



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
METROLINX RAILWAY BRIDGE FROM WELLINGTON STREET NORTH TO EDNA
STREET CONNECTION AND E-S RAMP
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 408-88-00**

GEOCRES No. 40P8-278

Latitude 43.457463 ° , Longitude -80.470548 °

Report

to

WSP

Date: June 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 E-S Ramp and Wellington to Edna Street Connection Road underpass bridge that will pass under the Metrolinx tracks as part of the Highway 7-New Project in the Regional Municipality of Waterloo, Ontario.

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, E-S Ramp and Connection Road under CNR Tracks, Highway 7-New, Kitchener to Guelph, G.W.P. 408-88-00,

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Geocres No. 40P8-166, Report to Ministry of Transportation Ontario Southwestern Region, File: 15-64-17, dated November 10, 2009. (Reference 1).

- Foundation investigation report for C.N.R. Subway, Kitchener-Waterloo Expressway, District #4 (Hamilton), Geocres No. 40P8-45, W.J. 66-F-37, W.P. 636-64, dated July 4, 1966. (Reference 2).

Records of boreholes from the previous reports (Boreholes 08-041 and 08-042) are attached in Appendix B for reference.

2. SITE DESCRIPTION

The site lies on the west side of Kitchener-Waterloo Expressway (KWE), approximately 250 m to the south of Wellington Street and 110 m north of Victoria Street. At this location, the proposed E-S Ramp and Wellington to Edna Connection Road will pass under the existing twin east-west Metrolinx tracks. Approximately 50 m west of the existing Metrolinx bridge over KWE, 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 m west, to Lancaster Street East. The site lies within an area of industrial and commercial lands and is generally flat. Photographs of the site are included in Appendix E.

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.

3. SITE INVESTIGATION AND FIELD TESTING

A detailed site investigation was carried out from July 3, 2018 to August 29, 2019. Eight boreholes, numbered CN16-01 to CN16-08, were drilled near the west and east abutments of the proposed structure. A summary of the borehole locations, designations, borehole termination depths and termination elevations for each borehole is provided in Table 3.1. The boreholes were drilled to depths from 15.8 to 38.3 m (Elevation 310.0 to 282.0). The coordinates and elevations of the boreholes are given on the drawings and on the individual Record of Borehole Sheets. It should be noted that no borehole was drilled to investigate the railway embankment due to access constraints as well as restrictions imposed by Metrolinx.

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 current and previous boreholes are shown on the attached Borehole Locations and Soil Strata Drawing 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.

Groundwater conditions in the open boreholes were observed during the drilling operations. Three piezometers were installed at Boreholes CN16-01, CN16-04 and CN16-07 to permit for longer term monitoring of the groundwater levels. The piezometers consisted of 25 mm or 50 mm diameter PVC pipe with a slotted screen enclosed in filter sand. The piezometers are planned to be decommissioned in the summer of 2020. The completion of the boreholes were carried out in accordance with the requirements of O. Reg. 903 (as amended by O. Reg. 372/07).

Table 3.1 – Borehole Completion Details

Foundation Unit	Borehole	Ground Surface Elevation	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
East Abutment	CN16-01	325.5	15.8/309.7	15.2/310.3	Piezometer with 3.0 m slotted screen installed with sand filter from 15.2 m to 11.6 m, bentonite holeplug from 11.6 m to 9.1 m, grout from 9.1 m to 0.3 m and bentonite holeplug from 0.3 m to ground surface.
	CN16-03	321.3	38.3/283.1	No Installation	Borehole backfilled with grout holeplug.



Foundation Unit	Borehole	Ground Surface Elevation	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
	CN16-05	325.5	38.3/287.3	No Installation	Borehole backfilled with cement and grout, and bentonite holeplug to surface.
	CN16-07	320.8	15.8/305.0	15.2/305.6	Piezometer with 3.0 m slotted screen installed with sand filter from 15.2 m to 11.6 m, bentonite holeplug from 11.6 m to 10.7 m and grout from 10.7 m to ground surface.
	08-042	322.8	20.1/302.7	19.2/303.6	Piezometer with 1.5 m slotted screen installed with sand filter to 17.4 m, holeplug from 17.4 m to 16.8 m, grout from 16.8 m to 0.6 m, then holeplug to surface.
West Abutment	CN16-02	326.1	37.0/289.1	No Installation	Borehole backfilled with cement and grout, and bentonite holeplug to surface.
	CN16-04	323.3	41.3/282.0	41.1/282.2	Piezometer with 3.0 m slotted screen installed with sand filter from 41.1 m to 37.2 m, bentonite pellets from 37.2 m to 36.3 m, grout from 36.3 m to 1.5 m and bentonite holeplug from 1.5 m to ground surface.
	CN16-06	325.9	15.8/310.0	No Installation	Borehole backfilled with cement and grout, and bentonite holeplug to surface.
	CN16-08	322.0	15.8/306.2	No Installation	Borehole backfilled with cement and grout, and bentonite holeplug to surface.
	08-041	326.3	37.2/289.1	No Installation	Grout to 0.6 m then bentonite holeplug to ground surface.

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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 silty sand fill 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 upper sand, silty clay till, silty clay, a lower sand layer and sandy silt till.

5.1 Topsoil

A layer of topsoil was encountered surficially in nine boreholes drilled at this site, CN16-02 to CN16-08, 08-041 and 08-042. It was generally dark brown in colour. The thickness of the topsoil layer ranged from 40 mm to 300 mm. The topsoil thickness may vary between the borehole locations and in other areas of the site.



5.2 Fill

Fill was encountered surficially in Borehole CN16-01 and immediately below the topsoil in the other boreholes at this site, Boreholes CN16-02 to CN16-08, 08-041 and 08-042.

The fill generally consisted of silty sand and contained trace gravel to gravelly, trace to some clay, and was generally brown in colour. Zones of sandy silt fill and sand fill were also encountered in Boreholes CN16-06 and 08-041.

A layer of clayey silt fill was also encountered below the sand fill in Borehole 08-041 and contained some sand to sandy and trace gravel. The clayey silt fill was generally brown in colour.

Occasional organics were encountered in the fill in Boreholes CN16-01, CN16-02, CN16-07, CN16-08 and 08-042, and occasional decayed wood fragments were encountered in Borehole CN16-07. Occasional cobbles were encountered in the fill in Boreholes CN16-01, CN16-02, CN16-06 and CN16-07. Auger grinding was noted in the fill in Borehole CN16-01.

The thickness of the fill ranged from 1.2 m to 4.0 m, with the lower boundary of this layer encountered at depths ranging from 1.4 m to 4.1 m (Elevation 324.9 to 317.8).

SPT N-values recorded in the cohesionless fill generally ranged from 6 blows for 0.3 m penetration to 100 blows for 0.25 m penetration, indicating a loose to very dense relative density.

Moisture content of samples of the cohesionless fill generally ranged from 4 percent to 18 percent.

Select 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	Fill (%)
Gravel	1 to 24
Sand	38 to 60
Silt	25 to 44
Clay	4 to 14



5.3 Organics

A layer of buried organics was encountered below the silty sand fill layer in Borehole CN16-05, at a depth of 3.5 m (Elevation 322.0).

The thickness of the organics layer was 0.6 m, with the lower boundary of this layer encountered at a depth of 4.1 m (Elevation 321.4).

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

The moisture content from a sample of the organics layer was measured to be 15 percent.

The organics thickness may vary beyond the borehole location and in other areas of the site.

5.4 Upper Sand

An upper sand layer was encountered below the fill in all the boreholes at this site, except for CN16-05, where the sand was encountered below the buried organics layer.

The upper sand layer was encountered at depths ranging from 1.4 m to 4.1 m (Elevation 324.9 to 317.8).

The upper sand layer was brown to grey in colour and contained trace gravel to gravelly, trace to some silt and trace clay. Occasional organics were encountered in the sand layer in Borehole CN16-02, and occasional cobbles were encountered in Boreholes CN16-02 and CN16-06.

The thickness of the upper sand layer ranged from 1.1 m to 10.4 m, with the lower boundary of the sand layer encountered at depths ranging from 4.1 m to 11.8 m (Elevation 318.5 to 314.5).

SPT N-values recorded in the upper sand ranged from 4 blows for 0.3 m penetration to 100 blows for 0.175 m penetration, indicating a loose to very dense relative density.

Moisture content of samples of the upper sand generally ranged from 3 percent to 28 percent.

Select samples of the upper 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 A3 and Figure B1. The results of this testing are summarized as follows:

Soil Particles	Upper Sand (%)
Gravel	0 to 27
Sand	64 to 97
Silt and Clay	2 to 22

5.5 Silty Sand to Sandy Silt

A silty sand pocket was encountered below the silty clay till in Borehole CN16-06 at a depth of 13.3 m (Elevation 312.6). The silty sand pocket contained some clay and trace gravel, with a thickness of 2.4 m and a lower boundary at 15.7 m (Elevation 310.2).

A sandy silt pocket was also encountered within the silty clay in Borehole CN16-03 at a depth of 14.8 m (Elevation 306.5). The sandy silt pocket contained some clay, with a thickness of 0.9 m and a lower boundary at 15.7 m (Elevation 305.6).

SPT N-Values recorded in the silty sand and sandy silt ranged from 39 blows to 90 blows for 0.3 m penetration, indicating a dense to very dense relative density.

Moisture content of samples of the silty sand to sandy silt generally ranged from 16 percent to 19 percent.

One sample of silty sand underwent laboratory gradation analysis, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and the grain size distribution curves for these samples are plotted on Figure A4.

Soil Particles	Silty Sand (%)
Gravel	6
Sand	59
Silt	20
Clay	15

5.6 Silty Clay Till

A layer of silty clay till was encountered below the upper sand layer in all boreholes at this site, at depths ranging from 4.1 m to 11.8 m (Elevation 318.5 to 314.5).

The silty clay till was generally grey in colour and contained some sand to sandy and trace gravel.



The thickness of the silty clay till ranged from 3.0 m to 8.2 m, with the lower boundary encountered at depths ranging from 10.0 m to 20.0 m (Elevation 313.8 to 306.3).

SPT N-values recorded in the silty clay till ranged from 15 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a very stiff to hard consistency.

Moisture content of samples of the silty clay till generally ranged from 8 percent to 26 percent.

Select samples of the silty clay 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 A5 and Figure B2. The results of the Atterberg Limits tests are plotted on Figure A11 and B5.

Soil Particles	Silty Clay Till (%)
Gravel	1 to 3
Sand	16 to 30
Silt	47 to 55
Clay	19 to 35

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

The above results indicate that the silty clay 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 Sandy Gravel

A pocket of sandy gravel was encountered below the silty clay till in Borehole CN16-05 at a depth of 14.8 m (Elevation 310.7). The sandy gravel was generally grey in colour and contained trace silt and clay and occasional cobbles.

The thickness of the sandy gravel pocket was 1.5 m, with the lower boundary encountered at a depth of 16.3 m (Elevation 309.2).



The SPT-N value recorded in the sandy gravel was 55 blows for 0.3 m penetration, indicating a very dense relative density.

The moisture content of the sample of the sandy gravel was 12 percent.

One sample of the sandy gravel underwent laboratory gradation analysis, the results which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and the grain size distribution curves for these samples are plotted on Figure A6.

Soil Particles	Sandy Gravel (%)
Gravel	51
Sand	30
Silt and Clay	19

5.8 Silty Clay

A thick layer of silty clay was encountered below the silty clay till layer in Boreholes CN16-01 to CN16-04, CN16-07, CN16-08, 08-041 and 08-042. Silty clay was also encountered below the sandy gravel pocket in CN16-05 and the silty sand pocket in CN16-06.

The silty clay layer was encountered at depths ranging from 10.0 m to 20.0 m (Elevation 313.8 to 306.3).

The silty clay was generally grey in colour and contained trace sand to sandy and trace gravel. Occasional cobbles were encountered in Borehole CN16-05.

Boreholes CN16-01, CN16-02, CN16-06 to CN16-08 and 08-042 were terminated in the silty clay layer at depths ranging from 15.8 m to 37.0 m (Elevation 310.0 to 289.1).

In Boreholes CN16-03 to CN16-05 and 08-041, the thickness of the silty clay ranged from 14.4 m to 27.4 m, with the lower boundary encountered at depths ranging from 33.7 m to 40.7 m (Elevation 291.9 to 282.6).

SPT N-values recorded in the silty clay ranged from 19 blows for 0.3 m penetration to 100 blows for 0.1 m penetration, indicating a very stiff to hard consistency.

Moisture content of samples of the silty clay generally ranged from 12 percent to 39 percent.

Select samples of the silty clay 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 A7 and A8 and Figure B3. The results of the Atterberg Limits tests are plotted on Figure A12, A13 and B6.

Soil Particles	Silty Clay (%)
Gravel	0 to 3
Sand	0 to 36
Silt	24 to 57
Clay	16 to 66

Index Property	
Liquid Limit	22 to 48
Plastic Limit	12 to 21
Plasticity Index	10 to 27

The above results indicate that the silty clay is of low to intermediate plasticity with a group symbol of CL – CI.

5.9 Lower Sand

A lower sand pocket was encountered within the silty clay in Borehole CN16-02 at a depth of 34.4 m (Elevation 291.6).

The lower sand was generally grey in colour and contained some silt and trace clay.

The thickness of the lower sand pocket was 1.7 m, with the lower boundary encountered at a depth of 36.1 m (Elevation 290.0).

The SPT-N value recorded in the lower sand was 100 blows for 0.3 m penetration, indicating a very dense relative density.

The moisture content of the sample of the lower sand was 21 percent.

One sample of the lower sand underwent laboratory gradation analysis, the results which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and the grain size distribution curve for this sample is plotted on Figure A9.



Soil Particles	Lower Sand (%)
Gravel	0
Sand	77
Silt	16
Clay	7

5.10 Sandy Silt Till

A sandy silt till layer was encountered below the silty clay in Boreholes CN16-03 to CN16-05 and 08-041, at depths ranging from 33.7 m to 40.7 m (Elevation 291.9 to 282.6).

The silt till was generally grey in colour, and contained some sand to sandy, trace to some gravel, trace to some clay, with occasional cobbles encountered in Borehole CN16-05.

Boreholes CN16-03 to CN16-05 and 08-041 were terminated in the silt till at depths from 37.2 to 41.3 m (Elevation 289.1 to 282.0).

All SPT N-values recorded in the silt till were above 100 blows for 0.3 m penetration, indicating a very dense relative density.

Moisture content of samples of the silt till generally ranged from 13 percent to 26 percent.

Two samples of the silt till 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 A10 and B4. The results of this testing are summarized as follows:

Soil Particles	Silt Till (%)
Gravel	0 to 6
Sand	19 to 28
Silt	50 to 75
Clay	6 to 16

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



5.11 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Three standpipe piezometers were installed at this site, in Borehole CN16-01, CN16-04 and CN16-07, to monitor water levels after completion of drilling. One piezometer was installed in the previous investigation, in Borehole 08-042. The water levels measured in the piezometers are summarized in Table 5.1, along with the measurements in the open boreholes upon completion of drilling.

Table 5.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
CN16-01	Aug 31, 2018	8.3	317.2	Piezometer
	Aug 08, 2019	8.1	317.4	
	Aug 29, 2019	8.3	317.2	
CN16-02	July 04, 2019	-	-	Water level upon completion not available due to mud rotary drilling method.
CN16-03	Aug 26, 2019	-	-	Water level upon completion not available due to mud rotary drilling method.
CN16-04	Aug 29, 2019	16.8	306.6	Piezometer
CN16-05	July 08, 2019	-	-	Water level upon completion not available due to mud rotary drilling method.
CN16-06	July 08, 2019	-	-	Water level upon completion not available due to mud rotary drilling method.
CN16-07	Aug 31, 2019	5.8	315.0	Piezometer
CN16-08	Aug 29, 2019	-	-	Water level upon completion not available due to mud rotary drilling method.
08-041	Aug 11, 2008	-	-	Water level upon completion not available.

