REPORT

Foundation Investigation and Design Report

Two Overhead Sign Support Structures
Highway 400, Steeles Avenue West to Langstaff Road
City of Toronto and City of Vaughan, Ontario
GWP 2324-16-00

Submitted to:

Morrison Hershfield Ltd.
Suite 120, 1005 Skyview Drive
Burlington, ON
L7P 5B1

Submitted by:

Golder, Member of WSP

6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

GEOCRES No.: 30M13-328

OS-1: Lat. 43.769674º **Long.** -79.533934º

OS-2: Lat. 43.774545º **Long.** -79.535243º

19115306

January 4, 2022

Distribution List

1 e-copy - MTO - Central Region

1 e-copy - MTO - Foundations Section

1 e-copy - Morrison Hershfield Ltd.

1 e-copy - Golder, Member of WSP

Table of Contents

REFERENCES

TABLES

DRAWINGS

LIST OF APPENDICES

PART A

FOUNDATION INVESTIGATION REPORT
OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 400 – STEELES AVENUE WEST TO LANGSTAFF ROAD
CITY OF TORONTO AND CITY OF VAUGHAN, ONTARIO
GWP 2324-16-00

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 for the detail design of two overhead signs spanning across Highway 400 northbound lanes and associated off-ramp lanes.

The purpose of this investigation is to assess the subsurface conditions near the locations of the new sign supports by methods of borehole drilling, in-situ testing, and laboratory testing on selected soil samples.

This report summarizes the factual results of field and laboratory work (including field investigation procedures, borehole stratigraphy, and geotechnical and analytical laboratory test results) and provides a description of the interpreted soil and groundwater conditions near each overhead sign support.

2.0 PROJECT AND SITE DESCRIPTION

The orientation (i.e., north, south, east, west) stated in the text of the report is referenced to project north and therefore may differ from magnetic north shown on Drawing 1. For the purpose of this report, Highway 400, which extends between Toronto and Barrie, is considered to be oriented in a south-north direction with the proposed overhead signs perpendicular to the highway in a generally east-west direction.

2.1 Project Description

As part of the rehabilitation of the pavement on Highway 400 core and collector lanes between Steels Avenue West and Langstaff Road, two existing overhead signs spanning across the Highway 400 northbound lanes and associated off-ramp lanes are proposed to be demolished and replaced with two new simply supported tri-chord overhead signs. The new overhead signs, designated as OS-1 and OS-2, are proposed to be located about 235 m north and about 370 m south of Steeles Avenue West, respectively. The western legs are proposed to be median mounted (i.e., mounted to the top of the median concrete jersey barriers), while the eastern legs are proposed to be ground mounted (i.e., mounted directly to the founding caissons).

2.2 Site Description

The site of the proposed overhead sign OS-1 is located about 370 m south of Steeles Avenue West in the northern limit of City of Toronto, Ontario. Highway 400 at the location of the proposed overhead sign consists of an approximately 4 m high earth fill embankment carrying six southbound lanes, four northbound lanes, and three off-ramp lanes associated with the Highway 400 to Highway 407 S-E/W Ramp. The travelled portion of the highway, including the shoulders, consists of an asphalt surface which is at approximately Elevation 190.5 m in the vicinity of the proposed overhead sign. The embankment side slopes are vegetated with grasses. The highway corridor is surrounded by commercial/industrial units.

The site of the proposed overhead sign OS-2 is located about 235 m north of Steeles Avenue West in the southern limit of City of Vaughan, Ontario. Highway 400 at the location of the proposed overhead sign consists of an approximately 7 m to 8 m high earth fill embankment carrying four southbound lanes, one on-ramp lane associated with the Steeles Avenue West E/W-S Ramp, four northbound lanes, and one off-ramp lane associated with the Highway 400 to Steeles Avenue West S-E/W Ramp. The travelled portion of the highway, including the shoulders, consists of an asphalt surface which is at approximately Elevation 194 m in the vicinity of the proposed overhead sign. While the existing ground surface outside of the Highway 400 corridor varies between approximately Elevation 187 m and Elevation 186 m. The embankment side slopes are vegetated with grasses. The highway corridor is surrounded by open fields inside the loop ramps and commercial/industrial units. A railway corridor extends below the Highway 400 corridor approximately 200 m north of the proposed overhead sign OS-2.

3.0 INVESTIGATION PROCEDURES

The field work at the site was carried out on October 31 and November 1, 2021 during which time a total of two boreholes (designated as Boreholes OHS-1 and OHS-2) were advanced near the proposed overhead sign support structures.

The subsurface conditions encountered in the boreholes are shown in detail on the borehole records in Appendix A. List of abbreviations, terms, and symbols are also provided in Appendix A to assist in the interpretation of the borehole records. The locations of the as-drilled boreholes are shown in plan on Drawing 1.

The boreholes were advanced using a CME-75 truck-mounted drilling rig, supplied and operated by Geo-Environmental Drilling Inc. of Halton Hills, Ontario. The boreholes were advanced using 150 mm outer diameter hollow stem augers. Soil samples were generally obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*). The split-spoon sampler 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. A field vane shear test was carried out in the cohesive fill encountered in Borehole OHS-2 to assess the undrained shear strength (ASTM D2573, *Standard Test Method for Field Vane Shear Strength Test in Cohesive Soil*) using the MTO Standard 'N'-size vane.

Groundwater conditions and water levels in the open boreholes were observed during and immediately following the drilling operations. The boreholes were backfilled with bentonite upon completion of drilling in accordance with Ontario Regulation 903 (*Wells*), as amended. At the surface, the boreholes were backfilled with cold patch to reinstate the pavement.

Prior to commencement of the field work, Golder arranged for the clearance of underground utilities and services. The field work was observed on a full-time basis by a member of Golder's engineering staff, who monitored the borehole drilling, in-situ testing, and soil sampling operations, and logged the borehole in the field. The soil samples were transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual and tactile examination and geotechnical laboratory testing.

Geotechnical index testing (i.e., water content, Atterberg limits and grain size distribution) was carried out on selected soil samples. The results of the laboratory testing are included in Appendix B. All the soil laboratory tests were carried out to MTO Laboratory and/or ASTM Standards, as appropriate.

One soil sample from each borehole was also collected for corrosivity testing. The selected soil samples were submitted, under chain-of-custody procedures, to Bureau Veritas of Mississauga, Ontario (A Standards Council of Canada accredited laboratory) for analysis of corrosivity parameters including, pH, sulphate, sulphide, chloride, and resistivity/conductivity.

The as-drilled borehole locations (in plan) and corresponding ground surface elevations were established on-site by Golder personnel using a Trimble Geo7 GPS unit with a horizontal accuracy of +/- 1 cm to 2 cm and a vertical accuracy of +/- 2 cm to 4 cm. The borehole survey information including, northing/easting coordinates (presented in the MTM NAD83 Zone 10 datum), latitude/longitude coordinates, corresponding ground surface elevations, and borehole depths, are provided on the borehole records in Appendix A and summarized below.

Borehole No.	Coordinates (MTM NAD83 Zone 10)		Ground Surface Elevation	Depth of Borehole
	Northing (Latitude)	Easting (Longitude)		
OHS-1	4,847,717.6 m (43.769421º)	302,077.7 m (-79.533817º)	190.4 m	8.1 m
OHS-2	4,848,311.9 m (43.774771º)	301,971.5 m (-79.535139º)	193.7 m	9.8 m

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The area surrounding the Highway 400 and Steeles Avenue West interchange is within the physiographic region known as the Peel Pain, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984).

The Peel Plain physiographic region covers the central portions of the Regional Municipalities of York, Peel and Halton. The general topography of this region consists of level to gently rolling terrain, sloping gradually southward toward Lake Ontario. A surficial till sheet, which generally follows the surface topography, is present throughout much of this area. The till typically consists of clayey silt to silty clay, with occasional sand to silt zones. Shallow, localized deposits of loose sand and silt and/or soft clay can overlie this uppermost till sheet, and these represent relatively recent deposits, formed in small glacial meltwater ponds scattered throughout the Peel Plain and concentrated near river valleys. The recent sand, silt and clay and uppermost till deposits in this area overlie and are interbedded with stratified deposits of sand, silt and clay.

4.2 Subsurface Conditions

The subsurface soil and groundwater conditions encountered in the boreholes advanced at the sites, together with the results of the in-situ and geotechnical/analytical laboratory testing, are presented on the borehole records in Appendix A and the laboratory figures/reports are presented in Appendices B and C.

The stratigraphic boundaries shown on the borehole records have been inferred from observations of drilling progress, generally non-continuous sampling and in-situ testing, and therefore represent transitions between soil types rather than exact planes of geologic change. Further, subsurface conditions will vary between and beyond the borehole locations.

In general, the subsurface soils encountered at both overhead sign sites consist of asphalt, underlain by granular fill which in turn is underlain by cohesive fill comprised of clayey silt-silt to clayey silt to silty clay with varying proportions of sand and gravel. The fill is then underlain by a cohesive glacial till deposit comprised of clayey silt-silt to clayey silt with varying proportions of sand and gravel. At one site, the cohesive glacial till deposit is underlain by (or transitions with depth into) a deposit of sandy silt till.

The subsurface soils encountered along the Highway 400 corridor between about 300 m north of Sheppard Avenue West and about 450 m north of Steeles Avenue West (at the CNR and Highway 400 site) are generally consistent with those encountered at the aforementioned overhead sign sites. Based on existing MTO GEOCRES information (GEOCRES Nos. 30M13-008, 30M13-010, 30M13-012, 30M13-058, 30M13-060, 30M13-079, 30M13-079, 30M13-080, 30M13-082, 30M13-087, and 30M14-479), the subsurface soils generally consist of cohesive fill (and/or granular fill in places) underlain by a cohesive glacial till deposit. In places, the cohesive glacial till deposit is underlain by or interlayered with a granular deposit typically comprised of sand, some silt.

A more detailed description of the subsurface conditions encountered in the boreholes advanced during the current field investigation is provided in the following sections.

4.2.1 Asphalt

An approximately 305 mm and 254 mm thick layer of asphalt was encountered at the ground surface in Boreholes OHS-1 and OHS-2, respectively, which were advanced on the shoulders of the off-ramps. The top of the asphalt layer was encountered at Elevation 190.4 m and Elevation 193.7 m at the respective borehole locations.

