



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
PROPOSED RETAINING WALLS AT HIGHWAY 85 AND FREDERICK STREET  
HIGHWAY 7- NEW, KITCHENER TO GUELPH  
G.W.P. 3005-20-00**

**GEOCRES NO. 40P8-290**

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**Report**

**to**

**WSP**

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Appendices A to D include:

- Record of Borehole Sheets
- Laboratory Test Results
- Drawing titled “Borehole Locations and Soil Strata”



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**PART 1: FACTUAL INFORMATION**

**1.0 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at four (4) proposed standalone retaining walls (i.e. 33X-0497/W0, 33X-0538/W0, 33X0860/W0 and 33X-0861/W0) within the vicinity of the proposed Frederick Street bridge replacement along the existing Kitchener-Guelph Expressway (KWE - Highway 85) corridor in the Regional Municipality of Waterloo, Ontario.

The purpose of the investigations was to explore the subsurface conditions at the proposed retaining wall sites and, based on the data obtained, to provide borehole location plans, records of boreholes, stratigraphic profiles, laboratory test results and written descriptions of the subsurface conditions. Models of the subsurface conditions under the proposed retaining walls 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:

- Foundation investigation and design report for Northeast Corner Retaining Wall, Frederick Street Underpass, Site No. 33-234, G.W.P. 3110-09-00, City of Kitchener, Ontario, prepared by Peto MacCallum Ltd., PML Ref. 10KF079C, Geocres No. 40P8-199, dated May 31, 2012 (Reference 1).

**2.0 SITE DESCRIPTION**

The site is located in the City of Kitchener, approximately 350 m south of the Kitchener-Waterloo Expressway and Victoria Street interchange, where the Frederick Street crosses over the KWE. There is an underpass structure present at this site which carries Frederick Street over the northbound and southbound lanes (NBL and SBL) and existing ramps (E-S and S-E) of the KWE.

The existing cut slopes to the north and south of the bridge are retained by concrete wingwalls which extend from the ends of the bridge abutments.

The area outside of the KWE corridor is surrounded by industrial and commercial lands and is generally flat.

The designations and approximate locations of the proposed retaining walls are as follows:

**Table 3.1 – Retaining Wall Details**

Site No.	Location	Approx. Chainage (From)	Approx. Chainage (To)	Approx. Length (m)	Approx. Maximum Exposed Height (m)
33X-0497/W0	South of Frederick Street and east of the KWE	20+900	21+241	341	6.0
33X-0538/W0	North of Frederick Street and east of the KWE	21+276	21+455	179	7.2
33X-0860/W0	North of Frederick Street and west of the KWE	10+202	10+295	93	6.6
33x-0861/W0	South of Frederick Street and west of the KWE	10+322	10+339	17	5.4

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 kames or kame moraines, with outwash sands occupying the intervening hollows.

### **3.0 SITE INVESTIGATION AND FIELD TESTING**

The current site investigation for the proposed walls was carried out between May 6, 2018 and August 19, 2020 at which time a total of fourteen (14) boreholes were advanced at the site. Four boreholes were previously drilled by Peto MacCallum Ltd. between April 8, 2011 and July 20, 2011.

A summary of the borehole locations, designations, borehole termination depths and termination elevations for each retaining wall is provided in Table 3.2. The coordinates and elevations of the boreholes are given on the drawings and on the individual Record of Borehole Sheets. Record of Borehole Sheets for each retaining wall are included in Appendices A to D.



**Table 3.2 – Borehole Designations**

Site No.	Approx. Chainage (From)	Approx. Chainage (To)	Boreholes	Borehole Termination Depth (m)	Borehole Termination Elevation (m)	Appendix
33X-0497/W0	20+900	21+241	RW01-01 to RW01-07	11.1 to 14.3	313.8 to 305.7	A
33X-0538/W0	21+276	21+455	RW02-02 to RW02-04, RW-1 to RW-4	6.4 to 17.4	316.5 to 301.7	B
33X-0860/W0	10+202	10+295	RW16-01 to RW16-03	11.3 to 12.5	310.0 to 307.4	C
33X-0861/W0	10+322	10+339	BH 20-01	38.3	289.2	D

The boreholes were drilled near the retaining wall alignments, with one borehole at each end and an approximate 50 m spacing in between boreholes with the exception of SW retaining wall (33X-0861/W0), where no borehole was drilled within its footprint. BH 20-01 drilled for the West Abutment of the proposed Frederick St. Bridge was the closest to the north end of this proposed SW retaining wall.

The approximate locations of the boreholes are shown on the drawings included in Appendices A through D.

Prior to commencing the site investigation, utility clearances were obtained for all borehole locations. All of the boreholes were drilled on MTO property and did not require Permission to Enter (PTE) to be obtained.

The boreholes were drilled using a track-mounted drill rig and the boreholes were advanced using 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) in the native soils.

The drilling, sampling and in-situ testing operations were supervised on a full-time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing. Results of field drilling and sampling of the investigation are presented on the Record of Borehole sheets in Appendices A to D.

Groundwater conditions in the open boreholes were observed during the drilling operations. One (1) piezometer was installed in borehole RW01-04 and one piezometer was installed in BH 20-01



to permit for longer term monitoring of groundwater levels. The piezometer consisted of a 19 mm diameter PVC pipe with a 3.0 m slotted screen enclosed in filter sand. The locations and completion details of the piezometer is summarized in Table 3.3 along with the borehole completion details. The completion of the boreholes and the standpipe piezometers were carried out in accordance with the requirements of O. Reg. 903 (as amended by O. Reg. 372/07). The boreholes were decommissioned following completion of drilling in accordance with O.Reg. 903 (as amended).

**Table 3.3 – Borehole Completion Details**

Site No.	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
33X-0497/W0	RW01-01	14.3/311.7	-	Borehole backfilled with grout to 4.3 m, bentonite holeplug to 0.2 m, then asphalt to surface.
	RW01-02	11.1/313.8	-	Borehole backfilled with grout to 3.7 m, bentonite holeplug to 0.1 m, then asphalt to surface.
	RW01-03	14.1/313.7	-	Borehole backfilled with bentonite holeplug to surface.
	RW01-04	14.0/312.8	13.7/313.1	Piezometer with 3.0 m slotted screen installed with sand filter from 14.0 m to 9.7 m, bentonite holeplug from 9.7 m to ground surface.
	RW01-05	14.3/307.1	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW01-06	14.3/306.2	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW01-07	14.3/305.7	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
33X-0538/W0	RW02-02	13.3/306.2	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW02-03	15.8/303.6	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW02-04	17.4/301.7	-	Borehole backfilled with bentonite holeplug to 0.6 m, sand to 0.2 m, then asphalt to surface.
33X-860/W0	RW16-01	11.3/310.0	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW16-02	11.3/309.1	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.



Site No.	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
	RW16-03	12.5/307.4	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
33X-0861/W0	BH20-01	38.3/289.2	19.8/307.7	Piezometer with 3.0 m slotted screen installed with sand filter from 19.8 m to 15.8 m, bentonite holeplug to 13.7 m, and grout from 13.7 m to surface

#### 4.0 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 included in Appendix A through D. The results of the previous investigation completed by Peto MacCallum are included in Appendix B.

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 the native soil from the retaining walls 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 E.

#### 5.0 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendices A to D and depicted on the "Borehole Locations and Soil Strata" drawings for each retaining wall alignments in these appendices. An overall description of the stratigraphy encountered in the current boreholes advanced at each retaining wall site 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.

##### 5.1 SE Retaining Wall Site #33X-0497/W0 (Sta. 20+900 to 21+241 - Appendix A)

In general, the soil stratigraphy at this site consisted of surficial topsoil or asphalt overlying a granular fill layer, a layer of native sand, silty clay, and a layer of sandy silt to silty sand.



### **5.1.1 Topsoil**

A layer of topsoil was encountered surficially in two boreholes drilled at this site, RW01-03 and RW01-04. It was generally dark brown in colour. The thickness of the topsoil layer ranged from 0.15 m to 0.2 m. The topsoil thickness may vary between the borehole locations and in other areas of the site.

### **5.1.2 Asphalt**

Asphalt with a thickness of 100 mm was encountered at Boreholes RW01-01, RW01-02 and RW01-05. Asphalt with a thickness of 75 mm was encountered at Boreholes RW01-06 and RW01-07.

### **5.1.3 Granular Fill**

Granular fill was encountered immediately below the asphalt at five boreholes at this site, Boreholes RW01-01, RW01-02 and RW01-05 to RW01-07. Granular fill was encountered immediately below the topsoil at Boreholes RW01-03 and RW01-04.

The granular fill consisted of sand to sand and gravel, generally brown in colour, with trace silt to silty and trace clay. Occasional organics were encountered in the granular fill in Borehole RW01-04. A layer of silt fill was also encountered below the sand fill in Boreholes RW01-02 and RW01-03, with trace to some sand and trace clay to clayey.

The thickness of the granular fill ranged from 0.6 m to 3.0 m, with the lower boundary of this layer encountered at depths of 0.7 m to 3.2 m (Elevation 324.6 to 319.4).

SPT N-values recorded in the granular fill ranged from 4 to 36 blows for 0.3 m penetration, indicating a loose to dense relative density.

Moisture content of samples of the granular fill generally ranged from 3 percent to 27 percent.

Three samples of the granular fill underwent laboratory gradation analysis, and one sample of the clayey silt fill underwent Atterberg limits testing. 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 the Atterberg Limits tests are plotted on Figure A5. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	0 to 32
Sand	0 to 46
Silt	22 to 76
Clay	5 to 27

Index Property	
Liquid Limit	20
Plastic Limit	13
Plasticity Index	7

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

#### **5.1.4 Sand**

A native sand layer was encountered below the granular fill in all boreholes at this site, Boreholes RW01-01 to RW01-07. The sand layer was encountered at depths ranging from 0.7 m to 3.2 m (Elevation 324.6 to 319.4).

The sand layer was brown in colour and contained some silt to silty, trace clay and trace gravel.

The thickness of the sand ranged from 0.6 m to 4.0 m, with the lower boundary of the sand layer encountered at depths ranging from 1.3 m to 7.2 m (Elevation 321.2 to 317.7).

SPT N-values recorded in the sand ranged from 5 to 37 blows for 0.3 m penetration, indicating a loose to dense relative density.

Moisture content of samples of the sand generally ranged from 4 percent to 23 percent.

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



Soil Particles	Sand (%)
Gravel	0 to 3
Sand	76 to 81
Silt	16 to 19
Clay	2 to 5

#### 5.1.5 Silty Clay

Silty clay was encountered below the sand layer in all boreholes, RW01-01 to RW01-07, at depths ranging from 1.3 m to 7.2 m (Elevation 321.2 to 317.7).

A 4.0 to 5.4 m thick silty sand to sandy silt layer was encountered within the silty clay in Boreholes RW01-05 and RW01-06.

The silty clay was grey and contained some trace to some sand and trace gravel.

The thickness of the silty clay layer where fully penetrated ranged from 1.3 m to 10.4 m, with the lower boundary of the silty clay encountered at depths ranging 5.6 m to 11.7 m (Elevation 319.3 to 308.3). Boreholes RW01-05 and RW01-06 were terminated in the silty clay layer at a depth of 14.3 m for both boreholes (Elevation 307.1 and 306.2).

SPT N-values recorded in the silty clay ranged from 7 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a firm to hard consistency (typically very stiff to hard).

The natural moisture content of samples of the silty clay ranged from 11 percent to 28 percent.

Six 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 the grain size distribution curves for these samples are plotted on Figure A3 of Appendix A. The results of the Atterberg Limits tests are plotted on Figure A6.

Soil Particles	Silty Clay (%)
Gravel	0 to 2
Sand	1 to 10
Silt	39 to 50
Clay	41 to 59



Index Property	
Liquid Limit	28 to 49
Plastic Limit	13 to 23
Plasticity Index	15 to 27

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

#### **5.1.6 Sandy Silt to Silty Sand**

A deposit of sandy silt to silty sand was encountered below the silty clay layer in Boreholes RW01-01 to RW01-04 at depths ranging from 5.6 m to 10.0 m (Elevation 319.3 to 316.8), and within the larger silty clay layer in Boreholes RW01-05 and RW01-06, at depths of 6.3 m and 7.2 m (Elevation 315.1 and 313.4), respectively.

Sandy silt to silty sand was also encountered below the silty clay layer in Borehole RW01-07 at a depth of 11.7 m (Elevation 308.3).

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

Boreholes RW01-01, to RW01-04 were terminated in the sandy silt to silty sand layer at depths ranging from 11.1 to 14.3 m (Elevation 313.8 to 311.7). Borehole RW01-07 was terminated in the sandy silt to silty sand at a depth of 14.3 m (Elevation 305.7).

The thickness of the sandy silt to silty sand encountered within the silty clay, in Boreholes RW01-05 and RW01-06 where the layer was fully penetrated, was 4.0 to 5.4 m, with the lower boundary of the sandy silt to silty sand encountered at depths from 11.2 to 11.7 m (Elevation 309.7 to 309.4).

SPT N-values recorded in the sandy silt to silty sand ranged from 30 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a dense to very dense relative density.

Moisture content of samples of the sandy silt to silty sand generally ranged from 10 percent to 22 percent.

Seven samples of the sandy silt to silty sand underwent laboratory gradation analysis, and one sample underwent Atterberg limits testing. The results are summarized on the Record of Borehole sheets included in Appendix A and the grain size distribution curves for these samples



are plotted on Figure A5 of Appendix A. The results of the Atterberg Limits tests are plotted on Figure A7. The results of this testing are summarized as follows:

Soil Particles	Sandy Silt to Silty Sand (%)
Gravel	0
Sand	22 to 72
Silt	26 to 68
Clay	1 to 19

Index Property	
Liquid Limit	17
Plastic Limit	12
Plasticity Index	5

The above results indicate one sample of the silty sand to sandy silt of low plasticity with a group symbol of CL-ML, indicating the possibility of silt or clay lenses within the silty sand to sandy silt.

### 5.1.7 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. One standpipe piezometer was installed at this site, in Borehole RW01-04, to monitor water levels after completion of drilling. The water levels measured in the piezometer 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	
RW01-01	Sept 24, 2019	2.2	323.8	Open borehole
RW01-02	Sept 24, 2019	3.2	321.7	Open borehole
RW01-03	June 05, 2018	5.0	322.8	Open borehole
RW01-04	June 25, 2018	4.9	321.9	Piezometer
RW01-05	Aug 12, 2019	4.1	317.3	Open borehole

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW01-06	Aug 13, 2019	2.3	318.2	Open borehole
RW01-07	Aug 14, 2019	4.1	315.9	Open borehole

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.

Upon completion of drilling, Borehole RW01-05 caved-in at 7.9 m, and Borehole RW01-07 caved-in at 8.2 m.

## **5.2 NE Retaining Wall Site #33X-0538/W0 (Sta. 21+276 to 21+455 – Appendix B)**

In general, the soil stratigraphy at this site consisted of asphalt and granular fill overlying a layer of silty clay, a layer of silt and sand, and a layer of sand. A layer of upper sand was encountered in Boreholes RW-03 and RW-04.

It should be noted that Borehole RW-03 and RW-04 were drilled behind the retaining wall and on the embankment, and not shown within the stratigraphy profiles.

### **5.2.1 Asphalt**

Asphalt with thicknesses ranging from 112 mm to 200 mm was encountered surficially at Boreholes RW02-02 to RW02-04. Asphalt was also encountered surficially at Boreholes RW01 and RW-02.

### **5.2.2 Granular Fill**

Granular fill consisting of sand was encountered immediately below the asphalt at Boreholes RW02-02 to RW02-04, RW01 and RW-02.

The granular fill below the asphalt consisted of sand generally brown in colour with gravel, trace silt to silty and trace clay.

The thickness of the granular fill ranged from 0.5 m to 1.4 m, with the lower boundary of this layer encountered at depths of 0.6 m to 1.4 m (Elevation 318.8 to 318.3).



Additionally, granular fill was encountered surficially in Boreholes RW-03 and RW-04 behind the retaining wall, in a previous investigation by others.

The granular fill in Boreholes RW-03 and RW-04 consisted of silty sand, silt, gravelly sand and contained clayey silt fill layers, generally brown in colour. The thickness of the fill layer was 2.3 m in both boreholes, with the lower boundary encountered at the depth of 2.3 m (Elevation 320.0 and 321.2).

SPT N-values recorded in the granular fill ranged from 3 to 27 blows for 0.3 m penetration, indicating a very loose to compact relative density.

Moisture content of samples of the granular fill generally ranged from 3 percent to 18 percent.

Six samples of the granular fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix B and the grain size distribution curves for these samples are plotted on Figures RW-GS-1 to RW-GS-4 from previous investigations. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	3 to 23
Sand	20 to 68
Silt	11 to 54
Clay	4 to 18

It should be noted that cohesive clayey silt fill layers were observed within the granular fill in Boreholes RW-03 and RW-04.

### 5.2.3 Upper Sand

An upper native sand layer was encountered below the granular fill layer in Boreholes RW02-02 to RW02-04, at depths ranging from 0.6 m to 0.8 m (Elevation 318.8 to 318.5).

The sand was generally brown in colour, with some silt to silty, trace clay and trace gravel.

The thickness of the upper sand layer in Boreholes RW02-02 to RW02-04 ranged from 3.3 to 4.2 m, with the lower boundary encountered at a depth ranging from 4.1 to 5.0 m (Elevation 315.4 to 314.3).



Additionally, an upper native sand layer was encountered beneath the fill layer in Boreholes RW-03 and RW-04 behind the retaining wall, at the depth of 2.3 m (Elevation 320.0 and 321.2).

The sand was generally brown in colour, with trace to with gravel, trace to some silt and trace clay. The sand encountered in Borehole RW-04 below Elevation 319.7 was gravelly to with gravel.

The thickness of the upper sand layer in Boreholes RW-03 and RW-04 was 2.1 m and 3.6 m, with the lower boundary encountered at the depth of 4.4 m and 5.9 m (Elevation 317.9 and 317.6), respectively.

SPT N-values recorded in the upper sand generally ranged from 9 blows to 34 blows for 0.3 m penetration, indicating a generally compact to dense relative density with local loose layers.

Moisture content of samples of the upper sand generally ranged from 3 percent to 24 percent.

Ten samples of the upper sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix B and the grain size distribution curves for these samples are plotted on Figure B1 and Figure RW-GS-6. The results of this testing are summarized as follows:

Soil Particles	Upper Sand (%)
Gravel	0 to 38
Sand	43 to 94
Silt	3 to 31
Clay	0 to 6

It should be noted that soil descriptions in the “Borehole Locations and Soil Strata” drawing in Appendix B do not include information from Boreholes RW-03 and RW-04.

#### **5.2.4 Silty Clay**

Silty clay was encountered below the granular fill in Boreholes RW02-02 to 02-04, RW01 and RW-02 at depths ranging from 1.4 m to 5.9 m (Elevation 318.3 to 314.3).

The silty clay was generally brown to grey in colour and contained trace to with sand and trace gravel.



Borehole RW02-04 was terminated within the silty clay layer at a depth of 17.4 m (Elevation 301.7). Boreholes RW01 and RW-02 were both terminated within the silty clay layer at a depth of 9.8 m (Elevation 309.9).

The thickness of the silty clay layer was 3.8 m and 8.7 m in Boreholes RW02-02 and RW02-03, respectively, with the lower boundary of the silty clay encountered at depths of 7.9 and 13.7 m (Elevation 311.6 and 305.8).

Additionally, silty clay was encountered in Boreholes RW-03 and RW-04 below the upper sand layer at depths of 4.4 m and 5.9 m (Elevation 317.9 and 316.5), respectively. The silty clay was generally brown to grey in colour and contained trace sand, trace gravel and occasional cobbles.

Boreholes RW-03 and RW-04 were terminated in the silty clay at depths of 6.4 m and 7.0 m (Elevation 315.9 and 316.5), respectively.

SPT N-values recorded in the silty clay generally ranged from 6 blows for 0.3 m penetration to 70 blows for 0.15 m penetration, indicating a firm to hard consistency.

The natural moisture content of samples of the silty clay ranged from 9 percent to 41 percent.

Nine samples of the silty clay underwent laboratory gradation analysis and seven samples underwent Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix B and the grain size distribution curves for these samples are plotted on Figure B2 and Figure RW-GS-7 of Appendix B. The results of the Atterberg Limits tests are plotted on Figure B5 and Figure RW-PC-2.

Soil Particles	Silty Clay (%)
Gravel	0 to 7
Sand	0 to 37
Silt	30 to 50
Clay	24 to 69

Index Property	
Liquid Limit	35 to 46
Plastic Limit	17 to 23
Plasticity Index	18 to 27



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

#### **5.2.5 Silt and Sand**

A silt and sand layer was encountered below the silty clay in RW02-02. The silt and sand was grey in colour and contained trace clay and trace gravel.

Borehole RW02-02 was terminated within the silt and sand layer at a depth of 12.8 m (Elevation 306.8). A DCPT was performed from the base of the sampled borehole and was terminated at 13.3 m depth (Elevation 306.2) upon DCPT refusal.

SPT N-values recorded in the silt and sand ranged from 83 to 98 blows for 0.3 m penetration, indicating a very dense relative density.

Moisture content of samples of the silt and sand generally ranged from 19 percent to 20 percent.

One sample of the silt and sand underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix B and the grain size distribution curves for these samples are plotted on Figure B3 of Appendix B. The results of this testing are summarized as follows:

<b>Soil Particles</b>	<b>Silt and Sand (%)</b>
Gravel	0
Sand	43
Silt	56
Clay	1

#### **5.2.6 Lower Sand**

A lower sand layer was encountered below the silty clay in RW02-03. The sand was grey in colour and contained trace to some silt and trace clay.

Borehole RW02-03 was terminated within the lower sand layer at the depth of 15.8 m (Elevation 303.6).

SPT N-values recorded in the lower sand ranged from 43 to 75 blows for 0.3 m penetration, indicating a dense to very dense relative density.



Moisture content of samples of the lower sand ranged from 17 percent to 18 percent.

One sample of the sand underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix B and the grain size distribution curves for these samples are plotted on Figure B4 of Appendix B. The results of this testing are summarized as follows:

Soil Particles	Lower Sand (%)
Gravel	0
Sand	87
Silt	10
Clay	3

### 5.2.7 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Two standpipe piezometers were installed at this site for previous investigations by others, in Boreholes RW01 and RW-03. The water levels measured in the open boreholes upon completion of drilling are summarized in Table 5.2.

**Table 5.2.– Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW02-02	Aug 22, 2019	N/A	N/A	Water level in open borehole not available. Cave-in observed at 4.6 m.
RW02-03	Sept 24, 2019	N/A	N/A	Water level in open borehole not available. Cave-in observed at 4.6 m
RW02-04	June 05, 2018	1.5	317.6	Open borehole
RW01 (*)	April 8, 2011	2.9	316.8	Piezometer
RW-02 (*)	April 8, 2011	7.3	312.4	Open borehole
RW-03 (*)	July 19, 2011	Dry	Dry	Piezometer
	Sept 23, 2011	3.3	319.0	
	Oct 8, 2011	3.3	319.0	

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW-04 (*)	July 20, 2011	N/A	N/A	Water level in open borehole N/A. Cave-in observed at 5 m.

(\*) *Peto MacCallum Ltd borehole (Reference 1)*

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.

Upon completion of drilling, Borehole RW02-02 caved-in at 4.6 m, Borehole RW02-03 caved-in at 4.6 m, Borehole RW02-04 caved-in at 8.7 m, Borehole RW-02 caved-in at 8.7 m and Borehole RW-04 caved-in at 5.0 m.

### **5.3 NW Retaining Wall Site #33X-0860/W0 (Sta. 10+202 to 10+295 – Appendix C)**

In general the soil stratigraphy at this site consisted of asphalt and granular fill overlying a layer of native sand or clayey silt, a layer of silty clay and a lower layer of silty sand to sandy silt..

#### **5.3.1 Asphalt**

Asphalt with a thickness of 150 mm was encountered at all boreholes at this site, Boreholes RW16-01, RW16-02 and RW16-03.

#### **5.3.2 Granular Fill**

Granular fill consisting of sand and gravel was encountered immediately beneath the asphalt layers for boreholes RW16-02 and RW16-03, and sandy silt fill for Borehole RW16-01.

The granular fill consisted of sand and gravel or sandy silt with gravel and was generally brown in colour.

The thickness of the granular fill ranged from 0.5 m to 0.6 m, with the lower boundary of this layer encountered at depths of 0.7 m to 0.8 m (Elevation 320.5 to 319.3).

Moisture content of samples of the granular fill generally ranged from 1 percent to 3 percent.



### 5.3.3 Sand

Native sand was encountered immediately beneath the asphalt layer in Boreholes RW16-01 and RW16-02.

The sand was brown in colour and contained some silt to silty, trace to some clay, trace gravel, with occasional cobbles.

The thickness of the sand layer was 1.5 m and 0.7 m, with the lower boundary of the sand encountered at a depth of 2.3 m and 1.4 m, at Boreholes RW16-01 and RW16-02, respectively (Elevation 319.0 and 319.0).

SPT N-values within the sand varied from 8 to 26 blows for 0.3 m penetration, indicating loose to compact relative density.

Measured moisture contents within the sand were 14% to 18%.

The result of grain size distribution analysis carried out on one sample of the native sand is presented on the Record of Borehole Sheets included in Appendix C and on Figure C1 of Appendix C. The result of the grain size distribution analysis is summarized below:

Soil Particle	Sand (%)
Gravel	2
Sand	78
Silt	16
Clay	4

### 5.3.4 Clayey Silt

A layer of clayey silt was encountered immediately below the granular fill at 0.7 m depth (Elevation 319.3) in Borehole RW16-03.

The clayey silt was grey in colour and contained some sand and gravel.

The thickness of the clayey silt was 0.7 m, with the lower boundary of the layer encountered at a depth of 1.4 m (Elevation 318.5).

The SPT N-value recorded in the clayey silt was 39 blows for 0.3 m penetration, indicating a hard consistency.



The moisture content of the sample of the clayey silt was 21 percent.

### 5.3.5 Silty Clay

A layer of silty clay was encountered below the upper sand layer in Boreholes RW16-01 and RW16-02, and below the clayey silt in Borehole RW16-03, at 2.3 m, 1.4 m and 1.4 m depth, respectively (Elevation 319.0, 319.0 and 318.5).

The silty clay was brown to grey in colour and contained trace to some sand, trace gravel and trace shale.

Borehole RW16-02 was terminated in the silty clay layer at a depth of 11.3 m (Elevation 309.1).

The thickness of the silty clay was 6.5 m and 7.3 m at Boreholes RW16-01 and RW16-03, respectively, with the lower boundary of the layer encountered at depths of 8.8 m and 8.7 m (Elevation 312.5 and 311.3).

SPT N-values recorded in the silty clay ranged from 15 to 58 blows for 0.3 m penetration, indicating a very stiff to hard consistency.

Moisture content of samples of the silty clay generally ranged from 10 percent to 33 percent.

Four 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 C and the grain size distribution curves for these samples are plotted on Figure C2 of Appendix C. The results of the Atterberg Limits tests are plotted on Figure C4.

Soil Particles	Silty Clay (%)
Gravel	0
Sand	1 to 5
Silt	32 to 53
Clay	42 to 67

Index Property	
Liquid Limit	36 to 46
Plastic Limit	18 to 21
Plasticity Index	17 to 26



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

Audible grinding of the auger during drilling in Borehole RW16-03 was noted between depths of 3.6 m and 9.1 m (Elevation 316.3 and 310.8), indicating the possibility of occasional cobbles within the silty clay layer and in the underlying sandy silty layer.

### **5.3.6 Silty Sand and Sandy Silt**

A silty sand to sandy silt layer was encountered immediately below the silty clay in Boreholes RW16-01 and RW16-03, at depths of 8.8 m and 8.7 m, respectively (Elevation 312.5 and 311.3).

The silty sand to sandy silt was grey in colour and contained trace clay.

Boreholes RW16-01 and RW16-03 were both terminated in the silty sand to sandy silt layer at a depth of 11.3 m (Elevation 310.0 and 308.7).

SPT N-values within the silty sand to sandy silt varied from 18 to 45 blows for 0.3 m penetration, indicating compact to dense relative density.

Measured moisture contents within the silty sand to sandy silt were 12 percent to 20 percent.

The result of grain size distribution analysis carried out on one sample of the silty sand to sandy silt is presented on the Record of Borehole Sheets included in Appendix C and on C3 of Appendix C. The result of the grain size distribution analysis is summarized below:

<b>Soil Particle</b>	<b>Silty Sand to Sandy Silt (%)</b>
Gravel	0
Sand	24
Silt	70
Clay	6

### **5.3.7 Groundwater Conditions**

Water levels were observed in the boreholes during and upon completion of drilling. No standpipe piezometers were installed at this site. The water levels measured in the open boreholes upon completion of drilling are summarized in Table 5.3.

**Table 5.3 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW16-01	Aug 19, 2019	N/A	N/A	Water level in open borehole not available. Cave-in observed at 0.2 m.
RW16-02	Aug 19, 2019	3.7	316.7	Open borehole
RW16-03	Aug 15, 2019	8.8	311.1	Open borehole

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.

Upon completion of drilling, Boreholes RW16-01 caved-in at 0.2 m, RW16-02 caved-in at 10.4 m and RW16-03 caved-in at 9.1 m.

#### **5.4 SW Retaining Wall Site #33X-0861/W0 (Sta. 10+322 to 10+339 – Appendix D)**

No borehole was drilled within the footprint of this retaining wall. The subsurface conditions are interpreted based on an adjacent borehole (BH20-01) advanced behind the proposed west abutment of Frederick St Underpass and it is only for preliminary design purposes. Additional boreholes need to be completed at each end of the retaining wall by the Design-Build Contractor to confirm subsurface conditions and detail design assumptions. In general, the soil stratigraphy at this site consisted of asphalt and granular fill overlying a layer of native sand over silty clay/ clayey silt layer. The cohesive layer is in turn overlying a lower silty sand to sandy silt layer over a lower silty clay deposit underlain by silty clay till

##### **5.4.1 Asphalt**

Asphalt with a thickness of 200 mm was encountered at this site in BH20-01.

##### **5.4.2 Granular Fill**

Granular fill consisting of sand and gravel to sand was encountered immediately beneath the asphalt layer in BH20-01. The granular fill was generally brown in colour.



The thickness of the granular fill was 3.9, with the lower boundary of this layer encountered at Elevation 323.4 m.

Moisture content of samples of the granular fill generally ranged from 3% to 5%.

SPT N-values within the granular fill varied from 3 to 28 blows for 0.3 m penetration, indicating a compact to very loose relative density.

The result of grain size distribution analysis carried out on one sample of the granular fill is presented on the Record of Borehole Sheets included in Appendix D and on Figure D1 of Appendix D. The result of the grain size distribution analysis is summarized below:

Soil Particle	Granular Fill (%)
Gravel	0
Sand	89
Silt	11
Clay	

#### **5.4.3 Sand**

Native sand was encountered immediately beneath the granular fill in BH20-01. The sand was brown in colour and contained a trace of silt.

The thickness of the sand layer was 3.1 m, with the lower boundary of the layer encountered at a depth of 7.2 m (Elevation 320.3).

SPT N-values within the sand varied from 17 to 27 blows for 0.3 m penetration, indicating a compact relative density.

Measured moisture contents within the sand ranged from 14% to 20%.

