

Foundation Investigation Report

High Fill Embankments and Retaining Walls

Replacement of Twin Structures over CN and CP Rails QEW from 1.4 km North of Bowen Road Interchange Southerly to Gilmore Road Interchange, Town of Fort Erie, Niagara Region, Ontario, GWP 2116-16-00

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services associated with high fill embankments and retaining walls for the widening of the Queen Elizabeth Way (QEW) and replacement of twin structures over Canadian National (CN) and Canadian Pacific (CP) Rails and ancillary structures (Site Nos. 34-129-1 and 34-129-2) near Bowen Road in the Town of Fort Erie, Regional Municipality of Niagara, located approximately as shown on the Key Plan on Drawings 1 to 7, attached.

This report addresses the results of the foundation investigation carried out for the high fill embankments and retaining walls, and associated ramps. The purpose of this investigation is to establish the subsurface (soil, bedrock and groundwater) conditions at the high fill embankments and retaining wall locations by borehole drilling, rock coring and geotechnical and chemical analytical laboratory testing of selected soil and bedrock core samples.

The Terms of Reference for the foundation engineering services are outlined in MTO's Work Item Order No. 2016-E-0029-001, dated July 2017, and MTO's Work Item Order No. 2016-E-0029-008, dated March 2018, which form part of the Consultant's Assignment for the Central Region Large Value Retainer under Agreement No. 2016-E-0029-001 and 2016-E-0029-008.

2.0 SITE DESCRIPTION

For the purposes of the project and this report, the QEW at the site is oriented in a north-south direction.

The existing CN/CP Rails twin structures are located approximately 650 m north of the Bowen Road / Queen Elizabeth Way (QEW) interchange in the Town of Fort Erie, Ontario. Based on the information provided by AECOM, a grade raise and widening (realignment) of the existing north bound lanes (NBL) and south bound lanes (SBL) of the QEW is proposed between approximate highway Stations 13+255 and 14+600 (Bowen Road), including construction of three retaining walls identified as RW-1, RW-2 and RW-3 to facilitate construction within the limits of the available highway QEW right-of-way, and realignment of the Bowen Road/QEW E/W-S and E/W-N Ramps. The existing QEW through the area is two lane roadway in each direction and the proposed widening of the QEW in support of the new structures is planned to stretch from approximately 300 m north of the railway structures to Bowen Road, a distance of approximately 1.3 km, while the proposed grade raise stretches from the north project limit to approximately 200 m north of Bowen Road. The existing QEW highway grade varies from approximately Elevation 177 m near the north project limit to Elevation 189 m at the existing CN/CP twin structure locations, and from Elevation 183 m approximately 275 m north of Bowen Road to Elevation 186 m at Bowen Road. The existing QEW embankments near the north and south limits of the high fill area are approximately 1.5 m to 2 m high relative to the natural ground surface. At the existing CN/CP overhead structure, the existing QEW embankments rise to about 9 m above natural ground surface. The existing natural ground surface at the toes of the existing highway embankment varies from about Elevation 175 m at the north project limit to about Elevation 185 m at the south project limit near Bowen Road.

Retaining walls RW-1 and RW-2 will extend along the west property limit at or near the toe of the widened SBL embankment; RW-1 will extend between Stations 13+670 and 13+858; and RW-2 will extend between Stations 14+010 and 14+313. Both retaining walls RW-1 and RW-2 will conjoin with the proposed north and south abutment retaining walls of the SBL CN/CP overhead structure. Retaining wall RW-3 will extend along the existing east shoulder of the NBL between Stations 14+190 and 14+470.

Review of historical information from MTO GEOCREs No. 30L15-011 for “QEW and Michigan Central Railway” suggests that an embankment failure occurred on the east side of the NBL, north of the existing CN and CP overhead structures. The exact location and extents of the failure cannot be confirmed based on the available information. The available drawing, dated August 1961, presents a plan view and three sections depicting details of the failure including tension cracks at the crest and bulging material at the toe of the highway embankment. The drawing also illustrates a mid-slope stabilization berm which is approximately 11.3 m wide, by 3.0 to 3.5 m high, by at least 100 m long. One of the sections shows stratigraphy inferred from boreholes drilled post-failure indicating that the failure surface was contained within the embankment fill material (i.e., not a foundation failure). Review of electronic design files provided to Golder by AECOM reveal a mid-slope bench exists along the east side of the NBL embankment between approximately Stations 13+845 to 13+940 (north abutment).

3.0 INVESTIGATION PROCEDURES

Field work for the high fill embankment and retaining wall subsurface exploration was carried out between September 6, 2018 and January 26, 2019, during which time 38 boreholes (designated as Boreholes HF-1 through HF-7, HF-9 through HF-15, and R1-1 through R1-6 and R2-1 through R2-6 and RW4A, RW-5 through RW-7, RW-9 through RW-16,) were advanced at the site. The subsurface information of the current exploration is supplemented with information from: three boreholes advanced at the culvert at Station 14+273 crossing the QEW (Boreholes C1-1 through C1-3); one borehole advanced at the culvert under the Bowen Road/QEW EW-S Ramp (Borehole C3-2); and six boreholes advanced for the CN/CP twin structures site (Boreholes CN/CP1, CN/CP3, CN/CP9, CN/CP10, CN/CP12 and CN/CP13). The boreholes at the CN/CP twin structures were advanced between August 23 and 30, 2018 and on November 29, 2018, while the boreholes at the culvert sites were advanced on September 4, 2018 and 24, 2018, December 24, 2018, and January 8 and 26, 2019. The borehole locations are shown on Drawings 1 to 3.

Boreholes CN/CP1, CN/CP3, CN/CP10, CN/CP12, CN/CP13, C1-1, C1-3, HF-1, HF-3, HF-5, HF-7, HF-12, HF-14, RW-4A, RW-5, RW-7, RW-9, RW-10, RW-11, R1-1, R1-3 through R1-6, and R2-1 through R2-6 were drilled using 152 mm or 203 mm outer diameter hollow-stem augers by a CME 75 truck-mounted drilling rig. Boreholes CN/CP9 and C3-2 were advanced using 203 mm outer diameter hollow stem augers by a CME 55 track-mounted drilling rig. The CME 55 and CME 75 drill rigs were supplied and operated by Geo-Environmental Drilling Ltd. of Halton Hills, Ontario. Boreholes C1-2, HF-2, HF-9, HF-11, HF-13, HF-15, RW-6, RW-12 through RW-16 and R1-2 were drilled using 191 mm outer diameter hollow-stem augers by a CME 45 track-mounted drilling rig. Boreholes HF-4 and HF-6 were drilled using a portable tripod drill rig. The CME 45 and portable tripod drilling rigs were supplied and operated by OGS Inc. of Almonte, Ontario. The portable tripod drilling rig utilized wash boring methods to advance BW and AW casing through the overburden. Soil samples were obtained at 0.6 m, 0.75 m and 1.5 m intervals of depth using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in all boreholes in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586)¹. In situ field vane shear testing, using MTO standard “N”-sized and “B”-sized vanes, was carried out to measure the undrained shear strength of cohesive soils (ASTM D2573)². Bedrock core samples were obtained using an ‘HQ3’ size (96 mm OD) rock core barrel.

¹ ASTM D1586 – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.

² ASTM D2573 - Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils.

The groundwater conditions in the open boreholes were observed during and immediately following the drilling operations. Standpipe piezometers were installed in Boreholes RW-6, C1-2 and C1-3 to permit monitoring of the water level. The installed piezometers consist of a 50 mm diameter PVC pipe with a 1.5 m slotted screen positioned within a filter sand pack sealed within the near surface bedrock formation about 2.8 m above the bottom of the borehole. The borehole and annulus surrounding the piezometer pipes above the filter sand pack were backfilled to near ground surface with bentonite pellets and the upper 200 mm of Boreholes RW-6 and C1-3 were capped with a steel well casing to road surface, while Borehole C1-2 was capped with a stick-up casing. All other boreholes were backfilled to ground surface with bentonite in accordance with Ontario Regulation 903, Wells (as amended) and the upper 200 mm of Boreholes C1-1, C1-3, HF-1, HF-3, HF-5, HF-7, HF-12, HF-14, HF-15, RW-4A, RW-5, RW-6, RW-7, RW-9, RW-10, and RW-11 were sealed to the roadway surface with cold patch asphalt upon completion..

Field work was monitored on a full-time basis by members of Golder's technical staff who located the boreholes in the field, directed the sampling and in situ testing operations, logged the boreholes and examined the soil and rock samples. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further visual examination and for geotechnical laboratory testing on selected samples, consisting of natural moisture content, organic content determination, Atterberg limits and grain size distribution, conducted in accordance with MTO and / or ASTM Standards as applicable. Select soil samples were submitted to Maxxam Analytics in Mississauga, Ontario for analysis of parameters used to assess the potential corrosivity and deterioration of the site soil to steel and concrete.

Rock quality (i.e., Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD), weathering and strength index), discontinuity characteristics and classification data were recorded in the field based on visual inspection of the recovered rock cores upon extraction from the core barrel. The bedrock was sequentially photographed, packed and transported to Golder's Mississauga laboratory for further visual examination. Unconfined (uniaxial) compression (UC) testing was carried out on selected rock samples by Geomechanica in Oakville, Ontario. Point load testing was carried out on selected samples of the bedrock core. The remainder of the bedrock core samples were placed in wooden core boxes and kept in storage.

Classification of the rock mass quality of the bedrock with respect to the RQD is described based on Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)³ while the strength of the bedrock core samples is based on Table 3.5 of CFEM, (2006)³. The degree of weathering of the bedrock core samples and the strength classification of the intact rock mass based on field identification are described in accordance with Table B.3 and Table B.6, respectively of the International Society of Rock Mechanics (ISRM, 1985)⁴ standard classification system.

The as-drilled borehole locations were surveyed by Callon Dietz, Ontario Land Surveyors, to an accuracy of 50 mm in the horizontal and vertical directions. The locations given in the Record of Borehole sheets and shown on Drawings 1 to 3 are positioned relative to MTM NAD 83 (Zone 10) CSRS CBNV6-ZD10.0 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, including in geographic (Latitude / Longitude) coordinates, the ground surface elevations and borehole drilled depths are summarized in Table A-1, included in Appendix A.

³ Canadian Foundation Engineering Manual. 2006. Fourth Edition, Canadian Geotechnical Society: Richmond, British Columbia.

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.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This section of the QEW is located in the Clay Plains subregion within the Haldimand Clay Plain physiographic region, as delineated in The Physiography of Southern Ontario (Chapman and Putnam, 1984)⁵. The Beaches and Limestone Plains, also within the Haldimand Clay Plain physiographic region, are located in close proximity to the site.

Generally, this section of Haldimand Clay Plain, located in the farthest southeast reach of the Niagara peninsula, consists of fine-textured glaciolacustrine deposits of silt and clay with minor amounts of sand and gravel. These deposits range from massive to well-laminated. This area of the Haldimand Clay Plain can be considered a separate subregion, characterized by level topography and poor drainage.

The overburden in this area is underlain by dolomitic limestone and dolostone of the Bois Blanc and Salina Formations, specifically the Bertie Member of the Salina Formation. These limestone and dolostone units are typically characterized as medium strong to extremely strong, grey, crystalline and slightly argillaceous.

4.2 General Overview of Subsurface Conditions

The detailed subsurface soil, bedrock and groundwater conditions encountered in the boreholes of the investigation including piezometer installation details and water level readings, and the summary results of the in situ and laboratory tests are provided on the Record of Borehole Sheets in Appendix A. The results of the in-situ field tests (i.e., in-situ field vane and SPT "N"-values) as presented on the borehole records and values provided in Section 4 are uncorrected. The results of the geotechnical laboratory testing on soil samples are presented on the laboratory test figures in Appendix B. Photographs and laboratory test results of the rock core samples are provided in Appendix C. The results of the analytical testing are provided in Appendix D.

The stratigraphic boundaries shown on the borehole records and on the interpreted stratigraphic profiles on Drawings 4 through 7 are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations; however, the factual data presented in the borehole records governs any interpretation of the site conditions.

In general, the subsurface conditions encountered in the boreholes advanced at the site consists of Highway QEW embankment fill (at the boreholes drilled from the highway grade) comprised of layers of non-cohesive and cohesive fill, underlain by cohesive soil deposits of clayey silt to silty clay to clay, and non-cohesive deposits of sandy silt to sand, silty sand to sand and gravel. Localized thin layers of fill materials were encountered at some locations at the toe of the existing highway embankment in portions of the SBL embankment widening area. Fills were also encountered at the locations of the proposed realigned E/W-N and E/W-S Ramps. It should be noted that the E/W-N Ramp area is currently an active construction zone, and fills in this area are likely to have been recently placed / reworked. Dolomitic limestone bedrock was encountered at and confirmed by coring in Boreholes CN/CP3, CN/CP9, CN/CP10, CN/CP12, C1-1, C1-2, C1-3, C3-2, HF-9, , HF-11, RW-6, RW-7, and RW-15, and inferred from auger and/or split spoon refusal in Boreholes HF-13, RW-16, R1-1 to R1-6 and R2-1 to R2-6. More detailed

⁵ Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P. 2715, Scale 1:600,000.

descriptions of the subsurface conditions for sections along the QEW are provided in the following sub-section of this report.

4.2.1 QEW Station 13+550 to Station 13+900 – North of CN/CP Twin Structure

Ten boreholes were advanced for the high fill area and retaining wall RW-1 between Stations 13+550 and 13+900 (Boreholes HF-1 to HF-7 and RW-11 to RW-13), supplemented with two boreholes advanced for the CN and CP twin structures replacement (Boreholes CN/CP1 and CN/CP3) to provide subsurface information at the south limits of the area, adjacent to the twin bridges north approach embankment. The borehole locations and stratigraphic profile for this high fill/retaining wall section are shown on Drawings 1 and 4, respectively.

4.2.1.1 Topsoil

An approximately 30 mm to 150 mm thick layer of topsoil was encountered immediately below ground surface in Boreholes HF-2, HF-4 and RW-12, advanced to the west of the QEW near the toe of the existing highway embankment. Layers of topsoil and organic soils were encountered near the base of the fill (described below) at depths ranging from 2.7 m to 8.5 m below ground surface in Boreholes HF-1, HF-5, HF-7, CN/CP3, RW-11.

4.2.1.2 Asphalt/Sand to Sand and Gravel (Fill)

Boreholes CN/CP1, CN/CP3, HF-1, HF-3, HF-5, HF-7, and RW-11 were advanced through the existing pavement structure on the southbound lanes of the QEW. The pavement is comprised of an approximately 280 mm to 460 mm thick layer of asphalt, underlain by an approximately 0.5 m to 1.2 m thick layer of sand to sand and gravel fill. The measured Standard Penetration Test (SPT) “N”-values within the sand to sand and gravel fill range between 4 blows and 13 blows per 0.3 m of penetration, indicating a loose to compact compactness condition.

4.2.1.3 Clayey Silt to Silty Clay to Clay Fill

A 2.5 m to 7.7 m thick layer of cohesive fill comprised of clayey silt to silty clay to clay was encountered underlying the pavement structure granular fill in Boreholes CN/CP1, CN/CP3, HF-1, HF-3, HF-5, HF-7, and RW-11 advanced from the highway grade. This cohesive fill is associated with the existing Highway QEW embankment. The existing embankment fill extends to between Elevations from 179.7 m to 176.5 m. The fill contained trace organics, and in some instances, distinct layers of topsoil (as noted in Section 4.2.1.2).

An approximately 1.2 m thick layer of clay fill was encountered immediately below ground surface in Borehole HF-6 which was advanced at the toe of the existing embankment. This fill extends to Elevation 179.2 m.

The measured SPT “N”-values within the cohesive fill layer range from 4 blows to 15 blows per 0.3 m of penetration. In situ field vane tests carried out within this layer measured undrained shear strengths ranging from about 98 kPa to greater than 144 kPa (shearing did not occur), with sensitivities ranging from 1.8 to 2.8. The undrained shear strengths together with the SPT “N”-values suggest the cohesive fill is soft to very stiff in consistency and generally has a stiff to very stiff consistency.

The results of grain size distribution testing completed on seven (7) samples of the cohesive fill layer are presented on Figure B-1 in Appendix B. The organic content measured on one sample from the cohesive fill layer in Borehole CN/CP1 is 4.8 per cent.

The natural water content measured on eighteen (18) samples of the cohesive fill layer ranges from about 18 per cent to 28 per cent. Atterberg limits tests were carried out on nine (9) selected samples of the cohesive fill layer and measured plastic limits ranging from about 16 per cent to 24 per cent, liquid limits ranging from about 33 per cent to 60 per cent, and plasticity indices ranging from about 13 per cent to 36 per cent. The results of the

Atterberg limits tests are shown on the plasticity chart on Figures B-2A and B-2B in Appendix B, and indicate that the fill can be classified as clayey silt of low plasticity to clay of high plasticity.

4.2.1.4 Silty Clay to Clay

A 2.3 m to 5.3 m thick deposit of silty clay to clay was encountered underlying the cohesive fill layer in Boreholes CN/CP1, CN/CP3, HF-1, HF-3, HF-5, HF-6, HF-7 and RW-11, underlying the topsoil in Boreholes HF-2, HF-4, and RW-12 and immediately below ground surface in Borehole RW-13. The surface of the deposit was encountered between Elevations 179.4 m and 176.5 m, and the deposit extends to depths ranging from 3.0 m to 13.3 m below ground surface (Elevations 171.6 m to 175.0 m). Borehole CN/CP1 was terminated in this deposit, penetrating it for a thickness of 1.1 m.

The measured SPT “N”-values within the silty clay to clay deposit range from 4 blows to 35 blows per 0.3 m of penetration, and one value of to 71 blows per 0.3 m of penetration, but generally were greater than 15 blows per 0.3 m of penetration. In situ field vane tests carried out with this deposit measured undrained shear strengths ranging from about 54 kPa to greater than 144 kPa (shearing did not occur), with sensitivities ranging from 1.5 to 4.1. The undrained shear strengths, together with the SPT “N”-values, suggest that the deposit generally has a stiff to hard consistency. The lower portion of the deposit is considered to be of firm to stiff consistency in Borehole HF-2 (north of Station 13+725) where an SPT “N”-value of 7 and undrained shear strengths of about 54 kPa to 81 kPa were measured.

Grain size distribution testing was completed on twelve (12) samples of the silty clay to clay deposit and the test results are shown on Figures B-3A and B-3B in Appendix B.

The natural water content measured on twenty-two (22) samples of the silty clay to clay deposit ranges from about 13 per cent to 37 per cent. Atterberg limits tests were carried out on thirteen (13) selected samples of the silty clay to clay deposit and measured plastic limits ranging from about 17 per cent to 24 per cent, liquid limits ranging from about 36 per cent to 59 per cent, and plasticity indices ranging from about 19 per cent to 36 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figures B-4A and B-4B in Appendix B, and indicate that the deposit can be classified as silty clay of intermediate plasticity to clay of high plasticity.

A laboratory consolidation test (oedometer test) was carried out on one sample of the firm to stiff portion of the silty clay deposit from Borehole HF-2 and the test results are presented on Figures B-5 in Appendix B and summarized below.

| Borehole/ Sample No. | Sample Depth/ Elevation | Unit Wt. (kN/m ³) | σ_{vo}' (kPa) | σ_p' (kPa) | $\sigma_p' - \sigma_{vo}'$ (kPa) | C_c | C_r | e_o | OCR |
|----------------------------|-------------------------------|----------------------------------|-------------------------|-------------------|-------------------------------------|-------|-------|-------|-----|
| HF-2 / SA5 | 4.1 m / 172.9 m | 19.5 | 55* | 200 | 145 | 0.20 | 0.021 | 0.745 | 3.8 |

where: σ_{vo}' is the in situ vertical effective overburden stress in kPa
 σ_p' is the preconsolidation stress in kPa
 OCR is the over consolidation ratio
 C_c is the compression index
 C_r is the recompression index
 e_o is the initial void ratio
 * for an inferred groundwater level at 1.5 m depth (~Elev. 175.5 m)

Laboratory consolidated undrained triaxial test (CIU) with pore pressure measurement were carried out on one sample of the firm to stiff portion of the silty clay deposit from Borehole HF-2. In total, 1 set of 3 specimens (total of 3 tests) were tested. All tests were carried out on specimens trimmed from a relatively ‘undisturbed’ Shelby tube sample. The details of the test results are shown on Figures B-6 in Appendix B and the results are summarized below.

| Borehole/Sample No. | Sample Depth/Elevation | Peak | | Post-Peak / Softened | |
|---------------------|----------------------------------|--|---|--|---|
| | | Effective Cohesion Intercept, c' (kPa) | Effective Angle of Internal Friction, ϕ' (degrees) | Effective Cohesion Intercept, c' (kPa) | Effective Angle of Internal Friction, ϕ' (degrees) |
| HF-2 / SA5 | 3.8 – 4.4 m / 173.2 – 172.6 m | 0 | 26 | 0 | 23 |

Note: The assessed shear strength parameters are only valid over the range of stress conditions employed in the test.

4.2.1.5 Clayey Silt

A 2.0 m to 7.7 m thick deposit of clayey silt was encountered underlying the silty clay to clay deposit in Boreholes CN/CP3, HF-1 to HF-7, and RW-11 to RW-13. The surface of the deposit was encountered between Elevations 179.7 m and 171.6 m, and extended to depths ranging from 6.3 m to 21.0 m below ground surface (Elevations 166.8 m to 171.9 m). Boreholes HF-1, HF-2, HF-4, HF-6, and RW-13 were terminated in this deposit, penetrating it for thicknesses ranging from 2.9 m to 5.7 m.

The SPT “N”-values measured within the clayey silt deposit range from 0 blows (weight of the automatic hammer on the rods) to 46 blows per 0.3 m of penetration, one ‘N’-value of 100 blows for 0.29 m of penetration. In situ field vane tests carried out with this deposit measured undrained shear strengths ranging from about 36 kPa to greater than 144 kPa (shearing did not occur), with sensitivities ranging from 1.3 to 2.1. The undrained shear strengths, together with the SPT “N”-values, suggest that the deposit is very soft to hard and generally soft to hard in consistency. North of approximately Station 13+725 the upper portion of the deposit in Boreholes HF-1 to HF-3 and RW-12, is considered to be very soft to stiff in consistency where SPT “N”-values ranging from 0 blows to 4 blows per 0.3 m of penetration and undrained shear strengths ranging from about 36 kPa to 80 kPa were measured.

Grain size distribution testing was completed on eleven (11) samples of the clayey silt deposit and the test results are shown on Figures B-7A and B-7B in Appendix B.

The natural water content measured on twenty (20) samples of the clayey silt deposit ranges from about 12 per cent to about 23 per cent. Atterberg limits tests were carried out on thirteen (13) selected samples of the clayey silt deposit and measured plastic limits ranging from about 12 per cent to 15 per cent, liquid limits ranging from about 21 per cent to 29 per cent, and plasticity indices ranging from about 8 per cent to 16 per cent. These test results, which are plotted on the plasticity chart on Figure B-8A and B-8B in Appendix B, indicate that the deposit can be classified as clayey silt of low plasticity.

4.2.1.6 *Sandy Silt to Sand*

A 0.7 m to 2.2 m thick deposit of sandy silt to silt and sand to silty sand to sand was encountered below or interbedded with the clayey silt deposit in Boreholes CN/CP3, HF-7, RW-11, RW-12 and RW-13. The surface of the deposit was encountered between Elevations 173.4 m and 169.0 m, and the deposit extends to depths ranging from 5.6 m to 21.6 m below ground surface (Elevations 172.4 m to 166.8 m). Boreholes RW-11 and RW-12 terminated in this deposit, penetrating it to depths of 17.4 m and 8.2 m below ground surface (Elevations 169.3 m and 168.9 m), respectively.

The measured SPT “N”-values within the sandy silt to sand deposit range from 20 blows to 35 blows per 0.3 m of penetration, indicating that the deposit is a compact to dense compactness condition.

Grain size distribution testing was completed on four (4) samples of the sandy silt to sand deposit and the test results are shown on Figure B-9 in Appendix B.

The natural water content measured on four (4) samples of the sandy silt to sand deposit ranged from about 15 to 21 per cent.

4.2.1.7 *Sand and Gravel*

A deposit of silty sand and gravel to sand and gravel was encountered underlying the clayey silt deposit in Boreholes HF-3, HF-5, and HF-7 and underlying the sandy silt deposit in Borehole CN/CP3. The surface of the deposit was encountered between Elevations 168.1 m to 166.8 m. Boreholes HF-3, HF-5 and HF-7 were terminated in this deposit at depths ranging from 14.3 m to 22.9 m below ground surface (Elevations 167.8 m to 164.9 m), penetrating the deposit for thicknesses ranging from 0.3 m to 1.9 m. The sand and gravel deposit in Borehole CN/CP3 was measured to be 1.6 m thick, extending to a depth of 23.2 m below ground surface (Elevation 165.2 m).

The measured SPT “N”-values within the sand and gravel deposit range from 25 blows to 31 blows, per 0.3 m of penetration with one ‘N’-value of 155 blows per 0.2 m of penetration at the bedrock contact, indicating that the deposit is in a compact to very dense compactness condition.

Grain size distribution testing was completed on two (2) samples of the sand and gravel deposit and the test results are shown on Figure B-10 in Appendix B.

The natural water content measured on four (4) samples of the sand and gravel deposit ranges from about 7 per cent to 13 per cent.

4.2.1.8 *Dolomitic Limestone (Bedrock)*

Bedrock was encountered in Borehole CN/CP3 at a depth of 23.2 m below ground surface (Elevation 165.2 m) and was cored for a depth of 3.9 m.

Based on the review of the bedrock core samples, the bedrock consists of dolomitic limestone of the Bois Blanc Formation. The core samples are generally described as slightly weathered (W2), crystalline, grey, fine to medium grained, non-porous to faintly porous, medium strong (R3) dolomitic limestone as presented on the relevant Record of Drillhole sheet, and shown on the photographs of the recovered core samples on Figure C-1 in Appendix C.

The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered from Boreholes CN/CP3 are between 89 per cent and 100 per cent and between 70 per cent and 100 per cent; respectively. the RQD ranges from 51 per cent to 100 per cent, indicative of a rock mass of fair to excellent quality, per Table 3.10 in CFEM, (2006)³.

The majority of the logged discontinuities are joints or faults within the dolomitic limestone bedrock or contacts between siltstone/limestone interbeds. In general, the identified discontinuity surfaces are undulating, planar or curved in shape, with smooth to rough surface roughness. The surfaces of the identified discontinuities generally range from clean to slightly altered. A 110 mm thick seam or interbed of gypsum infill was noted present in Borehole CN/CP3 as noted on the Records of Drillhole sheet in Appendix A.

An unconfined compression test (UC) (ASTM D7012)⁶ was carried out on a core specimen of limestone bedrock and strength test results are as shown on Record of Drillhole sheet in Appendix A, detailed in the laboratory test reports contained in Appendix C, and summarized below.

| Borehole No. | Depth From (m) | Depth To (m) | Density (g/cm ³) | UCS (Mpa) |
|--------------|----------------|--------------|------------------------------|-----------|
| CN/CP3 | 26.0 | 262.2 | 2.70 | 133 |

Point load strength tests (ASTM D5731)⁷ were carried out on selected core specimens of the bedrock and the axial and diametral point load strength indices ($I_{s(50)}$) are presented on Figure C-13 in Appendix C. One axial test on a core sample from Borehole CN/CP3 measured an $I_{s(50)}$ value of about 6.0 MPa. Two diametral tests measured $I_{s(50)}$ values of about 0.3 MPa and 2.0 MPa.

Based on the laboratory UC and Point Load test results, the bedrock is generally classified as medium strong to very strong (R3 to R5) in accordance with Table 3.5 of CFEM (2006)³.

4.2.1.9 Groundwater Conditions

The groundwater levels in the open boreholes were measured upon completion of drilling operations, as summarized below.

| Borehole No. | Ground Surface Elevation (m) | Depth to Groundwater (m) | Groundwater Elevation (m) | Date | Comments |
|--------------|------------------------------|--------------------------|---------------------------|---------------|---------------|
| HF-1 | 179.8 | Dry | - | Sep. 13, 2018 | Open Borehole |
| HF-2 | 177.0 | Dry | - | Jan. 16, 2019 | Open Borehole |
| HF-3 | 182.1 | 6.2 | 175.9 | Sep. 12, 2018 | Note 1. |
| HF-4 | 177.6 | N/A | N/A | Dec. 3, 2018 | Note 2. |
| HF-5 | 185.1 | 12.0 | 173.1 | Sep.12, 2018 | Note 1. |
| HF-6 | 180.4 | N/A | N/A | Nov. 30, 2018 | Note 2. |
| HF-7 | 187.8 | 14.3 | 173.5 | Sep. 19, 2018 | Note 1. |
| CN/CP1 | 188.1 | Dry | - | Aug.23, 2018 | Open Borehole |
| CN/CP3 | 188.4 | 12.5 | 175.9 | Aug.28, 2018 | Note 3. |

⁶ ASTM D7012 - Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens

⁷ ASTM D5731 - Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications

| Borehole No. | Ground Surface Elevation (m) | Depth to Groundwater (m) | Groundwater Elevation (m) | Date | Comments |
|--------------|------------------------------|--------------------------|---------------------------|---------------|---------------|
| RW-11 | 186.7 | 13.8 | 172.9 | Sep. 19, 2018 | Note 1. |
| RW-12 | 177.1 | 7.2 | 169.9 | Jan. 16, 2019 | Open Borehole |
| RW-13 | 178.0 | 0.0 | 178.0 | Jan. 16, 2019 | Open Borehole |

Notes: 1. Inside H.S. auger upon completion of soil drilling.

2. Not Recorded – used water for drilling.

3. Inside H.S. auger prior to bedrock coring.

As the water levels were measured during or immediately after completion of drilling and within low permeable fine grained soils, they may not represent the stabilized groundwater level at the site. However, in general, the groundwater level at the site is anticipated to range from approximately Elevations 178.0 m to 169.9 m. The groundwater level will be subject to seasonal fluctuations and should be expected to be higher during the spring season or during and following periods of heavy precipitation.

4.2.2 QEW Station 14+000 to Station 14+500 – South of CN/CP Twin Structure

Sixteen (16) boreholes were advanced for the high fill area and retaining walls RW-2 and RW-3 south of the CN/CP overhead structure, between Stations 14+000 and 14+500 (Boreholes HF-9 to HF-15 and RW-4A, RW-5 to RW-7, RW-9, RW-10, and RW-14 to RW-16). In addition, four boreholes advanced for the CN and CP twin structure replacement (Boreholes CN/CP9, CN/CP10, CN/CP12 and CN/CP13) and three boreholes advanced for a culvert replacement (Boreholes C1-1 to C1-3) were used to supplement the high Fill/retaining wall boreholes adjacent to the bridges south approach embankment and near the south limit of the high fill/retaining wall areas. The borehole locations and stratigraphic profiles for this high fill/retaining walls section are shown on Drawing 1 and Drawings 5 and 6, respectively.

4.2.2.1 Topsoil

An approximately 200 mm to 700 mm thick layer of topsoil was encountered immediately below ground surface in Boreholes CN/CP9, HF-9, RW-14, RW-15 and RW-16, advanced along the west side of the QEW near the toe of the existing highway embankment.

4.2.2.2 Asphalt/Sand to Sandy Gravel (Fill)

Boreholes CN/CP10, CN/CP12, CN/CP13, HF-10, HF-12, C1-1 and C1-3 RW-4A to RW-7 and RW-9 to RW-11 which were advanced through the existing pavement structure of the northbound and southbound lanes of the QEW encountered an approximately 150 mm to 370 mm thick layer of asphalt, underlain by a 0.5 m to 1.9 m thick interlayers of granular fill materials comprised of sandy silt to silt and sand and sand to silty sand to sand and gravel to sandy gravel. A 0.4 m thick layer of clayey silt was encountered within the granular material in Borehole RW-10.

The measured Standard Penetration Test (SPT) “N”-values within the granular materials ranges from 5 blows to per 0.3 m of penetration and one ‘N’-value of 50 blows for 0.25 m of penetration, indicating a loose to very dense compactness condition.

4.2.2.3 Clayey Silt to Silty Clay Fill

A 0.8 m to 7.8 m thick layer of cohesive fill comprised of sandy clayey silt to silty clay was encountered underlying the pavement structure in all boreholes advanced from the highway grade (noted above), except in Borehole HF-14. The cohesive fill extends depth between 1.5 m and 812 m below ground/pavement surface, to between Elevations ranging 182.4 m to 179.2 m. The cohesive fill contains trace organics and wood fragments in places.

An approximately 0.4 m to 0.6 m thick layer of clayey silt fill was encountered immediately below ground surface in Boreholes HF-13, HF-15 and C1-2 which were advanced at the west toe of the existing embankment. This layer of cohesive fill extends to between Elevations from 182.4 m and 181.3 m.

The measured SPT “N”-values within the cohesive fill layer range from 4 blows to 24 blows per 0.3 m of penetration. Two in situ field vane tests carried out within this layer measured undrained shear strengths of about 125 kPa and greater than 144 kPa (shearing did not occur), with a sensitivity of 1.6. The vane undrained shear strengths together with the SPT “N”-values suggest that the cohesive fill is soft firm to very stiff in consistency.

Grain size distribution testing was completed on ten (10) samples of the cohesive fill layer and the test results are shown on Figures B-11A and B-11B in Appendix B. The organic content measured on one sample from the cohesive fill layer is 3.8 per cent.

The natural water content measured on twenty-six (26) samples of the cohesive fill layer ranges from about 11 per cent to 26 per cent. Atterberg limits tests were carried out on twelve (12) selected samples of the cohesive fill layer and measured plastic limits ranging from about 14 per cent to 20 percent, liquid limits ranging from about 24 per cent to 43 per cent, and plasticity indices ranging from about 8 per cent to 24 per cent. These test results, which are plotted on the plasticity chart on Figures B-12A and B-12B in Appendix B, indicate that the deposit is classified as clayey silt of low plasticity to silty clay of intermediate plasticity.

4.2.2.4 Silt and Sand to Silty Sand Fill

A 1.8 m thick layer of silt and sand to silty sand fill was encountered from ground surface in Borehole HF-11 advanced at the west toe of the existing embankment which extended to Elevation 181.9 m. Dolostone fragments were noted within the fill. The measured SPT “N”-values within this layer of non-cohesive fill are 3 and 9 blows per 0.3 m of penetration, indicating a very loose to loose compactness condition. An SPT “N”-value of 50 blows for 0.1 m of penetration was measured near the bottom of the borehole at the depth that dolostone fragments were recovered.

Grain size distribution testing was completed on one sample of the silt and sand fill interlayer and the test result is shown on Figure B-13 in Appendix B. The natural water content measured on one sample of the silt and sand fill is about 19 per cent.

4.2.2.5 Silty Clay

A 2.1 m to 5.4 m thick deposit of silty clay was encountered underlying the topsoil in Boreholes CN/CP9, HF-9 and RW-10, and underlying the fill layers in Boreholes CN/CP10, CN/CP12 and CN/CP13. The surface of the deposit was encountered between Elevations from 179.2 m and 181.0 m, and the deposits extends to depths ranging from 3.7 m to 13.3 m below ground surface (Elevations 178.1 m to 174.5 m). Borehole CN/CP13 was terminated within this deposit, penetrating it for a thickness of 1.1 m.

An interlayer of silt and sand was encountered within the silty clay deposit in Borehole CN/CP10, as described in Section 4.2.2.7.

The measured SPT “N”-values within the silty clay deposit range from 9 blows to 23 blows per 0.3 m suggesting that the deposit is stiff to very stiff in consistency.

Grain size distribution testing was completed on five (5) samples of the silty clay deposit and the test results are shown on Figures B-14A and B-14B in Appendix B.

The natural water content measured on eleven (11) samples of the silty clay deposit range from about 13 per cent to about 27 per cent. Atterberg limits tests were carried out on five (5) selected samples of the silty clay deposit and measured plastic limits ranging from about 16 to 21 per cent, liquid limits ranging from about 36 to 44 per cent, and plasticity indices ranging from about 20 to 23 per cent. These test results, which are plotted on the plasticity chart on Figures B-15A to B-15B in Appendix B, indicate that the deposit can be classified as silty clay of intermediate plasticity.

4.2.2.6 Clayey Silt

A 0.4 m to 4.6 m thick deposit of clayey silt was encountered underlying the topsoil in Boreholes RW-14, underlying the silty clay in Boreholes CN/CP9, CN/CP12, underlying the silt and sand to silty sand deposit in Boreholes CN/CP10, C1-1 and RW-15, and underlying the fill layers in Boreholes C1-3, HF-10, HF-12, RW-7, RW-9. The surface of the deposit was encountered between Elevations from 174.4 m and 182.4 m, and the deposit extends to depths ranging from 4.0 m to 16.3 m below ground surface (Elevations 179.6 m to 171.9 m). Borehole RW-14 was terminated within this deposit, penetrating for a thickness of 2.8 m.

Interlayers of sandy silt to silty sand and silty sand and gravel were encountered within the silty clay deposit in a number of boreholes, as described in Section 4.2.2.7.

The measured SPT “N”-values within the clayey silt to silty clay deposit range from 4 blows to 71 blows per 0.3 m of penetration, and up to 60 blows for 0.05 m of penetration, but generally greater than 8 blows per 0.3 m of penetration, suggesting that the deposit is generally stiff to hard in consistency.

Grain size distribution testing was completed on fourteen (14) samples of the clayey silt deposit and the test results are shown on Figures B-14A to B-14C in Appendix B.

The natural water content measured on seventeen (17) samples of the clayey silt deposit range from about 10 per cent to about 22 per cent. Atterberg limits tests were carried out on twelve (12) selected samples of the clayey silt deposit and measured plastic limits ranging from about 10 to 15 per cent, liquid limits ranging from about 18 to 30 per cent, and plasticity indices ranging from about 6 to 16 per cent. These test results, which are plotted on the plasticity chart on Figures B-15A to B-15C in Appendix B, indicate that the deposit can be classified as clayey silt of low plasticity.

4.2.2.7 Sandy Silt to Silty Sand to Silty Sand and Gravel

A 0.2 m to 2.6 m thick deposit of sandy silt to silt and sand to silty sand was encountered underlying the topsoil in Borehole RW-15, underlying the clayey silt to silty clay deposit in Boreholes HF-9 and RW-9 and underlying the fill layers in Boreholes C1-1, HF-14, RW-4A, RW-5 and RW-6. The surface of the deposit was encountered between Elevations 182.6 and 179.0 m and the deposit extends to depths ranging from 0.3 m to 6.1 m below ground surface (Elevations 182.1 m to 176.4 m).

In Borehole RW-7, a 0.7 m thick layer of silty sand and gravel layer was encountered within the clayey silt to silty clay deposit at a depth of 5.1 m below ground surface (Elevation 178.6 m).

In Boreholes CN/CP10, HF-12, and RW-14, sandy silt to silty sand deposits were encountered interlayered within the clayey silt and silty clay deposits. The elevations of the surface and based of the sandy silt to silty sand interlayers, and interlayer thickness as encountered in the boreholes, are summarized below.

| Borehole ID | Depth to Surface of Interlayer (m) | Interlayer Surface Elevation (m) | Interlayer Thickness (m) | Interlayer Base Elevation (m) |
|-------------|------------------------------------|----------------------------------|--------------------------|-------------------------------|
| CN/CP10 | 10.8 | 177.4 | 0.9 | 176.5 |
| HF-12 | 3.0 | 181.2 | 1.7 | 179.5 |
| RW-14 | 1.0 | 180.5 | 2.0 | 178.5 |

The measured SPT “N”-values within the sandy silt to silty sand deposit range from 3 blows to 29 blows per 0.3 m of penetration, and to 80 blows for 0.07 m of penetration, indicating that the deposit is in a very loose to very dense compactness condition, but generally is compact.

The natural water content measured on eleven (11) samples of the sandy silt to silty sand deposit range from about 7 per cent to about 21 per cent.

Grain size distribution testing was completed on nine (8) samples of the sandy silt to silty sand deposit and the test results are shown on Figure B-16A and B-16B in Appendix B.

4.2.2.8 Sand to Sand and Gravel

A deposit of sand to sand and gravel was encountered underlying the clayey silt to silty clay deposit in Boreholes CN/CP9, CN/CP10, CN/CP12, HF-10, HF-12, RW-7, RW-10, and RW-15 and underlying the silty sand to sand and silt to sandy silt deposit in Borehole HF-14, RW-4A, RW-5, RW-9. The surface of the deposit was encountered between Elevations 181.5 m and 170.4 m. Boreholes HF-10, HF-12, HF-14, RW-4A, RW-5, RW-7, RW-9, RW-10 and RW-15 were terminated within this deposit, penetrating it for thicknesses ranging from 0.6 m to 13.3 m. Where fully penetrated, the thickness of the deposit ranges from 6.9 m to 7.6 m and extends to depths ranging from 15.5 m to 23.3 m below ground surface (Elevations 165.3 m to 164.5 m). The deposit is noted to contain cobbles, boulders and rock fragments as inferred from grinding of the augers during drilling. In Borehole HF-12, a 0.7 m thick layer of sandy silt was encountered within the sand to sand and gravel deposit at a depth of 13.0 m below ground surface (Elevation 171.2 m).

The measured SPT “N”-values within the sand to sand and gravel deposit range from 11 blows to 69 blows per 0.3 m of penetration and up to 100 blows for 0.02 m of penetration, indicating that the deposit has a compact to very dense relative density.

Grain size distribution testing was completed on thirteen (13) samples of the sand to sand and gravel deposit and the test results are shown on Figure B-17A and B-17B in Appendix B.

The natural water content measured on twenty-five (25) samples of the sand to sand and gravel deposit range from about 3 per cent to 14 per cent, with one sample from a sand interlayer in Borehole CN/CP12 measuring 26 per cent. Atterberg limits testing was carried out on one sample of the sand and gravel portion of the deposit from Borehole CN/CP12 and measured a plastic limit of about 15 percent, a liquid limit of about 16 per cent, and a plasticity index of about 1 per cent. The test result, which is plotted on Figure B-18 in Appendix B, indicates that the finer material of the deposit may be classified as silt with slight plasticity.

4.2.2.9 Dolomitic Limestone (Bedrock)

Refusal to further split spoon penetration was recorded in Boreholes HF-10, RW-1 and RW-14 to RW-16 at depths ranging from 0.4 m to 11.6 m below ground surface, corresponding to Elevations 181.5 m to 174.6 m.

Bedrock was encountered and cored in Boreholes C1-1, C1-2, C1-3, HF-9, HF-11 and RW-6 between Elevations 181.9 m and 176.5 m, and in Boreholes CN/CP9, CN/CP10 and CN/CP12 between Elevations 165.3 m and 164.5 m. The upper 4.6 m depth of the weathered portion of the bedrock was penetrated by augering and recovered by split-spoon sampling in Borehole C1-1. The depths to bedrock, the corresponding bedrock surface elevations and the recovered core length are summarized below.

| Borehole | Depth to Bedrock Surface (m) | Bedrock Surface Elevation (m) | Cored Depth (m) |
|----------|------------------------------|-------------------------------|--|
| CN/CP9 | 15.5 | 164.5 | 3.1 |
| CN/CP10 | 23.2 | 165.0 | 4.0 |
| CN/CP12 | 23.3 | 165.3 | 3.9 |
| C1-1 | 4.1 | 179.6 | 4.7 (below the augered upper 4.6 m depth) |
| C1-2 | 0.4 | 181.4 | 3.3 |
| C1-3 | 7.6 | 176.5 | 1.5 |
| HF-9 | 4.3 | 177.2 | 4.7 |
| HF-10 | 11.6 | 174.6 | Inferred from refusal to split spoon penetration |
| HF-11 | 1.8 | 181.9 | 4.4 |
| RW-6 | 3.4 | 180.2 | 5.8 |

Based on the review of the bedrock core samples, the bedrock consists of dolomitic limestone of the Bois Blanc Formation. In general, the bedrock core samples are described as fresh to completely weathered (W1 to W5), crystalline, grey, fine to coarse grained, non-porous to slightly porous, weak to medium strong (R2 to R3) dolomitic limestone as presented on the relevant Record of Drillhole sheets, and shown on the photographs of recovered core samples on Figures C-2 through C-10 in Appendix C.

The RQD measured on core samples ranges from about 0 per cent to 84 per cent, indicative of a rock mass of very poor to good quality, as per Table 3.10 CFEM(2006)³. The TCR and SCR of samples recovered from Boreholes C1-1 to C1-3, HF-9, HF-11 and RW-6 are between 8 per cent and 100 per cent, and between 0 per cent and 94 per cent, respectively.

The bedrock core samples recovered from Boreholes CN/CP9, CN/CP10 and CN/CP 12 indicate TCR and SCR ranging between 94 per cent and 100 per cent, and between 75 per and 100 per cent, respectively. The RQD ranges from 69 per cent to 100 per cent, indicating a rock mass of fair to excellent quality CFEM (2006)³.

The majority of the logged discontinuities are joints or faults within the dolomitic limestone bedrock or contacts between siltstone/limestone interbeds. In general, the identified discontinuity surfaces are undulating, planar or curved in shape, with smooth to rough surface roughness. The surfaces of the identified discontinuities generally range from clean to slightly altered. Three occurrences of gypsum infills, or interbeds, were noted present in Borehole CN/CP9, as indicated on the Records of Drillhole sheet in Appendix A.

A grain size distribution test was completed on one split spoon sample of the upper weathered portion of the dolomitic limestone bedrock recovered in Borehole C1-1 and the test result is shown on Figure C-12 in Appendix C.

Two unconfined compression tests (UC) (ASTM D7012)⁶ were carried out on core specimens of limestone bedrock and strength test results are as shown on Record of Drillhole sheets in Appendix A, detailed in the laboratory test reports contained in Appendix C and are summarized below.

| Borehole No. | Depth From (m) | Depth To (m) | Density (g/cm ³) | UCS (Mpa) |
|--------------|----------------|--------------|------------------------------|-----------|
| CN/CP9 | 16.0 | 16.1 | 2.75 | 97 |
| CN/CP12 | 23.4 | 23.6 | 2.62 | 93 |

Point load strength tests (ASTM D5731)⁷ were carried out on selected core specimens. The axial and diametral point load strength index values ($I_{s(50)}$) are shown Figure C-13 in Appendix C. Nine axial tests measured $I_{s(50)}$ indices ranging from about 0.7 MPa to 7.7 MPa and an average of 4.1 MPa. Eleven diametral tests measured $I_{s(50)}$ indices ranging from about 0.1 MPa to 3.0 MPa, with an average of 0.5 MPa.

Based on the laboratory UC and Point Load Index tests, the bedrock is generally classified as weak to strong (R2 to R4) in accordance with Table 3.5 of CFEM (2006)³.

4.2.2.10 Groundwater Conditions

The groundwater levels in the open boreholes were measured upon completion of drilling operations, as summarized below.

| Borehole No. | Ground Surface Elevation (m) | Depth to Groundwater (m) | Groundwater Elevation (m) | Date | Comments |
|--------------|------------------------------|--------------------------|---------------------------|---------------|-----------|
| C1-1 | 183.7 | Dry | - | Sep. 5, 2018 | Note 3. |
| C1-2 | 181.8 | 3.9 | 177.9 | Jan. 13, 2019 | Standpipe |
| | | 3.2 | 178.6 | Feb. 8, 2019 | |
| | | 3.8 | 178.0 | Feb. 22, 2019 | |
| C1-3 | 184.1 | 3.2 | 180.9 | Feb. 8, 2019 | Standpipe |
| | | 5.9 | 178.2 | Feb. 22, 2019 | |
| CN/CP9 | 180.0 | 7.9 | 172.1 | Nov. 29, 2018 | Note 2. |

| Borehole No. | Ground Surface Elevation (m) | Depth to Groundwater (m) | Groundwater Elevation (m) | Date | Comments |
|--------------|------------------------------|--------------------------|---------------------------|--------------------|---------------|
| CN/CP10 | 188.2 | 12.5 | 175.7 | Aug. 29, 2018 | Note 1. |
| CN/CP12 | 188.6 | 12.2 | 176.4 | Aug. 24, 2018 | Note 1. |
| CN/CP13 | 187.9 | Dry | - | Aug. 30, 2018 | Note 1. |
| HF-9 | 181.5 | Dry | - | Jan. 11, 2019 | Note 3. |
| HF-10 | 186.2 | 9.7 | 176.5 | Sep. 6 and 7, 2018 | Note 1. |
| HF-11 | 183.7 | Dry above 1.6 | - | Jan. 12, 2019 | Note 1. |
| HF-12 | 184.2 | 7.5 | 176.7 | Sep. 6, 2018 | Note 1. |
| HF-13 | 181.9 | Dry | - | Jan. 12, 2019 | Open Borehole |
| HF-14 | 183.3 | 6.8 | 176.5 | Sep. 7, 2018 | Note 1. |
| HF-15 | 183.0 | Dry | - | Jan. 12, 2019 | Open Borehole |
| RW-4A | 184.5 | Dry | - | Sep. 21, 2018 | Note 1. |
| RW-5 | 184.2 | Dry | - | Sep. 17, 2018 | Note 1. |
| RW-6 | 183.6 | 4.9 | 178.7 | Jan. 14, 2019 | Note 3. |
| | | 6.6 | 177.0 | January 15, 2019 | Open Borehole |
| | | 3.3 | 180.3 | Feb. 22, 2019 | Standpipe |
| RW-7 | 183.7 | 7.3 | 176.4 | Sep. 17, 2018 | Note 1. |
| RW-9 | 185.1 | 5.5 | 179.6 | Sep. 17, 2018 | Note 1. |
| RW-10 | 186.6 | 10.7 | 175.9 | Sep. 21, 2018 | Note 1. |
| RW-14 | 181.5 | N/A | N/A | Jan. 25, 2019 | Not Recorded |
| RW-15 | 182.9 | 5.3 | 177.6 | Jan. 25, 2019 | Note 1. |
| RW-16 | 181.9 | Dry | - | Jan. 26, 2019 | Open Borehole |

Notes: 1. Inside H.S. auger upon completion of soil drilling.

2. Not Recorded – used water for drilling.

3. Inside H.S. auger prior to bedrock coring.

As the water levels were measured during or immediately after completion of drilling and within low permeable fine grained soils, they may not represent the stabilized groundwater level at the site. However, in general, the groundwater level at the site is anticipated to range from approximately Elevations 180.3 m to 176.0 m. The

groundwater level will be subject to seasonal fluctuations and should be expected to be higher during the spring season or during and following periods of heavy precipitation.

4.2.3 Bowen Road E/W-S and E/W-N Ramps

Twelve (12) boreholes were advanced for the realignment of ramp E/W-S (Boreholes R1-1 to R1-6) and ramp EW-S (Boreholes R2-1 to R2-6); supplemented with one borehole advanced for the culvert under ramp E/W-S (Borehole C3-2) to provide additional subsurface information within the ramp area. The borehole locations at these high fill ramps are shown on Drawings 2 and 3 and the respective stratigraphic profiles are shown on Drawing 7.

It should be noted that the subsurface stratigraphy encountered within the boreholes advanced at the ramps as shown on the Record of Borehole sheets and on the stratigraphic profiles on Drawing 7 may change as there was active construction occurring at the time of the field investigation related to the realignment of the Bowen Road overpass. Local grading may impact the presence and/or thickness of the deposits that were encountered at the time of the investigation.

4.2.3.1 Topsoil

An approximately 75 mm to 180 mm thick layer of topsoil was encountered immediately below ground surface in Boreholes R1-2, R1-3, R1-4, and R1-5 at the E/W-S Ramp.

4.2.3.2 Asphalt/Sand (Fill)

Boreholes R1-1, R2-5 and R2-6 were advanced through the existing pavement structure of the existing ramps and penetrated an approximately 100 mm to 300 mm thick layer of asphalt, underlain by a 0.8 m to 1.3 m thick layer of granular fill comprised of an upper 0.8 m thick layer of sand or 0.9 m thick layer of sand and gravel and a lower 0.3 m to 0.4 m thick layer of sand. The measured Standard Penetration Test (SPT) "N"-values within the granular materials are 23 blows and 31 blows per 0.3 m of penetration, indicating a compact to dense level of compactness condition.

The natural water content measured on two samples of the granular material ranged from about 2 to 14 per cent.

4.2.3.3 Clayey Silt to Silty Clay (Fill)

A 0.2 m to 3.9 m thick layer of sandy clayey silt to clayey silt to silty clay fill was encountered underlying the granular fill in Borehole R1-1, underlying the topsoil in Borehole R1-2, underlying the sand fill in Borehole R1-5 and immediately below ground surface in Boreholes R1-6, R2-1, and R2-3. The cohesive fill extended to depths ranging from 1.1 m to 4.8 m auger and/or (Elevations 182.9 m and 185.8 m). Boreholes R1-1, R1-2 and R1-5 were terminated in the fill layer on split spoon and auger refusal below ground surface to further penetration.

The measured SPT "N"-values within the cohesive fill layer range from 2 blows to 30 blows per 0.3 m of penetration and up to 103 blows for 0.15 m of penetration. An in-situ field vane test carried out with this deposit measured an undrained shear strength greater than 144 kPa (shearing did not occur). The undrained shear strength together with the SPT "N"-values, suggest that the deposit generally has a soft to hard consistency.

Grain size distribution testing was completed on four (4) samples of the clayey silt to silty clay fill layers and the test results are shown on Figure B-19 in Appendix B.

The natural water content measured on six (6) samples of the clayey silt to silty clay fill range from about 12 per cent to 21 per cent. Atterberg limits testing was carried out on four (4) selected samples of the clayey silt to silty clay fill and measured plastic limits ranging from about 15 per cent to 19 per cent, liquid limits ranging from about

27 per cent to 40 per cent, and plasticity indices ranging from about 8 per cent to 22 per cent. These test results, which are plotted on the plasticity chart on Figure B-20 in Appendix B, indicate the cohesive fill can be classified as clayey silt of low plasticity to silty clay of intermediate plasticity.

4.2.3.4 Sand to Sand and Gravel (Fill)

Layers of sand to silty sand and gravel to sand and gravel fill were encountered immediately the ground surface in borehole R2-2, below the topsoil in Borehole R1-5 and interlayered with the clayey silt to silty clay fill in Borehole R1-1. The non-cohesive fill layers range in thickness between about 0.3 m and 0.8 m and the interlayer in Borehole R1-1 was encountered at a depth of 2.2 m below ground surface (Elevation 187.6 m).

One SPT “N”-value measured within the non-cohesive fill is 29 blows per 0.3 m of penetration indicating a compact compactness condition.

4.2.3.5 Silt

A 0.7 m and 0.8 m thick deposit of silt to sandy silt was encountered underlying the topsoil in Boreholes R1-3 and R1-4. The surface of the silt deposit was encountered at Elevation 183.9 m and extends to depths of 0.9 m below ground surface (Elevation 183.2 m and 183.1 m) in the respective boreholes. Both boreholes were terminated in this deposit on auger and/or to split spoon and refusal to further penetration.

One SPT “N”-value within the silt deposit is 100 blows per 0.08 m of penetration, measured at the refusal depth.

4.2.3.6 Clayey Silt to Silty Clay

A 0.2 m to 4.1 m thick deposit of clayey silt with sand to clayey silt to silty clay was encountered immediately below ground surface in Borehole R2-4, underlying the pavement structure in Boreholes R2-5 and R2-6, and underlying the fill layers in Boreholes R1-6, and R2-1 to R2-3. The surface of the clayey silt to silty clay was encountered between Elevations 185.8 m and 184.1 m and the deposit extends to depths ranging from 1.5 m to 4.5 m (Elevations 184.5 m and 180.6 m). All seven boreholes were terminated within this deposit due to split spoon and/or auger refusal.

The measured SPT “N”-values within the clayey silt to silty clay deposit ranged from 10 blows to 33 blows per 0.3 m of penetration, and up to 100 blows for 0.3 m of penetration, suggesting a stiff to hard consistency within the deposit.

Grain size distribution testing was completed on five (5) samples of the clayey silt to silty clay deposit and the test results are shown on Figure B-21 in Appendix B.

The natural water content measured on thirteen (14) samples of the clayey silt to silty clay deposit range from about 6 to 21 per cent. Atterberg limits testing was carried out on five (5) selected samples of the clayey silt to silty clay deposit and measured plastic limits ranging from about 12 per cent to 19 per cent, liquid limits ranging from about 22 per cent to 43 per cent, and plasticity indices ranging from about 10 per cent to 24 per cent. These test results, which are plotted on the plasticity chart on Figure B-22 in Appendix B, indicate the deposit can be classified as clayey silt of low plasticity to silty clay of intermediate plasticity.

4.2.3.7 Dolomitic Limestone (Bedrock)

Refusal to further split spoon and/or auger advancement was recorded in Boreholes R1-1 to R1-6 and R2 to R2-6 at depths between 1.1 m and 4.8 m below ground surface (between Elevations 185.0 m and 180.6 m).

Bedrock was encountered in Borehole C3-2 immediately at ground surface (outcrop) at Elevation 183.9 m and the bedrock was cored for 3.2 m depth.

Based on the review of the bedrock core samples, the bedrock consists of dolomitic limestone of the Bois Blanc Formation. In general, the bedrock core samples are described as moderately weathered (W3), crystalline, grey, fine grained, non-porous, medium strong (R3) dolomitic limestone, as presented on the Record of Drillhole C3-2, and shown on the photographs of recovered core samples on Figure C-11 in Appendix C.

The RQD measured on core samples ranges from about 34 per cent to 71 per cent, indicative of a rock mass of poor to fair quality, as per Table 3.10 CFEM (2006)³. The TCR and SCR of the core samples recovered from Borehole C3-2 range between 71 per cent and 100 per cent and between 65 per cent and 80 per cent, respectively.

The majority of the logged discontinuities are faults within the dolomitic limestone bedrock or contacts between siltstone/limestone interbeds. In general, the identified discontinuity surfaces are undulating or planar in shape, with smooth to rough surface roughness. The surfaces of the identified discontinuities generally range from clean to partially coated. Where the surfaces were partially coated with infill, the material is generally clay or crushed rock.

Point load strength tests (ASTM D5731)⁷ were carried out on selected core specimens. The axial and diametral strength index point load strength index ($I_{s(50)}$) are shown Figure C-13 in Appendix C: one axial test measured an $I_{s(50)}$ value of about 2.3 MPa; and two diametral tests measured $I_{s(50)}$ values of about 0.3 MPa and 0.4 MPa.

Based on the laboratory Point Load tests, the bedrock is generally classified as weak to strong (R2 to R4) in accordance with Table 3.5 of CFEM (2006)³.

4.2.3.8 Groundwater Conditions

The groundwater conditions in the open boreholes were noted during drilling operations and all boreholes were noted as dry upon completion of drilling. Surface water was noted at the location of Borehole C3-2 prior to drilling.

As the water level observations were made during or immediately after completion of drilling, and within low permeable fine grained soils, the recorded dry conditions may not represent the stabilized groundwater level at the site. The groundwater level will be subject to seasonal fluctuations and should be expected to be higher during the spring season or during and following periods of heavy precipitation.

