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REPORT ON

**FOUNDATION INVESTIGATION AND DESIGN
VARIABLE MESSAGE SIGN #8
HIGHWAY 11 NORTHBOUND, 0.4 KM NORTH OF MCKEOWN AVENUE
G.W.P 5671-04-00
MINISTRY OF TRANSPORTATION, ONTARIO
NORTH BAY, ONTARIO**

Submitted to:

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PART A

**FOUNDATION INVESTIGATION REPORT
VARIABLE MESSAGE SIGN #8
HIGHWAY 11 NORTHBOUND, 0.4 KM NORTH OF MCKEOWN AVENUE
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MINISTRY OF TRANSPORTATION, ONTARIO
NORTH BAY, ONTARIO**

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by IBI Group (IBI) to carry out a foundation investigation as part of the detailed design for a variable message sign (VMS) truss structure on Highway 11 Northbound, 0.4 km north of McKeown Avenue in North Bay Ontario, for the Ministry of Transportation, Ontario (MTO). 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 P61-9106, dated March 2, 2006, that formed part of the Consultant's Agreement (Number 5005-E-0054) for this project. The work was carried out in accordance with Golder's Quality Control Plan for this project dated May 2006. The plans and profiles detailing the proposed sign location were provided to Golder by IBI in September 2006.

2.0 SITE DESCRIPTION

The proposed location of the VMS structure is Highway 11 Northbound, 0.4 km north of McKeown Avenue at Station 11+025 in North Bay Ontario. The terrain over this area generally comprises rock outcrops. The ground surface elevation along Highway 11 rises steeply from the south to the north. The ground surface at the proposed structure location is at approximately Elevation 247.8 m.

3.0 INVESTIGATION PROCEDURES

3.1 Foundation Investigation

The subsurface investigation work for the VMS structure was carried out by Golder between August 1 and 31, 2006, at which time four sampled boreholes were advanced. Boreholes BH06-1 and BH06-2 were advanced at a location about 10 m north of the proposed sign footings and boreholes BH06-3 and BH06-4 were advanced at the proposed sign footing locations. The borehole locations are shown on Drawing 1.

The foundations investigation was carried out using a truck-mounted CME-55 drill rig supplied and operated by Landcore Drilling of Chelmsford, Ontario. The boreholes were advanced using hollow stem augers and NQ-size diamond drilling equipment. Rock core samples were obtained in the bedrock. The boreholes were advanced to depths from 4.2 m to 7.3 m below the existing ground surface. Details of the subsurface conditions are shown on the Record of Borehole and Drillhole sheets following the text of this report. The boreholes were backfilled with bentonite holeplug through the bedrock in accordance with Ontario Regulation 128 (Amendment to O. Reg. 903).

The fieldwork was supervised throughout by members of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground services and traffic control, supervised the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the 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. Point load tests were carried out to MTO Standards.

The boreholes were located using references to existing site features (light poles, etc.). Northing and easting coordinates were not provided, so stations and offsets were determined. The elevations, referenced to the geodetic datum, were obtained from a site survey conducted by surveyors retained by IBI. The elevations and stations and offsets are depicted on the Record of Borehole and Drillhole sheets and on Drawing 1.

4.0 GENERAL SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology and Site Stratigraphy

In the vicinity of the site, glaciofluvial outwash deposits comprising sand and gravel overlie the Precambrian rocks of the Grenville Structural Province (Northern Ontario Engineering Geology Terrain Study, OGS Map 5041). The bedrock is characterized by the metasediments of the middle Precambrian eon, including biotite gneiss derived from greywacke, siltstone, immature sandstone, and minor calcareous siltstone and sandstone (Sudbury-Cobalt Geological Compilation Series; OGS Map 2361). The local physiography tends to be characterized by an irregular, variable bedrock surface with rock outcrops.

4.2 Subsoil Conditions

Detailed descriptions of the subsurface conditions at this site are provided in the following sections of this report, and the detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected samples, are given on the Record of Borehole and Drillhole sheets following the text of this report. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests and in situ testing. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations.

Boreholes BH06-1 and BH06-3 were drilled through the median shoulder of the northbound lanes of Highway 11. Boreholes BH06-2 and BH06-4 were drilled through the right shoulder of the northbound lanes of Highway 11. The ground surface at the location of boreholes BH06-1 and BH06-2 is at Elevation 248.8 m to 248.7 m, respectively. The ground surface at the location of boreholes BH06-3 and BH06-4 is at Elevation 247.9 m to 247.8 m, respectively. In general, the boreholes encountered road embankment fill overlying bedrock.

4.2.1 Asphalt and Fill

Approximately 75 mm of asphalt was encountered at the ground surface in the boreholes. Between 0.1 m and 0.3 m of Granular 'A' fill was encountered in the boreholes below the asphalt. In boreholes BH06-3 and BH06-4, a 0.4 m to 0.5 m thick layer of Granular 'B' fill was encountered below the Granular 'A' fill.

4.2.2 Rock Fill

Blast rock fill, 1.8 m to 3.8 m thick, was encountered in all the boreholes except borehole BH06-4. The rock fill was contained in a matrix of silty sand, as inferred from the wash water during casing advancement. In some boreholes, the rock fill encountered directly above the bedrock surface may be blast rock shatter.

