



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
S-E RAMP CONNECTION BRIDGE UNDER METROLINX TRACKS  
HIGHWAY 7-NEW, KITCHENER TO GUELPH  
G.W.P. 408-88-00**

**Geocres Number: 40P8-279**

**Report**

**To**

**WSP**

Date: July 17, 2020

File: 11375



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**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the site of the proposed S-E Ramp Rail Bridge under the Metrolinx tracks in the Regional Municipality of Waterloo. This structure is part of the exit ramp from Kitchener Waterloo Expressway (KWE) northbound lanes (NBL) north to the proposed New Highway 7 for the Highway 7-New Project.

The purpose of this investigation was to explore the subsurface conditions at the site, and based on the data obtained, to provide a borehole location plan, records of boreholes, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions. Models of the subsurface conditions under the potential foundation footprint were developed from the data obtained in the course of the current and previous investigations.

Thurber was retained by WSP to carry out the site investigation under the Ministry of Transportation Ontario (MTO) Agreement Order Number 3014-E-0013.

Reference has been made to information on subsurface conditions contained in a previous foundation report prepared for this site during the preliminary design phase. The title of the report is:

- Preliminary, Foundation Investigation and Design Report, S-E Ramp Under CNR Tracks, Highway 7-New, Kitchener to Guelph, G.W.P. 408-88-00, Geocres No. 40P8-162, Report to Ministry of Transportation Ontario West Region, File: 15-64-17, dated June 2, 2009. (Reference 1).

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- Foundation investigation report for C.N.R. Subway, Kitchener-Waterloo Expressway, District #4 (Hamilton), W.J. 66-F-37, W.P. 636-64, Geocres Number 40P8-45, dated July 4, 1966. (Reference 2).

Records of boreholes from the previous reports are attached in Appendix B for reference.

## **2. SITE DESCRIPTION**

The site lies in the proximity of the Kitchener-Waterloo Expressway (KWE), approximately 20.0 m to the east of the existing KWE and Metrolinx bridge and 100.0 m north of Victoria Street. At this location, the proposed S-E Ramp will pass under the existing twin CNR tracks running east-west. Approximately 160.0 m west of the existing Metrolinx bridge, the double tracks emerge from a Metrolinx yard with a number of tracks as well as a spur line. The Metrolinx yard extends some 980.0 m west, to Lancaster Street East. The site lies within an area of industrial and commercial lands and is generally flat.

A vacant lot is currently situated on the south side of Metrolinx tracks; lands on the north side of Metrolinx tracks are vacant and covered with long grass and shrubs.

Based on the Ontario Geological Survey Special Volume 2, The Physiography of Southern Ontario, Third Edition by Chapman and Putnam, the site lies within the physiographic region known as the Waterloo Hills, characterized by ridges of sandy till and kames or kame moraines, with outwash sands occupying the intervening hollows.

Site photographs, are included in Appendix E and show the general nature of the land surrounding the drilling locations.

## **3. SITE INVESTIGATION AND FIELD TESTING**

A detailed site investigation was carried out from July 3, 2019 to July 22, 2019. Four boreholes, numbered CN16-09 to CN16-12, were drilled near the west and east abutments of the proposed structure. Boreholes CN16-09 to CN16-12 ranged in depth from 15.8 m to 35.2 m (Elevation 304.2 to 283.4). It should be noted that no boreholes were drilled to investigate the railway embankment due to access constraints as well as restrictions imposed by Metrolinx.

A summary of the borehole locations, designations, borehole termination depths and termination elevations for each borehole is provided in Table 3.1. The coordinates and elevations of the boreholes are given on the drawings and on the individual Record of



Borehole Sheets. The ground surface elevations and coordinates of the recent boreholes were provided by WSP.

The Record of Borehole sheets for the current investigation boreholes are included in Appendix A, and the Record of Borehole sheets for the previous investigation boreholes are included in Appendix B. The approximate locations of the five boreholes are shown on the attached Borehole Locations and Soil Strata Drawings in Appendix D.

Prior to commencing the site investigation, utility clearances were obtained for all borehole locations. The boreholes were drilled using a track-mounted drill rig and advanced with a combination of hollow stem augers and mud rotary drilling. Samples were obtained at selected depth intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

The drilling, sampling and in-situ testing 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 samples for transport to Thurber's laboratory for further examination and testing. Results of field drilling and sampling of the investigation are presented on the Record of Borehole sheets in Appendix A.

Groundwater conditions in the open boreholes were observed during the drilling operations. One piezometer was installed at Borehole CN16-11 to permit for longer term monitoring of groundwater levels. The piezometer consisted of 50 mm diameter PVC pipe with a slotted screen enclosed in filter sand. The location and completion details of the piezometer are summarized in Table 3.1 along with the borehole completion details. The completion of the boreholes were carried out in accordance with the requirements of O. Reg. 903 (as amended by O. Reg. 372/07). The piezometer is planned to be decommissioned in the summer of 2020.



**Table 3.1 – Borehole Completion Details**

<b>Borehole</b>	<b>Ground Surface Elevation</b>	<b>Borehole Depth / Base Elevation (m)</b>	<b>Piezometer Tip Depth / Elevation (m)</b>	<b>Completion Details</b>
CN16-09	321.6	17.4/304.2	No Installation	Borehole backfilled with bentonite holeplug and cuttings to surface.
CN16-10	319.5	32.2/287.3	No Installation	Borehole backfilled with cement and grout, and bentonite holeplug to surface.
CN16-11	318.6	35.2/283.4	35.1/283.6	Piezometer with 3.0 m slotted screen installed with sand filter from 35.1 m to 31.4 m, bentonite pellets from 31.4 m to 30.5 m, grout from 30.5 m to 4.6 m and bentonite holeplug from 4.6 m to ground surface.
CN16-12	318.7	15.8/302.8	No Installation	Borehole backfilled with cement and grout, and bentonite holeplug to surface.
08-045	322.2	32.1/290.1	No Installation	Borehole backfilled with grout to surface.

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

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to gradation analysis (sieve and hydrometer) and Atterberg Limits testing, where appropriate. The results of this testing program are summarized on the Record of Borehole sheets and figures in Appendix A for the current investigation, and Appendix B for the previous investigation.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, a sample of native soil was collected and submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters. The results of the analytical testing are summarized in this report and presented in Appendix C.



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

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix A and Appendix B and on the “Borehole Locations and Soil Strata” drawings included in Appendix D.

An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It should be recognized and expected that soil conditions may vary between and beyond borehole locations.

In general, the soil stratigraphy at this site consisted of surficial topsoil overlying a cohesionless fill layer, a layer of native sand, underlain by clayey silt till, silty clay, silty sand, and silt till.

### **5.1 Topsoil**

A layer of topsoil was encountered surficially in four boreholes drilled at this site, CN16-09 to CN16-12. It was generally dark brown in colour. The thickness of the topsoil layer ranged from 100 mm to 125 mm. The topsoil thickness may vary between the borehole locations and in other areas of the site.

### **5.2 Asphalt**

Asphalt with a thickness of 150 mm was encountered surficially at Borehole 08-045, which was drilled in an existing parking lot.

### **5.3 Cohesionless Fill**

Cohesionless fill was encountered immediately below the topsoil in four boreholes at this site, Boreholes CN16-09 to CN16-12, and encountered below the asphalt at Borehole 08-045. The fill consisted of a layer of gravelly sand fill in Boreholes CN16-09 and 08-045, underlain by generally silty sand fill, which was encountered in all of the boreholes.

The gravelly sand fill contained some silt, trace to some clay, occasional cobbles, and occasional organics. A gasoline odour was also noted in Borehole 08-045. The gravelly sand fill was generally brown to black in colour.





The silty sand fill ranged in composition from sand with some silt to sandy silt, and also contained trace to some gravel, trace to some clay, and occasional organics and rootlets.

The gravelly sand fill in Boreholes CN16-09 and 08-045 was 2.1 m thick, and extended to depths of 2.2 to 2.3 m (Elevation 319.9 to 319.4). The silty sand fill ranged in thickness from 1.3 to 2.9 m, with the lower boundary of this layer encountered at depths ranging from 1.4 m to 4.6 m (Elevation 318.1 to 315.7).

SPT N-values recorded in the gravelly sand fill ranged from 12 to 67 blows for 0.3 m penetration, indicating a compact to very dense relative density. The silty sand fill was very loose to compact, with SPT N-values ranging from 1 to 14 blows for 0.3 m penetration.

The moisture content of samples of the soil ranged from 8 to 11 percent for the gravelly sand fill, and generally ranged from 11 to 25 percent for the silty sand fill. Two samples of the silty sand fill in Boreholes CN16-11 and 08-045, were measured to contain moisture contents of 60 and 114 percent, indicating the presence of organics within the samples.

Three samples of the cohesionless fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix A and the grain size distribution curves for these samples are plotted on Figure A1 of Appendix A. The results of this testing are summarized as follows:

Soil Particles	Gravelly Sand Fill (%)	Silty Sand Fill (%)
Gravel	30	9 to 20
Sand	47	47 to 51
Silt	18	24 to 38
Clay	5	5 to 6

#### 5.4 Organics

A layer of organics was encountered below the cohesionless fill layer in Borehole CN16-09, at a depth of 4.1 m (Elevation 317.5).

The thickness of the organics layer was 0.8 m, with the lower boundary of this layer encountered at a depth of 4.9 m (Elevation 316.7).



The organics layer was generally black in colour and contained occasional roots and rootlets.

The SPT N-Value recorded in the organic layer was 4 blows for 0.3 m penetration, indicating a loose relative density.

The moisture content from a sample of the organics layer was measured to be 47 percent.

## **5.5 Sand**

A native sand layer was encountered below the cohesionless fill in four boreholes at this site, Boreholes CN16-10 to CN16-12 and 08-045. Native sand was encountered below the organics layer in Borehole CN16-09.

The native sand layer was encountered at depths ranging from 1.4 m to 4.9 m (Elevation 318.1 to 315.7), respectively.

The sand layer was brown to grey in colour and contained some silt to silty, trace to some gravel and trace clay, with occasional cobbles encountered in Boreholes CN16-10 and CN16-11.

The thickness of the sand layer ranged from 1.1 m to 3.7 m, with the lower boundary of the sand layer encountered at depths ranging from 4.1 m to 7.2 m (Elevation 315.8 to 312.6).

SPT N-values recorded in the sand ranged from 3 to 46 blows for 0.3 m penetration, indicating a very loose to dense relative density.

Moisture content of samples of the sand generally ranged from 10 percent to 34 percent.

Two samples of the sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix A and B and the grain size distribution curves for these samples are plotted on Figure A2 and Figure B1. The results of this testing are summarized as follows:

Soil Particles	Sand (%)
Gravel	1 to 16
Sand	72 to 81
Silt and Clay	12 to 18

## 5.6 Clayey Silt Till

A layer of clayey silt till was encountered below the sand layer in all boreholes at this site, at depths ranging from 4.1 m to 7.2 m (Elevation 315.8 to 312.6).

The clayey silt till was generally grey in colour and contained some sand to sandy and trace gravel. Occasional silty sand seams were encountered in Borehole 08-045.

The thickness of the clayey silt till ranged from 1.5 m to 4.3 m, with the lower boundary encountered at depths ranging from 5.6 m to 10.7 m (Elevation 313.1 to 310.0).

SPT N-values recorded in the clayey silt till ranged from 16 blows to 33 blows for 0.3 m penetration, indicating a very stiff to hard consistency.

Moisture content of samples of the clayey silt till generally ranged from 10 percent to 24 percent.

Three samples of the clayey silt till underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and Appendix B and the grain size distribution curves for these samples are plotted on Figure A3 and Figure B2. The results of the Atterberg Limits tests are plotted on Figure A6 and B5.

Soil Particles	Clayey Silt Till (%)
Gravel	0 to 6
Sand	17 to 23
Silt	49 to 56
Clay	20 to 27

Index Property	(%)
Liquid Limit	22 to 28
Plastic Limit	13 to 16
Plasticity Index	9 to 13

The above results indicate that the clayey silt till is of low plasticity with a group symbol of CL.

It should be noted that glacial tills are known to contain cobbles and boulders.

## 5.7 Silty Clay

Silty clay was encountered below the clayey silt till layer in all boreholes at this site, at depths ranging from 5.6 m to 10.7 m (Elevation 313.1 to 310.0).

The silty clay was generally grey in colour and contained trace sand and trace gravel. Occasional cobbles and silt lenses were encountered in Borehole 08-045.

