



**June 29, 2011**

**FOUNDATION INVESTIGATION AND DESIGN REPORT**

**VARIABLE MESSAGE SIGN #17  
HIGHWAY 11 SOUTHBOUND  
APPROXIMATELY 8.7 KM SOUTH OF HIGHWAY 101  
MATHESON, ONTARIO  
MINISTRY OF TRANSPORTATION, ONTARIO  
GWP 5122-06-00**

**Submitted to:**

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REPORT





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# PART A

FOUNDATION INVESTIGATION REPORT  
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## **1.0 INTRODUCTION**

Golder Associates Ltd. (Golder) has been retained by IBI Group (IBI) on behalf of Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for a variable message sign (VMS #17) on Highway 11 southbound in Matheson, Ontario. The general location of the site is shown on the Key Plan on Drawing 1.

The terms of reference for the scope of work were outlined in Golder's Proposal P0-1191-0006, dated February 5, 2010 that formed part of IBI's agreement (Number 5009-E-0018) for this project. The work was carried out in accordance with Golder's Quality Control Plan for this project dated August 23, 2010. The site plan was provided to Golder by Trow Geomatics Inc. (Trow) on behalf of IBI in March 2011.

We understand that the proposed variable message sign will be mounted on a single pole supported by a spread footing.

## **2.0 SITE DESCRIPTION**

The site of the proposed VMS #17 sign is located on the west side of Highway 11 at Station 12+750, approximately 8.7 km south of the intersection with Highway 101, south of Matheson, Ontario in the Township of Hislop. This section of Highway 11 consists of one northbound lane and one southbound lane. The southbound granular shoulder is approximately 3 m wide and a shallow drainage ditch parallels the gravel shoulder. The roadway embankment is about 1 m high above the bottom of the ditch and the ground surface at the proposed sign location is approximately Elevation 297 m.

The topography of the site generally consists of a relatively flat-lying area vegetated with trees and low-lying shrubs and grass. A bedrock outcrop is located on the west side of the adjacent highway ditch about 10 m north of the proposed sign location. The land use beyond about 100 m of the proposed sign location is mainly residential. Photographs of the site are presented on Figure 1.

## **3.0 INVESTIGATION PROCEDURES**

The subsurface investigation work for the VMS #17 structure was carried out on February 23 and 28, 2011, at which time one (1) sampled borehole, numbered BH-VMS#17, and seven (7) Dynamic Cone Penetration Tests (DCPTs), numbered DCPT-N1 to DCPT-N5, DCPT-S1 and DCPT-S2, were drilled at the locations shown on Drawing 1. Borehole BH-VMS#17 was drilled on the granular shoulder of the southbound lane and the DCPTs were advanced within the area between about 5 m north and about 3 m south of the borehole to delineate the depth to refusal in the vicinity of the borehole.

The foundation investigation was carried out using a track-mounted CME-55 drill rig supplied and operated by Landcore Drilling of Chelmsford, Ontario. The borehole was advanced to a depth of 7.5 m below ground surface, including 4.0 m of bedrock core, using 108 mm inner diameter (I.D.) hollow stem augers, HW casing and NQ coring equipment. Soil samples were obtained within the borehole at depth intervals of about 0.76 m, using a 50 mm outside diameter split-spoon sampler, where possible, in accordance with the Standard Penetration Test (SPT) procedures (ASTM D1586-08). The DCPTs were advanced to refusal at depths ranging from 0.8 m to 3.8 m below the existing ground surface except at DCPT-N3, which could not be advanced deeper than about 50 mm into the existing asphalt pavement. Details of the subsurface conditions encountered at the borehole location are shown on the Record of Borehole and Record Drillhole sheets in Appendix A. The borehole was backfilled with bentonite upon completion of drilling in accordance with Ontario Regulation 903 (as amended by O. Reg. 372).



The fieldwork was supervised throughout by a member of Golder's technical staff, who located the borehole and DCPTs, arranged for the clearance of underground services and for traffic protection, supervised the drilling, sampling and in situ testing operations, logged the boreholes and drillhole, and examined and cared for the soil and rock samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Sudbury geotechnical laboratory, where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM standards, as appropriate. Classification testing (water contents and grain size distributions) was carried out on selected soil samples. One Unconfined Compressive Strength (UCS) test was carried out on a sample of the bedrock core.

The boreholes were located in the field by Golder based on the position staked by IBI. The as-drilled borehole and DCPTs locations and the ground surface elevations (referenced to Geodetic datum) were subsequently surveyed by Trow and forwarded to Golder. The approximate borehole and DCPT locations are shown on Drawing 1 and the coordinates and ground surface elevations are provided below.

<b>Borehole Number</b>	<b>MTM NAD83 Zone 17 Northing (m)</b>	<b>MTM NAD83 Zone 17 Easting (m)</b>	<b>Ground Surface Elevation (m)</b>	<b>Depth Drilled (m)</b>
BH-VMS#17	5370345.2	349348.0	296.9	7.5
DCPT-N1	5370346.1	349344.9	296.4	0.8
DCPT-N2	5370347.2	349345.1	296.7	1.5
DCPT-N3	5370348.4	349345.6	297.0	0.0 (Asphalt Pavement)
DCPT-N4	5370346.3	349342.7	296.0	0.8
DCPT-N5	5370345.2	349346.1	296.5	1.2
DCPT-S1	5370340.6	349347.6	295.9	3.3
DCPT-S2	5370343.4	349348.0	296.7	3.8

## **4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY**

### **4.1 Regional Geology**

Based on terrain mapping by the Ontario Geological Survey<sup>1</sup>, the subsurface soils in the vicinity of the site consist of glaciolacustrine deposits comprised of silts, sands and gravels, bordering with areas of organic terrain and outcropping bedrock. The bedrock in the vicinity of the site is characterized in Ontario Ministry of Northern Development and Mines<sup>2</sup> maps as mafic to intermediate metavolcanic rocks or massive granodiorite to granite rocks of the Archean eon.

