



## FOUNDATION INVESTIGATION AND DESIGN REPORT

*Noise Barrier Walls and Noise Barrier / Retaining Walls, Queen Elizabeth Way (QEW) Widening from West of Mississauga Road to West of Hurontario Street, Ministry of Transportation, Ontario, GWP 2002-13-00*

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## **APPENDIX K – Non-Standard Special Provisions and Notice to Contractor**

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Notice to Contractor – Subsurface Obstructions

# PART A

FOUNDATION INVESTIGATION REPORT  
NOISE BARRIER WALLS AND NOISE BARRIER / RETAINING WALLS  
QEW WIDENING FROM WEST OF MISSISSAUGA ROAD TO WEST OF  
HURONTARIO STREET,  
MINISTRY OF TRANSPORTATION, ONTARIO, GWP 2002-13-00



## 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services associated with the new noise barrier walls (NBWs) and combination noise barrier walls / retaining walls (NBRWs), in support of the widening of the Queen Elizabeth Way (QEW) from west of Mississauga Road to west of Hurontario Street in the City of Mississauga, Ontario.

The purpose of this investigation is to establish the subsurface (soil, bedrock and groundwater) conditions at the proposed noise barrier and noise barrier / retaining wall locations by borehole drilling, rock coring and geotechnical and chemical analytical laboratory testing of selected soil and bedrock core samples.

The Terms of Reference (TOR) and the Scope of Work for the foundation investigation are outlined in MTO's Request for Proposal, dated July 2016, and the approved Change Request letter dated February 20, 2018, which forms part of the Consultant's Assignment Number (2015-E-0033) for this project. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated February 3, 2017.

## 2.0 SITE DESCRIPTION

Based on the information provided by MH, a description of each site within which the proposed noise barrier walls or noise barrier / retaining wall extends is summarized below and the approximate location / extent of each wall is shown on Drawings 1 and 2. For each noise barrier wall section the corresponding Line, as per the Contract Documents is provided.

Noise Barrier Wall or Noise Barrier / Retaining Wall Designation	Approximate Stationing <sup>1</sup> (Approximate Wall Length)	Site Description at Proposed Noise Barrier Wall or Noise Barrier / Retaining Wall
NBW	QEW Sta 15+300 to Sta 15+430 (Approx. Length = 130 m)	NBW extends along the north side of the QEW and is positioned between the QEW Hamilton-bound lane and North Sheridan Way, southwest of the QEW-Mississauga Road interchange, near the intersection of North Sheridan Way and Mississauga Road.
NBW - Line 'B'	QEW Sta 16+350 to Sta 16+660 (Approx. Length = 310 m)	NBW – Line 'B' extends along the north side of the QEW from east of the QEW-Mississauga Road interchange to the west abutment of the Credit River Bridge. The wall alignment is positioned between the QEW Hamilton-bound lane and the west access road and trail path paralleling the highway.

Noise Barrier Wall or Noise Barrier / Retaining Wall Designation	Approximate Stationing <sup>1</sup> (Approximate Wall Length)	Site Description at Proposed Noise Barrier Wall or Noise Barrier / Retaining Wall
NBRW – Line ‘F’	QEW Sta 16+931 to Sta 17+660 (Approx. Length = 729 m)	NBRW – Line ‘F’ extends along the north side of the QEW from the east abutment of the Credit River Bridge to near the intersection of Premium Way and Lynchmere Avenue, and is positioned between the QEW Hamilton-bound lane and Premium Way. The wall passes under the proposed Active Transport Crossing structure (i.e., proposed pedestrian bridge).
NBW – Line ‘H’	QEW Sta 17+660 to 17+728 (Approx. Length = 68 m)	NBW – LINE ‘H’ extends along the north side of the QEW from near the intersection of Premium Way and Lynchmere Avenue to about 68 m easterly and is positioned between the QEW Hamilton-bound lane and Premium Way.
NBW – Line ‘A’	QEW Sta 15+622 to Sta 15+866 (Approx. Length = 244 m)	NBW – Line ‘A’ extends along the south side of the QEW west of the QEW-Mississauga Road interchange, westerly to about the intersection of South Sheridan Way and Indian Grove, and is positioned between the QEW Toronto-bound lane and South Sheridan Way.
NBW – Line ‘C’	S-E Ramp Sta 10+033 to Sta 10+227 (ramp stationing) QEW Sta 16+519 to 16+623 (mainline stationing) (Approx. Length = 298 m)	NBW – Line ‘C’ extends along the south side of the Mississauga Road S-E On-Ramp, from the intersection of South Sheridan Way and Mississauga Road to the west abutment of the Credit River Bridge. The wall alignment is positioned between the highway on-ramp / merge lane to the QEW Toronto-bound On-Ramp and residential development.
NBW – Line ‘I’	QEW Sta 16+918 to Sta 16+920 (Approx. Length = 2 m)	NBW – Line ‘I’ is situated at the east abutment of the Credit River Bridge, connecting to an existing noise barrier wall located south of the QEW Toronto-bound lane.
NBRW – Line ‘G’	QEW Sta 17+415 to Sta 17+520 (Approx. Length = 105 m)	NBRW – Line ‘G’ extends along the south side of the QEW to the west of the Kenollie Creek culvert. The wall alignment is positioned between the QEW Toronto-bound lane and Pinetree Way.
NBW – Line ‘J’	QEW Sta 17+076 to Sta 17+124 (Approx. Length = 48 m)	NBW – Line ‘J’ extends along the south side of the QEW the east of Stavebank Creek Culvert. The wall alignment is positioned between the QEW Toronto-bound lane and Pinetree Way, and passes under the proposed Active Transport Crossing structure (i.e., proposed pedestrian bridge).

**Notes:**

<sup>1</sup> Approximate stationing is referenced to the adjacent QEW highway and ramps, as provided by Morrison Hershfield Limited. Land use along both sides of the QEW, beyond existing noise barrier walls and vacant areas in places, is residential development with interspersed green spaces and the Credit River Valley.

## 3.0 INVESTIGATION PROCEDURES

### 3.1 Current Investigation

#### 3.1.1 Borehole Drilling and Sampling

The field work for the current foundation investigation was carried out between August 2017 and December 2018, during which time a total of 56 boreholes, as listed in Table 1 (following the text of this report), were advanced in the vicinity of the proposed Noise Barrier and Noise Barrier / Retaining Walls. The overall foundation investigation is comprised of 42 boreholes drilled specifically along the proposed noise barrier walls (i.e., NW series) or noise barrier / retaining walls (i.e., NRW series), supplemented with 14 boreholes drilled for other immediately adjacent structures, such as culverts and bridges.

The borehole investigation was carried out using a truck-mounted CME 55 drill rig and CME 850 drill rig, supplied and operated by Aardvark Drilling Inc. of Guelph, Ontario; a truck-mounted CME 75 drill rig and a track-mounted CME 55 drill rig, supplied and operated by Davis Drilling Ltd. of Milton, Ontario; and portable drilling equipment (tripod) supplied and operated by Walker Drilling of Utopia, Ontario.

The boreholes were advanced through the overburden using: 50 mm, 108 mm, 114 mm and 120 mm inner diameter hollow stem augers; 190 mm, 203 mm and 210 mm outer diameter hollow stem augers; 38 mm, 150 mm and 152 mm outer diameter solid stem augers; and appropriately sized combinations of augers and 'HQ' casing together with 73 mm and 156 mm tricone wash boring techniques. Soil samples were obtained at 0.75 m intervals of depth to a depth of 4.6 m, after which they were obtained at 1.50 m intervals, using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedures ASTM D1586-08)<sup>1</sup>.

Where bedrock was encountered, augering and SPT sampling was performed in the top of weathered bedrock, and selected boreholes were advanced into the bedrock using HQ-size (90 mm outer diameter) rotary coring. Borehole NW5-2 was advanced using a portable tripod drill equipped with NW-size casing throughout the overburden and an NQ core barrel into the bedrock.

The groundwater conditions and water levels in the open boreholes were observed during and immediately following drilling operations. Standpipe piezometers were installed in select boreholes after completion of drilling. The installed piezometers consist of a 50 mm diameter PVC pipe, with a slotted screen. The annulus surrounding the piezometer screens were backfilled with a filter sand pack. The section of borehole below the standpipe piezometers were backfilled with bentonite to the underside of the sand pack level, and the remainder of the borehole above the sand pack was backfilled with bentonite to near the ground surface and topped with cold patch asphalt or sand and gravel to match the adjacent ground surface material. All open boreholes were backfilled with and with bentonite pellets (hole plug) to ground surface upon completion of drilling in accordance with Ontario Regulation 903, Wells (as amended).

The field work was observed by members of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in-situ testing operations, logged the boreholes, and examined and cared for the soil and bedrock core samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing.

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<sup>1</sup> ASTM D1586-08a – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the soil.

### 3.1.2 Laboratory Testing

Classification testing (water content, Atterberg limits, grain size distribution and organic content) was carried out on selected soil samples by Golder. All of the geotechnical soil laboratory tests were carried out to MTO and / or ASTM Standards, as appropriate.

Point Load Index tests (PLT) were carried out on selected bedrock core samples by Golder. Unconfined compression (UC) tests (including assessment of Young's modulus, Poisson's ratio, and core density) were carried out on selected specimens of the bedrock core samples by Geomechanica Inc., on behalf of Golder.

Selected soil and bedrock core samples were submitted to Maxxam, a Standards Council of Canada (SCC) accredited laboratory of Mississauga, Ontario and analysed for a suite of characteristics that indicate corrosivity potential including pH, resistivity, conductivity, chloride content and sulphate content. The bedrock samples were crushed and homogenized by Maxxam prior to completing the chemical analytical testing.

### 3.1.3 Bedrock Classification

Classification of the rock mass quality of the bedrock with respect to Rock Quality Designation (RQD) and Uniaxial Compressive Strength (UCS) are described based on Table 3.10 and Table 3.5, respectively, of the Canadian Foundation Engineering Manual (CFEM, 2006)<sup>2</sup>. The degree of weathering of the bedrock core samples (e.g., fresh to slightly weathered) and strength classification of the intact rock mass based on field identification (e.g. strong to very strong) are described in accordance with Table B.3 and Table B.6, respectively, of the International Society for Rock Mechanics (ISRM)<sup>3</sup> standard classification system and are included in the appendices.

### 3.1.4 Surveying

The as-drilled locations of Boreholes NW5-3, NW5-4, NW5-5/5A, NW6-1, NW6-2, NRW7-1, NRW7-2, NRW7-3 were referenced to site features and then plotted on the borehole location drawing to obtain the coordinates of the drilled locations. The ground surface elevations were obtained by plotting the coordinates on the digital terrain model and interpreting the elevation. The remaining as-drilled borehole locations and the ground surface elevations were obtained using a GPS (Trimble Geo 7X), and have an accuracy of 0.1 m in the vertical and horizontal directions. The locations given in the Record of Borehole / Drillhole sheets and shown on Drawings 1 and 2 are positioned relative to North American Datum 1983 (NAD83CSRS, CBNV6-2010.0), Modified Transverse Mercator, (MTM) northing and easting coordinates, Zone 10; the ground surface elevations and drilled depths are summarized in Table 1 (following the text of this report).

## 4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

### 4.1 Regional Geology

The project area is located within the Iroquois Plain physiographic region, as delineated in The Physiography of Southern Ontario (Chapman and Putman, 1984)<sup>3</sup>. The glacial Iroquois Plain stretches along the northern shoreline of Lake Ontario, extending from the Niagara Escarpment in the west to the Scarborough Bluffs in the east. The Iroquois Plain soils consist of glaciolacustrine sediments deposited in Lake Iroquois, primarily sands,

<sup>2</sup> Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.

<sup>3</sup> International Society for Rock Mechanics Commission on Test methods, 1985. Int. J. Rock Mechanics Min Sci & Geomech. Abstr. Vol. 22, No. 2, pp. 51-60.

<sup>3</sup> Chapman, L.J. and Putman, D.F., 1984, The Physiography of Southern Ontario, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.

silts and gravels, with a shallow cover of till remaining over the bedrock. Bedrock of the Georgian Bay Formation that underlies the study area consists mainly of blue-grey shale, containing siltstone, sandstone and limestone interbeds. Outcrops of this formation are commonly found along water courses on the west side of Toronto and in Mississauga, notably in the Humber River, Mimico Creek, Etobicoke Creek and Credit River valleys.

## 4.2 Subsurface Conditions

Fifty-six (56) boreholes were advanced along the extents of proposed Noise Barrier Wall and Noise Barrier / Retaining Walls. The borehole locations and ground surface elevations are listed in Table 1 (following the report text) and are shown on Drawings 1 and 2.

The detailed subsurface soil and groundwater conditions encountered in the boreholes, including standpipe piezometer installation details, as well as the results of in-situ testing and select laboratory testing, are given on the Record of Borehole and Record of Drillhole sheets. Appendices A to H contain the Record of Borehole / Drillhole sheets, results of soil classification laboratory testing plots, and bedrock core photographs. The results of the in-situ field tests (i.e., SPT "N"-values) as presented on the Record of Borehole sheets and in sub-sections of Section 4.2 are uncorrected. Lists on abbreviations and symbols and lithological, geotechnical rock description terminology, field estimation of rock hardness and rock weathering classification are also included just before Appendix A to assist in the interpretation of the Record of Borehole and Record of Drillhole sheets. The results of the laboratory testing on bedrock core specimens, including testing carried out by Geomechanica Inc., are presented in Appendix I. The results of the chemical analysis of soil samples carried out by Maxxam are included in Appendix J.

Stratigraphic boundaries shown on the Record of Borehole sheets and on the stratigraphic profile on Drawing 1 are inferred from non-continuous sampling, observations of drilling progress and the results of the Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations; however, the factual data presented in the borehole and drillhole records governs any interpretation of the site conditions.

Detailed descriptions of the subsurface conditions encountered at the proposed Noise Barrier Wall and Noise Barrier / Retaining Wall locations are summarized in the following sub-sections rather than being presented as detailed descriptions given the high number of boreholes advanced at the sites and interlayered subsurface conditions encountered. Where relatively significant thicknesses of overburden were encountered, the various soil types are described in detail for each main deposit.

### 4.2.1 Noise Barrier Wall - QEW Sta 15+300 to Sta 15+430

#### 4.2.1.1 Overburden Conditions

Three (3) boreholes (NW1-1, NW1-2 and NW1-3) were advanced adjacent to the proposed Noise Barrier Wall at the locations summarized in Table 1 and shown on Drawing 1. In general, the subsoil conditions encountered at the NBW borehole locations consist of asphalt pavement underlain by fill material consisting of sand to sand and gravel, in turn underlain by till deposits of clayey silt to silty clay and cohesive residual soil deposit in Borehole NW1-1, which is underlain by shale bedrock at all borehole locations.

The borehole records and laboratory testing results are presented in Appendix A, and a description of the soil deposits encountered in the boreholes is provided below.

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
Asphalt	NW1-1, NW1-2 NW1-3	0.13 – 0.18	102.6 – 102.4	n/a	n/a
Sand and Gravel to Sand, some silt, trace to some gravel, trace to some clay (FILL)	NW1-1, NW1-3	0.9 – 2.1	102.3 – 102.2	N = 4 – 20  Very Loose to Compact	w = 8% – 11% 1 – MH (Fig. A-1)
Clayey Silt to Silty Clay, trace to some sand, trace to some gravel (TILL)	NW1-1, NW1-2 NW1-3	0.6 – 2.0	102.4 – 100.2	N = 3 – 39  Soft to Hard	w = 10% – 25% w <sub>l</sub> = 30% – 38% w <sub>p</sub> = 20% I <sub>p</sub> = 10% – 18% 3 – MH (Fig. A-2) 3 – AL (Fig. A-3)
Clayey Silt, some sand, some shale fragments (RESIDUAL SOIL)	NW1-1	0.8	100.2	N = 44  Hard	w = 12%

**Where:**

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)**4.2.1.2 Bedrock / Refusal Conditions**

Bedrock was confirmed by rock coring in Boreholes NW1-1, NW1-2 and NW1-3. The length of bedrock sampled by split-spooning and by coring and the depths to, and corresponding elevation of, the completely to moderately weathered shale bedrock and the depths to, and corresponding elevations of, the slightly weathered to fresh shale bedrock are summarized below.

Borehole No.	Completely to Moderately Weathered Bedrock		Length of Bedrock Split-Spoon Sampled (m)	Slightly Weathered to Fresh Bedrock		Length of Bedrock Cored (m)
	Depth (m)	Elevation (m)		Depth (m)	Elevation (m)	
NW1-1	3.0 – 3.7	99.4 – 98.7	0.9	3.7 – 8.51	98.7 – 93.89	3.94
NW1-2	2.2 – 2.9	100.4 – 99.7	0.8	2.9 – 7.86	99.7 – 94.73	3.77
NW1-3	--	--	0.2	2.8 – 6.40	99.6 – 96.02	3.15



### Completely to Moderately Weathered Shale

Completely to moderately weathered shale bedrock was inferred based on drilling behaviour, observations of drilling cuttings and split-spoon sampling. The thickness of the completely to moderately weathered bedrock is inferred to be 0.7 m. The split-spoon samples obtained from within the inferred completely to moderately weathered bedrock do not contain larger fragments of rock due to the sampler size and sampling method. Larger fragments of unweathered shale bedrock may be present in-situ.

Deposit / Layer Description	Borehole Numbers	N Values (blows/0.30 m)	Laboratory Testing Results
Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)	NW1-1, NW1-2	N = 100/0.28 m	n/a

### Slightly Weathered to Fresh Shale

The retrieved bedrock core samples from the boreholes advanced within the limits of NBW is described as slightly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, weak shale with strong to very strong limestone interbeds (Georgian Bay Formation).

More detailed descriptions of the bedrock cores are presented on the Record of Drillhole sheets in Appendix A, including data regarding the discontinuity frequency and type. Photographs of the bedrock core samples are also contained in Appendix A. The bedrock properties, as encountered in the cored boreholes, are summarized below.

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
NW1-1	98% – 100%	0% – 100%	R2	n/a
		Very Poor to Excellent	Weak	
NW1-2	100%	70% – 100%	R2	1 – UC (Appendix I): UCS (shale) = 23.3 MPa E (shale) = 1.26 GPa $\gamma$ (shale) = 2.62 g/cm <sup>3</sup>
		Fair to Excellent	Weak	
NW1-3	97% – 100%	75% – 100%	R2	1 – UC (Appendix I): UCS (shale) = 16.8 MPa $\gamma$ (shale) = 2.60 g/cm <sup>3</sup>
		Fair to Excellent	Weak	

UC = unconfined compression test

UCS = uniaxial compressive strength

E = tangent Young's modulus

$\gamma$  = bulk density

## 4.2.2 Noise Barrier Wall - Line 'B' - QEW Sta 16+350 to Sta 16+660

### 4.2.2.1 Overburden Conditions

Eight (8) boreholes (NW2-1 to NW2-6, OHS-4 and CRB-2A) were advanced adjacent to the proposed Noise Barrier Wall – Line 'B' at the locations summarized in Table 1 and shown on Drawing 1. The subsoil conditions along NBW – Line 'B' generally consist of topsoil and / or gravel to sandy clayey silt fill at ground surface, underlain by deposits of silty clay in places, clayey silt to silty clay till and / or residual soil, underlain by shale bedrock.

The borehole records and laboratory testing results are presented in Appendix B, and a description of the soil deposits encountered in the boreholes is provided below.

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m) Consistency or Compactness	Laboratory Testing Results
Topsoil	NW2-2, NW2-4, NW2-6, OHS-4, CRB-2A,	0.1 – 0.7	98.2 – 94.5	N = 7 – 12 <sup>1</sup>  Loose (or Firm) to Compact	w = 25%
Sandy Silt to Gravelly Sand to Gravel / Sandy Clayey Silt, trace asphalt fragments or organics in places (Fill)	NW2-1, NW2-3, NW2-4, NW2-5, CRB-2A, OHS-4,	0.2 – 1.2	98.3 – 94.4	N = 7 – 64  Loose to Dense / Firm to Hard	w = 5% – 42%
Silty Clay	CRB-2A	0.1	93.5	n/a	w = 14% 1 – MH (Fig. B-1)
Sandy Silty Clay to Silty Clay to Clay, some sand, trace to some gravel, trace organics in places (TILL)	NW2-2 to NW2-6	0.2 – 0.9	97.5 – 94.5	N = 8 – 12, 50/0.08 m  Stiff to Hard	w = 13% – 18% w <sub>L</sub> = 46% – 51% w <sub>p</sub> = 20% – 22% I <sub>p</sub> = 25% – 32% 2 – MH (Fig. B-2) 3 – AL (Fig. B-3)
Sandy Clayey Silt to Clayey Silt, trace to some sand, trace to some gravel / shale fragments (RESIDUAL SOIL)	NW2-1, NW2-2, NW2-3 and NW2-6	0.4 – 1.1	97.5 – 93.8	N = 19 <sup>2</sup> – 51  Very Stiff to Hard	w = 8% – 11% w <sub>L</sub> = 31% – 33% w <sub>p</sub> = 20% – 22% I <sub>p</sub> = 10% – 12% 2 – MH (Fig. B-4) 3 – AL (Fig. B-5)

Where:

N = SPT 'N'-value; number of blows for 0.3 m of penetration  
 w = natural moisture content (%)  
 MH = combined sieve and hydrometer analysis  
 AL = Atterberg limits test  
 w<sub>p</sub> = plastic limit (%)  
 w<sub>l</sub> = liquid limit (%)  
 I<sub>p</sub> = plasticity index (%)

**Notes:**

<sup>1</sup> SPT 'N' value of 12 was obtained over the interface of topsoil and sandy silty clay (till) in Borehole NW2-6.

<sup>2</sup> SPT 'N' value of 19 was obtained over the interface of sandy silty clay (till) and clayey silt (residual soil) in Borehole NW2-6.

#### 4.2.2.2 Bedrock / Refusal Conditions

Bedrock was confirmed by rock coring in all boreholes along the proposed NBW – Line 'B'. The length of bedrock sampled by split-spooning and by coring and the depths to, and corresponding elevations of, the completely to moderately weathered shale bedrock and the depths to, and corresponding elevations of, the slightly weathered to fresh shale bedrock are summarized below.

Borehole No.	Completely to Moderately Weathered Bedrock		Length of Bedrock Split-Spoon Sampled (m)	Slightly Weathered to Fresh Bedrock		Length of Bedrock Cored (m)
	Depth (m)	Elevation (m)		Depth (m)	Elevation (m)	
NW2-1	--	--	0.7	1.5 – 5.89	96.8 – 92.36	3.60
NW2-2	--	--	0.9	2.2 – 6.53	96.0 – 91.66	3.48
NW2-3	--	--	0.7	2.5 – 6.60	95.3 – 91.20	3.55
OHS-4	0.7 – 3.2	96.6 – 94.1	1.0	3.2 – 5.56	94.1 – 91.77	3.83
NW2-4	0.9 – 2.3	95.3 – 93.9	2.2	2.3 – 6.58	93.9 – 89.61	3.67
NW2-5	1.4 – 2.9	94.2 – 92.7	1.7	2.9 – 6.58	92.7 – 89.03	3.53
NW2-6	1.4 – 3.6	93.4 – 91.2	2.3	3.6 – 6.62	91.2 – 88.21	3.57
CRB-2A	1.1 – 2.1	93.4 – 92.37	0.1	2.13 – 8.96	92.37 – 85.54	7.84

#### Completely to Moderately Weathered Shale

Completely to moderately weathered shale bedrock was inferred based on drilling behaviour, observations of drilling cuttings and split-spoon sampling. The thickness of the completely to moderately weathered bedrock is inferred to range from about 0.5 m to 2.5 m. The split-spoon samples obtained from within the inferred completely to moderately weathered bedrock do not contain larger fragments of rock due to the sampler size and sampling method. Larger fragments of unweathered shale bedrock may be present in-situ. In addition, the percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behaviour of the in-situ or excavated completely to moderately weathered shale bedrock.

Deposit / Layer Description	Borehole Numbers	N Values (blows/0.30 m)	Laboratory Testing Results
Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)	NW2-4 <sup>1</sup> , NW2-5, NW2-6 and OHS-4	N = 47, 52, 50/0.13 m to 50/0.10 m, 100/0.25 m to 100/0.10 m	w = 8% – 16% w <sub>i</sub> = 32% – 39% w <sub>p</sub> = 21% I <sub>p</sub> = 11% – 18% 3 – MH (Fig. B-6) 3 – AL (Fig. B-7)

<sup>1</sup> A cobble was encountered in the clayey silt (residual soil) deposit in Borehole NW2-4, from 0.9 m to 1.7 m depth (Elevation 95.3 m to 94.5 m).

### *Moderately Weathered to Fresh Shale*

The retrieved bedrock core samples from the boreholes advanced adjacent to NBW – Line 'B' is predominately described as moderately weathered to fresh (the exception to this is the highly to moderately weathered bedrock was cored in Borehole CRB-2A), thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, very weak to weak shale with strong to very strong limestone interbeds (Georgian Bay Formation).

More detailed descriptions of the bedrock cores are presented on the Record of Drillhole sheets in Appendix B, including data regarding the discontinuity frequency and type. Photographs of the bedrock core samples are also contained in Appendix B. The bedrock properties, as encountered in the cored boreholes, are summarized below.

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
NW2-1	88% – 100%	53% – 97%	R2	n/a
		Fair to Excellent	Weak	
NW2-2	100%	67% – 100%	R2	n/a
		Fair to Excellent	Weak	
NW2-3	84% – 100%	76% – 100%	R2	n/a
		Good to Excellent	Weak	
NW2-4	100%	87% – 100%	R2	n/a
		Good to Excellent	Weak	

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
NW2-5	100%	69% – 100%	R2	n/a
		<b>Fair to Excellent</b>	<b>Weak</b>	
NW2-6	75% – 100%	19% – 100%	R2	n/a
		<b>Very Poor to Excellent</b>	<b>Weak</b>	
OHS-4	43% – 100%	0% – 89%	R2	n/a
		<b>Very Poor to Good</b>	<b>Weak</b>	
CRB-2A	54% – 100%	0% – 100%	R1 – R2	6 – PLT, 2 – UC (Appendix I): $I_{s(50),A}$ (shale) = 0.13 MPa – 0.40 MPa $I_{s(50),D}$ (shale) = 0.18 MPa – 0.44 MPa UCS (shale) = 17.1 MPa, 18.2 MPa E (shale) = 0.75 GPa, 0.76 GPa $\gamma$ (shale) = 2.59 g/cm <sup>3</sup> , 2.60 g/cm <sup>3</sup>
		<b>Very Poor to Excellent</b>	<b>Very Weak to Weak</b>	

**Where:**

PLT = point load index test

 $I_{s(50),A}$  = axial point load strength index, corrected for 50-mm sample diameter $I_{s(50),D}$  = diametral point load strength index, corrected for 50-mm sample diameter

UC = unconfined compression test

UCS = uniaxial compressive strength

E = tangent Young's modulus

 $\gamma$  = bulk density

## 4.2.3 Noise Barrier / Retaining Wall - Line 'F' - QEW Sta 16+931 to Sta 17+660 and Noise Barrier Wall - Line 'H' - QEW Sta 17+660 to Sta 17+728

### 4.2.3.1 Overburden Conditions

Twenty-two (22) boreholes (CRB-6, CRB-8, AR-1, PED-01, NW3-1 to NW3-5, NW3-2A, NRW3-1 to NRW3-10 and S2 and S3) were advanced adjacent to the proposed Noise Barrier / Retaining Wall (NBRW) and Noise Barrier Wall (NBW) at the locations summarized in Table 1 and shown on Drawing 2. Based on the results of the present investigation, the overburden conditions along NBRW – Line 'F' and NBW – Line 'H' may be considered in four sections as follows:

- The west section of the wall (QEW Sta 16+931 to Sta 17+030), including Boreholes CRB-6, CRB-8, AR-1 and NW3-1, along which the encountered subsoil conditions generally consist of a layer of topsoil, underlain by silty sand to sand fill, underlain by deposits of silt to silty sand and silty clay to sandy clayey silt, in turn underlain by a till deposit and residual soil deposit, which is underlain by shale bedrock;
- The centre-west section of the wall (QEW Sta 17+030 to Sta 17+130), including Boreholes PED-01, NW3-2, NW3-2A, NW3-3, S2 and S3 along which the encountered subsoil conditions generally consist of a layer of asphalt pavement, underlain by sandy clayey silt to sand and gravel fill, underlain by deposits of clayey silt

(in one borehole), in turn underlain by interlayered deposits of silt and sand till and gravelly clayey silt with sand till, and silt to sand and gravel, underlain by shale bedrock (in one borehole);

- The centre-east section of the wall (QEW Sta 17+130 to Sta 17+480), including Boreholes NW3-4, NW3-5 and NRW3-1 to NRW3-5, along which the encountered subsoil conditions generally consist of a layer of asphalt pavement or topsoil at ground surface, underlain by sandy silt to sand and gravel fill, underlain by deposits of sandy silt to silty sand, underlain by silt, in turn underlain by deposits of clayey silt till and gravelly silty sand till, underlain by shale bedrock (in one borehole); and,
- The east section of the wall (QEW Sta 17+480 to Sta 17+728), including Boreholes NRW3-6 to NRW3-10, along which the encountered subsoil conditions generally consist of a layer of asphalt pavement or topsoil at ground surface, underlain by sandy silt to sand and gravel fill, underlain by deposits of silt and sand to silty sand, or clayey silt (in one borehole), in turn underlain by deposits of clayey silt till to silty sand till and / or residual soil, underlain by shale bedrock.

The borehole records and laboratory testing results are presented in Appendix C, and a description of the soil deposits encountered in the boreholes is provided below.

Noise Barrier / Retaining Wall – Line ‘F’ – West Section QEW Sta 16+931 to Sta 17+030					
Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m) Consistency or Compactness	Laboratory Testing Results
<b>Topsoil</b>	CRB-8, AR-1, NW3-1	0.1 – 0.7	96.5 – 94.7	N = 9 <b>Loose</b>	n/a
<b>Silty Sand to Sand, some silt, trace brick fragments in places (FILL)</b>	CRB-6, CRB-8, AR-1, NW3-1	0.7 – 1.7	96.3 – 91.7	N = 3 – 12 <b>Very Loose to Compact</b>	w = 4% – 22% 2 – MH (Fig. C-1A)
<b>Silt and Sand to Silty Sand to Sand</b>	CRB-8, AR-1, NW3-1	2.2 – 5.7	95.0 – 93.3	N = 5 – 78 <b>Loose to Very Dense</b>	w = 4% – 28% 5 – MH (Fig C-3A)
<b>Silt, trace to some sand</b>	CRB-8, AR-1	1.9, 2.7	91.0, 90.4	N = 22 <sup>1</sup> and 32 – 67 <b>Dense to Very Dense</b>	w = 13% - 15% w <sub>L</sub> = 19% w <sub>p</sub> = 16% I <sub>p</sub> = 3% 2 – MH (Fig. C-3A) 1 – AL (Fig. C-4)



Noise Barrier / Retaining Wall – Line ‘F’ – West Section QEW Sta 16+931 to Sta 17+030					
Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Sandy Clayey Silt to Silty Clay, trace to some gravel</b>	CRB-6, CRB-8, AR-1, NW3-1	1.2 – 2.7	90.0 – 88.3	N = 2 – 9 and 22 <sup>1</sup>	w = 12% – 31% w <sub>l</sub> = 23% - 36% w <sub>p</sub> = 14% - 16% I <sub>p</sub> = 9% - 20% 2 – MH (Fig. C-5) 3 – AL (Fig. C-6)
				<b>Very Soft to Very Stiff</b>	
<b>Sandy Clayey Silt, trace to some gravel (TILL)</b>	NW3-1	1.4	87.8	N = 12	w = 16% w <sub>l</sub> = 23% w <sub>p</sub> = 15% I <sub>p</sub> = 8% 1 – MH (Fig. C-7A) 1 – AL (Fig. C-8A)
				<b>Stiff</b>	
<b>Sandy Clayey Silt to Sandy Gravelly Clayey Silt, some shale fragments (RESIDUAL SOIL)</b>	CRB-6, CRB-8, AR-1, NW3-1	0.2 – 1.7	87.3 – 86.4	N = 64, and 50/0.13 m to 100/0.08 m	w = 9% – 11% w <sub>l</sub> = 23% – 24% w <sub>p</sub> = 15% – 16% I <sub>p</sub> = 7% – 8% 2 – MH (Fig. C-11) 3 – AL (Fig. C-12)
				<b>Hard</b>	

**Where:**

N = SPT ‘N’-value; number of blows for 0.3 m of penetration

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)**Notes:**<sup>1</sup> SPT ‘N’ value of 22 was obtained over the interface of silt and clayey silt in Borehole CRB-8.

Noise Barrier / Retaining Wall – Line 'F' - Centre-West Section QEW Sta 17+030 to Sta 17+130					
Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
Asphalt Pavement	PED-01, NW3-2, S2	0.2	96.3 – 94.9	n/a	n/a
Topsoil	S3	0.2	90.0	n/a	n/a
Interlayered Sandy Clayey Silt, Gravelly Silty Sand, Silt and Sand, Sand and Gravel, trace organics / asphalt fragments in places (FILL)	PED-01, NW3-2, NW3-3, S2, S3	1.5 – 7.6	96.1 – 89.8	N = 1 – 34  <b>Very Loose to Dense</b>	w = 3% – 28% w <sub>l</sub> = 99% (NW3-2) w <sub>p</sub> = 19% - 24% w <sub>p</sub> = 14% I <sub>p</sub> = 5% - 10% 9 – MH (Fig. C-1B and Fig. C-1C) 3 – AL (Fig. C-2)
Silty Sand, trace to some clay	S2	1.5	89.3	N=10  <b>Compact</b>	w = 22% 1-MH (Fig C-3B)
Clayey Silt	PED-01	1.6	90.7	N = 9  <b>Stiff</b>	w = 23% w <sub>l</sub> = 26% w <sub>p</sub> = 14% I <sub>p</sub> = 12% 1 – AL (Fig. C-6)
Clayey Silt with Sand (TILL) Interlayered in places with Silty Sand to Gravelly Silty Sand to Gravelly Sand (TILL)	PED-01, NW3-2, NW3-2A, NW3-3, S2, S3	4.5 – 12.5	89.1 – 87.3	N = 4 – 97, and 100/0.25 m to 131/0.08 m  <b>Soft to Hard / Loose to Very Dense</b>	w = 7% – 19% w <sub>l</sub> = 16% – 29% w <sub>p</sub> = 13% – 17% I <sub>p</sub> = 3% – 12% 10 – MH (Fig. C-7B and Fig. C-7C) 10 – AL (Fig. C-8B and Fig. C-8C)
Silt, some sand to Silty Sand to Sand and Gravel, some silt	PED-01, NW3-2A, S2	2.8 – 10.6	84.6 – 75.0	N = 46 – 121, 100/0.28 m – 100/0.05 m  <b>Dense to Very Dense</b>	w = 3% – 22% w <sub>l</sub> = 19% w <sub>p</sub> = 17% I <sub>p</sub> = 2% 6 – MH (Fig. C-9) 1 – AL (Fig. C-10)

**Where:**

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)

**Notes:**

<sup>1</sup> Water content measured at the depth where organics were encountered.

Noise Barrier / Retaining Wall – Line ‘F’ - Centre-East Section QEW Sta 17+130 to Sta 17+480					
Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Asphalt Pavement</b>	NRW3-2, NRW3-3, NRW3-4, NRW3-5	0.13 – 0.15	96.1 – 93.7	n/a	n/a
<b>Topsoil</b>	NRW3-1	0.2	96.0	n/a	n/a
<b>Sandy Silt to Silty Sand to Sand and Gravel, trace organics / rootlets in places (FILL)</b>	NW3-4, NW3-5, NRW3-1, NRW3-2, NRW3-3, NRW3-4, NRW3-5	0.2 – 1.4	96.0 – 93.5	N = 5 – 20  <b>Loose to Compact</b>	w = 9% – 20%
<b>Sandy Silt to Silt and Sand to Silty Sand</b>	NW3-4, NW3-5, NRW3-1, NRW3-2, NRW3-3 <sup>1</sup> , NRW3-4, NRW3-5	1.5 – 4.9	95.8 – 92.2	N = 6 – 48  <b>Loose to Dense</b>	w = 10% – 23% 10 – MH (Fig. C-3B and Fig. C-3C)
<b>Silt, trace to some clay, trace to some sand</b>	NW3-4, NW3-5, NRW3-2, NRW3-3	1.5 – 4.2	93.1 – 89.0	N = 23 – 46  <b>Compact to Dense</b>	w = 14% – 18% w <sub>l</sub> = 18% w <sub>p</sub> = 16% I <sub>p</sub> = 2% 4 – MH (Fig. C-5) 1 – AL (Fig. C-6)
<b>Silt and Sand / Sandy Clayey Silt to Clayey Silt with Sand to Gravelly Silty Sand (TILL)</b>	NW3-4, NW3-5, NRW3-1, NRW3-2, NRW3-3, NRW3-4, NRW3-5	1.0 – 8.5	90.7 – 87.4	N = 11 – 96, and 100/0.25 m – 50/0.08 m  <b>Stiff to Hard / Very Dense</b>  <b>Hard</b>	w = 7% – 16% w <sub>l</sub> = 18% – 24% w <sub>p</sub> = 13% – 15% I <sub>p</sub> = 4% – 9% 9 – MH (Fig. C-7D and Fig. C-7E) 7 – AL (Fig. C-8D)

**Where:**

N = SPT ‘N’-value; number of blows for 0.3 m of penetration

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)

w<sub>l</sub> = liquid limit (%)

$I_p$  = plasticity index (%)

**Notes:**

<sup>1</sup> A layer of organic silt and sand was encountered at the top of the silt and sand deposit in Borehole NRW3-3.

Noise Barrier / Retaining Wall – Line ‘F’ - Centre-East Section QEW Sta 17+480 to Sta 17+660 Noise Barrier Wall – Line ‘H’ - QEW Sta 17+660 to Sta 17+728					
Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Asphalt Pavement</b>	NRW3-7, NRW3-9, NRW3-10	0.13 – 0.25	98.2 – 93.9	n/a	n/a
<b>Topsoil</b>	NRW3-8	0.1	96.0	n/a	n/a
<b>Interlayered Sandy Silt to Silt and Sand to Silty Sand to Sand to Sand and Gravel, trace organics in places (FILL)</b>	NRW3-6, NRW3-7, NRW3-8, NRW3-9, NRW3-10	0.1 – 3.6	98.1 – 92.9	N = WH – 55  <b>Very Loose to Very Dense</b>	w = 5% – 24% 2 – MH (Fig. C-1D)
<b>Silt and Sand to Silty Sand, trace to some gravel, trace to some clay</b>	NRW3-7, NRW3-8, NRW3-9, NRW3-10	1.3 – 4.8	97.4 – 93.6	N = 4 – 35  <b>Very Loose to Dense</b>	w = 6% – 25% 5 – MH (Fig. C-3D)
<b>Clayey Silt, some sand, trace shale fragments</b>	NRW3-9	1.4	92.6	N = 15  <b>Stiff</b>	w = 15% w <sub>L</sub> = 24% w <sub>p</sub> = 15% I <sub>p</sub> = 9% 1 – AL (Fig. C-6)
<b>Sandy Clayey Silt to Clayey Silt with Sand to Silty Sand, some gravel (TILL)</b>	NRW3-6, NRW3-7, NRW3-8, NRW3-10	1.4 – 3.6	94.0 – 89.3	N = 4 – 32  <b>Soft to Very Stiff / Dense</b>	w = 12% – 22% w <sub>L</sub> = 15% – 27% w <sub>p</sub> = 12% – 16% I <sub>p</sub> = 3% – 12% 5 – MH (Fig. C-7F) 6 – AL (Fig. C-8E)
<b>Clayey Silt to Clayey Silt with Gravel, some sand, some shale fragments (RESIDUAL SOIL)</b>	NRW3-6, NRW3-7	0.6, 0.8	90.2, 87.3	N = 19  <b>Very Stiff</b>	w = 8% – 13% w <sub>L</sub> = 27% w <sub>p</sub> = 17% I <sub>p</sub> = 10% 1 – MH (Fig. C-11) 1 – AL (Fig. C-12)

**Where:**

N = SPT 'N'-value; number of blows for 0.3 m of penetration

WH = weight of hammer

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)**4.2.3.2 Bedrock / Refusal Conditions**

Bedrock was confirmed by bedrock coring in eleven boreholes (CRB-6, CBR-8, AR-1, NW3-1, PED-01, NRW3-4, NRW3-6, NRW3-7, NRW3-8, NRW3-9 and NRW3-10). The length of bedrock sampled by split-spooning and by coring and the depths to, and corresponding elevations of, the completely to moderately weathered shale bedrock and the depths to, and corresponding elevations of, the slightly weathered to fresh shale bedrock are summarized below.

Borehole No.	Completely to Moderately Weathered Bedrock		Length of Bedrock Split-Spoon Sampled (m)	Slightly Weathered to Fresh Bedrock		Length of Bedrock Cored (m)
	Depth (m)	Elevation (m)		Depth (m)	Elevation (m)	
CRB-6	4.8 - 5.5	86.9 – 86.3	0.3	5.50 – 13.27	86.25 – 78.48	8.15
CRB-8	8.1 – 8.5	86.7 – 86.2	0.4	--	--	--
AR-1	8.9 – 9.2	86.8 – 86.5	0.3	--	--	--
NW3-1	--	--	--	11.80 – 15.42	84.70 – 81.08	3.62
PED-01	--	--	--	22.32 – 25.41	73.99 – 70.90	3.09
NRW3-4	10.7 – 11.5	83.9 – 83.1	0.8	--	--	--
NRW3-6	6.2 – 7.5	86.7 – 85.4	1.3	7.47 – 11.38	85.39 – 81.48	3.91
NRW3-7	4.5 – 7.8	89.4 – 86.1	3.1	7.8 – 11.69	86.1 – 82.23	4.09
NRW3-8	--	--	0.9	5.60 – 10.52	90.4 – 85.43	3.79
NRW3-9	7.0 – 7.8	91.2 – 83.4	0.1	7.8 – 11.01	91.2 – 87.19	3.35
NRW3-10	--	--	0.1	5.5 – 9.53	90.9 – 86.84	3.31

**Completely to Moderately Weathered Shale**

Completely to moderately weathered shale bedrock was inferred based on drilling behaviour, observations of drilling cuttings and split-spoon sampling. The thickness of the completely to moderately weathered bedrock is inferred to range from about 0.3 m to 3.3 m. The split-spoon samples obtained from within the inferred completely to moderately weathered bedrock do not contain larger fragments of rock due to the sampler size and sampling method. Larger fragments of unweathered shale bedrock may be present in-situ.

Deposit / Layer Description	Borehole Numbers	N Values (blows/0.30 m)	Laboratory Testing Results
Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)	CRB-8, AR-1, NRW3-4, NRW3-6 and NRW3-7	N = 50/0.08 m, 100/0.20 m to 100/0.18 m	w = 12%

### *Moderately Weathered to Fresh Shale*

The retrieved bedrock core from the boreholes advanced within the limits of NBRW – Line ‘F’ and NBW – Line ‘H’ is described as highly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous to non-porous, very weak to medium strong shale with strong to very strong limestone interbeds (Georgian Bay Formation).

More detailed descriptions of the bedrock cores are presented on the Record of Drillhole sheets in Appendix C, including data regarding the discontinuity frequency and type. Photographs of the bedrock core samples are also contained in Appendix C. The bedrock properties, as encountered in the cored boreholes, are summarized below.

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
CRB-6	86% – 100%	47% – 100%	R2	6 – PLT, 1 – UC (Appendix I): $I_{s(50),A}$ (shale) = 0.61 MPa – 0.70 MPa $I_{s(50),D}$ (shale) = 0.15 MPa – 0.51 MPa UCS (shale) = 14.6 MPa E (shale) = 0.63 GPa $\gamma$ (shale) = 2.17 g/cm <sup>3</sup>
		Poor to Excellent	Weak	
NW3-1	96% – 100%	90% – 97%	R2	6 – PLT (Appendix I): $I_{s(50),A}$ (shale) = 0.4 MPa – 0.6 MPa $I_{s(50),D}$ (shale) = 0.2 MPa – 0.4 MPa
		Excellent	Weak	
PED-01	92% – 100%	90% – 95%	R2	n/a
		Excellent	Weak	
NRW3-6	94% – 100%	80%* – 88%	R2	n/a
		Good	Weak	
NRW3-7	90% – 100%	90%* – 97%	R2	1 – UC (Appendix I): UCS (shale) = 14.4 MPa E (shale) = 0.68 GPa $\gamma$ (shale) = 2.60 g/cm <sup>3</sup>
		Excellent	Weak	
NRW3-8	91% – 100%	76% – 86%	R2	n/a
		Good	Weak	



Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
NRW3-9	92% – 100%	76%* – 78%	R1 – R2	n/a
		<b>Good</b>	<b>Very Weak to Weak</b>	
NRW3-10	96% – 100%	38% – 89%	R2	n/a
		<b>Poor to Good</b>	<b>Weak</b>	

**Where:**

PLT = point load index test

 $I_{s(50),A}$  = axial point load strength index, corrected for 50-mm sample diameter $I_{s(50),D}$  = diametral point load strength index, corrected for 50-mm sample diameter

UC = unconfined compression test

UCS = uniaxial compressive strength

E = tangent Young's modulus

 $\gamma$  = bulk density

\* = 0% RQD of upper approx. 0.2 m of core due to breakage by split spoon sampling

## 4.2.4 Noise Barrier Wall – Line 'A' - QEW Sta 15+622 to Sta 15+866

### 4.2.4.1 Overburden Conditions

Five (5) boreholes (NW4-1 to NW4-5) were advanced adjacent to the proposed Noise Barrier Wall – Line 'A' (NBW – Line 'A') at the locations summarized in Table 1 and shown on Drawing 1. The subsoil conditions along NBW – Line 'A' generally consist of asphalt pavement, underlain by gravelly sand to sand and gravel fill, in turn underlain by a deposit of silty clay in Borehole NW4-5 and till deposit in the other four boreholes, underlain by shale bedrock.

The borehole records and laboratory testing results are presented in Appendix D, and a description of the soil deposits encountered in the boreholes is provided below.

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Asphalt Pavement</b>	NW4-1 to NW4-5	0.08 – 0.16	101.0 – 100.3	n/a	n/a
<b>Gravelly Sand to Sand and Gravel, trace to some silt (FILL)</b>	NW4-1 to NW4-5	0.5 – 1.3	100.9 – 100.1	N = 8 – 15	w = 11%, 22% 1 – MH (Fig. D-1)
				<b>Loose to Compact</b>	

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Silty Clay, some gravel, trace to some sand</b>	NW4-5	0.8	99.6	19	w = 15% w <sub>l</sub> = 40% w <sub>p</sub> = 22% I <sub>p</sub> = 18% 1 – MH (Fig. D-2) 1 – AL (Fig. D-3)
				<b>Very Stiff</b>	
<b>Silty Clay, trace to some sand, trace to some gravel (TILL)</b>	NW4-1 to NW4-4 <sup>1</sup>	0.7 – 1.7	100.0 – 99.6	N = 4 – 24	w = 13% – 33% w <sub>l</sub> = 36% – 44% w <sub>p</sub> = 19% – 21% I <sub>p</sub> = 16% – 25% 4 – MH (Fig. D-4) 4 – AL (Fig. D-5)
				<b>Soft to Very Stiff</b>	

**Where:**

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)**Notes:**<sup>1</sup> Organics (e.g., rootlets) were encountered between 0.8 m and 1.4 m depth (Elevations 99.9 m and 99.3 m) in Borehole NW4-2.**4.2.4.2 Bedrock / Refusal Conditions**

Bedrock was confirmed by rock coring in the five boreholes (NW4-1 to NW4-5) adjacent to the proposed NBW – Line 'A'. The length of bedrock sampled by split-spooning and by coring and the depths to, and corresponding elevations of, the completely to moderately weathered shale bedrock and the depths to, and corresponding elevations of, the slightly weathered to fresh shale bedrock are summarized below.

Borehole No.	Completely to Moderately Weathered Bedrock		Length of Bedrock Split-Spoon Sampled (m)	Slightly Weathered to Fresh Bedrock		Length of Bedrock Cored (m)
	Depth (m)	Elevation (m)		Depth (m)	Elevation (m)	
NW4-1	3.0 – 3.3	98.0 – 97.7	0.3	3.27 – 6.32	97.73 – 94.68	3.05
NW4-2	2.3 – 4.9	98.4 – 96.7	0.1	4.94 – 6.27	95.76 – 94.43	3.27
NW4-3	2.4 – 2.7	98.2 – 97.9	0.7	2.7 – 7.71	97.9 – 92.84	4.66
NW4-4	1.4 – 2.7	99.1 – 97.8	2.4	2.7 – 8.00	97.8 – 92.51	3.58
NW4-5	1.5 – 3.8	98.8 – 96.5	2.6	3.8 – 7.63	96.5 – 92.70	3.51

### Completely to Moderately Weathered Shale

Completely to moderately weathered shale bedrock was inferred based on drilling behaviour, observations of drilling cuttings and split-spoon sampling. The thickness of the completely to moderately weathered bedrock is inferred to range from about 0.3 m to 1.6 m. The split-spoon samples obtained from within the inferred completely to moderately weathered bedrock do not contain larger fragments of rock due to the sampler size and sampling method. Larger fragments of unweathered shale bedrock may be present in-situ. In addition, the percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behaviour of the in-situ or excavated completely to moderately weathered shale bedrock.

Deposit / Layer Description	Borehole Numbers	N Values (blows/0.30 m)	Laboratory Testing Results
Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)	NW4-1 to NW4-5	N = 26 – 69, 50/0.08 m, 100/0.23 m to 100/0.05 m	w = 9% – 13% w <sub>L</sub> = 33% w <sub>p</sub> = 21% I <sub>p</sub> = 12% 1 – AL (Fig. D-6)

### Moderately Weathered to Fresh Shale

The retrieved bedrock core from the boreholes advanced within the limits of NBW – Line 'A' is described as moderately weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, weak shale with strong to very strong limestone interbeds (Georgian Bay Formation).

More detailed descriptions of the bedrock cores are presented on the Record of Drillhole sheets in Appendix D, including data regarding the discontinuity frequency and type. Photographs of the bedrock core samples are also contained in Appendix D. The bedrock properties, as encountered in the cored boreholes, are summarized below.

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
NW4-1	83% – 100%	0% – 80%	R2	n/a
		Very Poor to Good	Weak	
NW4-2	79% – 100%	0% – 72%	R2	n/a
		Very Poor to Fair	Weak	
NW4-3	48% – 100%	0% – 96%	R2	n/a
		Very Poor to Excellent	Weak	
NW4-4	60% – 100%	23% – 73%	R2	n/a
		Very Poor to Fair	Weak	

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
NW4-5	100%	78% – 100%	R2	n/a
		<b>Good to Excellent</b>	<b>Weak</b>	

#### 4.2.5 Noise Barrier Wall – Line ‘C’ – S-E Ramp Sta 10+033 to Sta 10+227, QEW Sta 16+519 to Sta 16+663

##### 4.2.5.1 Overburden Conditions

Seven (7) boreholes (NW5-1 to NW5-5, including NW5-3A and NW5-5A) were advanced adjacent to the proposed Noise Barrier Wall – Line ‘C’ (NBW – Line ‘C’) at the locations summarized in Table 1 and shown on Drawing 1. The subsoil conditions along NBW – Line ‘C’ generally consist of topsoil or a layer of concrete or asphalt pavement, underlain by layers of fill of variable composition (gravelly clayey silt with sand to clayey silt to silt and sand to sand and gravel), underlain by deposits of silty clay and residual soil, underlain by shale bedrock.

The borehole records and laboratory testing results are presented in Appendix E, and a description of the soil deposits encountered in the boreholes is provided below.

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Topsoil</b>	NW5-1, NW5-2	0.3	97.3, 97.1	N = 9 <sup>1</sup> , 11	n/a
<b>Asphalt Pavement</b>	NW5-3	0.2	97.4	n/a	n/a
<b>Concrete</b>	NW5-4, NW5-5	0.3 – 0.6	96.3, 95.8	n/a	n/a
<b>Gravelly Sand to Sand and Gravel, trace to some silt, trace clay (FILL)</b>	NW5-3, NW5-4, NW5-5	0.3 – 0.9	97.2 – 95.5	N = 7 <sup>2</sup> – 34 <b>Loose to Dense</b>	w = 4% 1 – MH (Fig. E-1)
<b>Silt and Sand to Silty Sand to Sand / Gravelly Clayey Silt with Sand to Clayey Silt, some sand, some gravel (FILL)</b>	NW5-2, NW5-3, NW5-4, NW5-5	0.8 – 1.8	97.0 – 94.6	N = 6 – 20 <b>Loose to Compact / Stiff</b>	w = 7% – 21 % 3 – MH (Fig. E-2)

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Silty Clay, trace to some sand, trace gravel, trace rootlets</b>	NW5-1, NW5-4	0.6, 0.8	96.8, 94.6	N= 6, 23 <sup>3,4</sup>	w = 13% – 22% w <sub>l</sub> = 31%, 46% w <sub>p</sub> = 20%, 21% I <sub>p</sub> = 11%, 25% 2 – MH (Fig. E-3) 2 – AL (Fig. E-4)
				<b>Firm to Very Stiff</b>	
<b>Sandy Silty Clay, trace gravel, some shale fragments (RESIDUAL SOIL)</b>	NW5-5	1.1	93.6	N = 21, 100/0.23 m <sup>5</sup>	w = 17% w <sub>l</sub> = 35% w <sub>p</sub> = 19% I <sub>p</sub> = 16% 1 – MH (Fig. E-5) 1 – AL (Fig. E-6)
				<b>Very Stiff to Hard</b>	

**Where:**

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = natural moisture content (%)

M = sieve analysis

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)**Notes:**<sup>1</sup> SPT 'N' value of 9 was obtained over the interface of topsoil and silty clay in Borehole NW5-1.<sup>2</sup> SPT 'N' value of 7 was obtained over the interface of sand and gravel (fill) and clayey silt (fill) deposits in Borehole NW5-5.<sup>3</sup> SPT 'N' value of 6 was obtained over the interface of silt and sand (fill) and clayey silt deposits in Borehole NW5-4.<sup>4</sup> SPT 'N' value of 23 was obtained over the interface of silty clay and inferred bedrock in Borehole NW5-1.<sup>5</sup> SPT 'N' value of 100/0.23m was obtained over the interface of residual soil and inferred bedrock in Borehole NW5-5.**4.2.5.2 Bedrock / Refusal Conditions**

Bedrock was confirmed by bedrock coring in all boreholes (NW5-1, NW5-2, NW5-3A, NW5-4, and NW5-5A) adjacent to the proposed NBW - Line 'C'. The length of bedrock sampled by split-spooning and by coring and the depths to, and corresponding elevations of, the completely to moderately weathered shale bedrock and the depths to, and corresponding elevations of, the slightly weathered to fresh shale bedrock are summarized below.

Borehole No.	Completely to Moderately Weathered Bedrock		Length of Bedrock Split-Spoon Sampled (m)	Slightly Weathered to Fresh Bedrock		Length of Bedrock Cored (m)
	Depth (m)	Elevation (m)		Depth (m)	Elevation (m)	
NW5-1	1.1 – 3.0	96.0 – 93.6	2.1	3.53 – 6.63	93.61 – 90.51	3.58
NW5-2	1.3 – 2.2	96.0 – 95.1	0.9	2.21 – 5.61	95.13 – 91.73	3.40

Borehole No.	Completely to Moderately Weathered Bedrock		Length of Bedrock Split-Spoon Sampled (m)	Slightly Weathered to Fresh Bedrock		Length of Bedrock Cored (m)
	Depth (m)	Elevation (m)		Depth (m)	Elevation (m)	
NW5-3 <sup>1</sup>	2.7 – 3.1	94.7 – 94.3	0.4	--	--	--
NW5-3A	2.6 – 2.8	94.8 – 94.6	0.5	2.8 – 7.97	94.6 – 89.47	4.84
NW5-4	2.3 – 2.7	94.0 – 93.6	0.6	2.7 – 6.78	93.6 – 89.56	3.63
NW5-5	3.3 – 5.0	92.5 – 90.8	5.9	5.0 – 9.2	90.8 – 86.6	--
NW5-5A	3.3 – 5.0	92.5 – 90.8	0.2	4.95 – 8.63	90.86 – 87.18	4.44

NOTE:

1. Split-spoon refusal encountered in Borehole NW5-3. Borehole NW5-3A was advanced approximately 1.5 m east of NW5-3 and the bedrock was split-spoon sampled and cored.

### **Completely to Moderately Weathered Shale**

Completely to moderately weathered shale bedrock was inferred based on drilling behaviour, observations of drilling cuttings and split-spoon sampling. The thickness of the completely to moderately weathered bedrock is inferred to range from about 0.2 m to 1.9 m. The split-spoon samples obtained from within the inferred completely to moderately weathered bedrock do not contain larger fragments of rock due to the sampler size and sampling method. Larger fragments of unweathered shale bedrock may be present in-situ. In addition, the percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behaviour of the in-situ or excavated completely to moderately weathered shale bedrock.

Deposit / Layer Description	Borehole Numbers	N Values (blows/0.30 m)	Laboratory Testing Results
<b>Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)</b>	NW5-1, NW5-2, NW5-3, NW5-3A, NW5-4, NW5-5	N = 23, 65 50/0.08 m, 100/0.23 m to 100/0.08 m	w = 7% – 26% w <sub>l</sub> = 32% w <sub>p</sub> = 17% I <sub>p</sub> = 15% 1 – MH (Fig. E-7) 1 – AL (Fig. E-8)

### **Moderately Weathered to Fresh Shale**

The retrieved bedrock core from the boreholes advanced within the limits of NBW – Line 'C' is described as highly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, very weak to weak shale with strong to very strong limestone interbeds (Georgian Bay Formation).

More detailed descriptions of the bedrock cores are presented on the Record of Drillhole sheets in Appendix E, including data regarding the discontinuity frequency and type. Photographs of the bedrock core samples are also contained in Appendix E. The bedrock properties, as encountered in the cored boreholes, are summarized below.

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
NW5-1	83% – 100%	6% – 88%	R2	1 – UC (Appendix I): UCS (shale) = 13.6 MPa $\gamma$ (shale) = 2.59 g/cm <sup>3</sup>
		<b>Very Poor to Good</b>	<b>Weak</b>	
NW5-2	37% – 100%	0% – 77%	R2	n/a
		<b>Very Poor to Good</b>	<b>Weak</b>	
NW5-3A	0% – 100%	0% – 94%	R2	n/a
		<b>Very Poor to Excellent</b>	<b>Weak</b>	
NW5-4	79% – 100%	50% – 93%	R2 (shale) / R5 (limestone)	1 – UC (Appendix I): UCS (limestone) = 196.3 MPa E (limestone) = 60.8 GPa $\gamma$ (limestone) = 2.73 g/cm <sup>3</sup>
		<b>Fair to Excellent</b>	<b>Weak (shale) / Very Strong (limestone)</b>	
NW5-5A	96% – 100%	0% – 100%	R0 to R2	n/a
		<b>Very Poor to Excellent</b>	<b>Extremely Weak to Weak</b>	

UC = unconfined compression test

UCS = uniaxial compressive strength

E = tangent Young's modulus

$\gamma$  = bulk density

## 4.2.6 Noise Barrier Wall – Line 'I' - QEW Sta 16+918 to Sta 16+920

### 4.2.6.1 Overburden Conditions

Two (2) boreholes (NW6-1 to NW6-2) were advanced adjacent to the proposed Noise Barrier Wall – Line 'I' (NBW – Line 'I') at the locations summarized in Table 1 and shown on Drawing 2. In general, the subsoil conditions encountered at the NBW – Line 'I' borehole locations consist of a layer of asphalt pavement and / or concrete, underlain by silty sand to gravelly sand fill, underlain by deposits of silt to silty sand, in turn underlain by a deposit of sandy clayey silt till.

The borehole records and laboratory testing results are presented in Appendix F, and a description of the soil deposits encountered in the boreholes is provided below.



Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Asphalt Pavement</b>	NW6-1, NW6-2	0.15, 0.17	96.6, 95.3	n/a	n/a
<b>Concrete</b>	NW6-1, NW6-2	0.15, 0.25	96.4, 95.1	n/a	n/a
<b>Silty Sand / Gravelly Sand to Sand and Gravel (FILL)</b>	NW6-1, NW6-2	1.8, 2.7	96.2, 95.0	N = 3 – 60  <b>Very Loose to Very Dense</b>	w = 7%, 12% 1 – M (Fig. F-1)
<b>Silt and Sand to Silty Sand, trace to some clay</b>	NW6-1, NW6-2	2.3, 4.6	94.4, 92.3	N = 3 – 43  <b>Very Loose to Dense</b>	w = 8% – 20% 3 – MH (Fig. F-2)
<b>Silt</b>	NW6-1	2.0	90.0	N = 32 – 41  <b>Dense</b>	w = 14% – 15% 1-MH (Fig-2)
<b>Sandy Clayey Silt, trace to some gravel (TILL)</b>	NW6-1, NW6-2	0.2, 1.4	89.8, 88.0	N = 7 – 15  <b>Firm to Stiff</b>	w = 13% – 16% w <sub>l</sub> = 23% – 25% w <sub>p</sub> = 14% – 15% I <sub>p</sub> = 9% – 10% 2 – MH (Fig. F-3) 3 – AL (Fig. F-4)

**Where:**

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)**4.2.7 Noise Barrier / Retaining Wall – Line 'G' - QEW Sta 17+415 to Sta 17+520****4.2.7.1 Overburden Conditions**

Four (4) boreholes (NRW7-1, NRW7-2, K6 and NRW7-3) were advanced adjacent to the proposed Noise Barrier / Retaining Wall – Line 'G' (NRW – Line 'G') at the locations summarize in Table 1 and shown on Drawing 2. The subsoil conditions along NRW – Line 'G' generally consist of asphalt pavement and / or concrete, underlain by sandy silt to sand and gravel fill, underlain by deposits of silt to clayey silt with sand, in turn is underlain by a till deposit consisting of silty sand to clayey silt, interlayered with granular layers consisting of silt, sand and gravel. The granular layers are underlain by residual soil at Borehole NRW7-3 and by shale bedrock at Borehole K6.

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
Asphalt	NRW7-1, NRW7-2, K6	0.15, 0.20	95.0, 94.9	n/a	n/a
Concrete	NRW7-1, NRW7-2, K6, NRW7-3	0.20 – 0.43	94.9 – 94.8	n/a	n/a
Gravelly Sand, some silt to Sand and Gravel (FILL)	NRW7-1, NRW7-2, NRW7-3	0.3 – 0.6	94.6 – 94.5	N = 32, 49 Dense	n/a
Sandy Silt to Silty Sand to Sand, trace organics (FILL)	NRW7-1, NRW7-2, K6, NRW7-3	2.1 – 5.1	94.4 – 93.9	N = WH – 36 Very Loose to Dense	w = 7% – 49% 6 – MH (Fig. G-1)
Silt, some sand	NRW7-1	0.8	91.3	N = 4 Loose	w = 25% 1 MH – Fig (G-2)
Clayey Silt with Sand, some gravel	K6, NRW7-3	1.6	89.3	N = 6, 26 Firm, Very Stiff	w = 19% - 22% w <sub>L</sub> = 21%, 22% w <sub>p</sub> = 15%, 16% I <sub>p</sub> = 6% 1 – MH (Fig. G-2) 2 – AL (Fig. G-3)
Sandy Silty Clay to Sandy Clayey Silt, some gravel (TILL)	NRW7-1, NRW7-2	1.3, 2.7	90.6, 90.5	N = 5, 6, 12 Firm to Stiff	w = 12% – 22% w <sub>L</sub> = 22%, 36% w <sub>p</sub> = 15%, 20% I <sub>p</sub> = 7%, 16% 2 – MH (Fig. G-4) 2 – AL (Fig. G-5)
Silt and Sand, some gravel to Silty Sand and Gravel (TILL)	NRW7-1, NRW7-2 <sup>1</sup>	3.0, 3.1	89.3, 87.8	N = 62 and 50/0.03 m to 100/0.05 m Very Dense	w = 3% – 10% w <sub>L</sub> = 16%, 17% w <sub>p</sub> = 15% I <sub>p</sub> = 1%, 2% 2 – MH (Fig. G-6) 2 – AL (Fig. G-7)
Silty Sand, some gravel fragments, some clay to Sand	NRW7-1, NRW7-2, K6, NRW7-3	1.1 – 4.5	87.7 – 84.8	N = 16 – 60 and 100/0.13 m 50/0.25 m Compact to Very Dense	w = 6% – 21% 3 – MH (Fig. G-8)

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Silty Sand, trace to some clay to Clayey Silt, some sand (TILL)</b>	NRW7-2, K6	0.6	84.7, 83.2	N = 100/0.23 m, 100/0.17 m	W = 5% – 14%
				<b>Very Dense / Hard</b>	
<b>Clayey Silt, some sand, some shale fragments (RESIDUAL SOIL)</b>	NRW7-3	1.5	84.1	N = 50/0.25 m, 100/0.08 m	w = 14%
				<b>Hard</b>	

**Where:**

N = SPT 'N'-value; number of blows for 0.3 m of penetration

WH = weight of hammer

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)**Notes:**<sup>1</sup> 0.3 m size boulder at Elev. 87.6 m encountered in the till deposit in Borehole NRW7-2.**4.2.7.2 Bedrock / Refusal Conditions**

Bedrock was encountered and cored in Borehole K6 advanced adjacent to the proposed NBRW – Line 'G' at the depth / elevation presented below. Refusal to split spoon advancement was recorded in Borehole NRW7-3 at a depth of 12.3 m below ground surface (Elevation 82.6).

Borehole Number	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Comments
K6	12.3	82.6	2.0 m split-spoon penetration and augering into bedrock; 0.7 m bedrock coring

The retrieved bedrock core from the borehole advanced within the limits of NBRW – Line 'G' is described as slightly weathered, thinly bedded, grey, fine grained, faintly porous, weak shale with strong to very strong limestone interbeds (Georgian Bay Formation).

More detailed description of the bedrock core is presented on the Record of Drillhole sheets in Appendix G, including data regarding the discontinuity frequency and type. Photographs of the bedrock core samples are also contained in Appendix G. The bedrock properties, as encountered in the cored boreholes, are summarized below.

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
K6	62% – 100%	0%* – 62%	R2	n/a
		Fair	Weak	

\*Obtained on core run of about 0.05 m length

## 4.2.8 Noise Barrier Wall – Line ‘J’ - QEW Sta 17+076 to Sta 17+124

### 4.2.8.1 Overburden Conditions

Four (4) boreholes (PED-03, PED-03B, S6 and S7) were advanced adjacent to the proposed Noise Barrier Wall – Line ‘J’ (NBW – Line ‘J’) at the locations summarized in Table 1 and shown on Drawing 2, and a standpipe piezometer was installed in an adjacent unsampled borehole (Borehole PED-03A). The subsoil conditions along NBW – Line ‘J’ generally consist of asphalt pavement or topsoil, underlain by silt and sand to sand and gravel fill, underlain by deposits of silty sand or clayey silt with sand in places, in turn underlain by deposits of sandy clayey silt to gravelly clayey silt with sand till, underlain by shale or limestone bedrock.

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
Asphalt	S6	0.20	95.2	n/a	n/a
Topsoil	PED-03, S7	0.20, 0.30	93.7, 90.1	n/a	n/a
Silt and Sand / Sand and Gravel (FILL)	PED-03 <sup>1</sup> , S6, S7	2.0 – 6.0	95.0 – 89.8	N = 3 – 39 Very Loose to Dense	w = 5% – 24% 5 – MH (Fig. H-1)
Silty Sand, trace to some clay	S6	1.6	89.6	N = WH Very Loose	w = 27%
Clayey Silt with Sand	S7	0.4	87.8	N = 7 Firm	w = 24% w <sub>L</sub> = 22% w <sub>p</sub> = 16% I <sub>p</sub> = 6% 1 – MH (Fig. H-2) 1 – AL (Fig. H-3)

Deposit / Layer Description	Borehole Numbers	Deposit Thickness (m)	Deposit Surface Elevation (m)	N Values (blows/0.30 m)	Laboratory Testing Results
				Consistency or Compactness	
<b>Sandy Clayey Silt to Gravelly Clayey Silt with Sand, trace shale fragments (TILL)</b>	PED-03, PED-03B, S6, S7	1.6 – 7.6	88.0 – 87.4	N = 12 – 66, 100/0.25 m to 50/0.08 m	w = 8% – 22% w <sub>l</sub> = 21% – 28% w <sub>p</sub> = 14% - 17% I <sub>p</sub> = 7% – 12% 4 – MH (Fig. H-4) 4 – AL (Fig. H-5)
				<b>Firm to Hard</b>	
<b>Silt and Sand, trace to some clay (TILL) Interlayer</b>	S-6	1.8	83.6	N = 100/0.23	w = 13% w <sub>p</sub> = 16% w <sub>l</sub> = 19% I <sub>p</sub> = 3% 1 – MH (Fig H-4) 1 – AL (Fig H-5)
				<b>Very Dense</b>	
<b>Silt, some clay, some sand</b>	PED-03B	1.1	82.5	N = 35	w = 19%
				<b>Dense</b>	
<b>Gravelly Clayey Silt with Sand (TILL)</b>	PED-03B	2.1	81.4	N = 50/0.10 m to 100/0.10 m	w = 12%, 18% w <sub>l</sub> = 23% w <sub>p</sub> = 14% I <sub>p</sub> = 9% 1 – MH (Fig. H-6) 1 – AL (Fig. H-7)
				<b>Hard</b>	

**Where:**

N = SPT 'N'-value; number of blows for 0.3 m of penetration

WH = weight of hammer

w = natural moisture content (%)

MH = combined sieve and hydrometer analysis

AL = Atterberg limits test

w<sub>p</sub> = plastic limit (%)w<sub>l</sub> = liquid limit (%)I<sub>p</sub> = plasticity index (%)**4.2.8.2 Bedrock / Refusal Conditions**

Bedrock was encountered and cored in Borehole PED-03B advanced adjacent to the proposed NBW – Line 'J' at the depth / elevation presented below. Refusal to further split spoon penetration on / into shale bedrock was recorded in Boreholes S6 and S7 at depths of 14.8 m and 4.6 m below ground surface (Elevation 80.4 m and 85.5 m), respectively.

Borehole Number	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Comments
PED-03B	14.8	79.3	3.0 m bedrock coring

The retrieved bedrock core from the borehole advanced within the limits of NBW – Line ‘J’ is described as slightly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, weak shale (Georgian Bay Formation) with strong to very strong limestone interbeds.

More detailed description of the bedrock core is presented on the Record of Drillhole sheet in Appendix H, including data regarding the discontinuity frequency and type. Photographs of the bedrock core samples are also contained in Appendix H. Laboratory testing results of bedrock core samples are provided in Appendix I. The bedrock properties, as encountered in the cored borehole, are summarized below.

Borehole Number	Total Core Recovery (TCR)	Rock Quality Designation (RQD) Value	Field Estimation of Rock Strength Index	Laboratory Testing Results
		Classification	Description	
PED-03B	96% – 100%	38% – 78%	R2	1 – UC (Appendix I): UCS (shale) = 6.7 MPa E (shale) = 0.29 Gpa $\gamma$ (shale) = 2.57 g/cm <sup>3</sup>
		Poor to Good	Weak	

**Where:**

UC = unconfined compression test  
 UCS = uniaxial compressive strength  
 E = tangent Young's modulus  
 $\gamma$  = bulk density

## 4.2.9 Groundwater Conditions

The groundwater conditions and water levels in the open boreholes were observed during and immediately following drilling operations. Standpipe piezometers were installed in select boreholes after completion of drilling. Details of the groundwater observations and piezometer installations are provided on the Record of Borehole and Drillhole sheets in Appendices A to H, as applicable.

Generally, the boreholes located to the west of the Credit River (at NBW, NBW – Line ‘A’, NBW – Line ‘B’, and NBW – Line ‘C’) were observed to be dry upon completion of soil drilling (prior to rock coring, if performed). The water level recorded upon completion of soil drilling in open Boreholes NW1-1 and NW4-1 is at 0.9 m and 1.5 m below ground surface (Elevations 101.9 m and 99.5 m), respectively. A water level is at 1.0 m below ground surface (Elevation 96.3 m) in Borehole NW5-2, due to the addition of water from wash boring.

East of the Credit River, (at NBW – Line ‘F’, NBW – Line ‘G’, NBW – Line ‘H’, NBW – Line ‘I’ and NBW – Line ‘J’), the groundwater conditions in the open boreholes generally range from dry to about 1.4 m to 12.3 m below ground surface (between Elevation 93.3 m and 82.3 m).

The depths to the water level observed in the boreholes upon completion of drilling and prior to rock coring is presented below. It is noted that these observations are not necessarily representative of the stabilized groundwater level at the site.

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events and should be expected to be higher during wet periods of the year.

Noise Barrier Wall / Retaining Wall Designation	Borehole Number	Ground Surface Elevation (m)	Water Level Depth (m)	Water Level Elevation (m)	Comment
NBW	NW1-1	102.4	0.9	101.9	Water level observed upon completion of overburden drilling and prior to rock coring.
NBRW - Line 'F'	CRB-8	94.7	1.5	93.2	Water level observed upon completion of drilling.
	AR-1	95.7	3.7	92.0	
	NW3-1	96.5	4.5	92.0	Water level observed upon completion of overburden drilling and prior to rock coring.
	NW3-2A	95.3	3.4	91.9	Water level observed when the borehole was advanced to a depth of 23.5 m in overburden, one day after introduction of drilling mud / water.
	NW3-4	94.6	6.6	88.0	Water level observed upon completion of drilling.
	NW3-5	95.6	3.6	92.0	
	NRW3-1	96.0	4.1	91.9	
	NRW3-3	95.2	9.5	85.7	
	NRW3-4	94.6	1.4	93.2	
	NRW3-5	93.7	1.5	92.2	
NBW - Line 'H'	NRW3-6	92.9	5.2	87.7	Water level observed upon completion of overburden drilling and prior to rock coring.
	NRW3-8	96.0	4.3	91.7	
	NRW3-10	96.4	5.2	91.2	
NBW - Line 'A'	NW4-1	101.0	1.5	99.5	



Noise Barrier Wall / Retaining Wall Designation	Borehole Number	Ground Surface Elevation (m)	Water Level Depth (m)	Water Level Elevation (m)	Comment
NBW - Line 'C'	NW5-2	97.3	1.0	96.3	Water level observed upon completion of drilling; however, not reflective of in-situ conditions as water was during wash boring.
NBW - Line 'I'	NW6-1	95.3	6.3	89.0	Water level observed upon completion of drilling.
	NW6-2	96.6	4.3	82.3	
NBRW - Line 'G'	NRW7-1	95.0	8.5	86.5	Water level observed upon completion of drilling.
NBRW - Line 'G' (cont.)	NRW7-2	94.9	8.2	86.7	
	NRW7-3	94.9	6.4	88.5	
	K6	94.9	12.3	82.6	Water level observed upon completion of overburden drilling and prior to rock coring.
NBW - Line 'J'	S6	95.2	11.9	83.3	Water level observed upon completion of drilling.

Standpipe piezometers were installed in selected boreholes advanced throughout the site for the noise barrier wall and noise barrier / retaining walls as well as for other adjacent structures to allow measurements of the groundwater levels at these locations. The groundwater levels recorded in the standpipe piezometers are summarized below.

Borehole Number	QEW Station (m) (Wall Location)	Stratum Sealed Into	Depth to Water Level (m)	Water Level Elevation (m)	Date of Water Level Observation in Piezometer
NW1-3	15+425 (NBW)	Shale Bedrock	2.6	99.8	14-Aug-2018
			2.5	99.9	06-Nov-2018
CRB-6	16+925 (NBRW – Line 'F')	Shale Bedrock	5.6	86.1	21-Nov-2017
			5.0	86.7	12-Mar-2018
			4.9	86.8	30-Apr-2018
			4.9	86.8	06-Nov-2018

Borehole Number	QEW Station (m) (Wall Location)	Stratum Sealed Into	Depth to Water Level (m)	Water Level Elevation (m)	Date of Water Level Observation in Piezometer
NRW3-2	17+325 (NBRW – Line 'F')	Sandy Clayey Silt Till	4.0	92.1	14-Aug-2018
			4.0	92.1	06-Nov-2018
NRW3-9	17+645 (NBRW – Line 'H')	Shale Bedrock	2.8	95.4	14-Aug-2018
			2.8	95.4	06-Nov-2018
S3	17+100 (NBRW – Line 'F')	Silt and Sand (Fill) / Clayey Silt with Sand Till	0.8	89.2	06-Nov-2018
NW4-3	17+695 (NBW – Line 'A')	Shale Bedrock	1.0	99.6	14-Aug-2018
			0.8	99.8	06-Nov-2018
NW5-1	16+350 (NBW – Line 'C')	Shale Bedrock	3.3	93.8	14-Aug-2018
			3.1	94.0	06-Nov-2018
PED-03A	17+075 (NBW – Line 'J')	Sand and silt to silty sand (FILL)	4.3	89.8	14-Nov-2017
			4.4	89.7	21-Nov-2017
			4.4	89.7	28-Nov-2017
			4.1	90.0	06-Nov-2018

#### 4.2.10 Analytical Testing Results

Nine (9) soil samples and one (1) sample of crushed and homogenized bedrock core were submitted to an analytical laboratory for chemical analysis of parameters used to assess the potential corrosivity of the subsurface materials to steel and concrete. The analytical testing results and certificates of analysis reports are included in Appendix J and the test results are summarized below:

Borehole Number	Resistivity (ohm-cm)	Soluble (20:1) Chloride (Cl-) (µg/g)	Electrical Conductivity (µmho/cm)	Available (CaCl <sub>2</sub> ) pH	Soluble (20:1) Sulphate (SO <sub>4</sub> ) (µg/g)
NW3-01 <sup>1</sup>	490	1000	2040	7.86	69
CRB-06 <sup>2</sup>	5000	<20	201	8.11	30
PED-03 <sup>1</sup>	1300	350	762	7.73	70
NRW3-1 <sup>1</sup>	1400	330	721	7.94	88
NRW3-3 <sup>1</sup>	5500	36	180	7.94	32

Borehole Number	Resistivity (ohm-cm)	Soluble (20:1) Chloride (Cl-) (µg/g)	Electrical Conductivity (µmho/cm)	Available (CaCl <sub>2</sub> ) pH	Soluble (20:1) Sulphate (SO <sub>4</sub> ) (µg/g)
NRW3-5 <sup>1</sup>	3000	<20	337	8.04	240
NRW3-7 <sup>1</sup>	350	1300	2870	8.01	55
NRW3-9 <sup>1</sup>	2600	180	386	8.05	21
NRW7-1 <sup>1</sup>	1200	390	805	7.86	31
NRW7-3 <sup>1</sup>	1800	170	564	7.71	<20

**Where:**

&lt;20 = Below Reportable Detection Limit

**Notes:**<sup>1</sup> Soil sample<sup>2</sup> Sample of crushed and homogenized bedrock core.

## 5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Sheri Burton, M.A.Sc., P.Eng. and was reviewed by Ms. Sandra McGaghran, M.Eng., P.Eng., an Associate and Senior Geotechnical Engineer and with Golder. Mr. Jorge Costa, P.Eng., an MTO Foundations Designated Contact and a Senior Consultant with Golder conducted an independent and quality control review of the report.

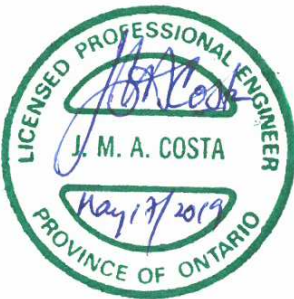
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# PART B

FOUNDATION DESIGN REPORT

NOISE BARRIER WALLS AND NOISE BARRIER / RETAINING WALLS

QEW WIDENING FROM WEST OF MISSISSAUGA ROAD TO WEST OF  
HURONTARIO STREET, MISSISSAUGA

MINISTRY OF TRANSPORTATION, ONTARIO, GWP 2002-13-00

## 6.0 DISCUSSION AND ENGINEERING INVESTIGATION

This section of the report provides geotechnical parameters and recommendations for the foundations aspects of design of the new noise barrier walls (NBWs) and combination noise barrier walls and retaining walls (NBRWs), in support of the widening of the Queen Elizabeth Way (QEW) from west of Mississauga Road to west of Hurontario Street in the City of Mississauga, in the Regional Municipality of Peel, Ontario. The design parameters and recommendations have been developed based on interpretation of the factual data obtained from boreholes advanced during the current subsurface investigation in the vicinity of the proposed noise barrier and noise barrier / retaining walls. The discussion and recommendations presented are intended to provide the designers with sufficient information to assess the feasible noise wall foundation alternatives, develop construction cost estimates, and identify items or issues to be addressed in the Contract Documents. The foundation investigation report, discussion and recommendations are intended for the use of the Ministry of Transportation, Ontario (MTO) and shall not be used or relied upon for any other purpose or by any other parties, including the construction or design-build contractor. The contractor must make their own interpretation based on the factual data in Part A (Foundation Investigation) of the report. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project and for which special provisions may be required in the Contract Documents. Those requiring information on the aspects of construction must make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling, and the like.

### 6.1 General

The proposed alignments of Noise Barrier and Noise Barrier / Retaining Walls Lines 'A' to 'C' and 'F' to 'H' are shown on Drawings 1 and 2. It is understood that the Noise Barrier Wall from QEW Station 15+300 to 15+430 shown on Drawing 1 is no longer planned for construction. It is further understood that the noise barrier and noise barrier / retaining walls will be approximately 5 m high and, where there is a grade difference between one side of a wall and the other side, the maximum retained height of soil will be up to about 2 m. Typically, the walls are supported using conventional augered caissons, with a diameter between 0.6 m and 0.9 m. Recommendations for support of the noise barrier walls using augered caissons are presented in the subsequent sections of this report.

### 6.2 Noise Barrier / Noise Barrier - Retaining Walls Foundation Design

Geotechnical parameters for design of the caisson foundations for the proposed Noise Barrier Wall – Lines 'A' to 'C' and 'F' to 'J' are provided in Table 2 following the text of this report, based on the subsurface conditions encountered in the boreholes advanced in the vicinity of the proposed respective noise barrier walls and noise barrier / retaining walls. The stratigraphy presented in Table 2 has been simplified from the detailed stratigraphic descriptions present the Record of Boreholes for the purposes of the noise barrier / noise barrier – retaining wall foundation design, and the design values and stations over which they apply has been further simplified in SP 760F01 amending OPSS 760 (*Noise Barrier Systems*) for the designer fill-in soil design parameter. The parameters presented in Table 2 are based on field and laboratory test data as well as on accepted correlations (NAVFAC (1986), Bowles (1984) and Kulhawy and Mayne, (1990)) and the analysis was tempered by engineering judgment based on experience in similar soils.

Where both undrained shear strength ( $s_u$ ) and drained parameters (effective cohesion, ( $c'$ ) and effective friction angle, ( $\phi'$ )) have been given in Table 2 for a cohesive deposit, the caisson design should be checked for both the undrained and the drained conditions, and the greater of the two calculated caisson depths shall govern.

The resistance within the upper 1.2 m below ground surface should be neglected to account for frost action within the depth of frost penetration zone as interpreted from OPSS 3090.101 (*Foundation Frost Penetration Depths for Southern Ontario*). In addition, for foundation design, full resistance will be mobilized only where the ground surface in front of and behind the caissons is level (i.e., the zone width of soil in front of and behind the caissons is equal to or greater than eight caisson diameters). If the zone width of soil in front of and / or behind the caissons is insufficient for development of the full resistance (i.e., if there is sloping ground adjacent to the noise barrier wall), the magnitude of resistance may be determined by interpolating between zero resistance at ground surface and full resistance at the depth where the slope face is at a distance of eight caisson diameters away from the caissons.

Geotechnical design parameters in moderately weathered to fresh bedrock have been described as an “upper zone” and “lower zone,” as follows:

- The upper zone of shale bedrock extends from the top of the bedrock surface to between about 0.5 m to 2.7 m below the top of bedrock. In accordance with the CFEM (2006), the upper zone is generally characterized as inferred moderately to slightly weathered, extremely weak to weak, Very Poor to Fair quality shale bedrock (with or without limestone interbeds); and,
- The lower zone of shale bedrock includes depths greater than between about 0.5 m to 2.7 m below the bedrock surface. In accordance with the Canadian Foundation Engineering Manual (CFEM) (2006), the lower zone is generally characterized as slightly weathered to fresh, very weak to weak, Fair to Excellent quality shale bedrock (with or without limestone interbeds).

The factored ultimate geotechnical lateral resistance in bedrock is provided as  $f_{\text{horiz}}$  in Table 2. In order to rely on this resistance in design, the caissons must extend a minimum of 1 m into bedrock. As discussed in Section 3.1.3 the classification of the rock mass quality of the bedrock with respect to Rock Quality Designation (RQD) and Uniaxial Compressive Strength (UCS) are described based on Table 3.10 and Table 3.5, respectively, of the CFEM (2006). The description of weathering inferred from split-spoon samples in the upper zone of the bedrock, and the degree of weathering of the bedrock core samples (e.g., moderately weathered to fresh) and strength classification of the intact rock mass based on field identification are described in accordance with Table B.3 and Table B.6, respectively, of the ISRM (1985) standard classification system. It is noted that there can be variations in the weathering and strength of the bedrock between and beyond boreholes.

## 6.3 Construction Considerations

The noise barrier / retaining walls should be constructed in accordance with OPSS 760 (*Noise Barrier Systems*).