#### **5.4.4 Upper Clayey Silt/ Silty Clay**

A layer of clayey silt/ silty clay was encountered immediately below the sand layer at 7.2 m depth (Elevation 320.3) in BH 20-01.

The clayey silt/ silty clay layer was brown to grey in colour and contained traces of sand and gravel.

The thickness of the clayey silt and silty clay layers were 1.5 m and 4.6 m respectively, with the lower boundary of the silty clay layer encountered at a depth of 13.3 m (Elevation 314.2 m).

The SPT N-value recorded in the clayey silt/ silty clay layer varied between 9 and 31 blows for 0.3 m penetration, indicating a stiff to hard consistency.

The moisture contents of the samples of the clayey silt/ silty clay layer were 18% to 40%.

Three samples of the silty clay/ clayey silt 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 D and the grain size distribution curves for these samples are plotted on Figure D2 of Appendix D. The results of the Atterberg Limits tests are plotted on Figure D6.

<b>Soil Particles</b>	<b>Clayey Silt/ Silty Clay (%)</b>
Gravel	0 to 1
Sand	0 to 7
Silt	30 to 78
Clay	14 to 70

<b>Index Property</b>	
Liquid Limit	49
Plastic Limit	20
Plasticity Index	29

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

#### **5.4.5 Sandy Silt to Silty Sand**

A deposit of sandy silt to silty sand containing trace clay was encountered underlying the upper clayey silt / silty clay deposit in BH 20-01. The thickness of the sandy silt to silty sand deposit was 6.1 m and the base of the deposit was encountered at depth of 19.4 m below ground surface (Elevation 308.1).

SPT 'N' values measured in the sandy silt to silty sand ranged from 45 to 88 blows per 0.3 m of penetration, indicating a dense to very dense relative density (typically very dense). The natural moisture contents measured on samples of the sandy silt to silty sand ranged from 12% to 31 %.

The result of a grain size analysis testing conducted on one sample of the sandy silt to silty sand is provided on the Record of Borehole Sheets in Appendix D and shown on Figure D3 in Appendix D. A summary of the test result is provided below:

Soil Particles	(%)
Gravel	0
Sand	28
Silt	66
Clay	6

#### 5.4.6 Lower Silty Clay

A relatively thick deposit of grey silty clay containing a trace of sand was encountered underlying the sandy silt to silty sandy deposit in BH 20-01. This lower silty clay deposit was 14.4 m thick and the base of the layer was located at a depth of 33.8 m (Elevation of 293.7 m).

SPT 'N' values measured within the lower silty clay ranged from 23 to 39 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. The natural moisture contents measured on samples of the lower silty clay ranged from 16 % to 25 %.

Grain size analysis was carried out on one sample of the lower silty clay as part of the current investigation. The result of grain size analysis is provided on the Record of Borehole Sheets in Appendix D and illustrated in Figure D4 in Appendix D. The results are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	4
Silt	36
Clay	60

The results of an Atterberg Limits test conducted on a sample of the lower silty clay are shown in Figure D7 in Appendix D and summarized below.

Liquid Limit	42
Plastic Limit	18
Plasticity Index	24

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

#### **5.4.7 Silty Clay Till**

Silty clay till, sandy with trace gravel, was encountered underlying the lower silty clay layer in BH20-01. The surface of the till was encountered at a depth of 33.8 m (Elevation 293.7 m). BH20-01 was terminated in this till deposit at a depth of 38.3 m (Elevation 289.2 m).

SPT 'N' values measured within the till ranged from 76 blows per 0.250 m of penetration to 105 blows per 0.175 m of penetration, indicating a hard consistency. The natural moisture contents measured on samples of the till ranged from 9 % to 10 %.

The result of a grain size analysis conducted on a sample of the till is provided on the Record of Borehole Sheets in Appendix D and illustrated in Figure D5 in Appendix D. The results are summarized as follows:

<b>Soil Particles</b>	<b>(%)</b>
Gravel	3
Sand	31
Silt	51
Clay	15

#### **5.4.8 Groundwater Conditions**

A monitoring well was installed in BH20-01 to permit monitoring of the water level. Water level measured in the piezometer on August 24, 2020 was at a depth of 5.5 m (Elevation 322.0 m).

In general, the groundwater level is expected to be located slightly below the adjacent highway grade (i.e. at or below Elev. 320 m).

The above value is a short-term reading, and seasonal fluctuation of the groundwater level is to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

## 6.0 CORROSIVITY AND SULPHATE TEST RESULTS

Samples of the sand from Boreholes RW01-02, SS4 (depth of 2.3 m) and RW16-01, SS2 (depth of 0.8 m), and the sand fill from Boreholes RW02-04, SS3 (depth of 1.5 m) and BH20-01, SS4 (depth of 3.4m) were 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 E.

**Table 6.1 – Analytical Test Results**

Parameter	Units (Soil)	Test Results			
		RW01-02 SS4 2.3 m	RW02-04 SS3 1.5 m	RW16-01 SS2 0.8 m	BH20-01 SS 4 3.4 m
		(Soil Sample)			
Corrosivity Index	none	9	5	4	8
Soil Redox Potential	mV	309	218	309	287
Sulphide	%	< 0.02	< 0.02	< 0.02	<0.04
Moisture Content	%	17.2	17.5	13.8	5.0
pH	pH Units	8.79	8.97	8.95	9.66
Chloride	µg/g	190	100	140	210
Sulphate	µg/g	13	5.8	12	8.3
Conductivity	uS/cm	543	356	117	547
Resistivity (calculated)	ohms.cm	1840	2810	8550	1830

## 7.0 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 for the boreholes were obtained with GPS equipment by Thurber, and the elevations 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. and Mr. Geoff Lay, P.Eng. Interpretation of the data and preparation of the report was carried out by Mr. Hooman Robin Motamedi, P.Eng., and Mr. Geoff Lay, 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.

Thurber Engineering Ltd.



Hooman Robin Motamedi, P.Eng.  
Geotechnical Engineer



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



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



**APPENDIX A**

**Record of Borehole Sheets, Laboratory Test Results, Borehole Locations, and Soil Strata  
Drawing  
SE Retaining Wall - Site # 33X-0497/W0**

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

### 1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

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

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

NOTE: Hierarchy of Soil Strength Prediction

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

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

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

### 5. LEGEND FOR RECORDS OF BOREHOLES

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

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


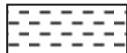



 Water Level  
 Shear Strength Determination by Pocket Penetrometer

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

# UNIFIED SOILS CLASSIFICATION

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

## EXPLANATION OF ROCK LOGGING TERMS


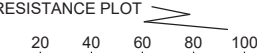

ROCK WEATHERING CLASSIFICATION		SYMBOLS			
Fresh (FR)	No visible signs of weathering.				
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE		
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of 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 (MPa) (psi)	Field Estimation of Hardness*	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
TERMS		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.				
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

# RECORD OF BOREHOLE No RW01-01

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 375.5 E 226 297.0 ORIGINATED BY ES  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2019.09.24 - 2019.09.24 LATITUDE 43.455902 LONGITUDE -80.469603 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
326.0	GROUND SURFACE													
0.0	<b>ASPHALT:</b> (100mm)						○ UNCONFINED      + FIELD VANE				WATER CONTENT (%)			
0.1	<b>SAND</b> , some to trace gravel Compact Brown Moist (FILL)		1	GS			● QUICK TRIAXIAL      × LAB VANE							
			2	SS	12									
	clayey silt layer at 1.4m (500mm)													
324.1			3	SS	22									
1.9	<b>SAND</b> , some silt to silty, trace gravel, trace clay Compact to Dense Brown Wet		4	SS	34									
			5	SS	27									
			6	SS	37									
320.4														
5.6	Silty <b>CLAY</b> , trace sand Very Stiff Grey Moist		7	SS	21									
			8	SS	17									
316.9														
9.1	Silty <b>SAND</b> , trace gravel Dense to Very Dense Grey Moist		9	SS	37									
316.0														

Continued Next Page

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

# RECORD OF BOREHOLE No RW01-01

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 375.5 E 226 297.0 ORIGINATED BY ES  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2019.09.24 - 2019.09.24 LATITUDE 43.455902 LONGITUDE -80.469603 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								20 40 60 80 100							
								<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></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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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No RW01-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 419.6 E 226 272.7 ORIGINATED BY ES  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2019.09.24 - 2019.09.24 LATITUDE 43.456484 LONGITUDE -80.470036 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
324.9	GROUND SURFACE					<div>▽</div>	<div>20406080100</div>	<div>204060</div>	<div>204060</div>	<div>204060</div>	<div>0 19 76 5</div>	<div>GR SA SI CL</div>	
0.0	ASPHALT: (100mm)												
0.1	SAND, some to trace gravel Loose Brown Moist (FILL)		1	GS									
			2	SS	6								
	Clayey silt layer at 1.1m (400mm)												
323.4													
1.5	SILT, some sand, trace clay Dense Brown Moist (FILL)		3	SS	36								
322.7													
2.3	SAND, some silt, trace gravel Compact to Loose Brown Moist to Wet		4	SS	15								
			5	SS	9								
320.7													
4.3	Silty CLAY, some sand, trace gravel Hard Grey Moist		6	SS	31								
319.3													
5.6	Sandy SILT, trace clay Very Dense Grey Moist		7	SS	57								
			8	SS	95								
			9	SS	106								
				</									

Continued Next Page

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

RECORD OF BOREHOLE No RW01-02

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 419.6 E 226 272.7 ORIGINATED BY ES  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
DATUM Geodetic DATE 2019.09.24 - 2019.09.24 LATITUDE 43.456484 LONGITUDE -80.470036 CHECKED BY NB





SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
314.7																	
10.2	Silty <b>SAND</b> , trace gravel Very Dense Grey Wet																
313.8			10	SS	105		314										
11.1	END OF BOREHOLE AT 11.1m. WATER LEVEL AT 3.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH GROUT TO 3.7m, HOLEPLUG TO 0.1m, THEN ASPHALT TO SURFACE.																

# RECORD OF BOREHOLE No RW01-03

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 475.3 E 226 263.8 ORIGINATED BY AF  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.06.05 - 2018.06.05 LATITUDE 43.457067 LONGITUDE -80.470499 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				W <sub>P</sub> W      W <sub>L</sub> WATER CONTENT (%)				GR	SA	SI	CL	
327.8	GROUND SURFACE							20	40	60	80	100								
0.0	TOPSOIL (150mm)							20	40	60	80	100								
0.2	<b>SAND</b> and <b>GRAVEL</b> , some silt to silty, trace asphalt Compact Brown Moist (FILL)		1	SS	13		327							○						
			2	SS	20		326							○						
325.5																				
2.3	<b>SILT</b> , some clay, trace sand Compact Brown Moist (FILL)		3	SS	19		325							○					0   0   73   27	
324.6	<b>SAND</b> , some silt to silty, trace clay, trace gravel Compact Brown Wet		4	SS	25		324							○						
					5	SS	15		323							○				
							322													
			6	SS	19		321													
320.6	Silty <b>CLAY</b> , trace to some sand, trace gravel Very Stiff to Hard Grey Moist																			
7.2																				
			7	SS	27		320							○						
							319													
			8	SS	100/ 0.175		318							○						
317.8																				

Continued Next Page

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

RECORD OF BOREHOLE No RW01-03

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 475.3 E 226 263.8 ORIGINATED BY AF  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.06.05 - 2018.06.05 LATITUDE 43.457067 LONGITUDE -80.470499 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								20   40   60   80   100					w <sub>P</sub> w                      w <sub>L</sub>							
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE												
10.0	Continued From Previous Page  SILT, some sand to sandy, some clay Dense to Very Dense Grey Moist																			
			9	SS	47		317													
							316													
			10	SS	100/ 0.250		315													
							314													
313.7			11	SS	100/ 0.200															
14.1	END OF BOREHOLE AT 14.1m. WATER LEVEL AT 5.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																			

# RECORD OF BOREHOLE No RW01-04

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 519.0 E 226 257.8 ORIGINATED BY JB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2018.05.06 - 2018.05.06 LATITUDE 43.457461 LONGITUDE -80.470575 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
326.8	GROUND SURFACE							20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>	GR	SA	SI	CL	
0.0	TOPSOIL (200mm)							20	40	60	80	100								
0.2	SAND, some silt to silty, trace to some gravel, occasional organics Loose to Compact Brown Moist (FILL)		1	SS	4		326							○						
			2	SS	6		325									○				
324.5																				
2.3	SAND, some silt to silty, trace clay Compact Brown Moist		3	SS	20		324							○						
			4	SS	21											○				0   79   19   2
							323													
			5	SS	24		322							○						
321.2																				
5.6	Silty CLAY, trace sand, trace gravel Very Stiff to Hard Grey Wet		6	SS	7		321								○					
			7	SS	17		319									○				
							318													
			8	SS	39										○				0   5   47   48	
316.8							317													

Continued Next Page

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

# RECORD OF BOREHOLE No RW01-04

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 519.0 E 226 257.8 ORIGINATED BY JB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2018.05.06 - 2018.05.06 LATITUDE 43.457461 LONGITUDE -80.470575 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
10.0	Continued From Previous Page Sandy <b>SILT</b> , some clay, trace gravel Very Dense Grey Moist		9	SS	64		316									
			10	SS	90		315									
			11	SS	100/		314									
312.8							313									
14.0	END OF BOREHOLE AT 14.0m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.06.25 4.9 321.9				0.150											0 22 59 19

# RECORD OF BOREHOLE No RW01-05

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 571.9 E 226 227.3 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.12 - 2019.08.13 LATITUDE 43.457951 LONGITUDE -80.470715 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE						PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W    LIQUID LIMIT W <sub>L</sub>			
321.4	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT: (100mm)																
0.1	SAND and GRAVEL Brown Dry (FILL)		1	GS			321										
320.7																	
0.7	Silty SAND, trace gravel Compact Brown Moist		2	SS	16		320										
			3	SS	16												
319.2																	
2.2	Silty CLAY, trace sand Stiff to Hard Grey Moist		4	SS	11		319										
			5	SS	23		318										0 3 39 58
							317										
			6	SS	36												
							316										
315.1																	
6.3	Silty SAND to Sandy SILT, trace clay Dense to Very Dense Grey Moist		7	SS	42		315										
							314										
			8	SS	67												
							313										
			9	SS	32		312										
311.4																	

Continued Next Page

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

# RECORD OF BOREHOLE No RW01-05

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 571.9 E 226 227.3 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.12 - 2019.08.13 LATITUDE 43.457951 LONGITUDE -80.470715 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
								20 40 60 80 100						20 40 60			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)					
Continued From Previous Page																	
10.0	Silty <b>SAND</b> , trace clay Dense Grey Moist	.....					311										
			10	SS	45									○			0 71 28 1
							310										
309.7																	
11.7	Silty <b>CLAY</b> , trace sand Hard Grey Moist						309							○			
			11	SS	32												
							308										
			12	SS	42									○	—		0 2 39 59
307.1																	
14.3	END OF BOREHOLE AT 14.3m. BOREHOLE CAVED TO 7.9m AND WATER LEVEL AT 4.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.																

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

# RECORD OF BOREHOLE No RW01-06

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 618.5 E 226 222.2 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.13 - 2019.08.13 LATITUDE 43.458395 LONGITUDE -80.470785 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				WATER CONTENT (%) w <sub>P</sub> w      w <sub>L</sub>				GR	SA	SI	CL
320.5	GROUND SURFACE					▽	320												
0.0 0.1	ASPHALT: (75mm)		1	GS															
319.9	SAND and GRAVEL, trace silt, trace clay Brown																		
0.7	Dry (FILL)		2	SS	15														
	SAND, some silt, trace clay, trace gravel Loose to Dense																		
	Brown		3	SS	5														
	Moist to Wet																		
			4	SS	34														
317.7																			
2.8	Silty CLAY, trace sand Very Stiff to Hard Grey Moist		5	SS	34														
			6	SS	30														
			7	SS	29														
313.4																			
7.2	Sandy SILT to SILT and SAND, trace to some clay, trace gravel Compact to Dense Grey Moist to Wet		8	SS	30														
			9	SS	32														

Continued Next Page

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

RECORD OF BOREHOLE No RW01-06

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 618.5 E 226 222.2 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.13 - 2019.08.13 LATITUDE 43.458395 LONGITUDE -80.470785 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR  SA  SI  CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT  W <sub>P</sub> W                      W <sub>L</sub> WATER CONTENT (%)
	Continued From Previous Page							20    40    60    80    100						
309.4			10	SS	30		310							
11.2	Silty <b>CLAY</b> , trace to some sand Hard Grey Moist						309							
			11	SS	33		308							0   10   45   45
							307							
306.2			12	SS	33									
14.3	END OF BOREHOLE AT 14.3m. BOREHOLE CAVED TO 4.4m AND WATER LEVEL AT 2.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.													

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

# RECORD OF BOREHOLE No RW01-07

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 661.7 E 226 221.5 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.14 - 2019.08.14 LATITUDE 43.458833 LONGITUDE -80.471043 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
320.0	GROUND SURFACE												
0.0 0.1	ASPHALT: (75mm)		1	GS									GR SA SI CL
319.4 0.7	SAND and GRAVEL, some silt, trace clay Brown Dry (FILL)												32 46 22 (SI+CL)
318.8 1.3	Silty SAND, trace gravel Dense Brown Moist		2	SS	32								
	Silty CLAY, trace to some sand, trace gravel Very Stiff to Hard Grey Moist		3	SS	32								
			4	SS	32								
			5	SS	35								
			6	SS	34								2 7 50 41
			7	SS	28								
			8	SS	24								
			9	SS	23								

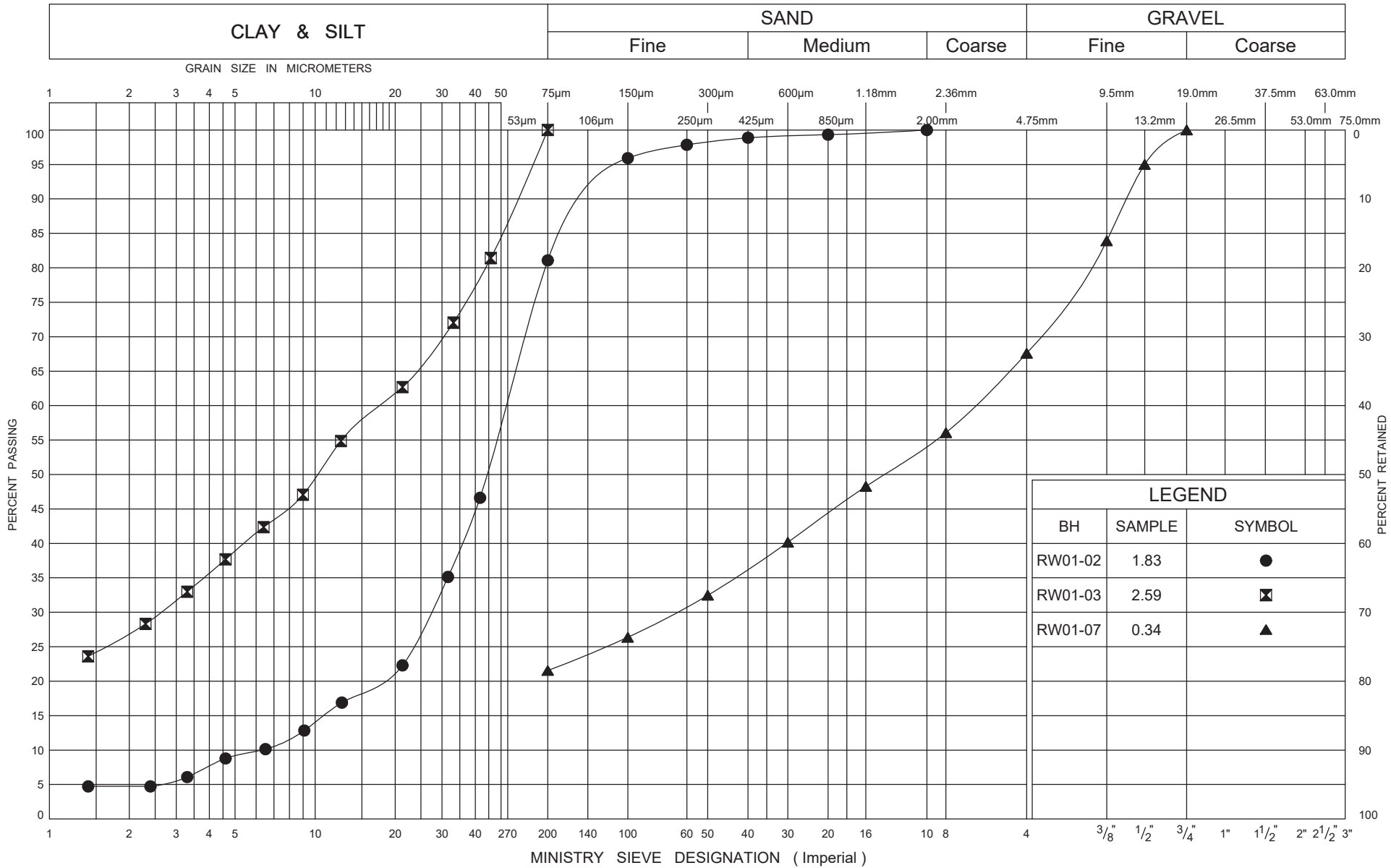
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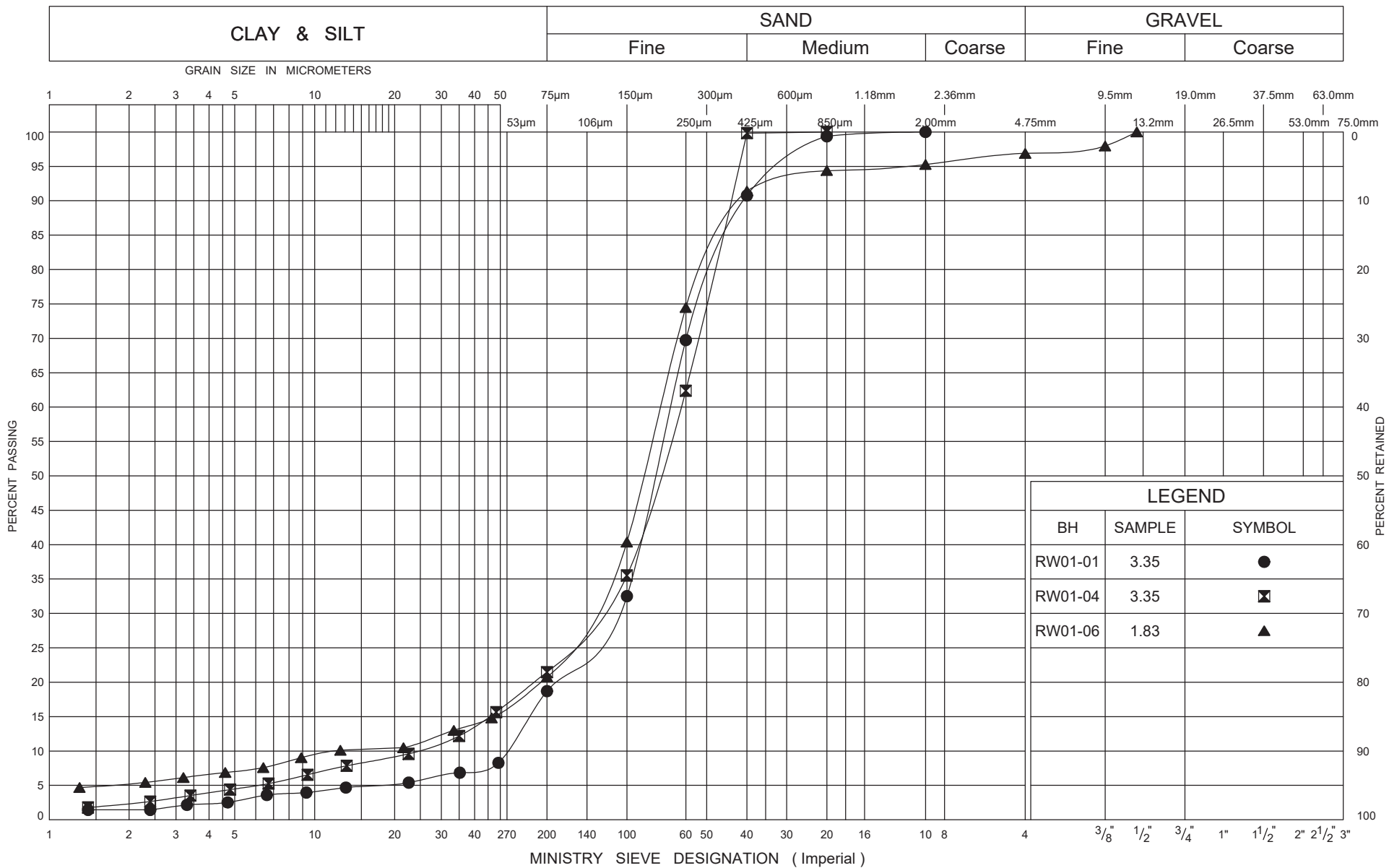
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
 20  
 15  
 10  
 (%) STRAIN AT FAILURE

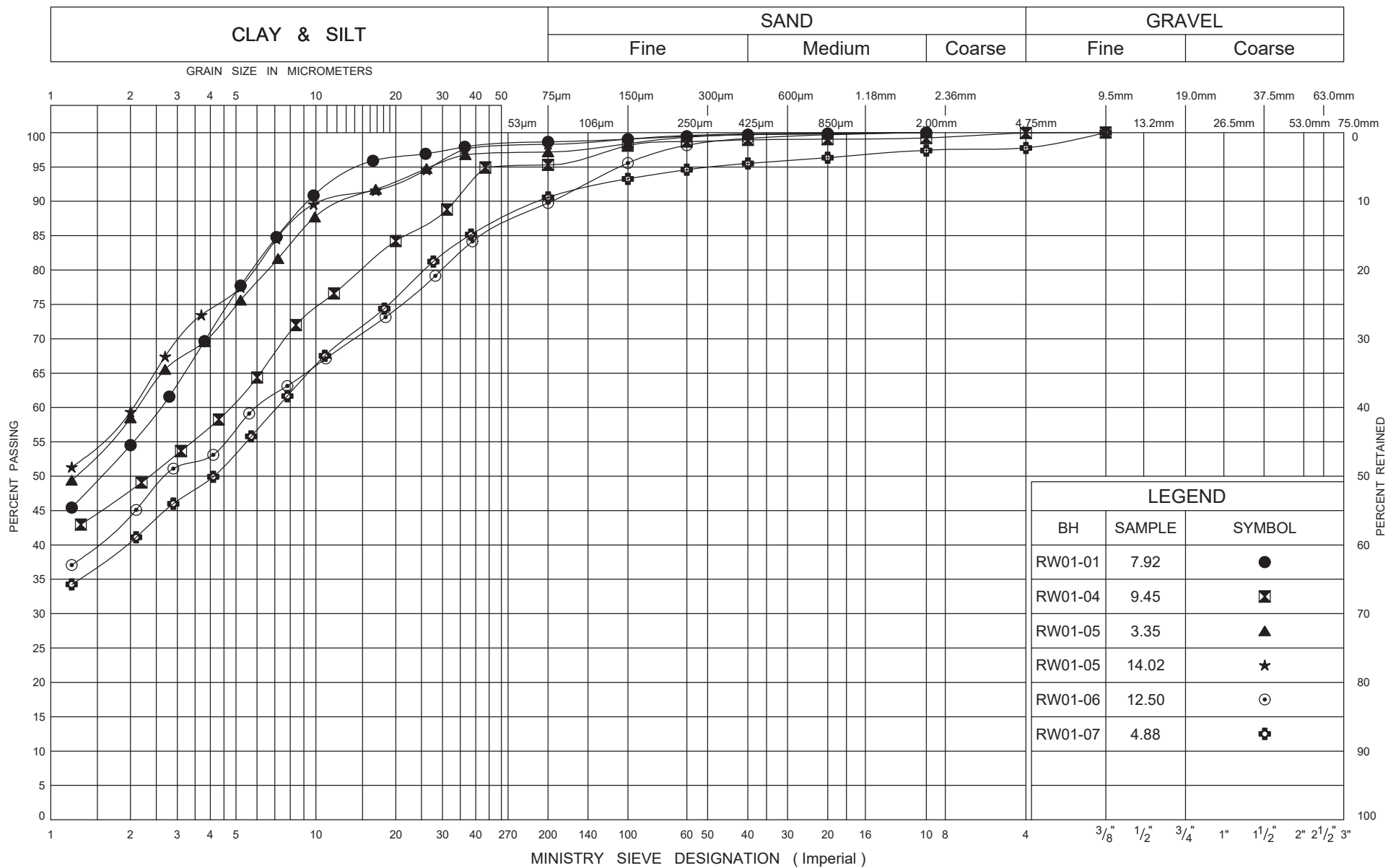
RECORD OF BOREHOLE No RW01-07 2 OF 2 METRIC

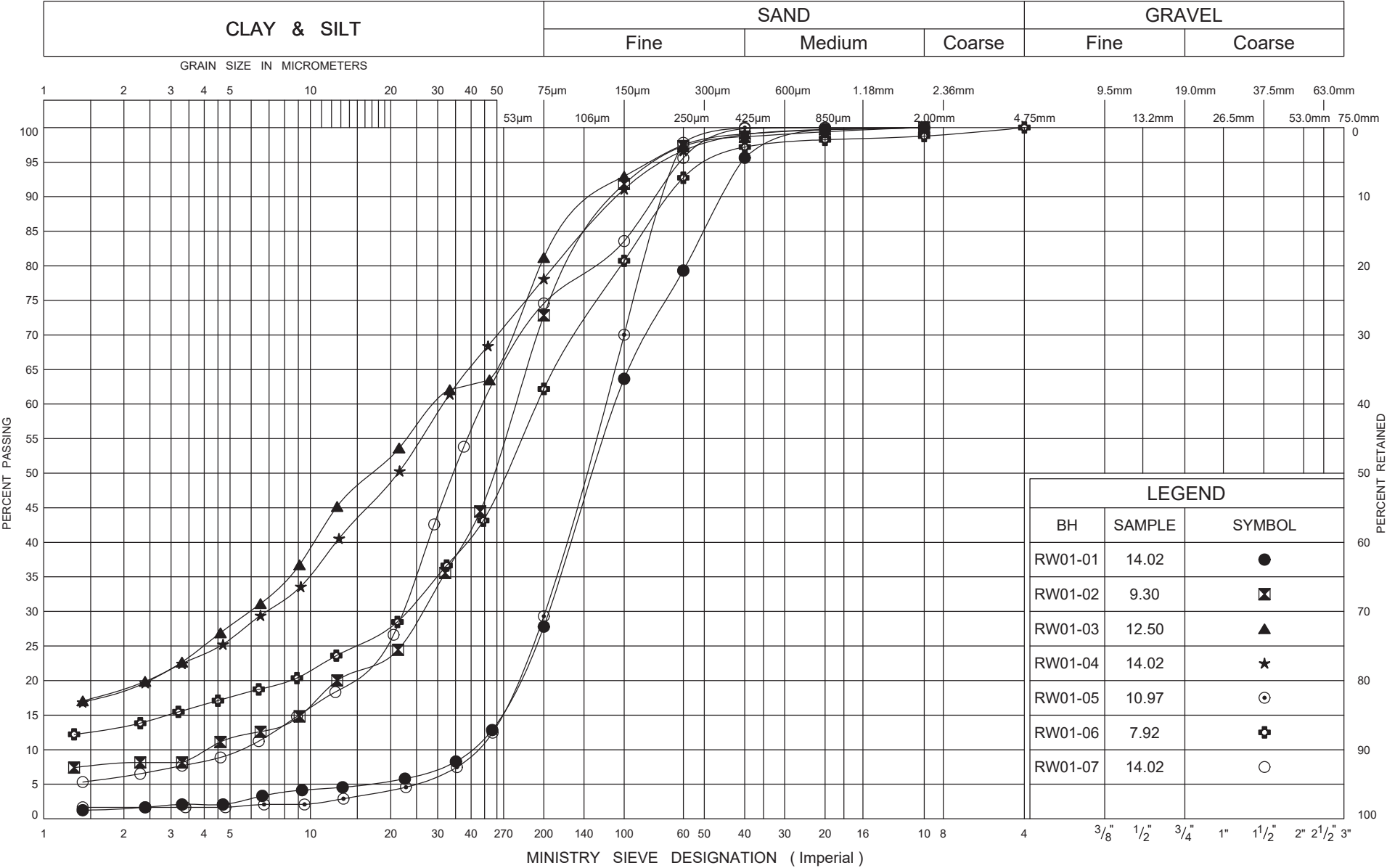
GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 661.7 E 226 221.5 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.14 - 2019.08.14 LATITUDE 43.458833 LONGITUDE -80.471043 CHECKED BY NB

