



**THURBER** ENGINEERING LTD.

**PRELIMINARY  
FOUNDATION INVESTIGATION REPORT  
HIGHWAY 17 TWINNING, RENFREW AREA  
BRUCE STREET (COUNTY ROAD 20) INTERCHANGE  
STA. 18+517, HORTON TOWNSHIP  
BRUCE STREET UNDERPASS - SITE NO. 29X-0408/B1  
WP 4068-09-00 / ASSIGNMENT NO. 4018-E-0009**

Geocres No.: 31F-234

Report to:

**Ministry of Transportation Ontario**

Latitude: 45.497693°  
Longitude: -76.670952°

December 2024  
Thurber File No.: 24726



## TABLE OF CONTENTS

### PART 1. FACTUAL INFORMATION

1	INTRODUCTION .....	1
2	SITE DESCRIPTION .....	2
2.1	General .....	2
2.2	Site Geology .....	3
3	SITE INVESTIGATION AND FIELD TESTING.....	3
3.1	Previous Investigation (2003) .....	3
3.2	Current Investigation (2019/2020/2021/2024) .....	4
4	LABORATORY TESTING.....	7
5	GENERAL DESCRIPTION OF SUBSURFACE CONDITIONS.....	7
5.1	Topsoil .....	8
5.2	Fill .....	8
5.3	Upper Sand and Silt.....	9
5.4	Silty Clay to Clayey Silt.....	9
5.4.1	Silty Clay to Clay (Weathered Crust, CI to CH).....	9
5.4.2	Silty Clay to Clayey Silt (CI to CL-ML).....	10
5.5	Interlayered Silt, Sand and Clayey Silt.....	16
5.6	Dense Sand .....	17
5.7	Till .....	17
5.8	Bedrock.....	18
5.9	Groundwater .....	19
5.10	Analytical Testing.....	20
6	MISCELLANEOUS .....	21



### **Appendices**

Appendix A.	Borehole Location Plan and Stratigraphic Drawings
Appendix B.	Record of Test Hole Sheets
Appendix B.1	Current (2019/2020/2021/2024) Investigation
Appendix B.2	Previous (2003) Investigation
Appendix B.3	Cone Penetration Test Summary Sheets (ConeTec Investigations Ltd.)
Appendix B.4	Soil Summary Figures
Appendix C.	Laboratory Testing Current (2019/2020/2021) Investigation
Appendix D.	Laboratory Testing Previous (2003) Investigation
Appendix E.	Site Photographs



**PRELIMINARY  
FOUNDATION INVESTIGATION REPORT  
HIGHWAY 17 TWINNING, RENFREW AREA  
BRUCE STREET (COUNTY ROAD 20) INTERCHANGE  
STA. 18+517, HORTON TOWNSHIP  
BRUCE STREET UNDERPASS - SITE NO. 29X-0408/B1  
WP 4068-09-00 / ASSIGNMENT NO. 4018-E-0009**

**Geocres No.: 31F-234**

**PART 1. FACTUAL INFORMATION**

**1 INTRODUCTION**

Thurber Engineering Ltd. (Thurber) has been engaged by the Ministry of Transportation Ontario (MTO) to carry out Foundation Investigations to support the design of the Highway 17 Twinning Project which extends from Scheel Drive westerly to 3 km west of Bruce Street in the Renfrew area. Thurber carried out the investigation under MTO Assignment No. 4018-E-0009.

This report addresses the Bruce Street Interchange, which includes the proposed Highway 17 Bruce Street Underpass (Site No. 29X-0408/B1) to carry local traffic over the new, twinned highway, and the four associated ramps: the W-N/S Ramp, the N-E Ramp, the S-W Ramp, and the E-N/S Ramp. The existing Highway 17 alignment at this site will become the future Highway 17 westbound lanes and new eastbound lanes will be constructed adjacent to the existing alignment.

Previous foundation investigation information from boreholes completed in 2004 for the proposed underpass was available under Geocres 31F-139.

This section of the report presents the factual findings obtained from historical foundation investigations available from the online Geocres Library and from the foundation investigation completed as part of the current study.

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

It should be noted that the use of and reliance on Part 1 of the Report is governed by and limited to the terms and conditions set out in the Report and a reliance letter. The Preferred Proponent remains responsible to assess the need for additional investigations and to complete that work.





## **2 SITE DESCRIPTION**

### **2.1 General**

The site is located on Highway 17 at the existing County Road 20 intersection. For project purposes, although Highway 17 is oriented north south at the site it is generally an eastbound westbound highway thus it will be described as oriented east west and County Road 20 will be described as being oriented north south. Within the project limits County Road 20 is also known as Bruce Street to the south and Castleford Road to the north of Highway 17. For clarity and consistency with project documentation, County Road 20 will typically be referred to by its local road names, and the structure as the Bruce Street Underpass.

The existing intersection is an at-grade crossing controlled with traffic lights. In the vicinity of the site, Highway 17 is an undivided highway with one through lane in each direction, left and right turning lanes from westbound Highway 17 to Castleford Road and Bruce Street, as well as off-and on-ramps at Bruce Street and a left turn lane to Castleford Road from the eastbound direction. Highway 17 has gravel shoulders and a posted speed limit of 90 km/hr. It is understood that the AADT projected for 2022 for the section of Highway 17 just east of the site is 15,100.

At the intersection, the Highway 17 road surface elevation is approximately 150.9 m and decreases to the east towards the Bonnechere River. The existing road surface along Bruce Street/Castleford Road decreases nominally from south to north; however, the existing ground northeast of the intersection in the vicinity of the proposed E-N/S Ramp slopes up and away from Castleford Road to a plateau at about Elevation 154.9 m.

West of the intersection, Highway 17 is at or slightly above the natural ground surface elevation. East of the intersection, Highway 17 enters a cut section with the slope heights increasing to the east to as much as about 9 m, within the area of interest addressed herein (to approximately 450 m east of the intersection). The cut slopes generally include a bench at around mid-height and are vegetated with grass. Further to the east, bedrock outcrops are visible about 300 m and 450 m east of the intersection on the south and north sides of the highway, respectively.

Near the intersection, Bruce Street and Castleford Road comprise two-lane roadways with gravel shoulders and a rural cross-section. Elevated and paved bull-noses are present at the northwest and southwest quadrants of the intersection, directing traffic flow from the eastbound off-ramp and to the eastbound on-ramps. It is understood that the AADT values projected for 2022 are approximately 6,500 and 2,300 for Bruce Street and Castleford Road respectively. An at-grade T-intersection is present on Bruce Street approximately 140 m north of Highway 17 connecting to Dugald Road which heads eastward.

It is understood that the intersection of County Road 20 and Highway 17 was reconfigured at some point in the past with the current intersection located approximately 50 m to the west of the previous, and the old alignment of Bruce Street more linear prior to its shift to the currently curved alignment to the east.



Photographs showing the existing conditions in the area of the site are included in Appendix E for reference.

## 2.2 Site Geology

Based on published geological information in *The Physiography of Southern Ontario* by Chapman and Putnam (1984), the site lies within the physiographic region known as the Ottawa Valley Clay Plains. The Ottawa Valley Clay Plains are characterized primarily by clay plains deposited by the Champlain Sea (Leda Clay) interrupted by ridges of rock or sand.

Ontario Geological Survey Map P.3784 for Precambrian Geology for the Horton Area suggests the bedrock is dolomitic and calcitic carbonate metasedimentary bedrock including dolomite and calcite marble.

## 3 SITE INVESTIGATION AND FIELD TESTING

An initial foundation investigation was carried out at the site in October 2003 (Geocres 31F-139) as input to the preliminary design and environmental assessment study completed at that time. The current investigation was carried out in 2019, 2020, 2021 and 2024 to collect additional subsurface information for design of the proposed underpass structure and associated ramps at the interchange.

### 3.1 Previous Investigation (2003)

A total of three boreholes were put down as part of the 2003 investigation. The boreholes were advanced to depths of up to about 53.2 m below the existing ground surface at the time of the investigation using hollow stem augers, casing and wash-boring, and NQ sized coring equipment.

The northing, easting and elevation of the 2003 boreholes are shown on the Borehole Location and Soil Strata Drawings No. 1 to 3 in Appendix A, the individual Record of Borehole sheets in Appendix B, and in the table below. The site is located within MTM Zone 9.

**Table 3-1: Borehole Summary – Previous Investigation (2003)**

Test Hole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface* Elevation (m)	Termination Depth (m)
BRU-1	South Abutment	5039748.0 (45.497526)	291406.0 (-76.671380)	151.6	50.2
BRU-2	Pier	5039748.7 (45.497533)	291445.8 (-76.670871)	150.3	53.2
BRU-3	North Abutment	5039768.7 (45.497714)	291479.6 (-76.670439)	149.3	51.2

\* Ground surface elevation measured during investigation and may have changed in intervening time.

Piezometers, 19 mm in diameter, were installed in all three boreholes. The installation details are illustrated on the respective Record of Borehole sheets provided in Appendix B.

### 3.2 Current Investigation (2019/2020/2021/2024)

The current site investigation and field-testing program was carried out in several phases in the period between September 2019 and March 2024. The investigation consisted of advancing a total of 46 testholes which comprised: initial boreholes put down at 25 locations, supplementary boreholes put down for additional information at four of those locations, five additional boreholes for subsequent installation of monitoring wells, eight Cone Penetration Tests (CPTu), and four supplementary boreholes put down along the eastern extent of the E-N/S Ramp. Shear wave velocity measurements were taken at regular intervals of depth during advancement of two of the CPTu soundings (BRU19-20 and BRU19-24). Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

The locations and elevations of the testholes were surveyed by Thurber with a Trimble Catalyst DA1 antenna with centimeter accuracy. The locations were surveyed prior to advancement of the testholes and, at locations where the testholes were shifted due to utility or access conflicts they were re-surveyed at the completed location. The northing, easting and elevation of the boreholes are shown on the Borehole Location and Soil Strata Drawings No. 1 to 3 in Appendix A, the individual Record of Borehole sheets and CPTu summary plots in Appendix B and in Table 3-2, below.

**Table 3-2: Testhole Summary – Current Investigation (2019/2020/2021)**

Test Hole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
BRU19-01	South Abutment	5039726.4 (45.497332)	291413.0 (-76.671291)	151.2	48.2
BRU19-01A	South Abutment	5039731.4 (45.497377)	291409.7 (-76.671333)	152.2	26.5
BRU19-02	Pier	5039766.5 (45.497693)	291439.5 (-76.670952)	150.1	52.4
BRU19-03	North Abutment	5039787.2 (45.497881)	291475.1 (-76.670497)	149.8	54.1
BRU19-03A	North Abutment	5039786.4 (45.497873)	291482.2 (-76.670407)	149.9	31.1
BRU19-04	North Approach	5039792.9 (45.497932)	291496.6 (-76.670223)	149.8	1.5
BRU19-04A	North Approach	5039792.9 (45.497932)	291496.6 (-76.670223)	149.8	32.6
BRU19-05 (CPTu)	North Approach	5039813.7 (45.498119)	291524.1 (-76.669871)	149.0	31.0
BRU19-06	North Approach	5039844.3 (45.498396)	291564.0 (-76.669361)	148.5	32.0
BRU19-07	North Approach	5039876.9 (45.498689)	291602.4 (-76.668871)	148.1	29.6
BRU19-08 (CPTu)	North Approach	5039910.2 (45.49899)	291640.1 (-76.668390)	147.4	25.6

Test Hole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
BRU19-09	North Approach	5039944.0 (45.499294)	291677.4 (-76.667913)	146.9	24.5
BRU19-10	North Approach	5039979.2 (45.499612)	291713.0 (-76.667459)	146.2	11.3
BRU19-11 (CPTu)	South Approach	5039628.1 (45.496444)	291230.2 (-76.673626)	152.7	13.7
BRU19-12	South Approach	5039651.1 (45.496651)	291274.4 (-76.673061)	152.7	24.1
BRU19-13	South Approach	5039677.0 (45.496886)	291320.2 (-76.672476)	152.5	40.6
BRU19-14 (CPTu)	South Approach	5039706.8 (45.497155)	291367.5 (-76.671872)	152.6	46.5
BRU19-15	South Approach	5039724.0 (45.497310)	291393.0 (-76.671546)	152.6	40.2
BRU19-15A	South Approach	5039724.0 (45.497310)	291393.0 (-76.671546)	152.6	2.9
BRU19-16	W-N/S Ramp	5039789.1 (45.497892)	291224.4 (-76.673705)	151.5	44.5
BRU19-17 (CPTu)	W-N/S Ramp	5039729.3 (45.497354)	291240.2 (-76.673501)	149.9	32.8
BRU19-18	N-E Ramp	5039695.1 (45.497047)	291274.9 (-76.673056)	150.9	34.1
BRU19-19	N-E Ramp	5039715.7 (45.497234)	291347.4 (-76.672129)	152.2	40.9
BRU19-20 (CPTu)	South Abutment	5039735.1 (45.49741)	291411.0 (-76.671317)	152.1	39.1
BRU19-21	N-E Ramp	5039747.3 (45.497517)	291247.1 (-76.673413)	150.7	41.8
BRU19-22	S-W Ramp	5039809.4 (45.498081)	291558.9 (-76.669425)	147.3	39.5
BRU19-23	S-W Ramp	5039802.4 (45.498019)	291606.4 (-76.668817)	146.6	31.8
BRU19-24 (CPTu)	North Abutment	5039779.7 (45.497812)	291476.8 (-76.670475)	149.7	34.9
BRU19-25	S-W Ramp	5039790.3 (45.497909)	291513.8 (-76.670002)	147.9	42.4
BRU19-26	E-N/S Ramp	5039464.6 (45.494980)	291599.5 (-76.668897)	149.7	17.4
BRU19-27	E-N/S Ramp	5039515.3 (45.495436)	291601.2 (-76.668876)	154.6	21.4
BRU19-28	E-N/S Ramp	5039562.5 (45.495861)	291611.3 (-76.668749)	155.0	32.1
BRU19-29	E-N/S Ramp	5039614.8 (45.496331)	291618.2 (-76.668662)	154.7	36.5
BRU19-30	E-N/S Ramp	5039657.2 (45.496713)	291643.3 (-76.668342)	154.1	35.4

Test Hole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
BRU19-31	E-N/S Ramp	5039746.3 (45.497516)	291650.0 (-76.668258)	149.9	37.9
BRU19-32 (CPTu)	E-N/S Ramp	5039793.0 (45.497935)	291638.4 (-76.668408)	146.9	31.6
BRU19-33	E-N/S Ramp	5039840.9 (45.498365)	291598.8 (-76.668916)	146.9	33.6
BRU21-02	Pier	5039761.4 (45.497647)	291427.9 (-76.671101)	151.4	6.7
BRU21-05	North Approach	5039811.7 (45.498101)	291523.6 (-76.669878)	149.2	6.7
BRU21-15	South Approach	5039724.3 (45.497312)	291390.6 (-76.671577)	152.6	6.1
BRU21-18	N-E Ramp	5039688.1 (45.496984)	291279.4 (-76.672999)	151.4	6.1
BRU21-23	S-W Ramp	5039799.9 (45.497997)	291606.7 (-76.668814)	146.6	6.1
BRU23-1	E-N/S Ramp	5039441.2 (45.494769)	291624.5 (-76.668576)	154.9	18.6*
BRU23-2	E-N/S Ramp	5039400.1 (45.494399)	291636.3 (-76.668424)	153.9	17.7*
BRU23-3	E-N/S Ramp	5039344.1 (45.493897)	291655.6 (-76.668176)	151.5	8.0
BRU23-4	E-N/S Ramp	5039302.8 (45.493525)	291667.7 (-76.668020)	149.1	5.8

\* termination depth of DCPT advanced below sampled borehole

Boreholes BRU19-04, BRU19-04A, BRU19-06, BRU19-07, BRU19-12, BRU-13, and BRU19-15 were put down with a CME 75 truck-mounted drill rig equipped with hollow stem augers and NW casing. Boreholes BRU21-02, BRU21-05, BRU21-15, BRU21-18, and BRU21-23 were drilled with a Diedrich 50, track-mount rig equipped with hollow stem augers. The remaining boreholes were put down from a track-mounted drill rig (CME 55, CME 75, or CME 850) equipped with hollow stem augers and either NW or HW casing. Bedrock was cored in Boreholes BRU19-01, BRU19-02, and BRU19-03 with NQ-sized coring.

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). At Boreholes BRU23-1 and BRU23-2 the drilling depth exceeded the equipment available, so a Dynamic Cone Penetration Test (DCPT) was advanced at each location to provide an indication of depth to competent stratum. Thin-walled (Shelby) tube samples of the cohesive materials were retrieved at various elevations in the boreholes to obtain relatively undisturbed soil samples for further laboratory testing. In-situ vane shear testing was conducted in the cohesive deposits with an MTO 'N' sized vane.

Piezometers, 19 mm in diameter, were installed in Boreholes BRU19-01, BRU19-03, BRU19-06, and BRU19-13. Monitoring wells, 50 mm in diameter, were installed in Boreholes BRU19-21, BRU19-29, BRU21-02, BRU21-05, BRU21-15, BRU21-18, BRU21-23, BRU-23-1, and BRU23-3.



The installation details are illustrated on the respective Record of Borehole sheets provided in Appendix B. The piezometers and monitoring wells installed as part of the current investigation will be decommissioned by Thurber, as outlined in the Hydrogeological Investigation and Design Report.

The boreholes were backfilled in accordance with MOE requirements (O.Reg 903, as amended).

The drilling and sampling operations were supervised on a full-time basis by members of Thurber's geotechnical staff. The drilling supervisors logged the boreholes and processed the recovered soil samples for transport to Thurber's Ottawa geotechnical laboratory for further examination and testing, as well as submission to external laboratories.

#### **4 LABORATORY TESTING**

Laboratory testing was selected in accordance with the current MTO Guideline for Foundation Engineering Services, Section 5. Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all retained soil samples. At least 25% of the recovered soil samples were subjected to testing for grain size distribution analysis and, where appropriate, Atterberg Limits in accordance with MTO and ASTM standards. Supplementary specialized laboratory testing was carried out on selected soil samples in accordance with the project-specific requirements outlined in Section 7.7.1.3 RFP and included one-dimensional consolidation testing (standard incremental loading, long-term incremental loading, and controlled-strain loading), triaxial testing (unconsolidated-undrained and consolidated-drained), and unconfined compressive strength testing.

Rock cores were logged and total core recovery (TCR), solid core recovery (SCR) and rock quality designation (RQD) were determined in the field. Unconfined compressive strength (UCS) testing was carried out on selected samples to give an indication of the bedrock strength.

Chemical analysis for determination of pH, conductivity, resistivity, sulphide, sulphate, and chloride was carried out on three soil samples.

The results of the geotechnical tests are summarized on the Record of Borehole sheets included in Appendix B and all laboratory results are presented on the figures included in Appendix C (current investigation) and Appendix D (2003 investigation).

#### **5 GENERAL DESCRIPTION OF SUBSURFACE CONDITIONS**

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and CPTu summary plots included in Appendix B, as well as the Borehole Location and Soil Strata Drawings 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 Borehole Records takes precedence over the Soil Strata Drawing and the general description. It must be recognized that the soil, bedrock and groundwater conditions may vary between and beyond borehole locations. Soil classification is in accordance with ASTM D2487. Description of cohesive soils and secondary components of all deposits from the current



boreholes are described as outlined in the MTO Guideline for Foundation Engineering Services manual (October 2020) and the 4<sup>th</sup> Edition of the Canadian Foundation Engineering Manual (2006). Terminology from the 2003 borehole information may vary from current practice.

The stratigraphy at the site generally consists of topsoil and/or granular fill overlying an extensive native deposit of silty clay to clayey silt. Toward the eastern extend of the site, the silty clay to clayey silt is overlain by a deposit of native sand and silt. The extensive silty clay to clayey silt deposit is underlain by interlayered silt, sand and clayey silt which is, in turn, underlain by glacial till and marble bedrock.

## 5.1 Topsoil

Topsoil was encountered at surface at several boreholes put down near the proposed Bruce Street alignment (BRU-1, BRU-3, BRU19-06, BRU19-07, BRU19-13, BRU19-22, BRU19-25 and BRU21-05), the W-N/S and N-E Ramps (BRU19-16 and BRU19-21), and the E-N/S Ramp (BRU19-23, BRU19-26, BRU19-29, and BRU19-31). The topsoil thickness ranged from about 50 to 800 mm. The topsoil ranged from clayey silt and organics to silty sand trace gravel trace roots. The N-values obtained from three SPTs completed within the topsoil ranged from 11 to 14 blows per 0.3 m of penetration, indicating a compact relative density.

The moisture content of recovered topsoil samples ranged from about 11% to 37%. The results of a grain size analysis test conducted on one sample of topsoil from Borehole BRU19-25 are summarized below and are illustrated on Figure C1.1 in Appendix C.

Soil Particle	Percentage (%)
Gravel	4
Sand	80
Silt	16
Clay	

## 5.2 Fill

Non-cohesive granular fill consisting of sand to gravelly silty sand was encountered at boreholes put down along the proposed Bruce Street alignment (BRU-1, BRU-2, and BRU19-01 to BRU19-15A, BRU21-02 and BRU 21-05). The thickness ranged from 0.6 m to 2.3 m (base elevation 144.7 m to 151.8 m). The SPT N-values in the fill material ranged from 4 to 73 blows but were generally between about 10 and 25 blows per 0.3 m of penetration, indicating a compact relative density.

The moisture content of samples of the granular fill ranged from 2% to 34%. The results of grain size analysis tests conducted on eight samples of fill are summarized below and are illustrated on Figures C2.1 and C2.2 in Appendix C.

Soil Particle	Percentage (%)
Gravel	5 – 46
Sand	37 – 86
Silt	8 – 30
Clay	

### 5.3 Upper Sand and Silt

A near-surface layer of sand and silt was encountered at boreholes BRU19-26 to BRU19-30, BRU23-1 to BRU23-4, put down along the proposed E-N/S Ramp. The layer ranged from silt trace sand to sand trace silt. The thickness ranged from 0.6 m to 3.8 m (base elevation 145.3 m to 153.4 m). The N-values obtained from SPTs conducted in this material ranged from 4 to 23 indicating a loose to compact relative density.

The moisture content of samples of the sand and silt ranged from 7% to 42%. The results of grain size analysis tests conducted on nine samples are summarized below and are illustrated on Figures C3.1 and C3.2 in Appendix C. Atterberg Limit testing carried out on one sample of the deposit from Borehole BRU19-30 gave non-plastic results. Atterberg Limit testing on samples from BRU23-3 and BRU23-4 yielded liquid limit values of 23% and 25%, and plastic limit values of 14% and 18% and are illustrated on Figure C4.1 in Appendix C. This soil unit could be classified as CL to ML to SM.

Soil Particle	Percentage (%)	
Gravel	0 – 6	
Sand	9 – 92	
Silt	46 – 69	8 – 91
Clay	12 – 29	

### 5.4 Silty Clay to Clayey Silt

Beneath the topsoil and fill or upper sand and silt, an extensive deposit of silty clay to clayey silt was encountered at most test hole locations. The deposit generally transitions from silty clay to clayey silt with depth. The overall thickness of the deposit ranges from about 9 m at the northern extent of the proposed Bruce Street alignment (Borehole 19-10) to 40 m within the southern portion (Borehole 19-19) with base elevations ranging from 135.6 m to 112.6 m.

Along the western portion of the proposed E-N/S Ramp (between Bruce Street and about Sta. 18+400) the deposit ranges from about 14 m to 32 m thick, with base elevations ranging from 133.7 to 119.6 m. The results of the boreholes put down adjacent to the eastern portion of the E-N/S Ramp (east of about Sta. 18+400) indicate that the thickness of the deposit decreases to the east and was not encountered in the boreholes near the eastern extent. However, it should be noted that the boreholes near the eastern extent of the proposed E-N/S Ramp were put down within the cut slope north of the proposed ramp alignment and may also indicate a decrease in thickness of the deposit to the north.

Further description of the material properties and field test results within the layers are described in the following sections.

#### 5.4.1 Silty Clay to Clay (Weathered Crust, CI to CH)

The upper portion of the deposit is weathered to a grey-brown crust, which generally ranges from about 1.5 to 6.9 m thick (base elevations 149.2 to 141.2m). It generally consists of silty clay to



clay. SPTs conducted in the weathered crust gave N-values ranging from 3 to 28 blows per 0.3 m of penetration. In-situ shear vane tests gave the maximum recordable undrained shear strength values of 93 to 114 kPa (depending on the dimensions of the vane used), except for isolated tests carried out within the deposit at Boreholes BRU19-15 and BRU19-25 which gave undrained shear strengths of 81 and 76 kPa, respectively. These values indicate that the weathered crust is stiff to very stiff.

The corrected CPTu tip resistance ( $q_t$ ) recorded during advancement of the CPTu through the weathered crust ranged between about 1,300 and 3,000 kPa, with spikes up to about 5,000 kPa.

The natural moisture content of samples of the weathered crust portion of the silty clay deposit ranged from about 16% to 52%. The results of grain size analysis tests conducted on 34 samples of the weathered crust collected during the current investigation and three samples collected during the 2003 investigation are summarized below and are illustrated on Figures C5.1 to C5.6 in Appendix C and Figures D1.1 and D1.2 in Appendix D.

Soil Particle	Percentage (%)
Gravel	0 – 1
Sand	0 – 8
Silt	37 – 58
Clay	41 – 63

The results of Atterberg Limits testing carried out on 33 samples of the weathered silty clay crust collected during the current investigation and three samples obtained during the 2003 investigation are summarized below and are illustrated on Figures C6.1 to C6.6 in Appendix C and Figure D2 in Appendix D. The laboratory results indicate that the material is generally a silty clay to clay of intermediate to high plasticity (CI to CH).

Parameter	Value
Liquid Limit	28 – 57
Plastic Limit	19 – 30
Plasticity Index	9 – 32

#### 5.4.2 Silty Clay to Clayey Silt (CI to CL-ML)

Beneath the weathered crust, the lower portion of the deposit consists of grey silty clay to clayey silt. Along the proposed Bruce Street alignment, it extends to depths ranging up to about 40 m below the existing ground surface (base elevations ranging from 135.6 m to 112.6 m). Along the proposed E-N/S Ramp alignment, it extends to depths up to about 35 m below the existing ground surface (base elevations ranging from 142.7 m to 119.6 m, where encountered).

The SPT N-values recorded ranged from weight-of-rods (WR) to 23 blows per 0.3 m of penetration but were generally between about 1 and 6 blows. In situ shear vane tests gave undrained shear strengths between about 50 kPa and the maximum recordable value ranging from 98 to 114 kPa (depending on the vane size). Remolded vane tests recorded sensitivities



ranging from about 2 to 25, but generally between about 4 and 10, indicating a sensitive to extra sensitive material (CFEM, 2006).

The peak shear strength values measured at borehole locations along the proposed Bruce Street and the E-N/S Ramp alignments are shown on Figures B4.1 and B4.2 in Appendix B, respectively.

The corrected CPTu tip resistance ( $q_t$ ) recorded during advancement of the CPTu through the unweathered silty clay to clayey silt ranged between about 1,000 and 3,500 kPa, with spikes up to about 7,800 kPa in the lower portions.

The moisture content of samples of the unweathered silty clay to clayey silt ranged from 23% to 54%.

Above about Elevation 133 m, the deposit generally consists of a silty clay to clayey silt.

The results of grain size analysis test conducted on 41 samples of silty clay to clayey silt from the current investigation and three samples from the 2003 investigation from above Elevation 133 m are summarized below and are illustrated on Figures C7.1 to C7.7 in Appendix C and Figures D1.1 and D1.2 in Appendix D.

Soil Particle	Percentage (%)
Gravel	0 – 5
Sand	0 – 20
Silt	39 – 65
Clay	29 – 61

The results of Atterberg Limits testing carried out on 37 samples of the deposit from the current investigation and three samples from the 2003 investigation from above Elevation 133 m are summarized below and are illustrated on Figures C8.1 to C8.7 in Appendix C and Figure D2 in Appendix D. The laboratory results indicate that the material is generally a silty clay to clayey silt of intermediate to low plasticity (CI to CL). Five additional Atterberg Limit tests carried out on samples obtained from the deposit above Elevation 133 m in Boreholes BRU19-01A, BRU19-03A, BRU19-18, BRU19-28, and BRU19-29 gave non-plastic results.

Parameter	Value
Liquid Limit	22 – 52
Plastic Limit	13 – 25
Plasticity Index	4 – 33

Below about Elevation 133 m, the deposit generally consists of a clayey silt.

The results of grain size analysis test conducted on 26 samples of clayey silt from the current investigation and four samples from the 2003 investigation from below Elevation 133 m are summarized below and are illustrated on Figures C9.1 to C9.5 in Appendix C Figures D1.1 and D1.2 in Appendix D.

Soil Particle	Percentage (%)
Gravel	0 – 2
Sand	0 – 19
Silt	49 – 66
Clay	22 – 47

The results of Atterberg Limits testing carried out on 22 samples of the deposit below Elevation 133 m are summarized below and are illustrated on Figures C10.1 to C10.4 in Appendix C. The laboratory results indicate that the material is generally a clayey silt low plasticity (CL-ML to CL). Six additional Atterberg Limit tests carried out on samples obtained from the deposit below Elevation 133 m in Boreholes BRU19-01, BRU19-03A, BRU19-15, BRU19-18, and BRU19-29 gave non-plastic results.

Parameter	Value
Liquid Limit	16 – 51
Plastic Limit	12 – 22
Plasticity Index	3 – 29

Additional laboratory testing was carried out on relatively undisturbed samples of the unweathered silty clay to clayey silt obtained with thin-walled tubes during the current investigation at Boreholes BRU19-01, BRU19-01A, BRU19-03, and BRU19-03A.

Laboratory oedometer (one-dimensional consolidation) tests using standard incremental loading per ASTM D2435, and as outlined in the RFP, were carried out on five samples of the silty clay to clayey silt. The results of testing carried out on samples from the current investigation from Boreholes BRU19-01, BRU19-01A, and BRU19-03A are presented in Appendix C. The results of testing carried out on one sample from the 2003 investigation from Borehole BRU-1 are presented in Appendix D. The results from all five tests are summarized in Table 5-1, below.

**Table 5-1: Summary of One-Dimensional Consolidation Testing – Silty Clay to Clayey Silt**

Parameter	Results				
Borehole	BRU19-01	BRU19-01A	BRU19-01A	BRU19-03	BRU-1
Sample	ST10	ST1	ST5	ST14	TW1
Sample Depth (m)	11	4.9	17.7	14.0	11.9
Sample Elevation (m)	140.2	147.3	134.5	135.8	139.7
Approx. Existing Effective Stress, $P_0'$ (kPa)	104.1	57.3	167.3	120.6	160.2
Moisture Content (%)	35.6	43.7	38.4	36.3	40.7
Liquid Limit (%)	34.5	49	NP	38.9	33
Plastic Limit (%)	22	23	NP	24.8	22
Plasticity Index (%)	12.5	26	NP	14.1	11
Unit Weight, $\gamma$ (kN/m <sup>3</sup> )	17.4	17.3	18.1	17.5	18

Parameter	Results				
Degree of Saturation, $S_{ro}$ (%)	88	97	99	90	100
Specific Gravity, $G_s$	2.80	2.75	2.76	2.79	2.79
Initial Void Ratio $e_o$	1.137	1.234	1.069	1.128	1.14
Pre-consolidation Pressure, $P_c'$ (kPa)	310	666	282	570	360
Over Consol. Ratio, OCR	2.8	11.2	1.7	4.2	2.4
Compression Index, $C_c$	0.33	0.72	0.50	0.55	0.44
Recompression Index, $C_r$	0.055	0.053	0.036	0.023	0.086
Coefficient of consolidation, $c_v$ (cm <sup>2</sup> /s)	0.007	0.001	0.001	0.009	0.003
Coefficient of re-consolidation, $c_{vr}$ (cm <sup>2</sup> /s)	0.022	0.003	0.003	0.060	0.013

Laboratory oedometer tests using controlled-strain loading (constant rate-of-strain, CRS) were carried out on six samples of the silty clay to clayey silt per ASTM D4186, and as outlined in the RFP. All tests imposed a strain rate of 0.8% per hour during loading, and 0.1% per hour for unloading. The results of the testing are presented in Appendix C and summarized in Table 5-2 below.

**Table 5-2: Summary of One-Dimensional Consolidation (CRS) Testing – Silty Clay to Clayey Silt**

Parameter	Results					
Borehole (BRU*)	19-01	19-01	19-01A	19-01A	19-03A	19-03A
Sample	ST14	ST20	ST2	ST6	ST3	ST8
Sample Depth (m)	17.1	26.2	7.9	20.1	14.0	30.8
Sample Elevation (m)	134.1	125.0	144.3	132.1	135.9	119.4
Approx. Existing Effective Stress, $P_0'$ (kPa)	150.4	250.9	82.9	177.2	119.0	283.5
Moisture Content (%)	40.1	29.7	41.3	37.4	38.8	29.8
Liquid Limit (%)	N/A	29.3	36.6	17.5	31.3	19.8
Plastic Limit (%)	N/A	14.2	21.2	13.7	20.8	13
Liquidity Index	N/A	15.1	15.4	3.8	10.5	6.8
Unit Weight, $\gamma$ (kN/m <sup>3</sup> )	17.4	18.6	17.7	17.6	17.4	18.6
Degree of Saturation, $S_{ro}$	-	-	-	-	-	-
Specific Gravity, $G_s$	2.77	2.78	2.75	2.78	2.78	2.76
Initial Void Ratio $e_o$	1.2	0.92	1.15	1.19	1.2	0.94
Pre-consolidation Pressure, $P_c'$ (kPa)	270	600	690	320	780	710
Over Consol. Ratio, OCR	1.8	2.4	8.3	1.8	6.6	2.5

Parameter	Results					
Compression Index, $C_c$	0.39	0.35	0.59	0.67	0.68	0.38
Recompression Index, $C_r$	0.100	0.033	0.043	0.050	0.020	0.049
Coefficient of consolidation, $c_v$ (cm <sup>2</sup> /s)	0.040	0.008	0.190	0.002	0.034	0.007
Coefficient of re-consolidation, $c_{vr}$ (cm <sup>2</sup> /s)	0.120	0.045	0.650	0.016	0.400	0.052

Long-term laboratory oedometer (creep) tests were carried out on samples of the silty clay to clayey silt using standard incremental loading per ASTM D2435, and as outlined in the RFP to include minimum 7-day loading hold times once the test had reached the approximate estimated sampled in-situ effective stress, and then again once the test had reached the effective stress associated with the final proposed embankment height. The test parameters and results are presented in Appendix C and summarized in Table 5-3 below.

Triaxial testing was carried out on selected samples of the silty clay to clayey silt and included testing of four samples under unconsolidated-undrained conditions and two samples under consolidated-drained conditions. The test results are presented in Appendix C and summarized in Table 5-4 and Table 5-5 below.

**Table 5-3: Summary of One-Dimensional Consolidation (Creep) Testing – Silty Clay to Clayey Silt**

Parameter		Results	
Borehole		BRU19-01	BRU19-03
Sample		ST16	ST20
Sample Depth (m)		20.1	23.2
Sample Elevation (m)		131.1	126.6
Approx. Existing Effective Stress, $P_0'$ (kPa)		173.2	230.6
Moisture Content (%)		37.9	27.7
Liquid Limit (%)		31.2	24.1
Plastic Limit (%)		18.3	14.8
Plasticity Index, %		12.9	9.3
Unit Weight, $\gamma$ (kN/m <sup>3</sup> )		17.4	19.2
Degree of Saturation, $S_{ro}$		90.4	95.7
Specific Gravity, $G_s$		2.79	2.74
Initial Void Ratio $e_o$		1.167	0.795
Secondary Compression Index, $C_\alpha$	$\sigma' = 193.2$ kPa	0.004	0.003
	$\sigma' = 385.7$ kPa	0.014	0.010

**Table 5-4: Summary of Triaxial (Unconsolidated-Undrained) Testing – Silty Clay to Clayey Silt**

Parameter	Results			
Borehole	BRU19-01A	BRU19-01A	BRU19-03A	BRU19-03A
Sample	ST2	ST6	ST3	ST7
Sample Depth, (m)	7.9	20.1	14.0	27.7
Sample Elevation, (m)	144.3	132.1	135.9	122.2
Approx. Exist Eff. Stress, $P_0'$ , (kPa)	86.3	205.5	123.9	281.0
Moisture Content, (%)	37.0	36.6	38.7	29.5
Liquid Limit, %	36.6	17.5	31.3	20.5
Plastic Limit, %	21.2	13.7	20.8	17.4
Plasticity Index, %	15.4	3.8	10.5	3.1
Moist Unit Weight, $\gamma$ (kN/m <sup>3</sup> )	18.1	19.0	17.7	19.5
Specific Gravity, $G_s$	2.75	2.76	2.78	2.77
Initial Void Ratio $e_0$	1.045	0.943	1.129	0.808
Deviator Stress at Failure (kPa)	208	100	213	135
Undrained Shear Strength (kPa)	104	50	107	67

**Table 5-5: Summary of Triaxial (Consolidated-Drained) Testing – Silty Clay to Clayey Silt**

Parameter	Results					
Borehole	BRU19-01A			BRU19-03A		
Sample	ST4			ST5		
Sample Depth, (m)	14.6			18.6		
Sample Elevation, (m)	137.6			131.3		
Max. Major Principal Stress, $\sigma_1$ (kPa)	505.1	661.5	978.9	617.0	800.5	1112.1
Max. Minor Principal Stress, $\sigma_3$ (kPa)	188.0	280	465	214	320	531

Unconfined compressive strength testing was carried out on select soil samples as per ASTM D2166, and as outlined in the RFP. The test parameters and results are presented in Appendix C and summarized in Table 5-6 below.

**Table 5-6: Summary of Unconfined Compressive Strength Testing – Silty Clay to Clayey Silt**

Parameter	Results		
Borehole	BRU19-01	BRU19-03	BRU19-03
Sample	ST20	ST7	ST25
Sample Depth, (m)	26.8	4.9	30.8
Sample Elevation, (m)	124.4	144.9	119.0
Approx. Existing Effective Stress, $P_0'$ , (kPa)	259.8	61.6	296.0
Moisture Content, (%)	36.0	38.7	35.2

Parameter	Results		
Liquid Limit, %	29.3	62.3	32.7
Plastic Limit, %	14.2	22.3	16.2
Plasticity Index, %	15.1	40.0	16.5
Moist Unit Weight, $\gamma$ (kN/m <sup>3</sup> )	18.7	18.2	19.0
Unconfined Compressive Strength (kPa)	101	175	100
Shear Strength (kPa)	50	87	50

## 5.5 Interlayered Silt, Sand and Clayey Silt

Interlayered silt, sand and clayey silt was encountered at all boreholes that penetrated the extensive silty clay to clayey silt deposit except at Boreholes BRU19-09, BRU19-10, BRU19-12, BRU19-26 and BRU19-28. At the east end of the E-N/S Ramp, interlayered clayey silt and silty sand was encountered in BRU23-3. Where fully penetrated, the interlayered deposits generally consist of a predominantly silt and sand portion overlying a sandy clayey silt portion. At some borehole locations the interlayering was more irregular, and distinct portions were not discernable.

The thickness of the interlayered silt, sand, and clayey silt, when fully penetrated ranges from 1.5 m to greater than 11.9 m (base elevations ranging from 144.8 m to 105.2 m). The N-values obtained from SPTs conducted in this material ranged from weight-of-hammer (WH) to 67 blows per 0.3 m of penetration. At Borehole BRU19-16, a Dynamic Cone Penetration Test (DCPT) was carried out within the deposit from about Elevation 111.3 m to 107.0 m and gave DCPT N-values ranging from 11 to 65 blows per 0.3 m of advancement of the probe. The SPT and DCPT results indicate that the interlayered deposits have a very loose to very dense relative density.

The moisture content ranged from 15% to 41%. The results of grain size analysis tests conducted on 26 samples of the interlayered, sand and clayey silt obtained during the current investigation and two samples obtained during the 2003 investigation are summarized below and are illustrated on Figures C11.1 to C11.5 in Appendix C and Figure D3 in Appendix D.

Soil Particle	Percentage (%)	
Gravel	0 – 12	
Sand	1 – 86	
Silt	20 – 63	14 – 38
Clay	6 – 36	

The results of Atterberg Limits testing carried out on 17 samples recovered from cohesive interlayers of this material are summarized below and are illustrated on Figures C12.1 to C12.3 in Appendix C. The laboratory results indicate that the fines are generally a clayey silt of low plasticity (CL to CL-ML). Six additional Atterberg Limit tests carried out on samples obtained from the interlayered deposits in Boreholes BRU19-01, BRU19-02, BRU19-07, BRU19-23, BRU19-25, and BRU19-33 gave non-plastic results.

Parameter	Value
Liquid Limit	15 – 29
Plastic Limit	12 – 17
Plasticity Index	3 – 14

## 5.6 Dense Sand

Near the east end of the E-N/S Ramp, at Boreholes BRU-19-26, BRU23-1 and BRU23-2, a deposit of dense sand containing trace to some gravel was encountered below the silty clay to clayey silt deposit (BRU1-26 and BRU23-1) or near surface at 0.6 m depth (BRU23-2).

The N-values obtained from SPTs conducted in the deposit ranged from 10 to 90 blows per 0.3 m of penetration but were generally greater than 50 blows indicating a very dense relative density. Sampled drilling at Boreholes BRU23-1 and BRU23-2 was terminated in the very dense sand deposit, and a DCPT advanced below. The DCPTs met effective refusal (greater than 100 blows for advancement of 25 mm) at depths of 18.6 m and 17.7 m below the ground surface at the borehole locations (base elevations of 136.3 m and 136.2 m).

The moisture content of samples tested ranged from 3% to 24%. The results of grain size analysis test conducted on five samples of the dense sand material are summarized below and are illustrated on Figure C13.1 in Appendix C.

Soil Particle	Percentage (%)
Gravel	0 – 16
Sand	75 – 96
Silt	4 – 14
Clay	

## 5.7 Till

A deposit of glacial till consisting of silty sand and gravel, containing occasional to frequent cobbles and boulders was encountered beneath the silty clay to clayey silt and interbedded layers of silt, sand, and clayey silt, where fully penetrated. Boreholes BRU23-3 and BRU23-4 were terminated at SPT refusal in the till at elevations of 143.5 m and 143.3 m. The glacial till was fully penetrated at Boreholes BRU-1, BRU-2, BRU-3, BRU19-01, BRU19-02, and BRU19-03; the thickness at these locations ranged from 2.3 m to 7.4 m (base elevations ranging from 106.2 m to 98.8 m).

The N-values obtained from SPTs conducted in the till material ranged from 7 to greater than 100 blows per 0.3 m of penetration but were generally greater than 50 blows indicating a very dense relative density. Refusals within this deposit are likely due to presence of cobbles and boulders. Penetration through this layer often required the use of coring techniques.



The moisture content of samples tested ranged from 6% to 30%. The results of grain size analysis test conducted on 12 samples of till material are summarized below and are illustrated on Figures C14.1 and C14.2 in Appendix C.

Soil Particle	Percentage (%)
Gravel	3 – 52
Sand	41 – 79
Silt	7 – 34
Clay	

## 5.8 Bedrock

Bedrock was encountered in Boreholes BRU19-01, BRU19-02, BRU19-03, BRU-1, BRU-2, and BRU-3. The bedrock encountered consisted of moderately weathered to fresh, fine to large grained, marble that is predominantly white, grey, and black in colour. Bedrock logs are provided in Appendix B. Photographs of the bedrock cores are provided in Appendix C. The following table summarizes the rock core quality:

Summary of Rock Core Quality Parameter	Range	Average
Total Core Recovery (TCR), %	98 – 100	99
Solid Core Recovery (SCR), %	29 – 100	76
Rock Quality Designation (RQD), %	39 – 100	77
Fracture Index (fractures per 0.3m)	0 – >10	2

Based on the RQD values, the bedrock is classified as poor to excellent quality.

Unconfined compressive strength (UCS) testing was carried out on eight samples of the bedrock in the boreholes listed above. The UCS values ranged from 42 MPa to 133 MPa with an average of 86 MPa. Based on the unconfined compressive strength testing the bedrock is classified as medium strong to very strong. It should be noted that fractured zones and vertical and sub-vertical fractures were present in the bedrock encountered in most boreholes.

A summary of the bedrock surface information is provided in the table below.

Borehole No.	Depth to Bedrock Surface (mbgs)	Bedrock Surface Elevation (m)
BRU19-01	45.0	106.2
BRU19-02	48.3	101.8
BRU19-03	51.0	98.8
BRU-1	48.8	102.8
BRU-2	50.3	100.0
BRU-3	48.6	100.7

Bedrock outcrops were observed at ground surface at the east end of the project limits on both sides of the existing highway (see Drawing 1). The existing outcrop on the north side of the

highway right-of-way, at the east end of the proposed E-N/S Ramp and between the existing Highway 17 and Borehole BRU23-4, has a surface elevation ranging up to about 147.0 m.

## 5.9 Groundwater

Groundwater levels recorded in the piezometer and monitoring wells are presented in Table 5-7.

**Table 5-7: Summary of Groundwater Levels**

Borehole No.	Elevation (m)		Screened Material	Groundwater Depth (m) <sup>b</sup>	Groundwater Elevation (m)	Date of Measurement
	Ground Surface <sup>a</sup>	Screen Bottom				
BRU19-01	151.2	141.3	Clayey Silt	2.1	149.1	November 26, 2019
				1.3	149.9	April 21, 2020
				1.3	149.9	December 15, 2020
				1.7	149.5	August 4, 2021
				1.4	149.8	December 22, 2021
				1.8	149.4	January 11, 2022
				1.8	149.4	January 18, 2022
BRU19-03	149.8	139.7	Silty Clay	1.3	148.4	November 26, 2019
				-0.2	149.9	April 21, 2020
				0.8	148.9	December 15, 2020
				1.2	148.5	August 4, 2021
				0.8	148.9	December 22, 2021
				1.5	148.2	January 11, 2022
				1.5	148.2	January 18, 2022
BRU19-06	148.5	141.2	Silty Clay	1.9	146.6	November 26, 2019
				1.8	146.7	April 21, 2020
				1.8	146.7	December 15, 2020
				2.0	146.5	August 4, 2021
				1.8	146.7	December 22, 2021
				2.1	146.4	January 11, 2022
				2.1	146.4	January 18, 2022
BRU19-13	152.5	142.1	Clayey Silt	2.6	149.9	November 26, 2019
				2.2	150.3	April 21, 2020
				2.5	150.0	December 15, 2020
				2.4	150.1	August 4, 2021
				2.4	150.1	December 22, 2021
				2.4	150.1	January 11, 2022
				2.4	150.1	January 18, 2022
BRU19-21	150.7	141.6	Clayey Silt	1.9	148.8	December 15, 2020
				0.7	150.0	August 4, 2021
				0.9	149.8	September 22, 2021
				7.1	143.6	October 21, 2021
				6.9	143.8	November 1, 2021
				4.1	146.6	January 11, 2022
				4.1	146.6	January 18, 2022
				3.8	146.9	January 27, 2022



Borehole No.	Elevation (m)		Screened Material	Groundwater Depth (m) <sup>b</sup>	Groundwater Elevation (m)	Date of Measurement
	Ground Surface <sup>a</sup>	Screen Bottom				
BRU19-29	154.7	147.4	Silty Clay Crust	3.3	151.4	December 15, 2020
				3.5	151.2	August 4, 2021
				4.3	150.4	September 30, 2021
				4.3	150.4	October 5, 2021
BRU19-29	154.7	147.4	Silty Clay Crust	3.5	151.2	January 11, 2022
				3.6	151.1	January 18, 2022
				3.5	151.2	January 26, 2022
BRU21-02	151.4	145.3	Clay Crust	2.4	149.0	November 4, 2021
				2.3	149.1	November 30, 2021
				2.2	149.2	December 23, 2021
				2.5	148.9	January 19, 2022
BRU 21-05	149.2	143.1	Silty Clay Crust	2.0	147.2	November 16, 2021
				2.0	147.2	December 1, 2021
				2.3	146.9	January 19, 2022
BRU21-15	152.6	146.5	Silty Clay Crust	2.6	150.0	November 2, 2021
				2.6	150.0	November 3, 2021
				3.0	149.6	January 19, 2022
BRU21-18	151.4	145.3	Silty Clay	1.5	149.9	November 2, 2021
				1.6	149.8	November 3, 2021
				1.7	149.7	January 19, 2022
BRU21-23	146.6	140.5	Silty Clay Crust	0.3	146.3	November 16, 2021
				0.3	146.3	November 24, 2021
				0.7	145.9	January 19, 2022
BRU-1	151.6	105.9	Till	6.4	145.2	October 22, 2003
				5.4	146.2	December 18, 2003
				5.8	145.8	February 4, 2004
				5.6	146.0	March 11, 2004
BRU-2	150.3	97.1	Bedrock	1.8	148.5	October 22, 2003
BRU-3	149.3	98.1	Bedrock	3.5	145.8	December 18, 2003
				4.1	145.2	February 4, 2004
				3.6	145.7	March 11, 2004
BRU23-1	154.9	139.1	Sand	11.7	143.2	March 7, 2024
				11.6	143.3	March 22, 2024
				11.5	143.4	April 10, 2024
BRU23-3	151.5	143.8	Sand/Till	Dry		March 7, 2024
				Dry		March 22, 2024
				Dry		April 10, 2024
				Dry		April 24, 2024

<sup>a</sup> Ground surface elevation at the time of borehole survey

<sup>b</sup> Negative values indicate artesian conditions

## 5.10 Analytical Testing

Three samples were submitted to Paracel Laboratories in Ottawa, Ontario for analysis of pH, water soluble sulphate, sulphide and chloride concentrations, resistivity and conductivity. The



analysis results are summarized in the table below. Copies of the test results are provided in Appendix C.

Borehole	Sample (Soil Type)	Depth (m)	Chloride (µg/g)	Sulphate (µg/g)	Sulphide (%)	pH (-)	Resistivity (Ohm-cm)
BRU19-01	SS4 (Silty Clay)	2.3 – 2.9	9	9	0.02	7.78	4850
BRU19-02	SS3 (Silty Clay)	1.5 – 2.1	1280	55	< 0.02	7.91	524
BRU19-03	SS5 (Silty Clay)	3.0 – 3.7	662	38	< 0.02	7.5	902

## 6 MISCELLANEOUS

Borehole locations were selected by Thurber relative to existing site features. The as-drilled locations and ground surface elevation of the boreholes were surveyed by Thurber following completion of the field program. The elevation survey was carried out with reference to geodetic elevation benchmarks provided by the MTO.

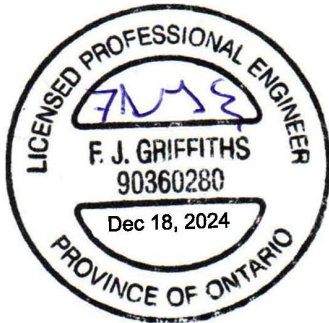
Eastern Ontario Diamond Drilling Ltd. of Hawkesbury, Ontario and Marathon Underground Ltd. of Greely, Ontario supplied and operated the drilling equipment and carried out the drilling, soil sampling, in-situ testing, piezometer/monitoring well installation. ConeTec Investigations Ltd. of Richmond Hill, Ontario supplied and operated the CPT equipment and carried out the in-situ testing. The field investigation was supervised on a full-time basis by Richard Howarth, Michel Johnston, Anderson de Oliveira, and Michael Wong of Thurber. Overall supervision of the investigation program was provided by Justin Gray, P.Eng.

Routine geotechnical laboratory testing was completed by Thurber's laboratory in Ottawa, Ontario. One-dimensional oedometer testing was carried out by Thurber's laboratories in Ottawa and Oakville, Ontario. UCS testing of soil and rock was completed by Thurber's laboratory in Oakville. Triaxial testing was carried out by Thurber's laboratory in Oakville and by Golder Associates Ltd. in Mississauga. Specific gravity testing was carried out by Stantec Consulting Ltd. in Ottawa. Analytical testing was completed by Paracel Laboratories in Ottawa.