4.2.3 Bedrock

The bedrock surface was encountered below the fill at the depths and elevations given in the table below. Between 2.0 m and 3.6 m of bedrock coring was carried out in the boreholes (excluding coring through the rock fill). Based on the rock core, the bedrock consists of fine to medium grained gneiss. The bedrock ranges in colour from pink to grey, and is weakly banded. The bedrock is generally fresh, with only slight weathering. The discontinuities observed in the rock core are typically iron stained.

<i>Borehole</i>	<i>Depth to Bedrock Surface (m)</i>	<i>Bedrock Surface Elevation (m)</i>
BH06-1	4.2	244.6
BH06-2	3.7	245.0
BH06-3	2.6	245.3
BH06-4	0.6	247.2

In boreholes BH06-1 and BH06-2, the surface of the bedrock was inferred by the wash water return during coring as well as examination of the rock core. Through the rock fill, the wash water return was zero percent, whereas as soon as the surface of the bedrock was encountered, the wash water return was 100 percent. Also, the total core recovery in these boreholes was essentially zero within the rock fill and consistently 100 percent within the bedrock. Rock Quality Designation (RQD) values measured on the recovered bedrock core samples from these two boreholes ranged from 48 percent to 100 percent, increasing with depth and indicating that the rock is generally of fair to excellent quality.

In borehole BH06-3, rock fill was encountered from 0.8 m below ground surface to a depth of at least 2.6 m. Between 2.6 m and 3.4 m, it was not possible to discern whether the material recovered was blast rock fill or highly fractured gneiss bedrock (i.e. bedrock shatter from blasting). The RQD measured on the recovered core in this zone was zero percent and the core recovery was 99 percent. Based on the recovery data, this material is likely bedrock and we have considered the bedrock surface to be at 2.6 m. "Intact" bedrock was encountered from 3.4 m to

4.6 m depth, with a measured RQD value of 53 percent indicating bedrock of fair quality. During coring, all wash water was lost, indicating that the rock is highly fractured.

In borehole BH06-4, possible bedrock was encountered at a depth of 0.6 m, immediately below the granular road base fill. Bedrock coring was carried out to a depth of 4.2 m. The recovery of the rock within the core barrel was between 85 and 95 percent, and the RQD values measured on the recovered bedrock core samples ranged from 45 to zero percent, decreasing with depth, indicating the bedrock is of poor to very poor quality. The high recovery values indicate that the surface of the bedrock is likely at 0.6 m depth. All wash water was lost during coring, indicating that the rock is highly fractured.

Point load testing was performed on samples of the rock core, resulting in measured unconfined compressive strengths between 63 MPa and 127 MPa, as shown in Table 1. Using the Intact Rock Strength Classification table, these values indicate the gneiss bedrock is classified as strong to very strong.

4.2.4 Groundwater Conditions

The groundwater level in the boreholes could not be measured due to the influence of water introduced for casing and coring advance. It should be noted that groundwater elevations will vary depending on precipitation.

4.3 Closure

The fieldwork was carried out by an intermediate technician from our Sudbury office under the coordination of Mr. André Bom, P.Eng. This report was prepared by Ms. Kerry Salvatori Lee, P.Eng., and was reviewed by Ms. Sarah Poot, P.Eng., Senior Geotechnical Engineer. Mr. Fintan J. Heffernan, P.Eng., a Designated MTO Contact for Golder, conducted a quality control review of the report.

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PART B

**FOUNDATION DESIGN REPORT
VARIABLE MESSAGE SIGN #8
HIGHWAY 11 NORTHBOUND, 0.4 KM NORTH OF MCKEOWN AVENUE
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5.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

5.1 General

This section of the report provides foundation design recommendations for the proposed variable message sign foundations. The recommendations are based on interpretation of the factual data obtained from the boreholes 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 the feasible alternatives and to design the proposed sign foundations. 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.

5.2 Variable Message Sign Foundations

At the location of the sign supports (Highway 11 Northbound, Station 11+025), bedrock is expected to be present at about 3.4 m and 0.6 m below the ground surface in boreholes BH06-3 and BH06-4, respectively. The foundations for the sign supports can be designed as caissons socketted into the rock or, alternatively, the sign can be supported on spread footings. Recommendations for these two foundation options are provided in Sections 5.2.1 and 5.2.2. Given the subsurface conditions at this sign location, spread footings are considered to be the most practical and it would avoid the coring of large-diameter caissons into the strong to very strong gneiss bedrock at this location.

5.2.1 Caisson Foundations Socketted into Rock

The variable message sign foundations should be designed in accordance with the MTO *Sign Support Manual*. In the standard design, caisson foundations are extended 5 m below the design frost depth, unless bedrock is encountered within this depth. In accordance with Standard Drawing SS118-6 of MTO's *Sign Support Manual*, where bedrock is encountered at a depth, z (in metres), of less than 5 m below the bottom of the frost layer, the required depth of the foundation below the frost layer may be taken as follows:

$$z + ((5 \text{ m} - z) / 2)$$

The frost depth in the North Bay area may be taken as 2 m. Therefore, for the median sign support where bedrock was encountered at 2.6 m depth in borehole BH06-3, the caisson should be extended to a total depth of 4.8 m, which corresponds to 2.8 m below the design frost depth or

1.8 m into the bedrock. For the sign support on the east side of the highway, where bedrock was encountered in borehole BH06-4 at 0.6 m depth, the caisson should be extended to a total depth of 3.1 m, which corresponds to a bedrock embedment of 2.5 m. However, it may be extremely difficult to advance a caisson through the rock fill/highly fractured rock and socket the caisson into the strong to very strong gneiss bedrock at this site. ✓

5.2.2 Spread Footings

As an alternative to caissons, consideration is usually given to a non-standard footing design which for this site would involve spread footings placed on the properly prepared rock fill at or below the frost depth (median footing) or directly on the bedrock (both footings). Although rock fill is typically considered to be non-frost susceptible, a minimum footing depth of 2 m (Elevation 245.9 m) is recommended to account for fines that are present within the rock fill (silty sand matrix) as well as potential water ingress. These footings could be anchored into the bedrock to resist sliding and uplift pressures or they could be sized accordingly to resist these loads.

