



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
PROPOSED RETAINING WALLS  
HIGHWAY 7-NEW, KITCHENER TO GUELPH  
G.W.P. 408-88-00**

**Geocres Number: 40P9-58**

**Report**

**To**

**WSP**

Date: May 6, 2020  
File: 11375



## **TABLE OF CONTENTS**

### **PART 1: FACTUAL INFORMATION**

#### **Appendices**

Appendix A	Retaining Wall RW01 – (Boreholes RW01-01 to RW01-07)
Appendix B	Retaining Wall RW02 – (Boreholes RW02-02 to RW02-04, RW-01 to RW-04)
Appendix C	Retaining Wall RW10 – (Boreholes RW09-02, RW10-02 to RW10-06)
Appendix D	Retaining Wall RW12 – (Boreholes RW12-01 to RW12-06)
Appendix E	Retaining Wall RW16 – (Boreholes RW16-01 to RW16-03)
Appendix F	Retaining Wall RW24 – (Boreholes RW24-01 to RW24-03)
Appendix G	Retaining Wall RW28 – (Boreholes RW28-01 to RW28-03)

Appendices A to G include:

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



**FOUNDATION INVESTIGATION REPORT  
PROPOSED RETAINING WALLS  
HIGHWAY 7-NEW, KITCHENER TO GUELPH  
G.W.P. 408-88-00**

**Geocres Number: 40P9-58**

**PART 1: FACTUAL INFORMATION**

**1.0 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at seven (7) proposed standalone retaining wall sites along the proposed Highway 7-New mainline alignment and the existing Kitchener-Guelph Expressway (KWE - Highway 85) corridor in the City of Kitchener, 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.

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).

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

**2.0 SITE DESCRIPTION**

The retaining wall sites addressed in this report are located within the existing Highway 7/Highway 85 interchange from north of Guelph Street to South of Frederick Street. A total of



seven (7) retaining walls were identified within this section of the proposed Highway 7-New mainline.

The area is surrounded by industrial and commercial lands and is generally flat.

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

Retaining Wall No.	Location	Approx. Chainage (From)	Approx. Chainage (To)	Approx. Length (m)	Maximum Height (m)
RW01	Frederick St - S/E - Becker Street Retaining Wall	20+910	21+250	340.0	6.0
RW02	Frederick St - N/E - Ann Street Retaining Wall	21+270	21+455	185.00	7.2
RW10	E-S Ramp Hwy 85 Overpass - N/E	19+830	20+075	245.0	4.5
RW12	S-E Ramp-Wellington St Overpass - S/E	19+867	20+150	283.0	7.6
RW16	Highway 85 SB/E-S Ramp - North of Frederick Street	18+800	18+880	80.0	5.5
RW24	E-N Ramp over Guelph Street - North Abutment	19+412	19+500	88.0	3.5
RW28	Dumfries Avenue	21+030	21+120	90.0	2.8

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

A detailed site investigation was carried out for the seven proposed retaining walls. Thirty one boreholes were drilled by Thurber Engineering between October 20, 2016 and September 24, 2019. Four boreholes were 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 3.1. 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 G.

**Table 3.1 – Borehole Designations**

Retaining Wall	Approx. Chainage (From)	Approx. Chainage (To)	Borehole	Borehole Termination Depth (m)	Borehole Termination Elevation (m)	Appendix
RW01	20+910	21+250	RW01-01 to RW01-07	11.1 m to 14.3 m	313.8 to 305.7	A
RW02	21+270	21+455	RW02-02 to RW02-04, (RW1 to RW4) <sup>1</sup>	9.8 m to 17.4 m	309.9 to 301.7	B
RW10	19+830	20+075	RW09-02, RW10-02 to RW10-06	9.6 m to 13.5 m	313.2 to 305.1	C
RW12	19+867	20+150	RW12-01 to RW12-06	15.6 m to 20.1 m	322.8 m to 325.3 m	D
RW16	18+800	18+880	RW16-01 to RW16-03	11.3 m to 12.5 m	310.0 to 307.4	E
RW24	19+412	19+500	RW24-01 to RW24-03	11.3 m to 12.8 m	307.4 to 305.3	F
RW28	21+030	21+120	RW28-01 to RW28-03	9.8 m to 11.3 m	325.3 to 323.6	G

<sup>1</sup> Boreholes RW1 to RW4 were drilled in a previous investigation conducted by Peto MacCallium, as detailed in Reference 1.

Three to seven boreholes were drilled at each retaining wall site. The boreholes were drilled along the retaining wall alignments, with one borehole at each end and an approximate 50 m spacing in between boreholes.

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

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 with a combination of hollow stem augers and mud rotary drilling. Samples were obtained at



selected depth intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) 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 G.

Groundwater conditions in the open boreholes were observed during the drilling operations. Five piezometers were installed at boreholes RW01-04, RW10-03, RW12-03, RW12-04 and RW12-05 to permit for longer term monitoring of groundwater levels. The piezometers consisted of 25 mm diameter PVC pipe with a slotted screen enclosed in filter sand. The locations and completion details of the piezometers are summarized in Table 3.2 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).

**Table 3.2 – Borehole Completion Details**

Retaining Wall	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
RW01	RW01-01	14.3	-	Borehole backfilled with grout to 4.3 m, bentonite holeplug to 0.2 m, then asphalt to surface.
	RW01-02	11.1	-	Borehole backfilled with grout to 3.7 m, bentonite holeplug to 0.1 m, then asphalt to surface.
	RW01-03	14.1	-	Borehole backfilled with bentonite holeplug to surface.
	RW01-04	14.0	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	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW01-06	14.3	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW01-07	14.3	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
RW02	RW02-02	13.3	-	Borehole backfilled with bentonite holeplug



Retaining Wall	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
				and asphalt patch to surface.
	RW02-03	15.8	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW02-04	17.4	-	Borehole backfilled with bentonite holeplug to 0.6 m, sand to 0.2 m, then asphalt to surface.
RW10	RW09-02	9.6	-	Borehole backfilled with bentonite holeplug and grout to surface.
	RW10-02	9.4	-	Borehole backfilled with bentonite holeplug to 0.3 m and cuttings to surface.
	RW10-03	9.8	9.1/.319.3	Piezometer with 3.0 m slotted screen installed with sand filter from 9.1 m to 5.5 m, bentonite holeplug from 5.5 m to 0.3 m, then well gravel to ground surface.
	RW10-04	9.5	-	Borehole backfilled with bentonite holeplug to 0.15 m and cuttings to surface.
	RW10-05	8.1	-	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
	RW10-06	13.5	-	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
RW12	RW12-01	15.8	-	Borehole backfilled with bentonite holeplug to 0.3 m and auger cuttings to surface.
	RW12-02	15.8	-	Borehole backfilled with bentonite holeplug to surface.
	RW12-03	15.8	13.7/311.6	Piezometer with 3.0 m slotted screen installed with sand filter from 14.3 m to 10.1 m, then bentonite holeplug from 10.1 m to ground surface.
	RW12-04	15.8	4.5/320.6	Piezometer with 1.5 m slotted screen installed with sand filter from 4.8 m to 2.7 m, bentonite holeplug from 2.7 m to 0.9 m, then cuttings to ground surface.
	RW12-05	15.6	15.2/308.2	Piezometer with 3.0 m slotted screen installed with sand filter from 15.2 m to 11.6 m, bentonite holeplug from 11.6 m to 0.3 m, then well gravel to ground surface.
	RW12-06	20.1	-	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
RW16	RW16-01	11.3	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW16-02	11.3	-	Borehole backfilled with bentonite holeplug



Retaining Wall	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
				and asphalt patch to surface.
	RW16-03	12.5	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
RW24	RW24-01	12.8	-	Borehole backfilled with bentonite holeplug and auger cuttings, then asphalt to surface.
	RW24-02	12.8	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.
	RW24-03	11.3	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.
RW28	RW28-01	9.8	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.
	RW28-02	9.8	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.
	RW28-03	11.3	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt 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 G.

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 H.

#### 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 G and depicted on the “Borehole Locations and Soil Strata” drawings for each retaining wall alignments in these appendices. An overall description of the stratigraphy 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 Retaining Wall RW01 - Frederick St - S/E - Becker Street (Station 20+910 to 21+250 - 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 to clayey 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 5.3 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 brown to 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 5.1.1, along with the measurements in the open boreholes upon completion of drilling.

**Table 5.1.1 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
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
RW01-06	Aug 13, 2019	2.3	318.3	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 Retaining Wall RW02 - Frederick St - N/E - Ann Street (Station 21+270 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. Due to the difference in elevations and location, the encountered soil depths and elevations will be discussed separately to Boreholes RW02-02 to 02-04, RW-01 and RW-02.



### 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 RW-01 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, RW-01 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 0.6 m to 1.4 m, with the lower boundary of this layer encountered at depths of 0.8 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 320.2 and 321.1).

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 16 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 320.2 and 321.1).

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 317.6 and 317.9), 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:

<b>Soil Particles</b>	<b>Upper Sand (%)</b>
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, RW-01 and RW-02 at depths ranging from 1.4 m to 5.0 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 RW-01 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 1.5 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 5.6 and 13.7 m (Elevation 313.9 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 sand till 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).

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 16 percent to 19 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:

Soil Particles	Silt and Sand (%)
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 RW-01 and RW-03. The water levels measured in the open boreholes upon completion of drilling are summarized in Table 5.2.1.

**Table 5.2.1 – 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
RW-01	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	
RW-04	July 20, 2011	N/A	N/A	Water level in open borehole N/A. Cave-in observed at 5 m.

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 Retaining Wall RW10 - E-S Ramp Hwy 85 Overpass - N/E (Station 19+830 to 20+075 – Appendix C)

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

#### 5.3.1 Topsoil

A layer of topsoil was encountered surficially in three boreholes drilled at this site, RW10-04, RW10-05 and RW10-06. It was generally dark brown in colour.

The thickness of the topsoil layer ranged from 0.2 m to 0.5 m. The topsoil thickness may vary between the borehole locations and in other areas of the site.

Moisture content of samples of the topsoil generally ranged from 25 percent to 50 percent.

### 5.3.2 Granular Fill

Granular fill consisting of sand to sand and gravel was encountered surficially at three boreholes at this site, Boreholes RW10-02 and RW10-03. Granular fill was encountered immediately below the topsoil at Borehole RW10-04.

The granular fill consisted of sand generally brown in colour, with trace silt to silty, trace to some clay and trace to no gravel, or consisted of sand and gravel.

The thickness of the granular fill ranged from 2.7 m to 3.2 m, with the lower boundary of this layer encountered at depths of 3.0 m to 3.7 m (Elevation 325.3 to 323.9).

SPT N-values recorded in the granular fill ranged from 2 to 20 blows for 0.3 m penetration, indicating a loose to compact relative density.

Moisture content of samples of the granular fill generally ranged from 6 percent to 14 percent.

Three samples of the granular fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C1 of Appendix C. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	0 to 13
Sand	64 to 87
Silt	10 to 25
Clay	3 to 11

### 5.3.3 Upper Sand

An upper native sand layer was encountered at ground surface in RW09-02, below the granular fill in RW10-02, RW10-03 and RW-04 and immediately below the topsoil in Borehole RW10-05.

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



The thickness of the upper sand layer ranged from 1.7 m to 3.4 m with the lower boundary of the sand layer encountered at depths ranging from 2.2 to 7.1 (Elevation 322.5 to 320.4).

SPT N-values recorded in the upper sand layer ranged from 6 to 32 blows for 0.3 m penetration, indicating a loose to compact relative density.

Moisture content of samples of the upper sand layer generally ranged from 1 percent to 14 percent.

Three samples of the sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C2 of Appendix C. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	0 to 4
Sand	79 to 89
Silt and Clay	7 to 19

#### **5.3.4 Silty Clay**

Silty clay was encountered below the granular fill in Boreholes RW09-02, RW10-02 and RW10-04, at depths ranging from 2.4 m to 7.1 m (Elevation 322.1 to 320.4).

Silty clay was also encountered below the upper native sand layer at 7.0 m depth (Elevation 321.4) in Borehole RW10-03, and 2.2 m depth (Elevation 322.5) in Borehole RW10-05, and immediately below the topsoil in Borehole RW10-06.

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

Boreholes RW10-02, RW10-03 and RW10-04 were terminated within the silty clay at a depth of 9.4 m, 9.8 m and 9.5 m, respectively (Elevation 319.6, 318.6 and 317.3).

The thickness of the silty clay layer was 2.3 m, 3.4 m and 2.9 m for Boreholes RW09-02, RW10-05 and RW10-06, respectively, with the lower boundary of the silty clay encountered at depths of 9.4 m, 5.6 m and 3.4 m (Elevation 318.7, 319.1 and 315.2).

SPT N-values recorded in the silty clay ranged from 12 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a stiff to hard consistency.

The natural moisture content of samples of the silty clay ranged from 6 percent to 23 percent.

Six samples of the silty clay underwent laboratory gradation analysis and five 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 C and the grain size distribution curves for these samples are plotted on Figure C3 of Appendix C. The results of the Atterberg Limits tests are plotted on Figure C6.

Soil Particles	Silty Clay (%)
Gravel	0
Sand	0 to 38
Silt	39 to 49
Clay	19 to 53

Index Property	
Liquid Limit	29 to 37
Plastic Limit	14 to 16
Plasticity Index	15 to 21

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

### 5.3.5 Sand and Silt

Sand and silt was encountered below the silty clay at the depth of 4.1 m (Elevation 318.7) in Borehole RW09-02 and 5.6 m (Elevation 319.1) in Borehole RW10-05.

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

Borehole RW09-02 was terminated in the sand and silt at the depth of 9.6 m (Elevation 313.2) and Borehole RW10-05 was terminated in the sand and silt at the depth of 8.1 m (Elevation 316.6).

SPT N-values recorded in the sand and silt ranged from 41 to 109 blows for 0.3 m penetration, indicating a dense to very dense relative density.

Moisture content of samples of the sand and silt generally ranged from 2 percent to 19 percent.

Two samples of the sand and silt underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C4 of Appendix C. The results of this testing are summarized as follows:

Soil Particles	Sand and Silt (%)
Gravel	0
Sand	49 to 52
Silt	38 to 41
Clay	10

### 5.3.6 Lower Sand to Silty Sand

A lower sand to silty sand layer was encountered below the silty clay in RW10-06 at the depth of 3.4 m (Elevation 315.2).

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

Borehole RW10-06 was terminated in the lower sand to silty sand layer at the depth of 13.5 m (Elevation 305.1).

SPT N-values recorded in the sand to silty sand ranged from 5 to 72 blows for 0.3 m penetration, indicating a loose to very dense relative density.

Moisture content of samples of the sand to silty sand generally ranged from 14 percent to 20 percent.

Two samples of the sand to silty sand underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C5 of Appendix B. The results of this testing are summarized as follows:

Soil Particles	Lower Sand to Sandy Silt (%)
Gravel	0
Sand	71 to 87
Silt	13 to 25
Clay	0 to 4



### 5.3.7 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 RW10-03, to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.3.1, along with the measurements in the open boreholes upon completion of drilling.

**Table 5.3.1 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW09-02	April 11, 2018	7.1	315.7	Open borehole
RW10-02	April 19, 2018	Dry	-	Open borehole
RW10-03	April 27, 2018	6.2	322.2	Piezometer
	May 16, 2018	6.1	322.3	
	May 31, 2018	6.0	322.4	
	June 25, 2018	5.7	322.6	
RW10-04	April 18, 2019	4.9	322.0	Open borehole
RW10-05	Oct 26, 2016	Dry	-	Open borehole
RW10-06	Oct 24, 2016	4.6	314.0	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 RW10-04 caved-in at 4.6 m and Borehole RW10-04 caved-in at 5.3 m.

### 5.4 Retaining Wall RW12 - S-E Ramp-Wellington St Overpass - S/E (Station 19+867 to 20+150 – Appendix D)

In general the soil stratigraphy at this site consisted of granular fill overlying a layer of upper native sand, an upper layer of silty clay or silty clay till, a lower sand or silt layer, and a lower layer of silty clay.



#### **5.4.1 Topsoil**

A layer of topsoil was encountered surficially at one borehole drilled at this site, RW12-03. It was generally dark brown in colour. The thickness of the topsoil layer 0.3 m. The topsoil thickness may vary between the borehole locations and in other areas of the site.

The moisture content of samples of the topsoil was 15 percent.

#### **5.4.2 Granular Fill**

Granular fill was encountered surficially at five boreholes at this site, Boreholes RW-12-01, RW12-02, RW12-04, RW12-05 and RW12-06. Granular fill was encountered immediately below the topsoil layer in Borehole RW12-03.

The granular fill was brown to grey in colour and consisted of sand, with trace silt to silty, trace to some gravel and trace clay, or sand and silt. Occasional organics were observed at Boreholes RW12-01 and RW12-04.

The thickness of the granular fill ranged from 0.7 m to 3.0 m, with the lower boundary of this layer encountered at depths of 0.7 m to 3.0 m (Elevation 320.5 to 323.7).

SPT N-values recorded in the granular fill ranged from 3 to 38 blows for 0.3 m penetration, indicating a very loose to dense relative density.

Moisture content of samples of the granular fill generally ranged from 3 percent to 26 percent.

Four samples of the granular fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix D and the grain size distribution curves for these samples are plotted on Figure D1 of Appendix D. The results of this testing are summarized as follows:

<b>Soil Particles</b>	<b>Granular Fill (%)</b>
Gravel	0 to 15
Sand	35 to 86
Silt	5 to 60
Clay	0 to 8

### 5.4.3 Upper Sand

An upper native sand layer was encountered immediately below the granular fill in five boreholes at this site, Boreholes RW12-01 to RW12-05, at depths ranging from 1.4 m to 3.0 m (Elevation 323.7 m to 321.3 m).

The upper native sand layer was brown to grey in colour and contained trace silt, trace clay and trace gravel.

The thickness of the upper sand ranged from 0.6 m to 1.9 m, with the lower boundary of the sand layer encountered at depths ranging from 2.0 m to 4.1 m (Elevation 323.1 to 320.5).

SPT N-values recorded in the upper sand ranged from 4 to 26 blows for 0.3 m penetration, indicating a loose to compact relative density.

Moisture content of samples of the upper sand generally ranged from 15 percent to 39 percent.

One sample of the upper sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix D and the grain size distribution curves for these samples are plotted on Figure D2 of Appendix D. The results of this testing are summarized as follows:

Soil Particles	Upper Sand (%)
Gravel	0
Sand	93
Silt	7
Clay	0

### 5.4.4 Silty Clay Till

A silty clay till layer was encounter below the upper native sand layer at a depth of 4.1 m in Boreholes RW12-01, RW12-02 and RW12-03 (Elevation 320.4, 321.0, 321.2).

The silty clay till was brown to grey and contained some to with sand, trace gravel and occasional cobbles.

The thickness of the silty clay till layer ranged from 1.5 m to 4.6 m in Boreholes RW12-01 to RW12-03, with the lower boundary of the silty clay till encountered at depths ranging from 5.6 m to 8.7 m (Elevation 315.9 to 319.6).



SPT N-values recorded in the silty clay till ranged from 19 to 34 blows for 0.3 m penetration, indicating a very stiff to hard consistency.

The natural moisture content of samples of the silty clay till ranged from 8 percent to 30 percent.

Two samples of the silty clay till underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix D and the grain size distribution curve for this sample is plotted on Figure D3 of Appendix D. The results of the Atterberg Limits tests are plotted on Figure D7.

Soil Particles	Silty Clay Till (%)
Gravel	3 to 7
Sand	19 to 24
Silt	39 to 50
Clay	23 to 35

Index Property	
Liquid Limit	24 to 27
Plastic Limit	14 to 15
Plasticity Index	10 to 12

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

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

#### **5.4.5 Upper Silty Clay**

An upper silty clay layer was encountered immediately below the granular fill in Borehole RW12-06 at a depth of 0.7 m (Elevation 320.5 m) and below the upper sand layer in Boreholes RW12-04 and RW12-05 at a depth of 2.0 m and 2.9 m, respectively (Elevation 323.1 and 320.5).

Silty clay was also encountered below the silty clay till layer at Borehole RW12-03 at a depth of 5.6 m (Elevation 319.6), and below the lower sand layer at Boreholes RW12-01 and RW12-02 at depths of 12.3 m and 12.2 m (Elevation 312.2 and 312.9), respectively.



The upper silty clay was brown to grey and contained trace to with sand.

Boreholes RW12-01 and RW12-02 were terminated in the silty clay layer at the depth of 15.8 m for both boreholes (Elevation 308.7 and 309.2).

In Boreholes RW12-03, RW12-04 and RW12-06, the thickness of the silty clay layer was 5.4 m, 5.2 m and 9.8 m, with the lower boundary of the silty clay encountered at a depth of 11.0 m, 7.2 m and 10.5 m (Elevation 314.3, 317.9 and 310.7), respectively.

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

The natural moisture content of samples of the upper silty clay ranged from 12 percent to 43 percent.

Eight samples of the upper 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 D and the grain size distribution curve for this sample is plotted on Figure D4 of Appendix D. The results of the Atterberg Limits tests are plotted on Figure D8.

Soil Particles	Upper Silty Clay (%)
Gravel	0 to 3
Sand	0 to 39
Silt	35 to 57
Clay	19 to 61

Index Property	
Liquid Limit	17 to 42
Plastic Limit	9 to 18
Plasticity Index	8 to 24

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

#### **5.4.6 Lower Sand to Sand and Silt**

A lower sand to sand and silt layer was encountered below the silty clay till at Boreholes RW12-01 and RW12-02 at a depth of 8.7 m and 7.2 m, respectively (Elevation 315.9

and 317.9). A lower sand to sand and silt layer was also encountered below the silty clay at Boreholes RW12-03 to RW12-06, at depths ranging from 7.2 m to 11.0 m (Elevation 315.1 to 310.7).

The lower sand to sand and silt layer was generally brown to grey in colour, and contained trace gravel and trace clay, with occasional cobbles.

The thickness of the lower sand to sand and silt layer ranged from 1.3 m to 4.8 m, with the lower boundary of the sand encountered at depths ranging from 10.0 m to 15.2 m (Elevation 315.1 to 308.6).

And additional sand layer was encountered in Borehole RW12-06 below the lower silty clay, at a depth of 17.8 m (Elevation 303.4). Borehole RW12-06 was terminated in this second sand layer at a depth of 20.1 m (Elevation 301.1).

SPT N-values recorded in the lower sand ranged from 11 to 130 blows for 0.3 m penetration, indicating a compact to very dense relative density.

Moisture content of samples of the lower sand generally ranged from 9 percent to 25 percent.

Six samples of the lower sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix D and the grain size distribution curves for these samples are plotted on Figure D5 of Appendix D. The results of this testing are summarized as follows:

Soil Particles	Lower Sand (%)
Gravel	0 to 7
Sand	40 to 94
Silt	6 to 53
Clay	0 to 9

#### **5.4.7 Lower Silty Clay**

A lower silty clay layer was encountered below the lower sand to sand and silt layer in Boreholes RW12-03 to RW12-06, at depths ranging from 11.7 m to 15.2 m (Elevation 313.3 to 308.6).

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



Boreholes RW12-03, RW12-04 and RW12-05 were terminated in the lower silty clay layer at a depth of 15.8, 15.8 m and 15.6 m (Elevation 309.4, 309.2 and 307.8), respectively.

In Borehole RW12-06, the thickness of the lower silty clay layer was 5.2 m, with the lower boundary of the silty clay encountered at a depth of 17.8 m (Elevation 303.4).

SPT N-values recorded in the lower silty clay ranged from 26 to 100 blows for 0.3 m penetration, indicating a very stiff to hard consistency.

The natural moisture content of samples of the lower silty clay ranged from 14 percent to 26 percent.

Four samples of the lower silty clay underwent laboratory gradation analysis and two 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 D and the grain size distribution curve for this sample is plotted on Figure D6 of Appendix D. The results of the Atterberg Limits tests are plotted on Figure D9.

Soil Particles	Lower Silty Clay (%)
Gravel	0
Sand	0 to 14
Silt	29 to 69
Clay	17 to 59

Index Property	
Liquid Limit	37 to 38
Plastic Limit	16 to 18
Plasticity Index	20

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

#### 5.4.8 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Three standpipe piezometers were installed at this site, in Boreholes RW12-03, RW12-



04 and RW12-05 to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.4.1, along with the measurements in the open boreholes upon completion of drilling.

**Table 5.4.1 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW12-01	N/A	N/A	N/A	Water level in open borehole not available. No cave-in observed.
RW12-02	N/A	N/A	N/A	Water level in open borehole not available. No cave-in observed.
RW12-03	May 16, 2018	8.3	316.9	Piezometer
	May 31, 2018	8.2	317.1	
	June 25, 2018	7.9	317.3	
RW12-04	April 19, 2018	13.4	311.7	Open borehole (Water reading N/A as piezometer was destroyed)
RW12-05	April 27, 2018	5.9	317.5	Piezometer
	May 16, 2018	6.0	317.5	
	May 31, 2018	5.9	317.5	
	June 25, 2018	5.6	317.8	
RW12-06	Oct 20, 2016	10.7	310.5	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.

## 5.5 Retaining Wall RW16 - Highway 85 SB/E-S Ramp (Station 18+800 to 18+880 – Appendix E)

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.





### **5.5.1 Asphalt**

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

### **5.5.2 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.

### **5.5.3 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 E and on Figure E1 of Appendix E. The result of the grain size distribution analysis is summarized below:

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

#### **5.5.4 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.

#### **5.5.5 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 E and the grain size distribution curves for these samples are plotted on Figure E2 of Appendix E. The results of the Atterberg Limits tests are plotted on Figure E4.

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.

#### **5.5.6 Silty Sand to 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 42 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 E and on E3 of Appendix E. The result of the grain size distribution analysis is summarized below:

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

#### 5.5.7 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 5.5.1.

**Table 5.5.1 – 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.



## **5.6 Retaining Wall RW24 - E-N Ramp over Guelph Street (Station 19+412 to 19+500 – Appendix F)**

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

### **5.6.1 Asphalt**

Asphalt with thicknesses ranging from 125 mm to 200 mm was encountered at all boreholes at this site, Boreholes RW24-01 to RW24-03.

### **5.6.2 Granular Fill**

Granular fill consisting of sand to sand and gravel fill was encountered immediately below the asphalt in all three boreholes at this site, Boreholes RW24-01 to RW24-03. A lower granular fill layer consisting of sand/silt fill was encountered below the sand and gravel fill.

The upper granular fill consisted of sand and gravel generally brown in colour, with some silt and clay. The lower granular fill consisted of sand or silt fill generally brown in colour, with trace to some clay and trace gravel.

The thickness of the granular fill ranged from 3.2 m to 3.9 m, with the lower boundary of this layer encountered at depths of 3.3 m to 4.1 m (Elevation 314.7 to 314.4).

SPT N-values recorded in the granular fill ranged from 11 to 49 blows for 0.3 m penetration, indicating a compact to dense relative density.

Moisture content of samples of the granular fill generally ranged from 3 percent to 11 percent.

Four samples of the granular fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix F and the grain size distribution curves for these samples are plotted on Figure F1 of Appendix F. The results of this testing are summarized as follows:

<b>Soil Particles</b>	<b>Granular Fill (%)</b>
Gravel	2 to 42
Sand	35 to 80
Silt	12 to 42
Clay	1 to 11

### 5.6.3 Cohesive Fill

A layer of cohesive fill was encountered below the granular fill in Boreholes RW24-01 and RW24-02, at depths of 3.3 m and 3.4 m (Elevation 314.4 and 314.7), respectively.

The cohesive fill consisted of silty clay generally brown to grey in colour and contained some sand to sandy and trace gravel.

The thickness of the cohesive fill ranged from 0.7 m to 2.3 m, with the lower boundary of the layer encountered at a depth of 4.1 m to 5.6 m (Elevation 312.0 and 314.0).

The SPT N-value recorded in the cohesive fill ranged from 16 to 27 blows for 0.3 m penetration, indicating a very stiff consistency.

The moisture content of the samples of cohesive fill ranged from 12 percent to 16 percent.

One sample of the cohesive fill 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 F and the grain size distribution curves for these samples are plotted on Figure F2 of Appendix F. The results of the Atterberg Limits tests are plotted on Figure F6.

Soil Particles	Cohesive Fill (%)
Gravel	3
Sand	26
Silt	51
Clay	20

Index Property	
Liquid Limit	20
Plastic Limit	11
Plasticity Index	9

The above results indicate that the cohesive fill is low plasticity with a group symbol of CL.

#### 5.6.4 Sand

A layer of native sand was encountered below the cohesive fill in Borehole RW24-02 and below the granular fill in Borehole RW24-03, at depths of 4.1 m for both boreholes (Elevation 314.0 and 314.5).

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

The thickness of the sand layer was 3.1 m for both boreholes, with the lower boundary of the sand encountered at a depth of 7.2 m for both boreholes (Elevation 310.9 and 311.5) for Boreholes RW24-02 and RW24-03, respectively).

SPT N-values within the sand varied from 23 to 57 blows for 0.3 m penetration, indicating compact to very dense relative density.

Measured moisture contents within the sand were 7 percent to 20 percent.

The result of grain size distribution analysis carried out on one sample of the sand is presented on the Record of Borehole Sheets included in Appendix F and on Figure F3 of Appendix F. The result of the grain size distribution analysis is summarized below:

Soil Particle	Sand (%)
Gravel	5
Sand	78
Silt	14
Clay	3

#### 5.6.5 Sand and Silt

A layer of sand and silt to sandy silt was encountered below the cohesive fill in Borehole RW24-01, and below the sand layer in Boreholes RW24-02 and RW24-03. The sand and silt to sandy silt was generally brown in colour and contained trace to some clay and trace to some gravel.

The sand and silt layer was encountered at depths of 5.6 m, 7.2 m and 7.2 m (Elevation 312.0, 310.9 and 311.5) in Boreholes RW24-01, RW24-02 and RW24-03, respectively.

Borehole RW24-03 was terminated within the sand and silt layer at a depth of 11.3 m (Elevation 307.4).



The thickness of the sand and silt layer was 1.6 m and 3.0 m thick, with the lower boundary of this layer encountered at depths of 7.2 m and 10.2 m (Elevation 310.5 and 307.9) for Boreholes RW24-01 and RW24-02, respectively.

SPT N-values recorded in the sand and silt layer ranged from 3 to 69 blows for 0.3 m penetration, indicating a loose to very dense relative density.

Moisture content of samples of the sand and silt layer generally ranged from 10 percent to 28 percent.

One sample of the sand and silt underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix F and the grain size distribution curves for these samples are plotted on Figure F4 of Appendix F. The results of this testing are summarized as follows:

Soil Particles	Sand and Silt (%)
Gravel	3
Sand	56
Silt	36
Clay	5

#### 5.6.6 Silty Clay

A layer of silty clay was encountered below the sand and silt layer in Boreholes RW24-01 and RW24-02 at the depth of 7.2 m and 10.2 m, respectively (Elevation 310.5 and 307.9).

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

Boreholes RW24-01 and RW24-02 were terminated within the silty clay layer at a depth of 12.8 m for both boreholes (Elevation 304.9 and 305.3, respectively).

SPT N-values recorded in the silty clay ranged from 11 to 32 blows for 0.3 m penetration, indicating a stiff to hard consistency.

Moisture content of samples of the silty clay generally ranged from 15 percent to 27 percent.

Two 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 F and the grain size





distribution curves for these samples are plotted on Figure F5 of Appendix F. The results of the Atterberg Limits tests are plotted on F7.

Soil Particles	Silty Clay (%)
Gravel	0 to 1
Sand	1 to 31
Silt	43 to 46
Clay	22 to 56

Index Property	
Liquid Limit	22 to 37
Plastic Limit	12 to 17
Plasticity Index	10 to 20

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

### 5.6.7 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 5.6.1.

**Table 5.6.1 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW24-01	Sept 6, 2019	10.1	307.6	Open borehole
RW24-02	Sept 6, 2019	10.1	308.0	Open borehole
RW24-03	Sept 6, 2019	10.2	308.4	Open borehole

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.



Upon completion of drilling, Boreholes RW24-01 caved-in at 9.4 m, RW24-02 caved-in at 7.0 m and RW24-03 caved-in at 7.5 m.

## **5.7 Retaining Wall RW28 - Dumfries Ave (Station 21+030 to 21+120 – Appendix G)**

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

### **5.7.1 Asphalt**

Asphalt with thicknesses ranging from 100 mm to 125 mm was encountered at all boreholes at this site, Boreholes RW28-01 to RW28-03.

### **5.7.2 Granular Fill**

Granular fill consisting of sand and gravel was encountered immediately below the asphalt at all three boreholes at this site, Boreholes RW28-01 to RW28-03.

The granular fill consisted of sand and gravel, generally brown in colour, with some silt and clay.

The thickness of the granular fill was 0.6 m, with the lower boundary of the layer encountered at depths of 0.7 m (Elevation 324.6 to 322.9) for all boreholes.

Moisture content of samples of the granular fill generally ranged from 2 percent to 4 percent.

One sample of the granular fill underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix G and the grain size distribution curves for these samples are plotted on Figure G1 of Appendix G. The results of this testing are summarized as follows:

<b>Soil Particles</b>	<b>Granular Fill (%)</b>
Gravel	44
Sand	44
Silt and Clay	12

### **5.7.3 Sand**

Native sand was encountered below the granular fill layer at a depth of 0.7 m in all three boreholes at this site, Boreholes RW28-01 to RW28-03 (Elevation 324.6, to 322.9).

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

The thickness of the sand layer ranged from 2.6 m to 3.5 m with the lower boundary of the sand encountered at a depth ranging from 3.3 m to 4.2 m (Elevation 321.1 to 320.4)

SPT N-values within the sand varied from 7 to 34 blows for 0.3 m penetration, indicating loose to dense relative density.

Measured moisture contents within the sand were 3% to 25%.

The result of grain size distribution analysis carried out on two samples of the sand is presented on the Record of Borehole Sheets included in Appendix G and on Figure G2 of Appendix G. The result of the grain size distribution analysis is summarized below:

Soil Particle	Sand (%)
Gravel	0 to 2
Sand	87 to 92
Silt	7 to 9
Clay	1 to 2

#### **5.7.4 Silty Clay to Clayey Silt**

A layer of silty clay to clayey silt was encountered below the native sand layer in all boreholes at this site, at depths ranging from 3.3 to 4.2 m (Elevation 321.1 to 320.4).

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

The thickness of the silty clay to clayey silt ranged from 3.6 m to 5.3 m, with the lower boundary of the layer encountered at depths ranging from 7.2 m to 8.6 m (Elevation 319.5 to 315.8)

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

Moisture content of samples of the silty clay to clayey silt generally ranged from 11 percent to 22 percent.

Two samples. of the silty clay to 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 G and the grain size



distribution curves for these samples are plotted on Figure G3 of Appendix G. The results of the Atterberg Limits tests are plotted on Figure G5.

Soil Particles	Silty Clay to Clayey Silt (%)
Gravel	0 to 5
Sand	18 to 46
Silt	32 to 60
Clay	17 to 22

Index Property	
Liquid Limit	17 to 19
Plastic Limit	10 to 12
Plasticity Index	5 to 8

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

It should be noted that high sand contents observed in the silty clay to clayey silt layer indicate the possibility of sand lenses or pockets within the silty clay to clayey silt.

#### 5.7.5 Sand and Silt

A layer of sand and silt was encountered below the silty clay in all boreholes at this site, at depths ranging from 7.2 m to 8.6 m (Elevation 317.4 to 315.8).

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

All three boreholes were terminated in the sand and silt layer at depths of 9.8 m, 9.8 m and 11.3 m (Elevation 315.5, 314.6 and 316.5) for Boreholes RW28-01, RW28-02 and RW28-03, respectively.

SPT N-values recorded in the sand and silt ranged from 18 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a compact to very dense relative density.

Moisture content of samples of the sand and silt generally ranged from 12 percent to 18 percent.

Three samples of the sand and silt underwent laboratory gradation analysis, and one sample of the silty sand underwent Atterberg limits testing. The results are summarized

on the Record of Borehole sheets included in Appendix G and the grain size distribution curves for these samples are plotted on Figure G4 of Appendix G. The results of this testing are summarized as follows:

Soil Particles	Sand and Silt (%)
Gravel	0 to 5
Sand	37 to 62
Silt	32 to 59
Clay	1 to 17

#### 5.7.6 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 5.7.1.

**Table 5.7.1 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW28-01	Aug 11, 2019	2.7	322.5	Open borehole
RW28-02	Aug 11, 2019	2.4	322.0	Open borehole
RW28-03	Sept 6, 2019	2.4	321.2	Open borehole

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

Upon completion of drilling, Boreholes RW28-01 caved-in at 4.9 m, RW28-02 caved-in at 7.9 m and RW28-03 caved-in at 2.4 m.

## 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), sand fill from Boreholes RW02-04, SS3 (depth of 1.5 m), RW09-02, SS3 (depth of 1.5 m), RW10-04, SS4 (depth of 2.3 m), sandy silt from Borehole RW12-05, SS3 (depth of 1.5 m) and silty sand from Borehole RW24-02, SS4 (depth of



3.0 m) 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 H.

