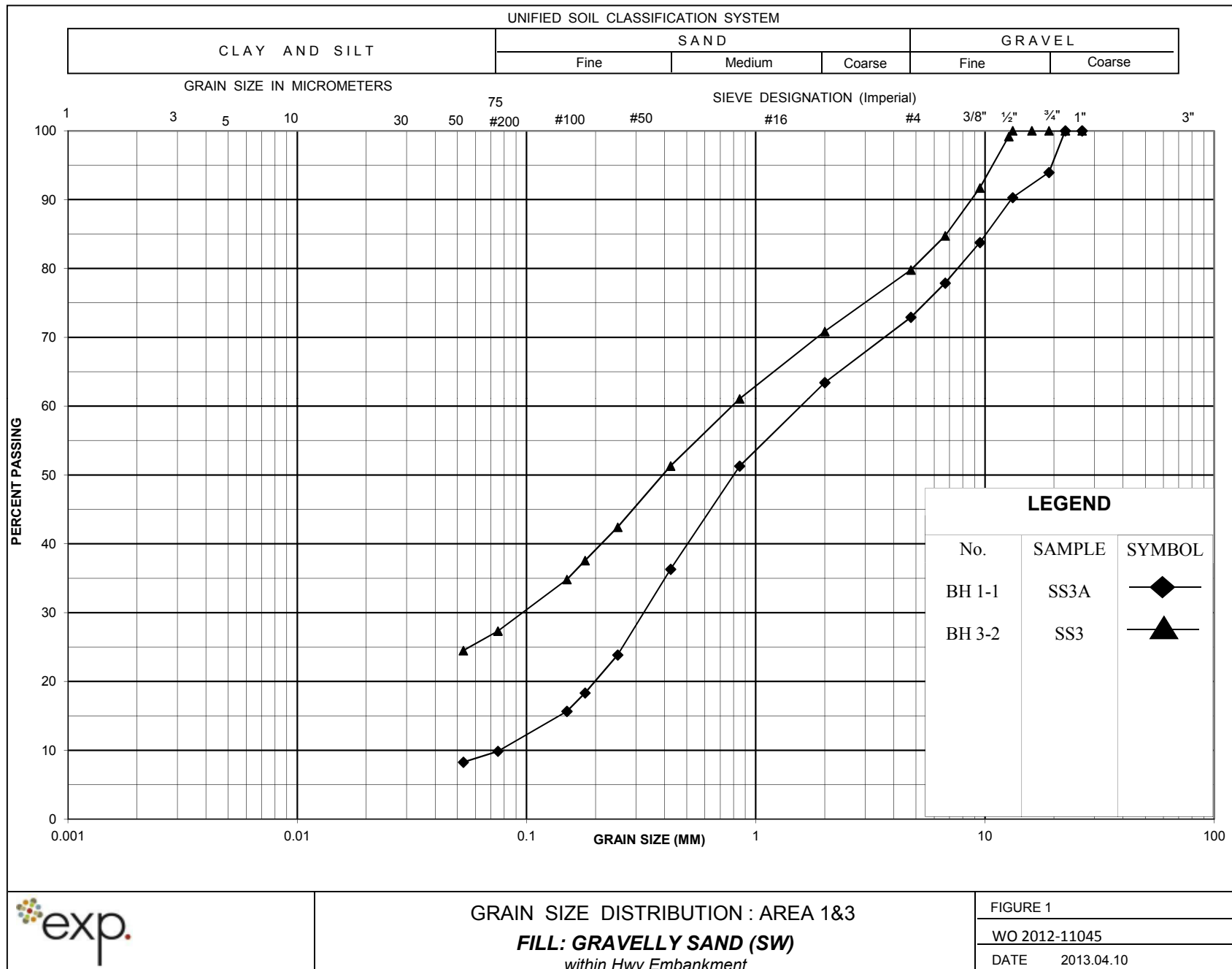
METRIC

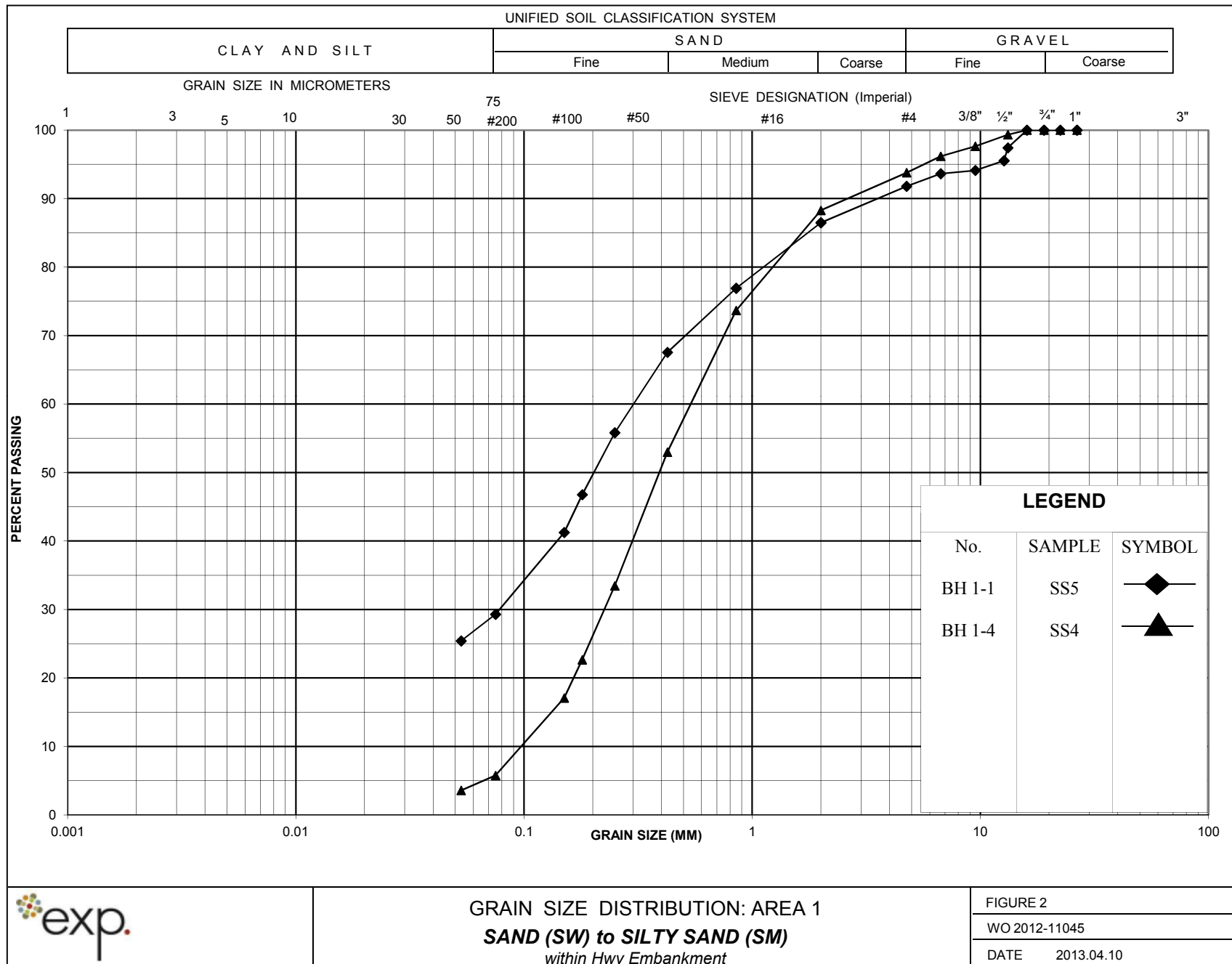
W.P. ADM-00210117-A0 LOCATION Highway 118, Haliburton ON, MTM 17T 4990567.1, 382418.7; Area 3 Sta. 17+071 ORIGINATED BY EF  
 DIST Huntsville 52 HWY 118 BOREHOLE TYPE CME-850 Track, Continuous hollow stem augering COMPILED BY TSA  
 DATUM GBM 778012 Elev. 322.366 m DATE 1.31.13 - 1.31.13 CHECKED BY SM

