REPORT

March 13, 2015

FOUNDATION INVESTIGATION REPORT

EMBANKMENT OVER SWAMP, TOWNSHIP OF SHAWANAGA
HIGHWAY 7182 RECONSTRUCTION
FROM THE CARLING/SHAWANAGA TOWNSHIP BOUNDARY, NORTHERLY 7.3 KM
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5163-10-00

Submitted to:
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PART A

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Golder Associates

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the roadway embankment crossing a swamp area and for replacement of two culverts as part of the reconstruction of Highway 7182 (Shebeshekong Road) in the Township of Shawanaga. The proposed reconstruction of Highway 7182 extends from the boundary of the Townships of Carling and Shawanaga, northerly for 7.3 km. The locations of the swamp crossing and culverts are shown on the Index Plan on Drawing 1.

The original Terms of Reference and the Scope of Work for the foundation investigation are outlined in MTO's Request for Proposal, dated November 2012. Golder's proposal (Scope of Work) for foundation engineering services associated with the swamp crossing and culvert replacements is contained in Section 6.8 of MH's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated June 18, 2013. The drawings showing the vertical profile and cross-sections along the Highway alignment were provided to Golder by MH on December 17, 2014.

This report addresses the investigation carried out at the roadway embankment swamp crossing only.

The purpose of this investigation is to obtain subsurface information along the existing highway alignment at the swamp crossing by methods of borehole drilling, bedrock coring, in situ testing and laboratory testing on selected soil and rock samples. The foundation investigation was carried out within the limits of the swamp area as defined in the Terms of Reference. The boreholes for the swamp crossing were located in the field by Golder and were surveyed relative to stakes and/or nail pins installed by Tulloch Engineering (Tulloch), a licensed surveyor retained by MH. The investigation area is shown in plan on Drawing 2.

2.0 SITE DESCRIPTION

The existing Highway 7182 is oriented generally in a south-north direction extending from Highway 559 at the south end to Highway 69 at the north end in the Township of Shawanaga, Ontario. The area of the swamp crossing is located between approximately STA 10+200 and 10+345 on Highway 7182, extending over a length of about 145 m.

In general, the topography within the project limits consists of rolling terrain, including densely treed areas and numerous bedrock outcrops separated by low-lying swamps containing areas of standing water and various types of vegetation and organic soils. The ground surface at the borehole and DCPT locations advanced within the limits of the swamp crossing, including through the existing Highway 7182 embankments, varies between Elevation 206.4 m and 204.9 m, referenced to Geodetic datum. Section 4.0 of this report presents a detailed description for the area of the swamp crossing.

3.0 INVESTIGATION PROCEDURES

The field investigation for the swamp crossing area was carried out between June 9 and 16, 2014 during which time a total of eight boreholes and seven Dynamic Cone Penetration Tests (DCPTs) were advanced within the identified swamp area.

The results of the borehole investigation and dynamic cone penetration test are presented on the Record of Borehole/Drillhole sheets and Record of DCPTs in Appendix A.

The field borehole investigation was carried out using portable equipment and a truck-mounted CME 55 drill rig supplied and operated by Landcore Drilling of Chelmsford, Ontario. The boreholes were advanced through the overburden using 203 mm outer diameter (O.D.) continuous flight hollow-stem augers and 'NW' casing. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm O.D. split-spoon sampler driven by an automatic hammer on the truck-mounted drill rig in accordance with Standard Penetration Test (SPT) procedures.[1] Boreholes advanced by portable equipment employed a full-weight hammer lifted manually and dropped from the standard SPT height. Bedrock samples were recovered using an 'NQ'-size rock core barrel. Field vane shear tests were carried out in cohesive soils for assessment of undrained shear strengths[2] using MTO Standard 'N'-size vanes. The boreholes and DCPTs were advanced to depths of up to about 10.3 m (including coring of bedrock for a core length of about 1.8 m to 3.7 m) below existing ground surface.

Where possible, the groundwater conditions in the open boreholes were observed during and upon completion of drilling operations. All open boreholes were backfilled with bentonite pellets upon completion in accordance with Ontario Regulation 903, Wells (as amended).

The fieldwork was observed by a member of Golder's engineering and technical staff who located the boreholes, arranged for the clearance of underground services, observed the drilling and sampling operations, and logged the boreholes. The soil and rock samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Sudbury geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, organic content, grain size distribution and Atterberg limits) was carried out on selected soil samples. Unconfined compression strength testing was carried out on a selected specimen of the rock core. The results of the laboratory testing are included in Appendix B.

Classification of the rock mass quality of the bedrock with respect to the Rock Quality Designation (RQD) is described based on Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)[3] while the strength of the bedrock core samples is based on Table 3.5 of CFEM (2006). The degree of weathering of the bedrock samples and the strength classification of the intact rock mass based on field identification are described in accordance with Table B.3 and Table B.6, respectively, of the International Society for Rock Mechanics (ISRM, 1985)[4] standard classification system.

The as-drilled borehole locations, in stations and offset, were measured relative to the centerline alignment and were subsequently converted to MTM NAD 83 coordinates in AutoCAD. Borehole top elevations were surveyed by a member of Golder's technical staff in reference to temporary benchmarks that were surveyed by Tulloch. The borehole locations shown on the Record of Borehole/Drillhole sheets and Drawing 2 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, ground surface elevations and drilled depths are summarized below.

[1] ASTM D1586 – Standard Test Method for Standard Penetration Test.

[2] ASTM D2573 – Standard Test Method for Field Vane Strength Shear Test.

[3] Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.

[4] International Society for Rock Mechanics Commission on Test Methods, 1985. Int. J. Rock Mech.Min. Sci. & Geomech. Abstr. Vol 22, No. 2, pp. 51-60.

Borehole/DCPT Designation	Location (MTM NAD 83)		Ground Surface Elevation	Borehole/ DCPT Depth
	Northing	Easting		
S1-01	5,039,636.4	246,346.6	205.5	3.8
S1-02	5,039,653.7	246,327.1	205.7	10.3
S1-03	5,039,655.6	246,300.4	204.9	8.7
S1-04	5,039,685.5	246,258.1	206.2	7.9
S1-05	5,039,689.3	246,287.4	205.2	2.8
S1-06	5,039,679.1	246,311.3	205.0	4.2
S1-07	5,039,660.6	246,330.3	205.7	10.1
S1-08	5,039,639.4	246,375.6	206.2	5.8
S1-DC01A	5,039,631.3	246,374.0	206.4	1.2
S1-DC01B	5,039,630.4	246,375.8	206.4	1.7
S1-DC02	5,039,664.9	246,276.1	205.0	7.7
S1-DC03A	5,039,692.6	246,261.4	206.3	2.1
S1-DC03B	5,039,691.7	246,263.2	206.3	2.3
S1-DC04	5,039,658.3	246,356.8	205.0	4.2
S1-DC05	5,039,688.5	246,289.2	205.1	1.8

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*[5] , this section of Highway 7182, formerly 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[6]. Deposition of Paleozoic strata and later erosion during glaciation exposed these Precambrian rocks.

[5] 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.

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

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, are provided in Appendices A and B, respectively. The results of the in situ field tests (i.e. SPT 'N'-values and field vanes) as presented on the borehole records and in Section 4.2 are uncorrected. The stratigraphic boundaries shown on the borehole records and on the profile on Drawings 2 and 3 are inferred from non-continuous sampling, observations of drilling progress and the results of in situ field tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations. It should be noted that the interpreted stratigraphy as shown on Drawings 2 and 3 is a simplification of the subsurface conditions.

In general, the subsurface conditions in the swamp area consist of a surface layer of fill or peat underlain by alternating deposits of cohesive and non-cohesive soils overlying the granitic gneiss bedrock. Bedrock outcrops are encountered at the limits of the swamp area.

A detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Sand to Sandy Gravel Fill

Boreholes S1-02, S1-04, S1-07 and S1-08 were advanced through the shoulder of the existing Highway 7182 and penetrated a layer of non-cohesive fill which generally consists of brown to grey sand, trace to some gravel, to sandy gravel, trace to some silt, trace clay. The lower portion of the fill deposit as encountered in Borehole S1-02 is described as organic silty sand containing organic materials. The top of the fill layer ranges from about Elevation 206.2 m to 205.7 m and its thickness varies between about 1.5 m and 2.3 m.

The SPT 'N'-values measured within the non-cohesive fill layer generally range from 7 blows to 23 blows per 0.3 m of penetration, indicating a loose to compact relative density. An SPT 'N'-value of 2 blows per 0.3 m of penetration was measured within the lower organic silty sand portion of the fill layer in Borehole S1-02, suggesting a very loose relative density.

The natural water content measured on three samples of the fill ranges from about 2 per cent to 16 per cent and on a sample of organic silty sand is about 82 per cent. The organic content measured on a sample of the sand fill is about 1 per cent, and on a sample of the organic silty sand fill is about 9 per cent.

The grain size distributions of three samples of sand to gravelly sand fill and one sample of organic silty sand fill are shown on Figures B1-A and B1-B, respectively, in Appendix B.

Atterberg limits tests were completed on the fines portion of a sample of sand fill and a sample of organic silty sand fill, and indicate that the fines portion of these materials is non-plastic.

4.2.2 Peat

A deposit of fibrous or amorphous peat was encountered immediately below ground surface in Boreholes S1-01, S1-03, S1-05 and S1-06, and below the fill layer in Boreholes S1-02, S1-04 and S1-07. The peat layer was not encountered in Borehole S1-08. The surface of the peat was encountered between Elevation 205.4 m and

203.4 m and it ranges from 0.7 m to 3.8 m in thickness except at Borehole S1-01, where the layer is only 0.1 m thick and directly overlies bedrock.