**Table 6.1 – Analytical Test Results**

Parameter	Units (Soil)	Test Results						
		RW01-02 SS4 2.3 m	RW02-04 SS3 1.5 m	RW09-02 SS3 1.5 m	RW10-04 SS4 2.3 m	RW12-05 SS3 1.5 m	RW16-01 SS2 0.8 m	RW24-02 SS4 3.0 m
		(Soil Sample)						
Corrosivity Index	none	9	5	4	3	4	4	11
Soil Redox Potential	mV	309	218	274	182	230	309	263
Sulphide	%	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Moisture Content	%	17.2	17.5	11.3	4.4	9.3	13.8	13.1
pH	pH Units	8.79	8.97	9.04	9.11	8.67	8.95	8.18
Chloride	µg/g	190	100	53	3.2	70	140	760
Sulphate	µg/g	13	5.8	13	1.1	15	12	31
Conductivity	uS/cm	543	356	150	59	217	117	1280
Resistivity (calculated)	ohms.cm	1840	2810	6670	17100	4610	8550	780

## 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. Interpretation of the data and preparation of the report was carried out by Ms. Judy Mei, EIT, and Dr. Nancy Berg, P.Eng.



Thurber Engineering Ltd.

Judy Mei, EIT  
Geotechnical EIT



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**

#### **Retaining Wall 1 (RW01-01 to RW01-07)**



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

### 1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

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

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

NOTE: Hierarchy of Soil Strength Prediction

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

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

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

### 5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level


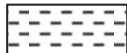



$C_{pen}$  Shear Strength Determination by Pocket Penetrometer

- (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		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				


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.				
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

# RECORD OF BOREHOLE No 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						<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>				<div><div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div><div>W<sub>P</sub>      W      W<sub>L</sub></div><div>WATER CONTENT (%)</div><div>204060</div></div>				GR   SA   SI   CL
0.0	ASPHALT: (100mm)														
0.1	SAND, some to trace gravel Compact Brown Moist (FILL)		1	GS											
			2	SS	12										
	clayey silt layer at 1.4m (500mm)														
324.1			3	SS	22										
1.9	SAND, 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 CLAY, trace sand Very Stiff Grey Moist														
			7	SS	21										
			8	SS	17										
316.9															
9.1	Silty SAND, 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									
								20 40 60 80 100									
Continued From Previous Page							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>					<div><div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div><div>W<sub>P</sub> W W<sub>L</sub></div><div>WATER CONTENT (%)</div><div>204060</div></div>					
10.0	Silty <b>SAND</b> , trace gravel Dense to Very Dense Grey Moist						315										
	silt layer at 12.0m (600mm)						314										
313.4			11	SS	70												
12.6	Silty <b>SAND</b> , trace clay Very Dense Grey Wet						313										
			12	SS	74		312										
311.7																	
14.3	END OF BOREHOLE AT 14.3m. WATER LEVEL AT 2.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH GROUT TO 4.3m, BENTONITE HOLEPLUG TO 0.2m, THEN ASPHALT TO SURFACE.																

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

# RECORD OF BOREHOLE No RW01-02

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>DYNAMIC CONE PENETRATION RESISTANCE PLOT</div> <div>20 40 60 80 100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>20 40 60 80 100</div>				<div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div> <div>W<sub>P</sub> W W<sub>L</sub></div> <div>WATER CONTENT (%)</div> <div>20 40 60</div>				GR SA SI CL
0.0	ASPHALT: (100mm)														
0.1	SAND, some to trace gravel Loose Brown Moist (FILL)		1	GS			○								
	Clayey silt layer at 1.1m (400mm)		2	SS	6		○								
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 5 (%) 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													
								20 40 60 80 100													
Continued From Previous Page												○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) 20 40 60				
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																					
3.2	<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																					
7.2	Silty <b>CLAY</b> , trace to some sand, trace gravel Very Stiff to Hard Grey Moist		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  
(%) 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 (%)				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				W <sub>P</sub> W      W <sub>L</sub>				
	Continued From Previous Page							20	40	60	80	100	20	40	60	
10.0	<b>SILT</b> , some sand to sandy, some clay Dense to Very Dense Grey Moist						317							○		
			9	SS	47											
							316									
			10	SS	100/ 0.250									Φ		0   19   62   19
							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.															

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

# 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								○							
							320															
			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 SILT, 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
321.4	GROUND SURFACE							20 40 60 80 100					
0.0	<b>ASPHALT:</b> (100mm)												
0.1	<b>SAND</b> and <b>GRAVEL</b> Brown Dry (FILL)		1	GS			321						
320.7													
0.7	Silty <b>SAND</b> , trace gravel Compact Brown Moist		2	SS	16		320						
			3	SS	16								
319.2							319						
2.2	Silty <b>CLAY</b> , trace sand Stiff to Hard Grey Moist		4	SS	11								
			5	SS	23		318						0 3 39 58
							317						
			6	SS	36								
							316						
315.1							315						
6.3	Silty <b>SAND</b> to Sandy <b>SILT</b> , trace clay Dense to Very Dense Grey Moist		7	SS	42								
							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									
								○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									
								20	40	60	80	100	PLASTIC LIMIT    NATURAL MOISTURE CONTENT    LIQUID LIMIT W <sub>P</sub> W                      W <sub>L</sub> WATER CONTENT (%)				
Continued From Previous Page																	
10.0	Silty <b>SAND</b> , trace clay Dense Grey Moist	.....					311										
			10	SS	45												
							310										
309.7																	
11.7	Silty <b>CLAY</b> , trace sand Hard Grey Moist		11	SS	32		309										
			12	SS	42		308										
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.																


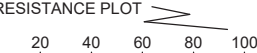
























+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# 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				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							
320.5	GROUND SURFACE														GR SA SI CL
0.0 0.1	<b>ASPHALT:</b> (75mm)		1	GS			○ UNCONFINED    + FIELD VANE				wP                      w                      wL				
319.9	<b>SAND</b> and <b>GRAVEL</b> , trace silt, trace clay Brown Dry (FILL)						● QUICK TRIAXIAL    × LAB VANE				WATER CONTENT (%)				
0.7	<b>SAND</b> , some silt, trace clay, trace gravel Loose to Dense Brown Moist to Wet		2	SS	15										
															
			3	SS	5										
															
			4	SS	34										
317.7															
2.8	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist		5	SS	34										
															
															
			6	SS	30										
															
															
			7	SS	29										
															
															
313.4	Sandy <b>SILT</b> to <b>SILT</b> and <b>SAND</b> , trace to some clay, trace gravel Compact to Dense Grey Moist to Wet		8	SS	30										
7.2															
															
			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  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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
								20 40 60 80 100 PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub> WATER CONTENT (%)							
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.														

# 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  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							
320.0	GROUND SURFACE						20	40	60	80	100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
0.0 0.1	ASPHALT: (75mm)		1	GS											32   46   22 (SI+CL)
319.4 0.7	SAND and GRAVEL, some silt, trace clay Brown Dry (FILL)		2	SS	32										
318.8 1.3	Silty SAND, trace gravel Dense Brown Moist		3	SS	32										
	Silty CLAY, trace to some sand, trace gravel Very Stiff to Hard Grey Moist		4	SS	32										
			5	SS	35										
			6	SS	34										2   7   50   41
			7	SS	28										
			8	SS	24										
			9	SS	23										

Continued Next Page

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

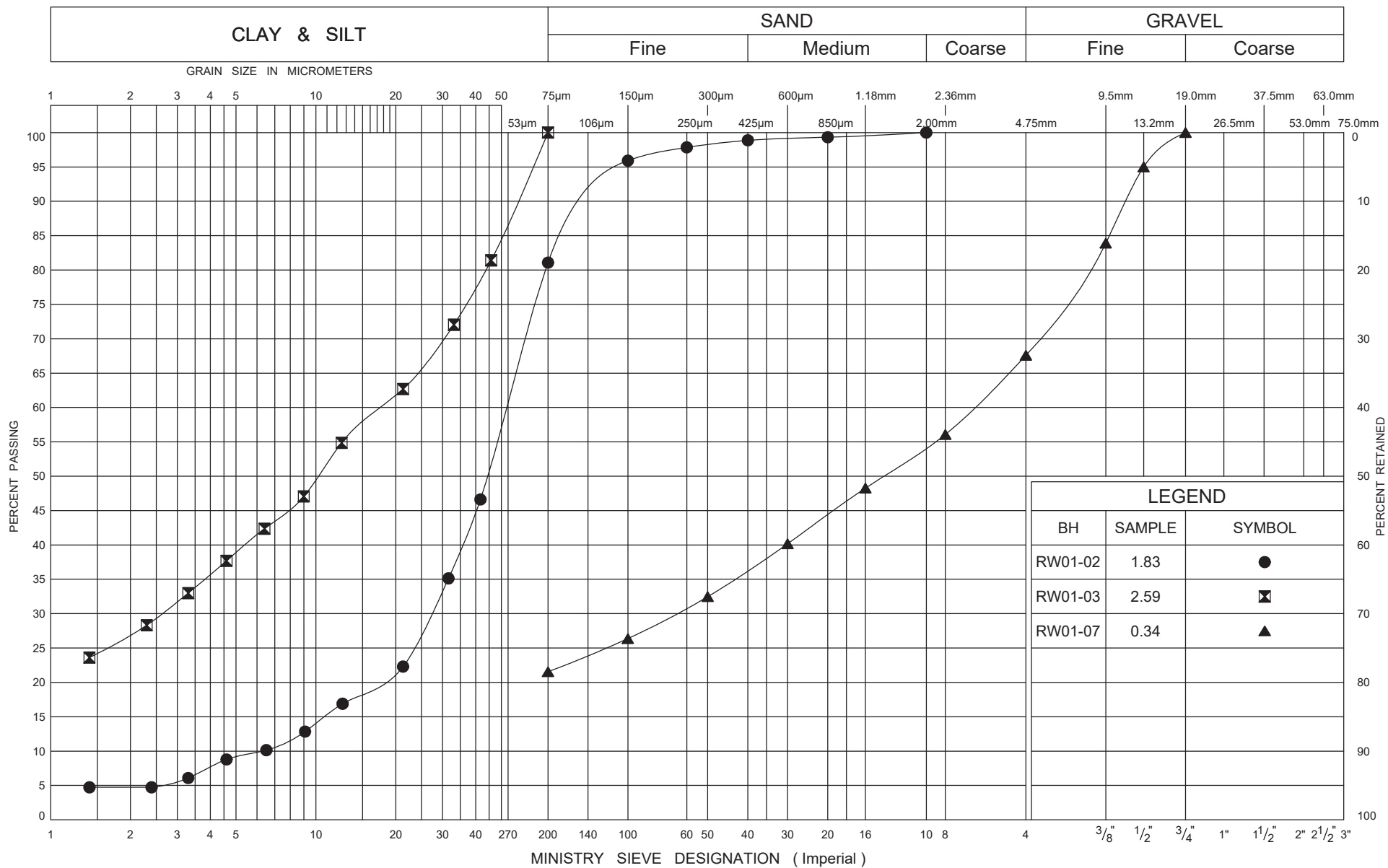


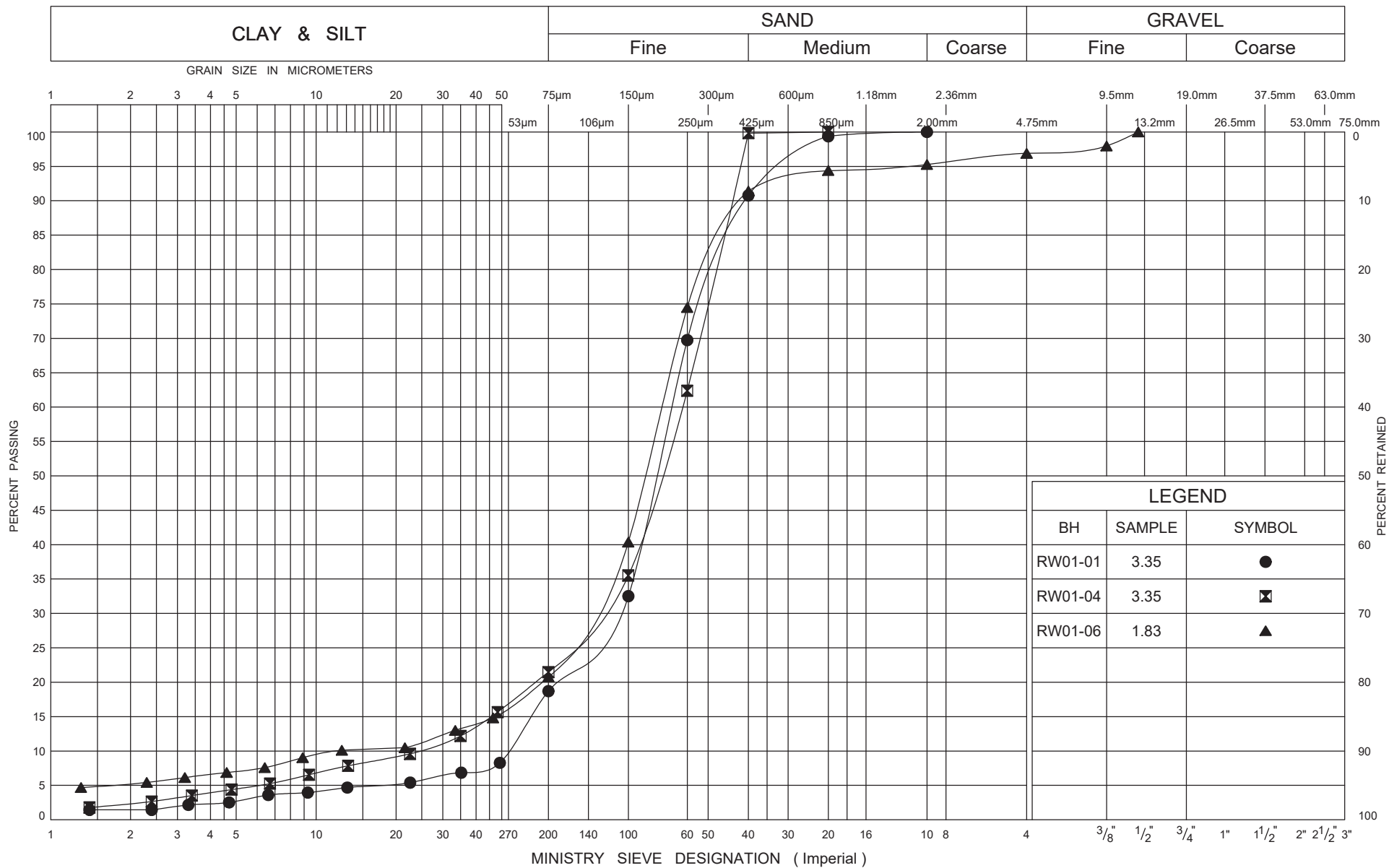
RECORD OF BOREHOLE No RW01-07 2 OF 2 METRIC

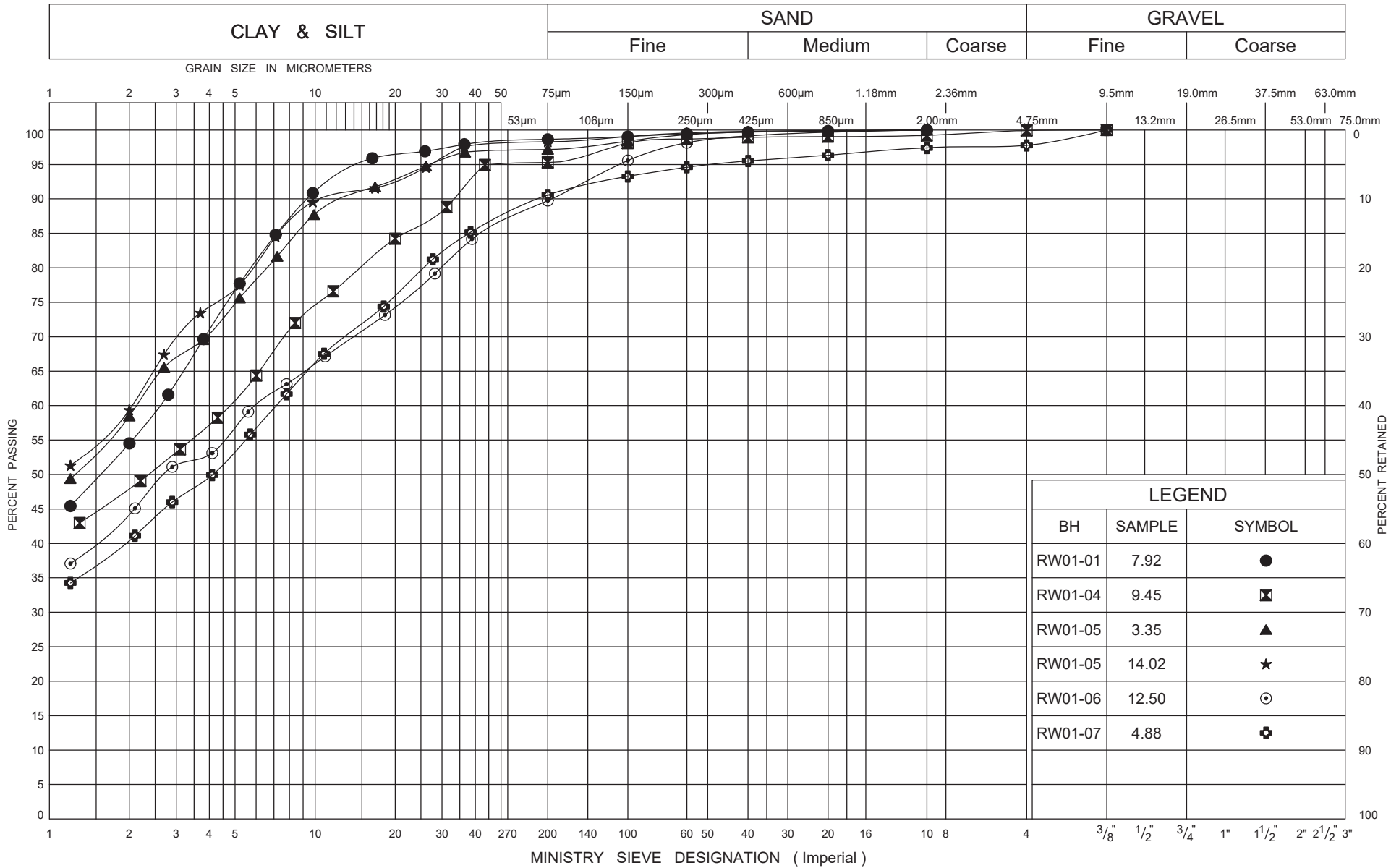
GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 661.7 E 226 221.5 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.14 - 2019.08.14 LATITUDE 43.458833 LONGITUDE -80.471043 CHECKED BY NB

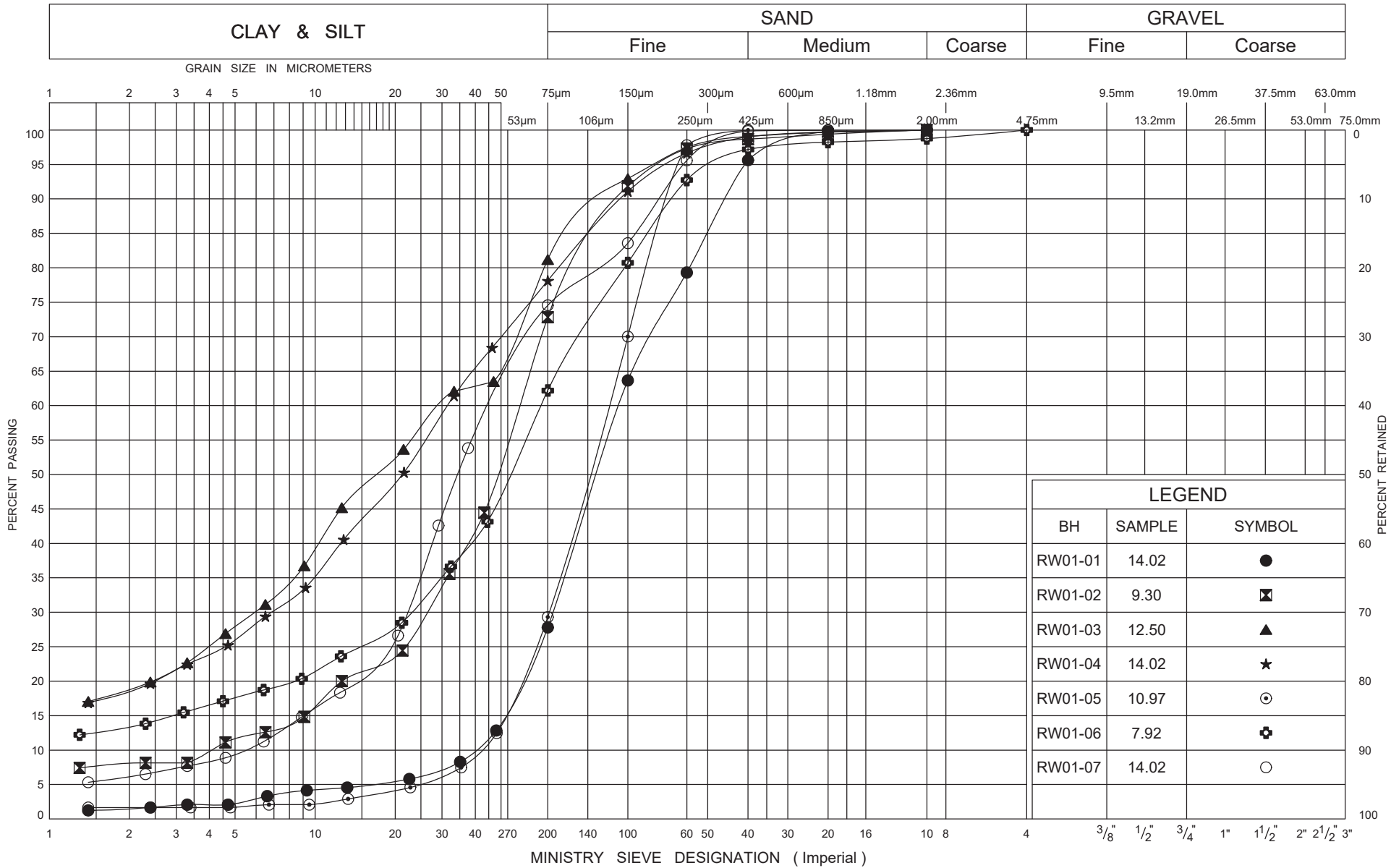
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
	Continued From Previous Page												
	Silty <b>CLAY</b> , trace to some sand, trace gravel Very Stiff to Hard Grey Moist		10	SS	19		310						
308.3							309						
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.												

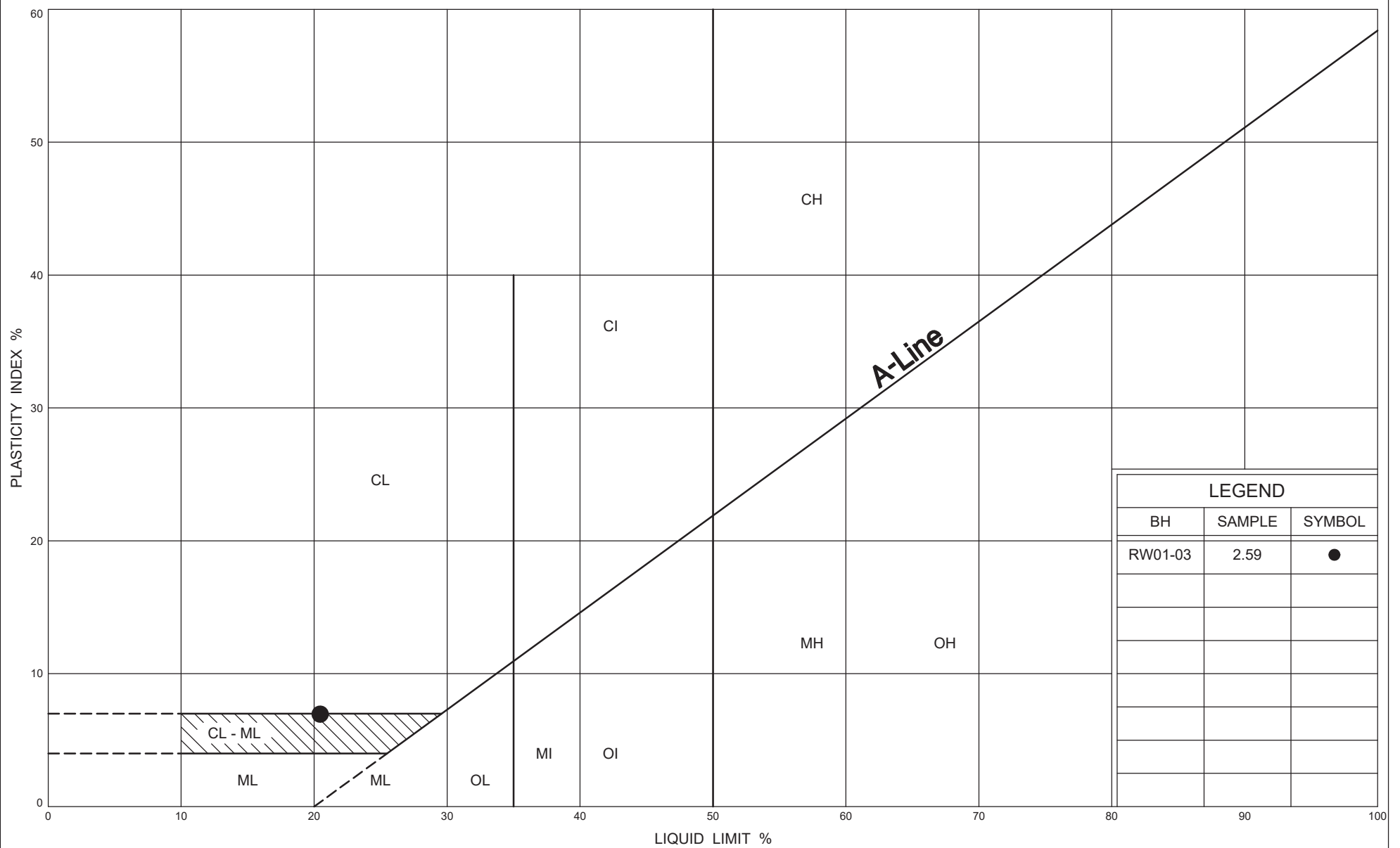
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE



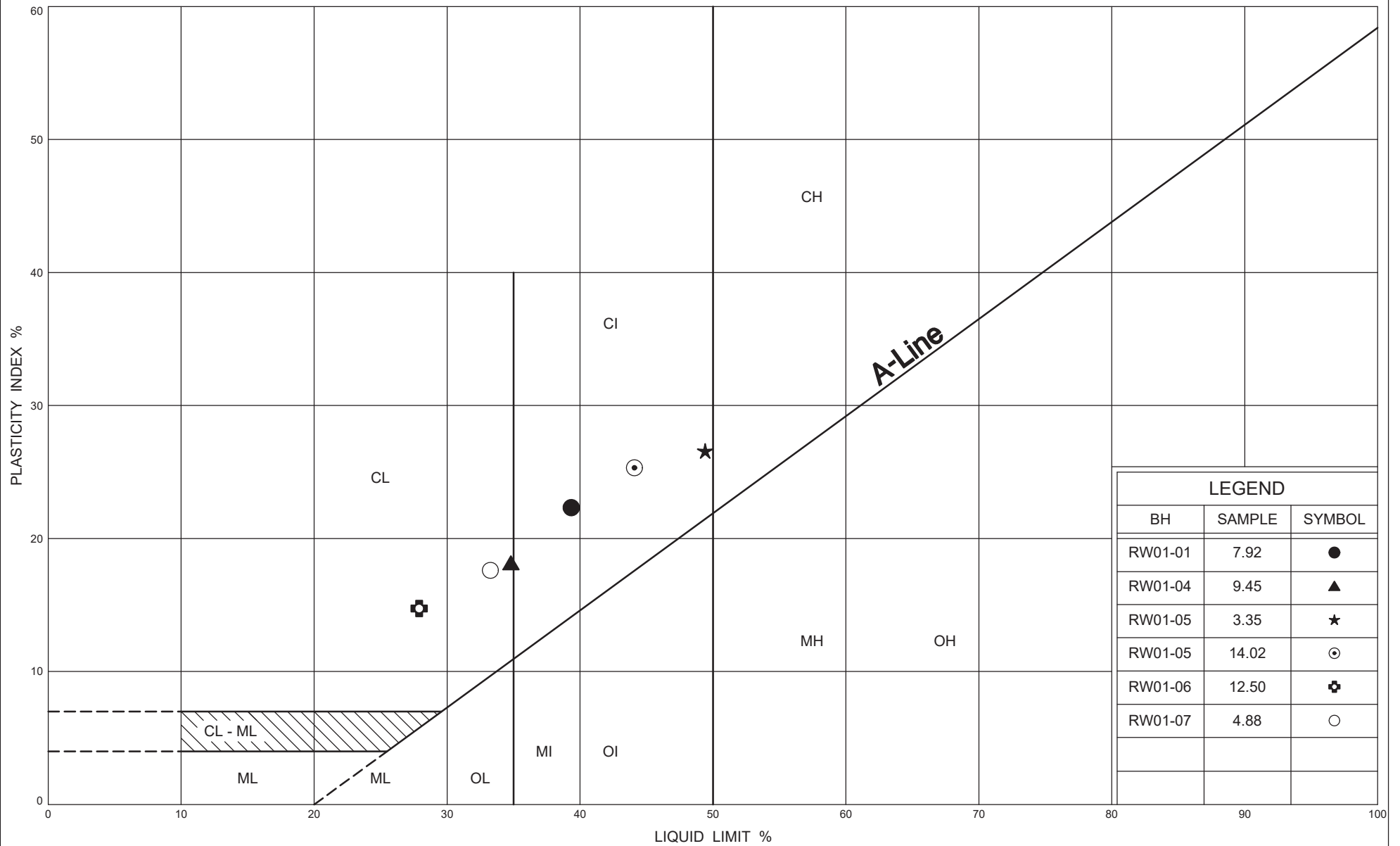








LEGEND		
BH	SAMPLE	SYMBOL
RW01-03	2.59	●



Ministry of  
Transportation

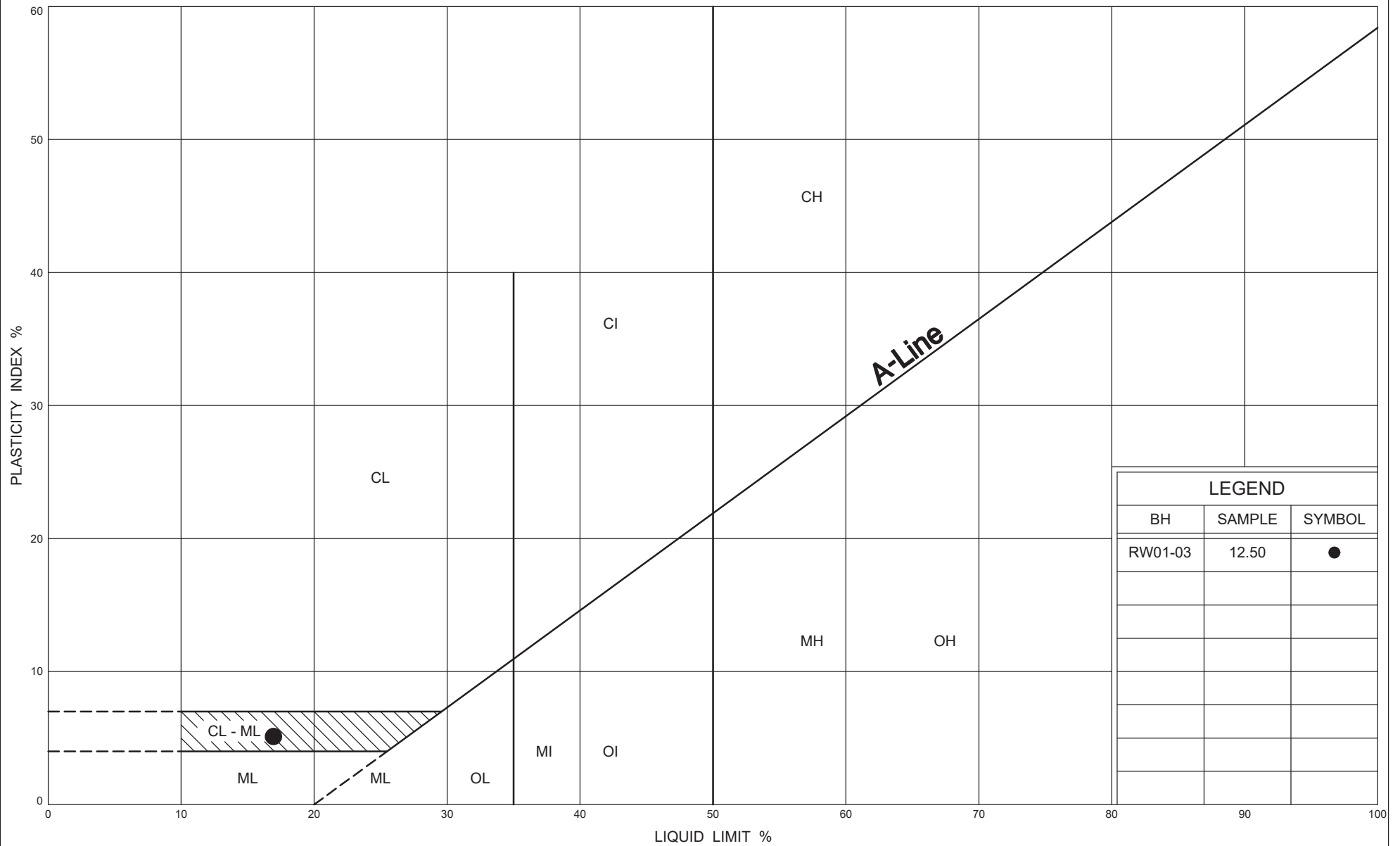
## PLASTICITY CHART

Silty CLAY

FIG No A6

W P 408-88-00

Retaining Wall 1



Ministry of  
Transportation

## PLASTICITY CHART

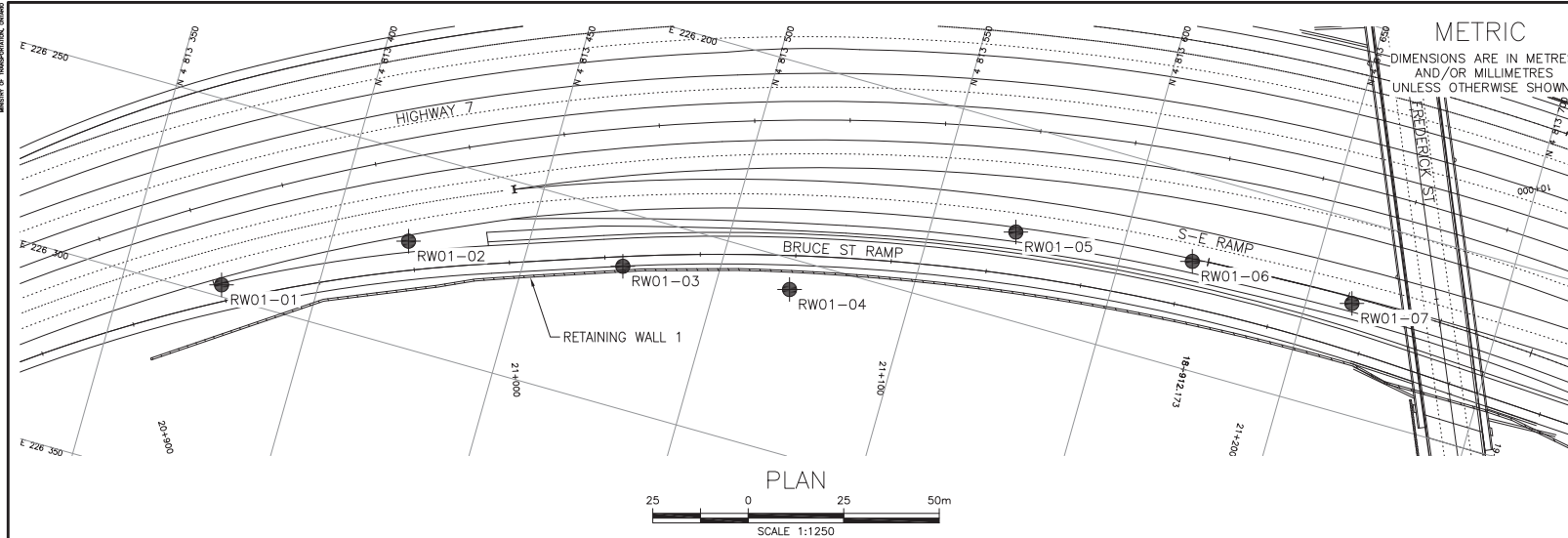
Sandy SILT / Silty SAND

FIG No A7

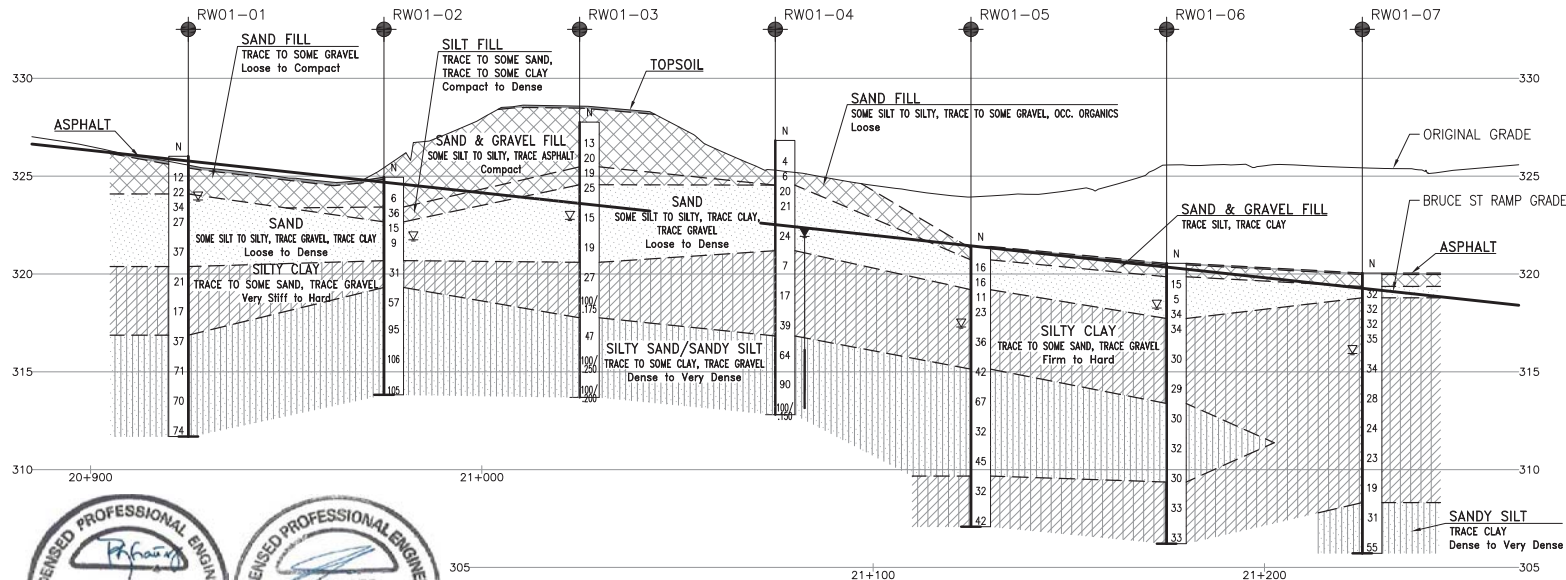
W P 408-88-00

Retaining Wall 1

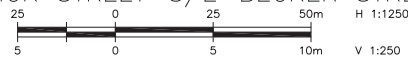




## PLAN



217100  
PROFILE ALONG BRUCE STREET RAMP  
FREDERICK STREET-S/E-BECKER STREET

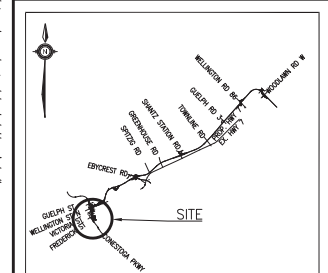


## METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN






CONT No  
GWP No 408-88-00

HIGHWAY 7 FREDERICK ST.-S/E-BECKER ST. RETAINING WALL 1 BOREHOLE LOCATIONS AND SOIL STRATA
---



Latitude: 43.457463°      Longitude: -80.470548°

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-

- 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. 40P9-58



REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	NB	CHK	PKC	CODE	LOAD	DATE MAY 2020			
DRAWN	MFA	CHK	NB	SITE	STRUCT	DWG 1			