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
08-042	Aug 20, 2008	7.9	314.9	Piezometer

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 silty sand fill from Borehole CN16-04 (depth of 2.6 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
		CN16-04 (SS4 at 2.6 m)
		(Soil Sample)
Soil Redox Potential	mV	312
Sulphide	%	< 0.02
pH	pH Units	8.29
Chloride	µg/g	7.8
Sulphate	µg/g	12
Conductivity	uS/cm	317



Parameter	Units (Soil)	Test Results
		CN16-04 (SS4 at 2.6 m)
		(Soil Sample)
Resistivity (calculated)	ohms.cm	3200

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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Judy Mei, EIT

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Review Principal, Designated MTO Contact



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 ⁽¹⁾ '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

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


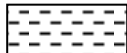



 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (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 _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	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>	
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)

<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>		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 CN16-01

1 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 134.5 E 226 136.6 ORIGINATED BY SB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY MP
 DATUM Geodetic DATE 2018.07.13 - 2018.07.13 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _p w w _L								
325.5	GROUND SURFACE						20	40	60	80	100					GR	SA	SI	CL	
0.0	Silty SAND , some clay, trace gravel, occasional organics, occasional cobbles Dense to Very Dense Brown Moist (FILL)		1	SS	31									○						
				2	SS	64									○					Auger grinding
	Loose		3	SS	6									○					Auger grinding	
																			3 56 27 14	
			4	SS	30									○						
322.5																				
3.0	SAND , some silt, trace clay Loose to Compact Brown Moist		5	SS	51									○						
				6	SS	11										○				
			7	SS	4										○					
			8	SS	80									○						
	Very Dense																			
316.8																				
8.7	Silty CLAY , some sand, trace gravel Hard Grey Moist (TILL)		9	SS	37									○						

Continued Next Page

+ ³ , × ³ : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-01

2 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 134.5 E 226 136.6 ORIGINATED BY SB
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY MP
DATUM Geodetic DATE 2018.07.13 - 2018.07.13 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
313.8	Continued From Previous Page															
	Silty CLAY, some sand Very Stiff Grey Moist (TILL)		10	SS	24											
11.7	Silty CLAY, trace sand Very Stiff to Hard Grey Moist		11	SS	19											
			12	SS	26											
			13	SS	32											
309.7	END OF BOREHOLE AT 15.8m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.															
15.8	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.08.31 8.3 317.2 2019.08.08 8.1 317.4 2019.08.29 8.3 317.2															

ONTMT4S2 MTO-11375(GINTDATA)\GPU 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-02

1 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 122.9 E 226 124.1 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.07.03 - 2019.07.04 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							WATER CONTENT (%) W P W W L PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			
326.1	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (100mm) Silty SAND , gravelly, trace clay, occasional cobbles, occasional organics Compact Brown Moist (FILL) <																	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA)GPU 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-02

2 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 122.9 E 226 124.1 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.07.03 - 2019.07.04 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						W _P W W _L			
	Continued From Previous Page						20 40 60 80 100										
315.0	SAND , trace gravel, trace silt and clay Compact Brown Wet		10	SS	15												
11.0	Silty CLAY , some sand Very Stiff to Hard Grey Moist (TILL)																
			11	SS	40												
			12	SS	40												
311.3																	
14.8	Silty CLAY , trace sand Hard Grey Moist		13	SS	44												
			14	SS	34												
			15	SS	38												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CN16-02

3 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 122.9 E 226 124.1 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.07.03 - 2019.07.04 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)						
	Continued From Previous Page														
	Silty CLAY , trace sand, trace gravel Hard Grey Moist		16	SS	53		306								Tricone grinding
							305								
							304								
			17	SS	100/ 0.250		303								
							302								Tricone grinding
			18	SS	100/ 0.300		301								
							300								
			19	SS	100/ 0.300		299								
							298								
			20	SS	74		297								

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CN16-02

4 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 122.9 E 226 124.1 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.07.03 - 2019.07.04 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

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

ONTMT4S2 MTO-11375(GINTDATA)GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-03

1 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 090.7 E 226 146.6 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.08.25 - 2019.08.26 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
						<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div><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+³, ×³: Numbers refer to
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(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA)\GPU 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-03

2 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 090.7 E 226 146.6 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.08.25 - 2019.08.26 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
309.6			10	SS	56		311						
11.7	Silty CLAY , trace sand Hard Grey Moist		11	SS	33		310						
			12	SS	33		309						
306.5							308						
14.8	Sandy SILT , some clay Very Dense Grey Moist		13	SS	90		307						
305.6							306						
15.7	Silty CLAY , trace sand Hard Grey Moist		14	SS	72		305						
			15	SS	90		304						
							303						
							302						

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(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-03

3 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 090.7 E 226 146.6 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.08.25 - 2019.08.26 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									WATER CONTENT (%)
	Continued From Previous Page						20	40	60	80	100	20	40	60			
	Silty CLAY , trace sand Hard Grey Moist		16	SS	72		301										
							300										
							299										
			17	SS	51		298										
							297										
							296										
			18	SS	62		295										
							294										
							293										
			19	SS	51		292										

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CN16-03

4 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 090.7 E 226 146.6 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.08.25 - 2019.08.26 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80					
	Continued From Previous Page															
			20	SS	97		291									
							290									
							289									
							288									
287.6							287									
33.7	Sandy SILT , some clay, trace gravel Very Dense Grey Moist (TILL)		21	SS	100/ 0.150		286									
							285									
			22	SS	100/ 0.125		284									
283.1																
38.3	END OF BOREHOLE AT 38.3m. CAVED-IN DEPTH AND WATER LEVEL NOT AVAILABLE DUE TO USE OF MUD ROTARY DRILLING. BOREHOLE BACKFILLED WITH GROUT HOLEPLUG.															

ONTMT4S2 MTO-11375(GINTDATA)GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-04

1 OF 5

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 089.0 E 226 130.4 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.08.23 - 2019.08.24 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
323.3	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL: (50mm)							20	40	60	80	100					
0.1	Silty SAND , some gravel, trace clay Loose to Compact Brown Dry to Moist (FILL)		1	SS	15		323							○			
			2	SS	8		322							○			
			3	SS	6		321							○			18 52 25 5
			4	SS	7		320							○			
320.3	SAND , trace to some gravel, trace silt, trace clay Dense Brown Moist		5	SS	14		319										Switch to tricone
3.0																	
			6	SS	32		318							○			6 79 15 (SI+CL)
			7	SS	37		317							○			17 73 10 (SI+CL)
	75mm thick gravel layer at 6.4m																
316.2																	
7.2	Silty CLAY , some sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		8	SS	23		316							○			
							315										
			9	SS	35		314							○			

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CN16-04

2 OF 5

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 089.0 E 226 130.4 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.08.23 - 2019.08.24 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page															
	Silty CLAY , some sand, trace gravel Hard Grey Moist (TILL)		10	SS	35		313									
							312									
			11	SS	48		311									
310.1							310									
13.3	Silty CLAY , trace sand Hard Grey Moist		12	SS	40		309									0 2 43 55
							308									
			13	SS	37		307									
							306									
			14	SS	48		305									
							304									
			15	SS	39											

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ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-04

4 OF 5

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 089.0 E 226 130.4 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.08.23 - 2019.08.24 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
	Continued From Previous Page														
	Silty CLAY , some sand to sandy, trace gravel Hard Grey Moist						293								
							292								
			20	SS	75		291								
							290								
							289								
							288								
	Silt seams		21	SS	62		287								
							286								
			22	SS	100/ 0.125		285								
							284								
			23	SS	100/										

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(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-04

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METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 089.0 E 226 130.4 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.08.23 - 2019.08.24 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
282.6					0.250												
40.7	Sandy SILT , trace gravel Very Dense Brown Moist																
282.0			24	SS	100/												
41.3	(TILL) END OF BOREHOLE AT 41.3m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2019.08.29 16.8 306.6				0.125												

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+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

METRIC

SOIL PROFILE						SAMPLES		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			
325.5	GROUND SURFACE							
0.0	TOPSOIL: (125mm)							
0.1	Silty SAND, some clay, trace gravel Loose to Compact Brown Moist (FILL)		1	SS	16			
			2	SS	13			
			3	SS	7			
	Very Dense		4	SS	53			
			5	SS	50			
322.0	ORGANICS occasional roots and rootlets Black Moist							
321.4	SAND, trace silt, trace clay, trace gravel Very Dense Brown Moist		6	SS	34			
			7	SS	100/ 0.275			
			8	SS	100/ 0.250			
	Wet		9	SS	92			
316.0	Silty CLAY, sandy, trace gravel Hard Grey							

DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
SHEAR STRENGTH kPa				WATER CONTENT (%)				
<div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>				<div>w_P w w_L</div>				
20	40	60	80	100	20	40	60	GR SA SI C

+³, ×³: Numbers refer to Sensitivity

CONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-05

2 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 129.0 E 226 137.3 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.07.04 - 2019.07.08 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page															
	Silty CLAY , sandy, trace gravel Hard Grey Moist (TILL)		10	SS	45		315									
							314									
			11	SS	58		313									3 27 47 23
							312									
			12	SS	64		311									Tricone grinding
310.7							310									51 30 19 (SI+CL)
14.8	Sandy GRAVEL , trace silt and clay, occasional cobbles Very Dense Grey Moist		13	SS	55											
309.2							309									
16.3	Silty CLAY , trace sand Hard Grey Moist		14	SS	35		308									
							307									
			15	SS	26		306									

Continued Next Page

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

ONTMT4S2 MTO-11375(GINTDATA)GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-05

3 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 129.0 E 226 137.3 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.07.04 - 2019.07.08 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page															
	Silty CLAY , trace sand Hard Grey Moist		16	SS	43											
							305									
							304									
							303									
			17	SS	88		302									0 2 42 56
							301									
							300									
			18	SS	80		299									
							298									
							297									
			19	SS	93		296									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CN16-05

4 OF 4

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 129.0 E 226 137.3 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.07.04 - 2019.07.08 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
	Silty CLAY , trace sand, trace gravel, occasional cobbles Hard Grey Moist						295										
							294										
			20	SS	80		293						○				
							292										
							291										
	0.3m thick sandy silt layer at 34.6m		21	SS	100/ 0.125		290						○				
							289						○				
			22	SS	100/ 0.150		288						○				
287.9																	
37.6	Sandy SILT , gravelly, some clay, occasional cobbles Very Dense Grey Moist (TILL)		23	SS	100/ 0.150								○				
287.3																	
38.3	END OF BOREHOLE AT 38.3m. CAVED-IN DEPTH AND WATER LEVEL NOT AVAILABLE DUE TO USE OF MUD ROTARY DRILLING. BOREHOLE BACKFILLED WITH CEMENT AND GROUT, THEN BENTONITE HOLEPLUG TO SURFACE.																

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RECORD OF BOREHOLE No CN16-06

1 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 136.3 E 226 121.6 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
 DATUM Geodetic DATE 2019.07.08 - 2019.07.08 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
325.9	GROUND SURFACE							20 40 60 80 100							
0.0	TOPSOIL: (125mm)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
0.1	Silty SAND to Sandy SILT , trace clay, trace gravel Loose to Compact Brown Moist (FILL)		1	SS	11		325	20 40 60 80 100						○ ○	
			2	SS	6									○	
			3	SS	8		324							○	
			4	SS	21		323							○	2 60 30 8
	Occasional cobbles Very Dense		5	SS	56									○	Switch to tricone 1 51 44 4
321.8							322								
4.1	SAND , some gravel, trace silt, trace clay Very Dense Brown Moist		6	SS	70		321							○	
							320							○	10 79 11 (SI+CL)
	Occasional cobbles		7	SS	80		319								
			8	SS	100/ 0.175		318							○	
							317							○	
	some silt		9	SS	100/ 0.275		316								

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA)GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-06

2 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 136.3 E 226 121.6 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.07.08 - 2019.07.08 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						WATER CONTENT (%) W _P W W _L				
	Continued From Previous Page							20	40	60	80	100						
315.8 10.1	Silty CLAY , some sand, trace gravel Hard Grey Moist (TILL) 0.5m thick silty sand layer at 10.9m		10	SS	100/ 0.225		315											
							314											
			11	SS	65		313											
312.6 13.3	Silty SAND , some clay, trace gravel with silty clay seams Dense to Very Dense Grey Moist		12	SS	63		312											
							311											
310.2 310.0 15.8	Silty CLAY , some to trace sand, trace gravel Hard Grey Moist END OF BOREHOLE AT 15.8m. CAVED-IN DEPTH AND WATER LEVEL NOT AVAILABLE DUE TO USE OF MUD ROTARY DRILLING. BOREHOLE BACKFILLED WITH CEMENT AND GROUT, THEN BENTONITE HOLEPLUG TO SURFACE.		13	SS	39													

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METRIC

SOIL PROFILE			SAMPLES		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
320.8	GROUND SURFACE				
0.9 0.1	TOPSOIL: (75mm) Silty SAND, trace clay, trace gravel, occasional organics, occasional decayed wood fragments, occasional cobbles Very Dense Brown Moist (FILL)	[Pattern]	1	SS	27
			2	SS	80
			3	SS	27
			4	SS	100/ 0.250
317.8 3.0	SAND, some silt, trace gravel Dense Brown Moist	[Pattern]	5	SS	34
316.7 4.1	Silty CLAY, sandy, trace gravel Very Stiff to Hard Grey Moist (TILL)	[Pattern]	6	SS	23
			7	SS	27
			8	SS	27
			9	SS	30

(%) STRAIN AT FAILURE

CONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-07

2 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 089.7 E 226 153.3 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
							20	40	60	80	100	20	40	60		
310.6	Continued From Previous Page															
10.2	Silty CLAY , some sandy to sandy, trace gravel Hard Grey Wet		10	SS	31								○			
			11	SS	39								○			
			12	SS	31								○			
													○			
			13	SS	43											
305.0																0 22 50 28
15.8	END OF BOREHOLE AT 15.8m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2019.08.31 5.8 315.0															

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/8/20

RECORD OF BOREHOLE No CN16-08

1 OF 2

METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 087.3 E 226 137.0 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20 40 60 80 100							
322.0	GROUND SURFACE							20 40 60 80 100							
0.0	TOPSOIL: (125mm)							20 40 60 80 100							
0.1	Silty SAND, trace gravel, occasional organics Loose Brown Moist (FILL)		1	SS	13		321								
			2	SS	9										
			3	SS	7		320								
319.8															
2.2	SAND, some silt, trace clay, trace gravel Loose to Compact Brown Moist		4	SS	7		319								4 74 22 (SI+CL)
			5	SS	17										Switch to tricone
							318								
317.9															
4.1	Silty CLAY, some sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		6	SS	16		317								
			7	SS	29		316								
							315								
			8	SS	31		314								1 16 49 34
			9	SS	40		313								

Continued Next Page

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

RECORD OF BOREHOLE No CN16-08

2 OF 2

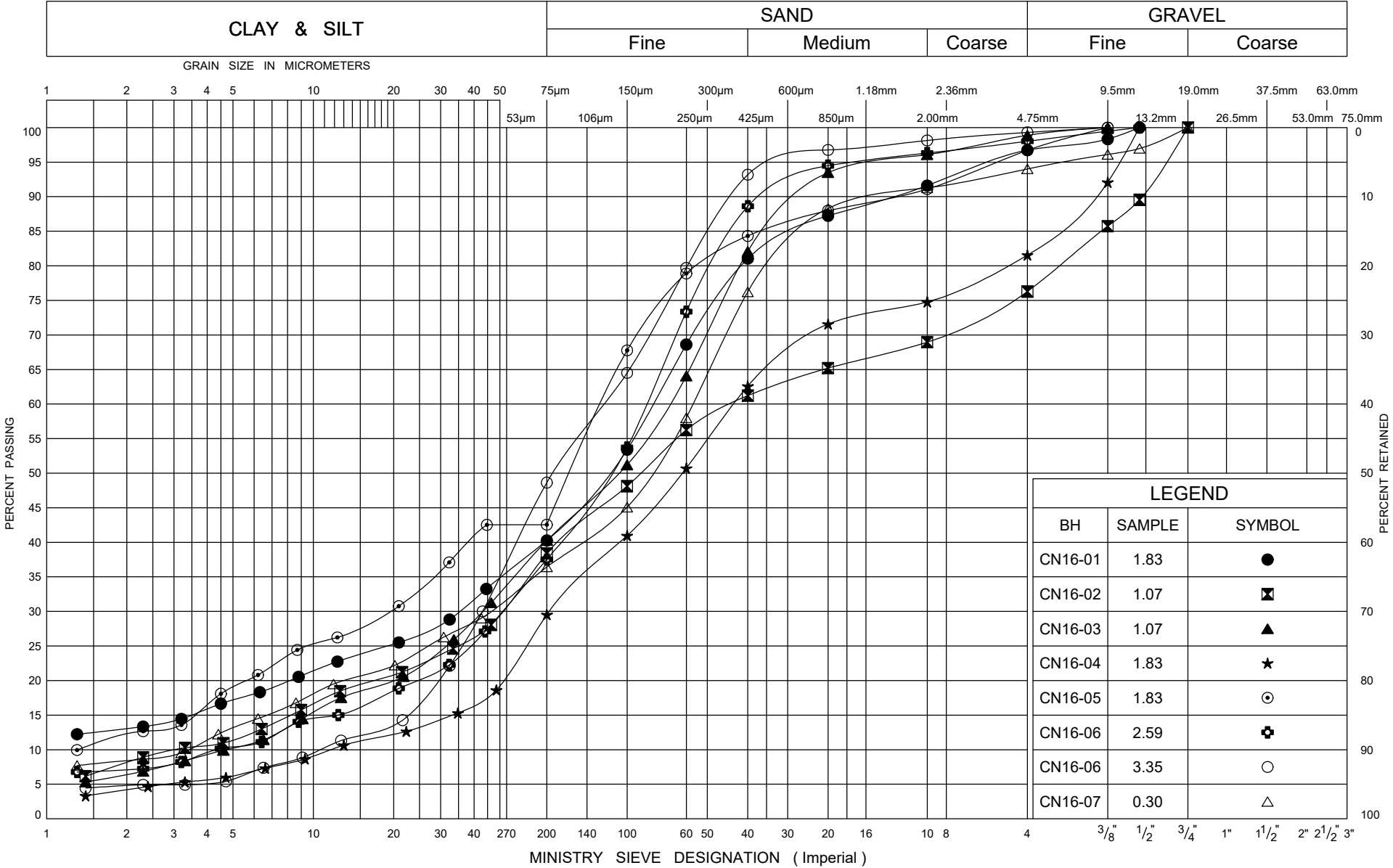
METRIC

GWP# 408-88-00 LOCATION MTM NAD 83 Zone 10: N 4 814 087.3 E 226 137.0 ORIGINATED BY BL
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY BH
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 LATITUDE _____ LONGITUDE _____ CHECKED BY JPL