The SPT 'N'-values measured within the peat layer range from 0 blows (weight of hammer) to 2 blows per 0.3 m of penetration, suggesting a very soft consistency.

The natural water content measured on four samples of the peat ranges from about 42 per cent to 812 per cent.

4.2.3 Clayey Organic Silt

Boreholes S1-03 and S1-06 penetrated approximately 1.2 m and 0.8 m thick layers of clayey organic silt below the peat deposit at about Elevation 201.1 m and 203.6 m, respectively.

SPT 'N'-values of 0 blows (weight of hammer) per 0.3 m of penetration were measured within the clayey organic silt deposit in both boreholes.

The natural water content measured on three samples of this deposit ranges from 100 per cent to 187 per cent. The organic content measured on a sample of this layer is about 9 per cent.

Atterberg limits test were completed on two samples of this deposit and measured liquid limits of about 133 per cent and 134 per cent, plastic limits of about 52 per cent and 46 per cent and plasticity indices of about 81 per cent and 88 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure B2 in Appendix B and indicate that the material is classified as clayey organic silt.

4.2.4 Clayey Silt to Clay

A deposit of brown to grey clayey silt to clay was encountered below the fill in Borehole S1-08, underlying the peat and/or clayey organic silt layers in Boreholes S1-02, S1-04 and S1-06, and below the silt and sand to silty sand deposit in Boreholes S1-03 and S1-07. The top of this deposit was encountered between Elevation 204.7 m and 199.3 m, and the thickness of the deposit varies between about 0.8 m and 3.1 m. Boreholes S1-03 and S1-06 were terminated within this deposit on refusal to further penetration of split-spoon sampler and/or casing at depths of about 8.7 m and 4.2 m corresponding to Elevation 196.2 m and 200.8 m, respectively.

The SPT 'N'-values measured within cohesive deposit range from 0 blows (weight of rod or hammer) to 1 blow per 0.3 m of penetration. In situ field vane tests were carried out within this deposit in Boreholes S1-02, S1-04, S1-06 and S1-07 and measured undrained shear strengths ranging from approximately 10 kPa to 19 kPa, and sensitivity values of between 2 and 8. The measured SPT 'N'-values and field vane test results indicate that the deposit has a very soft to soft consistency.

The natural water content measured on nine samples of the clayey silt to clay deposit ranges from about 38 per cent to 89 per cent.

Atterberg limits tests were completed on four samples of this deposit and measured liquid limits ranging from about 27 per cent to 62 per cent, plastic limits ranging from about 15 per cent to 29 per cent and plasticity indices of about 12 per cent to 33 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure B3 in Appendix B and indicate that the material is classified as clayey silt of low plasticity to clay of high plasticity.

4.2.5 Silt and Sand to Sand and Gravel

A non-cohesive soil deposit was encountered underlying the peat layer in Boreholes S1-05 and S1-07, below the clayey organic silt layer in Borehole S1-03 and underlying the cohesive deposit in Boreholes S1-02 and S1-08. In Borehole S1-07, non-cohesive soil layers were encountered both above and below the silty clay deposit. The non-cohesive deposit is underlain by granitic gneiss bedrock in all boreholes except Borehole S1-03, where it is underlain by the clayey silt deposit. The top of this deposit ranges from Elevation 204.5 m to 199.9 m, and the thickness of the deposit varies between about 0.3 m and 1.9 m.

The SPT 'N'-values measured within the non-cohesive deposit generally range from 7 blows per 0.15 m of penetration to 22 blows per 0.3 m of penetration, indicating a loose to compact relative density. An SPT 'N'-value of 0 blows (weight of hammer) per 0.3 m of penetration was measured at the interface of this deposit and overlying cohesive deposit in Borehole S1-08; however, this value is considered to be more representative of the silty clay deposit and/or disturbance due to groundwater inflow to the borehole during sampling.

The natural water content measured on five samples of the non-cohesive deposit ranges from about 13 per cent to 24 per cent.

The deposit is generally comprised of silt and sand, to gravelly silt and sand, to silty sand to sand to gravelly sand to sand and gravel. Auger grinding was noted within this deposit in Boreholes S1-02 and S1-07, and it is interpreted to represent the presence of cobbles and/or boulders. The results of grain size distribution tests completed on four samples of the non-cohesive deposit are shown on Figure B4 in Appendix B.

4.2.6 Refusal / Bedrock

The bedrock surface in all boreholes and DCPTs is inferred by refusal to further penetration of the split-spoon sampler, and/or refusal to further advancement of the auger and/or casing or dynamic cone penetration, at depths between about 0.1 m and 8.7 m below ground surface (between about Elevation 205.4 m and 196.2 m). The bedrock was cored in Boreholes S1-01, S1-02, S1-04, S1-05, S1-07 and S1-08, with between about 1.8 m and 3.7 m of core samples were recovered.

Based on a review of the bedrock core samples, the bedrock consists of granitic gneiss and the core samples are generally described as fresh, foliated, grey, medium to coarse crystalline, faintly to moderately porous, and strong to very strong, as presented on the drillhole records sheets in Appendix A.

The Rock Quality Designation (RQD) measured on the core samples is generally between about 82 per cent and 100 per cent, indicating a rock mass of good to excellent quality; one RQD value of 42 per cent was measured within the upper portion of the bedrock in Borehole S1-05, indicating a rock mass of poor quality in this area. The Total Core Recovery (TCR) of the core samples is between 94 per cent and 100 per cent, and the Solid Core Recovery (SCR) of the core samples is between 58 per cent and 100 per cent.

An Unconfined Compression (UC) test[7] was carried out on a selected core sample of the bedrock and measured a uniaxial compressive strength of about 98 MPa. The details of the UC test are presented in Table B1 in Appendix B. Based on the laboratory UC test result, the approximate uniaxial compressive strength of the granitic gneiss bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa).

[7] ASTM D7012 – Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens.

4.3 Groundwater Condition

In general, the soil samples taken in the boreholes were moist to wet. The groundwater level was measured in the open boreholes upon completion of overburden drilling and ranges from about Elevation 204.7 m to 203.3 m measured at depths between 0.3 m and 2.9 m below the ground surface. However, these measured levels may not represent the stabilized groundwater level at the site. In general, it should be expected that the groundwater level is at or near the natural ground surface at the site.

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

5.0 CLOSURE

Mr. Indulis Dumpis, a senior technician with Golder, directed the drilling program. This report was prepared by Mr. Al Varshoi, EIT, and reviewed by Mr. Christopher Ng, P.Eng., a geotechnical engineer and Associate with Golder. Ms. Lisa Coyne, P.Eng., a Designated MTO Foundations Contact and Principal with Golder, conducted an independent quality control review of the report.

Report Signature Page

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ASTM International:

ASTM D1586	Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
ASTM D2573	Standard Test Method for Field Vane Shear Test in Cohesive Soil
ASTM D7012	Standard Test Method for Strength and Elastic Moduli of Intact Rock Core Specimen

Ontario Water Resources Act:

Ontario Regulation 903	Wells (as amended)

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d:

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

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

Piezo-Cone Penetration Test (CPT)

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

III. SOIL DESCRIPTION

(a) Non-Cohesive Soils

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

(b) Cohesive Soils

Consistency

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

IV. SOIL TESTS

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

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

V. MINOR SOIL CONSTITUENTS

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

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering

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

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

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

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

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

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

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

CORE CONDITION

Total Core Recovery (TCR)

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

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

DISCONTINUITY DATA

Fracture Index

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

Dip with Respect to Core Axis

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

Description and Notes

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

Abbreviations

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

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

DRAWINGS

MINISTRY OF TRANSPORTATION, ONTARIO

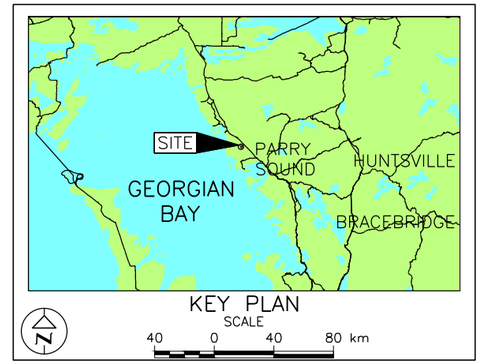
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

