



Foundation Investigation Report

*Sanitary Sewer Installation at Station 17+460, QEW Widening from West of Mississauga Road to West of Hurontario Street, Mississauga
Ministry of Transportation, Ontario, GWP 2002-13-00*

Submitted to:

Morrison Hershfield Limited

125 Commerce Valley Drive West, Suite 300
Markham, ON
L3T 7W2

Submitted by:

Golder Associates Ltd.

6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada
+1 905 567 4444

1662333 - 16

July 30, 2019

GEOCRES No.: 30M12-451

(Latitude: 43.561664, Longitude: -79.606192)



Distribution List

1 PDF & 3 Copies - Ministry of Transportation, Ontario (Central Region)

1 PDF & 1 Copy - Ministry of Transportation, Ontario (Foundation Section)

1 PDF - Morrison Hershfield Limited

1 PDF - Golder Associates Ltd.

Table of Contents

1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	1
3.0 INVESTIGATION PROCEDURES.....	1
4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS.....	3
4.1 Regional Geology.....	3
4.2 Subsurface Conditions	3
4.2.1 Asphalt / Concrete Pavement	4
4.2.2 Fill.....	4
4.2.3 Sandy Silt to Silt and Sand	4
4.2.4 Silty Gravelly Sand to Clayey Silt (Till)	4
4.2.5 Groundwater Conditions	6
4.2.6 Analytical Testing Results.....	6
5.0 CLOSURE.....	7

DRAWINGS

Drawing 1 Borehole Locations Plan and Soil Strata

APPENDICES

APPENDIX A Record of Borehole Sheets and Limestone Cobbles and / or Boulders Core Photograph (Borehole C5-3)

Lists of Symbols and Abbreviations

Records of Boreholes C5-1, C5-2, C5-3 and NRW3-5

Figure A-1 Limestone Cobbles and / or Boulders Core Photograph - Borehole C5-3

APPENDIX B Geotechnical Laboratory Test Results

Figure B-1 Grain Size Distribution – Sandy Silt to Silt and Sand

Figure B-2A Grain Size Distribution – Gravelly Silt and Sand to Silty Gravelly Sand (Till)

Figure B-2B Grain Size Distribution – Clayey Silt with Sand to Clayey Silt (Till)

Figure B-3 Grain Size Distribution – Silty Sand to Sand

Figure B-4 Plasticity Chart – Silt and Sand with slight plasticity / Clayey Silt with Sand / Sandy Clayey Silt / Clayey Silt (Till)

APPENDIX C Analytical Laboratory Test Results

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the sanitary sewer installation at Station 17+460, associated with the widening of the Queen Elizabeth Way (QEW) from west of Mississauga Road to west of Hurontario Street in the City of Mississauga, Ontario, as shown on the Key Plan on Drawing 1.

The purpose of the foundation investigation is to explore the subsurface soil, bedrock (where present) and groundwater conditions along the alignment of the proposed sanitary sewer installation by borehole drilling / rock coring and geotechnical laboratory testing and analytical chemistry laboratory testing on selected soil and rock samples.

The Terms of Reference (TOR) and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated July 2016, and the approved Change Request letters, which forms part of the Consultant's Assignment Number (2015-E-0033) 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 February 3, 2017.

2.0 SITE DESCRIPTION

The proposed sanitary sewer installation at Station 17+460 is located approximately 600 m east of the Credit River and extends from Premium Way to the south side of the QEW, in the City of Mississauga, Ontario (see Drawing 1). The QEW and Premium Way are oriented in a southwest-northeast direction which at this location and for the purpose of this report, is referred to as west-east orientation.

The QEW consists of three eastbound lanes (to Toronto) and three westbound lanes (to Hamilton), while Premium Way consists of one lane in each direction. Residential areas are located on the north side of Premium Way and between the south side of the QEW and Pinetree Way. The existing ground surface along the sanitary sewer alignment varies from about Elevation 93.5 m at the north end of the sanitary sewer alignment, to about Elevation 95.0 m on the pavement surface of the QEW (eastbound lanes), to about Elevation 90.0 m at the south end of the alignment.

3.0 INVESTIGATION PROCEDURES

Field work was carried out between February 19, 2019 and March 8, 2019, during which time a total of three sampled boreholes, designated as Boreholes C5-1, C5-2 and C5-3 were advanced along or adjacent to the proposed sanitary sewer alignment approximately at the locations shown on Drawing 1. This information was supplemented with Borehole NRW3-5 advanced on June 25, 2018 for the proposed Noise Barrier Wall.

Field drilling for Boreholes C5-1, C5-2 and NRW3-5 was carried out using a truck-mounted CME 55 drilling rig supplied and operated by Aardvark Drilling Inc. of Guelph, Ontario, a truck-mounted CME 75 drilling rig supplied and operated by Davis Drilling Ltd. of Milton Ontario, and a truck-mounted CME 75 drilling rig supplied and operated by Geo-Environmental Drilling Inc. of Halton Hills, Ontario. Borehole C5-3 was advanced using a Portable Tripod drilling rig with a manual hammer drive system supplied and operated by OGS Inc. from Almonte, Ontario. Boreholes C5-1, C5-2 and NRW3-5 were advanced through the overburden using 50 mm, 70 mm, and 83 mm inner diameter (I.D.) hollow-stem augers and soil samples were obtained at 0.60 m, 0.75 m and 1.5 m

intervals of depth, using a 50 mm O.D. split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586-11)¹. Borehole C5-3 was advanced using portable drilling and a combination of wash boring techniques using 75 mm O.D. casings and coring with an approximately 55 mm O.D. core barrel to advance through the overburden soils. Samples of cobbles / boulders were obtained using the core barrel where encountered in the borehole. Soil samples were obtained in Borehole C5-3 using a 50 mm O.D. split-spoon sampler driven by a manual hammer, one third of the weight of the standard hammer used in the ASTM SPT test procedure. The boreholes were advanced to depths between 6.3 m and 11.5 m below existing ground surface in the overburden soils.

Groundwater conditions and water levels in the open boreholes were observed during and immediately following the drilling operations. A standpipe piezometer was installed in Boreholes C5-1 and C5-3 to permit monitoring of the water level at these borehole locations. The installed piezometers consist of a 32 mm or 50 mm diameter PVC pipe, with a slotted screen. The annulus surrounding the piezometer screens was backfilled with a filter sand pack. The section of borehole below the standpipe piezometers was backfilled with bentonite to the underside of the sand pack level, and the remainder of the borehole above the sand pack was backfilled with bentonite to near the ground surface and topped with cold patch asphalt or sand and gravel to match the adjacent ground surface material. All Boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903, Wells (as amended).

Field work was observed by members of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in-situ testing operations, logged the boreholes, and examined and cared for the soil samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the geotechnical laboratory tests were carried out to MTO and / or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected soil samples.

Selected soil samples were submitted to Maxxam Analytics (Maxxam) of Mississauga, Ontario, which is a Standards Council of Canada (SCC) accredited laboratory, for chemical analysis of a suite of characteristics that indicate corrosivity potential including pH, resistivity, conductivity, chloride content and sulphate content.

The as-drilled borehole locations and the ground surface elevations were obtained using a GPS Trimble Geo 7X, having an accuracy of approximately 0.1 m in the vertical and 0.1 m in the horizontal directions. The locations given on the Record of Borehole sheets and shown on Drawing 1 are positioned relative to MTM NAD 83 (Zone 10) CSRS CBNV6-2010.0 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, geographic coordinates, ground surface elevations and drilled depths are summarized below.

¹ ASTM D1586-11 – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the soil.

Borehole No.	Location (MTM NAD 83 Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (Latitude)	Easting (Longitude)		
C5-1	4,824,657.1 (43.561802)	296,188.7 (-79.606597)	93.7	9.8
C5-2	4,824,641.8 (43.561664)	296,221.4 (-79.606192)	95.0	11.1
C5-3	4,824,619.4 (43.561463)	296,238.7 (-79.605978)	89.8	6.3
NRW3-5	4,824,661.4 (43.561832)	296,190.9 (-79.606567)	93.7	11.5

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The project area is located within the Iroquois Plain physiographic region, as delineated in *The Physiography of Southern Ontario* (Chapman and Putman, 1984)². The glacial Iroquois Plain stretches along the northern shoreline of Lake Ontario, extending from the Niagara Escarpment in the west to the Scarborough Bluffs in the east. The Iroquois Plain soils consist of glaciolacustrine sediments deposited in Lake Iroquois, primarily sands, silts and gravels, with a shallow cover of till remaining over the bedrock. Bedrock of the Georgian Bay Formation that underlies the study area consists mainly of blue-grey shale, containing siltstone, sandstone and limestone interbeds. Outcrops of this formation are commonly found along water courses on the west side of Toronto and in Mississauga, notably in the Humber River, Mimico Creek, Etobicoke Creek and Credit River valleys.

4.2 Subsurface Conditions

Subsurface soil and groundwater conditions as encountered in the boreholes, the details of the piezometer installations and water level readings, and the results of the geotechnical laboratory tests carried out on selected soil samples are presented on the Records of Borehole sheets provided in Appendix A. Photographs of the cobbles and/or boulders recovered as core samples from Borehole C5-3 are presented on Figure A-1, in Appendix A. The results of the in-situ field tests (i.e., SPT "N"-values) as presented on the Record of Borehole sheets and in sub-sections of Section 4.2 are uncorrected. Lists of abbreviations and symbols and lithological and geotechnical rock description terminology are also included in Appendix A to assist in the interpretation of the borehole records. The results of the geotechnical laboratory testing on the soil samples are presented in Appendix B. The analytical laboratory test report is included in Appendix C and the test results are summarized in Section 4.2.6.