Borehole CN16-09 was terminated in the silty clay layer at a depth of 17.4 m (Elevation 304.2). Borehole CN16-12 was terminated in the silty clay layer at a depth of 15.8 m (Elevation 302.8).

In Boreholes CN16-10, CN16-11 and 08-45, the thickness of the silty clay ranged from 15.7 m to 18.4 m, with the lower boundary encountered at depths ranging from 23.9 m to 29.1 m (Elevation 295.6 to 293.1).

SPT N-values recorded in the silty clay ranged from 13 blows for 0.3 m penetration and 100 blows for 0.275 m penetration, indicating a stiff to hard consistency.

Moisture content of samples of the silty clay generally ranged from 10 percent to 39 percent.

Ten samples of the silty clay underwent laboratory gradation analysis and eight samples underwent Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and Appendix B and the grain size distribution curves for these



samples are plotted on Figure A4 and Figure B3. The results of the Atterberg Limits tests are plotted on Figure A7 and B6.

Soil Particles	Silty Clay (%)
Gravel	0
Sand	0 to 8
Silt	21 to 51
Clay	47 to 79

Index Property	(%)
Liquid Limit	37 to 63
Plastic Limit	16 to 23
Plasticity Index	20 to 40

The above results indicate that the silty clay is of intermediate to high plasticity with a group symbol of CI to CH.

## 5.8 Silty Sand

A silty sand layer was encountered below the silty clay in Boreholes CN16-10, CN16-11 and 08-045, at depths ranging from 23.9 m to 29.1 m (Elevation 295.6 to 293.1).

The silty sand was generally grey in colour, and contained trace gravel, trace clay and occasional cobbles. Tri-cone grinding was noted during drilling in this layer.

The thickness of the silty sand layer ranged from 1.1 m to 3.7 m, with the lower boundary encountered at depths ranging from 26.3 m to 30.2 m (Elevation 292.4 to 291.9).

SPT N-values recorded in the silty sand ranged from 59 blows for 0.3 m penetration to 100 blows for 0.275 m penetration, indicating a very dense relative density.



Moisture content of samples of the silty sand generally ranged from 15 percent to 18 percent.

One sample of the silty sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix A and the grain size distribution curves for these samples are plotted on Figure A5. The results of this testing are summarized as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	7
Sand	64
Silt	24
Clay	5

## 5.9 Silt Till

A silt till layer was encountered below the silty sand till in Boreholes CN16-10, CN16-11 and 08-045, at depths ranging from 26.3 m to 30.2 m (Elevation 292.4 to 291.9)

Boreholes CN16-10, CN16-11 and 08-045 were terminated in the silt till at the depth of 32.2 m, 35.2 m and 32.1 m, respectively (Elevation 287.3, 283.4 and 290.1).

The silt till was generally grey in colour, and contained some sand to sandy, trace to some clay, trace to some gravel and occasional cobbles. Tricone grinding was noted during drilling in this layer.

The SPT N-value recorded in the silt till ranged from 100 blows for 0.075 m penetration to 100 blows for 0.15 m penetration, indicating a very dense relative density.

Moisture content of samples of the silt till generally ranged from 10 percent to 19 percent.

One sample of the silt till underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix B and the



grain size distribution curves for these samples are plotted on Figure B4. The results of this testing are summarized as follows:

Soil Particles	Silt Till (%)
Gravel	0
Sand	11
Silt	81
Clay	8

It should be noted that glacial tills are known to contain cobbles and boulders.

#### 5.10 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling.

One standpipe piezometer was installed at this site, in Borehole CN16-11, to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.1.1, along with the measurements in the open boreholes upon completion of drilling.

**Table 5.1.1 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
CN16-09	July 3, 2019	4.9	316.7	Open borehole
CN16-10	July 19, 2019	-	-	Water level upon completion not available due to use of drilling mud.
CN16-11	July 29, 2019	9.0	309.7	Piezometer
CN16-12	July 10, 2019	-	-	Water level upon completion not available due to use of drilling mud.
08-045	Aug 15, 2008	-	-	Water level upon completion not available.



Water level was measured at 3.2 m depth (Elevation 319.0) on October 5, 2008, in a piezometer previously installed at the site.

Previous geotechnical investigation conducted in 1966 (Reference 1), indicates that groundwater level is near Elevation 318.4.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

## 6. CORROSIVITY AND SULPHATE TEST RESULTS

A sample of the native sand from Borehole CN16-10 (depth of 3.4 m) was submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix C.

**Table 6.1 – Analytical Test Results**

Parameter	Units (Soil)	Test Results
		CN16-10 (SS5 at 3.4 m)
Soil Redox Potential	mV	306
Sulphide	%	< 0.02
pH	pH Units	8.56
Chloride	µg/g	25
Sulphate	µg/g	25
Conductivity	uS/cm	195
Resistivity (calculated)	ohms.cm	5100





## **7. MISCELLANEOUS**

Landshark Drilling of Brantford, Ontario supplied a rubber track mounted B-57 drill rig and conducted the drilling, sampling and in-situ testing operations for the investigation.

The coordinates and elevations for the boreholes were provided by WSP.

The drilling and sampling operations in the field, were supervised on a full-time basis by Thurber field technicians.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory in Oakville. Analytical laboratory testing was carried out by SGS Canada Inc.

Overall supervision of the field program for the investigation was conducted by Dr. Nancy Berg, P.Eng. Interpretation of the data and preparation of the report was carried out by Ms. Judy Mei, EIT, and Dr. Nancy Berg, P.Eng.

Mr. Jason Lee, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.



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## **Appendix A**

### **Record of Borehole Sheets and Laboratory Test Results**

#### **Present Investigation**

## 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

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


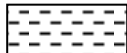



 Water Level  
 Shear Strength Determination by Pocket Penetrometer

- (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	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
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.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
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 CN16-09

1 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 145.3 E 226 267.2 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
DATUM Geodetic DATE 2019.07.03 - 2019.07.03 LATITUDE LONGITUDE CHECKED BY JPL

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						
								20 40 60 80 100						
321.6	GROUND SURFACE													
0.0	TOPSOIL (100mm)													
0.1	Gravelly <b>SAND</b> , some silt, trace clay, occasional organics Compact Brown Moist (FILL)		1	SS	29		321							
			2	SS	12									
			3	SS	24		320							
319.4														
2.2	<b>SAND</b> , silty to some silt, trace gravel, Very Loose to Loose Brown Moist		4	SS	7		319							
			5	SS	2		318							
317.5														
4.1	<b>ORGANICS</b> , occasional roots and rootlets Loose Black Moist		6	SS	4		317							
316.7														
4.9	Silty <b>SAND</b> Loose to Compact Brown Wet		7	SS	22		316							
							315							
314.4														
7.2	Clayey <b>SILT</b> , some sand, trace gravel Stiff Grey Moist (TILL)		8	SS	20		314							
312.9							313							
8.7	Silty <b>CLAY</b> , trace sand Stiff Grey Moist		9	SS	13		312							

Continued Next Page

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

# RECORD OF BOREHOLE No CN16-09

2 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 145.3 E 226 267.2 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
 DATUM Geodetic DATE 2019.07.03 - 2019.07.03 LATITUDE LONGITUDE CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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						20 40 60 80 100	PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT w <sub>P</sub> w      w <sub>L</sub> WATER CONTENT (%)						
	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist (TILL)						311							
			10	SS	13		310							
			11	SS	15		309							
			12	SS	30		308							
			13	SS	15		307							
							306							
			14	SS	60		305							
304.2														0 4 45 51
17.4	END OF BOREHOLE AT 17.4m. BOREHOLE OPEN TO 5.2m. AND WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS.													

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 7/9/20



# RECORD OF BOREHOLE No CN16-10

1 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 145.3 E 226 257.3 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH  
DATUM Geodetic DATE 2019.08.19 - 2019.08.22 LATITUDE LONGITUDE CHECKED BY JPL

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											
319.5	GROUND SURFACE							20	40	60	80	100							
0.0	TOPSOIL (100mm)							20	40	60	80	100							
0.1	Silty <b>SAND</b> , some clay, trace gravel, occasional organics Loose Brown to Black Moist (FILL)		1	SS	8		319												
			2	SS	9														
318.1							318												
1.4	<b>SAND</b> , some silt, trace clay, trace gravel, occasional cobbles Compact Brown Moist		3	SS	30														
			4	SS	20		317												
			5	SS	12		316												
315.4							315												
4.1	Clayey <b>SILT</b> , sandy, trace gravel Very Stiff to Hard Grey Moist (TILL)		6	SS	27		314												
			7	SS	33		313												
312.3							312												
7.2	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist		8	SS	36		311												
			9	SS	25		310												

Continued Next Page

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No CN16-10

2 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 145.3 E 226 257.3 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH  
 DATUM Geodetic DATE 2019.08.19 - 2019.08.22 LATITUDE LONGITUDE CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W L	UNIT WEIGHT γ kN/m <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 (%)					
	Continued From Previous Page													
	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist		10	SS	23									
			11	SS	38									
	Sandy SILT layer (125mm)		12	SS	60									0 2 51 47
			13	SS	73									
			14	SS	43									
			15	SS	40									0 5 38 57

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT  W <sub>P</sub> W                      W <sub>L</sub> WATER CONTENT (%) 20                      40                      60	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			20    40    60    80    100	20    40    60    80    100			
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED                      + FIELD VANE ● QUICK TRIAXIAL                      × LAB VANE 20    40    60    80    100				

[illegible]

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

# RECORD OF BOREHOLE No CN16-10

4 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 145.3 E 226 257.3 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH  
 DATUM Geodetic DATE 2019.08.19 - 2019.08.22 LATITUDE LONGITUDE CHECKED BY JPL


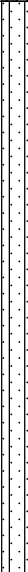
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W L	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
Continued From Previous Page																	
287.3			20	SS	100/ 0.100		289										
							288										
32.2	END OF BOREHOLE AT 32.2m. CAVED-IN DEPTH AND WATER LEVEL NOT AVAILABLE DUE TO USE OF MUD ROTARY DRILLING. BOREHOLE BACKFILLED WITH CEMENT AND GROUT, THEN HOLEPLUG TO SURFACE.		21	SS	100/ 0.150												

# RECORD OF BOREHOLE No CN16-11

1 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 188.4 E 226 266.1 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH  
 DATUM Geodetic DATE 2019.07.10 - 2019.07.10 LATITUDE LONGITUDE CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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							PLASTIC LIMIT w <sub>p</sub> NATURAL MOISTURE CONTENT w      LIQUID LIMIT w <sub>L</sub> WATER CONTENT (%)			
318.6	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL (125mm)							20	40	60	80	100						
0.1	Silty <b>SAND</b> , some gravel to gravelly, trace clay, occasional organics and rootlets Very Loose to Compact Brown Moist (FILL)		1	SS	14													
			2	SS	12													
			3	SS	2													
316.4	0.6m thick Clayey SILT layer at 2.3m																	
2.3	Silty <b>SAND</b> , trace gravel, trace clay, occasional cobbles Very Loose to Loose Brown Moist      Dense		4	SS	3													
			5	SS	5													
			6	SS	7													
			7	SS	41													
			8	SS	46													
			9	SS	32													
			10	SS	30													
312.6	Clayey <b>SILT</b> , sandy, trace gravel Hard Grey Moist (TILL)																	
6.0																		
310.0	Silty <b>CLAY</b> , trace sand Hard Grey Moist																	
8.7	0.5m sandy SILT layer at 9.5m																	
			11	SS	40													

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 7/9/20

## METRIC

[illegible]

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

## METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT  W <sub>P</sub> W      W <sub>L</sub> WATER CONTENT (%) 20    40    60	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	20				40	60
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE 20    40    60    80    100						

[illegible]

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

CONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 7/9/20

# RECORD OF BOREHOLE No CN16-11

4 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 188.4 E 226 266.1 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH  
 DATUM Geodetic DATE 2019.07.10 - 2019.07.10 LATITUDE LONGITUDE CHECKED BY JPL

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 (%)						
						20	40	60	80	100	20	40	60				
	Continued From Previous Page																
	SILT, some sand, some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)																
			22	SS	100/ 0.125												
			23	SS	100/ 0.150												
			24	SS	100/ 0.150												
283.4																	
35.2	END OF BOREHOLE AT 35.2m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2019.08.11 1.6 317.1 2019.08.29 9.0 309.7																

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 7/9/20


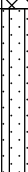
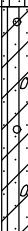



# RECORD OF BOREHOLE No CN16-12

1 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 194.5 E 226 265.5 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH  
 DATUM Geodetic DATE 2019.07.10 - 2019.07.10 LATITUDE LONGITUDE CHECKED BY JPL

