September 9, 2016

PRELIMINARY FOUNDATION INVESTIGATION REPORT

INNISFIL BEACH ROAD OVERPASS, SITE NO. 30-210
HIGHWAY 400 WIDENING
FROM 1 KM SOUTH OF HIGHWAY 89 TO JUNCTION OF HIGHWAY 11
MINISTRY OF TRANSPORTATION, ONTARIO
G.W.P. 06-20016

Submitted to:
AECOM
30 Leek Crescent, 4th Floor
Richmond Hill, Ontario
L4B 4N4

GEOCRES NO: 31D-655

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Distribution:

1 Copy – Ministry of Transportation, Ontario – Foundations Section
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FINAL REPORT

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PART A

PRELIMINARY FOUNDATION INVESTIGATION REPORT
INNISFIL BEACH ROAD OVERPASS – SITE NO. 30-210
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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM (formerly URS Canada Inc.) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services in support of the preliminary design for the replacement of the Innisfil Beach Road Overpass in the Town of Innisfil. The proposed work is part of the preliminary and design-build ready design associated with the Highway 400 widening from 1 km south of Highway 89 to the junction of Highway 11 in Simcoe County, Ontario.

This report addresses the proposed replacement of the Innisfil Beach Road Overpass (MTO Structure Site No. 30-210) and the associated approach embankments only.

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated July 2013. Golder's scope of work for foundation engineering services associated with the Innisfil Beach Road Overpass replacement is contained in Section 5.8 of AECOM's (previously URS Canada) 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 January 20, 2014.

2.0 SITE DESCRIPTION

The Innisfil Beach Road Overpass, which is part of the Highway 400-Innisfil Beach Road (Simcoe Road 21) Interchange, is located approximately 9.6 km north of Highway 89 Interchange, in the Town of Innisfil, in the County of Simcoe. The existing Innisfil Beach Road Overpass is an about 35 m wide by 28.5 m long single-span structure supported on spread footings.

The Innisfil Beach Road-Highway 400 Interchange is located in the Innisfil Heights strategic settlement employment area. The overall surface topography in the vicinity of the site is relatively flat and consists of rural farmland to the west of Highway 400 and an industrial and residential area to the east. The natural ground surface at the site ranges between approximately Elevations 303 m and 306 m. At this structure site, Highway 400 has been constructed on an approximately 5 m high embankment and has an existing grade at about Elevation 308 m. The Innisfil Beach Road surface is near the original ground surface, with the existing grade varying between about Elevations 302.5 m and 303 m.

3.0 INVESTIGATION PROCEDURES

3.1 Previous Borehole Investigation

Two boreholes were advanced at this site as part of a previous Golder geotechnical investigation in 2000 (MTO, 2002) for the widening or replacement of the existing Innisfil Beach Road Overpass structure, associated with the widening of Highway 400. Borehole B4-1 was advanced on the north side of Innisfil Beach Road, east of Highway 400, to a depth of about 6.2 m below ground surface; and Borehole B4-2 was advanced south of Innisfil Beach Road, west side of Highway 400, to a depth of about 10.8 m. The borehole locations are shown on Drawing 1.

Both boreholes were advanced using 108 mm diameter solid stem augers and soil samples were obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outer diameter split-spoon sampler driven by a manual hammer in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586).

The water level in the open boreholes was observed during and following the drilling operations and a piezometer was installed in Borehole B4-2 to allow monitoring of the groundwater level at the site.

The borehole locations in MTM NAD83 northing and easting coordinates, ground surface elevations reference to Geodetic datum and drilled depths are summarized below.

Borehole Number	Location (MTM NAD83)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (m)	Easting (m)		
BH4-1	4,905,036.5	290,509.0	302.7	6.2
BH4-2	4,904,989.7	290,437.7	305.6	10.8

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*[1], this section of Highway 400 from 6 km south of Highway 89 to the junction of Highway 11 traverses, generally in a south–north direction, the following physiographic regions: the Peterborough Drumlin Field; the Simcoe Lowlands; and the Simcoe Uplands. Along Highway 400, the Peterborough Drumlin Field is present from the southern limit of the project site to south of Line 13 of the Township of Bradford West Gwillimbury, as well as between about 1 km north of Highway 89 to about Essa Road. The Simcoe Lowlands covers the area from south of Line 13 to approximately 1 km north of Highway 89 and from about Essa Road to just north of Anne Street. The Simcoe Uplands extends from just north of Anne Street to beyond the northern limit of this project site.

The surficial soils in the western portion of the Peterborough Drumlin Field, which encompasses the Innisfil Beach Road site, consist primarily of sandy till deposits and sand to sand and gravel deposits. Deposits of silt, clay or peat may also be found in the low-lying areas between drumlins and eskers.