### 6.3.1 Control of Soil and Groundwater for Caissons

Caisson construction is anticipated to require augering / excavation through the existing fill, overburden deposits and in places along noise barrier wall alignment the posts are anticipated to extend into the bedrock. The existing fill and overburden deposits contain granular layers (potentially saturated) which may be susceptible to disturbance during caisson excavation and construction (i.e., water-bearing non-cohesive layers). Wet non-cohesive soil layers and pockets should be expected to run or flow into the drilled hole during or after augering for foundations. In accordance with OPSS.PROV 903 (*Deep Foundations*), as amended by SP 109F57, the contractor is required to maintain sidewall stability throughout the excavation of the caisson and concrete placement and therefore use of temporary liners will be required.

### 6.3.2 Obstructions in Overburden

Cobbles and boulders were encountered or are inferred present within the fill and till deposits and appropriate equipment and methods will be needed to penetrate through such obstructions, if encountered. It is recommended that an NSSP be included in the Contract Documents to warn the Contractor of this condition. An NSSP for obstructions in the overburden is provided in Appendix K.

### 6.3.3 Foundations in Bedrock

Caisson construction for supporting the noise barrier wall where the overburden thickness is minimal, will likely extend (in places) into the upper zone (extremely weak to weak) and potentially into the lower zone of the shale bedrock (very weak to weak shale), with medium strong to very strong limestone interbeds. Appropriate construction procedures and equipment (such as coring, churn drilling or down-hole hammer equipment) may be required to penetrate the bedrock to form the required socket depth. It is recommended that an NSSP be included in the Contract Documents to warn the Contractor of this condition. An NSSP for penetration of bedrock is provided in Appendix K.



## 7.0 CLOSURE

This Foundation Design Report was prepared by Ms. Sandra McGaghran, M.Eng., P.Eng., a senior geotechnical engineer and Associate with Golder. Mr. Jorge Costa, P.Eng., an MTO Foundations Designated Contact and a Senior Consultant with Golder conducted an independent and quality control review of the report.

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Canadian Geotechnical Society. 2006. Canadian Foundation Engineering Manual (CFEM), 4<sup>th</sup> Edition. The Canadian Geotechnical Society, BiTech Publisher Ltd., British Columbia.

Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.

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Kulhawy, F.H. and Mayne, P.W. 1990. Manual on Estimating Soil Properties for Foundation Design. EL-6800, Research Project 1493-6. Prepared for Electric Power Research Institute, Palo Alto, California

Thurber Engineering Ltd., "Foundation Investigation and Design Report, Construction Access Road for Bridge Rehabilitation, QEW Bridge over Credit River, Mississauga, Ontario" File No. 19-92-92-174, dated April 8, 2011 (GEOCRE 30M12-324).

Thurber Engineering Ltd., "Foundation Investigation and Design Report, Preliminary Design and Environmental Assessment, QEW Bridge Twinning Over Credit River, Mississauga, Ontario" File No. 19-1351-174, dated May 18, 2012 (GEOCRE 30M12-341).

Unified Facilities Criteria, U.S. Navy. 1986. NAVFAC Design Manual 7.02. Soil Mechanics, Foundation and Earth Structures. Alexandria, Virginia.

### ASTM International:

ASTM D1586	Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
ASTM D7012	Standard Test Method for Compressive Strength and Elastic moduli of Intact Rock Core Specimens under Varying States of Stress and Temperature

### Ontario Provisional Standard Drawing:

OPSD 3090.101	Foundation Frost Penetration Depths for Southern Ontario
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### Ontario Provincial Standard Specification:

OPSS.MUNI 760	Construction Specification for Noise Barrier Systems
OPSS.PROV 903	Construction Specification for Deep Foundations

### Special Provisions:

Special Provision No. 109F57 Amendment to OPSS 903
Special Provision No. 760F01 Amendment to OPSS 760

### Ontario Water Resources Act:

Ontario Regulation 903	Wells (as amended)
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### Ontario Occupational Health and Safety Act:

Ontario Regulation 213/91	Construction Projects (as amended)
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**APPENDICES A - H**

LIST OF SYMBOLS

LIST OF ABBREVIATIONS

LITHOLOGICAL AND GEOTECHNIAL ROCK  
DESCRIPTION TERMINOLOGY

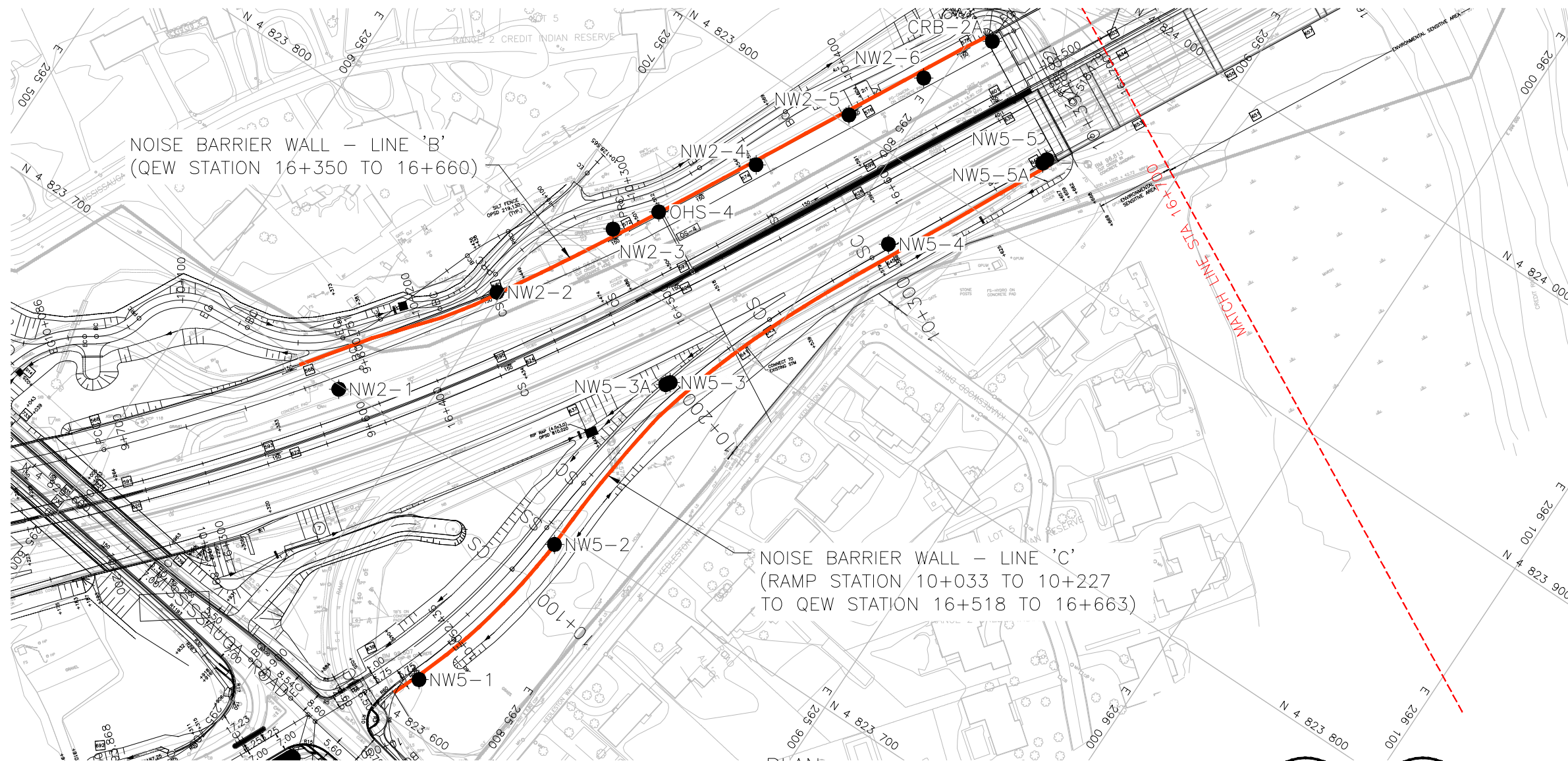
FIELD ESTIMATION OF ROCK HARDNESS

ROCK WEATHERING CLASSIFICATION

**DRAWINGS**

**Drawings 1 & 2**





This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

PLAN  
SCALE



*METRIC*  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

SHEET



● Borehole – Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
CRB-2A	94.5	4823960.1	295808.0
NW1-1	102.4	4823035.9	294842.0
NW1-2	102.6	4823084.3	294885.4
NW1-3	102.4	4823122.4	294920.9
NW2-1	98.2	4823698.5	295666.6
NW2-2	98.2	4823766.1	295698.0
NW2-3	97.8	4823813.0	295722.8
NW2-4	96.2	4823866.3	295756.4
NW2-5	95.6	4823903.6	295776.4
NW2-6	94.8	4823932.6	295793.2
NW4-1	101.0	4823192.5	295107.9
NW4-2	100.7	4823234.5	295162.8
NW4-3	100.6	4823274.0	295219.9
NW4-4	100.5	4823308.8	295274.5
NW4-5	100.3	4823340.0	295333.6
NW5-1	97.1	4823619.2	295758.0
NW5-2	97.3	4823694.5	295773.3
NW5-3	97.4	4823774.4	295776.0
NW5-3A	97.4	4823772.7	295775.0
NW5-4	96.3	4823869.2	295818.3
NW5-5	95.8	4823932.6	295852.6
NW5-5A	95.8	4823930.6	295851.9
OHS-4	97.3	4823828.9	295734.3

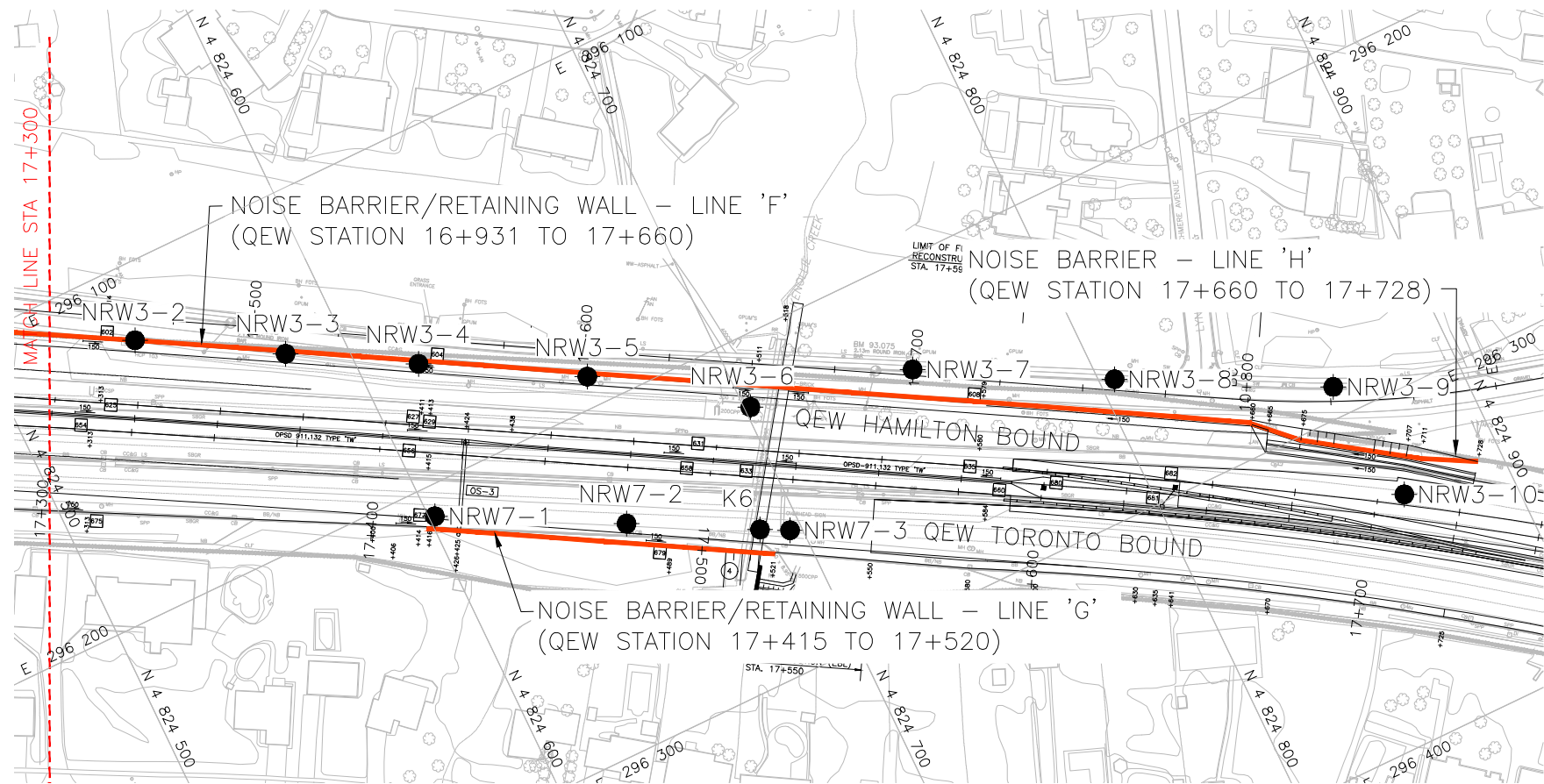
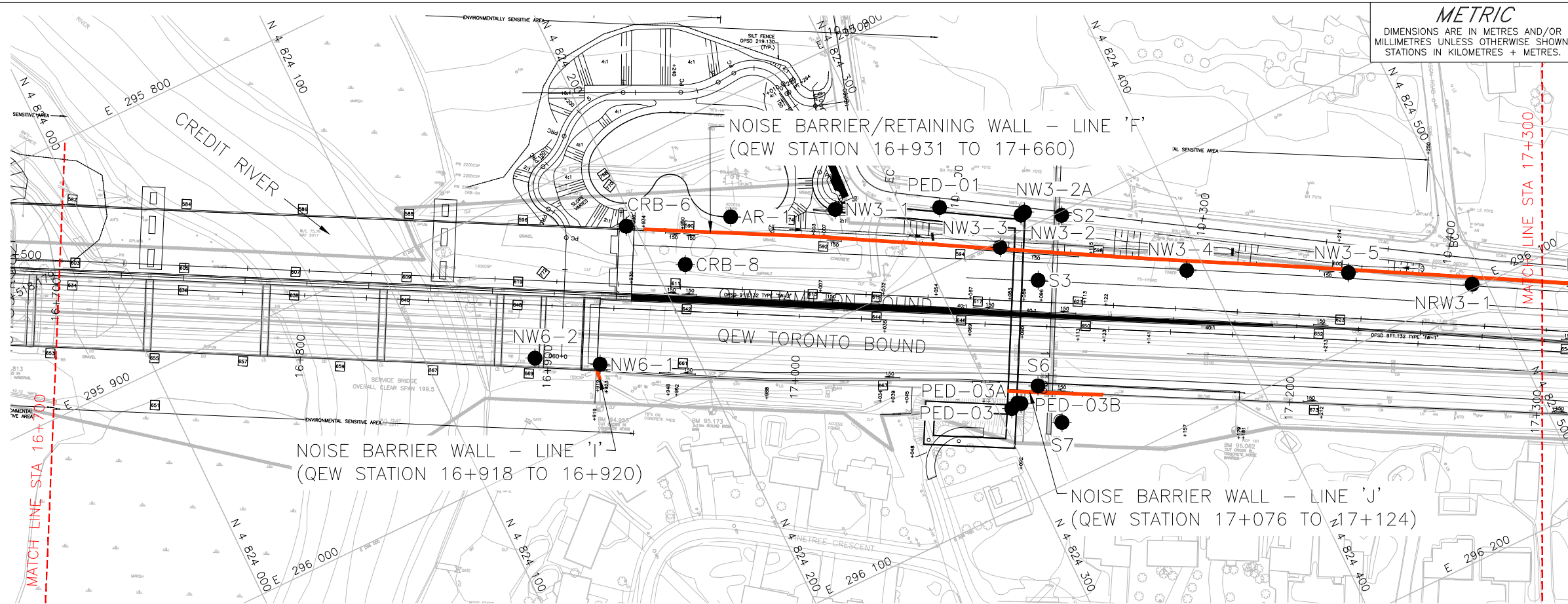
Base plans provided in digital format by Morrison Hershfield, drawing file no. X11609340Base.dwg, received April 12, 2018.  
Design plan provided in digital format by Morrison Hershfield, drawing file no. 1160934\_NoiseWallPlan.dwg, received March 19, 2019.  
Alignment plan provided in digital format by Morrison Hershfield, drawing file no. X1160934\_Align.dwg, received November 19, 2018.

NO.	DATE	BY	REVISION

HWY. QEW		PROJECT NO. 1662333		DIST. CENTRAL
SUBM'D. CL/AM	CHKD. DM	DATE: 05/15/2019		SITE: .
DRAWN: DD	CHKD. SMM/SB	APPD. JMAC		DWG. 1



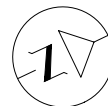




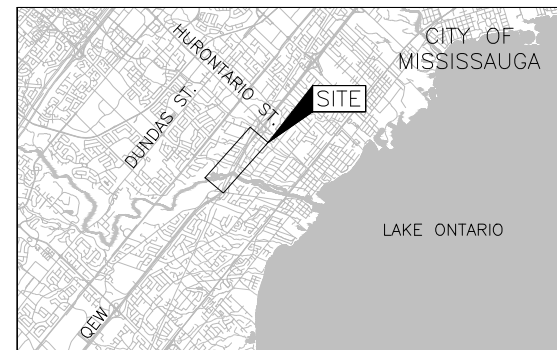
PLAN  
SCALE  
2 0 2 4 km

**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
GWP No. 2002-13-00



QEW WIDENING MISSISSAUGA RD TO HURONTARIO ST  
NOISE BARRIER WALLS  
BOREHOLE LOCATIONS



KEY PLAN  
SCALE  
2 0 2 4 km

#### LEGEND

● Borehole - Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
AR-1	95.7	4824236.4	295944.2
CRB-6	91.7	4824196.7	295929.5
CRB-8	94.7	4824211.5	295953.7
NW3-1	96.5	4824275.8	295959.8
NW3-2	95.3	4824342.4	295994.3
NW3-2A	95.3	4824344.2	295993.8
NW3-3	90.6	4824329.2	296002.3
NW3-4	94.6	4824393.1	296043.3
NW3-5	95.6	4824451.6	296072.3
NW6-1	95.3	4824163.1	295975.2
NW6-2	96.6	4824140.5	295961.6
PED-01	96.3	4824314.1	295977.3
PED-03	93.7	4824305.3	296063.0
PED-03A	94.1	4824308.4	296062.1
PED-03B	94.1	4824309.6	296062.8
S2	94.9	4824357.2	296001.4
S3	90.0	4824337.3	296021.0
S6	95.2	4824318.8	296059.4
S7	90.1	4824321.2	296076.9

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
K6	94.9	4824688.5	296254.9
NRW3-1	96.0	4824494.6	296098.1
NRW3-2	96.0	4824543.1	296122.0
NRW3-3	95.2	4824582.3	296145.3
NRW3-4	94.6	4824617.2	296165.4
NRW3-5	93.7	4824661.4	296190.9
NRW3-6	92.9	4824701.8	296220.4
NRW3-7	93.9	4824750.8	296231.3
NRW3-8	96.0	4824804.5	296260.3
NRW3-9	98.2	4824863.0	296290.8
NRW3-10	96.4	4824868.3	296329.3
NRW7-1	95.0	4824601.8	296209.0
NRW7-2	94.9	4824652.9	296236.0
NRW7-3	97.5	4824696.6	296259.0

#### NOTES

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#### REFERENCE

Base plans provided in digital format by Morrison Hershfield, drawing file no. X11609340Base.dwg, received April 12, 2018.  
Design plan provided in digital format by Morrison Hershfield, drawing file no. 1160934\_NoiseWallPlan.dwg, received March 19, 2019.  
Alignment plan provided in digital format by Morrison Hershfield, drawing file no. X1160934\_Align.dwg, received November 19, 2018.



NO.	DATE	BY	REVISION
Geocres No. 30M12-446			
HWY. QEW	PROJECT NO. 1662333	DIST. CENTRAL	
SUBM'D. CL/AM	CHKD. DM	DATE: 05/15/2019	SITE:
DRAWN: DD	CHKD. SMM/SB	APPD. JMAC	DWG. 2

**TABLES**

**Tables 1 & 2**

**Table 1: Summary of Boreholes, Noise Barrier Walls and Noise Barrier / Retaining Walls**

Borehole Number	Corresponding Noise Barrier or Noise Barrier / Retaining Wall Designation	Northing (m) (Latitude (°))	Easting (m) (Longitude (°))	Ground Surface Elevation (m)	Drilled Depth (m)	Reference Appendix
NW1-1	NBW	4,823,035.9 (43.547183)	294,842.0 (-79.623234)	102.4	8.5*	A
NW1-2		4,823,084.3 (43.547619)	294,885.4 (-79.622698)	102.6	7.9*	
NW1-3		4,823,122.4 (43.547963)	294,920.9 (-79.622260)	102.4	6.4*	
NW2-1	NBW - Line 'B'	4,823,698.5 (43.553158)	295,666.6 (-79.613041)	98.3	5.9*	B
NW2-2		4,823,766.1 (43.553767)	295,698.0 (-79.612653)	98.2	6.5*	
NW2-3		4,823,813.0 (43.554189)	295,722.8 (-79.612346)	97.8	6.6*	
NW2-4		4,823,866.3 (43.554669)	295,756.4 (-79.611932)	96.2	6.6*	
NW2-5		4,823,903.6 (43.555006)	295,776.4 (-79.611685)	95.6	6.6*	
NW2-6		4,823,932.6 (43.555267)	295,793.2 (-79.611478)	94.8	6.6*	
OHS-4		4,823,828.9 (43.554333)	295,734.3 (-79.612205)	97.3	5.6*	
CRB-2A		4,823,960.1 (43.555523)	295,808.0 (-79.611298)	94.5	9.0*	
CRB-6	NBRW - Line 'F'	4,824,196.7 (43.557650)	295,929.5 (-79.609801)	91.7	13.3*	C
CRB-8		4,824,211.5 (43.557788)	295,953.7 (-79.609499)	94.7	8.5	
AR-1		4,824,236.4 (43.558012)	295,944.3 (-79.609616)	95.7	9.2	
PED-01		4,824,314.1 (43.558703)	295,977.3 (-79.609205)	96.3	25.4*	
NW3-1		4,824,275.8 (43.558358)	295,959.8 (-79.609422)	96.5	15.4*	



Borehole Number	Corresponding Noise Barrier or Noise Barrier / Retaining Wall Designation	Northing (m) (Latitude (°))	Easting (m) (Longitude (°))	Ground Surface Elevation (m)	Drilled Depth (m)	Reference Appendix
NW3-2	NBRW - Line 'F' (cont.)	4,824,342.4 (43.558958)	295,994.3 (-79.608996)	95.3	12.3	C (cont.)
NW3-2A		4,824,344.2 (43.558975)	295,993.8 (-79.609002)	95.3	27.6	
NW3-3		4,824,329.2 (43.558840)	296,002.3 (-79.608895)	90.6	8.1	
NW3-4		4,824,393.1 (43.559415)	296,043.3 (-79.608389)	94.6	8.2	
NW3-5		4,824,451.6 (43.559942)	296,072.3 (-79.608030)	95.6	8.2	
NRW3-1		4,824,494.6 (43.560338)	296,098.1 (-79.607716)	96.0	10.9	
NRW3-2		4,824,543.1 (43.560766)	296,122.0 (-79.607417)	96.1	10.9	
NRW3-3		4,824,582.3 (43.561120)	296,145.3 (-79.607129)	95.2	11.1	
NRW3-4		4,824,617.2 (43.561433)	296,165.4 (-79.606882)	94.6	11.5	
NRW3-5		4,824,661.4 (43.561832)	296,190.9 (-79.606567)	93.7	11.5	
NRW3-6		4,824,701.8 (43.562195)	296,220.4 (-79.606203)	92.9	11.4*	
NRW3-7		4,824,750.8 (43.562637)	296,231.3 (-79.606068)	93.9	11.7*	
NRW3-8		4,824,804.5 (43.563121)	296,260.3 (-79.605711)	96.0	10.5*	
S2		4,824,357.2 (43.559092)	296,001.4 (-79.608907)	94.9	17.4	
S3		4,824,337.3 (43.558912)	296,021.0 (-79.608665)	90.0	16.6	
NRW3-9	NBW - Line 'H'	4,824,863.0 (43.563647)	296,290.8 (-79.605333)	98.2	11.0*	
NRW3-10		4,824,868.9 (43.563709)	296,329.5 (-79.604857)	96.4	9.5*	

Borehole Number	Corresponding Noise Barrier or Noise Barrier / Retaining Wall Designation	Northing (m) (Latitude (°))	Easting (m) (Longitude (°))	Ground Surface Elevation (m)	Drilled Depth (m)	Reference Appendix
NW4-1	NBW - Line 'A'	4,823,192.5 (43.548605)	295,107.9 (-79.619950)	101.0	6.3*	D
NW4-2		4,823,234.5 (43.548975)	295,162.8 (-79.619267)	100.7	6.3*	
NW4-3		4,823,274.0 (43.549332)	295,219.9 (-79.618561)	100.6	7.7*	
NW4-4		4,823,308.8 (43.549645)	295,274.5 (-79.617886)	100.5	8.0*	
NW4-5		4,823,340.0 (43.549927)	295,333.6 (-79.617156)	100.3	7.6*	
NW5-1	NBW - Line 'C'	4,823,619.2 (43.552445)	295,758.0 (-79.611908)	97.1	6.6*	E
NW5-2		4,823,694.5 (43.553123)	295,773.3 (-79.611720)	97.3	5.6*	
NW5-3		4,823,774.4 (43.553851)	295,776.0 (-79.611691)	97.4	3.1	
NW5-3A		4,823,772.7 (43.553836)	295,775.0 (-79.611704)	97.4	8.0*	
NW5-4		4,823,869.2 (43.554705)	295,818.3 (-79.611169)	96.3	6.8*	
NW5-5		4,823,932.6 (43.555242)	295,852.6 (-79.610833)	95.8	9.2**	
NW5-5A		4,823,930.6 (43.555219)	295,851.9 (-79.610772)	95.8	8.6*	
NW6-1	NBW - Line 'I'	4,824,163.1 (43.557371)	295,975.2 (-79.609278)	95.3	7.5	F
NW6-2		4,824,182.1 (43.557524)	295,985.5 (-79.609105)	96.6	8.2	
NRW7-1	NBRW - Line 'G'	4,824,601.8 (43.561304)	296,209.0 (-79.606346)	95.0	11.3	G
NRW7-2		4,824,652.9 (43.561765)	296,236.0 (-79.606012)	94.9	10.8	
NRW7-3		4,824,696.6 (43.562158)	296,259.1 (-79.605727)	94.9	12.3	

Borehole Number	Corresponding Noise Barrier or Noise Barrier / Retaining Wall Designation	Northing (m) (Latitude (°))	Easting (m) (Longitude (°))	Ground Surface Elevation (m)	Drilled Depth (m)	Reference Appendix
K6	NBRW - Line 'G' (cont.)	4,824,688.5 (43.562085)	296,254.9 (-79.605778)	94.9	15.0*	G (cont.)
PED-03	NBW - Line 'J'	4,824,305.3 (43.558625)	296,063.0 (-79.608144)	93.7	13.8	H
PED-03A		4,824,308.4 (43.558653)	296,062.1 (-79.608155)	94.1	6.1***	
PED-03B		4,824,309.6 (43.558664)	296,062.8 (-79.608146)	94.1	17.8*	
S6		4,824,318.8 (43.558755)	296,059.4 (-79.608192)	95.2	14.8	
S7		4,824,321.2 (43.558768)	296,076.9 (-79.607973)	90.1	4.6	

\* Includes bedrock coring for length ranging between 0.7 m and 8.1 m

\*\* Split spoon (SS) sampling into bedrock for a length of 5.5 m

\*\*\* Borehole drilled specifically for standpipe piezometer installation only

Table 2: Geotechnical Design Parameters for Noise Barrier Walls and Noise Barrier / Retaining Walls

Noise Barrier or Noise Barrier / Retaining Wall Designation	Approximate Stationing <sup>1</sup>	Avg. Final Ground Surface Elevation Along Wall <sup>2</sup> [approx. max – min] (m)	Relevant Borehole Numbers	Deposit / Layer Description	Approximate Deposit Depth <sup>3</sup> (m)	Approximate Elevation (m)	Design Parameters <sup>4,5,7</sup>							Design Groundwater Elevation (m)
							$s_u$ (kPa)	$c'$ (kPa)	$\phi'$ (°)	$K_p$ <sup>6</sup>	$f_{horiz}$ (kPa)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	
NBW - Line 'B'	QEW STA 16+350 to 16+450	97.3 [97.8 – 96.7]	NW2-1, NW2-2	Hard Clayey Silt (RESIDUAL SOIL) / Completely to highly weathered Shale Bedrock	0 – 0.8	97.3 – 96.5	200	0	32	3.25	-	22	12	96.5
				Shale Bedrock (Upper Zone)	0.8 – 2.3	96.5 – 95.0	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	2.3 – 5.5	95.0 – 91.7	-	-	-	-	4500	26	16	
	QEW STA 16+450 to 16+530	96.6 [96.7 – 96.4]	NW2-3, OHS-4	Very stiff Clayey Silt (TILL)	0 – 0.2	96.6 – 96.4	150	0	32	3.25	-	22	12	95.5
				Very stiff to hard Clayey Silt (RESIDUAL SOIL) / Completely to highly weathered Shale Bedrock	0.2 – 1.3	96.6 – 95.3	150	0	34	3.54	-	22	12	
				Shale Bedrock (Upper Zone)	1.3 – 3.6	95.3 – 93.0	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	3.6 – 5.4	93.0 – 91.2	-	-	-	-	4500	26	16	
	QEW STA 16+530 to 16+610	96.3 [96.6 – 96.0]	NW2-4, NW2-5	*FILL (New) / *FILL (Existing compact Gravelly Sand)	0 – 0.8	96.3 – 95.5	-	0	28	2.77	-	19	9	94.5
				Stiff to hard Clayey Silt (TILL)	0.8 – 2.1	95.5 – 94.2	100	0	32	3.25	-	22	12	
				Completely to highly weathered Shale Bedrock	2.1 – 3.3	94.2 – 93.0								
				Shale Bedrock (Upper Zone)	3.3 – 3.8	93.0 – 92.5	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	3.8 – 7.3	92.5 – 89.0	-	-	-	-	4500	26	16	
	QEW STA 16+610 to 16+650	96.0 [96.0 – 95.9]	NW2-6	*FILL (New)	0 – 1.5	96.0 – 94.5	-	0	28	2.77	-	19	9	93.5
				Stiff to very stiff Sandy Silty Clay (TILL)	1.5 – 2.2	94.5 – 93.8	100	0	32	3.25	-	22	12	
				Very stiff to hard Clayey Silt (RESIDUAL SOIL) / Completely to highly weathered Shale Bedrock	2.2 – 3.7	93.8 – 92.3	150	0	34	3.54	-	22	12	
				Shale Bedrock (Upper Zone)	3.7 – 5.0	92.3 – 91.0	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	5.0 – 7.8	91.0 – 88.2	-	-	-	-	4500	26	16	
	QEW STA 16+650 to 16+660	95.9 [95.9 – 95.8]	CRB-2A	*FILL (New) / *FILL (Existing firm to hard Clayey Silt)	0 – 2.4	95.9 – 93.5	50	0	28	2.77	-	19	9	93.5
				Completely to highly weathered Shale Bedrock	2.4 – 4.4	93.5 – 91.5	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	4.4 – 10.4	91.5 – 85.5	-	-	-	-	4500	26	16	

Noise Barrier or Noise Barrier / Retaining Wall Designation	Approximate Stationing <sup>1</sup>	Avg. Final Ground Surface Elevation Along Wall <sup>2</sup> [approx. max – min] (m)	Relevant Borehole Numbers	Deposit / Layer Description	Approximate Deposit Depth <sup>3</sup> (m)	Approximate Elevation (m)	Design Parameters <sup>4,5,7</sup>							Design Groundwater Elevation (m)
							S <sub>u</sub> (kPa)	c' (kPa)	φ' (°)	K <sub>p</sub> <sup>6</sup>	f <sub>horiz</sub> (kPa)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	
NBRW - Line 'F'	QEW STA 16+931 to 16+960	94.4 [94.6]	CRB6	*FILL (New) / *FILL (Existing loose to compact Silty Sand)	0 – 4.4	94.4 – 90.0	-	0	28	2.77	-	19	9	87.0
				Firm to hard Sandy Clayey Silt / Sandy Clayey Silt (RESIDUAL SOIL)	4.4 – 7.5	90.0 – 86.9	75	0	30	3.00	-	22	12	
				Shale Bedrock (Upper Zone)	7.5 – 8.9	86.9 – 85.5	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	8.9 – 16.0	85.5 – 78.4	-	-	-	-	4500	26	16	
	QEW STA 16+960 to 17+030	94.4 [94.6 – 94.2]	CRB-8, AR-1, NW3-1	*FILL (New) / *FILL (Existing very loose to very dense Silty Sand / Compact to very dense Silt and Sand)	0 – 4.0	94.4 – 90.4	-	0	28	2.77	-	19	9	93.0
				Dense to very dense Silt	4.0 – 5.9	90.4 – 88.5	-	0	32	3.25	-	20	10	
				Very soft to very stiff Clayey Silt / Stiff Sandy Clayey Silt (TILL)	5.9 – 7.4	88.5 – 87.0	10	0	28	2.77	-	20	10	
				Hard Sandy Clayey Silt (RESIDUAL SOIL)	7.4 – 9.7	87.0 – 84.7	200	0	32	3.25	-	22	12	
				Shale Bedrock (Lower Zone)	9.7 – 13.4	84.7 – 81.0	-	-	-	-	4500	26	16	
	QEW STA 17+030 to 17+140	94.5 [94.7 – 94.2]	PED-01, NW3-2/2A, NW3-3, S2, S3	*FILL (New) / *FILL (Existing very loose to dense Sandy Silt to Sand and Gravel) / *FILL (Existing stiff to very stiff Sandy Clayey Silt to Gravelly Clayey Silt with Sand)	0 – 7.0	94.5 – 87.5	-	0	28	2.77	-	19	9	89.5
				Hard Clayey Silt with Sand (TILL) / Very dense Silt and Sand (TILL) / Very dense Sand / Silty Sand	7.0 – 20.5	87.5 – 74.0	200	0	34	3.54	-	22	12	
	QEW STA 17+140 to 17+340	94.9 [95.1 – 94.7]	NW3-4, NW3-5, NRW3-1, NRW3-2	*FILL (New) / *FILL (Existing loose to compact Silt and Sand)	0 – 0.9	94.9 – 94.0	-	0	28	2.77	-	19	9	92.0
				Loose Sandy Silt / Silt and Sand	0.9 – 2.5	94.0 – 92.4	-	0	30	3.00	-	20	10	
				Compact to dense Silt / Compact to dense Silt and Sand	2.5 – 6.4	92.4 – 88.5	-	0	32	3.25	-	20	10	
				Very stiff to hard Sandy Clayey Silt (TILL / RESIDUAL SOIL)	6.4 – 8.4	88.5 – 86.5	150	0	34	3.54	-	22	12	

Noise Barrier or Noise Barrier / Retaining Wall Number	Approximate Stationing <sup>1</sup>	Avg. Final Ground Surface Elevation Along Wall <sup>2</sup> [approx. max – min] (m)	Relevant Borehole Numbers	Deposit / Layer Description	Approximate Deposit Depth <sup>3</sup> (m)	Approximate Elevation (m)	Design Parameters <sup>4,5,7</sup>							Design Groundwater Elevation (m)
							s <sub>u</sub> (kPa)	c' (kPa)	φ' (°)	K <sub>p</sub> <sup>6</sup>	f <sub>horiz</sub> (kPa)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	
NBRW - Line 'F' (cont.)	QEW STA 17+340 to 17+470	95.1 [95.1 – 95.0]	NRW3-3, NRW3-4, NRW3-5	*FILL (New) / *FILL (Existing loose to compact Silty Sand to Sand and Gravel)	0 – 2.6	95.1 – 92.5	-	0	28	2.77	-	19	9	92.0
				Loose to dense Silt and Sand / Compact to dense Silt	2.6 – 5.1	92.5 – 90.0	-	0	30	3.00	-	20	10	
				Stiff to hard Sandy Clayey Silt (TILL)	5.1 – 7.6	90.0 – 87.5	100	0	32	3.25	-	22	12	
				Hard Sandy Clayey Silt (TILL) / Very dense Silt and Sand to Gravelly Silty Sand (TILL)	7.6 – 11.2	87.5 – 83.9	200	0	34	3.54	-	22	12	
	QEW STA 17+470 to 17+530	95.3 [95.5 – 95.1]	NRW3-6	*FILL (New) / *FILL (Existing very loose to compact Silt and Sand)	0 – 6.0	95.3 – 89.3	-	0	28	2.77	-	19	9	90.0
				Soft Clayey Silt with Sand (TILL)	6.0 – 6.9	89.3 – 88.4	25	0	28	2.77	-	20	10	
				Dense Silty Sand (TILL) / Hard Clayey Silt (RESIDUAL SOIL)	6.9 – 8.6	88.4 – 86.7	-	0	32	3.25	-	22	12	
				Completely to highly weathered Shale Bedrock	8.6 – 10.3	86.7 – 85.0	200	0	34	3.54	-	22	16	
				Shale Bedrock (Lower Zone)	10.3 – 13.8	85.0 – 81.5	-	-	-	-	4500	26	16	
	QEW STA 17+530 to 17+585	95.6 [95.7 – 95.5]	NRW3-7	*FILL (New) / *FILL (Existing Sand and Gravel)	0 – 2.0	95.6 – 93.6	-	0	28	2.77	-	19	9	92.0
				Compact Silty Sand	2.0 – 3.6	93.6 – 92.0	-	0	30	3.00	-	20	10	
				Stiff to very stiff Sandy Clayey Silt (TILL)	3.6 – 5.6	92.0 – 90.0	75	0	32	3.25	-	22	12	
				Very stiff to hard Clayey Silt with Gravel (RESIDUAL SOIL)	5.6 – 6.2	90.0 – 89.4	150	0	32	3.25	-	22	12	
				Completely to highly weathered Shale Bedrock	6.2 – 9.6	89.4 – 86.0	200	0	34	3.54	-	22	16	
				Shale Bedrock (Lower Zone)	9.6 – 13.4	86.0 – 82.2	-	-	-	-	4500	26	16	

Noise Barrier or Noise Barrier / Retaining Wall Number	Approximate Stationing <sup>1</sup>	Avg. Final Ground Surface Elevation Along Wall <sup>2</sup> [approx. max – min] (m)	Relevant Borehole Numbers	Deposit / Layer Description	Approximate Deposit Depth <sup>3</sup> (m)	Approximate Elevation (m)	Design Parameters <sup>4,5,7</sup>							Design Groundwater Elevation (m)
							s <sub>u</sub> (kPa)	c' (kPa)	φ' (°)	K <sub>p</sub> <sup>6</sup>	f <sub>horiz</sub> (kPa)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	
NBRW - Line 'F' (cont.)	QEW STA 17+585 to 17+660	96.1 [96.4 – 95.7]	NRW3-8	*FILL (New) / *FILL (Existing loose to compact Silty Sand)	0 – 0.8	96.1 – 95.3	-	0	28	2.77	-	19	9	92.5
				Compact Silty Sand	0.8 – 2.1	95.3 – 94.0	-	0	30	3.00	-	20	10	
				Firm to stiff Sandy Clayey Silt (TILL)	2.1 – 5.7	94.0 – 90.4	50	0	30	3.00	-	22	12	
				Shale Bedrock (Upper Zone)	5.7 – 7.1	90.4 – 89.0	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	7.1 – 10.6	89.0 – 85.5	-	-	-	-	4500	26	16	
NBW - Line 'H'	QEW STA 17+660 to 17+728	98.2 [98.0 – 99.8]	NRW3-9 NRW3-10	*FILL (New) / *FILL (Existing loose to compact Silty Sand)	0 – 0.8	98.2 – 97.4	-	0	28	2.77	-	19	9	95.5
				Compact to Dense Silt and Sand to Silty Sand	0.8 – 5.7	97.4 – 92.5	-	0	30	3.00	-	20	10	
				Stiff Clayey Silt / Stiff Sandy Clayey Silt (TILL)	5.7 – 7.2	92.5 – 91.0	100	0	30	3.00	-	22	12	
				Shale Bedrock (Upper Zone)	7.2 – 8.2	91.0 – 90.0	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	8.2 – 11.3	90.0 – 86.9	-	-	-	-	4500	26	16	
NBW - Line 'A'	QEW STA 15+622 to 15+830	100.4 [100.8 – 99.9]	NW4-1, NW4-2, NW4-3, NW4-4	*FILL (New) / *FILL (Existing loose to compact Sand and Gravel)	0 – 0.6	100.4 – 99.8	-	0	28	2.77	-	19	9	99.5
				Soft to hard Silty Clay (TILL) / Completely to highly weathered Shale Bedrock	0.6 – 2.5	99.8 – 97.9	25	0	30	3.00	-	20	10	
				Shale Bedrock (Upper Zone)	2.5 – 4.9	97.9 – 95.5	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	4.9 – 7.9	95.5 – 92.5	-	-	-	-	4500	26	16	
	QEW STA 15+830 to 15+866	100.9 [101.0 – 100.7]	NW4-5	*FILL (New) / *FILL (Existing compact Sand and Gravel)	0 – 1.3	100.9 – 99.6	-	0	28	2.77	-	19	9	99.5
				Stiff Silty Clay (TILL) / Completely to highly weathered Shale Bedrock	1.3 – 3.9	99.6 – 97.0	100	0	32	3.25	-	22	12	
				Shale Bedrock (Upper Zone)	3.9 – 4.9	97.0 – 96.0	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	4.9 – 8.2	96.0 – 92.7	-	-	-	-	4500	26	16	
NBW - Line 'C'		97.3 [97.7 – 96.8]	NW5-1, NW5-2	*FILL (New) / *FILL (Existing compact Sand and Gravel to Silty Sand) / Stiff Silty Clay (TILL)	0 – 2.3	97.3 – 95.0	-	0	28	2.77	-	19	9	96.0



Noise Barrier or Noise Barrier / Retaining Wall Number	Approximate Stationing <sup>1</sup>	Avg. Final Ground Surface Elevation Along Wall <sup>2</sup> [approx. max – min] (m)	Relevant Borehole Numbers	Deposit / Layer Description	Approximate Deposit Depth <sup>3</sup> (m)	Approximate Elevation (m)	Design Parameters <sup>4,5,7</sup>							Design Groundwater Elevation (m)
							s <sub>u</sub> (kPa)	c' (kPa)	φ' (°)	K <sub>p</sub> <sup>6</sup>	f <sub>horiz</sub> (kPa)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	
NBW – Line ‘C’	RAMP STA 10+033 to 10+125		NW5-1, NW5-2	Shale Bedrock (Upper Zone)	2.3 – 3.8	95.0 – 93.5	-	-	-	-	1500	26	16	96.0
				Shale Bedrock (Lower Zone)	3.8 – 7.8	93.5 – 89.5	-	-	-	-	4500	26	16	
NBW - Line ‘C’ (cont.)	RAMP STA 10+125 to 10+227 and 16+519 to 16+623	96.4 [96.8 – 96.0]	NW5-3/3A NW5-4, NW5-5/5A	*FILL (New) / *FILL (Existing loose to dense Silt and Sand to Sand and Gravel) / *FILL (Existing firm Clayey Silt) / Firm Clayey Silt	0 – 2.8	96.4 – 93.6	50	0	28	2.77	-	19	9	94.0
				Hard Clayey Silt (RESIDUAL SOIL) / Shale Bedrock	2.8 – 4.3	93.6 – 92.1	200	0	32	3.25	-	22	12	
				Shale Bedrock (Upper Zone)	4.3 – 5.4	92.1 – 91.0	-	-	-	-	1500	26	16	
				Shale Bedrock (Lower Zone)	5.4 – 9.8	91.0 – 86.6	-	-	-	-	4500	26	16	
NBW - Line ‘I’	QEW STA 16+918 to 16+920	95.3	NW6-1	*FILL (Existing compact to very dense Gravelly Sand)	0 – 3.0	95.3 – 92.3	-	0	28	2.77	-	19	9	89.0
				Very loose to dense Silty Sand	3.0 – 4.3	92.3 – 91.0	-	0	28	2.77	-	20	10	
				Dense Silt to Silty Sand	4.3 – 7.3	91.0 – 88.0	-	0	32	3.25	-	20	10	
				Hard Sandy Clayey Silt (TILL)	7.3 – 7.5	88.0 – 87.8	200	0	32	3.25	-	22	12	
NBRW - Line ‘G’	QEW STA 17+415 to 17+500	94.7 [95.0 – 94.4]	NRW7-1, NRW7-2	*FILL (Existing very loose to dense Sandy Silt to Sand and Gravel)	0 – 4.4	94.7 – 90.6	-	0	28	2.77	-	19	9	87.0
				Very loose to loose Silt / Soft to stiff Sandy Clayey Silt to Sandy Silty Clay (TILL)	4.1 – 6.7	90.6 – 88.0	25	0	28	2.77	-	20	10	
				Hard Clayey Silt with Sand (TILL)	6.7 – 9.2	88.0 – 85.5	200	0	34	3.54	-	22	12	
				Very dense Silt and Sand (TILL) / Dense to very dense Silty Sand to Sand	9.2 – 11.0	85.5 – 83.7	-	0	34	3.54	-	20	10	
	QEW STA 17+500 to 17+520	94.6 [94.6 – 94.5]	K6, NRW7-3	*FILL (Existing very loose to dense Silt and Sand to Gravelly Sand)	0 – 5.3	94.6 – 89.3	-	0	28	2.77	-	19	9	88.5
				Firm to very stiff Clayey Silt with Sand	5.3 – 6.9	89.3 – 87.7	50	0	26	2.56	-	20	10	
				Compact to very dense Silty Sand to Sand	6.9 – 11.4	87.7 – 83.2	-	0	32	3.25	-	20	10	
				Hard Clayey Silt (TILL / RESIDUAL SOIL)	11.4 – 12.0	83.2 – 82.6	200	0	34	3.54	-	22	12	
				Shale Bedrock (Upper Zone)	12.0 – 14.7	82.6 – 79.9	-	-	-	-	1500	26	16	

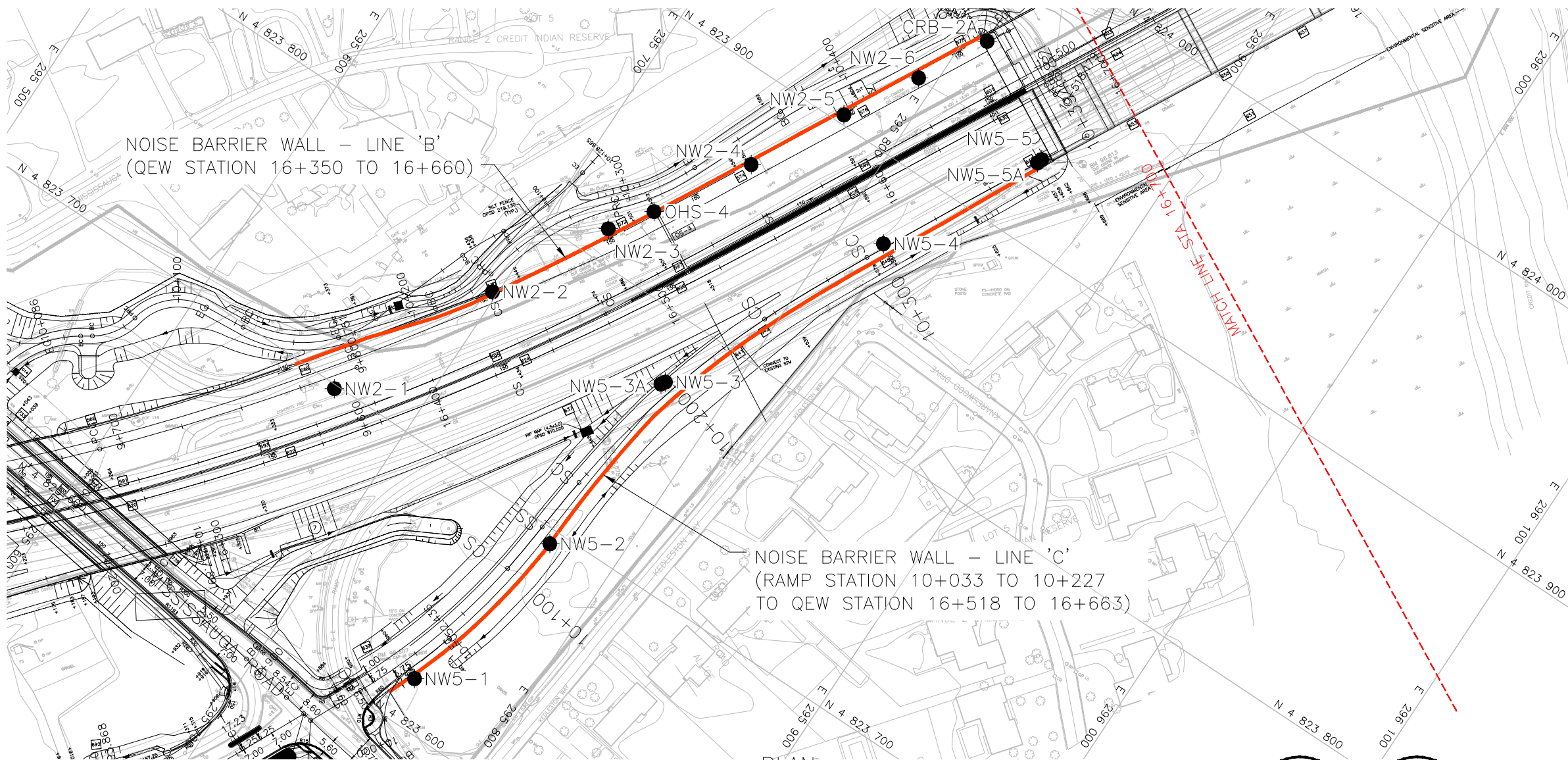
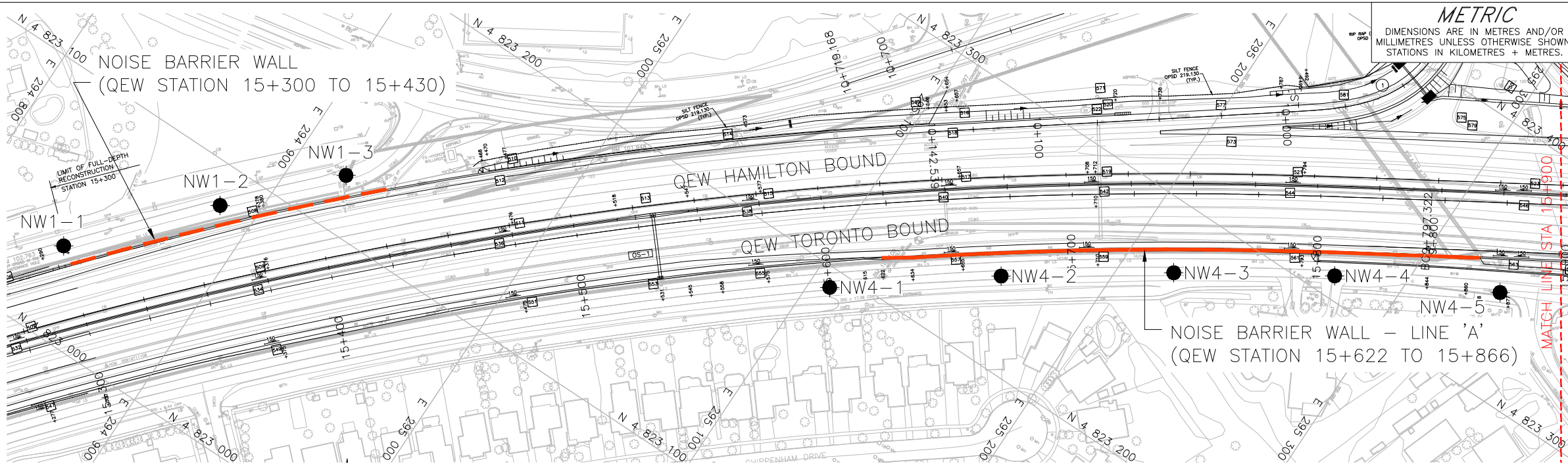


Noise Barrier or Noise Barrier / Retaining Wall Number	Approximate Stationing <sup>1</sup>	Avg. Final Ground Surface Elevation Along Wall <sup>2</sup> [approx. max – min] (m)	Relevant Borehole Numbers	Deposit / Layer Description	Approximate Deposit Depth <sup>3</sup> (m)	Approximate Elevation (m)	Design Parameters <sup>4,5,7</sup>							Design Groundwater Elevation (m)
							$s_u$ (kPa)	$c'$ (kPa)	$\phi'$ (°)	$K_p$ <sup>6</sup>	$f_{horiz}$ (kPa)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	
NBW - Line 'J'	QEW STA 17+076 to 17+124	95.2 [95.2 – 95.1]	PED-03 /03A/03B, S6, S7	*FILL (New) / *FILL (Existing very loose to very dense Silt and Sand to Sand and Gravel) / Very loose Silty Sand / Stiff Clayey Silt with Sand (TILL)	0 – 7.6	95.2 – 87.6	-	0	28	2.77	-	19	9	90.0
				Stiff to hard Clayey Silt with Sand (TILL) / Very Dense Silt and Sand (TILL)	7.6 – 15.2	87.6 – 80.0	50	0	32	3.25	-	20	10	

NOTES:

- \*Deposit thickness for design to be considered ½ of the fill thickness presented.
1. Approximate stationing provided along adjacent roadway(s), as per Morrison Hershfield Limited. See Drawings 1 and 2 for noise barrier wall locations and adjacent roadway chainages.
  2. Noise Barrier Wall (NBW) and Noise Barrier / Retaining Wall (NBRW) final ground surface elevations provided by Morrison Hershfield Limited.
  3. Approximate deposit depths and elevations are provided relative to the final ground surface elevations along the sections of NBWs or NBRWs. Should the location(s) of the wall(s) change, the deposit depths / elevations must be reviewed and confirmed by the Foundations Consultants.
  4. Design parameters:
    - $s_u$  = undrained shear strength (kPa)
    - $c'$  = effective (drained) cohesion (kPa)
    - $\phi'$  = effective (drained) friction angle (degrees)
    - $K_p$  = passive earth pressure coefficient
    - $f_{horiz}$  = factored geotechnical lateral resistance of bedrock at Ultimate Limit States, where caisson extends a minimum of 1 m into bedrock (kPa)
    - $\gamma$  = bulk unit weight (kN/m<sup>3</sup>)
    - $\gamma'$  = effective unit weight (below the groundwater level) (kN/m<sup>3</sup>)
  5. The resistance in the upper 1.2 m below ground surface should be neglected to account for frost action.
  6. The passive earth pressure coefficients provided assume a vertical foundation element, zero interface friction between the soil and the foundation element, and a horizontal backslope.
  7. The total passive resistance below frost depth may be calculated based on the values of  $K_p$  provided, reduced by an appropriate factor considering the allowable wall movement (i.e., large strain required for mobilization of the full passive resistance), in accordance with Figure C6.16 of the CHBDC (2014).
  8. The upper zone of shale bedrock extends from the top of the bedrock surface to between about 0.5 m to 2.7 m below the top of bedrock. In accordance with the CFEM) (200)), the upper zone is generally characterized as inferred moderately to slightly weathered, extremely weak to weak, Very Poor to Fair quality shale bedrock (with or without limestone interbeds); and,
  9. The lower zone of shale bedrock includes depths greater than between about 0.5 m to 2.7 m below the top of the bedrock surface. In accordance with the CFEM) (2006), the lower zone is generally characterized as slightly weathered to fresh, very weak to weak, Fair to Excellent quality shale bedrock (with or without limestone interbeds).





#### NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

CONT No.  
GWP No. 2002-13-00

QEW WIDENING MISSISSAUGA RD TO HURONTARIO ST  
NOISE BARRIER WALLS  
BOREHOLE LOCATIONS

SHEET



KEY PLAN  
SCALE  
0 2 4 km

LEGEND

Borehole - Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
CRB-2A	94.5	4823960.1	295808.0
NW1-1	102.4	4823035.9	294842.0
NW1-2	102.6	4823084.3	294885.4
NW1-3	102.4	4823122.4	294920.9
NW2-1	98.2	4823698.5	295666.6
NW2-2	98.2	4823766.1	295698.0
NW2-3	97.8	4823813.0	295722.8
NW2-4	96.2	4823866.3	295756.4
NW2-5	95.6	4823903.6	295776.4
NW2-6	94.8	4823932.6	295793.2
NW4-1	101.0	4823192.5	295107.9
NW4-2	100.7	4823234.5	295162.8
NW4-3	100.6	4823274.0	295219.9
NW4-4	100.5	4823308.8	295274.5
NW4-5	100.3	4823340.0	295333.6
NW5-1	97.1	4823619.2	295758.0
NW5-2	97.3	4823694.5	295773.3
NW5-3	97.4	4823774.4	295776.0
NW5-3A	97.4	4823772.7	295775.0
NW5-4	96.3	4823869.2	295818.3
NW5-5	95.8	4823932.6	295852.6
NW5-5A	95.8	4823930.6	295851.9
OHS-4	97.3	4823828.9	295734.3

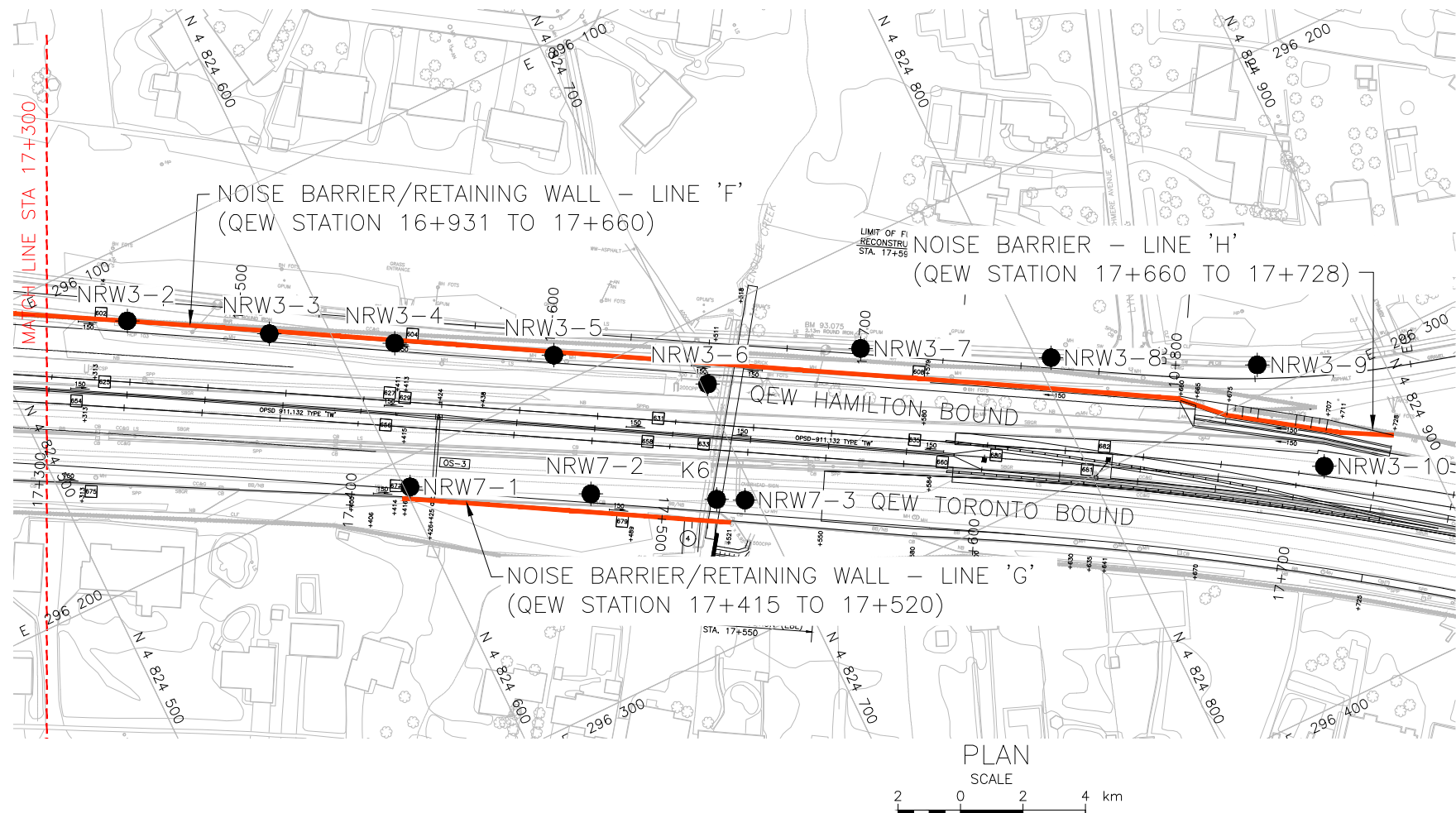
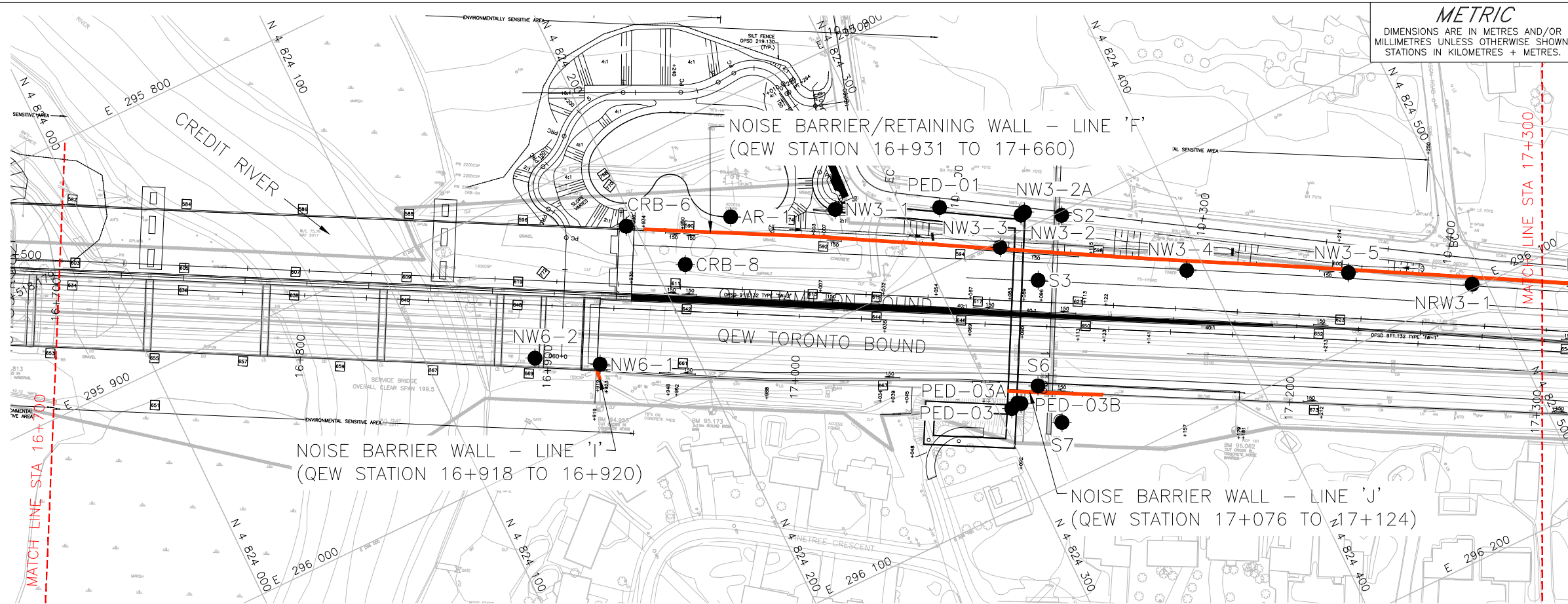
#### REFERENCE

Base plans provided in digital format by Morrison Hershfield, drawing file no. X11609340Base.dwg, received April 12, 2018.  
Design plan provided in digital format by Morrison Hershfield, drawing file no. 1160934\_NoiseWallPlan.dwg, received March 19, 2019.  
Alignment plan provided in digital format by Morrison Hershfield, drawing file no. X1160934\_Align.dwg, received November 19, 2018.

NO.	DATE	BY	REVISION
1	05/15/2019	JMAC	ISSUED FOR CONSTRUCTION
Geocres No. 30M12-446			
HWY. QEW	PROJECT NO. 1662333	DIST. CENTRAL	
SUBM'D. CL/AM	CHKD. DM	DATE: 05/15/2019	SITE: .
DRAWN: DD	CHKD. SMM/SB	APPD. JMAC	DWG. 1





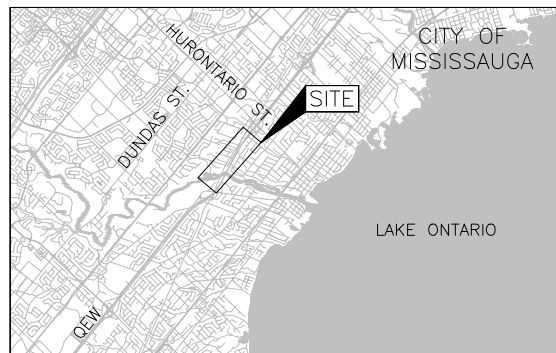


BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
AR-1	95.7	4824236.4	295944.2
CRB-6	91.7	4824196.7	295929.5
CRB-8	94.7	4824211.5	295953.7
NW3-1	96.5	4824275.8	295959.8
NW3-2	95.3	4824342.4	295994.3
NW3-2A	95.3	4824344.2	295993.8
NW3-3	90.6	4824329.2	296002.3
NW3-4	94.6	4824393.1	296043.3
NW3-5	95.6	4824451.6	296072.3
NW6-1	95.3	4824163.1	295975.2
NW6-2	96.6	4824140.5	295961.6
PED-01	96.3	4824314.1	295977.3
PED-03	93.7	4824305.3	296063.0
PED-03A	94.1	4824308.4	296062.1
PED-03B	94.1	4824309.6	296062.8
S2	94.9	4824357.2	296001.4
S3	90.0	4824337.3	296021.0
S6	95.2	4824318.8	296059.4
S7	90.1	4824321.2	296076.9

CONT No.  
GWP No. 2002-13-00QEW WIDENING MISSISSAUGA RD TO HURONTARIO ST  
NOISE BARRIER WALLS

SHEET

BOREHOLE LOCATIONS

KEY PLAN  
SCALE  
2 0 2 4 km

LEGEND

Borehole - Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
K6	94.9	4824688.5	296254.9
NRW3-1	96.0	4824494.6	296098.1
NRW3-2	96.0	4824543.1	296122.0
NRW3-3	95.2	4824582.3	296145.3
NRW3-4	94.6	4824617.2	296165.4
NRW3-5	93.7	4824661.4	296190.9
NRW3-6	92.9	4824701.8	296220.4
NRW3-7	93.9	4824750.8	296231.3
NRW3-8	96.0	4824804.5	296260.3
NRW3-9	98.2	4824863.0	296290.8
NRW3-10	96.4	4824868.3	296329.3
NRW7-1	95.0	4824601.8	296209.0
NRW7-2	94.9	4824652.9	296236.0
NRW7-3	97.5	4824696.6	296259.0

NOTES

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REFERENCE

Base plans provided in digital format by Morrison Hershfield, drawing file no. X11609340Base.dwg, received April 12, 2018.  
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NO.	DATE	BY	REVISION
Geocres No. 30M12-446			
HWY. QEW	PROJECT NO. 1662333	DIST. CENTRAL	
SUBM'D. CL/AM	CHKD. DM	DATE: 05/15/2019	SITE: .
DRAWN: DD	CHKD. SMM/SB	APPD. JMAC	DWG. 2



**TABLES**

**Table 1**

**APPENDICES A - H**

LIST OF SYMBOLS

LIST OF ABBREVIATIONS

LITHOLOGICAL AND GEOTECHNIAL ROCK  
DESCRIPTION TERMINOLOGY

FIELD ESTIMATION OF ROCK HARDNESS

ROCK WEATHERING CLASSIFICATION

## LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

### I. GENERAL

$\pi$	3.1416
$\ln x$ ,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

### II. STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\varepsilon$	linear strain
$\varepsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

### III. SOIL PROPERTIES

#### (a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
$\gamma'$	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )
$D_R$	relative density (specific gravity) of solid particles ( $D_R = \rho_s / \rho_w$ ) (formerly $G_s$ )
e	void ratio
n	porosity
S	degree of saturation

#### (a) Index Properties (continued)

w	water content
$w_l$ or LL	liquid limit
$w_p$ or PL	plastic limit
$I_p$ or PI	plasticity index = $(w_l - w_p)$
$w_s$	shrinkage limit
$I_L$	liquidity index = $(w - w_p) / I_p$
$I_c$	consistency index = $(w_l - w) / I_p$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$I_D$	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

#### (b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

#### (c) Consolidation (one-dimensional)

$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (over-consolidated range)
$C_s$	swelling index
$C_{\alpha}$	secondary compression index
$m_v$	coefficient of volume change
$C_v$	coefficient of consolidation (vertical direction)
$C_h$	coefficient of consolidation (horizontal direction)
$T_v$	time factor (vertical direction)
U	degree of consolidation
$\sigma'_p$	pre-consolidation stress
OCR	over-consolidation ratio = $\sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

$\tau_p, \tau_r$	peak and residual shear strength
$\phi'$	effective angle of internal friction
$\delta$	angle of interface friction
$\mu$	coefficient of friction = $\tan \delta$
$c'$	effective cohesion
$c_u, s_u$	undrained shear strength ( $\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
$p'$	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
$q_u$	compressive strength $(\sigma_1 - \sigma_3)$
$S_t$	sensitivity

\* Density symbol is  $\rho$ . Unit weight symbol is  $\gamma$  where  $\gamma = \rho g$  (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1  
2

$\tau = c' + \sigma' \tan \phi'$   
shear strength = (compressive strength)/2

## LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

### I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### II. PENETRATION RESISTANCE

#### Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

#### Dynamic Cone Penetration Resistance; $N_d$ :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

**WH:** Sampler advanced by static weight of hammer

**WR:** Sampler advanced by weight of sampler and rod

#### Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm<sup>2</sup> pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance ( $Q_t$ ), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

### III. SOIL DESCRIPTION

#### (a) Non-Cohesive (Cohesionless) Soils

Compactness	N
Condition	Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

#### (b) Cohesive Soils Consistency

	$C_u, S_u$	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

### IV. SOIL TESTS

w	water content
$w_p$	plastic limit
$w_l$	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	relative density (specific gravity, $G_s$ )
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO <sub>4</sub>	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	unit weight

**Note:** 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

### V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand



## WEATHERINGS STATE

**Fresh:** no visible sign of weathering

**Faintly weathered:** weathering limited to the surface of major discontinuities.

**Slightly weathered:** penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

**Moderately weathered:** weathering extends throughout the rock mass but the rock material is not friable.

**Highly weathered:** weathering extends throughout rock mass and the rock material is partly friable.

**Completely weathered:** rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

## BEDDING THICKNESS

<u>Description</u>	<u>Bedding Plane Spacing</u>
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

## JOINT OR FOLIATION SPACING

<u>Description</u>	<u>Spacing</u>
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

## GRAIN SIZE

<u>Term</u>	<u>Size*</u>
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: \* Grains greater than 60 microns diameter are visible to the naked eye.

## CORE CONDITION

### Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

### Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

### Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varied from 0% for completely broken core to 100% for core in solid sticks.

## DISCONTINUITY DATA

### Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

### Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

### Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

### Abbreviations

JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	



## FIELD ESTIMATION OF ROCK HARDNESS

Grade	Description	Field Identification	Approx. Range of UCS (MPa)
R0	Extremely Weak Rock	Indented by thumbnail	0.25 - 1
R1	Very Weak Rock	Material can be peeled or shaped with a knife. Crumbles under firm blows from geological hammer.	1 - 5
R2	Weak Rock	Knife cuts material but too hard to shape into triaxial specimens or material can be peeled with a knife with difficulty. Shallow (<5mm) indentations made by firm blows from pick of a geological hammer.	5 - 25
R3	Moderately Strong Rock	Cannot be peeled or scraped with a knife. Hand held specimens can be fractured with single firm blow of geological hammer.	25 - 50
R4	Strong Rock	Hand held specimen requires more than one blow of geological hammer to fracture.	50 - 100
R5	Very Strong Rock	Hand held specimen requires many blows of geological hammer to fracture.	100 - 250
R6	Extremely Strong Rock	Specimen can only be chipped under repeated hammer blows, rings when hit.	> 250

### Notes:

1. Hand held specimens should have height approximately 2 times the diameter.
2. Materials having a uniaxial compressive strength of less than approximately 0.5 MPa and cohesionless materials should be classified using soil classification systems.
3. Rocks with a uniaxial compressive strength below 25 MPa (i.e. below R2) are likely to yield highly ambiguous results under point load testing.

### Reference:

Brown, 1981. "Suggested Methods for Rock Characterization Testing and Monitoring", International Society for Rock Mechanics.

Hoek, E., Kaiser, P.K., Bawden, W.F., 1995. "Support of Underground Excavations in Hard Rock", Balkema, Rotterdam.

## ROCK WEATHERING CLASSIFICATION

Term	Symbol	Description	Discoloration Extent	Fracture Condition	Surface Characteristics
Residual soil	W6	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	Throughout	N/A	Resembles soil
Completely weathered	W5	100% of rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	Throughout	Filled with alteration minerals	Resembles soil
Highly weathered	W4	More than 50% of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.	Throughout	Filled with alteration minerals	Friable and possibly pitted
Moderately weathered	W3	Less than 50% of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones. Visible texture of the host rock still preserved. Surface planes are weathered (oxidized or carbonate filling) even when breaking the "intact rock".	>20% of fracture spacing on both sides of fracture	Discoloured, may contain thick filling	Partial to complete discoloration, not friable except poorly cemented rocks
Slightly weathered	W2	Discoloration indicates weathering of rock material on discontinuity surfaces (usually oxidized). Less than 5% of rock mass altered.	<20% of fracture spacing on both sides of fracture	Discoloured, may contain thin filling	Partial discoloration
Fresh	W1	No visible sign of rock material weathering.	None	Closed or discoloured	Unchanged

### Reference:

Brown, 1981. "Suggested Methods for Rock Characterization Testing and Monitoring", International Society for Rock Mechanics.

**APPENDIX A**

**NOISE BARRIER WALL**  
**QEW Sta 15+300 to Sta 15+430**

PROJECT 1662333		RECORD OF BOREHOLE No NW1-1				SHEET 1 OF 1		METRIC								
G.W.P. 2002-13-00		LOCATION N 4823035.9; E 294842.0 MTM NAD 83 ZONE 10 (LAT. 43.547183; LONG. -79.623234)				ORIGINATED BY ACM										
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 120 mm I.D. Hollow Stem Augers				COMPILED BY SE										
DATUM Geodetic		DATE July 3, 2018				CHECKED BY SMM										
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								
102.4	GROUND SURFACE															
0.0	ASPHALT (150 mm)															
0.2	Sand and gravel (FILL) Loose to compact Brown Moist		1	SS	20											
101.3	- Auger grinding from 0.3 m to 0.6 m		2A	SS	5											
1.1	SILTY CLAY, trace sand, trace gravel (TILL) Firm to very stiff Mottled grey and brown Moist		2B													
			3	SS	18											
100.2	CLAYEY SILT, some sand, some shale fragments (RESIDUAL SOIL) Hard Grey Moist		4	SS	44											
99.4	Inferred completely to moderately weathered, brow to grey, extremely weak to weak SHALE (Georgian Bay Formation)		5	SS	100/0.28											
3.0	SHALE (BEDROCK) Grey Slightly weathered to fresh		6	SS	100/0.13											
98.7	Bedrock cored from a depth of 4.6 m to 8.5 m		1	RC	REC 100%											
3.7	For bedrock coring details, refer to Record of Drillhole NW1-1 - Auger grinding from 4.0 m to 4.6 m		2	RC	REC 100%											
			3	RC	REC 100%											
			4	RC	REC 98%											
			5	RC	REC 100%											
93.9	END OF BOREHOLE															
8.5	NOTES: 1. Water level measured at a depth of about 0.9 m below ground surface (Elev. 101.9 m) upon completion of soil drilling.															

PROJECT: 1662333

## RECORD OF DRILLHOLE: NW1-1

SHEET 1 OF 1

LOCATION: N 4823035.9 ; E 294842.0

DRILLING DATE: July 4, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Aardvark Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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						TOTAL CORE %	SOLID CORE %			B Angle °	DIP w.r.t. CORE AXIS °	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4	R2	R3	R1	W1	W2	W3				W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: ACM

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\GINT\QEW-CREDIT\_RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT 1662333		RECORD OF BOREHOLE No NW1-2				SHEET 1 OF 1		METRIC								
G.W.P. 2002-13-00		LOCATION N 4823084.3; E 294885.4 MTM NAD 83 ZONE 10 (LAT. 43.547619; LONG. -79.622698)				ORIGINATED BY CC										
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 150 mm O.D. Solid Stem Augers				COMPILED BY SE										
DATUM Geodetic		DATE July 3, 2018				CHECKED BY SMM										
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								
102.6	GROUND SURFACE															
0.0	ASPHALT (180 mm)															
0.2	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff to hard Brown Moist		1	SS	20											
			2	SS	19											
			3	SS	39											
100.4	Inferred completely to moderately weathered, brow to grey, extremely weak to weak SHALE (Georgian Bay Formation)		4	SS	100/0.28											
99.7	SHALE (BEDROCK) - Grey Slightly weathered to fresh		5	SS	50/0.05											
2.9	Bedrock cored from a depth of 4.1 m to 7.8 m															
	For bedrock coring details, refer to Record of Drillhole NW1-2 - Auger grinding from 2.9 m to 3.0 m		1	RC	REC 100%											RQD = 70%
			2	RC	REC 100%											RQD = 100%
			3	RC	REC 100%											RQD = 94%
94.7	END OF BOREHOLE															
7.9	NOTES: 1. Borehole dry upon completion of soil drilling.															

