



Foundation Investigation and Design Report

Mid-Block Connection Road Underpass (Site No. 35X-0618/B0)

Highway 6/Hanlon Expressway Mid-Block Interchange

County of Wellington, Ontario

MTO DB 2021-3004

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GEOCRES No.: 40P8-291-1

Longitude: -80.183754°

Latitude: 43.464815°

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PART A

**FOUNDATION INVESTIGATION REPORT
MID-BLOCK CONNECTION ROAD UNDERPASS (SITE NO. 35X-0618/B0)
HIGHWAY 6/HANLON EXPRESSWAY MID-BLOCK INTERCHANGE
COUNTY OF WELLINGTON, ONTARIO
MTO DB 2021-3004**

1.0 INTRODUCTION

The Ministry of Transportation Ontario (MTO) has engaged Dufferin Construction Company, A Division of CRH Canada Group Inc. (Dufferin) as the Design-Builder for the Highway 6/Hanlon Expressway Mid-Block Interchange Improvements south of Guelph in the County of Wellington, Ontario, as part of MTO's Design-Build Major Contract DB 2021-3004. WSP Global Inc. (WSP), the lead designer, has engaged Golder Associates Ltd. (Golder, now a member of WSP) to provide geotechnical/foundation engineering services in support of this contract.

This report addresses the new Mid-Block Connection Road underpass (MTO Structure Site No. 35X-0618/B0) and its immediate approach embankments. Other foundation engineering elements of this project, including the new Highway 6/Wellington Road 34 underpass, deep cuts and high fill embankments, stormwater management ponds, culverts within high fill embankment or deep cut sections, and sign supports along Highway 6 are addressed in separate Foundation Investigation and Design Reports.

2.0 PROJECT AND SITE DESCRIPTION

The Mid-Block Interchange (MBI) project limits extend along Highway 6/Hanlon Expressway from approximately 300 m south of Wellington Road 34 to 150 m north of Maltby Road/Concession Road 4, as well as along Wellington Road 34 and Concession Road 7, as shown in Figure 1. A new Mid-Block Connection Road will be constructed, extending from Wellington Road 34 and crossing Highway 6 to connect to Concession Road 7, with the new Mid-Block Connection Road underpass located approximately 2 km north of Highway 401, and approximately 900 m north of the Highway 6/Wellington Road 34 intersection.

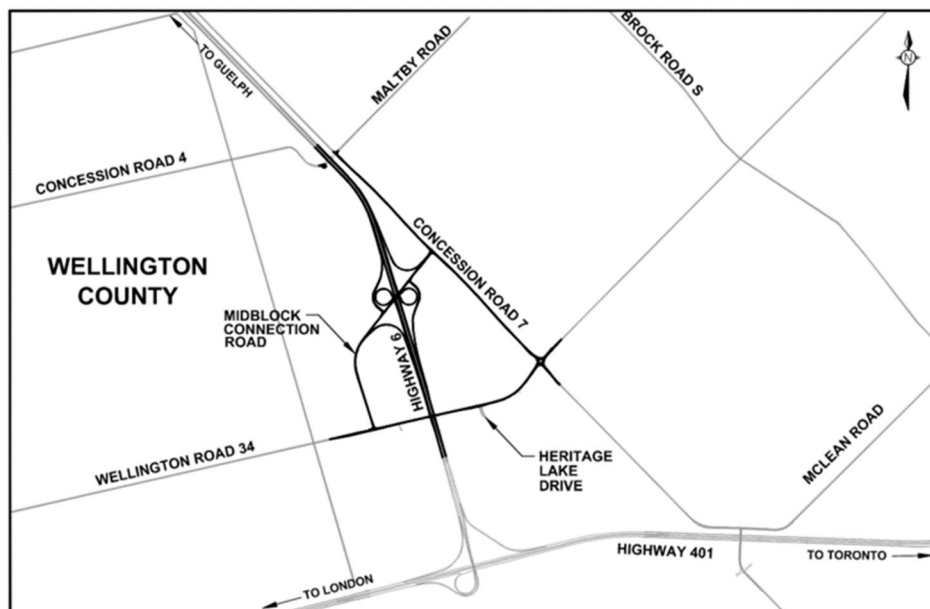


Figure 1: Highway 6/Hanlon Expressway Mid-Block Interchange project limits

The project area includes a low-lying wetland surrounding the intersection of Highway 6/Wellington Road 34, with the ground surface generally rising northward throughout the project limits. Irregular hummocky and undulating topography is present along Concession Road 7.

At the proposed Mid-Block Connection Road underpass site, Highway 6 has been constructed in a cut with its grade at approximately Elevation 323 m to 324 m. The surrounding original ground surface is at approximately Elevation 327 m to 329 m, such that the existing cut slopes along the west and east sides of Highway 6 are up to approximately 6 m high. The area on the west and east sides of Highway 6 is agricultural, with a golf driving range located northeast of the proposed structure site.

3.0 INVESTIGATION PROCEDURES

3.1 2017 and 2021 Investigations

Site-specific investigations, including borehole drilling and geotechnical and analytical laboratory testing, have been completed previously by Peto McCallum Limited (PML), which is documented in the following report:

- **MTO GEOCREs No. 40P8-291:** “Preliminary Foundation Investigation and Design Report for Design-Build Ready Alternative Bid Package for Wellington Road 34 Connector Underpass, Site No. 35X-0618/B0, Station 10+000, Mid-Block Interchange (MBI) Area, Highway 6 and Highway 401 Improvements from Hamilton North Limits to Guelph South Limits, City of Guelph, Ontario, GWP 3059-20-00”, dated October 2021.

Boreholes were advanced at the Mid-Block Connection Road underpass under the supervision of PML in two phases: November to December 2017 and November to December 2021. Nine boreholes were drilled near the abutments and centre pier, as well as at the west and east approach embankment areas. A summary of the field investigation programs conducted by PML in 2017 and 2021 is provided in Table 3.1, including MTM NAD83 (Zone 10) northing and easting coordinates and ground surface elevations referenced to geodetic datum, as surveyed by J.D. Barnes Limited and Callon Dietz for the 2017 and 2021 boreholes, respectively. The borehole locations are shown on Drawing 1 following the text of this report.

Table 3.1: Borehole Coordinates, Ground Surface Elevations and Depths – 2017 and 2021 Investigations

| Borehole No. | Borehole Location | MTM NAD 83 Coordinates (MTM Zone ON10) | | Ground Surface Elevation (m) | Borehole Depth (m) |
|-------------------------|-------------------|---|----------------|---------------------------------|-----------------------|
| | | Northing (m) | Easting (m) | | |
| 35-618-01 | West Approach | 4 814 069.0 | 249 441.2 | 328.1 | 9.8 |
| 35-618-02 | West Abutment | 4 814 088.5 | 249 438.0 | 328.0 | 34.8 |
| 35-618-03A | West Abutment | 4 814 062.3 | 249 445.5 | 328.0 | 13.3 |
| 35-618-03B ¹ | West Abutment | 4 814 061.4 | 249 444.5 | 328.0 | 14.7 |
| 35-618-04 | Centre Pier | 4 814 119.6 | 249 471.6 | 322.3 | 20.5 |
| 35-618-05 | Centre Pier | 4 814 093.6 | 249 479.6 | 321.5 | 25.0 |
| 35-618-06 | East Abutment | 4 814 143.6 | 249 487.0 | 323.3 | 25.9 |
| 35-618-07 | East Approach | 4 814 145.9 | 249 520.1 | 328.2 | 10.5 |
| 35-618-08 | East Abutment | 4 814 138.6 | 249 508.2 | 328.5 | 34.5 |
| 35-618-09 | East Abutment | 4 814 155.2 | 249 503.6 | 329.7 | 29.9 |

1. Borehole 35-618-03B was advanced by dynamic cone penetration test (DCPT) adjacent to Borehole 35-618-3A.

Monitoring wells were installed in three boreholes – Borehole 35-618-02 near the west abutment and Boreholes 35-618-06 and 35-618-08 near the east abutment. The wells consist of 50 mm outer diameter PVC pipe with a 1.5 m long screen surrounded by a sand filter pack sealed at a selected depth within the boreholes. According to the PML (2021) report, all remaining boreholes were backfilled with soil cuttings and decommissioned in accordance with MECP Regulation 903 (Wells, as amended).

Laboratory tests were conducted on representative soil samples recovered from the 2017 and 2021 boreholes. Geotechnical classification testing, consisting of water contents, grain size distributions and Atterberg limits determinations on soil samples and uniaxial compressive strength testing on bedrock core specimens, was conducted at PML's laboratory in Toronto, Ontario. Analytical testing for a suite of corrosivity parameters, including sulphates, chlorides, pH and resistivity, was completed by AGAT Laboratories and SGS Canada Inc. in Mississauga, Ontario.

3.2 2022 Investigation

Additional validation investigation was completed by Golder at the Mid-Block Connection Road underpass in June 2022. One additional borehole (Borehole GBH-31A) was drilled to supplement Borehole 35-618-02 and confirm the subsoil conditions and bedrock surface elevation in the vicinity of the west abutment. Casing and tricone methods were used in conjunction with drilling mud; however, significant challenges were encountered during advancement of this borehole below approximately 3 m depth due to the presence of cobbles and boulders. This borehole was abandoned on the third day of drilling at a depth of 14.3 m due to the very slow advancement rate. A second borehole (Borehole GBH-31B) was advanced near the west abutment using casing and tricone methods and was successfully advanced to and into the limestone bedrock.

The locations of Boreholes GBH-31A and GBH-31B are shown on Drawing 1 following the text of this report and summarized in Table 3.2 including MTM NAD83 (Zone 10) northing and easting coordinates and ground surface elevations referenced to geodetic datum.

Table 3.2: Borehole Coordinates, Ground Surface Elevations and Depths - 2022 Investigation

| Borehole No. | Borehole Location | MTM NAD 83 Coordinates (MTM Zone ON10) | | Ground Surface Elevation (m) | Borehole Depth (m) |
|--------------|-------------------|---|----------------|---------------------------------|-----------------------|
| | | Northing (m) | Easting (m) | | |
| GBH-31A | West Abutment | 4 814 057.3 | 249 437.6 | 329.2 | 14.3 |
| GBH-31-B | West Abutment | 4 814 066.0 | 249 440.9 | 328.7 | 30.5 |

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Physiography and Regional Geology

The Mid-Block Interchange area is located within the western flank of the northeast-to-southwest trending Paris Moraine, which is characterized by a broad band of high-relief hummock topography with hilly irregular slopes and enclosed basins, as demonstrated by the presence of frequent small ponds and marshy areas. The Paris Moraine is composed of an extensive network of coarsely stratified sand and gravel deposits on adjacent outwash plains.

The Quaternary Geology map published by the Ontario Ministry of Northern Development and Mines (MNDM) indicates that the subsurface conditions in the area consist predominantly of silty sand to sandy silt associated

with the Wentworth Till. The bedrock in the area belongs to the Lower Silurian sandstone, shale, dolostone and siltstone of the Guelph Formation. The Guelph Formation is identified as an important aquifer in City of Guelph and surrounding areas.

4.2 Subsurface Conditions

The detailed subsurface conditions encountered during the 2017 and 2021 foundation investigations by PML are shown on the borehole records in Appendix A, while those from the 2022 investigation by Golder are provided in Appendix B. The geotechnical and analytical laboratory test results from PML's previous investigations are contained in Appendices C and D, respectively. The results of the in situ field tests (i.e., Standard Penetration Test "N" values) as presented on the borehole records and described in the following sub-sections are uncorrected.

The interpreted stratigraphic profile and cross-sections at the underpass site are shown on Drawings 1 and 2, following the text of this report. The stratigraphic boundaries or variations shown on the borehole records and on the stratigraphic profile and sections are inferred from non-continuous sampling, observations of drilling progress and SPT results. Such boundaries or variations therefore represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the boreholes. It should be noted that the interpreted stratigraphy is a simplification of the subsurface conditions.

Based on the borehole information, the stratigraphy at the proposed Mid-Block Connection Road underpass site consists of topsoil overlying approximately 0.5 m to 0.8 m of silty sand to sandy silt fill, which is underlain by an extensive silty sand to sandy silt till deposit that contains varying proportions of gravel and cobbles. Dolostone bedrock was encountered beneath the till deposit. The following sub-sections provide brief descriptions of these soil layers and subsurface conditions encountered during the investigation.

4.2.1 Topsoil

A surficial topsoil layer, approximately 200 mm to 300 mm thick, was encountered in all the boreholes advanced at this structure site. It is noted that all boreholes were advanced outside of the existing Highway 6 pavement structure.

4.2.2 Silty Sand to Sandy Silt Fill

Approximately 0.5 m to 0.8 m of fill was encountered below the topsoil in all boreholes except GBH-31A/31B. This layer consists of silty sand to sandy silt and may represent a disturbed zone of the native till deposit that underlies the site.

The SPT "N" values within the fill ranged between 4 blows and 15 blows per 0.3 m of penetration, indicating that the fill is loose to compact.

The moisture contents of the tested samples of the fill ranged from approximately 7% to 23%.

4.2.3 Silty Sand to Sandy Silt Till

An extensive silty sand to sandy silt till deposit was encountered below the topsoil and fill in all of the boreholes. This till contains zones of gravel, cobbles and boulders, based on high SPT "N" values and evidence of auger grinding or chattering during advancement of the boreholes, as noted on the borehole records. Where fully penetrated in the boreholes, this layer is approximately 21.4 m to 22.1 m thick relative to the Highway 6 cut grade, and up to about 31.4 m thick relative to the original ground surface outside of the highway cut.

The SPT “N” values in the till deposit varied from 5 blows to greater than 100 blows per 0.3 m of penetration, indicating a variable, loose to very dense relative density. In general, however, the SPT “N” values in the silty sand to sandy silt till were less than approximately 60 blows per 0.3 m of penetration, with periodic higher SPT “N” values of greater than 100 blows per 0.3 m of penetration generally attributed the presence of gravel and cobbles within the till. Such higher SPT “N” values typically occur in a single sample at a random location within a borehole, as well as immediately overlying the bedrock in the majority of the boreholes; more frequent instances of SPT “N” values greater than 100 blows per 0.3 m of penetration were observed in two of the boreholes (35-618-08 and 35-618-09) near the east abutment. In addition, a more significant zone of gravel, cobbles and boulders was encountered near the west abutment in Borehole GBH-31A as part of the 2022 investigation, between approximately 3 m and 14.3 m depth corresponding to Elevation 326.2 m to 314.9 m, where advancement of the casing and tricone was slow and challenging.

The results of grain size distribution tests on 39 samples of the till from the PML boreholes are presented on five figures contained in Appendix C. Atterberg limits tests were completed on three samples of the till and measured plastic limits of approximately 11% to 15%, liquid limits of approximately 16% to 20%, and plasticity indices of approximately 2% to 9%; these results, which are plotted on a plasticity chart on the final figure in Appendix C, indicates that the fine portion of the till is generally non-plastic, but grades to low plasticity clayey silt at some locations. The moisture contents of samples tested from this deposit ranged from approximately 1% to 23%.

4.2.4 Dolostone Bedrock

Bedrock was encountered and cored below the till deposit in four of the boreholes. In addition to these four boreholes where bedrock was cored, bedrock was confirmed via tricone sampling in Borehole GBH-31B, and inferred at two other boreholes due to auger refusal and abruptly higher dynamic cone penetration test (DCPT) values. As summarized in Table 4.1, the bedrock surface was confirmed between approximately Elevation 296.6 m and 301.2 m in the boreholes where coring was completed.

Table 4.1: Summary of Bedrock Surface Elevations

| Foundation Element | Reference Borehole No. | Depth to Bedrock Surface (m) | Bedrock Surface Elevation (mASL) | Depth of Rock Coring (m) |
|--------------------|------------------------|------------------------------|----------------------------------|--------------------------|
| West Abutment | 35-618-02 | 31.4 | 296.6 | 3.4 |
| | BGH-31B | 27.5 | 301.2 | 3.0 (Tricone) |
| Centre Pier | 35-618-04* | 20.5* | 301.8* | N/A (DCPT refusal) |
| | 35-618-05 | 21.4 | 300.1 | 3.6 |
| East Abutment | 35-618-06 | 22.1 | 301.2 | 3.8 |
| | 35-618-08 | 31.4 | 297.1 | 3.1 |
| | 35-618-09* | 29.9* | 299.7* | N/A (Auger refusal) |

* Probable bedrock inferred due to DCPT or auger refusal; no bedrock coring was completed in Boreholes 35-618-04 and 35-618-09.

The bedrock consists of slightly to moderately weathered dolostone of the Guelph Formation. Rock core photographs and rock description logs are included after the borehole records in Appendix A. The rock core recovery from all four boreholes ranged from 72% to 100% while the Rock Quality Designation (RQD) of the rock

cores ranged from 34% to 95%. Based on the RQD values, the quality of the bedrock to about El. 297.5 to El. 295 may be described as poor to fair and, below that, as good to excellent.

The uniaxial compressive strength (UCS) of a rock core specimen from the upper portion of the bedrock in Borehole 35-618-05 was 58 MPa and the UCS value of a specimen from Borehole 35-618-08 was 154 MPa. Based on these test results, the bedrock may be classified as strong to very strong with respect to strength of intact bedrock. The detailed UCS test results are provided in Appendix C.

4.3 Groundwater Conditions

The groundwater conditions were observed in the open boreholes during drilling and monitoring wells were installed in three boreholes, screened within the silty sand to sandy silt till or the underlying bedrock: Borehole 35-618-02 near the west abutment, and Boreholes 35-618-06 and 35-618-08 near the east abutment. The groundwater levels measured in these monitoring wells are shown on the borehole records in Appendix A and summarized in Table 4.2.

Based on these readings, the stabilized groundwater level at the site is estimated to vary between approximately Elevation 310.0 m and 312.5 m; however, the water level should be expected to vary seasonally and may be higher during wet seasons and years particularly following snow melt and periods of heavy precipitation.

The unstabilized water level observed in the open boreholes was generally consistent with the range of water levels measured in the monitoring wells, where the boreholes extended to sufficient depth. Groundwater was encountered at a higher level (approximately Elevation 322.5 m) in Borehole 35-618-01 at the west abutment/approach embankment area; this water level appears to represent a localized perched condition, atop a zone of till with a slightly higher clay content. Similar zones of localized perched water may be encountered elsewhere when excavating through the till deposit.

Table 4.2: Groundwater Level Readings in Monitoring Wells

| Borehole No. | Well Screen Depth and Elevation (m) | Date of Reading | Depth to Water Level (m) | Elevation of Water Level (m) |
|--|--|-------------------|--------------------------|------------------------------|
| 35-618-02 (Installed November 27, 2017) | 21.3 – 22.8 (306.7 – 305.2) Screened in till deposit | December 08, 2017 | 17.6 | 310.4 |
| | | January 10, 2018 | 17.6 | 310.4 |
| | | January 18, 2018 | 17.3 | 310.7 |
| | | February 15, 2018 | 17.3 | 310.7 |
| | | April 03, 2018 | 17.2 | 310.8 |
| | | July 30, 2021 | 18.0 | 310.0 |
| | | August 04, 2021 | 17.4 | 310.6 |
| | | August 11, 2021 | 17.7 | 310.3 |
| | | August 17, 2021 | 17.8 | 310.2 |
| 35-618-06 (Installed December 1, 2017) | 15.2 – 16.8 (308.1 – 306.6) | December 08, 2017 | 11.9 | 311.4 |
| | | January 10, 2018 | 11.6 | 311.7 |
| | | January 17, 2018 | 11.6 | 311.7 |

| Borehole No. | Well Screen Depth and Elevation (m) | Date of Reading | Depth to Water Level (m) | Elevation of Water Level (m) |
|--|---|-----------------|--------------------------|------------------------------|
| | Screened in till deposit | April 03, 2018 | 11.5 | 311.8 |
| | | August 19, 2021 | 12.0 | 311.3 |
| 35-618-08 (Installed August 10, 2021) | 32.9 – 34.4 (295.6 – 294.1) Screened in bedrock | August 11, 2021 | 16.1 | 312.4 |
| | | August 16, 2021 | 17.5 | 311.1 |
| | | August 19, 2021 | 16.0 | 312.5 |

4.4 Chemical Test Results

A summary of the corrosivity test results for two samples of the silty sand to sandy silt till is provided in Table 4.3. The analytical laboratory certificates are provided in Appendix D.

Table 4.3: Summary of Corrosivity Test Results

| Borehole No. | Elevation (m) | Soil Type | Sulphide (%) | Sulphate (µg /g, ppm) | Chloride (µg /g, ppm) | pH | Resistivity (ohm-cm) |
|--------------|---------------|-------------------------------|--------------|-----------------------|-----------------------|-----|----------------------|
| 35-618-04 | 319.7 | Silty sand to sandy silt till | < 0.05 | 6 | 21 | 8.7 | 9620 |
| 35-618-08 | 325.2 | | <0.04 | 9 | 7 | 8.4 | 7580 |

5.0 CLOSURE

This Foundation Investigation Report was prepared by Akshay Ramprakash, Geotechnical Consultant, and reviewed by Michael Beadle, P.Eng., Senior Geotechnical Engineer, and Lisa Coyne, P.Eng., Senior Geotechnical Engineer and an MTO Designated Foundations Contact approved in MTO's Registry, Appraisal and Qualifications System (RAQS).

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[https://golderassociates.sharepoint.com/sites/162438/project files/6 deliverables/foundations/mid-block underpass/r01-fidr/22522311-h6-fnd-fidr-rep-001 final.docx](https://golderassociates.sharepoint.com/sites/162438/project%20files/6%20deliverables/foundations/mid-block%20underpass/r01-fidr/22522311-h6-fnd-fidr-rep-001%20final.docx)

PART B

**FOUNDATION DESIGN REPORT
MID-BLOCK CONNECTION ROAD UNDERPASS (SITE NO. 35X-0618/B0)
HIGHWAY 6/HANLON EXPRESSWAY MID-BLOCK INTERCHANGE
COUNTY OF WELLINGTON, ONTARIO
MTO DB 2021-3004**

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides detailed geotechnical/foundation engineering recommendations for design of the foundations for the Mid-Block Connection Road underpass (MTO Structure Site No. 35X-0618/B0) as part of the Highway 6/Hanlon Expressway Mid-Block Interchange Improvements contract in the County of Wellington, Ontario. These recommendations are based on interpretation of the factual data obtained from the boreholes advanced during 2017 and 2021 investigations by PML associated with the procurement-ready design for the site.

The discussion and recommendations presented herein are intended to provide the designers with sufficient information to complete the detail design of the Mid-Block Connection Road underpass foundations. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project and for which special provisions may be required for construction.

The recommendations in this report are in accordance with the *Canadian Highway Bridge Design Code* (CHBDC 2019, CAN/CSA-S6-19) and its *Commentary*, the *Canadian Foundation Engineering Manual* (CFEM, 2006), Ontario Provincial Standard Specifications (OPSS), Design-Build Special Provisions (DBSP) and Ontario Provincial Standard Drawings (OPSD).

6.2 Proposed Structure and Selected Foundation Type

Based on the General Arrangement drawing prepared by WSP, the proposed Mid-Block Connection Road underpass will be a two-span structure with span lengths of 45.0 m each. The abutments and centre pier will be supported on battered HP 310x110 piles driven to the dolostone bedrock; 7.5 m long wingwalls will be incorporated at the abutments.

The design grade on the Mid-Block Connection Road will rise from approximately Elevation 330.9 m at the west abutment to 332.2 m at the east abutment, requiring placement of up to approximately 3 m of fill above the natural ground surface beyond the Highway 6 cut. The underpass will have an open configuration, with the abutment foreslopes cut at 2 horizontal to 1 vertical (2H:1V) and covered with concrete slope paving; based on the proposed grading, these foreslopes will be approximately 5 m in height.

6.3 General Design Considerations

6.3.1 Consequence and Site Understanding Classification

The proposed Mid-Block Connection Road underpass and its foundation system are classified as having a “typical consequence level” associated with exceeding limit states design; therefore, a consequence factor, ψ , of 1.0 is applicable per Table 6.1 of CHBDC. Given the level of foundation investigation completed at this structure site in comparison to the degree of site understanding in Section 6.5 of CHBDC, the level of confidence for design is considered to be a “typical degree of site and prediction model understanding.” The applicable geotechnical resistance factors, ϕ_{gu} and ϕ_{gs} , from Table 6.2 of CHBDC have been used in the assessment of axial and lateral capacity for the pile foundations, settlement and global stability.

6.3.2 Seismic Design

The seismic site classification uses the conditions of soils encountered in the upper 30 m of the subsurface. Based on the average SPT “N” values of the silty sand to sandy silt till and the bedrock, the subsurface conditions at the site are classified as Seismic Site Class C for design purposes, based on Clause 4.4.3.2 of CHBDC (2019).