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								
								20 40 60 80 100								
318.7	GROUND SURFACE															
0.0	TOPSOIL (125mm)															
0.1	Silty <b>SAND</b> to <b>SAND</b> and <b>SILT</b> , trace gravel, trace clay, occasional organics Loose Black/Brown Moist (FILL)		1	SS	6											
			2	SS	7											
			3	SS	9											
			4	SS	6											
	Occasional decayed wood fragments															
315.7																
3.0	Silty <b>SAND</b> , trace gravel, trace clay Very Loose Grey Moist		5	SS	3											
314.6																
4.1	Clayey <b>SILT</b> , some sand, trace gravel Very Stiff Grey Moist (TILL)		6	SS	29											
313.1																
5.6	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist		7	SS	35											
			8	SS	21											
			9	SS	39											

Continued Next Page

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

## METRIC

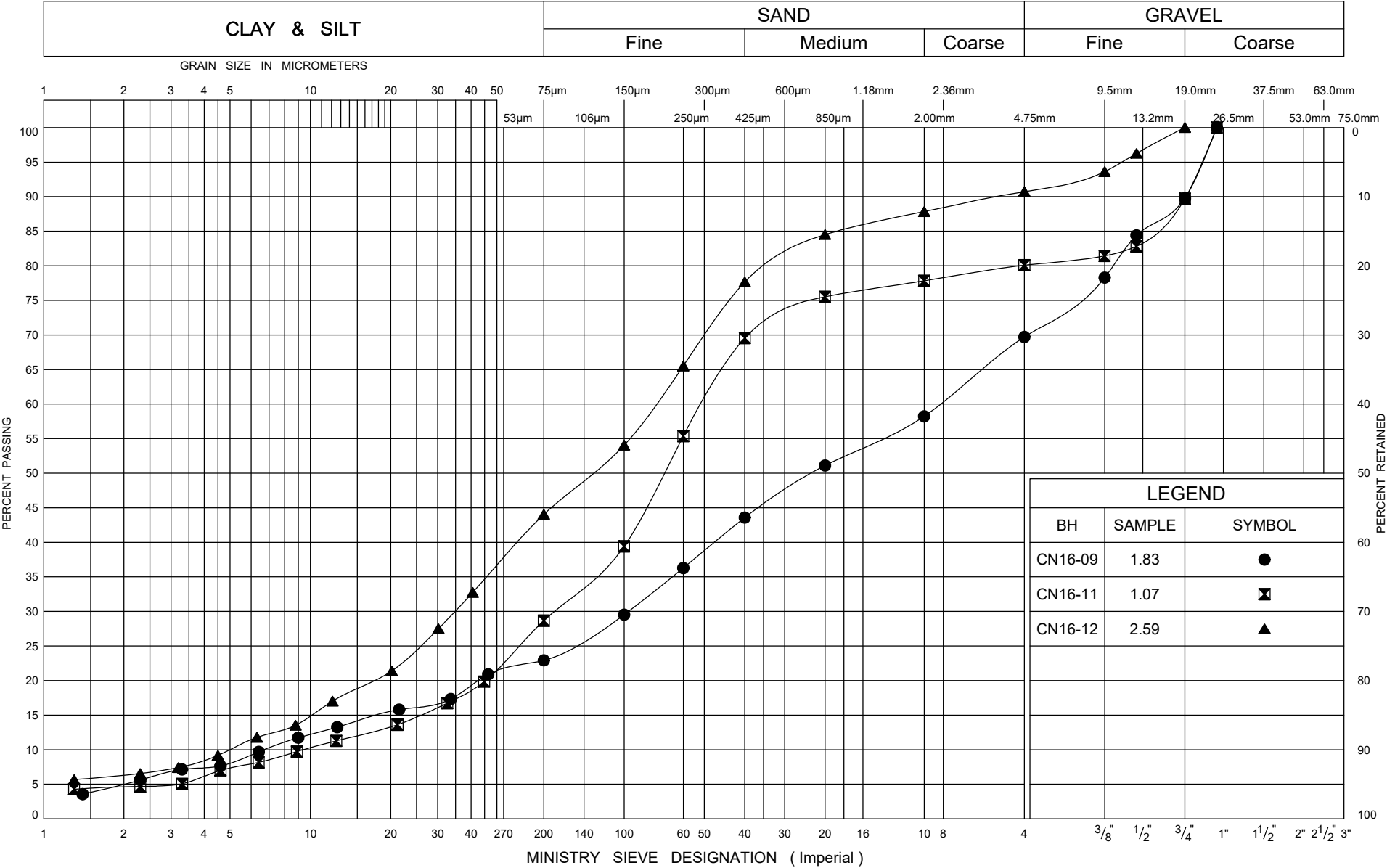
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT  W <sub>P</sub> W      W <sub>L</sub> WATER CONTENT (%) 20    40    60	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	20				40	60
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE 20    40    60    80    100						

[illegible]

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

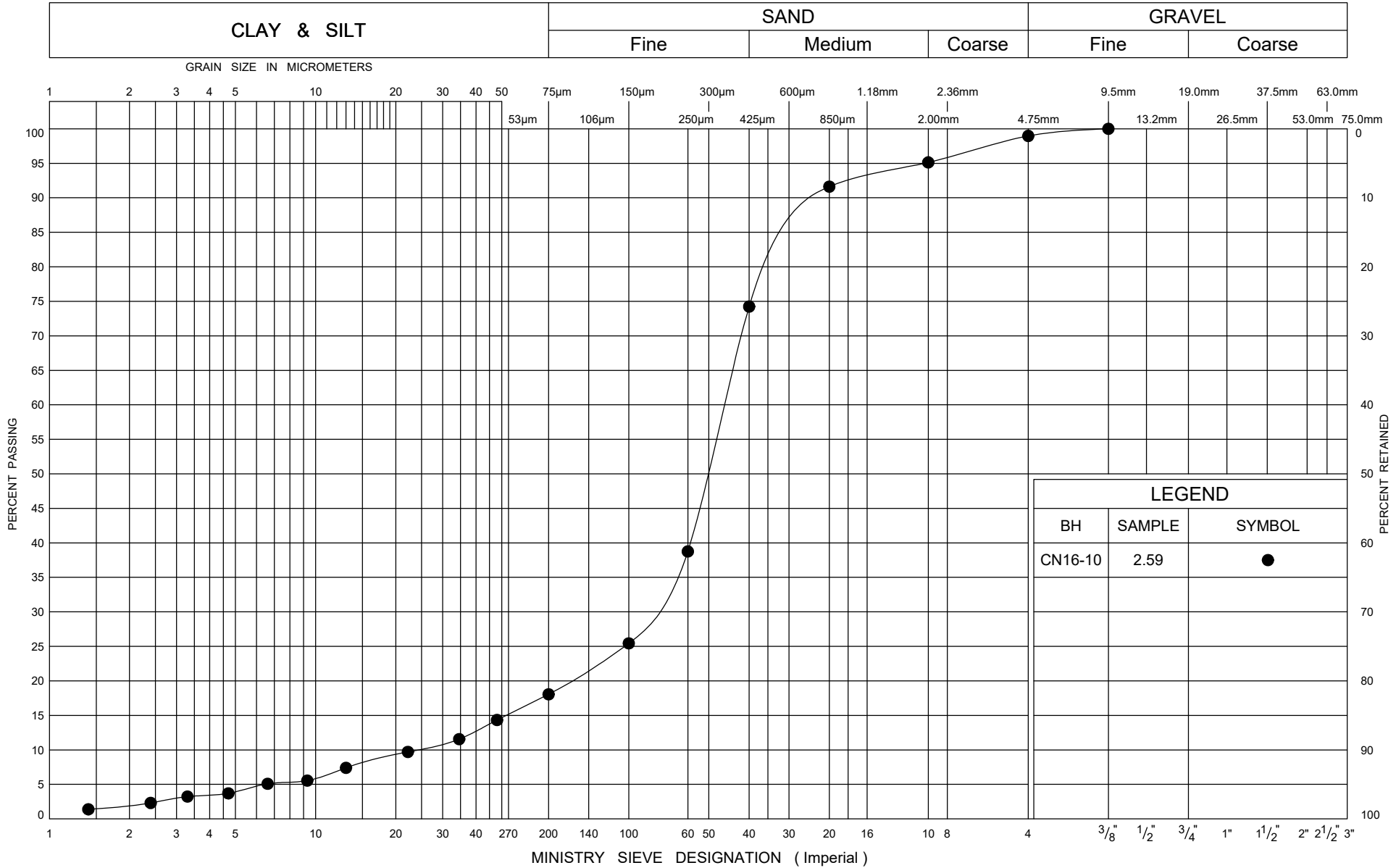
CONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 7/9/20