For spread footings placed on the rock fill, a minimum of 150 mm of Granular 'B' Type II compacted to 100 percent standard Proctor maximum dry density (SPMDD) should be placed underneath the footings. Alternatively, a combination of 100 mm of Granular 'B' Type II and 50 mm of Granular 'A' compacted to 100 percent SPMDD may be used to form the level surface for the footing. A geotextile separator should be placed below and around the sides of the Granular 'B' Type II to prevent migration of fine soil particles from the Granular 'B' into any voids in the rock fill or highly fractured rock. The geotextile separator (non-woven Class 2, FOS = 105 to 210 µm) may require reinforcement (i.e. additional geo-web or geo-grid material) to prevent puncturing of the geotextile material by sharp points or edges within the rock fill. Chinking of the rock fill surface should be carried out in accordance with SP206S03 prior to placement of geotextile. Proper chinking could eliminate the requirement for geo-grid.

The approximate founding elevations for spread footings founded on bedrock are 245.3 m at borehole BH06-3 and 247.2 m at borehole BH06-4. Sub-excavation of any loose, highly fractured bedrock will be required prior to the construction of footings founded directly on the relatively intact bedrock. In this regard, MTO's Special Provision SP902S01 should be included in the Contract Documents, requiring inspection and approval of the foundation area by the Quality Verification Engineer prior to footing construction, to ensure that all loose and/or highly fractured rock has been removed from the foundation areas. Variation in the bedrock surface should be anticipated at the sign support locations, and a Non-Standard Special Provision (NSSP) should be included in the Contract Documents for mass concrete placement to accommodate variations in the bedrock surface. A sample is included in Appendix A for reference. ✓

Footings bearing on well-compacted Type II engineered fill overlying rock fill may be designed for a factored geotechnical resistance at Ultimate Limit States (ULS) of 400 kPa. A geotechnical resistance at Serviceability Limit States (SLS) of 250 kPa (based on 25 mm of settlement) may be used. Footings bearing directly on the highly fractured bedrock surface at 2.6 m and 0.6 m depth for the median and right shoulder, respectively, a factored geotechnical resistance at ULS of 500 kPa may be used. SLS conditions do not apply for footings founded on bedrock.

Resistance to lateral forces / sliding resistance between the concrete footings and the subgrade should be calculated in accordance with Section 6.7.5 of the *CHBDC*. The coefficient of friction, $\tan \delta'$, may be taken as 0.70 for cast-in-place concrete footings constructed on the properly prepared rock fill subgrade or bedrock surface. This represents an unfactored value; in accordance with the *CHBDC*, a factor of 0.8 is to be applied in calculating the horizontal resistance.

If anchors are required, the anchors will have to be extended to at least 3 m depth below the surface of the bedrock to provide resistance to uplift loading due to the presence of rock fill / blast-damaged rock and highly fractured zones of bedrock in boreholes BH06-3 and BH06-4. The horizontal resistance of the anchors is dependent on the strength of the anchors, grout and steel. Where the rock mass is as strong as or stronger than concrete, as is the case for this site, the design of the anchors in the rock may be handled in the same way as the anchor embedment into the concrete, assuming that the unconfined compressive strength of the grout is similar to that of the concrete. The structural strength of the anchor and the compressive strength of the grout should not be exceeded.

Rock anchors can also be used to provide uplift resistance, to supplement the weight of the sign footing if necessary. For uplift of the anchors, a factored value of 500 kPa may be assumed for the grout-to-rock bond stress for ULS design. The actual bond stress along the rock-grout interface may vary from the design value given. Normal construction practice would use pull-out testing to verify the actual bond stress. However, in this case, pull-out testing may not be practical for the limited number of anchors at this site. The bond stress given is considered to be a conservative value to be used where pull-out testing is not practical. If a higher factored bond stress of 600 kPa is desired, then pull-out testing would be mandatory. If required, an NSSP should be included in the Contract Documents to cover this testing, and a sample is included in Appendix A for reference.

The required anchor lengths for resistance of uplift loads should also be checked against a conical mode of failure through the rock mass. For this type of failure, taking into account the potential for intersecting sets of discontinuities, it is common practice to consider the dead weight of the rock (based on a unit weight of bedrock of 25 kN/m³) within a cone extending from the centre of

the bond zone to the rock surface with an apex angle of 90 degrees; however, at this site, due to the highly fractured nature of the rock, the apex angle should be reduced to 30 degrees.

5.3 Excavation and Backfilling

Special care should be taken by the Contractor during excavation adjacent to the highway. Temporary excavation side slopes no steeper than 1H:1V will be required within the rock fill. Depending on the size of the rock fragments, shallower side slopes may form naturally. Temporary roadway shoring may be required; however, installing shoring in rock fill may prove extremely difficult. Temporary roadway protection should be in accordance with SP105S19 and should be specified as Performance Level 2. Standard sheet-pile or soldier pile and lagging walls will not be appropriate for this site; rather, a trench box may be the most practical alternative. The most likely scenario is that the excavations are carried out in open cut.