Overall project management and direction of the field program was provided by Fred Griffiths, P.Eng. Interpretation of the factual data and preparation of this report were carried out by Muhammad Imran Khan, EIT, Matt Kennedy, P.Eng., and Fred Griffiths, P.Eng. The report was reviewed by P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



Matt Kennedy, M.Sc.(Eng.), P.Eng.  
Senior Geotechnical Engineer



Dr. Fred Griffiths, P.Eng.  
Principal, Senior Geotechnical Engineer



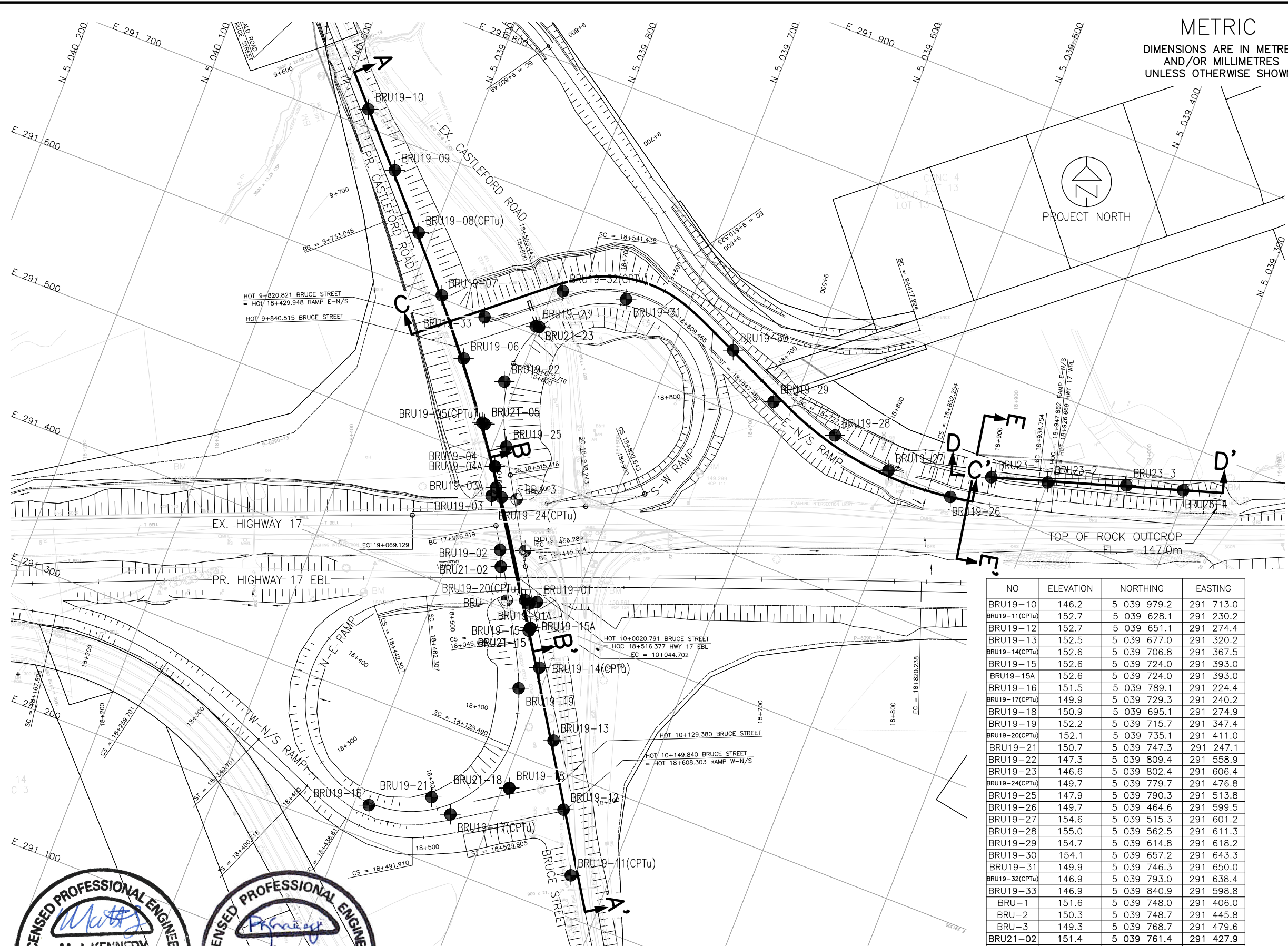
Dr. P.K. Chatterji, P.Eng.  
MTO Review Principal,  
Senior Geotechnical Engineer



## **Appendix A.**

### **Borehole Location Plan and Stratigraphic Drawings**





METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

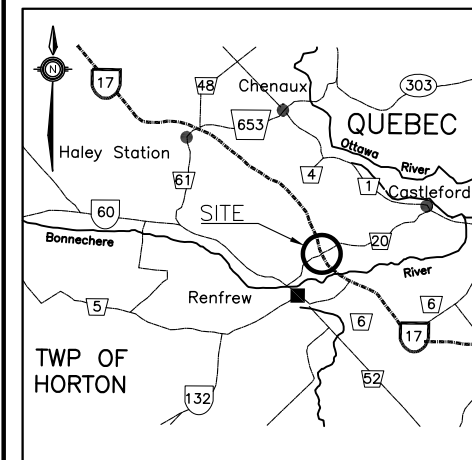
CONT No  
WP No 4068-09-00

HIGHWAY 17 TWINNING  
BRUCE STREET  
INTERCHANGE  
BOREHOLE LOCATION PLAN



SHEET

Ontario



KEYPLAN  
LEGEND

- Borehole
- Borehole (2003 Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level Upon Completion of Drilling
- Water Level in Monitoring Well/Piezometer
- Monitoring Well/Piezometer Screen
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BRU19-01	151.2	5 039 726.4	291 413.0
BRU19-01A	152.2	5 039 731.4	291 409.7
BRU19-02	150.1	5 039 766.5	291 439.5
BRU19-03	149.8	5 039 787.2	291 475.1
BRU19-03A	149.9	5 039 786.4	291 482.2
BRU19-04	149.8	5 039 792.9	291 496.6
BRU19-04A	149.8	5 039 792.9	291 496.6
BRU19-05(CPTu)	149.0	5 039 813.7	291 524.1
BRU19-06	148.5	5 039 844.3	291 564.0
BRU19-07	148.1	5 039 876.9	291 602.4
BRU19-08(CPTu)	147.4	5 039 910.2	291 640.1
BRU19-09	146.9	5 039 944.0	291 677.4

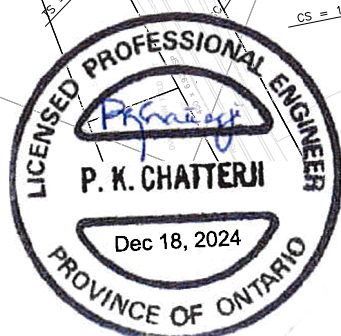
-NOTES-

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

GEORES No. 31F-234

NO	ELEVATION	NORTHING	EASTING
BRU19-10	146.2	5 039 979.2	291 713.0
BRU19-11(CPTu)	152.7	5 039 628.1	291 230.2
BRU19-12	152.7	5 039 651.1	291 274.4
BRU19-13	152.5	5 039 677.0	291 320.2
BRU19-14(CPTu)	152.6	5 039 706.8	291 367.5
BRU19-15	152.6	5 039 724.0	291 393.0
BRU19-15A	152.6	5 039 724.0	291 393.0
BRU19-16	151.5	5 039 789.1	291 224.4
BRU19-17(CPTu)	149.9	5 039 729.3	291 240.2
BRU19-18	150.9	5 039 695.1	291 274.9
BRU19-19	152.2	5 039 715.7	291 347.4
BRU19-20(CPTu)	152.1	5 039 735.1	291 411.0
BRU19-21	150.7	5 039 747.3	291 247.1
BRU19-22	147.3	5 039 809.4	291 558.9
BRU19-23	146.6	5 039 802.4	291 606.4
BRU19-24(CPTu)	149.7	5 039 779.7	291 476.8
BRU19-25	147.9	5 039 790.3	291 513.8
BRU19-26	149.7	5 039 464.6	291 599.5
BRU19-27	154.6	5 039 515.3	291 601.2
BRU19-28	155.0	5 039 562.5	291 611.3
BRU19-29	154.7	5 039 614.8	291 618.2
BRU19-30	154.1	5 039 657.2	291 643.3
BRU19-31	149.9	5 039 746.3	291 650.0
BRU19-32(CPTu)	146.9	5 039 793.0	291 638.4
BRU19-33	146.9	5 039 840.9	291 598.8
BRU-1	151.6	5 039 748.0	291 406.0
BRU-2	150.3	5 039 748.7	291 445.8
BRU-3	149.3	5 039 768.7	291 479.6
BRU21-02	151.4	5 039 761.4	291 427.9
BRU21-05	149.2	5 039 811.7	291 523.6
BRU21-15	152.6	5 039 724.3	291 390.6
BRU21-18	151.4	5 039 695.2	291 274.5
BRU21-23	146.6	5 039 799.9	291 606.7
BRU23-1	154.9	5 039 441.2	291 624.5
BRU23-2	153.9	5 039 400.1	291 636.3
BRU23-3	151.5	5 039 344.1	291 655.6
BRU23-4	149.1	5 039 302.8	291 667.7

PLAN OF BRUCE STREET INTERCHANGE



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MJK	CHK -	CODE
DRAWN	MFA	CHK MJK	SITE
LOAD		STRUCT	DWG 1
DATE	JULY 2024		



METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

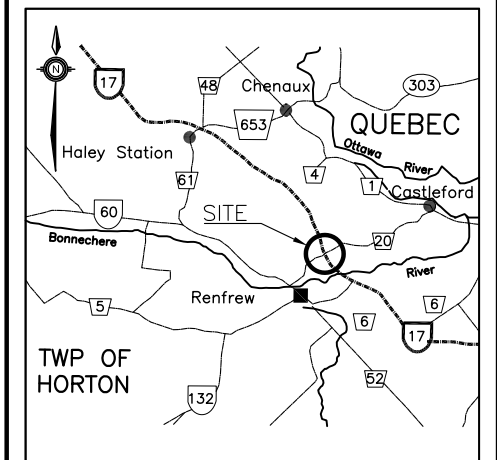
CONT No  
WP No 4068-09-00

HIGHWAY 17 TWINNING  
BRUCE STREET  
INTERCHANGE  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Ontario

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- Borehole
- Borehole (2003 Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level Upon Completion of Drilling
- Water Level in Monitoring Well/Piezometer
- Monitoring Well/Piezometer Screen
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BRU19-01	151.2	5 039 726.4	291 413.0
BRU19-01A	152.2	5 039 731.4	291 409.7
BRU19-02	150.1	5 039 766.5	291 439.5
BRU19-03	149.8	5 039 787.2	291 475.1
BRU19-03A	149.9	5 039 786.4	291 482.2
BRU19-04	149.8	5 039 792.9	291 496.6
BRU19-04A	149.8	5 039 792.9	291 496.6
BRU19-05(CPTu)	149.0	5 039 813.7	291 524.1
BRU19-06	148.5	5 039 844.3	291 564.0
BRU19-07	148.1	5 039 876.9	291 602.4
BRU19-08(CPTu)	147.4	5 039 910.2	291 640.1
BRU19-09	146.9	5 039 944.0	291 677.4

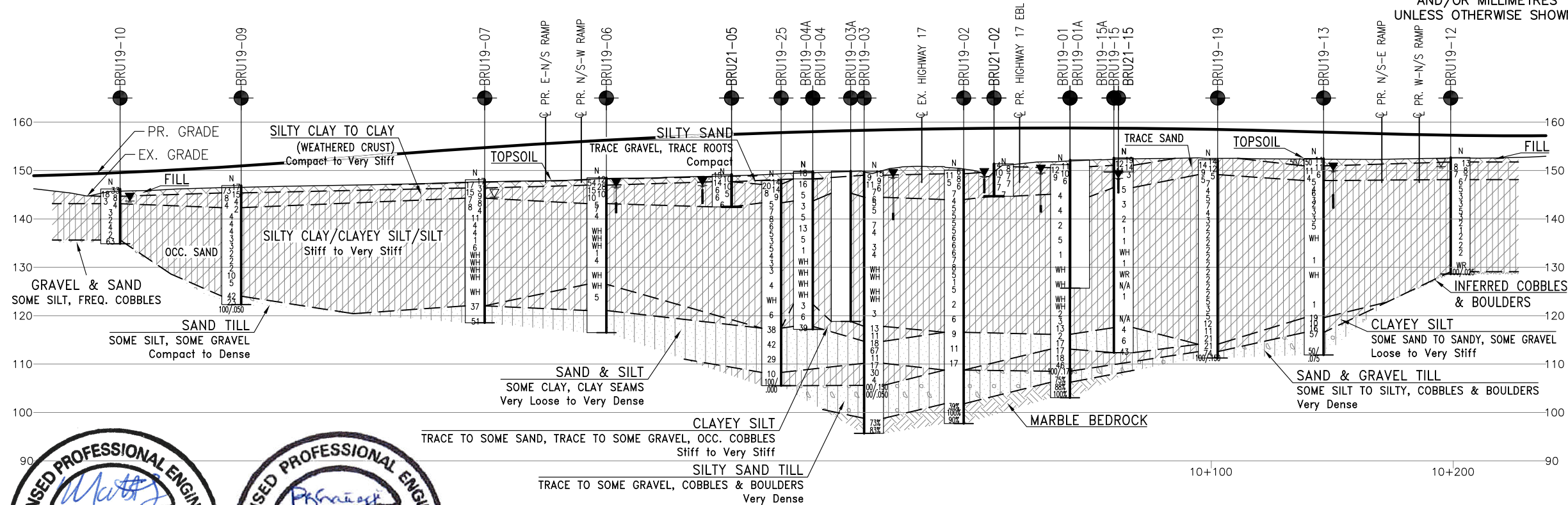
-NOTES-

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

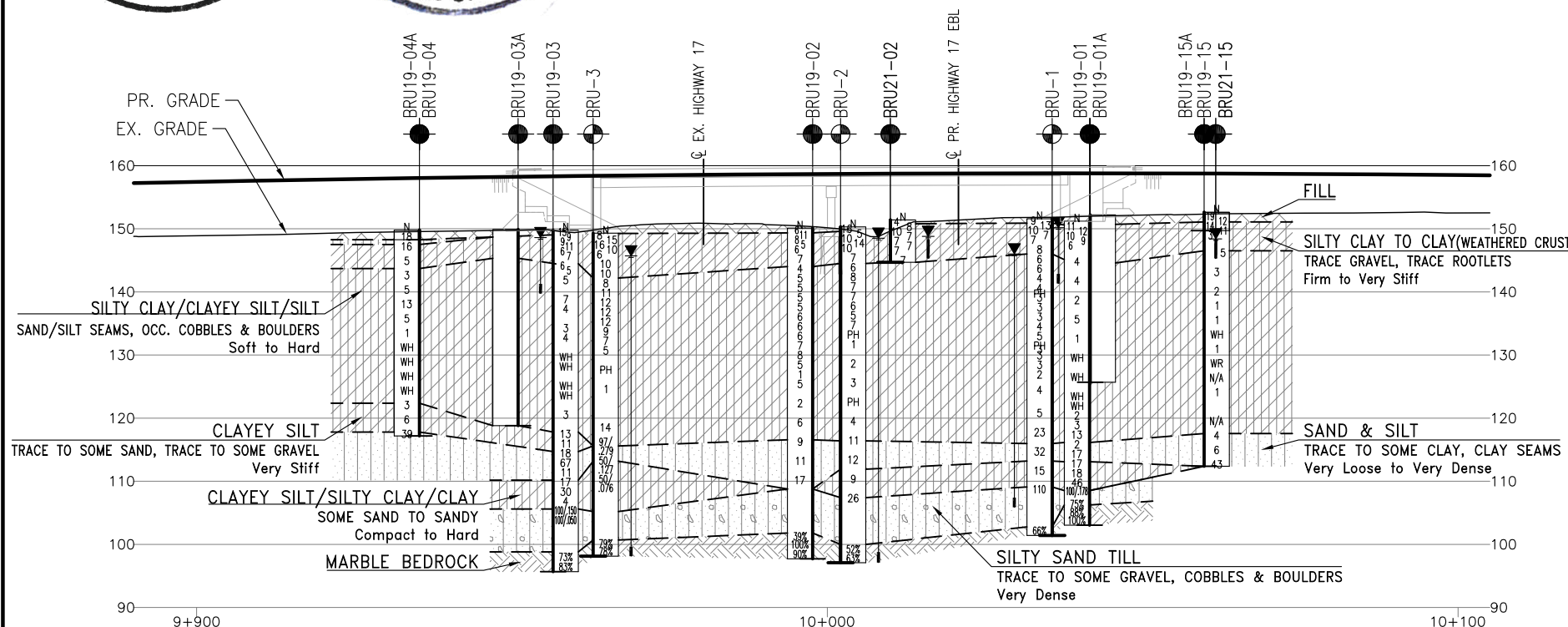
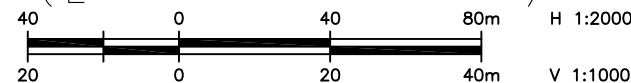
GEOCRES No. 31F-234

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MJK	CHK -	CODE
DRAWN	MFA	CHK MJK	SITE
LOAD			
STRUCT			
DWG	2		
DATE	JULY 2024		

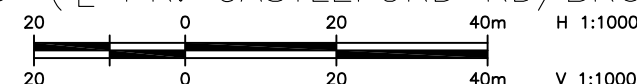
FILENAME: H:\Drafting\20000\24726\1ED-24726-BHPP-BRU(2024).dwg  
PLOTDATE: 7/6/2024 12:29 AM



PROFILE A-A' (CL PR. CASTLEFORD RD/BRUCE ST)



PROFILE B-B' (CL PR. CASTLEFORD RD/BRUCE ST)



NO	ELEVATION	NORTHING	EASTING
BRU19-10	146.2	5 039 979.2	291 713.0
BRU19-11(CPTu)	152.7	5 039 628.1	291 230.2
BRU19-12	152.7	5 039 651.1	291 274.4
BRU19-13	152.5	5 039 677.0	291 320.2
BRU19-14(CPTu)	152.6	5 039 706.8	291 367.5
BRU19-15	152.6	5 039 724.0	291 393.0
BRU19-15A	152.6	5 039 724.0	291 393.0
BRU19-16	151.5	5 039 789.1	291 224.4
BRU19-17(CPTu)	149.9	5 039 729.3	291 240.2
BRU19-18	150.9	5 039 695.1	291 274.9
BRU19-19	152.2	5 039 715.7	291 347.4
BRU19-20(CPTu)	152.1	5 039 735.1	291 411.0
BRU19-21	150.7	5 039 747.3	291 247.1
BRU19-22	147.3	5 039 809.4	291 558.9
BRU19-23	146.6	5 039 802.4	291 606.4
BRU19-24(CPTu)	149.7	5 039 779.7	291 476.8
BRU19-25	147.9	5 039 790.3	291 513.8
BRU19-26	149.7	5 039 464.6	291 599.5
BRU19-27	154.6	5 039 515.3	291 601.2
BRU19-28	155.0	5 039 562.5	291 611.3
BRU19-29	154.7	5 039 614.8	291 618.2
BRU19-30	154.1	5 039 657.2	291 643.3
BRU19-31	149.9	5 039 746.3	291 650.0
BRU19-32(CPTu)	146.9	5 039 793.0	291 638.4
BRU19-33	146.9	5 039 840.9	291 598.8
BRU-1	151.6	5 039 748.0	291 406.0
BRU-2	150.3	5 039 748.7	291 445.8
BRU-3	149.3	5 039 768.7	291 479.6
BRU21-02	151.4	5 039 761.4	291 427.9
BRU21-05	149.2	5 039 811.7	291 523.6
BRU21-15	152.6	5 039 724.3	291 390.6
BRU21-18	151.4	5 039 695.2	291 274.5
BRU21-23	146.6	5 039 799.9	291 606.7
BRU23-1	154.9	5 039 441.2	291 624.5
BRU23-2	153.9	5 039 400.1	291 636.3
BRU23-3	151.5	5 039 344.1	291 655.6
BRU23-4	149.1	5 039 302.8	291 667.7

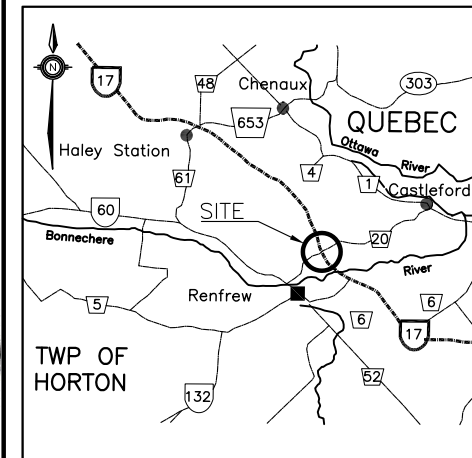


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 4068-09-00

HIGHWAY 17 TWINNING  
BRUCE STREET  
INTERCHANGE  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN  
LEGEND

- Borehole
- Borehole (2003 Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level Upon Completion of Drilling
- Water Level in Monitoring Well/Piezometer
- Monitoring Well/Piezometer Screen
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BRU19-01	151.2	5 039 726.4	291 413.0
BRU19-01A	152.2	5 039 731.4	291 409.7
BRU19-02	150.1	5 039 766.5	291 439.5
BRU19-03	149.8	5 039 787.2	291 475.1
BRU19-03A	149.9	5 039 786.4	291 482.2
BRU19-04	149.8	5 039 792.9	291 496.6
BRU19-04A	149.8	5 039 792.9	291 496.6
BRU19-05(CPTu)	149.0	5 039 813.7	291 524.1
BRU19-06	148.5	5 039 844.3	291 564.0
BRU19-07	148.1	5 039 876.9	291 602.4
BRU19-08(CPTu)	147.4	5 039 910.2	291 640.1
BRU19-09	146.9	5 039 944.0	291 677.4

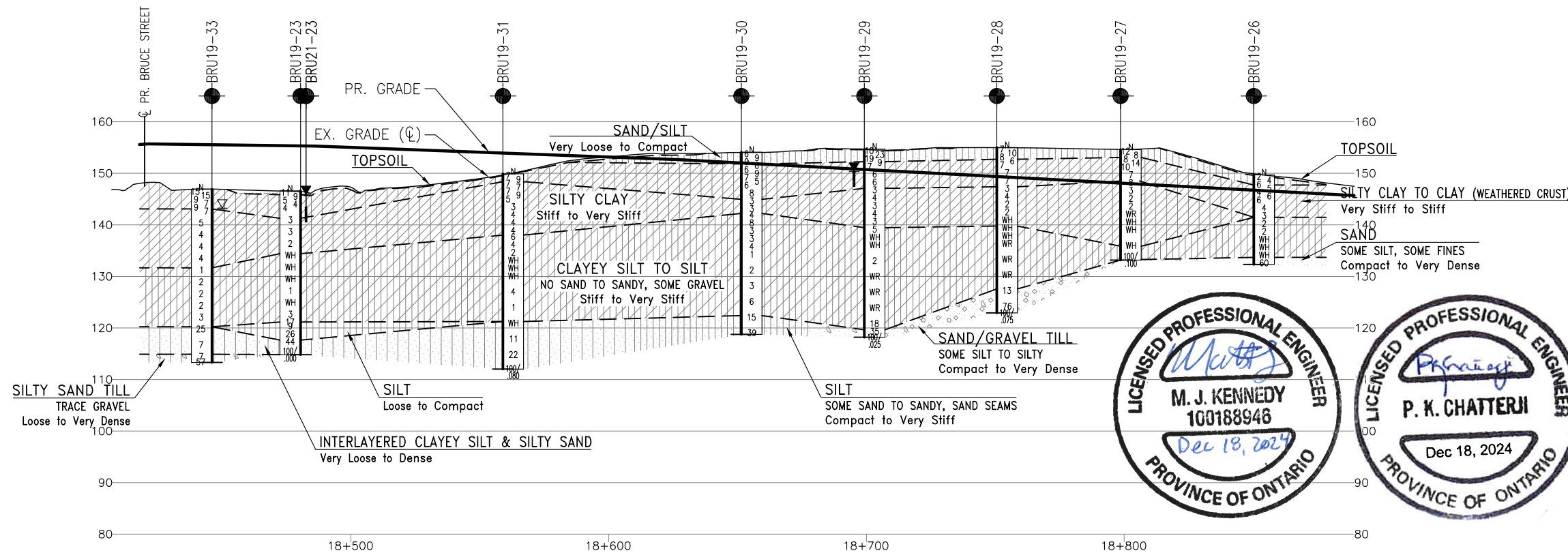
-NOTES-

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

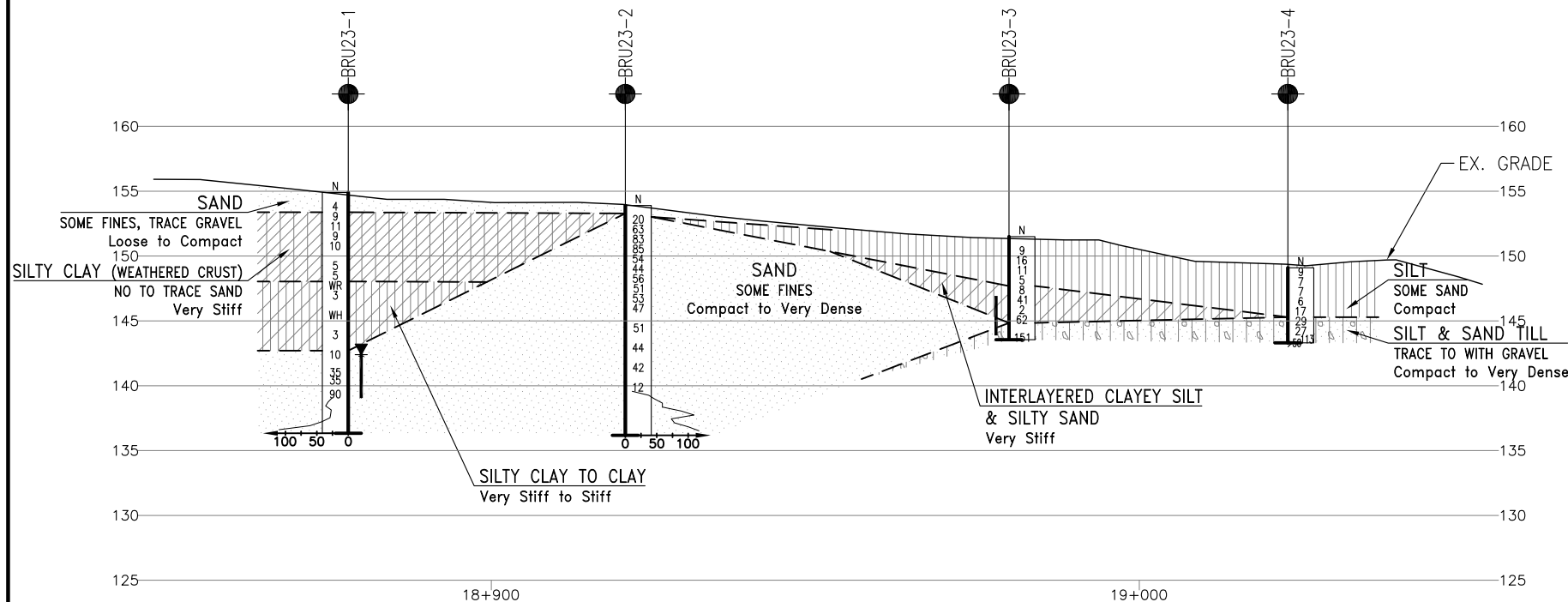
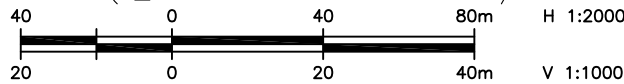
GEOCRES No. 31F-234

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MJK	CHK -	CODE
DRAWN	MFA	CHK MJK	SITE
LOAD		STRUCT	
DATE	JULY 2024		
DWG	3		

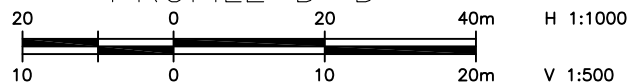
FILENAME: H:\Drafting\20000\24726\24726-BHP-BrU(2024).dwg  
PLOTDATE: 7/6/2024 12:50 AM



PROFILE C-C' (Q PROPOSED E-N/S RAMP)



PROFILE D-D'



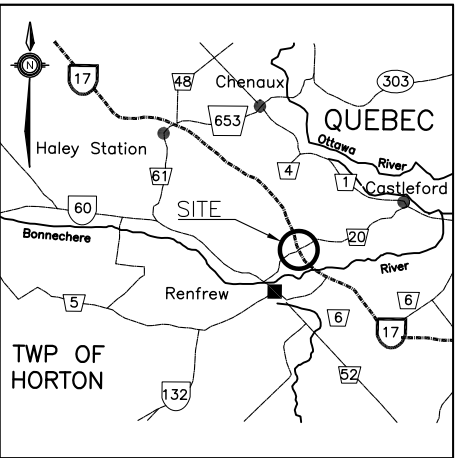
NO	ELEVATION	NORTHING	EASTING
BRU19-10	146.2	5 039 979.2	291 713.0
BRU19-11(CPTu)	152.7	5 039 628.1	291 230.2
BRU19-12	152.7	5 039 651.1	291 274.4
BRU19-13	152.5	5 039 677.0	291 320.2
BRU19-14(CPTu)	152.6	5 039 706.8	291 367.5
BRU19-15	152.6	5 039 724.0	291 393.0
BRU19-15A	152.6	5 039 724.0	291 393.0
BRU19-16	151.5	5 039 789.1	291 224.4
BRU19-17(CPTu)	149.9	5 039 729.3	291 240.2
BRU19-18	150.9	5 039 695.1	291 274.9
BRU19-19	152.2	5 039 715.7	291 347.4
BRU19-20(CPTu)	152.1	5 039 735.1	291 411.0
BRU19-21	150.7	5 039 747.3	291 247.1
BRU19-22	147.3	5 039 809.4	291 558.9
BRU19-23	146.6	5 039 802.4	291 606.4
BRU19-24(CPTu)	149.7	5 039 779.7	291 476.8
BRU19-25	147.9	5 039 790.3	291 513.8
BRU19-26	149.7	5 039 464.6	291 599.5
BRU19-27	154.6	5 039 515.3	291 601.2
BRU19-28	155.0	5 039 562.5	291 611.3
BRU19-29	154.7	5 039 614.8	291 618.2
BRU19-30	154.1	5 039 657.2	291 643.3
BRU19-31	149.9	5 039 746.3	291 650.0
BRU19-32(CPTu)	146.9	5 039 793.0	291 638.4
BRU19-33	146.9	5 039 840.9	291 598.8
BRU-1	151.6	5 039 748.0	291 406.0
BRU-2	150.3	5 039 748.7	291 445.8
BRU-3	149.3	5 039 768.7	291 479.6
BRU21-02	151.4	5 039 761.4	291 427.9
BRU21-05	149.2	5 039 811.7	291 523.6
BRU21-15	152.6	5 039 724.3	291 390.6
BRU21-18	151.4	5 039 695.2	291 274.5
BRU21-23	146.6	5 039 799.9	291 606.7
BRU23-1	154.9	5 039 441.2	291 624.5
BRU23-2	153.9	5 039 400.1	291 636.3
BRU23-3	151.5	5 039 344.1	291 655.6
BRU23-4	149.1	5 039 302.8	291 667.7

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 4068-09-00

HIGHWAY 17 TWINNING  
BRUCE STREET  
INTERCHANGE  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

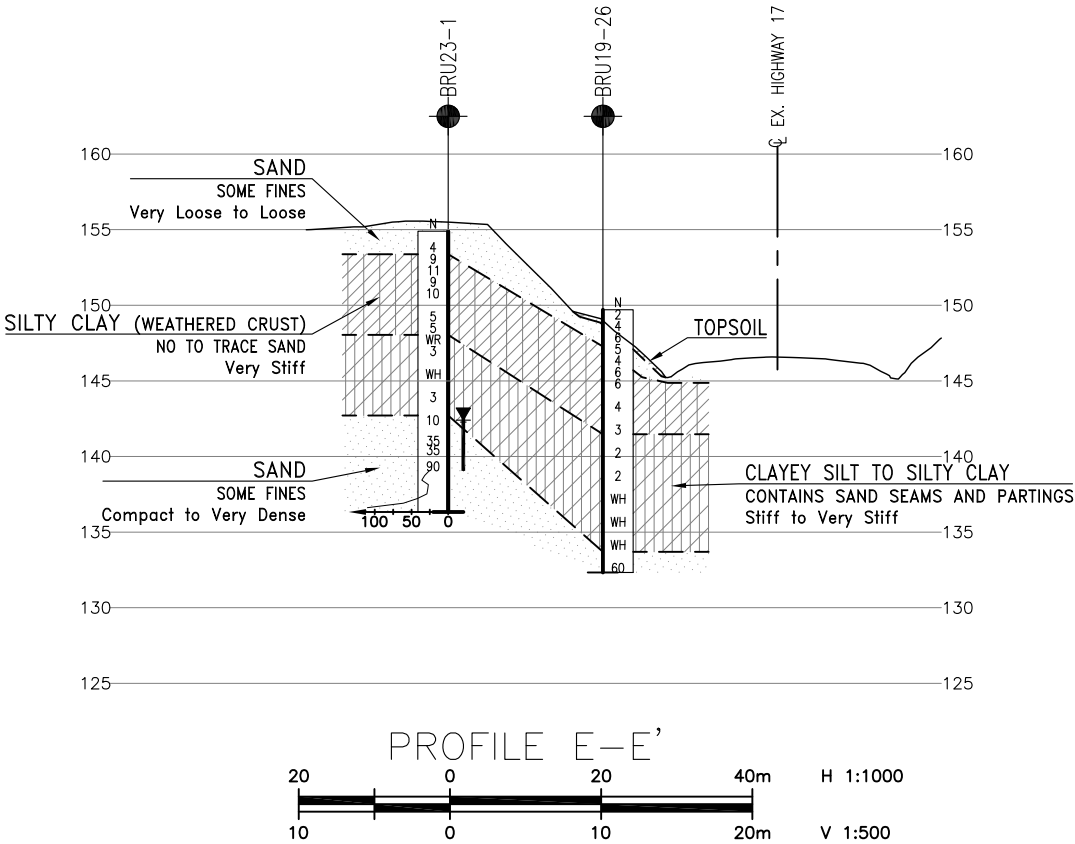
- Borehole
- Borehole (2003 Investigation)
- N
- Blows /0.3m (Std Pen Test, 475J/blow)
- CONE
- Blows /0.3m (60° Cone, 475J/blow)
- PH
- Pressure, Hydraulic
- Water Level Upon Completion of Drilling
- Water Level in Monitoring Well/Piezometer
- Monitoring Well/Piezometer Screen
- Rock Quality Designation (RQD)
- 90%
- A/R
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BRU19-01	151.2	5 039 726.4	291 413.0
BRU19-01A	152.2	5 039 731.4	291 409.7
BRU19-02	150.1	5 039 766.5	291 439.5
BRU19-03	149.8	5 039 787.2	291 475.1
BRU19-03A	149.9	5 039 786.4	291 482.2
BRU19-04	149.8	5 039 792.9	291 496.6
BRU19-04A	149.8	5 039 792.9	291 496.6
BRU19-05(CPTu)	149.0	5 039 813.7	291 524.1
BRU19-06	148.5	5 039 844.3	291 564.0
BRU19-07	148.1	5 039 876.9	291 602.4
BRU19-08(CPTu)	147.4	5 039 910.2	291 640.1
BRU19-09	146.9	5 039 944.0	291 677.4

-NOTES-

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

GEOCRES No. 31F-234



NO	ELEVATION	NORTHING	EASTING
BRU19-10	146.2	5 039 979.2	291 713.0
BRU19-11(CPTu)	152.7	5 039 628.1	291 230.2
BRU19-12	152.7	5 039 651.1	291 274.4
BRU19-13	152.5	5 039 677.0	291 320.2
BRU19-14(CPTu)	152.6	5 039 706.8	291 367.5
BRU19-15	152.6	5 039 724.0	291 393.0
BRU19-15A	152.6	5 039 724.0	291 393.0
BRU19-16	151.5	5 039 789.1	291 224.4
BRU19-17(CPTu)	149.9	5 039 729.3	291 240.2
BRU19-18	150.9	5 039 695.1	291 274.9
BRU19-19	152.2	5 039 715.7	291 347.4
BRU19-20(CPTu)	152.1	5 039 735.1	291 411.0
BRU19-21	150.7	5 039 747.3	291 247.1
BRU19-22	147.3	5 039 809.4	291 558.9
BRU19-23	146.6	5 039 802.4	291 606.4
BRU19-24(CPTu)	149.7	5 039 779.7	291 476.8
BRU19-25	147.9	5 039 790.3	291 513.8
BRU19-26	149.7	5 039 464.6	291 599.5
BRU19-27	154.6	5 039 515.3	291 601.2
BRU19-28	155.0	5 039 562.5	291 611.3
BRU19-29	154.7	5 039 614.8	291 618.2
BRU19-30	154.1	5 039 657.2	291 643.3
BRU19-31	149.9	5 039 746.3	291 650.0
BRU19-32(CPTu)	146.9	5 039 793.0	291 638.4
BRU19-33	146.9	5 039 840.9	291 598.8
BRU-1	151.6	5 039 748.0	291 406.0
BRU-2	150.3	5 039 748.7	291 445.8
BRU-3	149.3	5 039 768.7	291 479.6
BRU21-02	151.4	5 039 761.4	291 427.9
BRU21-05	149.2	5 039 811.7	291 523.6
BRU21-15	152.6	5 039 724.3	291 390.6
BRU21-18	151.4	5 039 695.2	291 274.5
BRU21-23	146.6	5 039 799.9	291 606.7
BRU23-1	154.9	5 039 441.2	291 624.5
BRU23-2	153.9	5 039 400.1	291 636.3
BRU23-3	151.5	5 039 344.1	291 655.6
BRU23-4	149.1	5 039 302.8	291 667.7



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MJK	CHK -	CODE
DRAWN	MFA	CHK MJK	SITE
LOAD		STRUCT	DWG 3
DATE	JULY 2024		



## **Appendix B.**

### **Record of Test Hole Sheets**



## **Appendix B.1**

### **Current (2019/2020/2021/2024) Investigation**



## 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).

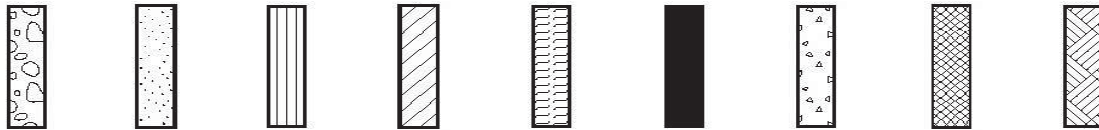
### DYNAMIC CONE PENETRATION TEST (DCPT):

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 BRU19-01

1 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497332°, Long: -76.671291°  
Bruce Street MTM Zone 9: N 5 039 726.4 E 291 413.0 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA, NW Casing, NQ Coring COMPILED BY MW  
DATUM Geodetic DATE 2019.10.07 - 2019.10.10 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT		UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE		W P      W      W L WATER CONTENT (%)			GR	SA	SI	CL						
151.2	Ground Surface							20	40	60	80	100										
0.0	Sandy SILT (ML), trace roots Compact Brown (FILL)		1	SS	11																	
150.6																						
0.6	CLAY (CH) to SILTY CLAY (CI) Very Stiff Brown (WEATHERED CRUST)		2	SS	12												0	2	38	60		
			3	SS	10																	
			4	SS	9																	
			5	SS	6														0	0	41	59
			6	ST	-																	

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

[illegible]

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

## METRIC

Continued Next Page

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

## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-01

5 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497332°, Long: -76.671291°  
Bruce Street MTM Zone 9: N 5 039 726.4 E 291 413.0 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA, NW Casing, NQ Coring COMPILED BY MW  
DATUM Geodetic DATE 2019.10.07 - 2019.10.10 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								20 40 60 80 100				w <sub>p</sub> w w <sub>L</sub>				
	Continued From Previous Page															
108.5	Sandy <b>CLAYEY SILT (CL-ML)</b> Compact to Dense Grey						111									
42.7	<b>SILTY SAND</b> , trace gravel Occasional cobbles Very Dense Black and Grey <b>(TILL)</b>  - 300mm diameter boulder encountered at 43.8 m depth.		30	SS	46		110						○			
							109									
			31	SS	100/ 178mm		108						○			
			32	NQ			107						○			
106.2			33	NQ			106									
45.0	<b>MARBLE BEDROCK</b> Strong, slightly weathered to fresh jointed, grey and white		1	RUN			105									
			2	RUN			104									
			3	RUN												
103.0																
48.2	<b>End of Borehole</b>  Piezometer consists of 19 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen <b>WATER LEVEL READINGS:</b> DATE DEPTH (m) ELEV. (m) 2019.11.26 2.1 149.1 2020.04.21 1.3 149.9 2020.12.15 1.3 149.9 2021.08.04 1.7 149.5 2021.12.22 1.4 149.8 2022.01.11 1.8 149.4															

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

SOIL PROFILE				SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			W <sub>P</sub> W      W <sub>L</sub>				
								○ UNCONFINED      + FIELD VANE	WATER CONTENT (%)						
							● QUICK TRIAXIAL      × LAB VANE	20   40   60   80   100	20   40   60						
	Continued From Previous Page														
	CLAYEY SILT (CL) Stiff to Very Stiff						142								
			3	ST	-		141					○			
							140								
							139								
			4	ST	-		138								
							137								
							136								
134.8							135					○			
17.4	CLAYEY SILT (CL) to SILT (ML) Stiff to Very Stiff		5	ST	-		134								
							133								

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

## METRIC

SOIL PROFILE				SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20      40      60      80      100	W <sub>P</sub> W      W <sub>L</sub>						
								SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE			WATER CONTENT (%)				
	Continued From Previous Page		6	ST	-		132								
	CLAYEY SILT (CL) to SILT (ML) Stiff to Very Stiff						131								
			7	ST	-		129								
							128								
				8	ST	-	127								
125.7 26.5	End of Borehole						126								

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



# RECORD OF BOREHOLE No BRU19-02

1 OF 6

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497693°, Long: -76.670952°  
Bruce Street MTM Zone 9: N 5 039 766.5 E 291 439.5 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0' to 5'), NW (5' to 135'7"), NQ COMPILED BY MW  
DATUM Geodetic DATE 2019.10.15 - 2019.10.18 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			20	40	60	80	100		
150.1	Ground Surface													
0.0	Silty SAND , some gravel, trace roots Loose Brown (FILL)		1	SS	6		150							
149.3														
0.8	CLAY (CH) Very Stiff Brown (WEATHERED CRUST)		2	SS	11		149							
			3	SS	8		148							
			4	SS	5		147							
			5	SS	6		146							
			6	SS	7		145							
							144							
144.0														
6.1	SILTY CLAY (CI) Very Stiff Grey		7	SS	4		143							
			8	SS	5		142							
			9	SS	5		141							

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P		W		W L			
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)					
							20 40 60 80 100			20 40 60							
	Continued From Previous Page																
	CLAY (CI) Very Stiff Grey						140										
			10	SS	5												
							139										
			11	SS	5												
							138										
			12	SS	6												
							137										
			13	SS	6												
							136										
							135										
							134										
133.3																	
16.8	CLAYEY SILT (CL-ML) Very Stiff Grey		14	SS	6		133										
							132										
			15	SS	7												
							131										

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

# RECORD OF BOREHOLE No BRU19-02

3 OF 6

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497693°, Long: -76.670952°  
Bruce Street MTM Zone 9: N 5 039 766.5 E 291 439.5 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0' to 5'), NW (5' to 135'7"), NQ COMPILED BY MW  
DATUM Geodetic DATE 2019.10.15 - 2019.10.18 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								WATER CONTENT (%)		
								○ UNCONFINED      + FIELD VANE										
								● QUICK TRIAXIAL      × LAB VANE										
	Continued From Previous Page		16	SS	8		130											
	CLAYEY SILT (CL-ML) Very Stiff Grey						129											
		17	SS	5		128												
						127												
		18	SS	1		126												
						125												
		19	SS	5		124												
						123												
		20	SS	2		122												
						121												

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 0 (%) STRAIN AT FAILURE

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## 4 OF 6

WP#	4068-09-00	LOCATION	Lat: 45.497693°, Long: -76.670952° Bruce Street MTM Zone 9: N 5 039 766.5 E 291 439.5	ORIGINATED BY	MW
HWY	17	BOREHOLE TYPE	CME 850 Trackmount, HSA (0' to 5'), NW (5' to 135'7"), NQ	COMPILED BY	MW
DATUM	Geodetic	DATE	2019.10.15 - 2019.10.18	CHECKED BY	

[illegible]

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-02

5 OF 6

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497693°, Long: -76.670952°  
Bruce Street MTM Zone 9: N 5 039 766.5 E 291 439.5 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0' to 5'), NW (5' to 135'7"), NQ COMPILED BY MW  
DATUM Geodetic DATE 2019.10.15 - 2019.10.18 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								
	Continued From Previous Page							20	40	60	80	100				

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 0  
(%) STRAIN AT FAILURE

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-02

6 OF 6

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497693°, Long: -76.670952°  
Bruce Street MTM Zone 9: N 5 039 766.5 E 291 439.5 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0' to 5'), NW (5' to 135'7"), NQ COMPILED BY MW  
DATUM Geodetic DATE 2019.10.15 - 2019.10.18 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										
								20 40 60 80 100										
	Continued From Previous Page		2	RUN			100									2	RUN #2 TCR=100% SCR=85% RQD=100% UCS=42MPa	
	<b>MARBLE BEDROCK</b> Strong, moderately to slightly weathered, grey and white						99									1		
																1		
				3	RUN											1		
																1		
97.7							98									2	RUN #3 TCR=100% SCR=80% RQD=90%	
52.4	End of Borehole																	

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-03

1 OF 6

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497881°, Long: -76.670497°  
Bruce Street MTM Zone 9: N 5 039 787.2 E 291 475.1 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-167'4"), NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.27 - 2019.10.04 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT		UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W <sub>P</sub> W                      W <sub>L</sub>			
149.8	Ground Surface							20   40   60   80   100					
0.0	Silty SAND, trace roots Compact Brown (FILL)		1	SS	15			○ UNCONFINED      + FIELD VANE					
149.0								● QUICK TRIAXIAL      × LAB VANE					
0.8	SILTY CLAY (CI) Very Stiff Brown (WEATHERED CRUST)		2	SS	9		149						
			3	SS	9		148						
			4	SS	11		147						
			5	SS	6		146						
			6	SS	7		145						
			7	ST	-		144						
144.5			8	SS	6		143						
5.3	SILTY CLAY (CI) to SILT (ML) Stiff to Very Stiff Grey		9	SS	5		142						
			10	SS	5		141						
			11	ST	-		140						

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-03

2 OF 6

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497881°, Long: -76.670497°  
Bruce Street MTM Zone 9: N 5 039 787.2 E 291 475.1 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-167'4"), NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.27 - 2019.10.04 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL LIMIT      MOISTURE CONTENT      LIQUID LIMIT			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				WATER CONTENT (%)				
								○ UNCONFINED      + FIELD VANE				W <sub>P</sub> W      W <sub>L</sub>				
								● QUICK TRIAXIAL      × LAB VANE	20   40   60   80   100				20   40   60			
	Continued From Previous Page															
	SILTY CLAY (CI) to SILT (ML) Stiff to Very Stiff Grey															
			12	SS	7		139									
							138									
			13	SS	4											
							137									
								6.6 +								
							136									
			14	ST	-											
							135									
			15	SS	3		134									
							133									
			16	SS	4											
							132									
								9.2 +								
								≥10 +								
			17	ST	-		131									
								8.0 +								
							130									
								10.0 +								

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 0  
(%) STRAIN AT FAILURE



## 3 OF 6

WP#	4068-09-00	LOCATION	Lat: 45.49/881", Long: -76.6/049/~ Bruce Street MTM Zone 9: N 5 039 787.2 E 291 475.1	ORIGINATED BY	MW
HWY	17	BOREHOLE TYPE	CME 850 Trackmount, HSA (0'-20'), NW (20'-167'4"), NQ	COMPILED BY	JP
DATUM	Geodetic	DATE	2019.09.27 - 2019.10.04	CHECKED BY	

[illegible]

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

[illegible]

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



DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

RECORD OF BOREHOLE No BRU19-03

6 OF 6

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497881°, Long: -76.670497°  
Bruce Street MTM Zone 9: N 5 039 787.2 E 291 475.1 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-167'4"), NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.27 - 2019.10.04 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 (%)									
	Continued From Previous Page						20	40	60	80	100		20	40	60		
98.8	Silty <b>SAND (SM)</b> , trace to some gravel Frequent Cobbles and Boulders Very Dense Grey <b>(TILL)</b>		39	NQ	-												
51.0	<b>MARBLE BEDROCK</b> Moderately Weathered Coarse Grain Grey, Black, White, and Red		1	RUN													
	- Silt Seam at 53.4 m		2	RUN													
95.7	- Silt Seam at 54.0 m																
54.1	<b>End of Borehole</b>  Piezometer consists of 19 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen <b>WATER LEVEL READINGS:</b> DATE DEPTH (m) ELEV. (m) 2019.11.26 1.3 148.4 2020.04.21 -0.2 149.9 2020.12.15 0.8 148.9 2021.08.04 1.2 148.5 2021.12.22 0.8 148.9 2022.01.11 1.5 148.2 2022.01.18 1.5 148.2																


+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 5 10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-03A

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497873°, Long: -76.670407°  
Bruce Street MTM Zone 9: N 5 039 786.4 E 291 482.2 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.12.03 - 2020.12.03 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL LIMIT      MOISTURE      LIQUID CONTENT      LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								20   40   60   80   100	○ UNCONFINED      + FIELD VANE	● QUICK TRIAXIAL      × LAB VANE	W <sub>P</sub> W      W <sub>L</sub>				
149.9 0.0															
145.3 4.6															
	SILTY CLAY (CI) to SILT (ML) Stiff to Very stiff Grey		1	ST	-										

Continued Next Page

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

# RECORD OF BOREHOLE No BRU19-03A

2 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497873°, Long: -76.670407°  
Bruce Street MTM Zone 9: N 5 039 786.4 E 291 482.2 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.12.03 - 2020.12.03 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								
	Continued From Previous Page															
	SILTY CLAY (CI) to SILT (ML) Stiff to Very stiff Grey															
			3	ST	-		139									
							138									
							137									
							136									
			4	ST	-		135									
							134									
							133									
							132									
			5	ST	-		131									
							130									

Continued Next Page

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

# RECORD OF BOREHOLE No BRU19-03A

3 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497873°, Long: -76.670407°  
Bruce Street MTM Zone 9: N 5 039 786.4 E 291 482.2 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.12.03 - 2020.12.03 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						
	Continued From Previous Page <b>SILTY CLAY (CI) to SILT (ML)</b> Stiff to Very stiff Grey													
			6	ST	-		129							
							128							
							127							
							126							
							125							
							124							
							123							
			7	ST	-		122							
							121							
							120							

Continued Next Page

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



# RECORD OF BOREHOLE No BRU19-03A

4 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497873°, Long: -76.670407°  
Bruce Street MTM Zone 9: N 5 039 786.4 E 291 482.2 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.12.03 - 2020.12.03 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									
	Continued From Previous Page						20	40	60	80	100						
118.8	<b>SILTY CLAY (CI) to SILT (ML)</b> Stiff to Very stiff Grey		8	ST	-												
31.1	End of Borehole																

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-04

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497932°, Long: -76.670223°  
Bruce Street MTM Zone 9: N 5 039 792.9 E 291 496.6 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW Casing COMPILED BY MW  
DATUM Geodetic DATE 2019.09.20 - 2019.09.20 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			20	40	60	80	100		
149.8	Ground Surface													
0.0	SAND, some silt, trace gravel Compact Brown (FILL)		1	SS	18									6 86 8 (SI+CL)
148.3							149							
1.5	End of Borehole See BRU19-04A for continuation of log													

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

## METRIC

SOIL PROFILE						SAMPLES									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
149.8 0.0	Ground Surface  See Borehole BRU19-04 for stratigraphy						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)			kN/m <sup>3</sup>	GR SA SI CL
147.5 2.3	SILTY CLAY (CI) Very Stiff Brown (WEATHERED CRUST)		1	SS	16										
			2	SS	5										
143.7 6.1	SILTY CLAY (CI) to CLAYEY SILT (CL-ML) Very stiff Brown		3	SS	3										
			4	SS	5										

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-04A

3 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497932°, Long: -76.670223°  
Bruce Street MTM Zone 9: N 5 039 792.9 E 291 496.6 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW Casing COMPILED BY JP  
DATUM Geodetic DATE 2019.09.20 - 2019.09.24 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL LIMIT      MOISTURE      LIQUID CONTENT      LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE										
								20   40   60   80   100	20   40   60   80   100	20   40   60								
	Continued From Previous Page																	
122.4 27.4	CLAYEY SILT (CL to CL-ML) Stiff to very stiff Grey		9	SS	WH		129											
			10	SS	WH		127											
			11	SS	WH		124											
															</			

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-04A

4 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497932°, Long: -76.670223°  
Bruce Street MTM Zone 9: N 5 039 792.9 E 291 496.6 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW Casing COMPILED BY JP  
DATUM Geodetic DATE 2019.09.20 - 2019.09.24 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								20 40 60 80 100						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub> WATER CONTENT (%) 20 40 60						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE													
	Continued From Previous Page		13	SS	6															
	CLAYEY SILT (CL-ML) , trace sand Very Stiff Grey						119													
117.8							118													
32.0	SAND and SILT (SM) Dense Grey		14	SS	39															
117.2																				
32.6	End of Borehole																			

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-06

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498396°, Long: -76.669361°  
Bruce Street MTM Zone 9: N 5 039 844.3 E 291 564.0 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount COMPILED BY JP  
DATUM Geodetic DATE 2019.09.24 - 2019.09.27 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 $\gamma$  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						
148.5	Ground Surface							20 40 60 80 100		20 40 60				
0.0	50mm TOPSOIL													
	Silty gravelly SAND (SM) Compact to Very Dense Light Brown (FILL)		1	SS	12					○				
			2	SS	54					○				22 48 30 (SI+CL)
147.0														
1.5	SILTY CLAY (CI/CH) Very Stiff Brown (WEATHERED CRUST)		3	SS	28					○				
			4	SS	15						○			
			5	SS	10							┌─○─┐		0 1 44 55
			6	SS	10						○			
143.2														
5.3	SILTY CLAY (CI) to CLAYEY SILT (CL) Stiff to Very Stiff Grey		7	SS	5						○			
			8	SS	7						○			
									+					
			9	SS	4						○			
									+					
			1	ST	-									

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 0 (%) STRAIN AT FAILURE



## METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	<div><div></div><div>PLASTIC LIMITNATURAL MOISTURE CONTENTLIQUID LIMIT</div><div>w Pw w L</div></div>	UNIT WEIGHT <div><math>\gamma</math></div> kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES				SHEAR STRENGTH kPa <div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div>
	Continued From Previous Page										
	SILTY CLAY (CI) to CLAYEY SILT (CL) Stiff to Very Stiff Grey										
			10	SS	WH			5.3			
								5.1			
			11	SS	WH			>10			
			12	SS	WH						
			13	SS	1						
			14	SS	4						
			2	ST	-			3.1			
128.7 19.8											

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

### METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-06

4 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498396°, Long: -76.669361°  
 Bruce Street MTM Zone 9: N 5 039 844.3 E 291 564.0 ORIGINATED BY MJJ  
 HWY 17 BOREHOLE TYPE CME 75 Truckmount COMPILED BY JP  
 DATUM Geodetic DATE 2019.09.24 - 2019.09.27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  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					WATER CONTENT (%)					
								○ UNCONFINED      + FIELD VANE	20	40	60	80	100	W <sub>P</sub>	W			W <sub>L</sub>
								● QUICK TRIAXIAL      × LAB VANE	20	40	60	80	100					
	Continued From Previous Page																	
	Inferred Silty Sand		18	SS	-		118											
							117											
116.5			10	SS														
32.0	<b>End of Borehole</b> Piezometer consists of 19 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen <b>WATER LEVEL READINGS:</b> DATE    DEPTH (m)    ELEV. (m) 2019.11.26    1.9    146.6 2020.04.21    1.9    146.7 2020.12.15    1.8    146.7 2021.08.04    2.0    146.5 2021.12.22    1.8    146.7 2022.01.11    2.1    146.4 2022.01.18    2.1    146.4																	

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-07

1 OF 3

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498689°, Long: -76.668871°  
Bruce Street MTM Zone 9: N 5 039 876.9 E 291 602.4 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount COMPILED BY JP  
DATUM Geodetic DATE 2019.09.26 - 2019.09.27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
148.1	Ground Surface							20 40 60 80 100		W <sub>P</sub> W W <sub>L</sub>			
0.0	50mm TOPSOIL						148						6 86 8 (SI+CL)
	SAND, trace silt Compact Light to Dark Brown (FILL)		1	SS	17								
			2	SS	17		147						
146.4													
1.7	SILTY CLAY (CI/CH) Compact Dark Brown (WEATHERED CRUST)		3	SS	31		146						
			4	SS	15								1 8 40 51
			5	SS	9		145						
144.3													
3.8	SILTY CLAY (CI) to CLAYEY SILT (CL) Stiff to Very Stiff Grey		6	SS	7		144						
			7	SS	8								
			8	SS	8		143						
			9	SS	4		142						0 0 52 48
			10	SS	11		141						
							140						
			11	SS	4		139						

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

## 2 OF 3

METRIC

[illegible]

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

[illegible]

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

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

# RECORD OF BOREHOLE No BRU19-09

1 OF 3

METRIC

WP# 4068-09-00 LOCATION Lat: 45.499294°, Long: -76.667913°  
Bruce Street MTM Zone 9: N 5 039 944.0 E 291 677.4 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-80'8") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.26 - 2019.09.27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  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			WATER CONTENT (%)							
								20   40   60   80   100	○ UNCONFINED      + FIELD VANE	● QUICK TRIAXIAL      × LAB VANE	W <sub>P</sub> W      W <sub>L</sub>							
146.9	Ground Surface																	
0.0	Gravelly <b>SAND (SM)</b> Compact to Very Dense Brown <b>(FILL)</b>		1	SS	17		146								27   58   15 (SI+CL)			
			2	SS	73													
145.4																		
1.5	<b>SILTY CLAY (CI)</b> Very Stiff Brown <b>(WEATHERED CRUST)</b>		3	SS	15		145											
			4	SS	8		144											
			5	SS	4									0   1   48   51				
			6	SS	4		143											
142.3																		
4.6	<b>SILTY CLAY (CI) to CLAYEY SILT (CL-ML)</b> , occasional silt seams Very Stiff Grey		7	SS	2		142											
							141											
			8	SS	4		140											
			9	SS	4		139							0   0   54   46				
							138											
			10	SS	4													
							137											

