THURBER ENGINEERING LTD.

FINAL
PRELIMINARY FOUNDATION INVESTIGATION REPORT
HIGHWAY 401 WIDENING, HIGHWAY 16 TO MAITLAND ROAD
HIGHWAY 401 UNDERPASS AT HIGHWAY 16, SITE NO. 16X-0130/B0
GWP 4024-20-00 / ASSIGNMENT NO.: 4019-E-0010.2

SITE NO. 16X-0130/B0

Geocres No.: 31B-112

Report to:

MTO c/o AECOM Canada Ltd.

Latitude: 44.754353°
Longitude: -75.478514°

November 2023
Thurber File No.: 29381

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PART 1. FACTUAL INFORMATION

1 INTRODUCTION

Thurber Engineering Ltd. (Thurber) has been retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation Ontario (MTO) under Assignment No. 4019-E-0010, Work Item No. 2, to carry out Foundation Investigations to support the Preliminary Design and Environmental Assessment for the widening of Highway 401 from Highway 16 to Maitland Road. The overall scope of work comprises replacement or rehabilitation of 14 existing structures, including 10 bridges and four structural culverts.

This report addresses the Highway 16 structure (Site No.16X-0130/B0) that crosses over Highway 401 in the Township of Edwardsburgh within Leeds and Grenville County, Ontario.

This section of the report presents the factual findings obtained from a foundation investigation completed at the site and was informed by existing subsurface information pertinent to the site, obtained from the MTO's Foundation Library (Geocres No. 31B00-033).

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, provide a borehole location plan, records of boreholes, a stratigraphic profile, laboratory test results, and a written description of the subsurface conditions. A model of the subsurface conditions influencing design and replacement of the structure was developed in the course of the current investigation.

It is a condition of this report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

2 BACKGROUND AND SITE DESCRIPTION

2.1 General

The Highway 16 Underpass crosses over Highway 401 at an interchange approximately 1.0 km northwest of the community of Johnstown and approximately 5.0 km northeast of the Highway 401 Underpass at Edward Street. For project orientation purposes, Highway 16 will be described as oriented north-south and Highway 401 as oriented east-west.

The existing one-span structure carries Highway 16 (two through lanes in each direction) over Highway 401. Turn tapers associated with interchange on-ramps start just beyond the bridge abutments. Traffic volume on this section of Highway 16 is understood to have been 4,250 AADT in 2016. Concrete parapet walls are placed along the east and west edges of the structure deck, and an approximately 3 m non-traversable paved median is present between the north and south bound lanes. The outside shoulders are of limited width on the bridge and no sidewalks are present. Rectangular concrete wingwalls are present at the four quadrants. Galvanized W-beam guiderails supported on metal posts are present at all four quadrants and extend to as much as approximately 160 m back from the abutments. The embankment side slopes are inclined at about 2H:1V and as steep as approximately 1.6H:1V near the west corner of the south abutment and are vegetated with short trees, shrubs, and grasses. No signs of global instability of the embankment were noted during the field investigation.

Highway 401, at the location of the Highway 16 Interchange, has two through lanes in each direction, a W-N/S off-ramp and N-E and S-E on-ramps in the eastbound direction, and a E-N/S off-ramp and S-W and N-W on-ramps in the westbound direction. The outside and median shoulders are paved, and the east and west bound lanes are separated by a median barrier. Traffic volume on Highway 11 is understood to have been 19,900 AADT in 2016.

The site is in a semi-rural setting, and the area directly adjacent to the Highway 16 Underpass is undeveloped land with a mix of cleared private properties and densely vegetated areas with deciduous trees and shrubs. The CNR Overhead (Site No. 16X-0130) is located about 275 m to the south of the site. Overhead utility lines are not present but light poles are present near the entry/exit of the Highway 401 ramps. The terrain is relatively flat, aside from the existing highway embankments and associated ditches, which are relatively rugged. Storm water drainage in the area includes a median storm sewer system and roadside ditching.

Photographs showing general conditions in the project area at the time of the field investigation are presented in Appendix D.

2.2 Existing Structure Information

The Ontario Structure Inspection Manual (OSIM) report prepared by MTO on June 9, 2016, indicates that the existing structure was built in 1961 and is a one-span rectangular beam structure with reinforced cast-in-place concrete. The inspection report indicates that the bridge deck is approximately 38 m long and 21 m wide, with an approximate 12-degree skew to the highway. There are cast-in-place concrete retaining wing wall walls located at all four quadrants of the bridge to retain the embankment slopes adjacent to Highway 401. The bridge was rehabilitated in 2003.

2.3 Existing Subsurface Information

The following historical foundation investigation report was available for this site within the Online Geocres library:

- Geocres Report No. 31B00-033 (e. m. peto associates ltd., 1959) presents the results of a foundation investigation carried out for the design and construction of the existing bridge structure. The field investigation included five boreholes drilled near the abutments and

existing centerline of Highway 401. In general, the boreholes indicated the presence of topsoil over sand underlain by clay which is, in turn, underlain by silty sand glacial till. The glacial till was typically composed of silty sand containing cobbles and boulders. No bedrock was cored in the investigation. The boreholes were advanced to depths ranging from 4.6 m to 6.9 m below the existing ground surface (base elev. 79.0 m to 76.3 m).

The historical stratigraphy drawings and borehole logs have been included in Appendix A and Appendix B, respectively.

2.4 Site Geology

Based on published geological information in *The Physiography of Southern Ontario* by Chapman and Putnam (1984) and the Ontario Geological Survey maps (MRD228), the site lies on the border of the physiographic regions known as the Glengarry Till Plain and the Edwardsburg Sand Plain. The Glengarry Till Plain is characterized by typically undulating to rolling surface containing well-formed drumlins, intervening clay flats, and stony glacial tills with a high proportion of limestone pieces. The Edwardsburg Sand Plain is characterized by slightly undulating sand plain of glaciofluvial origin. The bedrock in both areas is generally limestone, dolostone, and calcareous sandstone.

According to Crins et al. (2009)[i], the project area is described as Ecoregion 6E (Lake Simcoe-Rideau) within the Ontario Shield Ecozone. According to Wester et al. (2018)[ii], the ecoregion is subdivided into Ecodistrict 6E-11 (Smiths Falls Ecodistrict). The area is characterized by discontinuous layer of shallow calcareous morainal material overlying Paleozoic bedrock.

The Ontario Geological Survey maps (MRD126) suggest the site is underlain by dolostone and sandstone. Map P.2722[iii] indicates that the bedrock in the project area is of Oxford Formation that consists of sub lithographic to fine crystalline dolostone.

3 SITE INVESTIGATIONS AND FIELD TESTING

A site investigation and field-testing program was carried out between November 28 and December 12, 2022, and consisted of two on-road boreholes identified as 130-22-01 and 130-22-02, put down on Highway 16 near the underpass abutments, and one on-road borehole identified as 130-22-03, put down on Highway 401 in the eastbound median shoulder. The boreholes were advanced using a truck mounted CME 55 drill rig equipped with Hollow Stem Augers, NW casing, and NQ coring equipment. Thurber contacted Ontario One Call in advance of the field investigation to obtain utility locates/clearances in the vicinity of the borehole locations. In addition, MTO was contacted to obtain Electrical and Fibre Optic locates for the project limits.

The borehole coordinates, elevations, and termination depths are provided in Table 3-1. The as-drilled elevations of all boreholes were surveyed by Thurber with a Trimble Catalyst DA1 antenna with centimeter accuracy. The elevations were surveyed relative to the benchmark information provided by AECOM and were reviewed with reference to the topographic survey received from AECOM. The horizontal locations were measured by Thurber relative to existing site features. The borehole coordinates and elevation are shown on the Borehole Location and Soil Strata Drawings in Appendix A and on the individual Record of Borehole sheets included in Appendix B. The borehole coordinates are referenced to MTM Zone 9.

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Table 3-1: Borehole Summary

Borehole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
130-22-01	South Abutment (Hwy 16)	4 957 630.0 (44.754103°)	385 688.8 (-75.478361°)	91.6	27.2
130-22-02	North Abutment (Hwy 16)	4 957 680.0 (44.754557°)	385 652.4 (75.478812°)	91.4	18.3
130-22-03	Highway 401 EB median shoulder	4 957 632.6 (44.754129°)	385 653.7 (-75.478803°)	84.3	14.7

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Tests (SPT) in general accordance with ASTM D 1586. In-situ shear vane testing was carried out within the cohesive strata, where possible, using an MTO 'N' sized vane in general accordance with ASTM D 2573. The boreholes were advanced to depths ranging from 14.7 m to 27.2 m (base elev. 73.1 m to 64.4 m). Coring was required to advance the boreholes past cobbles and boulders and into bedrock. A standpipe piezometer was installed in Borehole 130-22-01 to allow for measurements of the groundwater level after drilling. The details for the standpipe piezometer are illustrated on the respective Record of Borehole sheets provided in Appendix B.

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's technical staff. The drilling supervisor logged the boreholes and processed the recovered soil and rock samples for transport to the Thurber's Ottawa laboratory for further examination and testing.

Following completion of the field investigation, the boreholes without a standpipe piezometer were decommissioned in general accordance with O.Reg. 903, as amended. Boreholes 130-22-02 and 130-22-03 were capped with cold patch asphalt to reinstate the pavement surface. The standpipe piezometer was decommissioned in general accordance with Ontario MOE Regulation 903 in April 2023.

4 LABORATORY TESTING

Geotechnical laboratory testing carried out as part of the current investigation included natural moisture content determination and visual identification of all retained soil samples. Testing for grain size distribution and Atterberg Limits was also carried out on selected samples to MTO and ASTM standards. All rock cores were photographed and their total core recovery (TCR), solid core recovery (SCR) and rock quality designation (RQD) were measured. One Unconfined Compressive Strength (UCS) Test was conducted on a recovered core sample from Borehole 130-22-01.

The results of the geotechnical tests are summarized on the Record of Borehole sheets included in Appendix B and all laboratory test results are presented on the figures included in Appendix C.

5 GENERAL DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and on the Borehole Location and Soil Strata Drawing included in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following sections. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions will vary between and beyond borehole locations. Soil classification is in accordance with ASTM D 2487. Description of cohesive soils and secondary components are described as outlined in the MTO Guideline for Foundation Engineering Services Manual (April 2022).