## **Appendix B**

**Record of Borehole Sheets, Laboratory Test Results and Borehole Locations,  
and Soil Strata Drawing**

**Retaining Wall 2  
(RW-01 to RW-04 and RW02-02 to RW02-04)**



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									
318.8													
0.8	Silty <b>SAND</b> , trace clay, trace gravel Dense to Compact Brown Moist		2	SS	30								
			3	SS	34								
			4	SS	24								
			5	SS	21								
315.4													
4.1	Silty <b>CLAY</b> , some to with sand, trace gravel Stiff to Hard Grey Moist		6	SS	14								
			7	SS	35								
					</								

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					
								20 40 60 80 100					
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
								20 40 60 80 100					
								WATER CONTENT (%) W <sub>P</sub> W W <sub>L</sub>					

# 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				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					
319.5	GROUND SURFACE												
0.0	ASPHALT: (200mm)												
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								
			4	SS	16		317						
			5	SS	11		316						
							315						
			6	SS	27								
314.5													
5.0	Silty <b>CLAY</b> , trace sand Very Stiff Grey Moist						314						
	Firm		7	SS	6		313						Switch to tricone
			8	SS	29		312						
							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 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 (%)				GR	SA	SI	CL		
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					w <sub>P</sub> w      w <sub>L</sub>									
	Continued From Previous Page							20	40	60	80	100		20	40	60						
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)						309															
			10	SS	28									○								
							308							○								
			11	SS	68		307							○								
							306															
305.8																						
13.7	<b>SAND</b> , trace to some silt, trace clay Dense to Very Dense Grey Wet		12	SS	75		305							○								
														○								
							304															
			13	SS	43									○					0	87	10	3
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

# RECORD OF BOREHOLE No RW02-04

1 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				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					
								20    40    60    80    100					
319.1	GROUND SURFACE												
0.0	ASPHALT:(112mm)												
0.1	SAND, with gravel Brown Moist (FILL)		1	GS									
318.5													
0.6	SAND, trace silt and clay, trace gravel Compact to Dense Brown Wet		2	SS	26								
			3	SS	32								
			4	SS	21								
			5	SS	34								
314.3			6	SS	17								
4.8	Silty CLAY, some sand to sandy, trace gravel Very Stiff Grey Moist												
			7	SS	16								
			8	SS	26								

Continued Next Page

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



# RECORD OF BOREHOLE No RW02-04

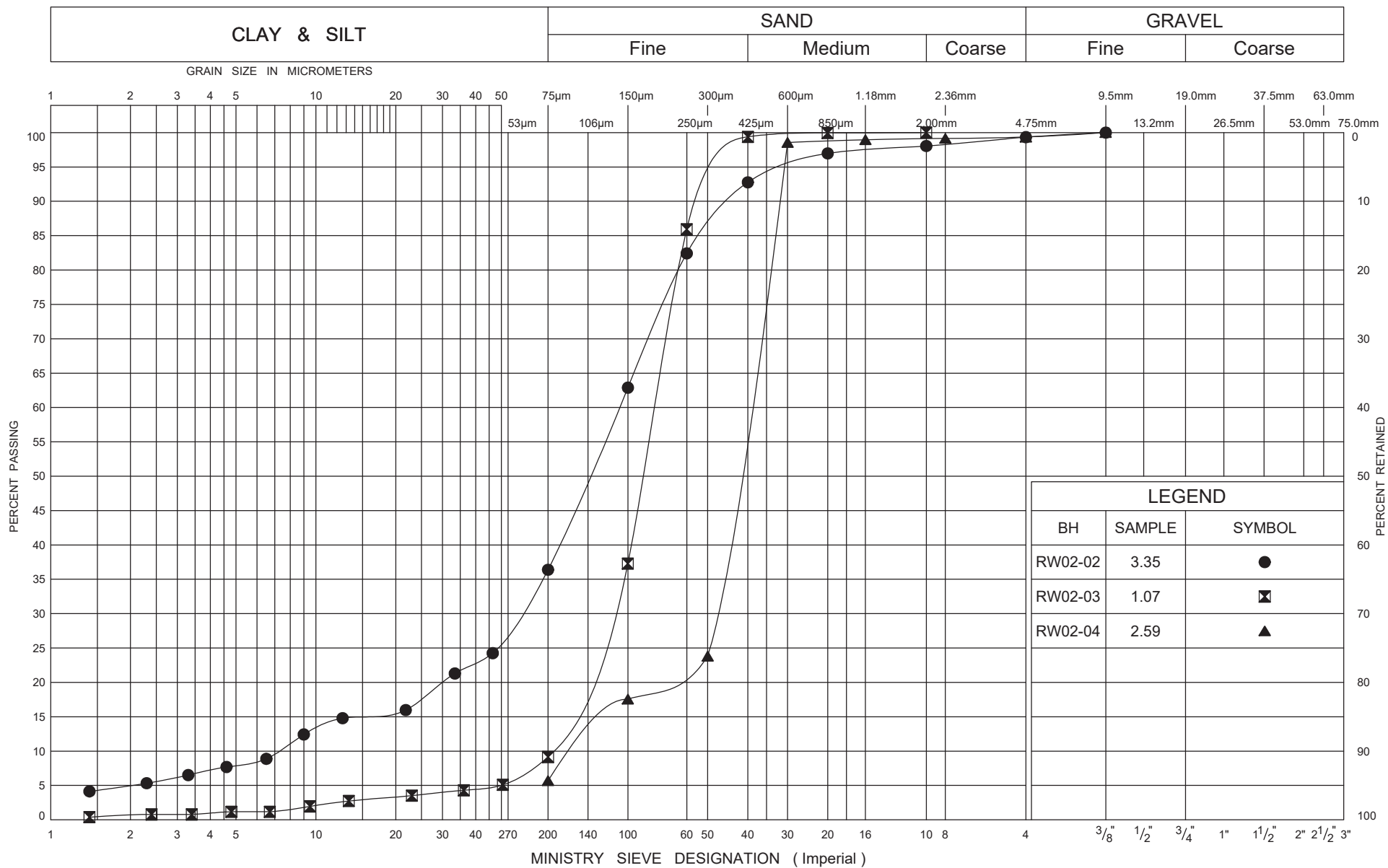
2 OF 2

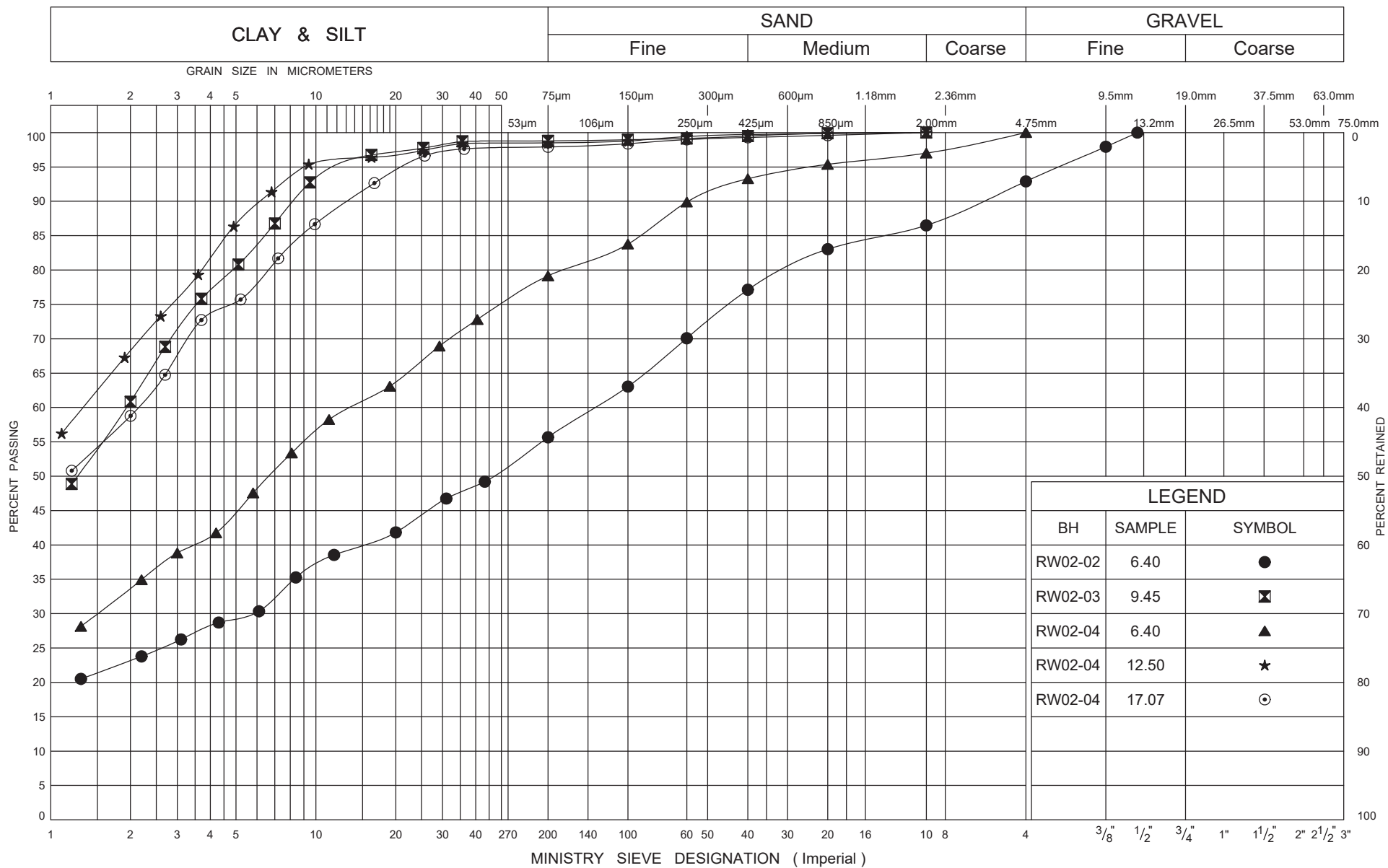
METRIC

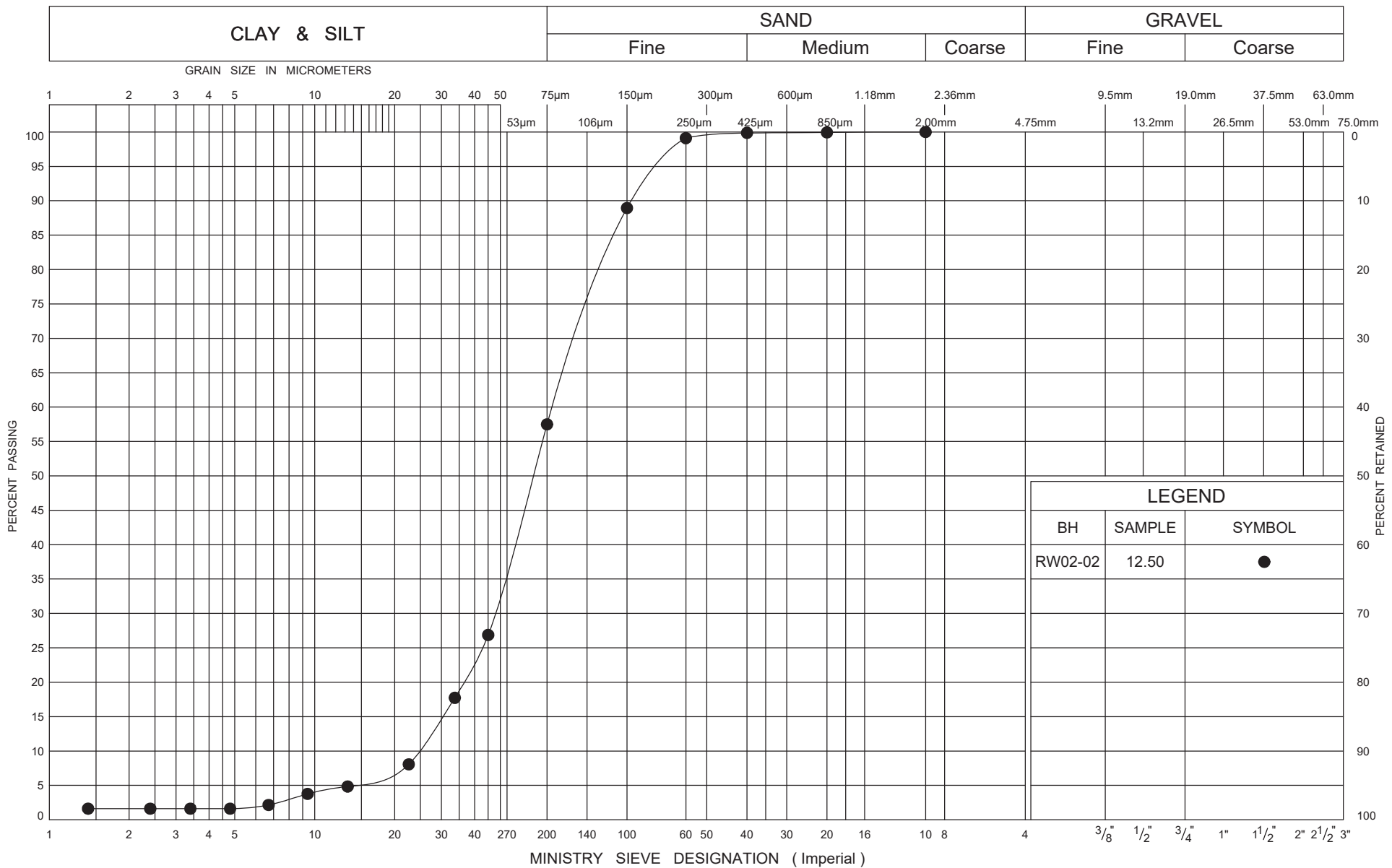
GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 856.9 E 226 242.2 ORIGINATED BY ES  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2019.09.23 - 2019.09.23 LATITUDE 43.460514 LONGITUDE -80.470774 CHECKED BY NB

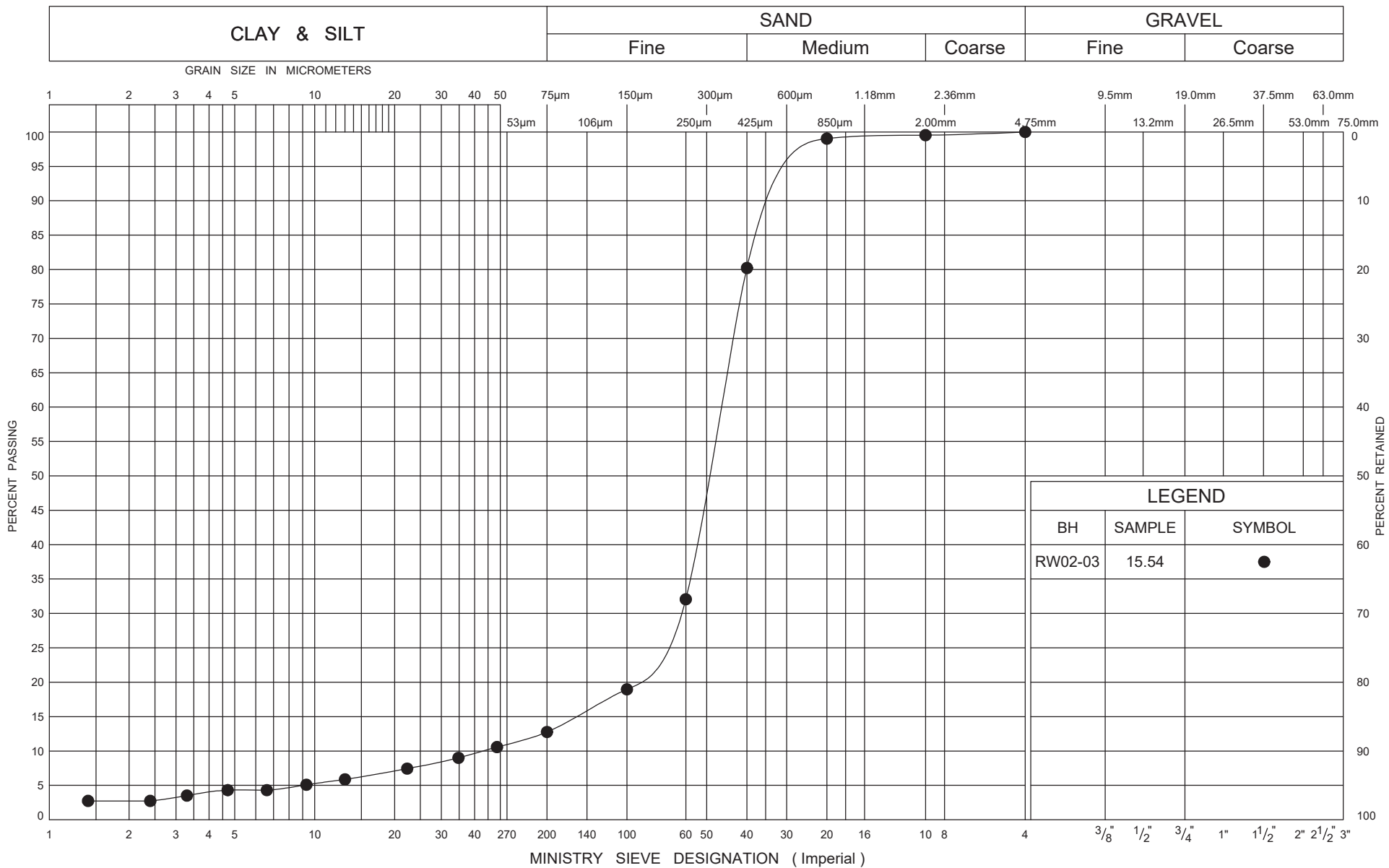
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT 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									
			12	SS	12		304									
							303									
			13	SS	12		302									
			14	SS	37											0 2 39 59
301.7																
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.															

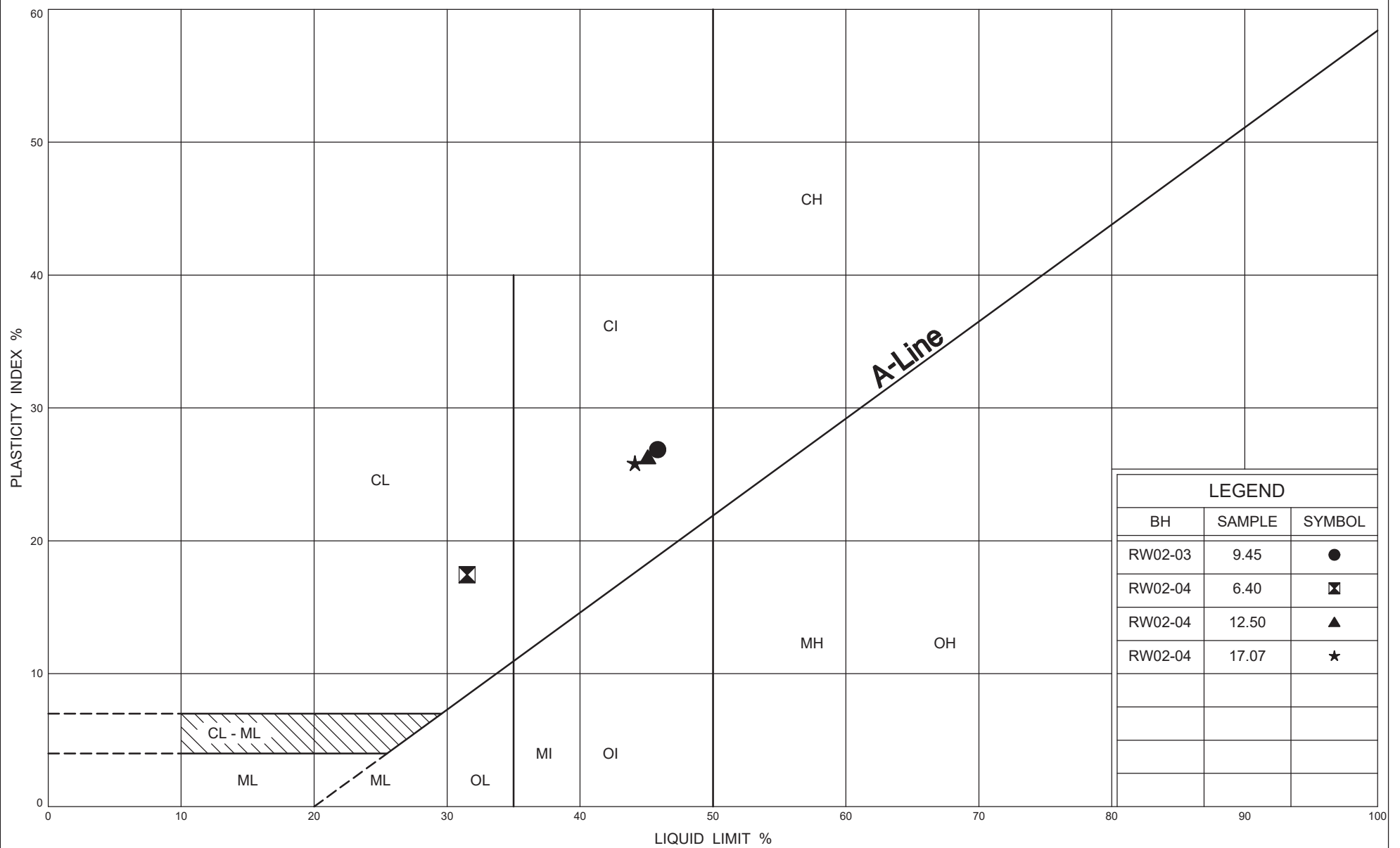
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE













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	APL		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									WATER CONTENT (%)				
								○ UNCONFINED		+ FIELD VANE							○				
								● QUICK TRIAXIAL		× LAB VANE											
319.7	Ground Surface						20	40	60	80	100	20	40	60							
0.0	Asphalt over sand some silt, some gravel Very loose Brown Wet  (FILL)		1	AS	-																
318.3			2	SS	3																
1.4	Silty clay, trace sand Very stiff Brown Moist  sand layers to 4.9m  Hard to Greyish very stiff brown		3	SS	17											(**)					
			4	SS	34																
			5	SS	25																
			6	SS	28																
			7	SS	37																
			8	SS	31																
			9	SS	33																
			10	SS	39																
309.9	End of borehole																				
9.8	<p>* Borehole dry</p> <p>(**) Base of footing -El.318.2</p> <p>Note: Borehole cave-in at 8.5m</p> <p>C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers</p> <p>Water Level Readings:</p> <table><tr><td>Date</td><td>Depth (m)</td><td>Elev.</td></tr><tr><td>Apr. 08, '11</td><td>2.9</td><td>316.8</td></tr></table> <p>Piezometer Legend:</p> <p> Bentonite seal</p> <p> Filter sand</p> <p> 19mm dia. PVC screen</p> <p> Bentonite grout</p>	Date	Depth (m)	Elev.	Apr. 08, '11	2.9	316.8														
Date	Depth (m)	Elev.																			
Apr. 08, '11	2.9	316.8																			

**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 NATURAL LIMIT MOISTURE LIQUID LIMIT CONTENT LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>		
319.7	Ground Surface						20	40	60	80	100					
0.0	Asphalt over sand and crushed gravel, trace silt		1	AS	-											
	Compact Brown Moist (FILL)		2	SS	11											
318.3																
1.4	Silty clay, trace gravel sand layers		3	SS	9											(**)
	Stiff Dark brown Moist sand layers to 3.7m		4	SS	31											1 4 43 52
	Hard Greyish brown		5	SS	23											0 2 45 53
			6	SS	44											
			7	SS	43											0 0 32 68
			8	SS	35											
			9	SS	29											
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									
								20	40	60	80	100					
322.3	Ground Surface																
0.0	Silty sand some clay, trace gravel organic inclusions		1	SS	14		322										8 37 37 18
	Compact Grey Moist																
	(FILL)																
	clayey silt layers		2	SS	27		321										3 50 34 13
	gravelly sand																
	Compact Brown Damp		3	SS	20		320										4 26 45 25
320.0	clayey silt layers																23 39 27 11
2.3	Sand trace to some gravel trace clay		4	SS	21		320										4 25 42 29
	Compact Brown Moist to wet		5	SS	18		319										15 76 6 3
			6	SS	14		318										10 76 10 4
317.9																	(1#) 73 12 4
4.4	Silty clay trace sand, trace gravel silty sand and gravelly sand layers, cobbles		7	SS	36		317										3 23 50 24
	Hard Grey Moist		8	SS	67		316										
315.9			9	SS	70/15cm												
6.4	End of borehole																
	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**

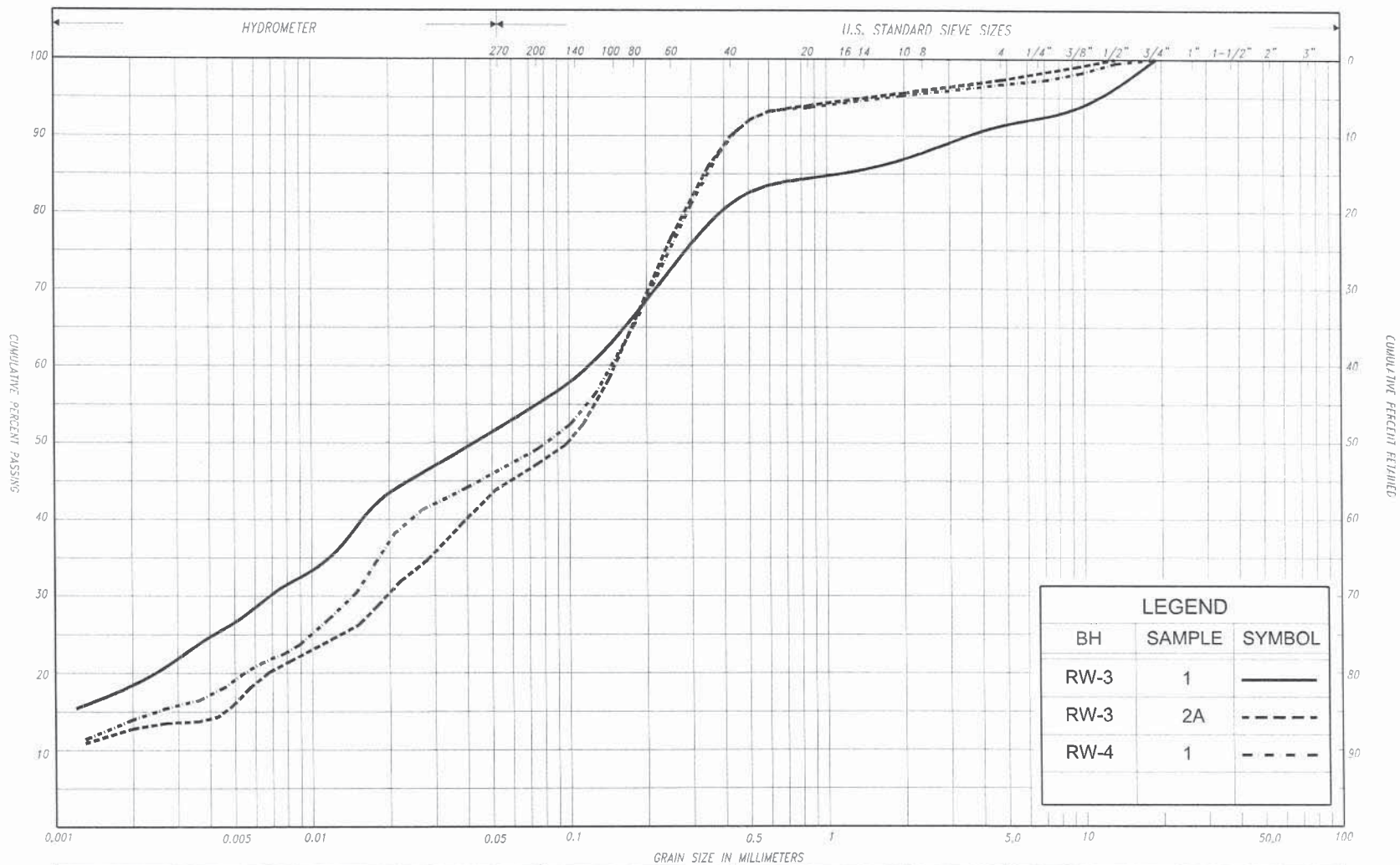
**G.W.P.** 3110-09-00      **LOCATION** Coords: 4 813 705.4 N; 226 228.2 E      **ORIGINATED BY** A.L.  
**DIST** London      **HWY** 7/ 85      **BOREHOLE TYPE** Dynamic Ram Sounder      **COMPILED BY** N.S.B.  
**DATUM** Geodetic      **DATE** July 20, 2011      **CHECKED BY** B.R.G.