The stratigraphic boundaries shown on the Record of Borehole sheets and on the stratigraphic profile on Drawing 1 are inferred from non-continuous sampling, observations of drilling progress and the results of the Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes

² Chapman, L.J. and Putman, D.F., 1984, *The Physiography of Southern Ontario*, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.)

of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations; however, the factual data presented in the borehole records governs any interpretation of the site conditions. It should be noted that the interpreted stratigraphy shown on Drawing 1 is a simplification of the subsurface conditions.

In general, the stratigraphy encountered at the various borehole locations typically consists of surficial layers of asphalt / concrete pavement underlain by fill, underlain by a sandy silt to silt and sand deposit, underlain by a till deposit interlayered with sandy silt to sand deposits. Detailed descriptions of the subsurface conditions are provided in the following sections of this report. Where relatively significant thicknesses of overburden were encountered, the various soil types are described in detail for each main deposit.

4.2.1 Asphalt / Concrete Pavement

An approximately 150 mm, 100 mm and 150 mm thick layer of asphalt pavement was encountered at ground surface in Boreholes C5-1, C5-2 and NRW3-5, respectively. A 510 mm thick layer of concrete was encountered underlying the asphalt pavement in Borehole C5-2.

4.2.2 Fill

An approximately 1.0 m to 4.3 m thick layer of fill comprised of silty sand to silt and sand to sand, trace to some gravel was encountered underlying the asphalt / concrete pavement in Boreholes C5-1, C5-2 and NRW3-5 at depths of between 0.2 m to 0.6 m below ground surface (between Elevations 94.4 m and 93.5 m) and extends to depths of between 1.2 m and 4.9 m below ground surface (between Elevations 92.5 m and 90.1 m).

The Standard Penetration Test (SPT) “N”-values within the fill layers range from 3 blows to 13 blows per 0.3 m of penetration, suggesting a very loose to compact compactness condition.

The water content measured on four samples of the fill ranges from about 3 per cent to about 25 per cent.

4.2.3 Sandy Silt to Silt and Sand

A 0.4 m to 3.4 m thick granular deposit comprised of sandy silt to silt and sand was encountered at ground surface in Borehole C5-3 and underlying the fill in Boreholes C5-1, C5-2 and NRW3-5 at depths of between about 0.0 m and 4.9 m below ground surface (between Elevations 92.5 m and 89.8 m) and extends to depths of between about 0.8 m and 5.3 m below ground surface (between Elevations 90.7 m and 89.0 m).

The SPT “N”-values within the sandy silt to sand deposit range from 2 blows to 36 blows per 0.3 m of penetration, suggesting a very loose to dense compactness condition.

Grain size distribution testing was carried out on five samples of the sandy silt to silt and sand deposit and the results are shown on Figure B-1 in Appendix B. Atterberg limits testing was carried out on one sample of the silt and sand deposit and the results indicated that the sample was non-plastic.

The water content measured on seven samples of the sandy silt to sand deposit ranges between 28 per cent and 27 per cent.

4.2.4 Silty Gravelly Sand to Clayey Silt (Till)

Underlying the granular deposit in Boreholes C5-1 to C5-3 and NRW3-5, a 5.3 m to greater than 8.5 m thick till deposit consisting of clayey silt with sand to sandy clayey silt to clayey silt, and coarser material consisting of gravelly silt and sand to silty gravelly sand was encountered at depths of between about 0.8 m and 4.6 m below ground surface (between Elevations 90.7 m and 89.0 m). Boreholes C5-1, C5-2 and NRW3-5 terminated in this till

deposit at depths of about 9.8 m, 11.1 m and 11.5 m below ground surface (Elevations 83.9 m, 83.9 m and 82.2 m), respectively. In Borehole C5-3 the till deposit extended to a depth of about 6.1 m below ground surface (Elevation 83.7 m) where it was underlain by a sand deposit of unknown thickness; Borehole C5-3 was terminated in this sand deposit.

Although the till deposit is predominately cohesive and ranges in composition from clayey silt with sand to clayey silt, there are portions that consist of gravelly silt and sand to silty gravelly sand. These granular portions of the till deposit were encountered in Borehole NRW3-5 at a depth of 8.7 m below ground surface (Elevation 85.0 m) and in Borehole C5-1 where an approximately 2.3 m thick layer of gravelly silt and sand was encountered at a depth of 4.9 m below ground surface (Elevation 88.8 m). In Borehole C5-3, which was advanced with a Portable Tripod rig and a manual hammer drive system, limestone cobbles and boulders were encountered at the following depths and elevations:

Depth Below Ground Surface (m)	Elevation (m)	Cobble and/or Boulder Thickness (mm)
2.2	87.6	300
3.7	86.1	280
4.0	85.8	230
4.9	84.9	150

Due to the presence of cobbles, the sample recovery within the till on Borehole C5-3 was limited; however, based on geotechnical laboratory testing, zone(s) of silt and sand till with slight plasticity are present within the clayey silt till. In addition, in Borehole C5-1, a 1.5 m thick interlayer of silty sand was encountered within the till at a depth of 7.2 m below ground surface (Elevation 86.5 m).

The SPT “N”-values the cohesive till deposit in Borehole C5-2 from a depth of about 5.3 m to 8.2 m (Elevations 89.7 m to 86.8 m) range from 2 blows to 9 blows per 0.3 m of penetration, suggesting a soft to stiff consistency. The SPT “N”-values within the till deposit in Boreholes C5-1, C5-2, NRW3-5 and below Elevation 86.8 m in Borehole C5-2 range from 12 blows per 0.3 m of penetration to 100 blows for 0.25 m of penetration, suggesting a stiff to hard consistency.

Grain size distribution testing was carried out on nine selected samples of the till deposit and the results are shown on Figures B-2A and B-2B in Appendix B. Grain size distribution testing was carried out on two samples of the silty sand to sand interlayers and the results are shown on Figure B-3 in Appendix B. Atterberg limits testing was carried out on the finer fraction of eight samples of the till deposit and measured liquid limits between about 14 per cent and 27 per cent, plastic limits between about 12 per cent and 21 per cent, and plasticity indices ranging between about 2 per cent and 12 per cent. These results, which are plotted on a plasticity chart on Figure B-4 in Appendix B, indicate that the finer fraction of the till deposit is comprised of clayey silt of low plasticity and silt and sand of slight plasticity.

The water content measured on sixteen samples of the till deposit range between about 7 per cent and 22 per cent.

4.2.5 Groundwater Conditions

Details of the water levels observed in the open boreholes at the time of drilling are presented on the Records of Boreholes in Appendix A. A standpipe piezometer was installed in Boreholes C5-1 and C5-3 to monitor the groundwater level at the borehole locations. The water levels measured in the open boreholes and the piezometers are summarized below. It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events and should be expected to be higher during wet periods of the year.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date	Comments
C5-1	93.7	7.9	85.8	February 19, 2019	Upon completion of drilling
		3.5	90.2	February 19, 2019	Within piezometer – sealed into sandy clayey silt till / Gravelly Silt and Sand / Silty Sand
		2.2	91.5	March 19, 2019	
C5-2	95.0	Dry	-	March 3, 2019	Dry upon completion of drilling
C5-3	89.8	At ground surface	89.8	March 8, 2019	Borehole advanced with wash boring, therefore water level not reflective of in-situ conditions.
		2.7	87.1	March 13, 2019	Within piezometer – sealed into Clayey Silt Till / Silt and Sand Till
NRW3-5	93.7	1.5	92.2	June 25, 2018	Upon completion of drilling

4.2.6 Analytical Testing Results

As noted in Section 3.0, three soil samples collected were submitted to Maxxam Analytics (Maxxam), a Standards Council of Canada (SCC) accredited laboratory, of Mississauga, Ontario, for analysis of parameters used to assess the potential corrosivity of the site soil to steel and concrete. Detailed analytical test results are included in Appendix D and the following table summarizes the results of the testing:

Borehole No.	Borehole NRW3-5 Sample 4 Elev. 91.1 m	Borehole C5-1 Sample 6 and 9 Elev. 90.3 and 88.2 m	Borehole C5-2 Samples 8 and 9 Elev. 88.2 m
pH	8.04	7.78	7.85
Resistivity (ohm-cm)	3,000	3,100	1,700
Electrical Conductivity (umho/cm)	337	323	578
Chlorides (ug/g)	<20*	<20*	240
Soluble Sulphates (ug/g)	240	220	130

Notes:

* Lower than Reportable Detection Limit

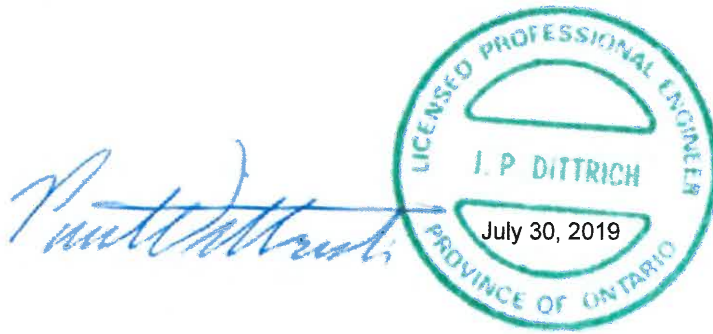
5.0 CLOSURE

This report was prepared by Ms. Alex MacMillan, E.I.T., a geotechnical Engineer-In-Training with Golder and reviewed by Ms. Sandra McGaghran, M.Eng., P.Eng. an Associate and Senior Geotechnical Engineer with Golder. Mr. Paul Dittrich, Ph.D., P.Eng., an MTO Foundations Designated Contact and Principal with Golder, conducted a technical and quality control review of the report.

Golder Associates Ltd.



