



**THURBER** ENGINEERING LTD.

**PRELIMINARY FOUNDATION INVESTIGATION REPORT  
HIGHWAY 401 WIDENING, HIGHWAY 16 TO MAITLAND ROAD  
HIGHWAY 16 OVERHEAD AT CNR RAILWAY, SITE NO. 16X-0131  
GWP 4024-20-00 / ASSIGNMENT NO.: 4019-E-0010.2**

**SITE NO. 16X-0131/B0**

**Geocres No.: 31B12-003**

Report to:

**MTO c/o AECOM Canada Ltd.**

Latitude: 44.752392°  
Longitude: -75.476957°

March 2024  
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-131/B0) that crosses over the Canada National Railway (CNR) Line 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. 31B00-034 and 31B00-047).

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 overhead structure crosses over the CNR railway approximately 1.2 km northwest of County Rd 2 in the community of Johnstown and approximately 285 m south of the Highway 401 Underpass at Highway 16. For project orientation purposes, Highway 16 will be described as oriented north-south and the CNR railway as oriented east-west.



The Highway 16 structure carries two through lanes in each direction over the CNR railway. Traffic volume on this section of Highway 16 is understood to have been 2,400 AADT in 2016. Concrete parapet walls are present along the east and west edges of the structure deck, and an approximately 3-m wide non-traversable paved median is present between the north and south bound lanes. Galvanized W-beam guiderails supported on metal posts are present at all four quadrants and extend to as much as approximately 300 m back from the abutments. Narrow shoulders are present between the travelled lanes and the concrete parapet walls. No sidewalks are present along the structure. Concrete wingwalls are present at the four quadrants. The embankments are approximately 10 m in height with side slopes inclined as steep as approximately 2H:1V and are vegetated with deciduous trees, shrubs, and grasses. No signs of global instability of the embankments were noted during the field investigation.

The CNR railway at the location of the site includes two lines of tracks and has a total right-of-way width of about 11.1 m between the main span piers. The Highway 401 W-N/S off-ramp and the N-E and S-E on-ramps are located immediately north of the site. Traffic volume on Highway 401 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 bridge is undeveloped land with a mix of cleared private properties and swampy and densely vegetated areas with deciduous trees and shrubs. Overhead utility lines are present parallel the south side of the railway alignment, beneath the bridge structure. Light poles are present near the entry/exit of the Highway 401 ramps. The terrain is relatively flat, aside from the existing embankments, ramps, and associated ditches, which are relatively rugged. Storm water drainage in the area is to roadside ditches.

Photographs showing general conditions in the project area at the time of the field investigation in December 2022 are presented in Appendix D.

## **2.2 Existing Structure Information**

As per the original General Plan Drawing (No. TWP#27-131-1-A) dated 1959, the existing structure was built in 1963 and is a five-span cast-in-place reinforced concrete slab bridge. The drawing indicates that the bridge deck is approximately 54.0 m long and 20.7 m wide, with an approximate 14-degree skew to the CNR tracks. The structure contains a total of four piers which comprise five columns each. There are cast-in-place concrete retaining wing walls located at all four quadrants of the bridge to retain the embankment slopes. It is understood that the structure was rehabilitated in 1989, 1997, 2014 and 2016 under Contract No. 89-37 (WP No. 58-81-01), Contract No. 40-97-35 (WP No. 81-91-01), Contract No. 2014-4010 and Contract No. 2016-4036 (WP No. 4094-13-01), respectively. The rehabilitation included modification to the existing expansion joints, installation of drainage improvements, replacement of the abutment bearings, waterproofing and deck paving works, conversion to semi-integral abutments, installation of a 60 mm concrete overlay, replacement of the existing steel handrails with new concrete barrier walls with railing, replacement of the approach slabs and installation of a thermally sprayed anode system on the soffit.



Drawing No. TWP#27-131-2-A indicates that the abutments and piers are supported on BP 12x53 H-Piles driven to bedrock and installed on batter and vertically. The design load per pile is indicated to be 45 tons.

### 2.3 Existing Subsurface Information

The following historical foundation investigation report was available for this site within MTO's online Geocres library:

- Geocres Report No. 31B00-034 (e. m. peto associates ltd., March 1959) presents the results of a foundation investigation carried out for the design and construction of the existing bridge structure. The field investigation included six boreholes drilled near the four quadrants of the proposed bridge structure or along the Highway 16 centreline. In general, the boreholes indicated the presence of topsoil over silty clay underlain by clayey silt which is, in turn, underlain by bedrock. Bedrock was proven by coring in two boreholes in the investigation. The boreholes were advanced to depths ranging from 10.4 m to 13.1 m below the existing ground surface (base elev. 71.3 m to 69.2 m).
- Geocres Report No. 31B00-047 (e. m. peto associates ltd., August 1959) presents the results of a supplementary foundation investigation carried out for the design and construction of the existing bridge structure. The field investigation included three boreholes drilled near the existing centreline of Highway 16 to better assess the strength-depth characteristics of the sub-soil. In general, the boreholes indicated the presence of topsoil over silty clay underlain by clayey silt. No bedrock was cored during the investigation. The boreholes were advanced to depths ranging from 10.4 m to 11.0 m below the existing ground surface.

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

### 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 rock strata in both areas are generally composed of limestone, dolostone, and calcareous sandstone.

According to Crins et al. (2009)<sup>i</sup>, the project area is described as Ecoregion 6E (Lake Simcoe-Rideau) within the Ontario Shield Ecozone. According to Wester et al. (2018)<sup>ii</sup>, 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<sup>iii</sup> 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 December 1 and 5, 2022, and consisted of two on-road boreholes identified as 131-22-01 and 131-22-02 put down near the Highway 16 Overhead abutments. 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 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.

**Table 3-1: Borehole Summary**

<b>Borehole No.</b>	<b>Drilled Location</b>	<b>Northing (Latitude)</b>	<b>Easting (Longitude)</b>	<b>Ground Surface Elevation (m)</b>	<b>Termination Depth (m)</b>
131-22-01	Near the South Abutment	4 957 388.9 (44.751917)	385 837.4 (-75.476522)	91.8	23.4
131-22-02	Near the North Abutment	4 957 445.7 (44.752432)	385 801.1 (-75.476972)	92.4	26.4

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 23.4 to 26.4 m (base elev. 68.4 m to 66.0 m). Coring was required to advance the boreholes through portions of the fill and into bedrock. A standpipe piezometer was installed in Borehole 131-22-02 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, Borehole 131-22-01 was decommissioned in general accordance with O.Reg. 903, as amended. The standpipe piezometer at Borehole 131-22-02 was decommissioned in accordance with MOE requirements on April 26, 2023. The pavement surface at both borehole locations was reinstated with cold patch asphalt.

#### **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 were 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 131-22-02.

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 general accordance with ASTM D 2487 with descriptions of cohesive soils and secondary components as outlined in the MTO Guideline for Foundation Engineering Services Manual (April 2022).

In general, the encountered stratigraphy consisted of fill over a native deposit of clay to clayey silt underlain by dolostone bedrock.

##### **5.1 Pavement Structure**

Both boreholes were advanced from the road surface and encountered a 100 mm to 255 mm layer of asphalt. A 200 mm thick layer of concrete was encountered beneath the asphalt in Borehole 131-22-02.





A fill layer composed of gravelly sand with some fines was encountered below the asphalt/concrete in both boreholes. The layer was 0.2 m to 1.2 m thick (base elev. 90.9 m to 91.3 m).

A single Standard Penetration Test (SPT) N-value of 30 blows per 0.3 m of penetration was recorded in the layer, indicating a dense relative density. The recorded moisture content on one sample of the fill was 3%.

The results of a gradation analysis completed on one sample 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 sheet in Appendix B.

Soil Particle	Percentage (%)
Gravel	24
Sand	57
Silt	19
Clay	

## 5.2 Embankment Fill

### 5.2.1 Silty Sand Embankment Fill

Silty sand embankment fill was encountered beneath the gravelly sand fill in both boreholes. Some gravel was noted within the layer. The silty sand embankment fill layer was 4.1 m to 6.1 m thick (base elev. 87.2 m to 84.8 m). SPT N-values ranged from 6 to 64 blows per 0.3 m of penetration, but were typically over 15, indicating a loose to very dense, typically compact to dense material.

The recorded moisture contents of samples of the silty sand embankment fill ranged from 5% to 12%. 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	11 to 12
Sand	46 to 53
Silt	36 to 42
Clay	

### 5.2.2 Gravelly Silty Sand Fill

Gravelly silty sand fill was encountered beneath the silty sand fill in Borehole 131-22-02. Cobbles and boulders were inferred within the layer. The fill layer was 3.1 m thick (base elev. 81.7 m). SPT



N-values ranged from 110 blows per 0.3 m of penetration to greater than 100 blows for 75 mm of penetration, indicating a very dense relative density.

The recorded moisture contents ranged from 3% to 5%. The results of a gradation analysis completed on one sample of the fill are illustrated on Figure C3 of Appendix C. The results of the tests are summarized below and on the Record of Borehole sheet in Appendix B.

Soil Particle	Percentage (%)
Gravel	26
Sand	49
Silt	25
Clay	

### 5.2.3 Clay Fill

Clay fill was encountered beneath the silty sand fill in Borehole 131-22-01. The fill layer was 4.5 m thick (base elev. 82.7 m). SPT N-values ranged from 7 to 14 blows for 0.3 m of penetration. In-situ undrained shear strength testing was attempted but the vane was unable to be turned as the material has an undrained shear strength greater than 102 kPa. The clay fill can be described as very stiff in consistency.

The recorded moisture contents ranged from 27 to 33%. The results of a gradation analysis completed on one sample of the fill are summarized in the table below and on the Record of Borehole sheet in Appendix B, and are illustrated on Figure C4 of Appendix C.

Soil Particle	Percentage (%)
Gravel	0
Sand	9
Silt	40
Clay	51

Results of Atterberg Limit testing carried out on the sample are illustrated in Figure C5 of Appendix C. The results of this test are summarized below and on the Record of Borehole sheet in Appendix B. The laboratory results indicate that the clay exhibits intermediate plastic behaviour (CI).

Parameter	Value
Liquid Limit	45
Plastic Limit	23
Plasticity Index	22



### 5.3 Silty Sand (SM)

A native deposit of silty sand with organics, inferred to be a historical topsoil layer, was encountered below the gravelly silty sand fill in Borehole 131-22-02. The deposit was approximately 100 mm thick (base elev. 81.6 m).

The recorded moisture content of one sample of the deposit was 25%. The results of Atterberg Limit testing conducted on the fines portion sample from Borehole 131-22-02 indicate a non-plastic material. The results of a gradation analysis completed on the sample of the deposit are illustrated on Figure C6 of Appendix C. The results of the tests are summarized below and on the Record of Borehole sheet in Appendix B.

Soil Particle	Percentage (%)
Gravel	0
Sand	59
Silt	28
Clay	13

### 5.4 Clay (CH) to Silty Clay (CI)

A deposit of clay to silty clay was encountered below the embankment fill and the silty sand with organics. The thickness of the layer ranged from 11.0 to 11.9 m (base elev. 71.7 m to 69.7 m). Where SPTs were conducted within the layer, the N-values ranged from 2 to 33 blows per 0.3 m of penetration but were typically between about 4 and 14 blows per 0.3 m of penetration. Several attempts were made to carry out in-situ undrained shear strength testing but the vane was unable to be turned as the material has an undrained shear strength greater than 102 kPa. The clay to silty clay can be described as very stiff in consistency.

