



April 6, 2017

FOUNDATION INVESTIGATION REPORT

**Centreline Culvert Replacement - Highway 112
STA 27+691, Township of Teck
Ministry of Transportation, Ontario
G.W.P. 5105-12-00; W.P. 5428-15-01**

Submitted to:

MMM Group Limited
610 Chartwell Rd, Suite 300
Oakville, ON



REPORT

GEOCRES NO: 42A-114

Report Number: 1531057-4

Distribution:

5 Copies - Ministry of Transportation, Ontario, North Bay, Ontario (Northeastern Region)
1 Copy - Ministry of Transportation, Ontario, Downsview, Ontario (Foundations Section)
1 Copy - MMM Group Limited
1 E-Copy - 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	4
4.1 Regional Geology	4
4.2 General Overview of Local Subsurface Conditions	4
4.3 Culvert at STA 27+691	5
4.3.1 Asphalt.....	5
4.3.2 Silty Peat.....	5
4.3.3 Embankment Fill	5
4.3.4 Gravelly Silty Sand to Sand and Gravel	5
4.3.5 Sandy Silt to Silt and Sand to Silty Sand.....	6
4.3.6 Silty Clay	6
4.3.7 Cobbles.....	6
4.3.8 Bedrock / Refusal.....	7
4.3.9 Groundwater Conditions	7
4.3.10 Analytical Testing of Creek Water.....	7
5.0 CLOSURE.....	8

REFERENCES

TABLES

Table 1	Summary of Existing Culvert Details
---------	-------------------------------------

FIGURES

Figures 1A and 1B	Site Photographs
-------------------	------------------

DRAWINGS

Drawing 1	Borehole Locations and Soil Strata
Drawing 2	Soil Strata

APPENDICES



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

Appendix A Record of Boreholes

List of Symbols and Abbreviations
Lithological and Geotechnical Rock Description Terminology
Record of Boreholes C4-1 to C4-6B
Record of Drillholes C4-2, C4-4, C4-5 and C4-6A
Record of DCPTs C4-DCPT-1 to C4-DCPT-9

Appendix B Geotechnical Laboratory Test Results

Table B1 Summary of Point Load Tests on Rock Samples
Figure B1 Grain Size Distribution –Silty Sand and Gravelly Sand (FILL)
Figure B2 Grain Size Distribution – Gravelly Silty Sand and Sand and Gravel
Figure B3 Grain Size Distribution – Silt and Sand
Figure B4 Grain Size Distribution – Silty Clay
Figure B5 Plasticity Chart – Silty Clay
Figure B6 Bedrock Core Photographs
Figure B7 Unconfined Compression Test (UC) – Borehole C4-2, Run No. 3

Appendix C Analytical Test Results



1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by MMM Group Limited (MMM) on behalf of Ministry of Transportation, Ontario (MTO) to provide Foundation Engineering services for the replacement of the centreline culvert at STA 27+691 on Highway 112 in the Township of Teck, approximately 3 km south of Kirkland Lake, Ontario.

The Terms of Reference and the Scope of Work for the foundation investigation are outlined in MTO's Work Order / Assignment #2, dated March 2016. Golder's proposal for the foundation engineering services associated with the various culverts is contained in Golder's letter addressed to MMM, dated April 13, 2016. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated May 25, 2016.

This report addresses the investigation carried out for the culvert at STA 27+691 on Highway 112 which has been identified for replacement. The foundation investigation and design associated with the other culverts for Work Order / Assignment #2 are presented in separate reports.

2.0 SITE DESCRIPTION

The centreline culvert requiring replacement is located at approximately STA 27+691 on Highway 112 in the Township of Teck, approximately 3 km south of Kirkland Lake, Ontario. The existing culvert is buried and the dimensions of it are unknown. The highway embankment at the approximate culvert location is about 2.5 m and 5.0 m high on the east side and west side of the highway, respectively. Details of the culvert and associated foundation investigation are summarized in Table 1 following the text of this report.

In general, the topography in the area of the culvert consists of rolling surface topography with sparsely to densely populated treed areas and numerous bedrock outcrops separated by valleys which generally contain agricultural land or swamps containing slow flowing to standing water, various types of vegetation and organic soils. The developed area directly adjacent to Highway 112 is primarily used for residential purposes and agriculture. The ground surface at the boreholes and DCPT locations advanced for the culvert investigation, including through the existing Highway 112 embankment, varies between Elevation 314.2 m and 319.7 m, referenced to Geodetic datum. Figure 1A and 1B contains photographs of the culvert location.

3.0 INVESTIGATION PROCEDURES

The fieldwork for the foundation investigation associated with the culvert at STA 27+691 was carried out between June 6 and 10, 2016, during which time a total of seven boreholes and nine Dynamic Cone Penetration Test (DCPT) were advanced at, or in the immediate vicinity of the culvert alignment, as summarized in Table 1 and as shown on Drawing 1.

The field investigation was carried out using a truck-mounted CME55 drill rig and portable drilling equipment which were supplied and operated by Landcore Drilling of Sudbury, Ontario.

The boreholes drilled by the truck-mounted CME55 drill rig were advanced through the overburden using 152 mm diameter solid stem augers and wash boring techniques. The boreholes completed by the portable equipment were advanced through the overburden using NQ and HQ sized casing with wash boring techniques. Boreholes that were completed with rock coring were advanced using NW size casing and NQ size core barrel. In general,



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

soil samples were obtained at intervals of depth of about 0.75 m and 1.5 m using a 50 mm outside diameter (O.D.) split-spoon sampler operated by an automatic hammer on the drill rig, performed in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). Boreholes advanced using portable equipment employed a full-weight hammer lifted manually and dropped from the SPT height.

The groundwater conditions and water levels in the open boreholes were observed during the drilling operations and are described on the Record of Borehole sheets in Appendix A. Boreholes were backfilled with bentonite upon completion in accordance with R.R.O 1990, Regulation 903 (Wells) (as amended).

A sample of creek water was obtained on June 12, 2016 at the culvert location, and submitted to an accredited analytical laboratory under chain of custody procedures for testing for a suite of parameters, including pH, resistivity, conductivity, sulphates and chlorides. The results of the analytical testing are included in Appendix C.

The fieldwork 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 the soil samples. The soil and bedrock core 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 laboratory tests were carried out to MTO Laboratory Standards and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected soil samples. Point load tests (PLT) and unconfined compression (UC) tests were carried out on selected specimens of the rock core samples. The results of the laboratory testing are summarized on the Record of Borehole and Drillhole sheets in Appendix A and presented on the laboratory test figures in Appendix B.

Classification of the rock mass quality of the bedrock with respect to the Rock Quality Designation (RQD) is described based on Table 3.10 of the Canadian Foundation Engineering Manual (CFEM)¹. Classification of the bedrock core samples with respect to strength from point load tests and unconfined compression test is described based on Table 3.5 of CFEM¹. The degree of weathering of the bedrock samples (i.e. fresh to slightly weathered – W1 to W2) and the strength classification of the intact rock mass based on field identification (i.e. strong – R4) are described in accordance with the International Society for Rock mechanics (ISRM)² standard classification system.

Borehole locations were surveyed in the field relative to fixed markers on site. The as-drilled borehole locations, in stations and offsets, were measured in reference to the applicable markers and from existing site features and were subsequently converted into MTM NAD 83 (Zone 12) coordinates in AutoCAD. Borehole elevations were surveyed by a member of our technical staff in reference to the centreline of Highway 112 and the existing culvert and were subsequently converted to Geodetic elevations using topographic information, provided by MTO. The borehole locations, ground surface elevations and depths drilled are as follows:

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

² International Society for Rock Mechanics Commission on test Methods. (1985). Int. J. Rock Mech. Min. Sci & Geomech. Abstr. Vol 22, No. 2, pp.51-60.



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

Culvert Location	Borehole / DCPT	Location		Ground Surface Elevation (m)	Depth of Borehole / DCPT (m)
		Northing (m) / Latitude (°)	Easting (m) / Longitude (°)		
STA 27+691 (Township of Teck)	C4-1	5,330,640.9 / 48.110835	374,470.0 / -80.064304	314.7	2.7
	C4-2	5,330,648.9 / 48.110906	374,477.6 / -80.064201	319.7	10.5*
	C4-3	5,330,676.4 / 48.111153	374,475.0 / -80.064230	317.4	3.2
	C4-4	5,330,654.7 / 48.110960	374,454.1 / -80.064515	316.9	3.2*
	C4-5	5,330,662.5 / 48.111030	374,460.3 / -80.064430	319.7	5.1*
	C4-6A	5,330,636.5 / 48.110793	374,493.3 / -80.063992	319.3	5.6*
	C4-6B	5,330,628.1 / 48.110718	374,487.8 / -80.064066	315.0	2.8
	C4-DCPT-1	5,330,682.3 / 48.111207	374,470.8 / -80.064287	317.1	0.6
	C4-DCPT-2	5,330,679.2 / 48.111179	374,481.1 / -80.064148	317.2	1.2
	C4-DCPT-3	5,330,672.1 / 48.111114	374,480.5 / -80.064157	317.5	1.3
	C4-DCPT-4	5,330,643.2 / 48.110856	374,465.4 / -80.064364	314.2	1.1
	C4-DCPT-5	5,330,634.5 / 48.110777	374,470.0 / -80.064304	314.2	1.9
	C4-DCPT-6	5,330,636.4 / 48.110794	374,474.1 / -80.064250	314.2	0.9
	C4-DCPT-7	5,330,627.1 / 48.110709	374,485.8 / -80.064094	315.0	2.0
	C4-DCPT-8	5,330,625.6 / 48.110695	374,490.9 / -80.064025	315.0	1.7
	C4-DCPT-9	5,330,631.2 / 48.110746	374,483.9 / -80.064118	315.0	1.3

Note: * Includes between 2.0 m and 3.8 m length of bedrock coring.



4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

Highway 112 is located in the Abitibi Uplands physiographic region, within the Canadian Shield as delineated by the *Geomorphic Systems of North America*³. The Abitibi Uplands generally slopes down towards Hudson Bay and is typically characterized by low broad hills with gently sloping, rolling or undulating topography and subdued relief. This region is underlain by massive, mainly crystalline rocks covered by Quaternary glaciolacustrine, glaciofluvial, and till deposits, as well as more recent organic deposits within the depressions between bedrock knobs⁴.

Highway 112 crosses four main assemblages, or batholiths associated with the southern Abitibi Greenstone Belt: Round Lake Batholith; Catharine-Pacaud assemblage; Boston assemblage and Temiskaming assemblage⁵. The southern end of the highway, where it meets the TransCanada Highway is located within the granodioritic Round Lake Batholith. The highway trends north passing through the Catharine-Pacaud and Boston assemblages which are characterized by mafic to intermediate grey to green basalt flows with felsic to silicious banding and plagioclase phenocrysts and metavolcanic to metasedimentary basalts, cherts and conglomerates, respectively. The northern end of Highway 112 in the area of the culvert south of Swastika contains the Temiskaming assemblage, characterized by clastic metasedimentary rocks, primarily cherts (jasper) and sandstones. This area contains multiple faults and deformations associated within the Larder-Cadillac shear zone which generally runs along Highway 11 in the area where it intersects with Highway 112.

4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil and bedrock samples, are presented on the Record of Borehole sheets and the laboratory test sheets in Appendices A and B, respectively. The results of the in situ field testing (i.e. SPT 'N' values) as presented in the Record of Borehole sheets and in Section 4.3 are uncorrected. The stratigraphic boundaries shown on the Record of Boreholes sheets are inferred from non-continuous sampling, observations of drilling progress and in situ testing and are approximate. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations.

The stratigraphy at the borehole locations at the culvert site consists of surficial layers of asphalt, silty sand to sand to gravelly sand fill (at boreholes drilled through the highway embankment) and very loose to loose silt and sand or firm silty clay. The embankment fill is underlain by very loose to dense gravelly silty sand, sand and gravel and silty sand in places. The overburden deposits generally contain some cobbles and are underlain in places by zones of cobbles, in turn underlain by andesite or granite bedrock. A detailed description of the subsurface conditions at the culvert crossing is provided in the following section of this report. Where relatively significant thicknesses of overburden were encountered, the various soil types are described in detail for each main deposit or stratum.

