FOUNDATION INVESTIGATION REPORT

Highway 65, Station 15+380, Township of James
Culvert Replacement
Ministry of Transportation, Ontario
GWP 5204-14-00

Submitted to:

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FOUNDATION INVESTIGATION REPORT
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CULVERT REPLACEMENT
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5204-14-00

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services related to the replacement of the culvert located on Highway 65 at Station 15+380, approximately 700 m southeast of the intersection with Highway 560, in the Township of James, Ontario. The Key Plan of the general location of this section of Highway 65 and the location of the investigated area are shown on Drawing 1.

The purpose of this investigation is to establish the subsurface conditions for the culvert replacement by borehole drilling with laboratory testing carried out on selected soil samples.

The Terms of Reference (TOR) and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated February 2018, and the subsequent clarifications/addenda, which forms part of the Consultant's Assignment Number 5017-E-0039 for this project. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project dated November, 2018.

2.0 SITE DESCRIPTION

It should be noted that the orientation (i.e., north, south, east, west) stated in the text of the report is typically referenced to project north and therefore may differ from magnetic north shown on the Drawing 1. For the purpose of this report, Highway 65 is oriented in a west-east direction with the culvert positioned perpendicular to the highway generally in a north-south orientation. At the culvert location, creek water flows in a north-south direction.

The existing culvert consists of a 750 mm diameter, 26 m long Corrugated Steel Pipe (CSP). The inlet (north end) and outlet (south end) inverts are approximately at Elevations 283.3 m and 281.7 m, respectively. In general, the topography within the vicinity of the culvert consists of relatively flat terrain to the north with the Montreal River flowing easterly about 30 m to the south of Highway 65. At the culvert location, the highway grade is at approximately Elevation 286.3 m and the embankment is approximately 3.0 m and 4.6 m high relative to the culvert invert at the inlet and outlet, respectively. The ground surface conditions at select locations in the culvert area are shown on Photographs 1 to 4.

3.0 INVESTIGATION PROCEDURES

Field work for this subsurface investigation was carried out on October 17 and 18 and on November 15, 2018 during which time five boreholes (Boreholes C2-1 to C2-5) were advanced at approximate locations shown on Drawing 1. Three boreholes were advanced through the roadway embankment and one borehole was advanced near the north toe of the highway embankment slope adjacent to the culvert inlet using a track mounted CME-55LC drill rig supplied and operated by George Downing Estate Drilling (Downing) of Grenville-Sur-La-Rouge, Quebec. One borehole was advanced near the south toe of the highway embankment slope adjacent to the culvert outlet using a portable tripod supplied and operated by Downing. Traffic control, where required, was performed in accordance with MTO's Ontario Traffic Control Manual Book 7 – Temporary Conditions.

Boreholes C2-1 to C2-4 were advanced by the drill rig used 108 mm I.D. Hollow Stem Augers and NW casing with wash boring techniques. Borehole C2-5 was advanced by the portable tripod used NW casing with wash boring techniques. Soil samples were obtained in the boreholes at 0.75 m and 1.5 m intervals of depth using 50 mm

outer diameter split-spoon samplers driven by an automatic or cathead hammer in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586). The split-spoon sampler utilized by the portable drilling equipment to obtain soil samples in Borehole C2-5 was driven by a ½ weight hammer and the STP "N"-values were adjusted to the inferred values that would be obtained using a standard weight (63.6 kg) hammer. The groundwater level inside the augers/casing was observed during the drilling operations. The boreholes were backfilled using the native sand soil cuttings upon completion consistent with Ontario Regulation 903 (Wells) considering the consistent subsurface soil conditions at the boreholes. The roadway surface at the boreholes drilled through Highway 65 were capped at ground surface using cold patch asphalt.

Field work was supervised on a full-time basis by a member of Golder's technical staff who: located the boreholes in the field; arranged for the clearance of underground services; supervised the drilling and sampling operations; logged the boreholes; and examined the soil samples. The soil samples were identified in the field, placed in labelled containers and transported to Golder's geotechnical laboratory in Sudbury for further examination and laboratory testing. Index and classification testing, consisting of water content and organic content determinations, grain size distributions, and Atterberg limits were carried out on selected soil samples. The geotechnical laboratory testing was completed according to ASTM and MTO LS standards, as applicable.

The as-drilled borehole locations were measured relative to highway chainages/station marked on the pavement by a member of our technical staff to an accuracy of 0.1 m and converted into northing/easting coordinates on the plan drawing provided by AECOM. The ground surface elevations at the borehole locations were surveyed by Golder relative to the highway and culvert centreline to an accuracy of 0.1 m, with the elevation of the centreline provided by AECOM. The MTM NAD 83-CSRS CBN v6-2010.0 (Zone 12) northing and easting coordinates, geographical coordinates, ground surface elevations referenced to Geodetic datum, and borehole depths at each borehole location are presented on the borehole records in Appendix A and summarized below.

Borehole Number	MTM NAD 83 Northing (m) (Latitude)	MTM NAD 83 Easting (m) (Longitude)	Ground Surface Elevation (m)	Borehole Depth (m)
C2-1	5287952.5 (47.728673)	355694.4 (-80.321486	286.6	15.9
C2-2	5287958.8 (47.728731	355674.3 (-80.321753)	286.1	15.9
C2-3	5287949.0 (47.728642)	355686.5 (-80.321592)	286.3	20.4
C2-4	5287964.1 (47.728777)	355698.2 (-80.321434)	285.0	11.3
C2-5	5287940.4 (47.728565)	355675.9 (-80.321734)	282.1	11.3

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

Based on Northern Ontario Engineering Geology Terrain Study (NOEGTS)[1] mapping, the subsoils in the vicinity of the culvert site are located within a glaciolacustrine plain, consisting of clay and sand.

Based on geological mapping (MNDM)[2], the site is underlain by siltstone, argillite, sandstone and conglomerate.

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the summary results of in situ and laboratory testing are given on the Record of Borehole sheets contained in Appendix A. The detailed results of geotechnical laboratory testing are contained in Appendix B. The results of the in-situ field tests (i.e., SPT “N” values) as presented on the Record of Borehole sheets and discussed in Section 4 are uncorrected. The stratigraphic boundaries shown on the Record of Borehole sheets and on the interpreted stratigraphic profiles shown on Drawing 1 are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change.

The subsurface conditions will vary between and beyond the borehole locations, however, the factual data presented on the record of borehole governs any interpretation of the site conditions. A summary description of the soil deposits and groundwater conditions encountered in the boreholes is provided below. It should be noted that the interpreted stratigraphy shown on Drawing 1 is a simplification of the subsurface conditions.

4.2.1 Asphalt/Fill

An approximate 50 mm to 75 mm thick layer of asphalt pavement was penetrated in the roadway Boreholes C2-1 to C2-3, from pavement surface between Elevations 286.6 m and 286.1 m. A 0.8 m to 0.9 m thick layer of embankment fill consisting of sand and gravel was encountered below the asphalt pavement in Boreholes C2-1 to C2-3, between Elevations 286.5 m and 286.0 m. A 1.6 m to 2.7 m thick layer of fill comprised of clayey silt to silt, underlain by a 2.1 m thick layer of sandy silt fill in one borehole, was encountered in Boreholes C2-1 to C2-3, between Elevations 285.6 m and 285.2 m. Pockets of organic silt were encountered within the fill at a depth of about 3.7 m to 4.9 m in Borehole C2-2 and at a depth of about 3.6 m in Borehole C2-3.

From ground surface at the culvert ends in Boreholes C2-4 and C2-5, a 0.8 m and 0.6 m thick layer of silty sandy topsoil fill was encountered at Elevations 285.0 and 282.1, respectively. A 2.9 m and 1.2 m thick layer of fill comprised of sand and silty sand was encountered at Elevations 284.2 m and 280.7 m in Boreholes C2-4 and C2-5, respectively.