Recorded moisture contents ranged from 14% to 43%. Atterberg Limit testing was completed on five samples of the deposit. Results are illustrated in Figure C7 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 clay to silty clay generally exhibits intermediate to high plastic behaviour (CI to CH). One sample towards the bottom of the deposit in Borehole 131-22-02 (elev. 70.8 m) exhibited low plasticity (CL-ML).

Parameter	Value
Liquid Limit	22 - 56
Plastic Limit	17 - 26
Plasticity Index	5 - 31

The results of gradation analyses completed on five samples of the layer are illustrated on Figure C8 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	0 – 4
Silt	39 – 78
Clay	19 – 61

## 5.5 Bedrock

Bedrock was proven by coring in both boreholes. The depth to bedrock from the existing road grade ranged from 20.1 m to 22.7 m (elev. 71.7 m to 69.7 m). The bedrock encountered consisted of fresh, fine-grained, grey dolostone. Quartz inclusions were noted in Borehole 131-22-02. 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), %	100
Solid Core Recovery (SCR), %	67 – 98
Rock Quality Designation (RQD), %	57 – 100
Fracture Index (fractures per 0.3 m) <sup>(1)</sup>	0 – 7
Unconfined Compressive Strength (UCS) <sup>(2)</sup> , MPa	237

Notes: (1) Indicated as "FI" on Borehole Logs

(2) Sample tested from Borehole 131-22-02

Based on the RQD, the bedrock quality is classified as fair to excellent (CFEM, 2006). The result of an unconfined compressive strength test was 237 MPa, indicating that the bedrock is very strong (CFEM, 2006).

## 5.6 Groundwater

A 19 mm diameter standpipe piezometer was installed in Borehole 131-22-02 to allow for measurements of the stabilized groundwater level. The measured groundwater levels are summarized in Table 5-2.

**Table 5-2: Groundwater Level Observations**

Borehole	Bottom of Screen Elev. (m)	Screened Unit	Groundwater Level		Date of Measurement
			Depth (mbgs)	Elevation (m)	
131-22-02	71.2	Silty Clay	11.2	81.2	2022-12-05
			11.4	81.0	2022-12-18
			10.9	81.5	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. 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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## REFERENCES

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

## 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

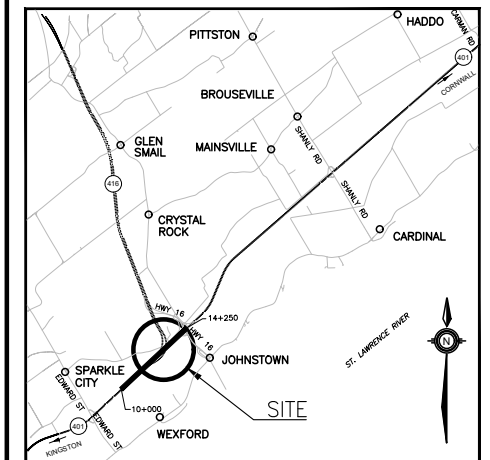
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or 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.










## **Appendix A.**

### **Borehole Location Plan and Stratigraphic Drawing**



## KEYPLAN

## LEGEND

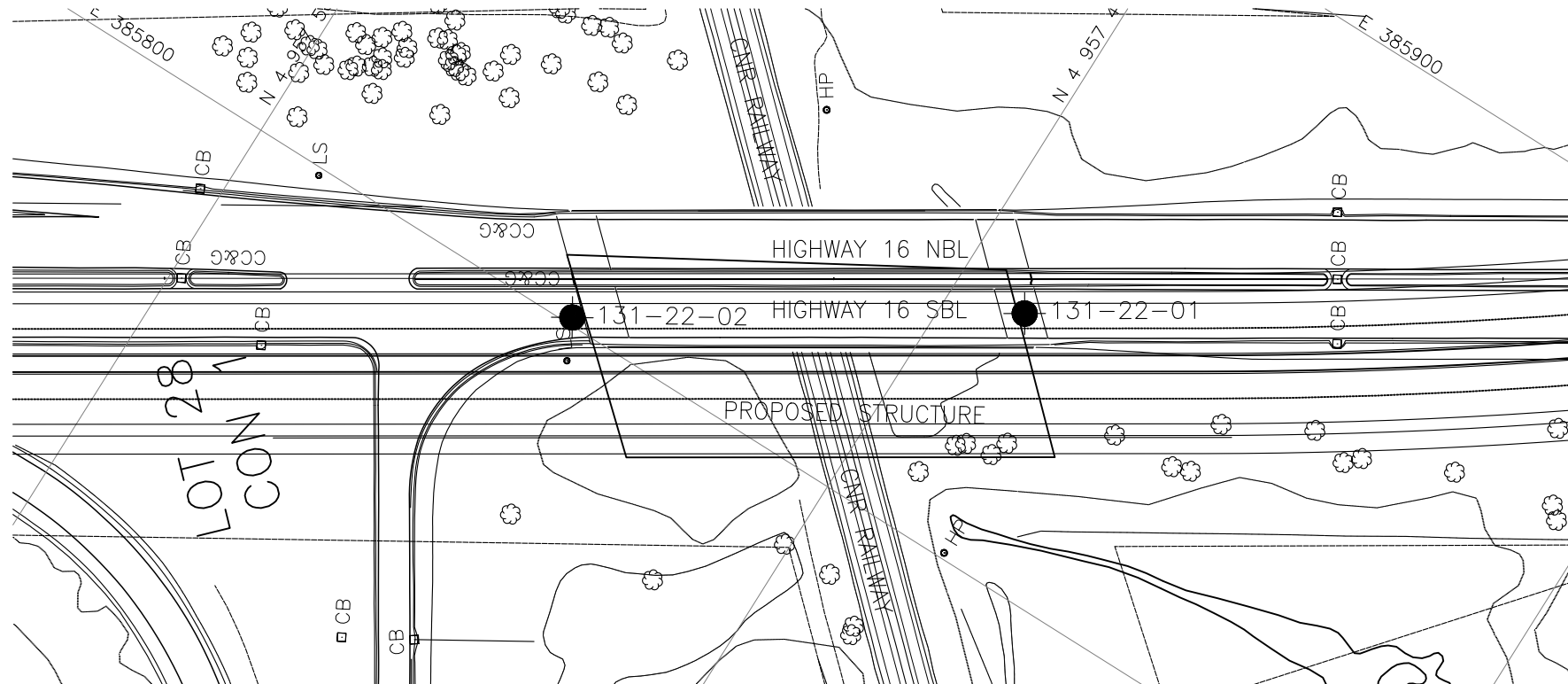
	Borehole (Current Investigation)
	Borehole (Previous Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
131-22-01	91.8	4 957 388.9	385 837.4
131-22-02	92.4	4 957 445.7	385 801.1

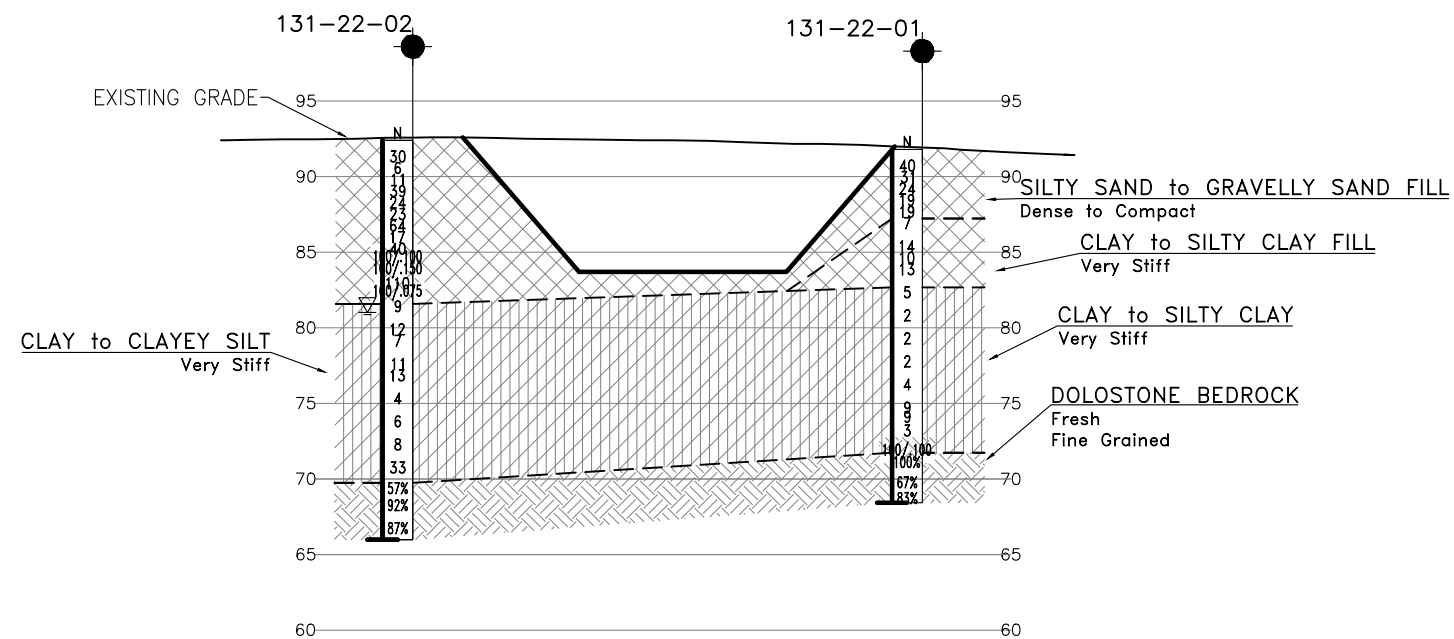
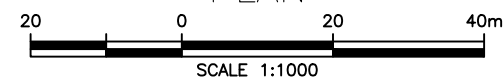
-NOTES-

- 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.