Along Highway 400, the Simcoe Lowlands include: the Holland River valley; the lowlands of the Lake Simcoe basin to the east; the lowlands of the Nottawasaga basin to the west, which includes Innisfil Creek and the Nottawasaga River to the south and west of the project limits, respectively. The Lake Simcoe and Nottawasaga basins are connected by a flat floored valley through Barrie which extends from the shores of Kempenfelt Bay west generally along Highway 90. The Simcoe Lowlands are generally characterized by deep deposits of deltaic or lacustrine silts, sands and clays associated with glacial Lake Algonquin.

The Simcoe Uplands consist of till plains and ancient shorelines. The till deposits range from clayey to silty and generally become more sandy and containing more boulders in the north. The low-lying areas of this region may also contain shallow deposits of sand and gravel associated with former glacial lake shorelines.

4.2 Subsurface Conditions

The Record of Borehole sheets and laboratory testing results from the previous investigation are presented in Appendix A. The interpreted stratigraphic profile and cross-sections are shown on Drawings 1 and 2.

[1] 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. Ontario Ministry of Natural Resources.

The results of the in situ field tests (i.e. SPT 'N'-values) carried out during the previous investigation as presented on the Record of Borehole sheets and in Section 4.2 are uncorrected. According to the Canadian Foundation Engineering Manual (*CFEM*, 2006), the energy delivered to the drill rod varies with the hammer release system, hammer type, anvil and operator characteristics.

The stratigraphic boundaries shown on the Record of Borehole sheets and on the interpreted stratigraphic profile and cross-sections are inferred from observations of drilling progress and non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

In general, the subsurface conditions at the site consist of a layer of fill and/or topsoil underlain by a glacial till deposit comprised of clayey silt with sand which extends to the refusal condition.

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

4.2.1 Topsoil

A 0.2 m and 0.5 m thick layer of topsoil was encountered in Boreholes BH4-1 and BH4-2, respectively. The topsoil layer in Borehole B4-2 is fill material, having been spread over an underlying fill deposit.

4.2.2 Clayey Silt with Sand Fill

A 1.7 m thick deposit of fill was encountered at Elevation 305.1 m below the topsoil in Borehole B4-2. The fill consists of an upper 1.0 m thick layer of clayey silt with sand trace organics, underlain by a lower 0.7 m thick layer of silty sand.

The SPT 'N'-values measured within the fill deposit are 11 blows per 0.3 m of penetration and 27 blows per 0.3 m of penetration, suggesting a stiff consistency and indicating a compact relative density for the clayey silt with sand fill and silty sand fill, respectively.

The natural water content measured on a sample of the silty sand fill is about 8 per cent.

4.2.3 Clayey Silt with Sand Till

A 6.0 m and 8.6 m thick till deposit comprised of clayey silt with sand was encountered below the topsoil in Borehole BH4-1 and below the fill in Borehole B4-2 at Elevations 302.5 m and 303.4 m, respectively. A 0.6 m thick pocket of silty sand was encountered within the clayey silt with sand till deposit in Borehole B4-1 at Elevation 300.6 m. Silty sand till was also encountered in a split-spoon sample in Borehole B4-2 at about Elevation 299.5 m. Cobbles were inferred within the till deposit at depths between 5.5 m and 5.8 m in Borehole B4-1 and at a depth of 3.7 m in Borehole B4-2, corresponding to Elevations 296.9 m, 297.2 m and 301.9 m, respectively.

The SPT 'N'-values measured within the cohesive till deposit generally range from 120 blows per 0.3 m of penetration to 151 blows per 0.15 m of penetration, suggesting a hard consistency. An SPT 'N'-value of 48 blows per 0.3 m of penetration was measured at the top of the till deposit below the fill in Borehole B4-2 suggesting a hard consistency. The SPT 'N'-values measured within the silty sand pocket and the zone of silty sand till are 103 blows per 0.15 m of penetration and 43 blows per 0.3 m of penetration, indicating a very dense and dense relative density, respectively.

The natural water content measured on samples of the clayey silt with sand till deposit ranges from about 6 per cent to 9 per cent.

The result of a grain size distribution test completed on a sample of the clayey silt with sand till from Borehole B4-1 is shown on Figure 1 in Appendix A.

Atterberg limits test carried out on three samples of clayey silt with sand till deposit measured liquid limits between about 13 per cent and 14 per cent, plastic limits between about 10 per cent and 11 per cent and plastic indices between about 3 per cent and 4 per cent, indicating that the till deposit is comprised of clayey silt of low plasticity.