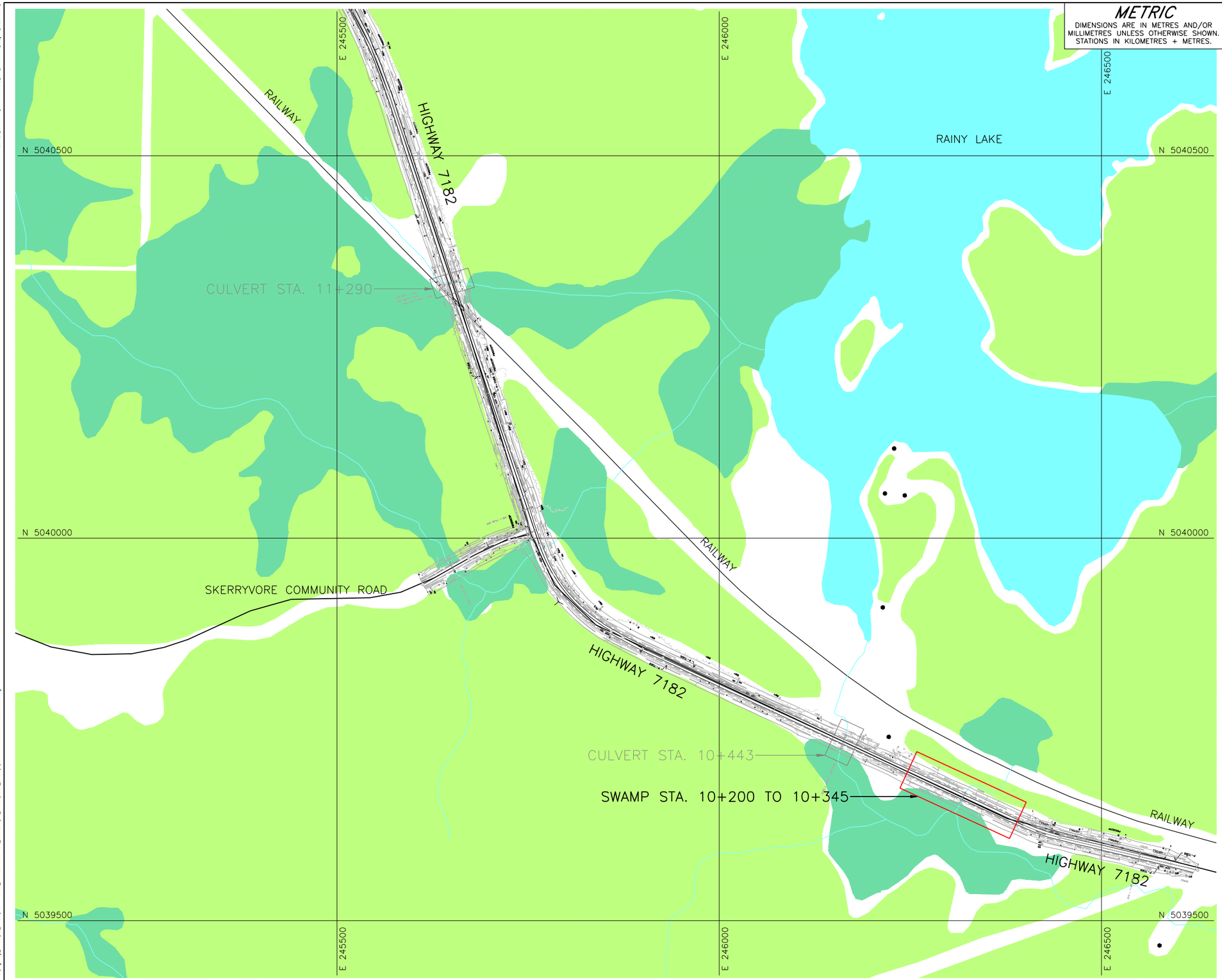
CONT No.
GWP No. 5163-10-00

HIGHWAY 7182
SWAMP
INDEX PLAN

SHEET

Golder Associates





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, profile and topographic data provided in digital format by Morrison Hershfield, drawing file nos. bc04537182001.dwg and Alignment-profile.dwg, dated Dec., 2013, received Dec. 17, 2014

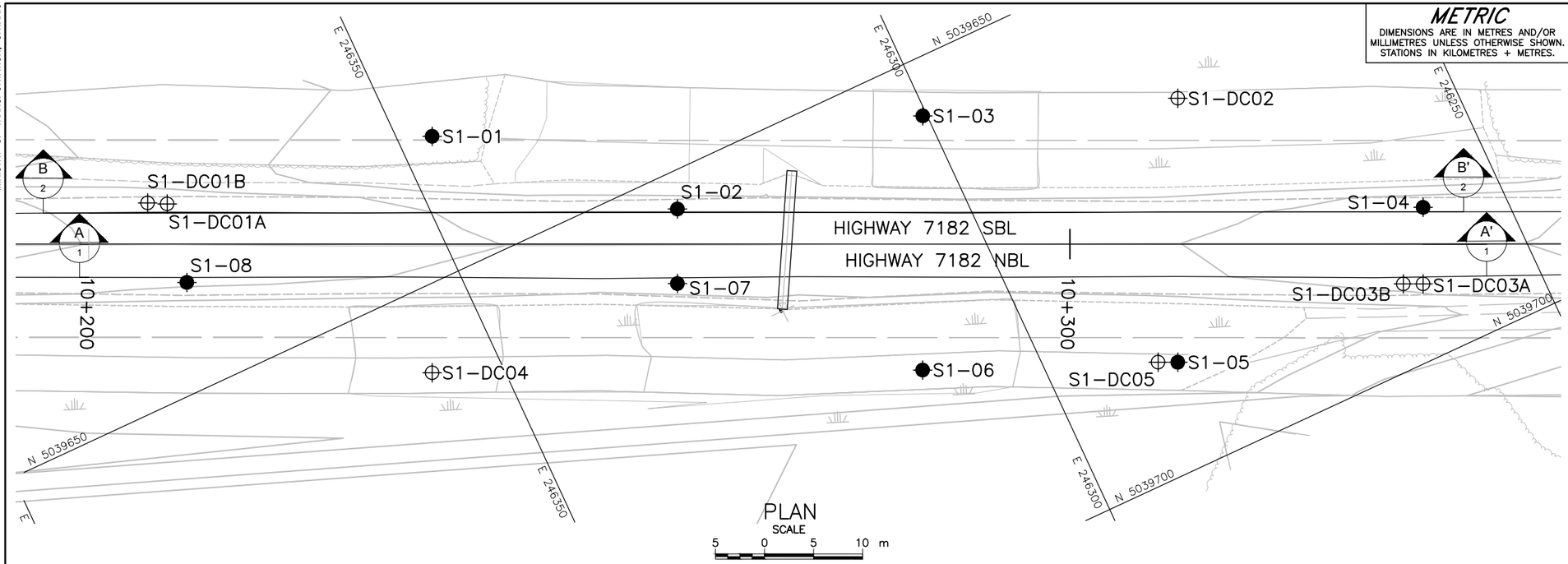
NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 41H-149

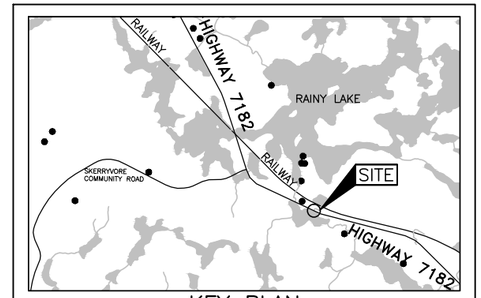
HWY. 7182	PROJECT NO. 12-1111-0102		DIST. .
SUBM'D. CN	CHKD. CN	DATE: 2/4/2015	SITE: .
DRAWN: MR	CHKD. CN	APPD. LCC	DWG. 1

PLOT DATE: March 12, 2015
FILENAME: S:\Clients\MTO\Highway_7182\09_PROJ\12111102_MorrisonHershfield_Geotech\40_PROD\0001_Swamp\12111102-0001-BC-0003.dwg

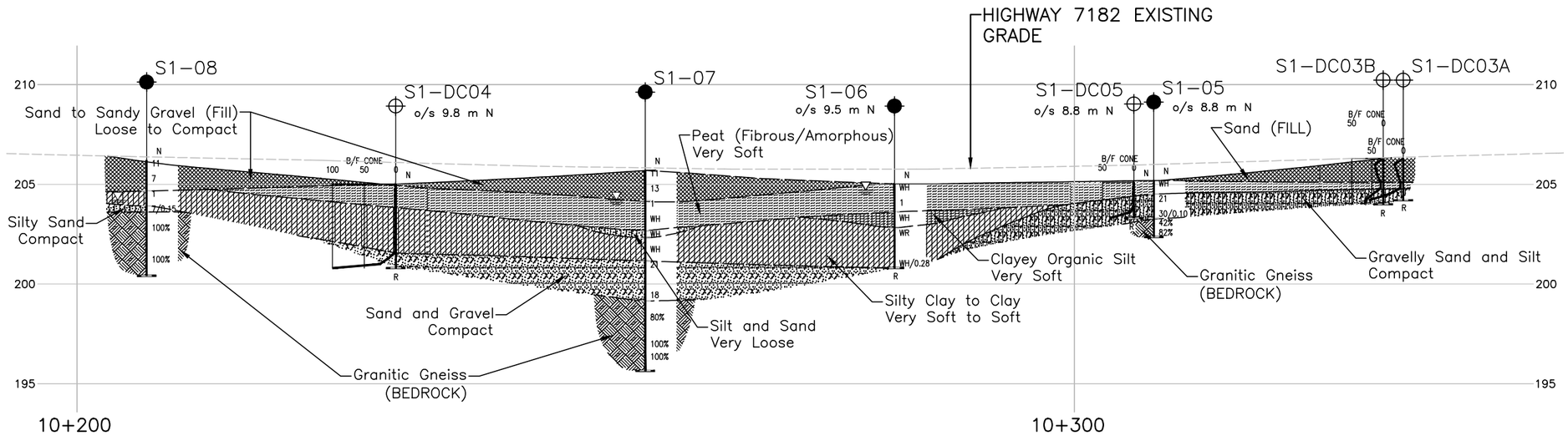
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN
SCALE
5 0 5 10 m



KEY PLAN
SCALE
500 0 500 1000 m



A-A' / 1 NORTHBOUND LANE
PROFILE A–A'

HORIZONTAL SCALE
5 0 5 10 m

VERTICAL SCALE
2.5 0 2.5 5 m

LEGEND

- Borehole
- Dynamic Cone Penetration Test
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO–ORDINATES			
No.	ELEVATION	NORTHING	EASTING
S1–01	205.5	5039636.4	246346.6
S1–02	205.7	5039653.7	246327.1
S1–03	204.9	5039655.6	246300.4
S1–04	206.2	5039685.5	246258.1
S1–05	205.2	5039689.3	246287.4
S1–06	205.0	5039679.1	246311.3
S1–07	205.7	5039660.6	246330.3
S1–08	206.2	5039639.4	246375.6
S1–DC01A	206.4	5039631.3	246374.0
S1–DC01B	206.4	5039630.4	246375.8
S1–DC02	205.0	5039664.9	246276.1
S1–DC03A	206.3	5039692.6	246261.4
S1–DC03B	206.3	5039691.7	246263.2
S1–DC04	205.0	5039658.3	246356.8
S1–DC05	205.1	5039688.5	246289.2

NOTES

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REFERENCE

Base plans, profile and topographic data provided in digital format by Morrison Hershfield, drawing file nos. bc04537182001.dwg and Alignment–profile.dwg, dated Dec., 2013, received Dec. 17, 2014

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 Mar. 13, 2015 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER L.C. COYNE Mar. 13, 2015 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 41H–149

HWY. 7182		PROJECT NO. 12–1111–0102	DIST. .
SUBM'D. ARV	CHKD. CN	DATE: 2/4/2015	SITE: .
DRAWN: MR	CHKD. CN	APPD. LCC	DWG. 2

CONT No. .
GWP No. 5163–10–00

HIGHWAY 7182
STA. 10+200 TO 10+345 (NBL)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET .