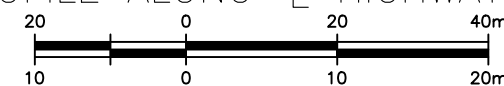
**GEOCRES No.** 31B12-003



## PLAN



# PROFILE ALONG C HIGHWAY 16

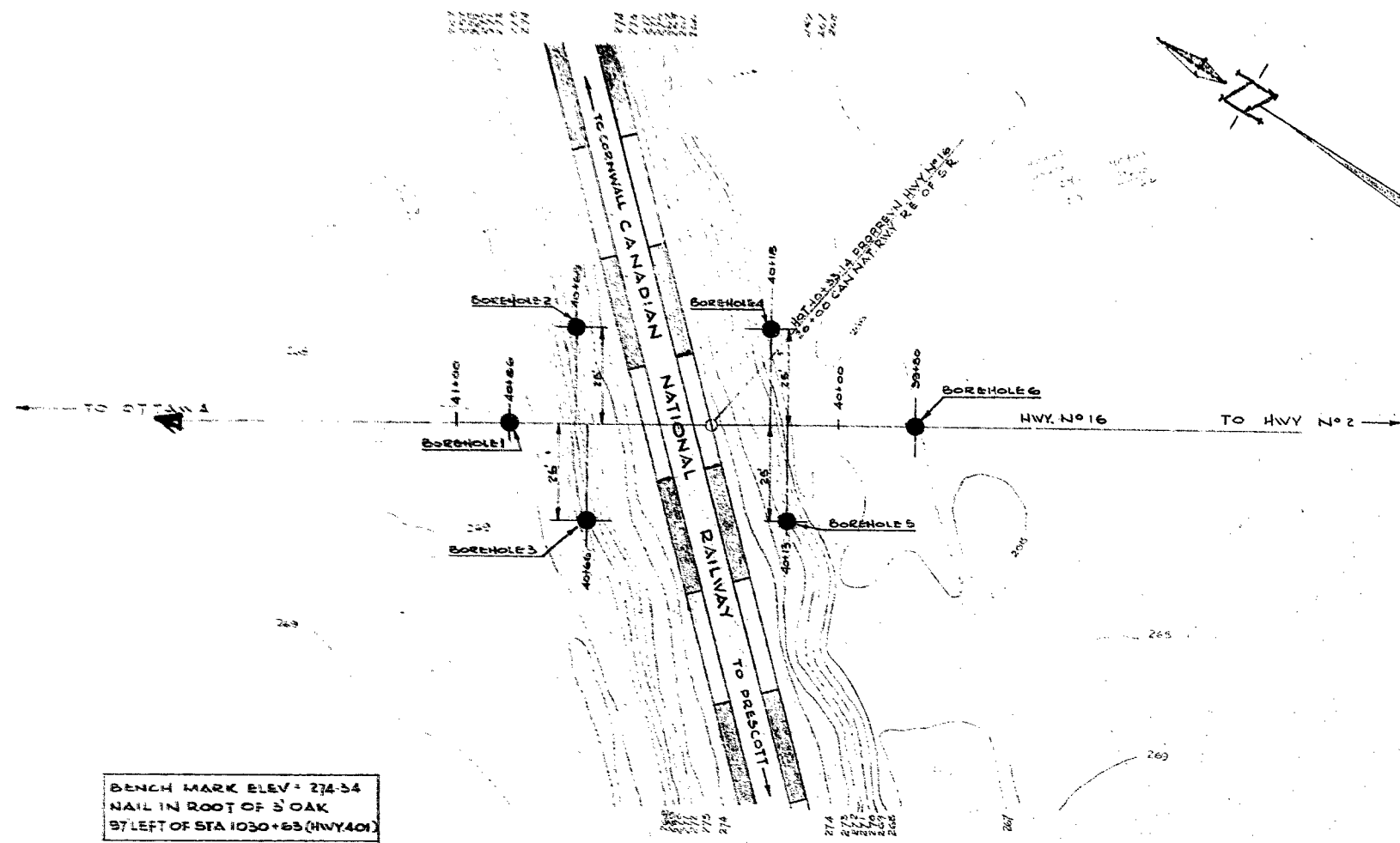


H 1:1000

V 1:500

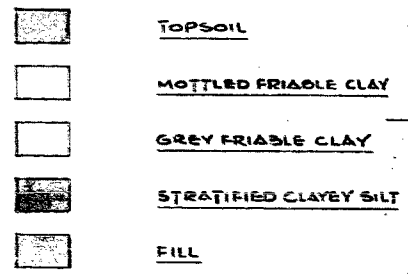


REVISIONS							
	DATE	BY		DESCRIPTION			
DESIGN	AO	CHK	MK		LOAD		DATE MARCH 2024
DRAWN	JW	CHK	AO	CODE	SITE	STRUCT	DWG 1

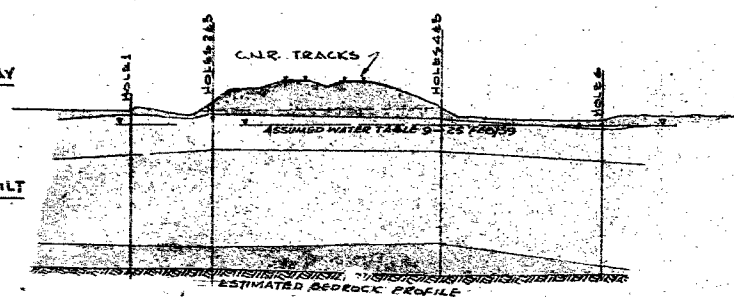


PLAN of SITE  
SCALE 20:1

COLOUR KEY



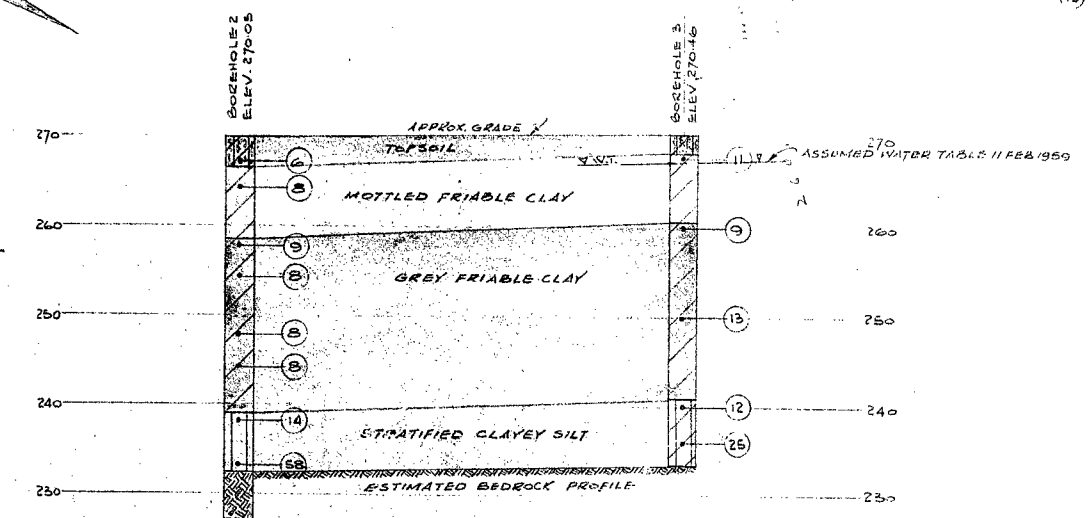
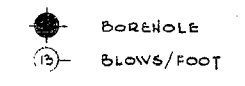
NOTE: HOLES 2 & 3 AND 4 & 5 HAVE BEEN INTERPOLATED TO PRODUCE THESE RESULTS



SECTION ALONG LINE HWY 16 SHOWING STRATIFICATION

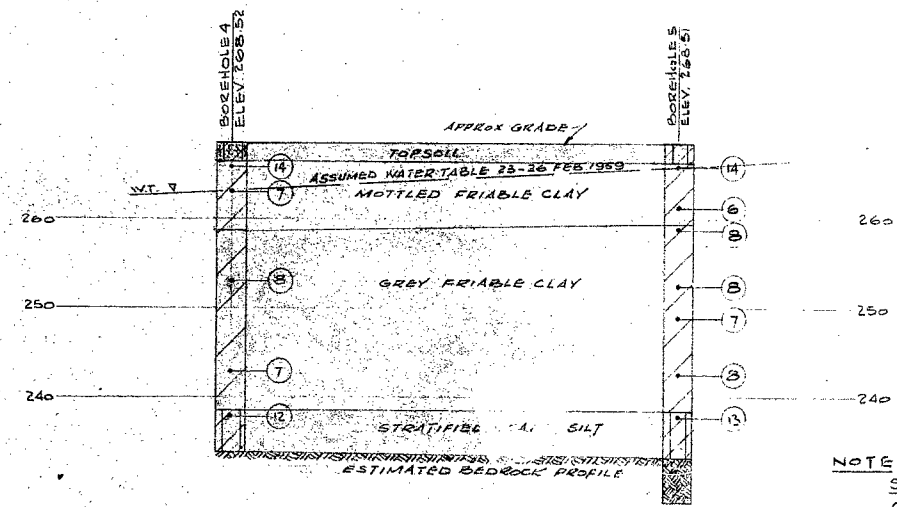
PROFILE SCALES  
VERT 20:1  
HOR 20:1

LEGEND



SECTION THROUGH HOLES 2 & 3

PROFILE SCALE  
VERT 10:1  
HOR 10:1



SECTION THROUGH HOLES 4 & 5

PROFILE SCALE  
VERT 10:1  
HOR 10:1

NOTE: SEE BOREHOLE LOGS FOR COMPLETE SOIL DATA



e.m. peto & associates ltd.

SOIL SITE INVESTIGATION  
AT  
C.N.R. OVERHEAD HWY 16  
EDWARDSBURG TWP JOHNSTOWN  
FOR  
DEPT. OF HIGHWAYS OF ONTARIO  
OUR JOB NO. 5920 DATE 5 MAR 1959  
CLIENTS PLAN NO. E3554-1 PER. C.J.W.





## **Appendix B.**

### **Record of Borehole Sheets**



## 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).

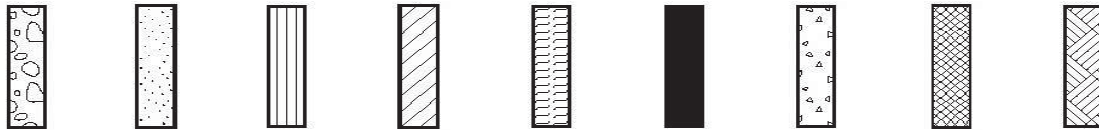
### DYNAMIC CONE PENETRATION TEST (DCPT):

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.



