



JULY 2012

FOUNDATION INVESTIGATION REPORT

**VARIABLE MESSAGE SIGN
HIGHWAY 69 FOUR-LANING
FROM 1.0 KM NORTH OF THE NEW HIGHWAY 559
INTERCHANGE NORTHERLY TO 1.5 KM NORTH OF
HIGHWAY 7182 (SHEBESHEKONG ROAD) FOR 17 KM
MINISTRY OF TRANSPORTATION, ONTARIO
G.W.P. 5402-05-00**

Submitted to:
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REPORT

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PART A

FOUNDATION INVESTIGATION REPORT

VARIABLE MESSAGE SIGN

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by McCormick Rankin, a member of MMM Group Limited (MRC) on behalf of Ministry of Transportation, Ontario (MTO) to provide detail foundation engineering services for one (1) variable message sign (VMS) located along the proposed Highway 69 alignment within the Phase 1 section of the project. The proposed work is part of the four-laning of Highway 69 from 1.0 km north of the new Highway 559 Interchange northerly to 1.5 km north of Highway 7182 (Shebeshekong Road), which involves high fill embankments and embankments over swamps, the New Woods Road and Shebeshekong Road interchanges and structures, the Shawanaga River and Site 9 Road structures, as well as culvert crossings. The general location/extent of the Phase 1 section of the new Highway 69 four-laning alignment within which the variable message sign is located is shown on the Site Location Plan on Drawing 1. The general location of the VMS is shown on Drawings 1 and 2.

The Terms of Reference and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated January 2007. Golder's proposal for foundation engineering services associated with the variable message sign is contained in Section 6.8 of MRC's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Project Specific Supplementary Specialty Plan for foundation engineering services for this project, dated July 4, 2007.

This report addresses the investigation carried out for the proposed variable message sign along Highway 69 only. Separate reports address the foundation investigations for the related swamp crossings, high fill areas for the associated interchange ramps and roadways, culverts and other bridge structures for the project.

The purpose of this investigation is to establish the subsurface conditions at the proposed variable message sign foundations by borehole drilling, rock coring, in situ testing and laboratory testing on selected samples. The foundation limits for this investigation were located in the field using survey stakes put down by Callon Dietz Inc. (Callon Dietz), a professional surveying company retained by MRC. The area of the investigation is shown in plan on Drawing 2.

2.0 SITE DESCRIPTION

The proposed VMS is located at STA 18+380, on the proposed Highway 69 NBL alignment in the Township of Carling.

In general, the topography in the area of the VMS consists of rolling terrain including densely treed areas and low-lying swamps containing areas of standing water with various types of vegetation and organic soils immediately to the north. The immediate area surrounding the proposed VMS is flat and covered by shrubs and trees. Bedrock outcrops are present to the east and west of the site.

The existing ground surface at the proposed locations of the VMS supports is at about Elevation 214.1 m and 215.2 m, generally sloping downward from the west to the east. At this location, the proposed Highway 69 NBL embankment will be up to about 3 m above the existing ground surface.

3.0 INVESTIGATION PROCEDURES

3.1 Foundation Investigation

The field work for the investigation at the VMS location was carried out on May 19, 2009, during which time two (2) boreholes were drilled near the shoulders of the proposed Highway 69 NBL, at or near the proposed VMS supports. The boreholes, designated as Boreholes VMS1-01 and VMS1-02 were advanced at the locations shown in plan on Drawing A1 in Appendix A.



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The field investigation was carried out using a track-mounted Diedrich D-25 drill rig, supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. The boreholes were advanced through the overburden using 165 mm outside diameter (O.D.) solid-stem augers, and soil samples were obtained at 0.75 m intervals of depth using 50 mm outside diameter (O.D.) split-spoon samplers driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedures (ASTM D1586 Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the Soil). Samples of the bedrock were obtained using an 'NQ' size rock core barrel.

The boreholes were advanced through the overburden to auger and/or sampler refusal (i.e. inferred bedrock) and bedrock was confirmed by coring in both boreholes. The boreholes were advanced to depths of up to about 6.1 m below existing ground surface, including coring of bedrock for core lengths up to about 3.1 m.

The groundwater conditions in the open boreholes were observed during the drilling operations and a piezometer was installed in Borehole VMS1-01 to permit monitoring of the water level at this location. The piezometer consists of 32 mm diameter PVC pipe, with a slotted screen sealed at a select depth within the borehole. The borehole and annulus surrounding the piezometer pipe above the sand pack/screen was backfilled to the surface with bentonite pellets/grout. Piezometer installation details and water level readings are described on the Record of Borehole sheets presented in Appendix A. The borehole in which a standpipe piezometer was not installed was backfilled with bentonite upon completion, in accordance with Ontario Regulation 903 Wells (as amended).

The field work was observed by a member of our technical staff who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes, 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 our Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing, such as water content and grain size distribution, was carried out on selected soil samples. Classification of the bedrock rock mass quality with respect to the Rock Quality Designation is described based on Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)¹. Point load strength tests, both perpendicular to the core axis (diametral test) and along the core axis (axial test) were performed on selected samples of the rock core to provide an indication of the point load strength index (Is_{50})² of the rock. The bedrock was then classified with respect to strength based on the Is_{50} values as suggested in Table 3.5 of the Canadian Foundation Engineering Manual (2006)¹. The results of the laboratory testing are included in Appendix A.