Sandra McGaghran, M.Eng., P.Eng.
Associate, Senior Geotechnical Engineer

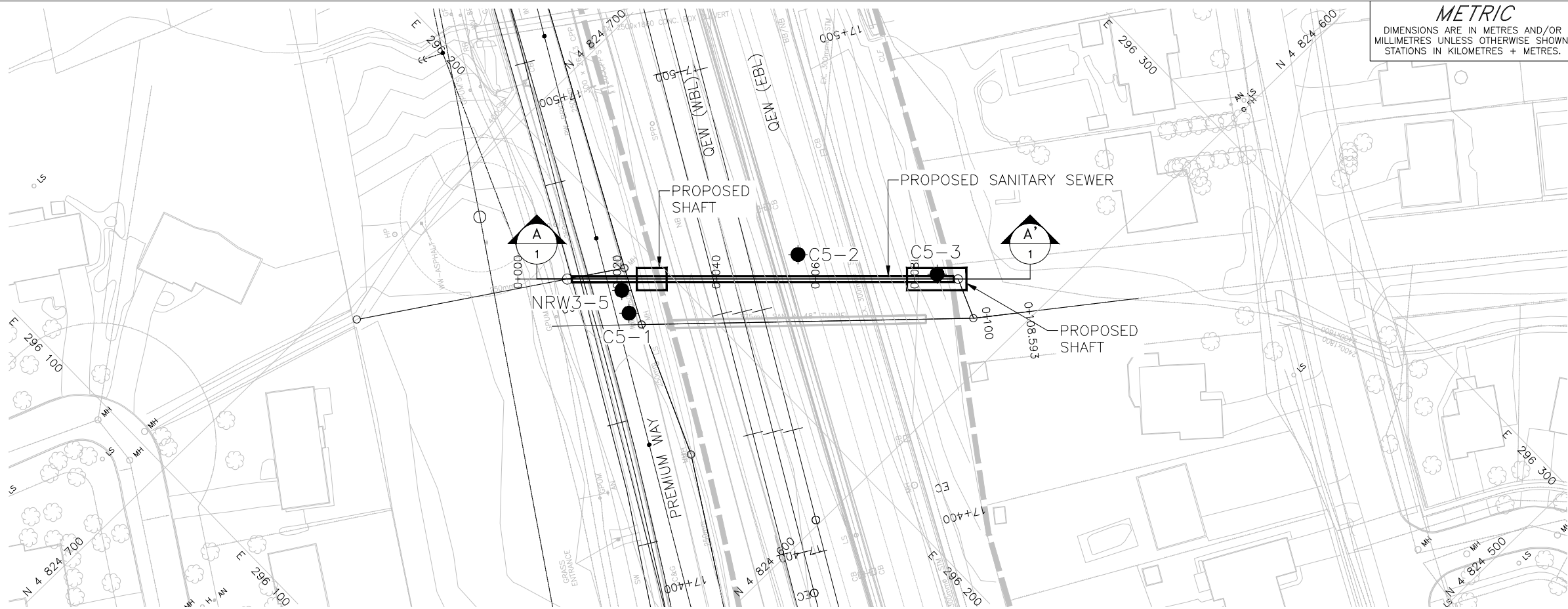


Paul Dittrich, Ph.D., P.Eng.
MTO Foundations Designated Contact, Principal

ACM/DM/SMM/JPD/SJB/rb

Golder and the G logo are trademarks of Golder Associates Corporation

[https://golderassociates.sharepoint.com/sites/11176g/shared documents/07-reporting/foundations/12 - peel crossing fidr/crossing 5/3 - final/1662333 fir peel crossing 5 - 2019july30.docx](https://golderassociates.sharepoint.com/sites/11176g/shared%20documents/07-reporting/foundations/12%20-%20peel%20crossing%20fidr/crossing%205/3%20-%20final/1662333%20fir%20peel%20crossing%205%20-%202019july30.docx)

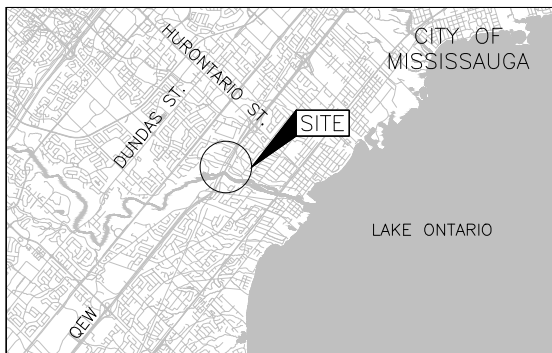


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. GWP No. 2002-13-00



QEW WIDENING - MISSISSAUGA RD TO HURONTARIO ST
SANITARY SEWER INSTALLATION STATION 17+460
BOREHOLE LOCATIONS PLAN AND
SOIL STRATA



KEY PLAN
SCALE

2 0 2 4 km

LEGEND

- Borehole - Current Investigation
- ⊢ Seal
- ⊢ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- R Split-Spoon Refusal
- ≡ WL in piezometer, March 19, 2019
- ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
C5-1	93.7	4824657.1	296188.7
C5-2	95.0	4824641.8	296221.4
C5-3	89.8	4824619.4	296238.7
NRW3-5	93.7	4824661.4	296190.9

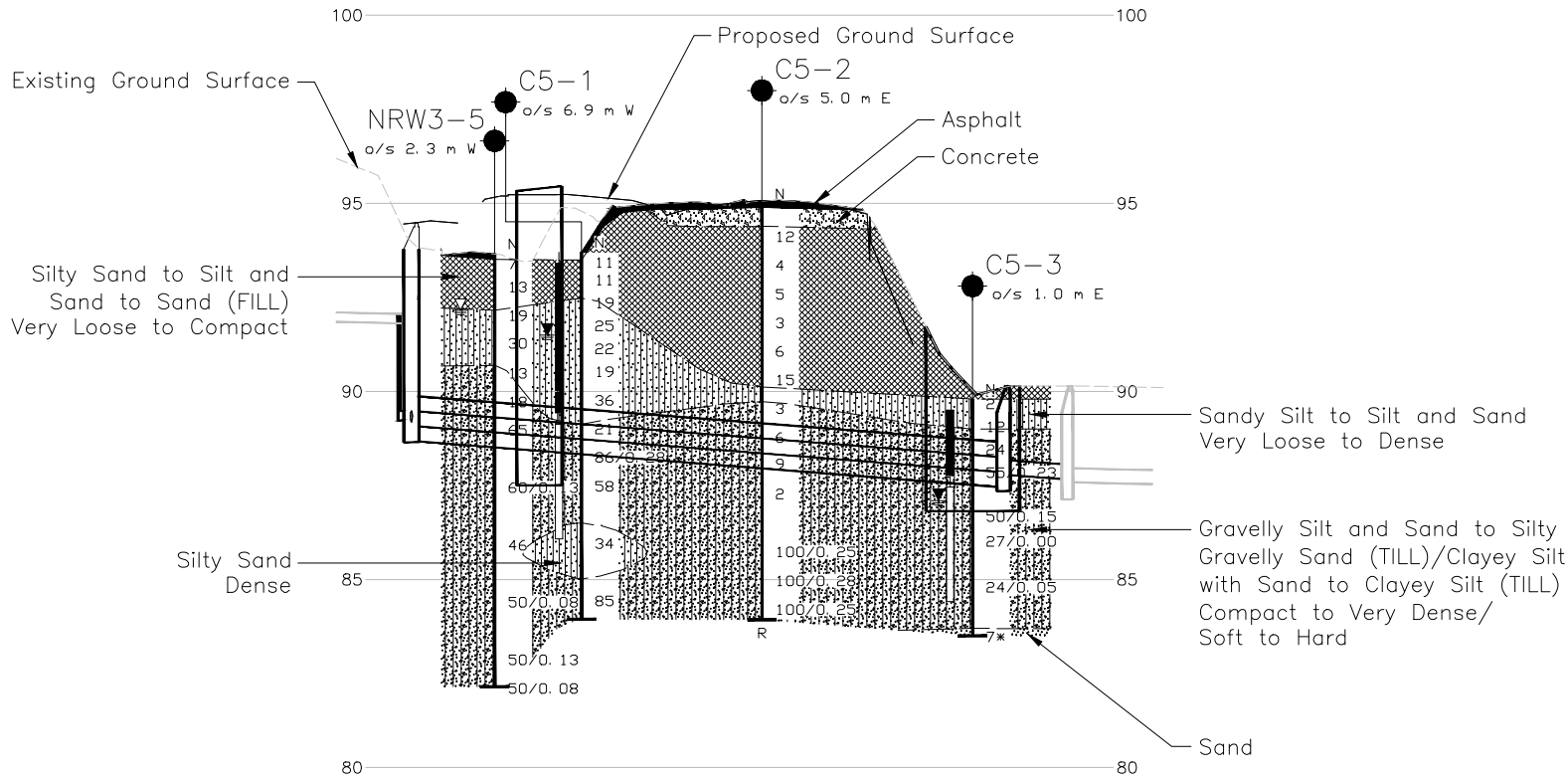
NOTES

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 MH, drawing file nos. X11609340Base.dwg, X-Final Merged Util.dwg, X-PROP-UTIL.dwg, Existing Property.dwg, 11609340 - QEW Prop Util-Dickson & Lynchmere - C3D 2017.dwg, 11609340 - QEW Prop Util-IndianGroveAve - C3D 2017.dwg, 11609340 - QEW Prop Util-Stavebank Rd - C3D 2017.dwg, 11609340 - QEW Prop Util-Knareswood Dr - C3D 2017.dwg, and x1160934_Align.dwg, received March 25, 2019.