The rock fill excavated for the construction of the footings may be used as backfill. During backfilling operations, care should be taken to limit the size of the material placed adjacent to the footing. If the rock fill is unworkable due to its gradation, it should be substituted with Granular 'B' Type II fill placed and compacted in accordance with SP206S03. For design purposes, the unit weight of the rock fill may be taken as 19 kN/m^3 . A geotextile separator (non-woven Class 2, FOS = 105 to 210 μm) should be placed between the rock fill and the Granular 'B' Type II to prevent migration of fine soil particles from the granular into potential voids within the rock fill.

5.4 Construction Considerations

It is recommended that NSSPs be included in the Contract Documents to warn the Contractor of the following items which are expected to affect the installation of the variable message sign foundations:

- **Control of overburden soils for caisson foundations:** Excavations for the sign foundations will be advanced through rock fill, which should be expected to be unstable and could also contain voids within the fill matrix. Excavation below the groundwater level may also be required at this site. It should be anticipated that the caisson holes will have to be advanced using a temporary liner or casing, in order to minimize ground loss during drilling and concrete placement. The contractor is responsible to ensure that appropriate construction procedures and equipment are used for the caisson construction.
- **Anchor pull-out testing:** The actual bond stress along the rock-grout interface may vary from the design value given, and should be verified by field testing, if the higher bond stress value is used. This requirement can be waived if the lower bond stress value is used in the design.
- **Mass concrete:** An allowance for mass concrete should be included to accommodate variations in the bedrock surface for spread footings.

- **Arrestor Bed:** The median footing will impact the southbound truck arrestor bed. This provision should provide details for excavation adjacent to and restoration of the arrestor bed.

These NSSPs have been developed by Golder and are attached in Appendix A.

5.5 Closure

This report was prepared by Ms. Kerry Salvatori Lee, P.Eng., a Geotechnical Engineer, and the technical aspects were reviewed by Ms. Sarah Poot, P.Eng., a Senior Geotechnical Engineer with Golder. Mr. Fintan J. Heffernan, P.Eng., the Designated MTO Contact for Golder, conducted a quality control review of the report.

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TABLE 1
POINT LOAD TEST RESULTS
G.W.P 5671-04-00
VMS #8, NORTH BAY

<i>Borehole Number</i>	<i>Sample Depth (m)</i>	<i>Rock Type</i>	<i>Test Type</i>	<i>Core Diameter (mm)</i>	<i>Ram Pressure (MPa)</i>	<i>Load (kN)</i>	<i>I_s Diametral (MPa)</i>	<i>I_s (50 mm) (MPa)</i>	<i>Approximate UCS (MPa)²</i>
BH06-1	4.6	Gneiss	D	47.0	7.59	0.007	3.26	3.17	63
BH06-1	6.7	Gneiss	D	47.0	9.94	0.009	4.27	4.15	83
BH06-2	5.2	Gneiss	D	47.0	15.27	0.014	6.55	6.37	127
BH06-2	6.7	Gneiss	D	47.0	11.99	0.011	5.15	5.00	120
BH06-3	3.5	Gneiss	D	47.0	8.43	0.008	3.62	3.52	70
BH06-4	2.9	Gneiss	D	47.0	8.98	0.009	3.85	3.75	75

NOTES:

1. Depths are given below the ground surface at the borehole location.
2. Where: D = Diametral test;
I_s Diametral = Uncorrected point load strength;
I_s 50 mm = Corrected point load strength; and
UCS = Unconfined compressive strength = I_s 50 mm x 20 (based on experience with similar rock types).
3. Based on removal of the 2 highest and 2 lowest values.

Compiled by: AB

Checked by: SEP

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.).

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 cm² 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 (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	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.

LIST OF SYMBOLS

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

I. General		(a) Index Properties (continued)	
π	3.1416	w	water content
ln x,	natural logarithm of x	w_L	liquid limit
\log_{10}	x or log x, logarithm of x to base 10	w_p	plastic limit
g	acceleration due to gravity	I_p	plasticity index = $(w_L - w_p)$
t	time	w_s	shrinkage limit
F	factor of safety	I_L	liquidity index = $(w - w_p)/I_p$
V	volume	I_C	consistency index = $(w_L - w)/I_p$
W	weight	e_{max}	void ratio in loosest state
II. STRESS AND STRAIN		e_{min}	void ratio in densest state
		I_D	density index = $(e_{max} - e)/(e_{max} - e_{min})$ (formerly relative density)
		(b) Hydraulic Properties	
γ	shear strain	h	hydraulic head or potential
Δ	change in, e.g. in stress: $\Delta \sigma$	q	rate of flow
ϵ	linear strain	v	velocity of flow
ϵ_v	volumetric strain	i	hydraulic gradient
η	coefficient of viscosity	k	hydraulic conductivity (coefficient of permeability)
ν	Poisson's ratio	j	seepage force per unit volume
σ	total stress	(c) Consolidation (one-dimensional)	
σ'	effective stress ($\sigma' = \sigma - u$)	C_c	compression index (normally consolidated range)
σ'_{vo}	initial effective overburden stress	C_r	recompression index (over-consolidated range)
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)	C_s	swelling index
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$	C_a	coefficient of secondary consolidation
τ	shear stress	m_v	coefficient of volume change
u	porewater pressure	c_v	coefficient of consolidation
E	modulus of deformation	T_v	time factor (vertical direction)
G	shear modulus of deformation	U	degree of consolidation
K	bulk modulus of compressibility	σ'_p	pre-consolidation pressure
III. SOIL PROPERTIES		OCR	over-consolidation ratio = σ'_p/σ'_{vo}
(a) Index Properties		(d) Shear Strength	
$\rho(\gamma)$	bulk density (bulk unit weight*)	τ_p, τ_r	peak and residual shear strength
$\rho_d(\gamma_d)$	dry density (dry unit weight)	ϕ'	effective angle of internal friction
$\rho_w(\gamma_w)$	density (unit weight) of water	δ	angle of interface friction
$\rho_s(\gamma_s)$	density (unit weight) of solid particles	μ	coefficient of friction = $\tan \delta$
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)	c'	effective cohesion
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s/\rho_w$) (formerly G_s)	c_{u, S_u}	undrained shear strength ($\phi = 0$ analysis)
e	void ratio	p	mean total stress $(\sigma_1 + \sigma_3)/2$
n	porosity	p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
S	degree of saturation	q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)		q_u	compressive strength $(\sigma_1 + \sigma_3)$
		S_t	sensitivity