Continued Next Page

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

## METRIC

Continued Next Page

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



# RECORD OF BOREHOLE No BRU19-09

3 OF 3

METRIC

WP# 4068-09-00 LOCATION Lat: 45.499294°, Long: -76.667913°  
Bruce Street MTM Zone 9: N 5 039 944.0 E 291 677.4 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-80'8") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.26 - 2019.09.27 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										WATER CONTENT (%)		
								○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE												
	Continued From Previous Page		17	SS	5			20	40	60	80	100		20	40	60				
	<b>SILTY CLAY (CI) to CLAYEY SILT (CL-ML)</b> , occasional silt seams Very Stiff Grey						126							○						
							125													
124.0							124													
22.9	<b>SAND</b> , some silt, some gravel Compact to Dense Grey (TILL)		18	SS	42									○						
							123													
			19	SS	23									○						
122.4														○						
24.5	<b>End of Borehole</b>		20	SS	100/ 50 mm									○						

14 76 10  
(SI+CL)

# RECORD OF BOREHOLE No BRU19-10

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.499612°, Long: -76.667459°  
Bruce Street MTM Zone 9: N 5 039 979.2 E 291 713.0 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA, NW COMPILED BY JP  
DATUM Geodetic DATE 2019.09.26 - 2019.09.29 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
146.2	Ground Surface							20	40	60	80	100							
0.0	Silty SAND, trace gravel, trace organics Dense Brown (FILL)		1	SS	33	▽	146								○			5 73 22 (SI+CL)	
145.4																			
0.8	Sandy SILT, some gravel, trace organics Compact Brown (FILL)		2	SS	18		145									○			
144.7																			
1.5	SILTY CLAY (CI) Very Stiff Brown (WEATHERED CRUST)		3	SS	8		144										○		
			4	SS	3												┌───┐       └───┘		0 1 48 51
143.2																			
3.0	CLAYEY SILT (CL) Very Stiff Grey		5	SS	4		143									○			
								142											
			6	SS	3											○			
							141												
							140									┌──┐       └──┘	○	0 3 61 36	
			7	SS	2														
							139												
			</																

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

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

# RECORD OF BOREHOLE No BRU19-12

1 OF 3

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496651°, Long: -76.673061°  
Bruce Street MTM Zone 9: N 5 039 651.1 E 291 274.4 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW, NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.09 - 2019.09.10 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
152.7	Ground Surface							20 40 60 80 100	○ UNCONFINED	+ FIELD VANE					
0.0	<b>SAND and GRAVEL</b> , some silt and organics Brown sand, White gravel <b>(FILL)</b>		1	GS			152								40 46 14 (SI+CL)
151.8															
0.9	<b>SILTY CLAY (CI/CH)</b> Very Stiff Brown <b>(WEATHERED CRUST)</b>		1	SS	13										
			2	SS	8		151								
			3	SS	8		150								
			4	SS	7		149								0 1 46 53
			5	SS	7										
148.1							148								
4.6	<b>SILTY CLAY (CI)</b> Stiff to Very Stiff Grey		6	SS	6										
							147	8.0 +		+					
			7	SS	5										0 0 53 47
							146								
							145		+						
			8	SS	3										
							144								
										+					
			9	SS	3										
							143								

Continued Next Page

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


DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-12

2 OF 3

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496651°, Long: -76.673061°  
Bruce Street MTM Zone 9: N 5 039 651.1 E 291 274.4 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW, NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.09 - 2019.09.10 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE      LIQUID CONTENT      LIMIT			UNIT WEIGHT  <b>γ</b>  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				WATER CONTENT (%)				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				w <sub>P</sub> w      w <sub>L</sub>				
								20   40   60   80   100	20   40   60							
	Continued From Previous Page															
	SILTY CLAY (CI) Stiff to Very Stiff Grey															
			10	SS	5											
			11	SS	3											
			12	SS	2											
			13	SS	1											

Continued Next Page

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

# RECORD OF BOREHOLE No BRU19-12

3 OF 3

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496651°, Long: -76.673061°  
Bruce Street MTM Zone 9: N 5 039 651.1 E 291 274.4 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW, NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.09 - 2019.09.10 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									
								20	40	60	80	100					
	Continued From Previous Page																
	<b>SILTY CLAY (CI)</b> Stiff to Very Stiff Grey																
			17	SS	WR												
129.1																	
23.6	Inferred Cobbles and Boulders (TILL)		18	SS	100/												
128.6			19	NQ	25 mm												
24.1	End of Borehole																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-13

1 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496886°, Long: -76.672476°  
Bruce Street MTM Zone 9: N 5 039 677.0 E 291 320.2 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW, NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.11 - 2019.09.17 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
152.5	Ground Surface							20 40 60 80 100							
0.0	TOPSOIL							20 40 60 80 100							
151.7	Gravelly SAND to SAND Compact Brown (FILL)		1	SS	11		152								
0.8	GRAVEL and SAND, some silt Very Dense Brown (FILL)		2	SS	50/0.15		151							46 37 17 (SI+CL)	
151.0	SILTY CLAY (CI/CH) Very Stiff Brown (WEATHERED CRUST)		3	SS	11		150								
1.5			4	SS	11		149								
			5	SS	6		148								
			6	SS	4		147							0 1 44 55	
147.9	CLAYEY SILT (CL to CL-ML) Very Stiff Grey		7	SS	5		146								
4.6			8	SS	4		145								
			9	SS	6		144								
			10	SS	3		143							0 0 49 51	
			11	SS	2										

Continued Next Page

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

## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29



# RECORD OF BOREHOLE No BRU19-13

3 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496886°, Long: -76.672476°  
Bruce Street MTM Zone 9: N 5 039 677.0 E 291 320.2 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW, NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.11 - 2019.09.17 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)					
								○ UNCONFINED      + FIELD VANE			W <sub>P</sub> W      W <sub>L</sub>					
								● QUICK TRIAXIAL      × LAB VANE	20   40   60   80   100		20   40   60					
	Continued From Previous Page															
	CLAYEY SILT (CL-ML) Stiff to Very Stiff Grey						132									
			16	SS	1											
			17	SS	WH											
			3	ST												

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-13

4 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496886°, Long: -76.672476°  
Bruce Street MTM Zone 9: N 5 039 677.0 E 291 320.2 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW, NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.11 - 2019.09.17 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			20	40	60	80	100		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								WATER CONTENT (%) W <sub>p</sub> W W <sub>L</sub>						
119.6	<b>CLAYEY SILT (CL-ML)</b> Stiff to Very Stiff Grey		18	SS	1		122							
32.9	<b>CLAYEY SILT (CL)</b> , some sand, some gravel Loose to Dense Grey  -difficult to advance casing from 33.8 m depth		19	SS	19		119							
			20	SS	10		118							12 13 48 27
			21	SS	16		117							
116.5	<b>SAND and GRAVEL</b> , some silt to silty Very Dense Grey (TILL)		22	SS	57		116							45 47 8 (SI+CL)
36.0							115							
							114							
							113							
	- frequent cobbles and boulders below 39.6 m depth													

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

RECORD OF BOREHOLE No BRU19-13

5 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496886°, Long: -76.672476°  
Bruce Street MTM Zone 9: N 5 039 677.0 E 291 320.2 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW, NQ COMPILED BY JP  
DATUM Geodetic DATE 2019.09.11 - 2019.09.17 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			20	40	60	80	100																											
	Continued From Previous Page																																						
111.9			23	SS	50/																																		
40.6	<p><b>End of Borehole</b></p> <p>Piezometer consists of 19 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen</p> <p><b>WATER LEVEL READINGS:</b></p> <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (m)</th> <th>ELEV. (m)</th> </tr> </thead> <tbody> <tr> <td>2019.11.26</td> <td>2.6</td> <td>149.9</td> </tr> <tr> <td>2020.04.21</td> <td>2.2</td> <td>150.3</td> </tr> <tr> <td>2020.12.15</td> <td>2.5</td> <td>150.0</td> </tr> <tr> <td>2021.08.04</td> <td>2.4</td> <td>150.1</td> </tr> <tr> <td>2021.12.22</td> <td>2.4</td> <td>150.1</td> </tr> <tr> <td>2022.01.11</td> <td>2.4</td> <td>150.1</td> </tr> <tr> <td>2022.01.18</td> <td>2.4</td> <td>150.1</td> </tr> </tbody> </table>	DATE	DEPTH (m)	ELEV. (m)	2019.11.26	2.6	149.9	2020.04.21	2.2	150.3	2020.12.15	2.5	150.0	2021.08.04	2.4	150.1	2021.12.22	2.4	150.1	2022.01.11	2.4	150.1	2022.01.18	2.4	150.1														
DATE	DEPTH (m)	ELEV. (m)																																					
2019.11.26	2.6	149.9																																					
2020.04.21	2.2	150.3																																					
2020.12.15	2.5	150.0																																					
2021.08.04	2.4	150.1																																					
2021.12.22	2.4	150.1																																					
2022.01.11	2.4	150.1																																					
2022.01.18	2.4	150.1																																					



DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-15

1 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497311°, Long: -76.671546°  
Bruce Street MTM Zone 9: N 5 039 724.0 E 291 393.0 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 75 Truckmount, HSA, NW COMPILED BY JP  
DATUM Geodetic DATE 2019.09.17 - 2019.09.20 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT		UNIT WEIGHT  <b>γ</b>  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		W <sub>P</sub> W      W <sub>L</sub> WATER CONTENT (%)				
152.6	Ground Surface													
0.0	See Borehole BRU19-15A for stratigraphy													
149.7	SILTY CLAY (CI) Stiff to Very Stiff Brown (WEATHERED CRUST)		2	SS	3									
2.9														
146.5	CLAYEY SILT (CL) Very Stiff Grey		3	SS	5									
6.1														
			4	SS	3									

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## 2 OF 5

METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## 3 OF 5

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   C
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 <b>CLAYEY SILT (CL-ML) to SILT(ML)</b> Stiff to Very Stiff Grey							20   40   60   80   100		20   40   60					
							132								
			9	SS	1		131						NP	0   3   51   4	
							130								
			10	SS	WR		129								
							128								
							127								
			11	SS	N/A		126								
							125								
			12	SS	1		124								
							123								

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## 4 OF 5

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE      LIQUID LIMIT			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				WATER CONTENT (%)				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE	20	40	60	80	100	W <sub>P</sub>		
	Continued From Previous Page															
	CLAYEY SILT (CL-ML) to SILT(ML) Stiff to Very Stiff Grey															
			13	SS	N/A								H ○		0   4   62   34	
117.5																
35.1	Sandy SILT Loose Grey		14	SS	4								○			
115.3																
37.3	Sandy SILT, low-plastic fines (CL-ML) Loose to Dense Grey		15	SS	6								○			

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

[illegible]

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



# RECORD OF BOREHOLE No BRU19-15A

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497311°, Long: -76.671546°  
Bruce Street MTM Zone 9: N 5 039 724.0 E 291 393.0 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-9'5") COMPILED BY MW  
DATUM Geodetic DATE 2019.10.07 - 2019.10.07 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20 40 60 80 100							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
						WATER CONTENT (%) w P w w L									
152.6	Ground Surface														
0.0	Silty SAND, trace gravel and roots Compact Brown (FILL)		1	SS	19		152								
151.8															
0.8	SILT, with sand Compact Brown (FILL)		2	SS	12										
151.1															
1.5	Clayey SILTY CLAY (CI) Very Stiff Brown (WEATHERED CRUST)		3	SS	14		151								
			4	SS	11		150								
149.7															
2.9	End of Borehole														

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-16

1 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497892°, Long: -76.673705°  
Bruce Street MTM Zone 9: N 5 039 789.1 E 291 224.4 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.10 - 2020.12.21 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT		UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P      W      W L			
151.5								20   40   60   80   100					
0.0	<b>TOPSOIL (50mm)</b> CLAYEY SILT Some organics Trace fine sand Stiff Brown		1	SS	10		151						
	<b>SILTY CLAY (CI)</b> Stiff to Very Stiff <b>(WEATHERED CRUST)</b>		2	SS	12		150						
			3	SS	12		149						0   1   44   55
			4	SS	7		148						
			5	SS	7		147						
			6	SS	7		146						
			7	SS	9		145						0   0   45   55
			8	SS	3		144						
144.8	<b>SILTY CLAY (CI)</b> Stiff to Very stiff Grey		9	SS	3		143						0   0   47   53
6.7			10	SS	5		142						

Continued Next Page

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

20  
15  
10  
5  
0  
(%) STRAIN AT FAILURE



DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-16

2 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497892°, Long: -76.673705°  
Bruce Street MTM Zone 9: N 5 039 789.1 E 291 224.4 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.10 - 2020.12.21 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																	
Continued From Previous Page							20	40	60	80	100	WATER CONTENT (%) 20      40      60					
	<b>SILTY CLAY (CI)</b> Stiff to Very stiff Grey																
			11	SS	4												
				12	SS	4											
137.8																	
13.7	<b>CLAYEY SILT (CL to CL/ML)</b> Stiff to Very stiff Grey		13	SS	1											0   0   43   57	
						</											

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-16

3 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497892°, Long: -76.673705°  
Bruce Street MTM Zone 9: N 5 039 789.1 E 291 224.4 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.10 - 2020.12.21 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL		
								20    40    60    80    100	W <sub>P</sub> W    W <sub>L</sub>													
Continued From Previous Page									○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE													
	CLAYEY SILT (CL to CL/ML) Stiff to Very stiff Grey		17	SS	WR									○								
							131					5.8 +										
												+										
			18	SS	1		130							H					0	1	63	36
							129			23.0 +			≥10 +									
			19	SS	3											○						
							128															
												8.0 +										
													4.0 +									
			20	SS	WH		127									○						
							126			7.0 +												
													1.8 +									
			21	SS	1											○						
							125															
													+									
													+									
			22	SS	WH		124							H	○							
							123			8.0 +												
													+									
			23	SS	WR											○						
							122															
													+									

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-16

4 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497892°, Long: -76.673705°  
Bruce Street MTM Zone 9: N 5 039 789.1 E 291 224.4 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.10 - 2020.12.21 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			20	40	60	80	100		
	Continued From Previous Page													
	CLAYEY SILT (CL to CL/ML) Stiff to Very stiff Grey													
			24	SS	WH		121							
							120							
			25	SS	1		119							
							118							
			26	SS	1		117							
							116							
			27	SS	WH		115							
							114							
			28	SS	4		113							
							112							
113.4 38.1	CLAYEY SILT (CL-ML), some sand Stiff to Very Stiff Grey		29	SS	1									
			30	SS	6									

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-16

5 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497892°, Long: -76.673705°  
Bruce Street MTM Zone 9: N 5 039 789.1 E 291 224.4 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.10 - 2020.12.21 CHECKED BY

SOIL PROFILE			SAMPLES			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 NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%) 20 40 60 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				
111.3 40.2	Inferred CLAYEY SILT								
107.0 44.5	End of Borehole								

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-18

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497047°, Long: -76.673056°  
Bruce Street MTM Zone 9: N 5 039 695.1 E 291 274.9 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.27 - 2020.11.27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT		UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W <sub>p</sub> W   W <sub>L</sub>				WATER CONTENT (%)									
150.9	<b>SILTY CLAY (CI/CH)</b> Very Stiff Grey brown to grey <b>(WEATHERED CRUST)</b>		1	SS	6	150			NP	GR	SA	SI	CL										
0.0			2	SS	6									149									
			3	SS	5												148						
			4	SS	4															147			
147.9	<b>SILTY CLAY (CI) to CLAYEY SILT (CL-ML)</b> Very stiff to stiff Grey	5	SS	4	146			0	1	48	51												
3.0		6	SS	5								145											
		7	SS	3											144								
		8	SS	3														143					
		9	SS	3																	142		
		10	SS	3																			
141.8	<b>CLAYEY SILT (CL-ML) to SILT (ML)</b> Very stiff to stiff Grey	11	SS	2				NP	0	0	51	49											
9.1																							

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-18

2 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497047°, Long: -76.673056°  
Bruce Street MTM Zone 9: N 5 039 695.1 E 291 274.9 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.27 - 2020.11.27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL	
								○ UNCONFINED      + FIELD VANE					W P      W      W L							
								● QUICK TRIAXIAL      × LAB VANE	20	40	60	80	100	20		40	60			
	Continued From Previous Page																			
	CLAYEY SILT (CL-ML) to SILT (ML) Very stiff to stiff Grey											+								
			12	SS	3										○					
												+								
												+								
			13	SS	WH										○					
												≥10 +								
												≥10 +								
															○					
			14	SS	3									○						
											+									
											+									
										</										

Continued Next Page

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



# RECORD OF BOREHOLE No BRU19-18

3 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497047°, Long: -76.673056°  
Bruce Street MTM Zone 9: N 5 039 695.1 E 291 274.9 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.27 - 2020.11.27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE										
	Continued From Previous Page																		
	CLAYEY SILT (CL-ML) to SILT (ML) Very stiff to stiff Grey																		

Continued Next Page

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

# RECORD OF BOREHOLE No BRU19-18

4 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497047°, Long: -76.673056°  
Bruce Street MTM Zone 9: N 5 039 695.1 E 291 274.9 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.27 - 2020.11.27 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			20	40	60	80	100		
	Continued From Previous Page							SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								WATER CONTENT (%)						
								20	40	60	80	100		
120.4	CLAYEY SILT (CL-ML) to SILT (ML) Very stiff to stiff Grey													
30.5	CLAYEY SILT (CL), some sand, trace gravel Very Stiff Grey		19	SS	9		120							
							119							
							118							
			20	SS	29		117							
116.8														
34.1	End of Borehole													

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-19

1 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497234°, Long: -76.672129°  
Bruce Street MTM Zone 9: N 5 039 715.7 E 291 347.4 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.25 - 2020.11.25 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			20	40	60	80	100		
152.2														
0.0	SILTY CLAY (CI/CH) Trace sand Very stiff Grey (WEATHERED CRUST)		1	SS	14		152							
151.4														
0.8	SILTY CLAY (CI/CH) Very stiff Grey (WEATHERED CRUST)		2	SS	14		151							
			3	SS	12									
							150							
			4	SS	9									
149.2														
3.0	SILTY CLAY (CI/CH) Very stiff Grey		5	SS	5		149							
			6	SS	5		148							
			7	SS	7									
							147							
			8	SS	4		146							
							145							
			9	SS	5									
							144							
			10	SS	7		143							

Continued Next Page

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

## METRIC

[illegible]

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

## METRIC

Continued Next Page

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

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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		WATER CONTENT (%)				
							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE	W <sub>P</sub> W      W <sub>L</sub>				
	Continued From Previous Page												
	<b>SILTY CLAY (CH) to SILT (CL-ML)</b> Stiff to very stiff Grey		24	SS	3								
			25	SS	5								
			26	SS	12								
			27	SS	11								
			28	SS	21								
114.1 38.1	Sandy <b>CLAYEY SILT</b> Very stiff Grey		29	SS	21								
112.6 39.6	<b>GRAVEL</b> and <b>SAND</b> Very dense		30	SS	74								

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

# RECORD OF BOREHOLE No BRU19-19

5 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497234°, Long: -76.672129°  
Bruce Street MTM Zone 9: N 5 039 715.7 E 291 347.4 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.25 - 2020.11.25 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
	Continued From Previous Page							20	40	60	80	100		W <sub>p</sub>	W	W <sub>L</sub>	GR SA SI CL (SI+CL)
							112										
111.3	GRAVEL and SAND Very dense Grey (TILL)		31	SS	100/6												
40.9	End of Borehole																

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-21

1 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497517°, Long: -76.673413°  
Bruce Street MTM Zone 9: N 5 039 747.3 E 291 247.1 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.04 - 2020.12.10 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 (%)	
150.7 0.9 0.1	<b>TOPSOIL (50 mm)</b> CLAYEY SILT and organics Very soft Brown  <b>SILTY CLAY (CH)</b> Stiff to Very Stiff Grey brown <b>(WEATHERED CRUST)</b>		1	SS	8											
			2	SS	6											
			3	SS	9											
			4	SS	9											
			5	SS	8											
			6	SS	8											
146.0 4.7	<b>CLAYEY SILT (CL/CL-ML)</b> Firm to Stiff Grey		7	SS	3											
			8	SS	4											
			9	SS	3											
			10	SS	2											

Continued Next Page

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




# RECORD OF BOREHOLE No BRU19-21

2 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497517°, Long: -76.673413°  
Bruce Street MTM Zone 9: N 5 039 747.3 E 291 247.1 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.04 - 2020.12.10 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIQUID 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		w P                      w                      w L						
								● QUICK TRIAXIAL		× LAB VANE								
	Continued From Previous Page							20	40	60	80	100	20	40	60		GR SA SI CL	
	CLAYEY SILT (CL/CL-ML) Firm to Stiff Grey																	
			11	SS	1													
			12	SS	2													
			13	SS	1													
			14	SS	2													
			15	SS	1													
			16	SS	WH													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-21

3 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497517°, Long: -76.673413°  
Bruce Street MTM Zone 9: N 5 039 747.3 E 291 247.1 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.04 - 2020.12.10 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE      LIQUID CONTENT      LIMIT			UNIT WEIGHT  $\gamma$  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				WATER CONTENT (%)				
								20   40   60   80   100				W <sub>P</sub> W      W <sub>L</sub>				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE								
	Continued From Previous Page		17	SS	1											
	CLAYEY SILT (CL/CL-ML) Trace to some sand Stiff Grey						130									
			18	SS	WR											

Continued Next Page

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

## METRIC

[illegible]

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


DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-21

5 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497517°, Long: -76.673413°  
Bruce Street MTM Zone 9: N 5 039 747.3 E 291 247.1 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount (HSA) COMPILED BY AO  
DATUM Geodetic DATE 2020.12.04 - 2020.12.10 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page							20	40	60	80	100					
39.9	INFERRED TILL																
108.9			24	SS	40												
41.8	<b>End of Borehole</b> Monitoring well consists of 51 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) 2020.12.15      1.9      148.8 2021.08.04      0.7      150.0 2021.09.22      0.9      149.8 2021.10.21      7.1      143.6 2021.11.01      6.9      143.8 2022.01.11      4.1      146.6 2022.01.18      4.1      146.6 2022.01.27      3.8      146.9																

# RECORD OF BOREHOLE No BRU19-22

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498081°, Long: -76.669425°  
Bruce Street MTM Zone 9: N 5 039 809.4 E 291 558.9 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-129'9") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.19 - 2019.09.20 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			20	40	60	80	100		
147.3	Ground Surface													
0.0	Silty <b>SAND</b> , some gravel, trace roots Compact Brown ( <b>TOPSOIL</b> )		1	SS	13		147							
146.5														
0.8	<b>SILTY CLAY (CI)</b> Very Stiff Brown ( <b>WEATHERED CRUST</b> )		2	SS	18		146							
			3	SS	8		145							
			4	SS	8		144							
			5	SS	6		143							
			6	SS	4		142							
141.2							141							
6.1	<b>SILTY CLAY (CI)</b> to Clayey <b>SILT</b> ( <b>CL-ML</b> ) Very Stiff Grey		7	SS	4		140							
			8	SS	6		139							
			9	SS	5		138							

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-22

2 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498081°, Long: -76.669425°  
Bruce Street MTM Zone 9: N 5 039 809.4 E 291 558.9 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-129'9") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.19 - 2019.09.20 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 (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>						
								SHEAR STRENGTH kPa						WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
130.5 16.8	CLAY (CI) to Clayey SILT (CL-ML) Very Stiff Grey		10	SS	5		137										
			11	SS	4		136										
							</										

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

RECORD OF BOREHOLE No BRU19-22

3 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498081°, Long: -76.669425°  
Bruce Street MTM Zone 9: N 5 039 809.4 E 291 558.9 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-129'9") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.19 - 2019.09.20 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL LIMIT      MOISTURE      LIQUID CONTENT      LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE								
								20   40   60   80   100	20   40   60							
	Continued From Previous Page		16	SS	1		127						○			
	CLAYEY SILT (CL/CL-ML) Stiff to very stiff Grey															
			17	SS	3		124						H ○		0   1   58   41	
			18	SS	3		121						○			
											</					

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

RECORD OF BOREHOLE No BRU19-22

4 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498081°, Long: -76.669425°  
Bruce Street MTM Zone 9: N 5 039 809.4 E 291 558.9 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-129'9") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.19 - 2019.09.20 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
Continued From Previous Page							20 40 60 80 100				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub> WATER CONTENT (%)			
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	SAND and SILT Compact to Dense Grey						117							0 62 38 (SI+CL)
							116							
			20	SS	32		115							
							114							
							113							
			21	SS	17		112							
							111							
							110							
							109							
							108							
109.2 38.1	Sandy CLAYEY SILT (CL-ML) Compact Grey		22	SS	25								0 29 49 22	
107.8 39.5	End of Borehole		23	SS	100/ 75 mm									

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No BRU19-23

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498019°, Long: -76.668817°  
Bruce Street MTM Zone 9: N 5 039 802.4 E 291 606.4 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-104'3") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.23 - 2019.09.24 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				GR	SA	SI	CL		
146.6	Ground Surface							20 40 60 80 100				W <sub>P</sub> W      W <sub>L</sub>								
0.0	<b>SILT</b> , trace roots Compact Brown <b>(TOPSOIL)</b>		1	SS	11		146						○							
145.8																				
0.8	<b>SILTY CLAY (CI/CH)</b> Very Stiff Brown <b>(WEATHERED CRUST)</b>		2	SS	9		145						○							
			3	SS	5		145						○							
			4	SS	4		144						┌───┐	└───┘			0	0	48	52
			5	SS	4		143						○							
							142													

Continued Next Page

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



DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-23

2 OF 4

METRIC

















WP# 4068-09-00 LOCATION Lat: 45.498019°, Long: -76.668817°  
Bruce Street MTM Zone 9: N 5 039 802.4 E 291 606.4 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-104'3") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.23 - 2019.09.24 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								20   40   60   80   100	W <sub>P</sub> W      W <sub>L</sub>										
Continued From Previous Page								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE											
134.4	<b>SILTY CLAY (CI)</b> Stiff to Very Stiff Grey		8	SS	2		136							○					
12.2	<b>CLAYEY SILT (CL-ML)</b> Stiff to Very Stiff Grey		9	SS	WH		134							○					

Continued Next Page

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

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20      40      60      80      100	W <sub>P</sub> W      W <sub>L</sub>	20      40      60					
								SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE			WATER CONTENT (%)				
	Continued From Previous Page														
121.1 25.5	CLAYEY SILT (CL-ML) Stiff to Very Stiff Grey								6.6 +						
117.6 29.0	SILT Loose to Compact Grey		13	SS	WH										
117.6 29.0	Silty SAND Dense Grey		14	SS	3										
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														
117.6 29.0	Silty SAND Dense Grey														

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

## METRIC

[illegible]

# RECORD OF BOREHOLE No BRU19-25

1 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497909°, Long: -76.670002°  
Bruce Street MTM Zone 9: N 5 039 790.3 E 291 513.8 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-40'), NW (40'-139') COMPILED BY JP  
DATUM Geodetic DATE 2019.09.17 - 2019.09.18 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
								○ UNCONFINED      + FIELD VANE	● QUICK TRIAXIAL      × LAB VANE								
								20   40   60   80   100				W <sub>p</sub> W      W <sub>L</sub>					
147.9	Ground Surface																
0.0	Silty <b>SAND</b> , trace gravel, trace roots Compact Brown <b>(TOPSOIL)</b>		1	SS	14						○				4   80   16 (SI+CL)		
147.1																	
0.8	<b>CLAY (CH)</b> Stiff to Very Stiff Brown <b>(WEATHERED CRUST)</b>		2	SS	20						○						
			3	SS	14						○						
			4	SS	8						○				0   1   44   55		
			5	SS	9						○						
143.3																	
4.6	<b>SILTY CLAY (CI)</b> Very Stiff Grey		6	SS	5						○				0   0   51   49		
					</												

Continued Next Page

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

## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

Continued Next Page

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

# RECORD OF BOREHOLE No BRU19-25

4 OF 5

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497909°, Long: -76.670002°  
Bruce Street MTM Zone 9: N 5 039 790.3 E 291 513.8 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-40'), NW (40'-139') COMPILED BY JP  
DATUM Geodetic DATE 2019.09.17 - 2019.09.18 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	WATER CONTENT (%)					
	Continued From Previous Page													
117.4	<b>SILTY CLAY (CI)</b> Stiff to Very Stiff Grey													
30.5	<b>SILT and SAND</b> Compact to Dense Grey		19	SS	38		117						NP	0 39 47 14
							116							
							115							
			20	SS	42		114							
							113							
							112							
			21	SS	29		111							
							110							
							109							
108.3														
39.6	<b>CLAYEY SILT (CL)</b> , some sand Compact, Grey		22	SS	10		108							0 19 48 33

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29



## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20      40      60      80      100	W <sub>P</sub> W      W <sub>L</sub>	20      40      60					
	Continued From Previous Page														
105.5	CLAYEY SILT (CL), some sand Compact Grey		23	SS	100/		107								
42.4	End of Borehole				0mm		106								

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

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

# RECORD OF BOREHOLE No BRU19-26

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.494981°, Long: -76.668897°  
Bruce Street MTM Zone 9: N 5 039 464.6 E 291 599.5 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME850 Trackmount, HSA COMPILED BY AO  
DATUM Geodetic DATE 2021.05.19 - 2021.05.20 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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
149.7								20 40 60 80 100						
0.0	TOPSOIL (300 mm)							○ UNCONFINED + FIELD VANE						
149.4			1	SS	2			● QUICK TRIAXIAL × LAB VANE						
0.3	SAND, some silt Yellow-brown Very loose to loose						149							
			2	SS	4									
							148							0 82 18 (SI+CL)
147.7			3	SS	6									
2.0	SILTY CLAY (CI) No to trace sand Grey-brown with yellow mottles Very stiff (WEATHERED CRUST)						147							
			4	SS	5									
							146							
			5	SS	4									
			6	SS	6									0 1 47 52
							145							
			7	SS	6									
							144							
			8	SS	4									
							143							
							142							
			9	SS	3									
141.5							141							
8.2	CLAYEY SILT (CL) Contains sand seams and partings Grey-brown Stiff						140							
			10	SS	2									

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## 2 OF 2

## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-27

2 OF 3

METRIC

WP# 4068-09-00 LOCATION Lat: 45.495436°, Long: -76.668876°  
Bruce Street MTM Zone 9: N 5 039 515.3 E 291 601.2 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.19 - 2020.11.19 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
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	W <sub>p</sub>	W	W <sub>L</sub>				
	<b>SILTY CLAY (CI)</b> Very stiff to stiff Grey																	
			10	SS	2													
			11	SS	WR													
			12	SS	WH													
			13	SS	WH													
135.9			14	SS	WH													
18.7	Sandy <b>CLAYEY SILT (CL)</b> , some gravel Stiff Grey																	

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

RECORD OF BOREHOLE No BRU19-27

3 OF 3

METRIC

WP# 4068-09-00 LOCATION Lat: 45.495436°, Long: -76.668876°  
Bruce Street MTM Zone 9: N 5 039 515.3 E 291 601.2 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.19 - 2020.11.19 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			20	40	60	80	100					
	Continued From Previous Page																
	Sandy <b>CLAYEY SILT (CL)</b> , some gravel Stiff Grey																
133.3																	
133.2																	
21.4	GRAVEL trace sand Trace silt Very dense Grey (TILL) End of Borehole		15	SS	100/4"												

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-28

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.495861°, Long: -76.668749°  
Bruce Street MTM Zone 9: N 5 039 562.5 E 291 611.3 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.18 - 2020.11.19 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			20	40	60	80	100		
155.0														
0.0	SILT, trace to some sand Compact to loose Grey brown		1	SS	7									
			2	SS	10		154							0 9 82 9
			3	SS	8		153							
152.7														
2.3	SILTY CLAY (CI) Very Stiff Grey (WEATHERED CRUST)		4	SS	6		152							
			5	SS	7		151							
			6	SS	7		150							0 0 46 54
			7	SS	7		149							
							148							
147.4			8	SS	3		147							
7.6	SILTY CLAY (CI) Very Stiff Grey						146							
			9	SS	4									

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT GPJ 2012TEMPLATE(MTO)GDT 22-6-29

## METRIC

SOIL PROFILE						SAMPLES		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS		
Continued From Previous Page								
139.8  15.2	<b>SILTY CLAY (CI)</b> Very Stiff Grey							
			10	SS	2			
			11	SS	2			
			12	SS	WH			
	<b>CLAYEY SILT (CL) to SILT (ML)</b> Stiff to Very Stiff Grey		13	SS	WH			
14			SS	WH				
	15	SS	WR					

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




# RECORD OF BOREHOLE No BRU19-28

3 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.495861°, Long: -76.668749°  
Bruce Street MTM Zone 9: N 5 039 562.5 E 291 611.3 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.18 - 2020.11.19 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
	Continued From Previous Page							20    40    60    80    100		W <sub>P</sub> W                      W <sub>L</sub>					
	CLAYEY SILT (CL/CL-ML) Stiff to Very Stiff Grey							○ UNCONFINED      + FIELD VANE							
			16	SS	WR				● QUICK TRIAXIAL      × LAB VANE						
			17	SS	WR										

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-28

4 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.495861°, Long: -76.668749°  
Bruce Street MTM Zone 9: N 5 039 562.5 E 291 611.3 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.18 - 2020.11.19 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									
	Continued From Previous Page							20	40	60	80	100					
	SAND, some silt to silty Compact to very dense Grey (TILL)		19	SS	76		124										7 79 14 (SI+CL)
122.9																	
32.1	End of Borehole		20	SS	100/3"		123										

# RECORD OF BOREHOLE No BRU19-29

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496331°, Long: -76.668662°  
Bruce Street MTM Zone 9: N 5 039 614.8 E 291 618.2 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.16 - 2020.11.18 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
154.7								20	40	60	80	100					
0.0	TOPSOIL																
0.1																	
	SAND and SILT Compact to loose Brown		1	SS	10												
			2	SS	23												
			3	SS	19												
152.3																	
	SILTY CLAY (CI) Very stiff to Stiff Grey (WEATHERED CRUST)		4	SS	9												
2.4																	
			5	SS	7												
			6	SS	6												
			7	SS	6												

Continued Next Page

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

20  
15 10 5 0  
(%) STRAIN AT FAILURE

DOUBLE LINE 24726 BRUCE STREET GINT GPJ 2012TEMPLATE(MTO) GDT 22-6-29

## METRIC

[illegible]

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

# RECORD OF BOREHOLE No BRU19-29

3 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496331°, Long: -76.668662°  
Bruce Street MTM Zone 9: N 5 039 614.8 E 291 618.2 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME 75 Trackmount, HSA, H Casing COMPILED BY AO  
DATUM Geodetic DATE 2020.11.16 - 2020.11.18 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W P W W L								
								SHEAR STRENGTH kPa		WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page							20 40 60 80 100		20 40 60							
	CLAYEY SILT (CL/CL-ML) Stiff to Very stiff Grey						134							NP	0 0 57 43		
			16	SS	2		133										
							132										
							131										
			17	SS	WR		130										
							129										
							128										
							127										
			18	SS	WR		126										
							125										
124.8																	
20.0																	

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

124.8  
29.9

Continued Next Page

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

## 4 OF 4

WP#	4068-09-00	LOCATION	Lat: 45.496331°, Long: -76.668662° Bruce Street MTM Zone 9: N 5 039 614.8 E 291 618.2	ORIGINATED BY	RH
HWY	17	BOREHOLE TYPE	CME 75 Trackmount, HSA, H Casing	COMPILED BY	AO
DATUM	Geodetic	DATE	2020.11.16 - 2020.11.18	CHECKED BY	

[illegible]

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

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

# RECORD OF BOREHOLE No BRU19-30

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496713°, Long: -76.668342°  
Bruce Street MTM Zone 9: N 5 039 657.2 E 291 643.3 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 55 Trackmount HSA (0'-40'), NW (40'-  
DATE Geodetic DATE 2019.11.28 - 2019.11.29 COMPILED BY JP  
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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
154.1	Ground Surface						154							
0.0	Sandy SILT Loose Brown		1	SS	6		153						NP	0 23 66 11
			2	SS	9		152							
			3	SS	9		151							
151.8							150							
2.3	SILTY CLAY (CI) Very Stiff Grey (WEATHERED CRUST)		4	SS	6		149							
			5	SS	6		148							
			6	SS	9		147							
			7	SS	7		146							
			8	SS	5		145							
			9	SS	6									
			10	SS	8									
145.0														
9.1	SILTY CLAY (CI) Very Stiff Grey		11	SS	3									
144.1														

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU19-30

2 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496713°, Long: -76.668342°  
Bruce Street MTM Zone 9: N 5 039 657.2 E 291 643.3 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 55 Trackmount HSA (0'-40'), NW (40'-  
DATUM Geodetic DATE 2019.11.28 - 2019.11.29 COMPILED BY JP  
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	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20	40	60						80	100	20
	Continued From Previous Page																	
10.0	SILTY CLAY (CI) Very Stiff Grey						144											
			12	SS	3													
							143											
142.2																		
11.9	CLAYEY SILT (CL/CL-ML) Stiff to Very Stiff Grey		13	SS	4		142											
			14	SS	8		141											
							140											
			15	SS	3		139											
							138											
			16	SS	3		137											
							136											
			17	SS	4													
							135											
			18	SS	1													

Continued Next Page

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



## METRIC

[illegible]

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



DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

RECORD OF BOREHOLE No BRU19-30

4 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.496713°, Long: -76.668342°  
Bruce Street MTM Zone 9: N 5 039 657.2 E 291 643.3 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 55 Trackmount HSA (0'-40'), NW (40'-  
DATUM Geodetic DATE 2019.11.28 - 2019.11.29 COMPILED BY JP  
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									
	Continued From Previous Page						20	40	60	80	100						
122.4	<b>CLAYEY SILT (CL/CL-ML)</b> Stiff to Very Stiff Grey						124										
31.7	<b>SILT</b> , some sand to sandy With sand seams, contains low-plastic fines Compact to Dense Grey		22	SS	15		122						H	o		0 10 59 31	
							121										
							120										
118.7			23	SS	39		119										
35.4	<b>End of Borehole</b>																

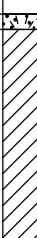

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-31

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497516°, Long: -76.668258°  
Bruce Street MTM Zone 9: N 5 039 746.3 E 291 650.0 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 55 Trackmount, HSA (0°-35'), NW (35°-124°3") COMPILED BY JP  
DATUM Geodetic DATE 2019.11.26 - 2019.11.27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT		UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W <sub>P</sub> W                      W <sub>L</sub>			WATER CONTENT (%)				
149.9	Ground Surface																
0.0	100mm TOPSOIL																
0.1	CLAY (CH) Very Stiff Brown (WEATHERED CRUST)		1	SS	7												
			2	SS	9												
148.4																	
1.5	SILTY CLAY (CI) Very Stiff Grey		3	SS	7												
				4	SS	7											
				5	SS	7											
				6	SS	9											
				7	SS	5											
				8	SS	3											
				9	SS	4											
			10	SS	4												

Continued Next Page

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

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	W P W L				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)				
	Continued From Previous Page												
138.0	<b>SILTY CLAY (CI)</b> Very Stiff Grey		11	SS	4								
11.9	<b>CLAYEY SILT (CL/CL-ML)</b> Stiff to Very Stiff Grey		12	SS	6								
			13	SS	4								
			14	SS	2								
			15	SS	WH								
			16	SS	WH								
			17	SS	WH								

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


DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU19-31

3 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497516°, Long: -76.668258°  
Bruce Street MTM Zone 9: N 5 039 746.3 E 291 650.0 ORIGINATED BY MJJ  
HWY 17 BOREHOLE TYPE CME 55 Trackmount, HSA (0°-35'), NW (35°-124°3") COMPILED BY JP  
DATUM Geodetic DATE 2019.11.26 - 2019.11.27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  $\gamma$  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		WATER CONTENT (%)					
								○ UNCONFINED      + FIELD VANE							
								● QUICK TRIAXIAL      × LAB VANE							
	Continued From Previous Page														
121.2 28.7	CLAYEY SILT (CL/CL-ML) Stiff to Very Stiff Grey														
			18	SS	4										

Continued Next Page

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

## METRIC

SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE
			NUMBER	TYPE	"N" VALUES
<div>DYNAMIC CONE PENETRATION RESISTANCE PLOT <div>20406080100</div><div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div></div> <div>SHEAR STRENGTH kPa <div>20406080100</div></div> <div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W<sub>P</sub> W W<sub>L</sub> WATER CONTENT (%)</div> <div>UNIT WEIGHT γ kN/m<sup>3</sup></div> <div>REMARKS &amp; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL</div>					
	Continued From Previous Page				
	Interlayered <b>CLAYEY SILT (CL/CL-ML)</b> and Silty <b>SAND (SM)</b> Very Loose to Compact Grey		21	SS	11
			22	SS	22
			23	SS	100/
112.0 37.9	End of Borehole			0.08m	

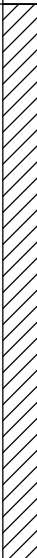

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No BRU19-33

1 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498365°, Long: -76.668916°  
Bruce Street MTM Zone 9: N 5 039 840.9 E 291 598.8 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-110'2") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.24 - 2019.09.25 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  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								
								20 40 60 80 100								
146.9	Ground Surface															
0.0	<b>CLAY (CH)</b> Very Stiff Brown <b>(WEATHERED CRUST)</b>		1	SS	15											
			2	SS	15											
			3	SS	9											
			4	SS	7											
			5	SS	9											
143.1																
3.8	<b>SILTY CLAY (CI)</b> Very Stiff Grey-Brown to Grey		6	SS	7											
					7	SS	5									
									</							

Continued Next Page

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

# RECORD OF BOREHOLE No BRU19-33

2 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498365°, Long: -76.668916°  
Bruce Street MTM Zone 9: N 5 039 840.9 E 291 598.8 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-110'2") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.24 - 2019.09.25 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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						
	Continued From Previous Page						20 40 60 80 100					PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub>		
	<b>SILTY CLAY (CI)</b> Very Stiff Grey-Brown to Grey													
			9	SS	4		136							
			10	SS	4		134							

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29



## METRIC

[illegible]

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

RECORD OF BOREHOLE No BRU19-33

4 OF 4

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498365°, Long: -76.668916°  
Bruce Street MTM Zone 9: N 5 039 840.9 E 291 598.8 ORIGINATED BY MW  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA (0'-20'), NW (20'-110'2") COMPILED BY JP  
DATUM Geodetic DATE 2019.09.24 - 2019.09.25 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								20 40 60 80 100									20 40 60		
	Continued From Previous Page		17	SS	7														
	Interlayered Silty <b>SAND (SM)</b> and <b>CLAYEY SILT (CL/CL-ML)</b> Compact Grey						116												
114.9							115												
32.0	Silty <b>SAND</b> , trace gravel Loose to Very Dense Grey <b>(TILL)</b>		18	SS	7														
							114												
113.3			19	SS	57											6 73 21 (SI+CL)			
33.6	End of Borehole																		

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU21-02

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.497647°, Long: -76.671101°  
Bruce Street MTM Zone 9: N 5 039 761.4 E 291 427.9 ORIGINATED BY NW  
HWY 17 BOREHOLE TYPE Diedrich 50 (D-50) Trackmount, HSA COMPILED BY AO  
DATUM Geodetic DATE 2021.11.01 - 2021.11.01 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												
								20	40	60						80	100	WATER CONTENT (%)		
								○ UNCONFINED    + FIELD VANE												
						● QUICK TRIAXIAL    × LAB VANE														
151.4	Ground Surface																			
0.0	SILTY SAND some gravel Loose Brown [FILL]		1	SS	4		151						○							
150.8																				
0.6	CLAY (CH) Very stiff Brown to Grey (WEATHERED CRUST)																			
			2	SS	8		150						○							
			3	SS	10								○							
			4	SS	7		149						┌──○──┐			0   1   38   61				
			5	SS	7		148						○							
			6	SS	7								○							
							147													
			7	SS	7								┌──○──┐			0   0   41   59				
							146													
			8	SS	7		145						○							
144.7	End of Borehole																			
6.7	Monitoring well consists of 50 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen  Water level readings: Date      Depth (m)      Elev. (m) 2021.11.04      2.4      149.0 2022.11.30      2.3      149.1 2021.12.23      2.2      149.2 2022.01.19      2.5      148.9																			

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

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

# RECORD OF BOREHOLE No BRU21-05

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.498101°, Long: -76.669878°  
Bruce Street MTM Zone 9: N 5 039 811.7 E 291 523.6 ORIGINATED BY NW  
HWY 17 BOREHOLE TYPE Diedrich 50 (D-50) Trackmount, HSA COMPILED BY AO  
DATUM Geodetic DATE 2021.11.02 - 2021.11.02 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
149.2	Ground Surface							20 40 60 80 100		W <sub>p</sub> W      W <sub>L</sub>			GR SA SI CL	
0.0 0.1	TOPSOIL (75 mm)							20 40 60 80 100						
	SILTY SAND some gravel Contains asphalt Compact Brown to Grey [FILL]		1	SS	15		149							11 81 8 (SI+CL)
			2	SS	10		148							
147.7														
1.5	CLAY (CH) to SILTY CLAY (CI) Very stiff Brown (WEATHERED CRUST)		3	SS	14									
			4	SS	10		147							0 1 38 61
			5	SS	6		146							
			6	SS	5		145							
			7	SS	6		144							
							143							0 0 51 49
142.5	End of Borehole		8	SS	6									
6.7	Monitoring well consists of 50 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen  Water level readings: Date      Depth (m)      Elev. (m) 2021.11.16      2.0      147.2 2021.12.01      2.0      147.2 2022.01.19      2.3      146.9													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

## METRIC

[illegible]

## METRIC

[illegible]

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

## 1 OF 1

METRIC

[illegible]

DOUBLE LINE 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 22-6-29

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

RECORD OF BOREHOLE No BRU23-1

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Bruce Street MTM Zone 9: N 5 039 441.2 E 291 624.5 ORIGINATED BY BC  
HWY 17 BOREHOLE TYPE CME75 Trackmount, HSA COMPILED BY RH  
DATUM Geodetic DATE 2024.03.04 - 2024.03.05 CHECKED BY MJK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		SHEAR STRENGTH kPa		WATER CONTENT (%)		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>P</sub> W W <sub>L</sub>	GR SA SI CL							
154.9	Ground Surface																	
0.0	<b>SAND (SP)</b> , some fines Loose Brown <b>FILL</b>		1	GS	-											0	92	8 (SI+CL)
			1	SS	4													
153.4																		
1.5	<b>SILTY CLAY (CI)</b> , trace sand to no sand Very stiff Grey with yellow mottles <b>(WEATHERED CRUST)</b>		2	SS	9													
			3	SS	11											0	1	51 48
			4	SS	9													
			5	SS	10													
			6	SS	5													
			7	SS	5											0	1	58 41
148.0																		
6.9	<b>CLAYEY SILT to SILTY CLAY (CI)</b> Contains sand seams Stiff to very stiff Grey		8	SS	WR													
			9	SS	3													
			10	SS	WH											0	1	65 34

Continued Next Page

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

ONTMT4S 24726 BRUCE STREET GINT.GPJ 2012TEMPLATE(MTO).GDT 6-26-24



RECORD OF BOREHOLE No BRU23-1

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Bruce Street MTM Zone 9: N 5 039 441.2 E 291 624.5 ORIGINATED BY BC  
HWY 17 BOREHOLE TYPE CME75 Trackmount, HSA COMPILED BY RH  
DATUM Geodetic DATE 2024.03.04 - 2024.03.05 CHECKED BY MJK

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 (%)					
	Continued From Previous Page													
142.7	CLAYEY SILT to SILTY CLAY (CI) Contains sand seams Stiff to very stiff Grey		11	SS	3		144							
12.2	SAND (SP), some fines Compact to very dense Grey to grey-brown		12	SS	10		143							
			3A/B	SS	35		141							
139.1			14	SS	90		140							
15.8	End of Drilled Borehole Start of DCPT						139							
136.3	End of DCPT (Refusal) Monitoring well consists of 51 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2024.03.07 11.7 143.2 2024.03.22 11.6 143.3 2024.04.10 11.5 143.4						138							
							137							

RECORD OF BOREHOLE No BRU23-2

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Bruce Street MTM Zone 9: N 5 039 400.1 E 291 636.3 ORIGINATED BY BC  
HWY 17 BOREHOLE TYPE CME75 Trackmount, HSA COMPILED BY RH  
DATUM Geodetic DATE 2024.03.04 - 2024.03.04 CHECKED BY MJK

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								
153.9	Ground Surface															
0.0	SAND (SP), some fines Trace gravel Compact Brown		1	GS	-											6 74 20 (SI+CL)
153.3																
0.6	SAND (SP/SW) Some to trace gravel Dense to very dense Brown		1	SS	20	153										
			2	SS	63	152										
			3	SS	83											
			4	SS	85	151										
			5	SS	54	150										
			6	SS	44	149										16 75 9 (SI+CL)
			7	SS	56	148										
			8	SS	51											
			9	SS	53	147										
			10	SS	47	146										3 90 7 (SI+CL)
			11	SS	51	145										
						144										

Continued Next Page

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

RECORD OF BOREHOLE No BRU23-2

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Bruce Street MTM Zone 9: N 5 039 400.1 E 291 636.3 ORIGINATED BY BC  
HWY 17 BOREHOLE TYPE CME75 Trackmount, HSA COMPILED BY RH  
DATUM Geodetic DATE 2024.03.04 - 2024.03.04 CHECKED BY MJK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ 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 (%) W P W W L				
	Continued From Previous Page															
	<b>SAND (SP/SW)</b> Some to trace gravel Dense to very dense Brown		12	SS	44		143									
								142								
								141								
								140								
139.6			14	SS	12										0 96 4 (SI+CL)	
14.3	End of Drilled Borehole Start of DCPT						139									
							138									
							137									
136.2																
17.7	End of DCPT (Refusal)															

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
20  
15  
10  
5  
0  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BRU23-3

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Bruce Street MTM Zone 9: N 5 039 344.1 E 291 655.6 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME75 Trackmount, HSA COMPILED BY RH  
DATUM Geodetic DATE 2024.02.29 - 2024.02.29 CHECKED BY MJK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE				WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>				GR	SA	SI	CL	
151.5	Ground Surface							20	40	60	80	100								
0.0	SILT and SAND (ML/SM) Compact Grey		1	GS	-		151													
			2	SS	9		150													
			3	SS	16		149										0	42	46	12
			4	SS	11		148										0	13	69	18
			5	SS	5		147													
147.7	Interlayered CLAYEY SILT (CL) and SILTY SAND (SM) Very stiff to Dense Grey		6A/B	SS	8		146													
			7	SS	41		145										0	80	20 (SI+CL)	
			8	SS	2		144										0	8	61	31
			9A/B	SS	62		143													
144.8	SILTY SAND (SM) with gravel Very dense Grey (TILL)						142													
6.7							141													
143.5	End of Borehole Monitoring well consists of 51 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) 2024.03.07      dry 2024.03.22      dry 2024.04.10      dry 2024.04.24      dry		10	SS	151		140													
8.0							139													

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

RECORD OF BOREHOLE No BRU23-4

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Bruce Street MTM Zone 9: N 5 039 302.8 E 291 667.7 ORIGINATED BY RH  
HWY 17 BOREHOLE TYPE CME75 Trackmount, HSA COMPILED BY RH  
DATUM Geodetic DATE 2024.02.28 - 2024.02.28 CHECKED BY MJK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE										
149.1	Ground Surface																				
0.0	<b>SILT (ML)</b> , some sand to sandy Loose to compact Brown-grey		1	SS	9																
			2	SS	7																
			3	SS	7																
			4	SS	6																
			5	SS	17																
145.3			6	SS	29																
3.8	<b>SILT and SAND (SM)</b> trace to some gravel Compact to very dense Brown-red-grey <b>(TILL)</b>		7	SS	27																
			8	SS	113																
143.3			9	SS	>50																
5.8	<b>End of Borehole</b>																				

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



## **Appendix B.2**

### **Previous (2003) Investigation**

# RECORD OF BOREHOLE No BRU-1

1 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 748.0 E 291 406.0 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 07.10.03 - 10.10.03 CHECKED BY SKP

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									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							WATER CONTENT (%)										
							20 40 60 80 100										
							20 40 60 80 100										
151.6																	
150.6	TOPSOIL (125mm)																
0.1	Sandy SILT, some gravel, occasional rootlets		1	SS	9												
150.9	Loose																
0.7	Brown																
	Moist																
	(FILL) (ML)		2	SS	13												
	Silty CLAY to CLAY, occasional oxide staining, sand seams and trace rootlets to 2.2m																
	Stiff to Firm																
	Brown/ Grey		3	SS	10												
	Moist																
	(CI-CH)																
	( dessicated crust )																
			4	SS	7										0 1 37 63		
			5	SS	7												
			6	SS	8												
146.0																	
5.6	Grey																
			7	SS	6												
			8	SS	6												
			9	SS	4												
141.6																	

Continued Next Page

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

# RECORD OF BOREHOLE No BRU-1

2 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 748.0 E 291 406.0 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 07.10.03 - 10.10.03 CHECKED BY SKP

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							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE						
10.0	Silty CLAY, to CLAY, sand seams Firm Grey (CI-CH)							20 40 60 80 100	20 40 60						
			10	SS	4		141							0 1 63 37	
			1	TW	PH		140							Consolidation Test	
			11	SS	3		139								
							138								
			12	SS	3		137							Blow back in augers	
							136								
			13	SS	3		135								
							134								
			14	SS	4		133							Commence casing and washboring	
							132								
			15	SS	5										
131.6															

Continued Next Page

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





# RECORD OF BOREHOLE No BRU-1

3 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 748.0 E 291 406.0 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NO Coring COMPILED BY SS  
 DATUM Geodetic DATE 07.10.03 - 10.10.03 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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									
								20 40 60 80 100					WATER CONTENT (%)				
								20 40 60 80 100					20 40 60				
							PLASTIC LIMIT w <sub>p</sub>			NATURAL MOISTURE CONTENT w			LIQUID LIMIT w <sub>L</sub>				
							○ UNCONFINED    + FIELD VANE										
							● QUICK TRIAXIAL    × LAB VANE										
20.0	Silty CLAY, to CLAY Firm to Soft Grey (CI-CH)		2	TW	PH												
			16	SS	3			131									0 5 64 31
			17	SS	3			130									
			18	SS	3		129										

Continued Next Page

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

# RECORD OF BOREHOLE No BRU-1

4 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 748.0 E 291 406.0 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 07.10.03 - 10.10.03 CHECKED BY SKP

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
30.0	Silty <b>CLAY to CLAY</b> , with sand and silt layers and seams Firm Grey (CI-CH)		21	SS	5		121					
							120					
							119					
	move frequent sand layers		22	SS	23		118					
							117					
116.0							116					
35.6	Silty <b>SAND to Sandy SILT</b> , trace clay Dense Grey Wet		23	SS	32		115					
							114					
113.2							113					
38.4	Silty <b>CLAY to CLAY</b> , with sand and silt layers and seams Stiff Grey Moist to Wet		24	SS	15		112					

