Foundation Investigation Report

East-West Active Transport Bridge Along Credit River Bridge, QEW Widening from West of Mississauga Road to West of Hurontario Street, Mississauga Ministry of Transportation, Ontario, GWP 2002-13-00

Submitted to:

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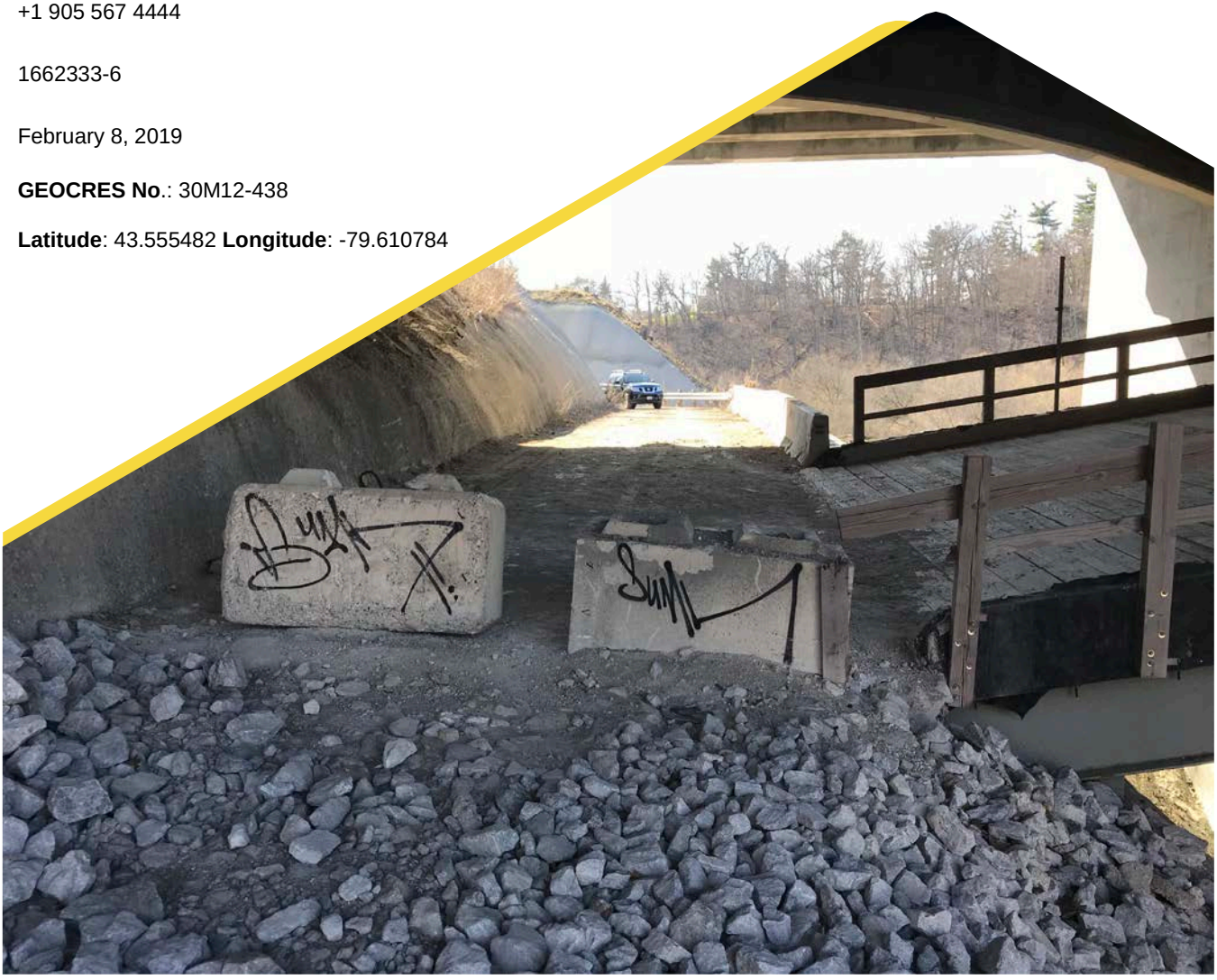
February 8, 2019

GEOCRES No.: 30M12-438

Latitude: 43.555482 **Longitude**: -79.610784



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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services associated with the proposed East-West Active Transport (E-W AT) bridge in support of the widening of the Queen Elizabeth Way (QEW) from west of Mississauga Road to west of Hurontario Street in the City of Mississauga, in the Regional Municipality of Peel, Ontario.

The purpose of this investigation is to establish the subsurface (soil, bedrock and groundwater) conditions at the proposed E-W AT bridge abutment locations, by borehole drilling, rock coring and geotechnical / analytical laboratory testing of selected soil and bedrock core samples.

The Terms of Reference (TOR) and the Scope of Work for the foundation investigation are outlined in MTO's Request for Proposal, dated July 2016 and the approved Change Request letter dated February 20, 2018, which forms part of the Consultant's Assignment Number (2015-E-0033) for this project. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated February 3, 2017.

2.0 SITE DESCRIPTION

At the E-W AT bridge site, the QEW is generally oriented in a northeast-southwest direction; for the purpose of this report the QEW is described as being in an east-west orientation. The abutments for the proposed E-W AT bridge will be located beneath the existing Credit River bridge, which is located approximately 400 m east of the QEW-Mississauga Road interchange and approximately 1.4 km west of the QEW - Hurontario Street interchange and crosses the Credit River Valley floodplain and river channel.

The existing Credit River bridge is an approximately 256 m long and 29 m wide, seven-span structure, with concrete arches between the piers, supporting six lanes of traffic. The base of the Credit River Valley is located about 19 m below the surrounding plateau beyond the abutments. The ground surface at the east and west plateau at the top of the valley (and on the highway near the abutments) is at about Elevation 95 m. The bridge west abutment and piers are reportedly supported on shallow foundations seated on / into the bedrock; but the east abutment may possibly have been founded on stiff to hard till or hard residual soil deposits, overlying the bedrock.

At the west side of the valley, a construction access road was constructed in 2006. The access road alignment was cut through the shale bedrock and shotcrete was applied to the exposed rock faces. The access road splits into an upper access road which leads to the underside of the bridge at the west abutment, and a lower access road which extends down to the base of the valley near the area of Pier 1. The upper access road (in the area of the north side of the existing bridge) is oriented parallel to the west abutment and the surface of the road is at about Elevation 89 m (see Photograph 1). At the existing west abutment shotcrete was applied to the front slope, above the upper access road surface (see Photograph 2). The downslope side of the upper access road is supported by a concrete "Lock-Block[1]" retaining wall (see Photograph 3). The west valley slope (between the abutment and access roads) descends near vertical to meet the flood plain of the Credit River Valley. The west plateau is relatively flat and vegetated mainly with tall grass and some shrubs.

[1] Trademark of United Lock-Block Ltd.

The east slope of the valley beneath the existing Credit River bridge has soil exposed at the ground surface between the east abutment of the existing Credit River bridge and Pier 6 and contains rip rap on the ground surface between Piers 5 and 6. The east valley slope descends to meet the east bank of the Credit River at a slope of about 2.1 Horizontal to 1 Vertical (2.1H:1V) (see Photograph 4), but there are locally steeper sections, immediately adjacent to the Credit River, that are inclined at approximately 1.4H:1V.

In 2011, a raised construction access deck was built along and beneath the existing QEW Credit River Bridge structure as shown in Profile A-A' on Drawing 1. It is understood that the existing raised access deck will be re-purposed for the proposed E-W AT bridge structure.

3.0 INVESTIGATION PROCEDURES

3.1 Previous Investigations

A foundation investigation was completed in 1933 for the original bridge by the Department of Highways of Ontario and a total of eight boreholes were advanced, one borehole at each abutment and pier of the existing Credit River bridge. The subsurface conditions encountered at each borehole location are shown on the Department of Highways, Ontario (DHO) Drawing No. D-2241-1 dated November 21, 1933 and revised on December 26, 1933 and April 26, 1934 presented in Appendix A. The drawing provides ground surface elevations at the borehole locations, as well as the depths of the soil and rock strata; however, the locations of the boreholes in plan are not shown on the drawing.

Three boreholes (Hole No. 1, No. 2 and No. 7), advanced on the alignment of the existing Credit River bridge as part of the DHO investigation in 1933, are considered relevant to the proposed E-W AT bridge. Details of the location, ground surface elevation and borehole depth, including the length of rock coring are provided below. As plan locations of the boreholes are not available, the coordinates of the boreholes have been based on an assumed location at the centre of the existing piers as shown on Drawing 1.

Borehole No.	Location	Location (MTM NAD 83, Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
		Northing (Latitude, °)	Northing (Latitude, °)		
Hole No. 1	Existing West Abutment	4,824947.0 (43.555406)	295,846.5 (-79.610821)	93.1	3.0 (includes approx. 1.5 m of bedrock coring)
Hole No. 2	Existing Pier 1	4,823,965.6 (43.555573)	295,865.3 (-79.610589)	79.3	6.4 (includes 3.0 m of bedrock coring)
Hole No. 7	Existing Pier 6	4,824,148.4 (43.557220)	295,952.2 (-79.609516)	87.5	7.1 (includes 2.5 m of bedrock coring)

A foundation investigation for the west access road was carried out by Thurber Engineering Ltd. (Thurber) from September to November 2010, during which time a total of seven boreholes, designated as Boreholes 10-01 to 10-05, 10-03A and 10-03B were advanced at the site.

The results of the Thurber investigation are contained in their report titled:

- "Foundation Investigation and Design Report, Construction Access Road for Bridge Rehabilitation, QEW Bridge over Credit River, Mississauga, Ontario" File No. 19-92-92-174, dated April 8, 2011 (GEOCRES No. 30M12-324).

A preliminary foundation investigation for the new Credit River Bridge was carried out by Thurber in May and June 2011, during which time a total of two boreholes, designated as Boreholes 11-01 and 11-02, were advanced at the proposed west abutment and west pier for the proposed Credit River bridge, respectively at the locations shown on Drawing 1.

The results of the Thurber investigation are contained in their report titled:

- "Foundation Investigation and Design Report, Preliminary Design and Environmental Assessment, QEW Bridge Twinning Over Credit River, Mississauga, Ontario" File No. 19-1351-174, dated May 18, 2012 (GEOCRES No. 30M12-341).

While the Thurber reports do not reference the coordinate system of the borehole locations, it is inferred that they are referenced to the MTM NAD 83 (Zone 10) coordinate system based on the plotted position relative to that reference system. While a total of nine boreholes were drilled by Thurber in the west access road area, only one borehole, Borehole 10-03A, is considered relevant to the proposed E-W AT bridge structure as it was advanced on the bridge alignment about 30 m east of the proposed west abutment. The location of the relevant borehole advanced by Thurber is shown on Drawing 1, and the borehole record and the summary of the laboratory testing results from their investigation are presented in Appendix A. The borehole location, ground surface elevation in Geodetic Datum, and the drilled depth as presented on the Thurber borehole record are summarized below.

Borehole No.	Location (MTM NAD 83, Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (Latitude, °)	Easting (Longitude, °)		
10-03A	4,823,979.0 (43.555694)	295,865.1 (-79.610592)	76.2	4.3 (split-spoon sampled 0.6 m into bedrock)

3.2 Current Investigation

The field work for the current foundation investigation was carried out on May 1 and 2, 2018 during which time a total of two boreholes, designated as Boreholes EW-1 and EW-2, were advanced near the footprint of the proposed west and east abutments respectively, at the locations shown on Drawing 1. In addition, the current investigation at the E-W AT bridge site is supplemented with Borehole CRB-2, located on the south side of the west abutment for the proposed new Credit River bridge, with Boreholes NW5-5 and NW5-5A which are located within about 1 m of each other on the south side of the west abutment for the existing Credit River bridge, and Borehole NW6-1 located on the south side of the east abutment for the existing Credit River bridge. These four boreholes were advanced by Golder as part of the investigation for the new Credit River bridge and associated noise barrier walls.

The borehole investigation was carried out using a track-mounted CME 55 drill rig, supplied and operated by Geo-Environmental Drilling Inc., of Acton, Ontario. The boreholes were advanced through the overburden using 159 mm outer diameter hollow stem augers and 'HQ' casing. Soil samples were obtained at 0.75 m intervals of depth,

using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedures ASTM D1586-08)[2]. Core samples of the bedrock encountered in the boreholes were obtained by coring techniques using an 'HQ', 90 mm O.D., size rock core barrel. Boreholes EW-1 and EW-2 were advanced to depths of 11.2 m and 9.7 m, including coring of bedrock for core lengths of 6.3 m and 6.7 m, respectively.

The groundwater conditions and water levels in the open boreholes were observed during and immediately following drilling operations. Boreholes EW-1 and EW-2 were backfilled with cement-bentonite grout to 3.0 m and 1.5 m respectively, below ground surface and with bentonite pellets (hole plug) to ground surface upon completion of drilling in accordance with Ontario Regulation 903, Wells (as amended).

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

Selected bedrock core samples were submitted to Maxxam, a Standards Council of Canada (SCC) accredited laboratory of Mississauga, Ontario for chemical analysis. One sample of bedrock core from each of Boreholes EW-01 and EW-02, were crushed and homogenized by Maxxam prior to testing, and analyzed for a suite of corrosivity parameters, including conductivity, resistivity, soluble chloride, soluble sulphate and pH.

The boreholes were advanced beneath the existing structure which precluded obtaining coordinates using a GPS. The ground surface elevation at the borehole locations was estimated by obtaining the elevation of a point north of the existing bridge that visually appeared to be at about the same elevation using a GPS (Trimble XH 3.5G), having an accuracy of 0.1 m in the vertical direction. The elevation data obtained by the GPS was then compared to the elevation data obtained from the Digital Terrain Model to check that the ground surface elevation at the borehole locations was consistent between the two methods utilized.

The locations given in the Record of Borehole / Drillhole sheets and shown on Drawing 1 are positions relative to MTM NAD 83 (Zone 10) northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, geographic coordinates, ground surface elevations and drilled depths are summarized below.

[2] ASTM D1586-08a – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the soil.

Borehole No.	Location (MTM NAD 83)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (m) (Latitude, °)	Easting (m) (Longitude, °)		
EW-1	4,823,955.5 (43.555482)	295,849.5 (-79.610784)	88.5	11.2 (includes 6.3 m of bedrock coring)
EW-2	4,824,156.8 (43.557295)	295,956.2 (-79.609467)	89.1	9.7 (includes 6.7 m of bedrock coring)
CRB-2	4,823,949.7 (43.555430)	295,828.3 (-79.611047)	95.6	12.8 (incl. 9.6 m rock core)
NW5-5	4,823,932.6 (43.555242)	295,852.6 (-79.610833)	95.8	9.2 (incl. 4.6 m penetration into bedrock by augering / spilt-spoon sampling)
NW5-5A	4,823,930.6 (43.555219)	295,851.9 (-79.610772)	95.8	8.6 (incl. 4.8 m rock core)
NW6-1	4,824,163.1 (43.557371)	295,975.2 (-79.609278)	95.3	7.5

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The project area is located within the Iroquois Plain physiographic region, as delineated in *The Physiography of Southern Ontario* (Chapman and Putman, 1984)[3].

The glacial Iroquois Plain stretches along the northern shoreline of Lake Ontario, extending from the Niagara Escarpment in the west to the Scarborough Bluffs in the east. The Iroquois Plain soils consist of glaciolacustrine sediments deposited in Lake Iroquois, primarily sands, silts and gravels, with a shallow cover of till remaining over the bedrock.

The bedrock of the Georgian Bay Formation that underlies the study area consists mainly of blue-grey shale, containing siltstone, sandstone and limestone interbeds. Outcrops of this formation are commonly found along water courses on the west side of Toronto and in Mississauga, notably in the Humber River, Mimico Creek, Etobicoke Creek and Credit River valleys.