4.3 Analytical Testing Results

Fourteen soil samples were submitted to Maxxam Analysis for analysis of parameters used to assess the potential corrosivity of the site soil to steel and potential deterioration of concrete. Detailed analytical test results are included in Appendix D and the test results are summarized below.

| Borehole No. / Sample No. | pH | Resistivity (ohm-cm) | Electrical Conductivity (µmho/cm) | Chlorides (µg/g) | Soluble Sulphates (µg/g) |
|---------------------------|------|----------------------|-----------------------------------|------------------|--------------------------|
| RW-4A / 3 | 8.02 | 610 | 1,640 | 810 | 120 |
| RW-5 / 8 | 7.71 | 2,100 | 483 | 200 | 81 |
| RW-7 / 5B | 7.84 | 3,300 | 302 | 95 | <20* |

| Borehole No. / Sample No. | pH | Resistivity (ohm-cm) | Electrical Conductivity (µmho/cm) | Chlorides (µg/g) | Soluble Sulphates (µg/g) |
|---------------------------|------|----------------------|-----------------------------------|------------------|--------------------------|
| RW-9 / 6 | 7.87 | 1,600 | 623 | 340 | 39 |
| RW-10 / 7 | 7.89 | 710 | 1,400 | 660 | 88 |
| RW-11 / 5 | 7.70 | 1,600 | 642 | <20* | 530 |
| RW-12 / 4 | 7.84 | 1,000 | 1,000 | <20* | 1,400 |
| RW-13 / 2 | 8.02 | 270 | 3,640 | 120 | 4,800 |
| RW-14 / 6 | 7.82 | 3,100 | 323 | 58 | 100 |
| RW-16 / 1A | 7.22 | 4,400 | 227 | 26 | <20* |
| C1-1 / AS1 | 8.06 | 2,000 | 504 | 150 | 110 |
| CN/CP3 / 12 | 7.91 | 680 | 1,470 | <20* | 2,900 |
| CN/CP9 / 4 | 7.86 | 300 | 3,300 | 310 | 7,400 |
| CN/CP12 / 11 | 7.89 | 3,400 | 297 | <20* | 180 |

*Concentration is below Reportable detection limit

5.0 CLOSURE

This Foundation Investigation Report was prepared by Eric Naylor, an EIT with Golder, and Matt Soderman, P.Eng, a geotechnical engineer with Golder. Mr. Jorge Costa, P.Eng., an MTO Foundations Designated Contact and senior consultant with Golder, conducted an independent technical and quality control review of the report.

Golder Associates Ltd.



Matt Soderman, P.Eng.
Geotechnical Engineer

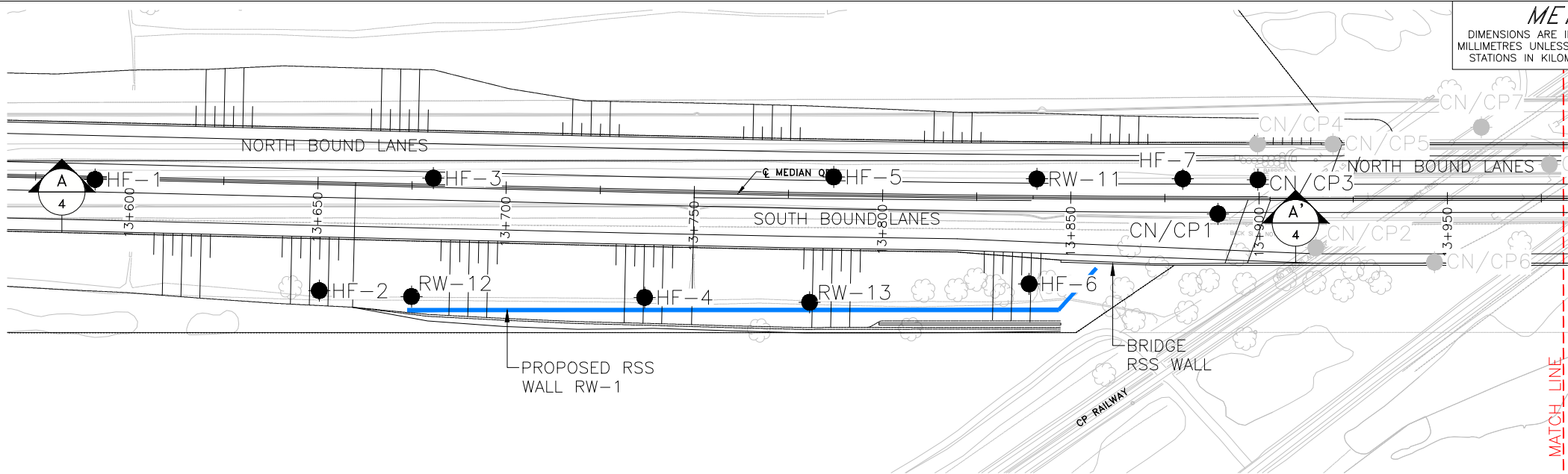


Jorge M.A. Costa, P.Eng.
Senior Consultant, MTO Designated Foundations Contact

EN/MAS/JMAC/jl/rb

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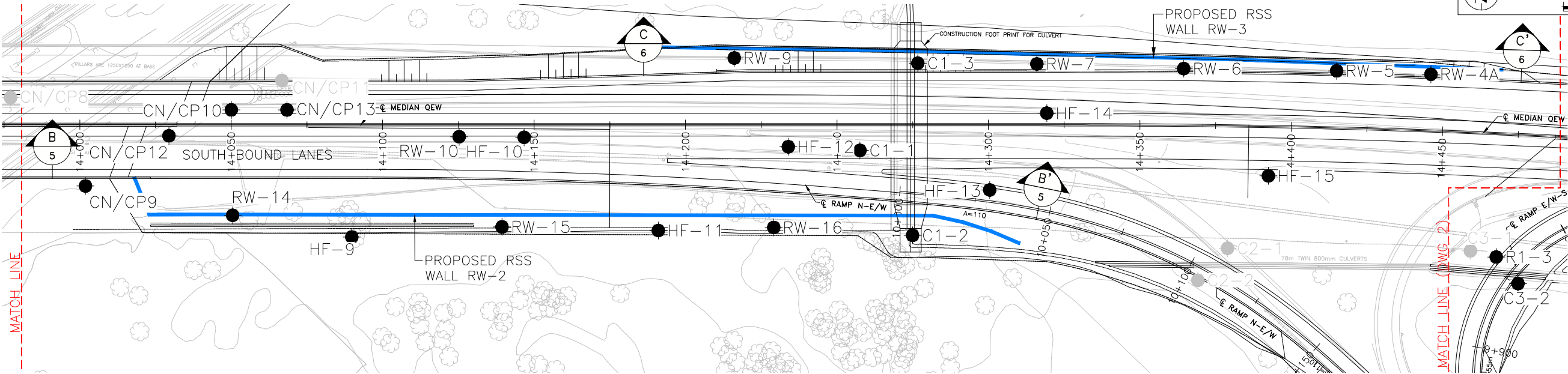
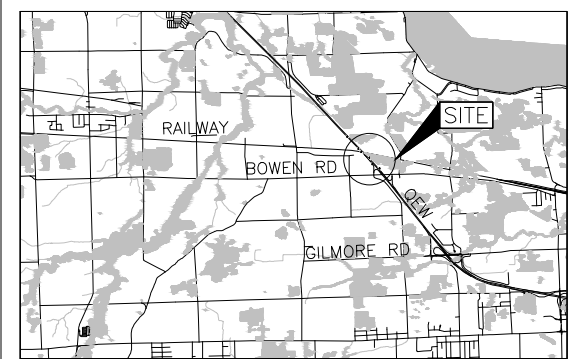
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CONT No.
GWP No.2116-16-00



QEW
RETAINING WALLS AND HIGH FILLS
BOREHOLE LOCATIONS

SHEET



| BOREHOLE CO-ORDINATES | | | |
|-----------------------|-----------|-----------|----------|
| No. | ELEVATION | NORTHING | EASTING |
| C1-1 | 183.7 | 4755249.3 | 346719.3 |
| C1-2 | 181.8 | 4755217.3 | 346711.3 |
| C1-3 | 184.1 | 4755255.7 | 346753.2 |
| CN/CP1 | 188.1 | 4755516.6 | 346465.5 |
| CN/CP3 | 188.4 | 4755515.3 | 346479.4 |
| CN/CP9 | 180.0 | 4755424.5 | 346532.6 |
| CN/CP10 | 188.2 | 4755407.5 | 346584.2 |
| CN/CP12 | 188.6 | 4755416.3 | 346563.7 |
| CN/CP13 | 187.9 | 4755394.3 | 346597.0 |
| HF-1 | 179.8 | 4755736.8 | 346264.2 |
| HF-2 | 177.0 | 4755673.5 | 346284.5 |
| HF-3 | 182.1 | 4755672.6 | 346327.1 |

| BOREHOLE CO-ORDINATES | | | |
|-----------------------|-----------|-----------|----------|
| No. | ELEVATION | NORTHING | EASTING |
| HF-4 | 177.6 | 4755610.3 | 346343.4 |
| HF-5 | 185.1 | 4755596.6 | 346401.4 |
| HF-6 | 180.4 | 4755539.6 | 346417.2 |
| HF-7 | 187.8 | 4755529.8 | 346465.7 |
| HF-9 | 181.5 | 4755349.7 | 346581.8 |
| HF-10 | 186.2 | 4755331.9 | 346645.1 |
| HF-11 | 183.7 | 4755278.6 | 346653.9 |
| HF-12 | 184.2 | 4755267.2 | 346703.6 |
| HF-13 | 181.9 | 4755209.5 | 346739.8 |
| HF-14 | 183.3 | 4755213.7 | 346771.1 |
| HF-15 | 183.0 | 4755146.8 | 346807.2 |
| RW-4A | 184.5 | 4755131.7 | 346868.7 |

| BOREHOLE CO-ORDINATES | | | |
|-----------------------|-----------|-----------|----------|
| No. | ELEVATION | NORTHING | EASTING |
| RW-5 | 184.2 | 4755154.8 | 346847.8 |
| RW-6 | 183.6 | 4755191.5 | 346813.2 |
| RW-7 | 183.7 | 4755227.4 | 346780.4 |
| RW-9 | 185.1 | 4755300.4 | 346712.2 |
| RW-10 | 186.6 | 4755347.4 | 346630.3 |
| RW-11 | 186.7 | 4755557.6 | 346438.6 |
| RW-12 | 177.1 | 4755654.9 | 346300.5 |
| RW-13 | 178.0 | 4755578.0 | 346373.1 |
| RW-14 | 181.5 | 4755382.9 | 346559.5 |
| RW-15 | 182.9 | 4755316.5 | 346618.8 |
| RW-16 | 181.9 | 4755252.0 | 346681.2 |

LEGEND

● Borehole - 2018/2019 Investigation

NOTES

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REFERENCE

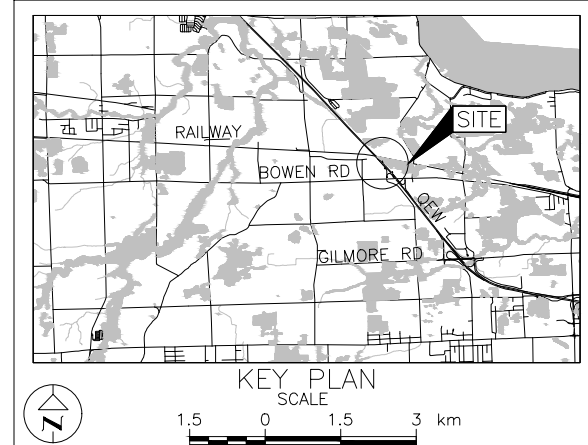
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| NO. | DATE | BY | REVISION |
|----------------------|------|---------------------|----------|
| | | | |
| Geocres No. 30L15-19 | | | |
| HWY. QEW | | PROJECT NO. 1671430 | |
| SUBM'D. MAS | | DATE: 2019-05-23 | |
| DRAWN: DD | | APPD. JMAC | |
| CHKD. MAS | | DIST. . | |
| CHKD. MAS | | SITE: . | |
| | | DWG. 1 | |



QEW RAMP E/W-S
RETAINING WALLS AND HIGH FILLS
BOREHOLE LOCATIONS



LEGEND

  Borehole - 2018/2019 Investigation

| BOREHOLE CO-ORDINATES | | | |
|-----------------------|-----------|-----------|----------|
| No. | ELEVATION | NORTHING | EASTING |
| C3-2 | 183.9 | 4755062.9 | 346839.2 |
| R1-1 | 189.8 | 4755030.0 | 346786.6 |
| R1-2 | 185.6 | 4755052.6 | 346799.4 |
| R1-3 | 184.0 | 4755074.2 | 346840.4 |
| R1-4 | 184.0 | 4755057.1 | 346877.7 |
| R1-5 | 184.7 | 4755034.3 | 346905.7 |
| R1-6 | 186.0 | 4755001.3 | 346931.0 |

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28, 2019.

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|-----------------------------|------|-----------|---------------------|---|---------|---------|---|
| | - | - | - | - | - | - | - |
| NO. | DATE | BY | REVISION | | | | |
| Geocres No. 30L15-19 | | | | | | | |
| HWY. QEW | | | PROJECT NO. 1671430 | | | DIST. : | |
| SUBM'D. MAS | | CHKD. MAS | DATE: 05/23/2019 | | SITE: . | | |
| DRAWN: DD | | CHKD. MAS | APPD. JMAG | | DWG. 2 | | |

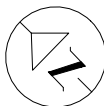
NOTES

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PLAN



CONT No.
GWP No.2116-16-00



QEW RAMP E/W-N
RETAINING WALLS AND HIGH FILLS
BOREHOLE LOCATIONS


SHEET



KEY PLAN
SCALE

1.5 0 1.5 3 km

LEGEND

 Borehole – 2018/2019 Investigation

| BOREHOLE CO-ORDINATES | | | |
|-----------------------|-----------|-----------|----------|
| No. | ELEVATION | NORTHING | EASTING |
| R2-1 | 185.2 | 4754977.0 | 347137.7 |
| R2-2 | 184.4 | 4754939.4 | 347121.1 |
| R2-3 | 186.0 | 4754920.6 | 347097.9 |
| R2-4 | 184.7 | 4754921.4 | 347063.8 |
| R2-5 | 186.6 | 4754944.2 | 347021.9 |
| R2-6 | 186.2 | 4754965.7 | 347003.2 |

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XX-60581660--RETAINING WALL_14+010--14+313.dwg and
XX-60581660--RETAINING WALL_14+190--14+470.dwg, received January
28, 2019.

| | | | |
|----------------------|-----------|---------------------|----------|
| NO. | DATE | BY | REVISION |
| Geocres No. 30L15-19 | | | |
| HWY. QEW | | PROJECT NO. 1671430 | DIST. |
| SUBM'D. MAS | CHKD. MAS | DATE: 05/23/2019 | SITE: |
| DRAWN: SW | CHKD. MAS | APPD. JMAM | DWG. 3 |

NOTES

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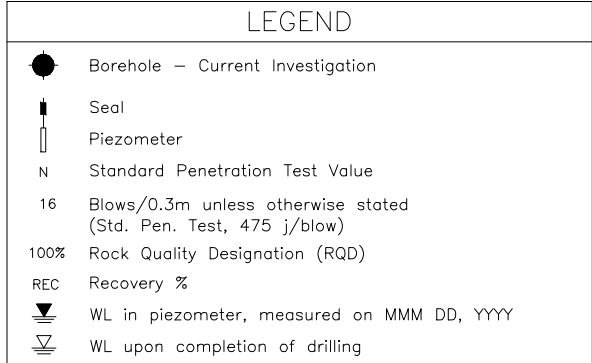
PLAN

SCALE

10 0 10 20 m



SHEET



VERTICAL SCALE

3 0 3 6 m

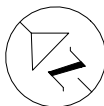
HORIZONTAL SCALE

15 0 15 30 m

| | | | | | | | |
|----------------------|--|-----------|--|---------------------|--|----------|---------|
| NO. | | DATE | | BY | | REVISION | |
| Geocres No. 30L15-19 | | | | | | | |
| HWY. QEW | | | | PROJECT NO. 1671430 | | | DIST. . |
| SUBM'D. MAS | | CHKD. MAS | | DATE: 05/23/2019 | | | SITE: |
| DRAWN: SW | | CHKD. MAS | | APPD. JMAC | | | DWG. 4 |

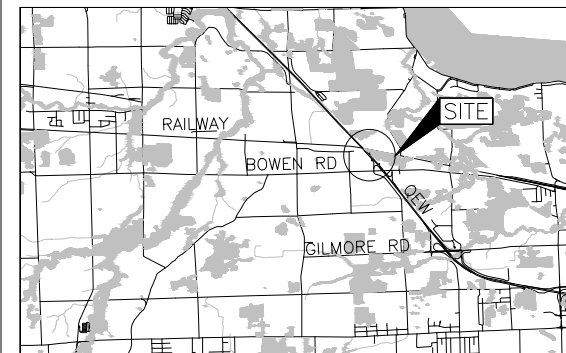
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STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2116-16-00



QEW
RETAINING WALLS AND HIGH FILLS
SOIL STRATA

SHEET



KEY PLAN
SCALE
1.5 0 1.5 3 km

LEGEND

- Borehole - Current Investigation
- ⊥ Seal
- ⊥ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- REC Recovery %
- ≡ WL in piezometer, measured on MMM DD, YYYY
- ≡ WL upon completion of drilling

Refer to Drawing 1 for Borehole Location Coordinates and Ground Surface Elevation Coordinates.

NOTES

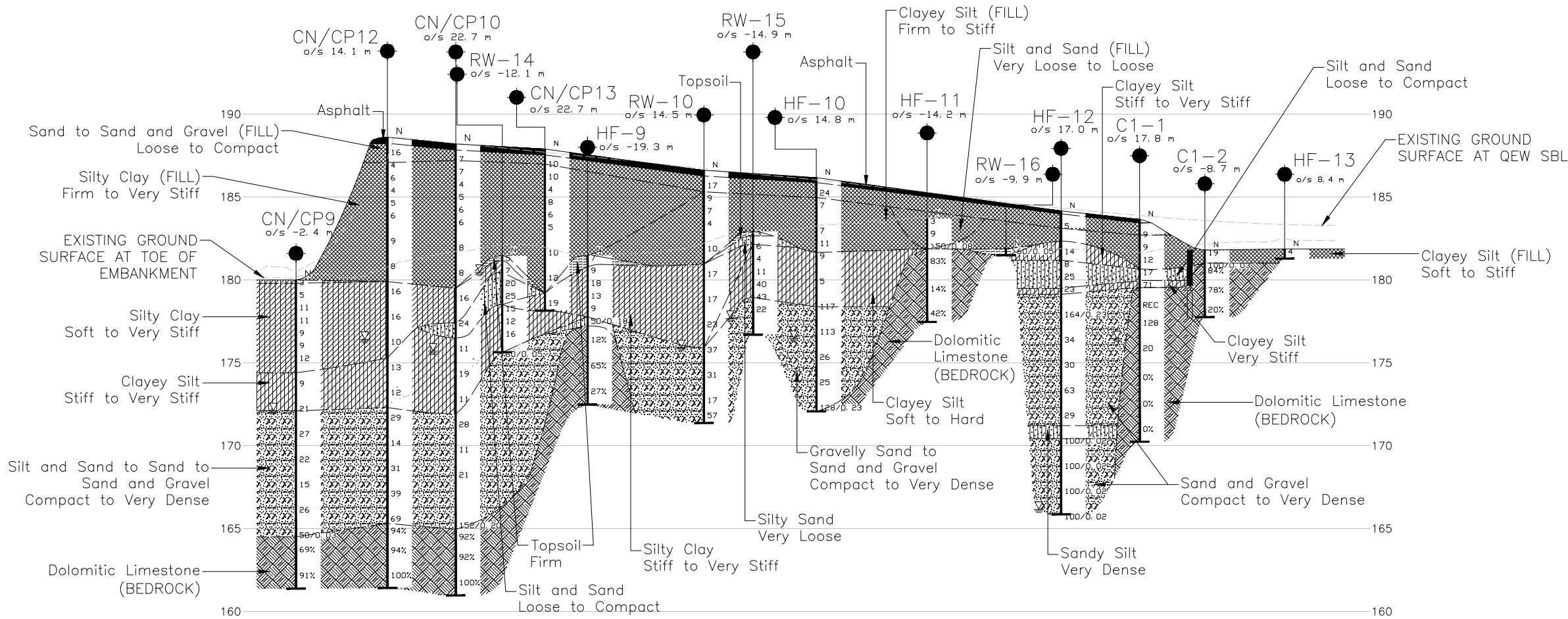
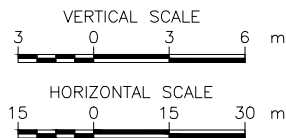
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

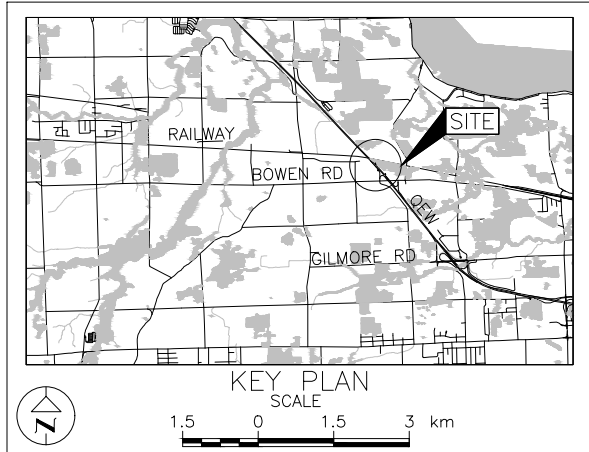
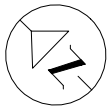
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B-B
1
PROFILE - HIGH FILL/RETAINING WALL 2

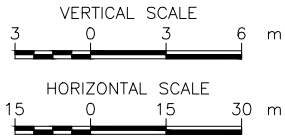
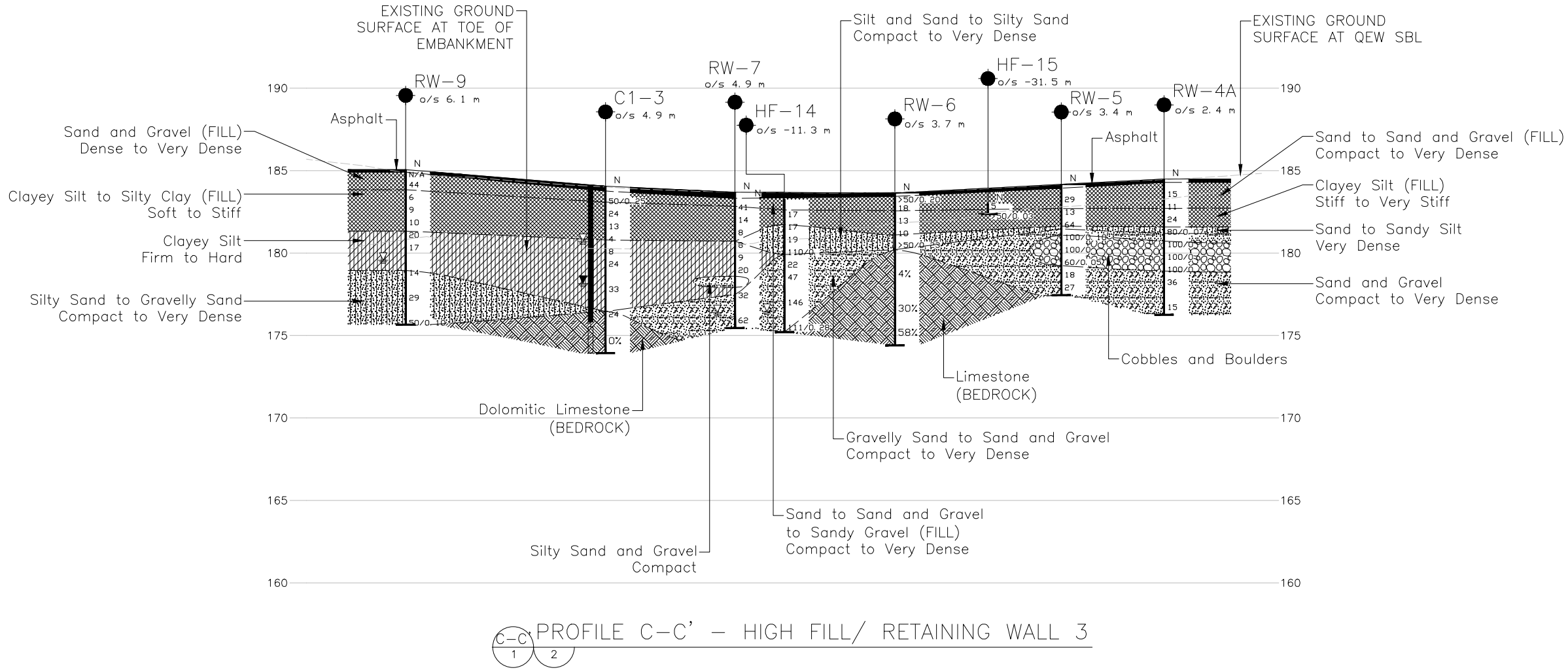


| NO. | DATE | BY | REVISION |
|----------------------|---------------------|------------------|----------|
| | | | |
| Geocres No. 30L15-19 | | | |
| HWY. QEW | PROJECT NO. 1671430 | | DIST. . |
| SUBM'D. MAS | CHKD. MAS | DATE: 05/23/2019 | SITE: . |
| DRAWN: SW | CHKD. MAS | APPD. JMAC | DWG. 5 |



| LEGEND | |
|--------|--|
| | Borehole - Current Investigation |
| | Seal |
| | Piezometer |
| | N Standard Penetration Test Value |
| | 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow) |
| | 100% Rock Quality Designation (RQD) |
| | WL in piezometer, measured on MMM DD, YYYY |
| | WL upon completion of drilling |

Refer to Drawing 2 for Borehole Location Coordinates and Ground Surface Elevation Coordinates.



NOTES

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

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

REFERENCE

Base plan provided in digital format by Aecom, drawing file nos. X-60581660-C-CNCP-QEW-DES.dwg, received November 15, 2018, X-60581660-C-CNCP-QEW-BASE.dwg and 60581660 QEW Berti Alignments_2019Jan03mw.dwg, received January 08, 2019. Retaining wall plans provided in digital format by Aecom, drawing file nos. XX-60581660--RETAINING WALL_13+670-13+858.dwg, XX-60581660--RETAINING WALL_14+010-14+313 and XX-60581660--RETAINING WALL_14+190-14+470.dwg, received January 28, 2019.

| NO. | DATE | BY | REVISION |
|----------------------|------|---------------------|------------------|
| Geocres No. 30L15-19 | | | |
| HWY. QEW | | PROJECT NO. 1671430 | |
| SUBM'D. MAS | | CHKD. MAS | DATE: 05/23/2019 |
| DRAWN: SW | | APPD. JMAC | SITE: . |
| | | | DWG. 6 |

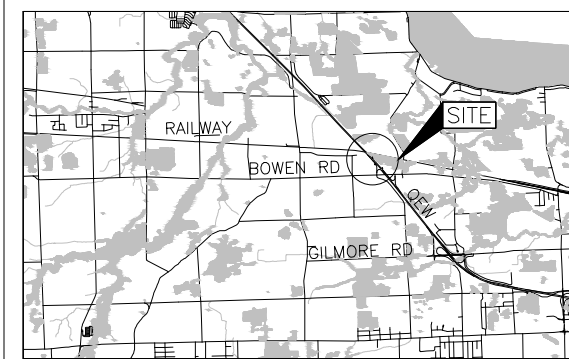
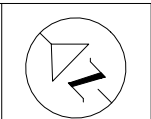


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2116-16-00

QEW RAMPS E/W-N AND E/W-S
RETAINING WALLS AND HIGH FILLS

SOIL STRATA



KEY PLAN
SCALE
1.5 0 1.5 3 km

LEGEND

- Borehole - Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL in piezometer, measured on MMM DD, YYYY
- WL upon completion of drilling

Refer to Drawing 2 and 3 for Borehole Location Coordinates and Ground Surface Elevation Coordinates.

NOTES

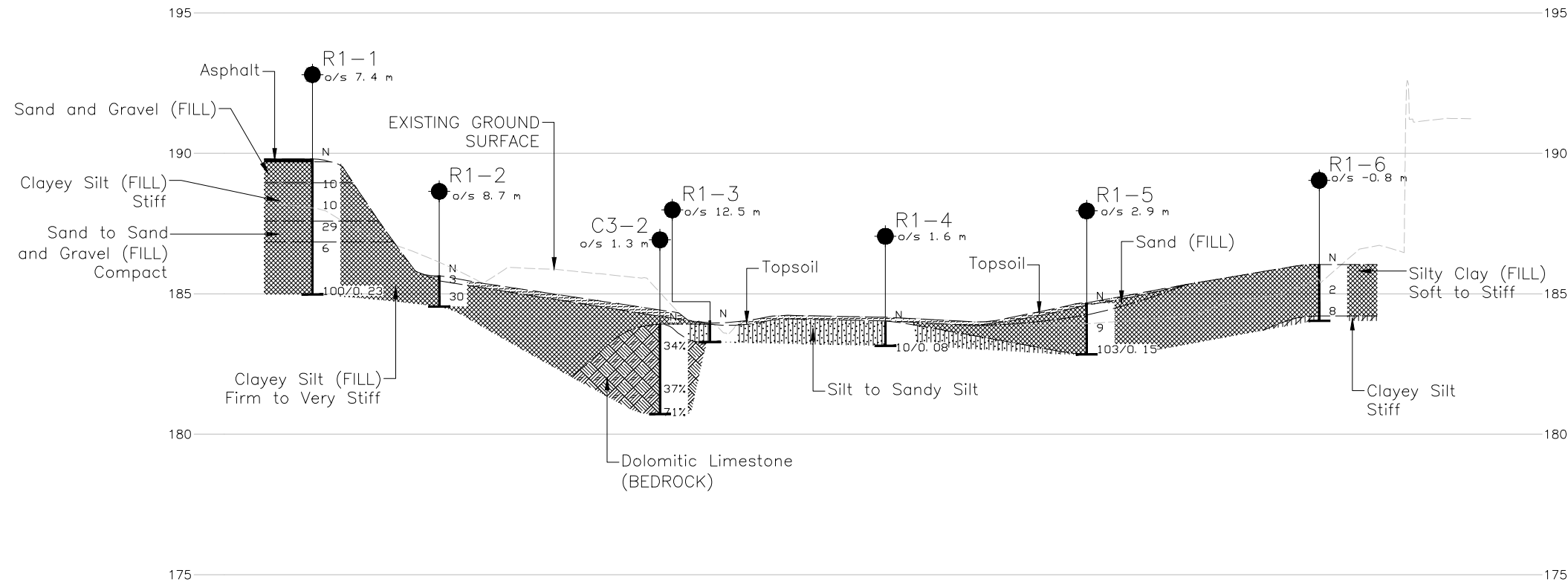
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

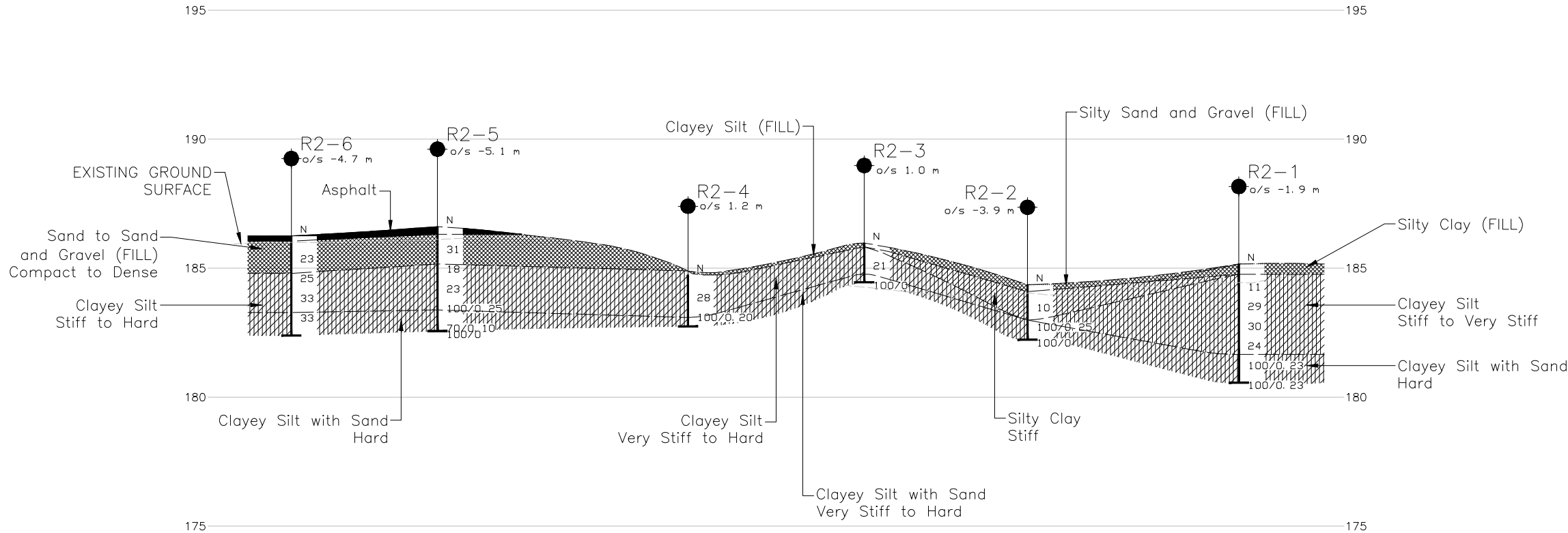
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Base plan provided in digital format by Aecom, drawing file nos. X-60581660-C-CNCP-QEW-DES.dwg, received November 15, 2018, X-60581660-C-CNCP-QEW-BASE.dwg and 60581660 QEW Berti Alignments_2019Jan03mw.dwg, received January 08, 2019. Retaining wall plans provided in digital format by Aecom, drawing file nos. XX-60581660--RETAINING WALL_13+670-13+858.dwg, XX-60581660--RETAINING WALL_14+010-14+313 and XX-60581660--RETAINING WALL_14+190-14+470.dwg, received January 28, 2019.

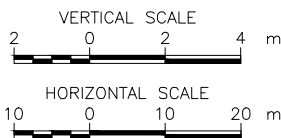
| NO. | DATE | BY | REVISION |
|----------------------|---------------------|------------------|----------|
| | | | |
| | | | |
| Geocres No. 30L15-19 | | | |
| HWY. QEW | PROJECT NO. 1671430 | | DIST. . |
| SUBM'D. MAS | CHKD. MAS | DATE: 05/23/2019 | SITE: . |
| DRAWN: SW | CHKD. MAS | APPD. JMAC | DWG. 7 |



D-D
2 PROFILE - BOWEN ROAD E/W-QEW S RAMP



E-E
3 PROFILE - BOWEN ROAD E/W-QEW N RAMP



APPENDIX A

Borehole and Drillhole Records

Table A-1: Summary of Borehole Locations, Ground Surface Elevations and Drilled Depths

| Area | Borehole No. | MTM NAD83 Zone 10 | | Ground Surface Elevation (m) | Borehole Depth (m) |
|---|--------------|--------------------------------|--------------------------------|------------------------------|--------------------|
| | | Northing (m) (Latitude (°)) | Easting (m) (Longitude (°)) | | |
| North of CN/CP Twin Structure - SBL (including RSS Wall RW-1) | HF-1 | 4,755,736.8 (42.936639) | 346,264.2 (-78.987300) | 179.8 | 11.3 |
| | HF-2 | 4,755,673.5 (42.939733) | 346,284.5 (-78.991693) | 177.0 | 9.8 |
| | RW-12 | 4,755,654.9 (42.939564) | 346,300.5 (-78.991499) | 177.1 | 8.2 |
| | HF-3 | 4,755,672.6 (42.939722) | 346,327.1 (-78.991171) | 182.1 | 14.3 |
| | HF-4 | 4,755,610.3 (42.939161) | 346,343.4 (-78.990975) | 177.6 | 6.3 |
| | RW-13 | 4,755,578.0 (42.938868) | 346,373.1 (-78.990615) | 178.0 | 9.8 |
| | HF-5 | 4,755,596.6 (42.939034) | 346,401.4 (-78.990266) | 185.1 | 18.9 |
| | HF-6 | 4,755,539.6 (42.938520) | 346,417.2 (-78.990077) | 180.4 | 8.5 |
| | RW-11 | 4,755,557.6 (42.938681) | 346,438.6 (-78.989813) | 186.7 | 17.4 |
| | HF-7 | 4,755,529.8 (42.938429) | 346,465.7 (-78.989483) | 187.8 | 22.9 |
| | CN/CP1 | 4,755,516.6 (42.938311) | 346,465.5 (-78.989487) | 188.1 | 9.8 |
| | CN/CP3 | 4,755,515.3 (42.938298) | 346,479.4 (-78.989317) | 188.4 | 27.1 |
| South of CN/CP Twin Structure - SBL (including RSS Wall RW-2) | CN/CP9 | 4,755,424.5 (42.937469) | 346,532.6 (-78.988668) | 180.0 | 18.6 |
| | CN/CP12 | 4,755,416.3 (42.937402) | 346,563.7 (-78.988291) | 188.6 | 27.2 |
| | CN/CP10 | 4,755,407.5 (42.937321) | 346,584.2 (-78.988041) | 188.2 | 27.2 |
| | RW-14 | 4,755,382.9 (42.937102) | 346,559.5 (-78.988345) | 181.5 | 5.8 |
| | CN/CP13 | 4,755,394.3 | 346,597.0 | 187.9 | 9.8 |

| Area | Borehole No. | MTM NAD83 Zone 10 | | Ground Surface Elevation (m) | Borehole Depth (m) |
|--|--------------|--------------------------------|--------------------------------|------------------------------|--------------------|
| | | Northing (m) (Latitude (°)) | Easting (m) (Longitude (°)) | | |
| | | (42.937202) | (-78.987885) | | |
| | HF-9 | 4,755,349.7 (42.936802) | 346,581.9 (-78.988074) | 181.5 | 9.0 |
| | RW-10 | 4,755,347.4 (42.936778) | 346,630.3 (-78.987481) | 186.6 | 15.2 |
| | RW-15 | 4,755,316.5 (42.936501) | 346,618.8 (-78.987624) | 182.9 | 6.3 |
| | HF-10 | 4,755,331.9 (42.936638) | 346,645.1 (-78.987300) | 186.2 | 14.1 |
| | HF-11 | 4,755,278.6 (42.936158) | 346,653.9 (-78.987197) | 183.7 | 6.2 |
| | RW-16 | 4,755,252.0 (42.935917) | 346,681.2 (-78.986864) | 181.9 | 0.4 |
| | HF-12 | 4,755,267.2 (42.936052) | 346,703.6 (-78.986588) | 184.2 | 18.3 |
| | C1-1 | 4,755,249.3 (42.935891) | 346,719.3 (-78.986398) | 183.7 | 13.4 |
| | C1-2 | 4,755,217.3 (42.935603) | 346,711.3 (-78.986498) | 181.8 | 4.1 |
| | HF-13 | 4,755,209.5 (42.935531) | 346,739.8 (-78.986150) | 181.9 | 0.6 |
| South of CN/CP Twin Structure - NBL (including RSS Wall RW-3) | RW-9 | 4,755,300.4 (42.936351) | 346,712.2 (-78.986480) | 185.1 | 9.4 |
| | C1-3 | 4,755,255.7 (42.935947) | 346,753.3 (-78.985981) | 184.1 | 10.1 |
| | RW-7 | 4,755,227.4 (42.935690) | 346,780.4 (-78.985650) | 183.7 | 8.2 |
| | HF-14 | 4,755,213.7 (42.935567) | 346,771.1 (-78.985765) | 183.3 | 8.1 |
| | RW-6 | 4,755,191.5 (42.935365) | 346,813.2 (-78.985252) | 183.6 | 9.2 |
| | HF-15 | 4,755,146.8 (42.934963) | 346,807.2 (-78.985327) | 183.0 | 0.6 |
| | RW-5 | 4,755,154.8 | 346,847.8 | 184.2 | 6.7 |

| Area | Borehole No. | MTM NAD83 Zone 10 | | Ground Surface Elevation (m) | Borehole Depth (m) |
|------------|--------------|--------------------------------|--------------------------------|------------------------------|--------------------|
| | | Northing (m) (Latitude (°)) | Easting (m) (Longitude (°)) | | |
| | | (42.935033) | (-78.984830) | | |
| | RW-4A | 4,755,131.7 (42.934824) | 346,868.7 (-78.984576) | 184.5 | 8.2 |
| Ramp E/W-S | R1-1 | 4,755,030.0 (42.933912) | 346,786.6 (-78.985589) | 189.8 | 4.8 |
| | R1-2 | 4,755,052.6 (42.934115) | 346,799.4 (-78.985430) | 185.6 | 1.1 |
| | C3-2 | 4,755,062.9 (42.934206) | 346,839.2 (-78.984942) | 183.9 | 3.2 |
| | R1-3 | 4,755,074.2 (42.934307) | 346,840.4 (-78.984927) | 184.0 | 0.8 |
| | R1-4 | 4,755,057.1 (42.934151) | 346,877.7 (-78.984471) | 184.0 | 0.9 |
| | R1-5 | 4,755,034.3 (42.933945) | 346,905.7 (-78.984130) | 184.7 | 1.8 |
| | R1-6 | 4,755,001.3 (42.933646) | 346,931.0 (-78.983822) | 186.0 | 2.0 |
| Ramp E/W-N | R2-1 | 4,754,977.0 (42.933416) | 347,137.7 (-78.981292) | 185.2 | 4.6 |
| | R2-2 | 4,754,939.4 (42.933079) | 347,121.1 (-78.981498) | 184.4 | 2.1 |
| | R2-3 | 4,754,920.6 (42.932910) | 347,097.9 (-78.981783) | 186.0 | 1.5 |
| | R2-4 | 4,754,921.4 (42.932919) | 347,063.8 (-78.982201) | 184.7 | 2.0 |
| | R2-5 | 4,754,944.2 (42.933127) | 347,021.9 (-78.982713) | 186.6 | 4.1 |
| | R2-6 | 4,754,965.7 (42.933322) | 347,003.2 (-78.982940) | 186.2 | 3.9 |

Note: Boreholes listed by area and in order of location along alignment from north to south.

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

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

Notes: 1
2

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

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d :

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

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

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

(b) Cohesive Soils Consistency

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

IV. SOIL TESTS

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

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

V. MINOR SOIL CONSTITUENTS

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

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° angle is horizontal.

Description and Notes

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

Abbreviations

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

| PROJECT | | RECORD OF BOREHOLE | | | | No HF-1 | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|---------------|---|--------------------|---------|----------|------------|---|-----------------|--|--|---|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|--|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755736.8; E 346264.2 MTM NAD 83 ZONE 10 (LAT. 42.936639; LONG. -78.987300) | | | | ORIGINATED BY | | MA | | | | | |
| DIST | | Central | | HWY | | QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY | | EN/KN | |
| DATUM | | Geodetic | | DATE | | September 13, 2018 | | | | CHECKED BY | | MAS | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) | |
| | | | | | | | | <div><div></div><div></div><div></div><div></div><div></div></div> | | | | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | | | |
| | | | | | | | | ● QUICK TRIAXIAL × REMOULDED | | | | | | | | | |
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| 179.8 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (340 mm) | | | | | | | | | | | | | | | | |
| 179.5 | | | | | | | | | | | | | | | | | |
| 179.1 | Sand and gravel, some silt (FILL) Brown Moist | | | | | | | | | | | | | | | | |
| 0.8 | Sand, trace silt (FILL) Brown Moist | | 1 | SS | 9 | | 179 | | | | | | | | | | |
| | Silty clay, trace to some sand, trace gravel, some silty sand layers, trace organics and topsoil (FILL) Firm to very stiff Brown Moist - 150 mm layer of topsoil encountered at 2.7 m | | 2 | SS | 6 | | 178 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
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| 176.5 | | | 3A | SS | 11 | | 177 | | | | | | | | | | |
| 3.3 | SILTY CLAY to CLAY, trace sand, silt partings Stiff to very stiff Brown Moist | | 3B | | | | | | | | | | | | | | |
| | | | 4 | SS | 14 | | 176 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 16 | | 175 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 174.2 | | | | | | | | | | | | | | | | | |
| 5.6 | CLAYEY SILT, some sand, trace to some gravel Firm to stiff Brown Moist to wet below 7.1 m | | 6 | SS | WH | | 174 | | | | | | | | | | |
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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

| PROJECT | | 1671430 WO8F | | RECORD OF BOREHOLE No RW-12 | | | | SHEET 1 OF 1 | | METRIC | | | | | | |
|---------------|---|-----------------|---------|-----------------------------|------------|---|-----------------|--|--|--------|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | | | LOCATION | | N 4755654.9; E 346300.5 MTM NAD 83 ZONE 10 (LAT. 42.939564; LONG. -78.991499) | | ORIGINATED BY | | LK | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | COMPILED BY | | JMP | | | | | | |
| DATUM | | Geodetic | | DATE | | January 16, 2019 | | CHECKED BY | | MAS | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | |
| 177.1 | GROUND SURFACE | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL (150 mm) | | | | | | | | | | | | | | | |
| 0.2 | SILTY CLAY, trace gravel, trace sand, trace rootlet, trace organics Firm to stiff Mottled brown Moist | | 1 | SS | 5 | | | | | | | | | | | |
| | | | 2 | SS | 15 | | | | | | | | | | | |
| 175.7 | | | | | | | | | | | | | | | | |
| 1.4 | SILTY CLAY, trace to some sand, trace gravel Stiff to very stiff Mottled greyish brown Moist - Coarser sand pockets at a depth of 1.5 m - 2.1 m - Finer sand pockets at a depth of 2.3 m - 2.9 m | | 3 | SS | 16 | | | | | | | | | | | |
| | | | 4 | SS | 9 | | | | | | | | | | | |
| | | | 5 | SS | 6 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 9 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 171.6 | | | | | | | | | | | | | | | | |
| 5.5 | CLAYEY SILT, some sand, trace gravel Firm to stiff Brown Moist | | 7 | SS | WH | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 169.6 | | | | | | | | | | | | | | | | |
| 7.5 | SILT and SAND, trace clay Compact Grey Moist | | 8 | SS | 27 | | | | | | | | | | | |
| 168.9 | | | | | | | | | | | | | | | | |
| 8.2 | END OF BOREHOLE | | | | | | | | | | | | | | | |
| | NOTE: 1. Water level in open borehole at a depth 7.2 m below ground surface (Elev. 169.9 m) upon completion of drilling. | | | | | | | | | | | | | | | |

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| PROJECT | | RECORD OF BOREHOLE No HF-3 | | | | SHEET 1 OF 2 | | METRIC | | | | |
|---------------|--|----------------------------|---------|------|------------|-------------------------|-----------------|--|--|--|--|---------------------------------------|
| G.W.P. | | LOCATION | | | | ORIGINATED BY | | MA | | | | |
| DIST | | BOREHOLE TYPE | | | | COMPILED BY | | EN/KN | | | | |
| DATUM | | DATE | | | | CHECKED BY | | MAS | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | |
| 182.1 | GROUND SURFACE | | | | | | | | | | | |
| 0.0 | ASPHALT (300 mm) | | | | | | | | | | | |
| 181.8 | | | | | | | | | | | | |
| 181.5 | Sand and gravel, some silt (FILL) Brown Moist | | | | | | | | | | | |
| 181.2 | Sand, trace silt (FILL) Brown Moist | | 1 | SS | 4 | | | | | | | |
| 0.9 | Silty clay, some sand to with sand, some silty topsoil seams (FILL) Soft to very stiff Brown Moist | | 2 | SS | 7 | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | 3 | SS | 10 | | | | | | | |
| | | | | | | | | | | | | |
| | | | 4A | SS | 10 | | | | | | | |
| | | | 4B | | | | | | | | | |
| | | | | | | | | | | | | |
| 176.5 | SILTY CLAY, trace sand Firm to very stiff Brown Moist | | 5 | SS | 18 | | | | | | | |
| 5.6 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | 6 | SS | 8 | | | | | | | |
| | | | | | | | | | | | | |
| 173.5 | CLAYEY SILT, trace sand Stiff to very stiff Brown Moist | | 7 | SS | 4 | | | | | | | |
| 8.6 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | 8 | SS | 4 | | | | | | | |
| | | | | | | | | | | | | |
| | | | 9A | SS | 10 | | | | | | | |
| | | | 9B | | | | | | | | | |
| | | | | | | | | | | | | |
| 168.1 | Silty SAND and GRAVEL Dense Brown Wet | | 10A | SS | 36 | | | | | | | |
| 167.8 | | | 10B | | | | | | | | | |
| 14.3 | | | | | | | | | | | | |

Continued Next Page

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

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

GTA-MTO 001 S:\CLIENTS\IMTO\QEW-BERTIE\02 DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No HF-4 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | | | | |
|---------------|---|-------------|---------|----------------------------|------------|---|-----------------|--|--|--------------------------------|--|-----|---|-------------|----------------|--|---------------------------------------|----|----|----|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755610.3; E 346343.4 MTM NAD 83 ZONE 10 (LAT. 42.939161; LONG. -78.990975) | | | | ORIGINATED BY | | LK | | | | | | | | |
| DIST | | Central | | HWY | | QEW | | BOREHOLE TYPE | | Manual Tripod, BW & AW Casings | | | | COMPILED BY | | JMP | | | | |
| DATUM | | Geodetic | | DATE | | December 11-13, 2018 | | | | CHECKED BY | | MAS | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | W _p | W | W _L | | GR | SA | SI | CL |
| 177.6 0.0 | GROUND SURFACE TOPSOIL (30 mm) | | 1 | SS | 4 | | | | | | | | | | | | | | | |
| | CLAY, trace rootlets, trace organics, trace sand with grey sand pockets from 1.2 m to 3.1 m, trace gravel Soft to very stiff Mottled grayish brown Moist | | 2 | SS | 17 | | | | | | | | | | | | | | | |
| | | | 3 | SS | 15 | | | | | | | | | | | | | | | |
| | | | 4 | SS | 9 | | | | | | | | | | | | | | | |
| | | | 5 | SS | 8 | | | | | | | | | | | | | | | |
| 174.2 3.4 | CLAYEY SILT, trace to some sand, trace to some gravel Very stiff to hard Dark brown Moist | | 6 | SS | 26 | | | | | | | | | | | | | | | |
| | | | 7 | SS | 29 | | | | | | | | | | | | | | | |
| | | | 8 | SS | 40 | | | | | | | | | | | | | | | |
| | | | 9 | SS | 46 | | | | | | | | | | | | | | | |
| 171.3 6.3 | END OF BOREHOLE NOTE: 1. Water level not measured due to addition of water during drilling. | | | | | | | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE | | | | No RW-13 | | SHEET 1 OF 1 | | METRIC | | |
|---------------|---|--------------------|---------|---------------|------------|---|-----------------|--|--|--------|--|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755578.0; E 346373.1 MTM NAD 83 ZONE 10 (LAT. 42.938868; LONG. -78.990615) | | ORIGINATED BY | | LK | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | COMPILED BY | | EN | | |
| DATUM | | Geodetic | | DATE | | January 16, 2019 | | CHECKED BY | | MAS | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | |
| 178.0 | GROUND SURFACE | | | | | | | | | | | |
| 0.0 | Organic SILTY CLAY, trace sand, trace gravel with roots | | 1 | SS | 4 | | | | | | | |
| 177.3 | Soft Brown Moist | | | | | | | | | | | |
| 0.7 | SILTY CLAY to CLAY, trace sand | | 2 | SS | 20 | | 177 | | | | | |
| | Stiff to very stiff | | | | | | | | | | | |
| | Mottled greyish brown | | 3 | SS | 18 | | 176 | | | | | |
| | Moist | | | | | | | | | | | |
| | | | 4 | SS | 15 | | | | | | | |
| 175.0 | CLAYEY SILT, trace to some sand, trace gravel | | 5 | SS | 14 | | 175 | | | | | |
| 3.0 | Stiff to hard Brown Moist | | 6 | SS | 60/0.05 | | 174 | | | | | |
| | - Sample spoon bouncing at a depth of 4.0 m on inferred cobbles/boulder | | | | | | | | | | | |
| 173.4 | SAND, some silt, trace clay | | 7 | SS | 20 | | 173 | | | | | |
| 4.6 | Compact Greyish brown | | | | | | | | | | | |
| 172.4 | CLAYEY SILT, trace to some sand | | 8 | SS | 35 | | 172 | | | | | |
| 5.6 | Very stiff to hard Grey Moist | | | | | | 171 | | | | | |
| | | | 9 | SS | 27 | | 170 | | | | | |
| | | | | | | | 169 | | | | | |
| 168.2 | END OF BOREHOLE | | 10 | SS | 35 | | | | | | | |
| 9.8 | NOTE: 1. Water level in open borehole at a ground surface (Elev. 178.0 m) on completion of drilling. | | | | | | | | | | | |



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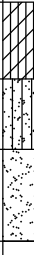
+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No HF-5 | | | | SHEET 2 OF 2 | | METRIC | | | | | | | |
|---|---|-----------------|---------|----------------------------|------------|---|-----------------|--|--|---------------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755596.6; E 346401.4 MTM NAD 83 ZONE 10 (LAT. 42.939034; LONG. -78.990266) | | | | ORIGINATED BY | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY | | | | | | | |
| DATUM | | Geodetic | | DATE | | September 11 and 12, 2018 | | | | CHECKED BY | | | | | | | |
| MAS | | | | | | | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | | |
| 167.3 | CLAYEY SILT, trace to some sand, trace to some gravel Very stiff Brown Moist | | 11 | SS | 9 | | 170 | | | | | | | | | | 8 19 40 33 |
| | | | | | | | 169 | | | | | | | | | | |
| | | | 12 | SS | 7 | | 168 | | | | | | | | | | |
| 17.8 | SAND and GRAVEL, trace silt, trace clay Compact Grey Wet | | | | | | 167 | | | | | | | | | | |
| 166.2 | | | 13 | SS | 25 | | | | | | | | | | | | 35 61 2 2 |
| 18.9 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| NOTES: 1. Water level in open borehole at a depth of 12.0 m below ground surface (Elev. 173.1 m) on completion of drilling. 2. Borehole caved to 16.8 m on removal of augers. 3. Water level in open borehole at a depth of 10.1 m (Elev. 175.0 m) on removal of augers. | | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No HF-6 | | | | SHEET 1 OF 1 | | METRIC | | | |
|---------------|---|-----------------|---------|----------------------------|------------|---|-----------------|--|--|---|--|--|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755539.6; E 346417.2 MTM NAD 83 ZONE 10 (LAT. 42.938520; LONG. -78.990077) | | ORIGINATED BY | | SE | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | Manual Tripod, BW & AW Casings | | COMPILED BY | | EN | | | |
| DATUM | | Geodetic | | DATE | | November 29-30, 2018 | | CHECKED BY | | MAS | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | W _p W W _L | | | |
| 180.4 | GROUND SURFACE | | | | | | | | | | | | |
| 0.0 | Clay, some sand (FILL) Soft to stiff Brown-red Moist | | 1 | SS | 4 | | | | | | | | |
| | | | 2 | SS | 9 | | | | | | | | |
| 179.2 | | | | | | | | | | | | | |
| 1.2 | SILTY CLAY to CLAY, trace to some sand, trace gravel Very stiff to hard Brown-red Moist | | 3 | SS | 34 | | | | | | | | |
| | | | 4 | SS | 71 | | | | | | | | |
| | | | 5 | SS | 28 | | | | | | | | |
| | | | 6 | SS | 33 | | | | | | | | |
| | | | 7 | SS | 35 | | | | | | | | |
| | | | 8 | SS | 35 | | | | | | | | |
| | | | | | | | | | | | | | |
| 175.0 | | | | | | | | | | | | | |
| 5.4 | CLAYEY SILT, some sand, trace gravel Hard Brown to red Wet | | 9 | SS | 36 | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 10 | SS | 100/0.29 | | | | | | | | |
| 171.9 | | | | | | | | | | | | | |
| 8.5 | END OF BOREHOLE | | | | | | | | | | | | |
| | NOTE: 1. Water level was not measured due to added water during drilling. | | | | | | | | | | | | |

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

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


| PROJECT | | RECORD OF BOREHOLE No RW-11 | | | | SHEET 2 OF 2 | | METRIC | | | | | | | | | |
|----------------------|--|--|---------|------|------------|-------------------------|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION N 4755557.6; E 346438.6 MTM NAD 83 ZONE 10 (LAT. 42.938681; LONG. -78.989813) | | | | ORIGINATED BY MA | | | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY EN/KN | | | | | | | | | | | |
| DATUM Geodetic | | DATE September 19, 2018 | | | | CHECKED BY MAS | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 170.9 | CLAYEY SILT, trace to some sand, trace to some gravel |  | 11A | SS | 18 | | | | | | | | | | | | |
| 15.8 | Very stiff Brown Moist | | 11B | | | | | | | | | | | | | | |
| 170.2 | Sandy SILT, some gravel, trace clay | | | | | | | | | | | | | | | | |
| 16.5 | Grey Moist | | | | | | | | | | | | | | | | |
| 169.3 | SAND, some silt, contains some sandy silt layers | | 12 | SS | 35 | | | | | | | | | | | | |
| 17.4 | Dense Grey Wet | | | | | | | | | | | | | | | | |
| | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| | NOTES: | | | | | | | | | | | | | | | | |
| | 1. Water level in open borehole at a depth of 13.8 m below ground surface (Elev. 172.9 m) on completion of drilling. | | | | | | | | | | | | | | | | |
| | 2. Borehole caved to a depth of 4.3 m on removal of augers. | | | | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE | | | | No HF-7 | | SHEET 1 OF 2 | | METRIC | | | |
|--------------|---|--------------------|---------|---------------|------------|---|-----------------|--|-----------------|---|-------------------|-------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755529.8; E 346465.7 MTM NAD 83 ZONE 10 (LAT. 42.938429; LONG. -78.989483) | | | | ORIGINATED BY | | MA | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY | | EN/KN | |
| DATUM | | Geodetic | | DATE | | September 11 and 19, 2018 | | | | CHECKED BY | | MAS | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | W _P W W _L | WATER CONTENT (%) | | |
| 187.8 | GROUND SURFACE | | | | | | | | | | | | |
| 0.0 187.5 | ASPHALT (300 mm) | | | | | | | | | | | | |
| 187.1 | Sand and gravel, trace silt (FILL) Brown Moist | | | | | | | | | | | | |
| 186.8 | Sand, some silt (FILL) Loose Brown Moist | | 1 | SS | 4 | | | | | | | | |
| 1.0 | Silty clay, trace to some sand, trace organics, trace rootlets (FILL) Stiff to very stiff Brown Moist | | 2 | SS | 9 | | | | | | | | |
| | | | 3 | SS | 5 | | | | | | | | |
| | | | 4 | SS | 10 | | | | | | | | |
| | | | 5 | SS | 15 | | | | | | | | |
| | | | 6 | SS | 11 | | | | | | | | |
| | | | | | | | | | | | | | |
| 179.1 | - Layer of clayey silt topsoil from 8.5 m to 8.7 m | | | | | | | | | | | | |
| 8.7 | CLAY, trace sand Very stiff Brown Moist | | 7 | SS | 26 | | | | | | | | |
| | | | 8 | SS | 20 | | | | | | | | |
| | | | 9 | SS | 16 | | | | | | | | |
| 174.5 | CLAYEY SILT, trace to some sand Very stiff to hard Brown Moist | | 10 | SS | 20 | | | | | | | | |
| 13.3 | | | | | | | | | | | | | |

