



October 21, 2016

## FOUNDATION INVESTIGATION AND DESIGN REPORT

**OVERHEAD SIGNS STA 9+662 AND STA 15+700  
HIGHWAY 69 FOUR-LANING FROM 0.4 KM NORTH OF HIGHWAY 7182  
(SHEBESHEKONG ROAD) NORTHERLY 11 KM  
MINISTRY OF TRANSPORTATION, ONTARIO  
GWP 5403-05-00**

**Submitted to:**

MMM Group  
100 Commerce Valley Drive West  
Thornhill, Ontario  
L3T 0A1



**GEOCRES NO.: 41H-167**

**Report Number: 07-1191-0020**

**Distribution:**

3 Copies Ministry of Transportation, Ontario, North Bay, ON (Northeastern Region)  
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1 Copy MMM Group, Thornhill, ON  
1 Copy Golder Associates Ltd., Sudbury, ON

REPORT





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## **FOUNDATION REPORT**

### **HIGHWAY 69 OVERHEAD SIGNS, GWP 5403-05-00**

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# **PART A**

**FOUNDATION INVESTIGATION REPORT**

**OVERHEAD SIGNS**

**HIGHWAY 69 FOUR-LANING**

**FROM 0.4 KM NORTH OF HIGHWAY 7182**

**(SHEBESHEKONG ROAD) NORTHERLY 11 KM**

**MINISTRY OF TRANSPORTATION, ONTARIO**

**GWP 5403-05-00**



## **1.0 INTRODUCTION**

Golder Associates Ltd. (Golder) has been retained by MMM Group (MMM) on behalf of Ministry of Transportation, Ontario (MTO) to provide detail foundation engineering services for two overhead signs for the new Highway 69 alignment. The two signs are located at STA 9+662 of the Northbound Lanes (NBL) Connection of the Existing Highway 69 and at STA 15+700 of the Northbound Lanes (NBL) on Highway 69. This project is part of the four-laning of Highway 69 from 0.4 km north of Highway 7182 (Shebeshekong Road) northerly 11 km. The general location of the two signs is shown on the Index Plan on Drawing 1.

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal dated March 28, 2007. Golder's proposal (P7-1191-0020, dated April 24, 2007) for foundation engineering services associated with the overhead signs is contained in Section 6.8 of MMM's Technical Proposal that forms part of the Consultant's Agreement (Purchase Order Number 5006-E-0031) for this project. The work was carried out in accordance with Golder's Supplemental Specialty Quality Control Plan for this project dated September 2007. The locations of the proposed overhead signs were provided to Golder by MMM in 2009 prior to the start of fieldwork; and updated drawings with sign locations were provided to us in February 2016.

This report addresses the investigations carried out for two overhead sign structures crossing Highway 69. Separate reports were submitted detailing the foundation investigations for two other overhead signs, as well as for swamp crossings, high fill areas, culverts and bridge structures for the project.

The purpose of this investigation is to establish the subsurface conditions at the proposed sign locations, by borehole drilling, rock coring and laboratory testing on selected soil and rock core samples. The investigated areas are shown on Drawings A1 and B1 in Appendices A and B, following the text of this report.

We understand that the proposed overhead sign will be a truss-mounted sign extending over the highway supported by a spread footing on each side of the highway embankment.

## **2.0 SITE DESCRIPTION**

The new NBL overhead sign at STA 9+662 is located along the existing two-lane alignment of the existing Highway 69 in the Township of Harrison approximately 0.6 km north of the south junction of Highway 529; and the new NBL overhead sign at STA 15+700 is located along the proposed alignment of the new four-lane section of Highway 69 in the Township of Harrison approximately 0.9 km south of the south junction of Highway 529.

In general, the topography in the area of the NBL overhead sign at STA 9+662 is generally flat to gently sloping down to the south with tree cover and bedrock exposed on both sides of the highway. The topography in the area of the NBL overhead sign at STA 15+700 is sloping to the south and to the west, with tree cover on both sides of proposed highway alignment and exposed bedrock on the east side.

## **3.0 INVESTIGATION PROCEDURES**

The fieldwork for the investigation at the proposed overhead sign locations was carried out between September 1 and 8, 2009, during which time a total of four boreholes were advanced at the locations shown on Drawings A1



## FOUNDATION REPORT HIGHWAY 69 OVERHEAD SIGNS, GWP 5403-05-00

and B1 in Appendices A and B, respectively. Two boreholes were advanced for each sign, one at each foundation location, designated Boreholes 09-01 and 09-02 and Boreholes 09-07 and 09-08.

The foundation investigation was carried out using a track-mounted CME 850 drill rig supplied and operated by Landcore Drilling of Chelmsford, Ontario. The boreholes were advanced to depths that ranging from 3.1 m to 5.4 m, including 3.0 m to 3.3 m of bedrock coring. The boreholes were advanced using 108 mm inside diameter continuous flight hollow stem augers and/or NQ coring. Where possible, soil samples were obtained either from the augers or from a 50 mm outside diameter split-spoon sampler driven in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). Rock core samples were obtained using an 'NQ' size core barrel. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 (as amended).

The fieldwork was supervised throughout by a member of Golder's technical staff, who located the boreholes, arranged for the clearance of underground services and for traffic protection, supervised the drilling, sampling and in situ testing operations, logged the boreholes and drillholes, 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. Due to the limited thickness or composition or lack of overburden present at the borehole locations, two auger soil samples and four split spoon samples were obtained; hence, classification testing (water contents, Atterberg limits and grain size distributions) was not carried out. Unconfined Compressive Strength (UCS) tests were carried out on select samples of the bedrock core. The laboratory UCS tests were carried out to MTO and/or ASTM standards, as appropriate.

The boreholes were located in the field by Golder based on the positions staked by MMM. The borehole locations shown on Drawings A1 and B1 are positioned relative to MTM NAD 83 (Zone 10) northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, ground surface elevations and drilled depths are also provided below.

Sign Location	Borehole Number	MTM NAD83 Zone 10 Northing (m)	MTM NAD83 Zone 10 Easting (m)	Ground Surface Elevation (m)	Drilled Depth (m)
STA 9+662	09-01	5053471.6	235860.1	198.1	5.4
	09-02	5053464.2	235844.8	197.1	3.8
STA 15+700	09-07	5052189.9	236713.1	205.1	3.1
	09-08	5052184.4	236698.1	204.3	3.7

## 4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

### 4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*<sup>1</sup>, this section of Highway 69 lies within the physiographic region known as the Georgian Bay Fringe, which extends along the east side of Georgian Bay through the Parry Sound and Muskoka areas, then eastward from Muskoka in patches into the area north of the Kawartha Lakes.