- Notes: 1 $\tau = c' + \sigma' \tan \phi'$
 2 Shear strength = (Compressive strength)/2

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

Description	Bedding Plane Spacing
Very thickly bedded	> 2 m
Thickly bedded	0.6 m to 2m
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

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

GRAIN SIZE

Term	Size*
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

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 separations) 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 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

B - Bedding	P - Polished
FO - Foliation/Schistosity	S - Slickensided
CL - Cleavage	SM - Smooth
SH - Shear Plane/Zone	R - Ridged/Rough
VN - Vein	ST - Stepped
F - Fault	PL - Planar
CO - Contact	FL - Flexured
J - Joint	UE - Uneven
FR - Fracture	W - Wavy
MF - Mechanical Fracture	C - Curved
- Parallel To	
⊥ - Perpendicular To	

PROJECT 06-1191-021-8			RECORD OF BOREHOLE No BH06-1			1 OF 1 METRIC														
W.P. 5671-04-00			LOCATION Station 11+033.2, Offset 0.8 Right			ORIGINATED BY DB														
DIST HWY 11			BOREHOLE TYPE NW Casing, NQ Coring			COMPILED BY AB														
DATUM Geodetic			DATE 08/01/06			CHECKED BY SEP														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L WATER CONTENT (%)			γ	GR	SA	SI	CL
248.8	GROUND SURFACE																			
0.0	Asphalt																			
248.4	Granular 'A' (FILL)																			
0.4	Blast Rock containing silty sand (FILL)																			
							248													
							247													
							246													
							245													
244.6	Gneiss (BEDROCK)																			
4.2	Bedrock cored from 4.2m to 7.3m depth						244													
							243													
							242													
	For bedrock coring details see Record of Drillhole BH06-1																			
241.4	End of Borehole																			
7.3																				

MIS-MTO 001 06-1191-021 SOIL.GPJ GAL-MISS.GDT 11/22/06

PROJECT: 06-1191-021-8

RECORD OF DRILLHOLE: BH06-1

SHEET 1 OF 1

LOCATION: Station 11+033.2, Offset 0.8 Right

DRILLING DATE: 08/01/06

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR & RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols										NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
									RECOVERY		R.Q.D. %	FRACT INDEX PER RU	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec		Diameter mm	Unit Load Index (MPa)	Q	MC AVG																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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DEPTH SCALE

1 : 50



LOGGED: DB

CHECKED: AB

MIS-RCK 002 06-1191-021 ROCK GPJ GAL-MISS.GDT 11/22/06

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

PROJECT: 06-1191-021-8

RECORD OF DRILLHOLE: BH06-2

SHEET 1 OF 1

LOCATION: Station 11+033.6, Offset 9.2 Right


DRILLING DATE: 08/02/06

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	CORING LOG														NOTES WATER LEVELS INSTRUMENTATION		
				ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT INDEX PER RUN	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec		Diameter Point Load Index (MPa)	RMC -Q- AVG
									TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION					
																JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate				
		Refer to previous page		245.1																
4	NQ Coring	Slightly weathered, strong to very strong, fine to medium grained, pinkish grey GNEISS, banded, joints are iron-stained		3.7																
				1																
5																				
6				Joints are curved and rough except where otherwise noted.	2															
7				3																
		End of Drillhole		241.4																
7.3																				
8																				
9																				
10																				
11																				
12																				
13																				

DEPTH SCALE

1 : 50



LOGGED: DB

CHECKED: AB

MIS-RCK 002 06-1191-021 ROCK GPJ GAL-MISS.GDT 11/22/06

PROJECT 06-1191-021-8		RECORD OF BOREHOLE No BH06-3				1 OF 1 METRIC										
W.P. 5671-04-00		LOCATION Station 11+022.5, Offset 0.8 Right				ORIGINATED BY ID										
DIST HWY 11		BOREHOLE TYPE NW Casing, NQ Coring				COMPILED BY AB										
DATUM Geodetic		DATE 08/31/06				CHECKED BY SEP										
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)	
247.9	GROUND SURFACE						20	40	60	80	100					
0.0	Asphalt															
0.3	Granular 'A' (FILL)															
	Granular 'B' (FILL)															
247.1	Blast Rock (FILL)															
0.8																
245.3	Gneiss (BEDROCK)															
2.6																
	Bedrock cored from 2.6m to 4.6m depth															
	For bedrock coring details see Record of Drillhole BH06-3															
243.2	End of Borehole															
4.6																