The SPT “N”-values measured within the sand and gravel fill range between 47 blows and 58 blows per 0.3 m of penetration indicating a dense to very dense compactness condition. The SPT “N”-values measured within the silty sandy topsoil fill and sand/silty sand/clayey silt/sandy silt fill range between 2 blows and 34 blows per 0.3 m

[1] Ontario Ministry of Natural Resources and Forestry. Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Electronic Mapping. Map 41PNE

[2] Ontario Ministry of Northern Development and Mines. Bedrock Geology of Ontario, East-Central Sheet. Map 2543

of penetration indicating a very loose to compact compactness condition. Within the fill in Borehole C2-2, one SPT “N”-value of 50 blows per 0.07 m of penetration was likely a result of the sand and gravel and possible cobbles, indicating a dense to very dense compactness condition.

Grain size distribution analysis was carried out on four samples of the clayey silt fill layers and the results are presented on Figure B-1 in Appendix B. Atterberg limits tests were carried out on two samples within the cohesive fill and measured liquid limits of 27 per cent and 28 per cent, plastic limits of 18 per cent and 20 per cent and the plasticity indexes of 8 per cent. The results of the Atterberg limit tests are presented on Figure B-2 in Appendix B and indicate the samples are comprised of clayey silt of low plasticity. Grain size distribution analysis was carried out on two samples of the sand fill and the results are presented on Figure B-3 in Appendix B. The natural moisture content measured on samples of clayey silt fill ranges from 21 per cent to 27 per cent and on samples of the sand fill is about 10 per cent and 20 per cent.

4.2.2 Clayey Silt-Silt

A 4.3 m and 1.8 m thick deposit of clayey silt-silt was encountered underlying the fill deposit in Boreholes C2-1, and C2-5, at Elevations 284.0 m and 279.5 m, respectively. The deposit contains trace to some sand.

The SPT “N”-values measured within the cohesive deposit range from 2 blows to 15 blows per 0.3 m of penetration suggesting that the deposit has a very soft to stiff consistency.

Grain size distribution analysis was carried out on three samples of the deposit and the results are presented on Figure B-4 in Appendix B. Atterberg limit tests were carried out on three samples of the deposit and measured liquid limits ranging from 23 per cent to 39 per cent, plastic limits ranging from 17 per cent to 28 per cent and plasticity indices ranging from 5 percent to 11 per cent. The results of the Atterberg limit test are presented in Figure B-5 and indicate the samples are comprised of silt of intermediate plasticity to clayey silt-silt of low plasticity. An organic content test conducted on one of the silt samples of the deposit yielding 2.6 per cent organic content. The natural moisture content measured on samples of the deposit range from 24 per cent to 40 per cent.

4.2.3 Silt

A 1.0 m thick deposit of silt, containing trace sand, was encountered underlying the fill deposit in Borehole C2-3 at Elevation 282.6 m.

An STP “N”-value of 8 blows per 0.3 m of penetration was measured within the silt deposit, indicating a loose compaction condition.

4.2.4 Sand

A deposit of sand was encountered underlying the clayey silt-silt deposit in Boreholes C2-1 and C2-5, underlying the fill in Boreholes C2-2 and C2-4 and underlying the silt deposit in Borehole C2-3, between Elevations 281.6 m and 277.7 m. The boreholes were terminated within the sand after penetrating into the deposit for a thickness between 6.9 m and 15.7 m.

The SPT “N”-values measured within the sand deposit range from 3 blows to 29 blows per 0.3 m of penetration, indicating that the deposit has a very loose to compact compactness condition.

Grain size distribution analysis was carried out on eight samples of the deposit and the results are presented on Figure B-6 in Appendix B. The natural moisture content measured on samples on the deposit ranged from 19 per cent to 26 per cent.

4.3 Groundwater Conditions

The unstabilized groundwater levels relative to ground surface measured inside the casing or augers upon completion of drilling are summarized below. The creek water level near the culvert inlet, as surveyed by Golder on October 18, 2018, is about Elevation 283.4 m. Groundwater and creek water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Depth to Unstabilized Groundwater Level (m)	Approximate Groundwater Elevation (m)
C2-1	4.9	281.7
C2-2	3.2	282.9
C2-3	4.4	281.9
C2-4	3.4	281.6
C2-5	0.8	281.3

4.4 Analytical Laboratory Testing Results

Analytical testing was carried out on a sand and gravel fill soil sample recovered from Borehole C2-3. The soil sample was submitted to Maxxam Analytics of Sudbury, Ontario for testing of a suite of corrosivity parameters. The detailed analytical laboratory test results are presented on the laboratory testing report in Appendix B and the test results are summarized below.

Borehole No.	Sample No.	Depth (m)	Parameters				
			Resistivity (ohm/cm)	Electrical Conductivity (µmho/cm)	Soluble Sulphate (SO4) Content (µg/g)	Chloride (Cl) Content (µg/g)	pH
C2-3	Sa 4	2.2 – 2.5	2300	429	<20[1]	150	7.74

Note:
1. The sulphate concentration is below the reportable detection limit of 20 µg/g

5.0 CLOSURE

The field drilling program was carried out under the supervision of Mr. Tibor Berecz, under the overall direction of Mr. André Bom, P.Eng. This Foundation Investigation Report was prepared by Mr. Gavin Mundry, and Mr. André Bom, P.Eng. carried out a technical review of the report. Mr. Jorge Costa, P.Eng., an MTO Foundations Designated Contact and Senior Consultant for Golder, conducted an independent quality control review of this report.

Signature Page

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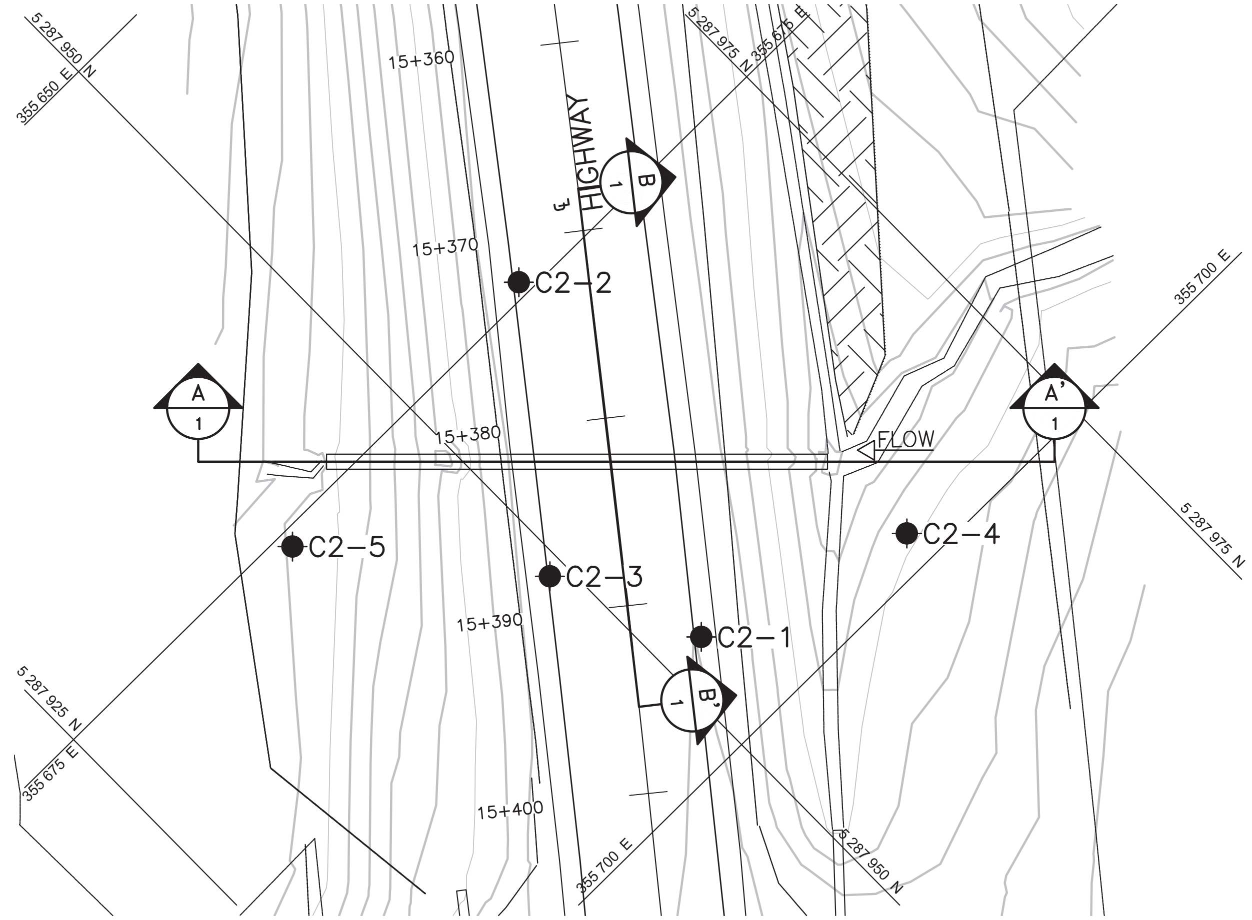
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 5204-14-00