Golder Associates

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

PLOT DATE: March 13, 2015
FILENAME: S:\Clients\MTO\Highway_7182\09_PRO\12111102_MorrisonHershfield_Geotech\40_PROD\0001_Swamp\12111102-0001-BS-0001.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

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

CONT No.
GWP No. 5163–10–00

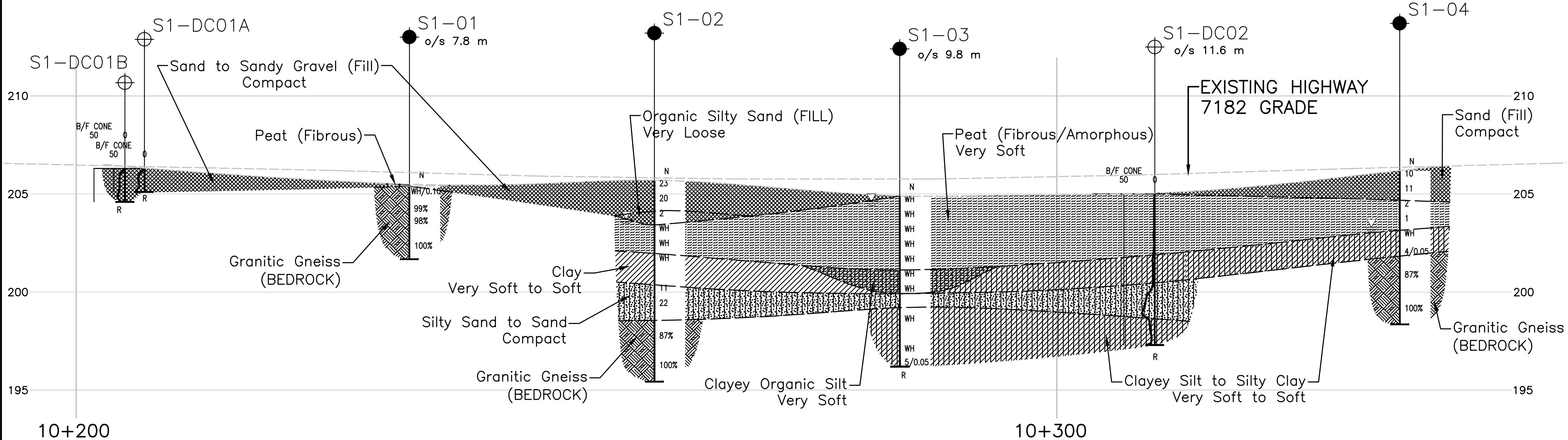
HIGHWAY 7182

STA. 10+200 TO STA. 10+345 (SBL)

SOIL STRATA

SHEET

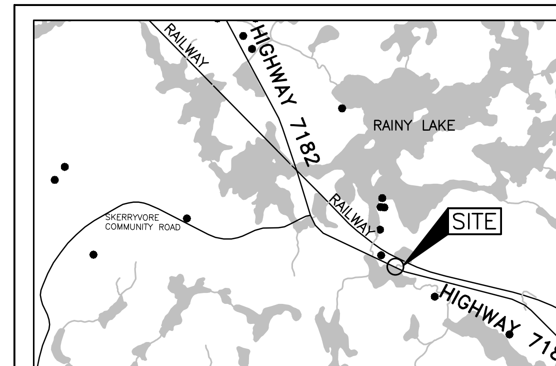
Golder Associates



SOUTHBOUND LANE
PROFILE B–B'

HORIZONTAL SCALE 5 0 5 10 m

VERTICAL SCALE 2.5 0 2.5 5 m



KEY PLAN
SCALE
500 0 500 1000 m

LEGEND

- Borehole
- Dynamic Cone Penetration Test
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- WL upon completion of drilling
- R — Refusal

BOREHOLE AND DCPT CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S1–01	205.5	5039636.4	246346.6
S1–02	205.7	5039653.7	246327.1
S1–03	204.9	5039655.6	246300.4
S1–04	206.2	5039685.5	246258.1
S1–DC01A	206.4	5039631.3	246374.0
S1–DC01B	206.4	5039630.4	246375.8
S1–DC02	205.0	5039664.9	246276.1

NOTES

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REFERENCE

Base plans, profile and topographic data provided in digital format by Morrison Hershfield, drawing file nos. bc04537182001.dwg and Alignment–profile.dwg, dated Dec., 2013, received Dec. 17, 2014

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 Mar. 13, 2015 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER L.C. COYNE Mar. 13, 2015 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 41H–149

HWY. 7182	PROJECT NO.		DIST.
SUBM'D. ARV	CHKD. CN	DATE: 2/4/2015	SITE:
DRAWN: MR	CHKD. CN	APPD. LCC	DWG. 3

PLOT DATE: March 13, 2015
FILENAME: S:\Clients\MTO\Highway_7182\99_PROJ\1211110102_MorrisonHershfield_Geotech\40_PROD\0001_Swamp\1211110102-0001-BG-0002.dwg

APPENDIX A

Record of Borehole/Drillhole and DCPT Sheets

Golder Associates

RECORD OF BOREHOLE No S1-01

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039636.4 ;E 246346.6 ORIGINATED BY GM

DIST HWY 7182 BOREHOLE TYPE NW Casing, Wash Boring COMPILED BY MT

DATUM Geodetic DATE June 16, 2014 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
205.5 0.0	GROUND SURFACE		1	SS	WH/0.10						
0.1	PEAT (Fibrous) Black Wet										
	Granitic Gneiss (BEDROCK)		1	RC	REC 100%		205				RQD = 99%
	Bedrock cored from depths of 0.1 m to 3.8 m.		2	RC	REC 100%		204				RQD = 98%
	For bedrock coring details refer to Record of Drillhole S1-01.		3	RC	REC 100%		203				RQD = 100%
201.7							202				
3.8	END OF BOREHOLE										
	NOTE: 1. Wet soils were encountered immediately below ground surface.										

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

PROJECT: 12-1111-0102

RECORD OF DRILLHOLE: S1-01

SHEET 1 OF 1

LOCATION: N 5039636.4 ;E 246346.6

DRILLING DATE: June 16, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Tripod

DRILLING CONTRACTOR: LANDCORE DRILLING

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		Continued from Record of Borehole S1-01		205.40																
1	NW Casing; NQ Coring; Double-Tube Sampling	Fresh, foliated, grey, medium to coarse crystalline, faintly to moderately porous, strong to very strong GRANITIC GNEISS		0.10	1	GREY 100%							JN,IR,RO JN,IR,RO JN,IR,RO							
2					2	GREY 100%														
3					3	GREY 100%							JN,IR,RO JN,FL,RO JN,IR,RO							
				201.68																
4		END OF DRILLHOLE		3.82																
5																				
6																				
7																				
8																				
9																				
10																				

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: GM

CHECKED: CN

GTA-RCK 018 S:\CLIENTS\MTO\HIGHWAY_7182\02_DATA\GINT\1211110102.GPJ GAL-MISS.GDT 03/12/15 TB

Golder Associates

RECORD OF BOREHOLE No S1-02

SHEET 1 OF 1 **METRIC**

PROJECT 12-1111-0102
G.W.P. 5163-10-00
LOCATION N 5039653.7 ;E 246327.1
ORIGINATED BY ID
DIST HWY 7182
BOREHOLE TYPE 203 mm O.D. Hollow Stem Augers, NW Casing, Wash Boring
COMPILED BY MT
DATUM Geodetic
DATE June 11, 2014
CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
205.7	GROUND SURFACE										
0.0	Sandy gravel, trace to some silt (FILL) Compact Grey Moist		1	SS	23		205				
204.2			2	SS	20						67 27 (6)
1.5	Organic silty sand, trace clay, trace gravel (FILL) Very loose Brown Wet		3	SS	2	▽	204		82 OC=9.3%		1 70 25 4 Non-Plastic
203.4											
2.3	PEAT (Amorphous), with silty sand seams Very soft Dark brown to black Wet		4	SS	WH		203				
202.0			5	SS	WH		202				
3.7	CLAY Very soft to soft Brown Wet		6	SS	WH				82.6		
200.4							201	6 5			
5.3	SAND, some silt, some gravel, trace clay Compact Grey Wet		7	SS	11		200				13 68 16 3
	Auger grinding between depths of 5.3 m and 7.2 m.		8	SS	22		199				
198.5											
7.2	Granitic Gneiss (BEDROCK) Bedrock cored from depths of 7.2 m to 10.3 m. For bedrock coring details refer to Record of Drillhole S1-02.		1	RC	REC 100%		198				RQD = 87%
			2	RC	REC 100%		197				RQD = 100%
195.4							196				
10.3	END OF BOREHOLE NOTE: 1. Water level in open borehole measured at a depth of 2.0 m below ground surface (Elev. 203.7 m) upon completion of drilling.										

