REPORT

September 1, 2015

FOUNDATION INVESTIGATION AND DESIGN REPORT

POLE MOUNTED VARIABLE MESSAGE SIGNS HIGHWAY 401 WIDENING FROM HIGHWAY 403/410 INTERCHANGE TO THE CREDIT RIVER CITY OF MISSISSAUGA, REGION OF PEEL G.W.P. 2150-01-00

Submitted to:
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GEOCRES No. 30M12-390

Report Number: 10-1111-0211-10

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PART A

FOUNDATION INVESTIGATION REPORT
POLE MOUNTED VARIABLE MESSAGE SIGNS
HIGHWAY 401 WIDENING FROM HIGHWAY 403/410 INTERCHANGE TO THE CREDIT RIVER
CITY OF MISSISSAUGA, REGION OF PEEL
G.W.P. 2150-01-00

September 1, 2015
Report No. 10-1111-0211-10

Golder Associates

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by IBI Group on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services in support of the detail design of two Pole Mounted Variable Message Sign (PVMS) structures associated with the proposed widening of Highway 401 from the Highway 403/410 Interchange to the Credit River in the City of Mississauga, Region of Peel, Ontario.

This report addresses the results of the foundation investigation carried out for the Highway 401 Mainline work which consists of two proposed Pole Mounted Variable Message Sign (PVMS) structures located along the Highway 401 Mainline corridor, within the areas shown on Drawing 1. Separate foundation investigation reports (GEOCRES No. 30M12-366 and 30M12-389) were prepared for the Overhead Sign (OHS) structures associated with the proposed widening of Highway 401 from the Highway 403/410 Interchange to the Credit River.

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal (RFP) dated October 5, 2010 and subsequent clarifications, and specifically in Golder's proposal letter dated June 1, 2014.

The Foundation Investigation for the PVMS structures is based on a field investigation conducted by Golder involving the advancement of a new borehole along Highway 401, supplemented with an existing relevant borehole obtained from the MTO GEOCRES library.

2.0 SITE DESCRIPTION

The west limit of the proposed new PVMS structures along the Highway 401 corridor is approximately 900 m west of Creditview Road, and the east limit is approximately 500 m east of Tomken Road. The road surface along the Highway 401 corridor in this area is at a low point at about Elevation 164 m near the Credit River and rises to about Elevation 188 m near the west limit (i.e., east of Mississauga Road) and to a high point at about Elevation 195 m immediately west of the Hwy 401/410 Interchange. The road surface east of the Hwy 401/410 Interchange slopes downward at a steady grade to about Elevation 165 m at the east limit of the site (i.e., west of Tomken Road). Bedrock outcrops are present near the Highway 401/410 Interchange and swampy areas are located near the low point (i.e., between Credit River and Fletcher's Creek). There are "Beware of Quicksand" signs located along the Highway 401 shoulders near the Fletcher's Creek culvert crossing due to known artesian groundwater conditions in the area.

Based on the information provided by IBI, the proposed PVMS structure designation, location and corresponding structure type are summarized below. The existing ground surface elevation at PVMS01 was interpreted from contour information provided by AECOM.

PVMS Structure Designation	Station	Existing Ground Surface Elevation (m)	Proposed Ground Surface Elevation (m)
PVMS01	13+944 Highway 401 EB	182.7[1]	TBD[2]
PVMS02	18+008 Highway 401 EB Collector/Express	189.7	190.2

[1] Elevations based on centreline profile drawings provided by AECOM and should be considered approximate.
[2] TBD = To be determined (final ground surface information not yet available).

3.0 INVESTIGATION PROCEDURES

3.1 Previous Investigations

As part of the original Highway 401 development, and subsequent rehabilitation/widening works, various subsurface investigations were carried out by or on behalf of the MTO. One of the boreholes used in this report was obtained from a previous Foundation Investigation Report prepared by others for structures within the Highway 401 corridor near the proposed sign locations, available from the MTO Pavement and Foundations Section's GEOCRES database, as follows:

- **MTO GEOCRES No. 30M12-277**: Report titled "Foundation Investigation Report, Overhead Sign Supports, From Dixie Road to McLaughlin Road, Hwy 401 widening, Hwy. 410 to Credit River, Mississauga, Ontario – G.W.P. 2107-05-00" by Thurber Engineering Ltd., dated April 20, 2009.

The relevant existing borehole information collected from the above-referenced source that is near the proposed new PVMS structure location is summarized below.

PVMS Structure Designation	Original Borehole No. (Geocres Reference No.)	Revised Borehole No. Designation	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation of Borehole at Time of Advancement (m)	Borehole Depth (m)
PVMS02	OHS-01 (Geocres No. 30M12-277)	277-01	4831676.8	288985.0	187.8	9.4

The GEOCRES-sourced borehole used in this report has been re-numbered to show the MTO GEOCRES No. followed by the original borehole designation (i.e., Borehole OHS-01 from MTO GEOCRES 30M12-277 has been re-numbered to 277-01). This borehole was advanced through the overburden using conventional solid stem augering techniques and through the bedrock using an "HQ2"-size core barrel. The groundwater level recorded in the open borehole is shown on the Record of Borehole sheets, a copy of which is provided in Appendix C.

The GEOCRES-sourced borehole location, as shown on Drawing 1, is based on the coordinates given in the GEOCRES report.

3.2 Current Investigation

As part of the current foundation investigation for the proposed Highway 401 widening in this section (i.e., G.W.P. 2150-01-00), about 90 boreholes have been drilled by Golder between May 2012 and July 2015. These boreholes were drilled as part of the overall foundation investigation associated with the lengthening of the Highway 401 / Mavis Road underpass, deep cut / high fill areas, Fletcher's Creek bridges, retaining walls, high mast lights (HMLs), overhead signs (OHS) and trenchless crossings along Highway 401 and Highway 403.

One borehole (designated PVMS-1) from the current investigation is relevant for the proposed new PVMS structure and is shown on Drawing 1 together with tabular borehole co-ordinate information.

Borehole PVMS-1 was drilled using a truck-mounted drill rig supplied and operated by Davis Drilling Inc. of Milton, Ontario. The borehole was advanced using 150 mm outside diameter solid stem augers, with soil samples obtained at 0.75 m and 1.5 m intervals of depth using a 50 mm outside diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedure *(ASTM D1586-08a, Standard Test Method for Standard Penetration Test).* Rock coring was completed using an "NQ" sized core barrel and conventional coring techniques.