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	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													
323.5	Ground Surface						20	40	60	80	100					GR	SA	SI	CL		
0.0	Silty sand, some clay trace gravel, rootlets		1	SS	21								○				4	47	35	14	
	Compact      Brown      Moist (FILL)		2	SS	21									○				22	20	54	
	Silt with sand, trace gravel		3	SS	21									○				15	68	11	6
	Compact      Grey Sand, some silt some gravel, trace clay																				
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				CORRIES	M.I.T.		
SILT																			
CLAY			SILT			V. FINE	FINE	MED.	COARSE		GRAVEL							U.S. BUREAU	
					SAND														

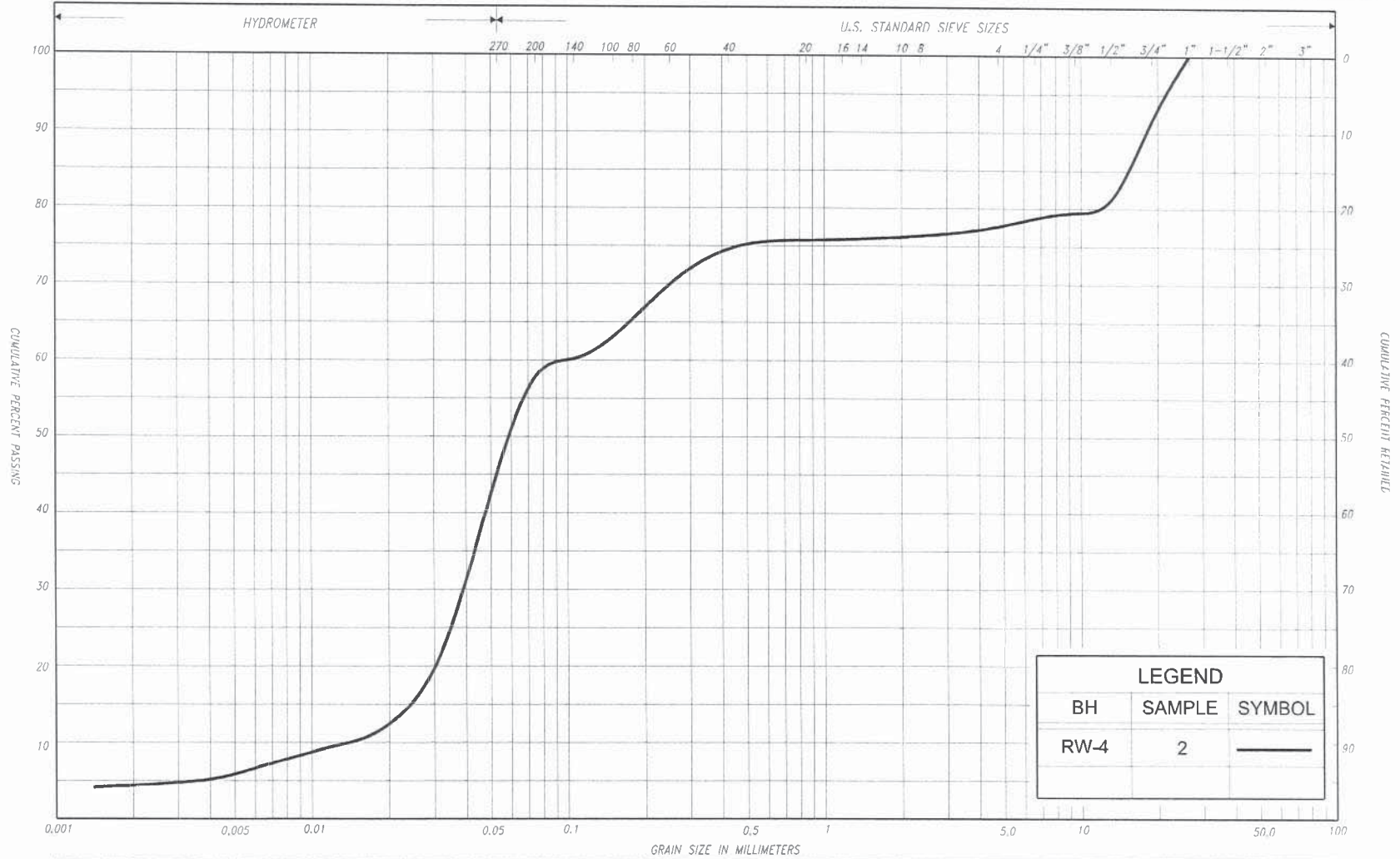
**GRAIN SIZE DISTRIBUTION**  
**SILTY SAND, some clay, trace gravel**  
**(FILL)**

FIG No. RW-GS-1

HWY: 7 / 85

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





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



## GRAIN SIZE DISTRIBUTION

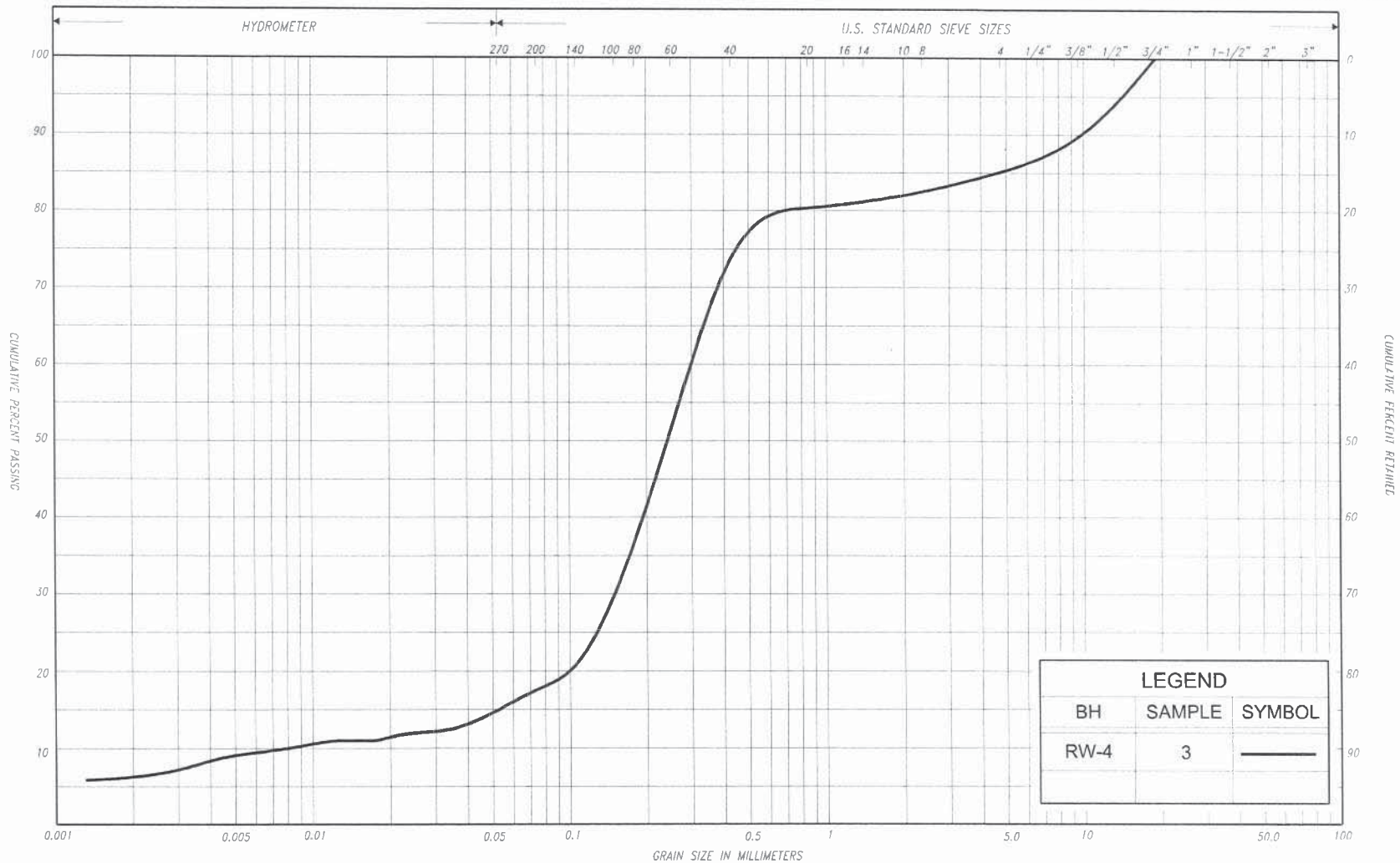
SILT, some sand, some gravel, trace clay  
(FILL)

FIG No. RW-GS-2

HWY: 7 / 85

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





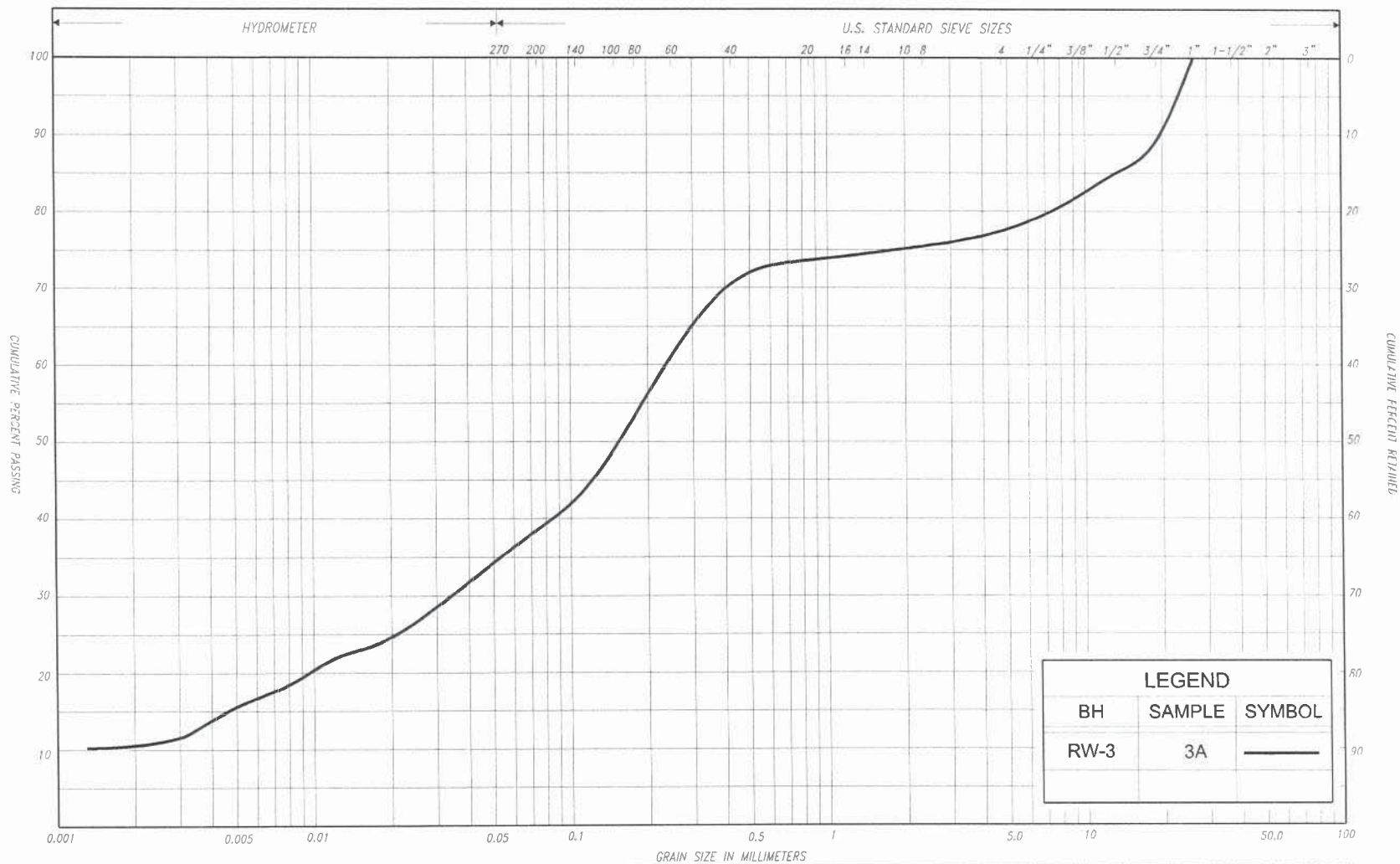
SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL			COR RIFES	UNIFIED		
				SAND											
CLAY	FINE		MEDIUM	COARSE	FINE		MEDIUM		COARSE		GRAVEL			CORRIFES	M.I.T.
SILT															
CLAY		SILT		V. FINE	FINE	MED.	COARSE		GRAVEL						U.S. BUREAU
				SAND											

**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







SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COR. BLES	UNIFIED
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	SAND	COARSE	GRAVEL		COBBLES	M.I.T.	
CLAY	SILT			V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. AIRFAI	

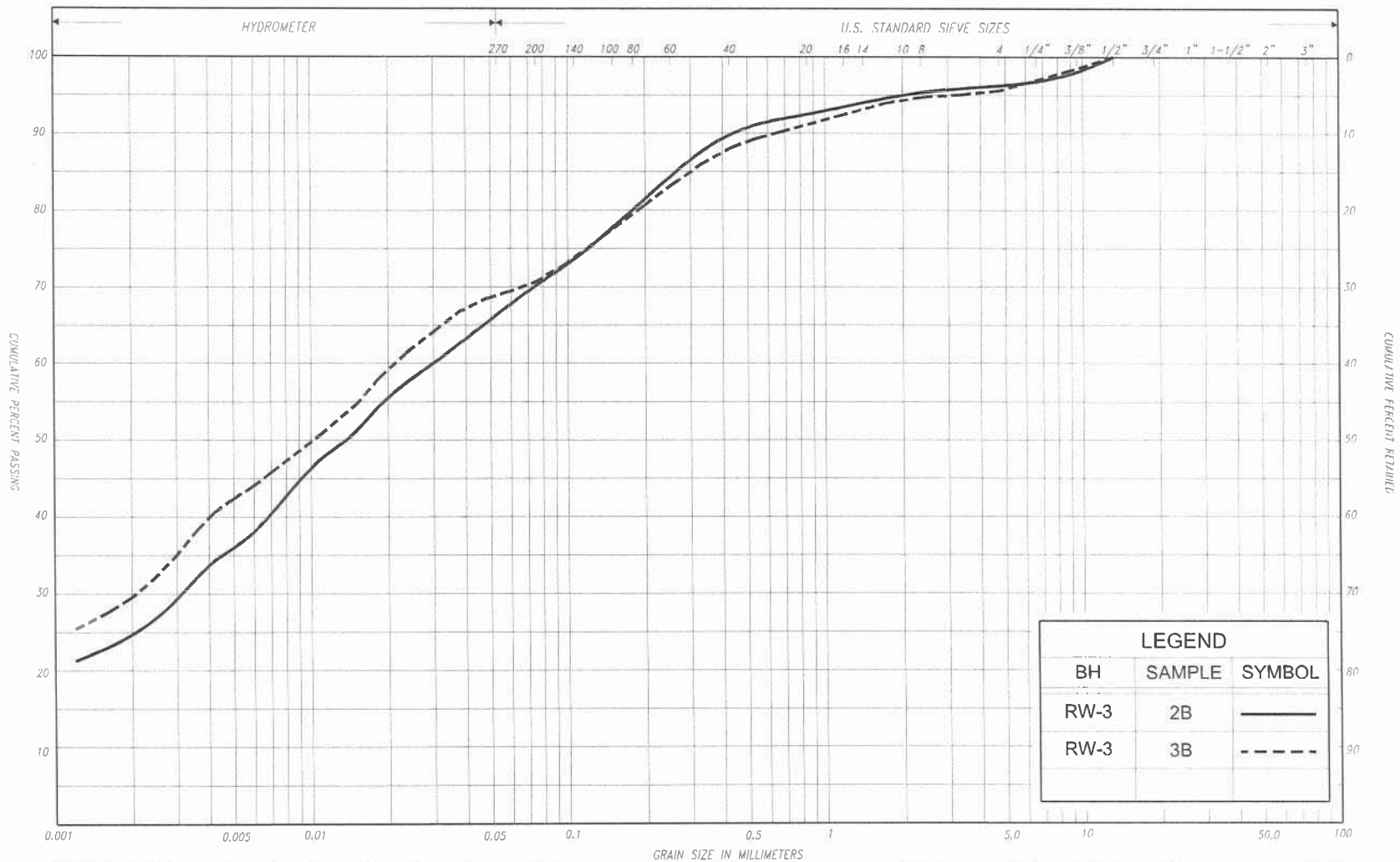


**GRAIN SIZE DISTRIBUTION**  
**GRAVELLY SAND, with silt, some clay**  
**(FILL)**

FIG No. RW-GS-4

HWY: 7 / 85

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



SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL			COR RIES	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. (AIRFAI)
				SAND										

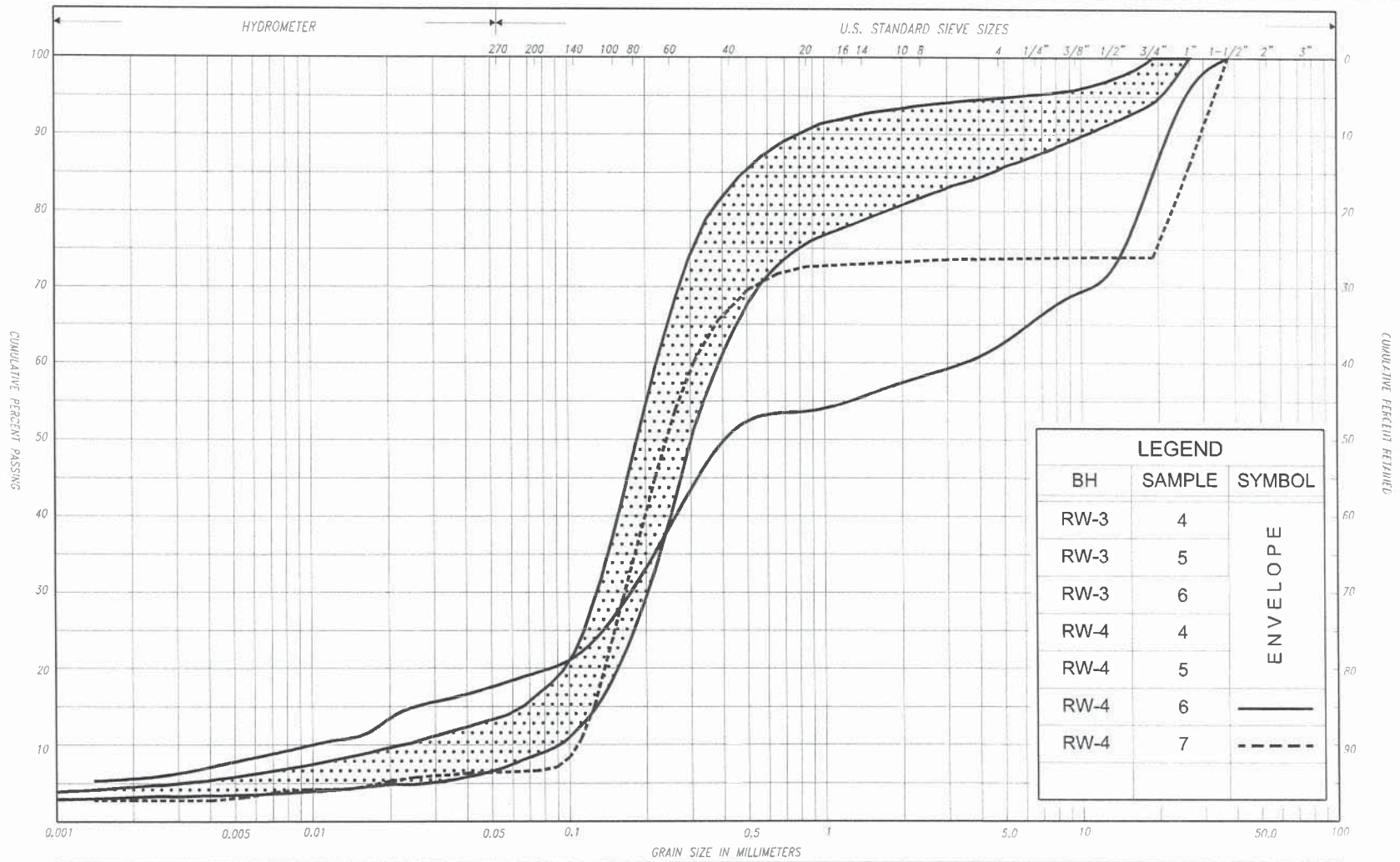
# GRAIN SIZE DISTRIBUTION CLAYEY SILT, with sand, trace gravel (CI) (FILL)

FIG No. RW-GS-5

HWY: 7 / 85

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





SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COR RILES	UNIFIED			
				SAND														
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL				CORRILES	M.I.T.
SILT																		
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

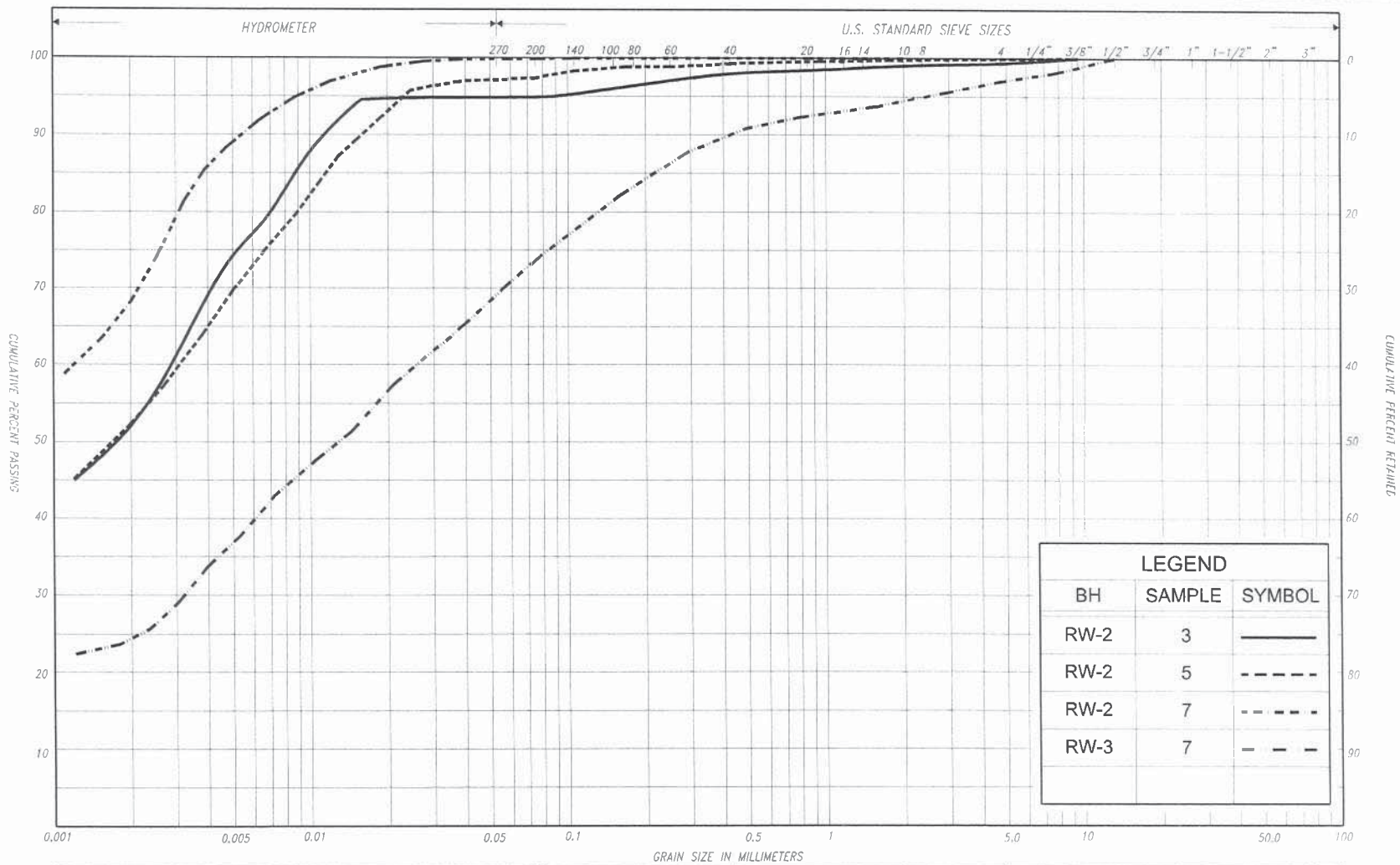
FIG No. RW-GS-6

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															
CLAY		SILT			V. FINE	FINE	MED.	COARSE		SAND		GRAVEL					U.S. BUREAU		

## GRAIN SIZE DISTRIBUTION

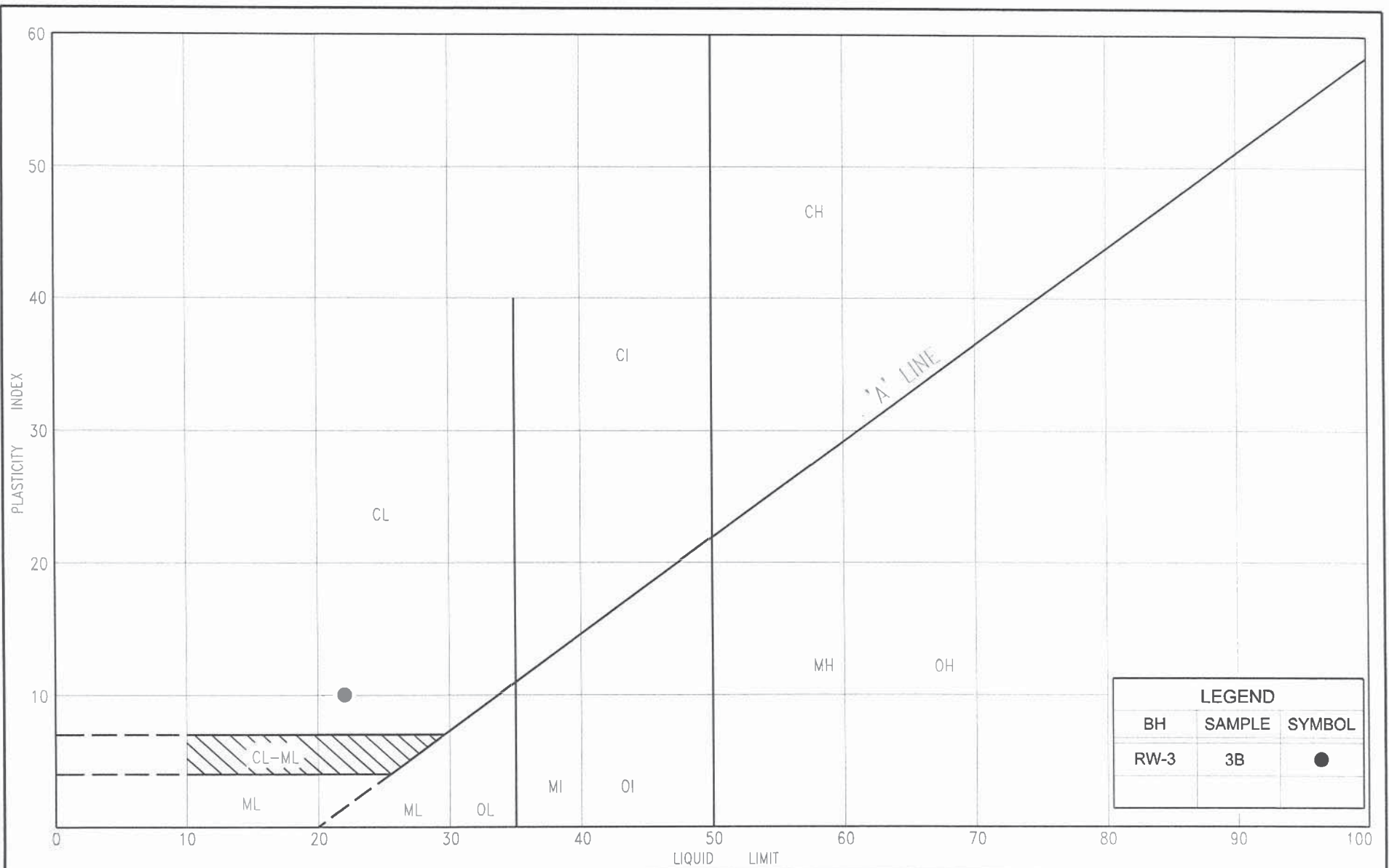
SILTY CLAY, trace to with sand, trace gravel (CI)

FIG No. RW-GS-7

HWY: 7 / 85

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





### PLASTICITY CHART

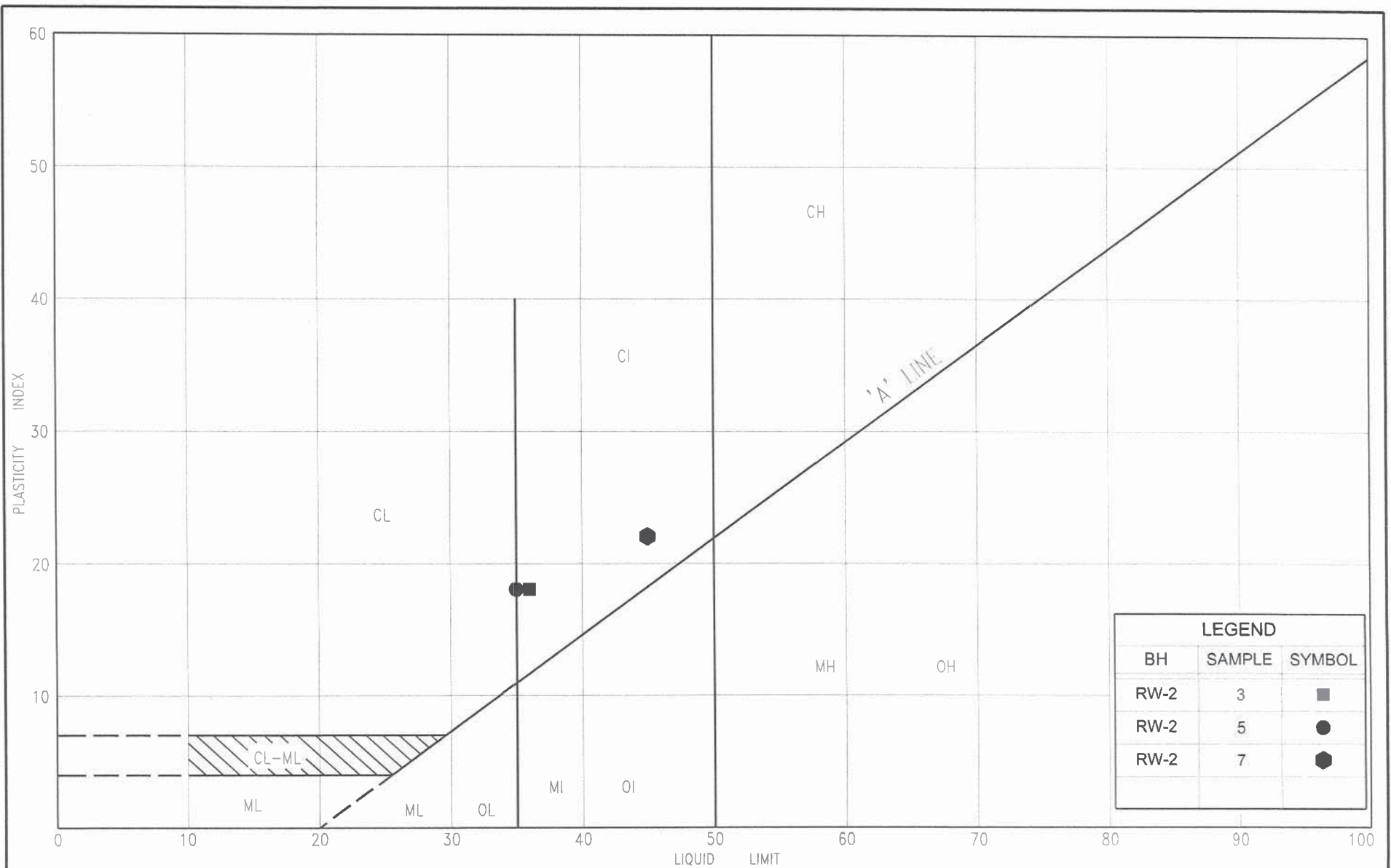
CLAYEY SILT, with sand, trace gravel (CL)  
(FILL)

FIG No. RW-PC-1

HWY: 7 / 85

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





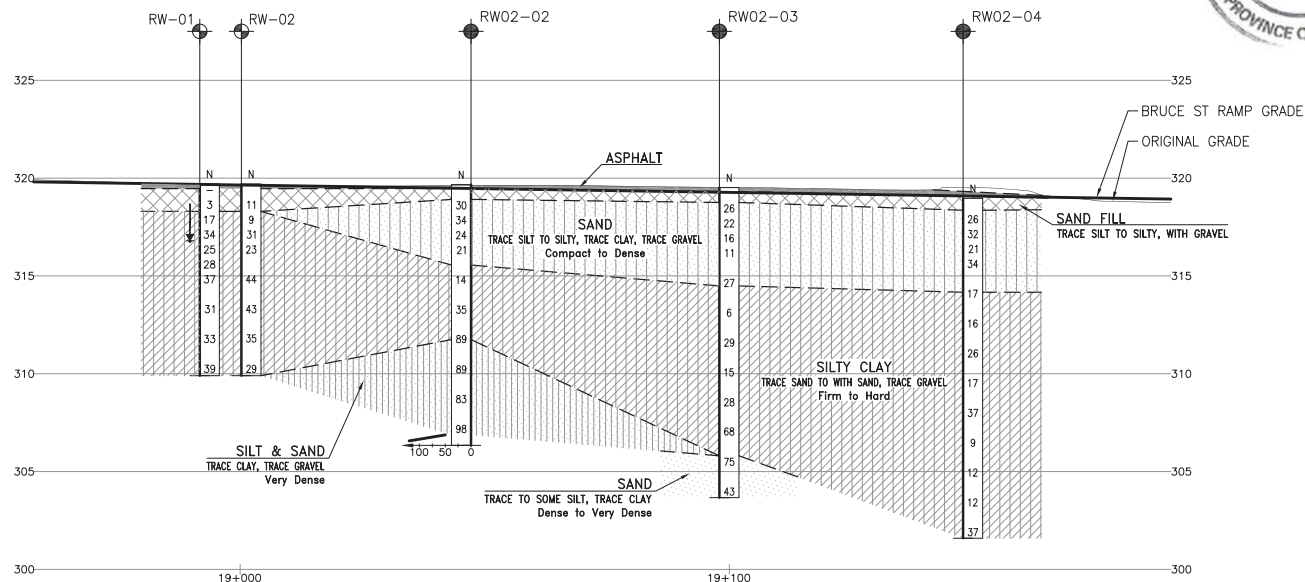
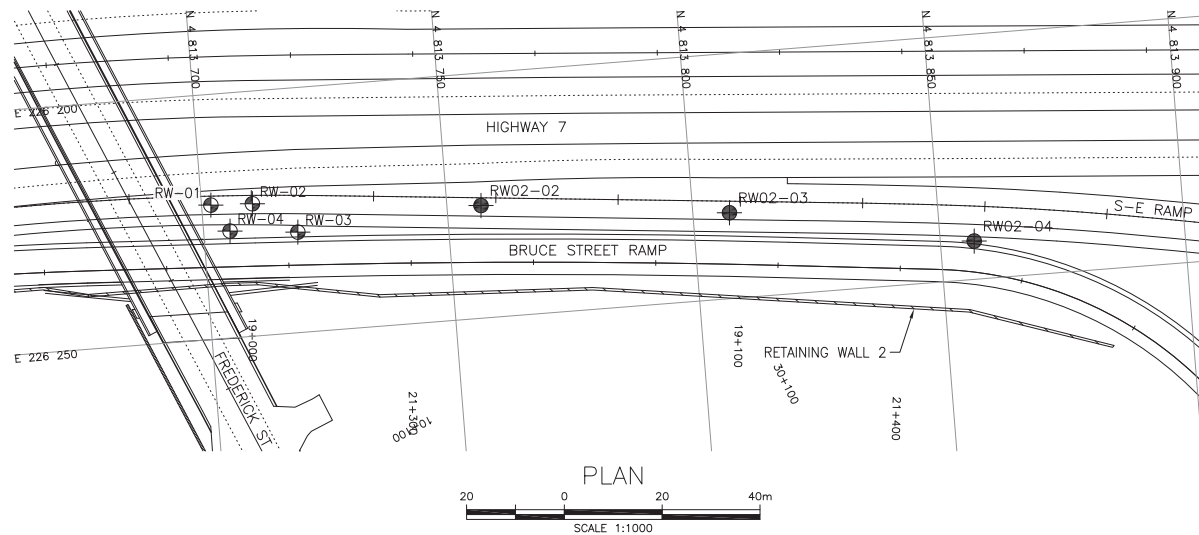
**PLASTICITY CHART**

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

FIG No. RW-PC-2

HWY: 7 / 85

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

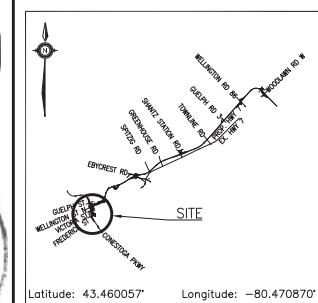


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No  
GWP No 408-88-00

HIGHWAY 7  
FREDERICK ST.-N/E-ANN ST.  
RETAINING WALL 2  
BOREHOLE LOCATIONS AND SOIL STRATA



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
- 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.

GEOCRIS No. 40P9-58

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	NB	CHK PKC	CODE
DRAWN	MFA	CHK NB	SITE
		STRUCT	LDWG 1



## **Appendix C**

### **Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing**

**Retaining Wall 10  
(RW09-02, RW10-02 to RW10-06)**



# RECORD OF BOREHOLE No RW09-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 9, MTM NAD 83 Zone 10: N 4 814 582.8 E 226 319.4 ORIGINATED BY GA  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.04.11 - 2018.04.11 LATITUDE 43.467045 LONGITUDE -80.469941 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	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					W P      W      W L									
322.8	GROUND SURFACE							20	40	60	80	100										
0.0	<b>SAND</b> , some silt, trace clay, trace gravel Loose to Compact Brown Moist		1	SS	8		322								○				2   79   14   5			
																	○					
			3	SS	6			321								○						
320.4	Silty <b>CLAY</b> , trace sand, trace gravel Very Stiff to Hard Brown Wet		4	SS	20			320													0   9   49   42	
					5				SS	33								○				
						319																
318.7	<b>SAND</b> and <b>SILT</b> , trace to some clay Very Dense Grey Wet						318									○						
								317														
			7	SS	104			316									○			0   52   38   10		
						315									○							
			8	SS	102																	
						314																
						313																
313.2	END OF BOREHOLE AT 9.6m. BOREHOLE OPEN TO 9.6m AND						312															
9.6																						

Continued Next Page

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

## METRIC

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			W <sub>P</sub>	W	W <sub>L</sub>
Continued From Previous Page									SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%)			γ				
		WATER LEVEL AT 7.1m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND GROUT TO SURFACE.							20	40	60	80	100	20	40	60	kN/m <sup>3</sup>	GR SA SI CL

RECORD OF BOREHOLE No RW10-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 587.1 E 226 370.2 ORIGINATED BY MB  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.04.19 - 2018.04.19 LATITUDE 43.467088 LONGITUDE -80.469313 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 (%)		
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE											
329.1	GROUND SURFACE						20	40	60	80	100								
0.0	<b>SAND</b> and <b>GRAVEL</b> Compact Brown Moist (FILL)		1	SS	16								○						
328.4																			
0.6	Silty <b>SAND</b> , trace to some clay Very Loose to Compact Brown Moist (FILL)		2	SS	3								○						
			3	SS	5								○			0 64 25 11			
			4	SS	20								○						
			5	SS	13								○						
325.3																			
3.7	<b>SAND</b> , trace gravel, trace silt and clay Compact to Dense Brown Moist		6	SS	27								○						
			7	SS	29								○			4 89 7 (SI+CL)			
			8	SS	32								○						
321.9																			
7.1	Silty <b>CLAY</b> , with sand Very Stiff to Hard Brown Moist		9	SS	29								○						
			10	SS	100/ 0.200								○	H		0 38 43 19			
319.6																			
9.4	END OF BOREHOLE AT 9.4m. BOREHOLE OPEN TO 9.4m AND DRY UPON COMPLETION.																		

Continued Next Page

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

## METRIC

[illegible]

# RECORD OF BOREHOLE No RW10-03

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 591.8 E 226 418.6 ORIGINATED BY MB  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.04.18 - 2018.04.18 LATITUDE 43.467136 LONGITUDE -80.468717 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 (%)				
328.4	GROUND SURFACE															
0.0	<b>SAND and GRAVEL</b> Compact Brown Moist (FILL)		1	SS	11											13 64 17 6
327.8																
0.5	<b>SAND</b> , trace silt and clay, trace gravel Loose to Compact Brown Moist (FILL)		2	SS	6											
			3	SS	8											
			4	SS	13											
			5	SS	11											
324.6																
3.7	<b>SAND</b> , trace silt, trace gravel Compact Brown Moist		6	SS	25											1 89 10 (SI+CL)
			7	SS	28											
			8	SS	28											
321.4																
7.0	Silty <b>CLAY</b> , trace to some sand Hard Brown Wet to Moist															
			9	SS	30											
			10	SS	73											0 10 39 51
318.6																
9.8	END OF BOREHOLE AT 9.8m.															