<sup>1</sup> Ontario Geological Survey, Ministry of Northern Development and Mines, and Northeast Science and Information Section, Ministry of Natural Resources 2005. Digital Northern Ontario Engineering Geology Terrain Study (NOEGTS); Ontario Geological Survey, Miscellaneous Release--Data 160.

<sup>2</sup> Ontario Ministry of Northern Development and Mines, Bedrock Geology of Ontario, East-Central Sheet, Map 2543.



## 4.2 Site Stratigraphy

Detailed descriptions of the subsurface soil, bedrock and groundwater conditions as encountered in the borehole advanced during this investigation, together with the results of the laboratory tests carried out on selected samples, are given on the attached Record of Borehole and Drillhole sheets in Appendix A. The stratigraphic boundaries shown on the Record of Borehole and Drillhole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of SPTs. These boundaries, therefore, represent transitions between material types rather than exact planes of geological change. Further, subsurface conditions will vary beyond the borehole location. Refusal elevations of the DCPTs are shown on Drawing 1.

In summary, the subsoil conditions at the site consist of sand and gravel fill (roadway shoulder material) underlain by deposits of sand and silt and sandy gravel, underlain by bedrock. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

### 4.2.1 Fill

A 0.8 m thick layer of moist, brown sand and gravel fill was encountered from ground surface in the borehole at Elevation 296.9 m.

### 4.2.2 Sand and Silt

A deposit of moist, brown sand and silt containing some gravel and trace to some clay was encountered underlying the sand and gravel fill. The sand and silt deposit is 1.4 m thick and the top of the deposit was encountered at Elevation 296.1 m.

Two SPT 'N'-values measured in this deposit are 25 blows per 0.1 m of penetration and 38 blows per 0.3 m of penetration indicating a dense relative density. The high N-value recorded at the top of the deposit was likely the result of the granular deposit being frozen.

A grain size distribution test was carried out on one sample of the sand and silt and the test result is presented on Figure B-1.

The natural water content measured on one sample of the sand and silt is 12 percent.

### 4.2.3 Sandy Gravel

A deposit of wet, grey sandy gravel containing trace silt was encountered underlying the sand and silt at a depth of 2.2 m below existing ground surface. The sandy gravel deposit is 1.3 m thick and the top of the deposit was encountered at Elevation 294.7 m. The bottom of the deposit was defined by bedrock coring.

The SPT 'N'-values measured in the sandy gravel deposit are 45 blows and 79 blows per 0.3 m of penetration indicating a dense to very dense relative density.

A grain size distribution test was carried out on one sample of the sandy gravel and the test result is presented on Figure B-2.

The natural water content measured on one sample of the sandy gravel is 7 percent.



#### 4.2.4 Bedrock/Refusal

Bedrock was encountered at a depth of 3.5 m below ground surface, corresponding to Elevation 293.4 m, and cored for a length of 4.0 m in Borehole BH-VMS#17. Based on a review of the bedrock core samples, the bedrock generally consists of fine to coarse grained, pinkish grey gneiss. The upper 1.2 m of the bedrock core was moderately weathered (i.e. highly fractured) and the lower portion of the bedrock was slightly weathered.

The Rock Quality Designation (RQD) value measured on the upper 1.2 m of bedrock core sample is 10 percent indicating a very poor quality rock in accordance with Table 3.10 of the 2006 Canadian Foundation Engineering Manual (CFEM)<sup>3</sup>. The RQD of the lower 2.8 m of the recovered bedrock core is 54 percent and 90 percent for the 1.3 m and 1.5 m long core runs, indicating the rock is of fair to good quality.

One UCS test on a sample of the rock core measured a UCS of 113 MPa, indicating the rock is very strong, in accordance with Table 3.5 of the 2006 CFEM.

On the north side of Borehole BH-VMS#17, each of the DCPTs encountered refusal on probable bedrock at depths between 0.8 and 1.5 m below ground surface, between Elevation 295.6 m and 295.2 m, except at DCPT-N3 as noted previously, which could not be advanced through the pavement structure. On the south side of the borehole, refusal was encountered at depths of 3.3 m and 3.8 m below ground surface, corresponding to Elevation 292.6 m and 292.9 m, at DCPT-S1 and DCPT-S2, respectively.

#### 4.2.5 Groundwater Conditions

Details of the groundwater conditions and water level observed in the open borehole at the time of drilling are summarized on the Record of Borehole sheet in Appendix A. The groundwater level observed in the open borehole, prior to the start of bedrock coring, was measured at a depth of 1.9 m below the existing ground surface, corresponding to Elevation 295.0 m. It should be noted that this water level does not represent the stabilized water level and that the groundwater elevation will fluctuate seasonally depending on precipitation and local soil permeability and should be expected to rise during wet periods of the year.

### 5.0 CLOSURE

The fieldwork was carried out under the direction of Mr. David Muldowney, EIT, who also prepared this report. The technical aspects were reviewed by Mr. André Bom, P.Eng., and Mr. Jorge M.A. Costa, P.Eng., a Principal with Golder. Mr. Costa, also a Designated MTO Contact for Golder, conducted a quality control review of the report.

<sup>3</sup> Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4<sup>th</sup> Edition.

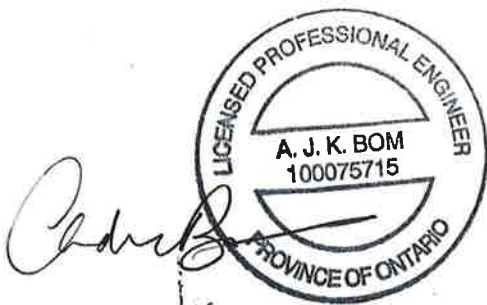


## Report Signature Page

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# PART B

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VARIABLE MESSAGE SIGN #17, HIGHWAY 11 SOUTHBOUND  
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## 6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

### 6.1 General

This section of the report provides foundation design recommendations for the proposed variable message sign (VMS #17). The recommendations are based on interpretation of the factual data obtained from the borehole and DCPTs advanced during the subsurface investigation at this site and from site observations. The interpretation and recommendations provided are intended only to provide the designers with sufficient information to assess feasible foundation design alternatives and to design the proposed sign foundation. As such, where comments are made on construction, they are provided only in order to highlight those aspects which could affect the planning of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods, scheduling and the like.