In accordance with Section 4.4.3.1 of CHBDC (2019) and based on the site location, the values provided in the Table 6.1 below are the reference Site Class C peak seismic hazard values based on the *National Building Code of Canada* (2020) Seismic Hazard Tool available at www.earthquakescanada.nrcan.gc.ca.

Table 6.1: Peak Seismic Hazard Values for Seismic Site Class C

| Parameter | 2% Probability of Exceedance in 50 Years (2,475-year) |
|------------------------|---|
| PGA | 0.127 |
| $T \leq 0.2$ s | 0.247 |
| $T = 0.5$ s | 0.159 |
| $T = 1.0$ s | 0.0869 |
| $T = 2.0$ s | 0.0409 |
| $T = 5.0$ s | 0.0108 |
| $T \Rightarrow 10.0$ s | 0.0037 |

In accordance with Clause 4.4.4, CHBDC (2019), a seismic performance category of 1 (major-route and other bridges) is considered applicable for the site.

6.4 Driven Pile Foundations

6.4.1 Founding Elevation and Axial Geotechnical Resistance

The factored ultimate axial geotechnical resistance may be taken as 3,000 kN for an HP 310x110 pile founded on the surface of the dolostone bedrock, based on the measured uniaxial compressive strength of the dolostone bedrock at this site and the rock quality. This factored ultimate geotechnical resistance is greater than the structural capacity of conventional HP 310x110 piles, which would govern the design if conventional steel piles were adopted. For the same size H-pile (HP 310x110) using higher grade 450 MPa steel, the factored ultimate axial geotechnical resistance will remain as 3,000 kN, and more of the geotechnical capacity can be utilized. The factored serviceability geotechnical resistance does not apply to piles founded on the dolostone bedrock at this site, as the factored serviceability geotechnical resistance for 25 mm of settlement is greater than the factored ultimate axial geotechnical resistance.

Based on the presence of cobbles and potential for boulders within the till deposit, there is a risk that some of the piles will not reach bedrock. Where the piles “hang up” on cobbles and/or boulders or within very dense zones of the till, a factored ultimate axial geotechnical resistance of 2,000 kN will apply; the factored serviceability geotechnical resistance for this condition will be greater than the factored ultimate geotechnical resistance. Where such conditions occur during construction piling, the Geotechnical and Structural Engineers shall confirm any requirement and details for additional piles to be placed in the group, as applicable.

Table 6.2 provides the approximate pile tip elevations and the lengths of piles for design purposes based on the current pile cut-off elevations. The structural engineer should incorporate potential for variability of the bedrock surface in the estimates for the lengths of the piles.

Table 6.2: Approximate Pile Tip Elevations and Length for HP 310x110 Piles

| Foundation Element | Design Pile Tip Elevation (m) | Approx. Pile Cut-Off Elevation (m) | Approximate Pile Length (m) |
|--------------------|-------------------------------|------------------------------------|-----------------------------|
| West Abutment | 296.6 ± 1.0 | 324.1 | 27.5 to 28 |
| Centre Pier | 300.1 ± 1.0 | 319.9 | 20 |
| East Abutment | 297.1 ± 1.0 | 325.6 | 28.5 to 29 |

A detailed wave equation analysis will be completed prior to production piling to confirm the hammer type and driving criteria. This analysis will consider the very dense zones or layers of gravel and cobbles noted in many of the boreholes; such zones or layers were encountered at various depths and were found to consist of soils (including gravel and cobbles) for which SPT “N” values exceeded 100 blows per 0.3 m of penetration.

All piles should be reinforced at the tip for protection during driving to reduce the potential for damage to the piles. Driving shoes (such as Titus Standard “H” Bearing Pile points as per OPSD 3000.10 (Foundation Piles – Steel H-Pile Driving Shoe)) are preferred over flange plates.

6.4.2 Lateral Geotechnical Resistance

The resistance to lateral loading will be derived from both the pile batter and the soil surrounding the piles. Where ground conditions are generally competent and the lateral loads on the piles are relatively small such that the maximum lateral deflections will be relatively small, the resistance to lateral loading in front of a single pile can be estimated using subgrade reaction theory. However, the response of piles to lateral loading can be highly non-linear, and methods that assume linear behaviour (such as subgrade reaction theory) are only appropriate where the maximum deflections are less than 1% of the pile dimension, where the loading is static (i.e., no cycling) and where the pile materials behave linearly (CFEM, 2006). Where these conditions are not met, non-linear lateral behaviour of the soil should be considered by the use of P-y curves.

The factored serviceability geotechnical response of the soil in front of the piles under lateral loading may be estimated using subgrade reaction theory, as described by Terzaghi (1955) and the *Canadian Foundation Engineering Manual* (CFEM 2006). The coefficient of horizontal subgrade reaction, k_h (MPa/m), is based on the equation below for the non-cohesive soils present at this site:

$$k_h = \frac{n_h z}{B} \quad \text{where: } n_h \quad \text{is the constant of horizontal subgrade reaction (MPa/m), as given in Table 6.2;}$$

z is the depth (m) of the pile below the pile cap; and,

B is the pile diameter/width (m)

The following values of n_h (American Petroleum Institute (API), 2002) may be incorporated into the calculations of horizontal subgrade reaction (k_h) for structural analyses for a single pile.

Table 6.3: Summary of Parameters for Horizontal Subgrade Reaction Modulus

| Foundation Element | Soil Layer | Elevation Range (m) | n_h (MPa/m) |
|-------------------------|--|---------------------|---------------|
| West and East Abutments | Silty sand to sandy silt till | 324-323 | 21 |
| | Silty sand to sandy silt till | 323-319 | 31 |
| | Gravelly sand with silt till (above water table) | 319-312 | 58 |
| | Gravelly sand with silt till (below water table) | 312-299* | 33 |
| Pier | Gravelly sand with silt till (above water table) | 320-312 | 38 |
| | Gravelly sand with silt till (below water table) | 312-300* | 29 |

* Bedrock surface elevation is approximate

Group action for lateral loading should also be evaluated by reducing the coefficient of horizontal subgrade reaction either in the direction of loading or perpendicular to the direction of loading by relevant group pile efficiency factors as outlined in Section C6.11.3.4 including Figures C6.22 to C6.24 of the *Commentary to the CHBDC* (2019).

If the conditions are not met for use of horizontal subgrade reaction moduli, it is recommended that the lateral behaviour and resistance of the piles be assessed using non-linear P-y curves. P-y curves can be generated for different layers using the procedure established by Reese et al (1974) for sand layers, based on the effective unit weights, drained friction angles, the corresponding 'k' values, and the thicknesses of the layers. Table 6.4 summarizes the parameters used to generate P-y curves.

Table 6.4: Summary of Parameters for P-y Curves

| Foundation Element | Soil Layer | Elevation Range (m) | Effective Unit Weight (kN/m ³) | Friction Angle (degrees) | k (MPa/m) |
|-------------------------|--|---------------------|--|--------------------------|-----------|
| West and East Abutments | Silty sand to sandy silt till | 324-323 | 18 | 32 | 15 |
| | Silty sand to sandy silt till | 323-319 | 19 | 34 | 25 |
| | Gravelly sand with silt till (above water table) | 319-312 | 21 | 38 | 50 |
| | Gravelly sand with silt till (below water table) | 312-299* | 11 | 38 | 35 |
| Pier | Gravelly sand with silt till (above water table) | 320-312 | 20 | 35 | 27 |
| | Gravelly sand with silt till (below water table) | 312-300* | 11 | 37 | 30 |

* Bedrock surface elevation is approximate

P-y curves have been generated using LPILE (2019) from Ensoft and are provided on Figures E-1 and E-2 in Appendix E for the abutments and centre pier respectively. If it is necessary to incorporate P-y curves in the structural analysis, p-multipliers will be required to account for the impacts to available lateral resistance from

centre-to-centre spacing, piles in leading and trailing rows, and angle/direction of batter. These p-multipliers will be established in coordination with the structural engineers if and as applicable in the next report submission.

6.4.3 Frost Protection

Pile caps for the abutments and pier should be provided with a minimum of 1.4 m of soil cover to provide adequate frost protection as interpreted from OPSD 3090.101 (Foundation Frost Depths for Southern Ontario).

6.5 Lateral Earth Pressures

The lateral earth pressure acting on the abutment walls and associated wingwalls will depend on the type and method of placement of the backfill materials, the nature of the soils behind the backfill, the magnitude of surcharge, the freedom of movement of the structure, and the drainage conditions behind the walls.

Select, free draining granular fill meeting the specifications of OPSS.PROV 1010 (*Aggregates*) Granular A or Granular B Type I or Type II should be used as backfill behind the walls. Longitudinal drains or weep holes should be installed to provide positive drainage of the granular backfill. Compaction (including type of equipment, target densities, etc.) should be carried out in accordance with OPSS.PROV 501 (*Compacting*). Other aspects of the granular backfill requirements with respect to subdrains and frost taper should be in accordance with OPSD 3101.150 (*Walls, Abutment, Backfill, Minimum Granular Requirement*), OPSD 3121.150 (*Walls, Retaining, Backfill, Minimum Granular Requirement*), and OPSD 3190.100 (*Walls, Retaining and Abutment, Wall Drain*).

For restrained walls, granular fill should be placed in a zone with the width equal to at least 1.4 m (equivalent to the depth of frost penetration at this site as interpreted from OPSD 3090.101) behind the back of the wall, as shown on Figure C6.31(a) of the *Commentary* to CHBDC (2019). For unrestrained walls, fill should be placed within the wedge-shaped zone defined by a line drawn flatter than 1H:1V extending up and back from the rear face of pile cap as shown on Figure C6.31(b) of the *Commentary* to CHBDC (2019).

The lateral earth pressure coefficients provided in Table 6.5 have been developed for flat (i.e., non-sloping) ground above the wall, as well as for a 2H:1V slope condition for unrestrained walls. If the inclination of the slope above the wall differs, revised lateral earth pressures parameters will need to be calculated in accordance with CHBDC Clause C6.12.1, Figures C6.28 (active earth pressure) and C6.29 (passive earth pressure), and Clause C6.12.2.2 (at-rest earth pressure).

Table 6.5: Earth Pressure Coefficients

| Wall Movement Condition | Restrained Wall | Unrestrained Wall | | | |
|--|---|---|-------|------------------------------------|-------|
| Fill Material | Native Till or Earth Fill Behind Granular, $\Phi'=32^\circ$ | Granular A and B Type II $\Phi'=36^\circ$ | | Granular B Type I $\Phi'=32^\circ$ | |
| Unit Weight (kN/m ³) | 19 | 22 | 22 | 21 | 21 |
| Ground Surface Above Top of Wall | Horizontal | Horizontal | 2H:1V | Horizontal | 2H:1V |
| Active Earth Pressure (K _a) | 0.31 | 0.26 | 0.36 | 0.31 | 0.46 |
| At-Rest Earth Pressure (K ₀) | 0.47 | 0.41 | 0.60 | 0.47 | 0.68 |
| Passive Earth Pressure (K _p) | 3.25 | 3.85 | - | 3.25 | - |

If the wall support and superstructure allow lateral yielding, active earth pressures may be used in the geotechnical design of the structure. The movement required to allow active pressures to develop within the backfill, and thereby assume an unrestrained structure for design, should be calculated in accordance with Section C6.12.1 and Table C6.12 of the *Commentary to the CHBDC* (2019).

If the wall does not allow lateral yielding (i.e., restrained structure where the rotational or horizontal movement is not sufficient to mobilize an active earth pressure condition), at-rest earth pressures (plus any compaction surcharge) should be assumed for geotechnical design.

6.6 Corrosion Impacts on Construction Materials

The results of analytical testing on two samples of the silty sand to sandy silt till are presented in Section 4.4 and Appendix C.

The analytical test results were compared to CSA A23.1 Table 3 (*"Additional requirements for concrete subjected to sulphate attack"*) for potential sulphate attack on concrete. The sulphate concentrations measured in the tested samples are less than 0.1% (1000 µg/g), indicating a low degree of sulphate attack when concrete is in contact with soil or groundwater. The measured resistivity values are greater than 2000 ohm-cm, which suggests a non-corrosive environment for buried metal based on Table 2 of the U.S. Criteria for Assessing Ground Corrosion Potential (as derived from Federal Highways Administration (FHWA) 2003).

The structural engineer should determine the appropriate exposure class to ensure that all aspects of CSA A23.1 Section 4.1.1 "Durability Requirements" are met, including consideration of potential exposure to roadway de-icing salts in the future.

6.7 Approach Embankments and Abutment Foreslopes

Construction of the Mid-Block Connection Road will require placement of up to approximately 2 m and 3.5 m of fill on top of the existing grade at the west and east approach embankment areas, respectively, to achieve the design roadway grades.

The existing ground surface on the west side of Highway 6 varies from approximately Elevation 322 m at the existing ditchline to Elevation 328.5 m to 329 m at and beyond the crest of the cut slope; on the east side, the existing ground surface varies from approximately Elevation 323 m to 329 m between the ditchline and cut slope crest, respectively. The proposed widened highway cut surrounding the abutments will be up to approximately 7 m in height at the proposed underpass site, with the foreslope in front of the abutment wall having a maximum height of approximately 5 m.

6.7.1 Subgrade Preparation

Prior to construction of the Mid-Block Connection Road approaches to the underpass, it is recommended that all topsoil and loosened/softened fill be removed from the footprint of the approach embankments.

6.7.2 Embankment/Cut Slope Construction and Surficial Treatment

Fill for construction of the new approach embankments, as well as any reconstruction of the abutment foreslopes as may be required following construction of the abutments, may consist of Granular A or Granular B Type I or Type II meeting the specifications of OPSS.PROV 1010 (Aggregates), or alternatively earth fill or select subgrade material (SSM). Excavated material from the cuts at the Mid-Block Interchange area are generally suitable for reuse as embankment fill on the project. Fill should be placed and compacted in accordance with OPSS.PROV 501 (Compacting) and OPSS.PROV 206 (Grading).

Where earth fill or select subgrade material is used for embankment construction, and for cuts within the native soils, the exposed materials will be susceptible to erosion and shallow ravelling. To reduce surface water erosion and ravelling on the embankment side slopes or cut slopes, treatment per OPSS.PROV 804 (Temporary Erosion Control) and OPSS.PROV 803 (Vegetative Cover) must be provided.

If slope protection is not in place prior to winter or periods of excessive precipitation, or if localized zones of seepage are encountered in cut slopes, alternate protection measures such as gravel sheeting per OPSS 511 (Rip-Rap, Rock Protection and Granular Sheeting) and OPSS.PROV 1004 (Aggregates – Miscellaneous) will be required to reduce the potential for erosion and associated requires for remedial works on the slope faces prior to topsoil dressing and seeding.

6.7.3 Embankment and Cut Slope Geometry and Global Stability

The Mid-Block Connection Road approach embankments and the Highway 6 cut slopes should be constructed with side slopes no steeper than 2H:1V. Where cut slopes exceed 6 m in height, as could be the case immediately outside of and adjacent to the underpass depending on final grading, the slope must incorporate a bench with a minimum width of 2 m such that the uninterrupted cut slope height does not exceed 6 m. Mid-height benches will not be applicable for the low approach embankment heights at this structure site.

Limit equilibrium slope stability analyses were performed for the abutment foreslope area using the commercially available program Slide2 produced by Rocscience Inc., employing the Morgenstern-Price method of analysis, to examine numerous potential failure surfaces to assess the minimum factor of safety. A minimum factor of safety of 1.5 has been targeted for long-term (effective stress) conditions for the slopes on this project, in accordance with CHBDC (2019).

For the predominantly non-cohesive soils present at the site, the effective stress parameters employed in the analysis were estimated from empirical correlations based on the results of the in-situ Standard Penetration Tests (SPT). The correlations proposed by Peck et al (1974) and U.S. Navy (1986) were employed and the results were adjusted by engineering judgment based on precedent experience in similar soil conditions. The parameters used in this global stability analysis are summarized in Table 6.6.

Table 6.6: Geotechnical Parameters for Global Stability Analysis

| Soil | Bulk Unit Weight (kN/m ³) | Effective Friction Angle (ϕ') (degrees) | Cohesion (c') (kPa) |
|---|---------------------------------------|--|-------------------------|
| Pavement structure (at Highway 6 beyond toe of cut slope) | 21 | 32 | - |
| Compact silty sand to sandy silt till | 19 | 28 | - |
| Dense to very dense silty sand to sandy silt till | 19 | 34 | - |

The results of the global stability analysis for the abutment foreslope area are provided on Figure E-3 in Appendix E, demonstrating that a factor of safety of 1.5 or greater is achieved for an approximately 4.5 m high, 2H:1V slope configuration. For this analysis, shallow slippages in the silty material were neglected, and treatment of the surface will be required to minimize such erosion and ravelling, as discussed in Section 6.7.2. For this site, the abutment foreslopes will be treated with slope paving, mitigating the potential for shallow erosion and ravelling.

The factor of safety for global stability of the west and east approach embankments, which are less than 3.5 m in height and founded on generally compact to dense silty sand to sandy silt till, will also be greater than 1.5; surficial protection must be established on the side slopes following completion of the embankments as discussed in Section 6.7.2.

6.7.4 Settlement Under Embankment Loading

The loading from the proposed west and east approach embankments, up to approximately 2 m and 3.5 m high respectively, will induce less than 15 mm of settlement in the generally compact to very dense till soils below the footprint of the embankments. This settlement will occur during and immediately following construction, and there is no requirement for preloading of the Mid-Block Connection Road approach embankment areas prior to paving.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Excavation

Excavations for construction of the pile caps will extend as follows:

- **West abutment:** Elevation 323.8 m (approximately 5 m depth relative to existing crest of cut slope)
- **Centre pier:** Elevation 320.0 m (approximately 3 m to 3.5 m below existing ground surface, and 2 m below the proposed grade in the highway median)
- **East abutment:** Elevation 325.6 m (approximately 2.5 m to 3.5 m depth relative to crest of cut slope)

Based on the site geometry, it is anticipated that open-cut (unsupported) excavations can be used at the abutments, and potentially at the centre pier depending on construction staging.

Temporary open-cut excavations must be carried out in accordance with the guidelines outlined in the latest edition of Occupational Health and Safety Act (OHSA) and Regulation for Construction Activities (O.Reg. 213/91). The silty sand to sandy silt till is generally compact to dense and is classified as Type 2 soil according to OHSA, while localized loose zones of the till or fill would be classified as Type 3 soil according to OHSA. Temporary excavations should be made with side slopes no steeper than 1H:1V in Type 3 soil. Appropriate control of localized perched groundwater seepage and precipitation runoff will be required to maintain these temporary open-cut slopes.

7.2 Temporary Protection Systems

Depending on construction staging, a temporary protection system may be required for excavation at the centre pier. The protection system should be designed and constructed in accordance with OPSS.PROV 539 (Temporary Protection Systems) or DBSP0539 to meet Performance Level 2 adjacent to the Highway 6 lanes.

The design of the temporary protection system will be the responsibility of the Design-Build Contractor. However, it is noted that the presence of gravel and/or cobble zones within the native soils may make driven steel sheet piles impracticable at this site. The geotechnical parameters provided in Table 7.1 are provided to aid the temporary works designer.

Table 7.1: Geotechnical Parameters for Temporary Protection Systems at Centre Pier

| Elevation (m) | Soil Type | Unit Weight (kN/m ³) | Effective Friction Angle (°) | Coefficient of Lateral Earth Pressure ¹ | | |
|---------------|---|----------------------------------|------------------------------|--|------------------------|-------------------------------------|
| | | | | Active K _a | At Rest K _o | Passive K _p ² |
| Below 320 | Generally compact to dense silty sand to sandy silt till, containing very dense zones | 20 | 32 | 0.31 | 0.47 | 3.25 |

Notes:

1. The earth pressure coefficients noted above are based on a horizontal surface adjacent to the excavation. If sloped surfaces are present, the coefficient of earth pressure must be adjusted accordingly, per CHBDC Clause C6.12.1, Figures C6.28 (active earth pressure) and C6.29 (passive earth pressure), and Clause C6.12.2.2 (at-rest earth pressure).
2. The total passive resistance below the base of the excavation (i.e., adjacent to the temporary protection system) may be calculated based on the values of K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6.27 of CHBDC (2019) to account for the large strain that would be required for mobilization of the full passive resistance.

7.3 Groundwater Control

At the structure location, the stabilized groundwater elevations measured in monitoring wells installed in boreholes drilled at west and east abutments (35-618-02 and 35-618-08) of the proposed underpass and at the toe of Highway 6 (35-618-06) ranged from El. 310.2 to El. 312.5.

The stabilized groundwater level at the site is estimated to vary between approximately Elevation 310.0 m and 312.5 m, although this water level will vary seasonally and may be higher during wet seasons and years particularly following snow melt and periods of heavy precipitation. This level is several metres below the underside of the lowest pile cap, and hence excavation dewatering is not expected to be required.

However, some localized seepage may occur within the excavations, attributable to groundwater perched on top of till zones with slightly higher clay content. Such seepage is expected to be relatively minor and of limited recharge, such that it can be managed with properly filtered sumps within the excavation.

7.4 Embankment Subgrade Preparation and Side Slope Treatment

As described in Section 6.7.1, it is recommended that all topsoil and any loosened/softened fill be removed from the footprint of the approach embankments prior to construction of the Mid-Block Connection Road.

As described in Section 6.7.2, where earth fill or select subgrade material is used for embankment construction, and for cuts within the native soils at this site, the exposed materials will be susceptible to erosion and shallow ravelling. To reduce surface water erosion and ravelling on the embankment side slopes or cut slopes, treatment per OPSS.PROV 804 (Temporary Erosion Control) and OPSS.PROV 803 (Vegetative Cover) must be provided as soon as possible after completion of the cut or fill slopes.

If slope protection is not in place prior to winter or periods of excessive precipitation, or where localized zones of seepage are encountered in cut slopes, alternate protection measures such as gravel sheeting per OPSS 511 (Rip-Rap, Rock Protection and Granular Sheeting) and OPSS.PROV 1004 (Aggregates – Miscellaneous) will be required to reduce the potential for erosion and associated requires for remedial works on the slope faces prior to topsoil dressing and seeding.

7.5 Pile Installation and Obstructions

Zones of gravel and cobbles were encountered during drilling in many of the boreholes at this site, and there is potential for boulders to be present within the till deposit. Boreholes 35-618-03A and 35-618-03B, near the west abutment, encountered refusal at approximately Elevation 314 m to 316 m, well above the surface of the dolostone bedrock.

All piles should be reinforced at the tip to reduce the potential for damage to the piles during driving through zones of very dense soil, gravel and cobbles. Driving shoes (such as Titus Standard “H” Bearing Pile points as per OPSD 3000.10 (Foundation Piles – Steel H-Pile Driving Shoe) are preferred over flange plates. Higher grade steel piles may also be considered to improve the ability of HP 310x110 piles to withstand difficult driving conditions.

As discussed in Section 6.4.1, a detailed wave equation analysis will be completed prior to production piling to confirm the pile driving equipment, considering the occasional very dense zones and layers of gravel and cobbles noted in many of the boreholes.

8.0 MONITORING DURING AND FOLLOWING CONSTRUCTION

If temporary protection systems are adopted at the centre pier, monitoring of pile deformations are required per OPSS.PROV 539 (Temporary Protection Systems). No other monitoring is proposed during construction as the estimated magnitude of settlement under the approach embankment loading is less than 15 mm and will occur immediately during construction.

Per RFP Section 2.4.9.11, measurement of differential settlements between the abutments and abutment approaches shall be taken at Months 3, 6, 12, 18 and 24 of the General Warranty period. Immediately following paving, elevations at the centreline of each lane of the Mid-Block Connection Road shall be measured at the bridge abutments and at distances of 20 m, 50 m, 75 m and 100 m from the abutments.

9.0 CLOSURE

This Foundation Design Report was prepared by Akshay Ramprakash, Geotechnical Consultant, and reviewed by Michael Beadle, P.Eng., Senior Geotechnical Engineer, and Lisa Coyne, P.Eng., Senior Geotechnical Engineer and MTO Designated Foundations Contact for Golder.

Golder Associates Ltd.