The groundwater conditions were observed in the open borehole during and immediately following the drilling operations. The borehole was backfilled with bentonite / holeplug upon completion, in accordance with Ontario Regulation 903 (as amended).

The field work was supervised on a full-time basis by a member of Golder's engineering staff who located the borehole in the field, supervised the drilling, sampling, and in situ testing operations, and logged the boreholes. The soil and rock samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further examination and laboratory testing. Index and classification tests consisting of water content determinations, Atterberg limits, and grain size distributions were carried out on selected soil samples. The results of the testing program are shown on the Record of Borehole sheets in Appendix A and the laboratory test figures contained in Appendix B.

The borehole location was recorded in the field by Golder personnel using a GPS-enabled Tablet connected to a Garmin GPS Booster device, with an accuracy of approximately 1 m to 3 m. The ground surface elevation at the borehole location was estimated from the digital terrain model information provided by IBI. The borehole location (referenced to the MTM NAD83 co-ordinate system) and approximate ground surface elevation (referenced to geodetic datum), as well as drilled depth, are provided on the Record of Borehole sheet and shown on Drawings 1, as summarized below.

PVMS Structure Designation	Relevant Borehole No.	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Borehole Ground Surface Elevation (m)	Borehole Depth (m)
PVMS01	PVMS-1	4829752.9	285374.7	182.7	7.6

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This section of Highway 401 is located within the Peel Plain physiographic region, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984)[1].

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

[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.

southward toward Lake Ontario. A surficial till sheet, which generally follows the surface topography, is present throughout much of this area. The till, which is mapped in this area as the Halton 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. The study area, in the western portion of the Peel Plain, is underlain by grey shale of the Georgian Bay Formation which contains limestone layers.

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the relevant boreholes advanced as part of the current and previous investigations and the results of in situ and laboratory testing are shown on the borehole records contained in Appendices A and C respectively. The results of geotechnical laboratory testing from the borehole advanced during the current investigation are also presented on Figures B1 to B2 contained in Appendix B.

The stratigraphic boundaries shown on the borehole records are inferred from observations of drilling progress and from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil and bedrock conditions will vary between and beyond the borehole locations.

A detailed description of the subsurface conditions encountered in the relevant boreholes advanced near each proposed PVMS location is provided in the following sections.

4.2.1 PVMS01 – Station 13+944

The proposed pole mounted variable message sign PVMS01 is located on the Highway 401 eastbound lanes at Station 13+944. The existing ground surface in the vicinity of the proposed sign location is at about Elevation 182.7 m. Borehole PVMS-1 was advanced at this location (see Drawing 1) to a depth of 7.6 m below ground surface (Elevation 175.7 m).

Based on Borehole PVMS-1, the subsoil conditions consist of: asphalt and recycled asphalt underlain by non-cohesive fill; underlain by native clayey silt with sand till transitioning to moderately to highly weathered shale bedrock. Although there was no indication of cobbles and/or boulders during drilling, glacial till deposits in southern Ontario typically contain such materials and they should be expected within such glacial deposits, especially near the bedrock interface.

A summary of the major stratigraphic units encountered in Borehole PVMS1 near this sign location, including laboratory test results, is presented below.

Borehole PVMS-1 for the Pole Mounted Variable Message Sign Support PVMS01 at Station 13+944							
Stratigraphic Unit (Consistency or Relative Density)	**Top Elevation - Bottom Elevation (m)**	**In Situ Testing Results**	**Laboratory Testing Results**				
		SPT 'N'-values*	**Moisture Content (%)**	**Atterberg Limits**			**Grain Size Distribution and UC Results**
				Plastic Limit (%)	**Liquid Limit (%)**	**Plasticity Index (%)**	
Asphalt / Recycled Asphalt	182.7-182.2	-	-	-	-	-	-
Non-Cohesive Fill (compact to very dense)	182.2-181.4	26 to 76	3	-	-	-	-
Clayey Silt Till with Sand (very stiff to hard)	181.4-181.0	26 to 47	11 to 12	15	24	9	Figure B1 Appendix B
Moderately to Highly Weathered Highly Altered Shale Bedrock with Limestone interbeds	181.0-175.1**	***TCR = 100% RQD = 62% to 78%	-	-	-	-	UC = 0.5 MPa Figure B3 Appendix B

*Blows per 0.3 m of penetration unless otherwise noted

**End of drillhole

***TCR = Total Core Recovery, RQD = Rock Quality Designation

4.2.2 PVMS02 – Station 18+008

The proposed pole mounted variable message sign PVMS02 is located on the Highway 401 eastbound lanes at Station 18+008. The existing ground surface in the vicinity of the proposed sign location is at about Elevation 190.3 m. Borehole 277-01 was advanced in the vicinity of the overhead sign PVMS02 location (see Drawing 1). The existing ground surface at Borehole 277-01 is at about Elevation 187.8 m and the borehole was advanced to a depth of 9.4 m below ground surface (Elevation 178.4 m).

Based on Borehole 277-01, the subsoil conditions in the vicinity of overhead sign PVMS02 consist of: topsoil underlain by cohesive fill underlain by silty clay till. Although there was no indication of cobbles and/or boulders during drilling, glacial till deposits in southern Ontario typically contain such materials and they should be expected within such glacial deposits, especially near the bedrock interface.

A summary of the stratigraphic units, including laboratory test results, are presented below.

Borehole 277-01 for Pole Mounted Variable Message Sign Support PVMS02 at Station 18+008							
Stratigraphic Unit (Consistency or Relative Density)	**Top Elevation - Bottom Elevation (m)**	**In Situ Testing Results**	**Laboratory Testing Results**				
		SPT 'N'-values*	**Moisture Content (%)*** **	**Atterberg Limits*** **			**Grain Size Distribution**
				Plastic Limit (%)	**Liquid Limit (%)**	**Plasticity Index (%)**	
Topsoil	187.8-187.8	-	-	-	-	-	-
Cohesive Fill (stiff to very stiff)	187.8-186.3	9 to 18	11 to 13	-	-	-	-
Silty Clay Till (very stiff to hard)	186.3-178.4**	19 to 32 and 50 per 0.15 m of penetration	9 to 14	12 to 13	22 to 24	10 to 11	***

* Blows per 0.3 m of penetration unless otherwise noted

**End of borehole

*** Refer to Record of Borehole in Appendix C

4.3 Groundwater Conditions

The groundwater conditions encountered in the boreholes nearest to the proposed PVMS structures are summarized below.