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATAGINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

| PROJECT | | RECORD OF BOREHOLE | | | | No HF-7 | | SHEET 2 OF 2 | | METRIC | | | | | | | |
|----------------------|---|--|---------|---|------------|-------------------------|-----------------|--|--|--------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION | | N 4755529.8; E 346465.7 MTM NAD 83 ZONE 10 (LAT. 42.938429; LONG. -78.989483) | | | | ORIGINATED BY | | MA | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY | | EN/KN | | | | | | | |
| DATUM Geodetic | | DATE | | September 11 and 19, 2018 | | | | CHECKED BY | | MAS | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | | |
| 169.0 | CLAYEY SILT, trace to some sand Very stiff to hard Brown Moist |  | 11 | SS | 38 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 168.8 | SILT and SAND, trace to some clay Dense Brown Wet | | 12 | SS | 22 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 167.5 | SANDY CLAYEY SILT, contains some sandy silt seams Brown Wet | | 13A | SS | 18 | | | | | | | | | | | | |
| | | | 13B | | | | | | | | | | | | | | |
| 166.8 | SANDY CLAYEY SILT, contains some sandy silt seams Brown Wet | | 14A | SS | 31 | | | | | | | | | | | | |
| | | | 14B | | | | | | | | | | | | | | |
| 166.8 | SAND and GRAVEL, trace silt Compact to very dense Grey Wet | | 15 | SS | 27 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 164.9 | END OF BOREHOLE SPLIT-SPOON REFUSAL | | 16 | SS | 100/0.02 | | | | | | | | | | | | |
| 22.9 | NOTES: 1. Borehole HF-7A was advanced 1.4 m south and 0.3 m west of Borehole HF-7. 2. Water level in open borehole at a depth of 14.3 m below ground surface (Elev. 173.5 m) on completion of drilling. 3. Borehole caved to 20.4 m on removal of augers. 4. Water level in open borehole at a depth of 8.2 m (Elev. 179.6 m) on removal of augers. | | | | | | | | | | | | | | | | |



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

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

| PROJECT | | 1671430 WO1 | | RECORD OF BOREHOLE No CN/CP3 | | | | SHEET 2 OF 3 | | METRIC | | | | | | | |
|--------------------------------------|--|-----------------|---------|-------------------------------------|------------|---|-----------------|--|--|------------------|--|--|---------------------------------|-------------------------------|--------------------------------|---------------------------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755515.3; E 346479.4 MTM NAD 83 ZONE 10 (LAT. 42.938298; LONG. -78.989317) | | | | ORIGINATED BY JK | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 203 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY EN | | | | | | | |
| DATUM | | Geodetic | | DATE | | August 27 and 28, 2018 | | | | CHECKED BY NK | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | | | |
| 169.0 | CLAYEY SILT, trace sand to sandy, trace to some gravel Stiff to very stiff Red to brown Moist - Auger grinding on inferred cobbles at 15.8 m | | 13 | SS | 20 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 169.4 | Sandy SILT, trace to some clay, trace gravel Dense Red-brown Moist - Seepage noted at 19.8 m | | 14 | SS | 27 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 166.8 | SAND and GRAVEL, some silt, trace clay Very dense Grey Moist | | 15 | SS | 18 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 165.2 | DOLOMITIC LIMESTONE (BEDROCK) Bedrock cored from 23.2 m to 27.1 m. For rock coring details refer to Record of Drillhole CN/CP3. | | 16 | SS | 34 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 161.3 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| 27.1 | NOTES: 1. Water level at a depth of 12.5 m below ground surface (Elev. 175.9 m) prior to rock coring. 2. Water level at a depth of 12.3 m (Elev. 176.1 m) after rock coring. | | | | | | | | | | | | | | | | |

PROJECT: 1671430 W01

RECORD OF DRILLHOLE: CN/CP3

SHEET 3 OF 3

LOCATION: N 4755515.30 ;E 346479.40

DRILLING DATE: August 28, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75 Truck Mounted Drill Rig

DRILLING CONTRACTOR: Geo-Environmental

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | TOTAL CORE % | SOLID CORE % | | | | TYPE AND SURFACE DESCRIPTION | Jr | Ja | Jcom | W1 | W2 | W3 | W4 | W5 | | | | W6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | Continued from Record of Borehole CN/CP3 | | 165.24 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | </ |

DEPTH SCALE

1 : 50



LOGGED: JK/EN

CHECKED: EN


GTA-RCK 046 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22

| PROJECT | | 1671430 | | RECORD OF BOREHOLE No CN/CP9 | | SHEET 1 OF 2 | | METRIC | | | | | | | | | | | |
|---------------|--|-----------------|---------|-------------------------------------|------------|---|-----------------|--|----|---------------------------------|-------------------------------|--------------------------------|---------------------------------------|---------------------------------------|----|----|-----|----|----|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755424.5; E 346532.6 MTM NAD 83 ZONE 10 (LAT. 42.937469; LONG. -78.988668) | | ORIGINATED BY | | | | | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 203 mm O.D Hollow Stem Augers; CME 55 Track-mounted Drill Rig | | COMPILED BY | | | | | | | | | | | |
| DATUM | | Geodetic | | DATE | | November 29, 2018 | | CHECKED BY | | | | | | | | | | | |
| | | | | | | | | NK | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | | | | | | 60 | 80 | 100 | 20 | 40 |
| 180.0 | GROUND SURFACE | | | | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL (200 mm) | | | | | | | | | | | | | | | | | | |
| 0.2 | SILTY CLAY, trace to some sand, trace gravel, trace rootlets to a depth of 1.4 m Soft to stiff Mottled grey-brown Moist | | 1A | SS | 3 | | | | | | | | | | | | | | |
| | | | 1B | | | | | | | | | | | | | | | | |
| | | | 2 | SS | 5 | | | | | | | | | | | | | | |
| | | | 3 | SS | 11 | | | | | | | | | | | | | | |
| | | | 4 | SS | 11 | | | | | | | | | | | | | | |
| | | | 5 | SS | 9 | | | | | | | | | | | | | | |
| | | | 6 | SS | 9 | | | | | | | | | | | | | | |
| | | | 7 | SS | 12 | | | | | | | | | | | | | | |
| 174.4 | | | | | | | | | | | | | | | | | | | |
| 5.6 | Gravelly Sandy CLAYEY SILT Stiff to very stiff Brown Moist | | 8 | SS | 9 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 172.1 | | | 9A | SS | 21 | | | | | | | | | | | | | | |
| 7.9 | SAND and GRAVEL, trace to some silt, trace clay Compact Grey Wet | | 9B | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 10 | SS | 27 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 11 | SS | 22 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 12 | SS | 15 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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| | | | 13 | SS | 26 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

| PROJECT 1671430 | | RECORD OF BOREHOLE No CN/CP9 | | | | SHEET 2 OF 2 | | METRIC | | | | | | | | | |
|----------------------|--|--|--------|------|-------------------------|------------------|--|--------------------|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|
| G.W.P. 2116-16-00 | | LOCATION N 4755424.5; E 346532.6 MTM NAD 83 ZONE 10 (LAT. 42.937469; LONG. -78.988668) | | | | ORIGINATED BY LK | | | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 203 mm O.D Hollow Stem Augers; CME 55 Track-mounted Drill Rig | | | | COMPILED BY EN | | | | | | | | | | | |
| DATUM Geodetic | | DATE November 29, 2018 | | | | CHECKED BY NK | | | | | | | | | | | |
| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | | |
| 164.5 15.5 | DOLOMITIC LIMESTONE (BEDROCK) Bedrock cored from 15.5 m to 18.6 m. For coring details refer to Record of Drillhole CN/CP9 |  | 14 | SS | 50/0.03 | | | | | | | | | | | | |
| | | | 1 | RC | REC 100% | | | | | | | | | | | | RQD = 69% |
| | | | 2 | RC | REC 100% | | | | | | | | | | | | RQD = 91% |
| 161.4 18.6 | END OF BOREHOLE NOTES: 1. Water level at a depth of 7.9 m below ground surface (Elev. 172.1 m) in hollow stem augers on completion of drilling and prior to rock coring. | | | | | | | | | | | | | | | | |

PROJECT: 1671430

RECORD OF DRILLHOLE: CN/CP9

SHEET 1 OF 1

LOCATION: N 4755424.50 ;E 346532.60


DRILLING DATE: November 29, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55 Track-Mounted Drill Rig

DRILLING CONTRACTOR: Geo-Environmental

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | TOTAL CORE % | SOLID CORE % | | | TYPE AND SURFACE DESCRIPTION | Jr | Ja | Jcom | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 16 | Rotary Diamond Drill HQ Core | Continued from Record of Borehole CN/CP9 |  | 164.51 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 50

**GOLDER**

LOGGED: LK/JL

CHECKED: EN

GTA-RCK 046 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22



GTA-MTO 001 S:\CLIENTSIMTO\QEW-BERTIE\02 DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

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

| PROJECT | | RECORD OF BOREHOLE | | | | No CN/CP12 | | SHEET 2 OF 2 | | METRIC | | | | | | | |
|----------------------|--|--------------------|---------|---|------------|-------------------------|-----------------|--|--|--------|--|--|---------------------------------|-------------------------------|--------------------------------|---------------------------------------|--|
| G.W.P. 2116-16-00 | | LOCATION | | N 4755416.3; E 346563.7 MTM NAD 83 ZONE 10 (LAT. 42.937402; LONG. -78.988291) | | | | ORIGINATED BY JK | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE | | 203 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY EN | | | | | | | | | |
| DATUM Geodetic | | DATE | | August 23 and 24, 2018 | | | | CHECKED BY NK | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | | |
| 172.3 | CLAYEY SILT, trace sand to sandy, trace to some gravel Stiff Red-brown Moist | | 13 | SS | 12 | | 173 | | | | | | | | | | |
| 16.3 | SAND and GRAVEL, trace to some silt, trace clay Compact to very dense Grey Wet | | 14 | SS | 29 | | 172 | | | | | | | | | | |
| | | | | | | | 171 | | | | | | | | | | |
| | | | 15 | SS | 14 | | 170 | | | | | | | | | | |
| | - 0.1 m sand layer at 19.8 m | | 16A | SS | 31 | | 169 | | | | | | | | | | |
| | | | 16B | SS | 31 | | 168 | | | | | | | | | | |
| | - Augers grinding on inferred cobbles at 20.7 m and between 21.6 m and 22.9 m | | 17 | SS | 39 | | 167 | | | | | | | | | | |
| | | | | | | | 166 | | | | | | | | | | |
| 165.3 | | | 18 | SS | 69 | | 165 | | | | | | | | | | |
| 23.3 | DOLOMITIC LIMESTONE (BEDROCK) | | 1 | RC | REC 94% | | 165 | | | | | | | | | RQD = 94% | |
| | Bedrock cored from 23.3 m to 27.2 m. | | 2 | RC | REC 100% | | 164 | | | | | | | | | RQD = 94% | |
| | For rock coring details refer to Record of Drillhole CN/CP12. | | 3 | RC | REC 100% | | 163 | | | | | | | | | RQD = 100% | |
| 161.4 | END OF BOREHOLE | | | | | | 162 | | | | | | | | | | |
| 27.2 | NOTES: 1. Water level at a depth of 12.2 m below ground surface (Elev. 176.4 m) prior to rock coring. | | | | | | | | | | | | | | | | |

PROJECT: 1671430 W01

RECORD OF DRILLHOLE: CN/CP12

SHEET 1 OF 1

LOCATION: N 4755416.30 ;E 346563.70

DRILLING DATE: August 24, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME75 Truck Mounted Drill Rig

DRILLING CONTRACTOR: Geo-Environmental

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | TOTAL CORE % | SOLID CORE % | | | | TYPE AND SURFACE DESCRIPTION | Jr | Ja | Jcom | W1 | W2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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GTA-MTO 001 S:\CLIENTS\IMTO\QEW-BERTIE\02 DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

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

| PROJECT | | RECORD OF BOREHOLE | | | | No CN/CP10 | | SHEET 2 OF 3 | | METRIC | | | | | | | |
|----------------------|--|--------------------|---------|---|------------|-------------------------|-----------------|--|----|--------|----|-----|---------------------------------|-------------------------------|--------------------------------|---------------------------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION | | N 4755407.5; E 346584.2 MTM NAD 83 ZONE 10 (LAT. 42.937321; LONG. -78.988041) | | | | ORIGINATED BY | | JK | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE | | 203 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY | | EN | | | | | | | |
| DATUM Geodetic | | DATE | | August 28 and 29, 2018 | | | | CHECKED BY | | NK | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 171.9 | CLAYEY SILT, some sand to sandy, trace gravel Stiff to very stiff Red-brown Moist | | 13 | SS | 11 | | | | | | | | | | | | 5 16 47 32 |
| 16.3 | SAND, some gravel, trace to some silt, trace clay Compact Grey Moist | | 14 | SS | 28 | | | | | | | | | | | | 16 73 9 2 |
| 170.4 | SAND and GRAVEL, trace to some silt, trace clay Compact Grey Wet - Auger grinding on inferred cobbles at 18.6 m | | 15 | SS | 11 | | | | | | | | | | | | 36 56 8 0 |
| 165.0 | - Auger grinding on inferred cobbles at 20.4 m, 21.6 m, 22.3 m and 22.6 m | | 16 | SS | 21 | | | | | | | | | | | | |
| 23.2 | DOLOMITIC LIMESTONE (BEDROCK) Bedrock cored from 23.2 m to 27.2 m. For rock coring details refer to Record of Drillhole CN/CP10. | | 17 | SS | 152/0.20 | | | | | | | | | | | | |
| | | | 1 | RC | REC 100% | | | | | | | | | | | | RQD = 92% |
| | | | 2 | RC | REC 100% | | | | | | | | | | | | RQD = 92% |
| | | | 3 | RC | REC 100% | | | | | | | | | | | | RQD = 100% |
| 161.0 | | | | | | | | | | | | | | | | | |
| 27.2 | | | | | | | | | | | | | | | | | |

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQEW-BERTIE02_DATAGINT\QEW-BERTIE.GPJ GAL-GTA GDT 19-5-22



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

PROJECT: 1671430 W01

RECORD OF DRILLHOLE: CN/CP10

SHEET 3 OF 3

LOCATION: N 4755407.50 ;E 346584.20

DRILLING DATE: August 29, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75 Truck Mounted Drill Rig

DRILLING CONTRACTOR: Geo-Environmental

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | RECOVERY | | R,Q,D. % | FRACT. INDEX PER | EXP w.r.t. CORE AXIS RQD CORR | DISCONTINUITY DATA | | | | WEATH- ERING INDEX | Diametral Point Load Index (MPa) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | TOTAL CORE % | SOLID CORE % | | | | TYPE AND SURFACE DESCRIPTION | Jr | Ja | Jcom | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | Continued from Record of Borehole CN/CP10 | | 164.96 23.24 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 50



LOGGED: JK/EN

CHECKED: EN

GTA-RCK 046 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No RW-14 | | SHEET 1 OF 1 | | METRIC | | | | | |
|--|---|-----------------|---------|-----------------------------|------------|---|-----------------|--|--|---|--|--|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755382.9; E 346559.5 MTM NAD 83 ZONE 10 (LAT. 42.937102; LONG. -78.988345) | | ORIGINATED BY | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | COMPILED BY | | | | | |
| DATUM | | Geodetic | | DATE | | January 25, 2019 | | CHECKED BY | | | | | |
| | | | | | | | | MAS | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | W _p W W _L | | | |
| 181.5 | GROUND SURFACE | | | | | | | | | | | | |
| 0.0 | TOPSOIL (300 mm) | | 1A | SS | 5 | | | | | | | | |
| 0.3 | CLAYEY SILT with SAND, trace gravel | | 1B | | | | | | | | | | |
| 180.5 | Firm Mottled greyish-brown Moist | | 2A | SS | 7 | | | | | | | | 4 30 43 23 |
| 1.0 | SILT and SAND, trace clay, trace gravel | | 2B | | | | | | | | | | |
| | Loose to compact Brown Moist to wet | | 3 | SS | 20 | | | | | | | | 2 62 32 4 |
| | | | 4 | SS | 25 | | | | | | | | |
| 178.5 | Sandy CLAYEY SILT, trace to some gravel | | 5 | SS | 15 | | | | | | | | |
| 3.0 | Stiff to very stiff Grey Moist | | 6 | SS | 12 | | | | | | | | 10 24 43 23 |
| | | | 7 | SS | 16 | | | | | | | | |
| 175.7 | SPLIT SPOON REFUSAL | | 8 | SS | 80/0.05 | | | | | | | | |
| 5.8 | END OF BOREHOLE | | | | | | | | | | | | |
| NOTE: 1. Water level in open borehole not recorded. | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO1 | | RECORD OF BOREHOLE No CN/CP13 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|---------------|--|-----------------|---------|--------------------------------------|------------|---|-----------------|--|--|---------------|--|----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755394.3; E 346597.0 MTM NAD 83 ZONE 10 (LAT. 42.937202; LONG. -78.987885) | | | | ORIGINATED BY | | JK | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 152 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY | | EN | | | | | |
| DATUM | | Geodetic | | DATE | | August 30, 2018 | | | | CHECKED BY | | NK | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 187.9 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (360 mm) | | | | | | | | | | | | | | | | |
| 187.5 | | | | | | | | | | | | | | | | | |
| 187.1 | Sand and gravel (FILL) Brown Moist | | 1A | | | | | | | | | | | | | | |
| 0.9 | Sand (FILL) Red-brown Moist | | 1B | SS | 10 | | | | | | | | | | | | |
| | Silty clay, trace sand to sandy, trace gravel, trace organics to 8.4 m (FILL) Soft to stiff Red-brown Moist | | 2 | SS | 10 | | | | | | | | | | | | |
| | | | 3 | SS | 4 | | | | | | | | | | | | |
| | | | 4 | SS | 8 | | | | | | | | | | | | |
| | | | 5 | SS | 6 | | | | | | | | | | | | |
| | | | 6 | SS | 5 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 10 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 12 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 179.2 | | | | | | | | | | | | | | | | | |
| 8.7 | Sandy SILTY CLAY, trace gravel Very stiff Red-brown Moist | | 9 | SS | 19 | | | | | | | | | | | | |
| 178.1 | | | | | | | | | | | | | | | | | |
| 9.8 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| | NOTE: 1. Open borehole dry on completion of drilling. | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No HF-9 | | SHEET 1 OF 1 | | METRIC | | | | | | | | | |
|---------------|--|-----------------|---------|----------------------------|------------|---|-----------------|--|--|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755349.7; E 346581.9 MTM NAD 83 ZONE 10 (LAT. 42.936802; LONG. -78.988074) | | ORIGINATED BY | | | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | COMPILED BY | | | | | | | | | |
| DATUM | | Geodetic | | DATE | | January 10-11, 2019 | | CHECKED BY | | | | | | | | | |
| MAS | | | | | | | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 181.5 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL (700 mm) Firm Dark brown | | 1 | SS | 7 | | | | | | | | | | | | |
| 180.8 | | | | | | | | | | | | | | | | | |
| 0.7 | Sandy SILTY CLAY, trace to some gravel Stiff to very stiff Mottled greyish brown | | 2 | SS | 9 | | | | | | | | | | | | |
| | | | 3 | SS | 18 | | | | | | | | | | | | |
| | | | 4 | SS | 13 | | | | | | | | | | | | |
| | | | 5 | SS | 9 | | | | | | | | | | | | |
| 177.8 | | | | | | | | | | | | | | | | | |
| 3.7 | SILT and SAND, trace clay Very dense Greyish to brown | | 6A | SS | 50/0.18 | | | | | | | | | | | | |
| 177.2 | | | 6B | SS | | | | | | | | | | | | | |
| 4.3 | Moist LIMESTONE (BEDROCK) | | | | | | | | | | | | | | | | |
| | Bedrock cored from 4.3 m to 9.0 m. For rock coring details refer to Record of Drillhole HF-9. | | 1 | RC | REC 53% | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 2 | RC | REC 67% | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 3 | RC | REC 38% | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 172.5 | | | | | | | | | | | | | | | | | |
| 9.0 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| | NOTE: 1. Borehole dry prior to rock coring. | | | | | | | | | | | | | | | | |

GTA-MTO 001 S:\CLIENTS\MTQEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

PROJECT: 1671430 W08

RECORD OF DRILLHOLE: HF-9

SHEET 1 OF 1

LOCATION: N 4755349.69 ;E 346581.86

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 45 Track-Mounted Drill Rig

DRILLING CONTRACTOR: OGS Drilling Rig

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | FLUSH RETURN | RECOVERY | | R.Q.D. % | FRACT. INDEX PER | DISCONTINUITY DATA | WEATH- ERING INDEX | Diametral Point Load Index (MPa) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | TOTAL CORE % | SOLID CORE % | | | | | | TYPE AND SURFACE DESCRIPTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | GROUND SURFACE | | 177.22 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 50



LOGGED:

CHECKED: EN

GTA-RCK 046 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22

| | | | | | | | |
|-----------------------------|--|---|--|--------------------------|--|---------------|--|
| PROJECT 1671430 WO8 | | RECORD OF BOREHOLE No RW-10 | | SHEET 1 OF 2 | | METRIC | |
| G.W.P. 2116-16-00 | | LOCATION N 4755347.4; E 346630.3 MTM NAD 83 ZONE 10 (LAT. 42.936778; LONG. -78.987481) | | ORIGINATED BY MA | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | COMPILED BY EN/KN | | | |
| DATUM Geodetic | | DATE September 21, 2018 | | CHECKED BY MAS | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|----------------|------|------------|----------------------------|-----------------|---|-----------------------------|--|---|----------------|--------------------------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | WATER CONTENT (%) | | | | |
| | | | | | | | | ○ UNCONFINED ● QUICK TRIAXIAL | + FIELD VANE × REMOULDED | W _p | W | W _L | | |
| 186.6 | GROUND SURFACE | | | | | | | | | | | | | |
| 0.0 | ASPHALT (340 mm) | | | | | | | | | | | | | |
| 186.3 | | | | | | | | | | | | | | |
| 0.3 | Sand and gravel, some silt (FILL) Compact Brown Moist | | 1A 1B 1C | SS | 17 | | | | | | | | | |
| 185.5 | | | | | | | | | | | | | | |
| 1.3 | Sand, trace silt (FILL) Compact Brown Moist | | 2A 2B | SS | 9 | | | | | | | | | |
| 184.9 | | | | | | | | | | | | | | |
| 1.7 | Clayey silt, trace sand, trace gravel (FILL) Stiff Brown Moist | | 3 | SS | 7 | | | | | | | | | |
| 184.4 | | | | | | | | | | | | | | |
| 2.2 | Silty sand, trace topsoil, clayey silt layers (FILL) Loose Brown Moist | | 4 | SS | 4 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | Clayey silt, trace to some sand, trace to some gravel, trace topsoil, trace wood fragments (FILL) Soft to stiff Brown and grey Moist | | 5 | SS | 10 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 181.0 | | | | | | | | | | | | | | |
| 5.6 | SILTY CLAY, some sand, trace to some gravel Very stiff Brown Moist to wet | | 6 | SS | 17 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 7 | SS | 17 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 8 | SS | 23 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 175.9 | | | | | | | | | | | | | | |
| 10.7 | Gravelly SAND, some silt, trace clay Compact to very dense Grey Wet | | 9 | SS | 37 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 10 | SS | 31 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 11 | SS | 17 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 12 | SS | 57 | | | | | | | | | |

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQEW-BERTIE02_DATAGINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22



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

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No RW-15 | | SHEET 1 OF 1 | | METRIC | | | | | |
|---|---|-----------------|---------|-----------------------------|------------|---|-----------------|--|--|---|--|--|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755316.5; E 346618.8 MTM NAD 83 ZONE 10 (LAT. 42.936501; LONG. -78.987624) | | ORIGINATED BY | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | COMPILED BY | | | | | |
| DATUM | | Geodetic | | DATE | | January 25, 2019 | | CHECKED BY | | | | | |
| | | | | | | | | MAS | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | W _p W W _L | | | |
| 182.9 | GROUND SURFACE | | | | | | | | | | | | |
| 0.0 | TOPSOIL (270 mm) | | 1 | SS | 3 | | | | | | | | |
| 0.3 | Silty SAND, trace gravel, trace clay | | | | | | | | | | | | |
| 182.1 | Very Loose Mottled greyish brown Moist | | 2 | SS | 6 | | | | | | | | |
| 0.8 | Sandy CLAYEY SILT, trace to some gravel | | | | | | | | | | | | |
| | Soft to hard Greyish brown Moist to wet | | 3 | SS | 4 | | | | | | | | |
| | | | 4 | SS | 11 | | | | | | | | |
| | | | 5 | SS | 40 | | | | | | | | |
| 178.9 | | | 6 | SS | 43 | | | | | | | | |
| 4.0 | SAND and GRAVEL, some rock fragments | | | | | | | | | | | | |
| | Compact to very dense Grey Moist | | 7 | SS | 22 | | | | | | | | |
| | | | | | | | | | | | | | |
| 176.6 | | | 8 | SS | 70/0.13 | | | | | | | | |
| 6.3 | END OF BOREHOLE SPLIT-SPOON REFUSAL | | | | | | | | | | | | |
| NOTE: 1. Water level in open borehole at 5.3 m below ground surface (Elev. 177.6 m) on completion of drilling. | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE | | | | No HF-10 | | SHEET 1 OF 2 | | METRIC | | |
|---------------|--|--------------------|----------|---------------|------------|---|-----------------|--|--|--------|--|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755331.9; E 346645.1 MTM NAD 83 ZONE 10 (LAT. 42.936638; LONG. -78.987300) | | ORIGINATED BY | | JK | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 152 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | COMPILED BY | | EN/KN | | |
| DATUM | | Geodetic | | DATE | | September 6 and 7, 2018 | | CHECKED BY | | MAS | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | |
| 186.2 | GROUND SURFACE | | | | | | | | | | | |
| 185.9 | ASPHALT (280 mm) | | | | | | | | | | | |
| 0.3 | Sand and gravel (FILL) Compact Brown Moist | | 1 | SS | 24 | | | | | | | |
| 185.1 | Sand (FILL) Compact Brown Moist | | 2 | SS | 7 | | | | | | | |
| 1.2 | Sandy clayey silt, trace gravel, trace organics (FILL) Firm to very stiff Grey-brown Moist | | 3 | SS | 7 | | | | | | | |
| | | | 4 | SS | 11 | | | | | | | |
| 181.7 | Sandy CLAYEY SILT to CLAYEY SILT with SAND, trace gravel Firm to stiff Grey Moist | | 5 | SS | 9 | | | | | | | |
| 4.5 | | | 6A 6B | SS | 5 | | | | | | | |
| 178.4 | SAND and GRAVEL, some silt, trace clay, some rock fragments Compact to very dense Grey Moist to wet below 10.7 m | | 7A 7B | SS | 117 | | | | | | | |
| 7.8 | | | 8 | SS | 113 | | | | | | | |
| | - Augers grinding at 9.8 m and between 10.1 m and 10.7 m | | | | | | | | | | | |
| | - Seepage observed at a depth of 10.7 m | | 9 | SS | 26 | | | | | | | |
| | - Augers grinding between 11.6 m and 12.2 m | | 10 | SS | 25 | | | | | | | |
| 172.1 | | | 11 | SS | 128/0.23 | | | | | | | |
| 14.1 | END OF BOREHOLE | | | | | | | | | | | |

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

| | | | | | | | |
|------------------------------------|--|---|--|--------------------------|--|---------------|--|
| PROJECT 1671430 WO8 | | RECORD OF BOREHOLE No HF-10 | | SHEET 2 OF 2 | | METRIC | |
| G.W.P. 2116-16-00 | | LOCATION N 4755331.9; E 346645.1 MTM NAD 83 ZONE 10 (LAT. 42.936638; LONG. -78.987300) | | ORIGINATED BY JK | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 152 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | COMPILED BY EN/KN | | | |
| DATUM Geodetic | | DATE September 6 and 7, 2018 | | CHECKED BY MAS | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|------------------|---|---|------------|---|-------------------|----------------|---|---|----|----|----|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | W _p | W | W _L | | GR | SA | SI | CL | |
| | | | | | | | | ○ UNCONFINED | ● QUICK TRIAXIAL | + | × | FIELD VANE | REMOULDED | WATER CONTENT (%) | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | | | | | | |
| | NOTES: 1. Water level in open borehole at a depth of 9.7 m below ground surface (Elev. 176.5 m) on completion of drilling. 2. Borehole caved to 10.5 m depth on removal of augers. 3. Water level in open borehole at a depth of 9.0 m below ground surface (Elev. 177.2 m) on removal of augers. | | | | | | | | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE | | | | No HF-11 | | SHEET 1 OF 2 | | METRIC | | | | | | | |
|----------------------|---|--------------------|---------|---|------------|-------------------------|-----------------|--|--|--------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION | | N 4755278.6; E 346653.9 MTM NAD 83 ZONE 10 (LAT. 42.936158; LONG. -78.987197) | | | | ORIGINATED BY | | LK | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | | | COMPILED BY | | JMP | | | | | | | |
| DATUM Geodetic | | DATE | | January 12, 2019 | | | | CHECKED BY | | MAS | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 183.7 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 183.4 | Silty sand, trace organics, wood fragments (FILL) Very loose Black Moist | | 1 | SS | 3 | | | | | | | | | | | | GR SA SI CL |
| 183.0 | Silt and sand, trace to some clay (FILL) Very loose to loose Brown to reddish brown Moist | | 2 | SS | 9 | | | | | | | | | | | | 0 35 56 9 |
| 181.9 | - Dolostone fragments at a depth of 1.6 m | | 3 | SS | 250/10.0% | | | | | | | | | | | | |
| 181.8 | LIMESTONE (BEDROCK) | | | | | | | | | | | | | | | | |
| | Bedrock cored from 1.8 m to 6.2 m. For rock coring details refer to Record of Drillhole HF-11. | | 1 | RC | REC 86% | | | | | | | | | | | | RQD = 83% |
| | | | 2 | RC | REC 41% | | | | | | | | | | | | RQD = 14% |
| | | | 3 | RC | REC 83% | | | | | | | | | | | | RQD = 42% |
| 177.5 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| 6.2 | NOTE: 1. Open borehole dry prior to rock coring. | | | | | | | | | | | | | | | | |

PROJECT: 1671430 W08

RECORD OF DRILLHOLE: HF-11

SHEET 2 OF 2

LOCATION: N 4755278.63 ;E 346653.88

DRILLING DATE: January 12, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 45 Track-Mounted Drill Rig

DRILLING CONTRACTOR: OGS Drilling Rig

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | TOTAL CORE % | SOLID CORE % | | | | TYPE AND SURFACE DESCRIPTION | Jr | Ja | Jcom | W1 | W2 | W3 | W4 | W5 | | W6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | Continued from Record of Borehole HF-11 | | 181.88 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE


1 : 50



LOGGED: LK

CHECKED: EN

GTA-RCK 046 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22

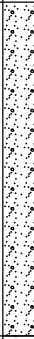
| PROJECT | | RECORD OF BOREHOLE No RW-16 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | | | |
|----------------------|--|--|---------|------|------------|--|-----------------|--------------------|---|----|---|-------------|-------------------|--|---------------------------------------|---|-------------|
| G.W.P. 2116-16-00 | | LOCATION N 4755252.0; E 346681.2 MTM NAD 83 ZONE 10 (LAT. 42.935917; LONG. -78.986864) | | | | ORIGINATED BY LK | | | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | | | COMPILED BY EN | | | | | | | | | | | |
| DATUM Geodetic | | DATE January 26, 2019 | | | | CHECKED BY MAS | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT | | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | γ | GR SA SI CL |
| | | | | | | | | 20 40 60 80 100 | 20 40 60 80 100 | Wp | W | Wl | 10 20 30 | | | | |
| 181.9 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL (375 mm) |  | 1A | SS | >60/0.05 | | | | | | | | | | | | |
| 181.5 | | | 1B | | | | | | | | | | | | | | |
| 0.4 | SPLIT SPOON REFUSAL LIMESTONE (BEDROCK) | | | | | | | | | | | | | | | | |
| | NOTE: 1. Open borehole dry on completion of drilling. | | | | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE | | | | No HF-12 | | SHEET 1 OF 2 | | METRIC | | | | | | |
|---------------|---|--------------------|---------|---------------|------------|---|-----------------|--|--|---------------|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755267.2; E 346703.6 MTM NAD 83 ZONE 10 (LAT. 42.936052; LONG. -78.986588) | | | | ORIGINATED BY | | JK | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 152 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY | | EN/KN | | | | |
| DATUM | | Geodetic | | DATE | | September 6, 2018 | | | | CHECKED BY | | MAS | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) |
| | | | | | | | | <div><div></div><div></div><div></div><div></div><div></div></div> | | | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | | |
| | | | | | | | | ● QUICK TRIAXIAL × REMOULDED | | | | | | | | |
| | | | | | | | | <div><div></div><div></div><div></div><div></div><div></div></div> | | | | | | | | |
| 184.2 | GROUND SURFACE | | | | | | 184 | | | | | | | | | |
| 0.0 | ASPHALT (180 mm) | | | | | | | | | | | | | | | |
| 0.2 | Sand and gravel (FILL) | | | | | | | | | | | | | | | |
| 183.3 | Brown-grey Moist | | | | | | | | | | | | | | | |
| 1.0 | Sand (FILL) | | 1 | SS | 5 | | 183 | | | | | | | | | |
| | Loose Brown-red Moist | | | | | | | | | | | | | | | |
| 182.4 | Sandy clayey silt (FILL) | | | | | | | | | | | | | | | |
| 1.8 | Firm Brown Moist | | | | | | | | | | | | | | | |
| | Sandy CLAYEY SILT, trace gravel | | 2 | SS | 14 | | 182 | | | | | | | | | |
| | Stiff to very stiff Brown Moist | | | | | | | | | | | | | | | |
| 181.2 | SILT and SAND, trace to some clay | | 3 | SS | 8 | | 181 | | | | | | | | | |
| 3.0 | Loose to compact Brown Moist | | | | | | | | | | | | | | | |
| | | | 4 | SS | 25 | | 180 | | | | | | | | | |
| 179.5 | | | | | | | | | | | | | | | | |
| 179.2 | Sandy CLAYEY SILT, trace gravel | | 5 | SS | 23 | | 179 | | | | | | | | | |
| 5.0 | Very stiff Brown Moist | | | | | | | | | | | | | | | |
| | SAND and GRAVEL, trace to some silt, trace clay, contains broken rock fragments | | | | | | | | | | | | | | | |
| | Compact to very dense Brown Moist to wet below 7.2 m | | 6 | SS | 164/0.23 | | 178 | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | - Augers grinding between a depth of 6.7 m and 7.6 m | | | | | | 177 | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 34 | | 176 | | | | | | | | | |
| | - Seepage observed at 8.2 m | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 30 | | 175 | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | - Augers grinding between a depth of 10.2 m and 10.4 m | | | | | | 174 | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 9 | SS | 63 | | 173 | | | | | | | | | |
| | - Augers grinding between a depth of 13.7 m and 14.5 m | | | | | | | | | | | | | | | |
| | | | | | | | 172 | | | | | | | | | |
| | | | 10 | SS | 29 | | 171 | | | | | | | | | |
| 171.2 | Sandy SILT, trace gravel | | | | | | | | | | | | | | | |
| 13.0 | Very dense Grey Wet | | | | | | | | | | | | | | | |
| 170.5 | | | 11 | SS | 100/0.02 | | 170 | | | | | | | | | |
| 13.7 | SAND and GRAVEL, trace to some silt, trace clay, contains broken rock fragments | | | | | | | | | | | | | | | |
| | Very dense Grey Wet | | | | | | | | | | | | | | | |

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATAGINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

| PROJECT | | RECORD OF BOREHOLE | | | | No HF-12 | | SHEET 2 OF 2 | | METRIC | | | | | | | |
|----------------------|---|---|--------|------|-------------------------|---|--|--------------------|----|-------------------|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|
| G.W.P. 2116-16-00 | | LOCATION | | | | N 4755267.2; E 346703.6 MTM NAD 83 ZONE 10 (LAT. 42.936052; LONG. -78.986588) | | | | ORIGINATED BY JK | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE | | | | 152 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY EN/KN | | | | | | | |
| DATUM Geodetic | | DATE | | | | September 6, 2018 | | | | CHECKED BY MAS | | | | | | | |
| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| | SAND and GRAVEL, trace to some silt, trace clay, contains broken rock fragments Very dense Grey Wet |  | 12 | SS | 100/0.02 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | - Augers grinding at a depth of 17.1 m | | 13 | SS | 100/0.02 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 165.9 | | | | | | | | | | | | | | | | | |
| 18.3 | END OF BOREHOLE | | 14 | SS | 100/0.02 | | | | | | | | | | | | |
| | NOTES: 1. Water level in open borehole at a depth of 18.0 m below ground surface (Elev. 166.2 m) on completion of drilling. 2. Borehole caved to 13.3 m on removal of augers. 3. Water level in open borehole at a depth of 7.5 m below ground surface (Elev. 176.7 m) on removal of augers. | | | | | | | | | | | | | | | | |

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No C1-1 | | SHEET 1 OF 2 | | METRIC | | | | | | |
|--|--|-----------------|---------|----------------------------|------------|---|-----------------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755249.3; E 346719.3 MTM NAD 83 ZONE 10 (LAT. 42.935891; LONG. -78.986398) | | ORIGINATED BY JK | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 203 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | COMPILED BY EN/KN | | | | | | |
| DATUM | | Geodetic | | DATE | | September 4, 2018 | | CHECKED BY NK | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | |
| 183.7 | GROUND SURFACE | | | | | | | | | | | | | |
| 0.0 | ASPHALT (200 mm) | | | | | | | | | | | | | |
| 0.2 | Sand and gravel (FILL) Brown | | | | | | | | | | | | | |
| 182.9 | | | | | | | | | | | | | | |
| 0.9 | Sand (FILL) Loose Brown-red Moist | | 1A | SS | 9 | | | | | | | | | |
| | | | 1B | | | | | | | | | | | |
| | Sandy clayey silt, trace gravel (FILL) Stiff Brown-grey Moist | | 2 | SS | 9 | | | | | | | | | |
| | | | 3 | SS | 12 | | | | | | | | | |
| 180.7 | | | | | | | | | | | | | | |
| 3.0 | SILT and SAND, some clay, trace gravel Compact Brown Moist | | 4 | SS | 17 | | | | | | | | | |
| 180.0 | | | | | | | | | | | | | | |
| 3.7 | Sandy CLAYEY SILT, trace gravel Hard Brown Moist | | 5A | SS | 71 | | | | | | | | | |
| 179.6 | | | 5B | | | | | | | | | | | |
| 4.1 | Dolomitic Limestone (BEDROCK) | | | | | | | | | | | | | |
| | - Augers grinding below a depth of 4.3 m | | | | | | | | | | | | | |
| | - Auger refusal at 4.5 m | | | | | | | | | | | | | |
| | - Cored from 4.5 m to 5.9 m | | | | | | | | | | | | | |
| | | | 6 | SS | 128 | | | | | | | | | |
| | - Auger grinding between depths of 6.9 m and 7.0 m, and at 8.2 m | | | | | | | | | | | | | |
| | | | 7 | SS | 20 | | | | | | | | | |
| | - Auger refusal at 8.7 m | | | | | | | | | | | | | |
| | - Augered to 8.7 m | | 1 | RC | REC 22% | | | | | | | | | |
| | Bedrock cored from 8.7 m to 13.4 m. | | | | | | | | | | | | | |
| | For rock details refer to Record of Drillhole C1-1. | | 2 | RC | REC 8% | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 3 | RC | REC 10% | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 170.3 | | | | | | | | | | | | | | |
| 13.4 | END OF BOREHOLE | | | | | | | | | | | | | |
| NOTES: | | | | | | | | | | | | | | |
| 1. Open borehole dry prior to rock coring. | | | | | | | | | | | | | | |

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22



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

PROJECT: 1671430 W08

RECORD OF DRILLHOLE: C1-1

SHEET 1 OF 1

LOCATION: N 4755249.34 ;E 346719.27

DRILLING DATE: September 4, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75 Truck Mounted Drill Rig

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | RECOVERY | | R.Q.D. % | FRACT. INDEX PER | EXP w.r.t. CORE AXIS | DISCONTINUITY DATA | | | | | WEATH- ERING INDEX | Diametral Point Load Index (MPa) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | TOTAL CORE % | SOLID CORE % | | | | TYPE AND SURFACE DESCRIPTION | | | Jr | Ja | | | Jcom | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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DEPTH SCALE

1 : 50

**GOLDER**

LOGGED: KN/JK

CHECKED: NK

GTA-RCK 046 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22

| PROJECT | | 1671430 WO8F | | RECORD OF BOREHOLE No C1-2 | | SHEET 1 OF 1 | | METRIC | | | | | | |
|---------------|--|-----------------|---------|----------------------------|------------|---|-----------------|--|-----------------|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755217.3; E 346711.3 MTM NAD 83 ZONE 10 (LAT. 42.935603; LONG. -78.986498) | | ORIGINATED BY | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 191 mm O.D Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | COMPILED BY | | | | | | |
| DATUM | | Geodetic | | DATE | | January 8, 2019 | | CHECKED BY | | | | | | |
| | | | | | | | | NK | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | |
| 181.8 | GROUND SURFACE | | | | | | | 20 40 60 80 100 | 20 40 60 80 100 | 10 20 30 | | | | GR SA SI CL |
| 0.0 | Clayey silt with sand, trace to some gravel, organics (FILL) | | 1A | SS | 19 | | | | | | | | | 8 32 42 18 |
| 181.4 | Very stiff | | 1B | SS | 19 | | | | | | | | | |
| 0.4 | Brown | | 2 | SS | 100/0.0 | | | | | | | | | |
| | Moist | | | | | | | | | | | | | |
| | Dolomitic Limestone (BEDROCK) | | 1 | RC | REC 94% | | | | | | | | | RQD = 84% |
| | Bedrock cored from 0.8 m to 4.1 m. | | | | | | | | | | | | | |
| | For rock coring details refer to Record of Drillhole C1-2. | | 2 | RC | REC 82% | | | | | | | | | RQD = 78% |
| | | | | | | | | | | | | | | |
| | | | 3 | RC | REC 27% | | | | | | | | | RQD = 20% |
| 177.7 | END OF BOREHOLE | | | | | | | | | | | | | |
| 4.1 | NOTES: | | | | | | | | | | | | | |
| | 1. Borehole dry prior to rock coring. | | | | | | | | | | | | | |
| | 2. Water level in standpipe piezometer | | | | | | | | | | | | | |
| | Date Depth (m) Elev. (m) | | | | | | | | | | | | | |
| | Jan. 13. 2019 3.9 177.9 | | | | | | | | | | | | | |
| | Feb. 08. 2019 3.2 178.6 | | | | | | | | | | | | | |
| | Feb. 22. 2019 3.8 178.0 | | | | | | | | | | | | | |

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: OGS

[illegible]

CHECKED: NK

\\GTA-RCK 046 S:\CLIENTS\MT0\QEW-BERTIE\02 DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22

| PROJECT | | RECORD OF BOREHOLE | | | | No HF-13 | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|----------------------|--|--------------------|---------|------|------------|---|-----------------|--|--|------------------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 1671430 WO8 | | LOCATION | | | | N 4755209.5; E 346739.8 MTM NAD 83 ZONE 10 (LAT. 42.935531; LONG. -78.986150) | | | | ORIGINATED BY LK | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE | | | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | | | COMPILED BY JMP | | | | | | | |
| DATUM Geodetic | | DATE | | | | January 12, 2019 | | | | CHECKED BY MAS | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 181.9 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | Sandy clayey silt, trace gravel, trace organics, trace rootlets (FILL) | | 1A | SS | 4 | | | | | | | | | | | | |
| 181.3 | Soft | | 1B | | | | | | | | | | | | | | |
| 0.6 | Brown to brownish red to grey Moist | | | | | | | | | | | | | | | | |
| | END OF BOREHOLE SPLIT-SPOON REFUSAL | | | | | | | | | | | | | | | | |
| | NOTE: 1. Open borehole dry upon completion of drilling. | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No RW-9 | | SHEET 1 OF 1 | | METRIC | | | | | |
|---|---|-----------------|---------|----------------------------|------------|---|-----------------|--|--|---|--|--|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755300.4; E 346712.2 MTM NAD 83 ZONE 10 (LAT. 42.936351; LONG. -78.986480) | | ORIGINATED BY | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | COMPILED BY | | | | | |
| DATUM | | Geodetic | | DATE | | September 17, 2018 | | CHECKED BY | | | | | |
| | | | | | | | | MAS | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | W _p W W _L | | | |
| 185.1 | GROUND SURFACE | | | | | | | | | | | | |
| 0.0 | ASPHALT (150 mm) | | | | | | | | | | | | |
| 0.2 | Silty sand and gravel, trace asphalt (FILL) Dense Grey Moist | | 1 | AS | - | | | | | | | | |
| 183.9 | | | 2A | SS | 44 | | | | | | | | |
| 1.2 | Silty clay, some sand to sandy, trace gravel (FILL) Firm to stiff Brown Moist | | 2B | | | | | | | | | | |
| | | | 3 | SS | 6 | | | | | | | | |
| | | | 4 | SS | 9 | | | | | | | | |
| | | | 5 | SS | 10 | | | | | | | | |
| 181.4 | | | | | | | | | | | | | |
| 3.7 | Sandy CLAYEY SILT, trace to some gravel Very stiff Red-brown Moist | | 6 | SS | 20 | | | | | | | | |
| | | | 7 | SS | 17 | | | | | | | | |
| | | | | | | | | | | | | | |
| 179.0 | | | | | | | | | | | | | |
| 6.1 | Silty SAND, trace to some clay, some clayey silt pockets Compact Brown Wet | | 8 | SS | 14 | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 9 | SS | 29 | | | | | | | | |
| 176.4 | | | | | | | | | | | | | |
| 8.7 | Gravelly SAND, some silt, trace clay, contains shale fragments Very dense Brown Wet | | | | | | | | | | | | |
| 175.7 | | | 10 | SS | 50/0.10 | | | | | | | | |
| 9.4 | END OF BOREHOLE | | | | | | | | | | | | |
| NOTES: | | | | | | | | | | | | | |
| 1. Water level in open borehole at a depth of 5.5 m below ground surface (Elev. 179.6 m) on completion of drilling. | | | | | | | | | | | | | |

| PROJECT | | 1671430 W08 | | RECORD OF BOREHOLE No C1-3 | | SHEET 1 OF 1 | | METRIC | | | | | | | | | | | | | | | | |
|--------------|-------|--|------------|----------------------------|------|---|--|---------------|-----------------|--|--|--|--|--|---|--|--|-------------|--|--|---------------------------------------|--|--|--|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755255.7; E 346753.3 MTM NAD 83 ZONE 10 (LAT. 42.935947; LONG. -78.985981) | | ORIGINATED BY | | | | | | | | | | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME45 Track/CME75 Truck mounted Drill Rigs | | COMPILED BY | | | | | | | | | | | | | | | | |
| DATUM | | Geodetic | | DATE | | January 26, 2019 | | CHECKED BY | | | | | | | | | | | | | | | | |
| | | | | | | | | NK | | | | | | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | | | ELEVATION SCALE | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT | | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
| ELEV | DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | | | | | | | | | | | | | | | | |
| 184.1 | 0.0 | GROUND SURFACE | | | | | | | | | | | | | | | | | | | | | | |
| 183.8 | 0.3 | ASPHALT (300 mm) | | | | | | | | | | | | | | | | | | | | | | |
| 183.3 | 0.3 | Sand and gravel to silty sand and gravel (FILL) Grey to dark grey | | 1 | AS | | | | | | | | | | | | | | | | | | | |
| 183.3 | 1.0 | Sand and gravel, trace silt to silty (FILL) Very dense Grey Dry | | 2 | SS | 50/0.25 | | | | | | | | | | | | | | | | | | |
| 183.3 | 1.0 | Sandy clayey silt, trace gravel (FILL) Soft to very stiff Mottled grey brown Moist | | 3 | SS | 24 | | | | | | | | | | | | | | | | | | |
| 183.3 | 1.0 | | | 4 | SS | 13 | | | | | | | | | | | | | | | | | | |
| 183.3 | 1.0 | | | 5 | SS | 4 | | | | | | | | | | | | | | | | | | |
| 180.4 | 3.7 | CLAYEY SILT, some sand, trace gravel Firm to hard Mottled grey-brown Moist to wet | | 6 | SS | 8 | | | | | | | | | | | | | | | | | | |
| 180.4 | 3.7 | - Auger increased resistance between 5.3 m and 5.5 m | | 7 | SS | 24 | | | | | | | | | | | | | | | | | | |
| 180.4 | 3.7 | | | 8 | SS | 33 | | | | | | | | | | | | | | | | | | |
| 176.5 | 7.6 | Dolomitic Limestone (BEDROCK) | | 9 | SS | 24 | | | | | | | | | | | | | | | | | | |
| 176.5 | 7.6 | Bedrock cored from 8.6 m to 10.1 m. For rock coring details refer to Record of Drillhole C1-3. | | | | | | | | | | | | | | | | | | | | | | |
| 176.5 | 7.6 | | | 1 | RC | REC 39% | | | | | | | | | | | | | | | | | | |
| 174.0 | 10.1 | END OF BOREHOLE | | | | | | | | | | | | | | | | | | | | | | |
| 174.0 | 10.1 | NOTE: 1. Water level in borehole at a depth of 7.5 m (Elev. 176.6 m) below ground surface prior to rock coring. 2. Water level in standpipe piezometer Date Depth (m) Elev. (m) Feb. 08, 2019 3.2 180.9 Feb. 22, 2019 5.9 178.2 | | | | | | | | | | | | | | | | | | | | | | |

PROJECT: 1671430 W08

RECORD OF DRILLHOLE: C1-3

SHEET 1 OF 1

LOCATION: N 4755255.74 ;E 346753.25

DRILLING DATE: January 26, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75 Truck Mounted Drill Rig

DRILLING CONTRACTOR: OGS

| DEPTH SCALE METRES | DRILLING RECORD | | DESCRIPTION | SYMBOLIC LOG | ELEV. | | RUN No. | FLUSH RETURN | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | | | FEATURES | PIEZOMETER | |
|-----------------------|-----------------|--|-------------|--------------|--------------|--------|---------|--------------|--|--|-------------|------------------------|--|--------------------|--|--|--|--------------------------|--|---|--|--|----------|------------|--|
| | | | | | DEPTH (m) | 175.45 | | | RECOVERY | | R.Q.D. % | FRACT. INDEX PER | DIP wrt. CORE AXIS D.C.C. O.P.P.P.P. | DISCONTINUITY DATA | | | | WEATH- ERING INDEX | | Diametral Point Load Index (MPa) | | | | | |
| | | | | | | | | | TOTAL CORE % P.P | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 50

**GOLDER**

LOGGED: LK

CHECKED: NK

GTA-RCK 046 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22

| PROJECT | | RECORD OF BOREHOLE No RW-7 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | | | |
|--|---|--|---------|-------------------|------------|-------------------------|-----------------|--|--|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 1671430 WO8 | | LOCATION N 4755227.4; E 346780.4 MTM NAD 83 ZONE 10 (LAT. 42.935690; LONG. -78.985650) | | ORIGINATED BY MA | | | | | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | COMPILED BY EN/KN | | | | | | | | | | | | | |
| DATUM Geodetic | | DATE September 17, 2018 | | CHECKED BY MAS | | | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 183.7 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (370 mm) | | | | | | | | | | | | | | | | |
| 183.3 | | | | | | | | | | | | | | | | | |
| 182.9 | Sand and gravel, some silt (FILL) Brown | | | | | | | | | | | | | | | | |
| 0.9 | Sand, trace silt (FILL) Brown Moist | | 1 | SS | 41 | | | | | | | | | | | | |
| 182.2 | Sandy gravel, some silt, some asphalt (FILL) Dense Brown Moist | | 2 | SS | 14 | | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | | | | | |
| 180.7 | Clayey silt, trace to some organics/wood fragments, trace gravel, trace sand (FILL) Firm to stiff Brown Moist | | 3 | SS | 8 | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | | | | | |
| | CLAYEY SILT with SAND, trace gravel Firm to very stiff Brown Moist | | 4 | SS | 8 | | | | | | | | | | | | |
| | | | 5A | SS | 9 | | | | | | | | | | | | |
| | | | 5B | | | | | | | | | | | | | | |
| | | | 6A | SS | 20 | | | | | | | | | | | | |
| 178.6 | | | 6B | | | | | | | | | | | | | | |
| 5.1 | Silty SAND and GRAVEL, trace clay Compact Brown Moist | | | | | | | | | | | | | | | | |
| 177.9 | | | | | | | | | | | | | | | | | |
| 177.5 | CLAYEY SILT, trace gravel, trace sand Brown Moist | | 7A | SS | 32 | | | | | | | | | | | | |
| 6.2 | | | 7B | | | | | | | | | | | | | | |
| | Gravelly SAND, some silt, trace clay, some rock fragments Dense to very dense Brown Moist | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 62 | | | | | | | | | | | | |
| 175.5 | | | | | | | | | | | | | | | | | |
| 8.2 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| NOTES: 1. Water level in open borehole at a depth of 7.3 m below ground surface (Elev. 176.4 m) on completion of drilling. 2. Borehole caved to a depth of 7.0 m on removal of augers. 3. Water level in open borehole at a depth of 6.9 m below ground surface (Elev. 176.8 m) on removal of augers. | | | | | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE No HF-14 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | | |
|----------------------|---|--|---------|------|------------|-------------------------|-----------------|--|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION N 4755213.7; E 346771.1 MTM NAD 83 ZONE 10 (LAT. 42.935567; LONG. -78.985765) | | | | ORIGINATED BY JK | | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 152 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | | | COMPILED BY EN/KN | | | | | | | | | | |
| DATUM Geodetic | | DATE September 7, 2018 | | | | CHECKED BY MAS | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | |
| 183.3 | GROUND SURFACE | | | | | | | | | | | | | | | |
| 183.0 | ASPHALT (280 mm) | | | | | | | | | | | | | | | |
| 182.7 | Sand and gravel (FILL) Brown | | | | | | | | | | | | | | | |
| 182.3 | Sand, some gravel (FILL) Compact | | | | | | | | | | | | | | | |
| 1.0 | Brown-red Moist | | 1 | SS | 17 | | | | | | | | | | | |
| 181.8 | Sandy silt, trace gravel (FILL) Compact | | | | | | | | | | | | | | | |
| 1.5 | Brown-grey Moist | | 2 | SS | 17 | | | | | | | | | | | |
| | SILT and SAND, some clay Compact to very dense | | | | | | | | | | | | | | | |
| | Brown Moist | | 3 | SS | 19 | | | | | | | | | | | |
| 180.0 | | | 4A | SS | 110/0.25 | | | | | | | | | | | |
| 3.4 | SAND and GRAVEL, some silt, trace clay, contains rock fragments Compact to very dense | | 4B | | | | | | | | | | | | | |
| | Grey Moist to wet | | 5 | SS | 22 | | | | | | | | | | | |
| | | | 6 | SS | 47 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 146 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 111/0.28 | | | | | | | | | | | |
| 175.2 | END OF BOREHOLE | | | | | | | | | | | | | | | |
| 8.1 | NOTES: 1. Water level in open borehole at a depth of 6.8 m below ground surface (Elev. 176.5 m) on completion of drilling. 2. Borehole caved to 7.0 m on removal of augers. 3. Water level in open borehole at a depth of 6.1 m below ground surface (Elev. 177.2 m) on removal of augers. | | | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE | | | | No RW-6 | | SHEET 1 OF 2 | | METRIC | | | | | |
|---------------|--|--------------------|---------|---------------|------------|---|-----------------|--|--|--------|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755191.5; E 346813.2 MTM NAD 83 ZONE 10 (LAT. 42.935365; LONG. -78.985252) | | ORIGINATED BY | | LK | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | COMPILED BY | | JMP | | | | | |
| DATUM | | Geodetic | | DATE | | January 14, 2019 | | CHECKED BY | | MAS | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | |
| 183.6 | GROUND SURFACE | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (240 mm) | | | | | | | | | | | | | | |
| 183.0 | Sand and gravel, trace asphalt pieces (FILL) | | 1A | SS | >50/0.2 | | | | | | | | | | |
| 0.6 | Very dense Grey Moist | | 1B | | | | | | | | | | | | |
| 182.5 | Sand and gravel (FILL) | | 2A | SS | 18 | | | | | | | | | | |
| 1.1 | Compact Grey Moist | | 2B | | | | | | | | | | | | |
| | Sandy clayey silt, some gravel (FILL) | | 3 | SS | 13 | | | | | | | | | | |
| 181.1 | Stiff to very stiff Brown Moist | | 4A | SS | 10 | | | | | | | | | | |
| 2.5 | Silty SAND, trace to some clay | | 4B | | | | | | | | | | | | |
| | Compact to very dense Brown Moist | | 5 | SS | >50/0.2 | | | | | | | | | | |
| 180.2 | LIMESTONE (BEDROCK) | | | | | | | | | | | | | | |
| 3.4 | Bedrock cored from 3.4 m to 9.2 m. | | | | | | | | | | | | | | |
| | For rock coring details refer to Record of Drillhole RW-6. | | | | | | | | | | | | | | |
| | | | 1 | RC | REC 29% | | | | | | | | | | RQD = 4% |
| | | | 2 | RC | REC 54% | | | | | | | | | | RQD = 30% |
| | | | 3 | RC | REC 65% | | | | | | | | | | RQD = 58% |
| 174.4 | END OF BOREHOLE | | | | | | | | | | | | | | |
| 9.2 | NOTE: 1. Water level at a depth of 4.9 m below ground surface (Elev. 178.7 m) prior to rock coring. 2. Water level at a depth of 6.6 m (Elev. 177.0 m) below ground surface measured on January 15, 2019 upon removal of augers and casing. 3. Water level in piezometer at a depth of 3.3 m below ground surface (Elev. 180.3 m) on February 22, 2019. | | | | | | | | | | | | | | |

PROJECT: 1671430 W08

RECORD OF DRILLHOLE: RW-6

SHEET 2 OF 2

LOCATION: N 4755191.53 ;E 346813.16

DRILLING DATE: January 14, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 45 Track-Mounted Drill Rig