PROFILE A-A'

VERTICAL SCALE
10 0 10 20 m

HORIZONTAL SCALE
10 0 10 20 m



NO.	DATE	BY	REVISION
1	7/30/2019	JPD	Initial Design
2	7/30/2019	JPD	Revised Design
3	7/30/2019	JPD	Final Design

Geocres No. 30M12-451

HWY. QEW	PROJECT NO. 1662333	DIST. CENTRAL
SUBM'D. AB/EJ	CHKD. DM	DATE: 7/30/2019
DRAWN: DD	CHKD. SMM	APPD. JPD
		DWG. 1

APPENDIX A

**Record of Borehole Sheets and Limestone Cobbles and
/ or Boulders Core Photograph (Borehole C5-3)**

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

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

Notes: 1
2

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

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d :

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

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

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

(b) Cohesive Soils Consistency

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

IV. SOIL TESTS

w	water content
w_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

PROJECT 1662333		RECORD OF BOREHOLE No C5-1		SHEET 1 OF 1		METRIC															
G.W.P. 2002-13-00		LOCATION N 4824657.1; E 296188.7 MTM NAD ZONE 10 (LAT. 43.561802; LONG. -79.606597)		ORIGINATED BY EJ																	
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 83 mm I.D. Hollow Stem Augers		COMPILED BY KN																	
DATUM Geodetic		DATE February 19, 2019		CHECKED BY SEMP/SMM																	
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
93.7	GROUND SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L 10 20 30			kN/m ³					
0.0	ASPHALT (150mm)																				
0.2	Silty sand, trace to some gravel (FILL) Compact Brown Moist		1	SS	11		93														
92.5			2	SS	11																
1.2	Sandy SILT, trace to some clay, trace gravel Compact to dense Brown to grey Moist to wet - Grey below a depth of 2.4 m		3	SS	19		92														
			4	SS	25		91														
			5	SS	22		90														
			6	SS	19		89												1 26 66 7		
			7	SS	36		88												0 21 73 6		
89.1			8A	SS	21		89														
88.8	Sandy CLAYEY SILT, trace to some gravel (TILL) Very stiff Grey Moist		8B																27 43 23 7		
4.9	Gravelly SILT and SAND to Silty Gravelly SAND, trace to some clay (TILL) Compact to very dense Grey Dry to moist - 0.3 m of sand and gravel at 6.1 m depth		9	SS	86/0.28		88									Non-plastic			26 32 34 8		
			10A	SS	58		87														
			10B				86														
86.5																					
7.2	Silty SAND, trace to some clay Dense Grey Wet		11	SS	34		86												0 65 25 10		
85.0							85														
8.7	CLAYEY SILT and GRAVEL, trace to some sand (TILL) Hard Grey Wet		12	SS	85		84														
83.9																					
9.8	END OF BOREHOLE																				
NOTES:																					
1. Water level measured at 7.9 m depth below ground surface (Elev.85.8 m) upon completion of drilling, prior to well installation.																					
2. Water level measured at 3.5 m depth below ground surface (Elev.90.2 m) after piezometer installation.																					
3. Water level measured at 2.2 m depth below ground surface (Elev. 91.5 m) in piezometer on March 19, 2019.																					

PROJECT 1662333		RECORD OF BOREHOLE No C5-2		SHEET 1 OF 1		METRIC															
G.W.P. 2002-13-00		LOCATION N 4824641.8; E 296221.4 MTM NAD ZONE 10 (LAT. 43.561664; LONG. -79.606192)		ORIGINATED BY AM																	
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 70 mm I.D. Hollow Stem Augers		COMPILED BY MPL																	
DATUM Geodetic		DATE March 3, 2019		CHECKED BY SEMP/SMM																	
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
95.0	GROUND SURFACE							20 40 60 80 100					10 20 30			kN/m ³					
8.0	ASPHALT (100 mm)							20 40 60 80 100					10 20 30								
0.1	CONCRETE (510 mm)							20 40 60 80 100					10 20 30								
94.4	Silty sand (FILL) Very loose to compact Brown with oxidation staining Moist		1	SS	12		94														
0.6			2	SS	4		93														
			3	SS	5		92														
			4	SS	3		91														
	- Becoming wet at a depth of 4.3 m		5	SS	6		90														
90.1			6A	SS	15		89														
89.7	SILT and SAND, trace clay Compact Grey Wet		6B	SS	3		88														
5.3	Sandy CLAYEY SILT, trace to some gravel (TILL) Soft to stiff Grey Moist		7	SS	6		87														
			8	SS	9		86														
			9	SS	2		85														
86.8			10	SS	100/0.25		84														
8.2	CLAYEY SILT with SAND, some gravel, containing shale fragments (TILL) Hard Grey Moist		11	SS	100/0.25																
			12	SS	100/0.25																
			13	SS	100/0.25																
83.9	END OF BOREHOLE																				
11.1	NOTE: 1. Open borehole dry upon completion of drilling.																				

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-CREDIT_RIVER\02_DATA\GINTQ\QEW-CREDIT_RIVER.GPJ GAL-GTA.GDT 07/29/19

PROJECT 1662333		RECORD OF BOREHOLE No C5-3		SHEET 1 OF 1		METRIC							
G.W.P. 2002-13-00		LOCATION N 4824619.4; E 296238.7 MTM NAD ZONE 10 (LAT. 43.561463; LONG. -79.605978)		ORIGINATED BY KN									
DIST Central HWY QEW		BOREHOLE TYPE Portable Rig - 76 mm O.D. Casing and Wash boring		COMPILED BY ACM									
DATUM Geodetic		DATE March 7-8, 2019		CHECKED BY SEMP/SMM									
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	γ	GR SA SI CL	
89.8	GROUND SURFACE												
0.0	SILT and SAND, trace to some organics, trace clay Very loose to compact Brown Wet		1	SS	2								
89.0	CLAYEY SILT to CLAYEY SILT with SAND to SILT and SAND, trace to some gravel, trace rootlets, cobbles and boulders present (TILL) Stiff to hard to very dense Brown to grey Moist to wet		2A	SS	12		89					0 49 48 3	
0.8			2B	SS	12								
			3	SS	24		88					13 32 42 13	
			4	SS	55/0.23								
	- Limestone boulder (300 mm thick) cored from 2.2 m to 2.5 m - Sand pockets present below 2.6 m - Split-spoon bouncing at 3.2 m		5A	RC									
			5B	RC									
			6	SC			87					2 11 60 27	
			7	SC									
			8	SS	50/0.15								
			9	SS	27/0.06								
	- Limestone boulders (280 mm thick) cored 3.7 m to 4.0 m		10	RC			86						
			11	RC									
	- Limestone cobble (230 mm thick) cored between 4.0 m to 4.6 m - Limestone cobble (150 mm thick) cored between 4.9 m to 5.9 m		12	SC			85						
			13	SS	24/0.06								
			14	RC									
83.7			15	SC			84						
6.3	SAND, trace to some silt, trace gravel, trace clay, trace cobble fragments present Grey Wet END OF BOREHOLE		16	SS	7							5 87 7 1	
NOTES: 1. Water level measured at ground surface within casing upon completion of drilling. 2. A third-weight hammer was used and the N values have been adjusted to reflect a full weight hammer for consistency. * The SPT "N" value for Sample 16 may not be representative due to blowing sands prior sampling. 3. Water level measured at 2.7 m depth below ground surface (Elev. 87.1 m) in piezometer on March 13, 2019.													

PROJECT 1662333		RECORD OF BOREHOLE No NRW3-5				SHEET 1 OF 1		METRIC						
G.W.P. 2002-13-00		LOCATION N 4824661.4; E 296190.9 MTM NAD 83 ZONE 10 (LAT. 43.561832; LONG. -79.606567)				ORIGINATED BY ACM								
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 50 mm I.D., Hollow Stem Augers				COMPILED BY CC								
DATUM Geodetic		DATE June 25, 2018				CHECKED BY SMM								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
93.7	GROUND SURFACE													
0.0	ASPHALT (150 mm)													
0.2	Silty sand to sand, some gravel (FILL) Loose to compact Brown Moist		1	SS	7									
			2A	SS	13									
92.2														
1.5	SILT and SAND, trace clay Compact Grey Moist to wet		3A	SS	19									
			3B											
			4	SS	30									
90.7														
3.0	CLAYEY SILT with SAND, some gravel to CLAYEY SILT with GRAVEL (TILL) Stiff to hard Grey Moist		5	SS	13									
			6	SS	18									
			7	SS	65									
	- Auger grinding from 5.2 m to 6.1 m and from 8.2 m to 9.1 m depth													
			8	SS	60/0.13									
			9	SS	46									
85.0														
8.7	Silty Gravelly SAND, trace clay (TILL) Very dense Grey Moist to wet below 10.7 m depth		10	SS	50/0.08									
			11	SS	50/0.13									
82.2														
11.5	END OF BOREHOLE		12	SS	50/0.08									
	NOTES: 1. Borehole caved to a depth of 1.5 m below ground surface upon removal of hollow-stem augers. 2. Water level measured at a depth of about 1.5 m below ground surface (Elev. 92.2 m) after removal of augers and borehole caved.													