PVMS Structure I.D.	Borehole No.	Ground Surface Elevation (m)	Borehole Depth (m)	Depth to Water Level below Ground Surface (m)	Water Level Elevation (m)	Date
PVMS01	PVMS-01	182.7	7.6	Dry**	-	July 12, 2015
PVMS02	277-01	187.8	9.4	2.8*	185.0*	Mar. 12, 2009

* *Water level was obtained upon completion of drilling.*

** *Water level was obtained upon completion of drilling and prior to rock coring.*

The groundwater levels provided above were taken during or shortly after drilling operations and may not represent the stabilized groundwater levels at the proposed PVMS sites. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events and creek/river levels, and should be expected to be higher during wet periods of the year. Although not encountered during the current investigation and not indicated on the previous borehole record prepared by others, "perched" groundwater conditions should be expected within the non-cohesvie fill soils, above the cohesive till and/or above the bedrock. The upper weathered portion of the bedrock is also anticipated to contain groundwater where bedrock was encountered near the ground surface.

5.0 CLOSURE

This Foundation Investigation Report was prepared by Alex Szot, EIT, and reviewed by Mr. Kevin Bentley, P.Eng., a geotechnical engineer and Associate with Golder. Ms. Lisa Coyne, P.Eng., a Principal and Designated MTO Foundations Contact for Golder, conducted an independent review of this report.

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PART B

FOUNDATION INVESTIGATION REPORT
POLE MOUNTED VARIABLE MESSAGE SIGNS
HIGHWAY 401 WIDENING FROM HIGHWAY 403/410 INTERCHANGE TO THE CREDIT RIVER
G.W.P. 2150-01-00

September 1, 2015
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Golder Associates

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides geotechnical parameters and recommendations for the detail foundation design of two proposed PVMS structures located along the Highway 401 Mainline corridor associated with the proposed widening of Highway 401 from Highway 403/410 Interchange to the Credit River in the City of Mississauga, Region of Peel, Ontario. The recommendations are based on interpretation of the factual data obtained from a borehole advanced during the current subsurface investigation for this project and existing borehole information collected from a desktop study search of available information from the GEOCRES library at MTO. The discussion and recommendations presented are intended to provide the designers with sufficient information to assess the feasible foundation alternatives and to carry out the detail design of the proposed PVMS structure foundations.

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 or operational constraints may be required in the Contract Documents. Those requiring information on the aspects of construction should make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

6.2 Caisson Foundations for Pole Mounted Variable Message Signs

Based on information provided by IBI, two pole mounted variable message signs will require new foundations as part of the project. Caisson foundations for pole mounted variable message supports should be designed in accordance with the requirements in MTO's *Sign Support Manual* (MTO 2015). The *Sign Support Manual* includes a standard foundation design for pole mounted variable message sign support structures in Section 8 and the associated Standard Drawings.

For the standard sign support design, the caissons for PVMS supports extend to a depth of 5 m below the frost penetration depth, except where sound bedrock is encountered within the standard design depth in which case the standard caisson length can be modified (see Section 8.1.4 of the *Sign Support Manual*).

As shown on the depth of frost penetration isopleths for Southern Ontario in OPSD 3090.101 (Foundation, Frost Penetration Depth), the estimated depth of frost penetration at this site is approximately 1.2 m; therefore the resulting total length of the caisson will be 6.2 m below proposed grade where there is sufficient thickness of suitable overburden.

The results of the foundation investigation indicate that sufficient overburden thickness (i.e., greater than 6.2 m below existing ground surface) of suitable quality / condition is present at the PVMS01 and PVMS02 support locations. Weathered bedrock was described as being encountered within a depth of 6.2 m at PVMS01; however, the bedrock was encountered is not considered to be "sound" (i.e., suitable quality) bedrock based on visual observations in the recovered bedrock core, and the result of unconfined compressive strength testing. Therefore, a standard and not a modified caisson foundation would apply at PVMS01.

6.2.1 Caisson Foundation Design in Soil

For the pole mounted variable message sings, the standard sign foundation design (as presented in the MTO's Sign Support Manual, Sections 3 and 4, and Standard Drawings SS118-3, SS118-4 and SS118-5) consists of a caisson 6.2 m long (for a frost penetration depth of 1.2 m for this site), as developed based on the minimum soil conditions given below.

- **Case 1 (Cohesionless 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 of the portion of the caisson below the design frost depth.
- **Case 2 (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.

Based on the review of the soil conditions encountered at the boreholes advanced at or near the proposed overhead sign locations, the soil conditions at the location of PVMS01 and PVMS02 generally have friction angles and/or undrained shear strengths equal to or greater than the input parameters used in the modelling of the standard caisson foundations and, therefore, the standard caisson foundation design is suitable for these sites.

If desired, a site-specific caisson foundation design can be carried out by the structural designer to optimize the foundation design 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 stratigraphy and geotechnical design parameters given in Table 1 following the text of this report.

$P_p = K_p \gamma d$ above the groundwater table, and

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

where:

K_p = passive earth pressure coefficient;

γ = bulk unit weight (kN/m^3);

γ' = effective unit weight below the groundwater level (kN/m^3);

d = depth below the ground surface (m); and

d_w = depth to the groundwater level (m).

Referring to the design parameters in Table 1, at the PVMS02 sign location where the proposed ground surface is higher than the ground surface was at the time of the investigation, it is assumed that suitable engineered fill was placed and compacted in accordance with OPSS.PROV 501.

In the design of the sign foundations, the passive resistance within the upper 1.2 m below ground surface should be neglected to account for frost action. The unfactored lateral resistance should be calculated assuming an equivalent width equal to three times the caisson diameter. A resistance factor of 0.5 should be applied to this unfactored lateral resistance to obtain the factored lateral geotechnical resistance at Ultimate Limit Status (ULS).

