

REPORT

Foundation Investigation and Design Report

*Noise Barrier Walls Between Victoria Park Avenue and Warden Avenue
Highway 401 Eastbound Collectors Widening, Avenue Road to Warden Avenue
MTO G.W.P. 2130-01-00*

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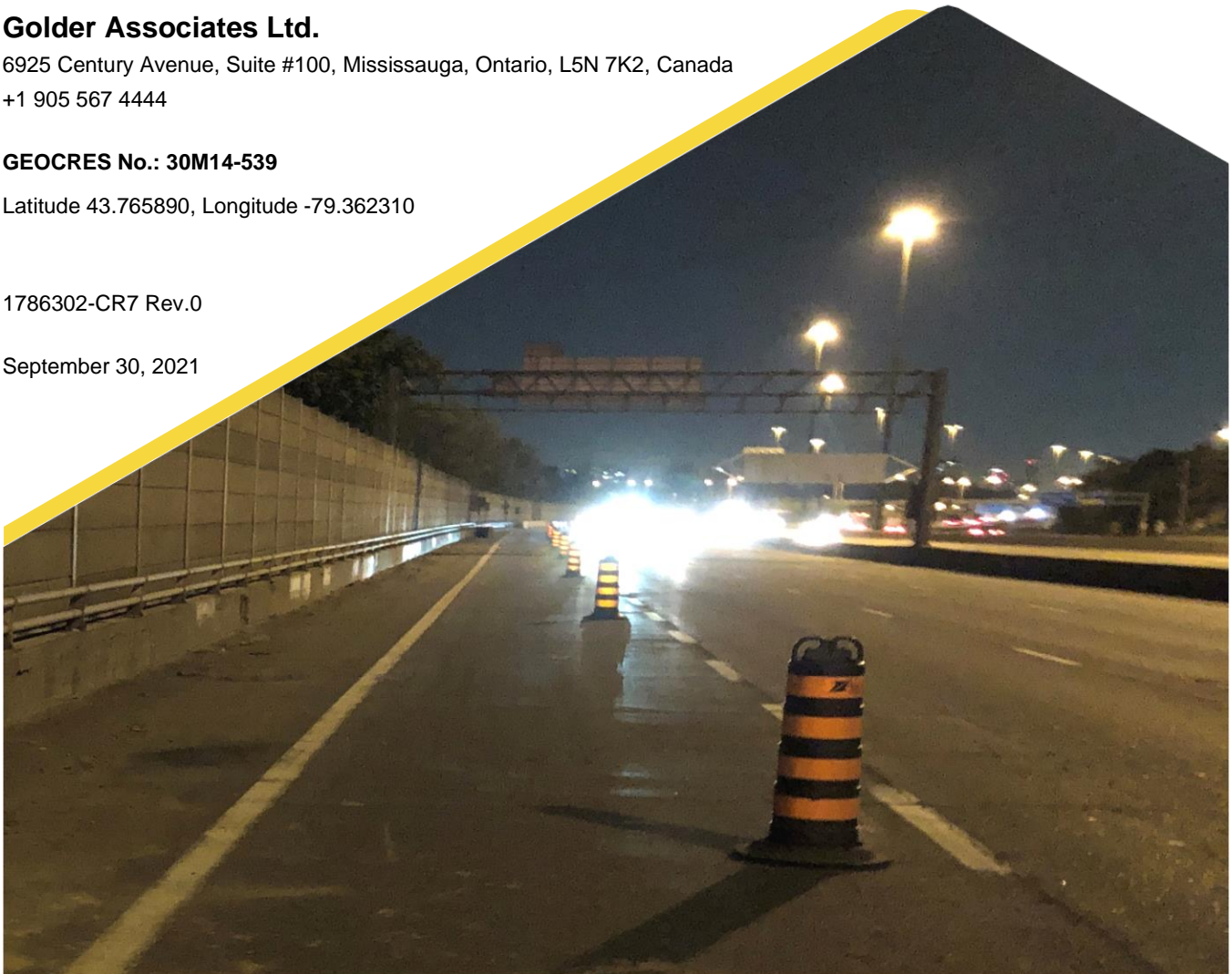
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GEOCRES No.: 30M14-539

Latitude 43.765890, Longitude -79.362310

1786302-CR7 Rev.0

September 30, 2021



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PART A

FOUNDATION INVESTIGATION REPORT
NOISE BARRIER WALLS BETWEEN VICTORIA PARK AVENUE AND
WARDEN AVENUE
HIGHWEAY 401 EASTBOUND COLLECTORS WIDENING, AVENUE ROAD
TO WARDEN AVENUE
MTO G.W.P. 2130-01-00

1.0 INTRODUCTION

Golder Associates Ltd. (Golder), member of WSP, has been retained by AECOM on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the detail design of the rehabilitation of the Highway 401 Eastbound Collector lanes between Avenue Road and Warden Avenue (approximately 10 km) in City of Toronto, Ontario (MTO Assignment No. 2016-E-0089).

This report presents the subsurface conditions for the replacement of two noise barrier walls / parapet walls and associated rehabilitation of two existing retaining walls between Victoria Park Avenue and Warden Avenue along the eastbound Highway 401 collector (EBC) lane. This report was developed based on the results from Golder's foundation investigation and laboratory testing.

The results of foundation investigations for other works associated with this assignment are presented in separate reports.

2.0 SITE DESCRIPTION

There is an existing noise barrier/retaining wall along the Highway 401 EBC between Victoria Park Avenue and Warden Avenue in which two sections are proposed to be replaced between STA 29+734 and 29+872, and between STA 30+059 and 30+361 as shown on Drawing 1.

The existing noise barrier wall is 4 m high and is located along the south limit of the MTO Right-of-Way. The existing noise barrier walls are constructed on retaining walls up to about 3.7 m high, and in a fill section (i.e. the front of the retaining wall faces away from the highway).

3.0 INVESTIGATION PROCEDURES

The foundation investigation for the proposed replacement of two noise walls was carried out between May 14, and 21, 2021, during which time a total of seven boreholes (designated as Boreholes NW1-1, NW1-2, NW2-1 to NW2-3, OHS-6, and OHS-7) were advanced in the vicinity of the proposed noise barrier walls. The locations of the boreholes are shown on Drawing 1 and the borehole records are provided in Appendix A. Lists of abbreviations and symbols are also provided in Appendix A to assist in the interpretation of the borehole records.

Due to the existing reinforced concrete composite pavement structure along Highway 401, the coring of the pavement structure was completed by 254 mm outside diameter (O.D.) core bit, at all borehole locations advanced through the highway, supplied and operated by Canadian Cutting and Coring of Brampton, Ontario. Upon completion of the coring of the pavement structure, boreholes were advanced using a CME-75 truck-mounted drill rig, supplied and operated by Geo-Environmental Drilling Inc. of Halton Hills, Ontario.

Soil samples from boreholes were generally obtained at 0.75 m, 1.5 m and 3.0 m intervals of depth, using a 50 mm O.D. split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures. The split-spoon samplers used in the investigation limit the maximum particle size that can be sampled and tested to about 35 mm. Therefore, particles or objects that may exist within the soils that are larger than this dimension would not be sampled or represented in the grain size distributions. Field vane shear tests were carried out in cohesive soils for assessment of undrained shear strengths using MTO Standard 'N' size vanes.

Groundwater conditions and water levels in the open boreholes were observed during and immediately following the drilling operations. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 Wells (as amended), and the ground surface was restored to near original condition as practical using cold-patch asphalt and quick-set concrete, as applicable.

The field work was observed by members of Golder's engineering and technical staff, who marked the borehole locations, arranged for the clearance of underground utilities, observed the drilling, sampling and in-situ testing operations, and logged the boreholes. The soil samples and bedrock cores were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory where the samples and cores underwent further visual examination and laboratory testing in accordance with MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected soil samples. The results of the laboratory testing on the soil samples from the investigation are included in Appendix B.

Selected soil samples were submitted to Bureau Veritas Laboratories, a Standards Council of Canada (SCC) accredited laboratory of Mississauga, Ontario for chemical analysis. The selected samples were analyzed for a suite of corrosivity parameters, including conductivity, resistivity, soluble chloride, soluble sulphate and pH. The results of the chemical analysis are presented in Appendix B.

The as-drilled borehole locations and the ground surface elevations were obtained using either a GPS Trimble GEO 7X, having an accuracy of approximately 0.1 m in the vertical and 0.1 m in the horizontal directions, or were measured relative to identifiable site features and superimposed on the base plan. The locations given on the borehole records and shown on Drawing 1 are positioned related to MTM NAD 83 (Zone 10) CSRS CGVD28 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, geographic coordinates, ground surface elevations and depths advanced prior to termination are summarized below.

Borehole / CPT No.	Location (MTM NAD 83 Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (Latitude, °)	Easting (Longitude, °)		
NW1-1	4,847,594.1 (43.768162)	319,849.9 (-79.313071)	174.3	8.2
NW1-2	4,847,623.3 (43.768422)	319,990.1 (-79.362610)	175.6	8.2
NW2-1	4,847,688.9 (43.769008)	320,218.5 (-79.308490)	177.4	9.8
NW2-2	4,847,720.2 (43.769288)	320,316.2 (-79.307276)	178.0	9.8
NW2-3	4,847,753.2 (43.769583)	320,421.9 (-79.305961)	179.0	9.8

Borehole / CPT No.	Location (MTM NAD 83 Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (Latitude, °)	Easting (Longitude, °)		
OHS-6	4,847,660.2 (43.768752)	320,127.5 (-79.309621)	176.7	9.8
OHS-7	4,847,779.1 (43.769813)	320,511.1 (-79.304853)	179.8	9.8

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The area surrounding along Highway 401 between Bayview Avenue and Warden Avenue is within the physiographic regions known as the Peel Plain, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984)¹.

The Peel Plain physiographic region covers portions of the Regional Municipalities of York, Peel and Halton. A surficial till sheet, which is mapped as the Halton Till, is present throughout much of the Peel Plain and generally follows the surface topography. The Halton Till typically consists of cohesive clayey silt to silty clay, with non-cohesive sand to silt zones. Shallow, local deposits of sand and silt and/or clay can overlie this uppermost till sheet, and these represent relatively recent deposits, formed in small glacial melt water ponds scattered throughout the Peel Plain and concentrated near river valleys. The recent sand, silt, and clay in the uppermost till deposits in this area overlie and are interbedded with stratified deposits of sand, silt, and clay.

The underlying bedrock consists of grey shale of the Georgian Bay Formation interbedded with limestone, siltstone, and sandstone. Within and adjacent to the East Don River, interglacial and post-glacial flooding in the valley has produced deposits of glaciolacustrine sands, silts, and silty clay.

4.2 Subsurface Conditions

The borehole records from the investigation are presented in Appendix A. The geotechnical and analytical laboratory test results including laboratory testing summary figures from the current investigation are presented in Appendix B.

The results of in-situ tests (i.e., SPT) as presented in the borehole records and in Section 4.2 are uncorrected. The boundaries between the soil deposits on the borehole records have been inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

¹ 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.

In general, the subsurface soils encountered at the proposed noise barrier wall location consist of pavement structure, underlain by cohesive and non-cohesive fill. The fill is then underlain by deposits of thin layer of sandy clayey silt to sandy clayey silt-silt, a non-cohesive deposit of sandy silt to silty sand, and a cohesive deposit of sandy clayey silt-silt to clayey silt-silt and sand, and. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Asphalt and Concrete Pavement Structure

An approximately 75 mm to 150 mm thick layer of asphalt was encountered at the ground surface in all the boreholes.

An approximately 210 mm to 260 mm thick layer of concrete was encountered underlying the asphalt in all boreholes except in Boreholes NW2-3 and OHS-6. Photographic records of the asphalt and concrete core are presented on Figure A1 to Figure A7 Appendix A.

4.2.2 SILTY SAND (SM) to Gravelly SILTY SAND (SM) (FILL)

A 0.4 m to 0.7 m thick layer of non-cohesive fill consisting of silty sand, trace gravel to gravelly was encountered underlying the pavement structure in all borehole locations. The top of the non-cohesive fill was encountered at depths ranging from about 0.2 m to 0.4 m below ground surface (between Elevations 179.5 m and 174.0 m) and extended to depths ranging from 0.7 m to 0.8 m below ground surface (between Elevations 179.0 m and 173.6 m).

Grain size distribution testing was carried out on a sample of the gravelly silty sand fill and the result is presented on Figure B1 in Appendix B. The water content measured on samples of the non-cohesive fill ranges from about 6% to 12%.

4.2.3 Sandy CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML/ML) and Sand (FILL)

A 1.1 m to 2.9 m thick layer of cohesive fill consisting of sandy clayey silt to clayey silt-silt and sand, trace gravel was encountered below the non-cohesive fill in all boreholes except Borehole OHS-6. The cohesive fill was encountered at depths ranging from 0.7 m to 0.8 m below ground surface (between Elevations 179.0 m and 173.6 m) and extends to depths ranging from 1.9 m to 3.7 m below ground surface (between Elevations 177.9 m and 171.3 m).