PROJECT: 1662333

## RECORD OF DRILLHOLE: NW1-2

SHEET 1 OF 1

LOCATION: N 4823084.3 ; E 294885.4

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Davis Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock <small>NOTE: For additional abbreviations refer to list of abbreviations &amp; symbols.</small>														FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
				DEPTH (m)		RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle 0° 90° 180° 270°	DP w.r.t. CORE AXIS 0° 90° 180° 270°	TYPE AND SURFACE DESCRIPTION	Jr	Ja	ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: CC

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\GINT\QEW-CREDIT\_RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT		1662333		RECORD OF BOREHOLE No NW1-3		SHEET 1 OF 1		METRIC						
G.W.P.		2002-13-00		LOCATION		N 4823122.4; E 294920.9 MTM NAD 83 ZONE 10 (LAT. 43.547963; LONG. -79.622260)		ORIGINATED BY						
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 150 mm O.D. Solid Stem Augers		COMPILED BY						
DATUM		Geodetic		DATE		July 4, 2018		CHECKED BY						
								SMM						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)	GR SA SI CL		
102.4	GROUND SURFACE													
0.0	ASPHALT (130 mm)													
102.0	Sand and gravel (FILL)		1A	SS	18									
0.4	Compact Brown Moist		1B	SS	6									
	Sand, some silt, trace to some gravel, trace to some clay (FILL)		2	SS	4									
	Very loose to compact		3	SS	3									
	Moist		4A	SS	3									
100.2	CLAYEY SILT, some sand, trace to some gravel (TILL)		4B	SS	3									
2.2	Soft		5	SS	100/0.18									
99.6	Brown Moist													
2.8	SHALE (BEDROCK)													
	Grey Slightly weathered		1	RC	REC 97%									
	Bedrock cored from a depth of 3.3 m to 6.4 m		2	RC	REC 100%									
	For bedrock coring details, refer to Record of Drillhole NW1-3		3	RC	REC 100%									
96.0	END OF BOREHOLE													
6.4	NOTES:													
	1. Open borehole dry upon completion of soil drilling.													
	2. Groundwater level measurements in piezometer:													
	Date Depth (m) Elev. (m)													
	14/08/18 2.6 99.8													
	06/11/18 2.5 99.9													



SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling

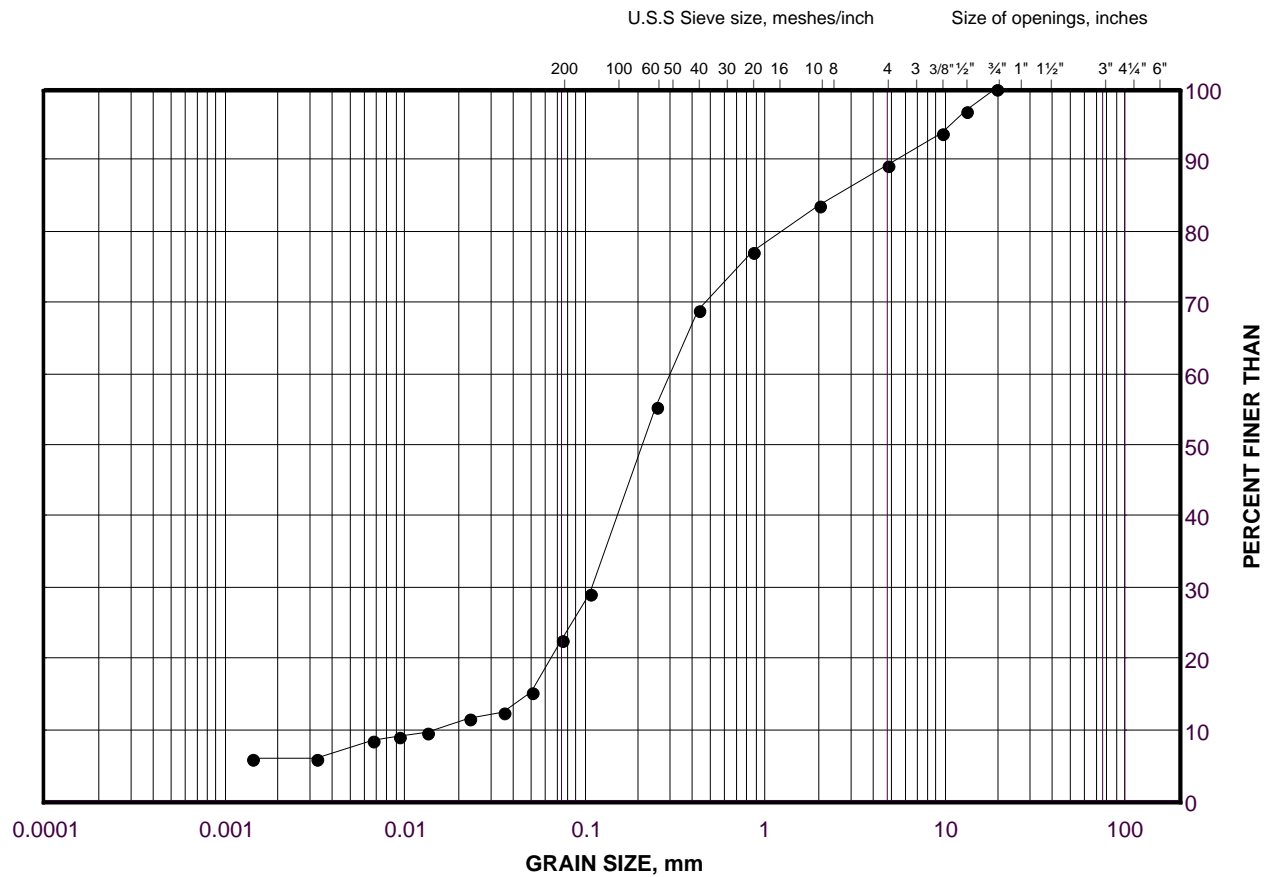
 BROKEN CORE
  CLAY SEAM
  LIMESTONE
  LOST CORE

CHECKED: AB

# GRAIN SIZE DISTRIBUTION

Sand (FILL)  
(Noise Barrier Wall)

FIGURE A-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	NW1-3	2	101.4

Project Number: 1662333

Checked By: SMM

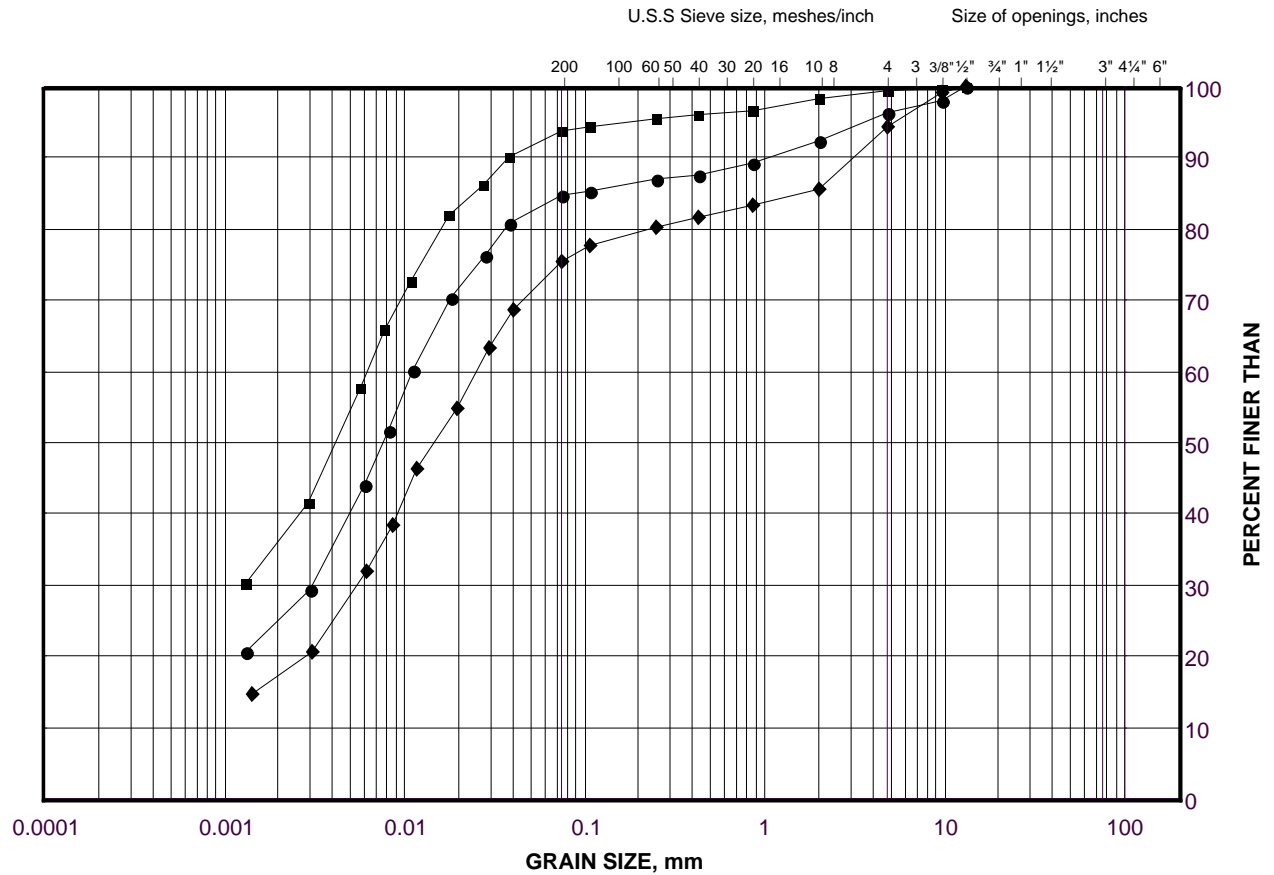
**Golder Associates**

Date: 12-Mar-19

# GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay (TILL)  
(Noise Barrier Wall)

FIGURE A-2



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

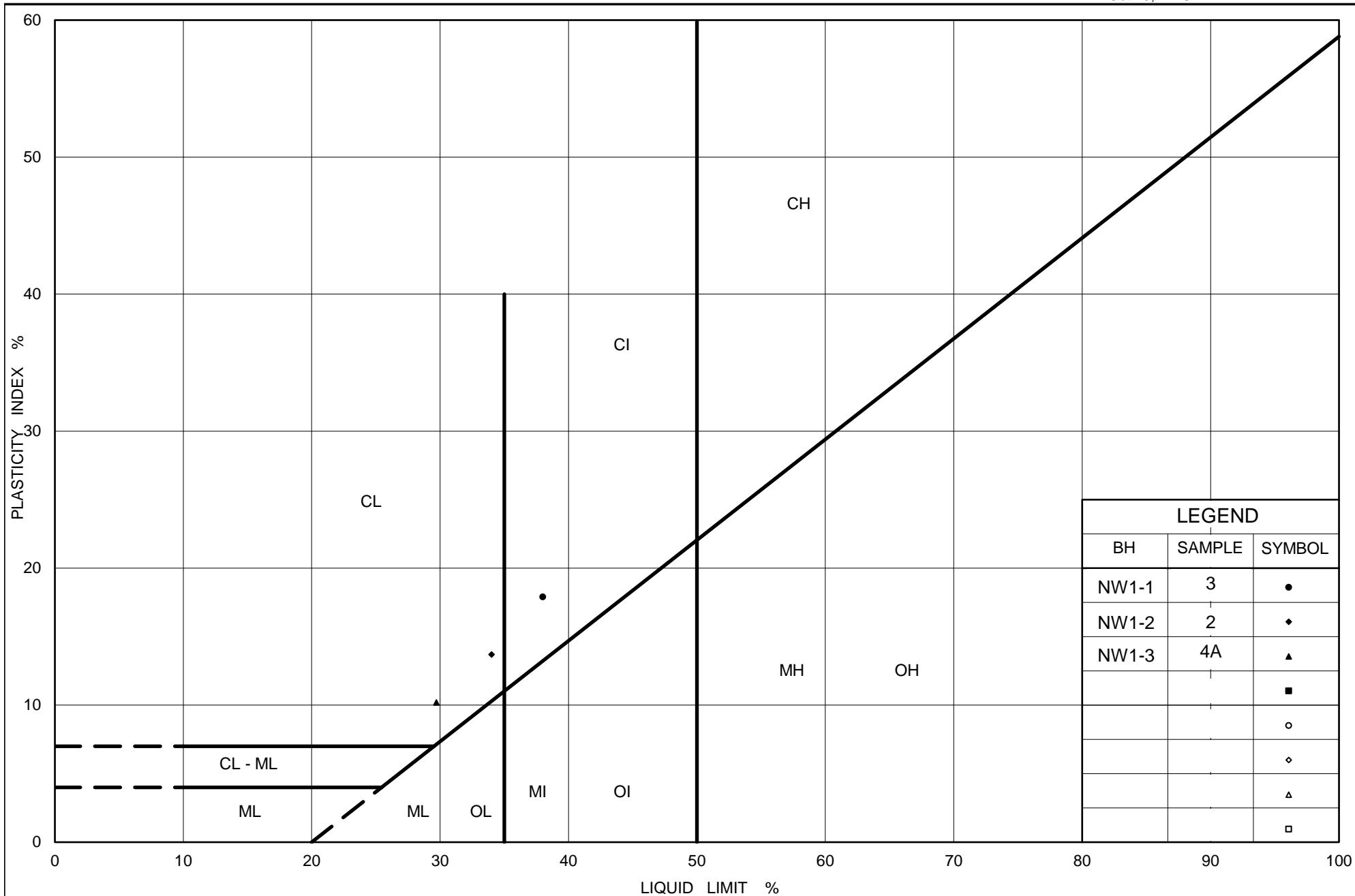
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW1-2	2	101.5
■	NW1-1	3	100.6
◆	NW1-3	4A	100.0

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 12-Mar-19



Ministry of Transportation

Ontario

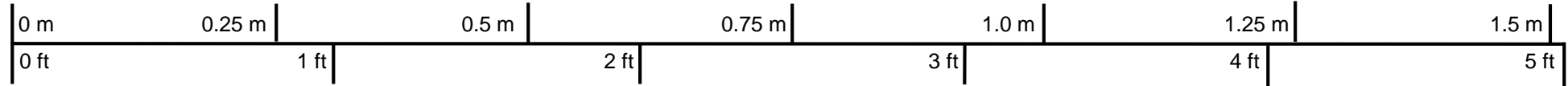
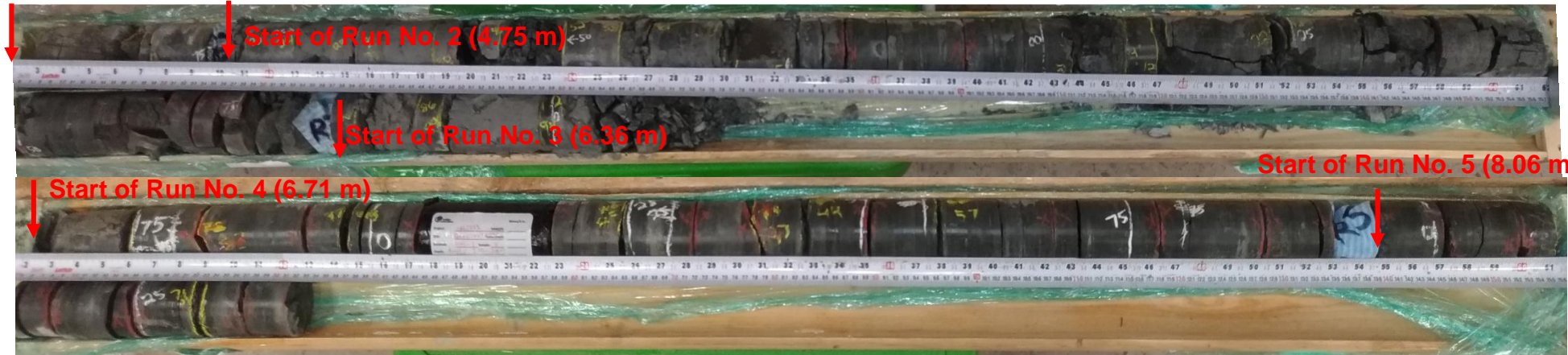
# PLASTICITY CHART Clayey Silt to Silty Clay (TILL) (Noise Barrier Wall)

Figure No. A-3


Project No. 1662333

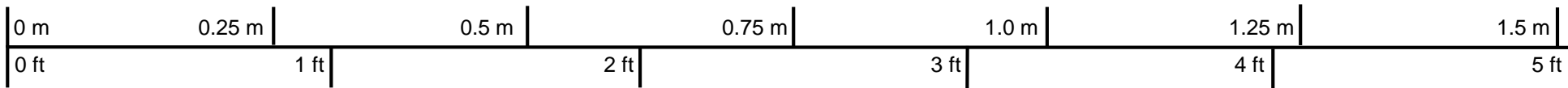
Checked By: SMM

Start of Run No. 1 (4.57 m)




Scale

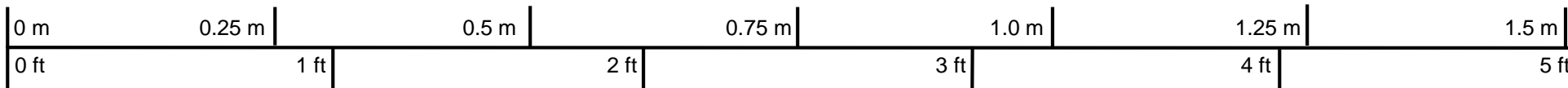
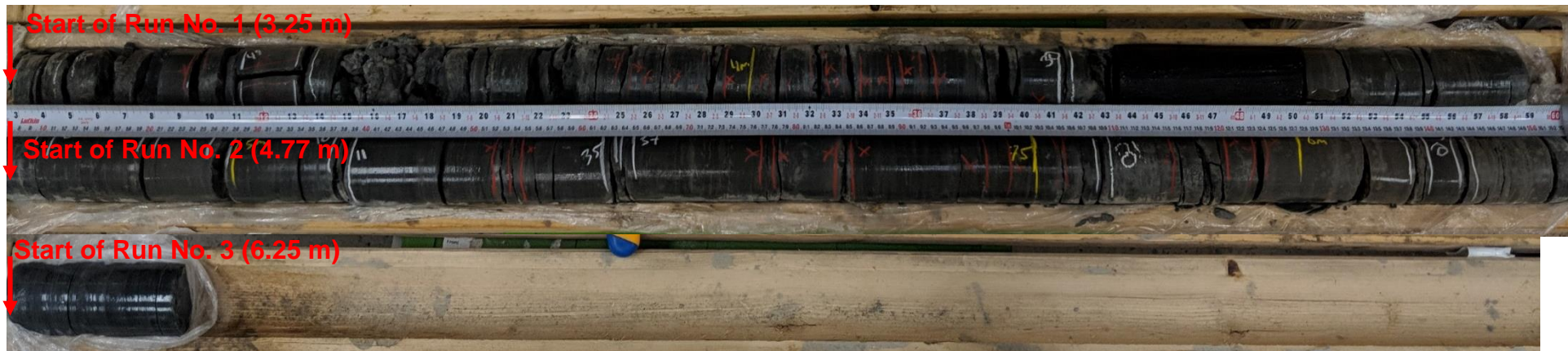
PROJECT	MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street					
	TITLE Bedrock Core Photograph Borehole NW1-1 (4.57 m to 8.51 m)					
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE A-4		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			




Scale

PROJECT	MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street					
	TITLE Bedrock Core Photograph Borehole NW1-2 (4.09 m to 7.85 m)					
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE A-5		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			





Scale

PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole NW1-3 (3.25 m to 6.4 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE A-6</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

**APPENDIX B**

**NOISE BARRIER WALL - Line 'B'**  
**QEW Sta 16+350 to Sta 16+660**



PROJECT		1662333		RECORD OF BOREHOLE		No CRB-2A		SHEET 1 OF 1		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4823960.1; E 295808.0 MTM NAD 83 ZONE 10 (LAT. 43.555523; LONG. -79.611298)		ORIGINATED BY		JL							
DIST		Central HWY QEW		BOREHOLE TYPE		64 mm O.D. 51 mm I.D. Continuous Split Spoon Sampling (Cathead/Safety Hammer)		COMPILED BY		KN							
DATUM		Geodetic		DATE		January 28, 2018		CHECKED BY		SMM							
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									
94.5	GROUND SURFACE																
0.0	TOPSOIL (100 mm)																
93.5	Clayey silt, sandy to with sand, trace organics / rootlets, oxidation staining, trace gravel (FILL)		1	SS	7												
	Firm to hard		2A	SS	50												
1.1	Brown to grey to black Moist		2B														
	SILTY CLAY, trace sand		2C	RC	REC 100%												
	Mottled brown to grey Dry		1	RC	REC 100%												
	SHALE (BEDROCK)		2	RC	REC 86%												
	Grey																
	Bedrock cored from a depth of 1.1 m to 9.0 m		3	RC	REC 100%												
	For bedrock coring details, refer to Record of Drillhole CRB-2A																
			4	RC	REC 100%												
			5	RC	REC 100%												
			6	RC	REC 100%												
			7	RC	REC 100%												
			8	RC	REC 100%												
			9	RC	REC 100%												
			10	RC	REC 100%												
			11	RC	REC 100%												
85.5	END OF BOREHOLE																
9.0	NOTE: 1. Borehole dry prior to rock coring.																

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: OGS Drilling

■ LOST CORE

LOGGED: JL  
CHECKED: MPL

1 : 50

PROJECT 1662333		RECORD OF BOREHOLE No NW2-1				SHEET 1 OF 1		METRIC						
G.W.P. 2002-13-00		LOCATION N 4823698.5; E 295666.6 MTM NAD 83 ZONE 10 (LAT. 43.553158; LONG. -79.613041)				ORIGINATED BY ACM								
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 114 mm I.D., Hollow Stem Augers				COMPILED BY SK								
DATUM Geodetic		DATE August 7, 2018				CHECKED BY SMM								
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						
98.3	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	Gravelly sand (FILL), trace asphalt fragments Compact Brown Moist		1	SS	19		98							
0.8	CLAYEY SILT with SAND, trace to some gravel, some shale fragments (RESIDUAL SOIL) Hard		2	SS	51		97							7 43 38 12
96.8	Grey to brown with oxidation staining Dry		3A	SS	50/0.10									
1.5	SHALE (BEDROCK) Grey Moderately weathered to 3.3 m depth to slightly weathered below 3.3 m depth  Bedrock cored from a depth of 2.3 m to 5.9 m  For bedrock coring details, refer to Record of Drillhole NW2-1  - Auger grinding from 1.8 m to 2.3 m		3B	SS	50/0.13		96							
			4	SS	50/0.13		95							RQD = 53%
			1	RC	REC 88%		94							RQD = 85%
			2	RC	REC 100%		93							RQD = 97%
			3	RC	REC 100%									
92.4	END OF BOREHOLE													
5.9	NOTES:  1. Open borehole dry upon completion of soil drilling.													

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PROJECT: 1662333

## RECORD OF DRILLHOLE: NW2-1

SHEET 1 OF 1

LOCATION: N 4823698.5 ; E 295666.6

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Davis Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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						TOTAL CORE %	SOLID CORE %			B Angle °	DIP w.r.t. CORE AXIS °	TYPE AND SURFACE DESCRIPTION		Jr	Ja	R4	R2	R3	W1	W2	W3				W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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3	HQ Core	Continued from Borehole NW2-1		95.96																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: ACM

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\GINT\QEW-CREDIT\_RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT 1662333		RECORD OF BOREHOLE No NW2-2				SHEET 1 OF 1			METRIC				
G.W.P. 2002-13-00		LOCATION N 4823766.1; E 295698.0 MTM NAD 83 ZONE 10 (LAT. 43.553767; LONG. -79.612653)				ORIGINATED BY ACM							
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 114 mm I.D., Hollow Stem Augers				COMPILED BY SK							
DATUM Geodetic		DATE August 8, 2018				CHECKED BY SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
98.2	GROUND SURFACE							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
0.0	TOPSOIL (700 mm) Firm		1	SS	7		98						
97.5													
0.7	SILTY CLAY, some sand, trace to some gravel, trace rootlets (TILL) Stiff		2	SS	12		97					47	6 18 39 37
96.8	Dark brown with oxidation staining Moist												
1.5	CLAYEY SILT, some sand, some shale fragments (RESIDUAL SOIL) Hard		3	SS	41								
96.0	Grey-brown with oxidation staining Moist		4	SS	100/0.23		96						
2.2	SHALE (BEDROCK) Grey Slightly weathered		5	SS	50/0.13		95						RQD = 67%
	Bedrock cored from a depth of 3.1 m to 6.5 m		1	RC	REC 100%								
	For bedrock coring details, refer to Record of Drillhole NW2-2		2	RC	REC 100%		94						RQD = 86%
							93						
			3	RC	REC 100%		92						RQD = 100%
91.7	END OF BOREHOLE												
6.5	NOTES: 1. Open borehole dry upon completion of soil drilling.												

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

LOGGED: ACM

CHECKED: AB

DATA\GINT\QEW-CREDIT RIVER\02 DATA\GINT\QEW-CREDIT RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT		RECORD OF BOREHOLE				No NW2-3		SHEET 1 OF 1		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4823813.0; E 295722.8 MTM NAD 83 ZONE 10 (LAT. 43.554189; LONG. -79.612346)				ORIGINATED BY		ACM					
DIST		Central		HWY		QEW		BOREHOLE TYPE		CME 55, 114 mm O.D., Hollow Stem Augers				COMPILED BY		CC	
DATUM		Geodetic		DATE		July 31, 2018				CHECKED BY		SMM					
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 (%)
97.8	GROUND SURFACE																
0.0	Sand and gravel, some silt (FILL) Compact Grey Dry		1	SS	25												
97.2																	
0.6	Sandy silt (FILL) Loose Dark brown to light brown Moist		2	SS	9		97										
96.6																	
1.4	CLAYEY SILT, some gravel, some shale fragments (TILL) Very stiff Grey brown with oxidation staining Moist		3	SS	25		96										
			4	SS	46												
95.3	Sandy CLAYEY SILT, some shale fragments (RESIDUAL SOIL) Very stiff to hard Grey-brown Dry		5	SS	50/0.13		95										
2.5			6	SS	50/0.13												
	SHALE (BEDROCK) Grey Slightly weathered to fresh		1	RC	84%		94									RQD = 76%	
	Bedrock cored from a depth of 3.1 m to 6.6 m		2	RC	REC 100%		93									RQD = 84%	
	For bedrock coring details, refer to Record of Drillhole NW2-3		3	RC	REC 100%		92									RQD = 100%	
91.2	END OF BOREHOLE																
6.6	NOTES:  1. Open borehole dry upon completion of soil drilling.																

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PROJECT: 1662333

**RECORD OF DRILLHOLE: NW2-3**

SHEET 1 OF 1

LOCATION: N 4823813.0 ; E 295722.8

DRILLING DATE: July 31, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Davis Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL- Planar CU- Curved UN- Undulating ST- Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	RO/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA				ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50

**GOLDER**

LOGGED: ACM

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\GPJ GAL-MISS.GDT 19-5-15



PROJECT		1662333		RECORD OF BOREHOLE No NW2-4				SHEET 1 OF 1		METRIC					
G.W.P.		2002-13-00		LOCATION		N 4823866.3; E 295756.4 MTM NAD 83 ZONE 10 (LAT. 43.554669; LONG. -79.611932)		ORIGINATED BY		ACM					
DIST		Central HWY QEW		BOREHOLE TYPE		CME 55, 114 mm O.D., Hollow Stem Augers		COMPILED BY		CC					
DATUM		Geodetic		DATE		July 31, 2018		CHECKED BY		SMM					
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							
96.2	GROUND SURFACE														
0.0	TOPSOIL (150 mm)		1A	SS	12		96								
0.3	Sand and gravel (FILL) Compact Brown Moist		1B 1C												
95.3			2A	SS	50/0.08										
0.9	SILTY CLAY, some gravel, trace to some sand (TILL) Stiff to hard Brown-grey Moist - Auger grinding from 0.5 m to 0.6 m		2B 3	SS	50/0.10		95								
93.9			4	SS	50/0.13										
2.3	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation) - Auger grinding from 0.9 m to 1.7 m - Cobble from 0.9 m to 1.7 m - Auger grinding from 2.0 m to 2.1 m		5	SS	50/0.13		94								
	SHALE (BEDROCK) Grey Slightly weathered  Bedrock cored from a depth of 2.9 m to 6.6 m  For bedrock coring details, refer to Record of Drillhole NW2-4		6	RC	REC 100%		93								RQD = 90%
			2	RC	REC 100%		92								RQD = 87%
			3	RC	REC 100%		91								RQD = 100%
89.6	END OF BOREHOLE						90								
6.6	NOTES:  1. Open borehole dry upon completion of soil drilling.														

PROJECT: 1662333

## RECORD OF DRILLHOLE: NW2-4

SHEET 1 OF 1

LOCATION: N 4823866.3 ; E 295756.4

DRILLING DATE: August 1, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Davis Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	RQ/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA					ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: ACM

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\GPJ GAL-MISS.GDT 19-5-15

PROJECT 1662333		RECORD OF BOREHOLE No NW2-5				SHEET 1 OF 1		METRIC								
G.W.P. 2002-13-00		LOCATION N 4823903.6; E 295776.4 MTM NAD 83 ZONE 10 (LAT. 43.555006; LONG. -79.611685)				ORIGINATED BY ACM										
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 114 mm O.D., Hollow Stem Augers				COMPILED BY CC										
DATUM Geodetic		DATE August 1, 2018				CHECKED BY SMM										
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								
95.6	GROUND SURFACE															
0.0 95.3 0.3	Gravelly sand (FILL) Compact Brown Moist		1	SS	10											
	CLAYEY SILT, some sand, some gravel (TILL) Stiff Grey-brown with oxidation staining Moist		2	SS	8											
94.2 1.4	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		3A 3B	SS	30											
92.7 2.9	SHALE (BEDROCK) Grey Slightly weathered to fresh  Bedrock cored from a depth of 3.1 m to 6.6 m  For bedrock coring details, refer to Record of Drillhole NW2-5		4 5A 5B 6 1 2 3	SS SS SS SS RC RC RC	100/0.25 100/0.20 50/0.10 REC 100% REC 100% REC 100%											14 16 52 18
																RQD = 69%
																RQD = 92%
																RQD = 100%
89.0 6.6	END OF BOREHOLE															
NOTES: 1. Open borehole dry upon completion of soil drilling																

PROJECT: 1662333

## RECORD OF DRILLHOLE: NW2-5

SHEET 1 OF 1

LOCATION: N 4823903.6 ; E 295776.4

DRILLING DATE: August 1, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Davis Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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						TOTAL CORE %	SOLID CORE %			B Angle DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4 R3 R2 R1	W1 W2 W3 W4 W5 W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: ACM

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\GINT\QEW-CREDIT\_RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT		RECORD OF BOREHOLE No NW2-6				SHEET 1 OF 1		METRIC				
G.W.P.		2002-13-00		LOCATION		N 4823932.6; E 295793.2 MTM NAD 83 ZONE 10 (LAT. 43.555267; LONG. -79.611478)		ORIGINATED BY		ACM		
DIST		Central HWY QEW		BOREHOLE TYPE		CME 55, 114 mm O.D., Hollow Stem Augers		COMPILED BY		CC		
DATUM		Geodetic		DATE		August 1, 2018		CHECKED BY		SMM		
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
94.8	GROUND SURFACE											
0.0	TOPSOIL (300 mm)		1A	SS	12							
94.5												
0.3	Sandy SILTY CLAY to CLAY (TILL)		1B									
93.8	Stiff to very stiff		2A									
1.0	Grey-brown with oxidation staining		2B	SS	19							
93.4	Moist											
1.4	CLAYEY SILT, trace to some sand, trace to some gravel (RESIDUAL SOIL)		3	SS	52							
	Very stiff											
	Grey-brown with oxidation staining											
	Moist											
92.3	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		4	SS	50/0.10							
2.5	SHALE (BEDROCK)		5	SS	100/0.20							
	Grey		1	RC	REC 75%							RQD = 19%
	Moderately weathered to 3.6 m depth to slightly weathered to fresh below 3.6 m depth											
	Bedrock cored from a depth of 3.1 m to 6.6 m		2	RC	REC 100%							RQD = 99%
	For bedrock coring details, refer to Record of Drillhole NW2-6											
			3	RC	REC 100%							RQD = 100%
88.2	END OF BOREHOLE											
6.6	NOTES:  1. Open borehole dry upon completion of soil drilling.											

PROJECT: 1662333

## RECORD OF DRILLHOLE: NW2-6

SHEET 1 OF 1

LOCATION: N 4823932.6 ; E 295793.2

DRILLING DATE: August 1, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Davis Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL- Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																		FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA						ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
						TOTAL CORE %	SOLID CORE %			B Angle °	DIP w.r.t. CORE AXIS °	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4	R3	R2	R1	W1	W2	W3	W4	W5				W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
		Continued from Borehole NW2-6		91.78																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: ACM

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\GINT\QEW-CREDIT\_RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT		RECORD OF BOREHOLE No OHS-4				SHEET 1 OF 1		METRIC						
G.W.P. 2002-13-00		LOCATION N 4823828.9; E 295734.3 MTM NAD 83 ZONE 10 (LAT. 43.554333; LONG. -79.612205)				ORIGINATED BY ACM								
DIST Central HWY QEW		BOREHOLE TYPE Portable Tripod				COMPILED BY DH								
DATUM Geodetic		DATE September 6, 2018				CHECKED BY SMM								
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						
97.3	GROUND SURFACE													
0.0	TOPSOIL (300mm)		1	SS	64									
96.6	Gravel, some sand, some silt (FILL) Dense Brown Moist		2	SS	47									
0.7														
95.6	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		3	SS	100/0.10									5 14 49 32
1.7	SHALE (BEDROCK)		1	RC	REC 100%									RQD = 0%
	Grey Moderately weathered to 3.2 m depth to slightly weathered to fresh below 3.2 m depth		2	RC	REC 43%									RQD = 0%
			3	RC	REC 53%									RQD = 0%
	Bedrock cored from a depth of 1.7 m to 5.6 m		4	RC	REC 82%									RQD = 35%
	For bedrock coring details, refer to Record of Drillhole OHS-4		5	RC	REC 92%									RQD = 89%
91.7	END OF BOREHOLE													
5.6	NOTES: 1. Borehole dry prior to rock coring.													

GTA-MTO 001 S:\CLIENTS\MTQEW-CREDIT\_RIVER\02\_DATA\INTQEW-CREDIT\_RIVER.GPJ GAL-GTA.GDT 19-5-15

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Walker Drilling

[illegible]

BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

LOGGED: ACM

CHECKED: AB

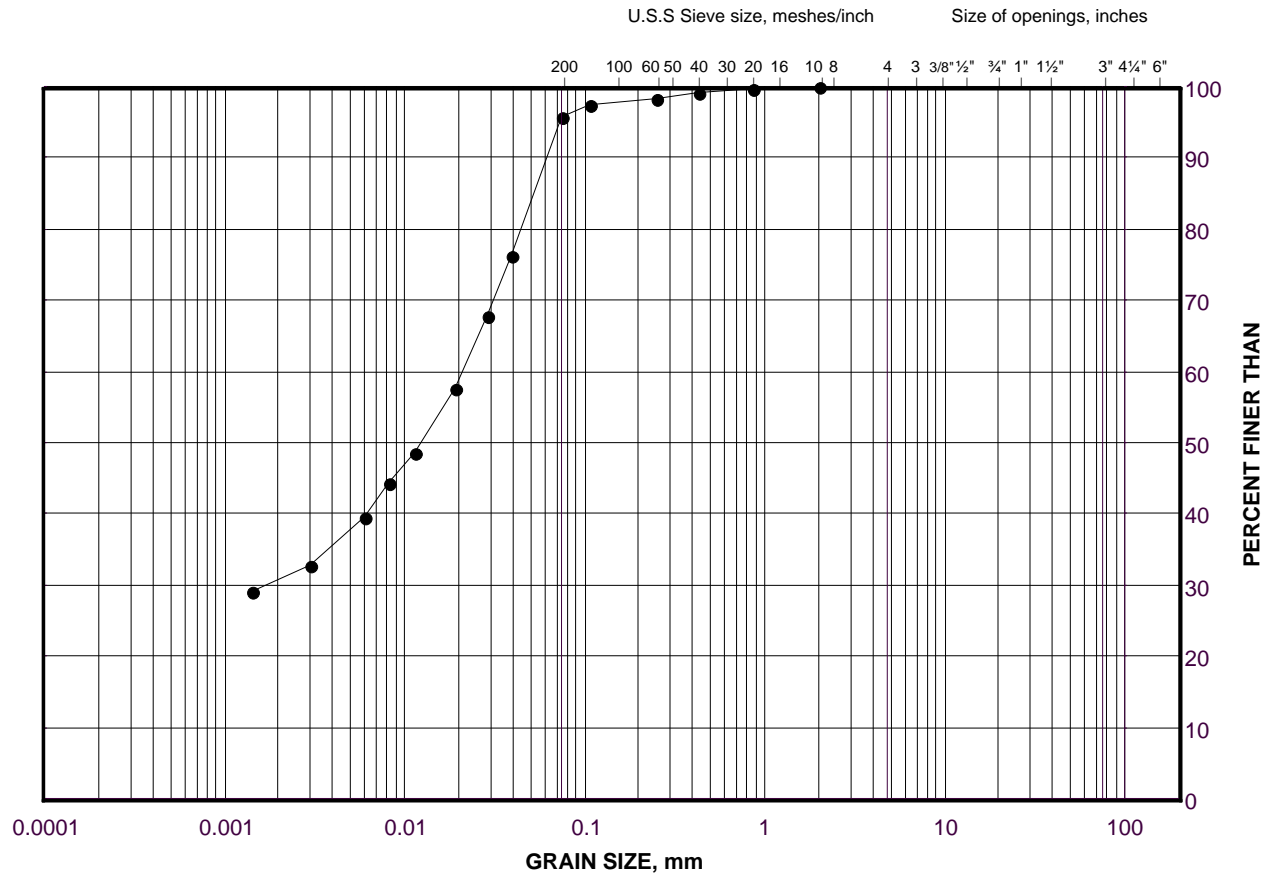
DATA\GINT\QEW-CREDIT RIVER\02 DATA\GINT\QEW-CREDIT RIVER.GPJ GAL-MISS.GDT 19-5-15



# GRAIN SIZE DISTRIBUTION

Silty Clay  
(Noise Barrier Wall - Line 'B')

FIGURE B-1



SILT AND CLAY SIZES				FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED				SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	CRB-2A	2B	93.4

Project Number: 1662333

Checked By: SMM

**Golder Associates**

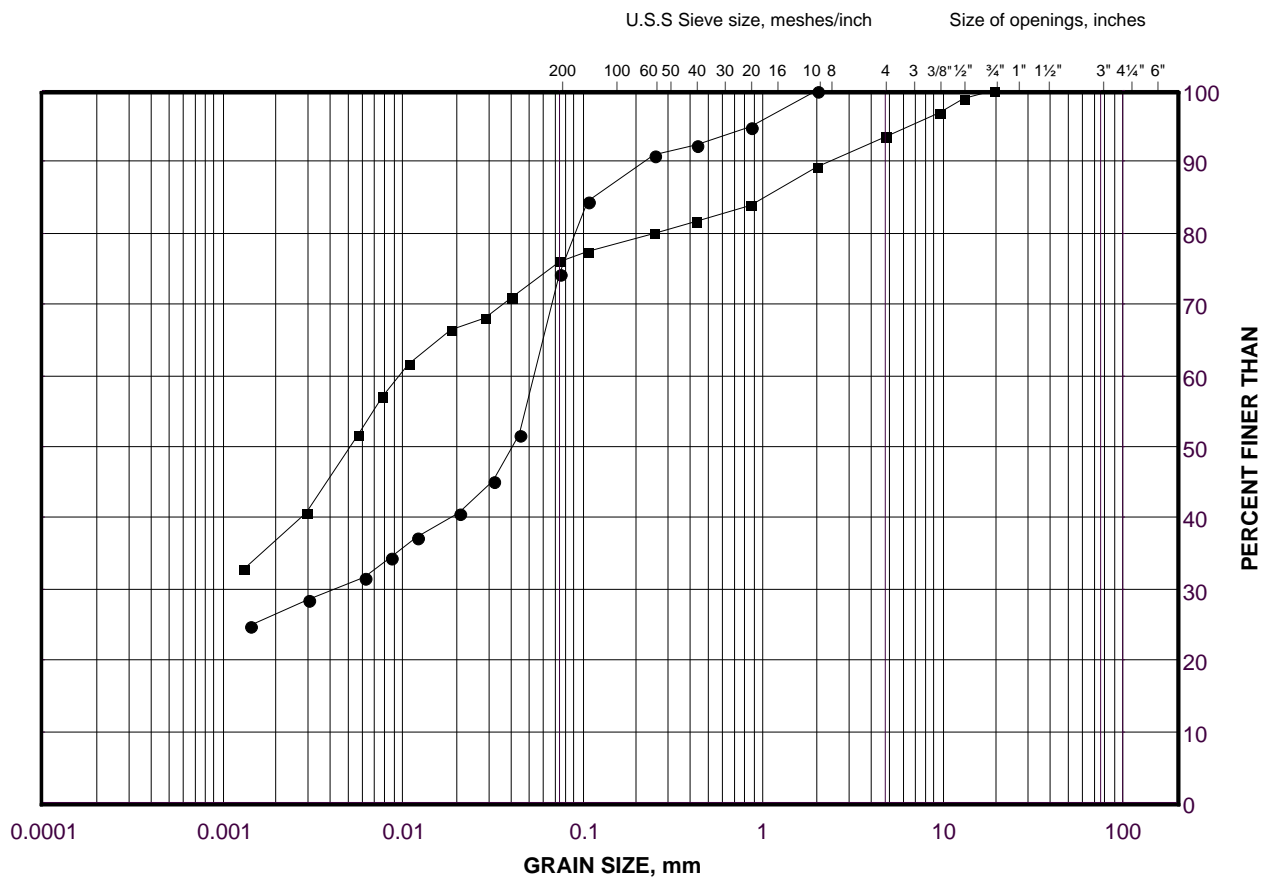
Date: 12-Mar-19

# GRAIN SIZE DISTRIBUTION

Sandy Silty Clay to Silty Clay (TILL)

(Noise Barrier Wall - Line 'B')

FIGURE B-2



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

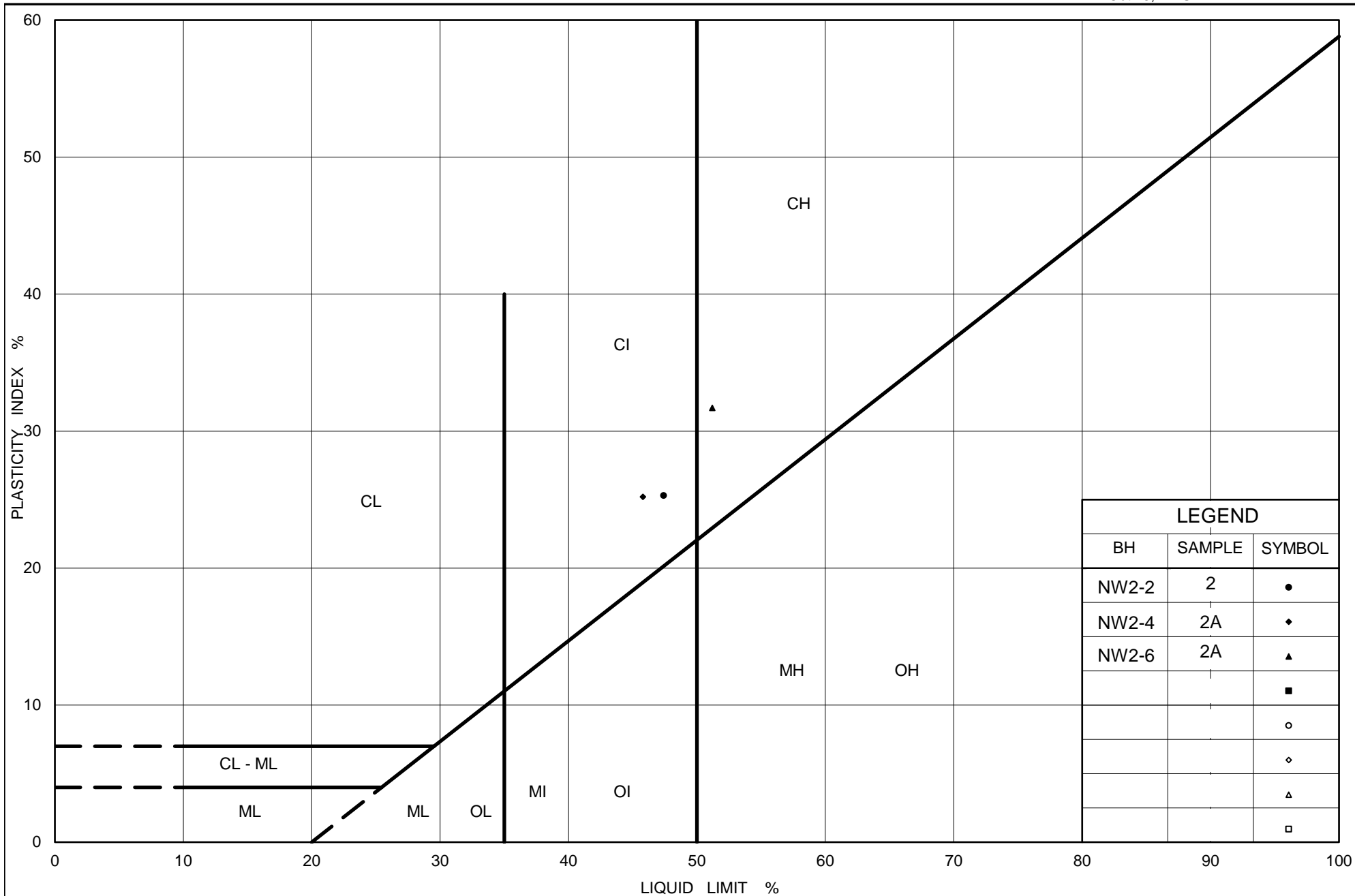
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW2-6	1B	94.4
■	NW2-2	2	97.1

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 12-Mar-19



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# **PLASTICITY CHART** Sandy Silty Clay to Clay (TILL) (Noise Barrier Wall - Line 'B')

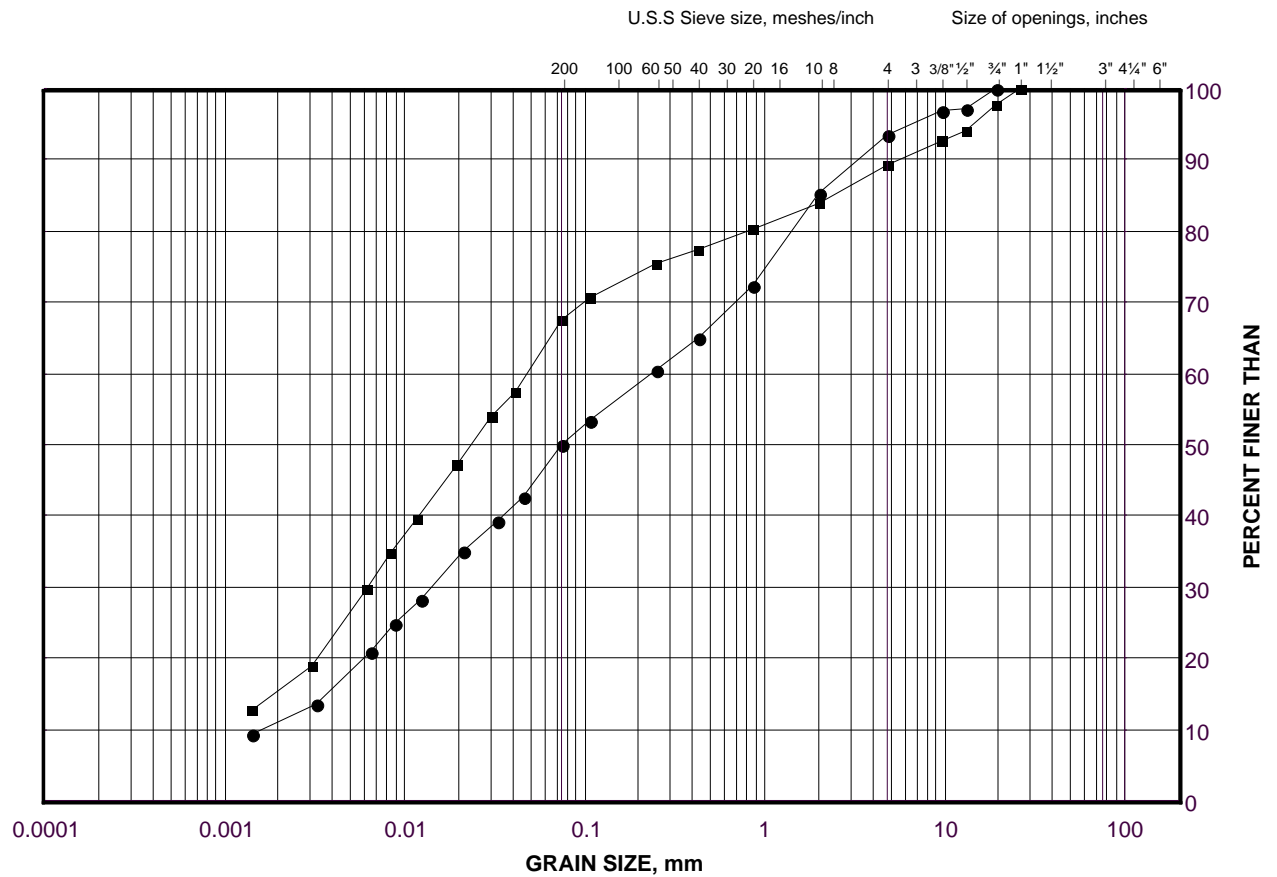
Figure No. B-3

Project No. 1662333

Checked By: SMM

Clayey Silt with Sand to Sandy Clayey Silt (Residual Soil)  
(Noise Barrier Wall - Line 'B')

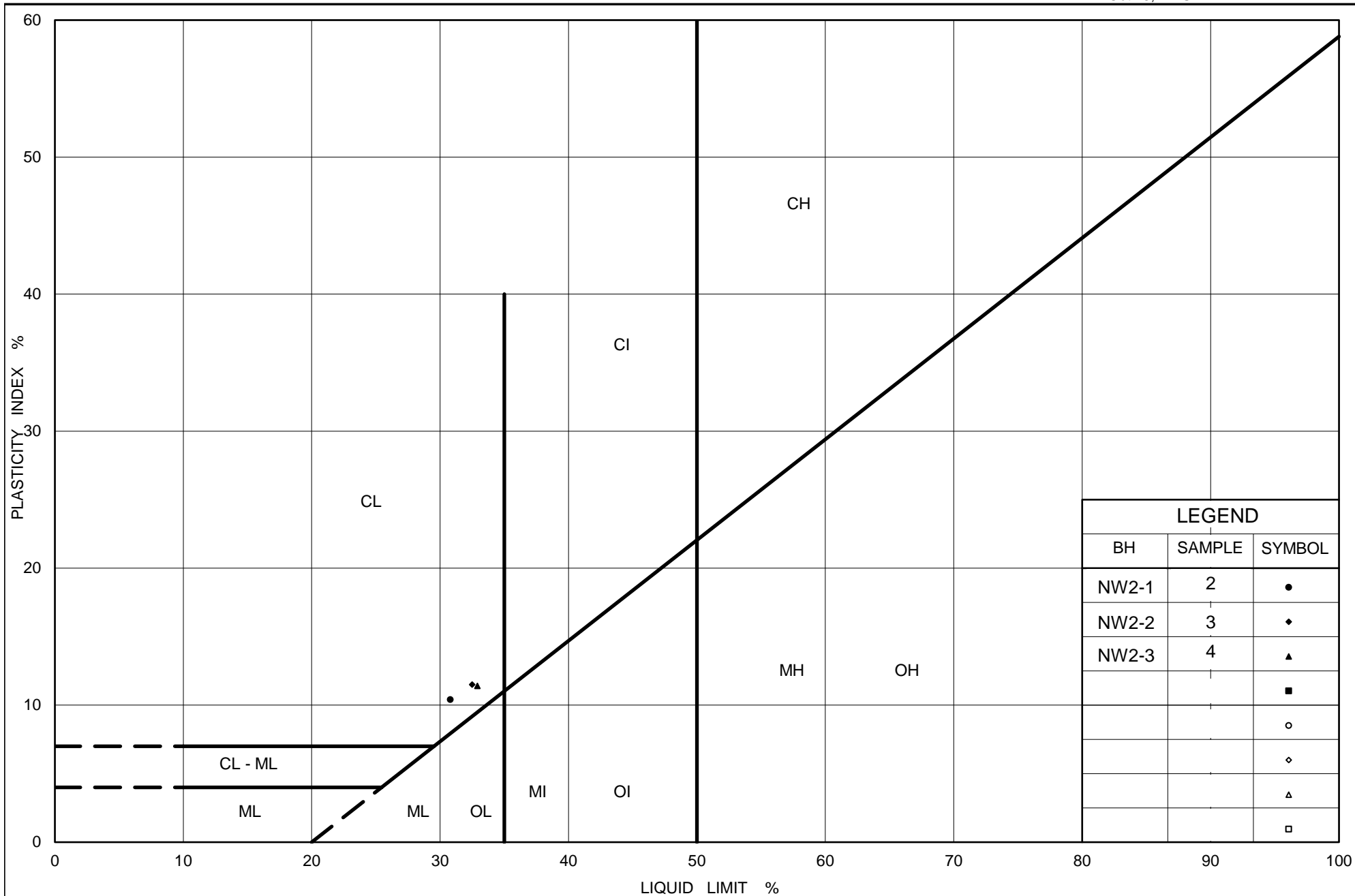
FIGURE B-4



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW2-1	2	97.2
■	NW2-3	4	95.7



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## PLASTICITY CHART

Clayey Silt with Sand to Clayey Silt (Residual Soil)  
(Noise Barrier Wall - Line 'B')

Figure No. B-5

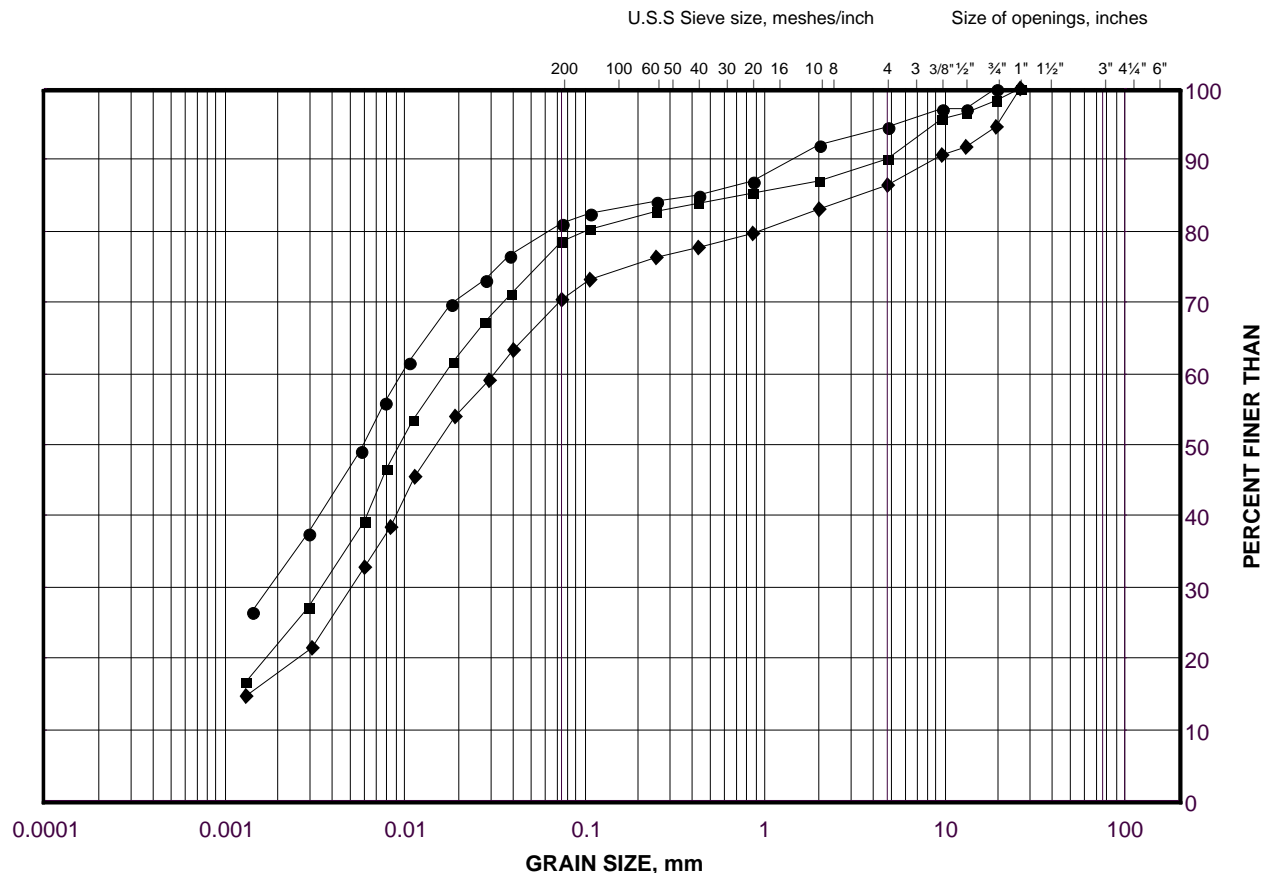
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Inferred Completely to Moderately Weathered Shale (Bedrock)  
(Noise Barrier Wall - Line 'B')

FIGURE B-6



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-4	3	95.8
■	NW2-6	3	93.0
◆	NW2-5	4	93.5

## NOTES:

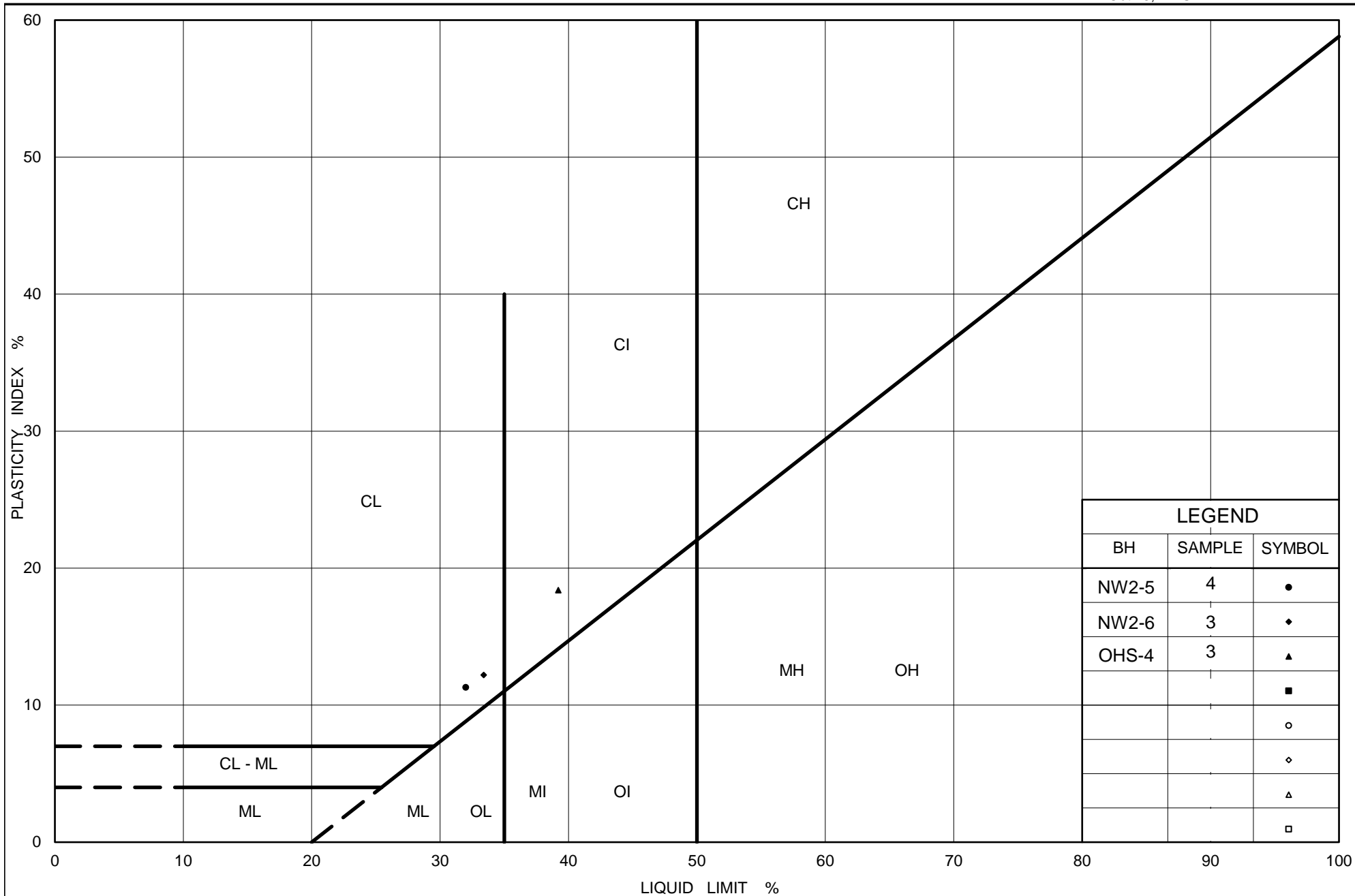
1. The samples of inferred completely to moderately weathered bedrock were obtained by split-spoon sampling, and as such, the particle size(s) are effected by the sampling method and are limited to the size of the sampler. Larger fragments of shale bedrock may be present in-situ.
2. The percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behavior of the in-situ or excavated completely to moderately weathered shale bedrock.

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 29-Apr-19



Ministry of Transportation

Ontario

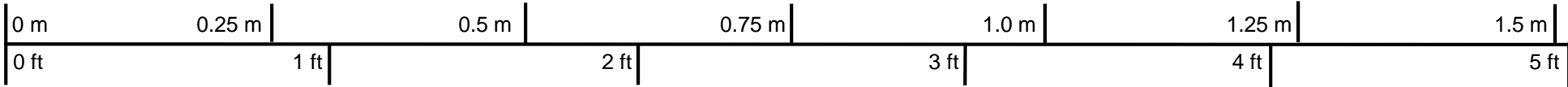
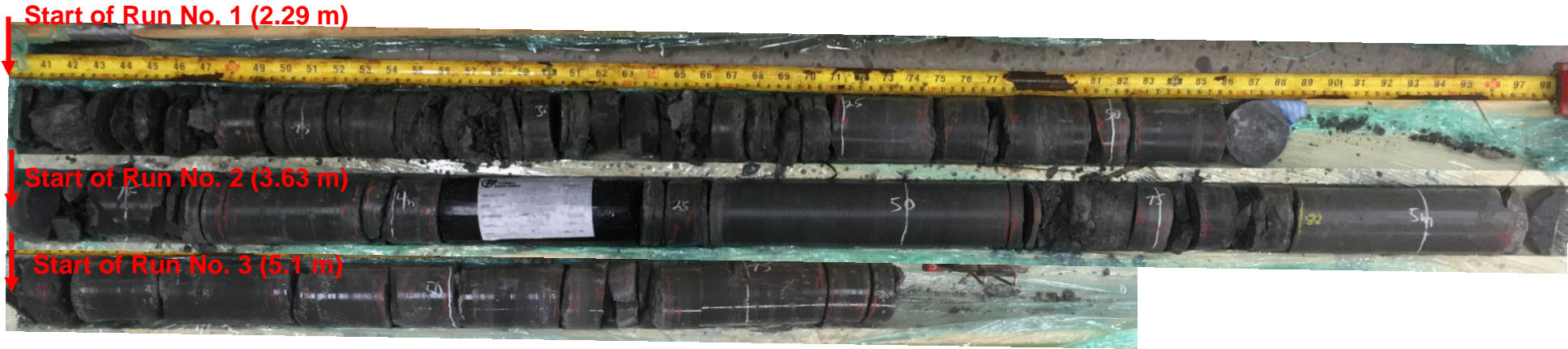
## PLASTICITY CHART

Inferred Completely to Moderately Weathered Shale (Bedrock)  
(Noise Barrier Wall - Line 'B')


Figure No. B-7

Project No. 1662333

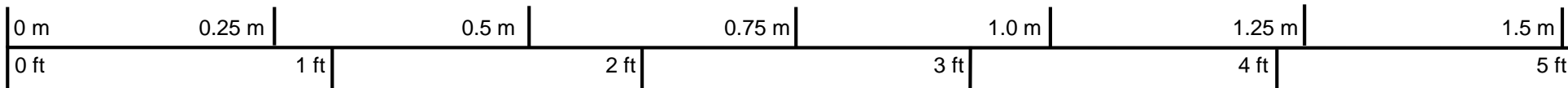
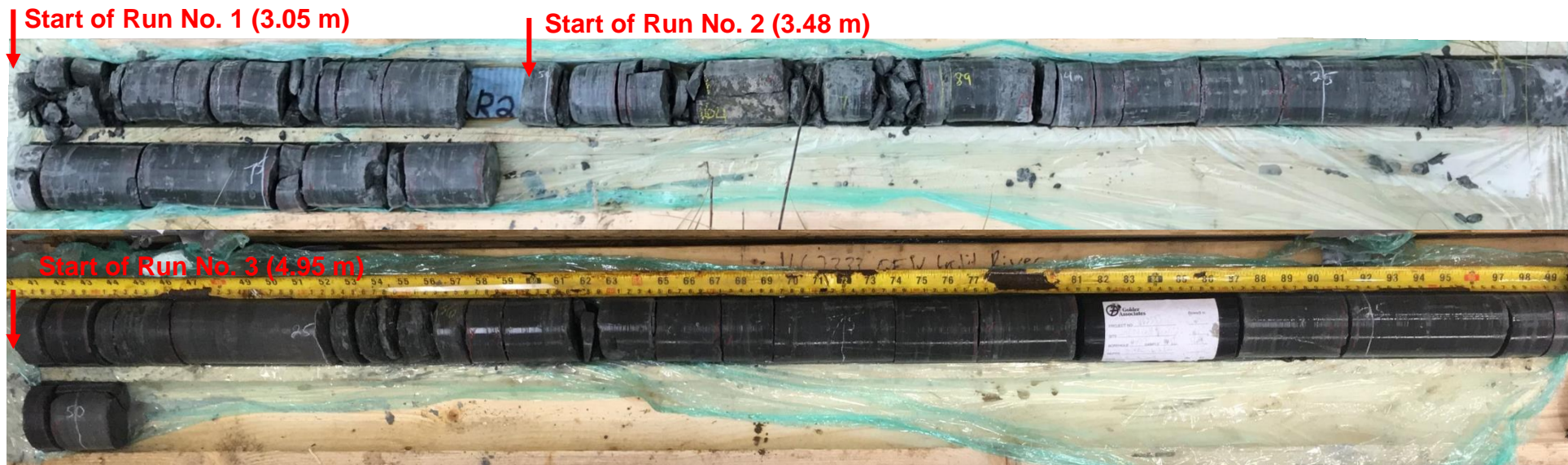
Checked By: SMM




Scale

PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole NW2-1 (2.29 m to 5.89 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE B-8</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			





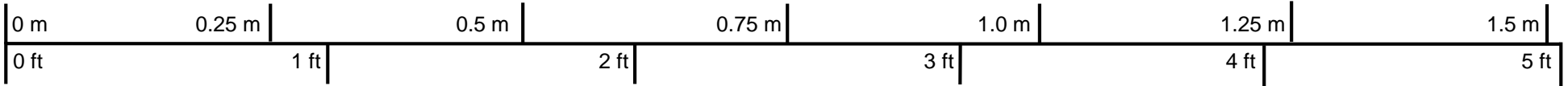
Scale

PROJECT		MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street				
TITLE		Bedrock Core Photograph Borehole NW2-2 (3.05 m to 6.53 m)				
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE B-9</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			


Start of Run No. 1 (3.05 m)

Start of Run No. 2 (3.56 m)

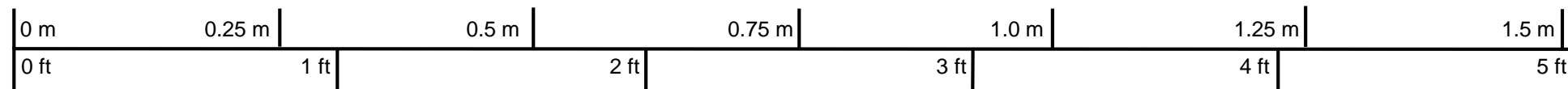
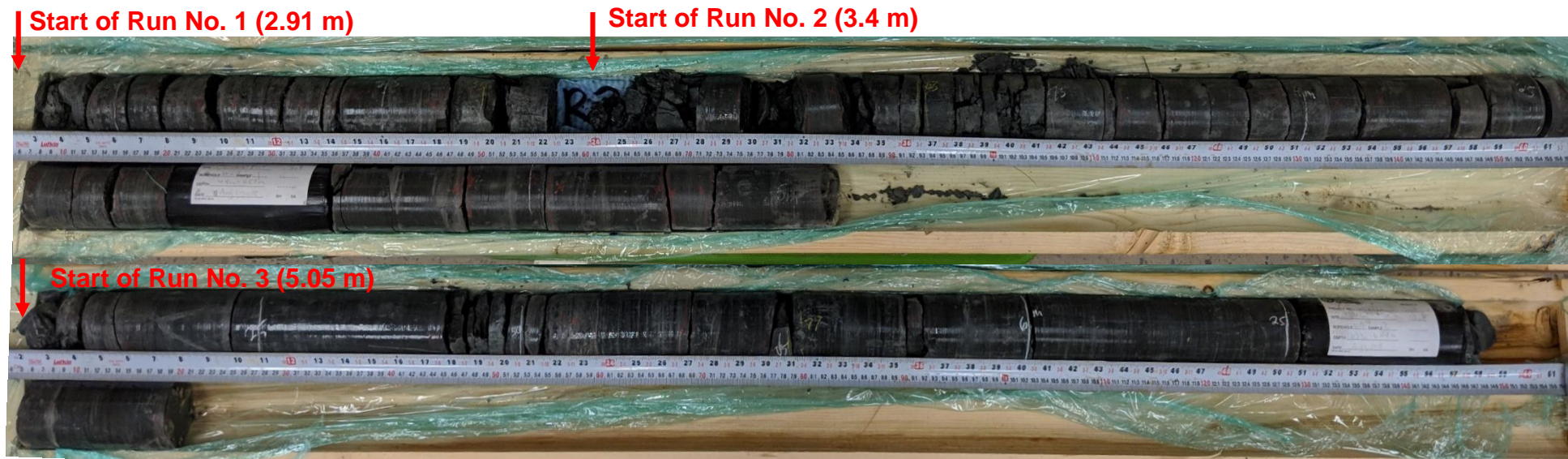
Start of Run No. 3 (5.05 m)




Scale

PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE Bedrock Core Photograph Borehole NW2-3 (3.05 m to 6.60 m)						
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE B-10		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			





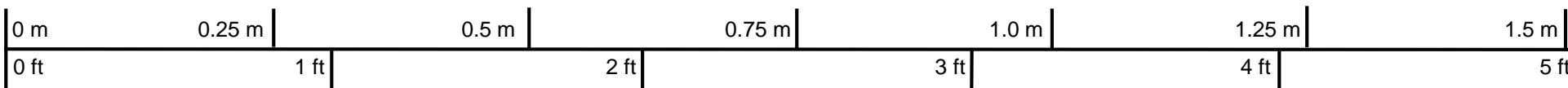
Scale

PROJECT	MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street					
	TITLE Bedrock Core Photograph Borehole NW2-4 (2.91 m to 6.58 m)					
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE B-11		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			


Start of Run No. 1 (3.05m)      Start of Run No. 2 (3.56 m)



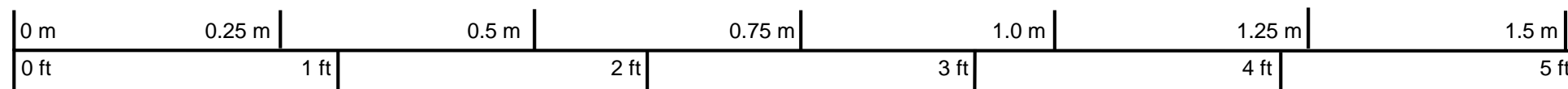
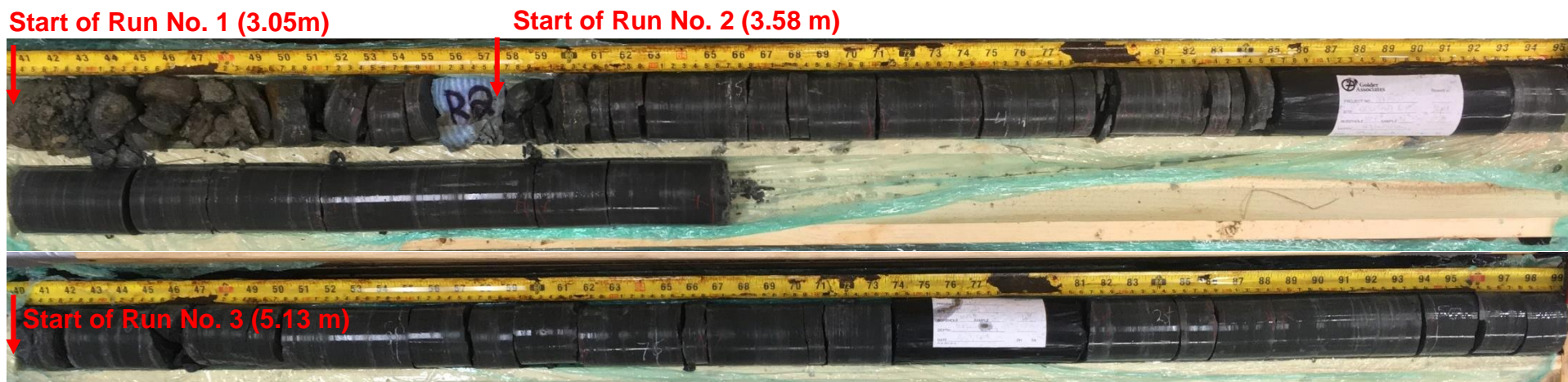
Start of Run No. 3 (5.1 m)




Scale

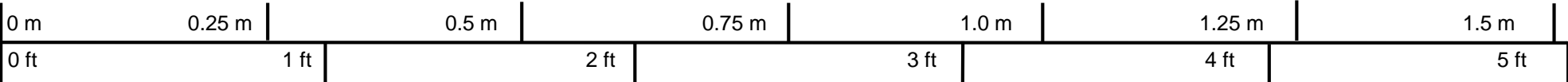
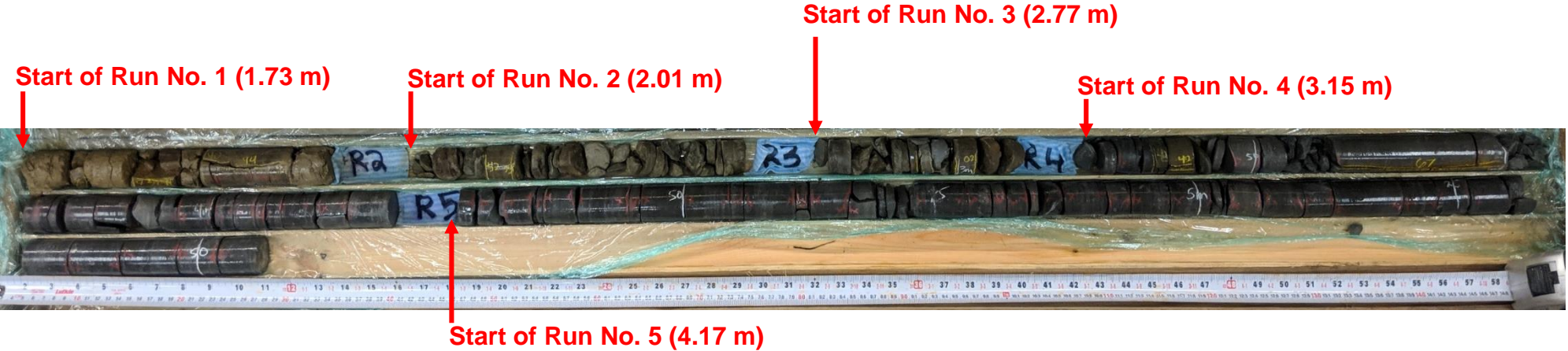
PROJECT		MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street				
TITLE		Bedrock Core Photograph Borehole NW2-5 (3.05 m to 6.58 m)				
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE B-12		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			






Scale

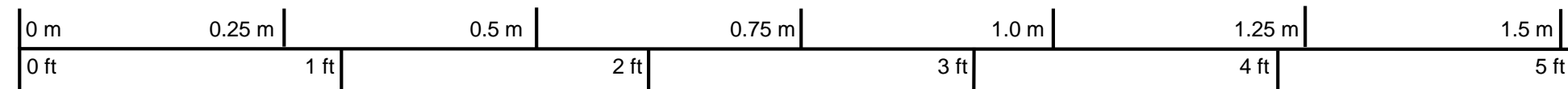
PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole NW2-6 (3.05 m to 6.62 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE B-13</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			




Scale

PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street					
TITLE Bedrock Core Photograph Borehole OHS-4 (1.73 m to 5.56 m)					
 GOLDER	PROJECT No. 1662333			FILE No. ----	
	DRAFT	SE	20180821	SCALE	AS SHOWN
	CADD	--		FIGURE B-14	
	CHECK	SMM	20190319		
	REVIEW	JMAC	20190321		





Scale

PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE Bedrock Core Photograph Borehole CRB-2A (1.12 m to 8.96 m)						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE B-15</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			



**APPENDIX C**

**NOISE BARRIER / RETAINING WALL - Line 'F'**

**QEW Sta 16+931 to Sta 17+660**

**NOISE BARRIER WALL - Line 'H'**

**QEW Sta 17+660 to Sta 17+728**

PROJECT		1662333		RECORD OF BOREHOLE No CRB-6				SHEET 1 OF 2		METRIC			
G.W.P.		2002-13-00		LOCATION		N 4824196.7; E 295929.5 MTM NAD 83 ZONE 10 (LAT. 43.557650; LONG. -79.609801)		ORIGINATED BY		JL			
DIST		Central HWY QEW		BOREHOLE TYPE		CME 850, 210 mm O.D. Hollow Stem Augers, HQ Casing (Auto Hammer)		COMPILED BY		MPL			
DATUM		Geodetic		DATE		October 18-20, 2017		CHECKED BY		SMM			
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)		
91.7	GROUND SURFACE												
0.0	Silty sand, trace to some gravel, trace clay, contains brick fragments (FILL) Loose to compact Brown Moist		1	SS	11								7 67 24 2
			2	SS	5								
90.0			3A	SS	5								
1.7	Sandy CLAYEY SILT, trace to some gravel Firm to stiff brown Moist to wet - Mottled brown-grey below a depth of about 2.3 m		3B										
			4	SS	7								
			5	SS	9								
	- Becoming gravelly at a depth of about 3.7 m - Auger grinding at a depth of about 3.7 m		6	SS	5								10 26 44 20
87.3													
4.4	Sandy CLAYEY SILT, some shale fragments (RESIDUAL SOIL) Hard Grey Moist		7	SS	50/0.13								
86.9													
4.8	SHALE (BEDROCK) Grey  Bedrock cored from a depth of 5.1 m to 13.3 m  For bedrock coring details, refer to Record of Drillhole CRB-6		1	RC	REC 86%								RQD = 47%
			2	RC	REC 100%								RQD = 95%
			3	RC	REC 100%								RQD = 100%
			4	RC	REC 100%								RQD = 95%
			5	RC	REC 100%								RQD = 100%
			6	RC	REC 96%								RQD = 96%
78.4	END OF BOREHOLE												
13.3	NOTES:  1. Borehole dry prior to rock coring.												

Continued Next Page

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

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

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Aardvark Drilling

■ LOST CORE

CHECKED: MPL

1 : 50

PROJECT		RECORD OF BOREHOLE No CRB-8				SHEET 1 OF 1		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4824211.5; E 295953.7 MTM NAD 83 ZONE 10 (LAT. 43.557788; LONG. -79.609499)		ORIGINATED BY		JL					
DIST		Central HWY QEW		BOREHOLE TYPE		CME 850, 210 mm O.D. Hollow Stem Augers (Auto Hammer)		COMPILED BY		MPL					
DATUM		Geodetic		DATE		October 17, 2017		CHECKED BY		SMM					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>
							20 40 60 80 100			WATER CONTENT (%)			GR SA SI CL		
							○ UNCONFINED + FIELD VANE								
							● QUICK TRIAXIAL × REMOULDED								
							20 40 60 80 100			10 20 30					
94.7	GROUND SURFACE					▽	94								
0.1	TOPSOIL (80 mm)		1	SS	3										
	Sand, some silt, trace clay (FILL) Very loose to compact Brown Moist		2	SS	12										
93.3															
1.5	SAND, some silt, trace clay Compact to dense Brown Moist		3	SS	21			93							
			4	SS	44			92							0 84 14 2
	- Becoming wet below a depth of about 3.1 m - Clayey silt pockets at a depth of about 3.1 m		5	SS	35			91							
91.0															
3.7	SILT, trace to some sand, trace to some clay Slight plasticity Dense to very dense Grey Wet		6	SS	67			90							0 7 85 8
			7	SS	32			89							
	- Becoming grey and brown at a depth of about 5.6 m														
88.3			8A												
6.4	CLAYEY SILT, some sand Very stiff Grey Wet		8B	SS	22		88								
87.1															
7.6	SANDY CLAYEY SILT with shale fragments (RESIDUAL SOIL)		9A	SS	50/0.13		87							31 27 34 8	
86.7	Hard		9B												
8.1	Grey														
86.2	Moist		10	SS	50/0.08										
8.5	- Auger grinding at a depth of about 7.6 m SHALE (BEDROCK) Grey END OF BOREHOLE - SPLIT-SPOON REFUSAL														
NOTE: 1. Water level measured at a depth of about 1.5 m (Elev. 93.2 m) below ground surface upon completion of drilling.															

PROJECT		1662333		RECORD OF BOREHOLE No AR-1		SHEET 1 OF 1		METRIC																
G.W.P.		2002-13-00		LOCATION		N 4824236.4; E 295944.3 MTM NAD 83 ZONE 10 (LAT. 43.558012; LONG. -79.609616)		ORIGINATED BY																
DIST		Central HWY QEW		BOREHOLE TYPE		CME 55, 114 mm I.D., Hollow Stem Augers		COMPILED BY																
DATUM		Geodetic		DATE		July 30, 2018		CHECKED BY																
SMM																								
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																		
95.7	0.0	GROUND SURFACE																						
		TOPSOIL (700 mm)		1	SS	9																		
95.0	0.7	Sand, some silt to silt and sand, trace clay (FILL)		2	SS	7																		
94.3	1.4	Loose Brown Moist		3	SS	7																		
		SAND, some silt SILT and SAND, trace clay Loose to very dense Brown Moist - Oxidation staining from 2.3 m to 3.7 m - Wet from 3.0 m to 3.7 m		4	SS	6																		
				5	SS	5																		
				6	SS	56																		
				7	SS	63																		
90.4	5.3	SILT, trace to some sand, trace to some clay Very dense Brown to grey Moist		8	SS	56																		
88.5	7.2	CLAYEY SILT, trace sand Very soft Grey Moist to wet		9	SS	2																		
87.0				10A	SS	50/0.05																		
86.5	9.2	Sandy CLAYEY SILT, trace to some gravel, some shale fragments (RESIDUAL SOIL) Hard Grey Moist to wet SHALE (BEDROCK) Grey		10B	SS	50/0.08																		
		END OF BOREHOLE SPLIT-SPOON REFUSAL		11	SS	50/0.08																		
		NOTES: 1. Water level at a depth of approximate 3.7 m below ground surface (Elev. 92.0 m) upon completion of drilling.																						

PROJECT		1662333		RECORD OF BOREHOLE No PED-01				SHEET 1 OF 2		METRIC									
G.W.P.		2002-13-00		LOCATION				N 4824314.1; E 295977.3 MTM NAD 83 ZONE 10 (LAT. 43.558703; LONG. -79.609205)		ORIGINATED BY		FC							
DIST		Central		HWY		QEW		BOREHOLE TYPE				CME 55, 203 mm O.D. Hollow Stem Augers, HQ Casing				COMPILED BY		KN	
DATUM		Geodetic		DATE		August 17-18, 2017						CHECKED BY				SMM			
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												
							○ UNCONFINED + FIELD VANE												
							● QUICK TRIAXIAL × REMOULDED												
							20 40 60 80 100			10 20 30									
96.3	GROUND SURFACE																		
0.0	ASPHALT (150 mm)																		
0.2	Gravelly silty sand, trace to some clay, trace rootlets, trace silty clay pockets (FILL) Compact to dense Brown Moist		1	AS	-		96												
			2	SS	28		95												
	- Asphalt fragments from a depth of about 1.7 m to 1.8 m		3	SS	30		94							21 52 21 6					
93.6	- Clayey silt pocket/zone, trace asphalt at a depth of about 2.5 m to 2.7 m		4A	SS	22		94												
2.7	Silt and sand, trace clay (FILL) Loose to dense Brown Moist - Wet at a depth of about 3.4 m		4B				93												
			4C				93												
			5	SS	7		92							0 37 60 3					
			6	SS	18		91												
			7	SS	32		90												
90.7	CLAYEY SILT, trace sand, trace gravel Stiff Grey Moist to wet						89												
5.6			8	SS	9		88												
89.1	CLAYEY SILT with SAND to some sand, trace to some gravel (TILL) Stiff to hard Grey Moist to wet						87							11 32 42 15					
7.2			9	SS	13		86												
			10A	SS	47		85												
			10B				84							3 75 15 7					
84.6	SAND, trace to some silt, trace to some clay, trace to some gravel Very dense Grey Moist to wet						83												
11.7			11	SS	50		82												
	- Clayey silt lens from a depth of about 14 m to 14.1 m		12	SS	77														
			13	SS	79														

Continued Next Page

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

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

PROJECT: 1662333

## RECORD OF DRILLHOLE: PED-01

SHEET 1 OF 1

LOCATION: N 4824314.1 ; E 295977.3

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Aardvark Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0,25 m	DISCONTINUITY DATA						ROCK STRENGTH INDEX		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
						TOTAL CORE %	SOLID CORE %			B Angle 0 to 90	DIP w.r.t. CORE AXIS 0 to 90	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4	R3	R2	R1	W1	W2	W3				W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
		Continued from Borehole PED-01		73.99																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							</

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: FC

CHECKED: JC

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PROJECT		1662333		RECORD OF BOREHOLE No NW3-1				SHEET 2 OF 2		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4824275.8; E 295959.8 MTM NAD 83 ZONE 10 (LAT. 43.558358; LONG. -79.609422)				ORIGINATED BY		JL					
DIST		Central		HWY		QEW		BOREHOLE TYPE		CME 850, 210 mm O.D. Hollow Stem Augers				COMPILED BY		MPL	
DATUM		Geodetic		DATE		October 16-17, 2017				CHECKED BY		SMM					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---																
81.1			3	RC	REC 97%												RQD = 97%
15.4	END OF BOREHOLE  NOTES:  1. Water level measured at a depth of about 4.5 m below ground surface (Elev. 92.0 m) prior to start of rock coring.  2. Water level measured at top of casing (Elev. 96.9 m) following completion of bedrock coring.																

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SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Aardvark Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

LOGGED: JL

CHECKED: JC

DATA\GINT\QEW-CREDIT RIVER\02 DATA\GINT\QEW-CREDIT RIVER.GPJ GAL-MISS.GDT 19-5-15





PROJECT		1662333		RECORD OF BOREHOLE No NW3-2				SHEET 1 OF 1		METRIC			
G.W.P.		2002-13-00		LOCATION				N 4824342.4; E 295994.3 MTM NAD 83 ZONE 10 (LAT. 43.558958; LONG. -79.608996)		ORIGINATED BY		FC	
DIST		Central HWY QEW		BOREHOLE TYPE				CME 55, 203 mm O.D. Hollow Stem Augers		COMPILED BY		KN	
DATUM		Geodetic		DATE				August 23, 2017		CHECKED BY		MWK	
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					
95.3	GROUND SURFACE							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
0.0	ASPHALT (150 mm)							20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>		
0.2	Silty sand, some gravel to gravelly, trace to some clay (FILL) Compact Brown Moist		1	AS	-			20 40 60 80 100	○ UNCONFINED	+	FIELD VANE		
			2	SS	28			20 40 60 80 100	● QUICK TRIAXIAL	×	REMOULDED		
	- Asphalt fragments at a depth of about 1.8 m		3	SS	26								
92.7			4A	SS	14								
2.6	Sandy clayey silt, trace to some gravel (FILL) Stiff to very stiff Brown to grey, mottled Moist		4B	SS	14								
			5	SS	29								
91.6			6	SS	34								
3.7	Sand and gravel, some silt, trace clay (FILL) Dense Grey to brown Moist to wet - Trace asphalt fragments at a depth of about 4.0 m												
90.0			7	SS	2								
5.3	Silty sand, trace clay, trace gravel, trace organics, trace asphalt fragments (FILL) Very loose Brown Moist to wet												
			8	SS	12								
87.5	- 100 mm silty sand, organic layer and pieces of wood at a depth of 7.6 m												
7.8	CLAYEY SILT with SAND, some gravel (TILL) Stiff to hard Grey Moist to wet - Trace organics at a depth of about 8.5 m												
			9	SS	131/0.06								
			10	SS	100/0.13								
83.0			11	SS	100/0.13								
12.3	END OF BOREHOLE												
NOTE: 1. Borehole dry prior to tricone drilling below a depth of 3.4 m and introduction of wash water.													

PROJECT 1662333		RECORD OF BOREHOLE No NW3-3				SHEET 1 OF 1		METRIC									
G.W.P. 2002-13-00		LOCATION N 4824329.2; E 296002.3 MTM NAD 83 ZONE 10 (LAT. 43.558840; LONG. -79.608895)				ORIGINATED BY ACM											
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 114 mm I.D., Hollow Stem Augers				COMPILED BY SK											
DATUM Geodetic		DATE August 9, 2018				CHECKED BY SMM											
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									
90.6	GROUND SURFACE							20	40	60	80	100					
0.0	Silty sand, some gravel, trace to some clay, trace organics (FILL) Very loose Dark brown Moist to wet below 0.7 m depth - Hydrocarbon odour at 0.8 m depth		1	SS	4												
			2	SS	4												
89.1																	
1.5	CLAYEY SILT with SAND, trace to some gravel (TILL) Soft to stiff Grey-brown to grey at 3.7 m depth with oxidation staining Moist		3	SS	4												
			4	SS	15												
87.2																	
3.4	SILT and SAND, some gravel, trace to some clay (TILL) Compact to very dense Grey Moist - Auger grinding from 3.4 m to 3.8 m depth		5	SS	22												
			6	SS	47												
			7	SS	100/0.28												
			8	SS	50/0.08												
			9A	SS	50/0.13												
			9B														
			10	SS	50/0.08												
			11	SS	100/0.28												
82.5																	
8.1	END OF BOREHOLE																
	NOTES:  1. Open borehole dry upon completion of drilling.																

PROJECT 1662333		RECORD OF BOREHOLE No NW3-4				SHEET 1 OF 1		METRIC									
G.W.P. 2002-13-00		LOCATION N 4824393.1; E 296043.3 MTM NAD 83 ZONE 10 (LAT. 43.559415; LONG. -79.608389)				ORIGINATED BY ACM											
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 114 mm I.D., Hollow Stem Augers				COMPILED BY CC											
DATUM Geodetic		DATE July 26, 2018				CHECKED BY SMM											
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 (%)
94.6	GROUND SURFACE																
0.0	Sandy silt to silt and sand, trace clay (FILL)		1	SS	5												
93.9	Loose to compact Brown Moist		2	SS	6												0 22 74 4
0.7	- Organic and wood fragments present from 0.0 m to 0.6 m depth																
	Sandy SILT, trace clay		3	SS	7												
92.4	Loose Brown Moist																
2.2	SILT and SAND, trace clay		4	SS	22												0 37 61 2
	Compact to dense Brown Moist		5	SS	21												
			6	SS	39												0 57 40 3
			7	SS	43												
89.0	SILT, trace to some clay, trace sand																
5.6	Dense Grey Moist	8	SS	46												0 5 88 7	
87.4	Sandy CLAYEY SILT, some gravel, (TILL)																
7.2	Hard Grey Moist	9	SS	50/0.08												18 26 39 17	
86.4																	
8.2	END OF BOREHOLE																
NOTES:																	
1. Borehole caved to a depth of 6.7 m below ground surface upon removal of hollow stem augers.																	
2. Water level measured at a depth of 6.6 m below ground surface (Elev. 88.0 m) after removal of augers and borehole caved.																	