### 6.2 Sign Foundation

We understand the proposed sign will be located on the west side of Highway 11 with the centre of the footing located approximately 4.5 m from the edge of the pavement at Station 12+750 facing the southbound traffic.

Borehole BH-VMS#17 was advanced at Station 12+750 approximately 0.9 m from the centre of the proposed sign location (i.e. approximately 3.6 m from the edge of the pavement) and encountered sand and gravel fill to a depth of 0.8 m below the existing ground surface, sand and silt to a depth of 2.2 m and sandy gravel to a depth of 3.5 m, underlain by bedrock at Elevation 293.4 m. DCPT refusal on probable bedrock was encountered at depths between 0.8 m and 1.5 m, between Elevation 295.6 m and 295.2 m, on the north side of the proposed borehole and at a depth of 3.3 m and 3.8 m, corresponding to Elevation 292.6 m and 292.9 m, on the south side of the borehole. The unstabilized groundwater level prior to the start of bedrock coring was measured in BH-VMS#17 at a depth of 1.9 m below ground surface, corresponding to Elevation 295.0 m.

Overhead sign supports are typically designed with a standard caisson foundation in accordance with the requirements in MTO's *Sign Support Manual* (2007). The foundation for the sign support can be designed as caissons socketted into the rock or, alternatively, the sign can be supported on a spread footing founded on the native soil or founded on the bedrock surface. Recommendations for these foundation options are provided in Sections 6.2.1 and 6.2.2.

Table 1 (attached) summarizes the advantages, disadvantages, relative costs and risks/consequences of the foundation alternatives. Given the subsurface conditions at this sign location, a spread footing founded on the native soils is considered to be the preferred option from a foundations perspective.

#### 6.2.1 Caisson Foundation

It may be difficult to socket the caisson into the very strong gneiss bedrock at this site. Further, we understand from IBI's structural designer that the current proposed sign is larger and different in configuration than the standard Changeable Message Sign in the *Sign Support Manual* and a non-standard design would be required. As caissons are not the preferred alternative, the specific design parameters (i.e. axial and lateral resistances) for a caisson foundation have not been included in this report.



### 6.2.2 Spread Footing

We understand from IBI that the preferred alternative foundation design for the support of VMS #17 is a spread footing and we have assumed for design purposes that the footing will have dimensions of 5 m long and 2.5 m wide.

Two foundation alternatives could be considered for the proposed spread footing: a foundation on native cohesionless soil; or a foundation on bedrock. Although bedrock was not proven/cored in the area of the shallow DCPTs to the north of Borehole BH-VMS#17, the refusal condition at each of the DCPTs is likely on bedrock, considering that a bedrock outcrop is exposed on the west side of the highway immediately to the north of the proposed sign location. Based on DCPTs S1 and S2 put down to the south of the borehole, refusal to further penetration was encountered at a depth similar to that of BH-VMS#17 but as a slightly lower elevation suggesting that the bedrock surface is sloping down to the south. Therefore, to ensure that the footing is fully founded on overburden, the sign foundation could be located further to the south of the presently proposed location to the area of DCPT-S2 that is about 2 m to the south.

Founding the footing on bedrock eliminates the need for frost cover as bedrock is considered not frost susceptible. However, at the presently proposed location, the excavation for the spread footing would be deeper to reach bedrock, require dewatering and potentially encroaching into the roadway. Moving the sign location further to the north about 5 m has the advantage of founding the footing on bedrock at shallow depth, thus avoiding the requirement for shoring adjacent to the existing roadway, and reducing the depth of sub-excavation below the groundwater level depending on the season of construction. However, the disadvantage of a spread footing constructed on the bedrock is likely the requirement for bedrock sub-excavation or mass concrete / dowels to prepare a level founding surface for the sign foundation. Should founding the footing on bedrock be considered at an alternative location north of the presently proposed location, then an additional borehole will be required in the area of shallow refusal to confirm/delineate the bedrock surface elevation and its characteristics. As such, we recommend that the footing for VMS #17 be founded on native cohesionless soils and, as a result, a spread footing constructed on bedrock has not been considered further in this report.

The non-stabilized groundwater level in Borehole BH-VMS#17 prior to the start of bedrock coring was encountered at a depth of 1.9 m below the existing ground surface and will vary depending on the season of construction. As shown on the depth of frost penetration isopleths for Northern Ontario in OPSD 3090.100 (Foundation Frost Penetration Depth), the depth of frost penetration for the Matheson area is approximately 2.4 m. At a depth of 2.4 m, that is Elevation 294.5 m, the footing will be founded within the dense to very dense sandy gravel and likely about 0.5 m below the groundwater level depending on the season of construction.

An open cut excavation may not be practical for the proposed footing construction due to the anticipated shallow groundwater level and the proximity of Highway 11 adjacent to the proposed excavation. Should an open cut excavation be proposed at this site, the excavation should be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OSHA) for Construction Projects. When referencing OSHA, the fill material and the native sand and silt soil may be classified as "Type 3 Soil". The dense to very dense sandy gravel is classified as "Type 2 Soil". Therefore, based on the subsurface conditions at the borehole location, the excavation should be carried out with side slopes no steeper than 1 horizontal to 1 vertical (1H:1V) from the ground surface to within 1.2 m of the bottom of excavation and vertical to the bottom of excavation, provided that the groundwater level is lowered to not less than 0.3 m below the base of excavation. Depending on the groundwater level at the time of construction, the excavation side slopes may have to be flatter (i.e. 2H:1V).



Shoring will likely not be practical at this site based on the shallow depth to bedrock at the proposed sign location. A trench box will likely be the most feasible method of worker protection for the excavation at this site; however, the groundwater level will have to be lowered to not less than 0.3 m below the base of excavation. As discussed with IBI, the Contractor should be alerted to the shallow bedrock conditions at the site, as noted in the NSSP in Appendix C.