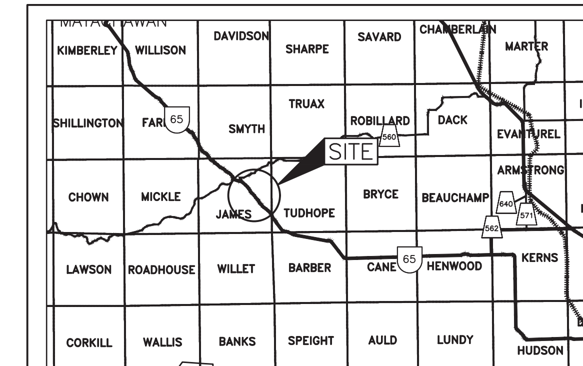
SHEET

HIGHWAY 65
STATION 15+380
TOWNSHIP OF JAMES CULVERT
BOREHOLE LOCATIONS AND SOIL STRATA

GOLDER



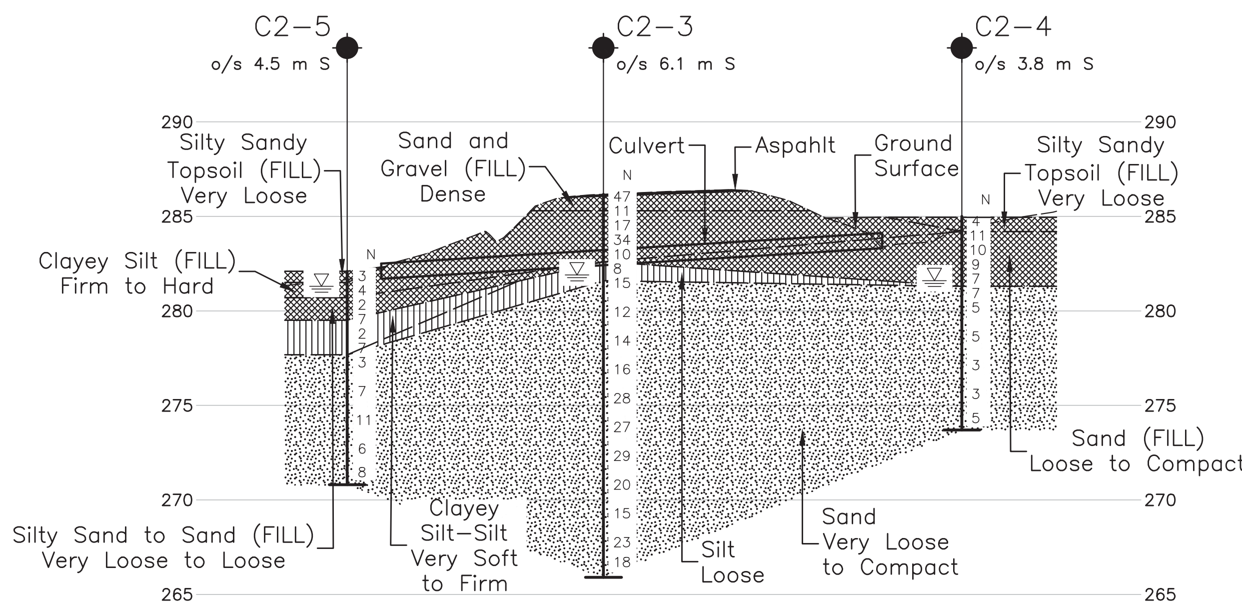
PLAN
SCALE
4 0 4 8 m



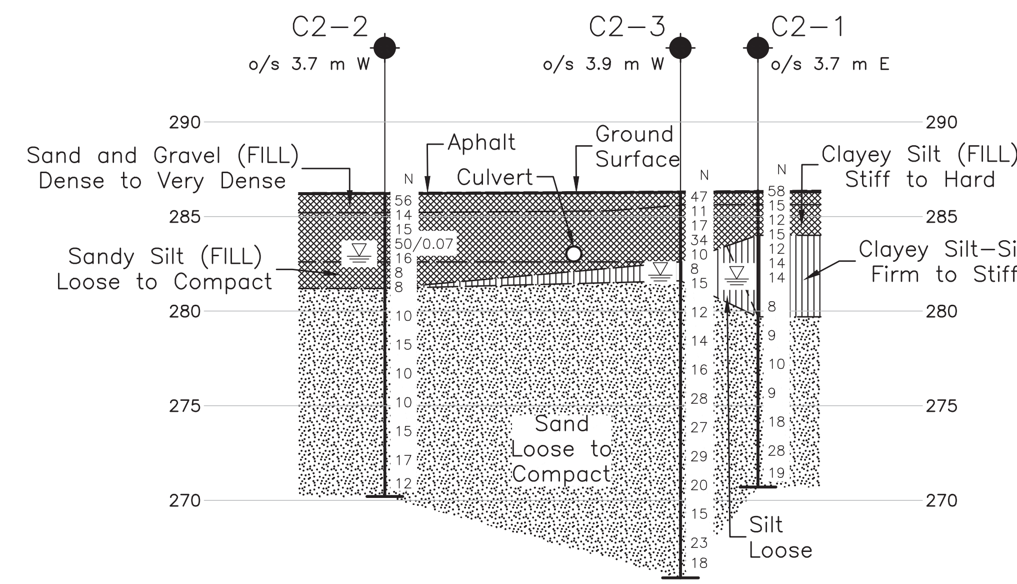
KEY PLAN
SCALE
10 0 10 20 km

LEGEND

●	Borehole – Current Investigation
N	Standard Penetration Test Value
16	Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
▽	WL upon completion of drilling



CULVERT CENTERLINE PROFILE (A-A' 1)
HORIZONTAL SCALE 4 0 4 8 m
4 0 4 8 m VERTICAL SCALE



HIGHWAY CENTERLINE PROFILE (B-B' 1)
HORIZONTAL SCALE 4 0 4 8 m
4 0 4 8 m VERTICAL SCALE

BOREHOLE CO-ORDINATES (NAD 83 MTM ZONE 12)

No.	ELEVATION	NORTHING	EASTING
C2-1	286.6	5287952.5	355694.4
C2-2	286.1	5287958.8	355674.3
C2-3	286.3	5287949.0	355686.5
C2-4	285.0	5287964.1	355698.2
C2-5	282.1	5287940.4	355675.9

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.

REFERENCE

Base plans provided in digital format by AECOM, drawing file nos. B065JAM.dwg, received MAR 15, 2019.