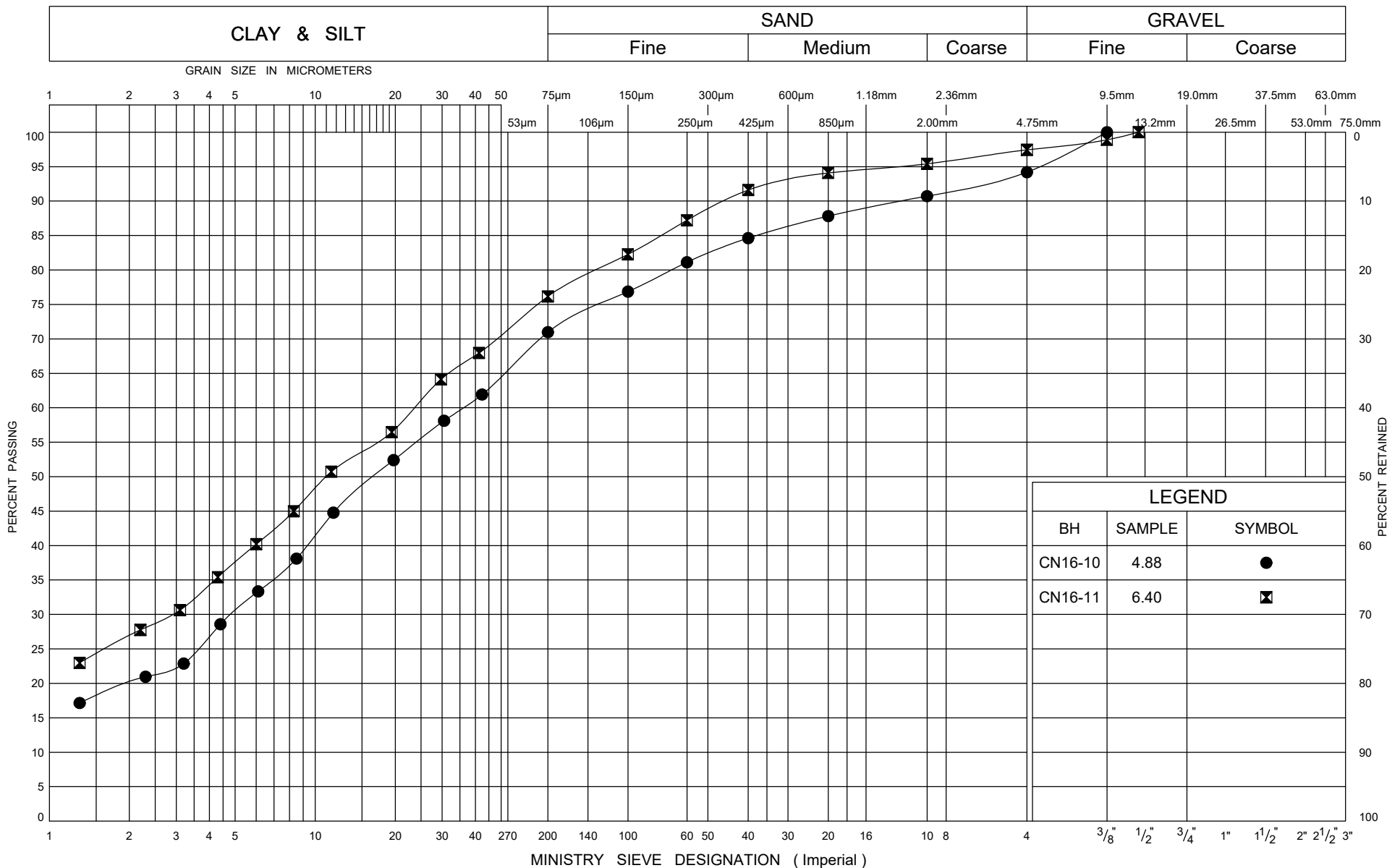
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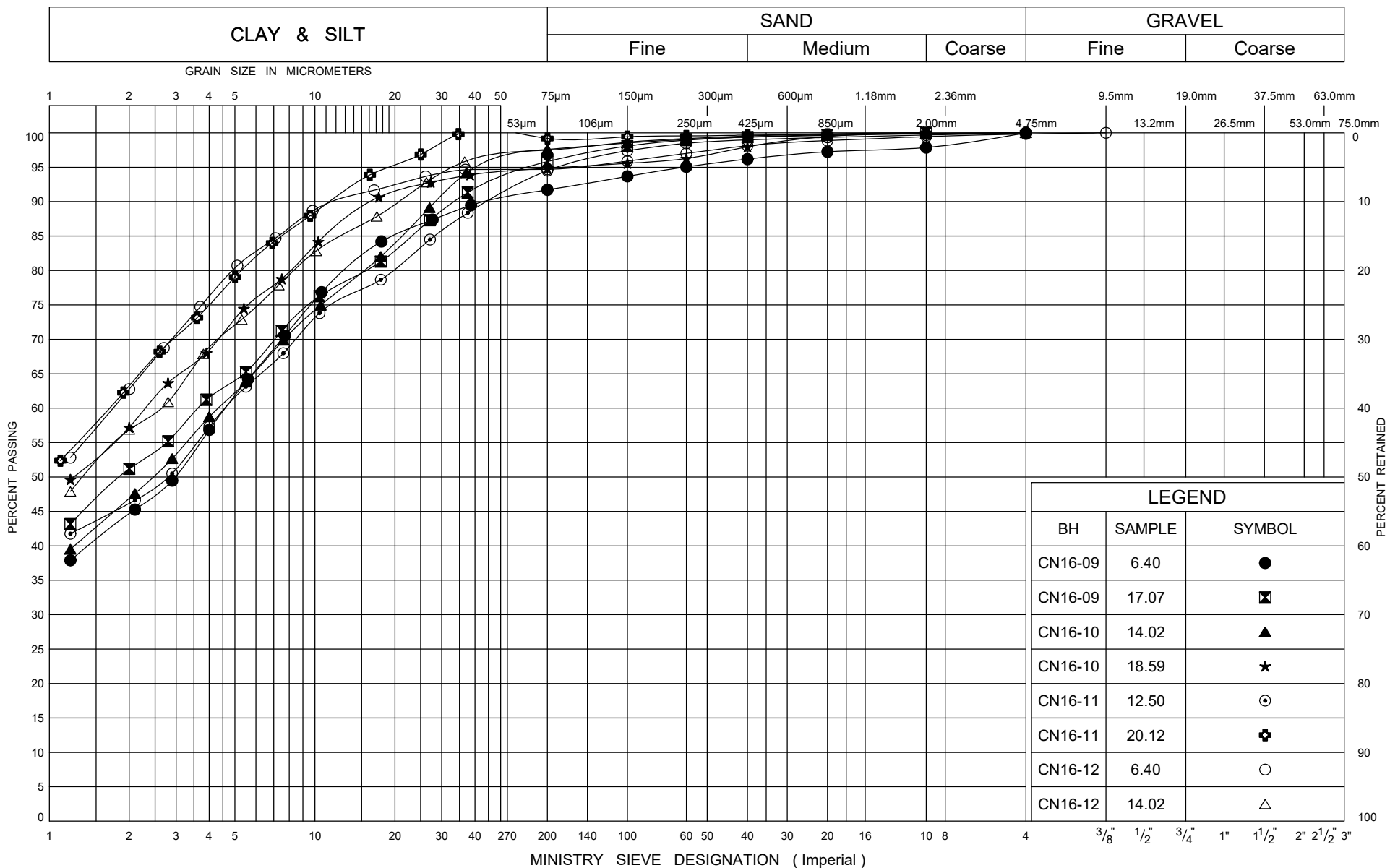