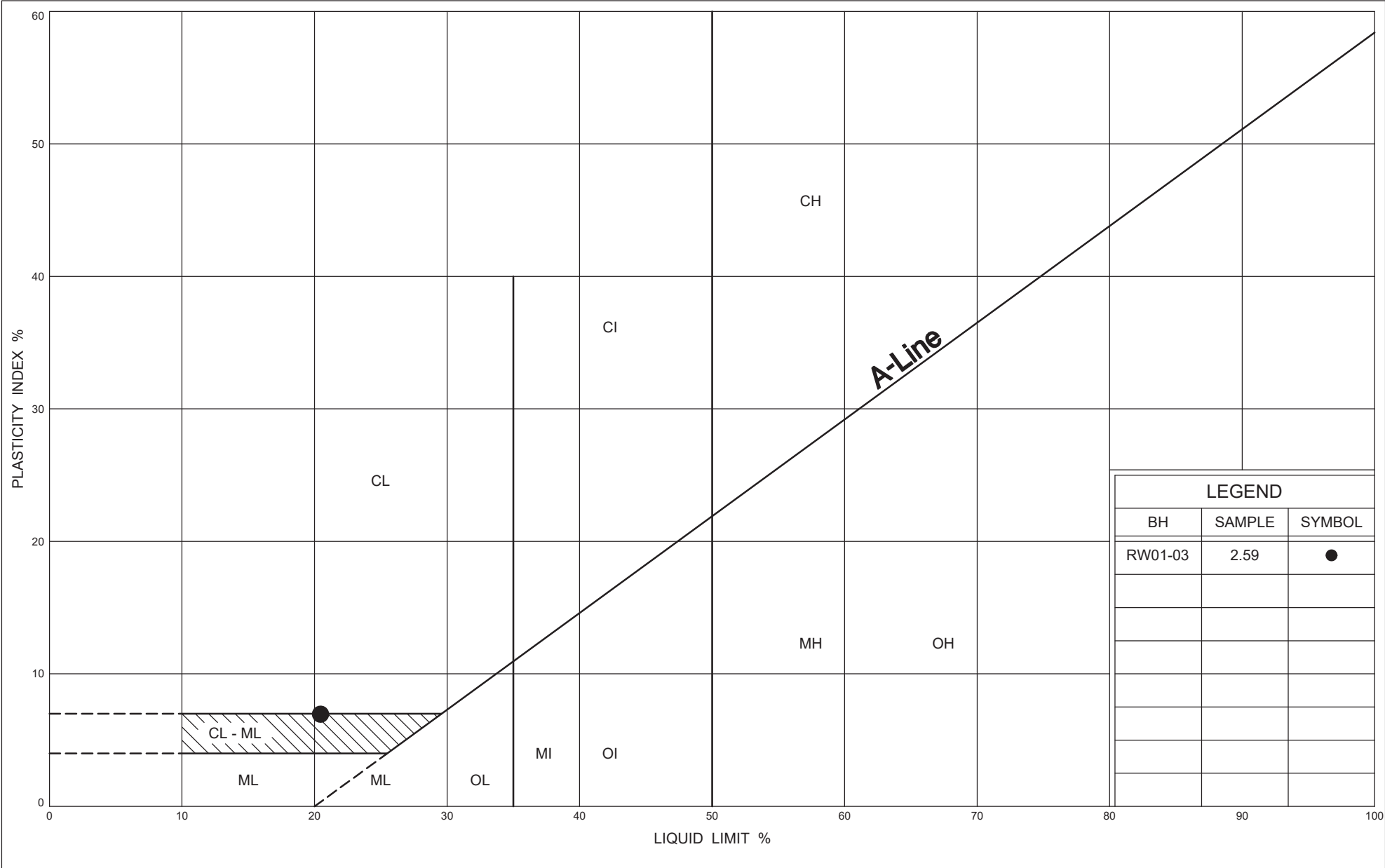
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
						WATER CONTENT (%)				W <sub>P</sub> W W <sub>L</sub>				
						20 40 60 80 100				20 40 60				
	Continued From Previous Page						310							
	Silty <b>CLAY</b> , trace to some sand, trace gravel Very Stiff to Hard Grey Moist		10	SS	19		309							
308.3														
11.7	Sandy <b>SILT</b> , trace clay Dense to Very Dense Grey Moist		11	SS	31		308							
							307							
305.7			12	SS	55		306							0 25 68 7
14.3	END OF BOREHOLE AT 14.3m. BOREHOLE CAVED TO 8.2m AND WATER LEVEL AT 4.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT TO SURFACE.													

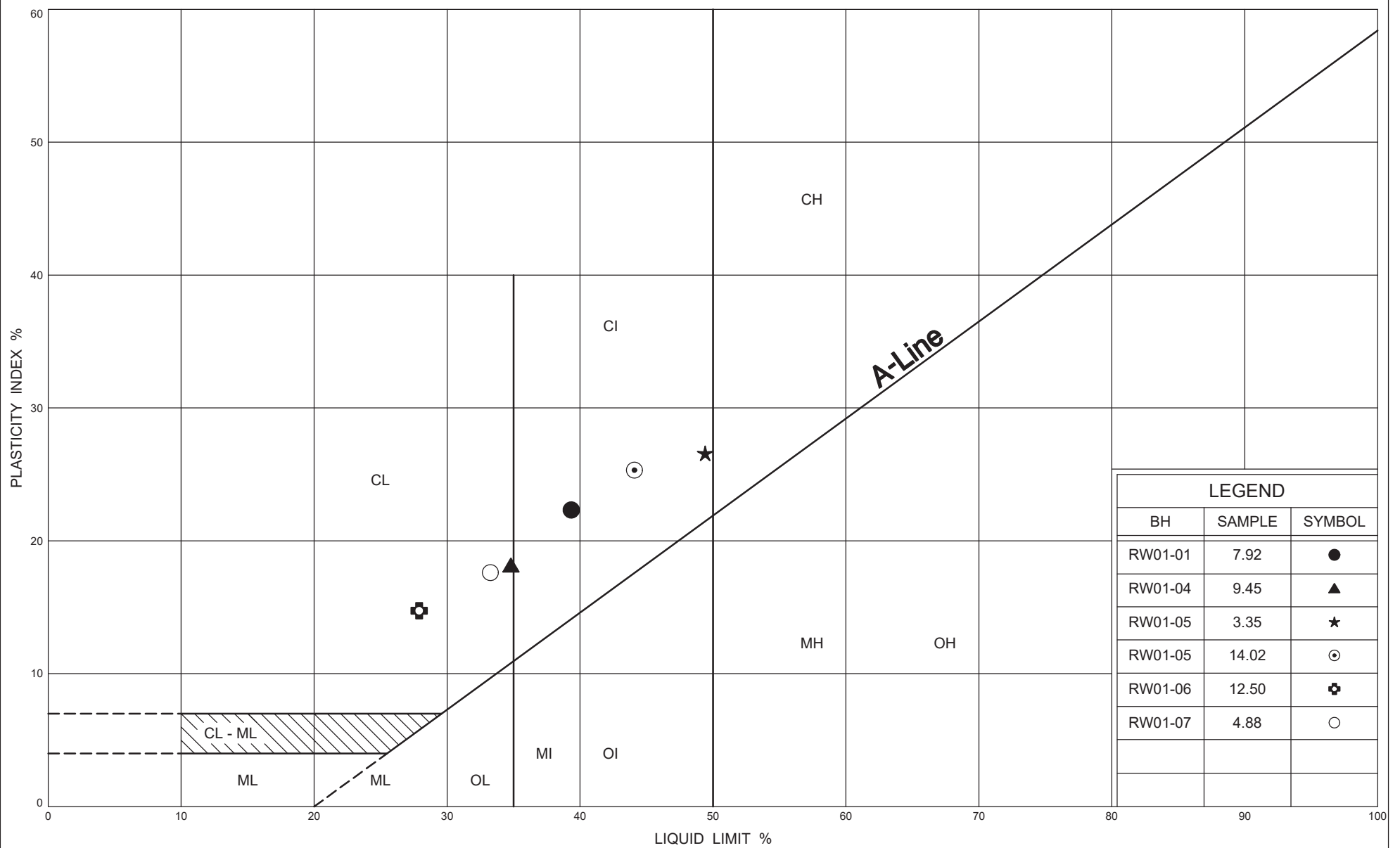












LEGEND		
BH	SAMPLE	SYMBOL
RW01-01	7.92	●
RW01-04	9.45	▲
RW01-05	3.35	★
RW01-05	14.02	⊙
RW01-06	12.50	⊕
RW01-07	4.88	○

# PLASTICITY CHART Silty CLAY

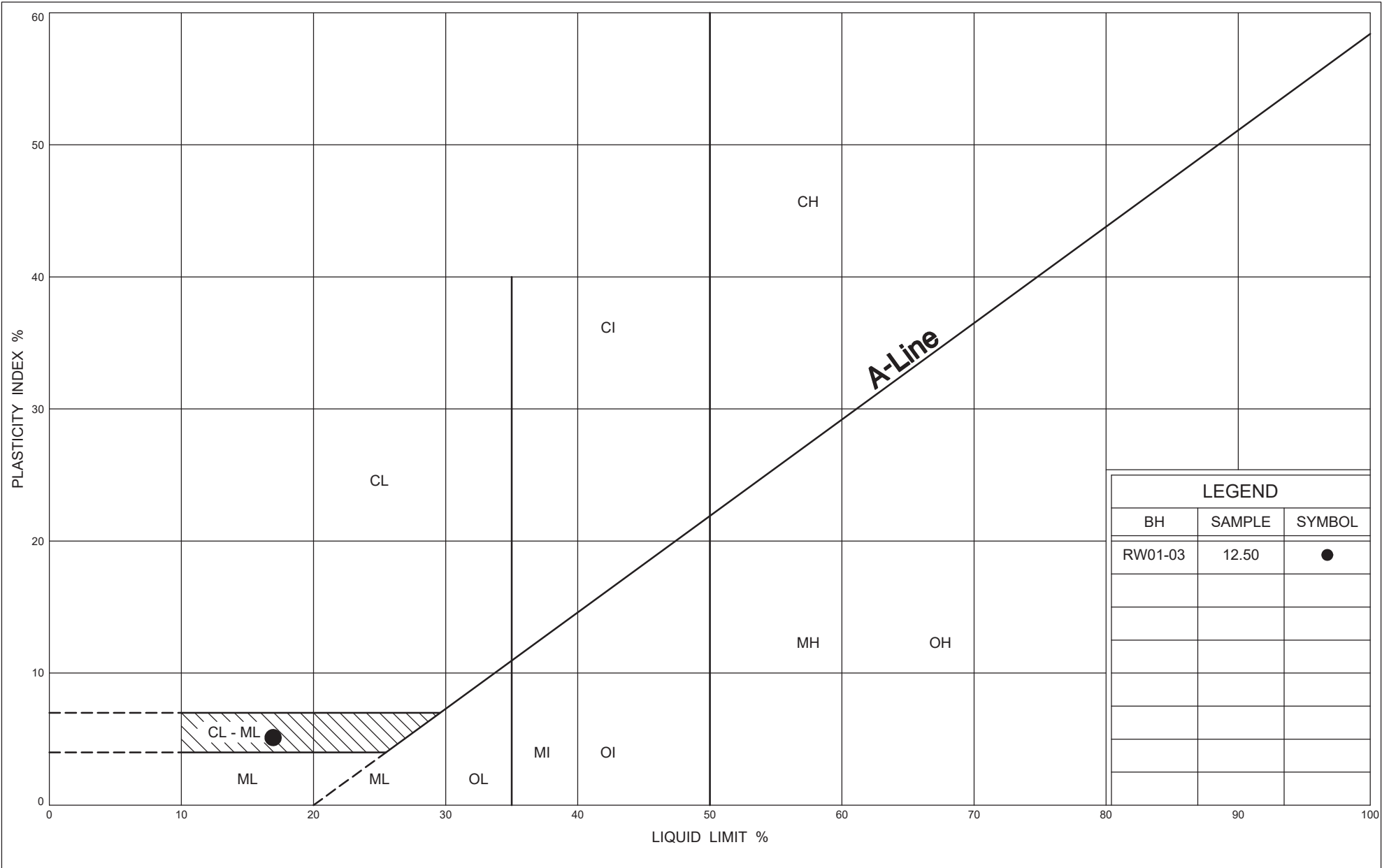
FIG No A6

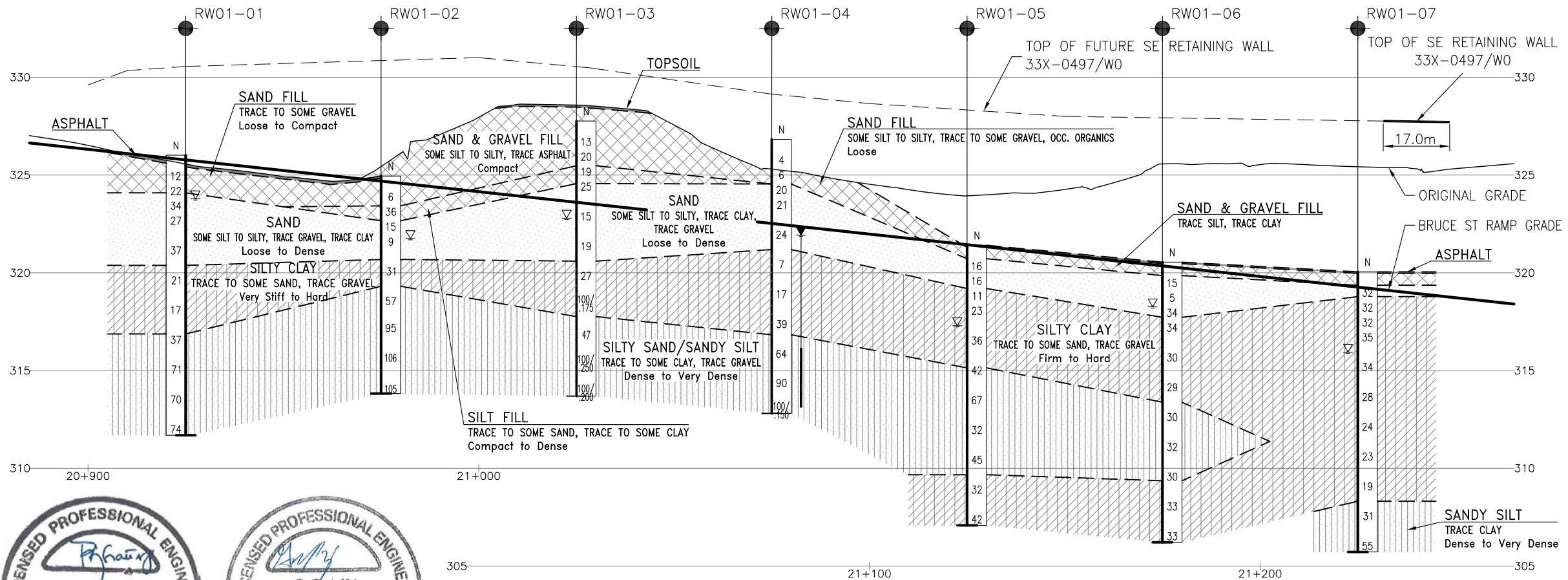
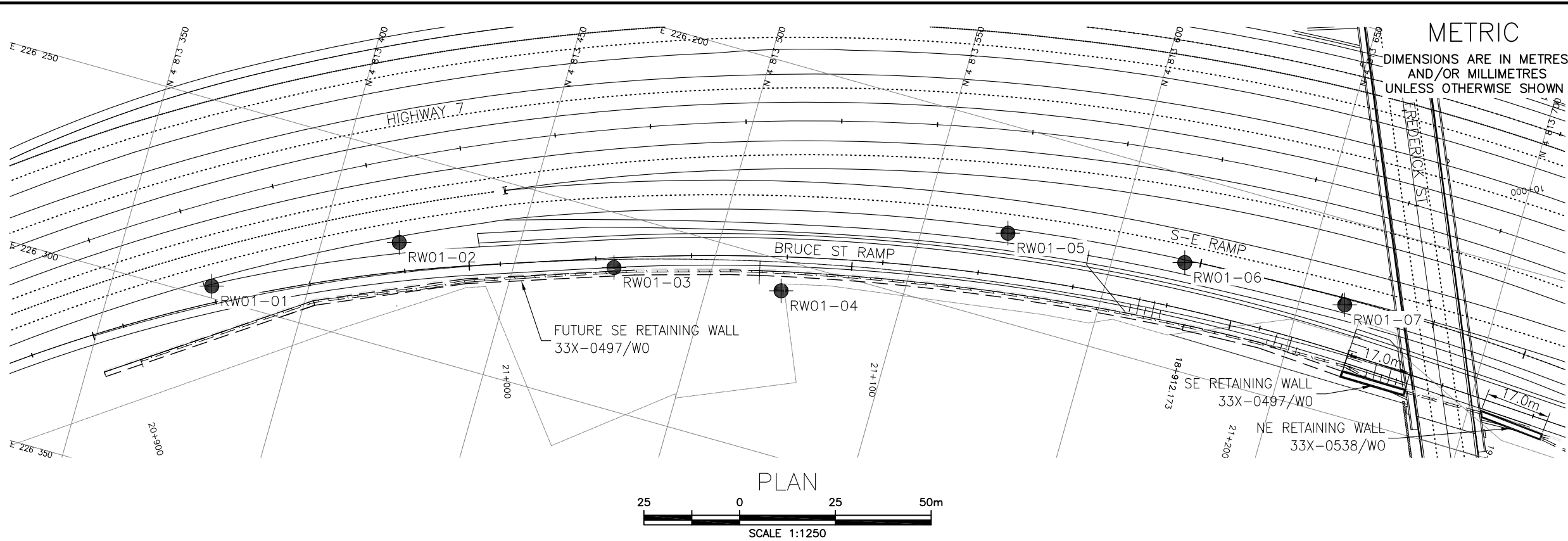
W P 408-88-00

Retaining Wall 1

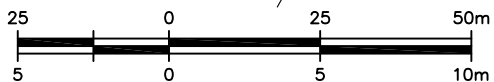

 Ministry of  
 Transportation

Ontario





PROFILE ALONG BRUCE STREET RAMP  
FREDERICK STREET-S/E-BECKER STREET



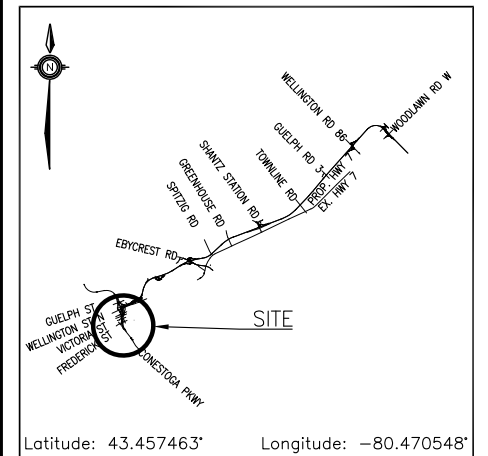
H 1:1250  
V 1:250

METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 3005-20-00

HIGHWAY 7  
FREDERICK ST.-S/E-BECKER ST.  
SE RETAINING WALL 33X-0497/W0  
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

LEGEND

●	Borehole (Current Investigation)
○	Borehole (by Others)
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
RW01-01	326.0	4 813 375.5	226 297.0
RW01-02	324.9	4 813 419.6	226 272.7
RW01-03	327.8	4 813 475.3	226 263.8
RW01-04	326.8	4 813 519.0	226 257.8
RW01-05	321.4	4 813 571.9	226 227.3
RW01-06	320.5	4 813 618.5	226 222.2
RW01-07	320.0	4 813 661.7	226 221.5

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 40P8-290

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**APPENDIX B**  
**Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil**  
**Strata Drawing**  
**NE Retaining Wall - Site # 33X-0538/W0**



Record of Borehole Sheets, Laboratory Test Results and Borehole Locations  
and Soil Strata Drawing for Current Investigation  
(RW02-02 to RW02-04)

# RECORD OF BOREHOLE No RW02-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 757.0 E 226 227.0 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.22 - 2019.08.22 LATITUDE 43.459602 LONGITUDE -80.470929 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE					
319.6	GROUND SURFACE												
0.0	ASPHALT: (200mm)												
0.2	Silty <b>SAND</b> , with gravel Brown Dry (FILL)		1	GS			319						
318.8													
0.8	Silty <b>SAND</b> , trace clay, trace gravel Dense to Compact Brown Moist		2	SS	30		318						
			3	SS	34								
			4	SS	24		317						
			5	SS	21		316						
315.4													
4.1	Silty <b>CLAY</b> , some to with sand, trace gravel Stiff to Hard Grey Moist		6	SS	14		315						
							314						
			7	SS	35		313						
							312						
311.6			8	SS	89		311						
7.9	<b>SILT</b> and <b>SAND</b> , trace clay, trace gravel Very Dense Grey Wet												
			9	SS	89		310						

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No RW02-02

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 757.0 E 226 227.0 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.22 - 2019.08.22 LATITUDE 43.459602 LONGITUDE -80.470929 CHECKED BY NB

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

# RECORD OF BOREHOLE No RW02-03

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 807.5 E 226 232.5 ORIGINATED BY JP  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.21 - 2019.08.21 LATITUDE 43.460057 LONGITUDE -80.470870 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE		WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>				GR	SA	SI	CL	
319.5	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (200mm)							20	40	60	80	100						
0.2	Silty <b>SAND</b> , with gravel Brown Dry (FILL)		1	GS			319						○					
318.7																		
0.8	<b>SAND</b> , trace to some silt, trace clay Compact Brown Wet		2	SS	26								○					0   91   8   1
							318											
			3	SS	22								○					
							317											
			4	SS	16								○					
							316						○					
							315											
			6	SS	27								○					
314.5							314						○					
5.0	Silty <b>CLAY</b> , trace sand Very Stiff Grey Moist																	
							313											Switch to tricone
	Firm		7	SS	6								○					
							312											
			8	SS	29								○					
							311											
			9	SS	15		310											0   1   38   61
309.5																		

Continued Next Page

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

# RECORD OF BOREHOLE No RW02-03

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 807.5 E 226 232.5 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.21 - 2019.08.21 LATITUDE 43.460057 LONGITUDE -80.470870 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE      LIQUID CONTENT      LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W P      W      W L				
								○ UNCONFINED      + FIELD VANE					WATER CONTENT (%)				
								● QUICK TRIAXIAL      × LAB VANE									
	Continued From Previous Page						20	40	60	80	100						
10.0	Silty <b>CLAY</b> , trace to some sand, trace gravel Very Stiff to Hard Grey Moist  Sandy silt layer at 11.0m (500mm)																
			10	SS	28								○				
													○				
			11	SS	68								○				
305.8																	
13.7	<b>SAND</b> , trace to some silt, trace clay Dense to Very Dense Grey Wet		12	SS	75								○				
													○				
			13	SS	43								○				
303.6																	
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE CAVED TO 4.6m AND WATER LEVEL NOT AVAILABLE UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT TO SURFACE.																

ONTMT452 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/13/19

## METRIC

[illegible]

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

# RECORD OF BOREHOLE No RW02-04

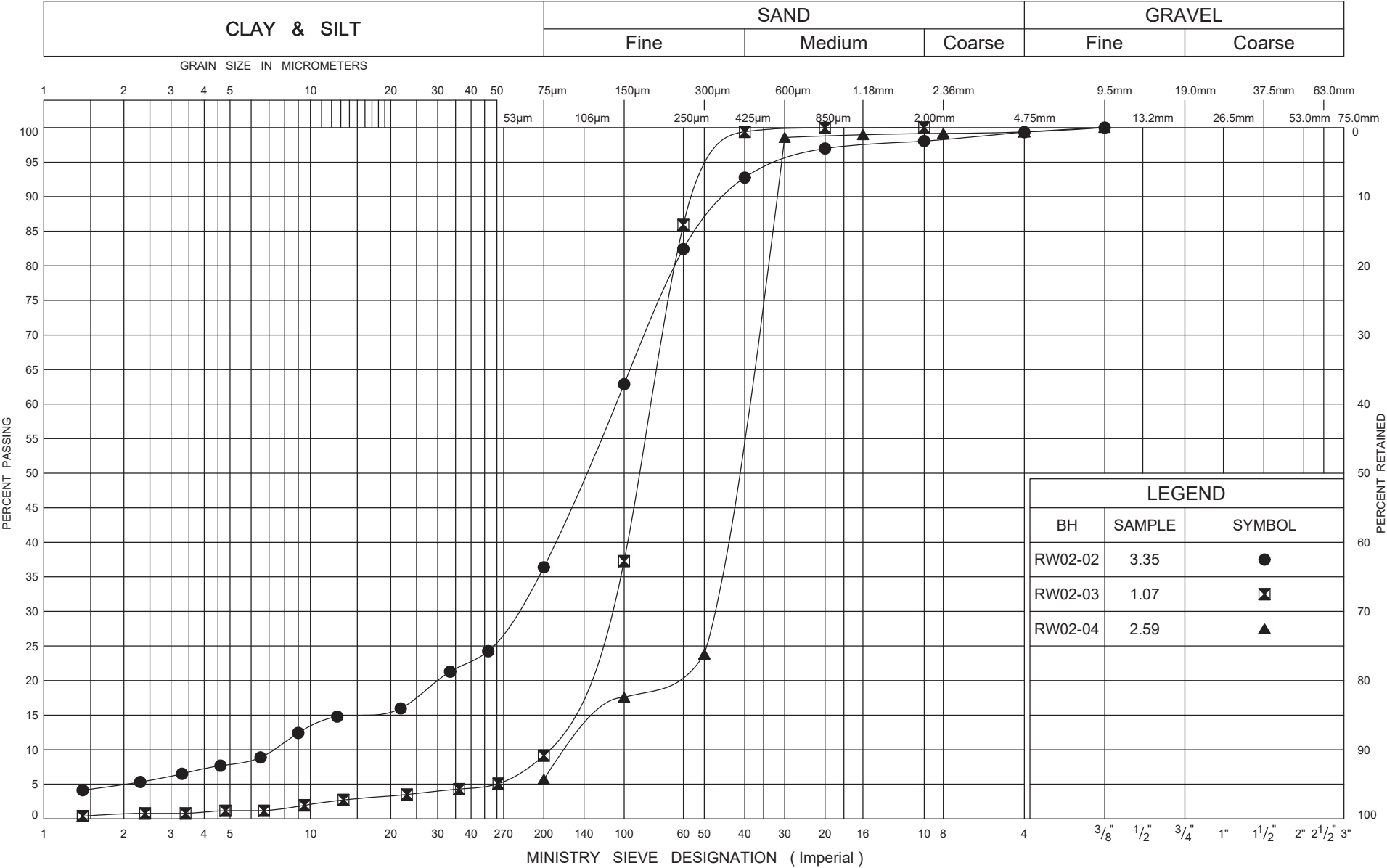
2 OF 2

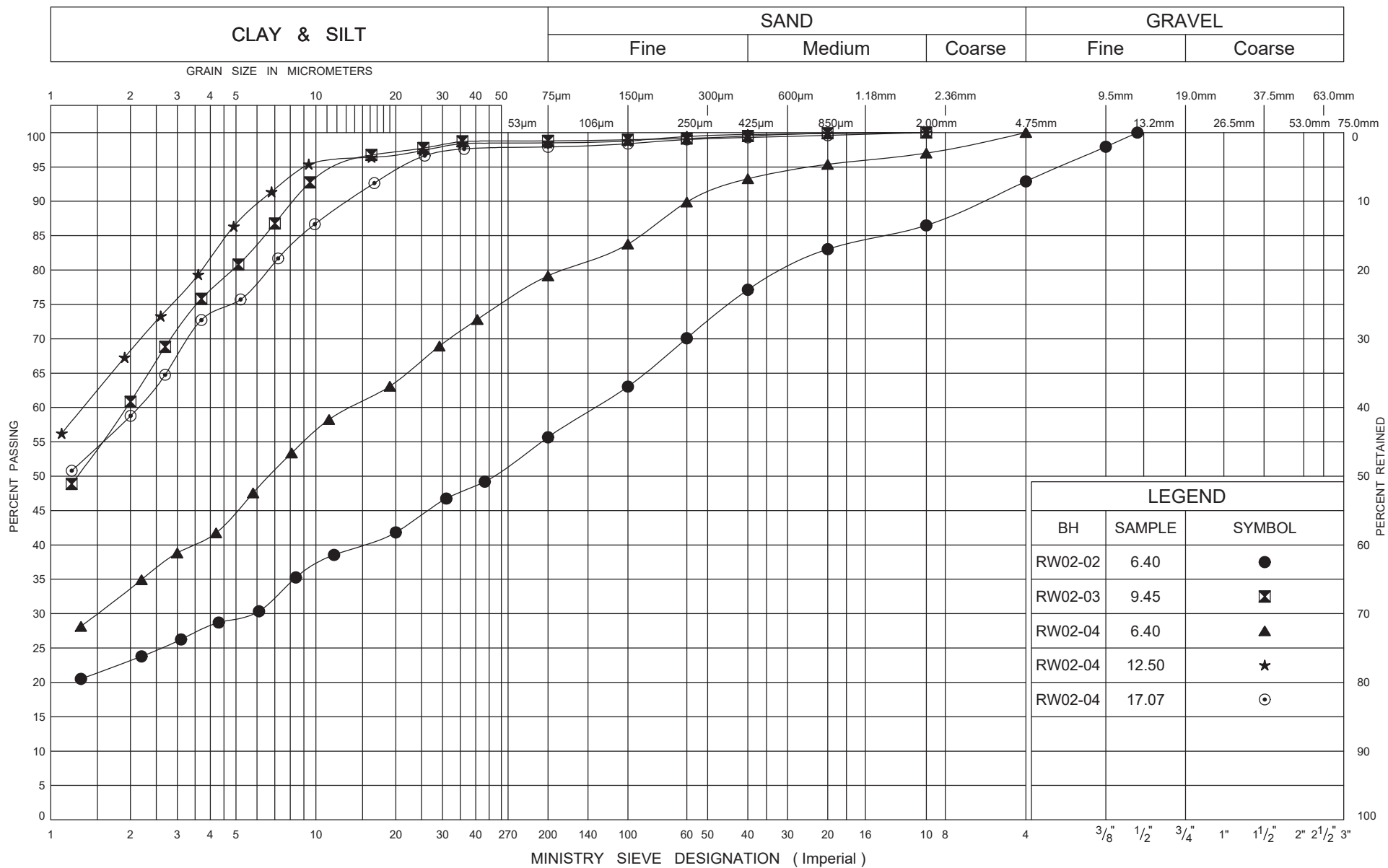
METRIC

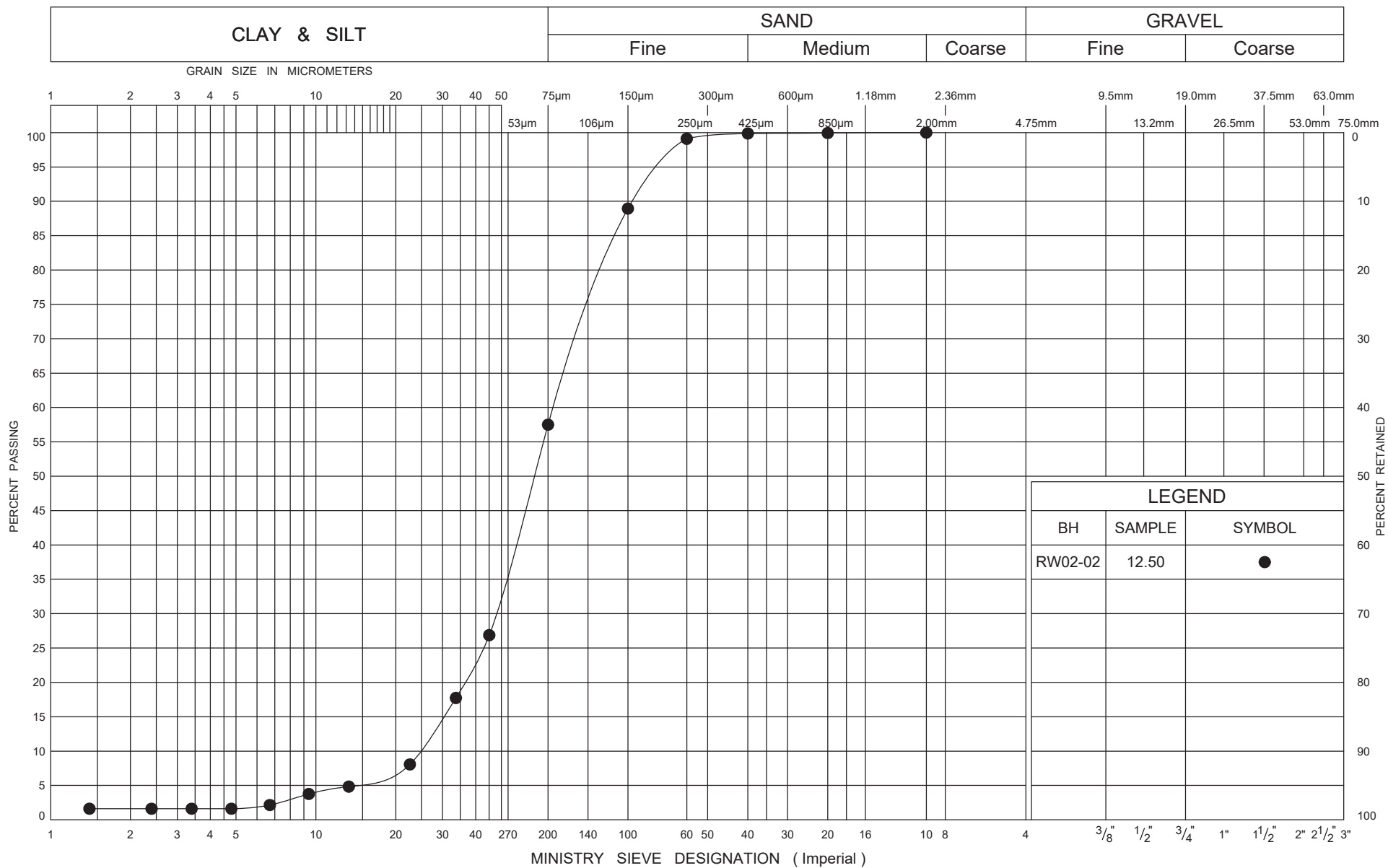
GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 856.9 E 226 242.2 ORIGINATED BY ES  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2019.09.23 - 2019.09.23 LATITUDE 43.460514 LONGITUDE -80.470774 CHECKED BY NB