Continued Next Page

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

## METRIC

[illegible]

# RECORD OF BOREHOLE No RW10-04

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 601.3 E 226 470.5 ORIGINATED BY MB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.04.18 - 2018.04.18 LATITUDE 43.467227 LONGITUDE -80.468076 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 (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa														
326.8	GROUND SURFACE							20	40	60	80	100						GR SA SI CL				
0.0 326.6	TOPSOIL (200mm)							20	40	60	80	100										
0.3	SAND, trace to some silt, trace clay Very Loose to Loose Brown Moist (FILL)		1	SS	4		326											0 87 10 3				
			2	SS	2																	
323.9			3	SS	2			325												0 9 48 43		
			4	SS	5																	
3.0	SAND, trace silt, trace gravel Compact to Dense Brown Moist		5	SS	15				324													
			6	SS	31																	
322.1			7	SS	30	322																
			8	SS	17																	
4.7	Silty CLAY, trace sand Very Stiff Brown Moist						321															
			9	SS	48																	
317.3	Hard							320														
9.5	END OF BOREHOLE AT 9.5m. BOREHOLE OPEN TO 5.3m AND WATER LEVEL AT 4.9m UPON		10	SS	72	319																
							318															

Continued Next Page

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

## METRIC

[illegible]








RECORD OF BOREHOLE No RW10-05

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 814 614.5 E 226 513.4 ORIGINATED BY JB  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
DATUM Geodetic DATE 2016.10.26 - 2016.10.26 LATITUDE 43.467350 LONGITUDE -80.467548 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 W <sub>P</sub> NATURAL MOISTURE CONTENT W      LIQUID LIMIT W <sub>L</sub>				
324.7	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL (400mm)		1	SS	8													
324.3																		
0.4	SAND, some silt to silty Compact to Loose Brown Moist		2	SS	23		324											
	Clayey silt layer at 1.10m (400mm)		3	SS	9		323											
322.5																		
2.2	Silty CLAY Very Stiff Grey Moist		4	SS	27		322											
			5	SS	25		321											
			6	SS	18		320											
319.1							319											
5.6	SAND and SILT, trace to some clay Dense to Very Dense Grey Wet		7	SS	41		318											
							317											
316.6			8	SS	61													
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE.																	

ONTMT452 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/16/19





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

# RECORD OF BOREHOLE No RW10-06

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 814 638.7 E 226 573.6 ORIGINATED BY JB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2016.10.24 - 2016.10.25 LATITUDE 43.467574 LONGITUDE -80.466808 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 (%)		
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												
318.6	GROUND SURFACE																	
0.0	TOPSOIL (500mm)		1	SS	10													
318.1																		
0.5	Silty <b>CLAY</b> Stiff to Very Stiff Brown to Grey Moist		2	SS	12		318											
			3	SS	17		317											
	Grey		4	SS	16		316											
315.2			5	SS	18													
3.4	<b>SAND</b> , trace to some silt, trace clay Compact Grey Wet						315									0   0   47   53		
			6	SS	29		314									0   87       13 (SI+CL)		
							313											
			7	SS	25		312											
							311											
	Loose		8	SS	5													
310.0							310											
8.6	Silty <b>SAND</b> , trace clay, trace gravel Compact Grey Wet		9	SS	19											0   71   25   4		
							309											

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 RW10-06

2 OF 2

METRIC

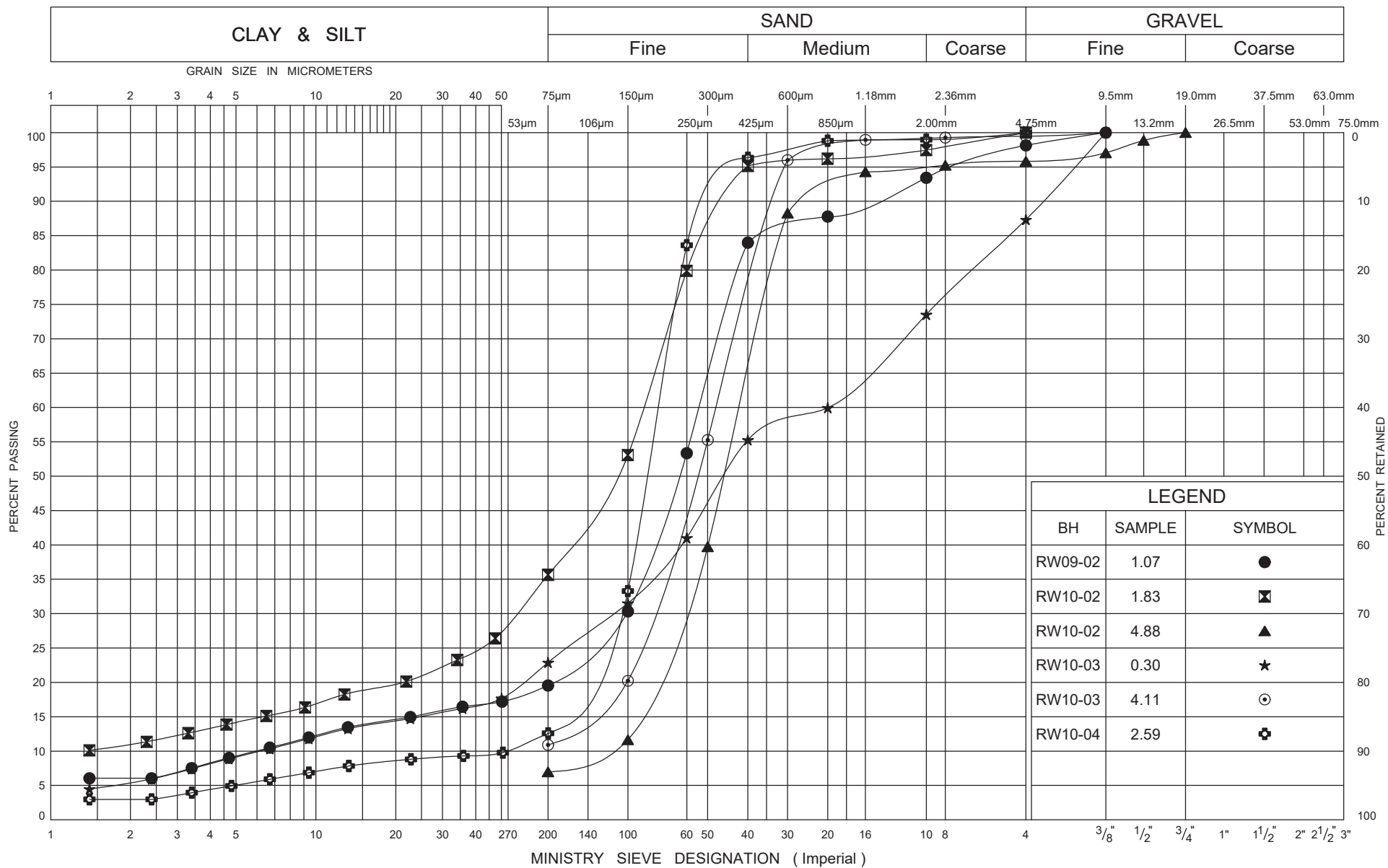
GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 814 638.7 E 226 573.6 ORIGINATED BY JB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2016.10.24 - 2016.10.25 LATITUDE 43.467574 LONGITUDE -80.466808 CHECKED BY NB

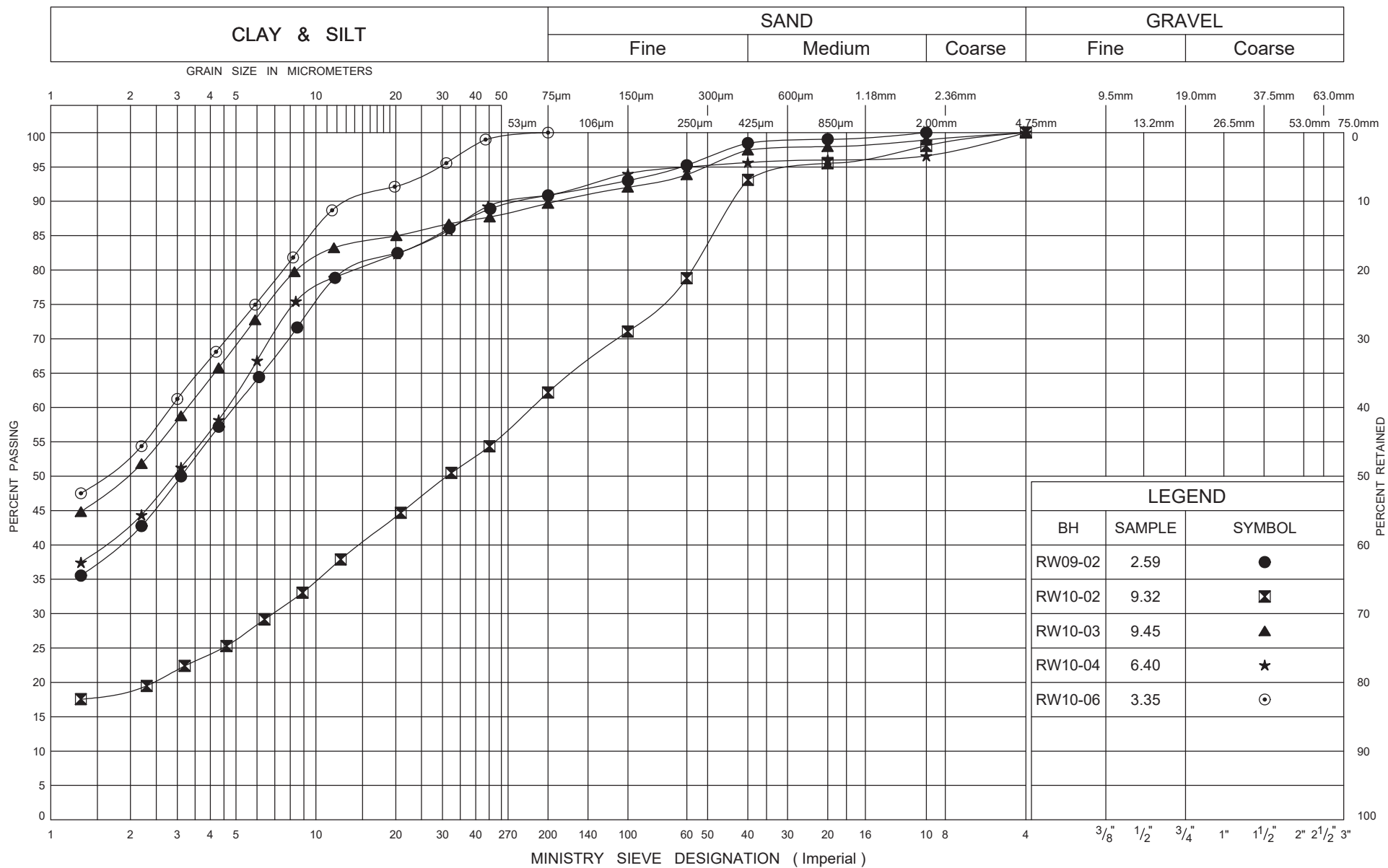
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			W <sub>P</sub>	W	W <sub>L</sub>			
								○ UNCONFINED      + FIELD VANE	WATER CONTENT (%)							
							● QUICK TRIAXIAL      × LAB VANE									
							20    40    60    80    100				20    40    60					
	Continued From Previous Page															
			10	SS	72		308									
							307									
	Loose		11	SS	9											
	DCPT from 12.9m to 13.5m						306									
305.1																
13.5	END OF BOREHOLE AT 13.5m UPON DCPT REFUSAL. WATER LEVEL AT 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE.															

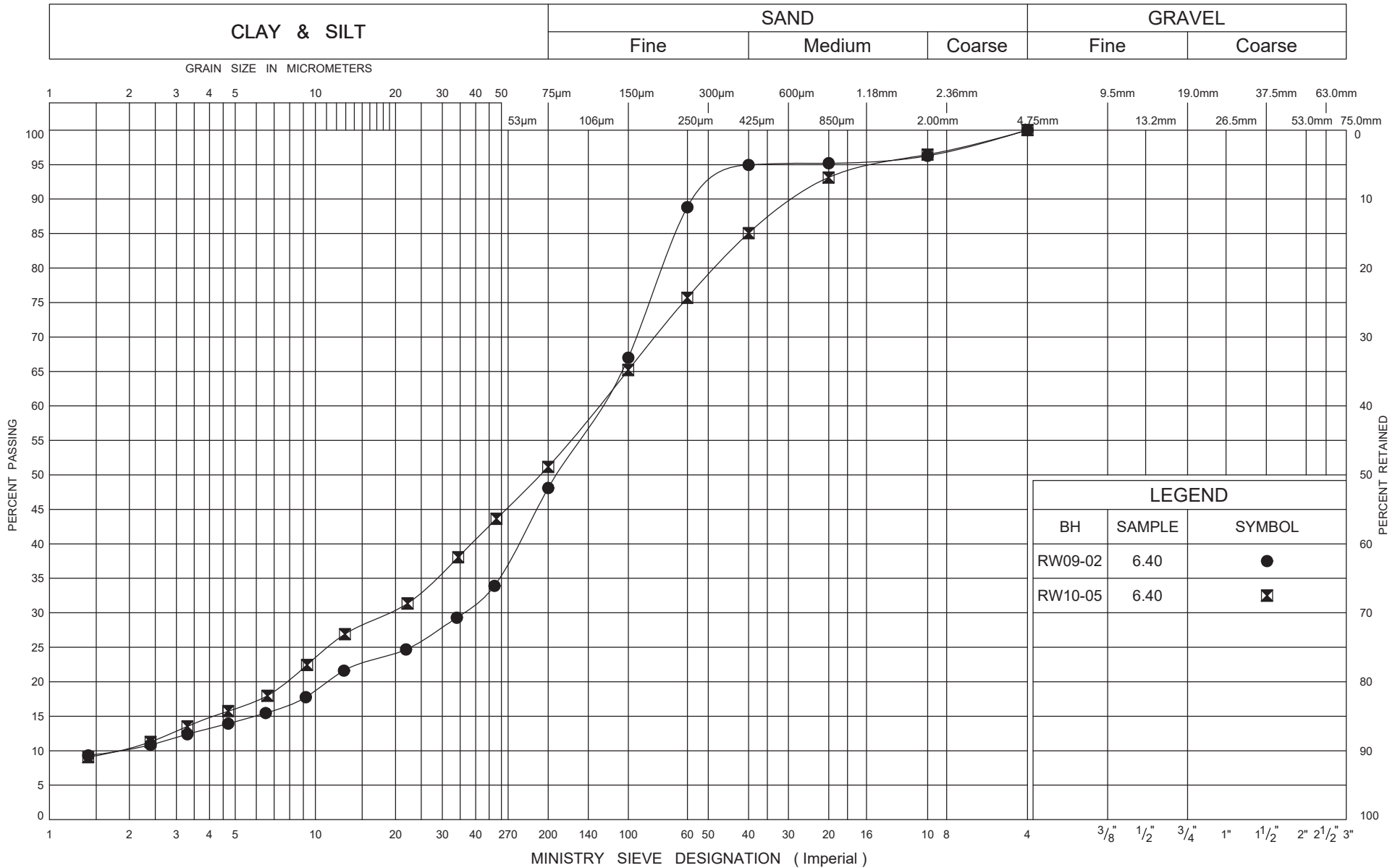
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

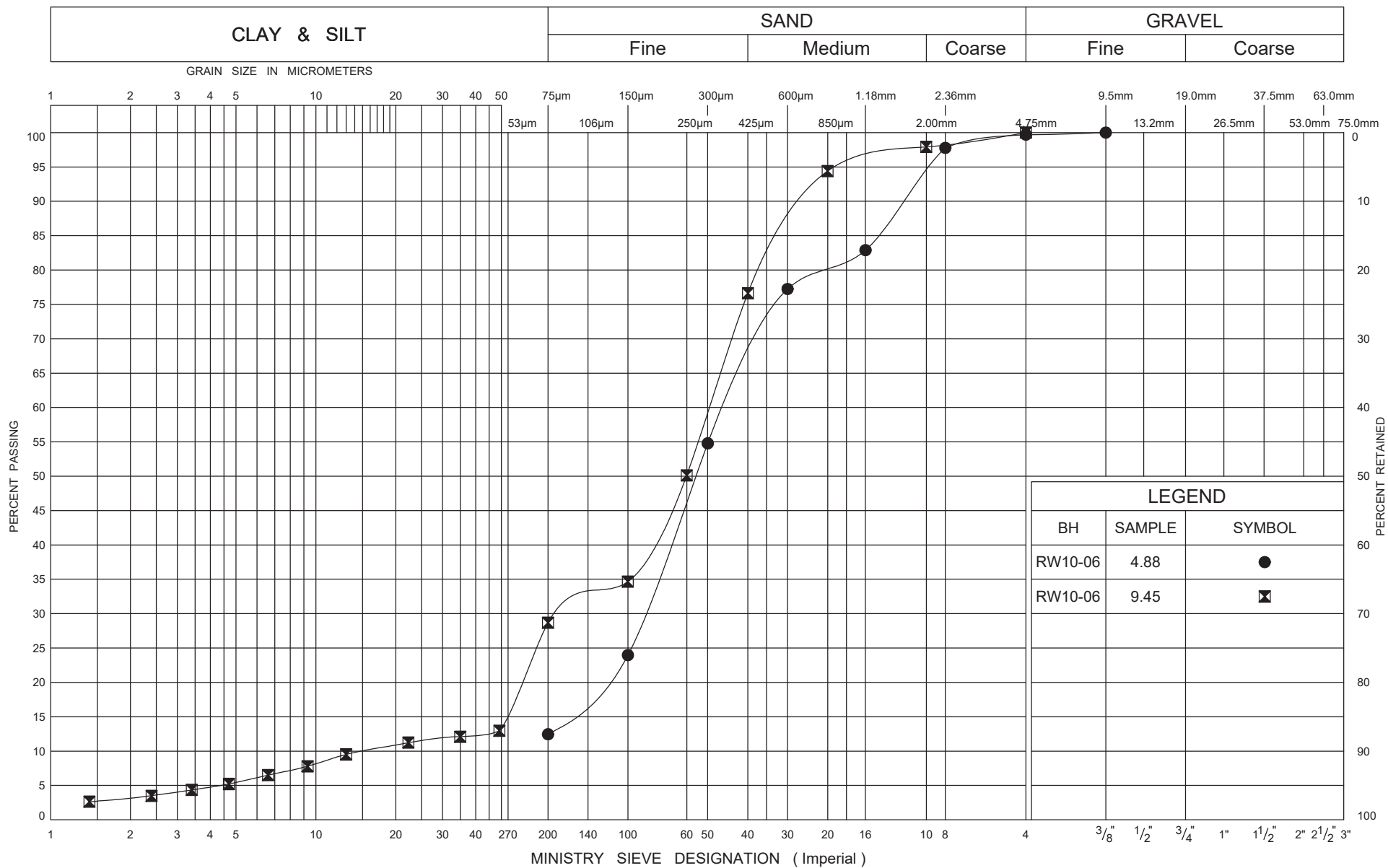
20  
15  
10

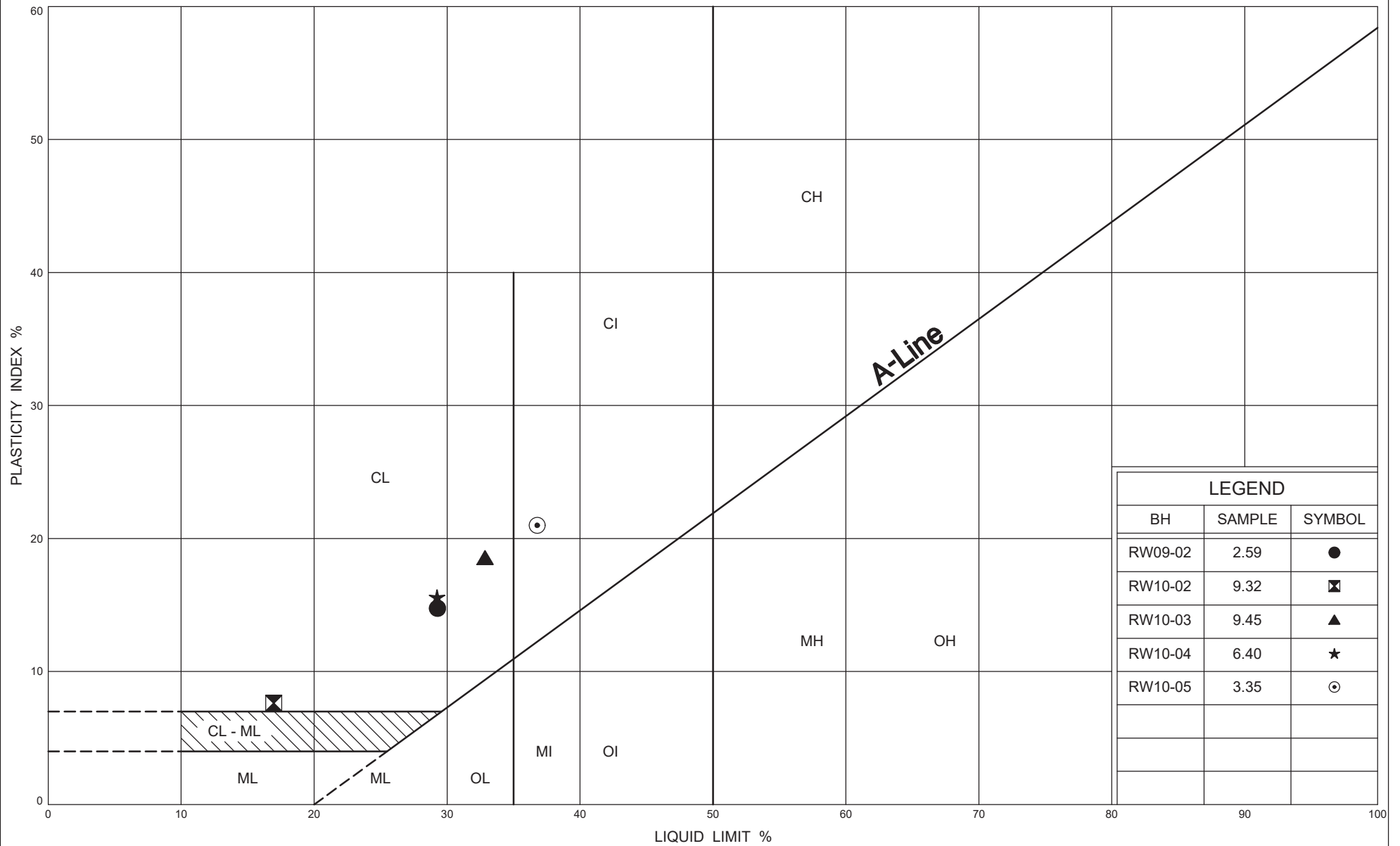
(%) STRAIN AT FAILURE

















## **Appendix D**

### **Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing**

**Retaining Wall 12  
(RW12-01 to RW12-06)**

# RECORD OF BOREHOLE No RW12-01

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 519.7 E 226 387.0 ORIGINATED BY MB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.04 - 2018.05.04 LATITUDE 43.466492 LONGITUDE -80.469093 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					
324.6	GROUND SURFACE							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
0.0	<b>SAND</b> , some gravel, trace silt and clay, occasional organics Compact Brown Moist (FILL)		1	SS	12		324	20 40 60 80 100	○	+			
			2	SS	20			20 40 60 80 100	○				15 80 5 (SI+CL)
			3	SS	15		323	20 40 60 80 100	○				
322.3													
2.2	<b>SAND</b> , trace silt, trace clay, trace gravel Compact to Loose Brown Moist		4	SS	19		322	20 40 60 80 100	○				
			5	SS	4		321	20 40 60 80 100	○				
320.4													
4.1	Silty <b>CLAY</b> , some sand, trace gravel Very Stiff Brown Moist (TILL)		6	SS	21		320	20 40 60 80 100	○				
							319	20 40 60 80 100					
			7	SS	19		318	20 40 60 80 100	○				7 19 39 35
							317	20 40 60 80 100					
			8	SS	19		316	20 40 60 80 100	○				
315.9													
8.7	<b>SAND</b> , trace gravel, trace silt, trace clay Dense to Very Dense Brown Moist		9	SS	38		315	20 40 60 80 100	○				
314.6													

Continued Next Page



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

# RECORD OF BOREHOLE No RW12-01

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 519.7 E 226 387.0 ORIGINATED BY MB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.04 - 2018.05.04 LATITUDE 43.466492 LONGITUDE -80.469093 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 (%) 20 40 60									
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub>									
10.0	Continued From Previous Page  <b>SAND</b> , trace gravel, trace silt, trace clay Very Dense Brown Moist						314									
			10	SS	74											1 84 8 7
312.2							313									
12.3	Silty <b>CLAY</b> Hard Brown Moist		11	SS	100		312									
			12	SS	64		311									
																0 0 43 57
							310									
			13	SS	52		309									
308.7																
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, THEN AUGER CUTTINGS TO SURFACE.															

ONTMT452 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

# RECORD OF BOREHOLE No RW12-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 541.0 E 226 436.3 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Casing Advance COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.07 - 2018.05.07 LATITUDE 43.466678 LONGITUDE -80.468481 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 (%)						
								20 40 60 80 100				w <sub>P</sub> w w <sub>L</sub>						
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
325.1	GROUND SURFACE																	
0.0	<b>SAND</b> , trace silt and clay, trace gravel Compact Brown Moist (FILL)		1	SS	18		325						○					
			2	SS	18		324						○					
			3	SS	15		323						○			5 86 9 (SI+CL)		
			4	SS	18		322						○					
322.1							321											
3.0	<b>SAND</b> , trace silt, trace gravel Compact Brown Wet		5	SS	14		320						○			Switch to casing advancer		
321.0							319											
4.1	Silty <b>CLAY</b> , some sand to sandy, trace gravel Hard Brown to Grey Moist (TILL)		6	SS	30		318						○			3 24 50 23		
			7	SS	34		317						○					
317.9							316											
7.2	<b>SAND</b> , trace to some silt, trace clay Very Dense Grey to Brown Wet		8	SS	64		315						○			0 89 7 4		
			9	SS	72													
315.1																		

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RW12-02 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 541.0 E 226 436.3 ORIGINATED BY JP  
DIST HWY 7 BOREHOLE TYPE Casing Advance COMPILED BY MP  
DATUM Geodetic DATE 2018.05.07 - 2018.05.07 LATITUDE 43.466678 LONGITUDE -80.468481 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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
				○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE															
	Continued From Previous Page							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>				
10.0	<b>SAND</b> , trace to some silt, trace clay Very Dense Grey Wet						315												
			10	SS	80		314							○					
														○					
312.9							313												
12.2	Silty <b>CLAY</b> , trace sand Hard Grey Moist		11	SS	90		312							○					
			12	SS	62		311							○					
							310												
			13	SS	31									○	—			0	7 35 58
309.2																			
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																		

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

## METRIC

[illegible]

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

# RECORD OF BOREHOLE No RW12-03

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 557.8 E 226 482.0 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.07 - 2018.05.07 LATITUDE 43.466834 LONGITUDE -80.467923 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 (%)	
								20 40 60 80 100	○ UNCONFINED + FIELD VANE									
Continued From Previous Page																		
10.0	Silty <b>CLAY</b> , trace to some sand Very Stiff Grey Moist						315									0 46 50 4		
314.3			10	SS	44													
11.0	<b>SAND</b> and <b>SILT</b> , trace gravel, trace clay Dense to Very Dense Grey Wet																	
			11	SS	54/ 0.125													
			12	SS	73/ 0.125													
310.0							311											
15.2	Silty <b>CLAY</b> Hard Grey Moist		13	SS	55		310									0 0 41 59		
309.4																		
15.8	END OF BOREHOLE AT 15.8m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.05.16 8.3 316.9 2018.05.31 8.2 317.1 2018.06.25 7.9 317.3																	

ONTMT452 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19



# RECORD OF BOREHOLE No RW12-04

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 584.9 E 226 524.5 ORIGINATED BY MB  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/DCPT COMPILED BY MP  
DATUM Geodetic DATE 2018.04.19 - 2018.04.19 LATITUDE 43.467045 LONGITUDE -80.467331 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
325.1	GROUND SURFACE							20 40 60 80 100						
0.0	Silty <b>SAND</b> , trace gravel, trace clay, occasional organics Dense to Compact Brown Moist (FILL)		1	SS	38			○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
			2	SS	15									0 64 28 8
323.7														
1.4	<b>SAND</b> , trace silt Compact Brown Moist		3	SS	16									
323.1														
2.0	Silty <b>CLAY</b> , trace to some sand Very Stiff Grey Moist		4	SS	23									
			5	SS	26									0 10 43 47
	layer of silty sand at 4.6m (100mm)		6	SS	28									
			7	SS	30									0 0 39 61
317.9														
7.2	<b>SAND</b> and <b>SILT</b> , trace clay Very Dense Brown Moist		8	SS	61									
	occasional cobbles													
			9	SS	100/ 0.250									0 40 53 7
315.1														

Continued Next Page

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

# RECORD OF BOREHOLE No RW12-04

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 584.9 E 226 524.5 ORIGINATED BY MB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/DCPT COMPILED BY MP  
 DATUM Geodetic DATE 2018.04.19 - 2018.04.19 LATITUDE 43.467045 LONGITUDE -80.467331 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	
	Continued From Previous Page							20	40	60	80	100								
10.0	<b>SAND</b> and <b>SILT</b> , trace clay Very Dense Brown Moist						315													
			10	SS	69		314							○						
313.3																				
11.7	Silty <b>CLAY</b> Hard Brown Moist						313							○						
			11	SS	37		312													
			12	SS	51		311							○						
							310													
			13	SS	51									○						
309.2																				
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 14.0m AND WATER LEVEL AT 13.4m UPON COMPLETION. DCPT FROM GROUND SURFACE TO 3.6m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.5m slotted screen.  WATER LEVEL READINGS DATE                  DEPTH(m)    ELEV.(m)  Piezometer was destroyed																			

ONTMT452 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

# RECORD OF BOREHOLE No RW12-05

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 607.0 E 226 600.3 ORIGINATED BY MB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/DCPT COMPILED BY MP  
 DATUM Geodetic DATE 2018.04.20 - 2018.04.20 LATITUDE 43.467165 LONGITUDE -80.466762 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
323.4	GROUND SURFACE							20 40 60 80 100	20 40 60					
0.0	Silt <b>SAND</b> , to <b>SAND</b> and <b>SILT</b> , trace clay, trace gravel Compact Brown Moist to Wet (FILL)		1	SS	11		323							
			2	SS	13		322							
			3	SS	16		321							
321.3							320							
2.1	<b>SAND</b> Compact Grey Wet		4	SS	26		319							
320.5							318							
2.9	Silty <b>CLAY</b> , with sand, trace gravel Very Stiff Brown to Grey Moist		5	SS	24		317							
			6	SS	28		316							
			7	SS	23		315							
			8	SS	39		314							
314.7							313							
8.7	<b>SAND</b> , trace silt and clay, trace gravel Compact to Dense Brown Moist		9	SS	11		312							
313.4							311							

Continued Next Page

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

## METRIC

[illegible]

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

# RECORD OF BOREHOLE No RW12-06

1 OF 3

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 632.6 E 226 676.8 ORIGINATED BY JB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2016.10.20 - 2016.10.20 LATITUDE 43.467360 LONGITUDE -80.466142 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>P</sub>	W			W <sub>L</sub>	WATER CONTENT (%)	GR
321.2	GROUND SURFACE																		
0.0	Silty <b>SAND</b> , occasional organics Very Loose Brown Moist (FILL)		1	SS	3														
320.5																			
0.7	Silty <b>CLAY</b> Stiff to Very Stiff Brown Moist		2	SS	11														
			3	SS	21														
			4	SS	26														
			5	SS	21														
			6	SS	23														
			7	SS	21														
			8	SS	18														
			9	SS	38														

Continued Next Page

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

## METRIC

[illegible]

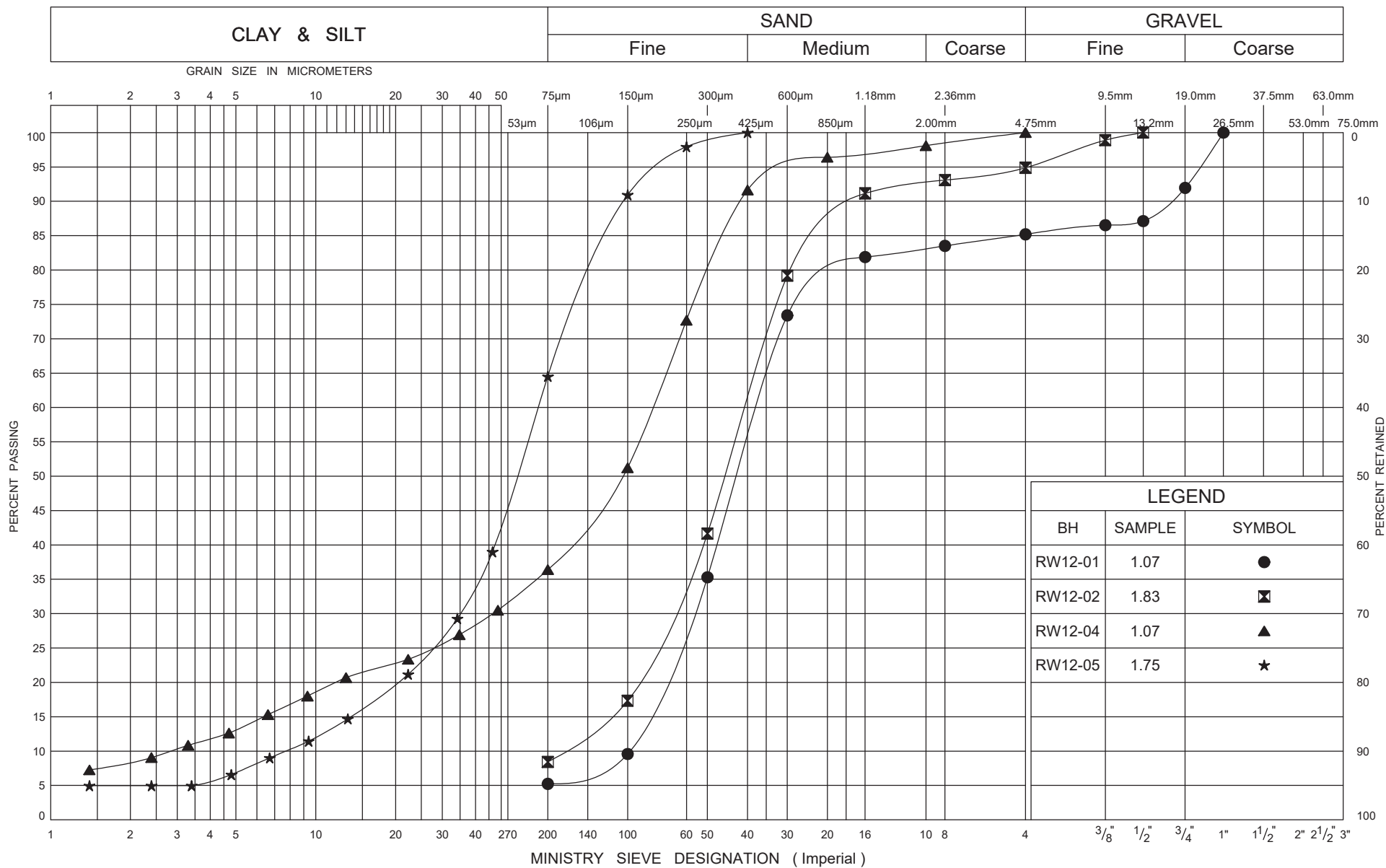
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