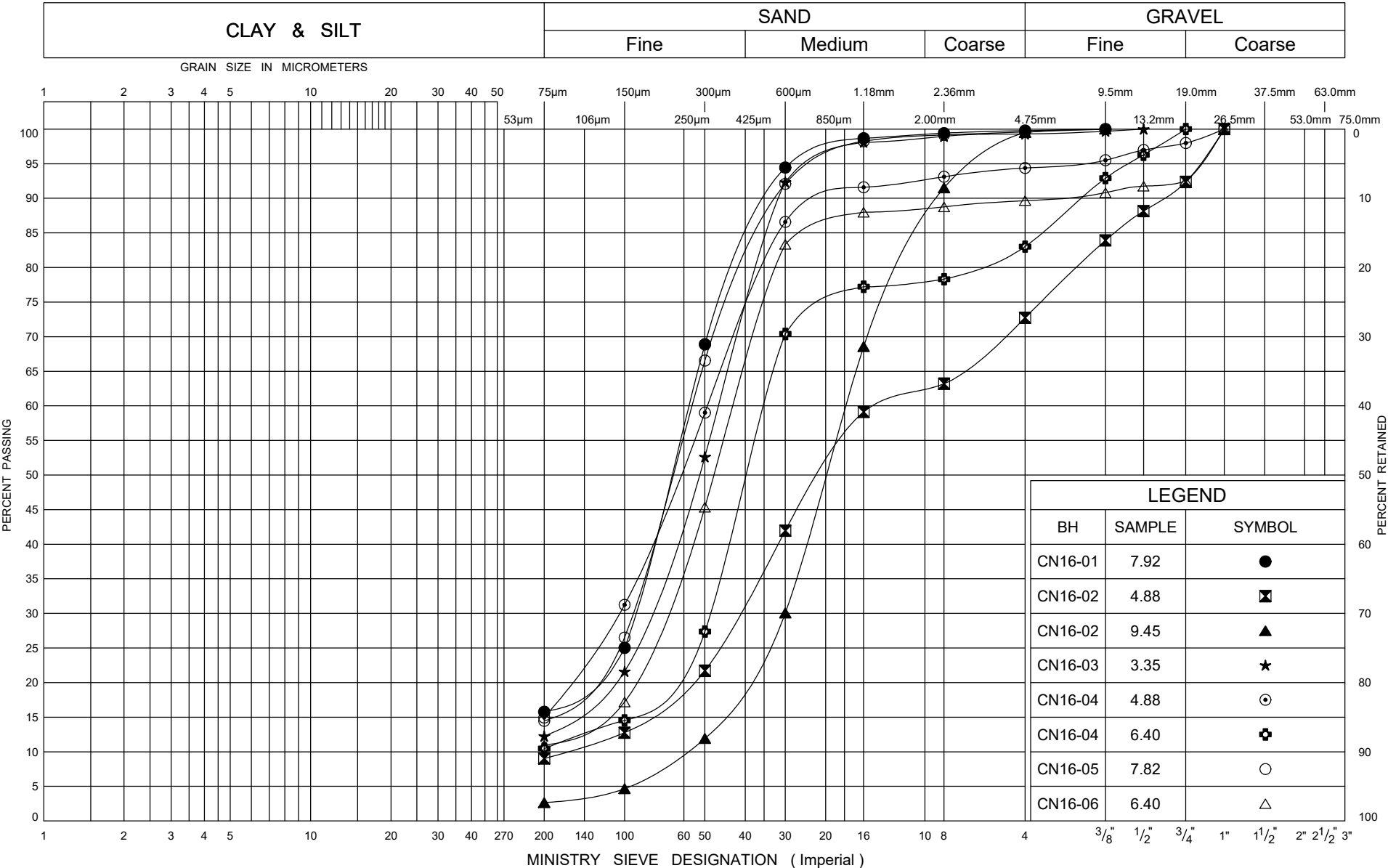
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20 40 60 80 100							
Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L WATER CONTENT (%)				
310.3	Silty CLAY , some sand, trace gravel Hard Grey Moist (TILL)		10	SS	34		311								0 6 45 49
11.7	Silty CLAY , trace sand Hard Grey Moist		11	SS	46		310								
							309								
			12	SS	44		308								
							307								
306.2			13	SS	62										
15.8	END OF BOREHOLE AT 15.8m. CAVED-IN DEPTH AND WATER LEVEL NOT AVAILABLE DUE TO USE OF MUD ROTARY DRILLING. BOREHOLE BACKFILLED WITH GROUT TO 3.0m, THEN HOLEPLUG TO SURFACE.														

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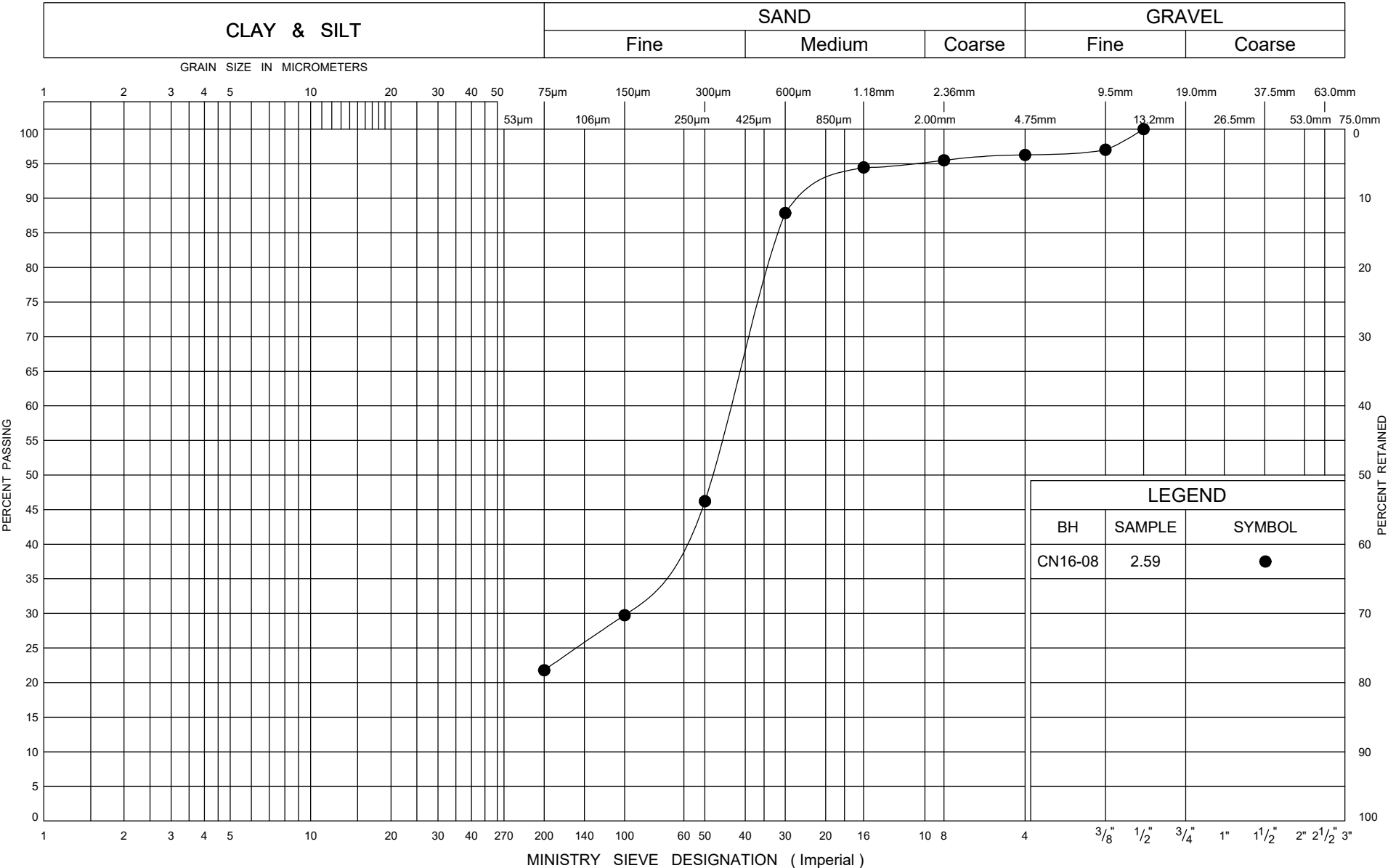
UNIFIED SOIL CLASSIFICATION SYSTEM



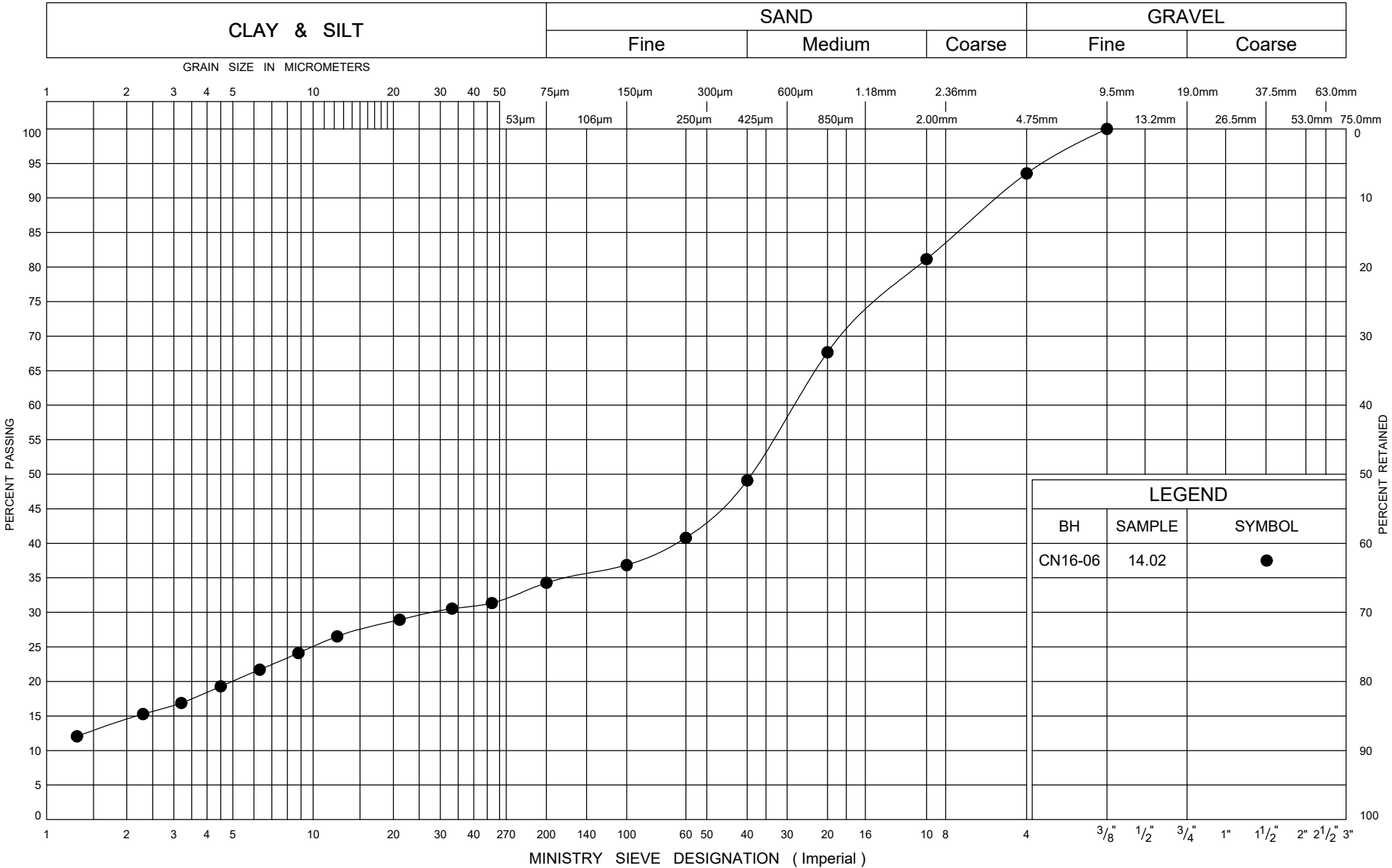
UNIFIED SOIL CLASSIFICATION SYSTEM



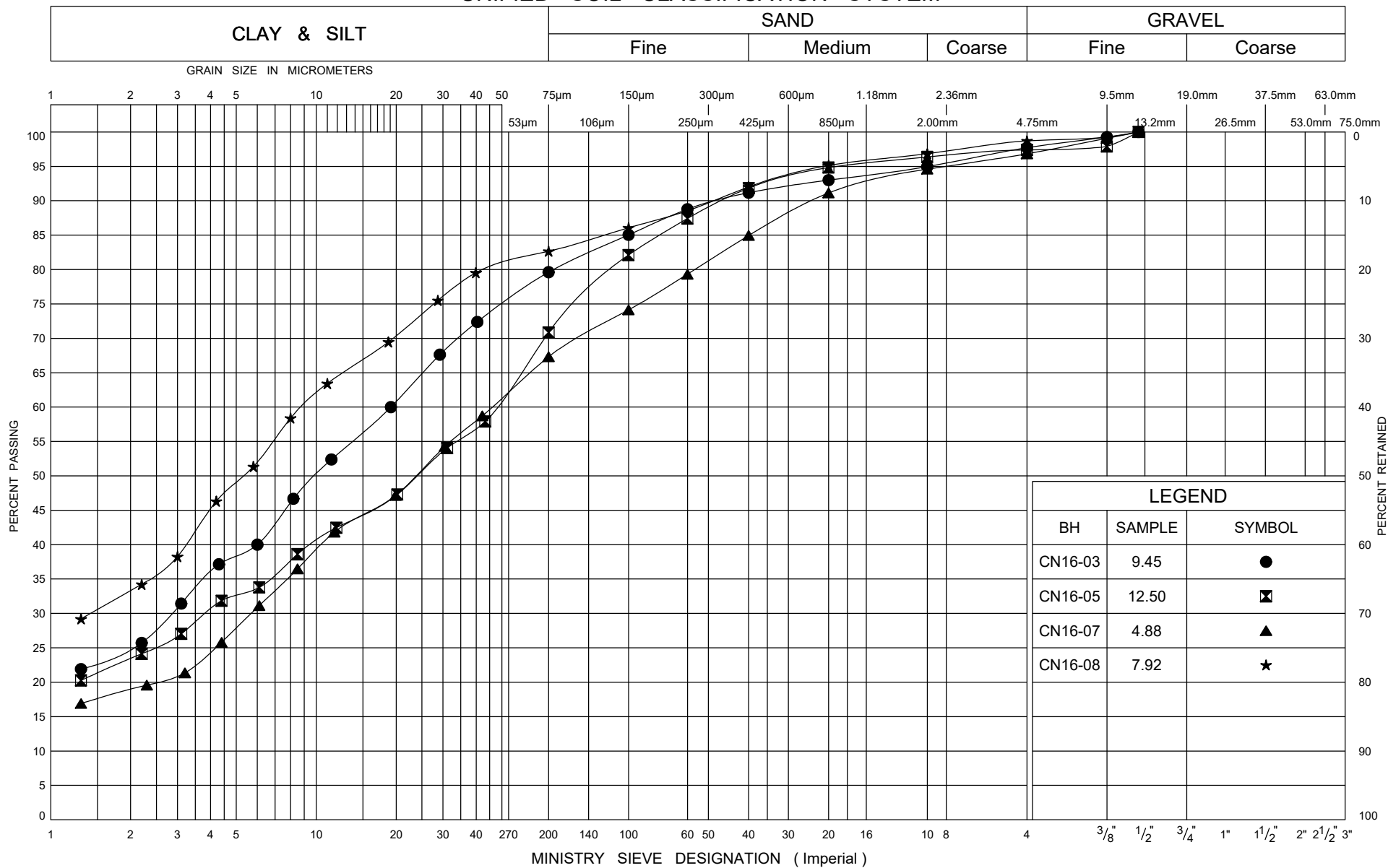
UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