GTA-MTO 001 S:\CLIENTS\MTQEW-CREDIT_RIVER\02_DATA\INTQEW-CREDIT_RIVER.GPJ GAL-GTA.GDT 07/29/19

Start of Sample No. 5 (2.21 m)



End of Sample No. 5 (2.62 m)

Start of Sample No. 10 (3.66 m)

Start of Sample No. 11 (3.94 m)



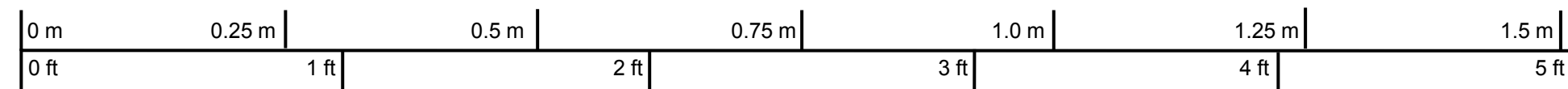
End of Sample No. 10 (3.94 m)

End of Sample No. 11 (4.57 m)


Start of Sample No. 14 (4.93 m)



End of Sample No. 14 (5.94 m)



Scale

PROJECT					
MTO Assignment 2015-E-0033 Sanitary Sewer Installation Station 17+460 Mississauga Road to Hurontario Street					
TITLE					
Limestone Cobbles and / or Boulders Core Photograph Borehole C5-3 (2.21 m to 5.94 m)					
 GOLDER			PROJECT No. 1662333		
			FILE No. ----		
			DRAFT	ACM	20190411
			CADD	--	
			CHECK	SMM	20190416
			REVIEW	JMAC	20190422
			SCALE	AS SHOWN	VER. 1.
			FIGURE A-1		

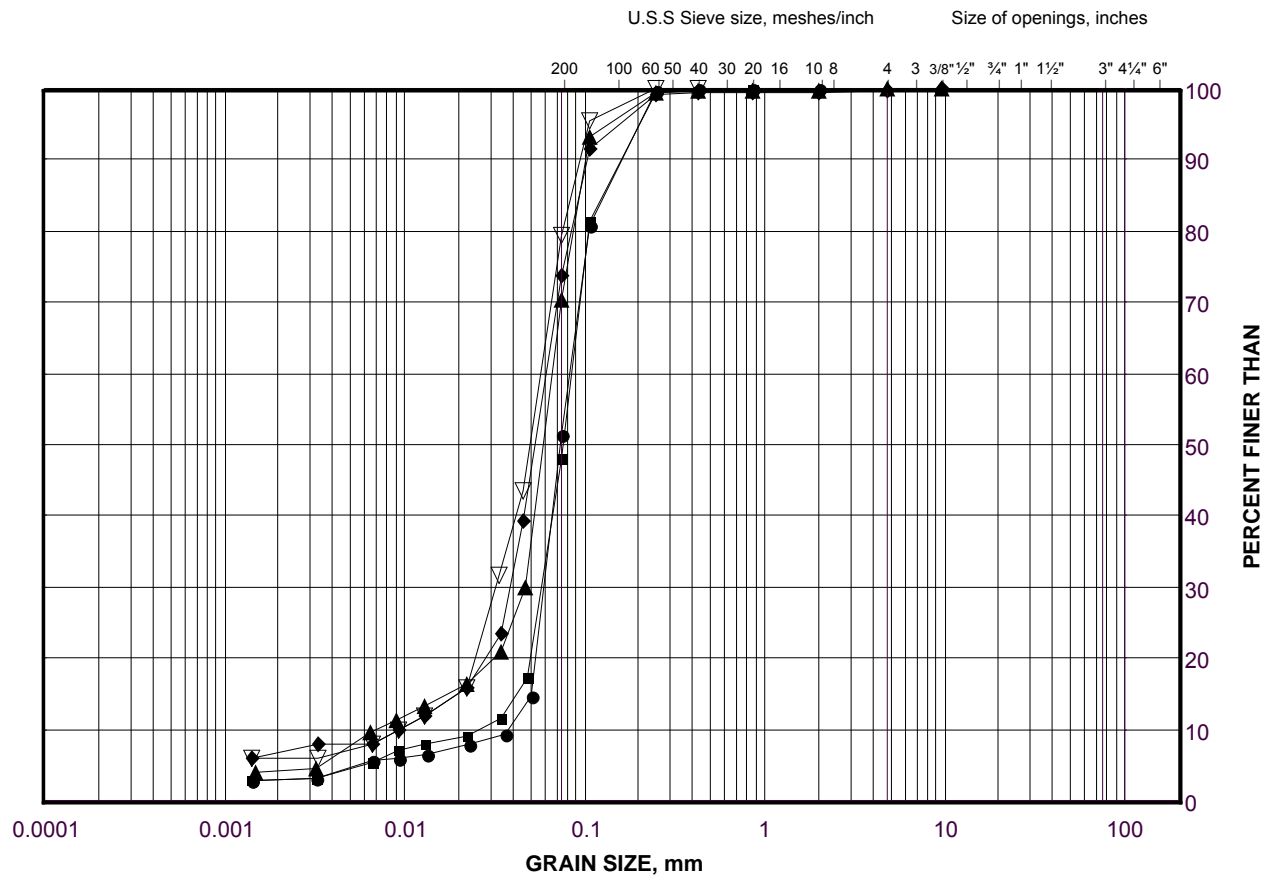
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sandy Silt to Silt and Sand

FIGURE B-1



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	C5-3	2A	89.1
■	NRW3-5	4	91.1
◆	C5-1	6	90.3
▲	C5-2	6B	90.0
▽	C5-1	7	89.6

Project Number: 1662333

Checked By: SMM

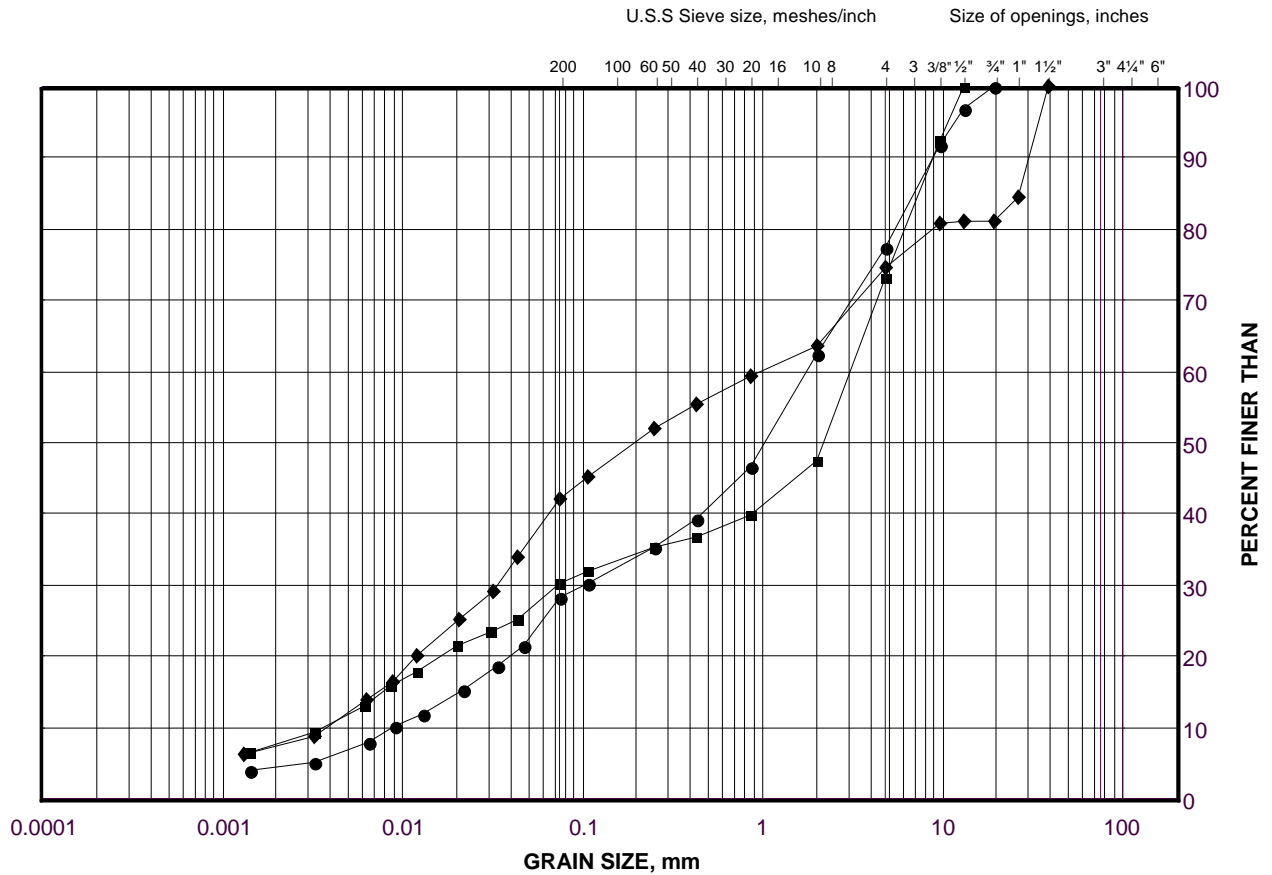
Golder Associates

Date: 05-Apr-19

GRAIN SIZE DISTRIBUTION

Gravelly Silt and Sand to Silty Gravelly Sand (Till)

FIGURE B-2A



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	NRW3-5	10	84.3
■	C5-1	8B	88.7
◆	C5-1	9	88.1