### 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

### 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





## 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

# RECORD OF BOREHOLE No 131-22-01

1 OF 3

METRIC

GWP# 4024-20-00 LOCATION Lat: 44.751917°, Long: -75.476522° Highway 16 & Railway, Edwardsburgh, MTM z9: N 4 957 388.9 E 385 837.4 ORIGINATED BY IK  
 HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO  
 DATUM Geodetic DATE 2022.12.05 - 2022.12.06 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									WATER CONTENT (%)
91.8	Ground Surface							20	40	60	80	100					
0.0 91.5	ASPHALT (255 mm)																
91.3 0.5	GRAVELLY SAND, some fines Brown FILL (BASE)																
	SILTY SAND, some gravel Dense to compact Brown FILL		1	SS	40		91							○			
			2	SS	31		90							○			
			3	SS	24		89							○			11 53 36 (SI+CL)
			4	SS	19									○			
			5	SS	19		88							○			
87.2 4.6	CLAY to SILTY CLAY Very stiff Brown to grey FILL		6	SS	7		87							○			
							86										
			7	SS	14									○			0 9 40 51
			8	SS	10		85							○			
			9	SS	13		84							○			
82.7 9.1	CLAY (CH) to SILTY CLAY (CI) Very stiff Brown to grey		10	SS	5		83										
							82										

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
 20  
 15  
 10  
 (%) STRAIN AT FAILURE


DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 3-19-24

RECORD OF BOREHOLE No 131-22-01

2 OF 3

METRIC

GWP# 4024-20-00 LOCATION Lat: 44.751917°, Long: -75.476522° Highway 16 & Railway, Edwardsburgh, MTM z9: N 4 957 388.9 E 385 837.4 ORIGINATED BY IK  
HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO  
DATUM Geodetic DATE 2022.12.05 - 2022.12.06 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT		UNIT WEIGHT  γ  kN/m <sup>3</sup>	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	W P                      W                      W L					
Continued From Previous Page								20    40    60    80    100	20    40    60				GR   SA   SI   CL	
	CLAY (CH) to SILTY CLAY (CI) Very stiff Brown to grey							>102 kPa +						
			11	SS	2		81							
									>102 kPa +					
							80		>102 kPa +					
			12	SS	2		79							0   0   40   60
									>102 kPa +					
									>102 kPa +					
			13	SS	2		78							
									>102 kPa +					
									>102 kPa +					
			14	SS	4		76							
									>102 kPa +					
						>102 kPa +								
15	SS	9		75										
16	SS	9		74								0   4   48   48		
17	SS	3		73										
								>102 kPa +						
								>102 kPa +						
18	SS	100/		72										

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 10 (%) STRAIN AT FAILURE


DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 3-19-24

RECORD OF BOREHOLE No 131-22-01

3 OF 3

METRIC

GWP# 4024-20-00 LOCATION Lat: 44.751917°, Long: -75.476522°  
Highway 16 & Railway, Edwardsburgh, MTM z9: N 4 957 388.9 E 385 837.4 ORIGINATED BY IK  
HWY 401 BOREHOLE TYPE CME 55 Truck Mount / HSA / NW Casing / NQ Coring COMPILED BY AO  
DATUM Geodetic DATE 2022.12.05 - 2022.12.06 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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												
	Continued From Previous Page							20	40	60	80	100								
71.7 20.1	<b>DOLOSTONE BEDROCK</b> Fresh Fine grained Grey Medium bedded Very strong		1	RUN	-												RUN #1 TCR=100% SCR=98% RQD=100%			
			2	RUN	-												RUN #2 TCR=100% SCR=79% RQD=67%			
			3	RUN	-												RUN #3 TCR=100% SCR=83% RQD=83%			
68.4 23.4	<b>End of Borehole</b>  Unstabilized water level at a depth of 3.7 m (elev. 88.1 m) in the open borehole. Water was introduced in the borehole during drilling.																			





DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 3-19-24

# RECORD OF BOREHOLE No 131-22-02

1 OF 3

METRIC

GWP# 4024-20-00 LOCATION Lat: 44.752432°, Long: -75.476972° Highway 16 & Railway, Edwardsburgh, MTM z9: N 4 957 445.7 E 385 801.1 ORIGINATED BY IK  
 HWY 401 BOREHOLE TYPE CME 55 Truck Mount / NW Casing / NQ Coring COMPILED BY AO  
 DATUM Geodetic DATE 2022.12.01 - 2022.12.05 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
92.4	Ground Surface		1	NQ	-		20	40	60	80	100	20	40	60	24 57 19 (SI+CL)
0.0	ASPHALT (100 mm)														
92.1	CONCRETE (200 mm)														12 46 42 (SI+CL)
0.3	GRAVELLY SAND, some fines Dense Brown FILL (BASE/SUBBASE)		1	SS	30										
90.9															
1.5	SILTY SAND, some gravel Loose to very dense Brown FILL		2	SS	6										
			3	SS	11										
			4	SS	39										
			5	SS	24										
			6	SS	23										
			7	SS	64										
			8	SS	17										
			9	SS	40										
84.8															
7.6	GRAVELLY SILTY SAND Contains cobbles and boulders Very dense Brown FILL		10	SS	100/ 100mm										26 49 25 (SI+CL)
			11	SS	100/ 150mm										
			12	SS	110										

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
 20  
 15  
 10  
 (%) STRAIN AT FAILURE



## METRIC

Lat: 44.752432°, Long: -75.476972°  
Highway 16 & Railway, Edwardsburgh, MTM z9: N 4 957 445.7 E 385 801.1

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

DOUBLE LINE 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 2012TEMPLATE(MTO).GDT 3-19-24





# e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

## BOREHOLE LOG

Edwardsburg Twp. C.N.R. Overhead  
 Job Name Hwy. 16. Johnstown. Job No. 5920 Borehole No. 1  
 Client Dep't. of Highways of Ontario. Casing BX ( 2 1/2" Dia.) Boring Date Feb. 9th. - 10th. 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"					
BLACK SANDY SILT LOAM TOP SOIL WITH ROOTS AND ORGANIC MATTER			268' 14"		1	FROM CASING		SATURATED
MOTTLED, FRIABLE CLAY	BROWN & GREY	STIFF - 3' 8"	267' 14"		2	S.S.	11	M.C. = 40.2% MUCH WETTER THAN PLASTIC LIMIT FEBRUARY 11, 1959 WATER FILLED HOLE OVERNIGHT
AS ABOVE	AS ABOVE	STIFF - 264' 47"	5' 0"		3	S.S.	9	M.C. = 36.0% W.T. P.L.
FRIABLE CLAY	DK. GREY		10' 0"		4	S.L. TAPPED		M.C. = 35.5% ; S <sub>r</sub> = 100% C = 984 TSF ; e = .964
AS ABOVE, OCCASIONAL PEBBLES	AS ABOVE	FIRM TO STIFF	15' 0"		5	S.S.	8	M.C. = 39.4% M.W.T. P.L.
AS ABOVE, GRITS	AS ABOVE		20' 0"		6	S.L. TAPPED		M.C. = 31.7% ; C = 590 TSF e = .877
AS ABOVE	AS ABOVE	FIRM TO STIFF	25' 0"		7	S.S.	8	M.C. = 32.0% M.W.T. P.L.
CLAYEY SILT WITH THIN SEAMS OF VERY FINE SAND (SLIGHTLY PLASTIC)	DK. GREY		30' 0"		8	S.L. TAPPED		WATER SEEPAGE AT 30' 0" M.C. = 22.1% W.T. P.L.
AS ABOVE	AS ABOVE	HARD	35' 9"		9	S.S.	100	M.C. = 15.1% DRIER THAN PLASTIC LIMIT
			232' 39"	REFUSAL				NOTE: HOLE SAMPLED DRY



e. m. peto associates ltd.





SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

# BOREHOLE LOG

Edwardsburg Twp.C.N.R.Overhead  
Job Name Hwy. 16. Johnstown..... Job No. 5920  
Client Dep't. of Highways of Ontario. Casing 4" Pipe.  
Datum Geodetic..... Compiled By K.P.

Borehole No. 2  
Boring Date Feb. 13th. - 14th. 1959.  
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"					
ORGANIC TOPSOIL WITH ROOTS & STONES	BLACK		270.05	1	FROM CASING			SATURATED
SANDY SILT WITH PEBBLES, ROOTS, ORG. MATTER	DK. BROWN	FIRM	2'0" 268.05 3'4" 266.72 5'0"	2	S.S.	6		SATURATED
MOTTLED, FRIABLE CLAY	BROWN & GREY	FIRM TO STIFF		3	S.S.	8		M.C. = 44.4% MUCH WETTER THAN PLASTIC LIMIT
OCCASIONAL PEBBLES								
			10'0"					
FRIABLE CLAY	DK. GREY	STIFF	11'5" 258.53	4 5	S.L. TAPPED S.S.	9		SAMPLE LOST M.C. = 34.5% M.W.T.P.L. e = 1.042
			15'0"					
AS ABOVE, SOME ORGANIC MATTER	AS ABOVE	FIRM TO STIFF		6	S.S.	8		M.C. = 36.6% M.W.T.P.L.
			20'0"					
AS ABOVE, FEW SMALL STONES	AS ABOVE			7	S.L. TAPPED			
AS ABOVE	AS ABOVE	FIRM TO STIFF		8	S.S.	8		W.T.P.L.
			25'0"					
AS ABOVE	AS A	FIRM TO STIFF		9	S.S.	8		M.C. = 21.7% W.T.P.L.
AS ABOVE, GRITS STRATIFIED CLAYEY SILT	AS ABOVE DK. GREY	STIFF	31'0" 239.05	10 11	S.L. TAPPED S.S.	14		M.C. = 24.6% M.W.T.P.L.
			35'0"					
AS ABOVE	AS ABOVE	HARD	37'9" 232.30	12	S.S.	58		M.C. = 17.5% W.T.P.L.
			40'0"		R.C.			RECOVERY 98%
LIMESTONE	GREY		42'11" 227.13					NOTE: HOLE DRIVEN WITH THE USE OF WASH WATER
					HOLE TERMINATED			

**e. m. peto & associates ltd.**  
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO  
**BOREHOLE LOG**

Job Name Edwardsburg Twp.C.N.R. Overhead  
Hwy. 16 Johnstown. Job No. 5920  
Client Dep't. of Highways of Ontario Casing BX (2 1/2" Dia.)  
Datum Geodetic. Compiled By K.P.R.

Borehole No. 3  
Boring Date Feb. 12th. - 13th. 1959.  
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"					
ORGANIC TOPSOIL WITH ROOTS	BLACK		270'46		1 	FROM CASING		VERY WET
MOTTLED, FRIABLE CLAY (FEW ROOTS)	BROWN & GREY	STIFF	3'0" 268'46		2 	S.S. W.T. 11		M.C.=38.2% MUCH WETTER THAN PLASTIC LIMIT e=.931
AS ABOVE	AS ABOVE		5'0"		3 	S.L. TAPPED		FEBRUARY 13-14, 1959 WATER FILLED HOLE OVERNIGHT
FRIABLE CLAY	DK. GREY	STIFF	10'0" 260'46		4 	S.S.	9	M.C.=33.5% M.W.T.P.L.
AS ABOVE	AS ABOVE		15'0"		5 	S.L. TAPPED		M.C.=40.5% M.W.T.P.L. e=1.043
AS ABOVE	AS ABOVE	STIFF	20'0"		6 	S.S.	13	M.C.=27.1% W.T.P.L.
AS ABOVE, FEW SMALL STONES	AS ABOVE		25'0"		7 	S.L. TAPPED		WATER SEEPAGE AT 25' M.C.=37.7% M.W.T.P.L. e=.915
STRATIFIED CLAYEY SILT	DK. GREY	STIFF	29'6" 240'96		8 	S.S.	12	M.C.=24.4% M.W.T.P.L.
AS ABOVE	AS ABOVE	VERY STIFF	35'0"		9 	S.S.	25	M.C.=19.7% W.T.P.L.
			37'0" 233'46					NOTE: HOLE SAMPLED DRY

**e. m. peto associates ltd.**  
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO  
**BOREHOLE LOG**

Edwardsburg Twp. C.N.R. Overhead  
Job Name Hwy. 16 Johnstown Job No. 5920  
Client Dep't. of Highways of Ontario Casing BX ( 2 1/2" Dia.)  
Datum Geodetic Compiled By K.P.