In general, the encountered stratigraphy consisted of granular fill over a native deposit of gravelly silty sand underlain by silty clay over glacial till. The glacial till was composed of gravelly silty sand to silty sandy gravel and was underlain by dolostone bedrock.

5.1 Surficial Layers

Asphalt

All the boreholes were advanced from the road surface and encountered a 125 mm to 150 mm thick layer of asphalt.

Base

A base layer was encountered below the asphalt in all the boreholes. The layer was 0.2 m thick and was composed of gravelly silty sand fill.

5.2 Fill Materials

Sand Fill

Sand fill was encountered beneath the gravelly silty sand base layer in Boreholes 130-22-01 and 130-22-02. Trace amounts of fines were noted within the layer. The fill layer was 4.5 m to 5.7 m thick (base elev. 86.5 m to 85.5 m). SPT N-values in the fill materials ranged from 4 to 29, indicating a loose to compact relative density.

The recorded moisture contents ranged from 3 to 8%. The results of gradation analyses completed on two samples of the fill are illustrated on Figure C1 of Appendix C. The results of the tests are summarized below and on the Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	0
Sand	91
Silt	9
Clay	

Silty Sand Fill

Silty sand fill was encountered beneath the sand fill in Boreholes 130-22-01 and 130-22-02 and below the gravelly silty sand base layer in Borehole 130-22-03. Some gravel was noted within the layer. The fill layer was 0.6 m to 2.3 m thick (base elev. 84.2 m to 83.2 m). SPT N-values in the fill materials ranged from 21 to 63 blows but were typically fewer than 42 blows, indicating a compact to dense relative density.

The recorded moisture contents ranged from 5 to 10%. The results of gradation analyses completed on two samples of the fill are illustrated on Figure C2 of Appendix C. The results of the tests are summarized below and on the Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	19 – 20
Sand	43 – 50
Silt	30 – 38
Clay	

5.3 Gravelly Silty Sand (SM)

A native deposit of gravelly silty sand was encountered below the silty sand fill in Boreholes 130-22-01 and 130-22-02. Varying amounts of organics were noted in the layer. The layer ranged in thickness from 0.3 m to 0.5 m (base elev. 83.9 m to 82.7 m). SPT N-values in the layer were 14 and 23 blows, indicating a compact relative density.

The recorded moisture content of samples of the fill layer ranged from 11 to 26%. The results of a gradation analysis completed on one sample of the layer are illustrated on Figure C3 of Appendix C. The results of the test are summarized below and on the Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	34
Sand	41
Silt	25
Clay	

5.4 Silty Clay (Cl)

A deposit of silty clay was encountered below the gravelly silty sand in Boreholes 130 22-01 and 130-22-02 and below the silty sand fill in Borehole 130-22-03. The thickness of the layer ranged from 0.6 m to 3.3 m (base elev. 82.8 m to 79.4 m). Where SPTs were conducted within the layer, the N-values ranged from 5 to 15 blows. Blow counts as high as 38 blows were recorded near the base of the layer. Several attempts were made to carry out in-situ undrained shear strength

testing; however, the vane was unable to be turned, and the material is inferred to have undrained shear strengths greater than 102 kPa. The silty clay can be described as very stiff in consistency.

Recorded moisture contents ranged from 25 to 37%. Atterberg Limit testing was completed on three samples of the layer. Results are illustrated in Figure C4 of Appendix C. The results of these tests are summarized below and on the Record of Borehole sheets in Appendix B. The laboratory results indicate that the silty clay exhibits intermediate plastic behaviour (CI).

Parameter	Value
Liquid Limit	39 – 41
Plastic Limit	19 – 24
Plasticity Index	17 – 20

The results of gradation analyses completed on three samples of the layer are illustrated on Figure C5 of Appendix C. The results of the tests are summarized below and on the Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	0
Sand	4 – 9
Silt	50 – 54
Clay	41 – 46

5.5 Gravelly Silty Sand (SC-SM) to Silty Sandy Gravel (GC-GM)

A native deposit of glacial till consisting of a mixture of silt, sand, and gravel was encountered below the silty clay in the boreholes. Varying amounts of plastic fines, cobbles, and boulders were also noted in the layer. The layer thickness ranged from 6.1 m to 11.6 m (base elev. 76.6 m to 67.8 m). SPT N-values in the layer ranged from 9 to 67 blows but were typically greater than 21 blows, indicating a compact to very dense relative density. Refusal blows counts were also observed, but this may represent the presence of cobbles and boulders. Coring was required to advance through cobbles and boulders.

The recorded moisture content of the layer ranged from 4 to 15%. The results of Atterberg Limit testing conducted on the fines portion of one tested sample from Borehole 130-22-02 indicate a non-plastic material. The results of gradation analyses completed on six samples of the layer are illustrated on Figure C6 of Appendix C. The results of the tests are summarized below and on the Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)	
Gravel	16 – 50	
Sand	23 – 52	
Silt	27 – 47	26
Clay		6

5.6 Bedrock

Bedrock was proven by coring in the boreholes. The depth to bedrock from the existing road grade ranged from 11.5 m to 23.8 m (elev. 76.6 m to 67.8 m). The bedrock encountered consisted of slightly weathered to fresh, fine-grained, grey dolostone interbedded with sandstone. In general, the discontinuities were rough, undulating bedding joints. Bedrock logs are provided in Appendix B, and photographs of the bedrock cores are provided in Appendix C. The rock core quality and strength are summarized in Table 5-1.

Table 5-1: Bedrock Details

Parameter	Range
Total Core Recovery (TCR), %	86 – 100
Solid Core Recovery (SCR), %	33 – 100
Rock Quality Designation (RQD), %	42 – 100
Fracture Index (fractures per 0.3 m)[(1)]	0 – >10
Unconfined Compressive Strength (UCS)[(2)], MPa	196

Notes: (1) Indicated as "FI" on Borehole Logs
(2) Sample tested from Boreholes 130-22-01

Based on the RQD, the bedrock quality is classified as poor to excellent (CFEM, 2006). The result of an unconfined compressive strength testing was 196 MPa, indicating that the bedrock is very strong (CFEM, 2006).

5.7 Groundwater

Observations of unstabilized water levels were completed in the open boreholes during and upon completion of drilling, however, water was used during the drilling operations and therefore this reading may not be representative.

At the completion of drilling, a standpipe piezometer of 19 mm in diameter was installed in Borehole 130-22-01 to allow for measurements of the groundwater level. The measured groundwater levels are summarized in Table 5-2.

Table 5-2: Groundwater Level Observations

Borehole	Groundwater Level		Date of Measurement	Comment
	Depth (mbgs)	Elevation (m)		
130-22-01	7.8	83.8	2022-12-01	Standpipe piezometer with a 1.5-m slotted screen installed with base at a depth of 14.9 m (elev. 76.7 m)
	7.6	84.0	2022-12-18	
	7.6	84.0	2023-04-26	

It should be noted that the values shown above are considered short-term readings and may not reflect groundwater levels at the time of construction, and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation events.

6 MISCELLANEOUS

The borehole locations reflect existing site features and access constraints. The as-drilled locations and ground surface elevations were measured by Thurber. George Downing Estate Drilling Ltd. of Hawkesbury, Ontario, supplied and operated the drill rig used to drill, test, sample, install a standpipe piezometer, and decommission the boreholes. Traffic control and water were provided by T.G. Carroll Cartage Ltd. of Carp, Ontario. Traffic control was performed in accordance with Ontario Book 7 for short duration closures. The field work was supervised on a full-time basis by I. Khan, E.I.T., under the direction of K. Walker, P.Eng.

Geotechnical laboratory testing was carried out by Thurber's geotechnical laboratory in Ottawa, Ontario. Unconfined Compressive Strength testing was carried out by Stantec in Ottawa, Ontario.

Interpretation of the data and preparation of this report were carried out by A. de Oliveira, E.I.T, I. Khan, E.I.T., and M. Kennedy, P.Eng. The report was reviewed by Fred Griffiths, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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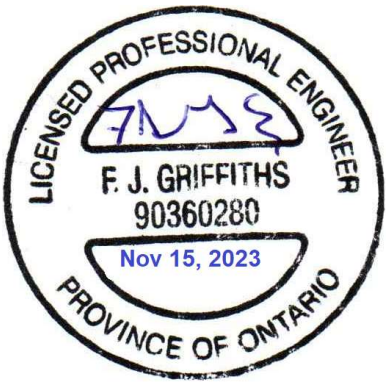

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REFERENCES

[i] https://files.ontario.ca/mnrf-ecosystemspart1-accessible-july2018-en-2020-01-16.pdf
[ii] https://files.ontario.ca/ecosystems-ontario-part2-03262019.pdf
[iii] http://www.geologyontario.mndm.gov.on.ca/index.html

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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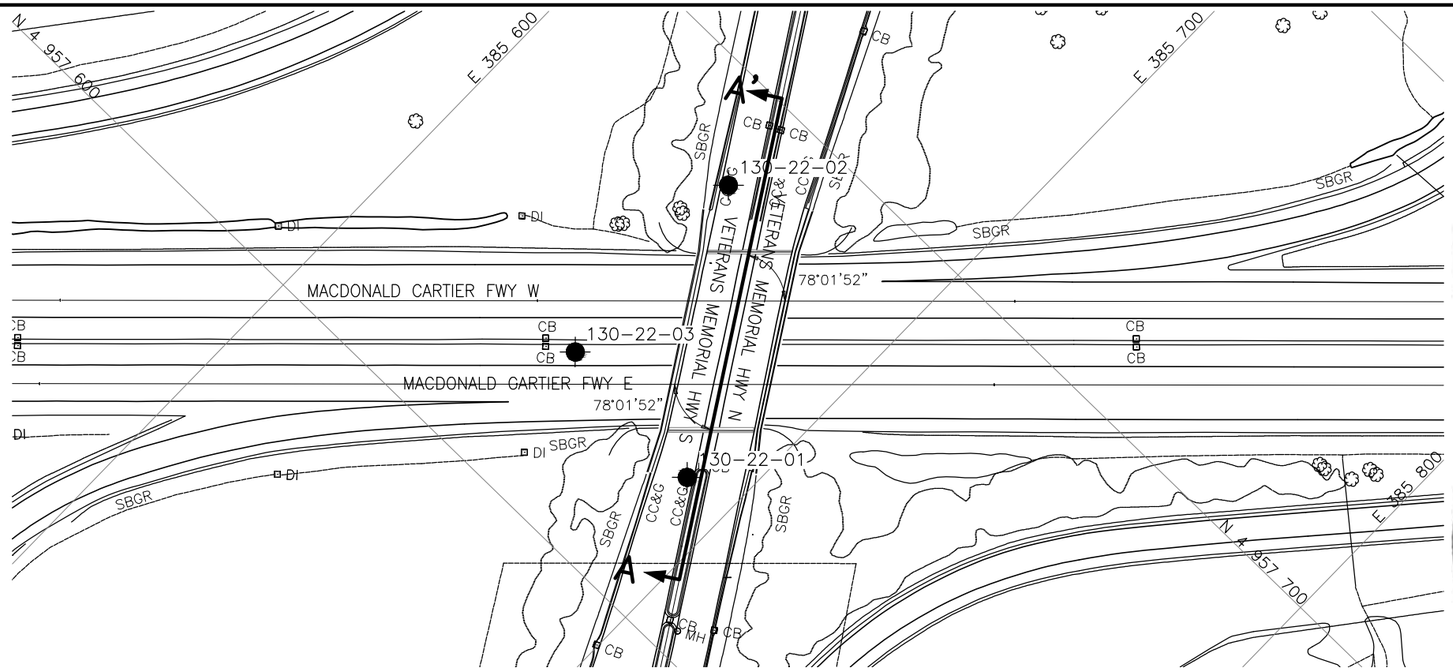
Appendix A.