Michael Beadle, P.Eng.
Senior Principal, Senior Geotechnical Engineer

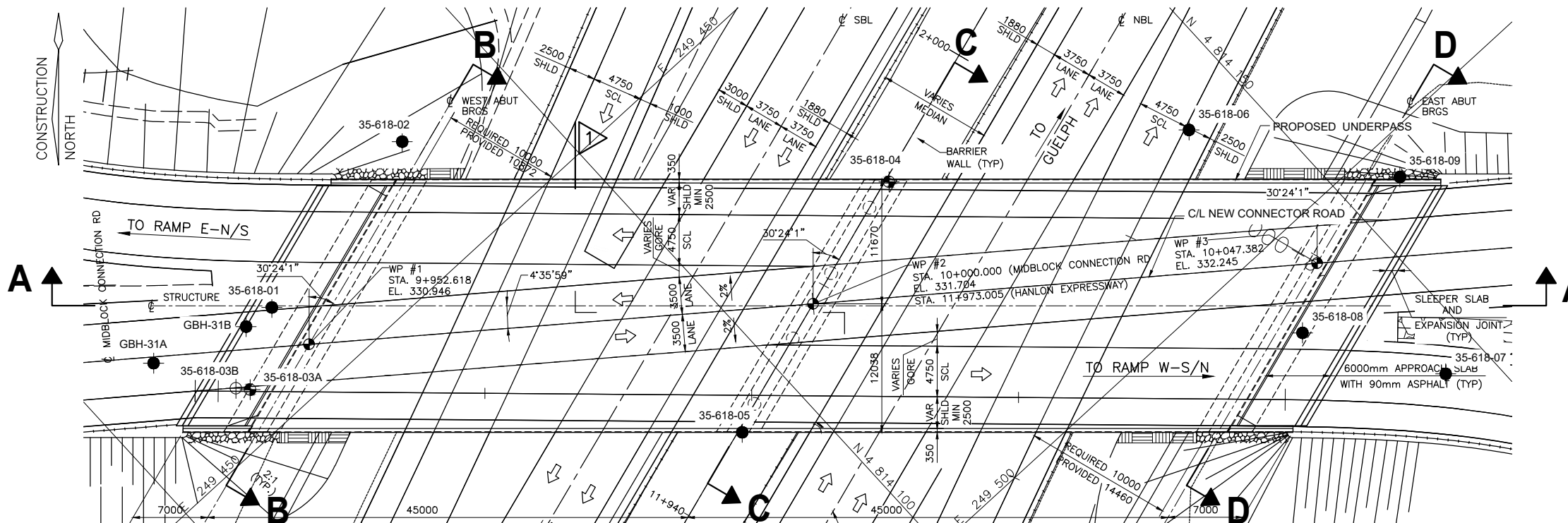


Lisa Coyne, P.Eng.
Senior Principal, MTO Designated Foundations Contact

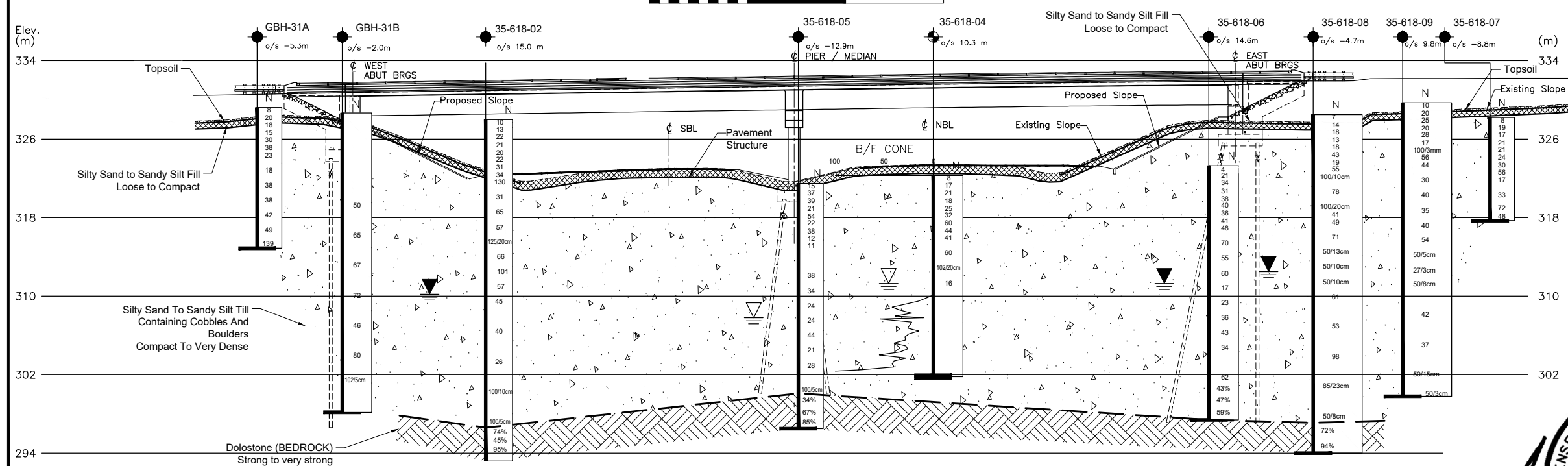
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| LEGEND | | | | |
|------------|---------------------------------------|-------------|-----------|--|
| | Borehole | | | |
| | Borehole & DCPT | | | |
| | DCPT | | | |
| N | Blows/0.3m (Std Pen Test, 475 J/blow) | | | |
| RQD | Rock Quality Designation | | | |
| CONE | Blows/0.3m (60° Cone, 475 J/blow) | | | |
| | WL measuring in monitoring well | | | |
| | WL observed during drilling | | | |
| No | ELEVATION | NORTHING | EASTING | |
| 35-618-01 | 328.1 | 4 814 069.0 | 249 441.2 | |
| 35-618-02 | 328 | 4 814 088.5 | 249 438 | |
| 35-618-03A | 328 | 4 814 062.3 | 249 445.5 | |
| 35-618-03B | 328 | 4 814 061.4 | 249 444.5 | |
| 35-618-04 | 322.3 | 4 814 119.6 | 249 471.6 | |
| 35-618-05 | 321.5 | 4 814 093.6 | 249 479.6 | |
| 35-618-06 | 323.3 | 4 814 143.6 | 249 487.0 | |
| 35-618-07 | 328.2 | 4 814 145.9 | 249 520.1 | |
| 35-618-08 | 328.5 | 4 814 138.6 | 249 508.2 | |
| 35-618-09 | 329.7 | 4 814 155.2 | 249 503.6 | |
| GBH-31A | 329.2 | 4 814 057.3 | 249 437.6 | |
| GBH-31B | 328.7 | 4 814 066.0 | 249 440.9 | |



A-A PROFILE ALONG ϕ OF MID-BLOCK CONNECTION ROAD UNDERPASS

NOTES:

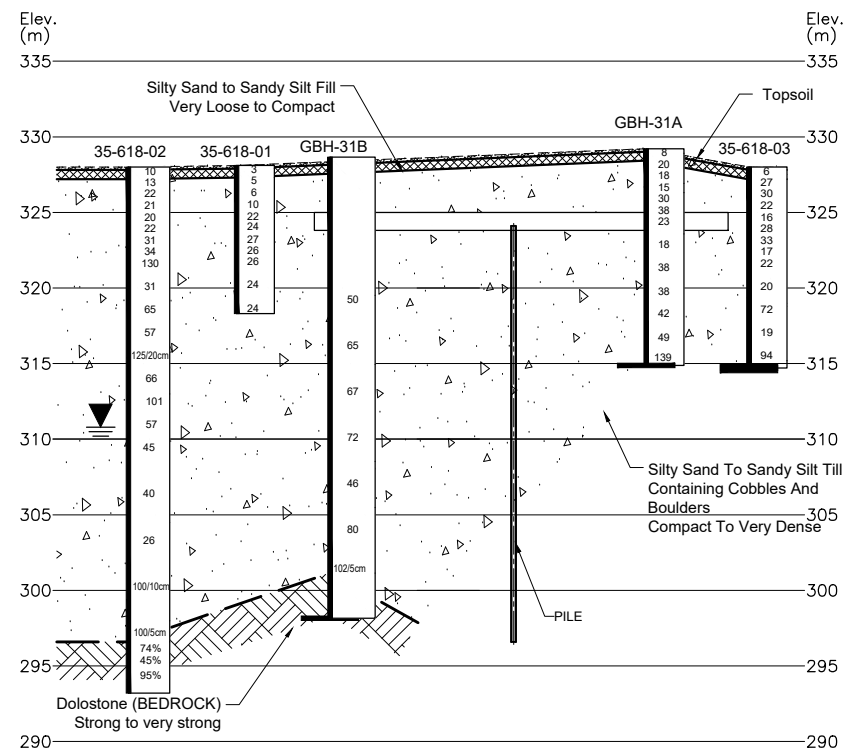
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. THE PROPOSED STRUCTURE DETAILS/WORKS ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY AND MAY NOT BE CONSISTENT WITH FINAL DESIGN CONFIGURATION AS SHOWN ELSEWHERE IN THE CONTRACT DRAWINGS.
- THE BOUNDARIES BETWEEN SOIL AND ROCK STRATA HAVE BEEN ESTABLISHED OR INTERPRETED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES, THE BOUNDARIES ARE ASSUMED AND INTERPRETED FROM GEOLOGICAL EVIDENCE.

| NO. | DATE | REVISIONS | BY | CHK | LEAD | PROJ. MGR. |
|-----|----------|---------------------------|-----|-----|------|------------|
| A | 22/09/02 | FINAL DESIGN PRESENTATION | MEB | LCC | PB | |

| CONSULTANT | NAME (PRINT) | INIT. | DATE |
|------------|--------------|-------|----------|
| DRAWN | G. DEAN | GD | 22/09/02 |
| CHECKED | M. BEADLE | MEB | 22/09/02 |
| APPROVED | L. COYNE | LCC | 22/09/02 |
| APPROVED | P. BAMFORTH | PB | 22/09/02 |

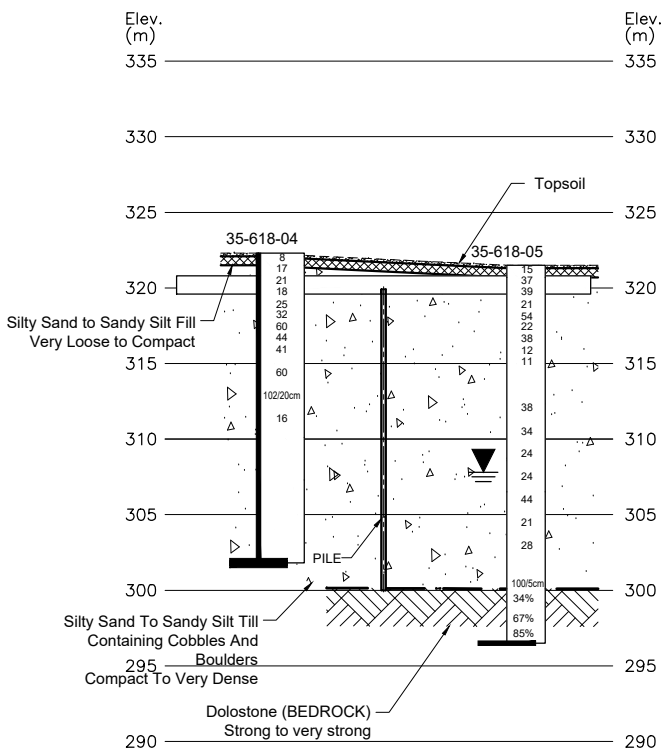
Highway 6 Hanlon Expressway
Midblock Connection Rd Underpass
Borehole Locations and Soil Strata

| PROJECT NO. | SUBMISSION STAGE IDENTIFIER | DISCIPLINE | STRUCTURE NUMBER | DESIGN ELEMENT | DOCUMENT TYPE | DRAWING NUMBER | REVISION NUMBER |
|-------------|-----------------------------|------------|------------------|----------------|---------------|----------------|-----------------|
| H6D | FDP | STR | M0618 | FS | DWG | 2201 | A |



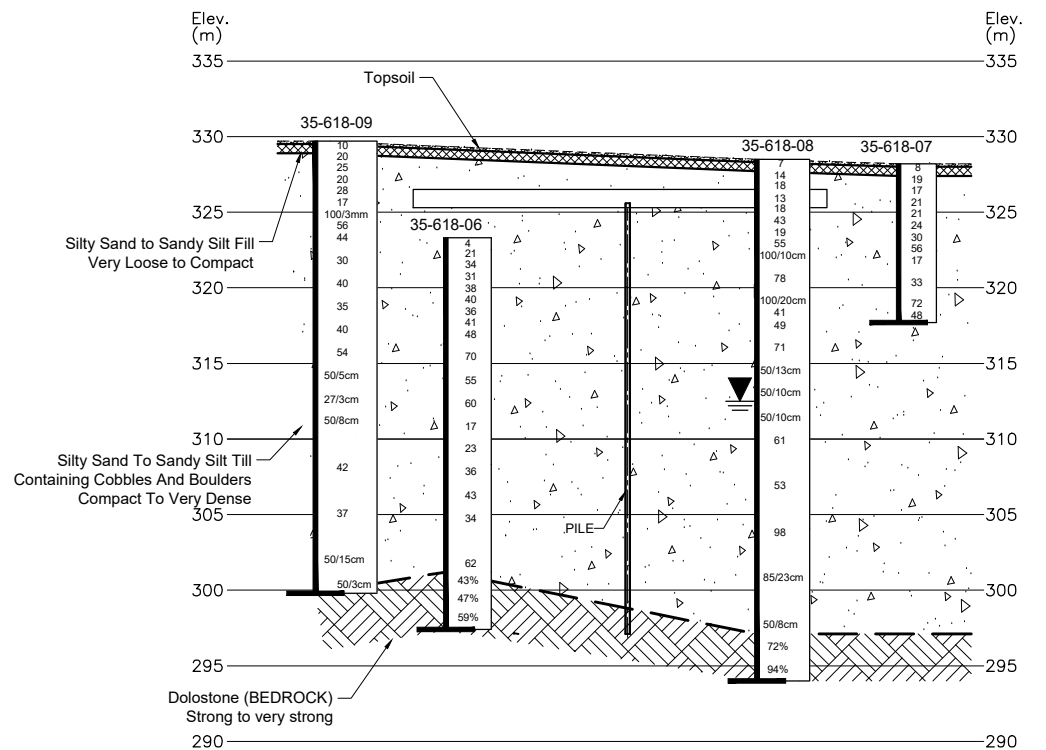
B-B' PROFILE ALONG Q-Q OF WEST ABUTMENT

NOTE:
PILE SHOWN FOR ILLUSTRATION PURPOSES ONLY.
WEST ABUTMENT PILES TO BE DRIVEN TO REFUSAL
ON BEDROCK AT ELEVATION 296.6 m +/- 1.0 m



C-C' PROFILE ALONG Q-Q OF PIER

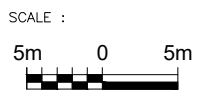
NOTE:
PILE SHOWN FOR ILLUSTRATION PURPOSES ONLY.
CENTRE PIER PILES TO BE DRIVEN TO REFUSAL ON
BEDROCK AT ELEVATION 300.0 m +/- 1.0 m



D-D' PROFILE ALONG Q-Q OF EAST ABUTMENT

NOTE:
PILE SHOWN FOR ILLUSTRATION PURPOSES ONLY.
EAST ABUTMENT PILES TO BE DRIVEN TO REFUSAL
ON BEDROCK AT ELEVATION 297.1 m +/- 1.0 m

- 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 FINAL DESIGN CONFIGURATION AS SHOWN ELSEWHERE IN THE CONTRACT DRAWINGS.
 - THE BOUNDARIES BETWEEN SOIL AND ROCK STRATA HAVE BEEN ESTABLISHED OR INTERPRETED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES, THE BOUNDARIES ARE ASSUMED AND INTERPRETED FROM GEOLOGICAL EVIDENCE.



GEOCREs No 40PB-291-1

| | | | | | | | |
|-----|----------|---------------------------|--|-----|-----|------|------|
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| | | | | | | | |
| A | 22/09/02 | FINAL DESIGN PRESENTATION | | MEB | LCC | PB | |
| NO. | DATE | REVISIONS | | BY | CHK | LEAD | PROJ |
| | | | | | | | |

| | | | | |
|------------|--------------|-------------|-------|----------|
| CONSULTANT | DRAWN | G. DEAN | GD | 22/09/02 |
| | CHECKED | M. BEADLE | MED | 22/09/02 |
| | APPROVED | L. COYNE | LCC | 22/09/02 |
| | LEAD ENGR | P. BAMFORTH | PB | 22/09/02 |
| | PROJ. MGR | | | |
| | NAME (PRINT) | | INIT. | DATE |



| | | | | | | | |
|---|------------|------------|-----------|--------|----------|---------|----------|
| HIGHWAY 6 HANLON EXPRESSWAY MIDBLOCK CONNECTION RD UNDERPASS | | | | | | | |
| SOIL STRATA | | | | | | | |
| PROJECT NO. | SUBMISSION | DISCIPLINE | STRUCTURE | DESIGN | DOCUMENT | DRAWING | REVISION |
| H6D | FDP | STR | M0618 | FS | DWG | 2202 | A |

APPENDIX A

**Borehole Records and Bedrock Core Photographs –
2017 and 2021 Investigations
(GEOCRES No. 40P8-291)**

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

COMPOSITION: SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

| PERCENT BY MASS | 0 - 10 | 10 - 20 | 20 - 30 | 30 - 40 | > 40 |
|-----------------|--------|---------|---------|-------------------|----------------|
| | TRACE | SOME | WITH | ADJECTIVE (SILTY) | AND (AND SILT) |

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

| c_u (kPa) | 0 - 12 | 12 - 25 | 25 - 50 | 50 - 100 | 100 - 200 | > 200 |
|-------------|-----------|---------|---------|----------|------------|-------|
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

| N (BLOWS/0.3m) | 0 - 5 | 5 - 10 | 10 - 30 | 30 - 50 | > 50 |
|----------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

| R Q D (%) | 0 - 25 | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100 |
|-----------|-----------|---------|---------|---------|-----------|
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

JOINTING AND BEDDING:

| SPACING | 50mm | 50 - 300mm | 0.3m - 1m | 1m - 3m | > 3m |
|----------|------------|------------|------------|---------|------------|
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

| | | | |
|-----|---------------------|-----|----------------------------|
| S S | SPLIT SPOON | T P | THINWALL PISTON |
| W S | WASH SAMPLE | O S | OSTERBERG SAMPLE |
| S T | SLOTTED TUBE SAMPLE | R C | ROCK CORE |
| B S | BLOCK SAMPLE | P H | T W ADVANCED HYDRAULICALLY |
| C S | CHUNK SAMPLE | P M | T W ADVANCED MANUALLY |
| T W | THINWALL OPEN | F S | FOIL SAMPLE |
| F V | FIELD VANE | | |

STRESS AND STRAIN

| | | |
|--------------------------------------|-----|-------------------------------|
| u_w | kPa | PORE WATER PRESSURE |
| u | 1 | PORE PRESSURE RATIO |
| σ | kPa | TOTAL NORMAL STRESS |
| σ' | kPa | EFFECTIVE NORMAL STRESS |
| τ | kPa | SHEAR STRESS |
| $\sigma_1, \sigma_2, \sigma_3$ | kPa | PRINCIPAL STRESSES |
| ϵ | % | LINEAR STRAIN |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | % | PRINCIPAL STRAINS |
| E | kPa | MODULUS OF LINEAR DEFORMATION |
| G | kPa | MODULUS OF SHEAR DEFORMATION |
| μ | 1 | COEFFICIENT OF FRICTION |

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|-------------------|--------------------------------------|
| m_v | kPa ⁻¹ | COEFFICIENT OF VOLUME CHANGE |
| C_c | 1 | COMPRESSION INDEX |
| C_s | 1 | SWELLING INDEX |
| C_α | 1 | RATE OF SECONDARY CONSOLIDATION |
| c_v | m ² /s | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| T_v | 1 | TIME FACTOR |
| U | % | DEGREE OF CONSOLIDATION |
| σ'_{v0} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| τ_f | kPa | SHEAR STRENGTH |
| c' | kPa | EFFECTIVE COHESION INTERCEPT |
| ϕ' | -° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| c_u | kPa | APPARENT COHESION INTERCEPT |
| ϕ_u | -° | APPARENT ANGLE OF INTERNAL FRICTION |
| τ_R | kPa | RESIDUAL SHEAR STRENGTH |
| τ_r | kPa | REMOULDED SHEAR STRENGTH |
| S_i | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

PHYSICAL PROPERTIES OF SOIL

| | | | | | | | | |
|----------------|-------------------|--------------------------------|-------|------|---|-----------|-------------------|---|
| ρ_s | kg/m ³ | DENSITY OF SOLID PARTICLES | n | 1, % | POROSITY | e_{max} | 1, % | VOID RATIO IN LOOSEST STATE |
| γ_s | kN/m ³ | UNIT WEIGHT OF SOLID PARTICLES | w | 1, % | WATER CONTENT | e_{min} | 1, % | VOID RATIO IN DENSEST STATE |
| ρ_w | kg/m ³ | DENSITY OF WATER | S_r | % | DEGREE OF SATURATION | I_D | 1 | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| γ_w | kN/m ³ | UNIT WEIGHT OF WATER | w_L | % | LIQUID LIMIT | D | mm | GRAIN DIAMETER |
| ρ | kg/m ³ | DENSITY OF SOIL | w_p | % | PLASTIC LIMIT | D_n | mm | n PERCENT - DIAMETER |
| γ | kN/m ³ | UNIT WEIGHT OF SOIL | w_s | % | SHRINKAGE LIMIT | C_u | 1 | UNIFORMITY COEFFICIENT |
| ρ_d | kg/m ³ | DENSITY OF DRY SOIL | I_p | % | PLASTICITY INDEX = $w_L - w_p$ | h | m | HYDRAULIC HEAD OR POTENTIAL |
| γ_d | kN/m ³ | UNIT WEIGHT OF DRY SOIL | I_L | 1 | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ | q | m ³ /s | RATE OF DISCHARGE |
| ρ_{sat} | kg/m ³ | DENSITY OF SATURATED SOIL | I_C | 1 | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ | v | m/s | DISCHARGE VELOCITY |
| γ_{sat} | kN/m ³ | UNIT WEIGHT OF SATURATED SOIL | | | | i | 1 | HYDRAULIC GRADIENT |
| ρ' | kg/m ³ | DENSITY OF SUBMERGED SOIL | DTPL | | DRIER THAN PLASTIC LIMIT | k | m/s | HYDRAULIC CONDUCTIVITY |
| γ' | kN/m ³ | UNIT WEIGHT OF SUBMERGED SOIL | APL | | ABOUT PLASTIC LIMIT | j | kN/m ³ | SEEPAGE FORCE |
| e | 1, % | VOID RATIO | WTPL | | WETTER THAN PLASTIC LIMIT | | | |

RECORD OF BOREHOLE No 35-618-01

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 069.0 N; 249 441.2 E (MTM ON10) ORIGINATED BY M.F.
 DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers COMPILED BY L.Y.
 DATUM Geodetic DATE 2017.11.27 LATITUDE 43.464480 LONGITUDE -80.184150 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|--|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | |
| 328.1 | GROUND SURFACE | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 327.9 | TOPSOIL | | | | | | | | | | | | | | | |
| 0.2 | SILTY SAND Very loose, Brown, Moist (FILL) | | 1 | SS | 3 | | | | | | | | | | | |
| 327.3 | SILTY SAND/SANDY SILT, trace/some gravel Loose to compact, Brown, Moist to wet (TILL) | | 2 | SS | 5 | | | | | | | | | | | |
| 0.8 | | | 3 | SS | 6 | | | | | | | | | | | 2 57 37 4 |
| | | | 4 | SS | 10 | | | | | | | | | | | |
| | | | 5 | SS | 22 | | | | | | | | | | | 20 38 38 4 |
| | | | 6 | SS | 24 | | | | | | | | | | | |
| | | | 7 | SS | 27 | | | | | | | | | | | |
| | | | 8 | SS | 26 | | | | | | | | | | | |
| | | | 9 | SS | 26 | | | | | | | | | | | 2 28 58 12 |
| | | | 10 | SS | 24 | | | | | | | | | | | |
| | | | 11 | SS | 24 | | | | | | | | | | | |
| 318.3 | End of borehole | | | | | | | | | | | | | | | |
| 9.8 | | | | | | | | | | | | | | | | |
| | <div>▽</div> Groundwater level observed during drilling | | | | | | | | | | | | | | | |