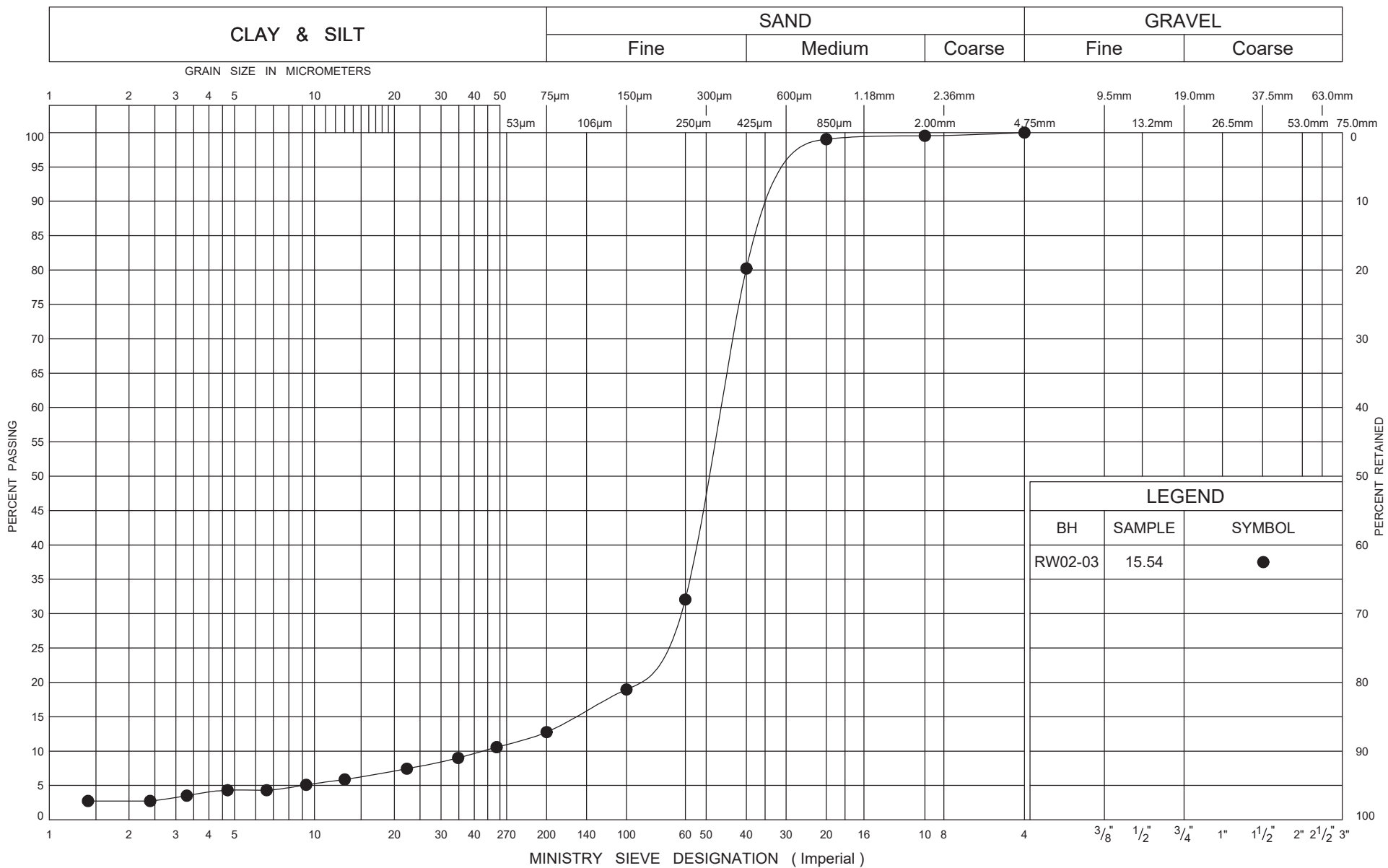
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
	Continued From Previous Page							20 40 60 80 100								
	Silty <b>CLAY</b> , some sand to sandy, trace gravel Very Stiff Grey Moist Hard		10	SS	37		309									
							308									
306.9							307									
12.2	Silty <b>CLAY</b> , trace sand Stiff Grey Wet		11	SS	9		306									0 1 30 69
							305									
							304									
							303									
	silty sand layer at 15.8m (80mm)						302									0 2 39 59
301.7			14	SS	37											
17.4	END OF BOREHOLE AT 17.4m. WATER LEVEL AT 1.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.6m, SAND TO 0.2m, THEN ASPHALT TO SURFACE.															

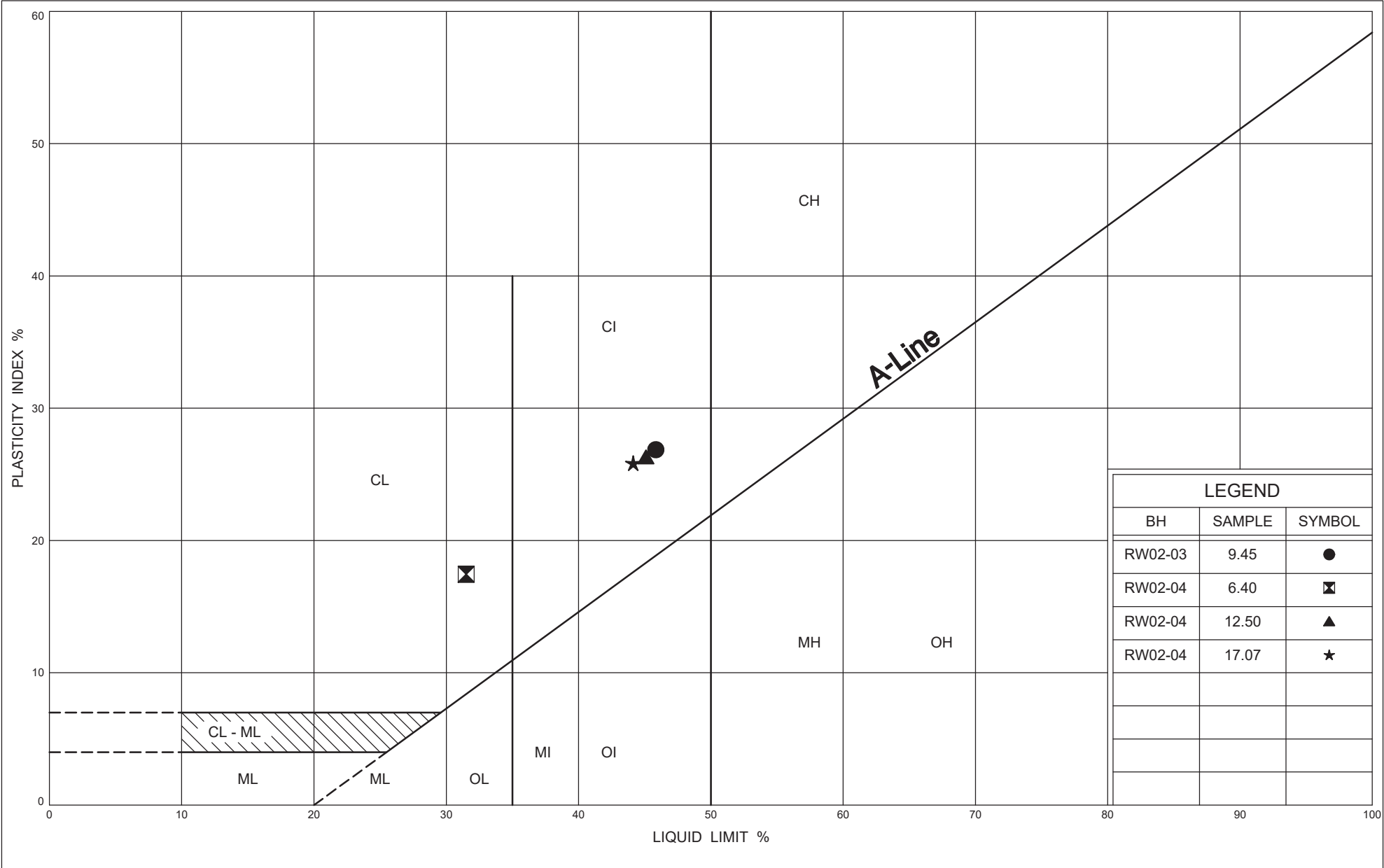
ONTMT452 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/13/19













Record of Borehole Sheets and Laboratory Test Results for Previous  
Investigation (Geocres No. 40P8-199 - Reference 1)

(RW-01 to RW-04)

Foundation investigation and design report for Northeast Corner Retaining Wall, Frederick Street Underpass, Site No. 33-234, G.W.P. 3110-09-00, City of Kitchener, Ontario, prepared by Peto MacCallum Ltd., PML Ref. 10KF079C, Geocres No. 4098-199, dated May 31, 2012

## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**COMPOSITION:** SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0 - 10	10 - 20	20 - 30	30 - 40	> 40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILT)

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

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

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

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

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

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

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

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

### STRESS AND STRAIN

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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$C_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_r$	1	SENSITIVITY = $\frac{C_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE
$\gamma_s$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	$S_r$	%	DEGREE OF SATURATION	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\gamma_w$	kN/m <sup>3</sup>	UNIT WEIGHT OF WATER	$w_L$	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_p$	%	PLASTIC LIMIT	$D_n$	mm	n PERCENT - DIAMETER
$\gamma$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_s$	%	SHRINKAGE LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
$\gamma_d$	kN/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
$\gamma_{sat}$	kN/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRYER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	APT		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
$\gamma'$	kN/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL	WTPL		WETTER THAN PLASTIC LIMIT	j	kN/m <sup>3</sup>	SEEPAGE FORCE
e	1, %	VOID RATIO						

**RECORD OF BOREHOLE No RW-1**

1 of 1

**METRIC**

**G.W.P.** 3110-09-00      **LOCATION** Coords: 4 813 701.9 N; 226 222.6 E      **ORIGINATED BY** R.B.  
**DIST** London      **HWY** 7/ 85      **BOREHOLE TYPE** C.F.H.S.A. and Dynamic Cone Penetration Test      **COMPILED BY** N.S.B.  
**DATUM** Geodetic      **DATE** April 08, 2011      **CHECKED BY** B.R.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
319.7	Ground Surface							20	40	60	80	100				
0.0	Asphalt over sand some silt, some gravel Very loose Brown Wet		1	AS	-											
	(FILL)		2	SS	3											
318.3																
1.4	Silty clay, trace sand Very stiff Brown Moist		3	SS	17											
	_____ sand layers to 4.9m _____															
	Hard to Greyish very stiff brown		4	SS	34											
			5	SS	25											
			6	SS	28											
	Hard		7	SS	37											
			8	SS	31											
			9	SS	33											

**RECORD OF BOREHOLE No RW-2**

1 of 1

**METRIC**

**G.W.P.** 3110-09-00      **LOCATION** Coords: 4 813 710.4 N; 226 223.0 E      **ORIGINATED BY** R.B.  
**DIST** London      **HWY** 7/ 85      **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers      **COMPILED BY** N.S.B.  
**DATUM** Geodetic      **DATE** April 08, 2011      **CHECKED BY** B.R.G.





SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT										PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa					WATER CONTENT (%)									
							○ UNCONFINED + FIELD VANE					○ UNCONFINED + FIELD VANE									
							● QUICK TRIAXIAL × LAB VANE					○ UNCONFINED + FIELD VANE									
319.7	Ground Surface						20	40	60	80	100										
0.0	Asphalt over sand and crushed gravel, trace silt Compact Brown Moist (FILL)		1	AS	-																
			2	SS	11																
318.3																					
1.4	Silty clay, trace gravel sand layers Stiff Dark brown Moist sand layers to 3.7m Hard Greyish brown		3	SS	9							225					(**)				
			4	SS	31							225					1 4 43 52				
			5	SS	23							225					0 2 45 53				
			6	SS	44							225									
			7	SS	43							225					0 0 32 68				
			8	SS	35							225									
			9	SS	29							225									
309.9	End of borehole																				
9.8																					

**RECORD OF BOREHOLE No RW-3**

1 of 1

**METRIC**

**G.W.P.** 3110-09-00      **LOCATION** Coords: 4 813 719.3 N; 226 229.5 E      **ORIGINATED BY** F.P.  
**DIST** London      **HWY** 7/ 85      **BOREHOLE TYPE** Dynamic Ram Sounder      **COMPILED BY** N.S.B.  
**DATUM** Geodetic      **DATE** July 19, 2011      **CHECKED BY** B.R.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	20						40	60	80
322.3	Ground Surface																GR SA SI CL			
0.0	Silty sand some clay, trace gravel organic inclusions		1	SS	14		322										8 37 37 18			
	Compact Grey Moist (FILL)		2	SS	27		321										3 50 34 13			
	clayey silt layers																4 26 45 25			
	gravelly sand		3	SS	20		320										23 39 27 11			
320.0	Compact Brown Damp clayey silt layers																4 25 42 29			
2.3	Sand trace to some gravel trace clay		4	SS	21		320										15 76 6 3			
	Compact Brown Moist to wet		5	SS	18		319										10 76 10 4			
			6	SS	14		318										(14*) 73 12 4			
317.9	Silty clay trace sand, trace gravel silty sand and gravelly sand layers, cobbles		7	SS	36		317										3 23 50 24			
4.4	Hard Grey Moist		8	SS	67		316													
315.9	End of borehole		9	SS	70/15cm		316													
6.4	Sample 9: Sampler bouncing																			
	  * 2011 07 19																			
	▽ Water level observed during drilling																			
	(**) Base of footing -El.318.2																			
	 Water Level Readings:																			
	 Date Depth Elev. (m)																			
	July 19,'11 Dry ----																			
	Sept. 23,'11 3.3 319.0																			
	Oct. 08, '11 3.3 319.0																			
	 Piezometer Legend:																			
	 Bentonite seal																			
	 Filter sand																			
	 30mm dia. PVC screen																			
	 Filter bed																			

**RECORD OF BOREHOLE No RW-4**

1 of 1

**METRIC**

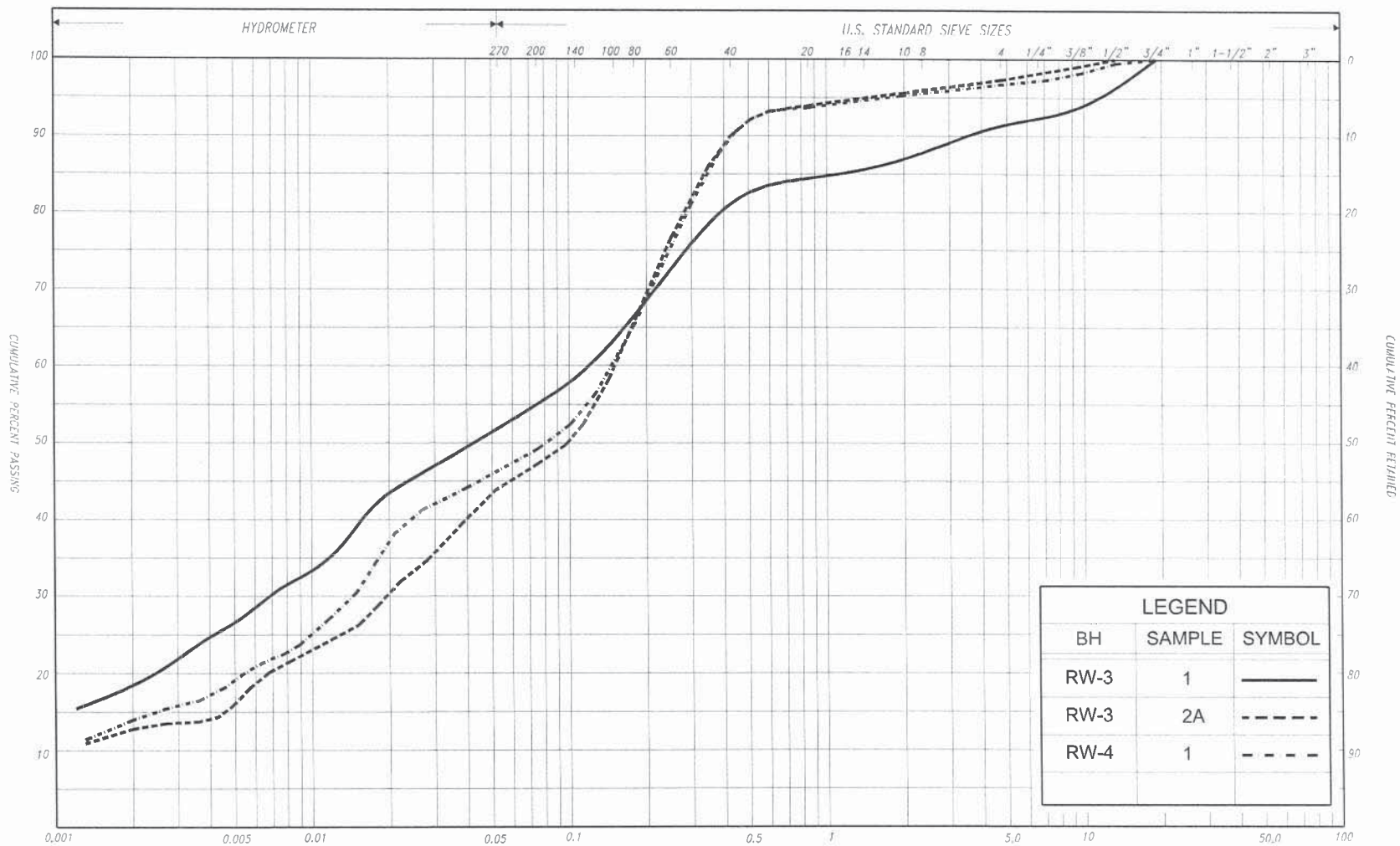
**G.W.P.** 3110-09-00      **LOCATION** Coords: 4 813 705.4 N; 226 228.2 E      **ORIGINATED BY** A.L.  
**DIST** London      **HWY** 7/ 85      **BOREHOLE TYPE** Dynamic Ram Sounder      **COMPILED BY** N.S.B.  
**DATUM** Geodetic      **DATE** July 20, 2011      **CHECKED BY** B.R.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE										
								● QUICK TRIAXIAL × LAB VANE										
323.5	Ground Surface					20	40	60	80	100								
0.0	Silty sand, some clay trace gravel, rootlets		1	SS	21							○				4 47 35 14		
	Compact Brown Moist (FILL)																	
	Silt with sand, trace gravel		2	SS	21							○				22 20 54		
	Compact Grey Sand, some silt some gravel, trace clay		3	SS	21							○				15 68 11 6		
321.2	Compact Brown Clayey silt, trace sand										125	■						
2.3	Very stiff Grey		4	SS	20							○				9 83 (8)		
	Sand trace to some gravel trace to some silt trace clay		5	SS	13							○				11 73 12 4		
	Compact Brown Moist to wet		6	SS	13							○				38 43 13 6		
	Gravelly to with gravel		7	SS	9							○				26 68 3 3		
			8	SS	14							○				(**)		
317.6	Silty clay, trace gravel cobbles		9	SS	49						175	■						
5.9	Stiff to Grey Moist hard		10	SS	52/15cm													
			11	SS	50/13cm													
316.5	End of borehole																	
7.0	Samples 10 and 11: Sampler bouncing																	
	 * 2011 07 20																	
	▽ Water level observed during drilling																	
	(**) Base of footing -El.318.2																	
	Note: Borehole cave-in at 5.0m																	



**TABLE A-1**  
**LIST OF ATTERBERG LIMITS RESULTS**

SOIL TYPE	BOREHOLE NO.	SAMPLE NO.	DEPTH / ELEVATION (m)	MOISTURE CONTENT (W %)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)
Clayey Silt Fill	RW-3	3B	2.1 / 320.2	-	22	12	10
Silty Clay	RW-2	3	1.9 / 317.8	19	36	18	18
	RW-2	5	3.3 / 316.3	19	35	17	18
	RW-2	7	6.3 / 313.4	21	45	23	22



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COR R.F.S.	UNIFIED			
				SAND														
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL				CORRIE.S.	M.I.T.
				SILT														
CLAY		SILT				V. FINE	FINE	MED.	COARSE		GRAVEL						U.S. BUREAU	
						SAND												

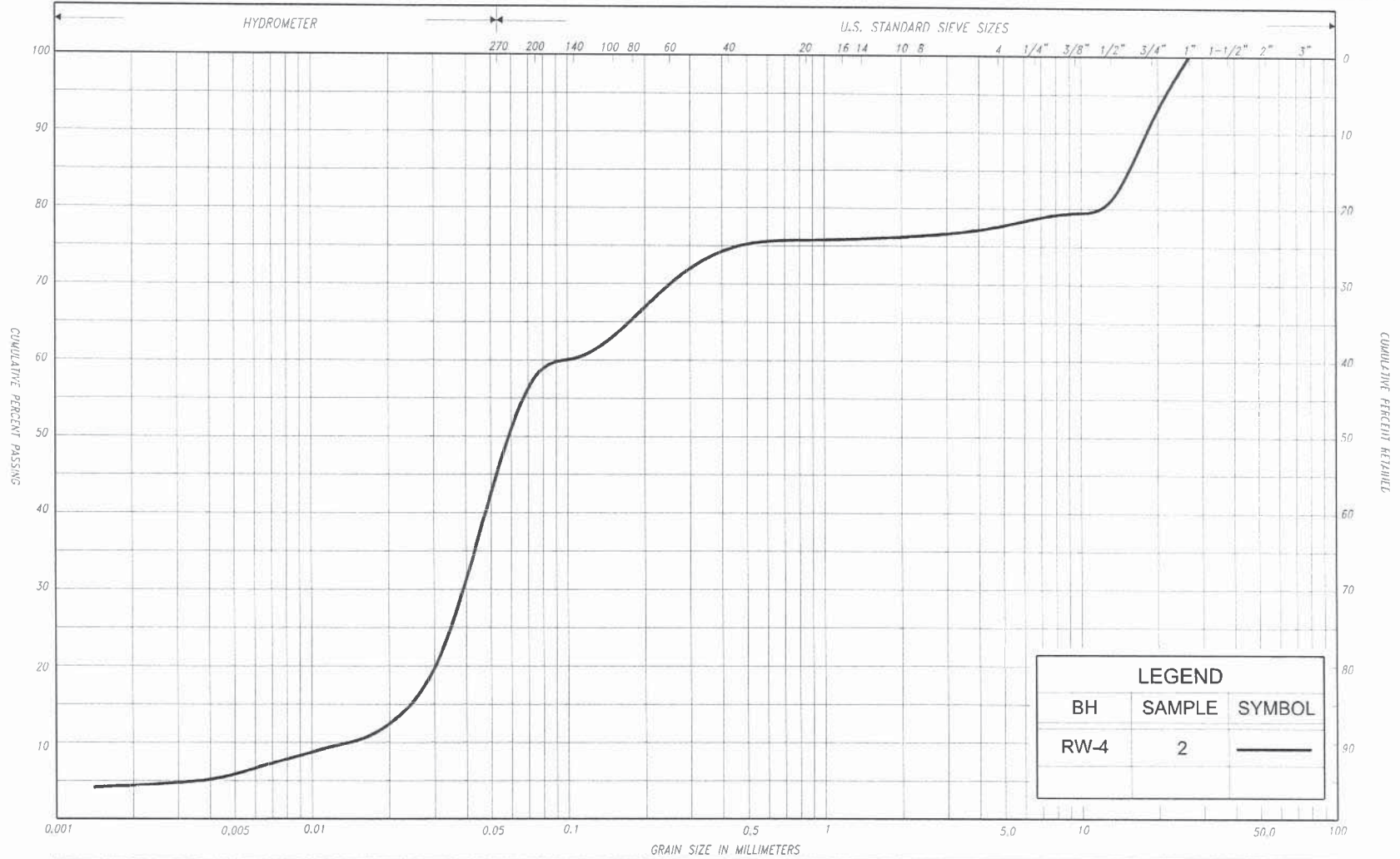
**GRAIN SIZE DISTRIBUTION**  
**SILTY SAND, some clay, trace gravel**  
**(FILL)**

FIG No. RW-GS-1

HWY: 7 / 85

G.W.P. No. 3110-09-00





SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL			COR RLES	UNIFIED			
				SAND													
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL		CORRIFLS	M.I.T.	
		SILT						SAND									
CLAY		SILT			V. FINE		FINE		MED.		COARSE		GRAVEL				U.S. BUREAU
									SAND								