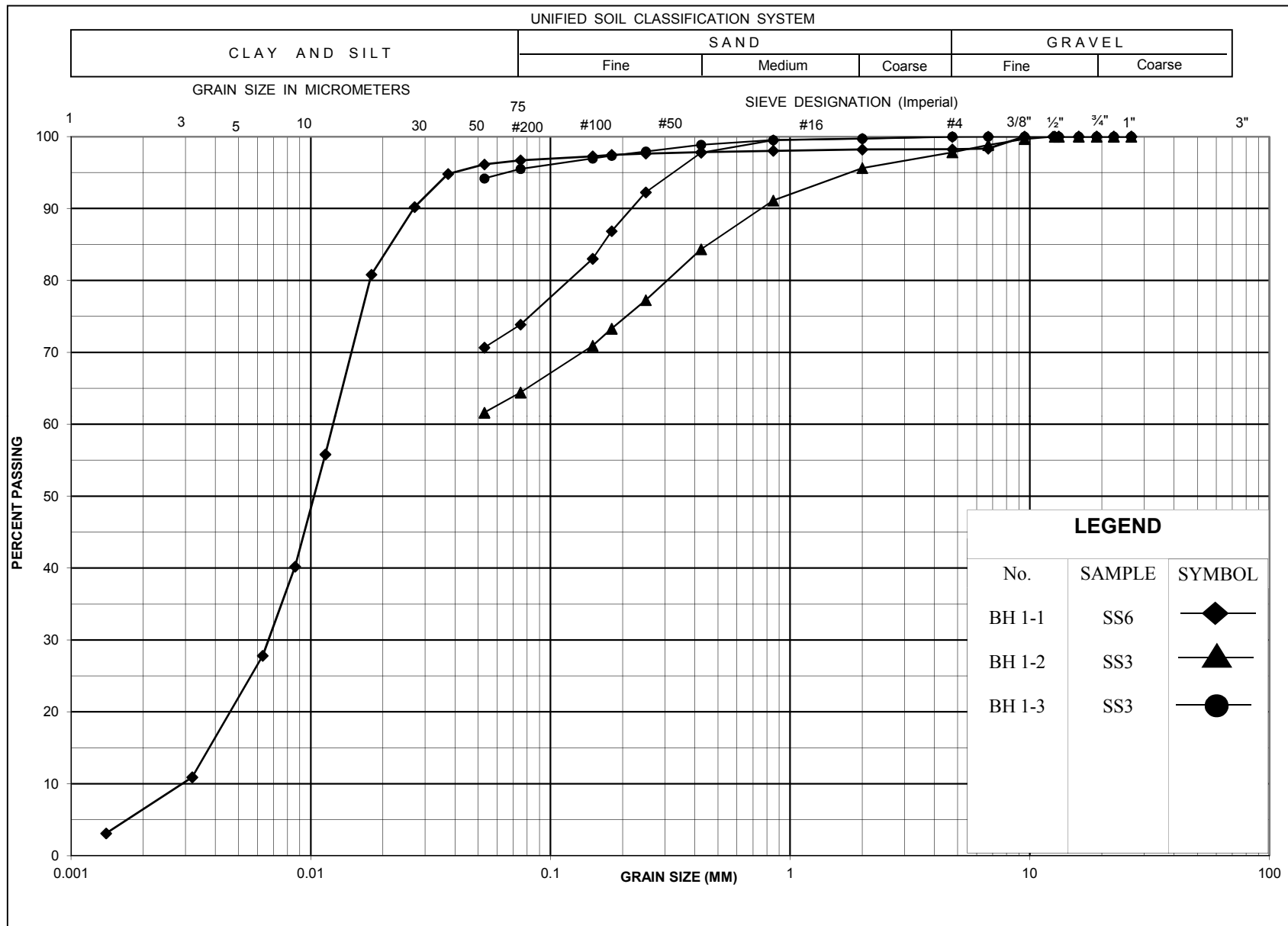
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV/ DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
318.3	Ground Surface					20	40	60	80	100	10	20	30							
0.0	FILL: SAND AND GRAVEL (SW) some silt, occasional to some blast rock, peat, root and rootlets, frozen (0.3 m), wet, brown, loose -becoming trace silt, trace peat		1	AS										○						
317.6			2	AS								○								
0.8	SILTY SAND (SM) some organics, wet, grey, loose		3	SS	6								○							
316.7			4A	SS	12							○								
1.7	SILT (ML) trace sand, wet, greyish brown, compact		4B	SS	13								○							
			5	VANE					+					○						
315.5	- Interbedded sand seam		6A	SS	8									○						
2.8	SAND AND GRAVEL (SW) wet, brown, loose		6B	SS	9								○							
	-cobble or boulder at 3.66 - 3.81 m -becoming trace silt		7	SS	8								○							
	-cobble or boulder at 4.27-4.58, -becoming very dense		8	SS	11								○							
313.4			9	SS	>50								○							
5.0	Split-Spoon and Auger Refusal on Possible Bedrock END OF BOREHOLE  NOTES:  1. This drawing is to be read with the subject report and project numbers as presented above.  2. Interpretation assistance by exp is required before use by others.  3. Groundwater level was measured in open borehole.																			