4.2.2 Gravelly SAND (SP) (FILL)

An approximately 1.2 m and 0.6 m thick layer of granular fill comprised of gravelly sand, trace fines was encountered below the asphalt in Boreholes OHS-1 and OHS-2, respectively. The top of the granular fill was encountered at a depth of about 0.3 m below ground surface corresponding to Elevation 190.1 m and Elevation 193.4 m in the respective boreholes. The granular fill extends to depths of about 1.5 m (Elevation 189.0 m) and 0.9 m (Elevation 192.8 m) below ground surface in Boreholes OHS-1 and OHS-2, respectively. Although there was no indication of abandoned underground infrastructure, construction debris, refuse, cobbles/boulders, or other obstructions within the fill, such obstructions may be expected in fills utilized to construct the Highway 400 corridor.

The SPT ‘N’-values measured within the granular fill were 46 blows and 47 blows per 0.3 m of penetration, indicating a dense state of compactness.

The water contents measured on four samples recovered from the gravelly sand fill range between about 3% and 7%.

4.2.3 CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT (CL) to SILTY CLAY (CI) (FILL)

An approximately 2.2 m to 6.3 m thick layer of cohesive fill was encountered below the gravelly sand fill in Boreholes OHS-1 and OHS-2, respectively. The cohesive fill consists of clayey silt-silt to clayey silt to silty clay to clayey silt, with varying proportions of sand and gravel. The cohesive fill was encountered at depths of about 1.5 m (Elevation 189.0 m) and 0.9 m (Elevation 192.8 m) below ground surface, and extends to depths of about 3.7 m (Elevation 186.7 m) and 7.2 m (Elevation 186.5 m) below ground surface in Boreholes OHS-1 and OHS-2, respectively. Although there was no indication of abandoned underground infrastructure, construction debris, refuse, cobbles/boulders, or other obstructions within the fill, such obstructions may be expected in fills utilized to construct the Highway 400 corridor.

The SPT ‘N’-values measured within the cohesive fill range from 5 blows to 17 blows per 0.3 m of penetration, suggesting a firm to very stiff consistency. An in-situ vane test was carried out within the cohesive fill in Borehole OHS-2 (between samples with SPT ‘N’-values of 5 and 7 blows per 0.3 m of penetration) measured an undrained shear strength greater than 96 kPa.

Grain size distribution testing was carried out on three samples of the cohesive fill, and the results are presented on Figure B1 in Appendix B. Atterberg limit testing was carried out on three samples of the cohesive fill. The tests measured liquid limits between about 27% and 30%, plastic limits between about 15% and 16%, and plasticity indices between about 12% and 14%. The results of these Atterberg limit tests are presented on Figure B2 in Appendix B, and indicate that the cohesive fill is classified as a clayey silt-silt to clayey silt of low plasticity to silty clay of intermediate plasticity. The water contents measured on samples of the cohesive fill generally range from about 8% to 21%. The water content measured on a sample of the silty clay fill recovered from Borehole OHS-2 is about 60%.

4.2.4 CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT (CL) (TILL)

A cohesive glacial till deposit comprised of clayey silt-silt to clayey silt, some sand to sandy, trace gravel was encountered below the cohesive fill in Boreholes OHS-1 and OHS-2 at depths of about 3.7 m (Elevation 186.7 m) and 7.2 m (Elevation 186.5 m) below ground surface, respectively. In Borehole OHS-1, the cohesive till deposit is approximately 3.5 m thick and extends to a depth of about 7.2 m below ground surface corresponding to Elevation 183.2 m. Borehole OHS-2 was terminated within the cohesive till deposit at a depth of about 9.8 m below ground surface corresponding to Elevation 184.0 m. Although there was no indication of cobbles and/or boulders within the cohesive till deposit during drilling, glacial till deposits in southern Ontario typically contain such obstructions, which should be expected within such glacial deposits.

The SPT ‘N’-values measured within the upper portion of the cohesive till deposit range from 8 blows to 18 blows per 0.3 m of penetration, indicating a stiff to very stiff consistency. A SPT ‘N’-value measured at the bottom of the cohesive till deposit in Borehole OHS-1 was 93 blows per 0.3 m of penetration, suggesting a hard consistency.

Grain size distribution testing was carried out on two samples of the clayey silt-silt to clayey silt till deposit, and the results are presented on Figure B3 in Appendix B. Atterberg limit testing was also carried out on two samples of the cohesive till deposit. The tests measured liquid limits of about 17% and 21%, plastic limits of about 11% and 13%, and corresponding plasticity indices of about 5% and 8%. The Atterberg limit test results are presented on Figure B4 in Appendix B and indicate that the materials are clayey silt to clayey silt-silt to clayey silt of low plasticity. The water content measured on samples of the cohesive till deposit range between about 9% and 24%.

4.2.5 Sandy SILT (ML) (TILL)

A granular till deposit comprised of sandy silt of slight plasticity, trace gravel, was encountered below the cohesive till deposit in Borehole OHS-1. The deposit was encountered at a depth of about 7.2 m below ground surface corresponding to Elevation 183.2 m. The borehole was terminated within the sandy silt till deposit at a depth of about 8.1 m below ground surface corresponding to Elevation 182.3 m. Although there was no indication of cobbles and/or boulders within the sandy silt till deposit during drilling, glacial till deposits in southern Ontario typically contain such obstructions, which should be expected within such glacial deposits.

An SPT ‘N’-value measured within the sandy silt till deposit was 101 blows per 0.3 m of penetration, indicating a very dense state of compactness.

Grain size distribution testing was carried out on a sample of the sandy silt till deposit, and the results are presented on Figure B5 in Appendix B. Atterberg limit testing was carried out on a sample of the fine-grained portion of the till deposit and the results are presented on Figure B6 in Appendix B. The Atterberg limit testing measured a liquid limit of about 15%, a plastic limit of about 13%, and a corresponding plasticity index of about 2%. The results indicate that the material is classified as a silt of slight plasticity. The water content measured on a sample of the sandy silt till deposit is about 15%.

4.3 Groundwater Conditions

In general, the soil samples recovered the boreholes were moist. The groundwater levels were measured in open boreholes upon completion of drilling operations. At the location of Borehole OHS-1, the borehole caved to a depth of about 6.7 m below ground surface (Elevation 183.7 m) upon completion of drilling and the groundwater level was observed at a depth of about 6.1 m below ground surface, corresponding to Elevation 184.3 m. At the location of Borehole OHS-2, the borehole caved to a depth of about 8.7 m below ground surface (Elevation 185.0 m) upon completion of drilling and the open borehole was dry above the caved depth. These water level measurements do not necessarily represent the stabilized groundwater conditions at the site. Based on the colour transition from brown to grey, it is anticipated that the groundwater level in the vicinity of Borehole OHS-1 is at approximately Elevation 186 m, while that in the vicinity of borehole OHS-2 is at approximately Elevation 184.5 m to 185 m.

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

4.4 Analytical Testing

Two soils samples, one from each borehole, were collected and submitted to Bureau Veritas in Mississauga, Ontario for analysis of parameters used to assess corrosion potential and sulphate attack. A summary of the results is presented in the following table. The Certificate of Analysis is provided in Appendix C.

Borehole No.	Sample No.	Average Approximate Sample Depth (Elevation) (m)	Soil Type	Parameters				
				Chloride (µg/g)	Sulphate (µg/g)	pH	Conductivity (µohm/cm)	Resistivity (ohm-cm)
OHS-1	6	4.1 (186.3)	Clayey Silt (Till)	1,100	87	7.68	1,980	510
OHS-2	5	3.4 (190.4)	Clayey Silt (Fill)	300	<20	7.77	671	1,500

Note:
1. The sulphate concentration measured on the soil sample recovered from Borehole OHS-2 is below the reportable detection limit of 20 µg/g.

The sulphide concentration measured on the soil samples recovered from Boreholes OHS-1 and OHS-2 was also analyzed and is 3.7 mg/kg.

5.0 CLOSURE

This Foundation Investigation Report was prepared by Mr. Bryan Lui, E.I.T., and reviewed by Mr. Tomasz Zalucki, P.Eng., a senior geotechnical engineer with Golder who is RAQS certified in the Foundations Engineering Category – Geotechnical (Structures and Embankments) – Low Complexity. Ms. Lisa Coyne, P.Eng., a Principal and MTO Foundations Designated Contact with Golder conducted an independent technical and quality review of this report.

Signature Page

Golder Associates Ltd.

Bryan Lui, E.I.T.
Geotechnical Engineer-in-Training

Tomasz Zalucki, P.Eng.
Senior Geotechnical Engineer

Lisa Coyne, P.Eng.
Principal, MTO Foundations Designated Contact

BL/TZ/LCC/bl/ml

https://golderassociates.sharepoint.com/sites/102477/deliverables/foundations/final fidr/19115306-rpt-rev0-hwy 400-overhead signs-fidr-20220104.docx

PART B

FOUNDATION DESIGN REPORT
OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 400 – STEELES AVENUE WEST TO LANGSTAFF ROAD
CITY OF TORONTO AND CITY OF VAUGHAN, ONTARIO
GWP 2324-16-00

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

This section of the report provides detail foundation recommendations for the design of two overhead sign support structures along Highway 400 near Steeles Avenue West in the City of Toronto and City of Vaughan, Ontario. These recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the current subsurface field investigation in the vicinity of each sign support.

The design report with the interpretation and recommendations is intended for the use of MTO and its designers, to provide the designers with sufficient information to carry out detail design of the OHS support structure foundations and shall not be used or relied upon for any other purpose or by any other parties, including the constructor or design-build contractor.

Contractors must make their own interpretation based on the factual data in the Foundation Investigation Report (i.e., Part A of this report). Where comments are made on construction, they are provided to highlight those aspects that could affect the design on the project, and for which special provisions may be required in the Contract Documents. Contractors 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

As part of the rehabilitation of the pavement on Highway 400 core and collector lanes between Steeles Avenue West and Langstaff Road, two existing overhead signs spanning across the Highway 400 northbound lanes and associated off-ramp lanes are proposed to be demolished and replaced with two new Tri-Chord overhead signs (refer to Figures 1 and 2).