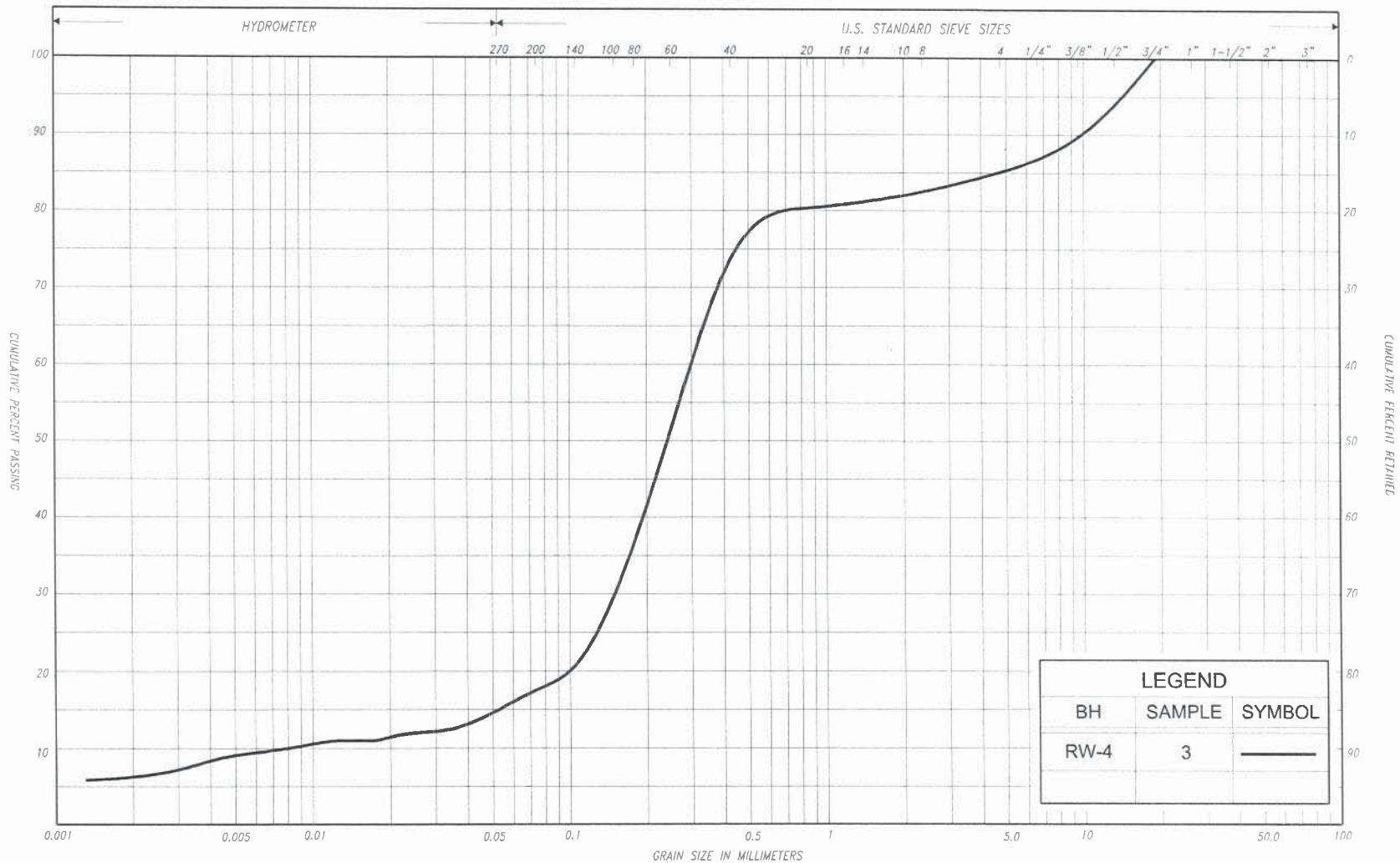


# **GRAIN SIZE DISTRIBUTION** **SILT, some sand, some gravel, trace clay** **(FILL)**

FIG No. RW-GS-2

HWY: 7 / 85

G.W.P. No. 3110-09-00

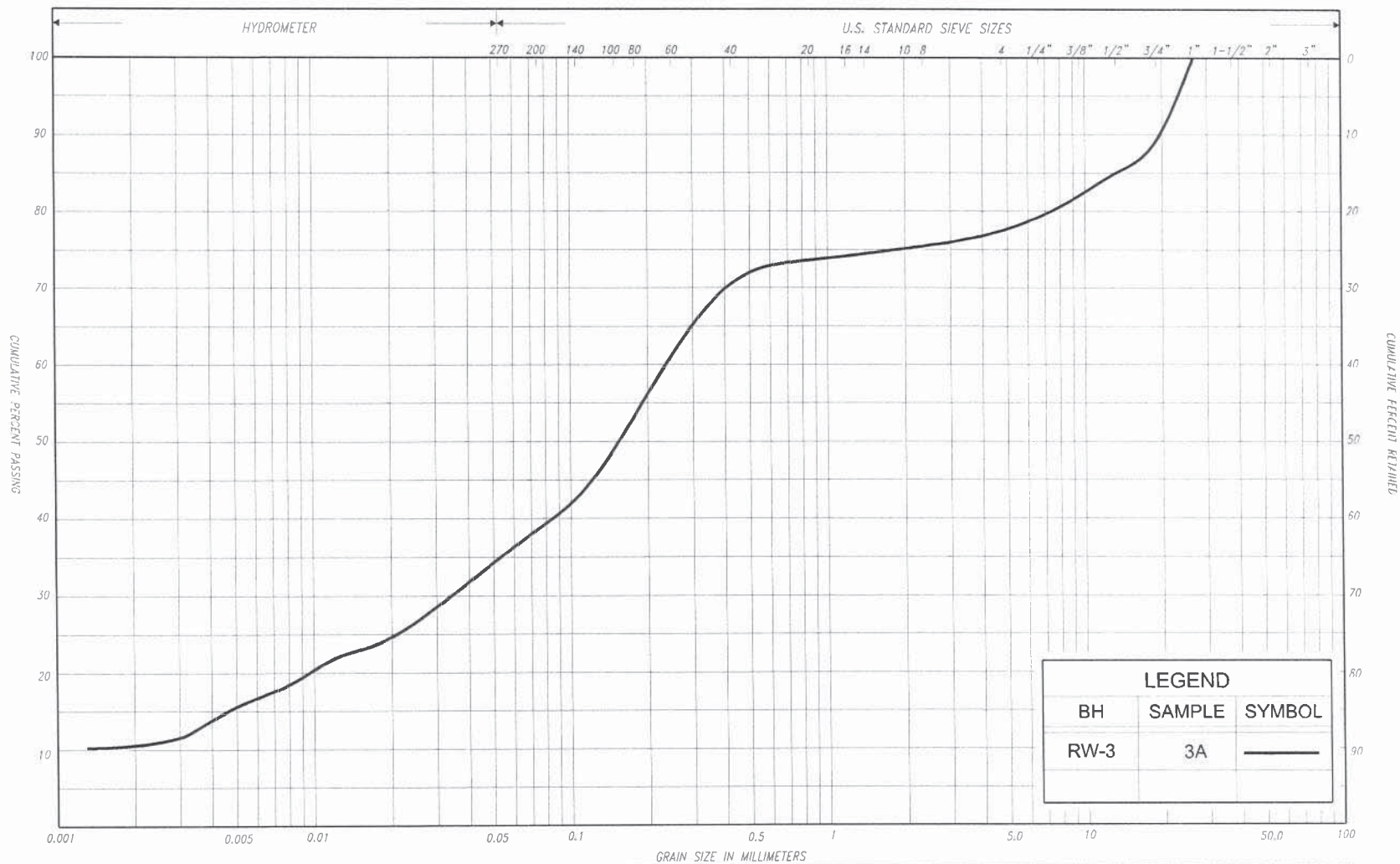


SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL			COR RIFES	UNIFIED			
				SAND												
CLAY	FINE		MEDIUM	COARSE	FINE		MEDIUM		COARSE		GRAVEL			CORRIFES	M.I.T.	
SILT																
CLAY		SILT			V. FINE	FINE	MED.	COARSE		GRAVEL						U.S. BUREAU
				SAND												

**GRAIN SIZE DISTRIBUTION**  
 SAND, some silt, some gravel, trace clay  
 (FILL)

FIG No. RW-GS-3  
 HWY: 7 / 85  
 G.W.P. No. 3110-09-00





LEGEND		
BH	SAMPLE	SYMBOL
RW-3	3A	—

SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COR BLES	UNIFIED
				SAND											
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM		COARSE	GRAVEL				COBBLES	M.I.T.		
	SILT														
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL				U.S. (H/RFAI)			
				SAND											

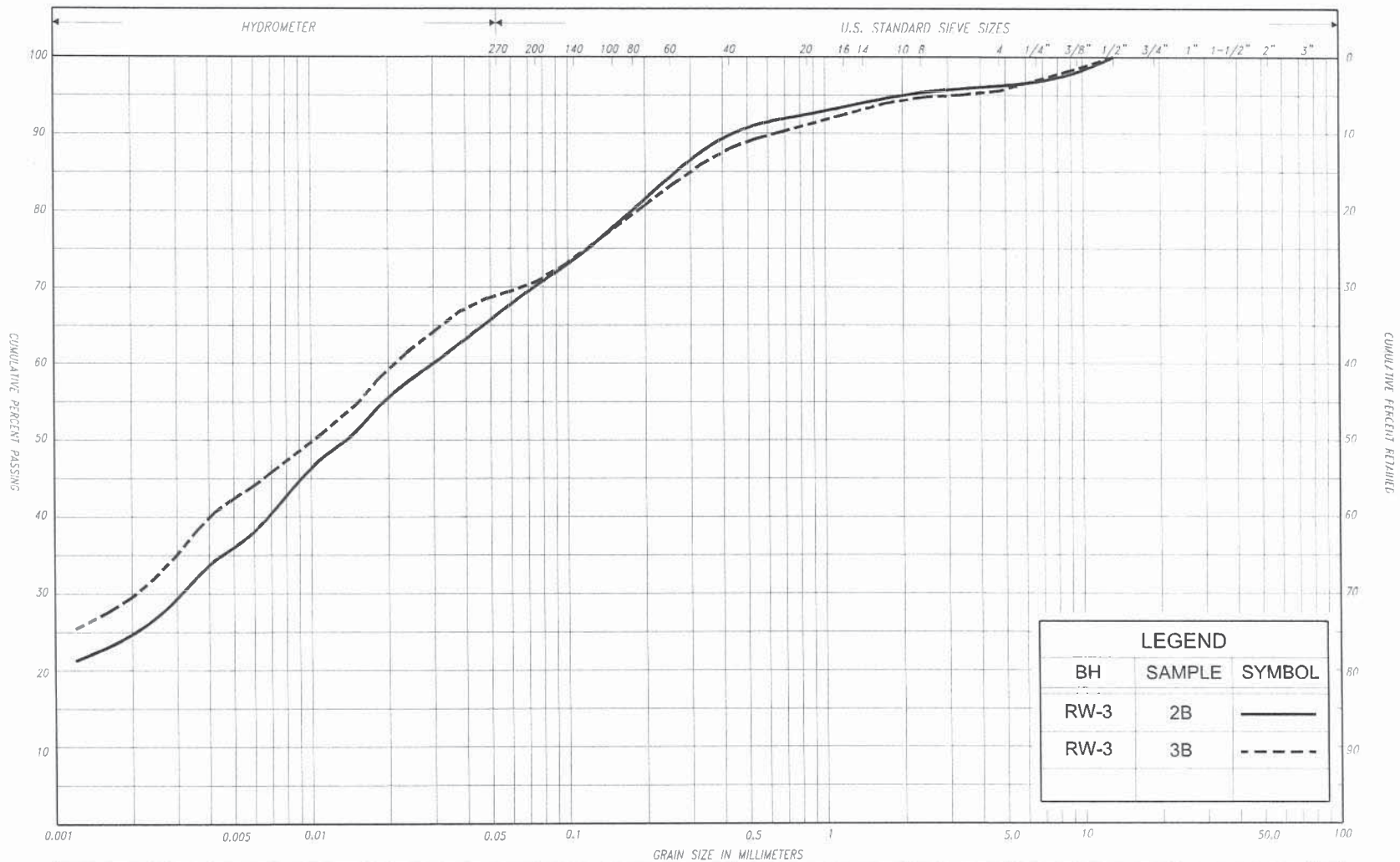


**GRAIN SIZE DISTRIBUTION**  
**GRAVELLY SAND, with silt, some clay**  
**(FILL)**

FIG No. RW-GS-4

HWY: 7 / 85

G.W.P. No. 3110-09-00



SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COB BLES	UNIFIED
						SAND						
CLAY	FINE		MEDIUM	COARSE	FINE	MEDIUM		COARSE	GRAVEL		COBBLES	M.I.T.
		SILT				SAND						
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL		U.S. (AURFAL)		

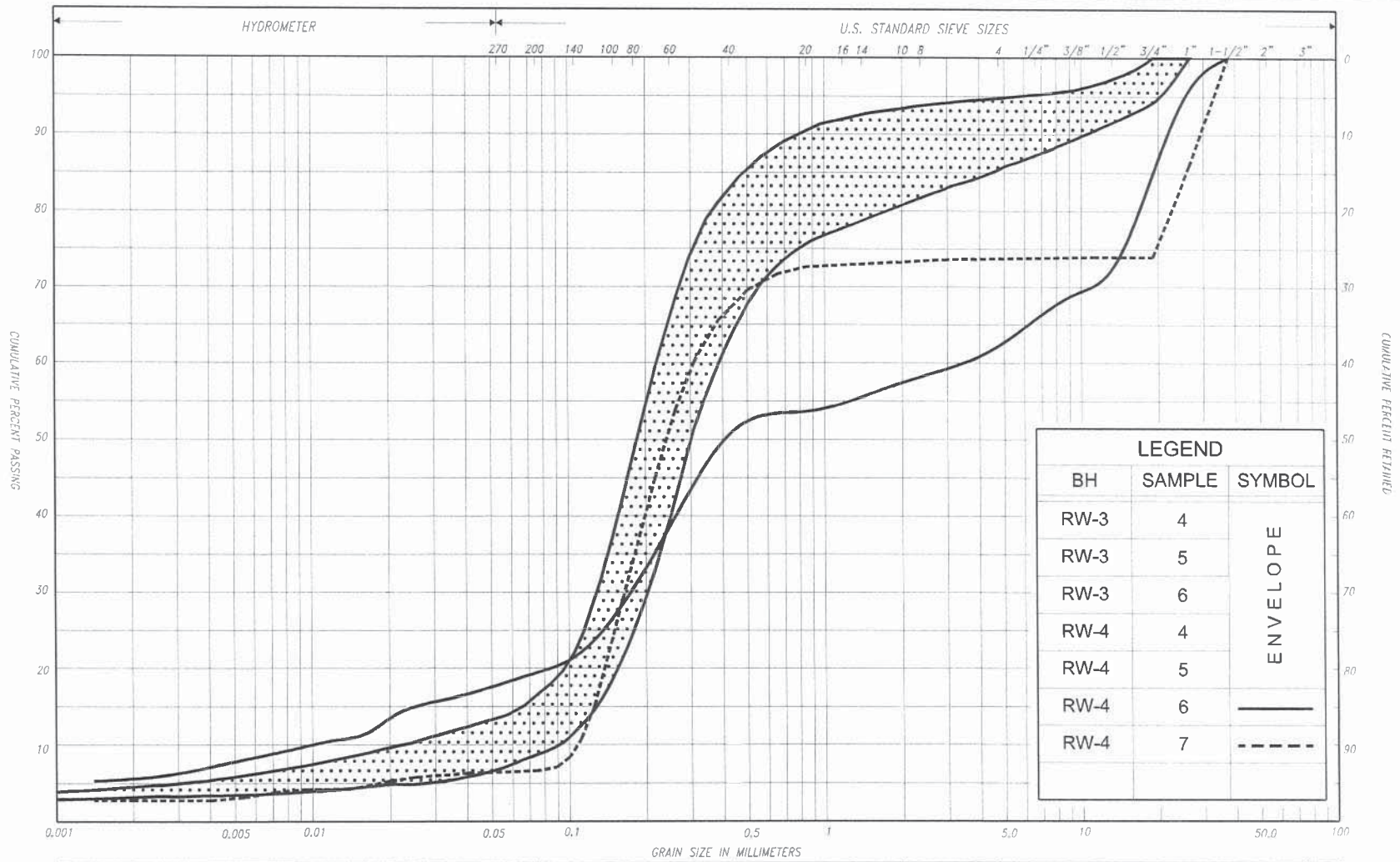
# GRAIN SIZE DISTRIBUTION CLAYEY SILT, with sand, trace gravel (CI) (FILL)

FIG No. RW-GS-5

HWY: 7 / 85

G.W.P. No. 3110-09-00





SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COR RIES	UNIFIED			
				SAND														
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL		CORRIES	M.I.T.		
	SILT						SAND											
CLAY		SILT				V. FINE		FINE		MED.		COARSE		GRAVEL				U.S. BUREAU
						SAND												

## GRAIN SIZE DISTRIBUTION

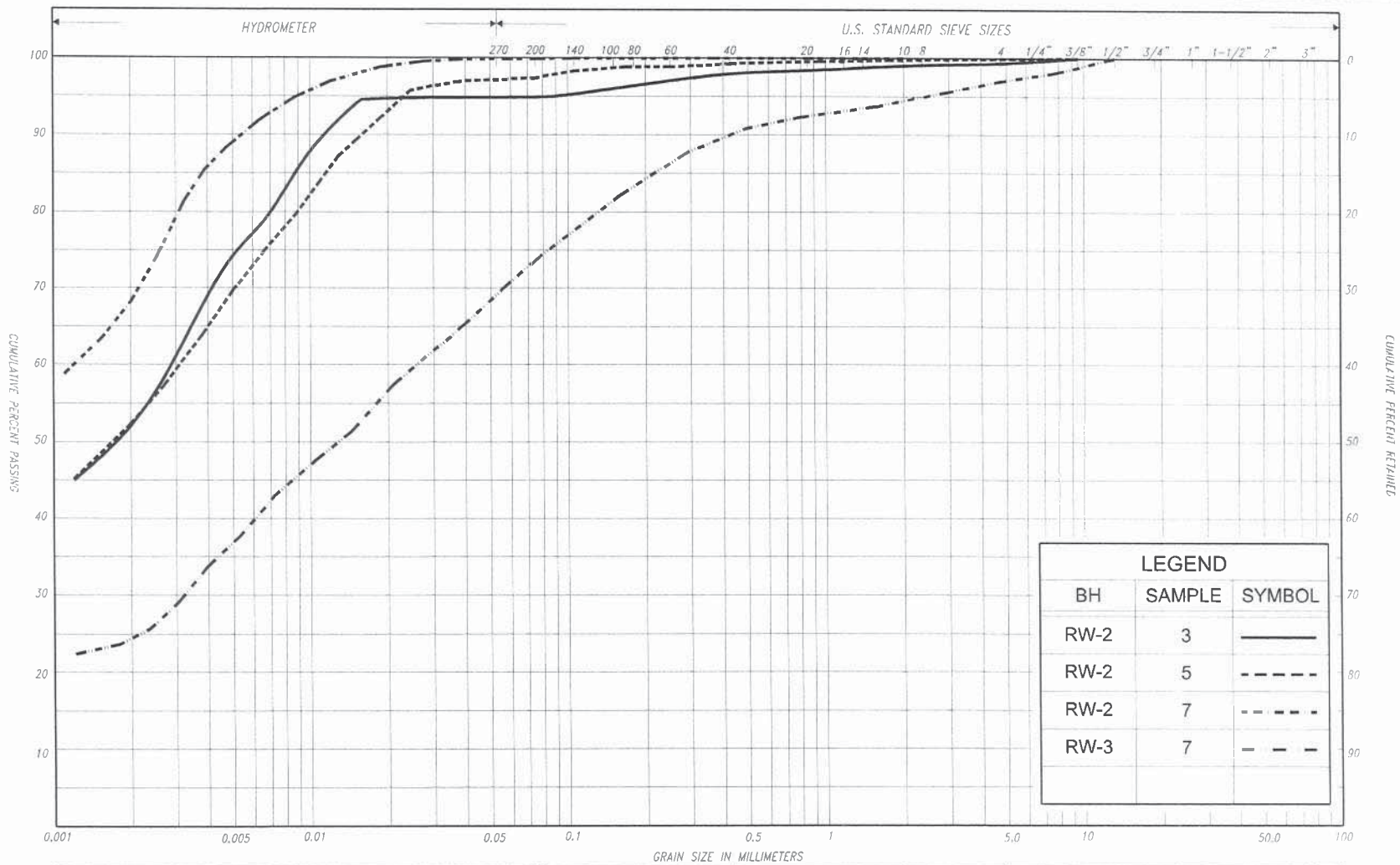
SAND, trace gravel to gravelly, trace to some silt, trace clay

FIG No. RW-GS-6

HWY: 7 / 85

G.W.P. No. 3110-09-00





SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COR BLFS	UNIFIED			
				SAND														
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL				CORRLES	M.I.T.
	SILT							SAND										
CLAY		SILT			V. FINE	FINE	MED.	COARSE									U.S. BUREAU	

## GRAIN SIZE DISTRIBUTION

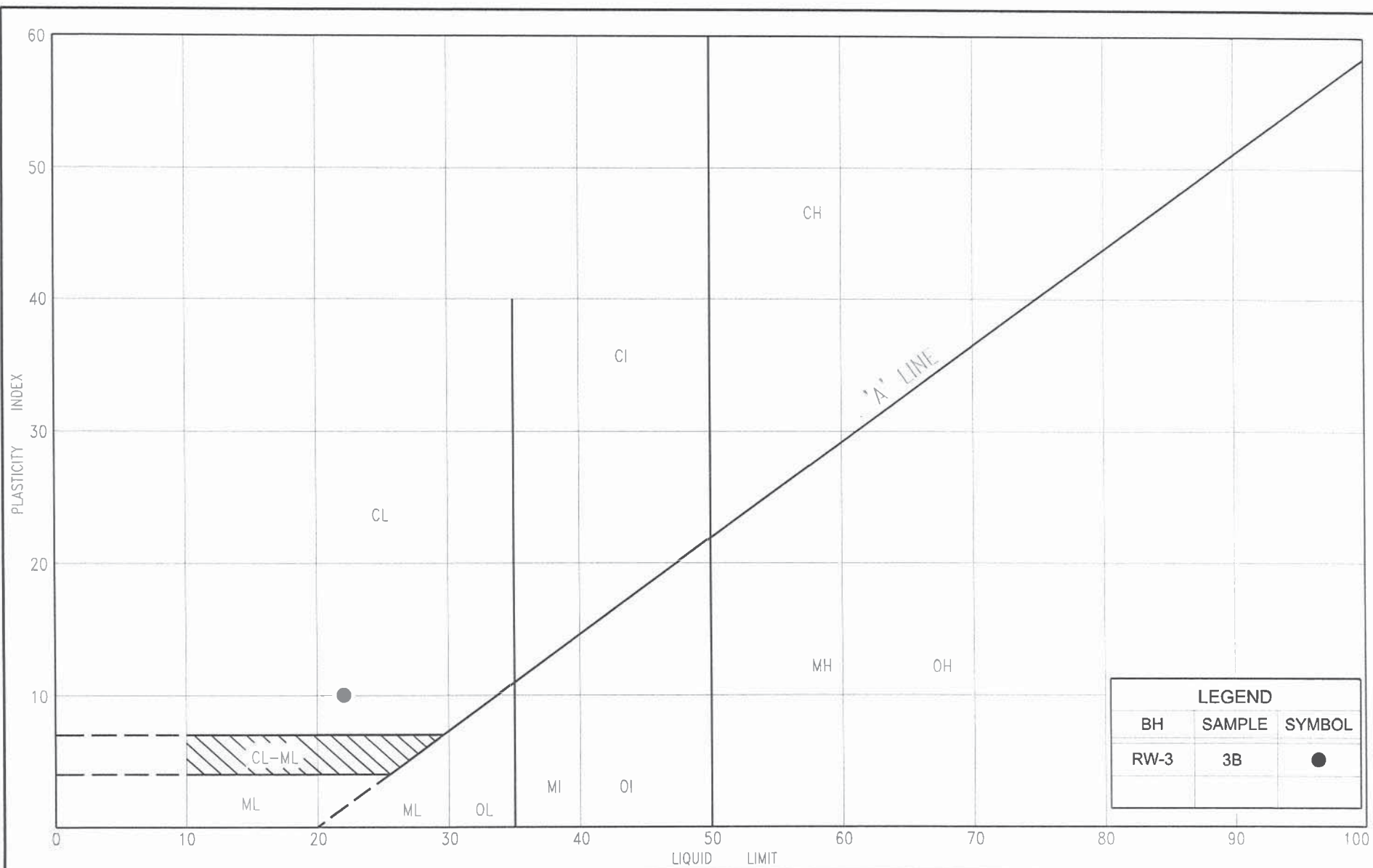
SILTY CLAY, trace to with sand, trace gravel (CI)

FIG No. RW-GS-7

HWY: 7 / 85

G.W.P. No. 3110-09-00





### PLASTICITY CHART

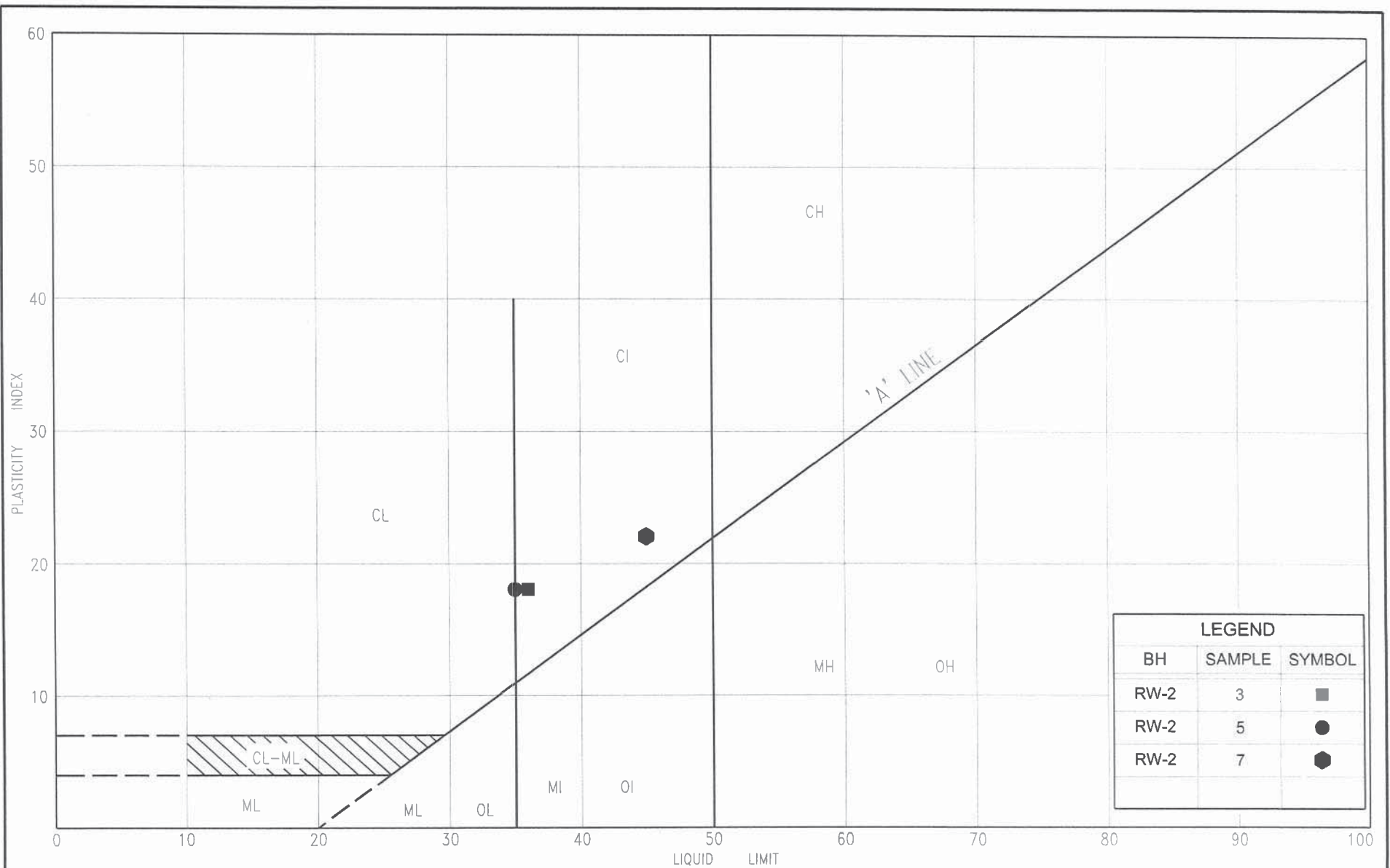
CLAYEY SILT, with sand, trace gravel (CL)  
(FILL)

FIG No. RW-PC-1

HWY: 7 / 85

G.W.P. No. 3110-09-00





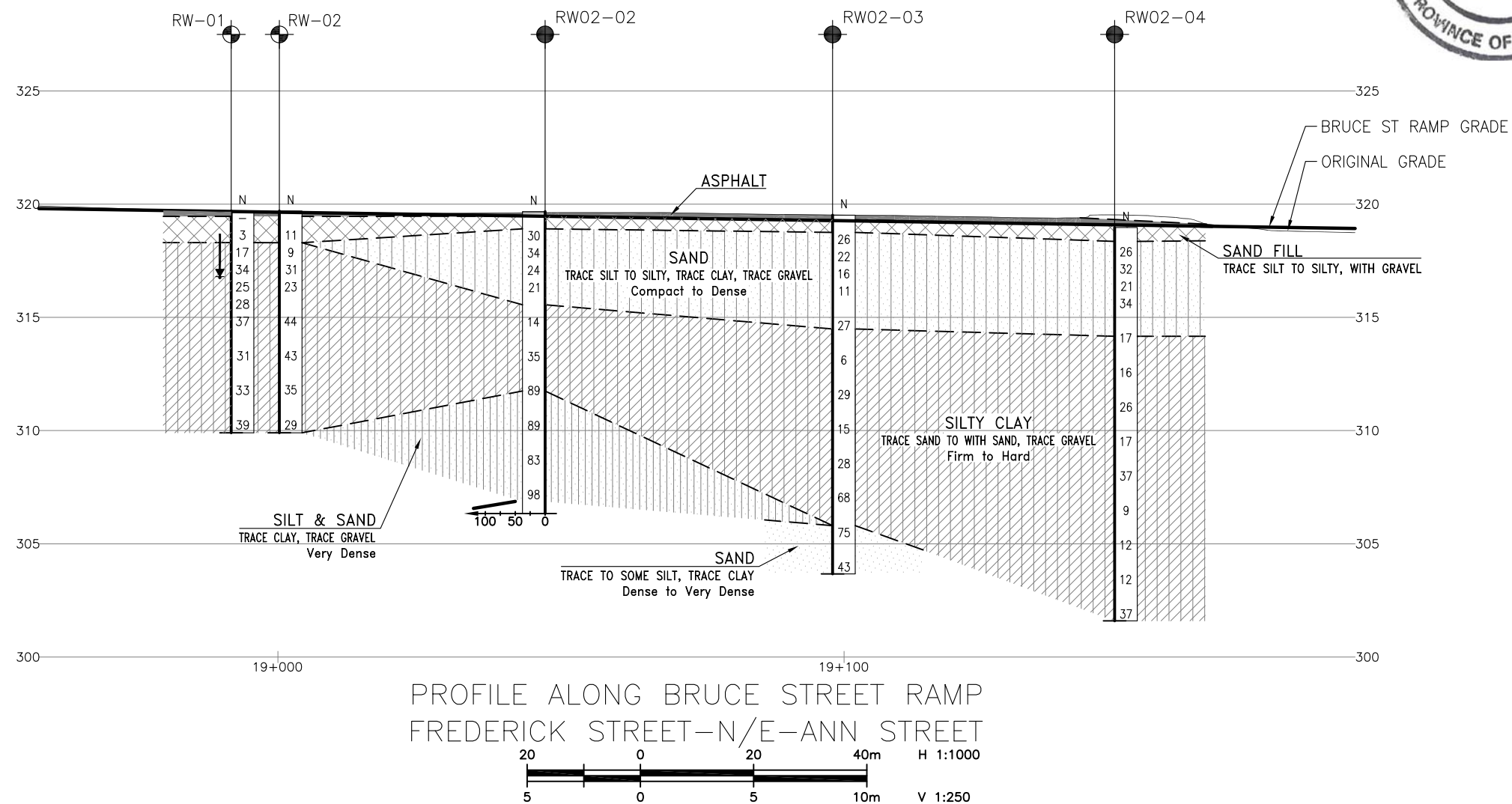
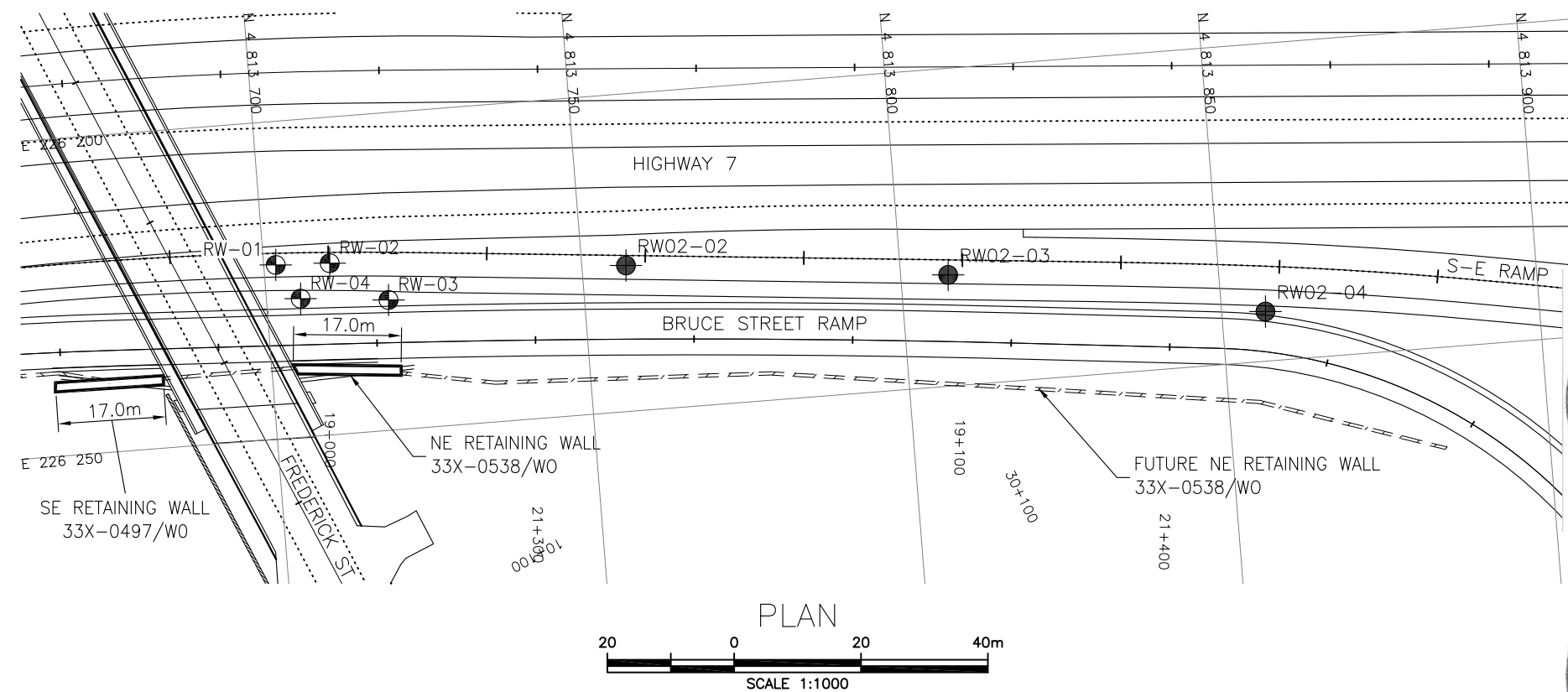
**PLASTICITY CHART**

**SILTY CLAY, trace to with sand, trace gravel (CI)**

FIG No. RW-PC-2

HWY: 7 / 85

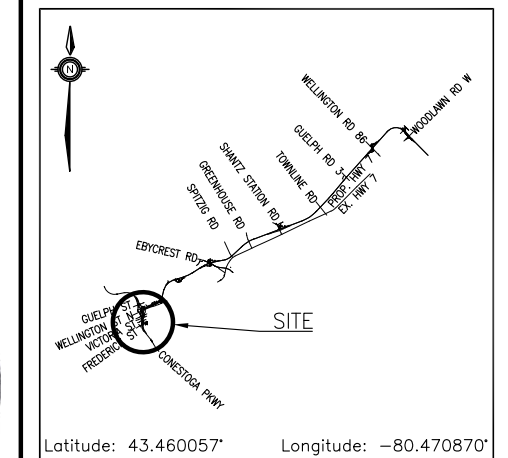
G.W.P. No. 3110-09-00



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






CONT No  
GWP No 3005-20-00

<p>HIGHWAY 7          FREDERICK ST.-N/E-ANN ST.          NE RETAINING WALL 33X-0538/WO          BOREHOLE LOCATIONS AND SOIL STRATA</p>	
--	--



## KEYPLAN

### LEGEND

	Borehole (Current Investigation)
	Borehole (by Others)
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
RW02-02	319.6	4 813 757.0	226 227.0
RW02-03	319.5	4 813 807.5	226 232.5
RW02-04	319.1	4 813 856.9	226 242.2
RW-01	319.7	4 813 710.9	226 222.6
RW-02	319.7	4 813 710.4	226 233.0
RW-03	322.3	4 813 719.2	226 229.5
RW-04	323.5	4 813 705.4	226 228.2

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 10.