ONTMT4S2 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

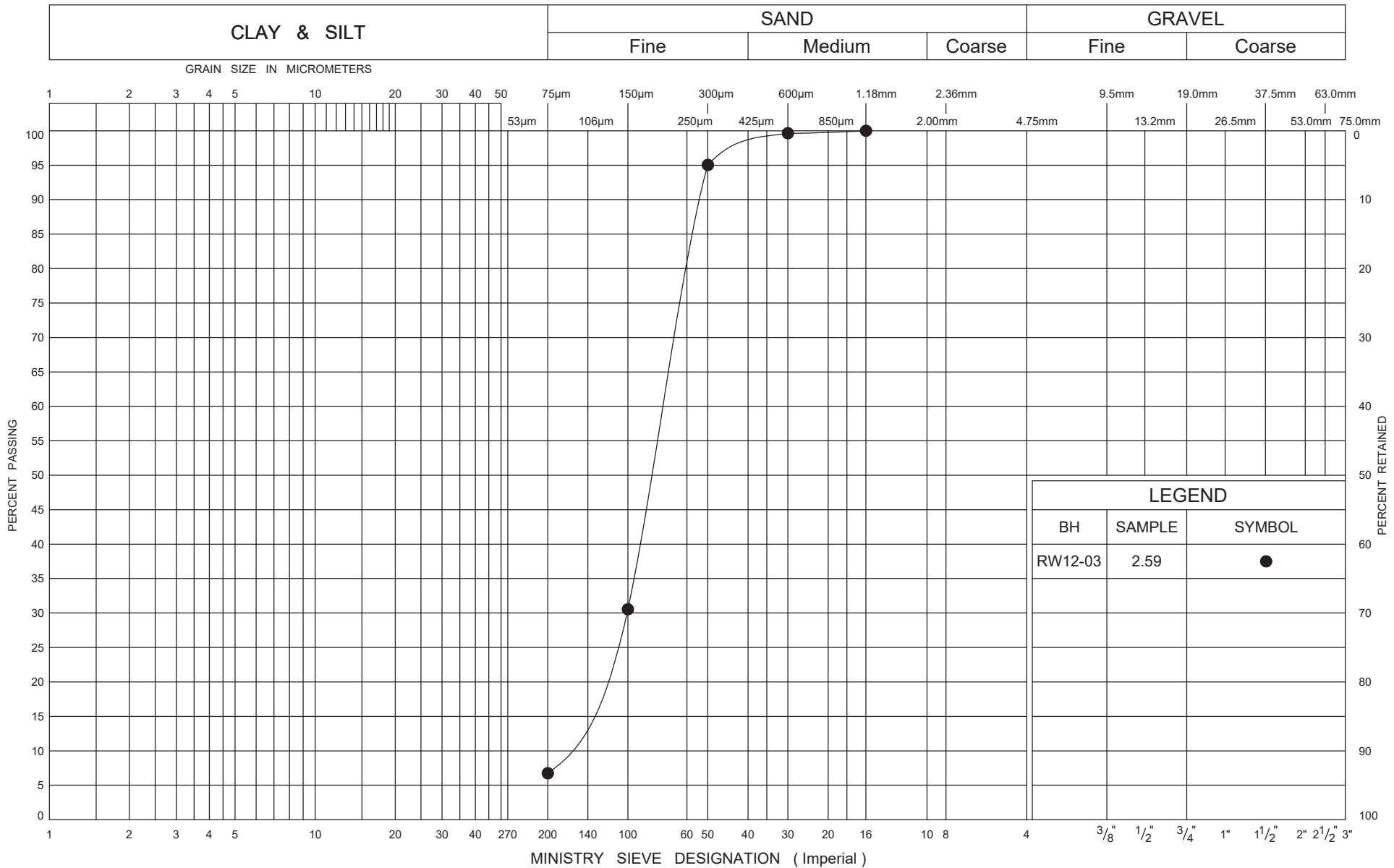
RECORD OF BOREHOLE No RW12-06 3 OF 3 METRIC

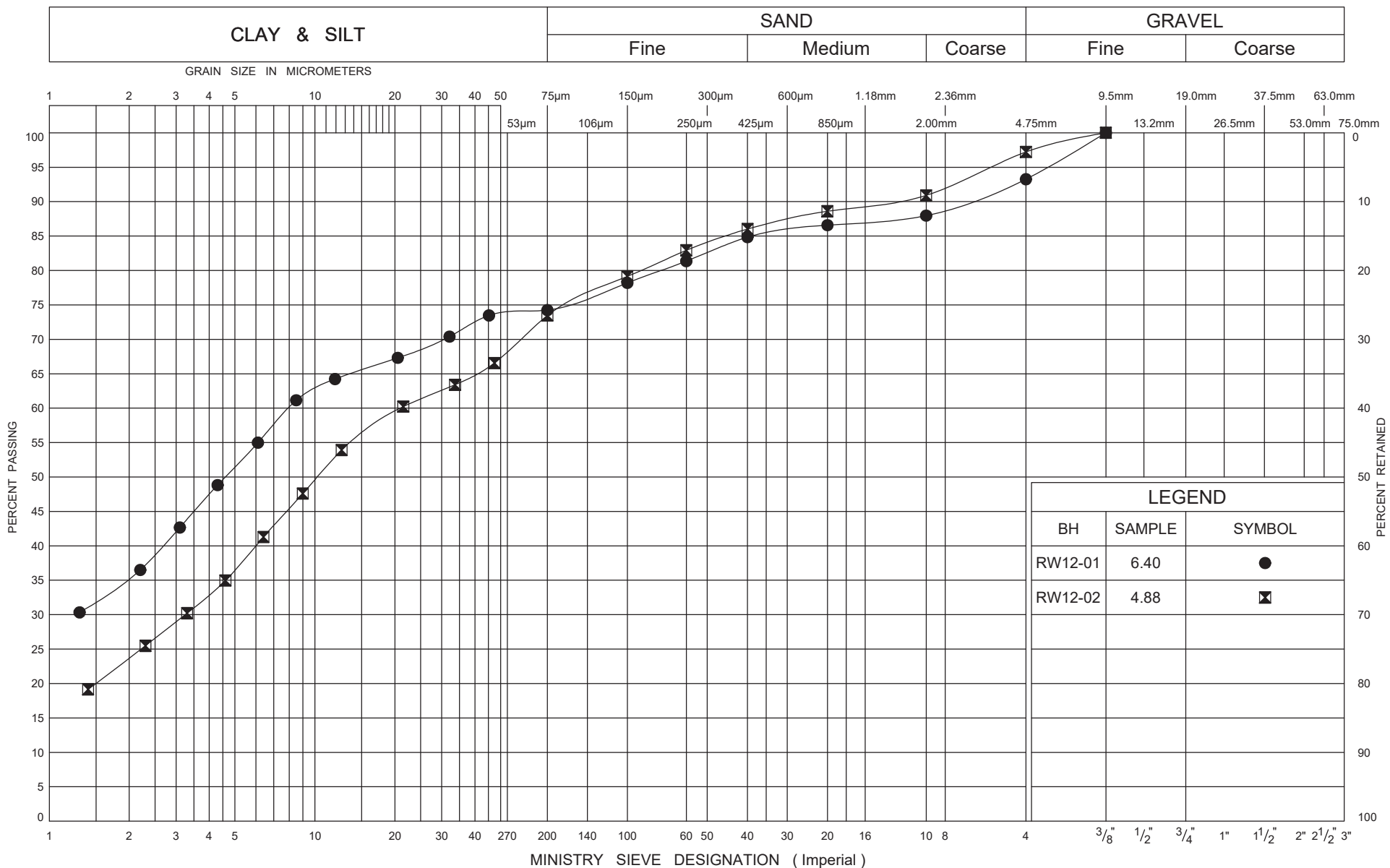
GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 632.6 E 226 676.8 ORIGINATED BY JB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2016.10.20 - 2016.10.20 LATITUDE 43.467360 LONGITUDE -80.466142 CHECKED BY NB

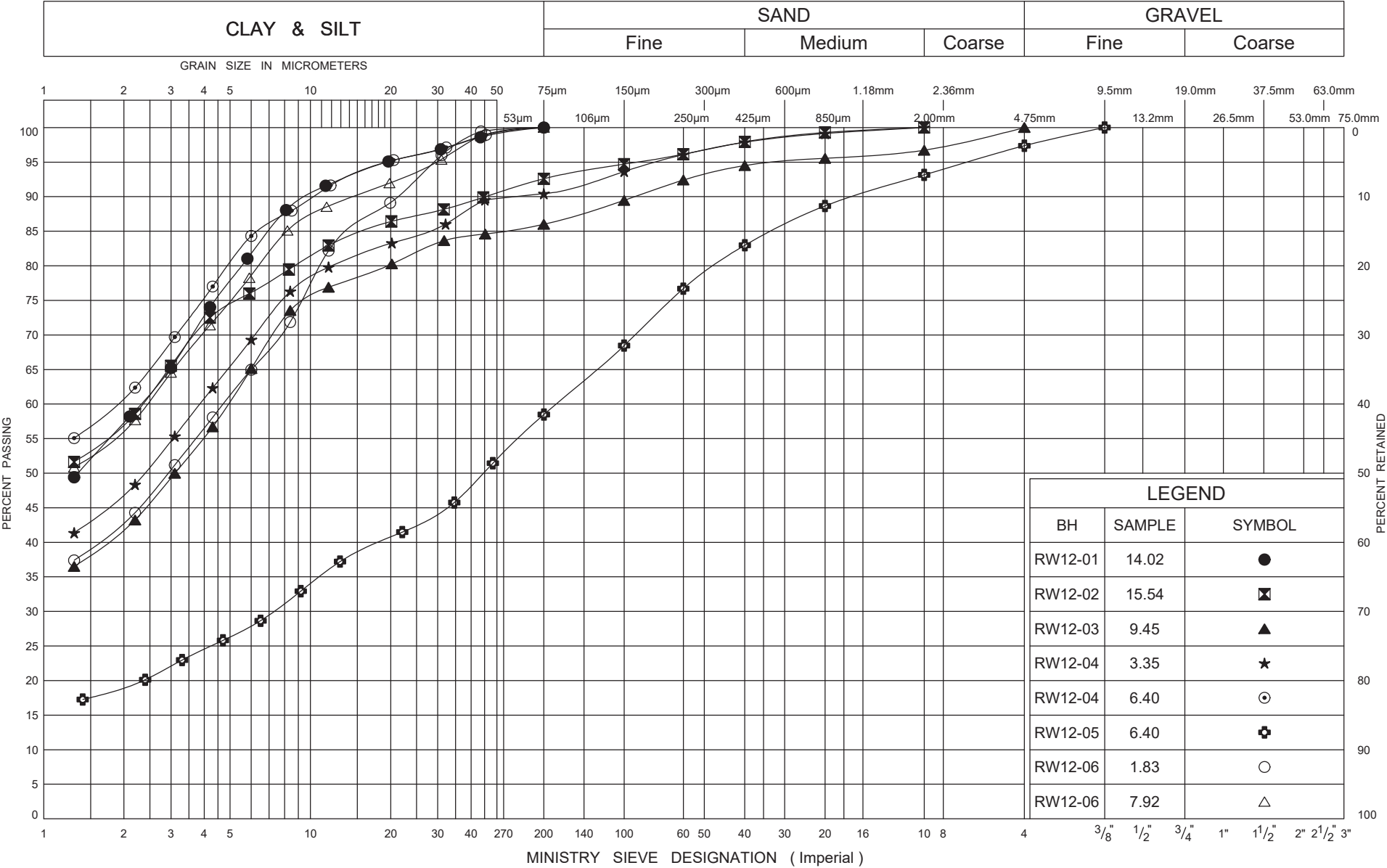
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT  W <sub>P</sub>	NATURAL MOISTURE CONTENT  W	LIQUID LIMIT  W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20	40	60	80	100						20	40	60
301.1	Continued From Previous Page		16	SS	130															
20.1	END OF BOREHOLE AT 20.1m. WATER LEVEL AT 10.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE.																			

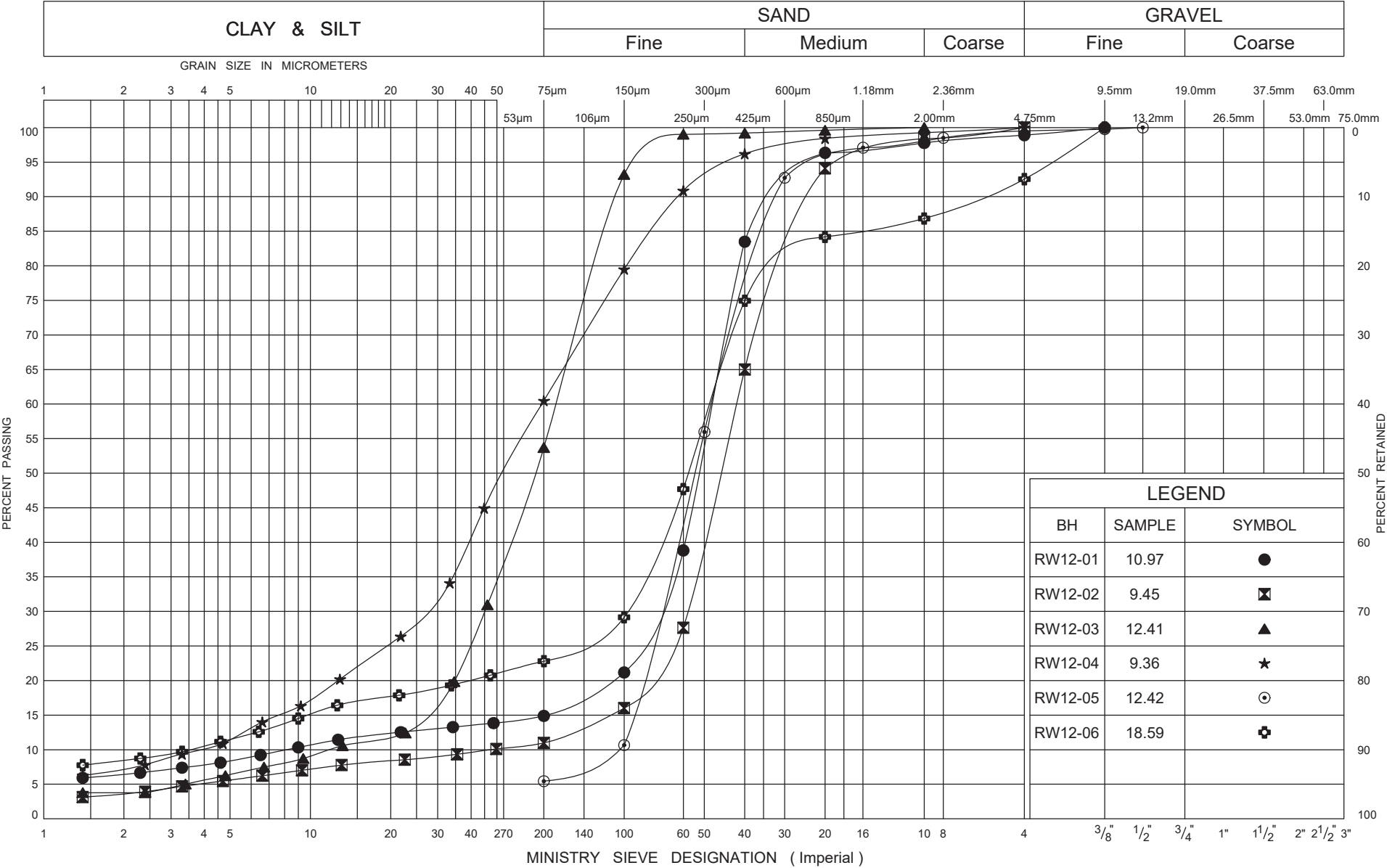


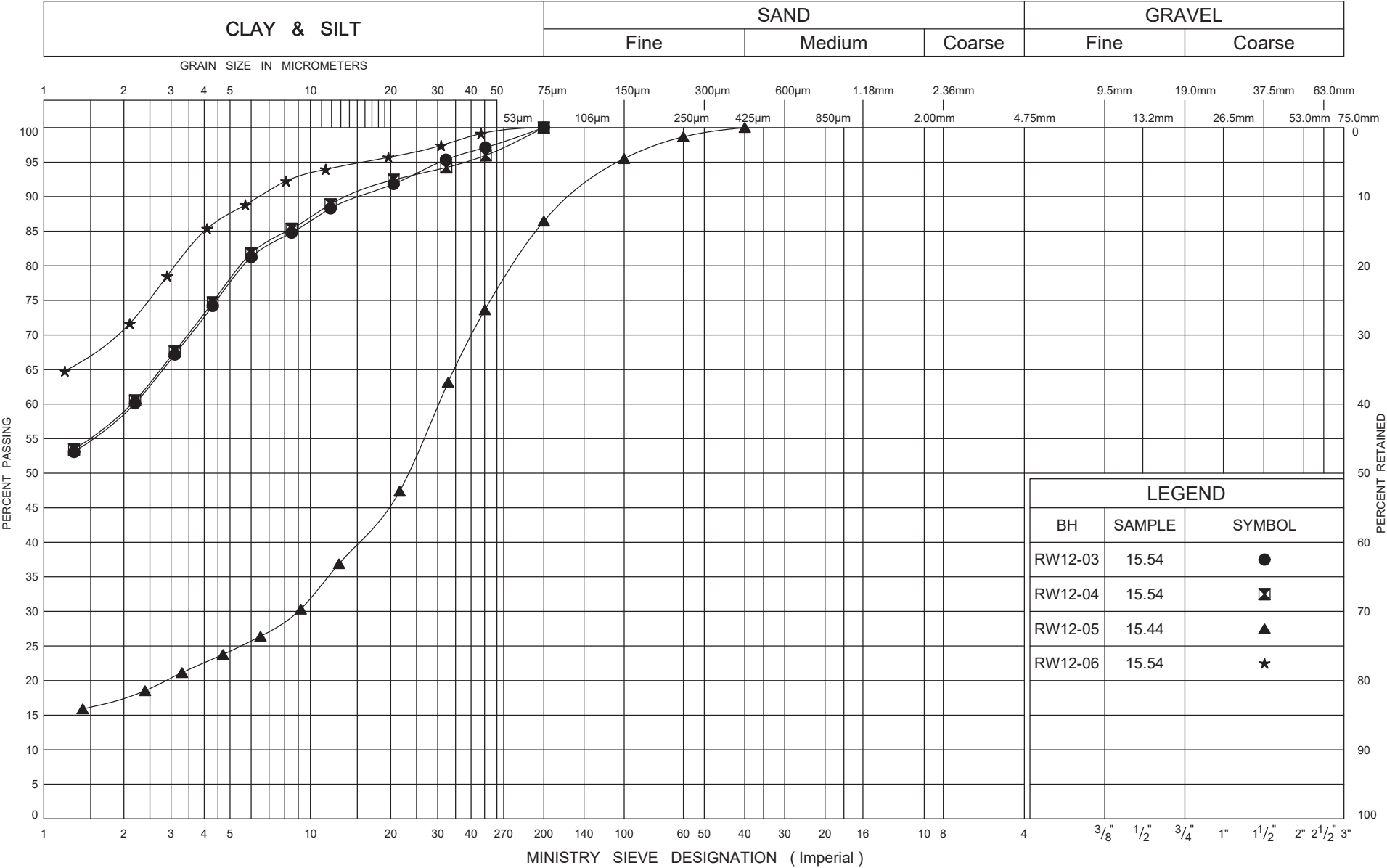


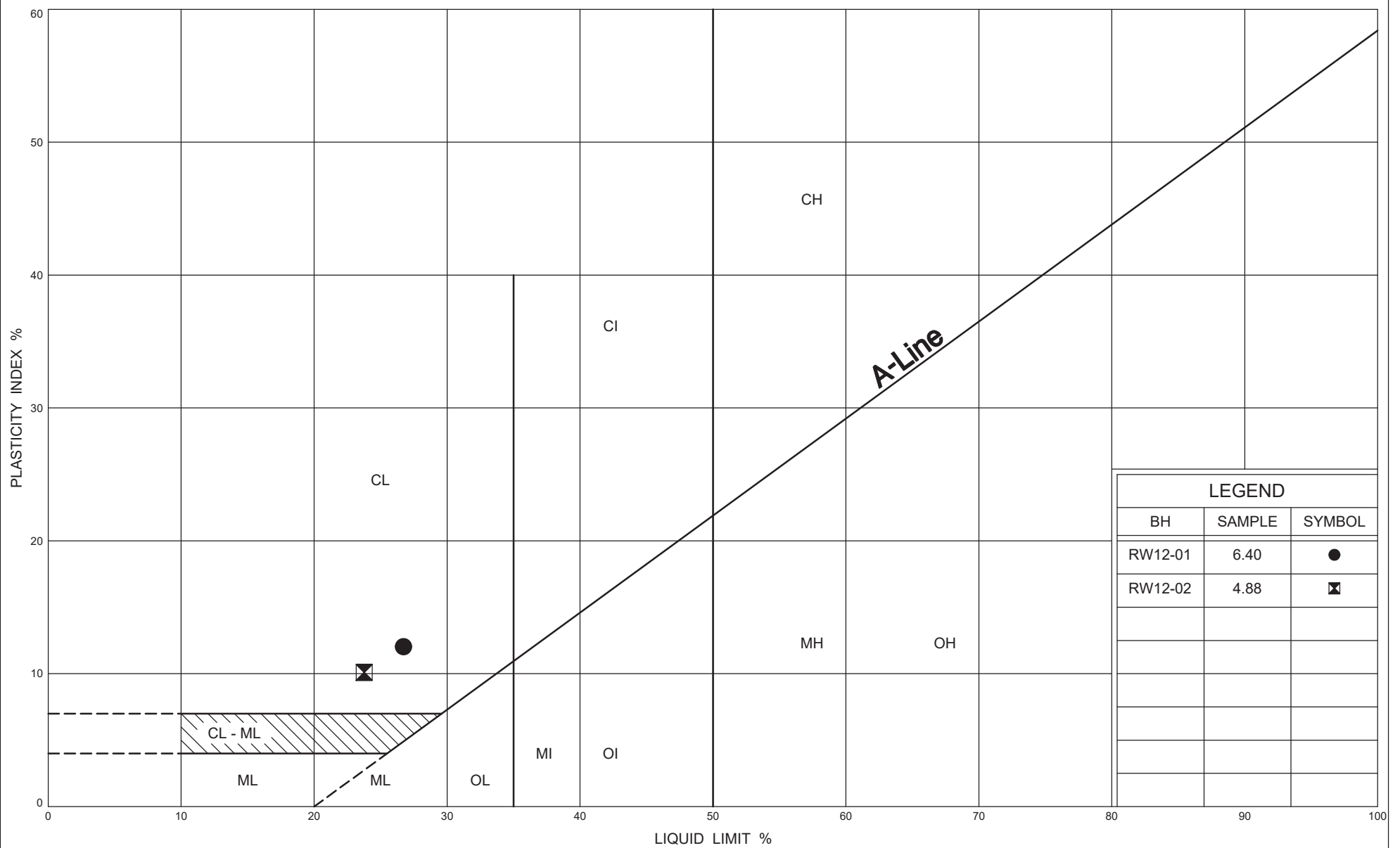












Ministry of  
Transportation

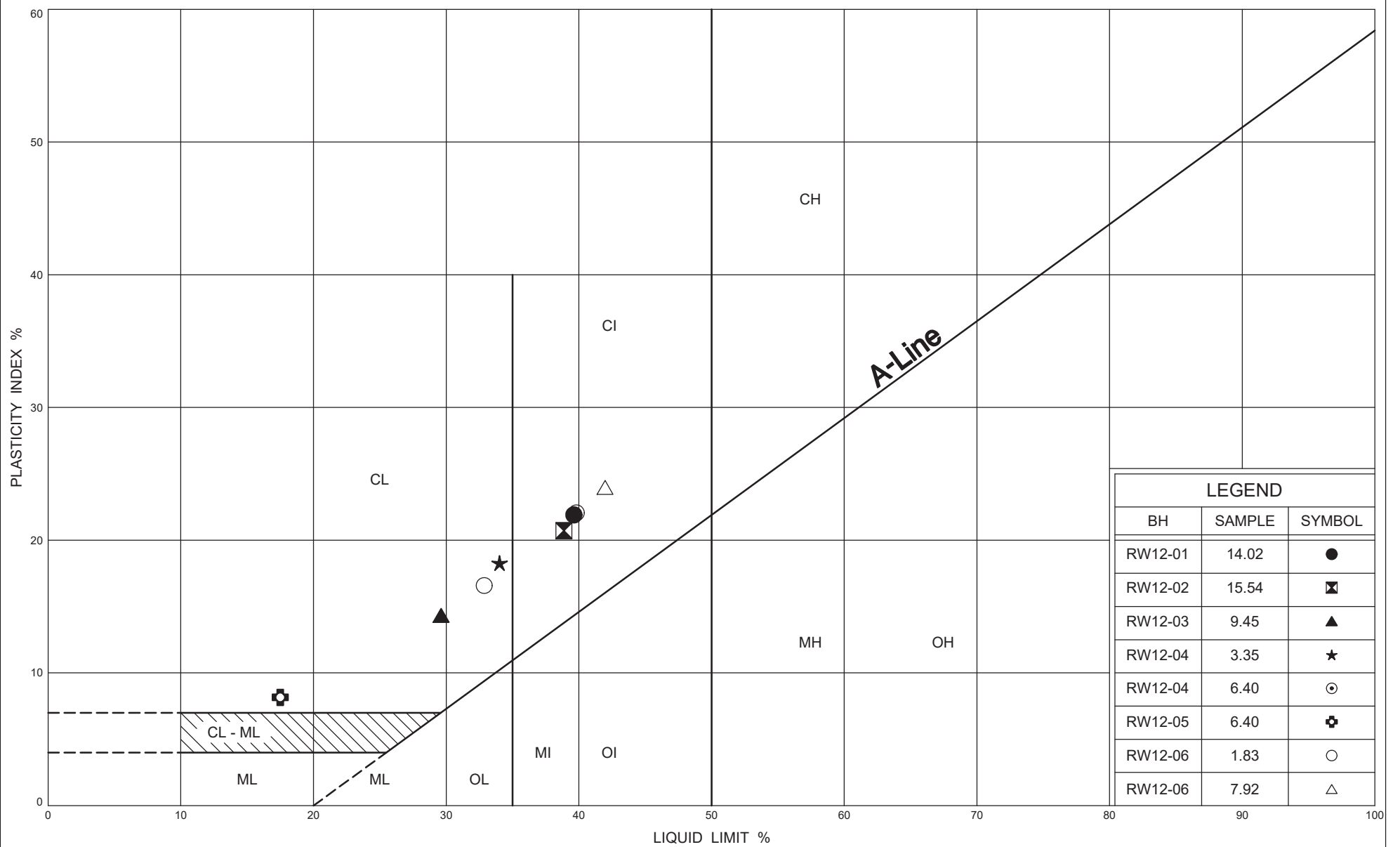
## PLASTICITY CHART

Silty CLAY TILL

FIG No D7

W P 408-88-00

Retaining Wall 12



Ministry of  
Transportation

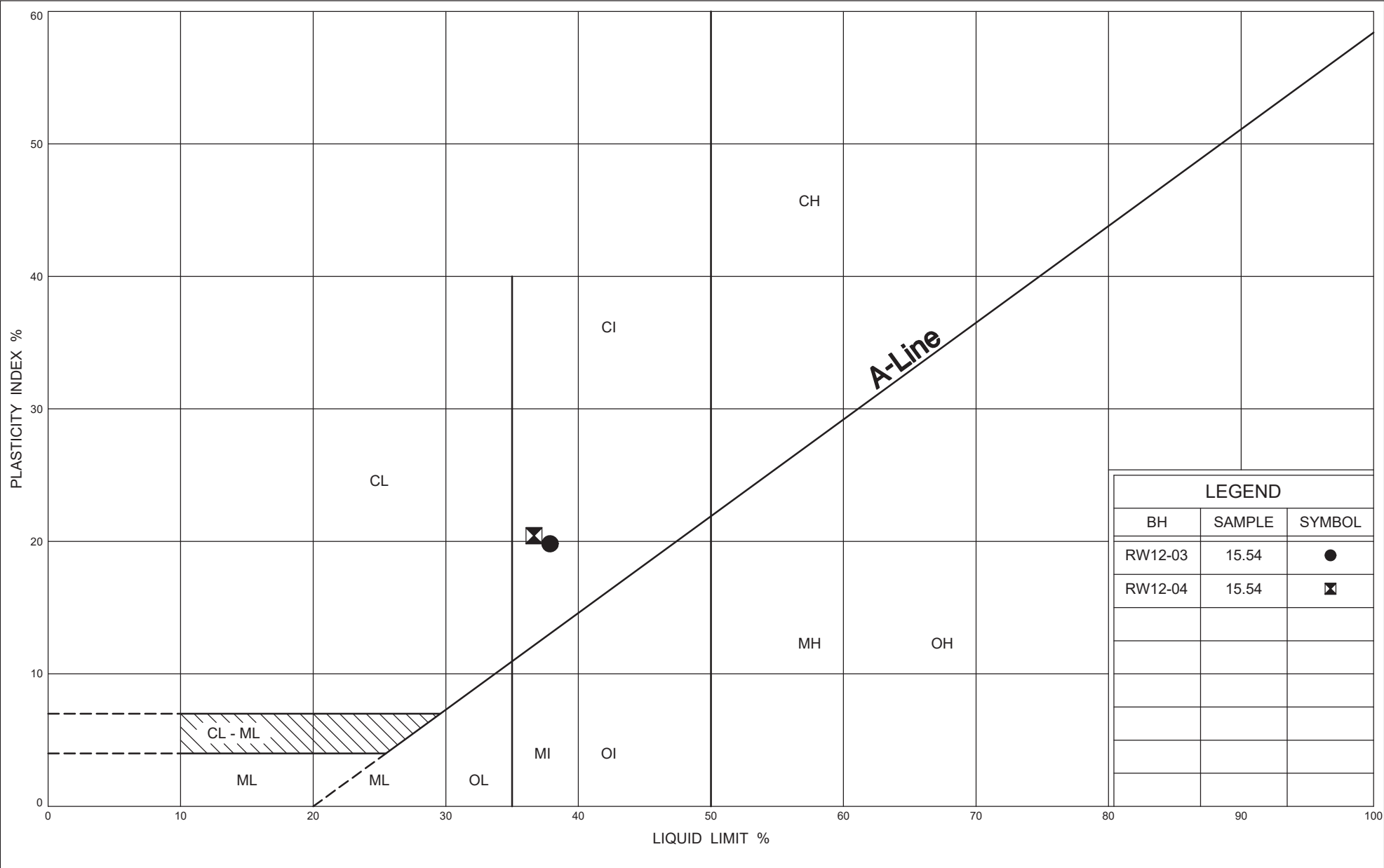
## PLASTICITY CHART

Upper Silty CLAY

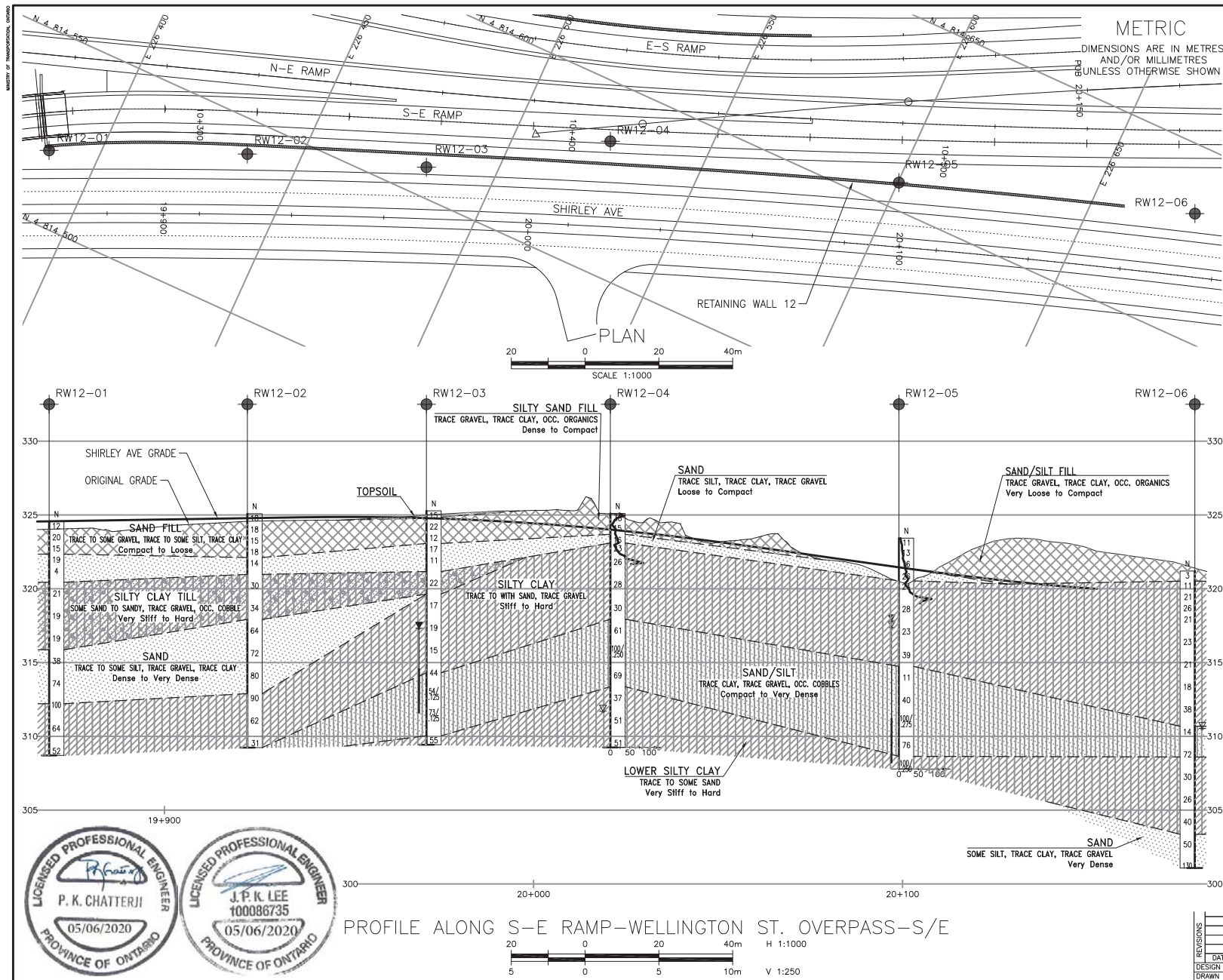
FIG No D8

W P 408-88-00

Retaining Wall 12







CONT No  
GWP No 408-88-00

HIGHWAY 7  
S-E RAMP-WELLINGTON ST. OVERPASS-S/E  
RETAINING WALL 12  
BOREHOLE LOCATIONS AND SOIL STRATA

**wsp**

**THURBER ENGINEERING LTD**

**SHEET**

**KEYPLAN**

Latitude: 43.466941° Longitude: -80.467629°

**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
- W Water Level
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW12-01	324.6	4 814 519.7	226 387.0
RW12-02	325.1	4 814 541.0	226 436.3
RW12-03	325.3	4 814 557.8	226 482.0
RW12-04	325.1	4 814 584.9	226 524.5
RW12-05	323.4	4 814 607.0	226 600.3
RW12-06	321.2	4 814 632.6	226 676.8

**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.

**GEOCRIS No. 40P9-58**

DATE	BY	DESCRIPTION
DESIGN	NB	CHK PKC CODE
DRAWN	MFA	CHK NB SITE
		STRUCT
		DWG 1



FILENAME: H:\Spatial\11000\11375\11375-TED-11375-BWP-RW12.dwg  
 PLOTDATE: 5/6/2020 4:24 PM



## **Appendix E**

### **Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing**

#### **Retaining Wall 16 (RW16-01 to RW16-03)**

# 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				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
321.3	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT: (150mm)							20	40	60	80	100					
0.2	Sandy SILT, with gravel Brown Dry (FILL)		1	GS			321										
320.5																	
0.8	SAND, some silt to silty, trace clay, trace gravel Compact Brown Wet		2	SS	25		320										
			3	SS	26												
319.0																	
2.3	Silty CLAY, trace sand, trace gravel Very Stiff Grey Moist		4	SS	25		319										
			5	SS	22		318										
							317										
			6	SS	21		316										
							315										
			7	SS	28												
							314										
	Hard		8	SS	58		313										
312.5																	
8.8	Sandy SILT, 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 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page							20 40 60 80 100	WATER CONTENT (%)									
							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									
319.0							319							
1.4	Silty CLAY, trace sand, trace shale Very Stiff to Hard Brown Dry to Moist		3	SS	25									
	Grey		4	SS	35		318							0   5   53   42
			5	SS	39		317							
							316							
			6	SS	38									
							315							
			7	SS	21		314							
							313							
			8	SS	32									
							312							
			9	SS	41		311							0   1   45   54
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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page							20	40	60	80	100					

# 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							
							316							Auger grinding
			6	SS	15		315							Auger grinding
							314							
							313							Auger grinding
			7	SS	23		312							
			8	SS	23		312							0 2 36 62
311.3														
8.7	Sandy SILT to Silty SAND Compact Grey Wet						311							Auger grinding
			9	SS	18		310							