The base of the excavation should be free of water and loose soil prior to placing concrete. Should the material(s) at bearing level become saturated or disturbed, we recommend that the affected material be removed immediately prior to placing concrete. We recommend that the prepared subgrade be protected using a minimum 100 mm thick concrete working slab as detailed in the NSSP included in Appendix C. As discussed with IBI, as an alternative to the placement of a concrete working slab at this site, consideration could be given to the placement of a Granular 'B' Type II working pad, meeting the requirements of MTO's Special Provision (SP) SP110S13 (Aggregates). The use of Granular 'A' is not recommended at this site based on the unstabilized water level encountered during drilling at the borehole.

Inspection and approval of the foundation area by the Quality Verification Engineer prior to placement of the working slab or pad and footing construction should be specified in the Contract to be carried out in accordance with OPSS 902 (Excavating and Backfilling) to confirm and approve the subgrade has been properly prepared for the placement of concrete.

During construction, stockpiles of excavated and backfill materials should be placed well away from the edge of the excavation, and the height of the stockpiles should be controlled so as not to surcharge the sides of the excavation and/or overall slope. Generally, for this site, the distance between the crest of the excavation and the toe of the stockpile should generally be greater than the diameter of the base of the stockpile.

### 6.2.3 Geotechnical Resistance

Spread footings, constructed on a properly prepared subgrade at Elevation 294.5 m on the dense to very dense sandy gravel deposit or Elevation 295.0 m on the dense sand and silt deposit may be designed based on a factored geotechnical resistance of 700 kPa at Ultimate Limit States (ULS) for a 5 m long by 2.5 m wide rectangular footing. For the same spread footing dimensions indicated above, a geotechnical resistance at Serviceability Limit States of 300 kPa (based on a total settlement of 25 mm) may be used.

The ULS resistance and settlement are dependent on the footing size, configuration and applied loads. The geotechnical resistances should, therefore, be reviewed if the selected footing dimensions or founding depth differs from those given above.

The geotechnical resistances provided above are given for loadings applied perpendicular to the surface of the footings. Where the load is not applied perpendicular to the surface of the footing, inclination of the load should be taken into account in accordance with Clauses 6.7.4 and C6.7.4 of the *Canadian Highway Bridge Design Code (CHBDC, 2006)* and the related commentary.

### 6.2.4 Resistance to Lateral Loads

For a concrete working slab on the native soils at this site or a cast-in-place footing constructed on a granular working pad, a coefficient of friction,  $\tan \phi'$ , equal to 0.58 should be used in assessing lateral forces/sliding resistance between the concrete and the subgrade soil. For a precast concrete footing constructed on the native subgrade soil or granular working pad, a coefficient of friction,  $\tan \delta$ , equal to 0.45 should be used in assessing lateral forces/sliding resistance between the concrete and the subgrade.



### **6.3 Construction Considerations**

The excavation around and above the spread footing may be backfilled using an approved granular material such as SP110S13 (Aggregates) Granular 'B' (Type I or II) or Granular 'A' placed in 0.3 mm thick loose lifts and uniformly compacted to not less than 95 percent of the SPMDD of the material.

The final grade surrounding the sign should be sloped to promote surface water drainage and pavement structure drainage away from the pavement and sign, to the adjacent ditch. It is recommended that the regraded slope and pad around the sign support be surfaced with R-10 Rip-Rap in accordance with OPSS 1004 (Aggregates – Miscellaneous) to reduce the potential for erosion of the slope locally, especially if the slope/pad consists of soil, Granular 'B' Type I or Granular 'A' material.

### **7.0 CLOSURE**

This report was prepared by Mr. David Muldowney, EIT, and Mr. André Bom, P.Eng. The technical aspects were reviewed by Mr. Jorge M.A. Costa, P.Eng., a Principal with Golder. Mr. Costa, also a Designated MTO Contact for Golder, conducted a quality control review of the report.

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- Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, Fourth Edition.
- Canadian Highway Bridge Design Code (CHBDC) and Commentary on CAN/CSA S6-06, 2006. CSA Special Publication, S6.1-06. Canadian Standard Association.
- Ministry of Transportation, Ontario, 2007. Sign Support Manual. Policy, Planning & Standards Division, Engineering Standards Branch, Bridge Office, April 2007.
- Occupational Health and Safety Act and Regulation for Construction Projects, January 2006.

## STANDARDS

### ASTM International

- |               |   |
|---------------|---|
| ASTM D1586-08 | Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils |
|---------------|---|

### Ministry of Transportation Ontario Special Provisions

- |           |  |
|-----------|--|
| SP 110S13 | Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material |
|-----------|--|

### Ontario Provincial Standard Drawings

- |               |  |
|---------------|--|
| OPSD 3090.100 | Foundation Frost Penetration Depths for Northern Ontario |
|---------------|--|

### Ontario Provincial Standard Specifications

- |           |  |
|-----------|--|
| OPSS 902  | Construction Specification for Excavating and Backfilling – Structures |
| OPSS 1004 | Material Specification for Aggregates – Miscellaneous                  |

### Ontario Water Resources Act

- |                           |                                     |
|---------------------------|-------------------------------------|
| Ontario Regulation 372/07 | Amendment to Ontario Regulation 903 |
| Ontario Regulation 903/90 | Wells                               |