**GEOCRES No. 40P8-290**

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	NB	CHK	PKC	CODE	LOAD	DATE	JUN 2021		
DRAWN	MFA	CHK	NB	SITE	STRUCT	DWG	1		



## **APPENDIX C**

**Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata  
Drawing  
NW Retaining Wall - Site # 33X-0860/W0**

# RECORD OF BOREHOLE No RW16-01

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 677.3 E 226 163.6 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.19 - 2019.08.19 LATITUDE 43.458863 LONGITUDE -80.471748 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
321.3	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT: (150mm)							20 40 60 80 100					
0.2	Sandy <b>SILT</b> , with gravel Brown Dry (FILL)		1	GS			321						
320.5													
0.8	<b>SAND</b> , some silt to silty, trace clay, trace gravel Compact Brown Wet		2	SS	25		320						
			3	SS	26								2 78 16 4
319.0							319						
2.3	Silty <b>CLAY</b> , trace sand, trace gravel Very Stiff Grey Moist		4	SS	25								
			5	SS	22		318						
							317						
			6	SS	21								
							316						
			7	SS	28		315						0 1 32 67
							314						
			8	SS	58		313						
312.5													
8.8	Sandy <b>SILT</b> , trace clay Dense Grey Wet		9	SS	42		312						

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RW16-01

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 677.3 E 226 163.6 ORIGINATED BY JP  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.19 - 2019.08.19 LATITUDE 43.458863 LONGITUDE -80.471748 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								20	40	60	80					
	Continued From Previous Page															
							311									
			10	SS	45											0 24 70 6
310.0																
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 0.2m AND WATER LEVEL NOT OBSERVED. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.															

# RECORD OF BOREHOLE No RW16-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 716.6 E 226 163.9 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.15 - 2019.08.19 LATITUDE 43.459222 LONGITUDE -80.471733 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE						PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W      LIQUID LIMIT W <sub>L</sub>				
320.4	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (150mm)							20	40	60	80	100						
0.2	SAND and GRAVEL, granular Brown Dry (FILL)		1	GS			320											
319.7																		
0.7	Silty SAND, some clay, occasional cobbles Loose Brown Moist		2	SS	8		319											
319.0																		
1.4	Silty CLAY, trace sand, trace shale Very Stiff to Hard Brown Dry to Moist		3	SS	25		318											
	Grey		4	SS	35		317											
							316											
			6	SS	38		315											
							314											
			7	SS	21		313											
							312											
			8	SS	32		311											
			9	SS	41													
310.4																		

Continued Next Page

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

RECORD OF BOREHOLE No RW16-02

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 716.6 E 226 163.9 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.15 - 2019.08.19 LATITUDE 43.459222 LONGITUDE -80.471733 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
10.0	Silty <b>CLAY</b> , trace sand, trace shale Very Stiff to Hard Brown Dry to Moist						310										
309.1			10	SS	21												
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 10.4m AND WATER LEVEL AT 3.7m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.																

# RECORD OF BOREHOLE No RW16-03

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 755.4 E 226 164.5 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.15 - 2019.08.15 LATITUDE 43.459582 LONGITUDE -80.471709 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
319.9	GROUND SURFACE							20	40	60	80	100				
0.0	ASPHALT: (150mm)							20	40	60	80	100				
0.2	SAND and GRAVEL, granular Brown Dry (FILL)		1	GS												
319.3																
0.7	Clayey SILT, some sand and gravel Hard Grey Moist		2	SS	39		319									
318.5																
1.4	Silty CLAY, trace sand Very Stiff Grey Moist		3	SS	18		318									
			4	SS	16		317									
			5	SS	21		316									
			6	SS	15		315									Auger grinding
							314									Auger grinding
							313									Auger grinding
			7	SS	23		312									
			8	SS	23		311									Auger grinding
311.3																
8.7	Sandy SILT to Silty SAND Compact Grey Wet		9	SS	18		310									

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

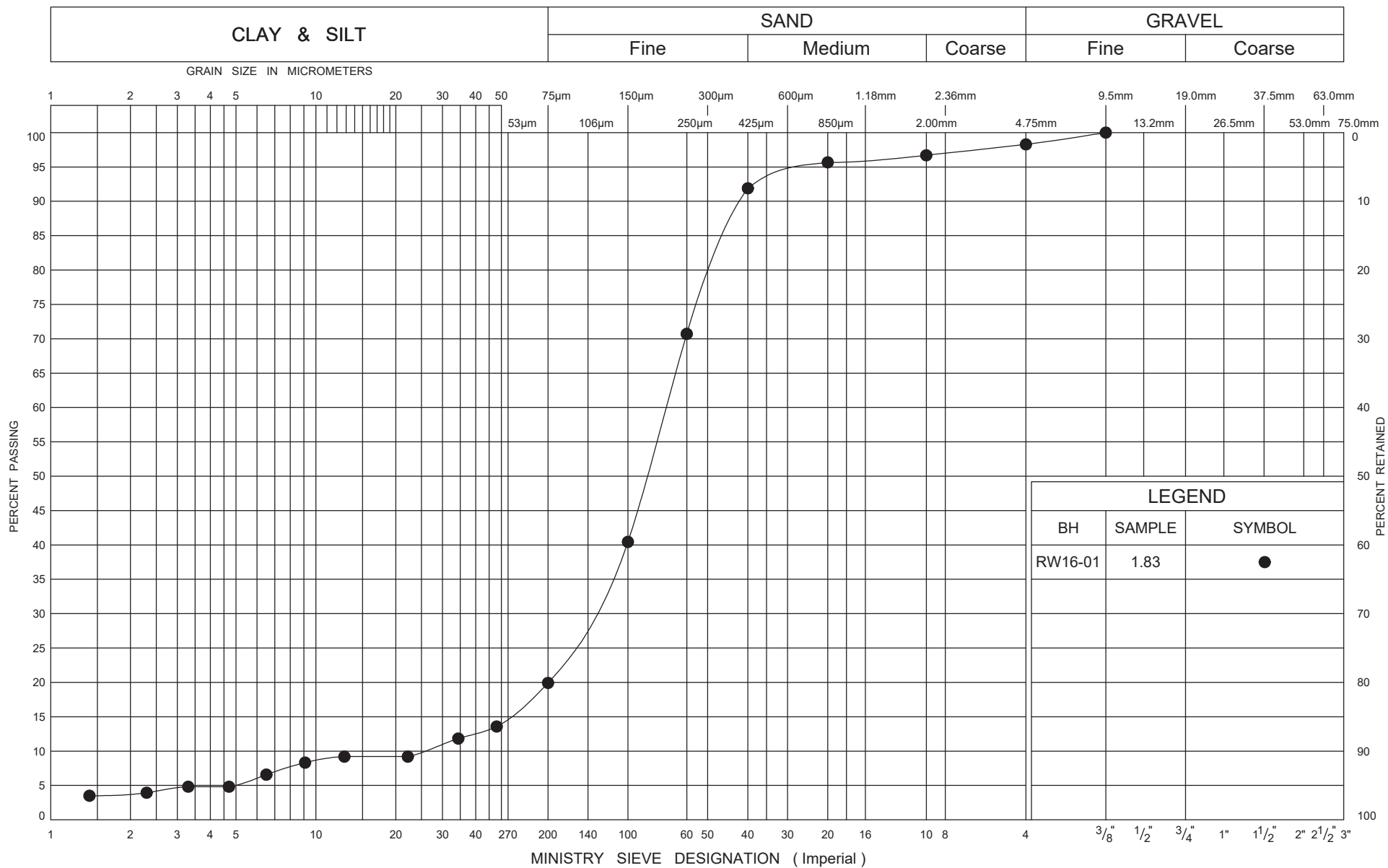
# RECORD OF BOREHOLE No RW16-03

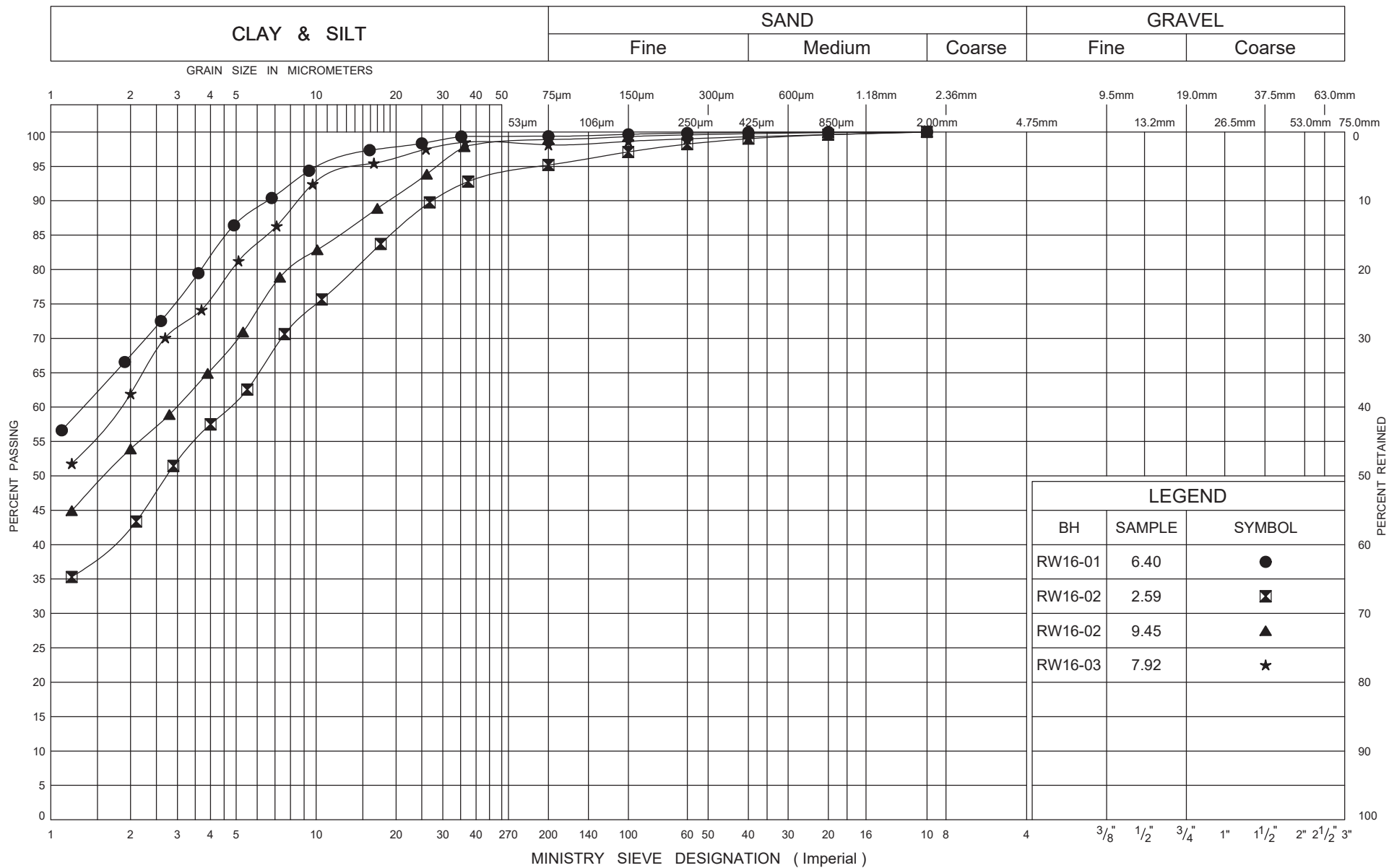
2 OF 2

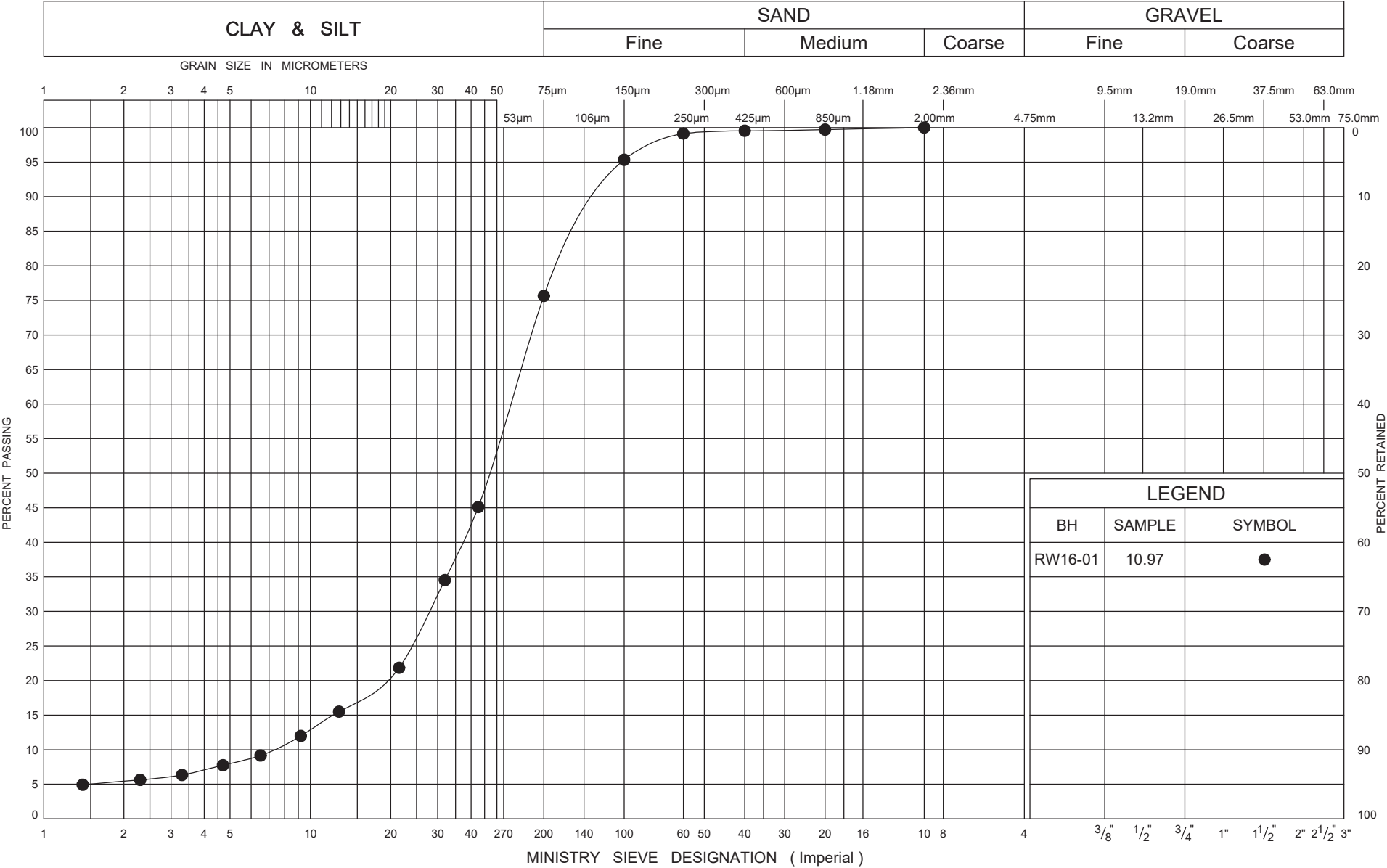
METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 755.4 E 226 164.5 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.15 - 2019.08.15 LATITUDE 43.459582 LONGITUDE -80.471709 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
308.7	Sandy <b>SILT</b> to Silty <b>SAND</b> Compact Grey Wet		10	SS	27									Auger grinding
11.3	End of sampling DCPT from 11.3m to 12.5m													
307.4														
12.5	END OF BOREHOLE AT 12.5m. BOREHOLE CAVED TO 9.1m AND WATER LEVEL AT 8.8m UPON DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.													





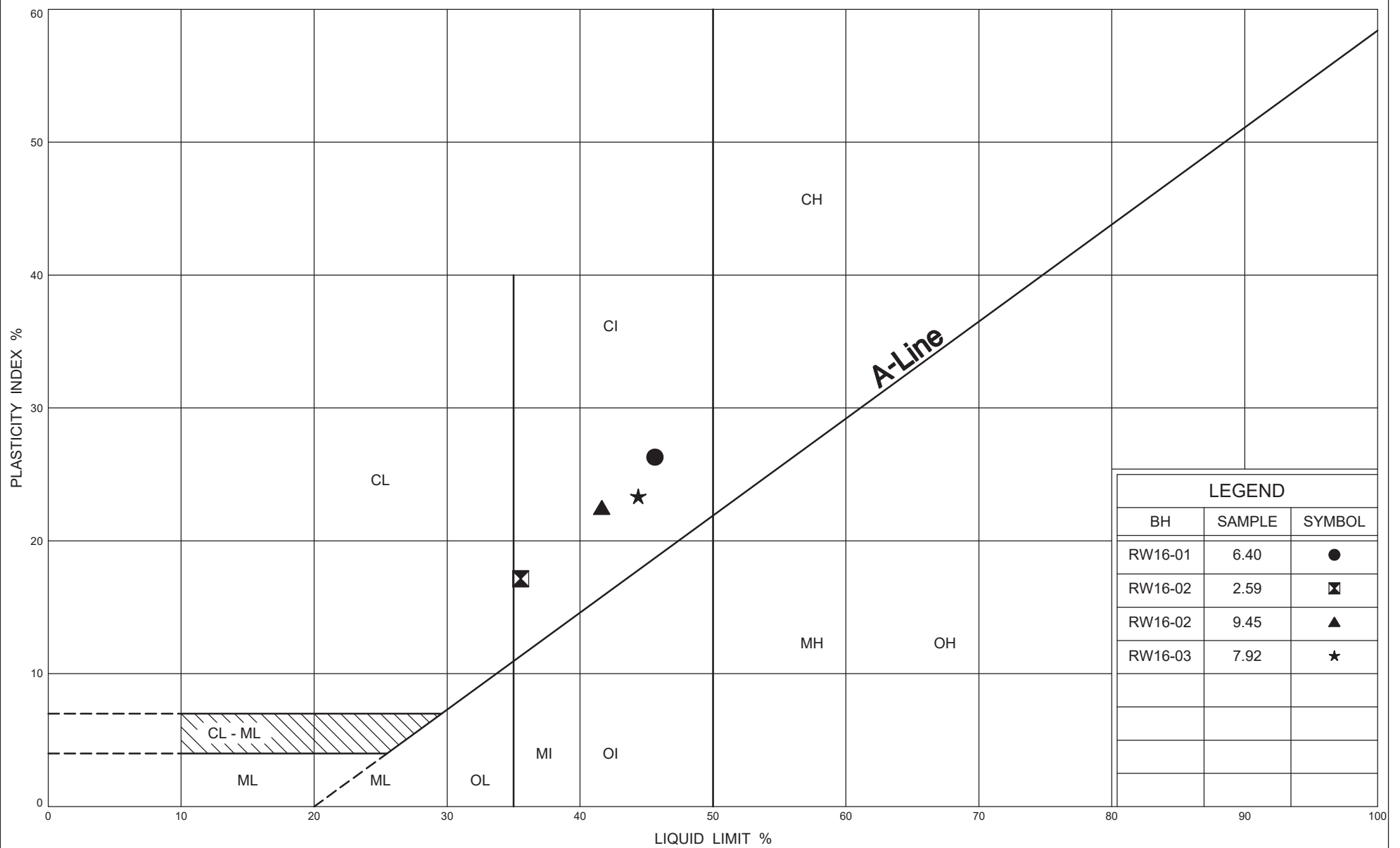


ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION  
Silty SAND to Sandy SILT

FIG No E3  
W P 408-88-00  
Retaining Wall 16



LEGEND		
BH	SAMPLE	SYMBOL
RW16-01	6.40	●
RW16-02	2.59	⊠
RW16-02	9.45	▲
RW16-03	7.92	★



Ministry of  
Transportation

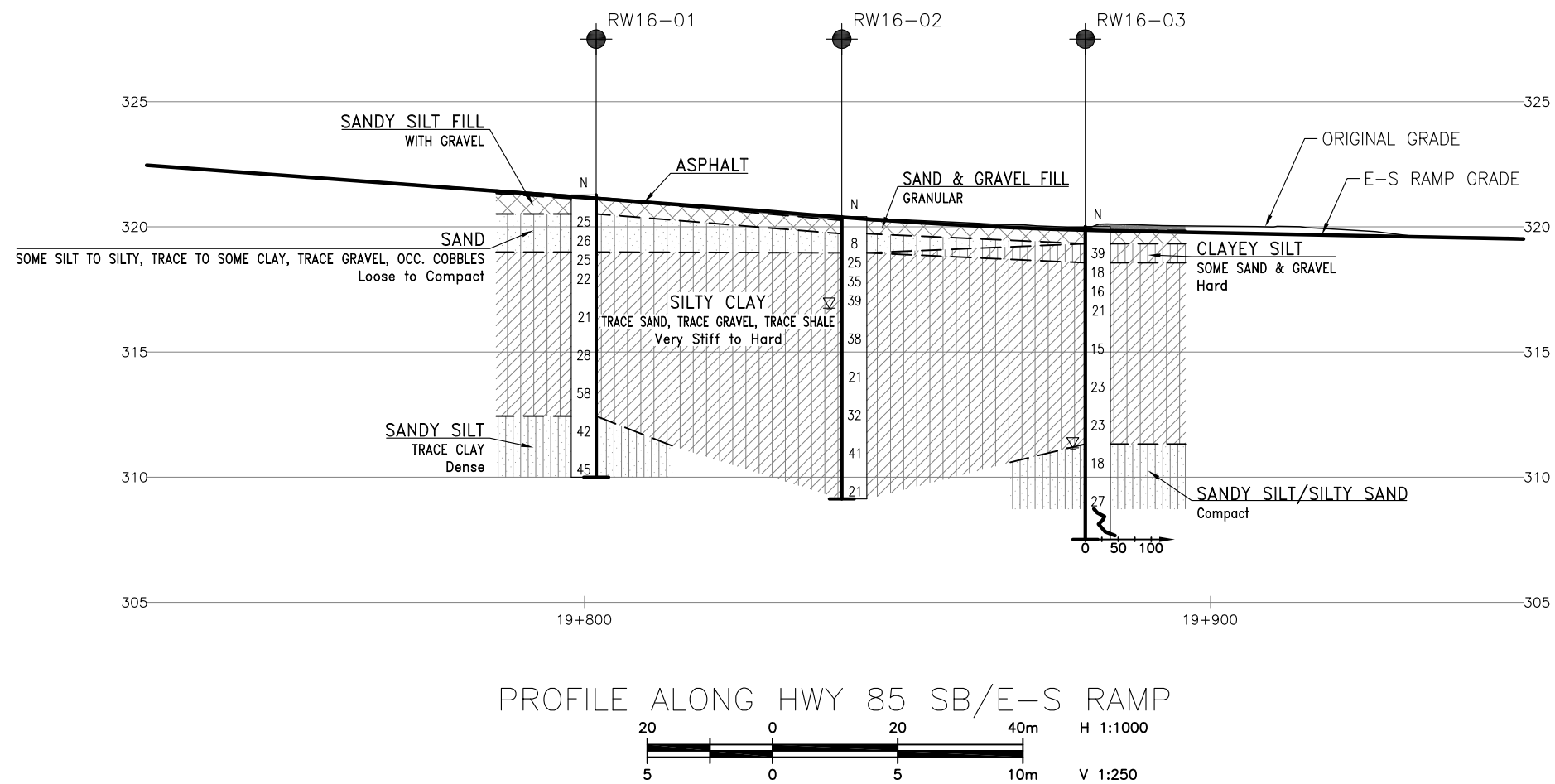
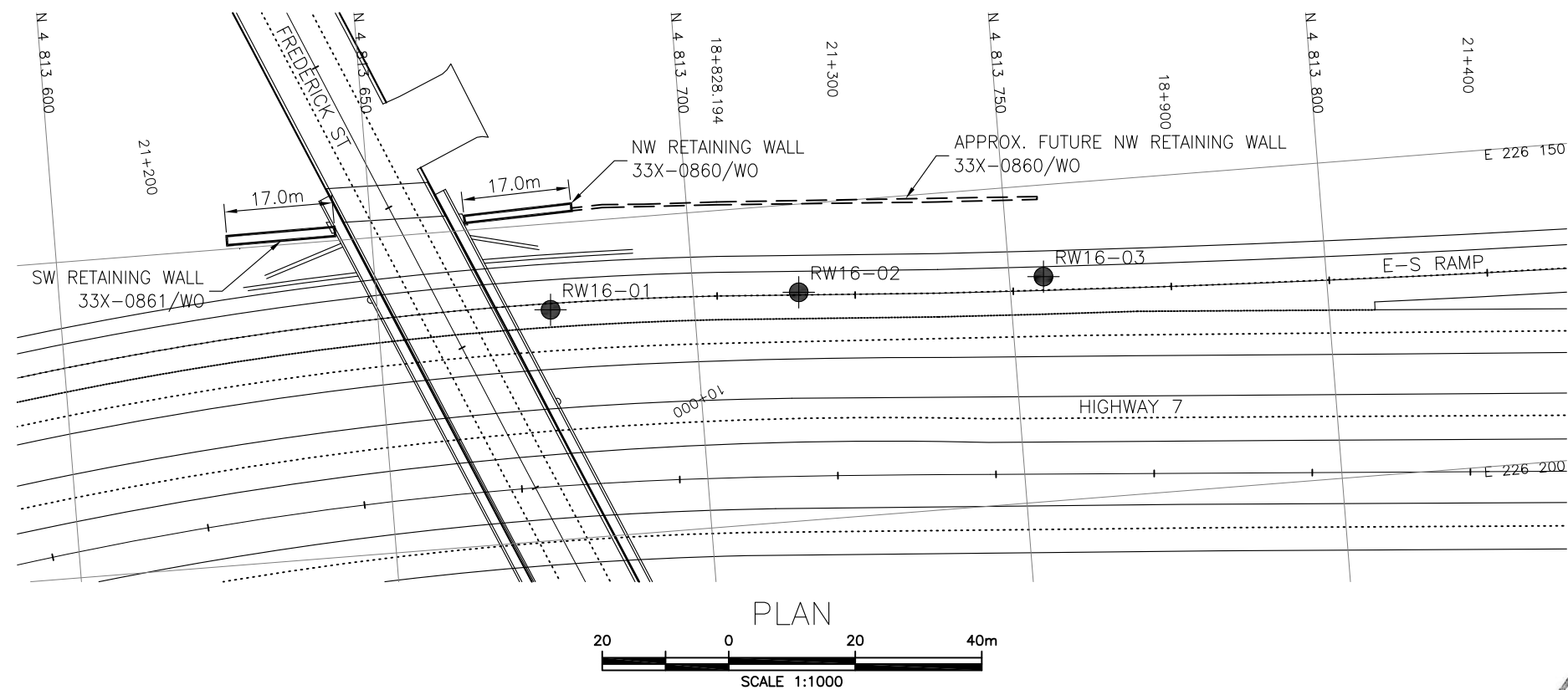
## PLASTICITY CHART

Silty CLAY

FIG No E4

W P 408-88-00

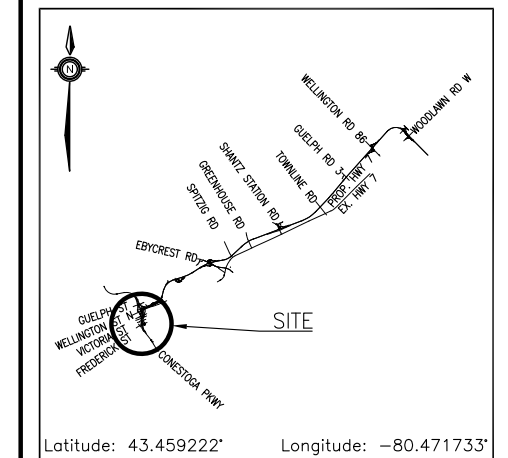
Retaining Wall 16



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






CONT No  
GWP No 3005-20-00

HIGHWAY 7  
HWY 85 SB/E-S RAMP  
NW RETAINING WALL 33X-0860/WO  
BOREHOLE LOCATIONS AND SOIL STRATA



## KEYPLAN

## LEGEND

	Borehole (Current Investigation)
	Borehole (by Others)
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
RW16-01	321.3	4 813 677.3	226 163.6
RW16-02	320.4	4 813 716.6	226 163.9
RW16-03	319.9	4 813 755.4	226 164.5

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 10.