³ Graf, W. L. (1987). *Geomorphic systems of North America*. Geological Society of America, Inc.: Boulder, Colorado.

⁴ Ministry of Northern Development and Mines, Ontario (MNDMO). (2016). *OGSEarth: Quaternary Geology* [Electronic Map]. 1:1,000,000. Retrieved July 28, 2016 from OGSEarth. Queen's Printer for Ontario, 2016.

⁵ Jackson, S. L. and Fyon, J. A. (1991). The western Abitibi subprovince in Ontario; in *Geology of Ontario*, Ontario Geological Survey, Special Volume 4, Part 1, p.405-482.



4.3 Culvert at STA 27+691

The plan and profile along the centreline of the existing culvert at STA 27+691 showing the borehole locations and interpreted stratigraphy are shown on Drawing 1. Profiles along the west toe and centerline of the embankment and cross sections of the roadway embankment, with interpreted stratigraphy are shown on Drawings 1 and 2. The height of the embankment at the culvert location is about 2.5 m on the east side of the highway and 5.0 m on the west side of the highway. The existing culvert dimensions are unknown. A total of seven boreholes and nine DCPT were completed to investigate the subsurface conditions at the culvert location: two boreholes (Borehole C4-1 and C4-3) and six DCPTs (C4-DCPT-1 to C4-DCPT-6) were advanced near the ends of the existing culvert; one borehole (Borehole C4-2) was advanced through the Highway 112 southbound lane roadway embankment, south of the existing culvert alignment; and four boreholes (Borehole C4-4, C4-5, C4-6A and C4-6B) and three DCPTs (C4-DCPT-7 to C4-DCPT-9) were advanced north and south of the culvert through the crest of the embankment and at the west toe of the embankment.

4.3.1 Asphalt

An approximately 100 mm layer of asphalt was encountered at ground surface in Boreholes C4-2, C4-5 and C4-6A.

4.3.2 Silty Peat

A 0.2 m thick deposit of silty peat was encountered at ground surface in Borehole C4-4.

4.3.3 Embankment Fill

An approximately 1.7 m to 4.5 m thick deposit of embankment fill was encountered below the asphalt in Boreholes C4-2, C4-5 and C4-6A between Elevations 319.6 m and 319.2 m. The embankment fill consists of an upper 0.4 m to 2.0 m thick layer of gravelly sand containing some cobbles and a lower 1.3 m and 2.5 m thick deposit of silty sand and sand, trace to some gravel, containing some cobbles encountered in Boreholes C4-2 and C4-5.

The SPT 'N'-values measured within the embankment fill deposit range between 7 blows and 51 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The natural water content measured on three samples of the non-cohesive fill range from about 3 per cent to 9 per cent.

The results of grain size distribution tests completed on two samples of the silty sand and gravelly sand fill are shown on Figure B1, in Appendix B.

4.3.4 Gravelly Silty Sand to Sand and Gravel

A 2.1 m thick deposit of gravelly silty sand to sand and gravel, some silt, trace clay was encountered at Elevation 315.1 m below the non-cohesive fill in Borehole C4-2.



The SPT 'N'-values measured within the gravelly silty sand to sand and gravel deposit are 13 blows and 43 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The natural water content measured on two samples of the gravelly silty sand and sand and gravel deposit is about 11 per cent and 20 per cent.

The results of grain size distribution tests completed on two samples of the gravelly silty sand to sand and gravel deposit are shown on Figure B2.

4.3.5 Sandy Silt to Silt and Sand to Silty Sand

A 0.5 m to 1.2 m thick deposit of various layers of silt and sand was encountered at ground surface in Boreholes C4-1 and C4-3, and below the surficial silty peat and the embankment fill in Boreholes C4-4 and C4-5, respectively between Elevations 317.9 m and 314.7 m.

The SPT 'N'-values measured within the sandy silt to silt and sand deposit range from 1 blow to 9 blows per 0.3 m of penetration, indicating a very loose to loose relative density.

The natural water content measured on two samples of the silty sand is about 8 per cent and 17 per cent.

The result of a grain size distribution test completed on a sample of silt and sand layer of the deposit is shown on Figure B3.

An Atterberg limits test carried out on a sample of the silt and sand layer of the deposit indicates that the material is non-plastic.

4.3.6 Silty Clay

A 2.2 m thick deposit of silty clay, trace to some sand, some gravel and trace organics was encountered at ground surface in Borehole C4-6B, at Elevation 315.0.

The measured SPT 'N'-values within the silty clay deposit range from 6 blows to 16 blows per 0.3 m of penetration suggesting that the deposit has a firm to very stiff consistency.

The natural water content measured on two samples of the silty clay deposit is about 29 per cent and 37 per cent.

The result of a grain size distribution test completed on a sample of silty clay is shown on Figure B4.

An Atterberg limits test was carried out on a sample of silty clay and measured a liquid limit of 37 per cent and a plastic limit of 19 per cent, corresponding to a plasticity index of 18 per cent. The test result, which is plotted on a plasticity chart on Figure B5 on in Appendix B, indicates that the material tested is a silty clay of intermediate plasticity.

4.3.7 Cobbles

An approximately 2.2 m and 2.5 m thick deposit of cobbles, generally between 50 mm and 250 mm diameter in size, was encountered below the surficial sandy silt to silt and sand and the sand deposits in Boreholes C4-1 and C4-3, respectively, at Elevations 314.2 m and 316.7 m. These two boreholes were terminated on the cobbles as



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

a result of jamming of the core barrel. A 200 mm thick layer of cobbles, generally 80 mm diameter in size, was encountered between the gravelly sand fill and the bedrock in Borehole C4-6A at Elevation 317.3 m.

4.3.8 Bedrock / Refusal

Bedrock was encountered in Boreholes C4-2, C4-4, C4-5 and C4-6A at depths between 1.2 m and 6.7 m below ground surface between Elevations 317.1 m and 313.0 m. DCPT Refusal was encountered in the Borehole C4-6B and in C4-DCPT-1 to C4-DCPT-9 at depths of 0.6 m to 2.8 m, corresponding to Elevations 316.5 m to 312.2 m.

Based on review of the bedrock core samples, the bedrock consists of grey, fine grained, non-porous, crystalline andesite and pink, medium grained, non-porous, crystalline granite. The bedrock is fresh to moderately weathered. The bedrock descriptions are shown on the Record of Drillhole sheets in Appendix A and the rock core samples are shown on the photographs on Figure B6 in Appendix B.

The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered range between 40 per cent and 100 per cent and between 0 per cent and 100 per cent, respectively. The Rock Quality Designation (RQD) of the bedrock core samples from the boreholes on the south side of the culvert ranges from 0 per cent to 85 per cent, indicating a rock mass of very poor to good quality as per Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006). The RQD of the bedrock core samples from the boreholes on the north side of the culvert ranges from 33 per cent to 100 per cent, indicating a rock mass of poor to excellent quality.

Point load strength index tests were carried out on a selected sample of the granite bedrock core from Borehole C4-4 and a core sample of the andesite bedrock from Borehole C4-6A. The corrected point load strength index values (Is_{50}) are presented on the Record of Drillhole sheets and in Table B1 in Appendices A and B, respectively, and are 7 MPa and 4 MPa for the axial and diametral tests, respectively on granite core sample; and 9 MPa for the diametral test on the andesite core sample. An Unconfined Compression (UC) test performed on a core sample of the granite bedrock from Borehole C4-2 measured a uniaxial compressive strength (UCS) of 12.9 MPa. The UC test result is presented on Figure B7 in Appendix B. Based on the laboratory point load strength index tests and the UC test, the bedrock is classified as weak (R_2 , $5 \text{ MPa} < \text{UCS} < 25 \text{ MPa}$).

4.3.9 Groundwater Conditions

The water level was measured in Boreholes C4-1 to C4-5 and C4-6B upon completion of drilling operations at depths between 0.0 m and 5.4 m below ground surface, ranging from Elevations 317.2 m to 314.3 m. 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.

4.3.10 Analytical Testing of Creek Water

Analytical testing was carried out on a sample of creek water taken from the culvert site to assess the corrosivity and concrete degradation potential from the creek water/groundwater for the new culvert structure. The results from the specialist analytical laboratory are presented in Appendix C and are summarised below:



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

Parameter	Test Result
Water Resistivity	7,000 ohm-cm
Water Conductivity	140 μ mho/cm
Sulphate Concentration	Less than 1.0 mg/L
Chloride Concentration	15 mg/L
Water pH	7.46

5.0 CLOSURE

Messrs. Shane Albert and Dave Marmor, EIT, supervised the borehole investigation program. This report was prepared by Ms. Marzieh Kamranzadeh, M.Sc., EIT., and was reviewed by Mr. Christopher Ng, P.Eng., a senior geotechnical engineer and an 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.



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

Report Signature Page

GOLDER ASSOCIATES LTD.

Marzieh Kamranzadeh, M.Sc., EIT
Geotechnical Group



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



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

MK/CN/JMAC/mck

\\golder.gds\gal\whitby\active\2015\3 proj\1531057 mmm_5015-e-0003_lv retainer ner\work order #2\foundations\04 - reporting\culvert 4\final\1531057-4 fdr 17apr04 gwp 5105-12-00 - culvert sta 27+691.docx



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

REFERENCES

Graf, W. L. (1987). *Geomorphic systems of North America*. Geological Society of America, Inc.: Boulder, Colorado.

International Society for Rock Mechanics Commission on test Methods. (1985). *Int. J. Rock Mech. Min. Sci & Geomech. Abstr.* Vol 22, No. 2, pp.51-60.

Jackson, S. L. and Fyon, J. A. (1991). The western Abitibi subprovince in Ontario; *in* *Geology of Ontario*, Ontario Geological Survey, Special Volume 4, Part 1, p.405-482.

Ministry of Northern Development and Mines, Ontario (MNDMO). (2016). *OGSEarth: Quaternary Geology* [Electronic Map]. 1:1,000,000. Retrieved July 28, 2016 from OGSEarth. Queen's Printer for Ontario, 2016.

ASTM International:

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

Ontario Water Resources Act:

Ontario Regulation 331/13 Amendment to Revised Regulations of Ontario 1990, Regulation 903



**FOUNDATION REPORT - CENTRELINE CULVERT
REPLACEMENT - HIGHWAY 112 STA 27+691**

TABLES



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

Table 1: Summary of Existing Culvert Details

Culvert Location (Township)	Culvert ID	Approximate Height of Embankment ¹	Existing Culvert			Approximate Invert Elevation ²		Boreholes	Dynamic Cone Penetration Tests
			Type	Approximate Dimension	Approximate Length	Upstream	Downstream		
STA 27+691 (Teck)	C4	Up to about 5 m	Unknown	Unknown	Unknown	316.8 m (East End)	315.2 m (West End)	7 Boreholes (C4-1 to C4-6A and C4-6B)	9 DCPTs (C4-DCPT-1 to C4-DCPT-9)

Notes:

1. Embankment height is relative to existing ground surface level at the toe of embankment adjacent to the culvert.
2. Culvert invert elevations are estimated based on the top of culvert surveys and culvert dimensions provided by MTO.

Prepared By: MK
Checked By: CN
Reviewed By: JMAC



FIGURES




West side of Highway 112 at STA 27+691 (Township of Teck) Culvert, looking west. May 31, 2016.



West side of Highway 112 at STA 27+691 (Township of Teck) Culvert, looking northeast. May 31, 2016.


REVISION DATE: February 3, 2017 BY: MCK Project: 1531057

PROJECT		Detail Design for Replacement of 3 Centreline Culverts – Highway 112 GWP 5105-12-00; WP 5428-15-01			
TITLE		Site Photographs Culvert STA 27+691 (Township of Teck) Highway 112			
		PROJECT No. 1530157		FILE No. ----	
		DESIGN	MCK	Aug16	SCALE NTS
		CADD	-- --		REV.
		CHECK	CN	Aug 16	
		REVIEW	JMAC	Aug 16	
					FIGURE 1A



East side of Highway 112 at STA 27+691 (Township of Teck) Culvert, looking southwest. June 1, 2016.