ONTARIO MTO 17TF006A - PART A.GPJ ONTARIO MTO.GDT 9/23/21

RECORD OF BOREHOLE No 35-618-02

1 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 088.5 N; 249 438.0 E (MTM ON10) ORIGINATED BY M.F.
 DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Mud Rotary Drilling, NQ Rock Coring COMPILED BY L.Y.
 DATUM Geodetic DATE 2017.11.23 - 2017.11.27 LATITUDE 43.464605 LONGITUDE -80.184004 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|------------------------------------|-------------------------------------|-----------------------------------|--|---|-------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) |
| 328.0 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 0.0 | TOPSOIL | | | | | | | | | | | | | | | | |
| 327.7 | | | | | | | | | | | | | | | | | |
| 0.3 | SANDY SILT Loose, Brown, Moist (FILL) | | 1 | SS | 10 | | | | | | | | | ○ | | | |
| 327.2 | | | | | | | | | | | | | | | | | |
| 0.8 | SILTY SAND/SANDY SILT, trace/some gravel | | 2 | SS | 13 | | | | | | | | | ○ | | | |
| | Compact, Brown, Moist (TILL) | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 22 | | | | | | | | | ○ | | | 0 18 73 9 |
| | _____ gravel, with sand | | | | | | | | | | | | | | | | |
| | | | 4 | SS | 21 | | | | | | | | | ○ | | | 61 33 5 1 |
| | _____ | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 20 | | | | | | | | | ○ | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 22 | | | | | | | | | ○ | H | | 0 5 79 16 |
| | | | | | | | | | | | | | | | | | |
| | _____ Dense to very dense | | 7 | SS | 31 | | | | | | | | | ○ | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 34 | | | | | | | | | ○ | | | 23 39 34 4 |
| | | | | | | | | | | | | | | | | | |
| | | | 9 | SS | 130 | | | | | | | | | ○ | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 10 | SS | 31 | | | | | | | | | ○ | | | 17 51 28 4 |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 11 | SS | 65 | | | | | | | | | ○ | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 12 | SS | 57 | | | | | | | | | ○ | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | _____ with gravel | | 13 | SS | 125/20cm | | | | | | | | | ○ | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 14 | SS | 66 | | | | | | | | | ○ | | | 45 51 (4) |
| | | | | | | | | | | | | | | | | | |
| 313.0 | | | | | | | | | | | | | | | | | |

Continued Next Page

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

RECORD OF BOREHOLE No 35-618-02

2 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 088.5 N; 249 438.0 E (MTM ON10) ORIGINATED BY M.F.
DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Mud Rotary Drilling, NQ Rock Coring COMPILED BY L.Y.
DATUM Geodetic DATE 2017.11.23 - 2017.11.27 LATITUDE 43.464605 LONGITUDE -80.184004 CHECKED BY G.U.

| 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 | | | 20 | 40 | 60 | 80 | 100 | | |
| 313.0 | | | | | | | | | | | | | | |
| 15.0 | SILTY SAND/SANDY SILT, with gravel Dense to very dense, Brown, Moist to wet (TILL) | | 15 | SS | 101 | | 312 | | | | | | | |
| | | | 16 | SS | 57 | | 311 | | | | | | | |
| | | | 17 | SS | 45 | | 310 | | | | | | | |
| | | | 18 | SS | 40 | | 309 | | | | | | | |
| | | | 19 | SS | 26 | | 308 | | | | | | | |
| | | | 20 | SS | 100/10cm | | 307 | | | | | | | |
| | | | | | | | 306 | | | | | | | |
| | | | | | | | 305 | | | | | | | |
| | | | | | | | 304 | | | | | | | |
| | | | | | | | 303 | | | | | | | |
| | | | | | | | 302 | | | | | | | |
| | | | | | | | 301 | | | | | | | |
| | | | | | | | 300 | | | | | | | |
| | | | | | | | 299 | | | | | | | |
| 298.0 | | | | | | | | | | | | | | |

Continued Next Page

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

RECORD OF BOREHOLE No 35-618-02

3 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 088.5 N; 249 438.0 E (MTM ON10) ORIGINATED BY M.F.
DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Mud Rotary Drilling, NQ Rock Coring COMPILED BY L.Y.
DATUM Geodetic DATE 2017.11.23 - 2017.11.27 LATITUDE 43.464605 LONGITUDE -80.184004 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------|---|------------|-----------|-------|------------|----------------------------|-----------------|---|------|-------|-----------|------|---|-----------|----------------|---|---|------|-------|------------|------|-------|------------|------|-------|------------|------|-------|------------|------|-------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | W _p | W | W _L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 298.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30.0 | SILTY SAND/SANDY SILT, occasional cobbles | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Very dense, Brown, Wet (TILL) | | 21 | SS | 100/5cm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 296.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31.4 | DOLOSTONE/DOLOMITE BEDROCK | | 22 | RC NQ | REC 99% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Slightly weathered | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 23 | RC NQ | REC 100% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Moderately weathered | | 24 | RC NQ | REC 96% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 293.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 34.8 | End of borehole | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <div style="display: flex; align-items: center;"> Groundwater level observed during drilling </div> <div style="display: flex; align-items: center;"> Groundwater level measured in monitoring well </div> <p>NOTES:</p> <ol style="list-style-type: none"> Borehole charged with drilling water, thus groundwater level could not be measured upon completion of drilling The presence of cobbles is inferred by auger grinding observed during drilling and is not indicative of quantity. <p><u>Monitoring Well Legend:</u></p> <table border="0"> <tr> <td>Date</td> <td>Depth (m)</td> <td>Elev.</td> </tr> <tr> <td>Dec.08/17</td> <td>17.6</td> <td>310.4</td> </tr> <tr> <td>Jan.10/18</td> <td>17.6</td> <td>310.4</td> </tr> <tr> <td>Jan.18/18</td> <td>17.3</td> <td>310.7</td> </tr> <tr> <td>Feb.15/18</td> <td>17.3</td> <td>310.7</td> </tr> <tr> <td>Apr.03/18</td> <td>17.2</td> <td>310.8</td> </tr> <tr> <td>Jul. 30/21</td> <td>18.0</td> <td>310.0</td> </tr> <tr> <td>Aug. 04/21</td> <td>17.4</td> <td>310.6</td> </tr> <tr> <td>Aug. 11/21</td> <td>17.7</td> <td>310.3</td> </tr> <tr> <td>Aug. 17/21</td> <td>17.8</td> <td>310.2</td> </tr> </table> <p><u>Monitoring Well Readings:</u></p> <div style="display: flex; flex-wrap: wrap;"> <div style="margin-right: 10px;"> Monument casing </div> <div style="margin-right: 10px;"> Bentonite seal </div> <div style="margin-right: 10px;"> Filter sand </div> <div> Screen </div> </div> | Date | Depth (m) | Elev. | Dec.08/17 | 17.6 | 310.4 | Jan.10/18 | 17.6 | 310.4 | Jan.18/18 | 17.3 | 310.7 | Feb.15/18 | 17.3 | 310.7 | Apr.03/18 | 17.2 | 310.8 | Jul. 30/21 | 18.0 | 310.0 | Aug. 04/21 | 17.4 | 310.6 | Aug. 11/21 | 17.7 | 310.3 | Aug. 17/21 | 17.8 | 310.2 | | | | | | | | | | | | | | | | |
| Date | Depth (m) | Elev. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dec.08/17 | 17.6 | 310.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Jan.10/18 | 17.6 | 310.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Jan.18/18 | 17.3 | 310.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Feb.15/18 | 17.3 | 310.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Apr.03/18 | 17.2 | 310.8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Jul. 30/21 | 18.0 | 310.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aug. 04/21 | 17.4 | 310.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aug. 11/21 | 17.7 | 310.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aug. 17/21 | 17.8 | 310.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

ONTARIO MTO 17TF006A - PART A.GPJ ONTARIO MTO.GDT 9/23/21

RECORD OF BOREHOLE No 35-618-03A

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 062.3 N; 249 445.5 E (MTM ON10) ORIGINATED BY M.F.
 DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Cone Penetration Test COMPILED BY L.Y.
 DATUM Geodetic DATE 2017.11.28 LATITUDE 43.464620 LONGITUDE -80.183844 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | 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 | | | | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | | | | | | |
| 328.0 | GROUND SURFACE | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | |
| 327.8 | TOPSOIL | | | | | | | | | | | | | | | | | | |
| 0.2 | SILTY SAND Loose, Brown, Moist (FILL) | | 1 | SS | 6 | | | | | | | | | | | | | | |
| 327.2 | SILTY SAND/SANDY SILT, some/with gravel | | 2 | SS | 27 | | | | | | | | | | | | | | |
| 0.8 | Compact to very dense, Brown, Moist (TILL) | | 3 | SS | 30 | | | | | | | | | | | | | | |
| | | | 4 | SS | 22 | | | | | | | | | | | | | | |
| | | | 5 | SS | 16 | | | | | | | | | | | | | | |
| | | | 6 | SS | 28 | | | | | | | | | | | | | | |
| | | | 7 | SS | 33 | | | | | | | | | | | | | | |
| | | | 8 | SS | 17 | | | | | | | | | | | | | | |
| | | | 9 | SS | 22 | | | | | | | | | | | | | | |
| | | | 10 | SS | 20 | | | | | | | | | | | | | | |
| | | | 11 | SS | 72 | | | | | | | | | | | | | | |
| | | | 12 | SS | 19 | | | | | | | | | | | | | | |
| | | | 13 | SS | 94 | | | | | | | | | | | | | | |
| 315.2 | End of borehole | | | | | | | | | | | | | | | | | | |
| 12.8 | Switched to cone penetration test | | | | | | | | | | | | | | | | | | |
| 314.7 | End of cone penetration test | | | | | | | | | | | | | | | | | | |
| 13.3 | NOTES: 1. Groundwater was not encountered during and after completion of drilling. | | | | | | | | | | | | | | | | | | |

1 OF 1

METRIC

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

RECORD OF BOREHOLE No 35-618-04

1 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 119.6 N; 249 471.6 E (MTM ON10) ORIGINATED BY M.F.
DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Cone Penetration Test COMPILED BY L.Y.
DATUM Geodetic DATE 2017.12.07 - 2017.12.08 LATITUDE 43.464940 LONGITUDE -80.183780 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|--|----|---|----|----------------|---|---|-------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | W _p | W | W _L | | | WATER CONTENT (%) | | |
| 322.3 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 322.0 | TOPSOIL | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 0.2 | SANDY SILT Loose, Brown, Moist (FILL) | | 1 | SS | 8 | | | | | | | | | | | | |
| 321.5 | SILTY SAND/SANDY SILT, with gravel Compact, Brown, Moist (TILL) | | 2 | SS | 17 | | | | | | | | | | | | |
| 0.8 | | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 21 | | | | | | | | | | | | |
| | | | 4 | SS | 18 | | | | | | | | | | | | |
| | | | 5 | SS | 25 | | | | | | | | | | | | |
| | | | 6 | SS | 32 | | | | | | | | | | | | |
| | | | 7 | SS | 60 | | | | | | | | | | | | |
| | | | 8 | SS | 44 | | | | | | | | | | | | |
| | | | 9 | SS | 41 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 10 | SS | 60 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 11 | SS | 102/20cm | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 12 | SS | 16 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 310.1 | End of borehole | | | | | | | | | | | | | | | | |
| 12.2 | Switched to cone penetration test | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 307.3 | | | | | | | | | | | | | | | | | |

Continued Next Page

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

RECORD OF BOREHOLE No 35-618-04

2 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 119.6 N; 249 471.6 E (MTM ON10) ORIGINATED BY M.F.
DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Cone Penetration Test COMPILED BY L.Y.
DATUM Geodetic DATE 2017.12.07 - 2017.12.08 LATITUDE 43.464940 LONGITUDE -80.183780 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----------------------------|---|---|----------------|---|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | W _p | W | W _L | | |
| 307.3 15.0 | Cone penetration test | | | | | | | ○ UNCONFINED ● QUICK TRIAXIAL | + FIELD VANE × LAB VANE | WATER CONTENT (%) | | | | |
| 301.8 20.5 | End of cone penetration test Refusal on probable bedrock | | | | | | | | | | | | | |
| | <div> <div>▽</div> Groundwater level observed during drilling NOTE: Borehole continued with cone penetration test, thus groundwater level could not be determined upon completion. </div> | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 35-618-05

1 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 093.6 N; 249 479.6 E (MTM ON10) ORIGINATED BY M.F.
DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Mud Rotary Drilling, NQ Rock Coring COMPILED BY L.Y.
DATUM Geodetic DATE 2017.12.04 - 2017.12.07 LATITUDE 43.464710 LONGITUDE -80.183670 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|---|---|----------------|---|---|---------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | w _p | w | w _L | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 321.5 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 320.9 | TOPSOIL | | | | | | | | | | | | | | | | |
| 0.2 | SANDY SILT Compact, Brown, Moist (FILL) | | 1 | SS | 15 | | 321 | | | | | | | | | | |
| 320.7 | SILTY SAND/SANDY SILT, with/some gravel | | 2 | SS | 37 | | | | | | | | | | | | |
| 0.8 | Dense to compact, Brown, Moist (TILL) gravel, with sand | | 3 | SS | 39 | | 320 | | | | | | | | | 57 | 35 (8) |
| | | | | | | | | | | | | | | | | | |
| | | | 4 | SS | 21 | | 319 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 54 | | 318 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 22 | | 317 | | | | | | | | | 36 | 45 17 2 |
| | | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 38 | | 316 | | | | | | | | | 4 | 90 (6) |
| | | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 12 | | 315 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 9 | SS | 11 | | 314 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | 313 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | 312 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | 311 | | | | | | | | | | |
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| | | | | | | | 310 | | | | | | | | | | |
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| | | | | | | | 309 | | | | | | | | | | |
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| | | | | | | | 308 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | 307 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 306.5 | | | | | | | | | | | | | | | | | |

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

RECORD OF BOREHOLE No 35-618-05

2 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 093.6 N; 249 479.6 E (MTM ON10) ORIGINATED BY M.F.
DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Mud Rotary Drilling, NQ Rock Coring COMPILED BY L.Y.
DATUM Geodetic DATE 2017.12.04 - 2017.12.07 LATITUDE 43.464710 LONGITUDE -80.183670 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|---------------|---|------------|---------|----------|-------------|----------------------------|-----------------|---|--------------|------------------|------------|----|------------------------------------|-------------------------------------|-----------------------------------|--|---|-------------------|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | ○ UNCONFINED | + FIELD VANE | ● QUICK TRIAXIAL | × LAB VANE | 20 | | | | | | 40 | 60 | 80 |
| 306.5 | | | | | | | | | | | | | | | | | | | | |
| 15.0 | SILTY SAND/SANDY SILT, with gravel Dense to compact, Brown, Wet (TILL) | | 15 | SS | 44 | | 306 | | | | | | | ○ | | | | | | |
| | | | | | | | 305 | | | | | | | | | | | | | |
| | | | 16 | SS | 21 | | 304 | | | | | | | | | | | | | |
| | | | | | | | 303 | | | | | | ○ | | | | 46 34 16 4 | | | |
| | | | 17 | SS | 28 | | 302 | | | | | | | | | | | | | |
| | | | | | | | 301 | | | | | | | | | | | | | |
| 300.1 | | | 18 | SS | 100/5cm | | 300 | | | | | | ○ | | | | | | | |
| 21.4 | DOLOSTONE/DOLOMITE BEDROCK Moderately weathered | | 19 | RC NQ | REC 72% | | 299 | | | | | | | | | | RQD 34% USC=58.5 (MPa) | | | |
| | | | 20 | RC NQ | REC 97% | | 298 | | | | | | | | | | RQD 67% | | | |
| | | | 21 | RC NQ | REC 100% | | 297 | | | | | | | | | | RQD 85% | | | |
| 296.5 | End of borehole | | | | | | | | | | | | | | | | | | | |
| 25.0 | | | | | | | | | | | | | | | | | | | | |
| |  Groundwater level observed during drilling NOTE: 1. Borehole charged with drilling water, thus groundwater level could not be determined upon completion of drilling. 2. The presence of cobbles is inferred by auger grinding observed during drilling and is not indicative of quantity. | | | | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 35-618-06

1 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 143.6 N; 249 487.0 E (MTM ON10) ORIGINATED BY M.F.
DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Mud Rotary Drilling, NQ Rock Coring COMPILED BY L.Y.
DATUM Geodetic DATE 2017.11.29 - 2017.12.01 LATITUDE 43.465215 LONGITUDE -80.183163 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|--------------|------------------|------------|------------------------------------|-------------------------------------|-----------------------------------|--|---|-------------------|----|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) | | | | |
| | | | | | | | | ○ UNCONFINED | + FIELD VANE | ● QUICK TRIAXIAL | × LAB VANE | | | | | | | | | | |
| 323.3 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | 20 | 40 | 60 | | GR | SA | SI | CL |
| 323.1 | TOPSOIL | | | | | | | | | | | | | | | | | | | | |
| 0.2 | SANDY SILT Loose, Brown, Moist (FILL) | | 1 | SS | 4 | | 323 | | | | | | | ○ | | | | | | | |
| 322.5 | SILTY SAND/SANDY SILT, with/trace gravel Compact to dense, Brown, Moist (TILL) | | 2 | SS | 21 | | | | | | | | | ○ | | | | 30 | 46 | 19 | 5 |
| 0.8 | | | | | | | 322 | | | | | | | ○ | | | | | | | |
| | | | 3 | SS | 34 | | | | | | | | | ○ | | | | | | | |
| | | | | | | | 321 | | | | | | | ○ | | | | | | | |
| | | | 4 | SS | 31 | | | | | | | | | ○ | | | | | | | |
| | | | | | | | 320 | | | | | | | ○ | | | | 33 | 43 | 21 | 3 |
| | | | 5 | SS | 38 | | | | | | | | | ○ | | | | | | | |
| | | | 6 | SS | 40 | | 319 | | | | | | | ○ | | | | | | | |
| | | | | | | | 318 | | | | | | | ○ | | | | 0 | 87 | 11 | 2 |
| | | | 7 | SS | 36 | | | | | | | | | ○ | | | | | | | |
| | | | 8 | SS | 41 | | 317 | | | | | | | ○ | | | | | | | |
| | | | 9 | SS | 48 | | | | | | | | | ○ | | | | | | | |
| | | | | | | | 316 | | | | | | | | | | | | | | |
| | | | 10 | SS | 70 | | 315 | | | | | | | ○ | | | | | | | |
| | | | | | | | 314 | | | | | | | ○ | | | | | | | |
| | | | | | | | 313 | | | | | | | | | | | | | | |
| | | | 12 | SS | 60 | | 312 | | | | | | | ○ | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | 311 | | | | | | | ○ | | | | | | | |
| | | | 13 | SS | 17 | | 310 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | 309 | | | | | | | ○ | | | | | | | |
| | | | 14 | SS | 23 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| 308.3 | | | | | | | | | | | | | | | | | | | | | |

Continued Next Page

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

RECORD OF BOREHOLE No 35-618-06

2 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 143.6 N; 249 487.0 E (MTM ON10) ORIGINATED BY M.F.
DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Mud Rotary Drilling, NQ Rock Coring COMPILED BY L.Y.
DATUM Geodetic DATE 2017.11.29 - 2017.12.01 LATITUDE 43.465215 LONGITUDE -80.183163 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w_p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | |
|--|---|------------|---------|----------|------------|----------------------------|-----------------|---|--|--|--|----------------------------------|---------------------------|---------------------------------------|--------------------------|---|---|--|------------|------------|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) | | | GR | SA | SI | CL |
| | | | | | | | | | | | | ○ UNCONFINED ● QUICK TRIAXIAL | | | | | + FIELD VANE × LAB VANE | | | | | | |
| 308.3 15.0 | SILTY SAND/SANDY SILT, with gravel Dense to very dense, Brown, Wet (TILL) | | | | | | 308 | | | | | | | | | | | | | | | | |
| | | | 15 | SS | 36 | | 307 | | | | | | | | | | | | | | | | |
| | | | 16 | SS | 43 | | 306 | | | | | | | | | | | | | | | | |
| | | | | | | | 305 | | | | | | | | | | | | | | | | |
| | | | 17 | SS | 34 | | 304 | | | | | | | | | | | | | | | | |
| | | | | | | | 303 | | | | | | | | | | | | | | | | |
| | | | 18 | SS | 62 | | 302 | | | | | | | | | | | | | | | | |
| | | | | | | | 301 | | | | | | | | | | | | | | | | |
| 301.2 22.1 | DOLOSTONE/DOLOMITE BEDROCK Moderately weathered | | 19 | RC NQ | REC 95% | 301 | | | | | | | | | | | | | RQD 43% | | | | |
| | | | 20 | RC NQ | REC 90% | 300 | | | | | | | | | | | | | | RQD 47% | | | |
| | | | 21 | RC NQ | REC 72% | 299 | | | | | | | | | | | | | | RQD 59% | | | |
| 297.4 25.9 | End of borehole | | | | | | 298 | | | | | | | | | | | | | | | | |
| <div>▽ Groundwater level observed during drilling.</div> <div>▼ Groundwater measured in monitoring well</div> <div>NOTES: 1. Borehole charged with drilling water, thus groundwater level could not be measured upon completion of drilling.</div> | | | | | | | | | | | | | | | | | | | | | | | |

▽ Groundwater level observed during drilling.
▼ Groundwater measured in monitoring well

NOTES:

- Borehole charged with drilling water, thus groundwater level could not be measured upon completion of drilling.

Continued Next Page




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

RECORD OF BOREHOLE No 35-618-06

3 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION Coords: 4 814 143.6 N; 249 487.0 E (MTM ON10) ORIGINATED BY M.F.
 DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Mud Rotary Drilling, NQ Rock Coring COMPILED BY L.Y.
 DATUM Geodetic DATE 2017.11.29 - 2017.12.01 LATITUDE 43.465215 LONGITUDE -80.183163 CHECKED BY G.U.

| 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 | | | 20 | 40 | 60 | 80 | 100 | W _p | W | W _L | | | | | | | | | | | | | | | | | | | |
| 293.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p><u>Monitoring Well Legend:</u></p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev.</th> </tr> </thead> <tbody> <tr> <td>Dec. 08/17</td> <td>11.9</td> <td>311.4</td> </tr> <tr> <td>Jan. 10/18</td> <td>11.6</td> <td>311.7</td> </tr> <tr> <td>Jan. 17/18</td> <td>11.6</td> <td>311.7</td> </tr> <tr> <td>Apr. 03/18</td> <td>11.5</td> <td>311.8</td> </tr> <tr> <td>Aug. 19/21</td> <td>12.0</td> <td>311.3</td> </tr> </tbody> </table> <p><u>Monitoring Well Readings:</u></p> <p>  Bentonite seal  Filter sand  Screen </p> | | | | | | | | | | | | | | | | | Date | Depth (m) | Elev. | Dec. 08/17 | 11.9 | 311.4 | Jan. 10/18 | 11.6 | 311.7 | Jan. 17/18 | 11.6 | 311.7 | Apr. 03/18 | 11.5 | 311.8 | Aug. 19/21 | 12.0 | 311.3 |
| Date | Depth (m) | Elev. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dec. 08/17 | 11.9 | 311.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Jan. 10/18 | 11.6 | 311.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Jan. 17/18 | 11.6 | 311.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Apr. 03/18 | 11.5 | 311.8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aug. 19/21 | 12.0 | 311.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

ONTARIO MTO 17TF006A - PART A.GPJ ONTARIO MTO.GDT 9/23/21

RECORD OF BOREHOLE No 35-618-07

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 145.9 N; 249 520.1 E (MTM ON10) ORIGINATED BY F.M.
DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.
DATUM Geodetic DATE 2021.07.12 LATITUDE 43.465184 LONGITUDE -80.183184 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | |
|---|---|------------|---------|------|------------|----------------------------|-----------------|---|--------------|------------------|------------|----|------------------------------------|-------------------------------------|-----------------------------------|--|---|----|----|----|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) | | | GR | SA | SI | CL |
| | | | | | | | | ○ UNCONFINED | + FIELD VANE | ● QUICK TRIAXIAL | × LAB VANE | 20 | | | | | 40 | 60 | 80 | | | | |
| 328.2 | GROUND SURFACE | | | | | | | | | | | | | | | | | | | | | | |
| 328.0 | Topsoil | | 1 | SS | 8 | | | | | | | | | | | | | | | | | | |
| 327.4 | SANDY SILT, trace clay, trace gravel, organics Loose, Brown, Moist (FILL) | | | | | | | | | | | | | | | | | | | | | | |
| 0.8 | SILTY SAND/SANDY SILT, trace gravel to gravelly Compact to very dense, Brown, Moist (TILL) | | 2 | SS | 19 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 17 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 4 | SS | 21 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 21 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 24 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 30 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 56 | | | | | | | | | | | | | | | | | | |
| | _____ Silt, some clay, Very stiff | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | _____ | | 9 | SS | 17 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 10 | SS | 33 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 11 | SS | 72 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 12 | SS | 48 | | | | | | | | | | | | | | | | | | |
| 317.7 | End of borehole | | | | | | | | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | | | | | | | | | |
| NOTES: 1. Groundwater level was not encountered in the borehole during or upon completion of drilling. 2. No cave-in was noted in the borehole upon extraction of augers. | | | | | | | | | | | | | | | | | | | | | | | |