DRILLING CONTRACTOR: OGS Drilling Rig

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | RECOVERY | | R.Q.D. % | FRACT. INDEX PER | EXP w.r.t. CORE AXIS | DISCONTINUITY DATA | | | | | WEATH- ERING INDEX | | | | | Diametral Point Load Index (MPa) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | TOTAL CORE % | SOLID CORE % | | | | TYPE AND SURFACE DESCRIPTION | Jr | Ja | Jcom | W1 | W2 | W3 | W4 | W5 | W6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | 000000 | 000000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | GROUND SURFACE | | 180.21 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 50



LOGGED: LK

CHECKED: EN

GTA-RCK 046 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-MISS.GDT 19-5-22

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No HF-15 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|--|--|-------------|---------|-----------------------------|------------|---|-----------------|--|--|--|--|-----|---|-------------|--|----------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755146.8; E 346807.2 MTM NAD 83 ZONE 10 (LAT. 42.934963; LONG. -78.985327) | | | | ORIGINATED BY | | LK | | | | | |
| DIST | | Central | | HWY | | QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | | | COMPILED BY | | JMP | |
| DATUM | | Geodetic | | DATE | | January 12, 2019 | | | | CHECKED BY | | MAS | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | | |
| 183.0 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | Clayey silt with sand, trace gravel, trace organics (FILL) | | 1A | | | | | | | | | | | | | | |
| | Firm | | 1B | SS | 5 | | | | | | | | | | | | |
| 182.4 | Dark brown to grey | | 2 | SS | 50/0.63 | | | | | | | | | | | | |
| 0.6 | Moist - Dolostone fragments, grey at a depth of 0.6 m | | | | | | | | | | | | | | | | |
| | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| NOTE: 1. Open borehole dry upon completion of drilling. | | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No RW-5 | | SHEET 1 OF 1 | | METRIC | | | | | | | | |
|--|--|-----------------|---------|----------------------------|------------|---|-----------------|--|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755154.8; E 346847.8 MTM NAD 83 ZONE 10 (LAT. 42.935033; LONG. -78.984830) | | ORIGINATED BY | | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | COMPILED BY | | | | | | | | |
| DATUM | | Geodetic | | DATE | | September 17, 2018 | | CHECKED BY | | | | | | | | |
| | | | | | | | | MAS | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | |
| 184.2 | GROUND SURFACE | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (230 mm) | | | | | | | | | | | | | | | |
| 0.2 | Sand and gravel, some silt (FILL) Compact Brown Moist | | 1A | SS | 29 | | | | | | | | | | | |
| 183.0 | | | 1B | | | | | | | | | | | | | |
| 182.7 | Sand, trace silt (FILL) Compact Brown-red Moist | | 2 | SS | 13 | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | | | | |
| 181.7 | Sandy clayey silt, trace gravel (FILL) Stiff to hard Brown Moist | | 3A | SS | 64 | | | | | | | | | | | |
| | | | 3B | | | | | | | | | | | | | |
| 2.7 | Sandy SILT, some gravel Very dense Brown Moist | | 4 | SS | 100/0.10 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | SAND and GRAVEL, trace to some silt, trace clay Compact to very dense Brown Moist | | 5 | SS | 100/0 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | - Containing dolostone cobbles and boulder between 2.7 m and 5.0 m depth | | 6 | SS | 60/0.05 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 18 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 27 | | | | | | | | | | | |
| 177.5 | | | | | | | | | | | | | | | | |
| 6.7 | END OF BOREHOLE | | | | | | | | | | | | | | | |
| NOTES: | | | | | | | | | | | | | | | | |
| 1. Open borehole dry on completion of drilling and on removal of augers. | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No RW-4A | | SHEET 1 OF 1 | | METRIC | | | | | | | | | |
|---------------|--|-----------------|---------|-----------------------------|------------|---|-----------------|--|--|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755131.7; E 346868.7 MTM NAD 83 ZONE 10 (LAT. 42.934824; LONG. -78.984576) | | ORIGINATED BY | | | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Truck-mounted Drill Rig | | COMPILED BY | | | | | | | | | |
| DATUM | | Geodetic | | DATE | | September 21, 2018 | | CHECKED BY | | | | | | | | | |
| | | | | | | | | MAS | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 184.5 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (200 mm) | | | | | | | | | | | | | | | | |
| 0.2 | Sand and gravel, some silt (FILL) Compact Brown Moist | | | | | | | | | | | | | | | | |
| 183.3 | | | 1A | SS | 15 | | | | | | | | | | | | |
| 1.2 | Sand, trace silt (FILL) Compact Brown Moist | | 1B | | | | | | | | | | | | | | |
| 182.7 | | | 2A | SS | 11 | | | | | | | | | | | | |
| 1.8 | Clayey silt, trace sand, trace gravel, sandy silt layers (FILL) Stiff to very stiff Brown Moist | | 2B | | | | | | | | | | | | | | |
| 181.6 | | | 3 | SS | 24 | | | | | | | | | | | | |
| 181.3 | Sandy SILT Very dense Brown Moist | | 4A | SS | 80/0.07 | | | | | | | | | | | | |
| 3.3 | | | 4B | | | | | | | | | | | | | | |
| | SAND, some silt, trace gravel Very dense Brown Moist | | 5 | SS | 100/0 | | | | | | | | | | | | |
| | | | 6 | SS | 100/0 | | | | | | | | | | | | |
| | SAND and GRAVEL, trace to some silt, trace clay Compact to very dense Brown Moist | | 7 | SS | 100/0 | | | | | | | | | | | | |
| | - Containing dolostone cobbles and boulder between 3.3 m and 5.5 m depth | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 36 | | | | | | | | | | | | 49 40 9 2 |
| | | | | | | | | | | | | | | | | | |
| | | | 9 | SS | 15 | | | | | | | | | | | | |
| 176.3 | END OF BOREHOLE | | | | | | | | | | | | | | | | |
| 8.2 | NOTES: 1. Open borehole dry during and on completion of drilling and on removal of augers. | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No R1-1 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|---------------|--|-----------------|---------|----------------------------|------------|---|-----------------|--|--|--------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755030.0; E 346786.6 MTM NAD 83 ZONE 10 (LAT. 42.933912; LONG. -78.985589) | | ORIGINATED BY | | MA | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | COMPILED BY | | EN/KN | | | | | | | |
| DATUM | | Geodetic | | DATE | | September 24, 2018 | | CHECKED BY | | MAS | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 189.8 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (100 mm) | | | | | | | | | | | | | | | | |
| 188.9 | Sand and gravel, some silt (FILL) Brown Moist | | | | | | | | | | | | | | | | |
| 0.9 | Clayey silt, some sand, some gravel, trace topsoil seams (FILL) Stiff Brown Moist | | 1 | SS | 10 | | | | | | | | | | | | |
| 187.6 | | | 2 | SS | 10 | | | | | | | | | | | | |
| 2.2 | Sand and gravel, some silt (FILL) Compact Brown Moist | | 3A | SS | 29 | | | | | | | | | | | | |
| 187.1 | | | 3B | SS | 29 | | | | | | | | | | | | |
| 186.8 | Sand, trace silt (FILL) Compact Brown Moist | | 4 | SS | 6 | | | | | | | | | | | | |
| 3.0 | Clayey silt, some sand, trace to come gravel (FILL) Firm to very stiff Brown Moist | | | | | | | | | | | | | | | | |
| 185.0 | END OF BOREHOLE AUGER REFUSAL | | 5 | SS | 100/0.23 | | | | | | | | | | | | |
| 4.8 | NOTES: 1. Open borehole dry during and after completion of drilling and on removal of augers. 2. Borehole caved to 3.7 m on removal of augers. | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No R1-2 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|---|---|-------------|---------|----------------------------|------------|---|-----------------|--|--|--|--|-----|---|-------------|--|----------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4755052.6; E 346799.4 MTM NAD 83 ZONE 10 (LAT. 42.934115; LONG. -78.985430) | | | | ORIGINATED BY | | LK | | | | | |
| DIST | | Central | | HWY | | QEW | | BOREHOLE TYPE | | 191 mm O.D. Hollow Stem Augers; CME 45 Track-mounted Drill Rig | | | | COMPILED BY | | JMP | |
| DATUM | | Geodetic | | DATE | | January 13, 2019 | | | | CHECKED BY | | MAS | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | | |
| 185.6 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL (180 mm) | | | | | | | | | | | | | | | | |
| 0.2 | Sandy clayey silt, trace to some gravel, trace organics (FILL) Soft to very stiff Brown Moist - Dolostone fragments at a depth of 1.1 m | | 1A | SS | 3 | | | | | | | | | | | | 8 29 44 19 |
| 184.5 | | | 1B | | | | | | | | | | | | | | |
| 1.1 | END OF BOREHOLE SPLIT SPOON REFUSAL | | 2A | SS | 30 | | | | | | | | | | | | |
| | | | 2B | | | | | | | | | | | | | | |
| NOTE: 1. Borehole dry upon completion of drilling. | | | | | | | | | | | | | | | | | |

PROJECT: 1671430 W08

RECORD OF DRILLHOLE: C3-2

SHEET 1 OF 1

LOCATION: N 4755062.89 ;E 346839.16

DRILLING DATE: September 24, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 Track-Mounted Drill Rig

DRILLING CONTRACTOR: Geo-Environmental Drilling Inc.

| DEPTH SCALE METRES | DRILLING RECORD | DESCRIPTION | SYMBOLIC LOG | ELEV. DEPTH (m) | RUN No. | NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY | | | | | | | | | | | | | | | FEATURES | PIEZOMETER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | TOTAL CORE % | SOLID CORE % | | | DIP w.r.t. CORE AXIS | TYPE AND SURFACE DESCRIPTION | Jr | Ja | Jzon | W1 | W2 | W3 | W4 | W5 | | | | W6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 0 | | GROUND SURFACE | | 183.92 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 50



LOGGED: MA/EN

CHECKED: NK

| PROJECT | | RECORD OF BOREHOLE | | | | No R1-3 | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|----------------------|---|--------------------|---------|---|------------|-------------------------|-----------------|--|--|--------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION | | N 4755074.2; E 346840.4 MTM NAD 83 ZONE 10 (LAT. 42.934307; LONG. -78.984927) | | | | ORIGINATED BY | | MA | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | | | COMPILED BY | | EN/KN | | | | | | | |
| DATUM Geodetic | | DATE | | September 24, 2018 | | | | CHECKED BY | | MAS | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 184.0 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL (130 mm) | | | | | | | | | | | | | | | | |
| 0.1 | SILT, some clay, trace sand, trace gravel Brown | | | | | | | | | | | | | | | | |
| 183.2 | END OF BOREHOLE AUGER REFUSAL | | | | | | | | | | | | | | | | |
| 0.8 | NOTES: 1. Open borehole dry on completion of drilling. | | | | | | | | | | | | | | | | |

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

| PROJECT | | RECORD OF BOREHOLE No R1-4 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | | |
|----------------------|--|--|--------|------|-------------------------|-------------------|--|--------------------|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| 1671430 WO8 | | | | | | | | | | | | | | | | |
| G.W.P. 2116-16-00 | | LOCATION N 4755057.1; E 346877.7 MTM NAD 83 ZONE 10 (LAT. 42.934151; LONG. -78.984471) | | | | ORIGINATED BY MA | | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | | | COMPILED BY EN/KN | | | | | | | | | | |
| DATUM Geodetic | | DATE September 24, 2018 | | | | CHECKED BY MAS | | | | | | | | | | |
| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | |
| 184.0 | GROUND SURFACE | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL (130 mm) | | | | | | | | | | | | | | | |
| 0.1 | Sandy SILT, some gravel Brown Moist | | | | | | | | | | | | | | | |
| 183.1 | END OF BOREHOLE SPLIT SPOON AND AUGER REFUSAL | | | | | | | | | | | | | | | |
| 0.9 | NOTES: 1. Open borehole dry during and on completion of drilling. | | | | | | | | | | | | | | | |

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-BERTIE\02_DATA\GINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-22

| PROJECT | | RECORD OF BOREHOLE No R1-5 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | | | |
|---|---|--|---------|------|------------|-------------------------|-----------------|--|--|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION N 4755034.3; E 346905.7 MTM NAD 83 ZONE 10 (LAT. 42.933945; LONG. -78.984130) | | | | ORIGINATED BY MA | | | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | | | COMPILED BY EN/KN | | | | | | | | | | | |
| DATUM Geodetic | | DATE September 24, 2018 | | | | CHECKED BY MAS | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 184.7 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | TOPSOIL (75 mm) | | | | | | | | | | | | | | | | |
| 184.3 | Sand, trace gravel, trace silt (FILL) Brown | | | | | | | | | | | | | | | | |
| 0.4 | Silty clay, some sand, trace gravel (FILL) Stiff Brown Moist | | 1A | SS | 9 | | | | | | | | | | | | |
| | | | 1B | | | | | | | | | | | | | | |
| 182.9 | | | 2 | SS | 103/0.15 | | | | | | | | | | | | |
| 1.8 | END OF BOREHOLE AUGER AND SPLIT SPOON REFUSAL | | | | | | | | | | | | | | | | |
| NOTES: 1. Open borehole dry during and on completion of drilling and on removal of augers. | | | | | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE | | | | No R1-6 | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|----------------------|--|--------------------|---------|------|------------|---|-----------------|--|--|-------------------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION | | | | N 4755001.3; E 346931.0 MTM NAD 83 ZONE 10 (LAT. 42.933646; LONG. -78.983822) | | | | ORIGINATED BY MA | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE | | | | 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | | | COMPILED BY EN/KN | | | | | | | |
| DATUM Geodetic | | DATE | | | | September 27, 2018 | | | | CHECKED BY MAS | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 186.0 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | Silty clay, some sand, trace to some gravel (FILL) Soft to stiff Brown Moist | | 1 | SS | 2 | | | | | | | | | | | | |
| 184.2 | CLAYEY SILT, trace sand, trace gravel Stiff Brown Moist | | 2A | SS | 8 | | | | | | | | | | | | |
| 2.0 | END OF BOREHOLE SPLIT SPOON AND AUGER REFUSAL NOTES: 1. Open borehole dry during and on completion of drilling. | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No R2-1 | | SHEET 1 OF 1 | | METRIC | | | | | | | | | |
|---------------|---|------------------|---------|----------------------------|------------|---|-----------------|--|--|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4754977.0; E 347137.7 MTM NAD 83 ZONE 10 (LAT. 42.933416; LONG. -78.981292) | | ORIGINATED BY | | | | | | | | | |
| DIST | | Central HWY QEWS | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | COMPILED BY | | | | | | | | | |
| DATUM | | Geodetic | | DATE | | September 13, 2018 | | CHECKED BY | | | | | | | | | |
| | | | | | | | | MAS | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 185.2 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | Silty clay, trace sand, trace gravel, trace topsoil (FILL) | | | | | | | | | | | | | | | | |
| 184.8 | Brown | | | | | | | | | | | | | | | | |
| 0.4 | CLAYEY SILT, trace to some sand, trace gravel | | | | | | | | | | | | | | | | |
| | Stiff to very stiff | | | | | | | | | | | | | | | | |
| | Brown | | | | | | | | | | | | | | | | |
| | Moist | | | | | | | | | | | | | | | | |
| | | | 1 | SS | 11 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 2 | SS | 29 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 30 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 4A | SS | 24 | | | | | | | | | | | | |
| 181.7 | CLAYEY SILT with SAND, some gravel | | 4B | SS | 24 | | | | | | | | | | | | |
| 3.5 | Hard | | | | | | | | | | | | | | | | |
| | Brown | | | | | | | | | | | | | | | | |
| | Moist | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 100/0.23 | | | | | | | | | | | | |
| 180.7 | POSSIBLE BEDROCK OR BOULDER | | | | | | | | | | | | | | | | |
| 4.6 | END OF BOREHOLE SPLIT SPOON AND AUGER REFUSAL | | | | | | | | | | | | | | | | |
| | NOTES: | | | | | | | | | | | | | | | | |
| | 1. Open borehole dry during and on completion of drilling and on removal of augers. | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No R2-2 | | | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|---------------|---|------------------|---------|----------------------------|------------|---|-----------------|--|--|---------------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4754939.4; E 347121.1 MTM NAD 83 ZONE 10 (LAT. 42.933079; LONG. -78.981498) | | | | ORIGINATED BY | | | | | | | |
| DIST | | Central HWY QEWE | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | | | COMPILED BY | | | | | | | |
| DATUM | | Geodetic | | DATE | | September 13, 2018 | | | | CHECKED BY | | | | | | | |
| MAS | | | | | | | | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 184.4 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 184.0 | Silty sand and gravel, some clay (FILL) Brown | | | | | | | | | | | | | | | | |
| 184.1 | | | | | | | | | | | | | | | | | |
| 0.3 | | | | | | | | | | | | | | | | | |
| | SILTY CLAY, trace to some sand | | | | | | | | | | | | | | | | |
| | Stiff | | | | | | | | | | | | | | | | |
| | Brown | | | | | | | | | | | | | | | | |
| | Moist | | | | | | | | | | | | | | | | |
| 183.0 | | | | | | | | | | | | | | | | | |
| 1.4 | CLAYEY SILT with SAND, trace gravel | | | | | | | | | | | | | | | | |
| | Hard | | | | | | | | | | | | | | | | |
| | Brown | | | | | | | | | | | | | | | | |
| | Moist | | | | | | | | | | | | | | | | |
| 182.3 | | | | | | | | | | | | | | | | | |
| 2.1 | END OF BOREHOLE SPLIT SPOON AND AUGER REFUSAL | | | | | | | | | | | | | | | | |
| | NOTES: | | | | | | | | | | | | | | | | |
| | 1. Open borehole dry during and on completion of drilling and on removal of augers. | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No R2-3 | | SHEET 1 OF 1 | | METRIC | | | | | | | | | |
|---|--|-----------------|---------|----------------------------|------------|---|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4754920.6; E 347097.9 MTM NAD 83 ZONE 10 (LAT. 42.932910; LONG. -78.981783) | | ORIGINATED BY | | | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | COMPILED BY | | | | | | | | | |
| DATUM | | Geodetic | | DATE | | September 14, 2018 | | CHECKED BY | | | | | | | | | |
| | | | | | | | | MAS | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 186.0 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 0.0 | Clayey silt, some sand, some gravel (FILL) Brown | | | | | | | | | | | | | | | | |
| 0.2 | CLAYEY SILT, trace sand, trace gravel Very stiff Brown Moist | | 1A | SS | 21 | | | | | | | | | | | | |
| 184.8 | | | 1B | | | | | | | | | | | | | | |
| 184.5 | CLAYEY SILT with SAND, some gravel Very stiff Brown Moist | | 2 | SS | 100/0 | | | | | | | | | | | | |
| 1.5 | END OF BOREHOLE AUGER REFUSAL | | | | | | | | | | | | | | | | |
| NOTES: 1. Open borehole dry during and on completion of drilling and on removal of augers. | | | | | | | | | | | | | | | | | |

GTA-MTO 001 S:\CLIENTS\MTQEW-BERTIE02_DATAGINT\QEW-BERTIE.GPJ GAL-GTA.GDT 19-5-23

| | | | | | | | |
|------------------------------------|--|---|--|--------------------------|--|---------------|--|
| PROJECT <u>1671430 WO8</u> | | RECORD OF BOREHOLE No R2-4 | | SHEET 1 OF 1 | | METRIC | |
| G.W.P. <u>2116-16-00</u> | | LOCATION <u>N 4754921.4; E 347063.8 MTM NAD 83 ZONE 10 (LAT. 42.932919; LONG. -78.982201)</u> | | ORIGINATED BY <u>MA</u> | | | |
| DIST <u>Central</u> HWY <u>QEW</u> | | BOREHOLE TYPE <u>178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig</u> | | COMPILED BY <u>EN/KN</u> | | | |
| DATUM <u>Geodetic</u> | | DATE <u>September 14, 2018</u> | | CHECKED BY <u>MAS</u> | | | |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT | | | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|--|---|------------|----------|------|------------|----------------------------|-----------------|---|----|----|----|----|---|----|---|--------------------------------------|---|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | | GR | SA | SI | CL |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | 20 | 40 | 60 | 80 | 100 | Wp | W | | WL | | | |
| 184.7 | GROUND SURFACE | | | | | | | | | | | | | | | | | | | |
| 0.0 | CLAYEY SILT, trace gravel, trace sand Very stiff Brown Moist | | 1 | SS | 28 | | | | | | | | | | | | | | | |
| 183.1 | | | | | | | | | | | | | | | | | | | | |
| 182.7 | CLAYEY SILT with SAND, some gravel Hard Brown Moist | | 2A 2B | SS | 100/0.20 | | | | | | | | | | | | | | | |
| 2.0 | END OF BOREHOLE SPLIT SPOON AND AUGER REFUSAL | | | | | | | | | | | | | | | | | | | |
| <div>NOTES:</div> <div>1. Open borehole dry during and on completion of drilling and on removal of augers.</div> | | | | | | | | | | | | | | | | | | | | |

| PROJECT | | 1671430 WO8 | | RECORD OF BOREHOLE No R2-5 | | SHEET 1 OF 1 | | METRIC | | | | | | | | |
|---------------|---|-----------------|--------|----------------------------|-------------------------|---|--|--------------------|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | 2116-16-00 | | LOCATION | | N 4754944.2; E 347021.9 MTM NAD 83 ZONE 10 (LAT. 42.933127; LONG. -78.982713) | | ORIGINATED BY | | | | | | | | |
| DIST | | Central HWY QEW | | BOREHOLE TYPE | | 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | COMPILED BY | | | | | | | | |
| DATUM | | Geodetic | | DATE | | September 14, 2018 | | CHECKED BY | | | | | | | | |
| MAS | | | | | | | | | | | | | | | | |
| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | |
| 186.6 | GROUND SURFACE | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (300 mm) | | | | | | | | | | | | | | | |
| 186.3 | | | | | | | | | | | | | | | | |
| 0.3 | Sand and gravel, some silt (FILL) Dense Brown Moist | | 1A | SS | 31 | | | | | | | | | | | |
| 185.4 | | | 1B | | | | | | | | | | | | | |
| | Sand, trace silt (FILL) Brown Moist | | | | | | | | | | | | | | | |
| 1.5 | CLAYEY SILT, trace gravel, trace sand Very stiff Brown Moist | | 2 | SS | 18 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 23 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 183.4 | | | 4A | | | | | | | | | | | | | |
| 3.2 | CLAYEY SILT with SAND, trace to some gravel Hard Brown Moist | | 4B | SS | 100/0.25 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 70/0.10 | | | | | | | | | | | |
| 182.5 | | | 6 | SS | 100/0 | | | | | | | | | | | |
| 4.1 | END OF BOREHOLE SPLIT SPOON AND AUGER REFUSAL | | | | | | | | | | | | | | | |
| | NOTES: 1. Open borehole dry during and on completion of drilling and on removal of augers. | | | | | | | | | | | | | | | |

| PROJECT | | RECORD OF BOREHOLE | | | | No R2-6 | | SHEET 1 OF 1 | | METRIC | | | | | | | |
|---|---|--|---------|------|------------|-------------------------|-----------------|--|--|--------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. 2116-16-00 | | LOCATION N 4754965.7; E 347003.2 MTM NAD 83 ZONE 10 (LAT. 42.933322; LONG. -78.982940) | | | | ORIGINATED BY | | MA | | | | | | | | | |
| DIST Central HWY QEW | | BOREHOLE TYPE 178 mm O.D Hollow Stem Augers; CME 75 Track-mounted Drill Rig | | | | COMPILED BY | | EN/KN | | | | | | | | | |
| DATUM Geodetic | | DATE September 14, 2018 | | | | CHECKED BY | | MAS | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | |
| 186.2 | GROUND SURFACE | | | | | | | | | | | | | | | | |
| 0.0 | ASPHALT (200 mm) | | | | | | | | | | | | | | | | |
| 0.2 | Sand and gravel, some silt (FILL) Compact Brown Moist | | | | | | | | | | | | | | | | |
| 185.1 | | | 1A | SS | 23 | | | | | | | | | | | | |
| 184.7 | Sand, trace silt (FILL) Compact Brown Wet | | 1B | | | | | | | | | | | | | | |
| 1.5 | Sandy CLAYEY SILT, trace gravel Very stiff to hard Brown Moist | | 2 | SS | 25 | | | | | | | | | | | | 4 24 47 25 |
| 183.2 | | | 3 | SS | 33 | | | | | | | | | | | | |
| 3.0 | CLAYEY SILT with SAND, trace gravel Hard Brown Moist | | 4 | SS | 33 | | | | | | | | | | | | |
| 182.3 | - Augers grinding below a depth of 3.8 m | | | | | | | | | | | | | | | | |
| 3.9 | END OF BOREHOLE SPLIT SPOON AND AUGER REFUSAL | | | | | | | | | | | | | | | | |
| NOTES: 1. Open borehole dry during and on completion of drilling and on removal of augers. | | | | | | | | | | | | | | | | | |

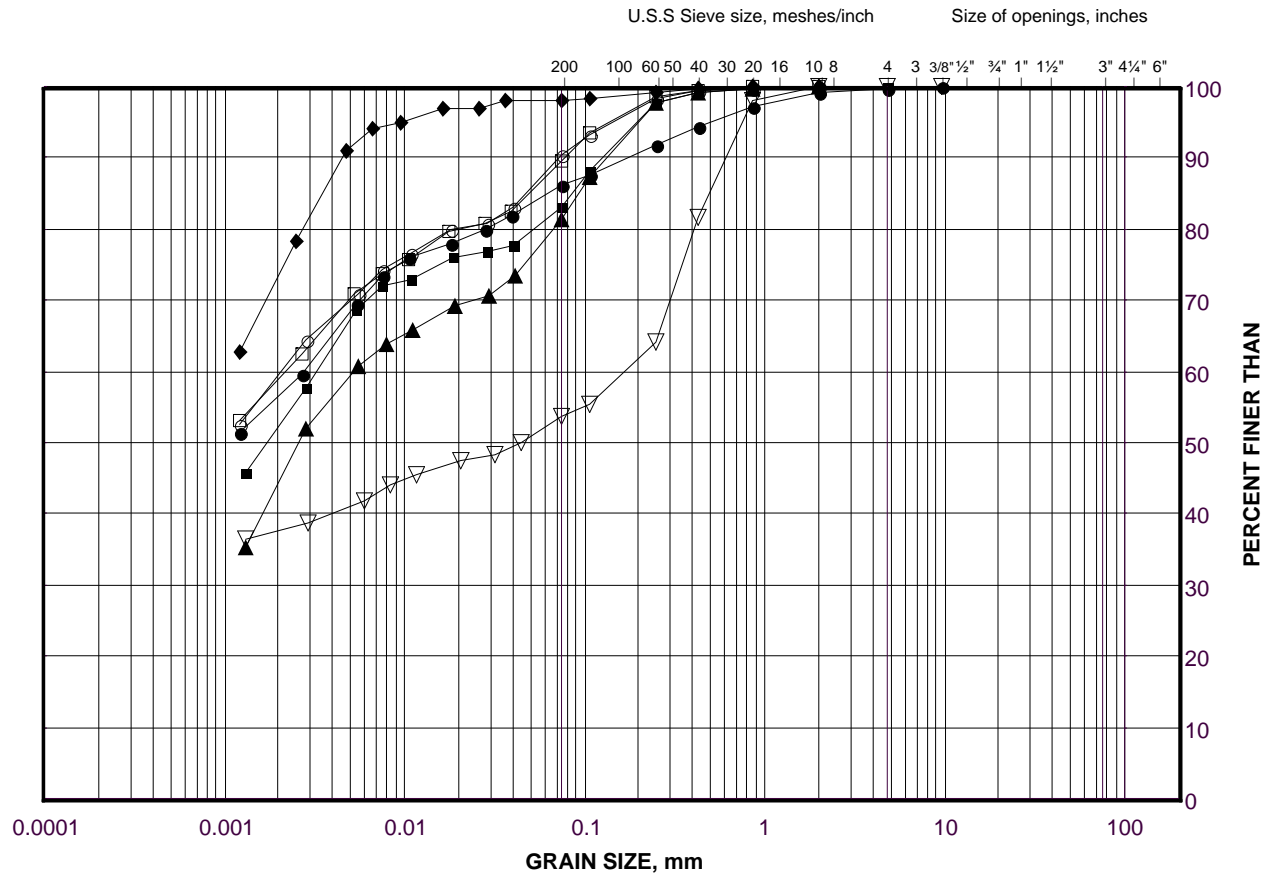
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Silty Clay with sand to Silty Clay to Clay (Fill)

FIGURE B-1



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

LEGEND

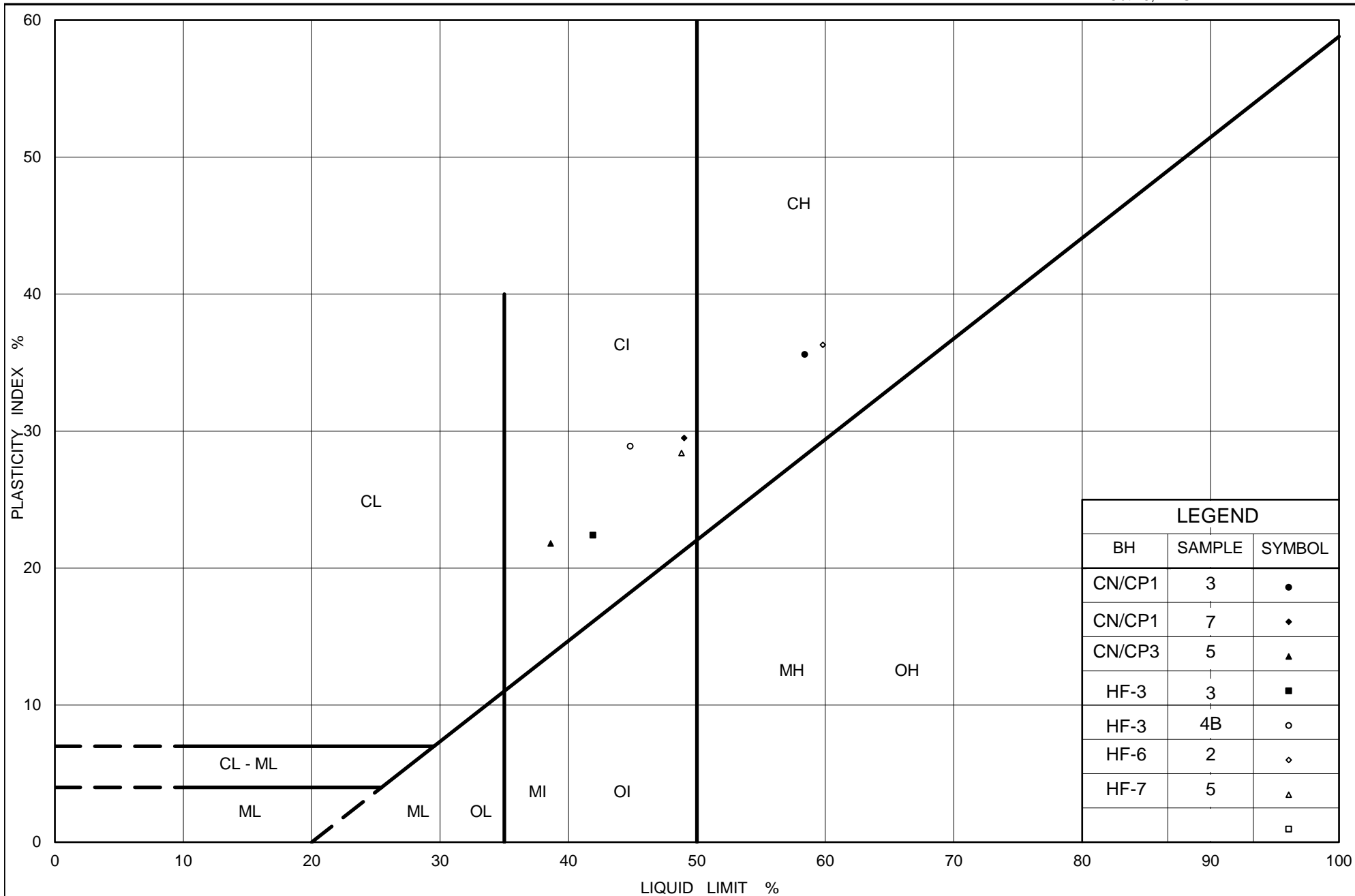
| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | HF-6 | 2 | 179.5 |
| ■ | HF-3 | 3 | 178.8 |
| ◆ | CN/CP1 | 3 | 185.5 |
| ▲ | RW-11 | 4 | 181.8 |
| ▽ | HF-3 | 4B | 177.1 |
| ○ | HF-7 | 5 | 181.4 |
| □ | CN/CP1 | 7 | 181.7 |

Project Number: 1671430

Checked By: MAS

Golder Associates

Date: 01-May-19



Ministry of Transportation

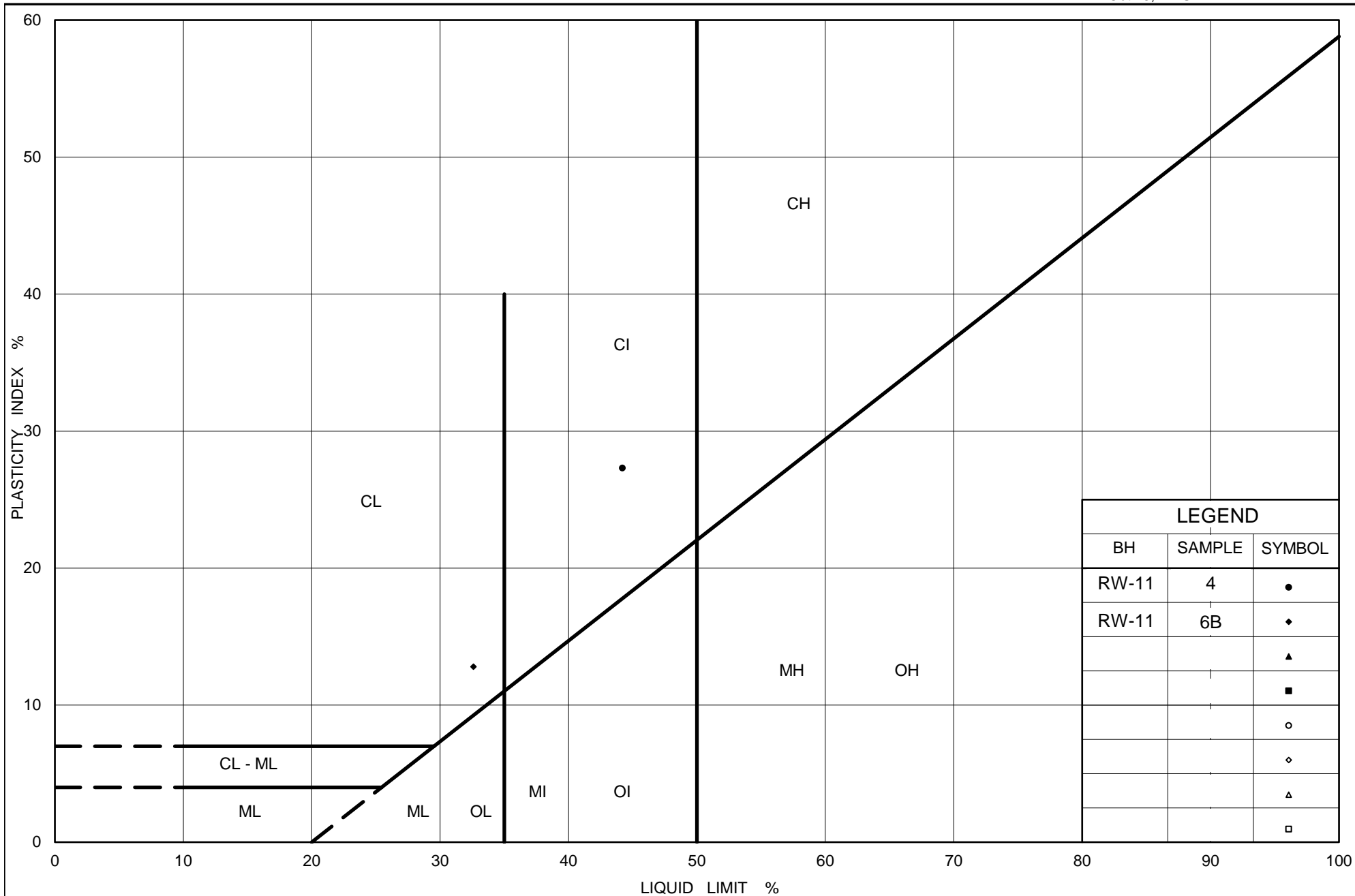
Ontario

PLASTICITY CHART Silty Clay to Clay (Fill)

Figure No. B-2A

Project No. 1671430 (WO 008)

Checked By: MAS



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt to Silty Clay (Fill)

Figure No. B-2B

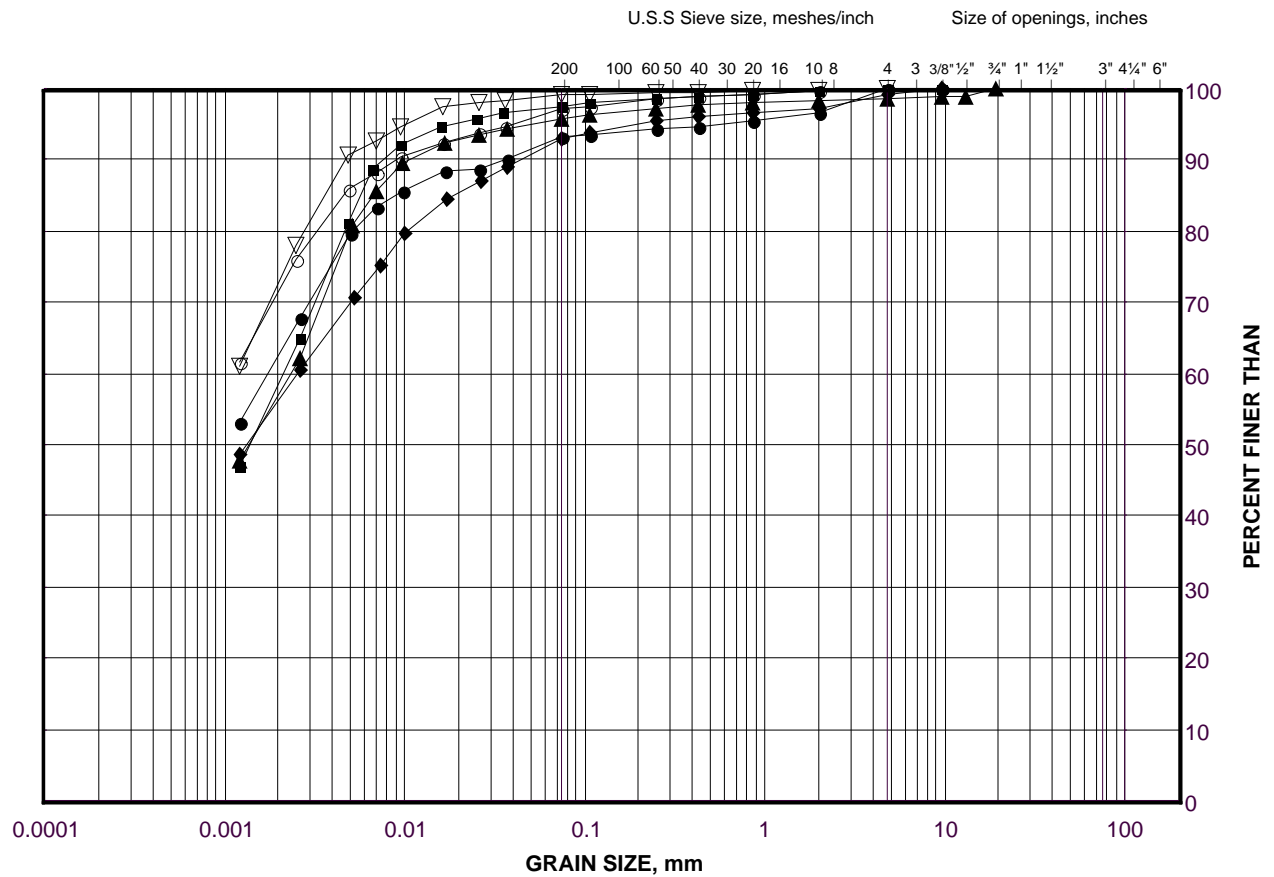
Project No. 1671430 (WO 008)

Checked By: MAS

GRAIN SIZE DISTRIBUTION

Silty Clay to Clay

FIGURE B-3A



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | HF-4 | 3 | 176.1 |
| ■ | HF-2 | 3 | 175.1 |
| ◆ | HF-2 | 5 | 172.9 |
| ▲ | HF-4 | 5 | 174.8 |
| ▽ | HF-1 | 5 | 174.9 |
| ○ | HF-5 | 6 | 177.2 |

Project Number: 1671430

Checked By: MAS

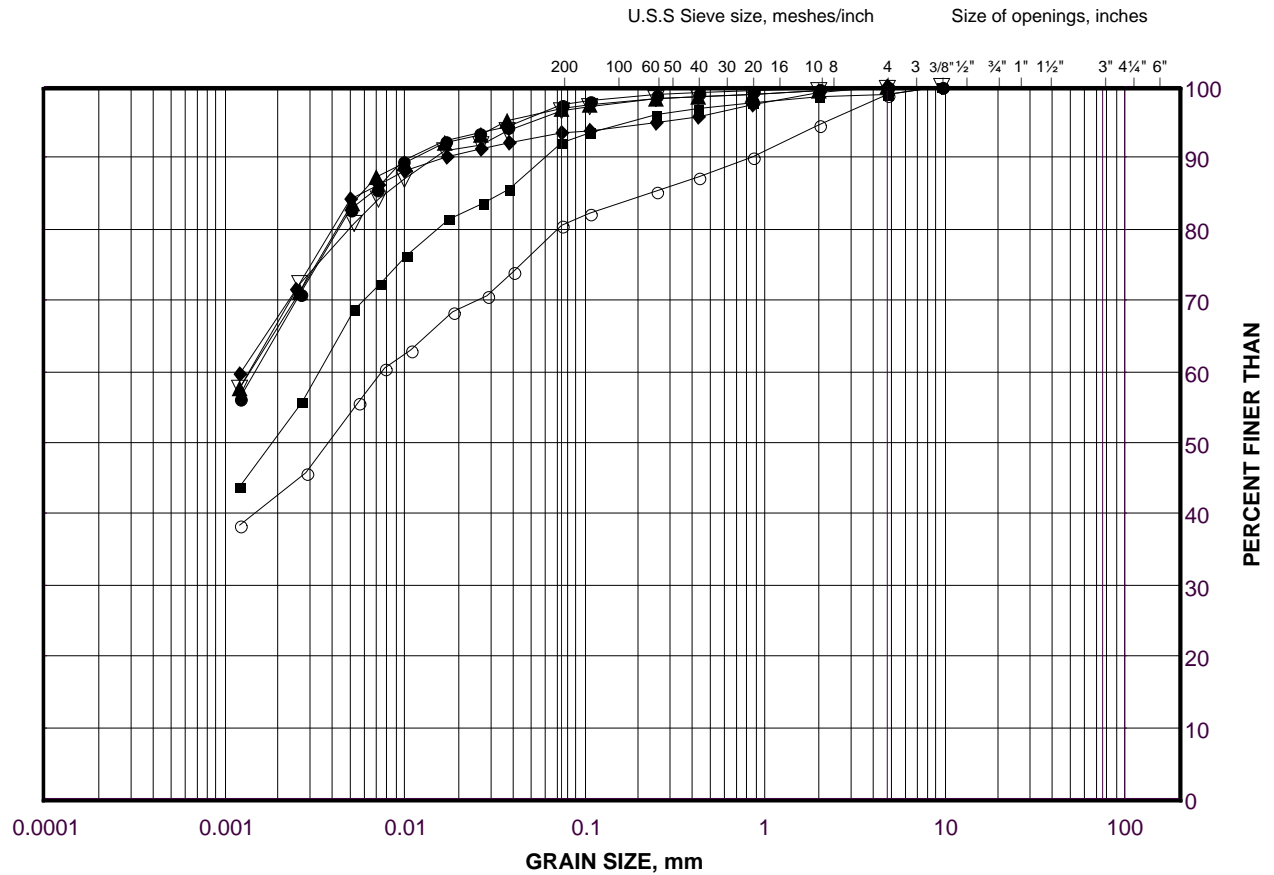
Golder Associates

Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Silty Clay to Clay

FIGURE B-3B



LEGEND

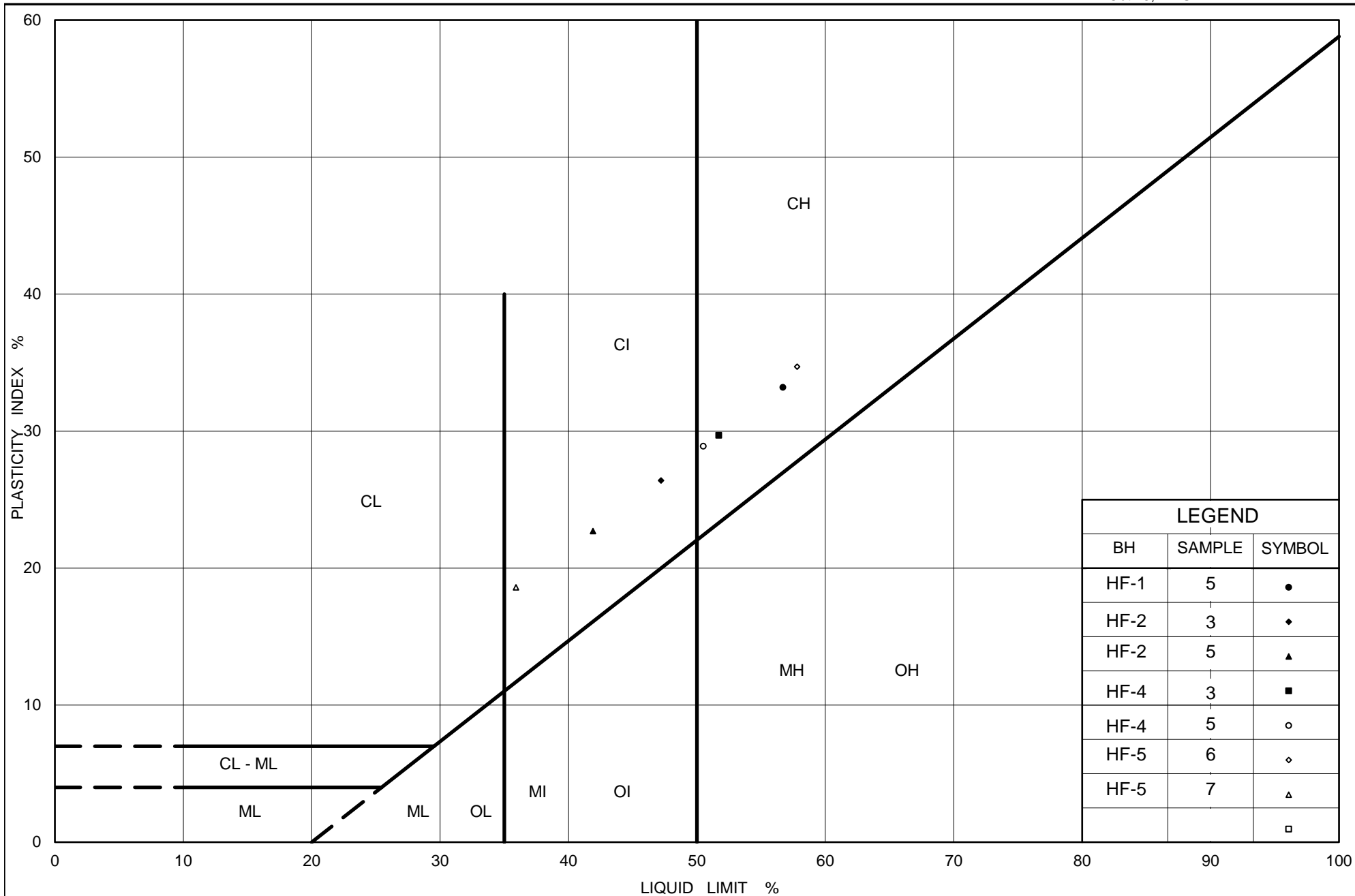
| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | RW-13 | 3 | 176.2 |
| ■ | RW-12 | 4 | 174.5 |
| ◆ | HF-6 | 4 | 178.3 |
| ▲ | RW-11 | 7 | 177.3 |
| ▽ | HF-7 | 7 | 178.4 |
| ○ | HF-6 | 8 | 175.8 |

Project Number: 1671430

Checked By: MAS

Golder Associates

Date: 01-May-19



Ministry of Transportation

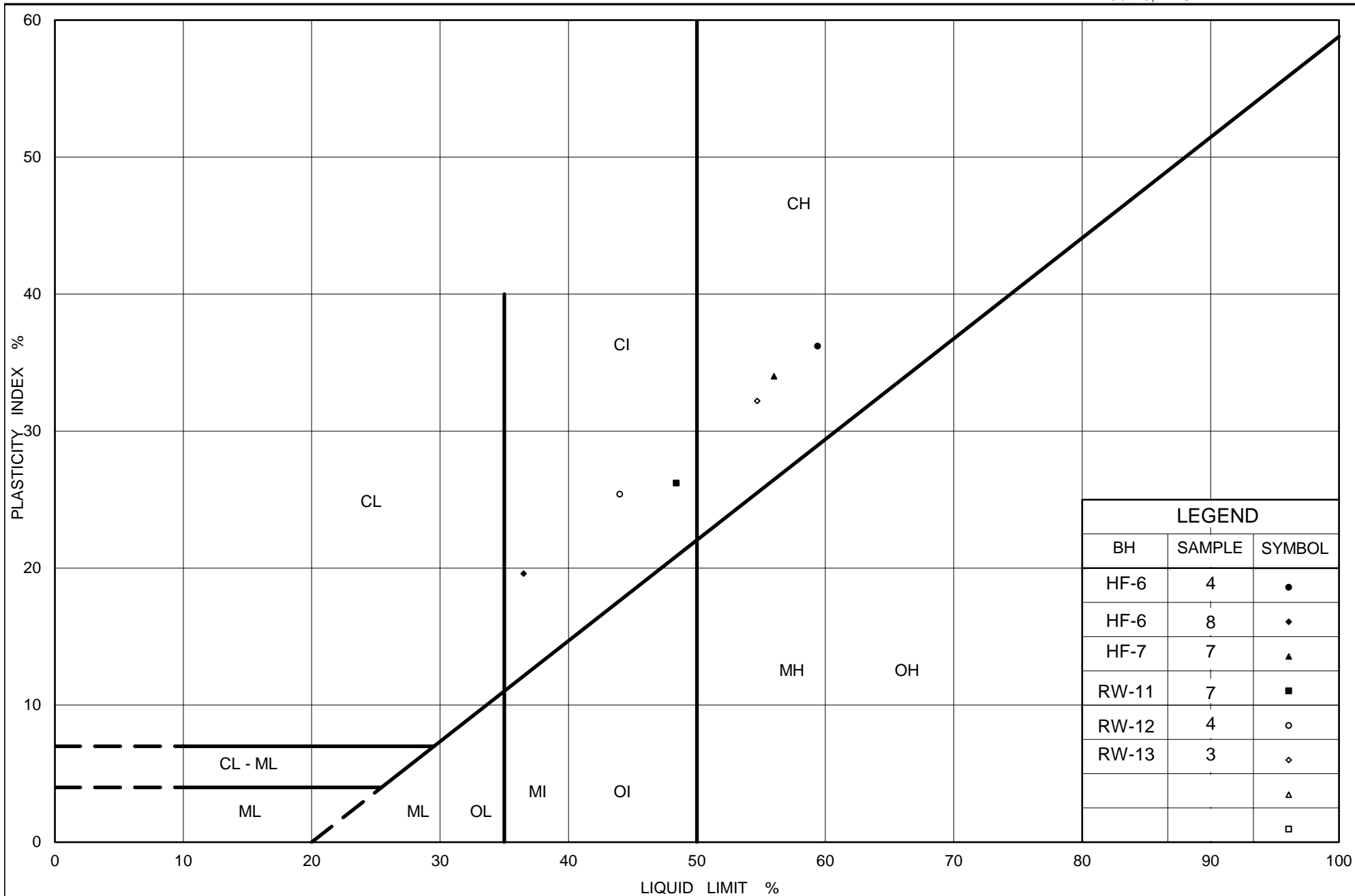
Ontario

PLASTICITY CHART **Silty Clay to Clay**

Figure No. B-4A

Project No. 1671430 (WO 008)

Checked By: MAS



Ministry of Transportation

Ontario

PLASTICITY CHART Silty Clay to Clay

Figure No. B-4B

Project No. 1671430 (WO 008)

Checked By: MAS

CONSOLIDATION TEST SUMMARY**ASTM D2435/D2435M****FIGURE B-5A****SAMPLE IDENTIFICATION**

| | | | |
|-----------------|--------------|-----------------|-----------|
| Project Number | 1671430(W08) | Sample Number | 5 |
| Borehole Number | HF-2 | Sample Depth, m | 3.81-4.42 |

TEST CONDITIONS

| | | | |
|------------------|---------------------|-------------------|----|
| Test Type | Laboratory Standard | Load Duration, hr | 24 |
| Oedometer Number | 10 | | |
| Date Started | 02/01/2019 | | |
| Date Completed | 02/14/2019 | | |

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

| | | | |
|-------------------------|--------|------------------------------------|-------|
| Sample Height, cm | 2.53 | Unit Weight, kN/m ³ | 19.45 |
| Sample Diameter, cm | 6.36 | Dry Unit Weight, kN/m ³ | 15.40 |
| Area, cm ² | 31.75 | Specific Gravity, measured | 2.74 |
| Volume, cm ³ | 80.42 | Solids Height, cm | 1.451 |
| Water Content, % | 26.33 | Volume of Solids, cm ³ | 46.08 |
| Wet Mass, g | 159.51 | Volume of Voids, cm ³ | 34.34 |
| Dry Mass, g | 126.26 | Degree of Saturation, % | 96.8 |

TEST COMPUTATIONS

| Stress kPa | Corr. Height cm | Void Ratio | Average Height cm | t ₉₀ sec | cv. cm ² /s | mv m ² /kN | k cm/s |
|---------------|-----------------------|---------------|-------------------------|------------------------|---------------------------|--------------------------|-----------|
| 0.00 | 2.533 | 0.745 | 2.533 | | | | |
| 5.93 | 2.529 | 0.743 | 2.531 | 7 | 1.94E-01 | 2.62E-04 | 4.97E-06 |
| 10.64 | 2.521 | 0.737 | 2.525 | 145 | 9.32E-03 | 6.62E-04 | 6.05E-07 |
| 20.33 | 2.507 | 0.727 | 2.514 | 437 | 3.07E-03 | 5.70E-04 | 1.71E-07 |
| 45.00 | 2.477 | 0.707 | 2.492 | 1058 | 1.24E-03 | 4.78E-04 | 5.84E-08 |
| 10.64 | 2.487 | 0.713 | 2.482 | | | | |
| 45.00 | 2.475 | 0.705 | 2.481 | 406 | 3.21E-03 | 1.33E-04 | 4.20E-08 |
| 78.31 | 2.452 | 0.689 | 2.463 | 936 | 1.37E-03 | 2.77E-04 | 3.74E-08 |
| 155.31 | 2.404 | 0.656 | 2.428 | 1220 | 1.02E-03 | 2.46E-04 | 2.47E-08 |
| 309.55 | 2.341 | 0.613 | 2.373 | 653 | 1.83E-03 | 1.60E-04 | 2.87E-08 |
| 618.73 | 2.264 | 0.560 | 2.303 | 821 | 1.37E-03 | 9.82E-05 | 1.32E-08 |
| 1236.80 | 2.181 | 0.502 | 2.222 | 634 | 1.65E-03 | 5.34E-05 | 8.64E-09 |
| 2468.72 | 2.096 | 0.444 | 2.139 | 346 | 2.80E-03 | 2.70E-05 | 7.42E-09 |
| 618.73 | 2.120 | 0.461 | 2.108 | | | | |
| 155.31 | 2.174 | 0.498 | 2.147 | | | | |
| 45.00 | 2.221 | 0.530 | 2.198 | | | | |
| 20.17 | 2.255 | 0.554 | 2.238 | | | | |
| 5.96 | 2.306 | 0.589 | 2.280 | | | | |

Note:

Consolidation loading and unloading schedule assigned by the client.

cv and k are approximate only based on t₉₀ estimated from Square Root of Time Method (ASTMD2435/2435M)

Specimen taken 0-9cm from bottom of the tube.