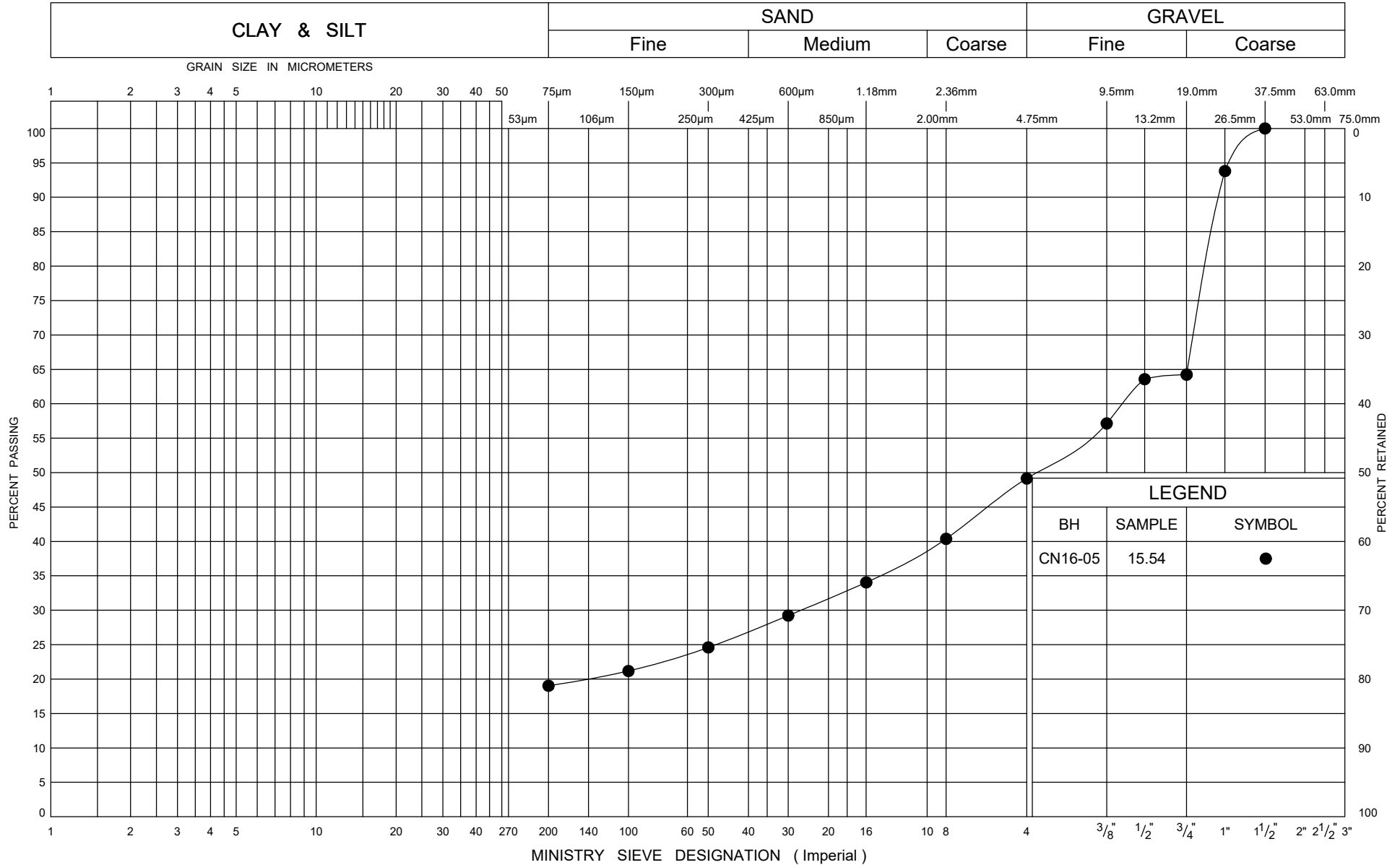
GRAIN SIZE DISTRIBUTION

Silty CLAY TILL

FIG No A5

W P 408-88-00

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

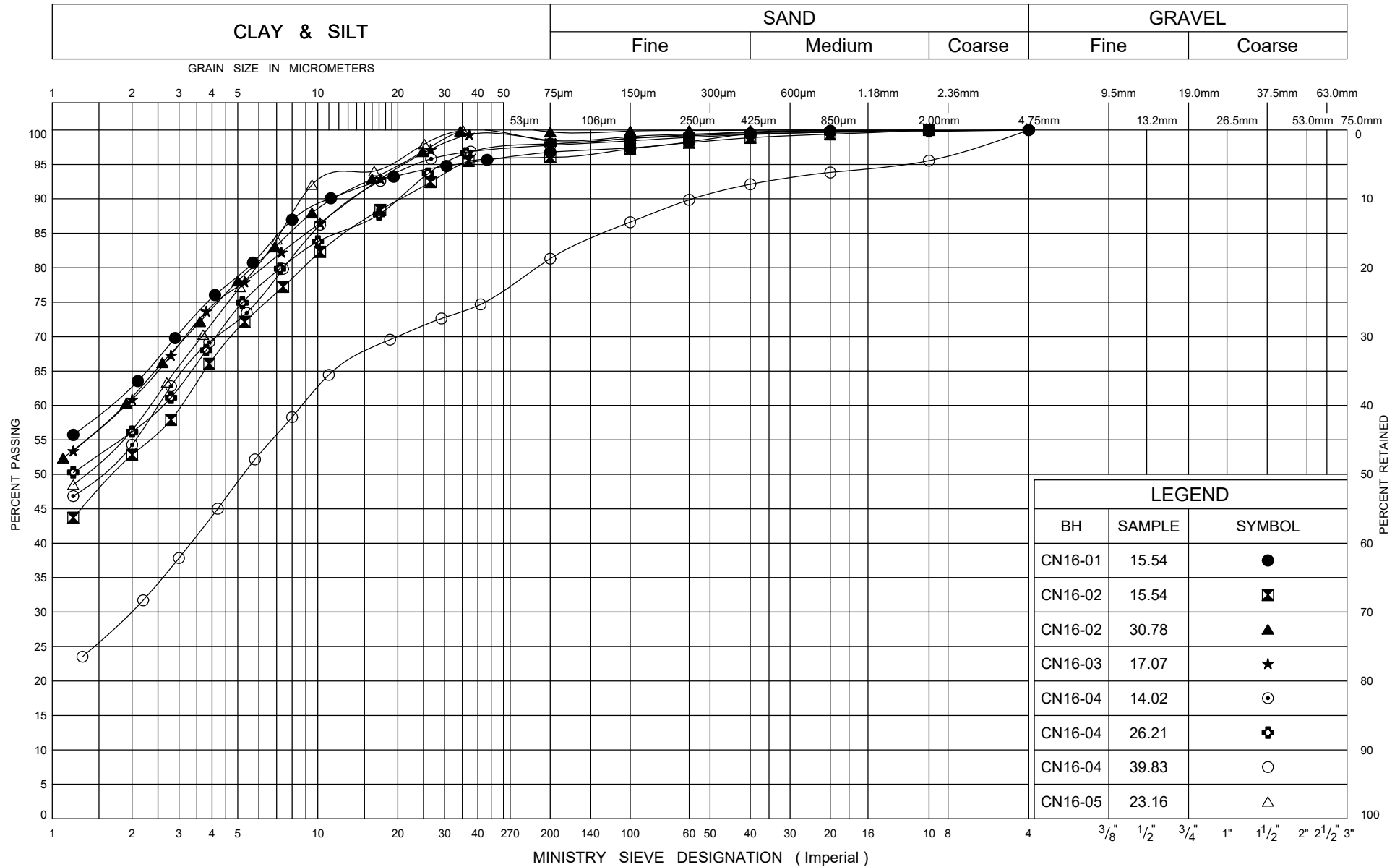
GRAIN SIZE DISTRIBUTION

Sandy GRAVEL

FIG No A6

W P 408-88-00

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

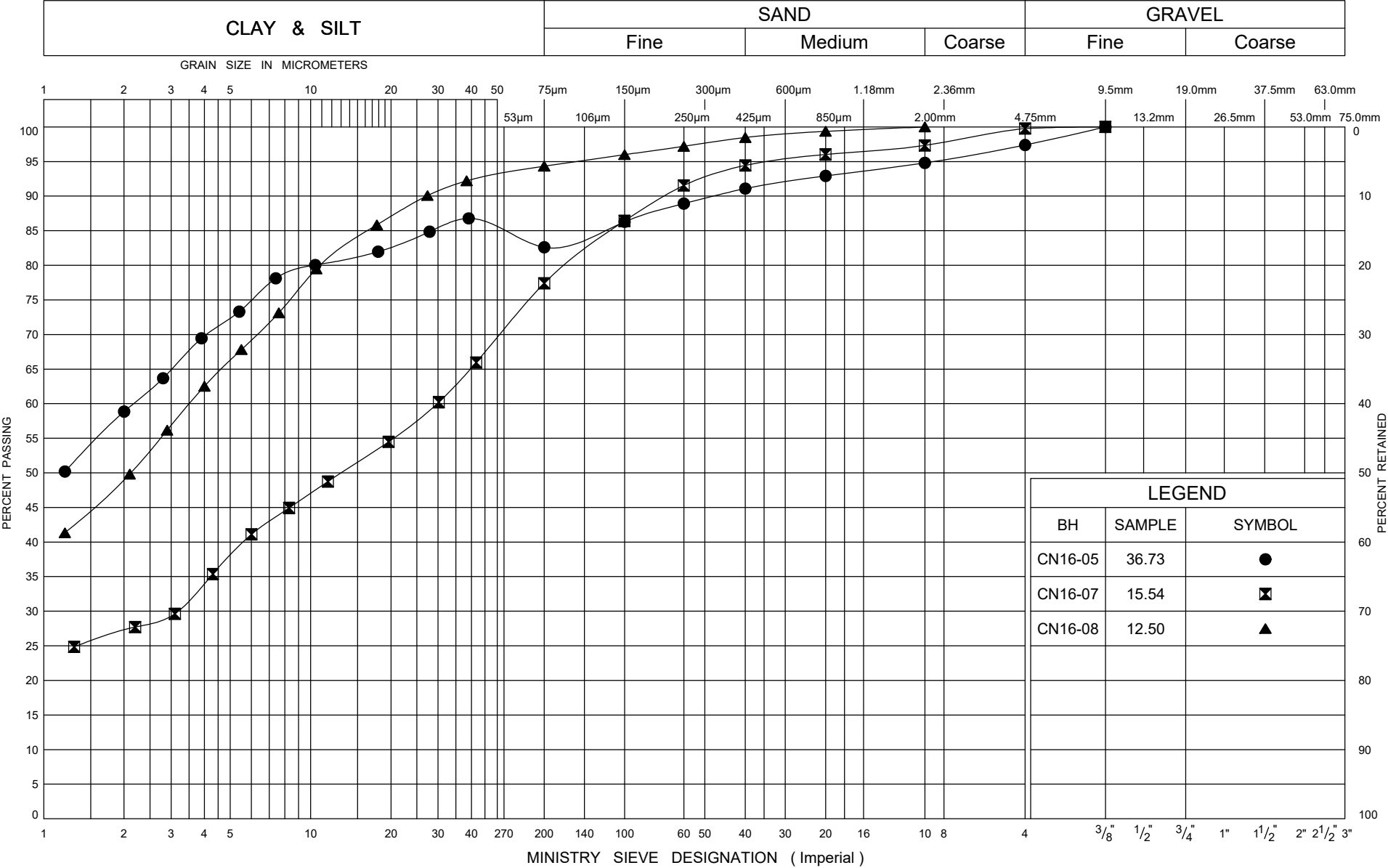
GRAIN SIZE DISTRIBUTION

Silty CLAY

FIG No A7

W P 408-88-00

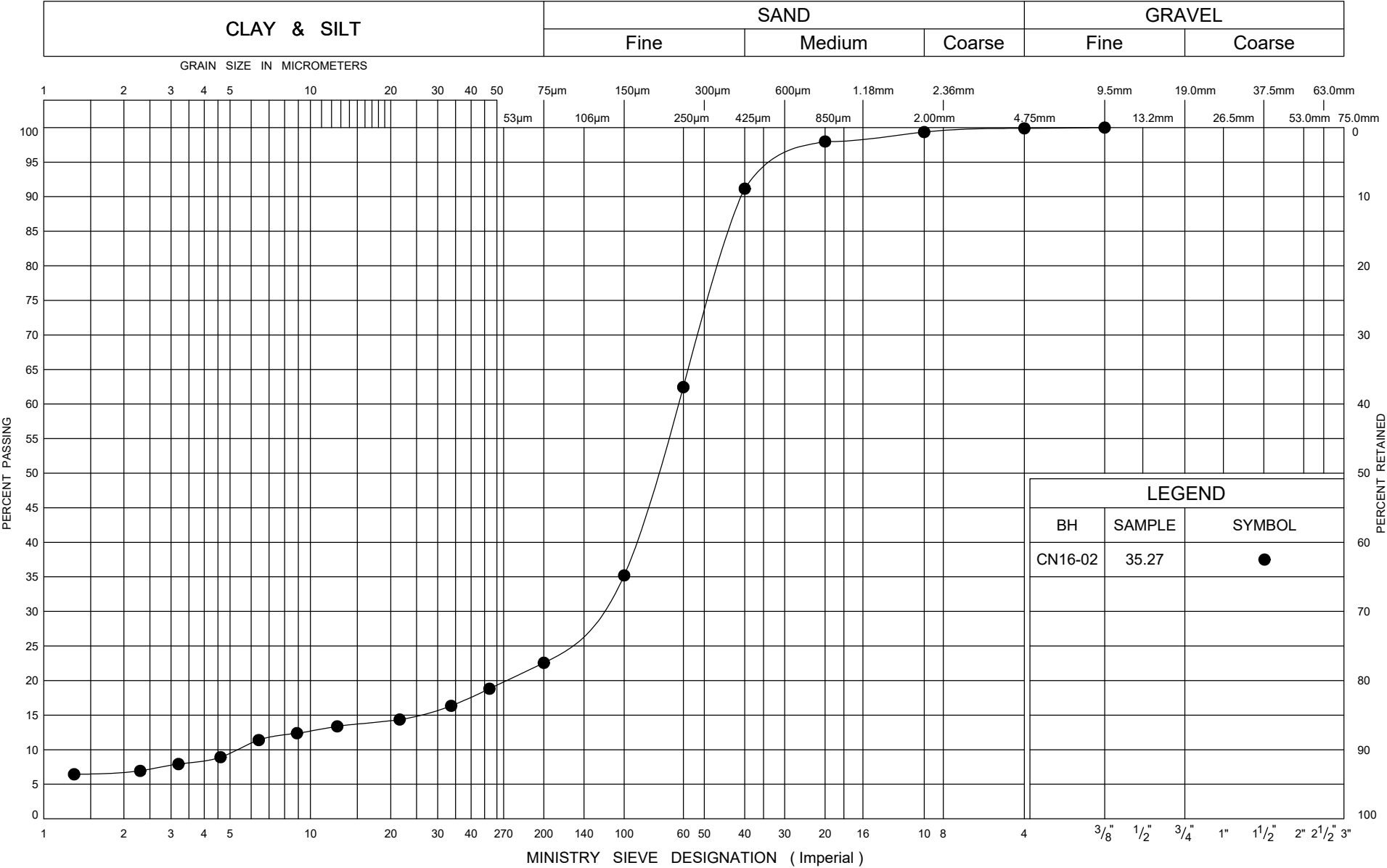
UNIFIED SOIL CLASSIFICATION SYSTEM



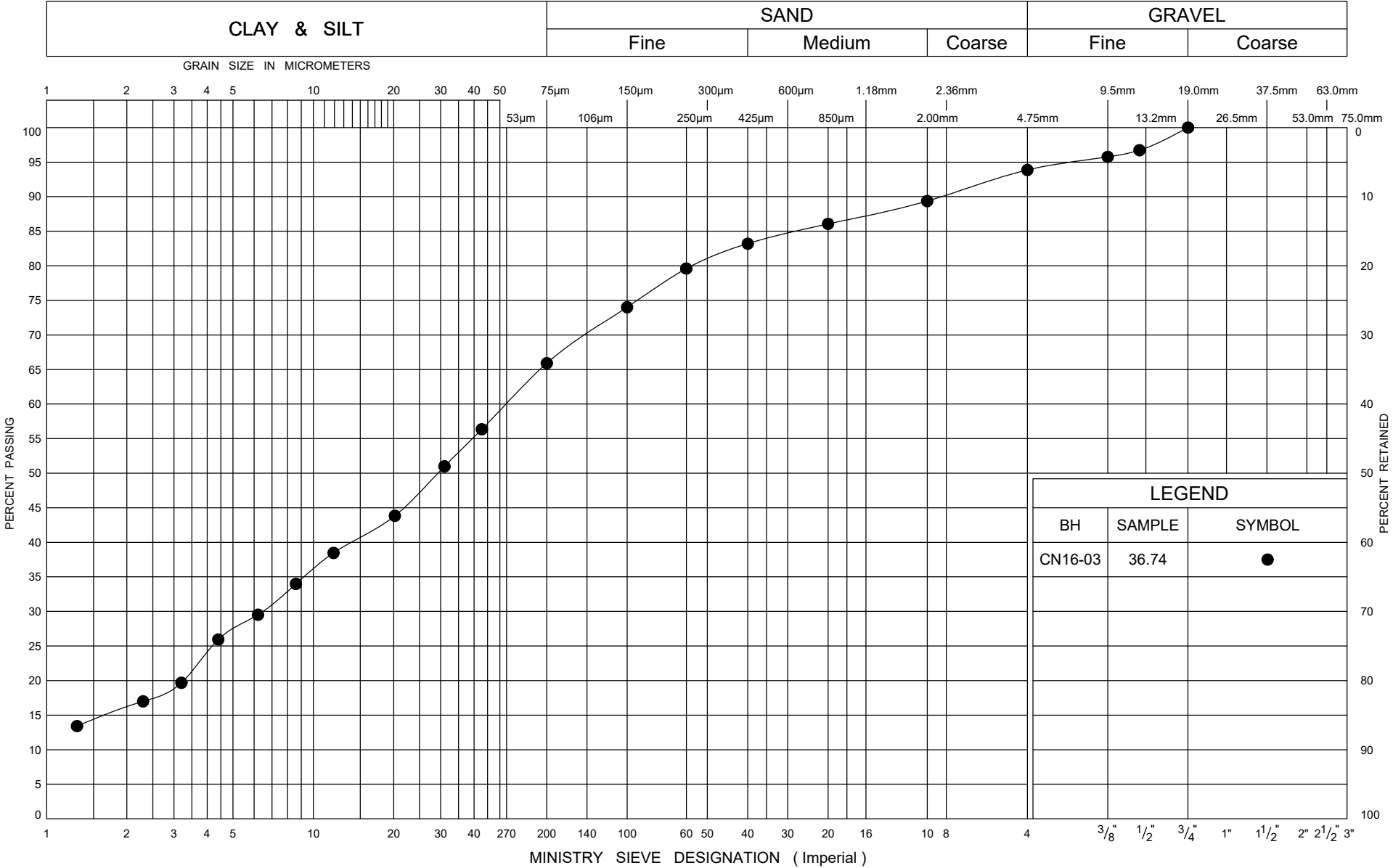
GRAIN SIZE DISTRIBUTION
Silty CLAY

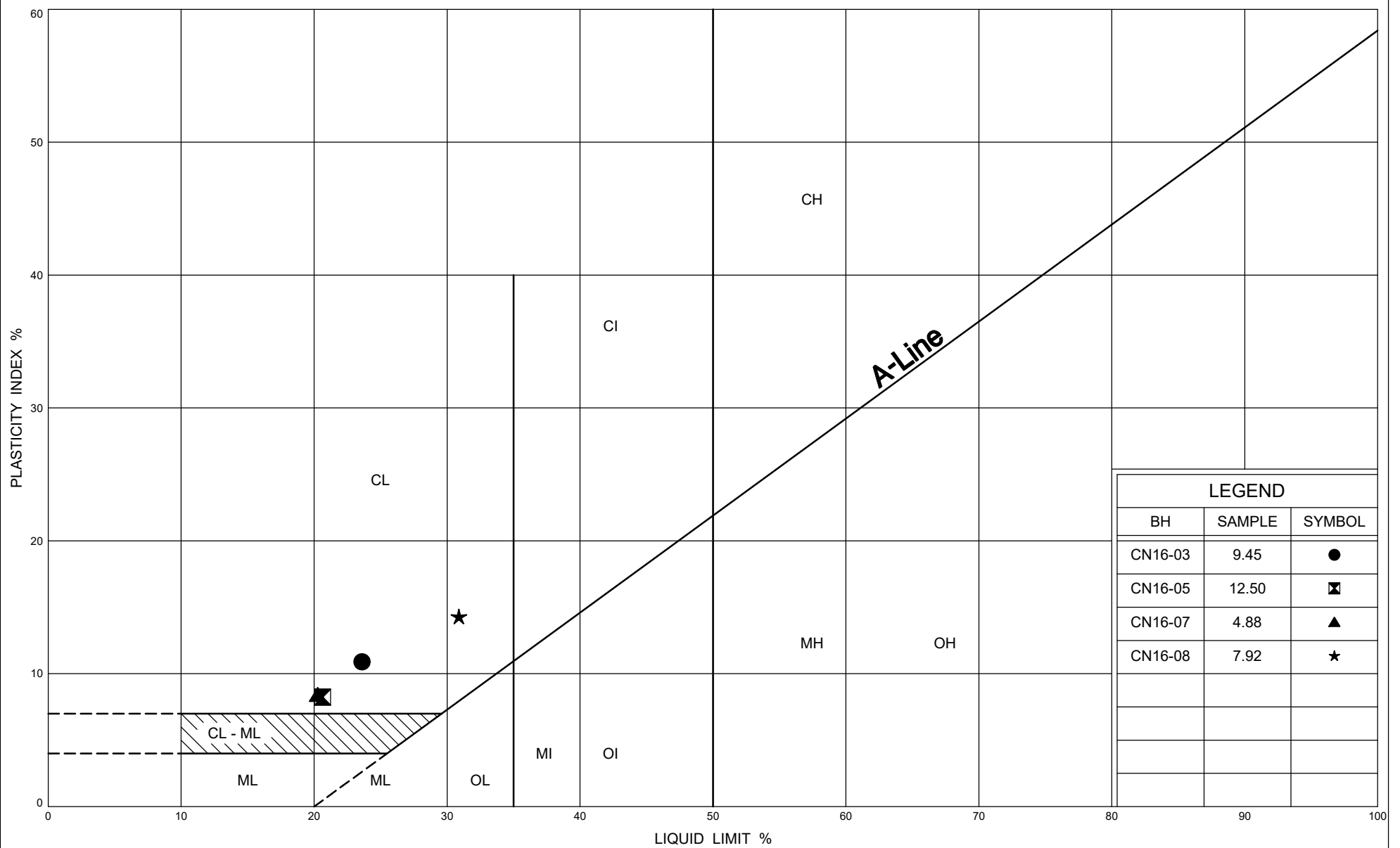
FIG No A8
W P 408-88-00

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM





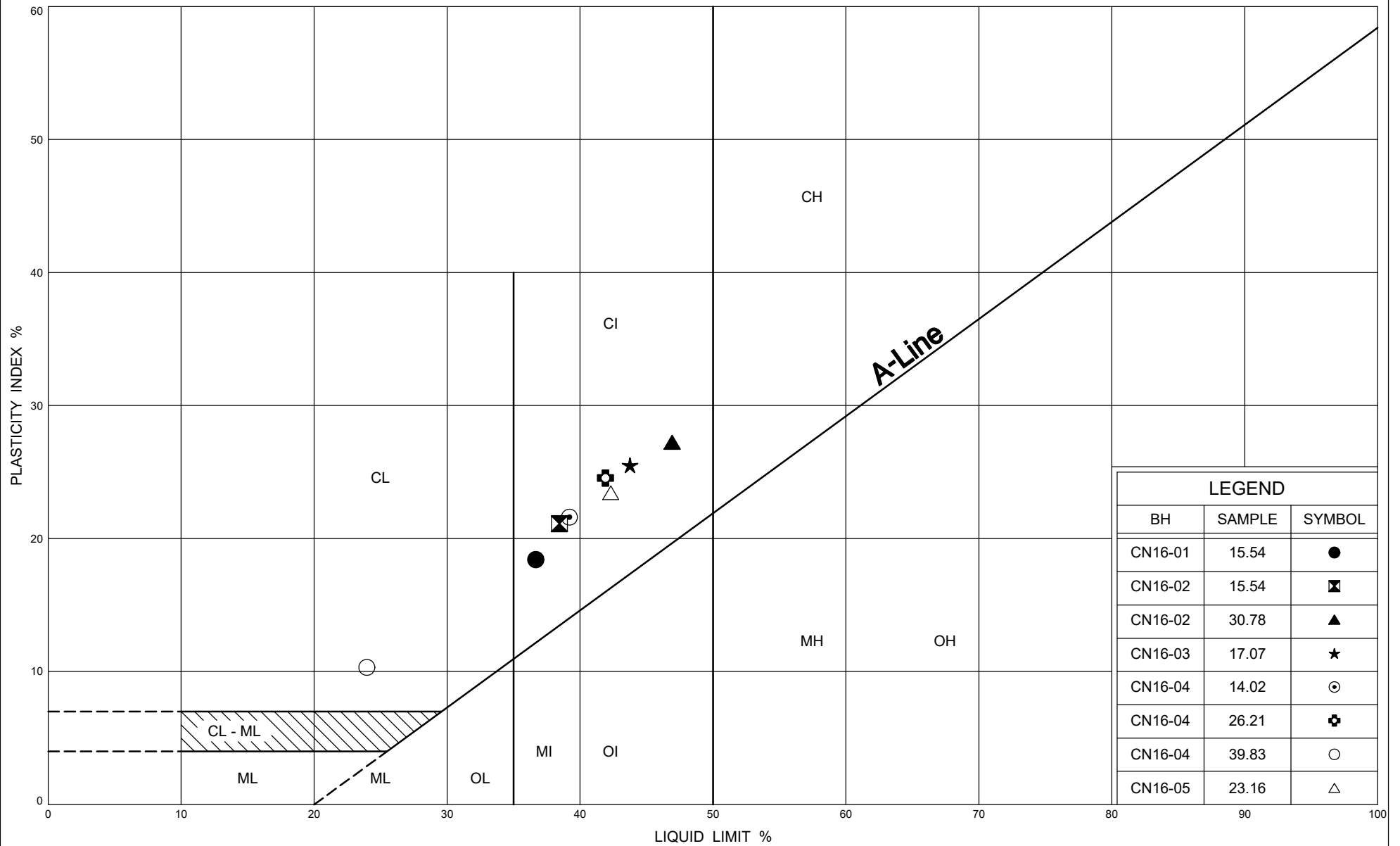
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PLASTICITY CHART

Silty CLAY TILL

FIG No A11

W P 408-88-00



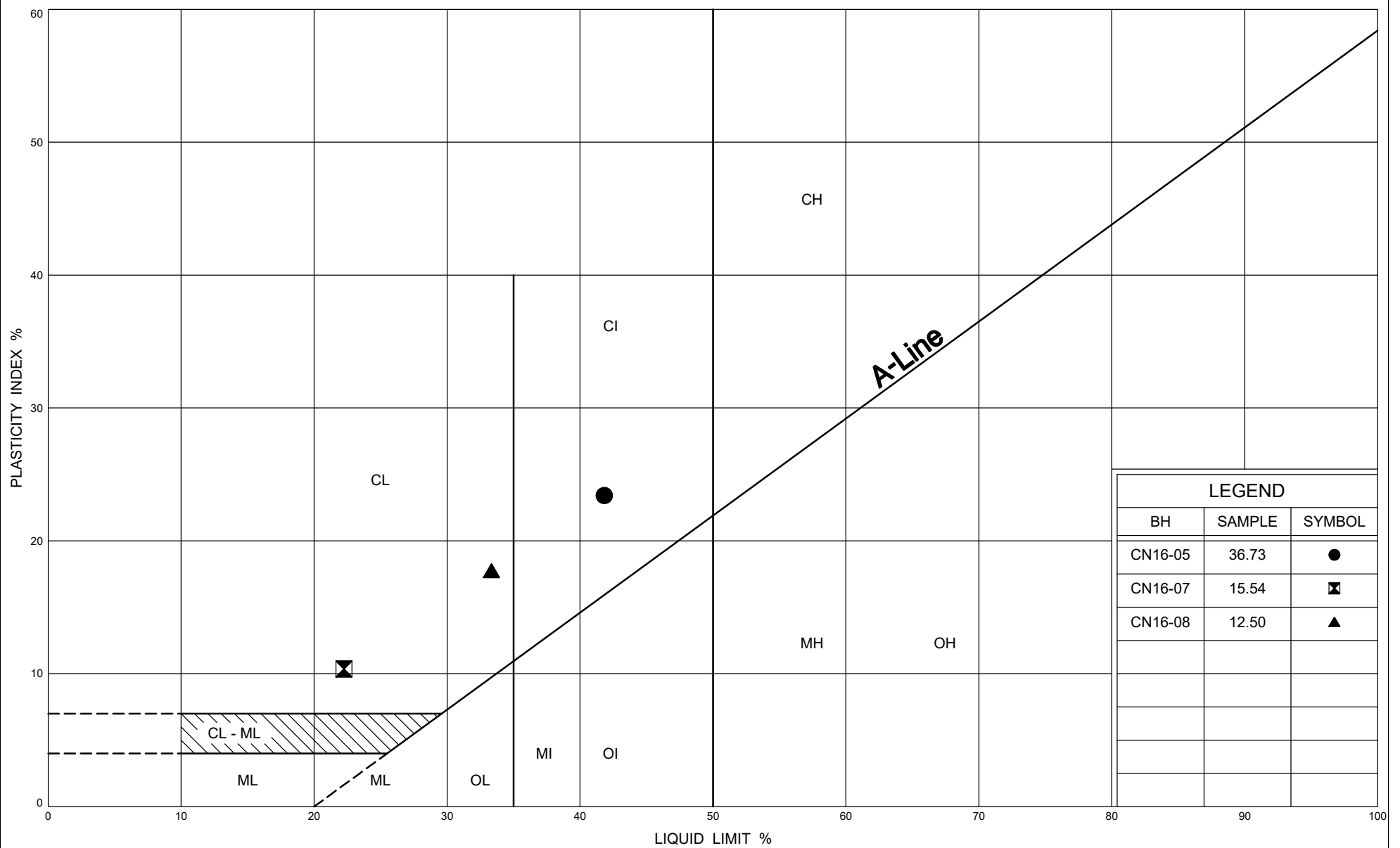
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PLASTICITY CHART

Silty CLAY

FIG No A12

W P 408-88-00



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PLASTICITY CHART

Silty CLAY

FIG No A13

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 ⁽¹⁾ '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 $W_L < 50\%$	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					
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 08-041

1 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 110.33 E 226 090.75 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FK
 DATUM Geodetic DATE 2008.08.11 - 2008.08.13 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
326.3								20 40 60 80 100							
0.0	TOPSOIL: (40mm), occasional rootlets and roots								○ UNCONFINED + FIELD VANE						
0.1									● QUICK TRIAXIAL × LAB VANE						
325.7	SAND, some gravel Brown Moist (FILL)						326								
0.6															
	Clayey SILT, some sand to sandy, trace gravel Very Stiff		1	SS	26								○		
324.9	Brown (FILL)						325								
1.4															
	SAND, trace to some silt, trace gravel Compact to Dense Brown Moist		2	SS	36								○		
	occasional topsoil, black		3	SS	32		324							○	
			4	SS	28		323							○	2 86 12 (SI+CL)
							322								
			5	SS	13								○		
							321								
							320						○		
							319								
			7	SS	100/ .200								○		2 89 10 (SI+CL)
							318								
							317							○	