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 9/23/21

RECORD OF BOREHOLE No 35-618-08

1 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 138.6 N; 249 508.2 E (MTM ON10) ORIGINATED BY F.M.V.L.
 DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers, Wash Boring, HQ Rock Coring COMPILED BY L.Y.
 DATUM Geodetic DATE 2021.08.03 - 2021.08.10 LATITUDE 43.465118 LONGITUDE -80.183330 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | |
|---------------|--|---------------------|---------|------|------------|----------------------------|-----------------|---|----|----|------------------------------------|-------------------------------------|-----------------------------------|--|---|-------------------|---------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) | |
| 328.5 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 328.9 | Topsoil | | | | | | | | | | | | | | | | |
| 0.2 | SANDY SILT Loose, Brown, Moist (FILL) | | 1 | SS | 7 | | 328 | | | | | | ○ | | | | |
| 327.7 | SILTY SAND/SANDY SILT Compact, Brown, Moist (TILL) | | 2 | SS | 14 | | | | | | | | ○ | | | | |
| 0.8 | | | 3 | SS | 18 | | 327 | | | | | | ○ | | | | |
| | | | 4 | SS | 13 | | 326 | | | | | | ○ | | | 28 | 37 30 5 |
| | | | 5 | SS | 18 | | 325 | | | | | | ○ | | | | |
| | | | 6 | SS | 43 | | 324 | | | | | | ○ | | | | |
| | | | 7 | SS | 19 | | 323 | | | | | | ○ | | | 20 | 40 31 9 |
| | | very dense | 8 | SS | 55 | | 322 | | | | | | ○ | | | | |
| | | | 9 | SS | 100/10cm | | 321 | | | | | | ○ | | | | |
| | | | | | | | 320 | | | | | | | | | | |
| | | | 10 | SS | 78 | | 319 | | | | | | ○ | | | 20 | 48 26 6 |
| | | | | | | | 318 | | | | | | ○ | | | 49 | 36 (15) |
| | | Sandy gravel, Dense | 12 | SS | 41 | | 317 | | | | | | ○ | | | 10 | 80 (10) |
| | | Sand, Dense | 13 | SS | 49 | | 316 | | | | | | | | | | |
| | | | | | | | 315 | | | | | | ○ | | | | |
| | | | | 14 | SS | 71 | | 314 | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | 15 | SS | 50/13cm | | | | | | | | ○ | | | | |
| | | | | | | | | | | | | | | | | | |

Continued Next Page

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

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 9/23/21

METRIC

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

RECORD OF BOREHOLE No 35-618-08

3 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 138.6 N; 249 508.2 E (MTM ON10) ORIGINATED BY F.M.V.L.
DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers, Wash Boring, HQ Rock Coring COMPILED BY L.Y.
DATUM Geodetic DATE 2021.08.03 - 2021.08.10 LATITUDE 43.465118 LONGITUDE -80.183330 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | | | | |
|---------------|--|------------|---------|----------|-------------|----------------------------|-----------------|---|----|----|------------------------------------|-------------------------------------|-----------------------------------|--|--|-----------------------------|-----|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) | | | | |
| | | | | | | | | 20 | 40 | 60 | | | | | | 80 | 100 | 20 | 40 | 60 |
| 298.5 | SILTY SAND/SANDY SILT | | | | | | | | | | | | | | | | | | | |
| | Compact, Brown, Moist (TILL) (Cont.d) | | 22 | SS | 50/8cm | | 298 | | | | | | | | | | | | | |
| 297.1 | | | | | | | | | | | | | | | | | | | | |
| 31.4 | DOLOSTONE/DOLOMITE | | 23 | RC HQ | REC 100% | | 297 | | | | | | | | | | | | | |
| | | | | | | | 296 | | | | | | | | | RQD 72% UCS=154.3 MPa | | | | |
| | | | 24 | RC HQ | REC 100% | | 295 | | | | | | | | | RQD 94% | | | | |
| 294.0 | End of borehole | | | | | | 294 | | | | | | | | | | | | | |
| 34.5 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | <div> Groundwater measured in monitoring well</div> <div>NOTES: 1. Borehole charged with drilling water, thus groundwater level could not be established upon completion of drilling. 2. No cave-in was noted in the borehole upon extraction of augers. 3. The presence of cobbles is inferred by auger grinding observed during drilling and is not indicative of quantity.</div> <div>Monitoring Well Readings: Date Depth (m) Elev. Aug. 11/21 16.1 312.4 Aug. 16/21 17.4 311.1 Aug. 19/21 16.0 312.5</div> <div>Monitoring Well Legend: Monument Casing Bentonite Seal Filter Sand Screen</div> | | | | | | | | | | | | | | | | | | | |



Groundwater measured in
monitoring well

NOTES:

- Borehole charged with drilling water, thus groundwater level could not be established upon completion of drilling.
- No cave-in was noted in the borehole upon extraction of augers.
- The presence of cobbles is inferred by auger grinding observed during drilling and is not indicative of quantity.

Monitoring Well Readings:

| Date | Depth (m) | Elev. |
|------------|--------------|-------|
| Aug. 11/21 | 16.1 | 312.4 |
| Aug. 16/21 | 17.4 | 311.1 |
| Aug. 19/21 | 16.0 | 312.5 |

Monitoring Well Legend:

- Monument Casing
- Bentonite Seal
- Filter Sand
- Screen

RECORD OF BOREHOLE No 35-618-09

1 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 155.2 N; 249 503.6 E (MTM ON10) ORIGINATED BY F.M./P.J.
DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers, Wash Boring COMPILED BY L.Y.
DATUM Geodetic DATE 2021.08.12 - 2021.08.17 LATITUDE 43.465267 LONGITUDE -80.183389 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|--|---|--|--|------------|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) | | | GR | SA | SI | CL |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 329.7 | GROUND SURFACE | | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | | | | |
| 329.6 | Topsoil | | | | | | | | | | | | | | | | | | | | | | |
| 0.2 | SANDY SILT, trace clay, trace gravel, organics Loose, Brown, Moist (FILL) | | 1 | SS | 10 | | 329 | | | | | | | ○ | | | | | | | | | |
| 328.9 | SILTY SAND/SANDY SILT, trace gravel | | 2 | SS | 20 | | | | | | | | | ○ | | | | | | 13 39 40 8 | | | |
| 0.8 | Compact to very dense, Brown, Moist (TILL) | | 3 | SS | 25 | | 328 | | | | | | | ○ | | | | | | | | | |
| | | | 4 | SS | 20 | | 327 | | | | | | | ○ | | | | | | | | | |
| | | | 5 | SS | 28 | | 326 | | | | | | | ○ | | | | | | | | | |
| | | | 6 | SS | 17 | | 325 | | | | | | | ○ | | | | | | 1 38 56 5 | | | |
| | — — — gravelly | | 7 | SS | 100/3mm | | 324 | | | | | | | ○ | | | | | | | | | |
| | | | 8 | SS | 56 | | 323 | | | | | | | ○ | | | | | | | | | |
| | | | 9 | SS | 44 | | 322 | | | | | | | ○ | | | | | | | | | |
| | | | 10 | SS | 30 | | 321 | | | | | | | ○ | | | | | | | | | |
| | | | 11 | SS | 40 | | 320 | | | | | | | ○ | | | | | | | | | |
| | | | 12 | SS | 35 | | 319 | | | | | | | ○ | | | | | | 8 45 43 4 | | | |
| | | | 13 | SS | 40 | | 318 | | | | | | | ○ | | | | | | | | | |
| | | | 14 | SS | 54 | | 317 | | | | | | | ○ | | | | | | | | | |
| | | | | | | | 316 | | | | | | | ○ | | | | | | 40 37 18 5 | | | |
| | | | | | | | 315 | | | | | | | | | | | | | | | | |

Continued Next Page

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

RECORD OF BOREHOLE No 35-618-09

2 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 155.2 N; 249 503.6 E (MTM ON10) ORIGINATED BY F.M./P.J.
DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers, Wash Boring COMPILED BY L.Y.
DATUM Geodetic DATE 2021.08.12 - 2021.08.17 LATITUDE 43.465267 LONGITUDE -80.183389 CHECKED BY G.U.

| 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 | | | 20 | 40 | 60 | 80 | 100 | | |
| 314.7 | SILTY SAND/SANDY SILT, trace gravel Compact to very dense, Brown, Moist (TILL) (Cont'd) | | 15 | SS | 50/5cm | | 314 | | | | | | | |
| | | | 16 | SS | 27/3cm | | 313 | | | | | | | |
| | | | 17 | SS | 50/8cm | | 312 | | | | | | | |
| | | | 18 | SS | 42 | | 311 | | | | | | | |
| | | | 19 | SS | 37 | | 310 | | | | | | | |
| | | | 20 | SS | 50/15cm | | 309 | | | | | | | |
| | | | 21 | SS | 50/3cm | | 308 | | | | | | | |
| | | | | | | | 307 | | | | | | | |
| | | | | | | | 306 | | | | | | | |
| | | | | | | | 305 | | | | | | | |
| | | | | | | | 304 | | | | | | | |
| | | | | | | | 303 | | | | | | | |
| | | | | | | | 302 | | | | | | | |
| | | | | | | | 301 | | | | | | | |
| | | | | | | | 300 | | | | | | | |

Continued Next Page

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

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 9/23/21

RECORD OF BOREHOLE No 35-618-09

3 OF 3

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 155.2 N; 249 503.6 E (MTM ON10) ORIGINATED BY F.M./P.J.
 DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers, Wash Boring COMPILED BY L.Y.
 DATUM Geodetic DATE 2021.08.12 - 2021.08.17 LATITUDE 43.465267 LONGITUDE -80.183389 CHECKED BY G.U.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | | | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|--|---|--|--|--|--|----|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) | | | | | GR | SA | SI | CL |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| 299.7 29.9 | Borehole terminated due to auger refusal | | | | | | | | | | | | | | | | | | | | | | | | |
| | NOTES: 1. Groundwater level was not encountered during or upon completion of drilling. 2. No cave-in was noted in the borehole upon extraction of augers. 3. The presence of cobbles is inferred by auger grinding observed during drilling and is not indicative of quantity. | | | | | | | | | | | | | | | | | | | | | | | | |

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 9/23/21

Photographs of Rock Core Samples Retrieved from Borehole 35-618-02





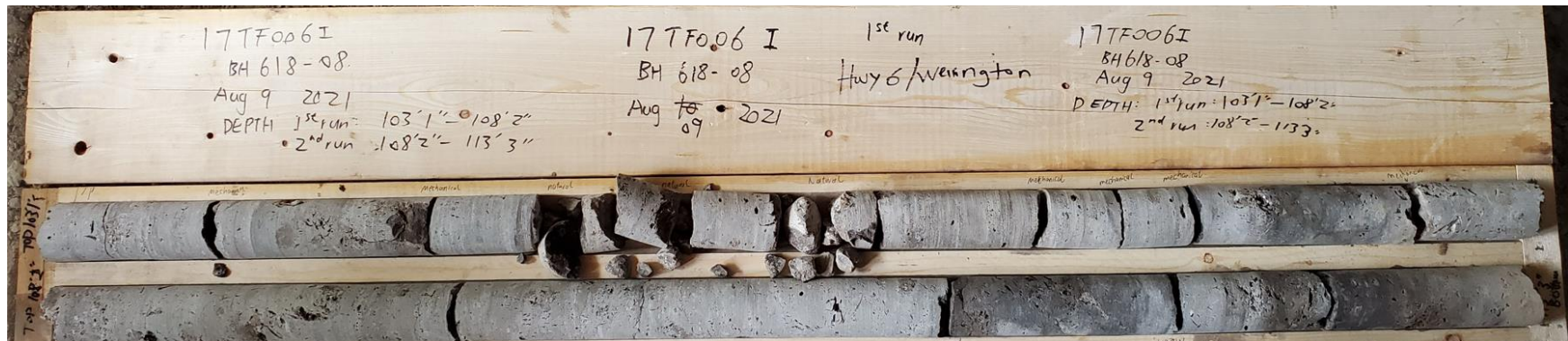
Photographs of Rock Core Samples Retrieved from Borehole 35-618-05



PART A - Preliminary Foundation Investigation Report
for Design-Build Ready Alternative Bid Package
Wellington Road 34 Connector Underpass, Site No. 35X-0618/B0, Sta. 10+000
Midblock Interchange Area
Highway 6 and 401 Improvements, From Hamilton North Limits to Guelph South Limits
G.W.P. 3059-2-00, Index No.: 065FIR, PML Ref.: 17TF006A, October 14, 2021



Photograph of Rock Core Samples Retrieved from Borehole 35-618-08





Rock Core Description

Project: Highway 6/Highway 401 Improvements, From Hamilton North Limits to Guelph South Limits, Ontario

PML Ref.: 17TF006A

| Borehole No. | Sample No. (Core Run) | Depth (m/ft) | % Core Recovery | % *RQD | Core Description |
|---------------------|------------------------------|------------------------------|------------------------|---------------|---|
| 35-618-02 | 22 (1) | 31.4-32.06 103'-105'2" | 98.5 (0.67m) | 74 | DOLOSTONE/DOLOMITE (GUELPH FORMATION) -: medium grey, fine crystalline dolostone, sucrosic (sugary) texture, thick bedded, hard, massive, slightly weathered, slightly fractured, Minerals: dolomite, calcite grains, containing mud/silt. Common diagenesis features: irregular size and shape of vugs/voids infilled calcite crystals/grains. Common mechanical core breaks. Intact Rock Strength: R4 (Strong) |
| | 23 (2) | 32.06-33.55 105'2"-110'1" | 100 (1.5m) | 45 (0.71m) | DOLOSTONE/DOLOMITE (GUELPH FORMATION) -: medium brown to grey, fine crystalline dolostone, sucrosic texture, thick bedded, moderately hard, massive, slightly weathered, slightly fractured. Minerals: dolomite/calcite grains/crystals, containing silt & mud. Common diagenesis features: irregular size and shape of vugs/voids infilled calcite crystals/grains/silt/mud. Diagonal/vertical mechanical core breaks from 33.0m to 33.55m Intact Rock Strength: R3 (Medium Strong) |
| | 24 (3) | 33.55-34.8 110'1"-114'3" | 96 (1.3m) | 95 | DOLOSTONE/DOLOMITE (GUELPH FORMATION) -: medium brown, fine crystalline dolostone, sucrosic texture, thick bedded, moderately hard, massive, moderately weathered associated with large vugs, unfractured to slightly fractured. Minerals: dolomite/calcite grains. Common diagenesis features: irregular size and shape of vugs/pores infilled calcite/dolomite crystals/grains with silt/mud. Intact Rock Strength: R3 (Medium Strong) |

*RQD – Rock Quality Designation

Compiled & logged by: Shahid Siddiqi, M.Sc. P.Geo
Reviewed by: Carlos Nascimento, P. Eng.

Note: Intact Rock Strength obtained using rock pick test in drill core from table "Rock Characterization Testing & Monitoring", International Society of Rock Mechanics.



Rock Core Description

Project: Highway 6/Highway 401 Improvements, From Hamilton North Limits to Guelph South Limits, Ontario

PML Ref.: 17TF006A

| Borehole No. | Sample No. (Core Run) | Depth (m/ft) | % Core Recovery | % *RQD | Core Description |
|---------------------|------------------------------|----------------------------|------------------------|---------------|---|
| 35-618-05 | 19 (1) | 21.4-22.76 70'3"-74'7" | 72 (0.98m) | 34 (0.46m) | <p>DOLOSTONE/DOLOMITE (GUELPH FORMATION) -: medium brown, fine crystalline dolostone, sucrosic texture, hard, thick bedded, moderately weathered/vuggy, moderately fractured associated with mechanical breaks. Minerals: calcite/dolomite crystals/grains.</p> <p>Common diagenesis features: irregular size and shape of vugs infilled calcite crystals/grains, silt & mud. Mechanical core breaks.</p> <p>Intact Rock Strength: R3 (Medium Strong)</p> |
| | 20 (2) | 22.76-24.3 74'7"-79'7" | 97 (1.5m) | 67 (1.04m) | <p>DOLOSTONE/DOLOMITE (GUELPH FORMATION) -: medium brown, fine crystalline dolostone, sucrosic texture, thick bedded, hard, moderately weathered associated with vugs/voids, slightly fractured. Minerals: dolomite, calcite, containing organic material, mud/silt.</p> <p>Common diagenesis features: irregular size and shape of vugs/pores contain calcite crystals/grains/silt/mud & dolomitization. Mechanical core breaks.</p> <p>Intact Rock Strength: R4 (Strong)</p> |
| | 21 (3) | 24.3-25.02 79'7"-82'11" | 100 (0.73m) | 85 | <p>DOLOSTONE/DOLOMITE (GUELPH FORMATION) - : medium brown, fine crystalline dolostone, sucrosic texture, thick bedded, hard, moderately weathered associated with vugs/voids, slightly fractured. Minerals: dolomite, calcite, containing organic material, mud/silt.</p> <p>Common diagenesis features: irregular size and shape of vugs/pores contain calcite crystals/grains/silt/mud. Mechanical core breaks.</p> <p>Intact Rock Strength: R4 (Strong)</p> |

*RQD – Rock Quality Designation

Compiled & logged by: Shahid Siddiqi, M.Sc. P.Geo
Reviewed by: Carlos Nascimento, P. Eng.

Notes: Intact Rock Strength obtained using rock pick test in drill core from table "Rock Characterization Testing & Monitoring", International Society of Rock Mechanics.



| Rock Core Description Project: Highway 6/Highway 401 Improvements, From Hamilton North Limits to Guelph South Limits, Ontario PML Ref.: 17TF006A | | | | | |
|---|------------------------------|----------------------------|------------------------|---------------|--|
| Borehole No. | Sample No. (Core Run) | Depth (m/ft) | % Core Recovery | % *RQD | Core Description |
| 35-618-06 | 19 (1) | 22.2-22.8 72'8"-75'0" | 95 (0.6m) | 43 (0.26m) | DOLOSTONE/DOLOMITE (GUELPH FORMATION) - : medium brown, fine crystalline dolostone, sucrosic texture, thick bedded, very hard, moderately weathered associated with vugs/voids, slightly fractured. Minerals: dolomite, calcite, occasional pyrite containing mud/silt. Common diagenesis features: irregular size and shape of vugs/pores contain calcite crystals/grains/silt/mud. Mechanical core breaks. Intact Rock Strength: R5 (Very Strong) |
| | 20 (2) | 22.8-24.3 75'-79'10" | 90 (1.35m) | 47 (0.7m) | DOLOSTONE/DOLOMITE (GUELPH FORMATION) - : medium brown, fine crystalline dolostone, sucrosic texture, thick bedded, hard, moderately weathered, slightly fractured. Minerals: dolomite, calcite, occasional pyrite containing mud/silt. Common diagenesis features: irregular size and shape of vugs/pores contain calcite crystals/grains/silt/mud. Mechanical core breaks. Intact Rock Strength: R4 (Strong) |
| | 21 (3) | 24.25-25.9 79'10"-85'1" | 72 (1.2m) | 59 (0.95m) | DOLOSTONE/DOLOMITE (GUELPH FORMATION) - : medium brown, fine crystalline dolostone, sucrosic texture, thick bedded, very hard, moderately weathered associated with vugs, slightly fractured. Minerals: dolomite, calcite, occasional pyrite containing mud/silt. Common diagenesis features: irregular size and shape of vugs/pores contain calcite crystals/grains/silt/mud. Mechanical core breaks. Intact Rock Strength: R5 (Very Strong) |

*RQD – Rock Quality Designation

Compiled & logged by: Shahid Siddiqi, M.Sc. P.Geo
Reviewed by: Carlos Nascimento, P. Eng.

Notes: Intact Rock Strength obtained using rock pick test in drill core from table "Rock Characterization Testing & Monitoring", International Society of Rock Mechanics.



Rock Core Description

Project: Highway 6/Highway 401 Improvements, From Hamilton North Limits to Guelph South Limits, Ontario
PML Ref.: 17TF006A

| Borehole No. | Sample No. (Core Run) | Depth (m/ft) | % Core Recovery | % *RQD | Core Description |
|--------------|-----------------------|----------------------------|-----------------|----------------|---|
| 35-618-08 | 23 (1) | 31.4-33.0 103'1"-108'2" | 100 (1.6 m) | 72 (1.15 m) | DOLOSTONE/DOLOMITE (GUELPH FORMATION) - : medium brown, fine crystalline dolostone, sucrosic texture, thick bedded, very hard, moderately weathered associated with vugs/voids, slightly fractured. Minerals: dolomite, calcite, occasional pyrite containing mud/silt. Common diagenesis features: irregular size and shape of vugs/pores contain calcite crystals/grains/silt/mud. Mechanical core breaks. Intact Rock Strength: R5 (Very Strong) |
| | 24 (2) | 33.0-34.5 108'2"-113'3" | 100 (1.5m) | 94 (1.41m) | DOLOSTONE/DOLOMITE (GUELPH FORMATION) - : medium brown, fine crystalline dolostone, sucrosic texture, thick bedded, very hard, moderately weathered associated with vugs/voids, slightly fractured. Minerals: dolomite, calcite, occasional pyrite containing mud/silt. Common diagenesis features: irregular size and shape of vugs/pores contain calcite crystals/grains/silt/mud. Mechanical core breaks. Intact Rock Strength: R5 (Very Strong) |

*RQD – Rock Quality Designation

Compiled & logged by: Frank Meng, M.Eng. EIT
Reviewed by: Lul Yimam, PhD., P. Eng.

Notes: Intact Rock Strength obtained using rock pick test in drill core from table "Rock Characterization Testing & Monitoring", International Society of Rock Mechanics.

APPENDIX B

Borehole Records - 2022 Investigation

| PROJECT | | 22522311 | | RECORD OF BOREHOLE No GBH-31A | | | | SHEET 1 OF 2 | | METRIC | | | | |
|---------------|--|--------------|---------|-------------------------------|------------|---|-----------------|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| G.W.P. | | DB 2021-3004 | | LOCATION | | N 4814057.3; E 249437.6 MTM NAD 83 ZONE 10 (LAT. 43.464390; LONG. -80.184198) | | | | ORIGINATED BY | | JGH | | |
| DIST | | HWY 6 | | BOREHOLE TYPE | | 108 mm ID Hollow Stem Augers; Tri-cone and HQ coring | | | | COMPILED BY | | JM | | |
| DATUM | | Geodetic | | DATE | | June 20-22, 2022 | | | | CHECKED BY | | LLC | | |
| 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 | | | | | | |
| 329.2 | GROUND SURFACE | | | | | | | | | | | | | |
| 0.0 | SILTY SAND (TOPSOIL) | | 1A | SS | 8 | | | | | | | | | |
| 0.3 | Loose Brown Moist | | 1B | SS | | | | | | | | | | |
| | SILTY SAND (SM), trace to some gravel, with cobbles | | 2 | SS | 20 | | | | | | | | | |
| | Compact Brown Moist | | 3 | SS | 18 | | | | | | | | | |
| 326.9 | SAND (SP), trace silt and gravel, with cobbles | | 4 | SS | 15 | | | | | | | | | |
| 2.3 | Compact Brown Moist | | 5 | SS | 30 | | | | | | | | | |
| 326.3 | SILTY SAND (SM), trace to some gravel, with cobbles | | 6 | SS | 38 | | | | | | | | | |
| 2.9 | Compact to dense Brown Moist | | 7 | SS | 23 | | | | | | | | | |
| | - Numerous cobbles inferred throughout based on tricone grinding below approximately 3 m depth | | | | | | | | | | | | | |
| | - Boulder encountered at 3.7 m depth | | | | | | | | | | | | | |
| 323.6 | Gravelly SAND (SP), trace to some silt, with cobbles and boulders | | 8 | SS | 18 | | | | | | | | | |
| 5.6 | Compact to very dense Brown Moist | | 9 | SS | 38 | | | | | | | | | |
| | - Numerous cobbles inferred throughout based on tricone grinding | | | | | | | | | | | | | |
| | - Boulder encountered at 7.2 m depth | | | | | | | | | | | | | |
| | - Boulder encountered at 11.6 m to 11.9m depth | | | | | | | | | | | | | |
| | - Boulder encountered at 13.1 m to 13.7m depth | | | | | | | | | | | | | |
| | | | 10 | SS | 38 | | | | | | | | | |
| | | | 11 | SS | 42 | | | | | | | | | |
| | | | 12 | SS | 49 | | | | | | | | | |
| | | | 13 | SS | 139 | | | | | | | | | |
| 314.9 | END OF BOREHOLE | | | | | | | | | | | | | |
| 14.3 | | | | | | | | | | | | | | |