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

4.2 Subsurface Conditions

The detailed subsurface soil, bedrock and groundwater conditions as encountered in the boreholes advanced during the current investigation(s) and the results of the laboratory tests carried out on selected soil and bedrock core samples are presented on the Record of Borehole and Drillhole sheets provided in Appendix B. It is noted that Record of Borehole and Drillhole sheets for Boreholes CRB-2, NW5-5 and NW5-5A are included in Appendix B of this report to primarily supplement the bedrock information; the overburden conditions encountered in these boreholes are not discussed in Section 4.2. Photographs of the recovered bedrock core samples are presented on Figures B-1 and B-2 in Appendix B. The results of the in-situ field tests (i.e. SPT "N" values) as presented on the Record of Borehole sheets of the current investigation and in sub-sections of Section 4.2 are uncorrected. Lists of abbreviations and symbols and lithological and geotechnical work description terminology are also included in Appendix B to assist in the interpretation of the borehole and drillhole records. The results of the geotechnical laboratory testing on soil and bedrock core samples obtained during the current investigation are presented in Appendix C. The results of the analytical testing are presented in Appendix C.

The stratigraphic boundaries shown on the Record of Borehole sheets and on the stratigraphic profiles on Drawings 1 and 2 are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil and rock types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations; however, the factual data presented on the record of Borehole and Drillhole sheets governs any interpretation of the site conditions. It should be noted that the interpreted stratigraphy shown on Drawings 1 and 2 is a simplification of the subsurface conditions.

In general, the subsurface conditions in the area of the west and east abutments of the proposed bridge abutments consist of fill underlain by gravelly sandy clayey silt till. The till deposit is underlain by shale bedrock. A more detailed description of the subsurface conditions encountered in the boreholes from the investigation is provided in the following sections.

4.2.1 Fill

Fill was encountered in Boreholes EW-1 and EW-2; it is variable in composition, ranging from cohesive to non-cohesive materials.

Cohesive fill consisting of sandy clayey silt was encountered at ground surface in Borehole EW-2 and extends to a depth of about 0.7 m below ground surface (Elevation 88.4 m). An SPT "N"- value measured in the cohesive fill is 13 blows per 0.3 m of penetration, suggesting a stiff consistency.

A non-cohesive fill deposit consisting of sand and gravel was encountered at ground surface in Borehole EW-1 and underlying the cohesive fill in Borehole EW-2, with thickness of 4.3 m and 0.2 m, respectively. It is noted that the split-spoon samples (#3 and #4) obtained at 1.8 m and 2.7 m depths from Borehole EW-1 contained pieces (fragments) of geotextile-like material inferred to be a piece of the geotextile-grid used for reinforcement of the Lock-Block retaining wall reinforced mass. The SPT "N"- values measured within the non-cohesive fill in Borehole EW-1 range from 26 blows to 39 blows per 0.3 m of penetration, indicating a compact to dense compactness condition.

Grain size distribution tests were carried out on three samples of the non-cohesive fill material and the results are shown on Figure C-1 in Appendix C. The non-cohesive fill is comprised of sand and gravel and contains trace to some silt, and trace clay. The non-cohesive fill encountered in Borehole EW-1, is associated with the backfill within the Retained Soil System (RSS) zone behind the concrete "Lock-Block" retaining wall. Fragments of geotextile,

associated with the concrete “Lock-Block” retaining wall construction, were encountered at depths of 1.5 m and 2.9 m within the fill in Borehole EW-1. The water content measured on four samples of the non-cohesive fill ranges between about 2 per cent and 6 per cent.

4.2.2 Gravelly Sandy Clayey Silt to Gravelly Clayey Silt with Sand (Till)

Underlying the fill in Boreholes EW-1 and EW-2, a till deposit was encountered at depths of about 4.3 m and 0.9 m (at Elevations 84.2 m and 88.2 m), respectively. The till deposit is 0.3 m and 1.3 m thick in the respective boreholes and the deposit extends to the bedrock surface at depths of 4.6 m and 2.2 m below ground surface (Elevations 83.9 m and 86.9 m) in Boreholes EW-1 and EW-2, respectively.

The SPT “N”-values measured within the cohesive till deposit are 9 blows and 17 blows per 0.3 m of penetration, suggesting that the cohesive till deposit has a stiff to very stiff consistency.

A grain size distribution test was carried out on a select sample of the till deposit and the result is shown on Figure C-2 in Appendix C. An Atterberg limits test was carried out on one sample of the cohesive till deposit and measured a liquid limit of about 29 per cent, a plastic limit of about 19 per cent, and a plastic index of about 10 per cent. The result is shown on Figure C-3 in Appendix C, and indicates that the cohesive till consists of clayey silt of low plasticity.

The natural water content measured on three samples of the cohesive till deposit range from about 13 per cent to 17 per cent.

4.2.3 Bedrock

Bedrock was encountered and core samples were recovered in Boreholes EW-1 and EW-2. Bedrock was encountered in Borehole 10-03A (from the 2010 Thurber investigation), by split-spoon sampling and was also encountered and cored in Hole No. 1, Hole No. 2 and Hole No. 7 advanced during the 1933 foundation investigation carried out by the DHO. The depths to bedrock below ground surface, and the corresponding bedrock surface elevation, and the cored depths are summarized below.

Foundation Element	Borehole	Ground Surface Elevation (m)	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Comments
Proposed West Abutment for E-W AT	EW-1	88.5	4.6	83.9	0.3 m split-spoon penetration; Bedrock Cored 6.3 m
Proposed Noise Barrier Wall (south side of existing west abutment)	NW5-5A	95.8	3.8	92.0	0.4 m split-spoon penetration; Bedrock Cored 4.4 m
Proposed West Abutment Credit River Bridge	CRB-2	95.6	3.2	92.4	Bedrock cored 9.6 m

Foundation Element	Borehole	Ground Surface Elevation (m)	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Comments
West Abutment of Existing Credit River bridge	Hole No. 1	93.1	1.5	91.6	Bedrock cored approx. 1.5 m
Existing Pier 1	Hole No. 2[1]	79.3	4.6	74.7	Bedrock cored 3.0 m
Approx.30 m East of West Abutment	10-03A	76.2	3.7	72.5	0.6 m split-spoon penetration
Existing Pier 6	Hole No. 7[1]	87.5	5.1	82.4	Bedrock cored 3.0 m
Proposed East Abutment for E-W AT	EW-2	89.1	2.2	86.9	0.8 m split-spoon penetration; Bedrock Cored 6.7 m

Note:
1. Borehole advanced by the DHO Foundation Investigation in 1933.

Based on a review of the bedrock core samples from the current investigation and description of the bedrock from the previous investigation(s), the bedrock consists of shale of the Georgian Bay Formation. In general, the bedrock samples are described as slightly weathered to fresh, thinly laminated to medium bedded, fine grained, faintly porous, very weak to weak, grey, with strong to very strong limestone interbeds at varying intervals of depth, as presented in the Record of Borehole and the Record of Drillhole sheets and photographs of the recovered bedrock core samples on Figures B-1 and B-2 in Appendix B. The degree of weathering of the bedrock samples (i.e. slightly weathered to fresh - W1) and the strength classification of the intact rock mass based on field identification (i.e. weak – R2) are described in accordance with the International Society for Rock Mechanics (ISRM)[4] standard classification system.

The Rock Quality Designation (RQD) measured on the core samples ranges from about 70 per cent to about 100 per cent, indicating a rock mass of fair to excellent quality, as per Table 3.10 of the Canadian Foundation Engineering Manual (CFEM)2006[5]. The Total Core Recovery (TCR) of samples recovered ranges from 22 per cent to 100 per cent. The Solid Core Recovery (SCR) from the samples recovered ranges from 84 per cent to 100 per cent.

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

[5] Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual (CFEM), 4th Edition. The Canadian Geotechnical Society, BiTech Published Ltd., British Columbia.

Unconfined Compression (UC) tests (ASTM D7012)[6] were carried out on two selected core samples; one sample of the shale bedrock and one sample of the interbedded limestone. The uniaxial compressive strength (UCS), bulk density and tangent Young's modulus of the intact samples are summarized below, and the details are presented in the Rock Laboratory test Results reports from Geomechanica Inc. in Appendix C.

Borehole No.	Sample Depth Interval (m)	Sample Elevation Interval (m)	Uniaxial Compressive Strength (UCS) (MPa)	Bulk Density (g/cm^3)	Tangent Young's Modulus (GPa)
EW-1[1](Run #3)	7.26 – 7.43	80.44 – 80.27	156.8	2.66	35.7
EW-2 (Run #2)	4.89 – 5.09	84.2 – 84.0	16.1	2.62	3.4

Note: [1]Specimen consists of limestone.

Based on the laboratory UCS values, in accordance with Table 3.5 in CFEM 2006, the shale bedrock is classified as weak (R2, 5 MPa < UCS < 25 MPa) and the limestone interlayers are classified as very strong (R5, 100 MPa < UCS < 250 MPa).

4.2.4 Groundwater Conditions

The overburden samples obtained from the current investigation were generally dry to moist. The open boreholes were observed to be dry upon completion of soil drilling and prior to rock coring. The water levels recorded in the standpipe piezometer installed at the east and west abutments for the proposed Credit River bridge installed during the current investigation are presented below:

Foundation Unit	Borehole	Stratum Well Sealed Into	Water Level Depth (m)	Water Elevation (m)	Date of Piezometer Reading
East Abutment for the Proposed Credit River bridge	CRB-6	Shale Bedrock	5.6	86.0	November 12, 2017
			5.0	86.7	March 12, 2018
			4.9	86.8	April 30, 2018
West Abutment for the Proposed Credit River bridge	CRB-2	Sand Fill / Clayey Silt (Residual Soil)	2.6	93.0	March 12, 2018
			2.6	93.0	April 30, 2018

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

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

4.2.5 Analytical Testing Results

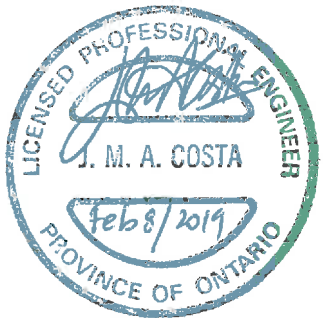
Two samples of crushed homogenized shale bedrock core were submitted to an analytical laboratory for testing of parameters used to assess the potential corrosivity of the site bedrock to steel and concrete. The following summarizes the results of testing and the detailed analytical laboratory test report is included in Appendix C.

Parameter	Borehole EW-1 Run 3 (7.20 m to 7.26 m)	Borehole EW-2 Run 1 (3.38 m to 3.51 m)
pH	8.28	8.00
Resistivity (ohm-cm)	1,800	1,300
Electrical Conductivity (umho/cm)	561	794
Chlorides (ug/g)	110	130
Soluble Sulphates (ug/g)	250	630

5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Katelyn Nero, and was reviewed by Ms. Sandra McGaghran, M.Eng., P.Eng., a senior geotechnical engineer and Associate with Golder. Mr. Jorge Costa, P.Eng., an MTO Foundations Designated Contact and a Senior Consultant with Golder conducted an independent and quality control review of the report.

Golder Associates Ltd.



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KN/DM/SMM/JPD/JMAC/rb

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

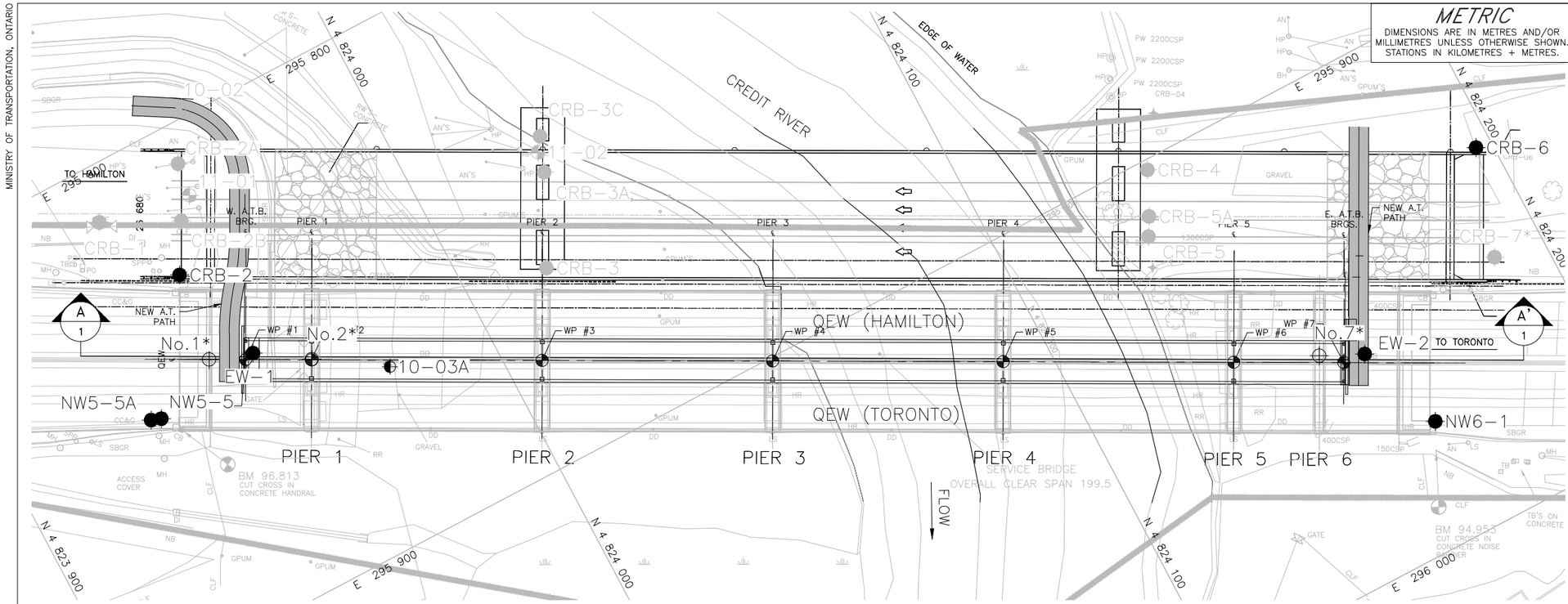
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. 2019-2016
GWP No. 2002-13-00

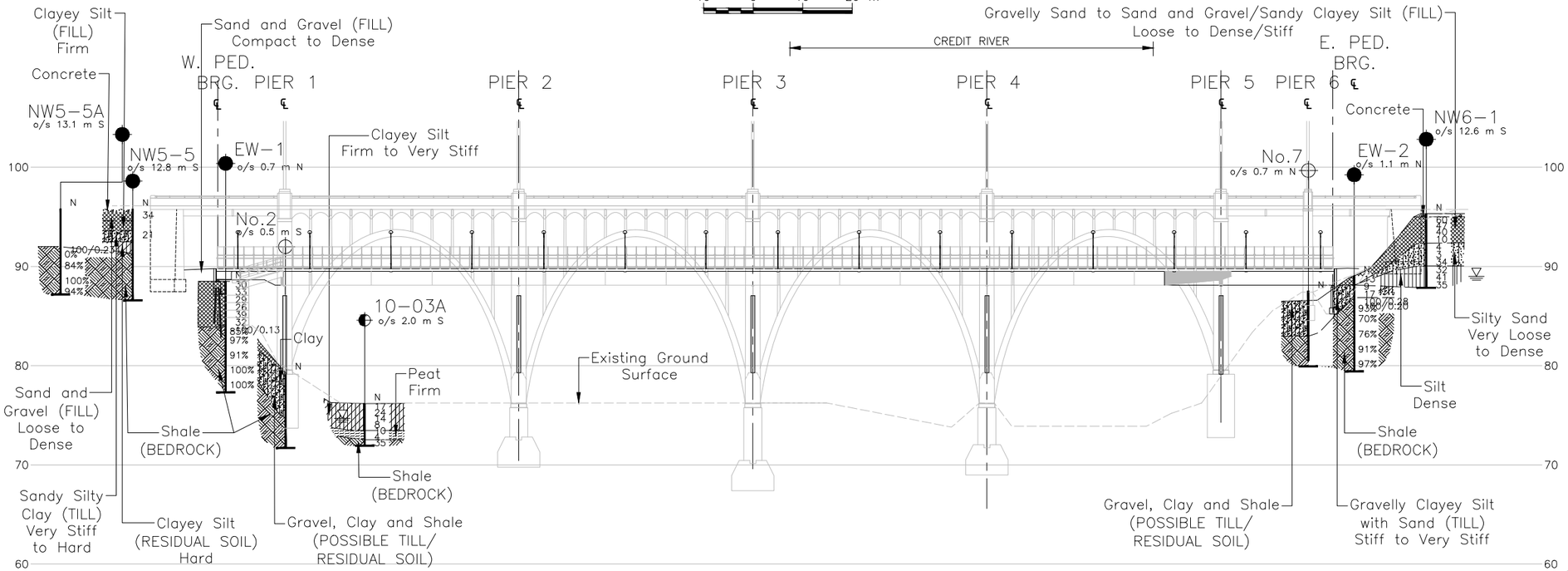
QEW WIDENING MISSISSAUGA RD TO HURONTARIO ST
E-W AT BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET .

GOLDER

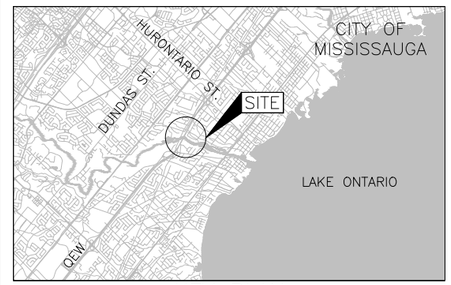


PLAN
SCALE
10 0 10 20 m



A-A' 1 E-W AT BRIDGE PROFILE A-A'

HORIZONTAL SCALE 10 0 10 20 m
VERTICAL SCALE 5 0 5 10 m



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

- Borehole – Current Investigation
- Borehole – (Geocres 30M12-341)
- Borehole – (Geocres 30M12-324)
- Borehole – (Dept. of Highways of Ontario archived drawing D-2241-1, 1993)
- 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

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
10-03A	76.2	4823979.0	295865.1
CRB-2	95.6	4823949.7	295828.3
CRB-6	91.7	4824196.7	295929.5
EW-1	88.5	4823955.5	295849.5
EW-2	89.1	4824156.8	295956.2
No.1*	93.1	4823947.0	295846.5
No.2*	79.3	4823965.6	295856.3
No.7*	87.5	4824148.4	295952.2
NW5-5	95.8	4823932.6	295852.6
NW5-5A	95.8	4823930.6	295851.9
NW6-1	95.3	4824163.1	295975.2

NOTES

* Northing and Easting for Borehole No.1, No.2 and No.7 based on assumption that borehole was advanced at the centre of the existing structure.

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plans provided in digital format by Morrison Hershfield, drawing file no. X11609340Base.dwg, received April 12, 2018. General Arrangement plan and profile provided in digital format by Morrison Hershfield, drawing file no. 01.GENERAL ARRANGEMENT (for Golder).dwg, received April, 13, 2018, 1160934-01 – GENERAL ARRANGEMENT-2018-05-15, received May 15, 2018 and 1160934-01 – GENERAL ARRANGEMENT.dwg, received January 16, 2019.
RSS Wall, anchors and micropile shown on this drawing at the proposed west abutment are based on Drawing SH15, prepared by RWH Engineering Inc. (RWH) and T.H. O'Rourke Structural Consultants, dated March to August 2011 (Project No. J11-022).

LICENSED PROFESSIONAL ENGINEER J.M.A.COSTAR Feb. 08, 2019 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER S. McGaghran Feb. 08, 2019 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 30M12-438

HWY. QEW		PROJECT NO. 1662333	DIST. CENTRAL
SUBM'D. JL	CHKD. DM	DATE: 02/08/2019	SITE: .
DRAWN: DD/MR	CHKD. SMM	APPD. JMAC	DWG. 1

PLOT DATE: February 8, 2019
FILENAME: S:\Clients\MTO\QEW-Credit_River\99_PROJ\1662333_MH_P&P_VID_PROD\001_E-w_at_Bridge\1662333-0011-BE-0001.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

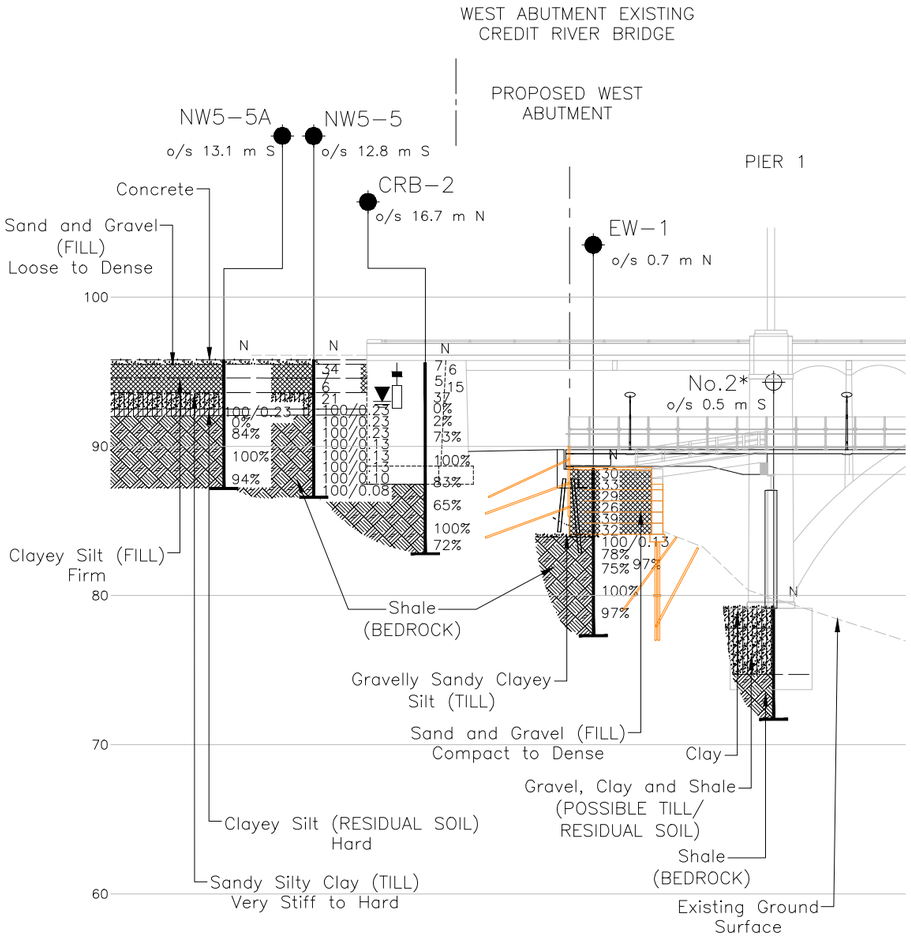
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. 2019-2016
GWP No. 2002-13-00

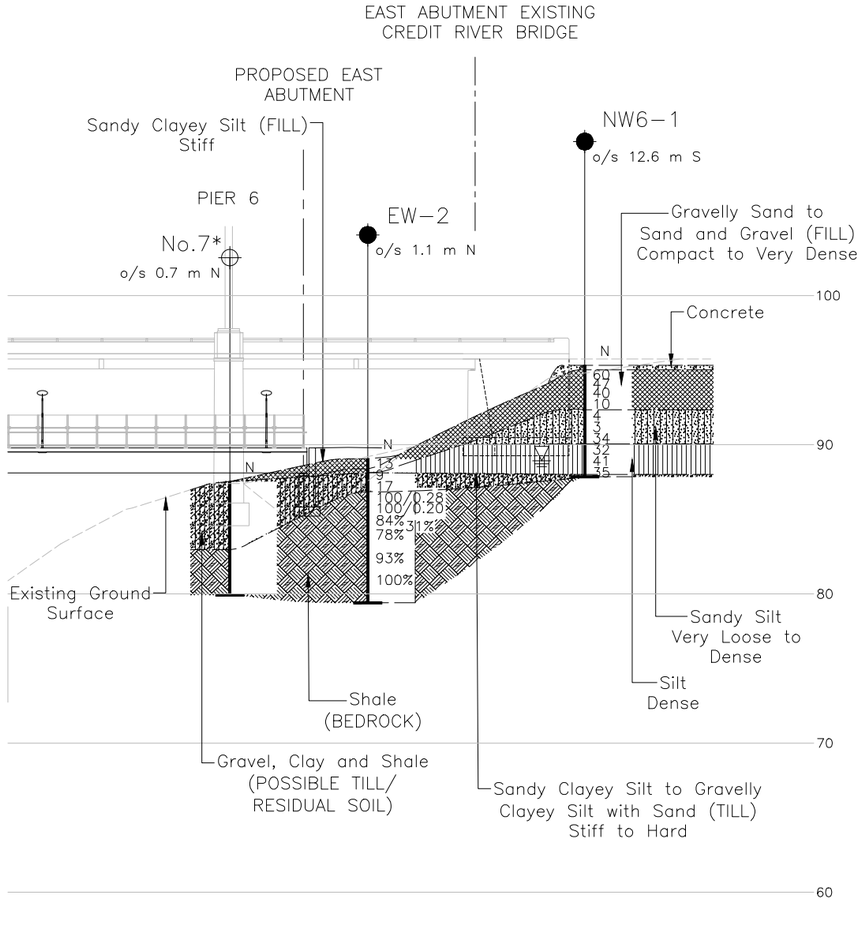
QEW WIDENING MISSISSAUGA RD TO HURONTARIO ST
E-W AT BRIDGE
SOIL STRATA

SHEET .

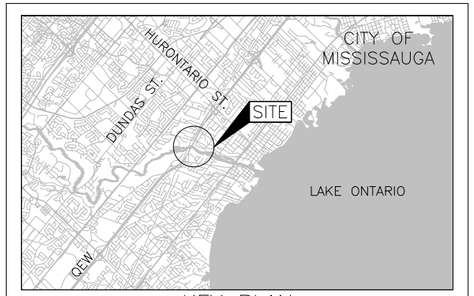
GOLDER



A-A' 1 E-W AT BRIDGE WEST ABUTMENT



A-A' 1 E-W AT BRIDGE EAST ABUTMENT



LEGEND

- Borehole – Current Investigation
- Borehole – (Dept. of Highways of Ontario archived drawing D-2241-1, 1933)
- 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

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

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CRB-6	91.7	4824196.7	295929.5
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NW5-5A	95.8	4823930.6	295851.9
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NOTES

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RSS Wall, anchors and micropile shown on this drawing at the proposed west abutment are based on Drawing SH15, prepared by RWH Engineering Inc. (RWH) and T.H. O'Rourke Structural Consultants, dated March to August 2011 (Project No. J11-022).

SCALE
4 0 4 8 m

LICENSED PROFESSIONAL ENGINEER J.M.A.COSTA Feb. 08, 2019 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER S. McGaghran Feb. 08, 2019 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 30M12-438

HWY. QEW	PROJECT NO. 1662333		DIST. CENTRAL
SUBM'D. ACM/JIL	CHKD. DM	DATE: 02/08/2019	SITE: .
DRAWN: DD	CHKD. SMM	APPD. JMAC	DWG. 2

PLOT DATE: February 8, 2019
FILENAME: S:\Clients\MTO\QEW-Credit_River\VSI_PROJ\1662333_MH_P&PI\AD_PROD\2011_E-W_AT_Bridge\1662333-0011-BC-0002.dwg

PROJECT
EAST-WEST ACTIVE TRANSPORT BRIDGE ALONG CREDIT RIVER BRIDGE, QEW WIDENING FROM MISSISSAUGA ROAD TO HURONTARIO

TITLE
EXISTING E-W AT BRIDGE WEST ABUTMENT LOOKING NORTH

GOLDER

PROJECT No. 1662333			FILE No. ----		
DRAFT	SMM	12/10/18	SCALE	AS SHOWN	VER. 1.
CADD	--		**Photograph 1**		
CHECK	SMM	12/10/18			
REVIEW	JMAC	12/10/18			

REVISION DATE: August 21, 2018 BY: SE Project: 1662333

PROJECT

EAST-WEST ACTIVE TRANSPORT BRIDGE ALONG CREDIT RIVER BRIDGE, QEW WIDENING FROM MISSISSAUGA ROAD TO HURONTARIO

TITLE

EXISTING E-W AT BRIDGE WEST ABUTMENT LOOKING SOUTH

GOLDER

PROJECT No. 1662333			FILE No. ----		
DRAFT	SMM	12/10/18	SCALE	AS SHOWN	VER. 1.
CADD	--		**Photograph 2**		
CHECK	SMM	12/10/18			
REVIEW	JMAC	12/10/18			

REVISION DATE: August 21, 2018 BY: SE Project: 1662333

PROJECT
EAST-WEST ACTIVE TRANSPORT BRIDGE ALONG CREDIT RIVER BRIDGE, QEW WIDENING FROM MISSISSAUGA ROAD TO HURONTARIO

TITLE
LOCK-BLOCK RSS WALL WEST ABUTMENT AND PIER 1

GOLDER

PROJECT No. 1662333			FILE No. ----		
DRAFT	SMM	12/10/18	SCALE	AS SHOWN	VER. 1.
CADD	--		**Photograph 3**		
CHECK	SMM	12/10/18			
REVIEW	JMAC	12/10/18			

REVISION DATE: August 21, 2018 BY: SE Project: 1662333

PROJECT
EAST-WEST ACTIVE TRANSPORT BRIDGE ALONG CREDIT RIVER BRIDGE, QEW WIDENING FROM MISSISSAUGA ROAD TO HURONTARIO

TITLE
BOREHOLE EW-2 BETWEEN EAST ABUTMENT AND PIER 6

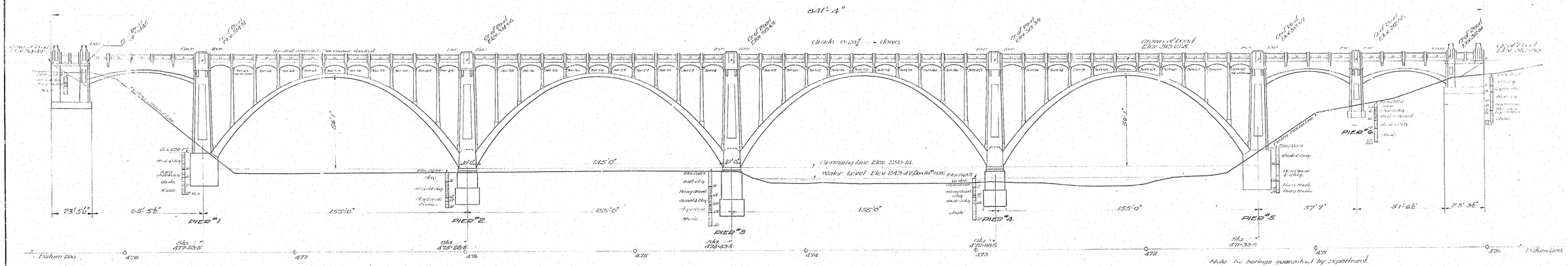
GOLDER

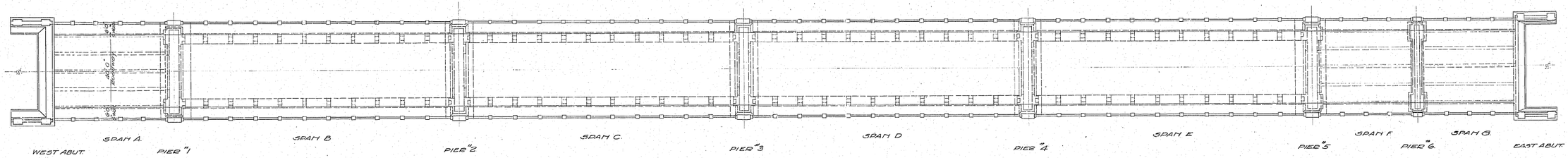
PROJECT No. 1662333			FILE No. ----		
DRAFT	SMM	12/10/18	SCALE	AS SHOWN	VER. 1.
CADD	--		**Photograph 4**		
CHECK	SMM	12/10/18			
REVIEW	JMAC	12/10/18			

REVISION DATE: August 21, 2018 BY: SE Project: 1662333

APPENDIX A

Previous Investigation





GENERAL DRAWING
SCALE: 1 INCH = 20 FEET.