Where the undrained shear strength, S_u, is provided for a cohesive soil layer in Table 1, the undrained lateral capacity of the foundation soils should also be checked to determine whether the drained or undrained case will govern. In this case, the lateral resistance for the length of the caisson within the cohesive soil should be calculated assuming an internal angle of friction, Φ' = 0 degrees, and an unfactored passive lateral pressure distribution varying from 2 S_u at 1.2 m below ground surface (i.e., frost penetration depth) to 9 S_u at and below a depth equivalent to three caisson diameters, acting over the actual width/diameter of the caisson. A resistance factor of 0.5 should be applied to this calculated lateral resistance in order to obtain the factored lateral geotechnical resistance at ULS.

6.3 Construction Considerations

Construction of the footing foundations for the sign support structures should be in accordance with OPSS.PROV 915 (Sign Support Structures).

In addition, it is recommended that a Non-Standard Special Provision (NSSP), similar to the example provided in Appendix D, be included in the Contract Documents to warn the Contractor of the following site-specific subsurface conditions.

6.3.1 Control of Soil and Groundwater

Water-bearing non-cohesive soil layers and lenses/interlayers within the cohesive fill/till deposit are present in many of the boreholes advanced as part of the current investigation for other elements of the project, even if not specifically encountered in the boreholes advanced near the proposed PVMS locations. Depending on the period of the year, "perched" groundwater may also be encountered within the fill soils above the clayey silt till layer. Perched groundwater may also be present within the upper weathered portion of the bedrock at the location of PVMS01. Wet non-cohesive soil layers and lenses/interlayers (if encountered) should be expected to run or flow into the drilled hole during or after augering for the sign support foundations. Therefore, temporary or permanent caisson liners and/or drilling mud/concrete tremie methods may be needed to minimize ground loss during drilling and concrete placement.

6.3.2 Cobbles and Boulders

Although not specifically encountered in the boreholes included in this report, cobbles and boulders have been inferred to be present within the glacial till deposits encountered in other boreholes drilled for this project, and they should be anticipated in the native soils (particularly near the bedrock interface) as discussed in Section 4 of this report. Appropriate equipment and procedures will be required to penetrate the cobbles and/or boulders during the drilling of the holes for the overhead sign support caisson foundations.

6.3.3 Bedrock

The caisson foundation for the pole mounted variable message sign PVMS01 are expected to encounter shale bedrock containing limestone interbeds within the design caisson depth. The quality of the shale bedrock varies from highly to moderately weathered and contains stronger interlayers of limestone bedrock. Appropriate construction procedures and equipment (such as coring or churn drilling equipment) will be required to penetrate the bedrock.

7.0 CLOSURE

This Foundation Design Report was prepared by Alex Szot, EIT, and reviewed by Mr. Kevin Bentley, P.Eng., a geotechnical engineer and Associate with Golder. Ms. Lisa Coyne, P.Eng., a Principal and Designated MTO Foundations Contact for Golder, conducted an independent review of this report.

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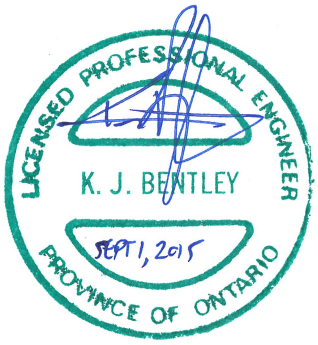

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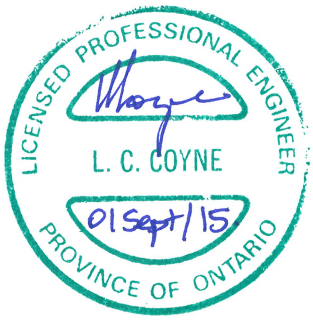

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Chapman, L.J., and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, 3rd Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

Ministry of Transportation, Ontario, 2015. *Sign Support Manual*. Policy, Planning & Standards Division, Engineering Standard Branch, Bridge Office.

Ontario Provincial Standard Specifications (OPSS)

OPSS.PROV 915	Construction Specification for Sign Support Structures
OPSS.PROV 501	Construction Specification for Compacting

Ontario Provincial Standard Drawings (OPSD)

OPSD 3090.101	Foundation, Frost Penetration Depths for Southern Ontario

TABLE 1 - GEOTECHNICAL DESIGN PARAMETERS FOR POLE MOUNTED VARIABLE MESSAGE SIGN FOUNDATIONS G.W.P. 2150-01-00

PVMS Structure Designation	*Sign Location and Station (Existing / Proposed Ground Surface Elevation)*	*Borehole No. (Ground Surface Elevation at Time of Borehole Advancement)*	*Stratum*	*Depth[1] (m)*	*Elevation[1] (m)*	*Design Parameters [2,3]*					*Design Groundwater Elevation (m)*
						S_u (kPa)	φ' (^{o})	γ (kN/m^3)	γ' (kN/m^3)	K_p	
PVMS01	Hwy 401 Eastbound STA 13+944 (182.7/ TBD)	PVMS-1 (182.7)	*Compact to very dense Sand and Gravel Fill*	*0-1.3*	*Above 181.4*	-	30	20	10	3.0	*180*
			Very stiff to hard Clayey Silt with Sand Till	*1.3-1.7*	*181.4-181.0*	150	32	21	11	3.3	
			Weathered Shale Bedrock	*Below 1.7*	*Below 181.0*	-	37	22	12	4.0	
PVMS02	Hwy 401 Eastbound STA 18+008 (189.7/190.2)	277-01 (187.8)	*Engineered Fill*	-	*Above 187.8*	-	30	20	10	3.0	*185*
			Stiff to very stiff Silty Clay Fill	*0-1.5*	*187.8- 186.3*	50	28	19	9	2.8	
			Very stiff to hard Silty Clay Till	*1.5-9.4*	*186.3-178.4*	150	32	21	11	3.3	

Prepared By: AJS

Reviewed By: LCC

NOTES:

TBD = to be determined

1. Depths are given relative to the ground surface elevation at the time of investigation (i.e., as recorded on the borehole record) at the proposed sign location. The existing ground surface elevation should be compared to the proposed design ground surface elevation at the actual sign support foundation location, and the depths to the various soil strata adjusted accordingly. In areas where new fill is to be placed to raise the grade at the proposed sign location, the soil parameters provided for the existing fill can be used for the new fill (unless otherwise noted) assuming suitable engineered fill is used.