The SPT “N”-values measured within the cohesive fill ranges from 7 to 21 blows per 0.3 m of penetration, suggested a firm to very stiff consistency. A single SPT “N”-value of 53 blows per 0.3 m measured in Borehole OHS-7 suggesting a hard consistency.

Grain size distribution testing was carried out on six samples of the cohesive fill, and the results are presented on Figure B2 in Appendix B. Atterberg limits testing was carried out on six samples of the cohesive fill and measured liquid limits ranging from 14% to 31% and plastic limits ranging from 10% to 16%, corresponding to plastic indices of about 4% and 15%. The Atterberg limit test results are presented on Figure B3 in Appendix B and indicates that the fill ranges from a sandy clayey silt to clayey silt and sand to clayey silt-silt and sand of low plasticity. The water content measured on samples of the deposit ranges from about 9% to 26%.

4.2.4 Sandy CLAYEY SILT (CL) to Sandy CLAYEY SILT-SILT (CL-ML/ML)

A 0.7 m to 1.4 m thick deposit of sandy clayey silt to sandy clayey silt-silt was encountered underlying the fill in Borehole NW2-1 and OHS-6, respectively. The top of the cohesive deposit was encountered at depths ranging from 0.8 m to 3 m below ground surface (between Elevations 175.9 m and 174.4 m) and extends to depths ranging from 2.2 m to 3.7 m below ground surface (between Elevations 174.5 m and 173.7 m).

The SPT “N”-values measured within the cohesive deposit ranges from 11 to 44 blows per 0.3 m of penetration, suggested a stiff to hard consistency.

Grain size distribution testing was carried out on a sample sandy clayey silt to sandy clayey silt-silt, and the results are presented on Figure B4 in Appendix B. Atterberg limits testing was carried out on a sample of the cohesive deposit and measured a liquid limit of 16% and a plastic limit of 12%, corresponding to plastic indices of about 4%. The Atterberg limit test results are presented on Figures B5 in Appendix B and indicates that the material is a clayey silt to silt of low plasticity. The water content measured on two samples of the cohesive deposit are about 8% and 9%.

4.2.5 Sandy SILT (ML) to SILT (ML) and Sand to SILTY SAND (SM)

A 2.8 m to 7.9 m thick deposit of sandy silt to silt and sand to silty sand containing trace to some gravel was encountered underlying the granular fill and cohesive fill in Boreholes OHS-6, OHS-7, and NW2-1 to NW2-3. The non-cohesive deposit was encountered at depths ranging from 1.9 m to 3.7 m below ground surface (between Elevations 177.9 m and 173.7 m) and extends to depths ranging from 5 m to 9.8 m below ground surface (between Elevations 171.8 m and 167.7 m). Boreholes OHS-7, and NW2-1 to NW2-3 were terminated in this deposit.

The SPT “N”-values measured within the granular deposit range from 36 blows per 0.3 m of penetration to 177 blows per 0.13 m of penetration, indicating a dense to very dense state of compactness.

Grain size distribution testing was carried out on nine samples of the non-cohesive deposit, and the results are presented on Figures B6A and B6B in Appendix B. Atterberg limits testing was carried out on a sample of the cohesive deposit and measured a liquid limit of 14% and a plastic limit of 11%, corresponding to plastic index of about 3%. The Atterberg limit test result is presented on Figure B7 in Appendix B and indicates the material is a silt of low plasticity. The water content measured on samples of the deposit range from about 3% to 19%.

4.2.6 Sandy CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT-SILT(CL-ML) and Sand

A 4.8 m to 5.4 m thick deposit of sandy clayey silt-silt to clayey silt-silt and sand was encountered underlying the cohesive fill in Boreholes NW1-1 and NW1-2 and underlying the silt and sand deposit in Borehole OHS-6. The top of the cohesive deposit was encountered at depths ranging from 2.8 m to 5 m below ground surface (between Elevations 172.8 m and 171.3 m) and extends to depths ranging from 8.2 m to 9.8 m below ground surface (between Elevations 167.4 m and 166.1 m). Boreholes OHS-6, NW1-1, and NW1-2 were terminated within this deposit.

The SPT “N”-values measured within the cohesive deposit range from 9 blows to 43 blows per 0.3 m of penetration suggested a stiff to hard consistency. A single SPT “N”-value of 85 blows per 0.3 m measured in Borehole OHS-6 suggesting a hard consistency.

Grain size distribution testing was carried out on five samples of the cohesive deposit and the results are shown on Figures B8 in Appendix B. Atterberg limits testing was carried out on five samples of the cohesive deposit and measured liquid limits ranging from about 14% to 17%, plastic limits ranging from about 10% to 11%, and plasticity indices ranging from about 4% to 6%. The Atterberg limit test results are presented on Figures B9 in Appendix B and indicates the material a clayey silt-silt of low plasticity. The water content was measured on samples of the cohesive deposit and ranges from about 8% to 15%.

4.3 Groundwater Conditions

In general, the soil samples taken in the boreholes were moist. Boreholes OHS-6, OHS-7, NW1-1, NW1-2, and NW2-3 were noted to be dry upon completion of drilling while groundwater was observed at a depth of 4.9 m (Elevation 172.5 m) and 7.9 m (Elevation 170.1 m) below ground surface in Boreholes NW2-1 and NW2-2, respectively. However, these conditions and groundwater levels do not represent the stabilized groundwater level at the site.

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

4.4 Analytical Testing

Four samples were collected and submitted to Bureau Veritas Laboratories for analysis of parameters used to assess corrosion potential and sulphate attack. A summary of the results is presented in the following table. The Certificates of Analysis are provided in Appendix B.

Borehole Number	Sample ID	Sample Depth (Elevation) (m)	Soil Type	Parameters				
				Chloride (µg/g)	Sulphate (µg/g)	pH	Conductivity (µmho/cm)	Resistivity (ohm-cm)
NW1-1	3	172.2 – 172.8	Sandy Clayey Silt (Fill)	1200	160	7.99	2290	440
NW1-2	4A	172.8 – 173.3	Sandy Clayey Silt (Fill)	540	71	7.91	1090	920
NW2-1	3	175.3 – 175.9	Clayey Silt and Sand (Fill)	940	<20	7.43	1880	530
NW2-2	4	175.1 – 175.7	Clayey Silt and Sand (Fill)	1800	<20	7.22	3090	320
NW2-3	2	177.6 – 178.2	Sandy Clayey Silt (Fill)	1500	<20	7.67	2470	410
OHS-6	2	175.3 – 175.9	Sandy Clayey Silt (Fill)	380	<20	7.92	797	1100
OHS-7	4	176.9 – 177.5	Silt and Sand to Silty Sand	400	50	8.08	861	1200

5.0 CLOSURE

The Foundation Investigation Report was prepared by Masers. Ashkan Talebi, Ph.D., P.Eng., and Shantanu Kar, M.Eng., P.Eng., and reviewed by Mr. Christopher Ng, P.Eng., a senior geotechnical engineer, and Associate with Golder and MTO Foundations Designated Contact with Golder.

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PART B

FOUNDATION DESIGN REPORT

NOISE BARRIER WALLS BETWEEN VICTORIA PARK AVENUE AND WARDEN AVENUE

HIGHWEAY 401 EASTBOUND COLLECTORS WIDENING, AVENUE ROAD TO WARDEN AVENUE

MTO G.W.P. 2130-01-00

6.0 DISCUSSION AND ENGINEERING INVESTIGATION

This section of the report provides geotechnical parameters and recommendations for the replacement of the noise barrier walls foundations between Victoria Park Avenue and Warden Avenue along the eastbound Highway 401 collector (EBC) lane. These recommendations are based on the interpretation of the factual data obtained from the boreholes advanced during the current field investigations. The discussion and recommendations presented are intended to provide the designers with information to delineate these walls in the contract drawings, and for information for the proprietary wall supplier/designer. The Foundation Design Report, discussion and recommendations are intended for the use of MTO and its designers and shall not be used or relied upon for any other purpose or by any other parties, including the construction contractor. Contractors must make their own interpretation based on the factual data presented in the Foundation Investigation Report (Part A of this 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 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 existing Noise Barrier Wall alignments are shown on Drawings 1. It is understood the existing noise barrier walls is to be replaced with 5 m high noise barrier walls, sections of which will be supported on retaining walls up to 3.7 m high. Due to property constraints and the proximity of the existing noise barrier/retaining wall to the limit of the right-of-way, it is understood that the proposed noise barrier/retaining wall will be constructed adjacent to/in front of the existing noise barrier/retaining wall. The existing noise barrier wall will be removed; however, the existing section of retaining wall is to remain in place. The proposed noise barrier/retaining wall will be supported on drilled shafts/augered footings to be designed by proprietary wall supplier/designer. Recommendations for support of the noise barrier walls are presented in the subsequent sections of this report.

6.2 Design of Noise Barrier Walls Foundation

Geotechnical parameters for design of the caisson foundations for the replacement of existing Noise Barrier Wall are provided in Table 1 following the text of this report, based on the subsurface conditions encountered in the boreholes advanced in the vicinity of the noise barrier walls. The stratigraphy presented in Table 1 has been simplified from the detailed stratigraphic descriptions present the Record of Boreholes for the purposes of the noise barrier wall foundation design, and the design values and locations over which they apply has been further simplified in Special Provision 760F01 amending OPSS 760 (*Noise Barrier Systems*) for the designer fill-in table of design parameters. The parameters presented in Table 1 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, ϕ') have been given in Table 1 for a cohesive deposit, the drilled shaft/augered footing design should be checked for both the total and effective stress 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 OPSD 3090.101 (*Foundation Frost Penetration Depths for Southern Ontario*). Passive resistance below the depth of frost penetration provided in Table 1 should be reduced by an appropriate factor considering the allowable wall movement in accordance with Figure C6.27 of the Canadian Highway Bridge Design Code (CHBDC, 2019).

6.3 Construction Considerations

6.3.1 Control of Soil and Groundwater for Drilled Shafts/Augered Footings

Construction of drilled shaft/augered footing is anticipated to require augering / excavation through the existing fill, overburden deposits, which may be susceptible to disturbance during excavation and construction. Wet non-cohesive soil deposits should be expected to collapse into the drilled/augered hole, especially during wet periods of the year. 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 drilled shafts/augered footings and concrete placement.

7.0 CLOSURE

The Foundation Design Report was prepared by Messrs. Ashkan Talebi, Ph.D., P.Eng., and Shantanu Kar, M.Eng., P.Eng., and reviewed by Mr. Christopher Ng, P.Eng., a senior geotechnical engineer and Associate with Golder and MTO Foundations Designated Contact with Golder.

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Ontario Provisional Standard Drawing

OPSD 3090.101 Foundation Frost Penetration Depths for Southern Ontario

Ontario Provincial Standard Specifications

OPSS.PROV 903 Construction Specification for Deep Foundations

Special Provisions

109F57	Amendment to OPSS 903
760F01	Amendment to OPSS 760

Ontario Water Resources Act

Ontario Regulation 903 Wells (as amended)

Table 1: Geotechnical Design Parameters for Noise Barrier Walls

Approximate Noise Barrier Wall Location (Station) ¹	Relevant Boreholes	Deposit / Layer	Approximate Deposit Depth ² (m)	Approximate Elevation ² (m)	Design Groundwater Elevation ³ (m)	Design Parameters ^{4,5,6}						
						s_u (kPa)	ϕ' (°)	γ (kN/m ³)	γ' (kN/m ³)	K_o	K_a	K_p
Highway 401 EBC Station 29+734 to 30+361	NW1-1 and NW1-2, NW2-1 to NW2-3, OHS-6 and OHS-7	Silty Sand to Gravelly Silty Sand to Sand (FILL)	0.2 – 0.8	179.5 – 173.6	172.5	-	34	21	11	0.44	0.28	3.54
		Firm to very stiff Sandy Clayey Silt to Clayey Silt-Silt and Sand (FILL)	0.7 – 3.7	179.0 – 171.3		65	32	21	11	0.47	0.31	3.25
		Stiff to hard Sandy Clayey Silt to Sandy Clayey Silt-Silt	0.8 – 3.7	175.9 – 173.7		80	32	21	11	0.47	0.31	3.25
		Dense to very dense Sandy Silt to Silt and Sand to Silty Sand	1.9 – 9.8	177.9 – 167.7		-	36	21	11	0.41	0.26	3.85
		Stiff to hard Sandy Clayey Silt-Silt to Clayey Silt-Silt and Sand	2.8 – 9.8	172.8 – 166.1		95	34	21	11	0.44	0.28	3.54

NOTES:

1. Approximate stationing provided along Highway 401 EBC. See Drawings 1 for noise barrier wall locations.

2. Depths are given related to the borehole ground surface elevation; the ground surface elevation at the borehole location(s) should be compared to the ground surface elevation at the noise barrier wall location, and the depths to various soil stratum adjusted accordingly

3. Groundwater level inferred based on the groundwater level measured inside augers upon completion of drilling at Borehole NW2-1.