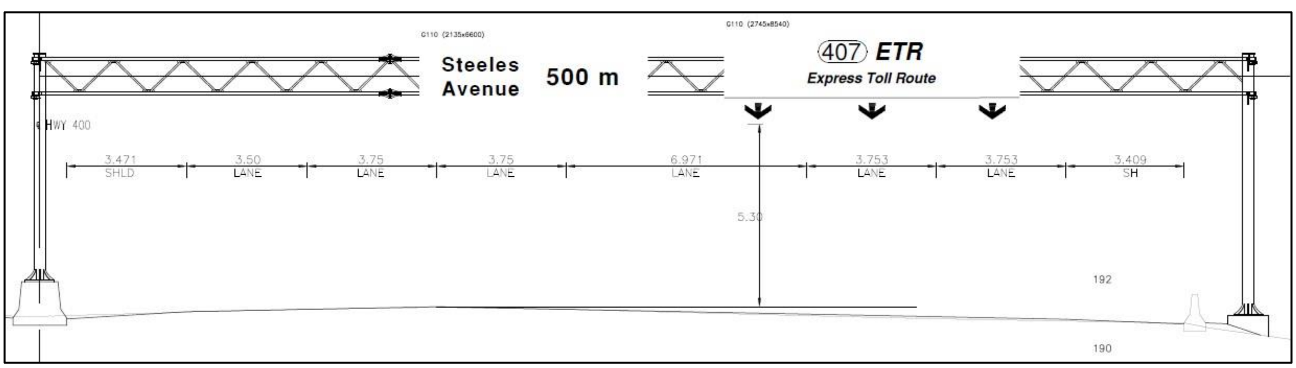


Figure 1: OS-1, south of Steeles Avenue West (courtesy Morrison Hershfield, provided to Golder on September 10, 2021)

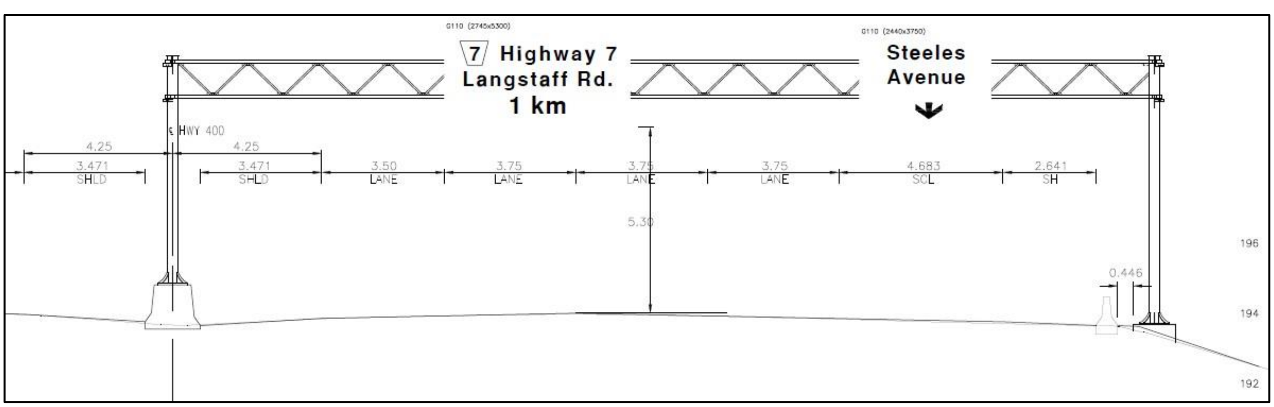


Figure 2: OS-2, north of Steeles Avenue West (courtesy Morrison Hershfield, provided to Golder on September 10, 2021)

The new overhead signs, designated as OS-1 and OS-2, are proposed to be located about 235 m north and about 370 m south of Steeles Avenue West, respectively. The western legs are proposed to be median mounted (i.e., mounted to the top of the median concrete jersey barriers), while the eastern legs are proposed to be ground mounted (i.e., mounted directly to the founding caissons).

6.2 Standard Design of Static Sign Support Foundations

As noted in Section 6.1 and confirmed by Morrison Hershfield, the western legs of the simply supported Tri-Chord Type I overhead signs are proposed to be mounted to the median concrete jersey barriers (i.e., at the centre of Highway 400) in accordance with OPSD 911.383 (*Guide Rail System, Concrete Barrier Permanent Transition Installation at Lighting Pole and Sign Support Footings*). The eastern sign supports are proposed to be ground mounted and supported on caissons constructed behind the concrete jersey barriers located at the eastern edge of the paved shoulders.

Caissons foundations for sign supports should be designed in accordance with the requirements provided in MTO's *Sign Support Manual (*MTO, 2019). The *Sign Support Manual* includes standard caisson foundation designs for simply supported Tri-Chord overhead signs. Refer to Section 4 (Tri-Chord Static Sign Supports) and Standard Drawings SS118-3, SS118-4 and SS118-5.

In the standard caisson foundation design for Tri-Chord Type I overhead signs, the caisson is extended at least 5 m below the design frost depth, which for this site is 1.4 m as interpreted from OPSD 3090.101 (*Foundation Frost Penetration Depths for Southern Ontario*), resulting in a total caisson length of at least 6.4 m below the final grade. The standard sign foundation designs presented in MTO's *Sign Support Manual* have been developed based on soil conditions and soil parameters given below.

- **Case 1 (Sand/Granular Soils):** Sand with a friction angle of 28 degrees surrounding the upper two-thirds of the portion of the caisson foundation below the frost depth, and sand with a friction angle of 30 degrees surrounding the lower third portion of the caisson below the frost depth.
- **Case 2 (Soft Clay/Cohesive Soils):** Soft clay with an undrained shear strength of 25 kPa surrounding the upper two-thirds of the portion of the caisson foundation below the frost depth, and "soft" clay with an undrained shear strength of 50 kPa surrounding the lower third of the portion of the caisson below the design frost depth.

The standard foundation design provided in MTO's *Sign Support Manual* does not apply to sites where extensive poor fill or materials looser or softer than those of Case 1 or Case 2 are present. For such subsurface conditions, a site-specific design is required. However, based on a review of the subsurface conditions in the vicinity of the proposed overhead sign supports, the footings for the overhead signs can be carried out using the standard foundation design as outlined in MTO's *Sign Support Manual*.

However, if the sign boards are larger than the standards included in the *Sign Support Manual*, a site-specific caisson foundation design can be carried out by the structural engineer to optimize the standard foundation design as outlined in Section 6.3.

6.3 Site-Specific Design of Static Sign Support Foundations

A site-specific caisson foundation design can be carried out by the structural designer using the equations provided below to calculate the unfactored passive lateral earth pressure P_p (kPa), distributed along the length of the caisson, based on the idealized stratigraphy and geotechnical parameters provided in Table 1 following the text of this report. The geotechnical parameters presented in Table 1 were estimated based on field and laboratory test data as well as empirical correlations (NAVFAC, 1986, Bowles, 1984 and Kulhawy and Mayne, 1990). The estimated parameters were adjusted using engineering judgement based on precedent experience in similar soil conditions.

The passive lateral earth pressure in granular soils (assuming triangular distribution along the length of the caisson) can be calculated as follows:

$P_p = K_p \cdot \gamma \cdot d$ (kPa) - above the groundwater table

$P_p = K_p \cdot \gamma \cdot d_w + K_p \cdot \gamma' \cdot (d - d_w)$ (kPa) - below the groundwater table

Where,

$K_p =$ passive lateral earth pressure coefficient

$\gamma =$ bulk unit weight (kN/m^3)

$\gamma' =$ effective unit weight below the groundwater level (kN/m^3)

$d =$ depth below the ground surface (m)

$d_w =$ depth of groundwater level (m)

The passive lateral earth pressure in cohesive soils (assuming rectangular distribution along the length of the caisson can be calculated as follows:

$P_p = 2 \cdot s_u$ (kPa)

Where,

$s_u =$ undrained shear strength (kPa)

In calculating the ultimate passive lateral resistance, it should be assumed that the lateral resistance acts over a width equal to two times the caisson diameter (i.e., the “effective” or “adjusted” pile width).

In the design of the sign support foundations, the passive resistance within the upper 1.4 m below ground surface should be neglected to account for frost action.

A consequence factor (Ψ) of 1.0 and a geotechnical resistance factor of 0.5 (assuming a “typical” consequence level and a “typical” degree of site understanding as outlined in the 2019 *Canadian Highway Bridge Design Code and its Commentary* (CHBDC, 2019) should be applied to this unfactored lateral resistance to obtain the factored ultimate lateral geotechnical resistance.

6.4 Caisson Installation and Construction Considerations

The footing foundations/caissons for the sign support structures should be constructed in accordance with OPSS.PROV 903 (*Deep Foundations*) as referenced in OPSS.PROV 915 (*Sign Support Structures*).

6.4.1 Control of Soil and Groundwater

In Borehole OHS-1 (advanced near the proposed OS-1), the groundwater level was measured at a depth of about 6.1 m below ground surface (Elevation 184.3 m) after the open borehole caved to a depth of about 6.7 m below ground surface (Elevation 183.7 m) upon removal of augers. In Borehole OHS-2 (advanced near the proposed OS-2), the open borehole was noted to be dry after the borehole caved to a depth of about 8.7 m below ground surface (Elevation 185.0 m). However, the stabilized groundwater levels are expected to be higher, especially during periods of heavy or sustained precipitation.

The majority of the fills and soils encountered near the proposed overhead signs have been classified as cohesive; however, some soil samples recovered during the field investigation comprised a significant portion of coarse-grained soils. Furthermore, the fills and the cohesive glacial till deposits may be interlayered with seams/pockets/layers of granular soils which may be water-bearing. Consequently, the water-bearing soils may flow and the dry soils may slough into unsupported auger holes during caisson installation. Therefore, appropriate equipment and procedures will be required to minimize ground loss during drilling and concrete placement. This could include the use of temporary caisson liners and/or the use of drilling mud. A Non-Standard Special Provision (NSSP) should be included in the Contract Documents to warn the Contractor of these conditions. An example of the NSSP is provided in Appendix D.

Consistent with good practice, surface water should be directed away from the caisson excavations during construction. However, the risks associated with surface water are considered very low based on the foundation locations, and given that these single caissons will be drilled and reinforcing steel/concrete placed relatively quickly, that any entry of surface water to the caisson would only affect the base and not the sides (as the predominant loading condition is lateral), and given that the above-noted NSSP requires use of a temporary liner and tremie placement of concrete where wet conditions are encountered in the borehole.

6.4.2 Obstructions

Abandoned underground infrastructure, construction debris, refuse, cobbles/boulders, or other obstructions should be anticipated within the fill, while cobbles and/or boulders should be anticipated within the glacial till deposits when advancing caissons though the fill and the glacial till deposits. Construction equipment, such as caisson drill rigs, must be capable of handling these obstructions during construction of the caissons. An NSSP should be included in the Contract Documents to warn the Contractor of the presence of these potential obstructions within the fill and glacial till deposits. An example of the NSSP is provided in Appendix D. Note that the extent and depth of the potential obstructions may vary between and beyond the boreholes.

6.5 Analytical Testing of Construction Materials

The results of analytical testing carried out on two soil samples (one soil sample recovered from each borehole advanced in the vicinity of the proposed overhead sign support structures) are summarized in Section 4.4 and presented on the *Certificate of Analysis* in Appendix C.