Continued Next Page

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

METRIC

G.W.P.	647-92-00	LOCATION	N 5 039 748.0 E 291 406.0 (Bruce Street)	ORIGINATED BY	JL
HWY	HWY 17	BOREHOLE TYPE	Hollow Stem Augers, Casing and Washboring, NQ Coring	COMPILED BY	SS
DATUM	Geodetic	DATE	07.10.03 - 10.10.03	CHECKED BY	SKP

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 (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE			
								20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub>			
109.1	Silty <b>CLAY</b> to <b>CLAY</b> , with sand and silt layers and seams Stiff Grey						111					
							110					
42.5	Silty <b>SAND</b> , some gravel, frequent cobbles and boulders Very Dense Grey (TILL)		25	SS	110		109					
	no recovery from 44.42m to 45.62m		1	RUN			108					
			2	RUN			107					
	boulder from 46.13m to 46.76m		3	RUN			106					
	no recovery from 46.69m to 47.14m						105					
	no recovery from 47.88m to 48.67m		4	RUN			104					
102.8					FI		103					
48.8	<b>MARBLE (BEDROCK)</b> Slightly to moderately weathered, grey, brown and white with subhorizontal black banding, strong. Subvertical joint at 49.8m. Multiple vertical and subvertical joints at 49.9m		5	RUN	1 0 1 >5		102				RUN 5# TCR=98%, SCR=67%, RQD=66%, UCS=79MPa	

Continued Next Page

 $+^3, \times^3,$ 

Numbers refer to  
Sensitivity

(%) STRAIN AT FAILURE

ONTMT4 7450BRU.GPJ 04/06/04

# RECORD OF BOREHOLE No BRU-1

6 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 748.0 E 291 406.0 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 07.10.03 - 10.10.03 CHECKED BY SKP

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			20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
101.4															
50.2	END OF BOREHOLE AT 50.19m. BOREHOLE OPEN TO 45.72m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.						101								
	WATER LEVEL READINGS: DATE ELEVATION(m) 22/10/03 145.2 18/12/03 146.2 04/02/04 145.8 11/03/04 146.0														

# RECORD OF BOREHOLE No BRU-2

1 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 748.7 E 291 445.8 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NO Coring COMPILED BY SS  
 DATUM Geodetic DATE 17.10.03 - 21.10.03 CHECKED BY SKP

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						
150.3								20 40 60 80 100						
0.0	SAND and GRAVEL		1	SS	16		150	○ UNCONFINED + FIELD VANE						
	Compact							● QUICK TRIAXIAL × LAB VANE						
149.6	Brown													
	Moist													
0.7	(FILL)													
	Silty CLAY to CLAY, sand seams		2	SS	5		149							
	Firm to Stiff													
	Grey/ Brown													
	(CI-CH)													
	( desiccated crust )													
			3	SS	10		148							
			4	SS	14		147							
			5	SS	10		146							
			6	SS	7		145							
144.5														
5.8	grey		7	SS	6		144							
			8	SS	8		143							
			9	SS	7		142							
							141							

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH kPa	WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							
	Silty CLAY to CLAY, sand seams Firm Grey (CI-CH)										
			10	SS	7						0 2 61 37
			11	SS	6						
			12	SS	5						
			13	SS	7						
			1	TW	PH						
			14	SS	1						
	Very Soft to Soft										Commence casing and washboring

(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa			WATER CONTENT (%)			
						20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	W P W W L			
	Silty CLAY to CLAY with sand and silt layers and seams Very Soft to Soft Grey (CI-CH)					130								
			15	SS	2	129								
						128								
						127								
						126								
			16	SS	3	125								
						124								
						123								
			2	TW	PH	122								
						121								

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

# RECORD OF BOREHOLE No BRU-2

4 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 748.7 E 291 445.8 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 17.10.03 - 21.10.03 CHECKED BY SKP

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 (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								20 40 60 80 100						
							WATER CONTENT (%)							
							20 40 60							
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT							
							W P W W L							
							○ UNCONFINED + FIELD VANE							
							● QUICK TRIAXIAL × LAB VANE							
							20 40 60 80 100							
	Silty <b>CLAY</b> to <b>CLAY</b> with sand and silt layers and seams Soft to Firm Grey (CI-CH)		17	SS	4		120							
							119							
							118							
							117							
116.4			18	SS	11									
33.9	Silty <b>SAND</b> to Sandy <b>SILT</b> , trace to some clay Compact Grey Wet						116							
							115							
							114							
			19	SS	12									
							113							
							112							
111.9							111							
38.4	Silty <b>CLAY</b> to <b>CLAY</b> , with sand and silt layers and seams Stiff Grey Wet		20	SS	9									

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No BRU-2

5 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 748.7 E 291 445.8 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 17.10.03 - 21.10.03 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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									
								20 40 60 80 100					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W P W W L				
							WATER CONTENT (%)					20 40 60					
107.4	Silty CLAY to CLAY						110										
							109										
							108										
42.9	Silty SAND, some gravel, frequent cobbles and boulders, occasional clayey silt seams/ partings Grey Very Dense Wet (TILL)		21	SS	26		107										
			1	WS			106										
			2	WS			105										
			3	WS			104										
			4	WS			103										
			5	WS			102										
							101										

Advancing NW casing and cleaning with NQ core barrel

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

METRIC

G.W.P.	647-92-00	LOCATION	N 5 039 748.7 E 291 445.8 (Bruce Street)	ORIGINATED BY	JL
HWY	HWY 17	BOREHOLE TYPE	Hollow Stem Augers, Casing and Washboring, NQ Coring	COMPILED BY	SS
DATUM	Geodetic	DATE	17.10.03 - 21.10.03	CHECKED BY	SKP

[illegible]

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

# RECORD OF BOREHOLE No BRU-3

1 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 768.7 E 291 479.6 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 27.10.03 - 29.10.03 CHECKED BY SKP

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			20 40 60 80 100	20 40 60 80 100					
149.3														
149.2	TOPSOIL (150mm)													
0.2	Black		1	SS	8		149							
	Silty CLAY to CLAY, trace rootlets, trace gravel to 1.4m Stiff to Very Stiff Brown Moist to Wet (CI-CH) (dissicated crust)		2	SS	15		148							
			3	SS	16		147							
			4	SS	10		146							0 0 40 60
			5	SS	6		145							
			6	SS	10		144							
			7	SS	10		143							
142.2	becoming grey		8	SS	8		142							
7.1	frequent sand and silt layers and seams		9	SS	11		141							Vane could not be turned
139.3							140							

Continued Next Page

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

# RECORD OF BOREHOLE No BRU-3

2 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 768.7 E 291 479.6 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 27.10.03 - 29.10.03 CHECKED BY SKP

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE												
								● QUICK TRIAXIAL × LAB VANE												
							20	40	60	80	100	20	40	60	kN/m <sup>3</sup>	GR	SA	SI	C	
10.0	Silty CLAY to CLAY Stiff Grey (CI-CH) ( dessicated crust )						139													
			10	SS	12		138													
							137													
			11	SS	12		136													
							135													
	with sand and silt layers and seams below this level		12	SS	12		134													
							133													
			13	SS	9		132													
							131													
	Firm		14	SS	7		130													
			15	SS	5															
129.3																				

Continued Next Page

+ 3 × 3  
Sensitivity

Numbers refer to

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

DATUM Geodetic DATE 27.10.03 - 29.10.03 CHECKED BY SKP

Continued Next Page

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

ONTMT4 74508RU.GPJ 04/06/04

# RECORD OF BOREHOLE No BRU-3

4 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 768.7 E 291 479.6 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 27.10.03 - 29.10.03 CHECKED BY SKP

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			20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
30.0	Silty CLAY to CLAY, with sand and silt layers and seams Stiff Grey (CI-CH)		18	SS	14		119					Vane could not be turned
115.6							118					
							117					
							116					
33.7	Silty SAND to Sandy SILT Very Dense Grey Wet		19	SS	97/ 279		115					0 73 27 (SI+CL)
							114					
113.2							113					
36.1	Silty CLAY to CLAY, with sand and silt layers and seams Hard Grey Wet		20	SS	50/ 127		112					
							111					
							110					
	frequent inferred cobbles		21	SS	50/ 076							
109.3												

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BRU-3

5 OF 6

METRIC

G.W.P. 647-92-00 LOCATION N 5 039 768.7 E 291 479.6 (Bruce Street) ORIGINATED BY JL  
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, Casing and Washboring, NQ Coring COMPILED BY SS  
 DATUM Geodetic DATE 27.10.03 - 29.10.03 CHECKED BY SKP

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
40.0	Silty <b>CLAY to CLAY</b> , with sand and silt layers and seams Grey						109					
	some gravel, occasional cobbles and boulders		1	WS			108					
105.2							107					
44.1	Silty <b>SAND</b> , some gravel, occasional cobbles and boulders Grey Wet (TILL)						106					
	boulder from 45.11m to 45.49m		2	WS			105					
			3	WS			104					
							103					
							102					
100.7							101					
48.6	<b>MARBLE (BEDROCK)</b> Slightly to moderately weathered, grey, brown and white with subhorizontal black banding, strong Multiple subvertical joints at 50.2m Subvertical joints at 49.2m and 50.0m Vertical joint at 50.9m		1	RUN			100					

RUN 1#  
TCR=100%,  
SCR=100%,  
RQD=79%,  
UCS=90MPa

Continued Next Page

+ 3 x 3

Numbers refer to  
Sensitivity

20  
15 5  
10  
(%) STRAIN AT FAILURE

ONTMT4 7450BRU.GPJ 04/06/04

METRIC

G.W.P.	647-92-00	LOCATION	N 5 039 768.7 E 291 479.6 (Bruce Street)	ORIGINATED BY	JL
HWY	HWY 17	BOREHOLE TYPE	Hollow Stem Augers, Casing and Washboring, NQ Coring	COMPILED BY	SS
DATUM	Geodetic	DATE	27.10.03 - 29.10.03	CHECKED BY	SKP

[illegible]

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

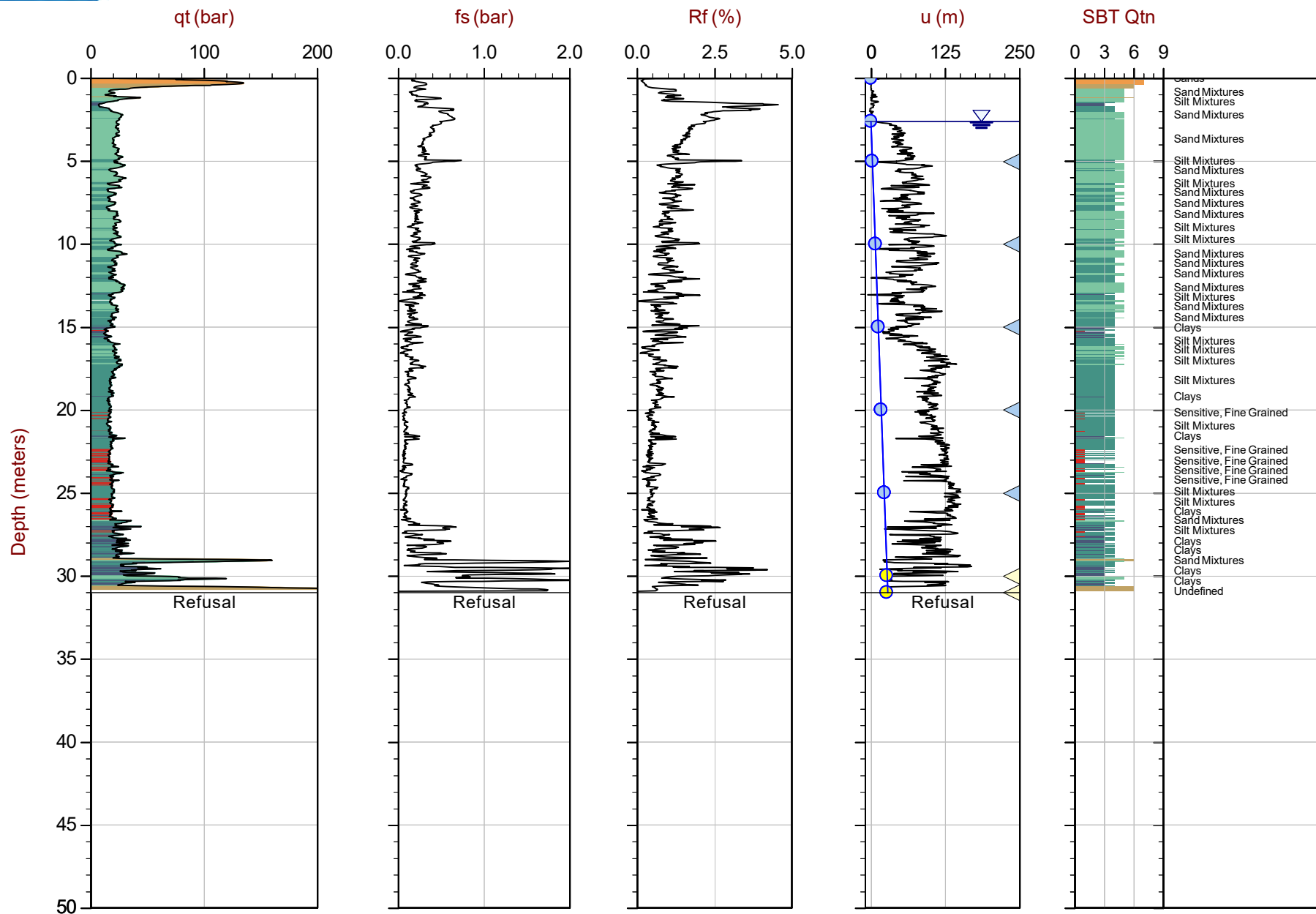
(%) STRAIN AT FAILURE





### **Appendix B.3**

#### **Cone Penetration Test Summary Sheets (ConeTec Investigations Ltd.)**



Max Depth: 31.000 m / 101.70 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: Every Point

File: 19-05076\_CP05.COR  
UnitWt: SBTQtn(PKR2009)

SBT: [Robertson, 2009 and 2010](#)  
 Coords: [MTM9N](#): 5039813.70m E: 291524.10m Elev: 149.00m  
 SheetNo: 1 of 1

OverplotItem: ● Ueq ● Assumed Ueq ◀ Dissipation, Ueq achieved ◀ Dissipation, Ueq not achieved ◀ Dissipation, Ueq assumed — HydrostaticLine



Thurber

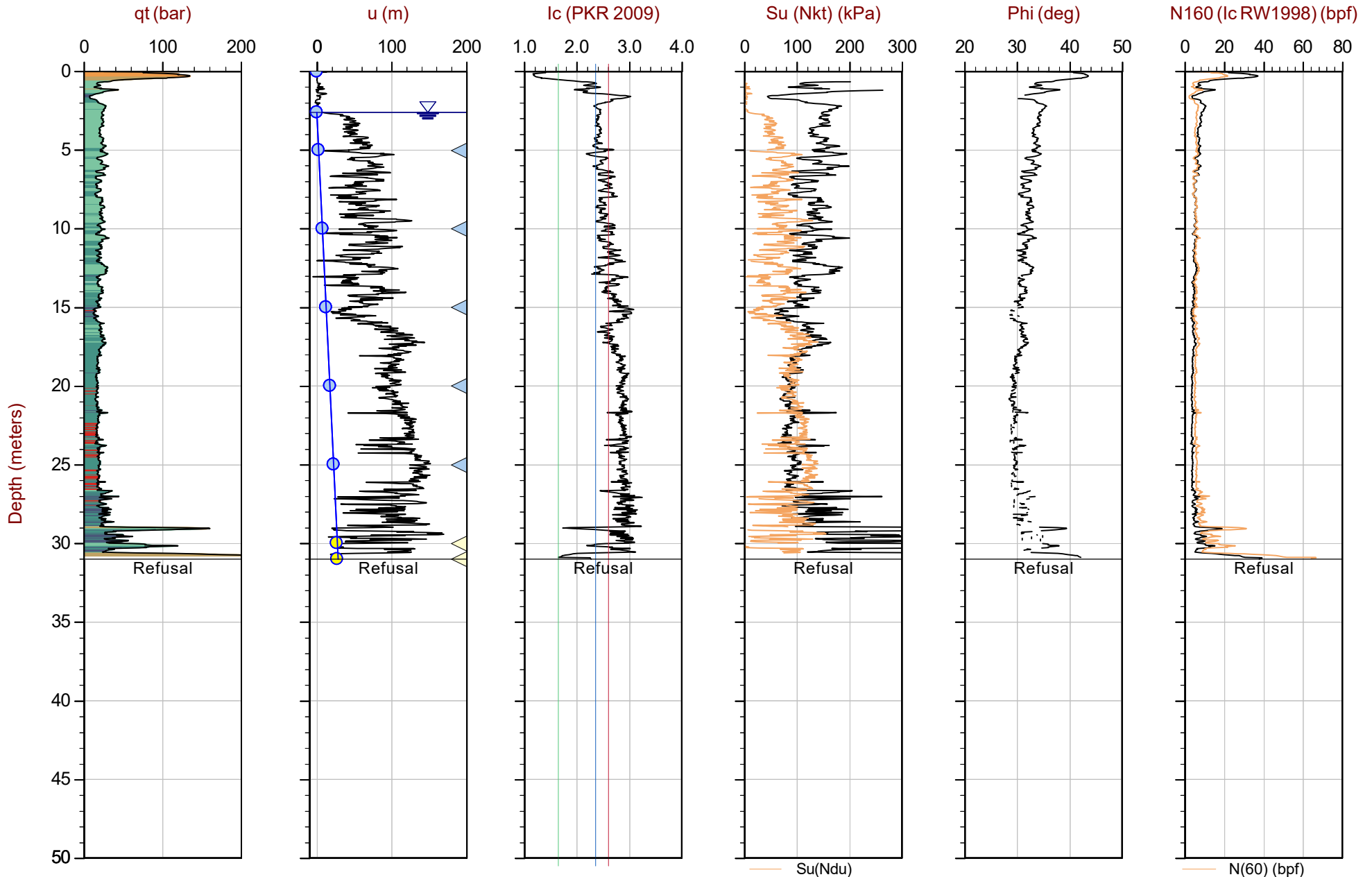
Job No: 19-05076

Date: 2019-11-28 07:10

Site: Bruce Street

Sounding: BRU19-05

Cone: 377:T1000F10U500



Max Depth: 31.000 m / 101.70 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

Overplot Item: ● Ueq ● Assumed Ueq

File: 19-05076\_CP05.COR

Unit Wt: SBTQtn (PKR2009)

Su Nkt/Ndu: 15.0 / 9.0

△ Dissipation, Ueq achieved

◀ Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010

Coords: MTM9N N: 5039813.70m E: 291524.10m Elev: 149.00m

Sheet No: 1 of 1

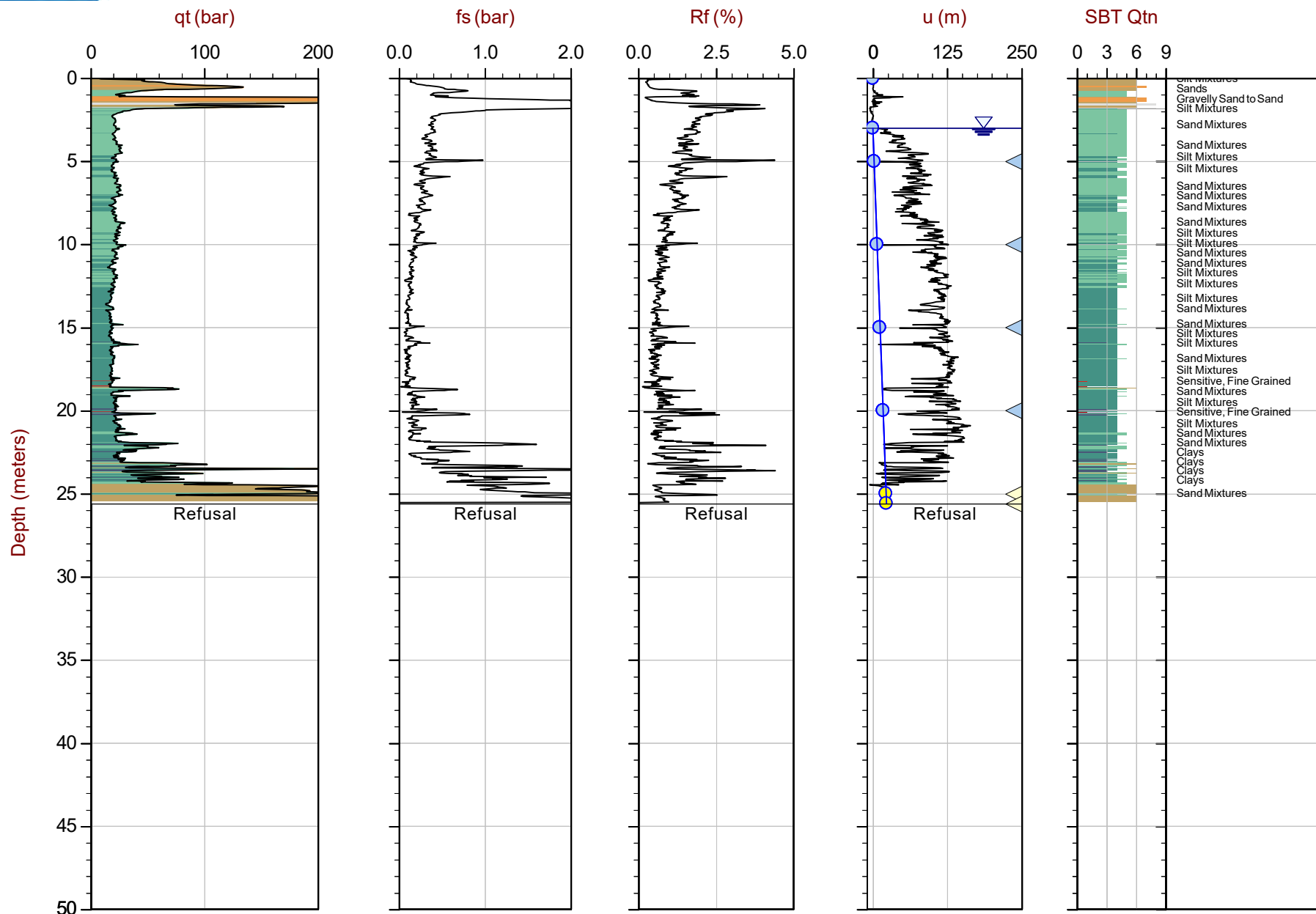
◀ Dissipation, Ueq assumed

— Hydrostatic Line



Job No: 19-05076  
Date: 2019-11-27 13:44  
Site: Bruce Street

Sounding: BRU19-08  
Cone: 377:T1000F10U500



Max Depth: 25.600 m / 83.99 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: EveryPoint

File: 19-05076\_CP08.COR  
Unit Wt: SBTQtn (PKR2009)

SBT: [Robertson, 2009 and 2010](#)  
 Coords: [MTM9N: 5039910.20m E: 291640.10m Elev: 147.40m](#)  
 Sheet No: [1 of 1](#)

Overplot Item: ● Ueq ● Assumed Ueq ◀ Dissipation, Ueq achieved ◀ Dissipation, Ueq not achieved ◀ Dissipation, Ueq assumed — Hydrostatic Line



Thurber

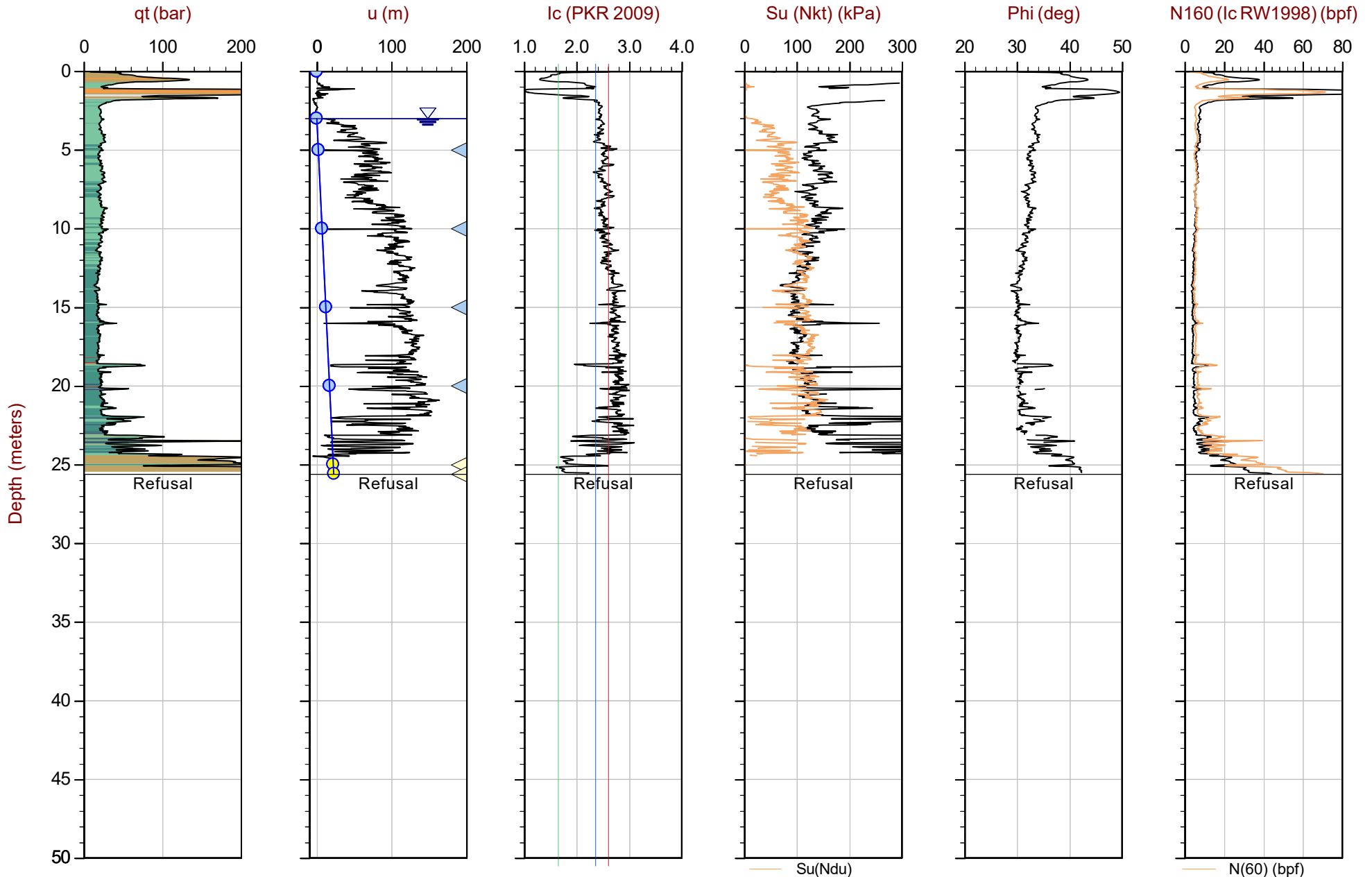
Job No: 19-05076

Date: 2019-11-27 13:44

Site: Bruce Street

Sounding: BRU19-08

Cone: 377:T1000F10U500



Max Depth: 25.600 m / 83.99 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

Overplot Item: ● Ueq ● Assumed Ueq

File: 19-05076\_CP08.COR

Unit Wt: SBTQtn (PKR2009)

Su Nkt/Ndu: 15.0 / 9.0

△ Dissipation, Ueq achieved

△ Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010

Coords: MTM9NN: 5039910.20m E: 291640.10m Elev: 147.40m

Sheet No: 1 of 1

△ Dissipation, Ueq assumed

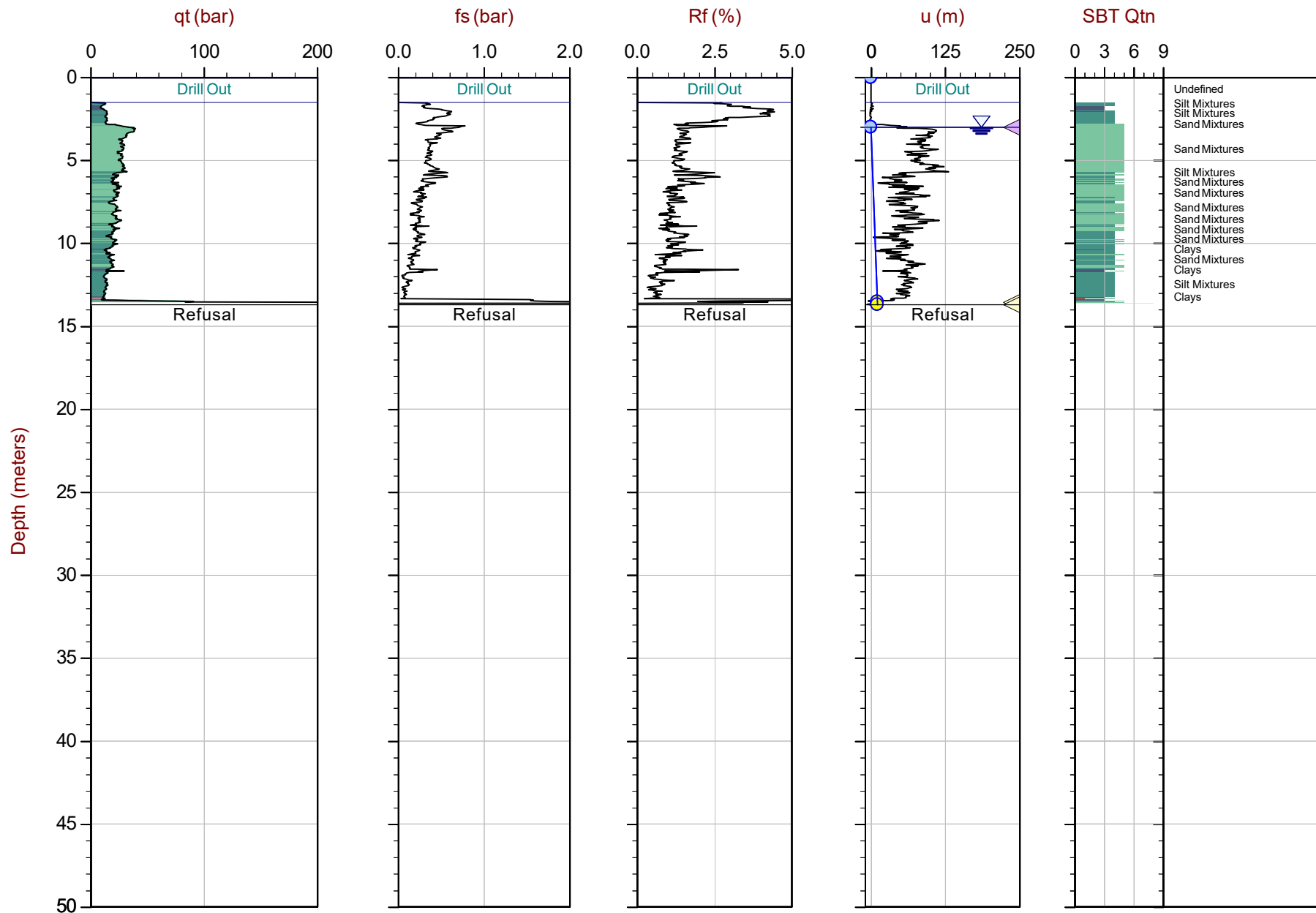
— Hydrostatic Line



Thurber

Job No: 19-05076  
Date: 2019-11-27 07:45  
Site: Bruce Street

Sounding: BRU19-11  
Cone: 377:T1000F10U500



Max Depth: 13.700 m / 44.95 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: Every Point

File: 19-05076\_CP11.COR  
Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010  
Coords: MTM9NN: 5039628.10m E: 291230.20m Elev: 152.70m  
Sheet No: 1 of 1

Overplot Item: ● Ueq ● Assumed Ueq ▲ Dissipation, Ueq achieved ▲ Dissipation, Ueq not achieved ▲ Dissipation, Ueq assumed — Hydrostatic Line



Thurber

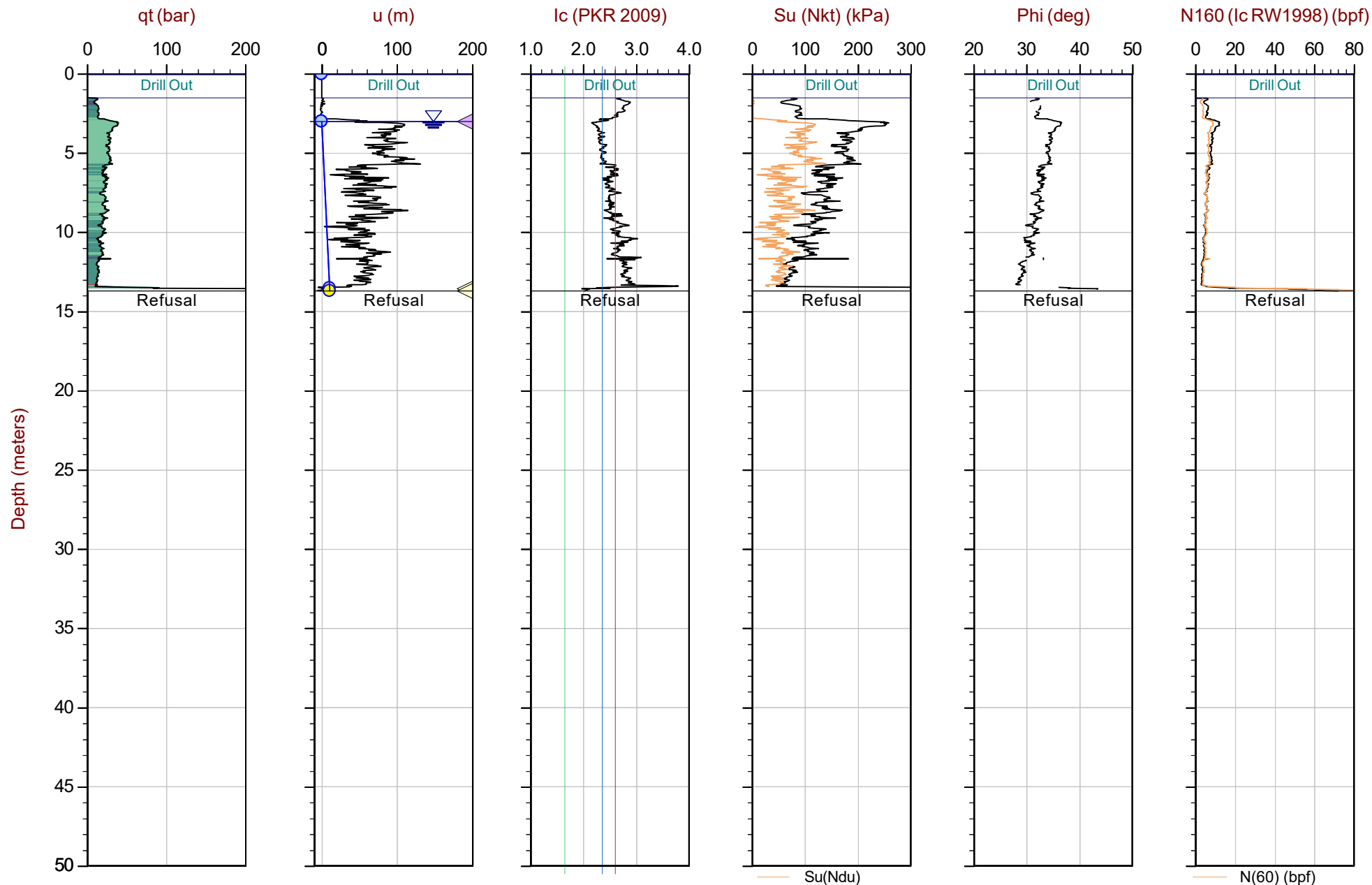
Job No: 19-05076

Date: 2019-11-27 07:45

Site: Bruce Street

Sounding: BRU19-11

Cone: 377:T1000F10U500



Max Depth: 13.700 m / 44.95 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

Overplot Item: ● Ueq ● Assumed Ueq

File: 19-05076\_CP11.COR

Unit Wt: SBTQtn(PKR2009)

Su Nkt/Ndu: 15.0 / 9.0

△ Dissipation, Ueq achieved

△ Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010

Coords: MTM9N N: 5039628.10m E: 291230.20m Elev: 152.70m

Sheet No: 1 of 1

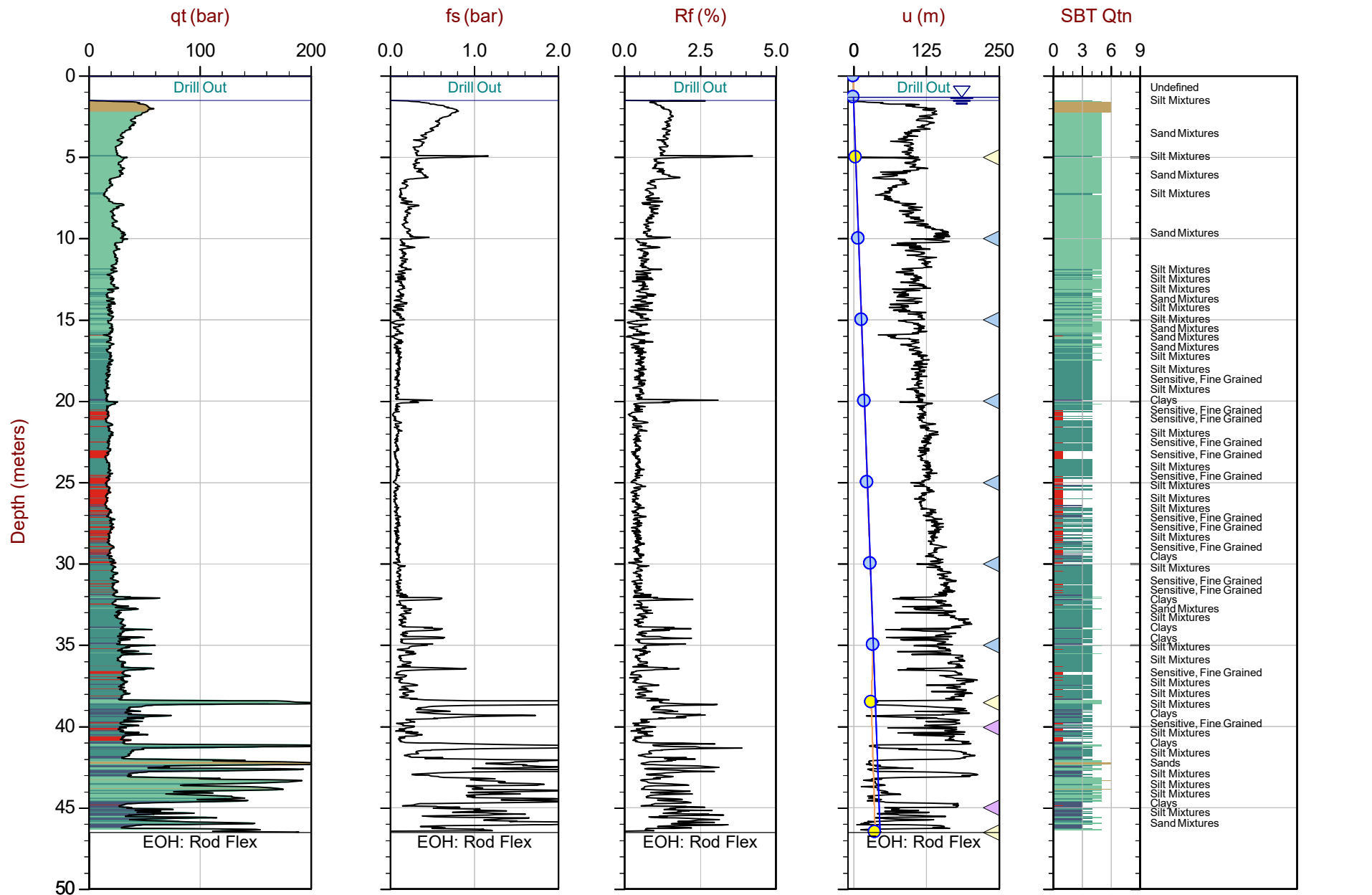
△ Dissipation, Ueq assumed

— Hydrostatic Line



Job No: 19-05076  
Date: 2019-11-26 11:31  
Site: Bruce Street

Sounding: BRU19-14  
Cone: 377:T1000F10U500



Max Depth: 46.525 m / 152.64 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: Every Point

File: 19-05076\_CP14.COR  
UnitWt: SBTQtn (PKR2009)

SBT: [Robertson, 2009 and 2010](#)  
 Coords: [MTM9N](#): 5039706.80m E: 291367.50m Elev: 152.60m  
 SheetNo: [1 of 1](#)

Overplot Item: ● Ueq ● Assumed Ueq ◀ Dissipation, Ueq achieved ◀ Dissipation, Ueq not achieved ◀ Dissipation, Ueq assumed — Hydrostatic Line — Ueq Line





Thurber

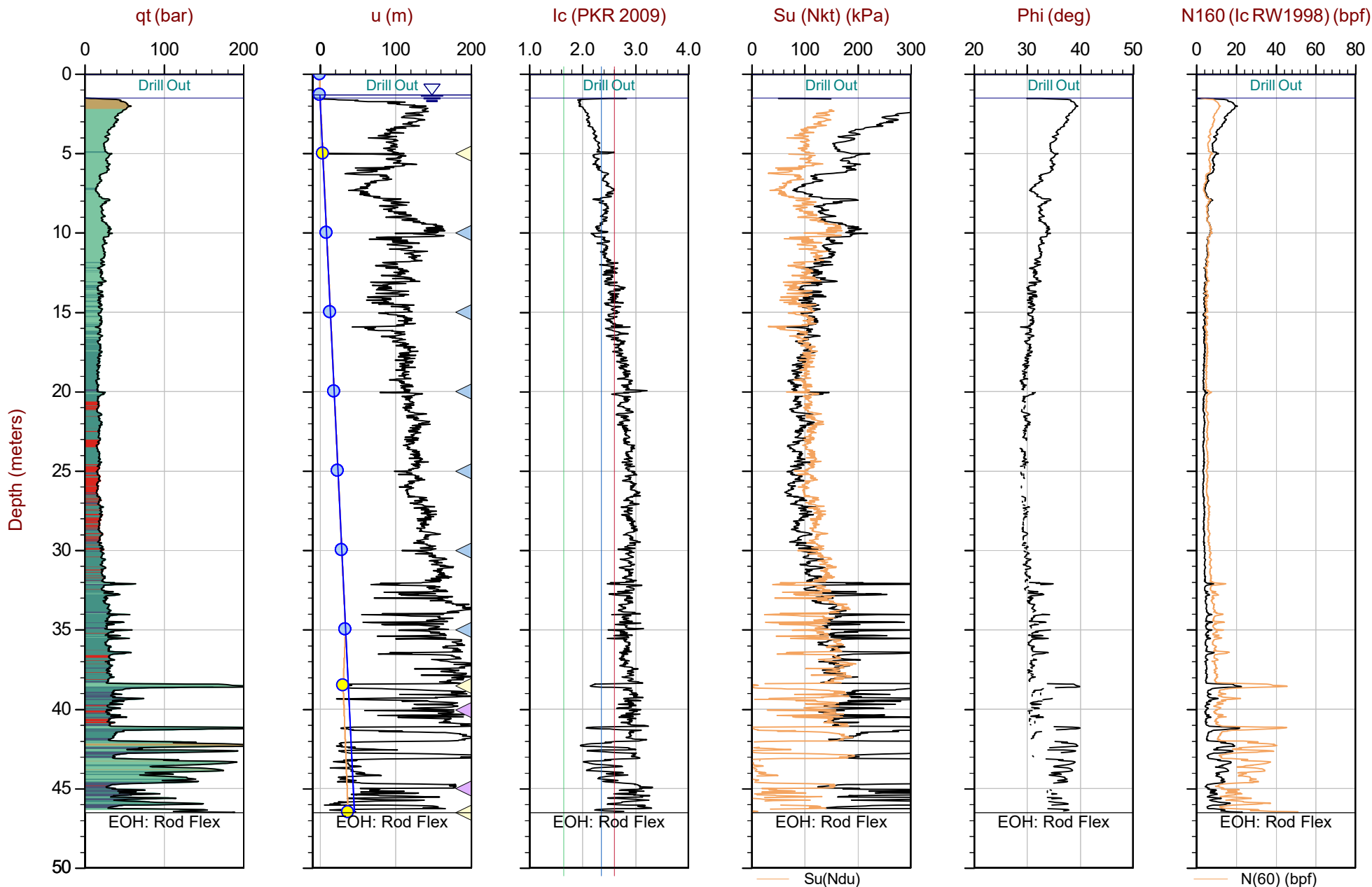
Job No: 19-05076

Date: 2019-11-26 11:31

Site: Bruce Street

Sounding: BRU19-14

Cone: 377:T1000F10U500



Max Depth: 46.525 m / 152.64 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

Overplot Item: ● Ueq ● Assumed Ueq

File: 19-05076\_CP14.COR

Unit Wt: SBTQtn(PKR2009)

Su Nkt/Ndu: 15.0 / 9.0

△ Dissipation, Ueq achieved

△ Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010

Coords: MTM9N N: 5039706.80m E: 291367.50m Elev: 152.60m

Sheet No: 1 of 1

— Hydrostatic Line

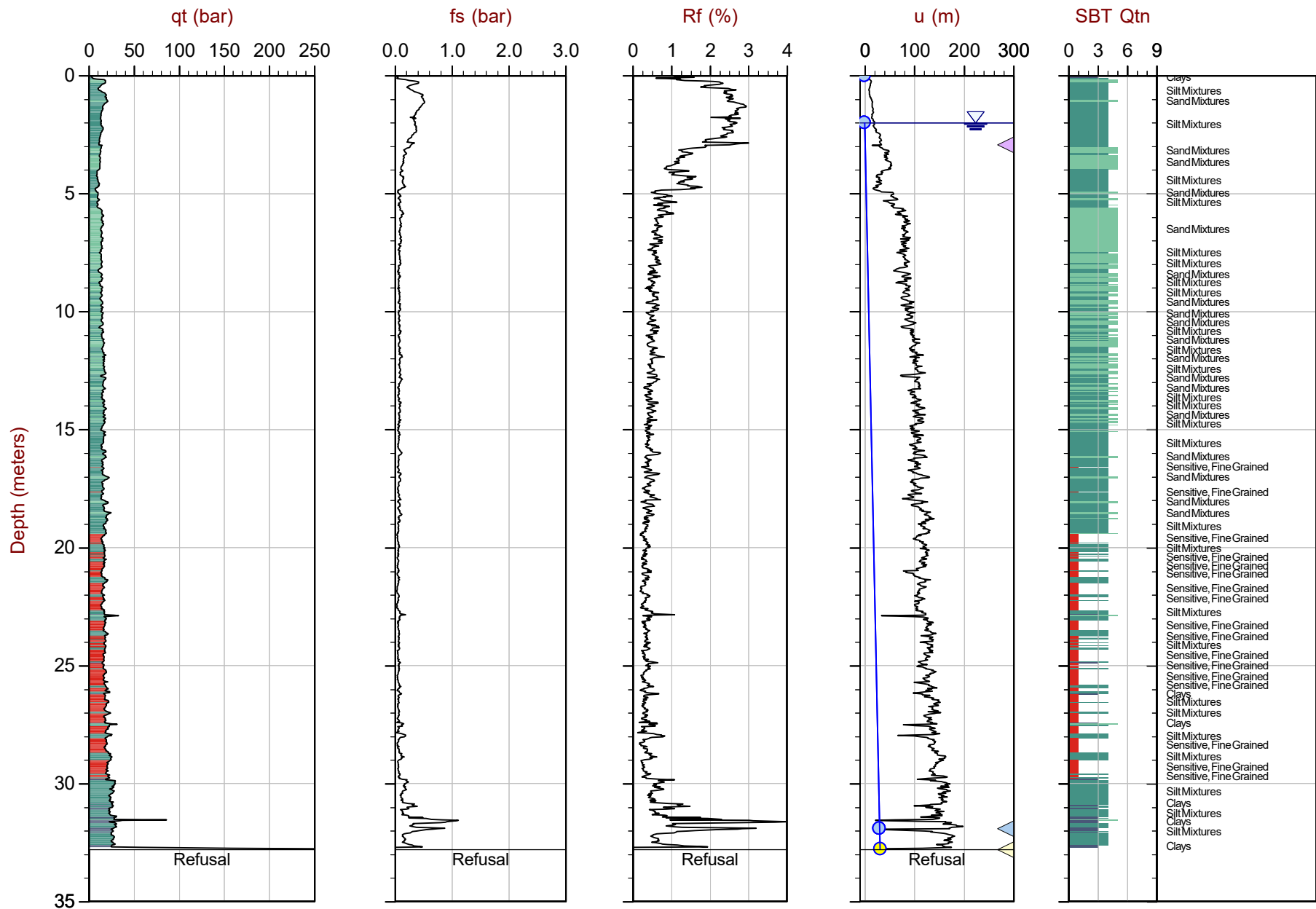
— Ueq Line



# Thurber Engineering

Job No: 21-05-22576  
Date: 2021-08-04 08:13  
Site: Renfrew Ontario

Sounding: BRU-19-17  
Cone: 609:T1500F15U35



Max Depth: 32.800 m / 107.61 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: Every Point

File: 21-05-22576\_CP-19-17.COR  
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010  
Coords: MTM 9N N: 5039729.30m E: 291240.20m Elev: 149.9m  
Page No: 1 of 1

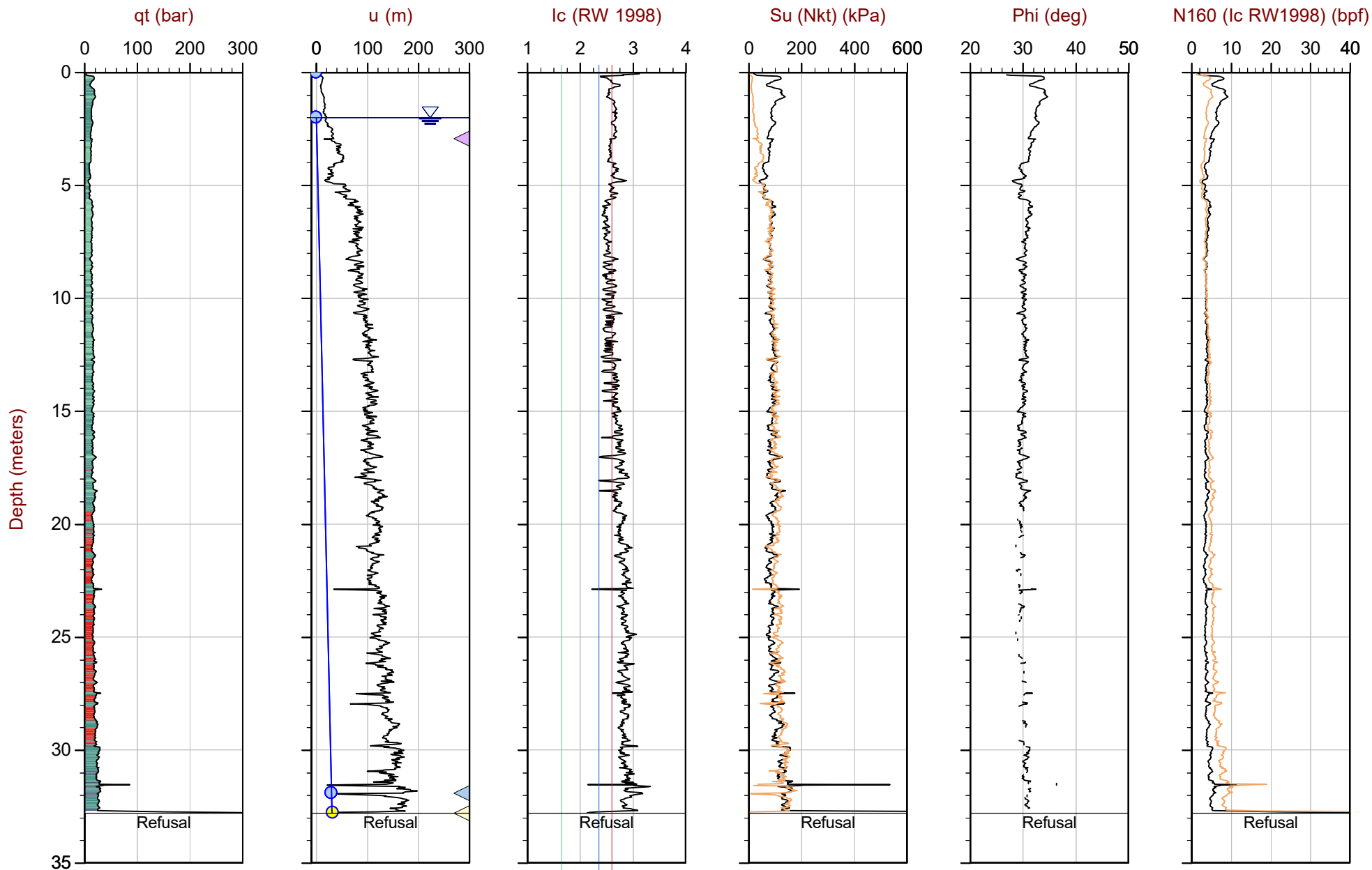
Overplot Item: ● Assumed Ueq ● Ueq ▲ Dissipation, equilibrium achieved ▲ Dissipation, equilibrium assumed — Hydrostatic Line — Equilibrium Profile ◀ Dissipation, equilibrium not achieved



# Thurber Engineering

Job No: 21-05-22576  
Date: 2021-08-04 08:13  
Site: Renfrew Ontario

Sounding: BRU-19-17  
Cone: 609:T1500F15U35



Max Depth: 32.800 m / 107.61 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: Every Point

Overplot Item:

Assumed Ueq  
Ueq

File: 21-05-22576\_CP-19-17.COR  
Unit Wt: SBTQtn (PKR2009)  
Su Nkt/Ndu: 15.0 / 9.0

Dissipation, equilibrium achieved  
Dissipation, equilibrium assumed

Ndu

Hydrostatic Line

Dissipation, equilibrium not achieved

SBT: Robertson, 2009 and 2010  
Coords: MTM 9N N: 5039729.30m E: 291240.20m Elev: 149.9m  
Page No: 1 of 1