The as-drilled borehole locations and ground surface elevations were surveyed by a member of our technical staff, referenced to the survey stakes put down by Callon Dietz. The borehole locations provided in the Record of Borehole and Drillhole sheets as well as on Drawing A1 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to geodetic datum, and are summarized below.

Borehole No.	Location (MTM NAD 83)		Collar Elevation (Geodetic Datum) (m)	Depth Drilled (m)
	Northing	Easting		
VMS1-01	5038325.5	251183.9	215.2	6.1
VMS1-02	5038337.3	251194.8	214.1	4.1

¹ Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.

² International Society for Rock Mechanics (ISRM), 1985. Suggested Method for Determining Point Load Strength. Int. J. Rock Mech. Min. Sci. and Geomech. Abst., Vol. 22, No 2, pp 51-60.



4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*³, 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.

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 underlain by metamorphic bedrock; numerous bare knobs and ridges of bedrock are present throughout the area. Localized low lying swampy areas, containing peat and/or organic soils underlain by soft/loose native soils, are present in valleys between the bedrock knobs and ridges.

The bedrock in the area consists typically of 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*⁴. Deposition of Palaeozoic strata initially covered the bedrock and later erosion during glaciation subsequently exposed these Precambrian rocks.

4.2 Subsurface Conditions

The detailed subsurface soil, bedrock and groundwater conditions as encountered in the boreholes advanced for this investigation, together with the results of the laboratory tests carried out on selected soil and rock core samples, are presented on the attached Record of Borehole and Drillhole sheets in Appendix A. The stratigraphic boundaries shown on the Record of Borehole and Drillhole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the subsurface conditions at the proposed variable message sign consist of a cohesionless deposit of silty sand to sand and silt underlain by granite gneiss bedrock. At one borehole location, the upper portion of the cohesionless stratum was visually observed to contain organic material.

The following sections provide information on the subsoils and groundwater conditions encountered in the boreholes advanced at the proposed variable message sign location.

4.2.1 Organic Silty Sand

An approximately 0.6 m thick layer of organic silty sand containing rootlets was encountered at the ground surface at about Elevation 215.2 m in Borehole VMS1-01.

The Standard Penetration Test (SPT) 'N' value measured within this layer is 3 blows per 0.3 m of penetration, indicating a very loose relative density.

The natural water content measured on one (1) sample of the organic silty sand is about 27 percent.

³ 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.

⁴ *Geology of Ontario*, 1991. Ontario Geological Society, Special Volume 4, Part 2. Ministry of Northern Development and Mines, Ontario.



4.2.2 Silty Sand to Sand and Silt

A deposit of reddish brown to grey silty sand to sand and silt, trace gravel and containing rootlets was encountered below the organic silty sand deposit in Borehole VMS1-01 and at the ground surface in Borehole VMS1-02. The near surface portion of the deposit in Borehole VMS1-02 was observed to be slightly organic, and cobbles were encountered within the lower portion of the deposit in Borehole VMS1-01. The top of the deposit is at about Elevation 214.6 m and 214.1 m, and the thickness of the deposit is about 2.4 m and 1.1 m in Boreholes VMS1-01 and VMS1-02, respectively.

The Standard Penetration Test (SPT) 'N'-values measured within this deposit range from 6 blows to 84 blows per 0.3 m of penetration, indicating a loose to very dense relative density. The high SPT 'N'-values were recorded within the lower portion of the deposit where cobbles were encountered.

The natural water content measured on two (2) samples of this deposit is about 14 percent and 17 percent.

The grain size distribution on one (1) sample of this deposit is presented on Figure A1 in Appendix A.

4.2.3 Bedrock

Bedrock was encountered and core samples were recovered below the deposit of silty sand to sand and silt in Boreholes VMS1-01 and VMS1-02. The depth to bedrock below ground surface and the corresponding bedrock surface elevation is summarized below.

Borehole No.	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Refusal Type
VMS1-01	3.0	212.2	Bedrock Cored
VMS1-02	1.1	213.0	Bedrock Cored

Based on the rock core samples, the bedrock consists of granite gneiss. In general, the bedrock samples are described as fresh, strongly foliated, medium to coarse grained with phenocryst and feldspar banding, low to moderate porosity and pink to grey to black. The Rock Quality Designation (RQD) measured on the core samples ranges from 90 percent to 100 percent, indicating a rock mass of excellent quality. The Total Core Recovery (TCR) of the core samples is about 100 percent, and the Solid Core Recovery (SCR) of the core samples recovered is about 98 percent and 100 percent.

Laboratory point load strength tests were performed on selected samples of the rock core. The axial and diametral point load strength index values are shown on the Record of Drillhole sheets and are presented in Table A1 in Appendix A. The axial tests carried out on nine (9) specimens of the granite gneiss bedrock measured Is_{50} values ranging from about 7.0 MPa to 11.8 MPa and the diametral tests carried out on nine (9) specimens of the granite gneiss bedrock measured Is_{50} values ranging from about 4.3 MPa to 6.7 MPa.

Also presented in Table A1 are the estimated Unconfined Compressive Strength (UCS) values for each sample tested for point load strength based on a relationship between Is_{50} and UCS which is given by a correlation factor (K) in accordance with ASTM D5731 Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classification, which may vary depending on the size of the core sample and the strength of the rock, as well as the estimated UCS of bedrock core samples from other structure sites in the area of the Variable Message Sign. For this site, the UCS values are based on an estimated average correlation factor (K) of 20.