<sup>1</sup> Chapman, L.J. and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.





This part of the Georgian Bay Fringe physiographic region was never submerged during periods of glacial recession. As a result, the surficial soils in this area consist of very shallow deposits of sand, silt and clay overlying metamorphic bedrock, and numerous bare knobs and ridges of bedrock are present throughout the area. Localised low-lying swampy areas, containing peat and/or organic soils overlying soft/loose native soils, are present in valleys between the bedrock knobs and ridges.

The bedrock in the area consists typically of granitic gneisses of the Britt Domain of the Central Gneiss Belt, a subdivision of the Grenville Structural Province, as described in Geology of Ontario, OGS Special Volume 4<sup>2</sup>. Deposition of Palaeozoic strata initially covered the bedrock and later erosion during glaciation exposed these Precambrian rocks.

## **4.2 Subsurface Conditions**

Detailed descriptions of the subsurface soil, bedrock and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected rock core samples, are given on the attached Record of Borehole and Drillhole sheets in Appendices A and B. 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 bedrock core sampling. These boundaries, therefore, represent transitions between material types rather than exact planes of geological change. Further, subsurface conditions will vary beyond the borehole locations.

In general, the subsoil conditions consist of embankment fill, organics and/or sand underlain by bedrock. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

## **4.3 STA 9+662 NBL-Connection (Harrison Township)**

Two boreholes (Boreholes 09-01 and 09-02) were advanced at the locations of the west and east foundation support elements of the proposed overhead sign at STA 9+662.

### **4.3.1 Silty Sand to Sand and Gravel (FILL)**

In Borehole 09-01, a 75 mm thick layer of asphalt was encountered at ground surface, at Elevation 198.1 m, and is underlain by a 0.9 m thick layer of sand to sand and gravel fill.

In Borehole 09-02, a 0.5 m thick deposit of silty sand to gravelly sand fill was encountered at ground surface, at Elevation 197.1 m.

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<sup>2</sup> Geology of Ontario, 1991. Ontario Geological Society Special Volume 4, Part 2. Ministry of Northern Development and Mines, Ontario.



#### **4.3.2 Blast Rock (FILL)**

In Borehole 09-01, a 1.3 m thick deposit of blast rock fill was encountered at a depth of 1.0 m below the asphalt surface at Elevation 197.1 m.

#### **4.3.3 Peat**

In Borehole 09-01, a 0.1 m thick layer of peat was encountered at a depth of 2.3 m below the asphalt surface at Elevation 195.8 m.

#### **4.3.4 Bedrock**

Bedrock was encountered below the peat deposit in Borehole 09-01 at Elevation 195.7 m and below the silty sand to sand and gravel fill in Borehole 09-02 at Elevation 196.6 m, and 3.0 m to 3.3 m of bedrock core was recovered in the respective boreholes.

Based on a review of the bedrock core samples, the bedrock generally consists of very strong, fresh, fine to medium grained, grey to pinkish grey gneiss.

The Total Core Recovery (TCR) is 100 per cent. Rock Quality Designation (RQD) values measured on the recovered bedrock core samples range from 74 per cent to 100 per cent, indicating that the rock is of fair to excellent quality in accordance with Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)<sup>3</sup>.

An Unconfined Compressive Strength (UCS) test was carried out on representative samples of the rock core taken from Boreholes 09-01 and 09-02 and the measured uniaxial compressive strength of the bedrock core samples is 105 MPa and 101 MPa, respectively, indicating that the bedrock is very strong ( $R_5$ ,  $100 \text{ MPa} < \text{UCS} < 250 \text{ MPa}$ ) in accordance with Table 3.5 of CFEM (2006).

#### **4.3.5 Groundwater Conditions**

The groundwater level in Borehole 09-01 was measured at a depth of 1.2 m below ground surface (at Elevation 196.9 m) and in Borehole 09-02 the groundwater level was measured at a depth of 0.5 m below ground surface (at Elevation 196.6 m) upon completion of drilling. Groundwater/surface water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

### **4.4 STA 15+700 SBL (Harrison Township)**

Two boreholes (Boreholes 09-07 and 09-08) were advanced at the locations of the west and east foundation support elements of the proposed overhead sign at STA 15+700.

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





#### **4.4.1 Sandy Topsoil**

In Boreholes 09-07 and 09-08, a 0.1 m and 0.3 m thick deposit of sandy topsoil was encountered at the ground surface, at Elevations 205.1 m and 204.3 m, in the respective boreholes.

#### **4.4.2 Sand**

In Borehole 09-08, a 0.2 m thick deposit of sand was encountered underlying the sandy topsoil at Elevation 204.0 m.

#### **4.4.3 Bedrock**

Bedrock was encountered below the sandy organic deposit in Borehole 09-07 at Elevation 205.0 m and below the sand in Borehole 09-08 at Elevation 203.8 m and 3.0 m and 3.2 m of bedrock core were recovered in the respective boreholes.

Based on a review of the bedrock core samples, the bedrock generally consists of slightly weathered, fine to coarse grained, grey to pinkish grey gneiss.

The TCR is 100 per cent for all core samples. RQD values measured on the recovered bedrock core samples range from 33 per cent to 84 per cent, indicating that the rock is of poor to good quality in accordance with Table 3.10 of CFEM (2006).

A UCS test was carried out on representative samples of the rock core taken from Boreholes 09-07 and 09-08 and the measured uniaxial compressive strength of the bedrock core samples is 98 MPa and 104 MPa, respectively, indicating that the bedrock is strong to very strong (R4 to R5, 50 MPa < UCS < 250 MPa) in accordance with Table 3.5 of CFEM (2006).

### **5.0 CLOSURE**

The fieldwork for this project was monitored by Mr. Ed Savard from our Sudbury office. This report was prepared by Mr. Tibor Berecz, and the technical aspects were reviewed by Mr. André Bom, P.Eng., a senior geotechnical engineer and Associate of Golder. Mr. Jorge M. A. Costa, P.Eng., a senior consultant with Golder and Designated MTO Foundations Contact for Golder, conducted a quality control review of the report.