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

GTA-MTO 001 S:\CLIENTS\MTO\HIGHWAY_7182\02_DATA\GINT\1211110102.GPJ GAL-GTA.GDT 03/12/15 TB

PROJECT: 12-1111-0102

RECORD OF DRILLHOLE: S1-02

SHEET 1 OF 1

LOCATION: N 5039653.7 ;E 246327.1

DRILLING DATE: June 12, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Truck Mount

DRILLING CONTRACTOR: LANDCORE DRILLING

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		Continued from Record of Borehole S1-02		198.54																
8	NW Casing; NQ Coring; Double-Tube Sampling	Fresh, foliated, grey, medium to coarse crystalline, faintly to moderately porous, strong to very strong GRANITIC GNEISS		7.16	1	GREY 100%							JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO							
9					2	GREY 100%														
10				195.43																
		END OF DRILLHOLE		10.27																
11																				
12																				
13																				
14																				
15																				
16																				
17																				

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: ID

CHECKED: CN

GTA-RCK 018 S:\CLIENTS\MTO\HIGHWAY_7182\02_DATA\GINT\1211110102.GPJ GAL-MISS.GDT 03/12/15 TB

Golder Associates

RECORD OF BOREHOLE No S1-03

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039655.6 ;E 246300.4 ORIGINATED BY GM

DIST HWY 7182 BOREHOLE TYPE NW Casing, Wash Boring COMPILED BY MT

DATUM Geodetic DATE June 16, 2014 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
204.9	GROUND SURFACE										
0.0	PEAT (Amorphous) Very soft Black Moist		1	SS	WH	▽					
			2	SS	WH		204				
			3	SS	WH		203		812		
			4	SS	WH		202				
201.1			5	SS	WH						
3.8	Clayey ORGANIC SILT Very soft Grey Wet		6	SS	WH		201		100.8		
199.9			7	SS	WH		200		187.4 134		
5.0	Silty SAND Grey Wet										
199.3											
5.6	CLAYEY SILT to SILTY CLAY, trace sand Very soft Brown to grey Wet		8	SS	WH		199		88.6		
			9	SS	WH		197				
196.2			10	SS	5/0.05						
8.7	END OF BOREHOLE SPLIT-SPOON AND CASING REFUSAL NOTE: 1. Water level in open borehole measured at a depth of 0.3 m below ground surface (Elev. 204.6 m) upon completion of drilling.										

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

Golder Associates

RECORD OF BOREHOLE No S1-04

SHEET 1 OF 1 **METRIC**

PROJECT 12-1111-0102
G.W.P. 5163-10-00 LOCATION N 5039685.5 ;E 246258.1 ORIGINATED BY ID
DIST HWY 7182 BOREHOLE TYPE 203 mm O.D. Hollow Stem Augers, NW Casing, Wash Boring COMPILED BY MT
DATUM Geodetic DATE June 12, 2014 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
206.2	GROUND SURFACE										
0.0	Sand, some gravel, trace to some silt, trace clay, trace organics (FILL) Compact Brown to grey Moist		1	SS	10		206				
			2	SS	11		205		○	OC=0.8%	14 74 9 3 Non-Plastic
204.7											
1.5	PEAT (Amorphous), with sand seams Very soft Dark brown to black Wet		3	SS	2				209.5 ○		
			4	SS	1		204				
203.2						▽					
3.0	SILTY CLAY, trace sand Very soft to soft Grey Wet		5	SS	WH		203		○		
			6	SS	4/0.05		202	+ 2			
201.9											
4.3	Granitic Gneiss (BEDROCK) Bedrock cored from depths of 4.3 m to 7.9 m. For bedrock coring details refer to Record of Drillhole S1-04.		1	RC	REC 100%		201				RQD = 87%
			2	RC	REC 100%		200				RQD = 100%
198.3							199				
7.9	END OF BOREHOLE NOTE: 1. Water level in open borehole measured at a depth of 2.9 m below ground surface (Elev. 203.3 m) upon completion of drilling.										

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

PROJECT: 12-1111-0102

RECORD OF DRILLHOLE: S1-04

SHEET 1 OF 1

LOCATION: N 5039685.5 ;E 246258.1

DRILLING DATE: June 12, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Truck Mount

DRILLING CONTRACTOR: LANDCORE DRILLING

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		Continued from Record of Borehole S1-04		201.87																
5	NW Casing; NQ Coring; Double-Tube Sampling	Fresh, foliated, grey, medium to coarse crystalline, faintly to moderately porous, strong to very strong GRANITIC GNEISS		4.33	1	GREY 100%							JN,IR,RO							
6												22	JN,IR,RO							
7					2	GREY 100%														
				198.30																
8		END OF DRILLHOLE		7.90																
9																				
10																				
11																				
12																				
13																				
14																				

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: ID
CHECKED: CN

GTA-RCK 018 S:\CLIENTS\MTO\HIGHWAY_7\82\02_DATA\GINT\1211110102.GPJ GAL-MISS.GDT 03/12/15 TB

Golder Associates

RECORD OF BOREHOLE No S1-05

SHEET 1 OF 1 **METRIC**

PROJECT 12-1111-0102
G.W.P. 5163-10-00 LOCATION N 5039689.3 ;E 246287.4 ORIGINATED BY GM
DIST HWY 7182 BOREHOLE TYPE NW Casing, Wash Boring COMPILED BY MT
DATUM Geodetic DATE June 16, 2014 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
205.2	GROUND SURFACE										
0.0	PEAT (Fibrous) Very soft Black Wet		1	SS	WH		205				
204.5											
0.7	Gravelly SILT and SAND, trace clay Compact Grey Wet		2	SS	21		204		○		25 37 35 3
203.4			3	SS	30/0.10						
1.8	Granitic Gneiss (BEDROCK) Bedrock cored from depths of 1.8 m to 2.8 m.		1	RC	REC 100%		203				RQD = 42%
202.4	For bedrock coring details refer to Record of Drillhole S1-05.		2	RC	REC 94%						RQD = 82%
2.8	END OF BOREHOLE NOTE: 1. Wet soils were encountered extending from the ground surface.										

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

PROJECT: 12-1111-0102

RECORD OF DRILLHOLE: S1-05

SHEET 1 OF 1

LOCATION: N 5039689.3 ;E 246287.4

DRILLING DATE: June 16, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Tripod

DRILLING CONTRACTOR: LANDCORE DRILLING

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		Continued from Record of Borehole S1-05		203.30																
2	NQ Coring / Double-Tube Sampling	Fresh, foliated, grey, medium to coarse crystalline, faintly to moderately porous, strong to very strong GRANITIC GNEISS		1.90	1	GREY 100%							JN,IR,RO JN,IR,RO							
					2	GREY 100%							JN,IR,RO JN,IR,RO JN,IR,RO							
		END OF DRILLHOLE		202.36 2.84																
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: GM

CHECKED: CN

Golder Associates

RECORD OF BOREHOLE No S1-06

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039679.1 ;E 246311.3 ORIGINATED BY GM

DIST HWY 7182 BOREHOLE TYPE NW Casing, Wash Boring COMPILED BY MT

DATUM Geodetic DATE June 13, 2014 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
205.0	GROUND SURFACE										
0.0	PEAT (Amorphous) Very soft Black Wet		1	SS	WH	▽					
			2	SS	1		204		565.8		
203.6											
1.4	Clayey ORGANIC SILT, trace sand Very soft Grey		3	SS	WH		203		161.4 133		OC=9.3%
202.8	Wet										
2.2	CLAY Very soft Brown Wet		4	SS	WR		202	4 +	82.7		
			5	SS	WH/0.28		201		83.5		
200.8											
4.2	END OF BOREHOLE SPLIT-SPOON REFUSAL NOTE: 1. Water level in open borehole measured at a depth of 0.3 m below ground surface (Elev. 204.7 m) upon completion of drilling.										

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

Golder Associates

RECORD OF BOREHOLE No S1-07

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039660.6 ;E 246330.3 ORIGINATED BY ID

DIST HWY 7182 BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers, NW Casing, Wash Boring COMPILED BY MT

DATUM Geodetic DATE June 16, 2014 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
205.7	GROUND SURFACE										
0.0	Sand, some gravel, trace to some silt (FILL) Compact Brown to grey Moist		1A 1B	SS	11		205				
204.2			2	SS	13	▽			○		12 80 (8)
1.5	PEAT (Amorphous) Very soft Dark brown to black Wet		3	SS	1		204				
202.7			4	SS	WH		203				
202.3	SILT and SAND, trace to some clay, trace gravel		5A 5B	SS	WH				○		5 47 41 7
3.4	Very loose Grey Wet						202	8 7			
	SILTY CLAY, trace sand Soft Grey Wet		6	SS	WH			6	○		
201.1											
4.6	SAND and GRAVEL, trace silt Compact Grey Wet Auger grinding at a depth of 5.4 m.		7	SS	21		201		○		
199.1			8	SS	18		200		○		31 65 (4)
6.6	Granitic Gneiss (BEDROCK) Bedrock cored from depths of 6.6 m to 10.1 m. For bedrock coring details refer to Record of Drillhole S1-07.		1	RC	REC 100%		199				RQD = 80%
			2	RC	REC 100%		198				RQD = 100%
			3	RC	REC 100%		197				RQD = 100%
195.6							196				
10.1	END OF BOREHOLE NOTES: 1. Water level in open borehole at a depth of 1.5 m below ground surface (Elev. 204.2 m) inferred from the field moisture condition of the obtained samples. 2. Additional borehole was advanced approximately 1.5 m east of Borehole S1-07 to carry out in situ field vane tests between depths of 3.5 m and 4.3 m below ground surface.										