4.3 Groundwater Conditions

In general the soil samples retrieved in the two boreholes were moist and both boreholes were dry upon completion of drilling.

A standpipe piezometer was installed in Borehole BH4-2 located on the south-west quadrant of the Highway 400-Innisfil Beach Road Interchange, and the groundwater level in the standpipe piezometer was measured at a depth of 7.7 m below ground surface, Elevation 297.9 m, on March 15, 2001.

The water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring and periods of precipitation.

5.0 CLOSURE

This report was prepared by Ms. Madison Kennedy, B.A.Sc., a member of the geotechnical engineering group, and was reviewed by Mr. Christopher Ng, P.Eng., a senior geotechnical engineer and Associate of Golder. Mr. Jorge M. A. Costa, P.Eng., a Senior Consultant with Golder and Designated MTO Foundations Contact, conducted an independent quality control review of this report.

GOLDER ASSOCIATES LTD.

LICENSED PROFESSIONAL ENGINEER
C.C. NG
100086170
9/9/2016
PROVINCE OF ONTARIO

Madison C. Kennedy, B.A.Sc.
Geotechnical Engineering Group

Christopher Ng, P.Eng.
Senior Geotechnical Engineer, Associate

LICENSED PROFESSIONAL ENGINEER
J. M. A. COSTA
Sept 8/2016
PROVINCE OF ONTARIO

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

MCK/CN/JMAC/mck

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REFERENCES

Canadian Geotechnical Society, 2006. *Canadian Foundation Engineering Manual*, 4th Edition. The Canadian Geotechnical Society, BiTech Publisher Ltd., British Columbia.

Chapman, L. J., and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, 3rd Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

Ministry of Transportation, Ontario. 2002. *Preliminary Foundation Investigation and Design Report Innisfil Beach Road Overpass, Structure Site 30-210; Highway 400 Widening from 1 km South of Highway 89 to Highway 11, G.W.P. 30-95-00*, GEOCRES No. 31D00-468, prepared by Golder Associates Ltd.

ASTM International:

ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

DRAWINGS

MINISTRY OF TRANSPORTATION, ONTARIO

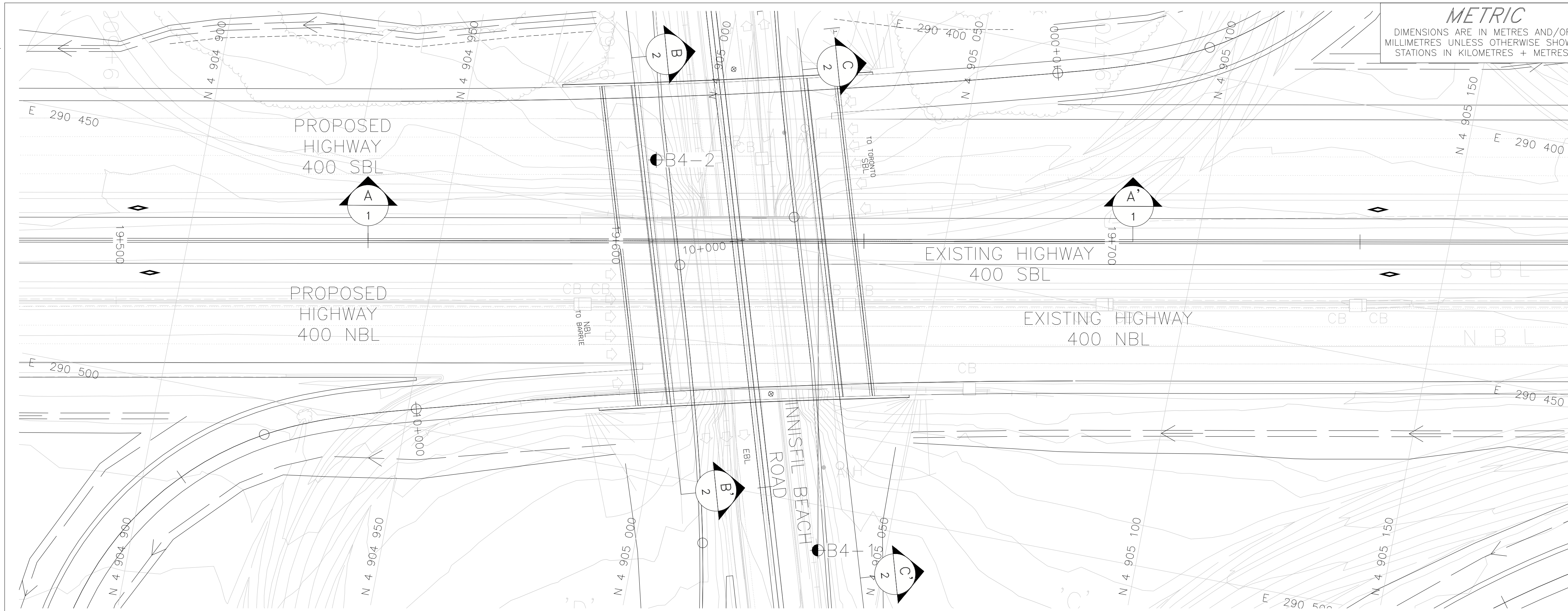
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 06–20016