Borehole Location Plan and Stratigraphic Drawing

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

25 0 25 50m

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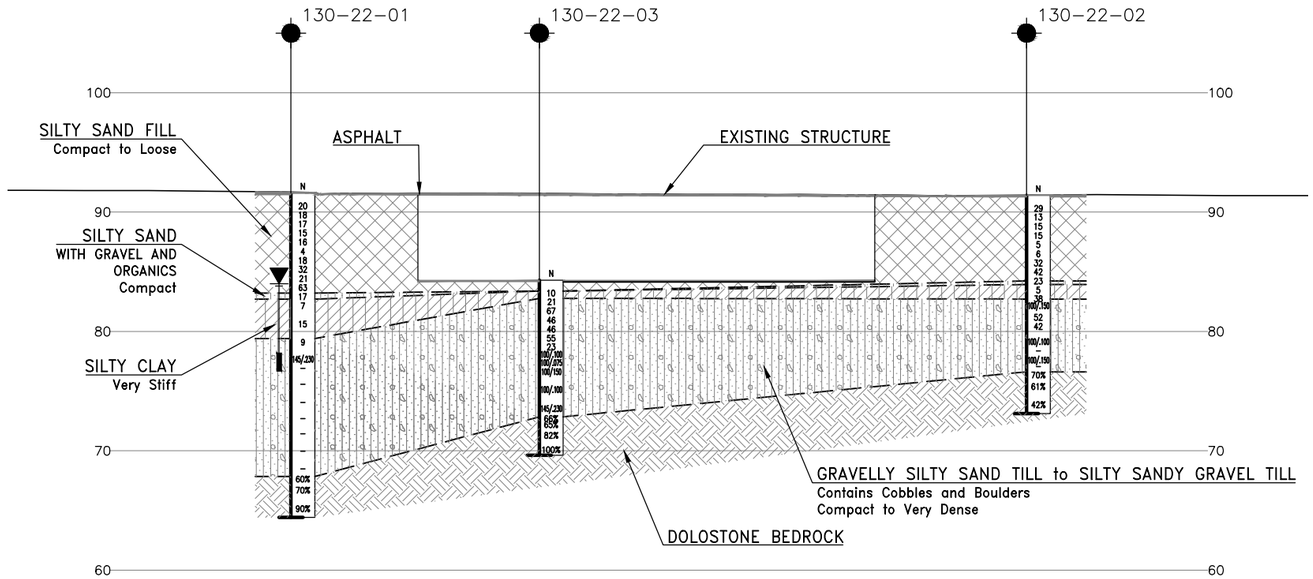

SECTION A–A'

10 0 10 20m H 1:500

5 0 5 10m V 1:250

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

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F. J. GRIFFITHS
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Nov 15, 2023
PROVINCE OF ONTARIO

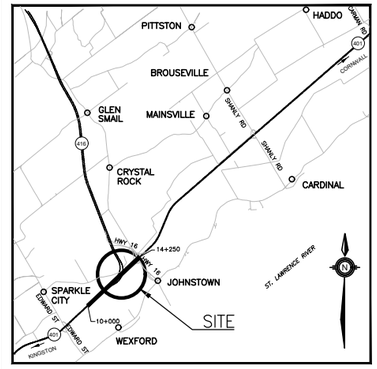
CONT No
GWP No 4024-20-00

HIGHWAY 401
HIGHWAY 16 UNDERPASS
BRIDGE REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Ontario

THURBER ENGINEERING LTD.



KEYPLAN

	LEGEND
●	Borehole (Current Investigation)
⊕	Borehole (Previous Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level
▼	Head Artesian Water
┃	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
130-22-01	91.6000	4957630.0400	385688.8100
130-22-02	91.4000	4957679.9700	385652.4100
130-22-03	84.3000	4957632.5500	385653.7000

-NOTES-

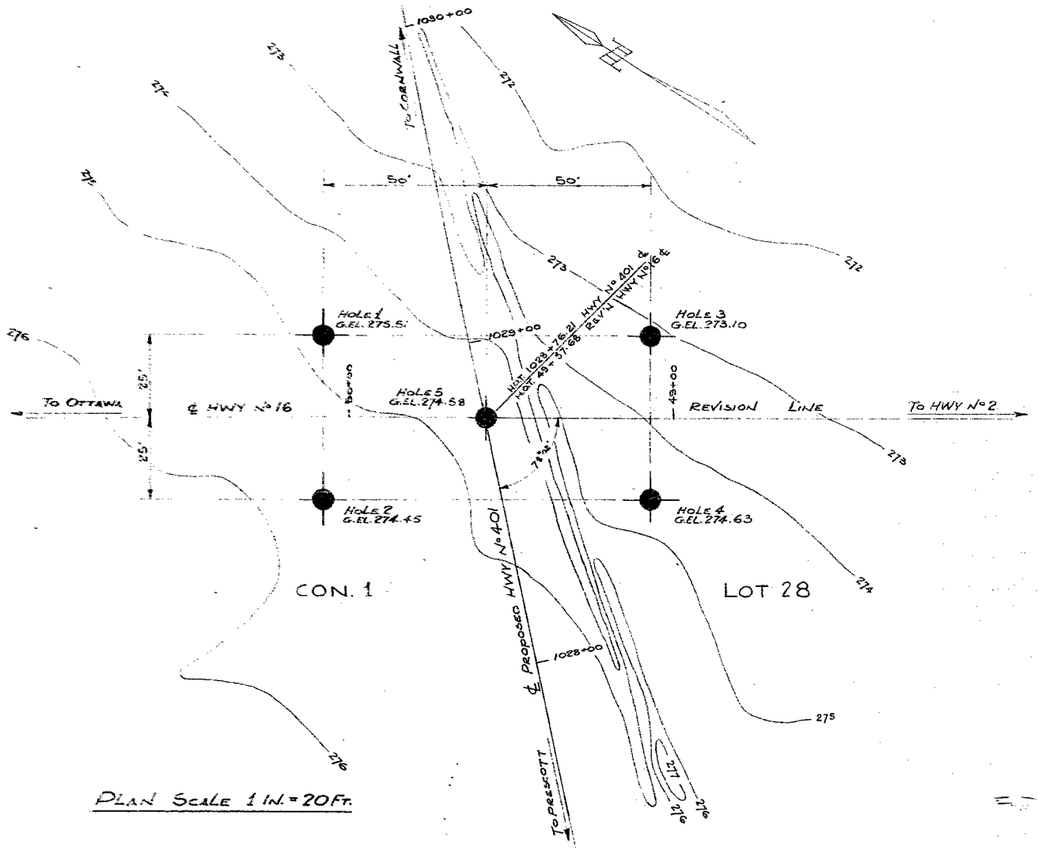
1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
3) Coordinate system is MTM NAD 83 Zone 9.

GEOCRES No. 31B-112

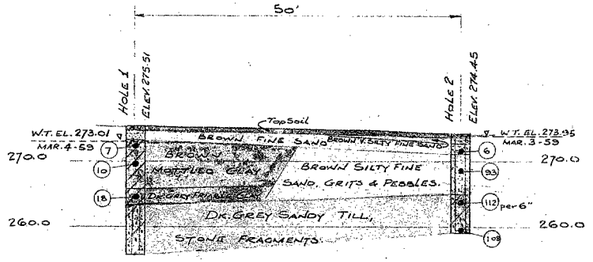
REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	MJK	CHK –	CODE	LOAD	DATE JUNE 2023
DRAWN	MC	CHK MJK	SITE 16-250/C	STRUCT	DWG 1

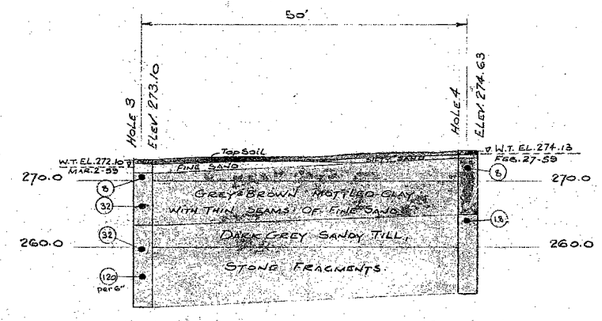
FILENAME: T:\Drafting\29000\29381\TED-29381-BHPP(130).dwg
PLOTDATE: 11/15/2023 9:51 AM



PLAN SCALE 1 IN. = 20 FT.

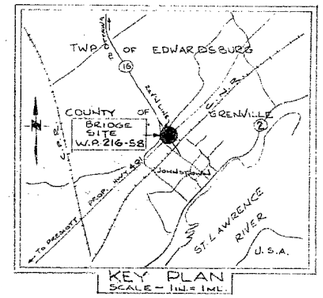


CROSS SECTION THROUGH HOLES 1 & 2.



CROSS SECTION THROUGH HOLES 3 & 4.

NOTE:- PLEASE SEE BOREHOLE LOGS FOR COMPLETE SOIL DETAILS.



PROFILES.

SCALES: HOR 1" = 10'
VERT.

LEGEND.

- TEST HOLE.
- (9) BLOWS / FOOT. STD. PENETRATION TEST.