Specimen swelled under 5.93kPa

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

| | | | |
|-------------------------|--------|------------------------------------|-------|
| Sample Height, cm | 2.31 | Unit Weight, kN/m ³ | 20.60 |
| Sample Diameter, cm | 6.36 | Dry Unit Weight, kN/m ³ | 16.91 |
| Area, cm ² | 31.75 | Specific Gravity, measured | 2.74 |
| Volume, cm ³ | 73.20 | Solids Height, cm | 1.451 |
| Water Content, % | 21.81 | Volume of Solids, cm ³ | 46.08 |
| Wet Mass, g | 153.80 | Volume of Voids, cm ³ | 27.12 |
| Dry Mass, g | 126.26 | | |

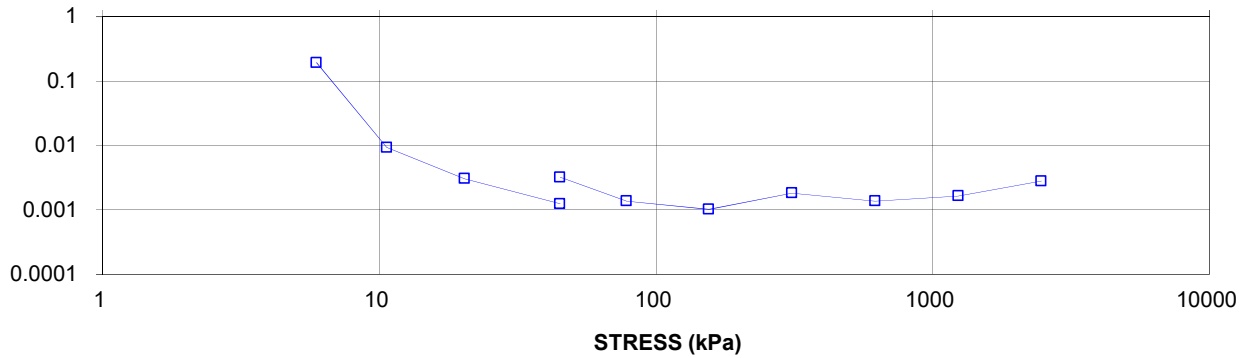
Prepared By: LH

Golder Associates

Checked By: MM

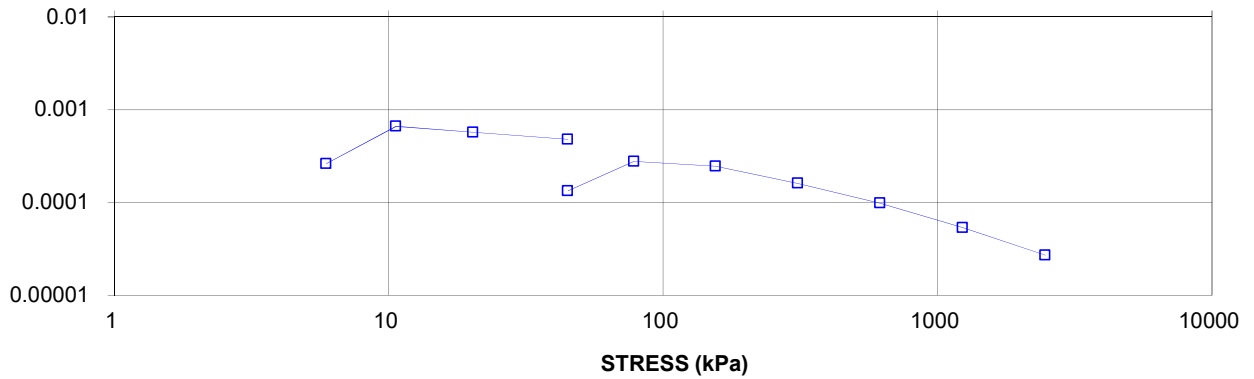
COEFFICIENT OF CONSOLIDATION,
cm²/s

CONSOLIDATION TEST
CV cm²/s VS STRESS (kPa)
HF-2 SA 5



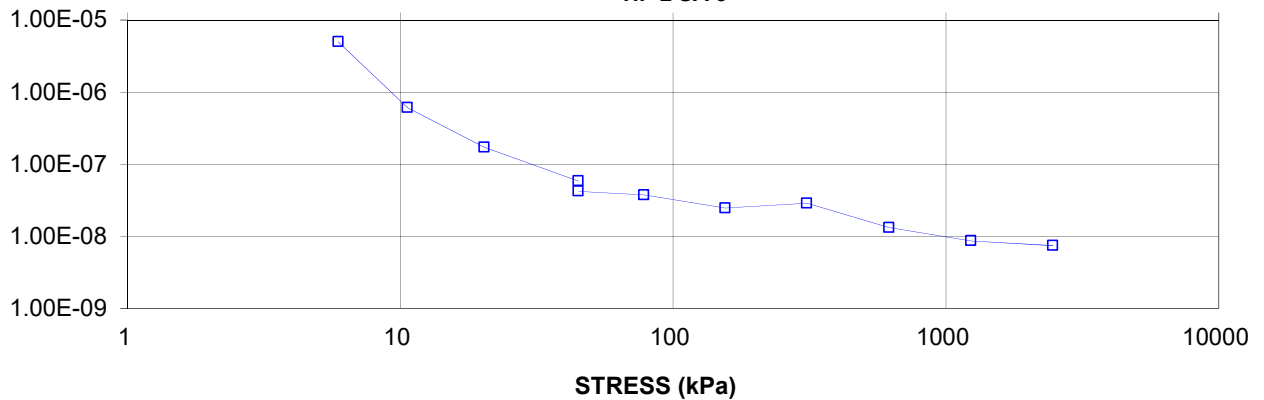
VOLUME COMPRESSIBILITY, m²/kN

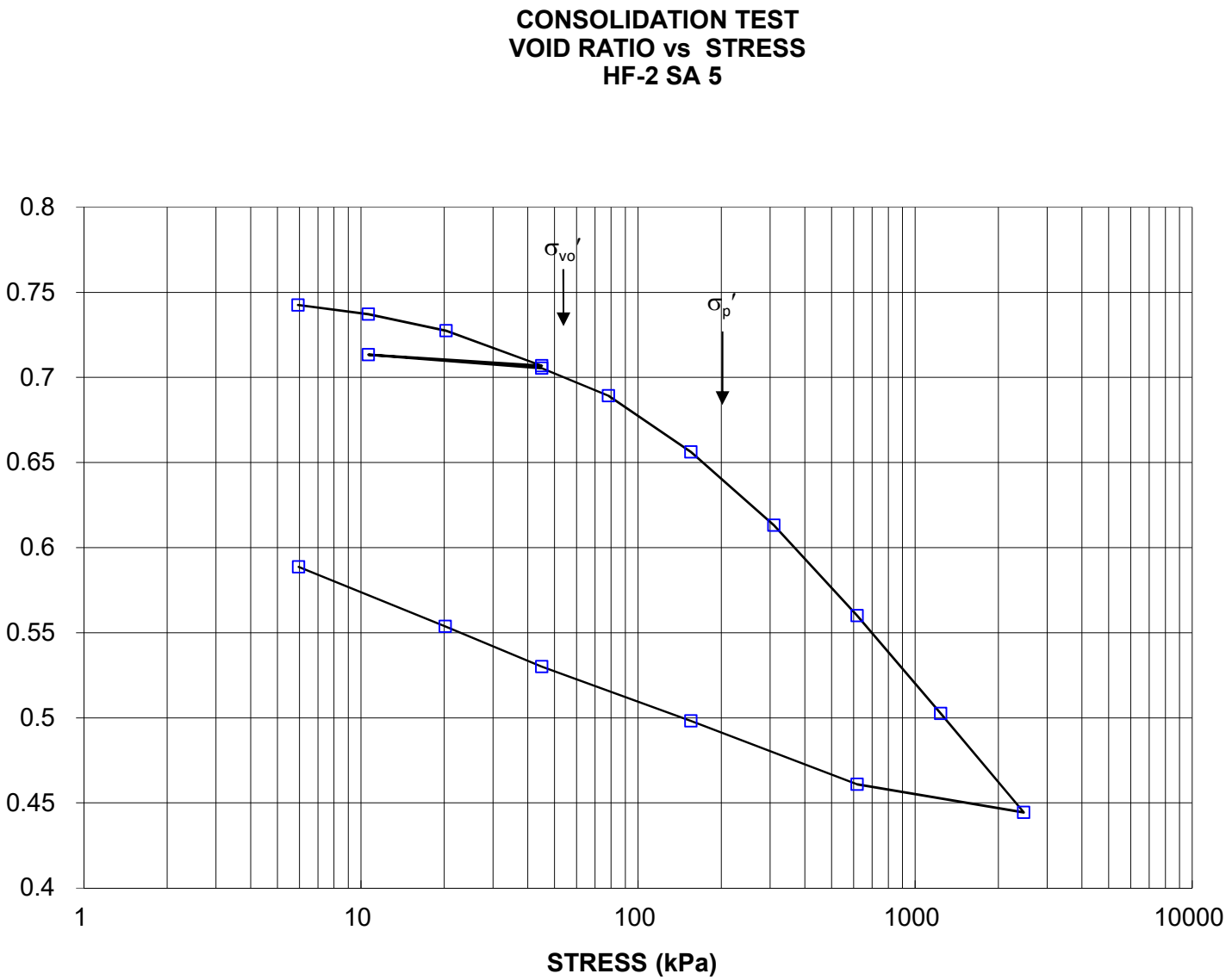
CONSOLIDATION TEST
MV m²/kN vs STRESS (kPa)
HF-2 SA 5



HYDRAULIC CONDUCTIVITY,
cm/s

CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
HF-2 SA 5





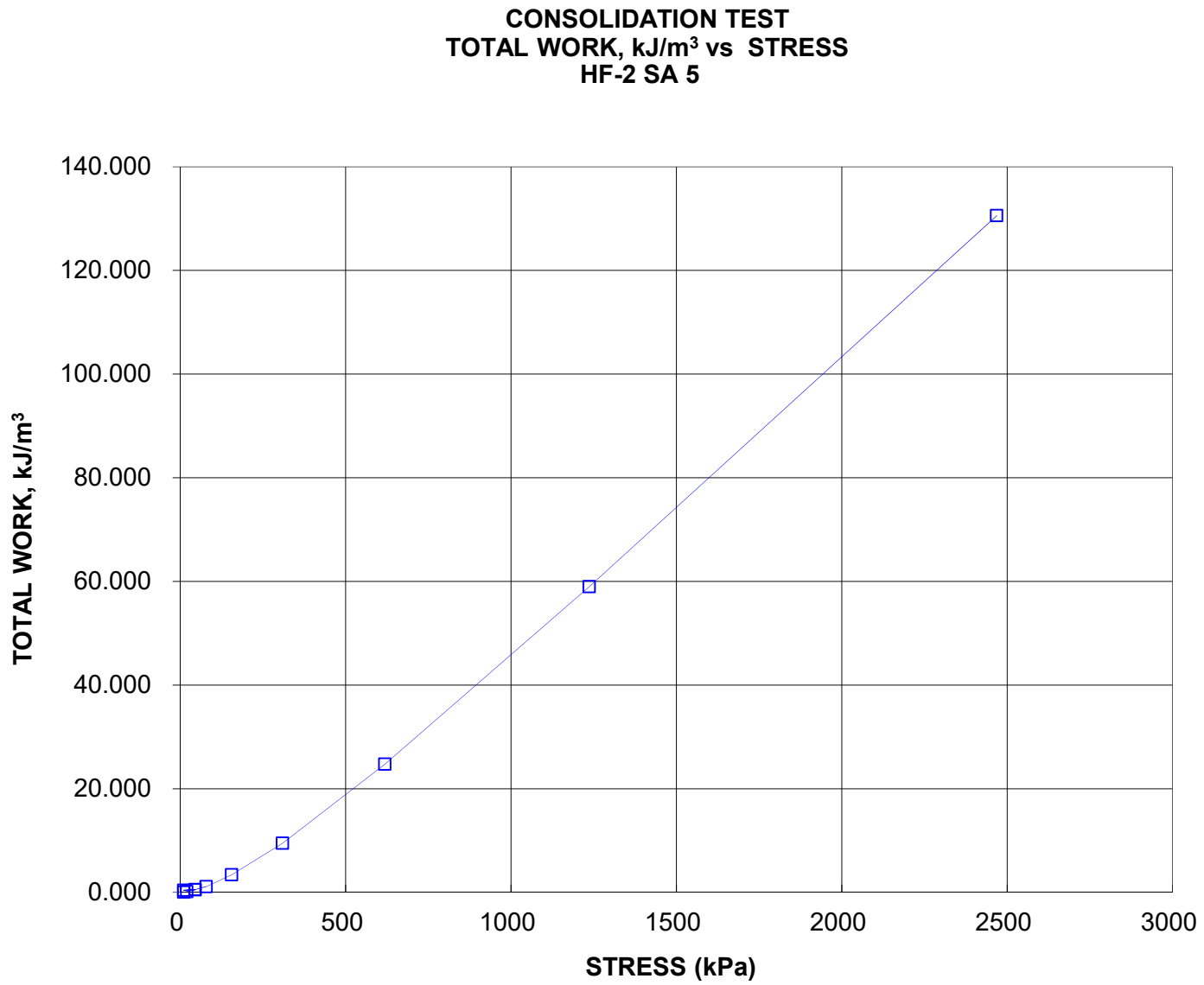
Project No. 167 1430(W08)

VOID RATIO

Prepared By: LH

Golder Associates

Checked By: MAS



**CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
ASTM D4767
SHEET 1 OF 4**

FIGURE B-6A

| TEST STAGE | A | B | C |
|---|-----------|-------|-------|
| BOREHOLE NUMBER | HF-2 | | |
| SAMPLE | 5 | | |
| DEPTH, m | 3.81-4.42 | | |
| SPECIMEN DIAMETER, cm | 4.99 | 5.04 | 5.00 |
| SPECIMEN HEIGHT, cm | 10.98 | 10.10 | 10.15 |
| NATURAL WATER CONTENT, % | 31.9 | 38.9 | 32.3 |
| DRY DENSITY, Mg/m ³ | 1.36 | 1.34 | 1.45 |
| WATER CONTENT AFTER SATURATION, % | 32.8 | 39.1 | 32.7 |
| CELL PRESSURE, σ_3 , kPa | 175.0 | 220.0 | 310.0 |
| BACK PRESSURE, kPa | 130.0 | 130.0 | 130.0 |
| PORE PRESSURE PARAMETER "B" | 0.97 | 0.96 | 0.96 |
| EFFECTIVE CONSOLIDATION STRESS, σ_c , kPa | 45.0 | 90.0 | 180.0 |
| VOLUMETRIC STRAIN DURING CONSOLIDATION, % | 1.7 | 8.0 | 5.8 |
| WATER CONTENT AFTER CONSOLIDATION, % | 31.4 | 33.1 | 28.6 |
| AVERAGE RATE OF STRAIN, %/hr | 0.5 | 0.5 | 0.5 |
| TIME TO FAILURE, HOURS | 15.4 | 11.8 | 10.0 |
| WATER CONTENT AFTER TEST, % | 31.8 | 38.0 | 30.8 |
| MAX. DEVIATOR STRESS, $(\sigma_1 - \sigma_3)$, kPa | 76.7 | 106.3 | 144.0 |
| AXIAL STRAIN AT $(\sigma_1 - \sigma_3)$ maximum, % | 7.7 | 5.9 | 5.0 |
| MAX EFFECTIVE PRINCIPAL STRESS RATIO, (σ'_1 / σ'_3) maximum | 3.0 | 2.8 | 2.5 |
| DEVIATOR STRESS AT (σ'_1 / σ'_3) maximum, kPa | 69.4 | 102.2 | 143.9 |
| AXIAL STRAIN AT (σ'_1 / σ'_3) maximum, % | 3.5 | 3.7 | 5.3 |
| PORE PRESSURE PARAMETER, Af, AT $(\sigma_1 - \sigma_3)$ maximum | 0.04 | 0.26 | 0.57 |
| PORE PRESSURE PARAMETER, Af, AT (σ'_1 / σ'_3) maximum | 0.15 | 0.31 | 0.57 |
| FILTER DRAINS USED, y/n | y | y | y |
| TEST NOTES: <div style="margin-left: 40px;"> Effective consolidation stresses are assigned by the client. Specimen A taken 0-12 cm from top of tube. Specimen B taken 12-24 cm from top of tube. Specimen C taken 24-36 cm from top of tube. </div> | | | |
| FAILURE PLANE NUMBER | 1.0 | 1.0 | 1.0 |
| ANGLE OF FAILURE PLANE, DEGREES | 70.0 | 50.0 | 50.0 |

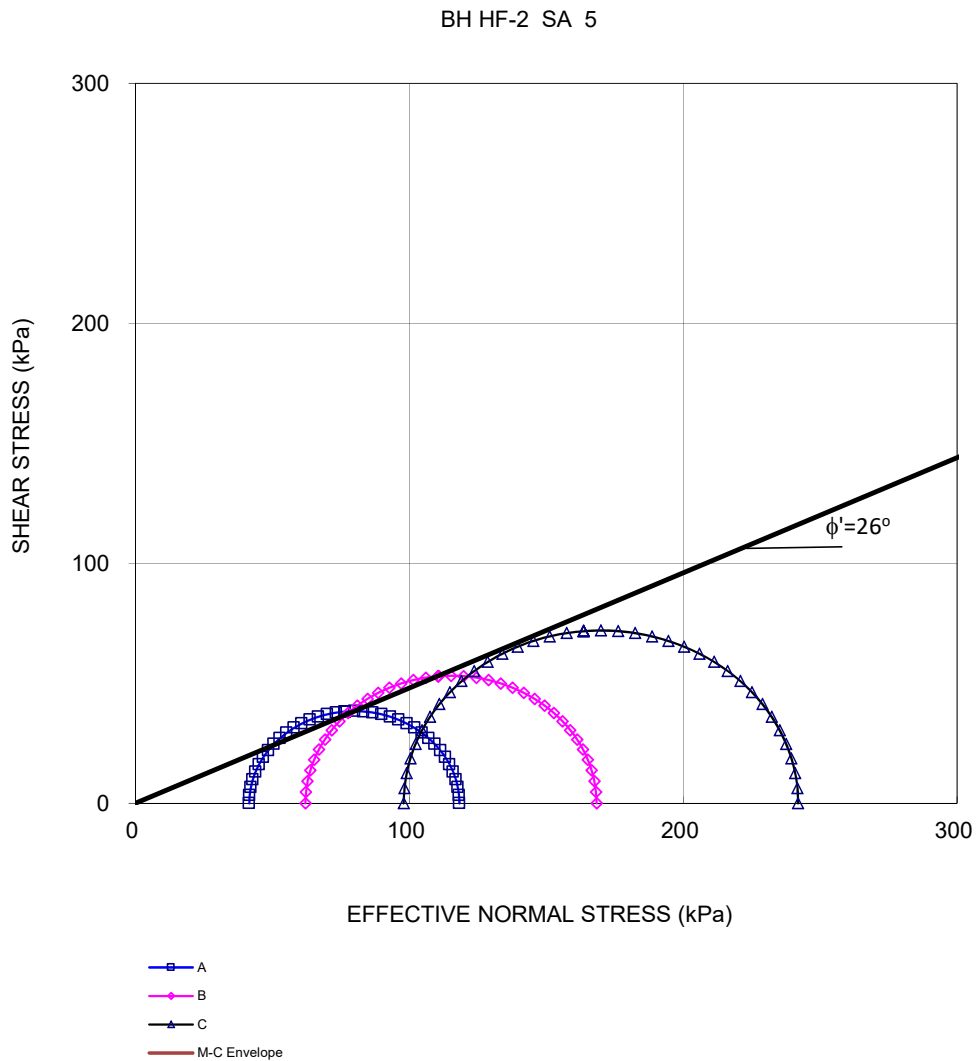
Date: 02/15/2019
Project No. 1671430(W08)

Golder Associates

Prepared By: LH
Checked By: MM

CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
ASTM D4767
SHEET 2 OF 4

FIGURE B-6B



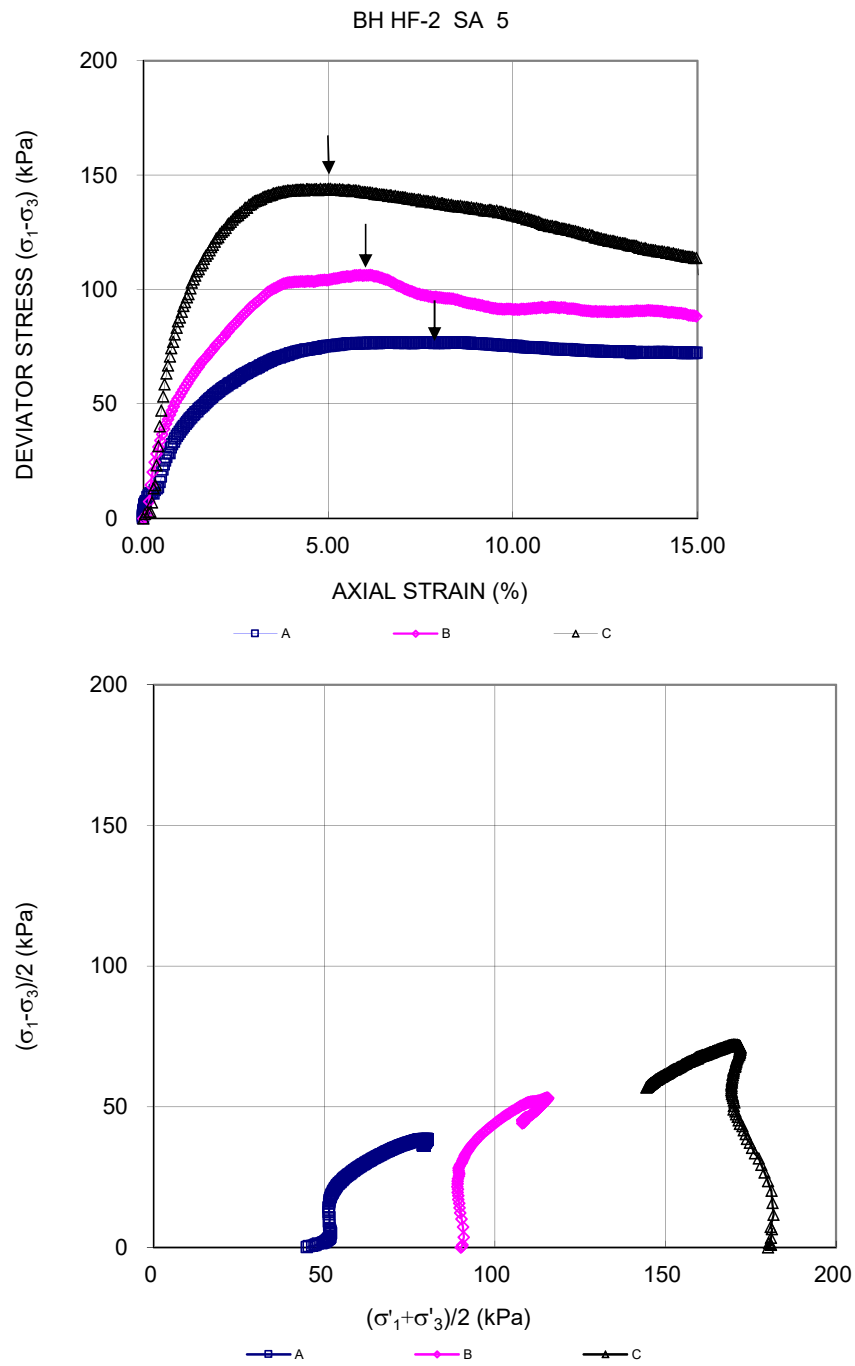
Date: 02/15/2019
Project No. 1671430(W08)

Golder Associates

Prepared By: LH
Checked By: MM

**CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
ASTM D4767
SHEET 3 OF 4**

FIGURE B-6C



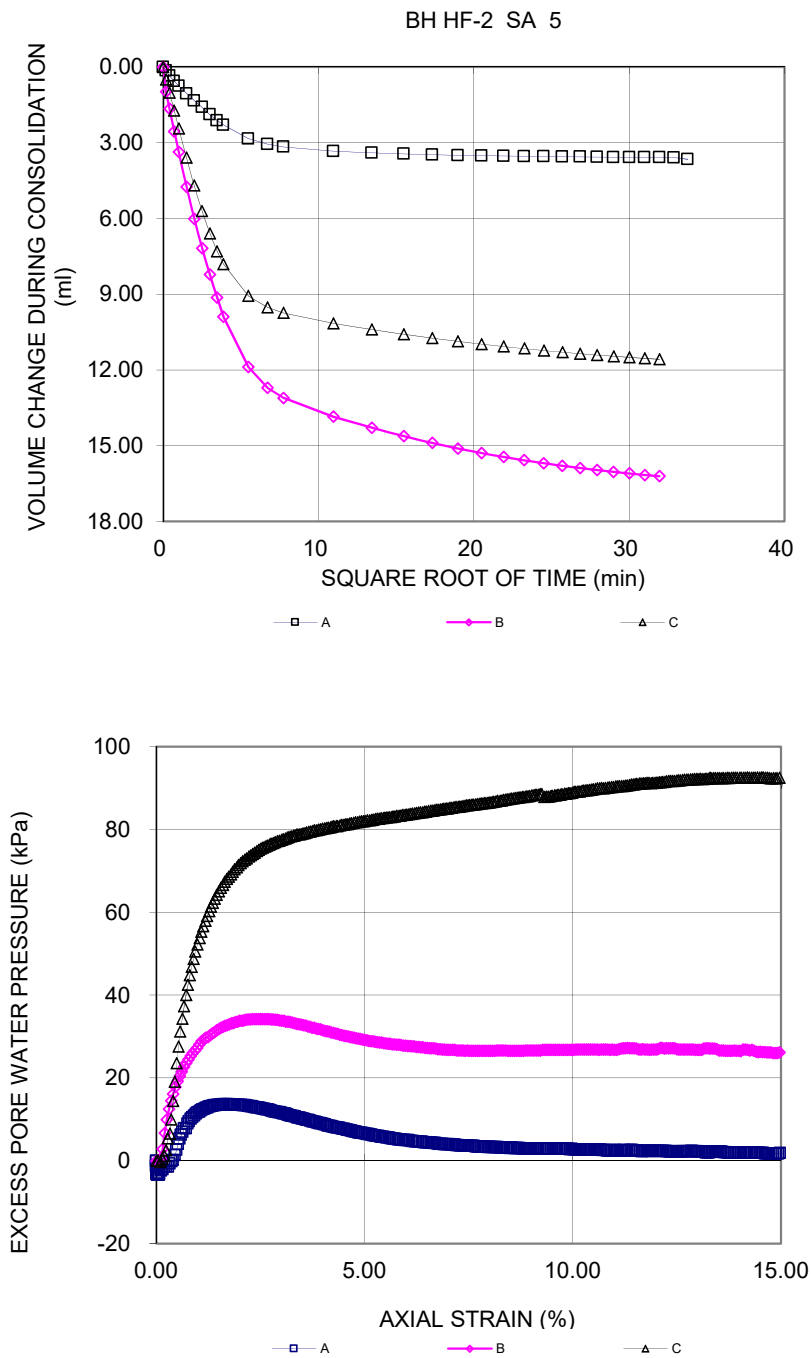
Date: 02/15/2019
Project No. 1671430(W08)

Golder Associates

Prepared By: LH
Checked By: MM

**CONSOLIDATED UNDRAINED TRIAXIAL
WITH PORE PRESSURE MEASUREMENTS
ASTM D4767
SHEET 4 OF 4**

FIGURE B-6D



Date: 02/15/2019
Project No. 1671430(W08)

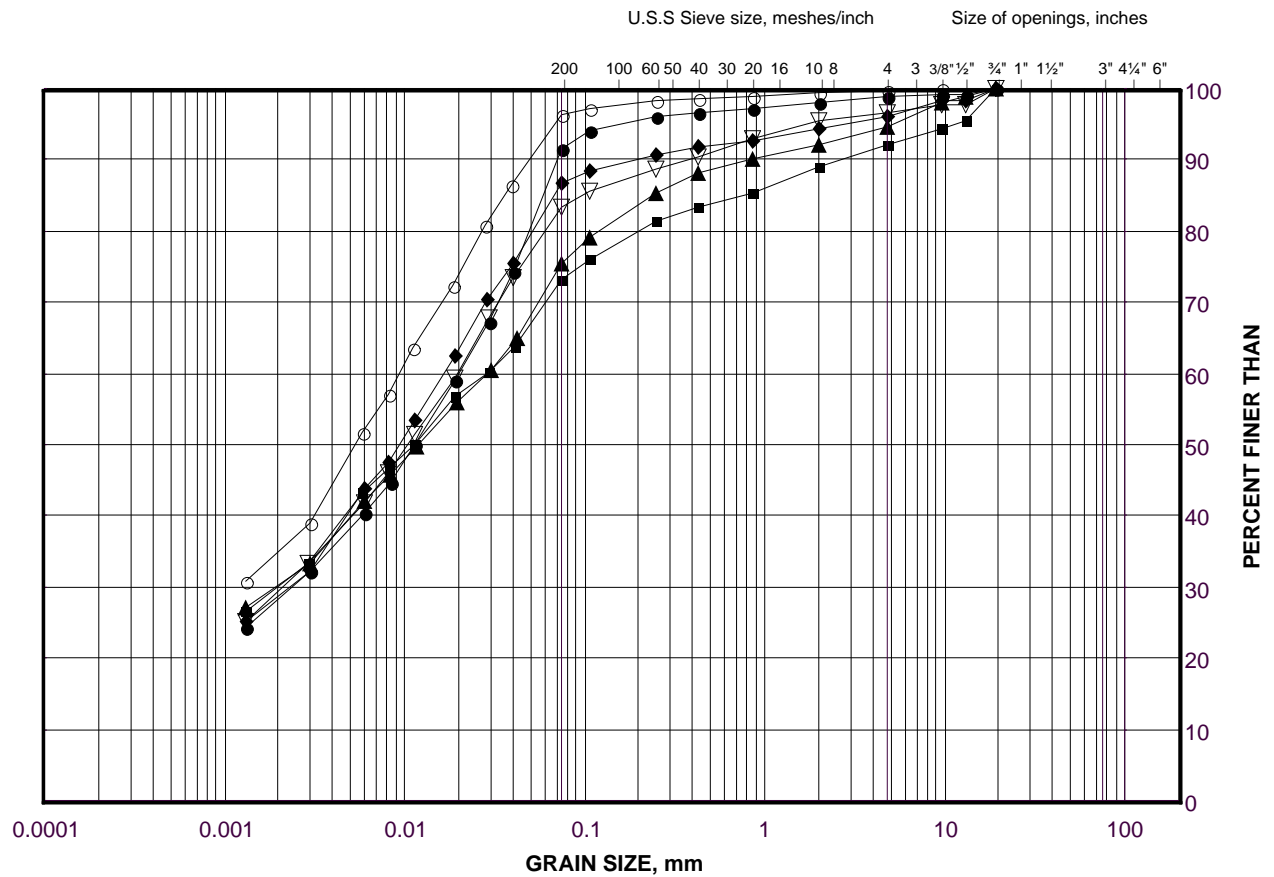
Golder Associates

Prepared By: LH
Checked By: MM

GRAIN SIZE DISTRIBUTION

Clayey Silt

FIGURE B-7A



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | CN/CP3 | 11 | 175.9 |
| ■ | CN/CP3 | 14 | 171.3 |
| ◆ | HF-2 | 6 | 170.5 |
| ▲ | HF-1 | 7 | 171.9 |
| ▽ | HF-4 | 8 | 172.2 |
| ○ | HF-3 | 8 | 171.2 |

Project Number: 1671430

Checked By: MAS

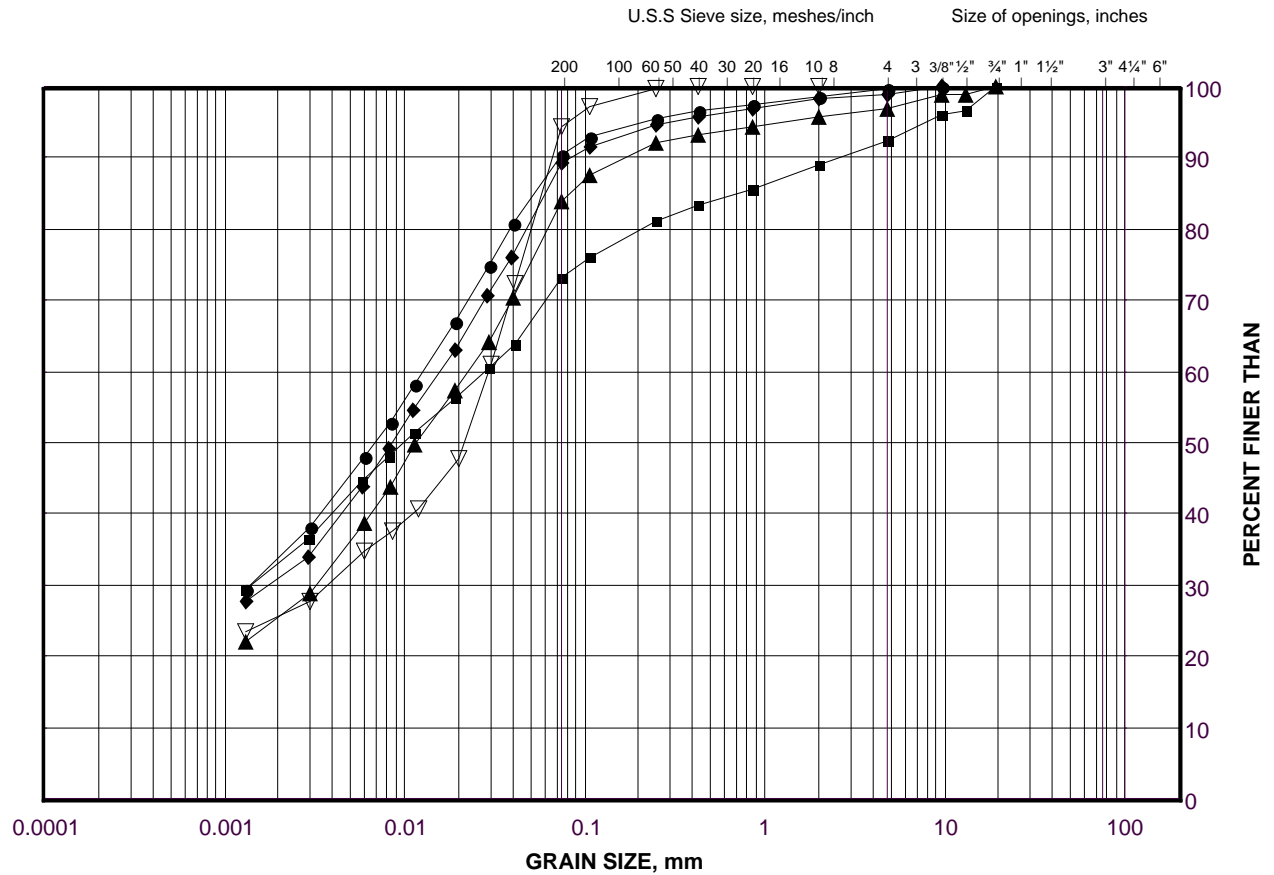
Golder Associates

Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Clayey Silt

FIGURE B-7B



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

LEGEND

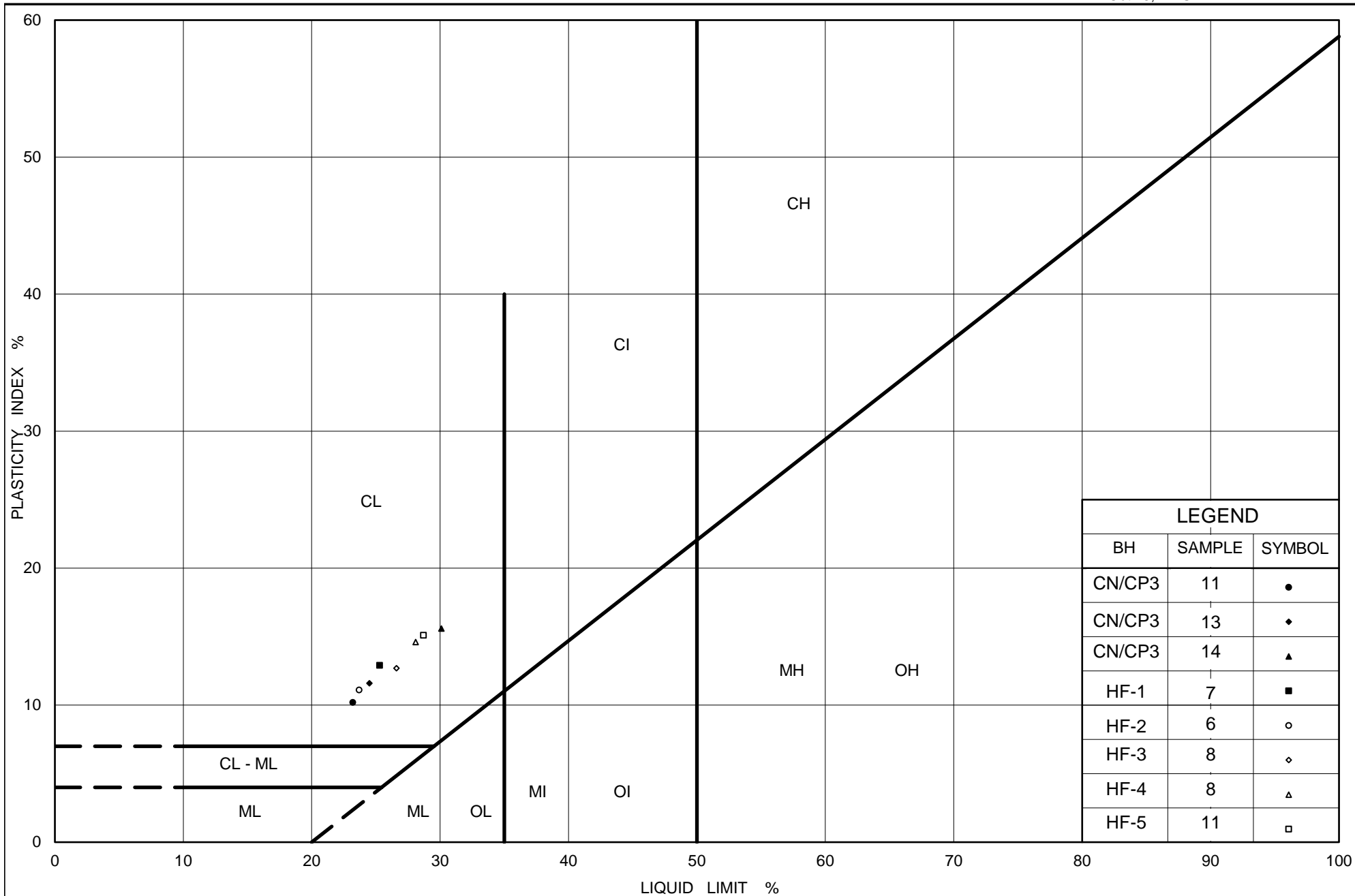
| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | HF-7 | 10 | 173.7 |
| ■ | HF-5 | 11 | 169.6 |
| ◆ | RW-13 | 5 | 174.7 |
| ▲ | RW-12 | 7 | 170.7 |
| ▽ | RW-13 | 9 | 170.1 |

Project Number: 1671430

Checked By: MAS

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Date: 01-May-19



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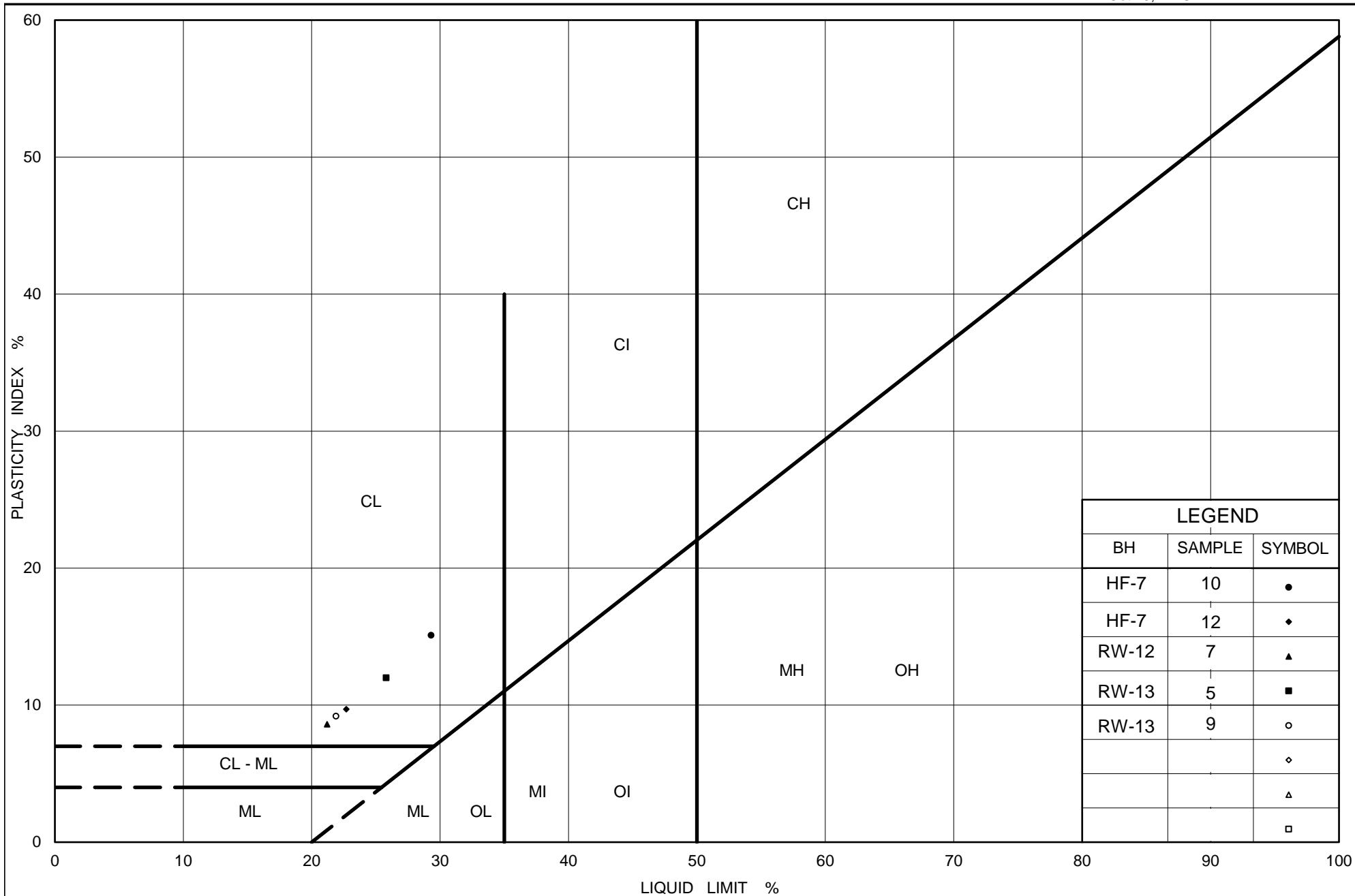
PLASTICITY CHART

Clayey Silt

Figure No. B-8A

Project No. 1671430 (WO 008)

Checked By: MAS



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt

Figure No. B-8B

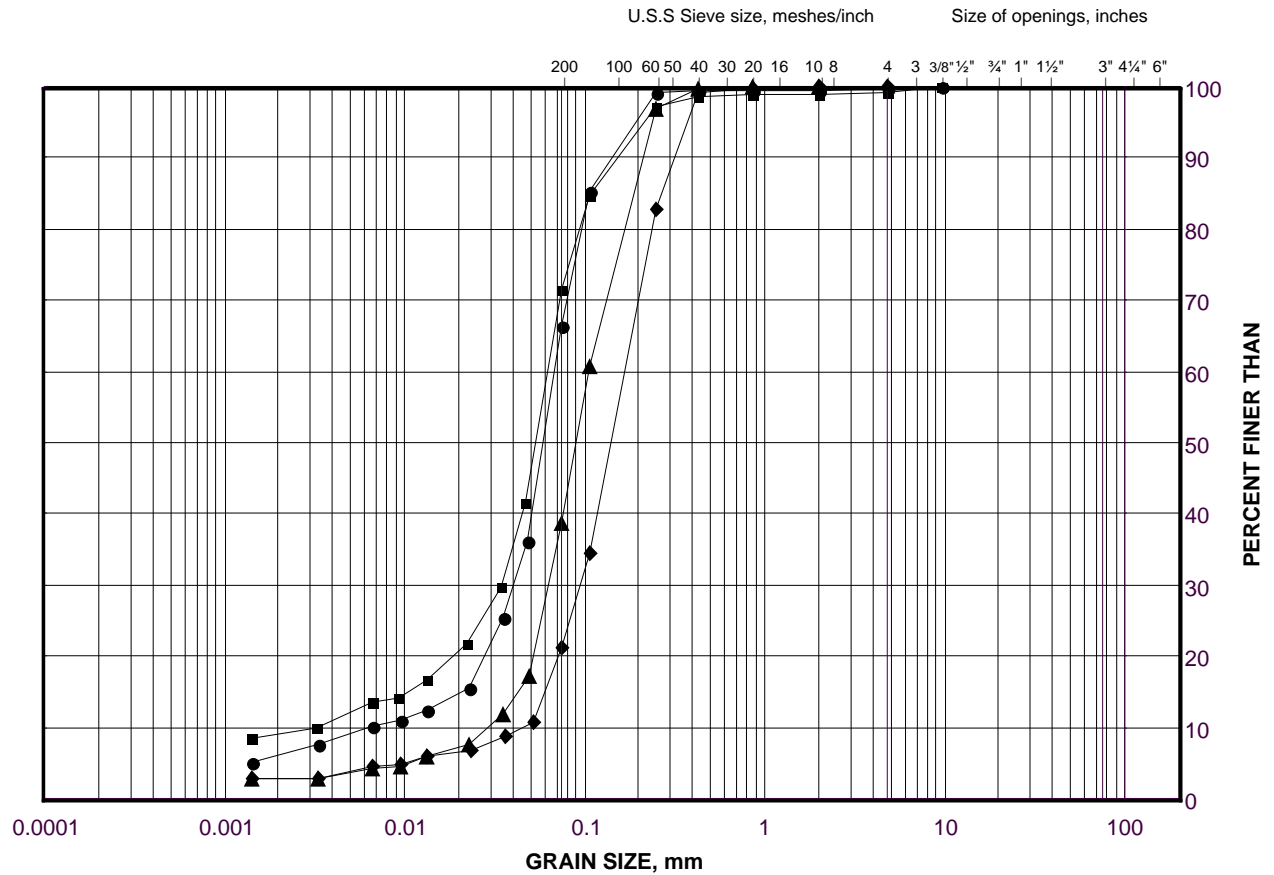
Project No. 1671430 (WO 008)

Checked By: MAS

GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand

FIGURE B-9



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | HF-7 | 14A | 167.8 |
| ■ | CN/CP3 | 16 | 168.3 |
| ◆ | RW-13 | 7 | 173.2 |
| ▲ | RW-12 | 8 | 169.2 |

Project Number: 1671430

Checked By: MAS

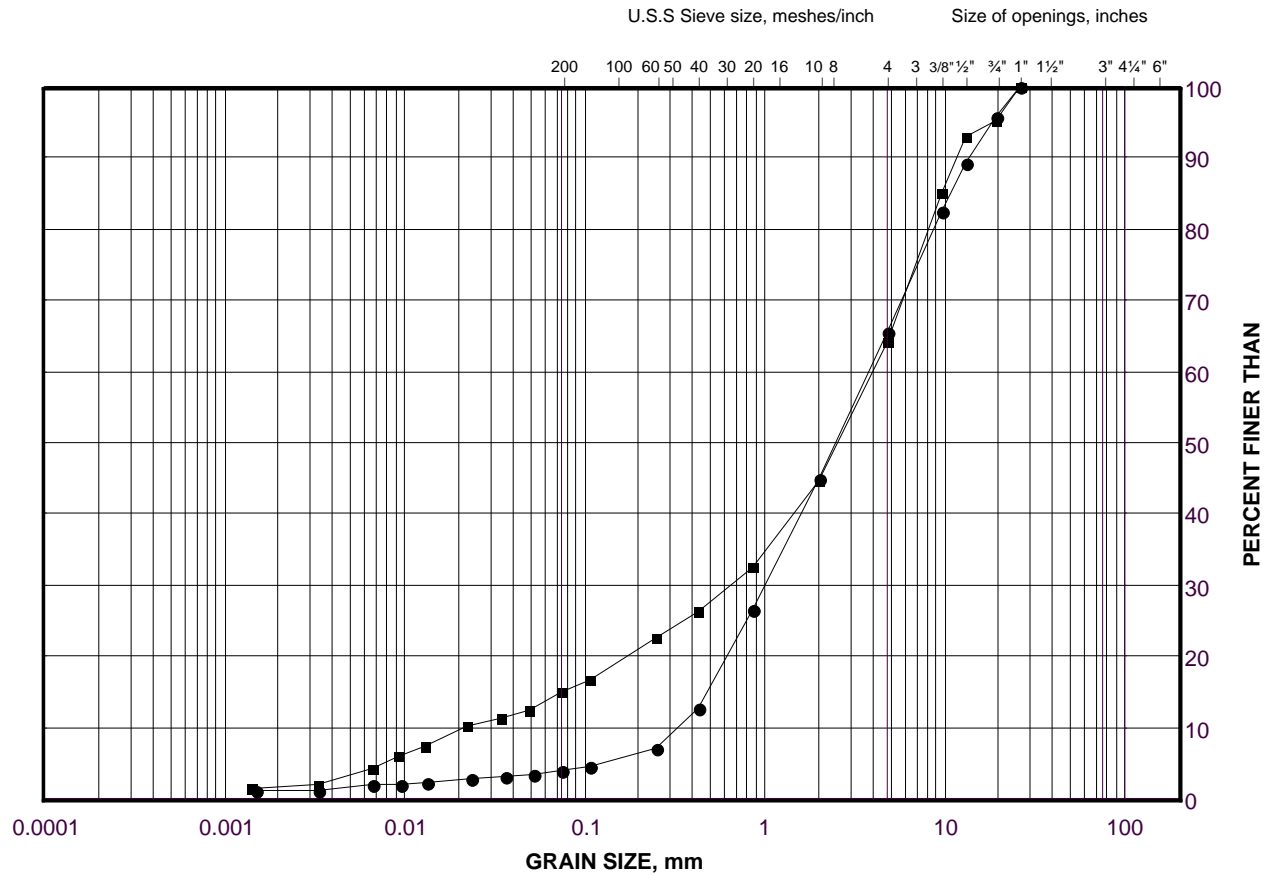
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Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Sand and Gravel

FIGURE B-10



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | HF-5 | 13 | 166.5 |
| ■ | CN/CP3 | 17 | 165.3 |

Project Number: 1671430

Checked By: MAS

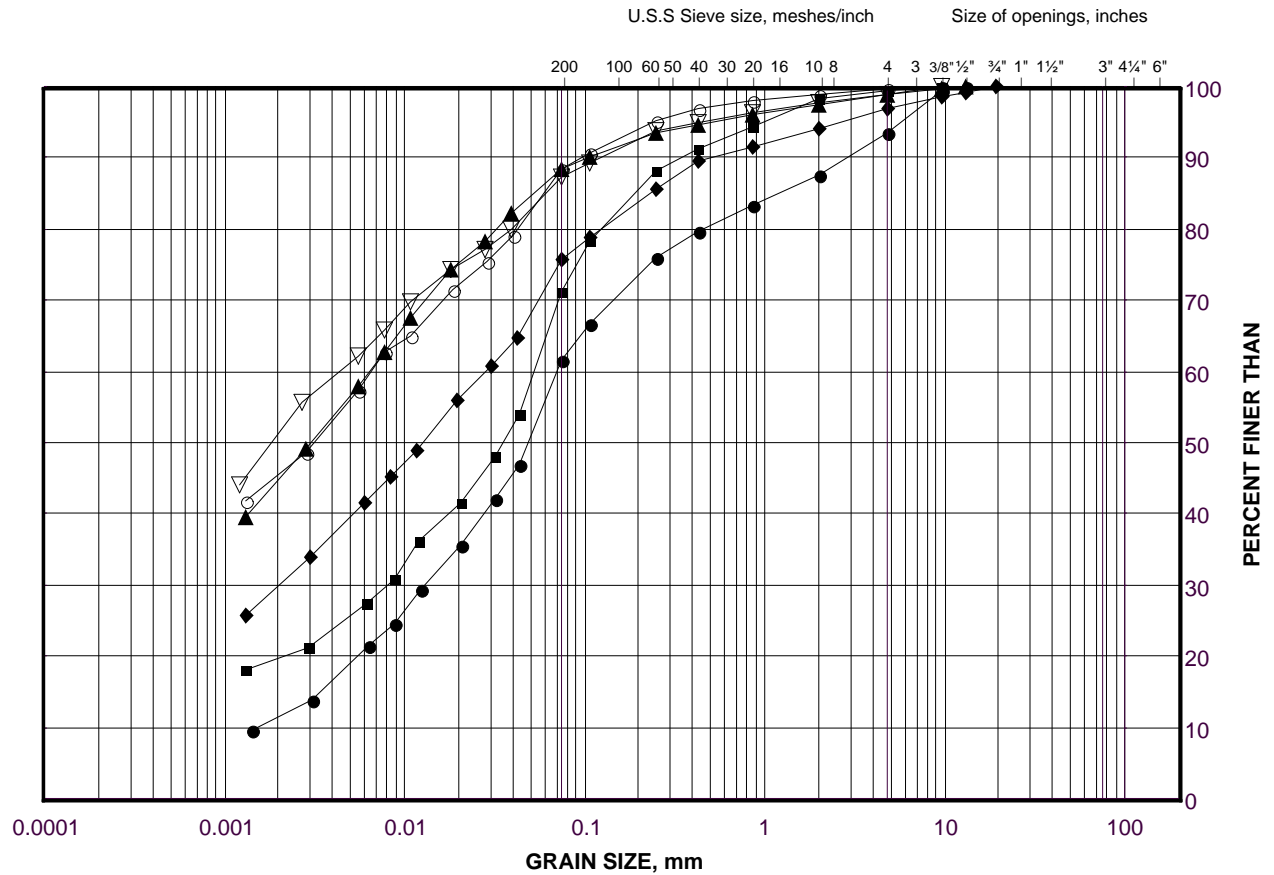
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Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay (Fill)

FIGURE B-11A



LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | HF-15 | 1B | 182.6 |
| ■ | HF-13 | 1B | 181.5 |
| ◆ | HF-10 | 3 | 182.8 |
| ▲ | CN/CP13 | 3 | 185.3 |
| ▽ | CN/CP12 | 4 | 185.2 |
| ○ | CN/CP13 | 7 | 181.5 |

Project Number: 1671430

Checked By: MAS

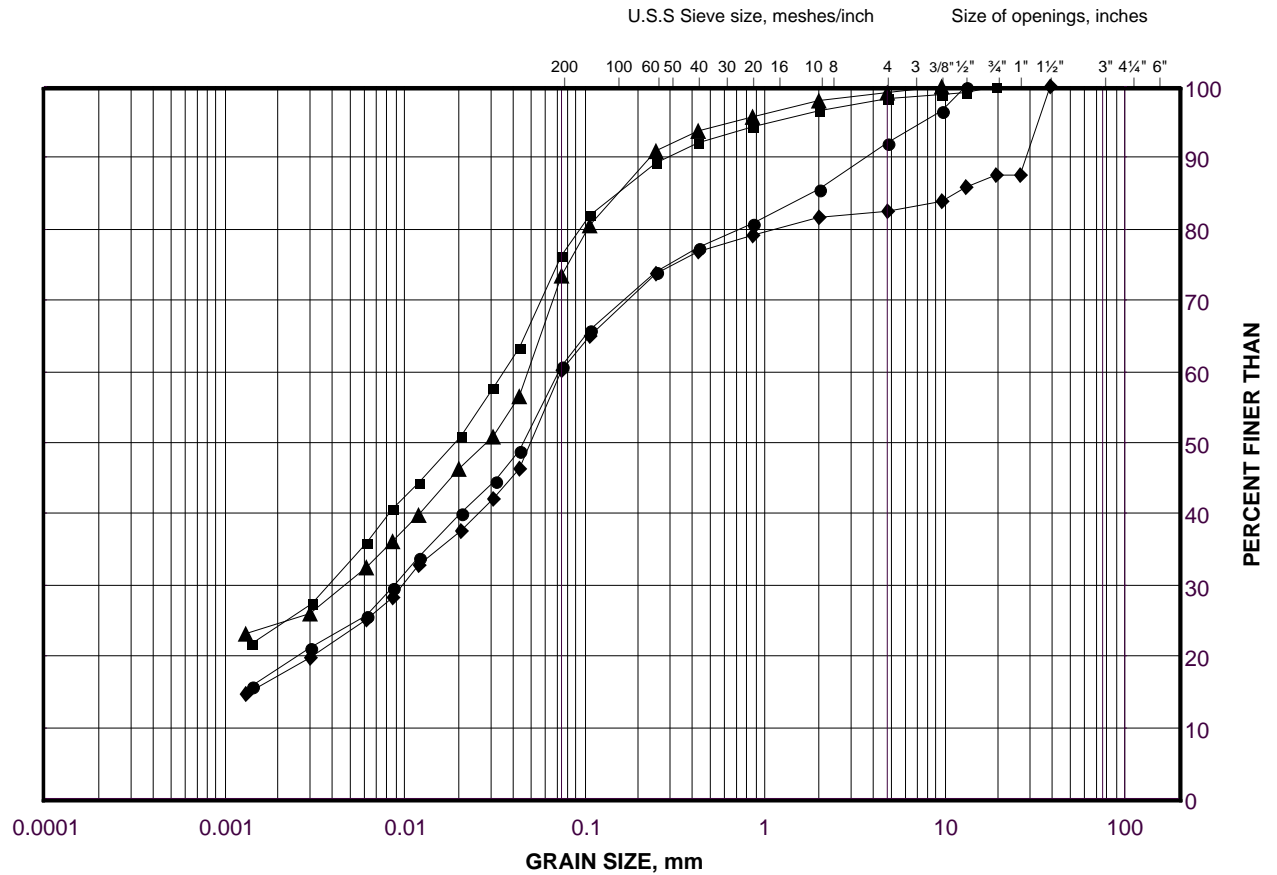
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Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Clayey Silt with Sand (Fill)

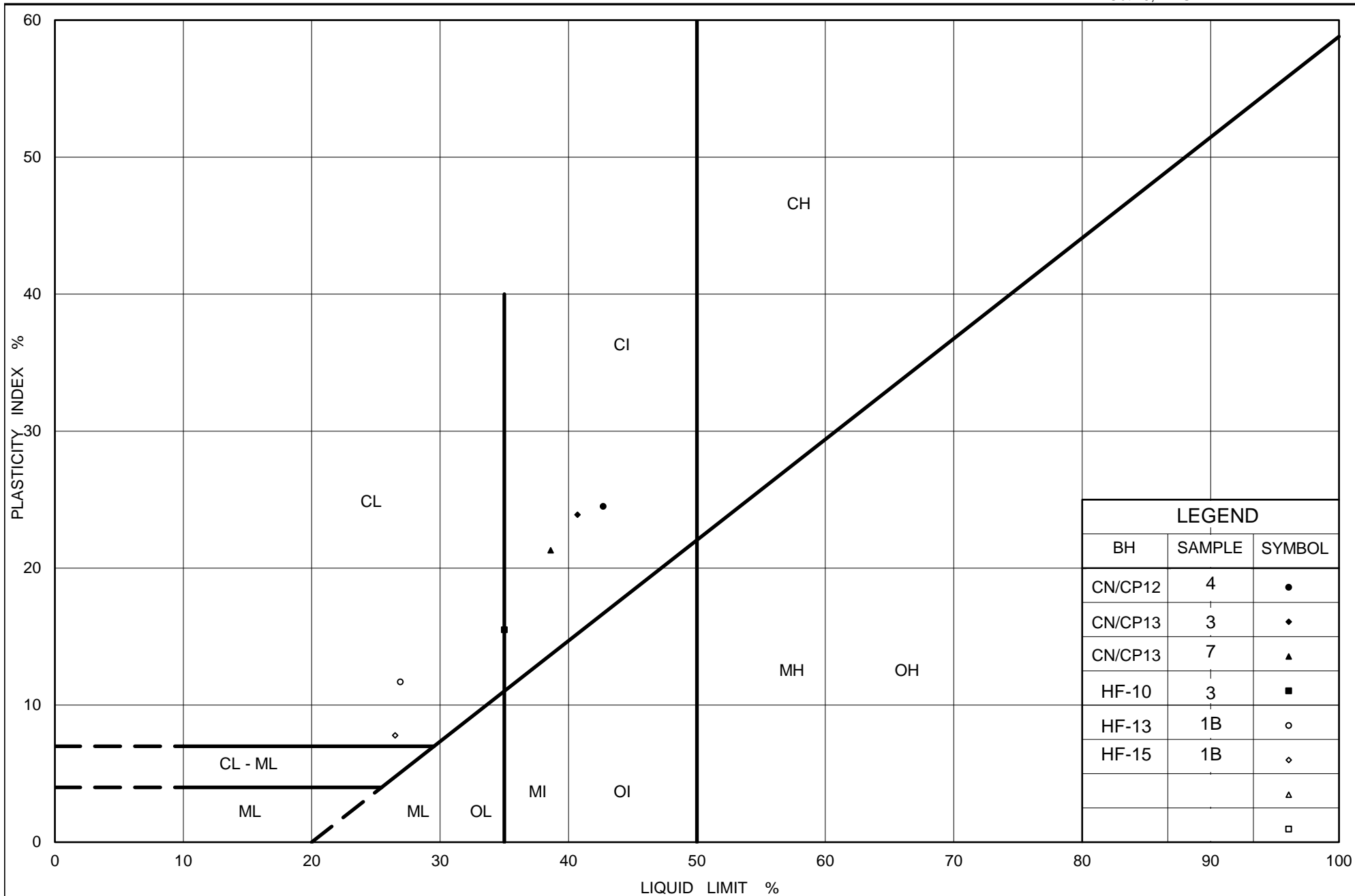
FIGURE B-11B



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | C1-2 | 1A | 181.6 |
| ■ | RW-5 | 2 | 182.3 |
| ◆ | RW-6 | 3 | 181.8 |
| ▲ | C1-3 | 4 | 181.4 |