MIS-MTO 001 06-1191-021 SOIL_GPJ GAL-MISS.GDT 11/22/06

PROJECT: 06-1191-021-8

RECORD OF DRILLHOLE: BH06-3

SHEET 1 OF 1

LOCATION: Station 11+022.5, Offset 0.8 Right

DRILLING DATE: 08/31/06

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLLOUR	% RETURN	RECOVERY				FRACT INDEX PER RUN	B Angle	DIP wrt CORE AXIS	DISCONTINUITY DATA	TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Diameter Point Loss Index (MPa)	RMC -Q' AVG	NOTES WATER LEVELS INSTRUMENTATION
										TOTAL CORE %	SOLID CORE %	R.Q.D. %										
		Refer to previous page		245.3																		
3	NQ Coating	Slightly weathered, strong to very strong, fine to medium grained, pinkish grey GNEISS, banded, joints are iron-stained Broken rock from 2.6m to 3.7m depth All joints are irregular and rough		2.6	1																	
4		2																				
5		End of Drillhole		243.2																		
6		Notes: 1. Solid Core Recovery not recorded.		4.6																		
7																						
8																						
9																						
10																						
11																						
12																						

DEPTH SCALE

1:50



LOGGED: ID

CHECKED: AB

MIS-RCK 002 06-1191-021 ROCK GPJ GAL-MISS.GDT 11/22/06

PROJECT 06-1191-021-8			RECORD OF BOREHOLE No BH06-4				1 OF 1 METRIC					
W.P. 5671-04-00		LOCATION Station 11+022.5, Offset 9.7 Right				ORIGINATED BY ID						
DIST HWY 11		BOREHOLE TYPE NW Casing, NQ Coring				COMPILED BY AB						
DATUM Geodetic		DATE 08/31/06				CHECKED BY SEP						
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED				WATER CONTENT (%) w _p — w — w _L
247.8	GROUND SURFACE							20 40 60 80 100				
0.0	Asphalt											
	Granular 'A' (FILL)											
	Granular 'B' (FILL)											
247.2	Gneiss (BEDROCK)											
0.6												
	Bedrock cored from 0.6m to 4.2m depth											
	For bedrock coring details see Record of Drillhole BH06-4											
243.6	End of Borehole											
4.2												

MIS-MTO 001 06-1191-021 SOIL.GPJ GAL-MISS.GDT 11/22/06

PROJECT: 06-1191-021-8

RECORD OF DRILLHOLE: BH06-4

SHEET 1 OF 1

LOCATION: Station 11+022.5, Offset 9.7 Right

DRILLING DATE: 08/31/06

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-55

DRILLING CONTRACTOR: Landcore

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	PENETRATION RATE (mm/min)	FLUSH	COLOUR	% RETURN	RECOVERY		R.Q.D. %	FRACT INDEX PER RU	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	BR	Diameter Index (MPa)	RMC AVG	NOTES WATER LEVELS INSTRUMENTATION		
										TOTAL CORE %	SOLID CORE %			Angle	DIP	W	R								T	S
										JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OP - 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										
		Refer to previous page		247.2																						
1		Slightly weathered, strong to very strong fine to medium grained, pinkish grey GNEISS, banded, joints are iron-stained		0.6	1																					
2		Broken rock from 1.7m to 2.9m depth			2																					
3		All joints are irregular and rough																								
4		Broken rock from 3.2m to 4.2m depth			3																					
5		End of Drillhole		243.6																						
6		Notes: 1. Solid Core Recovery not recorded.		4.2																						
7																										
8																										
9																										
10																										

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: AB

MIS-RCK-002 06-1191-021 ROCK.GPJ GAL-MISS.GDT 11/22/06

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

CONT No.
 WP No.5671-04-00

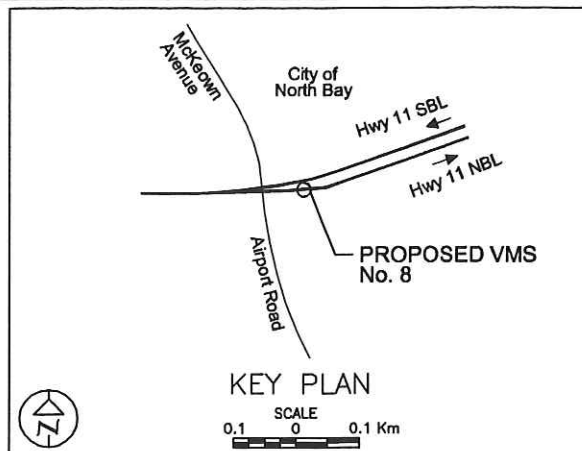


HIGHWAY 11, NORTH BAY
 OVERHEAD SIGN STATION 11+025
 BOREHOLE LOCATION PLAN

SHEET



Golder Associates Ltd.
 SUDBURY, ONTARIO, CANADA



LEGEND			
	Borehole		
No.	ELEVATION	STATION	OFFSET
BH06-1	248.76	11+033.2	0.8 RIGHT
BH06-2	248.74	11+033.6	9.2 RIGHT
BH06-3	247.86	11+022.5	0.8 RIGHT
BH06-4	247.82	11+022.5	9.7 RIGHT

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 Contract Documents.