2. Design parameters:
   - 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); and
   - K_p = passive earth pressure coefficient.

3. Although the passive resistance in the upper 1.2 m is neglected to account for frost action, S_u, φ' and K_p parameters are given for the soil in the event that the ground surface elevation varies significantly between the borehole and sign support locations.

DRAWING

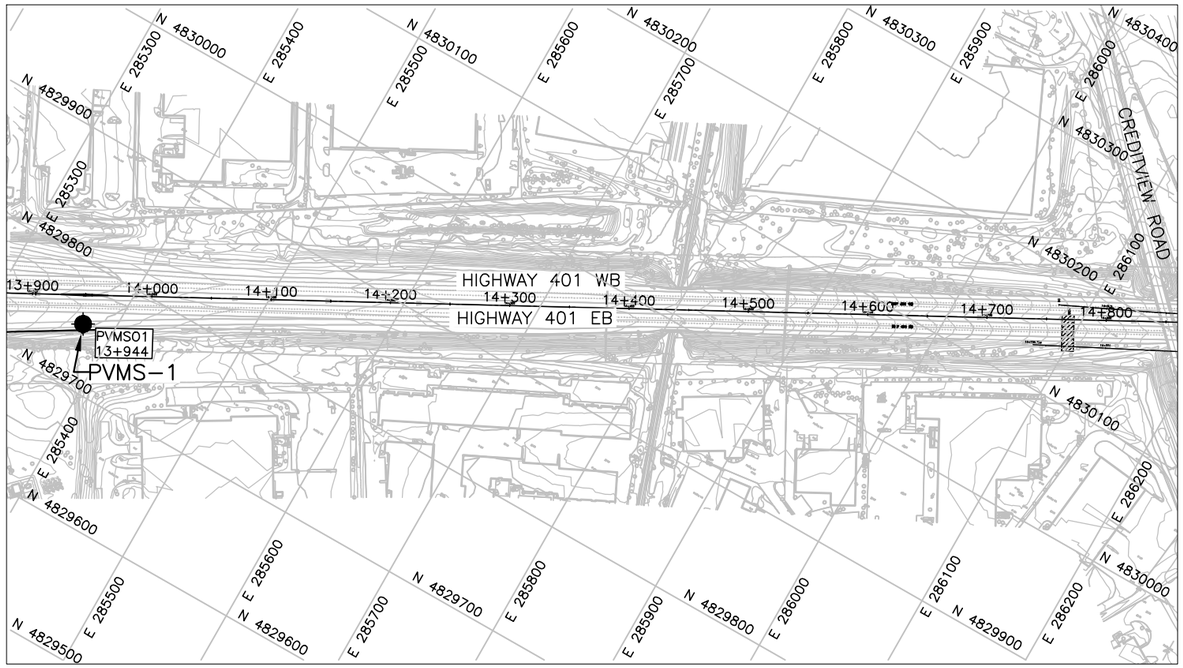
Highway 401, Pole Mounted Variable Message Signs- Borehole Locations

September 1, 2015
Report No. 10-1111-0211-10

Golder Associates

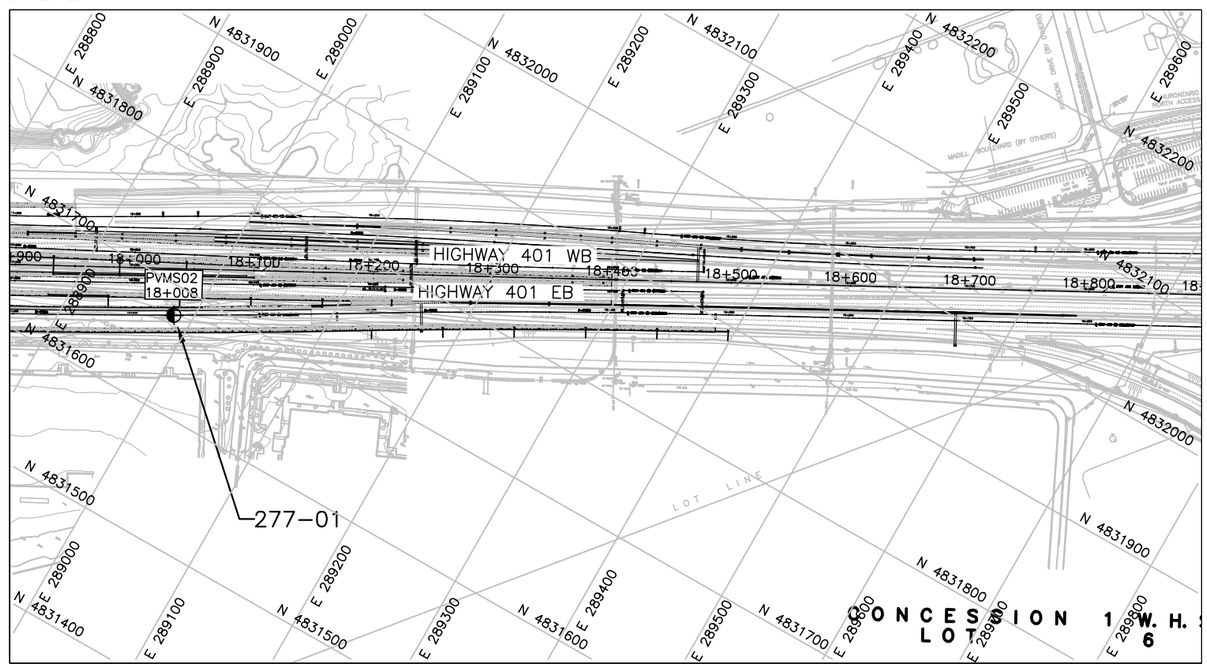
MINISTRY OF TRANSPORTATION, ONTARIO

SITE 1



PLAN
SCALE
50 0 50 100 m

SITE 2



PLAN
SCALE
50 0 50 100 m

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

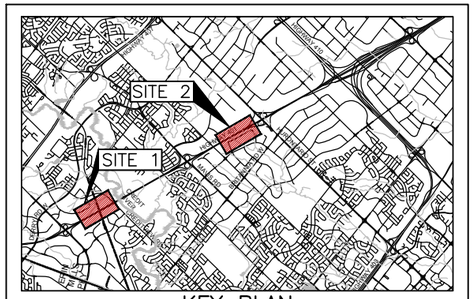
CONT No.
GWP No. 2150-01-00

HIGHWAY 401
POLE MOUNTED VARIABLE MESSAGE SIGNS

BOREHOLE LOCATIONS

SHEET

Golder Associates



KEY PLAN
SCALE
1.5 0 1.5 3 km

LEGEND

- Borehole – Current Investigation
- Borehole – Previous Investigation (Geocres 30M12-277)