INNISFIL BEACH ROAD
HIGHWAY 400 WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA

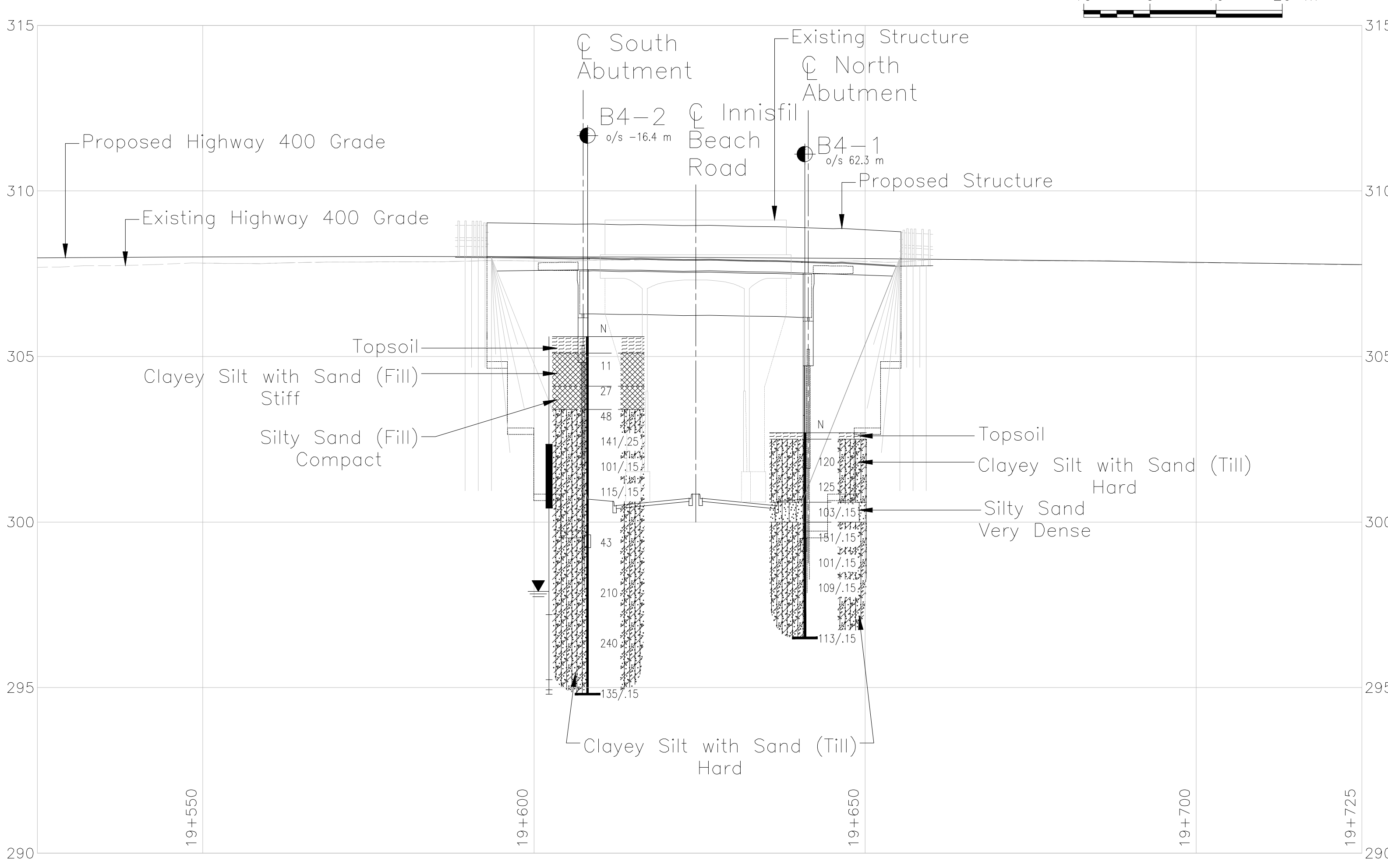
SHEET

Golder Associates



PLAN

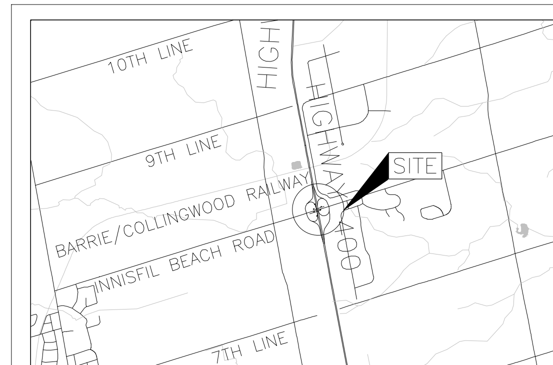
SCALE 10 0 10 20 m



HORIZONTAL SCALE 10 0 10 20 m

A–A / 1 HIGHWAY 400 CENTRELINE PROFILE

VERTICAL SCALE 2 0 2 4 m



KEY PLAN
SCALE 1 0 1 2 km

LEGEND

- Borehole – Previous Investigation (Geocress No. 31D00–468)
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL in piezometer (Mar. 15, 2001)

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
B4–1	302.7	4905036.5	290509.0
B4–2	305.6	4904989.7	290437.7

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

Design plans, base plans, profile and surface data provided in digital format by AECOM, drawing file nos. "Innisfil Beach Road_Overpass_GA.dgn", "2_3–Innisfil Beach Rd_BC Rail.dwg", with associated reference files, received May 11, 2016, "X–Base_All.dwg", received January 27, 2016 and "X–Design_4th Line_Interim.dwg", received June 22, 2015.

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA Sept. 9, 2016 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 Sept. 9, 2016 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 31D–655

HWY. 400		PROJECT NO. 14–1111–0002	DIST.
SUBM'D. MCK	CHKD. MCK	DATE: 5/25/2016	SITE: 30–210
DRAWN: MR	CHKD. CN	APPD. JMAC	DWG. 1