MTO\_EXP RECORD OF BOREHOLE HWY118\_SLOPE INSTABILITY.GPJ ONTARIO MOT.GDT 4/9/13

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE







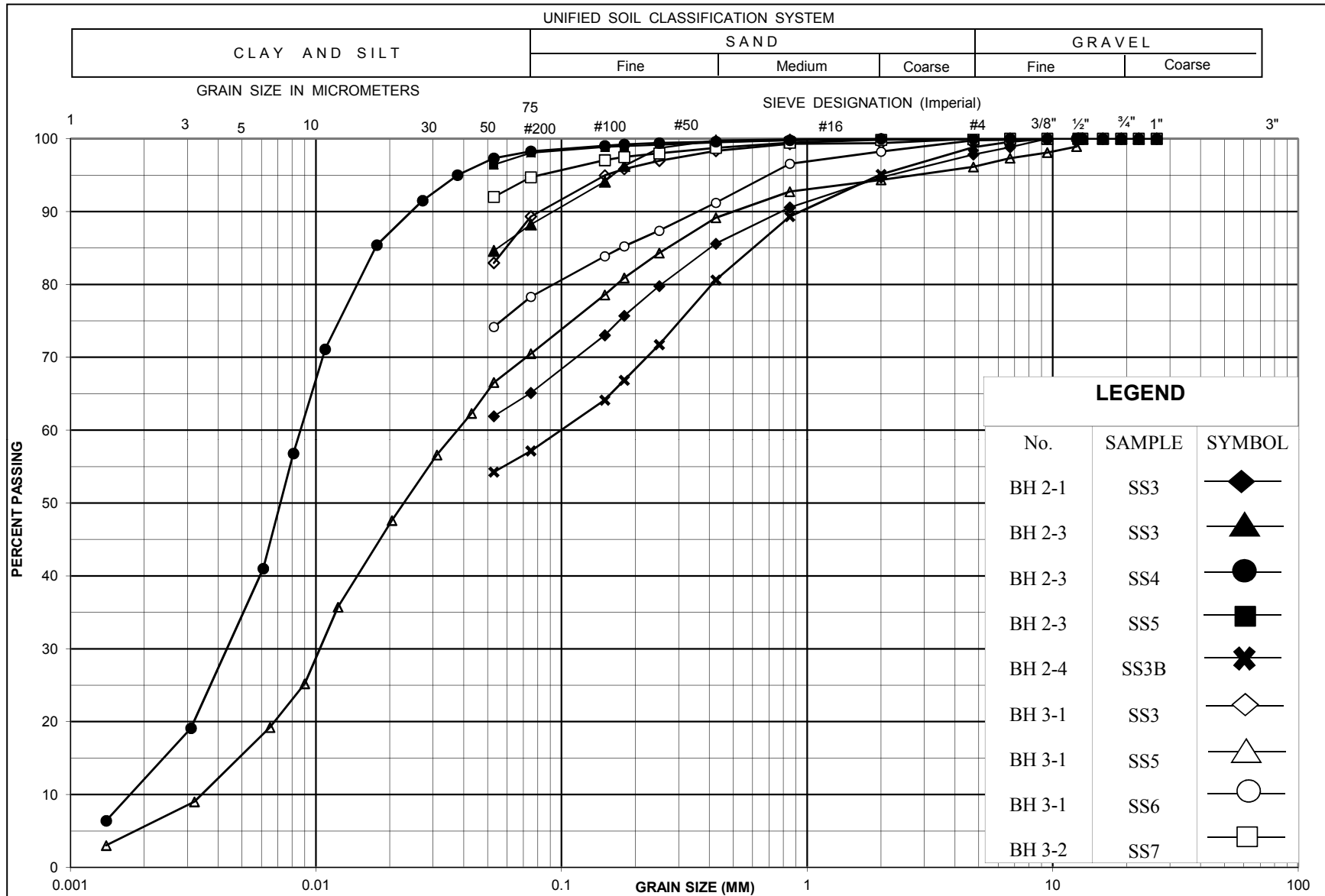
GRAIN SIZE DISTRIBUTION: AREA 1  
**SILT (ML) to SANDY SILT (ML)**  
*within Hwy Embankment*