## Report Signature Page

GOLDER ASSOCIATES LTD.

*Tibor Berecz*

Tibor Berecz, M.Sc. Civil Eng.  
Geotechnical Group



*Andre Bom*

Andre Bom, P.Eng.  
Geotechnical Engineer, Associate



Jorge M.A. Costa, P.Eng  
Designated MTO Foundations Contact, Senior Consultant

AB/JMAC/kp

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# **PART B**

**FOUNDATION DESIGN REPORT**

**OVERHEAD SIGNS**

**HIGHWAY 69 FOUR-LANING**

**FROM 0.4 KM NORTH OF HIGHWAY 7182**

**(SHEBESHEKONG ROAD) NORTHERLY 11 KM**

**MINISTRY OF TRANSPORTATION, ONTARIO**

**GWP 5403-05-00**



## **6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS**

### **6.1 General**

This section of the report provides foundation design recommendations for two proposed overhead signs on Highway 69 at STA 9+662 NBL-Connection and at STA 15+700 NBL, in the Township of Harrison. 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 feasible foundation design 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.

### **6.2 Overhead Sign Foundations**

We understand that the two proposed overhead signs will be supported on shallow foundations located on both the west and east sides of Highway 69 on the NBL connection at STA 9+662 and on the NBL at STA 15+700. We further understand that the centre of each footing will be located approximately 4.5 m from the edge of pavement and that MMM selected the sign locations where bedrock was observed to be at or near ground surface with the intent that the overhead signs would be supported by spread footings founded on bedrock.

The four boreholes advanced during the field program are located generally at or near the approximate proposed footing locations. Boreholes 09-01, 09-02, 09-07 and 09-08 encountered between 0.1 m and 2.4 m of overburden, underlain by bedrock. The overburden material generally consists of embankment granular fill, silty topsoil and/or a thin deposit of sand in places.

Overhead sign supports are typically designed with a standard caisson foundation in accordance with the requirements in MTO's Sign Support Manual (2015). The foundations for the sign supports can be designed as caissons drilled into suitable overburden or socketted into bedrock or, alternatively, the sign can be supported on spread footings founded on suitable overburden, fill, or on bedrock. At this site, due to the presence of bedrock at shallow depth below ground surface, caisson foundations socketted within the bedrock are cost prohibitive and have not been considered. Foundations comprised of spread footings founded on bedrock are recommended for these sites as presented in the following sections. In addition, as we understand that MMM is also considering the alternative of supporting the signs on 1.2 m diameter circular footings (Drawing SS118-3 of the Sign Support Manual) penetrating 100 mm into the bedrock and structurally connecting the footing to the bedrock using dowels installed to a depth of about 2 m into the bedrock, recommendations are also presented herein for this foundation alternative.

#### **6.2.1 Spread Footings**

Spread footings, whether square, rectangular or circular in configuration, constructed directly on bedrock will require the removal of between 0.5 m and 2.4 m of existing overburden, including up to about 1.3 m of rock fill material to expose the bedrock surface at the locations at the footings for the sign at STA 9+662 (i.e., at Boreholes



09-01 and 09-02). At the locations of the footings for the sign at STA 15+700 the required existing overburden material to be removed is between 0.1 m and 0.5 m (i.e., at Boreholes 09-07 and 09-08), to expose the bedrock surface. Excavations for the proposed footings should be carried out in accordance with the latest Occupational Health and Safety Act for Construction Projects (OHSA) (refer to Section 6.3).

Variation in the bedrock surface elevation should be anticipated and excavation of the bedrock or placement of a layer of mass concrete on bedrock may be required to provide a level surface for the footing subgrade. Bedrock excavation within the footprint of the footings (assumed to be 1.5 m wide by 4 m long) can likely be achieved by the use of hoe-ramming or similar excavation techniques. The bedrock at the founding depth will be of good quality but, nevertheless, the founding surface should be properly prepared (i.e., removing loose shattered rock fragments). Depending on the final bedrock surface slope, dowelling may be required to resist lateral sliding, as discussed in Section 6.2.3.

Depending on the seasonal time of footing construction, the groundwater level or perched groundwater may be encountered during construction. Excavations at these footing locations will generally be carried out in-the-dry, given the thin deposits of fill and native materials over bedrock, the bedrock topography and the existing ground surface elevation at these locations. Groundwater/surface water is anticipated to drain away from the sign footings based on the topography surrounding the footings, but if groundwater is encountered it should be readily possible to divert or pump any seepage away from the excavations.

Inspection and approval of the foundation area by the Quality Verification Engineer prior to footing construction should be required in accordance with OPSS 902 (Excavating and Backfilling), to ensure that all rock fragments have been removed from the foundation areas and that the foundation base has been properly prepared for the placement of concrete.

For spread footings founded directly on the bedrock, or on mass concrete over bedrock, frost susceptibility is not an issue. If mass concrete is used as a levelling platform at these sites, an NSSP should be included in the Contract Documents to specify the quality and placement of the material; an example NSSP is provided in Appendix C.

## **6.2.2 Geotechnical Resistance**

For footings bearing directly on bedrock, either on the bedrock surface or 100 mm deep excavated area into bedrock, or on mass concrete, a factored geotechnical axial resistance at Ultimate Limit States (ULS) of 10 MPa may be used for design. Serviceability Limit States [(SLS) for 25 mm settlement] conditions do not apply for footings founded on bedrock or on mass concrete.

The geotechnical resistances provided above are for loads that will be 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.



### **6.2.3 Resistance to Lateral Loads**

Resistance to lateral forces/sliding resistance between the cast-in-place concrete footings or mass concrete and the prepared bedrock surface should be calculated in accordance with Section 6.7.5 of the CHBDC using a coefficient of friction,  $\tan \delta$ , equal to 0.70.

For footings on bedrock or 100 mm into bedrock, the sliding/lateral resistance between the concrete footing/mass concrete and the bedrock may be supplemented by dowelling/anchoring into the bedrock, if necessary. The horizontal resistance of the dowels is dependent on the strength of the bedrock, grout and steel. For this site, where the rock mass is essentially as strong as, or stronger than, concrete, the design of the dowels into the rock may be considered in the same way as dowels embedded into the concrete. This assumes that the uniaxial compressive strength of the grout will be similar to that of the concrete. The dowels should have a 1 m minimum embedded length within the bedrock, for which the RQD of the bedrock core samples is greater than 50 per cent, and the structural strength of the dowel and compressive strength of the grout should not be exceeded. If dowelling into bedrock is adopted at these sites, an NSSP should be included in the Contract Documents to specify the installation, materials and testing of the dowels; an example is provided in Appendix C.