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PROJECT 1662333		RECORD OF BOREHOLE No NW3-5				SHEET 1 OF 1		METRIC									
G.W.P. 2002-13-00		LOCATION N 4824451.6; E 296072.3 MTM NAD 83 ZONE 10 (LAT. 43.559942; LONG. -79.608030)				ORIGINATED BY ACM											
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 114 mm I.D., Hollow Stem Augers				COMPILED BY CC											
DATUM Geodetic		DATE July 26, 2018				CHECKED BY SMM											
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									
95.6	GROUND SURFACE							20	40	60	80	100					
0.0	Silty sand, rootlets to 0.6 m (FILL) Loose to dense Brown Moist to wet		1	SS	6												
94.9																	
0.7	Silty SAND, trace clay Compact to dense Brown Wet		2	SS	26												
			3	SS	41												
			4	SS	40												
92.1			5	SS	45												
3.5	SILT, trace to some sand, trace to some clay Compact to dense Grey Moist																
			6	SS	43												
			7	SS	27												
89.0			8A	SS	23												
6.6	Sandy CLAYEY SILT, trace to some gravel (TILL) Hard Grey Moist																
			9A	SS	100/0.23												
87.4			9B														
8.2	END OF BOREHOLE SPLIT-SPOON REFUSAL																
	NOTES:  1. Borehole caved to a depth of 3.7 m below ground surface upon removal of hollow stem augers.  2. Water level measured at a depth of 3.6 m below ground surface (Elev. 92.0 m) after removal of augers and borehole caved.																

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

PROJECT		1662333		<b>RECORD OF BOREHOLE No NW3-2A</b>				SHEET 2 OF 3		<b>METRIC</b>							
G.W.P.		2002-13-00		LOCATION		N 4824344.2; E 295993.8 MTM NAD 83 ZONE 10 (LAT. 43.558975; LONG. -79.609002)				ORIGINATED BY		FC					
DIST		Central HWY QEW		BOREHOLE TYPE		CME 850, 156 mm Tricone with Drilling Mud				COMPILED BY		KN					
DATUM		Geodetic		DATE		November 17, 20, 21, 2017				CHECKED BY		MWK					
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									
--- CONTINUED FROM PREVIOUS PAGE ---								20	40	60	80	100					
	CLAYEY SILT with SAND, some gravel (TILL) Hard Grey Moist to wet		5	SS	72												18 64 14 4
			6	SS	85												
77.5																	
17.8	Gravelly CLAYEY SILT with SAND (TILL) Hard Grey Wet		7	SS	97												26 57 14 3
75.0			8	SS	73												
20.3	Silty SAND, trace to some clay, trace gravel Grey Moist to wet																
73.7			9A	SS	46												1 70 24 5
21.6	SILT, some sand, trace clay Dense Grey Wet		9B	SS	46												
73.1			10A	SS	100/0.18												
22.2	- Clayey silt pocket at a depth of about 21.9 m SAND and GRAVEL, trace to some silt, trace clay Very dense Grey Moist to wet		10B	SS	100/0.18												
			11	SS	70												
			12	SS	100/0.28												
			13	SS	100/0.28												37 44 16 3
67.7																	
27.6	END OF BOREHOLE		14	SS	100/0.05												
NOTES:																	
1. Water level measured at a depth of about 3.5 m below ground surface (Elev. 91.8 m) on November 20, 2017 before start of drilling when the borehole was at a depth of about 15.1 m below ground surface.																	

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

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



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

PROJECT		1662333		RECORD OF BOREHOLE		No NRW3-2		SHEET 1 OF 1		METRIC			
G.W.P.		2002-13-00		LOCATION		N 4824543.1; E 296122.0 MTM NAD 83 ZONE 10 (LAT. 43.560766; LONG. -79.607417)		ORIGINATED BY		CC			
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 85 mm I.D., 190 mm O.D., Hollow Stem Augers		COMPILED BY		ACM			
DATUM		Geodetic		DATE		June 25 & 26, 2018		CHECKED BY		SMM			
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)		
96.1	GROUND SURFACE												
0.0	ASPHALT (130 mm)												
0.3	Sand and gravel (FILL) Brown Moist		1A	SS	14								
	SILT and SAND, trace clay Compact Brown Moist to wet		1B										
			2	SS	26								
			3	SS	27								
			4	SS	20								
93.1													
3.0	SILT, trace to some sand, trace to some clay Compact to dense Brown to grey below 3.2 m depth Moist to wet		5	SS	29								
			6	SS	37								
			7	SS	25								
	-150 mm wet silt seam encountered at 5.0 m depth												
			8	SS	27								
88.9													
7.2	Sandy CLAYEY SILT, trace to some gravel (TILL) Hard Grey Moist - Augers grinding from 7.6 m to 7.9 m depth - Full weight of drilling rig used to advance augers from 8.2 m to 8.8 m depth		9	SS	32								
			10	SS	100/0.23								
85.2													
10.9	END OF BOREHOLE		11	SS	100/0.23								
NOTES:													
1. Water level measured at a depth of about 6.4 m below ground surface upon completion of well install. Note that water was added to the borehole during drilling.													
2. Groundwater level measurements in piezometer:													
	Date	Depth (m)	Elev. (m)										
	14/08/18	4.0	92.1										
	06/11/18	4.0	92.1										



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

PROJECT		1662333		RECORD OF BOREHOLE		No NRW-4		SHEET 1 OF 1		METRIC						
G.W.P.		2002-13-00		LOCATION		N 4824617.2; E 296165.4 MTM NAD 83 ZONE 10 (LAT. 43.561433; LONG. -79.606882)		ORIGINATED BY		ACM						
DIST		Central HWY QEW		BOREHOLE TYPE		CME 55, 108 mm I.D., Hollow Stem Augers		COMPILED BY		CC						
DATUM		Geodetic		DATE		June 22, 2018		CHECKED BY		SMM						
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								
94.6	GROUND SURFACE															
0.0	ASPHALT (150 mm)															
0.2	Sand and gravel (FILL)															
93.8	Compact Brown Moist		1	SS	20											
0.8	Silty SAND, trace clay		2	SS	9											
	Loose Brown Wet		3	SS	10											
			4	SS	10											
91.3	- Oxidation staining at approximately 3.2 m to 3.3 m depth		5A	SS	18											
3.3	SILT and SAND, some gravel, some clay, Compact Grey Wet		6A	SS	12											
90.4	Sandy CLAYEY SILT, trace to some gravel (TILL) Stiff to hard Grey Moist		7	SS	11											
4.2			8	SS	38											
87.4	SILT and SAND, some gravel, trace to some clay, shale fragments (TILL) Very dense Grey Moist		9	SS	96											
7.2			10	SS	89											
83.9	SHALE (BEDROCK) Grey Inferred completely to moderately weathered		11A	SS	50/0.08											
10.7			11B													
83.1	END OF BOREHOLE SPLIT-SPOON REFUSAL		12	SS	50/0.08											
11.5	NOTES: 1. Water level measured at a depth of about 1.4 m below ground surface (Elev. 93.2 m) upon completion of soil drilling.															



PROJECT		1662333		<b>RECORD OF BOREHOLE No NRW3-5</b>				SHEET 1 OF 1		<b>METRIC</b>						
G.W.P.		2002-13-00		LOCATION		N 4824661.4; E 296190.9 MTM NAD 83 ZONE 10 (LAT. 43.561832; LONG. -79.606567)				ORIGINATED BY		ACM				
DIST		Central HWY QEW		BOREHOLE TYPE		CME 55, 50 mm I.D., Hollow Stem Augers				COMPILED BY		CC				
DATUM		Geodetic		DATE		June 25, 2018				CHECKED BY		SMM				
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
93.7	GROUND SURFACE						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
0.0	ASPHALT (150 mm)						20	40	60	80	100					
0.2	Silty sand to sand, some gravel (FILL) Loose to compact Brown Moist		1	SS	7											
			2A	SS												
			2B	SS	13											
92.2																
1.5	SILT and SAND, trace clay Compact Grey Moist to wet		3A	SS	19											
			3B													
			4	SS	30											
90.7																
3.0	CLAYEY SILT with SAND, some gravel to CLAYEY SILT with GRAVEL (TILL) Stiff to hard Grey Moist		5	SS	13											
			6	SS	18											
			7	SS	65											
	- Auger grinding from 5.2 m to 6.1 m and from 8.2 m to 9.1 m depth															
			8	SS	60/0.13											
			9	SS	46											
85.0																
8.7	Silty Gravelly SAND, trace clay (TILL) Very dense Grey Moist to wet below 10.7 m depth		10	SS	50/0.08											
			11	SS	50/0.13											
82.2																
11.5	END OF BOREHOLE		12	SS	50/0.08											
	NOTES:  1. Borehole caved to a depth of 1.5 m below ground surface upon removal of hollow-stem augers.  2. Water level measured at a depth of about 1.5 m below ground surface (Elev. 92.2 m) after removal of augers and borehole caved.															

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PROJECT		1662333		RECORD OF BOREHOLE		No NRW3-6		SHEET 1 OF 1		METRIC						
G.W.P.		2002-13-00		LOCATION		N 4824701.8; E 296220.4 MTM NAD 83 ZONE 10 (LAT. 43.562195; LONG. -79.606203)		ORIGINATED BY		CC						
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 85 mm I.D., 190 mm O.D., Hollow Stem Augers		COMPILED BY		ACM						
DATUM		Geodetic		DATE		June 22, 2018		CHECKED BY		SMM						
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								
92.9	GROUND SURFACE															
0.0	Sandy silt, some gravel, rootlets, trace organics (FILL) Compact Brown		1	SS	10											
92.2	Dry		2	SS	4											
0.7	Silt and sand, trace clay, trace rootlets (FILL) Very Loose		3	SS	2											
	Brown, grey below 2.2 m depth Moist to wet below 2.3 m depth		4	SS	WH											
			5A	SS	WH											
89.3	CLAYEY SILT with SAND, trace to some gravel (TILL) Soft		5B													
3.6	Brown to grey with oxidation staining Moist		6	SS	4											
88.4	Silty SAND, some gravel, trace to some clay (TILL) Dense		7	SS	32											
4.5	Grey Wet															
87.3	- Augers grinding from 5.2 m to 7.6 m															
5.6	CLAYEY SILT, some sand, some shale fragments (RESIDUAL SOIL) Grey Wet		8A	SS	100/0.20											
86.7	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		8B													
6.2	SHALE (BEDROCK) Grey		1	RC	REC											
85.4	Bedrock cored from a depth of 7.5 m to 11.4 m For bedrock coring details, refer to Record of Drillhole NRW3-6		2	RC	REC 94%											
7.5			3	RC	REC 96%											
			4	RC	REC 100%											
81.5	END OF BOREHOLE															
11.4	NOTES:  1. Borehole caved to a depth of 6.7 m below ground surface upon completion of soil drilling prior to rock coring.  2. Water level measured at a depth of about 5.2 m below ground surface (Elev. 87.7 m) prior to rock coring.															

PROJECT: 1662333

## RECORD OF DRILLHOLE: NRW3-6

SHEET 1 OF 1

LOCATION: N 4824701.8 ; E 296220.4

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Davis Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0,25 m	DISCONTINUITY DATA					ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
						TOTAL CORE %	SOLID CORE %			B Angle °	DIP w.r.t. CORE AXIS °	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4	R3	R2	R1	W1	W2	W3				W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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		Continued from Borehole NRW3-6		85.39																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED:

CHECKED:

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PROJECT 1662333		RECORD OF BOREHOLE No NRW3-7					SHEET 1 OF 1		METRIC			
G.W.P. 2002-13-00		LOCATION N 4824750.8; E 296231.3 MTM NAD 83 ZONE 10 (LAT. 43.562637; LONG. -79.606068)					ORIGINATED BY CC					
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 85 mm I.D., 190 mm O.D., Hollow Stem Augers					COMPILED BY ACM					
DATUM Geodetic		DATE June 22, 2018					CHECKED BY SMM					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
93.9	GROUND SURFACE											
0.0	ASPHALT (170 mm)											
0.3	Sand and gravel (FILL) Brown Moist Silty SAND, trace clay Compact Brown with oxidation staining Moist		1A	SS	19		93					0 74 24 2
			1B	SS	26							
			2	SS	26							
			3A	SS	17		92					
			3B									
92.0	Sandy CLAYEY SILT, trace gravel (TILL) Firm to stiff Brown to grey Moist		4	SS	10		91					4 27 49 20
1.9			5	SS	8							
90.2			6	SS	19		90					45 15 31 9
3.7	CLAYEY SILT with GRAVEL, some sand, some shale fragments (RESIDUAL SOIL) Very stiff to hard Grey Moist		7	SS	100/0.18		89					
89.4	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation) - Augers grinding at 4.9 m and 5.5 m		8	SS	100/0.15		88					
4.5	SHALE (BEDROCK) Grey Moderately weathered to 7.8 m depth to slightly weathered to fresh below 7.8 m depth		9	SS	100/0.13		87					
88.3	Bedrock cored from a depth of 7.6 m to 11.7 m		1	RC	REC 99%		86					RQD = 0%
5.6	For bedrock coring details, refer to Record of Drillhole NRW3-7 - Augers grinding at 6.4 m and 6.7 m		2	RC	REC 99%		85					RQD = 90%
			3	RC	REC 100%		84					RQD = 92%
			4	RC	REC 100%		83					RQD = 97%
82.2	END OF BOREHOLE											
11.7	NOTES:  1. Borehole caved to a depth of 7.0 m below ground surface upon completion of soil drilling.  2. Open borehole was dry upon completion of soil drilling.											

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LOCATION: N 4824750.8 ;E 296231.3

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90°      AZIMUTH: --

DRILL RIG: CME 75

DRILLING CONTRACTOR: Davis Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

LOGGED:

CHECKED:

PROJECT		1662333		RECORD OF BOREHOLE		No NRW3-8		SHEET 1 OF 1		METRIC						
G.W.P.		2002-13-00		LOCATION		N 4824804.5; E 296260.3 MTM NAD 83 ZONE 10 (LAT. 43.563121; LONG. -79.605711)		ORIGINATED BY		ACM						
DIST		Central HWY QEW		BOREHOLE TYPE		CME 55, 114 mm I.D., Hollow Stem Augers		COMPILED BY		SK						
DATUM		Geodetic		DATE		August 3, 2018		CHECKED BY		SMM						
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								
96.0	GROUND SURFACE															
95.9	TOPSOIL (50 mm)		1	SS	7											
95.3	Silty sand, trace clay (FILL) Loose to compact Brown with oxidation staining Moist		2	SS	17											
94.0	Silty SAND, trace clay Compact Brown with oxidation staining Wet		3A 3B	SS	24											
94.0	Sandy CLAYEY SILT, trace to some gravel (TILL) Firm to stiff Grey Moist to wet at a depth of 4.3 m		4	SS	10											
			5	SS	10											
			6	SS	7											
			7	SS	5											
90.4	SHALE (BEDROCK) Grey Slightly weathered		8	SS	50/0.10											
90.4	Bedrock cored from a depth of 6.7 m to 10.5 m		9	SS	50/0.08											
	For bedrock coring details, refer to Record of Drillhole NRW3-8		1	RC	REC 100%											
			2	RC	REC 100%											
			3	RC	REC 91%											
85.5	END OF BOREHOLE															
10.5	NOTES:  1. Water level measured at a depth of about 4.3 m below ground surface (Elev. 91.7 m) upon completion of soil drilling.															

PROJECT: 1662333

LOCATION: N 4824804.5 ; E 296260.3

INCLINATION: -90° AZIMUTH: —

## RECORD OF DRILLHOLE: NRW3-8

SHEET 1 OF 1

DRILLING DATE:

DRILL RIG: CME 55

DRILLING CONTRACTOR: Davis Drilling

DATUM: Geodetic

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																		FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																				
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA				ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																													
						TOTAL CORE %	SOLID CORE %			B Angle DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4 R3 R2 R1	W1 W2 W3 W4 W5 W6																																																																																																																																																																																																																																															
7	HQ Core	Continued from Borehole NRW3-8		89.22 6.73	1							BD,UN,SM CC, CI 2 4 BD,UN,RO PC, CI 3 3																																																																																																																																																																																																																																																		

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: ACM

CHECKED: AB

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PROJECT		1662333		RECORD OF BOREHOLE		No NRW3-9		SHEET 1 OF 1		METRIC						
G.W.P.		2002-13-00		LOCATION		N 4824863.0; E 296290.8 MTM NAD 83 ZONE 10 (LAT. 43.563647; LONG. -79.605333)		ORIGINATED BY		CC						
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 150 mm O.D. Solid Stem Augers		COMPILED BY		SE						
DATUM		Geodetic		DATE		July 5, 2018		CHECKED BY		SMM						
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								
98.2	GROUND SURFACE															
0.0	ASPHALT (130 mm)															
97.8	Sand and gravel (FILL)		1A	SS	37											
97.4	Dense Brown Moist		1B													
0.8	Sand (FILL)		2	SS	32											
	Dense Brown Moist															
	SILT and SAND to Silty SAND, trace to some gravel, trace to some clay		3	SS	30											0 68 29 3
	Compact to dense Brown to grey Moist to wet below 2.3 m		4	SS	29											
			5	SS	24											
			6	SS	35											
			7	SS	32											0 51 44 5
92.6	CLAYEY SILT, some sand															
5.6	Stiff Grey Wet		8A													
	- Shale fragments encountered at a depth of about 6.7 m		8B	SS	15											
91.2	SHALE (BEDROCK)															
7.0	Grey Highly weathered to 7.8 m depth to slightly weathered below 7.8 m depth		9	SS	50											RQD = 0%
	Bedrock cored from a depth of 7.7 m to 11.0 m		2	RC	REC 92%											RQD = 76%
	For bedrock coring details, refer to Record of Drillhole NRW3-9		3	RC	REC 97%											RQD = 78%
87.2	END OF BOREHOLE															
11.0	NOTES:															
	1. Borehole caved to a depth of about 2.7 m below ground surface upon completion of soil drilling.															
	2. Water level measured at a depth of about 2.7 m below ground surface (Elev. 95.5 m) upon completion of soil drilling.															
	3. Groundwater level measurements in piezometer:															
	Date	Depth (m)	Elev. (m)													
	14/08/18	2.8	95.4													
	06/11/18	2.8	95.4													



PROJECT: 1662333

## RECORD OF DRILLHOLE: NRW3-9

SHEET 1 OF 1

LOCATION: N 4824863.0 ; E 296290.8

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Davis Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL- Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA						ROCK STRENGTH INDEX		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
						TOTAL CORE %	SOLID CORE %			B Angle 0 to 90 °	DIP w.r.t. CORE AXIS 0 to 90 °	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4 R3 R2 R1	W1 W2 W3 W4 W5 W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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		Continued from Borehole NRW3-9		90.54 7.66																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			

## FEATURES LEGEND



DEPTH SCALE

1 : 50



LOGGED: CC

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\GINT\QEW-CREDIT\_RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT		1662333		RECORD OF BOREHOLE No NRW3-10				SHEET 1 OF 1		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4824868.9; E 296329.5 MTM NAD 83 ZONE 10 (LAT. 43.563709; LONG. -79.604857)				ORIGINATED BY		CC					
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 85 mm I.D., 190 mm O.D., Hollow Stem Augers				COMPILED BY		SK					
DATUM		Geodetic		DATE		July 17, 2018				CHECKED BY		SMM					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>		
96.4	GROUND SURFACE																
0.0	ASPHALT (250 mm)																
0.3	Sand and gravel, some silt, trace clay (FILL) Dense to very dense Brown Moist		1	SS	55												
95.0			2	SS	41												30 54 13 3
1.4	SILT and SAND, trace to some clay, trace gravel Very loose to compact Brown Moist to wet below 2.3 m depth		3	SS	27												
94.0			4	SS	10												
93.0			5	SS	4												4 44 44 8
92.3			6A	SS	13												
4.1	Sandy CLAYEY SILT, trace to some gravel (TILL) Stiff Grey Moist		6B														
90.9			7	SS	11												8 27 42 23
5.5	SHALE (BEDROCK) Grey Slightly weathered																
	Bedrock cored from a depth of 6.2 m to 9.5 m		8	SS	50/0.05												
			1	RC	REC 100%												RQD = 38%
	For bedrock coring details, refer to Record of Drillhole NRW3-10 - Ground conditions become harder at 5.5 m depth and below when auger to 6.1 m depth		2	RC	REC 96%												RQD = 86%
			3	RC	REC 100%												RQD = 89%
86.9	END OF BOREHOLE																
9.5	NOTES:  1. Borehole caved to a depth of 6.1 m below ground surface upon completion of soil drilling.  2. Water level measured at a depth of about 5.2 m below ground surface (Elev. 91.2 m) upon completion of soil drilling.																

DATUM: Geodetic

DRILL RIG: CME 75

DRILLING CONTRACTOR: Davis Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

LOGGED: CC

CHECKED: AB

<b>PROJECT</b> 1662333		<b>RECORD OF BOREHOLE No S2</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. 2002-13-00		LOCATION N 4824357.2; E 296001.4 MTM NAD 83 ZONE 10 (LAT. 43.559092; LONG. -79.608907)		ORIGINATED BY ACM			
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 210 mm O.D. Hollow Stem Augers		COMPILED BY JMP			
DATUM Geodetic		DATE September 13, 2018		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>		
94.9	GROUND SURFACE													
0.0	ASPHALT (150 mm)		1A	SS	16									
94.2	Sand and gravel, some silt (FILL) Brown Moist		1B	SS	16									
0.9	Sandy silt, trace organics, some wood fragments (FILL) Compact Brown Moist		2A	SS	12									
	Gravelly sand, trace silt (FILL) Grey Moist		2B	SS	12									
	Gravelly clayey silt with sand (FILL) Stiff to very stiff Grey-brown Moist		3	SS	17									
			4	SS	8									
	- Auger grinding from 1.5 m to 2.7 m		5	SS	12									
91.2	Sand, some silt, some gravel, trace clay, asphalt pieces (FILL) Compact Brown-grey, contains oxidation staining Moist		6A	SS	23									21 49 21 9
3.7			6B	SS	23									19 61 15 5
90.4	Silty sand, trace to some clay (FILL) Loose Brown to grey Wet		7	SS	3									
4.5														
89.3	Silty SAND, trace to some clay Loose Brown to grey Wet		8	SS	10									0 72 22 6
5.6														
87.8	Sandy CLAYEY SILT, some gravel to gravelly (TILL) Hard Grey Moist		9	SS	100/0.23									
7.1														
	- Auger grinding from 9.8 m to 10.1 m		10	SS	100/0.25									
	- Auger grinding from 11.0 m to 11.6 m		11	SS	100/0.08									
	- Auger grinding at 13.4 m		12	SS	100/0.41									20 29 42 9
			13	SS	100/0.25									
80.3	Silty SAND													
14.6														

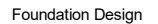
Continued Next Page

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

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
PROJECT		1662333		<b>RECORD OF BOREHOLE No S2</b>				SHEET 2 OF 2		<b>METRIC</b>							
G.W.P.		2002-13-00		LOCATION		N 4824357.2; E 296001.4 MTM NAD 83 ZONE 10 (LAT. 43.559092; LONG. -79.608907)				ORIGINATED BY							
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 210 mm O.D. Hollow Stem Augers				COMPILED BY							
DATUM		Geodetic		DATE		September 13, 2018				CHECKED BY							
SMM																	
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 ---																
	Silty SAND, some gravel, trace to some clay Very dense Grey Moist		14	SS	51												
77.5			15	SS	54												
17.4	END OF BOREHOLE																
	NOTE: 1. Borehole dry upon completion of drilling.																

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

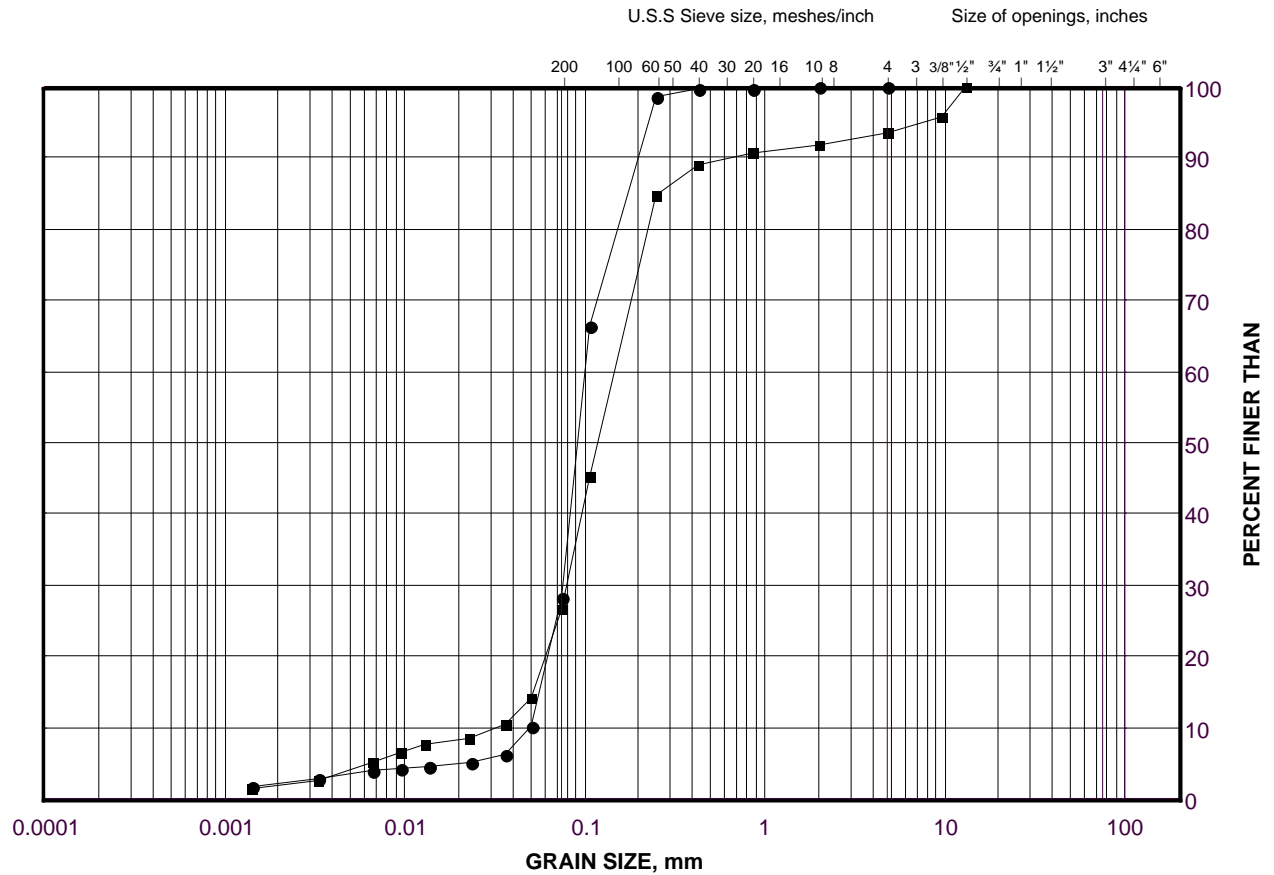
PROJECT 1662333		RECORD OF BOREHOLE No S3				SHEET 2 OF 2		METRIC									
G.W.P. 2002-13-00		LOCATION N 4824337.3; E 296021.0 MTM NAD 83 ZONE 10 (LAT. 43.558912; LONG. -79.608665)				ORIGINATED BY ACM											
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 108 mm I.D., Hollow Stem Augers				COMPILED BY JMP											
DATUM Geodetic		DATE October 9, 2018				CHECKED BY SMM											
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m³	GR SA SI CL
							20 40 60 80 100	20 40 60 80 100	Wp	W	WL	10 20 30					
	--- CONTINUED FROM PREVIOUS PAGE ---																
73.4	Gravelly SAND, trace to some silt, trace clay (TILL) Compact to dense Grey Wet		13	SS	25		74										
16.6	END OF BOREHOLE		14	SS	46												
	NOTES:  1. Water level measured at a depth of 15.9 m below ground surface (Elev. 74.1 m) upon completion of drilling.  2. Groundwater level measurements in piezometer:  Date    Depth (m)    Elev. (m) 06/11/18    0.8    89.2																

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# GRAIN SIZE DISTRIBUTION

Silty Sand (FILL)  
(Noise Barrier Wall - Line 'F')

FIGURE C-1A



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW3-1	2	95.4
■	CRB-6	2	90.7

Project Number: 1662333

Checked By: SMM

**Golder Associates**

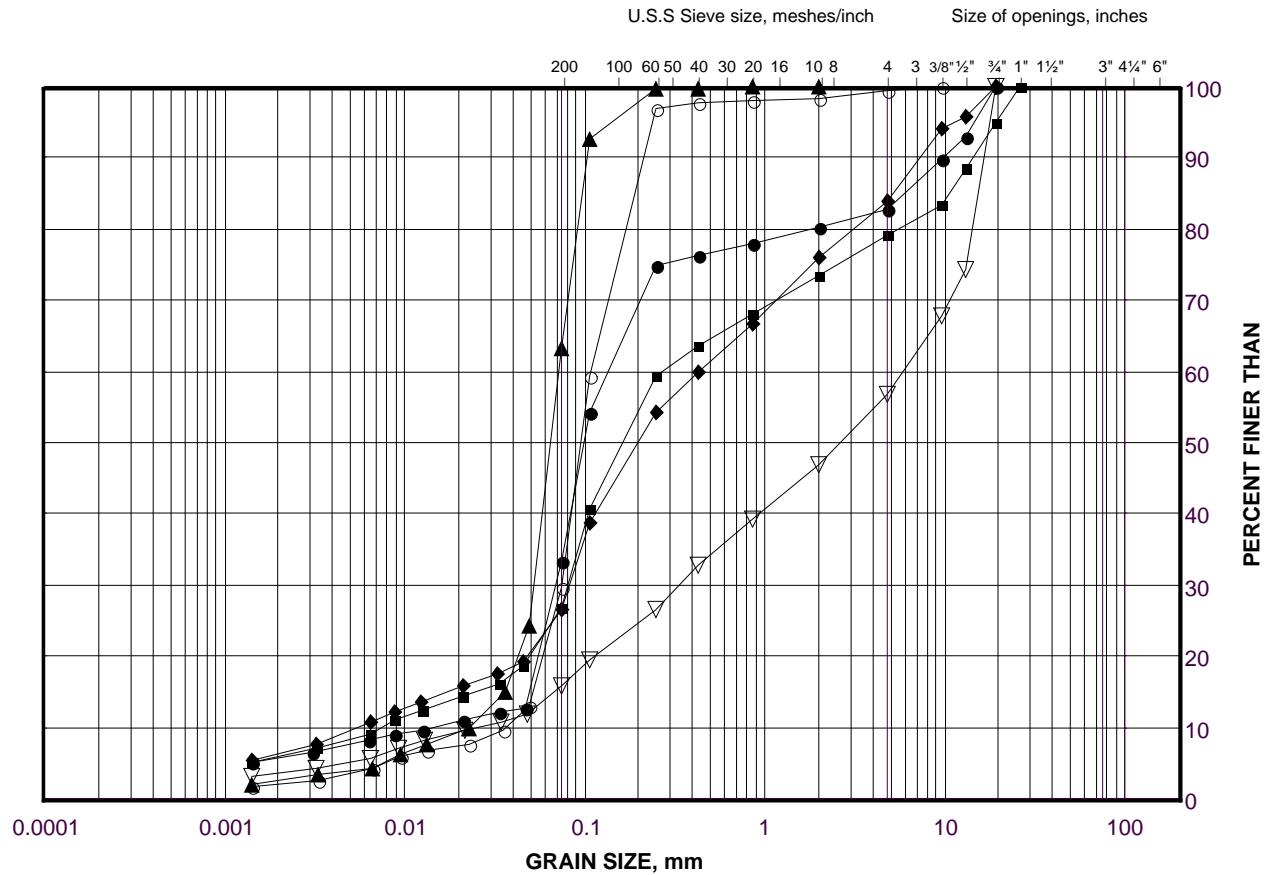
Date: 05-Apr-19



# GRAIN SIZE DISTRIBUTION

Silty Sand to Sand and Gravel (FILL)  
(Noise Barrier Wall - Line 'F')

FIGURE C-1B



## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW3-3	2	89.5
■	PED-01	3	94.5
◆	NW3-2	3	93.4
▲	PED-01	6	92.2
▽	NW3-2	6	91.2
○	NW3-2	7	88.9

Project Number: 1662333

Checked By: SMM

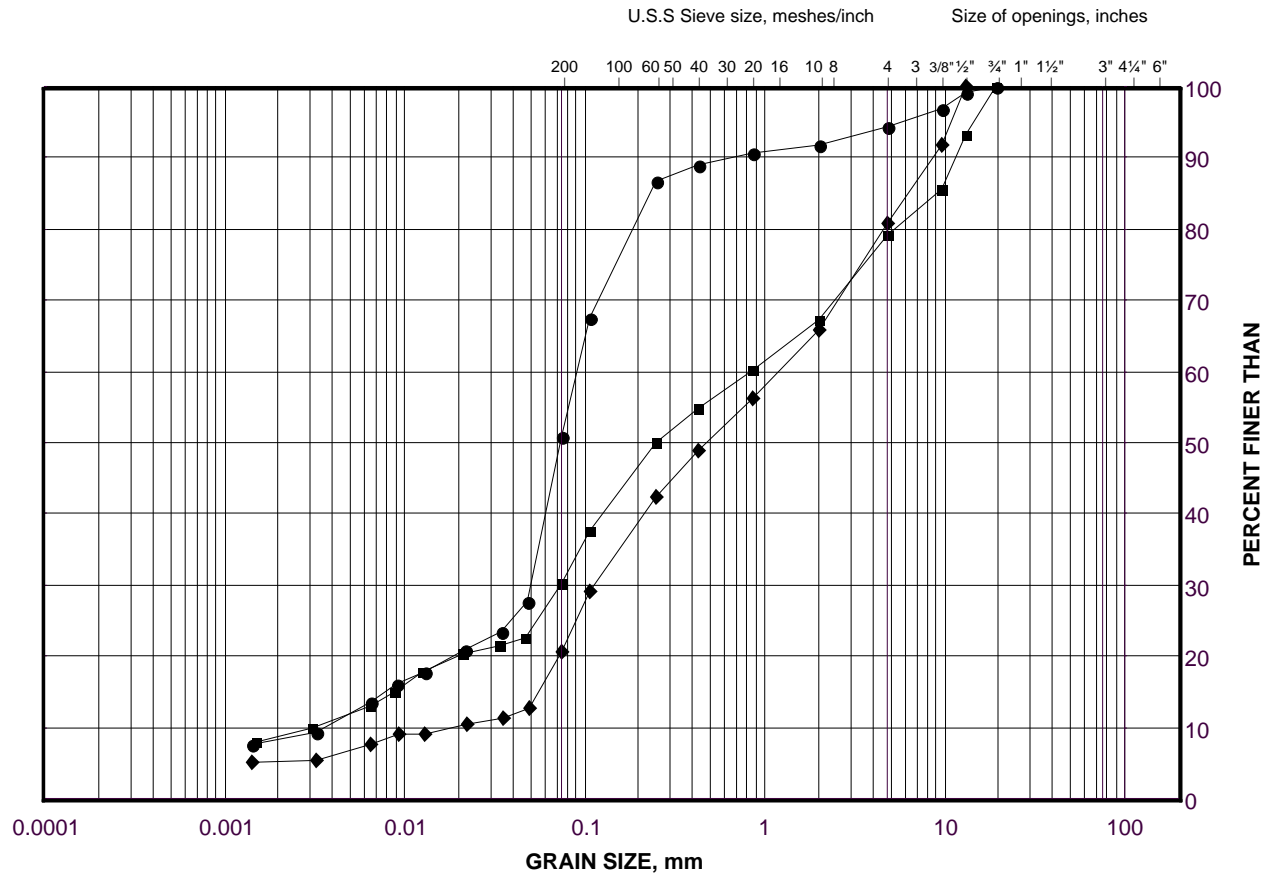
**Golder Associates**

Date: 05-Apr-19

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Gravelly Clayey Silt with Sand (FILL)  
(Noise Barrier Wall - Line 'F')

FIGURE C-1C



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	S3	3	88.2
■	S2	5	91.5
◆	S2	6A	90.8

Project Number: 1662333

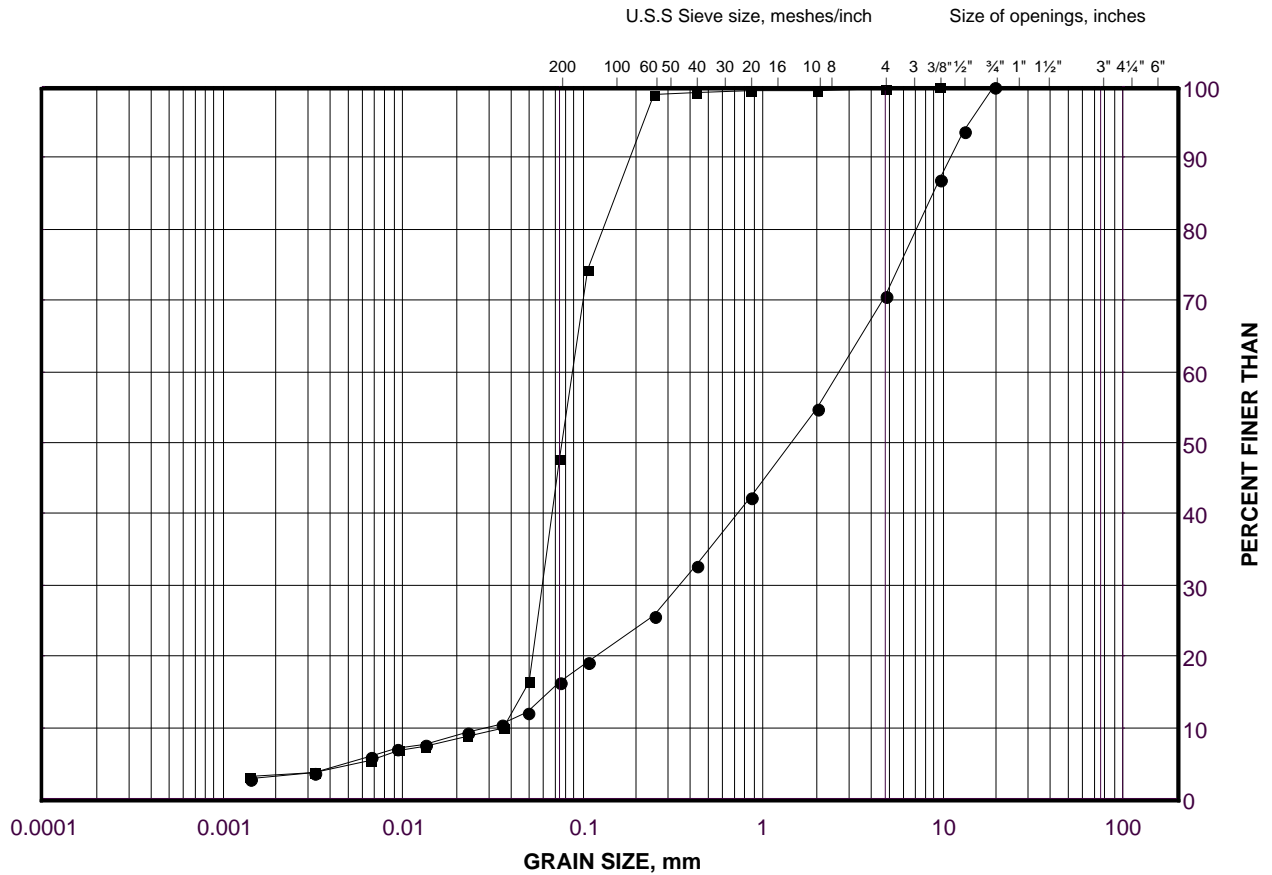
Checked By: SMM

**Golder Associates**

Date: 05-Apr-19

**GRAIN SIZE DISTRIBUTION**  
 Silt and Sand / Sand and Gravel (FILL)  
 (Noise Barrier Wall - Line 'F')  
 (Noise Barrier Wall - Line 'H')

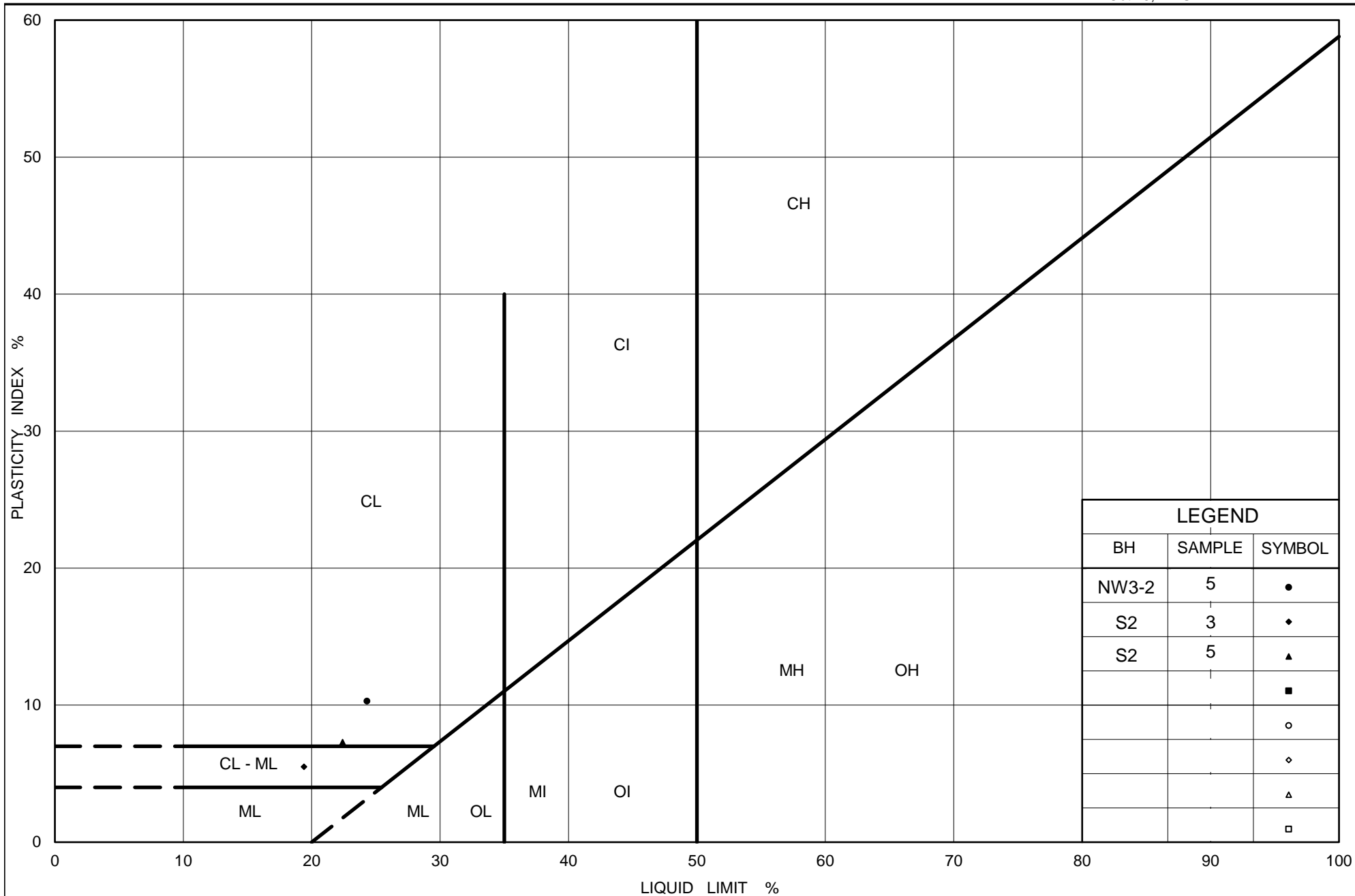
**FIGURE C-1D**



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

**LEGEND**

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW3-10	2	95.3
■	NRW3-6	4	90.3



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**PLASTICITY CHART**  
Sandy Clayey Silt (FILL)  
(Noise Barrier Wall - Line 'F')

Figure No. C-2

Project No. 1662333

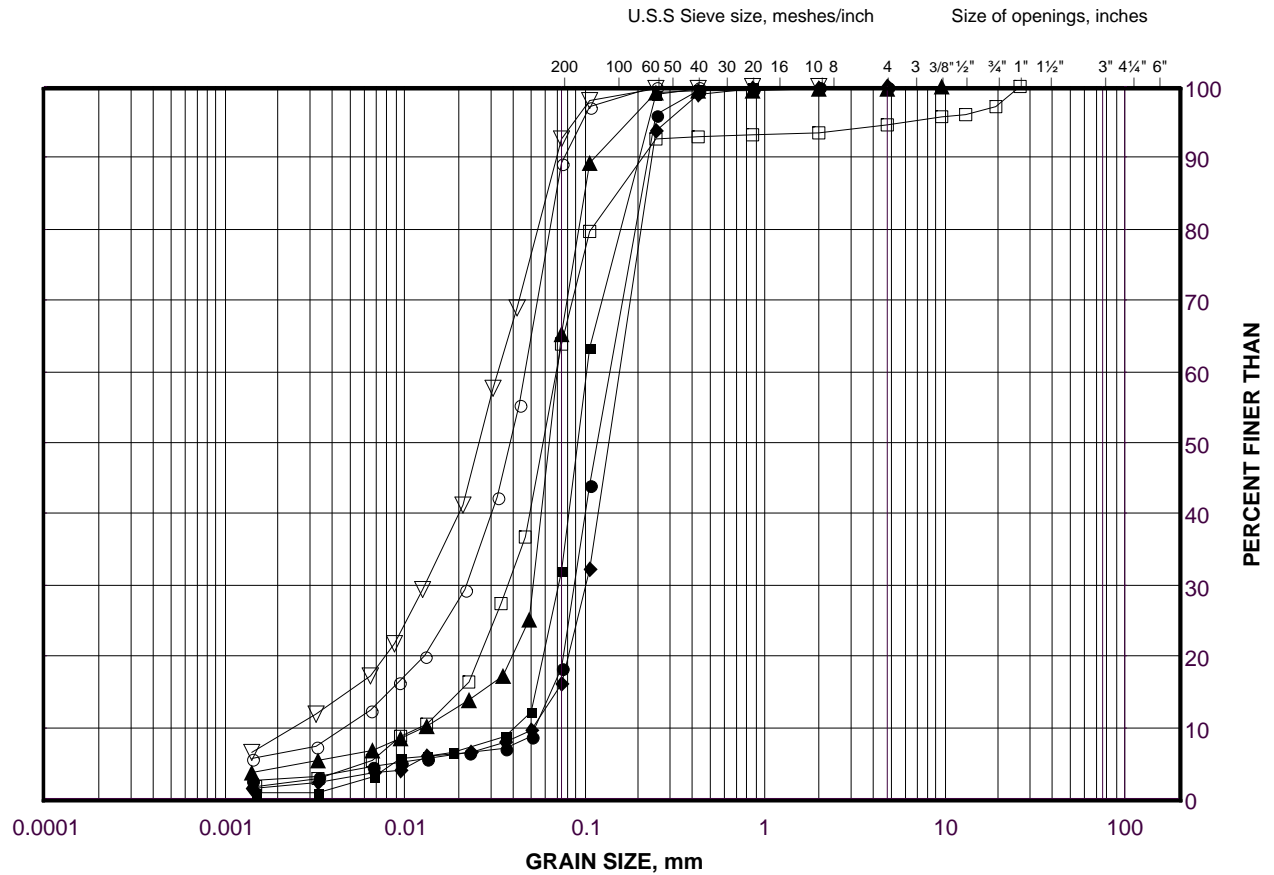
Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Silt to Silt and Sand to Sand

(Noise Barrier Wall - Line 'F')

FIGURE C-3A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	AR-1	3	93.9
■	NW3-1	4	93.9
◆	CRB-8	4	92.1
▲	AR-1	6	91.6
▽	CRB-8	7	89.8
○	AR-1	8	89.3
□	NW3-1	8	90.1

Project Number: 1662333

Checked By: SMM

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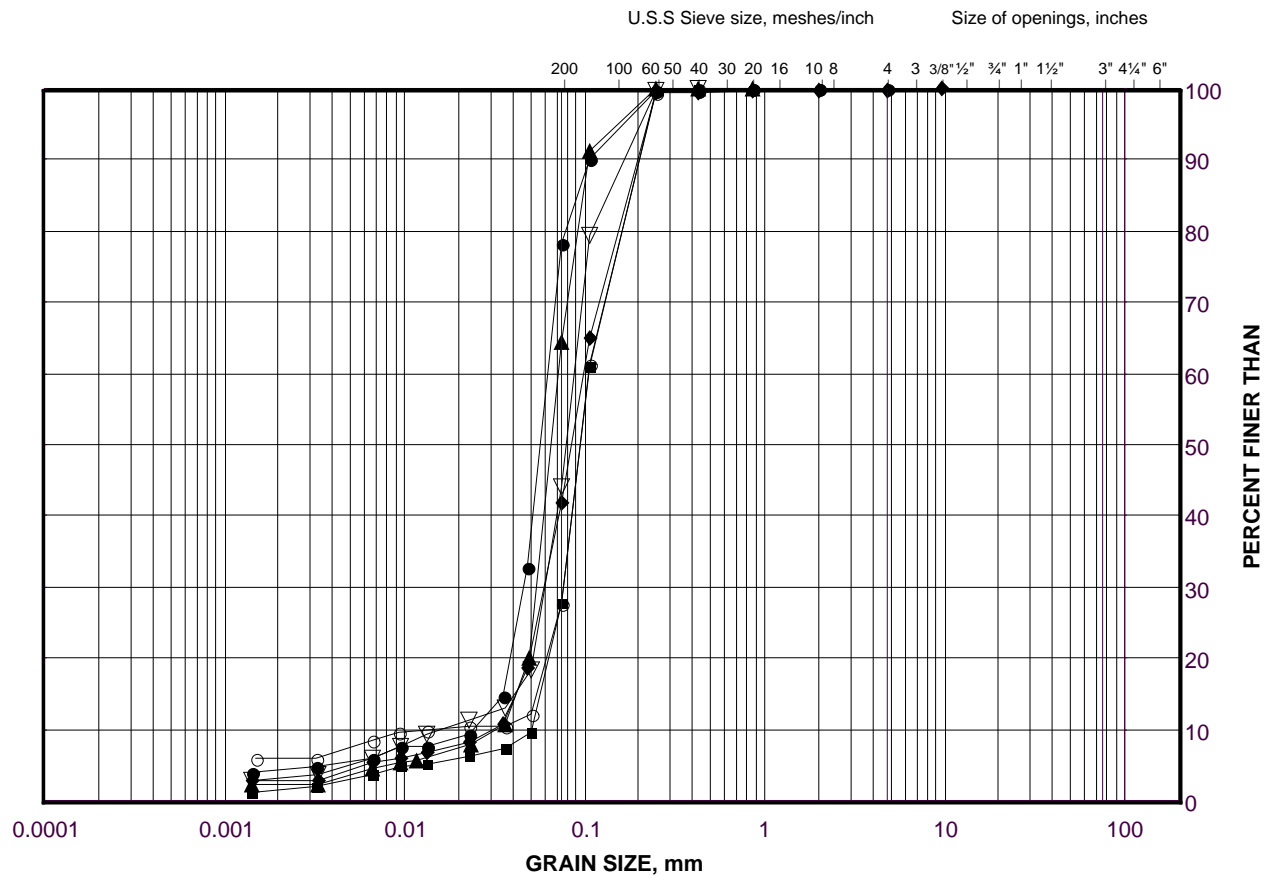
Date: 05-Apr-19

# GRAIN SIZE DISTRIBUTION

Sandy Silt to Silt and Sand

(Noise Barrier Wall - Line 'F')

FIGURE C-3B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW3-4	2	93.5
■	NW3-5	3	93.8
◆	NRW3-1	3	94.2
▲	NW3-4	4	92.0
▽	NW3-4	6	90.5
○	S2	8	88.5

Project Number: 1662333

Checked By: SMM

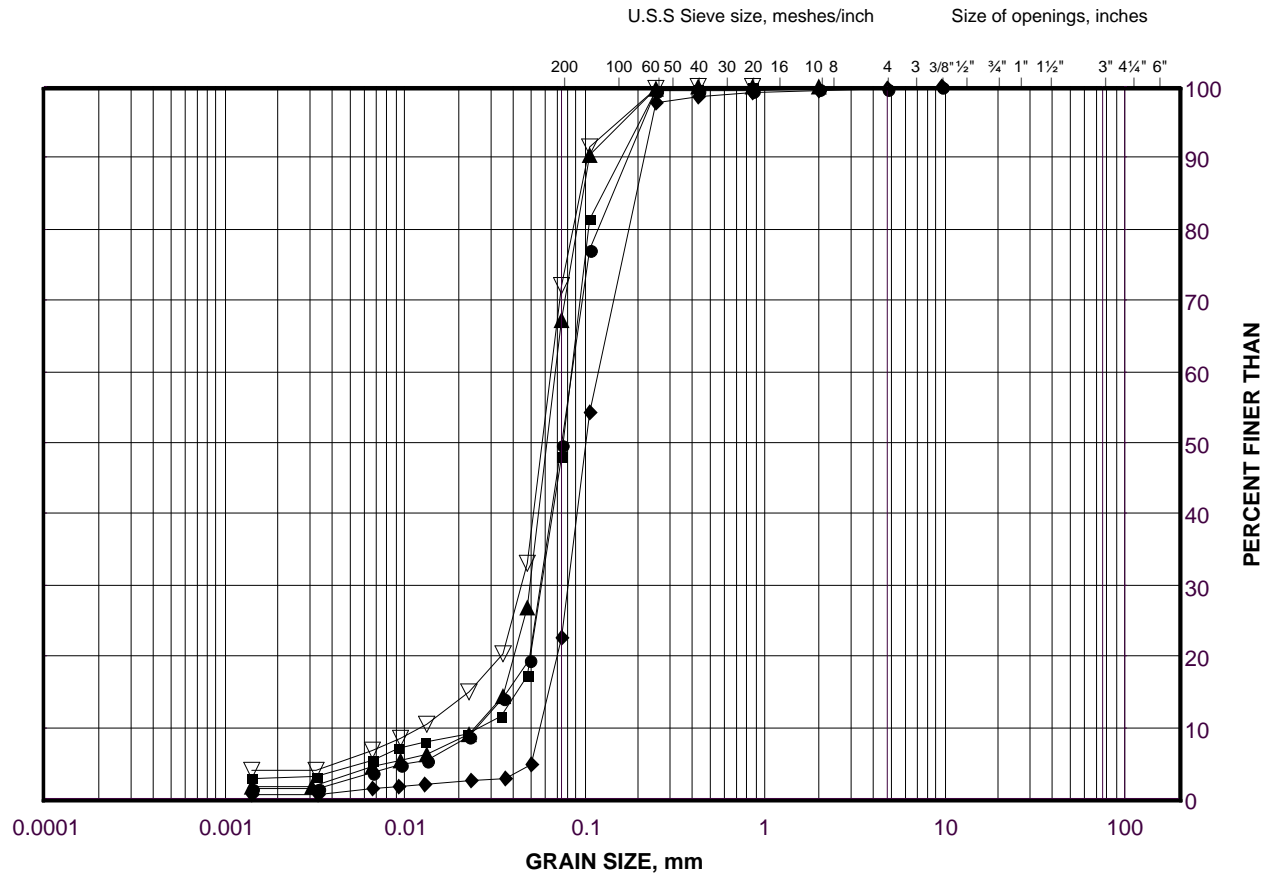
**Golder Associates**

Date: 05-Apr-19

# GRAIN SIZE DISTRIBUTION

Sandy Silt to Silt and Sand  
(Noise Barrier Wall - Line 'F')

FIGURE C-3C



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW3-2	3	94.2
■	NRW3-5	4	91.1
◆	NRW3-4	4	92.0
▲	NRW3-3	4	92.6
▽	NRW3-1	6	91.9

Project Number: 1662333

Checked By: SMM

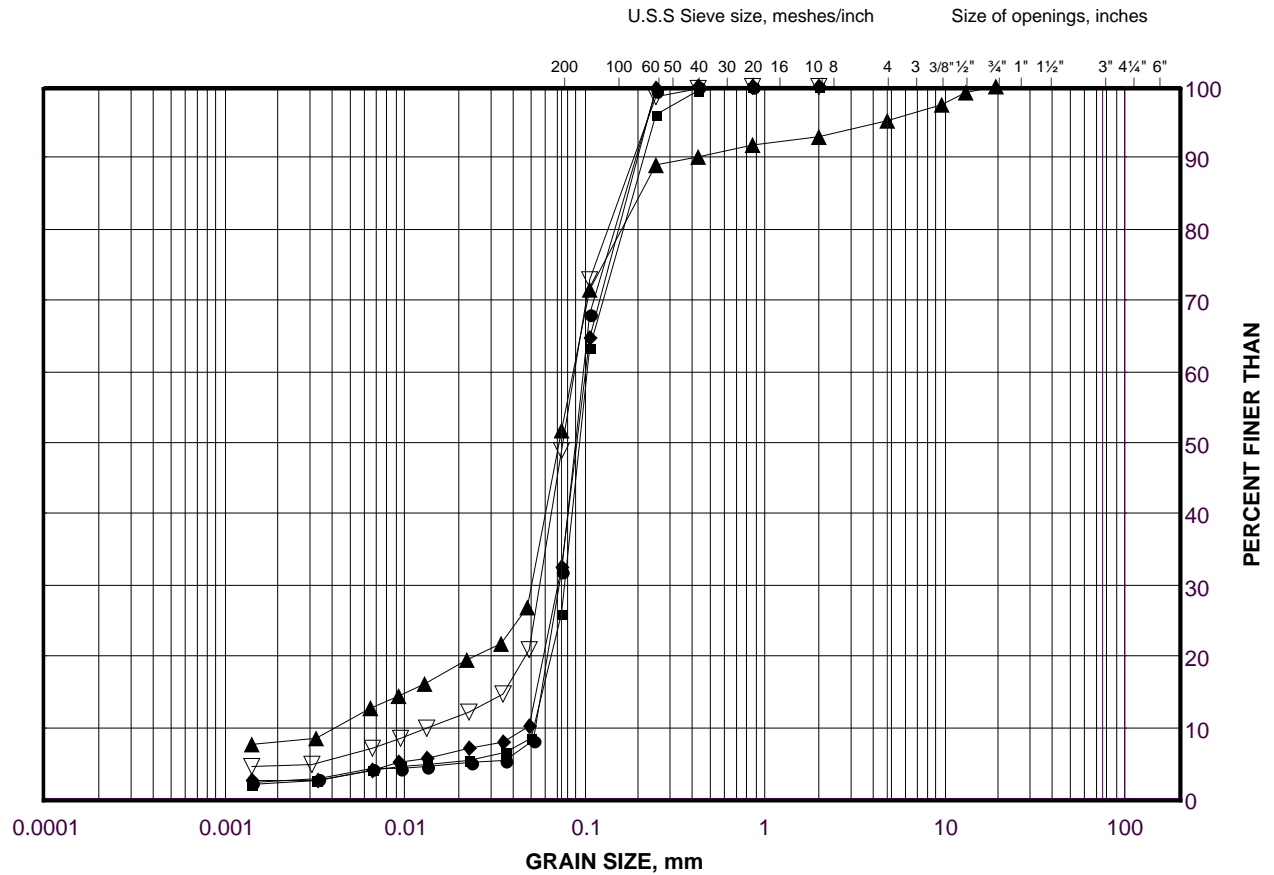
**Golder Associates**

Date: 05-Apr-19

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Silty Sand  
(Noise Barrier Wall - Line 'F')  
(Noise Barrier Wall - Line 'H')

FIGURE C-3D



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW3-8	2	94.9
■	NRW3-7	2	92.9
◆	NRW3-9	3	96.4
▲	NRW3-10	5	93.0
▽	NRW3-9	7	93.3

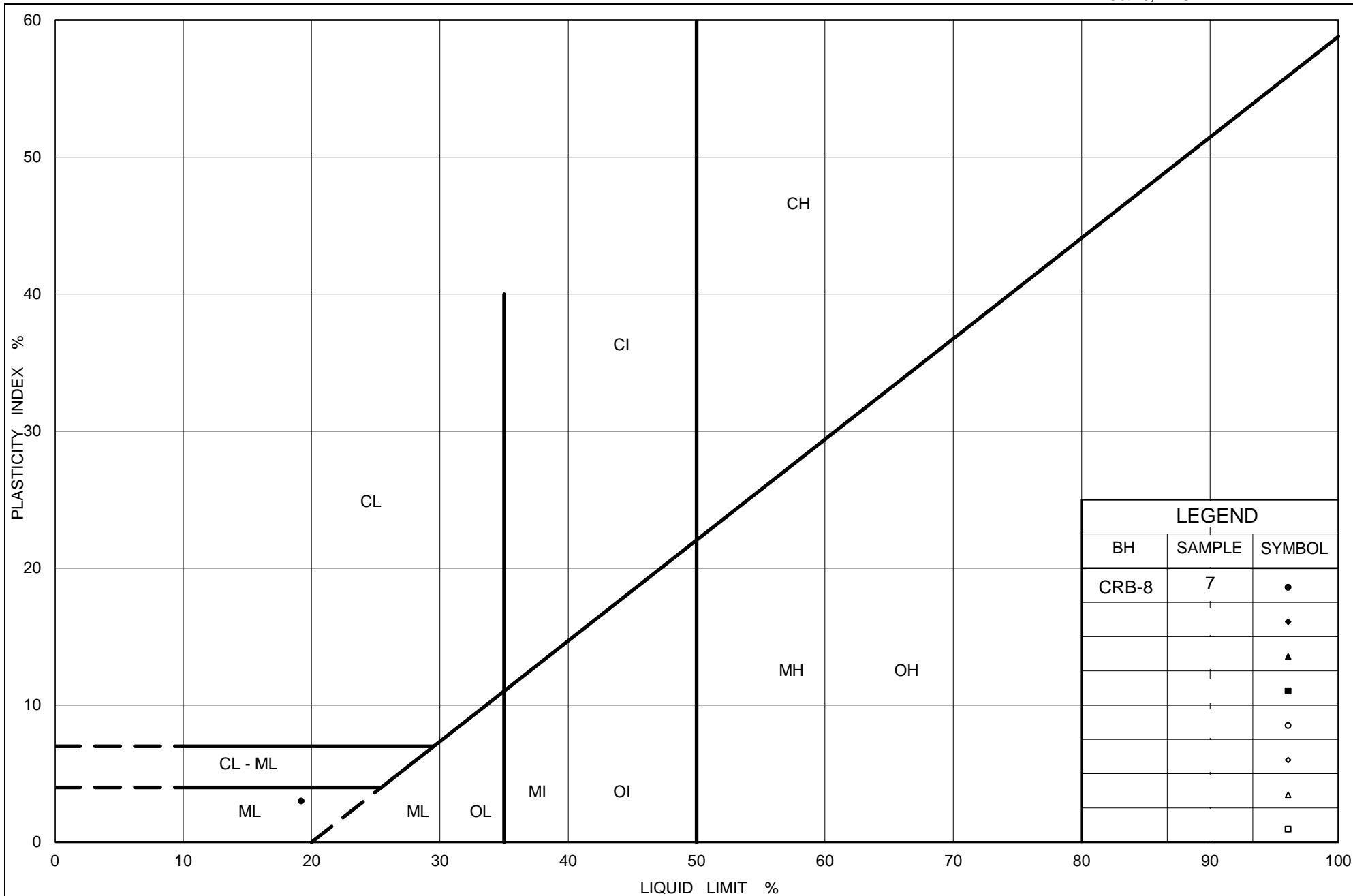
Project Number: 1662333

Checked By: SMM

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Date: 05-Apr-19





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# PLASTICITY CHART Silt (Noise Barrier Wall - Line 'F')

Figure No. C-4

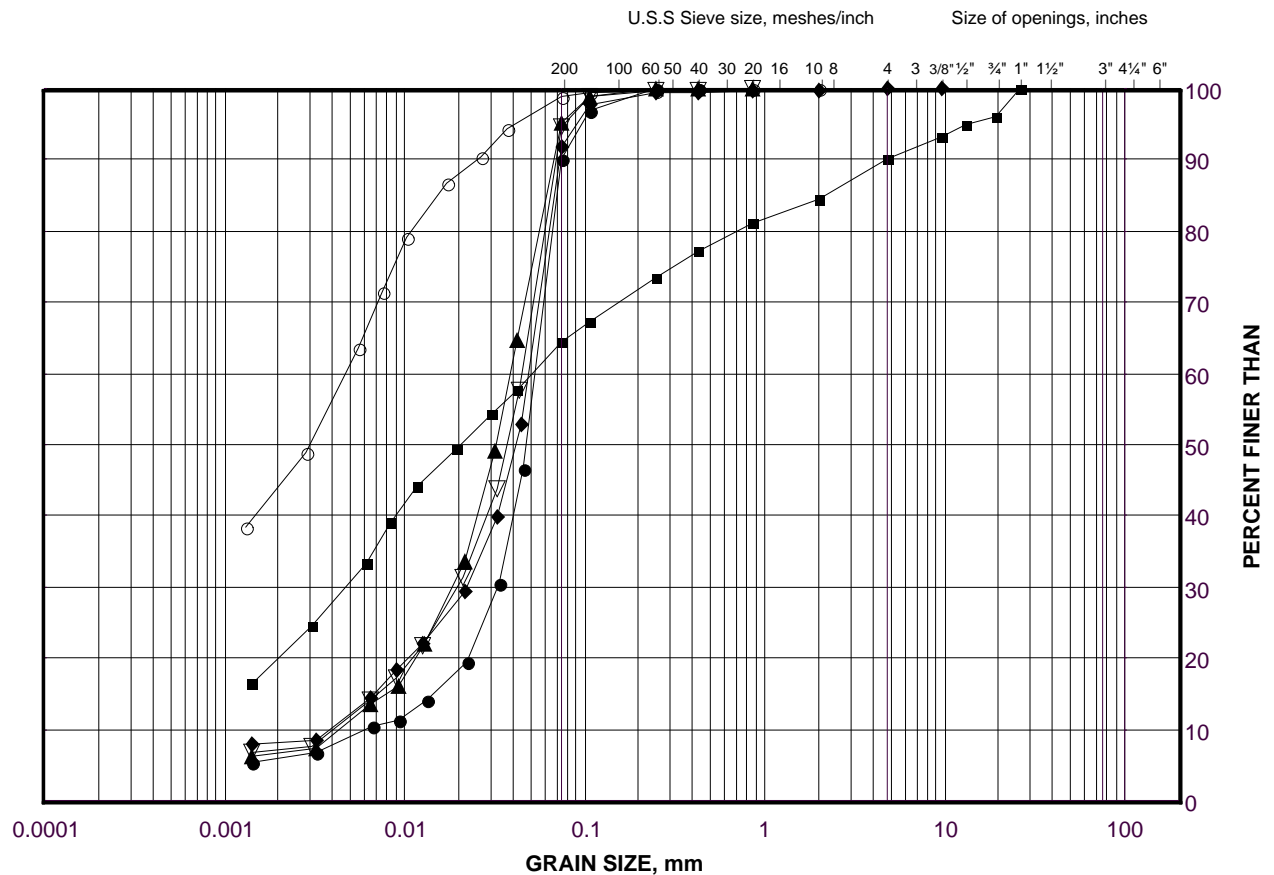
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Silt to Clayey Silt  
(Noise Barrier Wall - Line 'F')

FIGURE C-5



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

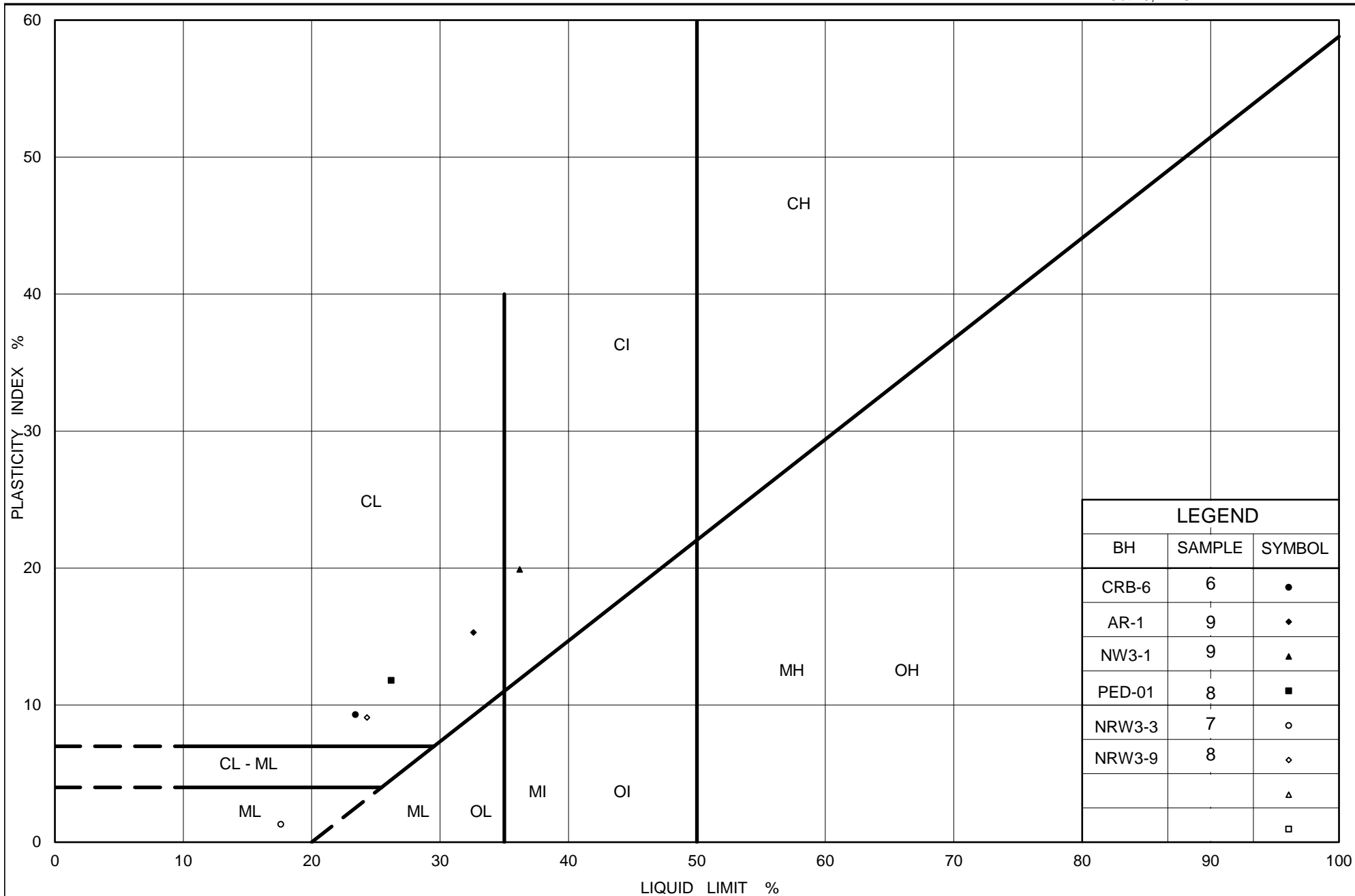
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW3-5	6	91.5
■	CRB-6	6	87.6
◆	NRW3-3	7	90.3
▲	NW3-4	8	88.2
▽	NRW3-2	8	89.6
○	AR-1	9	87.8

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 05-Apr-19



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**PLASTICITY CHART**

Silt to Clayey Silt to Silty Clay  
 (Noise Barrier Wall - Line 'F')  
 (Noise Barrier Wall - Line 'H')

Figure No. C-6

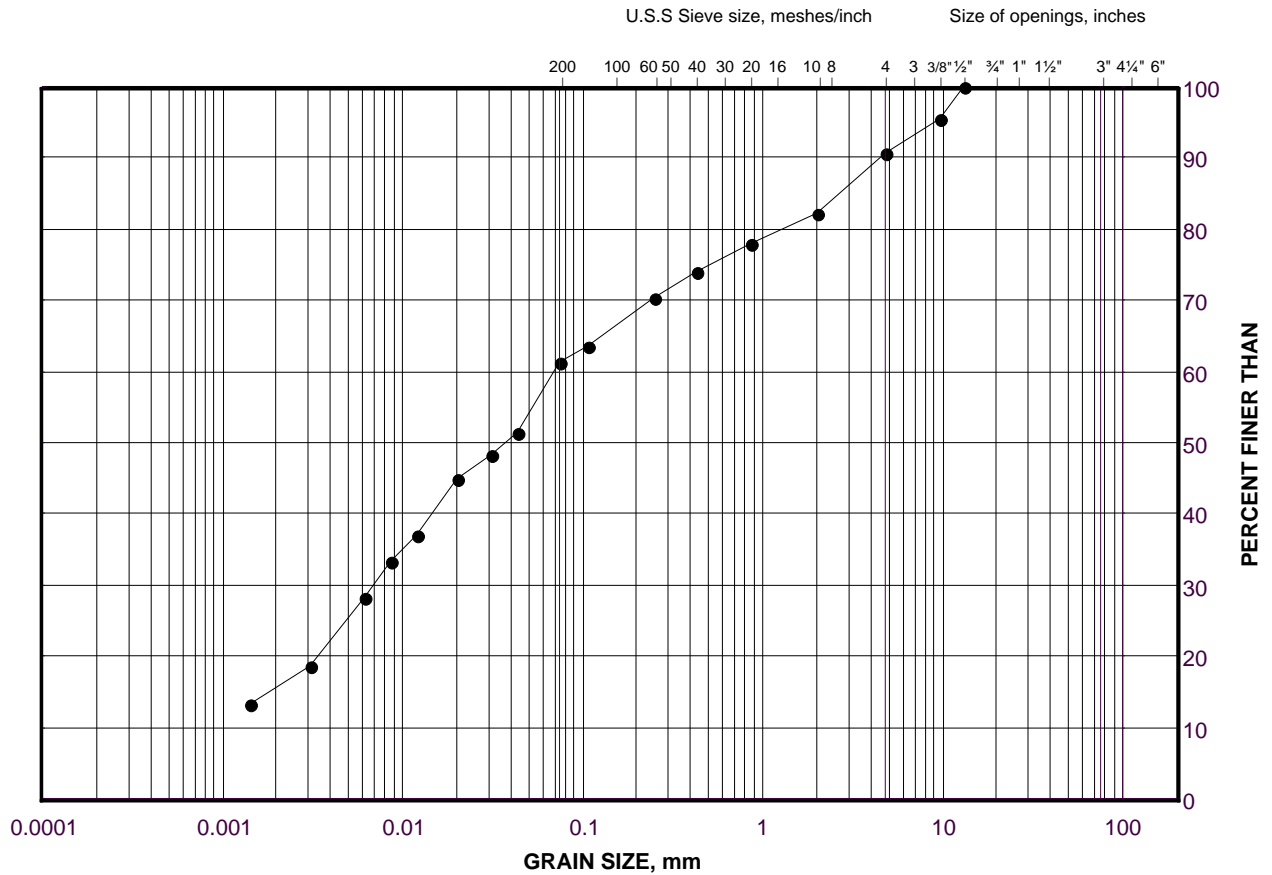
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt (TILL)  
(Noise Barrier Wall - Line 'F')

FIGURE C-7A



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	NW3-1	10	87.0

Project Number: 1662333

Checked By: SMM

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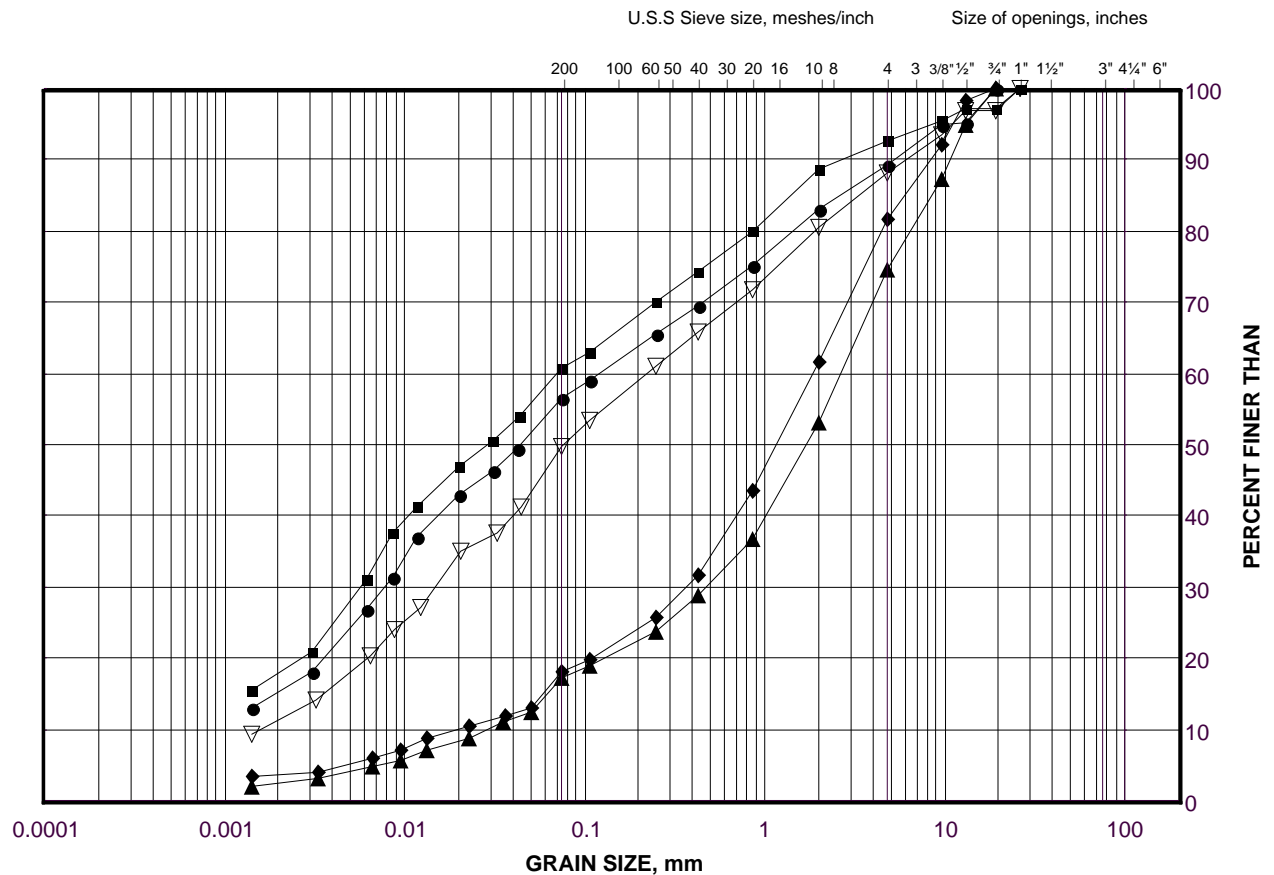
Date: 05-Apr-19

# GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand (TILL)

(Noise Barrier Wall - Line 'F')

FIGURE C-7B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

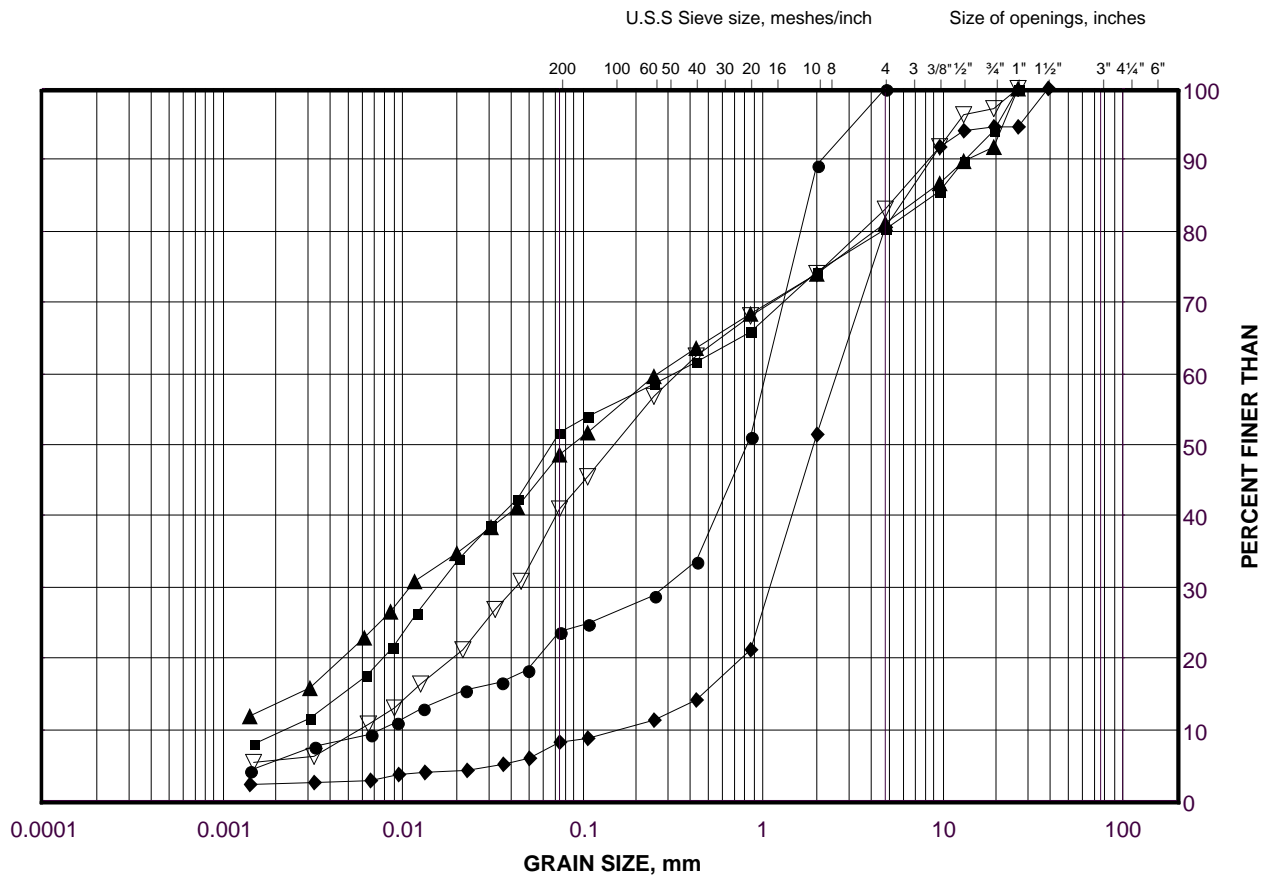
## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	PED-01	10A	87.0
■	NW3-3	4	88.0
◆	NW3-2A	5	79.7
▲	NW3-2A	7	76.7
▽	NW3-2	9	86.1

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Sandy Clayey Silt (TILL)  
(Noise Barrier Wall - Line 'F')

FIGURE C-7C



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	S3	10	79.2
■	S2	12	82.6
◆	S3	13	74.5
▲	S3	5	86.7
▽	S3	7	83.8

Project Number: 1662333

Checked By: SMM

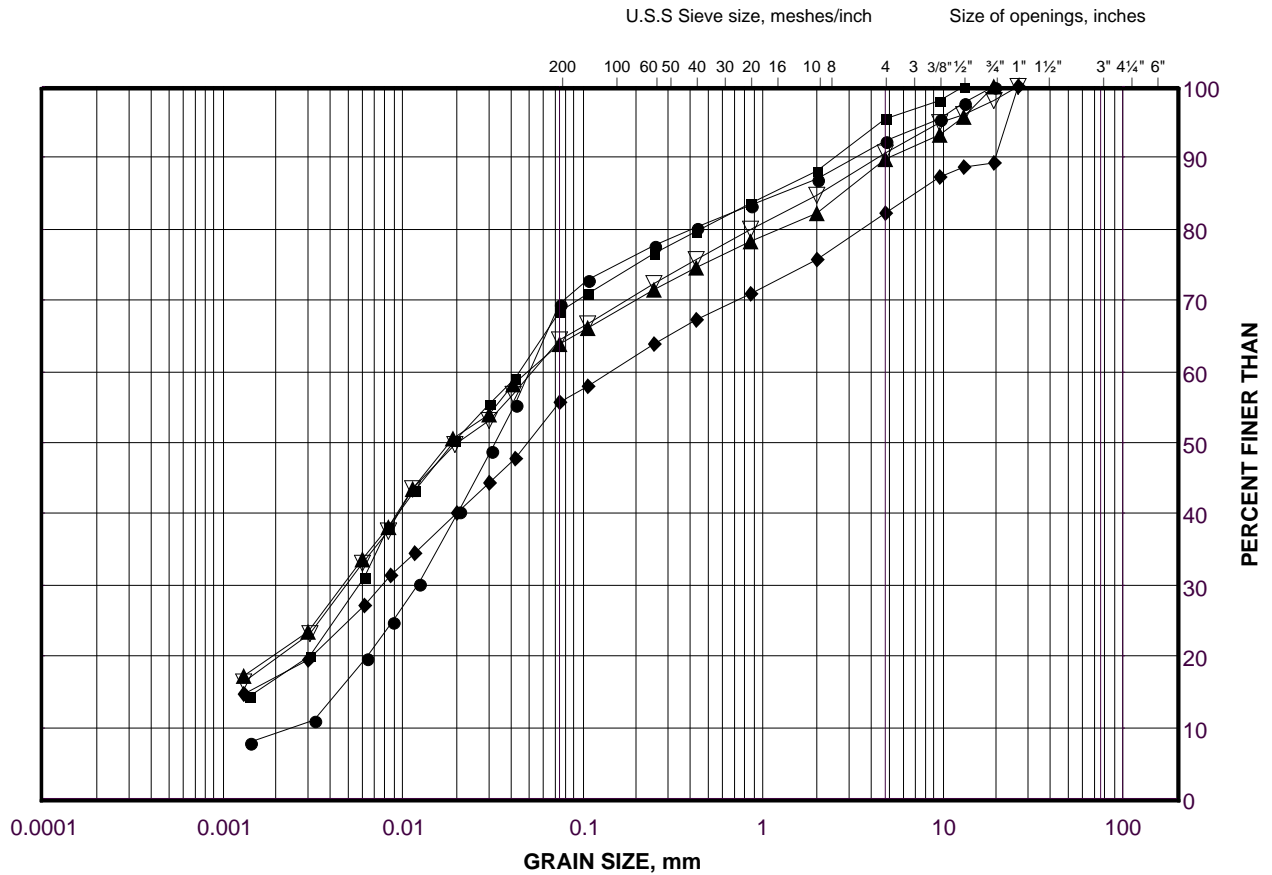
**Golder Associates**

Date: 05-Apr-19

# GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt (TILL)  
(Noise Barrier Wall - Line 'F')

FIGURE C-7D



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW3-2	10	86.7
■	NRW3-3	8	88.8
◆	NW3-4	9	86.7
▲	NRW3-1	9	88.1
▽	NW3-5	9A	87.8