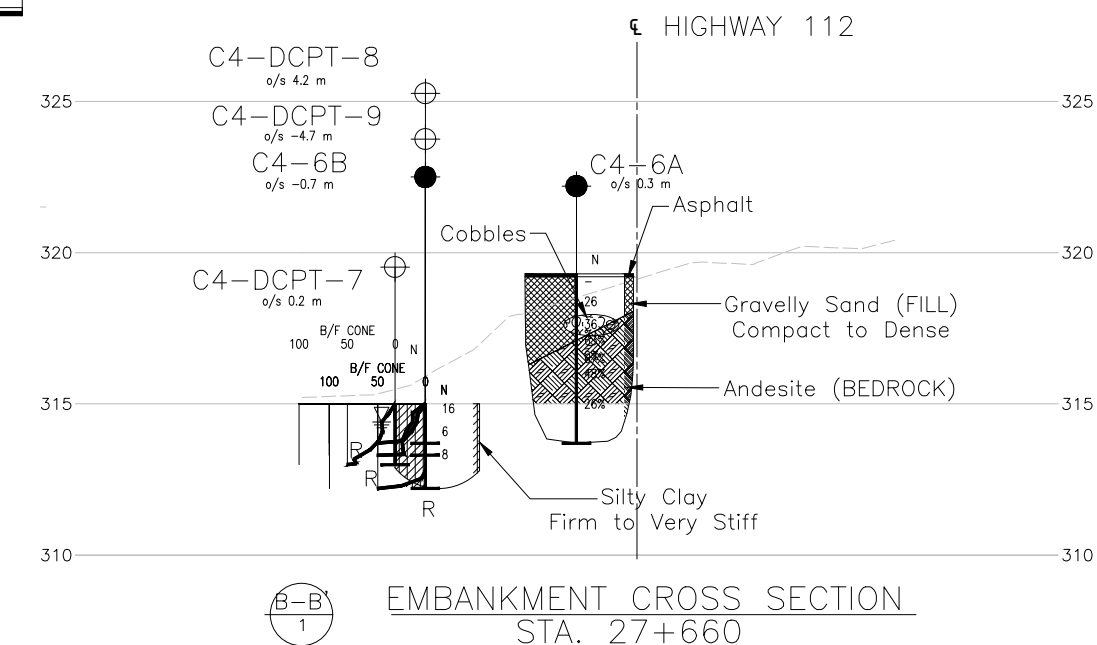
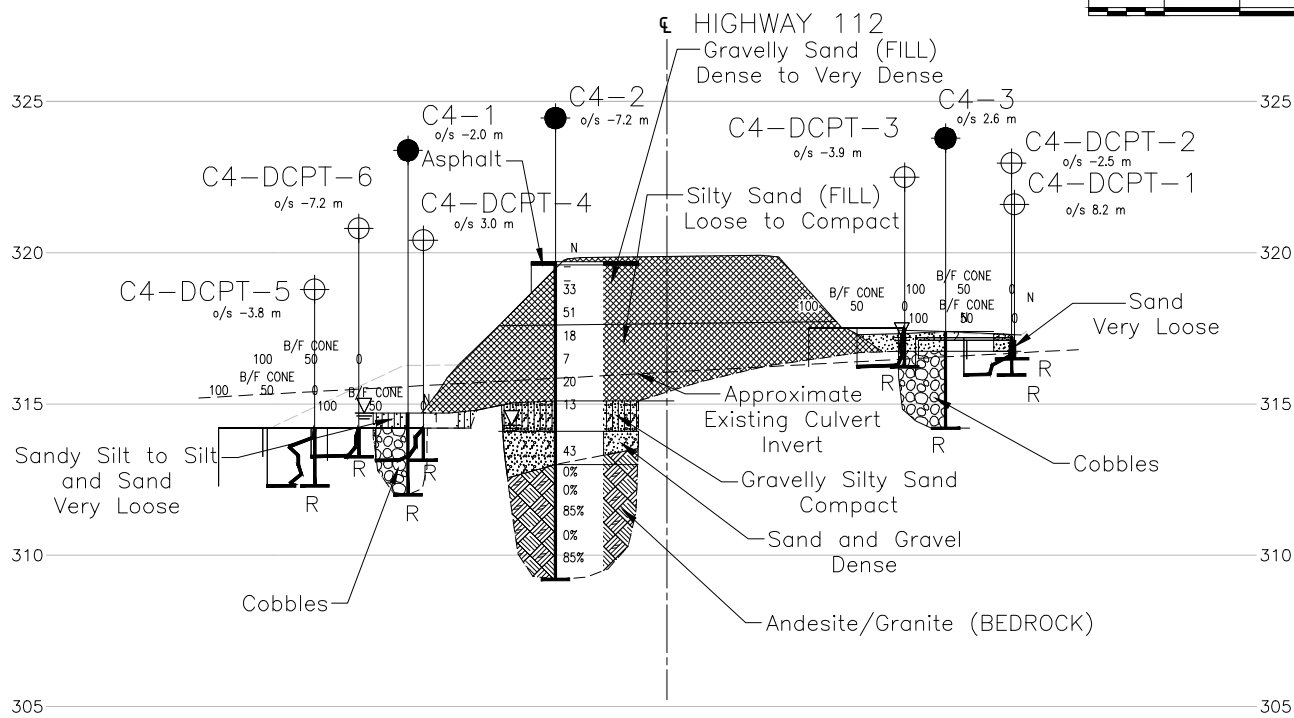
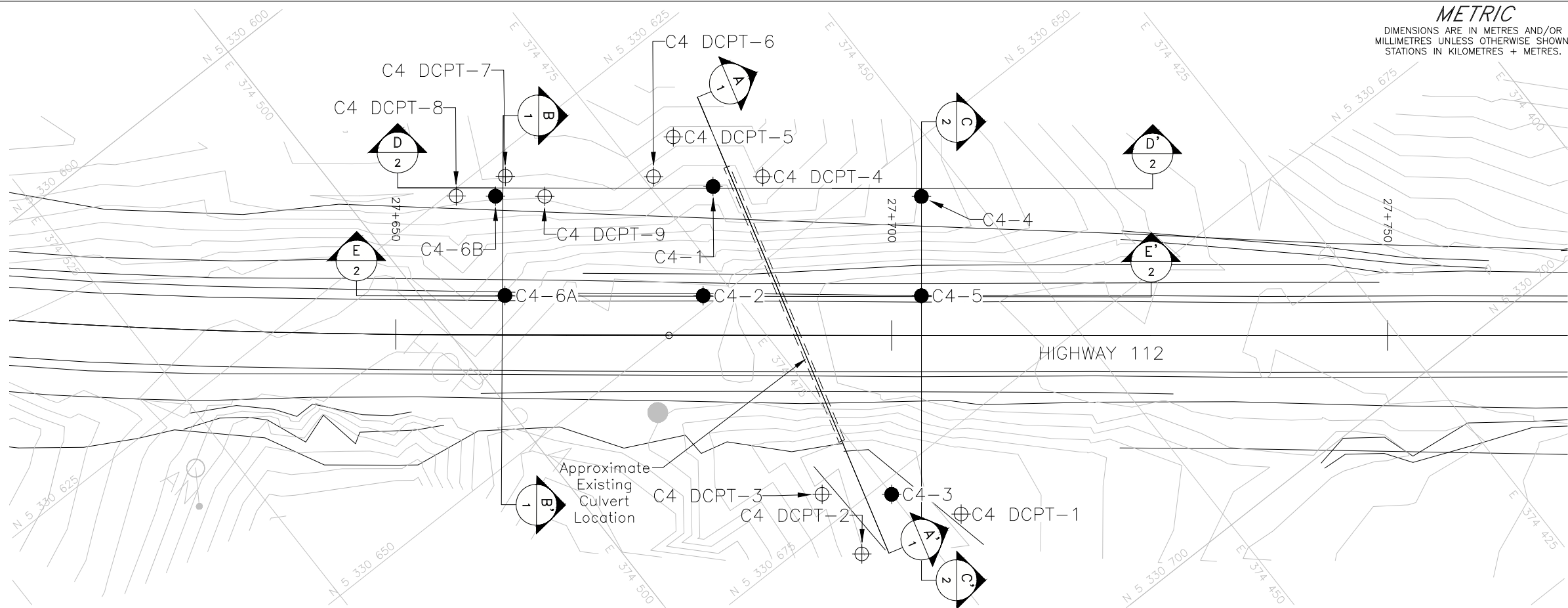
REVISION DATE: February 3, 2017 BY: MCK Project: 1531057

PROJECT		Detail Design for Replacement of 3 Centreline Culverts – Highway 112			
		GWP 5105-12-00; WP 5428-15-01			
TITLE		Site Photographs			
		Culvert STA 27+691 (Township of Teck)			
		Highway 112			
		PROJECT No. 1530157		FILE No. ----	
		DESIGN	MCK	Aug16	SCALE NTS REV.
		CADD	-- --		
		CHECK	CN	Aug 16	
		REVIEW	JMAC	Aug 16	
					FIGURE 1B



FOUNDATION REPORT - CENTRELINE CULVERT REPLACEMENT - HIGHWAY 112 STA 27+691

DRAWINGS



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.

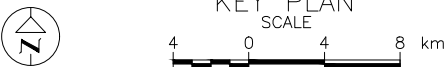
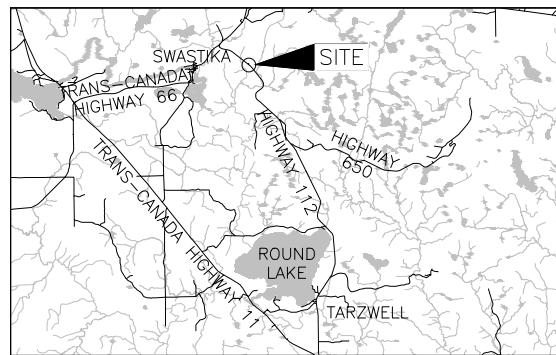
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.