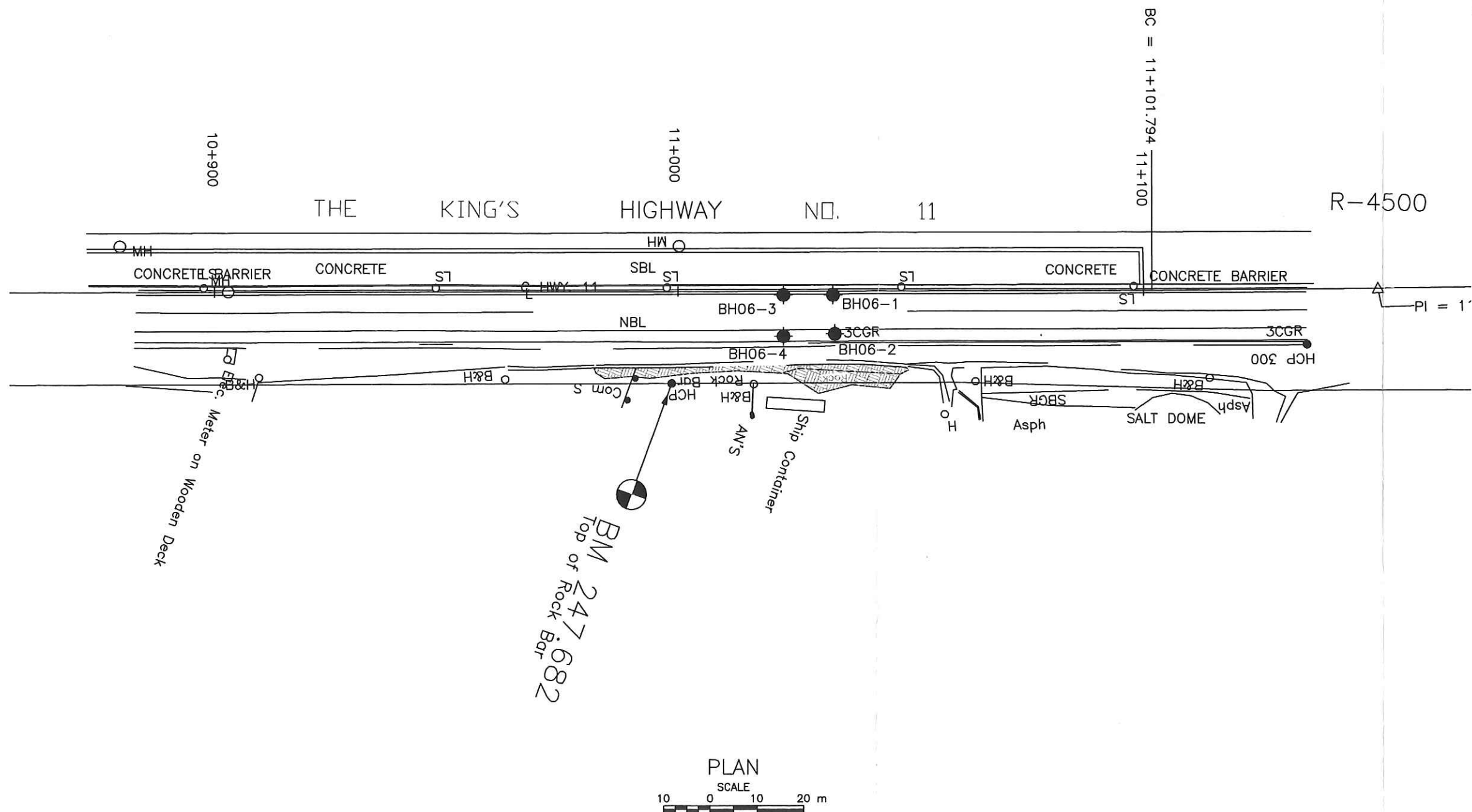
The boundaries between soil strata have been established only at borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

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 IBI, drawing file no. SB06019North Bay.dwg, dated September, 2006, received September 25, 2006.

NO.	DATE	BY	REVISION
Geocres No. 31L-104			
HWY. 11	PROJECT NO.06-1191-021-8 DIST.		
SUBM'D. KSL	CHKD. SEP	DATE: NOV 2006	SITE:
DRAWN: RN	CHKD.	APPD. FJH	DWG. 1



APPENDIX A
NON-STANDARD SPECIAL PROVISIONS (NSSPs)

CONCRETE SIGN SUPPORT STRUCTURE FOOTINGS - Item No.
MASS CONCRETE – Item No.

Non-Standard Special Provision

Scope

The work under this item shall include all supply and placement of the mass concrete under sign footings for the VMS#6 (Sudbury). *Vms #8 (North Bay)*

The purpose of the mass concrete pad is to provide a level working surface on the irregular founding bedrock surface.

Construction

Work under this item shall satisfy the following requirements:

The surface of the sign footing founding rock shall be exposed, cleaned, and any loose, fractured rock shall be removed so that sound rock is exposed;

The mass concrete shall have a strength equal to that used for the structural footings;

The mass concrete shall be placed on the exposed clean, sound, founding rock surface as per the Contract Drawings and Documents;

The thickness of the mass concrete shall depend on the slope and irregularities in the exposed founding rock surface.

Basis of Payment

Payment at the contract price shall include all labour, equipment and materials to carry out the above work.

CONCRETE SIGN SUPPORT STRUCTURE FOOTINGS - Item No.
EXCAVATION - Item No.

Non-Standard Special Provision

This special provision is to highlight the construction concerns for the installation of VMS#8 (North Bay). The Contactor shall be alerted that the overburden soils at the sign location include cohesionless sands and/or rock fill, which are susceptible to soil cave-in, sloughing and boiling. The contractor is responsible to ensure that appropriate construction procedures and equipment are used for the caisson construction.