4. Design parameters:

s_u

= undrained shear strength (kPa)

c'

= effective (drained) cohesion (kPa)

ϕ'

= effective (drained) friction angle (°)

K_a

= active earth pressure coefficient

K_p

= passive earth pressure coefficient

K_o

= earth pressure coefficient at rest

γ

= bulk unit weight (kN/m³)

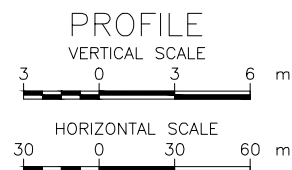
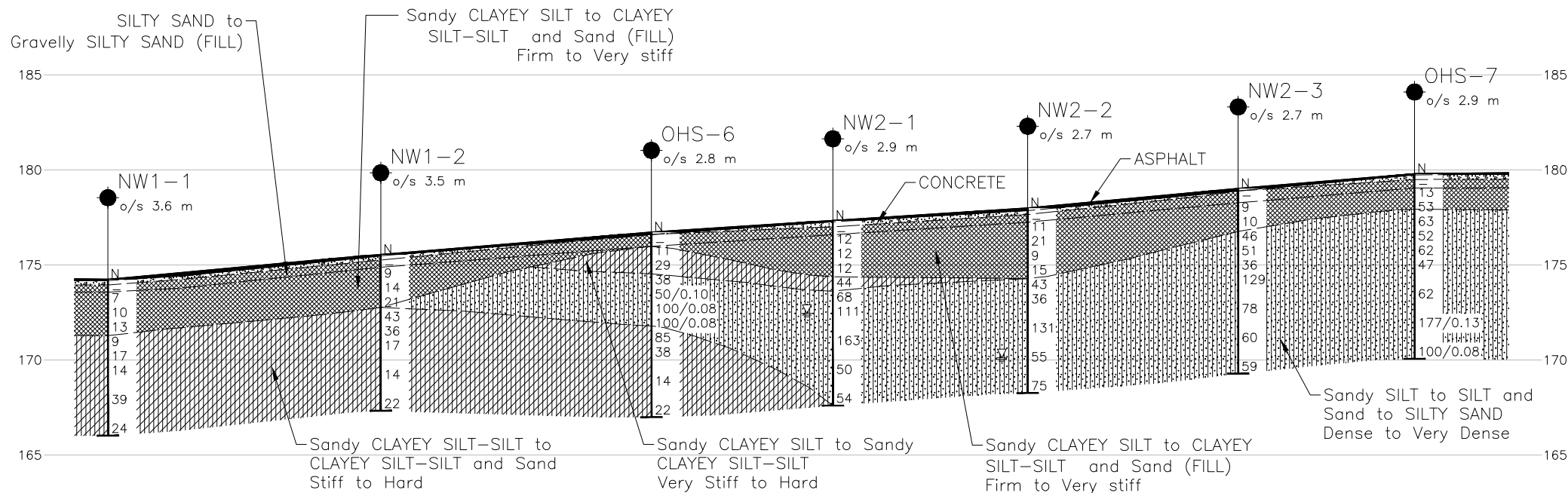
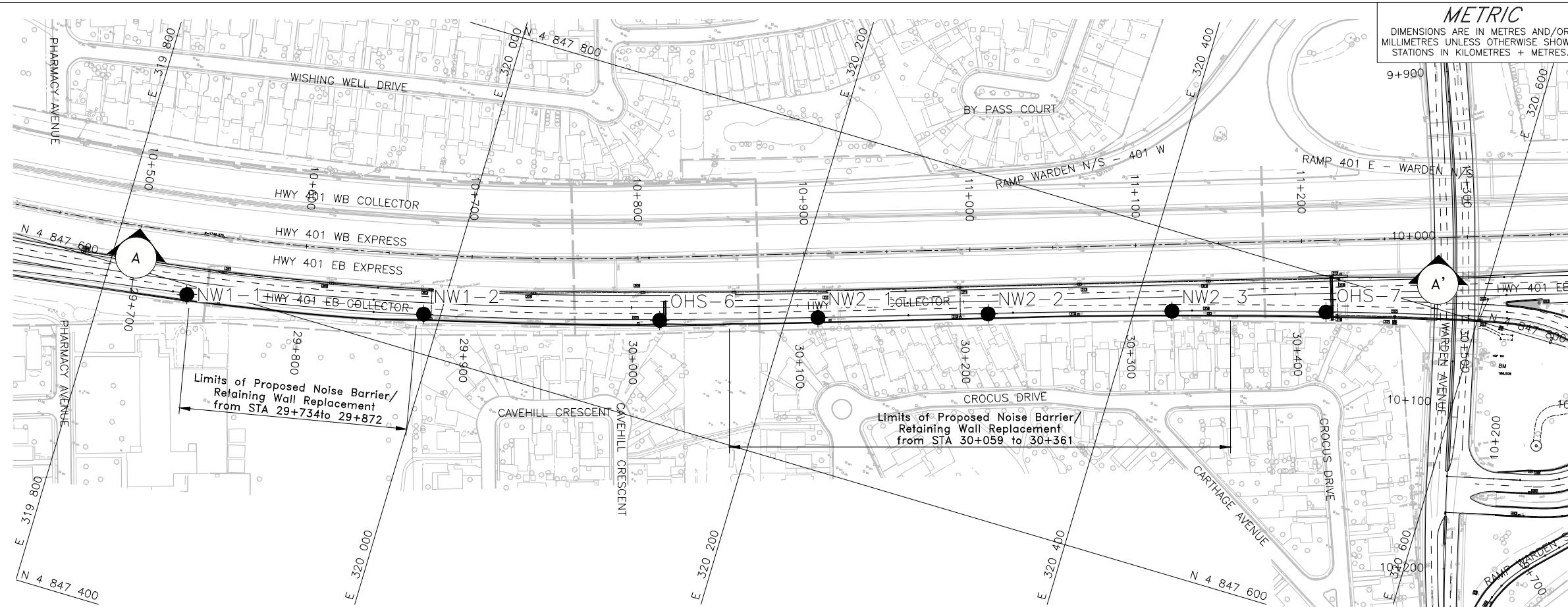
γ'

= effective unit weight (below the groundwater level) (kN/m³)

5. The resistance in the upper 1.2 m below ground surface should be neglected to account for frost action.

6. The total passive resistance below frost depth may be calculated based on the values of K_p provided, reduced by an appropriate factor that considers allowable wall movement in accordance with Figure C6.27 of the *Canadian Highway Bridge Design Code* (CHBDC, 2019) to account for large strains required to mobilize full passive resistance.

Drawings



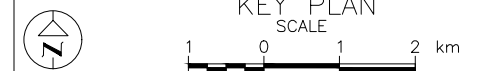
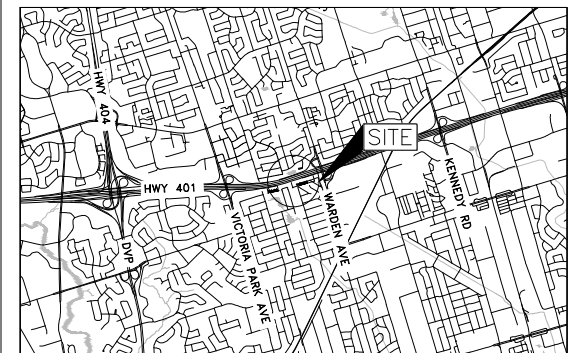
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2130-01-0



HIGHWAY 401
NOISE BARRIER WALLS REPLACEMENT
BOREHOLE LOCATIONS AND SOIL
STRATA

SHEET



LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES (NAD 83 MTM ZONE 10)

No.	ELEVATION	NORTHING	EASTING
NW1-1	174.2	4847594.1	319849.9
NW1-2	175.6	4847623.3	319990.1
NW2-1	177.4	4847688.9	320218.5
NW2-2	178.0	4847720.2	320316.2
NW2-3	179.0	4847753.2	320421.9
OHS-6	176.7	4847660.2	320127.5
OHS-7	179.8	4847779.1	320511.1



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.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Base and design plans provided in digital format by AECOM, drawing file no. 401_EBC_Avenue-Warden_base.dwg, received February 7, 2019 and 401_EBC_Avenue-Warden_plan.dwg, received March 29, 2021.

NO.	DATE	BY	REVISION
Geocres No. 30M14-539			
HWY. 401		PROJECT NO. 1786302	DIST. CENTRAL
SUBM'D. AT	CHKD. AT	DATE: 09/17/2021	SITE: .
DRAWN: DD/SA	CHKD. SK	APPD. CN	DWG. 1

APPENDIX A

Current Investigation – Record of Boreholes and Pavement Core Photographs

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>200	>8
COBBLES	Not Applicable	75 to 200	3 to 8
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS^{1,2}

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (i.e., SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (i.e., some sand)
≤ 10	trace (i.e., trace fines)

1. Only applicable to components not described by Primary Group Name.

2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

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.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve friction (f_s) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); 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

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC / SC	Rock core / Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample
OD / ID	Outer Diameter / Inner Diameter
HSA / SSA	Hollow-Stem Augers / Solid-Stem Augers

SOIL TESTS

w	water content
PL, w _p	plastic limit
LL, w _L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D _R	relative density (specific gravity, G _s)
DS	direct shear test
GS	specific gravity
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 ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
Y	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

COARSE-GRAINED SOILS

Compactness¹

Term	SPT 'N' (blows/0.3m) ²
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

3. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grain size. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

4. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N' ^{1,2} (blows/0.3m)
Very Soft	< 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	> 200	> 30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.

2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

LIST OF SYMBOLS

MINISTRY OF TRANSPORTATION, ONTARIO

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

I. GENERAL

π	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

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)

σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	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
γ'	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

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

(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 $= (w_l - w_p)$
NP	non-plastic
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_α	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
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	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

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$

PROJECT		1786302		RECORD OF BOREHOLE No NW1-1		SHEET 1 OF 1		METRIC							
G.W.P.		2130-01-00		LOCATION		N 4847594.1; E 319849.9 MTM NAD 83 ZONE 10 (LAT. 43.768162; LONG. -79.313071)		ORIGINATED BY							
DIST		Central HWY 401		BOREHOLE TYPE		CME 75, 198 mm O.D. Hollow Stem Augers (Auto Hammer)		COMPILED BY							
DATUM		Geodetic		DATE		May 14, 2021		CHECKED BY							
								CN							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
174.3	GROUND SURFACE														
0.0	ASPHALT (80 mm)														
	CONCRETE (220 mm)														
173.6	SILTY SAND (SM), some gravel (FILL) Brown Moist		1	AS	-										
0.7	Sandy CLAYEY SILT (CL), trace gravel (FILL) Firm to stiff Brown to grey Moist		2	SS	7										
			3	SS	10										
			4	SS	13										
171.3	CLAYEY SILT-SILT (CL-ML) and sand, trace gravel Stiff to hard Grey Moist		5	SS	9										
3.0			6	SS	17										
			7	SS	14										
			8	SS	39										
			9	SS	24										
166.1	END OF BOREHOLE														
8.2	NOTES: 1. Borehole dry upon completion of drilling. 2. Borehole caved to a depth of 6.4 m (Elev. 167.9 m) upon completion of drilling.														

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PROJECT 1786302		RECORD OF BOREHOLE No NW1-2				SHEET 1 OF 1		METRIC								
G.W.P. 2130-01-00		LOCATION N 4847623.3; E 319990.1 MTM NAD 83 ZONE 10 (LAT. 43.768422; LONG. -79.311329)				ORIGINATED BY BL/EE										
DIST Central HWY 401		BOREHOLE TYPE CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer)				COMPILED BY SK										
DATUM Geodetic		DATE May 14, 2021				CHECKED BY CN										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
175.6	GROUND SURFACE															
0.0	ASPHALT (85 mm)															
	CONCRETE (215 mm)															
174.9	Gravelly SILTY SAND (SM) (FILL) Brown Moist		1	AS	-											26 58 13 3
0.7	Sandy CLAYEY SILT (CL), trace gravel (FILL) Stiff to very stiff Brown Moist		2	SS	9											
			3	SS	14											3 28 45 24
172.8			4A 4B	SS	21											3 35 49 13
2.8	Sandy CLAYEY SILT-SILT (CL-ML/ML), trace gravel Stiff to hard Brown Moist		5	SS	43											
			6	SS	36											
			7	SS	17											3 35 45 17
			8	SS	14											
			9	SS	22											
167.4	END OF BOREHOLE															
8.2	NOTES: 1. Borehole dry upon completion of drilling. 2. Borehole caved to a depth of 6.7 m (Elev. 168.9 m) upon completion of drilling.															