			8	SS	76										

Continued Next Page

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

RECORD OF BOREHOLE No 08-041

2 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 110.33 E 226 090.75 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FK
 DATUM Geodetic DATE 2008.08.11 - 2008.08.13 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W _P	W	W _L	
								20 40 60 80 100				
314.5	SAND, trace to some silt, trace gravel Very Dense Grey Moist		9	SS	63		316					2 86 12 (SI+CL)
11.8	Silty CLAY, some sand to sandy, trace gravel Hard Grey (TILL)		10	SS	54		314					
			11	SS	33		313					1 16 48 35
							312					
							311					
			12	SS	31		310					
			13	SS	33		309					
			14	SS	31		308					
							307					
306.3												

Continued Next Page

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

RECORD OF BOREHOLE No 08-041

3 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 110.33 E 226 090.75 ORIGINATED BY SLL
HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FK
DATUM Geodetic DATE 2008.08.11 - 2008.08.13 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								WATER CONTENT (%)						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
								W P W W L						
20.0	Silty CLAY, trace to some sand Hard Grey		15	SS	23		306							0 6 30 64
							305							
							304							
			16	SS	73		303							
							302							0 6 41 53
			17	SS	108		301							
							300							
			18	SS	101/ .275		299							
							298							
			19	SS	58		297							0 2 32 66
			20	SS	76									

Continued Next Page

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

ONTMT4S 6417R GPJ 10/24/08

RECORD OF BOREHOLE No 08-041

4 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 110.33 E 226 090.75 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FK
 DATUM Geodetic DATE 2008.08.11 - 2008.08.13 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Continued From Previous Page													
	Silty CLAY Hard Grey		21	SS	55		296							
	silt seams		22	SS	74		295							
			23	SS	100/ .150		294							
291.9							293							
34.4	SILT, some sand, trace clay Very Dense Grey Moist (TILL)		24	SS	100/ .175		292							
							291							
289.1			25	SS	100/ .150		290							
37.2	END OF BOREHOLE AT 37.2m BOREHOLE BACK FILLED WITH GROUT TO 0.61m HOLEPLUG TO SURFACE													0 19 75 6