Based on the axial point load testing results, the granite gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).



4.2.4 Groundwater Conditions

In general, the soil samples taken in the boreholes were moist to wet. A standpipe piezometer was installed in Borehole VMS1-01 to permit monitoring of the water level at this site. Details of the piezometer installation are shown the Record of Borehole sheets in Appendix A. The groundwater level measured in the piezometer installation about two months following completion of drilling is summarized below.

Borehole No.	Ground Surface Elevation (m)	Groundwater Elevation (m)	Date of Measurement
VMS1-01	215.2	213.3	July 15, 2009

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events, and should be expected to be higher during wet periods of the year.

5.0 CLOSURE

Mr. Matt J. Riopelle, field technician with Golder, directed the field drilling program. This report was prepared by Ms. T. Veronica Ayetan, P. Eng. and Mr. Christopher Ng, P. Eng., and was reviewed by Mr. J. Paul Dittrich, P. Eng., a senior geotechnical engineer and Principal with Golder. Mr. Jorge M. A. Costa, P. Eng., Golder's Designated MTO Contact for this project and Principal with Golder, conducted an independent quality control review of the report.



Report Signature Page

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TVA/CN/JPD/JMAC/sm

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LIST OF SYMBOLS

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

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_{α}	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

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

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
shear strength = (compressive strength)/2



LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 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	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

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

IV. SOIL TESTS

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

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

V. MINOR SOIL CONSTITUENTS

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



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

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

<u>Description</u>	<u>Bedding Plane Spacing</u>
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

<u>Description</u>	<u>Spacing</u>
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

<u>Term</u>	<u>Size*</u>
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

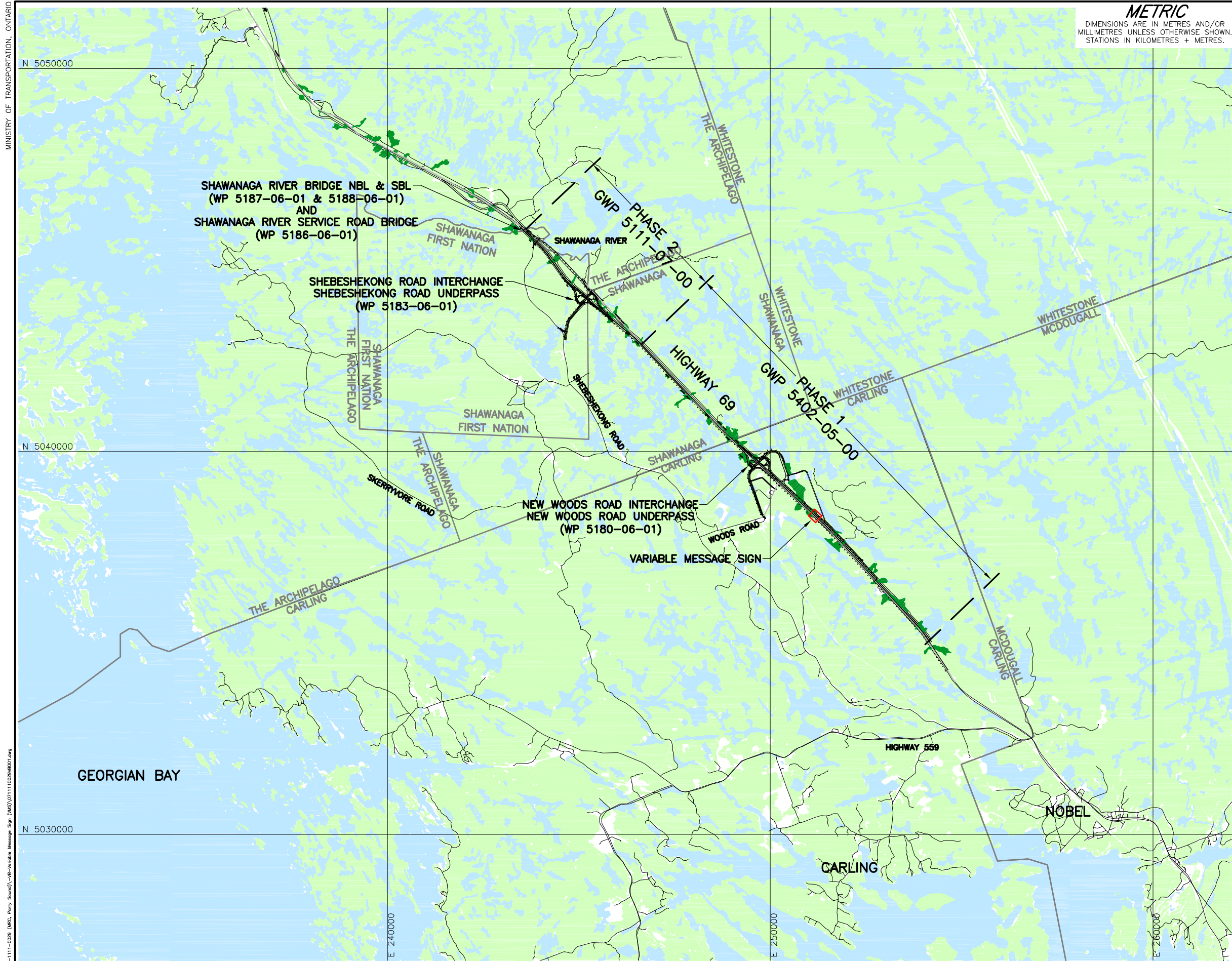
The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