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

CONT No. 5428-15-01
WP No. 5428-15-01

HIGHWAY 112
CULVERT STA. 27+691
BOREHOLE LOCATIONS AND SOIL STRATA



LEGEND

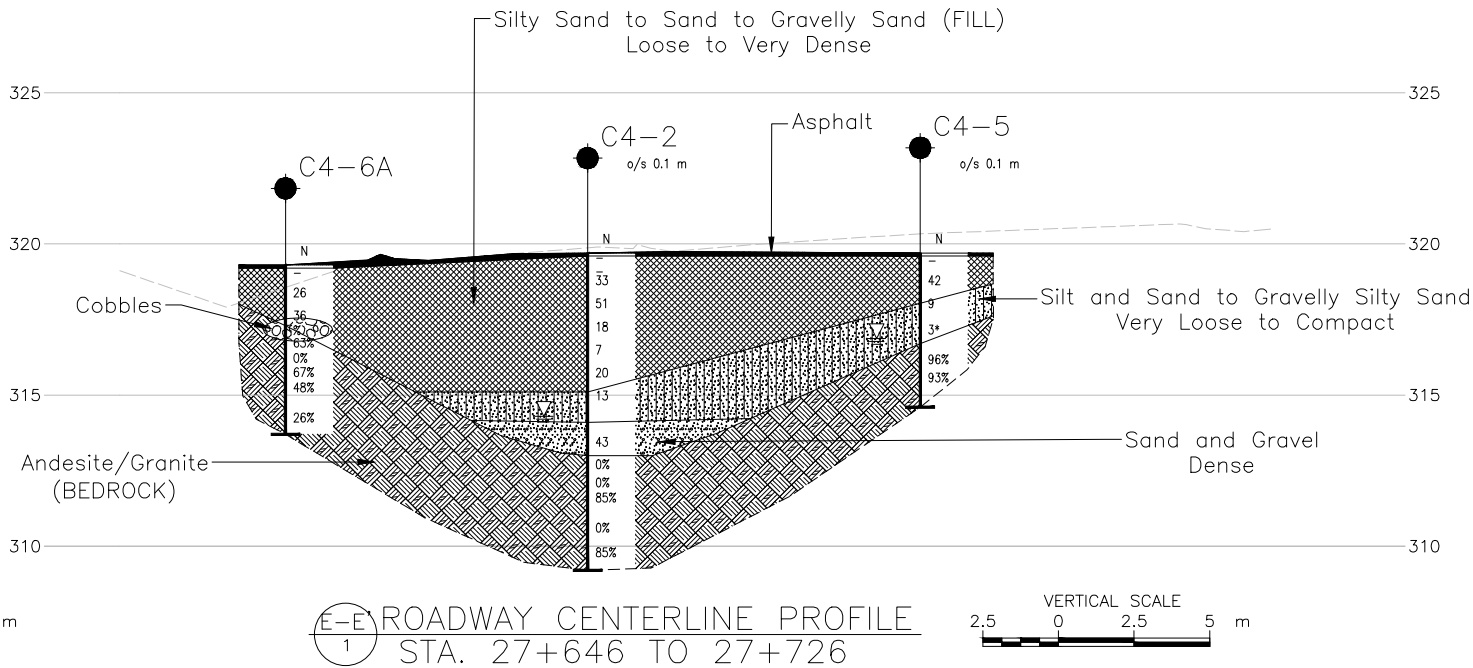
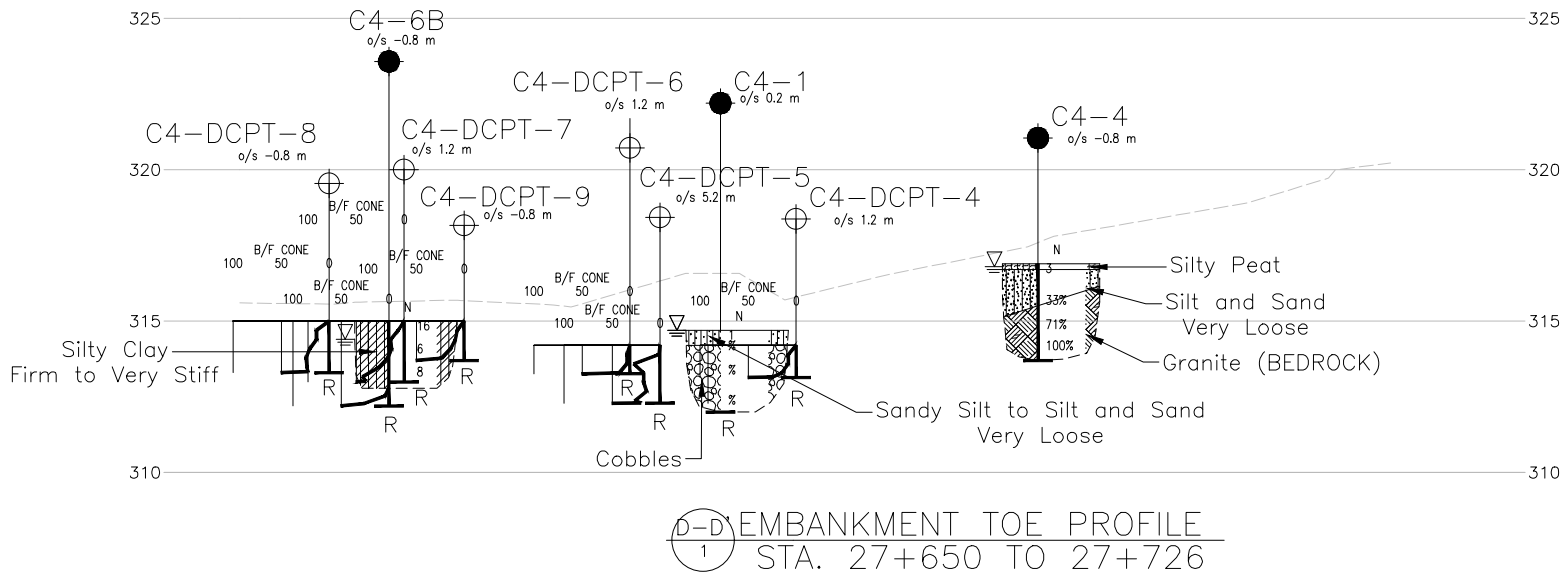
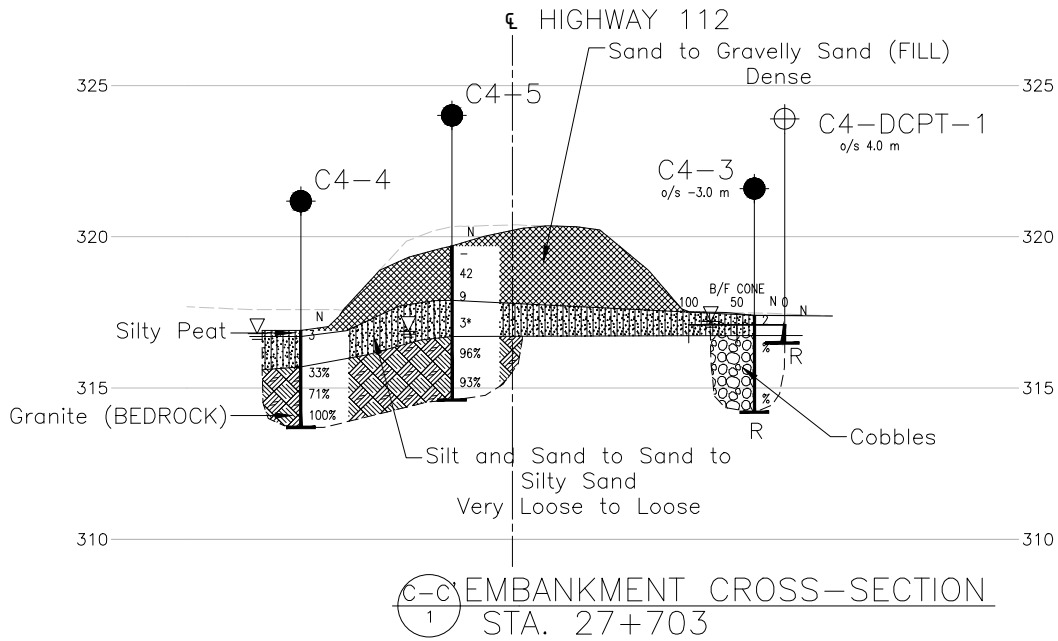
- Borehole - Current Investigation
- ⊕ Dynamic Cone Penetration Test
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- ≡ WL upon completion of drilling
- R Refusal

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
C4-1	314.7	5330640.9	374470.0
C4-2	319.7	5330648.9	374477.6
C4-3	317.4	5330676.4	374475.0
C4-4	316.9	5330654.7	374454.1
C4-5	319.7	5330662.5	374460.3
C4-6A	319.3	5330636.5	374493.3
C4-6B	315.0	5330628.1	374487.8
C4 DCPT-1	317.1	5330682.3	374470.8
C4 DCPT-2	317.2	5330679.2	374481.1
C4 DCPT-3	317.5	5330672.1	374480.5
C4 DCPT-4	314.2	5330643.2	374465.4
C4 DCPT-5	314.2	5330634.5	374470.0
C4 DCPT-6	314.2	5330636.4	374474.1
C4 DCPT-7	315.0	5330627.1	374485.8
C4 DCPT-8	315.0	5330625.6	374490.9
C4 DCPT-9	315.0	5330631.2	374483.9

REFERENCE

Base plan, culvert section and surface data provided in digital format by MTO, drawing file no. "b07590112001.dwg", dated May, 2016, received June 29, 2016.

NO.	DATE	BY	REVISION
Geocres No. 42A-114			
HWY. 112	PROJECT NO. 1531057	DIST. .	
SUBM'D. MK	CHKD. MCK	DATE: 4/4/2017	SITE: .
DRAWN: MR	CHKD. MCK	APPD. JMAC	DWG. 1

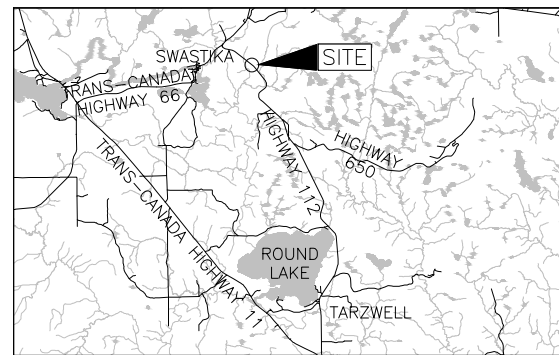


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5428-15-01

HIGHWAY 112
CULVERT STA. 27+691
SOIL STRATA

SHEET



KEY PLAN
SCALE
4 0 4 8 km

LEGEND

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

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
C4-1	314.7	5330640.9	374470.0
C4-2	319.7	5330648.9	374477.6
C4-3	317.4	5330676.4	374475.0
C4-4	316.9	5330654.7	374454.1
C4-5	319.7	5330662.5	374460.3
C4-6A	319.3	5330636.5	374493.3
C4-6B	315.0	5330628.1	374487.8
C4 DCPT-1	317.1	5330682.3	374470.8
C4 DCPT-4	314.2	5330643.2	374465.4
C4 DCPT-5	314.2	5330634.5	374470.0
C4 DCPT-6	314.2	5330636.4	374474.1
C4 DCPT-7	315.0	5330627.1	374485.8
C4 DCPT-8	315.0	5330625.6	374490.9
C4 DCPT-9	315.0	5330631.2	374483.9

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 plan, culvert section and surface data provided in digital format by MTO, drawing file no. "b07590112001.dwg", dated May, 2016, received June 29, 2016.



NO.	DATE	BY	REVISION
Geocres No. 42A-114			
HWY. 112	PROJECT NO. 1531057	DIST. .	
SUBM'D. MK	CHKD. MCK	DATE: 4/4/2017	SITE: .
DRAWN: MR	CHKD. MCK	APPD. JMAC	DWG. 2



**FOUNDATION REPORT - CENTRELINE CULVERT
REPLACEMENT - HIGHWAY 112 STA 27+691**

APPENDIX A

Record of Boreholes



LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

Notes: 1
2

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



LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d :

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

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

III. SOIL DESCRIPTION

(a) Non-Cohesive Soils

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

(b) Cohesive Soils Consistency

	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



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering

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

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

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

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

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

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

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

CORE CONDITION

Total Core Recovery (TCR)

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

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

DISCONTINUITY DATA

Fracture Index

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

Dip with Respect to Core Axis

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

Description and Notes

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

Abbreviations

JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	

PROJECT <u>1531057</u>		RECORD OF BOREHOLE No C4-1		SHEET 1 OF 1		METRIC	
W.P. <u>5428-15-01</u>		LOCATION <u>N 5330640.9; E 374470.0 MTM ZONE</u>		ORIGINATED BY <u>SA</u>			
DIST <u> </u> HWY <u>112</u>		BOREHOLE TYPE <u>Portable Equipment, HQ Casing, NQ Coring (Manual Hammer)</u>		COMPILED BY <u>MR</u>			
DATUM <u>Geodetic</u>		DATE <u>June 9, 2016</u>		CHECKED BY <u>MK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL
								<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>												


PROJECT		1531057		RECORD OF BOREHOLE No C4-2				SHEET 1 OF 1		METRIC						
W.P.		5428-15-01		LOCATION		N 5330648.9; E 374477.6 MTM ZONE		ORIGINATED BY		DM						
DIST		HWY 112		BOREHOLE TYPE		CME 55, 152 mm O.D. Solid Stem Augers		COMPILED BY		MR						
DATUM		Geodetic		DATE		June 6, 2016		CHECKED BY		MK						
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								
319.7	GROUND SURFACE															
0.0	ASPHALT (100 mm)		1	AS	-											
	Gravelly sand, some silt, containing cobbles (FILL) Dense to very dense Brown Moist		2	AS	-											
			3	SS	33											
			4A	SS	51											
317.6			4B													
2.1	Silty sand, trace to some gravel, trace clay, containing cobbles (FILL) Loose to compact Brown to light brown Moist		5	SS	18											
			6	SS	7											
			7	SS	20											
315.1																
4.6	Gravelly Silty SAND, trace clay, containing cobbles Compact Light brown Wet		8	SS	13											
314.1																
5.6	SAND and GRAVEL, some silt, trace clay Dense Brown Wet		9	SS	43											
313.0																
6.7	ANDESITE/GRANITE (BEDROCK)		1	RC	REC 40%											
	Bedrock cored from depths of 6.7 m to 10.5 m. For bedrock coring details refer to Record of Drillhole C4-2.		2	RC	REC 71%											
			3	RC	REC 100%											
			4	RC	REC 100%											
			5	RC	REC 100%											
309.2																
10.5	END OF BOREHOLE															
	NOTES: 1. Water level in open borehole at a depth of 5.4 m below ground surface (Elev. 314.3 m) upon completion of drilling. 2. Geographic Coordinates: Latitude: 48.110906 Longitude: -80.064201															



SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Landcore Drilling Inc.