Project Number: 1662333

Checked By: SMM

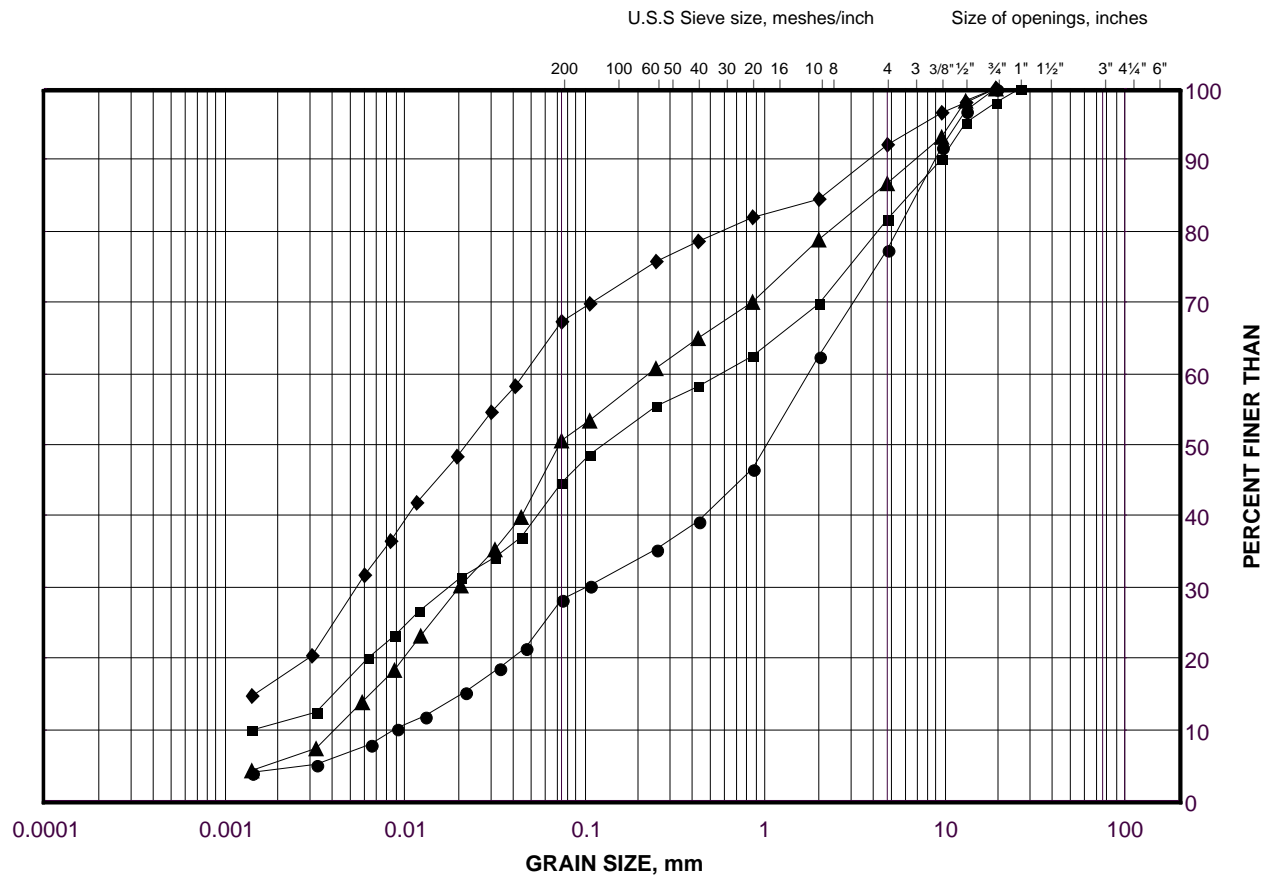
**Golder Associates**

Date: 05-Apr-19

# GRAIN SIZE DISTRIBUTION

Gravelly Silty Sand to Sandy Clayey Silt (TILL)  
(Noise Barrier Wall - Line 'F')

FIGURE C-7E



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW3-5	10	84.3
■	NRW3-5	6	89.5
◆	NRW3-4	7	89.9
▲	NRW3-4	9	86.6

Project Number: 1662333

Checked By: SMM

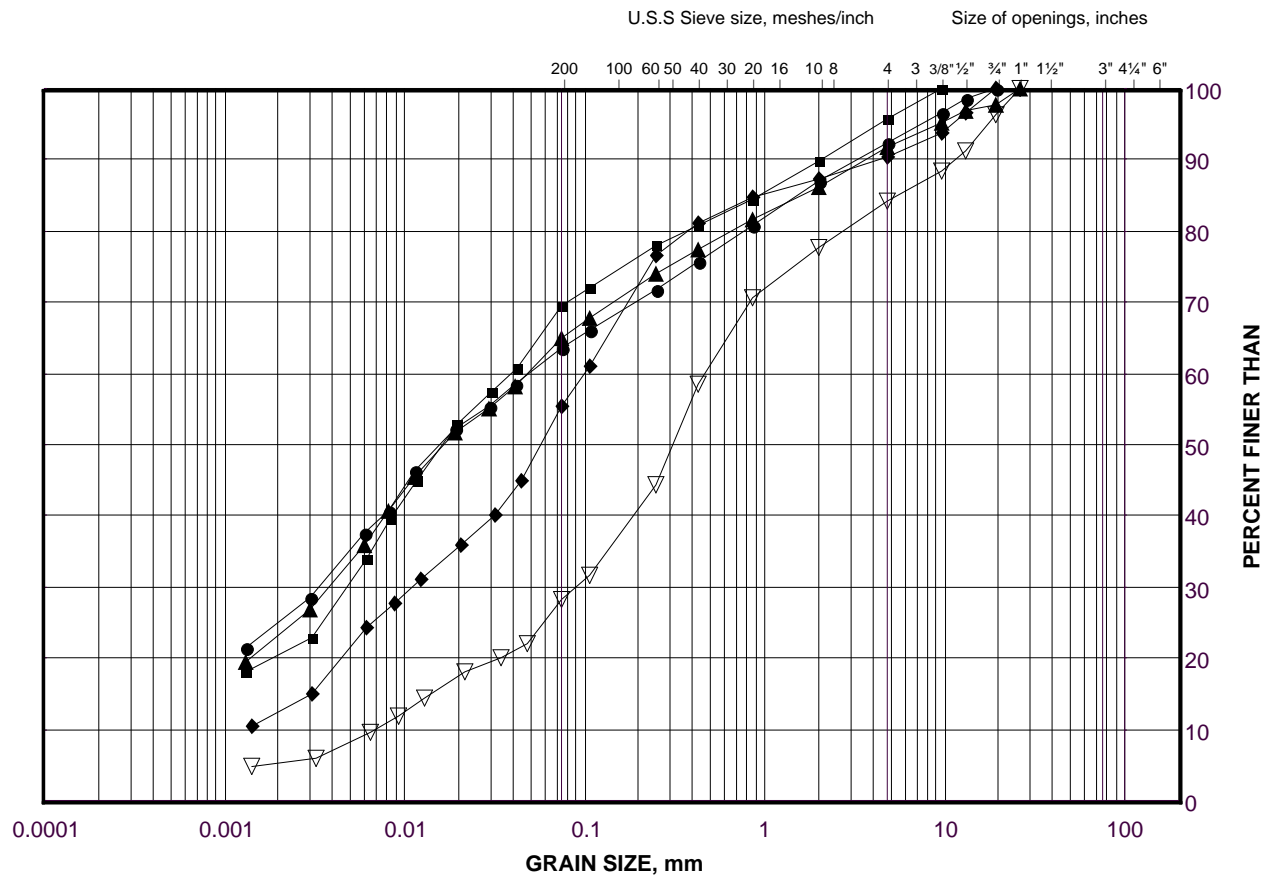
**Golder Associates**

Date: 05-Apr-19



**GRAIN SIZE DISTRIBUTION**  
 Silty Sand to Sandy Clayey Silt (TILL)  
 (Noise Barrier Wall - Line 'F')  
 (Noise Barrier Wall - Line 'H')

FIGURE C-7F



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

**LEGEND**

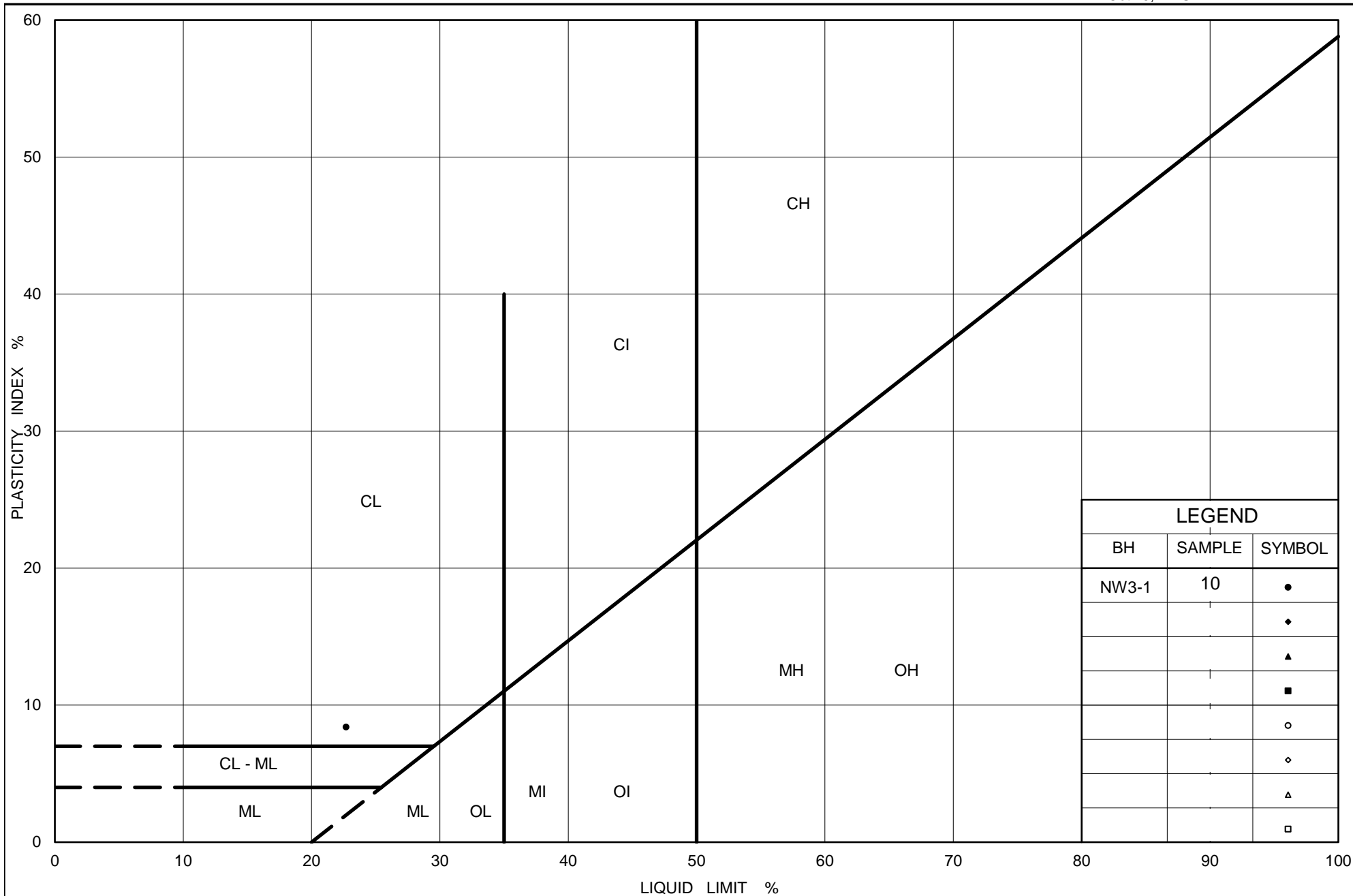
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW3-8	4	93.4
■	NRW3-7	4	91.4
◆	NRW3-6	6	88.7
▲	NRW3-10	7	91.5
▽	NRW3-6	7	88.0

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 05-Apr-19



Ministry of Transportation

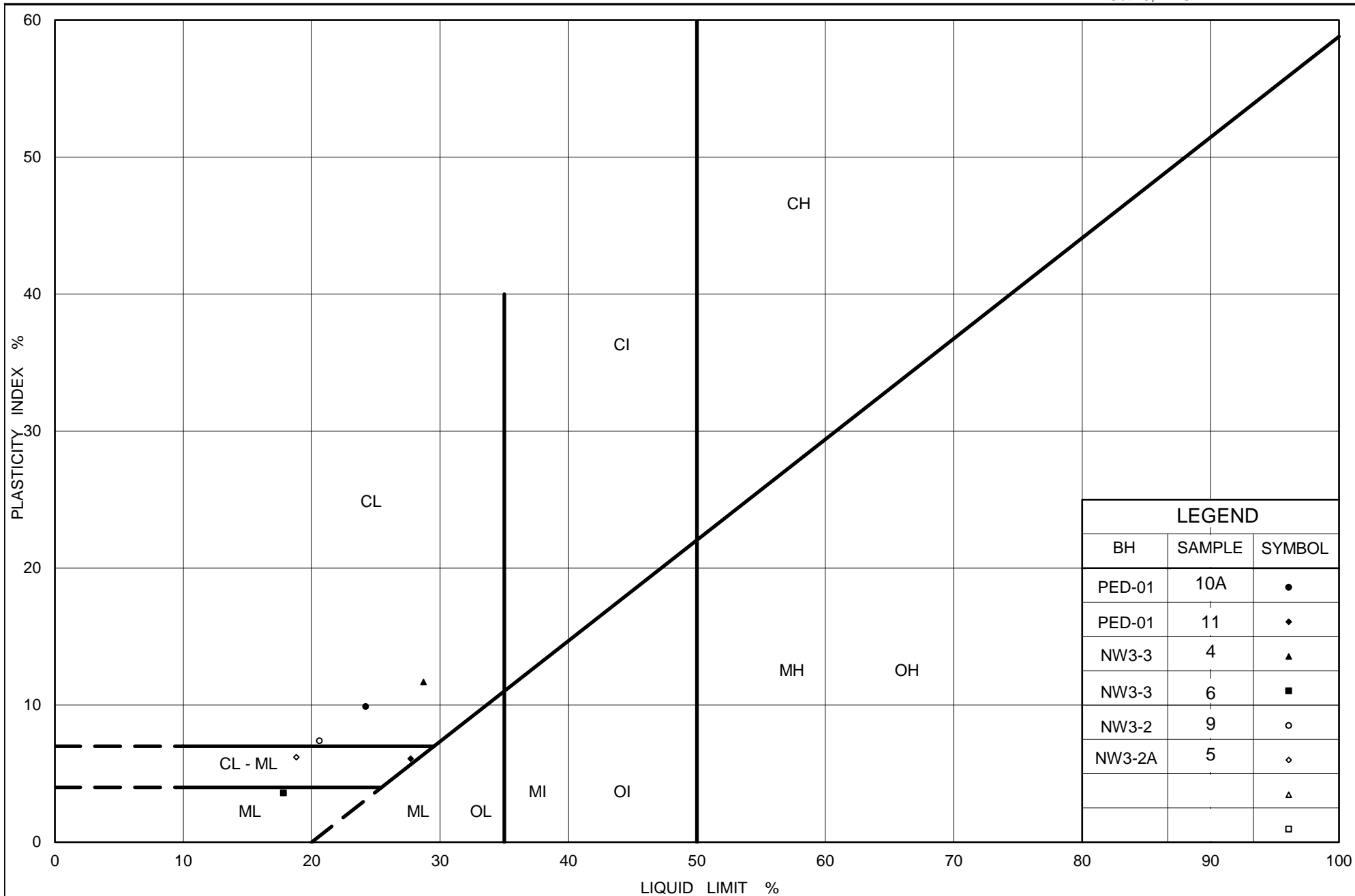
Ontario

# PLASTICITY CHART Sandy Clayey Silt (TILL) (Noise Barrier Wall - Line 'F')

Figure No. C-8A

Project No. 1662333

Checked By: SMM



Ministry of Transportation

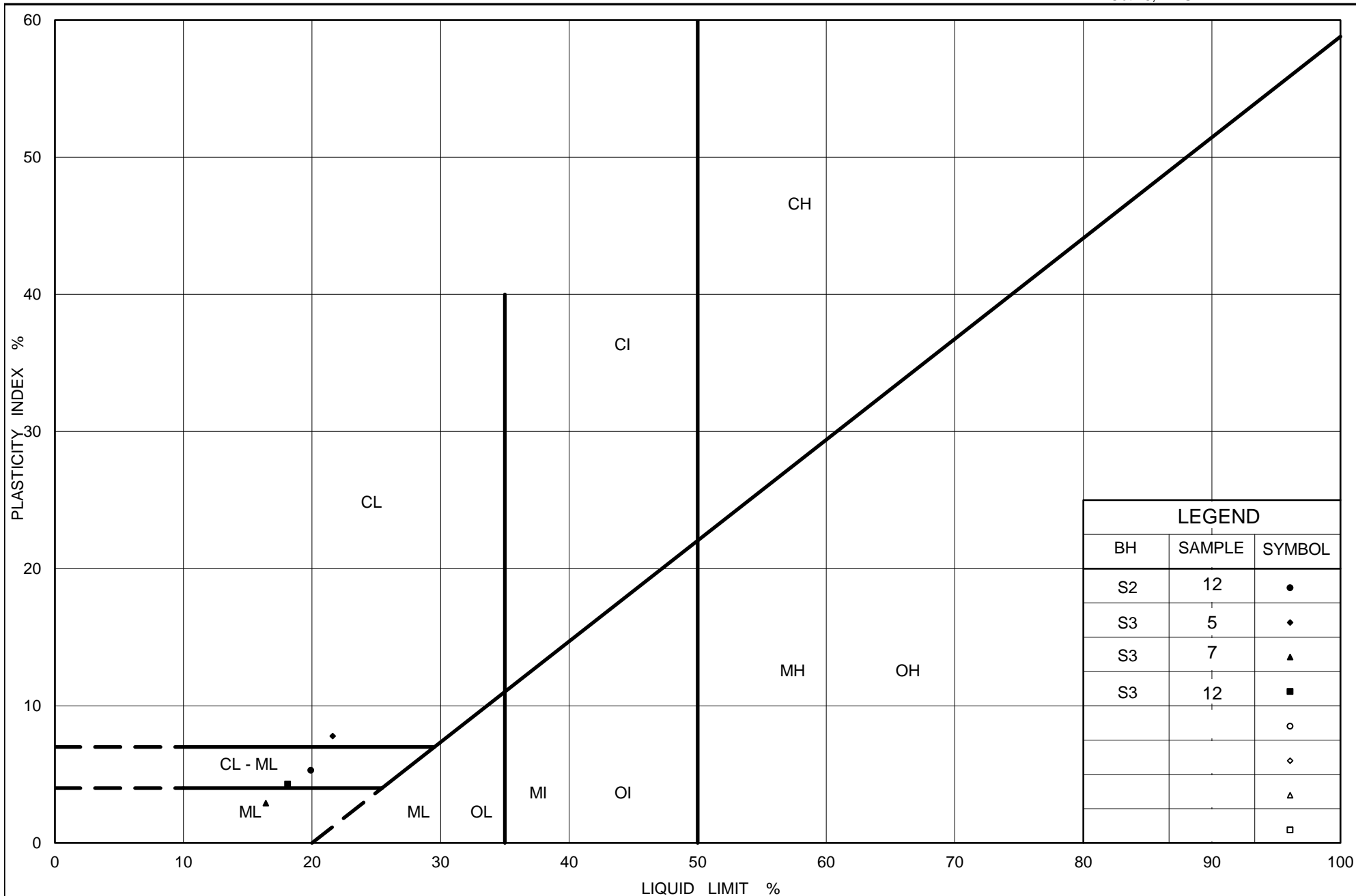
Ontario

# **PLASTICITY CHART** Silt and Sand to Clayey Silt (TILL) (Noise Barrier Wall - Line 'F')

Figure No. C-8B

Project No. 1662333

Checked By: SMM



Ministry of Transportation

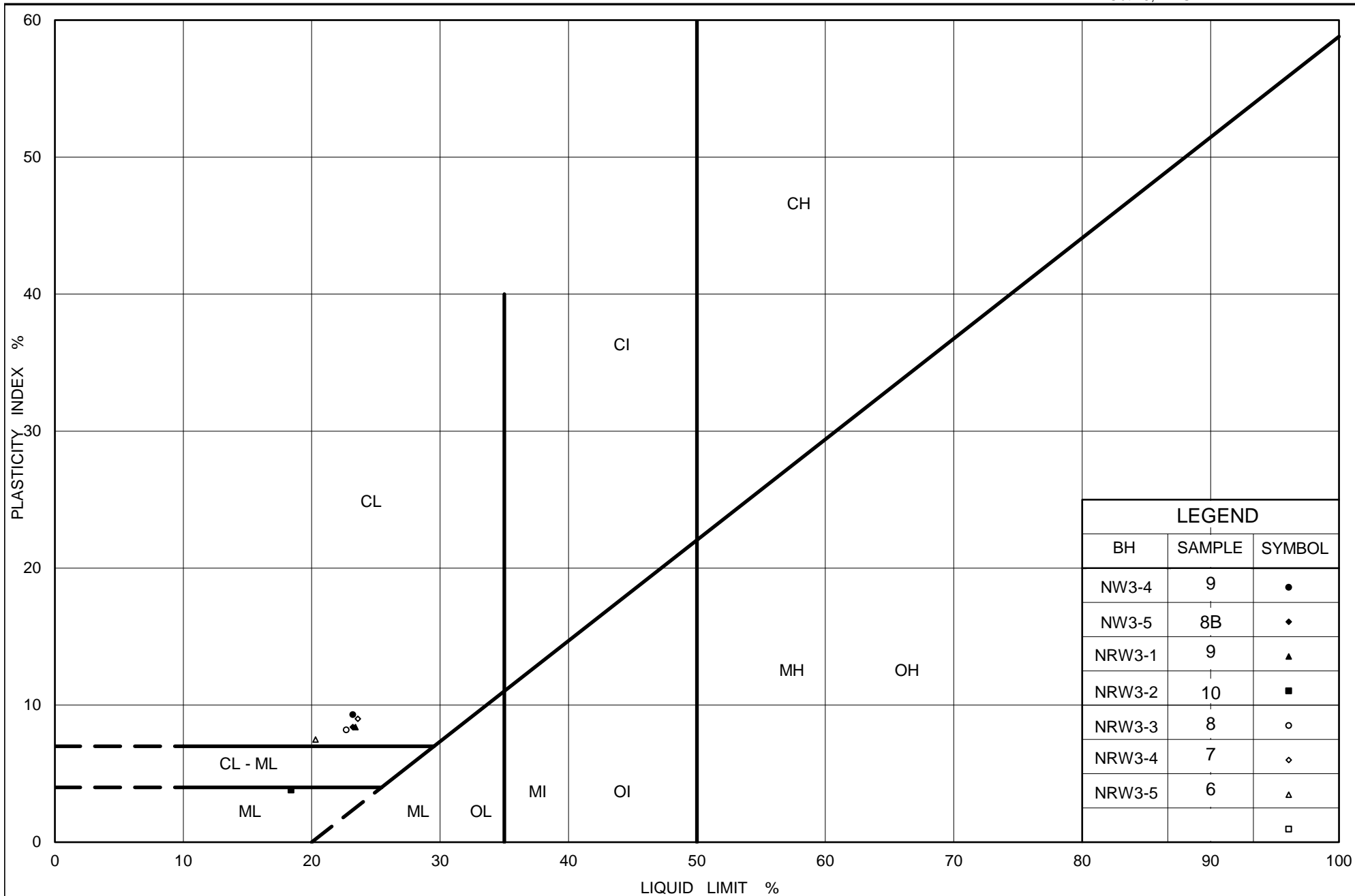
Ontario

# **PLASTICITY CHART** Silt and Sand to Sandy Clayey Silt (TILL) (Noise Barrier Wall - Line 'F')

Figure No. C-8C

Project No. 1662333

Checked By: SMM



Ministry of Transportation

Ontario

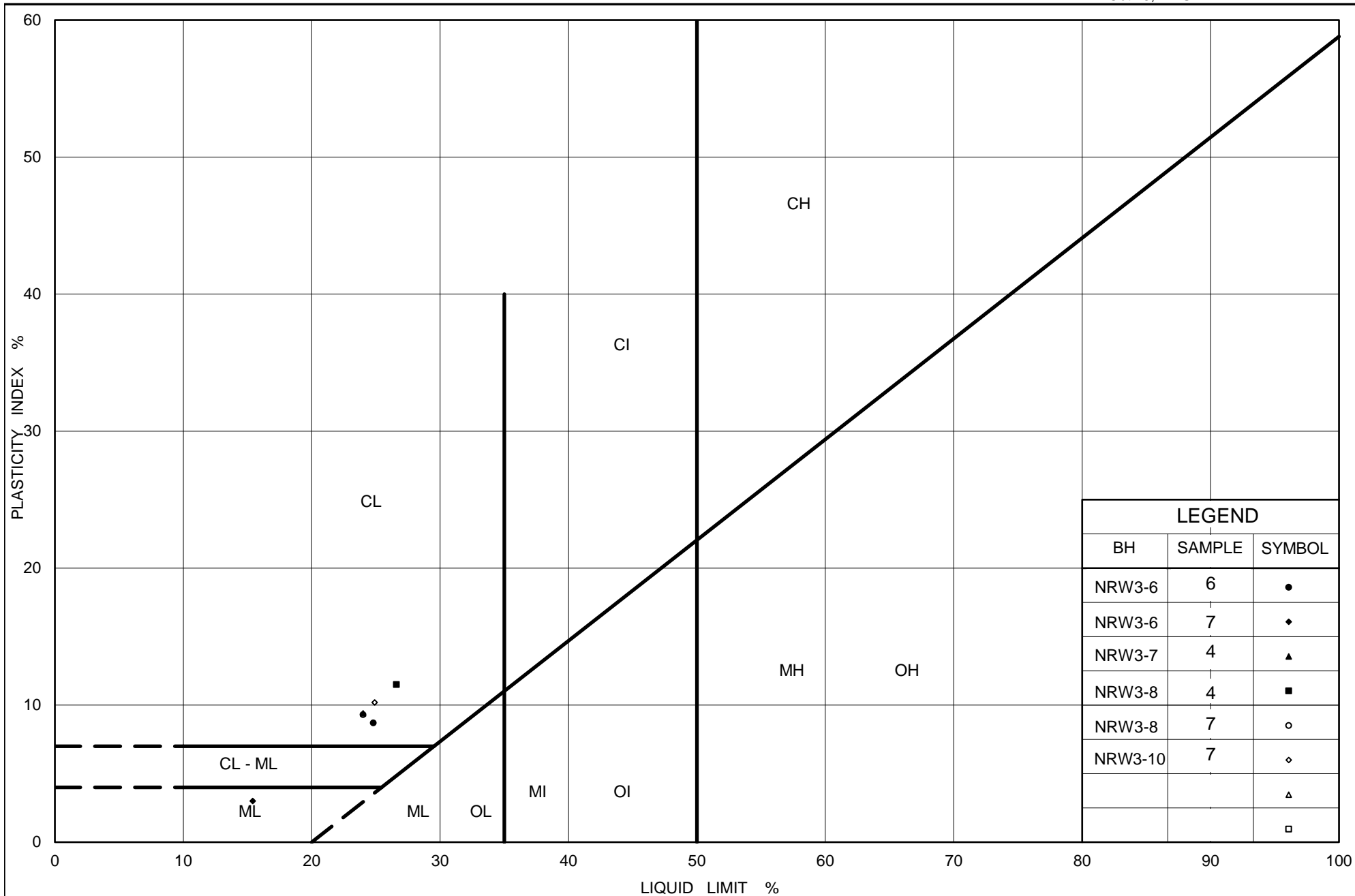
## PLASTICITY CHART

Clayey Silt with Sand to Sandy Clayey Silt (TILL)  
(Noise Barrier Wall - Line 'F')

Figure No. C-8D

Project No. 1662333

Checked By: SMM



Ministry of Transportation

Ontario

**PLASTICITY CHART**  
 Silty Sand to Sandy Clayey Silt (TILL)  
 (Noise Barrier Wall - Line 'F')  
 (Noise Barrier Wall - Line 'H')

Figure No. C-8E

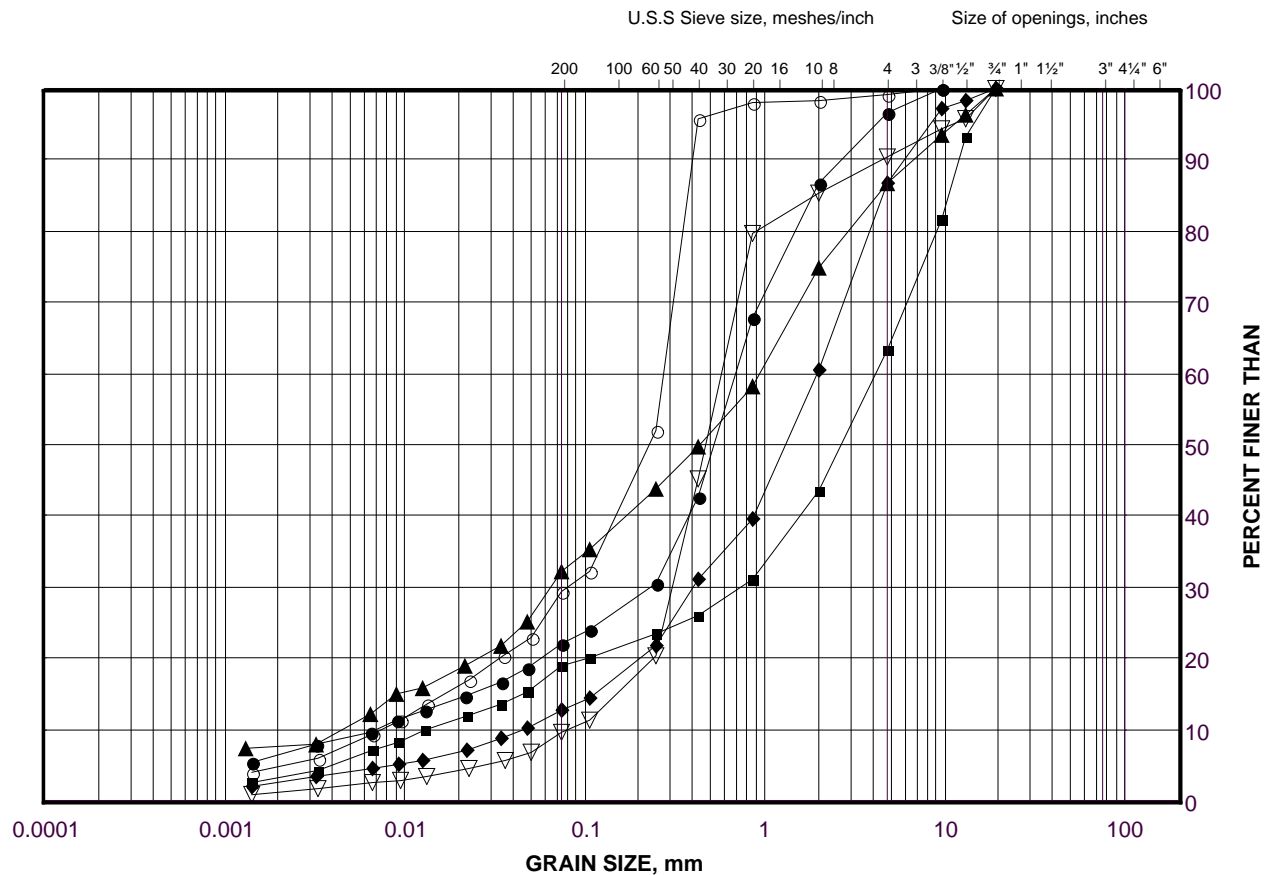
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Silty Sand to Sand and Gravel  
(Noise Barrier Wall - Line 'F')

FIGURE C-9



## LEGEND

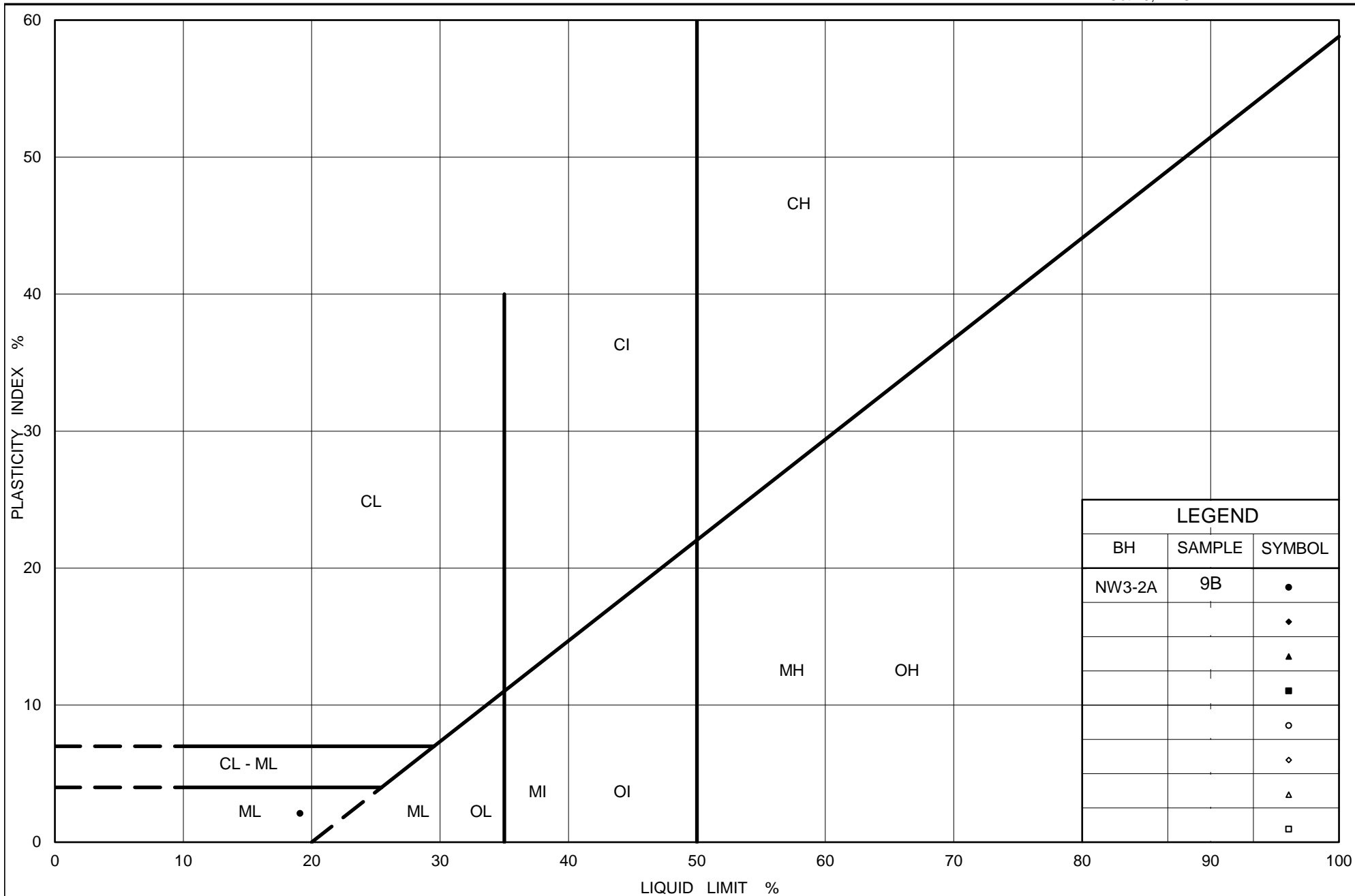
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	PED-01	12	83.8
■	NW3-2A	13	69.1
◆	PED-01	14	80.8
▲	S2	15	77.8
▽	PED-01	17	76.2
○	NW3-2A	9A	73.8

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 05-Apr-19



Ministry of Transportation

Ontario

# PLASTICITY CHART Silt (Noise Barrier Wall - Line 'F')

Figure No. C-10

Project No. 1662333

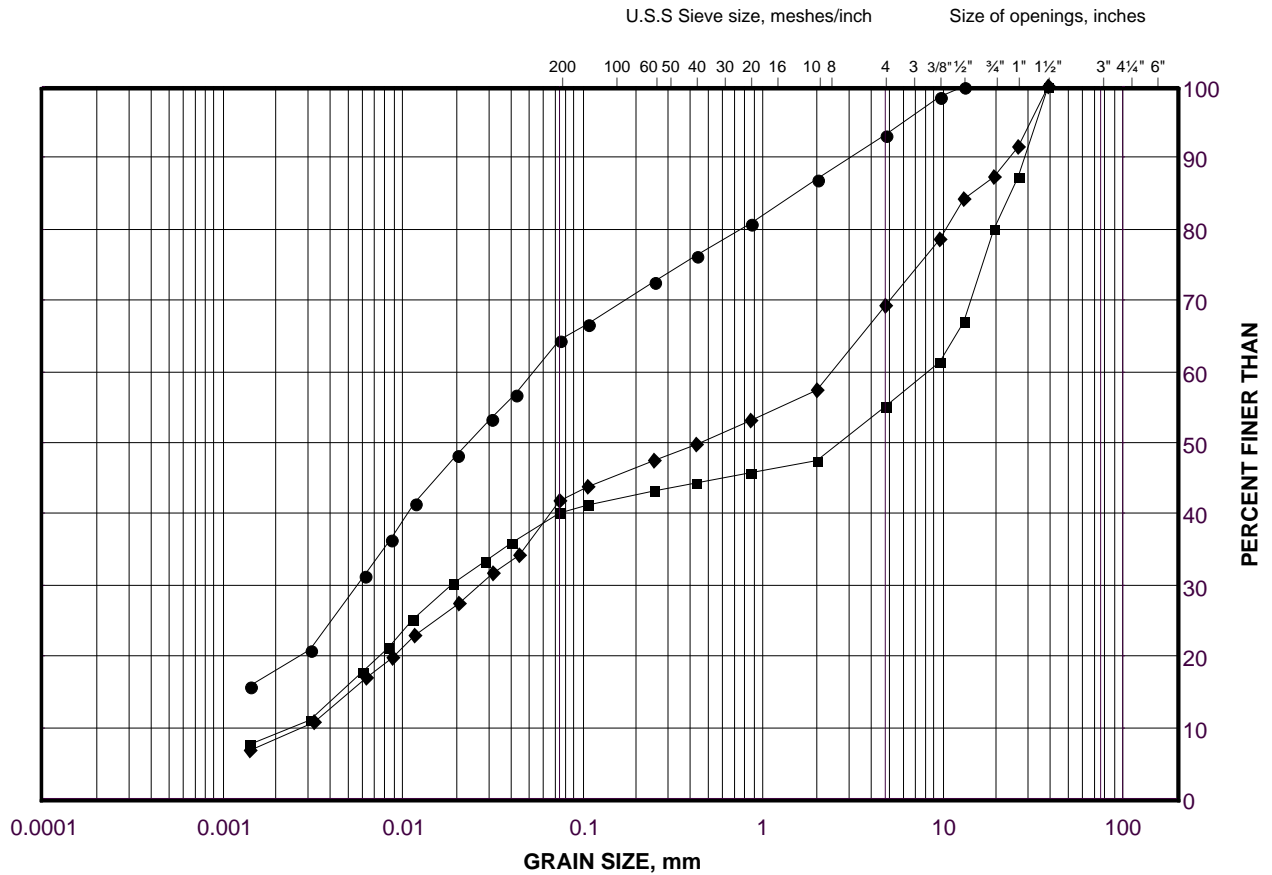
Checked By: SMM



# GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Clayey Silt with Gravel (Residual Soil)  
(Noise Barrier Wall - Line 'F')

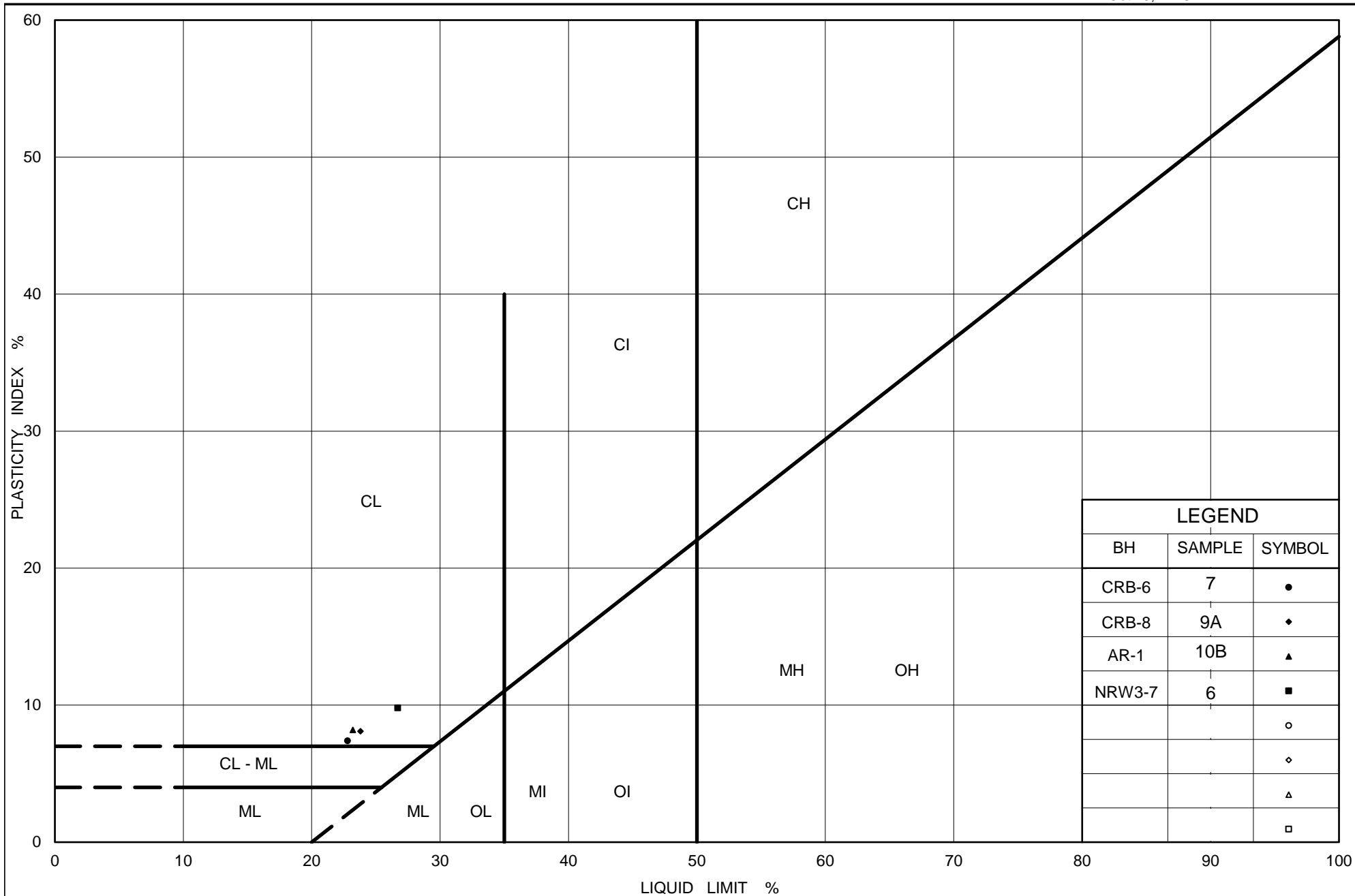
FIGURE C-11



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	AR-1	10B	86.9
■	NRW3-7	6	89.8
◆	CRB-8	9A	86.9



Ministry of Transportation

Ontario

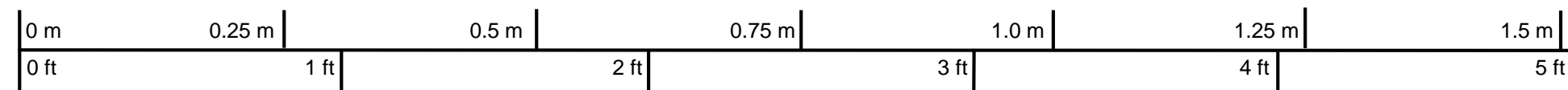
## PLASTICITY CHART

Sandy Clayey Silt to Clayey Silt with Gravel (Residual Soil)  
(Noise Barrier Wall - Line 'F')


Figure No. C-12

Project No. 1662333

Checked By: SMM



Scale

PROJECT		MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street				
TITLE		Bedrock Core Photograph Borehole CRB-6 (5.12 m to 13.27 m)				
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE C-13</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

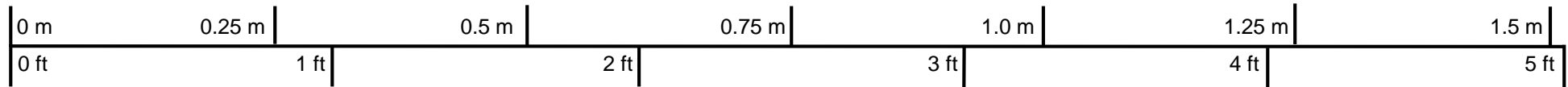
REVISION DATE: August 21, 2018 BY: SE Project: 1662333

Start of Run No. 2 (12.50 m)


Start of Run No. 1 (11.80 m)



Start of Run No. 3 (13.90 m)



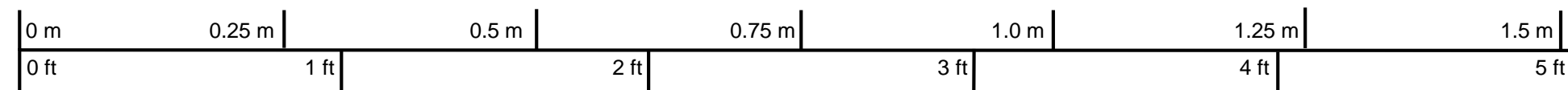
Scale

PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE Bedrock Core Photograph Borehole NW3-1 (11.80 m to 15.42 m)						
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE C-14		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			


Start of Run No. 1 (22.32 m)



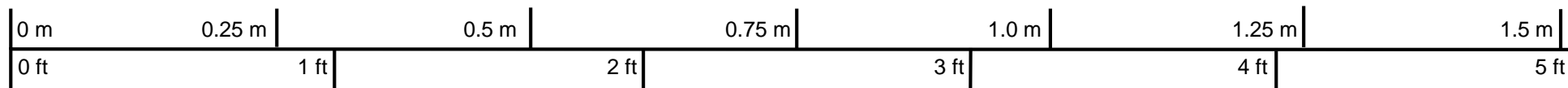
Start of Run No. 2 (23.86 m)




Scale

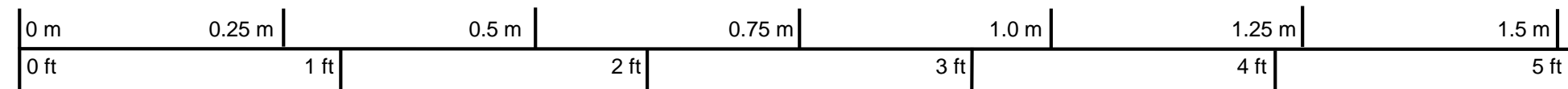
PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE Bedrock Core Photograph Borehole PED-01 (22.32 m to 25.41 m)						
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE C-15		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			






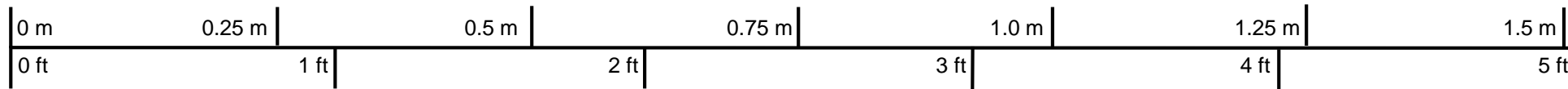
Scale

PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole NRW3-6 (7.47 m to 11.38 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE C-16</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			




Scale

PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole NRW3-7 (7.60 m to 11.69 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE C-17</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

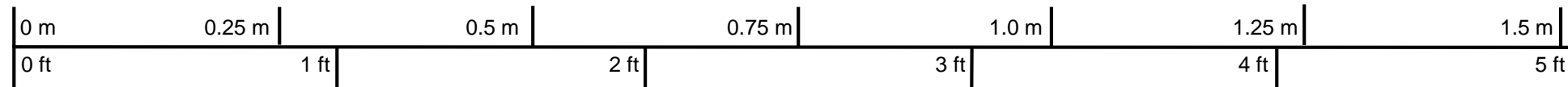


Scale


PROJECT						
MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE						
Bedrock Core Photograph Borehole NRW3-8 (6.73 m to 10.52 m)						
 GOLDER			PROJECT No. 1662333		FILE No. ----	
			DRAFT	SE	20180821	SCALE AS SHOWN
			CADD	--		VER. 1.
			CHECK	SMM	20190319	FIGURE C-18
			REVIEW	JMAC	20190321	



Start of Run No. 1 (7.66 m)      Start of Run No. 2 (7.82 m)

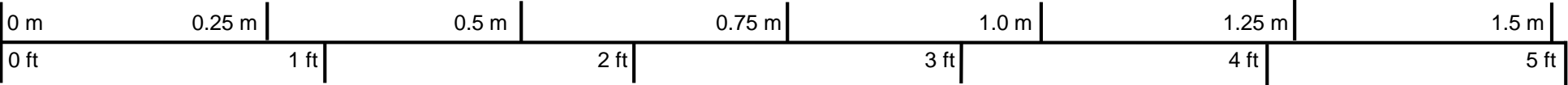
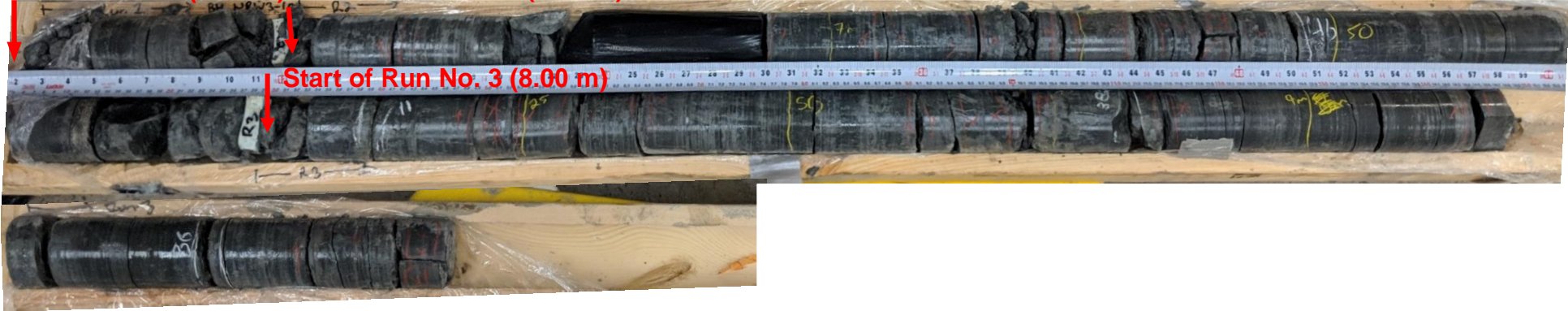


Scale


PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole NRW3-9 (7.66 m to 11.01 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE C-19</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

Start of Run No. 1 (6.22 m) Start of Run No. 2 (6.48 m)

Start of Run No. 3 (8.00 m)



Scale

PROJECT		MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street				
TITLE		Bedrock Core Photograph Borehole NRW3-10 (6.22 m to 9.53 m)				
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE C-20		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

**APPENDIX D**

**NOISE BARRIER WALL - Line 'A'**  
**QEW Sta 15+622 to Sta 15+866**

PROJECT 1662333		RECORD OF BOREHOLE No NW4-1				SHEET 1 OF 1		METRIC						
G.W.P. 2002-13-00		LOCATION N 4823192.5; E 295107.9 MTM NAD 83 ZONE 10 (LAT. 43.548605; LONG. -79.619950)				ORIGINATED BY ACM								
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 108 mm I.D., Hollow Stem Augers				COMPILED BY SE								
DATUM Geodetic		DATE June 28, 2018				CHECKED BY SMM								
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						
101.0	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
99.6	ASPHALT (80 mm) Gravelly sand, some silt, trace clay (FILL) Compact Brown Moist		1	SS	13									
99.6			2A	SS	13									
99.6			2B	SS	13									
98.0	SILTY CLAY, some sand, some gravel (TILL) Soft to very stiff Brown to grey, mottled Moist		3A	SS	4									
98.0			3B	SS	4									
98.0			4	SS	17									
97.7	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation) - Auger grinding from 3.2 m to 3.3 m depth		5	SS	100/0.20									
97.7	SHALE (BEDROCK) Grey Slightly weathered		1	RC	REC 100%									
97.7			2	RC	REC 83%									
97.7	Bedrock cored from a depth of 2.7 m to 6.3 m.		3	RC	REC 100%									
97.7	For bedrock coring details, refer to Record of Drillhole NW4-1.		4	RC	REC 96%									
94.7	END OF BOREHOLE													
94.7	NOTE: 1. Water level measured at a depth of about 1.5 m below ground surface (Elev. 99.5 m) upon completion of soil drilling.													

PROJECT: 1662333

## RECORD OF DRILLHOLE: NW4-1

SHEET 1 OF 1

LOCATION: N 4823192.5 ; E 295107.9

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55 Track Mount

DRILLING CONTRACTOR: Aardvark Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST- Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA				ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
						TOTAL CORE %	SOLID CORE %			B Angle °	DIP w.r.t. CORE AXIS °	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4	R3	R2	R1	W1	W2	W3				W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: ACM

CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\GINT\QEW-CREDIT\_RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT 1662333		RECORD OF BOREHOLE No NW4-2				SHEET 1 OF 1				METRIC							
G.W.P. 2002-13-00		LOCATION N 4823234.5; E 295162.8 MTM NAD 83 ZONE 10 (LAT. 43.548975; LONG. 79.619267)				ORIGINATED BY CC											
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 150 mm O.D. Solid Stem Augers				COMPILED BY SE											
DATUM Geodetic		DATE June 28, 2018				CHECKED BY SMM											
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 (%)
100.7	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT (160 mm)																
0.2	Sand and gravel, trace silt, trace clay (FILL)		1	SS	8		100										
100.0	Loose Brown Moist		2	SS	12												
0.7	SILTY CLAY, some sand, trace to some gravel (TILL)																
	Stiff to very stiff		3	SS	21		99										
	Grey to brown Moist																
98.4	- Organics and rootlets between 0.8 m and 1.4 m		4A	SS	100/0.05												
2.3	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		4B				98										
97.8	SHALE (BEDROCK)		1	RC	REC 100%												RQD = 0%
2.9	Grey Moderately weathered to 4.9 m depth to slightly weathered below 4.9 m depth		2	RC	REC 79%		97										RQD = 54%
	- Auger grinding from 2.9 m to 3.0 m depth																
	- Auger refusal at 3.0 m depth, limestone fragments present in cuttings.						96										
	Bedrock cored from a depth of 3.0 m to 6.3 m.		3	RC	REC 85%		95										RQD = 72%
	For bedrock coring details, refer to Record of Drillhole NW4-2.																
94.4	END OF BOREHOLE																
6.3	NOTES: 1. Open borehole dry upon completion of soil drilling.																

GTA-MTO 001 S:\CLIENTS\MTQEW-CREDIT\_RIVER\02\_DATA\INTQEW-CREDIT\_RIVER.GPJ GAL-GTA.GDT 19-5-15

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

LOGGED: CC

CHECKED: KG

DATA\GINT\QEW-CREDIT RIVER\02 DATA\GINT\QEW-CREDIT RIVER.GPJ GAL-MISS.GDT 19-5-15

PROJECT 1662333		RECORD OF BOREHOLE No NW4-3		SHEET 1 OF 1		METRIC					
G.W.P. 2002-13-00		LOCATION N 4823274.0; E 295219.9 MTM NAD 83 ZONE 10 (LAT. 43.549332; LONG. -79.618561)		ORIGINATED BY CC							
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 88 mm I.D., 190 O.D., Hollow Stem Augers		COMPILED BY ACM							
DATUM Geodetic		DATE June 26, 2018		CHECKED BY SMM							
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER			TYPE	"N" VALUES	SHEAR STRENGTH kPa			
100.6	GROUND SURFACE										
0.0	ASPHALT (150 mm)										
0.2	Sand and gravel (FILL)										
99.9	Compact Brown Moist		1A	SS	15						
0.7	SILTY CLAY, trace to some sand, trace gravel (TILL) Firm to very stiff Grey, mottled Moist		1B	SS	8						
			2	SS	8						
			3	SS	24						
98.2			4A	SS	100/0.13						
			4B	SS	100/0.13						
97.9	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		5	SS	100/0.13						
2.7	SHALE (BEDROCK) Grey Slightly weathered to fresh		1	RC	REC 48%						
	- Auger grinding from 2.6 m to 2.9 m depth		2	RC	REC 100%						
	Bedrock cored from a depth of 3.1 m to 7.7 m.		3	RC	REC 99%						
	For bedrock coring details, refer to Record of Drillhole NW4-3.		4	RC	REC 100%						
92.9	END OF BOREHOLE										
7.7	NOTES:										
	1. Open borehole dry upon completion of soil drilling.										
	2. Groundwater level measurements in piezometer:										
	Date Depth (m) Elev. (m)										
	14/08/18 1.0 99.6										
	06/11/18 0.8 99.8										



SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

LOGGED: CC

CHECKED: KG

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PROJECT		RECORD OF BOREHOLE No NW4-4				SHEET 1 OF 1				METRIC					
G.W.P.		2002-13-00		LOCATION		N 4823308.8; E 295274.5 MTM NAD 83 ZONE 10 (LAT. 43.549645; LONG. -79.617886)				ORIGINATED BY		ACM			
DIST		Central HWY QEW		BOREHOLE TYPE		CME 55, 108 mm I.D., Hollow Stem Augers				COMPILED BY		CC			
DATUM		Geodetic		DATE		June 26, 2018				CHECKED BY		SMM			
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							
100.5	GROUND SURFACE														
0.0	ASPHALT (150 mm)														
0.2	Sand and gravel (FILL)		1	SS	11										
99.8	Compact Brown Moist														
0.7	SILTY CLAY, trace to some sand, trace gravel, shale fragments (TILL)		2	SS	10										
99.1	Stiff Grey Moist		3	SS	38										
1.4	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		4	SS	50/0.08										
97.8	- Auger grinding from 1.8 m to 2.3 m		5	SS	55/0.08										
2.7	- Auger grinding from 2.4 m to 2.7 m depth		6	SS	50/0.08										
	SHALE (BEDROCK)														
	Grey Slightly weathered														
	Bedrock cored from a depth of 4.4 m to 8.0 m.														
	For bedrock coring details, refer to Record of Drillhole NW4-4.		1	RC	REC 60%										RQD = 23%
	- Auger grinding from 3.0 m to 3.2 m and from 4.0 m to 4.3 m		2	RC	REC 100%										RQD = 47%
			3	RC	REC 100%										RQD = 73%
92.5	END OF BOREHOLE														
8.0	1. Open borehole dry upon completion of soil drilling.														

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PROJECT: 1662333

LOCATION: N 4823308.8 ; E 295274.5

INCLINATION: -90° AZIMUTH: —

## RECORD OF DRILLHOLE: NW4-4

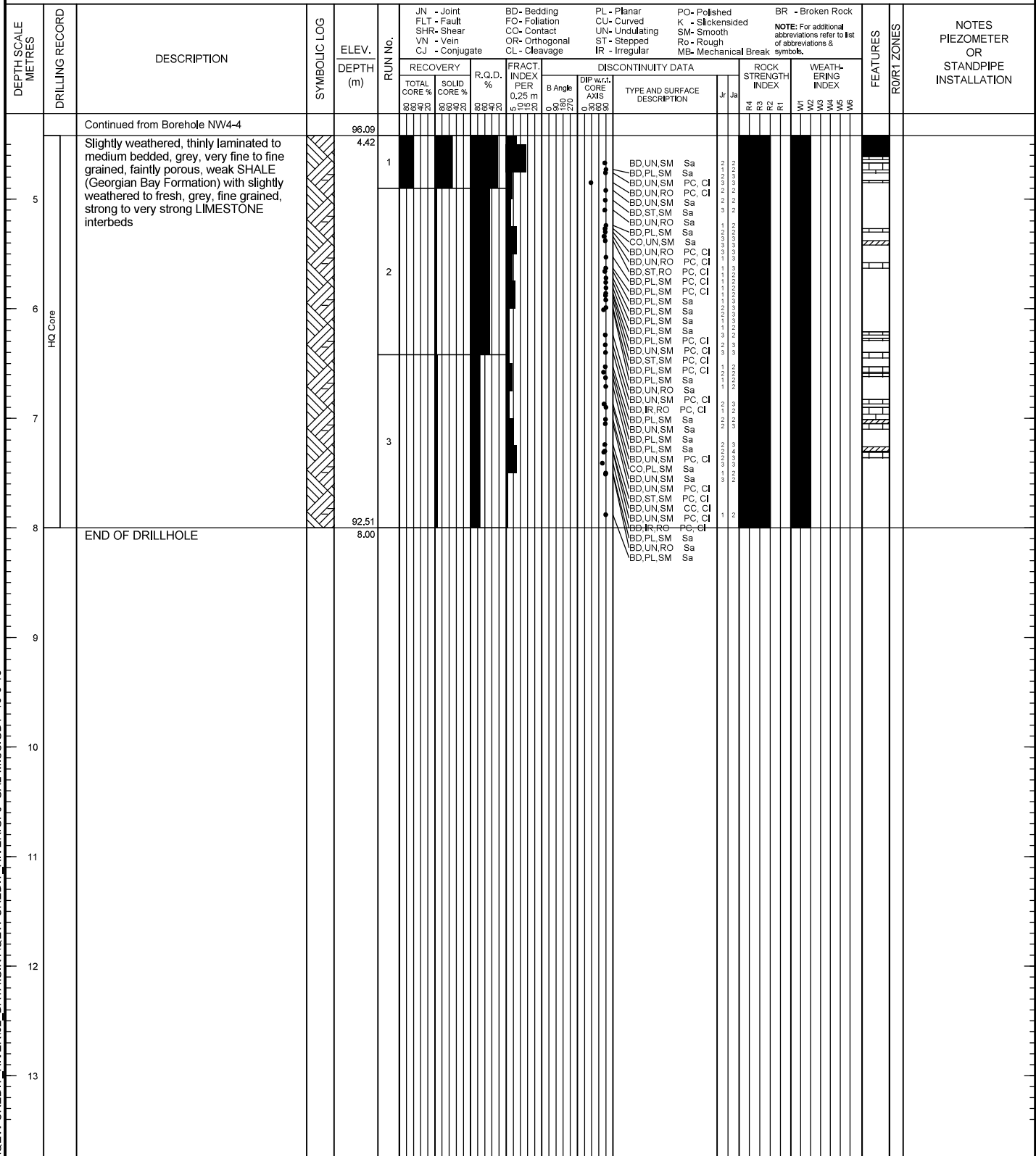
SHEET 1 OF 1

DRILLING DATE:

DRILL RIG: CME 55 Track Mount

DRILLING CONTRACTOR: Aardvark Drilling

DATUM: Geodetic



## FEATURES LEGEND



DEPTH SCALE

1 : 50



LOGGED: ACM

CHECKED: KG

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PROJECT		1662333		RECORD OF BOREHOLE No NW4-5				SHEET 1 OF 1		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4823340.0; E 295333.6 MTM NAD 83 ZONE 10 (LAT. 43.549927; LONG. -79.617156)				ORIGINATED BY		CC					
DIST		Central HWY QEWE		BOREHOLE TYPE		CME 75, 150 mm O.D., Solid Stem Augers				COMPILED BY		SE					
DATUM		Geodetic		DATE		July 3, 2018				CHECKED BY		SMM					
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									
100.3	GROUND SURFACE																
0.0	ASPHALT (150 mm)																
0.2	Sand and gravel, some silt (FILL)		1A	SS	10												
99.6	Compact Brown, mottled red, mottled grey		1B														
0.7	Moist SILTY CLAY, some gravel, trace to some sand		2	SS	19												
98.8	Very stiff Brown to grey																
1.5	Moist Inferred highly to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		3	SS	26												
			4	SS	69												
			5	SS	100/0.23												
96.5	SHALE (BEDROCK)		6	SS	100/0.10												
3.8	Grey Slightly weathered to fresh																
	Bedrock cored from a depth of 4.1 m to 7.6 m.		1	RC	REC 100%												RQD = 84%
	For bedrock coring details, refer to Record of Drillhole NW4-5.		2	RC	REC 100%												RQD = 78%
			3	RC	REC 100%												RQD = 100%
92.7	END OF BOREHOLE																
7.6	NOTE: 1. Open borehole dry upon completion of drilling.																

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



**GOLDER**

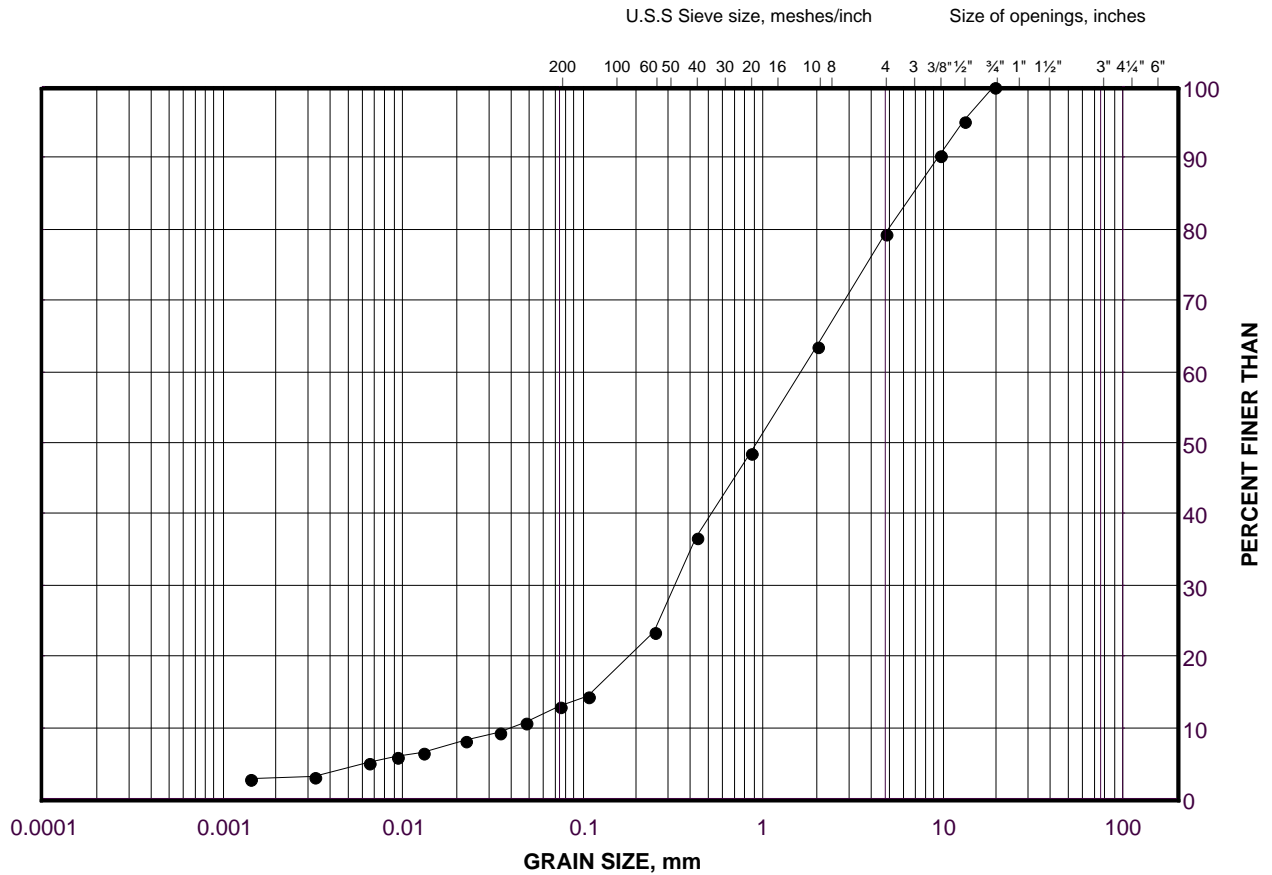
LOGGED: CC

CHECKED: AB

# GRAIN SIZE DISTRIBUTION

Gravelly Sand (FILL)  
(Noise Barrier Wall - Line 'A')

FIGURE D-1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	NW4-1	2B	99.8

Project Number: 1662333

Checked By: SMM

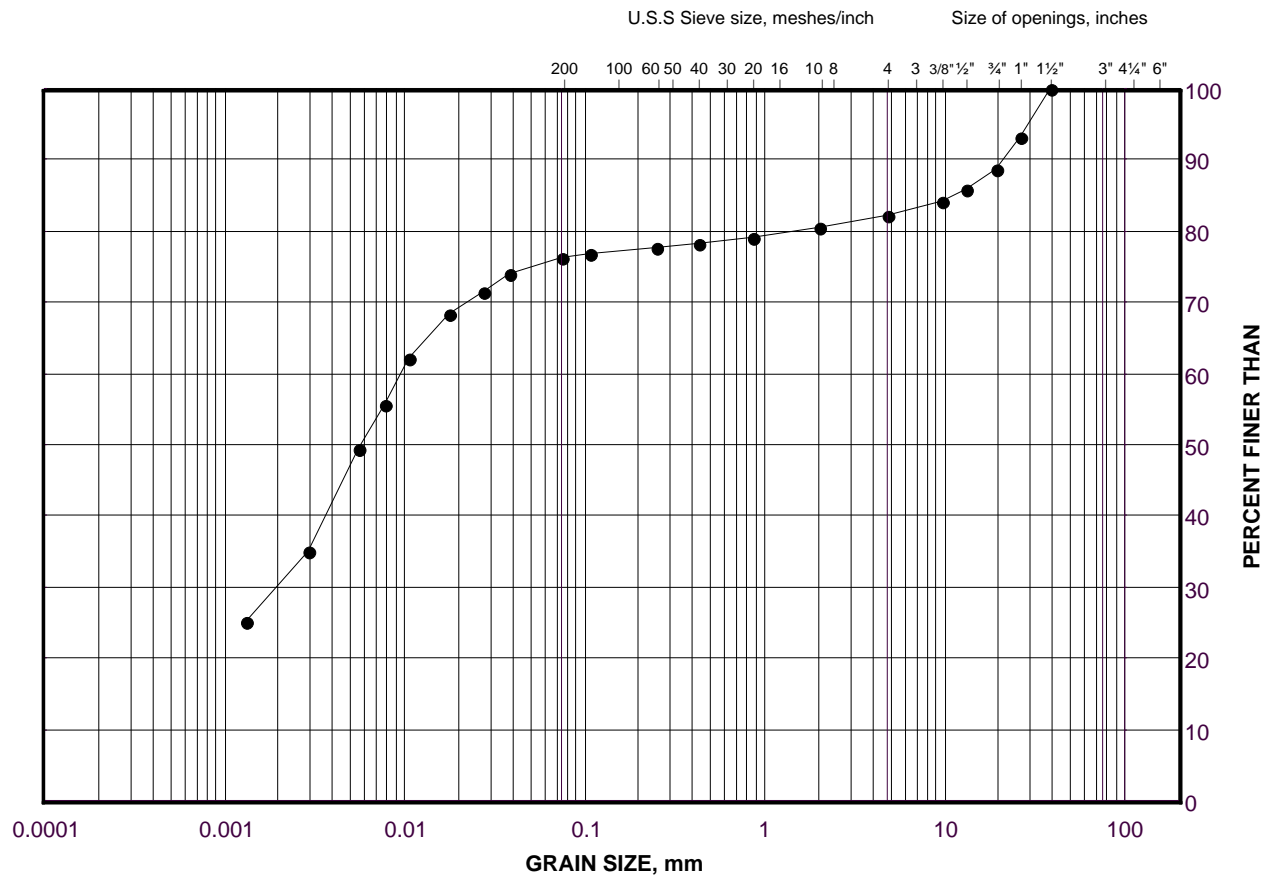
**Golder Associates**

Date: 12-Mar-19

# GRAIN SIZE DISTRIBUTION

Silty Clay  
(Noise Barrier Wall - Line 'A')

FIGURE D-2



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

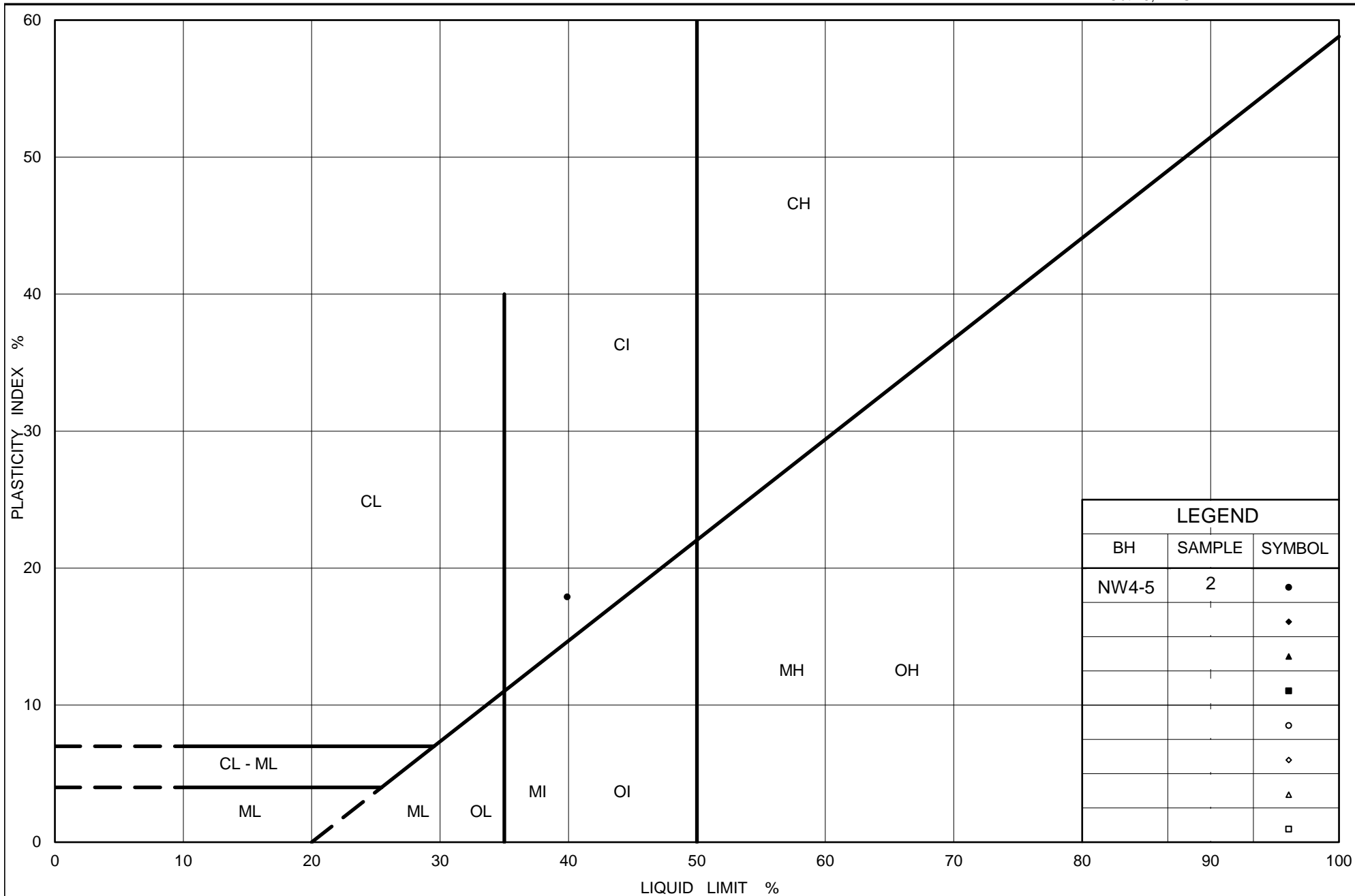
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	NW4-5	2	99.3

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 29-Apr-19



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Ontario

# PLASTICITY CHART Silty Clay (Noise Barrier Wall - Line 'A')

Figure No. D-3

Project No. 1662333

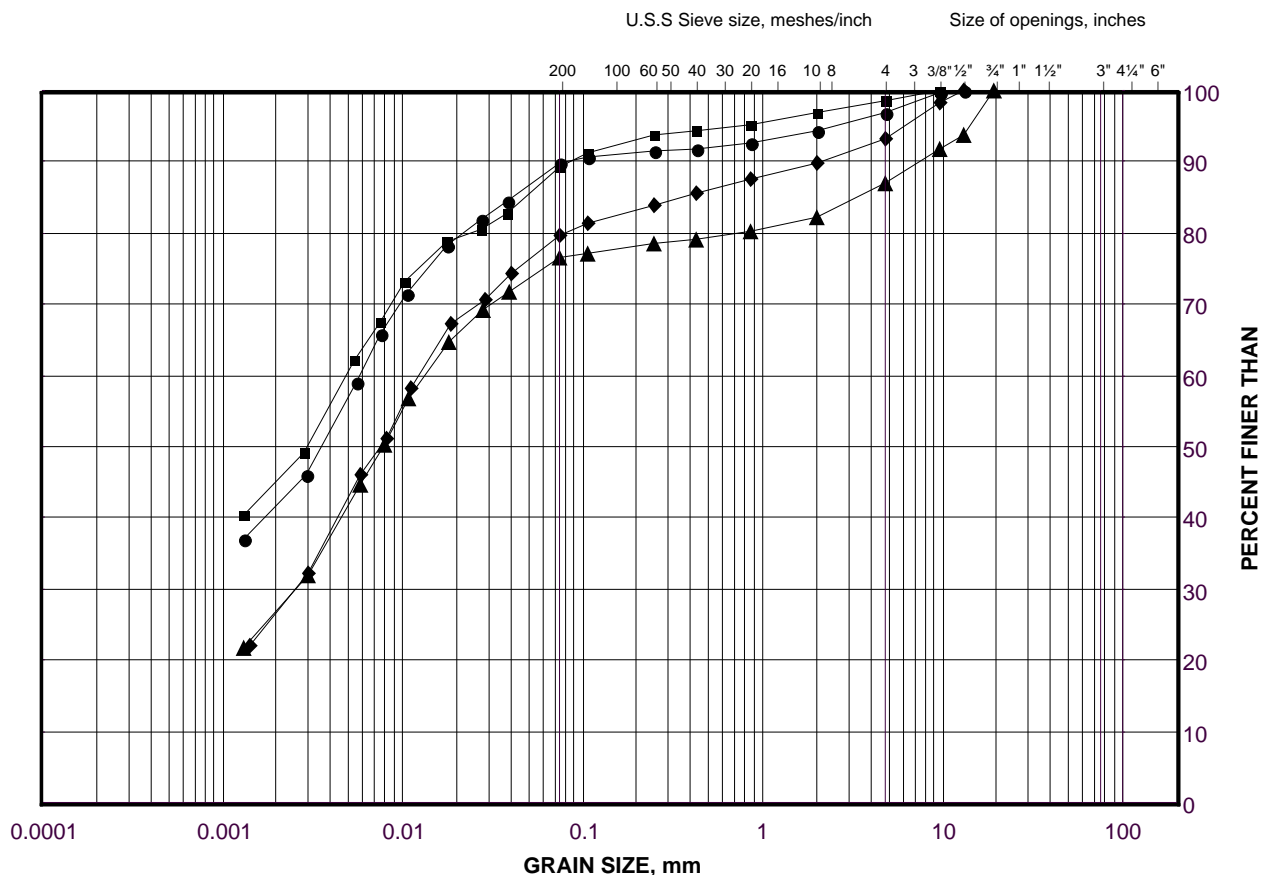
Checked By: SMM



# GRAIN SIZE DISTRIBUTION

Silty Clay (TILL)  
(Noise Barrier Wall - Line 'A')

FIGURE D-4



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

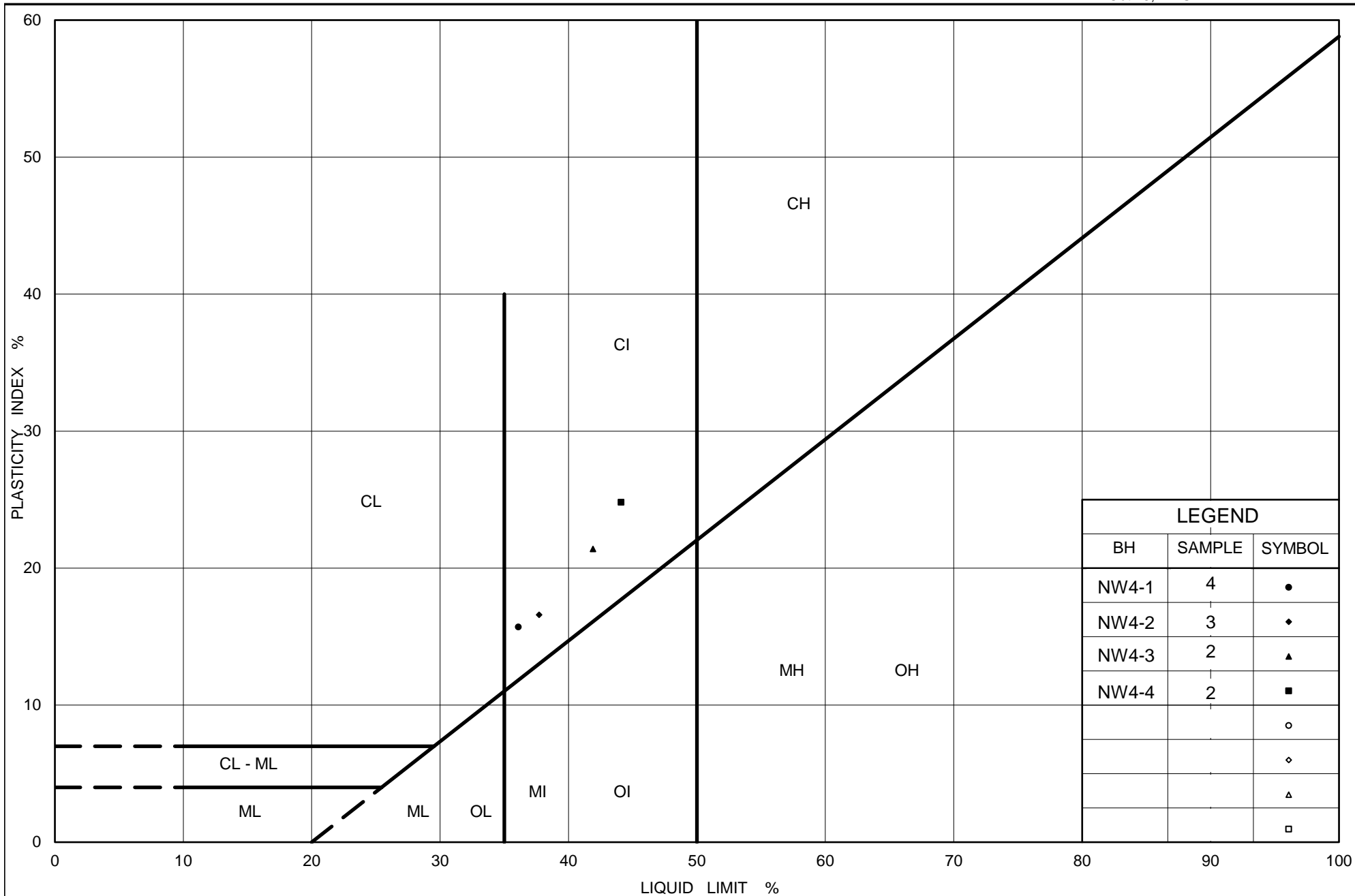
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW4-3	2	99.5
■	NW4-4	2	99.4
◆	NW4-2	3	98.9
▲	NW4-1	4	98.4