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	



PLAN



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

CONT No.
GWP No. 5402-05-00



HIGHWAY 69
SITE LOCATION PLAN

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN
NOT TO SCALE



REFERENCE

Base Data - MNR NRVS, obtained 2004, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Datum : NAD 83 Projection : MTM Zone 10

NO.	DATE	BY	REVISION
Geocres No. 41H-110			
HWY. 69	PROJECT NO. 07-1111-0029		DIST.
SUBM'D. VA	CHKD. VA	DATE: July 2012	SITE:
DRAWN: JFC/CD	CHKD. CN	APPD. JPD/JMAC	DWG. 1

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

CONT No.
GWP No. 5402-05-00

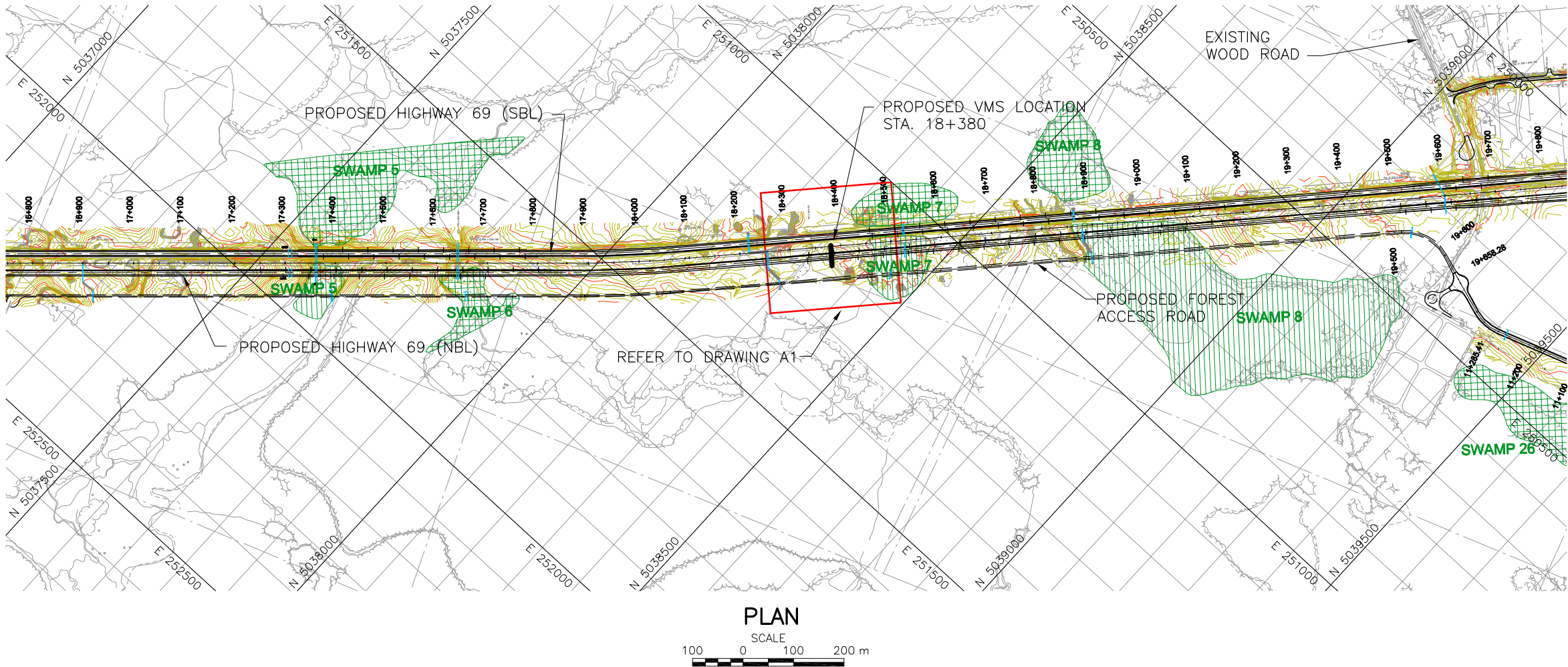
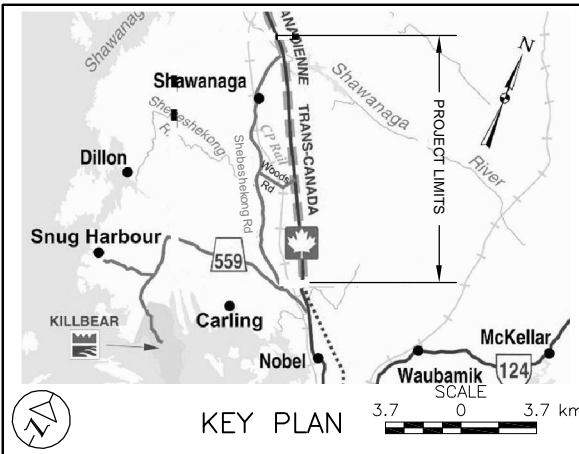


HIGHWAY 69
VARIABLE MESSAGE SIGN (VMS)
INDEX PLAN

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



REFERENCE



Base plans provided in digital format by MRC, drawing file 5271XB01.DWG, 5271-XPB-ARCHIPELAGO.dwg, 5271-XPB-Carling.dwg, 5271-XPB-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007, and h6878_PHASE1_XA1, h6878_PHASE1_XN1.dwg, received January 21, 2009, h6878_PHASE2_XA1, h6878_PHASE2_XN1.dwg, received January 21, 2009 and h6878_PHASE1_XN1.dwg, received September 19, 2011.