RELEVANT BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
277-01	187.6	4831676.8	288985.0
PVMS-1	182.7	4829752.9	285374.7

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 complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by AECOM, drawing file nos. X-60213979-C-OHS-403.dwg, X-60213979-DES-OHS-403.dwg, received February 18, 2015, X-60213979-C-DE-HWY401_FLTCH_CRK – RW Plan.dwg, X-60213979-C-DE-NB & SLOPE.dwg, received February 3, 2015, X-60213979-C-DE-HWY401_MAVIS.dwg, X-60213979-C-BA-HWY401_MAVIS.dwg, received September 24, 2014 and 403_410base.dwg, received September 30, 2011.

NO.	DATE	BY	REVISION
.	.	.	.

LICENSED PROFESSIONAL ENGINEER L.C. COYNE Aug. 31, 2015 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER K. J. BENTLEY Aug. 31, 2015 PROVINCE OF ONTARIO

Geocres No. 30M12-390

HWY. 401		PROJECT NO. 10-1111-0211	DIST. CENTRAL
SUBM'D. AJS	CHKD. AJS	DATE: August 2015	SITE: .
DRAWN: JFC	CHKD. KJB	APPD. LCC	DWG. 1

PLOT DATE: August 31, 2015
FILENAME: T:\Projects\2010\10-1111-0211 (AECOM, Mississauga)\-MA- IBR\101110211MA001.dwg

APPENDIX A

Record of Borehole from Current Investigation

LIST OF SYMBOLS

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 $\gamma = \rho g$ (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 = $(w_l - w_p)$
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 = σ'_p / σ'_{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 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d:

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

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

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

(b) Cohesive Soils

Consistency

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

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

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

V. MINOR SOIL CONSTITUENTS

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

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS STATE

Fresh: no visible sign of weathering

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

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

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

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

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

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

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

CORE CONDITION

Total Core Recovery (TCR)

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

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

DISCONTINUITY DATA

Fracture Index

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

Dip with Respect to Core Axis

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

Description and Notes

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

Abbreviations

JN Joint
FLT Fault
SH Shear
VN Vein
FR Fracture
SY Stylolite
BD Bedding
FO Foliation
CO Contact
AXJ Axial Joint
KV Karstic Void
MB Mechanical Break

PL Planar
CU Curved
UN Undulating
IR Irregular
K Slickensided
PO Polished
SM Smooth
SR Slightly Rough
RO Rough
VR Very Rough

Golder Associates

RECORD OF BOREHOLE No PVMS-1

SHEET 1 OF 1

METRIC

PROJECT 10-1111-0211

G.W.P. 2150-01-00 LOCATION N 4829752.9 ;E 285374.7 ORIGINATED BY JIL

DIST Central HWY 401 BOREHOLE TYPE 150 mm O.D. Solid Stem Augers COMPILED BY AJS

DATUM GEODETIC DATE July 12, 2015 CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
182.7	GROUND SURFACE										
0.0	ASPHALT										
	RECYCLED ASPHALT		1	SS	70		182		○		
0.5	Sand, some gravel to gravelly (FILL) Compact to very dense Brown Dry		2A 2B	SS	26				○		
181.4											
1.3	CLAYEY SILT with SAND, some gravel (TILL)										
181.0			3A 3B	SS	47		181		○		15 33 38 14
1.7	Very stiff to hard Reddish brown Moist										
	Weathered SHALE with LIMESTONE interbeds (BEDROCK) Red and grey		4	SS	85		180				
	Bedrock cored from depths of 3.3 m to 7.6 m. For bedrock coring details refer to Record of Drillhole PVMS-1.		5	SS	50/0.09						
			1	RC	REC 100%		179				RQD = 76%
			2	RC	REC 100%		178				RQD = 62%
			3	RC	REC 100%		177				RQD = 78%
175.1							176				
7.6	END OF BOREHOLE NOTE: 1. Open borehole dry upon completion of drilling and prior to rock coring.										

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

PROJECT: 10-1111-0211

RECORD OF DRILLHOLE: PVMS-1

SHEET 1 OF 1

LOCATION: N 4829752.90 ;E 285374.71

DRILLING DATE: July 12, 2015

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Truck-mounted CME - 75

DRILLING CONTRACTOR: Davis Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	WEATH-ERING INDEX	Diametral Point Load Index (MPa)	FEATURES	PIEZOMETER
		Continued from Record of Borehole PVMS-1		179.40															
4	NQRC July 12, 2015	Moderately to highly weathered, thinly bedded; red; non-porous, very weak SHALE, with thin interbeds of medium strong, grey LIMESTONE		3.29	1							BD,UN,SM BD,CU,SM	2 2	1 4					
5												BD,UN,SM BC,PL,SM BD,PL,SM BD,UN,SM BC,PL,SM	2 1 1 2 1	4 4 4 2 1					BC BC BC
6					2							CD,PL,RO JN,PL,SM	1.5 1	2 4					BC BC
7					3							BD,CU,RO BD,UN,RO	3 3	4 4					BC
												BD,PL,SM	1	4					UCS = 0.5 MPa
				175.07								CD,UN,RO	3	4					BC
		END OF DRILLHOLE		7.62								BD,UN,SM BD,UN,SM BD,ST,RO BD,UN,RO	2 2 3 3	2 1 1 1					