**GEOCRES No. 40P8-290**

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	NB	CHK	PKC		LOAD		DATE	JUN 2021	
DRAWN	MFA	CHK	NB	CODE	STRUCT	DWG	1		



**APPENDIX D**

**Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata  
Drawing  
SW Retaining Wall - Site # 33X-0861/W0**

# RECORD OF BOREHOLE No BH20-01

1 OF 4

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 653.3 E 226 144.0 ORIGINATED BY MC  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
DATUM Geodetic DATE 2020.08.17 - 2020.08.19 LATITUDE 43.458660 LONGITUDE -80.471975 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>P</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE							
327.5	GROUND SURFACE							20 40 60 80 100							
0.0	ASPHALT: (200mm)														
0.2	SAND and GRAVEL Brown Dry (FILL)						327								
326.7															
0.8	SAND, some silt, some gravel Compact Brown Dry (FILL)		1	SS	28						○				
			2	SS	12		326				○				
325.3															
2.2	SAND, trace silt Very Loose to Loose Brown Dry (FILL)		3	SS	3		325				○				
			4	SS	8		324				○				0 89 11 (SI+CL)
323.4															
4.1	SAND, trace silt Compact Brown Wet		5	SS	27		323				○				
							322								
			6	SS	17		321				○				
320.3															
7.2	Clayey SILT, trace sand, trace gravel Stiff Brown Wet		7	SS	9		320				○				1 7 78 14
318.8							319								
8.7	Silty CLAY, trace sand Very Stiff to Hard Grey Wet		8	SS	31		318				○				

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017\TEMPLATE(MTO)\_GDT 2/9/21

# RECORD OF BOREHOLE No BH20-01

2 OF 4

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 653.3 E 226 144.0 ORIGINATED BY MC  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
DATUM Geodetic DATE 2020.08.17 - 2020.08.19 LATITUDE 43.458660 LONGITUDE -80.471975 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 20 40 60			GR SA SI CL
314.2			9	SS	24		317					0 0 30 70
			10	SS	31		316					
							315					
13.3	Silty <b>SAND</b> to Sandy <b>SILT</b> , trace clay Very Dense to Dense Grey Wet		11	SS	72		314					
							313					
			12	SS	85		312					
							311					
			13	SS	88		310					0 28 66 6
							309					
308.1			14	SS	45		308					
19.4	Silty <b>CLAY</b> , trace sand Hard Grey Wet											

Continued Next Page

ONTMT452 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)\_GDT 2/9/21

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


20  
15  
10  
5  
0  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH20-01

3 OF 4

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 653.3 E 226 144.0 ORIGINATED BY MC  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
DATUM Geodetic DATE 2020.08.17 - 2020.08.19 LATITUDE 43.458660 LONGITUDE -80.471975 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W P NATURAL MOISTURE CONTENT W LIQUID LIMIT W L	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							
Continued From Previous Page												
			15	SS	39		307					
							306					
							305					
			16	SS	37		304					
							303					
							302					
			17	SS	32		301					
							300					
							299					
			18	SS	30		298					

Continued Next Page

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

# RECORD OF BOREHOLE No BH20-01

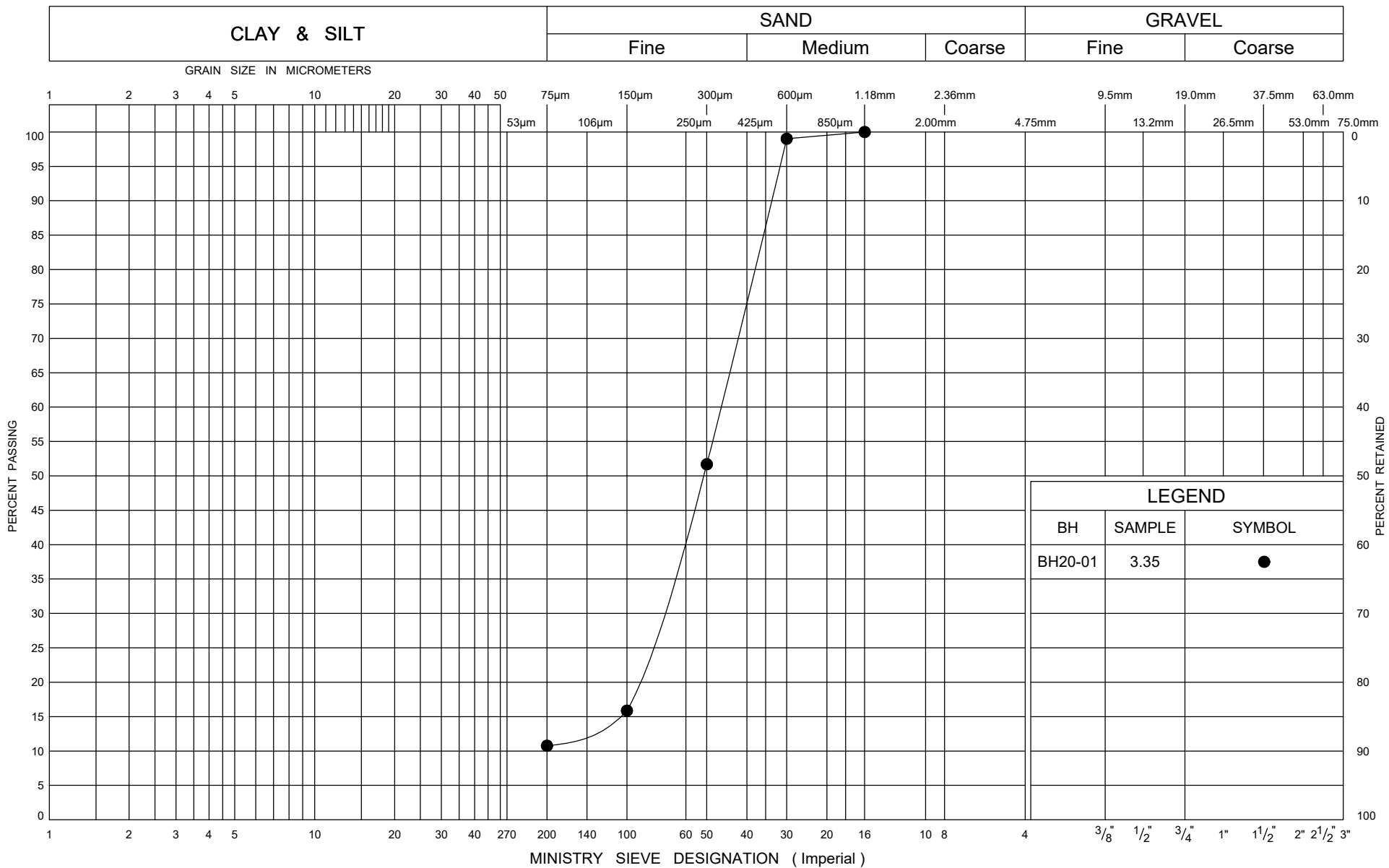
4 OF 4

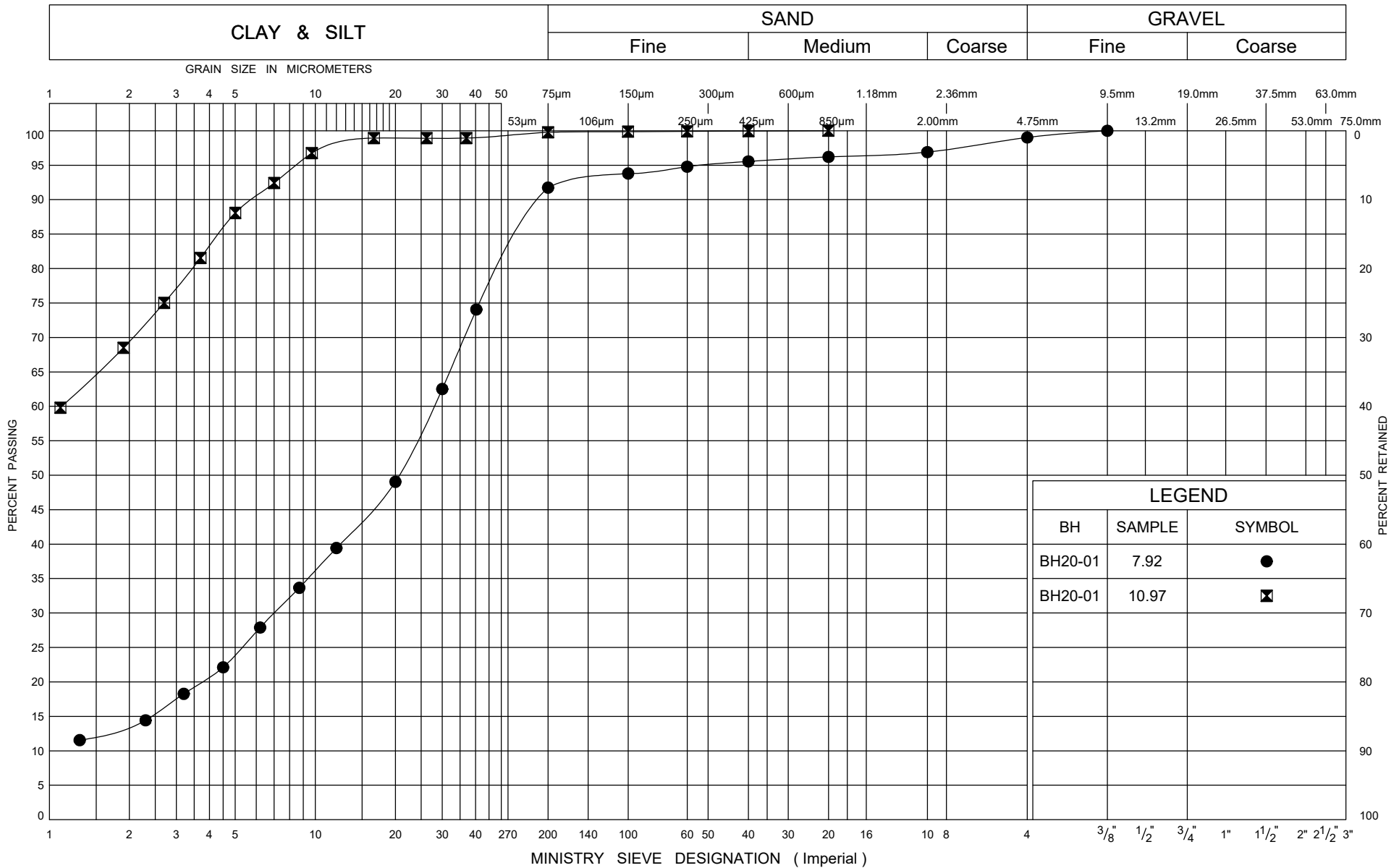
METRIC

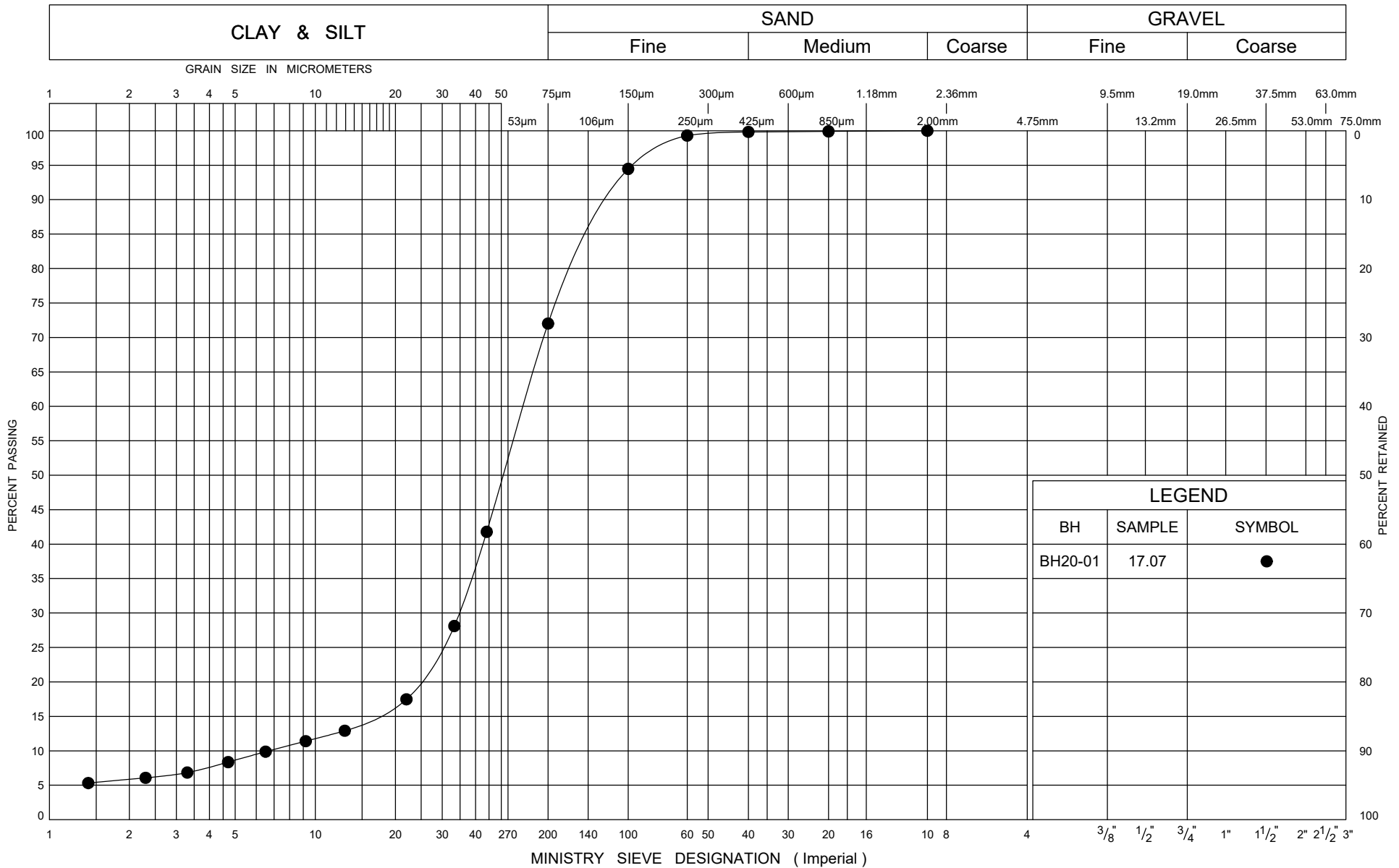
GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 653.3 E 226 144.0 ORIGINATED BY MC  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2020.08.17 - 2020.08.19 LATITUDE 43.458660 LONGITUDE -80.471975 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
	Continued From Previous Page													
293.7	Very Stiff		19	SS	23									
33.8	Silty <b>CLAY</b> , sandy, trace gravel Hard Grey Wet (TILL)		20	SS	100/ 0.275									
			21	SS	76/ 0.250									
289.2			22	SS	105/ 0.175									
38.3	END OF BOREHOLE AT 38.3m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2020.08.24 5.5 322.0													