NO.	DATE	BY	REVISION
Geocres No. 41H-110			
HWY. 69	PROJECT NO. 07-1111-0029		DIST.
SUBM'D. VA	CHKD. VA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. 2



APPENDIX A

Highway 69 NBL – Variable Message Sign – STA 18+380

PROJECT		RECORD OF BOREHOLE		No VMS1-01		SHEET 1 OF 2		METRIC										
G.W.P. 07-1111-0029		LOCATION		N 5038325.5 ; E 251183.9		ORIGINATED BY		MJR										
DIST _____ HWY 69		BOREHOLE TYPE		165 mm O.D. Continuous Flight Solid Stem Augers and NW Casing, Wash Boring		COMPILED BY		AT										
DATUM Geodetic		DATE		May 19, 2009		CHECKED BY		VA										
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 (%)
215.2	GROUND SURFACE							20	40	60	80	100						
0.0	Organic Silty SAND, containing rootlets		1	SS	3													
214.6	Very loose Dark brown to reddish brown Moist		2	SS	9													
213.8	Silty SAND, trace gravel, containing rootlets		3	SS	52													
1.4	Loose Reddish brown Moist		4	SS	84													
212.2	SAND and SILT, trace gravel, containing cobbles																	
3.0	Very dense Reddish brown to grey Moist to wet																	
212.2	Granite Gneiss (BEDROCK)		1	RC	REC 100%													
3.0	Bedrock cored from 3.0 m to 6.1 m																	
	For bedrock coring details, refer to Record of Drillhole VMS1-01		2	RC	REC 100%													
210																		
209.1	END OF BOREHOLE																	
6.1	NOTE: 1. Water level measured in piezometer at a depth of 1.9 m below ground surface (Elev. 213.3 m) on July 15, 2009.																	

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: VMS1-01

SHEET 2 OF 2

LOCATION: N 5038325.5 ;E 251183.9

DRILLING DATE: May 19, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Diedrich D-25

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SH - 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 VR - Very Rough	MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA						HYDRAULIC CONDUCTIVITY K, cm/sec			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 ⁻⁶			10 ⁻⁵	10 ⁻⁴	10 ⁻³																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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DEPTH SCALE

1 : 50



LOGGED: MJR

CHECKED: JB/VA

GTA-RCK 018 07-1111-0029-CULVERT-PHASE I-GPJ GAL-MISS.GDT 7/23/12 DD/SAC

PROJECT		RECORD OF BOREHOLE		No VMS1-02		SHEET 1 OF 2		METRIC									
G.W.P. 07-1111-0029		LOCATION		N 5038337.3 ; E 251194.8		ORIGINATED BY		MJR									
DIST _____ HWY 69		BOREHOLE TYPE		165 mm O.D. Continuous Flight Solid Stem Augers and NW Casing, Wash Boring		COMPILED BY		AT									
DATUM Geodetic		DATE		May 19, 2009		CHECKED BY		VA									
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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
214.1	GROUND SURFACE							20	40	60	80	100					
0.0	Silty SAND, trace gravel, slightly organic, containing rootlets		1	SS	6												
213.5	Loose Grey Moist		2	SS	31/0.15												
0.6																	
213.0	Silty SAND, trace gravel Very dense Grey Wet																
1.1	Granite Gneiss (BEDROCK)		1	RC	REC 100%												RQD = 93%
	Bedrock cored from 1.1 m to 4.1 m																
	For bedrock coring details, refer to Record of Drillhole VMS1-02		2	RC	REC 97%												RQD = 97%
210.0	END OF BOREHOLE																
4.1	NOTE: 1. Water level in open borehole not noted upon completion of drilling.																

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: VMS1-02

SHEET 2 OF 2

LOCATION: N 5038337.3 ;E 251194.8

DRILLING DATE: May 19, 2009

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Diedrich D-25

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	RECOVERY TOTAL CORE %	SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3 m	B Angle	DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q- AVG.	NOTES
		Continued from Record of Borehole VMS1-02		213.03													
	NW Casing May 19, 2009	GNEISS Fresh, strongly foliated, medium grained with phenocrysts and feldspar banding, moderate porosity, strong to very strong, pink, grey and black		1.07	1	Grey 100							FO,UNSM FO,CUSM FO,CURo FO,UNVR FO,PLSM FO,UNSM FO,IRVR				(Axial) 9.5 MPa (Axial) 9.2 MPa (Axial) 10.7 MPa
	NQ RC May 19, 2009				2	Grey 100											(Axial) 7.0 MPa (Axial) 9.7 MPa (Axial) 9.5 MPa
		END OF DRILLHOLE		210.02 4.08													
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	