GTA-RCK 046 T:\PROJECTS\2010\10-1111-0211 (AECOM, MISSISSAUGA)\LOG\1011110211.GPJ GAL-MISS.GDT 8/31/15

DEPTH SCALE
1 : 75

Golder Associates

LOGGED: JIL
CHECKED: AB

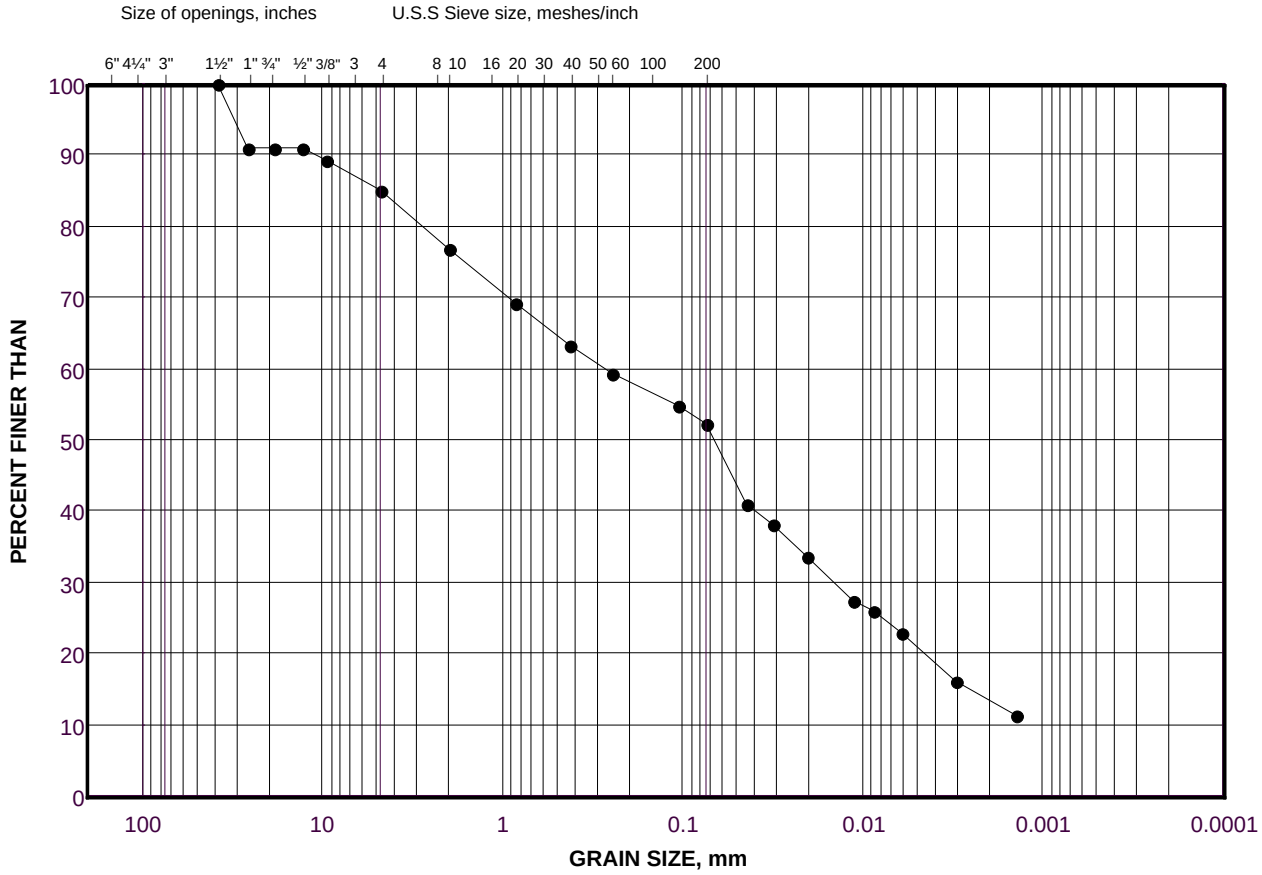
APPENDIX B

Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand (Till)

FIGURE B1



LEGEND

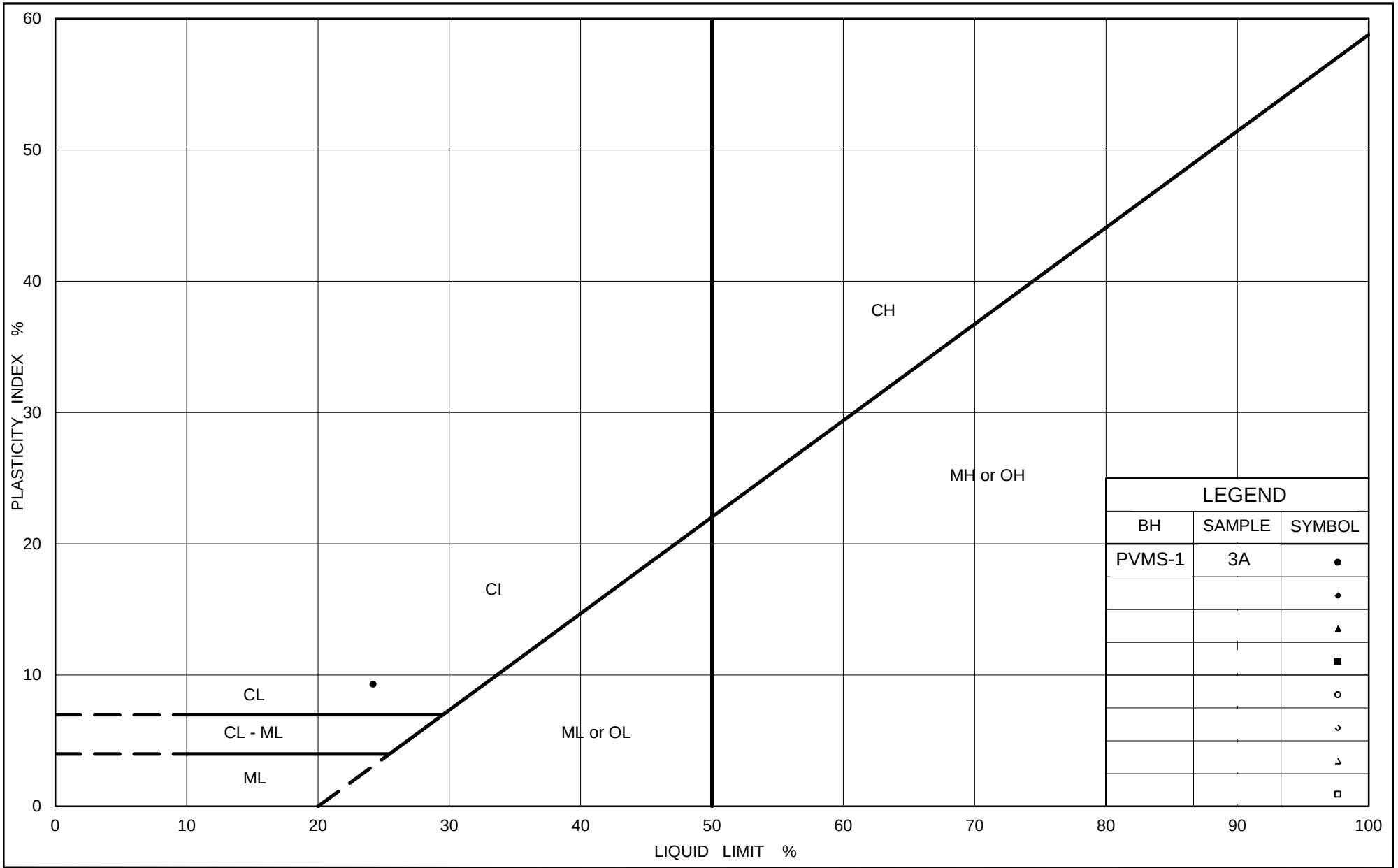
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	PVMS-1	3A	180.0