NO.	DATE	BY	REVISION
.	.	.	

Georcs No. 41P-78

HWY. 65	PROJECT NO. 1896349		DIST.
SUBM'D. GM	CHKD. TB	DATE: 5/21/2019	SITE:
DRAWN: TR	CHKD. AB	APPD. JMAC	DWG. 1

Photograph 1: Culvert Inlet (North End), Facing Southwest (October 2018)

Photograph 2: Culvert Outlet (South End), Facing Northwest (October, 2018)

Photograph 3: Road surface in Culvert Area, Facing West (October, 2018)

Photograph 4: Borehole C2-5 Location South of Hwy 65, Facing Southwest (November 2018)

APPENDIX A

Record of Boreholes

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
σ_1, σ_2, σ_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 (Cohesionless) Soils

Compactness Condition	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)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand

GOLDER

RECORD OF BOREHOLE No C2-1

1 OF 2 **METRIC**

PROJECT 1896349
G.W.P. 5204-14-00
DIST ____ HWY 65
DATUM GEODETIC

LOCATION N 5287952.5; E 355694.4 NAD83 MTM ZONE 12 (LAT. 47.728673; LONG. -80.321486)
BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers, NW Casing and Wash Boring
DATE October 17, 2018

ORIGINATED BY TB/GM
COMPILED BY GM
CHECKED BY AB

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
286.6	GROUND SURFACE										
0.0	ASPHALT (50 mm)										
0.1	Sand and gravel (FILL) Very dense Brown Moist		1	SS	58		286				
285.6											
1.0	Clayey silt, trace sand (FILL) Stiff Brown Moist to wet		2 A/B	SS	15						
			3	SS	12		285				0 3 74 23
284.0											
2.6	CLAYEY SILT-SILT Firm to stiff Brown Moist to wet		4 A/B	SS	15		284				
	Organic pocket in sample 4B		5	SS	12						
	Sand layer from 3.4 m to 3.7 m depth		6	SS	14		283				0 0 84 16
			7	SS	14	▽	282				
	Sand layer from 6.7 m to 6.8 m		8	SS	8		281				
279.7							280				
6.9	SAND, trace to some silt Loose to compact Brown to grey Wet		9	SS	9		279				
	Silt to sandy silt layer from 9.0 m to 9.6 m		10	SS	10		278				
			11	SS	9		277				0 90 (10)
							276				
							275				

Continued Next Page

+3, ×3: Numbers refer to Sensitivity

○3% STRAIN AT FAILURE

GOLDER

PROJECT 1896349

RECORD OF BOREHOLE No C2-1

2 OF 2 **METRIC**

G.W.P. 5204-14-00 LOCATION N 5287952.5; E 355694.4 NAD83 MTM ZONE 12 (LAT. 47.728673; LONG. -80.321486) ORIGINATED BY TB/GM

DIST HWY 65 BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers, NW Casing and Wash Boring COMPILED BY GM

DATUM GEODETIC DATE October 17, 2018 CHECKED BY AB

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						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SAND, trace to some silt Loose to compact Brown to grey Wet										
			12	SS	18		274				
							273				
			13	SS	28						
							272				
270.7			14	SS	19		271				
15.9	END OF BOREHOLE Note: 1. Water level at a depth of 4.9 m below ground surface (Elev. 281.7 m) upon completion of drilling.										

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

GOLDER

PROJECT 1896349

RECORD OF BOREHOLE No C2-2

1 OF 2 **METRIC**

G.W.P. 5204-14-00 LOCATION N 5287958.8; E 355674.3 NAD83 MTM ZONE 12 (LAT. 47.728731; LONG. -80.321753) ORIGINATED BY TB/GM

DIST HWY 65 BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers, NW Casing and Wash Boring COMPILED BY GM

DATUM GEODETIC DATE October 18, 2018 CHECKED BY AB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"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
286.1	GROUND SURFACE										
0.0	ASPHALT (75 mm)										
0.1	Sand and gravel (FILL) Very dense Brown Moist		1	SS	56		286				
285.2											
0.9	Clayey silt, trace sand (FILL) Stiff Brown to grey Moist		2	SS	14		285				
			3	SS	15				○		0 1 90 9
	Sand and gravel and possible cobbles from 2.3 m to 2.5 m		4	SS	50/0.07		284				
283.3											
2.8	Sandy silt, trace gravel (FILL) Loose to compact Grey Moist		5	SS	16	▽	283				
	Organic silt pockets from 3.7 m to 4.9 m		6	SS	8		282				
281.2			7 A/B	SS	8						
4.9	SAND, trace silt, trace clay Loose to compact Brown to grey Wet						281				
			8	SS	10		280		○		0 98 (2)
			9	SS	15		279				
			10	SS	10		278				
							277				
							276				
	Silt from 11.0 m to 11.1 m		11	SS	10		275		○		0 92 6 2

Continued Next Page

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

GOLDER

PROJECT 1896349

RECORD OF BOREHOLE No C2-2

2 OF 2 **METRIC**

G.W.P. 5204-14-00 LOCATION N 5287958.8; E 355674.3 NAD83 MTM ZONE 12 (LAT. 47.728731; LONG. -80.321753) ORIGINATED BY TB/GM

DIST HWY 65 BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers, NW Casing and Wash Boring COMPILED BY GM

DATUM GEODETIC DATE October 18, 2018 CHECKED BY AB

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						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SAND, trace silt, trace clay Loose to compact Brown to grey Wet						274				
			12	SS	15						
							273				
			13	SS	17		272				
							271				
270.2			14	SS	12						
15.9	END OF BOREHOLE Note: 1. Water level at a depth of 3.2 m below ground surface (Elev. 282.9 m) upon completion of drilling.										

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

GOLDER

RECORD OF BOREHOLE No C2-3

1 OF 2 **METRIC**

PROJECT 1896349

G.W.P. 5204-14-00 LOCATION N 5287949.0; E 355686.5 NAD83 MTM ZONE 12 (LAT. 47.728642; LONG. -80.321592) ORIGINATED BY TB/GM

DIST HWY 65 BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers, NW Casing and Wash Boring COMPILED BY GM

DATUM GEODETIC DATE October 18, 2018 CHECKED BY AB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"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
286.3	GROUND SURFACE										
0.0 / 0.1	ASPHALT (50 mm)										
	Sand and gravel (FILL) Dense Brown Moist		1	SS	47		286				
285.3											
1.0	Clayey silt, trace gravel, trace sand (FILL) Stiff to hard Brown to grey Moist		2	SS	11		285				
			3	SS	17				○		4 5 83 8
	Sand and gravel layer from 2.2 m to 2.5 m		4	SS	34		284				
			5	SS	10		283				
282.6	Organic silt pockets at 3.6 m										
3.7	SILT, trace sand Loose Grey to dark brown Moist		6	SS	8	▽	282				
281.6											
4.7	SAND, trace to some silt Compact Brown to grey Wet		7	SS	15		281				
			8	SS	12		280		○		0 92 (8)
			9	SS	14		279				
			10	SS	16		278				
			11	SS	28		277				
							276				
							275		○		0 98 (2)

Continued Next Page

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

GOLDER

PROJECT 1896349

RECORD OF BOREHOLE No C2-3

2 OF 2 **METRIC**

G.W.P. 5204-14-00 LOCATION N 5287949.0; E 355686.5 NAD83 MTM ZONE 12 (LAT. 47.728642; LONG. -80.321592) ORIGINATED BY TB/GM

DIST HWY 65 BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers, NW Casing and Wash Boring COMPILED BY GM

DATUM GEODETIC DATE October 18, 2018 CHECKED BY AB

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
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SAND, trace to some silt Compact Brown to grey Wet										
			12	SS	27		274				
							273				
			13	SS	29						
							272				
			14	SS	20		271		○		0 98 (2)
							270				
			15	SS	15						
							269				
			16	SS	23		268				
							267				
265.9			17	SS	18		266				
20.4	END OF BOREHOLE										
	Note: 1. Water level at a depth of 4.4 m below ground surface (Elev. 281.9 m) upon completion of drilling.										