Equilibrium Profile

N60



Thurber

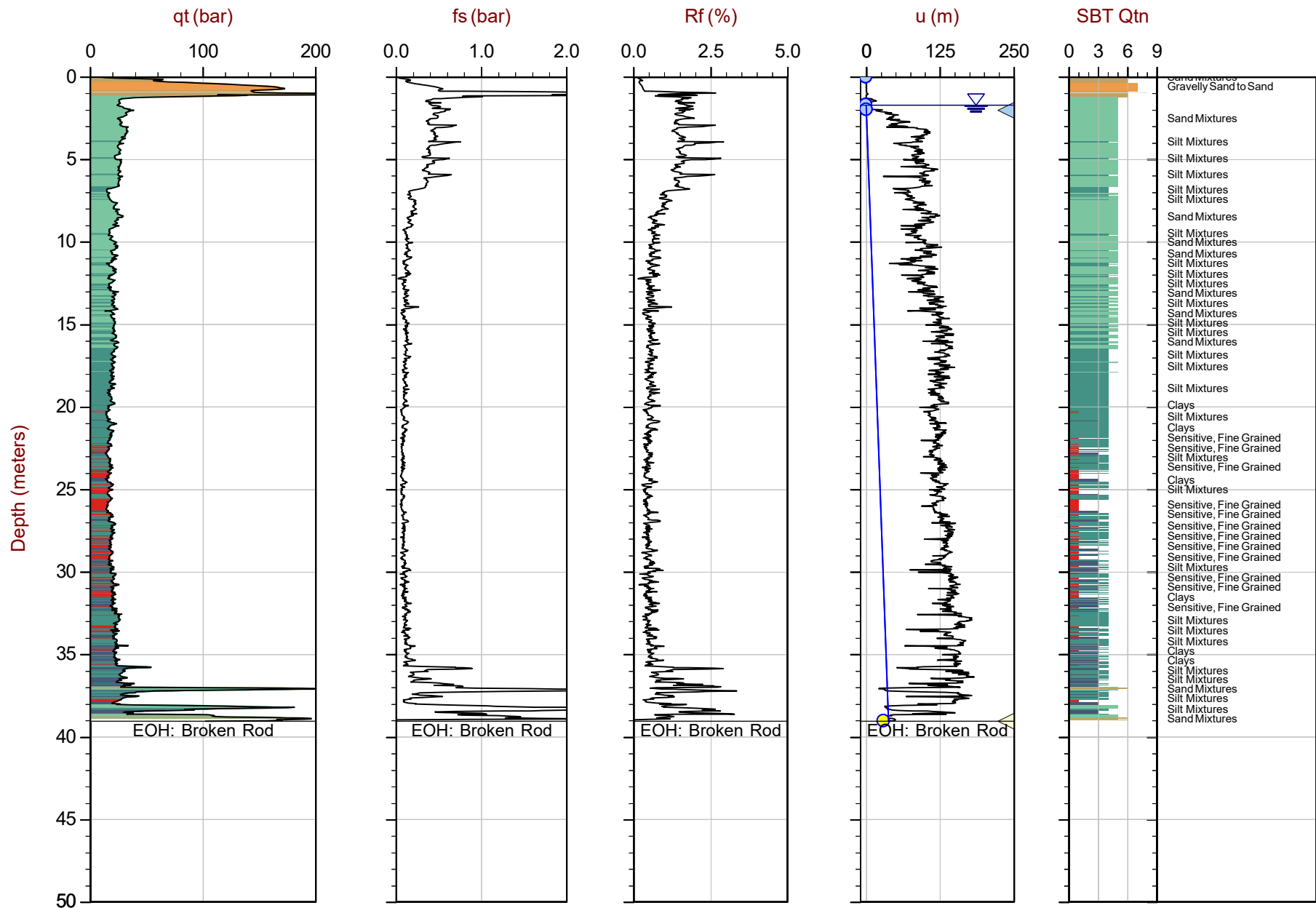
Job No: 19-05076

Date: 2019-11-26 07:42

Site: Bruce Street

Sounding: BRU19-20

Cone: 377:T1000F10U500



Max Depth: 39.050 m / 128.12 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

Overplot Item: ● Ueq ● Assumed Ueq

File: 19-05076\_SP20.COR

Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010

Coords: MTM9N: 5039735.10m E: 291411.00m Elev: 152.10m

Sheet No: 1 of 1

Overplot Item: ▲ Dissipation, Ueq achieved ▲ Dissipation, Ueq not achieved ▲ Dissipation, Ueq assumed — Hydrostatic Line



Thurber

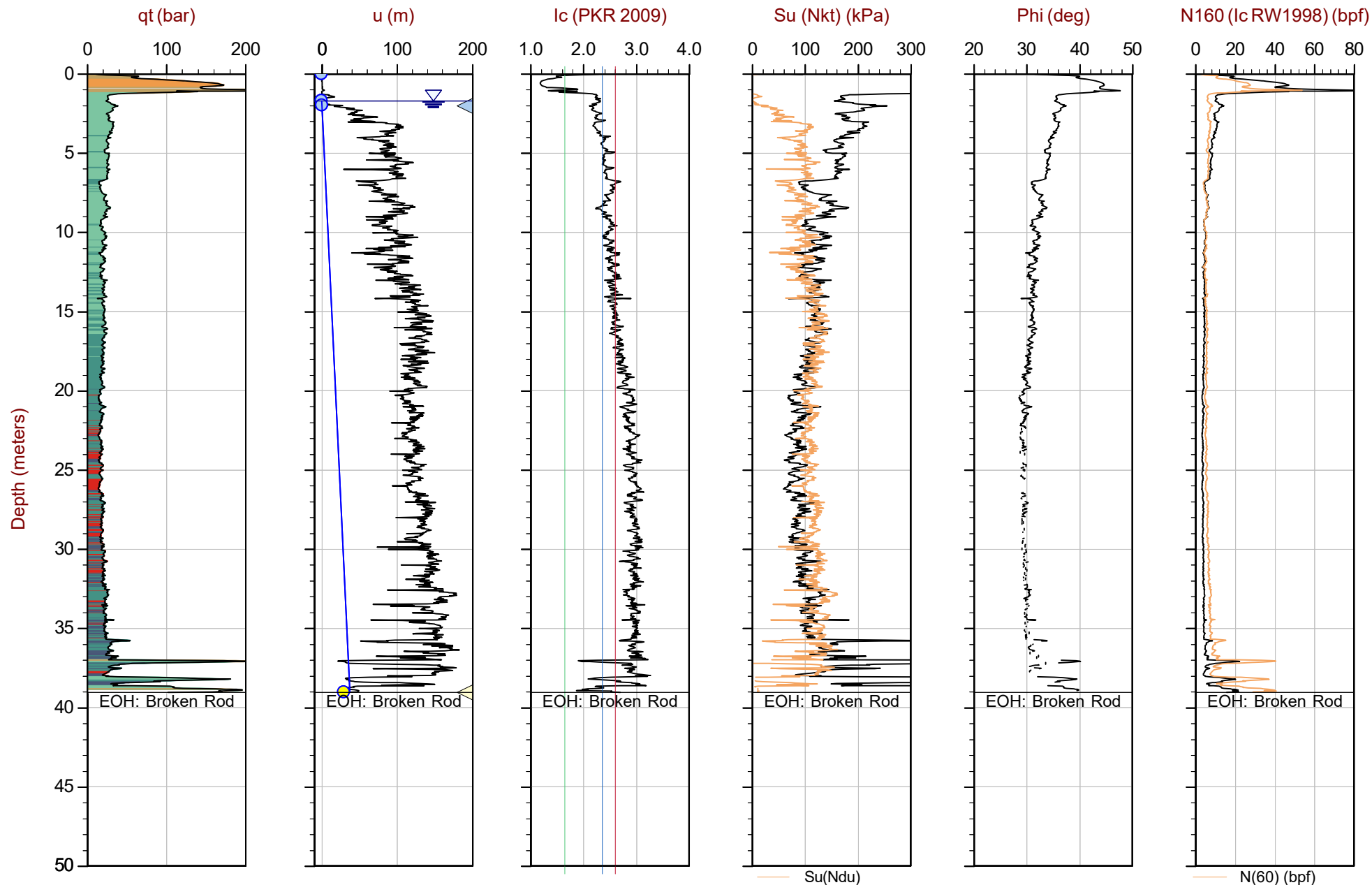
Job No: 19-05076

Date: 2019-11-26 07:42

Site: Bruce Street

Sounding: BRU19-20

Cone: 377:T1000F10U500



Max Depth: 39.050 m / 128.12 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

Overplot Item: ● Ueq ● Assumed Ueq

File: 19-05076\_SP20.COR

Unit Wt: SBTQtn(PKR2009)

Su Nkt/Ndu: 15.0 / 9.0

△ Dissipation, Ueq achieved

△ Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010

Coords: MTM9N N: 5039735.10m E: 291411.00m Elev: 152.10m

Sheet No: 1 of 1

△ Dissipation, Ueq assumed

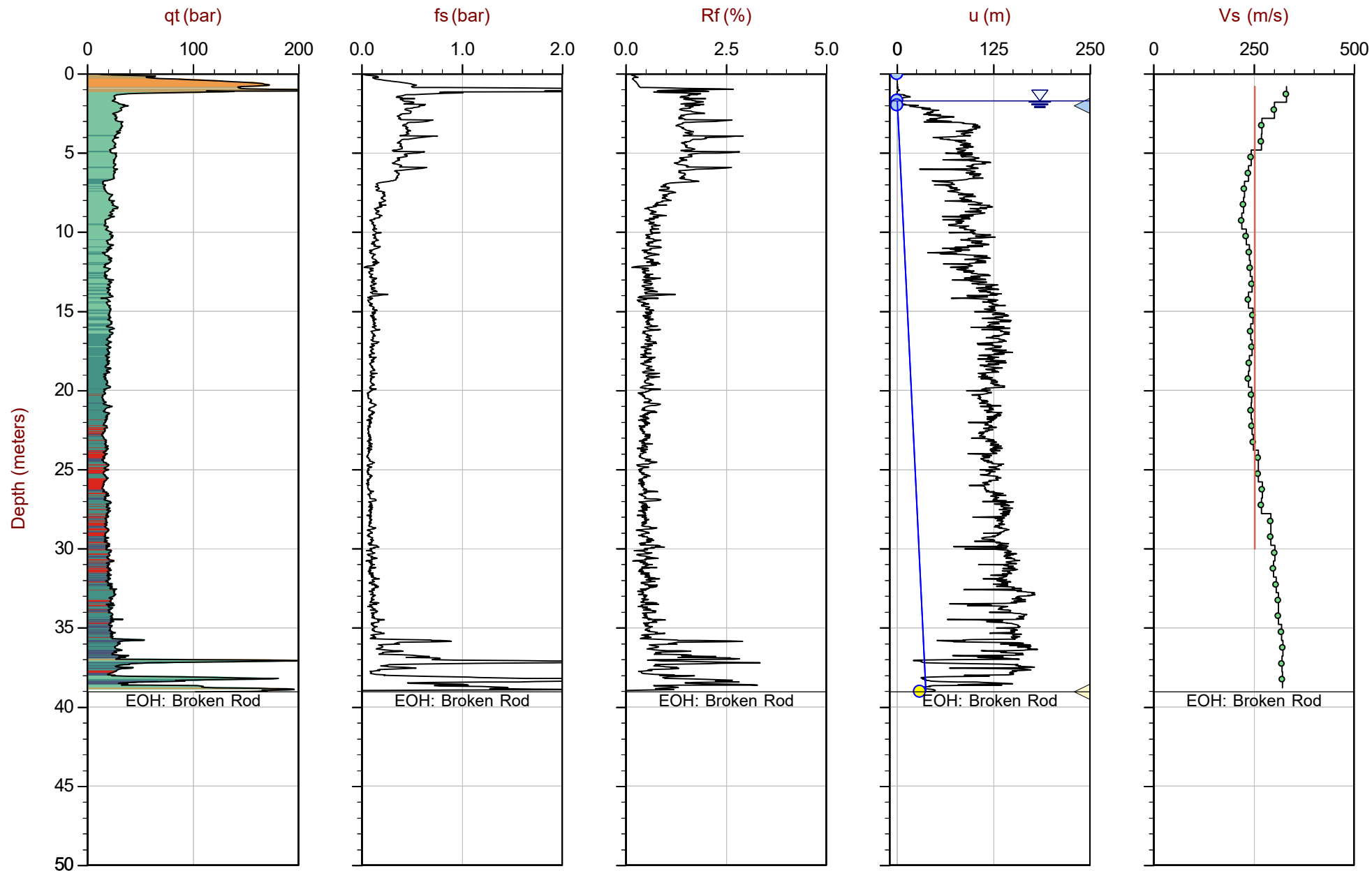
— Hydrostatic Line



Thurber

Job No: 19-05076  
Date: 2019-11-26 07:42  
Site: Bruce Street

Sounding: BRU19-20  
Cone: 377:T1000F10U500



Max Depth: 39.050 m / 128.12 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: EveryPoint

File: 19-05076\_SP20.COR  
Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010  
Coords: MTM9NN: 5039735.10m E: 291411.00m Elev: 152.10m  
Sheet No: 1 of 1

Overplot Item: ● Ueq    ● Assumed Ueq    ◀ Dissipation, Ueq achieved    ◀ Dissipation, Ueq not achieved    ◀ Dissipation, Ueq assumed    — Hydrostatic Line





Thurber

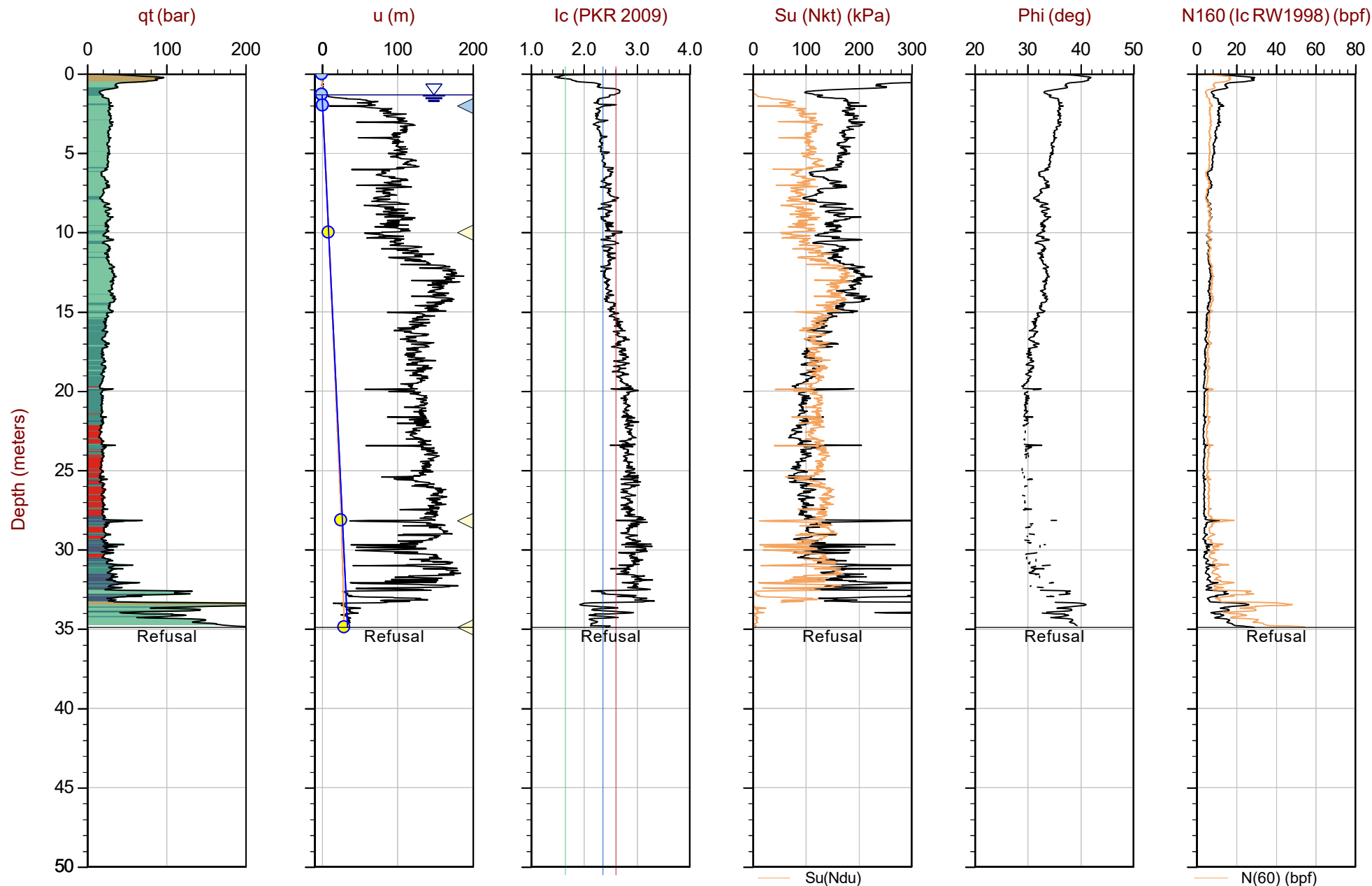
Job No: 19-05076

Date: 2019-11-28 10:39

Site: Bruce Street

Sounding: BRU19-24

Cone: 377:T1000F10U500



Max Depth: 34.900 m / 114.50 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

Overplot Item: ● Ueq ● Assumed Ueq

File: 19-05076\_SP24.COR

Unit Wt: SBTQtn(PKR2009)

Su Nkt/Ndu: 15.0 / 9.0

△ Dissipation, Ueq achieved

△ Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010

Coords: MTM9NN: 5039779.70m E: 291476.80m Elev: 149.70m

Sheet No: 1 of 1

— Hydrostatic Line

— Ueq Line

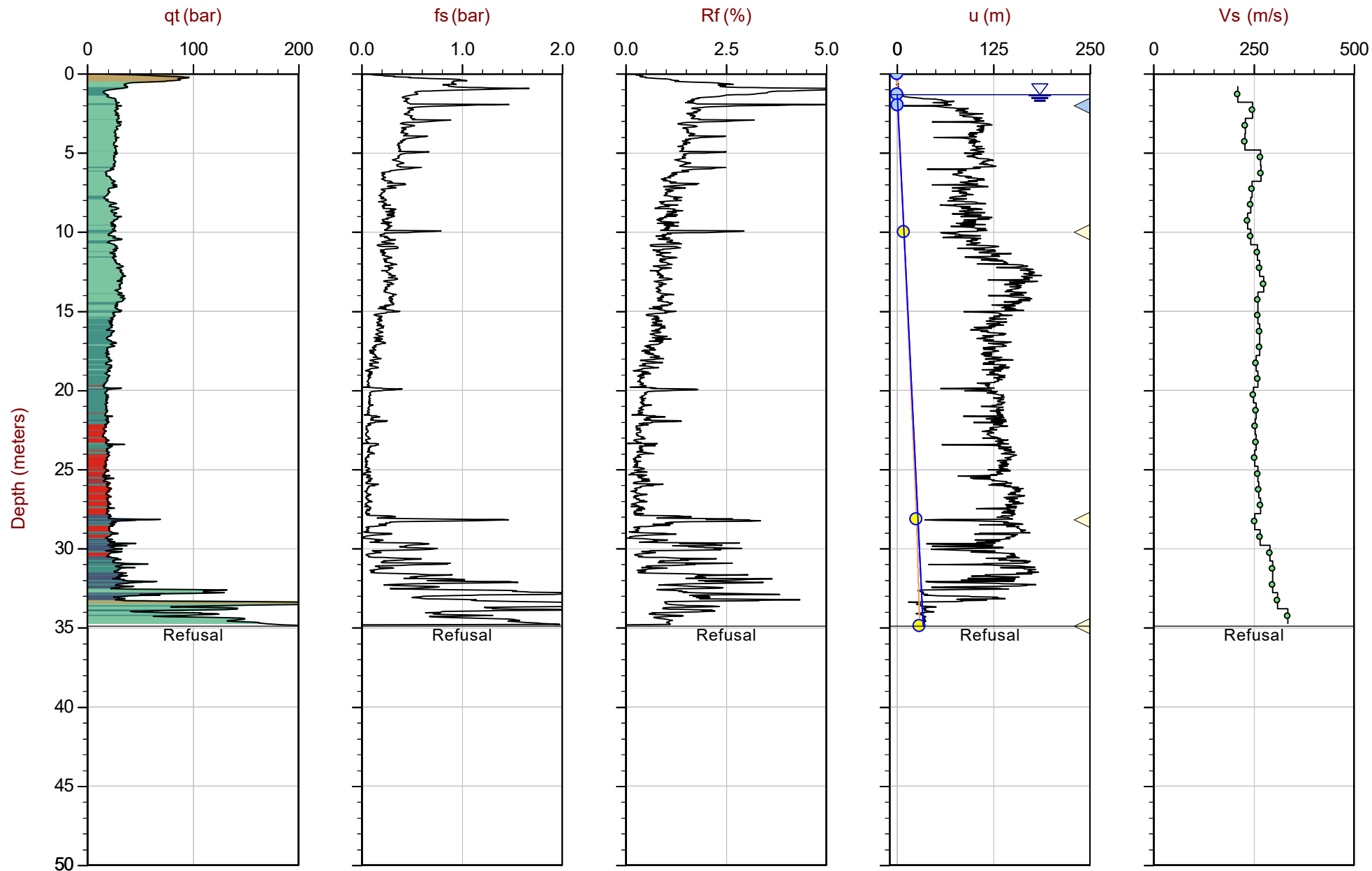




Thurber

Job No: 19-05076  
Date: 2019-11-28 10:39  
Site: Bruce Street

Sounding: BRU19-24  
Cone: 377:T1000F10U500



Max Depth: 34.900 m / 114.50 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: EveryPoint

File: 19-05076\_SP24.COR  
Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010  
Coords: MTM9NN: 5039779.70m E: 291476.80m Elev: 149.70m  
Sheet No: 1 of 1

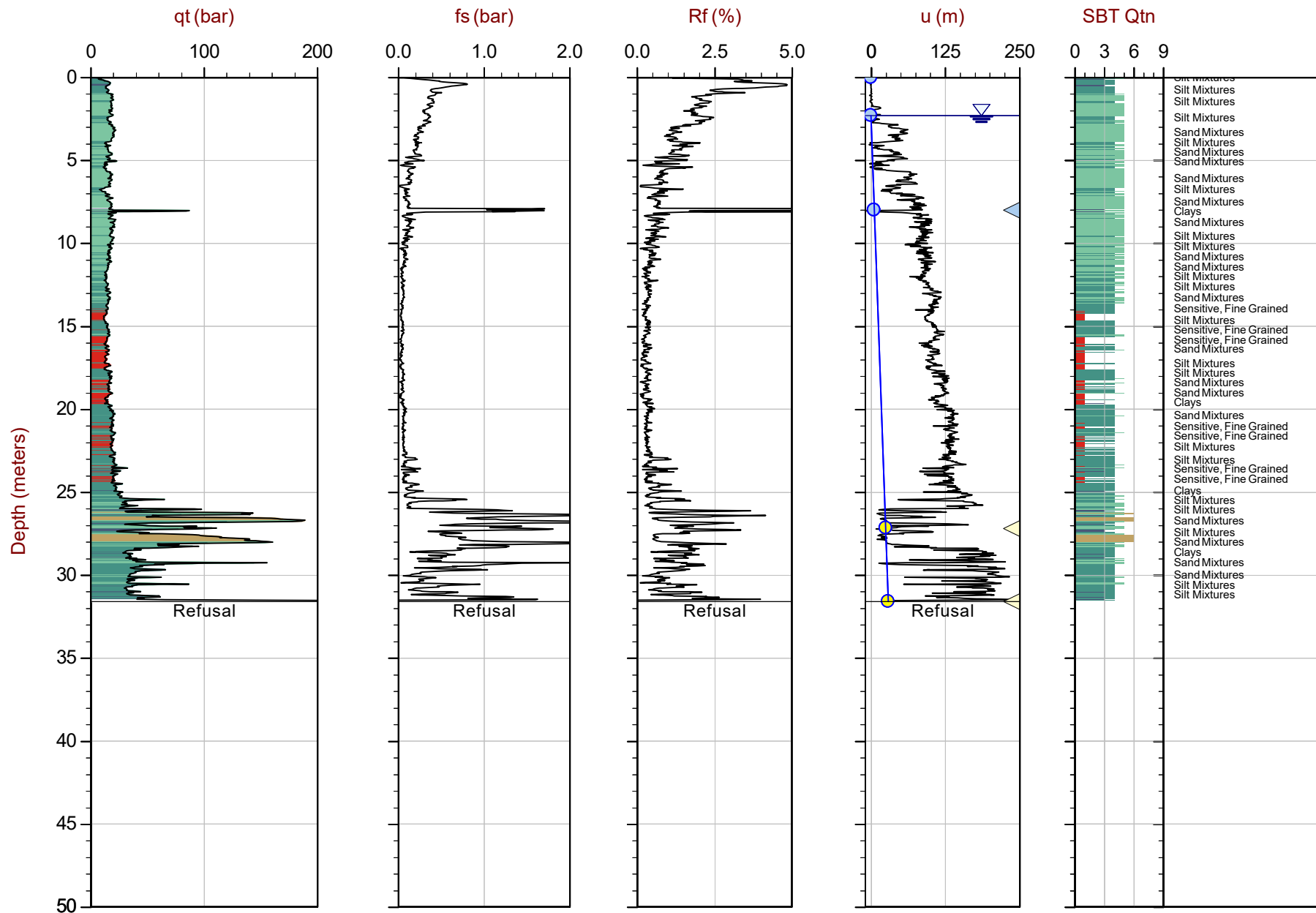
Overplot Item: ● Ueq    ● Assumed Ueq    ▲ Dissipation, Ueq achieved    ▲ Dissipation, Ueq not achieved    ▲ Dissipation, Ueq assumed    — Hydrostatic Line    — Ueq Line



Thurber

Job No: 19-05076  
Date: 2019-11-27 10:25  
Site: Bruce Street

Sounding: BRU19-32  
Cone: 377:T1000F10U500



Max Depth: 31.600 m / 103.67 ft  
Depth Inc: 0.025 m / 0.082 ft  
Avg Int: EveryPoint

File: 19-05076\_CP32.COR  
Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010  
Coords: MTM9N N: 5039793.00m E: 291638.40m Elev: 146.90m  
Sheet No: 1 of 1

Overplot Item: ● Ueq ● Assumed Ueq ▲ Dissipation, Ueq achieved ▲ Dissipation, Ueq not achieved ▲ Dissipation, Ueq assumed — Hydrostatic Line



Thurber

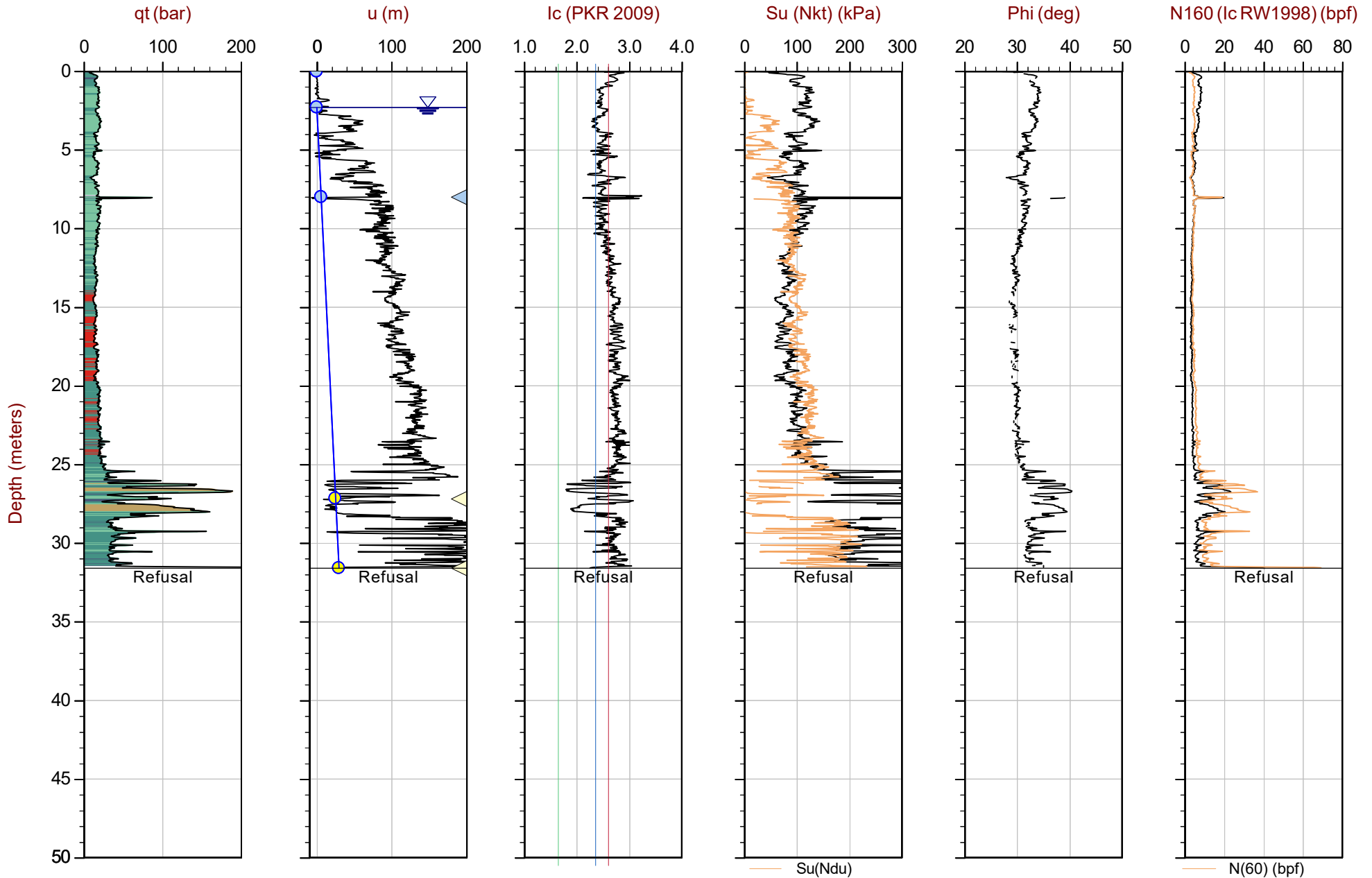
Job No: 19-05076

Date: 2019-11-27 10:25

Site: Bruce Street

Sounding: BRU19-32

Cone: 377:T1000F10U500



Max Depth: 31.600 m / 103.67 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: EveryPoint

Overplot Item: ● Ueq ● Assumed Ueq

File: 19-05076\_CP32.COR

Unit Wt: SBTQtn(PKR2009)

Su Nkt/Ndu: 15.0 / 9.0

△ Dissipation, Ueq achieved

◀ Dissipation, Ueq not achieved

SBT: Robertson, 2009 and 2010

Coords: MTM9N N: 5039793.00m E: 291638.40m Elev: 146.90m

Sheet No: 1 of 1

◀ Dissipation, Ueq assumed

— Hydrostatic Line



## **Appendix B.4**

### **Soil Summary Figures**

FIGURE B4.1

**SOIL SUMMARY - BRUCE STREET ALIGNMENT**

(BRU19-01 to BRU19-15A, BRU19-18, BRU19-19, BRU19-22 to BRU19-25)

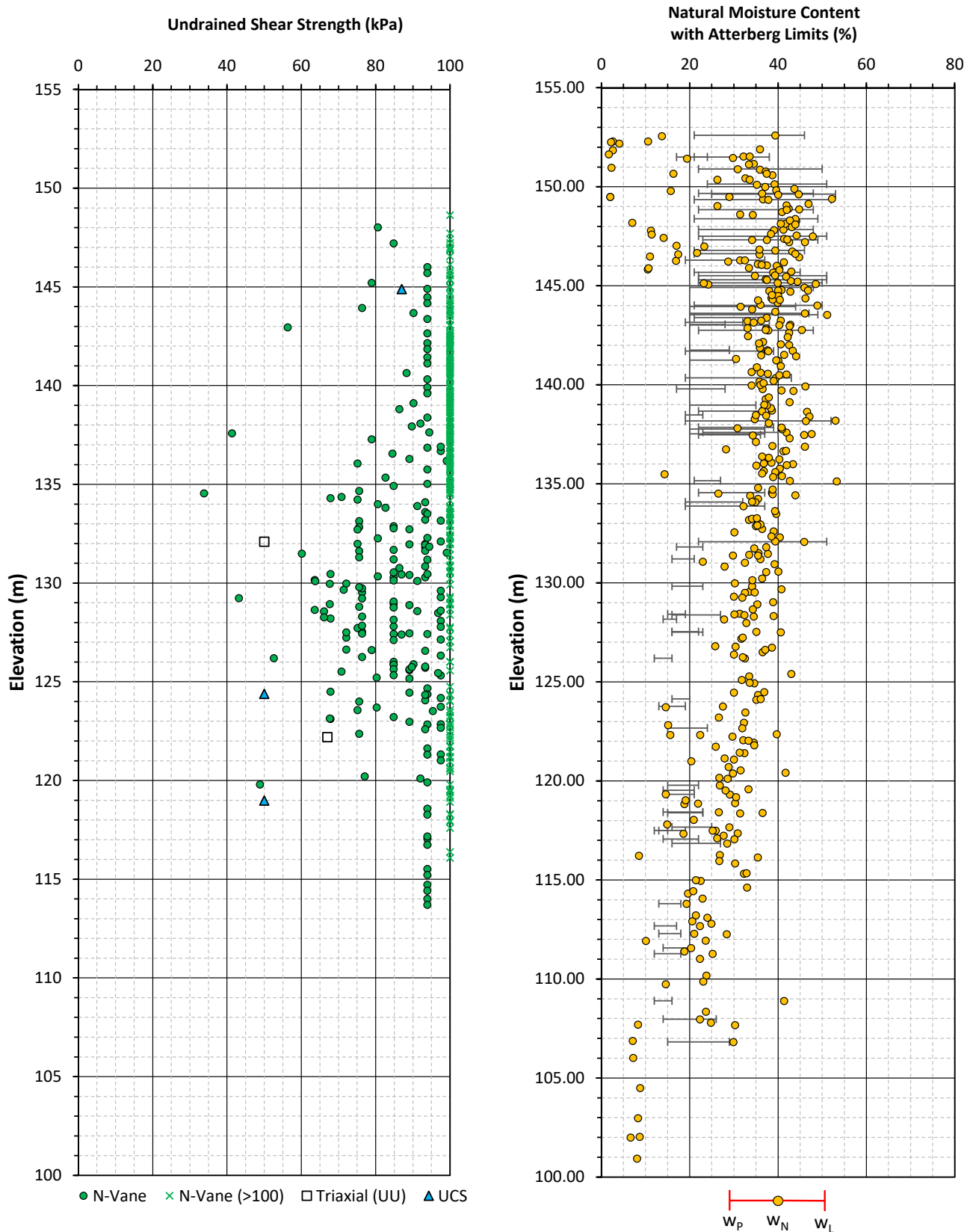
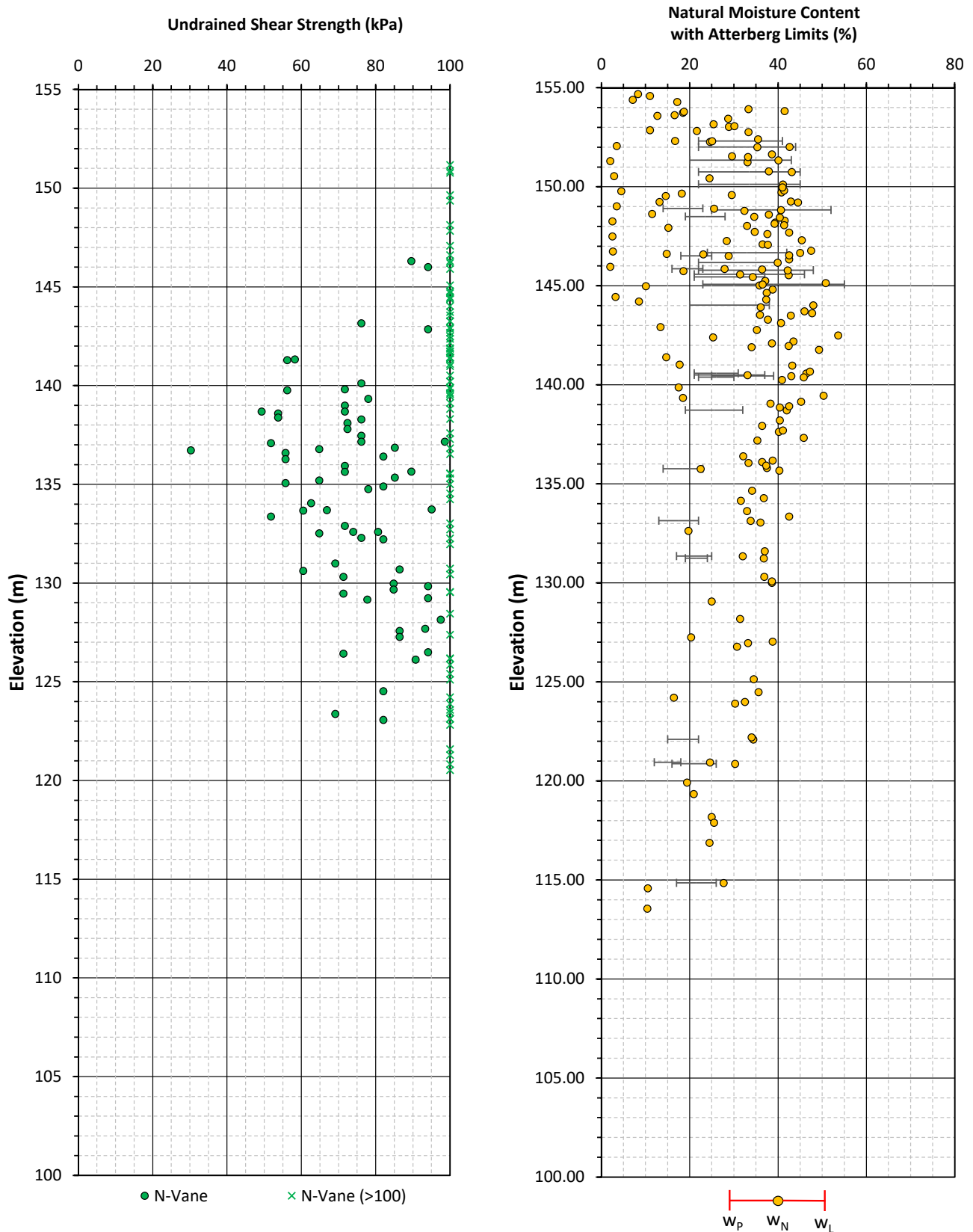


FIGURE B4.2

**SOIL SUMMARY - E-N/S RAMP ALIGNMENT**  
(BRU19-26 to BRU19-33, BRU23-1 to BRU23-4)





## **Appendix C.**

### **Laboratory Testing**

#### **Current (2019/2020/2021) Investigation**



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



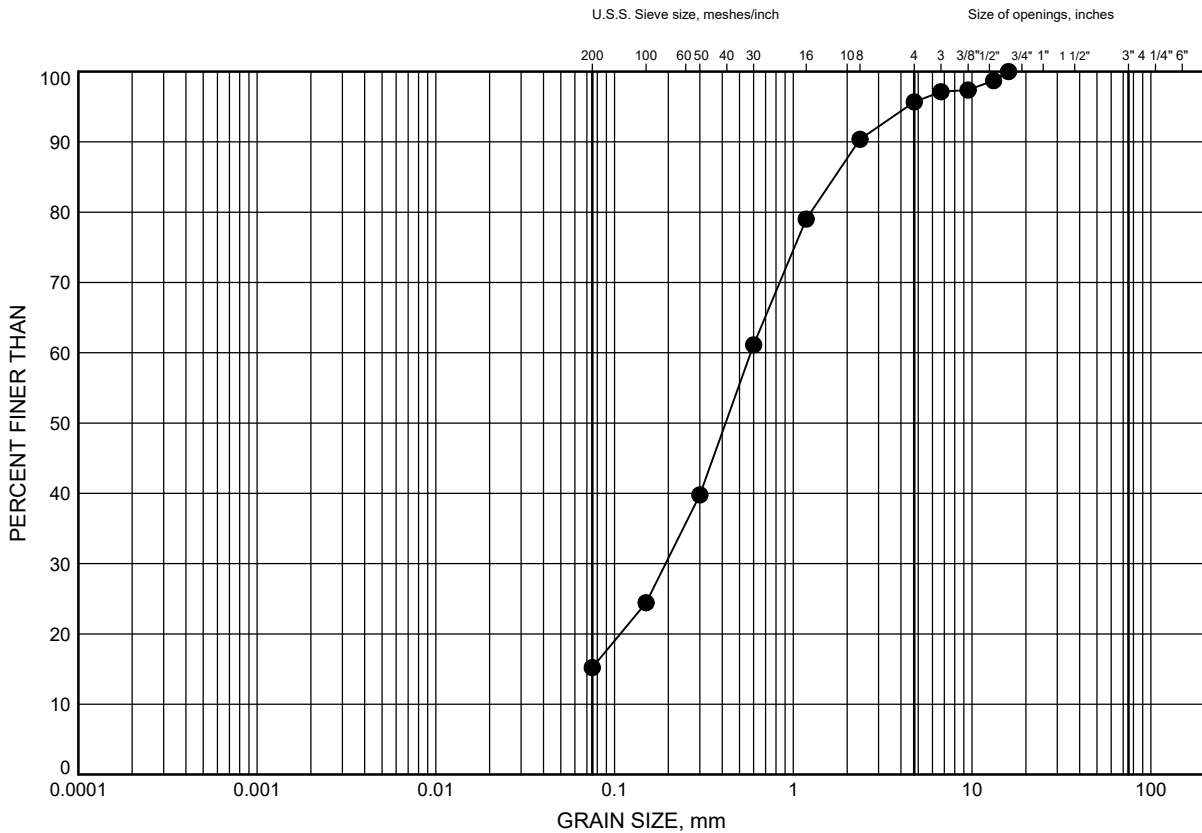


## List of Figures – Appendix C.1

Figure C1.1	Grain Size Distribution - Topsoil
Figures C2.1 to C2.2	Grain Size Distribution - Fill
Figures C3.1 to C3.2	Grain Size Distribution - Upper Sand and Silt
Figure C4.1	Atterberg Limit Test Results - Upper Sand and Silt
Figures C5.1 to C5.6	Grain Size Distribution - Silty Clay (Weathered Crust)
Figures C6.1 to C6.6	Atterberg Limit Test Results - Silty Clay (Weathered Crust)
Figures C7.1 to C7.7	Grain Size Distribution - Silty Clay to Clayey Silt (Above Elevation 133 m)
Figures C8.1 to C8.6	Atterberg Limit Test Results - Silty Clay to Clayey Silt (Above Elevation 133 m)
Figures C9.1 to C9.5	Grain Size Distribution - Clayey Silt (Below Elevation 133 m)
Figures C10.1 to C10.4	Atterberg Limit Test Results - Clayey Silt (Below Elevation 133 m)
Figures C11.1 to C11.5	Grain Size Distribution - Interlayered Silt, Sand, and Clayey Silt
Figures C12.1 to C12.3	Atterberg Limit Test Results - Interlayered Silt, Sand, and Clayey Silt
Figure C13.1	Grain Size Distribution – Dense Sand
Figures C14.1 to C14.2	Grain Size Distribution - Till: Silty Sand and Gravel

## GRAIN SIZE DISTRIBUTION

## Topsoil



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-25	0.3	147.6

Date February 2022

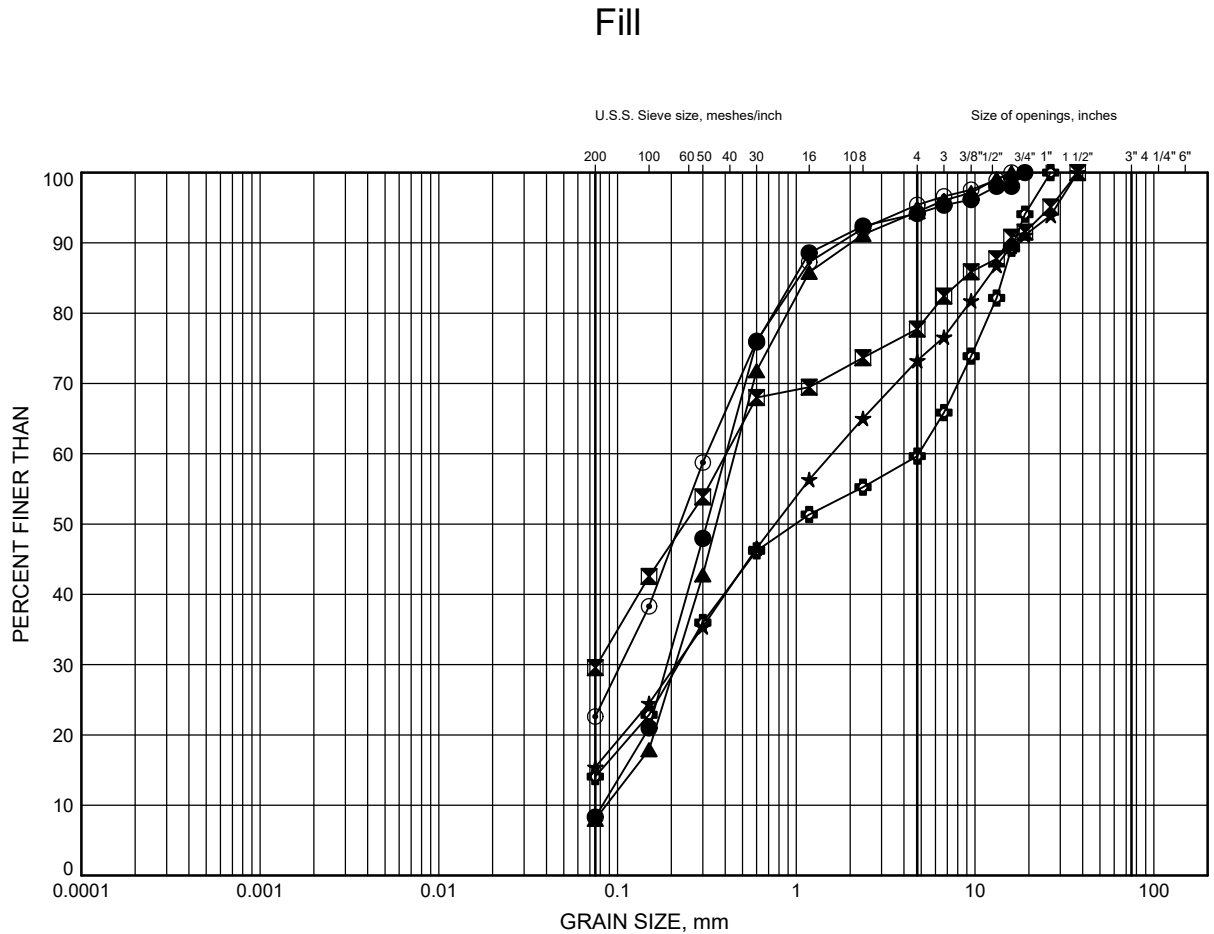
WP# 4068-09-00



Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-04	0.3	149.5
⊠	BRU19-06	1.1	147.4
▲	BRU19-07	0.3	147.8
★	BRU19-09	1.1	145.8
⊙	BRU19-10	0.3	145.9
⊕	BRU19-12	0.4	152.3

Date February 2022

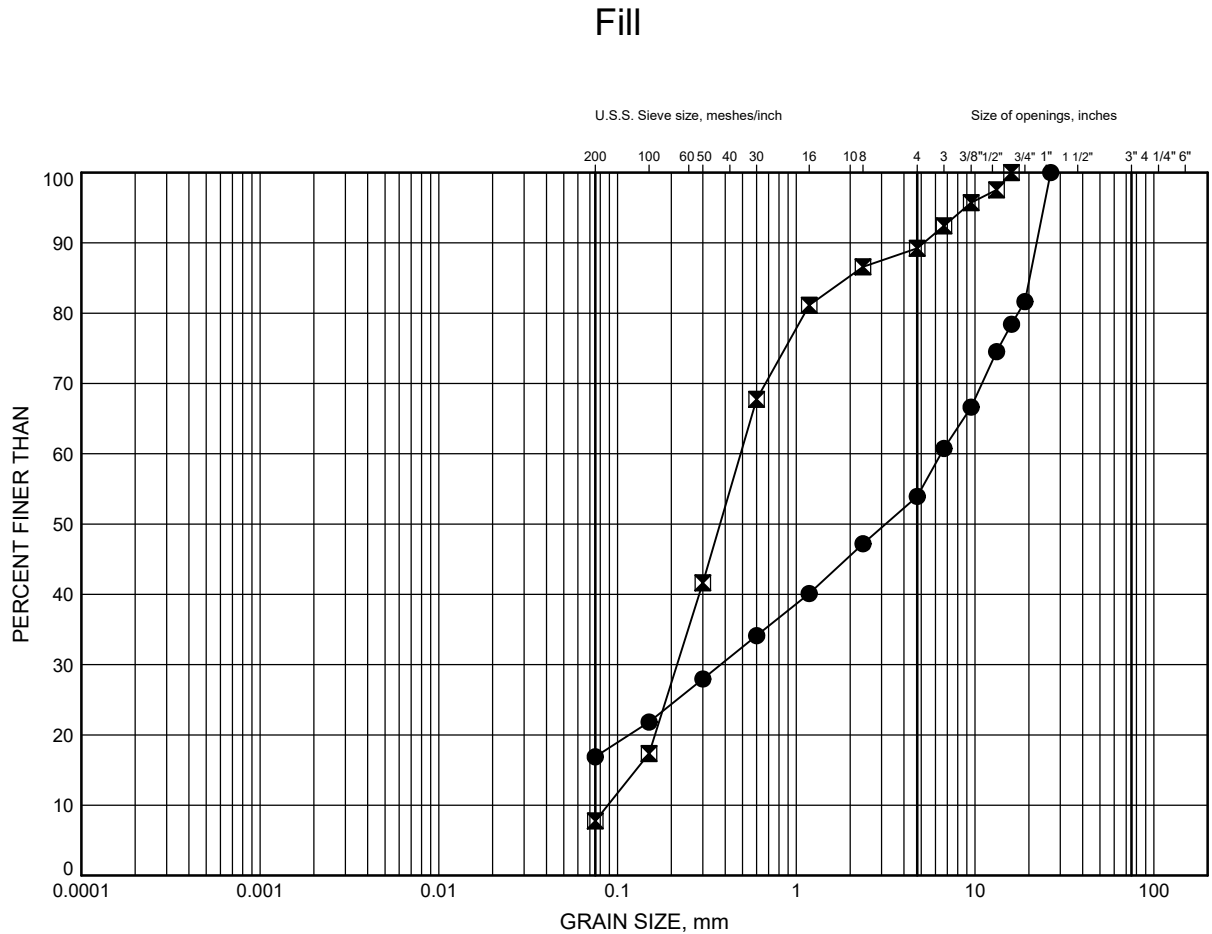
WP# 4068-09-00



Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-13	0.9	151.6
◻	BRU21-05	0.3	148.9

Date February 2022

WP# 4068-09-00

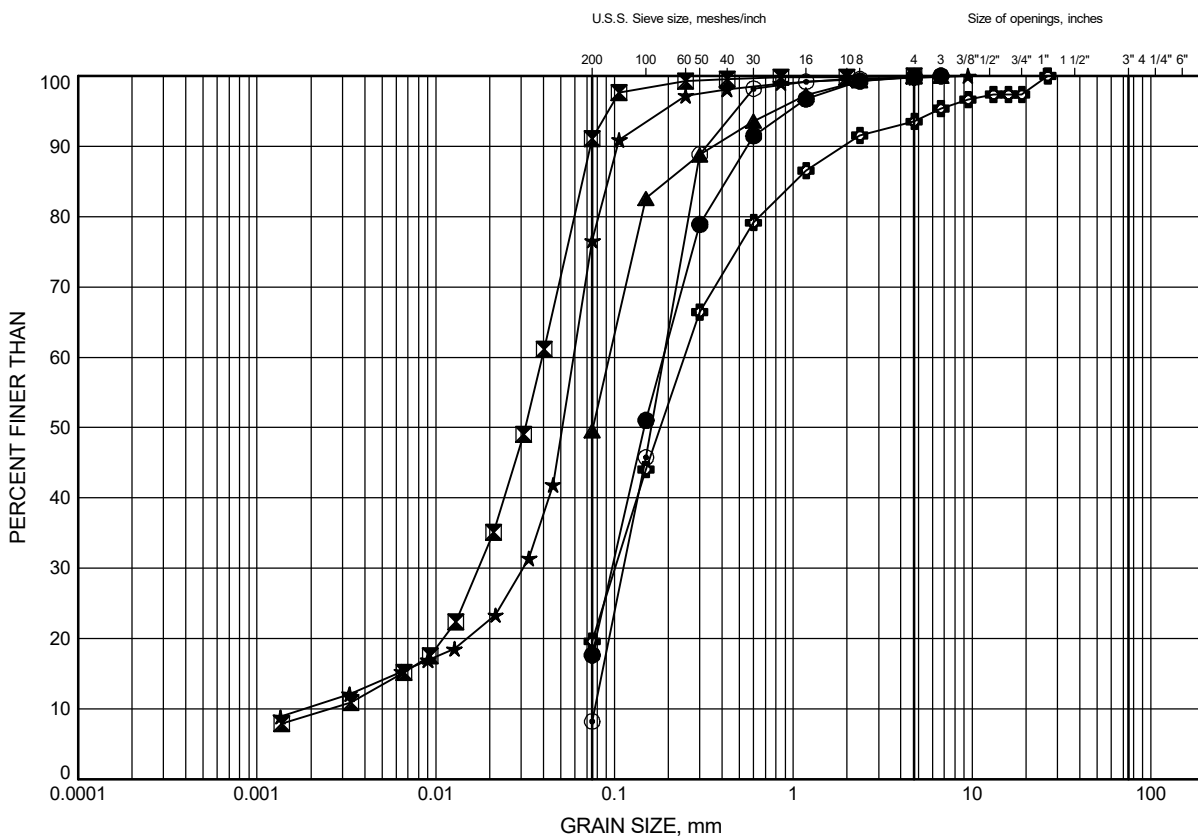


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Upper Sand and Silt



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-26	1.8	147.9
⊠	BRU19-28	1.1	153.9
▲	BRU19-29	1.8	152.9
★	BRU19-30	1.1	153.0
⊙	BRU23-1	0.3	154.6
⊕	BRU23-2	0.3	153.6

Date June 2024

WP# 4068-09-00

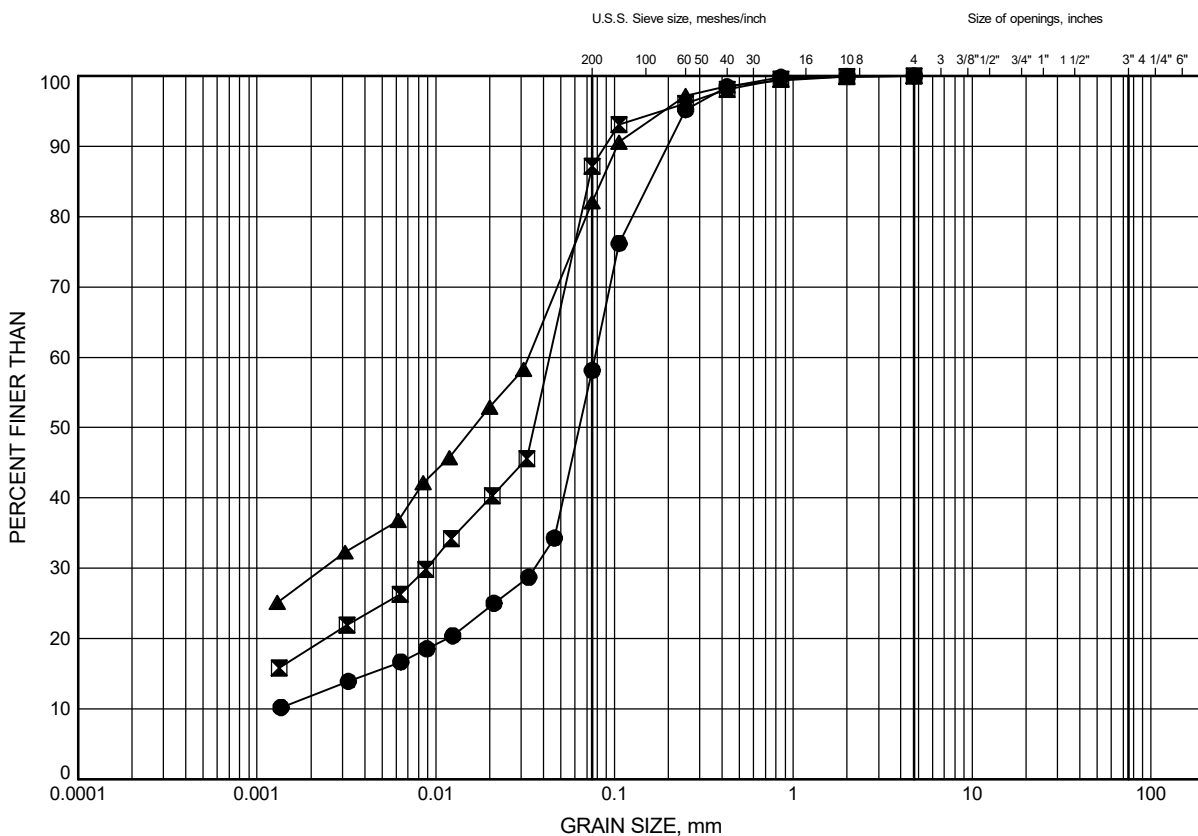


Prep'd RH

Chkd. MK

## GRAIN SIZE DISTRIBUTION

## Upper Sand and Silt



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU23-3	1.8	149.7
⊠	BRU23-3	2.6	148.9
▲	BRU23-4	2.6	146.5