CONCRETE SIGN SUPPORT STRUCTURE FOOTINGS – Item No.
ANCHORS INTO ROCK – Item No.

Non-Standard Special Provision

Rock Anchors Testing

All proposed testing procedures shall be in general conformance with ASTM D 3689-90 and ASTM D 114381 (Re-approved 1994). Field testing shall be carried out in the presence of, and the results reviewed and approved by, the Contract Administrator.

Performance Tests

Performance testing shall be carried out on two rock anchors to confirm that the design load of the rock dowels can be achieved for the installation of VMS#8 (North Bay). The Contract Administrator will select the rock dowels to be tested.

Performance test shall be by axial tensioning using a hydraulic jack with a capacity of at least 1.5 times the ultimate strength of the dowels.

Rock anchors shall be loaded and unloaded in 3 cycles and measurements of the displacement of the anchor shall be carried out at each load increment (step) in accordance with the following schedule:

Cycle-Step	1-1	1-2	1-3	2-1	2-2	2-3	2-4
% Design Load	50	75	25	50	75	100	25
Cycle-Step	3-1	3-2	3-3	3-4	3-5		
% Design Load	50	75	100	110	25		

The design load shall be taken as 360 kN for 35M anchors, 252 kN for 30M anchors, 180 kN, for 25M anchors, and 108 kN for 20M anchors.

Displacement measurements shall be carried out at each load increment using calibrated displacement gauges capable of measuring movements of 0.0025 cm. Measurements shall be referenced to an independent fixed referenced point.

Rock anchors which fail to meet the acceptance criteria shall be replaced at the Contractor's expense and re-tested. If a rock anchor fails, 3 additional rock anchors shall be tested at the same sign footing as directed by the Contract Administrator.

Acceptance criteria for the rock dowels shall be in accordance with the Post-tensioning Institute (1985) as follows:

The anchors are acceptable if the total elastic movement is greater than 80% of the theoretical elastic elongation of the free stressing and is less than the theoretical elongation of the free stressing length plus 50% of the bond length.

Performance Tests

All anchors must be proof-tested to 110% of the design load.

Basis of Payment

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

CONCRETE SIGN SUPPORT STRUCTURE FOOTINGS - Item No.
ARRESTOR BED - Item No.

Non-Standard Special Provision

1.0 GENERAL

1.1 Scope

This special provision describes requirements for excavation and re-instatement of the truck arrestor bed for the installation of the VMS#8 (North Bay) sign footing.

2.0 REFERENCES

The subsurface conditions at the site are described in the following Foundation Investigation Report for G.W.P. 5671-04-00:

Foundation Investigation Report, VMS#8 – North Bay, G.W.P. 5671-04-00, Ministry of Transportation, Ontario, Northeastern Region, Ontario, dated October 2006.

3.0 MATERIALS

Geotextile – Class II FOS 105-210, Non-woven
Geomembrane - VLDPE
Granular 'B' (modified)
Peastone Gravel

4.0 SUBMISSION REQUIREMENTS

The Contractor shall submit three (3) copies of the truck arrestor bed methodology to the Contract Administrator at least 3 weeks prior to the sign construction operations. The methodology shall satisfy the specifications and at a minimum contain the following specific information:

Proposed methodology for excavation adjacent to truck arrestor bed;
Proposed signage to alert trucks to construction; and
Proposed methodology for re-instatement of the arrestor bed.

5.0 PROCEDURES

5.1 Excavation

5.1.1 Based on the original construction drawings, a geomembrane is present at the base of the peastone gravel bed and overlies a geotextile. Below the geotextile, it is anticipated that a 150 mm layer of Granular 'B' (modified) overlies a second layer of geotextile. The granular arrestor bed shall be hand excavated at the footing location to expose the geomembrane. The geomembrane and first layer of geotextile shall be carefully cut so that tearing and ripping of the

geomembrane and geotextile do not occur. Hand excavation shall be used to expose the second layer of geotextile which shall be cut prior to proceeding with further excavation.

5.1.2 Excavation side slopes within the granular materials shall be no greater than 2 horizontal to 1 vertical (2H:1V). Excavation side slopes within rock fill shall be no greater than 1.25H:1V.

5.1.3 The excavation shall be protected against surficial sloughing and water runoff at all times.

5.2 Footing Construction

5.2.1 The footing shall be constructed such that no excess concrete runs into the exposed rock granular fill.

5.2.2 Backfilling above and adjacent to the footing up to the level of the lower geotextile layer shall take place using Granular 'B' Type II. The fill shall be placed simultaneously around the entire footing to prevent shifting of the footing. The backfill shall be compacted using care adjacent to the footing and shall be compacted to 98% of the materials standard maximum Proctor dry density. Backfilling shall not take place until a minimum of 48 hours after the concrete is poured.

5.3 Re-Instatement

5.3.1 Geotextile must be placed over the backfilled area such that there is a minimum overlap of 0.3 m with the existing geotextile (both layers).

5.3.2 Granular material shall be placed to match the type and compaction of the existing materials.

5.3.3 Sealant and patch shall be applied to the geomembrane to fuse the new material into the exiting geomembrane.

6.0 CERTIFICATE OF CONFORMANCE (COC)

Upon completion of the work, the Contractor shall submit to the Contract Administrator a CoC. The certificate shall state that the truck arrestor bed was re-instated to it's original state using the method outlined in the submission.

7.0 BASIS OF PAYMENT

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