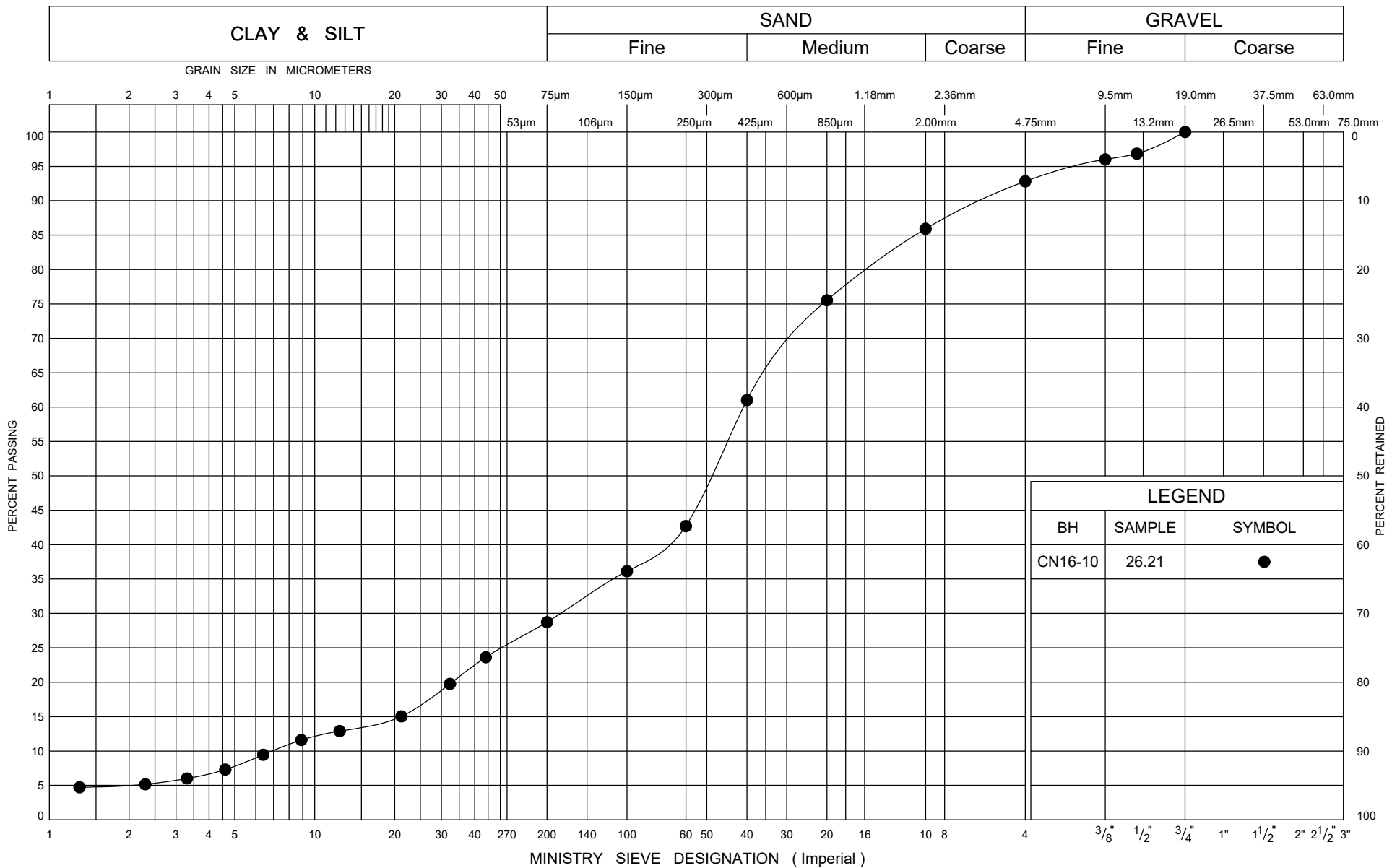
# GRAIN SIZE DISTRIBUTION FILL

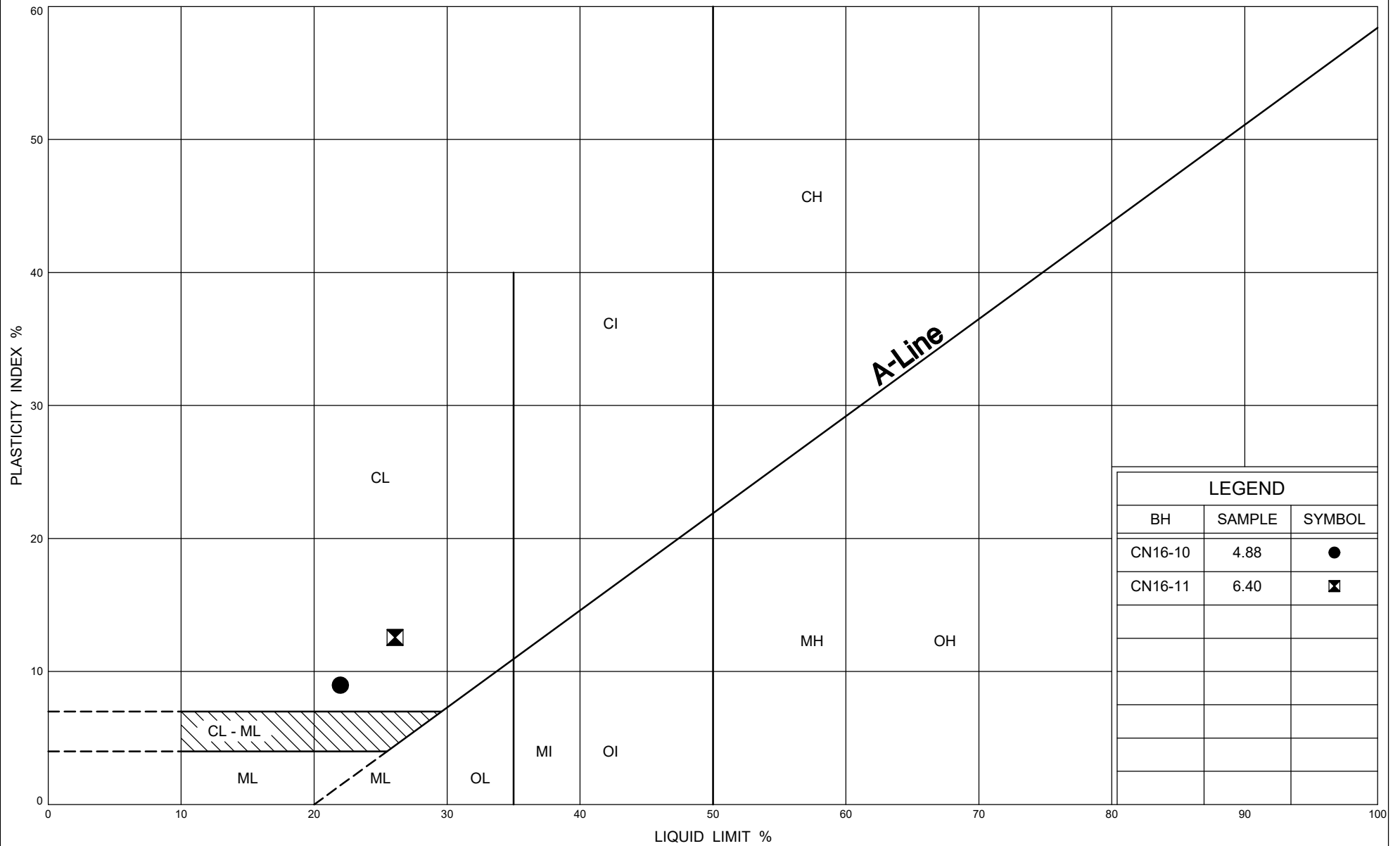
FIG No A1  
W P 408-88-00











Ministry of  
Transportation

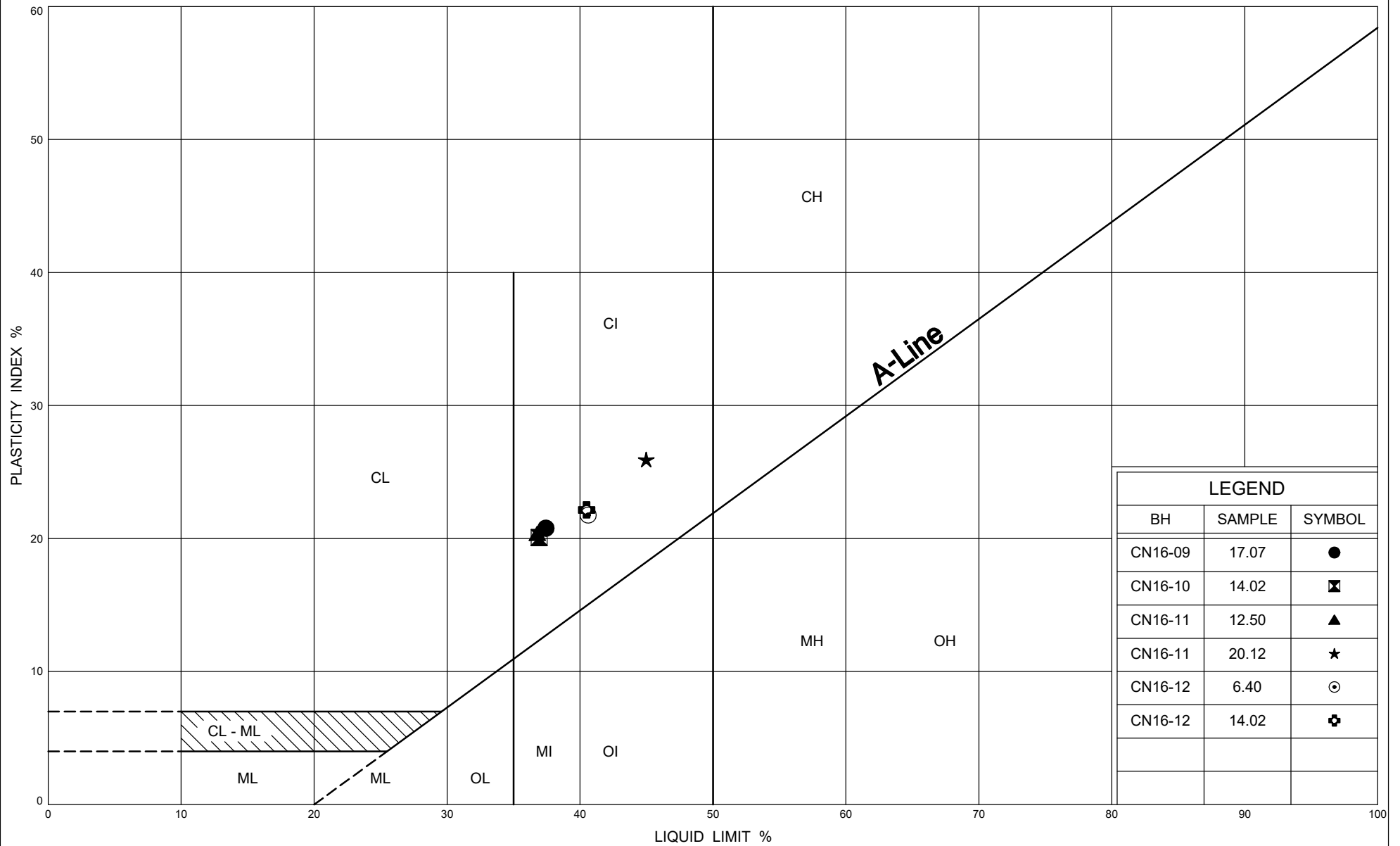
## PLASTICITY CHART

Clayey SILT TILL

FIG No A6

W P 408-88-00





Ministry of  
Transportation

## PLASTICITY CHART

Silty CLAY

FIG No A7

W P 408-88-00



## **Appendix B**

### **Record of Borehole Sheets and Laboratory Test Results**

#### **Previous investigation**

# 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

C<sub>pen</sub>


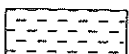



Shear Strength Determination by Pocket Penetrometer

- (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 $W_L < 50\%$	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. ( $W_L < 30\%$ ).
		CI	Inorganic clays of medium plasticity, silty clays. ( $30\% < W_L < 50\%$ ).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	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
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

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

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
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.

TERMS		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 08-045

1 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 152.87 E 226 282.83 ORIGINATED BY SA  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.08.15 - 2008.08.19 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
322.2							SHEAR STRENGTH kPa						
							○ UNCONFINED + FIELD VANE						
							● QUICK TRIAXIAL x LAB VANE						
							WATER CONTENT (%)						
							20	40	60	80	100		
0.0	ASPHALT: (150mm)		1	AS									
0.2	Gravelly SAND, some silt, occasional to numerous cobbles, gasoline odour Compact to Very Dense Dark Brown to Black Moist (FILL)		1	SS	20								
			2	SS	67								
319.9													
2.3	Sandy SILT, some clay, trace gravel, decayed wood fragments, mortar, glass pieces, strong gasoline odour, possible contamination, occasional organics Very Loose to Loose Black Wet (FILL)		3	SS	7								
			4	SS	1								
317.7													
4.6	SAND, some gravel, some silt, trace clay Compact Grey Wet		5	SS	25								
315.8													
6.4	Clayey SILT, some sand, trace gravel Very Stiff to Hard Grey (TILL)		6	SS	16								
			7	SS	35								
	occasional silty sand seams		8	SS	26								

Continued Next Page

+ 3 . x 3 : Numbers refer to  
Sensitivity

20  
15 10 5  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-045

3 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 152.87 E 226 282.83 ORIGINATED BY SA  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.08.15 - 2008.08.19 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
	Continued From Previous Page												
	Silty CLAY, trace gravel, occasional cobbles Hard Grey		15	SS	86		302						
			16	SS	96		301						
			17	SS	59		299						
			18	SS	50		298						
			19	SS	51		296						
			20	SS	57		295						
	occasional thin grey silt layers		21	SS	100/ .275		293						
293.1 29.1	Silty SAND Very Dense Grey Wet (TILL)												

Continued Next Page

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

20  
15 5  
10 (%) STRAIN AT FAILURE

ONTM4S 6417R.GPJ 11/25/08



# RECORD OF BOREHOLE No 08-045

4 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 152.87 E 226 282.83 ORIGINATED BY SA  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.08.15 - 2008.08.19 CHECKED BY RPR

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			20	40	60	80	100		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
292.0								20	40	60	80	100		
30.2	SILT, some sand, trace clay Very Dense Grey Wet (TILL) Layer of gravel (400mm)		22	SS	100/ .250		292							0 11 81 8
	Layer of gravel (200mm)						291							
290.1			23	SS	100/ .075									
32.1	END OF BOREHOLE AT 32.1m. BOREHOLE BACKFILLED WITH GROUT TO SURFACE.													

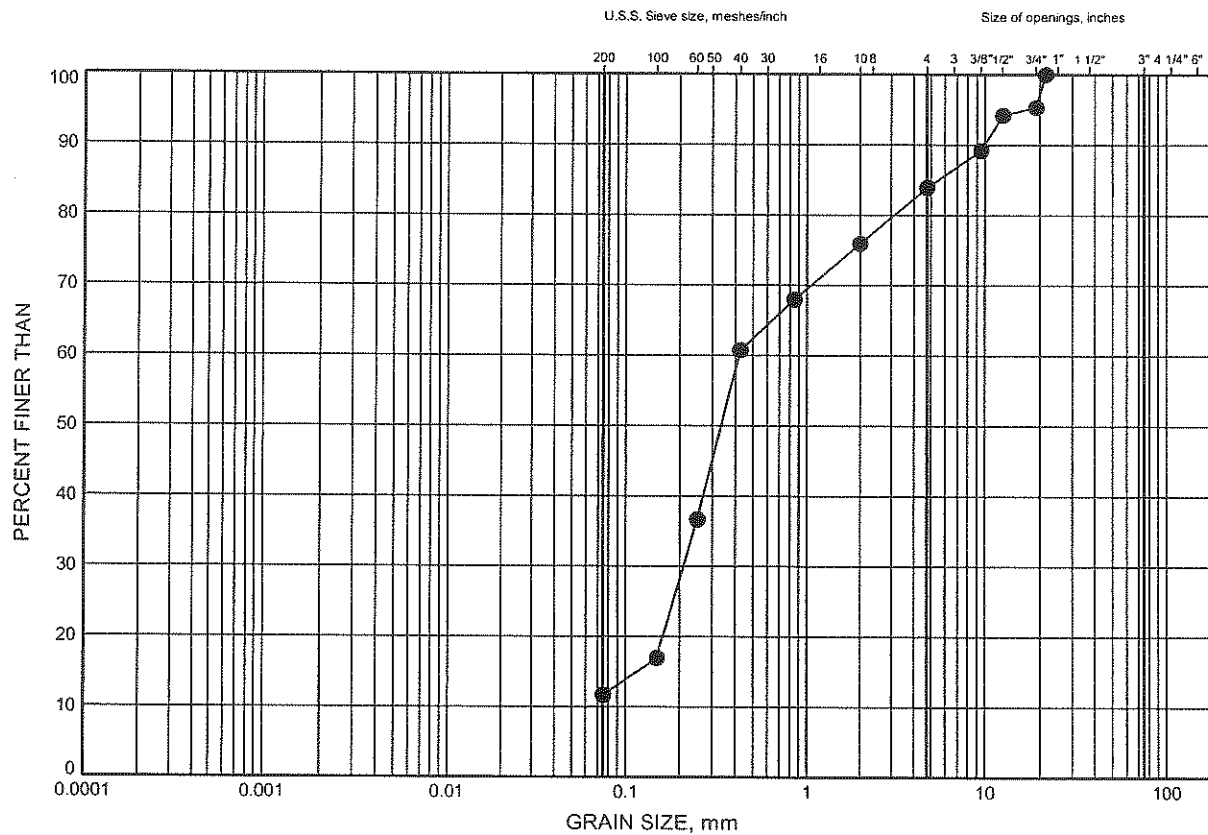
+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
5  
0  
5  
10  
15  
20  
(%) STRAIN AT FAILURE

# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B1

## SAND



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-045	4.88	317.35

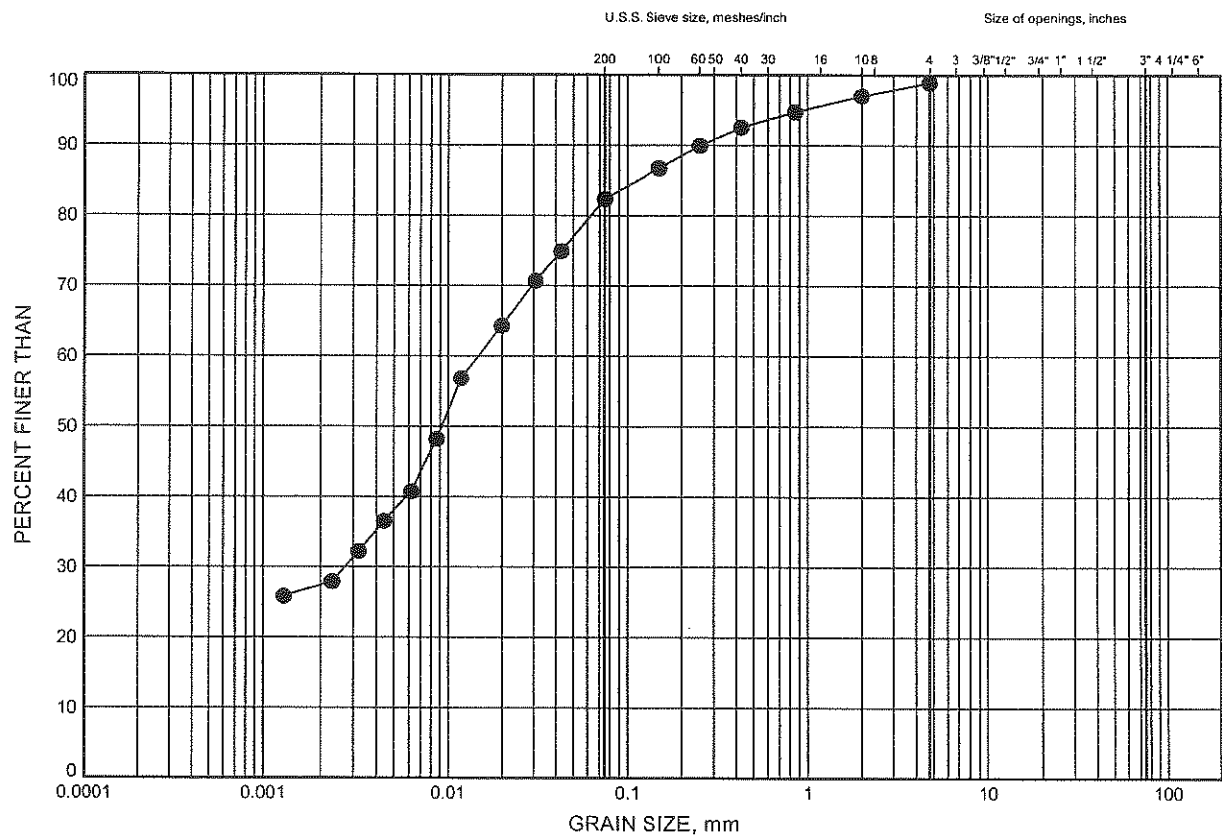


W.P.# 408-88-00  
Prepared By AN  
Checked By RPR

Highway 7 - New  
GRAIN SIZE DISTRIBUTION

FIGURE B2

CLAYEY SILT TILL



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

LEGEND

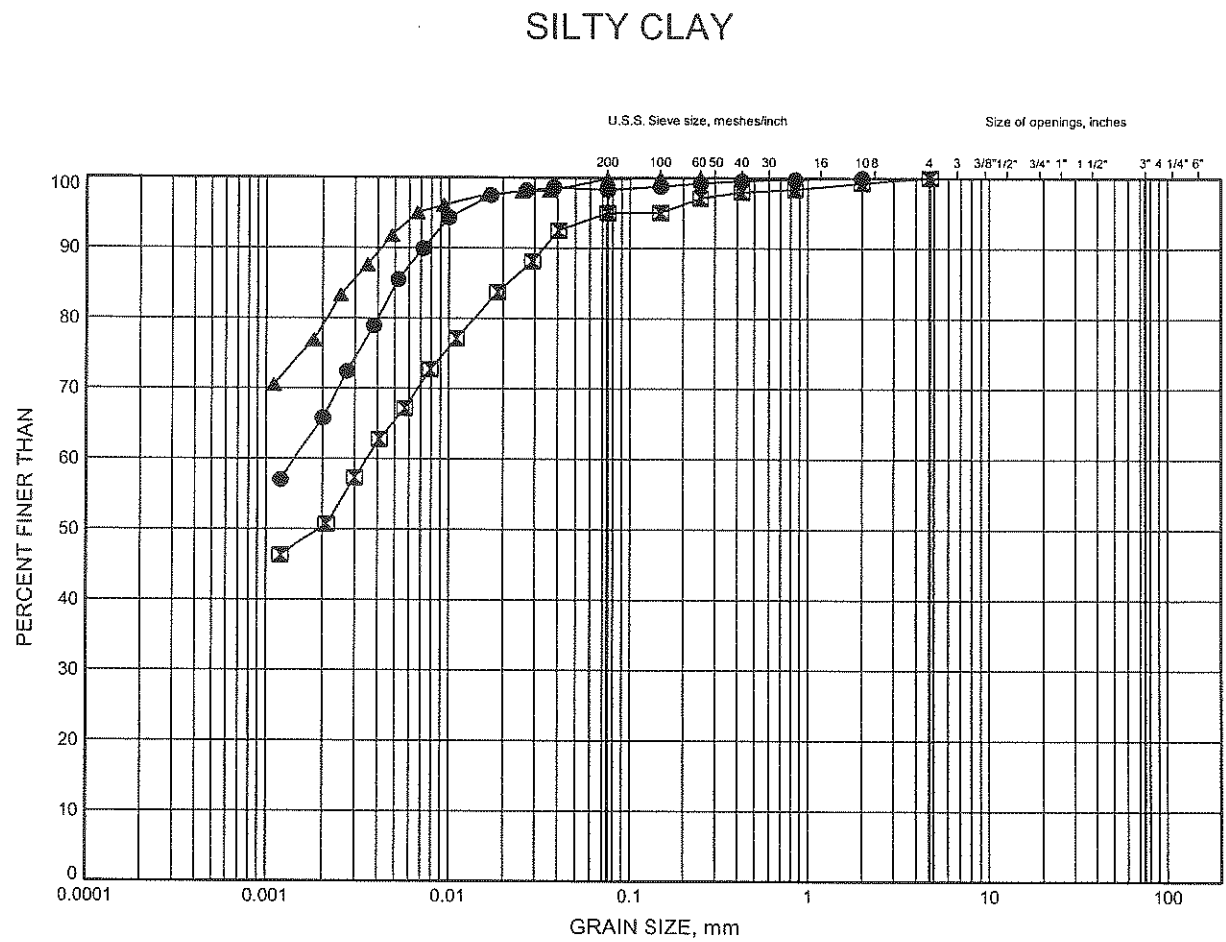
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-045	7.92	314.30



W.P.# 408-88-00  
Prepared By AN  
Checked By RPR

Highway 7 - New  
GRAIN SIZE DISTRIBUTION

FIGURE B3



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-045	12.50	309.73
⊠	08-045	18.59	303.63
▲	08-045	24.69	297.54

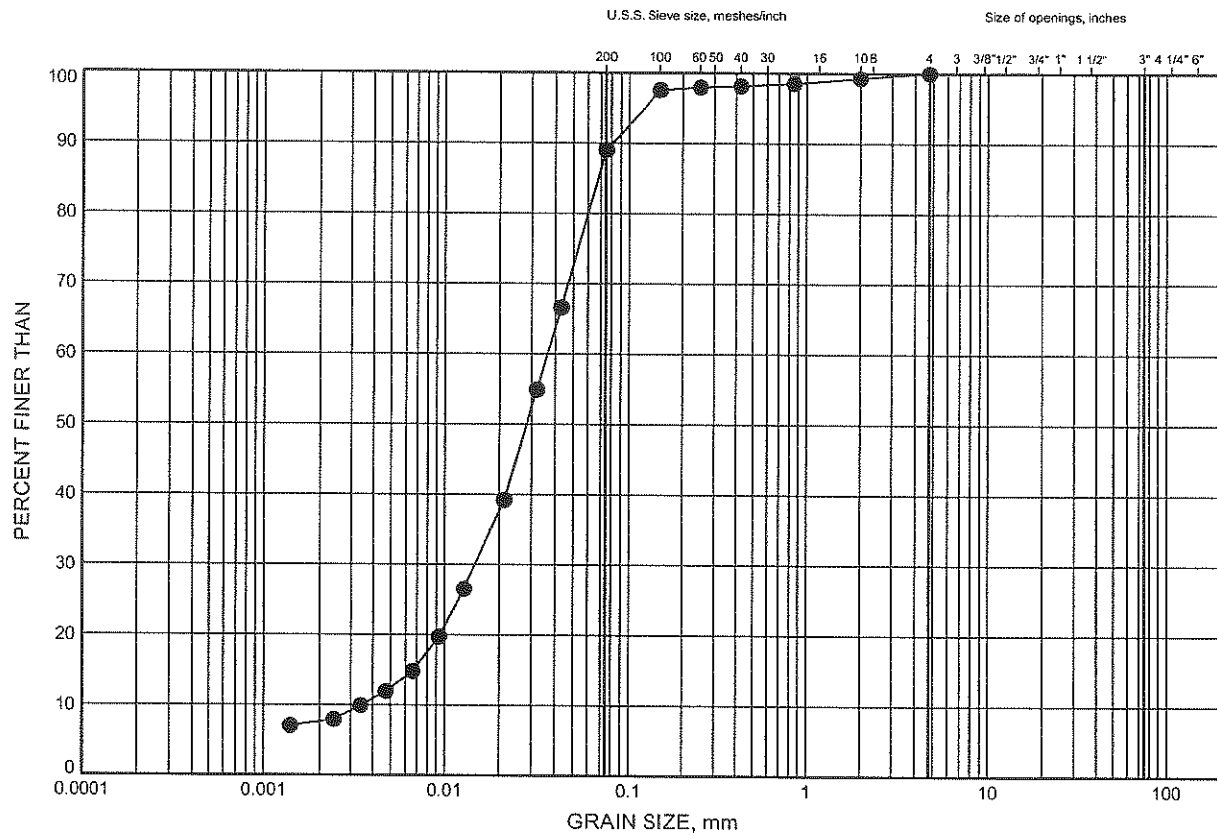


W.P.# .408-88-00.....  
Prepared By .AN.....  
Checked By .RPR.....

# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B4

## SILT TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-045	30.66	291.57

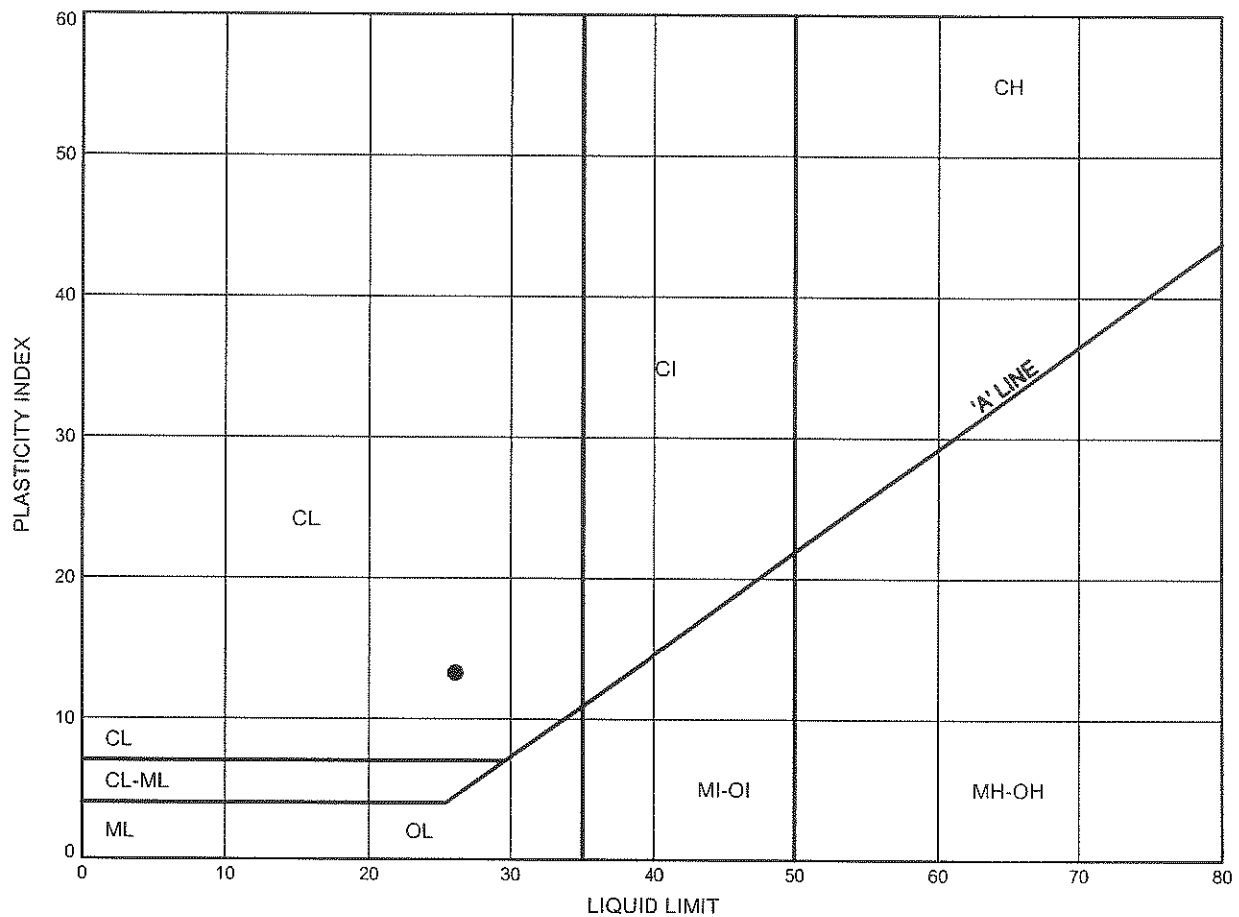


W.P.# 408-88-00  
Prepared By AN  
Checked By RPR

# Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B5

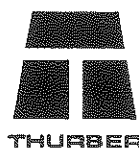
## CLAYEY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-045	7.92	314.30