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 2/9/21







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Transportation

## GRAIN SIZE DISTRIBUTION

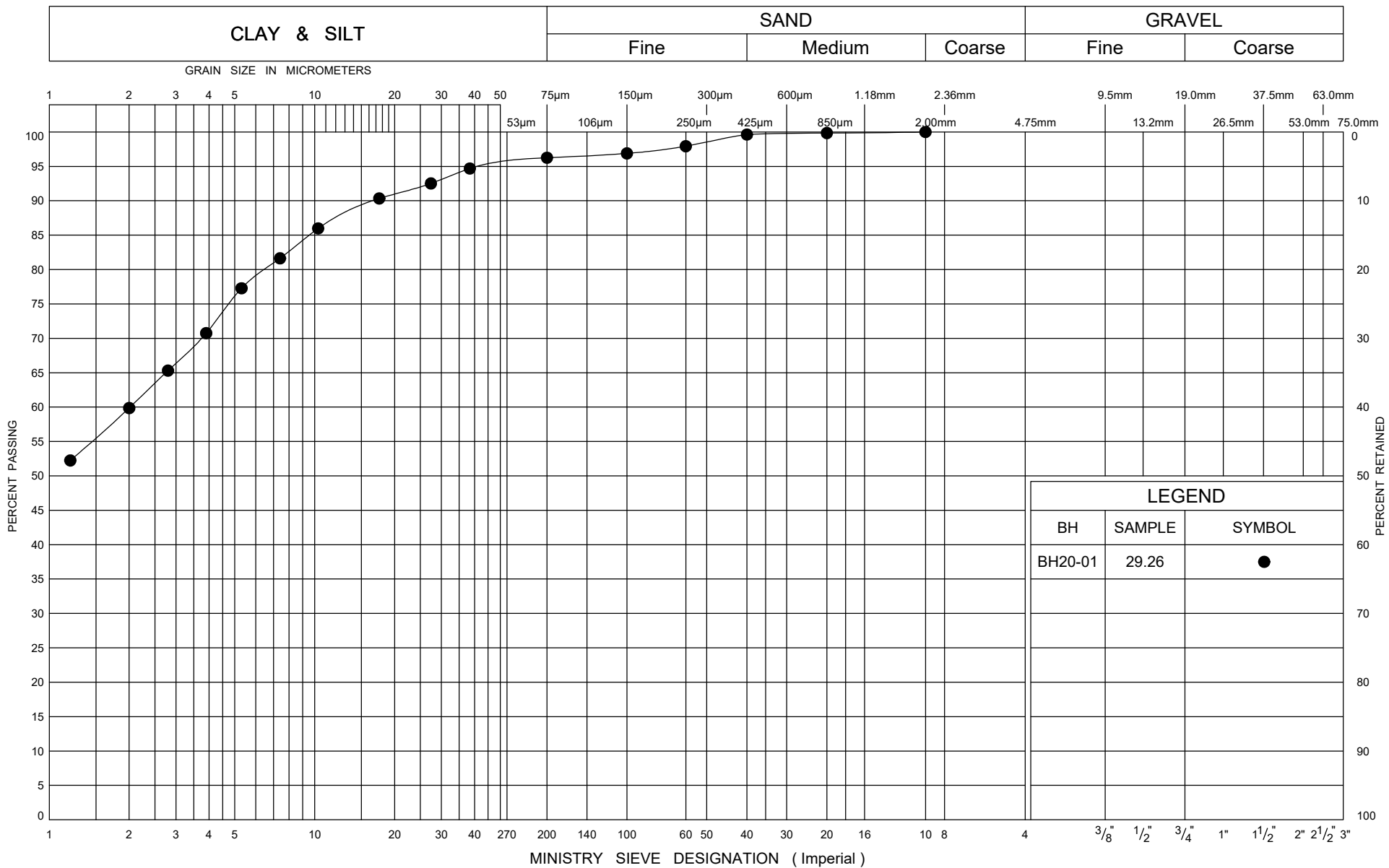
Silty SAND to Sandy SILT

FIG No D3

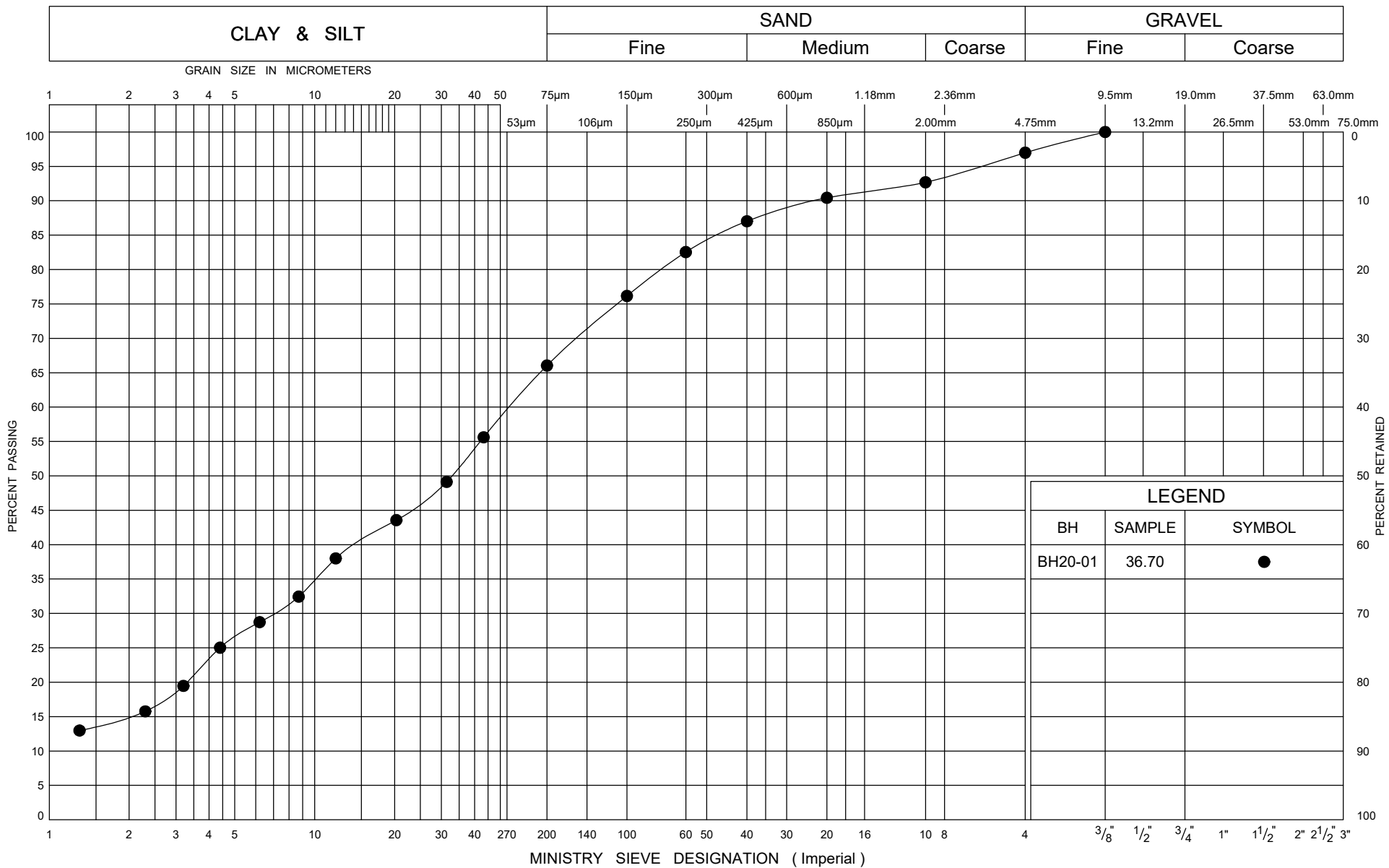
W P 408-88-00

SW Retaining Wall

ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 6/3/21

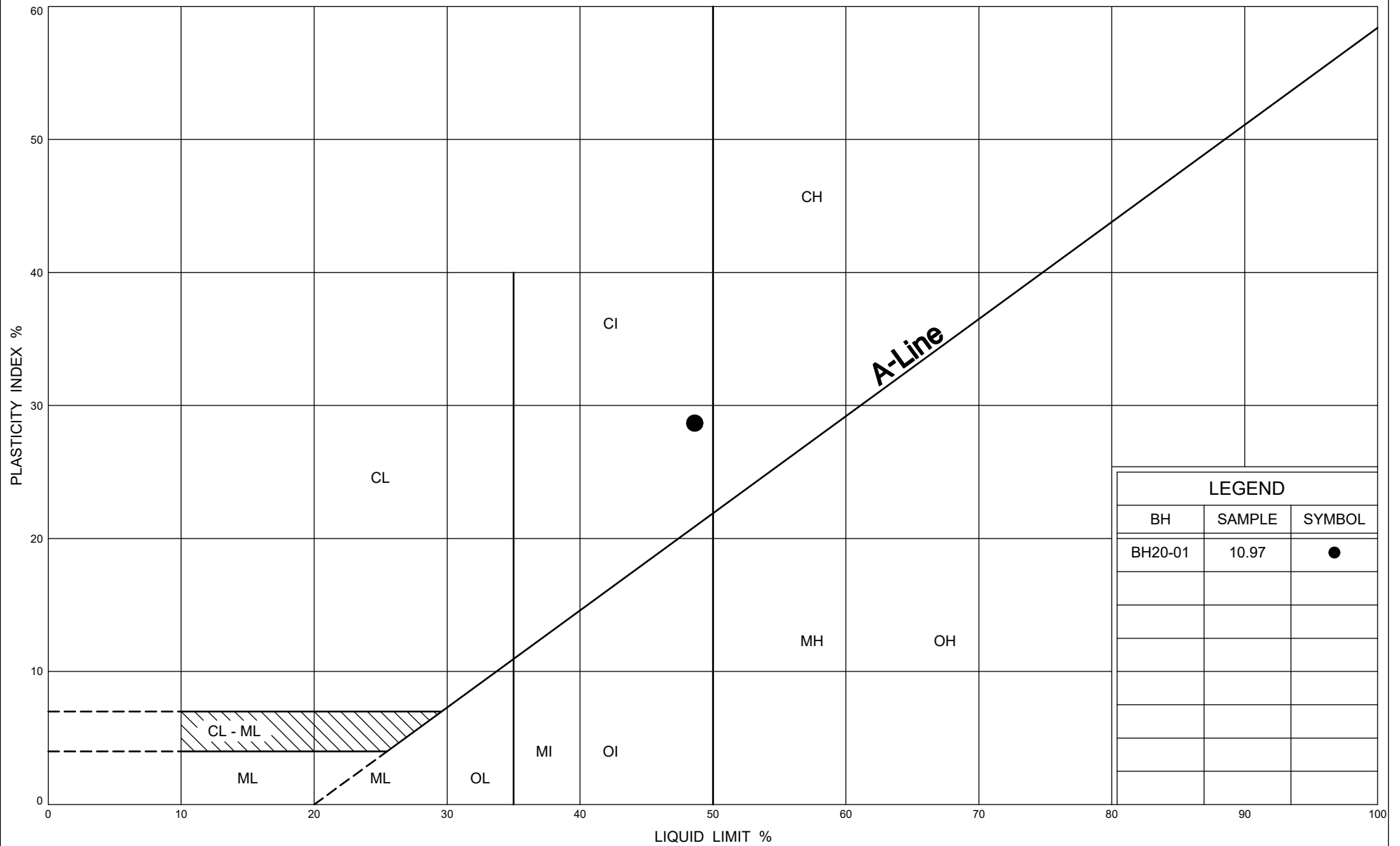


ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 6/3/21



GRAIN SIZE DISTRIBUTION  
Silty CLAY TILL

FIG No D5  
W P 408-88-00  
SW Retaining Wall



Ministry of  
Transportation

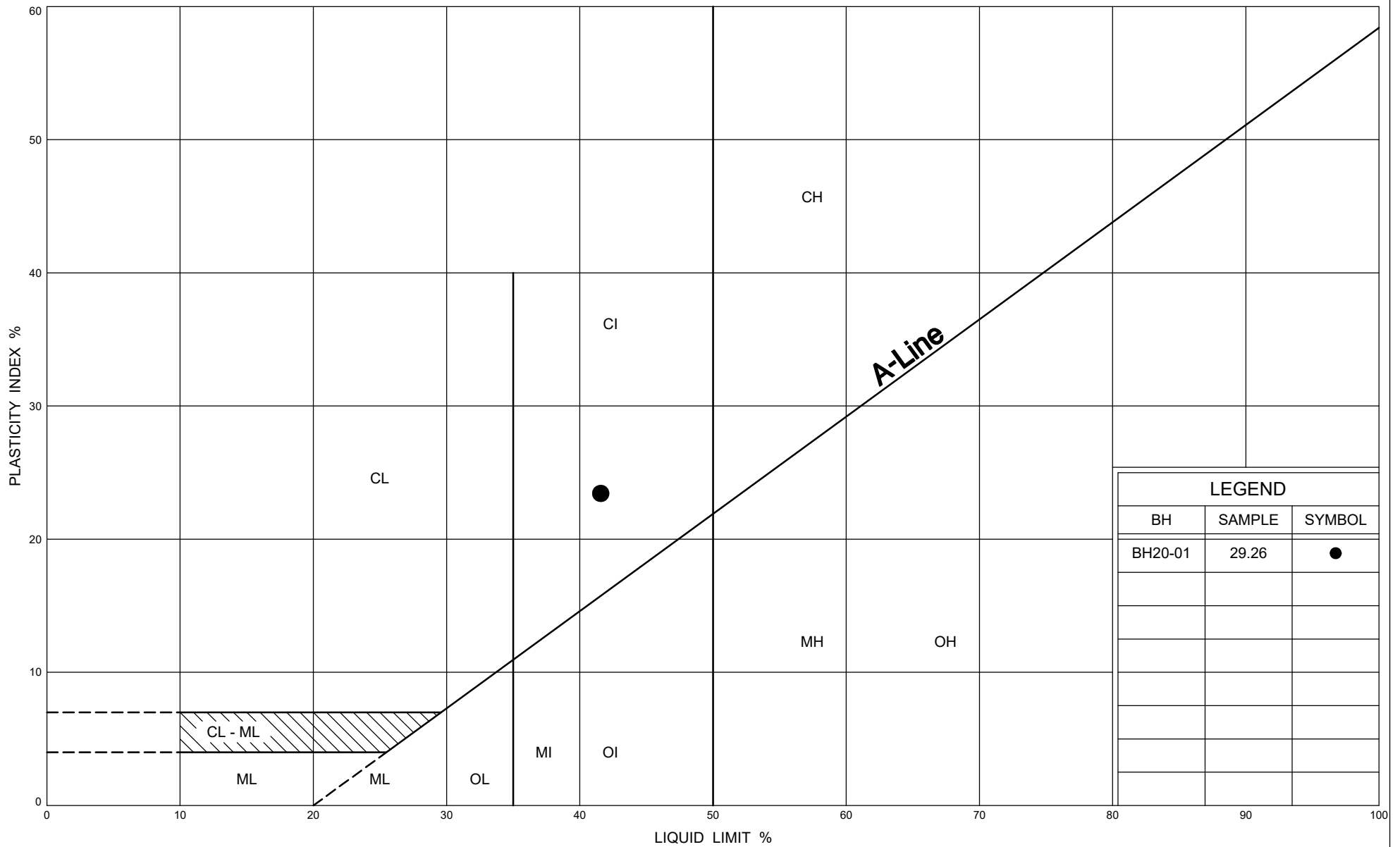
## PLASTICITY CHART

Upper Clayey SILT

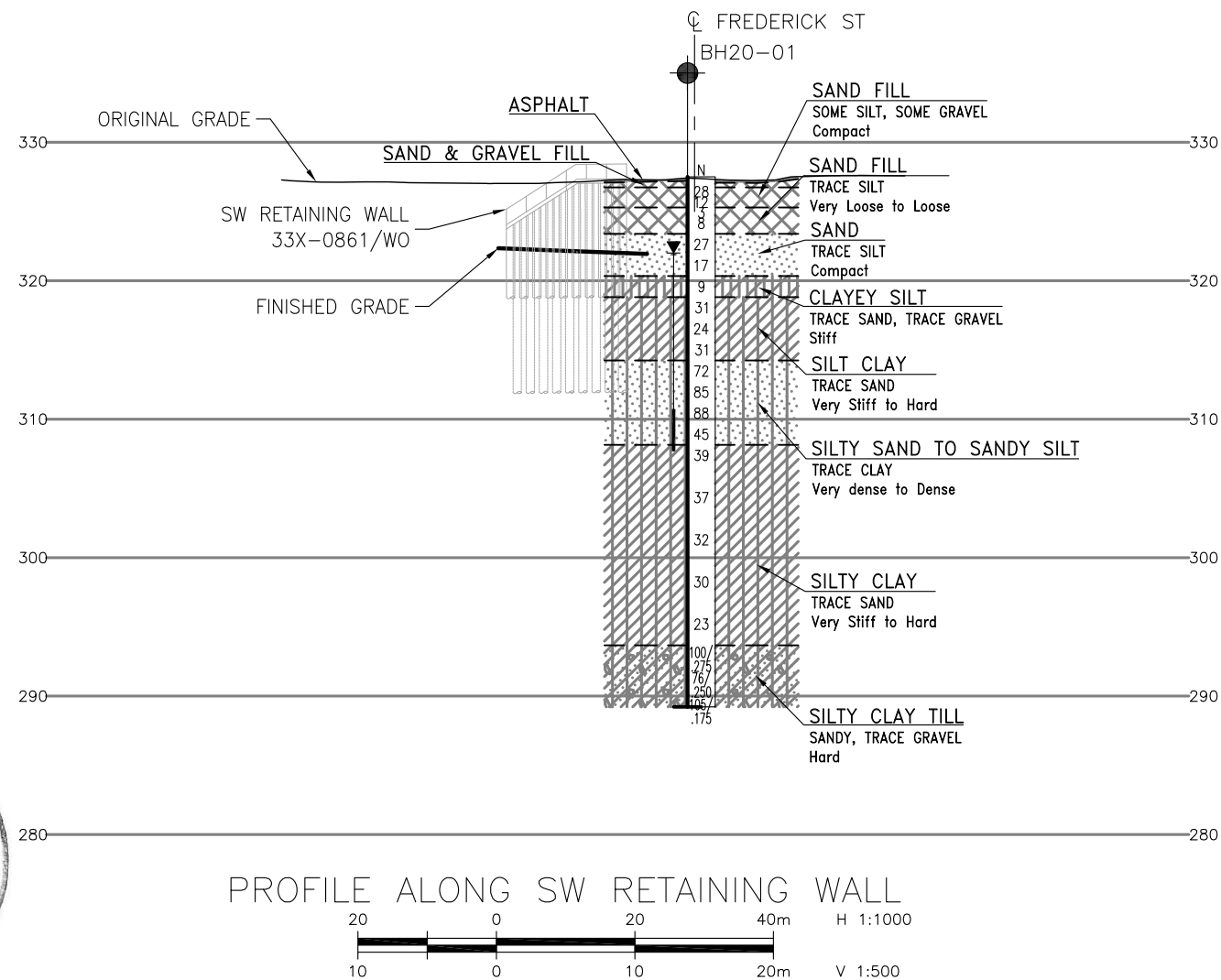
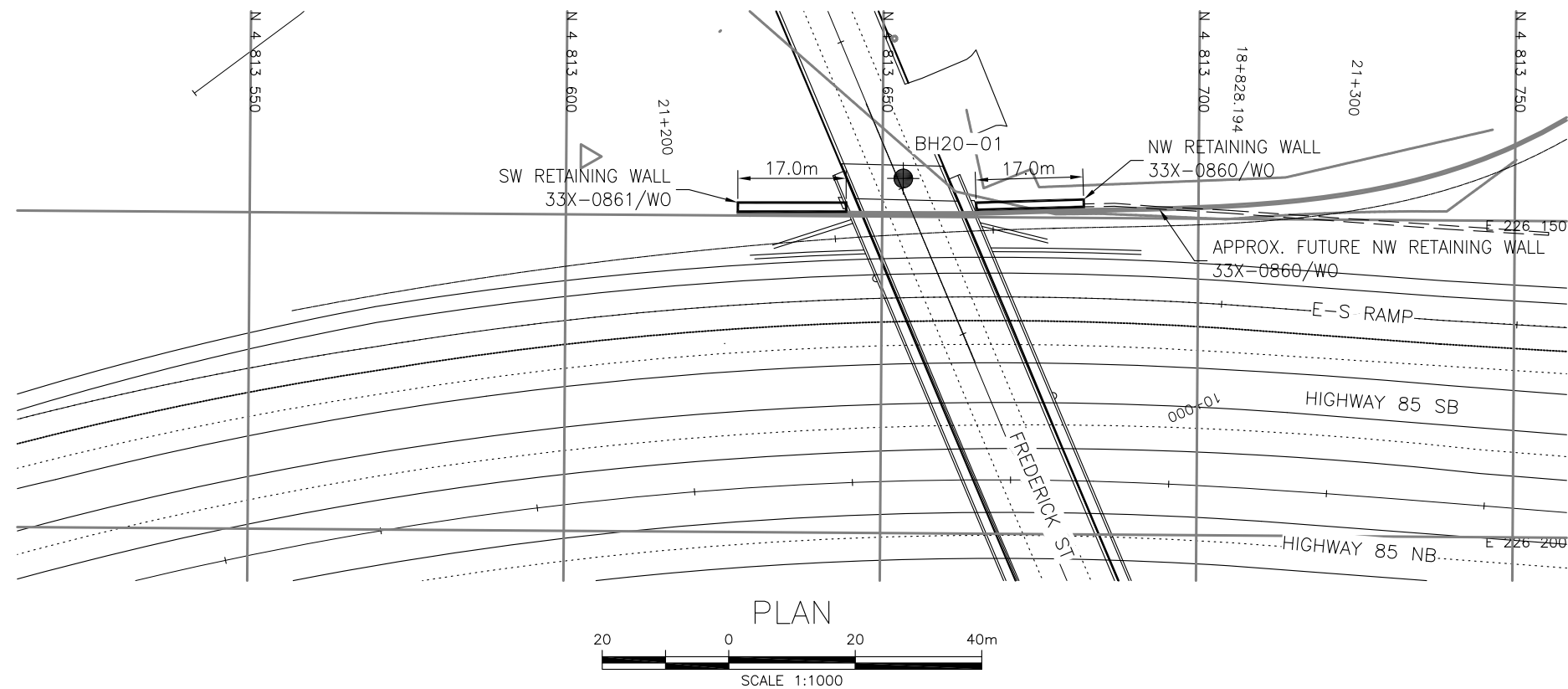
FIG No D6

W P 408-88-00

SW Retaining Wall



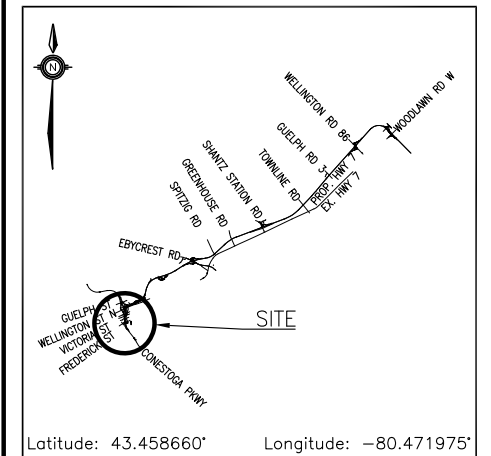
LEGEND		
BH	SAMPLE	SYMBOL
BH20-01	29.26	●



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






CONT No	(
GWP No 3005-20-00	

HIGHWAY 7  
HWY 85 & FREDERICK ST I/C  
SW RETAINING WALL 33X-0861/WO  
BOREHOLE LOCATIONS AND SOIL STRATA



## KEYPLAN

## LEGEND

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

[illegible]

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 10.

**GEOCRES No. 40P8-290**

[illegible]



## **APPENDIX E**

### **Corrosivity Results**



## FINAL REPORT

CA14058-MAY18 R1

11375

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client                   Thurber Engineering Ltd.

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

Contact               Rocio Palomeque

Telephone           905-829-8666 x 263

Facsimile

Email                  rreyna@thurber.ca

Project               11375

Order Number

Samples              Soil (7)

### LABORATORY DETAILS

Project Specialist     Deanna Edwards, B.Sc, C.Chem

Laboratory           SGS Canada Inc.

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

Telephone            705-652-2000

Facsimile             705-652-6365

Email                  deanna.edwards@sgs.com

SGS Reference        CA14058-MAY18

Received              05/02/2018

Approved             05/09/2018

Report Number       CA14058-MAY18 R1

Date Reported        05/09/2018

### COMMENTS

Temperature of Sample upon Receipt: 8 degrees C

Cooling Agent Present: No

Custody Seal Present: No

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

Deanna Edwards, B.Sc, C.Chem





TABLE OF CONTENTS

---

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Results..... 3-4

QC Summary..... 5-6

Legend..... 7

Annexes..... 8-9



# FINAL REPORT

CA14058-MAY18 R1

Client: Thurber Engineering Ltd.

Project: 11375

Project Manager: Rocío Palomeque

Samplers: N/A

## PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6	7	8	9	10	11
Sample Name	RW12-05	RW10-04 SS4	RW 09-02 SS3	NE 16-16 SS4	RW13-01 SS4	SE16-05 SS3	SE16-06 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	20/04/2018	18/04/2018	11/04/2018	11/04/2018	11/04/2018	12/04/2018	23/04/2018

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

### Corrosivity Index

Corrosivity Index	none	1	4	3	4	4	4	3	4
Soil Redox Potential	mV	-	230	182	274	164	133	232	215
Sulphide	%	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
pH	no unit	0.05	8.67	9.11	9.04	9.19	8.50	9.11	9.25
Resistivity (calculated)	ohms.cm	-9999	4610	17100	6670	13200	5250	13400	10100

## PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7	8	9	10	11
Sample Name	RW12-05	RW10-04 SS4	RW 09-02 SS3	NE 16-16 SS4	RW13-01 SS4	SE16-05 SS3	SE16-06 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	20/04/2018	18/04/2018	11/04/2018	11/04/2018	11/04/2018	12/04/2018	23/04/2018

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

### General Chemistry

Conductivity	uS/cm	2	217	59	150	76	190	75	99
--------------	-------	---	-----	----	-----	----	-----	----	----

## PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10	11
Sample Name	RW12-05	RW10-04 SS4	RW 09-02 SS3	NE 16-16 SS4	RW13-01 SS4	SE16-05 SS3	SE16-06 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	20/04/2018	18/04/2018	11/04/2018	11/04/2018	11/04/2018	12/04/2018	23/04/2018

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

### Metals and Inorganics

Moisture Content	%	0.1	9.3	4.4	11.3	8.3	13.4	4.1	8.8
Sulphate	µg/g	0.4	15	1.1	13	5.5	11	4.0	8.7



FINAL REPORT

CA14058-MAY18 R1

Client: Thurber Engineering Ltd.

Project: 11375

Project Manager: Rocío Palomeque

Samplers: N/A

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6	7	8	9	10	11
Sample Name	RW12-05	RW10-04 SS4	RW 09-02 SS3	NE 16-16 SS4	RW13-01 SS4	SE16-05 SS3	SE16-06 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	20/04/2018	18/04/2018	11/04/2018	11/04/2018	11/04/2018	12/04/2018	23/04/2018

Parameter	Units	RL		Result	Result	Result	Result	Result	Result	Result
Other (ORP)										
Chloride	µg/g	0.4		70	3.2	53	12	46	19	30

## 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	DIO0131-MAY18	µg/g	0.4	<0.4	6	20	95	80	120	106	75	125
Sulphate	DIO0131-MAY18	µg/g	0.4	<0.4	42	20	98	80	120	98	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	ECS0004-MAY18	%	0.02	<0.02	8	20	99	80	120			

## pH

Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-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	EWL0048-MAY18	no unit	0.05	NA	1		100			NA		



## QC SUMMARY

---

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

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

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

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

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

**RL:** Reporting limit

**RPD:** Relative percent difference

**AC:** Acceptance criteria

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

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

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

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

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

**ND** Non Detect

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

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

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

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

-- End of Analytical Report --



# Request for Laboratory Services and CHAIN OF CUSTODY

SGS Environmental Services

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365  
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

No:

Page 1 of 1

## Laboratory Information Section - Lab use only

Received By: 15mail  
Received Date (mm/dd/yyyy): 05/02/18 (mm/dd/yyyy)  
Received Time: 11:00 Am

Received By (signature): [Signature]  
Custody Seal Present: ☒ no  
Custody Seal Intact: ☒ no

Cooling Agent Present: ☒ no  
Temperature Upon Receipt (°C): 12.1/1.10 8x3

LAB LIMS #:

CA14058-May

## REPORT INFORMATION

Company: Thurber Eng.  
Contact: Rocio Palomede Reyna  
Address: 103-2010 Winston Park Dr  
Oakville, ON L6H 5R7  
Phone: \_\_\_\_\_  
Fax: \_\_\_\_\_  
Email: rreyna@thurber.ca

## INVOICE INFORMATION

☒ (same as Report Information)  
Company: \_\_\_\_\_  
Contact: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_  
Email: \_\_\_\_\_

## PROJECT INFORMATION

Quotation #: \_\_\_\_\_  
Project #: 11375  
P.O. #: \_\_\_\_\_  
Site Location/ID: \_\_\_\_\_

## TURNAROUND TIME (TAT) REQUIRED

☐ Regular TAT (5-7 days) TAT's are quoted in business days (exclude statutory holidays & weekends).  
Samples received after 3pm or on weekends : TAT begins the next business day

RUSH TAT (Additional Charges May Apply) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: \_\_\_\_\_ Rush Confirmation ID: \_\_\_\_\_

## REGULATIONS

### Regulation 153 (2011):

☐ Table 1 ☐ Res/Park ☐ Soil Texture: \_\_\_\_\_  
☐ Table 2 ☐ Ind/Com ☐ Coarse \_\_\_\_\_  
☐ Table 3 ☐ Agri/Other ☐ Medium \_\_\_\_\_  
☐ Table \_\_\_\_\_ ☐ Fine \_\_\_\_\_

### Other Regulations:

☐ Reg 347/558 (3 Day min TAT)  
☐ PWQO ☐ MMER  
☐ CCME ☐ Other: \_\_\_\_\_  
☐ MISA

### Sewer By-Law:

☐ Sanitary  
☐ Storm

Municipality: \_\_\_\_\_

## RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

### SAMPLE IDENTIFICATION

DATE SAMPLED

TIME SAMPLED

# OF BOTTLES

MATRIX

1	RW12-05	Apr 20/18	1	Soil
2	RW10-04	Apr 18/18	1	"
3	RW09-02	April 11/18	1	"
4	NE16-16	April 13/18	1	"
5	RW13-01	April 9/18	1	"
6	SE16-05	April 12/18	1	"
7	ES16-06	April 23	1	"
8				
9				
10				

## ANALYSIS REQUESTED

PHC F1-F4 BTEX

O.Reg 153 Metals  
(CP & hydride metals)

☐ Hg ☐ B-HWS ☐ Cr(VI)

O.Reg 153 VOCs

COMMENTS:  
Field Filtered (F)  
Preserved (P)

Observations/Comments/Special Instructions

Sampled By (NAME):

Relinquished by (NAME):

Revision #: 1.0  
Date of Issue: 01 June, 2014

Signature:

Signature:

Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ (mm/dd/yy)

Date: 01/10/2018 (mm/dd/yy)

Pink Copy - Client

Yellow & White Copy - SGS



## SAMPLE INTEGRITY REPORT

Project Number:

11375

ONTARIO REGULATION 153/04

SGS Sample ID

ON14058-May 18

Date / Time Sampled

Apr 11, 12, 18, 19, 20, 23

Client Sample ID

See CoC

ALL

## Sample Submission General Sample Integrity Violations

- Temperature >10 C upon receipt If not sampled same day ☐
- No evidence of cooling trend initiated If sampled same day ☐
- Chain of Custody not submitted ☐
- Chain of Custody incomplete ☐
- Chain of Custody not signed / dated ☐
- Chain of Custody not a current version ☐
- Bottles / Samples listed on CoC but not received ☐
- Bottles / Samples received but not listed on the CoC ☐
- Sample container received empty ☐

## Sample Specific Sample Integrity Violations

- |   |                          |                          |                          |                          |                          |                          |                          |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sample received past hold time                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Incorrect preservation (including no preservation where required) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Headspace present in VOC vial (aqueous)                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample(s) received frozen   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Bottle(s) broken or damaged in transport                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Discrepancy between sample label and chain of custody             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Analysis requirements absent / unclear                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Missing or incorrect sample label(s)                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Inappropriate sample container used                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient number of bottles received                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Limited sample volume   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient sample volume  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample contains multiple phases                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

## Sediment Log

- Groundwater samples contain visible sediment / particulate ☐
- Groundwater contains greater than 1cm of sediment / particulate matter in bottle ☐

## Additional Comments/Remarks:

No Issues upon receipt



Initials:

BM



## FINAL REPORT

CA14209-NOV19 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 (3)

### LABORATORY DETAILS

Project Specialist Brad Moore Hon. B.Sc

Laboratory SGS Canada Inc.

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

Telephone 705-652-2143

Facsimile 705-652-6365

Email brad.moore@sgs.com

SGS Reference CA14209-NOV19

Received 11/07/2019

Approved 11/13/2019

Report Number CA14209-NOV19 R1

Date Reported 11/13/2019

### COMMENTS

Temperature of Sample upon Receipt: 18 degrees C

Cooling Agent Present:Yes

Custody Seal Present:No

Chain of Custody Number:009973

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

Brad Moore Hon. B.Sc

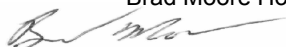




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Legend..... 8

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# FINAL REPORT

CA14209-NOV19 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
Sample Name	RW02-04 SS#3	RW16-01 SS#2	RW01-02 SS#4
Sample Matrix	Soil	Soil	Soil
Sample Date	23/09/2019	20/08/2019	24/09/2019

Parameter	Units	RL		Result	Result	Result
<b>Corrosivity Index</b>						
Corrosivity Index	none	1		5	4	9
Soil Redox Potential	mV	-		218	309	309
Sulphide	%	0.02		< 0.02	< 0.02	< 0.02
pH	pH Units	0.05		8.97	8.95	8.79
Resistivity (calculated)	ohms.cm	-9999		2810	8550	1840

## PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7
Sample Name	RW02-04 SS#3	RW16-01 SS#2	RW01-02 SS#4
Sample Matrix	Soil	Soil	Soil
Sample Date	23/09/2019	20/08/2019	24/09/2019

Parameter	Units	RL		Result	Result	Result
<b>General Chemistry</b>						
Conductivity	uS/cm	2		356	117	543

## PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7
Sample Name	RW02-04 SS#3	RW16-01 SS#2	RW01-02 SS#4
Sample Matrix	Soil	Soil	Soil
Sample Date	23/09/2019	20/08/2019	24/09/2019

Parameter	Units	RL		Result	Result	Result
<b>Metals and Inorganics</b>						
Moisture Content	%	0.1		17.5	13.8	17.2
Sulphate	µg/g	0.4		5.8	12	13



FINAL REPORT

CA14209-NOV19 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
Sample Name	RW02-04 SS#3	RW16-01 SS#2	RW01-02 SS#4
Sample Matrix	Soil	Soil	Soil
Sample Date	23/09/2019	20/08/2019	24/09/2019

Parameter	Units	RL		Result	Result	Result
Other (ORP)						
Chloride	µg/g	0.4		100	140	190

## 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	DIO0141-NOV19	µg/g	0.4	<0.4	6	20	100	80	120	114	75	125
Sulphate	DIO0141-NOV19	µg/g	0.4	<0.4	2	20	97	80	120	91	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	ECS0018-NOV19	%	0.02	<0.02	5	20	112	80	120			



# FINAL REPORT

CA14209-NOV19 R1

## QC SUMMARY

### Conductivity

Method: SM 2510 | Internal ref.: ME-CA-1ENVIEWL-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	EWL0137-NOV19	uS/cm	2	< 2	3	10	101	90	110	NA		
Conductivity	EWL0179-NOV19	uS/cm	2	< 0.002	0	10	99	90	110	NA		

### 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	EWL0137-NOV19	pH Units	0.05	NA	0		100			NA		
pH	EWL0179-NOV19	pH Units	0.05	NA	0		100			NA		

## QC SUMMARY

---

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

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

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

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

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

**RL:** Reporting limit

**RPD:** Relative percent difference

**AC:** Acceptance criteria

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

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

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

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

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

**ND** Non Detect

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

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

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

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-- End of Analytical Report --

## Request for Laboratory Services and CHAIN OF CUSTODY

## Laboratory Information Section - Lab use only

Received By: Amr Al-Madani  
 Received Date (mm/dd/yyyy): 11/03/19 (mm/dd/yyyy)  
 Received Time: 4:15

Received By (signature): [Signature]  
 Custody Seal Present: ☒ Yes ☒ No  
 Custody Seal Intact: ☒ Yes ☒ No

Cooling Agent Present: ☒ Yes ☒ No  
 Temperature Upon Receipt (°C): 18.18

LAB LIMS #: CA 14209-NDR19

## REPORT INFORMATION

Company: Thurber Engineering Ltd  
 Contact: Nancy Berg  
 Address: 103-2010 Winston Park Dr  
Oakville ON L6H 5Z7  
 Phone: 647-633-8417  
 Email: nberg@thurber.ca  
 Email:

## INVOICE INFORMATION

☐ (same as Report Information)  
 Company: \_\_\_\_\_  
 Contact: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Email: \_\_\_\_\_

Quotation #: \_\_\_\_\_  
 Project #: 11375  
 P.O. #: \_\_\_\_\_  
 Site Location/ID: Hwy 7 New, Kitchener

## TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7 days)  
 TAT's are quoted in business days (exclude statutory holidays & weekends).  
 Samples received after 6pm or on weekends: TAT begins next business day  
 RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days  
 PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION  
 Specify Due Date: \_\_\_\_\_  
 Rush Confirmation ID: \_\_\_\_\_

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE  
 SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

## ANALYSIS REQUESTED

Field Filtered (Y/N) \_\_\_\_\_  
 Metals & Inorganics \_\_\_\_\_  
 PAH ☐ ABN ☐ SVOC(all) ☐  
 PCB Total ☐ Aroclor ☐  
 PHC F1-F4 ☐ VOC ☐  
 BTEX ☐ BTEX/F1 ☐ F2-F4 ☐  
 VOC ☐ BTEX ☐ THM ☐  
 Pesticides OC ☐ OP ☐  
 TCLP M&I ☐ VOC ☐ PCB ☐  
 B(a)P ☐ ABN ☐ Ignit. ☐  
 Water Pkg Gen. ☐ Ext. ☐  
 Sewer Use: corrosivity

## COMMENTS:

## REGULATIONS

Regulation 153/04:  
☐ Table 1 ☐ R/P/I ☐ Soil Texture: ☐ Reg 347/558 (3 Day min TAT)  
☐ Table 2 ☐ I/C/C ☐ Coarse ☐ PWOO ☐ MMER  
☐ Table 3 ☐ A/O ☐ Medium ☐ CCME ☐ Other: \_\_\_\_\_  
☐ Table ☐ Fine ☐ MISA ☐ Municipality: \_\_\_\_\_

## Sewer By-Law:

☐ Sanitary  
☐ Storm  
☐ Other: \_\_\_\_\_

## RECORD OF SITE CONDITION (RSC)

☐ YES ☐ NO

## SAMPLE IDENTIFICATION

DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1 RW02-04 SS#3	Sept. 23/19	1	Soil
2 RW16-04 SS#2	Aug 28/19	1	Soil
3 RW01-02 SS#4	Sept 24/19	1	Soil
4			
5			
6			
7			
8			
9			
10			
11			
12			

## Observations/Comments/Special Instructions

Sampled By (NAME): Nancy Berg  
 Relinquished by (NAME): \_\_\_\_\_

Signature: [Signature]  
 Signature: \_\_\_\_\_

Date: 11/03/19 (mm/dd/yyyy)  
 Date: 11/03/19 (mm/dd/yyyy)

Pink Copy - Client  
 Yellow & White Copy - SGS



## FINAL REPORT

CA14437-AUG19 R1

11375 Hwy 7 New, Kitchener

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client Thurber Engineering Ltd.

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

Contact Nancy Berg

Telephone 905-829-8666 x 228

Facsimile

Email nberg@thurber.ca

Project 11375 Hwy 7 New, Kitchener

Order Number

Samples Soil (5)

### LABORATORY DETAILS

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

Laboratory SGS Canada Inc.

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

Telephone 705-652-2361

Facsimile 705-652-6365

Email rob.irwin@sgs.com

SGS Reference CA14437-AUG19

Received 08/13/2019

Approved 08/19/2019

Report Number CA14437-AUG19 R1

Date Reported 08/19/2019

### COMMENTS

Temperature of Sample upon Receipt: 4 degrees C

Cooling Agent Present: yes

Custody Seal Present: no

Chain of Custody Number: 009972

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

### SIGNATORIES

Rob Irwin B.Sc., C.Chem





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# FINAL REPORT

CA14437-AUG19 R1

**Client:** Thurber Engineering Ltd.

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

**Project Manager:** Nancy Berg

**Samplers:** Nancy Berg

## PACKAGE: - Corrosivity Index (SOIL)

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

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

### Corrosivity Index

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

## PACKAGE: - General Chemistry (SOIL)

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

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

### General Chemistry

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

## PACKAGE: - Metals and Inorganics (SOIL)

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

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

### Metals and Inorganics

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



FINAL REPORT

CA14437-AUG19 R1

Client: Thurber Engineering Ltd.

Project: 11375 Hwy 7 New, Kitchener

Project Manager: Nancy Berg

Samplers: Nancy Berg

PACKAGE: - Other (ORP) (SOIL)

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

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



FINAL REPORT

CA14437-AUG19 R1

QC SUMMARY

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

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

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

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

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

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



QC SUMMARY

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

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

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

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

**ND** Non Detect

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

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

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

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-- End of Analytical Report --

REPORT INFORMATION				INVOICE INFORMATION				PROJECT INFORMATION			
Received By: <u>Oleg Moshin</u>				Received By (signature): <u>[Signature]</u>				Quotation #: _____			
Received Date (mm/dd/yy): <u>8/15/19</u> (mm/dd/yy)				Custody Seal Present: <input checked="" type="checkbox"/> <u>ice</u>				Project #: <u>11375</u>			
Received Time: <u>11:05</u>				Custody Seal Intact: <input checked="" type="checkbox"/> <u>no</u>				Site Location/ID: <u>How 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				ANALYSIS REQUESTED			
Regulation 153/04:				Other Regulations:				Sewer By-Law:			
<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"/> Sanitary <input type="checkbox"/> Storm <input type="checkbox"/> Municipality:			
RECORD OF SITE CONDITION (RSC) <input type="checkbox"/> YES <input type="checkbox"/> NO				DATE SAMPLED				TIME SAMPLED			
SAMPLE IDENTIFICATION				# OF BOTTLES				MATRIX			
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>08/15/19</u> (mm/dd/yy)			
Sampled By (NAME): <u>Nancy Berg</u>				Signature: <u>Nancy Berg</u>				Date: <u>08/15/19</u> (mm/dd/yy)			
Relinquished by (NAME): <u>Nancy Berg</u>				Signature: <u>Nancy Berg</u>				Date: <u>08/15/19</u> (mm/dd/yy)			
Pink Copy - Client				Yellow & White Copy - SGS							



## FINAL REPORT

CA14882-AUG20 R1

1375 Frederick St.

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 Geoff Lay

Telephone 905-829-8666

Facsimile

Email glay@thurber.ca

Project 1375 Frederick St.

Order Number

Samples Soil (2)

### LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

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

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA14882-AUG20

Received 08/28/2020

Approved 09/03/2020

Report Number CA14882-AUG20 R1

Date Reported 09/03/2020

### COMMENTS

Temperature of Sample upon Receipt:7 degrees C

Cooling Agent Present:YES

Custody Seal Present:YES

Chain of Custody Number:NA

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

Jill Campbell, B.Sc.,GISAS







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# FINAL REPORT

CA14882-AUG20 R1

**Client:** Thurber Engineering Ltd.

**Project:** 1375 Frederick St.

**Project Manager:** Geoff Lay

**Samplers:** Brett Thomas

## PACKAGE: - Corrosivity Index (SOIL)

<b>Sample Number</b>	5	6
<b>Sample Name</b>	BH20-01 SS#4	BH20-02 SS#3
<b>Sample Matrix</b>	Soil	Soil
<b>Sample Date</b>	17/08/2020	20/08/2020

Parameter	Units	RL		Result	Result
<b>Corrosivity Index</b>					
Corrosivity Index	none	1		8	13
Soil Redox Potential	mV	-		287	285
Sulphide	%	0.04		< 0.04	< 0.04
pH	pH Units	0.05		9.66	9.37
Resistivity (calculated)	ohms.cm	-9999		1830	892

## PACKAGE: - General Chemistry (SOIL)

<b>Sample Number</b>	5	6
<b>Sample Name</b>	BH20-01 SS#4	BH20-02 SS#3
<b>Sample Matrix</b>	Soil	Soil
<b>Sample Date</b>	17/08/2020	20/08/2020

Parameter	Units	RL		Result	Result
<b>General Chemistry</b>					
Conductivity	uS/cm	2		547	1120

## PACKAGE: - Metals and Inorganics (SOIL)

<b>Sample Number</b>	5	6
<b>Sample Name</b>	BH20-01 SS#4	BH20-02 SS#3
<b>Sample Matrix</b>	Soil	Soil
<b>Sample Date</b>	17/08/2020	20/08/2020

Parameter	Units	RL		Result	Result
<b>Metals and Inorganics</b>					
Moisture Content	%	0.1		3.8	4.4
Sulphate	µg/g	0.4		8.3	21



FINAL REPORT

CA14882-AUG20 R1

**Client:** Thurber Engineering Ltd.  
**Project:** 1375 Frederick St.  
**Project Manager:** Geoff Lay  
**Samplers:** Brett Thomas

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6
Sample Name	BH20-01 SS#4	BH20-02 SS#3
Sample Matrix	Soil	Soil
Sample Date	17/08/2020	20/08/2020

Parameter	Units	RL		Result	Result
Other (ORP)					
Chloride	µg/g	0.4		210	750



FINAL REPORT

CA14882-AUG20 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	DIO0461-AUG20	µg/g	0.4	<0.4	2	20	96	80	120	103	75	125
Sulphate	DIO0461-AUG20	µg/g	0.4	<0.4	8	20	98	80	120	95	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	ECS0001-SEP20	%	0.04	< 0.04	ND	20	100	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	EWL0414-AUG20	uS/cm	2	< 0.002	1	20	99	90	110	NA		



QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-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	EWL0414-AUG20	pH Units	0.05	NA	1		100			NA		

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

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

**ND** Non Detect

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

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

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

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-- End of Analytical Report --