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 29-Apr-19



Ministry of Transportation

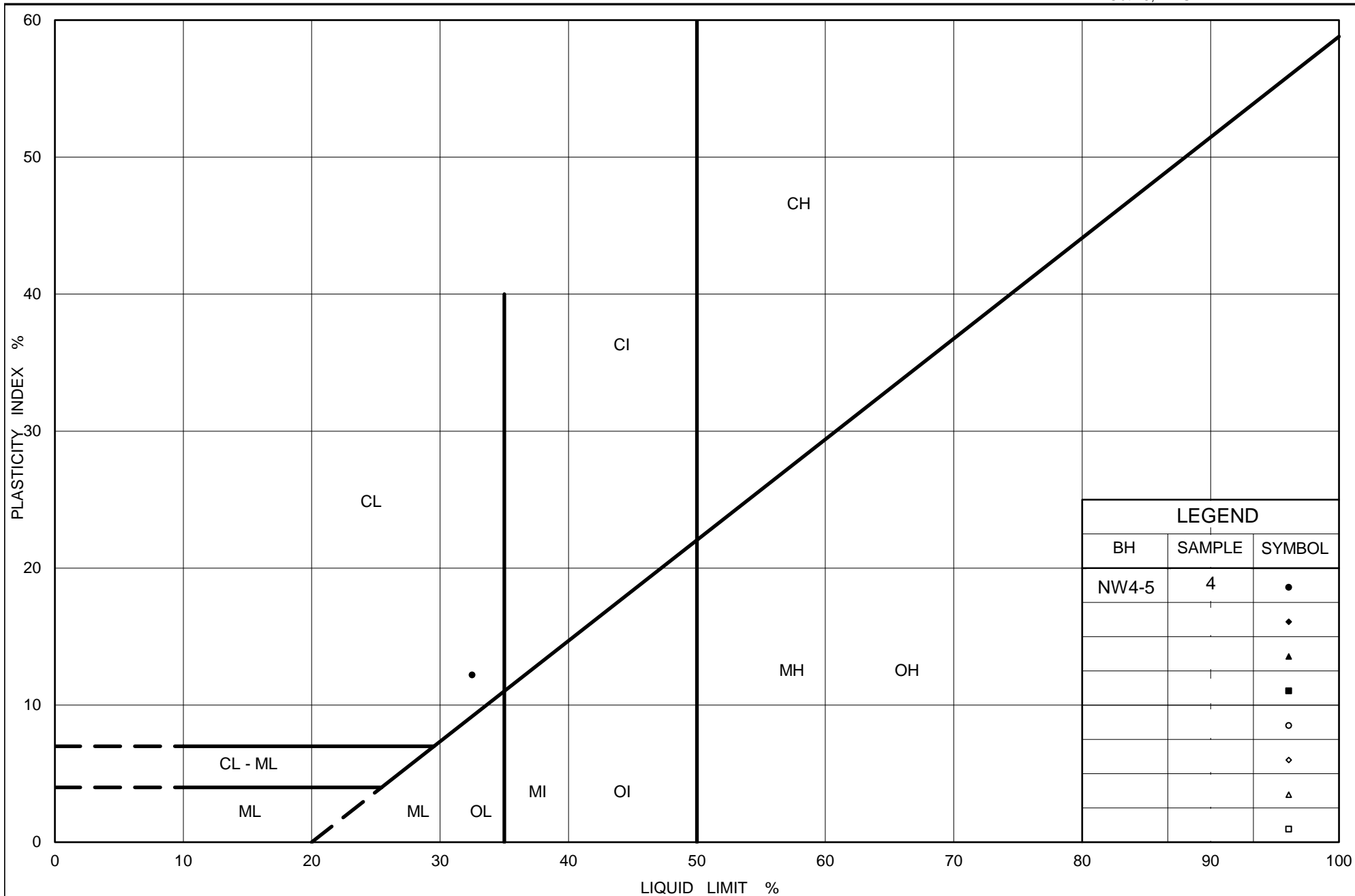
Ontario

# PLASTICITY CHART Silty Clay (TILL) (Noise Barrier Wall - Line 'A')

Figure No. D-5

Project No. 1662333

Checked By: SMM



Ministry of Transportation

Ontario

## PLASTICITY CHART

Inferred Completely to Moderately Weathered Shale (Bedrock)  
(Noise Barrier Wall - Line 'A')

Figure No. D-6

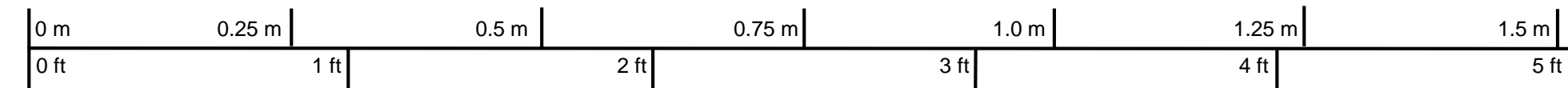
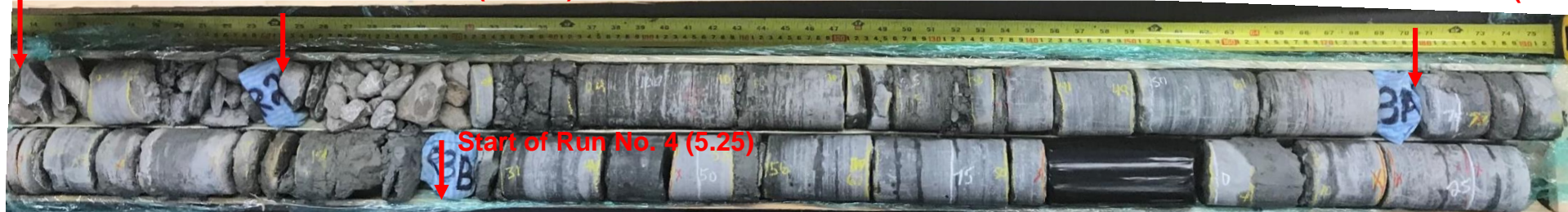
Project No. 1662333

Checked By: SMM


Start of Run No. 1 (3.27 m)

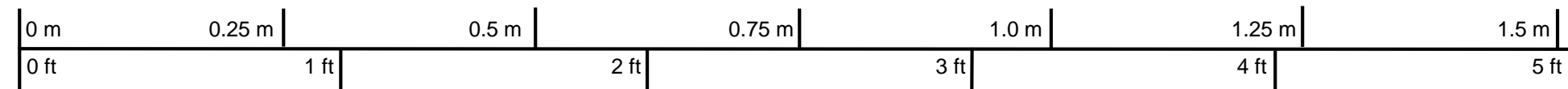
Start of Run No. 2 (3.43 m)

Start of Run No. 3 (4.72 m)




Scale

PROJECT		MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street				
TITLE		Bedrock Core Photograph Borehole NW4-1 (3.27 m to 6.32 m)				
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE D-7</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			



Scale

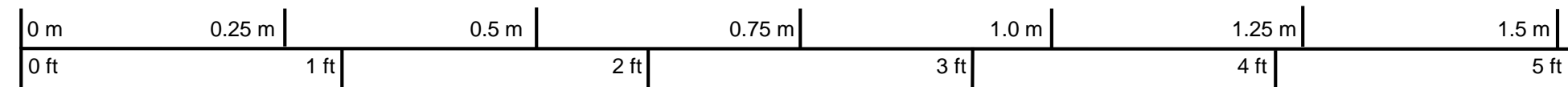
PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole NW4-2 (3.00 m to 6.27 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE D-8</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

Start of Run No. 1 (3.05 m)


Start of Run No. 2 (3.28 m)

Start of Run No. 3 (4.80 m)

Start of Run No. 4 (6.38 m)



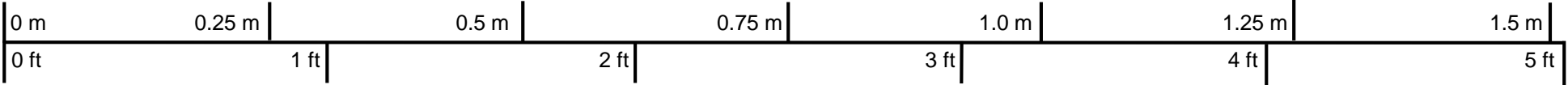
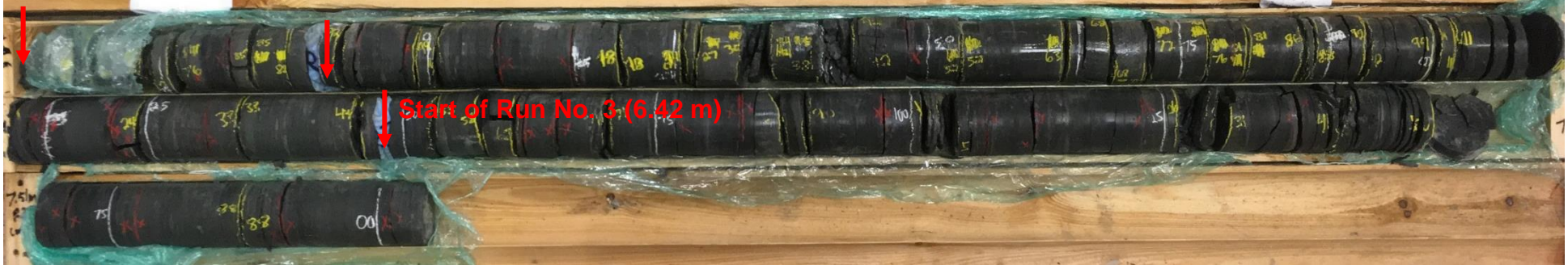
Scale

PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole NW4-3 (3.05 m to 7.71 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE D-9</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			




REVISION DATE: August 21, 2018 BY: SE Project: 1662333

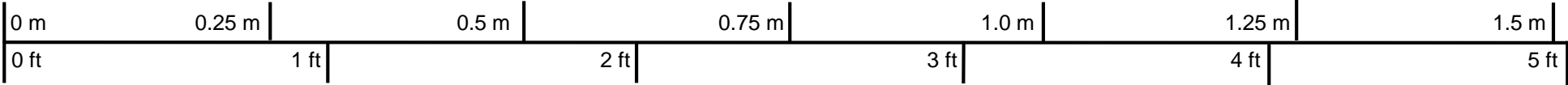
Start of Run No. 1 (4.42 m) Start of Run No. 2 (4.90 m)




Scale

PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE Bedrock Core Photograph Borehole NW4-4 (4.42 m to 8.00 m)						
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE D-10		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

REVISION DATE: August 21, 2018 BY: SE Project: 1662333



Scale

PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE Bedrock Core Photograph Borehole NW4-5 (4.12 m to 7.63 m)						
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE D-11		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			



**APPENDIX E**

**NOISE BARRIER WALL - Line 'C'**  
**Ramp Sta 10+033 to Sta 10+227,**  
**QEW Sta 16+518 to Sta 16+663**

PROJECT 1662333		RECORD OF BOREHOLE No NW5-1				SHEET 1 OF 1			METRIC			
G.W.P. 2002-13-00		LOCATION N 4823619.2; E 295758.0 MTM NAD 83 ZONE 10 (LAT. 43.552445; LONG. -79.611908)				ORIGINATED BY ACM						
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 108 mm I.D. Hollow Stem Augers				COMPILED BY SK						
DATUM Geodetic		DATE August 2, 2018				CHECKED BY SMM						
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa	W <sub>p</sub>	W	W <sub>L</sub>	
97.1	GROUND SURFACE							20 40 60 80 100				
0.0	TOPSOIL (300 mm)		1A	SS	9		97	20 40 60 80 100				
96.8			1B	SS								
0.3	SILTY CLAY, trace to some sand, trace gravel, trace rootlets		2A	SS	23							
96.0	Stiff to very stiff Grey-brown with oxidation staining Moist		2B	SS			96					
1.1	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		3	SS	50/0.08							
95.4	- Auger grinding from 1.5 m to 1.8 m depth		4	SS	50/0.13		95					
1.7	SHALE (BEDROCK)		5	SS	50/0.13							
	Grey Moderately weathered to 3.5 m depth to slightly weathered below 3.5 m depth		1	RC	REC 83%		94					
	Bedrock cored from a depth of 3.1 m to 6.6 m.		2	RC	REC 98%		93					
	For bedrock coring details, refer to Record of Drillhole NW5-1.		3	RC	REC 100%		92					
							91					
90.5	END OF BOREHOLE											
6.6	NOTES:											
	1. Open borehole dry upon completion of soil drilling.											
	2. Groundwater level measurements in piezometer:											
	Date Depth (m) Elev. (m)											
	14/08/18 3.3 93.8											
	06/11/18 3.1 94.0											



PROJECT		1662333		RECORD OF BOREHOLE No NW5-2				SHEET 1 OF 1		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4823694.5; E 295773.3 MTM NAD 83 ZONE 10 (LAT. 43.553123; LONG. -79.611720)				ORIGINATED BY		AM					
DIST		Central HWY QEW		BOREHOLE TYPE		73 mm O.D. Washbore Casing, Cat Head/Safety Hammer				COMPILED BY		DH					
DATUM		Geodetic		DATE		September 9, 2018				CHECKED BY		SMM					
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									
97.3	GROUND SURFACE																
0.0	TOPSOIL (300 mm)		1A	SS	11												0 88 (22)
0.3	Sand, some silt, trace clay (FILL) Compact Brown, oxidation staining Moist		1B														
			2	SS	20												
96.0																	
1.3	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		3A	SS	100/0.23												21 37 25 17
			3B														
			4A	SS	100/0.10												
			4B														
95.1																	
2.2	SHALE (BEDROCK) Grey Slightly weathered		1	RC	REC 100%												RQD = 22%
	Bedrock cored from a depth of 2.2 m to 5.6 m.		2	RC	REC 86%												RQD = 0%
			3	RC	REC 89%												RQD = 0%
	For bedrock coring details, refer to Record of Drillhole NW5-2.		4	RC	REC 100%												RQD = 77%
			5	RC	REC 46%												RQD = 29%
			6	RC	REC 37%												RQD = 37%
			7	RC	REC 48%												RQD = 3%
91.7																	
5.6	END OF BOREHOLE																
NOTES: 1. Water level measured at a depth of approximately 1.0 m below ground surface (Elev. 96.3 m) upon completion of soil drilling; however, water added for washboring.																	

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



**GOLDER**

LOGGED: AM

CHECKED: AB

PROJECT		1662333		RECORD OF BOREHOLE No NW5-3				SHEET 1 OF 1		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4823774.4; E 295776.0 MTM NAD 83 ZONE 10 (LAT. 43.553851; LONG. -79.611691)				ORIGINATED BY		CC					
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 150 mm O.D. Solid Stem Augers				COMPILED BY		SK					
DATUM		Geodetic		DATE		July 11, 2018				CHECKED BY		SMM					
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									
97.4	GROUND SURFACE																
0.0	ASPHALT (150 mm)																
0.2	Sand and gravel (FILL) Compact Brown Moist		1	SS	26												
96.5			2A														
96.1	Silty sand (FILL) Compact Brown, with oxidation staining Moist		2B	SS	17												
1.3			2C														
	Gravelly clayey silt with sand (FILL) Firm to very stiff Grey Moist		3	SS	9												
94.7			4	SS	7												
2.7	Inferred completely to highly weathered, grey, extremely weak to very weak SHALE (Georgian Bay Formation)		5	SS	50/0.08												
94.3																	
3.1	END OF BOREHOLE SPLIT-SPOON REFUSAL																
NOTE: 1. Open borehole dry upon completion of soil drilling. 2. Borehole NW5-3A advanced 1.5 m east.																	

PROJECT 1662333		RECORD OF BOREHOLE No NW5-3A				SHEET 1 OF 1		METRIC								
G.W.P. 2002-13-00		LOCATION N 4823772.7; E 295775.0 MTM NAD 83 ZONE 10 (LAT. 43.553836; LONG. -79.611704)				ORIGINATED BY CC										
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 150 mm O.D. Solid Stem Augers				COMPILED BY SK										
DATUM Geodetic		DATE July 11, 2018				CHECKED BY SMM										
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								
97.4 0.0	GROUND SURFACE															
	Refer to Record of Borehole NW5-3 for stratigraphy details.															
94.8																
2.8	Inferred completely to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation) (BEDROCK) Grey Slightly weathered		1A	SS	100/0.10											
			1B													
			1	RC	REC 0%											RQD = 0%
	Bedrock cored from a depth of 3.1 m to 8.0 m.		2	RC	REC 88%											RQD = 24%
	For bedrock coring details, refer to Record of Drillhole NW5-3A.		3	RC	REC 100%											RQD = 94%
			4	RC	REC 100%											RQD = 87%
89.4 8.0	END OF BOREHOLE															
	NOTES: 1. Open borehole dry upon completion of soil drilling.															

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PROJECT 1662333		RECORD OF BOREHOLE No NW5-4				SHEET 1 OF 1		METRIC								
G.W.P. 2002-13-00		LOCATION N 4823869.2; E 295818.3 MTM NAD 83 ZONE 10 (LAT. 43.554705; LONG. -79.611169)				ORIGINATED BY ACM										
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 114 mm I.D., Hollow Stem Augers				COMPILED BY SK										
DATUM Geodetic		DATE July 12, 2018				CHECKED BY SMM										
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								
96.3	GROUND SURFACE															
0.0	CONCRETE (610 mm)															
95.7																
95.4	Gravelly sand, trace to some silt (FILL)		1A	SS	15											
0.9	Compact Brown Moist		1B													
94.6	Silt and sand, trace to some clay (FILL)		2A	SS	6											
1.7	Loose to compact Brown Moist		2B													
94.0			3A	SS	65											
93.6	CLAYEY SILT, some sand, some gravel		3B													
2.7	Firm		4	SS	100/0.18											
	Moist		1	RC	REC 100%											
	- Trace organics encountered between depths of about 1.7 m and 1.8 m															
	Inferred highly to moderately weathered, brown to grey, extremely weak to weak SHALE (Georgian Bay Formation)		2	RC	REC 86%											
	SHALE (BEDROCK)															
	Grey Slightly weathered															
	- Auger grinding from 2.7 m to 2.9 m		3	RC	REC 97%											
	Bedrock cored from a depth of 3.2 m to 6.8 m.															
	For bedrock coring details, refer to Record of Drillhole NW5-4.		4	RC	REC 79%											
89.5	END OF BOREHOLE															
6.8	NOTE: 1. Open borehole dry upon completion of soil drilling.															

GTA-MTO 001 S:\CLIENTS\MTQEW-CREDIT\_RIVER\02\_DATA\INTQEW-CREDIT\_RIVER.GPJ GAL-GTA.GDT 19-5-15

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Aardvark Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

LOGGED: ACM

CHECKED: AB

DATA\GINT\QEW-CREDIT RIVER\02 DATA\GINT\QEW-CREDIT RIVER.GPJ GAL-MISS.GDT 19-5-15



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

PROJECT		1662333		<b>RECORD OF BOREHOLE No NW5-5A</b>				SHEET 1 OF 1		<b>METRIC</b>							
G.W.P.		2002-13-00		LOCATION		N 4823930.6; E 295851.9 MTM NAD 83 ZONE 10 (LAT. 43.555219; LONG. -79.610772)				ORIGINATED BY							
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 152 mm O.D., Solid Stem Augers				COMPILED BY							
DATUM		Geodetic		DATE		July 15, 2018				CHECKED BY							
SMM																	
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									
95.8 0.0	GROUND SURFACE							20	40	60	80	100					
	Refer to Record of Borehole NW5-5 for stratigraphy details.  SHALE (BEDROCK) Grey Highly weathered to 5.0 m depth to slightly weathered to fresh below 5.0 m depth.  Bedrock cored from a depth of 4.2 m to 8.6 m.  For bedrock coring details, refer to Record of Drillhole NW5-5A.																
92.0 3.8			1	SS	100/0.23												
			1	RC	REC 96%												RQD = 0%
			2	RC	REC 97%												RQD = 84%
			3	RC	REC 100%												RQD = 100%
			4	RC	REC 100%												RQD = 94%
87.2 8.6	END OF BOREHOLE																
	NOTES:  1. Borehole advanced 2.0 m offset of borehole NW5-5A.  2. Open borehole dry upon completion of soil drilling.																

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\INT\QEW-CREDIT\_RIVER.GPJ GAL-GTA.GDT 19-5-15

DATUM: Geodetic

DRILL RIG: CME 75

DRILLING CONTRACTOR: Davis Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



# GOLDER

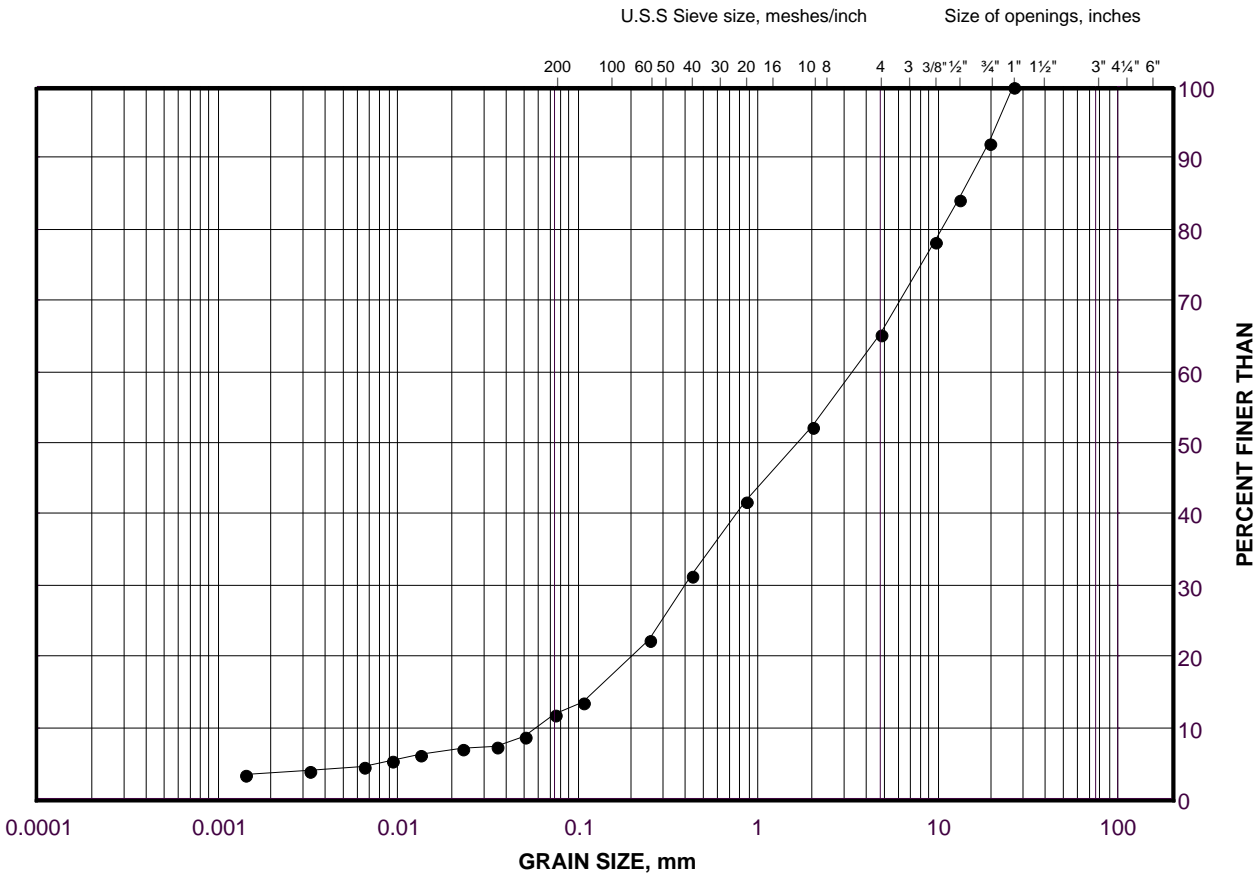
LOGGED: CC

CHECKED: AB

# GRAIN SIZE DISTRIBUTION

Sand and Gravel (FILL)  
(Noise Barrier Wall - Line 'C')

FIGURE E-1



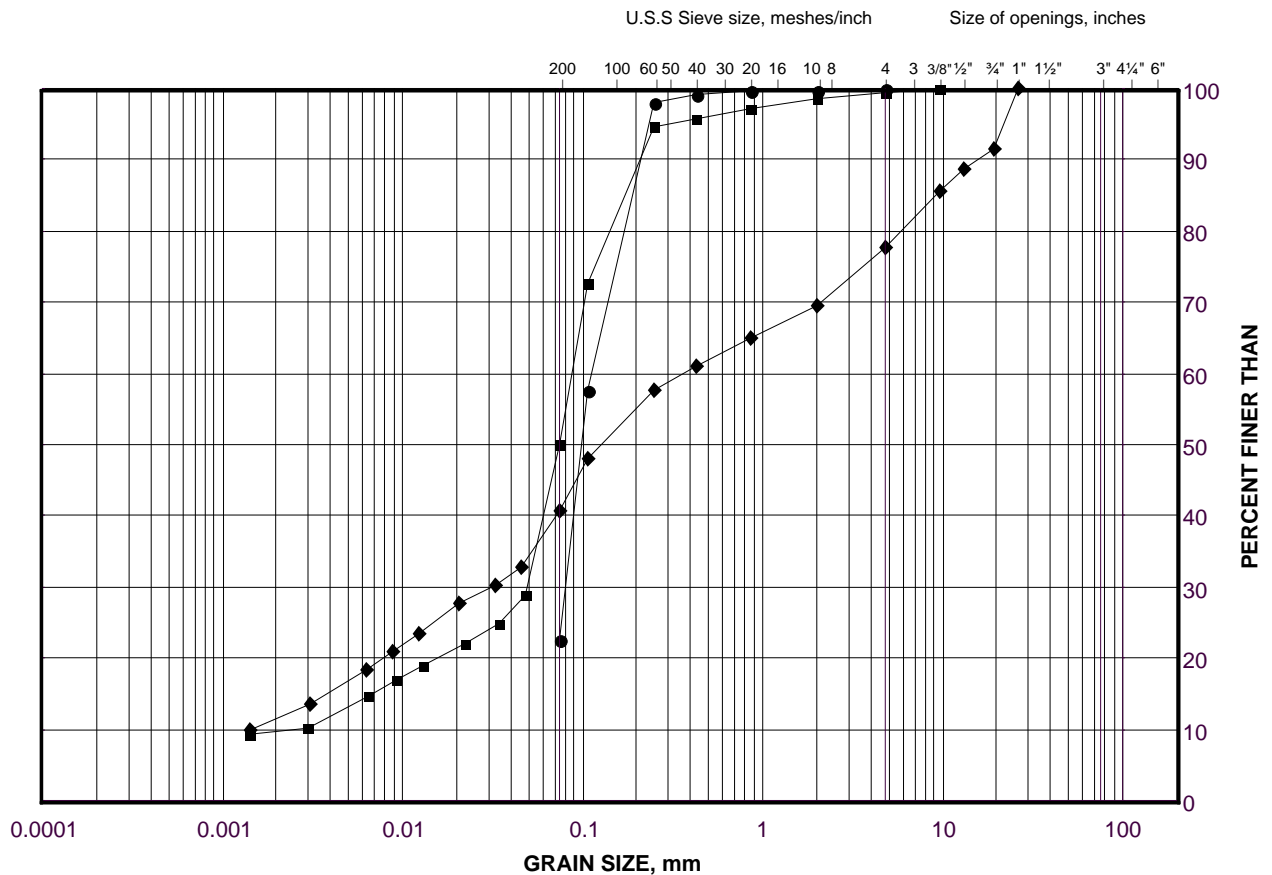
## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	NW5-5	1	95.2

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Gravelly Clayey Silt with Sand (FILL)  
(Noise Barrier Wall - Line 'C')

FIGURE E-2



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW5-2	1B	97.0
■	NW5-4	2A	94.8
◆	NW5-3	3	95.6

Project Number: 1662333

Checked By: SMM

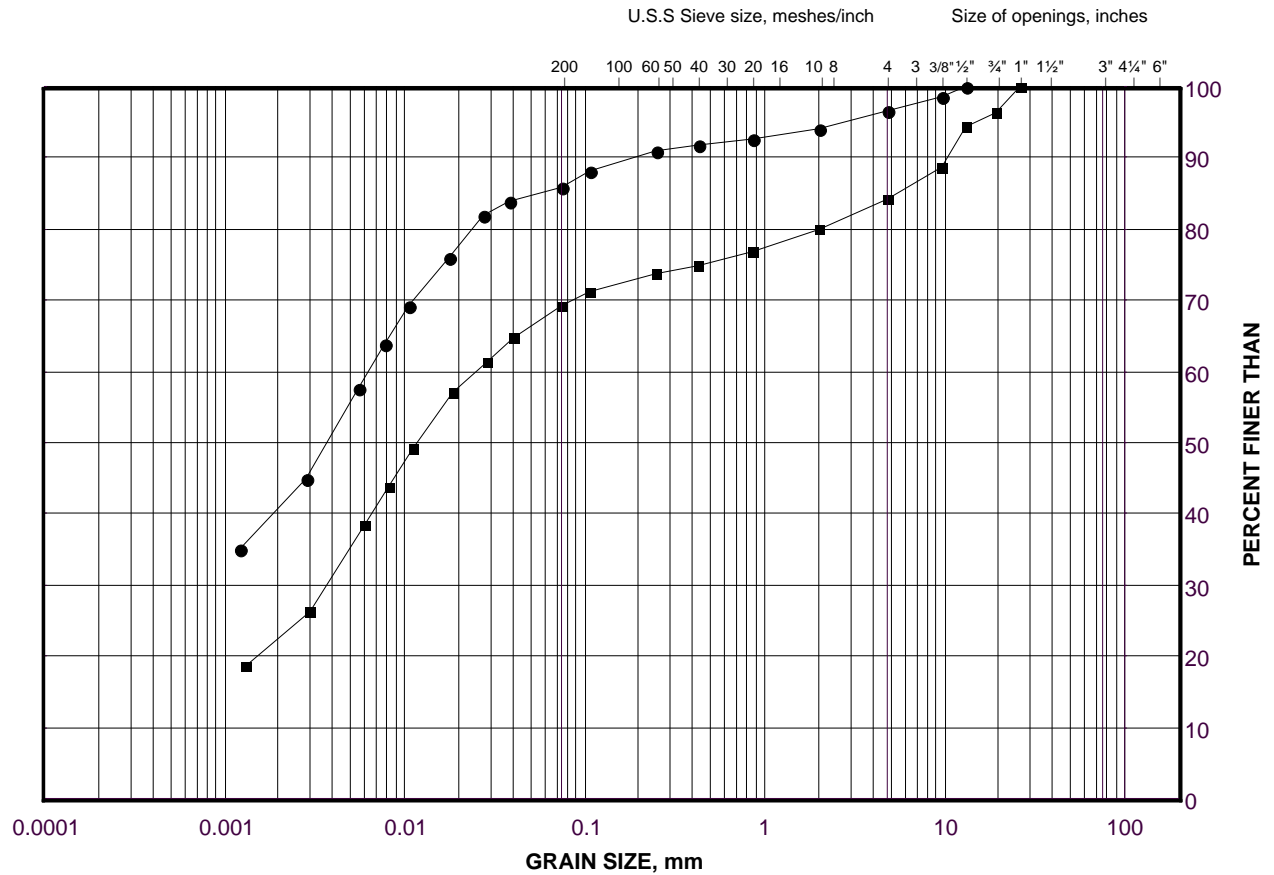
**Golder Associates**

Date: 29-Apr-19

# GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay  
(Noise Barrier Wall - Line 'C')

FIGURE E-3



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW5-1	2A	96.2
■	NW5-4	3A	94.1

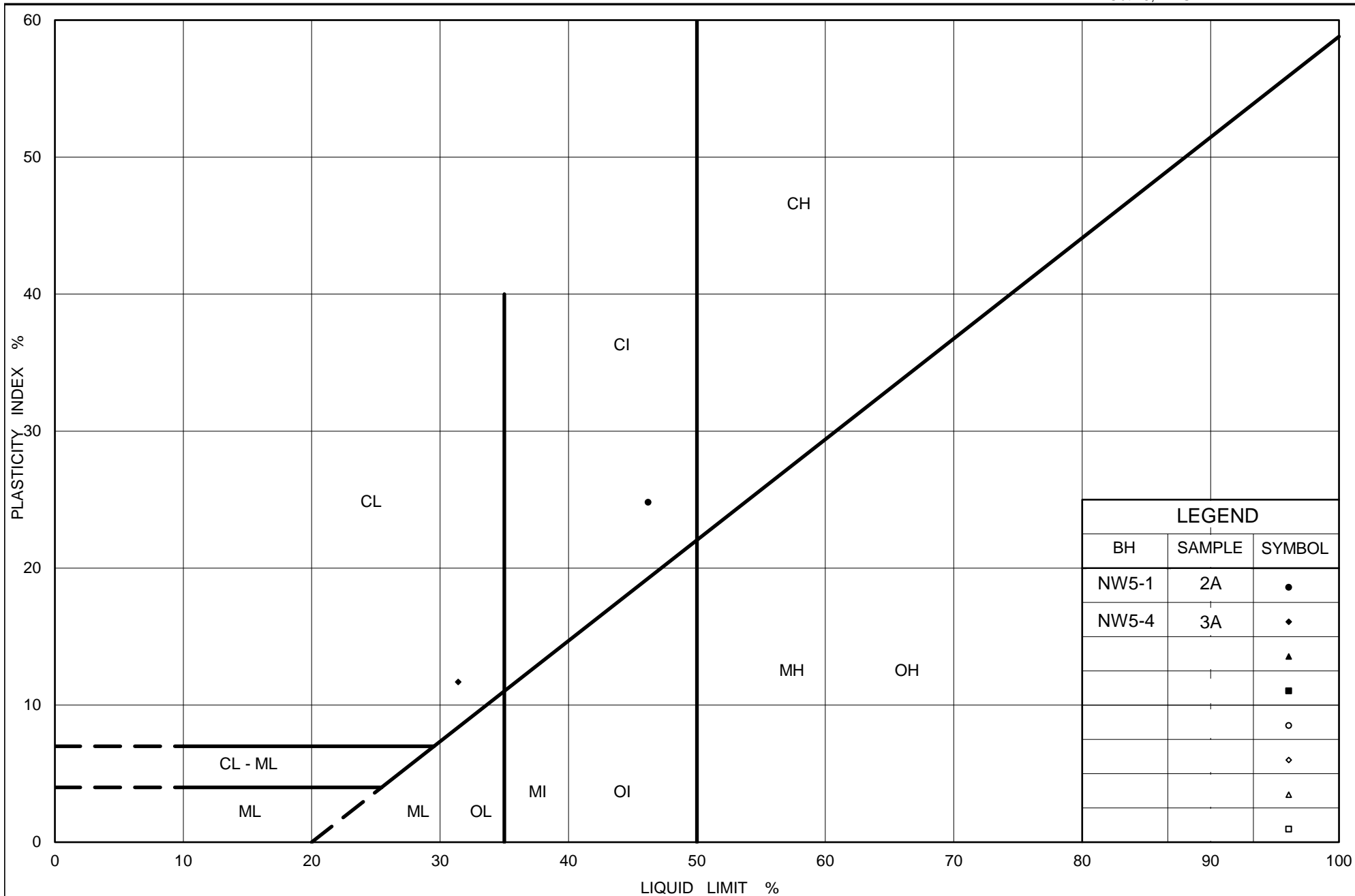
Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 29-Apr-19





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# PLASTICITY CHART Clayey Silt to Silty Clay (Noise Barrier Wall - Line 'C')

Figure No. E-4

Project No. 1662333

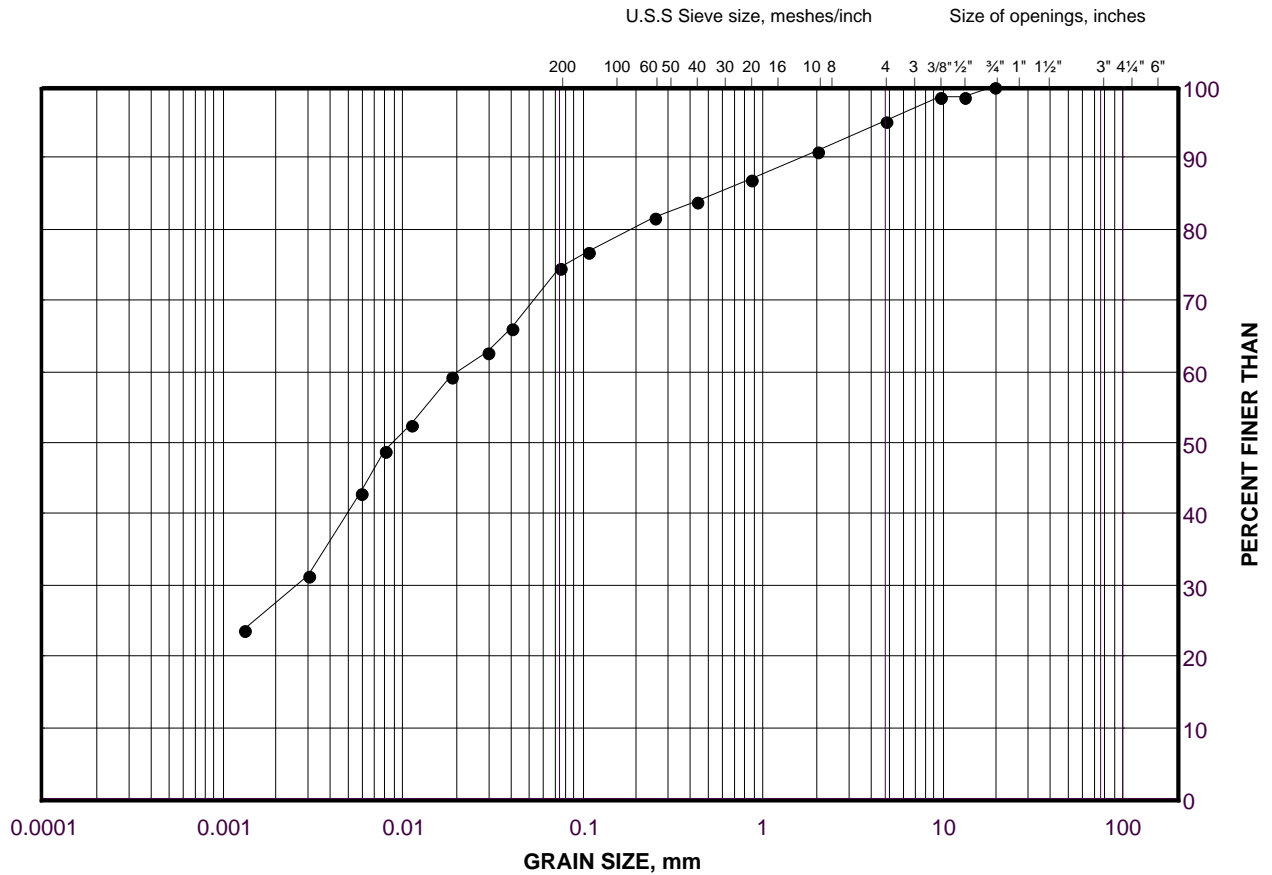
Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Sandy Silty Clay (Residual Soil)

(Noise Barrier Wall - Line 'C')

FIGURE E-5



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

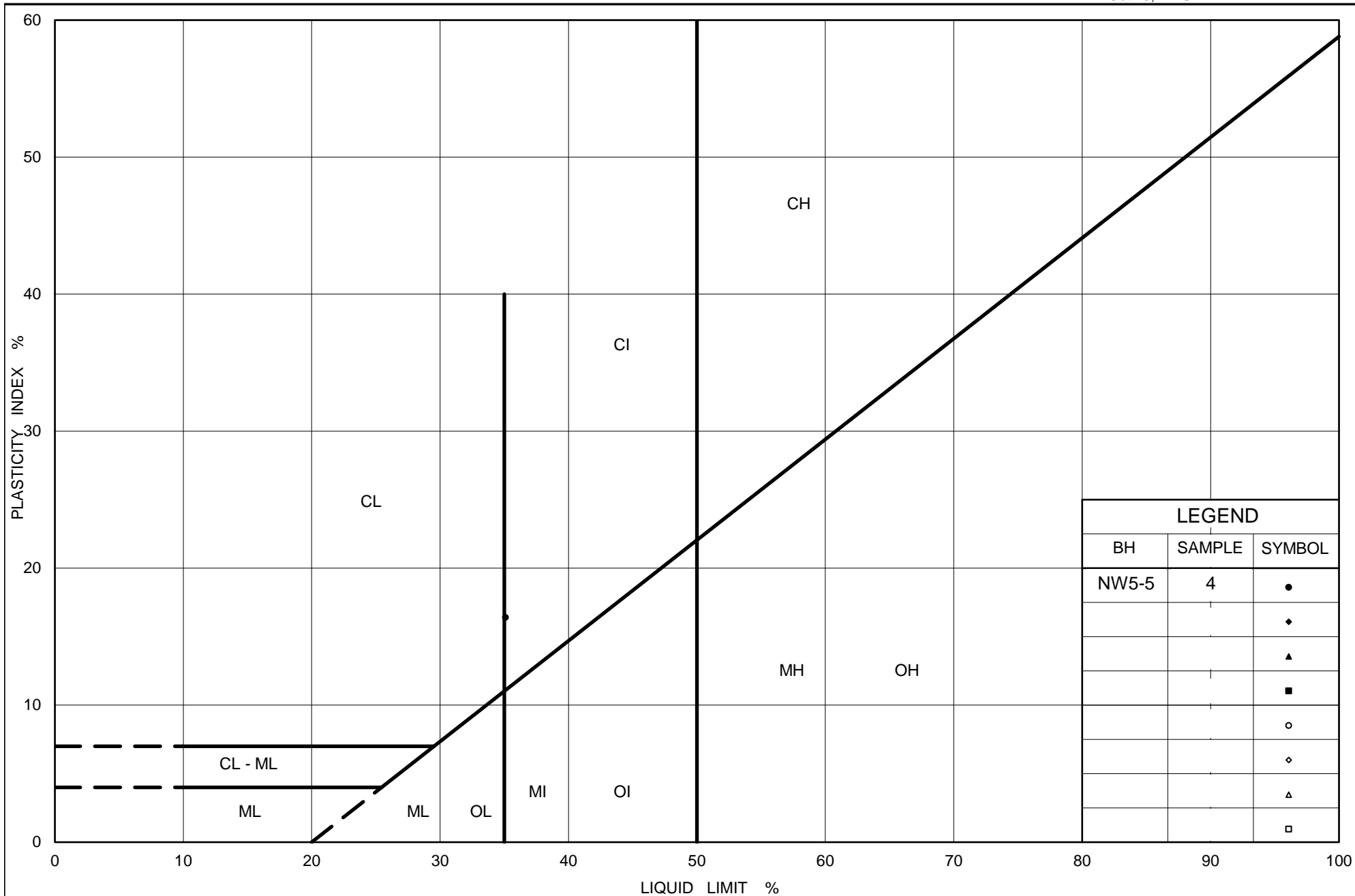
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	NW5-5	4	93.2

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 29-Apr-19



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# **PLASTICITY CHART** Sandy Silty Clay (Residual Soil) (Noise Barrier Wall - Line 'C')

Figure No. E-6

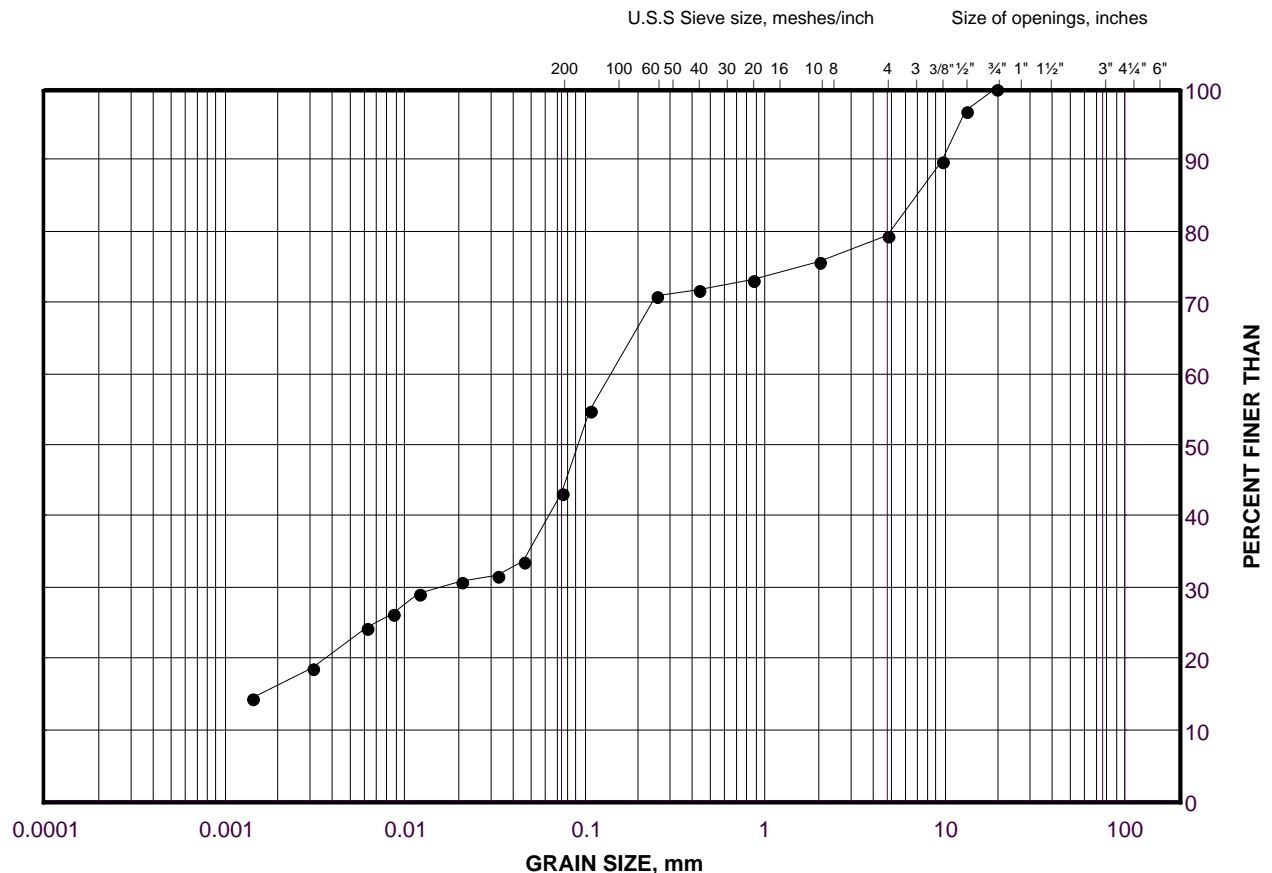
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Inferred Completely to Moderately Weathered Shale (Bedrock)  
(Noise Barrier Wall - Line 'C')

FIGURE E-7



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	NW5-2	3A	96.0

## NOTES:

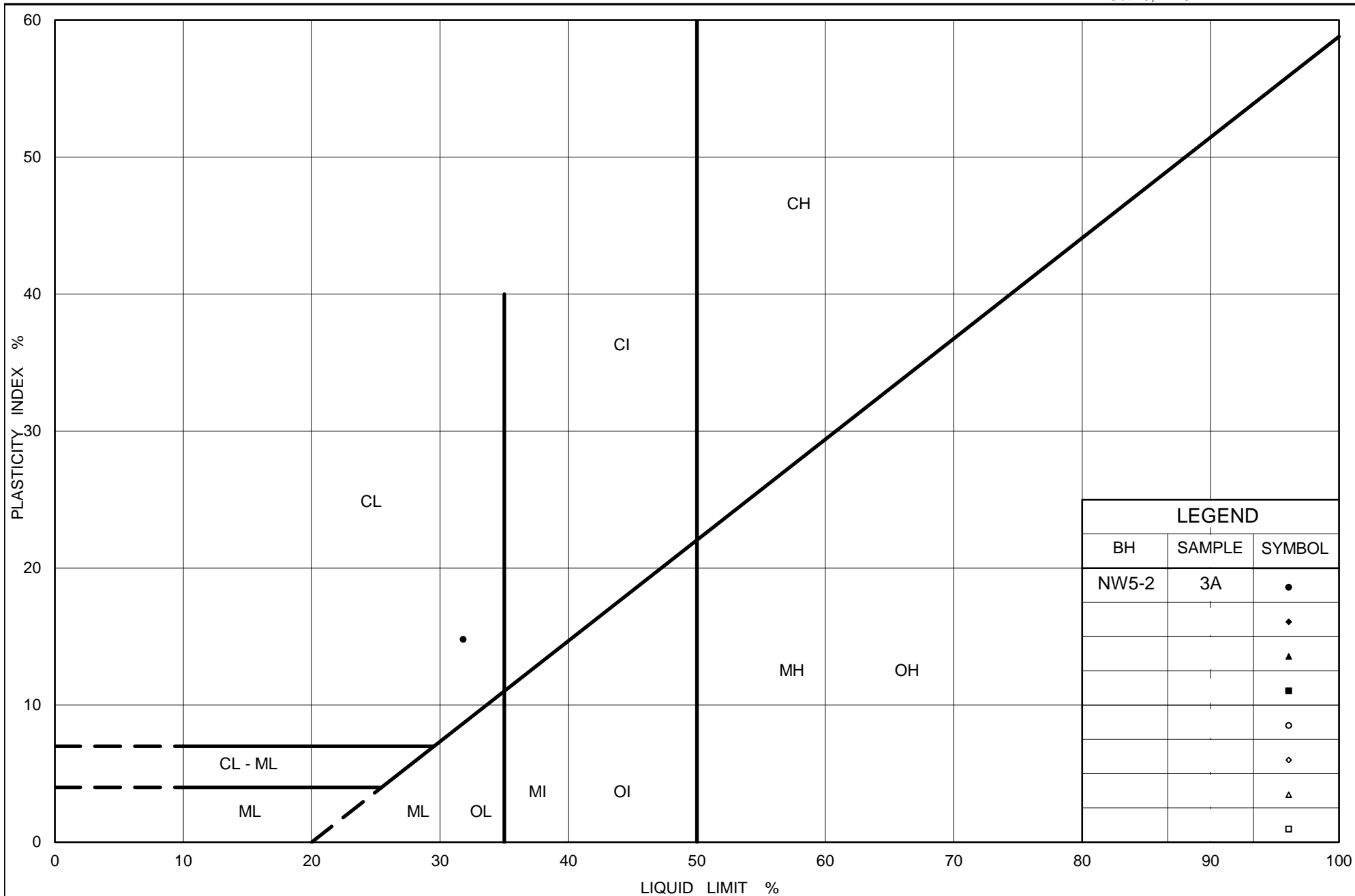
1. The samples of inferred completely to moderately weathered bedrock were obtained by split-spoon sampling, and as such, the particle size(s) are effected by the sampling method and are limited to the size of the sampler. Larger fragments of shale bedrock may be present in-situ.
2. The percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behavior of the in-situ or excavated completely to moderately weathered shale bedrock.

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 29-Apr-19



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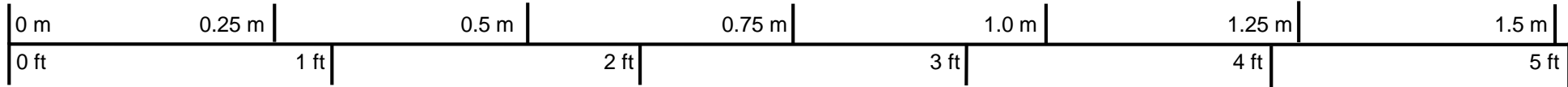
## PLASTICITY CHART

Inferred Completely to Moderately Weathered Shale (Bedrock)  
(Noise Barrier Wall - Line 'C')


Figure No. E-8

Project No. 1662333

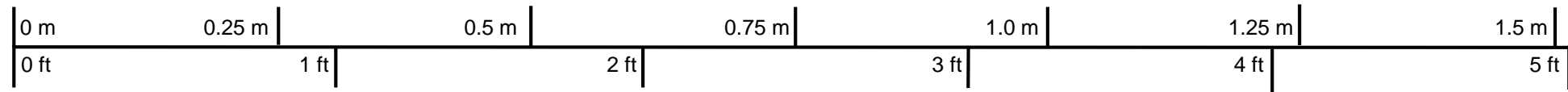
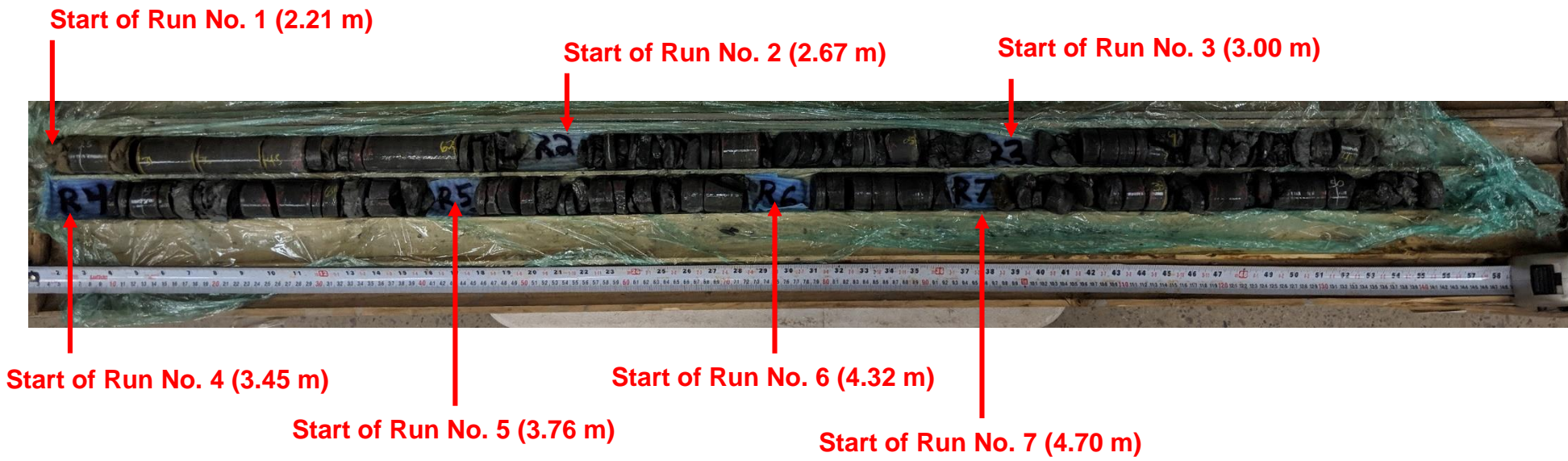
Checked By: SMM




Scale

PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE Bedrock Core Photograph Borehole NW5-1 (3.05 m to 6.63 m)						
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE E-9		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

REVISION DATE: August 21, 2018 BY: SE Project: 1662333

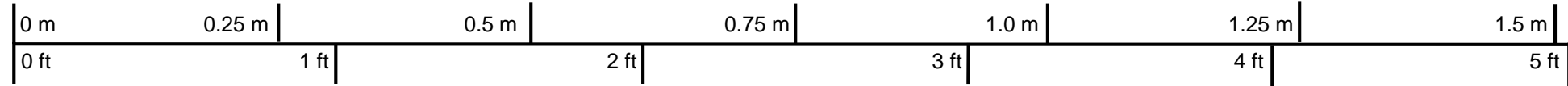


Scale


PROJECT					
MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street					
TITLE					
Bedrock Core Photograph Borehole NW5-2 (2.21 m to 5.61 m)					
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----	
	DRAFT	SE	20180821	SCALE	AS SHOWN
	CADD	--		<b>FIGURE E-10</b>	
	CHECK	SMM	20190319		
	REVIEW	JMAC	20190321		
			VER. 1.		



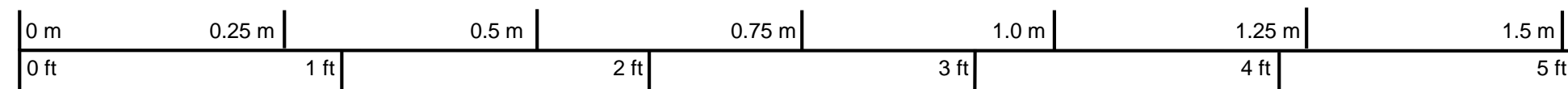
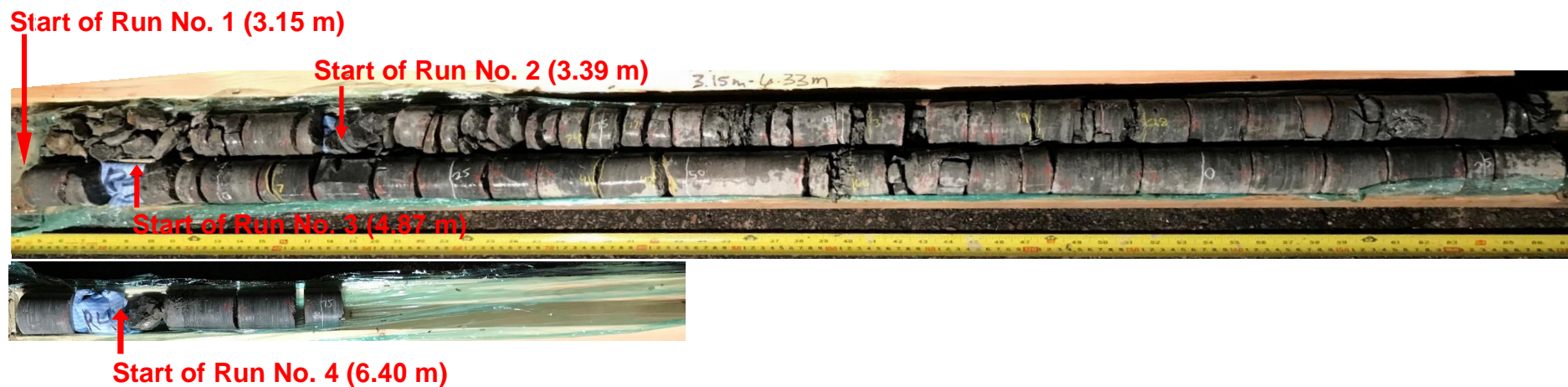
REVISION DATE: August 21, 2018 BY: SE Project: 1662333




Scale

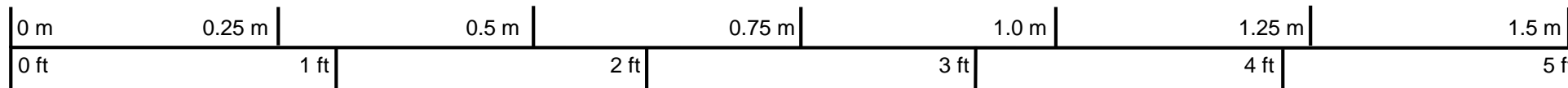
PROJECT MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street						
TITLE Bedrock Core Photograph Borehole NW5-3A (3.13 m to 7.97 m)						
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE E-11		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			






Scale

PROJECT					
MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street					
TITLE					
Bedrock Core Photograph Borehole NW5-4 (3.15 m to 6.78 m)					
 GOLDER			PROJECT No. 1662333		FILE No. ----
			DRAFT	SE	20180821
			CADD	--	
			CHECK	SMM	20190319
			REVIEW	JMAC	20190321
			SCALE	AS SHOWN	VER. 1.
FIGURE E-12					



Scale

PROJECT	MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street					
	TITLE Bedrock Core Photograph Borehole NW5-5A (4.19 m to 8.63 m)					
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE E-13</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

**APPENDIX F**

**NOISE BARRIER WALL - Line 'I'**  
**QEW Sta 16+918 to Sta 16+920**

PROJECT 1662333		RECORD OF BOREHOLE No NW6-1				SHEET 1 OF 1		METRIC						
G.W.P. 2002-13-00		LOCATION N 4824163.1; E 295975.2 MTM NAD 83 ZONE 10 (LAT. 43.557371; LONG. -79.609278)				ORIGINATED BY ACM								
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 108 mm I.D., Hollow Stem Augers				COMPILED BY SK								
DATUM Geodetic		DATE July 10, 2018				CHECKED BY SMM								
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						
95.3	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	ASPHALT (150 mm)													
0.3	CONCRETE (150 mm)													
	Gravelly sand to sand and gravel, some fines (FILL) Compact to very dense Brown Moist		1	SS	60									32 55 10 3
			2	SS	47									
			3	SS	40									21 60 (19)
			4	SS	10									
92.3														
3.0	Silty SAND, trace to some clay Very loose to dense Brown Moist		5	SS	4									
			6	SS	3									1 67 25 7
			7	SS	34									
90.0														
5.3	SILT, trace to some sand, trace to some clay Dense Brown to grey below 6.6 m depth Moist		8	SS	32									0 8 80 12
			9	SS	41									
			10A	SS	35									
88.0														
7.5	Sandy CLAYEY SILT, trace gravel (TILL) Hard Grey Moist END OF BOREHOLE		10B											3 22 50 25
NOTES: 1. Borehole caved to a depth of 6.4 m below ground surface upon removal of hollow stem augers. 2. Water level measured at a depth of 6.3 m (Elev. 89.0 m) below ground surface after removal of augers and borehole caved.														

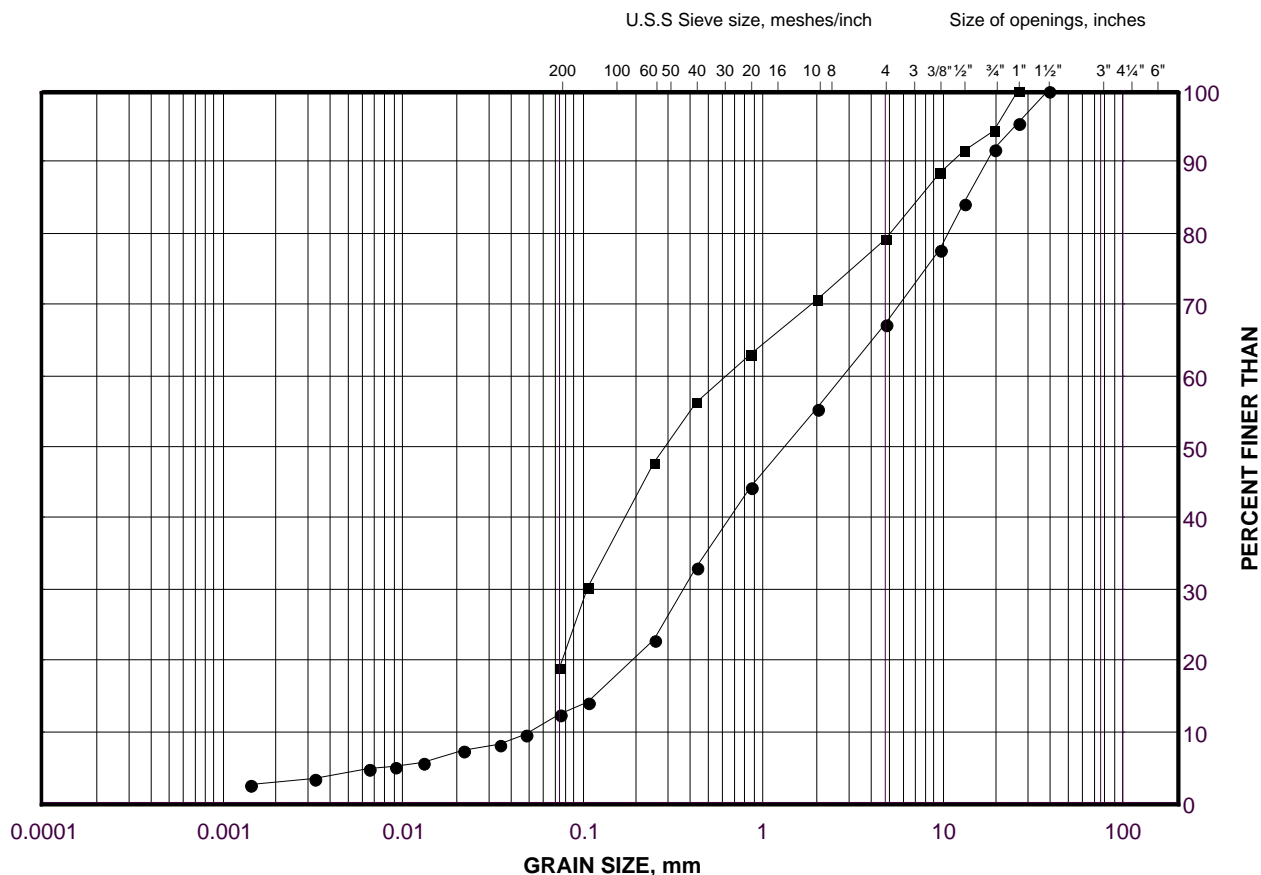
PROJECT		1662333		RECORD OF BOREHOLE No NW6-2		SHEET 1 OF 1		METRIC								
G.W.P.		2002-13-00		LOCATION		N 4824182.1; E 295985.5 MTM NAD 83 ZONE 10 (LAT. 43.557524; LONG. -79.609105)		ORIGINATED BY								
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 150 mm O.D. Solid Stem Augers		COMPILED BY								
DATUM		Geodetic		DATE		July 10, 2018		CHECKED BY								
								SMM								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
96.6	GROUND SURFACE															
0.0	ASPHALT (170 mm)															
	CONCRETE (250 mm)															
95.8	Gravelly sand (FILL) Brown Moist		1A	SS	8											
0.8	Silty sand (FILL) Very loose to loose Brown Moist		1B	SS	8											
			2	SS	3											
94.4																
2.2	SILT and SAND, trace clay Compact to dense Grey to brown Moist to wet below 3.0 m		3A	SS	32											
			3B	SS	32											
			4	SS	33											
	- 0.1 m sandy clayey silt layer at 4.4 m depth		5A	SS	32											
			5B	SS	32											
			6A	SS	25											
			6B	SS	25											
	- Wet sand pocket encountered between depths of about 5.6 m and 5.8 m		7	SS	43											
	- Clay pocket encountered between depths of about 5.8 m and 5.9 m		8	SS	26											
89.8																
6.8	Sandy CLAYEY SILT, trace to some gravel (TILL) Firm to very stiff Grey Wet		9	SS	7											
88.4			10	SS	15											
8.2	END OF BOREHOLE															
NOTES:																
1. Borehole caved to a depth of 5.2 m below ground surface upon removal of solid stem augers.																
2. Water level measured at a depth of about 4.3 m (Elev. 82.3 m) below ground surface after removal of augers and borehole caved.																

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# GRAIN SIZE DISTRIBUTION

Gravelly Sand to Sand and Gravel (FILL)  
(Noise Barrier Wall - Line 'I')

FIGURE F-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

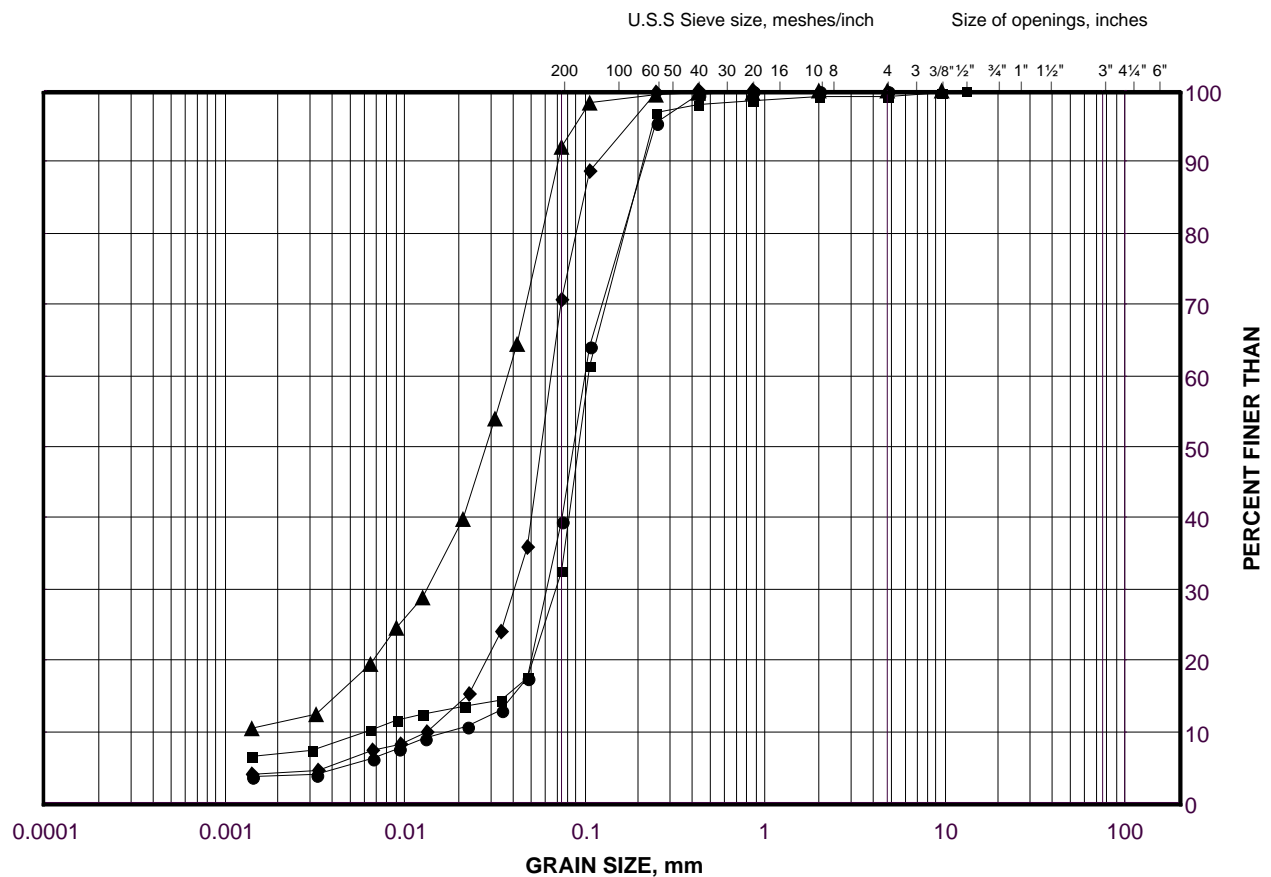
## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW6-1	1	94.7
■	NW6-1	3	93.5

# GRAIN SIZE DISTRIBUTION

Silt to Silty Sand  
(Noise Barrier Wall - Line 'I')

FIGURE F-2



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW6-2	4	93.2
■	NW6-1	6	91.2
◆	NW6-2	7	91.0
▲	NW6-1	8	89.7

Project Number: 1662333

Checked By: SMM

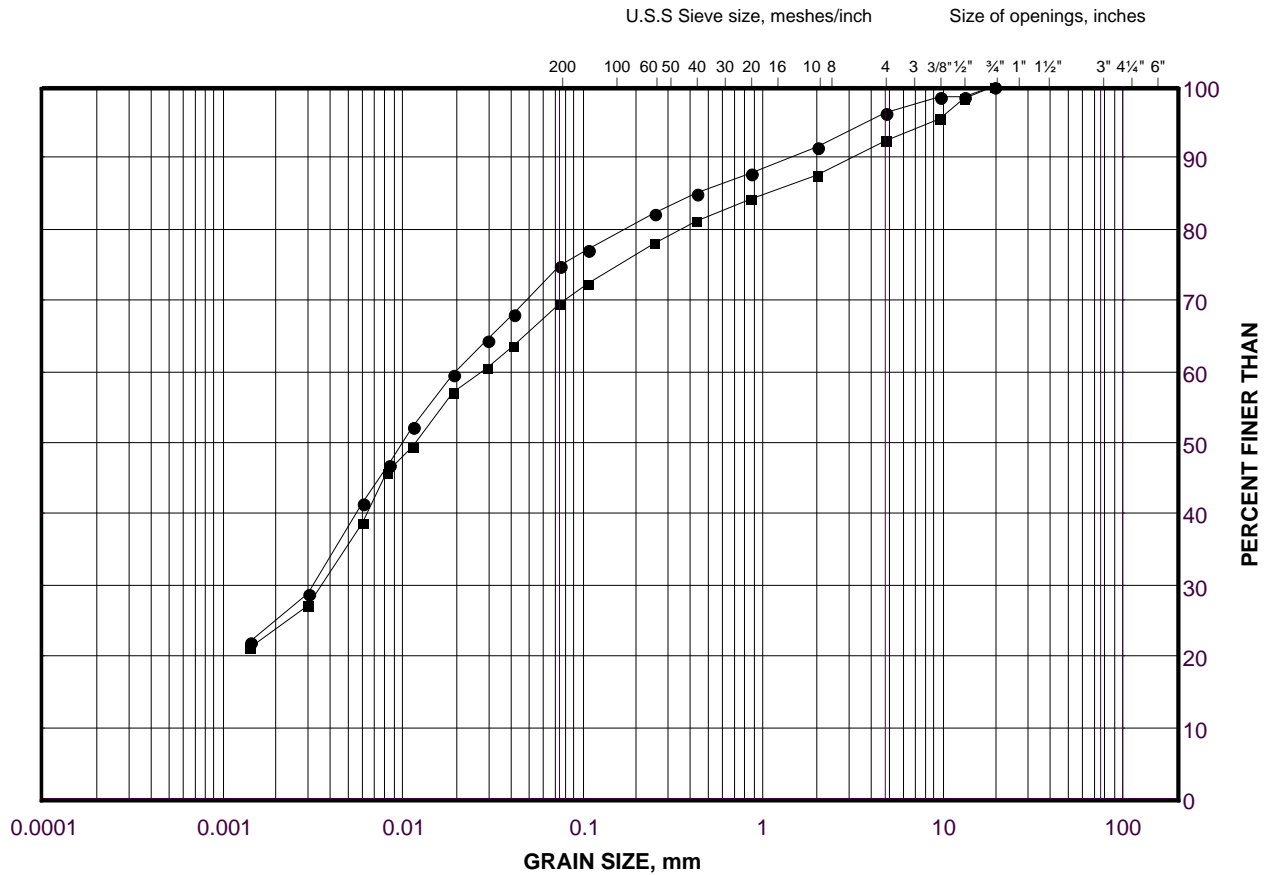
**Golder Associates**

Date: 05-Apr-19

# GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt (TILL)  
(Noise Barrier Wall - Line 'I')

FIGURE F-3

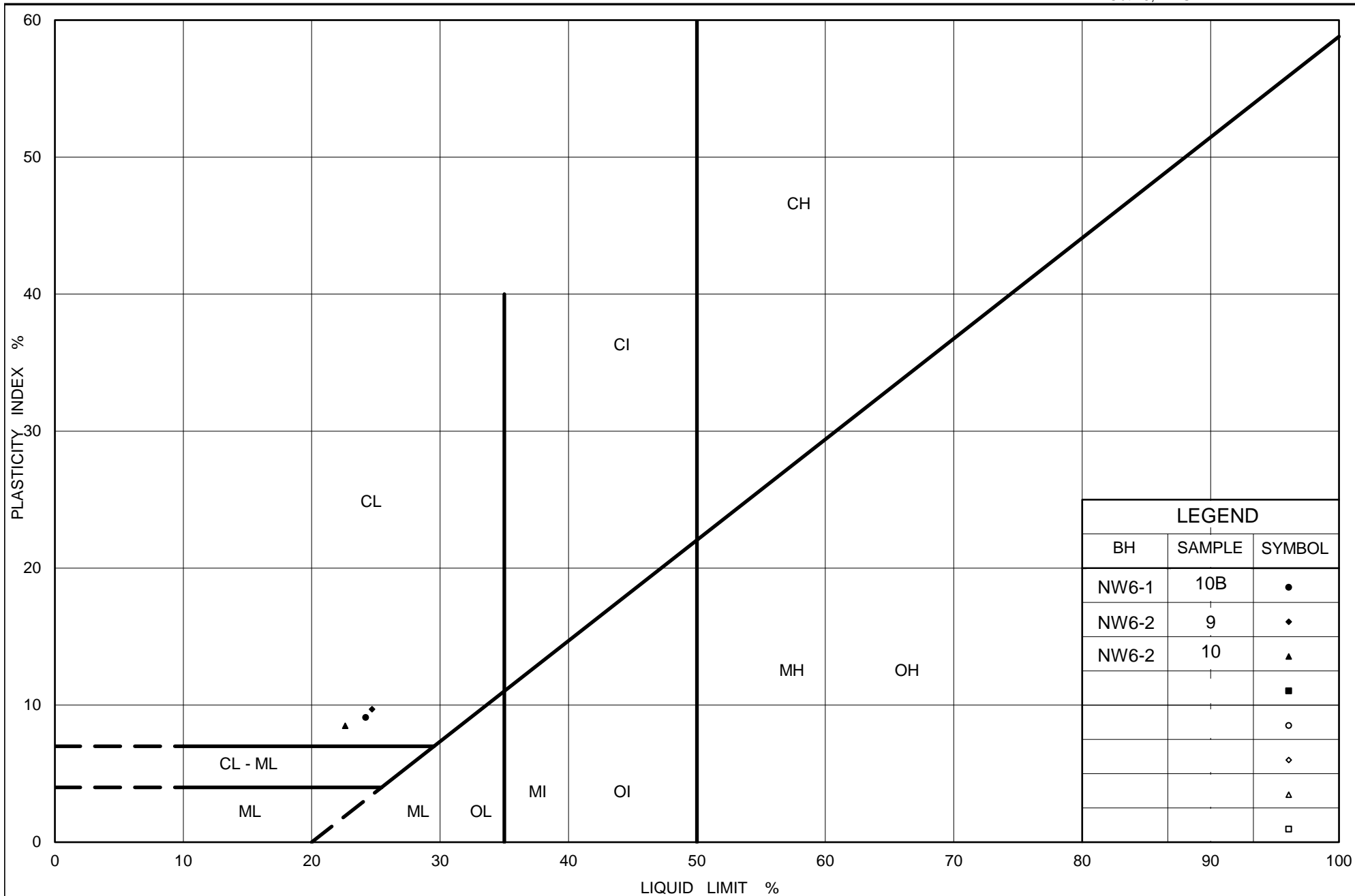


SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW6-1	10B	87.9
■	NW6-2	9	89.4





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# **PLASTICITY CHART** Sandy Clayey Silt (TILL) (Noise Barrier Wall - Line 'I')

Figure No. F-4

Project No. 1662333

Checked By: SMM

**APPENDIX G**

**NOISE BARRIER / RETAINING WALL - Line 'G'**  
**QEW Sta 17+415 to Sta 17+520**

PROJECT		1662333		RECORD OF BOREHOLE		No NRW7-1		SHEET 1 OF 1		METRIC							
G.W.P.		2002-13-00		LOCATION		N 4824601.8; E 296209.0 MTM NAD 83 ZONE 10 (LAT. 43.561304; LONG. -79.606346)		ORIGINATED BY		CC							
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 76 mm I.D., 190 mm O.D., Hollow Stem Augers		COMPILED BY		SK							
DATUM		Geodetic		DATE		July 12, 2018		CHECKED BY		SMM							
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 (%)
95.0	GROUND SURFACE																
0.0	ASPHALT (200 mm)																
	CONCRETE (200 mm)																
0.4	Gravelly sand (FILL)		1	SS	32												
94.1	Dense Brown Moist																
0.9	Silty sand to sand, trace clay (FILL)		2	SS	22												
	Very loose to compact Brown Moist to wet below 2.3 m depth		3	SS	5												
			4	SS	4												
92.0																	
3.0	Sandy silt, trace to some clay, trace organics, topsoil leaves, rootlets (FILL)		5	SS	1												
91.3	Very loose Brown / grey Wet																
3.7	SILT, some sand, trace clay		6	SS	4												
90.5	Very loose Brown Wet																
4.5	Sandy CLAYEY SILT, trace to some gravel, trace organics to 5.2 m depth (TILL)		7	SS	5												
	Firm to stiff Brown to grey below 4.9 m Moist to wet																
			8	SS	12												
	- Auger grinding from 6.7 m to 10.7 m, cobbles likely present																
87.8																	
7.2	SILT and SAND, some gravel, trace clay (TILL)		9	SS	50/0.03												
	Very dense Grey Moist																
			10	SS	50/0.05												
84.8																	
10.2	SAND																
	Very dense Grey Moist																
83.7			11	SS	60												
11.3	END OF BOREHOLE																
NOTES:																	
1. Borehole caved to a depth of 10.1 m below ground surface upon removal of augers.																	
2. Water level measured at a depth of about 8.5 m below ground surface (Elev. 86.5 m) upon completion of drilling.																	

PROJECT		1662333		RECORD OF BOREHOLE		No NRW-2		SHEET 1 OF 1		METRIC						
G.W.P.		2002-13-00		LOCATION		N 4824652.9; E 296236.0 MTM NAD 83 ZONE 10 (LAT. 43.561765; LONG. -79.606012)		ORIGINATED BY		CC						
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 152 mm O.D. Solid Stem Augers		COMPILED BY		SK						
DATUM		Geodetic		DATE		July 15, 2018		CHECKED BY		SMM						
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								
94.9	GROUND SURFACE															
0.0	ASPHALT (150 mm)															
	CONCRETE (230 mm)															
94.2	Sand and gravel (FILL)															
0.7	Brown Moist															
	Silt and sand, trace clay (FILL)		1	SS	22											
	Very loose to compact															
	Brown Moist to wet below 3.6 m		2	SS	18											
			3	SS	7											0 50 48 2
			4	SS	2											
			5A	SS	3											
90.6			5B													
4.3	Sandy SILTY CLAY, trace gravel (TILL)															
	Firm Brown Moist		6	SS	6											3 24 49 24
89.3																
5.6	Silty SAND and GRAVEL, trace clay, some cobble fragments (TILL)															
	Very dense Brown Moist		7	SS	62											31 37 26 6
	- Auger grinding from 6.1 m to 7.6 m depth															
	- Boulder encountered from 7.3 m to 7.6 m depth		8	SS	100/0.05											
86.2																
8.7	Silty SAND, trace to some clay, gravel size rock fragments															
	Dense Brown Moist		9	SS	41											0 62 29 9
	- Auger grinding from 9.8 m to 10.7 m depth															
84.7																
10.2	Silty SAND, trace to some clay (TILL)															
84.1	Very dense Grey Moist		10	SS	100/0.17											
10.8																
	END OF BOREHOLE															
NOTES: 1. Borehole caved to a depth of 9.6 m below ground surface upon removal of augers. 2. Water level measured at a depth of about 8.2 m below ground surface (Elev. 86.7 m) upon completion of drilling.																

PROJECT 1662333		RECORD OF BOREHOLE No NRW-3				SHEET 1 OF 1		METRIC								
G.W.P. 2002-13-00		LOCATION N 4824696.6; E 296259.1 MTM NAD 83 ZONE 10 (LAT. 43.562158; LONG. -79.605727)				ORIGINATED BY ACM										
DIST Central HWY QEW		BOREHOLE TYPE CME 108 mm I.D. Hollow Stem Auger				COMPILED BY SK										
DATUM Geodetic		DATE July 15, 2018				CHECKED BY SMM										
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								
94.9	GROUND SURFACE															
0.0	CONCRETE (430 mm)															
94.5																
0.4	Gravelly sand, trace to some silt (FILL)		1	SS	49											
93.9	Dense Brown Wet		2	SS	26											
1.0	Silt and sand, trace clay (FILL) Very loose to compact Brown Moist to wet below 3.6 m depth		3	SS	13											
			4	SS	2											0 67 31 2
	- 0.1 m lens of black organic silt present at 2.4 m depth		5	SS	2											
			6	SS	WH											0 64 34 2
			7	SS	1											
89.3																
5.6	CLAYEY SILT with SAND, some gravel Very stiff Grey Wet		8	SS	26											17 40 31 12
	- Auger grinding from 6.7 m to 7.0 m depth															
87.7																
7.2	Silty SAND, trace to some clay, trace gravel Very dense Grey Wet		9	SS	53											2 70 21 7
	- Auger grinding from 7.6 m to 8.2 m and from 9.1 m to 12.2 m depth															
			10	SS	100/0.13											
84.1																
10.8	CLAYEY SILT, some sand, some shale fragments below 11.6 m depth (RESIDUAL SOIL) Hard Grey Moist		11A 11B	SS	50/0.25											
82.6																
12.3	END OF BOREHOLE SPLIT-SPOON REFUSAL		12	SS	100/0.08											
	NOTES:  1. Borehole caved to a depth of 4.3 m below ground surface upon removal of hollow stem augers.  2. Water level measured at a depth of 6.4 m below ground surface (Elev. 88.5 m) within hollow stem augers upon completion of soil drilling.															