GENERAL NOTE-
Depth of foundations subject to revision by Engineer.
Footings must extend at least 12" into solid rock.
Structure to be built in accordance with General Specifications for Highway Bridges, Ontario, 1933, & Form "B" - 1933.
All exposed corners to be chamfered.
Where construction joints are found necessary in the Arch, they are to be made radial and parallel to Main reinforcing.
Handrails not to be poured until Falsework of superstructure has been removed.
Concrete in Arches must be carried up evenly on each side of Arches.

Concrete Mix:-
Handrail Posts - Arches, Superstructure } 1 : 1½ : 3¼
Substructure — 1 : 2¼ : 3½

List of Drawings Nos 2241-1-2-3-4-5-6-7.
for Concrete Design "B"

CONCRETE DESIGN "B"

PROPOSED
MIDDLE ROAD BRIDGE
OVER THE
CREDIT RIVER.

THE KING'S HIGHWAY No. TORONTO TO HAMILTON.
COUNTY - PEEL STRUCTURE No.
TOWNSHIP-TORONTO. LOTS-6 RANGE II

APPROVED

Arthur Redgrove
BRIDGE ENGINEER

A. A. Smith
CHIEF ENGINEER.

DEPARTMENT OF HIGHWAYS, ONTARIO.
TORONTO 21st Nov. 1933
DEPUTY MINISTER.
REVISED 26th Dec. 1933. 2nd April 1934.
CONTRACT No 33-48.

DESIGN	R.E.	DRAWING	R.E.	STEEL CHECK	R.H.	DRAWING No D-2241-1
CHECK		CHECK				

Plan 2241-1-A
2h-203-
D.2241

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 10-03A 1 OF 1 METRIC

W.P. 2186-07-00 LOCATION QEW - Credit River Access Road (N 4 823 979.03 E 295 865.10) ORIGINATED BY GA

HWY QEW BOREHOLE TYPE Tri-pod COMPILED BY AN

DATUM Geodetic DATE 2010.11.04 - 2010.11.04 CHECKED BY SKP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.2											
0.0 / 75.6	Clayey SILT, with sand, trace gravel, trace shale fragments, Very Stiff, Brown/Grey, Dry		1	SS	17		76				0 44 36 20
0.6 / 75.0	Frequent shale fragments, trace silt and sand		2	SS	24						
1.2	Clayey SILT, with sand, trace gravel, Stiff to Firm, Grey, Wet		3	SS	14	▽	75				3 33 47 17
			4	SS	8		74				
73.5			5	SS	10						1 38 46 15
2.7 / 72.6	PEAT, amorphous, occasional rootlets, Firm, Brown, Moist		6	SS	4		73				
3.7 / 72.0	SHALE, weathered, Grey, Moist		7	SS	35						
4.3	END OF BOREHOLE AT 4.3m UPON SPLIT SPOON SAMPLER REFUSAL. BOREHOLE OPEN TO 4.3m AND WATER LEVEL AT 1.5m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.						72				

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 ⊕ 20 5 10 (%) STRAIN AT FAILURE

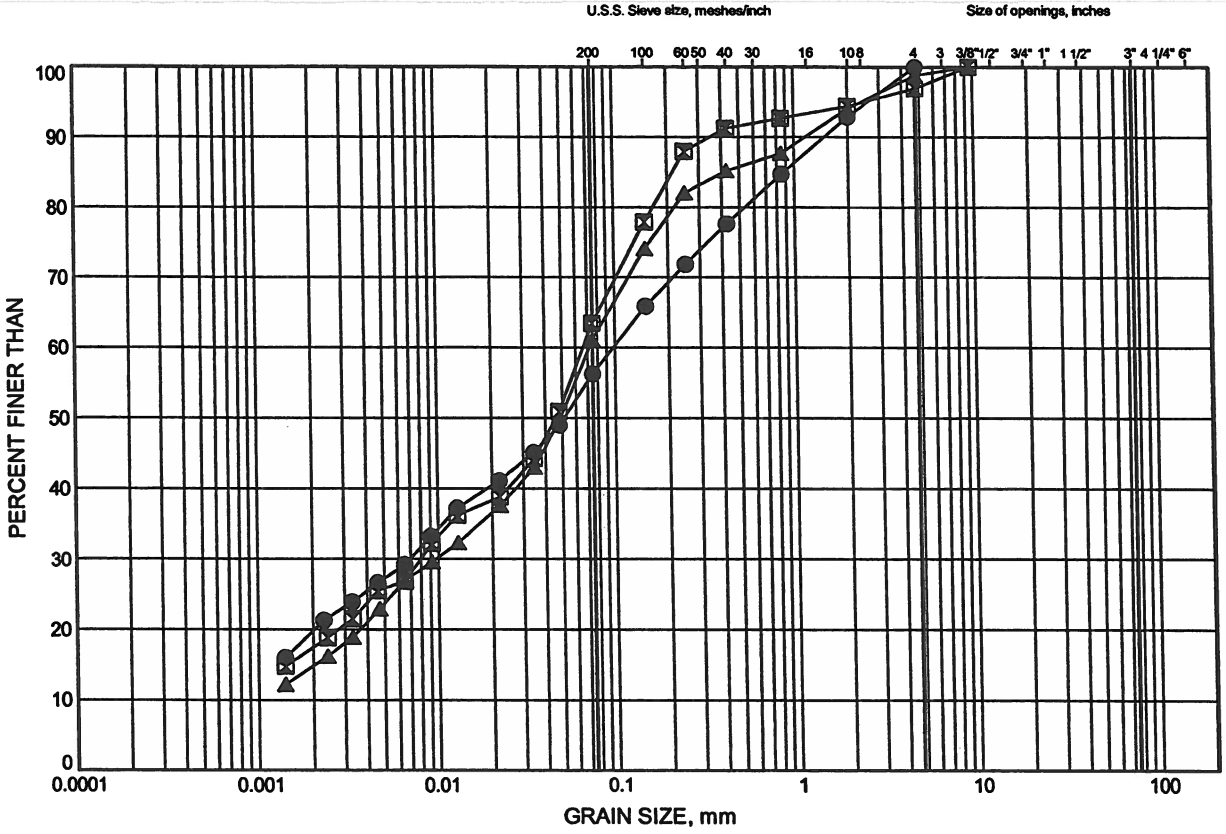
ONTMT4S 9292.GPJ 1/7/11

QEW - Credit River Access Road

GRAIN SIZE DISTRIBUTION

FIGURE B1

CLAYEY SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-03A	0.30	75.92
⊠	10-03A	1.52	74.70
▲	10-03A	2.74	73.48

W.P.# 2186-07-00

Prepared By AN

Checked By SKP

THURBER

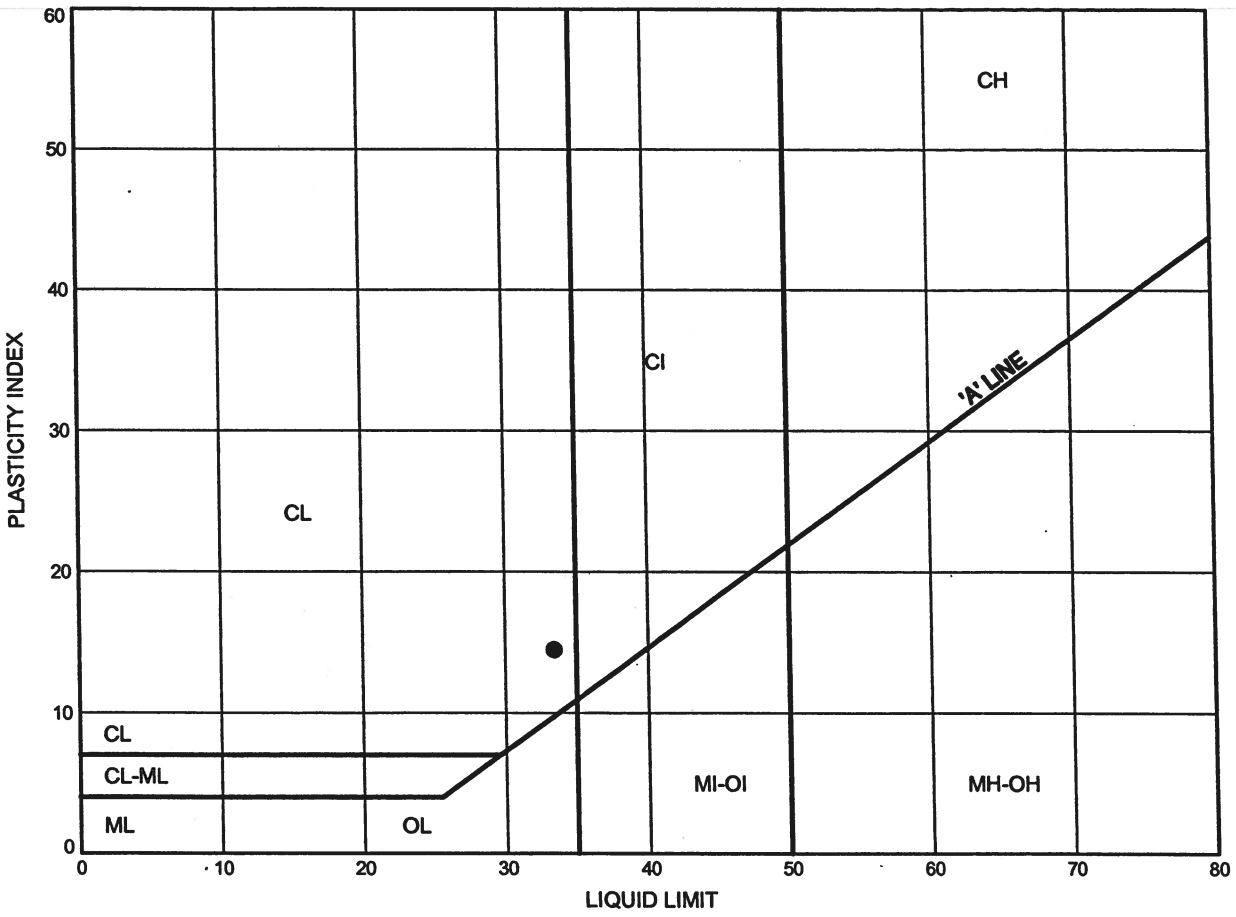
GRAIN SIZE DISTRIBUTION - THURBER 9292.GPJ 1/7/11

QEW - Credit River Access Road

ATTERBERG LIMITS TEST RESULTS

FIGURE B5

CLAYEY SILT



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	10-03A	0.30	75.92

Date January 2011

Project 2186-07-00

THURBER

Prep'd AN

Chkd. SKP

THURBALT 9292.GPJ 1/7/11

APPENDIX B

Current Investigation - Record of Borehole and Drillhole Sheets, Bedrock Core Photographs

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
σ_1, σ_2, σ_3	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

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

2 shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d:

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

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

Piezo-Cone Penetration Test (CPT)

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

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

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

(b) Cohesive Soils

Consistency

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

IV. SOIL TESTS

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

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

V. MINOR SOIL CONSTITUENTS

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

WEATHERINGS STATE

Fresh: no visible sign of weathering

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

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

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

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

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

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

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

CORE CONDITION

Total Core Recovery (TCR)

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

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

DISCONTINUITY DATA

Fracture Index

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

Dip with Respect to Core Axis

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

Description and Notes

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

Abbreviations

JN	Joint	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		

GOLDER

RECORD OF BOREHOLE No EW-1

SHEET 1 OF 1

METRIC

PROJECT 1662333

G.W.P. 2002-13-00

LOCATION N 4823955.5; E 295849.5 MTM NAD 83 ZONE 10 (LAT. 43.555482; LONG. -79.610784)

ORIGINATED BY JL

DIST Central HWY QEW

BOREHOLE TYPE CME 55, 159 mm O.D., Hollow Stem Augers, HQ Casing

COMPILED BY KN

DATUM Geodetic

DATE May 1, 2018

CHECKED BY SMM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
88.5	GROUND SURFACE										
0.0	Sand and gravel, some silt, trace clay (FILL) Compact to dense Grey to grey-brown Dry		1	SS	30		88				
			2	SS	33				○		37 46 15 2
	- Geotextile grid fragments recovered in split-spoon sample SA#3 at 1.8 m depth and SA#4 at 2.7 m depth		3	SS	29		87				
			4	SS	26		86		○		32 50 16 2
			5	SS	39				○		
84.2			6	SS	32		85		○		
83.9	Gravelly Sandy CLAYEY SILT (TILL) Grey to brown Moist to wet		7	SS	100/0.13		84				
4.6	SHALE (BEDROCK) Grey		1	RC	REC 100%						RQD = 78%
	Bedrock cored from a depth of 4.9 m to 11.2 m For bedrock coring details, refer to Record of Drillhole EW-1		2	RC	REC 100%		83				RQD = 97%
			3	RC	REC 100%		82				RQD = 75%
			4	RC	REC 100%		81				RQD = 100%
			5	RC	REC 100%		80				RQD = 97%
77.3							79				
11.2	END OF BOREHOLE NOTES: 1. Borehole dry prior to rock coring. 2. Borehole backfilled with bentonite cement grout to 3.0 m depth, and bentonite (Hole Plug) to ground surface.						78				

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

PROJECT: 1662333

RECORD OF DRILLHOLE: EW-1

SHEET 1 OF 1

LOCATION: N 4823955.5 ;E 295849.5

DRILLING DATE: May 1, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

JN - Joint, FLT - Fault, SHR- 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, MB- Mechanical Break | BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	ROCK STRENGTH INDEX	WEATHERING INDEX	FEATURES	R0/R1 ZONES	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Record of Borehole EW-1		83.60															
5	HQ Core	Slightly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, weak SHALE (Georgian Bay Formation) with LIMESTONE interbeds		4.90	1							BD,UN,SM CL	2	1	R4	W1			
												CO,UN,SM CL	2	1					
6					2							CO,UN,SM CL	2	1					
												BD,UN,SM PC, CI	2	3					
												CO,UN,SM SA, CI	2	2					
7					3							CO,UN,SM CC, CI	2	4				R1	
												JN,PL,SM CL	1	1				R0	
												CO,UN,SM CL	2	1					
												BD,UN,SM SA, CI	2	2					UCS=156.8 MPa (Limestone)
												BD,UN,SM CC, CI	2	4					
												JN,PL,SM CL	1	1					
8												JN,UN,SM CL	2	1					
												BD,UN,SM IN, CI	2	6					
												BD,UN,SM CL	2	1					
												BD,UN,SM CL	2	1					
					4							CO,UN,SM SA, CI	2	2					
												BD,UN,SM PC, CI	2	3					
9												JN,UN,SM CL	2	1					
												JN,UN,SM CL	2	1					
10					5							BD,UN,SM SA, CI	2	2					
												BD,UN,SM SA, CI	2	2					
												BD,UN,SM SO, CI	2	1					
11												BD,UN,SM PC, CI	2	3					
				77.31								BD,UN,SM IN, CI	2	6					
		END OF DRILLHOLE		11.19															
12																			
13																			