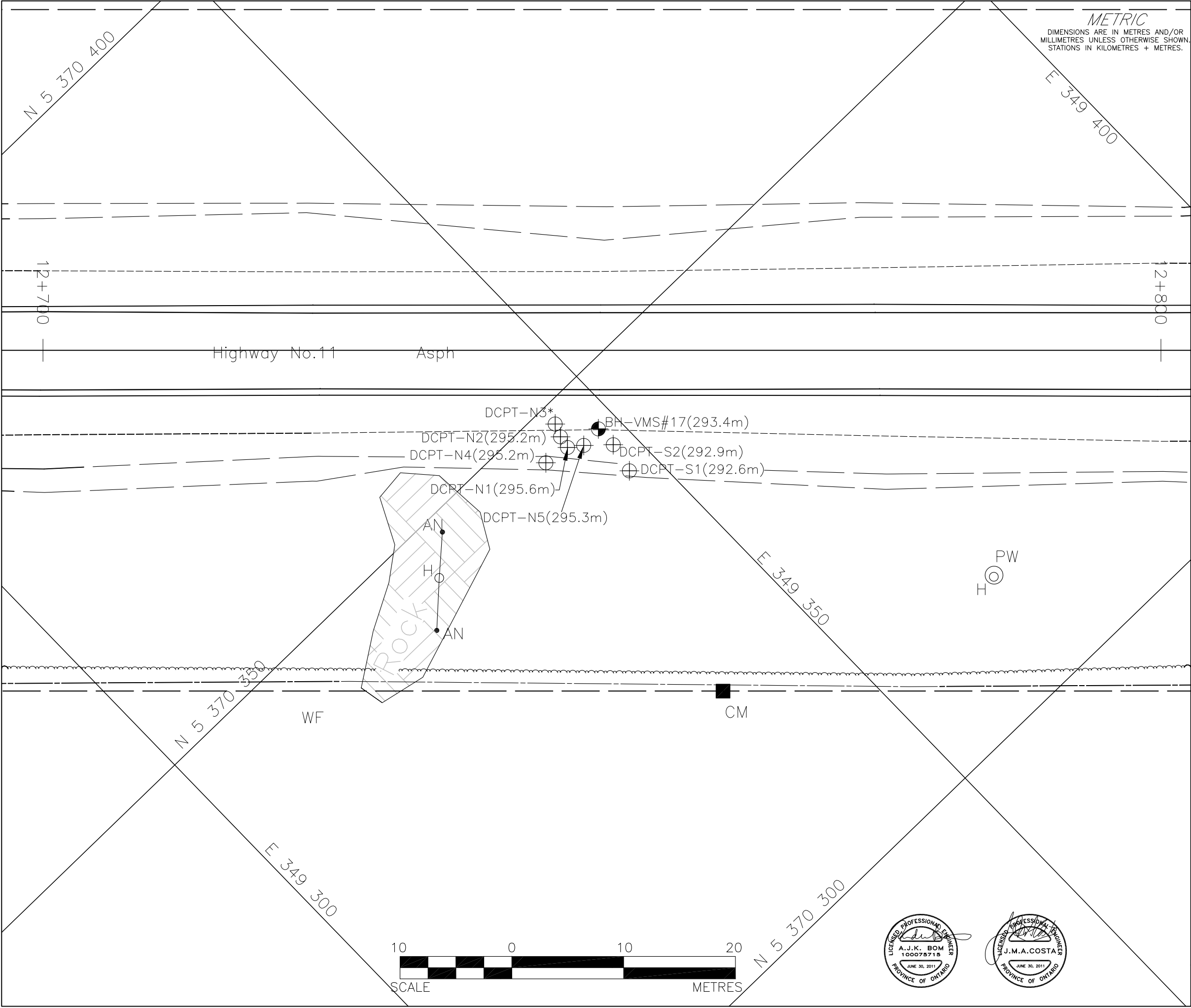


Table 1: Evaluation of Foundation Alternatives

Options	Rank	Advantages	Disadvantages	Relative Costs	Risks/Consequences
Spread Footing on Native Cohesionless Soil	1	<ul style="list-style-type: none"><li>■ Conventional construction.</li><li>■ Bedrock excavation not required if footing location moved about 2 m to the south of the presently proposed location.</li></ul>	<ul style="list-style-type: none"><li>■ Lower geotechnical resistances available on the native soils.</li><li>■ Will likely require dewatering of excavation.</li><li>■ Frost protection soil cover required for footing.</li><li>■ Excavation to footing founding level encroaches into travelled/paved roadway lane.</li></ul>	<ul style="list-style-type: none"><li>■ Much lower overall cost compared to caissons.</li><li>■ Additional costs required for granular working pad or concrete working slab, dewatering and/or insulation.</li><li>■ Depending on whether roadway temporary protection shoring is required, cost may be similar to footings on bedrock.</li></ul>	<ul style="list-style-type: none"><li>■ Risk of dewatering during construction depending on season of construction.</li></ul>
Spread Footings Founded on Bedrock Surface	2	<ul style="list-style-type: none"><li>■ Conventional construction.</li><li>■ High geotechnical axial resistances available on the very strong bedrock.</li><li>■ Increased excavation and dewatering requirements unless sign location is moved north about 5 m.</li><li>■ Frost cover protection not required for footings on bedrock.</li></ul>	<ul style="list-style-type: none"><li>■ Additional investigation will be required to confirm bedrock surface elevation and bedrock characteristics if sign location is moved northerly about 5 m.</li><li>■ Sloping bedrock may require a levelling concrete pad and/or anchors/dowels for footing construction depending on size of footing, or bedrock excavation to achieve a level surface as a footing base.</li></ul>	<ul style="list-style-type: none"><li>■ Much lower overall cost compared to caissons.</li><li>■ Additional costs may be required for bedrock excavation, levelling concrete pad and/or dowels compared to a footing on native soil.</li></ul>	<ul style="list-style-type: none"><li>■ Difficulties excavating bedrock.</li><li>■ Larger volumes of mass concrete and/or anchors/dowels for lateral sliding resistance if bedrock is sloping.</li></ul>
Caissons Socketted into Bedrock	3	<ul style="list-style-type: none"><li>■ High bearing resistances available in the very strong bedrock.</li><li>■ Dewatering not required but would need temporary liner and tremie concrete placement.</li></ul>	<ul style="list-style-type: none"><li>■ Non-standard caisson design is required.</li><li>■ Requires specialized drilling equipment into bedrock.</li><li>■ May require a levelling pad (fill or excavation of slope) to accommodate drilling equipment.</li></ul>	<ul style="list-style-type: none"><li>■ Cost many times higher than spread footings.</li></ul>	<ul style="list-style-type: none"><li>■ Difficulties socketting large diameter hole into bedrock.</li></ul>

Note: This table should be read in conjunction with the Foundation Investigation and Design Report.

Compiled by: AB Reviewed by: JMAC



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

CONT No.  
WP No.5122-06-00

SHEET

VARIABLE MESSAGE SIGN #17  
HIGHWAY 11 SOUTHBOUND, MATHESON  
BOREHOLE AND DCPT LOCATIONS

Golder Associates Ltd.  
SUDBURY, ONTARIO, CANADA

KEY PLAN  
N.T.S.