Continued Next Page

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

RECORD OF BOREHOLE No RW16-03

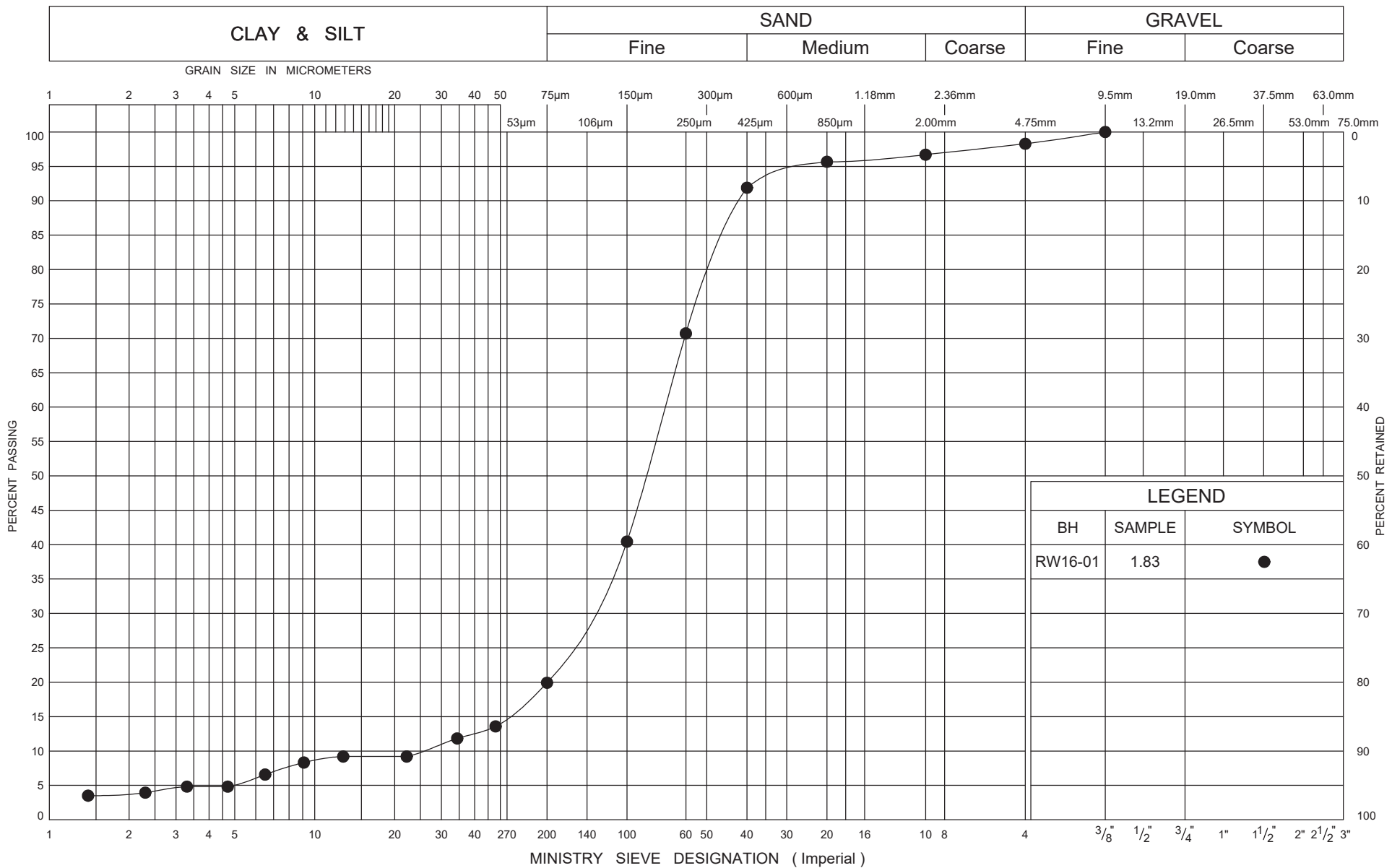
2 OF 2

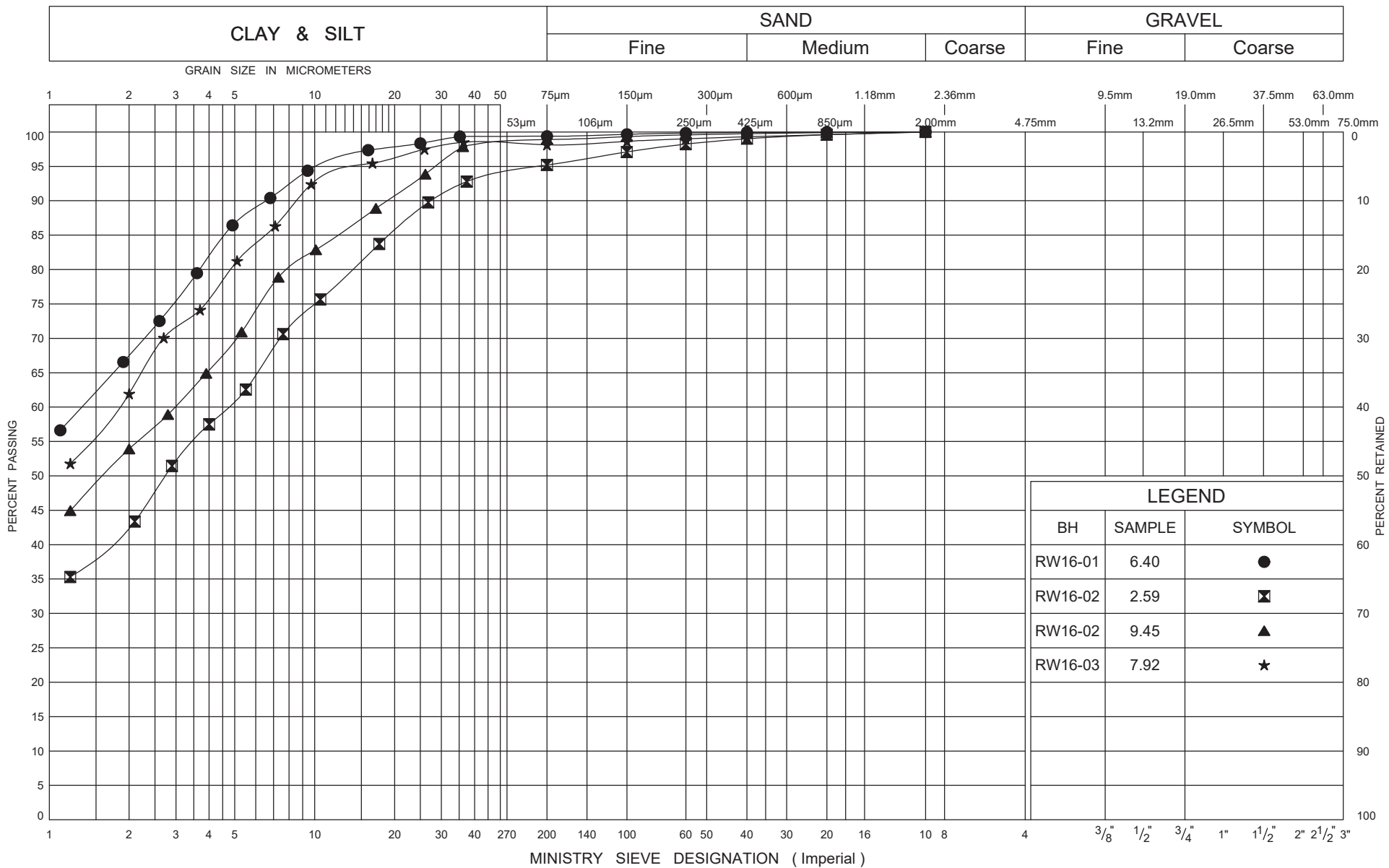
METRIC

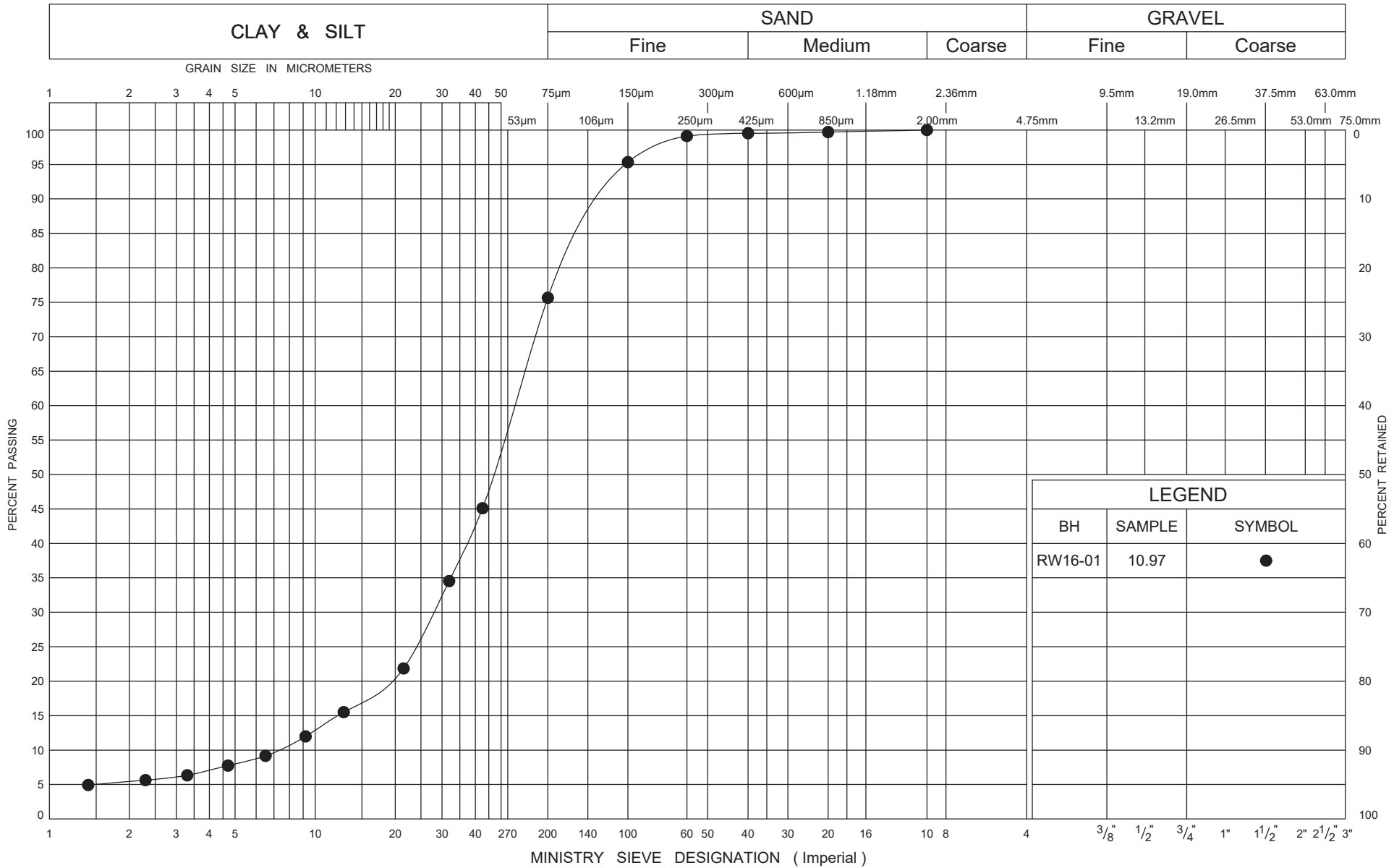
GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 755.4 E 226 164.5 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.15 - 2019.08.15 LATITUDE 43.459582 LONGITUDE -80.471709 CHECKED BY NB

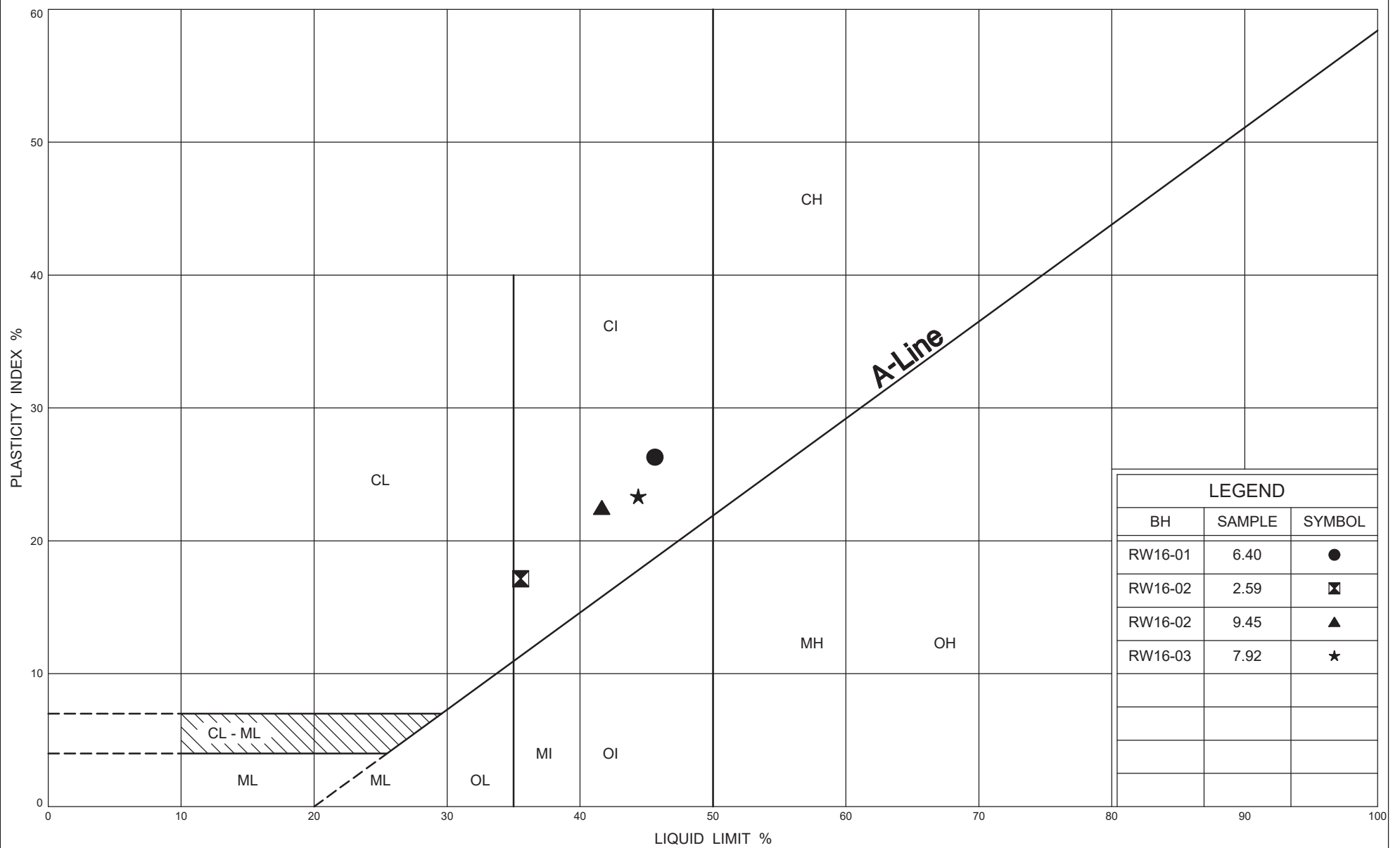
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page													
308.7	Sandy <b>SILT</b> to Silty <b>SAND</b> Compact Grey Wet		10	SS	27		309							Auger grinding
11.3	End of sampling DCPT from 11.3m to 12.5m						308							
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.													











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

## PLASTICITY CHART

### Silty CLAY

FIG No E4

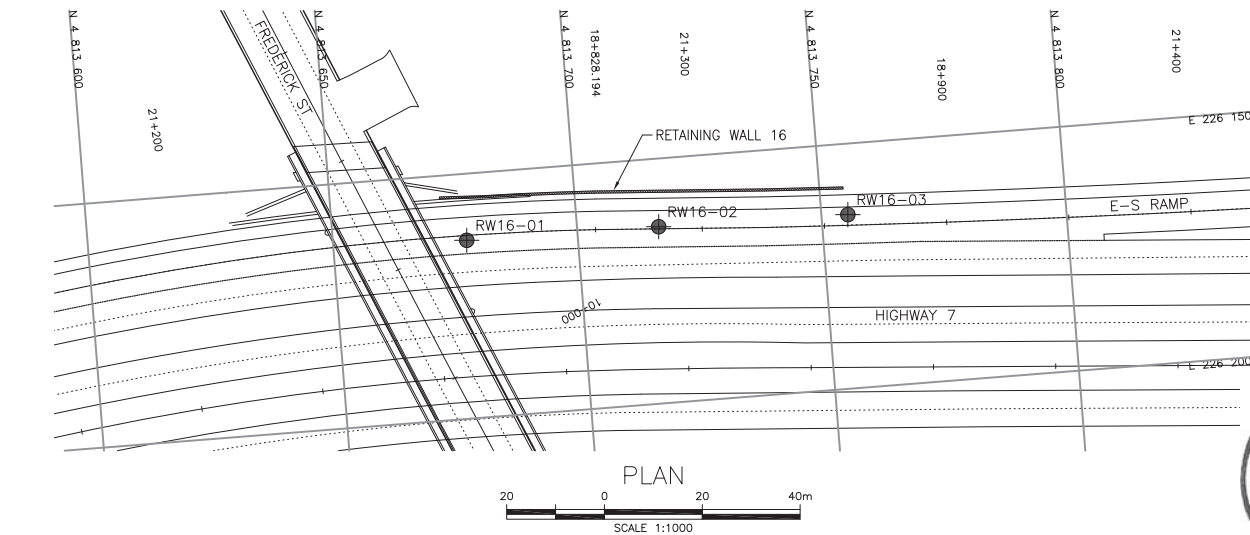
W P 408-88-00

Retaining Wall 16



Ministry of  
Transportation

Ontario



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

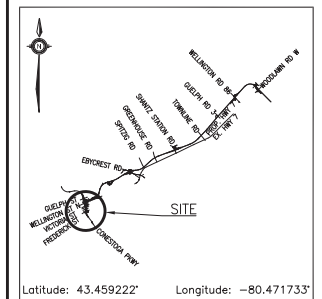
CONT No
GWP No 408-88-00








HIGHWAY 7  
HWY 85 SB/E-S RAMP  
RETAINING WALL 16  
BOREHOLE LOCATIONS AND SOIL STRATA



**THURBER ENGINEERING LTD.**



KEYPLAN  
LEGEND

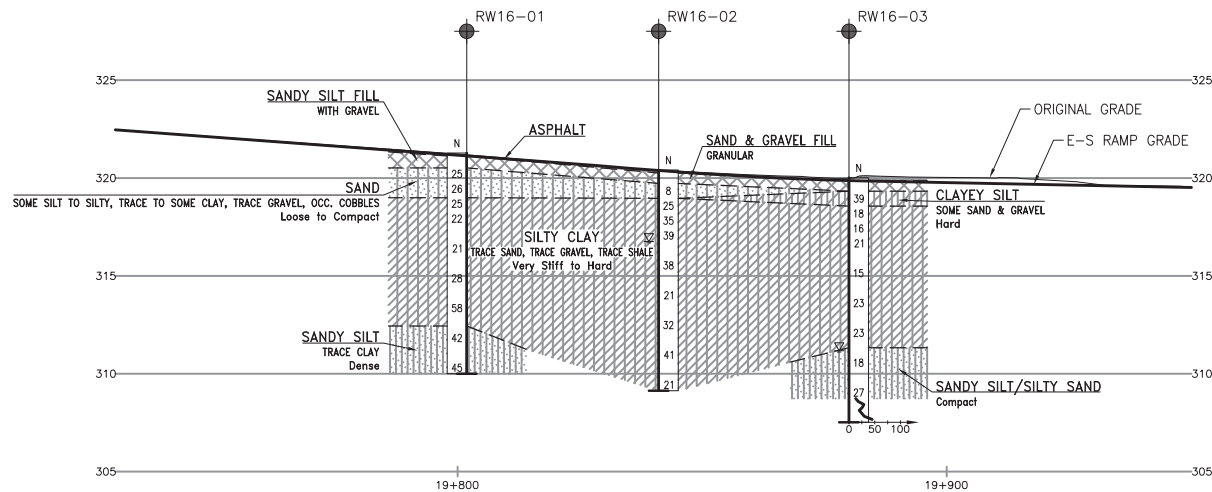
- |   |                                       |
|---|---------------------------------------|
|  | Borehole (Current Investigation)      |
|  | Borehole (by Others)                  |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic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

[illegible]

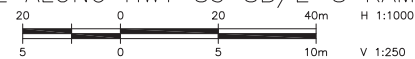
-NOTES-

- 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. 40P9-58



PROFILE ALONG HWY 85 SB/E-S RAMP

[illegible]



## **Appendix F**

### **Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing**

**Retaining Wall 24  
(RW24-01 to RW24-03)**

# RECORD OF BOREHOLE No RW24-01

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 847.4 E 226 015.2 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
 DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.469400 LONGITUDE -80.473725 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W <sub>P</sub>	W	W <sub>L</sub>			WATER CONTENT (%)
317.7	GROUND SURFACE							20	40	60	80	100					GR SA SI CL
0.0	ASPHALT: (125mm)																
0.1	SAND and GRAVEL Brown Moist (FILL)		1	GS			317										
317.0																	
0.7	SAND and SILT, trace to some clay, trace gravel Compact to Dense Brown Moist (FILL)		2	SS	14		316										
			3	SS	36												
			4	SS	26		315										2 45 42 11
314.4																	
3.3	Silty CLAY, some sand to sandy, trace gravel Very Stiff Brown to Grey Moist (FILL)		5	SS	16		314										
			6	SS	27		313										3 26 51 20
312.0							312										
5.6	Sandy SILT, some gravel Very Dense Brown Moist		7	SS	69		311										
310.5																	
7.2	Silty CLAY, sandy, trace gravel Stiff to Very Stiff Brown Moist		8	SS	11		310										1 31 46 22
							309										
												</					

Continued Next Page

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


20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RW24-01

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 847.4 E 226 015.2 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.469400 LONGITUDE -80.473725 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							20	40	60	80	100				
304.9	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist						307									
			10	SS	19											
			11	SS	30											
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE OPEN TO 9.4m AND WATER LEVEL AT 10.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.						305									



# RECORD OF BOREHOLE No RW24-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 806.8 E 226 031.5 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
 DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.469038 LONGITUDE -80.473502 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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
								○ UNCONFINED      + FIELD VANE		● QUICK TRIAXIAL      × LAB VANE		W <sub>P</sub>	W	W <sub>L</sub>			
						20	40	60	80	100	20	40	60				
318.1	GROUND SURFACE																
0.0	ASPHALT(150mm)																
0.2	SAND and GRAVEL		1	GS													
317.4	Brown Moist (FILL)																
0.7	SAND, some silt to silty, trace gravel, trace clay		2	SS	28												
	Dense Brown Moist (FILL)																
316.2			3	SS	31												
1.9	Sandy SILT to Silty SAND, trace to some gravel, trace clay																
	Dense Brown Moist (FILL)		4	SS	49												
	clayey silt layer at 2.8m (200mm)																
314.7			5	SS	26												
3.4	Silty CLAY, sandy Very Stiff																
	Brown Moist (FILL)																
314.0																	
4.1	SAND, some silt to silty, trace to some gravel, occasional cobbles		6	SS	57												
	Dense to Very Dense Brown Moist																

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RW24-02 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 806.8 E 226 031.5 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.469038 LONGITUDE -80.473502 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					
307.9							308						
10.2	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist		10	SS	19		307						
							306						
305.3			11	SS	32								0 1 43 56
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE OPEN TO 7.0m AND WATER LEVEL AT 10.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.												




ONTMT4S2 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

# RECORD OF BOREHOLE No RW24-03

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 766.3 E 226 047.4 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
 DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.468679 LONGITUDE -80.473272 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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
318.6	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT(200mm)							20	40	60	80	100					
0.2	SAND and GRAVEL, some silt and clay Compact Brown Dry to Moist (FILL)		1	GS			318										40 47 13 (SI+CL)
			2	SS	21												
			3	SS	22												
			4	SS	12												
			5	SS	11												
314.5																	
4.1	Silty SAND, trace to some gravel, occasional cobbles Compact Brown Moist		6	SS	24		314										
			7	SS	40												
311.5																	
7.2	SAND and SILT, trace clay, trace gravel Loose to Dense Brown Moist to Wet clayey silt layer at 7.5m (500mm)		8	SS	23		311										
			9	SS	3												
												</					

Continued Next Page

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

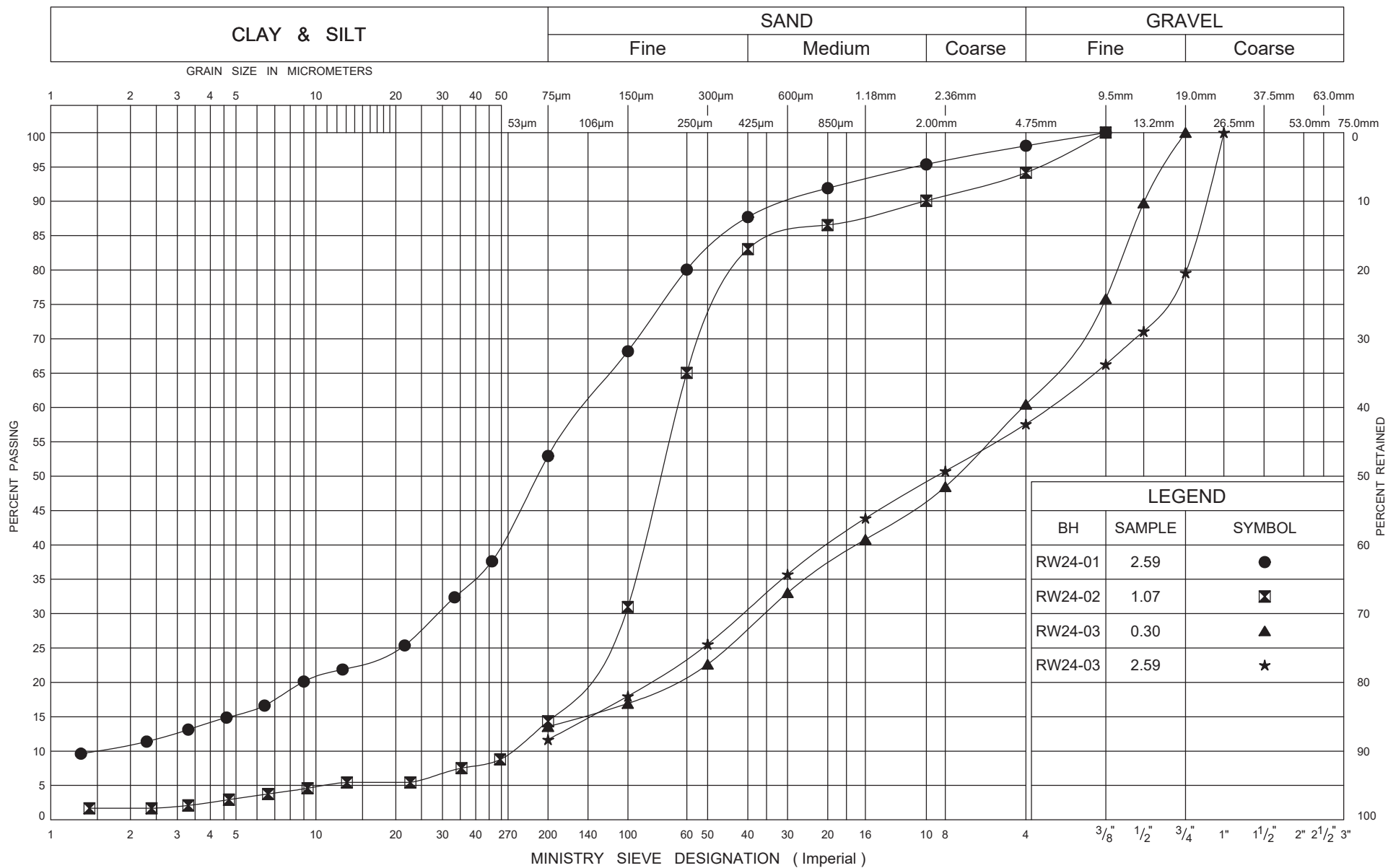
RECORD OF BOREHOLE No RW24-03

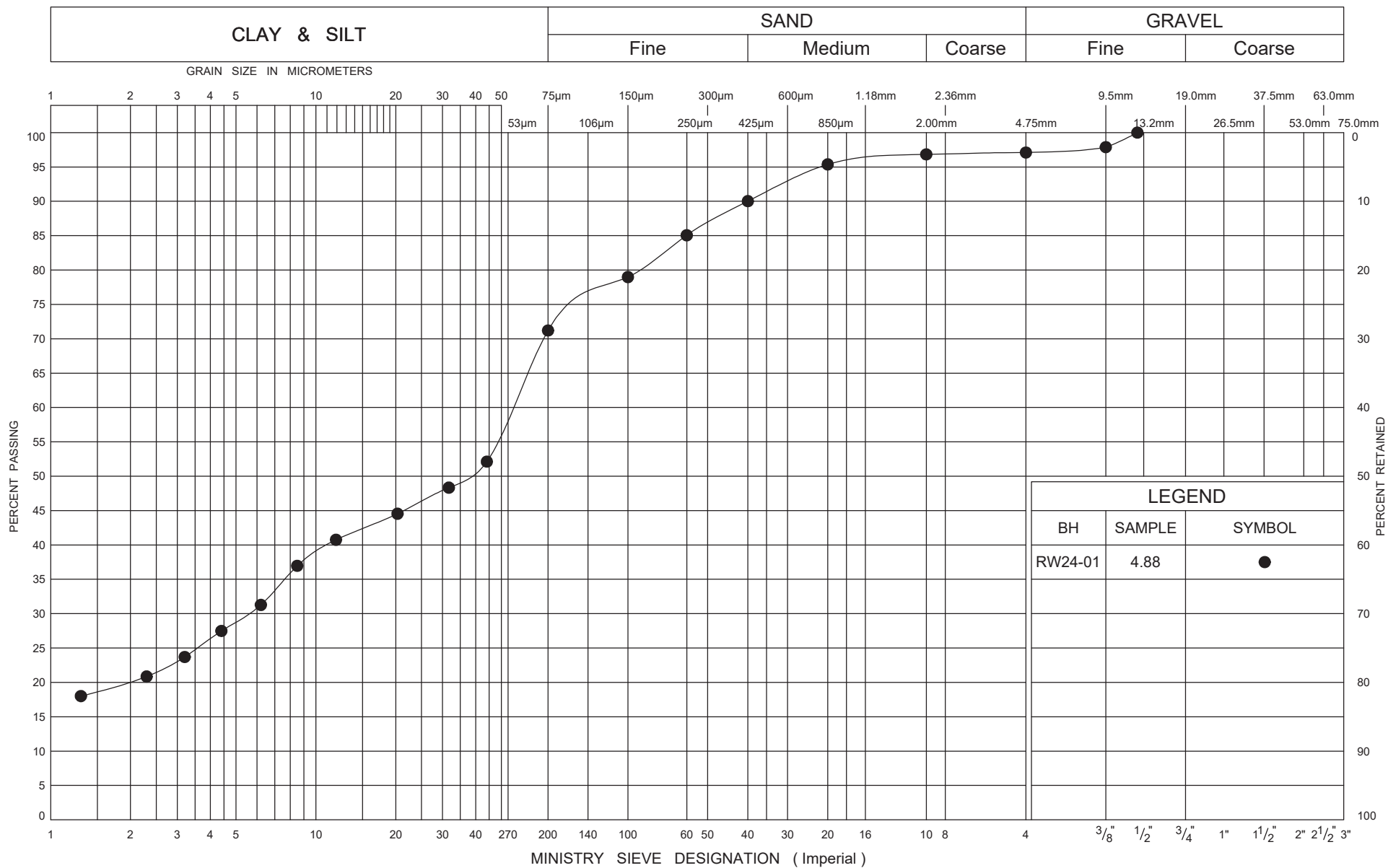
2 OF 2

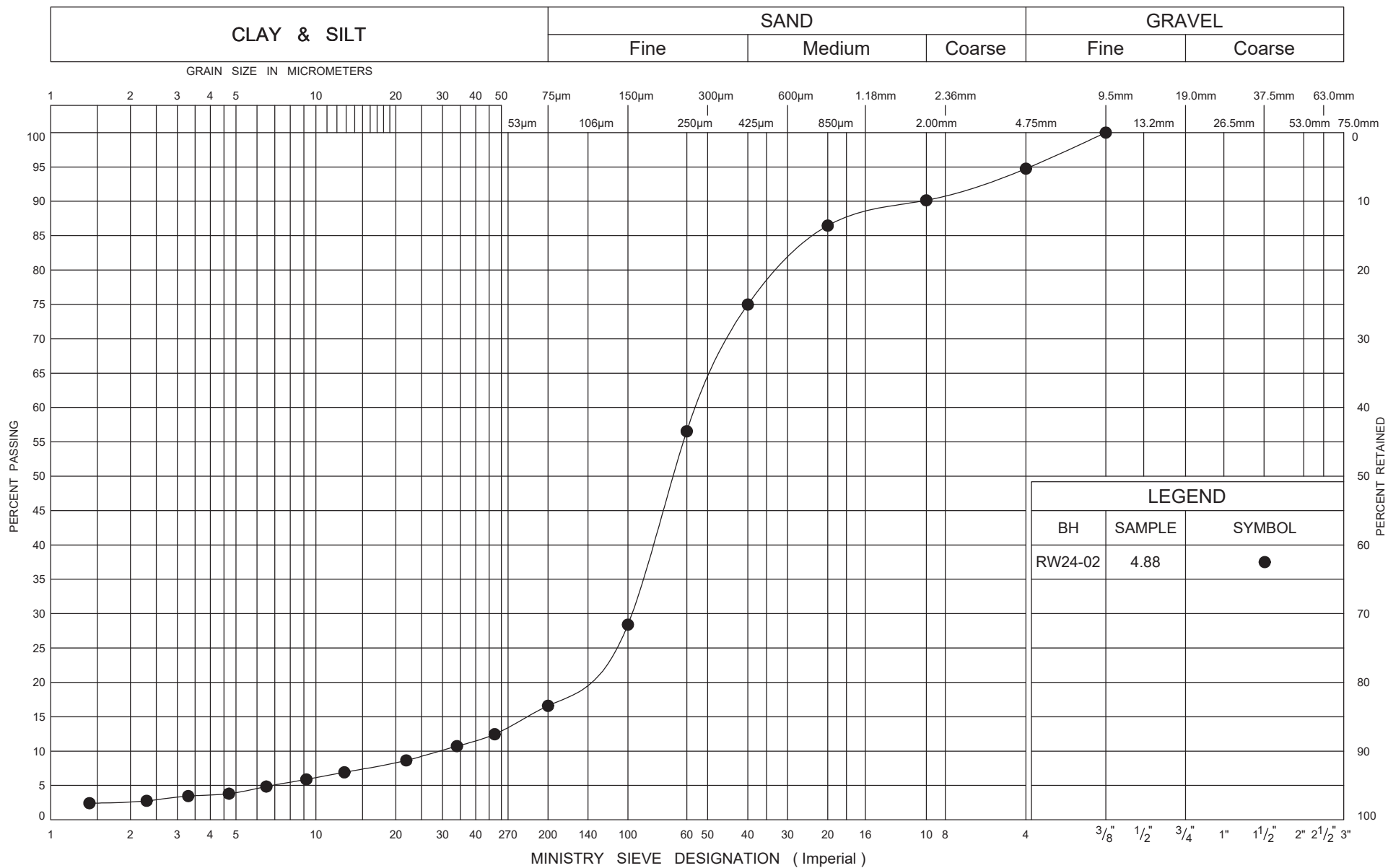
METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 766.3 E 226 047.4 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.468679 LONGITUDE -80.473272 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					WATER CONTENT (%)				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					w <sub>p</sub> w      w <sub>L</sub>				
	Continued From Previous Page							20	40	60	80	100					
307.4			10	SS	38		308										
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE OPEN TO 7.5m AND WATER LEVEL AT 10.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.																