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

GOLDER

RECORD OF BOREHOLE No C2-4

1 OF 2 **METRIC**

PROJECT 1896349
G.W.P. 5204-14-00
DIST ____ HWY 65
DATUM GEODETIC

LOCATION N 5287964.1; E 355698.2 NAD83 MTM ZONE 12 (LAT. 47.728777; LONG. -80.321434)
BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers
DATE November 15, 2018

ORIGINATED BY MR
COMPILED BY GM
CHECKED BY AB

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
285.0	GROUND SURFACE										
0.0	Silty sandy topsoil (FILL) Loose Black and brown Frozen to moist		1	SS	4						
284.2							284				
0.8	Sand, trace silt (FILL) Loose to compact Brown Moist to wet		2	SS	11						
			3	SS	10		283		○		0 96 (4)
			4	SS	9						
			5	SS	7	▽	282		○		0 93 (7)
281.3											
3.7	SAND, trace silt, trace clay Very loose to loose Brown Wet		6	SS	7		281				
			7	SS	5		280				
			8	SS	5		279		○		
			9	SS	3		278				0 95 2 3
			10	SS	3		277				
			11 A/B	SS	5		276				
273.7	Sandy silt layer from 11.1 m to 11.3 m						275				
11.3	END OF BOREHOLE						274				

Continued Next Page

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

GOLDER

RECORD OF BOREHOLE No C2-4

2 OF 2 **METRIC**

PROJECT 1896349
G.W.P. 5204-14-00
DIST HWY 65
DATUM GEODETIC

LOCATION N 5287964.1; E 355698.2 NAD83 MTM ZONE 12 (LAT. 47.728777; LONG. -80.321434)
BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers
DATE November 15, 2018

ORIGINATED BY MR
COMPILED BY GM
CHECKED BY AB

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
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Note: 1. Water level at a depth of 3.4 m below ground surface (Elev. 281.6 m) upon completion of drilling.										

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

GOLDER

RECORD OF BOREHOLE No C2-5

1 OF 2 **METRIC**

PROJECT 1896349
G.W.P. 5204-14-00
DIST ____ HWY 65
DATUM GEODETIC

LOCATION N 5287940.4; E 355675.9 NAD83 MTM ZONE 12 (LAT. 47.728565; LONG. -80.321734)
BOREHOLE TYPE NW Casing and Wash Boring
DATE November 15, 2018

ORIGINATED BY MR
COMPILED BY GM
CHECKED BY AB

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
282.1	GROUND SURFACE						282				
0.0 / 281.5	Silty sandy topsoil, trace gravel, trace wood (FILL) Very loose Brown and black Moist		1	SS	3						
0.6 / 280.7	Clayey silt, some sand, trace organics (FILL) Firm Brown Moist		2	SS	4	▽	281				0 15 69 16
1.4 / 279.5	Silty sand to sand, trace organics (FILL) Very loose to loose Grey to brown Wet		3	SS	2		280				
2.6 / 277.7	CLAYEY SILT-SILT, some sand, trace organics Very soft to firm Dark brown Wet		4 A/B	SS	7		279			OC=2.6%	0 7 87 6
			5	SS	2						
			6	SS	7		278				0 12 74 14
4.4 / 270.8	SAND, trace silt Loose to compact Brown Wet		7	SS	3		277				
			8	SS	7		276				
			9	SS	11		275				0 96 (4)
			10	SS	6		274				
			11	SS	8		273				
11.3	END OF BOREHOLE						272				
							271				

Continued Next Page

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

GOLDER

RECORD OF BOREHOLE No C2-5

2 OF 2 **METRIC**

PROJECT 1896349
G.W.P. 5204-14-00
DIST _____ HWY 65
DATUM GEODETIC

LOCATION N 5287940.4; E 355675.9 NAD83 MTM ZONE 12 (LAT. 47.728565; LONG. -80.321734)
BOREHOLE TYPE NW Casing and Wash Boring
DATE November 15, 2018

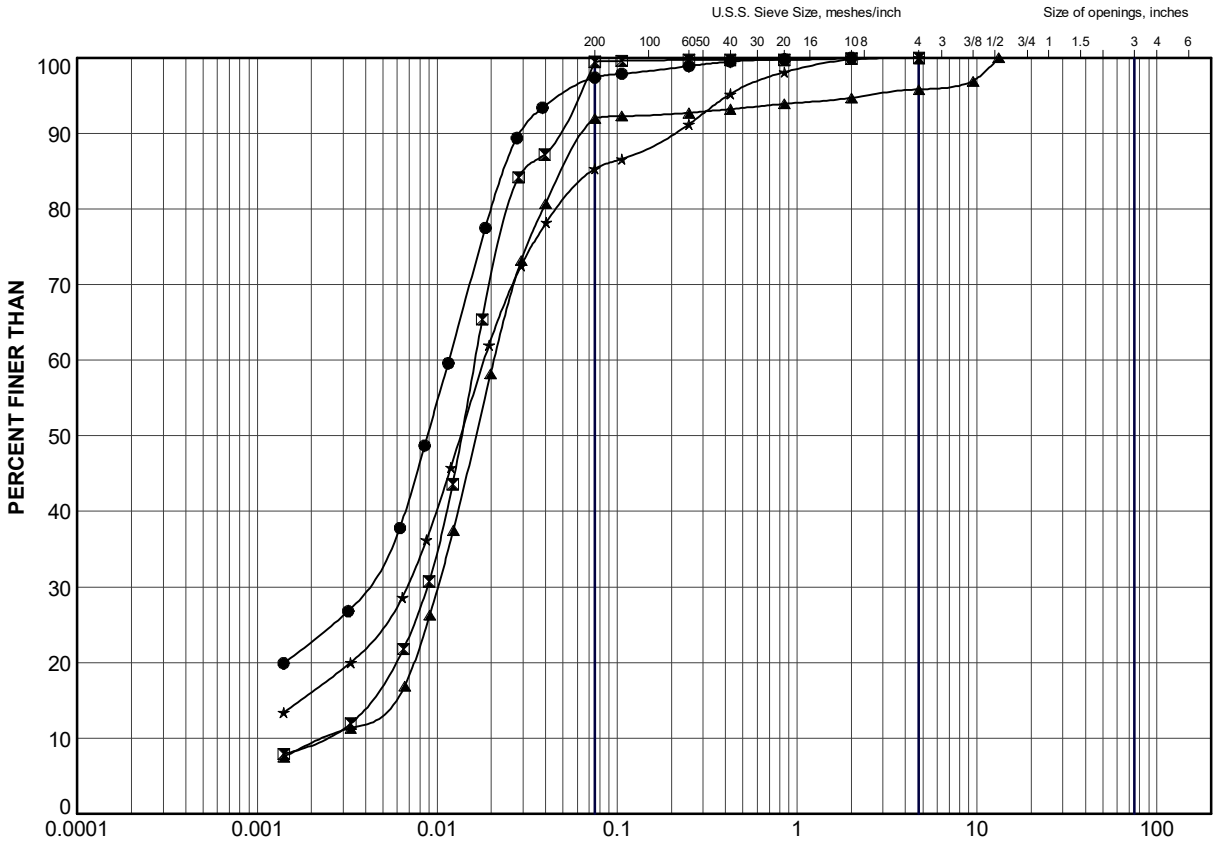
ORIGINATED BY MR
COMPILED BY GM
CHECKED BY AB

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
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Note: 1. Water level at a depth of 0.8 m below ground surface (Elev. 281.3 m) upon completion of drilling. 2. Split Spoon samples obtained by driving with a 1/2 weight hammer. SPT 'N' values have been adjusted to the inferred values that would be obtained using a standard weight hammer.										