ONTMT4S 6417R.GPJ 11/12/09

RECORD OF BOREHOLE No 08-042

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 134.35 E 226 152.53 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2008.08.14 - 2008.08.14 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
322.8												
0.0	TOPSOIL: (300mm), occasional roots											
322.5	Dark Brown		1	SS	32							
0.3	Moist											
	Silty SAND, trace gravel, occasional											
	topsoil											
	Compact to Dense		2	SS	25		322					
	Brown to Dark Brown											
	Moist											
	(FILL)											
321.3												
1.5	SAND, trace to some silt		3	SS	17		321					0 86 14
	Compact to Very Dense											(SI+CL)
	Brown		4	SS	52							
	Moist											
			5	SS	100		320					0 92 8
												(SI+CL)
							319					
318.5												
4.3	Silty CLAY, some sand, trace gravel,		6	SS	21		318					
	occasional silty sand seams											
	Very Stiff to Hard											
	Grey						317					
	(TILL)		7	SS	36							
							316					
			8	SS	82		315					
							314					
	Occasional sand seams		9	SS	42							
312.8							313					

Continued Next Page

+ 3 . X 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

ONTMT4S 6417R.GPJ 10/28/08

RECORD OF BOREHOLE No 08-042

2 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 134.35 E 226 152.53 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2008.08.14 - 2008.08.14 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W _P	W	W _L	
10.0	Silty CLAY, trace gravel, trace sand Hard Grey		10	SS	39		312					
			11	SS	36		311					0 1 36 63
			12	SS	61		310					
			13	SS	100/ .225		309					1 36 38 25
	sandy		14	SS	100/ .150		308					1 27 57 16
			15	SS	118/ .100		307					0 1 41 58
							306					
							305					
							304					
							303					

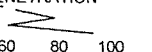
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+ 3 x 3

Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

METRIC

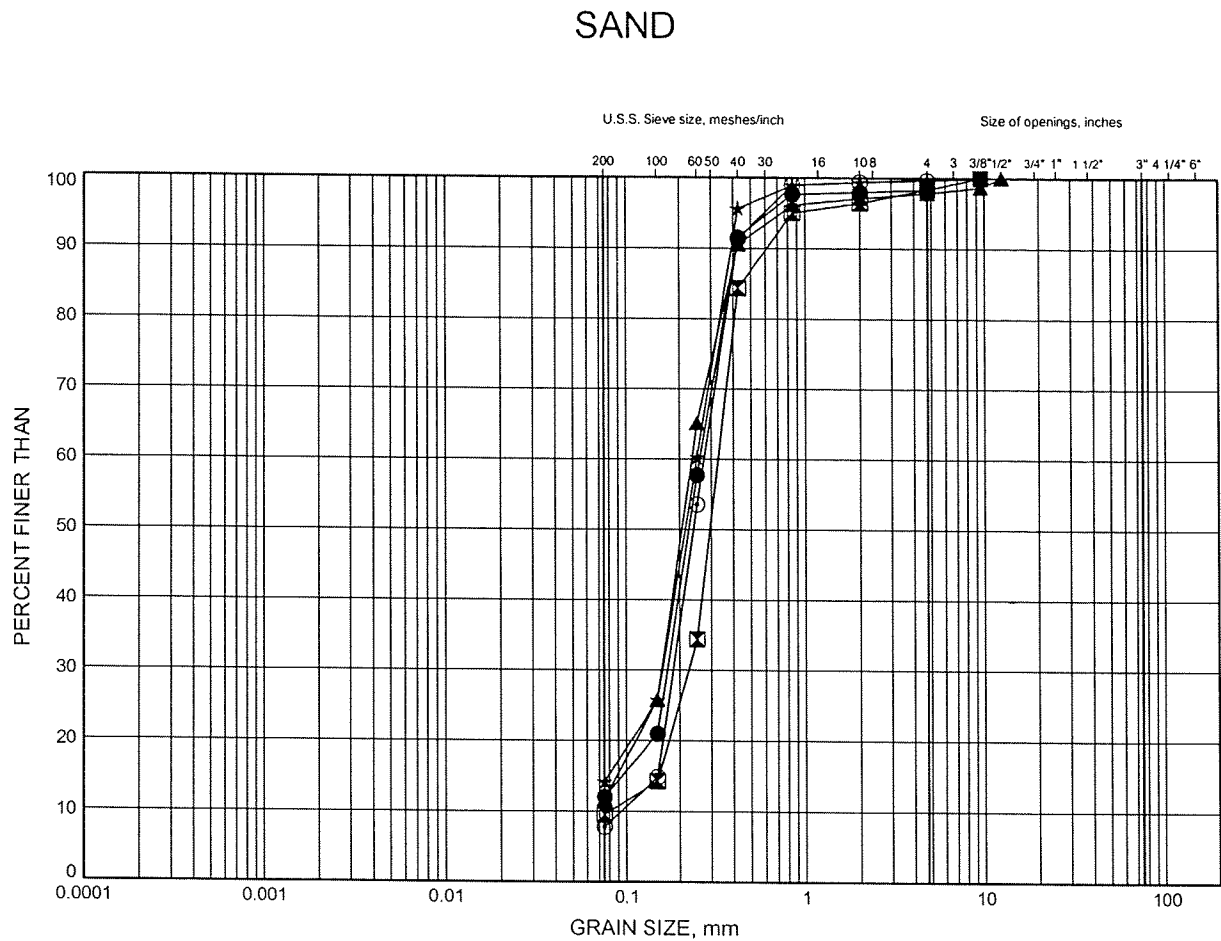
SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER TYPE "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
<div>DYNAMIC CONE PENETRATION RESISTANCE PLOT  20 40 60 80 100</div> <div>SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div> <div>WATER CONTENT (%) PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w p w w L</div> <div>UNIT WEIGHT γ kN/m³</div> <div>REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI C</div>					
302.7	Continued From Previous Page		16 SS 100		
20.1	END OF BOREHOLE AT 20.1m. WATER LEVEL OBSERVED AT 4.5m DURING DRILLING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.08.20 7.9 314.9				302

Appendix B

Laboratory Test Results

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-041	3.35	322.95
⊠	08-041	7.80	318.50
▲	08-041	10.96	315.34
☆	08-042	1.83	320.95
⊙	08-042	3.35	319.43

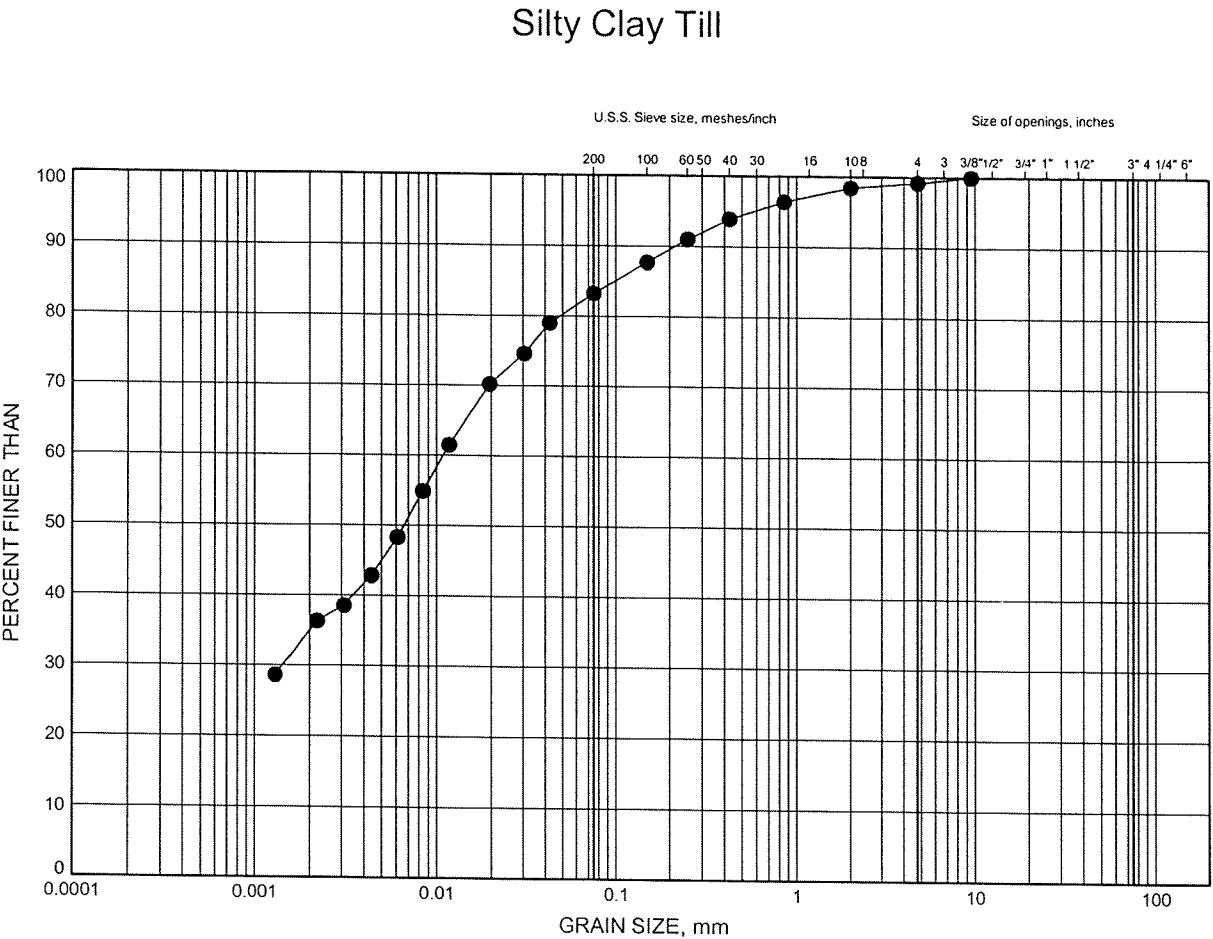
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 10/28/08

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



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-041	14.02	312.28

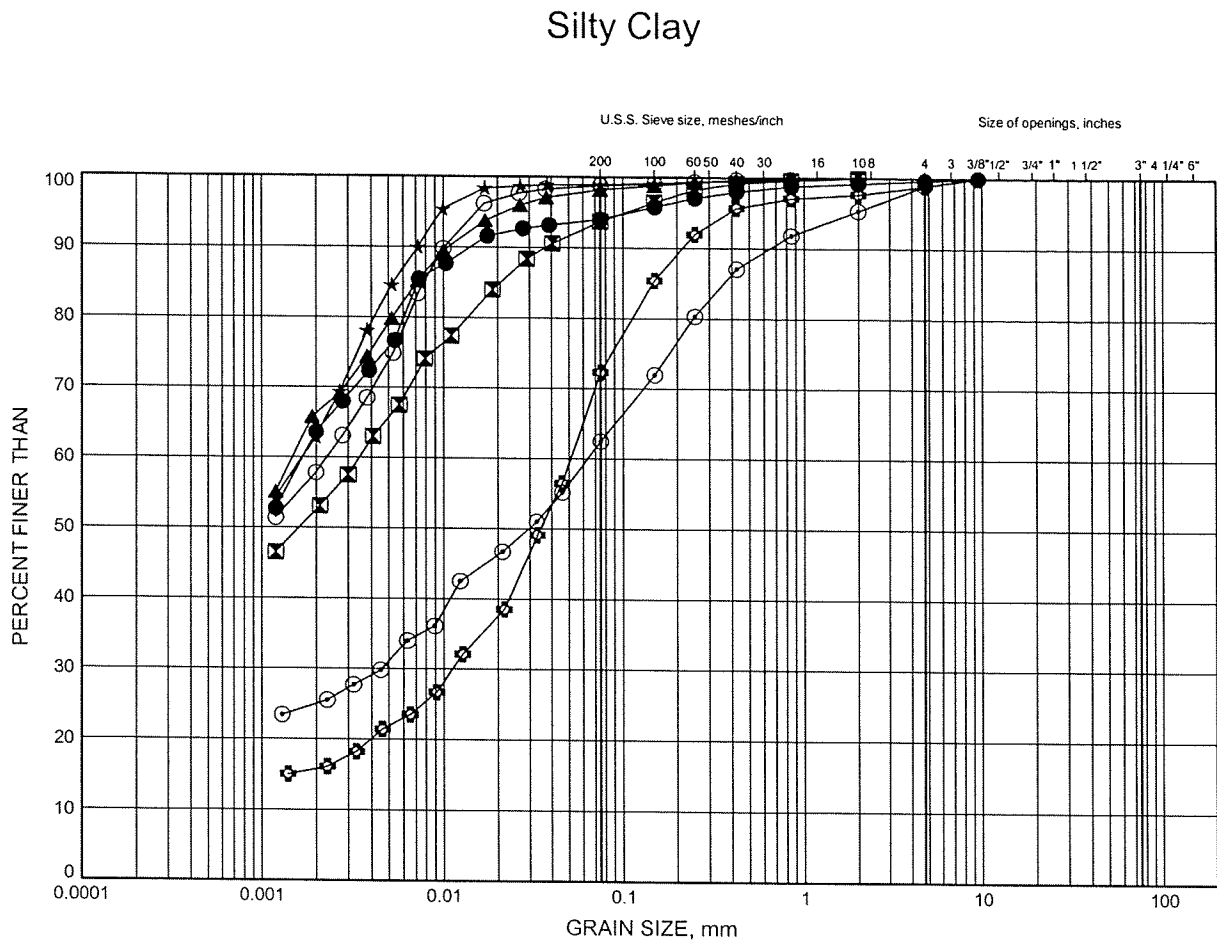
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 10/28/08

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)
●	08-041	20.12	306.18
⊠	08-041	24.46	301.84
▲	08-041	29.26	297.04
☆	08-042	12.50	310.29
⊙	08-042	15.29	307.49
⊛	08-042	16.92	305.87