Project Number: 1662333

Checked By: SMM

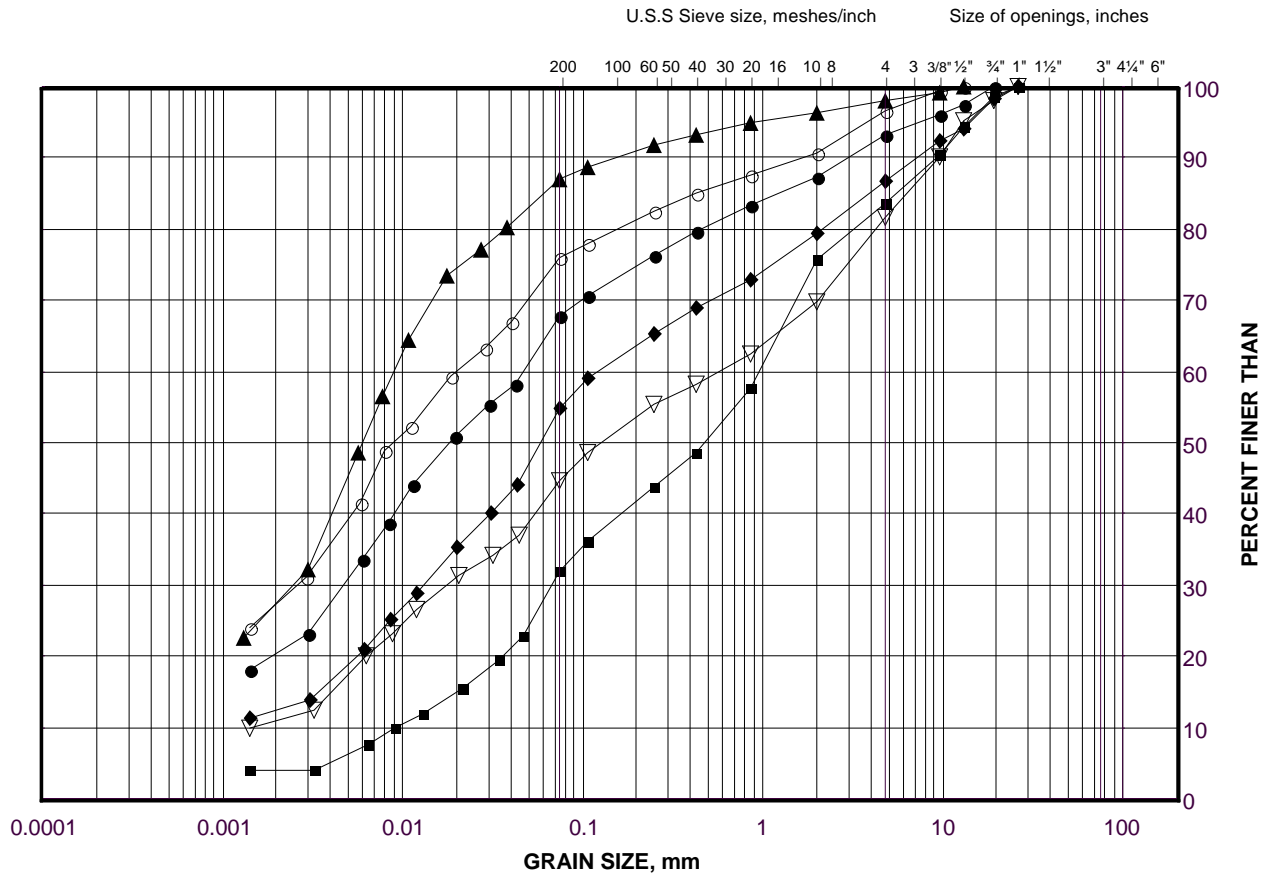
Golder Associates

Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand to Clayey Silt (Till)

FIGURE B-2B



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	C5-2	10	87.1
■	C5-2	11	85.7
◆	C5-3	3	88.3
▲	C5-3	6	87.1
▽	NRW3-5	6	89.6
○	C5-2	8	88.6

Project Number: 1662333

Checked By: SMM

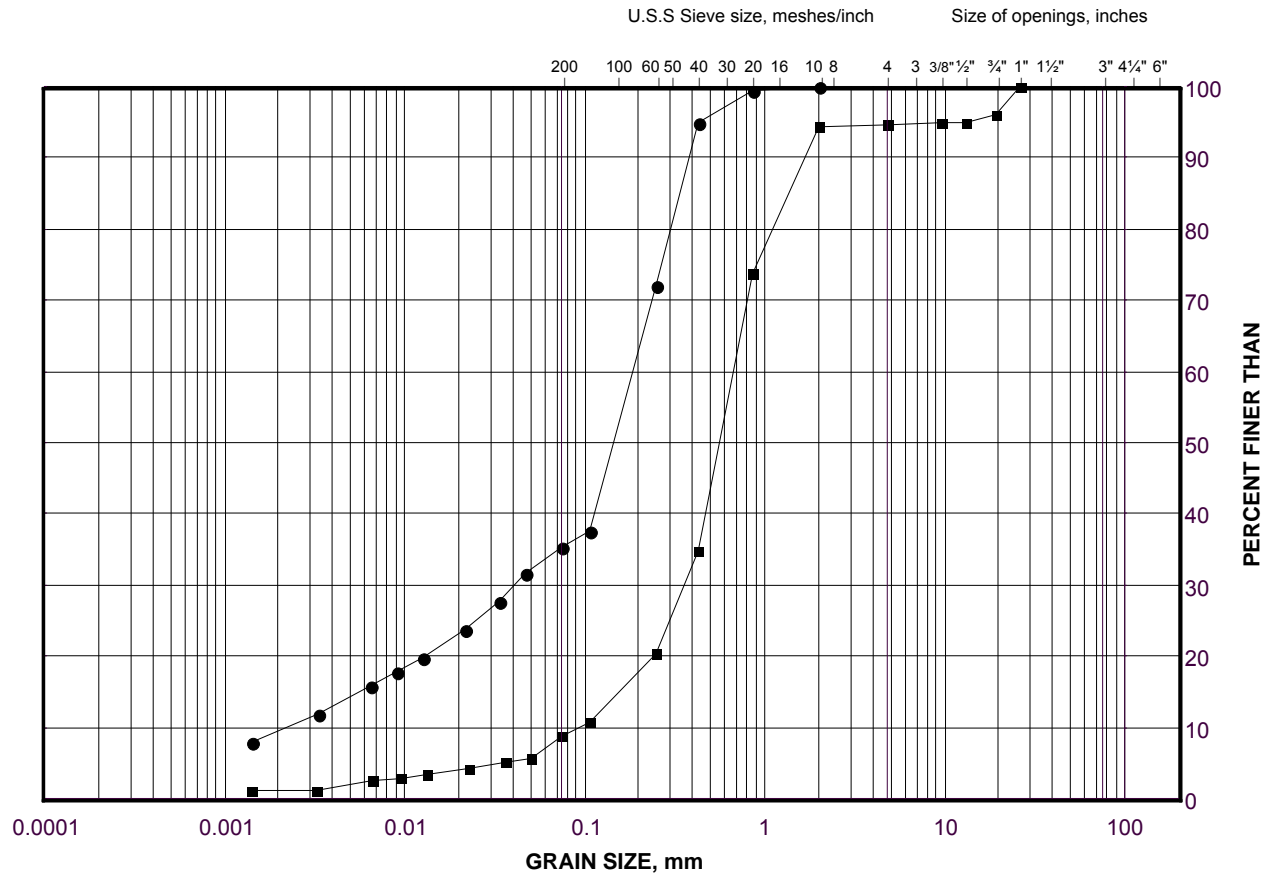
Golder Associates

Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Silty Sand to Sand

FIGURE B-3



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

LEGEND

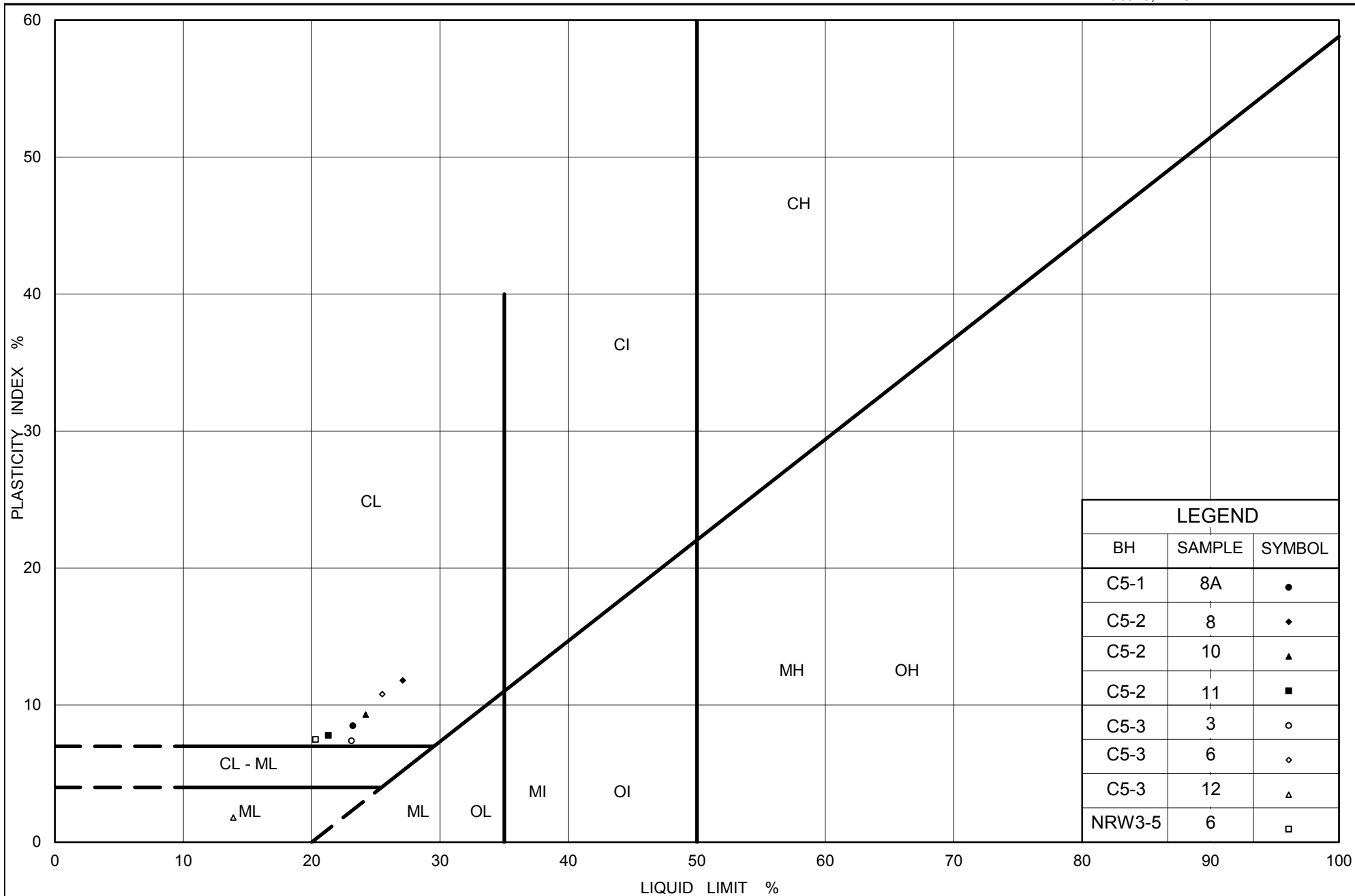
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	C5-1	11	85.8
■	C5-3	16	83.5