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

PROJECT: 12-1111-0102

RECORD OF DRILLHOLE: S1-07

SHEET 1 OF 1

LOCATION: N 5039660.6 ;E 246330.3

DRILLING DATE: June 16, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Truck Mount

DRILLING CONTRACTOR: LANDCORE DRILLING

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		Continued from Record of Borehole S1-07		199.10																
7	NW Casing	Fresh, foliated, grey, medium to coarse crystalline, faintly to moderately porous, strong to very strong GRANITIC GNEISS		6.60	1	GREY 100%							JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO JN,IR,RO							UCS = 98 MPa
8	NQ Coring Double-Tube Sampling				2	GREY 100%							JN,IR,RO							
9					3	GREY 100%														
10				195.64									JN,IR,RO							
		END OF DRILLHOLE		10.06																
11																				
12																				
13																				
14																				
15																				
16																				

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: ID

CHECKED: CN

GTA-RCK 018 S:\CLIENTS\MTO\HIGHWAY_7182\02_DATA\GINT\1211110102.GPJ GAL-MISS.GDT 03/12/15 TB

Golder Associates

RECORD OF BOREHOLE No S1-08

SHEET 1 OF 1 **METRIC**

PROJECT 12-1111-0102
G.W.P. 5163-10-00
LOCATION N 5039639.4 ;E 246375.6
ORIGINATED BY ID
DIST HWY 7182
BOREHOLE TYPE 203 mm O.D. Hollow Stem Augers, NW Casing, Wash Boring
COMPILED BY MT
DATUM Geodetic
DATE June 13, 2014
CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
206.2	GROUND SURFACE										
0.0	Sand, trace to some gravel, to sandy gravel (FILL) Loose to compact Grey to brown Moist		1	SS	11		206				
			2	SS	7		205				
204.7											
1.5	SILTY CLAY, trace organics Very soft Grey Wet		3	SS	1	▽					
203.9							204				
203.6	Silty SAND, trace to some gravel Compact		4	SS	7/0.15						
2.6	Grey Wet Granitic Gneiss (BEDROCK) Bedrock cored from depths of 2.6 m to 5.8 m. For bedrock coring details refer to Record of Drillhole S1-08.		1	RC	REC 100%		203				RQD = 100%
			2	RC	REC 100%		202				RQD = 100%
200.4							201				
5.8	END OF BOREHOLE NOTE: 1. Water level in open borehole measured at a depth of 2.0 m below ground surface (Elev. 204.2 m) upon completion of drilling.										

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

PROJECT: 12-1111-0102

RECORD OF DRILLHOLE: S1-08

SHEET 1 OF 1

LOCATION: N 5039639.4 ;E 246375.6

DRILLING DATE: June 13, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Truck Mount

DRILLING CONTRACTOR: LANDCORE DRILLING

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.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR, % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES
		Continued from Record of Borehole S1-08		203.61																
3	NW Casing	Fresh, foliated, grey, medium to coarse crystalline, faintly to moderately porous, strong to very strong GRANITIC GNEISS		2.59	1	GREY 100%							JN,IR,RO							
4	NQ Coring / Double-Tube Sampling												JN,IR,RO							
5					2	GREY 100%							JN,IR,RO							
				200.41																
		END OF DRILLHOLE		5.79																
6																				
7																				
8																				
9																				
10																				
11																				
12																				

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: ID
CHECKED: CN

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Golder Associates

RECORD OF DCPT No S1-DC01A

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039631.3 ;E 246374.0 ORIGINATED BY ID

DIST HWY 7182 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MT

DATUM Geodetic DATE June 12, 2014 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	w_P w w_L WATER CONTENT (%) 20 40 60	γ kN/m³	GR SA SI CL
206.4 GROUND SURFACE											
0.0 205.2	Dynamic Cone Penetration Test (DCPT)						206				
1.2	END OF DCPT Refusal to Further Penetration										

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

Golder Associates

RECORD OF DCPT No S1-DC01B

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039630.4 ;E 246375.8 ORIGINATED BY ID

DIST HWY 7182 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MT

DATUM Geodetic DATE June 12, 2014 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
206.4	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						206				
204.7							205				
1.7	END OF DCPT Refusal to Further Penetration										

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

Golder Associates

RECORD OF DCPT No S1-DC02

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039664.9 ;E 246276.1 ORIGINATED BY GM

DIST HWY 7182 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MT

DATUM Geodetic DATE June 13, 2014 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
205.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						204 203 202 201 200 199 198				
197.3											
7.7	END OF DCPT Refusal to Further Penetration										

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

Golder Associates

RECORD OF DCPT No S1-DC03A

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039692.6 ;E 246261.4 ORIGINATED BY ID

DIST HWY 7182 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MT

DATUM Geodetic DATE June 16, 2014 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
206.3	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						206 205				
204.2											
2.1	END OF DCPT Refusal to Further Penetration										

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

Golder Associates

RECORD OF DCPT No S1-DC03B

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039691.7 ;E 246263.2 ORIGINATED BY ID

DIST HWY 7182 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MT

DATUM Geodetic DATE June 16, 2014 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
206.3	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						206 205 204				
204.0											
2.3	END OF DCPT Refusal to Further Penetration										

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

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Golder Associates

RECORD OF DCPT No S1-DC04

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039658.3 ;E 246356.8 ORIGINATED BY GM

DIST HWY 7182 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MT

DATUM Geodetic DATE June 13, 2014 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
205.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						204 203 202 201				
200.8											
4.2	END OF DCPT Refusal to Further Penetration										

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

GTA-MTO 001 S:\CLIENTS\MTO\HIGHWAY_7182\02_DATA\GINT\1211110102.GPJ GAL-GTA.GDT 03/12/15 TB

Golder Associates

RECORD OF DCPT No S1-DC05

SHEET 1 OF 1

METRIC

PROJECT 12-1111-0102

G.W.P. 5163-10-00 LOCATION N 5039688.5 ;E 246289.2 ORIGINATED BY GM

DIST HWY 7182 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MT

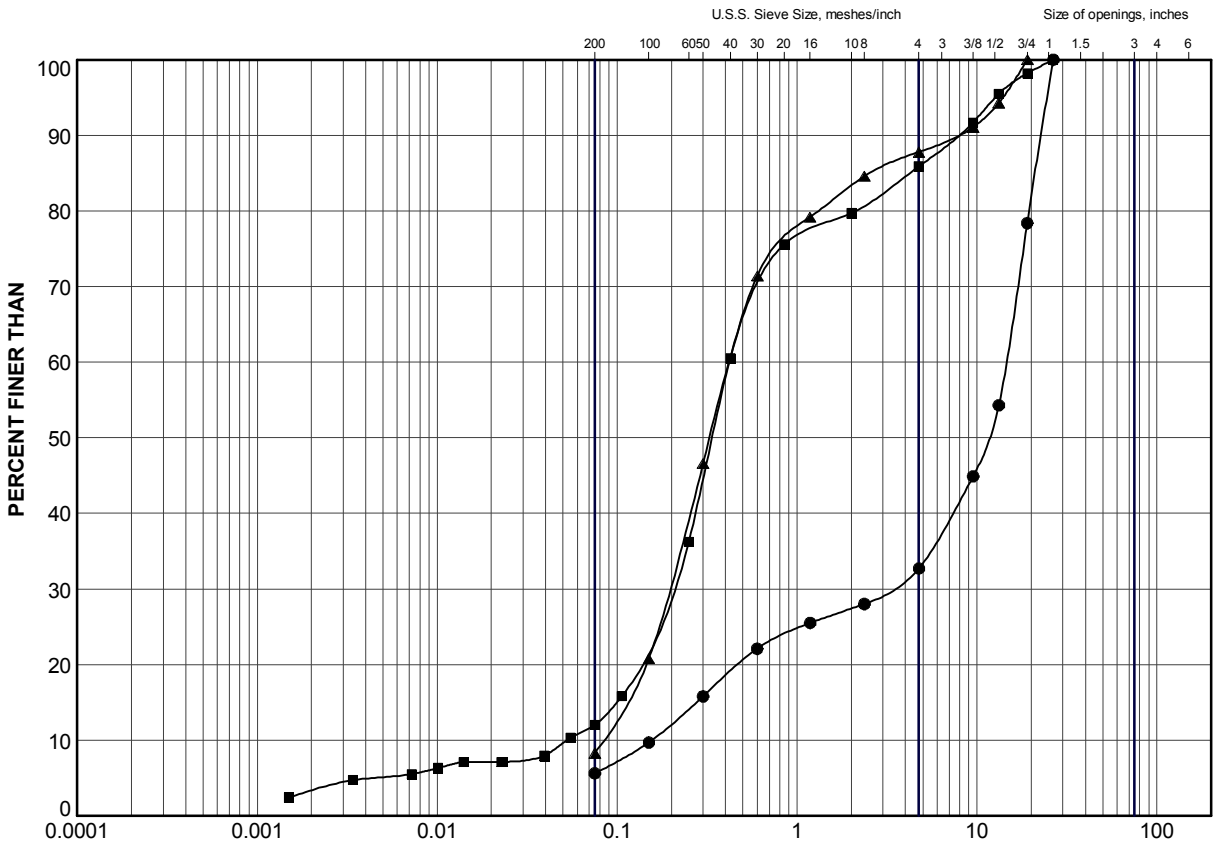
DATUM Geodetic DATE June 16, 2014 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
205.1	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						205				
							204				
203.3											
1.8	END OF DCPT Refusal to Further Penetration										