## **6.3 Construction Considerations**

For the sign proposed at Site 9+662, an open cut excavation for the foundation on the east side of the roadway (i.e., Borehole 09-01) to a depth of about 2.4 m (i.e., to bedrock) will encroach to the edge of the existing Highway 69. Shoring in the form of a sheet pile wall or soldier pile and lagging will not be practical at this site due to the presence of the blast rock fill and the shallow depth to bedrock. A trench box would be the most feasible method of worker protection for the excavation at this site but it does not provide protection against lateral movement of the adjacent soils. An open cut 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 may be classified as "Type 3 Soil". Therefore, based on the subsurface conditions at Borehole 09-01, the excavation should be carried out with side slopes no steeper than 1 horizontal to 1 vertical (1H:1V), provided that the groundwater level is lowered to the base of excavation (i.e., to the bedrock surface). Depending on the groundwater level at the time of construction, the excavation side slopes may have to be flatter (i.e., 2H:1V).

The excavation around and above the spread footing may be backfilled using an approved granular material such as OPSS.PROV 1010 (Aggregates) Granular 'A' or 'B' (Type I or II) placed in 0.3 m thick loose lifts and uniformly compacted to not less than 95 per cent of the standard Proctor maximum dry density of the material. The use of native excavated materials, where encountered, as backfill is not recommended.

The final grade surrounding the sign support should be sloped to promote surface water drainage and pavement structure drainage away from the pavement and sign support, to the adjacent ditch.

## **7.0 CLOSURE**

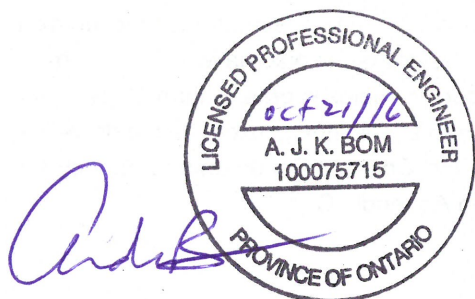
This report was prepared by Mr. Tibor Berecz, and the technical aspects were reviewed by Mr. André Bom, P.Eng., a senior geotechnical engineer and Associate of Golder. Mr. Jorge M.A. Costa, P.Eng., a Senior Consultant with Golder and Designated MTO Foundations Contact for Golder, conducted a quality control review of the report.





## Report Signature Page

**GOLDER ASSOCIATES LTD.**



Andre Bom, P.Eng.  
Geotechnical Engineer, Associate



Jorge M.A. Costa, P.Eng  
Designated MTO Foundations Contact, Senior Consultant

AB/JMAC/kp

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## REFERENCES

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, 2015. Sign Support Manual. Policy, Planning & Standards Division, Engineering Standards Branch, Bridge Office.

## STANDARDS

ASTM International:

ASTM D1586	Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
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Ontario Occupational Health and Safety Act:

Ontario Regulation 213	Construction Projects (as amended)
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Ontario Provincial Standard Specification

OPSS 902	Construction Specification for Excavating and Backfilling – Structures
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OPSS.PROV1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material
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Ontario Water Resources Act

Ontario Regulation 468/10	Amendment to Ontario Regulation 903
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Ontario Regulation 903/90	Wells
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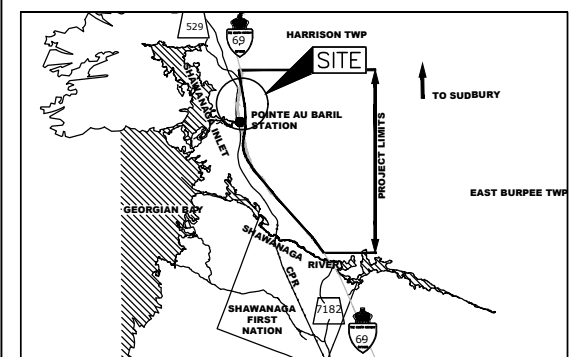
**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
GWP No. 5403-05-00