Project Number: 1662333

Checked By: SMM

Golder Associates

Date: 05-Apr-19



Ministry of Transportation

Ontario

PLASTICITY CHART

Silt and Sand (with slight plasticity) / Sandy Clayey Silt / Clayey
Silt with Sand / Clayey Silt (Till)

Figure No. Figure B-4

Project No. 1662333

Checked By: SMM

APPENDIX C

Analytical Laboratory Test Results

Your Project #: 1662333
Site Location: QEW/CREDIT RIVER
Your C.O.C. #: 674645-01-01

Attention: Sandra McGaghran

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2018/07/25
Report #: R5317501
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8I3581

Received: 2018/07/20, 16:17

Sample Matrix: Soil
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract)	7	N/A	2018/07/25	CAM SOP-00463	EPA 325.2 m
Conductivity	7	N/A	2018/07/24	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	7	2018/07/24	2018/07/24	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	7	2018/07/20	2018/07/24	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	7	N/A	2018/07/25	CAM SOP-00464	EPA 375.4 m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 1662333
Site Location: QEW/CREDIT RIVER
Your C.O.C. #: 674645-01-01

Attention: Sandra McGaghran

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2018/07/25
Report #: R5317501
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8I3581

Received: 2018/07/20, 16:17

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF ANALYSES OF SOIL

Maxxam ID		HGV911	HGV912	HGV913	HGV914	HGV915	HGV916		
Sampling Date		2018/06/28	2018/07/05	2018/06/25	2018/07/15	2018/07/12	2018/06/25		
COC Number		674645-01-01	674645-01-01	674645-01-01	674645-01-01	674645-01-01	674645-01-01		
	UNITS	NRW3-1-SA4	NRW3-9-SA4	NRW3-3-SA4	NRW7-3-SA4	NRW7-1-SA3	NRW3-5-SA4	RDL	QC Batch

Calculated Parameters									
Resistivity	ohm-cm	1400	2600	5500	1800	1200	3000		5640959

Inorganics									
Soluble (20:1) Chloride (Cl-)	ug/g	330	180	36	170	390	<20	20	5644648
Conductivity	umho/cm	721	386	180	564	805	337	2	5644382
Available (CaCl2) pH	pH	7.94	8.05	7.94	7.71	7.86	8.04		5642903
Soluble (20:1) Sulphate (SO4)	ug/g	88	21	32	<20	31	240	20	5644672

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Maxxam ID		HGV917		
Sampling Date		2018/06/22		
COC Number		674645-01-01		
	UNITS	NRW3-7-SA3A	RDL	QC Batch

Calculated Parameters				
Resistivity	ohm-cm	350		5640959

Inorganics				
Soluble (20:1) Chloride (Cl-)	ug/g	1300	40	5644648
Conductivity	umho/cm	2870	2	5644382
Available (CaCl2) pH	pH	8.01		5642903
Soluble (20:1) Sulphate (SO4)	ug/g	55	20	5644672

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

TEST SUMMARY

Maxxam ID: HGV911
Sample ID: NRW3-1-SA4
Matrix: Soil

Collected: 2018/06/28
Shipped:
Received: 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

Maxxam ID: HGV912
Sample ID: NRW3-9-SA4
Matrix: Soil

Collected: 2018/07/05
Shipped:
Received: 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

Maxxam ID: HGV913
Sample ID: NRW3-3-SA4
Matrix: Soil

Collected: 2018/06/25
Shipped:
Received: 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

Maxxam ID: HGV914
Sample ID: NRW7-3-SA4
Matrix: Soil

Collected: 2018/07/15
Shipped:
Received: 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

Maxxam ID: HGV915
Sample ID: NRW7-1-SA3
Matrix: Soil

Collected: 2018/07/12
Shipped:
Received: 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine

Maxxam Job #: B8I3581
Report Date: 2018/07/25

Golder Associates Ltd
Client Project #: 1662333
Site Location: QEW/CREDIT RIVER
Sampler Initials: CC

TEST SUMMARY

Maxxam ID: HGV915
Sample ID: NRW7-1-SA3
Matrix: Soil

Collected: 2018/07/12
Shipped:
Received: 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

Maxxam ID: HGV916
Sample ID: NRW3-5-SA4
Matrix: Soil

Collected: 2018/06/25
Shipped:
Received: 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

Maxxam ID: HGV917
Sample ID: NRW3-7-SA3A
Matrix: Soil

Collected: 2018/06/22
Shipped:
Received: 2018/07/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5644648	N/A	2018/07/25	Deonarine Ramnarine
Conductivity	AT	5644382	N/A	2018/07/24	Tahir Anwar
pH CaCl2 EXTRACT	AT	5642903	2018/07/24	2018/07/24	Gnana Thomas
Resistivity of Soil		5640959	2018/07/24	2018/07/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5644672	N/A	2018/07/25	Deonarine Ramnarine

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.0°C
-----------	-------

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1662333
Site Location: QEW/CREDIT RIVER
Sampler Initials: CC

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5642903	Available (CaCl ₂) pH	2018/07/24			100	97 - 103			1.9	N/A
5644382	Conductivity	2018/07/24			99	90 - 110	<2	umho/cm	4.7	10
5644648	Soluble (20:1) Chloride (Cl ⁻)	2018/07/25	NC	70 - 130	99	70 - 130	<20	ug/g	4.0	35
5644672	Soluble (20:1) Sulphate (SO ₄)	2018/07/25	NC	70 - 130	107	70 - 130	<20	ug/g	8.7	35

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.



Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).






Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#1326 Golder Associates Ltd .	Company Name:	GOLDER ASSOCIATES	Quotation #:	B80683	Maxxam Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Sandra McGaghran	P.O. #:			
Address:	6925 Century Ave Suite 100 Mississauga ON L5N 7K2	Address:	6925 CENTURY AVE. SUITE 100. MISSISSAUGA, ON.	Project:	1662333		674645
Tel:	(905) 567-4444	Tel:		Project Name:		COC #:	Project Manager:
Email:	Fax: (905) 567-6561 AP_CustomerService@golder.com	Email:	Fax: smcgaghran@golder.com	Site #			Ema Gitej
				Sampled By:	CC / AM	C#674645-01-01	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)			Other Regulations		Special Instructions
<input type="checkbox"/> Table 1	<input type="checkbox"/> Res/Park	<input type="checkbox"/> Medium/Fine	<input type="checkbox"/> CCME	<input type="checkbox"/> Sanitary Sewer Bylaw	
<input type="checkbox"/> Table 2	<input type="checkbox"/> Ind/Comm	<input type="checkbox"/> Coarse	<input type="checkbox"/> Reg 558	<input type="checkbox"/> Storm Sewer Bylaw	
<input type="checkbox"/> Table 3	<input type="checkbox"/> Agri/Other	<input type="checkbox"/> For RSC	<input type="checkbox"/> MISA	Municipality _____	
<input type="checkbox"/> Table _____			<input type="checkbox"/> PWQO		
			<input type="checkbox"/> Other _____		

Include Criteria on Certificate of Analysis (Y/N)?

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix
1	NRW3-1-SA4	QEW/CREDIT RIVER	2018/06/28	AM	SOIL
2	NRW3-9-SA4	"	2018/07/05	AM	SOIL
3	NRW3-3-SA4	"	2018/06/25	AM	SOIL
4	NRW7-3-SA4	"	2018/07/15	AM	SOIL
5	NRW7-1-SA3	"	2018/07/12	AM	SOIL
6	NRW3-5-SA4	"	2018/06/25	AM	SOIL
7	NRW3-7-SA3A	"	2018/06/22	AM	SOIL
8					
9					
10					

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

[illegible]

Turnaround Time (TAT) Required

Please provide advance notice for rush projects

Regular (Standard) TAT: 10-15 minutes

(will be applied if Rush TAT is not specified):

Standard TAT = 5-7 Working days for most tests

Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)

Date Required: _____ Time Required: _____

Rush Confirmation Number: _____

(call lab for #)

# of Bottles	Comments
--------------	----------

20-Jul-18 16:17

Ema Gitei



B8I3581

- KVG ENV-1180

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
SHANIANU KAR / <i>[Signature]</i>	12/07/20	4:00 PM.	<i>[Signature]</i>	2018/07/20	16:17		Time Sensitive	Temperature (°C) on Receipt	Custody Seal	. Yes	No
								16.3	Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT [HTTP://MAXXAM.CA/MP-CONTENT/UPLOADS/ONTARIO-COC.PDF](http://MAXXAM.CA/MP-CONTENT/UPLOADS/ONTARIO-COC.PDF)

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING
UNTIL DELIVERY TO MAXXAM

White: Maxxa Yellow: Client

Your Project #: 1662333
Your C.O.C. #: 709061-01-01

Attention: David Marmor

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2019/03/26
Report #: R5644475
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B974455