FIGURE 3

WO 2013-11045

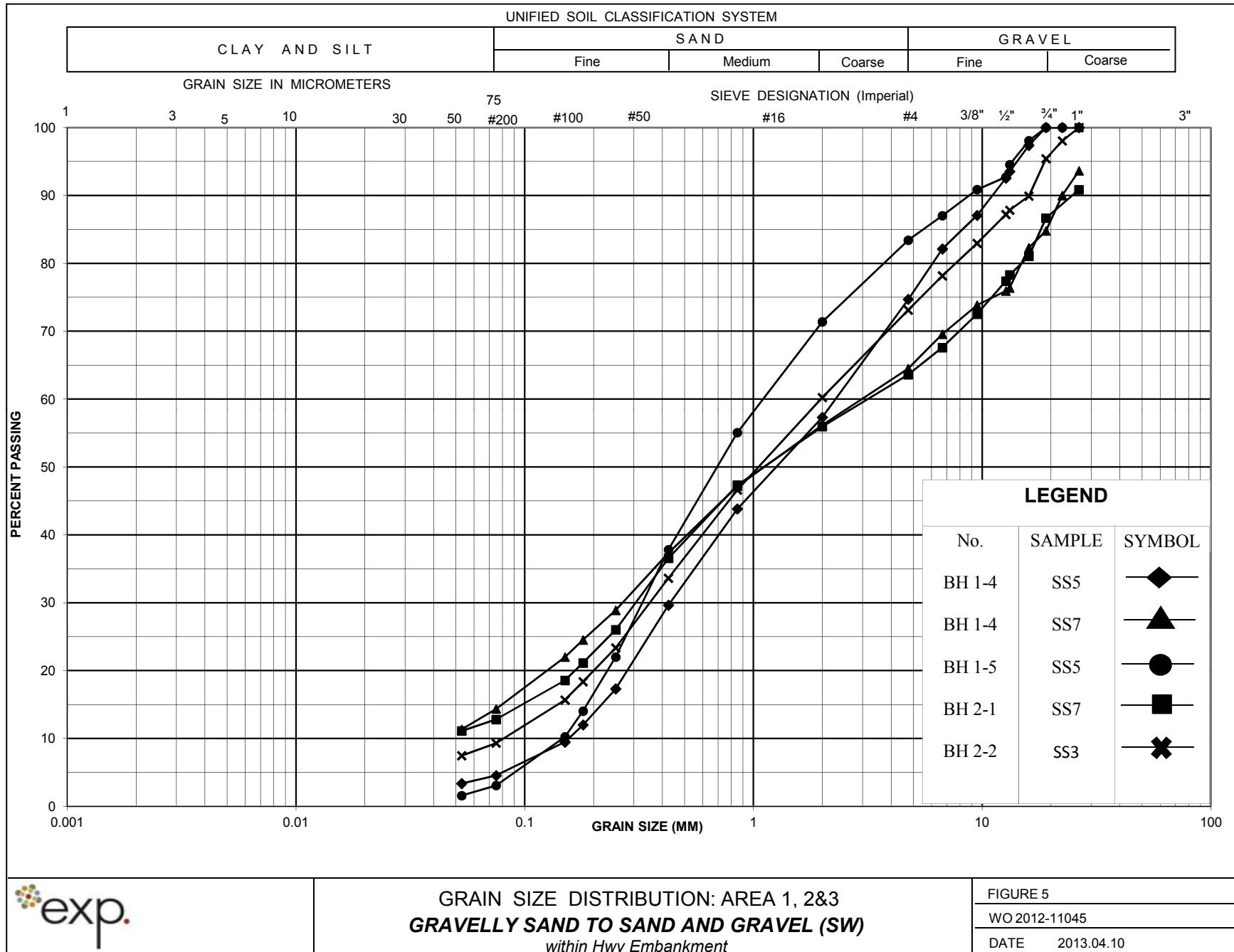
DATE 2013.04.10

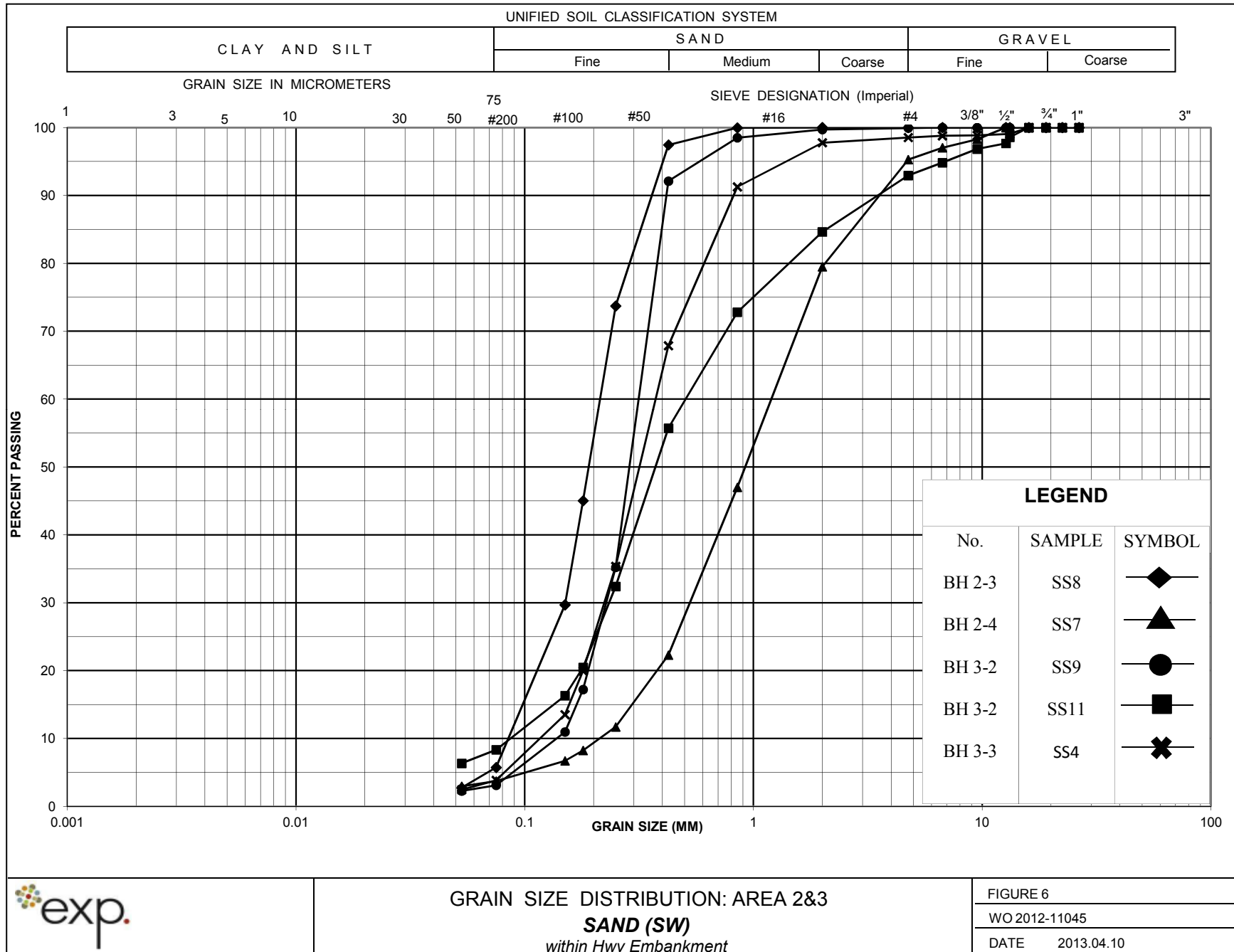


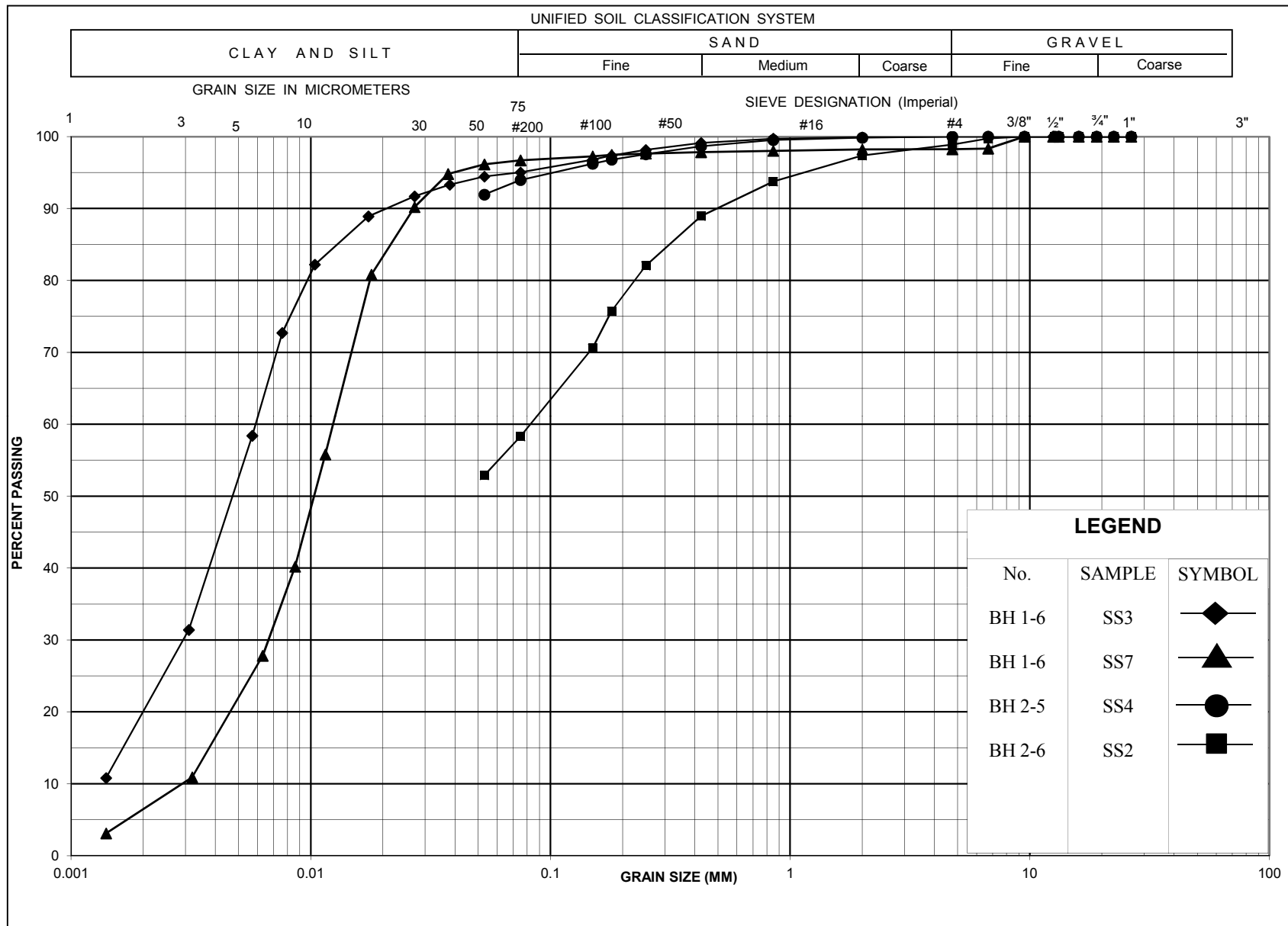