FEATURES LEGEND

BROKEN CORE | CLAY SEAM | LIMESTONE | LOST CORE

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JL

CHECKED: AKV

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GOLDER

RECORD OF BOREHOLE No EW-2

SHEET 1 OF 1 **METRIC**

PROJECT 1662333
G.W.P. 2002-13-00
DIST Central HWY QEW
DATUM Geodetic

LOCATION N 4824156.8; E 295956.2 MTM NAD 83 ZONE 10 (LAT. 43.557295; LONG. -79.609467)
BOREHOLE TYPE CME 55, 159 mm O.D., Hollow Stem Augers, HQ Casing
DATE May 2, 2018

ORIGINATED BY JL
COMPILED BY KN
CHECKED BY SMM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
89.1	GROUND SURFACE										
0.0	Sandy clayey silt, trace gravel (FILL) Stiff Brown Dry		1	SS	13						
88.4			2A	SS	9		88				36 50 12 2
0.9	Sand and gravel, trace to some silt, trace clay (FILL) Brown Moist		2B								
	Gravelly CLAYEY SILT with SAND (TILL) Stiff to very stiff		3A	SS	17						
86.9			3B				87				24 38 26 12
2.2	Brown Moist		4	SS	100/0.28						
	SHALE (BEDROCK), with limestone interbeds Grey		5	SS	100/0.20						
	Bedrock cored from a depth of 3.0 m to 9.7 m		1	RC	REC 100%		86				RQD = 84%
	For bedrock coring details, refer to Record of Drillhole EW-2		2	RC	REC 100%		85				RQD = 31%
			3	RC	REC 100%		84				RQD = 78%
			4	RC	REC 100%		83				RQD = 93%
			5	RC	REC 100%		82				RQD = 100%
79.4							81				
9.7	END OF BOREHOLE						80				

NOTES:

1. Borehole dry prior to rock coring.

2. Borehole backfilled with bentonite cement grout to 1.5 m depth, and bentonite (Hole Plug) to ground surface.

+ ³, × ³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

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PROJECT: 1662333

RECORD OF DRILLHOLE: EW-2

SHEET 1 OF 1

LOCATION: N 4824156.8 ;E 295956.2

DRILLING DATE: May 2, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

JN - Joint; FLT - Fault; SHR- 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; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	ROCK STRENGTH INDEX	WEATHERING INDEX	FEATURES	R0/R1 ZONES	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Record of Borehole EW-2		86.07															
3	HQ Core	Slightly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, weak SHALE (Georgian Bay Formation) with LIMESTONE interbeds		3.00	1							BD,UN,SM SA, CI	2	2					R0
												BD,UN,SM IN, CI	2	6					
												BD,UN,SM SA, CI	2	2					
												BD,UN,SM SO, CI	2	1					
												BD,UN,SM SA, CI	2	2					
4					2							BD,UN,SM PC, CI	2	3					
												CO,UN,SM SA, CI	2	2					
												CO,UN,SM CL	2	1					
												JN,CU,SM CL	2	1					
												CO,CU,SM SO, CI	2	1					
5																			UCS=16.1 MPa
												BD,UN,SM SO, CI	2	1					
												CO,UN,SM PC, CI	2	3					
												BD,UN,SM CL	2	1					
												BD,UN,SM CL	2	1					
												BD,UN,SM CL	2	1					
												BD,UN,SM CL	2	1					
												CO,UN,SM SO, CI	2	2					
					3							JN,UN,SM SA, CI	1	1					
6												JN,PL,SM CL							
												CO,UN,SM CL	2	1					R0
												BD,UN,SM SO, CI	2	1					
												BD,UN,SM SA, CI	2	2					
7																			
												BD,UN,SM PC, CI	2	3					
					4							BD,UN,SM PC, CI	2	3					
8												BD,UN,SM PC, CI	2	3					
					5														
9												CO,PL,SM PC, CI	1	3					
												BD,UN,SM SA, CI	2	2					
				79.42															
		END OF DRILLHOLE		9.65															
10																			
11																			
12																			

FEATURES LEGEND

BROKEN CORE | CLAY SEAM | LIMESTONE | LOST CORE

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JL

CHECKED: AKV

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GOLDER

RECORD OF BOREHOLE No CRB-2

SHEET 1 OF 2

METRIC

PROJECT 1662333

G.W.P. 2002-13-00

LOCATION N 4823949.7; E 295828.3 MTM NAD 83 ZONE 10 (LAT. 43.555430; LONG. -79.611047)

ORIGINATED BY JL

DIST Central HWY QEW

BOREHOLE TYPE CME 55, 210 mm O.D., 108 mm I.D. Hollow Stem Augers (Auto Hammer)

COMPILED BY KN

DATUM Geodetic

DATE February 6, 2018

CHECKED BY SMM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
95.6	GROUND SURFACE										
0.0	TOPSOIL (200 mm)										
0.2	Sandy clayey silt, some gravel (FILL)		1	SS	7		95				
94.9	Firm										
0.7	Grey Moist		2	SS	6						6 12 47 35
	Sand, some silt, trace to some gravel, trace clay, contains rootlets / organics (FILL) Loose to compact Brown to grey Moist, becoming wet at a depth of about 2.3 m		3	SS	5		94		○		10 67 19 4
93.0			4A 4B	SS	15	▼	93				
2.6	CLAYEY SILT, some sand, some gravel (TILL)										
92.4	Very stiff Grey		5A	RC	REC 37.5%						RQD = 0%
3.2	Moist to wet		5B	SS	37		92				
	SHALE (BEDROCK) Grey Bedrock cored from a depth of 3.2 m to 12.8 m For bedrock coring details, refer to Record of Drillhole CRB-2		2	RC	REC 23%						RQD = 2%
			3	RC	REC 100%		90				RQD = 73%
			4	RC	REC 100%		89				RQD = 100%
			5	RC	REC 100%		87				RQD = 83%
			6	RC	REC 71%		86				RQD = 65%
			7	RC	REC 100%		84				RQD = 100%
82.8			8	RC	REC 100%		83				RQD = 72%
12.8											

Continued Next Page

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No CRB-2

SHEET 2 OF 2 **METRIC**

PROJECT 1662333
G.W.P. 2002-13-00
LOCATION N 4823949.7; E 295828.3 MTM NAD 83 ZONE 10 (LAT. 43.555430; LONG. -79.611047)
ORIGINATED BY JL
DIST Central HWY QEW
BOREHOLE TYPE CME 55, 210 mm O.D., 108 mm I.D. Hollow Stem Augers (Auto Hammer)
COMPILED BY KN
DATUM Geodetic
DATE February 6, 2018
CHECKED BY SMM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	END OF BOREHOLE										

NOTES:

1. Borehole dry upon completion of drilling.

3. Groundwater level measurements in piezometer:

Date	Depth (m)	Elev. (m)
12/03/18	2.6	93.0
30/04/18	2.6	93.0
06/11/18	2.5	93.1

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

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PROJECT: 1662333

RECORD OF DRILLHOLE: CRB-2

SHEET 1 OF 2

LOCATION: N 4823949.7 ;E 295828.3

DRILLING DATE: February 6, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Track

DRILLING CONTRACTOR: Geo-Environmental Drilling

JN - Joint; FLT - Fault; SHR- 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; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	ROCK STRENGTH INDEX	WEATHERING INDEX	FEATURES	R0/R1 ZONES	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Borehole CRB-2		92.56															
		Completely weathered, thinly laminated to medium bedded, brown to grey, very fine to fine grained, faintly porous, extremely weak SHALE (Georgian Bay Formation) with LIMESTONE interbeds		3.04	1														
4					2														
				90.65															
5		Slightly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, very weak to weak SHALE (Georgian Bay Formation) with LIMESTONE interbeds		4.95	3							BD,UN,SM CL	2	1					
												BD,UN,SM CL	2	1					
												BD,UN,SM CL	2	1					
												BD,UN,SM CL	2	1					
												BD,UN,SM CL	2	1					
												JN,PL,SM CL	1	1					
6												BD,UN,SM PC, CI	2	3					
												CO,UN,SM PC, CI	2	3					
												CO,UN,SM PC, CI	2	3					
												BD,UN,SM PC, CI	2	3					
7					4														
																			UC = 11.2 MPa
8												BD,UN,SM PC, CI	2	3					
																			PLT(D) = 0.04
																			PLT(A) = 0.82
					5														
9												CO,CU,SM PC, CI	2	3					
												CO,UN,SM PC, CI	2	3					
												BD,UN,SM PC, CI	2	3					
												BD,UN,SM PC, CI	2	3					
												CO,ST,SM IN, CI	2	6					
10					6														
																			PLT(D) = 0.19
												BD,UN,SM CL	2	1					
												CO,UN,SM CL	2	1					
												CO,UN,SM PC, CI	2	3					
11																			
					7							BD,UN,SM PC, CI	2	3					
												BD,UN,SM IN, CI	2	6					UC = 13.0 MPa
																			PLT(A) = 0.33
												BD,UN,SM CL	2	1					
12												CO,CU,SM CL	2	1					
		CONTINUED NEXT PAGE																	

NQ Rock Core

FEATURES LEGEND

BROKEN CORE | CLAY SEAM | LIMESTONE | LOST CORE

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JL

CHECKED: AB

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PROJECT: 1662333

RECORD OF DRILLHOLE: CRB-2

SHEET 2 OF 2

LOCATION: N 4823949.7 ;E 295828.3

DRILLING DATE: February 6, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Track

DRILLING CONTRACTOR: Geo-Environmental Drilling

JN - Joint; FLT - Fault; SHR- 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; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	ROCK STRENGTH INDEX	WEATHERING INDEX	FEATURES	R0/R1 ZONES	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																	
13	NQ Rock Core	Slightly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, very weak to weak SHALE (Georgian Bay Formation) with LIMESTONE interbeds			7														PLT(D) = 0.10 PLT(A) = 0.24
					8							BD,UN,SM CC, Cl CO,CU,SM PC, Cl CO,UN,SM PC, Cl	2 2 2	4 3 3					
				82.80								CO,UN,SM IN, Cl	2	6					
		END OF DRILLHOLE		12.80															
14																			
15																			
16																			
17																			
18																			
19																			
20																			
21																			

FEATURES LEGEND

BROKEN CORE CLAY SEAM LIMESTONE LOST CORE

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JL
CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTO\QEW-CREDIT_RIVER\02_DATA\GINT\QEW-CREDIT_RIVER.GPJ GAL-MISS.GDT 02/08/19

GOLDER

RECORD OF BOREHOLE No NW5-5

SHEET 1 OF 1

METRIC

PROJECT 1662333

G.W.P. 2002-13-00 LOCATION N 4823932.6; E 295852.6 MTM NAD 83 ZONE 10 (LAT. 43.555242; LONG. -79.610833) ORIGINATED BY ACM

DIST Central HWY QEW BOREHOLE TYPE CME 55, 114 mm I.D., Hollow Stem Augers COMPILED BY SK

DATUM Geodetic DATE July 11, 2018 CHECKED BY SMM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
95.8	GROUND SURFACE										
0.0 / 95.5	CONCRETE (300 mm)										
0.3	Sand and gravel, trace to some silt, trace clay (FILL) Loose to dense Brown Moist		1	SS	34		95		○		35 53 9 3
94.6			2A 2B 2C	SS	7				○		
1.2	Clayey silt, some sand, trace to some gravel (FILL) Firm Brown to grey Moist		3A 3B	SS	6		94		○		
93.6									○		
2.2	Sandy SILTY CLAY, trace gravel, some shale fragments (TILL) Very stiff to hard brown to grey Moist		4	SS	21		93		○ —		5 21 47 27
92.5			5A 5B	SS	100/0.23				○		
92.1	CLAYEY SILT, some sand, some shale fragments (RESIDUAL SOIL) Hard Grey to brown Moist						92		○		
3.7	SHALE (BEDROCK) Grey		6	SS	100/0.23						
			7	SS	100/0.23		91				
			8	SS	100/0.13						
			9	SS	100/0.13		90				
			10	SS	100/0.13						
			11	SS	100/0.10		89				
							88				
86.6			12	SS	100/0.08		87				
9.2	END OF BOREHOLE										

NOTES:

1. Borehole caved to a depth of 8.5 m below ground surface upon completion of drilling.

2. Borehole dry upon completion of soil drilling.

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

GOLDER

RECORD OF BOREHOLE No NW5-5A

SHEET 1 OF 1 **METRIC**

PROJECT 1662333
G.W.P. 2002-13-00
DIST Central HWY QEW
DATUM Geodetic

LOCATION N 4823930.6; E 295851.9 MTM NAD 83 ZONE 10 (LAT. 43.555219; LONG. -79.610772)
BOREHOLE TYPE CME 75, 152 mm O.D., Solid Stem Augers
DATE July 15, 2018

ORIGINATED BY CC
COMPILED BY SK / AB
CHECKED BY SMM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
95.8	GROUND SURFACE										
0.0	Refer to Record of Borehole NW5-5 for stratigraphy details.						95				
							94				
							93				
92.0							92				
3.8	SHALE (BEDROCK) Grey Bedrock cored from a depth of 4.2 m to 8.6 m. For bedrock coring details, refer to Record of Drillhole NW5-5A.		1	SS	100/0.23						
			1	RC	REC 96%		91				RQD = 0%
			2	RC	REC 97%		90				RQD = 84%
			3	RC	REC 100%		89				RQD = 100%
87.2			4	RC	REC 100%		88				RQD = 94%
8.6	END OF BOREHOLE NOTES: 1. Borehole advanced 2.0 m offset of borehole NW5-5A. 2. Open borehole dry upon completion of soil drilling.										