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

APPENDIX B

Laboratory Test Results



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C2-1	3	284.8
⊠	C2-2	3	284.3
▲	C2-3	3	284.5
★	C2-5	2	281.0

PROJECT

HIGHWAY 65
STATION 15+380
TOWNSHIP OF JAMES CULVERT

TITLE

GRAIN SIZE DISTRIBUTION

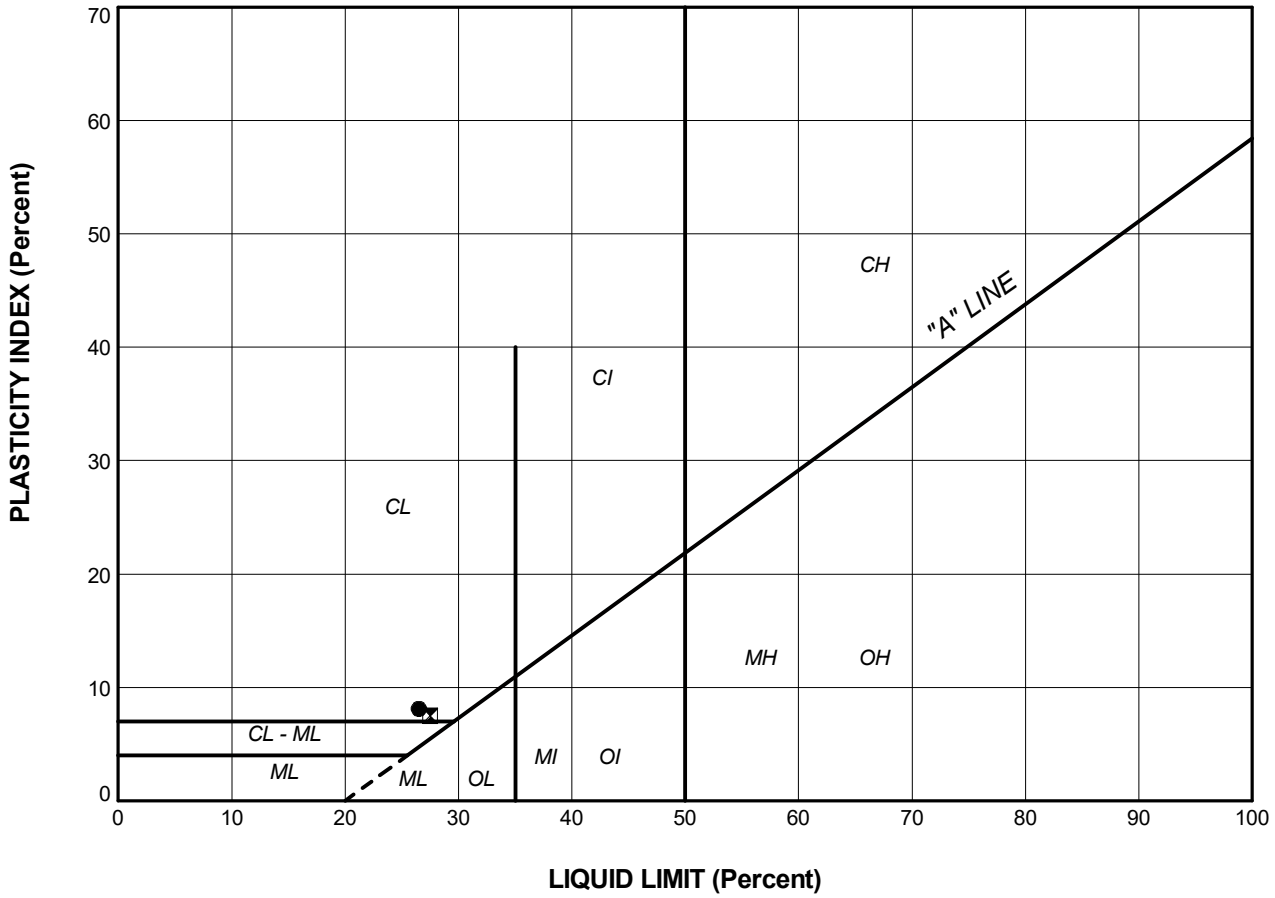
Clayey Silt (FILL)

GOLDER

SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.		1896349.GPJ
DRAWN	TR	Apr 2019	SCALE	N/A	REV.
CHECK	AB	Apr 2019			
APPR	JMAC	Apr 2019	FIGURE		B-1

SUD-MTO GSD 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
●	C2-1	3	26.5	18.4	8.1
⊠	C2-5	2	27.5	20.0	7.5

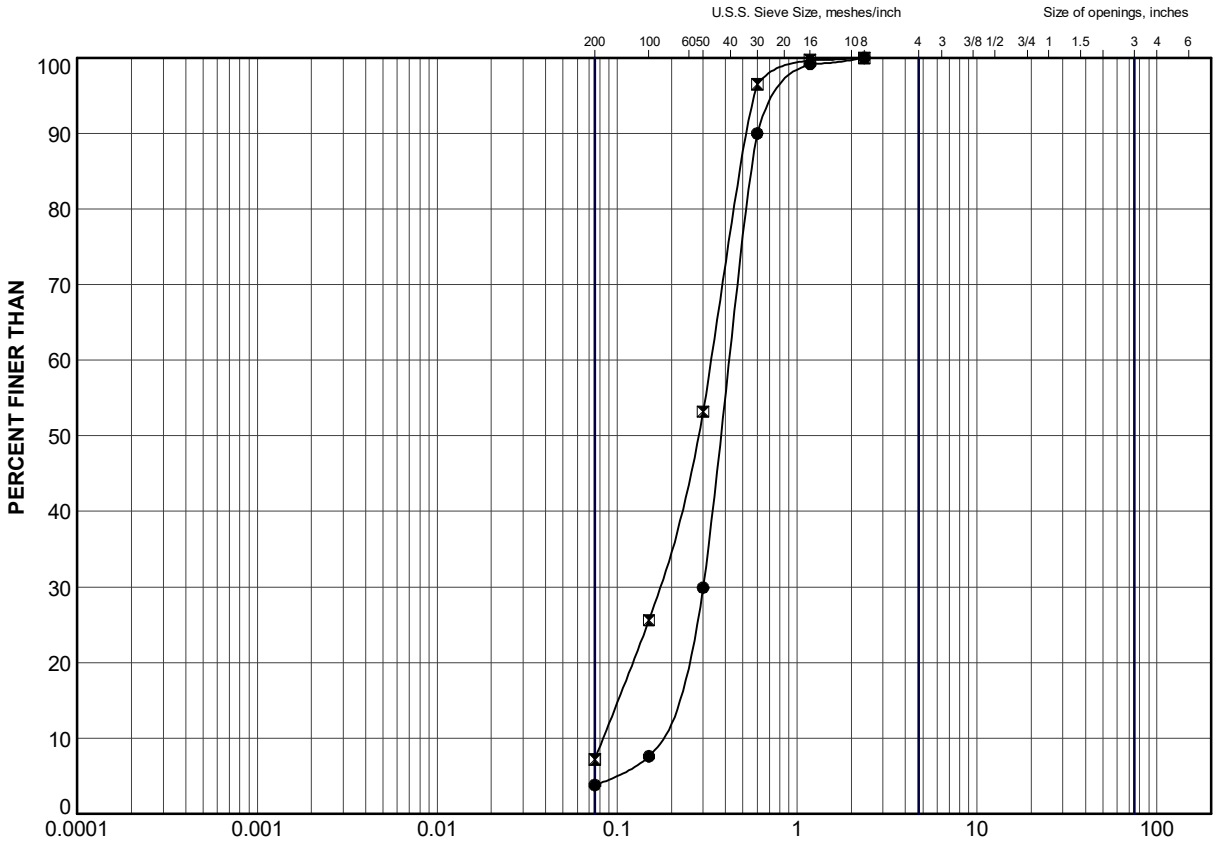
PROJECT
HIGHWAY 65
STATION 15+380
TOWNSHIP OF JAMES CULVERT