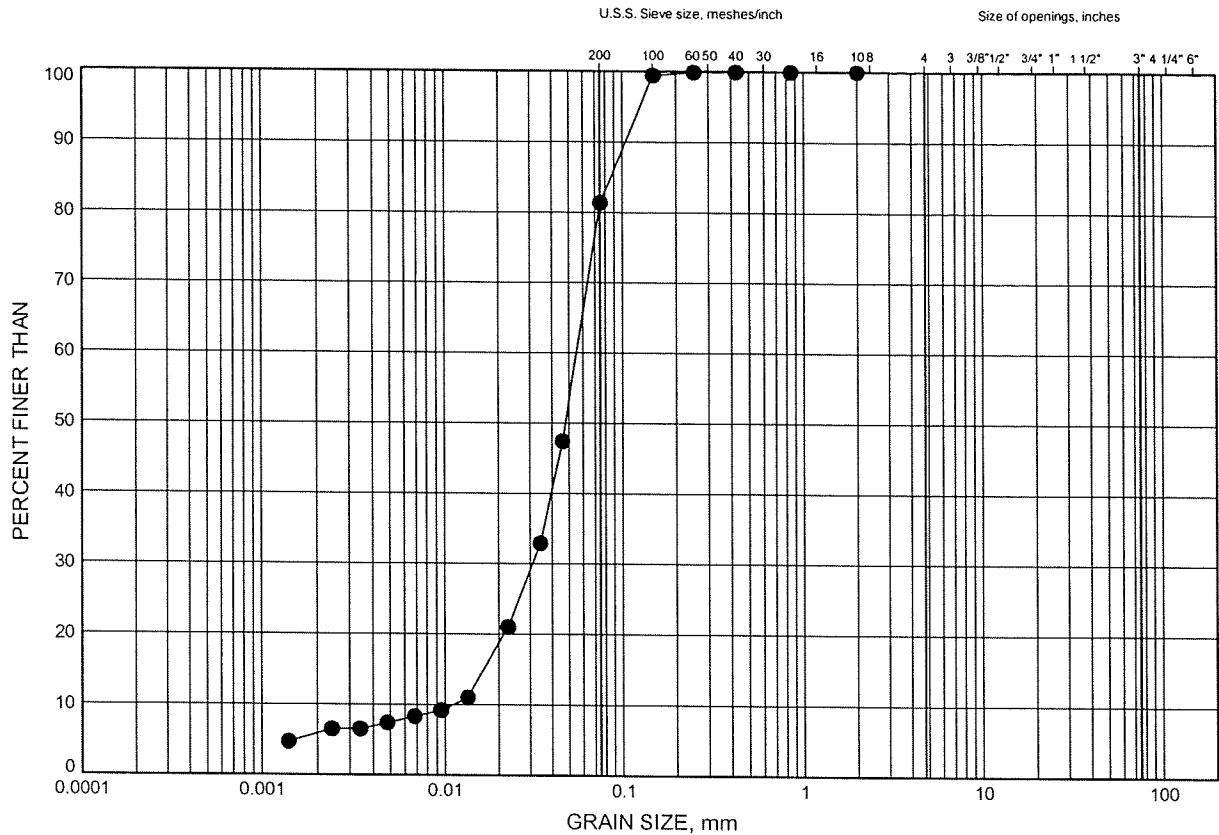


W.P.# 408-88-00
Prepared By AN
Checked By RPR

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)
●	08-041	36.73	289.57

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 10/28/08

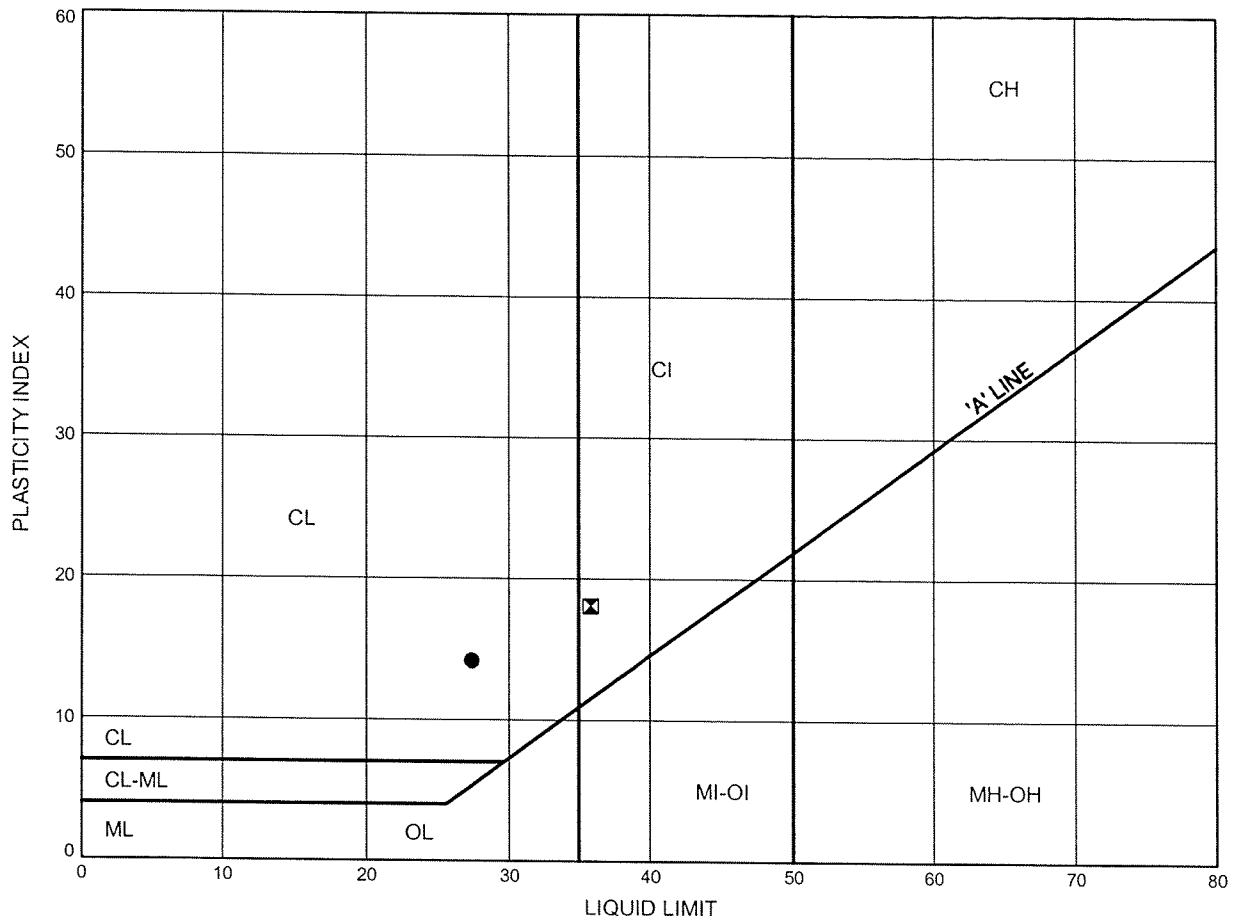
W.P.# 408-88-00
Prepared By AN
Checked By RPR



Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B5

Silty Clay Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-041	14.02	312.28
⊠	08-042	9.45	313.33

Date October 2008
 Project 408-88-00

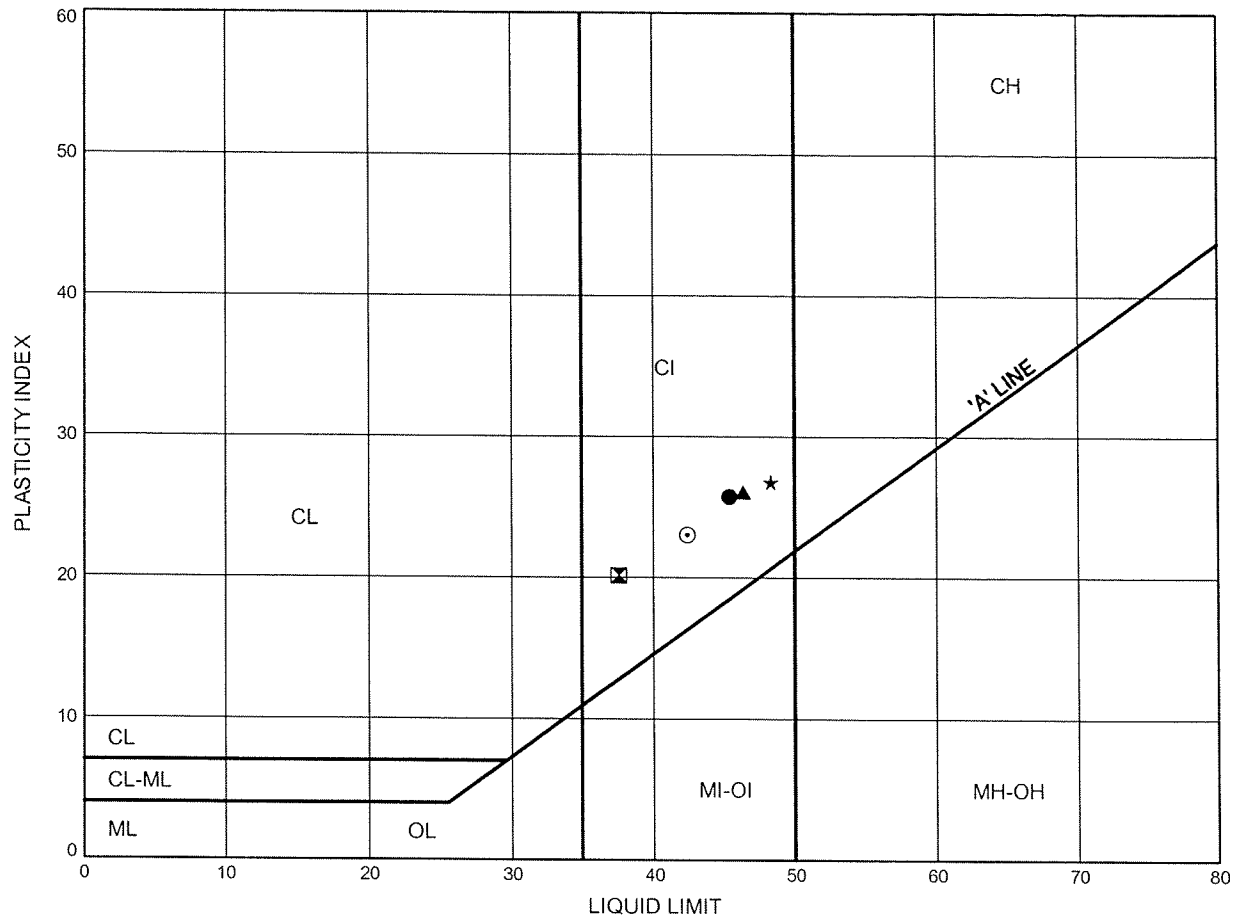


Prep'd AN
 Chkd. RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B6

Silty Clay



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-041	20.12	306.18
⊠	08-041	24.61	301.69
▲	08-041	29.26	297.04
★	08-042	12.50	310.29
⊙	08-042	18.59	304.19

Date October 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		



FINAL REPORT

CA14437-AUG19 R1

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. 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.

This report must not be reproduced, except in full. This report supersedes all previous versions.

-- End of Analytical Report --

REPORT INFORMATION				INVOICE INFORMATION				PROJECT INFORMATION			
Received By: <u>Oleg Mozhin</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			
REGULATIONS				REGULATIONS				COMMENTS:			
Regulation 153/04:				Regulation 153/04:				ANALYSIS REQUESTED			
<input type="checkbox"/> Table 1 <input type="checkbox"/> R/P/I <input type="checkbox"/> Soil Texture: <input type="checkbox"/> Coarse <input type="checkbox"/> Medium <input type="checkbox"/> Fine				<input type="checkbox"/> Reg 347/558 (3 Day min TAT) <input type="checkbox"/> PWQO <input type="checkbox"/> MMER <input type="checkbox"/> CCOME <input type="checkbox"/> MISA				<input type="checkbox"/> PAH <input type="checkbox"/> ABN <input type="checkbox"/> SVOC(all) <input type="checkbox"/> PCB Total <input type="checkbox"/> Aroclor <input type="checkbox"/> PHC F1-F4 <input type="checkbox"/> VOC <input type="checkbox"/> BTEX <input type="checkbox"/> BTEX/F1 <input type="checkbox"/> F2-F4 <input type="checkbox"/> VOC <input type="checkbox"/> BTEX <input type="checkbox"/> THM <input type="checkbox"/> Pesticides OC <input type="checkbox"/> OP <input type="checkbox"/> TCLP M&I <input type="checkbox"/> VOC <input type="checkbox"/> PCB <input type="checkbox"/> B(a)P <input type="checkbox"/> ABN <input type="checkbox"/> Ignit. <input type="checkbox"/> Water Pkg Gen. <input type="checkbox"/> Ext. <input type="checkbox"/> Sewer Use:			
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				Signature: <u>Nancy Berg</u>				Date: <u>08/11/19</u> (mm/dd/yy)			
Sampled By (NAME): <u>Nancy Berg</u>				Signature: <u>Nancy Berg</u>				Date: <u>08/11/19</u> (mm/dd/yy)			
Relinquished by (NAME): <u>Nancy Berg</u>				Signature: <u>Nancy Berg</u>				Date: <u>08/11/19</u> (mm/dd/yy)			
Revision #: 1.1				Pink Copy - Client				Yellow & White Copy - SGS			
Date of Issue: 04 April, 2018											



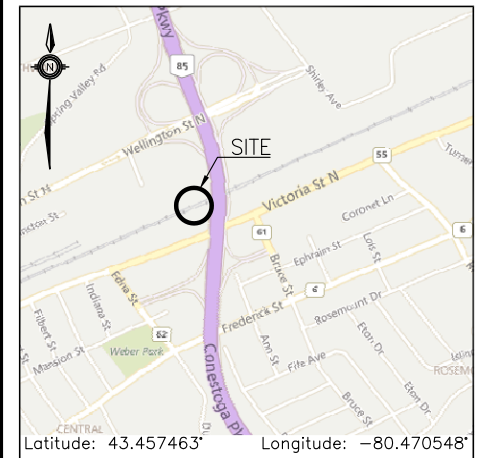
Appendix D

Borehole Locations and Soil Strata Drawing

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

CONT No
GWP No 408-88-00

METROLINX RAILWAY BRIDGE
FROM WELLINGTON ST N TO EDNA ST
CONNECTION AND E-S RAMP
BOREHOLE LOCATIONS PLAN



KEYPLAN

LEGEND

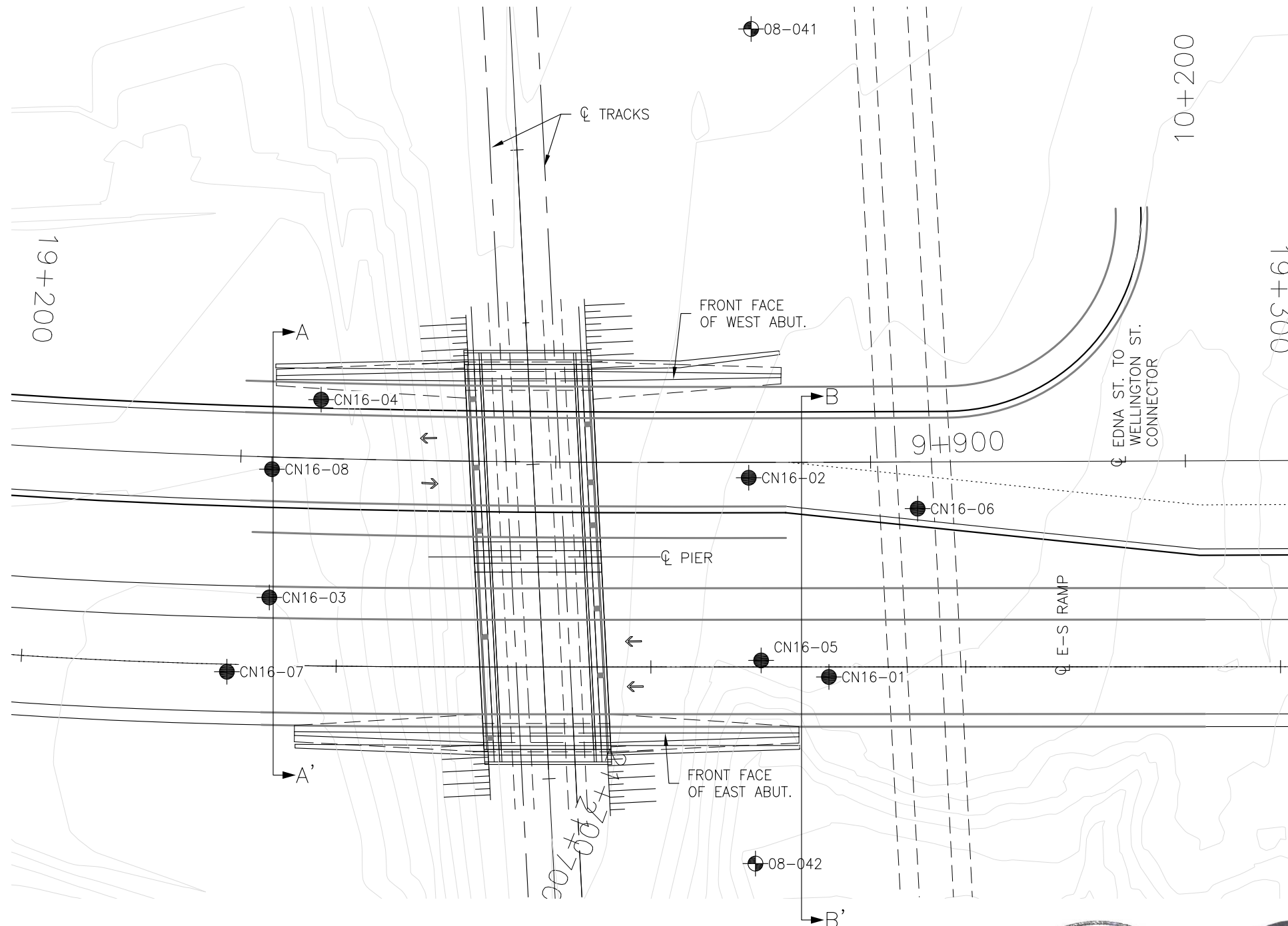
●	Borehole (Current Investigation)
⊙	Borehole (Previous Investigation By Thurber)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
≡	Water Level
⌵	Head Artesian Water
⌵	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-041	326.3	4 814 110.3	226 090.8
08-042	322.8	4 814 134.4	226 152.5
CN16-01	325.5	4 814 134.5	226 136.6
CN16-02	326.1	4 814 122.9	226 124.1
CN16-03	321.3	4 814 090.7	226 146.6
CN16-04	323.3	4 814 089.0	226 130.4
CN16-05	325.5	4 814 129.0	226 137.3
CN16-06	325.9	4 814 136.3	226 121.6
CN16-07	320.8	4 814 089.7	226 153.3
CN16-08	322.0	4 814 087.3	226 137.0