W.T. - GROUND WATER TABLE IN SOIL.

NOTE:- THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. A LINEAR VARIATION IN SOIL STRATIGRAPHY HAS BEEN ASSUMED BETWEEN BOREHOLES, AND THIS MAY ACTUALLY DIFFER FROM THAT SHOWN.

REGISTERED PROFESSIONAL ENGINEER — E. M. PETO — PROVINCE OF ONTARIO

e.m. peto & associates ltd.

SOIL SITE INVESTIGATION
AT
CROSSING HWY 401 - HWY 16
EDWARDSBURG Township BRIDGE № 4
FOR
DEPARTMENT OF HIGHWAYS OF ONTARIO

OUR JOB No. 5919	DATE: MAR. 13-59
CLIENTS PLAN No.: E 3556-1	PER: G.T.

THURBER

Appendix B.

Record of Borehole Sheets

THURBER

SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

N-VALUE:

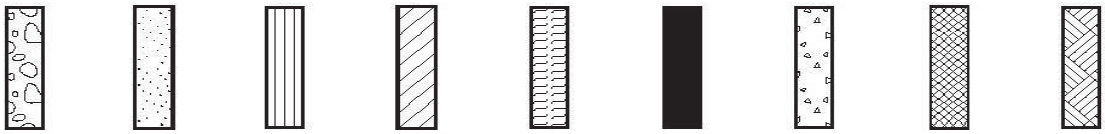
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in millimetres (e.g. 50/75).

DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an “A” size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.

THURBER

STRATA PLOT:
Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders
Cobbles
Gravel

Sand

Silt

Clay

Organics

Asphalt

Concrete

Fill

Bedrock

TEXTURING CLASSIFICATION OF SOILS

Classification	Particle Size
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	Undrained Shear Strength (kPa)
Very Soft	12 or less
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

SAMPLE TYPES

SS	Split spoon samples
ST	Shelby tube or thin wall tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	SPT "N" Value
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

THURBER

MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

THURBER

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock materials.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structures are preserved.

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1 m in length or larger, as a percentage of total core length
Unconfined Compressive Strength: (UCS)	Axial stress required to break the specimen.
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.

DISCONTINUITY SPACING

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

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)
Extremely Strong	Greater than 250
Very Strong	100 – 250
Strong	50 – 100
Medium Strong	25 – 50
Weak	5 – 25
Very Weak	1 – 5
Extremely Weak	0.25 – 1

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 130-22-01 1 OF 3 METRIC

GWP# 4024-20-00 LOCATION Lat: 44.754103°, Long: -75.478361° Highway 16 & 401, Edwardsburgh, MTM z9: N 4 957 630.0 E 385 688.8 ORIGINATED BY IK

HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO

DATUM Geodetic DATE 2022.11.29 - 2022.12.01 CHECKED BY KW

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.6	**Ground Surface**										
0.0	**ASPHALT (150 mm)**										
0.2 / 91.2	GRAVELLY SILTY SAND										
0.4	Brown										
	FILL (BASE)										
	SAND, trace fines Compact to loose Brown **FILL**		1	SS	20		91		○		
			2	SS	18		90		○		
			3	SS	17		89		○		0 91 9 (SI+CL)
			4	SS	15		88		○		
			5	SS	16				○		
			6	SS	4		87		○		
			7	SS	18		86		○		
85.5											
6.1	SILTY SAND, some gravel Compact to very dense Brown **FILL**		8	SS	32				○		
			9	SS	21		85		○		19 43 38 (SI+CL)
			10	SS	63	▽	84		○		
83.2											
8.4	Gravelly **SILTY SAND (SM)** Contains organics Compact		11	SS	17		83		○		
82.7	Grey										
8.9	**SILTY CLAY (CI)** Very stiff Brown to grey		12	SS	7		82		○		

Continued Next Page

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

20 / 15 5 / 10 (%) STRAIN AT FAILURE

DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 10-30-23

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 130-22-01 2 OF 3 METRIC

GWP# 4024-20-00 LOCATION Lat: 44.754103°, Long: -75.478361° Highway 16 & 401, Edwardsburgh, MTM z9: N 4 957 630.0 E 385 688.8 ORIGINATED BY IK

HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO

DATUM Geodetic DATE 2022.11.29 - 2022.12.01 CHECKED BY KW

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SILTY CLAY (CI) Very stiff Brown to grey							>102 kPa >102 kPa			
			13	SS	15		81				0 4 50 46
79.4								>102 kPa >102 kPa			
12.2	Gravelly **SILTY SAND (SC-SM)** Contains cobbles and boulders Contains plastic fines Compact to very dense Grey **GLACIAL TILL**		14	SS	9		79				
			15	SS	145/ 230mm		78				23 38 39 (SI+CL)
			1	NQ	-		77				
	- 140 mm cobble at a depth of 15.8 m		2	NQ	-		76				
			3	NQ	-		75				
			4	NQ	-		74				
	- 150 mm cobble at a depth of 19.5 m						73				
							72				

Continued Next Page

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

(%) STRAIN AT FAILURE

DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 10-30-23

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 130-22-01 3 OF 3 METRIC

GWP# 4024-20-00 LOCATION Lat: 44.754103°, Long: -75.478361° Highway 16 & 401, Edwardsburgh, MTM z9: N 4 957 630.0 E 385 688.8 ORIGINATED BY IK

HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO

DATUM Geodetic DATE 2022.11.29 - 2022.12.01 CHECKED BY KW

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Gravelly **SILTY SAND (SC-SM)** Contains cobbles and boulders Contains plastic fines Compact to very dense Grey **GLACIAL TILL** - 150 mm cobble at a depth of 20.3 m		5	NQ	-		71				
			6	NQ	-		70				19 34 47 (SI+CL)
			7	NQ	-		69				
	- 210 mm boulder at a depth of 23.0 m										
67.8							68			FI	
23.8	**DOLOSTONE BEDROCK** Interbedded with Sandstone Contains quartz inclusions Fresh Fine grained Grey Medium bedded Very strong		1	RUN	-					>10	RUN #1 TCR=86% SCR=60% RQD=60%
										5	
							67			1	
			2	RUN	-					4	RUN #2 TCR=100% SCR=70% RQD=70%
										0	
							66			4	
										6	
										2	
			3	RUN	-					1	RUN #3 TCR=100% SCR=70% RQD=90% UCS=196MPa
							65			2	
64.4										1	
27.2	**End of Borehole** Flushmount standpipe piezometer consists of a 19 mm diameter Schedule 40 PVC pipe with a 1.5-m slotted screen. **Water level readings:** DATE DEPTH (m) ELEV. (m) 2022.12.01 7.8 83.8 2022.12.18 7.6 84.0 2023.04.26 7.6 84.0										

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

20 / 15 5 / 10 (%) STRAIN AT FAILURE

DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 10-30-23

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 130-22-02 1 OF 2 METRIC

GWP# 4024-20-00 LOCATION Lat: 44.754557°, Long: -75.478812° Highway 16 & 401, Edwardsburgh, MTM z9: N 4 957 680.0 E 385 652.4 ORIGINATED BY IK

HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO

DATUM Geodetic DATE 2022.11.28 - 2022.11.29 CHECKED BY KW

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.4	**Ground Surface**						91				
0.0	**ASPHALT (150 mm)**										
0.2											
91.0	GRAVELLY SILTY SAND										
0.4	Brown										
	FILL (BASE)										
	SAND, trace fines										
	Compact to loose		1	SS	29				○		
	Brown						90				
	FILL		2	SS	13				○		
							89				
			3	SS	15				○		
			4	SS	15		88		○		0 91 9 (SI+CL)
			5	SS	5				○		
							87				
86.5			6	SS	6				○		
4.9	SILTY SAND, some gravel										
	Loose to dense										
	Brown										
	FILL		7	SS	32		86		○		20 50 30 (SI+CL)
			8	SS	42		85		○		
84.2			9	SS	23				○		
7.2	Gravelly **SILTY SAND (SM)**								○		34 41 25 (SI+CL)
83.9	Contains organics						84				
7.5	Dense										
	Grey										
	SILTY CLAY (CI)		10	SS	5						0 4 54 42
	Very stiff										
	Grey										
82.7			11	SS	38		83		○		
8.7	Gravelly **SILTY SAND (SC-SM)** to										
	Silty **SANDY GRAVEL (GC-GM)**										
	Contains cobbles and boulders										
	Contains plastic fines		12	SS	100/ 150mm						
	Dense to very dense										
	Grey						82		○		
	GLACIAL TILL										

Continued Next Page

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

15 20 10 5 (%) STRAIN AT FAILURE

DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 10-30-23

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 130-22-02 2 OF 2 METRIC

GWP# 4024-20-00 LOCATION Lat: 44.754557°, Long: -75.478812° Highway 16 & 401, Edwardsburgh, MTM z9: N 4 957 680.0 E 385 652.4 ORIGINATED BY IK

HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO

DATUM Geodetic DATE 2022.11.28 - 2022.11.29 CHECKED BY KW

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Gravelly **SILTY SAND (SC-SM)** to Silty **SANDY GRAVEL (GC-GM)** Contains cobbles and boulders Contains plastic fines Dense to very dense Grey **GLACIAL TILL**		13	SS	52		81	○	○		
			14	SS	42		80	○	○		16 52 26 6 Non-plastic
			15	SS	100/100mm		79	○	○		
			1	NQ	-		78				
	- 170 mm cobble at a depth of 13.6 m		16	SS	100/150mm		77	○	○		
76.6			2	NQ	-						41 26 33 (SI+CL)
14.8	**DOLOSTONE BEDROCK** Interbedded with Sandstone Contains quartz inclusions Slightly weathered to fresh Fine grained Grey Medium bedded Very strong		1	RUN	-		76			FI 1 2 4	RUN #1 TCR=100% SCR=65% RQD=70%
			2	RUN	-		75			>10 6 2 2	RUN #2 TCR=100% SCR=61% RQD=61%
			3	RUN	-		74			4 7 2 4	RUN #3 TCR=86% SCR=60% RQD=42%
73.1										1	
18.3	**End of Borehole** A representative open-hole groundwater level measurement was not obtained due to the introduction of water during drilling.										