PROJECT 1786302		RECORD OF BOREHOLE No NW2-1		SHEET 1 OF 1		METRIC						
G.W.P. 2130-01-00		LOCATION N 4847688.9; E 320218.5 MTM NAD 83 ZONE 10 (LAT. 43.769008; LONG. -79.308490)		ORIGINATED BY AM								
DIST Central HWY 401		BOREHOLE TYPE CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer)		COMPILED BY SK								
DATUM Geodetic		DATE May 16, 2021		CHECKED BY CN								
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID UNIT WEIGHT REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p W W _L	γ	GR SA SI CL
177.4	GROUND SURFACE											
0.0	ASPHALT (85 mm)											
	CONCRETE (260 mm)											
0.3	SILTY SAND (SM), some gravel (FILL)		1	AS	-		177					
176.6	Brown Moist		2	SS	12		176					
0.8	CLAYEY SILT (CL) and sand, trace gravel (FILL)		3	SS	12		175					
	Stiff Brown Moist		4	SS	12		174					
174.4	Sandy CLAYEY SILT-SILT (CL-ML/ML), trace gravel		5	SS	44		173					
3.0	Hard Brown Moist		6	SS	68		172					
173.7	Sandy SILT (ML) to SILT (ML) and sand to SILTY SAND (SM), trace to some gravel		7	SS	111		171					
3.7	Dense to very dense Brown to grey Moist		8	SS	163		170					
			9	SS	50		169					
			10A	SS	54		168					
167.7			10B									
9.8	END OF BOREHOLE											
NOTES: 1. Groundwater measured in open borehole at a depth of 4.9 m (Elev. 172.5 m) upon completion of drilling. 2. Borehole caved to a depth of 5.0 m (Elev. 172.4 m) upon completion of drilling.												

PROJECT 1786302		RECORD OF BOREHOLE No NW2-2		SHEET 1 OF 1		METRIC															
G.W.P. 2130-01-00		LOCATION N 4847720.2; E 320316.2 MTM NAD 83 ZONE 10 (LAT. 43.769288; LONG. -79.307276)		ORIGINATED BY AM																	
DIST Central HWY 401		BOREHOLE TYPE CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer)		COMPILED BY SK																	
DATUM Geodetic		DATE May 17, 2021		CHECKED BY CN																	
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			GR SA SI CL				
178.0	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30											
0.0	ASPHALT (150 mm)																				
	CONCRETE (210 mm)																				
177.2	SILTY SAND (SM), some gravel (FILL) Brown Moist		1	AS	-		177														
0.8	CLAYEY SILT (CL) and sand, trace gravel (FILL) Stiff to very stiff Brown to grey Moist		2	SS	11																
			3A	SS	21		176											4	40	38	18
			3B																		
			4	SS	9		175														
			5	SS	15																
174.3	SILT (ML) and sand to SILTY SAND (SM), trace to some gravel Dense to very dense Brown Moist		6	SS	43		174														
3.7			7	SS	36		173											13	39	40	8
			8	SS	131		172														
			9	SS	55		171														
			10	SS	75		170											7	39	46	8
168.3	END OF BOREHOLE						169														
9.8	NOTES: 1. Groundwater measured in open borehole at a depth of 7.9 m (Elev. 170.1 m) upon completion of drilling. 2. Borehole caved to a depth of 8.2 m (Elev. 169.8 m) upon completion of drilling.																				

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

PROJECT		1786302		RECORD OF BOREHOLE No OHS-6		SHEET 1 OF 1		METRIC							
G.W.P.		2130-01-00		LOCATION		N 4847660.2; E 320127.5 MTM NAD 83 ZONE 10 (LAT. 43.768752; LONG. -79.309621)		ORIGINATED BY							
DIST		Central HWY 401		BOREHOLE TYPE		CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer)		COMPILED BY							
DATUM		Geodetic		DATE		May 16, 2021		CHECKED BY							
								CN							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
176.7	GROUND SURFACE														
0.0	ASPHALT (140 mm)														
0.1	SILTY SAND (SM), some gravel (FILL)		1	AS	-										
175.9	Brown Moist														
0.8	Sandy CLAYEY SILT (CL)		2	SS	11										
	Stiff to very stiff														
	Brown Moist														
174.5			3	SS	29										
2.2	SILT (ML) and sand, trace gravel		4	SS	38										
	Dense to very dense														
	Brown Moist														
			5	SS	50/0.10										
			6	SS	100/0.08										
			7	SS	100/0.08										
171.8	Sandy CLAYEY SILT-SILT (CL-ML), trace to some gravel		8	SS	85										
	Stiff to hard														
	Brown Moist														
			9	SS	38										
			10	SS	14										
			11	SS	22										
167.0	END OF BOREHOLE														
9.8	NOTES:														
	1. Borehole dry upon completion of drilling.														
	2. Borehole caved to a depth of 7.9 m (Elev. 168.8 m) upon completion of drilling.														

GTA-MTO 001 S:\CLIENTS\MTOWHY_401_LESLIE_STREET\DATA\GINT\HWY_401_LESLIE_STREET.GPJ GAL-GTA.GDT 9/21/21

PROJECT		1786302		RECORD OF BOREHOLE No OHS-7		SHEET 1 OF 1		METRIC															
G.W.P.		2130-01-00		LOCATION		N 4847779.1; E 320511.1 MTM NAD 83 ZONE 10 (LAT. 43.769813; LONG. -79.304853)		ORIGINATED BY															
DIST		Central HWY 401		BOREHOLE TYPE		CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer)		COMPILED BY															
DATUM		Geodetic		DATE		May 20 and 21, 2021		CHECKED BY															
CN																							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			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		ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR	SA	SI	CL		
								20	40	60	80	100	20	40	60	80						100	10
179.8		GROUND SURFACE																					
0.0		ASPHALT (75 mm)																					
0.3		CONCRETE (240 mm)																					
179.0		SILTY SAND (SM), some gravel (FILL)		1	AS	-																	
0.8		Brown Moist		2	SS	13		179															
177.9		CLAYEY SILT-SILT (CL-ML/ML) and Sand, trace gravel (FILL)																					
1.9		Stiff to hard Brown Moist		3A	SS	53		178															
		SILT (ML/SM) and sand to SILTY SAND (SM), trace gravel		3B																			
		Dense to very dense Brown Moist		4	SS	63		177															
				5	SS	52																	
				6	SS	62		176															
				7	SS	47		175															
				8	SS	62		174															
				9	SS	77/0.13		173															
				10	SS	100/0.08		172															
								171															
170.1		END OF BOREHOLE																					
9.8		NOTES:																					
		1. Borehole dry upon completion of drilling.																					
		2. Borehole caved to a depth of 8.1 m (Elev. 171.7 m) upon completion of drilling.																					




PROJECT					
Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario					
TITLE					
PAVEMENT CORE PHOTOGRAPH BOREHOLE NW1-1 0 mm to 300 mm					
 GOLDER MEMBER OF WSP	PROJECT No. 1786302			FILE No. ----	
	DESIGN	AT	20210802	SCALE	NTS
	CADD	--	--	FIGURE A1	
	CHECK	CN	20210809		
	REVIEW	CN	20210811		



PROJECT Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario						
TITLE PAVEMENT CORE PHOTOGRAPH BOREHOLE NW1-2 0 mm to 300 mm						
 GOLDER MEMBER OF WSP	PROJECT No. 1786302			FILE No. ----		
	DESIGN	AT	20210802	SCALE	NTS	VER. 1.
	CADD	--	--	FIGURE A2		
	CHECK	CN	20210809			
	REVIEW	CN	20210811			



PROJECT Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario						
TITLE PAVEMENT CORE PHOTOGRAPH BOREHOLE NW2-1 0 mm to 345 mm						
 GOLDER MEMBER OF WSP	PROJECT No. 1786302			FILE No. ----		
	DESIGN	AT	20210802	SCALE	NTS	VER. 1.
	CADD	--	--	FIGURE A3		
	CHECK	CN	20210809			
	REVIEW	CN	20210811			



PROJECT						
Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario						
TITLE						
PAVEMENT CORE PHOTOGRAPH						
BOREHOLE NW2-2						
0 mm to 360 mm						
 GOLDER MEMBER OF WSP	PROJECT No. 1786302			FILE No. ----		
	DESIGN	AT	20210802	SCALE	NTS	VER. 1.
	CADD	--	--	FIGURE A4		
	CHECK	CN	20210809			
	REVIEW	CN	20210811			



PROJECT					
Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario					
TITLE					
PAVEMENT CORE PHOTOGRAPH BOREHOLE NW2-3 0 mm to 140 mm					
 GOLDER MEMBER OF WSP	PROJECT No. 1786302			FILE No. ----	
	DESIGN	AT	20210802	SCALE	NTS
	CADD	--	--	FIGURE A5	
	CHECK	CN	20210809		
	REVIEW	CN	20210811		



PROJECT					
Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario					
TITLE					
PAVEMENT CORE PHOTOGRAPH BOREHOLE OHS-6 0 mm to 140 mm					
 GOLDER MEMBER OF WSP	PROJECT No. 1786302			FILE No. ----	
	DESIGN	AT	20210802	SCALE	NTS
	CADD	--	--	FIGURE A6	
	CHECK	CN	20210809		
	REVIEW	CN	20210811		



PROJECT						
Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario						
TITLE						
PAVEMENT CORE PHOTOGRAPH BOREHOLE OHS-7 0 mm to 315 mm						
 GOLDER MEMBER OF WSP	PROJECT No. 1786302			FILE No. ----		
	DESIGN	AT	20210802	SCALE	NTS	VER. 1.
	CADD	--	--	FIGURE A7		
	CHECK	CN	20210809			
	REVIEW	CN	20210811			

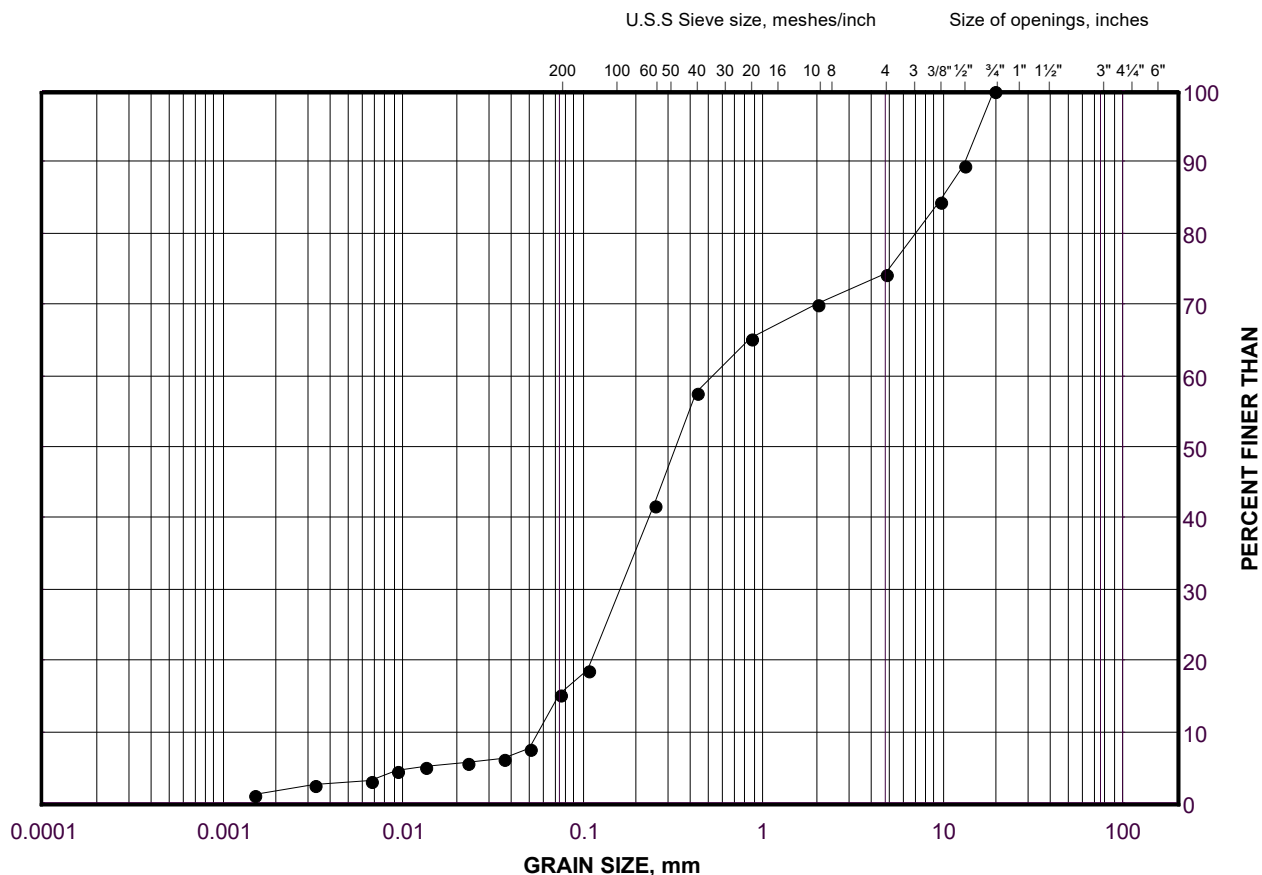
APPENDIX B

Geotechnical and Analytical Test Results

GRAIN SIZE DISTRIBUTION

Gravelly SILTY SAND (SM) (FILL)