Date June 2024

WP# 4068-09-00



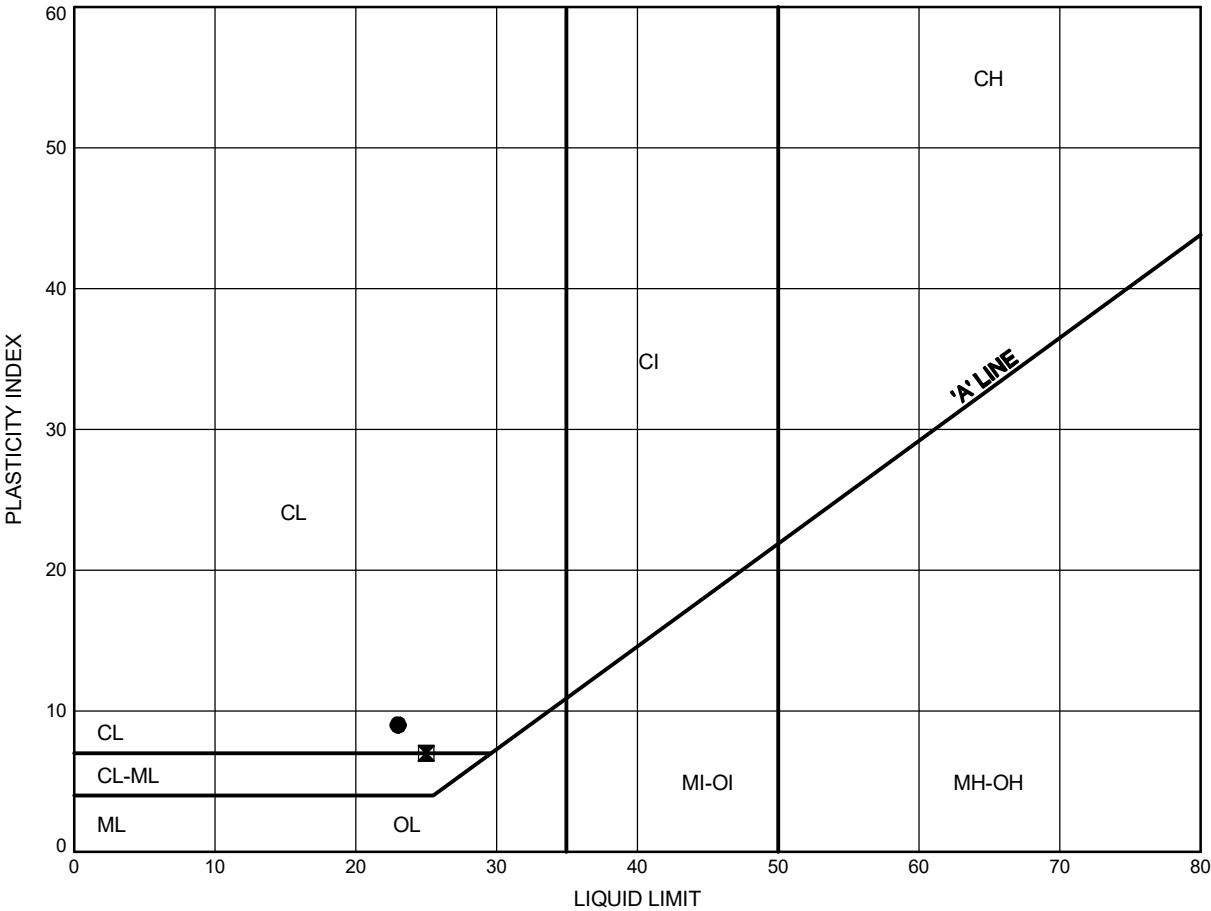
Prep'd RH

Chkd. MK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C4.1

Upper Sand and Silt



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU23-3	2.6	148.9
⊠	BRU23-4	2.6	146.5

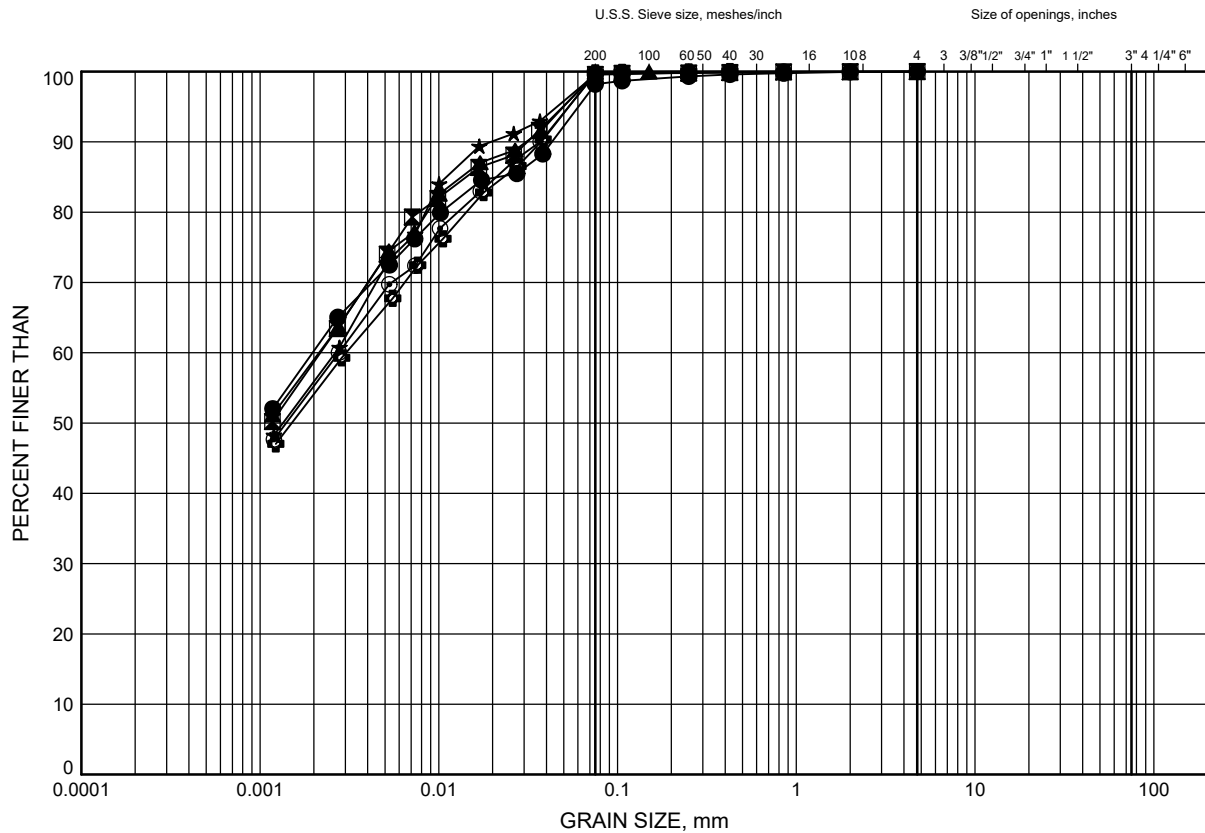
Date June 2024  
WP# 4068-09-00



Prep'd RH  
Chkd. MK

## GRAIN SIZE DISTRIBUTION

## Silty Clay (Weathered Crust)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-01	1.1	150.1
⊠	BRU19-01	3.4	147.8
▲	BRU19-01A	4.9	147.3
★	BRU19-02	2.6	147.5
⊙	BRU19-03	4.1	145.7
⊕	BRU19-04A	4.9	144.9

Date February 2022

WP# 4068-09-00



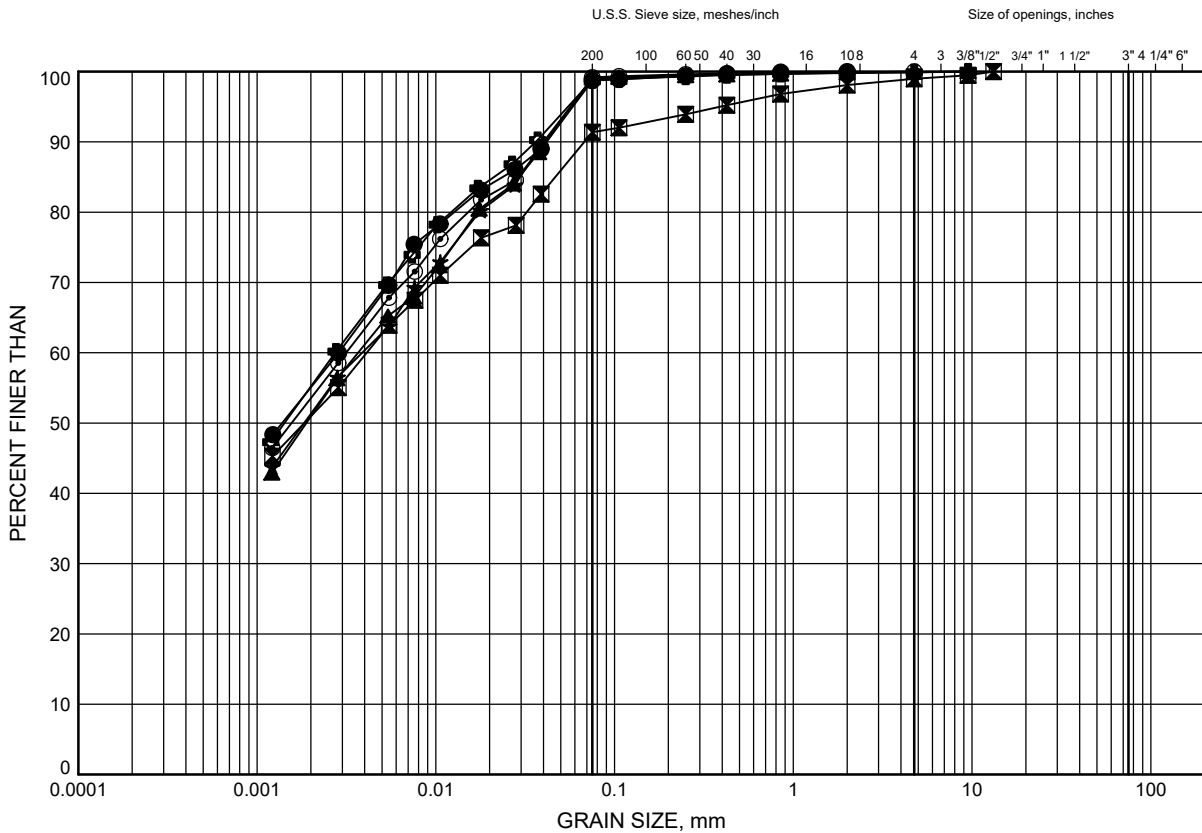
Prep'd MIK

Chkd. MJK



## GRAIN SIZE DISTRIBUTION

## Silty Clay (Weathered Crust)



## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-06	3.4	145.1
⊠	BRU19-07	2.6	145.5
▲	BRU19-09	3.4	143.5
★	BRU19-10	2.6	143.6
⊙	BRU19-12	3.4	149.3
⊕	BRU19-13	4.1	148.4

Date February 2022

WP# 4068-09-00

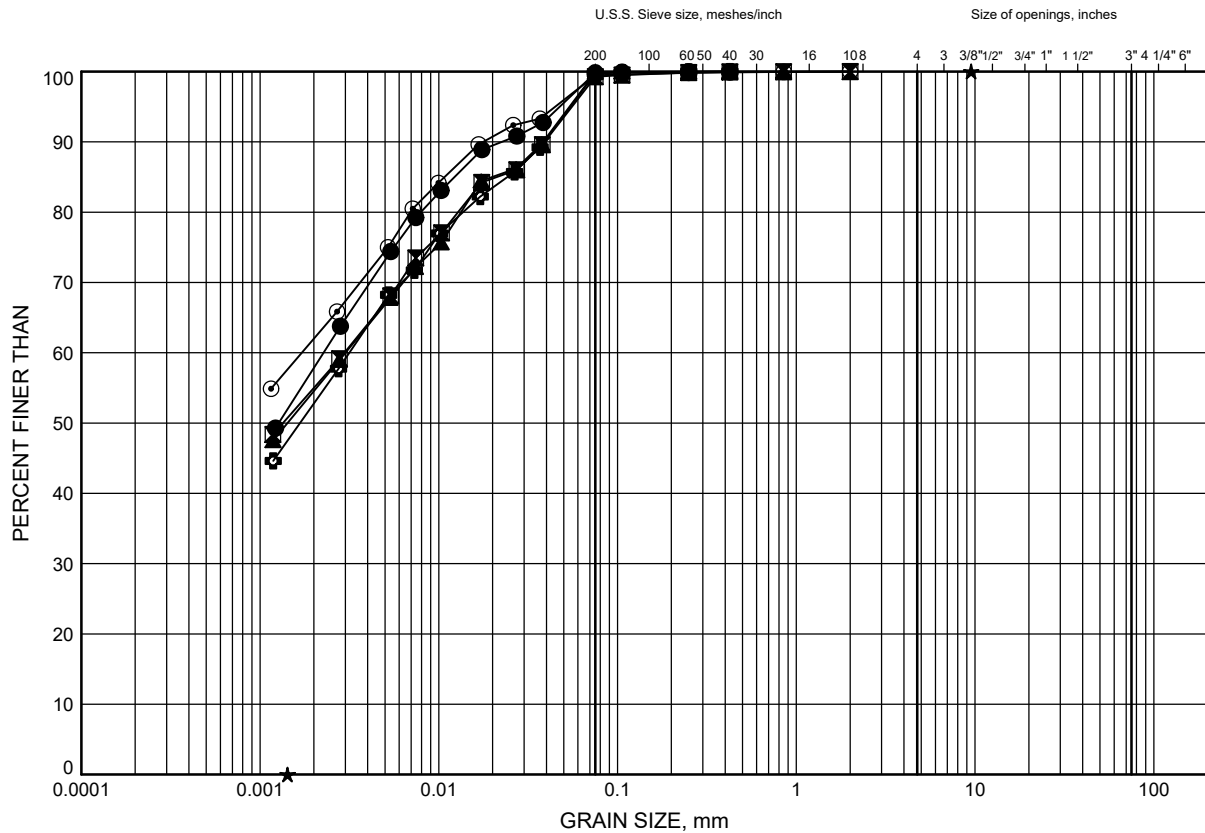


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Silty Clay (Weathered Crust)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-15	3.5	149.1
⊠	BRU19-16	1.8	149.7
▲	BRU19-16	4.9	146.6
⊙	BRU19-21	1.1	149.6
⊕	BRU19-22	3.4	143.9

Date February 2022

WP# 4068-09-00

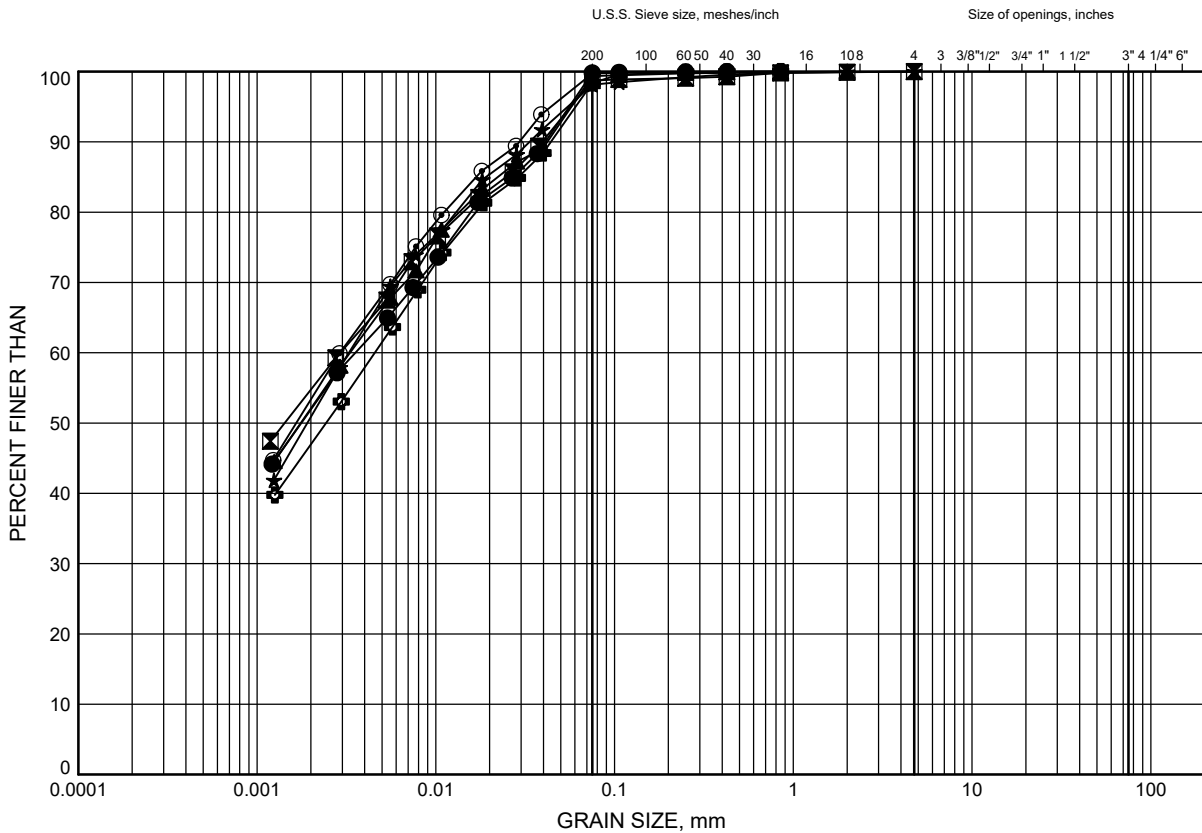


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Silty Clay (Weathered Crust)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-23	2.6	144.0
⊠	BRU19-25	2.6	145.3
▲	BRU19-26	4.1	145.6
★	BRU19-27	2.6	152.0
⊙	BRU19-28	4.9	150.1
⊕	BRU19-29	3.4	151.3

Date February 2022

WP# 4068-09-00

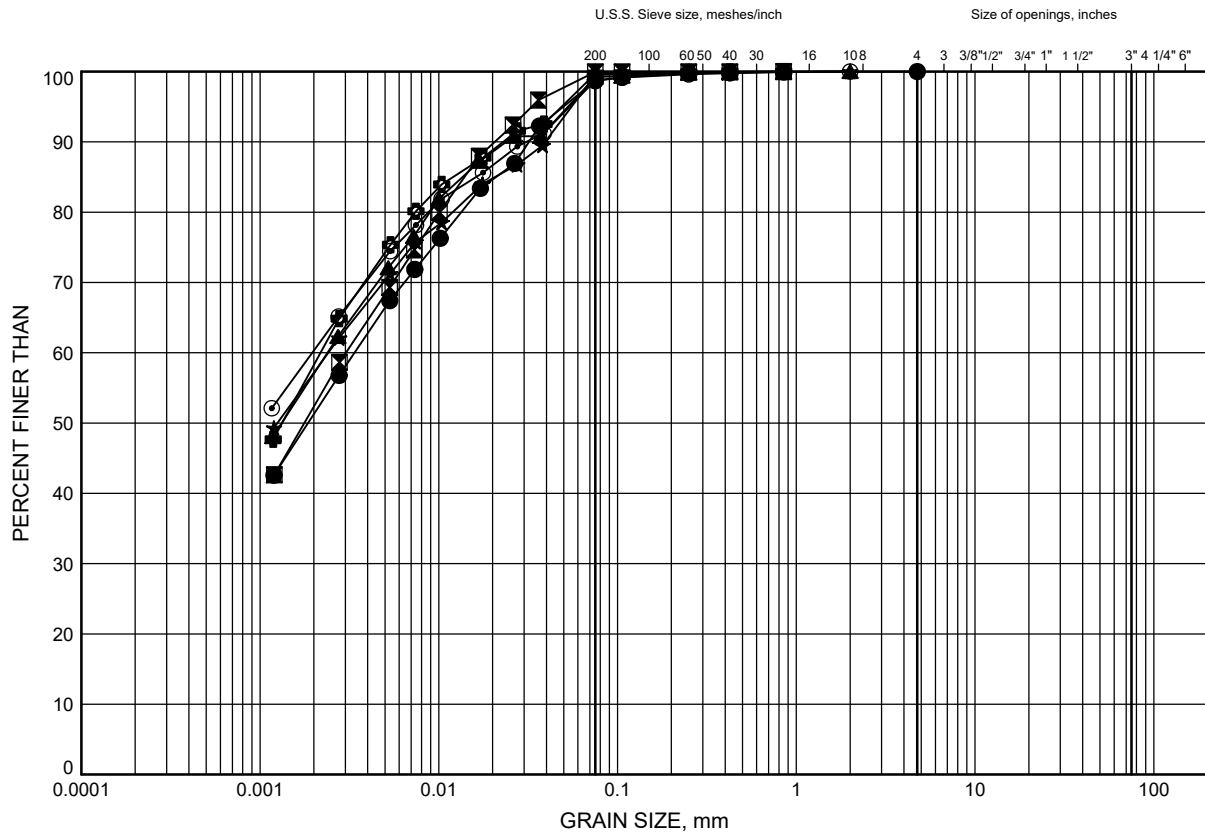


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Silty Clay (Weathered Crust)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-30	3.4	150.7
⊠	BRU19-30	7.9	146.2
▲	BRU19-31	1.1	148.8
★	BRU19-33	1.8	145.1
⊙	BRU21-02	2.6	148.8
⊕	BRU21-02	4.9	146.5

Date February 2022

WP# 4068-09-00

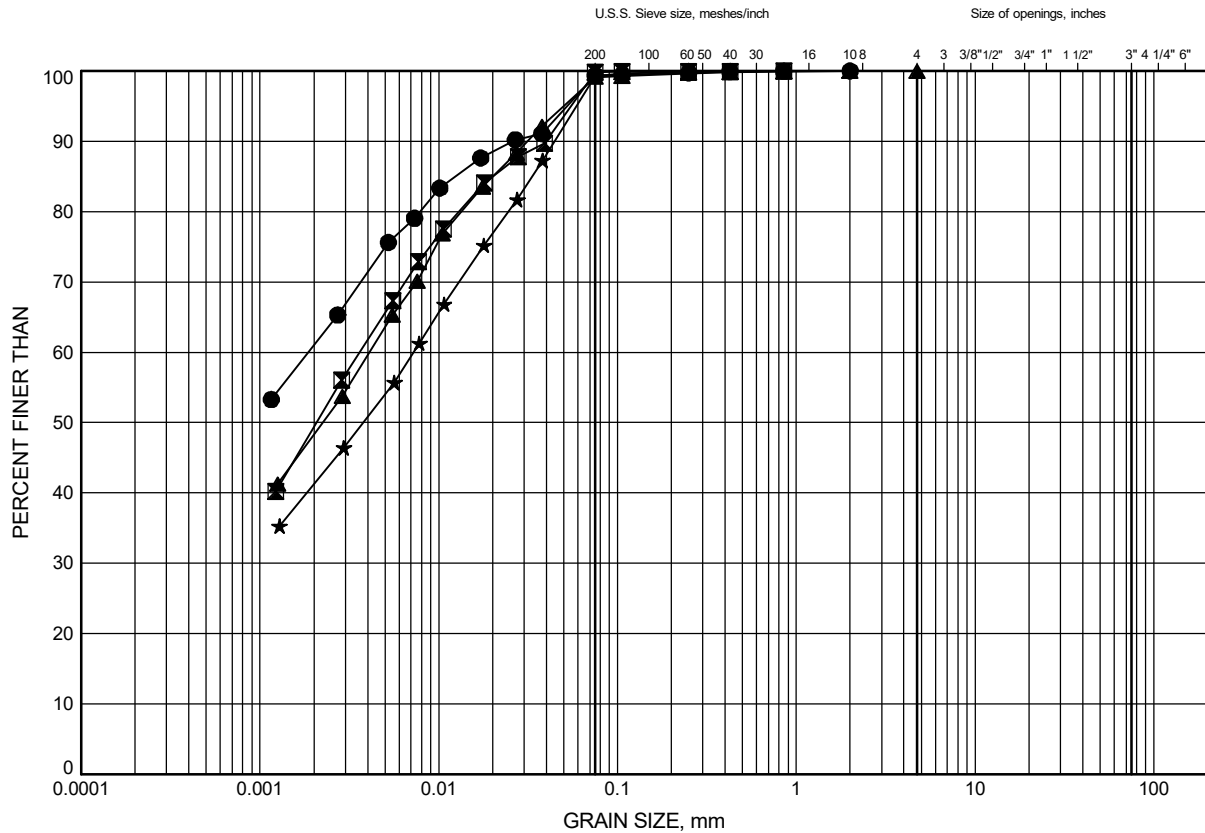


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Silty Clay (Weathered Crust)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU21-05	2.4	146.8
⊠	BRU21-05	6.4	142.8
▲	BRU23-1	2.6	152.3
★	BRU23-1	6.4	148.5

Date June 2024

WP# 4068-09-00



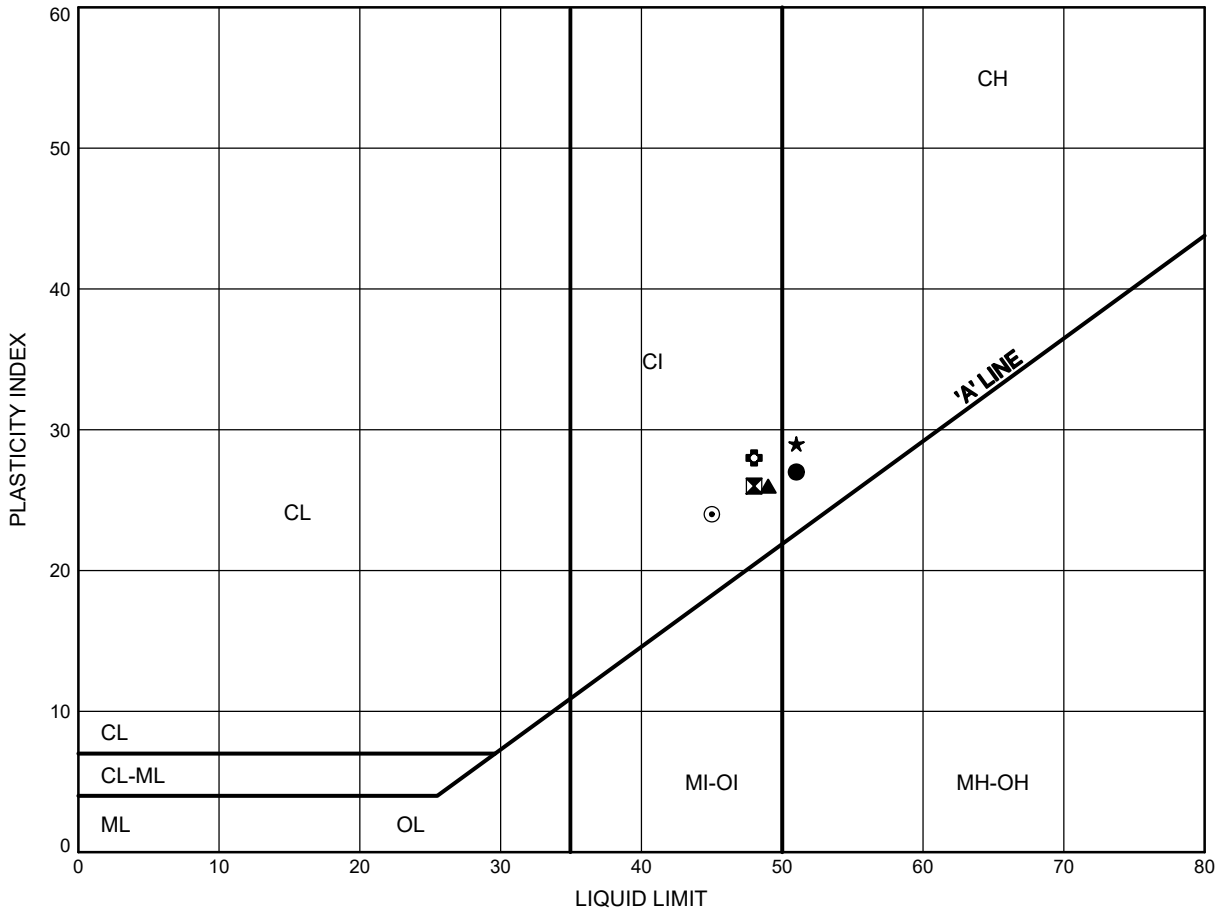
Prep'd RH

Chkd. MK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C6.1

Silty Clay (Weathered Crust)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-01	1.1	150.1
⊠	BRU19-01	3.4	147.8
▲	BRU19-01A	4.9	147.3
★	BRU19-02	2.6	147.5
⊙	BRU19-03	4.1	145.7
⊕	BRU19-04A	4.9	144.9

Date February 2022  
 WP# 4068-09-00

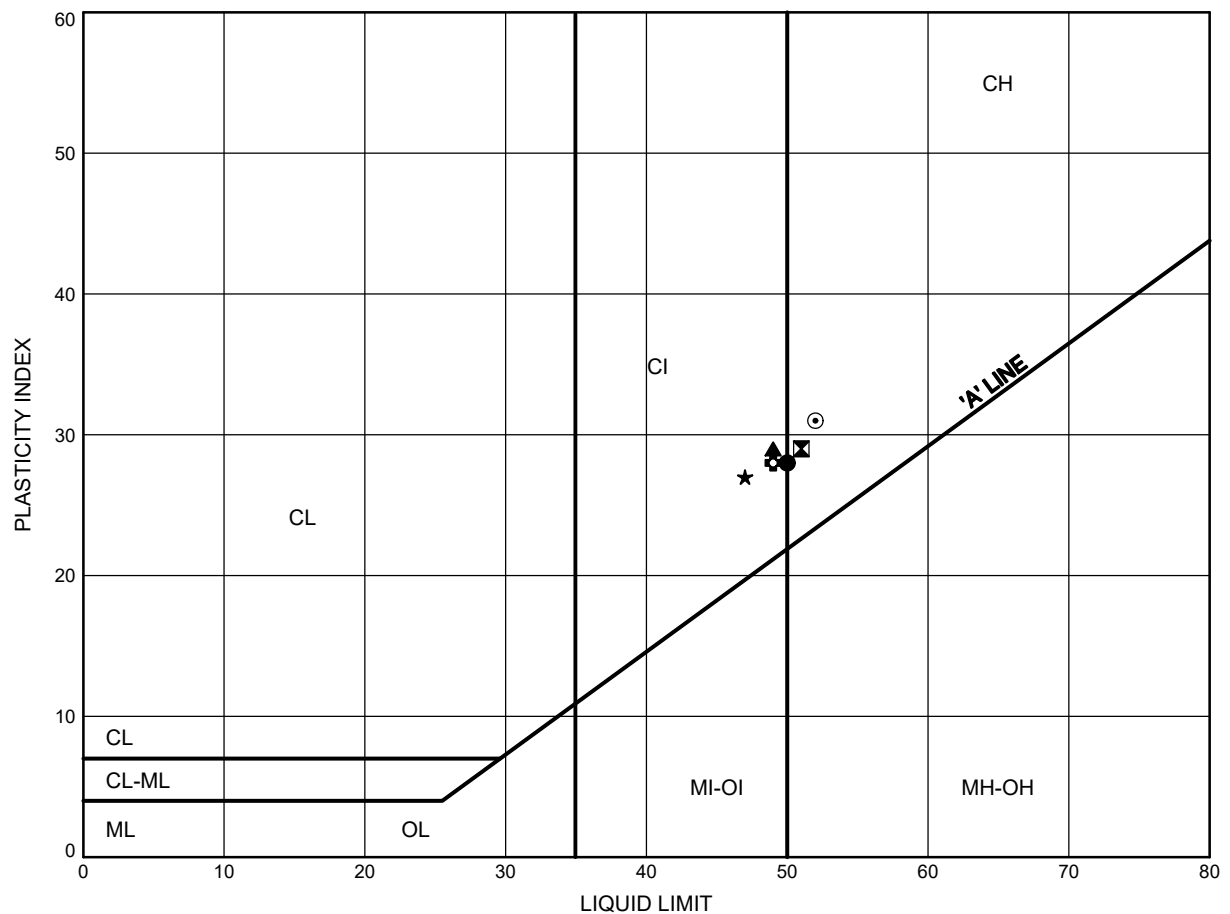


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C6.2

**Silty Clay (Weathered Crust)**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-06	3.4	145.1
⊠	BRU19-07	2.6	145.5
▲	BRU19-09	3.4	143.5
★	BRU19-10	2.6	143.6
⊙	BRU19-12	3.4	149.3
⊕	BRU19-13	4.1	148.4

Date February 2022  
 WP# 4068-09-00

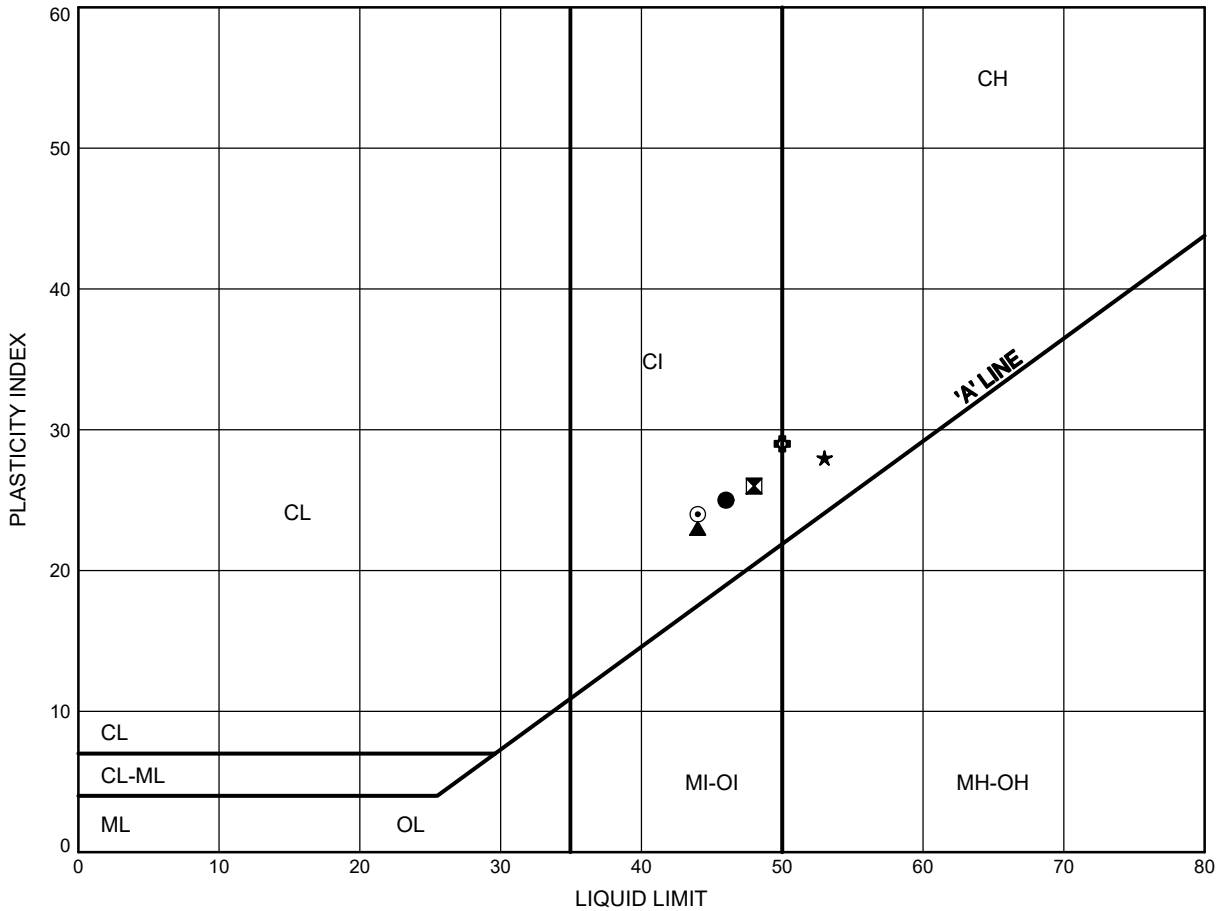


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C6.3

Silty Clay (Weathered Crust)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-15	3.5	149.1
⊠	BRU19-16	1.8	149.7
▲	BRU19-16	4.9	146.6
★	BRU19-21	1.1	149.6
⊙	BRU19-22	3.4	143.9
⊕	BRU19-23	2.6	144.0

Date February 2022  
 WP# 4068-09-00



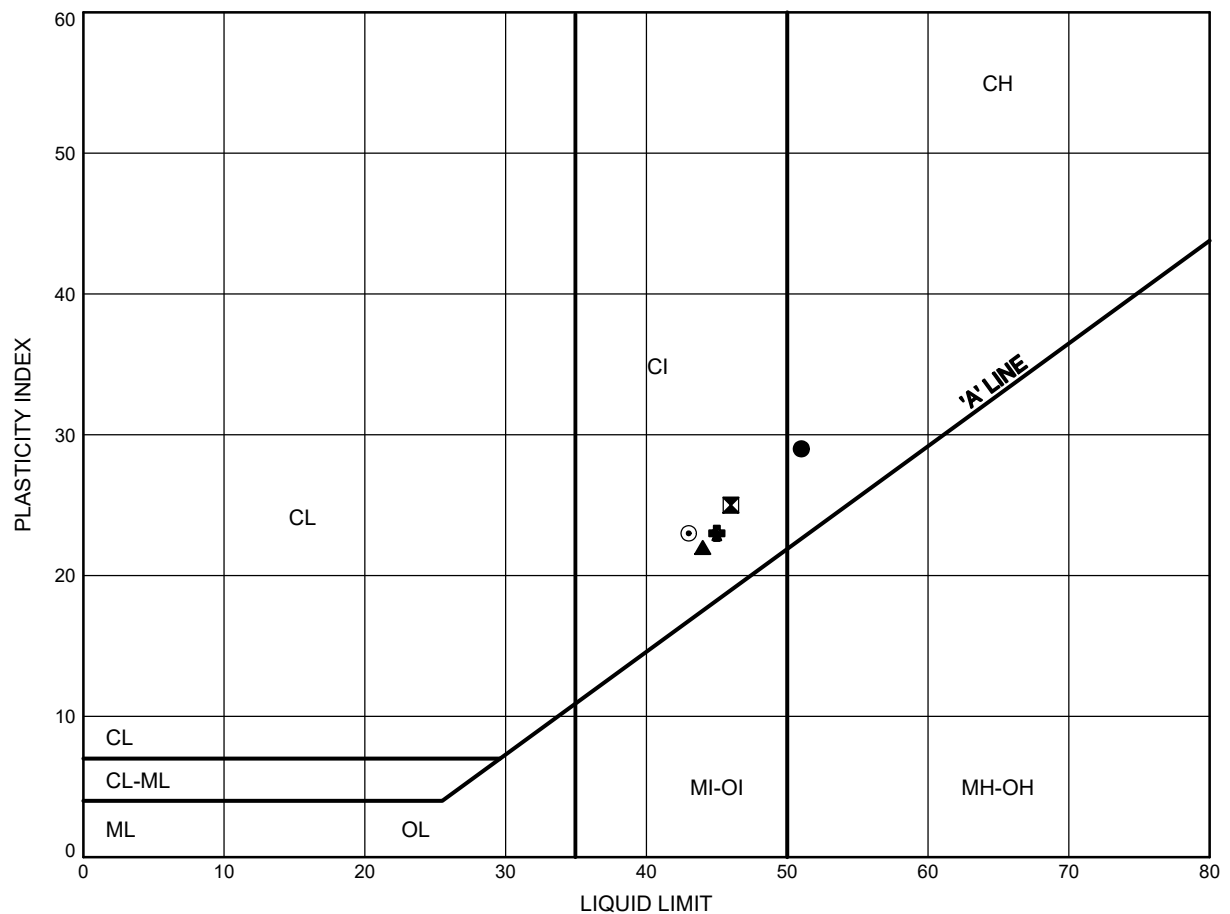
Prep'd MIK  
 Chkd. MJK



Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C6.4

**Silty Clay (Weathered Crust)**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-25	2.6	145.3
⊠	BRU19-26	4.1	145.6
▲	BRU19-27	2.6	152.0
★	BRU19-28	4.9	150.1
⊙	BRU19-29	3.4	151.3
⊕	BRU19-30	3.4	150.7

Date February 2022

WP# 4068-09-00



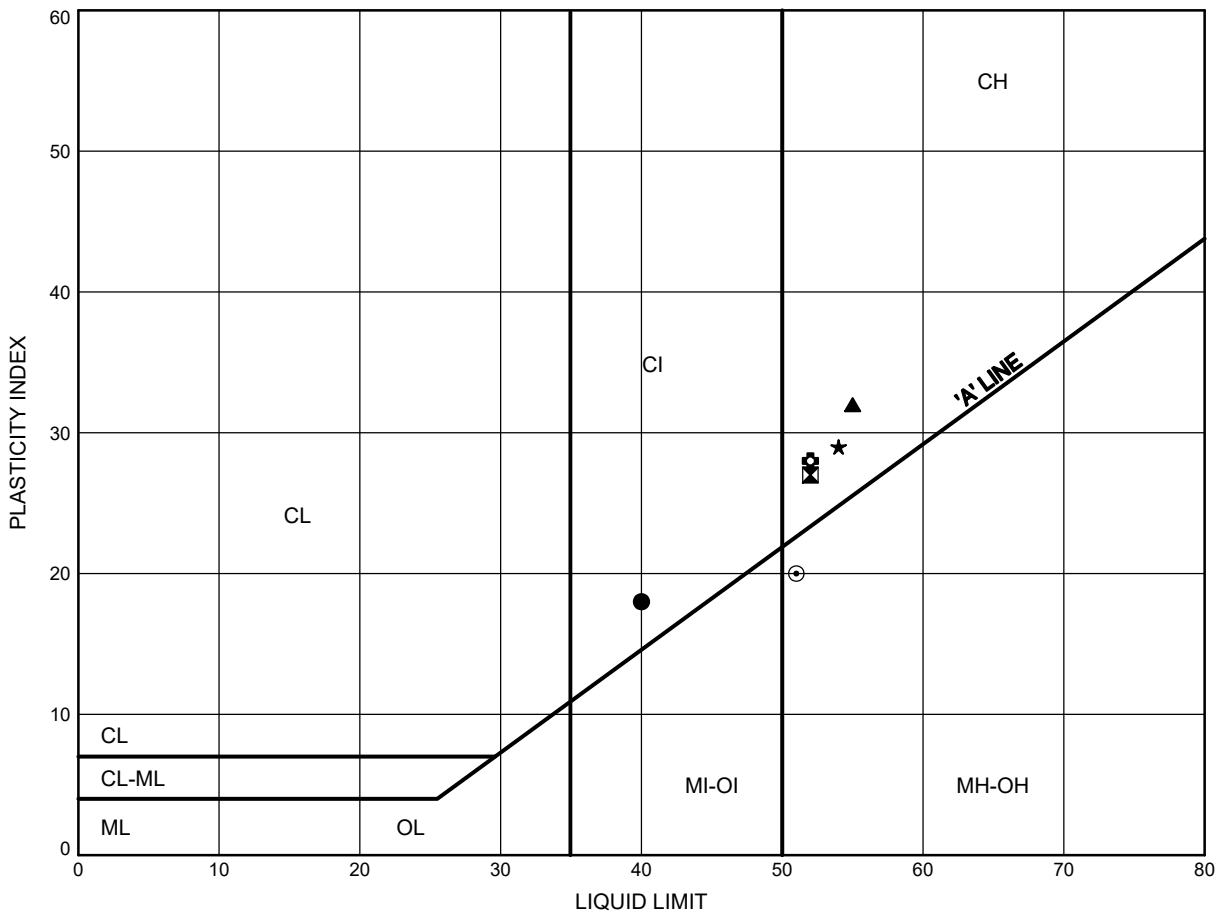
Prep'd MIK

Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C6.5

Silty Clay (Weathered Crust)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-30	7.9	146.2
⊠	BRU19-31	1.1	148.8
▲	BRU19-33	1.8	145.1
★	BRU21-02	2.6	148.8
⊙	BRU21-02	4.9	146.5
⊕	BRU21-05	2.4	146.8

Date February 2022  
 WP# 4068-09-00

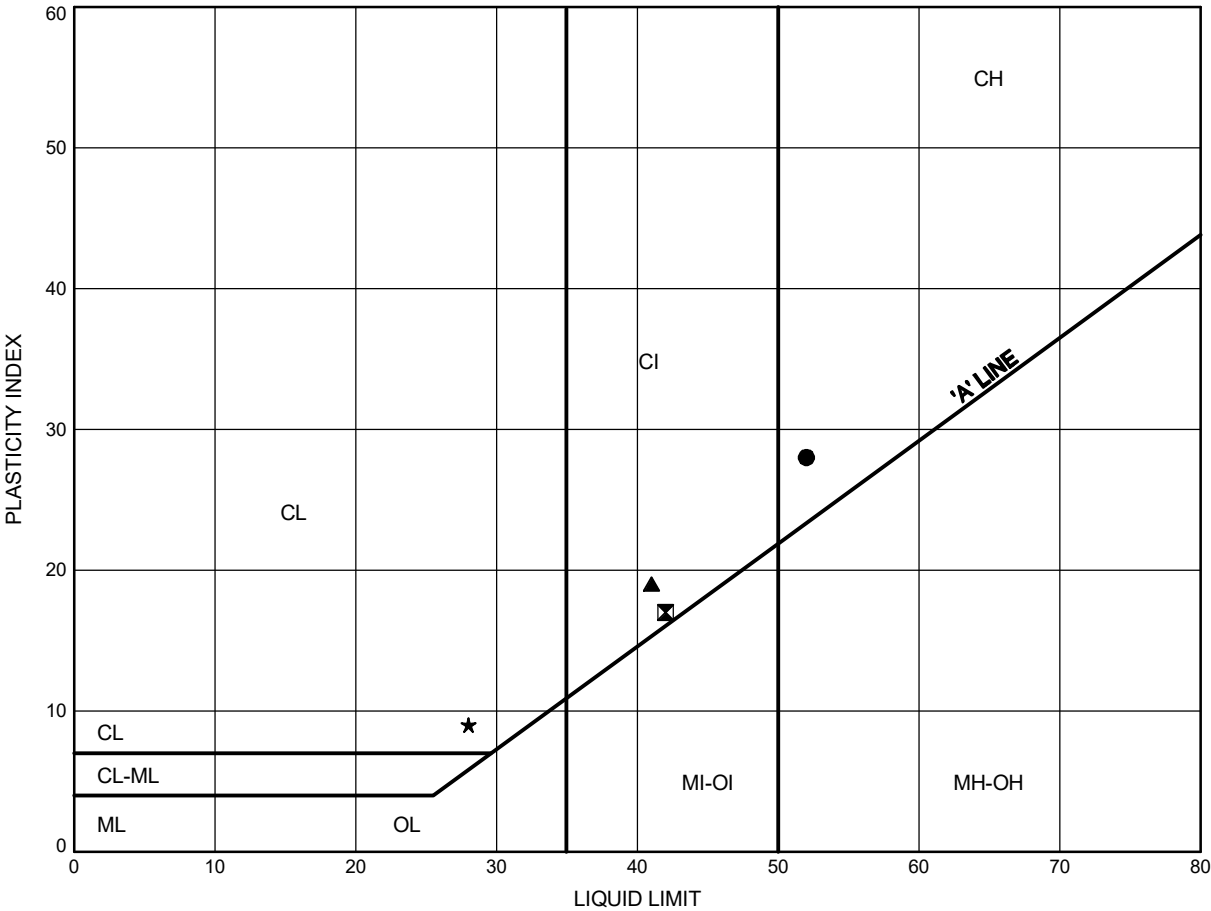


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C6.6

Silty Clay (Weathered Crust)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU21-05	2.4	146.8
⊠	BRU21-05	6.4	142.8
▲	BRU23-1	2.6	152.3
★	BRU23-1	6.4	148.5

THURBALT 24726 BRUCE STREET GINT.GPJ 6-4-24

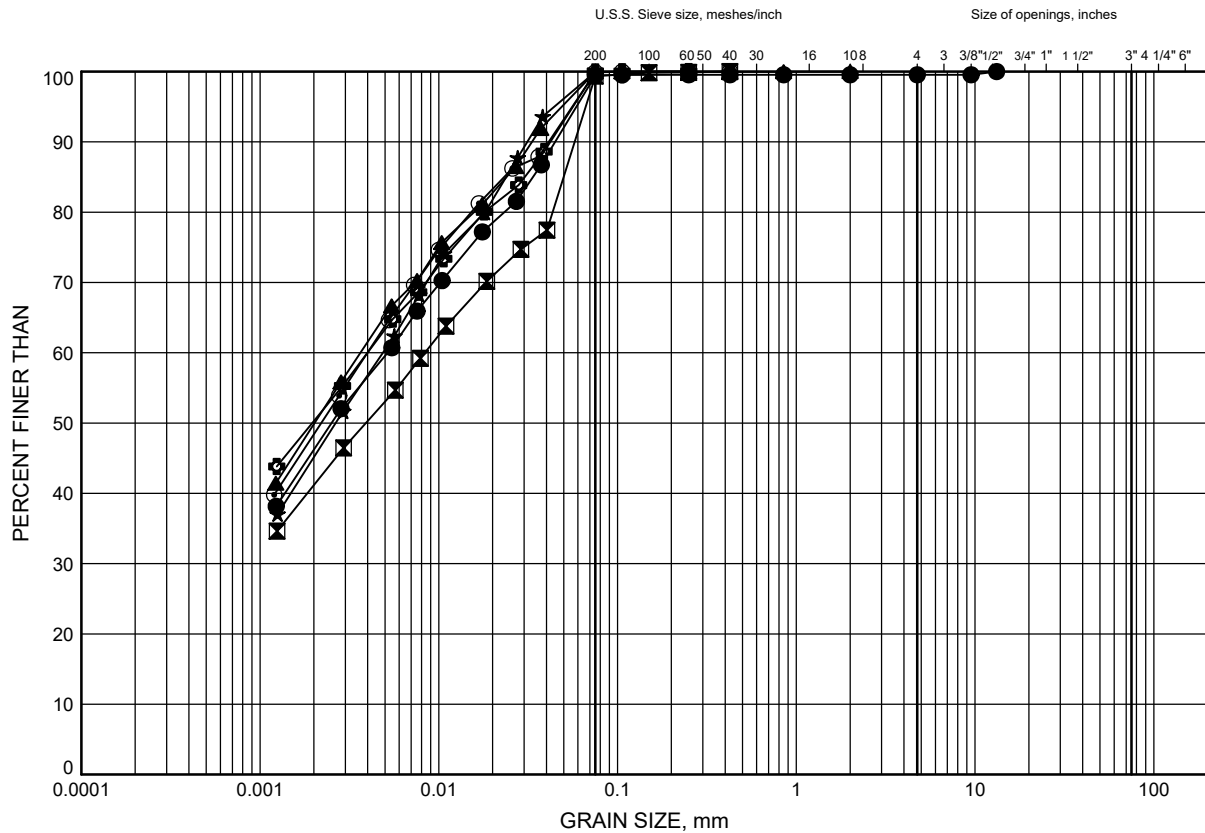
Date June 2024  
WP# 4068-09-00



Prep'd RH  
Chkd. MK

## GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt (Above Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-01	9.4	141.8
⊠	BRU19-01A	17.7	134.5
▲	BRU19-02	12.5	137.6
★	BRU19-02	15.5	134.6
⊙	BRU19-03	6.4	143.4
⊕	BRU19-04A	9.4	140.4

Date February 2022

WP# 4068-09-00

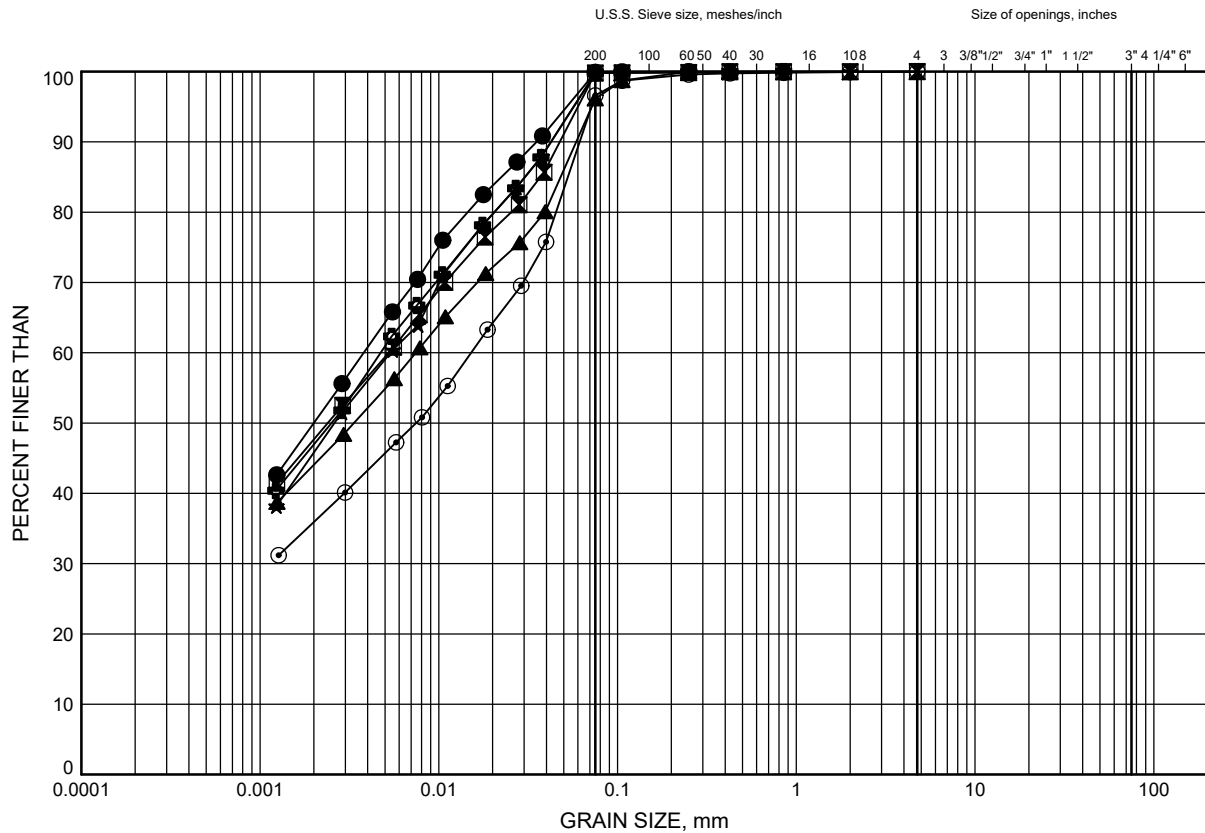


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt (Above Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-06	11.0	137.5
⊠	BRU19-07	6.4	141.7
▲	BRU19-07	14.0	134.1
★	BRU19-09	7.9	139.0
⊙	BRU19-10	6.4	139.8
⊕	BRU19-12	6.4	146.3