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

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 10-30-23

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 130-22-03 1 OF 2 METRIC

GWP# 4024-20-00 LOCATION Lat: 44.754129°, Long: -75.478803° Highway 16 & 401, Edwardsburgh, MTM z9: N 4 957 632.6 E 385 653.7 ORIGINATED BY IK

HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO

DATUM Geodetic DATE 2022.12.09 - 2022.12.12 CHECKED BY KW

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
84.3	**Ground Surface**						84				
0.0	**ASPHALT (125 mm)**										
84.0 0.3	GRAVELLY SILTY SAND Brown **FILL (BASE)**										
83.4 0.9	SILTY SAND, some gravel Compact Brown **FILL**		1	SS	10		83				0 9 50 41
82.8 1.5	**SILTY CLAY (CI)** Very stiff Brown		2	SS	21		82				
	Silty **SANDY GRAVEL (GC-GM)** to Gravelly **SILTY SAND (SC-SM)** Contains cobbles and boulders Contains plastic fines Very dense to compact Brown to grey **GLACIAL TILL**		3	SS	67		81				50 23 27 (SI+CL)
			4	SS	46		80				
			5	SS	46		79				23 42 35 (SI+CL)
			6	SS	55		78				
			7	SS	23		77				
			8	SS	100/ 100mm		76				
			9	SS	100/ 75mm		75				
			10	SS	100/ 150mm						
			11	SS	100/ 100mm						

Continued Next Page

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

15 20 10 5 (%) STRAIN AT FAILURE

DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 10-30-23

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 130-22-03 2 OF 2 METRIC

GWP# 4024-20-00 LOCATION Lat: 44.754129°, Long: -75.478803° Highway 16 & 401, Edwardsburgh, MTM z9: N 4 957 632.6 E 385 653.7 ORIGINATED BY IK

HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO

DATUM Geodetic DATE 2022.12.09 - 2022.12.12 CHECKED BY KW

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SANDY GRAVEL (GC-GM)** to Gravelly **SILTY SAND (SC-SM)** Contains cobbles and boulders Contains plastic fines Very dense to compact Brown to grey **GLACIAL TILL** - 150 mm cobble at a depth of 11.3 m		12	SS	100/100mm		74		o		
72.8			1	NQ	-		73			FI	RUN #1 TCR=100% SCR=33% RQD=66%
11.5	**DOLOSTONE BEDROCK** Interbedded with Sandstone Contains quartz inclusions Slightly weathered to fresh Fine grained Grey Medium bedded Very strong		1	RUN	-					3	
			2	RUN	-					2	RUN #2 TCR=100% SCR=75% RQD=65%
			3	RUN	-		72			>10 0 0	
							71			2 4 3	RUN #3 TCR=96% SCR=75% RQD=82%
			4	RUN	-		70			1 0	RUN #4 TCR=100% SCR=100% RQD=100%
69.6										0	
14.7	**End of Borehole** A representative open-hole groundwater level measurement was not obtained due to the introduction of water during drilling.										

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

20 / 15 5 / 10 (%) STRAIN AT FAILURE

DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 10-30-23

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name: Bridge # 4 Hwy 401 - Hwy. 16 Re-alignment, Johnstown. Job No. 5919 Borehole No. 1

Client: Dep't. of Highways of Ontario. Casing: BX (2½" Dia.) Boring Date: March 3rd. & 4th. 1959.

Datum: Geodetic Compiled By: K.P. Checked By: E.M.P.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
		0'0"						
ORGANIC TOPSOIL, ROOTS	BLACK	275.51	0'8"		1	FROM CASING		SATURATED
FINE SAND	BROWN		275.84 2'0"					WATER SEEPAGE AT 0'8"
MOTTLED FRIABLE	BROWN &	FIRM 2'6"	273.51		2	S.S.	7	▽W.T. MARCH 4, 1959.
CLAY	GREY	273.01						WETTER THAN PLASTIC LIMIT
AS ABOVE	AS ABOVE	STIFF			3	S.S.	10	M.C.= 31.1% WETTER THAN PLASTIC LIMIT.
			9'6" 266.01					
FRIABLE CLAY WITH	DK. GREY	VERY STIFF			4	S.S.	18	M.C.= 20.0% W.T.P.L.
GRITS & PEBBLES			12'0" 263.51					AT 12' REFUSAL ON BOULDER
						W.S.		
SANDY TILL WITH	GREY							
BOULDERS								
AS ABOVE	AS ABOVE					W.S.		"AX" ROD: 50 BLOWS FOR ½ IN.
			19'½" 256.47					NOTE: USING WASH WATER
			HOLE TERMINATED					FROM 6'

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name Bridge # 4 Hwy. # 401 – Hwy. # 16 Re-alignment, Johnstown Job No. 5919 Borehole No. 2.

Client Dep't. of Highways of Ontario. Casing BX (2½" Dia.) Boring Date March 2nd. & 3rd. 1959.

Datum Geodetic. Compiled By K.P. Checked By E.M.P.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0' 0"					
SILTY SAND LOAM TOP SOIL VERY SILTY FINE SAND PEBBLES, STONE FRAGMENTS	DK. BROWN BROWN	0'6" 273'95 1'3" 273'20	274.45		0'8" 273'78			W.T. MARCH 3, 1959. SATURATED
SILTY SAND, PEBBLES STONE FRAGMENTS	BROWN	LOOSE	3' 0" 271.45		1	S.S.	6	M.C.=10.6% SATURATED
			5' 0"					
SILTY FINE SAND WITH STONE FRAGMENTS GRITS, PEBBLES	BROWN	VERY DENSE			2	S.S.	93	M.C.=8.7% SATURATED
			9' 0" 265.45					L.L.=14.5%, P.L.=12.5%
SANDY TILL BOULDERS!	DK. GREY	VERY DENSE			3	S.S.	112/6"	M.C.=8.8% SATURATED REFUSAL ON BOULDER AT 10' 6"
						W.S.		
AS ABOVE, STONE FRAGMENTS	AS ABOVE		15' 3" 259.20			S.S.	108	M.C.=7.0% NOTE: USING WASH WATER FROM 8'.
					HOLE TERMINATED			

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Bridge # 4 Hwy. # 401 – Hwy.# 16

Job Name Re-alignment, Johnstown. Job No. 5919 Borehole No. 3

Client Dept. of Highways of Ontario Casing 4" Pipe Boring Date Feb.28th.& March 2nd. 195

Datum Geodetic. Compiled By K.P. Checked By E.M.P.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0' 0"					
SILTY SAND LOAM TOPSOIL ROOTS, ORG. MATTER, PEBBLES	BLACK	1'0"	273'10 / 0'8"		1	FROM CASING	▽ W.T.	SATURATED MARCH 2, 1959
FINE SAND, FEW ROOTS	BROWN	272'10	272'43 / 2'0"		2	FROM CASING		SATURATED
MOTTLED FRIABLE CLAY WITH THIN SEAMS OF FINE SAND,	BROWN & GREY	FIRM TO STIFF	271'10 / 5'0"		3	S.S.	8	M.C.= 35.1% WETTER THAN PLASTIC LIMIT
GRITS, PEBBLES & STONE FRAGMENTS					4	S.L.	TAPPED	M.C.= 41.0% L.L.= 56.8% P.L.= 27.8%
AS ABOVE, MORE SAND GRITS, PEBBLES & STONE FRAGMENTS	AS ABOVE	DENSE	10'0"		5	S.S.	32	γ_w = 114.2 lb/cu ft C = 1122 lbs.F. SATURATED
			263'10		6	W.S.		
SANDY TILL, PEBBLES, STONE FRAGMENTS	DK. GREY	DENSE	15'0"		7	S.S.	32	M.C.= 6.9%
					8	W.S.		
AS ABOVE	AS ABOVE	VERY DENSE	20'0"		9	S.S.	120/6"	M.C.= 6.0% NOTE: "AX" ROD ; 100 BLOWS FOR 1/2 IN.
			22'9"					NOTE: USING WASH WATER FROM 7'6"
			250'35					REFUSAL ON BOULDER

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name Bridge # 4 Hwy.# 401 – Hwy. 16 Re-alignment Johnstown.. Job No. 5919 Borehole No. 4

Client Dept. of Highways of Ontario Casing BX (2½" Dia.) Boring Date Feb. 27th. & 28th. 1959.

Datum Geodetic Compiled By K.P. Checked By E.M.P.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0'0"					
TOPSOIL SILTY SAND	BLACK BROWN	1'0"	0'7½" 274.63 / 273.98		0'6" 274.13	W.T.		FEBRUARY 27, 1959. ROOTS, ORG. MATTER -- SAT.
		275.63						WATER SEEPAGE AT 0'6"
MOTTLED FRIABLE CLAY WITH THIN SEAMS OF VERY FINE SAND	GREY & BROWN	FIRM TO STIFF			1		8	M.C. = 37.2% WETTER THAN PLASTIC LIMIT
SAME AS ABOVE	AS ABOVE				2	S.L.	TAPPED	M.C. = 30.4% W.T. P.L. γ_w = 122.9 lb/cuft e = .922 C = 1311 lb S.F.
			9'8"					
SANDY TILL, PEBBLES, STONE FRAGMENTS	DK. GREY	COMPACT	264.96		3	S.S.	18	L.L. = 14.1%, P.L. = 12.1% SATURATED
AS ABOVE	AS ABOVE					W.S.		
BOULDERS !								
AS ABOVE	AS ABOVE					W.S.		
			21'9" 252.88					NOTE: USING WASH WATER FROM 11'9"
					HOLE TERMINATED			

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Bridge # 4 Hwy. # 401 – Hwy.# 16

Job Name Re-alignment Johnstown. Job No. 5919 Borehole No. 5.

Client Dep't. of Highways of Ontario. Casing BX (2½" Dia.) Boring Date March 5th. & 6th. 1959.

Datum Geodetic. Compiled By K.P. Checked By E.M.P.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0'0"					
SILTY SAND ORGANIC TOPSOIL	BLACK		1'0" 274·58			W.T.		MARCH 6, 1959. SATURATED
SILTY SAND	BROWN		273·58 11'7"					
FRIABLE CLAY	BROWN & GREY	FIRM TO STIFF	272·96		1	S.S.	8	M.C. = 39·3% WETTER THAN PLASTIC LIMIT
AS ABOVE	AS ABOVE	STIFF			2	S.S.	9	M.C. = 38·5% W.T. P.L.
AS ABOVE	AS ABOVE				3	S.L.	TAPPED	
			9'5" 265·16					
FRIABLE CLAY	DK. GREY	VERY STIFF	11'3"		4	S.S.	18	M.C. = 18·1% ABOUT P.L.
			263·33					
SANDY TILL	DK. GREY				5	W.S.		
			15'0"					
AS ABOVE	AS ABOVE	VERY DENSE			6	S.S.	130	M.C. = 7·6%
			17'4" 257·25		7	S.S.	100/4"	NOTE: USING WASH WATER
	"AX" ROD	CANNOT BE DRIVEN.	HOLE TERMINATED					FROM 11'.