Received: 2019/03/21, 16:07

Sample Matrix: Rock
Samples Received: 10

Analyses	Quantity	Date	Date	Laboratory Method	Reference
		Extracted	Analyzed		
Chloride (20:1 extract)	10	2019/03/25	2019/03/26	CAM SOP-00463	EPA 325.2 m
Conductivity	10	2019/03/25	2019/03/25	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	10	2019/03/25	2019/03/25	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	10	2019/03/22	2019/03/26	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	10	2019/03/25	2019/03/26	CAM SOP-00464	EPA 375.4 m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing. Maxxam is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 1662333
Your C.O.C. #: 709061-01-01

Attention: David Marmor

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2019/03/26
Report #: R5644475
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B974455
Received: 2019/03/21, 16:07

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF ANALYSES OF ROCK

Maxxam ID		JGK384	JGK385	JGK386	JGK387	JGK388	JGK389		
Sampling Date		2019/03/21 01:30	2019/03/21 01:30	2019/03/21 01:30	2019/03/21 01:30	2019/03/21 01:30	2019/03/21 01:30		
COC Number		709061-01-01	709061-01-01	709061-01-01	709061-01-01	709061-01-01	709061-01-01		
	UNITS	1662333 C1-2	1662333 C1-1	1662333 C2-2	1662333 C2-3	1662333 C3-3	1662333 C3-1	RDL	QC Batch

Calculated Parameters

Resistivity	ohm-cm	2100	1700	2500	2600	3800	3700		6032288
-------------	--------	------	------	------	------	------	------	--	---------

Inorganics

Soluble (20:1) Chloride (Cl-)	ug/g	32	37	<20	71	<20	<20	20	6035188
Conductivity	umho/cm	469	583	407	391	266	274	2	6035037
Available (CaCl2) pH	pH	8.19	8.02	8.08	8.14	8.19	8.19		6035215
Soluble (20:1) Sulphate (SO4)	ug/g	160	350	190	72	51	35	20	6035189

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Maxxam ID		JGK390	JGK391	JGK392	JGK393		
Sampling Date		2019/03/20 04:30	2019/03/20 04:30	2019/03/20 04:30	2019/03/20 04:30		
COC Number		709061-01-01	709061-01-01	709061-01-01	709061-01-01		
	UNITS	1662333 C4-2	1662333 C4-3	1662333 C5-2	1662333 C5-1	RDL	QC Batch

Calculated Parameters

Resistivity	ohm-cm	1500	1000	1700	3100		6032288
-------------	--------	------	------	------	------	--	---------

Inorganics

Soluble (20:1) Chloride (Cl-)	ug/g	250	410	240	<20	20	6035188
Conductivity	umho/cm	670	991	578	323	2	6035037
Available (CaCl2) pH	pH	7.77	7.77	7.85	7.78		6035215
Soluble (20:1) Sulphate (SO4)	ug/g	130	190	130	220	20	6035189

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

TEST SUMMARY

Maxxam ID: JGK384
Sample ID: 1662333 C1-2
Matrix: Rock

Collected: 2019/03/21
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam ID: JGK385
Sample ID: 1662333 C1-1
Matrix: Rock

Collected: 2019/03/21
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam ID: JGK386
Sample ID: 1662333 C2-2
Matrix: Rock

Collected: 2019/03/21
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam ID: JGK387
Sample ID: 1662333 C2-3
Matrix: Rock

Collected: 2019/03/21
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam ID: JGK388
Sample ID: 1662333 C3-3
Matrix: Rock

Collected: 2019/03/21
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas

TEST SUMMARY

Maxxam ID: JGK388
Sample ID: 1662333 C3-3
Matrix: Rock

Collected: 2019/03/21
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam ID: JGK389
Sample ID: 1662333 C3-1
Matrix: Rock

Collected: 2019/03/21
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam ID: JGK390
Sample ID: 1662333 C4-2
Matrix: Rock

Collected: 2019/03/20
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam ID: JGK391
Sample ID: 1662333 C4-3
Matrix: Rock

Collected: 2019/03/20
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam ID: JGK392
Sample ID: 1662333 C5-2
Matrix: Rock

Collected: 2019/03/20
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

Maxxam Job #: B974455
Report Date: 2019/03/26

Golder Associates Ltd
Client Project #: 1662333
Sampler Initials: JP

TEST SUMMARY

Maxxam ID: JGK393
Sample ID: 1662333 C5-1
Matrix: Rock

Collected: 2019/03/20
Shipped:
Received: 2019/03/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	6035188	2019/03/25	2019/03/26	Deonarine Ramnarine
Conductivity	AT	6035037	2019/03/25	2019/03/25	Kazzandra Adeva
pH CaCl2 EXTRACT	AT	6035215	2019/03/25	2019/03/25	Gnana Thomas
Resistivity of Soil		6032288	2019/03/26	2019/03/26	Anastassia Hamanov
Sulphate (20:1 Extract)	KONE/EC	6035189	2019/03/25	2019/03/26	Alina Dobreanu

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	-2.0°C
-----------	--------

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1662333
Sampler Initials: JP

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6035037	Conductivity	2019/03/25			102	90 - 110	<2	umho/cm	0.40	10
6035188	Soluble (20:1) Chloride (Cl ⁻)	2019/03/26	108	70 - 130	103	70 - 130	<20	ug/g	NC	35
6035189	Soluble (20:1) Sulphate (SO ₄)	2019/03/26	115	70 - 130	109	70 - 130	<20	ug/g	3.8	35
6035215	Available (CaCl ₂) pH	2019/03/25			100	97 - 103			0.39	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Anastassia Hamanov, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #1326 Golder Associates Ltd		Company Name: David Marmor		Quotation #: B80683		Maxxam Job #:	
Attention: Accounts Payable		Attention: David Marmor		P.O. #:		Bottle Order #:	
Address: 6925 Century Ave Suite 100		Address:		Project: 1662332		709061	
Mississauga ON L5N 7K2				Project Name:		COC #:	
Tel: (905) 567-4444 Fax: (905) 567-6561		Tel: Fax:		Site #:		Project Manager:	
Email: AP_CustomerService@golder.com		Email: David_Marmor@golder.com		Sampled By:		C#709061-01-01	

<p>MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY</p>						<p>ANALYSIS REQUESTED (PLEASE BE SPECIFIC)</p>										<p>Turnaround Time (TAT) Required:</p> <p>Please provide advance notice for rush projects</p> <p>Regular (Standard) TAT: (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.</p> <p>Job Specific Rush TAT (if applies to entire submission) Date Required: Time Required: <input type="checkbox"/> Rush Confirmation Number: (call lab for #)</p>													
<p>Regulation 153 (2011)</p> <p><input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine</p> <p><input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse</p> <p><input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC</p> <p><input type="checkbox"/> Table</p>			<p>Other Regulations</p> <p><input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw</p> <p><input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw</p> <p><input type="checkbox"/> MISA Municipality</p> <p><input type="checkbox"/> PWQO</p> <p><input type="checkbox"/> Other</p>			<p>Special Instructions</p>			<p>Field Filtered (please circle):</p> <p>Metals / Hg / Cr VI</p> <p>Corrosivity pig (Cl, SO4, pH, EC/Resistivity)</p>										<p>Regular (Standard) TAT: (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.</p> <p>Job Specific Rush TAT (if applies to entire submission) Date Required: Time Required: <input type="checkbox"/> Rush Confirmation Number: (call lab for #)</p>										
<p>Include Criteria on Certificate of Analysis (Y/N)?</p>						<p>Sample Barcode Label</p>										<p>Sample (Location) Identification</p>		<p>Date Sampled</p>		<p>Time Sampled</p>		<p>Matrix</p>		<p>Field Filtered (please circle):</p> <p>Metals / Hg / Cr VI</p> <p>Corrosivity pig (Cl, SO4, pH, EC/Resistivity)</p>		<p>Turnaround Time (TAT) Required:</p> <p>Please provide advance notice for rush projects</p> <p>Regular (Standard) TAT: (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.</p> <p>Job Specific Rush TAT (if applies to entire submission) Date Required: Time Required: <input type="checkbox"/> Rush Confirmation Number: (call lab for #)</p>			
1		1662333		C1-2		21/3/2019		1:30		Rock		X																	
2		1662333		C1-1		21/3/2019		1:30		Rock		X																	
3		1662333		C2-2		21/3/2019		1:30		Rock		X																	
4		1662333		C2-3		21/3/2019		1:30		Rock		X																	
5		1662333		C3-3		21/3/2019		1:30		Rock		X																	
6		1662333		C3-1		21/3/2019		1:30		Rock		X																	
7		1662333		C4-2		20/3/2019		4:30		Soil		X																	
8		1662333		C4-3		20/3/2019		4:30		Soil		X																	
9		1662333		C5-2		20/3/2019		4:30		Soil		X																	
10		1662333		C5-1		20/3/2019		4:30		Soil		X																	
<p>* RELINQUISHED BY: (Signature/Print)</p> <p>JANE PETER (Jane)</p>						<p>Date: (YY/MM/DD)</p> <p>2019/03/21</p>		<p>Time</p> <p>3:00pm</p>		<p>RECEIVED BY: (Signature/Print)</p> <p>David Marmor</p>		<p>Date: (YY/MM/DD)</p> <p>21/3/2019</p>		<p>Time</p> <p>16:07</p>		<p># jars used and not submitted</p>		<p>Laboratory Use Only</p>		<p>Time Sensitive</p>		<p>Temperature (C) on Receipt</p> <p>-3/-2/-1</p>		<p>Custody Seal</p> <p>Present <input checked="" type="checkbox"/> Intact <input checked="" type="checkbox"/></p>		<p>Yes</p>		<p>No</p>	
<p>* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.</p>																													
<p>* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.</p>																													
<p>** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT HTTP://MAXXAM.CA/WWP-CONTENT/UPLOADS/ONTARIO-COC.PDF.</p>																													
<p>SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM</p>																													



golder.com