Date November 2008

Project 408-88-00



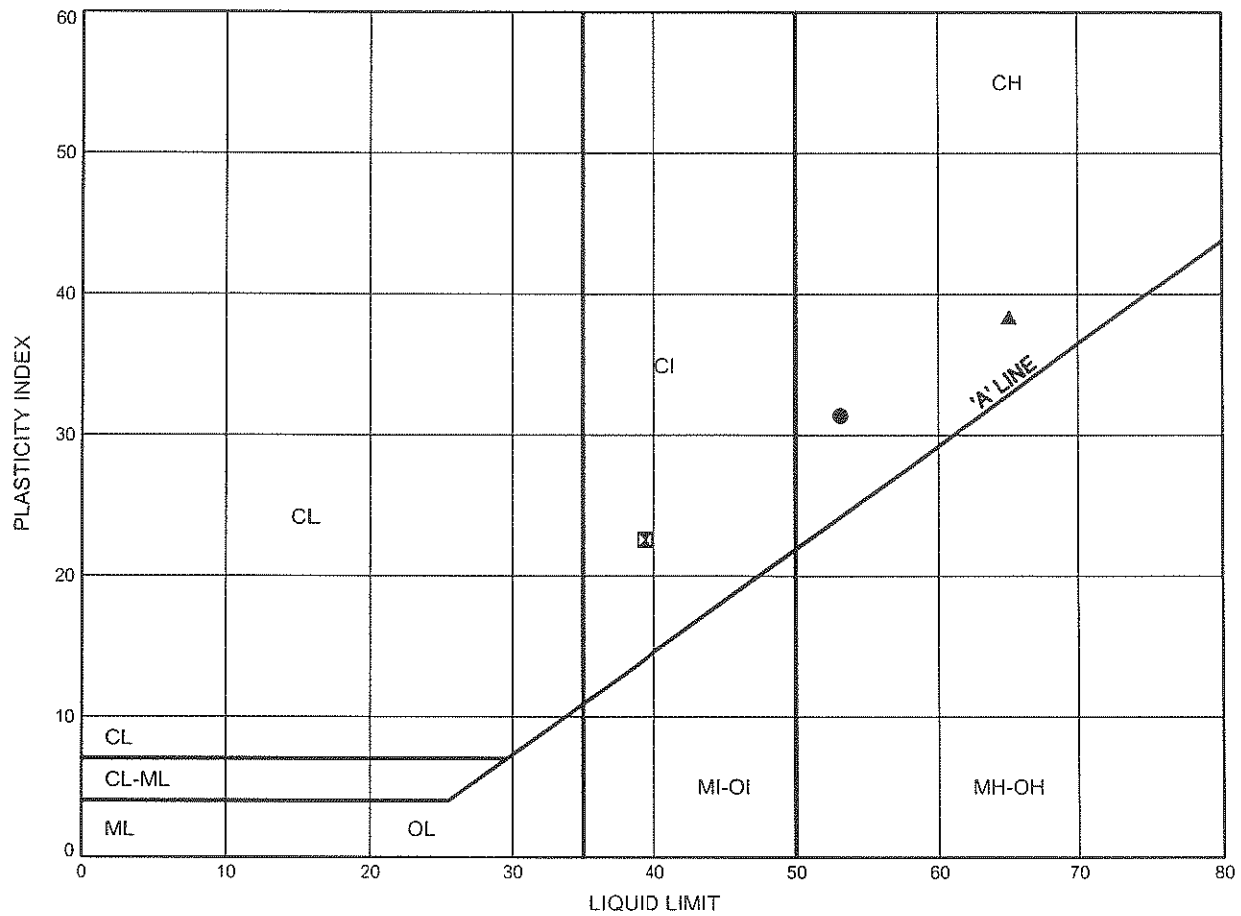
Prep'd AN

Chkd. RPR

# Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B6

## SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-045	12.50	309.73
⊠	08-045	18.59	303.63
▲	08-045	24.69	297.54

Date November 2008

Project 408-88-00



Prep'd AN

Chkd. RPR



## **Appendix C**

### **Analytical Laboratory Test Results (Present Investigation)**





## FINAL REPORT

CA14437-AUG19 R1

11375 Hwy 7 New, Kitchener

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive  
Oakville, ON  
L6H 5R7, Canada

Contact Nancy Berg

Telephone 905-829-8666 x 228

Facsimile

Email nberg@thurber.ca

Project 11375 Hwy 7 New, Kitchener

Order Number

Samples Soil (5)

### LABORATORY DETAILS

Project Specialist Rob Irwin B.Sc., C.Chem

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 705-652-2361

Facsimile 705-652-6365

Email rob.irwin@sgs.com

SGS Reference CA14437-AUG19

Received 08/13/2019

Approved 08/19/2019

Report Number CA14437-AUG19 R1

Date Reported 08/19/2019

### COMMENTS

Temperature of Sample upon Receipt: 4 degrees C

Cooling Agent Present: yes

Custody Seal Present: no

Chain of Custody Number: 009972

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

### SIGNATORIES

Rob Irwin B.Sc., C.Chem





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# FINAL REPORT

CA14437-AUG19 R1

**Client:** Thurber Engineering Ltd.

**Project:** 11375 Hwy 7 New, Kitchener

**Project Manager:** Nancy Berg

**Samplers:** Nancy Berg

## PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6	7	8	9
Sample Name	CN16-10 SS5	CN16-04 SS4	CN16-15 SS4	RW24-02 SS4	NE16-09 SS4
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	19/07/2019	23/07/2019	18/07/2019	06/08/2019	06/08/2019

Parameter	Units	RL	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------

### Corrosivity Index

Corrosivity Index	none	1	4	1	5	11	14
Soil Redox Potential	mV	-	306	312	255	263	227
Sulphide	%	0.02	< 0.02	< 0.02	0.02	< 0.02	< 0.02
pH	pH Units	0.05	8.56	8.29	7.88	8.18	8.66
Resistivity (calculated)	ohms.cm	-9999	5100	3200	2500	780	1400

## PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7	8	9
Sample Name	CN16-10 SS5	CN16-04 SS4	CN16-15 SS4	RW24-02 SS4	NE16-09 SS4
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	19/07/2019	23/07/2019	18/07/2019	06/08/2019	06/08/2019

Parameter	Units	RL	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------

### General Chemistry

Conductivity	uS/cm	2	195	317	400	1280	736
--------------	-------	---	-----	-----	-----	------	-----

## PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9
Sample Name	CN16-10 SS5	CN16-04 SS4	CN16-15 SS4	RW24-02 SS4	NE16-09 SS4
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	19/07/2019	23/07/2019	18/07/2019	06/08/2019	06/08/2019

Parameter	Units	RL	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------

### Metals and Inorganics

Moisture Content	%	0.1	20.1	6.1	24.6	13.1	6.5
Sulphate	µg/g	0.4	25	12	100	31	13



FINAL REPORT

CA14437-AUG19 R1

Client: Thurber Engineering Ltd.

Project: 11375 Hwy 7 New, Kitchener

Project Manager: Nancy Berg

Samplers: Nancy Berg

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6	7	8	9
Sample Name	CN16-10 SS5	CN16-04 SS4	CN16-15 SS4	RW24-02 SS4	NE16-09 SS4
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	19/07/2019	23/07/2019	18/07/2019	06/08/2019	06/08/2019

Parameter	Units	RL		Result	Result	Result	Result	Result
Other (ORP)								
Chloride	µg/g	0.4		25	7.8	60	760	430



# FINAL REPORT

CA14437-AUG19 R1

## QC SUMMARY

### Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0262-AUG19	µg/g	0.4	<0.4	9	20	93	80	120	98	75	125
Sulphate	DIO0262-AUG19	µg/g	0.4	<0.4	13	20	94	80	120	96	75	125

### Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0029-AUG19	%	0.02	<0.02	ND	20	110	80	120			

### Conductivity

Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0246-AUG19	uS/cm	2	< 0.002	0	10	100	90	110	NA		



QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0246-AUG19	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

**Multielement Scan Qualifier:** as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier:** for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

**Matrix Spike Qualifier:** for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at [http://www.sgs.com/terms\\_and\\_conditions.htm](http://www.sgs.com/terms_and_conditions.htm). The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

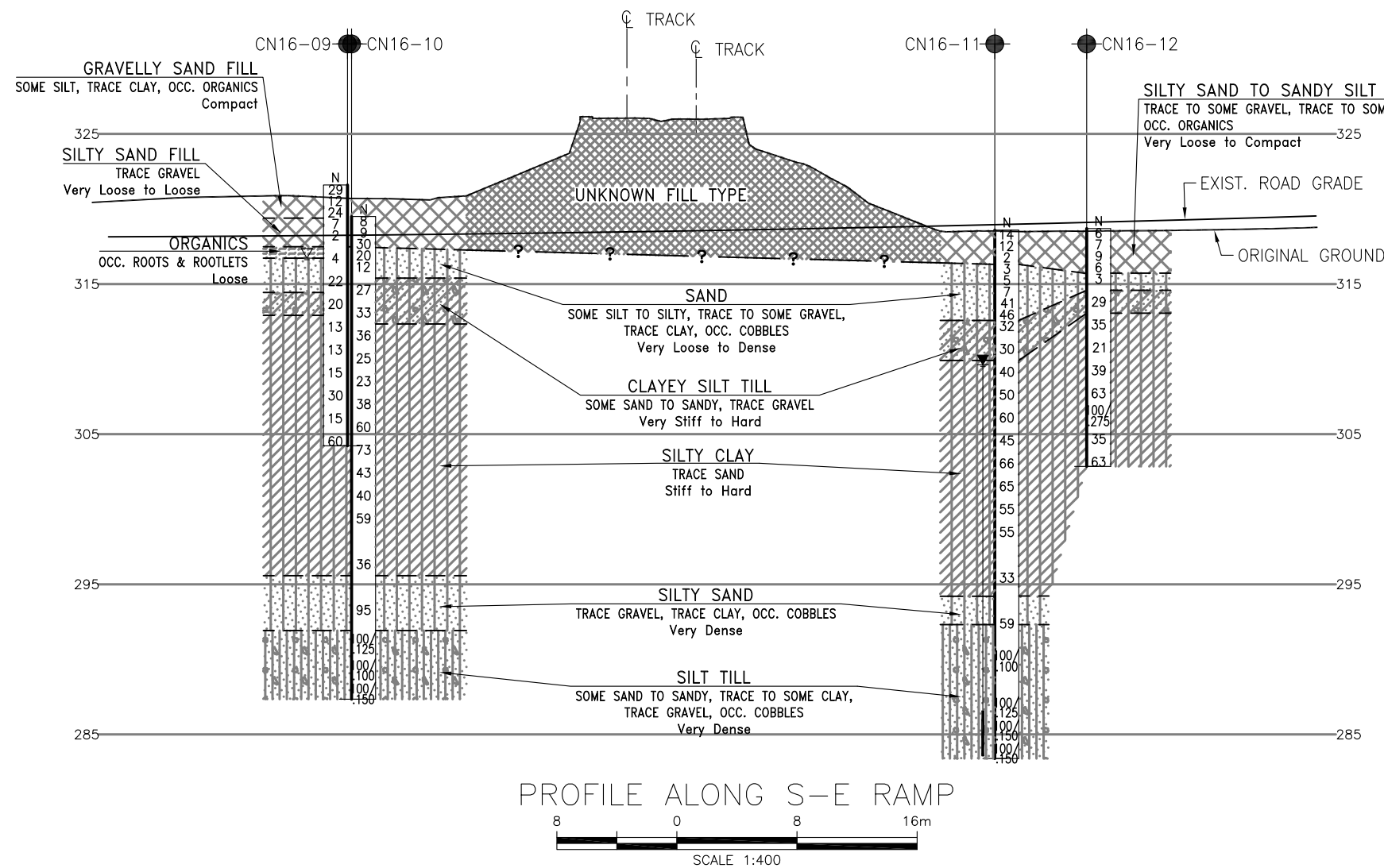
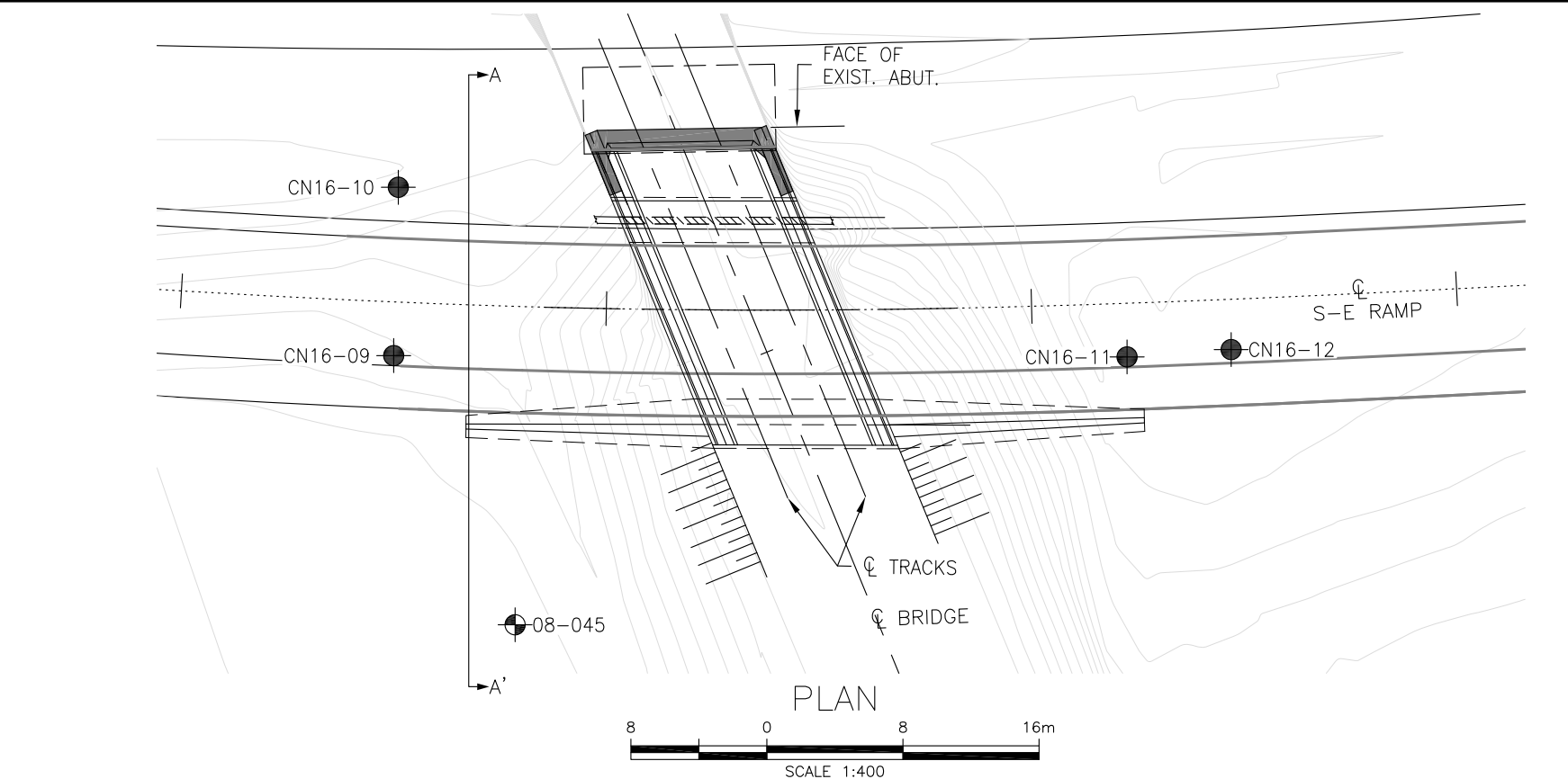