The analytical test results were compared to CSA A23.1 Table 3 (*Additional requirements for concrete subjected to sulphate attack*) to assess the potential severity of sulphate attack on the concrete caissons during its service life. The sulphate concentrations measured on the soil samples were less than 0.002% and 0.0087%, which is below the moderate degree of exposure (i.e., below the class S-3 exposure limits); suggesting that the effects of sulphates from the cohesive fill and cohesive till deposits in contact with the concrete caissons may not need to be considered. However, given that the proposed structure will be exposed to de-icing salt or other solutions, consideration should be given by the designer to design the concrete caissons for a “C” type exposure class as defined by CSA A23.1 Table 1.

The pH levels and resistivity analytical test results of the soil samples were also compared to the *MTO Gravity Pipe Design Guidelines* (MTO, 2014) to assess the relative level of corrosion potential on any buried steel elements in contact with the fill/soil. The pH levels measured on the soil samples were about 7.7 and 7.8, suggesting the cohesive fill and cohesive till deposits are basic (i.e., pH greater than 7). These pH levels are not considered detrimental to steel durability given that the pH levels are less than 8.5. The resistivity (R) measured on the two soil samples were about 510 ohm-cm and 1,500 ohm-cm, suggesting that the soil corrosiveness is “severe” ($R < 2,000$ ohm-cm) as per Table 3.2 of the *MTO Gravity Pipe Design Guideline* (2014). Consequently, some level of corrosion protection or sacrificial thickness of steel should be applied to any steel foundation elements in contact with the fill/soil.

Ultimately, it is the designer's decision to determine the appropriate exposure class and to ensure that all aspects of CSA A23.1 Section 4.1.1 (*Durability Requirements*) are satisfied.

7.0 CLOSURE

This Foundation Design Report was prepared by Mr. Bryan Lui, E.I.T., and reviewed by Mr. Tomasz Zalucki, P.Eng., a senior geotechnical engineer with Golder who is RAQS certified in the Foundations Engineering Category – Geotechnical (Structures and Embankments) – Low Complexity. Ms. Lisa Coyne, P.Eng., a Principal and MTO Foundations Designated Contact with Golder conducted an independent technical and quality review of this report.

Signature Page

Golder Associates Ltd.

Bryan Lui, E.I.T.
Geotechnical Engineer-in-Training

Tomasz Zalucki, P.Eng.
Senior Geotechnical Engineer

Lisa Coyne, P.Eng.
Principal, MTO Foundations Designated Contact

BL/TZ/LCC/bl/ml

https://golderassociates.sharepoint.com/sites/102477/deliverables/foundations/final fidr/19115306-rpt-rev0-hwy 400-overhead signs-fidr-20220104.docx

REFERENCES

Bowles, J.E., 1984. *Physical and Geotechnical Properties of Soils,* Second Edition. McGraw Hill Book Company, New York.

Canadian Standards Association (CSA). 2019. *Canadian Highway Bridge Design Code* and *Commentary on CAN/CSA S6-19*. CSA Special Publication, S6.1-19.

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.

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

Ministry of Transportation, Ontario. 2014. *MTO Gravity Pipe Design Guidelines – Circular Culverts and Stormsewers*. Prepared by the Drainage and Hydrology Design and Contract Standards Office.

Ministry of Transportation, Ontario. 2019. *Sign Support Manual*. Provincial Highways Management Division, Highway Standards Branch, Bridge Office.

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

ASTM International:

ATSM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

ASTM D2573 Standard Test Method for Field Vane Shear Strength Test in Cohesive Soil

Ontario Occupational Health and Safety Act:

Ontario Regulation 903 Wells (as amended)

Ontario Provincial Standard Specifications (OPSS)

OPSS.PROV 903 Construction Specification for Deep Foundations

OPSS.PROV 915 Construction Specification for Sign Support Structures

Ontario Provincial Standard Drawings (OPSD)

OPSD 3090.101 Foundation, Frost Penetration Depths for Southern Ontario

TABLES

Table 1: Geotechnical Design Parameters for Overhead Sign Support Foundations

Borehole No.	Approximate Overhead Sign Support Location	Overhead Sign Support Structure Designation	Fill / Soil Stratum	Depth [1] (m)	Elevation [1] (m)	Design Groundwater Elevation [2] (m)	Design Parameters [3]				
							S_u (kPa)	φ' (°)	γ (kN/m³)	γ' (kN/m³)	K_p [4, 5]
OHS-1	Highway 400 NBL / Highway 400 to Highway 407 S-E/W Ramp (30 m south of existing overhead sign)	OS-1	Dense Gravelly Sand (FILL)	0.3 – 1.5	190.1 – 189.0	186 m	--	35	21	11	3.7
			Stiff to Very Stiff Clayey Silt-Silt to Clayey Silt (FILL)	1.5 – 3.7	189.0 – 186.7		75	29	21	11	2.9
			Very Stiff to Hard Clayey Silt-Silt to Clayey Silt (TILL)	3.7- 7.2	186.7 – 183.2		100	30	21	11	3.0
			Very Dense Sandy Silt (TILL)	7.2 – 8.1	183.2 – 182.3		--	36	21	11	3.9
OHS-2	Highway 400 NBL / Highway 400 to Steeles Ave. W. S-E/W Ramp (5 m south of existing overhead sign)	OS-2	Dense Gravelly Sand (FILL)	0.3 – 0.9	193.4 – 192.8	185 m	--	35	21	11	3.7
			Firm to Stiff Clayey Silt to Silty Clay (FILL)	0.9 – 7.2	192.8 – 186.5		50	28	21	11	2.8
			Stiff Clayey Silt-Silt to Clayey Silt (TILL)	7.2 – 9.8	186.5 – 184.0		50	30	21	11	3.0

Notes:

1. Depths are given at the as-drilled borehole locations and not at the proposed sign support locations. Consequently, the elevations should be utilized for design purposes to establish the stratigraphic model at each sign support.
2. Groundwater elevations are based on field observations during the investigation, including the soil colour transition from brown to grey.
3. Design parameters are given for the full depth of the fill/soil, however, the passive resistance in the upper 1.4 m should be neglected to account for frost action. The design parameters are as follows:

   s_u = undrained shear strength (kPa)
   φ' = effective friction angle (degrees)
   γ = bulk unit weight (kN/m^3)
   γ' = effective unit weight below the groundwater level (kN/m^3)
   K_p = passive lateral earth pressure coefficient

4. For cohesive fills/soils, an assessment for the effective stress, drained (φ') and total stress, undrained (s_u) cases should be made to establish the more conservative earth pressure condition for design purposes.
5. The total passive resistance may be calculated based on the values of K_p indicated above but reduced by an approximate factor that considers the allowable movement of the caisson in accordance with Figure C6.27 of the *Canadian Highway Bridge Design Code* (CHBDC, 2019) to account for the fact that a large strain would be required for mobilization of the full passive resistance.