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

APPENDIX B

Laboratory Test Results



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	S1-02	2	204.6
■	S1-04	2	205.1
▲	S1-07	2	204.6

PROJECT

HIGHWAY 7182 RECONSTRUCTION

TITLE

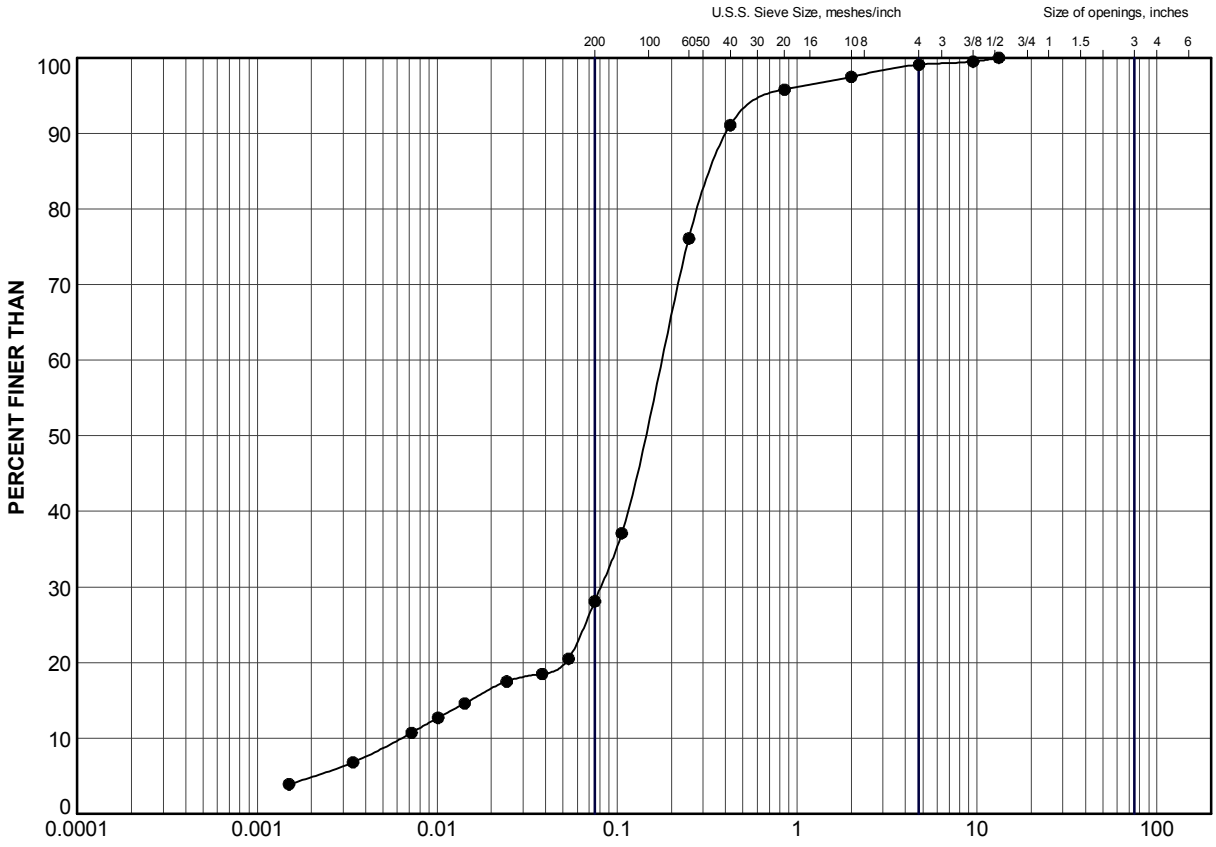
GRAIN SIZE DISTRIBUTION

SAND to SANDY GRAVEL (FILL)

Golder Associates
SUDBURY, ONTARIO

PROJECT No.	12-1111-0102		FILE No.	1211110102.GPJ
DRAWN	TB	Mar 2015	SCALE N/A	REV.
CHECK	MCK	Mar 2015		
APPR	CN	Mar 2015	**FIGURE B1-A**	

SUD-MTO GSD (NEW) GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	S1-02	3	203.9

PROJECT

HIGHWAY 7182 RECONSTRUCTION

TITLE

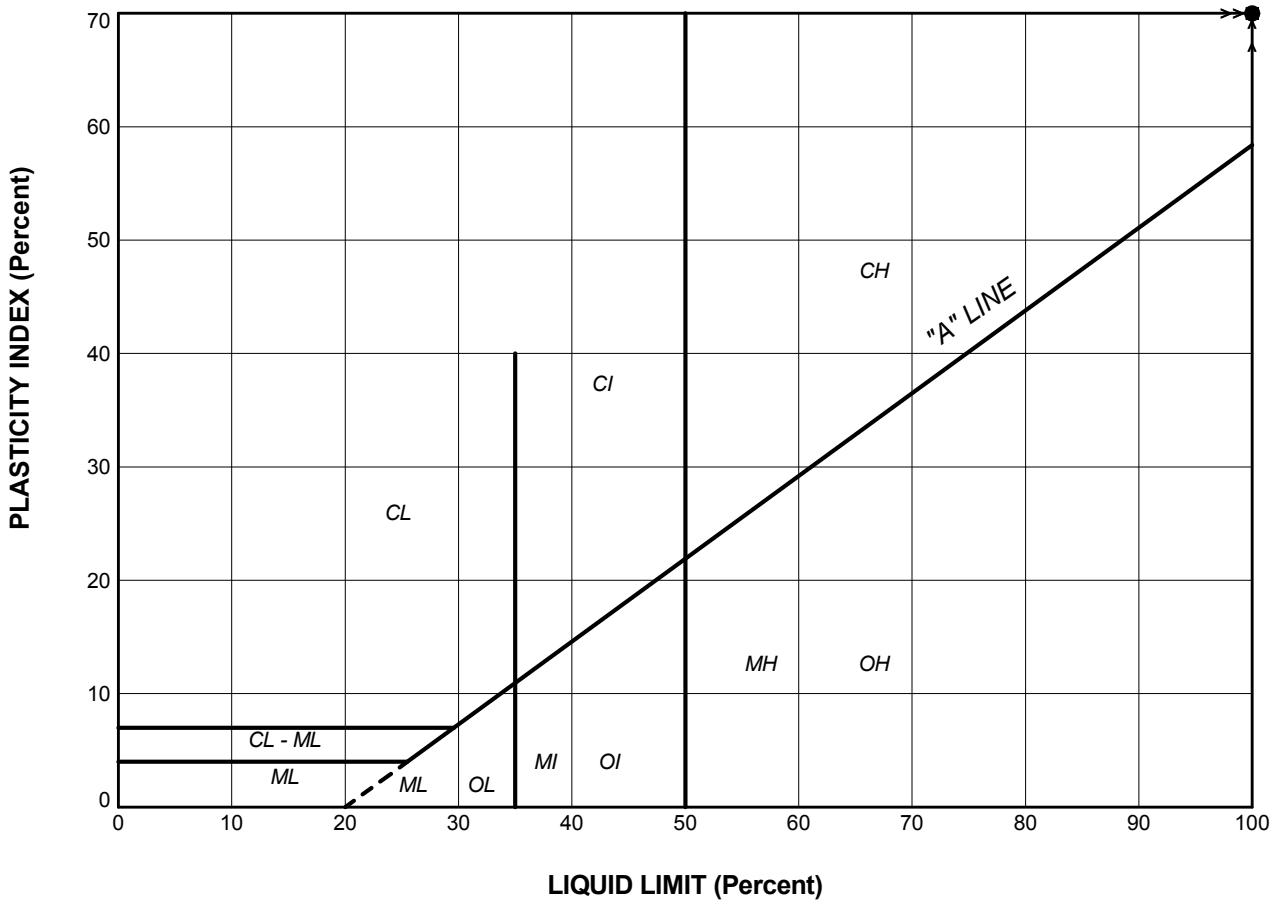
GRAIN SIZE DISTRIBUTION

ORGANIC SILTY SAND (FILL)

Golder Associates
SUDBURY, ONTARIO

PROJECT No.	12-1111-0102		FILE No.	1211110102.GPJ
DRAWN	TB	Mar 2015	SCALE N/A	REV.
CHECK	MCK	Mar 2015		
APPR	CN	Mar 2015	**FIGURE B1-B**	

SUD-MTO GSD (NEW) GLDR_LDN.GDT



SOIL TYPE	PLASTICITY
C = Clay	L = Low
M = Silt	I = Intermediate
O = Organic	H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	S1-03	7	133.8	45.7	88.1
■	S1-06	3	133.2	52.0	81.2