HIGHWAY 69  
OVERHEAD SIGNS  
INDEX PLAN

SHEET



KEY PLAN  
SCALE  
4 0 4 8 km

#### NOTES

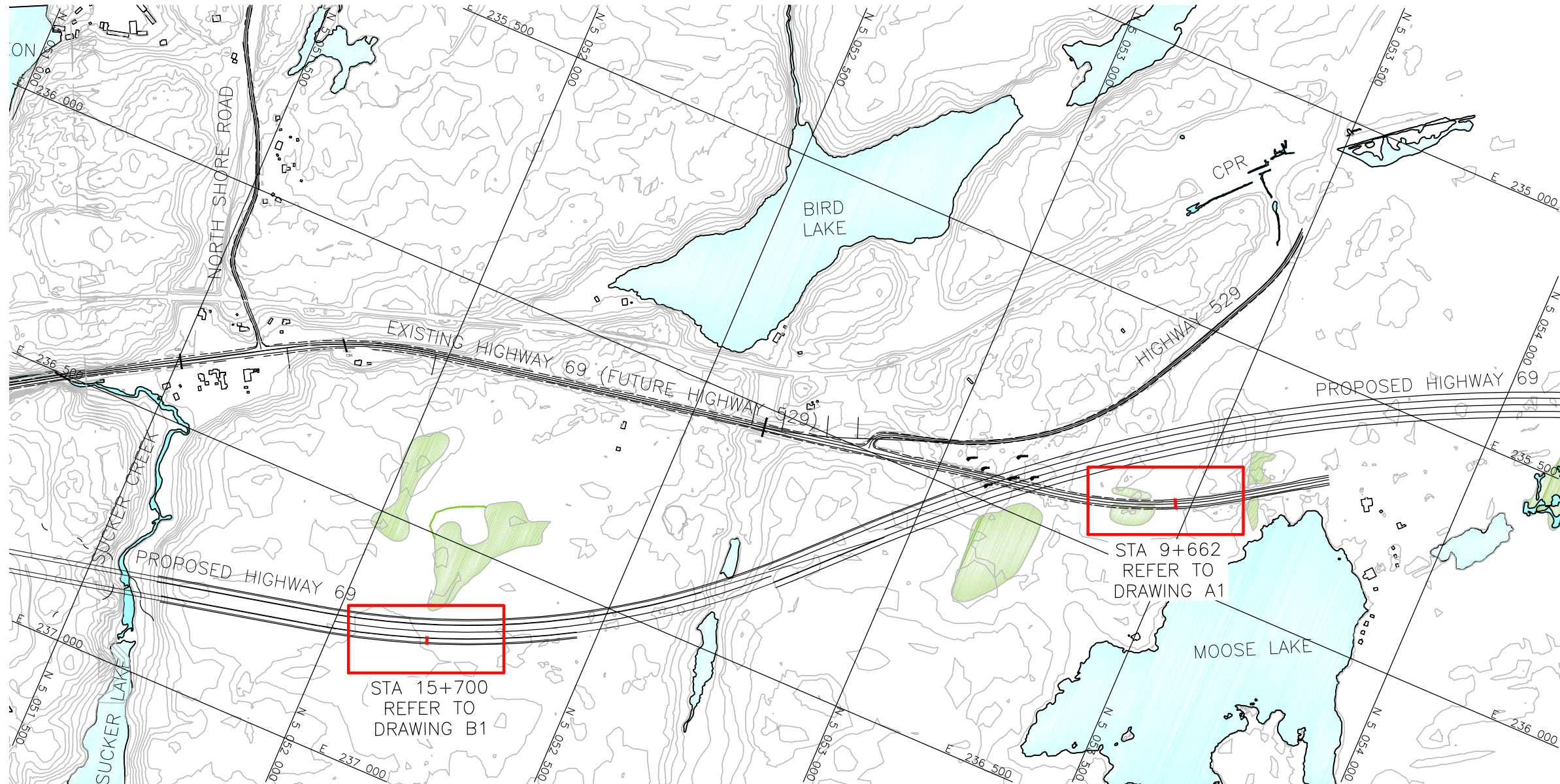
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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 MMM, drawing file nos. Hwy 69 5403-05-00 Design.dwg and Hwy 69 5403-05-00 PM\_Sign.dwg, received FEB 16, 2016.



#### PLAN

SCALE  
100 0 100 200 m

NO.	DATE	BY	REVISION
Geocres No. 41H-167			
HWY. 69	PROJECT NO. 07-1191-0020		DIST. .
SUBM'D.	CHKD.	DATE: 10/20/2016	SITE: .
DRAWN: TB	CHKD. AB	APPD. JMAC	DWG. 1



## LIST OF SYMBOLS

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

### I. 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

### II. STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\varepsilon$	linear strain
$\varepsilon_v$	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

<b>(a)</b>	<b>Index Properties</b>
$\rho(\gamma)$	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

### (a) Index Properties (continued)

w	water content
$w_l$ or LL	liquid limit
$w_p$ or PL	plastic limit
$I_p$ or PI	plasticity index = $(w_l - w_p)$
$w_s$	shrinkage limit
$I_L$	liquidity index = $(w - w_p) / I_p$
$I_C$	consistency index = $(w_l - w) / I_p$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$I_D$	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

### (b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

### (c) Consolidation (one-dimensional)

$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (over-consolidated range)
$C_s$	swelling index
$C_\alpha$	secondary compression index
$m_v$	coefficient of volume change
$C_v$	coefficient of consolidation (vertical direction)
$C_h$	coefficient of consolidation (horizontal direction)
$T_v$	time factor (vertical direction)
U	degree of consolidation
$\sigma'_p$	pre-consolidation stress
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

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

Notes: 1  
2

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

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



## LIST OF ABBREVIATIONS

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

### I. SAMPLE TYPE

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

### II. PENETRATION RESISTANCE

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

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

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

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 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 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) Non-Cohesive (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 <sub>p</sub>	plastic limit
w <sub>l</sub>	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 <sub>R</sub>	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