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<b>PROJECT</b> 1662333		<b>RECORD OF BOREHOLE No K6</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. 2002-13-00		LOCATION N 4824688.5; E 296254.9 MTM NAD 83 ZONE 10 (LAT. 43.562085; LONG. -79.605778)		ORIGINATED BY ACM			
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 38 mm I.D. Solid Stem Augers		COMPILED BY JMP			
DATUM Geodetic		DATE November 11, 2018		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>		
94.9	GROUND SURFACE													
0.0	ASPHALT (150 mm)													
94.4	CONCRETE													
0.5	Silt and sand, trace clay (FILL) Compact to very loose Brown with oxidation staining Moist to wet - Trace to some gravel from 0.8 m to 1.4 m		1	SS	36									
			2	SS	7									
			3	SS	2									
			4	SS	9									
91.2	Silty sand, trace clay (FILL) Very Loose Brown Wet  - Oxidation staining from 4.6 m to 6.1 m		5	SS	WH									
3.7			6	SS	WH									
89.3	CLAYEY SILT with SAND Firm Brown to grey Wet to moist		7	SS	6									
5.6			8	SS	43									
87.7	SAND, some silt, trace clay Very dense to compact Grey Wet		9	SS	51									
7.2			10	SS	16									
83.2	CLAYEY SILT, some sand, trace gravel (TILL) Hard Grey Moist		11A	SS	100/0.23									
11.7			11B											
82.6	SHALE (BEDROCK) Grey  Bedrock cored from a depth of 14.3 m to 15.0 m  For bedrock coring details, refer to Record of Drillhole K6		12	SS	100/0.08									
12.3														
79.9			1	RC	REC 62% REC									

Continued Next Page

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

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DATUM: Geodetic

DRILL RIG: CME 55

DRILLING CONTRACTOR: Triphase Drilling

[illegible]

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



**GOLDER**

LOGGED: ACM

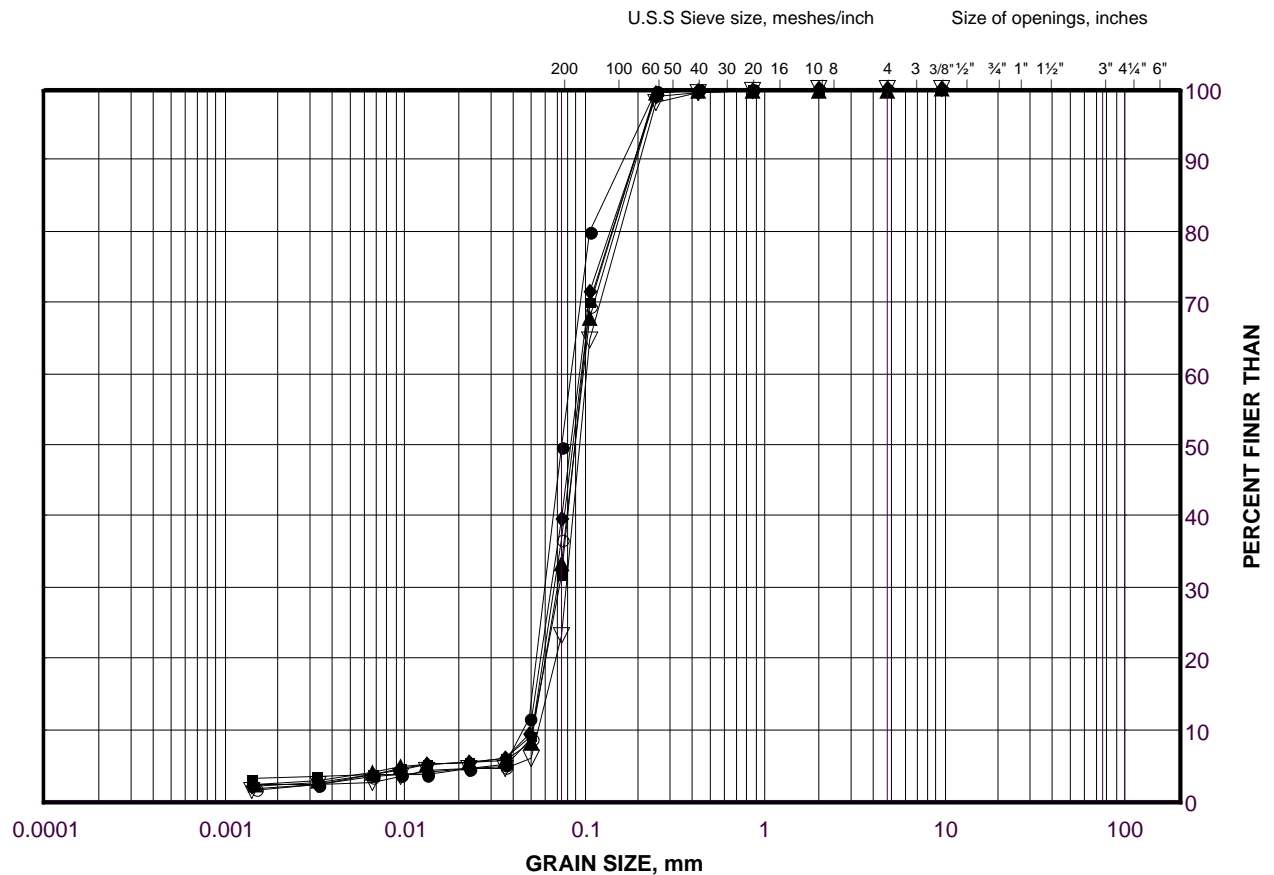
CHECKED: DPM

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Silty Sand (FILL)

(Noise Barrier Wall - Line 'G')

FIGURE G-1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW7-2	3	92.3
■	NRW7-1	3	93.1
◆	K-6	4	91.5
▲	NRW7-3	4	92.3
▽	K-6	6	90.0
○	NRW7-3	6	90.8

Project Number: 1662333

Checked By: SMM

**Golder Associates**

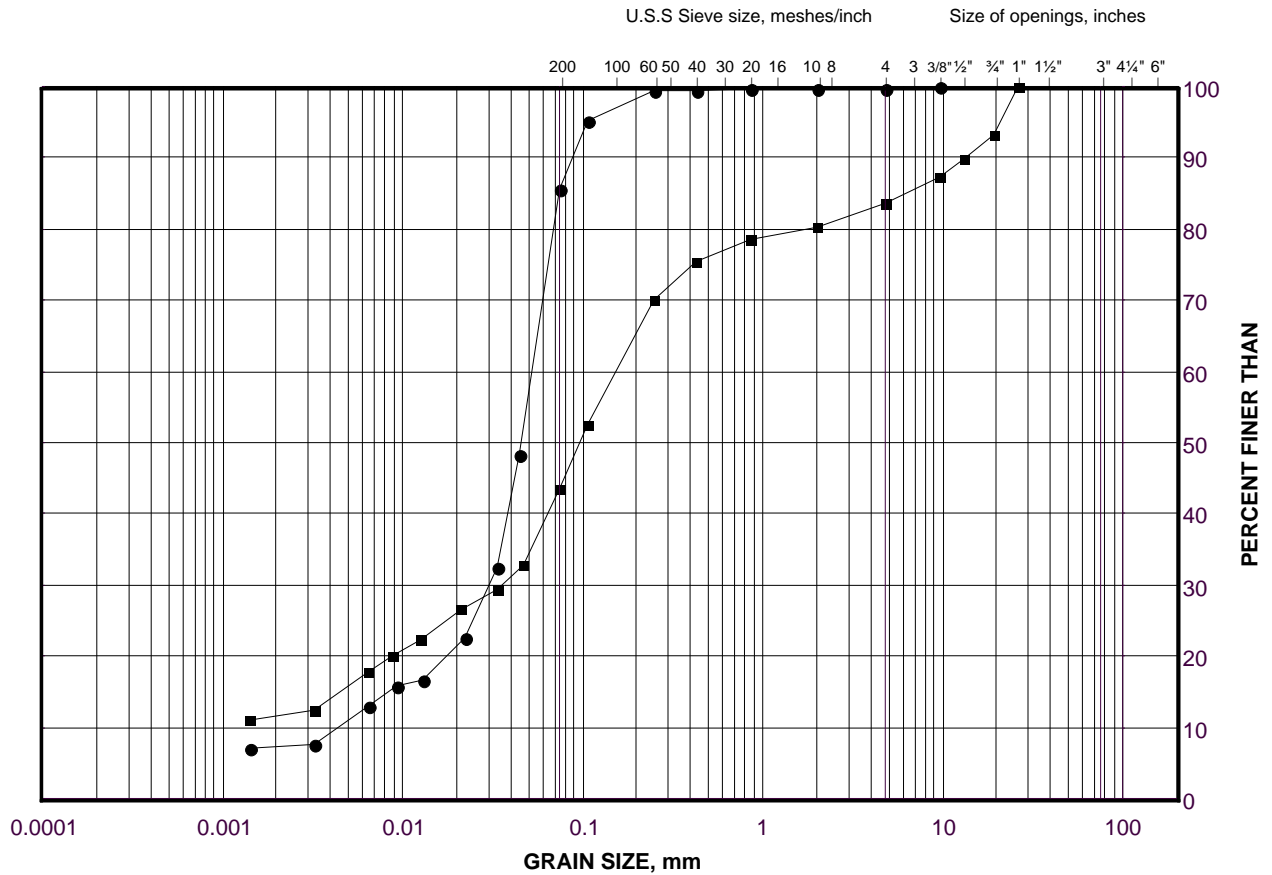
Date: 05-Apr-19



# GRAIN SIZE DISTRIBUTION

Silt to Clayey Silt with Sand  
(Noise Barrier Wall - Line 'G')

FIGURE G-2



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

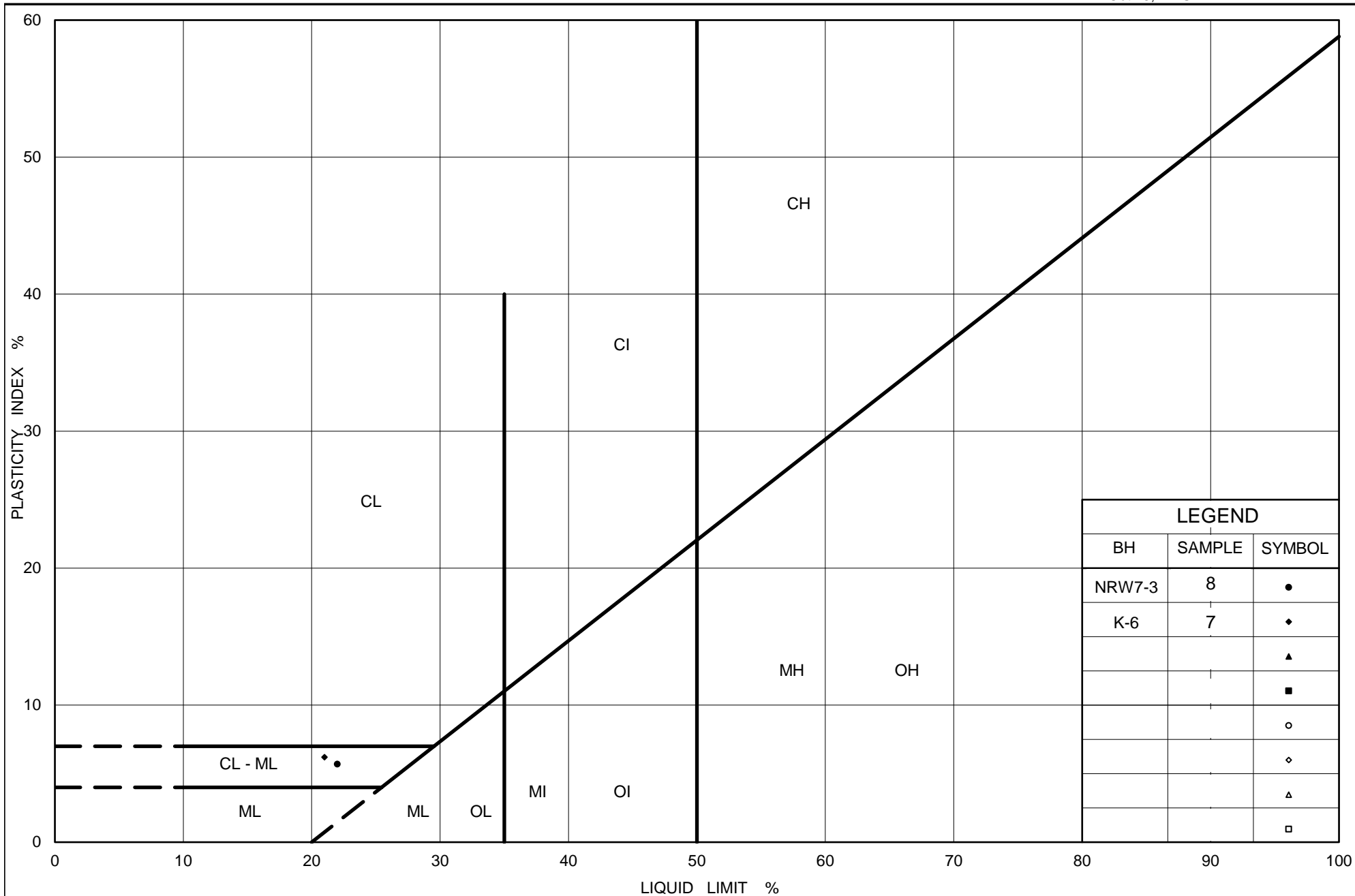
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW7-1	6	90.9
■	NRW7-3	8	88.5

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 05-Apr-19



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# **PLASTICITY CHART** Clayey Silt - Silt (Noise Barrier Wall - Line 'G')

Figure No. G-3

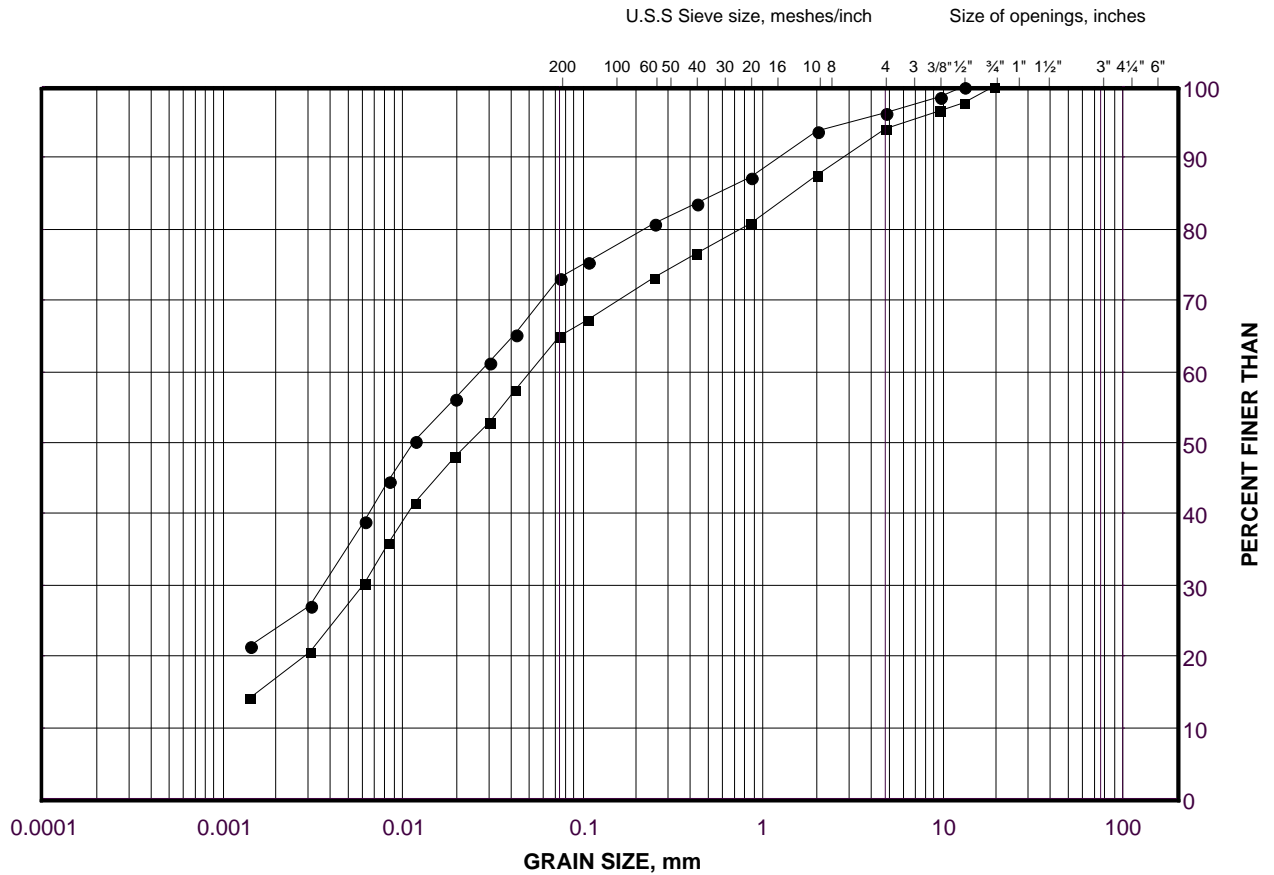
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Sandy Silty Clay (TILL)  
(Noise Barrier Wall - Line 'G')

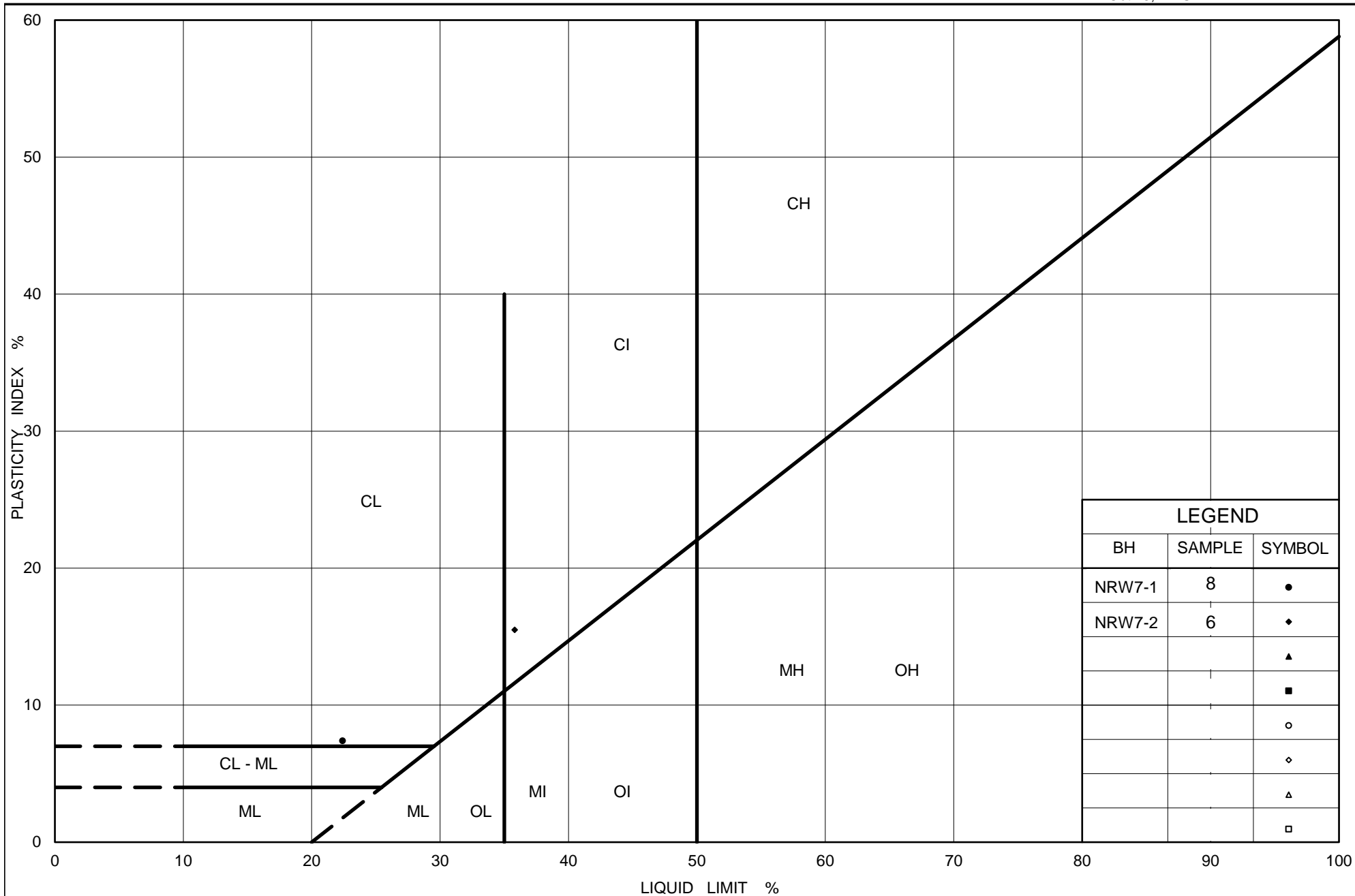
FIGURE G-4



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW7-2	6	90.0
■	NRW7-1	8	88.6



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## PLASTICITY CHART

Sandy Clayey Silt to Sandy Silty Clay (TILL)  
(Noise Barrier Wall - Line 'G')

Figure No. G-5

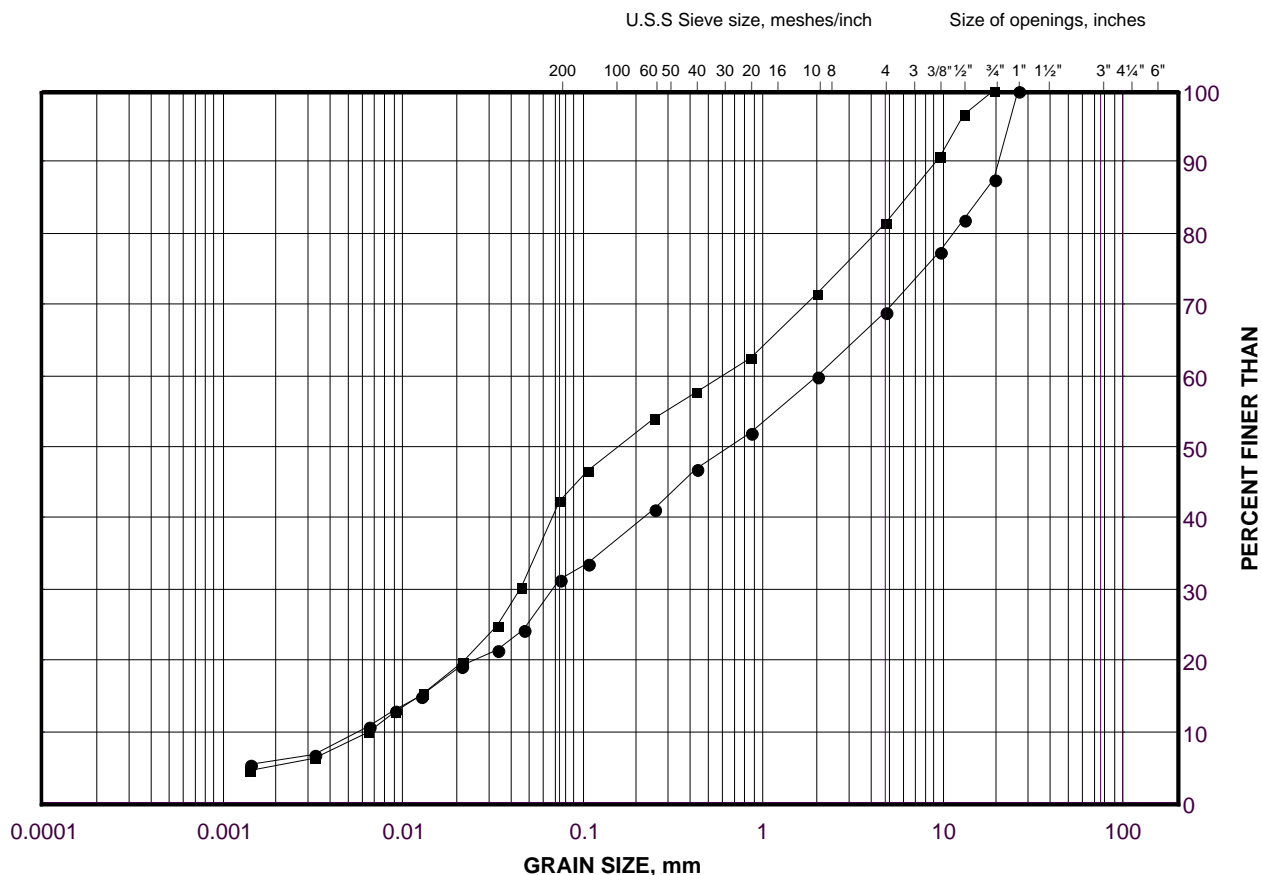
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Silty Sand and Gravel (TILL)  
(Noise Barrier Wall - Line 'G')

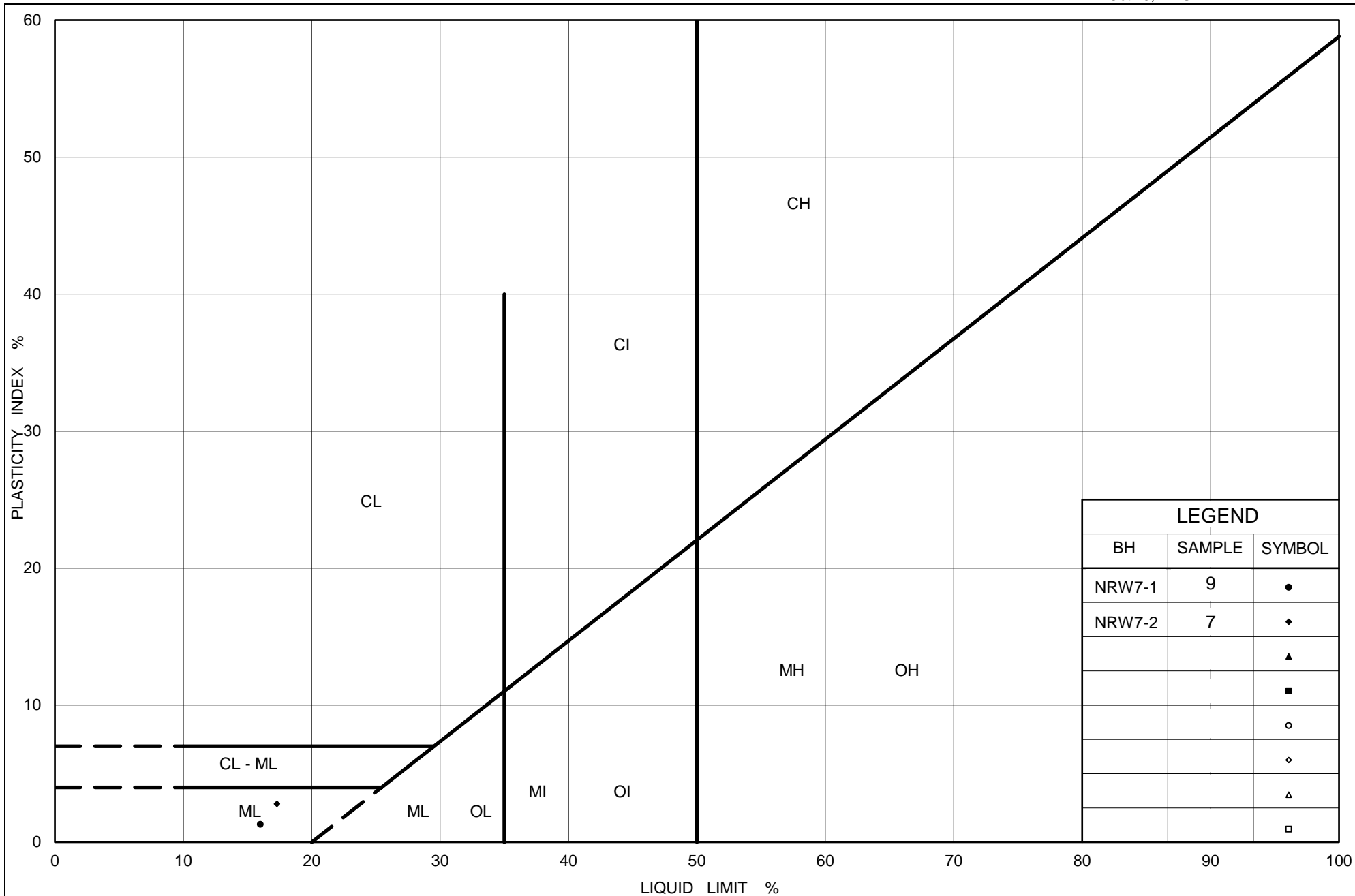
FIGURE G-6



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW7-2	7	88.5
■	NRW7-1	9	87.3



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## PLASTICITY CHART

Silt and Sand to Silty Sand and Gravel (TILL)  
(Noise Barrier Wall - Line 'G')

Figure No. G-7

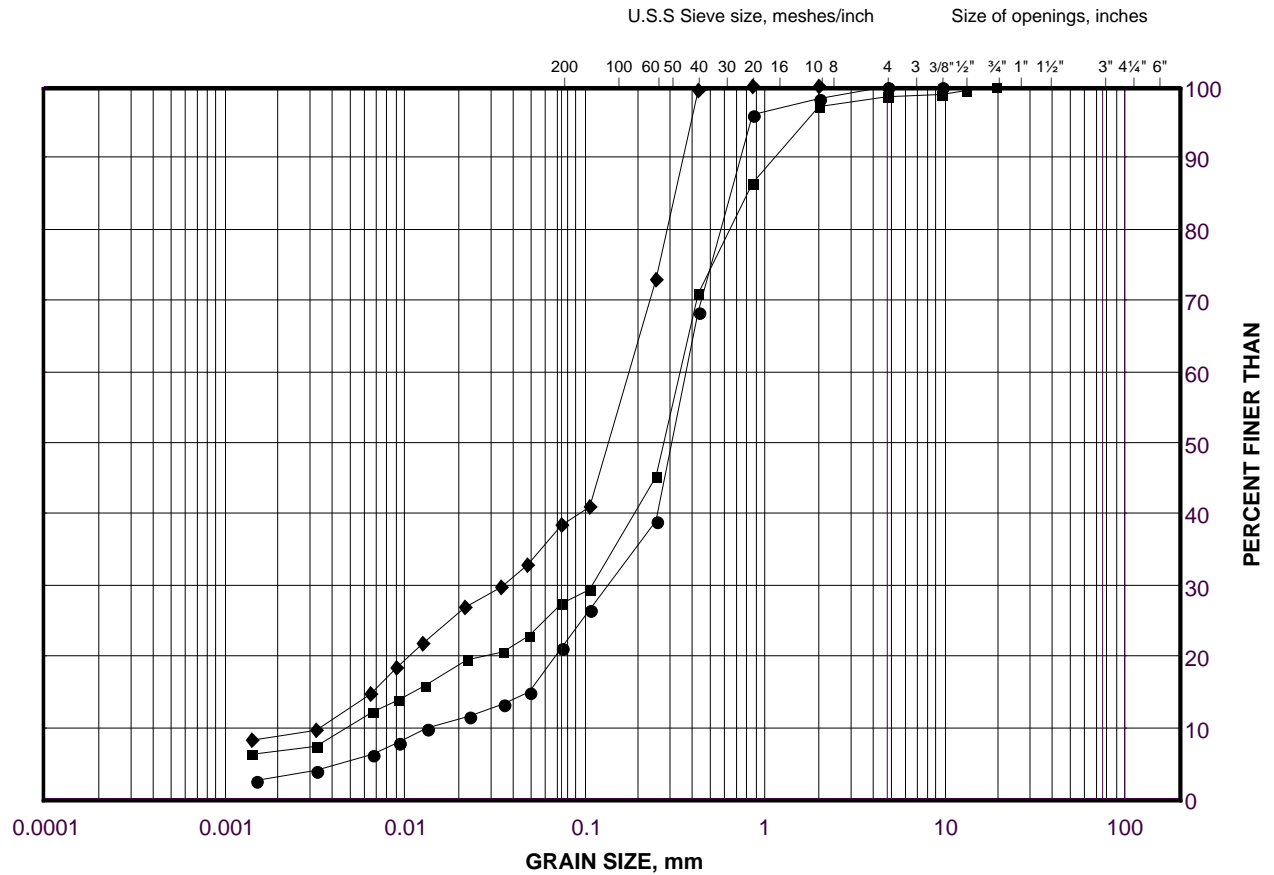
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Silty Sand to Sand  
(Noise Barrier Wall - Line 'G')

FIGURE G-8



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	K-6	10	83.9
■	NRW7-3	9	86.9
◆	NRW7-2	9	85.5

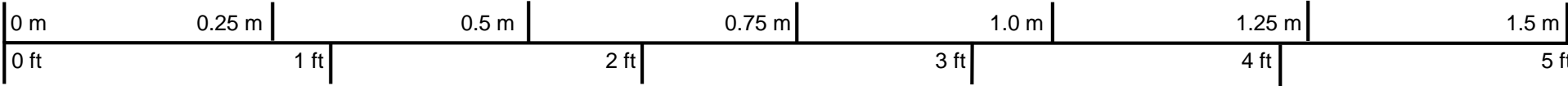
Project Number: 1662333

Checked By: SMM


**Golder Associates**

Date: 05-Apr-19

REVISION DATE: August 21, 2018 BY: SE Project: 1662333



Scale

PROJECT		MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street				
TITLE		Bedrock Core Photograph Borehole K-6 (14.33 m to 15.02 m)				
 GOLDER	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		FIGURE G-9		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			



**APPENDIX H**

**NOISE BARRIER WALL - Line 'J'**  
**QEW Sta 17+076 to Sta 17+124**

PROJECT 1662333		RECORD OF BOREHOLE No PED-03		SHEET 1 OF 1		METRIC												
G.W.P. 2002-13-00		LOCATION N 4824305.3; E 296063.0 MTM NAD 83 ZONE 10 (LAT. 43.558625; LONG. -79.608144)		ORIGINATED BY JL														
DIST Central HWY QEW		BOREHOLE TYPE CME 850, 210 mm O.D. Hollow Stem Augers, HQ Casing		COMPILED BY DPM														
DATUM Geodetic		DATE October 26-27, 2017		CHECKED BY MWK														
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)					
93.7	GROUND SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> — W — W <sub>L</sub> 10 20 30			GR SA SI CL		
0.0	TOPSOIL (200mm)																	
0.2	Silt and sand to silty sand, trace clay, trace organics (FILL) Very loose to compact Brown Moist		1	SS	7		93											
			2	SS	16													
			3	SS	6		92											0 66 31 3
			4	SS	9		91											
			5	SS	10		90											
	- Becoming grey at a depth of about 3.5 m - Auger grinding at a depth of about 3.7 m - PHC odour between depths of about 3.8 m and 6.1 m - Becoming black at a depth of about 4.1 m - Some asphalt fragments at a depth of about 4.1 m - Becoming wet at a depth of about 4.6 m - Some gravel at a depth of about 4.6 m		6	SS	8		89											14 57 27 2
			7	SS	3		88											
87.6	Sandy CLAYEY SILT, trace to some gravel to gravelly (TILL) Very stiff to hard Brown and grey Moist to wet		8	SS	16		87											18 26 41 15
6.2																		
			9	SS	19		86											
							85											
			10	SS	66		84											
							83											
			11	SS	50/0.08		82											
							81											
80.0							80											
13.8	END OF BOREHOLE																	
	NOTE: 1. Borehole dry prior to rock coring.																	

PROJECT		1662333		RECORD OF BOREHOLE No PED-03A				SHEET 1 OF 1		METRIC																													
G.W.P.		2002-13-00		LOCATION		N 4824308.4; E 296062.1 MTM NAD 83 ZONE 10 (LAT. 43.558653; LONG. -79.608155)				ORIGINATED BY		JL																											
DIST		Central		HWY		QEW		BOREHOLE TYPE		CME 850, 210 mm O.D. Hollow Stem Augers, HQ Casing				COMPILED BY		DPM																							
DATUM		Geodetic		DATE		October 27, 2017				CHECKED BY		MWK																											
SOIL PROFILE				SAMPLES				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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa				WATER CONTENT (%)				γ																						
94.1	0.0	GROUND SURFACE						94	20	40	60	80	100	10	20	30																							
		Refer to Record of Borehole PED-03 for soil profile details						93																															
									92																														
									91																														
									90																														
									89																														
88.0	6.1	END OF BOREHOLE																																					
NOTES: 1. Groundwater level measurements in piezometer: <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev. (m)</th> </tr> </thead> <tbody> <tr> <td>27/10/17</td> <td>DRY</td> <td></td> </tr> <tr> <td>14/11/17</td> <td>4.3</td> <td>89.8</td> </tr> <tr> <td>21/11/17</td> <td>4.4</td> <td>89.7</td> </tr> <tr> <td>28/11/18</td> <td>4.4</td> <td>89.7</td> </tr> <tr> <td>06/11/18</td> <td>4.1</td> <td>90.0</td> </tr> </tbody> </table>																						Date	Depth (m)	Elev. (m)	27/10/17	DRY		14/11/17	4.3	89.8	21/11/17	4.4	89.7	28/11/18	4.4	89.7	06/11/18	4.1	90.0
Date	Depth (m)	Elev. (m)																																					
27/10/17	DRY																																						
14/11/17	4.3	89.8																																					
21/11/17	4.4	89.7																																					
28/11/18	4.4	89.7																																					
06/11/18	4.1	90.0																																					

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<b>PROJECT</b> 1662333		<b>RECORD OF BOREHOLE No PED-03B</b>		SHEET 1 OF 2		<b>METRIC</b>	
<b>G.W.P.</b> 2002-13-00		<b>LOCATION</b> N 4824309.6; E 296062.8 MTM NAD 83 ZONE 10 (LAT. 43.558664; LONG. -79.608146)		<b>ORIGINATED BY</b> JL			
<b>DIST</b> Central HWY QEW		<b>BOREHOLE TYPE</b> CME 850, 156 mm Tricone with Drilling Mud		<b>COMPILED BY</b> KN			
<b>DATUM</b> Geodetic		<b>DATE</b> November 15-16, 2017		<b>CHECKED BY</b> MWK			


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			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>		GR	SA	SI	CL
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED								
94.1 0.0	GROUND SURFACE																
	Refer to Record of Borehole PED-03 for soil stratigraphy between ground surface and a depth of about 10.1 m																
84.0 10.1	Sandy gravelly CLAYEY SILT (TILL) Hard Grey Moist to wet		1	SS	44												
82.5 11.6	SILT, some clay, some sand Dense Grey Moist to wet		2	SS	35												
81.4 12.7	Gravelly CLAYEY SILT with SAND (TILL) Hard Red/grey Moist to wet		3	SS	100/0.10												
			4	SS	100/0.10												
79.3 14.8			5	SS	50/0.10												
			1	RC													
									</								

Continued Next Page

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

RQD = 38%

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PROJECT 1662333		RECORD OF BOREHOLE No PED-03B				SHEET 2 OF 2		METRIC									
G.W.P. 2002-13-00		LOCATION N 4824309.6; E 296062.8 MTM NAD 83 ZONE 10 (LAT. 43.558664; LONG. -79.608146)				ORIGINATED BY JL											
DIST Central HWY QEW		BOREHOLE TYPE CME 850, 156 mm Tricone with Drilling Mud				COMPILED BY KN											
DATUM Geodetic		DATE November 15-16, 2017				CHECKED BY MWK											
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 (%)
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100						
	Shale BEDROCK Grey		1	RC	REC 96%												RQD = 38%
	Bedrock cored from a depth of 14.8 m to 17.8 m For bedrock coring details, refer to Record of Drillhole PED-03B		2	RC	REC 100%	78											RQD = 78%
			3	RC	REC 100%	77											RQD = 67%
76.3 17.8	END OF BOREHOLE  NOTE: 1. Borehole dry prior to tricone drilling.																

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PROJECT: 1662333

## RECORD OF DRILLHOLE: PED-03B

SHEET 1 OF 1

LOCATION: N 4824309.6 ; E 296062.8

DRILLING DATE: November 14-15, 2017

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 850 Track

DRILLING CONTRACTOR: Aardvark Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD - Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST- Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA						ROCK STRENGTH INDEX		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
						TOTAL CORE %	SOLID CORE %			B Angle DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4 R3 R2 R1	W1 W2 W3 W4 W5 W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
15	NW Casing	Continued from Borehole PED-03		79.26																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

## FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: JL

CHECKED: SMM

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\GINT\QEW-CREDIT\_RIVER.GPJ GAL-MISS.GDT 19-5-15

S:\CLIENTS\MTO\QEW-CREDIT RIVER\02 DATA\GINT\QEW-CREDIT RIVER.GPJ GAL-GTA.GDT 19-5-15

Continued Next Page

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

PROJECT		RECORD OF BOREHOLE				No S6		SHEET 2 OF 2		METRIC						
G.W.P. 1662333		LOCATION		N 4824318.8; E 296059.4 MTM NAD 83 ZONE 10 (LAT. 43.558755; LONG. -79.608192)				ORIGINATED BY ACM								
DIST Central HWY QEW		BOREHOLE TYPE		CME 55, 108 mm I.D., Hollow Stem Augers				COMPILED BY JMP								
DATUM Geodetic		DATE		October 2, 2018				CHECKED BY SMM								
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 ---															
	END OF BOREHOLE															
	NOTES:  1. Water level measured at a depth of 11.9 m (Elev. 83.3 m) below ground surface upon completion of drilling.															

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-CREDIT\_RIVER\02\_DATA\INT\QEW-CREDIT\_RIVER.GPJ GAL-GTA.GDT 19-5-15



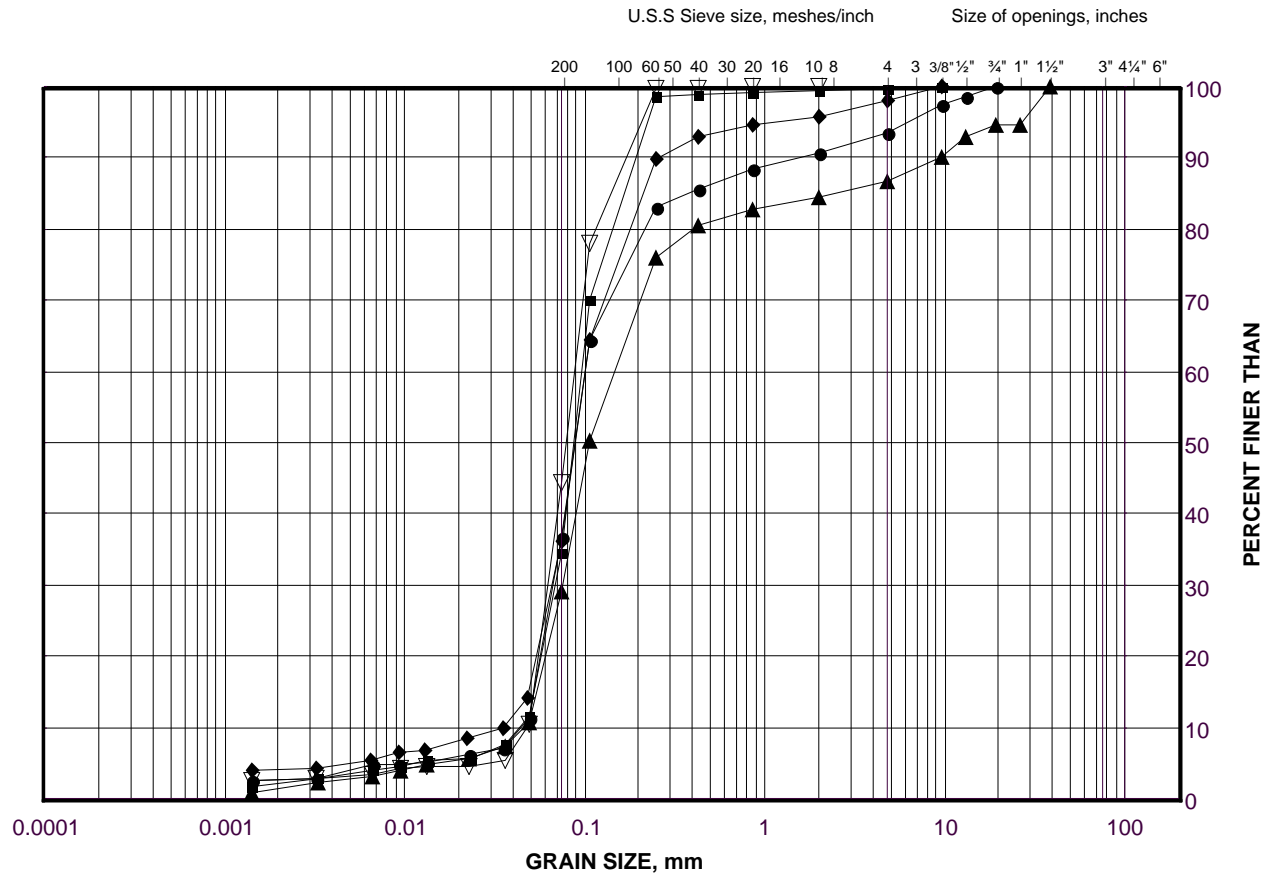
PROJECT		1662333		RECORD OF BOREHOLE No S7		SHEET 1 OF 1		METRIC											
G.W.P.		2002-13-00		LOCATION		N 4824321.2; E 296076.9 MTM NAD 83 ZONE 10 (LAT. 43.558768; LONG. -79.607973)		ORIGINATED BY											
DIST		Central HWY QEW		BOREHOLE TYPE		Portable Tripod - NW Casing and Wash Boring		COMPILED BY											
DATUM		Geodetic		DATE		December 20-21, 2018		CHECKED BY											
								SMM											
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			20	40						60	80	100	20	40
90.1	GROUND SURFACE																		
89.8	TOPSOIL		1A	SS	5														
0.3	Silt and sand, trace to some gravel, trace clay (FILL) Loose Brown with oxidation staining Moist to wet at 8.7 m		1B																
			2	SS	7														
	- 0.03 m concrete piece at 1.5 m		3	SS	6														
87.8																			
2.3	CLAYEY SILT with SAND, trace gravel		4A	SS	7														
87.4	Firm		4B																
2.7	Grey Wet - Oxidation staining from 2.7 m to 3.7 m		5	SS	33														
	CLAYEY SILT with SAND, trace gravel (TILL)		6	SS	100/0.20														
85.8	Hard Brown-grey to grey Moist																		
85.5	LIMESTONE		7	SS	200/0.03														
4.6	END OF BOREHOLE SPLIT-SPOON REFUSAL																		
NOTES:																			
1. Water level not taken due to water added during drilling.																			

# GRAIN SIZE DISTRIBUTION

Silt and Sand to Silty Sand (FILL)

(Noise Barrier Wall - Line 'J')

FIGURE H-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	S7	2	89.1
■	PED-03	3	91.9
◆	S6	4	92.6
▲	PED-03	6	89.6
▽	S6	7	90.3

Project Number: 1662333

Checked By: SMM

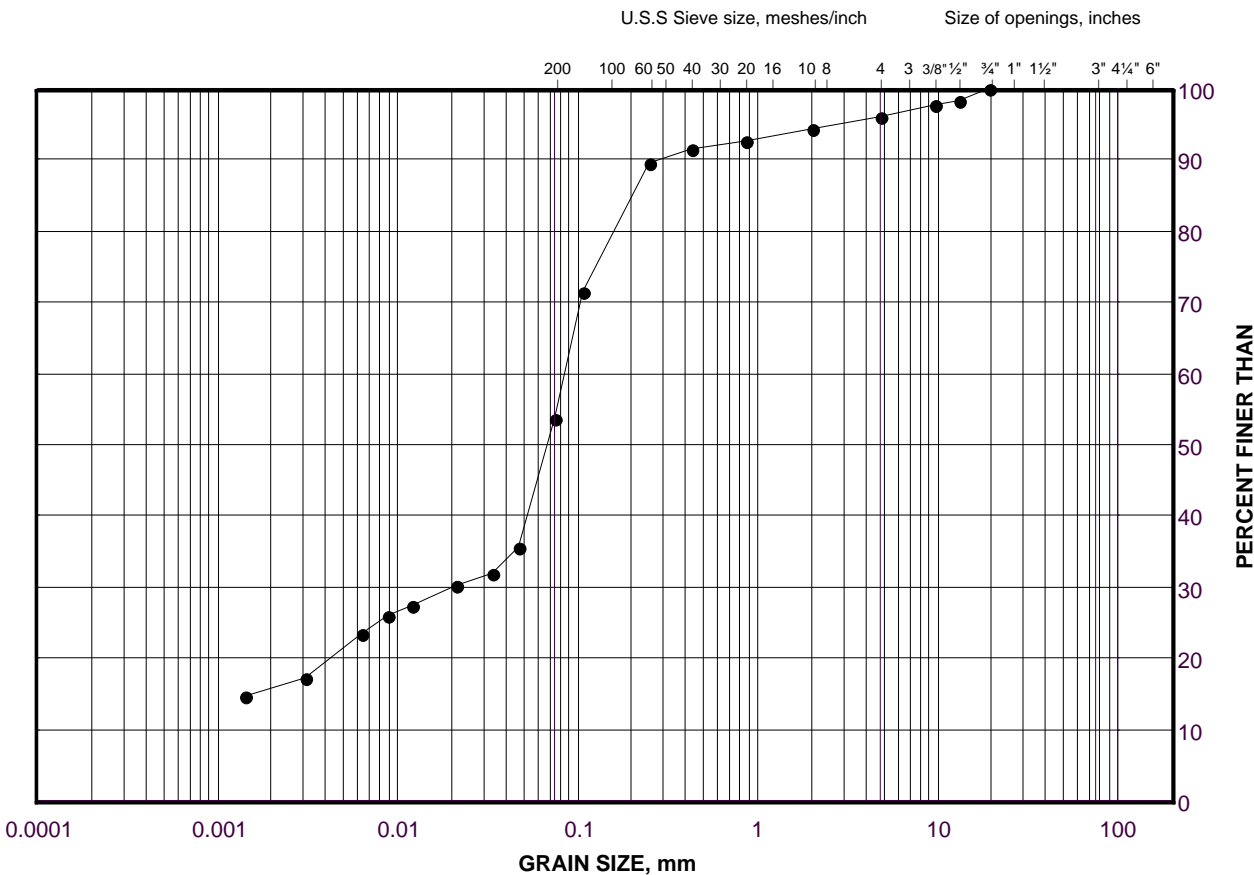
**Golder Associates**

Date: 12-Mar-19

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand  
(Noise Barrier Wall - Line 'J')

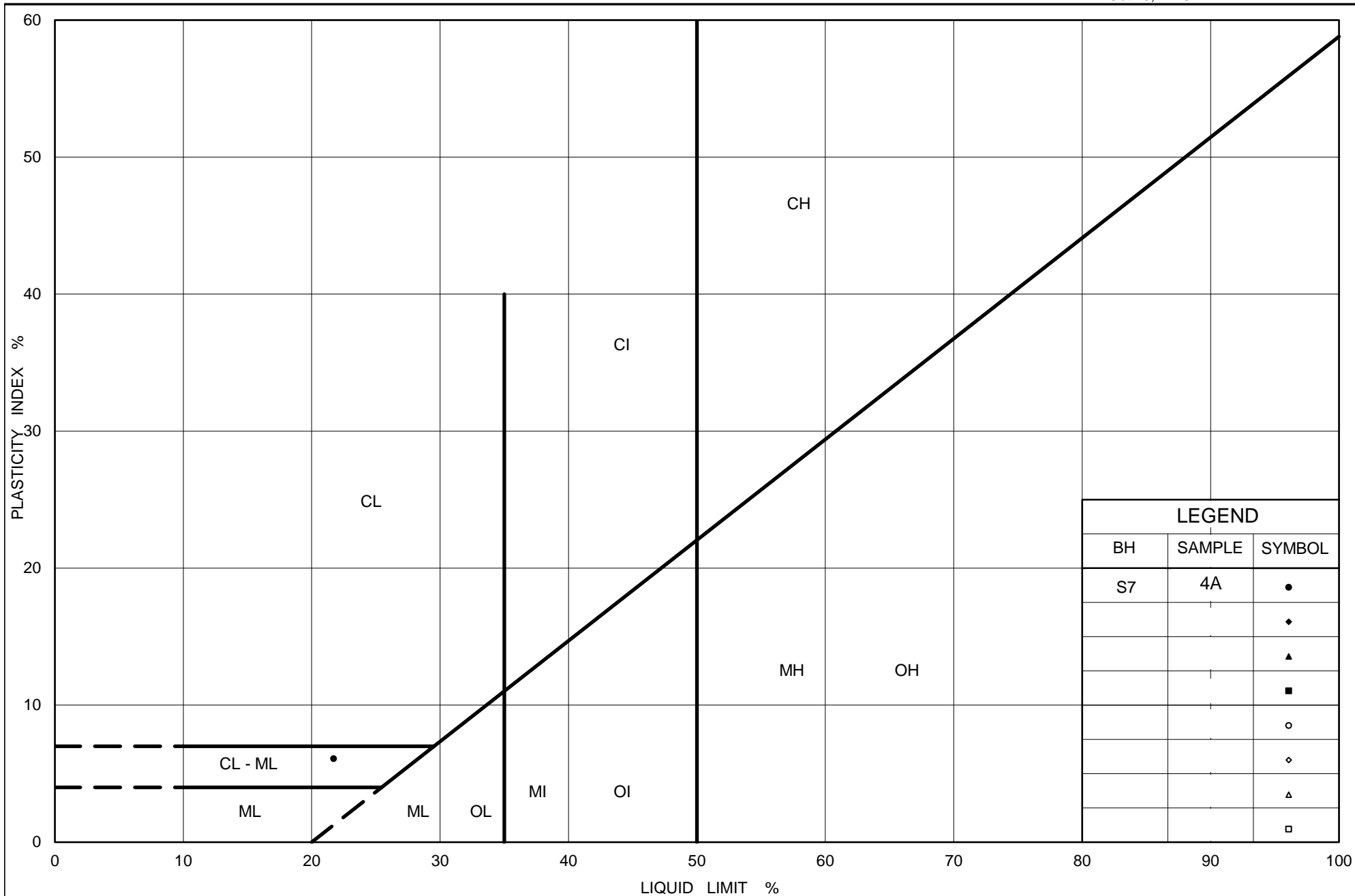
FIGURE H-2



SILT AND CLAY SIZES			FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED			SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	S7	4A	87.5



Ministry of Transportation

Ontario

# PLASTICITY CHART

Clayey Silt with Sand  
(Noise Barrier Wall - Line 'J')

Figure No. H-3

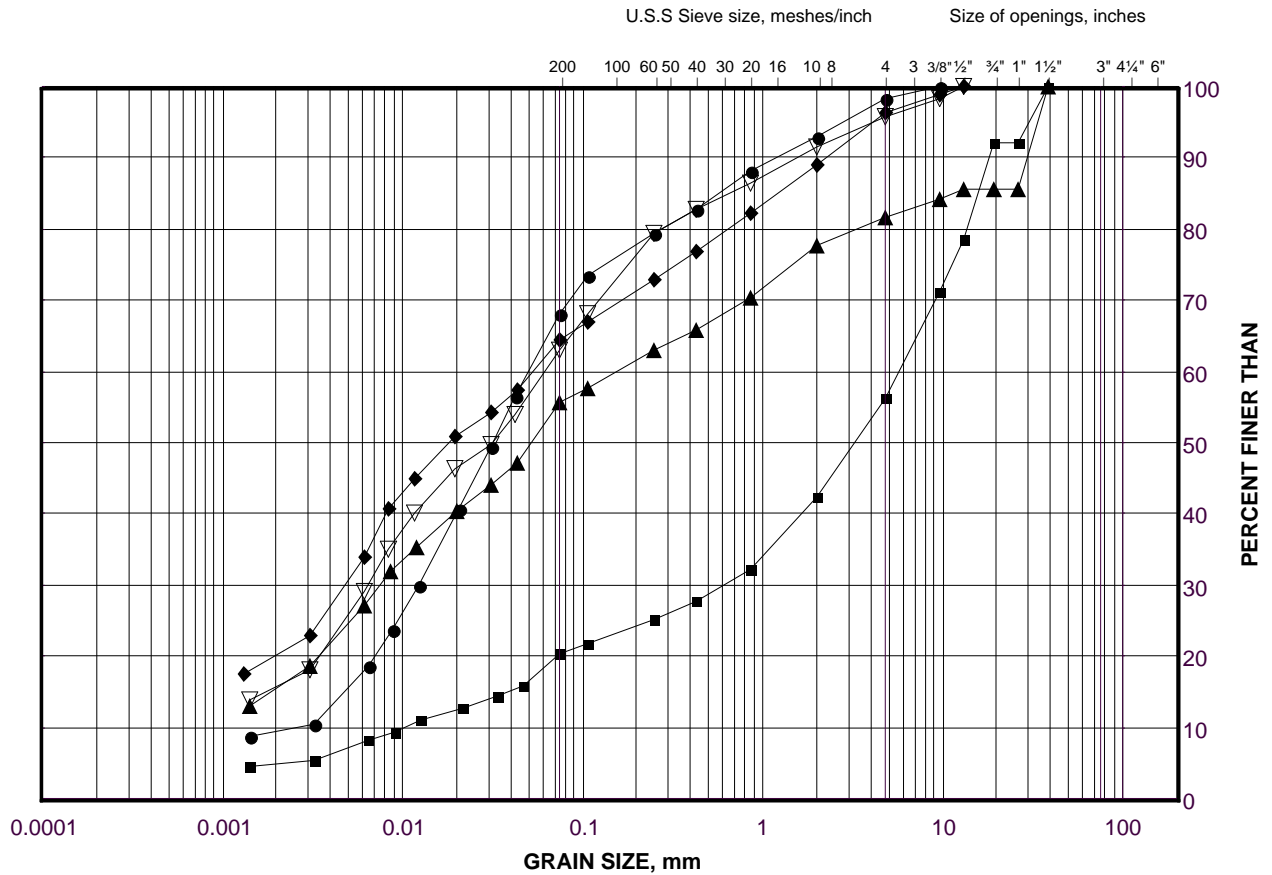
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

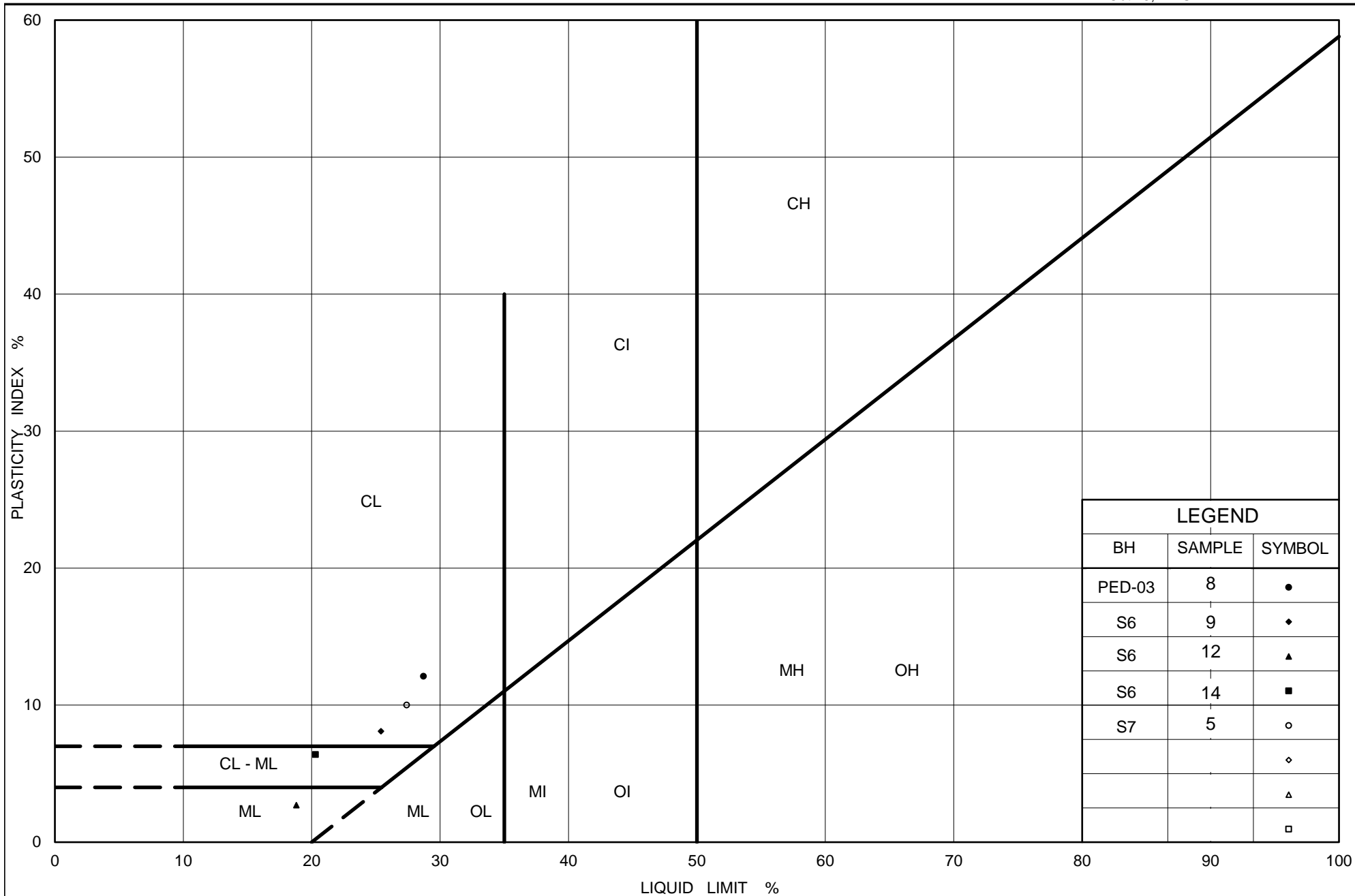
Silt and Sand to Clayey Silt with Sand with Gravel (TILL)  
(Noise Barrier Wall - Line 'J')

FIGURE H-4



## LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	S6	12	82.7
■	S6	14	80.6
◆	S7	5	86.8
▲	PED-03	8	87.3
▽	S6	9	87.3



Ministry of Transportation

Ontario

**PLASTICITY CHART**

Silt and Sand to Clayey Silt with Sand with Gravel (TILL)  
(Noise Barrier Wall - Line 'J')

Figure No. H-5

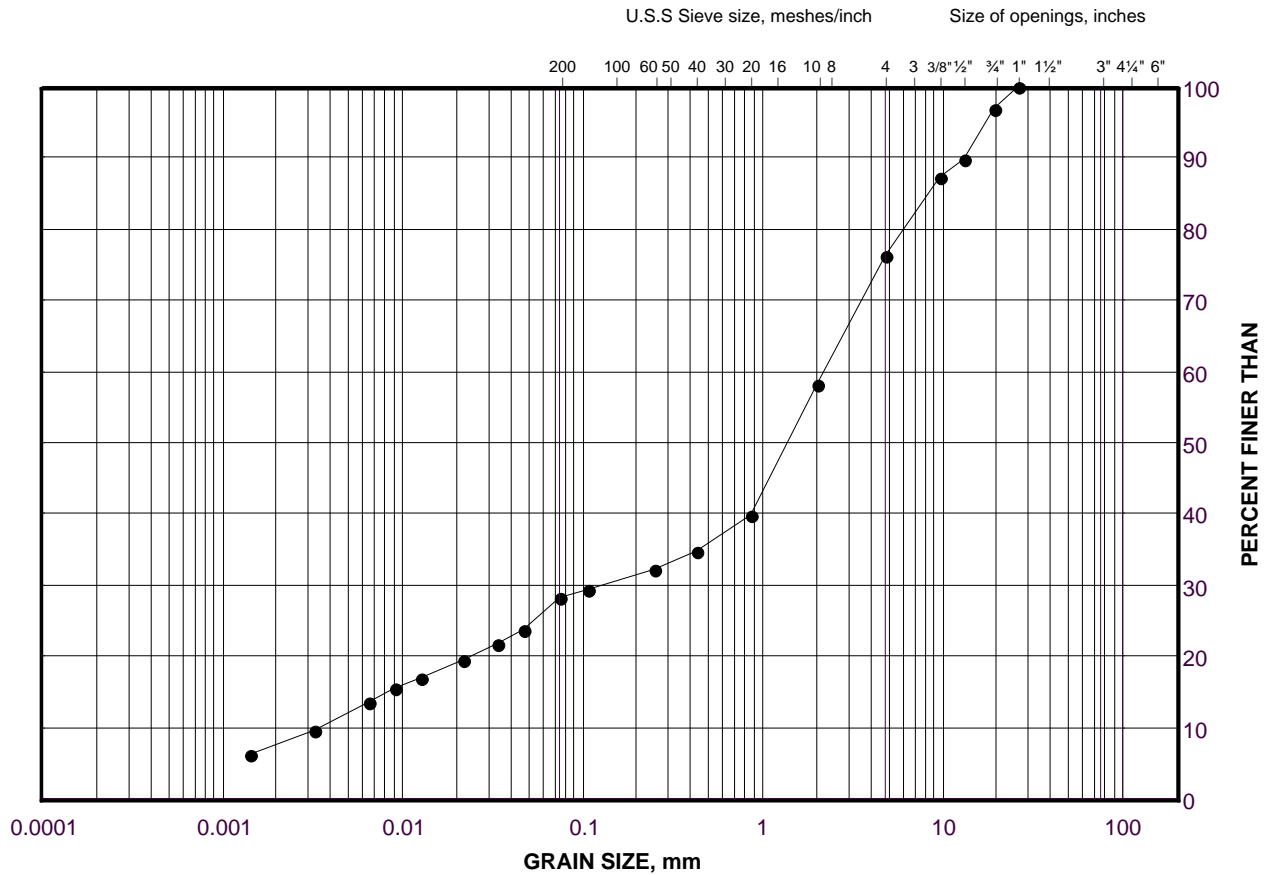
Project No. 1662333

Checked By: SMM

# GRAIN SIZE DISTRIBUTION

Gravelly Clayey Silt with Sand (TILL)  
(Noise Barrier Wall - Line 'J')

FIGURE H-6



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

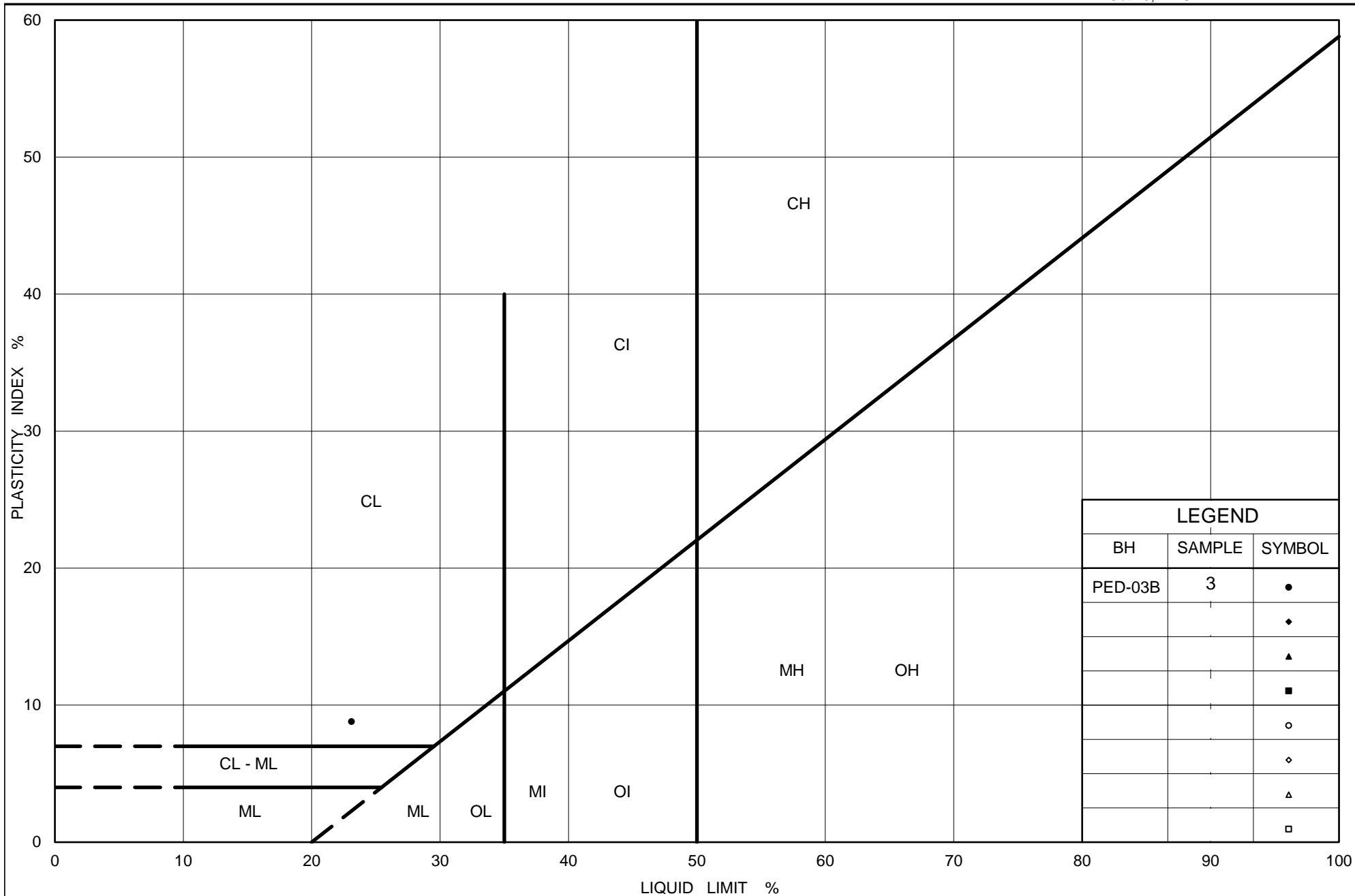
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	PED-03B	3	80.8

Project Number: 1662333

Checked By: SMM

**Golder Associates**

Date: 12-Mar-19



Ministry of Transportation

Ontario

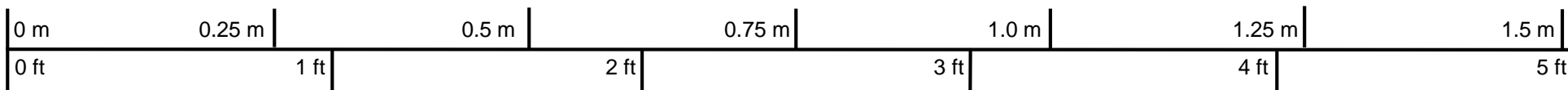
# **PLASTICITY CHART** Gravelly Clayey Silt with Sand (TILL) (Noise Barrier Wall - Line 'J')

Figure No. H-7


Project No. 1662333

Checked By: SMM



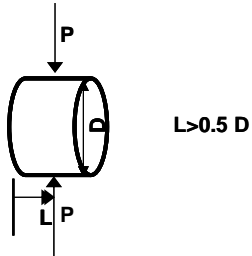
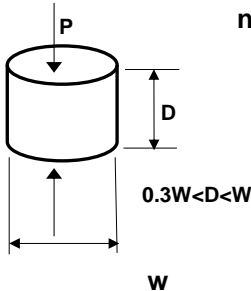


Scale

PROJECT <b>MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street</b>						
TITLE <b>Bedrock Core Photograph Borehole PED-03B (14.80 m to 17.77 m)</b>						
 <b>GOLDER</b>	PROJECT No. 1662333			FILE No. ----		
	DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
	CADD	--		<b>FIGURE H-8</b>		
	CHECK	SMM	20190319			
	REVIEW	JMAC	20190321			

**APPENDIX I**

**Geotechnical Laboratory Test  
Results of Bedrock Core Samples**

TABLE I1						
Point Load Test Results of Bedrock Core Samples						
Noise Barrier Walls and Noise Barrier/Retaining Walls						
QEW Widening from West of Mississauga Road to West of Hurontario Street, Mississauga, Ontario						
Borehole Number	Run Number	Core Sample Depth (m)	Core Sample Elevation (m)	Bedrock Description	Test Type	Corrected Is (50mm) (MPa)
CRB-2A	9	7.07	87.43	Shale	Axial	0.37
CRB-2A	10	7.50	87.00	Shale	Diametral	0.44
CRB-2A	10	7.55	86.95	Shale	Axial	0.13
CRB-2A	5	4.81	89.69	Shale	Diametral	0.18
CRB-2A	8	5.82	88.68	Shale	Diametral	0.28
CRB-2A	8	5.87	88.63	Shale	Axial	0.40
CRB-6	1	6.03	85.72	Shale	Axial	0.70
CRB-6	1	6.03	85.72	Shale	Diametral	0.44
CRB-6	2	7.34	84.41	Shale	Axial	0.65
CRB-6	2	7.34	84.41	Shale	Diametral	0.51
CRB-6	3	9.03	82.72	Shale	Axial	0.61
CRB-6	3	9.03	82.72	Shale	Diametral	0.15
NW3-1	1	12.41	84.09	Shale	Axial	0.60
NW3-1	1	12.41	84.09	Shale	Diametral	0.20
NW3-1	2	13.20	83.30	Shale	Axial	0.40
NW3-1	2	13.20	83.30	Shale	Diametral	0.40
NW3-1	3	14.54	81.96	Shale	Axial	0.40
NW3-1	3	14.54	81.96	Shale	Diametral	0.40
Refer to "Suggested Methods for Determining Point Load Strength", International Society for Rock Mechanics Commission on Testing Methods, Int.J.Rock. Mech. Min.Sci. and Geomechanical Abstr., Vol 22, No. 2 1985, PP 51-60.						
<b>DIAMETRAL SPECIMEN SHAPE REQUIREMENTS</b> note: Diametral tests are perpendicular to core axis (planes of weakness)				<b>AXIAL SPECIMEN SHAPE REQUIREMENTS</b> note: Axial tests are parallel to core axis (planes of weakness)		
						
				Compiled By: ACM Checked By: SMM Reviewed By: JMAC		

November 22, 2017

Mr. David Marmor  
Golder Associates Ltd.  
6925 Century Avenue, Suite #100  
Mississauga, Ontario  
Canada L5N 7K2

Re: UCS + E testing  
(Golder Project No. 166233)

Dear Mr. Marmor:

On November 3, 2017 four (4) HQ-sized core samples were received by Geomechanica Inc. via courier. These samples were identified as being from boreholes drilled as part of Golder project 166233 (denoted as QEW/Credit River UCS samples). A uniaxial compressive strength (UCS) specimen was prepared and tested from each of these samples (4 tests total).

Details regarding the steps of specimen preparation and testing along with the test results and specimen photographs before and after testing are presented in the accompanying laboratory report.

Sincerely,



Giovanni Grasselli Ph.D., P. Eng.

Geomechanica Inc.  
Tel: (647) 478-9767  
Email: [giovanni.grasselli@geomechanica.com](mailto:giovanni.grasselli@geomechanica.com)

# Rock Laboratory Testing Results

**A report submitted to:**

David Marmor  
Golder Associates Ltd.  
6925 Century Avenue, Suite #100  
Mississauga, Ontario  
Canada L5N 7K2

**Prepared by:**

Bryan Tatone, PhD  
Omid Mahabadi, PhD  
Giovanni Grasselli, PhD, PEng

Geomechanica Inc  
#300-90 Adelaide St W  
Toronto ON  
M5H 3V9 Canada  
Tel: +1-647-478-9767  
info@geomechanica.com

**November 22, 2017**  
Project number: 1662333

**Abstract**

This document summarizes the results of 4 uniaxial compression tests on HQ-sized core samples for Golder Project 1662333. Results including uniaxial compressive strength (UCS) and Young's modulus along with photographs of samples before and after testing are presented.

**In this document:**

1	Overview	1
2	Results	2

## 1 Overview

This report summarizes the results of laboratory testing of 4 uniaxial compression tests on HQ-sized core samples for Golder Project 1662333. The tests were performed in Geomechanica's laboratory in Oakville, Ontario, Canada using a 1.3 MN capacity Forney compression testing machine (Figure 1). The specimens were loaded with a nearly constant axial displacement rate of 0.150 mm/min. The specimen preparation and testing procedure included the following:

1. Unwrapping of the core samples, inspecting them for damage, and re-wrapping them in electrical tape to minimize disturbance during subsequent specimen preparation.
2. Diamond cutting of core samples to obtain cylindrical specimens with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Surface grinding of specimens to obtain flat (within  $\pm 0.025$  mm) and parallel end faces (within  $0.25^\circ$ ).
4. Placing each specimen into the loading frame, applying a 0.5-1.0 kN axial load, removing the electrical tape, and subsequently increasing the axial load gradually to cause rupture while continuously recording axial force and axial deformation to determine peak strength (UCS) and (tangent) Young's modulus.



Figure 1: UCS Test setup.

## 2 Results

The results of the tests are summarized in Table 1. The corresponding stress-strain curves for the uniaxial compression tests are presented in Figure 2. The Young's modulus is the tangent modulus, calculated as the slope of the best fit line through  $\pm 300$  data points on either side of the point representing 50% of the peak strength.

Table 1: Summary of laboratory test results.

Sample	Depth (m)	Bulk density $\rho$ (g/cm <sup>3</sup> )	UCS (MPa)	Young's Modulus $E$ (GPa)	Notes
CRB-3, UCS-1	11.44 - 11.66	2.61	9.4	2.10	<sup>1</sup>
CRB-6, UCS-1	6.06 - 6.17	2.17	14.6	0.63	<sup>1,2</sup>
CRB-7, UCS-1	9.21 - 9.369	2.59	15.5	0.65	<sup>1,2</sup>
CRB-7, UCS-3	12.11 - 12.36	2.59	7.4	1.28	
Mean		2.49	11.7	1.2	
Standard Deviation		0.18	3.4	0.6	

<sup>1</sup> Specimen emitted fresh pore water upon loading  
<sup>2</sup> length:diameter ratio < 2:1.

### 2.1 Specimen photographs

Photographs of the specimens before and after testing are presented in Figure 3.

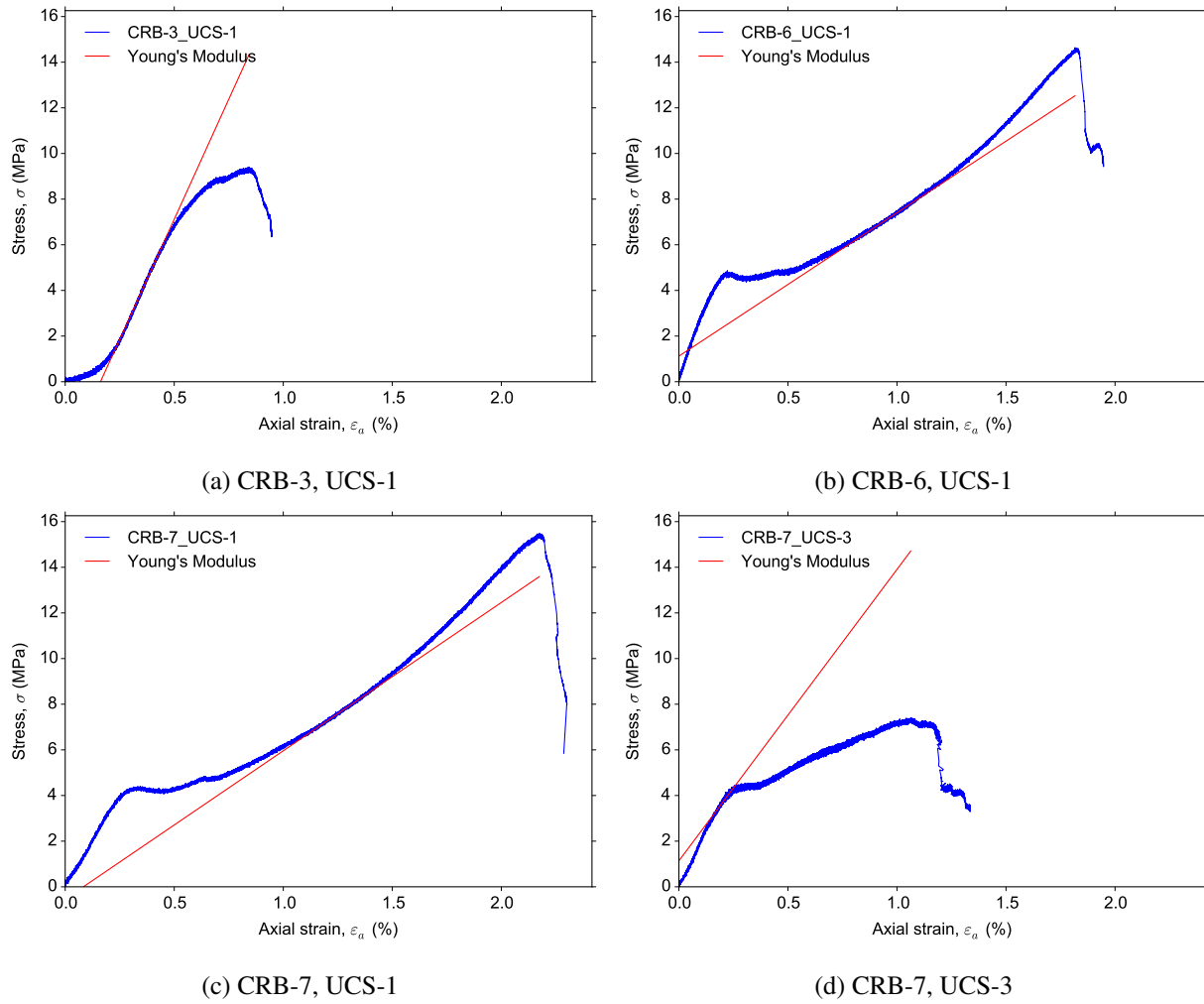


Figure 2: Measured stress-strain curves.





Figure 3: Photographs of specimens prior to testing.

January 03, 2018

Mr. David Marmor  
Golder Associates Ltd.  
6925 Century Avenue, Suite #100  
Mississauga, Ontario  
Canada L5N 7K2

Re: UCS + E testing  
(Golder Project No. 166233)

Dear Mr. Marmor:

On November 25, 2017 one (1) HQ-sized core sample was received by Geomechanica Inc. via drop-off by Golder personnel. On December 22, 2017 an additional three (3) HQ-sized core samples were received by Geomechanica Inc. via drop-off by Golder personnel. These samples were identified as being from boreholes drilled as part of Golder project 166233 (denoted as QEW South Ped. Bridge and QEW and Mississauga Road UCS samples). A uniaxial compressive strength (UCS) specimen was prepared and tested from each of these samples (4 tests total).

Details regarding the steps of specimen preparation and testing along with the test results and specimen photographs before and after testing are presented in the accompanying laboratory report.

Sincerely,



Giovanni Grasselli Ph.D., P. Eng.

Geomechanica Inc.  
Tel: (647) 478-9767  
Email: [giovanni.grasselli@geomechanica.com](mailto:giovanni.grasselli@geomechanica.com)

# Rock Laboratory Testing Results

**A report submitted to:**

David Marmor  
Golder Associates Ltd.  
6925 Century Avenue, Suite #100  
Mississauga, Ontario  
Canada L5N 7K2

**Prepared by:**

Bryan Tatone, PhD  
Omid Mahabadi, PhD  
Giovanni Grasselli, PhD, PEng

Geomechanica Inc  
#900-390 Bay St  
Toronto ON  
M5H 2Y2 Canada  
Tel: +1-647-478-9767  
info@geomechanica.com

**January 3, 2018**

Project number: 1662333

**Abstract**

This document summarizes the results of 4 uniaxial compression tests on HQ-sized core samples for Golder Project 1662333. Results including uniaxial compressive strength (UCS) and Young's modulus along with photographs of samples before and after testing are presented.

**In this document:**

1	Overview	1
2	Results	2

## 1 Overview

This report summarizes the results of 4 uniaxial compression tests on HQ-sized core samples for Golder Project 1662333. The tests were performed in Geomechanica's laboratory in Oakville, Ontario, Canada using a 1.3 MN capacity Forney compression testing machine (Figure 1). The specimens were loaded with a nearly constant axial displacement rate of 0.150 mm/min. The specimen preparation and testing procedure included the following:

1. Unwrapping of the core samples, inspecting them for damage, and re-wrapping them in electrical tape to minimize disturbance during subsequent specimen preparation.
2. Diamond cutting of core samples to obtain cylindrical specimens with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Surface grinding of specimens to obtain flat (within  $\pm 0.025$  mm) and parallel end faces (within  $0.25^\circ$ ).
4. Placing each specimen into the loading frame, applying a 0.5-1.0 kN axial load, removing the electrical tape, and subsequently increasing the axial load gradually to cause rupture while continuously recording axial force and axial deformation to determine peak strength (UCS) and (tangent) Young's modulus.



Figure 1: UCS Test setup.

## 2 Results

The results of the tests are summarized in Table 1. The corresponding stress-strain curves for the uniaxial compression tests are presented in Figure 2. Young's modulus is the tangent modulus, calculated as the slope of the best fit line through  $\pm 300$  data points on either side of the point representing 50.0% of the peak strength.

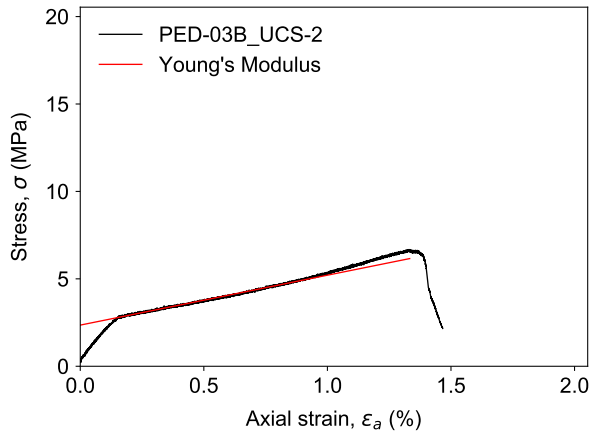
Table 1: Summary of laboratory test results.