Borehole No. 4  
Boring Date Feb. 25th, 1959  
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"					
ORGANIC TOPSOIL & SOME COARSE SAND	BLACK		268' 52"	1	FROM CASING			SATURATED
		STIFF	2' 0" 266' 02"	2	S.S.	14		W.T. WITH CASING AT 5'
MOTTLED, FRIABLE CLAY	GREY & BROWN		5' 0"	2/A	AUGER			
AS ABOVE	AS ABOVE	FIRM	5' 6" 263' 02"	3	S.S.	7		W.T. FEBRUARY 26, 1959. WATER LEVEL WITH CASING AT 20' M.C. = 39.4% MUCH WETTER THAN PLASTIC LIMIT
			9' 8"					
FRIABLE CLAY	DK. GREY		258' 85"	4	S.L. TAPPED			
			15' 0"					
AS ABOVE	AS ABOVE	FIRM TO STIFF		5	S.S.	8		M.C. = 33.4% M.W.T. P.L.
			20' 0"					
AS ABOVE	AS ABOVE			6	S.L. TAPPED			
			25' 0"					
AS ABOVE	AS ABOVE	FIRM		7	S.S.	7		M.C. = 29.1% W.T. P.L.
			30' 0"					
STRATIFIED CLAYEY SILT	DK. GREY	STIFF	238' 52"	8	S.S.	12		M.C. = 19.2% W.T. P.L.
				9	S.L. TAPPED			
			34' 8"					
			233' 85"					NOTE: HOLE SAMPLED DRY
					REFUSAL			





# e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

## BOREHOLE LOG

Edwardsburg Twp. C.N.R. Overhead  
 Job Name Hy. 16. Johnstown. Job No. 5920 Borehole No. 5  
 Client Dep't. of Highways of Ontario. Casing 4" Pipe Boring Date Feb. 19th. - 24th. 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"					
ORGANIC TOPSOIL, FEW STONES	BLACK		268'51"		1	FROM CASING		WATER SEEPAGE IN TOPSOIL
MOTTLED FRIABLE CLAY	BROWN & GREY	2 W.T. 2'-5" STIFF	2' 0" 266'51"		2	S.S.	14	M.C. = 43.1% WATER TABLE 23-24 FEB.
AS ABOVE	AS ABOVE		5' 0"		3	S.L. TAPPED		
AS ABOVE	AS ABOVE	FIRM			4	S.S.	6	
FRIABLE CLAY	DK. GREY	FIRM TO STIFF	9' 0" 259'51"		5	S.S.	8	M.C. = 30.9% MUCH WETTER THAN PLASTIC LIMIT
AS ABOVE	AS ABOVE		15' 0"		6	S.L. TAPPED		
AS ABOVE	AS ABOVE	FIRM TO STIFF			7	S.S.	8	
AS ABOVE, SEAMS OF SILT	AS ABOVE	FIRM	20' 0"		8	S.S.	7	M.C. = 26.2% W.T. P.L.
AS ABOVE	AS ABOVE		25' 0"		9	S.L. TAPPED		
AS ABOVE	AS ABOVE	FIRM TO STIFF			10	S.S.	8	
STRATIFIED CLAYEY SILT	DK. GREY	STIFF	30' 0" 238'51"		11	S.S.	13	M.C. = 21.3% W.T. P.L.
LIMESTONE	GREY		35' 2" 233'34"			R.C.		RECOVERY 98%
			40' 2" 228'34"					HOLE TERMINATED

**e. m. peto associates ltd.**  
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO  
**BOREHOLE LOG**

Edwardsburg Twp. C.N.R. Overhead  
Job Name Hwy. 16 Johnstown Job No. 5020  
Client Dep't. of Highways of Ontario Casing BX (2 1/2" Dia.)  
Datum Geodetic Compiled By K.P.

Borehole No. 10  
Boring Date Feb. 17th. - 18th. 1959.  
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"					
SANDY SILT TOPSOIL, ROOTS, STONES, ORG. MATTER	BLACK	W.T. 1'-0"	266'32"		1	FROM CASING		19 FEB
MOTTLED, FRIABLE CLAY	BROWN & GREY	FIRM	264'65"		2	S.S.	7	M.C. = 46.3% MUCH WETTER THAN PLASTIC LIMIT
AS ABOVE	AS ABOVE	FIRM	5' 0"		3	S.S.	7	M.C. = 44.8% M.W.T.P.L.
			9' 0"					
			257'32"					
FRIABLE CLAY	DK. GREY				4	S.L. TAPPED		
			15' 0"					
AS ABOVE	AS ABOVE	FIRM TO STIFF			5	S.S.	8	M.C. = 33.5% M.W.T.P.L.
			20' 0"					
AS ABOVE	AS ABOVE				6	S.L. TAPPED		M.C. = 30.6% M.W.T.P.L.
			25' 0"					
AS ABOVE	AS ABOVE	STIFF			7	S.S.	12	M.C. = 28.5% W.T.P.L.
			30' 0"					
AS ABOVE	AS ABOVE				8	S.L. TAPPED		
			32' 8"					
STRATIFIED CLAYEY SILT	DK. GREY	HARD	233'65" 34'3" 232'07"		9	S.S.	60	M.C. = 19.2% W.T.P.L.
						REFUSAL		

# e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

## BOREHOLE LOG

Hwy.# 16 & C.N.R. Crossing  
 Job Name Edwardsburg Twp. Job No. 59129 Borehole No. "A"  
 Client Dep't. of Highways of Ontario. Casing 4" Pipe Boring Date July 10th. 1959.  
 Datum Geodetic Compiled By B.L. Checked By

### SAMPLE CONDITION

UNDISTURBED  
 FAIR  
 DISTURBED  
 LOST

### SAMPLE TYPE

A.S. AUGER SAMPLE  
 C.S. CASING SAMPLE  
 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  
 C. SOIL SHEAR STRENGTH LBS/SQ.FT.  
 W.L. WATER LEVEL IN CASING  
 W.T. GROUND WATER TABLE IN SOIL  
 W.T.P.L. WETTER THAN PLASTIC LIMIT  
 D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Ground surface.			0' 0"						
Topsoil	Dk. Brown to Black		0' 6"						
Clay	Mottled brown & grey		5' 0"			3"S.L. Tapped			
			6' 2"			V.T. V.T.			
Clay	Brownish-grey		10' 0"			2"S.L. Tapped	31.1%		
Clay	Dk. Grey		10' 4"			V.T. 3"S.L. Tapped	38.4%		
At 12'6" seam (2" thick) of grey fine silty sand.						V.T. 2"S.L. Pushed	35.9%		
At 13'6"-2" thick seam of grey silt.			15' 0"			V.T. Tapped	43.1%		
Clay	Dk. Grey					2"S.L. Tapped	29.2%		
At 19'10" seam of gravel & large stones. (Boulder?)			20' 0"			3"S.T. 18			
						2"S.L. Tapped	24.4%		
			25' 0"			3"S.L. Tapped	42.7%		
Clay	Dark grey					2"S.L. Tapped	24.1%		
			30' 0"			3"S.L. Tapped	20.2%		
						2"S.L. Tapped			From 33'0" Dutch Cone penetration test.
			35' 0"				32		
Refusal (Bedrock)			36' 0"				72		
							112		

Hole terminated at 36'0"





### WATER LEVEL READINGS.

July 10th. 1959.	Time	Depth of Casing	Depth of Hole	Depth of Water	
July 10th. 1959.	9.30 am.	2'3"	5'0"	4'10"	
	11.20 am.	5'0"	10'9"	3'11"	
	12.10 pm.	10'0"	13'6"	None	After Bailing Out.
	12.30 pm.	10'0"	15'7"	15'2"	
	1.15 pm.	10'0"	15'7"	12'4"	
	4.50 pm.	20'0"	26'0"	8'7"	Note: Water came up very fast from a depth of 20'0" where the seam of gravel and stones was encountered/
	4.55 pm.	20'0"	26'0"	7'10"	
	5.00 pm.	20'0"	26'0"	7'10"	
	6.45 pm.	29'0"	32'10"	24'4"	After bailing out.
July 11th. 1959.	6.45 am.	29'0"	36'0"	2'2"	
	8.05 am.	None	36'0"	4'1"	
	10.35 am.	None	36'0"	2'5"	



e. m. peto associates ltd.  
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO  
BOREHOLE LOG

Hwy.# 16 & C.N.R.Crossing  
Job Name Edwardsburg Twp. Job No. 59129 Borehole No. "B"  
Client Dep't.of Highways of Ontario. Casing 4" Pipe Boring Date July 7th.& 8th. 1959.  
Datum Geodetic. Compiled By B.L. Checked By

SAMPLE CONDITION		SAMPLE TYPE		ABBREVIATIONS	
	UNDISTURBED	A.S.	AUGER SAMPLE	V.T.	IN SITU VANE SHEAR TEST
	FAIR	C.S.	CASING SAMPLE	C.	SOIL SHEAR STRENGTH LBS/SQ.FT.
	DISTURBED	S.S.	2" STANDARD SPLIT TUBE SAMPLE	W.L.	WATER LEVEL IN CASING
	LOST	S.L.	SPLIT BARREL WITH LINERS	W.T.	GROUND WATER TABLE IN SOIL
		S.T.	THIN-WALLED SHELBY TUBE SAMPLE	W.T.P.L.	WETTER THAN PLASTIC LIMIT
		W.S.	WASH SAMPLE	D.T.P.L.	DRIER THAN PLASTIC LIMIT
		R.C.	ROCK CORE		

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Ground surface			0'0"						
Topsoil	Dr. Brown to Black	266.14	0'0"						
Clay	Mottled brown & grey		5'0"			3"S.L. Pushed	18.4%		
			6' 3"			V.T.			
Clay	Brownish-grey		10'0"			2"S.L. Tapped	38.9%		
			15'0"			V.T.			
			20'0"			3"S.L. Pushed	38.1%		
			25'0"			V.T.			
Clay	Dk. Grey		30'3"			2"S.L. Tapped	34.8%		
			31'10"			V.T.			
			34'1"			3"S.L. Tapped	33.1%		
						V.T.			
						Pushed	32.3%		
						Tapped			
									Note: No sampling was performed from 19'11" to 30'0" depth as the sub-soil was disturbed by vane which broke down at 19'11"
Clayey silt	Grey		30'3"			2"S.L. Tapped	18.9%		
Silt	Grey		31'10"			3"S.L.	19.3%		Seepage observed at 32'0" depth.
Refusal (Bedrock)			34'1"						

Hole terminated at 34'1"				
WATER LEVEL READINGS.				
DATE	TIME	DEPTH OF CASING	DEPTH OF HOLE	DEPTH OF WATER
July 7th. 1959.	1.10 pm.	5'0"	8'3"	6'2"
	1.13 pm.	5'0"	8'3"	5'4"
	1.40 pm.	5'0"	8'3"	0'10"
	1.45 pm.	5'0"	8'3"	0' 7"
	1.50 pm.	5'0"	8'3"	0' 5"
	3.35 pm.	5'0"	10'10"	0' 4"
	3.45 pm.	10'0"	11' 0"	None
	3.55 pm.	10'0"	13'11"	None
	4.05 pm.	10'0"	15'4"	None
	4.50 pm.	10'0"	15'4½"	14'11½"
	5.10 pm.	10'0"	17' 0"	None
	7.55 am.	15' 0"	17'0"	16' 9"
	11.05 am.	15'0"	25' 0"	13' 5"
	11.10 am.	15'0"	25'0"	12'0½"
	11.15 am.	15'0"	25'0"	11'1½"
	11.19 am.	15'0"	25'0"	10' 6"
				3.40pm. 30'0" 32'9" 31'0"
				5.00pm. None 32'9" 27'4"
	11.31 am.	15'0"	25'0"	8' 8"
	1.15 pm.	30'0"	27'0"	26'11"
	3.20 pm.			