DEPTH SCALE

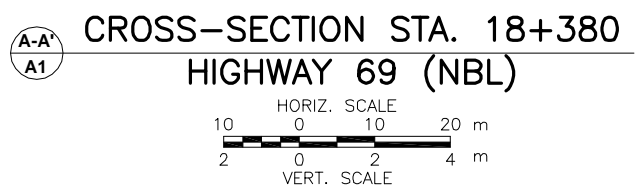
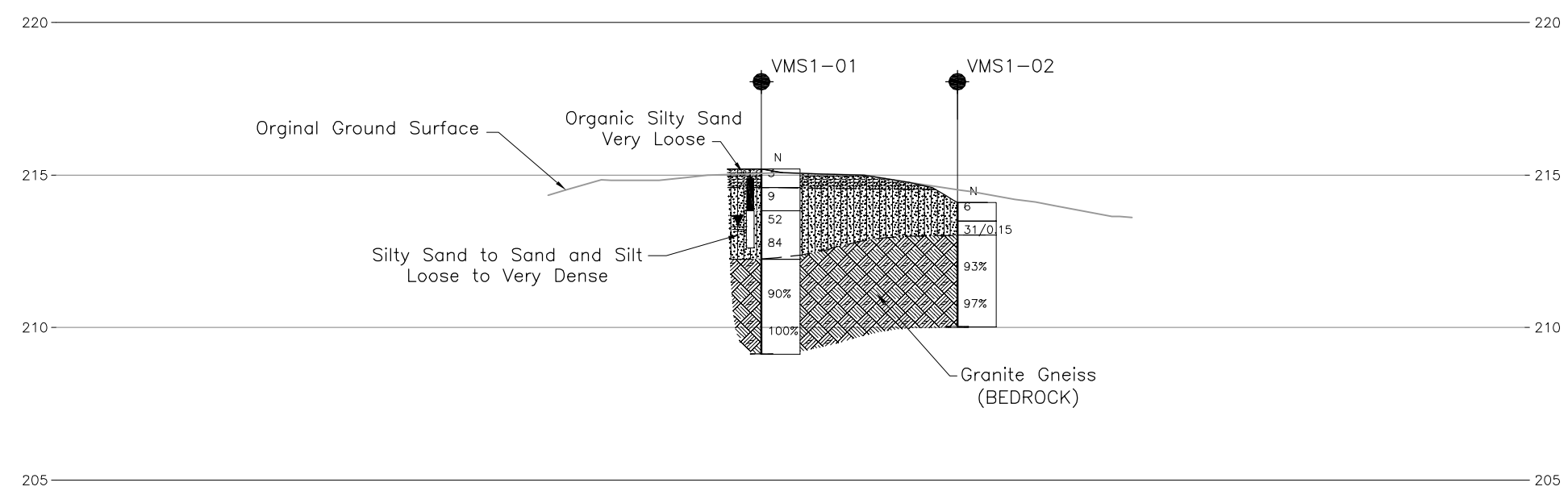
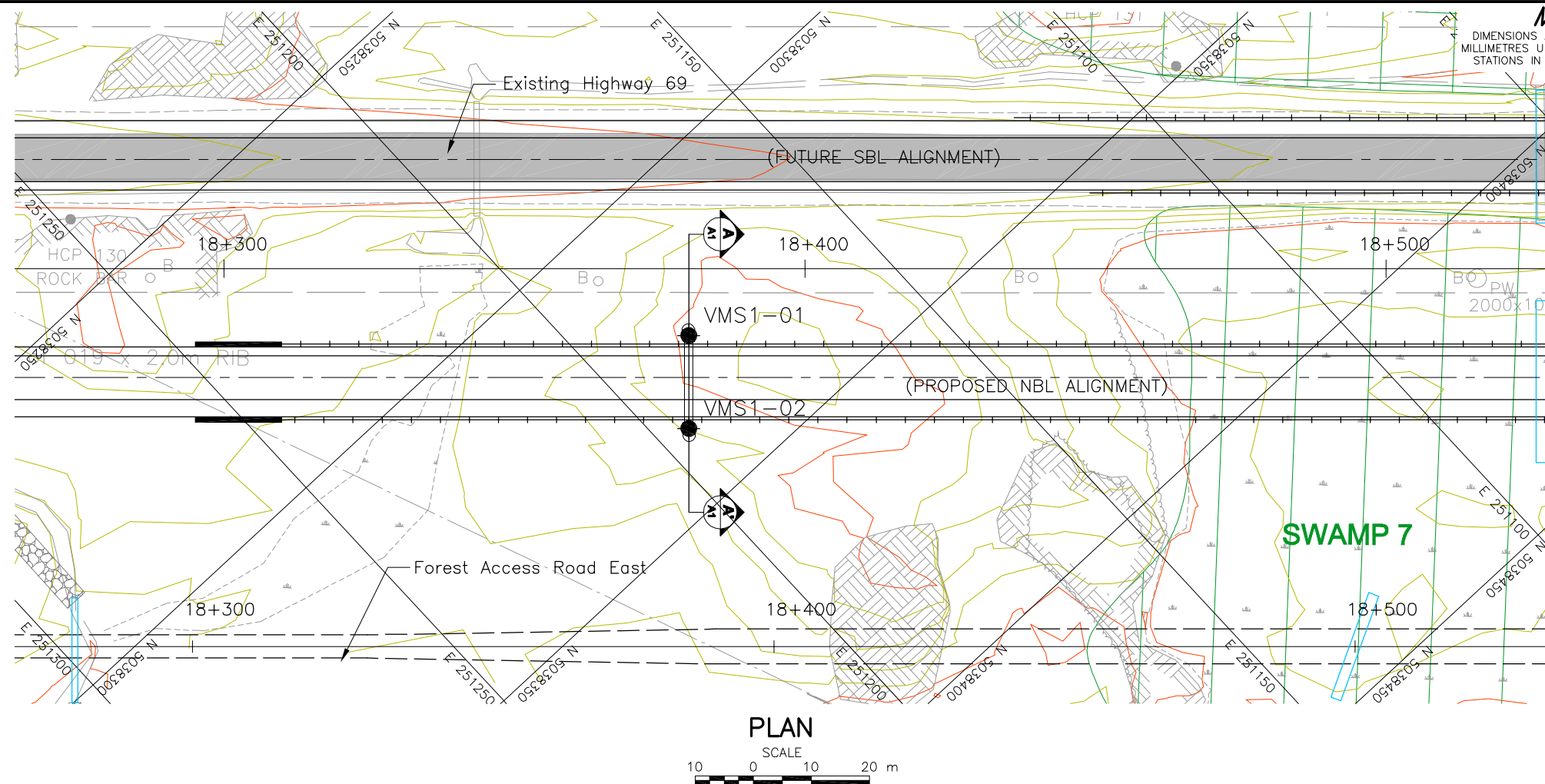
1 : 50