TITLE
PLASTICITY CHART
Clayey Silt (FILL)

GOLDER
SUDBURY, ONTARIO

PROJECT No.	1896349		FILE No.	1896349.GPJ
DRAWN	TR	Apr 2019	SCALE N/A	REV.
CHECK	AB	Apr 2019		
APPR	JMAC	Apr 2019	**FIGURE B-2**	

SUD-MTO PL GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C2-4	3	283.2
⊠	C2-4	5	281.7

PROJECT

HIGHWAY 65
STATION 15+380
TOWNSHIP OF JAMES CULVERT

TITLE

GRAIN SIZE DISTRIBUTION

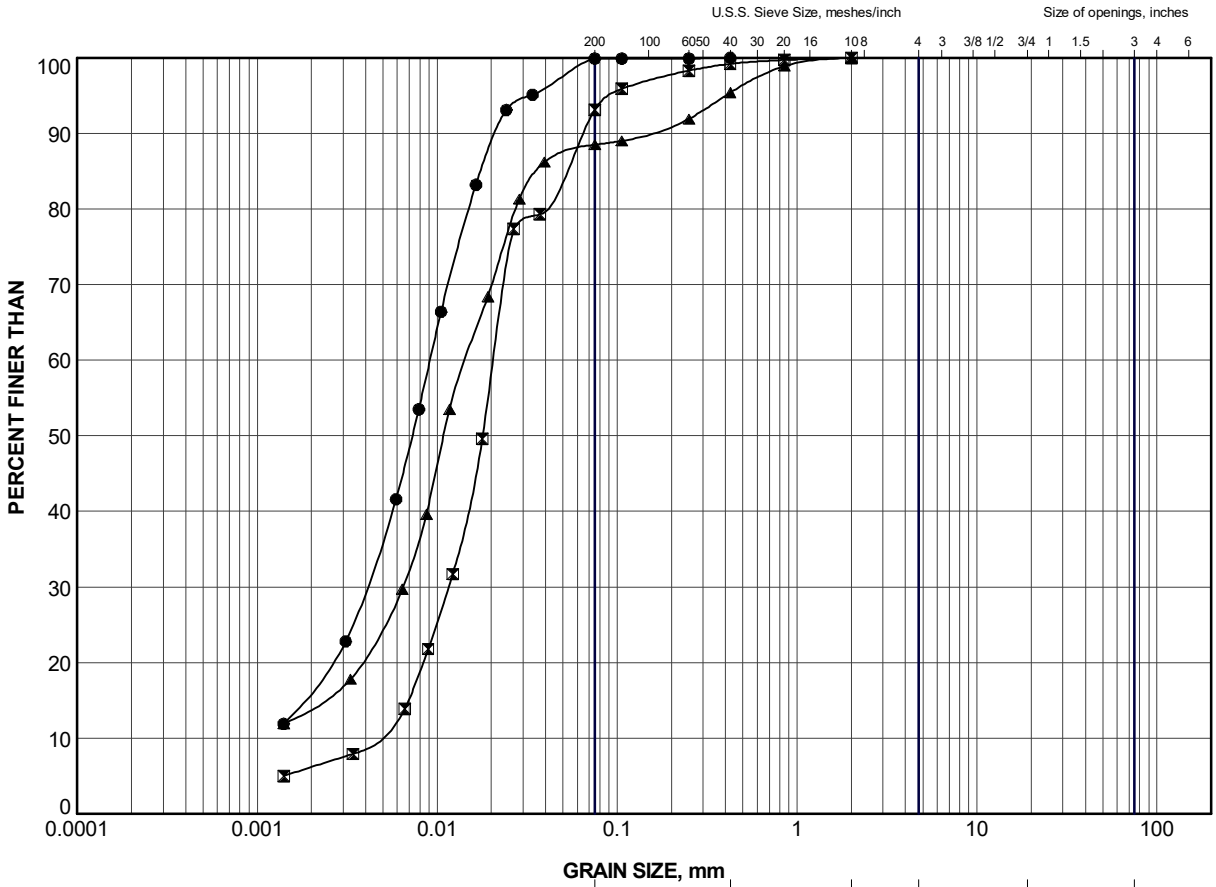
Sand (FILL)

GOLDER

SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.		1896349.GPJ
DRAWN	TR	Apr 2019	SCALE	N/A	REV.
CHECK	AB	Apr 2019			
APPR	JMAC	Apr 2019	FIGURE		B-3

SUD-MTO GSD_GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C2-1	6	282.5
⊠	C2-5	5	278.8
▲	C2-5	6	278.0