REPORT INFORMATION				INVOICE INFORMATION				PROJECT INFORMATION			
Received By: <u>Oleg Moshin</u>				Received By (signature): <u>[Signature]</u>				Quotation #: _____			
Received Date (mm/dd/yy): <u>8/15/19</u> (mm/dd/yy)				Custody Seal Present: <input checked="" type="checkbox"/> <u>ice</u>				Project #: <u>11375</u>			
Received Time: <u>11:05</u>				Custody Seal Intact: <input checked="" type="checkbox"/> <u>no</u>				Site Location/ID: <u>Hwy 7 New Kitchens</u>			
Company: <u>Thurber Engineering Ltd</u>				<input type="checkbox"/> (same as Report Information)				P.O. #: _____			
Contact: <u>Nancy Berg</u>				Company: _____				TURNAROUND TIME (TAT) REQUIRED			
Address: <u>103 - 2010 Winston Park Dr</u>				Contact: _____				TAT's are quoted in business days (exclude statutory holidays & weekends).			
City: <u>Oakville On L6H 5A7</u>				Address: _____				Samples received after 6pm or on weekends: TAT begins next business day			
Phone: <u>647-633-8411</u>				Phone: _____				<input checked="" type="checkbox"/> Regular TAT (5-7days)			
Email: <u>nberg@thurber.ca</u>				Email: _____				<input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3 Days <input type="checkbox"/> 4 Days			
Rush Confirmation ID: _____				Specify Due Date: _____				RUSH TAT (Additional Charges May Apply):			
NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY				NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY				PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION			
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Regulation 153/04:				Regulation 153/04:				ANALYSIS REQUESTED			
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RECORD OF SITE CONDITION (RSC) <input type="checkbox"/> YES <input type="checkbox"/> NO				Sewer By-Law: <input type="checkbox"/> Sanitary <input type="checkbox"/> Storm <input type="checkbox"/> Municipality: _____				Field Filtered (Y/N)			
SAMPLE IDENTIFICATION				DATE SAMPLED				TIME SAMPLED			
1 CN16-10 555				July 19/19				1 Soil			
2 CN16-04 554				July 23/19				1 Soil			
3 CN16-15 554				July 18/19				1 Soil			
4 RW24-02 554				Aug 6/19				1 Soil			
5 NE16-09 554				Aug 7/19				1 Soil			
6											
7											
8											
9											
10											
11											
12											
Observations/Comments/Special Instructions											
Sampled By (NAME): <u>Nancy Berg</u>				Signature: <u>[Signature]</u>				Date: <u>08/11/19</u> (mm/dd/yy)			
Relinquished by (NAME): <u>Nancy Berg</u>				Signature: <u>[Signature]</u>				Date: <u>08/11/19</u> (mm/dd/yy)			
Pink Copy - Client				Yellow & White Copy - SGS							



## **Appendix D**

### **Borehole Locations and Soil Strata Drawing**

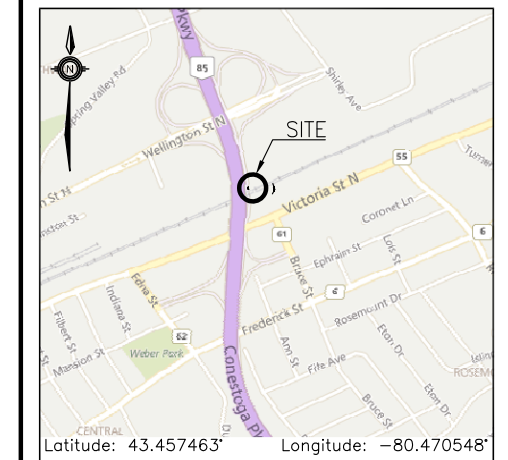


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN








CONT No  
GWP No 408-88-00

HIGHWAY 7  
S-E RAMP CONNECTION BRIDGE  
UNDER METROLINX TRACKS  
BOREHOLE LOCATIONS AND SOIL STRATA



## KEYPLAN

## LEGEND

	Borehole (Current Investigation)
	Borehole (Previous Investigation By Thurber)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

-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.
- 3) Coordinate system is MTM NAD 83 Zone 10.

**GEOCRES No. 40P8-279**

REVISIONS								
	DATE	BY				DESCRIPTION		
	DESIGN NB	CHK	PKC			LOAD	DATE	JUL 2020
	DRAWN AN	CHK	NB		CODE	STRUCT	DWG	1



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



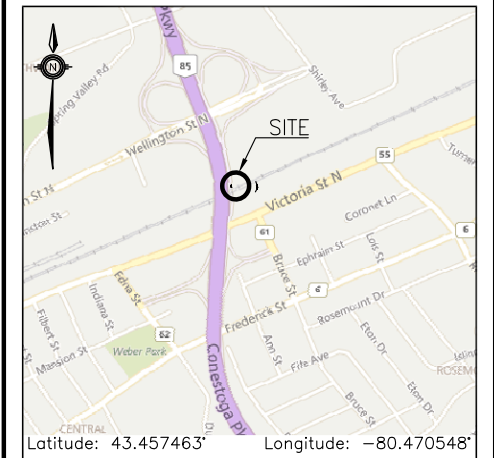
CONT No  
GWP No 408-88-00

HIGHWAY 7  
S-E RAMP CONNECTION BRIDGE  
UNDER METROLINX TRACKS  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



THURBER ENGINEERING LTD.



## KEYPLAN

### LEGEND

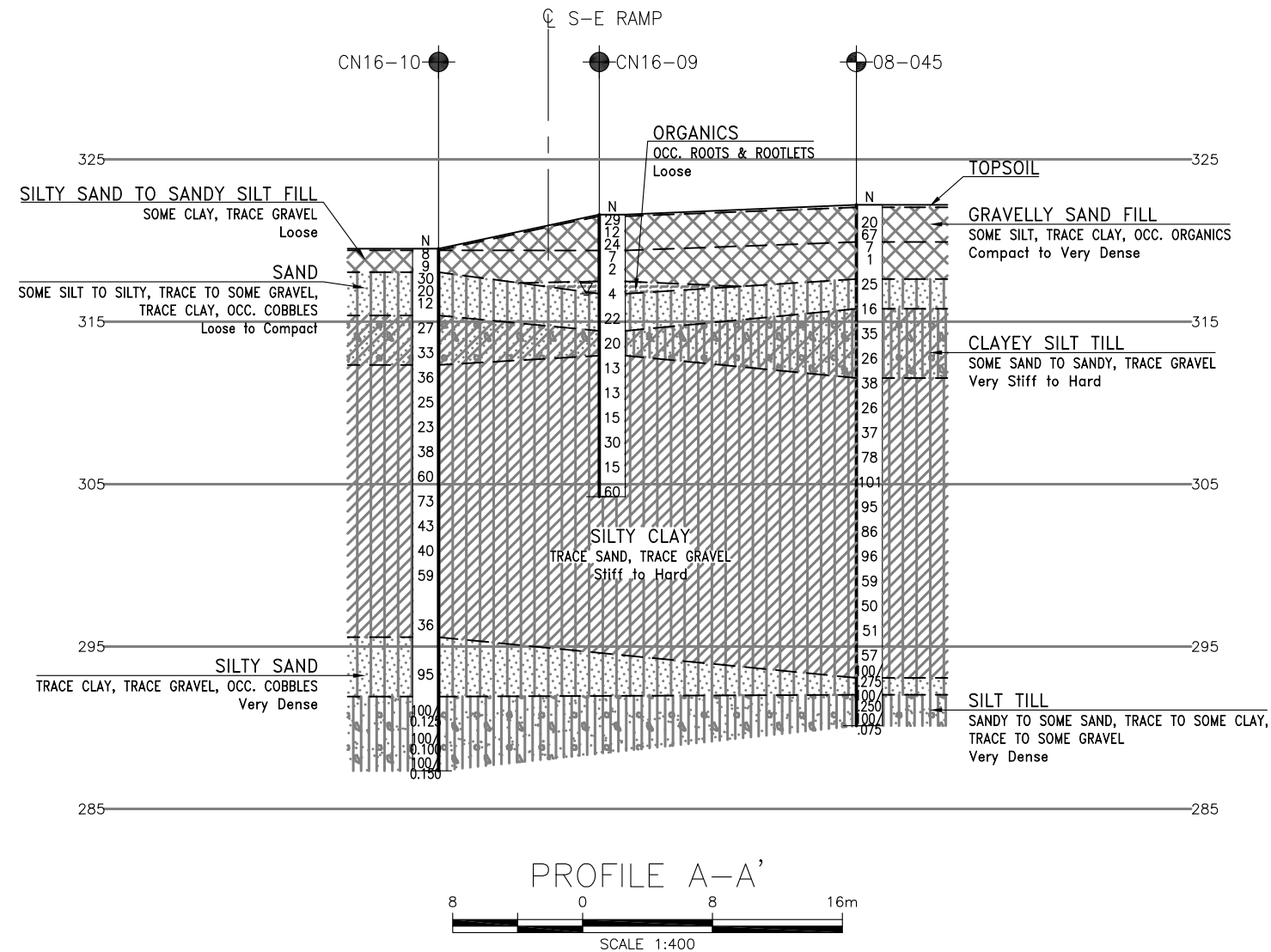
	Borehole (Current Investigation)
	Borehole (Previous Investigation By Thurber)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-045	322.2	4 814 152.9	226 282.8
CN16-09	321.6	4 814 145.3	226 267.2
CN16-10	319.5	4 814 145.3	226 257.3
CN16-11	318.6	4 814 188.4	226 266.1
CN16-12	318.7	4 814 194.5	226 265.5

### -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.
- Coordinate system is MTM NAD 83 Zone 10.

**GEOCRES No. 40P8-279**



REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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## **Appendix E**

### **Site Photographs**



Photo 1: Borehole CN 16-09, looking North at the existing East Abutment of the Metrolinx Bridge



Photo 2: Borehole CN 16-10, looking North at the existing East Abutment of the Metrolinx Bridge





Photo 3: Borehole CN 16-11, looking South at the existing East Abutment of the Metrolinx Bridge





Photo 4: Borehole CN 16-12, looking South at the existing East Abutment of the Metrolinx Bridge