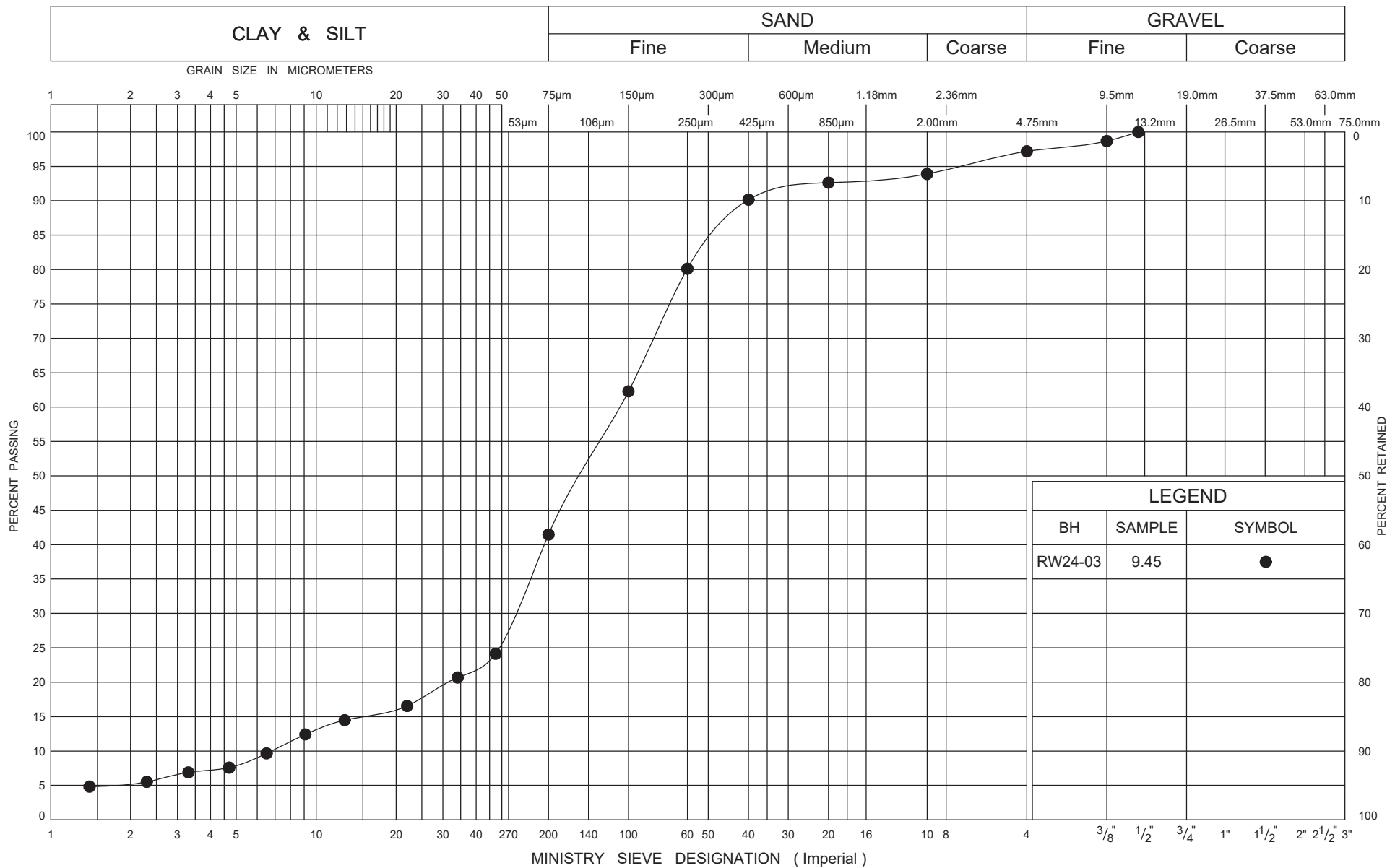
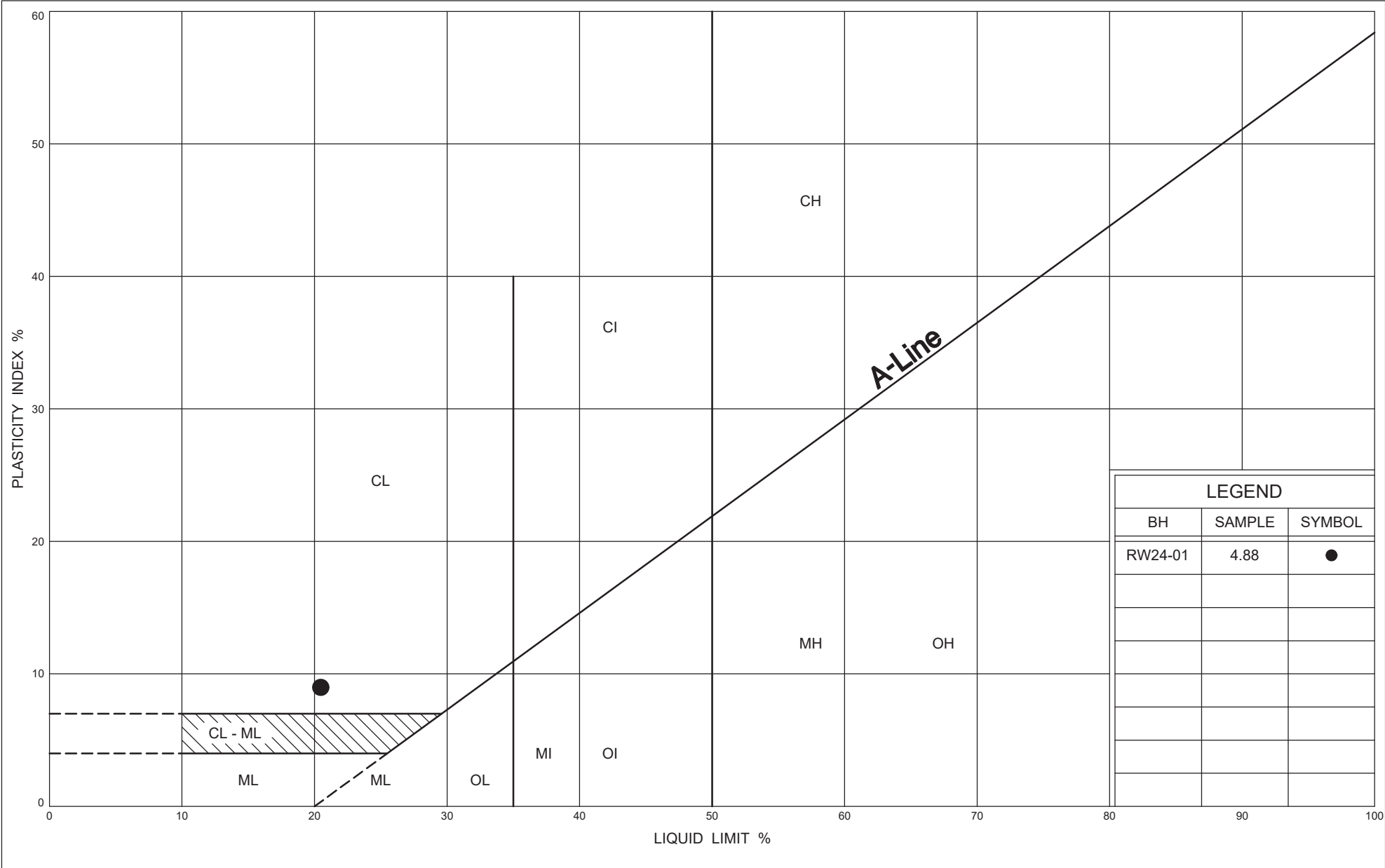


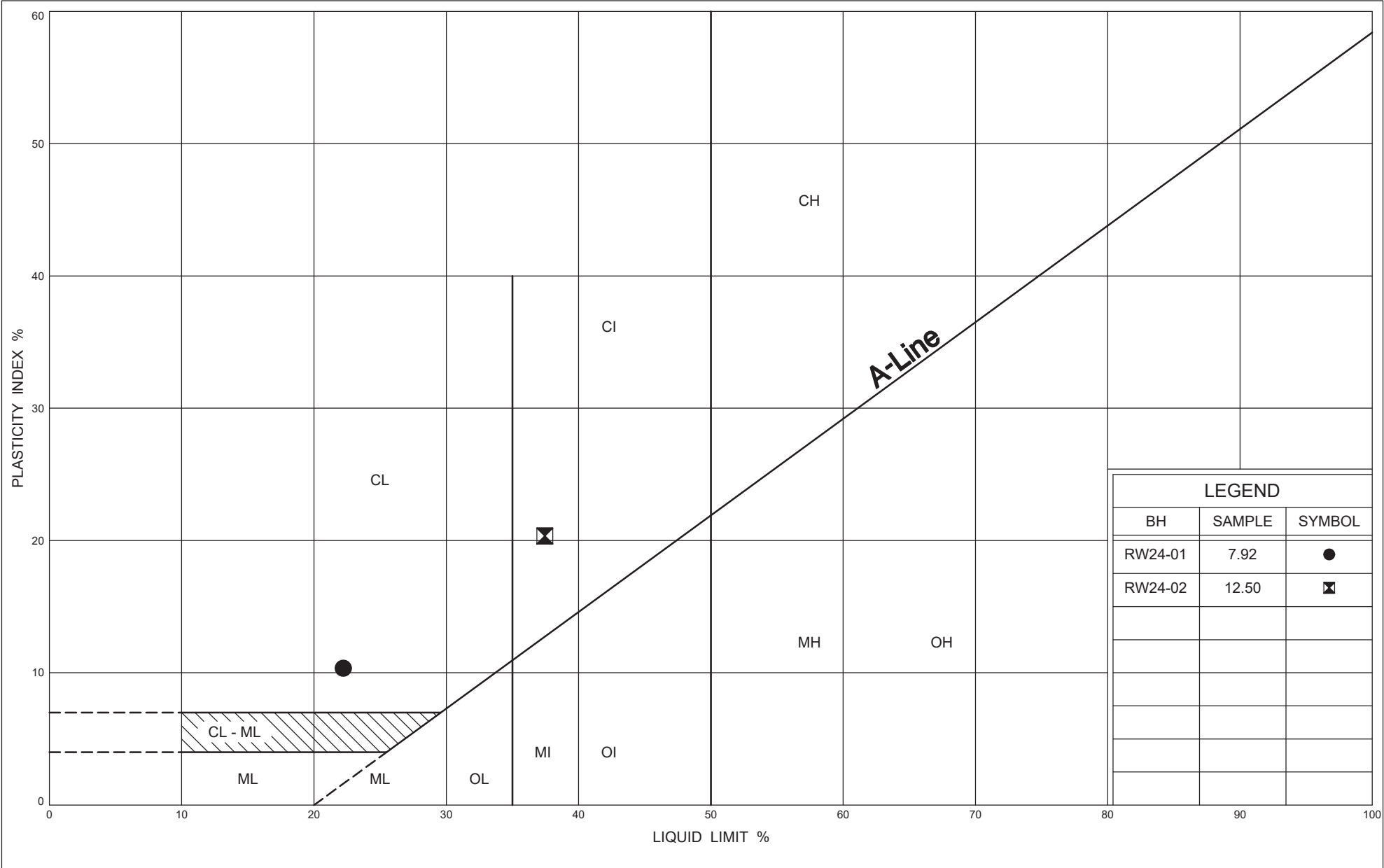




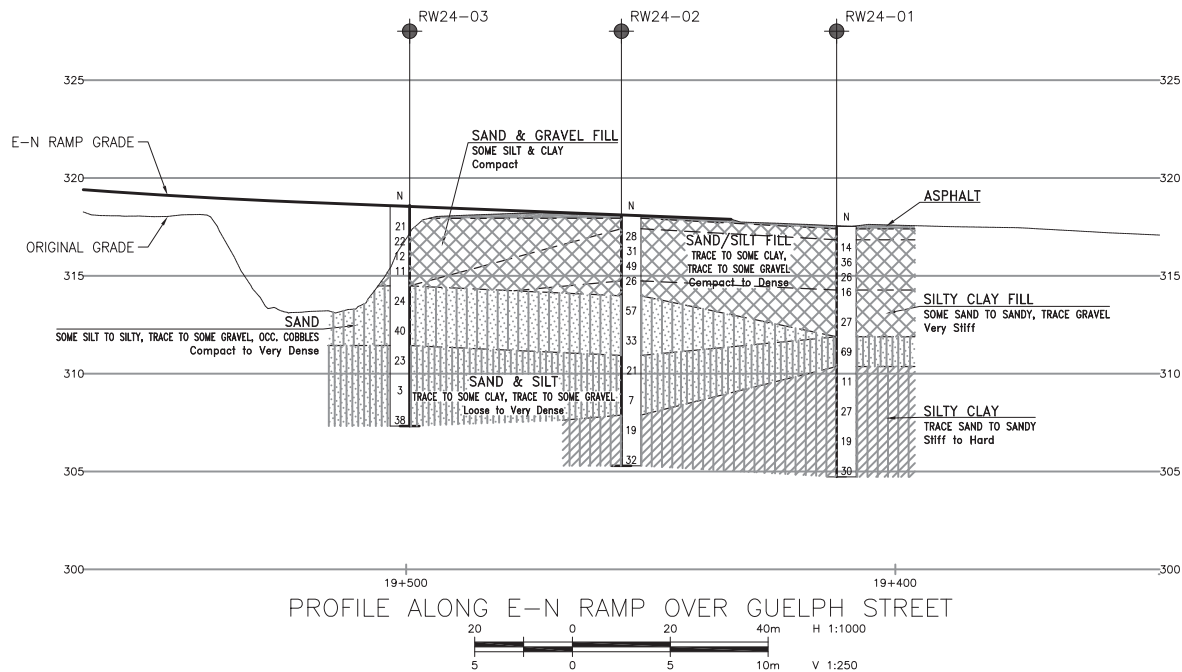
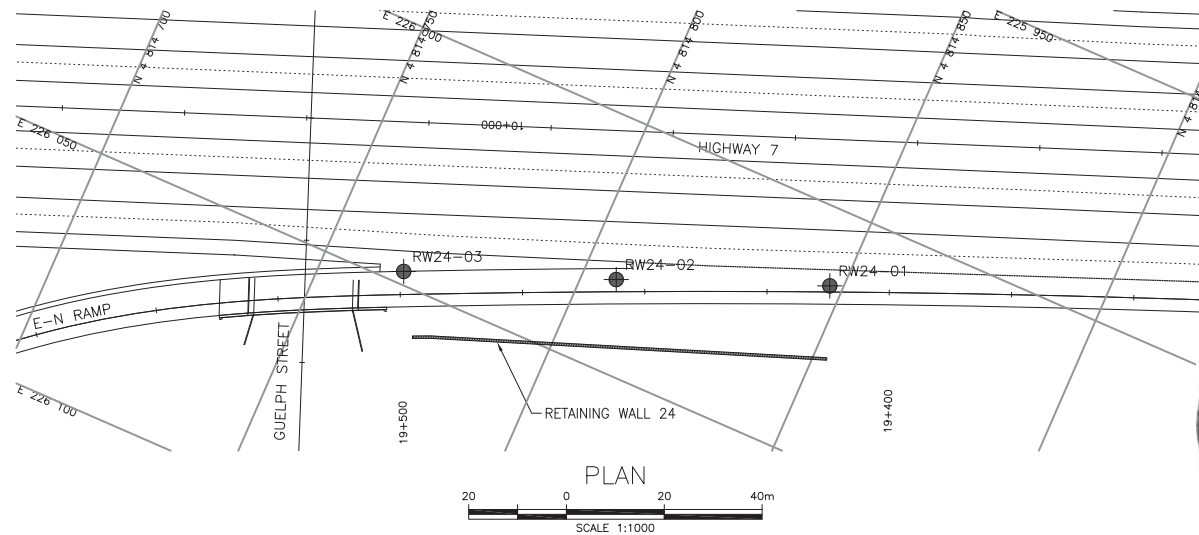
FIG No F5
W P 408-88-00
Retaining Wall 24



LEGEND		
BH	SAMPLE	SYMBOL
RW24-01	4.88	●



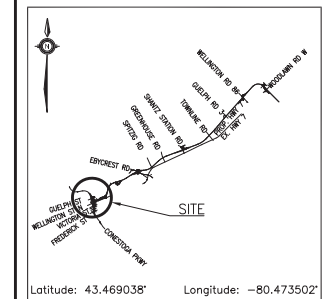
LEGEND		
BH	SAMPLE	SYMBOL
RW24-01	7.92	●
RW24-02	12.50	⊠







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

CONT No  
GWP No 408-88-00

HIGHWAY 7 E-N RAMP OVER GUELPH ST. RETAINING WALL 24 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

-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. 40P9-58

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	NB	CHK	PKC	CODE	LOAD	DATE	MAY 2020		
DRAWN	MFA	CHK	NB	SITE	STRUCT	DWG	1		



## **Appendix G**

### **Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing**

**Retaining Wall 28  
(RW28-01 to RW28-03)**

# RECORD OF BOREHOLE No RW28-01

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 453.3 E 226 205.0 ORIGINATED BY BL  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.456836 LONGITUDE -80.471249 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									
325.3	GROUND SURFACE					▽											
0.0	ASPHALT: (125mm)																
0.1	SAND and GRAVEL Brown Dry (FILL)		1	GS			325										
324.6																	
0.7	SAND, trace to some silt, trace clay Compact Brown Dry to Moist		2	SS	22		324										
			3	SS	21		323										
			4	SS	22		322										
	Loose Wet		5	SS	7		321										
321.1																	
4.2	Silty CLAY to Clayey SILT, some sand to sandy, trace gravel Hard Grey Moist		6	SS	47	320											
			7	SS	61	319											
							318										
317.4																	
7.8	SAND and SILT, trace clay Very Dense Grey Moist		8	SS	65	317											
							316										
			9	SS	65												
315.5																	
9.8	END OF BOREHOLE AT 9.8m.																

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No RW28-01

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 453.3 E 226 205.0 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.456836 LONGITUDE -80.471249 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																
	BOREHOLE OPEN TO 4.9m. WATER LEVEL AT 2.7M UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.																

# RECORD OF BOREHOLE No RW28-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 494.5 E 226 191.0 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.457223 LONGITUDE -80.471445 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							
324.4	GROUND SURFACE														
0.0	<b>ASPHALT:</b> (100mm)						○ UNCONFINED    + FIELD VANE				w <sub>P</sub> w                      w <sub>L</sub>				
0.1	<b>SAND</b> and <b>GRAVEL</b> Brown Dry (FILL)		1	GS			● QUICK TRIAXIAL    × LAB VANE				WATER CONTENT (%)				
323.7							20   40   60   80   100				20   40   60				
0.7	<b>SAND</b> , trace to some silt, trace gravel, trace clay Compact Brown Dry to Wet		2	SS	23										
			3	SS	17										
			4	SS	10										
	Occasional cobbles														
321.1			5	SS	18										
3.3	Silty <b>CLAY</b> to Clayey <b>SILT</b> , with sand, trace gravel Very Stiff to Hard Brown/Grey Moist														
			6	SS	47										
	Grey														
			7	SS	46										
	Some sand		8	SS	100/ 0.275										
315.8															
8.6	<b>SAND</b> and <b>SILT</b> , trace gravel Very Dense Brown Wet		9	SS	100/ 0.275										
314.6															
9.8															

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE



## METRIC

[illegible]

# RECORD OF BOREHOLE No RW28-03

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 538.7 E 226 177.8 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.457615 LONGITUDE -80.471620 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											
323.6	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (125mm)																		
0.1	SAND and GRAVEL, some silt and clay		1	GS			323												
322.9	Brown																		
0.7	Dry (FILL)																		
	Silty SAND, trace gravel		2	SS	34														
	Compact to Dense																		
	Brown																		
	Dry to Moist																		
			3	SS	26		322												
			4	SS	30		321												
	Wet																		
320.4																			
3.3	Silty CLAY to Clayey SILT, some sand to sandy, trace gravel		5	SS	13		320												
	Stiff to Hard																		
	Brown/Grey																		
	Moist																		
			6	SS	38		319												
							318												
			7	SS	100/ 0.275		317												
316.5																			
7.2	SAND and SILT, trace clay		8	SS	100/ 0.175		316												
	Dense to Very Dense																		
	Brown																		
	Moist																		
							315												
			9	SS	100/ 0.225		314												

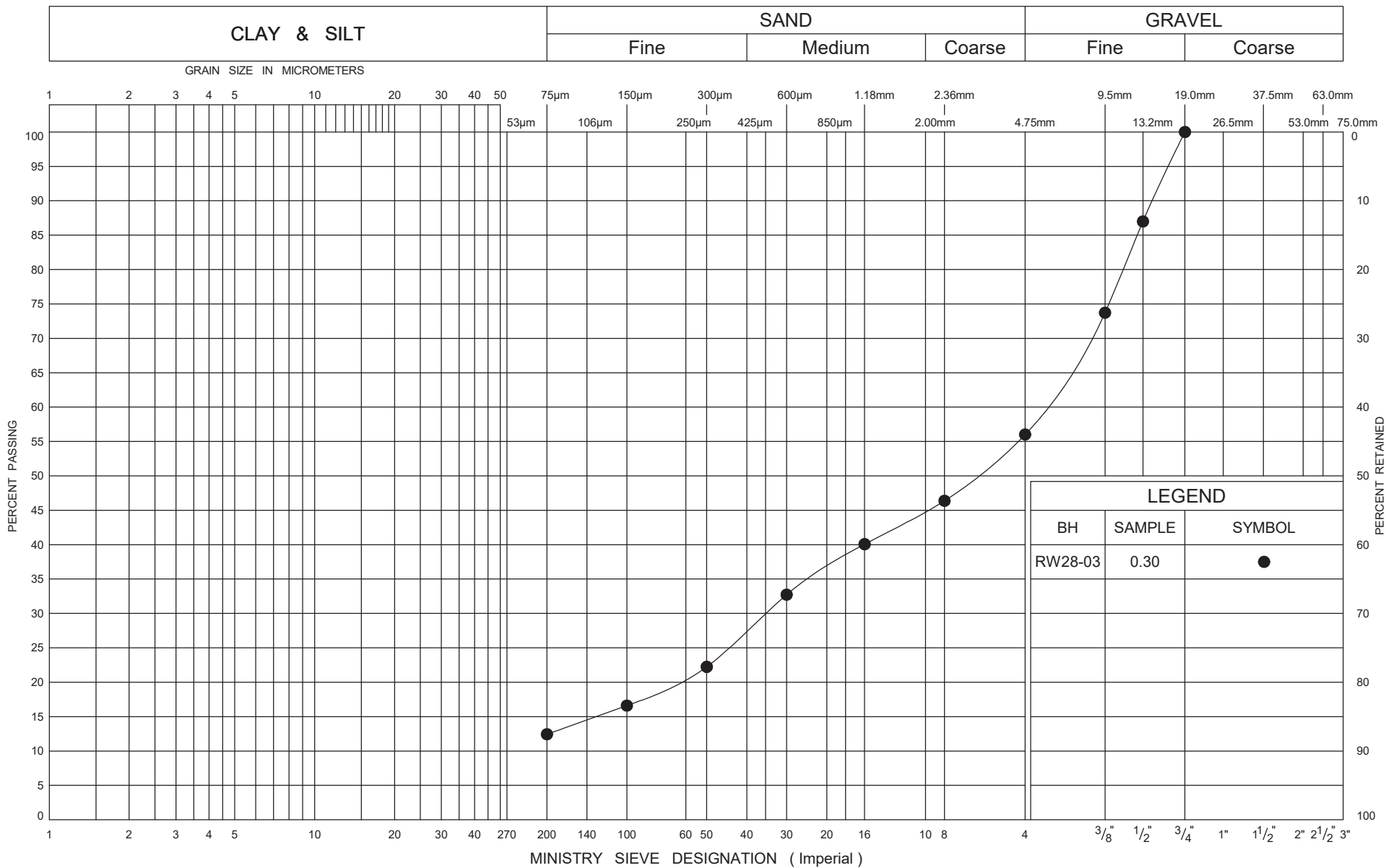
Continued Next Page

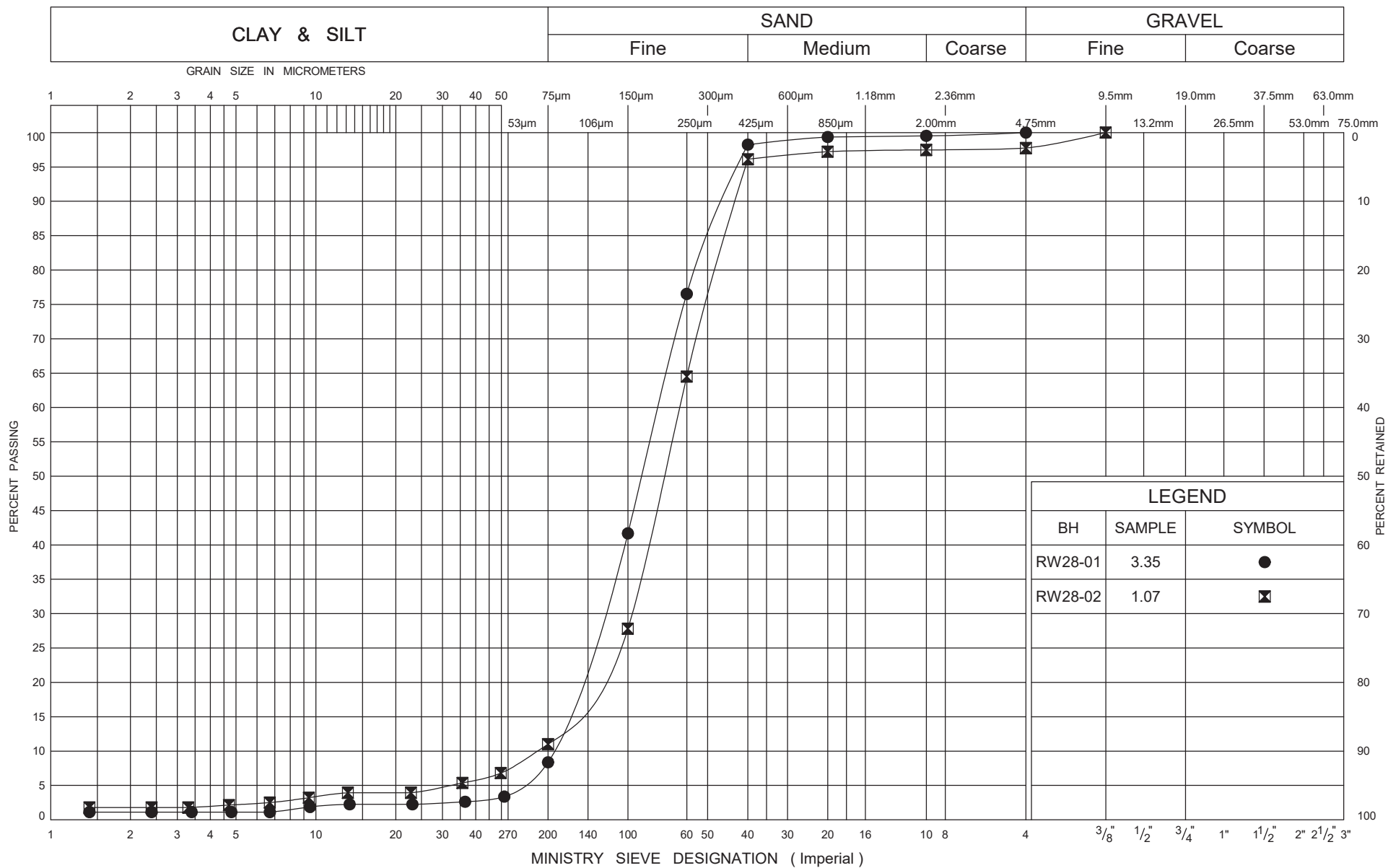
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
 20  
 15  
 10  
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RW28-03 2 OF 2 METRIC

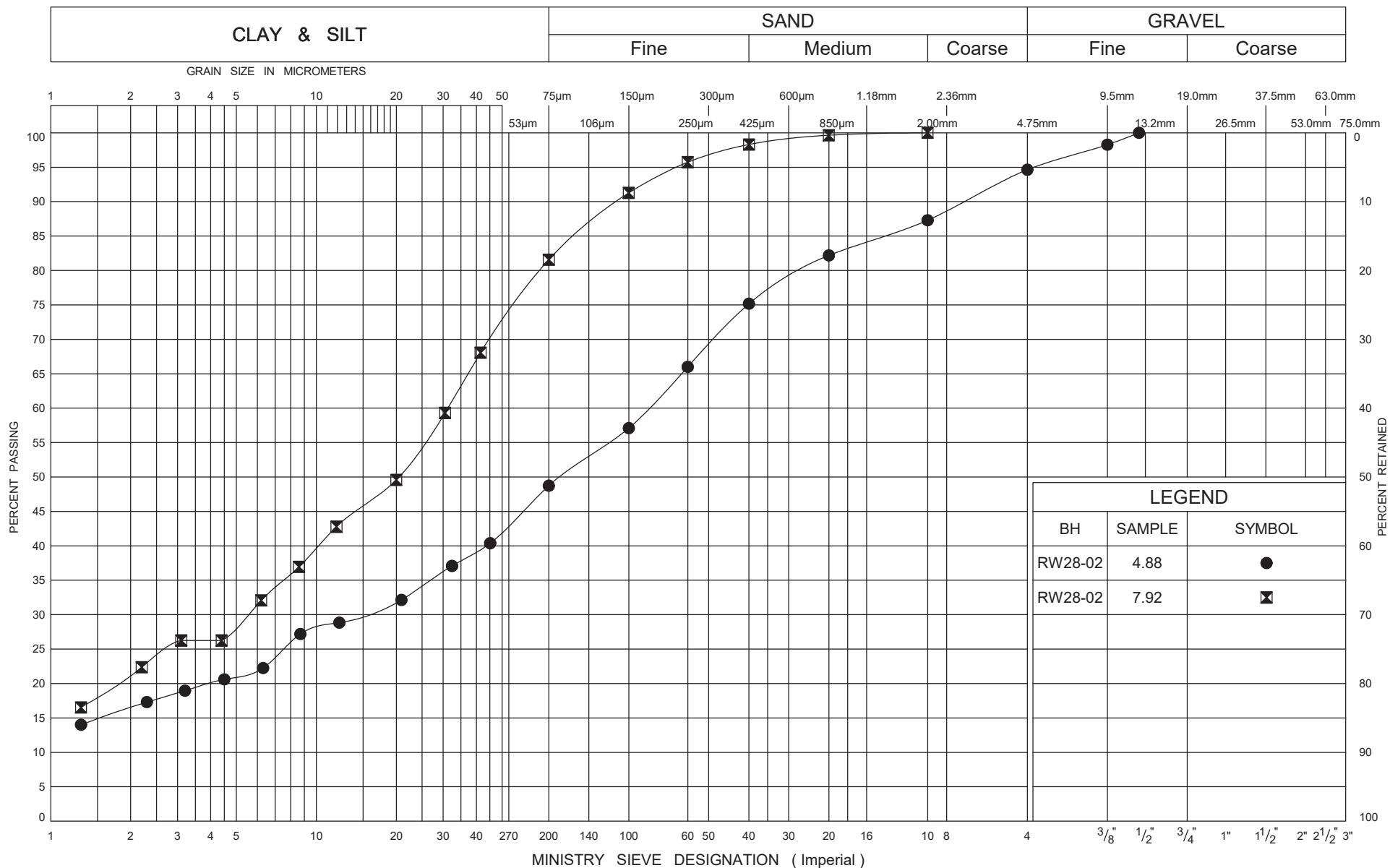
GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 538.7 E 226 177.8 ORIGINATED BY BL  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.457615 LONGITUDE -80.471620 CHECKED BY NB

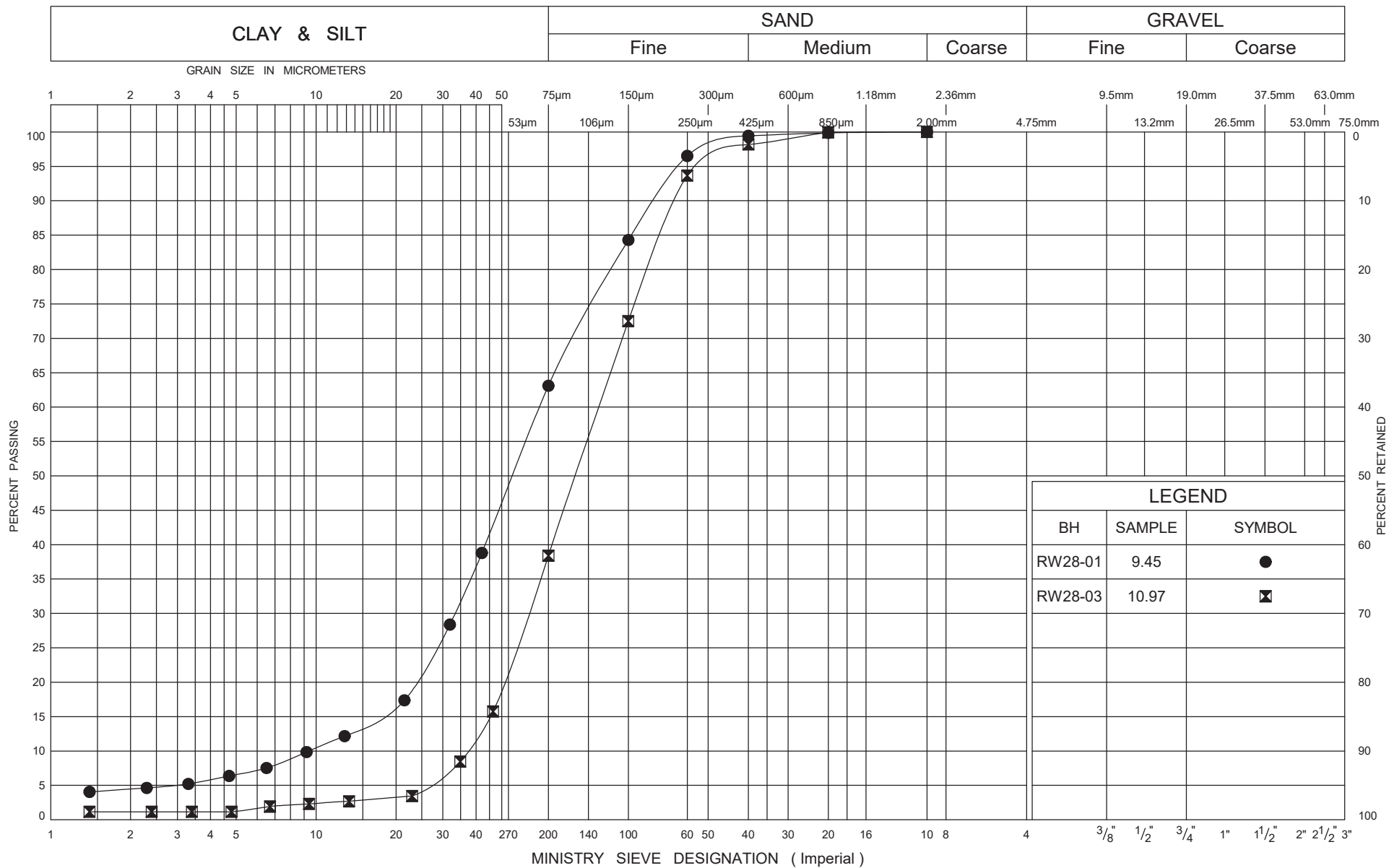
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										20 40 60		
Continued From Previous Page																				
312.4	SAND and SILT, trace clay Dense Brown Moist		10	SS	31		313										0 62 37 1			
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 2.4m AND WATER LEVEL AT 2.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.																			

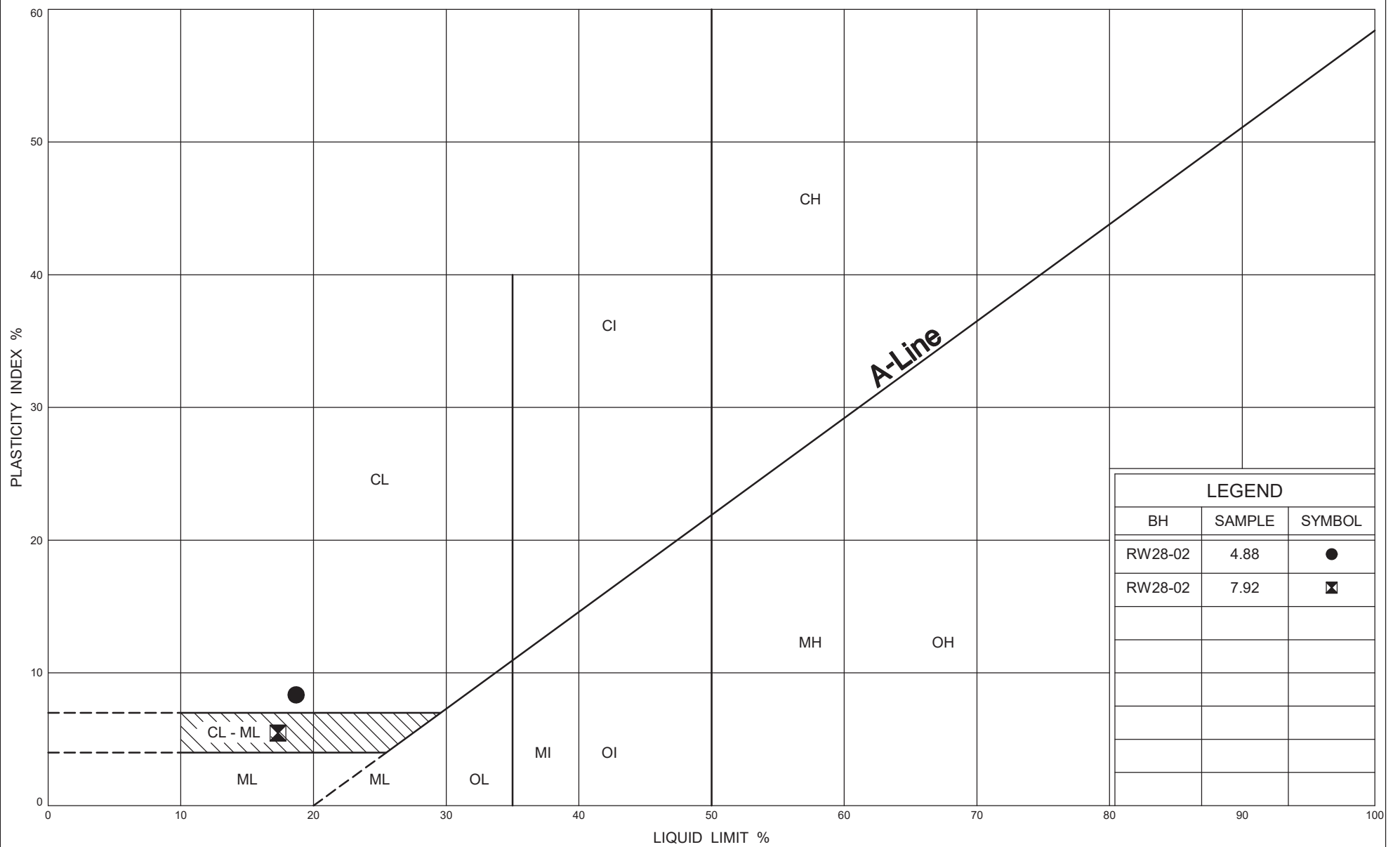




LEGEND		
BH	SAMPLE	SYMBOL
RW28-01	3.35	●
RW28-02	1.07	⊠







# PLASTICITY CHART

Silty CLAY to Clayey SILT

FIG No G5

W P 408-88-00

Retaining Wall 28



FILENAME: H:\Drafting\11000\11375\ED-11375-BHPP-RW28.dwg  
PLOTDATE: 5/6/2020 4:29 PM