DRAWINGS

MINISTRY OF TRANSPORTATION, ONTARIO

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

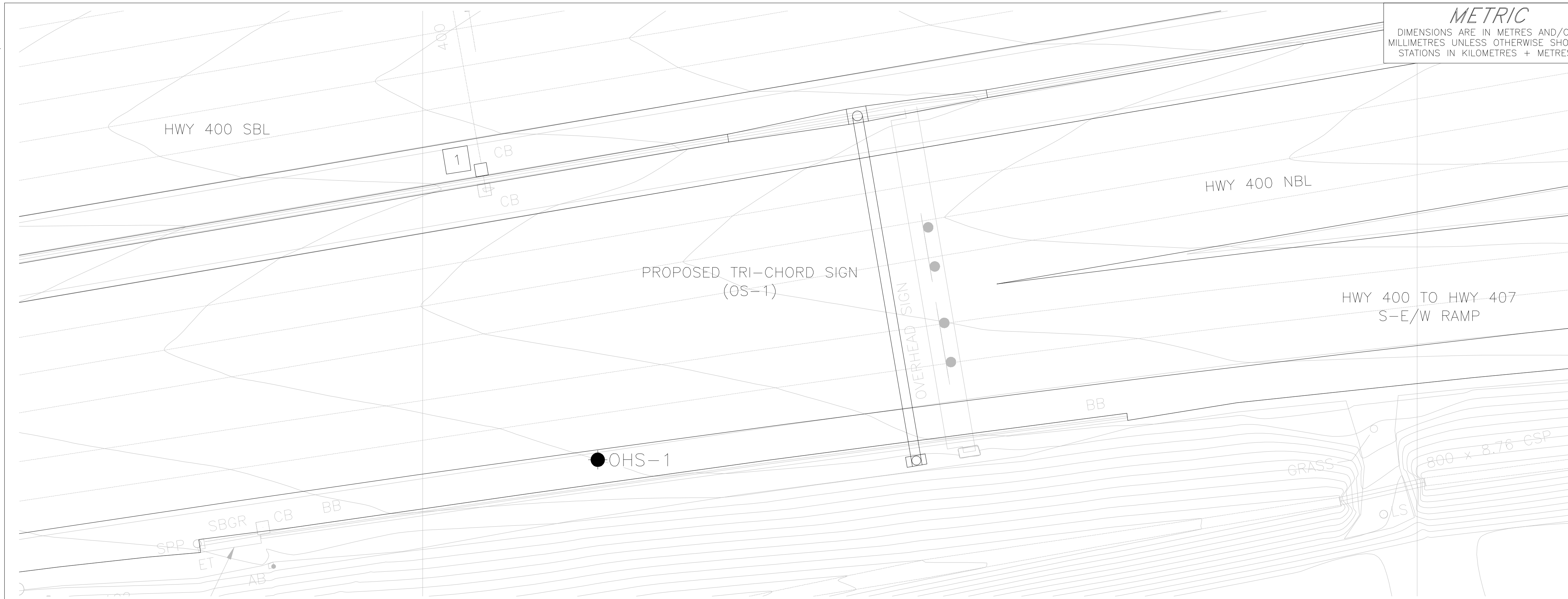
CONT No.
GWP No. 2324-16-00

SHEET

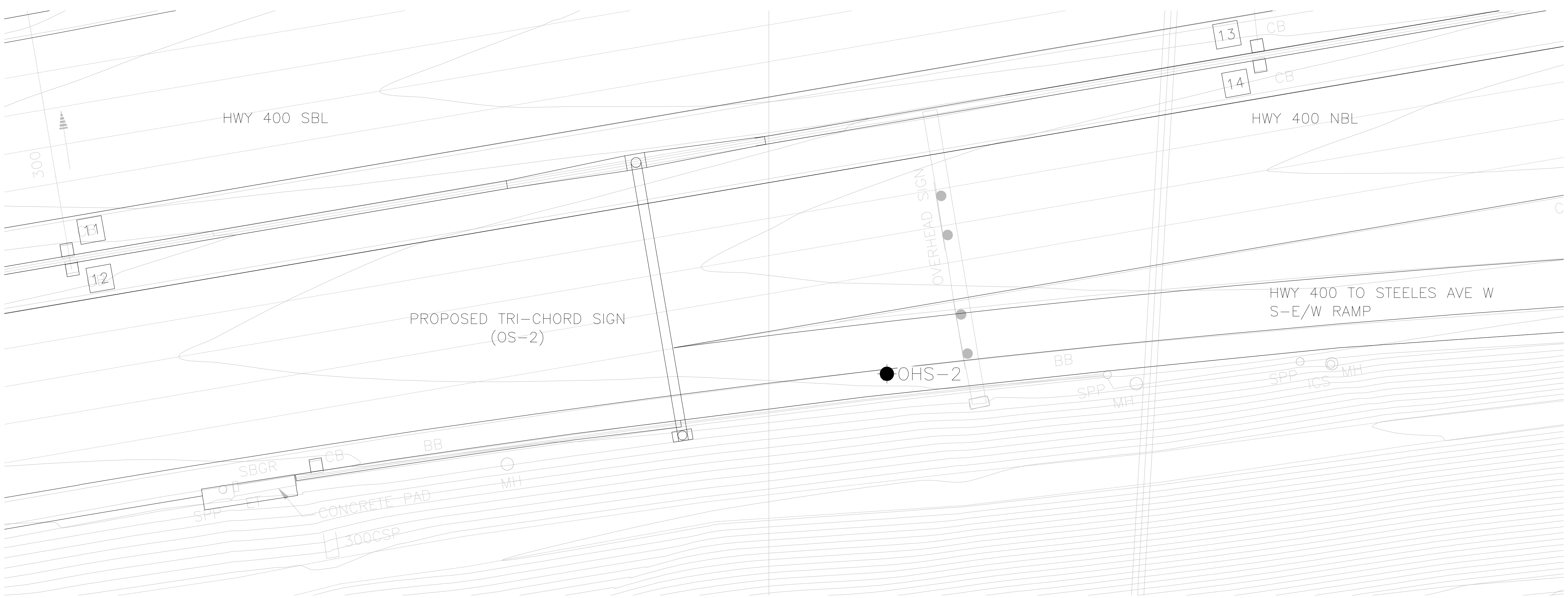
HIGHWAY 400
OVERHEAD SIGN SUPPORT STRUCTURES

BOREHOLE LOCATION PLAN

GOLDER
MEMBER OF WSP



PLAN
SCALE
5 0 5 10 m



PLAN
SCALE
5 0 5 10 m

KEY PLAN
SCALE
1.5 0 1.5 3 km

LEGEND

● Borehole – Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE10)			
No.	ELEVATION	NORTHING	EASTING
OHS-1	190.4	4847717.6	302077.7
OHS-2	193.7	4848311.9	301971.5

OS-1 SITE COORDINATES: Lon. -79.533934, Lat. 43.769674
OS-2 SITE COORDINATES: Lon. -79.535243, Lat. 43.774545

LICENSED PROFESSIONAL ENGINEER
L.C. COYNE
Jan. 04, 2022
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
T.ZALUCKI
100128614
Jan. 4, 2022
PROVINCE OF ONTARIO

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 plans provided in digital format by MH, drawing file nos. x190131000_Baseplan.dwg , dated September 10, 2021, Contours provided in digital format by MH, drawing file nos.x190131000_ExContours.dwg, dated September 10, 2021, Utilities provided in digital format by MH, drawing file nos. x190131000_ExUtilities.dwg , dated September 10, 2021 and Design provided in digital format by MH, drawing file nos. X1901310_NC.dwg , dated September 10, 2021.

NO.	DATE	BY	REVISION

Geocres No. 30M13-328

HWY. 400		PROJECT NO. 19115306	DIST.
SUBM'D. BL	CHKD. BL	DATE: 1/4/2022	SITE:
DRAWN: SA	CHKD. TZ	APPD. LCC	DWG. 1

PLOT DATE: January 4, 2022
FILENAME: S:\Clients\MTO\Hwy_400_Steeles_to_Langstaff\99_PROJ\19115306_MH\40_PROD\0001_OHS_Support_Structure\19115306-0001-BC-0001.dwg

APPENDIX A

Records of Borehole Sheets

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 cm^2 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, Gs)
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)
γ	unit weight

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

COARSE-GRAINED SOILS

Compactness[1]

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

1. 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 grainsize. 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.
2. 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.

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
υ	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 $\gamma = \rho \cdot g$ (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
$C_{\alpha(e)}$	secondary compression index
C_α	rate of secondary compression
$C_{\alpha(\varepsilon)}$	modified 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
c'	effective cohesion
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
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 or 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. $\tau = c' + \sigma' \tan \phi'$
2. shear strength = (compressive strength)/2

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No OHS-1

SHEET 1 OF 1 **METRIC**

PROJECT 19115306
G.W.P. 2324-16-00
DIST Central HWY 400
DATUM Geodetic
LOCATION N 4847717.6; E 302077.7 MTM NAD 83 ZONE 10 (LAT. 43.769421; LONG. -79.533817)
BOREHOLE TYPE 150 mm O.D. Continuous Flight Hollow Stem Augers
DATE October 31, 2021
ORIGINATED BY AM
COMPILED BY BL
CHECKED BY TZ

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
190.4	GROUND SURFACE								
0.0	ASPHALT (305 mm)	1	GS	-					
190.1 / 0.3	Gravelly SAND (SP), trace fines (FILL) Dense Brown Moist	2	SS	46					
189.0 / 1.5	CLAYEY SILT-SILT (CL-ML), some sand to sandy, trace gravel to CLAYEY SILT (CL), some sand to sandy, trace gravel (FILL) Stiff to very stiff Brown Moist	3	SS	17					
		4	SS	13		5	34	40	21
		5	SS	15					
186.7 / 3.7	CLAYEY SILT-SILT (CL-ML), some sand to sandy, trace gravel to CLAYEY SILT (CL), some sand to sandy, trace gravel (TILL) Very stiff to hard Brown to grey Moist - Grey below a depth of about 4.6 m (Elev. 185.8 m)	6	SS	16	CHEM				
		7	SS	18					
		8	SS	93		1	28	57	14
183.2 / 7.2	Sandy SILT of slight plasticity (ML), trace gravel (TILL) Very dense Brown Moist	9	SS	101		3	30	64	3
182.3 / 8.1	END OF BOREHOLE								

Ground water conditions: water level symbol (∇) at about Elev. 184.3 m.

Elevation scale: 190, 189, 188, 187, 186, 185, 184, 183

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × REMOULDED: 20 40 60 80 100
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L
WATER CONTENT (%): 10 20 30
REMARKS & GRAIN SIZE DISTRIBUTION (%)

NOTES:

1. Borehole caved to a depth of about 6.7 m (Elev. 183.7 m) upon completion of drilling.

2. Groundwater measured in open borehole at a depth of about 6.1 m (Elev. 184.3 m) upon completion of drilling.

$+^3, \times^3$: Numbers refer to Sensitivity $O^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS-2

SHEET 1 OF 1 **METRIC**

PROJECT 19115306

G.W.P. 2324-16-00

LOCATION N 4848311.9; E 301971.5 MTM NAD 83 ZONE 10 (LAT. 43.774771; LONG. -79.535139)

ORIGINATED BY AM

DIST Central HWY 400

BOREHOLE TYPE 150 mm O.D. Continuous Flight Hollow Stem Augers

COMPILED BY BL

DATUM Geodetic

DATE November 1, 2021

CHECKED BY TZ

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa	WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
193.7	GROUND SURFACE							
0.0	ASPHALT (254 mm)							
0.3	Gravelly SAND (SP), trace fines (FILL) Dense Brown Moist	1	SS	47				
192.8 / 0.9	CLAYEY SILT (CL), some sand to sandy, trace gravel to SILTY CLAY (CI), some sand, trace gravel (FILL) Firm to stiff Brown Moist	2A / 2B	SS	9				
		3	SS	11				1 26 42 31
		4	SS	9				
		5	SS	5				CHEM
					>95.7 +			
		6	SS	7		40; 59.6		5 15 38 42
		7	SS	13				
186.5 / 7.2	CLAYEY SILT-SILT (CL-ML), some sand to sandy, trace gravel to CLAYEY SILT (CL), some sand to sandy, trace gravel (TILL) Stiff Brown to grey Moist	8	SS	8				
	- Grey below a depth of about 9.2 m (Elev. 184.5 m)	9	SS	12				4 31 43 22
184.0 / 9.8	END OF BOREHOLE							

NOTES:

1. Borehole caved to a depth of about 8.7 m (Elev. 185.0 m) upon completion of drilling.

2. Borehole dry above the caved depth upon completion of drilling.

Elevation scale: 193, 192, 191, 190, 189, 188, 187, 186, 185, 184

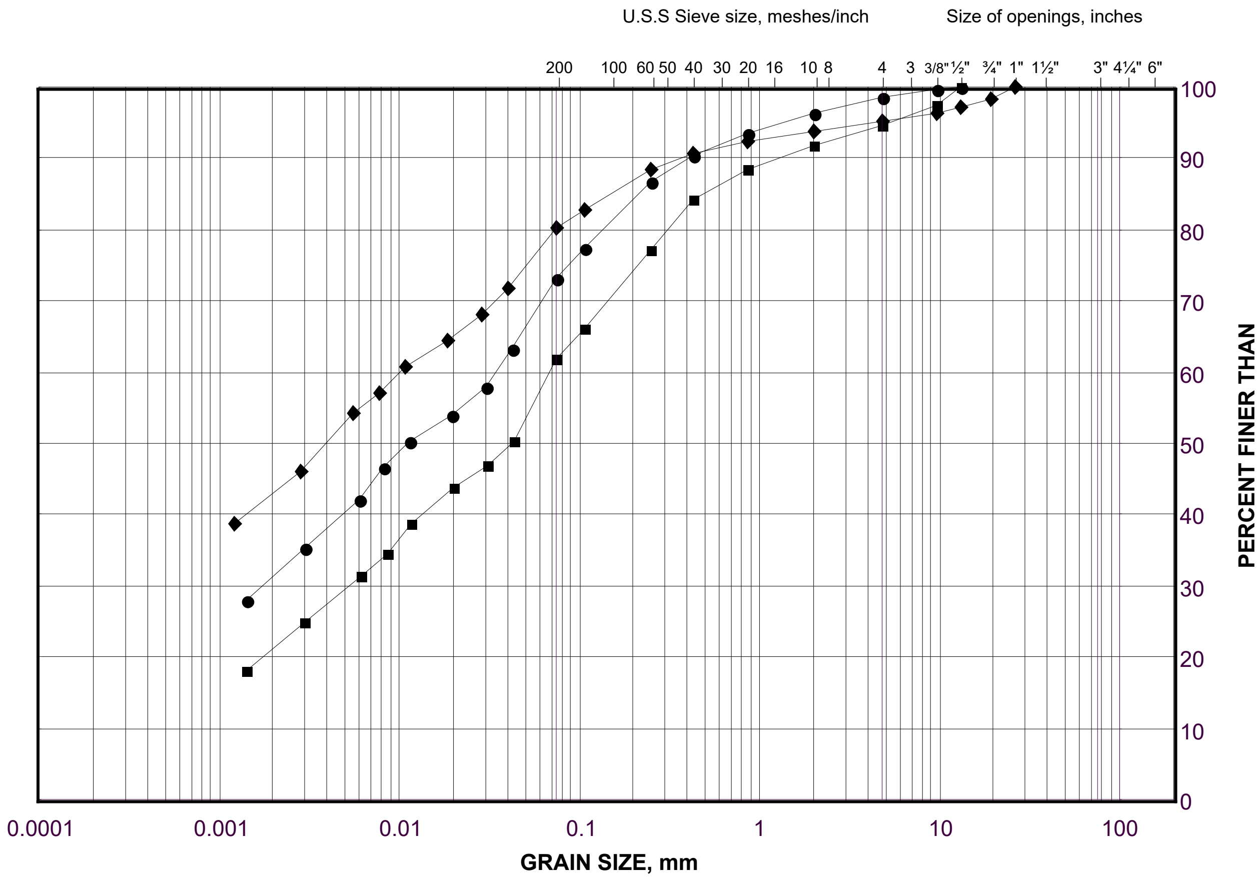
Dynamic cone penetration resistance plot: 20 40 60 80 100. Shear strength kPa: ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × REMOULDED; 20 40 60 80 100. Plastic limit W_P, natural moisture content W, liquid limit W_L; water content (%) 10 20 30.