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





## LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

### WEATHERINGS STATE

**Fresh:** no visible sign of weathering

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

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

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

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

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

### BEDDING THICKNESS

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

### JOINT OR FOLIATION SPACING

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

### GRAIN SIZE

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

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

### CORE CONDITION

#### Total Core Recovery (TCR)

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

#### Solid Core Recovery (SCR)

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

#### Rock Quality Designation (RQD)

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

### DISCONTINUITY DATA

#### Fracture Index

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

#### Dip with Respect to Core Axis

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

#### Description and Notes

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

#### Abbreviations

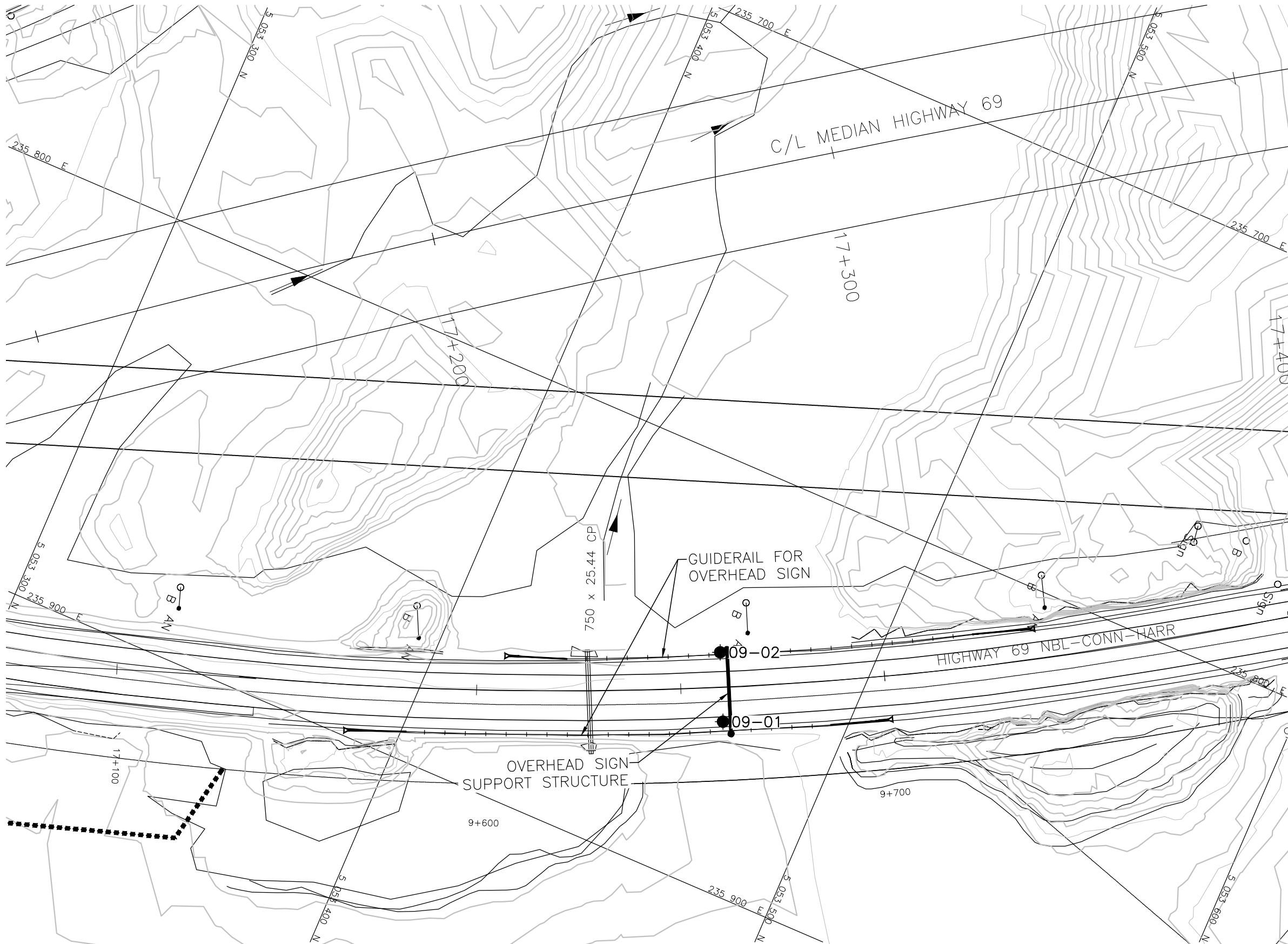
JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	



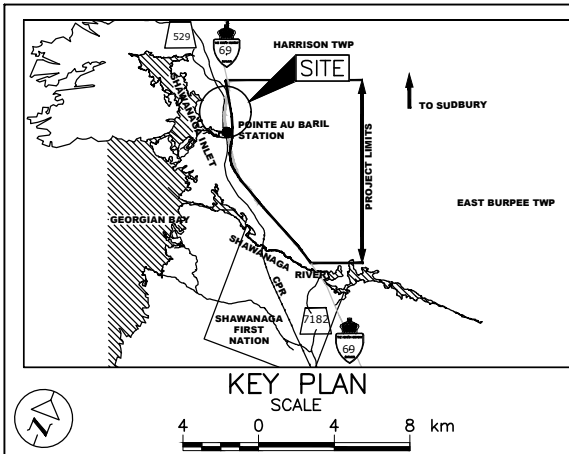
# **APPENDIX A**

## **Highway 69 NBL - Connection – Overhead Sign at STA 9+962**

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



CONT No. GWP No. 5403-05-00	
HIGHWAY 69 OVERHEAD SIGN AT STA. 9+662 BOREHOLE LOCATIONS	SHEET



BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
09-01	198.1	5053471.6	235860.1
09-02	197.1	5053464.2	235844.8

**NOTES**

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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 MMM, drawing file nos. Base 5403-05-00.dwg, Hwy 69 5403-05-00 Design.dwg and Hwy 69 5403-05-00 PM\_Sign.dwg, received FEB 16, 2016.



NO.	DATE	BY	REVISION
Geocres No. 41H-167			
HWY. 69	PROJECT NO. 07-1191-0020	DIST.	
SUBM'D.	CHKD.	DATE: 10/20/2016	SITE:
DRAWN: TB	CHKD. AB	APPD. JMAC	DWG. A1



PROJECT 07-1191-0020				<b>RECORD OF BOREHOLE No 09-01</b>				1 OF 2 <b>METRIC</b>									
G.W.P. 5403-05-00				LOCATION N 5053471.6; E 235860.1				ORIGINATED BY EHS									
DIST _____ HWY 69				BOREHOLE TYPE 108 mm Continuous Flight Hollow Stem Augers				COMPILED BY TB									
DATUM Geodetic				DATE September 1, 2009				CHECKED BY AB									
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 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									
198.1	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT (75 mm)		1	AS	-		198										
	Sand to sand and gravel (FILL)		2	AS	-												
197.1	Brown Moist																
1.0	Blast Rock (FILL)		3	SS	40/0.1		197										
195.8	PEAT						196										
2.4	Gneiss (BEDROCK)																
	Bedrock cored from 2.4 m to 5.4 m depth.		1	RC	REC 100%		195										RQD = 100%
	For coring details see Record of Drillhole 09-01.																
			2	RC	REC 100%		194										RQD = 95%
192.7	END OF BOREHOLE						193										
5.4	Note:  1. Water level at depth of 1.2 m below ground surface (Elev. 196.2 m) upon completion of drilling (and decreasing).																

SUD-MTO 001 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 31/05/16 DATA INPUT:

PROJECT: 07-1191-0020

**RECORD OF DRILLHOLE: 09-01**

SHEET 2 OF 2

LOCATION: N 5053471.6 ;E 235860.1

DRILLING DATE: September 1, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-850 Track

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN														NOTES WATER LEVELS INSTRUMENTATION			
						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.							
						RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY k, cm/s		Diametral Point Load Index (MPa)	RMC -Q AVG						
						TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn			10 <sup>-5</sup>	10 <sup>-4</sup>	10 <sup>-3</sup>	10 <sup>-2</sup>		
		REFER TO PREVIOUS PAGE		195.7 2.4		FLUSH	88 88																

USC = 104.8 MPa

DEPTH SCALE

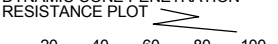

1 : 50



LOGGED: EHS

CHECKED: AB

SUD-RCK 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 31/05/16 DATA INPUT:

PROJECT 07-1191-0020			RECORD OF BOREHOLE No 09-02			1 OF 2 METRIC							
G.W.P. 5403-05-00			LOCATION N 5053464.2; E 235844.8			ORIGINATED BY EHS							
DIST _____ HWY 69			BOREHOLE TYPE 108 mm Continuous Flight Hollow Stem Augers			COMPILED BY TB							
DATUM Geodetic			DATE September 2, 2009			CHECKED BY AB							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
197.1	GROUND SURFACE												
0.0	Silty sand to gravelly sand (FILL)		1	SS	5	▽	197						
196.6	Loose Brown Moist						196						
0.5	GNEISS (BEDROCK)						195						
	Bedrock cored from 0.5 m to 3.8 m depth. For coring details see Record of Drillhole 09-02.		1	RC	REC 93%		194						
			2	RC	REC 100%								
193.3	END OF BOREHOLE												
3.8	Note:  1. Water level at depth of 0.5 m below ground surface (Elev. 195.6 m) upon completion of drilling.												