MINISTRY OF TRANSPORTATION, ONTARIO

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

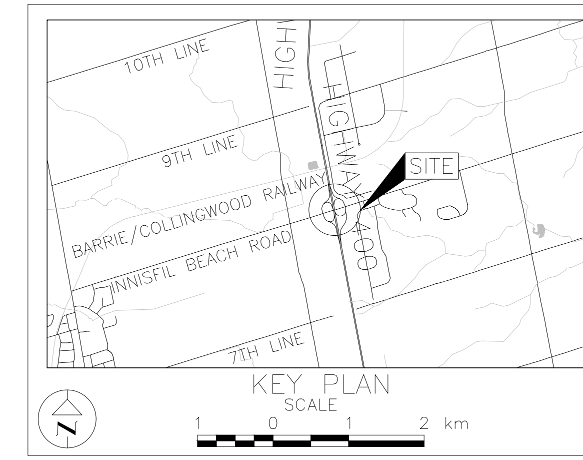
CONT No.
GWP No. 06-20016

INNISFIL BEACH ROAD
HIGHWAY 400 WIDENING

SOIL STRATA

SHEET

Golder Associates



KEY PLAN
SCALE
1 0 1 2 km

LEGEND

- Borehole - Previous Investigation (Geocress No. 31D00-468)
- Seal
- Piezometer
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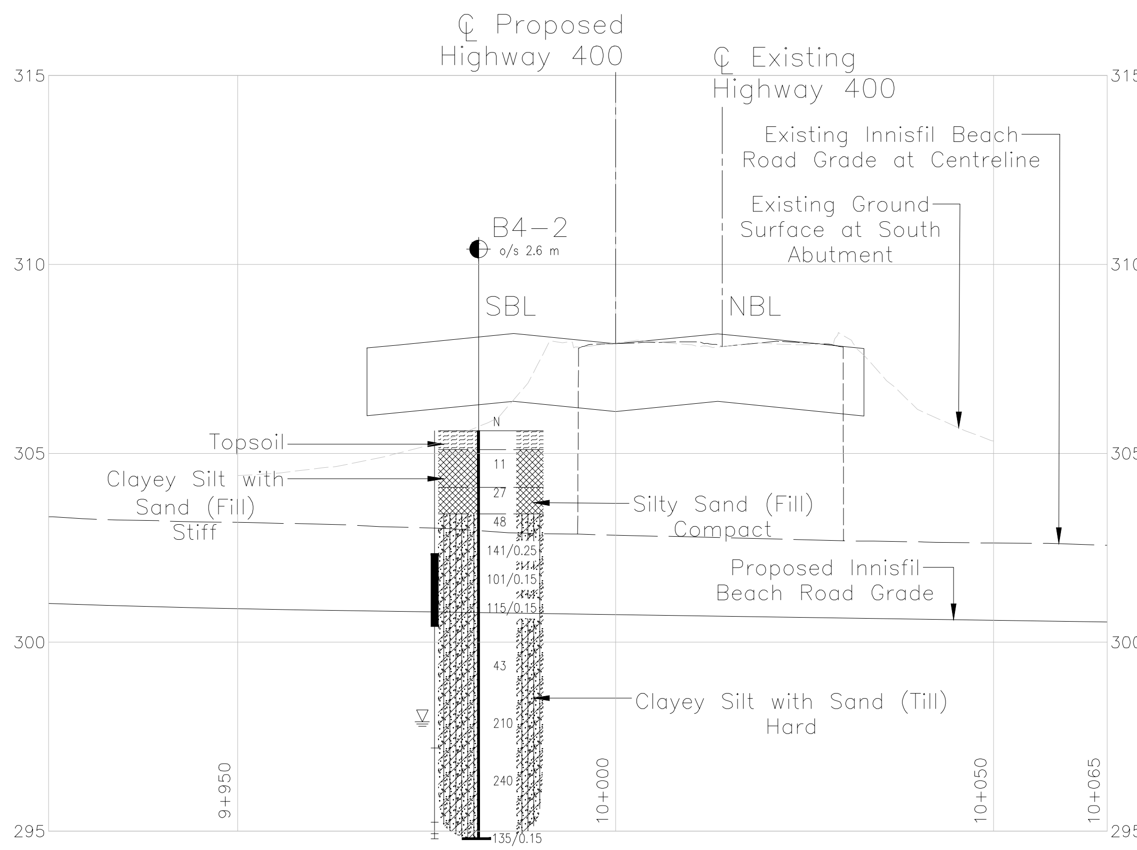
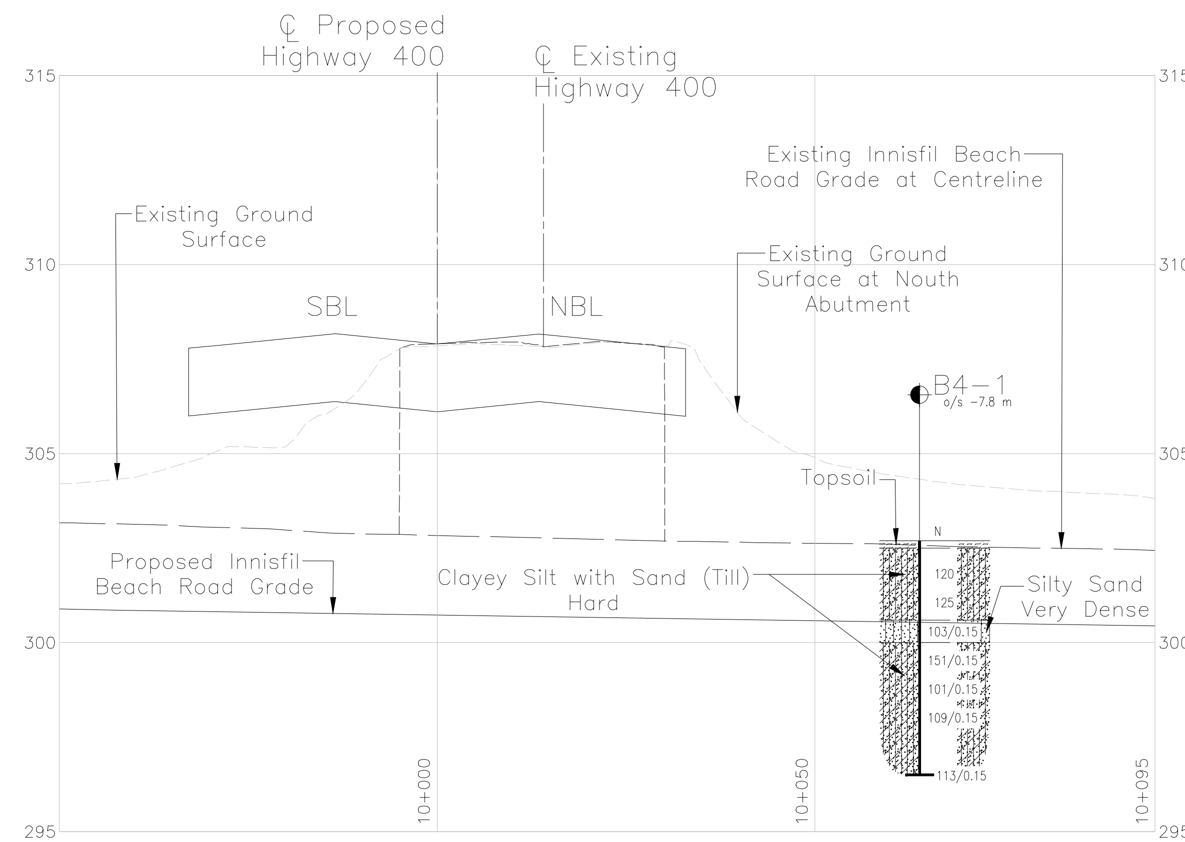
B4-2	305.6	4904989.7	290437.7