LEGEND

BH-VMS#17  
(293.4m)

Borehole Location  
(Bedrock Surface Elevation)

DCPT-N  
(295.6m)

Dynamic Cone Penetration Test  
Location (Refusal Elevation)

No.	ELEVATION(m)	CO-ORDINATES	
		NORTHING	EASTING
BH-VMS#17	296.9	5370345.2	349348.0
DCPT-N1	296.4	5370346.1	349344.9
DCPT-N2	296.7	5370347.2	349345.1
DCPT-N3	297.0	5370348.4	349345.6
DCPT-N4	296.0	5370346.3	349342.7
DCPT-N5	296.5	5370345.2	349346.1
DCPT-S1	295.9	5370340.6	349347.6
DCPT-S2	296.7	5370343.4	349348.0

\* DCPT-N3 could not be advanced through the pavement.

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

Key plan provided in digital format by IBI, drawing file no.TM-TWG-keyplan.dwg, received December 7, 2010

Base plan provided in digital format by TROW Geomatics inc, drawing file no.VMS17A.dwg, received March 7, 2010

Geocres No.42A-B3

A.J.K. BOM  
100075715  
JUNE 30, 2011  
PROVINCE OF ONTARIO

J.M.A. COSTA  
100075715  
JUNE 30, 2011  
PROVINCE OF ONTARIO



Figure 1 – Photographs of VMS #17 Site, Matheson

**Photograph 1: Looking north from sign location**



**Photograph 2: Looking south from sign location**





# APPENDIX A

## Record of Borehole and Drillhole



## LIST OF SYMBOLS

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

### 1. GENERAL

$\pi$	3.1416
$\ln x$ ,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	Factor of Safety
V	volume
W	weight

### II. STRESS AND STRAIN

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

### III. SOIL PROPERTIES

#### (a) Index Properties

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

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

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

w	water content
$w_l$	liquid limit
$w_p$	plastic limit
$I_p$	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
$C_a$	coefficient of secondary consolidation
$m_v$	coefficient of volume change
$c_v$	coefficient of consolidation
$T_v$	time factor (vertical direction)
U	degree of consolidation
$\sigma'_p$	pre-consolidation pressure
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

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

**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
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### II. PENETRATION RESISTANCE

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

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

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

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

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

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

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

### III. SOIL DESCRIPTION

#### (a) Cohesionless Soils

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

#### (b) Cohesive Soils Consistency

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

### IV. SOIL TESTS

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

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

### V. MINOR SOIL CONSTITUENTS

Percent 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 (cohesionless) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand





## LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

### WEATHERING 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 texture and structure are preserved.

### BEDDING THICKNESS

<u>Description</u>	<u>Bedding Plane Spacing</u>
Very thickly bedded	> 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	< 6 mm

### JOINT OR FOLIATION SPACING

<u>Description</u>	<u>Spacing</u>
Very wide	> 3 m
Wide	1 – 3 m
Moderately close	0.3 – 1 m
Close	50 – 300 mm
Very close	< 50 mm

### GRAIN SIZE

<u>Terms</u>	<u>Size*</u>
Very Coarse Grained	> 60 mm
Coarse Grained	2 – 60 mm
Medium Grained	60 microns – 2 mm
Fine Grained	2 – 60 microns
Very Fine Grained	< 2 microns

\* Note: Grains > 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 varies 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 separation) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

#### Dip with Respect to (W.R.T.) Core Axis





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

#### Description and Notes

An abbreviated description of the discontinuities, whether naturally occurring separation such as fractures, bedding planes and foliation planes or mechanically induced fractures 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

B - Bedding	⊥ - Perpendicular To
FO - Foliation / Schistosity	- Parallel To
CL - Cleavage	P - Polished
SH - Shear Plane / Zone	K - Slickensided
VN - Vein	SM - Smooth
F - Fault	R - Rough
CO - Contact	ST - Stepped
J - Joint	PL - Planar
FR - Fracture	U - Undulating
MF - Mechanical Fracture	C - Curved

PROJECT		10-1191-0006				<b>RECORD OF BOREHOLE No BH-VMS#17</b>				1 OF 1 <b>METRIC</b>							
W.P.		5122-06-00		LOCATION		N 5370345.2; E 349348.0				ORIGINATED BY		DAM					
DIST		HWY 11		BOREHOLE TYPE		108 mm I.D. Continuous Flight Hollow Stem Augers, HW Casing, NQ Coring				COMPILED BY		DAM					
DATUM		GEODETIC		DATE		February 28, 2011				CHECKED BY		AB					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
296.9	GROUND SURFACE						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
0.0	Sand and gravel, trace silt(FILL) Brown Moist		1	AS	-												
296.1	SAND and SILT, some gravel, trace to some clay Dense Brown to grey Moist		2	SS	250.1												
0.8			3	AS	-												
			4	SS	38												
294.7	Sandy GRAVEL, trace silt Dense to very dense Grey Wet		5	SS	45												
2.2			6	SS	79												
293.4	GNEISS (BEDROCK)		1	RC	REC 70%												
3.5	Bedrock cored from 3.5 m depth to 7.5 m depth.  For coring details see Record of Drillhole BH-VMS#17.		2	RC	REC 100%												
			3	RC	REC 100%												
289.4	END OF BOREHOLE																
7.5	Notes:  1. Water level measured at a depth of 1.9 m below existing ground surface (Elev. 295.0 m) prior to coring bedrock.  2. Seven (7) Dynamic Cone Penetration Tests (DCPTs) were advanced in the vicinity of the borehole. For refusal information see Drawing 1.																



PROJECT: 10-1191-0006

**RECORD OF DRILLHOLE: BH-VMS#17**

SHEET 1 OF 1

LOCATION: HWY 11 MATHESON S.B.L.