# BOREHOLE LOG

Checked By

Hole terminated at 34'1"





## **Appendix C.**

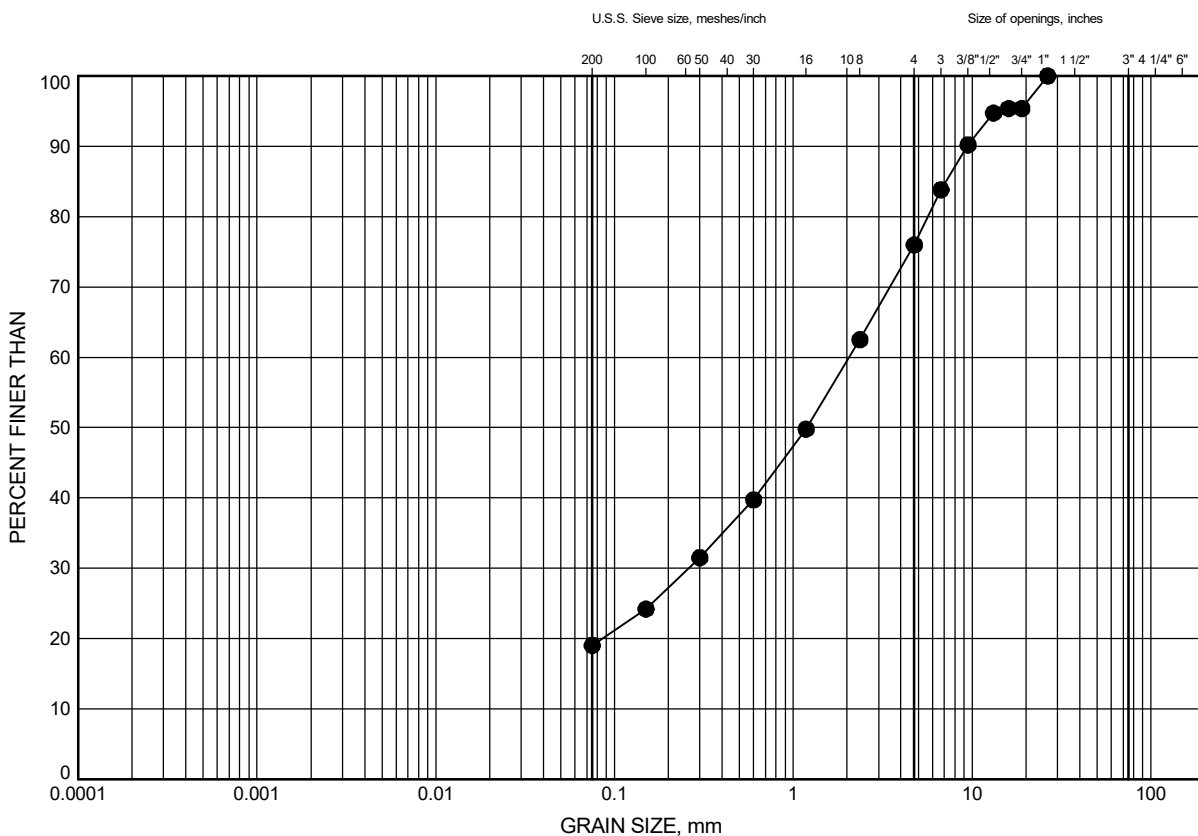
### **Laboratory Testing**



**Appendix C.1**  
**Particle Size Analysis Figures**  
**Atterberg Limit Test Results**

## GRAIN SIZE DISTRIBUTION

FILL: Gravelly Sand



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

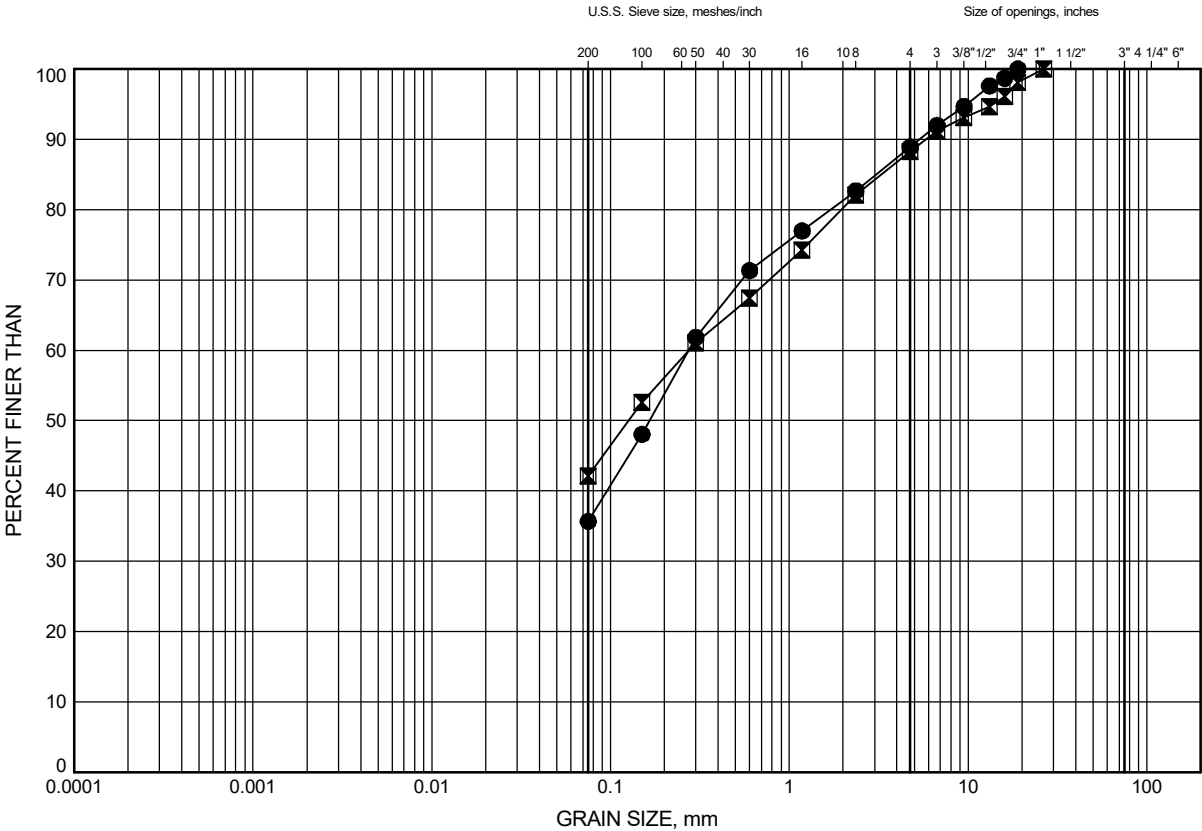
## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	131-22-02	1.1	91.3

Date March 2023GWP# 4024-20-00Prep'd RHChkd. CM

GRAIN SIZE DISTRIBUTION

FILL: Silty Sand



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

LEGEND

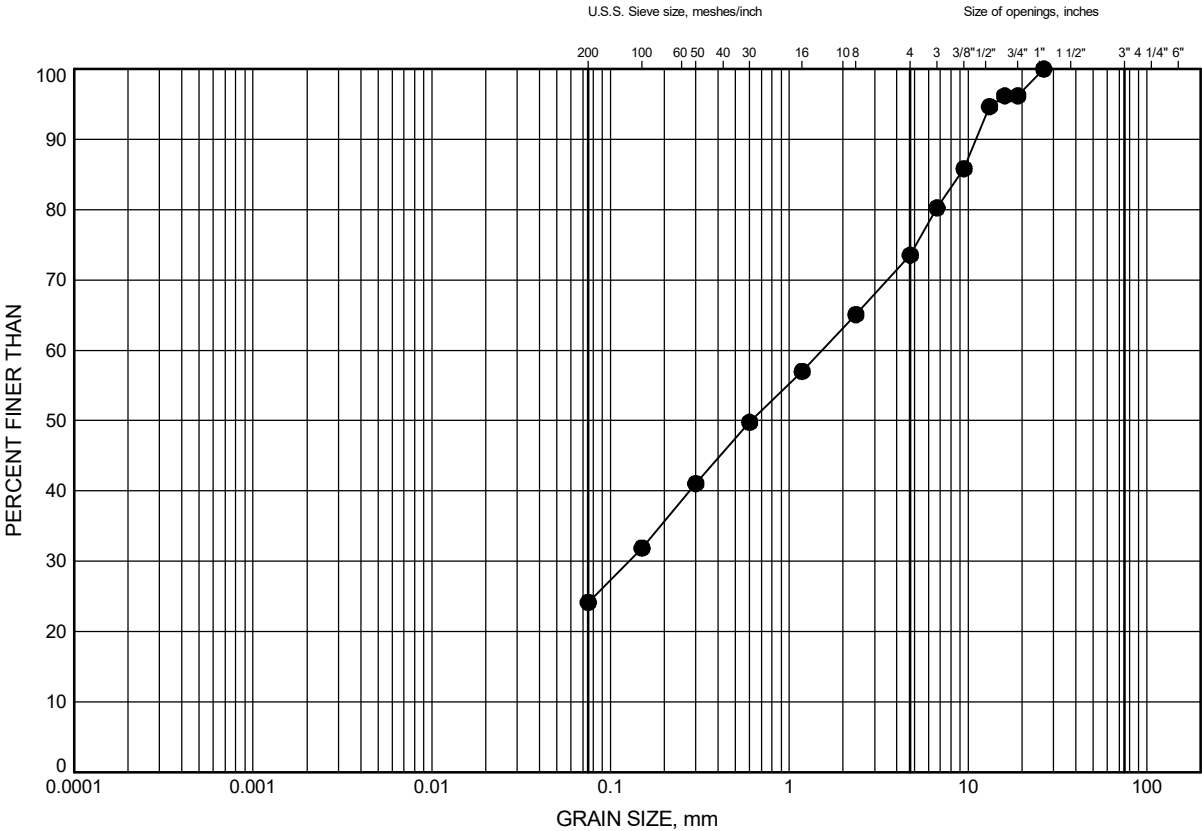
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	131-22-01	2.6	89.2
⊠	131-22-02	5.6	86.8

GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 8-22-23



GRAIN SIZE DISTRIBUTION

FILL: Gravelly Silty Sand



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

LEGEND

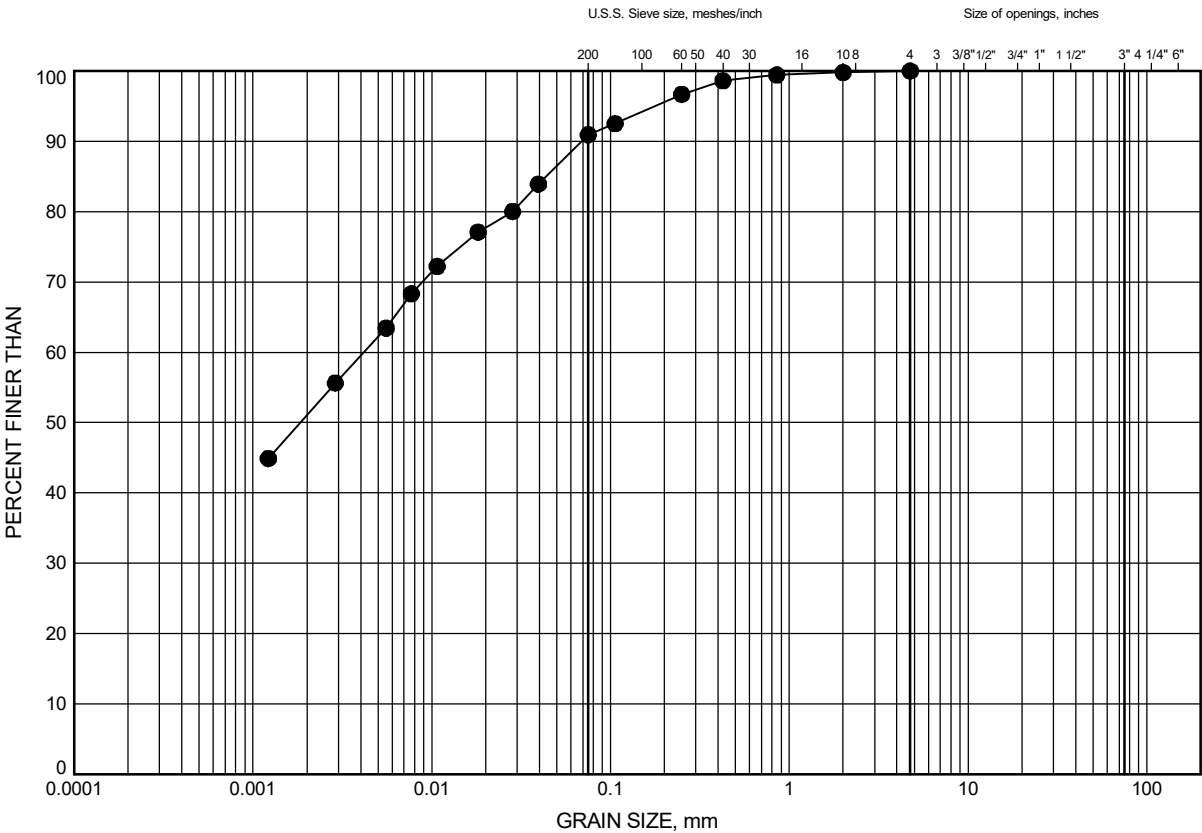
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	131-22-02	9.4	83.0

GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 3-13-23



GRAIN SIZE DISTRIBUTION

FILL: Clay



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	131-22-01	6.4	85.4

GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 8-21-23

Date August 2023  
GWP# 4024-20-00

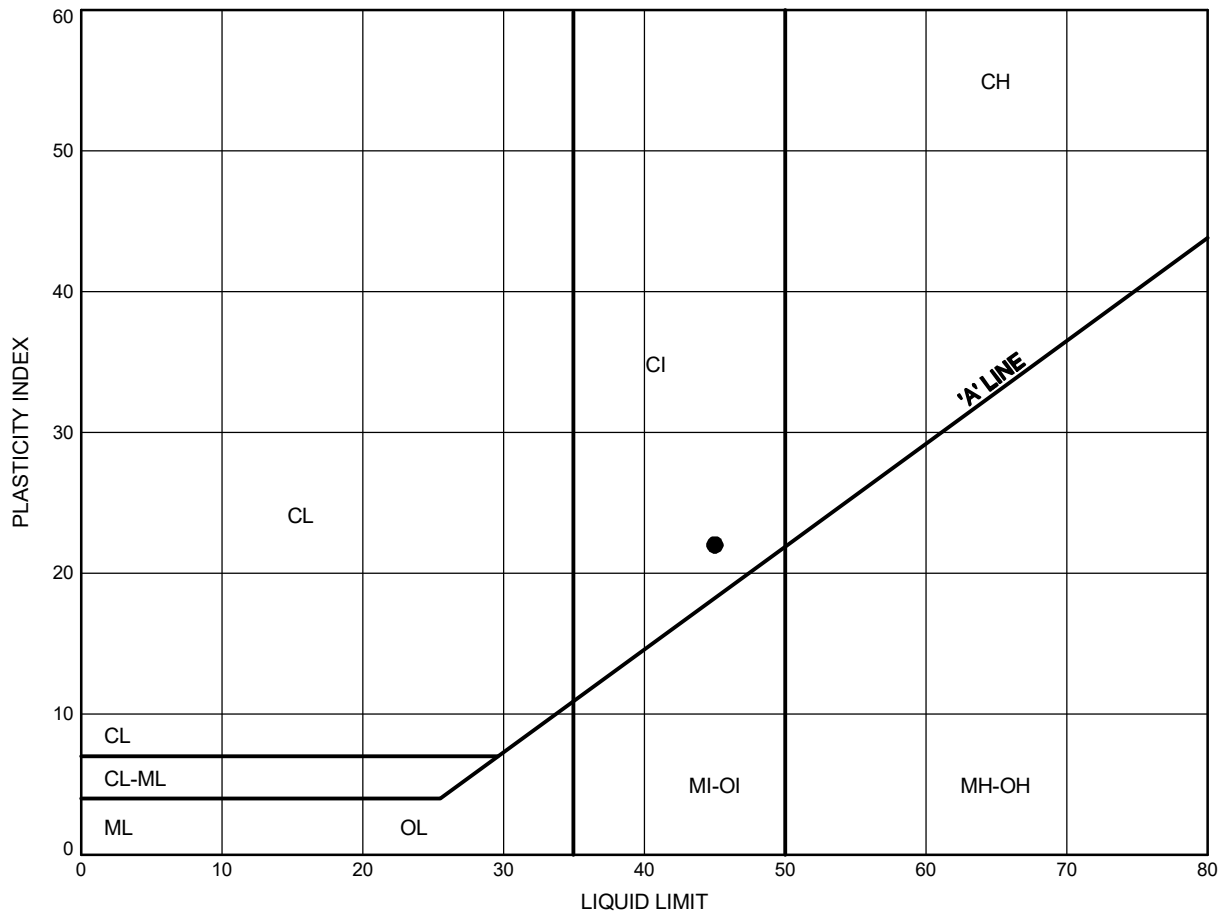


Prep'd RH  
Chkd. KW

Highway 16 Overhead at CNR Railway (Site No. 16X-0131)  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C5