Continued Next Page

3 3. Numbers refer to 3%


GTA-MTO 001 S:\CLIENTS\MTO\HWY 6 AND HWY 34\02 DATA\GIN\HWY 6 AND HWY 34.GPJ GAL-GTA.GDT 9/23/22 JM

S:\CLIENTS\MT01HWY 6 AND HWY 34\02 DATA\INT\HWY 6 AND HWY 34.GPJ GAL-GTA.GDT 9/23/22 JM

| PROJECT | | RECORD OF BOREHOLE | | | | No GBH-31B | | SHEET 2 OF 3 | | METRIC | | |
|--|--|---|---------|------------|------------|--|-----------------|-----------------|---------------------------------------|-------------------------------|--------------------------------|------------------|
| G.W.P. | | LOCATION | | DIST | | BOREHOLE TYPE | | COMPILED BY | | DATE | | |
| DB 2021-3004 | | N 4814066.0; E 249440.9 MTM NAD 83 ZONE 10 (LAT. 43.464468; LONG. -80.184158) | | HWY 6 | | 160 mm ID Hollow Stem Augers; PQ Casing and Tri-cone | | JM | | June 27-29, 2022 | | |
| DATUM | | DATE | | CHECKED BY | | | | LLC | | | | |
| Geodetic | | June 27-29, 2022 | | | | | | | | | | |
| SOIL PROFILE | | | SAMPLES | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | 20 40 60 80 100 | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ |
| <div style="display: flex; justify-content: space-between;"> <div> <p>--- CONTINUED FROM PREVIOUS PAGE ---</p> <p>SAND to Gravelly SAND (SP), with cobbles Very dense Brown Moist to wet</p> <p>- Cobble zone from 14.3 m to 14.6 m depth</p> <p>- Boulder encountered from 19.5 m to 19.8 m depth</p> </div> <div> <p>3 SS 67</p> </div> </div> | | | | | | | | | | | | |
| 308.6 | | | | | | | 313 | | | | | |
| 20.1 | Gravelly SILTY SAND (SM), with cobbles Dense Brown Moist to wet | | | | | | 312 | | | | | |
| | - Zone of cobbles or boulder encountered from 20.1 m to 20.4 m | | | | | | 311 | | | | | |
| | - Boulder encountered at 22.1 m | | | | | | 310 | | | | | |
| 305.5 | | | | | | | 309 | | | | | |
| 23.2 | Gravelly Sandy SILT (ML), with cobbles Very dense Brown to grey Moist | | | | | | 308 | | | | | |
| | | | | | | | 307 | | | | | |
| | | | | | | | 306 | | | | | |
| 301.2 | | | | | | | 305 | | | | | |
| 27.5 | Dolostone (BEDROCK) Grey | | | | | | 304 | | | | | |
| | | | | | | | 303 | | | | | |
| | | | | | | | 302 | | | | | |
| | | | | | | | 301 | | | | | |
| | | | | | | | 300 | | | | | |
| | | | | | | | 299 | | | | | |

Continued Next Page

3 3. Numbers refer to 3%

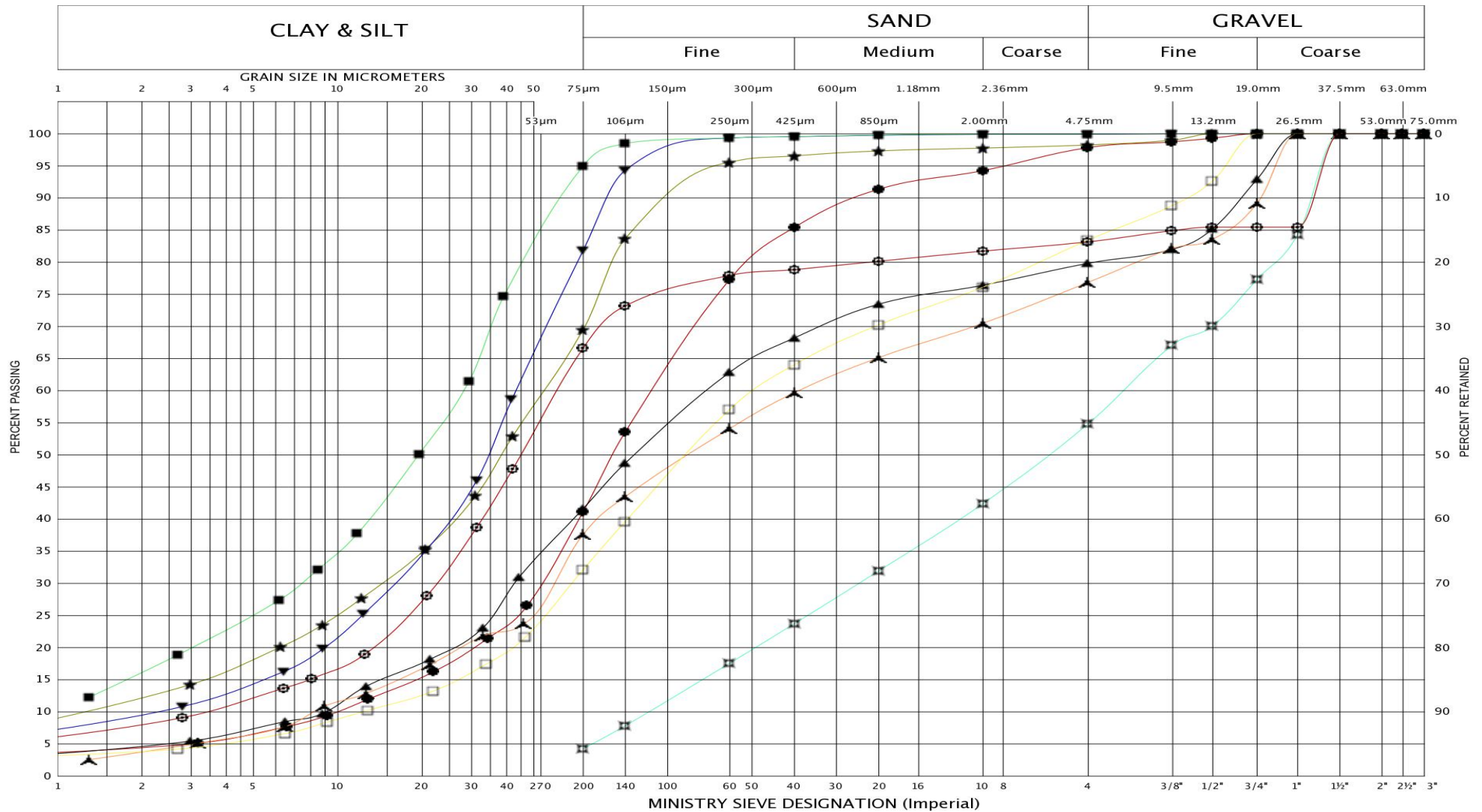
| PROJECT <u>22522311</u> | | RECORD OF BOREHOLE No GBH-31B | | | | SHEET 3 OF 3 | | METRIC | | | | | | | | | | | | | | | | |
|-----------------------------------|--|---|--------|------|----------------------------|--------------------------|--|--------------------|--|--|--|---|----------------|---|---|--|----------------|--|--|--|--|--|--|--|
| G.W.P. <u>DB 2021-3004</u> | | LOCATION <u>N 4814066.0; E 249440.9 MTM NAD 83 ZONE 10 (LAT. 43.464468; LONG. -80.184158)</u> | | | | ORIGINATED BY <u>JGH</u> | | | | | | | | | | | | | | | | | | |
| DIST <u> </u> HWY <u>6</u> | | BOREHOLE TYPE <u>160 mm ID Hollow Stem Augers; PQ Casing and Tri-cone</u> | | | | COMPILED BY <u>JM</u> | | | | | | | | | | | | | | | | | | |
| DATUM <u>Geodetic</u> | | DATE <u>June 27-29, 2022</u> | | | | CHECKED BY <u>LLC</u> | | | | | | | | | | | | | | | | | | |
| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | | | | | | | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | W _p | W | | | W _L | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | <div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE </div> <div style="display: flex; justify-content: space-between;"> ● QUICK TRIAXIAL × REMOULDED </div> | | | | | | | | | | | | | | | | | |
| 298.2 | Dolostone (BEDROCK) Grey |  | | | | | | | | | | | | | | | | | | | | | | |
| 30.5 | END OF BOREHOLE | | | | | | | | | | | | | | | | | | | | | | | |
| | NOTES: 1. Borehole GBH-31B located approximately 9 m north/northeast of Borehole GBH-31A after abandonment of Borehole GBH-31A. This borehole was advanced without sampling to 9.1 m depth. Hollow stem augers were set to a depth of 5.5 m depth, then PQ casing was used to support tricone advance to bedrock. 2. Groundwater level not measured in open borehole due to introduction of drilling fluids associated with tricone methods. 3. Borehole was abandoned by grouting from base to a depth of 6.4 m, with bentonite placed from 6.4 m to ground surface. | | | | | | | | | | | | | | | | | | | | | | | |

GTA-MTO 001 S:\CLIENTS\MTOWHY_6_AND_HWY_34\02_DATA\GINT\HWY_6_AND_HWY_34.GPJ GAL-GTA.GDT 9/23/22 JM

APPENDIX C

Geotechnical Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



| LEGEND | BH | 35-618-01 | 35-618-01 | 35-618-01 | 35-618-02 | 35-618-02 | 35-618-02 | 35-618-02 | 35-618-02 | 35-618-03 |
|--------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | SAMPLE | 3 | 5 | 9 | 3 | 6 | 8 | 10 | 14 | 4 |
| | SYMBOL | ● | ▲ | ★ | ▼ | ■ | ▲ | □ | ⊠ | ⊕ |



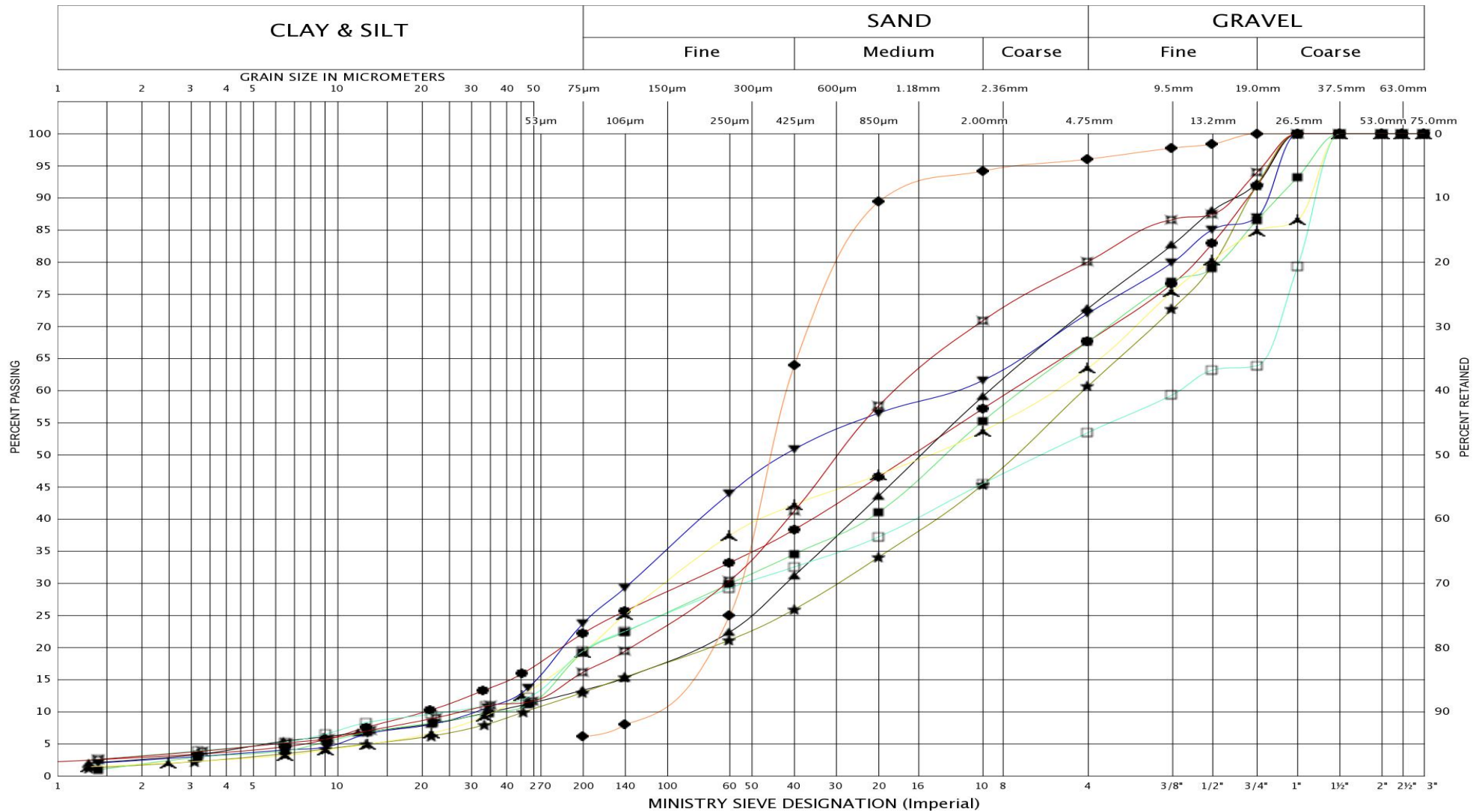
GRAIN SIZE DISTRIBUTION
Silty Sand/Sandy Silt, trace to with gravel (Till)

FIG No.: 618-GS-1A

HWY : 6

GWP 3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



| LEGEND | BH | 35-618-03 | 35-618-03 | 35-618-04 | 35-618-04 | 35-618-04 | 35-618-05 | 35-618-05 | 35-618-05 | 35-618-05 |
|--------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | SAMPLE | 7 | 11 | 2 | 7 | 11 | 6 | 8 | 10 | 17 |
| | SYMBOL | ● | ▲ | ▼ | ■ | ★ | △ | ◆ | ⊠ | □ |



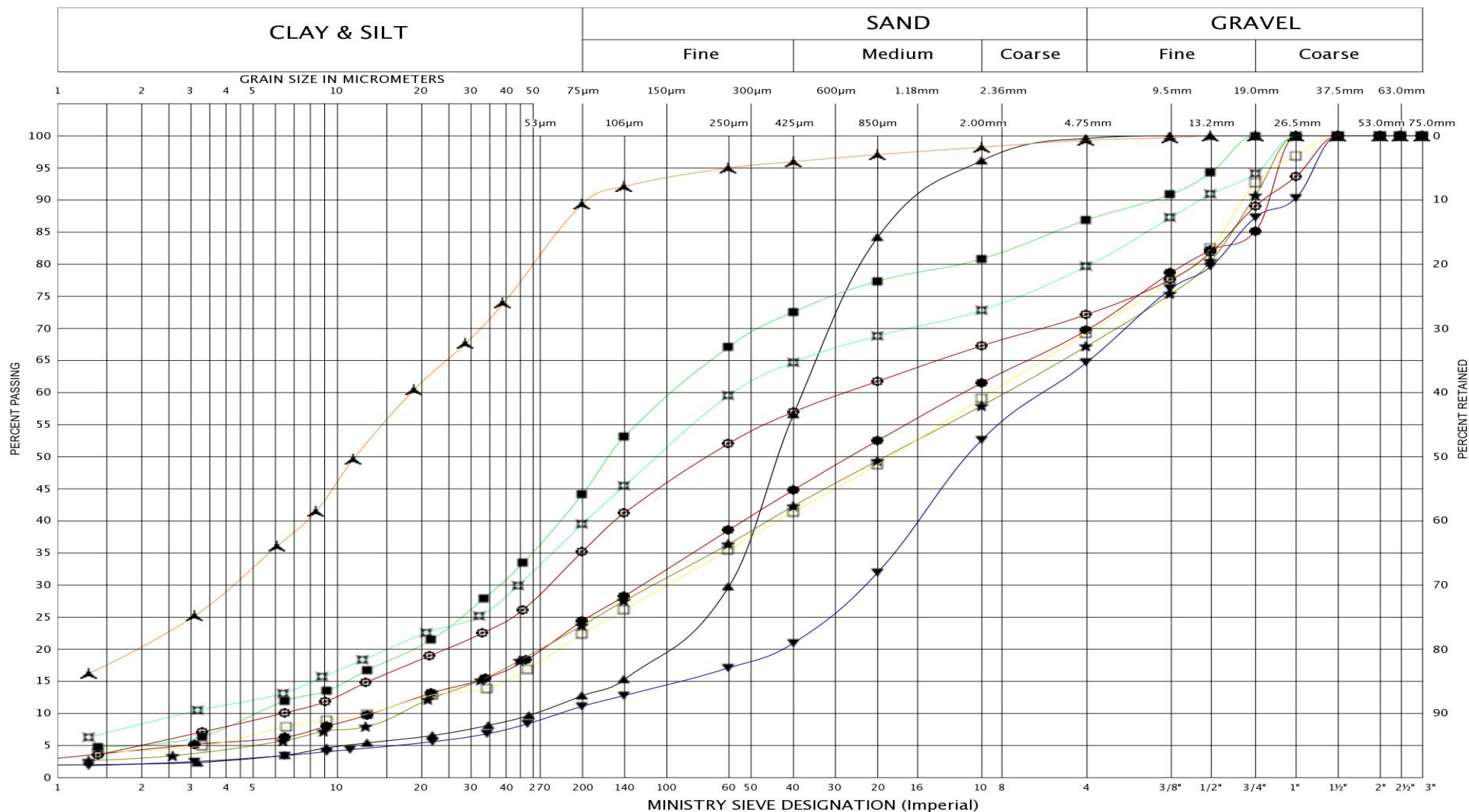
GRAIN SIZE DISTRIBUTION
Silty Sand/Sandy Silt, trace to with gravel (Till)










FIG No.: 618-GS-1B

HWY : 6

GWP 3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



| | | | | | | | | | | |
|--------|--------|---|---|---|---|---|---|---|---|---|
| LEGEND | BH | 35-618-06 | 35-618-06 | 35-618-06 | 35-618-06 | 35-618-07 | 35-618-07 | 35-618-07 | 35-618-08 | 35-618-08 |
| | SAMPLE | 2 | 5 | 8 | 17 | 4 | 9 | 11 | 4 | 7 |
| | SYMBOL |  |  |  |  |  |  |  |  |  |



GRAIN SIZE DISTRIBUTION

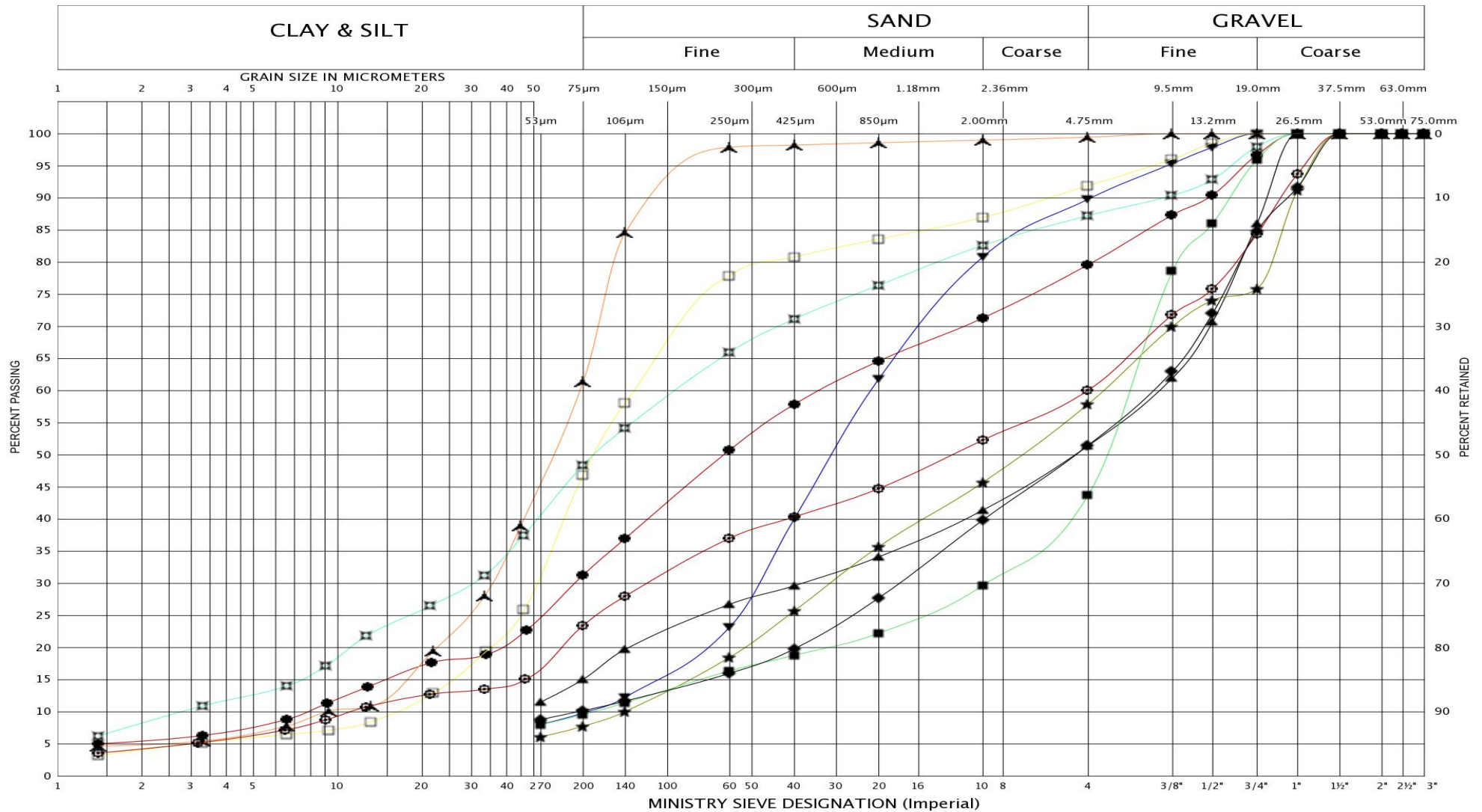
Silty Sand/Sandy Silt, trace to with gravel (Till)

FIG No.: 618-GS-1C

| | |
|-------|---|
| HWY : | 6 |
|-------|---|

| | |
|-----|------------|
| GWP | 3059-20-00 |
|-----|------------|

UNIFIED SOIL CLASSIFICATION SYSTEM



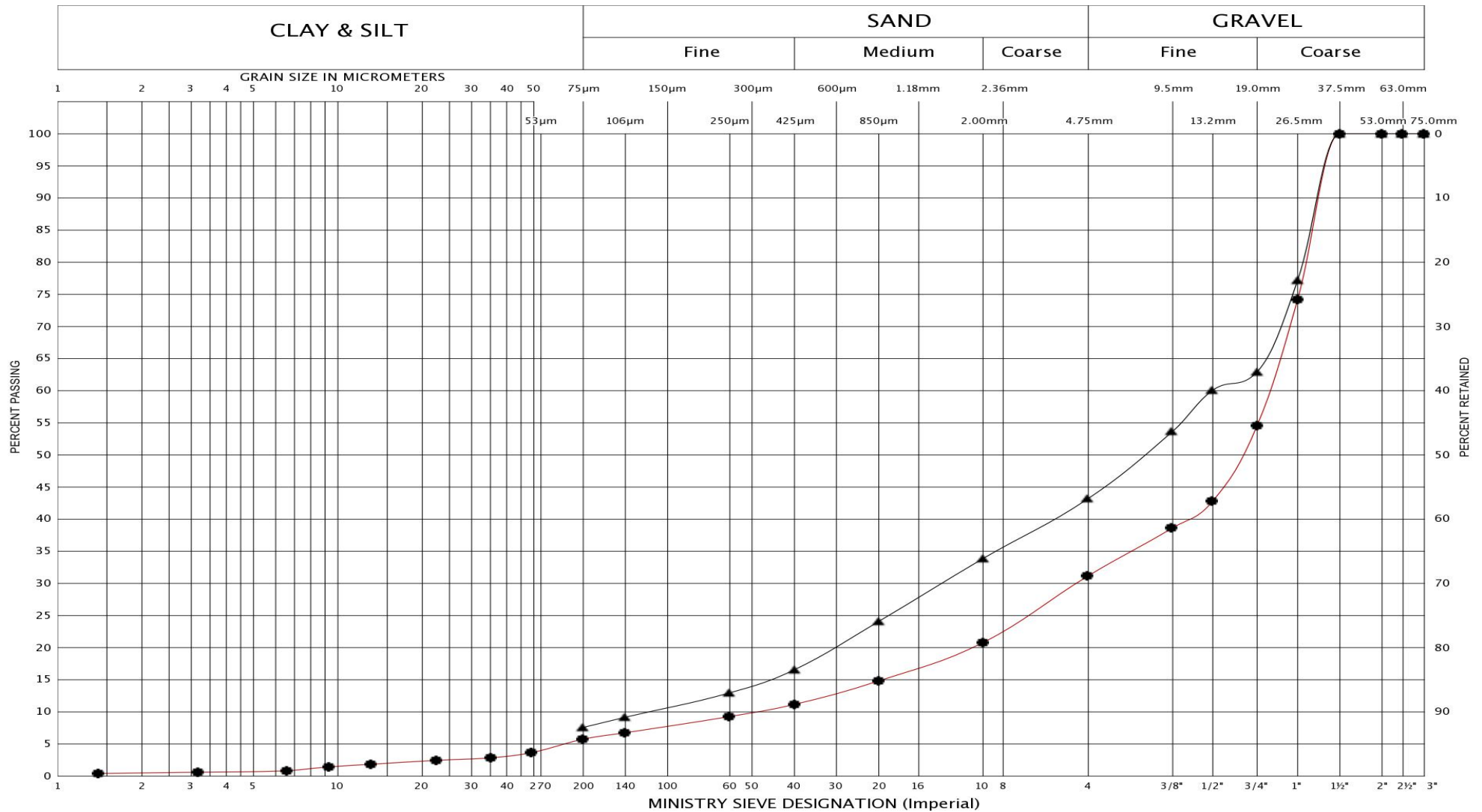
| LEGEND | BH | 35-618-08 | 35-618-08 | 35-618-08 | 35-618-08 | 35-618-08 | 35-618-09 | 35-618-09 | 35-618-09 | 35-618-09 | 35-618-09 |
|--------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | SAMPLE | 10 | 12 | 13 | 17 | 20 | 2 | 6 | 12 | 14 | 19 |
| | SYMBOL | ● | ▲ | ▼ | ★ | ■ | ⊠ | ▲ | □ | ⊕ | ◆ |