FIGURE B1



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	AS1	175.1

Project Number: 1786302 (2500)

Checked By: _____ AT _____

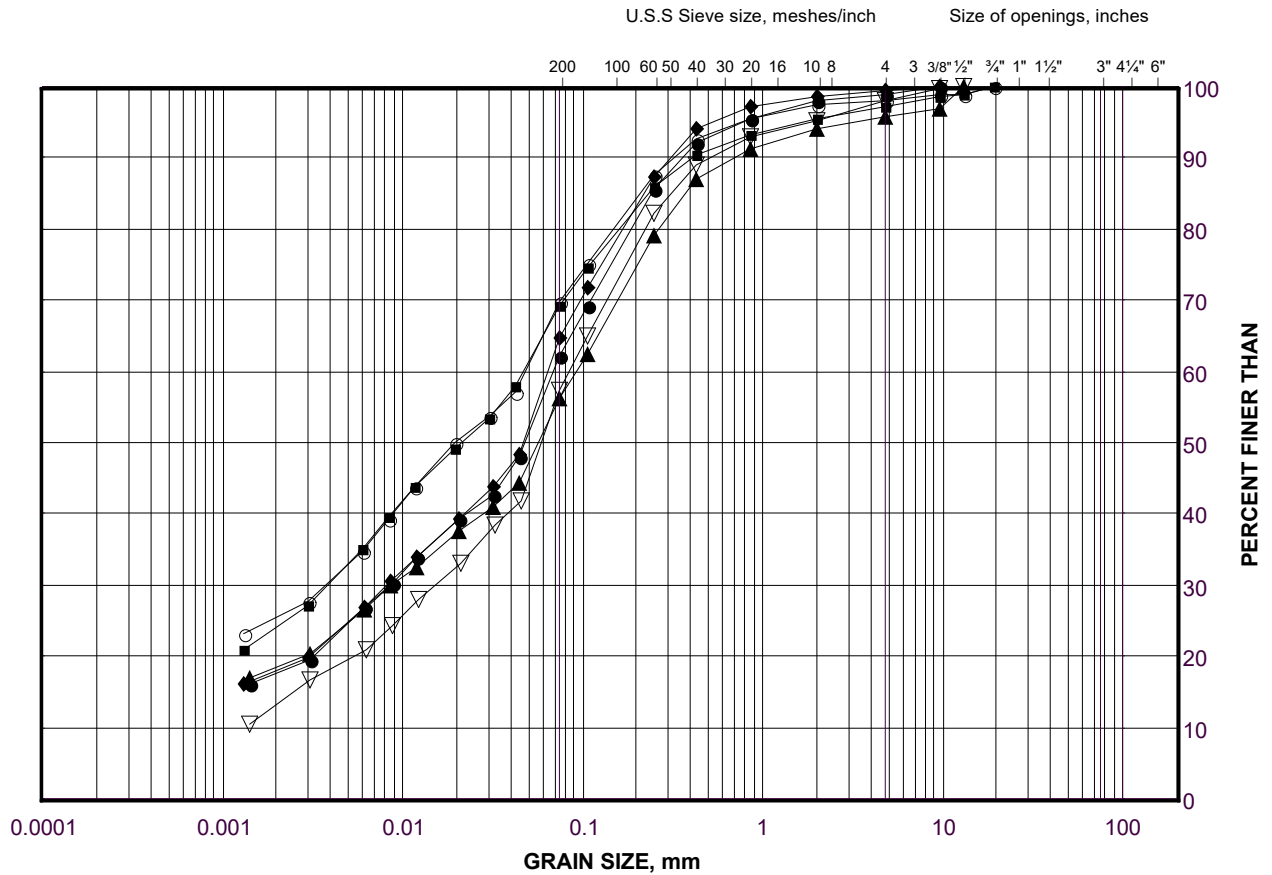
Golder Associates

Date: 09-Aug-21

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT (CL) to CLAYEY SILT (CL) and Sand to CLAYEY SILT-SILT (CL-ML/ML) and Sand (FILL)

FIGURE B2



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

LEGEND

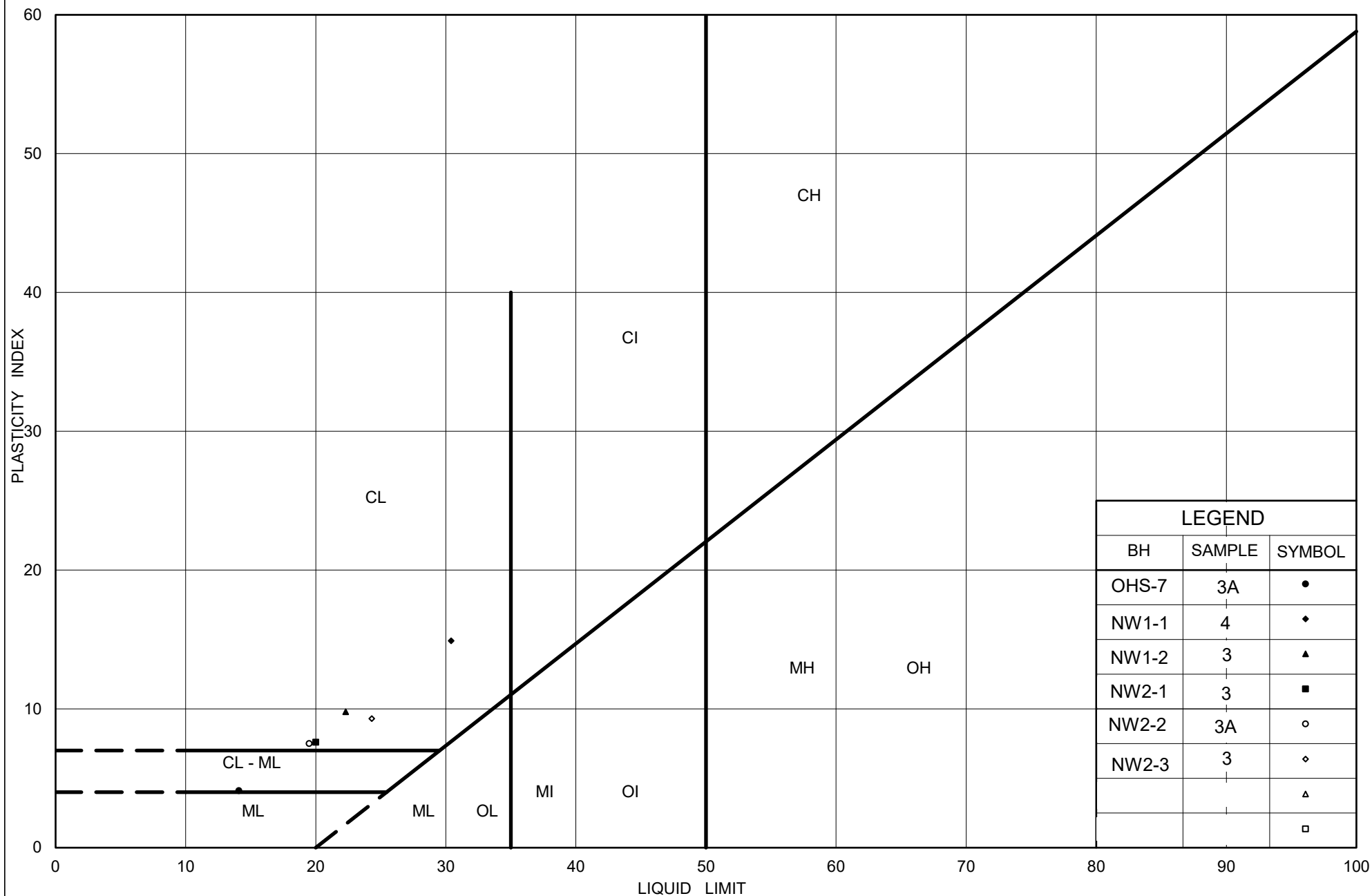
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW2-1	3	175.6
■	NW1-2	3	173.8
◆	NW2-3	3	177.2
▲	NW2-2	3A	176.2
▽	OHS-7	3A	178.1
○	NW1-1	4	171.7

Project Number: 1786302 (2500)

Checked By: _____ AT _____

Golder Associates

Date: 09-Aug-21



Ministry of Transportation

Ontario

PLASTICITY CHART

Sandy CLAYEY SILT (CL) to CLAYEY SILT (CL) and Sand to
CLAYEY SILT-SILT (CL-ML/ML) and Sand (FILL)

Figure No. B3

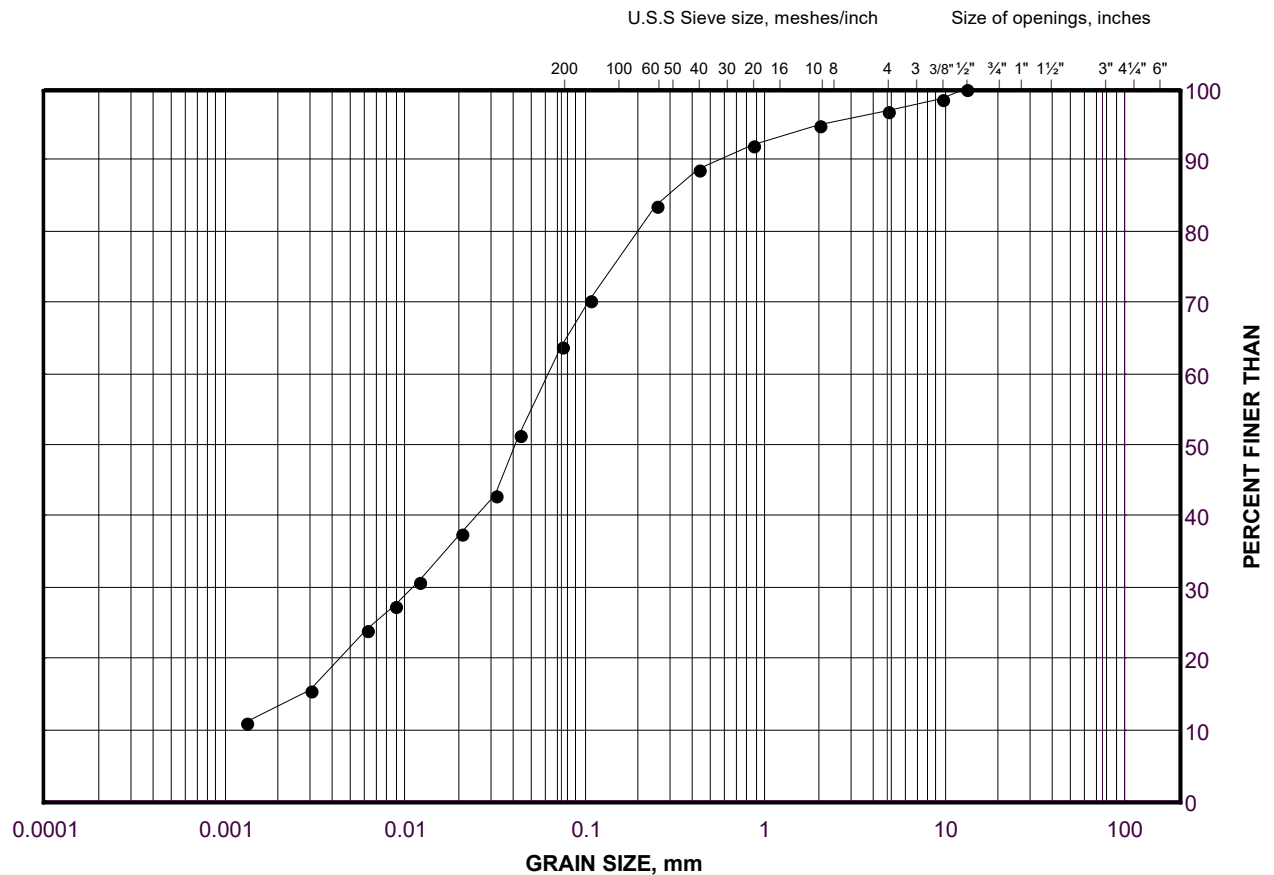
Project No. 1786302 (2500)

Checked By: AT

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT-SILT (CL-ML/ML)