CHECKED: MK

PROJECT		1531057		RECORD OF BOREHOLE No C4-3				SHEET 1 OF 1		METRIC							
W.P.		5428-15-01		LOCATION		N 5330676.4; E 374475.0 MTM ZONE		ORIGINATED BY		SA							
DIST		HWY 112		BOREHOLE TYPE		Portable Equipment, HQ Casing, NQ Coring (Manual Hammer)		COMPILED BY		MR							
DATUM		Geodetic		DATE		June 7, 2016		CHECKED BY		MK							
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									
317.4	GROUND SURFACE																
0.0	SAND, some gravel, trace silt, trace organics and rootlets Very loose Brown		1	SS	2	▽	317										
316.7	Wet COBBLES between 50 mm and 250 mm in diameter		2	RC	REC 48%		316										
0.7			3	RC	REC 0%		315										
314.2	END OF BOREHOLE CORE BARREL JAMMED																
3.2	NOTES: 1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 317.2 m) upon completion of drilling. 2. Geographic Coordinates: Latitude: 48.111153 Longitude: -80.064230																

PROJECT		1531057		RECORD OF BOREHOLE No C4-4				SHEET 1 OF 1		METRIC									
W.P.		5428-15-01		LOCATION		N 5330654.7; E 374454.1 MTM ZONE		ORIGINATED BY		SA									
DIST		HWY 112		BOREHOLE TYPE		Portable Equipment, HQ Casing (Manual Hammer)		COMPILED BY		MR									
DATUM		Geodetic		DATE		June 9, 2016		CHECKED BY		MK									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)	
316.9	GROUND SURFACE																		
0.0	Silty PEAT, some sand, trace clay		1	SS	3		316												
0.2	Dark brown Moist																		
315.7	SILT and SAND, some gravel, trace to some clay, trace organics and rootlets, containing cobbles Very loose Brown to grey Wet		1	RC	REC 90%			315											RQD = 33%
1.2	GRANITE (BEDROCK)																		
	Bedrock cored from depths of 1.2 m to 3.2 m.		2	RC	REC 100%		314											RQD = 71%	
	For bedrock coring details refer to Record of Drillhole C4-4.		3	RC	REC 100%													RQD = 100%	
313.7	END OF BOREHOLE																		
3.2	NOTES: 1. Water level in open borehole at a depth of 0.1 m below ground surface (Elev. 316.8 m) upon completion of drilling. 2. Geographic Coordinates: Latitude: 48.110960 Longitude: -80.064515																		

PROJECT		1531057		RECORD OF BOREHOLE No C4-5				SHEET 1 OF 1		METRIC							
W.P.		5428-15-01		LOCATION		N 5330662.5; E 374460.3 MTM ZONE		ORIGINATED BY		DM							
DIST		HWY 112		BOREHOLE TYPE		CME 55, 152 mm O.D. Solid Stem Augers		COMPILED BY		MR							
DATUM		Geodetic		DATE		June 6 to 9, 2016		CHECKED BY		MK							
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									
319.7	GROUND SURFACE																
0.0	ASPHALT (100 mm)		1	AS	-												
319.2	Gravelly sand, some slit, some crushed asphalt pieces (FILL)		2	SS	42												
0.5	Brown Moist																
317.9	Sand, some gravel, trace to some silt, containing cobbles (FILL)		3	SS	9												
1.8	Dense Brown Moist																
316.7	SILT and SAND, some gravel, trace to some clay, trace organics and cobbles		4	SS	3*												
3.0	Very loose to loose Brown to light brown Wet																
314.6	GRANITE (BEDROCK)		1	RC	REC 100%												
5.1	Bedrock cored from depths of 3 m to 5.1 m.		2	RC	REC 100%												
	For bedrock coring details refer to Record of Drillhole C4-5.																
314.6	END OF BOREHOLE																
5.1	NOTES: 1. Water level in open borehole at a depth of 2.8 m below ground surface (Elev. 316.9 m) upon completion of drilling. * Split-Spoon Bouncing 2. Geographic Coordinates: Latitude: 48.111030 Longitude: -80.064430																

PROJECT: 1531057

RECORD OF DRILLHOLE: C4-5

SHEET 1 OF 1

LOCATION: N 5330662.5 ;E 374460.3

DRILLING DATE: June 9, 2016

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	FLUSH	JN - Joint FLT - Fault SH - Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN - Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth RO- Rough VR- Very Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										NOTES				
								RECOVERY			FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA					HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q AVG	
								TOTAL CORE %	SOLID CORE %	R.Q.D. %		B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn		K ₁₀ cm/sec			
								80 60 40 20 0	80 60 40 20 0	80 60 40 20 0												
3	NQ RC June 9, 2016	GROUND SURFACE		316.70 3.00																		
		Fresh, crystalline, pink with white banding, medium grained, non-porous, weak to strong GRANITE		1																		
4					2																	
5		END OF DRILLHOLE		314.60 5.10																		
6																						
7																						
8																						
9																						
10																						
11																						
12																						
13																						

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: MK

PROJECT		1531057		RECORD OF BOREHOLE No C4-6A				SHEET 1 OF 1		METRIC							
W.P.		5428-15-01		LOCATION		N 5330636.5; E 374493.3 MTM ZONE		ORIGINATED BY		DM							
DIST		HWY 112		BOREHOLE TYPE		CME 55, 152 mm O.D. Solid Stem Augers		COMPILED BY		MR							
DATUM		Geodetic		DATE		June 9, 2016		CHECKED BY		MK							
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									
319.3	GROUND SURFACE																
0.0	ASPHALT (100 mm)		1	AS	-												
	Gravelly sand, some silt, trace clay, containing cobbles (FILL) Compact to dense Brown Moist		2	SS	26												28 58 12 2
			3	SS	36												
317.3	COBBLES 80 mm in diameter		4	RC	REC 50%												
2.2	ANDESITE (BEDROCK)		1	RC	REC 95%												RQD = 63%
	Bedrock cored from depths of 2 m to 5.6 m.		2	RC	REC 100%												RQD = 0%
	For bedrock coring details refer to Record of Drillhole C4-6A.		3	RC	REC 100%												RQD = 67%
			4	RC	REC 100%												RQD = 48%
			5	RC	REC 100%												RQD = 26%
313.7	END OF BOREHOLE																
5.6	NOTE: 1. Geographic Coordinates: Latitude: 48.110793 Longitude: -80.063992																

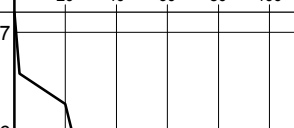
PROJECT <u>1531057</u>		RECORD OF BOREHOLE No C4-6B		SHEET 1 OF 1		METRIC	
W.P. <u>5428-15-01</u>		LOCATION <u>N 5330628.1; E 374487.8 MTM ZONE</u>		ORIGINATED BY <u>SA</u>			
DIST <u> </u> HWY <u>112</u>		BOREHOLE TYPE <u>Portable Equipment, HQ Casing (Manual Hammer)</u>		COMPILED BY <u>MR</u>			
DATUM <u>Geodetic</u>		DATE <u>June 10, 2016</u>		CHECKED BY <u>MK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
315.0	GROUND SURFACE									20	40	60	80	100	20	40	60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

PROJECT <u>1531057</u>		RECORD OF DCPT No C4-DCPT-1		SHEET 1 OF 1		METRIC	
W.P. <u>5428-15-01</u>		LOCATION <u>N 5330682.3; E 374470.8 MTM ZONE</u>		ORIGINATED BY <u>SA</u>			
DIST <u> </u> HWY <u>112</u>		BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)</u>		COMPILED BY <u>MR</u>			
DATUM <u>Geodetic</u>		DATE <u>June 8, 2016</u>		CHECKED BY <u>MK</u>			

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
317.1	GROUND SURFACE																
0.0	Dynamic Cone Penetration Test (DCPT)						317										
316.5	END OF DCPT REFUSAL TO FURTHER PENETRATION (20 Blows / 0.01 m) (HAMMER BOUNCING)																
0.6	NOTE: 1. Geographic Coordinates: Latitude: 48.111207 Longitude: -80.064287																

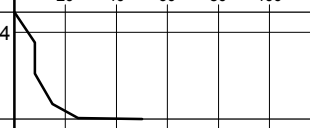
GTA-MTO 001 S:\CLIENTS\MTOWHWY_112\02_DATA\GINT\HWY_112.GPJ GAL-GTA.GDT 24/03/17

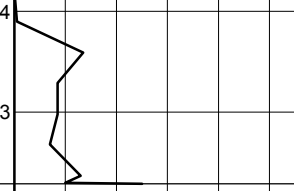
PROJECT <u>1531057</u>		RECORD OF DCPT No C4-DCPT-2				SHEET 1 OF 1		METRIC										
W.P. <u>5428-15-01</u>		LOCATION <u>N 5330679.2; E 374481.1 MTM ZONE</u>				ORIGINATED BY <u>SA</u>												
DIST <u> </u> HWY <u>112</u>		BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)</u>				COMPILED BY <u>MR</u>												
DATUM <u>Geodetic</u>		DATE <u>June 8, 2016</u>				CHECKED BY <u>MK</u>												
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa										
317.2	GROUND SURFACE						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE </div> <div style="display: flex; justify-content: space-between;"> ● QUICK TRIAXIAL × REMOULDED </div>											
0.0	Dynamic Cone Penetration Test (DCPT)					317												
316.0	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows / 0.02 m) (HAMMER BOUNCING)					316												
1.2	NOTE: 1. Geographic Coordinates: Latitude: 48.111179 Longitude: -80.064148																	

GTA-MTO 001 S:\CLIENTS\MTOWHY_112\02_DATA\GINT\HWY_112.GPJ GAL-GTA.GDT 24/03/17

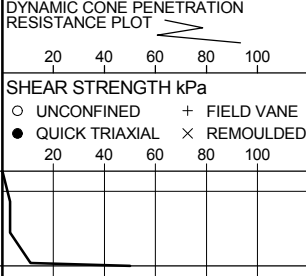
PROJECT		RECORD OF DCPT No C4-DCPT-3				SHEET 1 OF 1		METRIC									
W.P. 5428-15-01		LOCATION N 5330672.1; E 374480.5 MTM ZONE				ORIGINATED BY SA											
DIST _____ HWY 112		BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)				COMPILED BY MR											
DATUM Geodetic		DATE June 8, 2016				CHECKED BY MK											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
317.5	GROUND SURFACE						20	40	60	80	100						
0.0	Dynamic Cone Penetration Test (DCPT)						20	40	60	80	100						
316.2	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows / 0.05 m) (HAMMER BOUNCING)						20	40	60	80	100						
1.3	NOTE: 1. Geographic Coordinates: Latitude: 48.111114 Longitude: -80.064157																

GTA-MTO 001 S:\CLIENTS\MTOWHY_112\02_DATA\GINT\HWY_112.GPJ GAL-GTA.GDT 24/03/17

PROJECT <u>1531057</u>		RECORD OF DCPT No C4-DCPT-4				SHEET 1 OF 1		METRIC									
W.P. <u>5428-15-01</u>		LOCATION <u>N 5330643.2; E 374465.4 MTM ZONE</u>				ORIGINATED BY <u>SA</u>											
DIST <u> </u> HWY <u>112</u>		BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)</u>				COMPILED BY <u>MR</u>											
DATUM <u>Geodetic</u>		DATE <u>June 9, 2016</u>				CHECKED BY <u>MK</u>											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
314.2	GROUND SURFACE						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED </div>										
0.0	Dynamic Cone Penetration Test (DCPT)					314											
313.1	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows / 0.01 m) (HAMMER BOUNCING)																
1.1	NOTE: 1. Geographic Coordinates: Latitude: 48.110856 Longitude: -80.064364																