Date February 2022

WP# 4068-09-00

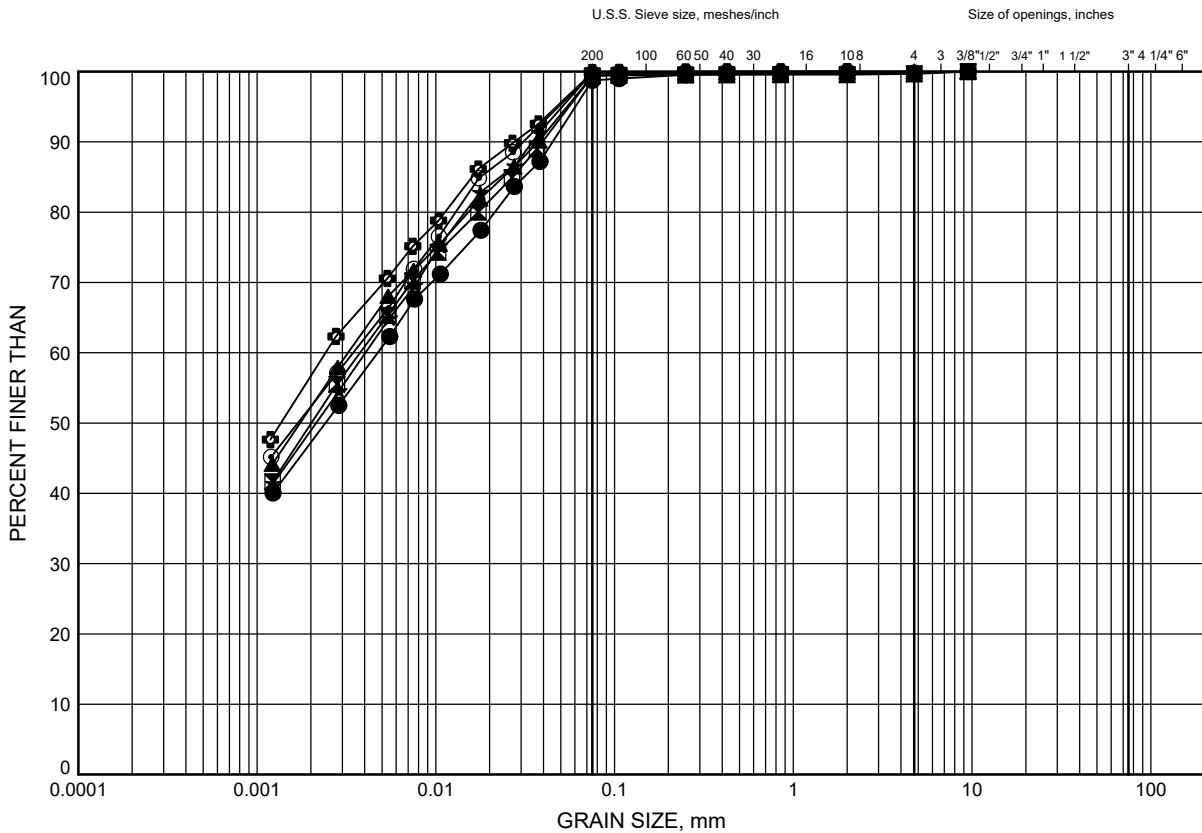


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt (Above Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-12	14.9	137.8
⊠	BRU19-13	9.4	143.1
▲	BRU19-13	14.0	138.5
★	BRU19-15	9.4	143.2
⊙	BRU19-16	7.9	143.6
⊕	BRU19-16	14.0	137.5

Date February 2022

WP# 4068-09-00

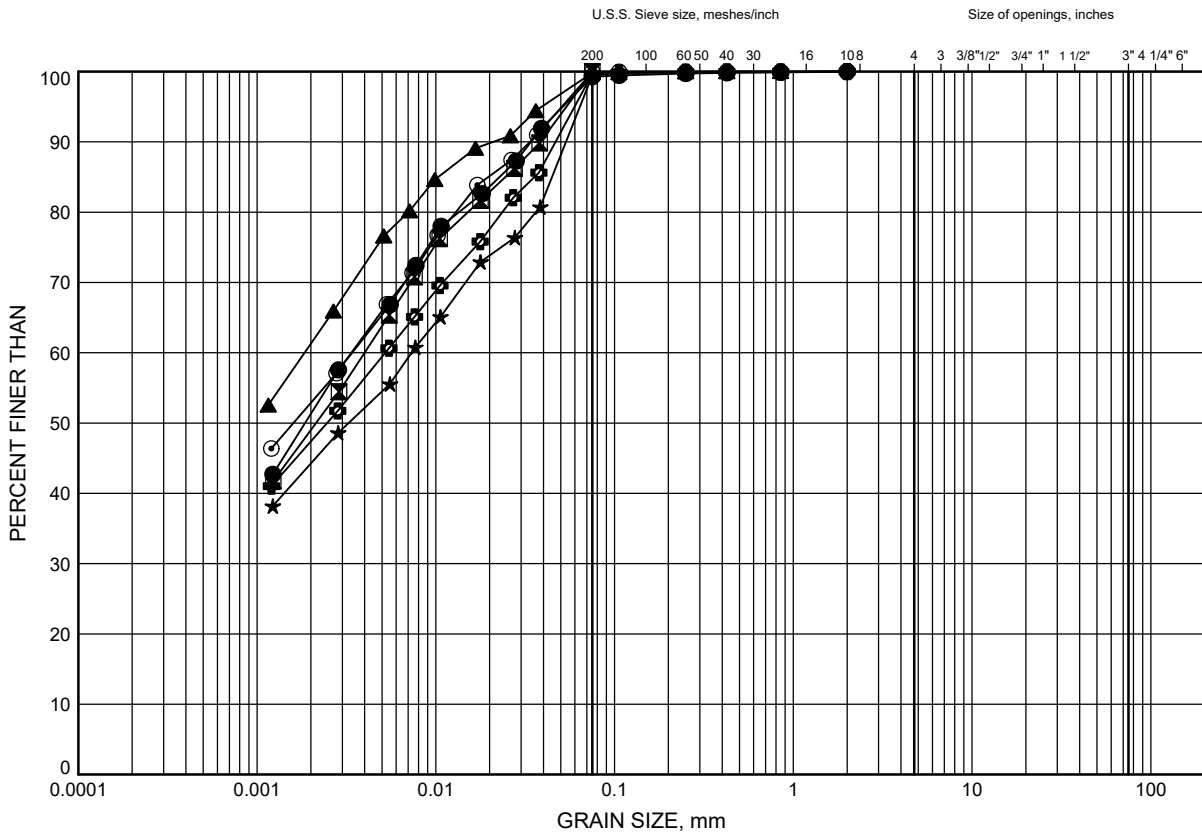


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt (Above Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-18	4.1	146.8
⊠	BRU19-18	9.4	141.5
▲	BRU19-19	3.4	148.8
★	BRU19-19	9.4	142.8
⊙	BRU19-19	14.0	138.2
⊕	BRU19-21	9.4	141.3

Date February 2022

WP# 4068-09-00

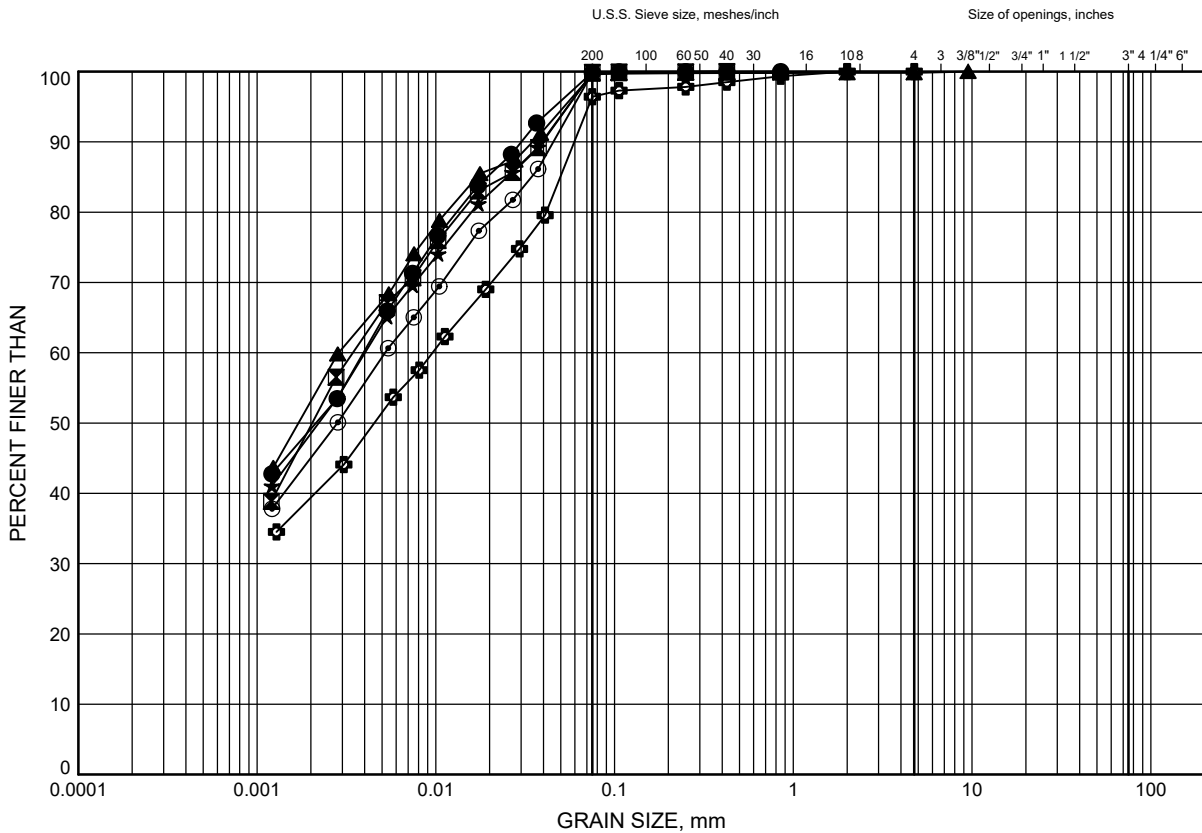


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt (Above Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-21	15.5	135.2
⊠	BRU19-22	9.4	137.9
▲	BRU19-23	7.9	138.7
★	BRU19-25	4.9	143.0
⊙	BRU19-25	14.0	133.9
⊕	BRU19-26	11.0	138.7

Date February 2022

WP# 4068-09-00



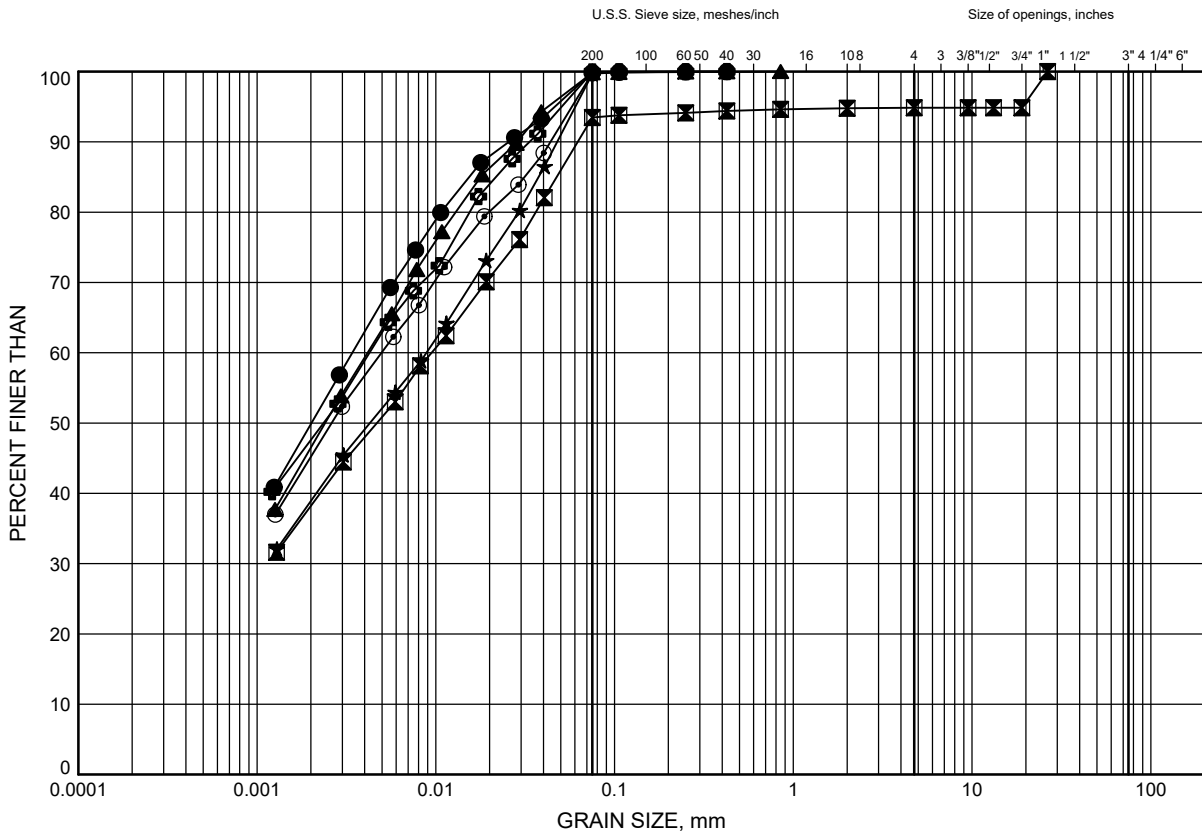
Prep'd MIK

Chkd. MJK



## GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt (Above Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-27	7.9	146.7
■	BRU19-27	14.0	140.6
▲	BRU19-28	11.0	144.0
★	BRU19-28	21.6	133.4
⊙	BRU19-29	17.1	137.6
⊕	BRU19-30	13.7	140.4

Date February 2022

WP# 4068-09-00

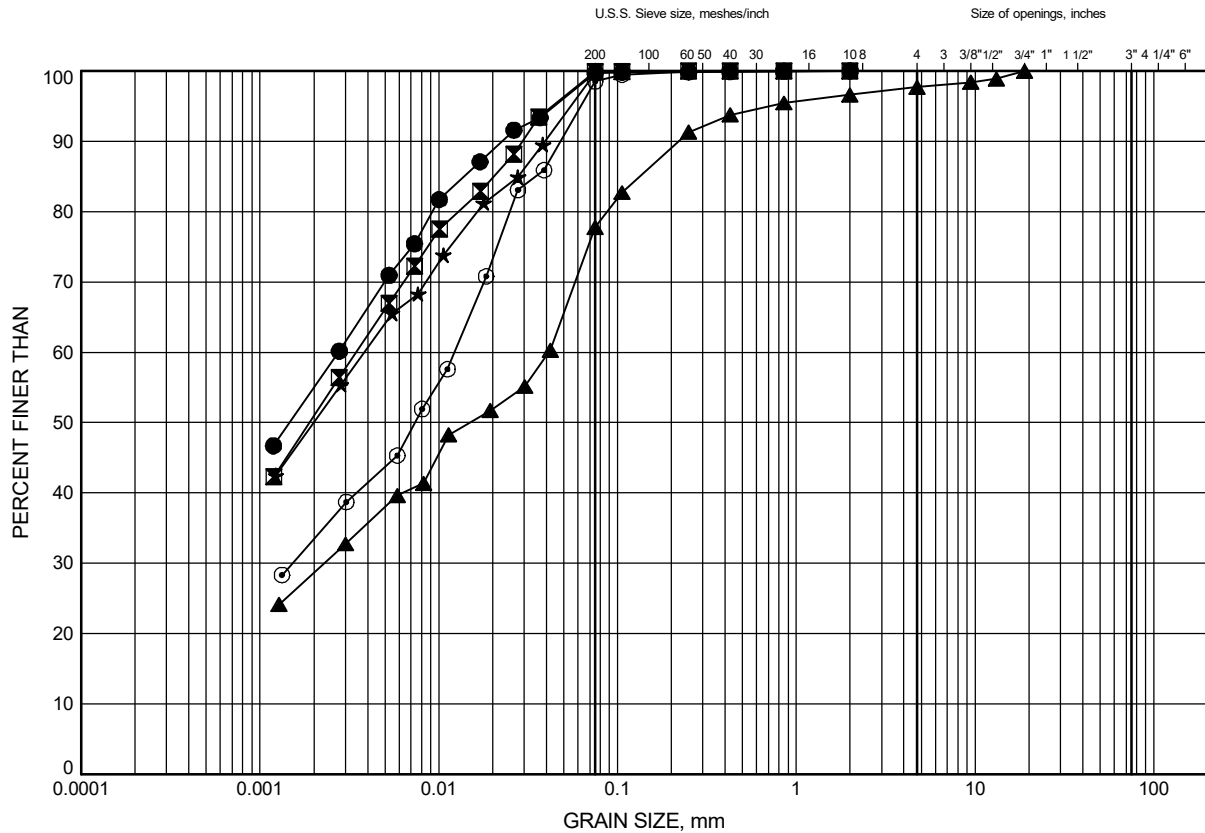


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt (Above Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-31	4.1	145.8
⊠	BRU19-31	9.4	140.5
▲	BRU19-31	16.8	133.1
★	BRU19-33	6.4	140.5
⊙	BRU23-1	9.4	145.5

Date June 2024

WP# 4068-09-00



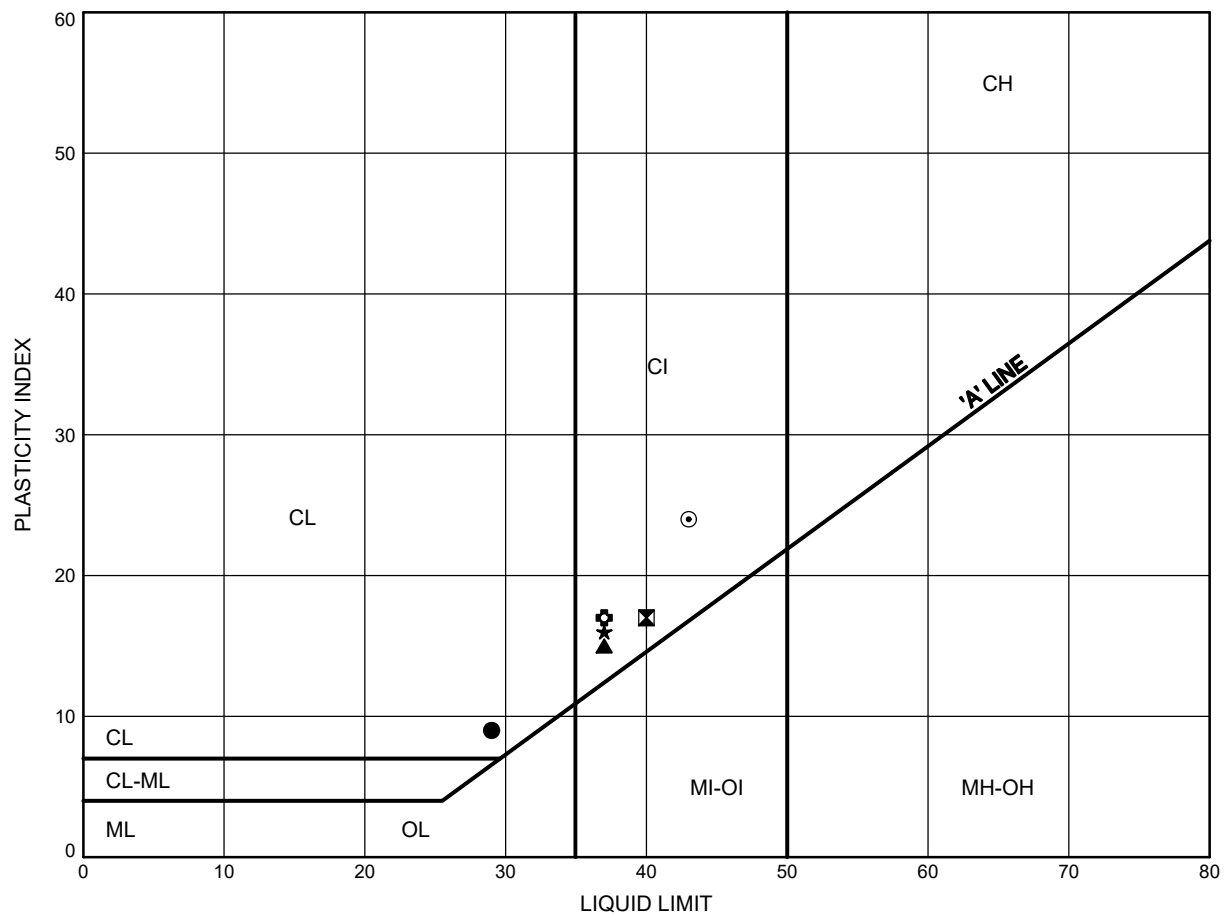
Prep'd RH

Chkd. MK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C8.1

Silty Clay to Clayey Silt (Above Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-01	9.4	141.8
⊠	BRU19-02	12.5	137.6
▲	BRU19-02	15.5	134.6
★	BRU19-03	6.4	143.4
⊙	BRU19-04A	9.4	140.4
⊕	BRU19-06	11.0	137.5

Date February 2022  
 WP# 4068-09-00

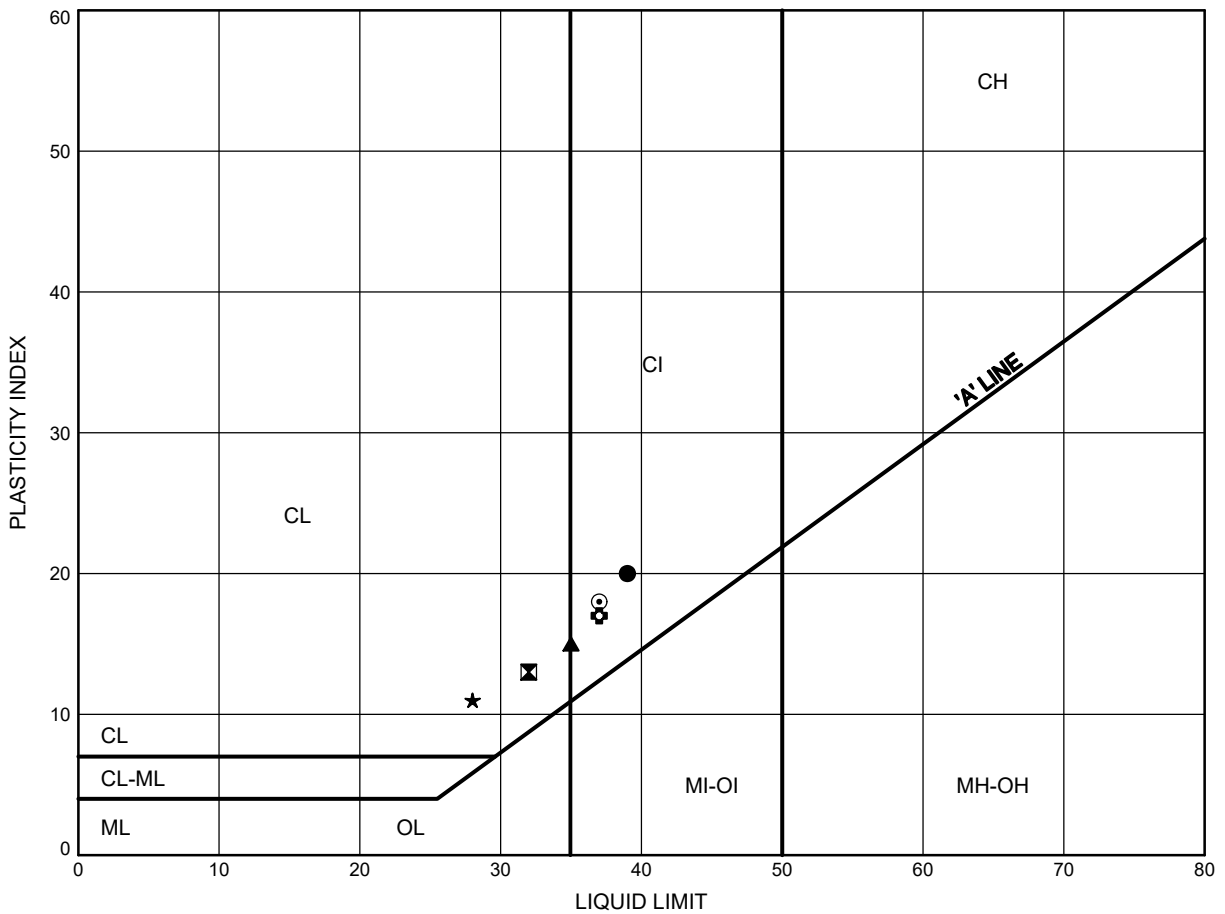


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C8.2

Silty Clay to Clayey Silt (Above Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-07	6.4	141.7
⊠	BRU19-07	14.0	134.1
▲	BRU19-09	7.9	139.0
★	BRU19-10	6.4	139.8
⊙	BRU19-12	6.4	146.3
⊕	BRU19-12	14.9	137.8

Date February 2022  
 WP# 4068-09-00

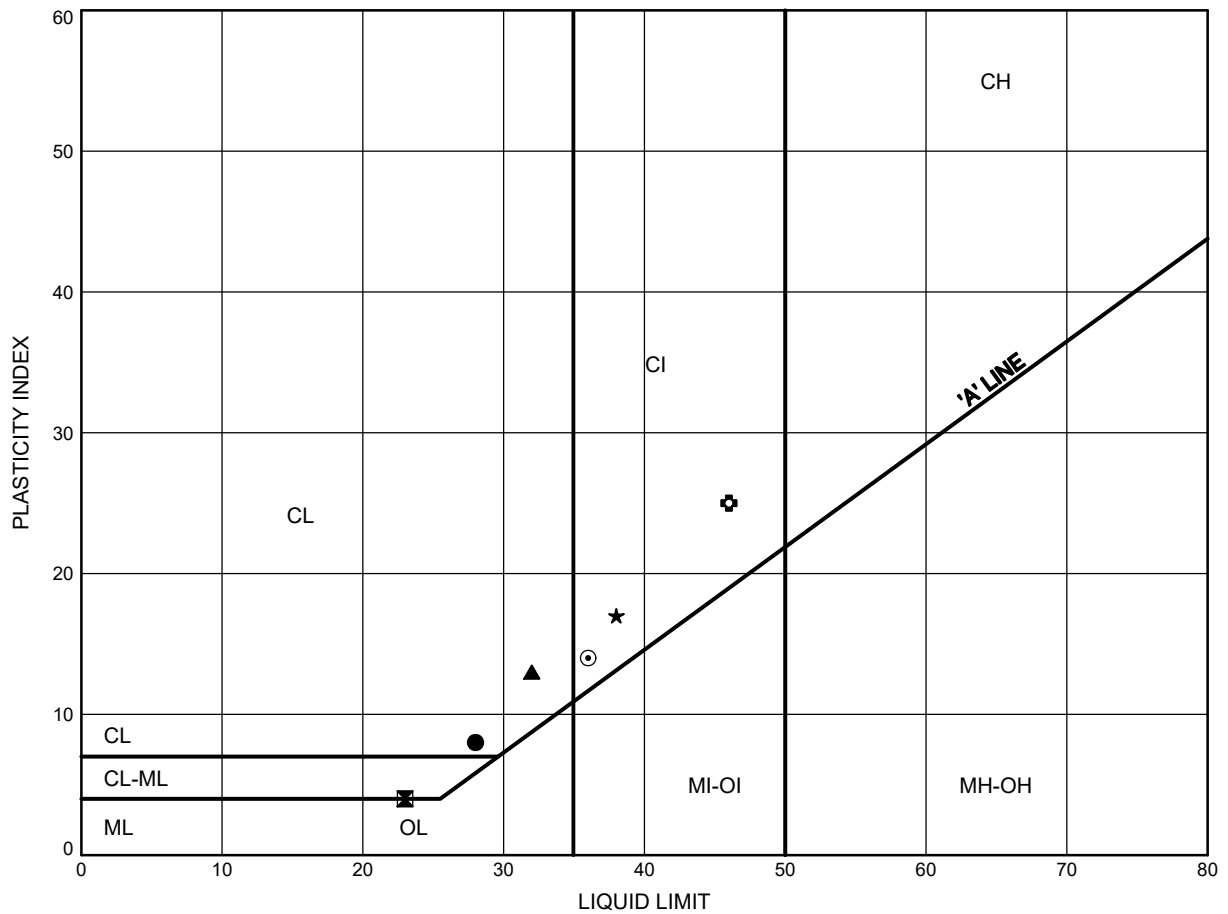


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C8.3

Silty Clay to Clayey Silt (Above Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-13	9.4	143.1
⊠	BRU19-13	14.0	138.5
▲	BRU19-15	9.4	143.2
★	BRU19-16	7.9	143.6
⊙	BRU19-16	14.0	137.5
⊕	BRU19-18	4.1	146.8

Date February 2022  
 WP# 4068-09-00

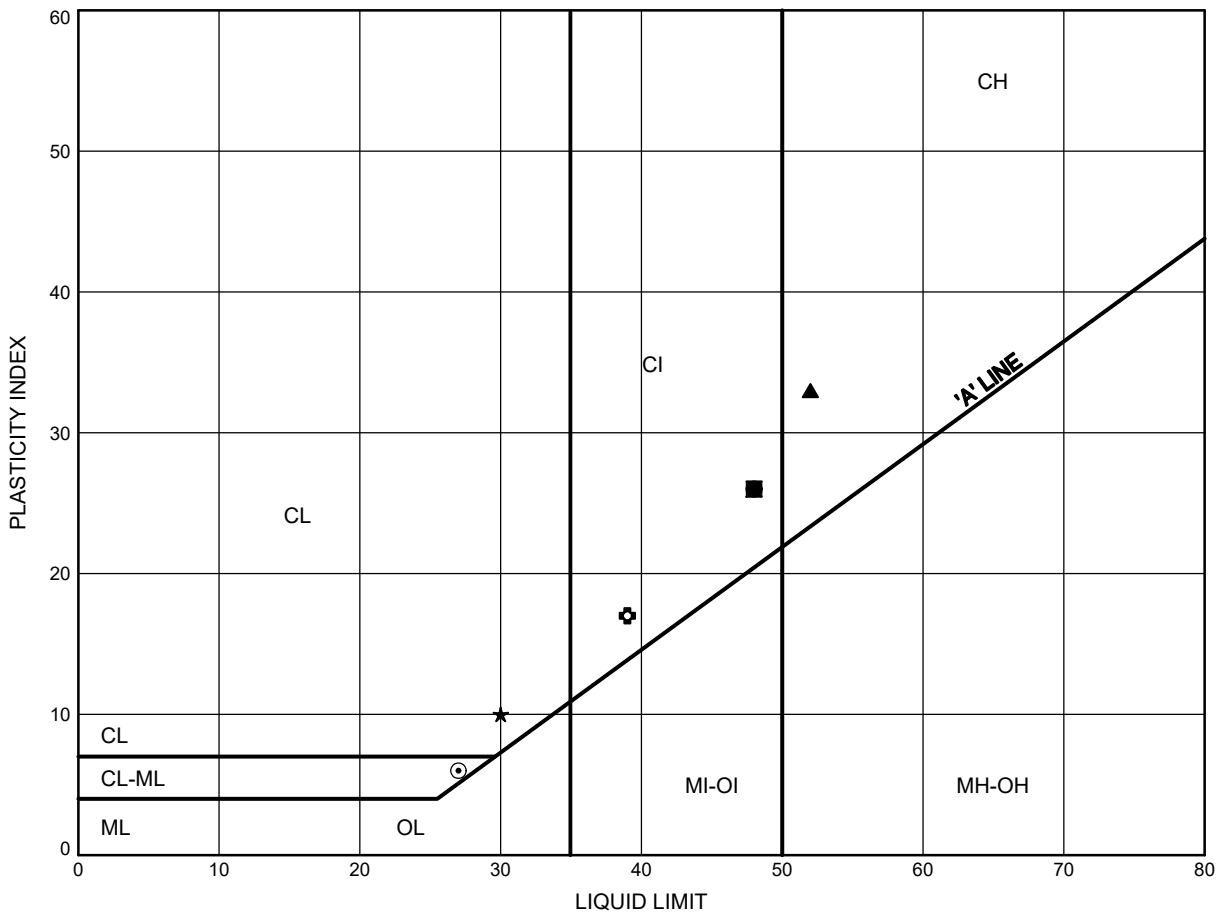


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C8.4

Silty Clay to Clayey Silt (Above Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-19	3.4	148.8
⊠	BRU19-19	9.4	142.8
▲	BRU19-19	14.0	138.2
★	BRU19-21	9.4	141.3
⊙	BRU19-21	15.5	135.2
⊕	BRU19-22	9.4	137.9

Date February 2022  
 WP# 4068-09-00

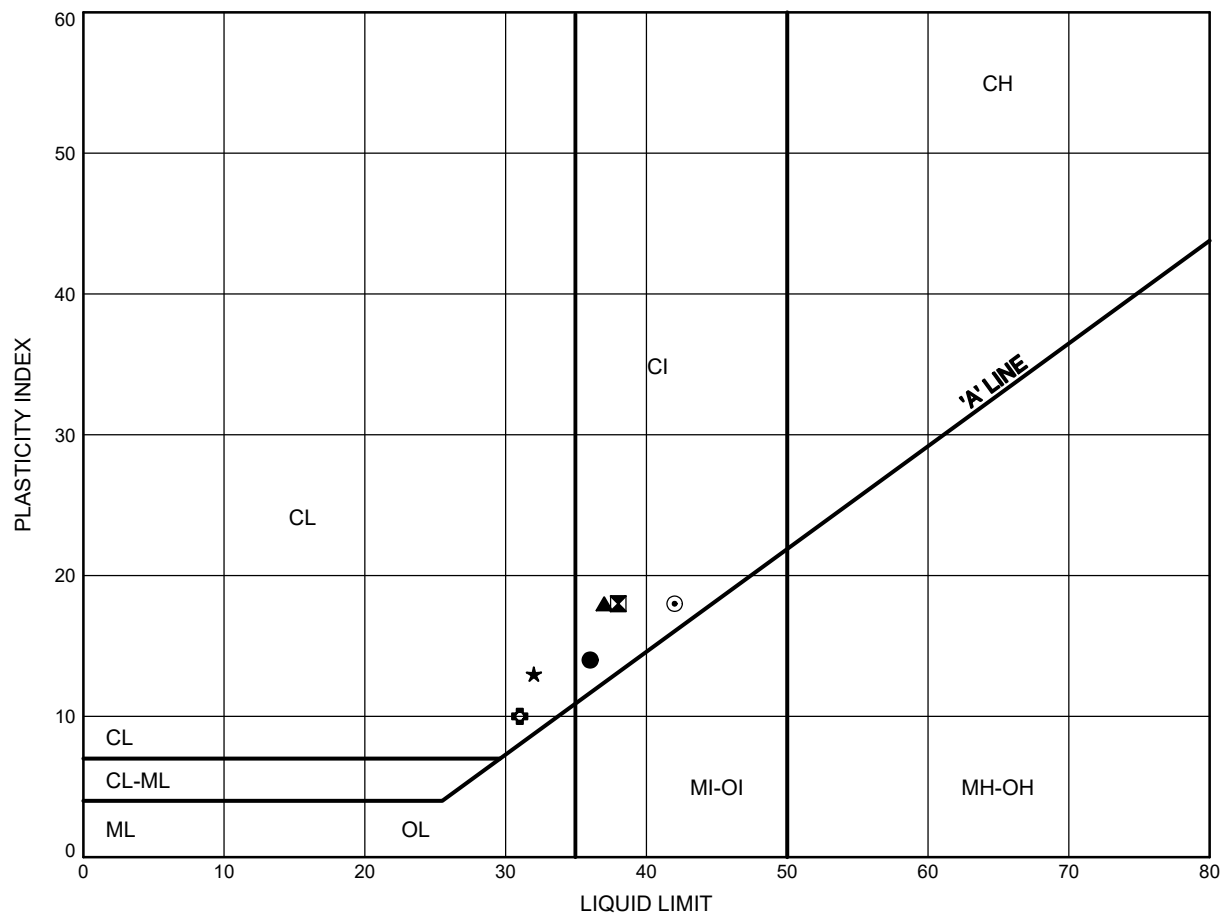


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C8.5

Silty Clay to Clayey Silt (Above Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-23	7.9	138.7
⊠	BRU19-25	4.9	143.0
▲	BRU19-25	14.0	133.9
★	BRU19-26	11.0	138.7
⊙	BRU19-27	7.9	146.7
⊕	BRU19-27	14.0	140.6

Date February 2022  
 WP# 4068-09-00

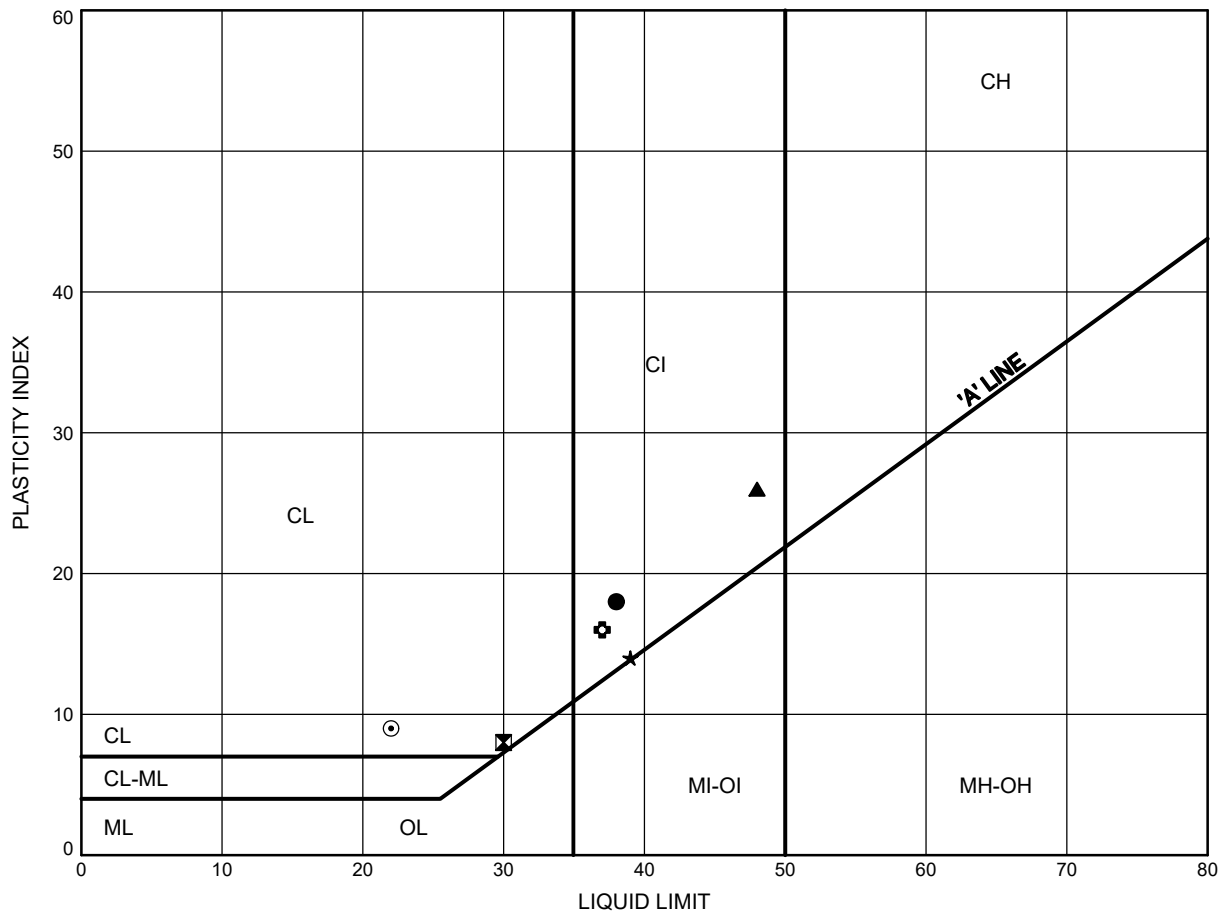


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C8.6

Silty Clay to Clayey Silt (Above Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-28	11.0	144.0
⊠	BRU19-30	13.7	140.4
▲	BRU19-31	4.1	145.8
★	BRU19-31	9.4	140.5
⊙	BRU19-31	16.8	133.1
⊕	BRU19-33	6.4	140.5

Date February 2022  
 WP# 4068-09-00



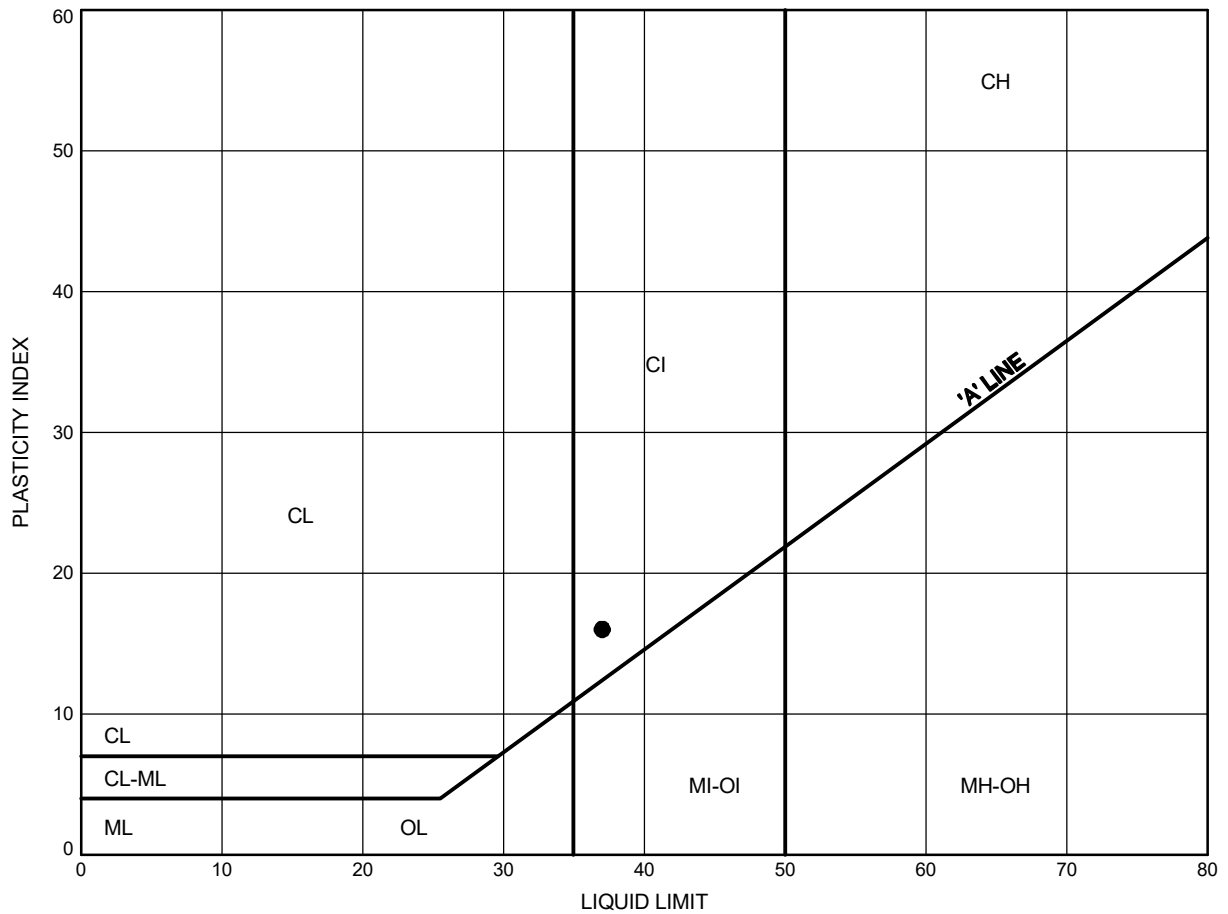
Prep'd MIK  
 Chkd. MJK



Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C8.7

Silty Clay to Clayey Silt (Above Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU23-1	9.4	145.5

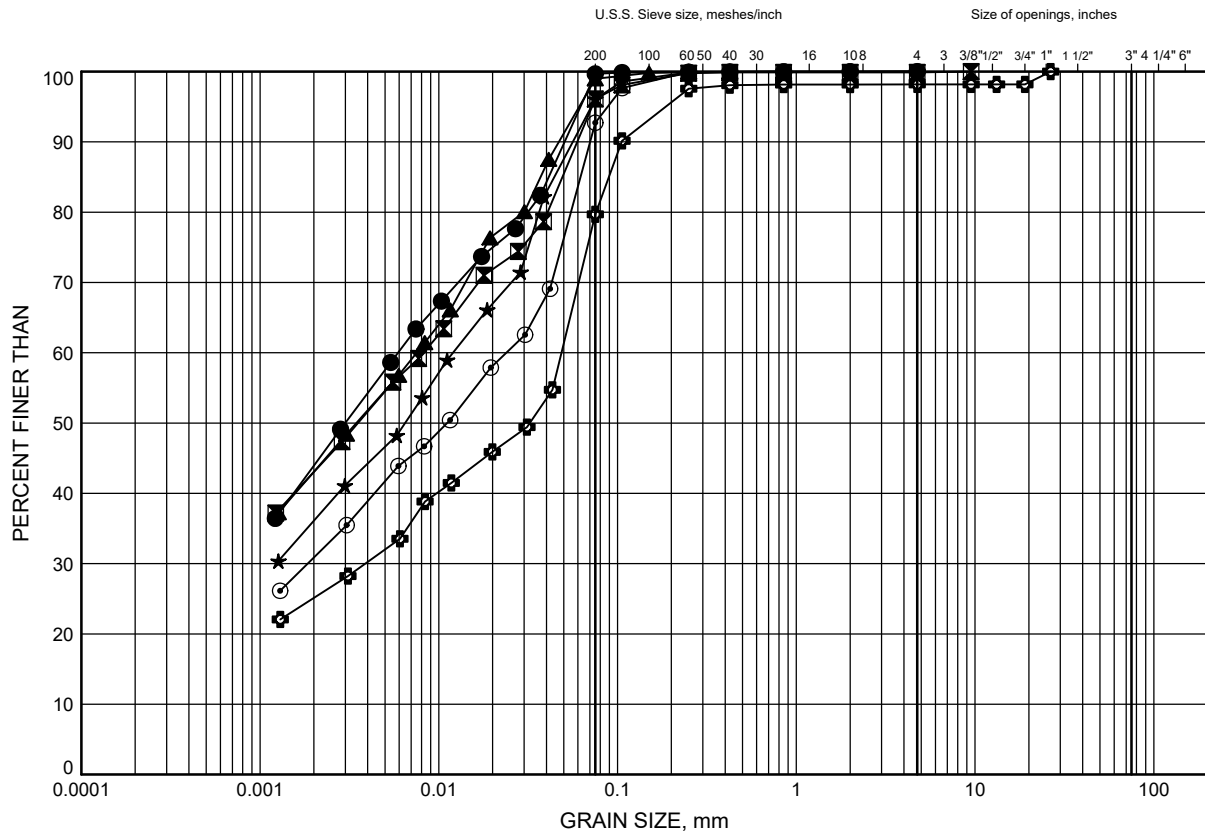
Date June 2024  
WP# 4068-09-00



Prep'd RH  
Chkd. MK

## GRAIN SIZE DISTRIBUTION

## Clayey Silt (Below Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-01	18.6	132.6
⊠	BRU19-01	30.8	120.4
▲	BRU19-01A	23.2	129.0
★	BRU19-02	30.8	119.3
⊙	BRU19-03	21.6	128.2
⊕	BRU19-03	32.3	117.5

Date February 2022

WP# 4068-09-00

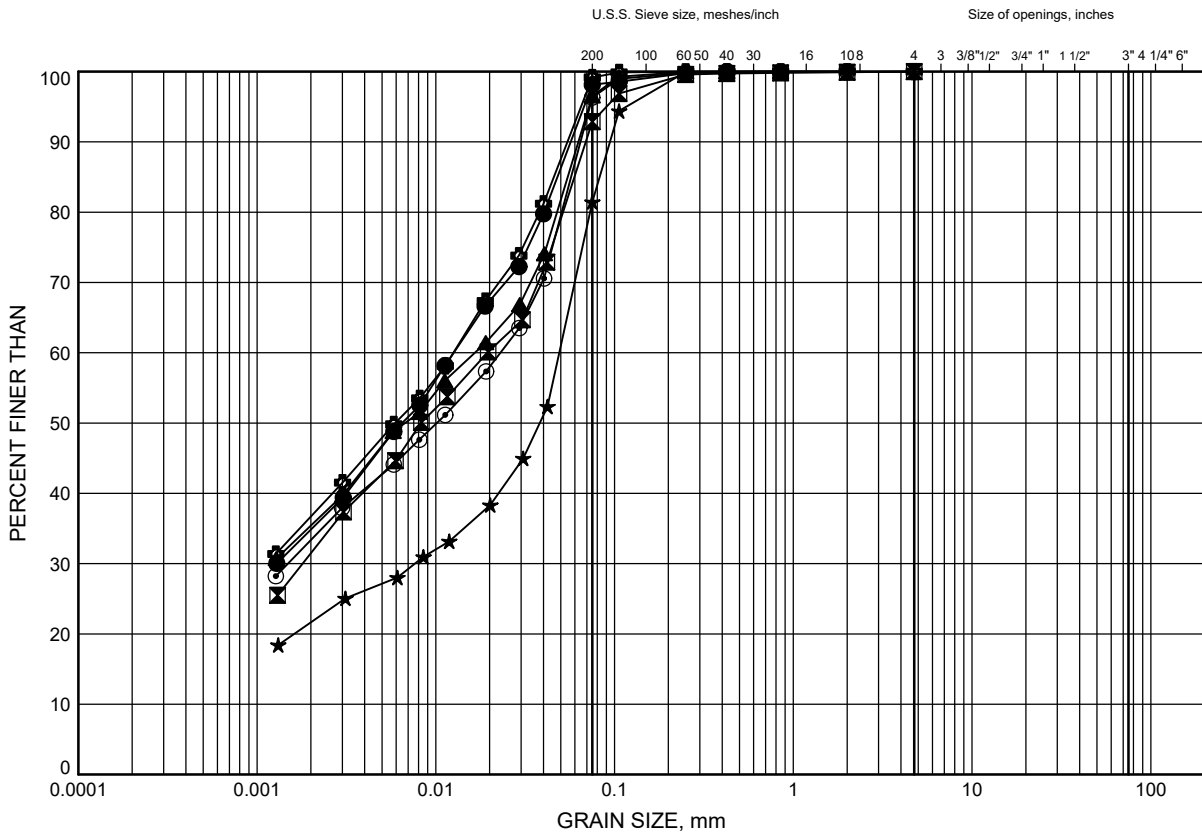


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Clayey Silt (Below Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-04A	18.6	131.2
⊠	BRU19-04A	30.0	119.8
▲	BRU19-06	20.1	128.4
★	BRU19-06	22.3	126.2
⊙	BRU19-09	17.1	129.8
⊕	BRU19-13	24.1	128.4

Date February 2022

WP# 4068-09-00

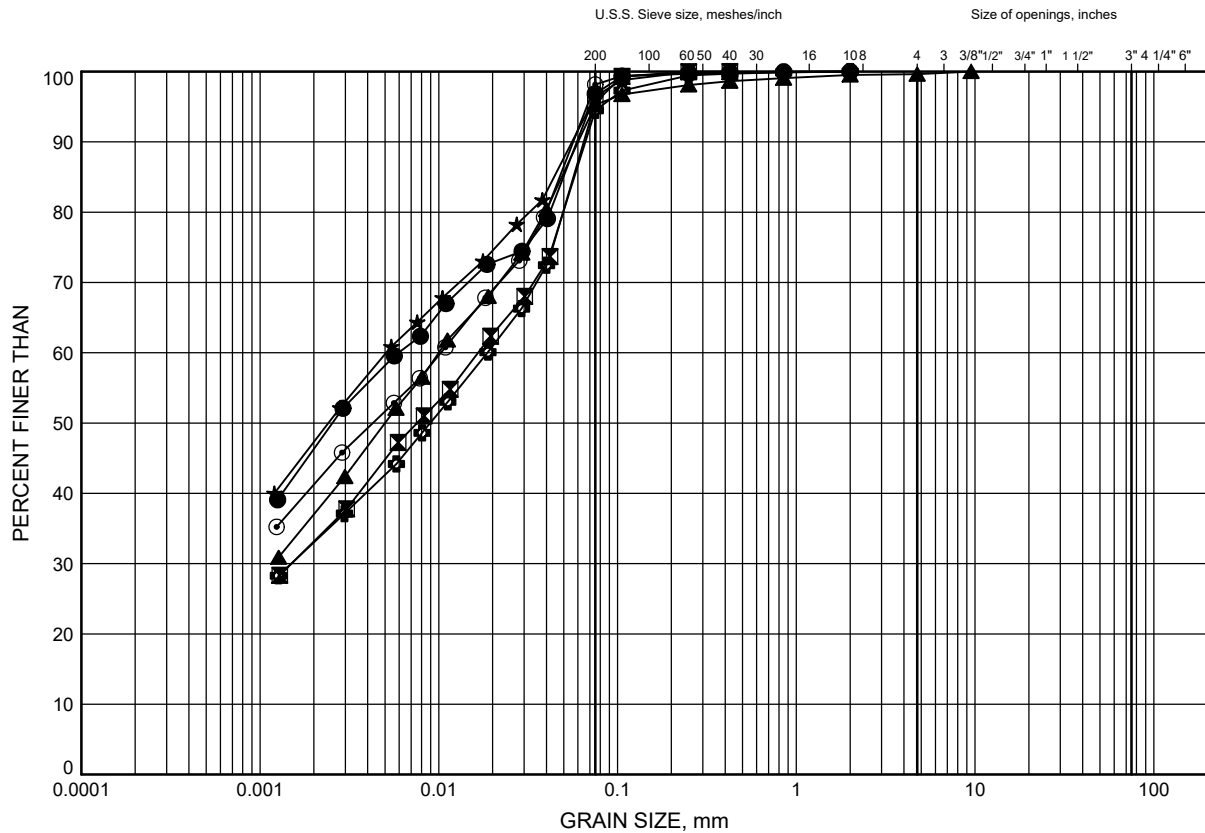


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Clayey Silt (Below Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-15	21.6	131.0
⊠	BRU19-15	33.1	119.5
▲	BRU19-18	21.6	129.3
★	BRU19-19	20.1	132.1
⊙	BRU19-19	24.7	127.5
⊕	BRU19-19	35.4	116.8