FIGURE B4



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

LEGEND

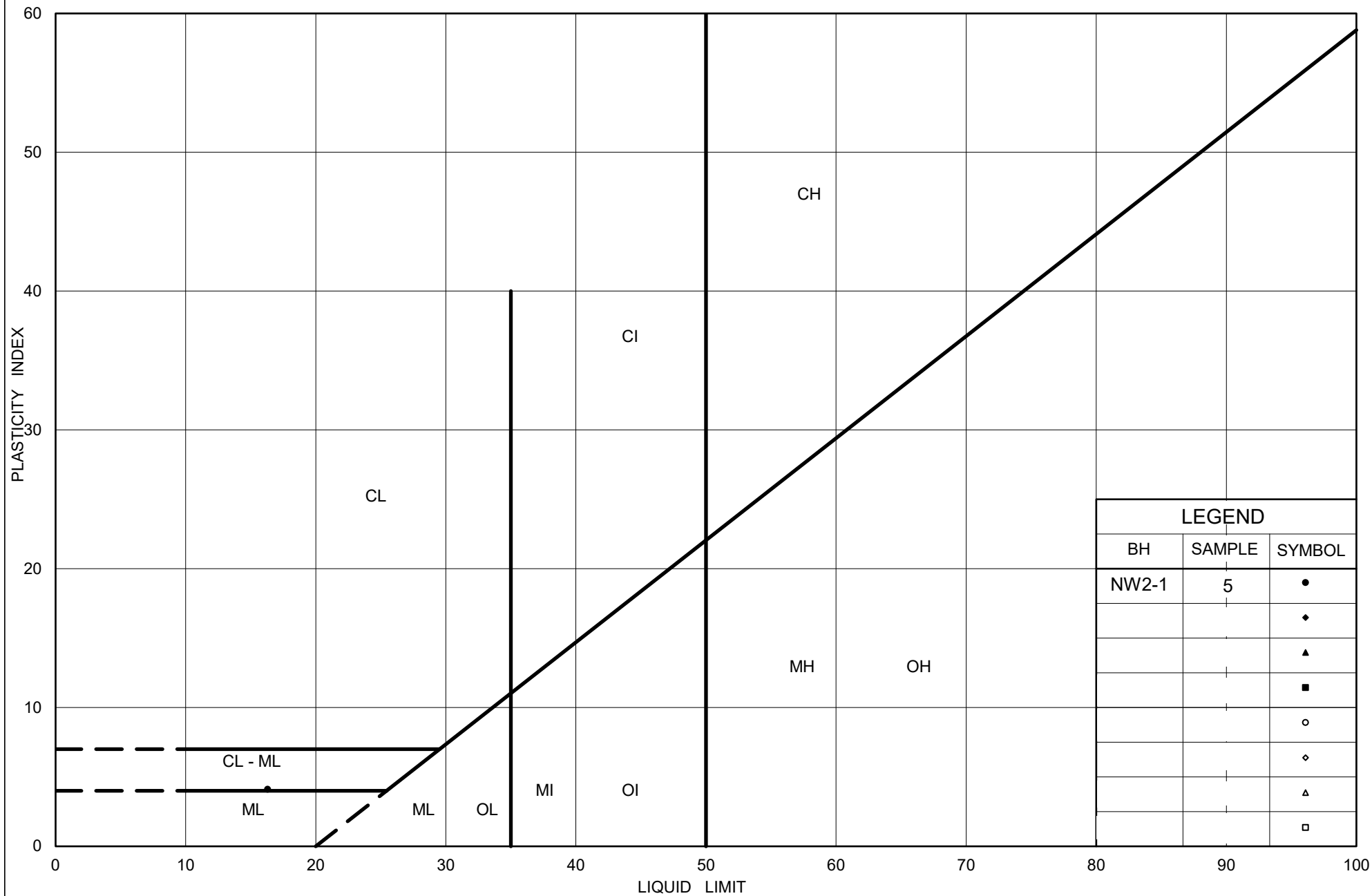
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	NW2-1	5	174.0

Project Number: 1786302 (2500)

Checked By: _____ AT _____

Golder Associates

Date: 09-Aug-21



Ministry of Transportation

Ontario

PLASTICITY CHART Sandy CLAYEY SILT-SILT (CL-ML/ML)

Figure No. B5

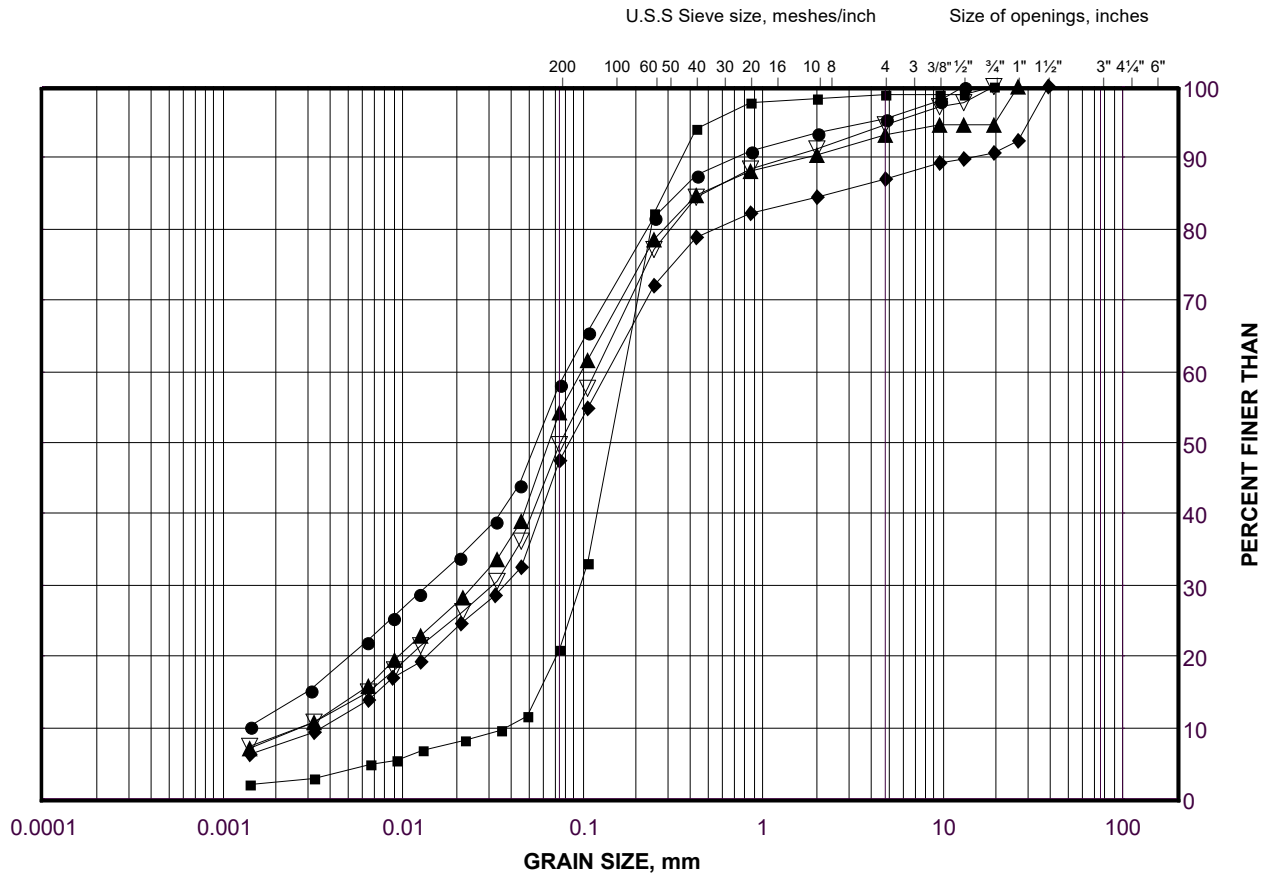
Project No. 1786302 (2500)

Checked By: AT

GRAIN SIZE DISTRIBUTION

SILT (ML) and Sand to SILTY SAND (SM)

FIGURE B6A



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-6	4	174.1
■	OHS-7	6	175.7
◆	NW2-2	7	173.2
▲	NW2-2	9	170.1
▽	OHS-7	9	172.0

Project Number: 1786302 (2500)

Checked By: _____ AT _____

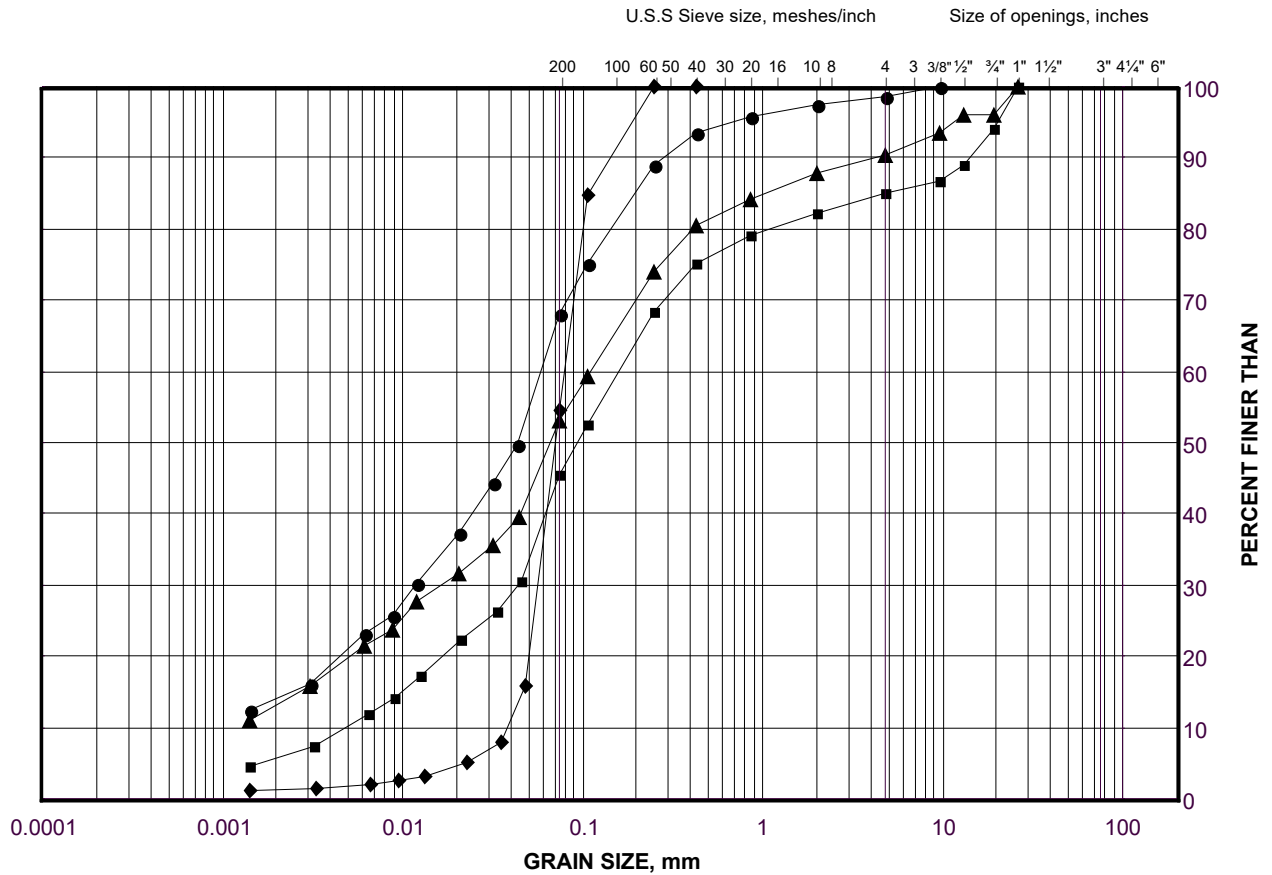
Golder Associates

Date: 09-Aug-21

GRAIN SIZE DISTRIBUTION

Sandy SILT (ML) to SILT (ML) and Sand to SILTY SAND (SM)