THURBER

Appendix C.

Laboratory Testing

THURBER

Appendix C.1

Particle Size Analysis Figures

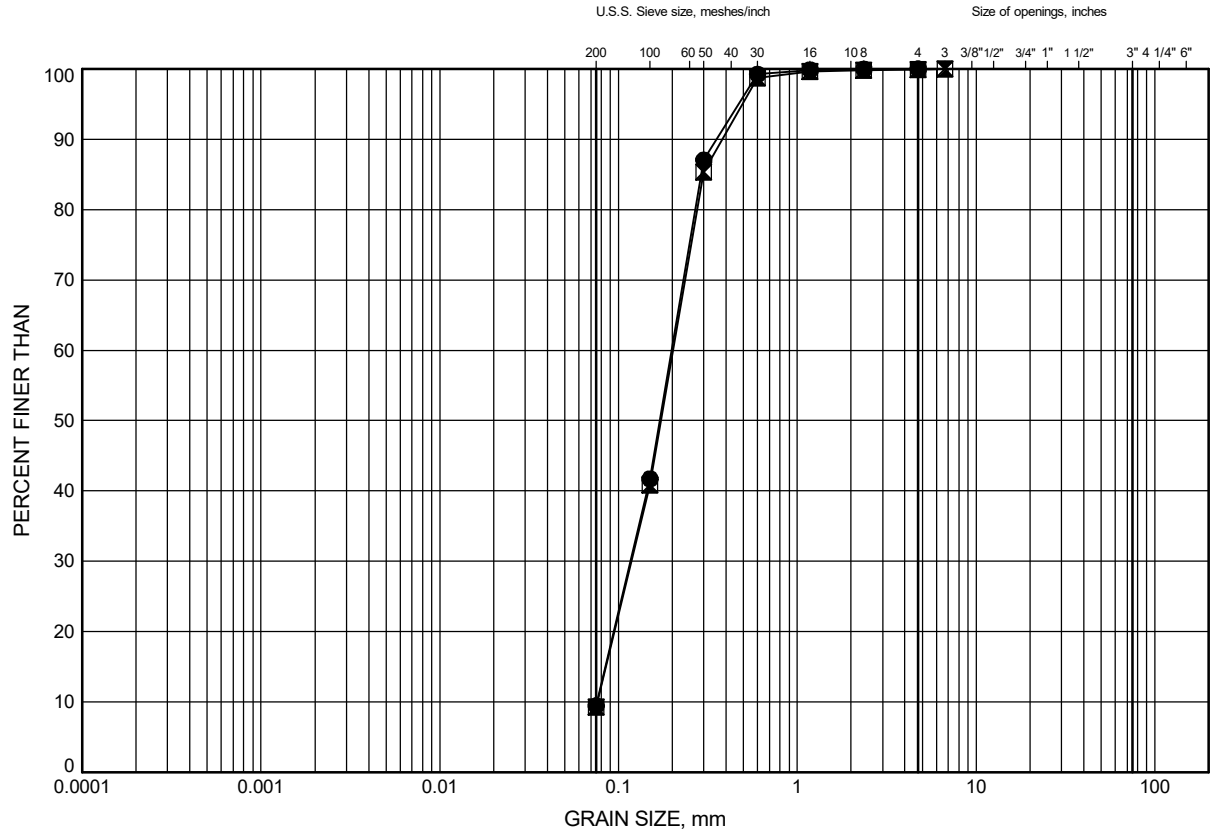
Atterberg Limit Test Results

Highway 401 Underpass at Highway 16 (Site No. 16X-0130)

GRAIN SIZE DISTRIBUTION

FIGURE C1

FILL: Sand



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	130-22-01	2.6	89.0
⊠	130-22-02	3.4	88.0

Date March 2023

GWP# 4024-20-00

THURBER

Prep'd RH

Chkd. AO

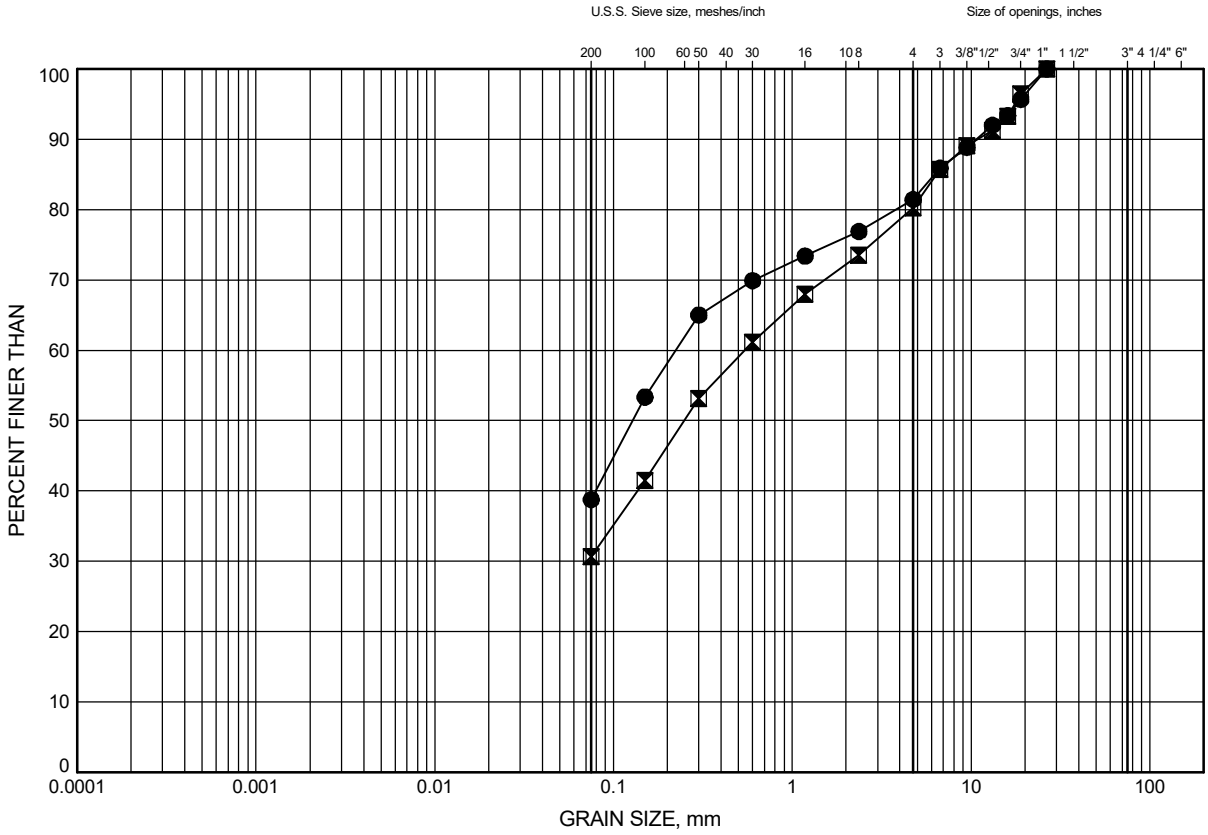
GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 3-9-23

Highway 401 Underpass at Highway 16 (Site No. 16X-0130)

GRAIN SIZE DISTRIBUTION

FIGURE C2

FILL: Silty Sand



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	130-22-01	7.2	84.4
⊠	130-22-02	5.6	85.8

Date March 2023

GWP# 4024-20-00

THURBER

Prep'd RH

Chkd. AO

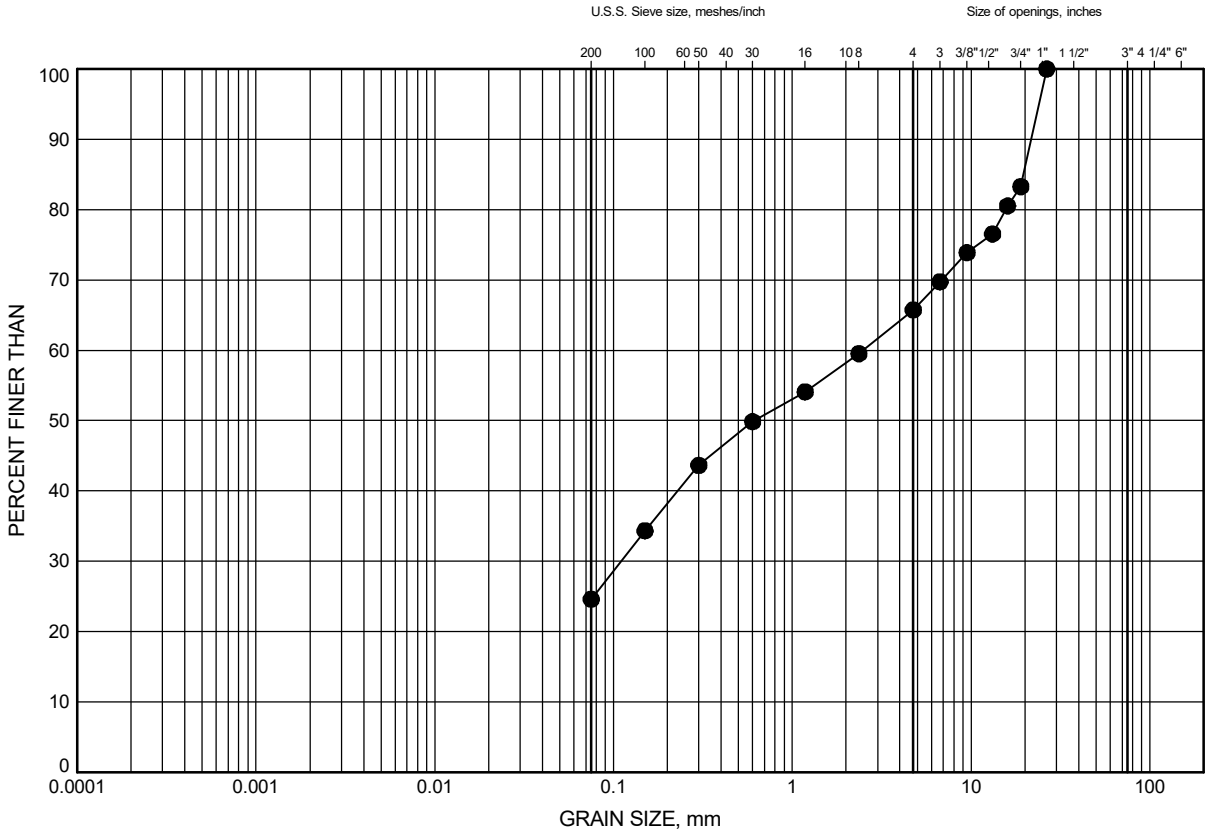
GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 3-9-23