LOGGED: MJR

CHECKED: JB/VA

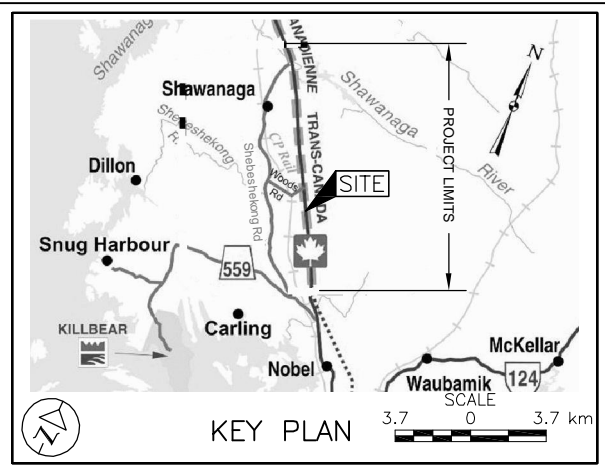
GTA-RCK 018 07-1111-0029-CULVERT-PHASE I-GPJ GAL-MISS.GDT 7/23/12 DD/SAC



CONT No.
GWP No. 5402-05-00

HIGHWAY 69 (NBL)
VARIABLE MESSAGE SIGN STA 18+380
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND

	Borehole - Current Investigation
	Seal
	Piezometer
N	Standard Penetration Test Value
16	Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
100%	Rock Quality Designation (RQD)
	WL in piezometer, measured on July 15, 2009

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
VMS1-01	215.2	5038325.5	251183.9
VMS1-02	214.1	5038337.3	251194.8

NOTES

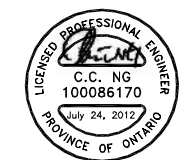
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The 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 MRC, drawing file 5271XB01.DWG, 5271-XPD-ARCHIPELAGO.dwg, 5271-XPD-Carling.dwg, 5271-XPD-SHAWANAGA.dwg, PR # 5377-02-00-PR-1.dwg, received October 1, 2007 and h6878_PHASE1_XA1, h6878_PHASE1_XN1.dwg, received January 21, 2009 and h6878_PHASE1_XN1.dwg, received September 19, 2011..