DRILLING DATE: February 28, 2011

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	FLUSH														DISCONTINUITY DATA										HYDRAULIC CONDUCTIVITY				Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
							RECOVERY		R.Q.D. %	FRACT. INDEX METRES	TYPE AND SURFACE DESCRIPTION						Jr		Ja		Jn		k, cm/s																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	R.O.	S.D.	C.S.	O.S.	Jr	Ja	Jn	10	20	30	40	50																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
							JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate	BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage																	PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular	PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break	BR - Broken Rock																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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DEPTH SCALE

1 : 50

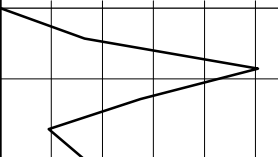



LOGGED: DAM

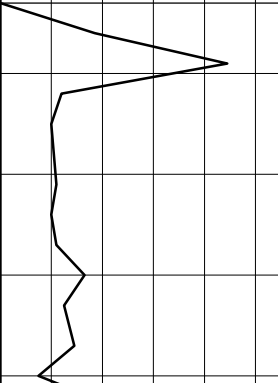
CHECKED: AB

SUD-RCK 1011910006.GPJ GAL-MISS.GDT 28/06/11 DATA INPUT:

PROJECT <u>10-1191-0006</u>		<b>RECORD OF PENETRATION TEST No DCPT-N2</b>		1 OF 1 <b>METRIC</b>	
W.P. <u>5122-06-00</u>		LOCATION <u>HWY 11 MATHESON S.B.L.</u>		ORIGINATED BY <u>DAM</u>	
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>DYNAMIC CONE PENETRATION TEST</u>		COMPILED BY <u>JJL</u>	
DATUM <u>GEODETIC</u>		DATE <u>February 28, 2011</u>		CHECKED BY <u>AB</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED			
296.7 0.0	GROUND SURFACE						296				
295.2 1.5	END OF DCPT REFUSAL TO FURTHER PENETRATION (HAMMER BOUNCING)										

PROJECT <u>10-1191-0006</u>		<b>RECORD OF PENETRATION TEST No DCPT-S2</b>		1 OF 1 <b>METRIC</b>	
W.P. <u>5122-06-00</u>		LOCATION <u>HWY 11 MATHESON S.B.L.</u>		ORIGINATED BY <u>DAM</u>	
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>DYNAMIC CONE PENETRATION TEST</u>		COMPILED BY <u>JJL</u>	
DATUM <u>GEODETIC</u>		DATE <u>February 28, 2011</u>		CHECKED BY <u>AB</u>	

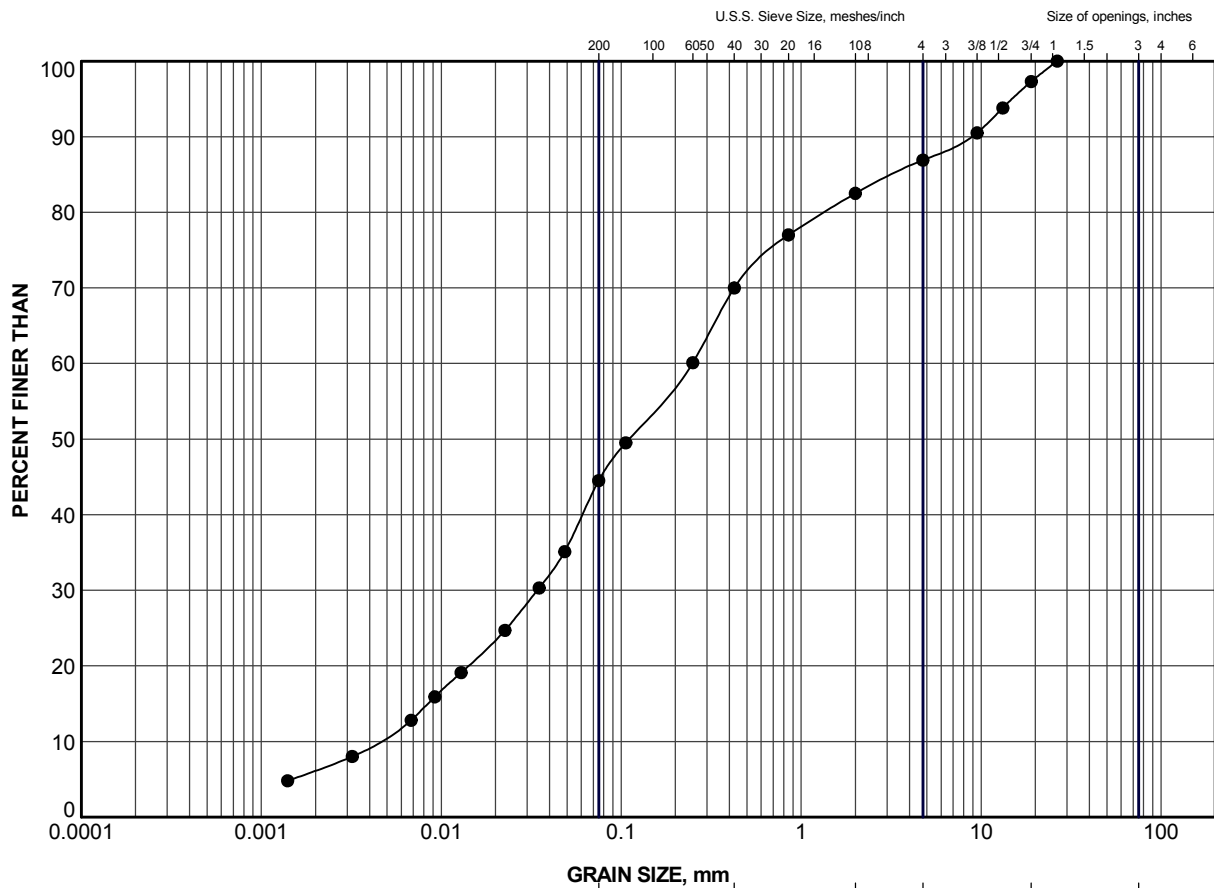
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
296.7 0.0	GROUND SURFACE											kN/m <sup>3</sup>	GR SA SI CL
292.9 3.8	END OF DCPT REFUSAL TO FURTHER PENETRATION (HAMMER BOUNCING)												

SUD-MTO 002 1011910006.GPJ GAL-MISS.GDT 28/06/11 DATA INPUT:



# APPENDIX B


## Laboratory Test Results

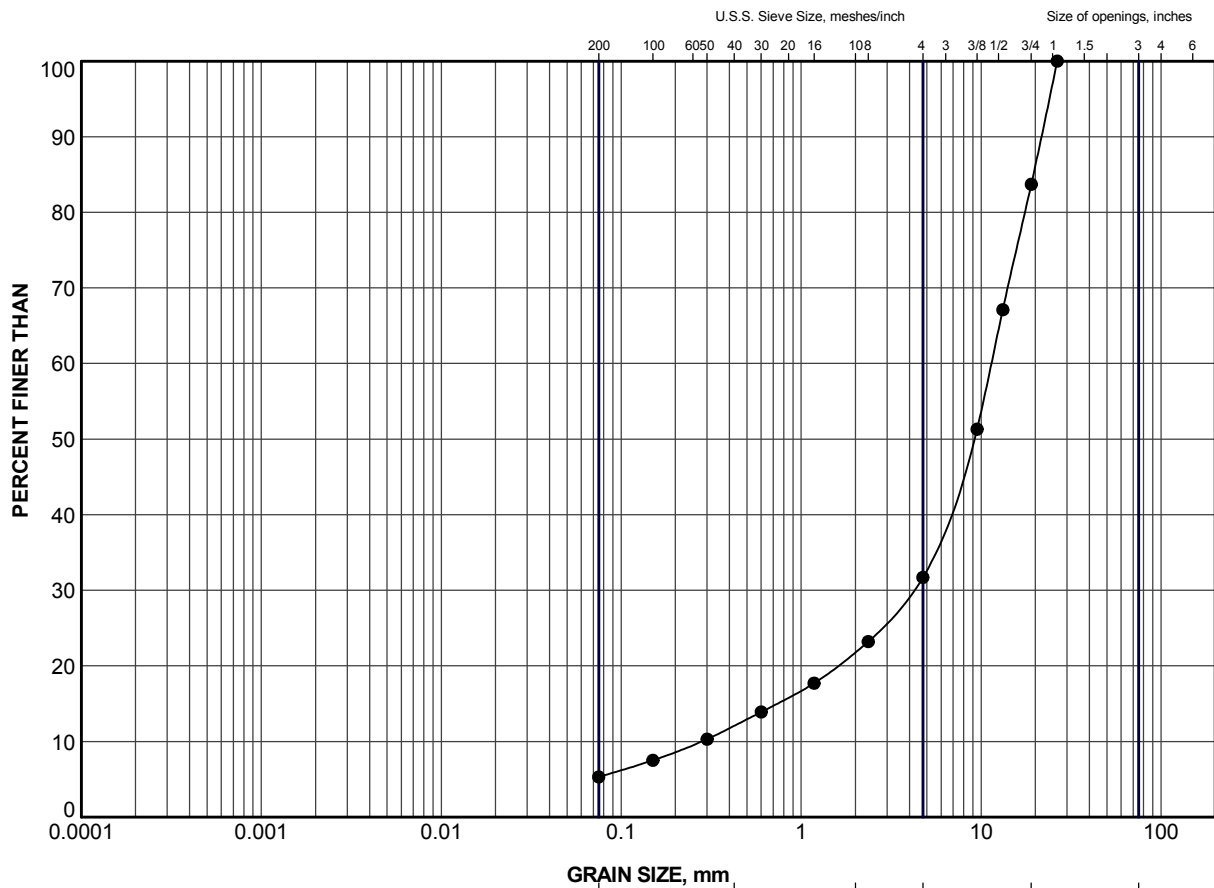


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BH-VMS#17	3	295.8


PROJECT					
HIGHWAY 11 SOUTHBOUND VMS #17					
TITLE					
GRAIN SIZE DISTRIBUTION					
SAND AND SILT					
 <b>Golder Associates</b> SUDBURY, ONTARIO		PROJECT No.		10-1191-0006	
		FILE No.		1011910006.GPJ	
		DRAWN	JJL	Jun 2011	SCALE N/A
		CHECK	AB	Jun 2011	REV.
		APPR		Jun 2011	
<b>FIGURE B-1</b>					



GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BH-VMS#17	5	294.3

PROJECT					
HIGHWAY 11 SOUTHBOUND VMS #17					
TITLE					
GRAIN SIZE DISTRIBUTION					
SANDY GRAVEL					
PROJECT No.		10-1191-0006		FILE No. 1011910006.GPJ	
DRAWN	JJL	Jun 2011	SCALE	N/A	REV.
CHECK	AB	Jun 2011			
APPR		Jun 2011			
 <b>Golder Associates</b> SUDBURY, ONTARIO			<b>FIGURE B-2</b>		



# APPENDIX C

## Non-Standard Special Provisions (NSSP)



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## **WORKING SLAB – Item No.**

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### **Non-Standard Special Provision**

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#### **Scope of Work**

This Special Provision covers the requirements for the supply and placement of a concrete working slab on a soil subgrade under the structure foundation for VMS #17. The purpose of the working slab is to protect the subgrade from disturbance and loosening due to construction traffic and ponded water and also to provide a level working surface.

#### **Construction**

##### Protection of Founding Soil

- Following inspection and approval of the prepared soil subgrade by the Quality Verification Engineer, a working slab, with a minimum thickness of 100 mm shall be placed on the foundation subgrade as per the contract drawings and documents. The concrete shall have a minimum 28 day compressive strength of 20 MPa.

Unwatering of the excavation for the footing construction might be required, including the construction of the working slab and shall be done in such a manner as to prevent any disturbance to the surrounding original soil.

#### **Basis of Payment**

Payment at the Contract Price for the above tender item includes full compensation for all labour, equipment and material to do the required work.



## **ROADWAY PROTECTION**

### **Non-Standard Special Provision**

The Contactor is hereby notified that bedrock is exposed north of the proposed VMS #17 sign footing location and will likely be shallow on the north side of the footing. Design and installation of the roadway protection system for foundation excavation and construction should take into account the shallow bedrock surface in the vicinity of the proposed sign.

END OF SECTION



At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. 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 now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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