GRAIN SIZE DISTRIBUTION
Silty Sand/Sandy Silt, trace to with gravel (Till)

FIG No.: 618-GS-1D
HWY : 6
GWP 3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



| | | | |
|--------|--------|-----------|-----------|
| LEGEND | BH | 35-618-02 | 35-618-05 |
| | SAMPLE | 4 | 3 |
| | SYMBOL | ● | ▲ |



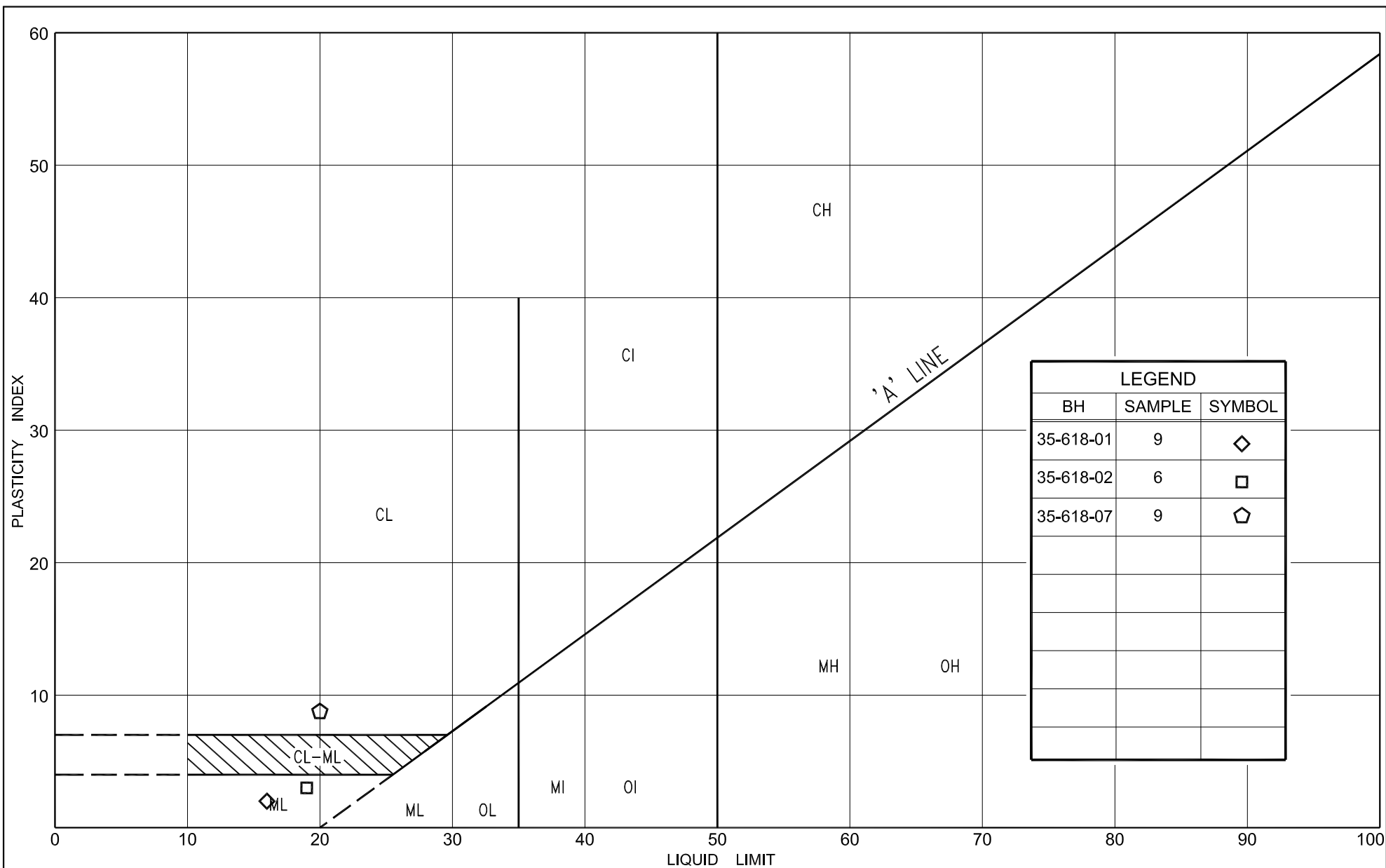
GRAIN SIZE DISTRIBUTION

GRAVEL, with sand (Till)

FIG No.: 618-GS-2

HWY : 6

GWP 3059-20-00



ROCK CORE DIMENSIONS
ASTM D4543

CLIENT AECOM
PROJECT HYW 401/6
SAMPLE IDENTIFICATION BH 35-618-5, RN-2, 77' 1"-77' 8"

PML REF 17TF006A
LAB NO. 1801322-B
DATE SAMPLED
DATE TESTED 2018-06-05
TESTED BY YA/BM

DEVIATION FROM STRAIGHTNESS

| DIAL READING (IN) | TRIAL | | |
|----------------------|--------|--------|------------|
| | 1 | 2 | 3 |
| MINIMUM | 0.0740 | 0.0760 | 0.0710 |
| MAXIMUM | 0.0860 | 0.0860 | 0.0890 |
| DIFFERENCE | 0.0120 | 0.0100 | 0.0180 |
| MAX DIFF. | 0.018 | SPEC. | 0.020 max. |

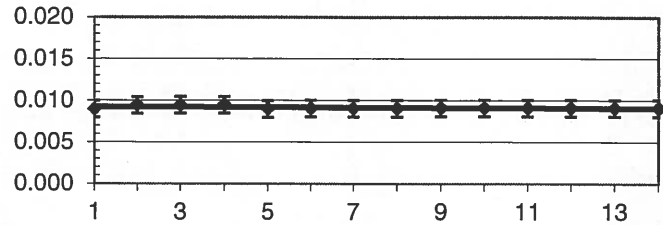
FLATNESS TOLERANCE

| DIAL READING (IN) | END 1 | | END 2 | |
|----------------------|--------|--------|--------|--------|
| | SET 1 | SET 2 | SET 1 | SET 2 |
| RDG 1 | 0.0090 | 0.0071 | 0.0082 | 0.0107 |
| RDG 2 | 0.0094 | 0.0071 | 0.0106 | 0.0110 |
| RDG 3 | 0.0095 | 0.0076 | 0.0111 | 0.0110 |
| RDG 4 | 0.0095 | 0.0081 | 0.0114 | 0.0108 |
| RDG 5 | 0.0090 | 0.0083 | 0.0114 | 0.0106 |
| RDG 6 | 0.0090 | 0.0084 | 0.0114 | 0.0102 |
| RDG 7 | 0.0090 | 0.0088 | 0.0114 | 0.0101 |
| RDG 8 | 0.0090 | 0.0093 | 0.0114 | 0.0101 |
| RDG 9 | 0.0091 | 0.0100 | 0.0115 | 0.0100 |
| RDG 10 | 0.0091 | 0.0103 | 0.0117 | 0.0098 |
| RDG 11 | 0.0091 | 0.0106 | 0.0118 | 0.0093 |
| RDG 12 | 0.0091 | 0.0110 | 0.0119 | 0.0093 |
| RDG 13 | 0.0091 | 0.0114 | 0.0119 | 0.0092 |
| RDG 14 | 0.0091 | 0.0117 | | 0.0085 |
| RDG 15 | | | | |
| RDG 16 | | | | |
| RDG 17 | | | | |
| RDG 18 | | | | |
| RDG 19 | | | | |
| RDG 20 | | | | |

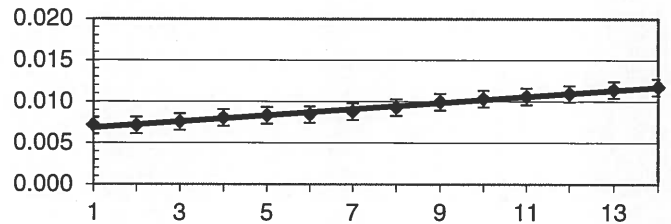
FLATNESS TOLERANCE= .001 in.

| | | | |
|------------------------|---------|---|--------|
| CORE DIAMETER (in.) | 1.7760 | 1.7750 | 1.7810 |
| AVE: | 1.7773 | PERPENDICULARITY RATIO (Specified .0043 max.) | |
| SLOPE OF BEST FIT LINE | | | |
| | MINIMUM | MAXIMUM | |
| END 1A | 0.0090 | 0.0092 | 0.0001 |
| END 2B | 0.0068 | 0.0117 | 0.0028 |
| END 2A | 0.0101 | 0.0123 | 0.0012 |
| END 2B | 0.0089 | 0.0112 | 0.0013 |

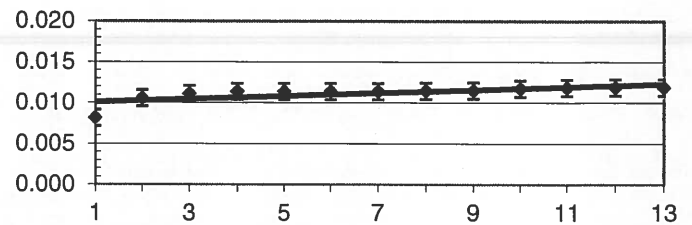
END 1a



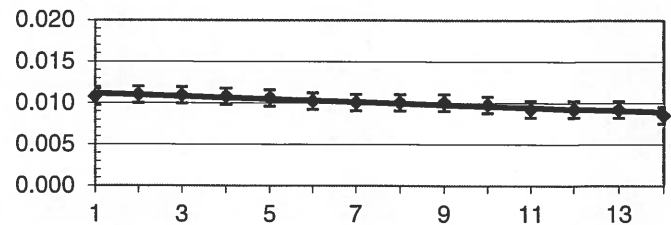
END 1b



END 2a



END 2b



REVIEWED BY

J.Noor

DATE

2018-06-08

ROCK CORE TESTING
ASTM D7012

CLIENT AECOM
PROJECT HYW 401/6
SAMPLE IDENTIFICATION BH 35-618-5, RN-2, 77' 1"-77' 8"

PML REF 17TF006A
LAB NO. 1801322-B
DATE SAMPLED
DATE TESTED 2018-06-06
TESTED BY YA/BM

UNCONFINED COMPRESSIVE STRENGTH

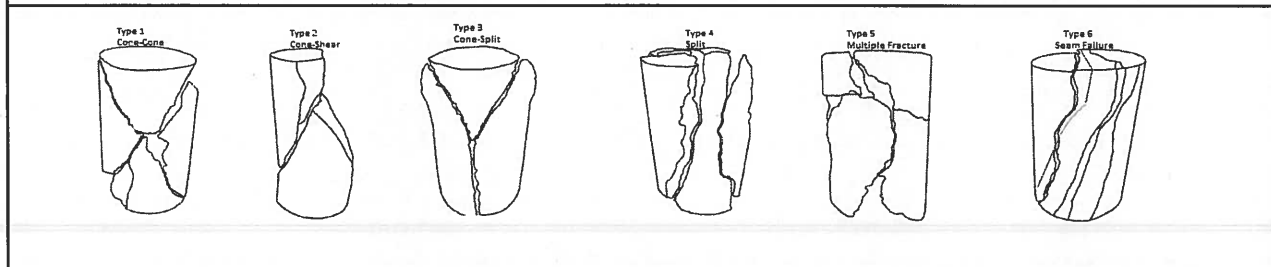
| CORE DIMENSIONS | | COMPRESSIVE STRENGTH | |
|-------------------------|------------|---------------------------------------|-------|
| SPECIMEN DIAMETER (in.) | 1.7773 | TEST TIME (min) (spec. 2 to 15) | 5:01 |
| SPECIMEN LENGTH (in.) | 4.220 | MAXIMUM LOAD APPLIED (kN) | 93.57 |
| | 4.221 | | |
| | 4.225 | COMPRESSIVE STRENGTH (MPa) | 58.5 |
| | AVE. 4.222 | TYPE OF FAILURE | 3 |
| SURFACE AREA (sq mm) | 1601 | LENGTH TO DIAMETER RATIO (spec 2-2.5) | 2.38 |

MOISTURE CONTENT

UNIT WEIGHT

| | | | |
|---------------------------------|--------|---------------------------------|----------|
| WEIGHT OF WET SAMPLE + TARE (g) | 529.30 | WEIGHT OF DRY SAMPLE IN AIR (g) | 4459.00 |
| WEIGHT OF DRY SAMPLE + TARE (g) | 523.20 | VOLUME OF SAMPLE (cu m) | 0.000172 |
| WEIGHT OF WATER (g) | 6.10 | UNIT WEIGHT (kg/cu m) | 25978 |
| WEIGHT OF TARE (g) | 116.10 | | |
| WEIGHT OF DRY SAMPLE (g) | 407.10 | | |
| MOISTURE CONTENT (%) | 1.5 | | |

REMARKS



REVIEWED BY

J.Noor

DATE

2018-06-08

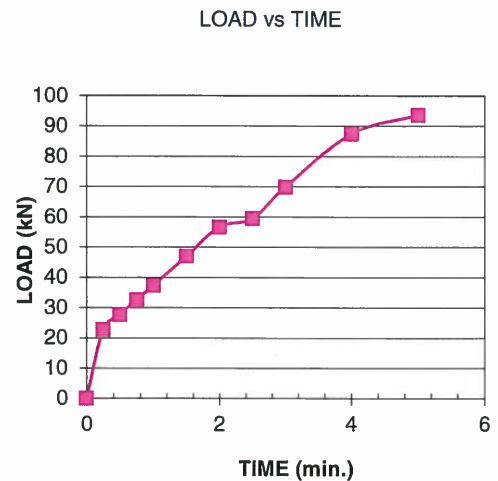
ROCK CORE TESTING
ASTM D7012

CLIENT AECOM
PROJECT HYW 401/6
SAMPLE IDENTIFICATION BH 35-618-5, RN-2, 77' 1"-77' 8"

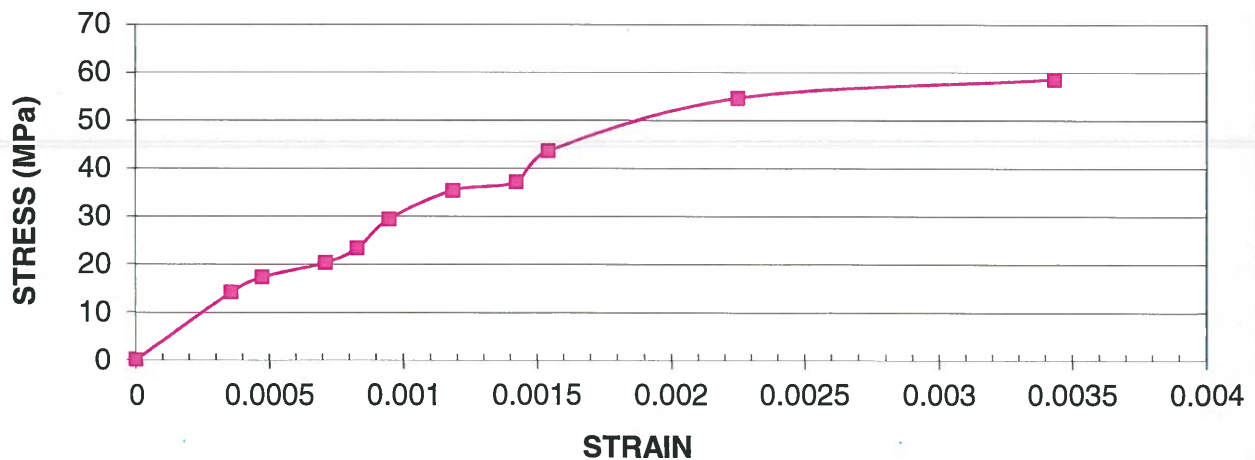
PML REF 17TF006A
LAB NO. 1801322-B
DATE SAMPLED
DATE TESTED 2018-06-06
TESTED BY YA/BM

UNCONFINED COMPRESSIVE STRENGTH CURVE

| TIME (min.) | DEFLECTION (in) | LOAD (kN) | STRESS (MPa) | STRAIN (mm/mm) |
|----------------|--------------------|--------------|-----------------|-------------------|
| 0 | 0.036 | 0 | 0 | 0 |
| 0.25 | 0.0375 | 22.61 | 14.1 | 0.0004 |
| 0.5 | 0.038 | 27.66 | 17.3 | 0.0005 |
| 0.75 | 0.039 | 32.50 | 20.3 | 0.0007 |
| 1 | 0.0395 | 37.29 | 23.3 | 0.0008 |
| 1.5 | 0.04 | 46.94 | 29.3 | 0.0009 |
| 2 | 0.041 | 56.55 | 35.3 | 0.0012 |
| 2.5 | 0.042 | 59.34 | 37.1 | 0.0014 |
| 3 | 0.0425 | 69.74 | 43.6 | 0.0015 |
| 4 | 0.0455 | 87.34 | 54.6 | 0.0023 |
| 5 | 0.0505 | 93.57 | 58.5 | 0.0034 |
| | | | | |
| | | | | |
| | | | | |



STRESS vs STRAIN



REVIEWED BY

J.Noor

DATE 2018-06-08

ROCK CORE DIMENSIONS
ASTM D4543

CLIENT AECOM Canada Ltd.
PROJECT Hwy 6 and 401 Improvements, Midblock Interchange Area
SAMPLE IDENTIFICATION BH35-618-8, Run1, 105'11"-106'5"

PML REF 17TF006I
LAB NO. 2104843 C
DATE SAMPLED
DATE TESTED 2021-08-24
TESTED BY L. Gowry

DEVIATION FROM STRAIGHTNESS

| DIAL READING (IN) | TRIAL | | |
|-------------------------|--------|--------|------------|
| | 1 | 2 | 3 |
| MINIMUM | 0.0800 | 0.0830 | 0.0840 |
| MAXIMUM | 0.0900 | 0.0930 | 0.0840 |
| DIFFERENCE | 0.0100 | 0.0100 | 0.0000 |
| MAX DIFF. | 0.01 | SPEC. | 0.020 max. |

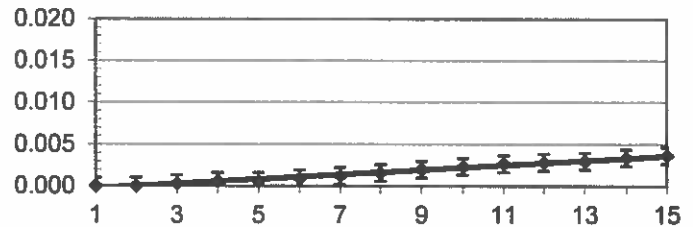
FLATNESS TOLERANCE

| DIAL READING (IN) | END 1 | | END 2 | |
|-------------------------|--------|--------|--------|--------|
| | SET 1 | SET 2 | SET 1 | SET 2 |
| RDG 1 | 0.0000 | 0.0000 | 0.0002 | 0.0107 |
| RDG 2 | 0.0001 | 0.0000 | 0.0003 | 0.0104 |
| RDG 3 | 0.0003 | 0.0003 | 0.0002 | 0.0104 |
| RDG 4 | 0.0006 | 0.0007 | 0.0002 | 0.0103 |
| RDG 5 | 0.0006 | 0.0008 | 0.0002 | 0.0104 |
| RDG 6 | 0.0009 | 0.0010 | 0.0002 | 0.0100 |
| RDG 7 | 0.0012 | 0.0012 | 0.0002 | 0.0099 |
| RDG 8 | 0.0016 | 0.0019 | 0.0000 | 0.0106 |
| RDG 9 | 0.0020 | 0.0019 | 0.0001 | 0.0111 |
| RDG 10 | 0.0023 | 0.0019 | 0.0004 | 0.0117 |
| RDG 11 | 0.0027 | 0.0019 | 0.0005 | 0.0122 |
| RDG 12 | 0.0029 | 0.0020 | 0.0006 | 0.0126 |
| RDG 13 | 0.0030 | 0.0021 | 0.0006 | 0.0125 |
| RDG 14 | 0.0034 | 0.0021 | 0.0007 | 0.0128 |
| RDG 15 | 0.0037 | 0.0025 | 0.0008 | 0.0145 |
| RDG 16 | | | | 0.0157 |
| RDG 17 | | | | 0.0162 |
| RDG 18 | | | | |
| RDG 19 | | | | |
| RDG 20 | | | | |

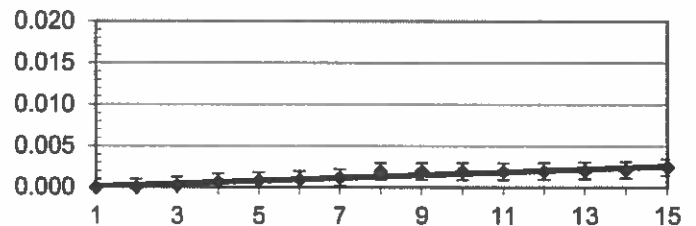
FLATNESS TOLERANCE= .001 in.

| CORE DIAMETER (in.) | | 2.3870 | 2.3895 | 2.3830 |
|------------------------|---------|---------|---|--------|
| AVE: | | 2.3865 | PERPENDICULARITY RATIO (Specified .0043 max.) | |
| SLOPE OF BEST FIT LINE | | | | |
| | MINIMUM | MAXIMUM | | |
| END 1A | -0.0003 | 0.0036 | 0.0016 | |
| END 2B | 0.0001 | 0.0026 | 0.0010 | |
| END 2A | 0.0001 | 0.0006 | 0.0002 | |
| END 2B | 0.0091 | 0.0146 | 0.0023 | |

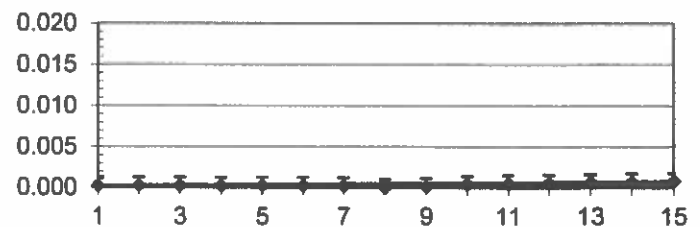
END 1a



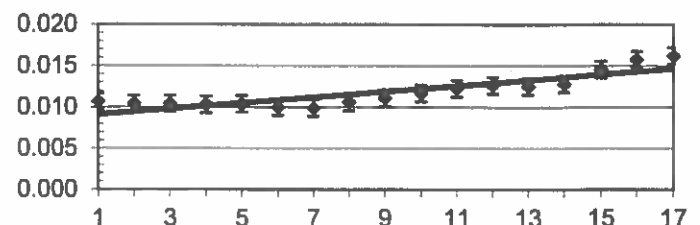
END 1b



END 2a



END 2b



REVIEWED BY

J. Noor

DATE

2021-08-25

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORE
ASTM D7012

| | | | |
|-----------------------|---|--------------|------------|
| CLIENT | AECOM Canada Ltd. | PML REF | 17TF006I |
| PROJECT | Hwy 6 and 401 Improvements, Midblock Interchange Area | LAB NO. | 2104843 C |
| SAMPLE IDENTIFICATION | BH35-618-8, Run1, 105'11"-106'5" | DATE SAMPLED | |
| | | DATE TESTED | 2021-08-24 |
| | | TESTED BY | L. Gowry |

| CORE DIMENSIONS | | COMPRESSIVE STRENGTH | |
|-------------------------|--------|---------------------------------------|--------|
| SPECIMEN DIAMETER (in.) | 2.3865 | TEST TIME (min) (spec. 2 to 15) | 9:36 |
| SPECIMEN LENGTH (in.) | 5.470 | MAXIMUM LOAD APPLIED (kN) | 445.30 |
| | 5.462 | | |
| | 5.465 | COMPRESSIVE STRENGTH (MPa) | 154.3 |
| AVE. | 5.465 | TYPE OF FAILURE | 1 |
| SURFACE AREA (sq mm) | 2886 | LENGTH TO DIAMETER RATIO (spec 2-2.5) | 2.29 |

| MOISTURE CONTENT | | UNIT WEIGHT | |
|---------------------------------|---------|---------------------------------|----------|
| WEIGHT OF WET SAMPLE + TARE (g) | 1108.45 | WEIGHT OF DRY SAMPLE IN AIR (g) | 1061.46 |
| WEIGHT OF DRY SAMPLE + TARE (g) | 1107.66 | VOLUME OF SAMPLE (cu m) | 0.000401 |
| WEIGHT OF WATER (g) | 0.79 | Density (kg/cu m) | 2650 |
| WEIGHT OF TARE (g) | 176.27 | UNIT WEIGHT (γ) | 25.97 |
| WEIGHT OF DRY SAMPLE (g) | 931.39 | | |
| MOISTURE CONTENT (%) | 0.1 | | |
| REMARKS | | | |