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

GTA-MTO 001 S:\CLIENTS\MTO\QEW-CREDIT_RIVER\02_DATA\GINT\QEW-CREDIT_RIVER.GPJ GAL-GTA.GDT 02/08/19

PROJECT: 1662333

RECORD OF DRILLHOLE: NW5-5A

SHEET 1 OF 1

LOCATION: N 4823930.6 ;E 295851.9

DRILLING DATE: July 15, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75

DRILLING CONTRACTOR: Davis Drilling

JN - Joint, FLT - Fault, SHR- 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, MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	ROCK STRENGTH INDEX: R4	ROCK STRENGTH INDEX: R3	ROCK STRENGTH INDEX: R2	ROCK STRENGTH INDEX: R1	WEATHERING INDEX: W1	WEATHERING INDEX: W2	WEATHERING INDEX: W3	WEATHERING INDEX: W4	WEATHERING INDEX: W5	WEATHERING INDEX: W6	FEATURES	R0/R1 ZONES	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Borehole NW5-5A		91.62																							
5	HQ Core	Highly weathered to fresh, thinly laminated to medium bedded, grey, very fine to fine grained, faintly porous, very weak to weak SHALE (Georgian Bay Formation) with LIMESTONE interbeds		4.19	1							CO,PL,RO CC, Cl	1.5	4													
												BD,PL,SM CC, Cl	1	4													
												BD,UN,SM CC, Cl	2	4												R1	
6					2							BD,PL,SM SA	1	2													
7					3							BD,IR,SM PC, He	2	3													
8					4							BD,IR,SM SO	2	1													
				87.18								BD,IR,SM SO	2	1													
		END OF DRILLHOLE		8.63																							
9																											
10																											
11																											
12																											
13																											

FEATURES LEGEND

BROKEN CORE | CLAY SEAM | LIMESTONE | LOST CORE

DEPTH SCALE
1 : 50

GOLDER

LOGGED: CC
CHECKED: AB

GTA-RCK 054 S:\CLIENTS\MTO\CEW-CREDIT_RIVER\02_DATA\GINT\CEW-CREDIT_RIVER.GPJ GAL-MISS.GDT 02/08/19

GOLDER

RECORD OF BOREHOLE No NW6-1

SHEET 1 OF 1

METRIC

PROJECT 1662333

G.W.P. 2002-13-00 LOCATION N 4824163.1; E 295975.2 MTM NAD 83 ZONE 10 (LAT. 43.557371; LONG. -79.609278) ORIGINATED BY ACM

DIST Central HWY QEW BOREHOLE TYPE CME 55, 108 mm I.D., Hollow Stem Augers COMPILED BY SK

DATUM Geodetic DATE July 10, 2018 CHECKED BY SMM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
95.3	GROUND SURFACE										
0.0	ASPHALT (150 mm)										
	CONCRETE (150 mm)										
0.3	Gravelly sand, some fines (FILL) Compact to very dense Brown Moist		1	SS	60		95				21 60 (19)
			2	SS	47		94				
			3	SS	40						
			4	SS	10		93				
92.3											
3.0	Silty SAND, trace to some clay Very loose to dense Brown Moist		5	SS	4		92				
			6	SS	3						1 67 25 7
			7	SS	34		91				
90.0											
5.3	SILT, trace to some sand, trace to some clay Dense Brown to grey below 6.6 m Moist		8	SS	32		90				0 8 80 12
			9	SS	41	▽	89				
			10A	SS	35						
88.0			10B				88				3 22 50 25
7.5	Sandy CLAYEY SILT, trace gravel (TILL) Hard Grey Moist										
	END OF BOREHOLE										

NOTES:

1. Borehole caved to a depth of 6.4 m below ground surface upon removal of hollow stem augers.

2. Water level measured at a depth of 6.3 m (Elev. 89.0 m) below ground surface upon completion of soil drilling.

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\MTO\QEW-CREDIT_RIVER\02_DATA\GINT\QEW-CREDIT_RIVER.GPJ GAL-GTA.GDT 02/08/19

Start of Run No. 1 (4.90 m)

Start of Run No. 2 (5.17 m)

Start of Run No. 3 (6.69 m)

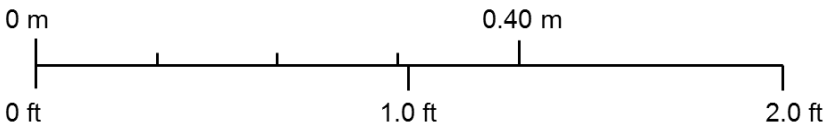
Box 1: 4.90 m to 8.19 m

Start of Run No. 4 (8.19 m)

Start of Run No. 5 (9.67 m)

End of Borehole (11.19 m)

Box 2: 8.19 m to 11.19 m



Scale

PROJECT

EAST-WEST ACTIVE TRANSPORT PEDESTRIAN BRIDGE ALONG CREDIT RIVER BRIDGE

TITLE

Bedrock Core Photographs
Borehole EW-1 (4.90 m to 11.19 m)

GOLDER

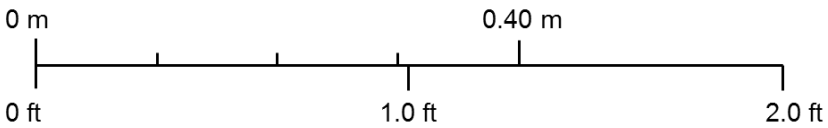
PROJECT No. 1662333			FILE No. ----		
DRAFT	SK	20180628	SCALE	NTS	VER. 1.
CADD	--				
CHECK	SMM				
REVIEW	JMAC	20181108			

FIGURE B-1

REVISION DATE: January 23, 2018 BY: DCB Project: 1530382

Box 1: 3.00 m to 6.66 m

Box 2: 6.66 m to 9.65 m



Scale

PROJECT

EAST-WEST ACTIVE TRANSPORT PEDESTRIAN BRIDGE ALONG CREDIT BRIDGE

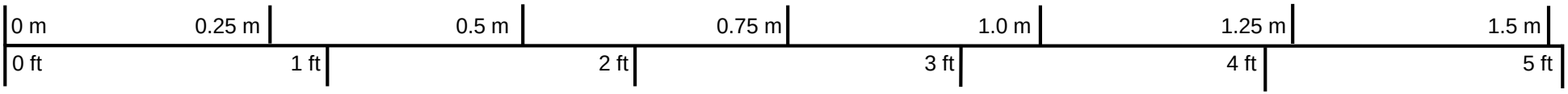
TITLE

Bedrock Core Photographs
Borehole EW-2 (3.00 m to 9.65 m)

GOLDER

PROJECT No. 1662333			FILE No. ----		
DRAFT	SK	20180628	SCALE	NTS	VER. 1.
CADD	--		**FIGURE B-2**		
CHECK	SMM				
REVIEW	JMAC	20181108			

REVISION DATE: January 23, 2018 BY: DCB Project: 1530382



Scale

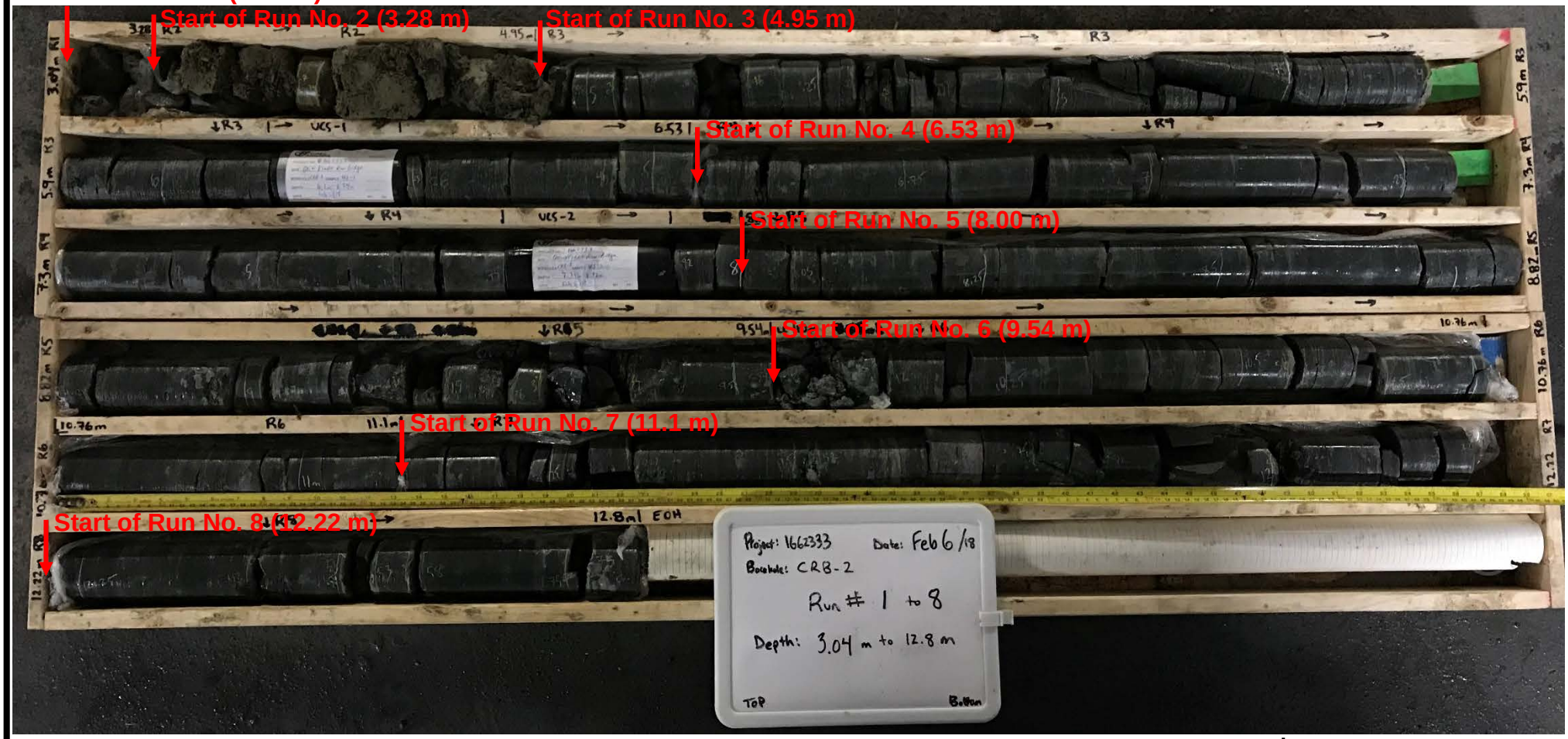
PROJECT
EAST-WEST ACTIVE TRANSPORT PEDESTRIAN BRIDGE ALONG CREDIT RIVER BRIDGE

TITLE
Bedrock Core Photograph
Borehole NW5-5A (4.19 m to 8.63 m)

GOLDER

PROJECT No. 1662333			FILE No. ----		
DRAFT	SE	20180821	SCALE	AS SHOWN	VER. 1.
CADD	--				
CHECK	SMM	11/14/2018	**FIGURE B-3**		
REVIEW	JMAC	11/14/2018			

REVISION DATE: August 21, 2018 BY: SE Project: 1662333



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
MTO Assignment 2015-E-0033: Detail Design for the widening/rehab/realignment of QEW Between Mississauga Road and Hurontario Street

TITLE
Bedrock Core Photograph
Borehole CRB-2 (3.04 m to 12.8 m)

Golder Associates

PROJECT No. 1662333			FILE No. ----		
DRAFT	JIL	Mar 2018	SCALE	AS SHOWN	VER. 1.
CADD	--				
CHECK	DM	June 2018	**FIGURE B-4**		
REVIEW	SMM	June 2018			

REVISION DATE: March 7, 2018 BY: JIL Project: 1662333

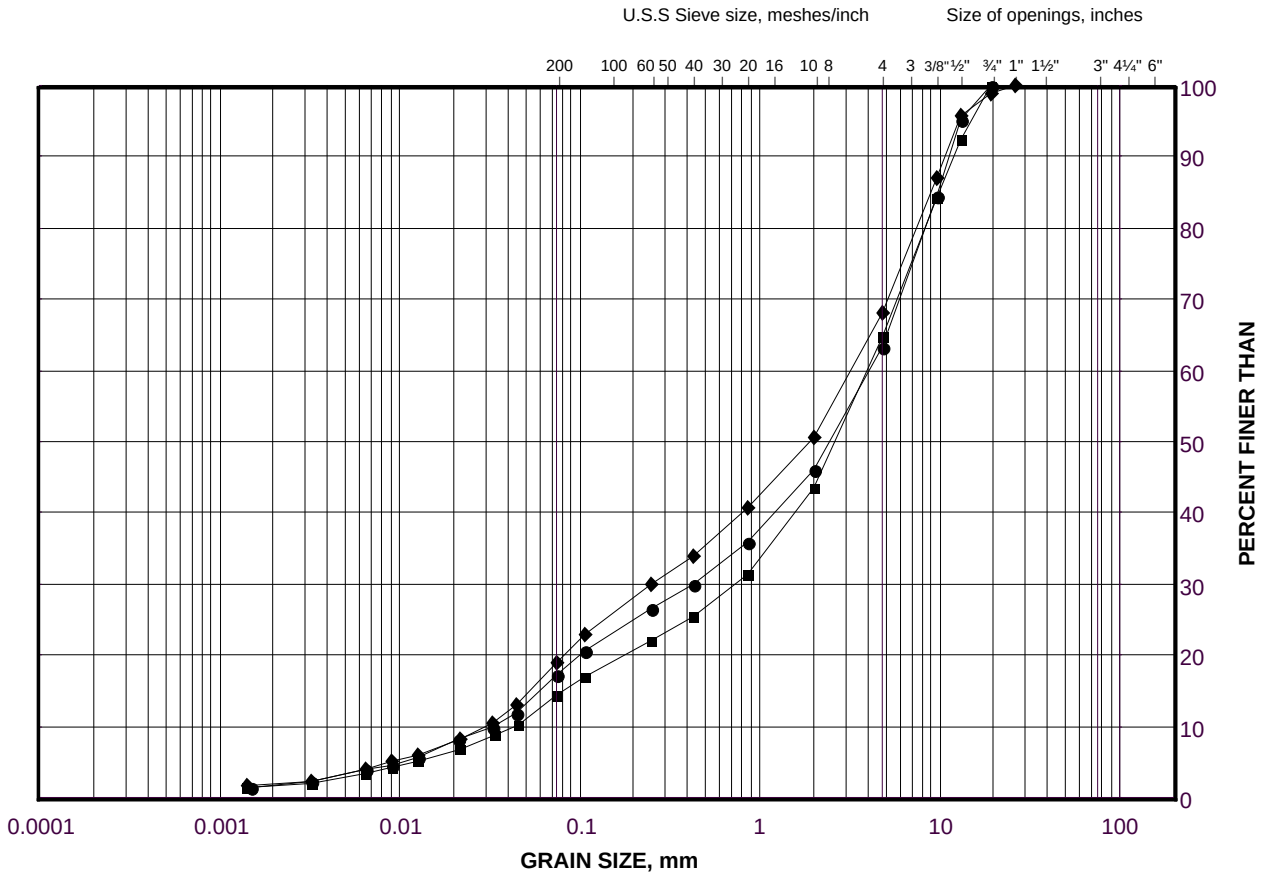
APPENDIX C

Geotechnical and Analytical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sand and Gravel (FILL)

FIGURE C-1



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	EW-1	2	87.5
■	EW-2	2A	88.2
◆	EW-1	4	85.9

Project Number: 1662333

Checked By: SMM

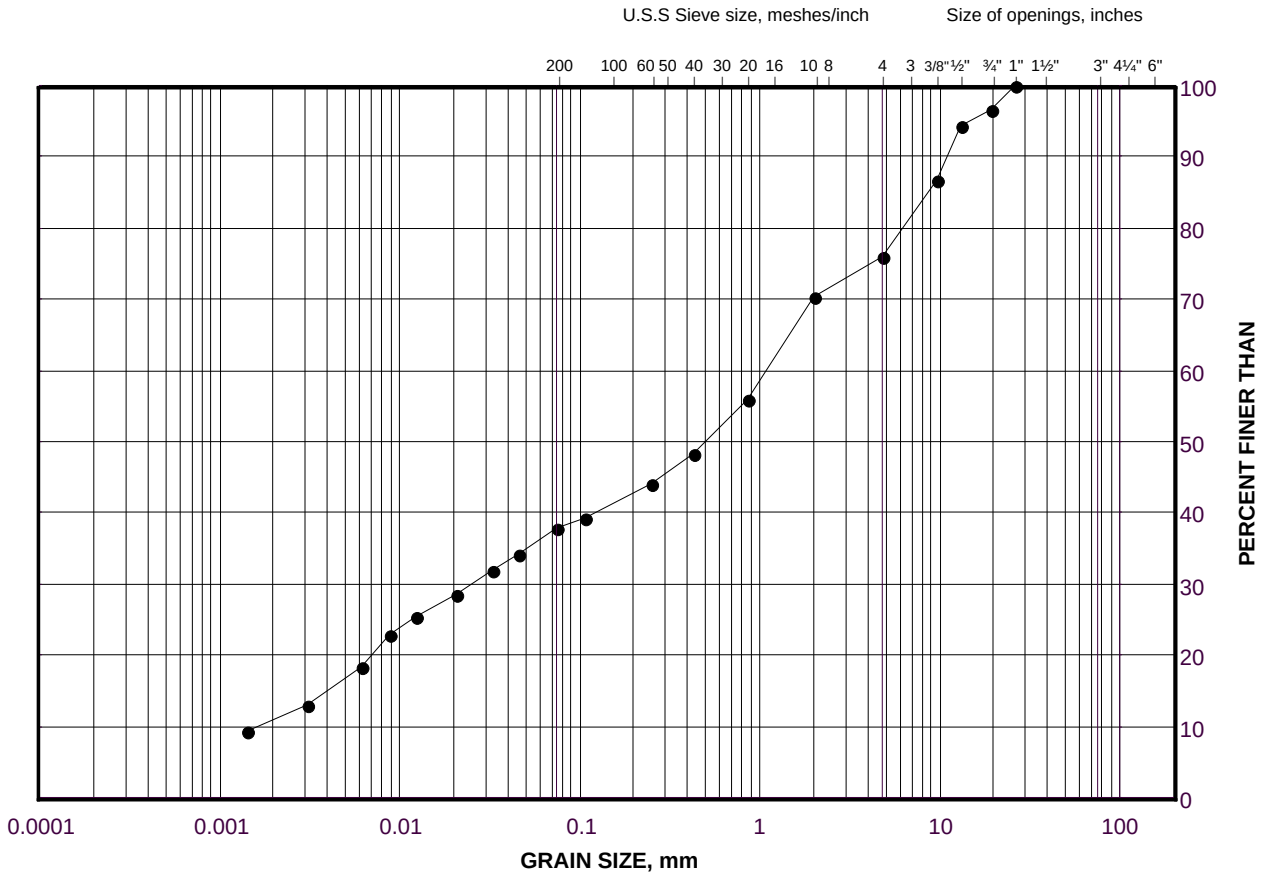
Golder Associates

Date: 25-Jun-18

GRAIN SIZE DISTRIBUTION

Gravelly Clayey Silt with Sand (TILL)