FILL: Clay



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	131-22-01	6.4	85.4

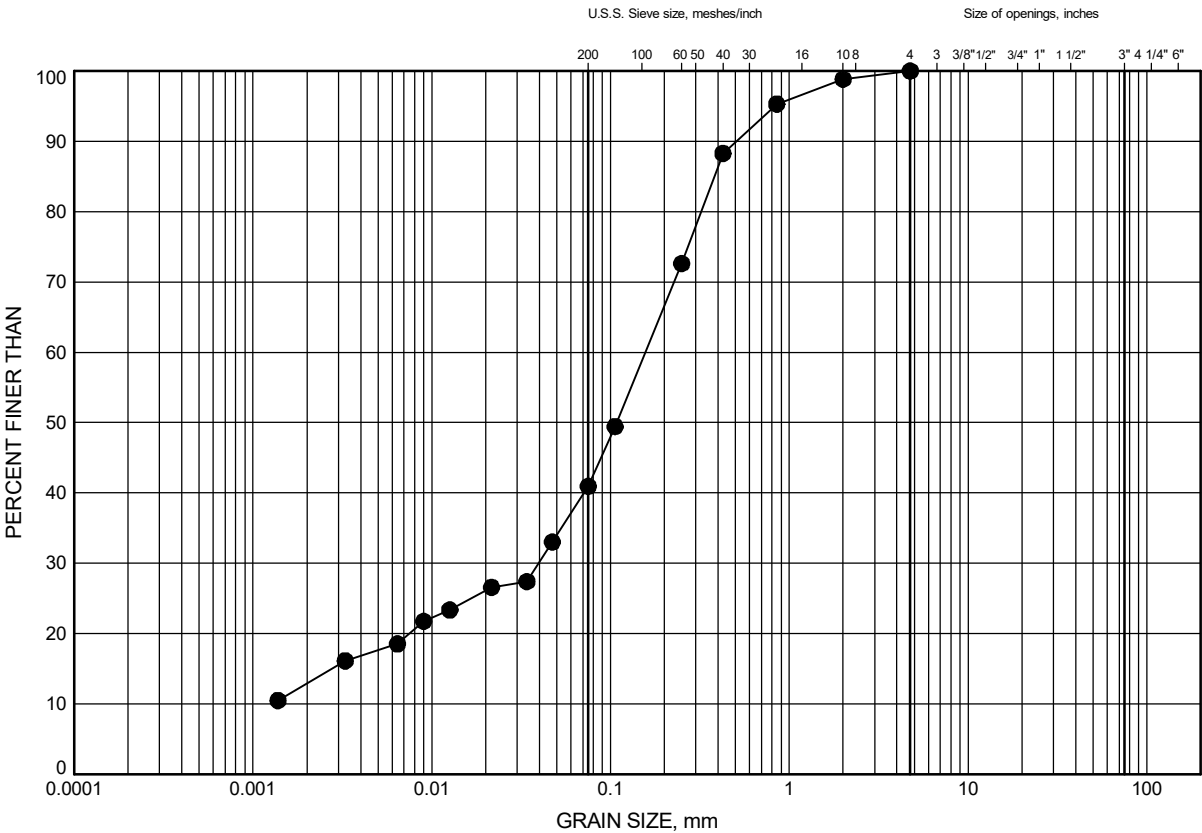
Date August 2023  
GWP# 4024-20-00



Prep'd RH  
Chkd. KW

GRAIN SIZE DISTRIBUTION

Silty Sand (SM) with organics



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	131-22-02	10.7	81.7

GRAIN SIZE DISTRIBUTION - THURBER 29381 BOREHOLE LOGS REPLACEMENT SITES.GPJ 8-21-23

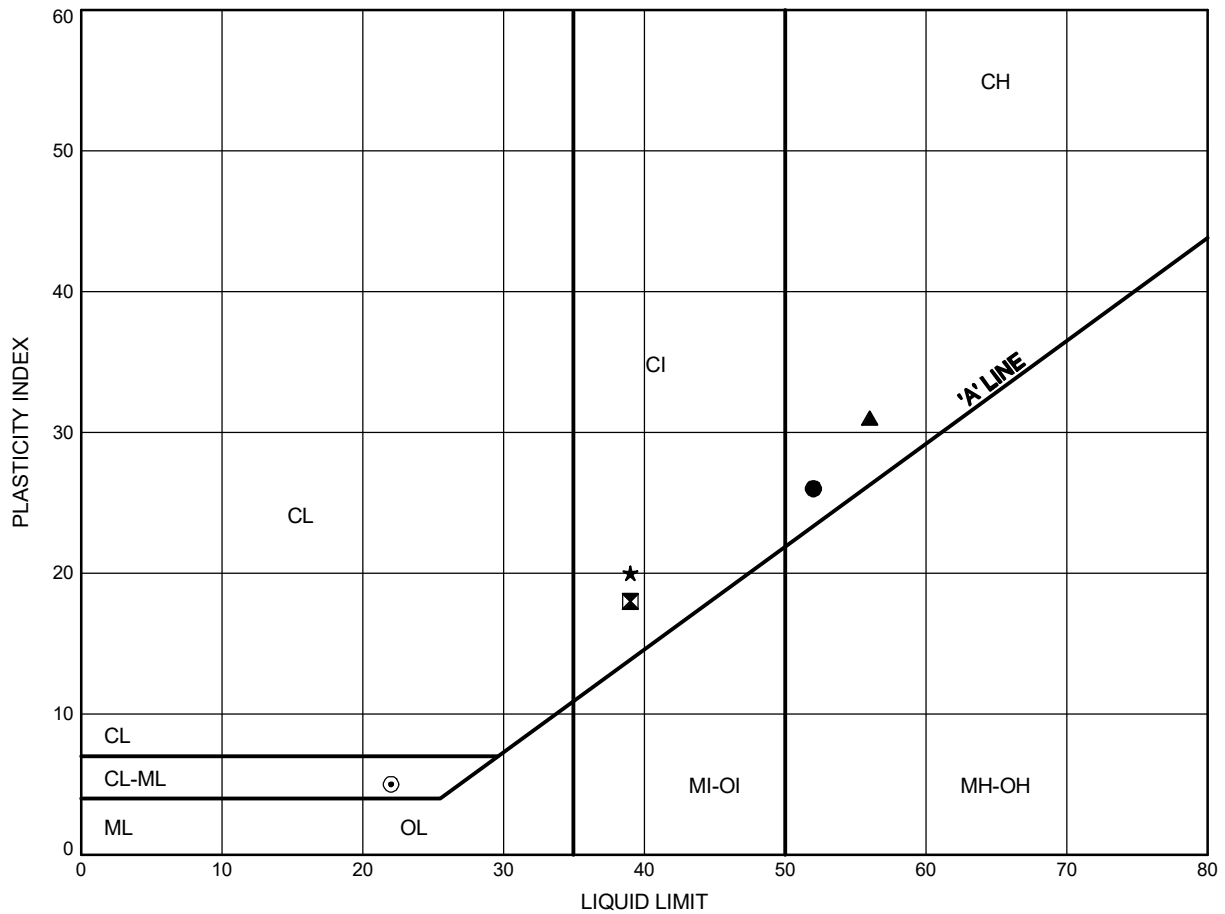




Highway 16 Overhead at CNR Railway (Site No. 16X-0131)  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C7

Clay (CH) to Silty Clay (CI)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	131-22-01	12.5	79.3
⊠	131-22-01	17.7	74.1
▲	131-22-02	13.3	79.1
★	131-22-02	17.1	75.3
⊙	131-22-02	21.6	70.8

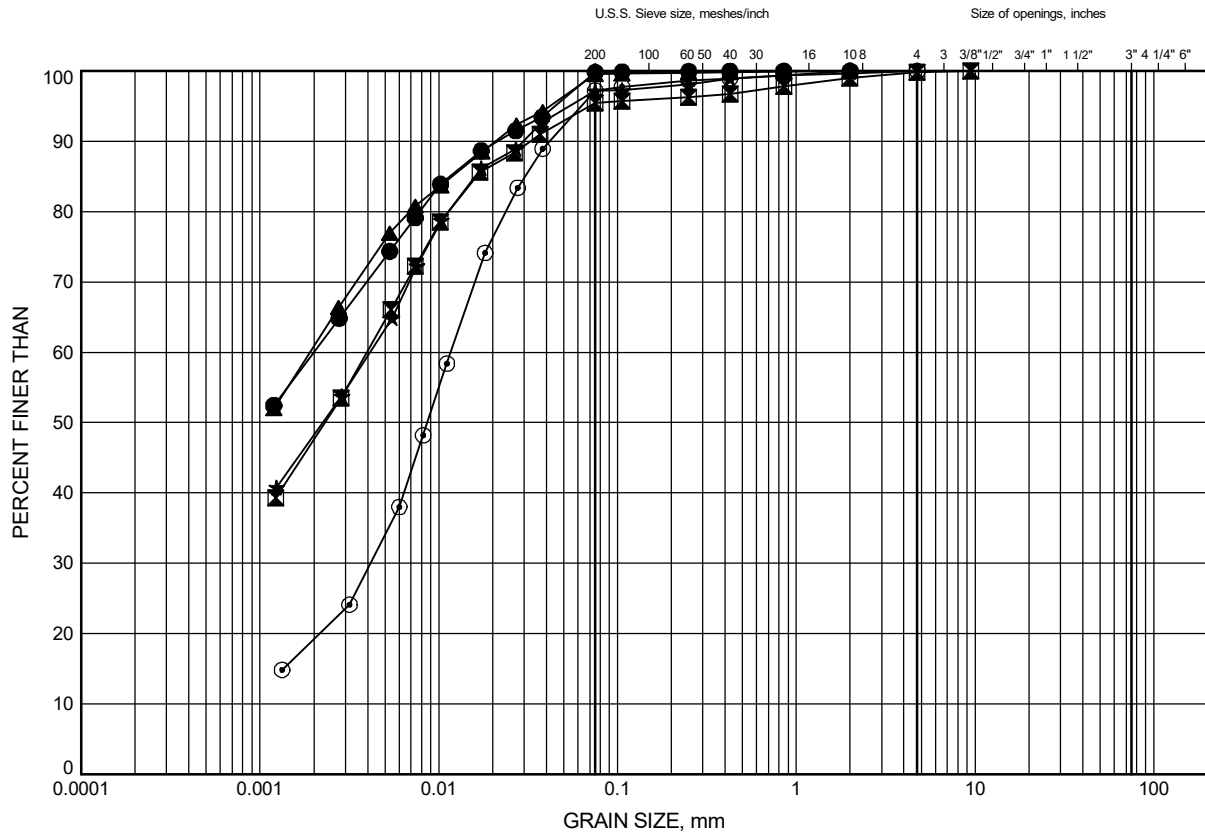
Date August 2023  
 GWP# 4024-20-00



Prep'd RH  
 Chkd. KW

# GRAIN SIZE DISTRIBUTION

Clay (CH) to Silty Clay (CI)





## **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](mailto:brian.prevost@stantec.com)



## **Appendix C.3**

### **Bedrock Core Photographs**

# Borehole 131-22-01

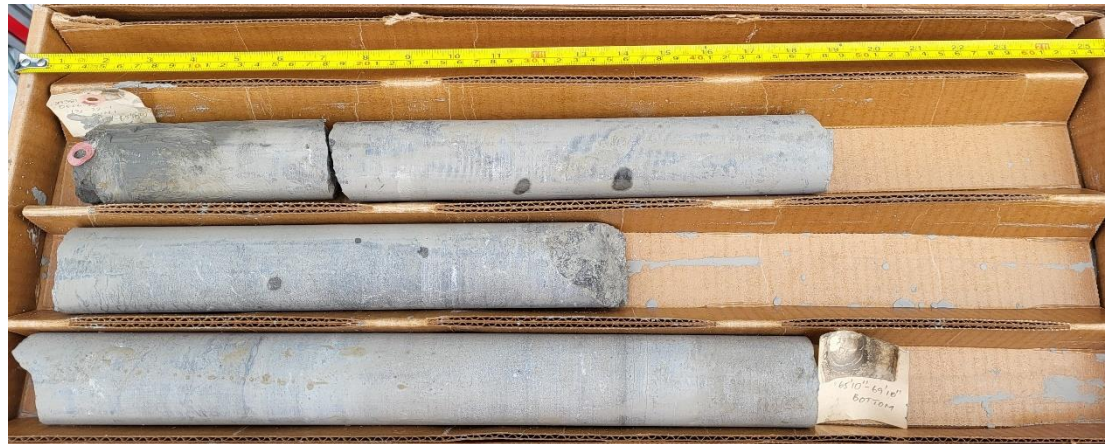
## RUN 1

Depth 20.1 m to 21.3 m

Elevation 71.7 m to 70.5 m

Dry Sample

Run 1 Start  
elev. 71.7 m



Run 1 End  
elev. 70.5 m

# Borehole 131-22-01

## RUN 1

Depth 20.1 m to 21.3 m

Elevation 71.7 m to 70.5 m

Wet Sample

Run 1 Start  
elev. 71.7 m



Run 1 End  
elev. 70.5 m

# Borehole 131-22-01

RUNS 2 and 3

Depth 21.3 m to 23.4 m

Elevation 70.5 m to 68.4 m

Dry Sample

Run 2 Start  
elev. 70.5 m



Run 2 End  
elev. 69.0 m



Run 3 Start  
elev. 69.0 m

Run 3 End  
elev. 68.4 m



# Borehole 131-22-01

RUNS 2 and 3

Depth 21.3 m to 23.4 m

Elevation 70.5 m to 68.4 m

Wet Sample

Run 2 Start  
elev. 70.5 m



Run 2 End  
elev. 69.0 m



Run 3 Start  
elev. 69.0 m

Run 3 End  
elev. 68.4 m

## Borehole 131-22-02

RUNS 1 and 2

Depth 22.7 m to 24.9 m

Elevation 69.7 m to 67.5 m

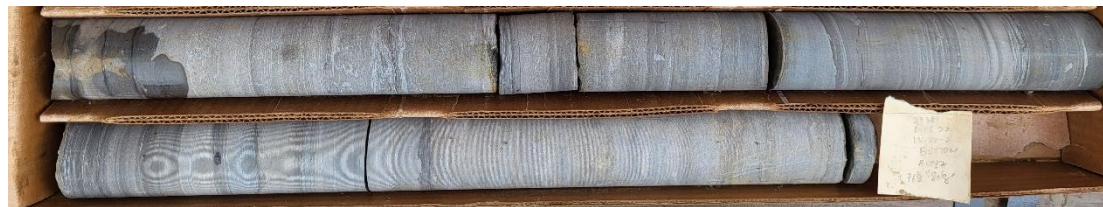
Dry Sample

Run 1 Start  
elev. 69.7 m



Run 1 End  
elev. 69.0 m

Run 2 Start  
elev. 69.0 m



Run 2 End  
elev. 67.5 m

# Borehole 131-22-02

RUNS 1 and 2

Depth 22.7 m to 24.9 m

Elevation 69.7 m to 67.5 m

Wet Sample

Run 1 Start  
elev. 69.7 m



Run 1 End  
elev. 69.0 m

Run 2 Start  
elev. 69.0 m



Run 2 End  
elev. 67.5 m



## Borehole 131-22-02

### RUN 3

Depth 24.9 m to 26.4 m

Elevation 67.5 m to 66.0 m

Dry Sample

Run 3 Start  
elev. 67.5 m



Run 3 End  
elev. 66.0 m

# Borehole 131-22-02

## RUN 3

Depth 24.9 m to 26.4 m

Elevation 67.5 m to 66.0 m

Wet Sample





## **Appendix D.**

### **Site Photographs**



Photograph 1: Looking project south of from Highway 16  
[taken on December 19, 2022]



Photograph 2: Looking project north of from Highway 16 Overhead  
[taken on December 19, 2022]





Photograph 3: Looking southeast at the southbound embankment  
[taken on December 19, 2022]



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





Photograph 5: Looking northwest at the northbound embankment  
[taken on December 19, 2022]



Photograph 6: Looking northeast at the southbound embankment  
[taken on December 19, 2022]