B-B 1 SOUTH ABUTMENT AREA CROSS-SECTION



C-C 1 NORTH ABUTMENT AREA CROSS-SECTION

HORIZONTAL SCALE
10 0 10 20 m

VERTICAL SCALE
2 0 2 4 m

NOTES

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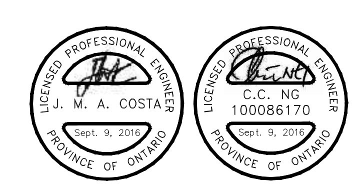

NO.	DATE	BY	REVISION

Geocres No. 31D-655

HWY. 400		PROJECT NO. 14-1111-0002	DIST.
SUBM'D. MCK	CHKD. MCK	DATE: 5/25/2016	SITE: 30-210
DRAWN: MR	CHKD. CN	APPD. JMAC	DWG. 2

PLOT DATE: September 8, 2016
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APPENDIX A

Record of Boreholes and Laboratory Test Results – Golder 2000 Investigation (GEOCRES No. 31D00-468)

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

RECORD OF BOREHOLE No B4-1

METRIC

PROJECT 001-1143F
W.P. 30-95-00
DIST SW HWY 400
DATUM Geodetic
LOCATION N 4905036.5; E 290509.0
BOREHOLE TYPE 108mm DIAMETER SOLID STEM AUGERS
DATE Oct.24/2000
ORIGINATED BY AZ
COMPILED BY LCC
CHECKED BY ASP

ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%)	GR	SA	SI	CL
302.7	GROUND SURFACE									
0.0	Topsoil									
0.2	Clayey Silt with sand, some gravel (Till) Hard Brown Moist				302					
		1	SS	120						
		2	SS	125	301	w plotted, with Wp–WL range	11	37	43	9
300.6 / 2.1	Silty Sand, some gravel, trace clay Very dense Brown Dry	3	SS	103/.15	300					
300.0 / 2.7	Clayey Silt with sand, some gravel (Till) Hard Brown Moist	4	SS	151/.15		w plotted				
		5	SS	101/.15	299					
		6	SS	109/.15	298	w plotted, with Wp–WL range				
	Cobbles at 5.5m and 5.8m depth				297					
296.5 / 6.2	END OF BOREHOLE	7	SS	113/.15						

Notes:
1. Refusal to auger advance was encountered at 1.4m depth. Borehole was relocated 1m west and drilling continued.
2. Borehole dry on completion of drilling operations.

Column headings: SOIL PROFILE; SAMPLES; STRAT PLOT; GROUND WATER CONDITIONS; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, X REMOULDED; 20 40 60 80 100); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ kN/m³; REMARKS & GRAIN SIZE DISTRIBUTION (%)

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

Ministry of Transportation Ontario

Foundation Design

RECORD OF BOREHOLE No B4-2

METRIC

PROJECT 001-1143F
W.P. 30-95-00
DIST SW HWY 400
DATUM Geodetic
LOCATION N 4904989.7; E 290437.7
BOREHOLE TYPE 108mm DIAMETER SOLID STEM AUGERS
DATE Oct.24/2000
ORIGINATED BY AZ
COMPILED BY LCC
CHECKED BY ASP

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
305.6	GROUND SURFACE				
0.0	Topsoil				
305.1 / 0.5	Clayey Silt with sand, some organics (Fill) Stiff Dark brown Moist	1	SS	11	305
304.1 / 1.5	Silty Sand, trace gravel, clay and organics (Fill) Compact Dark brown Moist	2	SS	27	304
303.4 / 2.2	Clayey Silt with sand, trace gravel (Till) Hard Brown becming grey at 7.3m depth Moist	3	SS	48	303
		4	SS	141/.25	
	Cobbles at 3.7m depth	5	SS	101/.15	302
		6	SS	115/.15	301
					300
	Silty sand, trace clay and gravel (Till) encountered in Sample 7.	7	SS	43	299
		8	SS	210	298
					297
		9	SS	240	296
294.8		10	SS	135/.15	295
10.8	END OF BOREHOLE				