GRAIN SIZE DISTRIBUTION: AREA 2&3  
**SILT (ML) to SANDY SILT(ML)**  
*within Hwy Embankment*

FIGURE 4  
 WO 2012-11045  
 DATE 2013.04.10





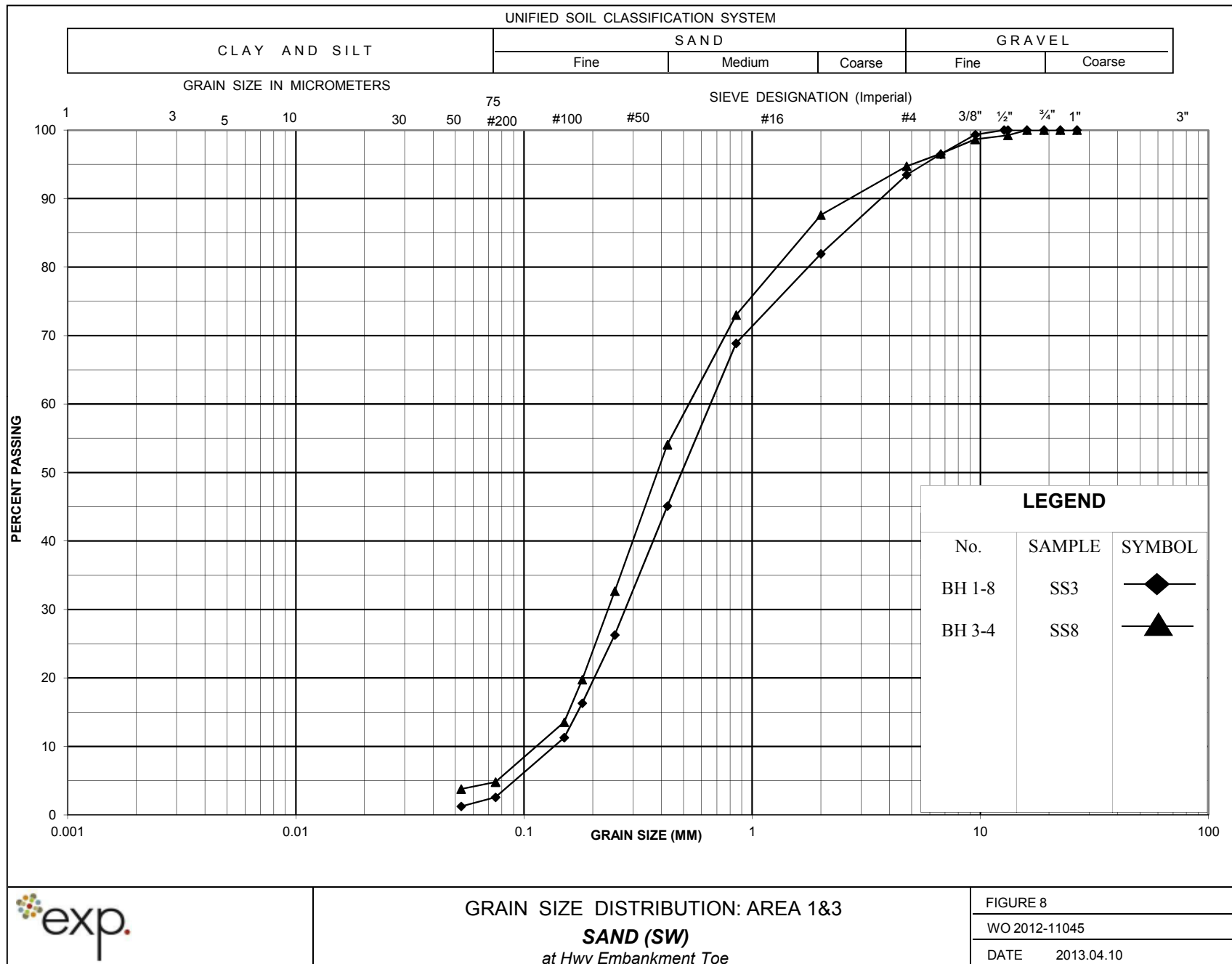


GRAIN SIZE DISTRIBUTION: AREA 1&2  
**SILT (CL-ML) to SANDY SILT (ML)**  
*at Hwy Embankment Toe*