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

APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION Sandy CLAYEY SILT (CL) to SILTY CLAY (CI) (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)
●	OHS-2	3	191.9
■	OHS-1	4	187.8
◆	OSH-2	6	188.8

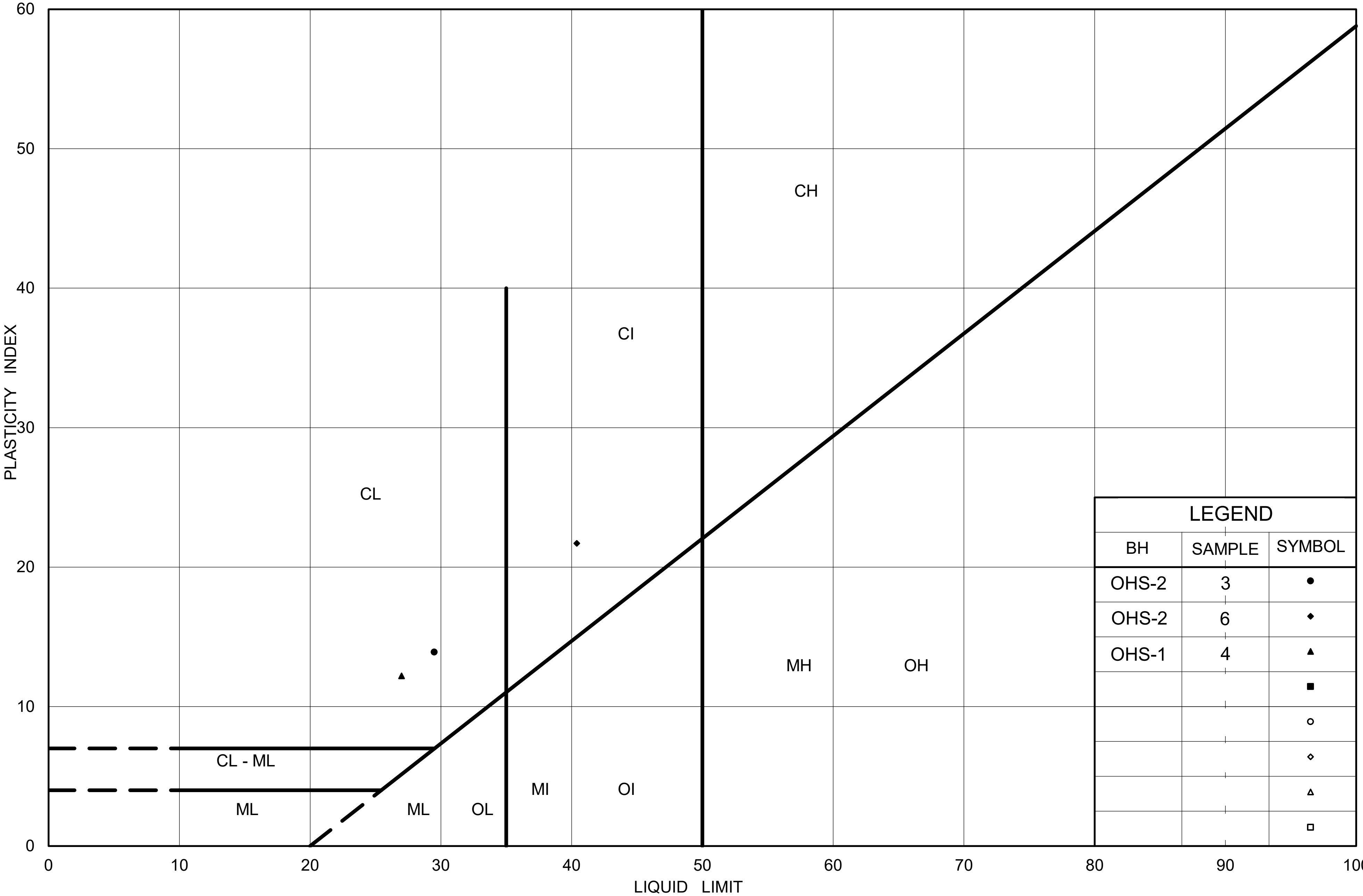
Project Number: 19115306

Checked By: TZ

Golder Associates

Date: 17-Dec-21

Oct 75, FF-S-21



LEGEND		
BH	SAMPLE	SYMBOL
OHS-2	3	●
OHS-2	6	◆
OHS-1	4	▲
		■
		○
		◇
		△
		□

Ministry of Transportation

Ontario

PLASTICITY CHART
Sandy CLAYEY SILT (CL) to SILTY CLAY (CI) (FILL)

Figure No. B2

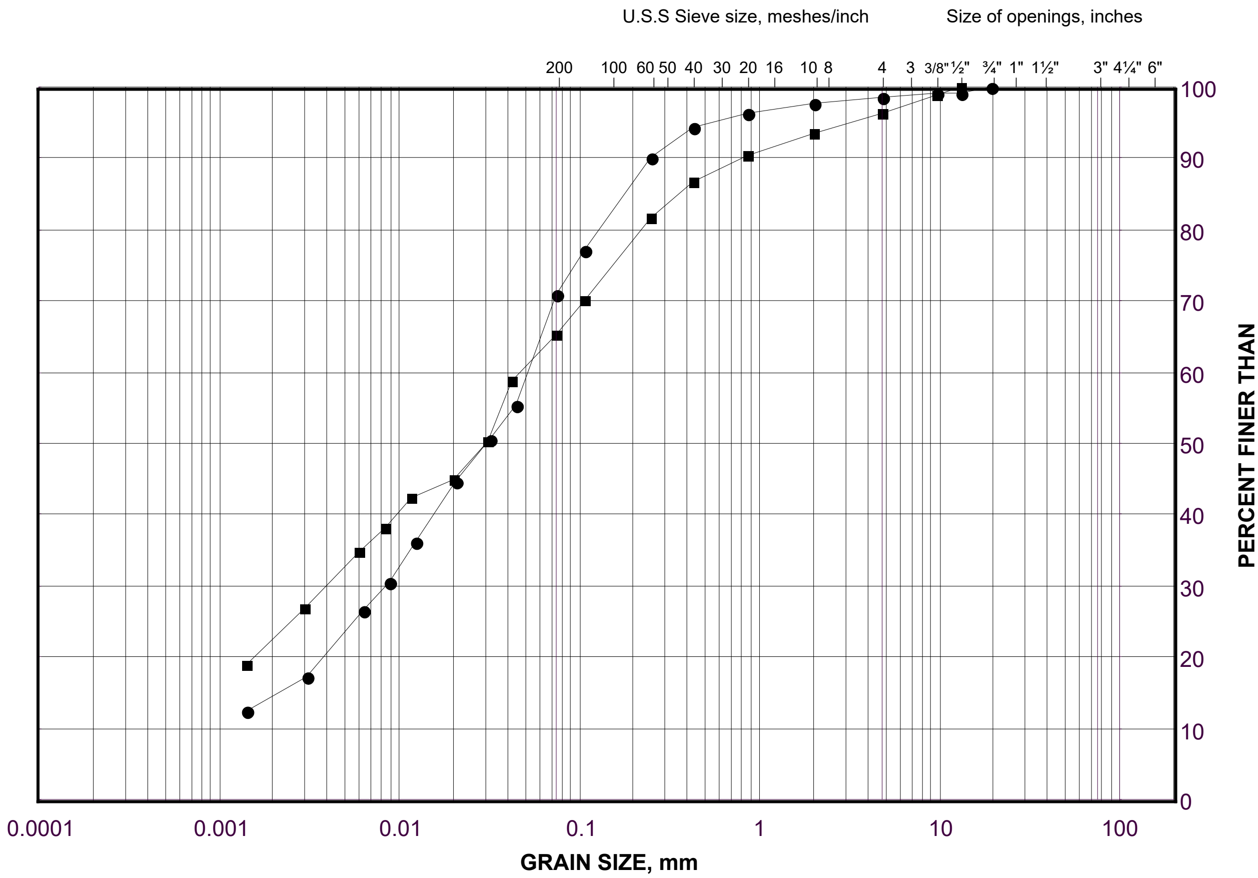
Project No. 19115306

Checked By: TZ

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT-SILT (CL-ML) to Sandy CLAYEY SILT (CL) (TILL)