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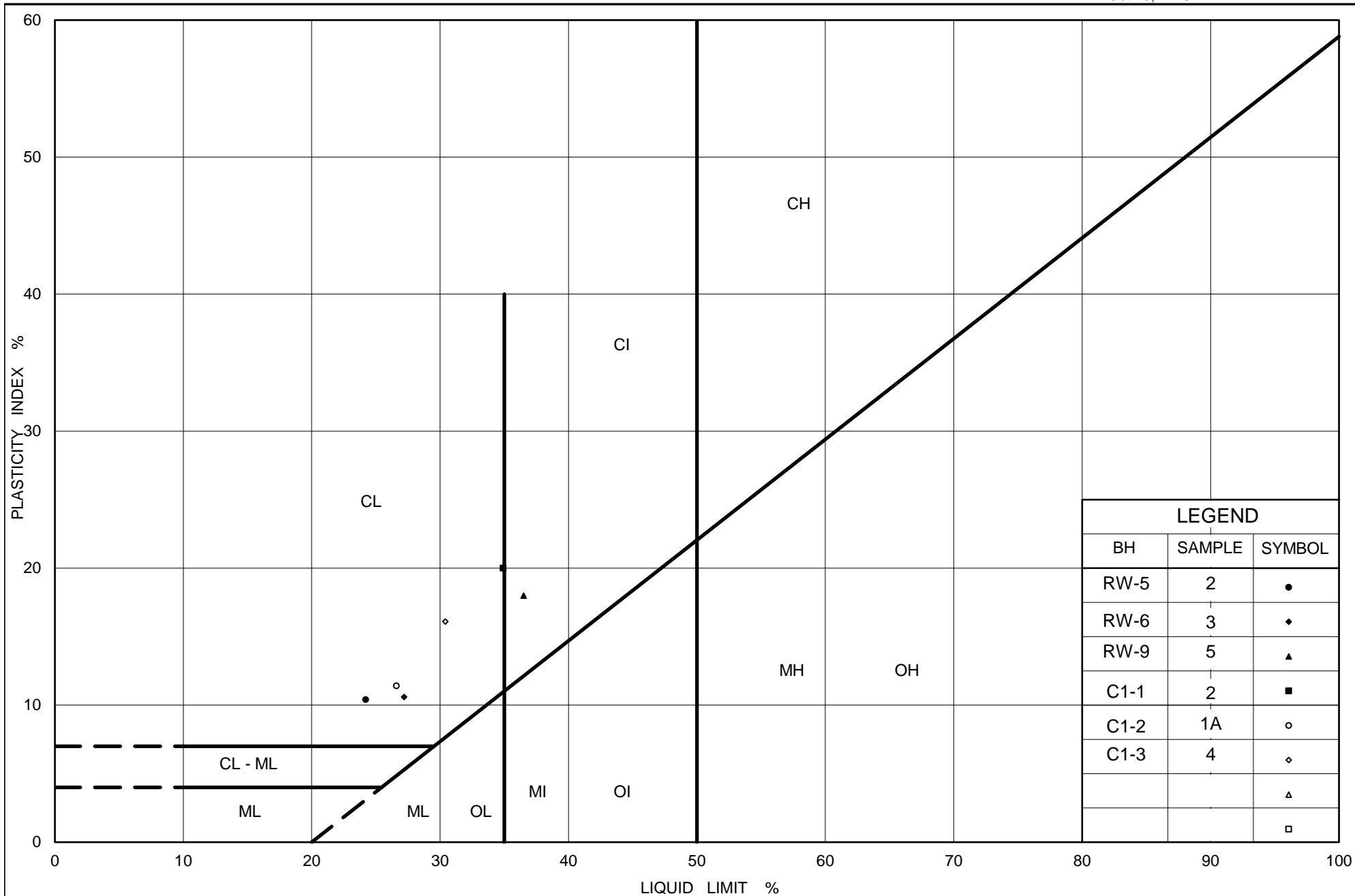
Ontario

PLASTICITY CHART Clayey Silt to Silty Clay Fill

Figure No. B-12A

Project No. 1671430 (WO 008)

Checked By: MAS



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Ontario

PLASTICITY CHART Clayey Silt to Silty Clay Fill

Figure No. B-12B

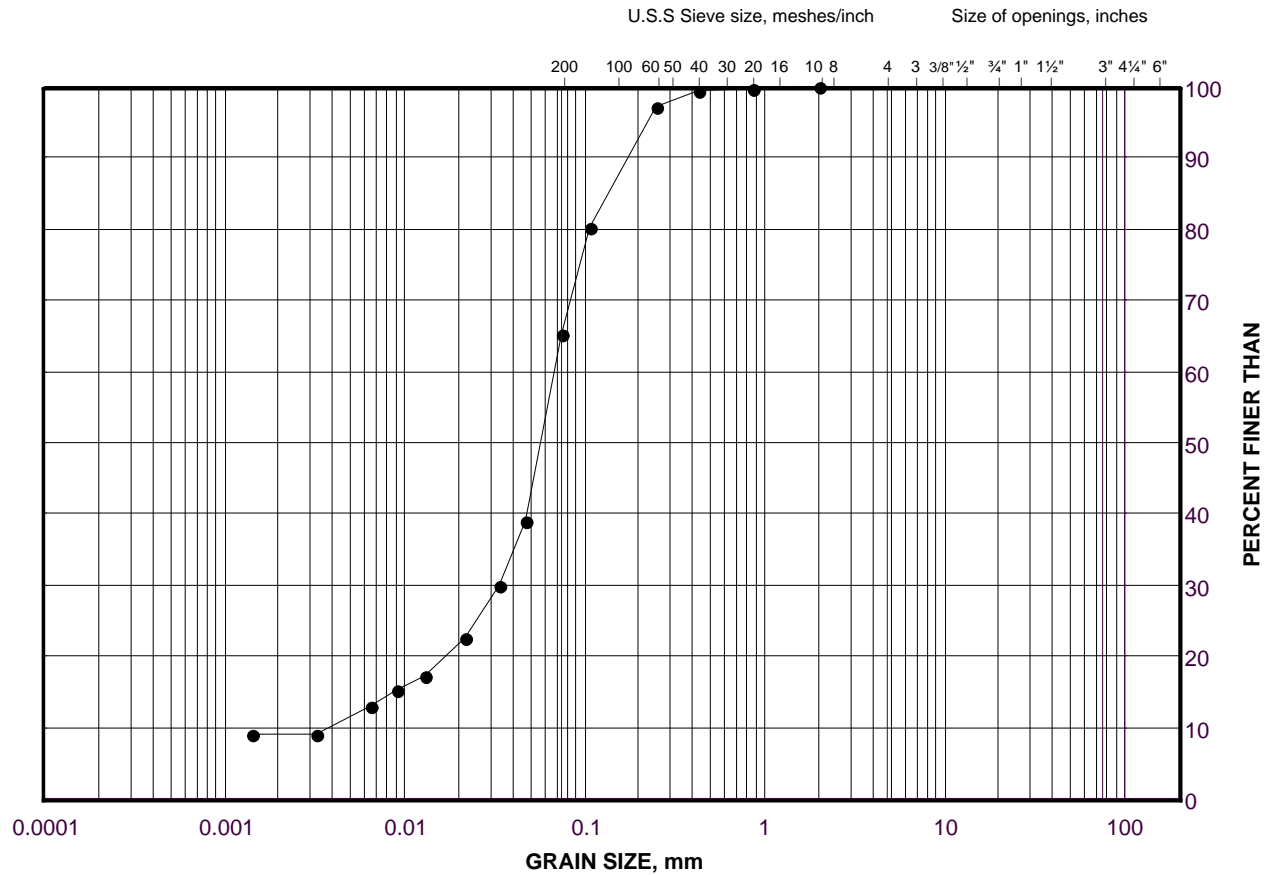
Project No. 1671430 (WO 008)

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GRAIN SIZE DISTRIBUTION

Silt and Sand (Fill)

FIGURE B-13



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| • | HF-11 | 2 | 182.6 |

Project Number: 1671430

Checked By: MAS

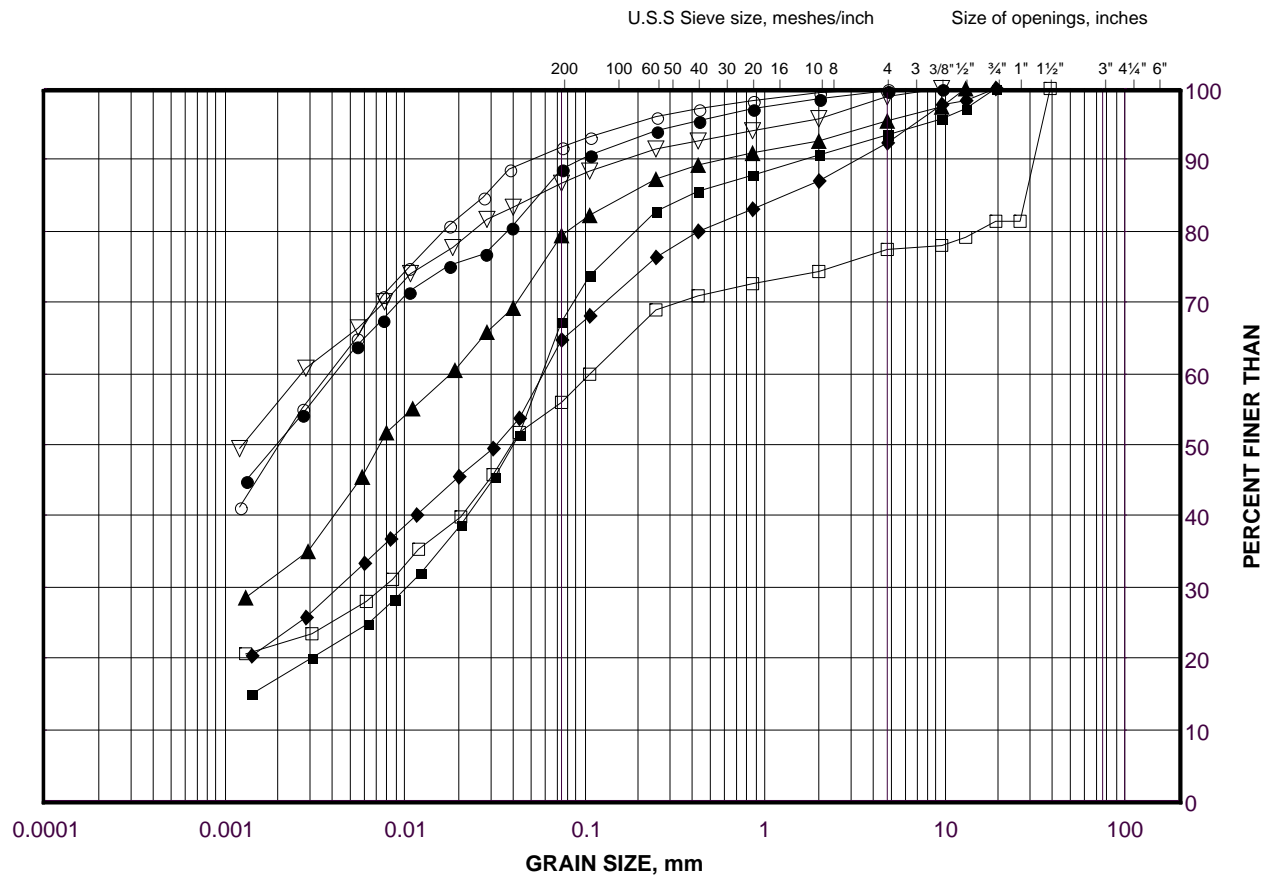
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Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay

FIGURE B-14A



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | CN/CP12 | 10 | 177.6 |
| ■ | CN/CP10 | 11 | 175.7 |
| ◆ | CN/CP12 | 12 | 174.6 |
| ▲ | CN/CP10 | 13 | 172.7 |
| ▽ | CN/CP9 | 1B | 179.5 |
| ○ | CN/CP9 | 5 | 176.6 |
| □ | CN/CP9 | 8 | 173.6 |

Project Number: 1671430

Checked By: MAS

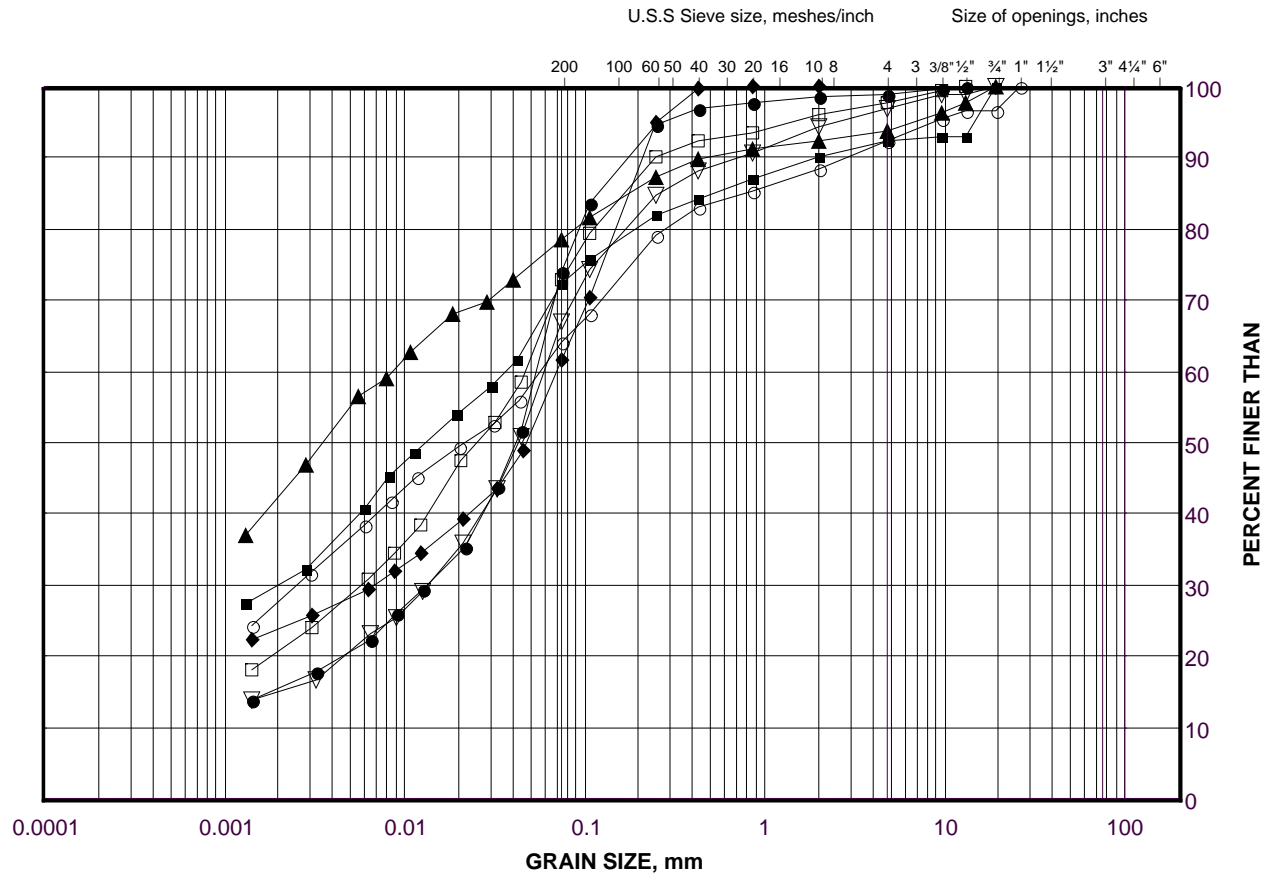
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Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand to Silty Clay

FIGURE B-14B



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | HF-12 | 2 | 181.6 |
| ■ | HF-9 | 4 | 178.9 |
| ◆ | HF-10 | 5 | 181.2 |
| ▲ | RW-10 | 6 | 180.2 |
| ▽ | RW-7 | 6A | 179.0 |
| ○ | RW-9 | 7 | 180.2 |
| □ | HF-10 | 7A | 178.4 |

Project Number: 1671430

Checked By: MAS

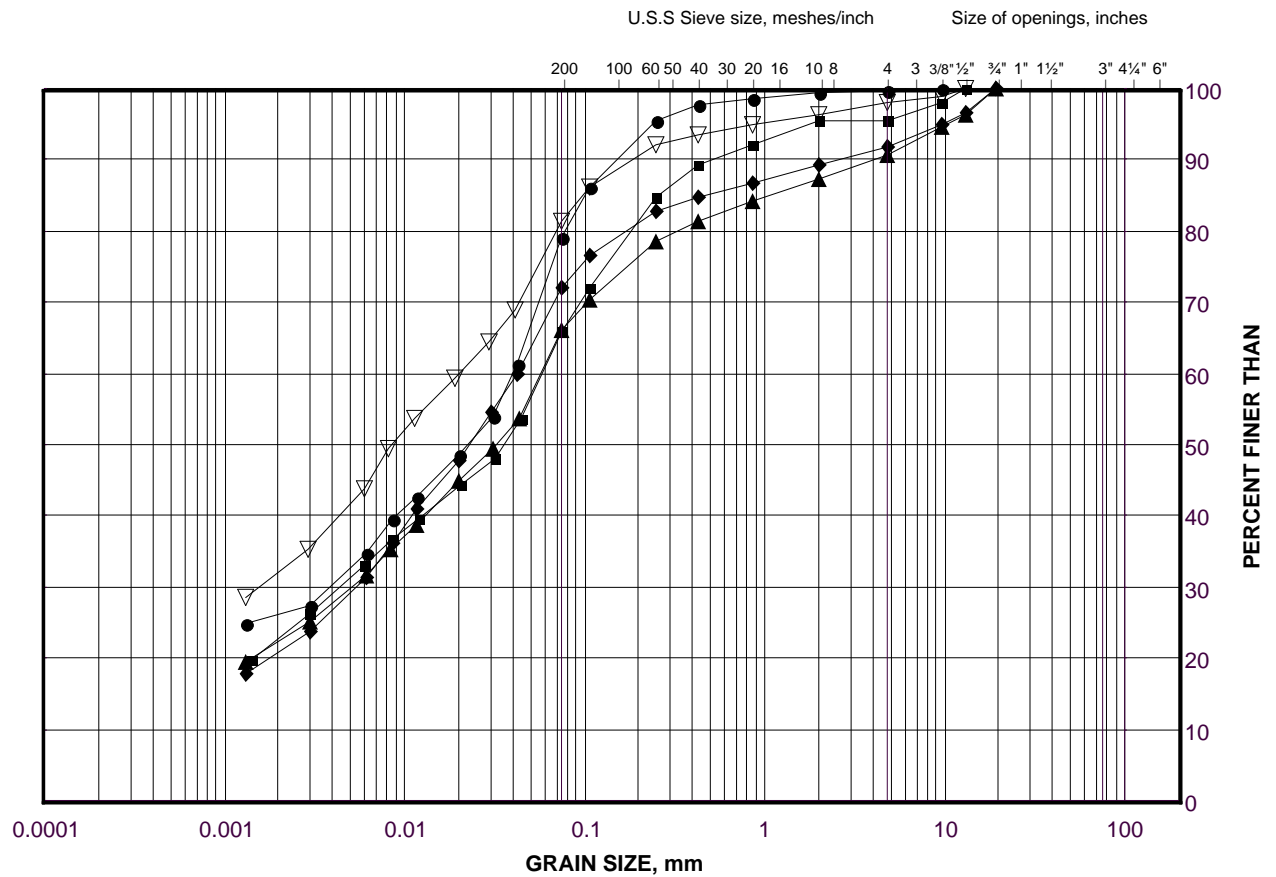
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GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand to Silty Clay

FIGURE B-14C



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

LEGEND

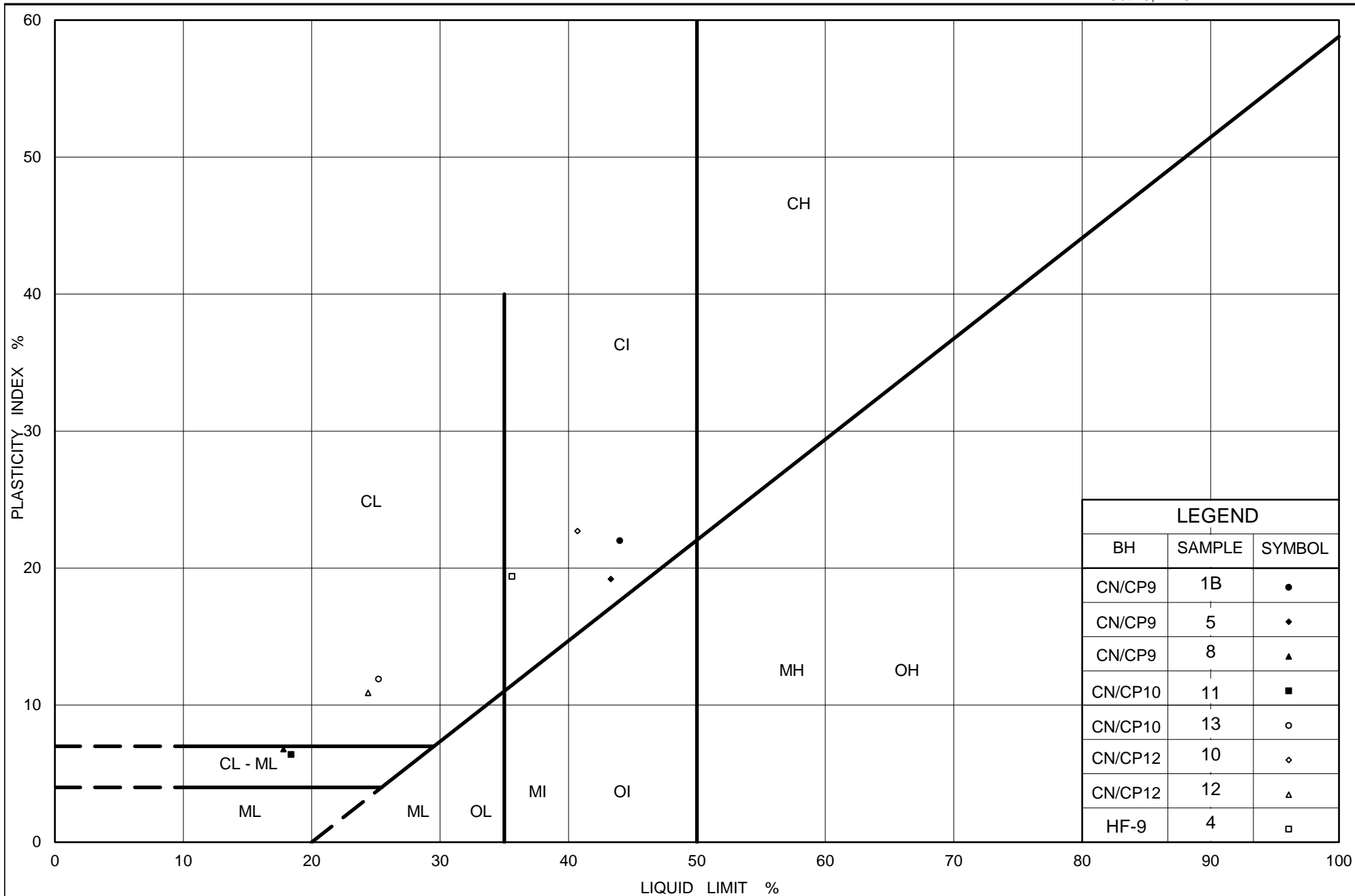
| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | RW-15 | 2 | 181.9 |
| ■ | RW-14 | 2A | 180.6 |
| ◆ | RW-15 | 5 | 179.6 |
| ▲ | RW-14 | 6 | 177.3 |
| ▽ | C1-3 | 7 | 179.2 |

Project Number: 1671430

Checked By: MAS

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Date: 01-May-19



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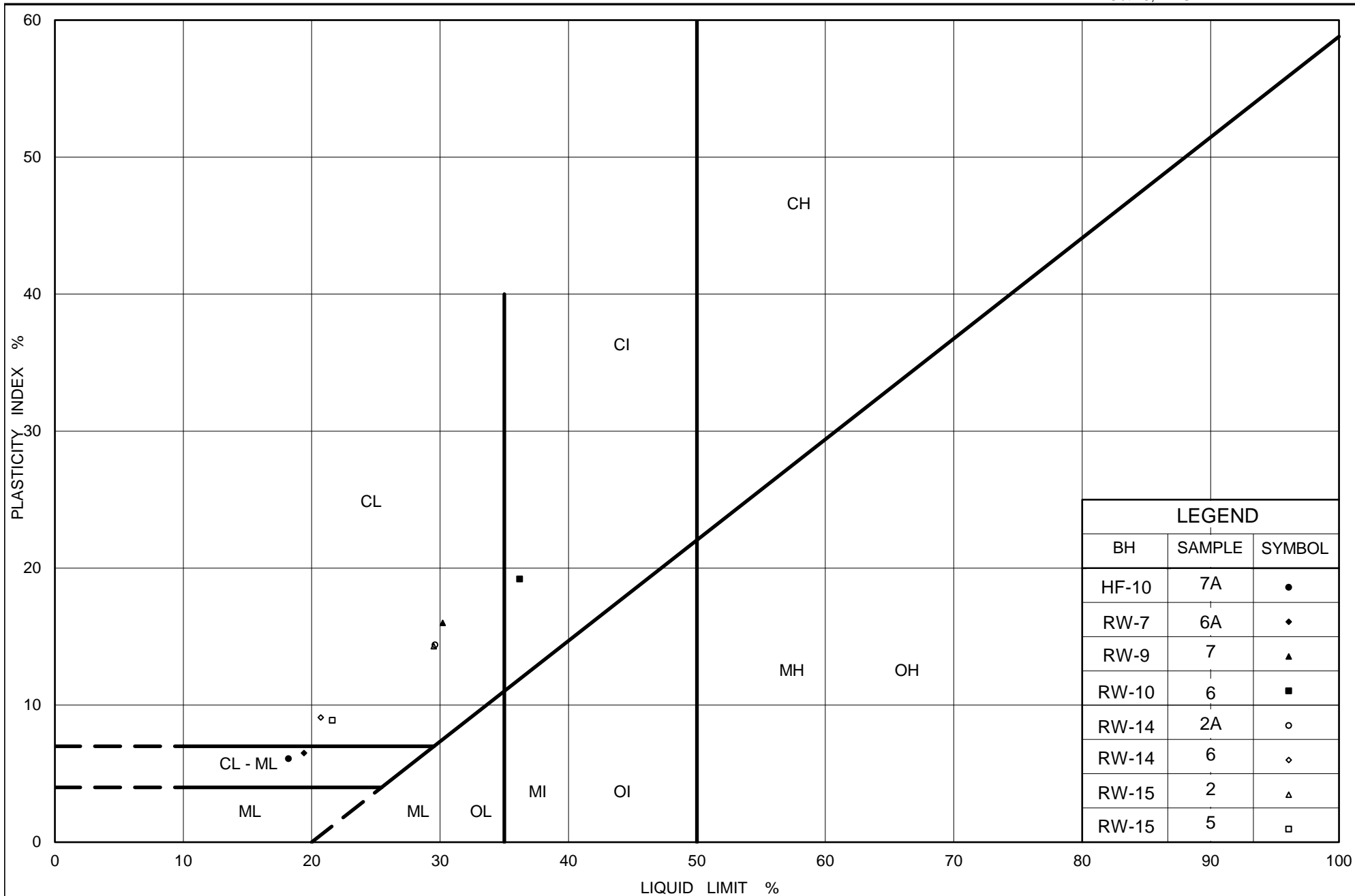
Ontario

PLASTICITY CHART Clayey Silt to Silty Clay

Figure No. B-15A

Project No. 1671430 (WO 008)

Checked By: MAS



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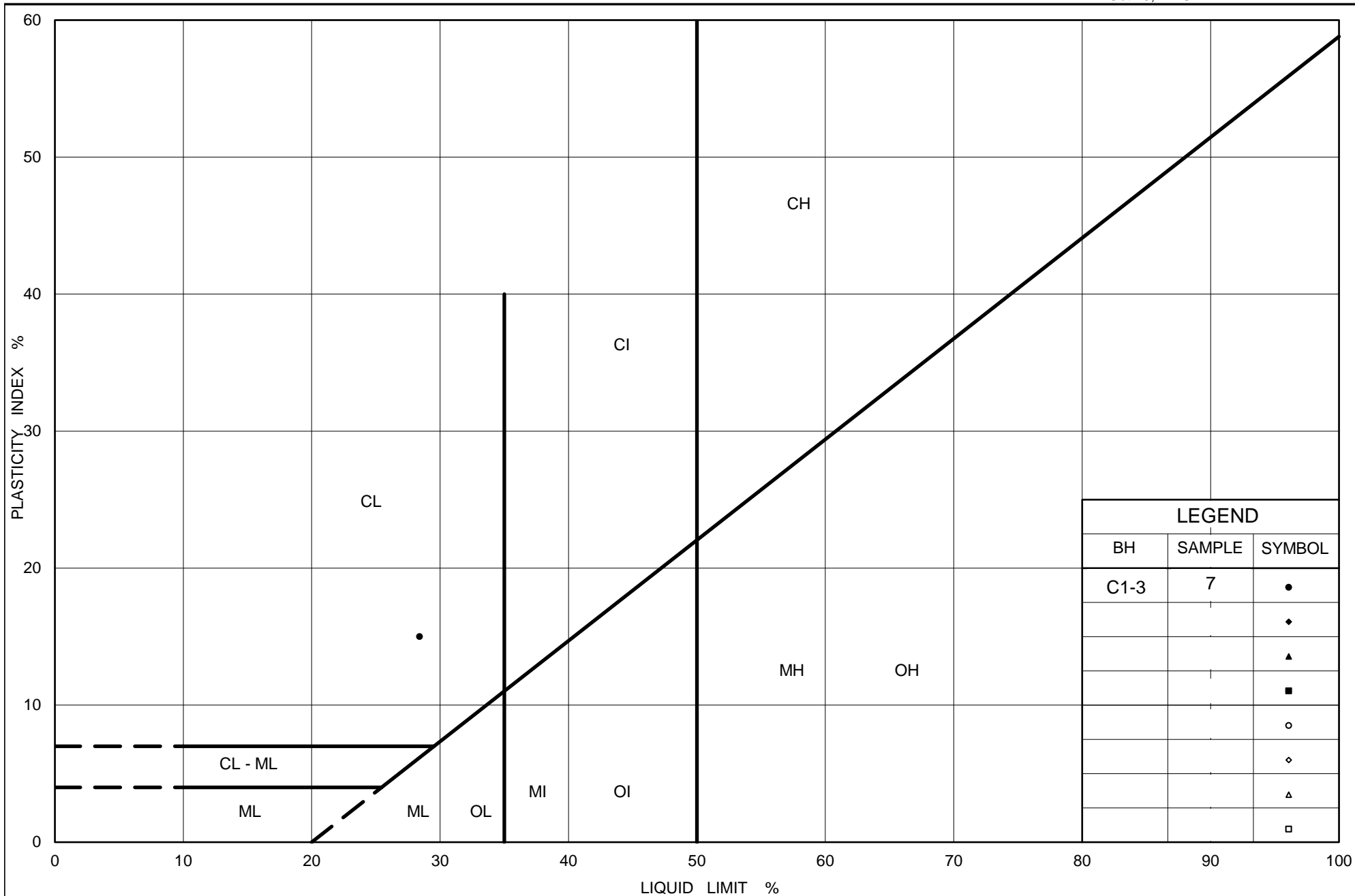
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PLASTICITY CHART Clayey Silt with Sand to Silty Clay

Figure No. B-15B

Project No. 1671430 (WO 008)

Checked By: MAS



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PLASTICITY CHART

Clayey Silt

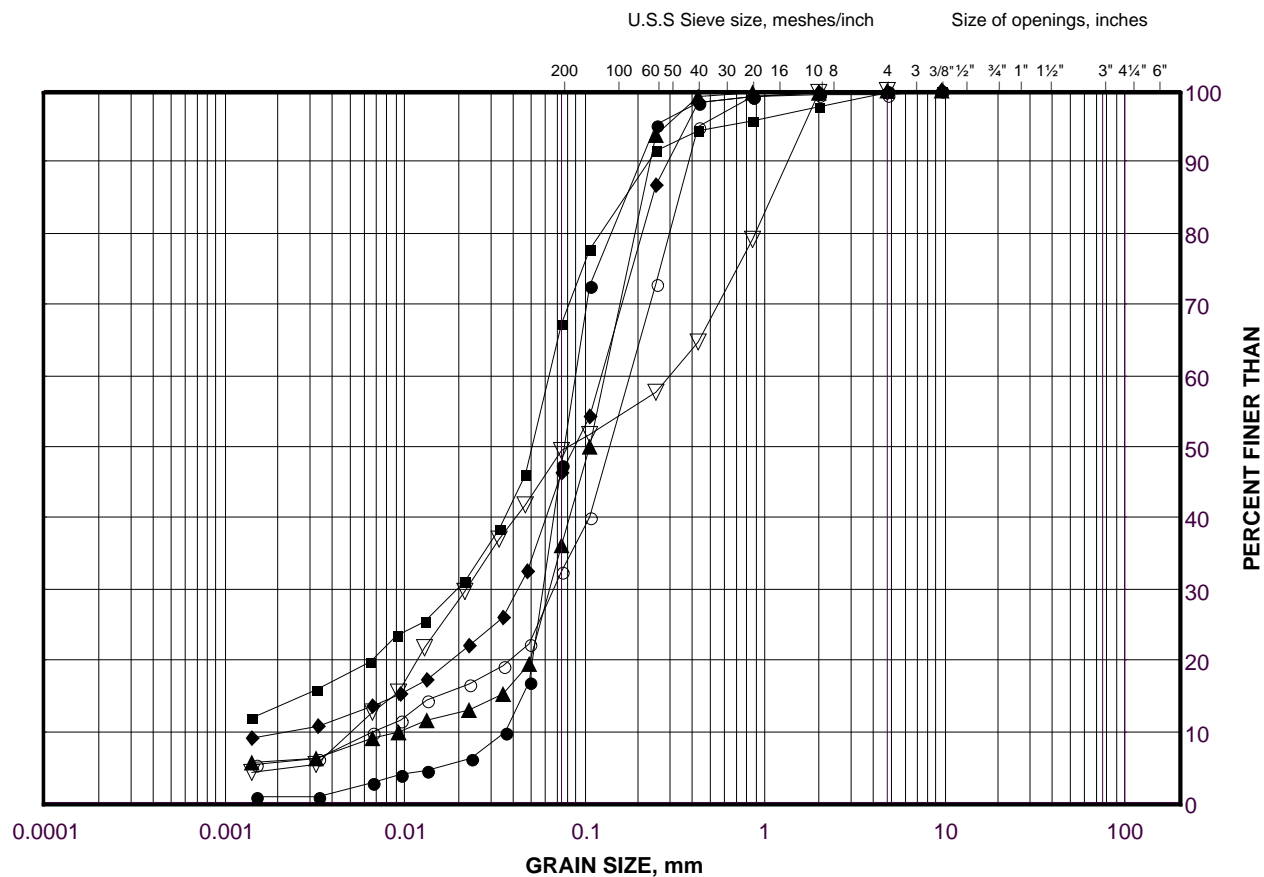
Figure No. B-15C

Project No. 1671430 (WO 008)

Checked By: MAS

Silt and Sand to Silty Sand

FIGURE B-16A



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | CN/CP10 | 10B | 177.1 |
| ■ | HF-14 | 2 | 181.4 |
| ◆ | HF-12 | 3 | 180.8 |
| ▲ | RW-6 | 4B | 180.9 |
| ▽ | HF-9 | 6A | 177.7 |
| ○ | RW-9 | 8 | 178.7 |

Project Number: 1671430

Checked By: MAS

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Date: 06-May-19

Sand to Silty Sand

FIGURE B-16B



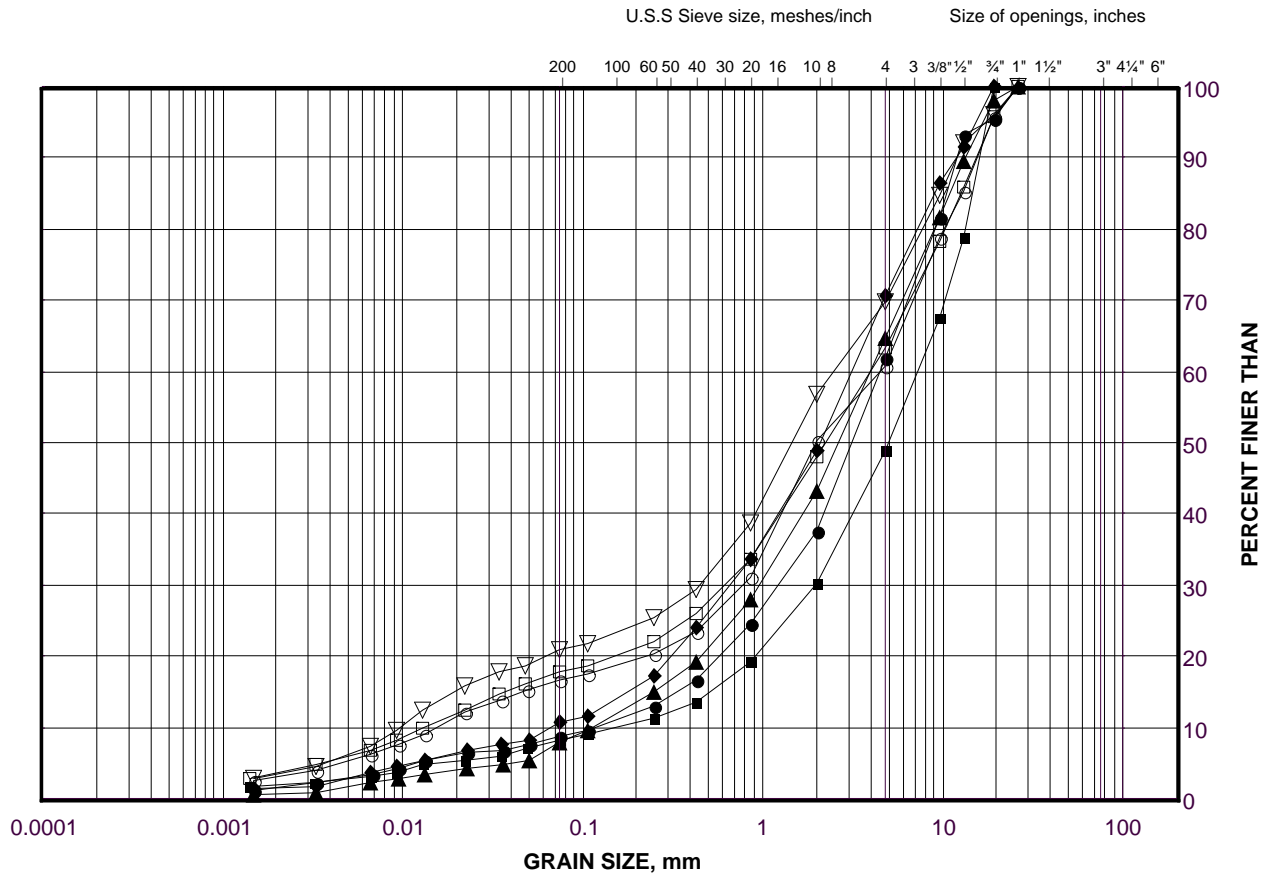
| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | RW-14 | 3 | 179.7 |
| ■ | C1-1 | 4 | 180.3 |

Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Sand and Gravel

FIGURE B-17A



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | HF-12 | 10 | 171.7 |
| ■ | CN/CP9 | 12 | 167.5 |
| ◆ | CN/CP12 | 14 | 171.4 |
| ▲ | CN/CP10 | 15 | 169.6 |
| ▽ | HF-14 | 6 | 178.3 |
| ○ | HF-12 | 7 | 176.2 |
| □ | HF-10 | 8 | 176.7 |

Project Number: 1671430

Checked By: MAS

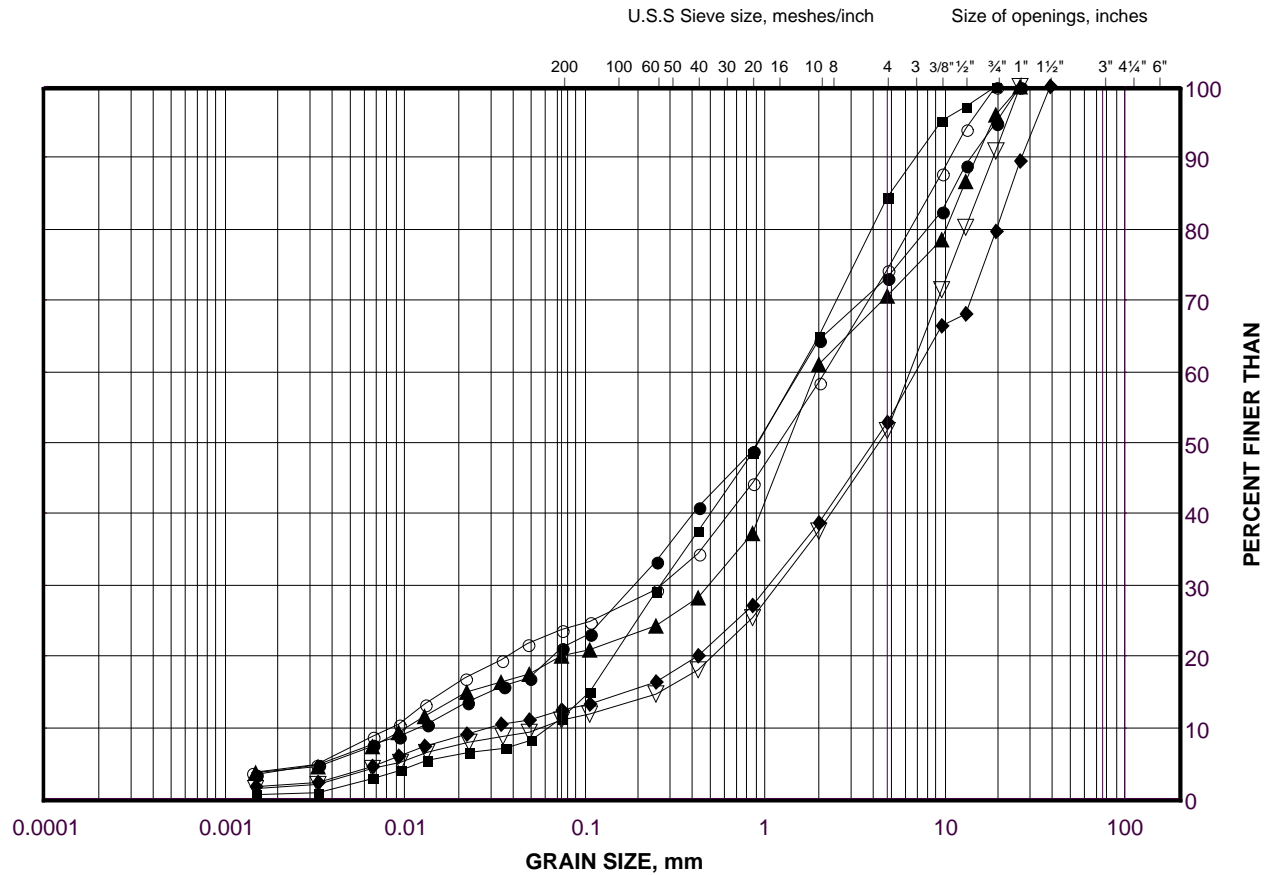
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Date: 01-May-19

GRAIN SIZE DISTRIBUTION

Sand to Gravelly Sand to Sand and Gravel

FIGURE B-17B



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

LEGEND

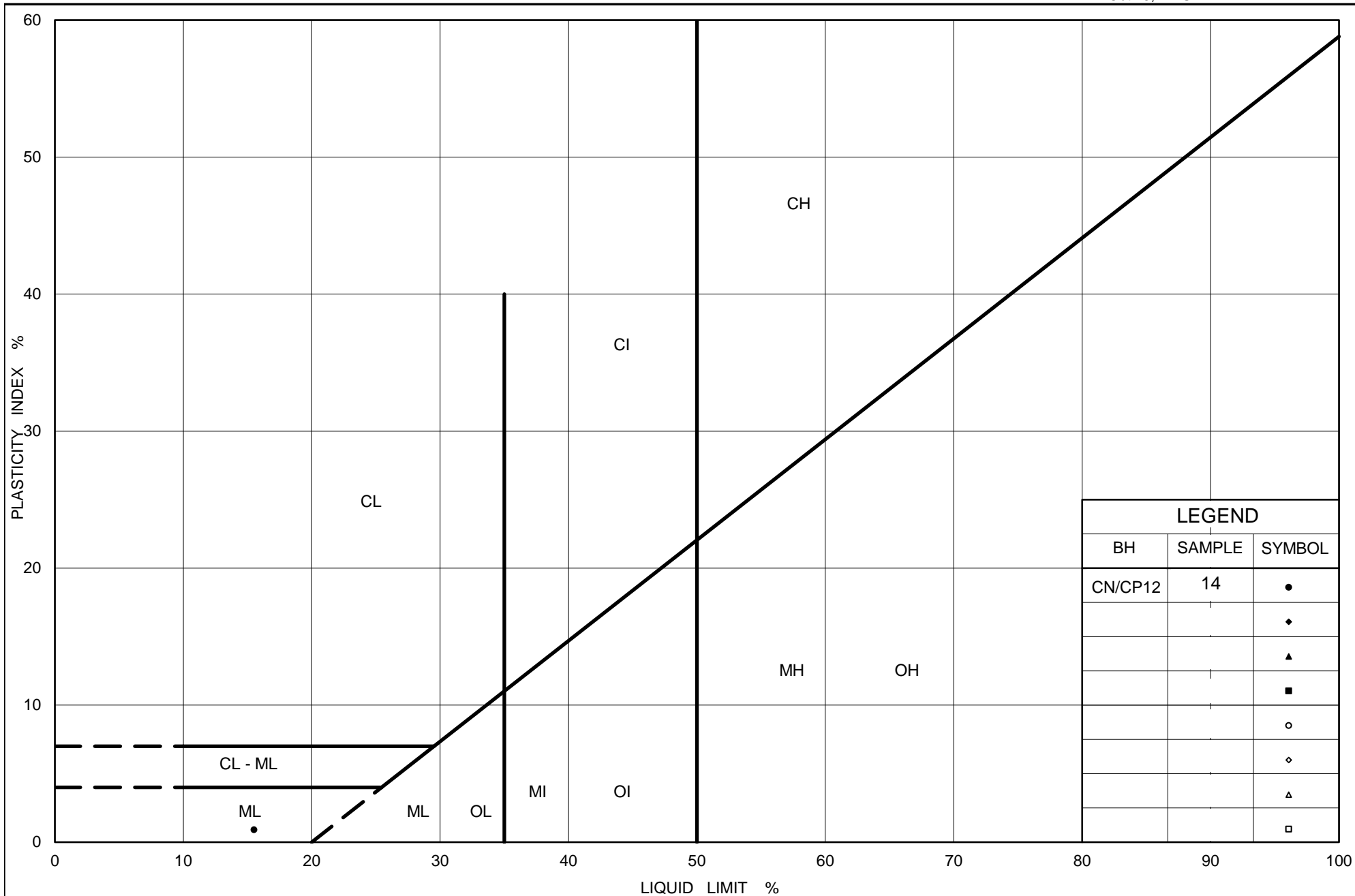
| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | RW-9 | 10 | 175.8 |
| ■ | CN/CP10 | 14 | 171.2 |
| ◆ | RW-5 | 7 | 178.5 |
| ▲ | RW-7 | 7B | 177.0 |
| ▽ | RW-4A | 8 | 178.0 |
| ○ | RW-10 | 9 | 175.6 |

Project Number: 1671430

Checked By: MAS

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Date: 06-May-19



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PLASTICITY CHART Sand and Gravel

Figure No. B-18

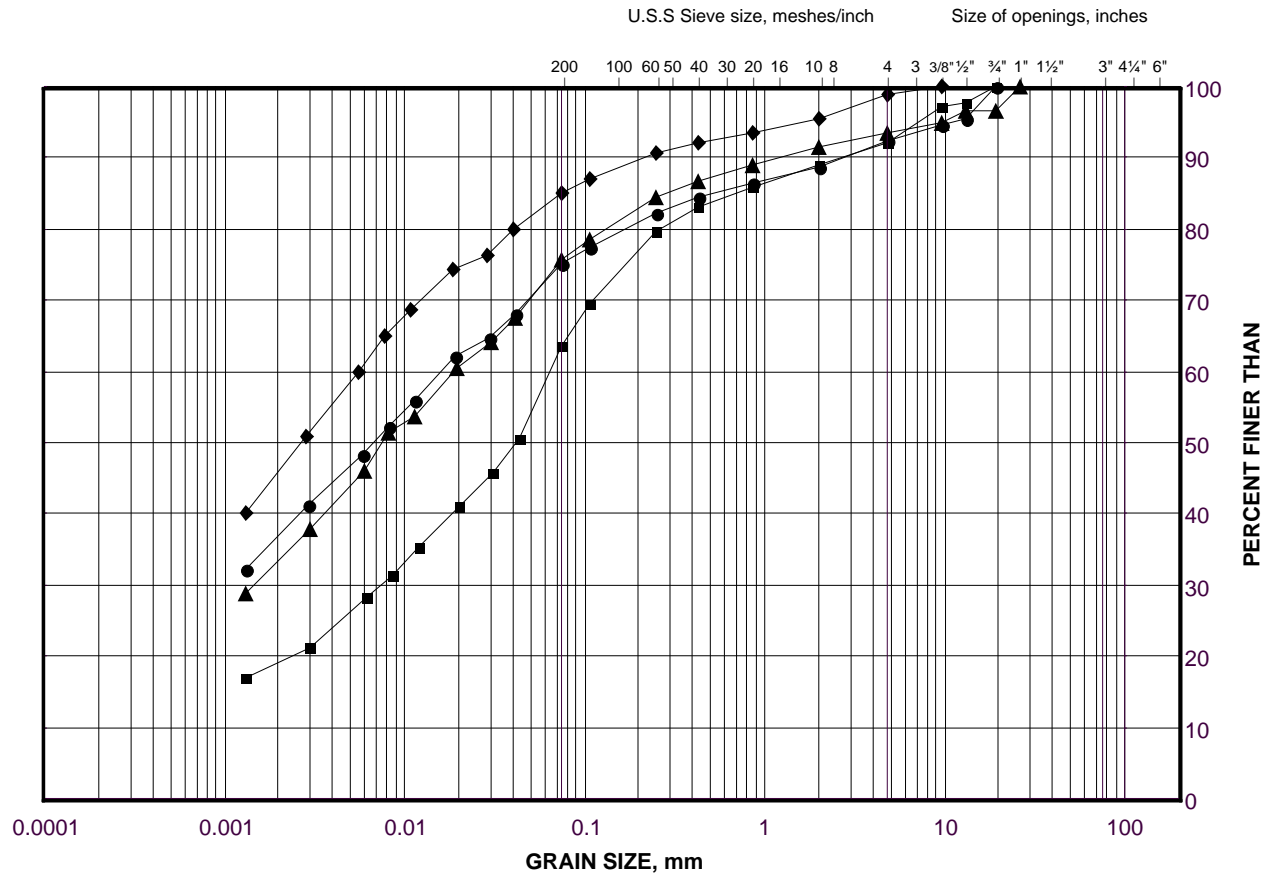
Project No. 1671430 (WO 008)

Checked By: MAS

GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay Fill
(Bowen Road Ramps)

FIGURE B-19



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

LEGEND

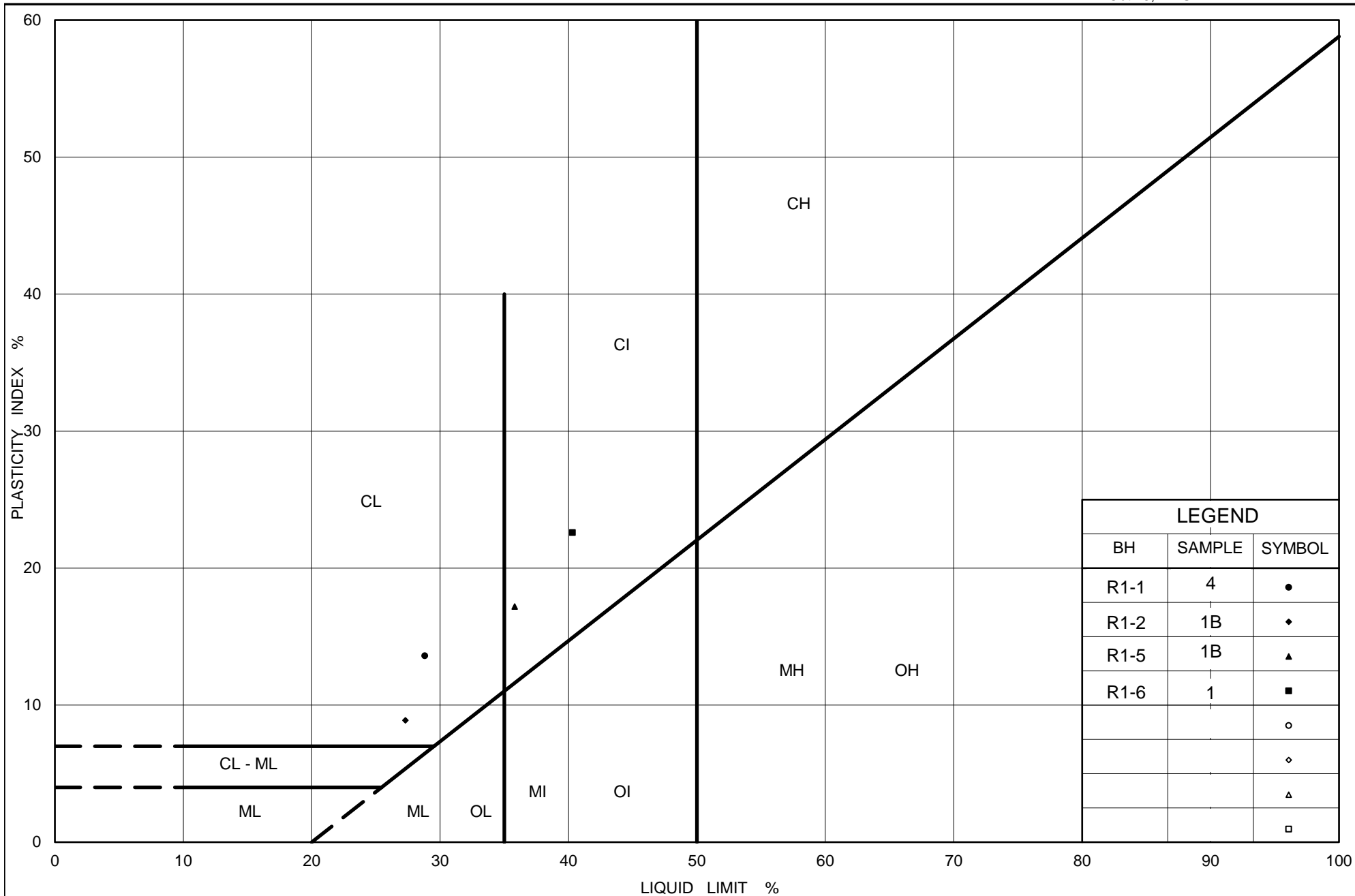
| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | R1-6 | 1 | 185.0 |
| ■ | R1-2 | 1B | 185.2 |
| ◆ | R1-5 | 1B | 183.6 |
| ▲ | R1-1 | 4 | 186.5 |

Project Number: 1671430

Checked By: MAS

Golder Associates

Date: 01-May-19



Ministry of Transportation

Ontario

PLASTICITY CHART Clayey Silt to Silty Clay Fill (Bowen Road Ramps)

Figure No. B-20

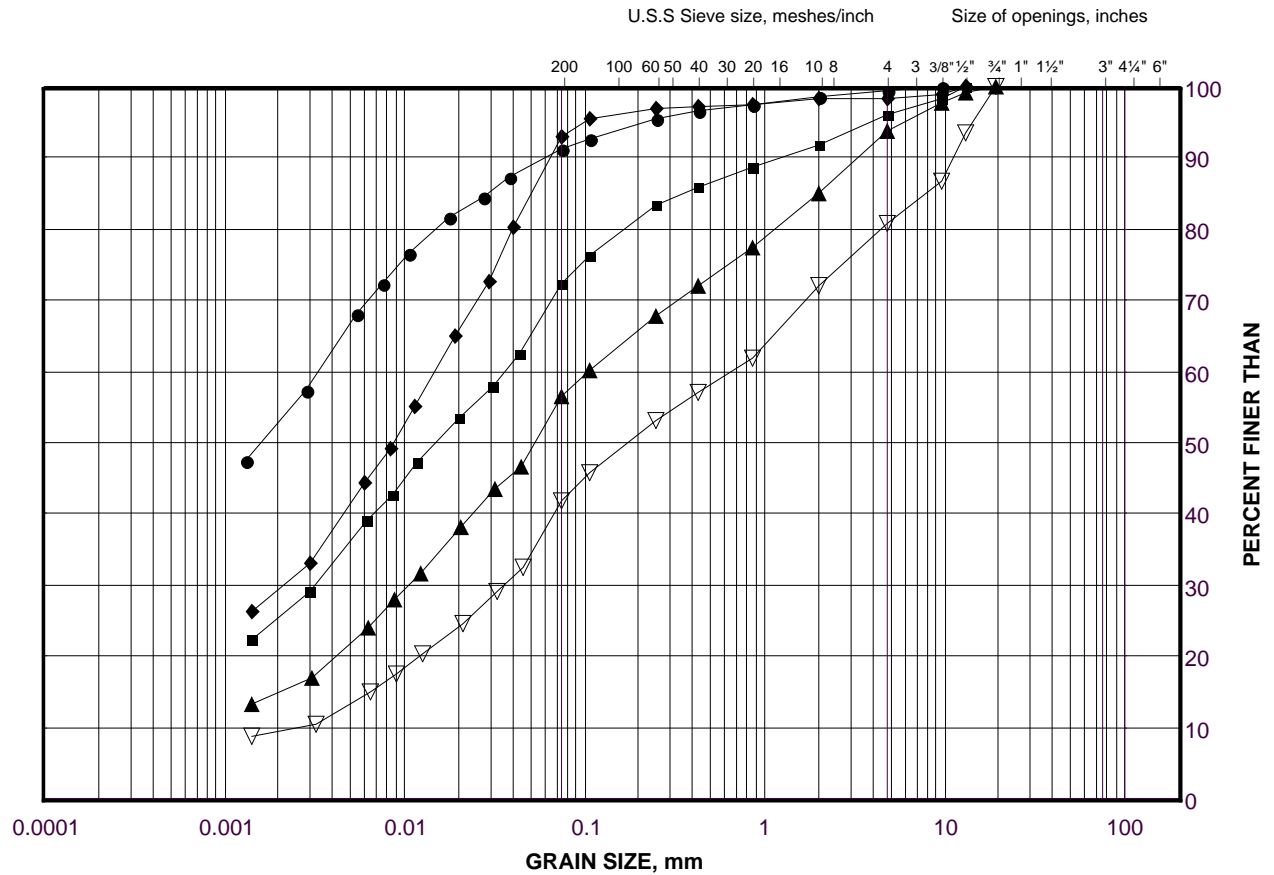
Project No. 1671430 (WO 008)