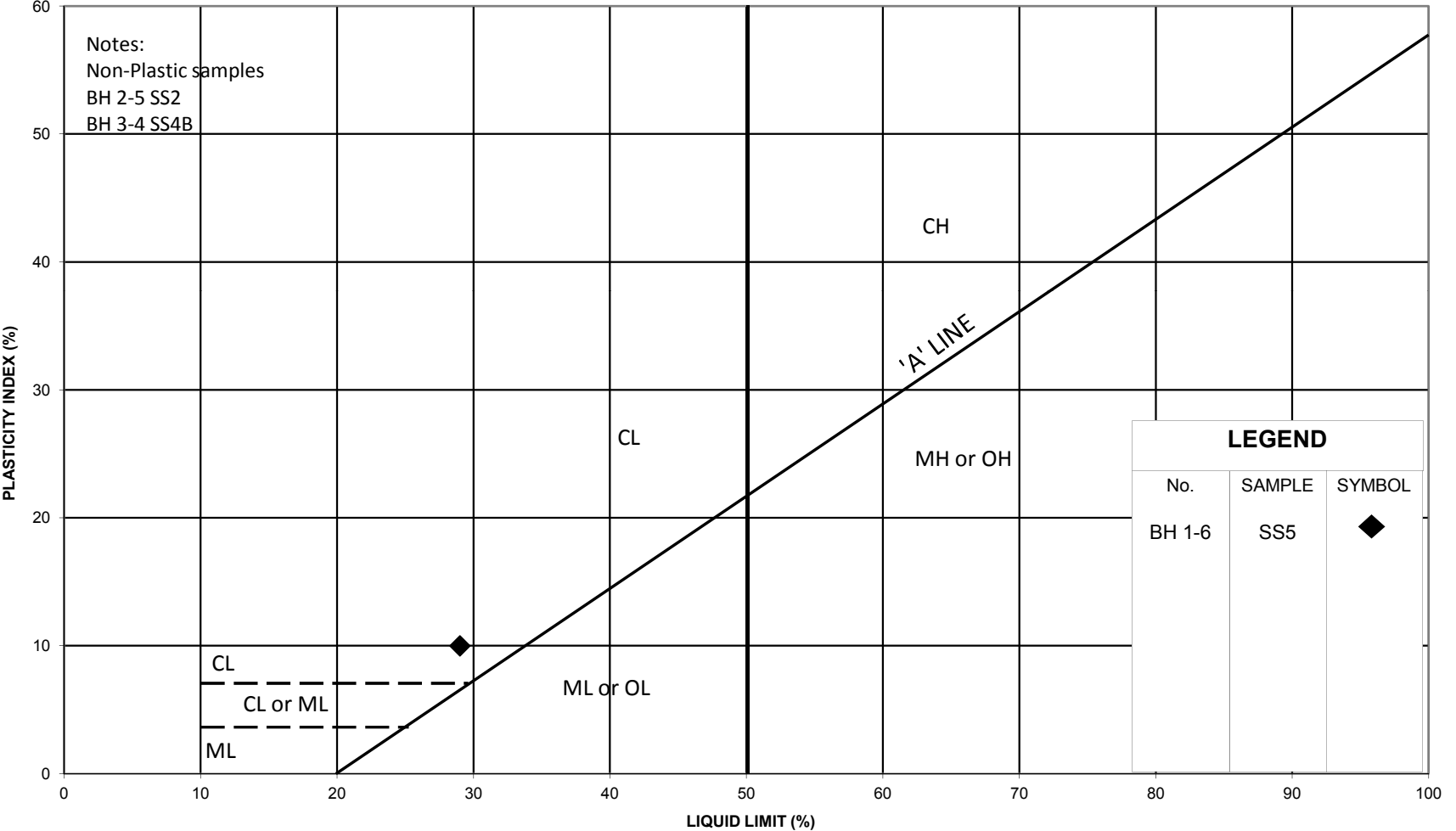
FIGURE 7

WO 2012-11045

DATE 2013.04.10



HWY 118, Haliburton ON



PLASTICITY CHART: AREA 1  
**SILT (CL)**  
at Hwy Embankment Toe

FIGURE 9  
WO 2012-11045  
DATE 2013.04.10

START RUN #1  
@ 19'10"

END OF RUN  
2 (25'55")

ADM-00210117-A0



ADM-00210117-A0  
BH 2-1



ADM-00210117-A0  
BH 2-4



ADM-00210117-A0  
BH 2-6





ADM-00210117-AO  
BH 3-1



ADM-00210117-AO  
BH 3-2