PROJECT 1531057										RECORD OF DCPT No C4-DCPT-5										SHEET 1 OF 1										METRIC									
W.P. 5428-15-01										LOCATION N 5330634.5; E 374470.0 MTM ZONE										ORIGINATED BY SA																			
DIST _____ HWY 112										BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)										COMPILED BY MR																			
DATUM Geodetic										DATE June 9, 2016										CHECKED BY MK																			
SOIL PROFILE					SAMPLES					GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)																		
ELEV DEPTH	DESCRIPTION				STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					W _p W W _L			γ	GR SA SI CL																			
314.2 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)									314	<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE </div> <div style="display: flex; justify-content: space-between;"> ● QUICK TRIAXIAL × REMOULDED </div>					<div style="display: flex; justify-content: space-between;"> 20 40 60 20 40 60 </div>																							
312.3 1.9	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows / 0.01 m) (HAMMER BOUNCING)									313																													
NOTE: 1. Geographic Coordinates: Latitude: 48.110777 Longitude: -80.064304																																							

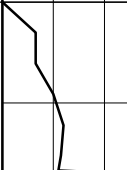
GTA-MTO 001 S:\CLIENTS\MTOWHY_112\02_DATA\GINT\HWY_112.GPJ GAL-GTA.GDT 24/03/17

PROJECT 1531057		RECORD OF DCPT No C4-DCPT-6				SHEET 1 OF 1		METRIC								
W.P. 5428-15-01		LOCATION N 5330636.4; E 374474.1 MTM ZONE				ORIGINATED BY SA										
DIST _____ HWY 112		BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)				COMPILED BY MR										
DATUM Geodetic		DATE June 9, 2016				CHECKED BY MK										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
314.2 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					314										
313.3 0.9	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows / 0.02 m) (HAMMER BOUNCING) NOTE: 1. Geographic Coordinates: Latitude: 48.110794 Longitude: -80.064250															

GTA-MTO 001 S:\CLIENTS\MTOWHY_112\02_DATA\GINT\HWY_112.GPJ GAL-GTA.GDT 24/03/17

PROJECT		RECORD OF DCPT No C4-DCPT-7				SHEET 1 OF 1		METRIC									
W.P. 5428-15-01		LOCATION N 5330627.1; E 374485.8 MTM ZONE				ORIGINATED BY SA											
DIST _____ HWY 112		BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)				COMPILED BY MR											
DATUM Geodetic		DATE June 9, 2016				CHECKED BY MK											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
315.0	GROUND SURFACE						20	40	60	80	100						GR SA SI CL
0.0	Dynamic Cone Penetration Test (DCPT)																
313.0	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows / 0.02 m) (HAMMER BOUNCING)																
2.0	NOTE: 1. Geographic Coordinates: Latitude: 48.110709 Longitude: -80.064094																

GTA-MTO 001 S:\CLIENTS\MTOWHY_112\02_DATA\GINT\HWY_112.GPJ GAL-GTA.GDT 24/03/17

PROJECT <u>1531057</u>										RECORD OF DCPT No C4-DCPT-8										SHEET 1 OF 1										METRIC																													
W.P. <u>5428-15-01</u>										LOCATION <u>N 5330625.6; E 374490.9 MTM ZONE</u>										ORIGINATED BY <u>SA</u>																																							
DIST <u> </u> HWY <u>112</u>										BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)</u>										COMPILED BY <u>MR</u>																																							
DATUM <u>Geodetic</u>										DATE <u>June 9, 2016</u>										CHECKED BY <u>MK</u>																																							
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																																	
315.0	GROUND SURFACE															20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L 20 40 60					kN/m ³					GR SA SI CL																												
0.0	Dynamic Cone Penetration Test (DCPT)														314																																												
313.3	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows / 0.02 m) (HAMMER BOUNCING)																																																										
1.7	NOTE: 1. Geographic Coordinates: Latitude: 48.110695 Longitude: -80.064025																																																										

PROJECT		RECORD OF DCPT No C4-DCPT-9				SHEET 1 OF 1		METRIC										
W.P. 1531057		LOCATION N 5330631.2; E 374483.9 MTM ZONE				ORIGINATED BY SA												
DIST _____ HWY 112		BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test (Manual Hammer)				COMPILED BY MR												
DATUM Geodetic		DATE June 9, 2016				CHECKED BY MK												
SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
315.0	GROUND SURFACE							20	40	60	80	100						
0.0	Dynamic Cone Penetration Test (DCPT)							20	40	60	80	100						
313.7							314											
1.3	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows / 0.08 m) (HAMMER BOUNCING) NOTE: 1. Geographic Coordinates: Latitude: 48.110746 Longitude: -80.064118																	



APPENDIX B

Geotechnical Laboratory Test Results

TABLE B1
SUMMARY OF POINT LOAD TESTS ON ROCK SAMPLES

PROJECT NO. 1531057						
DATE July, 2016						
Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)
C4-4	2	1.8	313.1	Granite	Diametral	4.0
C4-4	2	1.7	313.2	Granite	Axial	7.1
C4-6A	1	2.7	316.6	Andesite	Diametral	8.9

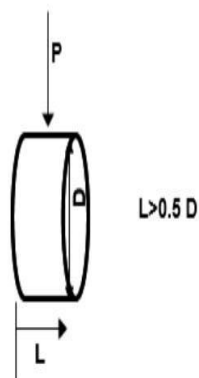
⁽¹⁾ $Is_{50} \times C$ (actual value will have to be confirmed by UCS testing), from ISRM ("Suggested Methods for Determining Point Load Strength", International Society for Rock Mechanics Commission on Testing Methods, Int. J. Rock. Mech. Min. Sci. and Geomechanical Abstr., Vol 22, No. 2 1985, pp. 51-60.

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

DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

note: Diametral tests are perpendicular to core axis

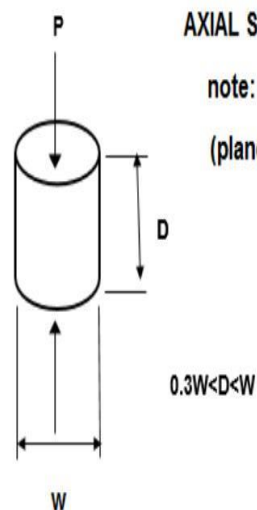
(planes of weakness)



AXIAL SPECIMEN SHAPE REQUIREMENTS

note: Axial tests are parallel to core axis

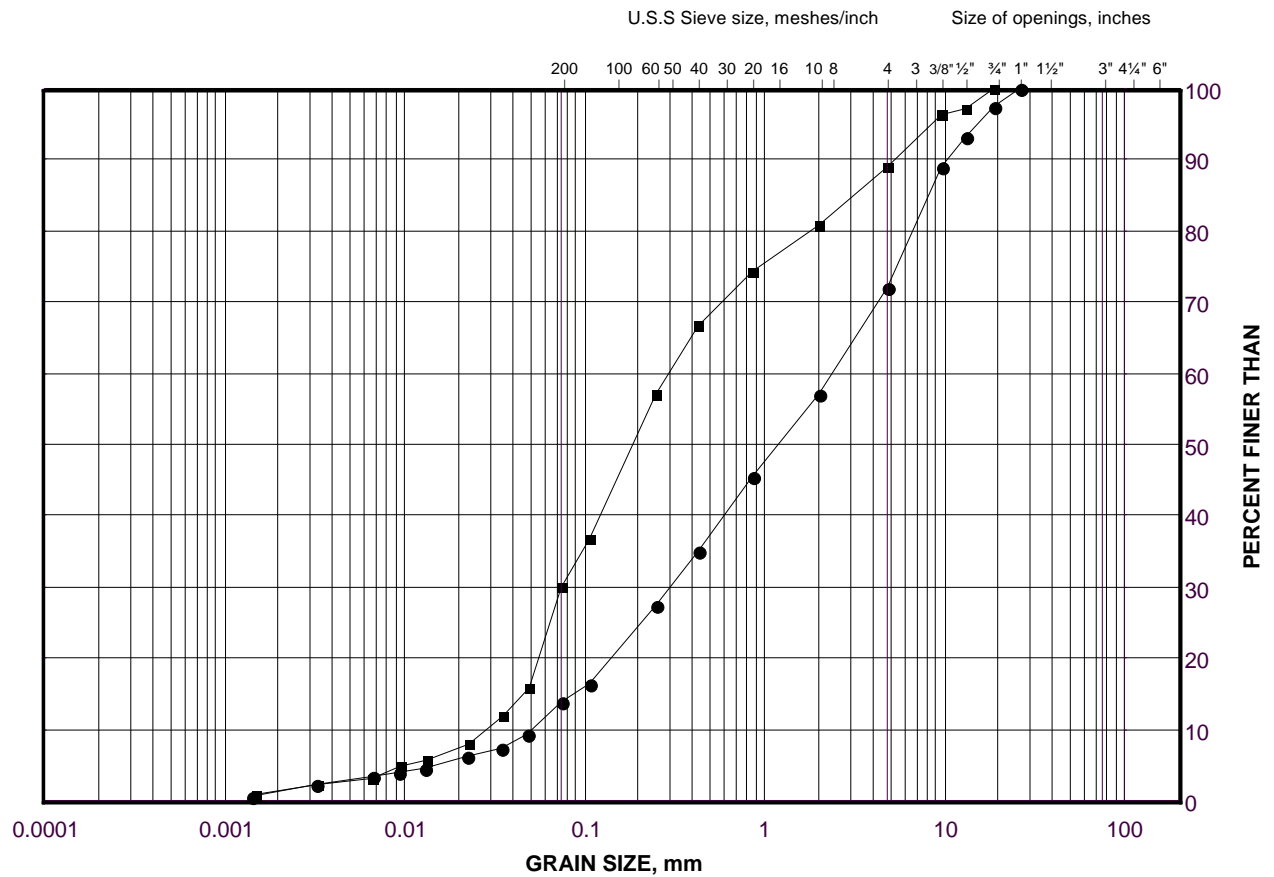
(planes of weakness)



GRAIN SIZE DISTRIBUTION

Silty Sand and Gravelly Sand (FILL)

FIGURE B1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C4-6A	2	318.2
■	C4-2	5	317.1