Checked By: MAS

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand to Silty Clay
(Bowen Road Ramps)

FIGURE B-21



LEGEND

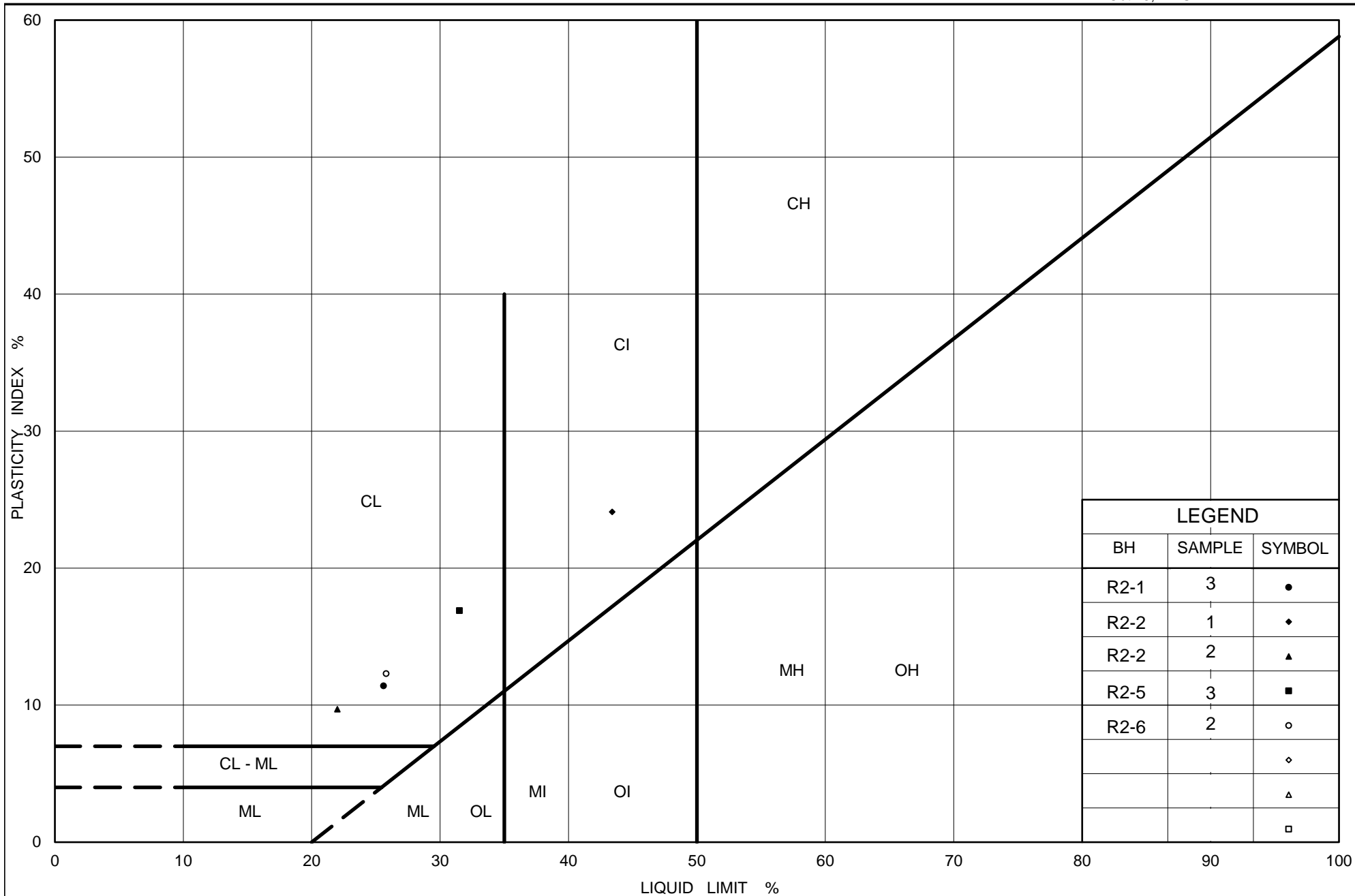
| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| ● | R2-2 | 1 | 183.3 |
| ■ | R2-6 | 2 | 184.4 |
| ◆ | R2-1 | 3 | 182.6 |
| ▲ | R2-5 | 5 | 182.7 |
| ▽ | R2-1 | 5 | 181.1 |

Project Number: 1671430

Checked By: MAS

Golder Associates

Date: 01-May-19



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt with Sand to Silty Clay
(Bowen Road Ramps)

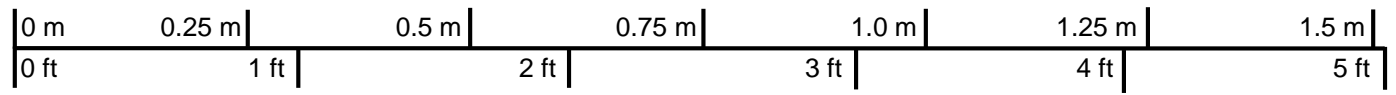
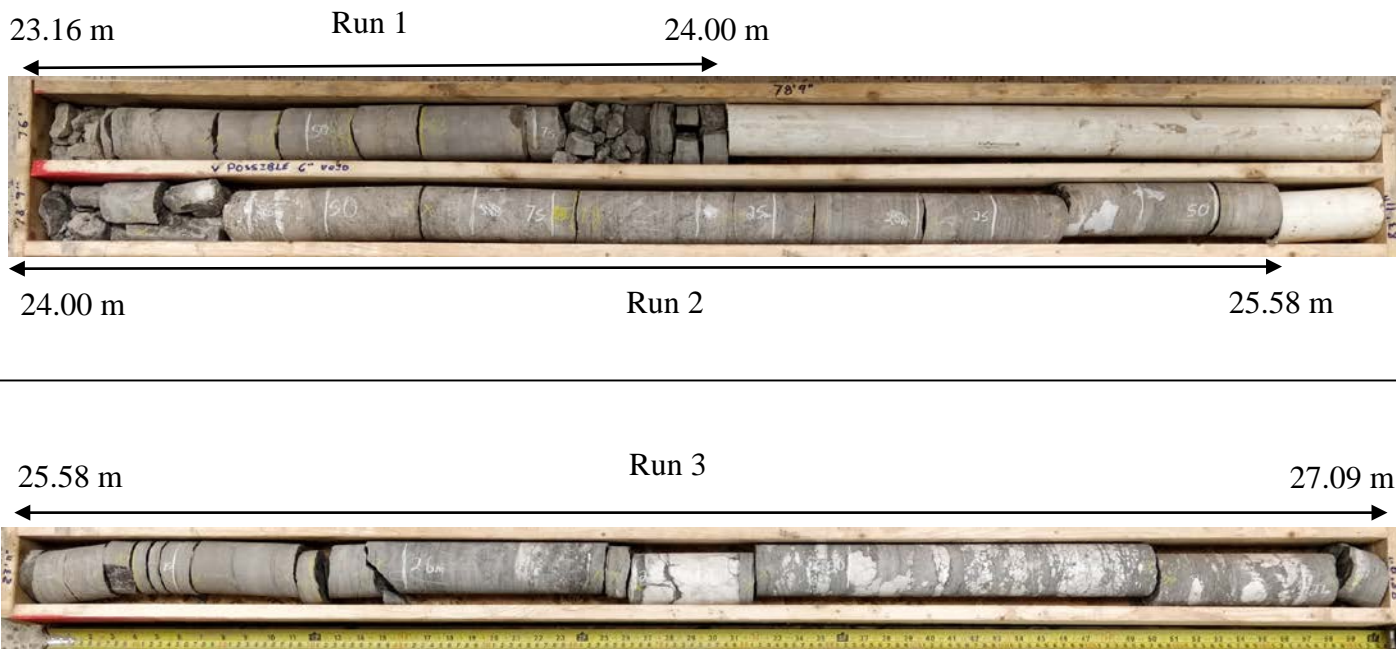
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Project No. 1671430 (WO 008)


Checked By: MAS

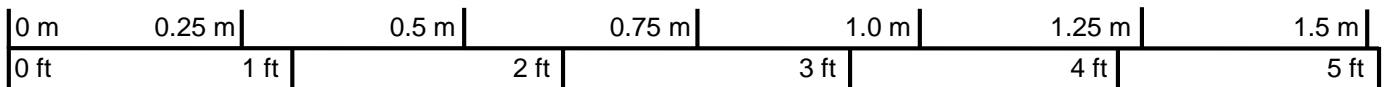
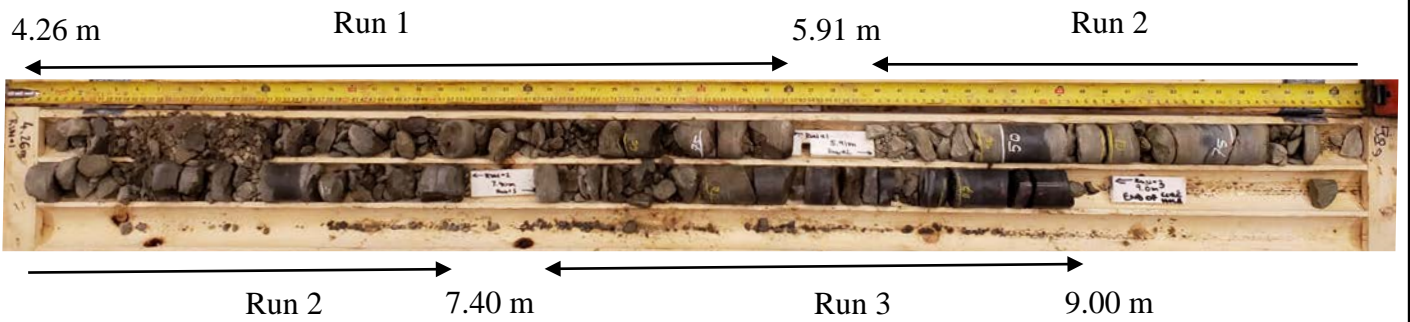
APPENDIX C

Bedrock Core Photographs and Laboratory Test Results




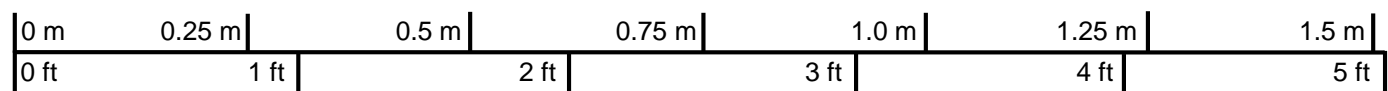
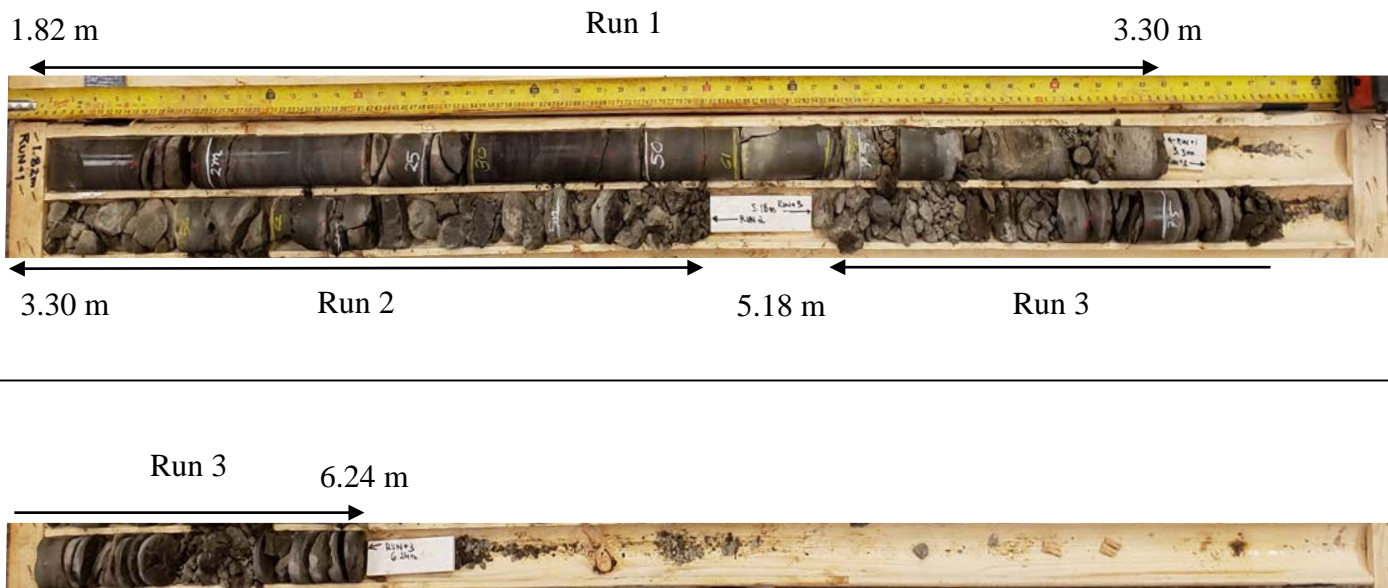
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| CLIENT AECOM | | | |
| TITLE BEDROCK CORE PHOTOGRAPHS – BOREHOLE CN/CP3 | | | |
|  GOLDER | PROJECT NO. 1671430 | | PHASE WO008 |
| | DESIGNED | SE | REV. A |
| | PREPARED | SE | |
| | REVIEWED | EN | |
| APPROVED | | | Figure C-1 |




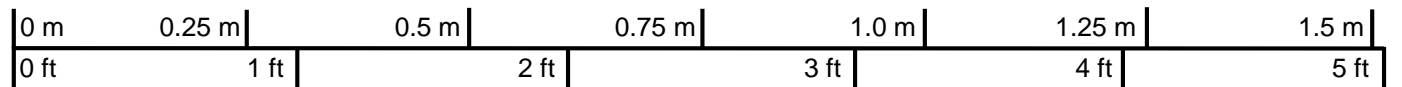
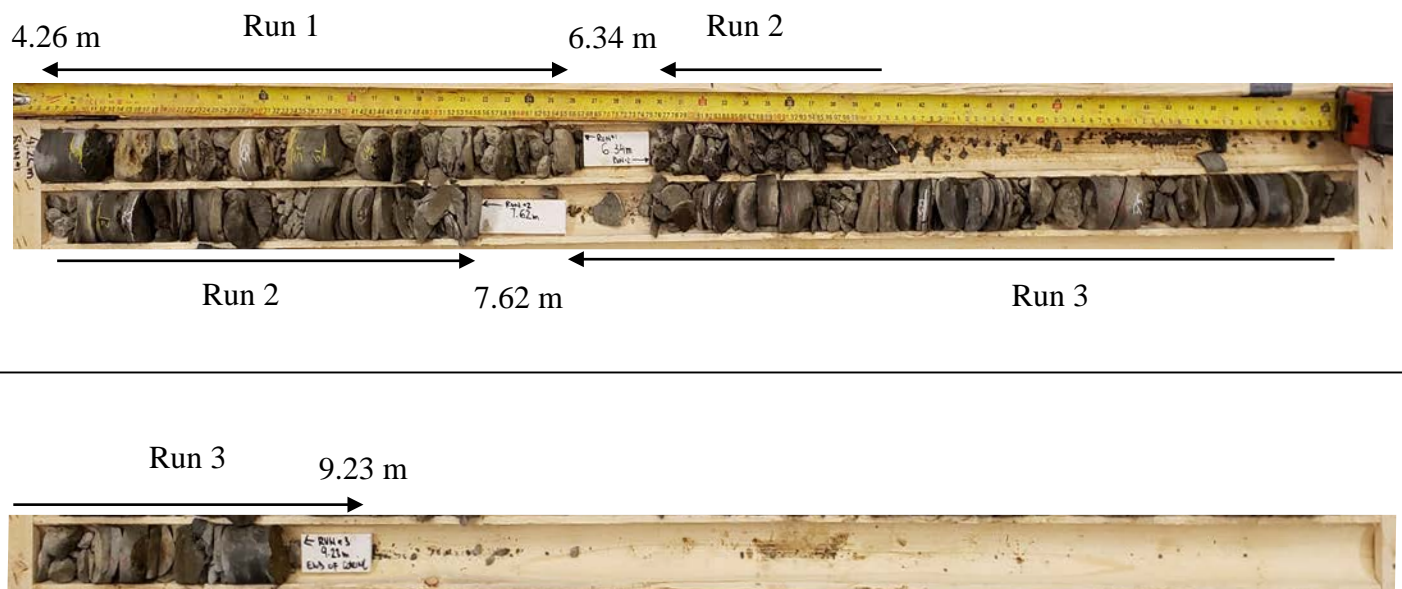
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| | REVIEWED | EN | |
| APPROVED | | | Figure C-2 |




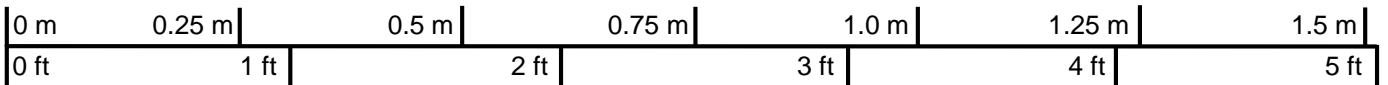
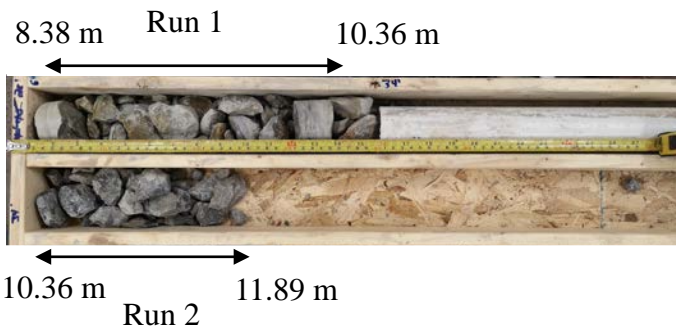
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| CLIENT AECOM | | | |
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| | REVIEWED | EN | |
| APPROVED | | | Figure C-3 |




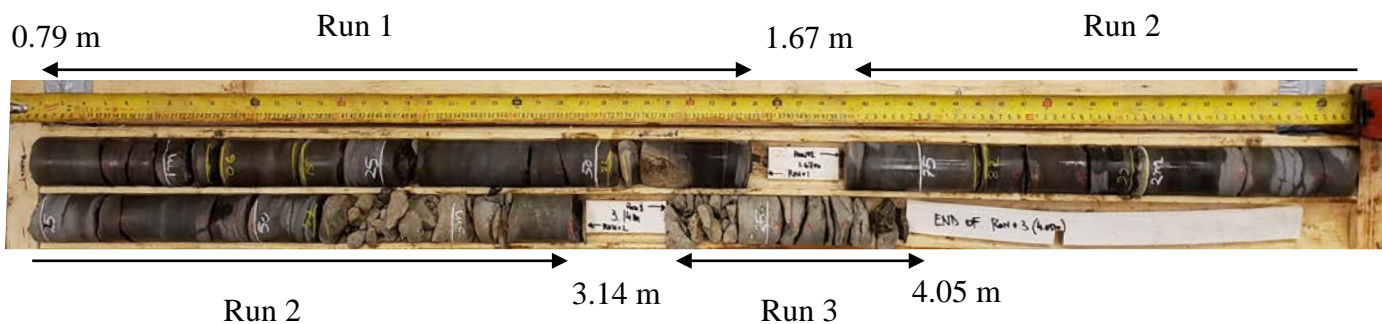
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| | DESIGNED | SE | REV. A |
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| | REVIEWED | EN | |
| APPROVED | | | Figure C-4 |



Scale

| | | | |
|--|---------------------|----|-------------|
| PROJECT HIGH FILL EMBANKMENTS AND RETAINING WALLS QEW BRIDGE REPLACEMENT AND ASSOCIATED HIGHWAY IMPROVEMENTS MINISTRY OF TRANSPORTATION G.W.P. 2116-16-00 | | | |
| CLIENT AECOM | | | |
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| | DESIGNED | SE | REV. A |
| | PREPARED | SE | |
| | REVIEWED | EN | |
| | APPROVED | | |
| Figure C-5 | | | |



Scale

PROJECT
HIGH FILL EMBANKMENTS AND RETAINING WALLS
QEW BRIDGE REPLACEMENT AND ASSOCIATED HIGHWAY IMPROVEMENTS
MINISTRY OF TRANSPORTATION G.W.P. 2116-16-00

CLIENT
AECOM

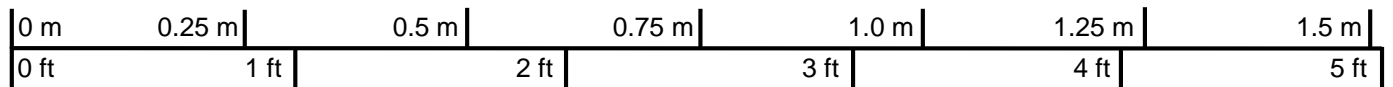
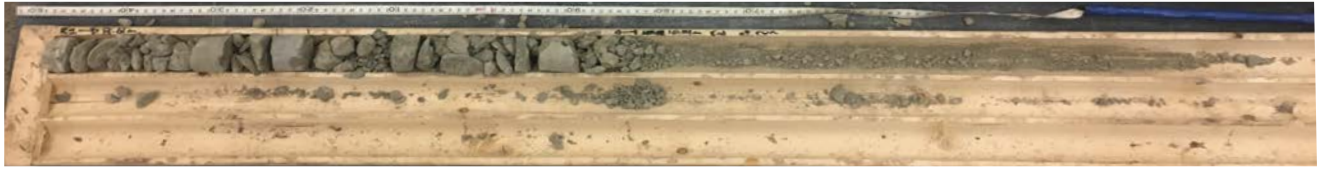
TITLE
BEDROCK CORE PHOTOGRAPHS – BOREHOLE C1-2



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| DESIGNED | SE | REV. | A |
| PREPARED | SE | | |
| REVIEWED | EN | | |
| APPROVED | | | |

Figure C-6

8.61 m Run 1 10.14 m



Scale

PROJECT
HIGH FILL EMBANKMENTS AND RETAINING WALLS
QEW BRIDGE REPLACEMENT AND ASSOCIATED HIGHWAY IMPROVEMENTS
MINISTRY OF TRANSPORTATION G.W.P. 2116-16-00

CLIENT
AECOM

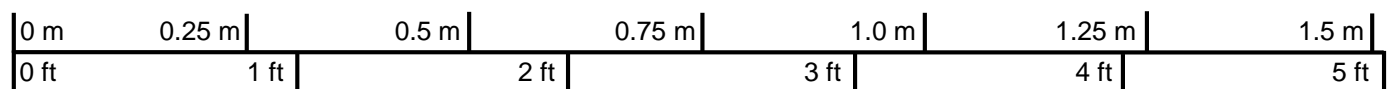
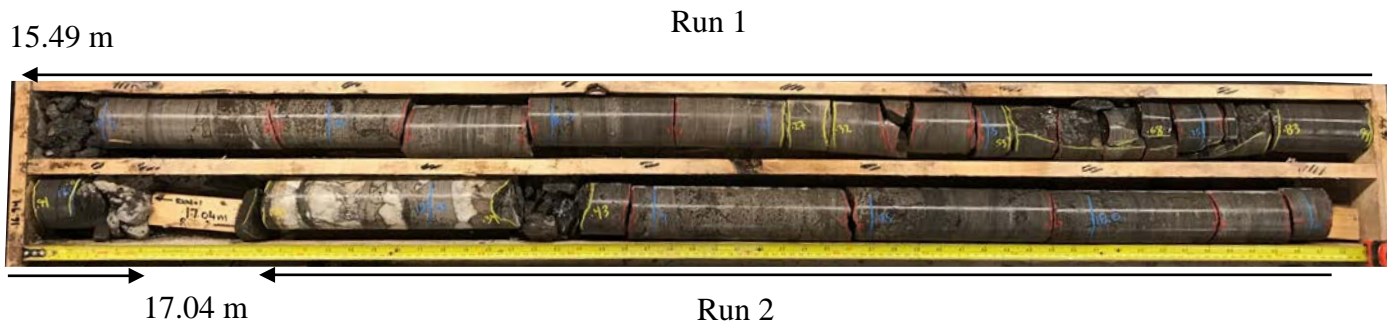
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BEDROCK CORE PHOTOGRAPHS – BOREHOLE C1-3




GOLDER

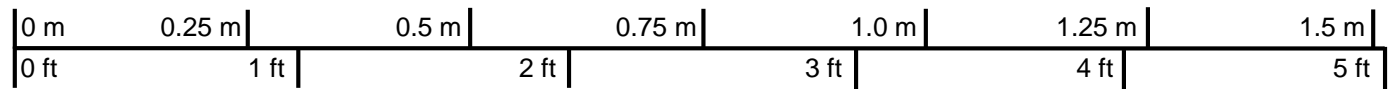
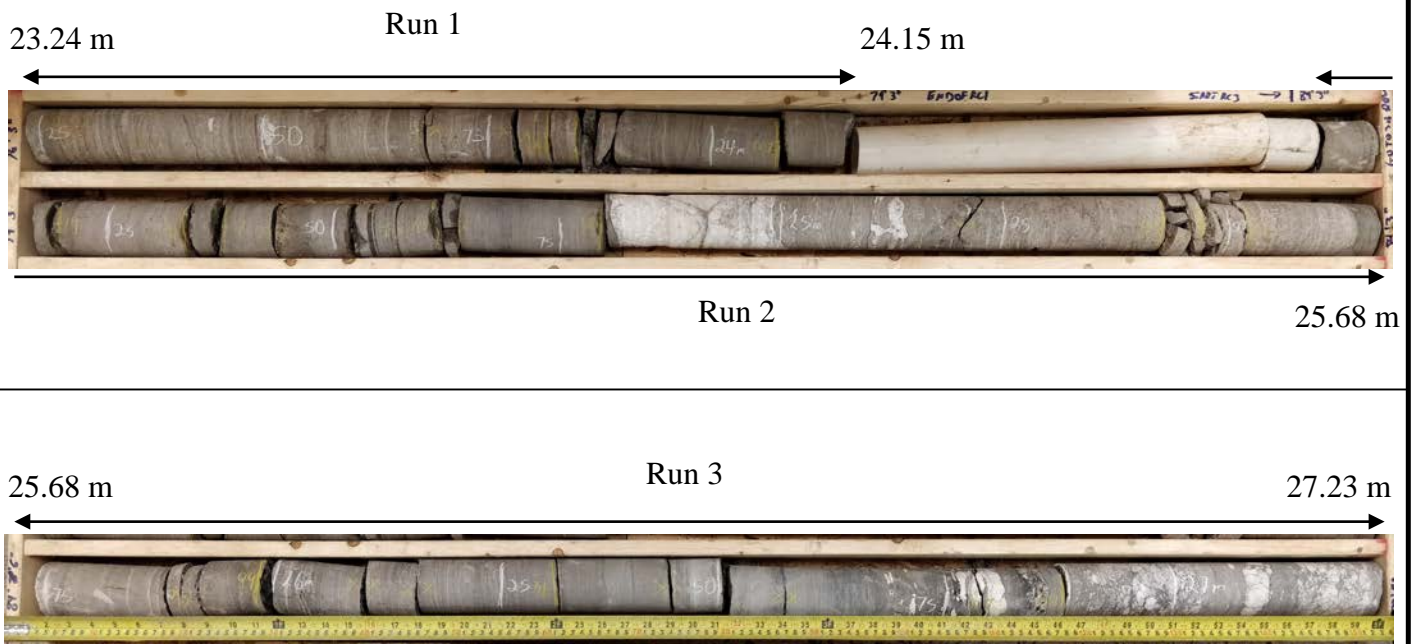
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| REVIEWED | EN | | |
| APPROVED | | | |

Figure C-7




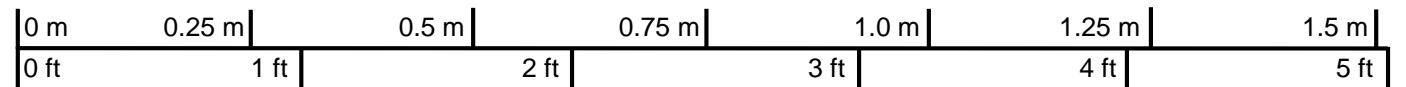
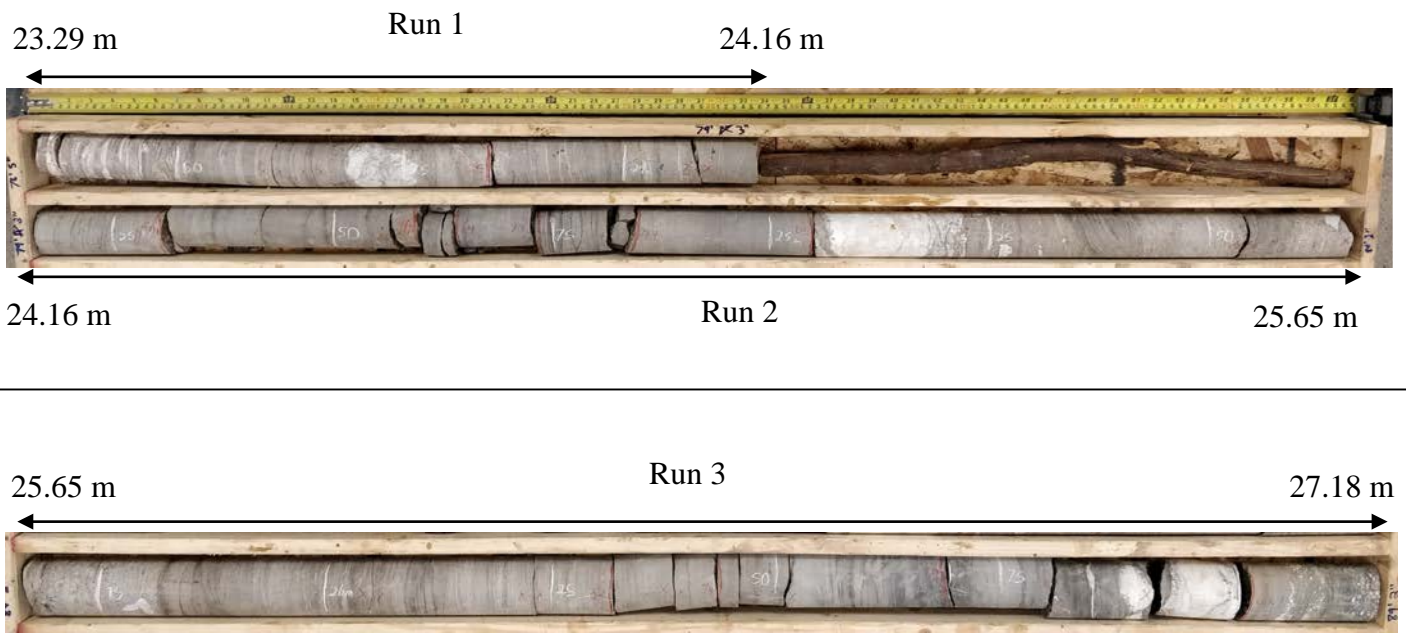
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|--|---------------------|----|-------------|
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| CLIENT AECOM | | | |
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| APPROVED | | | Figure C-8 |




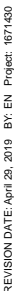
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| | DESIGNED | SE | REV. A |
| | PREPARED | SE | |
| | REVIEWED | EN | |
| APPROVED | | | Figure C-9 |




Scale

| | | | |
|--|---------------------|----|-------------|
| PROJECT HIGH FILL EMBANKMENTS AND RETAINING WALLS QEW BRIDGE REPLACEMENT AND ASSOCIATED HIGHWAY IMPROVEMENTS MINISTRY OF TRANSPORTATION G.W.P. 2116-16-00 | | | |
| CLIENT AECOM | | | |
| TITLE BEDROCK CORE PHOTOGRAPHS – BOREHOLE CN/CP12 | | | |
|  GOLDER | PROJECT NO. 1671430 | | PHASE WO008 |
| | DESIGNED | SE | REV. A |
| | PREPARED | SE | |
| | REVIEWED | EN | |
| APPROVED | | | Figure C-10 |



| | | | | | | |
|------|--------|-------|--------|-------|--------|-------|
| 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 | |

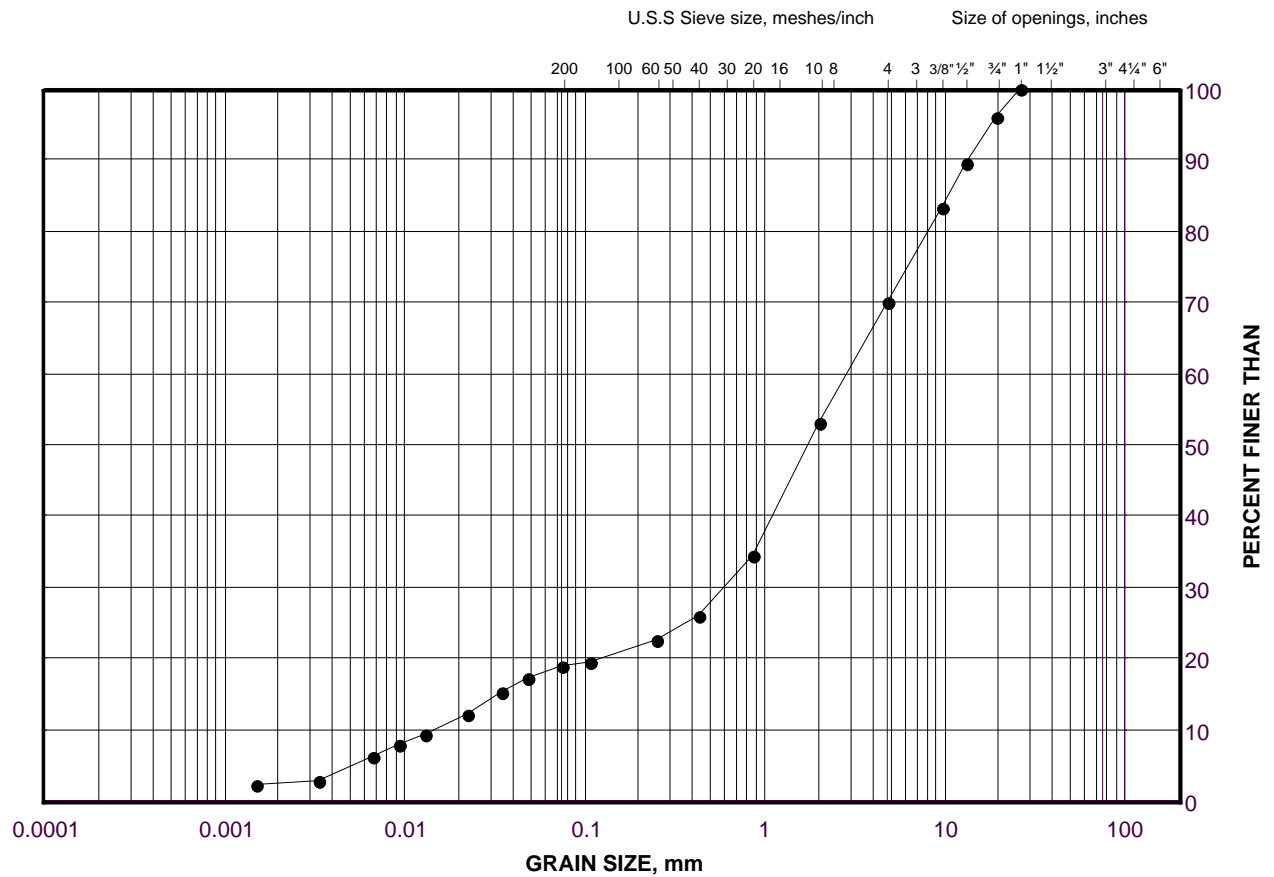
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|  GOLDER | PROJECT NO. 1671430 | PHASE WO008 |
| | DESIGNED SE | REV. A |
| | PREPARED SE | |
| | REVIEWED EN | |
| | APPROVED | |
| | | Figure C-11 |

GRAIN SIZE DISTRIBUTION

Dolomitic Limestone (Bedrock)

FIGURE C-12



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

LEGEND

| SYMBOL | Borehole | SAMPLE | ELEVATION(m) |
|--------|----------|--------|--------------|
| • | C1-1 | 7 | 175.8 |

Project Number: 1671430

Checked By: _____

Golder Associates

Date: 02-May-19

POINT LOAD STRENGTH TEST (ISRM, 1985)

Min W (mm)

A Axial Test

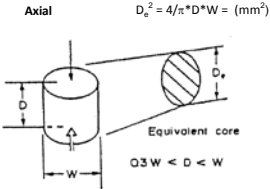
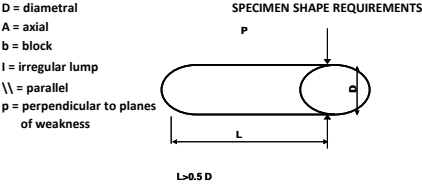
19

D Diametral Test

63

| Test # | Borehole | Rock type | Depth (top) | W | D | Gauge Reading | Load P | D_e^2 | $I_s = P/D_e^2$ | $F = (D_e/50)^{0.45}$ | $I_{s(50)}$ | Type | Valid Test | Remarks |
|--------|----------|-----------|-------------|-----|----|---------------|---------|-----------------|-----------------|-----------------------|-------------|------|------------|---------|
| | | | m | mm | mm | Mpa | MN | mm ² | MPa | | MPa | | | |
| 1 | C1-2 | Limestone | 2.50 | 75 | 46 | 0.36 | 0.00035 | 2116.0 | 0.16 | 0.963 | 0.16 | D | Y | NX core |
| 2 | C1-2 | Limestone | 1.21 | 60 | 46 | 1.74 | 0.00168 | 2116.0 | 0.80 | 0.963 | 0.77 | D | Y | NX core |
| 3 | C1-3 | Limestone | 8.80 | 46 | 45 | 2.52 | 0.00244 | 2635.6 | 0.92 | 1.012 | 0.94 | A | Y | |
| 4 | C3-2 | Limestone | 1.32 | 63 | 55 | 9.14 | 0.00884 | 4411.8 | 2.00 | 1.136 | 2.28 | A | Y | |
| 5 | C3-2 | Limestone | 1.63 | 90 | 63 | 1.02 | 0.00099 | 3969.0 | 0.25 | 1.110 | 0.28 | D | Y | |
| 6 | C3-2 | Limestone | 2.79 | 100 | 63 | 1.44 | 0.00139 | 3969.0 | 0.35 | 1.110 | 0.39 | D | Y | |
| 7 | CN/CP10 | Limestone | 26.44 | 63 | 60 | 9.76 | 0.00944 | 4812.8 | 1.96 | 1.159 | 2.27 | A | Y | |
| 8 | CN/CP10 | Limestone | 24.68 | 95 | 63 | 0.86 | 0.00083 | 3969.0 | 0.21 | 1.110 | 0.23 | D | Y | |
| 9 | CN/CP10 | Limestone | 25.34 | 70 | 63 | 1.16 | 0.00112 | 3969.0 | 0.28 | 1.110 | 0.31 | D | Y | |
| 10 | CN/CP12 | Limestone | 24.58 | 63 | 25 | 16.78 | 0.01623 | 2005.4 | 8.09 | 0.952 | 7.70 | A | Y | |
| 11 | CN/CP12 | Limestone | 26.44 | 63 | 25 | 14.58 | 0.01410 | 2005.4 | 7.03 | 0.952 | 6.69 | A | Y | |
| 12 | CN/CP12 | Limestone | 25.55 | 110 | 63 | 0.18 | 0.00017 | 3969.0 | 0.04 | 1.110 | 0.05 | D | Y | |
| 13 | CN/CP3 | Limestone | 23.39 | 63 | 40 | 18.94 | 0.01831 | 3208.6 | 5.71 | 1.058 | 6.04 | A | Y | |
| 14 | CN/CP3 | Limestone | 24.95 | 100 | 63 | 7.28 | 0.00704 | 3969.0 | 1.77 | 1.110 | 1.97 | D | Y | |
| 15 | CN/CP3 | Limestone | 26.39 | 60 | 63 | 1.02 | 0.00099 | 3969.0 | 0.25 | 1.110 | 0.28 | D | Y | |
| 16 | CN/CP9 | Limestone | 17.47 | 110 | 63 | 11.12 | 0.01075 | 3969.0 | 2.71 | 1.110 | 3.01 | D | Y | |
| 17 | CN/CP9 | Limestone | 18.40 | 63 | 30 | 18.84 | 0.01822 | 2406.4 | 7.57 | 0.991 | 7.51 | A | Y | |
| 18 | CN/CP9 | Limestone | 16.48 | 63 | 45 | 12.30 | 0.01189 | 3609.6 | 3.30 | 1.086 | 3.58 | A | Y | |
| 19 | HF-11 | Limestone | 1.95 | 30 | 46 | 0.30 | 0.00029 | 2116.0 | 0.14 | 0.963 | 0.13 | D | Y | NX core |
| 20 | HF-11 | Limestone | 3.65 | 45 | 46 | 0.68 | 0.00066 | 2116.0 | 0.31 | 0.963 | 0.30 | D | Y | NX core |
| 21 | HF-11 | Limestone | 6.01 | 46 | 20 | 4.90 | 0.00474 | 1171.4 | 4.05 | 0.843 | 3.41 | A | Y | NX core |
| 22 | HF-9 | Limestone | 8.87 | 65 | 46 | 1.82 | 0.00176 | 2116.0 | 0.83 | 0.963 | 0.80 | D | Y | NX core |
| 23 | HF-9 | Limestone | 7.18 | 70 | 46 | 4.86 | 0.00470 | 2116.0 | 2.22 | 0.963 | 2.14 | D | Y | NX core |
| 24 | HF-9 | Limestone | 6.61 | 46 | 35 | 1.54 | 0.00149 | 2049.9 | 0.73 | 0.956 | 0.69 | A | Y | NX core |
| 25 | RW-6 | Limestone | 9.12 | 85 | 46 | 0.38 | 0.00037 | 2116.0 | 0.17 | 0.963 | 0.17 | D | Y | NX core |
| 26 | RW-6 | Limestone | 8.75 | 46 | 35 | 9.04 | 0.00874 | 2049.9 | 4.26 | 0.956 | 4.08 | A | Y | NX core |

$I_{s(50)}$ = Size Corrected Point Load Strength
 F = Size Correction Factor
 $F = (D_e/50)^{0.45}$
 I_s = Uncorrected Point Load Strength
 $I_s = P/D_e^2$
 $I_{s(50)} = F I_s$
 D_e = equivalent core diameter (mm)
 $D_e^2 = D^2$ (mm²)
Ram Area = 9.67 E-04 m²



| | | | |
|--|----|-------------|---|
| PROJECT | | | |
| HIGH FILL EMBANKMENTS AND RETAINING WALLS | | | |
| QEW BRIDGE REPLACEMENT AND ASSOCIATED HIGHWAY IMPROVEMENTS | | | |
| MINISTRY OF TRANSPORTATION G.W.P. 2116-16-00 | | | |
| CLIENT | | | |
| AECOM | | | |
| TITLE | | | |
| POINT LOAD TEST RESULTS | | | |
| PROJECT NO. 1671430 | | PHASE W0008 | |
| DESIGNED | EN | REV | A |
| PREPARED | EN | | |
| REVIEWED | | | |
| APPROVED | | | |
| GOLDER | | | |
| Figure C-13 | | | |

January 22, 2019

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

Re: UCS testing
(Golder Project No. 1671430 WO-1)

Dear Mr. Naylor:

On November 15, 2018 and January 10, 2019 four (4) and five (5) HQ-sized samples were received by Geomechanica Inc. via drop-off by Golder Personnel, respectively. These samples were identified as being from Golder project 1671430 WO-1 (QEW Bertie). From these samples, six (6) UCS tests were completed.

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

Sincerely,



Bryan Tatone Ph.D., P. Eng.

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

Rock Laboratory Testing Results

A report submitted to:

Eric Naylor
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
lab@geomechanica.com

January 22, 2019

Project number: 1671430-WO1

Abstract

This document summarizes the results of rock laboratory testing, including the results of 6 Uniaxial Compressive Strength (UCS) tests. These samples are from a drilling investigation for the QEW Bertie Project (Golder Project No. 1671430-WO1). Results including uniaxial compressive strength (UCS) along with photographs of samples before and after testing are presented herein.

In this document:

| | |
|---------------------------------------|---|
| 1 Uniaxial Compressive Strength Tests | 1 |
| Appendices | 3 |

1 Uniaxial Compressive Strength Tests

1.1 Overview

This section summarizes the results of uniaxial compressive strength (UCS) testing of HQ-sized specimens. 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 0.100 mm/min (Figure 1). The preparation and testing of each specimen 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 sample to obtain cylindrical specimens with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding of specimen to obtain flat (within ± 0.025 mm) and parallel end faces (within 0.25°).
4. Placing specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axially loading the specimens to rupture while continuously recording axial force and axial deformation to determine the peak strength (UCS).



Figure 1: Forney loading frame setup for uniaxial compression testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-08. The side straightness criteria, as checked with a feeler gauge, was met for all samples and the minimum length:diameter criteria was met for all specimens unless noted otherwise in Table 1. Testing of the specimens followed ASTM D7012-14 Method C with the following exceptions:

- Rather than a spherical seat diameter equal to 1 to 2 times the specimen diameter, the setup used here employed a 25.4 mm diameter high precision ball bearing and seat. Despite the smaller diameter, this seat could move freely to accommodate small angular rotations in any direction, as needed, and therefore did not appreciably influence the results.

1.2 Results

The testing results are summarized in Table 1. Please note that additional specimen details and measurements are provided in the summary spreadsheet that accompanies this report.

Table 1: Summary of Uniaxial Compression test results.

| Sample | Depth (m) | Bulk density ρ (g/cm ³) | UCS (MPa) | Lithology | Failure description |
|--------------------|---------------|---|--------------|-----------|------------------------|
| CN-CP3 | 25.96 - 26.22 | 2.703 | 133.2 | Limestone | 1 |
| CN-CP5 | 25.03 - 25.39 | 2.540 | 62.9 | Limestone | 2 |
| CN-CP12 | 23.37 - 23.62 | 2.615 | 92.5 | Limestone | 2 |
| CN-CP6 | 17.88 - 18.08 | 2.696 | 136.9 | Limestone | 3 |
| CN-CP9 | 15.97 - 16.14 | 2.745 | 96.8 | Limestone | 1 |
| CN-CP8 | 16.18 - 16.37 | 2.794 | 215.6 | Limestone | 3 |
| Average | | 2.682 | 123.0 | | |
| Standard deviation | | 0.084 | 48.5 | | |

¹ Inclined shear band failure

² Axial splitting failure

³ Hourglass failure

1.3 Specimen photographs



Photographs of the specimens prior to and after testing are presented in the Appendix.

Appendices


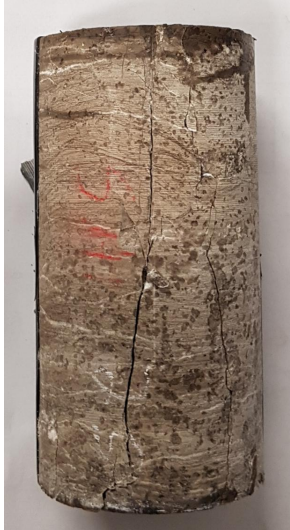
Specimen sheets

- CN-CP3
- CN-CP5
- CN-CP12
- CN-CP6
- CN-CP9
- CN-CP8



Uniaxial Compression Test

| Client | Golder Associates Ltd. | Project | 1671430-WO1 | | | | | | | | | | | | | | |
|--|------------------------|---------------------|---------------|----------------------------|-------|--------------------------|--------|--|-------|-----------|-------|-----------|-----------|----------------------------------|---|---|---|
| Sample | CN-CP3 | Depth | 25.96 - 26.22 | | | | | | | | | | | | | | |
| <table><tr><th colspan="2">Specimen parameters</th></tr><tr><td>Diameter (mm) ^a</td><td>63.20</td></tr><tr><td>Length (mm) ^a</td><td>127.70</td></tr><tr><td>Bulk density ρ (g/cm³)</td><td>2.703</td></tr><tr><td>UCS (MPa)</td><td>133.2</td></tr><tr><td>Lithology</td><td>Limestone</td></tr><tr><td>Failure description ^b</td><td>1</td></tr></table> | | Specimen parameters | | Diameter (mm) ^a | 63.20 | Length (mm) ^a | 127.70 | Bulk density ρ (g/cm ³) | 2.703 | UCS (MPa) | 133.2 | Lithology | Limestone | Failure description ^b | 1 | <p>Prior to testing</p>  | <p>After testing</p>  |
| Specimen parameters | | | | | | | | | | | | | | | | | |
| Diameter (mm) ^a | 63.20 | | | | | | | | | | | | | | | | |
| Length (mm) ^a | 127.70 | | | | | | | | | | | | | | | | |
| Bulk density ρ (g/cm ³) | 2.703 | | | | | | | | | | | | | | | | |
| UCS (MPa) | 133.2 | | | | | | | | | | | | | | | | |
| Lithology | Limestone | | | | | | | | | | | | | | | | |
| Failure description ^b | 1 | | | | | | | | | | | | | | | | |
| <p>^a Additional specimen measurement/details provides in accompanying summary spreadsheet.</p> <p>^b Failure description: ¹ Inclined shear band failure;</p> | | | | | | | | | | | | | | | | | |
| Remarks: | | | | | | | | | | | | | | | | | |
| Performed by | BSAT | Date | 2018-12-18 | | | | | | | | | | | | | | |



Uniaxial Compression Test

| | | | | | | | | | | | | | | | |
|--|------------------------|----------------------------|---------------|--------------------------|--------|--|-------|-----------|------|-----------|-----------|----------------------------------|---|---|---|
| Client | Golder Associates Ltd. | Project | 1671430-WO1 | | | | | | | | | | | | |
| Sample | CN-CP5 | Depth | 25.03 - 25.39 | | | | | | | | | | | | |
| <div><div>Specimen parameters</div><table><tr><td>Diameter (mm)^a</td><td>63.05</td></tr><tr><td>Length (mm)^a</td><td>127.90</td></tr><tr><td>Bulk density ρ (g/cm³)</td><td>2.540</td></tr><tr><td>UCS (MPa)</td><td>62.9</td></tr><tr><td>Lithology</td><td>Limestone</td></tr><tr><td>Failure description^b</td><td>2</td></tr></table></div> | | Diameter (mm) ^a | 63.05 | Length (mm) ^a | 127.90 | Bulk density ρ (g/cm ³) | 2.540 | UCS (MPa) | 62.9 | Lithology | Limestone | Failure description ^b | 2 | <div>Prior to testing</div>  | <div>After testing</div>  |
| Diameter (mm) ^a | 63.05 | | | | | | | | | | | | | | |
| Length (mm) ^a | 127.90 | | | | | | | | | | | | | | |
| Bulk density ρ (g/cm ³) | 2.540 | | | | | | | | | | | | | | |
| UCS (MPa) | 62.9 | | | | | | | | | | | | | | |
| Lithology | Limestone | | | | | | | | | | | | | | |
| Failure description ^b | 2 | | | | | | | | | | | | | | |
| <div><div>^a Additional specimen measurement/details provides in accompanying summary spreadsheet.</div><div>^b Failure description: ² Axial splitting failure;</div></div> | | | | | | | | | | | | | | | |
| Remarks: | | | | | | | | | | | | | | | |
| Performed by | BSAT | Date | 2018-12-18 | | | | | | | | | | | | |



Uniaxial Compression Test

| | | | | | | | | | | | | | | | |
|--|------------------------|----------------------------|---------------|--------------------------|--------|--|-------|-----------|------|-----------|-----------|----------------------------------|---|---|---|
| Client | Golder Associates Ltd. | Project | 1671430-WO1 | | | | | | | | | | | | |
| Sample | CN-CP12 | Depth | 23.37 - 23.62 | | | | | | | | | | | | |
| <div>Specimen parameters</div> <table><tr><td>Diameter (mm)^a</td><td>63.31</td></tr><tr><td>Length (mm)^a</td><td>128.16</td></tr><tr><td>Bulk density ρ (g/cm³)</td><td>2.615</td></tr><tr><td>UCS (MPa)</td><td>92.5</td></tr><tr><td>Lithology</td><td>Limestone</td></tr><tr><td>Failure description^b</td><td>2</td></tr></table> | | Diameter (mm) ^a | 63.31 | Length (mm) ^a | 128.16 | Bulk density ρ (g/cm ³) | 2.615 | UCS (MPa) | 92.5 | Lithology | Limestone | Failure description ^b | 2 | <div>Prior to testing</div>  | <div>After testing</div>  |
| Diameter (mm) ^a | 63.31 | | | | | | | | | | | | | | |
| Length (mm) ^a | 128.16 | | | | | | | | | | | | | | |
| Bulk density ρ (g/cm ³) | 2.615 | | | | | | | | | | | | | | |
| UCS (MPa) | 92.5 | | | | | | | | | | | | | | |
| Lithology | Limestone | | | | | | | | | | | | | | |
| Failure description ^b | 2 | | | | | | | | | | | | | | |
| <div>^a Additional specimen measurement/details provides in accompanying summary spreadsheet.</div> <div>^b Failure description: ² Axial splitting failure;</div> | | | | | | | | | | | | | | | |
| Remarks: | | | | | | | | | | | | | | | |
| Performed by | BSAT | Date | 2018-12-18 | | | | | | | | | | | | |



Uniaxial Compression Test

| | | | | | | | | | | | | | | | |
|---|------------------------|----------------------------|---------------|--------------------------|--------|--|-------|-----------|-------|-----------|-----------|----------------------------------|---|---|---|
| Client | Golder Associates Ltd. | Project | 1671430-WO1 | | | | | | | | | | | | |
| Sample | CN-CP6 | Depth | 17.88 - 18.08 | | | | | | | | | | | | |
| <div><div>Specimen parameters</div><table><tr><td>Diameter (mm)^a</td><td>63.38</td></tr><tr><td>Length (mm)^a</td><td>128.45</td></tr><tr><td>Bulk density ρ (g/cm³)</td><td>2.696</td></tr><tr><td>UCS (MPa)</td><td>136.9</td></tr><tr><td>Lithology</td><td>Limestone</td></tr><tr><td>Failure description^b</td><td>3</td></tr></table></div> | | Diameter (mm) ^a | 63.38 | Length (mm) ^a | 128.45 | Bulk density ρ (g/cm ³) | 2.696 | UCS (MPa) | 136.9 | Lithology | Limestone | Failure description ^b | 3 | <div>Prior to testing</div>  | <div>After testing</div>  |
| Diameter (mm) ^a | 63.38 | | | | | | | | | | | | | | |
| Length (mm) ^a | 128.45 | | | | | | | | | | | | | | |
| Bulk density ρ (g/cm ³) | 2.696 | | | | | | | | | | | | | | |
| UCS (MPa) | 136.9 | | | | | | | | | | | | | | |
| Lithology | Limestone | | | | | | | | | | | | | | |
| Failure description ^b | 3 | | | | | | | | | | | | | | |
| <div><div>^a Additional specimen measurement/details provides in accompanying summary spreadsheet.</div><div>^b Failure description: ³ Hourglass failure;</div></div> | | | | | | | | | | | | | | | |
| Remarks: | | | | | | | | | | | | | | | |
| Performed by | BSAT | Date | 2019-01-17 | | | | | | | | | | | | |

Uniaxial Compression Test

| | | | | | | | | | | | | | | | |
|--|------------------------|----------------------------|---------------|--------------------------|--------|--|-------|-----------|------|-----------|-----------|----------------------------------|---|--|--|
| Client | Golder Associates Ltd. | Project | 1671430-WO1 | | | | | | | | | | | | |
| Sample | CN-CP9 | Depth | 15.97 - 16.14 | | | | | | | | | | | | |
| <div><div>Specimen parameters</div><table><tr><td>Diameter (mm)^a</td><td>63.32</td></tr><tr><td>Length (mm)^a</td><td>127.37</td></tr><tr><td>Bulk density ρ (g/cm³)</td><td>2.745</td></tr><tr><td>UCS (MPa)</td><td>96.8</td></tr><tr><td>Lithology</td><td>Limestone</td></tr><tr><td>Failure description^b</td><td>1</td></tr></table></div> | | Diameter (mm) ^a | 63.32 | Length (mm) ^a | 127.37 | Bulk density ρ (g/cm ³) | 2.745 | UCS (MPa) | 96.8 | Lithology | Limestone | Failure description ^b | 1 | <div>Prior to testing</div> <div></div> | <div>After testing</div> <div></div> |
| Diameter (mm) ^a | 63.32 | | | | | | | | | | | | | | |
| Length (mm) ^a | 127.37 | | | | | | | | | | | | | | |
| Bulk density ρ (g/cm ³) | 2.745 | | | | | | | | | | | | | | |
| UCS (MPa) | 96.8 | | | | | | | | | | | | | | |
| Lithology | Limestone | | | | | | | | | | | | | | |
| Failure description ^b | 1 | | | | | | | | | | | | | | |
| <div><div>^a Additional specimen measurement/details provides in accompanying summary spreadsheet.</div><div>^b Failure description: ¹ Inclined shear band failure;</div></div> | | | | | | | | | | | | | | | |
| Remarks: | | | | | | | | | | | | | | | |
| Performed by | BSAT | Date | 2019-01-17 | | | | | | | | | | | | |