FIGURE B6B



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

LEGEND

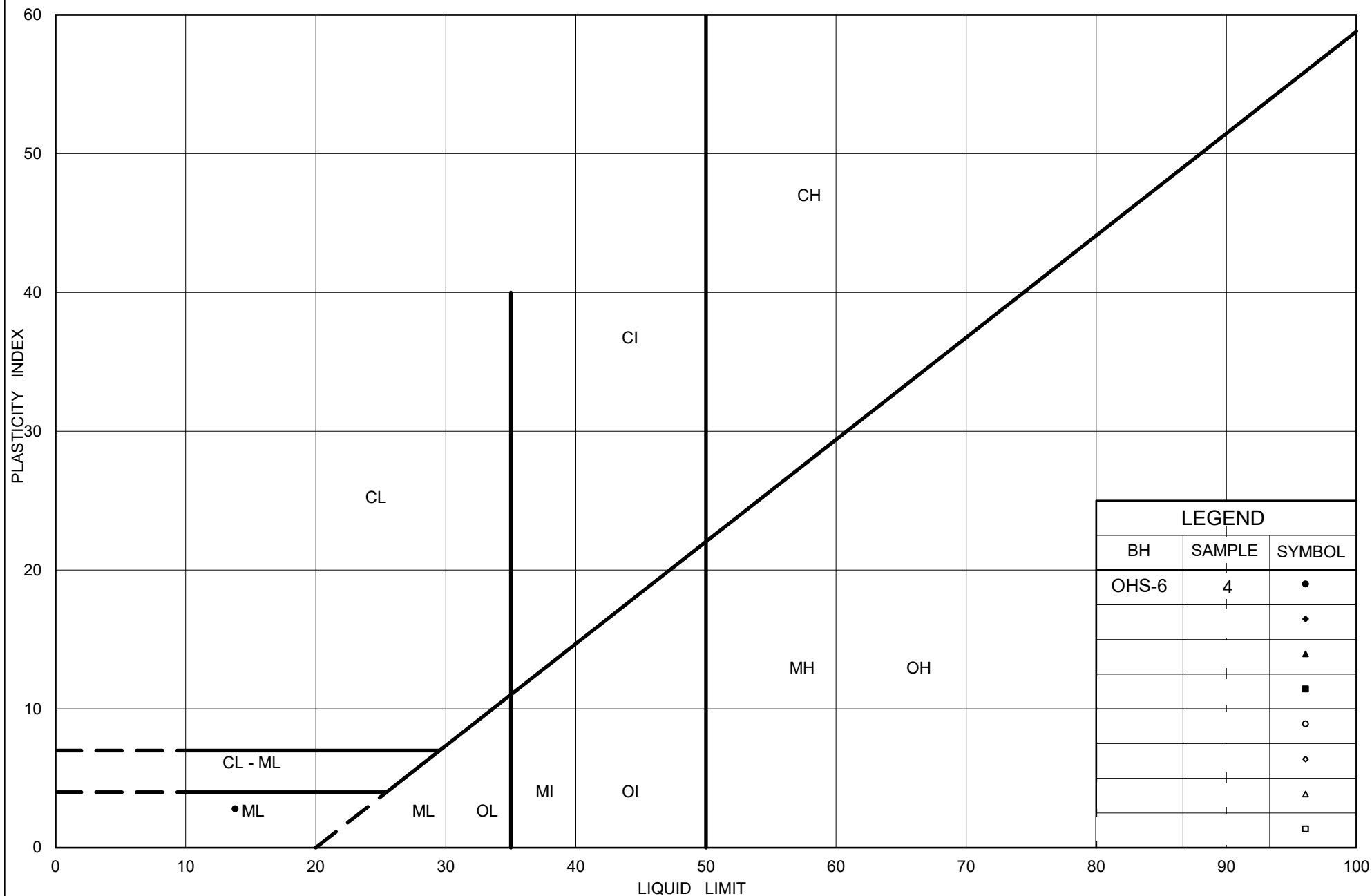
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NW2-3	6	174.9
■	NW2-1	7	172.5
◆	NW2-3	9	171.1
▲	NW2-1	9	169.5

Project Number: 1786302 (2500)

Checked By: _____ AT _____

Golder Associates

Date: 09-Aug-21



Ministry of Transportation

Ontario

PLASTICITY CHART

SILT (ML) and Sand

Figure No. B7

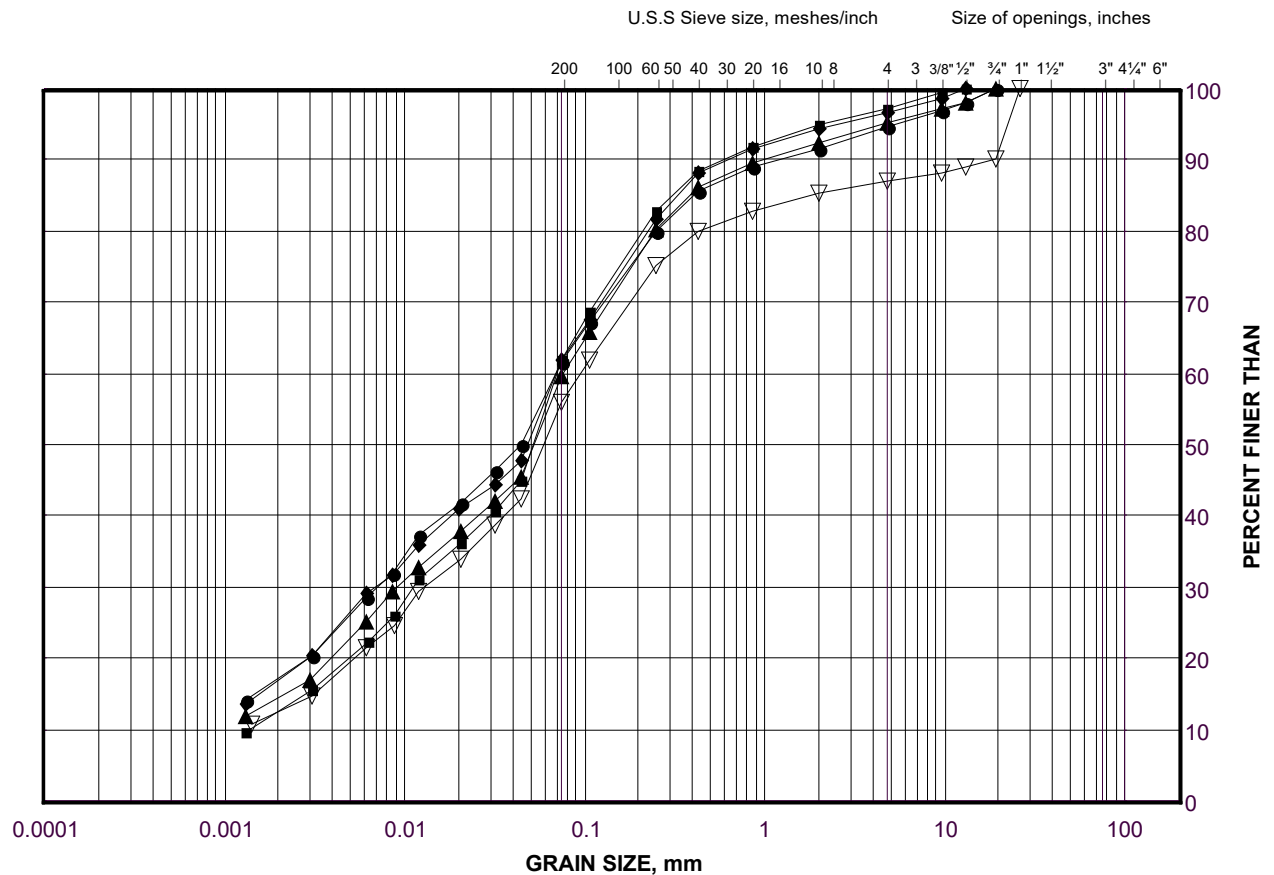
Project No. 1786302 (2500)

Checked By: AT

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT-SILT (CL-ML) to CLAYEY
SILT-SILT (CL-ML) and Sand

FIGURE B8



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

LEGEND

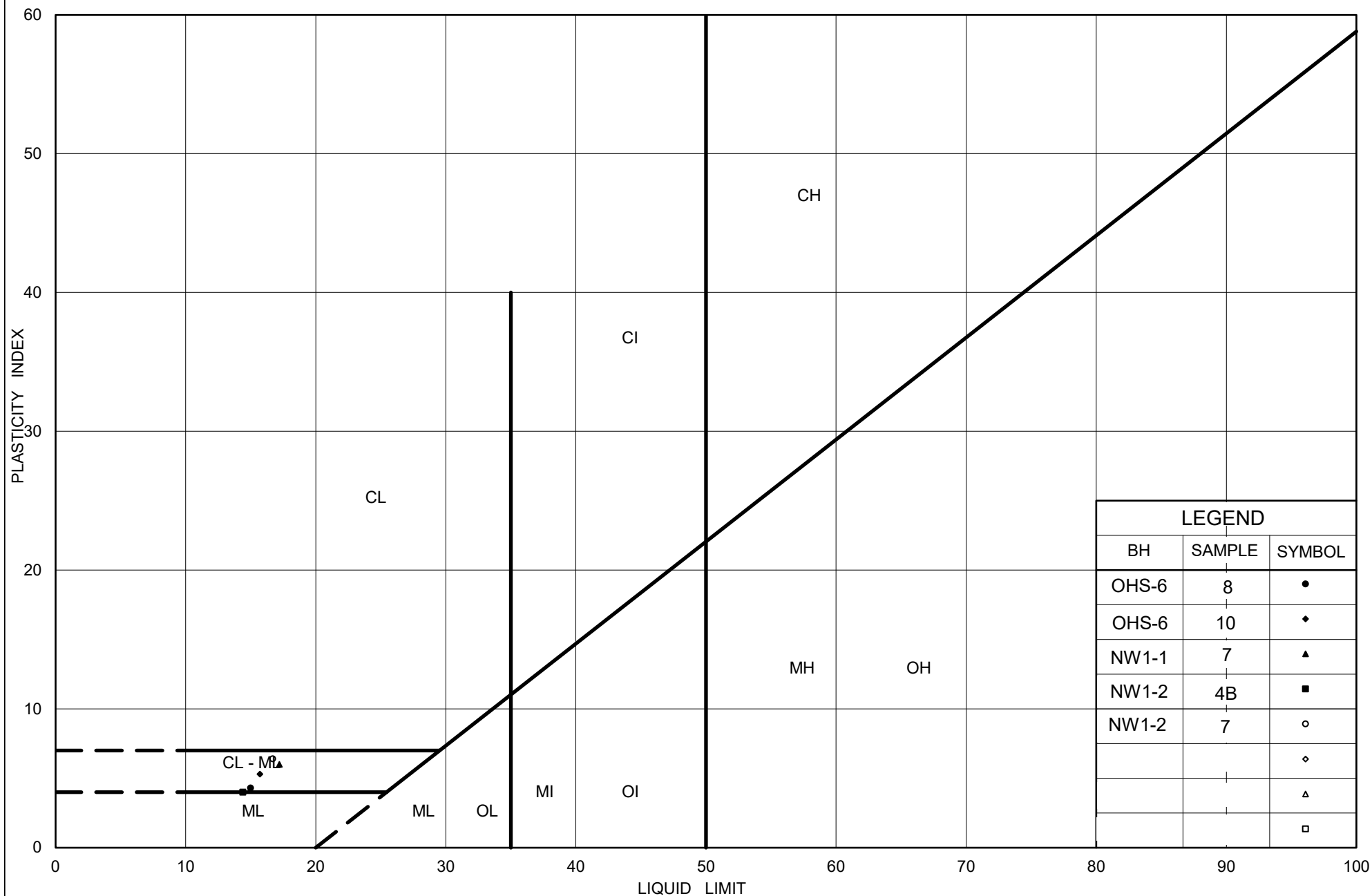
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-6	10	168.8
■	NW1-2	4B	173.0
◆	NW1-2	7	170.7
▲	NW1-1	7	169.4
▽	OHS-6	8	171.1

Project Number: 1786302 (2500)

Checked By: _____ AT _____

Golder Associates

Date: 09-Aug-21



Ministry of Transportation

Ontario

PLASTICITY CHART

Sandy CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT-SILT (CL-ML) and Sand

Figure No. B9

Project No. 1786302 (2500)

Checked By: AT



Your Project #: 1786302/2500/CR7
Site Location: HWY 401 & BAYVIEW
Your C.O.C. #: na

Attention: Katelyn Nero

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

Report Date: 2021/06/09
Report #: R6668738
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1F1818

Received: 2021/06/03, 14:03

Sample Matrix: Soil
Samples Received: 5

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	5	2021/06/08	2021/06/09	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	5	2021/06/08	2021/06/08	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	5	2021/06/08	2021/06/08	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	5	2021/06/04	2021/06/09	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	5	2021/06/08	2021/06/09	CAM SOP-00464	EPA 375.4 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by Bureau Veritas, results relate to the supplied 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 #: 1786302/2500/CR7
Site Location: HWY 401 & BAYVIEW
Your C.O.C. #: na

Attention: Katelyn Nero

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

Report Date: 2021/06/09
Report #: R6668738
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1F1818

Received: 2021/06/03, 14:03

Encryption Key

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

Ema Gitej, Senior Project Manager

Email: emese.gitej@bureauveritas.com

Phone# (905)817-5829

=====

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BUREAU
VERITAS

BV Labs Job #: C1F1818
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR7
Site Location: HWY 401 & BAYVIEW
Sampler Initials: SK

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		PSY920		PSY921		PSY922		
Sampling Date		2021/06/02		2021/06/02		2021/06/02		
COC Number		na		na		na		
	UNITS	NW1-1 SS3 5'-7'	RDL	NW1-2 SS4A 7'6'-9'2'	QC Batch	NW2-1 SS3 5'-7'	RDL	QC Batch