Sample	Depth (m)	Bulk density $\rho$ (g/cm <sup>3</sup> )	UCS (MPa)	Young's Modulus $E$ (GPa)	Notes
PED-03B, UCS-2	16.03 - 16.27	2.57	6.7	0.29	1
MO-10, UCS-2	2.68 - 2.83	2.60	19.6	0.86	1
MO-12, UCS-2	4.15 - 4.27	2.60	17.3	1.00	1,2
MO-11, UCS-3	3.66 - 3.79	2.59	18.3	0.97	1,2,3 - 2 layers 8 - 20 mm thick
Mean		2.59	15.5	0.8	
Standard Deviation		0.02	5.1	0.3	

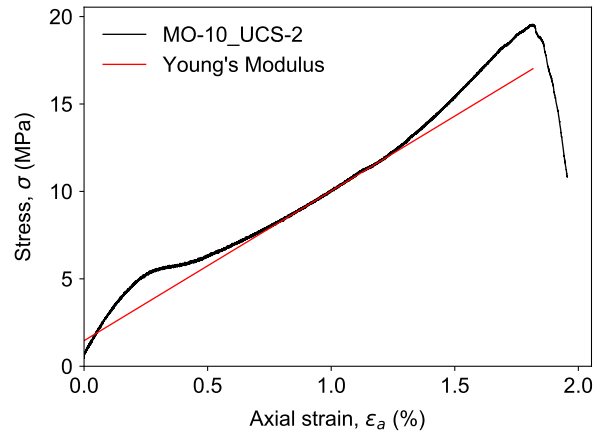
<sup>1</sup> Specimen emitted fresh pore water upon loading  
<sup>2</sup> Length:diameter ratio < 2:1  
<sup>3</sup> Contains limestone layers

### 2.1 Specimen photographs

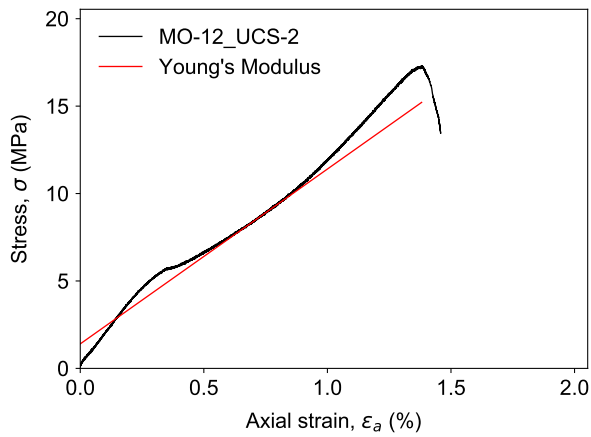
Photographs of the specimens before and after testing are presented in Figure 3.



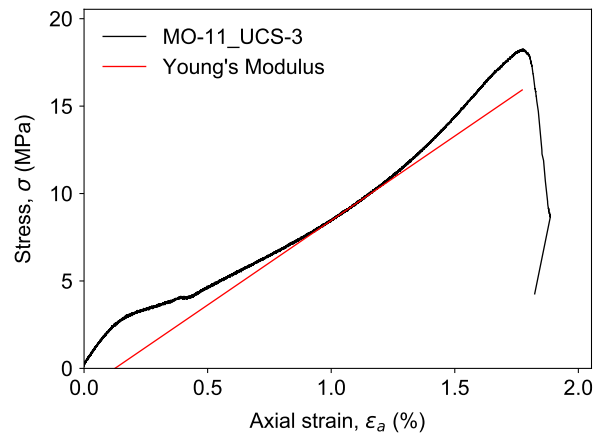
(a) PED-03B, UCS-2



(b) MO-10, UCS-2



(c) MO-12, UCS-2



(d) MO-11, UCS-3

Figure 2: Measured stress-strain curves.



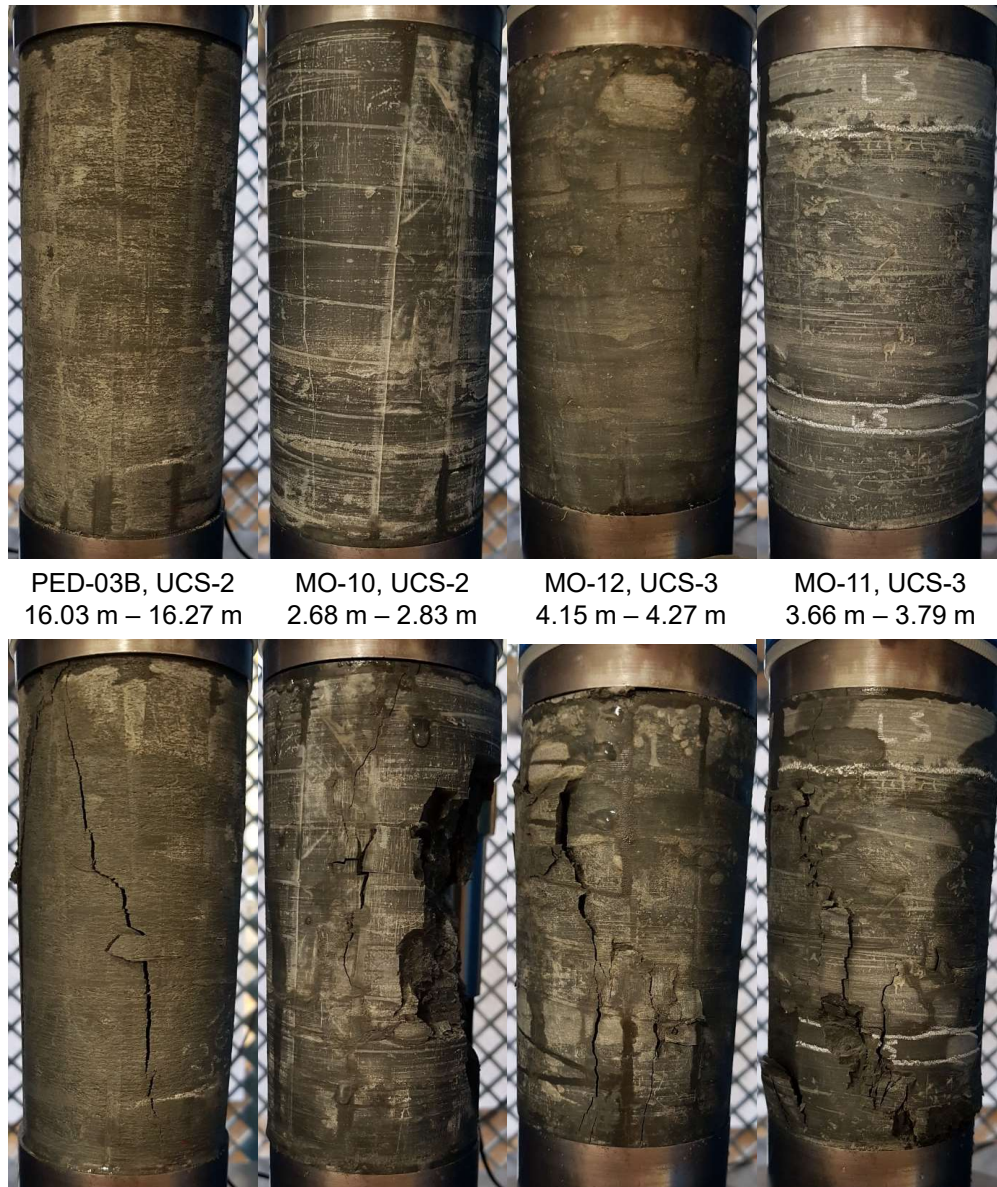


Figure 3: Photographs of specimens prior to testing.

April 09, 2018

Mr. David Marmor  
Golder Associates Ltd.  
6925 Century Avenue, Suite #100  
Mississauga, Ontario  
Canada L5N 7K2

Re: UCS + E testing  
(Golder Project No. 1662333)

Dear Mr. Marmor:

On March 27, 2018 three (3) NQ-sized and eight (8) HQ-sized core samples were received by Geomechanica Inc. via drop-off by Golder personnel. These samples were identified as being from boreholes drilled as part of Golder project. A uniaxial compressive strength (UCS) specimen was prepared and tested from each of these samples (11 tests total).

Details regarding the steps of specimen preparation and testing along with the test results and specimen photographs before and after testing are presented in the accompanying laboratory report.

Sincerely,



Bryan Tatone Ph.D., P. Eng.

Geomechanica Inc.  
Tel: (647) 478-9767  
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# Rock Laboratory Testing Results

**A report submitted to:**

David Marmor  
Golder Associates Ltd.  
6925 Century Avenue, Suite #100  
Mississauga, Ontario  
Canada L5N 7K2

**Prepared by:**

Bryan Tatone, PhD, PEng  
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**April 9, 2018**

Project number: 1662333

**Abstract**

This document summarizes the results of 11 uniaxial compression tests on a combination of NQ and HQ core samples. Results, including uniaxial compressive strength (UCS) and Young's modulus, along with photographs of test specimens before and after testing are presented.

**In this document:**

1	Overview	1
2	Results	1

## 1 Overview

This report summarizes the results of 11 uniaxial compression tests. The specimen preparation and testing procedure included the following:

1. Unwrapping of the core samples, inspecting them for damage, and re-wrapping them in electrical tape to minimize disturbance during subsequent specimen preparation.
2. Diamond cutting of core samples to obtain cylindrical specimens with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Surface grinding of specimens to obtain flat (within  $\pm 0.025$  mm) and parallel end faces (within  $0.25^\circ$ ).
4. Placing each specimen into the loading frame, applying a 0.5-1.0 kN axial load, removing the electrical tape, and axial loading at a constant displacement rate to rupture while continuously recording axial force and axial deformation to determine the peak strength (UCS) and (tangent) Young's modulus ( $E$ ).

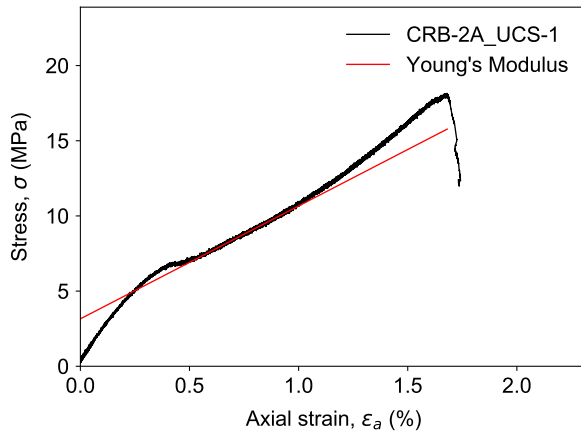
## 2 Results

The results of the tests are summarized in Table 1. The corresponding stress-strain curves for the uniaxial compression tests are presented in Figure 1 to Figure 2. The Young's modulus is the tangent modulus, calculated as the slope of the best fit line through  $\pm 300$  data points on either side of the point representing 50.0% of the peak strength.

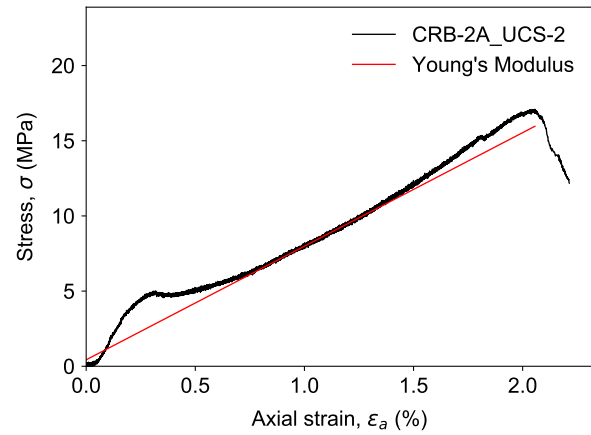
Table 1: Summary of laboratory test results.

Sample	Rock (m)	Depth type	Bulk density $\rho$ (g/cm <sup>3</sup> )	UCS (MPa)	Young's Modulus $E$ (GPa)	Notes
CRB-2A, UCS-1	Shale	4.31 - 4.46	2.59	18.2	0.75	1, 2
CRB-2A, UCS-2	Shale	4.92 - 5.15	2.60	17.1	0.76	1
CRB-3C, UCS-3	Limestone	7.87 - 7.98	2.61	114.1	22.91	2, 3
CRB-2, UCS-2	Shale	7.75 - 7.92	2.58	11.2	0.83	1
CRB-2, UCS-3	Shale	11.37 - 11.52	2.61	13.0	2.19	3
CRB-3A, UCS-3	Shale	10.19 - 10.33	2.60	8.9	0.48	1, 4 - 2 limestone layers 5-10 mm thick
CRB-3A, UCS-5	Shale	12.99 - 13.28	2.62	16.9	0.67	1
CRB-4, UCS-3	Shale	13.62 - 13.80	2.61	18.6	0.84	1
CRB-5, UCS-2	Shale	13.68 - 13.95	2.61	15.5	0.61	1
CRB-5A, UCS-2	Shale	12.43 - 12.57	2.60	14.2	0.96	1
CRB-5A, UCS-4	Shale	15.34 - 15.57	2.64	22.7	0.93	1

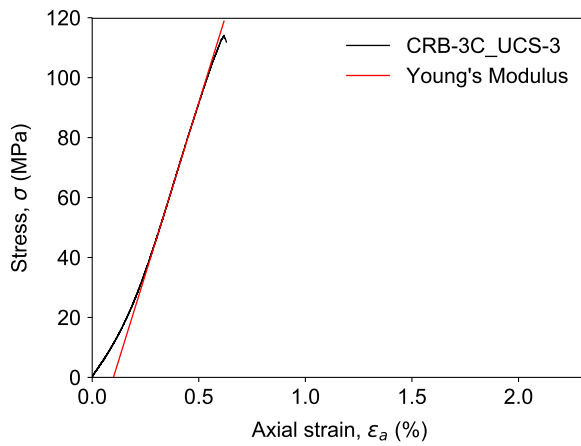
<sup>1</sup> Upon loading specimen emitted pore water  
<sup>2</sup> Irregular diameter > 0.5 mm  
<sup>3</sup> Length:Diameter ratio less than 2  
<sup>4</sup> Inter-bedded limestone and shale



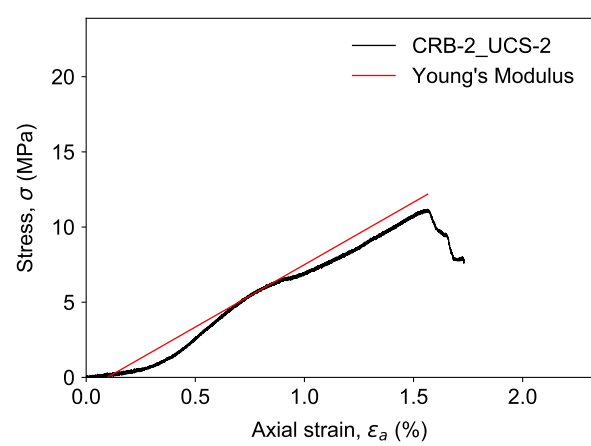
(a) CRB-2A, UCS-1



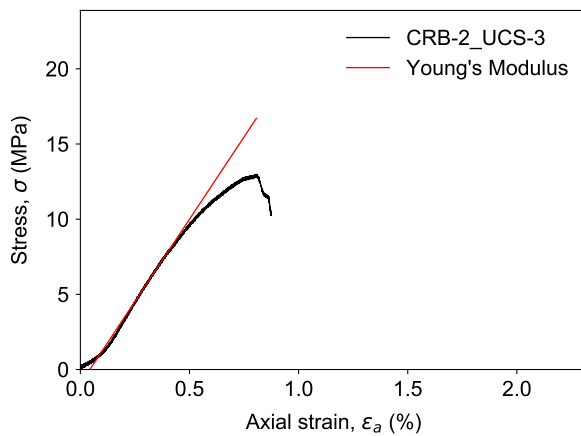
(b) CRB-2A, UCS-2



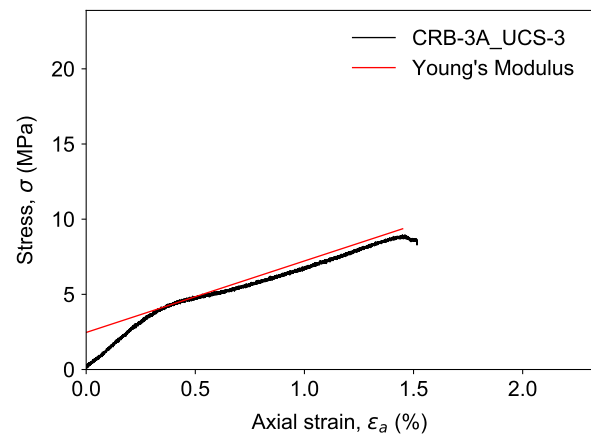
(c) CRB-3C, UCS-3



(d) CRB-2, UCS-2

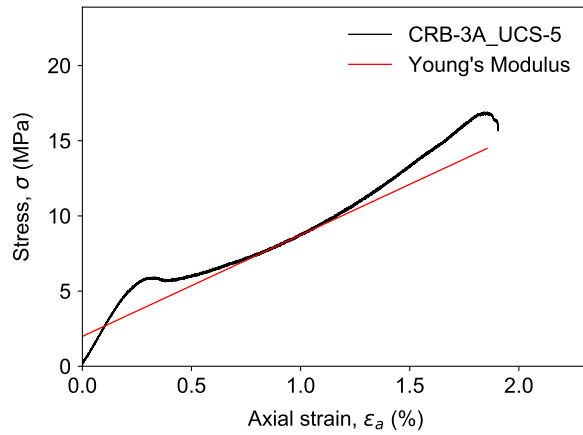


(e) CRB-2, UCS-3

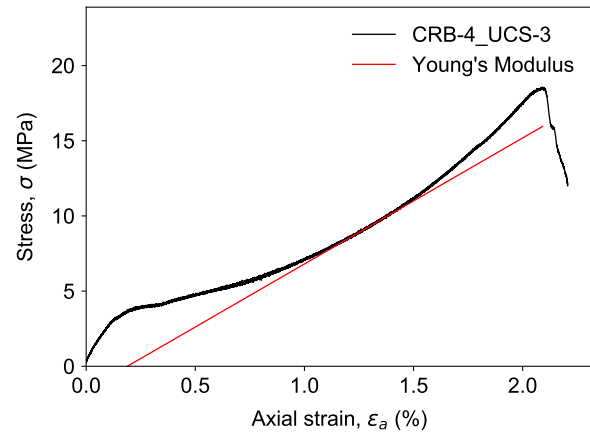


(f) CRB-3A, UCS-3

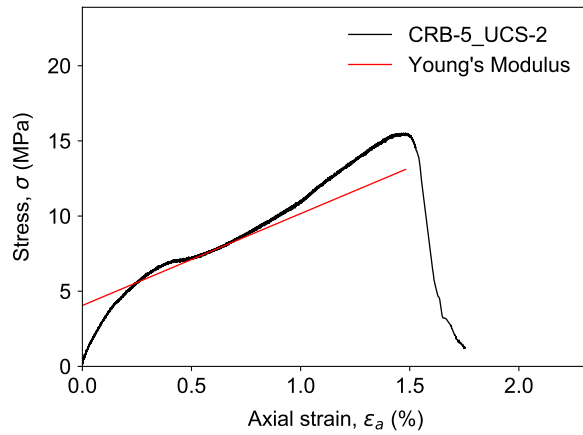
Figure 1: Measured stress-strain curves.



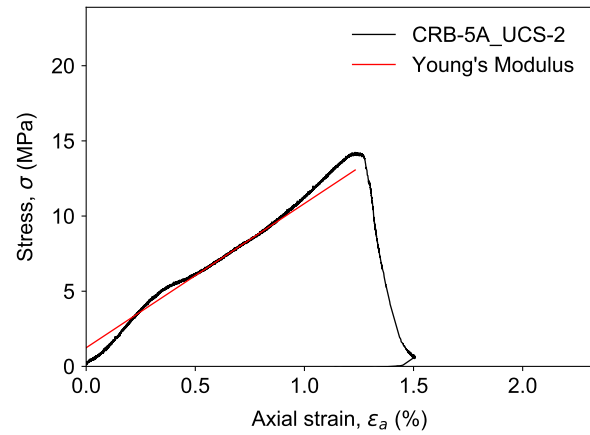
(a) CRB-3A, UCS-5



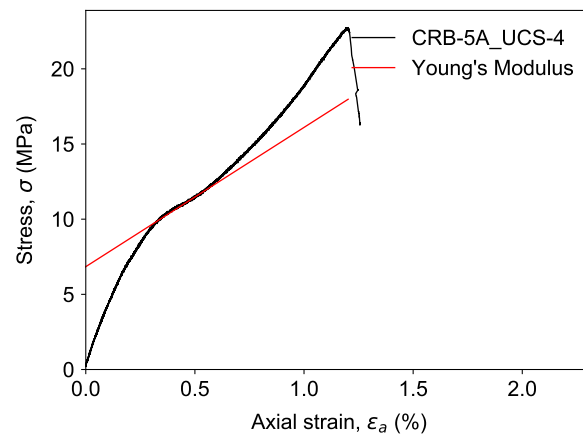
(b) CRB-4, UCS-3



(c) CRB-5, UCS-2



(d) CRB-5A, UCS-2



(e) CRB-5A, UCS-4

Figure 2: Measured stress-strain curves.

## 2.1 Specimen photographs

Photographs of the specimens before and after testing are presented in Figure 3 and Figure 4



Figure 3: Photographs of specimens prior to testing.



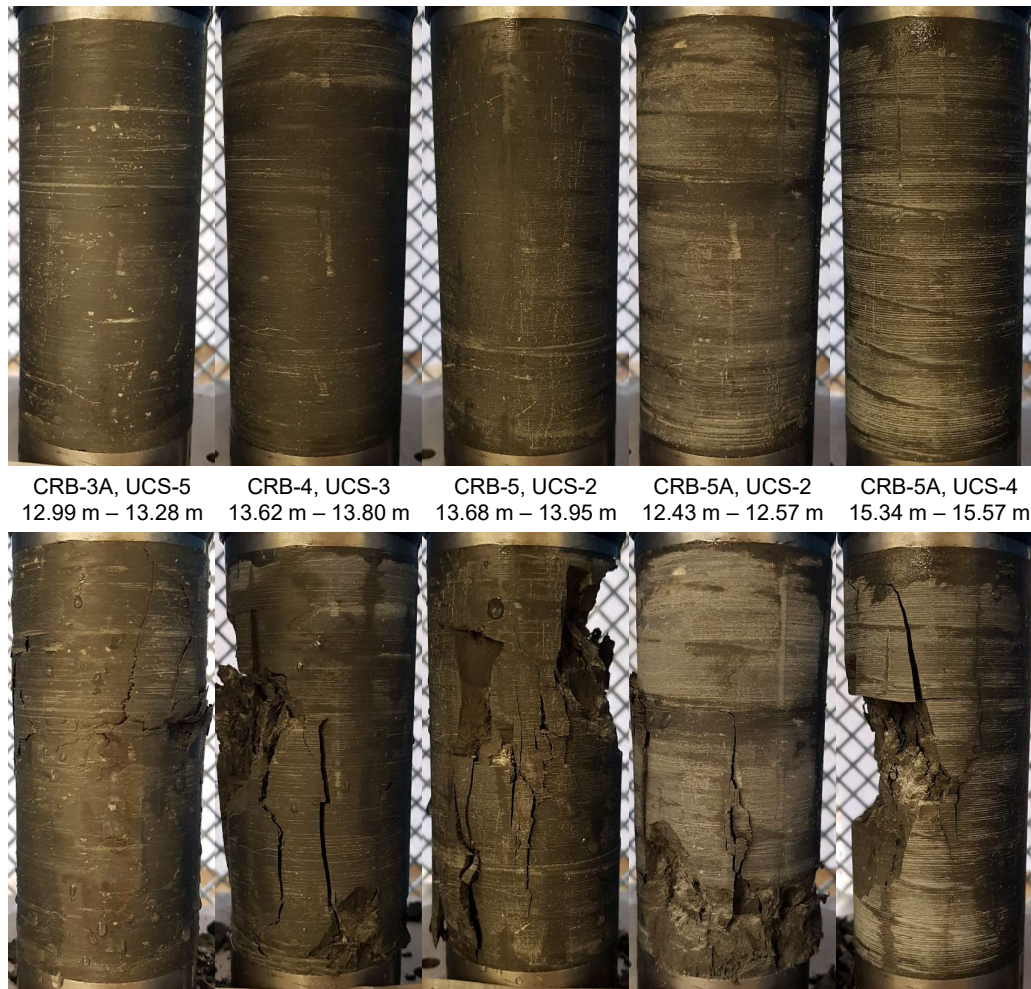


Figure 4: Photographs of failed specimens after testing.

August 27, 2018

Mr. David Marmor  
Golder Associates Ltd.  
6925 Century Avenue, Suite #100  
Mississauga, Ontario  
Canada L5N 7K2

Re: UCS only and UCS + E testing  
(Golder Project No. 1662333)

Dear Mr. Marmor:

On July 31, 2018 and August 17, 2018 seven (7) and six (6) HQ-sized core samples were received by Geomechanica Inc. via drop-off by Golder personnel, respectively. These samples were identified as being from boreholes drilled as part of Golder project 1662333. A total of 13 uniaxial compressive strength (UCS) specimens were prepared and tested from these samples. The tangent elastic modulus was measured for 5 of these 13 tests.

Details regarding the steps of specimen preparation and testing along with the test results and specimen photographs before and after testing are presented in the accompanying laboratory report.

Sincerely,



Bryan Tatone Ph.D., P. Eng.

Geomechanica Inc.  
Tel: (647) 478-9767  
Email: [bryan.tatone@geomechanica.com](mailto:bryan.tatone@geomechanica.com)

# Rock Laboratory Testing Results

**A report submitted to:**

David Marmor  
Golder Associates Limited  
6925 Century Avenue, Suite #100  
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Canada L5N 7K2

**Prepared by:**

Bryan Tatone, PhD, PEng  
Omid Mahabadi, PhD, PEng  
Geomechanica Inc  
#900-390 Bay St  
Toronto ON  
M5H 2Y2 Canada  
Tel: +1-647-478-9767  
info@geomechanica.com

**August 27, 2018**

Project number: 1662333

**Abstract**

This document summarizes the results of rock laboratory testing of 13 uniaxial compressive strength (UCS) tests. Results, including uniaxial compressive strength (UCS) and Young's modulus (for select samples) along with photographs of samples before and after testing are presented. Additional specimen information is included in an accompanying summary spreadsheet.

**In this document:**

1	Uniaxial Compressive Strength (UCS) testing	1
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## 1 Uniaxial Compressive Strength (UCS) testing

This report summarizes the results of 13 uniaxial compressive strength (UCS) tests. The testing was performed in Geomechanica's rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain an axial displacement rate of approximately 0.15 mm/min for shale and 0.075 mm/min for limestone samples (Figure 1). This displacement rate was selected to target specimen failure to occur within 2 - 15 minutes.

The specimen preparation and testing procedure included the following:

1. Unwrapping of the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture during subsequent specimen preparation.
2. Diamond cutting of core sample to obtain a cylindrical specimen with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding of specimen to obtain flat (within  $\pm 0.025$  mm) and parallel end faces (within  $0.25^\circ$ ).
4. Placement of the specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axial loading to rupture while continuously recording axial force and axial deformation to determine the peak strength (UCS) and (tangent) Young's modulus ( $E$ ) for select samples.



Figure 1: UCS test setup.

## 1.1 Results

The results of the tests are summarized in Table 1. The corresponding stress-strain curves for the uniaxial compression tests are presented in Figure 2 and 3. Young's modulus is the tangent modulus, calculated as the slope of the best fit line through  $\pm 300$  data points on either side of the point representing 50.0% of the peak strength. Additional specimen information is included in the accompanying summary spreadsheet.

Table 1: Summary of laboratory test results.

Sample	Depth (m)	Lithology description	Bulk density $\rho$ (g/cm <sup>3</sup> )	UCS (MPa)	Young's Modulus $E$ (GPa)	Failure description
NRW3-7, SA-1	9.57 - 9.71	Georgian Bay Formation - Shale	2.596	14.4	0.68	Axial splitting <sup>1, 2</sup>
NWI-2, SA-1	5.06 - 5.31	Georgian Bay Formation - Shale	2.619	23.3	1.26	Inclined shear fracture <sup>2</sup>
NWI-3, SA-1	4.29 - 4.44	Georgian Bay Formation - Shale with several limestone lenses < 5 mm	2.601	16.8	-	Localized crushing <sup>2</sup>
NW5-4, SA-1	5.47 - 5.61	Georgian Bay Formation - Limestone	2.732	196.3	60.84	Inclined shear fracture
OHS-1, SA-1	5.26 - 5.44	Georgian Bay Formation - Shale	2.591	13.0	-	Inclined shear fracture <sup>2</sup>
OHS-2, SA-1	5.38 - 5.49	Georgian Bay Formation - Shale with 2 limestone layers $\approx 5$ mm thick	2.449	23.4	-	Hourglass failure <sup>1, 2</sup>
OHS-5, SA-1	6.13 - 6.27	Georgian Bay Formation - Shale	2.603	16.7	-	Axial splitting <sup>2</sup>
AR-2, SA-1	5.92 - 6.12	Georgian Bay Formation - Shale	2.574	9.1	-	Axial splitting <sup>2</sup>
AR-2, SA-2	8.60 - 8.82	Georgian Bay Formation - Shale	2.588	11.5	-	Axial splitting <sup>2</sup>
NW5-1, SA-1	4.29 - 4.45	Georgian Bay Formation - Shale	2.593	13.6	-	Hourglass failure <sup>2</sup>
SWME-4, SA-1	10.40 - 10.54	Georgian Bay Formation - Shale	2.586	13.5	-	Axial splitting <sup>2</sup>
HMPL-1, SA-1	4.81 - 4.96	Georgian Bay Formation - Shale	2.573	11.8	0.50	Localized crushing <sup>2</sup>
HMPL-2, SA-1	3.70 - 3.85	Georgian Bay Formation - Shale	2.594	13.7	0.88	Axial splitting <sup>2</sup>

<sup>1</sup> Specimen Length:Diameter ratio < 2 due to short sample length

<sup>2</sup> Specimen emitted pore water upon loading

## 1.2 Specimen photographs

Photographs of the specimens before and after testing are presented in Figures 4 to 6.

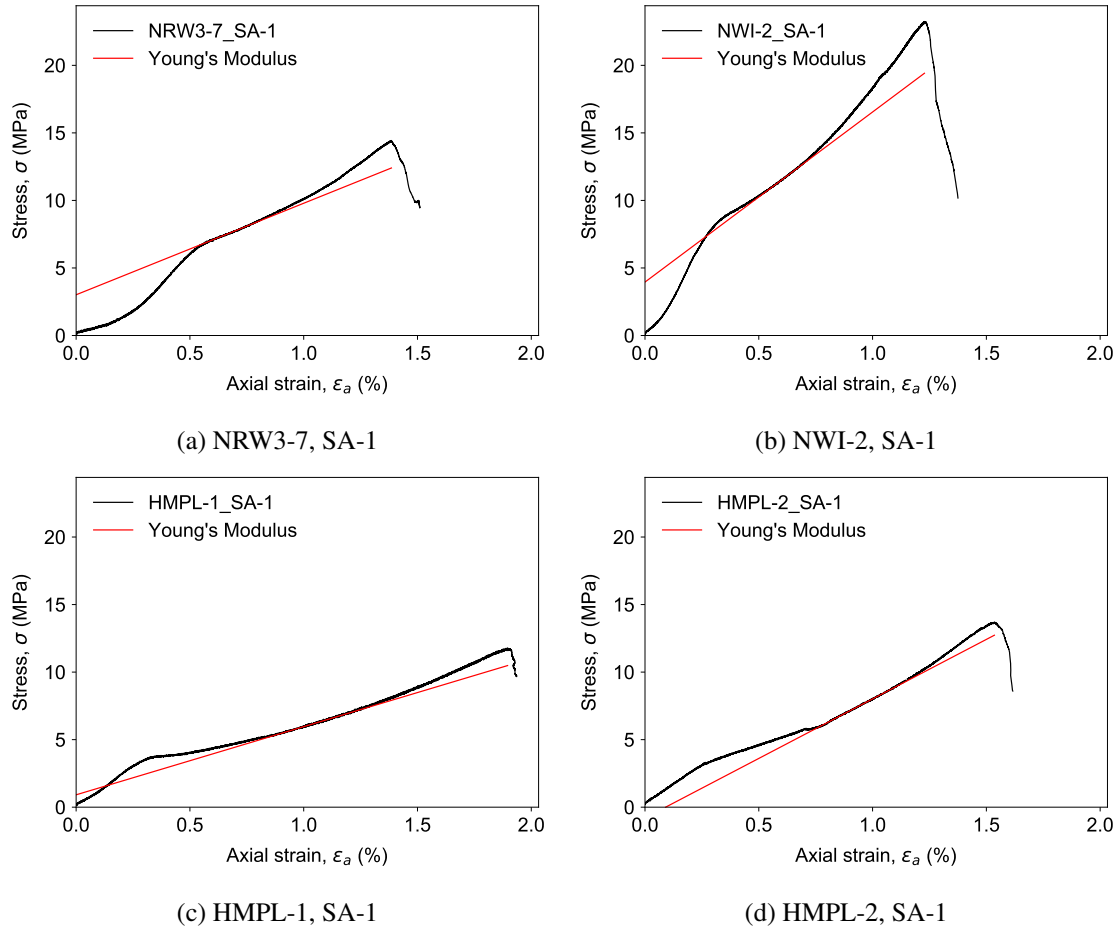
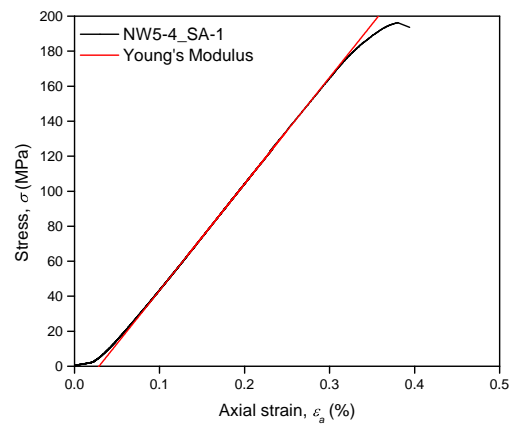


Figure 2: Measured stress-strain curves for shale samples.



(a) NRW5-4, SA-1

Figure 3: Measured stress-strain curves for limestone samples.

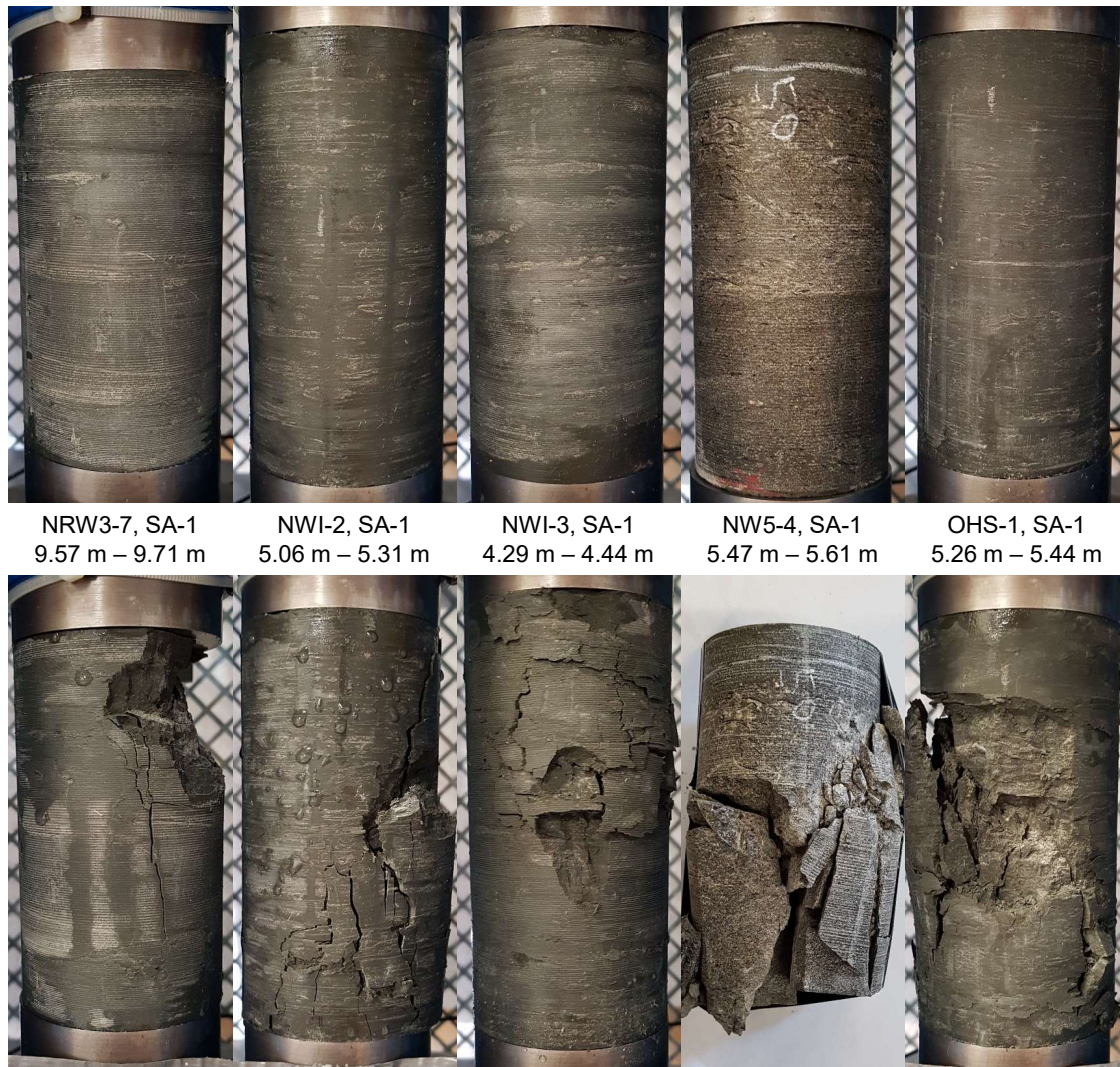


Figure 4: Photographs of specimens before and after testing.



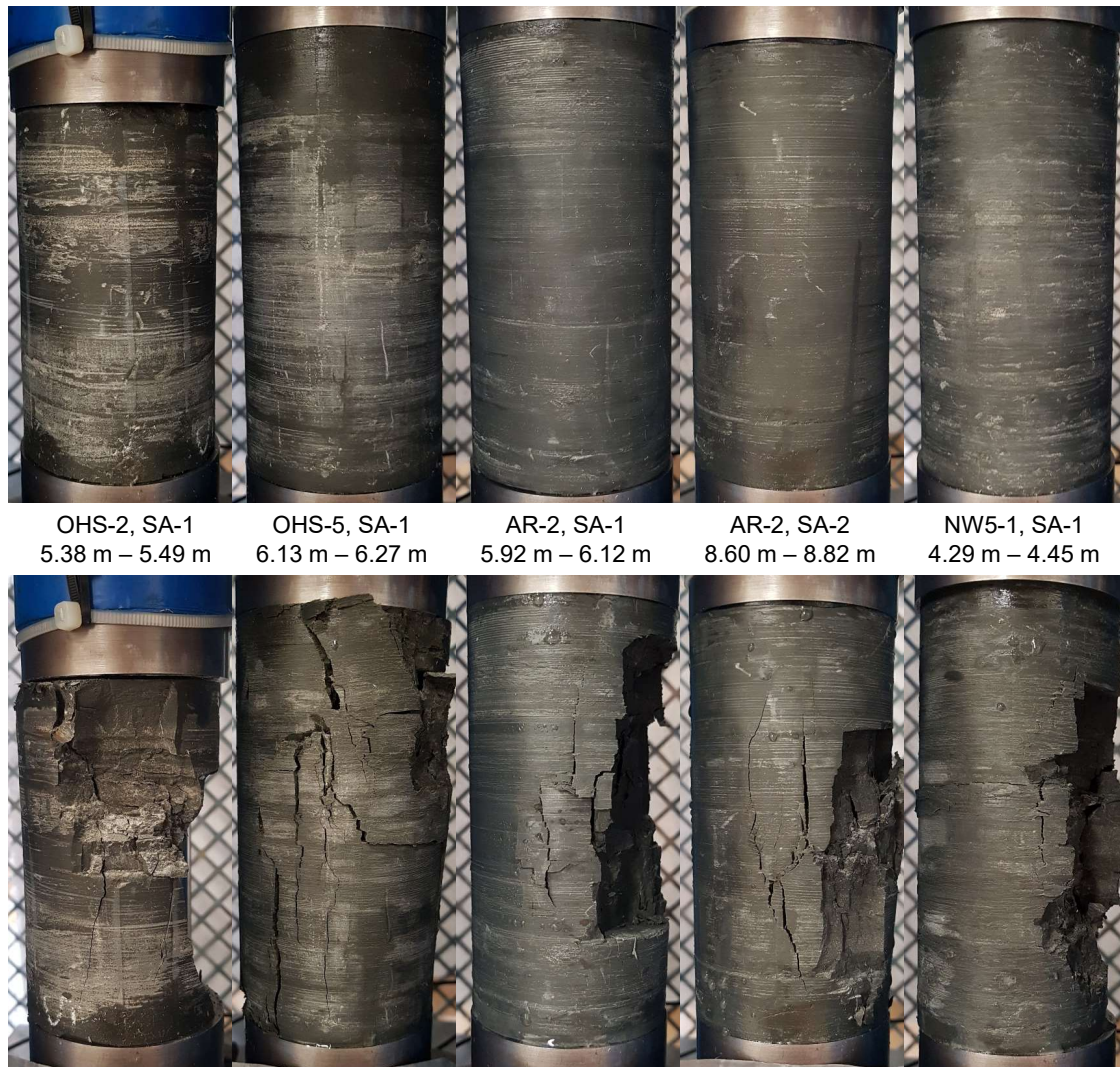


Figure 5: Photographs of failed specimens before and after testing (continued).

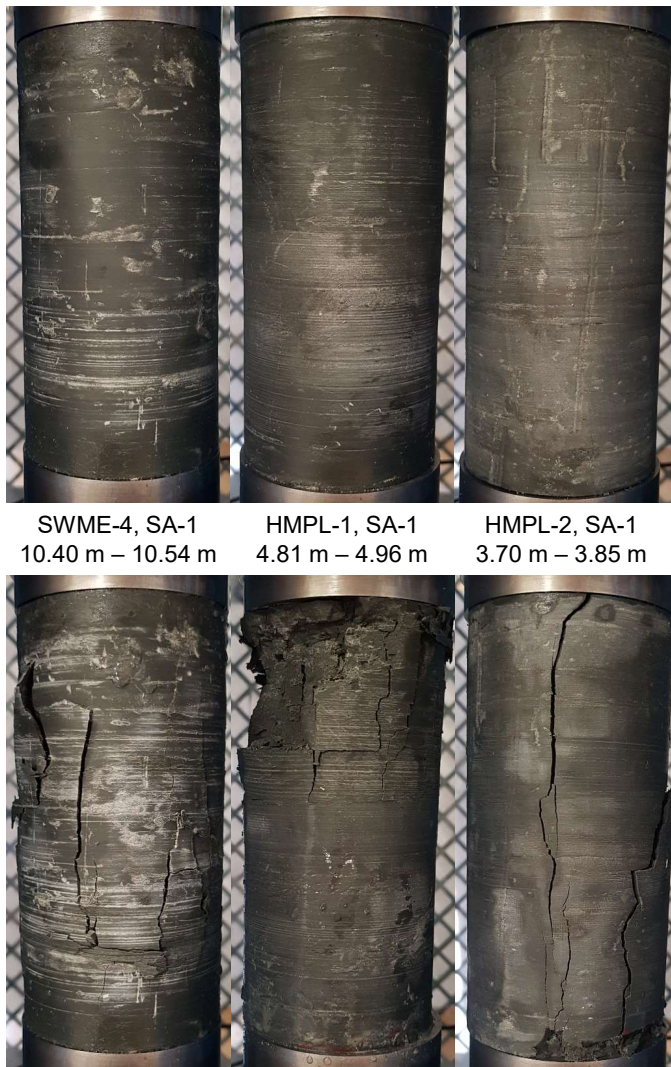


Figure 6: Photographs of failed specimens before and after testing (continued).

**APPENDIX J**

# Analytical Test Results on Soil and Bedrock Core Samples

Your Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Your C.O.C. #: 51329

**Attention:David Marmor**

Golder Associates Ltd  
Mississauga - Standing Offer  
6925 Century Ave  
Suite 100  
Mississauga, ON  
CANADA L5N 7K2

**Report Date: 2017/11/21**  
Report #: R4869236  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B7P4571**

**Received: 2017/11/13, 12:50**

Sample Matrix: Soil  
# Samples Received: 3

Analyses	Date		Date Analyzed	Laboratory Method	Reference
	Quantity	Extracted			
Chloride (20:1 extract)	3	N/A	2017/11/17	CAM SOP-00463	EPA 325.2 m
Conductivity	3	N/A	2017/11/20	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	3	2017/11/17	2017/11/17	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	3	2017/11/13	2017/11/20	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	3	N/A	2017/11/17	CAM SOP-00464	EPA 375.4 m

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.



Your Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Your C.O.C. #: 51329

**Attention:David Marmor**

Golder Associates Ltd  
Mississauga - Standing Offer  
6925 Century Ave  
Suite 100  
Mississauga, ON  
CANADA L5N 7K2

**Report Date: 2017/11/21**  
Report #: R4869236  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B7P4571**  
**Received: 2017/11/13, 12:50**

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ema Gitej, Senior Project Manager

Email: EGitej@maxxam.ca

Phone# (905)817-5829

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B7P4571  
Report Date: 2017/11/21

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: JC

### RESULTS OF ANALYSES OF SOIL

Maxxam ID		FNR708			FNR708		FNR709	FNR710		
Sampling Date		2017/10/16 16:00			2017/10/16 16:00		2017/10/20 10:00	2017/10/26 13:30		
COC Number		51329			51329		51329	51329		
	UNITS	NW3-01 SA7	RDL	QC Batch	NW3-01 SA7 Lab-Dup	QC Batch	CRB-06 RC-01 6.00-6.05	PED-03 SA8	RDL	QC Batch

Calculated Parameters										
Resistivity	ohm-cm	490		5263307			5000	1300		5263307
Inorganics										
Soluble (20:1) Chloride (Cl)	ug/g	1000	40	5268736			<20	350	20	5268736
Conductivity	umho/cm	2040	2	5273678			201	762	2	5273678
Available (CaCl2) pH	pH	7.86		5270614	7.93	5270614	8.11	7.73		5270614
Soluble (20:1) Sulphate (SO4)	ug/g	69	20	5268737			30	70	20	5268737
RDL = Reportable Detection Limit										
QC Batch = Quality Control Batch										
Lab-Dup = Laboratory Initiated Duplicate										

## TEST SUMMARY

**Maxxam ID:** FNR708  
**Sample ID:** NW3-01 SA7  
**Matrix:** Soil

**Collected:** 2017/10/16  
**Shipped:**  
**Received:** 2017/11/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5268736	N/A	2017/11/17	Deonarine Ramnarine
Conductivity	AT	5273678	N/A	2017/11/20	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5270614	2017/11/17	2017/11/17	Tahir Anwar
Resistivity of Soil		5263307	2017/11/20	2017/11/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5268737	N/A	2017/11/17	Deonarine Ramnarine

**Maxxam ID:** FNR708 Dup  
**Sample ID:** NW3-01 SA7  
**Matrix:** Soil

**Collected:** 2017/10/16  
**Shipped:**  
**Received:** 2017/11/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	5270614	2017/11/17	2017/11/17	Tahir Anwar

**Maxxam ID:** FNR709  
**Sample ID:** CRB-06 RC-01 6.00-6.05  
**Matrix:** Soil

**Collected:** 2017/10/20  
**Shipped:**  
**Received:** 2017/11/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5268736	N/A	2017/11/17	Deonarine Ramnarine
Conductivity	AT	5273678	N/A	2017/11/20	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5270614	2017/11/17	2017/11/17	Tahir Anwar
Resistivity of Soil		5263307	2017/11/20	2017/11/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5268737	N/A	2017/11/17	Deonarine Ramnarine

**Maxxam ID:** FNR710  
**Sample ID:** PED-03 SA8  
**Matrix:** Soil

**Collected:** 2017/10/26  
**Shipped:**  
**Received:** 2017/11/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5268736	N/A	2017/11/17	Deonarine Ramnarine
Conductivity	AT	5273678	N/A	2017/11/20	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5270614	2017/11/17	2017/11/17	Tahir Anwar
Resistivity of Soil		5263307	2017/11/20	2017/11/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5268737	N/A	2017/11/17	Deonarine Ramnarine

### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.3°C
-----------	-------

**Results relate only to the items tested.**

## QUALITY ASSURANCE REPORT

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: JC

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5268736	Soluble (20:1) Chloride (Cl)	2017/11/17	NC	70 - 130	103	70 - 130	<20	ug/g	14	35
5268737	Soluble (20:1) Sulphate (SO4)	2017/11/17	NC	70 - 130	107	70 - 130	<20	ug/g	13	35
5270614	Available (CaCl2) pH	2017/11/17			99	97 - 103			0.85	N/A
5273678	Conductivity	2017/11/20			100	90 - 110	<2	umho/cm	0	10

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

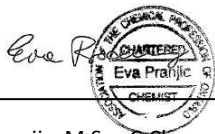
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

Maxxam Job #: B7P4571  
Report Date: 2017/11/21

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: JC

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjić, M.Sc., C.Chem, Scientific Specialist

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



6740 Campobello Road, Mississauga, Ontario L5N 2L8 www.maxxam.ca

Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266

## CHAIN OF CUSTODY RECORD

51329

Page 1 of 1

INVOICE INFORMATION		REPORT INFORMATION (if differs from invoice)		PROJECT INFORMATION		TURNAROUND TIME (TAT) REQUIRED		
Company Name: <u>Golden Associates</u>	Company Name:	Quotation #:	<input checked="" type="checkbox"/> Regular TAT (5-7 days)		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS  Rush TAT (Applicable Surcharge) <input type="checkbox"/> 1 Day (100%) <input type="checkbox"/> 2 Days (50%) <input type="checkbox"/> 3-4 Days (25%)			
Contact Name: <u>David Marmor</u>	Contact Name:	P.O. #:						
Address: <u>6925 Century Ave</u> <u>Suite #1000 Mississauga</u>	Address:	Project #:						
Phone: <u>905-792-8203</u> Fax: <u>905-567-6561</u>	Phone:	Site Location:	<u>BEW/Agarodit River</u>					
Email: <u>david-marmor@golden.com</u>	Email:	Site #:						
		Sampled By:	<u>Jeremy Lebow</u>					
<b>MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY</b>				<b>ANALYSIS REQUESTED</b>		<b>Rush Confirmation #:</b>		
<b>REGULATION 153 (2011)</b>		<b>OTHER REGULATIONS</b>		<b>LABORATORY USE ONLY</b>  CUSTODY SEAL (Y/N) Present: <input checked="" type="checkbox"/> Intact: <input checked="" type="checkbox"/> COOLING MEDIA PRESENT (Y/N) <input checked="" type="checkbox"/>  Temperature (°C) on Receipt: <u>4/17</u>		<b>COMMENTS / TAT COMMENTS</b>		
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Med/Fine	<input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw							
<input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse	<input type="checkbox"/> MISA <input type="checkbox"/> Storm Sewer Bylaw							
<input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other	<input type="checkbox"/> PWQO Municipality:	<input type="checkbox"/> Other (Specify):						
<input type="checkbox"/> Table <input type="checkbox"/> FOR RSC (PLEASE CIRCLE) YES / NO	<input type="checkbox"/> REG.558 (MINIMUM 3 DAY TAT REQUIRED)							
Include Criteria on Certificate of Analysis (Y/N)? <u>N</u>								
SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM								
SAMPLE IDENTIFICATION		DATE SAMPLED	TIME SAMPLED	MATRIX	# OF CONT.			
1 <u>NW3-01 Sa 7</u>		<u>17/10/16</u>	<u>4 pm</u>	<u>Soil</u>	<u>1</u>			
2 <u>CRB-06 RC-01 6.00-6.05</u>		<u>17/10/20</u>	<u>10 am</u>	<u>Soil/Rock</u>	<u>1</u>			
3 <u>PED-03 Sa 8</u>		<u>17/10/26</u>	<u>1:30 pm</u>	<u>Soil</u>	<u>1</u>			
4								
5								
6								
7								
8								
9								
10								
RELINQUISHED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME:	RECEIVED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME:	
<u>[Signature]</u>		<u>2017/11/13</u>	<u>12:50</u>	<u>Toussaint Tsimon</u>		<u>2017/11/13</u>	<u>12:50</u>	
# JARS USED AND NOT SUBMITTED		MAXXAM JOB #						

COC-1004 (11/13) - ENV. ENG.

Maxxam Analytics International Corporation o/a Maxxam Analytics

White: Maxxam - Yellow: Client

Your Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Your C.O.C. #: 674645-01-01

**Attention: Sandra McGaghran**

Golder Associates Ltd  
6925 Century Ave  
Suite 100  
Mississauga, ON  
CANADA L5N 7K2

**Report Date: 2018/07/25**  
Report #: R5317501  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B8I3581**

**Received: 2018/07/20, 16:17**

Sample Matrix: Soil  
# Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract)	7	N/A	2018/07/25	CAM SOP-00463	EPA 325.2 m
Conductivity	7	N/A	2018/07/24	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl <sub>2</sub> EXTRACT	7	2018/07/24	2018/07/24	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	7	2018/07/20	2018/07/24	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	7	N/A	2018/07/25	CAM SOP-00464	EPA 375.4 m

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.



Your Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Your C.O.C. #: 674645-01-01

**Attention: Sandra McGaghran**

Golder Associates Ltd  
6925 Century Ave  
Suite 100  
Mississauga, ON  
CANADA L5N 7K2

**Report Date: 2018/07/25**  
Report #: R5317501  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B8I3581**  
**Received: 2018/07/20, 16:17**

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.  
Ema Gitej, Senior Project Manager  
Email: EGitej@maxxam.ca  
Phone# (905)817-5829

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

### RESULTS OF ANALYSES OF SOIL

Maxxam ID		HGV911	HGV912	HGV913	HGV914	HGV915	HGV916		
Sampling Date		2018/06/28	2018/07/05	2018/06/25	2018/07/15	2018/07/12	2018/06/25		
COC Number		674645-01-01	674645-01-01	674645-01-01	674645-01-01	674645-01-01	674645-01-01		
	UNITS	NRW3-1-SA4	NRW3-9-SA4	NRW3-3-SA4	NRW7-3-SA4	NRW7-1-SA3	NRW3-5-SA4	RDL	QC Batch

Calculated Parameters									
Resistivity	ohm-cm	1400	2600	5500	1800	1200	3000		5640959

Inorganics									
Soluble (20:1) Chloride (Cl-)	ug/g	330	180	36	170	390	<20	20	5644648
Conductivity	umho/cm	721	386	180	564	805	337	2	5644382
Available (CaCl2) pH	pH	7.94	8.05	7.94	7.71	7.86	8.04		5642903
Soluble (20:1) Sulphate (SO4)	ug/g	88	21	32	<20	31	240	20	5644672

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Maxxam ID		HGV917		
Sampling Date		2018/06/22		
COC Number		674645-01-01		
	UNITS	NRW3-7-SA3A	RDL	QC Batch

Calculated Parameters				
Resistivity	ohm-cm	350		5640959

Inorganics				
Soluble (20:1) Chloride (Cl-)	ug/g	1300	40	5644648
Conductivity	umho/cm	2870	2	5644382
Available (CaCl2) pH	pH	8.01		5642903
Soluble (20:1) Sulphate (SO4)	ug/g	55	20	5644672

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

## TEST SUMMARY

**Maxxam ID:** HGV911  
**Sample ID:** NRW3-1-SA4  
**Matrix:** Soil

**Collected:** 2018/06/28  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV912  
**Sample ID:** NRW3-9-SA4  
**Matrix:** Soil

**Collected:** 2018/07/05  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV913  
**Sample ID:** NRW3-3-SA4  
**Matrix:** Soil

**Collected:** 2018/06/25  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV914  
**Sample ID:** NRW7-3-SA4  
**Matrix:** Soil

**Collected:** 2018/07/15  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV915  
**Sample ID:** NRW7-1-SA3  
**Matrix:** Soil

**Collected:** 2018/07/12  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine

Maxxam Job #: B8I3581  
Report Date: 2018/07/25

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: CC

## TEST SUMMARY

**Maxxam ID:** HGV915  
**Sample ID:** NRW7-1-SA3  
**Matrix:** Soil

**Collected:** 2018/07/12  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV916  
**Sample ID:** NRW3-5-SA4  
**Matrix:** Soil

**Collected:** 2018/06/25  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV917  
**Sample ID:** NRW3-7-SA3A  
**Matrix:** Soil

**Collected:** 2018/06/22  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.0°C
-----------	-------

**Results relate only to the items tested.**

## QUALITY ASSURANCE REPORT

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: CC

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5642903	Available (CaCl <sub>2</sub> ) pH	2018/07/24			100	97 - 103			1.9	N/A
5644382	Conductivity	2018/07/24			99	90 - 110	<2	umho/cm	4.7	10
5644648	Soluble (20:1) Chloride (Cl <sup>-</sup> )	2018/07/25	NC	70 - 130	99	70 - 130	<20	ug/g	4.0	35
5644672	Soluble (20:1) Sulphate (SO <sub>4</sub> )	2018/07/25	NC	70 - 130	107	70 - 130	<20	ug/g	8.7	35

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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

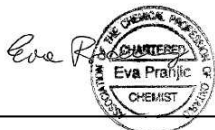
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

## Page of

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name	#1326 Golder Associates Ltd.	Company Name	GOLDER ASSOCIATES	Quotation #	B80683	Maxxam Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Sandra McGaghran	P.O. #:			
Address:	6925 Century Ave Suite 100	Address:	6925 Century Ave. SUITE 100	Project:	1662333		
	Mississauga ON L5N 7K2		MISSISSAUGA, ON.	Project Name:		COC #:	Project Manager:
Tel:	(905) 567-4444	Tel:		Site #			
Email:	AP_CustomerService@golder.com	Email:	smcgaghra@golder.com	Sampled By	CC/AM		

**MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY**

Regulation 153 (2011)			Other Regulations		Special Instructions
<input type="checkbox"/> Table 1	<input type="checkbox"/> Res/Park	<input type="checkbox"/> Medium/Fine	<input type="checkbox"/> CCME	<input type="checkbox"/> Sanitary Sewer Bylaw	
<input type="checkbox"/> Table 2	<input type="checkbox"/> Ind/Comm	<input type="checkbox"/> Coarse	<input type="checkbox"/> Reg 558	<input type="checkbox"/> Storm Sewer Bylaw	
<input type="checkbox"/> Table 3	<input type="checkbox"/> Agri/Other	<input type="checkbox"/> For RSC	<input type="checkbox"/> MISA	Municipality _____	
<input type="checkbox"/> Table _____			<input type="checkbox"/> PWQO		
			<input type="checkbox"/> Other _____		

Include Criteria on Certificate of Analysis (Y/N)?

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix
1	NRW3-1-SA4	QEW/CREDIT RIVER	2018/06/28	AM	SOIL
2	NRW3-9-SA4	"	2018/07/05	AM	SOIL
3	NRW3-3-SA4	"	2018/06/25	AM	SOIL
4	NRW7-3-SA4	"	2018/07/15	AM	SOIL
5	NRW7-1-SA3	"	2018/07/12	AM	SOIL
6	NRW3-5-SA4	"	2018/06/25	AM	SOIL
7	NRW3-7-SA3A	"	2018/06/22	AM	SOIL
8					
9					
10					

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

[illegible]

Turnaround Time (TAT) Required

Please provide advance notice for rush projects

Regular (Standard) TAT: 10-15 minutes

(will be applied if Rush TAT is not specified)

Standard TAT = 5-7 Working days for most tests

Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)

Date Required: \_\_\_\_\_ Time Required: \_\_\_\_\_

Rush Confirmation Number: \_\_\_\_\_ (call lab for #)

20-Jul-18 16:17

Ema Gitei



B8I3581

- KVG ENV-1180

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
SHANTANU KAR / <i>[Signature]</i>	12/07/20	4:00 PM.	<i>[Signature]</i>	20/8/20	16:17		Time Sensitive	Temperature (°C) on Receipt	Custody Seal	. Yes	No
								26.3	Present		
								Intact			

\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT [WWW.MAXXAM.CA/TERMS](http://WWW.MAXXAM.CA/TERMS).

\* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD, AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

\*\* SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT [HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF](http://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF)

SAMPLES MUST BE KEPT COOL ( < 10° C ) FROM TIME OF SAMPLING  
UNTIL DELIVERY TO MAXXAM

White: Maxxa      Yellow: Client



Your Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Your C.O.C. #: 51329

**Attention:David Marmor**

Golder Associates Ltd  
Mississauga - Standing Offer  
6925 Century Ave  
Suite 100  
Mississauga, ON  
CANADA L5N 7K2

**Report Date: 2017/11/21**  
Report #: R4869236  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B7P4571**

**Received: 2017/11/13, 12:50**

Sample Matrix: Soil  
# Samples Received: 3

Analyses	Date		Date Analyzed	Laboratory Method	Reference
	Quantity	Extracted			
Chloride (20:1 extract)	3	N/A	2017/11/17	CAM SOP-00463	EPA 325.2 m
Conductivity	3	N/A	2017/11/20	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	3	2017/11/17	2017/11/17	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	3	2017/11/13	2017/11/20	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	3	N/A	2017/11/17	CAM SOP-00464	EPA 375.4 m

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Your C.O.C. #: 51329

**Attention:David Marmor**

Golder Associates Ltd  
Mississauga - Standing Offer  
6925 Century Ave  
Suite 100  
Mississauga, ON  
CANADA L5N 7K2

**Report Date: 2017/11/21**  
Report #: R4869236  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B7P4571**

**Received: 2017/11/13, 12:50**

Encryption Key



Ema Gitej  
Senior Project Manager  
21 Nov 2017 20:35:45

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ema Gitej, Senior Project Manager

Email: EGitej@maxxam.ca

Phone# (905)817-5829

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B7P4571  
Report Date: 2017/11/21

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: JC

### RESULTS OF ANALYSES OF SOIL

<b>Maxxam ID</b>		FNR708			FNR708		FNR709	FNR710		
<b>Sampling Date</b>		2017/10/16 16:00			2017/10/16 16:00		2017/10/20 10:00	2017/10/26 13:30		
<b>COC Number</b>		51329			51329		51329	51329		
	<b>UNITS</b>	<b>NW3-01 SA7</b>	<b>RDL</b>	<b>QC Batch</b>	<b>NW3-01 SA7 Lab-Dup</b>	<b>QC Batch</b>	<b>CRB-06 RC-01 6.00-6.05</b>	<b>PED-03 SA8</b>	<b>RDL</b>	<b>QC Batch</b>

#### Calculated Parameters

Resistivity	ohm-cm	490		5263307			5000	1300		5263307
-------------	--------	-----	--	---------	--	--	------	------	--	---------

#### Inorganics

Soluble (20:1) Chloride (Cl)	ug/g	1000	40	5268736			<20	350	20	5268736
Conductivity	umho/cm	2040	2	5273678			201	762	2	5273678
Available (CaCl2) pH	pH	7.86		5270614	7.93	5270614	8.11	7.73		5270614
Soluble (20:1) Sulphate (SO4)	ug/g	69	20	5268737			30	70	20	5268737

RDL = Reportable Detection Limit  
QC Batch = Quality Control Batch  
Lab-Dup = Laboratory Initiated Duplicate

Maxxam Job #: B7P4571  
Report Date: 2017/11/21

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: JC

## TEST SUMMARY

**Maxxam ID:** FNR708  
**Sample ID:** NW3-01 SA7  
**Matrix:** Soil

**Collected:** 2017/10/16  
**Shipped:**  
**Received:** 2017/11/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5268736	N/A	2017/11/17	Deonarine Ramnarine
Conductivity	AT	5273678	N/A	2017/11/20	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5270614	2017/11/17	2017/11/17	Tahir Anwar
Resistivity of Soil		5263307	2017/11/20	2017/11/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5268737	N/A	2017/11/17	Deonarine Ramnarine

**Maxxam ID:** FNR708 Dup  
**Sample ID:** NW3-01 SA7  
**Matrix:** Soil

**Collected:** 2017/10/16  
**Shipped:**  
**Received:** 2017/11/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	5270614	2017/11/17	2017/11/17	Tahir Anwar

**Maxxam ID:** FNR709  
**Sample ID:** CRB-06 RC-01 6.00-6.05  
**Matrix:** Soil

**Collected:** 2017/10/20  
**Shipped:**  
**Received:** 2017/11/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5268736	N/A	2017/11/17	Deonarine Ramnarine
Conductivity	AT	5273678	N/A	2017/11/20	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5270614	2017/11/17	2017/11/17	Tahir Anwar
Resistivity of Soil		5263307	2017/11/20	2017/11/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5268737	N/A	2017/11/17	Deonarine Ramnarine

**Maxxam ID:** FNR710  
**Sample ID:** PED-03 SA8  
**Matrix:** Soil

**Collected:** 2017/10/26  
**Shipped:**  
**Received:** 2017/11/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5268736	N/A	2017/11/17	Deonarine Ramnarine
Conductivity	AT	5273678	N/A	2017/11/20	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5270614	2017/11/17	2017/11/17	Tahir Anwar
Resistivity of Soil		5263307	2017/11/20	2017/11/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5268737	N/A	2017/11/17	Deonarine Ramnarine

### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.3°C
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**Results relate only to the items tested.**

## QUALITY ASSURANCE REPORT

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: JC

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5268736	Soluble (20:1) Chloride (Cl)	2017/11/17	NC	70 - 130	103	70 - 130	<20	ug/g	14	35
5268737	Soluble (20:1) Sulphate (SO4)	2017/11/17	NC	70 - 130	107	70 - 130	<20	ug/g	13	35
5270614	Available (CaCl2) pH	2017/11/17			99	97 - 103			0.85	N/A
5273678	Conductivity	2017/11/20			100	90 - 110	<2	umho/cm	0	10

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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

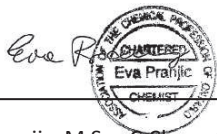
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjić, M.Sc., C.Chem, Scientific Specialist

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



6740 Campobello Road, Mississauga, Ontario L5N 2L8 www.maxxam.ca  
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266

# CHAIN OF CUSTODY RECORD

51329

Page 1 of 1

INVOICE INFORMATION		REPORT INFORMATION (if differs from invoice)		PROJECT INFORMATION		TURNAROUND TIME (TAT) REQUIRED		
Company Name: <u>Golden Associates</u>	Company Name:	Quotation #:	<input checked="" type="checkbox"/> Regular TAT (5-7 days)		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS  Rush TAT (Applicable Surcharge) <input type="checkbox"/> 1 Day (100%) <input type="checkbox"/> 2 Days (50%) <input type="checkbox"/> 3-4 Days (25%)			
Contact Name: <u>David Marmor</u>	Contact Name:	P.O. #:	1662333					
Address: <u>6925 Century Ave</u>	Address:	Project #:	1662333					
<u>Suite #1000 Mississauga</u>	Address:	Site Location:	<u>BEW/Agrocredit River</u>					
Phone: <u>905-792-8203</u> Fax: <u>905-567-6561</u>	Phone:	Site #:						
Email: <u>david-marmor@golden.com</u>	Email:	Sampled By:	<u>Jeremy Lebow</u>					
<b>MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY</b>				<b>ANALYSIS REQUESTED</b>		<b>Rush Confirmation #:</b>		
<b>REGULATION 153 (2011)</b>		<b>OTHER REGULATIONS</b>		<b>LABORATORY USE ONLY</b>  CUSTODY SEAL (Y/N) Present: <input checked="" type="checkbox"/> Intact: <input checked="" type="checkbox"/> COOLING MEDIA PRESENT (Y/N) <input checked="" type="checkbox"/>  Temperature (°C) on Receipt: <u>4/17</u>		<b>COMMENTS / TAT COMMENTS</b>		
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Med/Fine	<input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw							
<input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse	<input type="checkbox"/> MISA <input type="checkbox"/> Storm Sewer Bylaw							
<input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other	<input type="checkbox"/> PWQO Municipality:	<input type="checkbox"/> Other (Specify):						
<input type="checkbox"/> Table <input type="checkbox"/> FOR RSC (PLEASE CIRCLE) YES / NO	<input type="checkbox"/> REG.558 (MINIMUM 3 DAY TAT REQUIRED)							
Include Criteria on Certificate of Analysis (Y/N)? <u>N</u>								
SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM								
SAMPLE IDENTIFICATION		DATE SAMPLED	TIME SAMPLED	MATRIX	# OF CONT.			
1 <u>NW3-01 Sa 7</u>		<u>17/10/16</u>	<u>4 pm</u>	<u>Soil</u>	<u>1</u>			
2 <u>CRB-06 RC-01 6.00-6.05</u>		<u>17/10/20</u>	<u>10 am</u>	<u>Soil/Rock</u>	<u>1</u>			
3 <u>PED-03 Sa 8</u>		<u>17/10/26</u>	<u>1:30pm</u>	<u>Soil</u>	<u>1</u>			
4								
5								
6								
7								
8								
9								
10								
RELINQUISHED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME:	RECEIVED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME:	
<u>[Signature]</u>		<u>2017/11/13</u>	<u>12:50</u>	<u>Toussaint Tsimon</u>		<u>2017/11/13</u>	<u>12:50</u>	
# JARS USED AND NOT SUBMITTED		MAXXAM JOB #						

COC-1004 (11/13) - ENV. ENG.

Maxxam Analytics International Corporation o/a Maxxam Analytics

White: Maxxam - Yellow: Client



Your Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Your C.O.C. #: 674645-01-01

**Attention: Sandra McGaghran**

Golder Associates Ltd  
6925 Century Ave  
Suite 100  
Mississauga, ON  
CANADA L5N 7K2

**Report Date: 2018/07/25**  
Report #: R5317501  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B8I3581**

**Received: 2018/07/20, 16:17**

Sample Matrix: Soil  
# Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract)	7	N/A	2018/07/25	CAM SOP-00463	EPA 325.2 m
Conductivity	7	N/A	2018/07/24	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	7	2018/07/24	2018/07/24	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	7	2018/07/20	2018/07/24	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	7	N/A	2018/07/25	CAM SOP-00464	EPA 375.4 m

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Your C.O.C. #: 674645-01-01

**Attention: Sandra McGaghran**

Golder Associates Ltd  
6925 Century Ave  
Suite 100  
Mississauga, ON  
CANADA L5N 7K2

**Report Date: 2018/07/25**  
Report #: R5317501  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B8I3581**

**Received: 2018/07/20, 16:17**

Encryption Key



Colby Coutu  
Project Manager Assistant  
25 Jul 2018 17:35:58

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ema Gitej, Senior Project Manager

Email: EGitej@maxxam.ca

Phone# (905)817-5829

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B8I3581  
Report Date: 2018/07/25

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: CC

### RESULTS OF ANALYSES OF SOIL

Maxxam ID		HGV911	HGV912	HGV913	HGV914	HGV915	HGV916		
Sampling Date		2018/06/28	2018/07/05	2018/06/25	2018/07/15	2018/07/12	2018/06/25		
COC Number		674645-01-01	674645-01-01	674645-01-01	674645-01-01	674645-01-01	674645-01-01		
	UNITS	NRW3-1-SA4	NRW3-9-SA4	NRW3-3-SA4	NRW7-3-SA4	NRW7-1-SA3	NRW3-5-SA4	RDL	QC Batch

Calculated Parameters									
Resistivity	ohm-cm	1400	2600	5500	1800	1200	3000		5640959

Inorganics									
Soluble (20:1) Chloride (Cl-)	ug/g	330	180	36	170	390	<20	20	5644648
Conductivity	umho/cm	721	386	180	564	805	337	2	5644382
Available (CaCl2) pH	pH	7.94	8.05	7.94	7.71	7.86	8.04		5642903
Soluble (20:1) Sulphate (SO4)	ug/g	88	21	32	<20	31	240	20	5644672

RDL = Reportable Detection Limit  
QC Batch = Quality Control Batch

Maxxam ID		HGV917		
Sampling Date		2018/06/22		
COC Number		674645-01-01		
	UNITS	NRW3-7-SA3A	RDL	QC Batch

Calculated Parameters				
Resistivity	ohm-cm	350		5640959

Inorganics				
Soluble (20:1) Chloride (Cl-)	ug/g	1300	40	5644648
Conductivity	umho/cm	2870	2	5644382
Available (CaCl2) pH	pH	8.01		5642903
Soluble (20:1) Sulphate (SO4)	ug/g	55	20	5644672

RDL = Reportable Detection Limit  
QC Batch = Quality Control Batch

## TEST SUMMARY

**Maxxam ID:** HGV911  
**Sample ID:** NRW3-1-SA4  
**Matrix:** Soil

**Collected:** 2018/06/28  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV912  
**Sample ID:** NRW3-9-SA4  
**Matrix:** Soil

**Collected:** 2018/07/05  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV913  
**Sample ID:** NRW3-3-SA4  
**Matrix:** Soil

**Collected:** 2018/06/25  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV914  
**Sample ID:** NRW7-3-SA4  
**Matrix:** Soil

**Collected:** 2018/07/15  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV915  
**Sample ID:** NRW7-1-SA3  
**Matrix:** Soil

**Collected:** 2018/07/12  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine

## TEST SUMMARY

**Maxxam ID:** HGV915  
**Sample ID:** NRW7-1-SA3  
**Matrix:** Soil

**Collected:** 2018/07/12  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV916  
**Sample ID:** NRW3-5-SA4  
**Matrix:** Soil

**Collected:** 2018/06/25  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

**Maxxam ID:** HGV917  
**Sample ID:** NRW3-7-SA3A  
**Matrix:** Soil

**Collected:** 2018/06/22  
**Shipped:**  
**Received:** 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.0°C
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**Results relate only to the items tested.**

## QUALITY ASSURANCE REPORT

Golder Associates Ltd  
Client Project #: 1662333  
Site Location: QEW/CREDIT RIVER  
Sampler Initials: CC

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5642903	Available (CaCl <sub>2</sub> ) pH	2018/07/24			100	97 - 103			1.9	N/A
5644382	Conductivity	2018/07/24			99	90 - 110	<2	umho/cm	4.7	10
5644648	Soluble (20:1) Chloride (Cl <sup>-</sup> )	2018/07/25	NC	70 - 130	99	70 - 130	<20	ug/g	4.0	35
5644672	Soluble (20:1) Sulphate (SO <sub>4</sub> )	2018/07/25	NC	70 - 130	107	70 - 130	<20	ug/g	8.7	35

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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

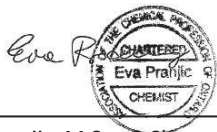
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist



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## CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name	#1326 Golder Associates Ltd.	Company Name	GOLDER ASSOCIATES	Quotation #	B80683	Maxxam Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Sandra McGaghran	P.O. #:			
Address:	6925 Century Ave Suite 100 Mississauga ON L5N 7K2	Address:	6925 Century Ave. SUITE 100 MISSISSAUGA, ON.	Project:	1662333		 674645
Tel:	(905) 567-4444	Tel:		Project Name:		COC #:	Project Manager:
Fax:	(905) 567-6561	Fax:		Site #			
Email:	AP_CustomerService@golder.com	Email:	smcgaghra@golder.com	Sampled By:	CC/AM	 C674645-01-01	Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)			Other Regulations		Special Instructions
<input type="checkbox"/> Table 1	<input type="checkbox"/> Res/Park	<input type="checkbox"/> Medium/Fine	<input type="checkbox"/> CCME	<input type="checkbox"/> Sanitary Sewer Bylaw	
<input type="checkbox"/> Table 2	<input type="checkbox"/> Ind/Comm	<input type="checkbox"/> Coarse	<input type="checkbox"/> Reg 558	<input type="checkbox"/> Storm Sewer Bylaw	
<input type="checkbox"/> Table 3	<input type="checkbox"/> Agr/Other	<input type="checkbox"/> For RSC	<input type="checkbox"/> MISA	Municipality _____	
<input type="checkbox"/> Table _____			<input type="checkbox"/> PWQO		
			<input type="checkbox"/> Other _____		

Include Criteria on Certificate of Analysis (Y/N)?

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix
1	NRW3-1- SA4	GEW/CREDIT RIVER	2018/06/28	AM	SOIL
2	NRW3-9- SA4	n	2018/07/05	AM	SOIL
3	NRW3-3- SA4	n	2018/06/25	AM	SOIL
4	NRW7-3- SA4	n	2018/07/15	AM	SOIL
5	NRW7-1- SA3	n	2018/07/12	AM	SOIL
6	NRW3-5- SA4	n	2018/06/25	AM	SOIL
7	NRW3-7- SA3A	n	2018/06/22	AM	SOIL
8					
9					
10					

## ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

[illegible]

## Turnaround Time (TAT) Required

Please provide advance notice for rush projects

**Regular (Standard) TAT:** (will be applied if Rush TAT is not specified)

Standard TAT = 5-7 Working days for most tests.

Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

**Job Specific Rush TAT (if applies to entire submission)**

Date Required: \_\_\_\_\_ Time Required: \_\_\_\_\_

Rush Confirmation Number: \_\_\_\_\_ (call lab for #)

20-Jul-18 16:17

Ema Gitei



B8I3581

- KVG ENV-1180

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
SHANTANU KAR / [Signature]	12/07/20	4:00 PM.	[Signature]	20/8/20	16:17		Time Sensitive	Temperature (°C) on Receipt	Custody Seal	. Yes	No
								16/3/14	Present Intact		

\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT [WWW.MAXXAM.CA/TERMS](http://WWW.MAXXAM.CA/TERMS).

\* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

\*\* SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT [HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF](http://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF)

SAMPLES MUST BE KEPT COOL ( < 10° C ) FROM TIME OF SAMPLING  
UNTIL DELIVERY TO MAXXAM

White: Maxxa      Yellow: Client



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**APPENDIX K**

**Non-Standard Special Provisions  
and Notice to Contractor**

**“height” NOISE BARRIER SYSTEM - Item No.**

**“height” NOISE BARRIER SYSTEM INCLUDING PRECAST NOISE/TRAFFIC BARRIER - Item No.**

**“height” NOISE BARRIER SYSTEM ON STRUCTURES - Item No.**

**NOISE BARRIER ACCESS - Item No.**

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Special Provision No. 760F01

March 2018

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**Amendment to OPSS 760, November 2014**

**760.03                      DEFINITIONS**

Section 760.03 of OPSS 760 is amended by the deletion of the definitions for **Certificate of Conformance** and **Quality Verification Engineer**.

**760.04                      DESIGN AND SUBMISSION REQUIREMENTS**

**760.04.01                  Design Requirements**

**760.04.01.01              Footings**

**760.04.01.01.01          General**

Clause 760.04.01.01.01 of OPSS 760 is amended by the addition of the following paragraph:

The soil design parameters for the design of footings shall be as specified in Table A: [\* Designer Fill-In for Table A, See Notes to Designer].

**Table A**  
**Soil Design Parameters**

Location	Soil Design Parameter	Bedrock Surface Elevation (m)
Line 'A' QEW East Bound Lanes 15+622 to 15+866	$\emptyset = 30^\circ$	Elevation 98.2 m
Line 'B' QEW West Bound Lanes 16+360 to 16+650 16+650 to 16+660	$\emptyset = 32^\circ$ $\emptyset = 28^\circ$	Declines from Elevation 96.5 m (Station 16+360) to Elevation 92.3 m (Station 16+660)
Line 'C' Mississauga Road S – QEW E On-Ramp 10+033 to 10+227 (ramp stationing) 16+519 to 16+623 (mainline stationing)	$\emptyset = 30^\circ$	Declines from Elevation 95.0 m (Station 10+050) to Elevation 92.0 m (Station 10+620)
Line 'F' QEW West Bound Lanes 16+931 to 17+140	$\emptyset = 28^\circ$	Declines from Elevation 86.9 m (Station 16+931) to Elevation 84.7 m (Station 17+040)
17+140 to 17+340	$\emptyset = 32^\circ$	N/A
17+340 to 17+470	$\emptyset = 30^\circ$	N/A
17+470 to 17+530	$\emptyset = 28^\circ$	Elevation 86.7 m
17+530 to 17+660	$\emptyset = 30^\circ$	Inclines from Elevation 89.4 m (Station 17+500) up to Elevation 90.4 m (Station 17+625)
Line 'G' QEW East Bound Lanes 17+415 to 17+520	$\emptyset = 28^\circ$	N/A
Line 'H' QEW West Bound Lanes 17+660 to 17+728	$\emptyset = 30^\circ$	Elevation 91.0 m
Line 'I' QEW East Bound Lanes 16+918 to 16+920	$\emptyset = 28^\circ$	N/A
Line 'J' QEW East Bound Lanes 17+076 to 17+124	$\emptyset = 28^\circ$	N/A

Subsection 760.04.01 of OPSS 760 is amended by the addition of the following clauses:

**760.04.01.02                      Wind Load**

The wind load applied for the design of structure shall be: [\*\* Designer Fill-In, See Notes to Designer].

### **760.04.01.03                      Acoustics**

The minimum acoustical characteristic of the noise barrier system shall be such that the noise barrier is: [\*\*\* Designer Fill-In, See Notes to Designer].

### **760.04.01.04                      Aesthetics**

The colour and texture for the noise barrier system shall be within the following parameters:

Number of colours adjacent to highway: [\*\*\*\* Designer Fill-in – See Notes to Designer]

in the proportion of \_\_\_\_\_

Number of textures \_\_\_\_\_

in the proportion of \_\_\_\_\_

Number of colours adjacent to residential property: [\*\*\*\* Designer Fill-In, See Notes to Designer].

in the proportion of \_\_\_\_\_

Number of textures \_\_\_\_\_

in the proportion of \_\_\_\_\_

Final colour selections shall be determined by the Contract Administrator at the point of manufacture from samples prepared by the manufacturer.

If only one colour and texture are specified, the noise barrier shall be constructed using the colour and texture specified by the Contract Administrator following the award of the Contract. Final colour selection shall be determined at the point of manufacture from samples prepared by the manufacturer.

## **760.07                                      CONSTRUCTION**

### **760.07.13                              Quality Control**

#### **760.07.13.01                      Interim Inspection of Footings and Posts**

Clause 760.07.13.01 of OPSS 760 is deleted in its entirety and replaced with the following:

#### **760.07.13.01                      Inspection before Installation of Noise Barrier Panels**

A Request to Proceed shall be submitted to the Contract Administrator after the construction of the noise barrier footings and posts and prior to the installation of the noise barrier panels

The installation of the noise barrier panels shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

**760.07.13.02                      Certificate of Conformance**

Clause 760.07.13.02 of OPSS 760 is deleted in its entirety and replaced by the following:

**760.07.13.02                      Inspection after Installation of Noise Barrier System**

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the installation of the noise barrier system.

**NOTES TO DESIGNER:**

- \*            Insert station to station limits and soil design parameters in Table A as per the example below:
- \*\*           Insert the reference wind load along with its respective area or city (e.g., 415 Pa for Hamilton area).
- \*\*\*        Insert one of the following acoustical characteristics:
  - Either sound absorptive or reflective
  - Sound absorptive on the highway side
  - Sound absorptive on the residential side
  - Sound absorptive on both sides.

If more than one acoustical characteristic applies to this Contract, each section shall be designed accordingly with clearly defined limits.

- \*\*\*\*       Insert the number of colours planned for this contract, the proportions in which each are required, the number of textures if applicable and their proportions of the total noise barrier area in the locations specified.

**WARRANT:**    Always with these tender items.

## **NOTICE TO CONTRACTOR – Subsurface Obstructions**

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### Special Provision

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The Contactor shall be alerted to the potential presence of cobbles, boulders and limestone and shale fragments in the fill and native soils, glacially derived soils and residual soils, as encountered in various boreholes advance at the various structure locations associated with the QEW widening from Mississauga Road to Hurontario Street. Consideration of the presence of these obstructions must be made in the selection of appropriate equipment and procedures for advancing caissons, excavations for shallow foundations, stormwater management pond, overhead sign supports, high mast light pole foundations, noise barrier walls, culverts, and installation of any temporary protection systems that may be required.

The Contractor is hereby notified that caissons for the noise barrier walls and noise barrier / retaining walls will extend into the shale bedrock, which is extremely weak to weak and contains clay seams and medium strong to very strong limestone interbeds at various depths/elevations.

The Contactor is hereby notified that in some areas of the site, and in particular in the general vicinity of the east pier for the QEW Credit River Bridge WB, rip-rap and other cobble and boulder size obstructions are present at and below ground surface. These obstructions may impede or prevent excavation, grading, construction of access roads and/or crane pads and lay-down areas, and the installation of some types of protection systems/cofferdams.

The Contractor is hereby notified that in some areas of the site, and in particular in the general vicinity of the front and side slopes adjacent to the west abutment for the QEW Credit River Bridge WB, soil/rock anchor obstructions are present at and below the ground surface. These obstructions may impede or prevent excavation, grading, and construction of the abutment and/or the Multi-Use Trail and are to be removed where encountered above the elevation of the existing upper access road only. No soil/rock anchors are to be removed below the elevation of the existing upper access road.

The Contractor is hereby notified that between the west abutment of the existing QEW Credit River Bridge and the west abutment of the existing multi-use path (beneath the existing QEW Credit River Bridge) soil/rock anchor obstructions are present at and below the ground surface. These obstructions may impede or prevent the advancement of the drilled shafts for the west abutment of the East-West Active Transportation bridge. If they are encountered the Contract Administrator is to be notified immediately and this may require adjustments to the drilled shaft layout.

The presence of the above-noted near surface conditions shall be considered by the Contractor in the selection of appropriate equipment and procedures for various activities, including but not limited to excavation, grading, installation of the foundations and installation of cofferdams/protection systems.





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