Project Number: 1531057

Checked By: CN

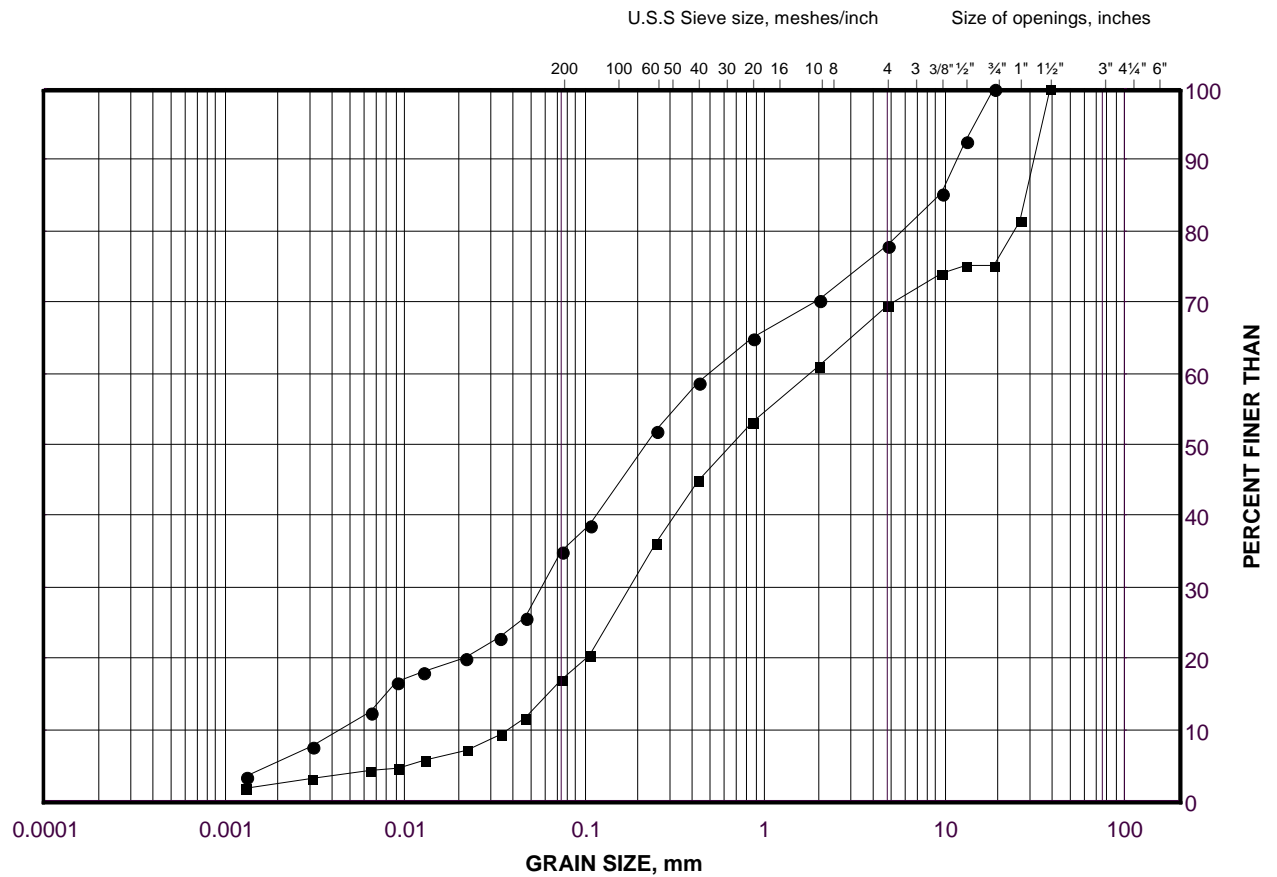
Golder Associates

Date: 03-Feb-17

GRAIN SIZE DISTRIBUTION

Gravelly Silty Sand and Sand and Gravel

FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	C4-2	8	314.8
■	C4-2	9	313.3

Project Number: 1531057

Checked By: CN

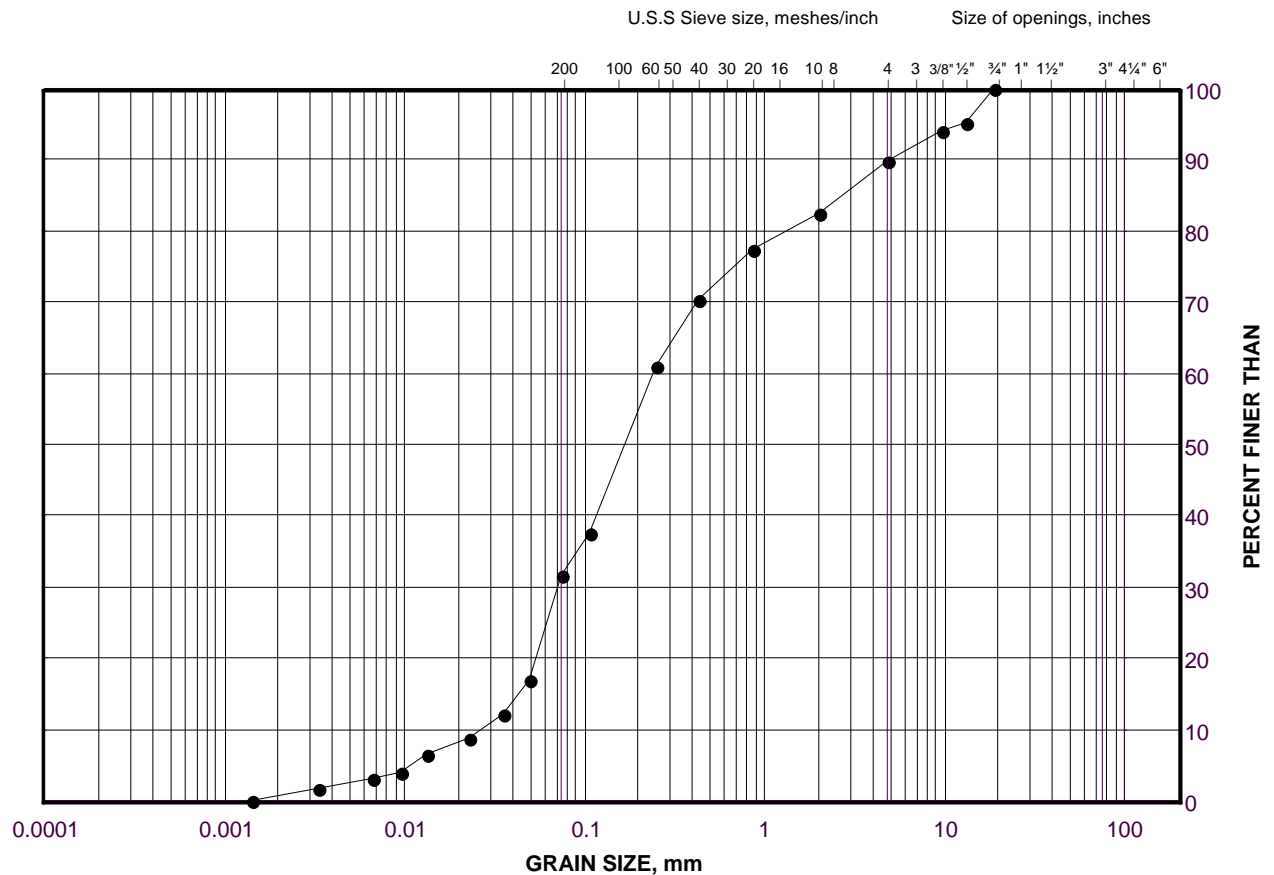
Golder Associates

Date: 03-Feb-17

GRAIN SIZE DISTRIBUTION

Silt and Sand

FIGURE B3



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C4-5	4	317.0

Project Number: 1531057

Checked By: CN

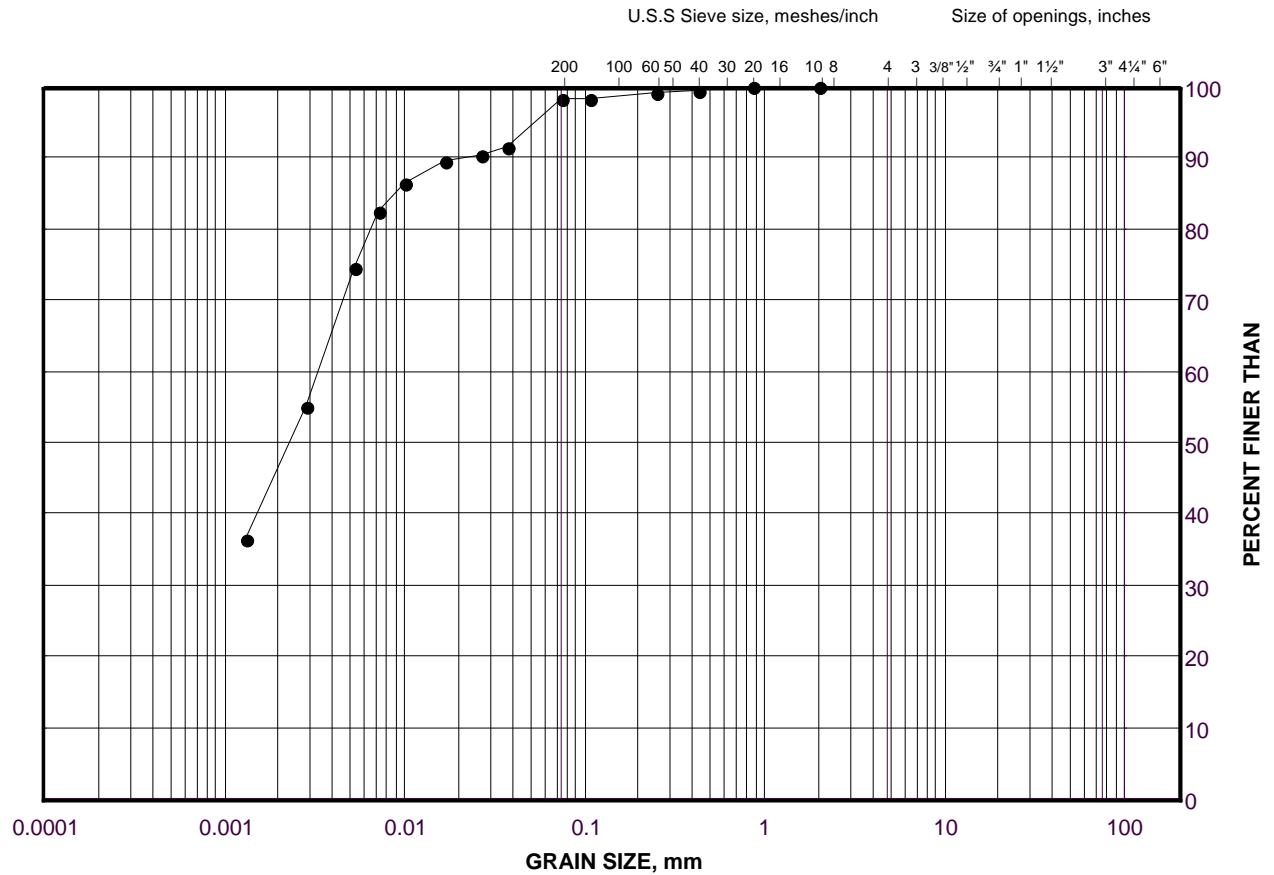
Golder Associates

Date: 03-Feb-17

GRAIN SIZE DISTRIBUTION

Silty Clay

FIGURE B4



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

LEGEND

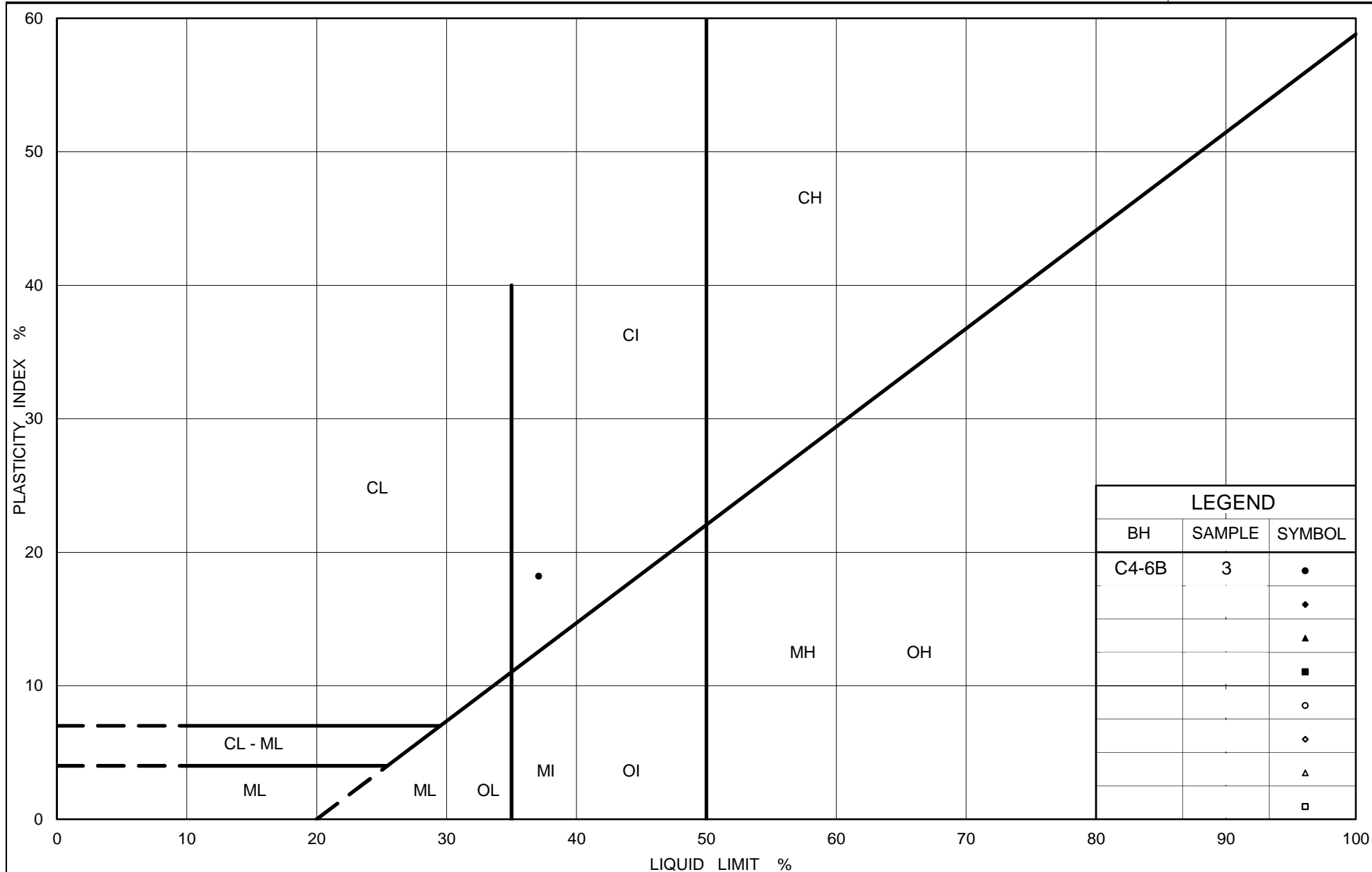
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	C4-6B	3	313.2