Uniaxial Compression Test

| | | | | | | | | | | | | | | | |
|--|------------------------|----------------------------|---------------|--------------------------|--------|--|-------|-----------|-------|-----------|-----------|----------------------------------|---|---|---|
| Client | Golder Associates Ltd. | Project | 1671430-WO1 | | | | | | | | | | | | |
| Sample | CN-CP8 | Depth | 16.18 - 16.37 | | | | | | | | | | | | |
| <div>Specimen parameters</div> <table><tr><td>Diameter (mm) ^a</td><td>63.27</td></tr><tr><td>Length (mm) ^a</td><td>128.53</td></tr><tr><td>Bulk density ρ (g/cm³)</td><td>2.794</td></tr><tr><td>UCS (MPa)</td><td>215.6</td></tr><tr><td>Lithology</td><td>Limestone</td></tr><tr><td>Failure description ^b</td><td>3</td></tr></table> | | Diameter (mm) ^a | 63.27 | Length (mm) ^a | 128.53 | Bulk density ρ (g/cm ³) | 2.794 | UCS (MPa) | 215.6 | Lithology | Limestone | Failure description ^b | 3 | <div>Prior to testing</div>  | <div>After testing</div>  |
| Diameter (mm) ^a | 63.27 | | | | | | | | | | | | | | |
| Length (mm) ^a | 128.53 | | | | | | | | | | | | | | |
| Bulk density ρ (g/cm ³) | 2.794 | | | | | | | | | | | | | | |
| UCS (MPa) | 215.6 | | | | | | | | | | | | | | |
| Lithology | Limestone | | | | | | | | | | | | | | |
| Failure description ^b | 3 | | | | | | | | | | | | | | |
| <div>^a Additional specimen measurement/details provides in accompanying summary spreadsheet.</div> <div>^b Failure description: ³ Hourglass failure;</div> | | | | | | | | | | | | | | | |
| Remarks: | | | | | | | | | | | | | | | |
| Performed by | BSAT | Date | 2019-01-17 | | | | | | | | | | | | |

APPENDIX D

Maxxam Certificate of Analysis

Your Project #: 1671430-W01
Site Location: BERTIC CNR
Your C.O.C. #: 654003-14-01

Attention: Nikol Kochmanova

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

Report Date: 2018/10/05
Report #: R5429894
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8P6311

Received: 2018/09/28, 19:45

Sample Matrix: Soil
Samples Received: 4

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Reference |
|------------------------------|----------|-------------------|------------------|-------------------|-----------------|
| Chloride (20:1 extract) | 4 | N/A | 2018/10/05 | CAM SOP-00463 | EPA 325.2 m |
| Conductivity | 4 | N/A | 2018/10/04 | CAM SOP-00414 | OMOE E3530 v1 m |
| pH CaCl ₂ EXTRACT | 4 | 2018/10/03 | 2018/10/03 | CAM SOP-00413 | EPA 9045 D m |
| Resistivity of Soil | 4 | 2018/10/02 | 2018/10/04 | CAM SOP-00414 | SM 23 2510 m |
| Sulphate (20:1 Extract) | 4 | N/A | 2018/10/05 | CAM SOP-00464 | EPA 375.4 m |

Remarks:

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

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

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

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

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

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

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

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

Your Project #: 1671430-W01
Site Location: BERTIC CNR
Your C.O.C. #: 654003-14-01

Attention: Nikol Kochmanova

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

Report Date: 2018/10/05
Report #: R5429894
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8P6311

Received: 2018/09/28, 19:45

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ema Gitej, Senior Project Manager

Email: EGitej@maxxam.ca

Phone# (905)817-5829

=====

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

SOIL CORROSIVITY PACKAGE (SOIL)

| | | | | | | | | | | |
|----------------------|--------------|-------------------|------------|--------------------|------------|--------------------|-----------------|----------------------------|------------|-----------------|
| Maxxam ID | | HWS185 | | HWS186 | | HWS187 | | HWS187 | | |
| Sampling Date | | 2018/08/27 | | 2018/08/23 | | 2018/08/18 | | 2018/08/18 | | |
| COC Number | | 654003-14-01 | | 654003-14-01 | | 654003-14-01 | | 654003-14-01 | | |
| | UNITS | CNCP3-SA12 | RDL | CNCP12-SA11 | RDL | CNCP11-SA15 | QC Batch | CNCP11-SA15 Lab-Dup | RDL | QC Batch |

| | | | | | | | | | | |
|--|---------|------|-----|------|----|------|---------|-----|----|---------|
| Calculated Parameters | | | | | | | | | | |
| Resistivity | ohm-cm | 680 | | 3400 | | 1600 | 5761982 | | | |
| Inorganics | | | | | | | | | | |
| Soluble (20:1) Chloride (Cl-) | ug/g | <20 | 20 | <20 | 20 | <20 | 5766534 | <20 | 20 | 5766534 |
| Conductivity | umho/cm | 1470 | 2 | 297 | 2 | 618 | 5765367 | 614 | 2 | 5765367 |
| Available (CaCl2) pH | pH | 7.91 | | 7.89 | | 7.91 | 5764259 | | | |
| Soluble (20:1) Sulphate (SO4) | ug/g | 2900 | 200 | 180 | 20 | 810 | 5766535 | 800 | 40 | 5766535 |
| RDL = Reportable Detection Limit | | | | | | | | | | |
| QC Batch = Quality Control Batch | | | | | | | | | | |
| Lab-Dup = Laboratory Initiated Duplicate | | | | | | | | | | |

| | | | | |
|----------------------|--------------|---------------------|------------|-----------------|
| Maxxam ID | | HWS188 | | |
| Sampling Date | | 2018/08/21 | | |
| COC Number | | 654003-14-01 | | |
| | UNITS | CNCP5-SA5-AB | RDL | QC Batch |

| | | | | |
|----------------------------------|---------|------|----|---------|
| Calculated Parameters | | | | |
| Resistivity | ohm-cm | 730 | | 5761982 |
| Inorganics | | | | |
| Soluble (20:1) Chloride (Cl-) | ug/g | 39 | 20 | 5766534 |
| Conductivity | umho/cm | 1370 | 2 | 5765367 |
| Available (CaCl2) pH | pH | 7.46 | | 5764259 |
| Soluble (20:1) Sulphate (SO4) | ug/g | 1400 | 60 | 5766535 |
| RDL = Reportable Detection Limit | | | | |
| QC Batch = Quality Control Batch | | | | |

TEST SUMMARY

Maxxam ID: HWS185
Sample ID: CNCP3-SA12
Matrix: Soil

Collected: 2018/08/27
Shipped:
Received: 2018/09/28

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|--------------------------|
| Chloride (20:1 extract) | KONE/EC | 5766534 | N/A | 2018/10/05 | Deonarine Ramnarine |
| Conductivity | AT | 5765367 | N/A | 2018/10/04 | Barbara Kalbasi Esfahani |
| pH CaCl2 EXTRACT | AT | 5764259 | 2018/10/03 | 2018/10/03 | Gnana Thomas |
| Resistivity of Soil | | 5761982 | 2018/10/04 | 2018/10/04 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5766535 | N/A | 2018/10/05 | Deonarine Ramnarine |

Maxxam ID: HWS186
Sample ID: CNCP12-SA11
Matrix: Soil

Collected: 2018/08/23
Shipped:
Received: 2018/09/28

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|--------------------------|
| Chloride (20:1 extract) | KONE/EC | 5766534 | N/A | 2018/10/05 | Deonarine Ramnarine |
| Conductivity | AT | 5765367 | N/A | 2018/10/04 | Barbara Kalbasi Esfahani |
| pH CaCl2 EXTRACT | AT | 5764259 | 2018/10/03 | 2018/10/03 | Gnana Thomas |
| Resistivity of Soil | | 5761982 | 2018/10/04 | 2018/10/04 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5766535 | N/A | 2018/10/05 | Deonarine Ramnarine |

Maxxam ID: HWS187
Sample ID: CNCP11-SA15
Matrix: Soil

Collected: 2018/08/18
Shipped:
Received: 2018/09/28

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|--------------------------|
| Chloride (20:1 extract) | KONE/EC | 5766534 | N/A | 2018/10/05 | Deonarine Ramnarine |
| Conductivity | AT | 5765367 | N/A | 2018/10/04 | Barbara Kalbasi Esfahani |
| pH CaCl2 EXTRACT | AT | 5764259 | 2018/10/03 | 2018/10/03 | Gnana Thomas |
| Resistivity of Soil | | 5761982 | 2018/10/04 | 2018/10/04 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5766535 | N/A | 2018/10/05 | Deonarine Ramnarine |

Maxxam ID: HWS187 Dup
Sample ID: CNCP11-SA15
Matrix: Soil

Collected: 2018/08/18
Shipped:
Received: 2018/09/28

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|-----------|---------------|--------------------------|
| Chloride (20:1 extract) | KONE/EC | 5766534 | N/A | 2018/10/05 | Deonarine Ramnarine |
| Conductivity | AT | 5765367 | N/A | 2018/10/04 | Barbara Kalbasi Esfahani |
| Sulphate (20:1 Extract) | KONE/EC | 5766535 | N/A | 2018/10/05 | Deonarine Ramnarine |

Maxxam ID: HWS188
Sample ID: CNCP5-SA5-AB
Matrix: Soil

Collected: 2018/08/21
Shipped:
Received: 2018/09/28

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|--------------------------|
| Chloride (20:1 extract) | KONE/EC | 5766534 | N/A | 2018/10/05 | Deonarine Ramnarine |
| Conductivity | AT | 5765367 | N/A | 2018/10/04 | Barbara Kalbasi Esfahani |
| pH CaCl2 EXTRACT | AT | 5764259 | 2018/10/03 | 2018/10/03 | Gnana Thomas |

Maxxam Job #: B8P6311
Report Date: 2018/10/05

Golder Associates Ltd
Client Project #: 1671430-W01
Site Location: BERTIC CNR
Sampler Initials: CN

TEST SUMMARY

Maxxam ID: HWS188
Sample ID: CNCP5-SA5-AB
Matrix: Soil

Collected: 2018/08/21
Shipped:
Received: 2018/09/28

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Resistivity of Soil | | 5761982 | 2018/10/04 | 2018/10/04 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5766535 | N/A | 2018/10/05 | Deonarine Ramnarine |

GENERAL COMMENTS

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

| | |
|-----------|--------|
| Package 1 | -0.7°C |
|-----------|--------|

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1671430-W01
Site Location: BERTIC CNR
Sampler Initials: CN

| QC Batch | Parameter | Date | Matrix Spike | | SPIKED BLANK | | Method Blank | | RPD | |
|----------|--|------------|--------------|-----------|--------------|-----------|--------------|---------|-----------|-----------|
| | | | % Recovery | QC Limits | % Recovery | QC Limits | Value | UNITS | Value (%) | QC Limits |
| 5764259 | Available (CaCl ₂) pH | 2018/10/03 | | | 100 | 97 - 103 | | | 0.028 | N/A |
| 5765367 | Conductivity | 2018/10/04 | | | 104 | 90 - 110 | <2 | umho/cm | 0.65 | 10 |
| 5766534 | Soluble (20:1) Chloride (Cl ⁻) | 2018/10/05 | 109 | 70 - 130 | 103 | 70 - 130 | <20 | ug/g | NC | 35 |
| 5766535 | Soluble (20:1) Sulphate (SO ₄) | 2018/10/05 | NC | 70 - 130 | 104 | 70 - 130 | <20 | ug/g | 0.39 | 35 |

N/A = Not Applicable

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

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

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

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

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

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

VALIDATION SIGNATURE PAGE

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

Cristina Carriere

Cristina Carriere, Scientific Service Specialist

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

| INVOICE TO: | | | | | | REPORT TO: | | | | | | PROJECT INFORMATION: | | | | | | Laboratory Use Only: | | | | | | | | | | | |
|--|--------------------------------|--------------|--------------|--------|--|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Company Name #1326 Golder Associates Ltd. | | | | | | Company Name Golder Associates Ltd. | | | | | | Quotation #: B00633 | | | | | | Maxxam Job #: | | | | | | Bottle Order #: | | | | | |
| Attention Accounts Payable | | | | | | Attention Boris Crowe Nikol Kochmanova | | | | | | P.O.#: | | | | | | Barcode 654003 | | | | | | | | | | | |
| Address 6925 Century Ave Suite 100 Mississauga ON L5N 7K2 | | | | | | Address 6925 Century Ave Suite 100 Mississauga ON | | | | | | Project: 1668075 1671430-WOI | | | | | | | | | | | | | | | | | |
| Tel (905) 567-4444 x Fax (905) 567-6561 x | | | | | | Tel (905) 567-6100 x 2134 | | | | | | Project Name Bertie CNR | | | | | | COC #: | | | | | | Project Manager: | | | | | |
| Email AP_CustomerService@golder.com | | | | | | Email bcrowe@golder.com Nikol.Kochmanova@golder.com | | | | | | Site # golder.com | | | | | | Barcode C#654003-14-01 | | | | | | Ema Gitej | | | | | |
| MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Regulation 153 (2011) <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table _____ | | | | | | | | | | | | Other Regulations <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA Municipality _____ <input type="checkbox"/> PWQO <input type="checkbox"/> Other _____ | | | | | | Special Instructions | | | | | | ANALYSIS REQUESTED (PLEASE BE SPECIFIC) | | | | | |
| Include Criteria on Certificate of Analysis (Y/N)? | | | | | | | | | | | | Field Filtered (please circle): Metals / Hg / Cr VI | | | | | | Corrosivity Package (pH, sulphate, chloride, resistivity, conduct) | | | | | | | | | | | |
| Sample Barcode Label | Sample Location Identification | Date Sampled | Time Sampled | Matrix | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 — | CNCP3-SA12 | 2018/08/27 | PM | SOIL | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 — | CNCPA-SA11 | 2018/08/23 | PM | SOIL | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 — | CNCP11-SA15 | 2018/08/18 | PM | SOIL | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 — | CNCP5-SA5-AB | 2018/08/21 | AM | SOIL | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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 #)

* RELINQUISHED BY: (Signature/Print) Kate Neo Kachhar Date: 18/09/28 Time: 7:44 AM RECEIVED BY: (Signature/Print) [Signature] Date: 20/09/28 Time: 19:45
 # jars used and not submitted Laboratory Use Only
 Time Sensitive Temperature (°C) on Receipt Custody Seal Present Yes No
 -1/-10 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

Your Project #: 1671430WO001
Site Location: QEW BERTIE
Your C.O.C. #: 641804-08-01

Attention: Nikol Kochmanova

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

Report Date: 2018/12/12
Report #: R5522750
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8W6726

Received: 2018/12/06, 12:29

Sample Matrix: Soil
Samples Received: 5

| Analyses | Date | | Date Analyzed | Laboratory Method | Reference |
|------------------------------|----------|------------|---------------|-------------------|-----------------|
| | Quantity | Extracted | | | |
| Chloride (20:1 extract) | 5 | N/A | 2018/12/12 | CAM SOP-00463 | EPA 325.2 m |
| Conductivity | 5 | N/A | 2018/12/12 | CAM SOP-00414 | OMOE E3530 v1 m |
| pH CaCl ₂ EXTRACT | 5 | 2018/12/11 | 2018/12/11 | CAM SOP-00413 | EPA 9045 D m |
| Resistivity of Soil | 5 | 2018/12/06 | 2018/12/12 | CAM SOP-00414 | SM 23 2510 m |
| Sulphate (20:1 Extract) | 5 | N/A | 2018/12/12 | CAM SOP-00464 | EPA 375.4 m |

Remarks:

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

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

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

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

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

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

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

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

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager

Your Project #: 1671430WO001
Site Location: QEW BERTIE
Your C.O.C. #: 641804-08-01

Attention: Nikol Kochmanova

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

Report Date: 2018/12/12
Report #: R5522750
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8W6726

Received: 2018/12/06, 12:29

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.

SOIL CORROSIVITY PACKAGE (SOIL)

| | | | | | | | | | | | |
|----------------------|--------------|------------------------|------------|------------------------|------------|------------------------|------------------------|------------|------------------------|------------|-----------------|
| Maxxam ID | | IMF686 | | IMF687 | | IMF688 | IMF689 | | IMF690 | | |
| Sampling Date | | 2018/11/20 | | 2018/11/28 | | 2018/11/22 | 2018/11/23 | | 2018/11/29 | | |
| COC Number | | 641804-08-01 | | 641804-08-01 | | 641804-08-01 | 641804-08-01 | | 641804-08-01 | | |
| | UNITS | CN/CP 2 SA6 | RDL | CN/CP 6 SA5 | RDL | CN/CP 7 SA2 | CN/CP 8 SA3 | RDL | CN/CP 9 SA4 | RDL | QC Batch |

Calculated Parameters

| | | | | | | | | | | | |
|-------------|--------|-----|--|-----|--|-----|------|--|-----|--|---------|
| Resistivity | ohm-cm | 870 | | 420 | | 980 | 1500 | | 300 | | 5875238 |
|-------------|--------|-----|--|-----|--|-----|------|--|-----|--|---------|

Inorganics

| | | | | | | | | | | | |
|-------------------------------|---------|------|----|------|-----|------|------|----|------|-----|---------|
| Soluble (20:1) Chloride (Cl-) | ug/g | <20 | 20 | 30 | 20 | 480 | 88 | 20 | 310 | 20 | 5882065 |
| Conductivity | umho/cm | 1150 | 2 | 2370 | 2 | 1020 | 667 | 2 | 3300 | 2 | 5882455 |
| Available (CaCl2) pH | pH | 8.00 | | 7.83 | | 7.75 | 7.78 | | 7.86 | | 5882163 |
| Soluble (20:1) Sulphate (SO4) | ug/g | 1300 | 60 | 2900 | 100 | 140 | 390 | 20 | 7400 | 200 | 5882077 |

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

| | | | |
|--|--------------|------------------------------------|-----------------|
| Maxxam ID | | IMF690 | |
| Sampling Date | | 2018/11/29 | |
| COC Number | | 641804-08-01 | |
| | UNITS | CN/CP 9 SA4 Lab-Dup | QC Batch |
| Inorganics | | | |
| Available (CaCl2) pH | pH | 7.70 | 5882163 |
| QC Batch = Quality Control Batch | | | |
| Lab-Dup = Laboratory Initiated Duplicate | | | |

TEST SUMMARY

Maxxam ID: IMF686
Sample ID: CN/CP 2 SA6
Matrix: Soil

Collected: 2018/11/20
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5882065 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5882455 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5882163 | 2018/12/11 | 2018/12/11 | Gnana Thomas |
| Resistivity of Soil | | 5875238 | 2018/12/12 | 2018/12/12 | Brad Newman |
| Sulphate (20:1 Extract) | KONE/EC | 5882077 | N/A | 2018/12/12 | Alina Dobreanu |

Maxxam ID: IMF687
Sample ID: CN/CP 6 SA5
Matrix: Soil

Collected: 2018/11/28
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5882065 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5882455 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5882163 | 2018/12/11 | 2018/12/11 | Gnana Thomas |
| Resistivity of Soil | | 5875238 | 2018/12/12 | 2018/12/12 | Brad Newman |
| Sulphate (20:1 Extract) | KONE/EC | 5882077 | N/A | 2018/12/12 | Alina Dobreanu |

Maxxam ID: IMF688
Sample ID: CN/CP 7 SA2
Matrix: Soil

Collected: 2018/11/22
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5882065 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5882455 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5882163 | 2018/12/11 | 2018/12/11 | Gnana Thomas |
| Resistivity of Soil | | 5875238 | 2018/12/12 | 2018/12/12 | Brad Newman |
| Sulphate (20:1 Extract) | KONE/EC | 5882077 | N/A | 2018/12/12 | Alina Dobreanu |

Maxxam ID: IMF689
Sample ID: CN/CP 8 SA3
Matrix: Soil

Collected: 2018/11/23
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5882065 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5882455 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5882163 | 2018/12/11 | 2018/12/11 | Gnana Thomas |
| Resistivity of Soil | | 5875238 | 2018/12/12 | 2018/12/12 | Brad Newman |
| Sulphate (20:1 Extract) | KONE/EC | 5882077 | N/A | 2018/12/12 | Alina Dobreanu |

Maxxam ID: IMF690
Sample ID: CN/CP 9 SA4
Matrix: Soil

Collected: 2018/11/29
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|-----------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5882065 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5882455 | N/A | 2018/12/12 | Kazzandra Adeva |

Maxxam Job #: B8W6726
Report Date: 2018/12/12

Golder Associates Ltd
Client Project #: 1671430WO001
Site Location: QEW BERTIE
Sampler Initials: LKE

TEST SUMMARY

Maxxam ID: IMF690
Sample ID: CN/CP 9 SA4
Matrix: Soil

Collected: 2018/11/29
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|----------------|
| pH CaCl2 EXTRACT | AT | 5882163 | 2018/12/11 | 2018/12/11 | Gnana Thomas |
| Resistivity of Soil | | 5875238 | 2018/12/12 | 2018/12/12 | Brad Newman |
| Sulphate (20:1 Extract) | KONE/EC | 5882077 | N/A | 2018/12/12 | Alina Dobreanu |

Maxxam ID: IMF690 Dup
Sample ID: CN/CP 9 SA4
Matrix: Soil

Collected: 2018/11/29
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|------------------|-----------------|---------|------------|---------------|--------------|
| pH CaCl2 EXTRACT | AT | 5882163 | 2018/12/11 | 2018/12/11 | Gnana Thomas |

GENERAL COMMENTS

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

| | |
|-----------|-------|
| Package 1 | 5.3°C |
|-----------|-------|

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1671430WO001
Site Location: QEW BERTIE
Sampler Initials: LKE

| QC Batch | Parameter | Date | Matrix Spike | | SPIKED BLANK | | Method Blank | | RPD | |
|----------|--|------------|--------------|-----------|--------------|-----------|--------------|---------|-----------|-----------|
| | | | % Recovery | QC Limits | % Recovery | QC Limits | Value | UNITS | Value (%) | QC Limits |
| 5882065 | Soluble (20:1) Chloride (Cl ⁻) | 2018/12/12 | NC | 70 - 130 | 100 | 70 - 130 | <20 | ug/g | 0.59 | 35 |
| 5882077 | Soluble (20:1) Sulphate (SO ₄) | 2018/12/12 | NC | 70 - 130 | 96 | 70 - 130 | <20 | ug/g | NC | 35 |
| 5882163 | Available (CaCl ₂) pH | 2018/12/11 | | | 100 | 97 - 103 | | | 2.1 | N/A |
| 5882455 | Conductivity | 2018/12/12 | | | 104 | 90 - 110 | <2 | umho/cm | 0.13 | 10 |

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)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference $\leq 2 \times \text{RDL}$).

VALIDATION SIGNATURE PAGE

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



Brad Newman, Scientific Service 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.

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|---|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|--|--|-------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-----------------------------------|--|--|--|--|--|--|--|--|--|--|--|-----------|--|--|--|--|--|--|--|--|--|--|--|
| Maxxam Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campbell Road, Mississauga, Ontario Canada L5N 2L8 Tel: (905) 817-5700 Toll-free 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca | | | | | | CHAIN OF CUSTODY RECORD Page of | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVOICE TO: | | | | | | REPORT TO: | | | | | | PROJECT INFORMATION: | | | | | | Laboratory Use Only: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Company Name: #1326 Golder Associates Ltd Attention: Accounts Payable Address: 6925 Century Ave Suite 100 Mississauga ON L5N 7K2 Tel: (905) 567-4444 x Fax: (905) 567-6561 x Email: AP_CustomerService@golder.com | | | | | | Company Name: N. Kol Kochmanova Attention: N. Kol Kochmanova Address: 905 567 6100 x 2134 Tel: 905 567 6100 x 2134 Email: n.kol.kochmanova@golder.com | | | | | | Quotation #: B70916 P.O. #: 1671430 WD 001 Project: QEW Bertie Project Name: QEW Bertie Site #: LK/EN Sampled By: LK/EN | | | | | | Maxxam Job #: 641804 Bottle Order #: 641804 COC #: 641804-08-01 Project Manager: Ema Gitej | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY | | | | | | | | | | | | ANALYSIS REQUESTED (PLEASE BE SPECIFIC) | | | | | | | | | | | | Turnaround Time (TAT) Required: Please provide advance notice for rush projects | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Regulation 153 (2011) <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table | | | | | | | | | | | | Other Regulations <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA Municipality <input type="checkbox"/> PWQO <input type="checkbox"/> Other | | | | | | | | | | | | Special Instructions | | | | | | | | | | | | Field Filtered (please circle): Metals / Hg / Cr VI Composite Package pH, Sulphate, Chlorides Resistivity, Conductivity | | | | | | | | | | | | 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. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Include Criteria on Certificate of Analysis (Y/N)? | | | | | | | | | | | | Job Specific Rush TAT (if applies to entire submission) Date Required: Time Required: <input type="checkbox"/> Rush Confirmation Number: (call lab for #) | | | | | | | | | | | | # of Bottles Comments | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sample Barcode Label | | | | | | | | | | | | Sample (Location) Identification | | | | | | | | | | | | Date Sampled | | | | | | | | | | | | Time Sampled | | | | | | | | | | | | Matrix | | | | | | | | | | | | Field Filtered (please circle): Metals / Hg / Cr VI Composite Package pH, Sulphate, Chlorides Resistivity, Conductivity | | | | | | | | | | | | # of Bottles | | | | | | | | | | | | Comments | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | CN/ICP 2 SA6 | | | | | | | | | | | | Nov 20, 18 | | | | | | | | | | | | AM | | | | | | | | | | | | Soil | | | | | | | | | | | | X | | | | | | | | | | | | 1 | | | | | | | | | | | | Standard Corrosivity Package | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | CN/ICP 6 SAS | | | | | | | | | | | | Nov 28, 18 | | | | | | | | | | | | PM | | | | | | | | | | | | ↓ | | | | | | | | | | | | X | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | CN/ICP 7 SA2 | | | | | | | | | | | | Nov 22, 18 | | | | | | | | | | | | AM | | | | | | | | | | | | ↓ | | | | | | | | | | | | X | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | CN/ICP 8 SA3 | | | | | | | | | | | | Nov 23, 18 | | | | | | | | | | | | AM | | | | | | | | | | | | ↓ | | | | | | | | | | | | X | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | CN/ICP 9 SA4 | | | | | | | | | | | | Nov 29, 18 | | | | | | | | | | | | PM | | | | | | | | | | | | ↓ | | | | | | | | | | | | X | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * RELINQUISHED BY: (Signature/Print) Eric Naylor | | | | | | | | | | | | Date: (YY/MM/DD) 18/12/06 | | | | | | | | | | | | Time 12:15 | | | | | | | | | | | | RECEIVED BY: (Signature/Print) K. Van Ganssen | | | | | | | | | | | | Date: (YY/MM/DD) 20/12/06 | | | | | | | | | | | | Time 12:29 | | | | | | | | | | | | # jars used and not submitted | | | | | | | | | | | | Laboratory Use Only Time Sensitive Temperature (°C) on Reel 2/3/5 | | | | | | | | | | | | Custody Seal Present Intact | | | | | | | | | | | | Yes No | | | | | | | | | | | |
| * 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Your Project #: 1671430-W08
Site Location: QEW BERTIE - DETAILED DESIGN
Your C.O.C. #: 674002-02-01

Attention: Nikol Kochmanova

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

Report Date: 2018/12/12
Report #: R5522878
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8W6738

Received: 2018/12/06, 12:29

Sample Matrix: ROCK
Samples Received: 2

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Reference |
|-------------------------|----------|-------------------|------------------|-------------------|-----------------|
| Chloride (20:1 extract) | 2 | N/A | 2018/12/12 | CAM SOP-00463 | EPA 325.2 m |
| Conductivity | 2 | N/A | 2018/12/12 | CAM SOP-00414 | OMOE E3530 v1 m |
| pH CaCl2 EXTRACT | 2 | 2018/12/12 | 2018/12/12 | CAM SOP-00413 | EPA 9045 D m |
| Resistivity of Soil | 2 | 2018/12/11 | 2018/12/12 | CAM SOP-00414 | SM 23 2510 m |
| Sulphate (20:1 Extract) | 2 | N/A | 2018/12/12 | CAM SOP-00464 | EPA 375.4 m |

Sample Matrix: Soil
Samples Received: 7

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Reference |
|-------------------------|----------|-------------------|------------------|-------------------|-----------------|
| Chloride (20:1 extract) | 7 | N/A | 2018/12/12 | CAM SOP-00463 | EPA 325.2 m |
| Conductivity | 7 | N/A | 2018/12/12 | CAM SOP-00414 | OMOE E3530 v1 m |
| pH CaCl2 EXTRACT | 7 | 2018/12/12 | 2018/12/12 | CAM SOP-00413 | EPA 9045 D m |
| Resistivity of Soil | 7 | 2018/12/11 | 2018/12/12 | CAM SOP-00414 | SM 23 2510 m |
| Sulphate (20:1 Extract) | 7 | N/A | 2018/12/12 | CAM SOP-00464 | EPA 375.4 m |

Remarks:

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

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

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

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

Your Project #: 1671430-W08
Site Location: QEW BERTIE - DETAILED DESIGN
Your C.O.C. #: 674002-02-01

Attention: Nikol Kochmanova

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

Report Date: 2018/12/12
Report #: R5522878
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8W6738

Received: 2018/12/06, 12:29

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

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

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

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

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ema Gitej, Senior Project Manager

Email: EGitej@maxxam.ca

Phone# (905)817-5829

=====

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

SOIL CORROSIVITY PACKAGE (ROCK)

| | | | | | |
|----------------------------------|--------------|--------------|--------------|------------|-----------------|
| Maxxam ID | | IMF770 | IMF771 | | |
| Sampling Date | | 2018/09/05 | 2018/09/24 | | |
| COC Number | | 674002-02-01 | 674002-02-01 | | |
| | UNITS | C2-1 | C3-1 | RDL | QC Batch |
| Calculated Parameters | | | | | |
| Resistivity | ohm-cm | 3800 | 5600 | | 5882461 |
| Inorganics | | | | | |
| Soluble (20:1) Chloride (Cl-) | ug/g | 53 | 23 | 20 | 5883825 |
| Conductivity | umho/cm | 260 | 179 | 2 | 5883994 |
| Available (CaCl2) pH | pH | 8.22 | 7.94 | | 5883840 |
| Soluble (20:1) Sulphate (SO4) | ug/g | <20 | <20 | 20 | 5883826 |
| RDL = Reportable Detection Limit | | | | | |
| QC Batch = Quality Control Batch | | | | | |

SOIL CORROSIVITY PACKAGE (SOIL)

| | | | | | | | | |
|----------------------|--------------|-----------------|----------------|-----------------|----------------|------------------|------------|-----------------|
| Maxxam ID | | IMF764 | IMF765 | IMF766 | IMF767 | IMF768 | | |
| Sampling Date | | 2018/09/21 | 2018/09/19 | 2018/09/19 | 2018/09/19 | 2018/09/21 | | |
| COC Number | | 674002-02-01 | 674002-02-01 | 674002-02-01 | 674002-02-01 | 674002-02-01 | | |
| | UNITS | RW4A_SA3 | RW5_SA8 | RW7_SA5B | RW9_SA6 | RW-10_SA7 | RDL | QC Batch |

| | | | | | | | | |
|----------------------------------|---------|------|------|------|------|------|----|---------|
| Calculated Parameters | | | | | | | | |
| Resistivity | ohm-cm | 610 | 2100 | 3300 | 1600 | 710 | | 5882461 |
| Inorganics | | | | | | | | |
| Soluble (20:1) Chloride (Cl-) | ug/g | 810 | 200 | 95 | 340 | 660 | 20 | 5883825 |
| Conductivity | umho/cm | 1640 | 483 | 302 | 623 | 1400 | 2 | 5883994 |
| Available (CaCl2) pH | pH | 8.02 | 7.71 | 7.84 | 7.87 | 7.89 | | 5883840 |
| Soluble (20:1) Sulphate (SO4) | ug/g | 120 | 81 | <20 | 39 | 88 | 20 | 5883826 |
| RDL = Reportable Detection Limit | | | | | | | | |
| QC Batch = Quality Control Batch | | | | | | | | |

| | | | | | | | | | | |
|----------------------|--------------|------------------------------|------------|-----------------|-----------------|-----------------|------------|-----------------|-----------------------------|-----------------|
| Maxxam ID | | IMF768 | | | IMF769 | IMF772 | | | IMF772 | |
| Sampling Date | | 2018/09/21 | | | 2018/09/04 | 2018/09/27 | | | 2018/09/27 | |
| COC Number | | 674002-02-01 | | | 674002-02-01 | 674002-02-01 | | | 674002-02-01 | |
| | UNITS | RW-10_SA7 Lab-Dup | RDL | QC Batch | C1-1_AS1 | C7-1 SA5 | RDL | QC Batch | C7-1 SA5 Lab-Dup | QC Batch |

| | | | | | | | | | | |
|--|---------|------|----|---------|------|------|----|---------|------|---------|
| Calculated Parameters | | | | | | | | | | |
| Resistivity | ohm-cm | | | | 2000 | 1200 | | 5882461 | | |
| Inorganics | | | | | | | | | | |
| Soluble (20:1) Chloride (Cl-) | ug/g | 650 | 20 | 5883825 | 150 | 330 | 20 | 5883825 | | |
| Conductivity | umho/cm | 1390 | 2 | 5883994 | 504 | 858 | 2 | 5883994 | | |
| Available (CaCl2) pH | pH | | | | 8.06 | 7.92 | | 5883840 | 8.02 | 5883840 |
| Soluble (20:1) Sulphate (SO4) | ug/g | | | | 110 | 270 | 20 | 5883826 | | |
| RDL = Reportable Detection Limit | | | | | | | | | | |
| QC Batch = Quality Control Batch | | | | | | | | | | |
| Lab-Dup = Laboratory Initiated Duplicate | | | | | | | | | | |

TEST SUMMARY

Maxxam ID: IMF764
Sample ID: RW4A_SA3
Matrix: Soil

Collected: 2018/09/21
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam ID: IMF765
Sample ID: RW5_SA8
Matrix: Soil

Collected: 2018/09/19
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam ID: IMF766
Sample ID: RW7_SA5B
Matrix: Soil

Collected: 2018/09/19
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam ID: IMF767
Sample ID: RW9_SA6
Matrix: Soil

Collected: 2018/09/19
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam ID: IMF768
Sample ID: RW-10_SA7
Matrix: Soil

Collected: 2018/09/21
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|-----------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |

TEST SUMMARY

Maxxam ID: IMF768
Sample ID: RW-10_SA7
Matrix: Soil

Collected: 2018/09/21
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam ID: IMF768 Dup
Sample ID: RW-10_SA7
Matrix: Soil

Collected: 2018/09/21
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|-----------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |

Maxxam ID: IMF769
Sample ID: C1-1_AS1
Matrix: Soil

Collected: 2018/09/04
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam ID: IMF770
Sample ID: C2-1
Matrix: ROCK

Collected: 2018/09/05
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam ID: IMF771
Sample ID: C3-1
Matrix: ROCK

Collected: 2018/09/24
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam Job #: B8W6738
Report Date: 2018/12/12

Golder Associates Ltd
Client Project #: 1671430-W08
Site Location: QEW BERTIE - DETAILED DESIGN
Sampler Initials: JK

TEST SUMMARY

Maxxam ID: IMF772
Sample ID: C7-1 SA5
Matrix: Soil

Collected: 2018/09/27
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5883825 | N/A | 2018/12/12 | Deonarine Ramnarine |
| Conductivity | AT | 5883994 | N/A | 2018/12/12 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |
| Resistivity of Soil | | 5882461 | 2018/12/12 | 2018/12/12 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5883826 | N/A | 2018/12/12 | Deonarine Ramnarine |

Maxxam ID: IMF772 Dup
Sample ID: C7-1 SA5
Matrix: Soil

Collected: 2018/09/27
Shipped:
Received: 2018/12/06

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|------------------|-----------------|---------|------------|---------------|--------------|
| pH CaCl2 EXTRACT | AT | 5883840 | 2018/12/12 | 2018/12/12 | Gnana Thomas |

GENERAL COMMENTS

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

| | |
|-----------|-------|
| Package 1 | 5.3°C |
|-----------|-------|

Conductivity Analysis: Analysis was performed past sample holding time. This may increase the variability associated with these results.

Sample IMF770 [C2-1] : Rock sample submitted, sample preparation completed by the lab as per client request.

Sample IMF771 [C3-1] : Rock sample submitted, sample preparation completed by the lab as per client request.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1671430-W08
Site Location: QEW BERTIE - DETAILED DESIGN
Sampler Initials: JK

| QC Batch | Parameter | Date | Matrix Spike | | SPIKED BLANK | | Method Blank | | RPD | |
|----------|--|------------|--------------|-----------|--------------|-----------|--------------|---------|-----------|-----------|
| | | | % Recovery | QC Limits | % Recovery | QC Limits | Value | UNITS | Value (%) | QC Limits |
| 5883825 | Soluble (20:1) Chloride (Cl ⁻) | 2018/12/12 | NC | 70 - 130 | 102 | 70 - 130 | <20 | ug/g | 1.9 | 35 |
| 5883826 | Soluble (20:1) Sulphate (SO ₄) | 2018/12/12 | NC | 70 - 130 | 103 | 70 - 130 | <20 | ug/g | 24 | 35 |
| 5883840 | Available (CaCl ₂) pH | 2018/12/12 | | | 101 | 97 - 103 | | | 1.3 | N/A |
| 5883994 | Conductivity | 2018/12/12 | | | 103 | 90 - 110 | <2 | umho/cm | 0.65 | 10 |

N/A = Not Applicable

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

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


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

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

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

VALIDATION SIGNATURE PAGE

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



Brad Newman, Scientific Service 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.

| | | | | | | | | | | | | | |
|--|----------------------------------|--|---------------|--|--|------------------------------|--|---|--|-----------|---------|-------------------------------|------------------------------|
| Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campbell Road, Mississauga, Ontario Canada L5N 2L8 Tel: (905) 817-5700 Toll-free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca | | CHAIN OF CUSTODY RECORD Page of | | | | | | | | | | | |
| IMMEDIATE Company Name: #1326 Golder Associates Ltd Attention: Accounts Payable Address: 6925 Century Ave Suite 100 Mississauga ON L5N 7K2 Tel: (905) 567-4444 Fax: (905) 567-6561 Email: AP_CustomerService@golder.com | | REPORT TO: Company Name: Nikol Kochmarov Attention: Nikol Kochmarov Address: 905 567 6100 x2134 Tel: 905 567 6100 x2134 Fax: 905 567 6100 Email: nikol.kochmarov@golder.com | | | | | | | | | | | |
| PROJECT INFORMATION: Quotation #: B8W638 P.O. #: 08-144-0039-447 Project: QEW Bette - Detailed Design Project Name: QEW Bette - Detailed Design Site #: JK/MA/EN Sampled By: | | Laboratory Use Only: Maxxam Job #: 674002 Bottle Order #: COC #: Project Manager: Ema Gitej Turnaround Time (TAT) Required: | | | | | | | | | | | |
| MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY | | | | | | | | | | | | | |
| Regulation 153 (2011) <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table | | Other Regulations <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA Municipality <input type="checkbox"/> PWGO <input type="checkbox"/> Other | | | | | | | | | | | |
| Special Instructions | | ANALYSIS REQUESTED (PLEASE BE SPECIFIC) Field Filtered (please circle): Metals / Hg / Cr VI O Reg 153 VOCs by HS & F1-F4 4-hydroxy-4-methyl-2-pentanone by SVOC Open Scan Corrosivity Package (pH, Sulphate, Chloride, resistivity, conductivity) | | | | | | | | | | | |
| Include Criteria on Certificate of Analysis (Y/N)? | | Turnaround Time (TAT) Required: Please provide advance notice for rush projects Regular (Standard) TAT: (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details. <input checked="" type="checkbox"/> | | | | | | | | | | | |
| Job Specific Rush TAT (if applies to entire submission) Date Required: Time Required: <input type="checkbox"/> Rush Confirmation Number: (call lab for #) | | # of Bottles Comments | | | | | | | | | | | |
| Sample Barcode Label | Sample (Location) Identification | Date Sampled | Time Sampled | Matrix | Field Filtered (please circle): Metals / Hg / Cr VI | O Reg 153 VOCs by HS & F1-F4 | 4-hydroxy-4-methyl-2-pentanone by SVOC Open Scan | Corrosivity Package (pH, Sulphate, Chloride, resistivity, conductivity) | Date/Time | Signature | Barcode | # jars used and not submitted | Laboratory Use Only |
| 1 | RW4A-SA3 | Sept. 21, 18 | AM | SOIL | X | | | X | 06-Dec-18 12:29 | Ema Gitej | | 1 | Standard Corrosivity Package |
| 2 | RWS-SA8 | Sept. 19, 18 | PM | SOIL | X | | | X | | | | 1 | |
| 3 | RW7-SASB | Sept. 19, 18 | AM | SOIL | X | | | X | | | | 1 | |
| 4 | RW9-SA6 | Sept. 19, 18 | AM | SOIL | X | | | X | | | | 1 | |
| 5 | RW-10-SA7 | Sept. 21, 18 | PM | SOIL | X | | | X | | | | 1 | |
| 6 | C1-1-AS1 | Sept. 4, 18 | AM | SOIL | X | | | X | | | | 1 | |
| 7 | C2-1 | Sept. 5, 18 | PM | ROCK | X | | | X | | | | 1 | |
| 8 | C3-1 | Sept. 24, 18 | PM | ROCK | X | | | X | | | | 1 | |
| 9 | C7-1 SAS | Sept. 27 | AM | SOIL | X | | | X | | | | 1 | |
| 10 | | | | | | | | | | | | | |
| * RELINQUISHED BY: (Signature/Print) Ben Naylor Eric Naylor | | Date: (YY/MM/DD) 18/12/06 | Time 12:15 | RECEIVED BY: (Signature/Print) KATE VAN DER VEGEN | | Date: (YY/MM/DD) 12/29 | Time 2018/12/06 | # jars used and not submitted | Laboratory Use Only Time Sensitive Temperature (°C) on Reel: 8/3/5 Custody Seal Present Intact Yes No White: Maxxa Yellow: Client | | | | |
| * 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/WWP-CONTENT/UPLOADS/ONTARIO-COC.PDF. | | | | | | | | | | | | | |

Your Project #: 1671430 W01
Site Location: QEW BERTIE
Your C.O.C. #: 700485-03-01

Attention: Nikol Kochmanova

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

Report Date: 2019/01/23
Report #: R5568144
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B915679

Received: 2019/01/18, 10:35

Sample Matrix: Soil
Samples Received: 1

| Analyses | Date | | Date Analyzed | Laboratory Method | Reference |
|-------------------------|----------|------------|---------------|-------------------|-----------------|
| | Quantity | Extracted | | | |
| Chloride (20:1 extract) | 1 | N/A | 2019/01/23 | CAM SOP-00463 | EPA 325.2 m |
| Conductivity | 1 | N/A | 2019/01/22 | CAM SOP-00414 | OMOE E3530 v1 m |
| pH CaCl2 EXTRACT | 1 | 2019/01/23 | 2019/01/23 | CAM SOP-00413 | EPA 9045 D m |
| Resistivity of Soil | 1 | 2019/01/19 | 2019/01/22 | CAM SOP-00414 | SM 23 2510 m |
| Sulphate (20:1 Extract) | 1 | N/A | 2019/01/23 | CAM SOP-00464 | EPA 375.4 m |

Remarks:

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

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

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

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

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

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

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

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

Your Project #: 1671430 W01
Site Location: QEW BERTIE
Your C.O.C. #: 700485-03-01

Attention: Nikol Kochmanova

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

Report Date: 2019/01/23
Report #: R5568144
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B915679
Received: 2019/01/18, 10:35

Encryption Key

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

=====

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

RESULTS OF ANALYSES OF SOIL

| | | | | |
|----------------------------------|--------------|------------------|------------|-----------------|
| Maxxam ID | | IUD610 | | |
| Sampling Date | | 2018/09/20 | | |
| COC Number | | 700485-03-01 | | |
| | UNITS | RW 11 SA5 | RDL | QC Batch |
| Calculated Parameters | | | | |
| Resistivity | ohm-cm | 1600 | | 5936840 |
| Inorganics | | | | |
| Soluble (20:1) Chloride (Cl-) | ug/g | <20 | 20 | 5940294 |
| Conductivity | umho/cm | 642 | 2 | 5940019 |
| Available (CaCl2) pH | pH | 7.70 | | 5941762 |
| Soluble (20:1) Sulphate (SO4) | ug/g | 530 | 20 | 5940279 |
| RDL = Reportable Detection Limit | | | | |
| QC Batch = Quality Control Batch | | | | |

Maxxam Job #: B915679
Report Date: 2019/01/23

Golder Associates Ltd
Client Project #: 1671430 W01
Site Location: QEW BERTIE
Sampler Initials: MA

TEST SUMMARY

Maxxam ID: IUD610
Sample ID: RW 11 SA5
Matrix: Soil

Collected: 2018/09/20
Shipped:
Received: 2019/01/18

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|---------------------|
| Chloride (20:1 extract) | KONE/EC | 5940294 | N/A | 2019/01/23 | Deonarine Ramnarine |
| Conductivity | AT | 5940019 | N/A | 2019/01/22 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5941762 | 2019/01/23 | 2019/01/23 | Gnana Thomas |
| Resistivity of Soil | | 5936840 | 2019/01/22 | 2019/01/22 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5940279 | N/A | 2019/01/23 | Deonarine Ramnarine |

GENERAL COMMENTS

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

| | |
|-----------|-------|
| Package 1 | 9.0°C |
|-----------|-------|

pH, Chloride, Sulphate, Conductivity/Resistivity: Sample submitted and analyzed past the recommended sample hold time. This may increase the variability associated with these results.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1671430 W01
Site Location: QEW BERTIE
Sampler Initials: MA

| QC Batch | Parameter | Date | Matrix Spike | | SPIKED BLANK | | Method Blank | | RPD | |
|----------|--|------------|--------------|-----------|--------------|-----------|--------------|---------|-----------|-----------|
| | | | % Recovery | QC Limits | % Recovery | QC Limits | Value | UNITS | Value (%) | QC Limits |
| 5940019 | Conductivity | 2019/01/22 | | | 103 | 90 - 110 | <2 | umho/cm | 0.68 | 10 |
| 5940279 | Soluble (20:1) Sulphate (SO ₄) | 2019/01/23 | 117 | 70 - 130 | 108 | 70 - 130 | <20 | ug/g | NC | 35 |
| 5940294 | Soluble (20:1) Chloride (Cl ⁻) | 2019/01/23 | 112 | 70 - 130 | 103 | 70 - 130 | <20 | ug/g | NC | 35 |
| 5941762 | Available (CaCl ₂) pH | 2019/01/23 | | | 100 | 97 - 103 | | | 0.44 | N/A |

N/A = Not Applicable

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

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

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

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

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

VALIDATION SIGNATURE PAGE

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



Anastassia Hamanov, Scientific Specialist

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

| | | | | | |
|--|----------------------------------|---|--------------|---|---|
| Maxxam <small>A Maxxam Analytics International Corporation</small> | | Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campbell Road, Mississauga, Ontario Canada L5N 2L8 Tel: (905) 817-5700 Toll-free 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca | | CHAIN OF CUSTODY RECORD Page of | |
| INVOICE TO: Company Name: #1326 Golder Associates Ltd Attention: Accounts Payable Address: 6925 Century Ave Suite 100 Mississauga ON L5N 7K2 Tel: (905) 567-4444 Fax: (905) 567-6561 Email: AP_CustomerService@golder.com | | REPORT TO: Company Name: Attention: <u>Nikol Kochmanova</u> Address: Tel: Email: <u>nikol.kochmanova@golder.com</u> | | PROJECT INFORMATION: Quotation #: B80683 P.O. #: Project: <u>1671430 WQI</u> Project Name: <u>NEW Bette</u> Site #: Sampled By: <u>MA</u> | |
| MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY | | ANALYSIS REQUESTED (PLEASE BE SPECIFIC) | | Laboratory Use Only: Maxxam Job #: Bottle Order #: COC #: Project Manager: Ema Gitej | |
| Regulation 153 (2011) <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table | | Other Regulations <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA Municipality <input type="checkbox"/> PWQO <input type="checkbox"/> Other | | Special Instructions | |
| Include Criteria on Certificate of Analysis (Y/N)? | | Field Filtered (please circle): Metals / Hg / Cr VI Corrosivity pK (pH, Cl, SO4, EC/Resistivity) | | 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 | Matrix | |
| 1 | RW 11 SAS | Sept 2018 | AM | Soil | ✓ |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |

18-Jan-19 10:35
 Ema Gitej

B915679
 CA2 ENV-835

| | | | | | | | | | | | |
|--------------------------------------|--|------------------|---------|--------------------------------|--|------------------|-------|-------------------------------|---------------------|--------------------------|--------------|
| * RELINQUISHED BY: (Signature/Print) | | Date: (YY/MM/DD) | Time | RECEIVED BY: (Signature/Print) | | Date: (YY/MM/DD) | Time | # jars used and not submitted | Laboratory Use Only | | |
| <u>Eric Naylor</u> | | 19/01/19 | 10:30AM | <u>RAID</u> | | 2019/01/18 | 10:35 | | Time Sensitive | Temperature (°C) on Reel | Custody Seal |
| | | | | | | | | | | 10/5/12 | Present |
| | | | | | | | | | | | Intact |
| | | | | | | | | | | | Yes |
| | | | | | | | | | | | No |

* 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.

White: Maxxa Yellow: Client

Your Project #: 1671430 W08
Site Location: QEW BERTIE
Your C.O.C. #: 702394-02-01

Attention: Matt Saderman

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

Report Date: 2019/02/07
Report #: R5586082
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B928404

Received: 2019/02/01, 09:34

Sample Matrix: Soil
Samples Received: 4

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Reference |
|-------------------------|----------|-------------------|------------------|-------------------|-----------------|
| Chloride (20:1 extract) | 4 | N/A | 2019/02/06 | CAM SOP-00463 | EPA 325.2 m |
| Conductivity | 4 | N/A | 2019/02/06 | CAM SOP-00414 | OMOE E3530 v1 m |
| pH CaCl2 EXTRACT | 4 | 2019/02/05 | 2019/02/05 | CAM SOP-00413 | EPA 9045 D m |
| Resistivity of Soil | 4 | 2019/02/01 | 2019/02/07 | CAM SOP-00414 | SM 23 2510 m |
| Sulphate (20:1 Extract) | 4 | N/A | 2019/02/06 | CAM SOP-00464 | EPA 375.4 m |

Remarks:

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

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

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

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

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

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

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

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

Your Project #: 1671430 W08
Site Location: QEW BERTIE
Your C.O.C. #: 702394-02-01

Attention: Matt Saderman

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

Report Date: 2019/02/07
Report #: R5586082
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B928404
Received: 2019/02/01, 09:34

Encryption Key

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

=====

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

RESULTS OF ANALYSES OF SOIL

| | | | | | | | | | | | |
|----------------------|--------------|-----------------|------------|-----------------|-----------------|-------------------------|------------|-----------------|-----------------|------------|-----------------|
| Maxxam ID | | IWV487 | | IWV488 | | IWV488 | | | IWV489 | | |
| Sampling Date | | 2019/01/16 | | 2019/01/16 | | 2019/01/16 | | | 2019/01/25 | | |
| COC Number | | 702394-02-01 | | 702394-02-01 | | 702394-02-01 | | | 702394-02-01 | | |
| | UNITS | RW12 SA4 | RDL | RW13 SA2 | QC Batch | RW13 SA2 Lab-Dup | RDL | QC Batch | RW14 SA6 | RDL | QC Batch |

Calculated Parameters

| | | | | | | | | | | | |
|-------------|--------|------|--|-----|---------|--|--|--|------|--|---------|
| Resistivity | ohm-cm | 1000 | | 270 | 5957440 | | | | 3100 | | 5957440 |
|-------------|--------|------|--|-----|---------|--|--|--|------|--|---------|

Inorganics

| | | | | | | | | | | | |
|-------------------------------|---------|------|----|------|---------|------|-----|---------|------|----|---------|
| Soluble (20:1) Chloride (Cl-) | ug/g | <20 | 20 | 120 | 5960699 | 120 | 20 | 5960699 | 58 | 20 | 5960699 |
| Conductivity | umho/cm | 1000 | 2 | 3640 | 5962188 | 3770 | 2 | 5962188 | 323 | 2 | 5962188 |
| Available (CaCl2) pH | pH | 7.84 | | 8.02 | 5960350 | | | | 7.82 | | 5960350 |
| Soluble (20:1) Sulphate (SO4) | ug/g | 1400 | 80 | 4800 | 5960713 | 5100 | 200 | 5960713 | 100 | 20 | 5960713 |

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

| | | | | |
|----------------------|--------------|------------------|------------|-----------------|
| Maxxam ID | | IWV490 | | |
| Sampling Date | | 2019/01/26 | | |
| COC Number | | 702394-02-01 | | |
| | UNITS | RW16 SA1A | RDL | QC Batch |

Calculated Parameters

| | | | | |
|-------------|--------|------|--|---------|
| Resistivity | ohm-cm | 4400 | | 5957440 |
|-------------|--------|------|--|---------|

Inorganics

| | | | | |
|-------------------------------|---------|------|----|---------|
| Soluble (20:1) Chloride (Cl-) | ug/g | 26 | 20 | 5960699 |
| Conductivity | umho/cm | 227 | 2 | 5962188 |
| Available (CaCl2) pH | pH | 7.22 | | 5960350 |
| Soluble (20:1) Sulphate (SO4) | ug/g | <20 | 20 | 5960713 |

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

TEST SUMMARY

Maxxam ID: IWV487
Sample ID: RW12 SA4
Matrix: Soil

Collected: 2019/01/16
Shipped:
Received: 2019/02/01

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|-------------------|
| Chloride (20:1 extract) | KONE/EC | 5960699 | N/A | 2019/02/06 | Alina Dobreanu |
| Conductivity | AT | 5962188 | N/A | 2019/02/06 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5960350 | 2019/02/05 | 2019/02/05 | Gnana Thomas |
| Resistivity of Soil | | 5957440 | 2019/02/07 | 2019/02/07 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5960713 | N/A | 2019/02/06 | Alina Dobreanu |

Maxxam ID: IWV488
Sample ID: RW13 SA2
Matrix: Soil

Collected: 2019/01/16
Shipped:
Received: 2019/02/01

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|-------------------|
| Chloride (20:1 extract) | KONE/EC | 5960699 | N/A | 2019/02/06 | Alina Dobreanu |
| Conductivity | AT | 5962188 | N/A | 2019/02/06 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5960350 | 2019/02/05 | 2019/02/05 | Gnana Thomas |
| Resistivity of Soil | | 5957440 | 2019/02/07 | 2019/02/07 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5960713 | N/A | 2019/02/06 | Alina Dobreanu |

Maxxam ID: IWV488 Dup
Sample ID: RW13 SA2
Matrix: Soil

Collected: 2019/01/16
Shipped:
Received: 2019/02/01

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|-----------|---------------|-----------------|
| Chloride (20:1 extract) | KONE/EC | 5960699 | N/A | 2019/02/06 | Alina Dobreanu |
| Conductivity | AT | 5962188 | N/A | 2019/02/06 | Kazzandra Adeva |
| Sulphate (20:1 Extract) | KONE/EC | 5960713 | N/A | 2019/02/06 | Alina Dobreanu |

Maxxam ID: IWV489
Sample ID: RW14 SA6
Matrix: Soil

Collected: 2019/01/25
Shipped:
Received: 2019/02/01

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|-------------------|
| Chloride (20:1 extract) | KONE/EC | 5960699 | N/A | 2019/02/06 | Alina Dobreanu |
| Conductivity | AT | 5962188 | N/A | 2019/02/06 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5960350 | 2019/02/05 | 2019/02/05 | Gnana Thomas |
| Resistivity of Soil | | 5957440 | 2019/02/07 | 2019/02/07 | Automated Statchk |
| Sulphate (20:1 Extract) | KONE/EC | 5960713 | N/A | 2019/02/06 | Alina Dobreanu |

Maxxam ID: IWV490
Sample ID: RW16 SA1A
Matrix: Soil

Collected: 2019/01/26
Shipped:
Received: 2019/02/01

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|------------|---------------|-------------------|
| Chloride (20:1 extract) | KONE/EC | 5960699 | N/A | 2019/02/06 | Alina Dobreanu |
| Conductivity | AT | 5962188 | N/A | 2019/02/06 | Kazzandra Adeva |
| pH CaCl2 EXTRACT | AT | 5960350 | 2019/02/05 | 2019/02/05 | Gnana Thomas |
| Resistivity of Soil | | 5957440 | 2019/02/07 | 2019/02/07 | Automated Statchk |

Maxxam Job #: B928404
Report Date: 2019/02/07

Golder Associates Ltd
Client Project #: 1671430 WO8
Site Location: QEW BERTIE
Sampler Initials: LK

TEST SUMMARY

Maxxam ID: IWV490
Sample ID: RW16 SA1A
Matrix: Soil

Collected: 2019/01/26
Shipped:
Received: 2019/02/01

| Test Description | Instrumentation | Batch | Extracted | Date Analyzed | Analyst |
|-------------------------|-----------------|---------|-----------|---------------|----------------|
| Sulphate (20:1 Extract) | KONE/EC | 5960713 | N/A | 2019/02/06 | Alina Dobreanu |

GENERAL COMMENTS

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

| | |
|-----------|--------|
| Package 1 | 12.7°C |
|-----------|--------|

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1671430 WO8
Site Location: QEW BERTIE
Sampler Initials: LK

| QC Batch | Parameter | Date | Matrix Spike | | SPIKED BLANK | | Method Blank | | RPD | |
|----------|--|------------|--------------|-----------|--------------|-----------|--------------|---------|-----------|-----------|
| | | | % Recovery | QC Limits | % Recovery | QC Limits | Value | UNITS | Value (%) | QC Limits |
| 5960350 | Available (CaCl ₂) pH | 2019/02/05 | | | 100 | 97 - 103 | | | 0.34 | N/A |
| 5960699 | Soluble (20:1) Chloride (Cl ⁻) | 2019/02/06 | NC | 70 - 130 | 101 | 70 - 130 | <20 | ug/g | 0.23 | 35 |
| 5960713 | Soluble (20:1) Sulphate (SO ₄) | 2019/02/06 | NC | 70 - 130 | 101 | 70 - 130 | <20 | ug/g | 5.8 | 35 |
| 5962188 | Conductivity | 2019/02/06 | | | 102 | 90 - 110 | <2 | umho/cm | 3.6 | 10 |

N/A = Not Applicable

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

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


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

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

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

VALIDATION SIGNATURE PAGE

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



Ewa Pranjić, 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.

J L ENV-1363

Ema Gitej

C#702394-02-01

| PROJECT INFORMATION: | |
|----------------------|-------------------|
| Quotation #: | B80683 |
| P.O. #: | |
| Project: | 1671430 WO8 |
| Project Name: | <i>DEW Bertie</i> |
| Site #: | |
| Sampled By: | <i>L K IEN</i> |

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

| Yes | No |
|-----|-------------------------------------|
| | <input checked="" type="checkbox"/> |

White: Maxxa Yellow: Client



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