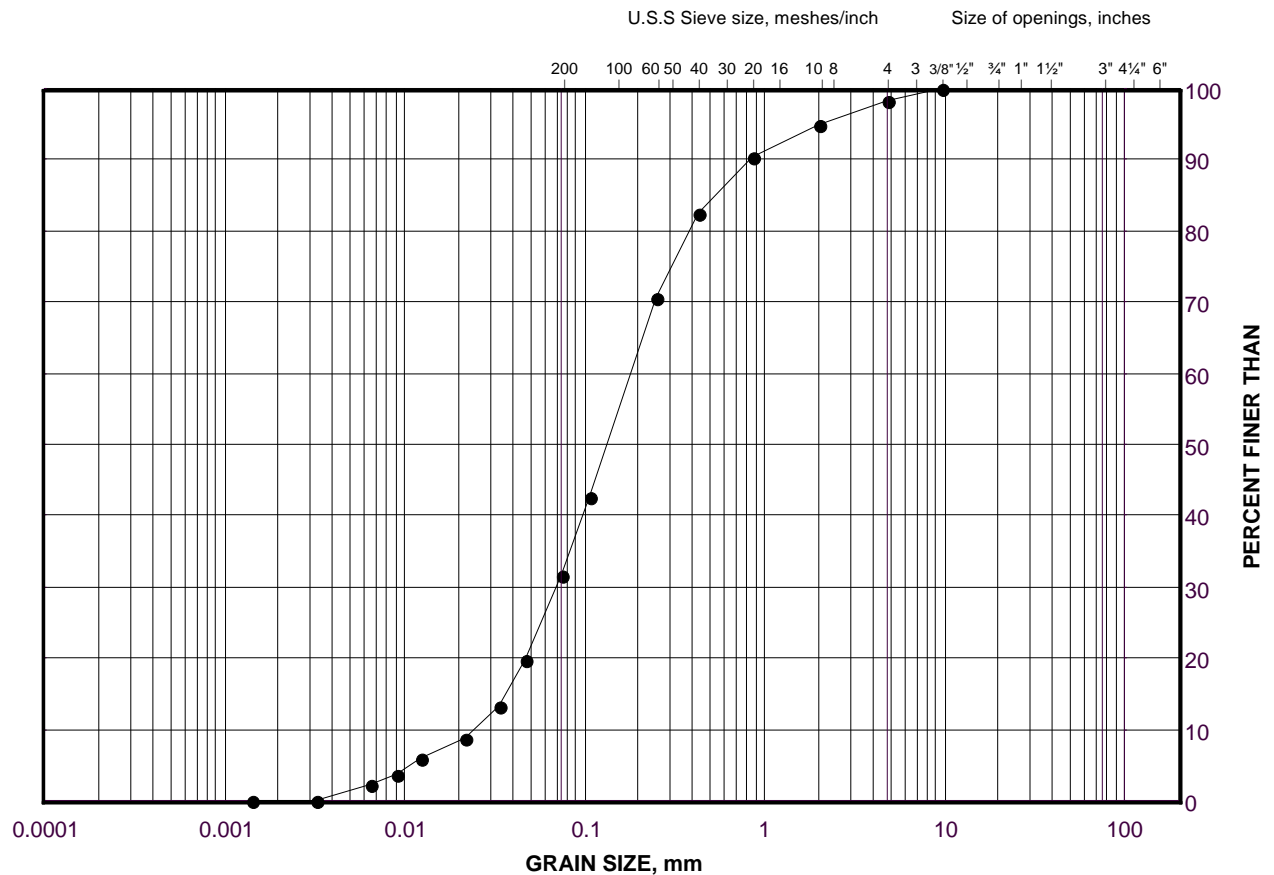
NO.	DATE	BY	REVISION
Geocres No. 41H-110			
HWY. 69		PROJECT NO. 07-1111-0029	DIST.
SUBM'D. VA	CHKD. VA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. A1



GRAIN SIZE DISTRIBUTION

Sand and Silt

FIGURE A1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	VMS1-01	3	213.4

Project Number: 07-1111-0029

Checked By: **TVA**

Golder Associates

Date: 25-Feb-11

TABLE A1
POINT LOAD TEST ON ROCK SAMPLES

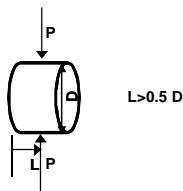
Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Core Length (mm)	Core Diameter (mm)	Is (50mm) (MPa)	Approx. UCS Value ⁽¹⁾ (MPa)
VMS1-01	1	3.0	212.2	Granite Gneiss	Diametral	101.6	47.00	5.609	112
VMS1-01	1	3.1	212.1	Granite Gneiss	Diametral	88.9	47.00	6.711	134
VMS1-01	1	3.1	212.1	Granite Gneiss	Axial	27.0	47.00	10.054	201
VMS1-01	1	3.1	212.1	Granite Gneiss	Axial	20.0	47.00	11.771	235
VMS1-01	1	3.2	212.0	Granite Gneiss	Diametral	88.9	47.00	4.533	91
VMS1-01	1	3.2	212.0	Granite Gneiss	Axial	25.0	47.00	10.526	211
VMS1-02	1	1.3	212.8	Granite Gneiss	Diametral	127.0	47.00	4.253	85
VMS1-02	1	1.3	212.8	Granite Gneiss	Axial	30.0	47.00	9.490	190
VMS1-02	1	1.4	212.7	Granite Gneiss	Diametral	127.0	47.00	4.416	88
VMS1-02	1	1.4	212.7	Granite Gneiss	Axial	25.0	47.00	9.244	185
VMS1-02	1	1.4	212.7	Granite Gneiss	Axial	25.0	47.00	10.711	214
VMS1-02	1	1.5	212.6	Granite Gneiss	Diametral	228.6	47.00	4.858	97
VMS1-02	2	2.7	211.4	Granite Gneiss	Diametral	114.3	47.00	5.893	118
VMS1-02	2	2.8	211.3	Granite Gneiss	Diametral	101.6	47.00	6.227	125
VMS1-02	2	2.9	211.2	Granite Gneiss	Diametral	127.0	47.00	4.942	99
VMS1-02	2	2.9	211.2	Granite Gneiss	Axial	30.0	47.00	7.005	140
VMS1-02	2	2.9	211.2	Granite Gneiss	Axial	30.0	47.00	9.727	195
VMS1-02	2	3.0	211.1	Granite Gneiss	Axial	35.0	47.00	9.526	191

⁽¹⁾ $Is_{50} \times K$, from ASTM Designation: D 5731-08 "Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications. A value of $K = 20$ has been estimated for this site.

⁽²⁾ Actual distance between point load cones at time of failure.

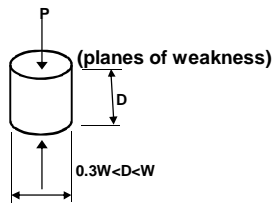
DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

note: Diametral tests are perpendicular to core axis
(planes of weakness)



AXIAL SPECIMEN SHAPE REQUIREMENTS

note: Axial tests are parallel to core axis



Compiled by: AM/AT
Reviewed by: TVA/CN

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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