Project Number: 1531057

Checked By: CN

Golder Associates

Date: 03-Feb-17



Ministry of Transportation

Ontario

PLASTICITY CHART

Silty Clay

Figure No. B5

Project No. 1531057

Checked By: CN

Borehole C4-2



Box 1: 6.70 m – 10.50 m

Borehole C4-4



Box 1: 1.20 m – 3.20 m

Borehole C4-5



Box 1: 3.0 m – 5.10 m

Borehole C4-6A



Box 1: 2.0 m – 5.60 m

0 m	0.25 m	0.5 m	0.75 m	1.0 m	1.25 m	1.5 m
0 ft	1 ft	2 ft	3 ft	4 ft	5 ft	

Scale

PROJECT					
Detail Design for Replacement of Centreline Culvert– Highway 112 WP 5428-15-01					
TITLE					
Bedrock Core Photographs – Highway 112 Boreholes C4-2 and C4-4 to C4-6A					
PROJECT No. 1531057			FILE No. ----		
DESIGN	MK	AUG 16	SCALE	NTS	REV.
CADD	--		FIGURE B6		
CHECK	CN	AUG 16			
REVIEW	JMAC	AUG 16			

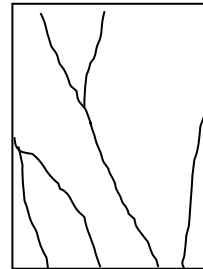


UNCONFINED COMPRESSION TEST (UC)**Figure B7****ASTM D7012**

SAMPLE IDENTIFICATION			
PROJECT NUMBER	1531057	SAMPLE NUMBER	Run 3
PROJECT NAME	MMM/5015-E-0003/LV Retainer NE	SAMPLE DEPTH, m	8.64-8.79
BOREHOLE NUMBER	C4-2	DATE:	2016-07-19

TEST CONDITIONS			
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.06

SPECIMEN INFORMATION			
SAMPLE HEIGHT, cm	9.74	WATER CONTENT, (specimen) %	0.09
SAMPLE DIAMETER, cm	4.73	UNIT WEIGHT, kN/m ³	26.79
SAMPLE AREA, cm ²	17.55	DRY UNIT WT., kN/m ³	26.77
SAMPLE VOLUME, cm ³	170.84	SPECIFIC GRAVITY	-
WET WEIGHT, g	466.90	VOID RATIO	-
DRY WEIGHT, g	466.48		

VISUAL INSPECTION**FAILURE SKETCH**

TEST RESULTS			
STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	12.9

REMARKS:

Checked By: CN

Golder Associates



APPENDIX C

Analytical Test Results

Your Project #: 1531057
Site Location: LV RETAINER NER ASSIGN#2, HWY 112
Your C.O.C. #: 565300-01-01

Attention:Chris Ng

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

Report Date: 2016/06/20
Report #: R4035051
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6C1265

Received: 2016/06/13, 11:35

Sample Matrix: Water
Samples Received: 4

Analyses	Date		Date Analyzed	Laboratory Method	Reference
	Quantity	Extracted			
Chloride by Automated Colourimetry	4	N/A	2016/06/16	CAM SOP-00463	EPA 325.2 m
Conductivity	4	N/A	2016/06/16	CAM SOP-00414	SM 22 2510 m
pH	4	N/A	2016/06/16	CAM SOP-00413	SM 4500H+ B m
Resistivity of Water	4	2016/06/14	2016/06/17	CAM SOP-00414	SM 22 2510 m
Sulphate by Automated Colourimetry	4	N/A	2016/06/16	CAM SOP-00464	EPA 375.4 m

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

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

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.

Maxxam Job #: B6C1265
Report Date: 2016/06/20

Golder Associates Ltd
Client Project #: 1531057
Site Location: LV RETAINER NER ASSIGN#2, HWY 112
Sampler Initials: SA

RESULTS OF ANALYSES OF WATER

Maxxam ID		CNJ774	CNJ775	CNJ776	CNJ777			
Sampling Date		2016/06/12 11:00	2016/06/12 10:45	2016/06/12 07:45	2016/06/12 07:40			
COC Number		565300-01-01	565300-01-01	565300-01-01	565300-01-01			
	UNITS	C1	C2	C3	C4	RDL	QC Batch	MDL
Calculated Parameters								
Resistivity	ohm-cm	21000	7900	28000	7000		4538726	
Inorganics								
Conductivity	umho/cm	48	130	36	140	1.0	4541542	0.20
pH	pH	6.72	7.11	7.16	7.46		4541543	
Dissolved Sulphate (SO ₄)	mg/L	<1.0	<1.0	<1.0	<1.0	1.0	4541170	0.10
Dissolved Chloride (Cl)	mg/L	2.0	24	1.3	15	1.0	4541163	0.30
RDL = Reportable Detection Limit								
QC Batch = Quality Control Batch								

TEST SUMMARY

Maxxam ID: CNJ774
Sample ID: C1
Matrix: Water

Collected: 2016/06/12
Shipped:
Received: 2016/06/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	4541163	N/A	2016/06/16	Alina Dobreanu
Conductivity	AT	4541542	N/A	2016/06/16	Yogesh Patel
pH	AT	4541543	N/A	2016/06/16	Yogesh Patel
Resistivity of Water		4538726	2016/06/17	2016/06/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4541170	N/A	2016/06/16	Deonarine Ramnarine

Maxxam ID: CNJ775
Sample ID: C2
Matrix: Water

Collected: 2016/06/12
Shipped:
Received: 2016/06/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	4541163	N/A	2016/06/16	Alina Dobreanu
Conductivity	AT	4541542	N/A	2016/06/16	Yogesh Patel
pH	AT	4541543	N/A	2016/06/16	Yogesh Patel
Resistivity of Water		4538726	2016/06/17	2016/06/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4541170	N/A	2016/06/16	Deonarine Ramnarine

Maxxam ID: CNJ776
Sample ID: C3
Matrix: Water

Collected: 2016/06/12
Shipped:
Received: 2016/06/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	4541163	N/A	2016/06/16	Alina Dobreanu
Conductivity	AT	4541542	N/A	2016/06/16	Yogesh Patel
pH	AT	4541543	N/A	2016/06/16	Yogesh Patel
Resistivity of Water		4538726	2016/06/17	2016/06/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4541170	N/A	2016/06/16	Deonarine Ramnarine

Maxxam ID: CNJ777
Sample ID: C4
Matrix: Water

Collected: 2016/06/12
Shipped:
Received: 2016/06/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	4541163	N/A	2016/06/16	Alina Dobreanu
Conductivity	AT	4541542	N/A	2016/06/16	Yogesh Patel
pH	AT	4541543	N/A	2016/06/16	Yogesh Patel
Resistivity of Water		4538726	2016/06/17	2016/06/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4541170	N/A	2016/06/16	Deonarine Ramnarine

Maxxam Job #: B6C1265
Report Date: 2016/06/20

Golder Associates Ltd
Client Project #: 1531057
Site Location: LV RETAINER NER ASSIGN#2, HWY 112
Sampler Initials: SA

GENERAL COMMENTS

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

Package 1	9.3°C
-----------	-------

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1531057
Site Location: LV RETAINER NER ASSIGN#2, HWY 112
Sampler Initials: SA

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4541163	Dissolved Chloride (Cl)	2016/06/16	NC	80 - 120	101	80 - 120	<1.0	mg/L	0.024	20
4541170	Dissolved Sulphate (SO ₄)	2016/06/16	NC	75 - 125	104	80 - 120	<1.0	mg/L	4.3	20
4541542	Conductivity	2016/06/16			102	85 - 115	<1.0	umho/cm	1.9	25
4541543	pH	2016/06/16			101	98 - 103			1.2	N/A

N/A = Not Applicable

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 spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of 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).

Cristina Carriere

Cristina Carriere, Scientific Services

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.

<div style="display: flex; justify-content: space-between;"> <div> Maxxam <small>A Maxxam Analytics International Corporation o/a Maxxam Analytics</small> <small>6740 Campbell Road, Mississauga, Ontario Canada L5N 2L8 Tel (905) 817-5700 Toll-Free (800) 563-6266 Fax (905) 817-5777 www.maxxam.ca</small> </div> <div> CHAIN OF CUSTODY RECORD </div> </div>										Page / of /					
INVOICE TO: Company Name: #1326 Golder Associates Ltd Attention: Central Acct: 1112, 1113, 1118 Address: 6925 Century Ave Suite 100 Mississauga ON L5N 7K2 Tel: (905) 567-4444 Fax: (905) 567-6561 Email: Catherine_Guido@golder.com, Rachel_Benjamin@gol			REPORT TO: Company Name: _____ Attention: _____ Address: _____ Tel: _____ Fax: _____ Email: _____			PROJECT INFORMATION: Quotation #: B52596 P.O. #: _____ Project: 1531057 Project Name: LV Retainer NER Assign #2 Site #: HWY 112 Sampled By: S.A. + D.M.			Laboratory Use Only: Maxxam Job #: _____ Bottle Order #: _____ COC #: _____ Project Manager: _____ Ema Gitej						
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY						ANALYSIS REQUESTED (PLEASE BE SPECIFIC)									
Regulation 153 (2011) <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table _____			Other Regulations <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA Municipality _____ <input type="checkbox"/> PWQO <input type="checkbox"/> Other _____			Special Instructions _____			Field Filtered (please circle): Metals / Hg / Cr-VI Chloride & Sulphate Conductivity, Resistivity and pH			Turnaround Time (TAT) Required: Please provide advance notice for rush projects 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. <input checked="" type="checkbox"/>			
Include Criteria on Certificate of Analysis (Y/N)? _____						Job Specific Rush TAT (if applies to entire submission) Date Required: _____ Time Required: _____ Rush Confirmation Number: _____ (call lab for #)									
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix								# of Bottles	Comments		
1	C1	June 12/16	11:00AM	Surface Water								1	small pottle (~3" deep) NOT Flowing		
2	C2	June 12/16	10:45AM	"								1			
3	C3	June 12/16	7:50AM	"								1			
4	C4	June 12/16	7:40AM	"								1			
5															
6															
7															
8															
9															
10															
* RELINQUISHED BY: (Signature/Print) _____ Shane Albert		Date: (YY/MM/DD) 16/06/13		Time 11:35am		RECEIVED BY: (Signature/Print) _____ Bradley Frappier		Date: (YY/MM/DD) 16/06/13		Time 11:35		# jars used and not submitted _____		Laboratory Use Only Time Sensitive: _____ Temperature (°C) on Receipt: 9, 10, 9°C Custody Seal: Present <input checked="" type="checkbox"/> Intact <input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input checked="" type="checkbox"/>	
<small>* 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.</small>										<small>SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM</small>				<small>White: Maxxam Yellow: Client</small>	

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

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