PROJECT

HIGHWAY 65
STATION 15+380
TOWNSHIP OF JAMES CULVERT

TITLE

GRAIN SIZE DISTRIBUTION

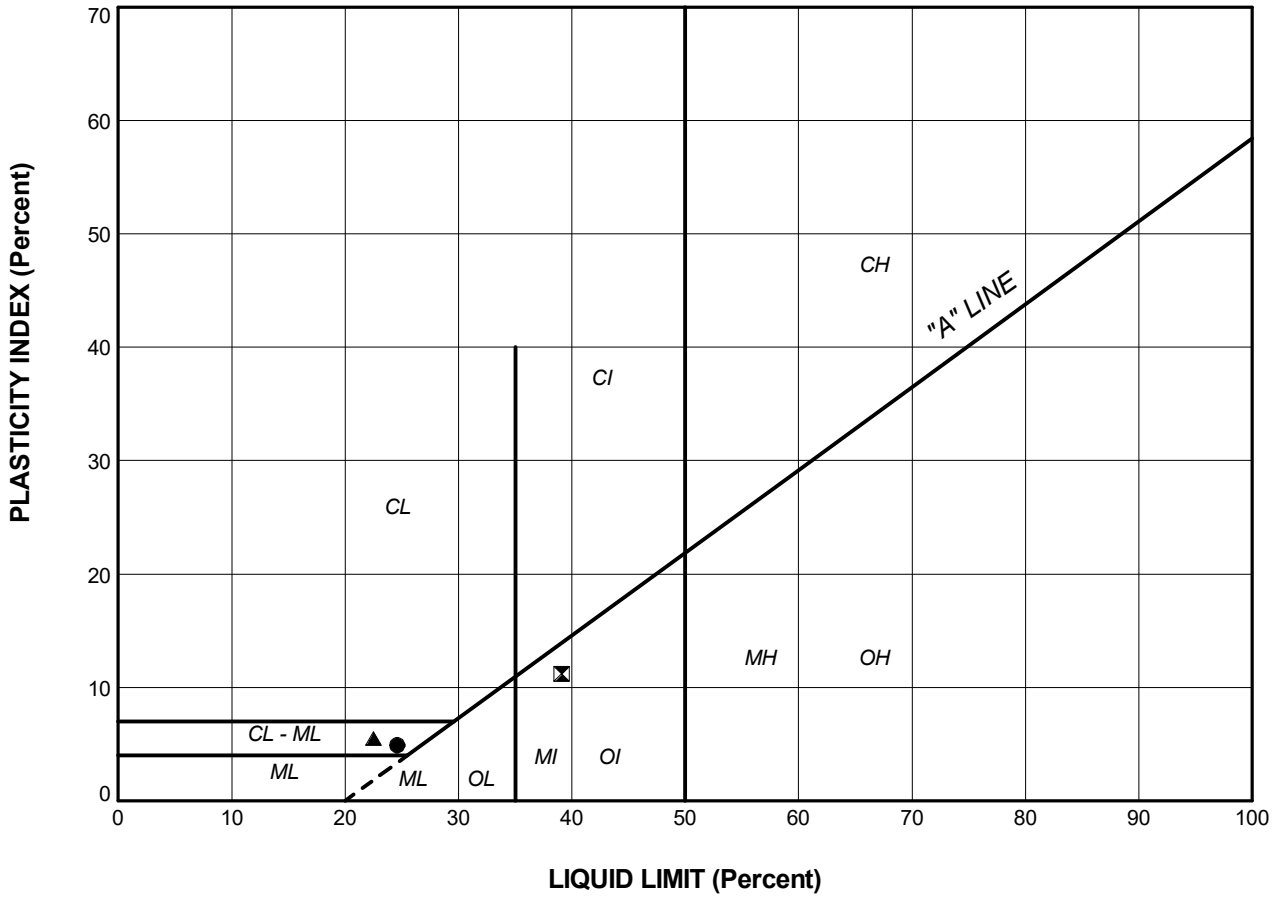
CLAYEY SILT - SILT

GOLDER

SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.	1896349.GPJ	
DRAWN	TR	Jun 2019	SCALE	N/A	REV.
CHECK	AB	Jun 2019			
APPR	JMAC	Jun 2019	**FIGURE**		**B-4**

SUD-MTO GSD 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
●	C2-1	6	24.6	19.7	4.9
⊠	C2-5	5	39.1	27.9	11.2
▲	C2-5	6	22.5	17.0	5.5

PROJECT
HIGHWAY 65
STATION 15+380
TOWNSHIP OF JAMES CULVERT

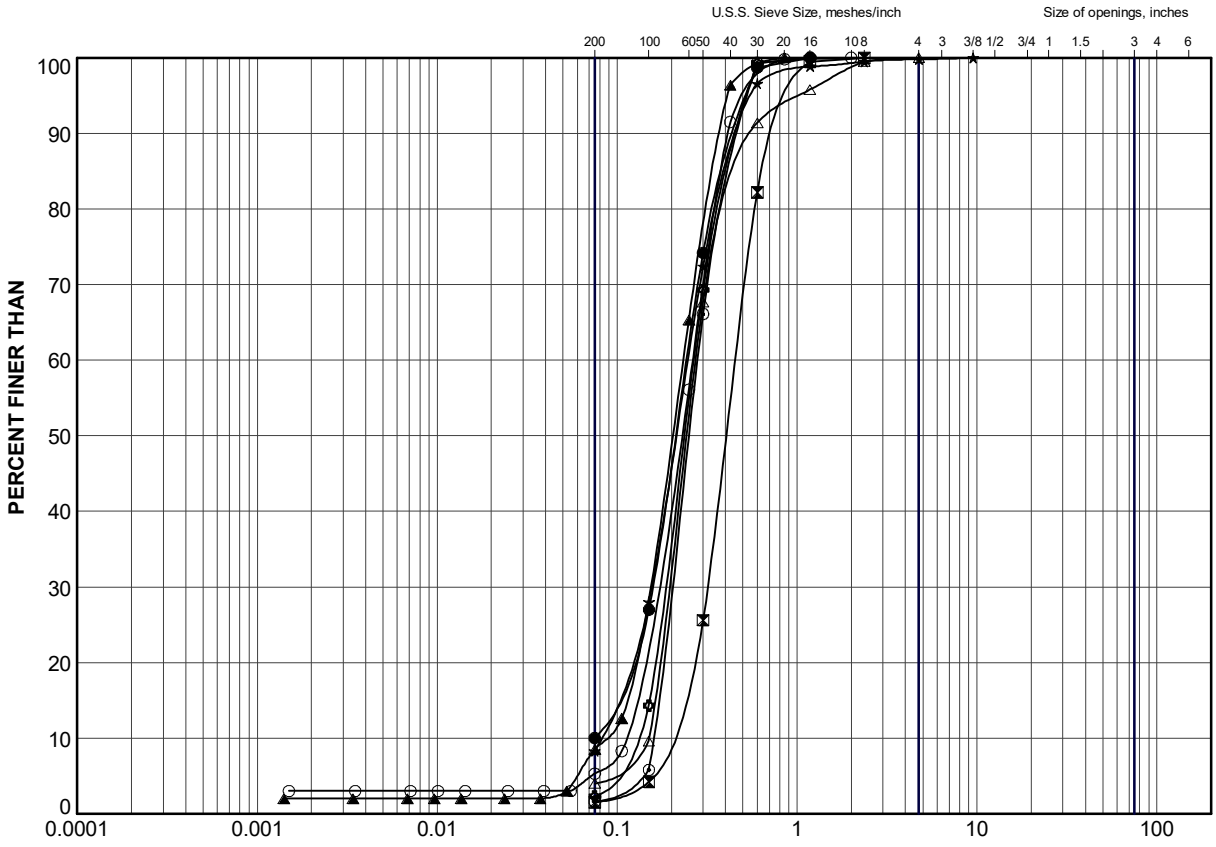
TITLE
PLASTICITY CHART
CLAYEY SILT - SILT

GOLDER
SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.		1896349.GPJ
DRAWN	TR	Jun 2019	SCALE	N/A	REV.
CHECK	AB	Jun 2019			
APPR	JMAC	Jun 2019			

FIGURE B-5

SUD-MTO PL GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C2-1	11	275.6
⊠	C2-2	8	279.7
▲	C2-2	11	275.1
★	C2-3	8	279.9
⊙	C2-3	11	275.3
✿	C2-3	14	270.8
○	C2-4	9	277.1
△	C2-5	9	274.2

PROJECT

HIGHWAY 65
STATION 15+380
TOWNSHIP OF JAMES CULVERT

TITLE

GRAIN SIZE DISTRIBUTION

SAND

GOLDER

SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.		1896349.GPJ
DRAWN	TR	Apr 2019	SCALE	N/A	REV.
CHECK	AB	Apr 2019			
APPR	JMAC	Apr 2019	FIGURE		B-6

SUD-MTO GSD GLDR_LDN.GDT

Maxxam Job #: B8R8556
Report Date: 2018/10/31

Golder Associates Ltd
Client Project #: 1896349
Site Location: HWY 65 CULVERTS
Sampler Initials: TB

RESULTS OF ANALYSES OF SOIL

Maxxam ID		IBQ378	IBQ379			IBQ379			IBQ380		
Sampling Date		2018/10/18 08:42	2018/10/11 09:58			2018/10/11 09:58			2018/10/12 09:34		
COC Number		35870	35870			35870			35870		
	UNITS	C2-3 SA# 4A	C8-3 SA# 3	RDL	QC Batch	C8-3 SA# 3 Lab-Dup	RDL	QC Batch	C9-3 SA# 3	RDL	QC Batch
Calculated Parameters											
Resistivity	ohm-cm	2300	3300		5794629				2500		5794629
Inorganics											
Soluble (20:1) Chloride (Cl-)	ug/g	150	71	20	5799805	77	20	5799805	170	20	5799805
Conductivity	umho/cm	429	302	2	5797627				396	2	5797627
Available (CaCl2) pH	pH	7.74	7.81		5796193				7.76		5796193
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	20	5799807	<20	20	5799807	<20	20	5799807

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Maxxam ID		IBQ380			IBQ381		
Sampling Date		2018/10/12 09:34			2018/10/13 09:21		
COC Number		35870			35870		
	UNITS	C9-3 SA# 3 Lab-Dup	RDL	QC Batch	C19-3 SA# 3	RDL	QC Batch
Calculated Parameters							
Resistivity	ohm-cm				10000		5794629
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g				21	20	5799805
Conductivity	umho/cm	397	2	5797627	99	2	5797627
Available (CaCl2) pH	pH				6.22		5796193
Soluble (20:1) Sulphate (SO4)	ug/g				<20	20	5799807

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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