REVIEWED BY

J. Noor

DATE

2021-08-25

APPENDIX D

Analytical Laboratory Test Results



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 17T297980

PROJECT: 17TF006A

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: PETO MACCALLUM LIMITED

SAMPLING SITE: Guelph, Puslinch

ATTENTION TO: Lul Yimam

SAMPLED BY: Mousa fall

Corrosivity Package

DATE RECEIVED: 2017-12-22

DATE REPORTED: 2018-01-03

SAMPLE DESCRIPTION: 35-617-BH2-SS6 35-618-BH4-SS4 35-352-BH6-SS6

| Parameter | Unit | SAMPLE TYPE: Soil | | | | |
|-------------------------------|----------|-------------------|-------|------------|------------|------------|
| | | DATE SAMPLED: | | | | |
| | | G / S | RDL | 2017-11-29 | 2017-12-07 | 2017-11-17 |
| | | | | 8994390 | 8994393 | 8994394 |
| Sulfide (S2-) | % | | 0.05 | 0.14 | <0.05 | <0.05 |
| Chloride (2:1) | µg/g | | 2 | 527 | 21 | 19 |
| Sulphate (2:1) | µg/g | | 2 | 119 | 6 | 5 |
| pH (2:1) | pH Units | | NA | 7.71 | 8.66 | 8.52 |
| Electrical Conductivity (2:1) | mS/cm | | 0.005 | 1.16 | 0.104 | 0.115 |
| Resistivity (2:1) | ohm.cm | | 1 | 862 | 9620 | 8700 |
| Redox Potential (2:1) | mV | | 5 | 152 | 138 | 160 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8994390-8994394 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

*Sulphide analyzed at AGAT 5623 McAdam

Certified By:

Amanjot Bhela

Quality Assurance

CLIENT NAME: PETO MACCALLUM LIMITED

PROJECT: 17TF006A

SAMPLING SITE: Guelph, Puslinch

AGAT WORK ORDER: 17T297980

ATTENTION TO: Lui Yimam

SAMPLED BY: Mousa fall

Soil Analysis

| RPT Date: Jan 03, 2018 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | METHOD BLANK SPIKE | | MATRIX SPIKE | |
|------------------------|-------|-----------|-----------|--------|-----|--------------|--------------------|-------------------|--------------------|----------|-------------------|-------|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper |

Corrosivity Package

| | | | | | | | | | | | | | | | |
|-------------------------------|---------|---------|-------|-------|------|---------|------|-----|------|------|-----|------|------|-----|------|
| Sulfide (S2-) | 8994390 | 8994390 | 0.14 | 0.14 | NA | < 0.05 | 99% | 80% | 120% | | | | | | |
| Chloride (2:1) | 8994393 | 8994393 | 21 | 20 | 4.9% | < 2 | 95% | 80% | 120% | 96% | 80% | 120% | 98% | 70% | 130% |
| Sulphate (2:1) | 8994393 | 8994393 | 6 | 5 | NA | < 2 | 101% | 80% | 120% | 102% | 80% | 120% | 106% | 70% | 130% |
| pH (2:1) | 8994393 | 8994393 | 8.66 | 8.59 | 0.8% | NA | 101% | 90% | 110% | NA | | | NA | | |
| Electrical Conductivity (2:1) | 8994393 | 8994393 | 0.104 | 0.108 | 3.8% | < 0.005 | 98% | 90% | 110% | NA | | | NA | | |
| Redox Potential (2:1) | 8994393 | 8994393 | 138 | 140 | 1.4% | < 5 | 104% | 70% | 130% | NA | | | NA | | |

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:





Method Summary

CLIENT NAME: PETO MACCALLUM LIMITED

AGAT WORK ORDER: 17T297980

PROJECT: 17TF006A

ATTENTION TO: Lui Yimam

SAMPLING SITE: Guelph, Puslinch

SAMPLED BY: Mousa fall

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|-------------------------------|---------------|---|---------------------------|
| Soil Analysis | | | |
| Sulfide (S ²⁻) | MIN-200-12025 | ASTM E1915-09 | GRAVIMETRIC |
| Chloride (2:1) | INOR-93-6004 | McKeague 4.12 & SM 4110 B | ION CHROMATOGRAPH |
| Sulphate (2:1) | INOR-93-6004 | McKeague 4.12 & SM 4110 B | ION CHROMATOGRAPH |
| pH (2:1) | INOR 93-6031 | MSA part 3 & SM 4500-H+ B | PH METER |
| Electrical Conductivity (2:1) | INOR-93-6036 | McKeague 4.12, SM 2510 B | EC METER |
| Resistivity (2:1) | INOR-93-6036 | McKeague 4.12, SM 2510 B, SSA #5 Part 3 | CALCULATION |
| Redox Potential (2:1) | | McKeague 4.12 & SM 2510 B | REDOX POTENTIAL ELECTRODE |



FINAL REPORT

CA14274-AUG21 R1

17TF006A

Prepared for

Peto MacCallum Ltd

First Page

CLIENT DETAILS

Client Peto MacCallum Ltd

Address 165 Cartwright Ave
Toronto, ON
M6A 1V5, Canada

Contact Lul Yimam

Telephone 416-525-5786

Facsimile 416-785-5120

Email lyimam@petomacallum.com

Project 17TF006A

Order Number

Samples Soil (3)

LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA14274-AUG21

Received 08/20/2021

Approved 08/26/2021

Report Number CA14274-AUG21 R1

Date Reported 08/26/2021

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present:Yes

Custody Seal Present:Yes

Chain of Custody Number:022438

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Jill Campbell, B.Sc.,GISAS





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QC Summary..... 6-7

Legend..... 8

Annexes..... 9



FINAL REPORT

CA14274-AUG21 R1

Client: Peto MacCallum Ltd

Project: 17TF006A

Project Manager: Lul Yimam

Samplers: N/A

PACKAGE: - Corrosivity Index (SOIL)

| Sample Number | 5 | 6 | 7 |
|---------------|-----------------------|-----------------------|-------------------------|
| Sample Name | BH618-08 5SS 10-12 | BH617-09 5SS 10-12 | BH617-10 4SS 7.5-9.5 |
| Sample Matrix | Soil | Soil | Soil |
| Sample Date | 19/08/2021 | 19/08/2021 | 19/08/2021 |

| Parameter | Units | RL | | Result | Result | Result |
|---|----------|-------|--|--------|--------|--------|
| Corrosivity Index | | | | | | |
| Corrosivity Index | none | 1 | | 1 | 14 | 16 |
| Soil Redox Potential | mV | - | | 256 | 249 | 189 |
| Sulphide (Na ₂ CO ₃) | % | 0.04 | | < 0.04 | < 0.04 | 0.85 |
| pH | pH Units | 0.05 | | 8.45 | 8.82 | 7.53 |
| Resistivity (calculated) | ohms.cm | -9999 | | 7580 | 874 | 358 |

PACKAGE: - General Chemistry (SOIL)

| Sample Number | 5 | 6 | 7 |
|---------------|-----------------------|-----------------------|-------------------------|
| Sample Name | BH618-08 5SS 10-12 | BH617-09 5SS 10-12 | BH617-10 4SS 7.5-9.5 |
| Sample Matrix | Soil | Soil | Soil |
| Sample Date | 19/08/2021 | 19/08/2021 | 19/08/2021 |

| Parameter | Units | RL | | Result | Result | Result |
|--------------------------|-------|----|--|--------|--------|--------|
| General Chemistry | | | | | | |
| Conductivity | uS/cm | 2 | | 132 | 1140 | 2790 |

PACKAGE: - Metals and Inorganics (SOIL)

| Sample Number | 5 | 6 | 7 |
|---------------|-----------------------|-----------------------|-------------------------|
| Sample Name | BH618-08 5SS 10-12 | BH617-09 5SS 10-12 | BH617-10 4SS 7.5-9.5 |
| Sample Matrix | Soil | Soil | Soil |
| Sample Date | 19/08/2021 | 19/08/2021 | 19/08/2021 |

| Parameter | Units | RL | | Result | Result | Result |
|------------------------------|-------|-----|--|--------|--------|--------|
| Metals and Inorganics | | | | | | |
| Moisture Content | % | 0.1 | | 10.3 | 15.4 | 38.6 |



FINAL REPORT

CA14274-AUG21 R1

Client: Peto MacCallum Ltd
Project: 17TF006A
Project Manager: Lul Yimam
Samplers: N/A

PACKAGE: - Metals and Inorganics (SOIL)

| | | | |
|---------------|-----------------------|-----------------------|-------------------------|
| Sample Number | 5 | 6 | 7 |
| Sample Name | BH618-08 5SS 10-12 | BH617-09 5SS 10-12 | BH617-10 4SS 7.5-9.5 |
| Sample Matrix | Soil | Soil | Soil |
| Sample Date | 19/08/2021 | 19/08/2021 | 19/08/2021 |

| Parameter | Units | RL | | Result | Result | Result |
|-----------------------------------|-------|-----|--|--------|--------|--------|
| Metals and Inorganics (continued) | | | | | | |
| Sulphate | µg/g | 0.4 | | 9.4 | 23 | 570 |

PACKAGE: - Other (ORP) (SOIL)

| | | | |
|---------------|-----------------------|-----------------------|-------------------------|
| Sample Number | 5 | 6 | 7 |
| Sample Name | BH618-08 5SS 10-12 | BH617-09 5SS 10-12 | BH617-10 4SS 7.5-9.5 |
| Sample Matrix | Soil | Soil | Soil |
| Sample Date | 19/08/2021 | 19/08/2021 | 19/08/2021 |

| Parameter | Units | RL | | Result | Result | Result |
|-------------|-------|-----|--|--------|--------|--------|
| Other (ORP) | | | | | | |
| Chloride | µg/g | 0.4 | | 7.1 | 490 | 2300 |



FINAL REPORT

CA14274-AUG21 R1

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|-----------|--------------------|-------|-----|--------------|-----------|--------|--------------------|---------------------|------|---------------------|---------------------|------|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Chloride | DIO0410-AUG21 | µg/g | 0.4 | <0.4 | 1 | 35 | 100 | 80 | 120 | 102 | 75 | 125 |
| Sulphate | DIO0410-AUG21 | µg/g | 0.4 | <0.4 | 1 | 35 | 99 | 80 | 120 | 99 | 75 | 125 |

Carbon/Sulphur
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|-------------------|--------------------|-------|------|--------------|-----------|--------|--------------------|---------------------|------|---------------------|---------------------|------|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Sulphide (Na2CO3) | ECS0053-AUG21 | % | 0.04 | < 0.04 | ND | 20 | 99 | 80 | 120 | | | |

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|--------------|--------------------|-------|----|--------------|-----------|--------|--------------------|---------------------|------|---------------------|---------------------|------|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| Conductivity | EWL0437-AUG21 | uS/cm | 2 | < 2 | ND | 20 | 99 | 90 | 110 | NA | | |



QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-LAK-AN-001

| Parameter | QC batch Reference | Units | RL | Method Blank | Duplicate | | LCS/Spike Blank | | | Matrix Spike / Ref. | | |
|-----------|-----------------------|----------|------|-----------------|-----------|-----------|--------------------------|------------------------|------|--------------------------|------------------------|------|
| | | | | | RPD | AC (%) | Spike Recovery (%) | Recovery Limits (%) | | Spike Recovery (%) | Recovery Limits (%) | |
| | | | | | | | | Low | High | | Low | High |
| pH | EWL0437-AUG21 | pH Units | 0.05 | NA | 0 | | 100 | | | NA | | |

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

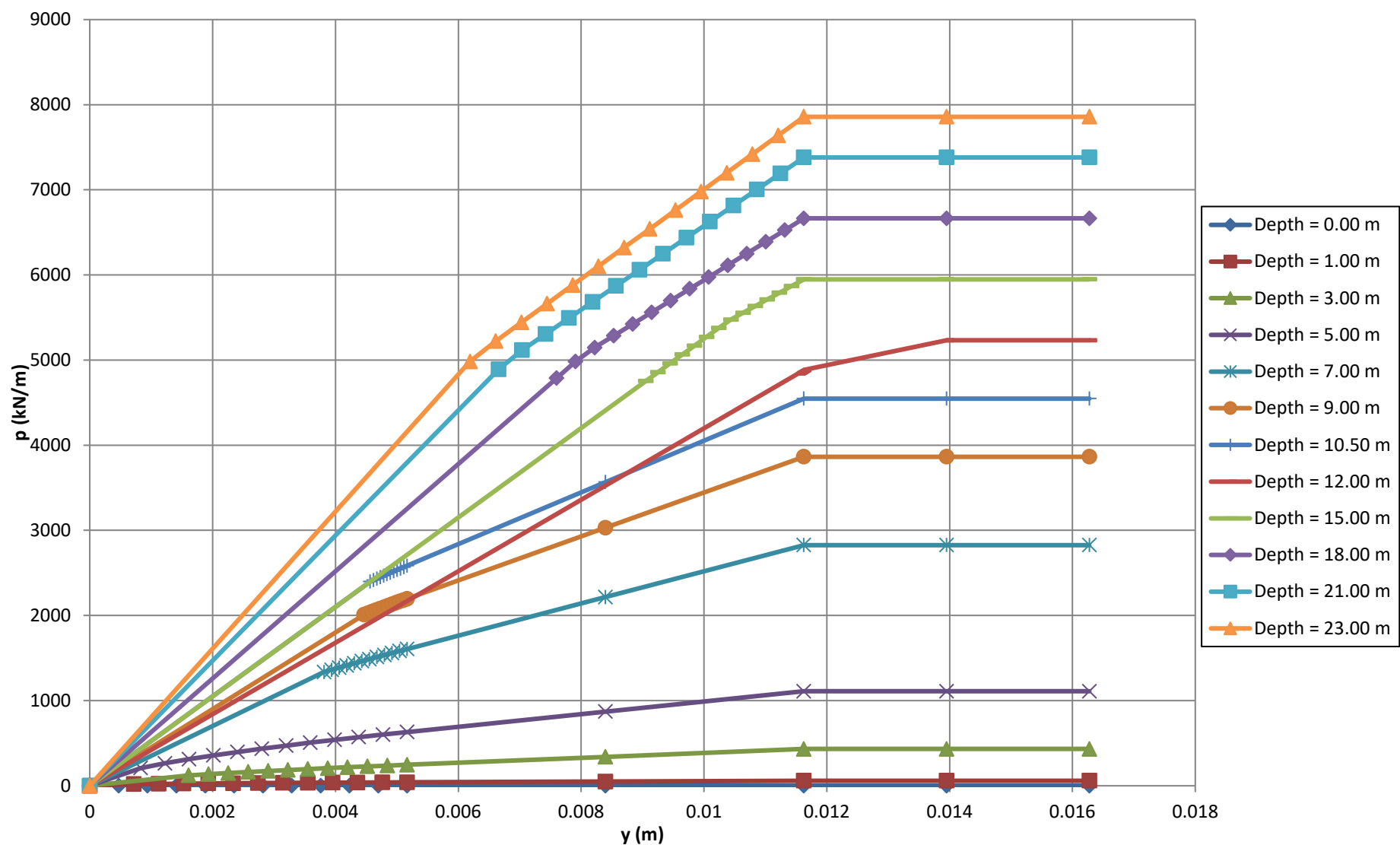
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-- End of Analytical Report --

APPENDIX E

Foundation and Embankment Analysis



CLIENT
ONTARIO MINISTRY OF TRANSPORTATION

CONSULTANT

wsp **GOLDER**

YYYY-MM-DD 2022-06-22

PREPARED AR

DESIGN AR

REVIEW LCC

APPROVED LCC

PROJECT
HIGHWAY 6 / HANLON EXPRESSWAY MID-BLOCK
INTERCHANGE IMPROVEMENTS
COUNTY OF WELLINGTON, ONTARIO

TITLE
P-y CURVES FOR ABUTMENT PILE DESIGN

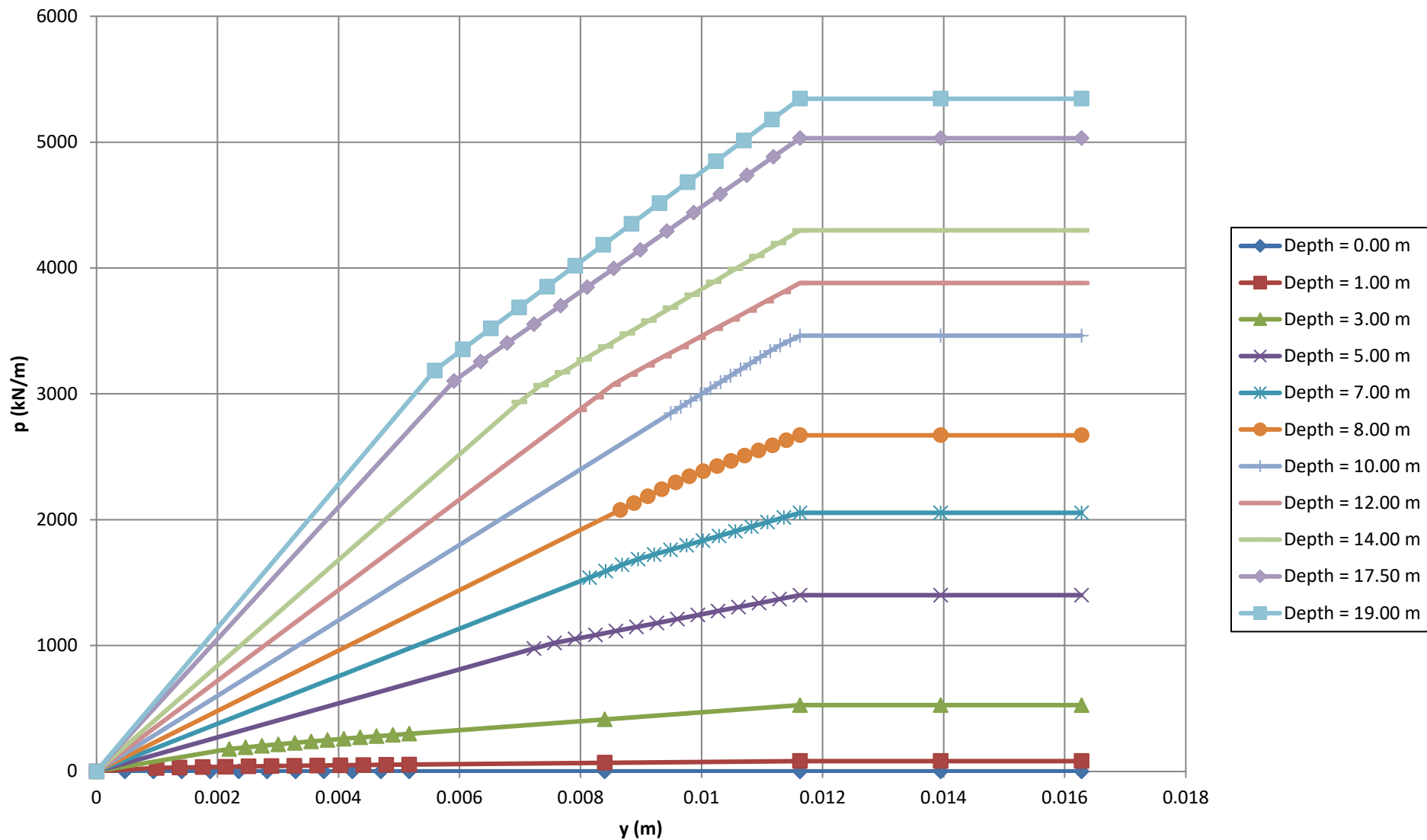
PROJECT No.
22522311

PHASE No.
2000

REVISION No.
DRAFT

FIGURE No.
E-1

1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI/A



CLIENT
ONTARIO MINISTRY OF TRANSPORTATION

CONSULTANT

wsp **GOLDER**

YYYY-MM-DD 2022-06-22

PREPARED AR

DESIGN AR

REVIEW LCC

APPROVED LCC

PROJECT
HIGHWAY 6 / HANLON EXPRESSWAY MID-BLOCK
INTERCHANGE IMPROVEMENTS
COUNTY OF WELLINGTON, ONTARIO

TITLE
P-y CURVES FOR CENTRE PIER PILE DESIGN

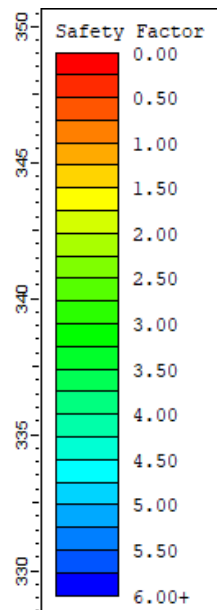
PROJECT No.
22522311

PHASE No.
2000

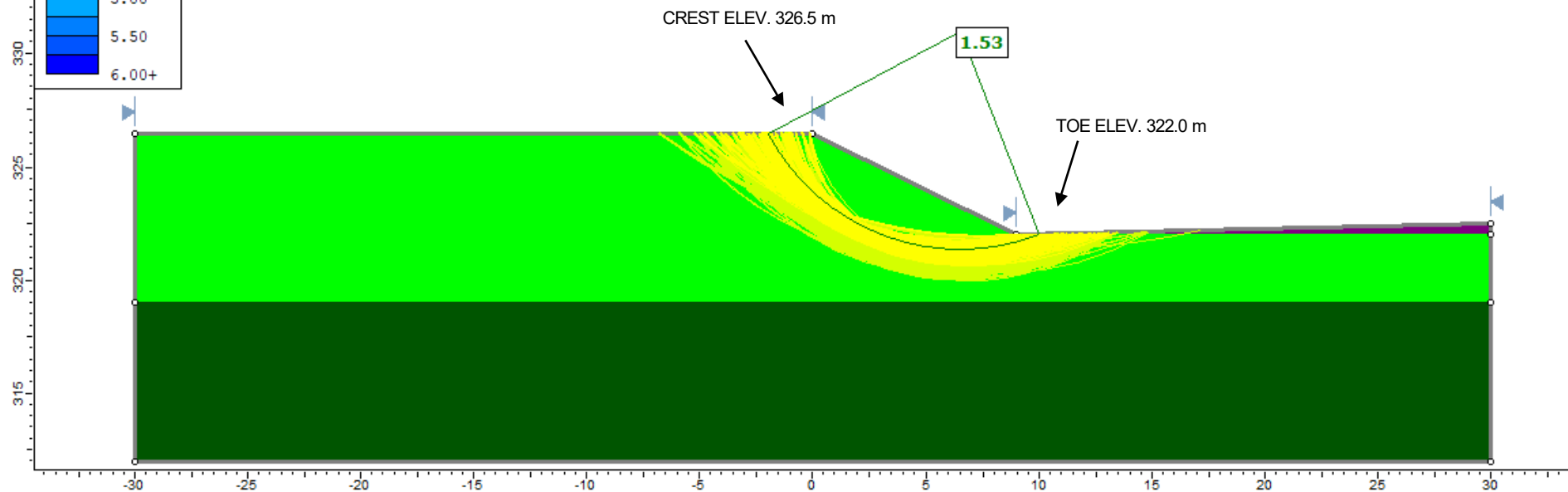
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DRAFT

FIGURE No.
E-2

1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI/A



| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (deg) | Water Surface | Ru |
|----------------------------|-------|---------------------|---------------|----------------|-----------|---------------|----|
| Pavement Fill | | 21 | Mohr-Coulomb | 0 | 32 | None | 0 |
| Silty Sand Till Compact | | 19 | Mohr-Coulomb | 0 | 28 | None | 0 |
| Silty Sand Till Very Dense | | 19 | Mohr-Coulomb | 0 | 34 | None | 0 |



CLIENT
ONTARIO MINISTRY OF TRANSPORTATION

CONSULTANT

GOLDER

YYYY-MM-DD 2022-06-21

PREPARED AN

DESIGN AN

REVIEW LCC

APPROVED LCC

PROJECT
HIGHWAY 6 / HANLON EXPRESSWAY MID-BLOCK
INTERCHANGE IMPROVEMENTS
COUNTY OF WELLINGTON, ONTARIO

TITLE
**STATIC GLOBAL STABILITY ANALYSIS
MID-BLOCK CONNECTION ROAD UNDERPASS
ABUTMENT FORESLOPES**

PROJECT No.
22522311

PHASE No.
2000

REVISION No.
DRAFT

FIGURE No.
E-3

1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3/34



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