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED — 20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

GROUND WATER CONDITIONS

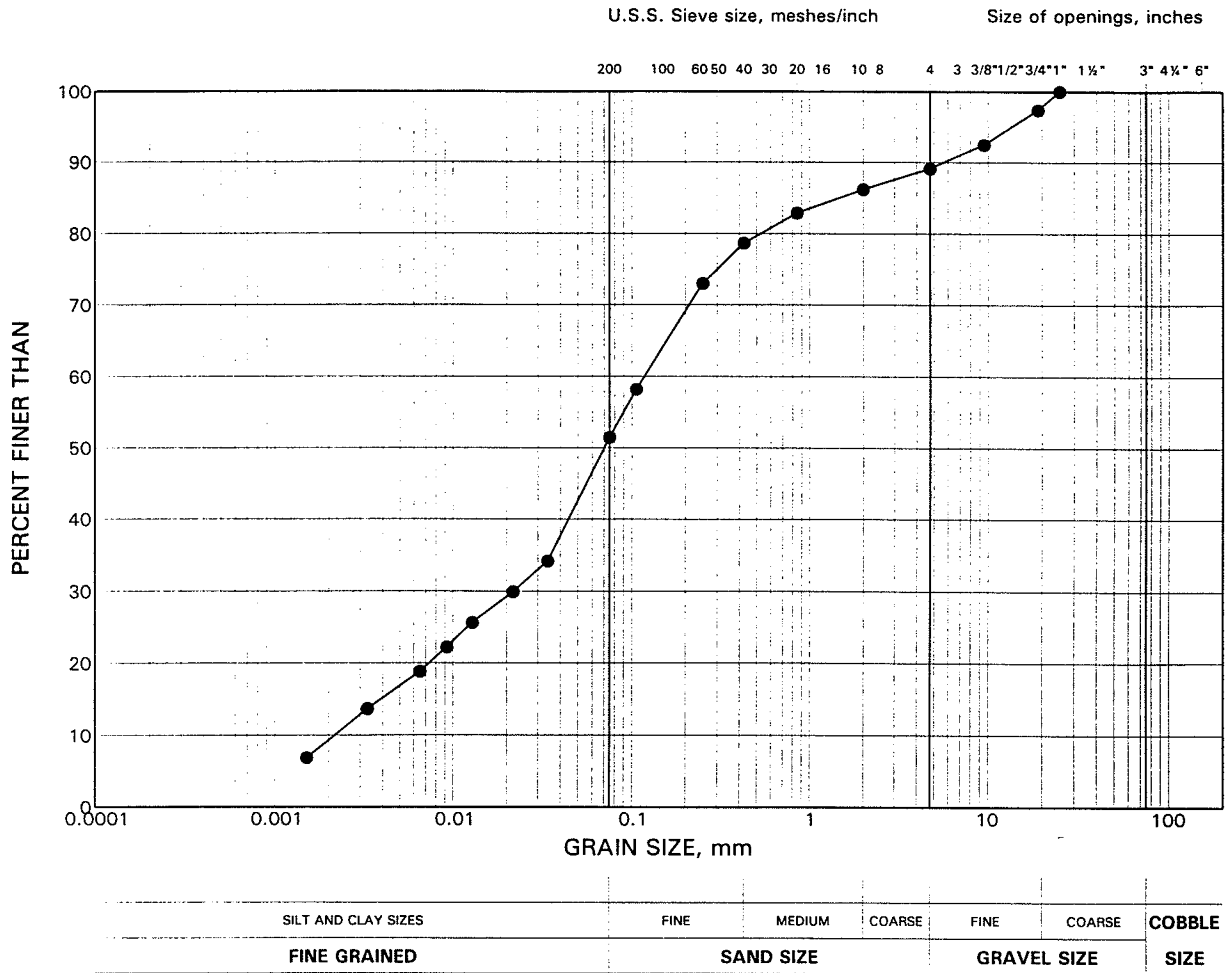
Notes:
1. Borehole dry on completion of drilling operations.
2. Water level in piezometer measured at 7.7m depth (Elev.297.9m) on March 15, 2001.

ON_MOT 0011143F.GPJ ON_MOT.GDT 14/1/02

+³, ×³: Numbers refer to Sensitivity   O³% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION TEST RESULT
Clayey Silt Till

FIGURE 1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	B4-1	2	300.9

Project 001-1143F

Golder Associates

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
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Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario, L5N 7K2
Canada
T: +1 (905) 567 4444

Golder Associates