FIGURE B3



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-1	8	184.0
■	OHS-2	9	184.2

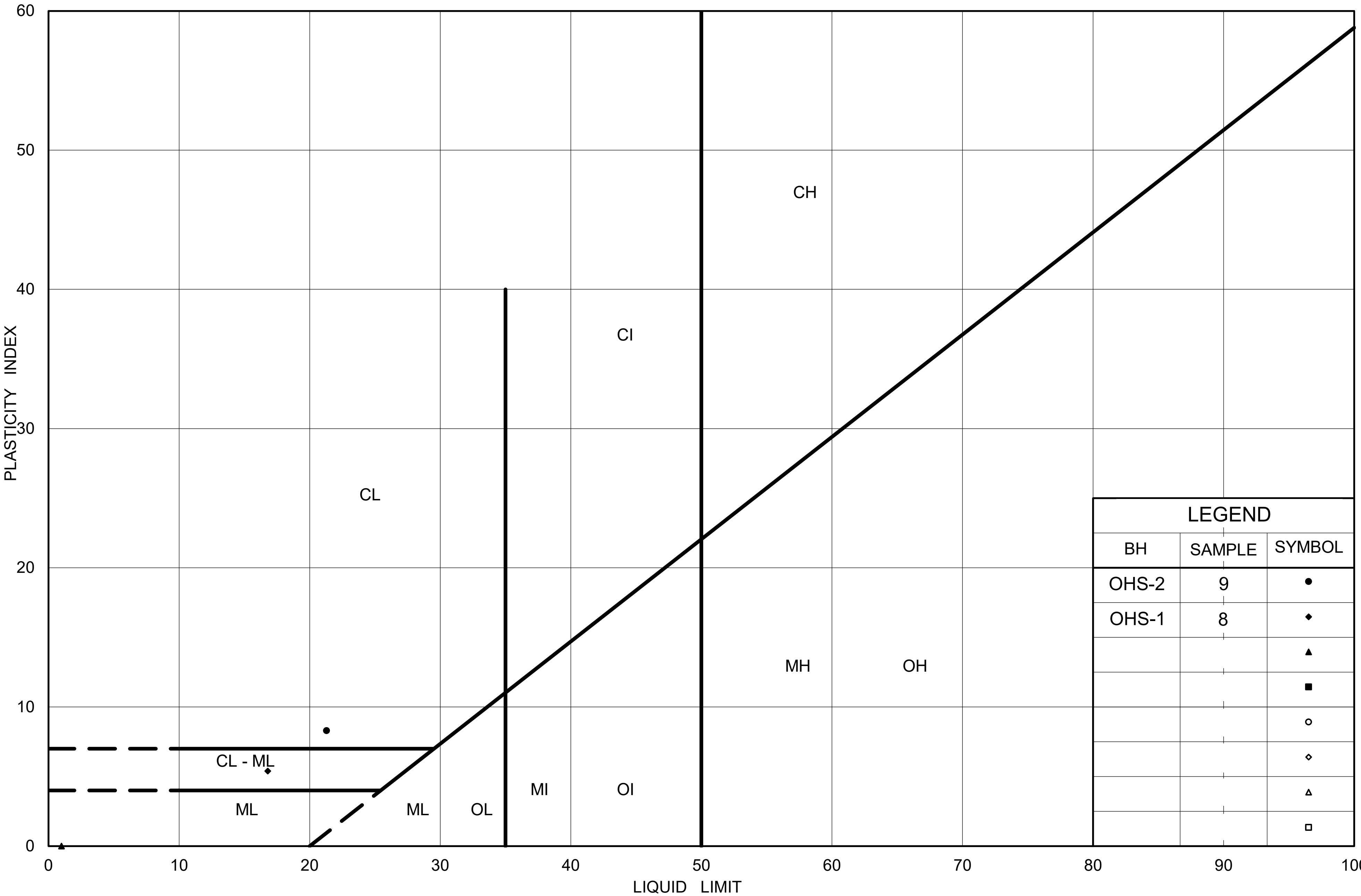
Project Number: 19115306

Checked By: TZ

Golder Associates

Date: 17-Dec-21

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Sandy CLAYEY SILT-SILT (CL-ML) to Sandy CLAYEY SILT (CL) (TILL)

Figure No. B4

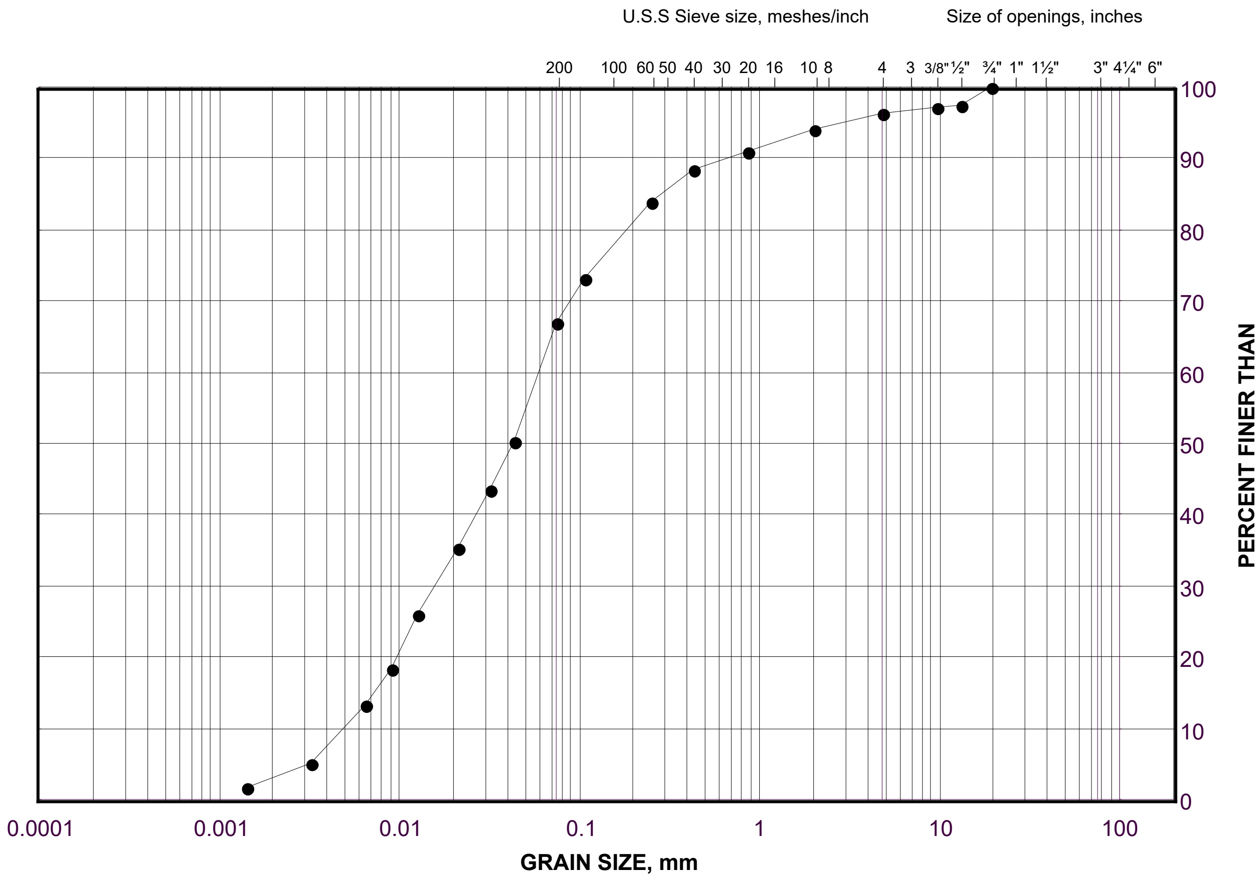
Project No. 19115306

Checked By: TZ

GRAIN SIZE DISTRIBUTION

Sandy SILT (ML) of slight plasticity

FIGURE B5



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-1	9	182.6

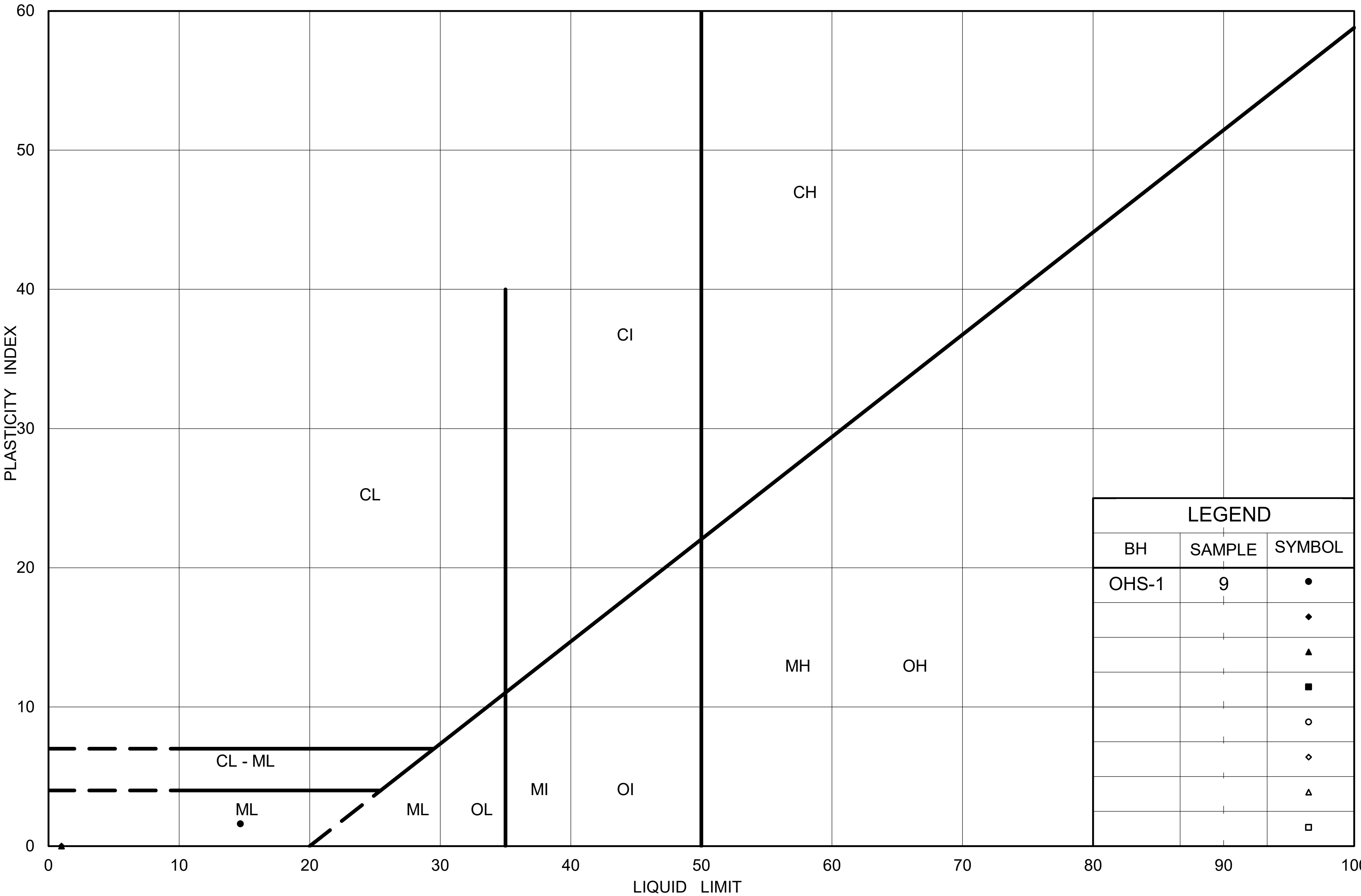
Project Number: 19115306

Checked By: TZ

Golder Associates

Date: 17-Dec-21

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
SILT (ML) of slight plasticity

Figure No. B6

Project No. 19115306

Checked By: TZ

APPENDIX C

Analytical Laboratory Test Results

Your Project #: 19115306
Site Location: HWY 400 VAUGHAN
Your C.O.C. #: N/A

Attention: Bryan Lui

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

Report Date: 2021/12/08
Report #: R6912263
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1W6270
Received: 2021/11/05, 15:59

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract)	2	2021/11/11	2021/11/11	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	2	2021/11/11	2021/11/11	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	2	N/A	2021/11/13	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	2	N/A	2021/11/10	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	2	2021/11/10	2021/11/10	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	2	2021/11/08	2021/11/11	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	2	2021/11/11	2021/11/11	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.
(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE , Calgary, AB, T2E 6P8
(2) Offsite analysis requires that subcontracted moisture be reported.