SUD-MTO 001 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 31/05/16 DATA INPUT:

PROJECT: 07-1191-0020

**RECORD OF DRILLHOLE: 09-02**

SHEET 2 OF 2

LOCATION: N 5053464.2 ;E 235844.8

DRILLING DATE: September 2, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-850 Track

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN															NOTES WATER LEVELS INSTRUMENTATION									
						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				
						RECOVERY					R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA										HYDRAULIC CONDUCTIVITY					Diametral Point Load Index (MPa)	RMC -Q AVG	
						TOTAL CORE %	SOLID CORE %						B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	φ	ψ	τ	σ								
		REFER TO PREVIOUS PAGE		196.6 0.5		FLUSH	88 8																							

DEPTH SCALE

1 : 50



LOGGED: EHS

CHECKED: AB

SUD-RCK 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS GDT 31/05/16 DATA INPUT:



# **APPENDIX B**

## **Highway 69 NBL – Overhead Sign at STA 15+700**

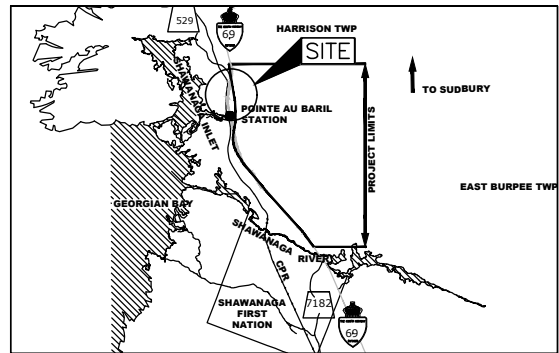
**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
GWP No. 5403-05-00

HIGHWAY 69  
OVERHEAD SIGN AT STA. 15+700  
BOREHOLE LOCATIONS



SHEET



KEY PLAN  
SCALE  
4 0 4 8 km

● Borehole – Current Investigation

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
09-07	205.1	5052189.9	236713.1
09-08	204.3	5052184.4	236698.1

NOTES

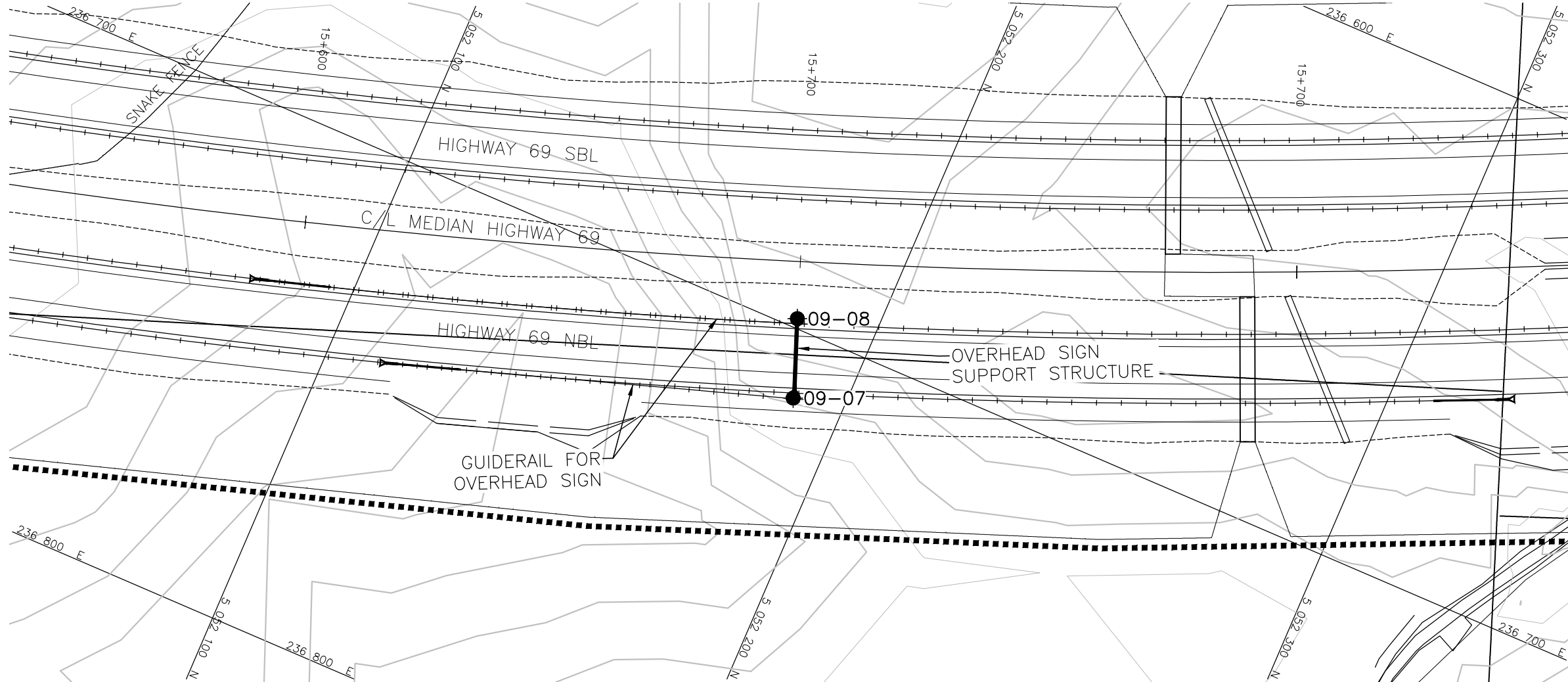
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.