FIGURE C-2



LEGEND

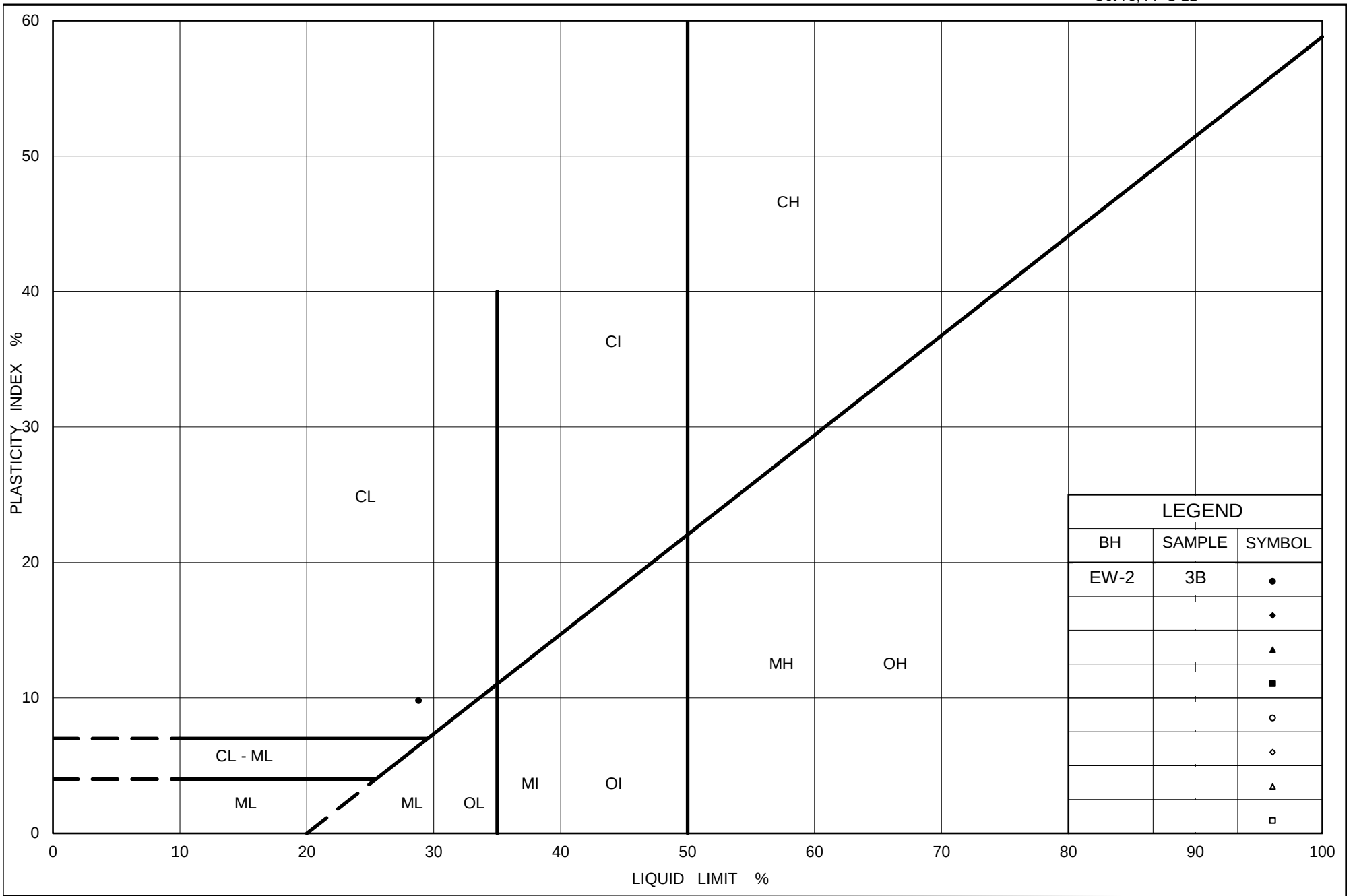
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	EW-2	3B	87.1

Project Number: 1662333

Checked By: SMM

Golder Associates

Date: 25-Jun-18



Ministry of Transportation

Ontario

PLASTICITY CHART
Gravelly CLAYEY SILT with Sand (TILL)

Figure No. C-3

Project No. 1662333

Checked By: SMM

Geomechanica Inc.
Suite 900 – 390 Bay St.
Toronto Ontario
Canada M5H 2Y2

June 05, 2018

Mr. David Marmor
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

Re: UCS + E testing
(Golder Project No. 1662333)

Dear Mr. Marmor:

On May 22, 2018 two (2) HQ-sized core samples were received by Geomechanica Inc. via drop-off by Golder personnel. These samples were identified as being from boreholes drilled as part of Golder project 1662333. A uniaxial compressive strength (UCS) specimen was prepared and tested from each of these samples (2 tests total).

Details regarding the steps of specimen preparation and testing along with the test results and specimen photographs before and after testing are presented in the accompanying laboratory report.

Sincerely,

Bryan Tatone Ph.D., P. Eng.

Geomechanica Inc.
Tel: (647) 478-9767
Email: bryan.tatone@geomechanica.com

GEOMECHANICA

Rock Laboratory Testing Results

A report submitted to:

David Marmor
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

Prepared by:

Bryan Tatone, PhD, PEng
Omid Mahabadi, PhD, PEng

Geomechanica Inc
#900-390 Bay St
Toronto ON
M5H 2Y2 Canada
Tel: +1-647-478-9767
info@geomechanica.com

June 5, 2018
Project number: 1662333

Abstract

This document summarizes the results of rock laboratory testing of 2 uniaxial compression tests. Results, including uniaxial compressive strength (UCS) and Young's modulus along with photographs of samples before and after testing are presented. Additional specimen information is included in an accompaning summary spreadsheet.

In this document:

1 Uniaxial Compressive Strength (UCS) testing

This report summarizes the results of 2 uniaxial compression tests. The testing was performed in Geomechanica's rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain an axial displacement rate of approximately 0.15 mm/min for shale and inter-bedded limestone/shale and 0.075 mm/min for limestone samples (Figure 1).

The specimen preparation and testing procedure included the following:

1. Unwrapping of the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture during subsequent specimen preparation.
2. Diamond cutting of core samples to obtain cylindrical specimens with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding of specimens to obtain flat (within ± 0.025 mm) and parallel end faces (within 0.25°).
4. Placement of the specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axial loading to rupture while continuously recording axial force and axial deformation to determine the peak strength (UCS) and (tangent) Young's modulus (E).

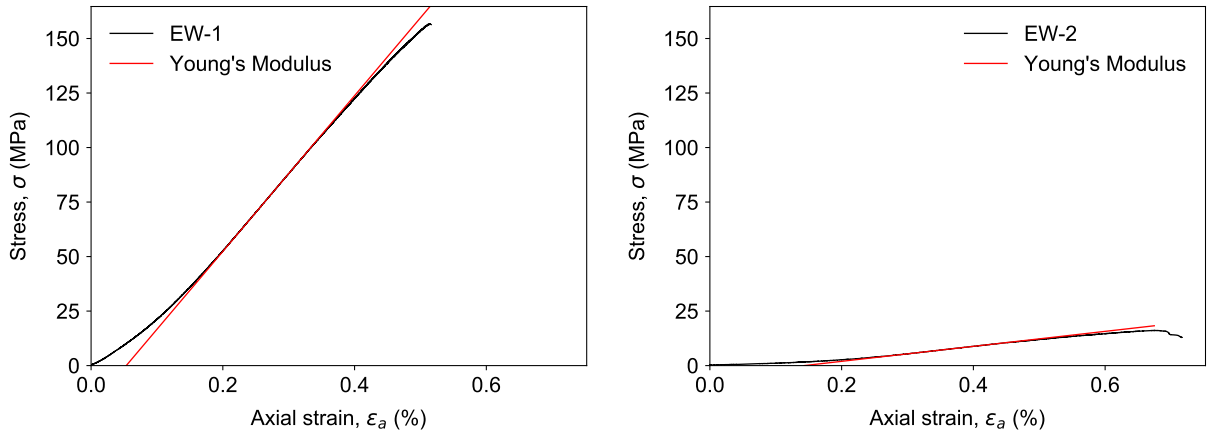
Figure 1: UCS test setup.

1.1 Results

The results of the tests are summarized in Table 1. The corresponding stress-strain curves for the uniaxial compression tests are presented in Figure 2. Young's modulus is the tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength. Additional specimen information is included in the accompaning summary spreadsheet.

Table 1: Summary of laboratory test results.

Sample	Depth (m)	Lithology description	Bulk density ρ (g/cm^3)	UCS (MPa)	Young's Modulus E (GPa)	Failure description
EW-1	7.26 - 7.43	Limestone	2.66	156.8	35.7	Axial splitting
EW-2	4.89 - 5.09	Inter-bedded shale & limestone	2.62	16.1	3.4	Axial splitting



(a) EW-1 - Limestone

(b) EW-2 - Inter-bedded shale/limestone

Figure 2: Measured stress-strain curves.

1.2 Specimen photographs

Photographs of the specimens before and after testing are presented in Figure 3.

Figure 3: Photographs of specimens before and after testing.

Maxxam
A Bureau Veritas Group Company

Your Project #: 1662333
Site Location: QEW/CREDIT
Your C.O.C. #: 655260-05-01

Attention: Sandra McGaghran

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

Report Date: 2018/05/30
Report #: R5183725
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8C0582
Received: 2018/05/22, 19:45

Sample Matrix: ROCK
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract)	2	N/A	2018/05/29	CAM SOP-00463	EPA 325.2 m
Conductivity	2	N/A	2018/05/29	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	2	2018/05/29	2018/05/29	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	2	2018/05/23	2018/05/29	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	2	N/A	2018/05/29	CAM SOP-00464	EPA 375.4 m

Remarks:

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

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

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

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

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Maxxam
A Bureau Veritas Group Company

Your Project #: 1662333
Site Location: QEW/CREDIT
Your C.O.C. #: 655260-05-01

Attention: Sandra McGaghran

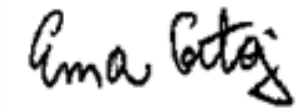
Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2018/05/30
Report #: R5183725
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8C0582
Received: 2018/05/22, 19:45

Encryption Key



Ema Gitej
Senior Project Manager
30 May 2018 13:52:07

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 Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B8C0582
Report Date: 2018/05/30

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

RESULTS OF ANALYSES OF ROCK

Maxxam ID		GTG829	GTG830			GTG830		
Sampling Date		2018/05/01	2018/05/02			2018/05/02		
COC Number		655260-05-01	655260-05-01			655260-05-01		
	UNITS	EW1-R3-7.20 TO 7.26	EW2-R1-3.38 TO 3.51	RDL	QC Batch	EW2-R1-3.38 TO 3.51 Lab-Dup	RDL	QC Batch
Calculated Parameters								
Resistivity	ohm-cm	1800	1300		5543388			
Inorganics								
Soluble (20:1) Chloride (Cl)	ug/g	110	130	20	5550731			
Conductivity	umho/cm	561	794	2	5552520	870	2	5552520
Available (CaCl2) pH	pH	8.28	8.00		5552937			
Soluble (20:1) Sulphate (SO4)	ug/g	250	630	20	5550732	630	20	5550732

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

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B8C0582
Report Date: 2018/05/30

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

TEST SUMMARY

Maxxam ID: GTG829
Sample ID: EW1-R3-7.20 TO 7.26
Matrix: ROCK

Collected: 2018/05/01
Shipped:
Received: 2018/05/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5550731	N/A	2018/05/29	Deonarine Ramnarine
Conductivity	AT	5552520	N/A	2018/05/29	Tahir Anwar
pH CaCl2 EXTRACT	AT	5552937	2018/05/29	2018/05/29	Gnana Thomas
Resistivity of Soil		5543388	2018/05/29	2018/05/29	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5550732	N/A	2018/05/29	Alina Dobreanu

Maxxam ID: GTG830
Sample ID: EW2-R1-3.38 TO 3.51
Matrix: ROCK

Collected: 2018/05/02
Shipped:
Received: 2018/05/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5550731	N/A	2018/05/29	Deonarine Ramnarine
Conductivity	AT	5552520	N/A	2018/05/29	Tahir Anwar
pH CaCl2 EXTRACT	AT	5552937	2018/05/29	2018/05/29	Gnana Thomas
Resistivity of Soil		5543388	2018/05/29	2018/05/29	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5550732	N/A	2018/05/29	Alina Dobreanu

Maxxam ID: GTG830 Dup
Sample ID: EW2-R1-3.38 TO 3.51
Matrix: ROCK

Collected: 2018/05/02
Shipped:
Received: 2018/05/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	5552520	N/A	2018/05/29	Tahir Anwar
Sulphate (20:1 Extract)	KONE/EC	5550732	N/A	2018/05/29	Alina Dobreanu

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B8C0582
Report Date: 2018/05/30

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

GENERAL COMMENTS

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

Package 1	8.7°C

Results relate only to the items tested.

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Maxxam Job #: B8C0582
Report Date: 2018/05/30

QUALITY ASSURANCE REPORT

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

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5550731	Soluble (20:1) Chloride (Cl)	2018/05/29	NC	70 - 130	108	70 - 130	<20	ug/g	3.1	35
5550732	Soluble (20:1) Sulphate (SO4)	2018/05/29	NC	70 - 130	99	70 - 130	<20	ug/g	0.89	35
5552520	Conductivity	2018/05/29			100	90 - 110	<2	umho/cm	9.2	10
5552937	Available (CaCl2) pH	2018/05/29			100	97 - 103			0.39	N/A

N/A = Not Applicable

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

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

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

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

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

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VALIDATION SIGNATURE PAGE

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

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

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

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CHAIN OF CUSTODY RECORD

Page 1 of 1

IMMEDIATE

REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #1326 Golder Associates Ltd	Company Name: Golder Associates	Quotation #: B80683		Maxxam Job #:	Bottle Order #: 655260
Attention: Accounts Payable	Attention: Sandra Megaghran	P.O. #:			
Address: 6925 Century Ave Suite 100	Address:	Project: ~~1674130 WO#9~~ 16662333			
Mississauga ON L5N 7K2		Project Name: DEW / CREDIT		COC #:	Project Manager:
Tel: (905) 567-4444 x Fax: (905) 567-6561 x	Tel: Fax:	Site #:		C#655260-05-01	Ema Gitej
Email: AP_CustomerService@golder.com	Email: Sandra-Megaghian@golder.com	Sampled By: JL			

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

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine	☐ CCME ☐ Sanitary Sewer Bylaw	
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ Reg 558 ☐ Storm Sewer Bylaw	
☐ Table 3 ☐ Agri/Other ☐ For RSC	☐ MISA Municipality	
☐ Table ___	☐ PWQO	
	☐ Other	

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

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.