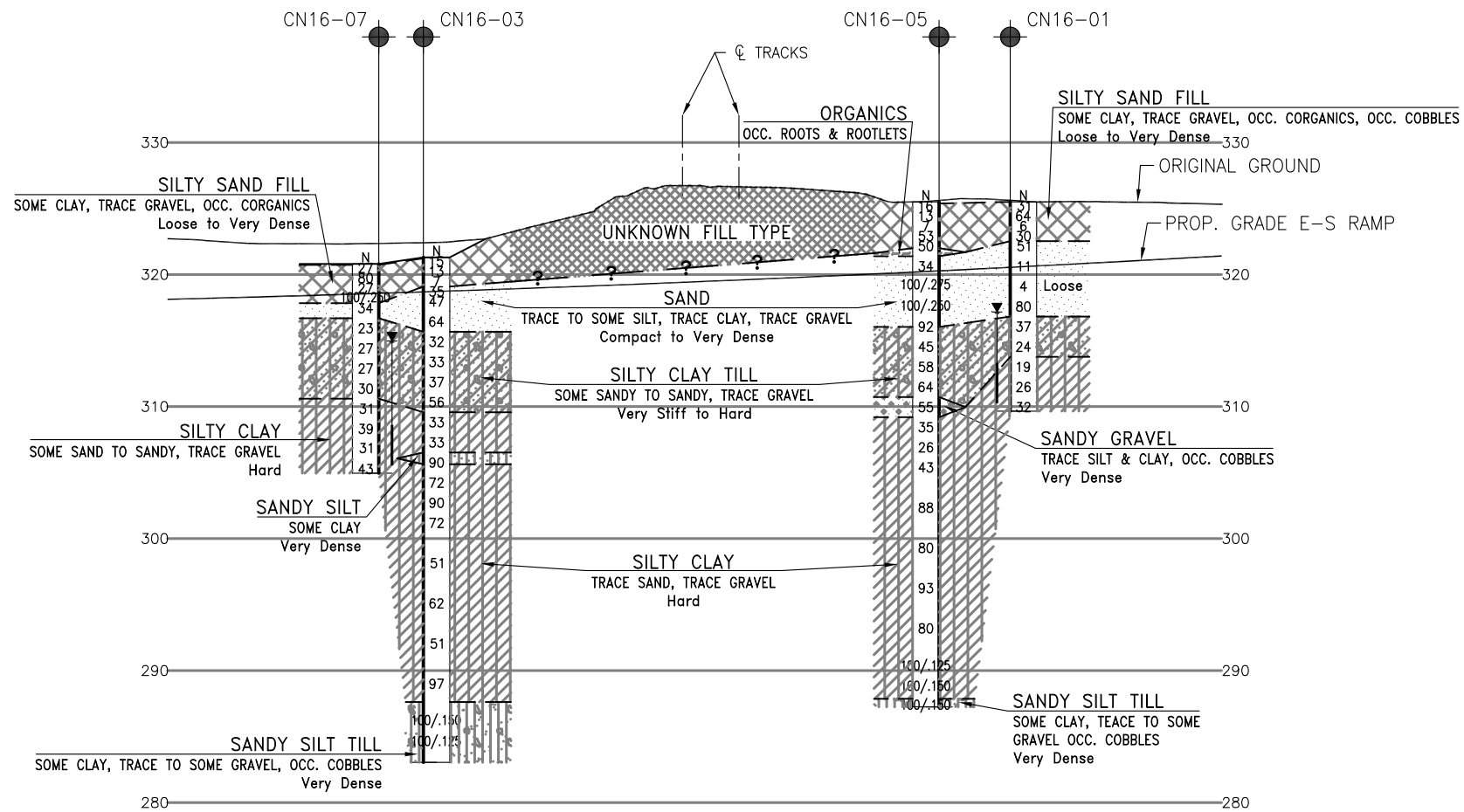
-NOTES-

- 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.

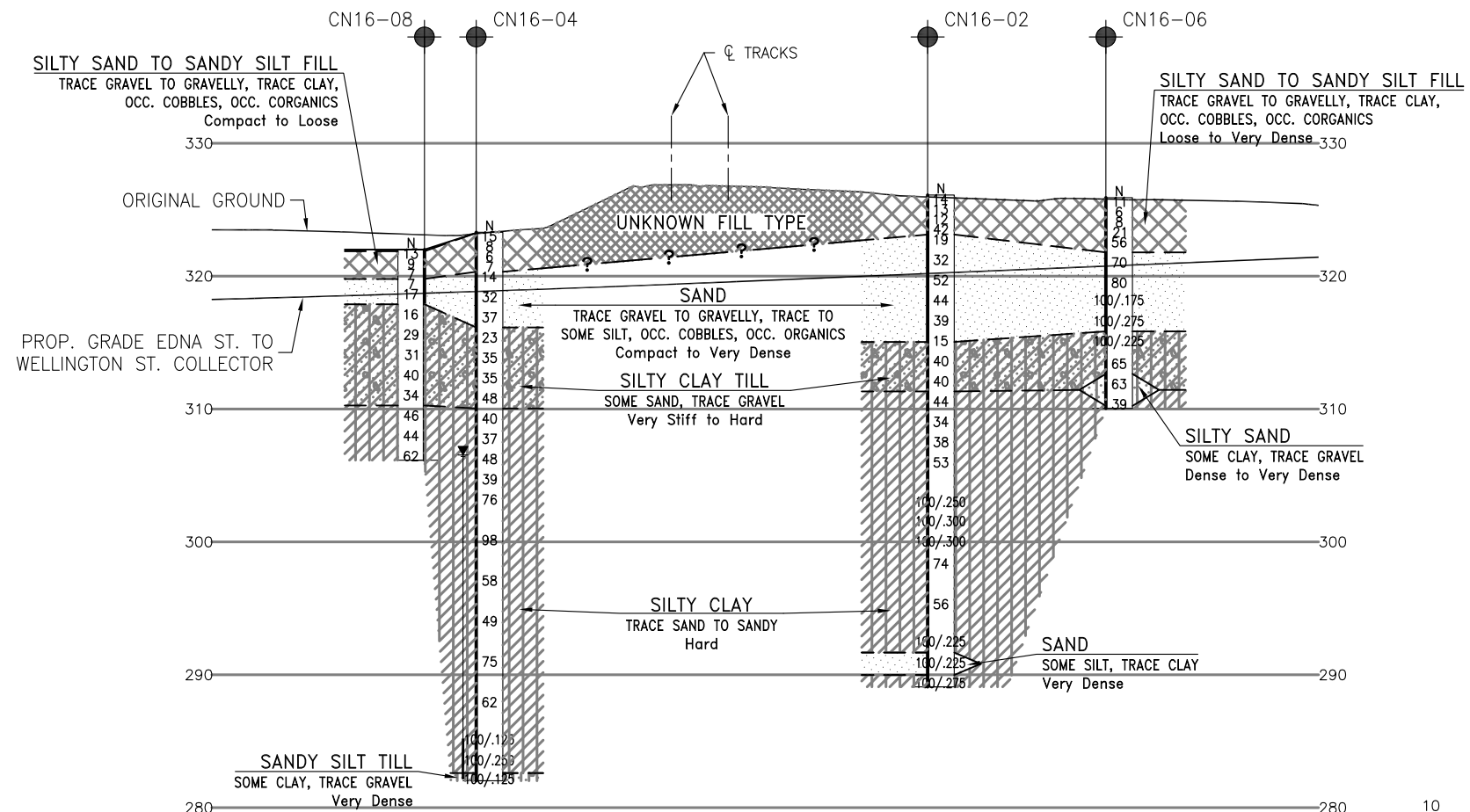
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PROFILE ALONG EAST ABUTMENT

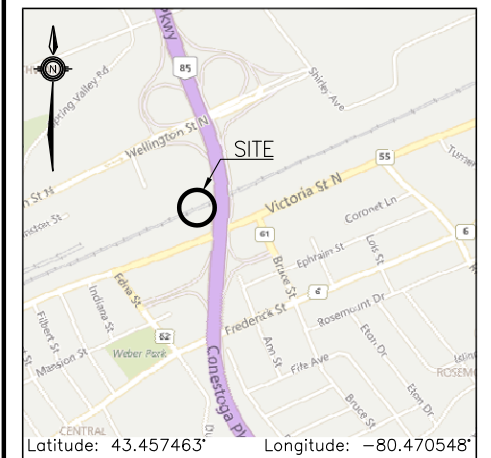


PROFILE ALONG WEST ABUTMENT

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWNCONT No
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FROM WELLINGTON ST N TO EDNA ST
CONNECTION AND E-S RAMP
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

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	Borehole (Previous Investigation By Thurber)
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GEOCRES No. 40P8-278



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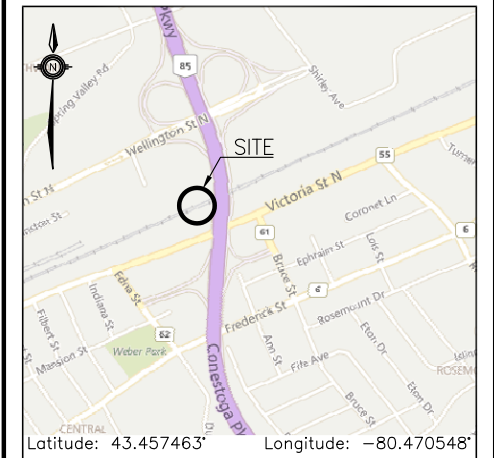
CONT No
GWP No 408-88-00

METROLINX RAILWAY BRIDGE
FROM WELLINGTON ST N TO EDNA ST
CONNECTION AND E-S RAMP
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
08-041	326.3	4 814 110.3	226 090.8
08-042	322.8	4 814 134.4	226 152.5
CN16-01	325.5	4 814 134.5	226 136.6
CN16-02	326.1	4 814 122.9	226 124.1
CN16-03	321.3	4 814 090.7	226 146.6
CN16-04	323.3	4 814 089.0	226 130.4
CN16-05	325.5	4 814 129.0	226 137.3
CN16-06	325.9	4 814 136.3	226 121.6
CN16-07	320.8	4 814 089.7	226 153.3
CN16-08	322.0	4 814 087.3	226 137.0

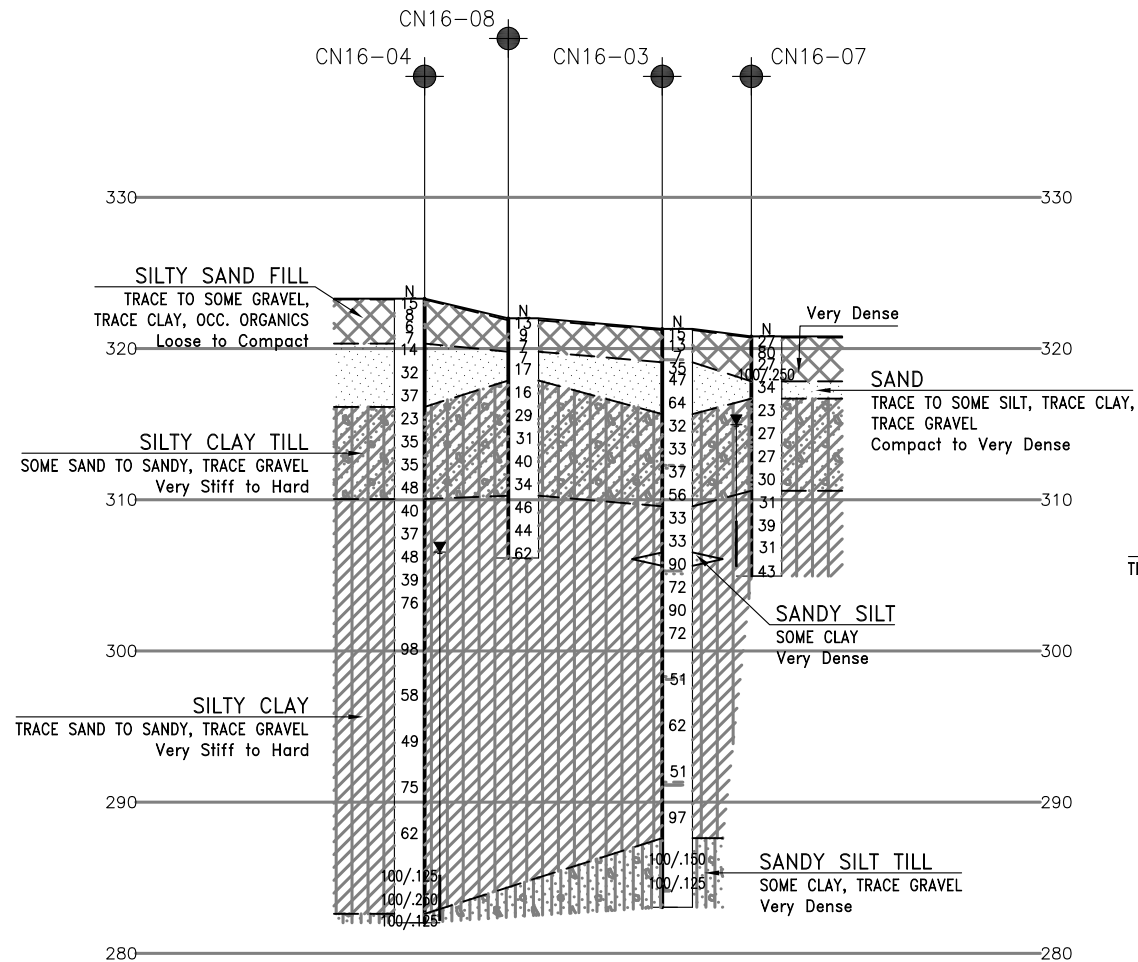
-NOTES-

- 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.

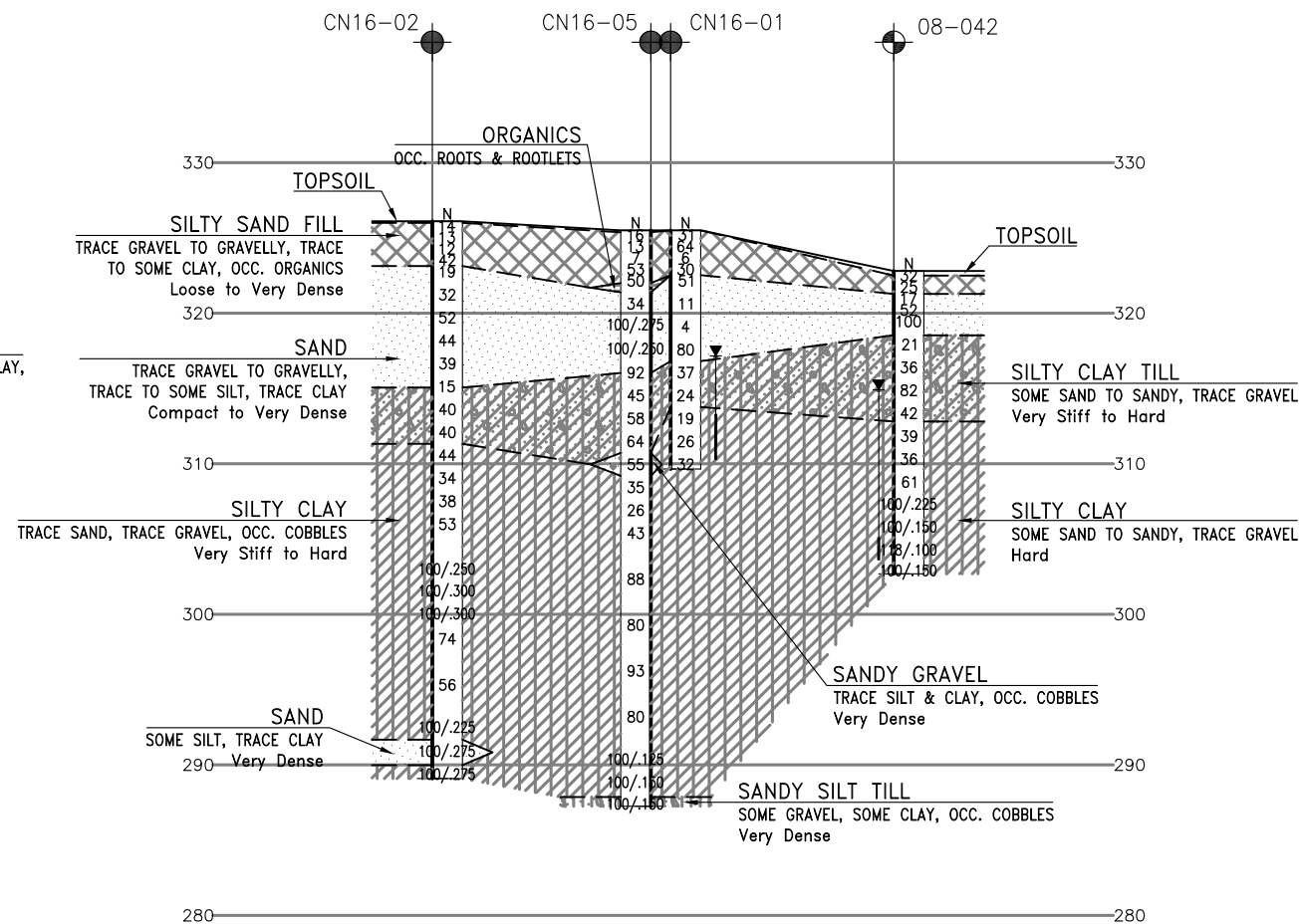
GEOCRES No. 40P8-278

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FILENAME: H:\Drafting\11000\11375\11375-BHPP-ES-Ramp.dwg
PLOTDATE: 6/17/2020 1:29 PM



SECTION ALONG A-A'



SECTION ALONG B-B'