PROJECT

HIGHWAY 7182 RECONSTRUCTION

TITLE

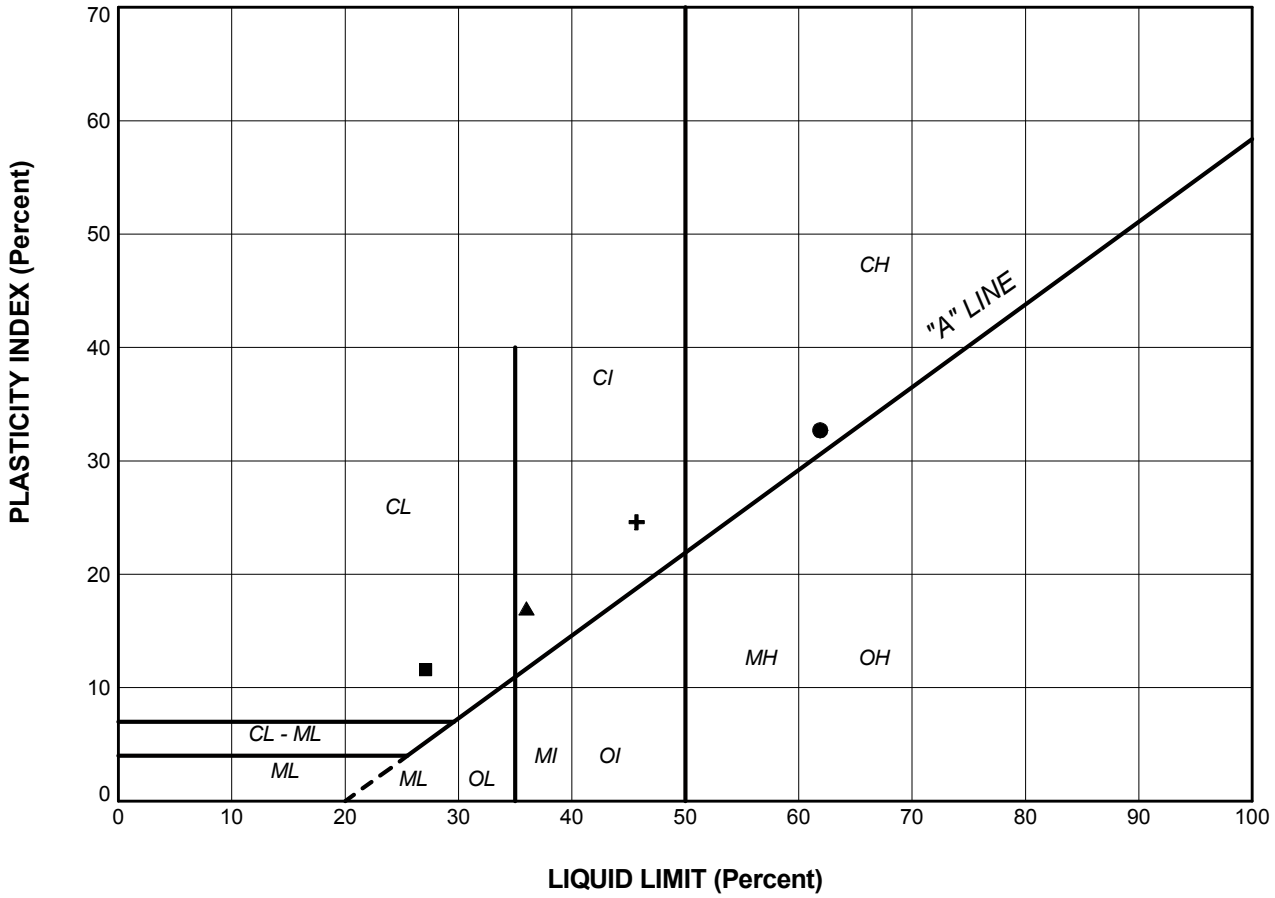
PLASTICITY CHART

CLAYEY ORGANIC SILT

Golder Associates
SUDBURY, ONTARIO

PROJECT No.	12-1111-0102		FILE No.	1211110102.GPJ
DRAWN	TB	Mar 2015	SCALE N/A	REV.
CHECK	MCK	Mar 2015		
APPR	CN	Mar 2015	**FIGURE B2**	

SUD-MTO PL (NEW) GLDR_LDN.GDT



SOIL TYPE
C = Clay
M = Silt
O = Organic

PLASTICITY
L = Low
I = Intermediate
H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	S1-02	6	61.9	29.2	32.7
■	S1-03	9	27.1	15.5	11.6
▲	S1-04	5	36.0	19.0	17.0
+	S1-08	3	45.7	21.1	24.6

PROJECT

HIGHWAY 7182 RECONSTRUCTION

TITLE

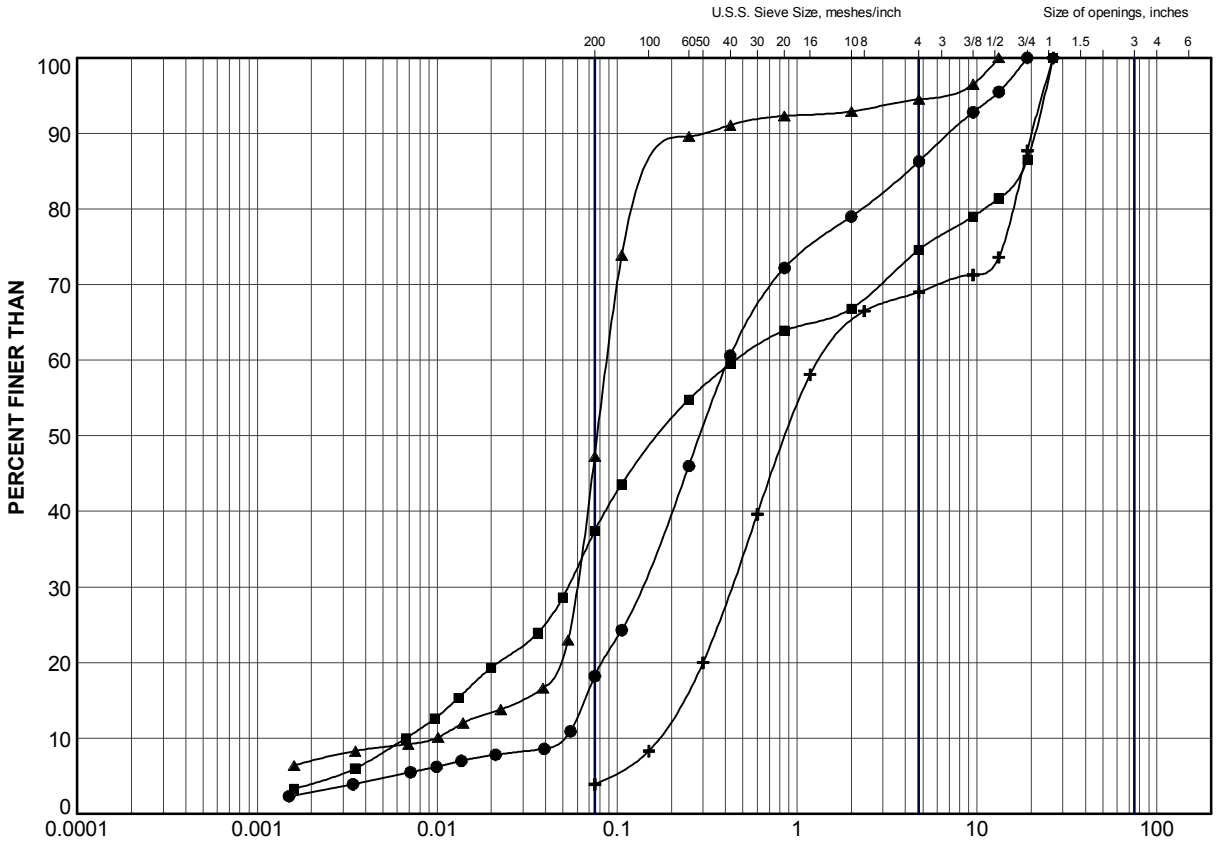
PLASTICITY CHART

CLAYEY SILT to CLAY

Golder Associates
SUDBURY, ONTARIO

PROJECT No.	12-1111-0102		FILE No.	1211110102.GPJ
DRAWN	TB	Mar 2015	SCALE N/A	REV.
CHECK	MCK	Mar 2015		
APPR	CN	Mar 2015	**FIGURE B3**	

SUD-MTO PL (NEW) GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	S1-02	7	200.1
■	S1-05	2	204.1
▲	S1-07	5A	202.5
+	S1-07	8	199.4

PROJECT

HIGHWAY 7182 RECONSTRUCTION

TITLE

GRAIN SIZE DISTRIBUTION

SILT and SAND to GRAVELLY SILT and SAND to SAND to SAND and GRAVEL

Golder Associates
SUDBURY, ONTARIO

PROJECT No.	12-1111-0102		FILE No.	1211110102.GPJ
DRAWN	TB	Mar 2015	SCALE N/A	REV.
CHECK	MCK	Mar 2015		
APPR	CN	Mar 2015	**FIGURE B4**	

SUD-MTO GSD (NEW) GLDR_LDN.GDT

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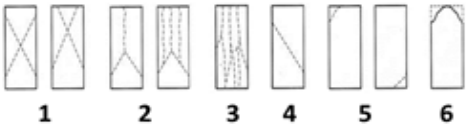
TABLE B1 - SUMMARY OF ROCK CORE TEST DATA

PROJECT NO.: **12-1111-0102**
JOB NAME: **Swamp - Highway 7182/Shawanaga**
TYPE OF UNIT: **Bedrock Core**

GOLDER LAB NUMBER	**G0734**
BOREHOLE	**S1-07**
DATE TESTED	**Aug. 12, 2014**
DEPTH OF TESTED CORE (m)	7.6
LENGTH AS CUT (mm)	99.0
DIAMETER (mm)	47.3
DENSITY (kg/m3)	2823
COMPRESSIVE STRENGTH (KN)	172.3
UNIAXIAL COMPRESSIVE STRENGTH (MPa)	**98.0**
TYPE OF FRACTURE	**3**

Type of Fracture



Tested by: SA
Reviewed by: CN

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