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~~ Date	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Standard Corrosivity pkg (No Sulphide and Redox Potential)	# of Bottles	Comments
1		EW1-R3-7.20 to 7.26	2018/05/01	Rock			X	1	Sample in Bag
2		EW2-R1-3.38 to 3.51	2018/05/02	Rock			X	1	Sample in Bag
3									
4									
5									
6									
7									
8									
9									
10									

22-May-18 19:45
Ema Gitej
B8C0582
GK1 ENV-632

RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Kate Nu	18/05/22	7:45 PM	[illegible]	180522	19:45	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Recei	Custody Seal Present	Yes	No
	7/10/9	Intact		

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

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

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF.

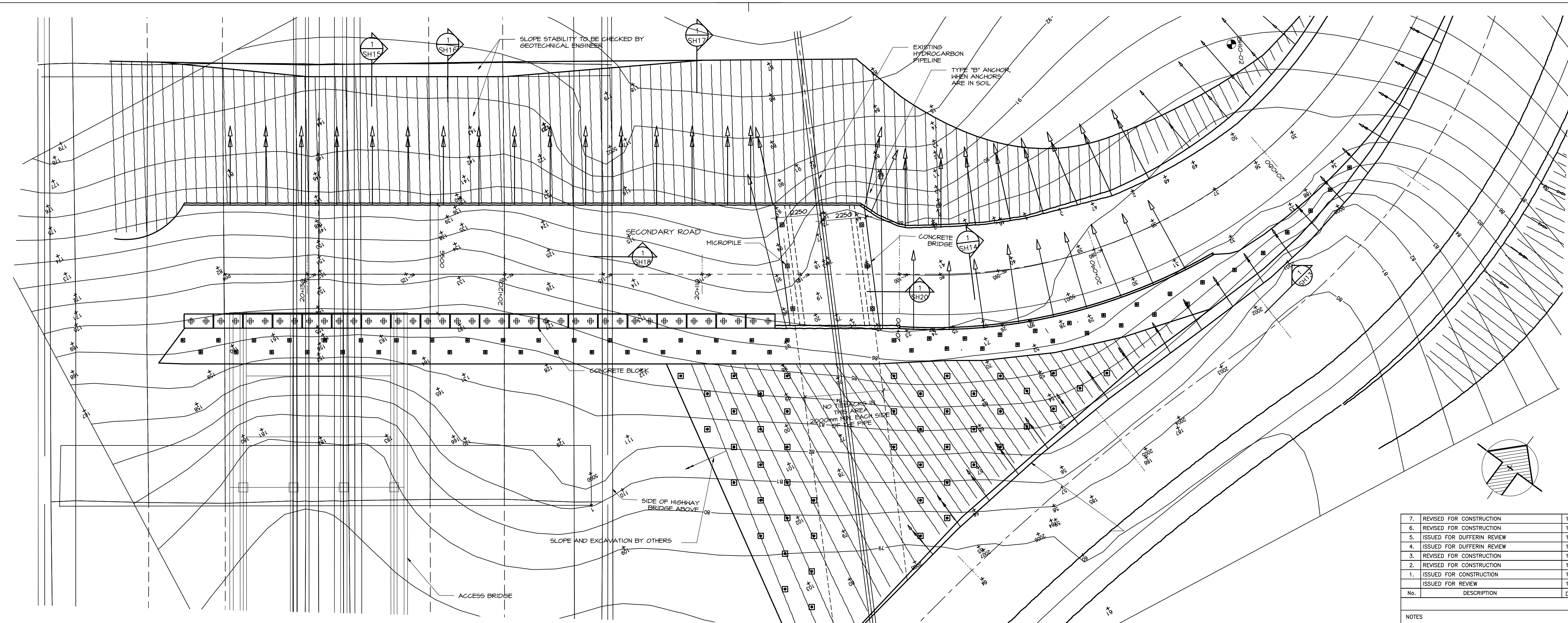
SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

White: Maxxa Yellow: Client

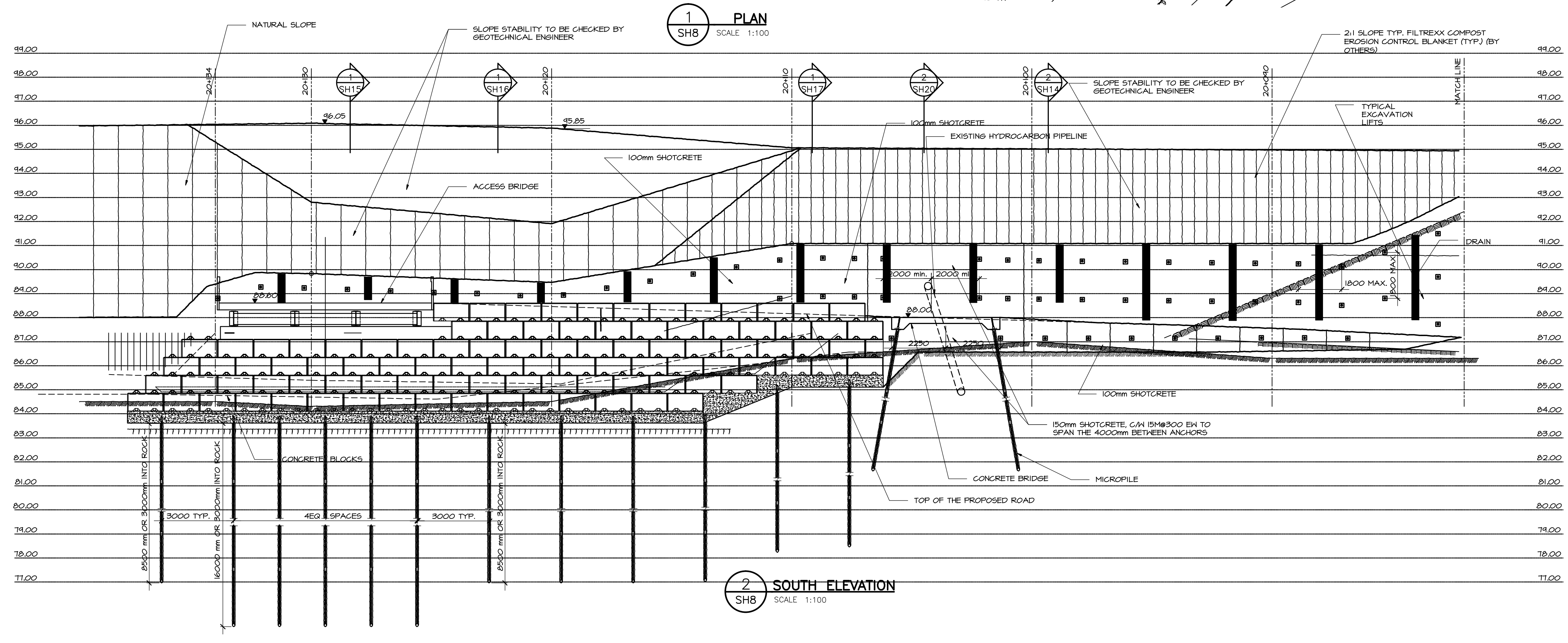
Maxxam Analytics International Corporation o/a Maxxam Analytics

APPENDIX D

Relevant Drawings from RWH Engineering Inc.



PLAN (1/SH8) SCALE 1:100



SOUTH ELEVATION (2/SH8) SCALE 1:100

Thursday, June 07, 2012 14:50:25

E:\PR\HCM\2011\J11-022 CREDIT RIVER\DWG\2012-05-03_SH1_CURRENT.DWG

No.	DESCRIPTION	Date
7.	REVISED FOR CONSTRUCTION	12/06/07
6.	REVISED FOR CONSTRUCTION	12/05/15
5.	ISSUED FOR DUFFERIN REVIEW	12/04/26
4.	ISSUED FOR DUFFERIN REVIEW	12/03/23
3.	REVISED FOR CONSTRUCTION	11/11/03
2.	REVISED FOR CONSTRUCTION	11/10/25
1.	ISSUED FOR CONSTRUCTION	11/09/14
	ISSUED FOR REVIEW	11/08/29

NOTES

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DO NOT SCALE THIS DRAWING.

Stamp

LICENSED PROFESSIONAL ENGINEER 34891507 T.H. O'ROURKE PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER D. KONDRATENKO PROVINCE OF ONTARIO

Client

HCM
TORONTO : (519) 623-6454
CALGARY: (403) 248-4884
www.hcgroup.ca
"Innovation in Foundations"

Consultant

RWH ENGINEERING INC
126 Earl Thompson Road, Ayr, ON N0B1E0
Telephone (416)457-8313, Fax (519)740-7091

Consultant

T.H. O'Rourke structural consultants
P.O. Box 599 Stouffville, ON L4A 7Z7
Telephone (905)640-6665, Fax (905)640-6655, Cell (416) 937-6999

Project

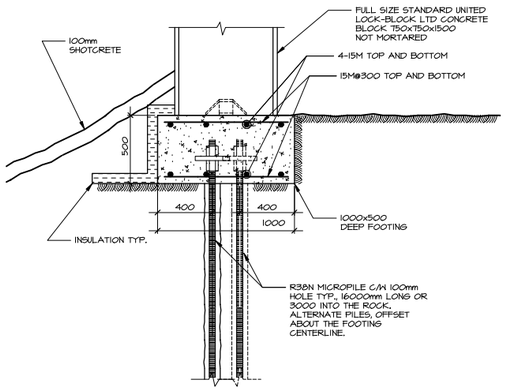
HWY. QEW - From Hurontario Street to Mississauga Road Site 24-203

MISSISSAUGUA ONTARIO

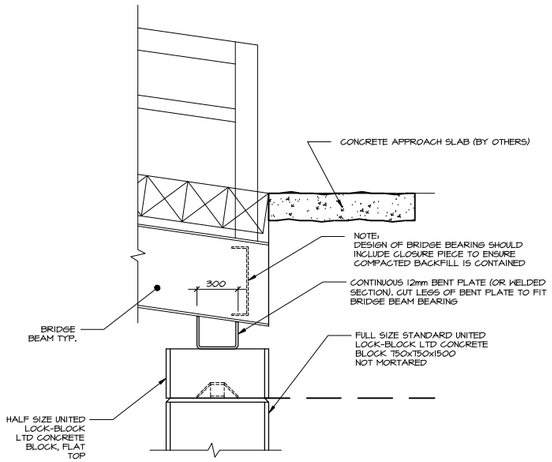
Drawing Title

PLAN AND ELEVATION

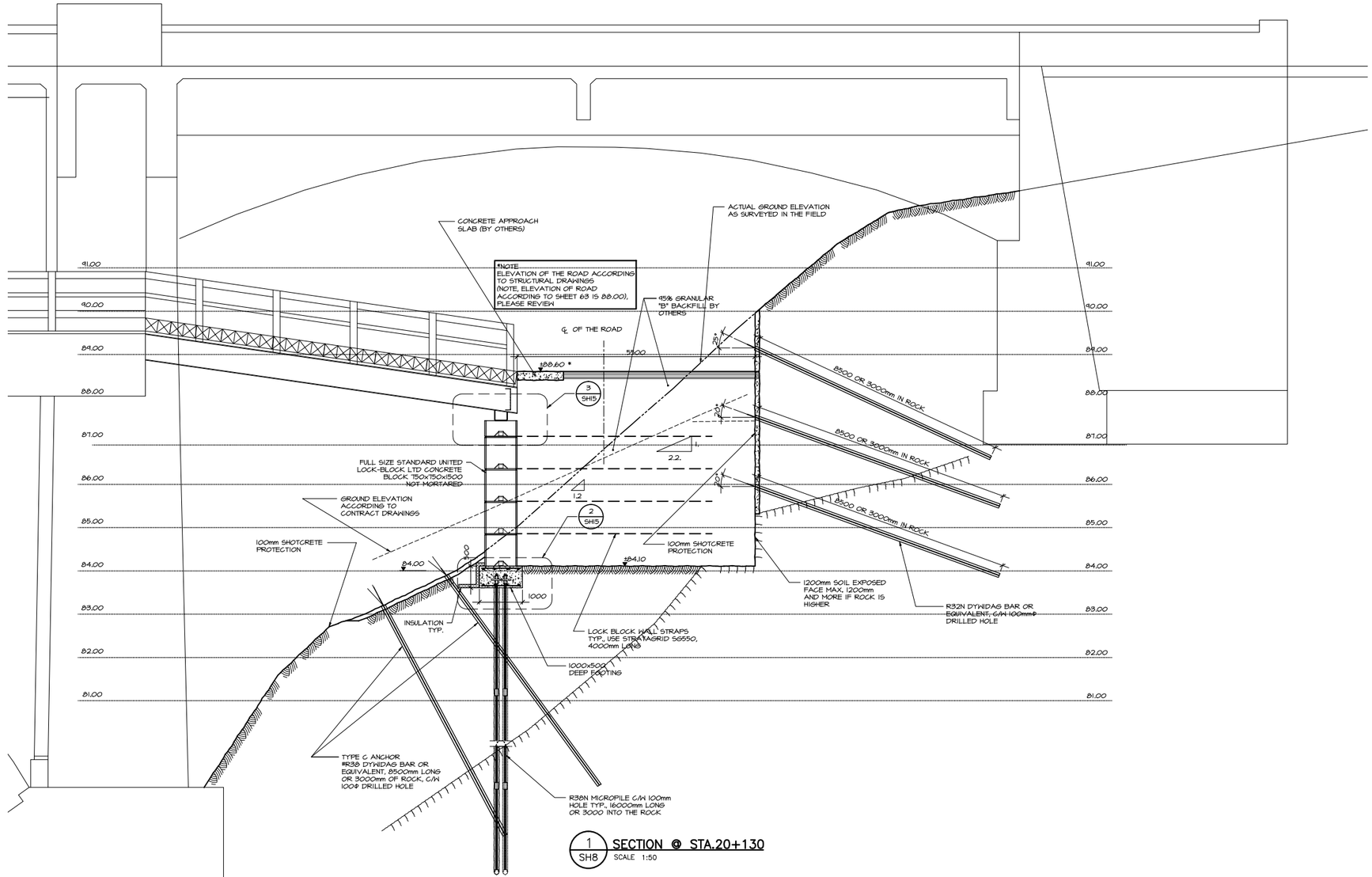
Drawn	D.K.	Scale	AS NOTED
Checked	TOR	Date	AUG., 2011
Project No.	J11-022	Drawing Number	SH8



2 / SH15 **DETAIL** SCALE 1:20



3 / SH15 **DETAIL** SCALE 1:20



1 / SH8 **SECTION @ STA.20+130** SCALE 1:50

No.	DESCRIPTION	Date
6.	REVISED FOR CONSTRUCTION	12/06/07
5.	ISSUED FOR DUFFERIN REVIEW	12/05/15
4.	ISSUED FOR DUFFERIN REVIEW	12/03/23

NOTES

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engineering@thorourke.com

Project
HWY. QEW - From Hurontario Street to Mississauga Road
Site 24-203
MISSISSAUGUA ONTARIO

Drawing Title
SECTION AT STATION 20+130

Drawn: O.K.	Scale: AS NOTED
Checked: TOR.	Date: AUGUST. 2011
Project No.: J11-022	Drawing Number: SH15

Monday, June 11, 2012 13:45:03

E:\PRVHOA\2011\J11-022 CREDIT RIVER\DWG\2012-06-08_SH1_CURRENT.DWG

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