Highway 401 Underpass at Highway 16 (Site No. 16X-0130)

GRAIN SIZE DISTRIBUTION

FIGURE C3

Gravelly Silty Sand (SM)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	130-22-02	7.3	84.1

Date March 2023

GWP# 4024-20-00

THURBER

Prep'd RH

Chkd. AO

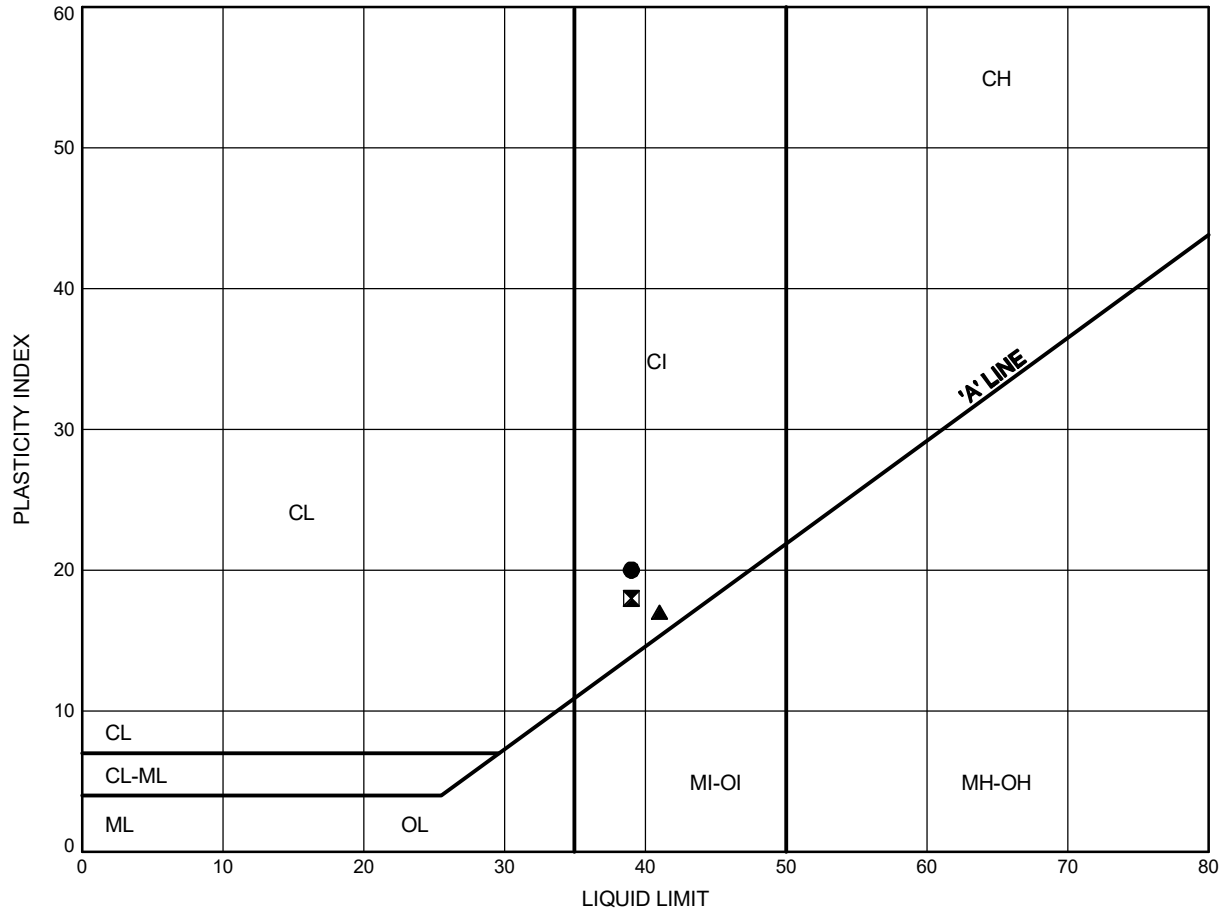
GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 3-9-23

Highway 401 Underpass at Highway 16 (Site No. 16X-0130)

ATTERBERG LIMITS TEST RESULTS

FIGURE C4

Silty Clay (CI)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	130-22-01	11.0	80.6
⊠	130-22-02	7.9	83.5
▲	130-22-03	1.1	83.2

Date March 2023

GWP# 4024-20-00

THURBER

Prep'd RH

Chkd. AO

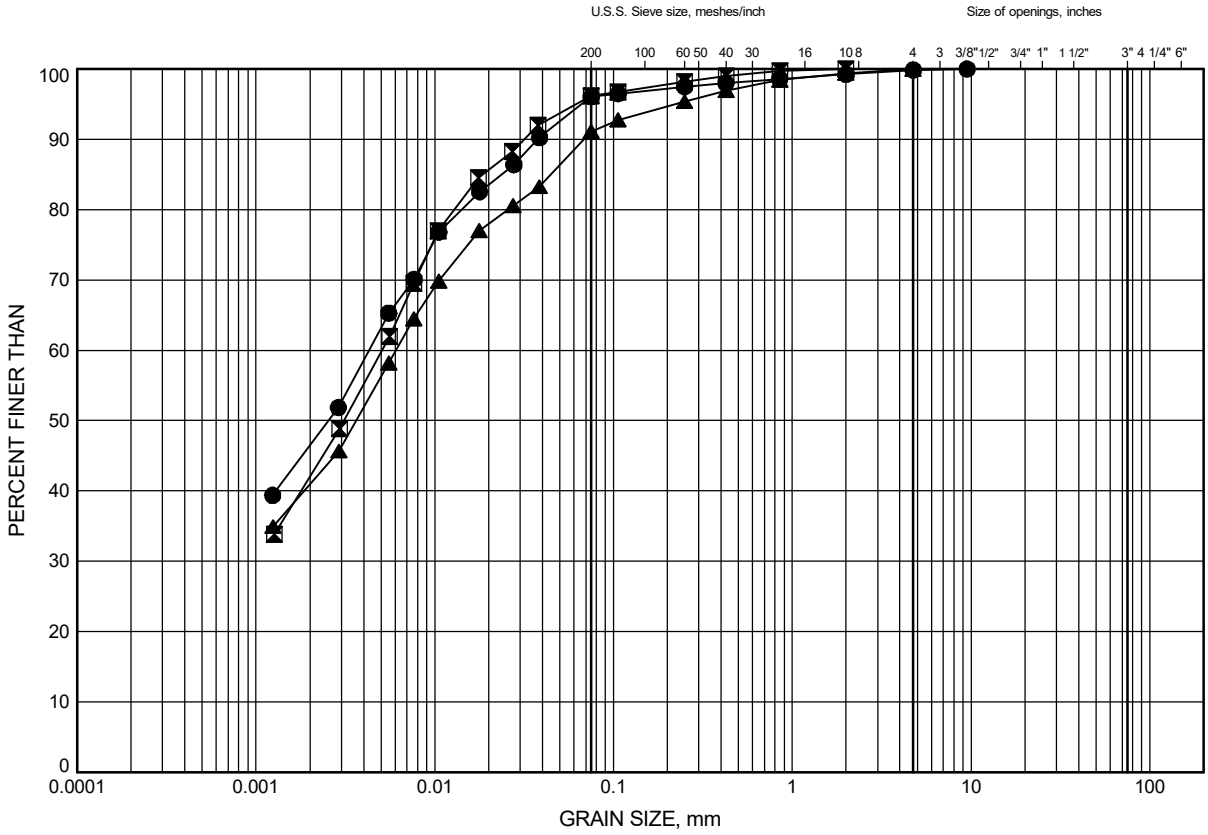
THURBALT 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 3-9-23

Highway 401 Underpass at Highway 16 (Site No. 16X-0130)

GRAIN SIZE DISTRIBUTION

FIGURE C5

Silty Clay (CI)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	130-22-01	11.0	80.6
⊠	130-22-02	7.9	83.5
▲	130-22-03	1.1	83.2

Date March 2023

GWP# 4024-20-00

THURBER

Prep'd RH

Chkd. AO

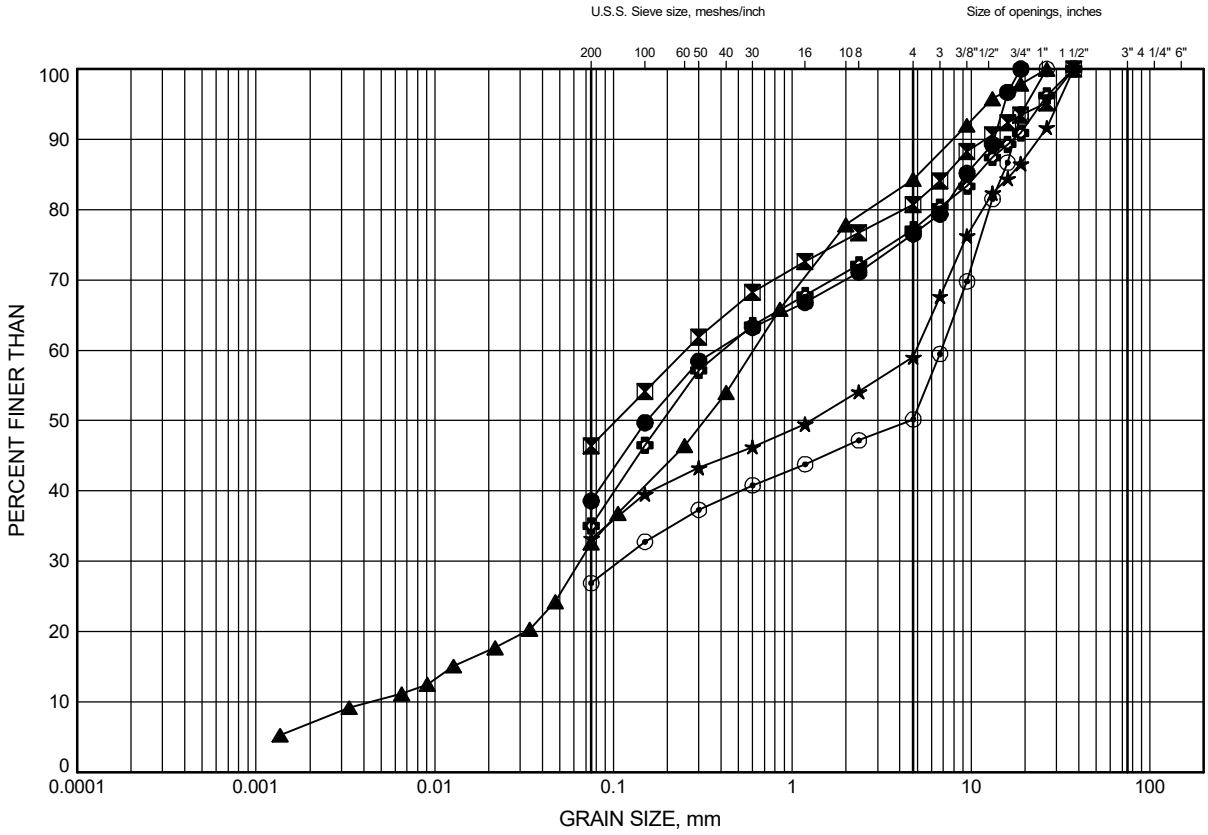
GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 3-9-23