Your Project #: 19115306
Site Location: HWY 400 VAUGHAN
Your C.O.C. #: N/A

Attention: Bryan Lui

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

Report Date: 2021/12/08
Report #: R6912263
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1W6270
Received: 2021/11/05, 15:59

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
==
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.

Bureau Veritas Job #: C1W6270
Report Date: 2021/12/08

Golder Associates Ltd
Client Project #: 19115306
Site Location: HWY 400 VAUGHAN
Sampler Initials: AM

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		RDS088		RDS089		
Sampling Date		2021/11/01		2021/10/31		
COC Number		N/A		N/A		
	UNITS	**OHS-2 SS6 12'6"-14'6"**	**RDL**	**OHS-1 SS5 10'-12'**	**RDL**	**QC Batch**
Calculated Parameters						
Resistivity	ohm-cm	1500		510		7686386
Inorganics						
Soluble (20:1) Chloride (Cl-)	ug/g	300	20	1100	40	7694175
Conductivity	umho/cm	671	2	1980	2	7694504
Available (CaCl2) pH	pH	7.77		7.68		7692003
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	87	20	7694179
Sulphide	mg/kg	3.7 (1)	0.5	3.7 (1)	0.5	7699458
Physical Testing						
Moisture-Subcontracted	%	12	0.30	13	0.30	7699668

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Sample extracted past method-specified hold time. Analyzed past method specified hold time

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Bureau Veritas Job #: C1W6270
Report Date: 2021/12/08

Golder Associates Ltd
Client Project #: 19115306
Site Location: HWY 400 VAUGHAN
Sampler Initials: AM

TEST SUMMARY

Bureau Veritas ID: RDS088
Sample ID: OHS-2 SS6 12'6"-14'6"
Matrix: Soil

Collected: 2021/11/01
Shipped:
Received: 2021/11/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7694175	2021/11/11	2021/11/11	Alina Dobreanu
Conductivity	AT	7694504	2021/11/11	2021/11/11	Kien Tran
Moisture (Subcontracted)	BAL	7699668	N/A	2021/11/13	Yong Mei (May) Liang
Sulphide in Soil	SPEC	7699458	N/A	2021/11/10	Bailey Morrison
pH CaCl2 EXTRACT	AT	7692003	2021/11/10	2021/11/10	Taslima Aktar
Resistivity of Soil		7686386	2021/11/11	2021/11/11	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7694179	2021/11/11	2021/11/11	Avneet Kour Sudan

Bureau Veritas ID: RDS089
Sample ID: OHS-1 SS5 10'-12'
Matrix: Soil

Collected: 2021/10/31
Shipped:
Received: 2021/11/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7694175	2021/11/11	2021/11/11	Alina Dobreanu
Conductivity	AT	7694504	2021/11/11	2021/11/11	Kien Tran
Moisture (Subcontracted)	BAL	7699668	N/A	2021/11/13	Yong Mei (May) Liang
Sulphide in Soil	SPEC	7699458	N/A	2021/11/10	Bailey Morrison
pH CaCl2 EXTRACT	AT	7692003	2021/11/10	2021/11/10	Taslima Aktar
Resistivity of Soil		7686386	2021/11/11	2021/11/11	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7694179	2021/11/11	2021/11/11	Avneet Kour Sudan

Bureau Veritas Job #: C1W6270
Report Date: 2021/12/08

Golder Associates Ltd
Client Project #: 19115306
Site Location: HWY 400 VAUGHAN
Sampler Initials: AM

GENERAL COMMENTS

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

Package 1	20.7°C

Revised report (2021/12/08): Sample IDs updated as requested.

Results relate only to the items tested.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7692003	Available (CaCl2) pH	2021/11/10			101	97 - 103			0.14	N/A
7694175	Soluble (20:1) Chloride (Cl-)	2021/11/11	109	70 - 130	108	70 - 130	<20	ug/g	NC	35
7694179	Soluble (20:1) Sulphate (SO4)	2021/11/11	NC	70 - 130	104	70 - 130	<20	ug/g	2.1	35
7694504	Conductivity	2021/11/11			99	90 - 110	<2	umho/cm	0.31	10
7699458	Sulphide	2021/11/10	32 (1)	75 - 125	97	75 - 125	<0.5	mg/kg	NC	30
7699668	Moisture-Subcontracted	2021/11/13					<0.30	%		

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)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

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

Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

(work Order) MSA between Golder and BV Lab.

bryan_lui@golder.com Dated May 18, 2021.

www.BVNA.com

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266

CHAIN OF CUSTODY RECORD

ENV COC - 00014v2

Page 1 of ____

Invoice Information	Invoice to (requires report) ☐	Report Information (if differs from invoice)		Project Information		LAB USE ONLY - PLACE STICKER HERE
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation #:	NA	
Contact Name:	Bryan Lui	Contact Name:	SAME	P.O. #/ AFE#:		
Street Address:	6925 Century Ave, Suite #100	Street Address:		Project #:	19115306	
City:	Mississauga Prov: ON Postal Code: L5N 7K2	City: Prov: Postal Code:		Site #:	Hwy 400 Vaughan	
Phone:	905-466-1745	Phone:	SAME.	Site Location:		Rush Confirmation #:
Email:	bryan_lui@golder.com	Email:	bryan_lui@golder.com	Site Location Province:		
Copies:		Copies:		Sampled By:	AM. AM	

Regulatory Criteria

REG 153: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ; ☐ Res/Park ☐ Ind/Comm ☐ Agri/other ; ☐ Med/Fine ☐ Course ☐ For RSC

OTHER: ☐ CCME ☐ Reg 558* *min 3 day TAT ☐ MISA ☐ PWQO ☐ Reg 406, Table: ____ ☐ Sanitary Sewer Bylaw ☐ Storm Sewer Bylaw Municipality ____ ☐ Other: ____

Include Criteria on Certificate of Analysis (check if yes): ☐

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

	Sample Identification	Date Sampled YY	MM	DD	Time (24hr) HH	MM	Matrix	1 FIELD FILTERED	2 FIELD PRESERVED	3 LAB FILTRATION REQUIRED	4 BTEX/ F1	5 F2 - F4	6 VOCs	7 Reg 153 metals and inorganics	8 Reg 153 ICPMS metals	9 Reg 153 metals (Hg, Cr VI, ICPMS metals, HWS - B)	10 Corrosivity &	11 Sulphide	12 ↳ A100	13	14	15	16	17	18	19	20	21 # OF CONTAINERS SUBMITTED	22 HOLD - DO NOT ANALYZE	Comments
1	OHS-1 SS5 10'-12'	21	11	01	P	M	SOIL										X													
2	OHS-2 SS6 12'6"-14'6"	21	10	31	P	M	SOIL.										X													
3																														
4																														
5																														
6																														
7																														
8																														
9																														
10																														
11																														
12																														

Regular Turnaround Time (TAT): ☒ 5 to 7 Day ☐ 10 Day

Rush Turnaround Time (TAT) Surcharges apply: ☐ Same Day ☐ 1 Day ☐ 2 Day ☐ 3 Day ☐ 4 Day

Date Required: YY ____ MM ____ DD ____

05-Nov-21 15:59
Ema Gitej
C1W6270
VTH ENV-1598

*UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS AND CONDITIONS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS OR BY CALLING THE LABORATORY LISTED ABOVE TO OBTAIN A COPY

LAB USE ONLY	Yes	No	°C	1	2	3
Seal present		✓		21	21	20
Seal intact		/				
Cooling media present		/				

LAB USE ONLY	Yes	No	°C	1	2	3
Seal present						
Seal intact						
Cooling media present						

LAB USE ONLY	Yes	No	°C	1	2	3	Temperature reading by:
Seal present							
Seal intact							
Cooling media present							

	Relinquished by: (Signature/ Print)	Date YY	MM	DD	Time HH	MM	Received by: (Signature/ Print)	Date YY	MM	DD	Time HH	MM	Special instructions
1	Bryan Lui	21	11	05	15	58	[signature]	2021	11	05	15	59	
2													

APPENDIX D

Non-Standard Special Provisions

DEEP FOUNDATIONS (CAISSONS FOR OVERHEAD SIGN SUPPORTS) - Item No.

Non-Standard Special Provision

Amendment to OPSS.PROV 903

903.01 SCOPE

Section 903.01 of OPSS.PROV 903 is amended by the addition of the following:

This specification covers the requirements for the supply and installation of caisson foundations for the overhead sign supports.

903.07 CONSTRUCTION

Section 903.07.03.02.01 of OPSS.PROV 903 is amended by the addition of the following:

Section 903.07.03.02.01 General

Augering for caissons for the overhead sign supports will extend through fills and glacial till deposits. The fills and overburden soils could slough (if dry) or flow (if water-bearing) into unsupported auger holes during caisson installation. Additionally, abandoned underground infrastructure, construction debris, refuse, cobbles and boulders, or other obstructions may be encountered within the fill, while the glacial till deposits may contain cobbles and boulders. Appropriate equipment and construction procedures will be required to penetrate the fills, overburden, and the potential obstructions, and advance the caissons to reach the design founding levels. Temporary liners may be required to provide support through the fills and overburden soils and minimize ground loss during drilling, caisson installation, and concrete placement.

Where the caisson holes for the overhead sign support are filled with water during construction, concrete shall be placed by tremie methods in accordance with the requirements of OPSS.PROV 903.

GOLDER
MEMBER OF WSP

golder.com