Project Number: 10-1111-0211

Checked By: AJS

Golder Associates

Date: 17-Aug-15



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PLASTICITY CHART
Clayey Silt (Till)

Figure No. B2

Project No. 10-1111-0211

Checked By: AJS

UNCONFINED COMPRESSION TEST (UC)

ASTM D7012

Figure B3

Part 1 of 2

SAMPLE IDENTIFICATION

PROJECT NUMBER	10-1111-0211	SAMPLE NUMBER	01
PROJECT NAME	AECOM / HWY 401 Widening / Mississauga	SAMPLE DEPTH, m	7.17-7.32
BOREHOLE NUMBER	PVMS-1	DATE:	07/14/15

TEST CONDITIONS

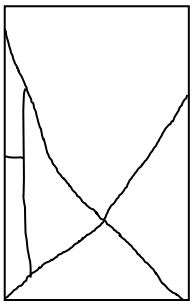
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.20

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.55	WATER CONTENT, (specimen) %	10.01
SAMPLE DIAMETER, cm	4.80	UNIT WEIGHT, kN/m^3	23.75
SAMPLE AREA, cm^2	18.08	DRY UNIT WT., kN/m^3	21.59
SAMPLE VOLUME, cm^3	190.79	SPECIFIC GRAVITY	-
WET WEIGHT, g	462.15	VOID RATIO	-
DRY WEIGHT, g	420.10		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	0.5

REMARKS:

Checked By: AJS

Golder Associates

UNCONFINED COMPRESSION TEST (UC)
ASTM D7012

Figure B3
Part 2 of 2

BEFORE COMPRESSION

AFTER COMPRESSION

Date July 13, 2015
Project 10-1111-0211

Golder Associates

Drawn Frank
Chkd. AJS

FORM PRODUCED JUNE 1986

Form GA-D-4 (imperial)

APPENDIX C

Record of Borehole from Previous Investigation

Ministry of Transportation
Ontario

277-01

THURBER

RECORD OF BOREHOLE No ~~OHS-01~~ 1 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION N 4 831 676.8 E 288 985.0 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
DATUM Geodetic DATE 2009.03.12 - 2009.03.12 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (40 80 120 160 200)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.8	Geodetic										
0.0	TOPSOIL (50mm)										
	Silty CLAY, trace to some sand, trace gravel Stiff Brown (FILL)		1	SS	9				○		
			2	SS	18		187		○		
186.3											
1.5	Silty CLAY, some sand, trace gravel, occasional oxidized staining Very Stiff Brown (TILL)		3	SS	29		186		○		2 41 42 15
			4	SS	25				○		3 48 40 9
	Grey		5	SS	20		185		○		
							184				
			6	SS	23		183		○		2 41 38 19
							182				
			7	SS	19				○		
							181				
			8	SS	32		180		○		1 39 41 19
							179				
178.4			9	SS	50/0.150						
9.4	END OF BOREHOLE AT 9.4m. BOREHOLE OPEN AND WATER LEVEL AT 2.8m UPON COMPLETION										

Continued Next Page

$+^3$. $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311HML.GPJ 6/4/09

Ministry of Transportation
Ontario

277-01

THURBER

RECORD OF BOREHOLE No OHS-01 2 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION N 4 831 676.8 E 288 985.0 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
DATUM Geodetic DATE 2009.03.12 - 2009.03.12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (40 80 120 160 200)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311HML.GPJ 8/4/09

APPENDIX D

Non-Standard Special Provisions

POLE MOUNTED VARIABLE MESSAGE SIGN SUPPORT FOUNDATIONS - Item No.

Special Provision

Where OPSS 903 is called up by OPSS 915, OPSS 903 is amended by the following. Where conflict occurs, this NSSP shall take precedence.

The Contractor shall construct the sign support foundations in conformance with the design and at the locations indicated in the Contract Documents.

The Contractor shall construct the sign support foundations against undisturbed base and sides of excavations. The base of caisson excavations shall be cleaned of loosened and/or softened materials prior to pouring concrete for the foundation. The construction methods and techniques shall be the responsibility of the Contractor, but consideration could be given to using temporary or permanent liners or tremie concreting techniques (or a combination thereof) where conditions warrant.

The Contractor is advised that variable subsurface conditions may be encountered at the sign locations. For bidding purposes, the Contractor should note that the overburden consists of cohesive and/or non-cohesive (sand to sand and gravel/clayey silt) fill underlain by cohesive deposit of clayey silt/silty clay till, underlain by shale and limestone bedrock. Till deposits are known to contain cobbles and boulders; and the "perched" groundwater level may be assumed to be near the ground surface. The Contractor may assume that the subsurface conditions at the sign caisson locations are generally similar to the closest of the boreholes, as illustrated in the Foundation Investigation Report.

Caisson foundations for PVMS01 will likely extend into the shale bedrock that contains layers of limestone. Appropriate construction procedures and equipment will be required to penetrate into the bedrock.

Basis of Payment

Payment at the lump sum contract price for this tender item shall be full compensation for all labour, equipment and materials for completion of the work.

END OF SECTION

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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