Calculated Parameters								
Resistivity	ohm-cm	440		920	7390239	530		7390239
Inorganics								
Soluble (20:1) Chloride (Cl-)	ug/g	1200	40	540	7395160	940	20	7395160
Conductivity	umho/cm	2290	2	1090	7395714	1880	2	7395714
Available (CaCl2) pH	pH	7.99		7.91	7395571	7.43		7394851
Soluble (20:1) Sulphate (SO4)	ug/g	160	20	71	7395222	<20	20	7395222
RDL = Reportable Detection Limit								
QC Batch = Quality Control Batch								

BV Labs ID		PSY923	PSY924		
Sampling Date		2021/06/02	2021/06/02		
COC Number		na	na		
	UNITS	NW2-2 SS4 7'6'-9'6'	NW2-3 SS2 2'6'-4'6'	RDL	QC Batch

Calculated Parameters					
Resistivity	ohm-cm	320	410		7390239
Inorganics					
Soluble (20:1) Chloride (Cl-)	ug/g	1800	1500	60	7395160
Conductivity	umho/cm	3090	2470	2	7395714
Available (CaCl2) pH	pH	7.22	7.67		7395571
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	20	7395222
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					



BUREAU
VERITAS

BV Labs Job #: C1F1818
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR7
Site Location: HWY 401 & BAYVIEW
Sampler Initials: SK

TEST SUMMARY

BV Labs ID: PSY920
Sample ID: NW1-1 SS3 5'-7'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7395571	2021/06/08	2021/06/08	Neil Dassanayake
Resistivity of Soil		7390239	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY921
Sample ID: NW1-2 SS4A 7'6'-9'2'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7395571	2021/06/08	2021/06/08	Neil Dassanayake
Resistivity of Soil		7390239	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY922
Sample ID: NW2-1 SS3 5'-7'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394851	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7390239	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY923
Sample ID: NW2-2 SS4 7'6'-9'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7395571	2021/06/08	2021/06/08	Neil Dassanayake
Resistivity of Soil		7390239	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY924
Sample ID: NW2-3 SS2 2'6'-4'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu



BUREAU
VERITAS

BV Labs Job #: C1F1818
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR7
Site Location: HWY 401 & BAYVIEW
Sampler Initials: SK

TEST SUMMARY

BV Labs ID: PSY924
Sample ID: NW2-3 SS2 2'6"-4'6"
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7395571	2021/06/08	2021/06/08	Neil Dassanayake
Resistivity of Soil		7390239	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu



BUREAU
VERITAS

BV Labs Job #: C1F1818
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR7
Site Location: HWY 401 & BAYVIEW
Sampler Initials: SK

GENERAL COMMENTS

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

Package 1	4.7°C
-----------	-------

Results relate only to the items tested.



BUREAU
VERITAS

BV Labs Job #: C1F1818

Report Date: 2021/06/09

QUALITY ASSURANCE REPORT

Golder Associates Ltd

Client Project #: 1786302/2500/CR7

Site Location: HWY 401 & BAYVIEW

Sampler Initials: SK

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7394851	Available (CaCl ₂) pH	2021/06/08			99	97 - 103			0.091	N/A
7395160	Soluble (20:1) Chloride (Cl ⁻)	2021/06/09	NC	70 - 130	103	70 - 130	<20	ug/g	1.5	35
7395222	Soluble (20:1) Sulphate (SO ₄)	2021/06/09	NC	70 - 130	108	70 - 130	<20	ug/g	1.7	35
7395571	Available (CaCl ₂) pH	2021/06/08			99	97 - 103			0.16	N/A
7395714	Conductivity	2021/06/08			99	90 - 110	<2	umho/cm	1.1	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)



BUREAU
VERITAS

BV Labs Job #: C1F1818
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR7
Site Location: HWY 401 & BAYVIEW
Sampler Initials: SK

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

WORK ORDER

CHAIN OF CUSTODY RECORD

Page 1 of 1

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Turnaround Time (TAT) Required				
Company Name: Golder Associates Ltd		Company Name: Golder Associates		Quotation #: B80683		<input checked="" type="checkbox"/> Regular TAT (5-7 days) Most analyses				
Contact Name: Accounts Payable		Contact Name: Shantanu Kar / Katelyn Nero		P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS				
Address: 6925 Century Ave, Suite 100 Mississauga, ON, L5N 7K2		Address:		Project #: 1786302/2500/CR7		Rush TAT (Surcharges will be applied) <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3-4 Days				
Phone: 905 567 4444 Fax:		Phone: Fax:		Site Location:						
Email: AP_CustomerService@golder.com		Email: shantanu_kar@golder.com / knero@golder.com		Site #: HWY 401/Bayview		Date Required:				
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS LABORATORIES' DRINKING WATER CHAIN OF CUSTODY						Sampled By: SK Rush Confirmation #:				
Regulation 153		Other Regulations		Analysis Requested						
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Med/ Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agr/ Other <input type="checkbox"/> Table _____ FOR RSC (PLEASE CIRCLE) Y / N		<input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> MISA <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> PWQU Region _____ <input type="checkbox"/> Other (Specify) _____ <input type="checkbox"/> REG 558 (MIN. 3 DAY TAT REQUIRED) <input type="checkbox"/> REG 406 Table _____		# OF CONTAINERS SUBMITTED FIELD FILTERED (CIRCLE) Metals / Hg / CrVI BTEX/ PHC F1 PHCS F2 - F4 VOCs REG 153 METALS & INORGANICS REG 153 ICPMS METALS Corrosivity Pkg (CL, SO4, EC, resistivity, pH)				LABORATORY USE ONLY <div>CUSTOMER SEAL Y/N Present Intact</div> <div>COOLER TEMPERATURES 8/6/5</div> <div>COOLING MEDIA PRESENT: Y / N</div> <div>COMMENTS</div>		
Include Criteria on Certificate of Analysis: Y / N		SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS								
SAMPLE IDENTIFICATION		DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	Corrosivity Pkg (CL, SO4, EC, resistivity, pH)	HOLD- DO NOT ANALYZE
1	NW1-1 SS3 5'- 7'	2021-06-02	PM	SOIL	1				X	
2	NW1-2 SS4A 7'6"- 9'2"	2021-06-02	PM	SOIL	1				X	
3	NW2-1 SS3 5'-7'	2021-06-02	PM	SOIL	1				X	
4	NW2-2 SS4 7'6"- 9'6"	2021-06-02	PM	SOIL	1				X	
5	NW2-3 SS2 2'6"- 4'6"	2021-06-02	PM	SOIL	1				X	
6										
7										
8										
9										
10										
RELINQUISHED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV JOB #		
ANKAREN MAHWSWARAN		2021-06-03				2021/06/03	14:03			



Your Project #: 1786302/2500/CR6
Site#: HWY 401/BAYVIEW
Site Location: HWY 401/BAYVIEW
Your C.O.C. #: na

Attention: Katelyn Nero

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

Report Date: 2021/06/09
Report #: R6668730
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1F1823

Received: 2021/06/03, 14:03

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	4	2021/06/08	2021/06/09	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	4	2021/06/08	2021/06/08	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	4	2021/06/08	2021/06/08	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	4	2021/06/03	2021/06/09	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	4	2021/06/08	2021/06/09	CAM SOP-00464	EPA 375.4 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by Bureau Veritas, results relate to the supplied 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 #: 1786302/2500/CR6
Site#: HWY 401/BAYVIEW
Site Location: HWY 401/BAYVIEW
Your C.O.C. #: na

Attention: Katelyn Nero

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

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CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1F1823

Received: 2021/06/03, 14:03

Encryption Key

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

Ema Gitej, Senior Project Manager

Email: emese.gitej@bureauveritas.com

Phone# (905)817-5829

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This report has been generated and distributed using a secure automated process.

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BUREAU
VERITAS

BV Labs Job #: C1F1823
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR6
Site Location: HWY 401/BAYVIEW
Sampler Initials: SK

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		PSY950	PSY951			PSY951		
Sampling Date		2021/06/02	2021/06/02			2021/06/02		
COC Number		na	na			na		
	UNITS	OHS 4 SS2 2'6'-4'6'	OHS 6 SS2 2'6'-4'6'	RDL	QC Batch	OHS 6 SS2 2'6'-4'6' Lab-Dup	RDL	QC Batch

Calculated Parameters								
Resistivity	ohm-cm	710	1100		7388747			
Inorganics								
Soluble (20:1) Chloride (Cl-)	ug/g	760	380	20	7395160			
Conductivity	umho/cm	1410	897	2	7395714	907	2	7395714
Available (CaCl2) pH	pH	7.91	7.92		7394841			
Soluble (20:1) Sulphate (SO4)	ug/g	53	<20	20	7395222			
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate								

BV Labs ID		PSY952			PSY952			PSY953		
Sampling Date		2021/06/02			2021/06/02			2021/06/02		
COC Number		na			na			na		
	UNITS	OHS 7 SS4 7'6'-9'6'	RDL	QC Batch	OHS 7 SS4 7'6'-9'6' Lab-Dup	RDL	QC Batch	OHS9 SS3 5'-7'	RDL	QC Batch

Calculated Parameters										
Resistivity	ohm-cm	1200		7388747				3000		7388747
Inorganics										
Soluble (20:1) Chloride (Cl-)	ug/g	400	20	7395160	410	20	7395160	44	20	7395160
Conductivity	umho/cm	861	2	7395714				339	2	7395714
Available (CaCl2) pH	pH	8.08		7394841	8.09		7394841	7.87		7394841
Soluble (20:1) Sulphate (SO4)	ug/g	50	20	7395222				140	20	7395222
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate										

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VERITAS

BV Labs Job #: C1F1823

Report Date: 2021/06/09

Golder Associates Ltd

Client Project #: 1786302/2500/CR6

Site Location: HWY 401/BAYVIEW

Sampler Initials: SK

TEST SUMMARY

BV Labs ID: PSY950
Sample ID: OHS 4 SS2 2'6'-4'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7388747	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY951
Sample ID: OHS 6 SS2 2'6'-4'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7388747	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY951 Dup
Sample ID: OHS 6 SS2 2'6'-4'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel

BV Labs ID: PSY952
Sample ID: OHS 7 SS4 7'6'-9'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7388747	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY952 Dup
Sample ID: OHS 7 SS4 7'6'-9'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai



BUREAU
VERITAS

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Golder Associates Ltd
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Site Location: HWY 401/BAYVIEW
Sampler Initials: SK

TEST SUMMARY

BV Labs ID: PSY953
Sample ID: OHS9 SS3 5'-7'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7388747	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu



BUREAU
VERITAS

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Site Location: HWY 401/BAYVIEW
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GENERAL COMMENTS

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

Package 1	4.7°C
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Results relate only to the items tested.



BUREAU
VERITAS

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QUALITY ASSURANCE REPORT

Golder Associates Ltd

Client Project #: 1786302/2500/CR6

Site Location: HWY 401/BAYVIEW

Sampler Initials: SK

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7394841	Available (CaCl ₂) pH	2021/06/08			99	97 - 103			0.14	N/A
7395160	Soluble (20:1) Chloride (Cl ⁻)	2021/06/09	NC	70 - 130	103	70 - 130	<20	ug/g	1.5	35
7395222	Soluble (20:1) Sulphate (SO ₄)	2021/06/09	NC	70 - 130	108	70 - 130	<20	ug/g	1.7	35
7395714	Conductivity	2021/06/08			99	90 - 110	<2	umho/cm	1.1	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)



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APPENDIX C

Non-Standard Special Provisions

5m NOISE BARRIER SYSTEM - Item No.

5m NOISE BARRIER SYSTEM INCLUDING PRECAST NOISE/TRAFFIC BARRIER - Item No.
NOISE BARRIER ACCESS - Item No.

Special Provision No. 760F01

March 2018

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:

Table A
Soil Design Parameters

Location	Soil Design Parameter
Hwy 401 East Bound Collector Sta 23+764 to Sta 23+887 (#1)	Cu = 65 KPa
Hwy 401 East Bound Collector Sta 23+840 to Sta 24+031 (#2)	Cu = 85 KPa
Hwy 401 East Bound Collector Sta 24+031 to Sta 24+335 (#3)	Ø = 35°
Hwy 401 East Bound Collector Sta 24+335 to Sta 24+578 (#4)	Cu = 85 KPa
Hwy 401 East Bound Collector Sta 24+566 to Sta 25+022 (#5)	Ø = 35°
Hwy 401 East Bound Collector Sta 29+734 to Sta 29+872	Cu = 65 KPa
Hwy 401 East Bound Collector Sta 30+059 to Sta 30+361	Ø = 34°

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: 460 Pa for Toronto area.

760.04.01.03 Acoustics

The minimum acoustical characteristic of the noise barrier system shall be such that the noise barrier is: Sound absorptive on both sides.

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: One (1) in the proportion of 100%

Number of textures One (1) in the proportion of 100%

Number of colours adjacent to residential property: One (1) in the proportion of 100%

Number of textures One (1) in the proportion of 100%

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.



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