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

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REFERENCE

Base plans provided in digital format by MMM, drawing file nos. Base 5403-05-00.dwg, Hwy 69 5403-05-00 Design.dwg and Hwy 69 5403-05-00 PM\_Sign.dwg, received FEB 16, 2016.



PROJECT <u>07-1191-0020</u>				<b>RECORD OF BOREHOLE No 09-07</b>				1 OF 2 <b>METRIC</b>									
G.W.P. <u>5403-05-00</u>				LOCATION <u>N 5052189.9; E 236713.1</u>				ORIGINATED BY <u>EHS</u>									
DIST <u>          </u> HWY <u>69</u>				BOREHOLE TYPE <u>108 mm Continuous Flight Hollow Stem Augers</u>				COMPILED BY <u>TB</u>									
DATUM <u>Geodetic</u>				DATE <u>September 8, 2009</u>				CHECKED BY <u>AB</u>									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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					WATER CONTENT (%)				
205.1	GROUND SURFACE							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
0.1	Sandy TOPSOIL		1	SS	5/0.1												
	GNEISS (BEDROCK)																
	Bedrock cored from 0.1 m to 3.1 m depth. For coring details see Record of Drillhole 09-07.		1	RC	REC 100%												
			2	RC	REC 100%												
202.0	END OF BOREHOLE																
3.1	Note: 1. Water level not recorded.																

SUD-MTO 001 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 01/06/16 DATA INPUT:





SHEET 2 OF 2

DATUM: Geodetic

DRILLING CONTRACTOR: Landcore Drilling

CHECKED: AB

SUD-RCK 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 01/06/16 DATA INPUT:

PROJECT <u>07-1191-0020</u>		<b>RECORD OF BOREHOLE No 09-08</b>				1 OF 2 <b>METRIC</b>											
G.W.P. <u>5403-05-00</u>		LOCATION <u>N 5052184.4; E 236698.1</u>				ORIGINATED BY <u>EHS</u>											
DIST <u>          </u> HWY <u>69</u>		BOREHOLE TYPE <u>108 mm Continuous Flight Hollow Stem Augers</u>				COMPILED BY <u>TB</u>											
DATUM <u>Geodetic</u>		DATE <u>September 8, 2009</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  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									
204.3	GROUND SURFACE							20	40	60	80	100					
0.0 204.0	Sandy TOPSOIL		1	SS	13												
0.5	SAND Compact Brown Moist  GNEISS (BEDROCK)  Bedrock cored from 0.5 m to 3.7 m depth.  For coring details see Record of Drillhole 09-08.		1	RC	REC 100%												RQD = 33%
			2	RC	REC 100%												RQD = 84%
200.6	END OF BOREHOLE																
3.7	Note:  1. Water level not recorded.																

SUD-MTO 001 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 01/06/16 DATA INPUT:

PROJECT: 07-1191-0020

## RECORD OF DRILLHOLE: 09-08

SHEET 2 OF 2

LOCATION: N 5052184.4 ;E 236698.1

DRILLING DATE: September 8, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-850 Track

DRILLING CONTRACTOR: Landcore Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	CORING LOG															NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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DEPTH SCALE

1 : 50



LOGGED: EHS

CHECKED: AB

SUD-RCK 07-1191-0020 SIGNS BH LOGS METRIC.GPJ GAL-MISS.GDT 01/06/16 DATA INPUT:



# **APPENDIX C**

## **Non-Standard Special Provisions**

## **MASS CONCRETE – Item No.**

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

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#### **Scope of Work**

The scope of work for the above noted tender item includes the supply and placement of mass concrete on bedrock for the support of the overhead sign footing.

#### **Construction**

Concrete shall be of the same strength as the footing concrete and placed in accordance with OPSS.PROV 904. The bedrock founding surface should be properly prepared including the removal of loose shattered rock fragments and cleaned of loosened particles/rock dust to permit adhesion between the concrete and the bedrock to take place.

#### **Basis of Payment**

Payment at the contract price for the above noted tender item includes full compensation for all labour, equipment and materials to do the required work.

## **DOWELS INTO ROCK – Item No.**

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

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#### **Scope of Work**

Work under this item is for the placement and field testing of dowels into rock.

#### **Construction**

Dowels into rock shall be constructed in accordance with OPSS.PROV 904 (Concrete Structures). All reinforcing steel supplied shall be in accordance with OPSS.PROV 1440 (Steel Reinforcement for Concrete) (dowel bars conforming to CSA Standard CSAG30.18, Grade 400).

For dowels into rock, holes shall be drilled to the required depth and size. Hole diameter shall be two times the nominal diameter of the dowel. Each hole shall be cleaned out, grouted and the dowel set in place. Grout shall be of the same strength as the footing concrete, or at least 25 MPa at 28 days.

If the hole contains water, the contractor shall remove the water; otherwise, a tremie procedure shall be used to completely fill the hole with grout. The dowel shall be forced into the hole after the grout has been placed and while it is still fresh.

#### **Rock Dowel Testing**

All proposed testing procedures shall be in general conformance with ASTM D3689-90 and ASTM D1143M-07. Field testing must be carried out in the presence of, and the results reviewed and approved by, the Contract Administrator.

#### **Performance Tests**

The following summarizes the number of dowels into rock where performance testing shall be carried out to confirm that the design load of the rock dowels can be achieved. The Contract Administrator will select the rock dowels to be tested.

<b>Foundation</b>	<b>Number of Dowels for Performance Testing</b>
Overhead Sign at STA 9+962 NBL Connection	2 per foundation element
Overhead Sign at STA 15+700 NBL	2 per foundation element

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 dowels shall be loaded and unloaded in 3 cycles and measurements of the displacement of the dowel 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 dowels, 252 kN for 30M dowels, 180 kN for 25M dowels, and 108 kN for 20M dowels.

Displacement measurements shall be carried out at each load increment using calibrated displacement gauges capable of measuring movements of 0.025 mm. Measurements shall be referenced to an independent fixed referenced pint.

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

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

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

### **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.

END OF SECTION



As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit [golder.com](http://golder.com)

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

[solutions@golder.com](mailto:solutions@golder.com)  
[www.golder.com](http://www.golder.com)

**Golder Associates Ltd.**  
**33 Mackenzie Street, Suite 100**  
**Sudbury, Ontario, P3C 4Y1**  
**Canada**  
**T: +1 (705) 524 6861**