Highway 401 Underpass at Highway 16 (Site No. 16X-0130)

GRAIN SIZE DISTRIBUTION

FIGURE C6

GLACIAL TILL: Gravelly Silty Sand (SC-SM) to Silty Sandy Gravel (GC-GM)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	130-22-01	14.0	77.6
⊠	130-22-01	21.6	70.0
▲	130-22-02	11.0	80.4
★	130-22-02	14.3	77.1
⊙	130-22-03	3.4	80.9
✿	130-22-03	4.9	79.4

Date March 2023

GWP# 4024-20-00

THURBER

Prep'd RH

Chkd. AO

GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 3-9-23

THURBER

Appendix C.2

UCS Test Results

Stantec Consulting Ltd.
2781 Lancaster Rd, Suite 100 A&B, Ottawa ON K1B 1A7

May 2, 2023
File: 122410864

Client: Thurber Engineering, File #29381

Reference: ASTM D7012, Method C, Unconfined Compressive Strength of Intact Rock Core

The following table summarizes unconfined compressive strength results for five intact rock cores.

Location	Sample Depth	Compressive Strength (MPa)	Description of Break
BH129-22-1 Run-1	88'7''-89'3''	212.5	Well-formed cones at both ends
BH129-22-2 Run-1	85'9''-86'3''	224.3	Well-formed cones at both ends.
BH130-22-1 Run-3	86'6''-87'4''	196.3	Vertical cracking throughout, no cones formed
BH131-22-2 Run-2	77'1''-77'10''	237.2	Vertical cracking throughout, no cones formed
BH166-22-2 Run-3	33'8''-34'2''	192.6	Well-formed cones at both ends

Sincerely,

Stantec Consulting Ltd.

Brian Prevost
Laboratory Supervisor
Tel: 613-738-6075
Fax: 613-722-2799
brian.prevost@stantec.com

THURBER

Appendix C.3

Bedrock Core Photographs

Borehole 130-22-01

RUNS 1 and 2
Depth 23.8 m to 25.7 m
Elevation 67.8 m to 65.9 m
Dry Sample

Run 1 Start
elev. 67.8 m

Run 1 End
elev. 67.5 m

Run 2 Start
elev. 67.5 m

Run 2 End
elev. 65.9 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-01
Project No.: 29381

Borehole 130-22-01

RUNS 1 and 2
Depth 23.8 m to 25.7 m
Elevation 67.8 m to 65.9 m
Wet Sample

Run 1 Start
elev. 67.8 m

Run 1 End
elev. 67.5 m

Run 2 Start
elev. 67.5 m

Run 2 End
elev. 65.9 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-01
Project No.: 29381

Borehole 130-22-01

RUN 3

Depth 25.7 m to 27.2 m

Elevation 65.9 m to 64.4 m

Dry Sample

Run 3 Start
elev. 65.9 m

Run 3 End
elev. 64.4 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-01
Project No.: 29381

Borehole 130-22-01

RUN 3

Depth 25.7 m to 27.2 m

Elevation 65.9 m to 64.4 m

Wet Sample

Run 3 Start
elev. 65.9 m

Run 3 End
elev. 64.4 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-01
Project No.: 29381

Borehole 130-22-02

RUNS 1 and 2
Depth 14.8 m to 16.8 m
Elevation 76.6 m to 74.6 m
Dry Sample

Run 1 Start
elev. 76.6 m

Run 1 End
elev. 76.1 m

Run 2 Start
elev. 76.1 m

Run 2 End
elev. 74.6 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-02
Project No.: 29381

Borehole 130-22-02

RUNS 1 and 2
Depth 14.8 m to 16.8 m
Elevation 76.6 m to 74.6 m
Wet Sample

Run 1 Start
elev. 76.6 m

Run 1 End
elev. 76.1 m

Run 2 Start
elev. 76.1 m

Run 2 End
elev. 74.6 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-02
Project No.: 29381

Borehole 130-22-02

RUN 3

Depth 16.8 m to 18.3 m

Elevation 74.6 m to 73.1 m

Dry Sample

Run 3 Start
elev. 74.6 m

Run 3 End
elev. 73.1 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-02
Project No.: 29381

Borehole 130-22-02

RUN 3

Depth 16.8 m to 18.3 m

Elevation 74.6 m to 73.1 m

Wet Sample

Run 3 Start
elev. 74.6 m

Run 3 End
elev. 73.1 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-02
Project No.: 29381

Borehole 130-22-03

RUNS 1 and 2
Depth 11.5 m to 12.3 m
Elevation 72.8 m to 72.0 m
Dry Sample

NQ1 – Cobbles and Boulders
elev. 73.0 m to 72.8 m

Run 1 Start
elev. 72.8 m

Run 1 End
elev. 72.5 m

Run 2 Start
elev. 72.5 m

Run 2 End
elev. 72.0 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-03
Project No.: 29381

Borehole 130-22-03

RUNS 1 and 2

Depth 11.5 m to 12.3 m

Elevation 72.8 m to 72.0 m

Wet Sample

NQ1 – Cobbles and Boulders
elev. 73.0 m to 72.8 m

Run 1 Start
elev. 72.8 m

Run 1 End
elev. 72.5 m

Run 2 Start
elev. 72.5 m

Run 2 End
elev. 72.0 m

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BH 130-22-03
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Borehole 130-22-03

RUN 3

Depth 12.3 m to 13.7 m

Elevation 72.0 m to 70.6 m

Dry Sample

Run 3 Start
elev. 72.0 m

Run 3 End
elev. 70.6 m

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Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-03
Project No.: 29381

Borehole 130-22-03

RUN 3

Depth 12.3 m to 13.7 m

Elevation 72.0 m to 70.6 m

Wet Sample

Run 3 Start
elev. 72.0 m

Run 3 End
elev. 70.6 m

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RUN 4

Depth 13.7 m to 14.7 m

Elevation 70.6 m to 69.6 m

Dry Sample

Run 4 Start
elev. 70.6 m

Run 4 End
elev. 69.6 m

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Geotechnical Investigation
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Edwardsburgh Township

BH 130-22-03
Project No.: 29381

Borehole 130-22-03

RUN 4

Depth 13.7 m to 14.7 m

Elevation 70.6 m to 69.6 m

Wet Sample

Run 4 Start
elev. 70.6 m

Run 4 End
elev. 69.6 m

THURBER ENGINEERING LTD.

Geotechnical Investigation
Highway 401 Underpass at Highway 16
Edwardsburgh Township

BH 130-22-03
Project No.: 29381

THURBER

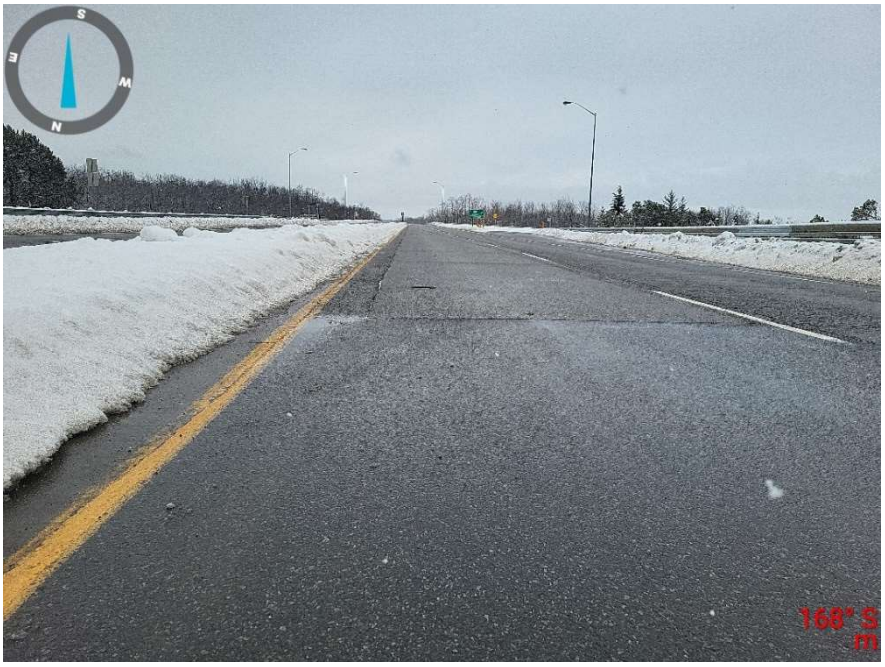
Appendix D.

Site Photographs

Photograph 1: Looking northwest at the southbound embankment
[taken on December 12, 2022]

Photograph 2: Looking southwest at the southbound embankment
[taken on December 12, 2022]

Photograph 4: Looking north at the southbound embankment
[taken on December 19, 2022]



Photograph 5: Looking south of from Highway 16 Underpass
[taken on December 19, 2022]

Photograph 6: Looking north of from Highway 16 Underpass
[taken on December 19, 2022]

Photograph 7: Looking east at the Highway 16 Underpass from the Highway 401
[taken on December 09, 2022]