Date February 2022

WP# 4068-09-00

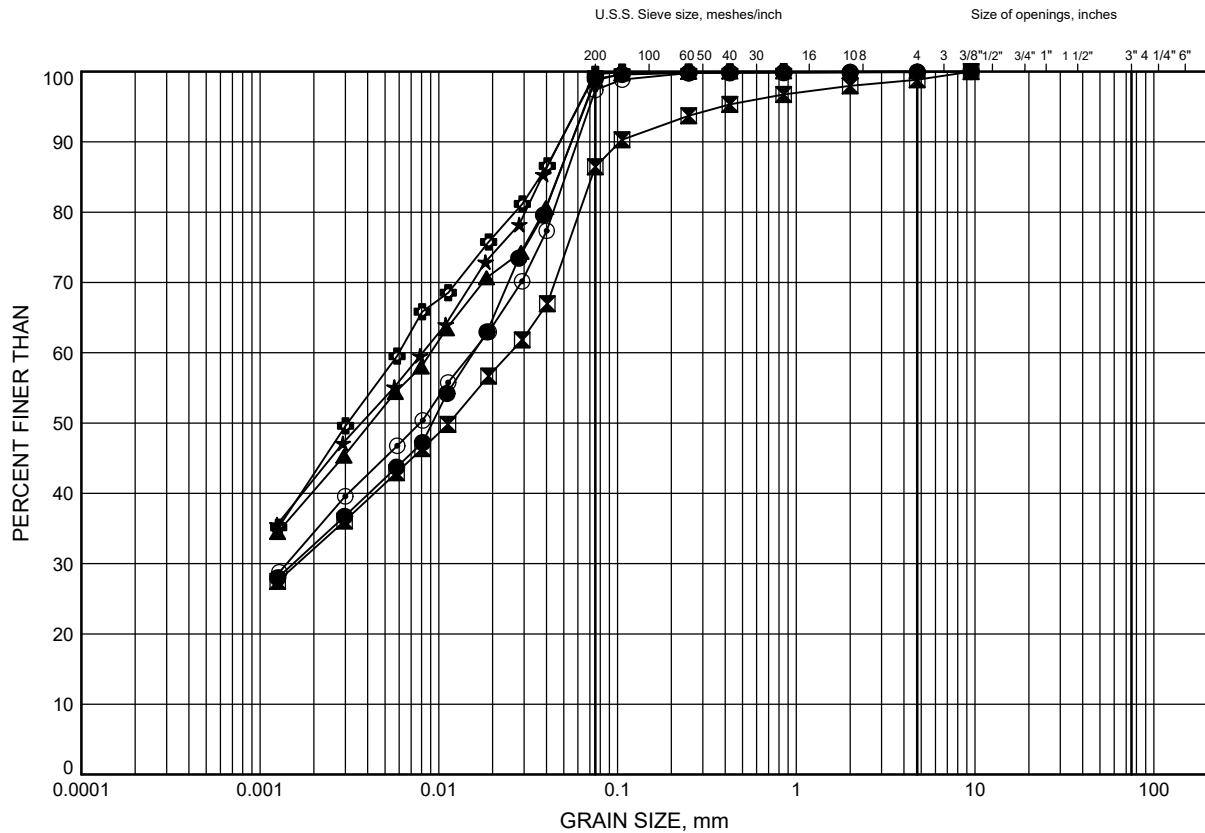


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Clayey Silt (Below Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-21	23.2	127.5
⊠	BRU19-21	32.3	118.4
▲	BRU19-22	23.2	124.1
★	BRU19-23	14.8	131.8
⊙	BRU19-23	23.9	122.7
⊕	BRU19-29	24.7	130.0

Date February 2022

WP# 4068-09-00

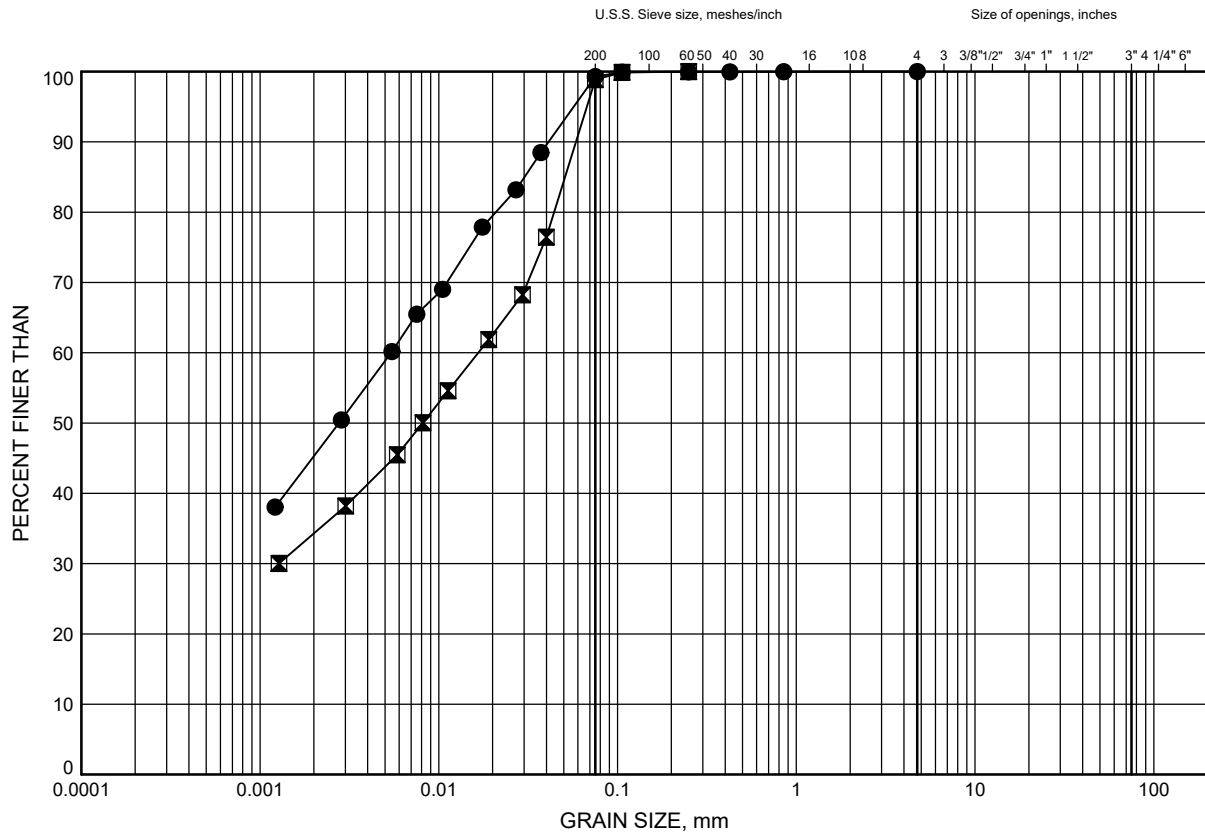


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Clayey Silt (Below Elevation 133 m)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-30	22.9	131.2
⊠	BRU19-33	15.5	131.4

Date February 2022

WP# 4068-09-00



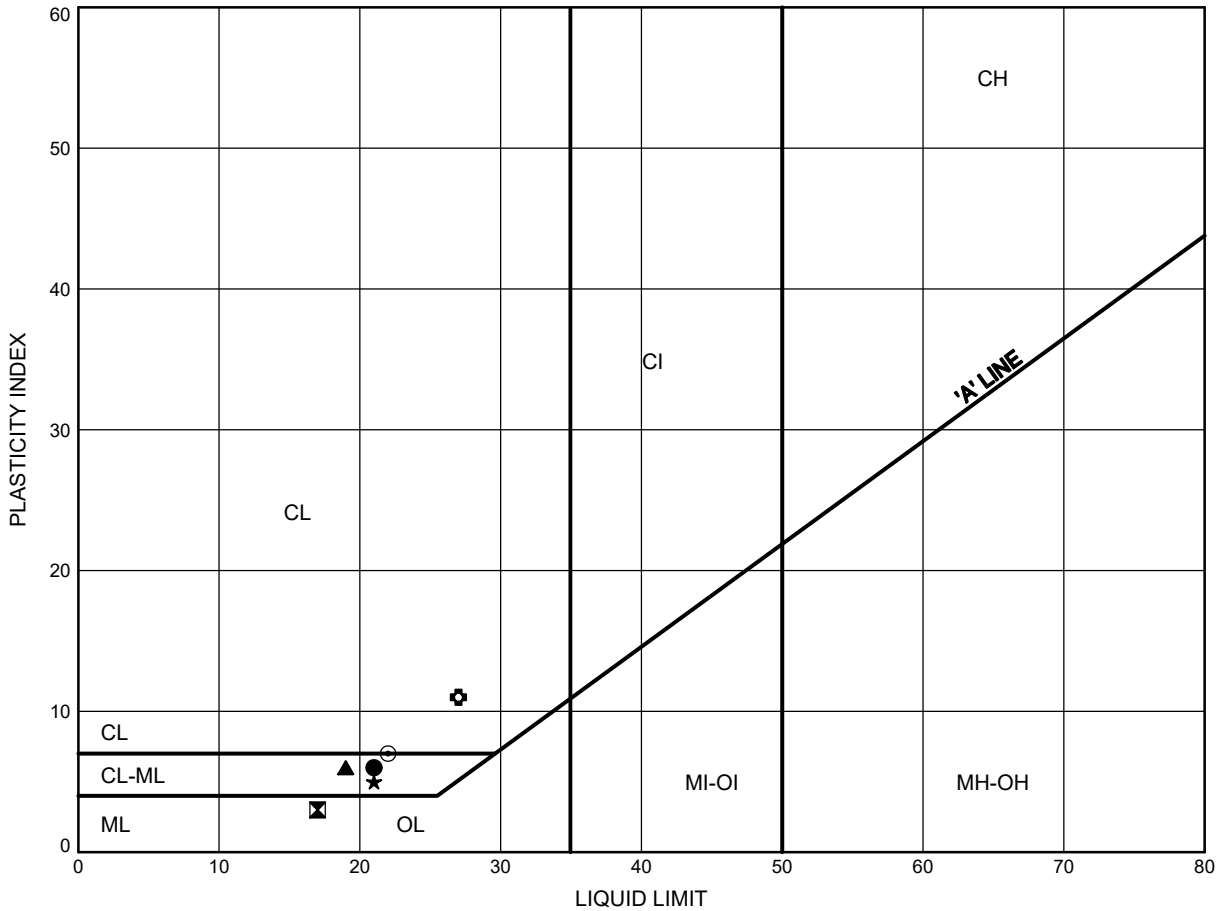
Prep'd MIK

Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C10.1

Clayey Silt (Below Elevation 133 m)



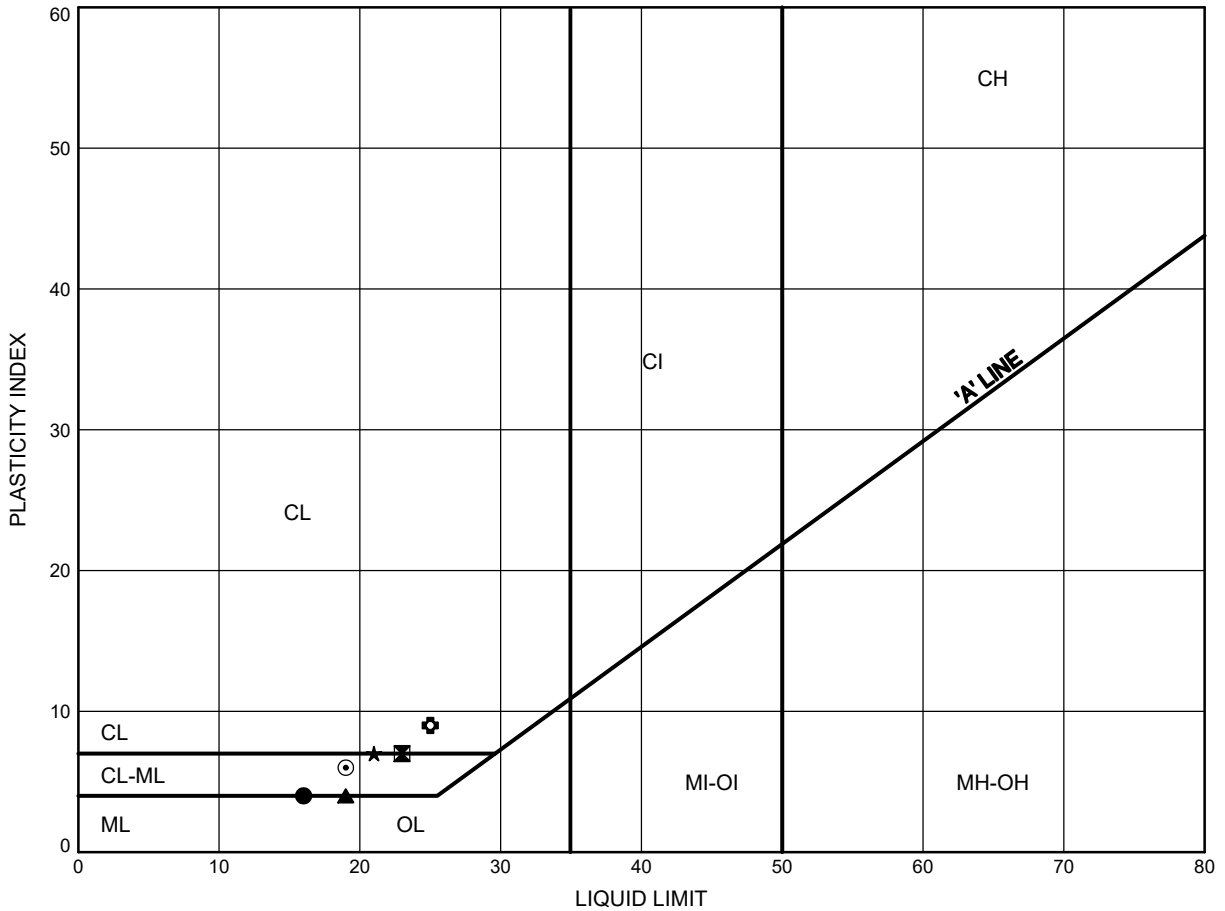
**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-02	30.8	119.3
⊠	BRU19-03	21.6	128.2
▲	BRU19-03	32.3	117.5
★	BRU19-04A	18.6	131.2
⊙	BRU19-04A	30.0	119.8
⊕	BRU19-06	20.1	128.4

Date February 2022  
 WP# 4068-09-00



Prep'd MIK  
 Chkd. MJK

**Clayey Silt (Below Elevation 133 m)****LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-06	22.3	126.2
☒	BRU19-09	17.1	129.8
▲	BRU19-13	24.1	128.4
★	BRU19-15	33.1	119.5
⊙	BRU19-16	27.7	123.8
⊕	BRU19-16	33.8	117.7

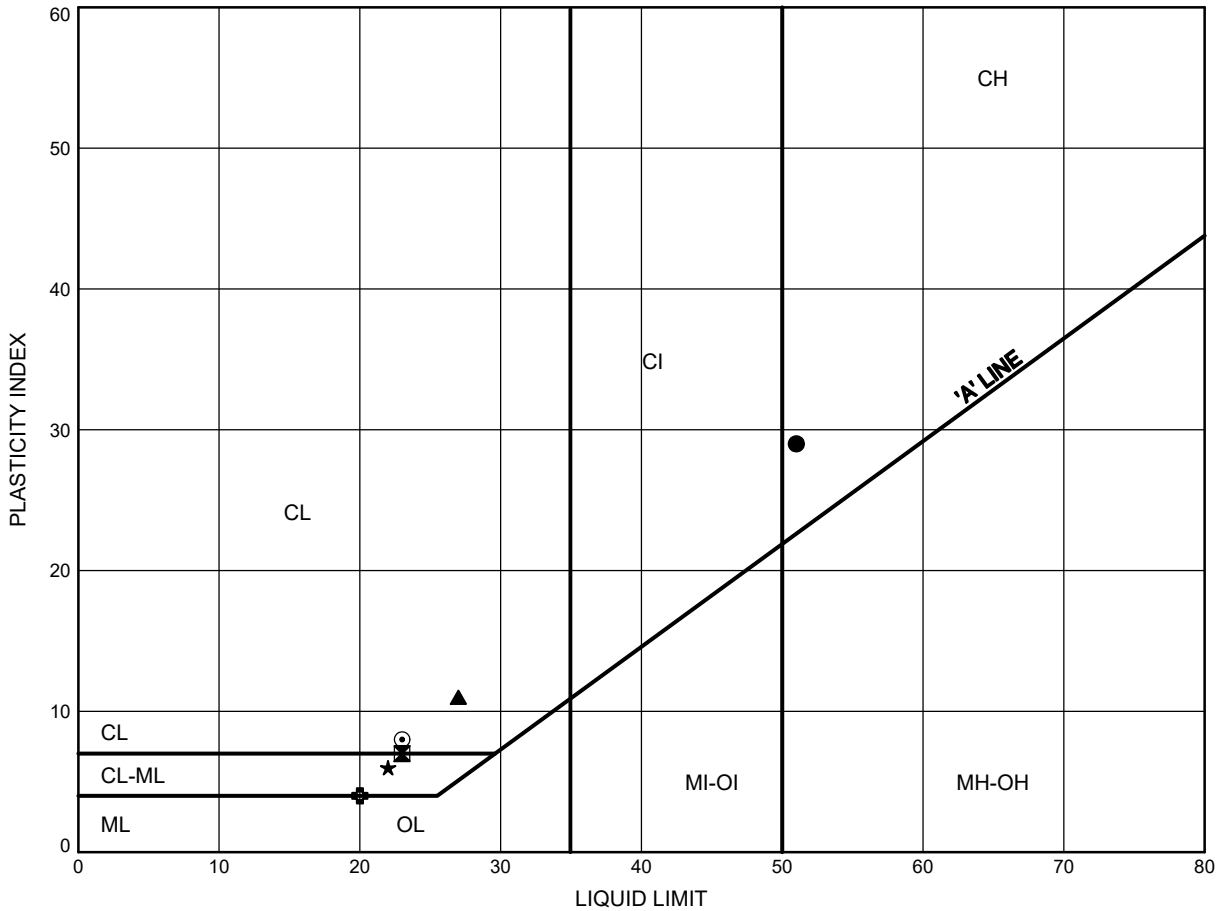
Date February 2022WP# 4068-09-00Prep'd MIKChkd. MJK



Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C10.3

Clayey Silt (Below Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-19	20.1	132.1
⊠	BRU19-19	24.7	127.5
▲	BRU19-19	35.4	116.8
★	BRU19-21	23.2	127.5
⊙	BRU19-21	32.3	118.4
⊕	BRU19-22	23.2	124.1

Date February 2022  
 WP# 4068-09-00

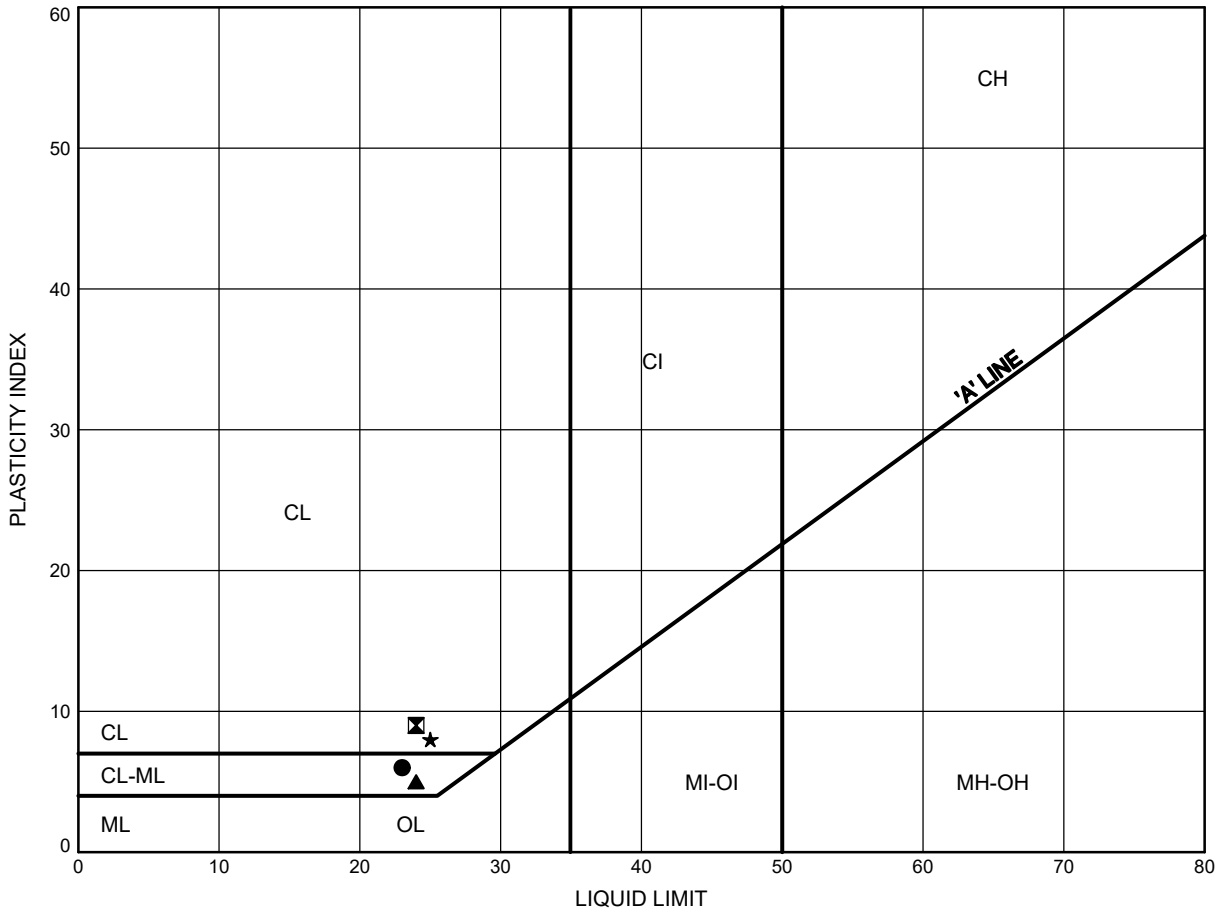


Prep'd MIK  
 Chkd. MJK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C10.4

Clayey Silt (Below Elevation 133 m)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-23	14.8	131.8
⊠	BRU19-23	23.9	122.7
▲	BRU19-30	22.9	131.2
★	BRU19-33	15.5	131.4

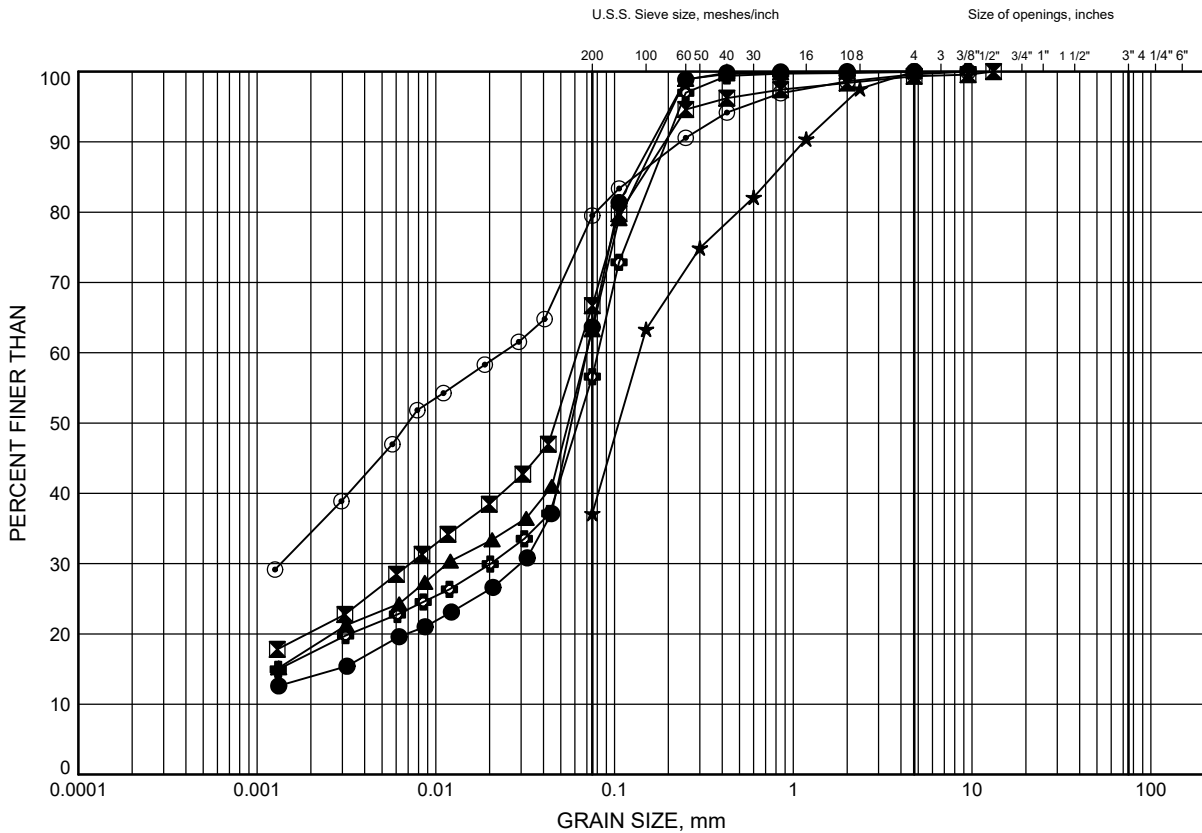
Date February 2022  
 WP# 4068-09-00



Prep'd MIK  
 Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Interlayered Silt, Sand, and Clayey Silt



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-01	36.9	114.3
⊠	BRU19-01	39.9	111.3
▲	BRU19-02	33.8	116.3
★	BRU19-03	38.4	111.4
⊙	BRU19-03	43.0	106.8
⊕	BRU19-04A	32.3	117.5

Date February 2022

WP# 4068-09-00

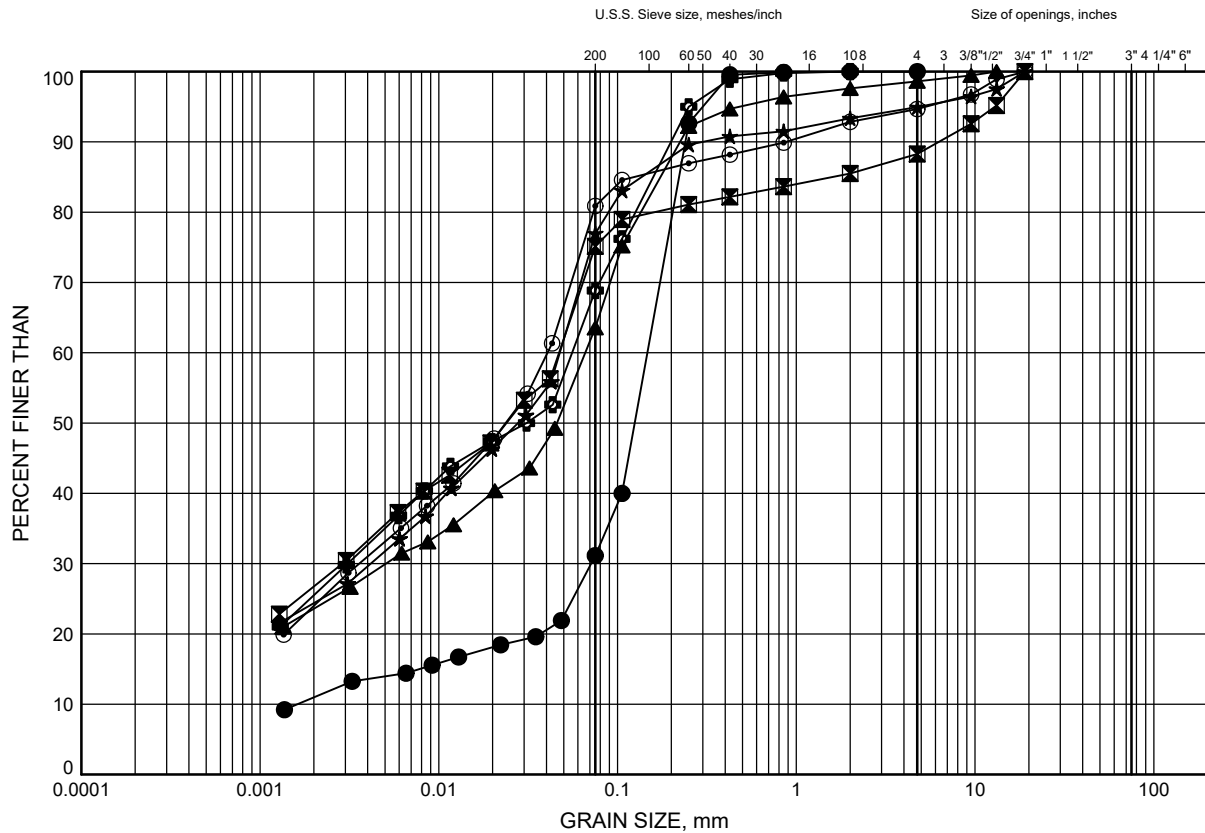


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Interlayered Silt, Sand, and Clayey Silt



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-07	26.4	121.7
⊠	BRU19-13	34.1	118.4
▲	BRU19-15	39.9	112.7
★	BRU19-16	39.9	111.6
⊙	BRU19-18	33.8	117.1
⊕	BRU19-19	38.4	113.8

Date February 2022

WP# 4068-09-00

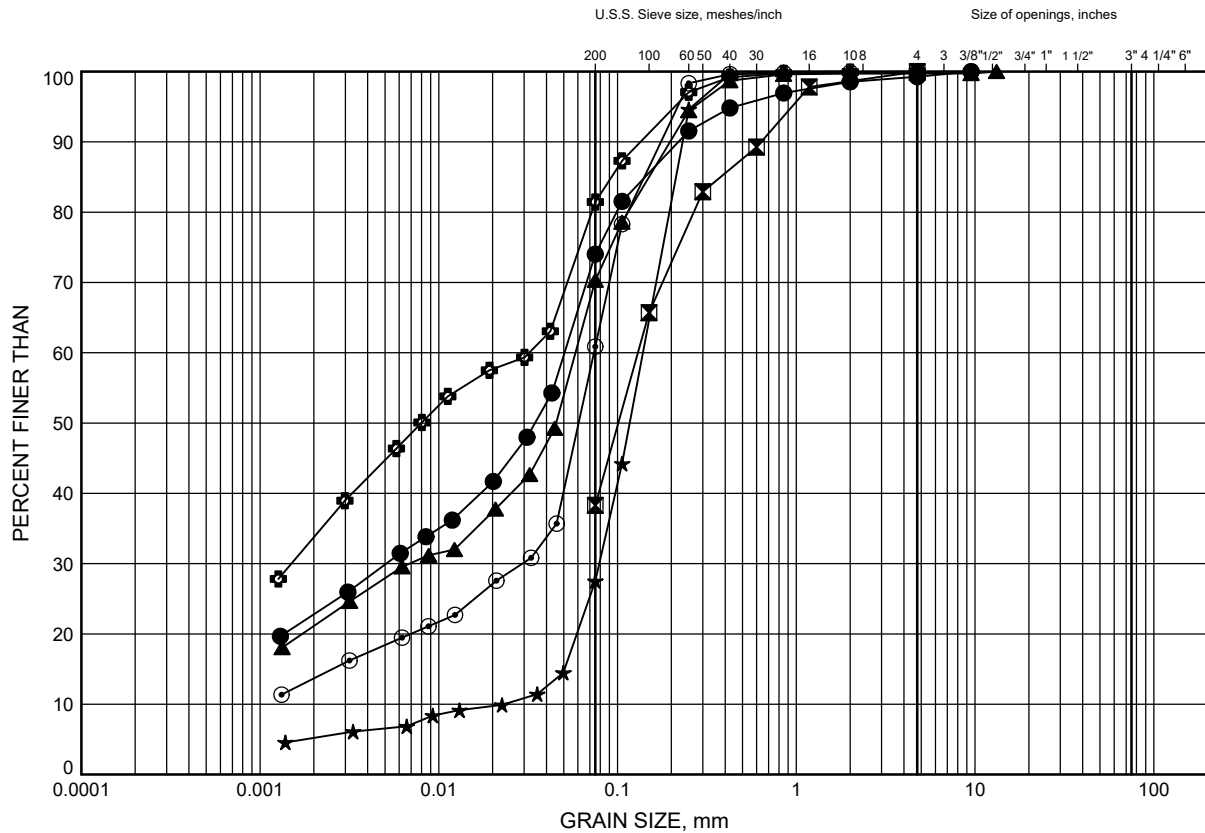


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Interlayered Silt, Sand, and Clayey Silt



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-21	38.4	112.3
⊠	BRU19-22	32.3	115.0
▲	BRU19-22	38.4	108.9
★	BRU19-23	29.3	117.3
⊙	BRU19-25	30.8	117.1
⊕	BRU19-25	39.9	108.0

Date February 2022

WP# 4068-09-00

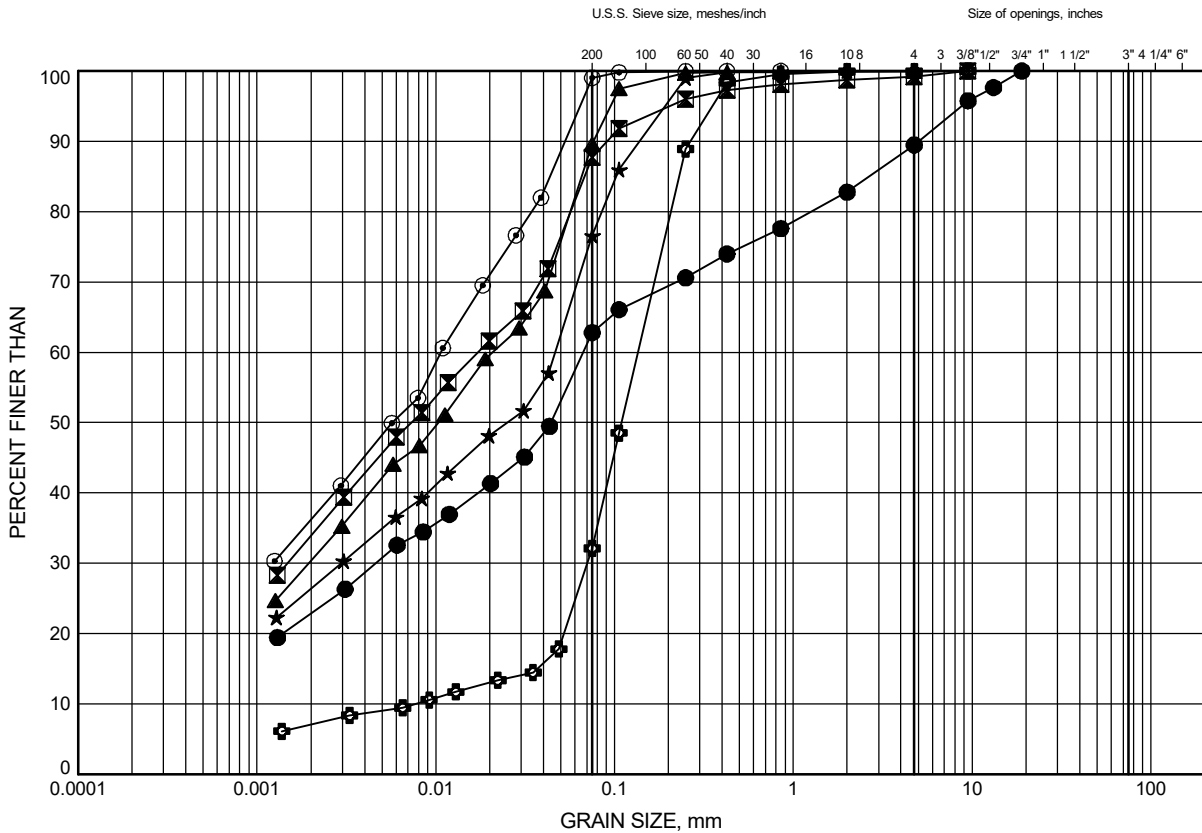


Prep'd MIK

Chkd. MJK

## GRAIN SIZE DISTRIBUTION

## Interlayered Silt, Sand, and Clayey Silt



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-27	18.8	135.8
⊠	BRU19-29	33.8	120.9
▲	BRU19-30	32.0	122.1
★	BRU19-31	29.0	120.9
⊙	BRU19-31	35.1	114.8
⊕	BRU19-33	27.0	119.9

Date June 2024

WP# 4068-09-00

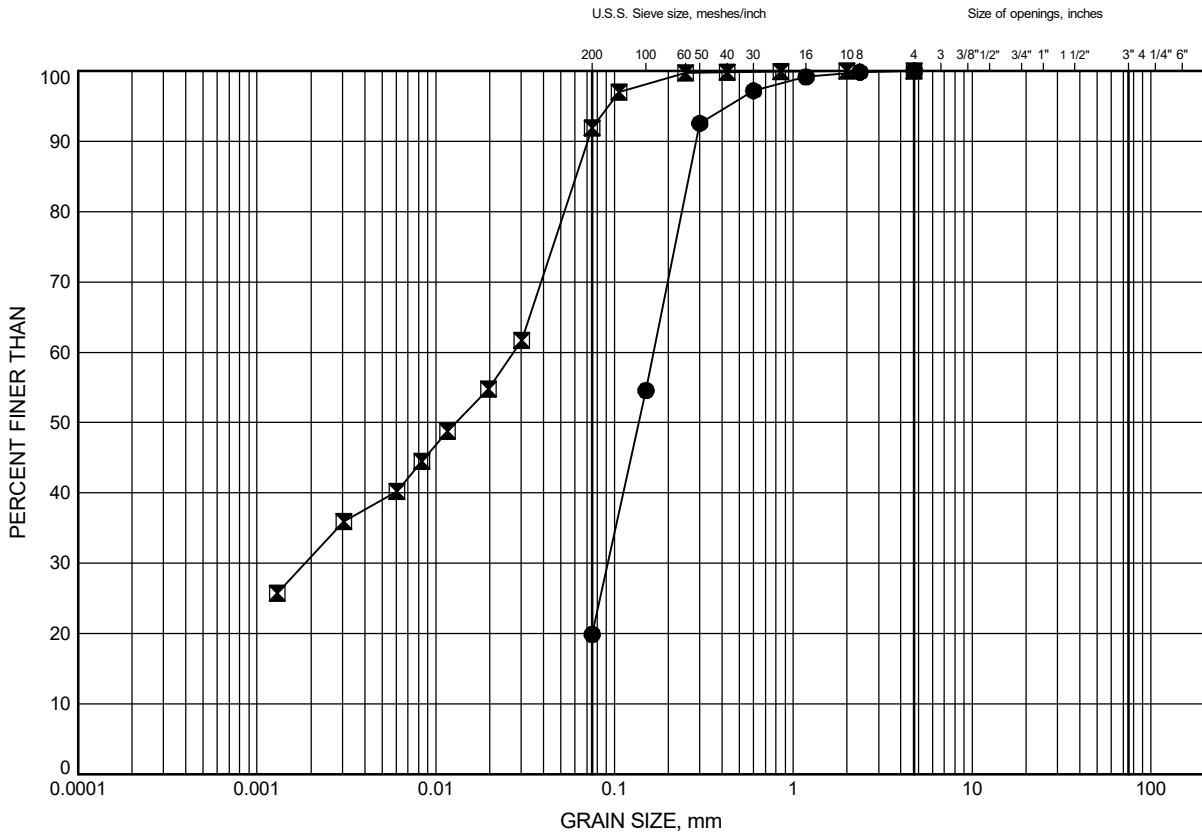


Prep'd RH

Chkd. MK

## GRAIN SIZE DISTRIBUTION

## Interlayered Silt, Sand, and Clayey Silt



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU23-3	4.9	146.6
⊠	BRU23-3	5.6	145.9

Date June 2024

WP# 4068-09-00



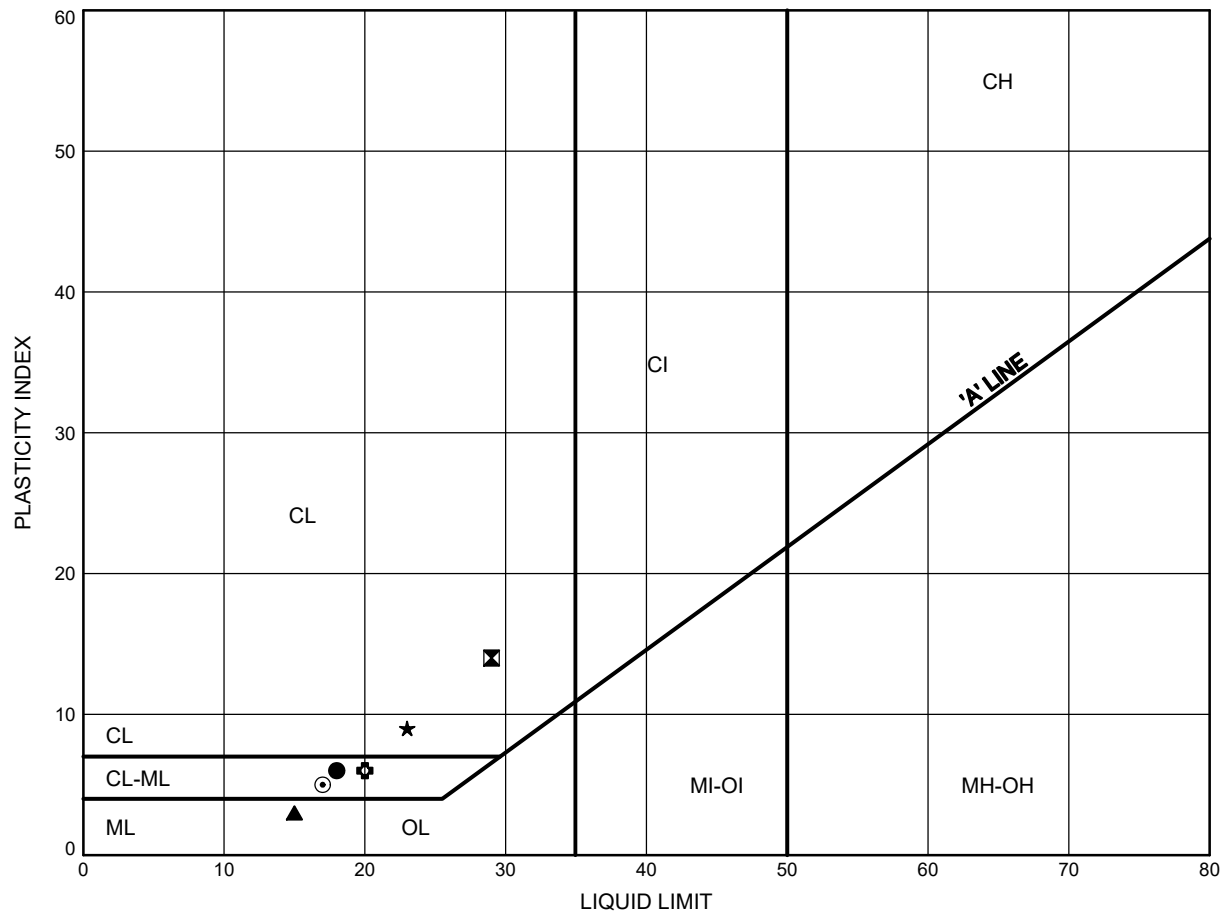
Prep'd RH

Chkd. MK

Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C12.1

Interlayered Silt, Sand, and Clayey Silt



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-01	39.9	111.3
⊠	BRU19-03	43.0	106.8
▲	BRU19-04A	32.3	117.5
★	BRU19-13	34.1	118.4
⊙	BRU19-15	39.9	112.7
⊕	BRU19-16	39.9	111.6

Date February 2022  
 WP# 4068-09-00



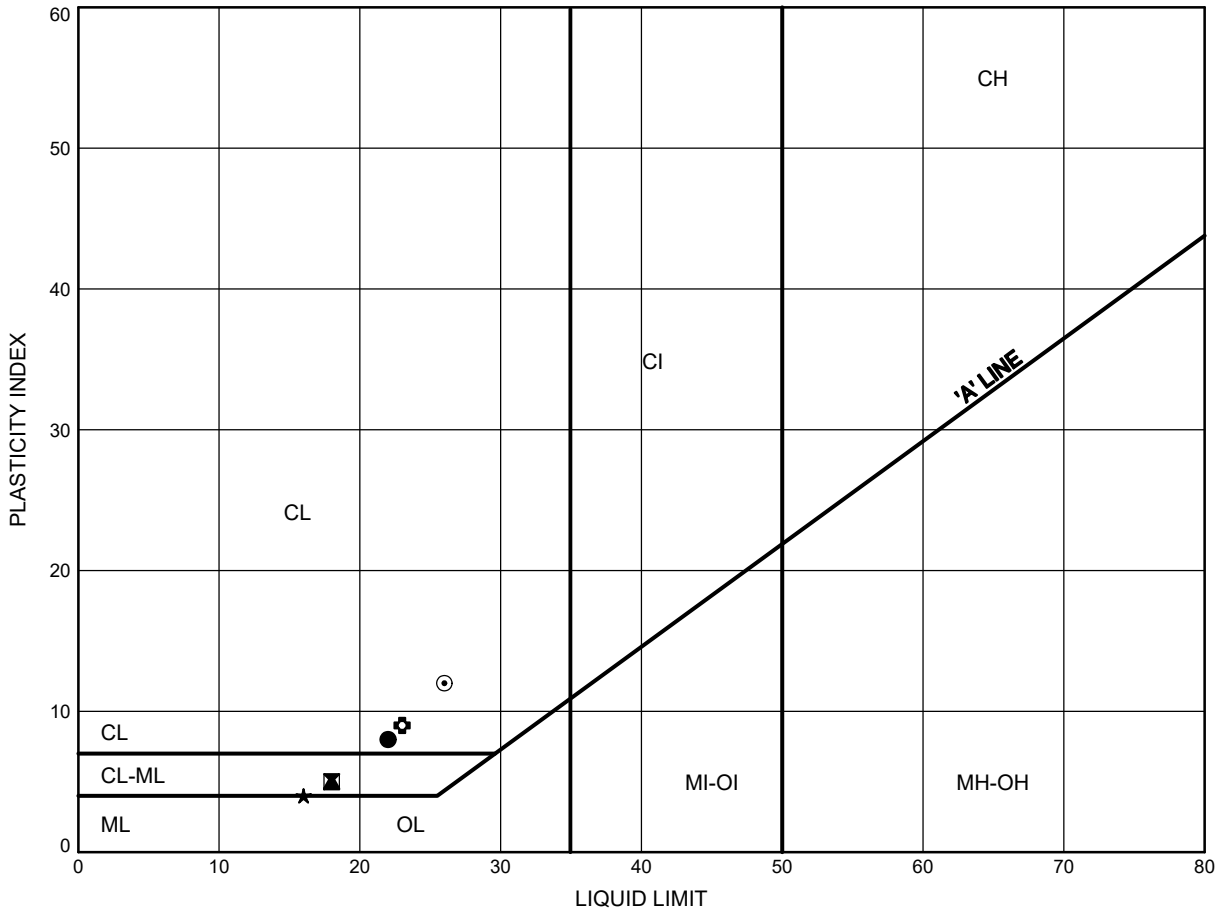
Prep'd MIK  
 Chkd. MJK



Hwy 17 Twinning, Bruce Street (County Road 20) Interchange  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C12.2

Interlayered Silt, Sand, and Clayey Silt



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-18	33.8	117.1
⊠	BRU19-19	38.4	113.8
▲	BRU19-21	38.4	112.3
★	BRU19-22	38.4	108.9
⊙	BRU19-25	39.9	108.0
⊕	BRU19-27	18.8	135.8

Date February 2022  
 WP# 4068-09-00

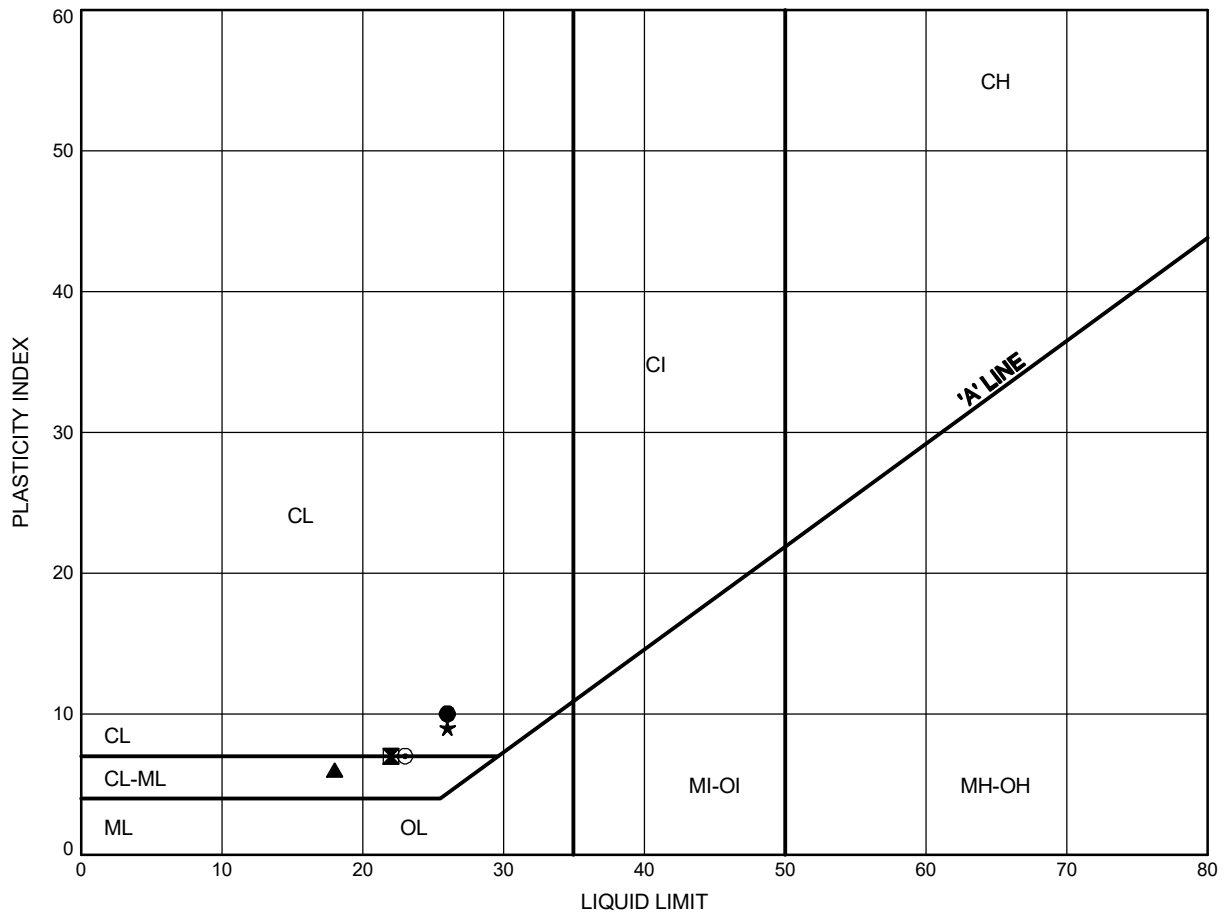


Prep'd MIK  
 Chkd. MJK

# Hwy 17 Twinning, Bruce Street (County Road 20) Interchange ATTERBERG LIMITS TEST RESULTS

FIGURE C12

Interlayered Silt, Sand, and Clayey Silt



## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-29	33.8	120.9
⊠	BRU19-30	32.0	122.1
▲	BRU19-31	29.0	120.9
★	BRU19-31	35.1	114.8
⊙	BRU23-3	5.6	145.9

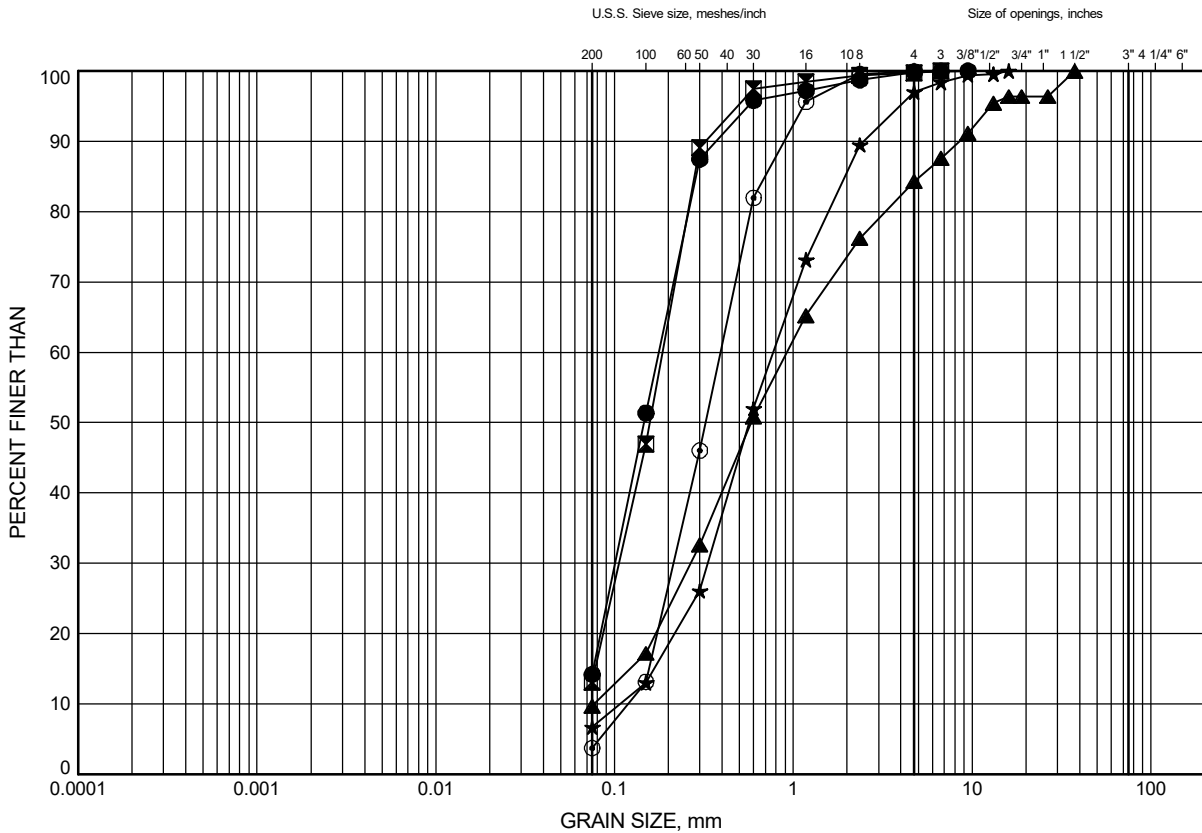
Date June 2024  
WP# 4068-09-00



Prep'd RH  
Chkd. MK

## GRAIN SIZE DISTRIBUTION

## Dense Sand



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-26	17.1	132.6
⊠	BRU23-1	12.5	142.4
▲	BRU23-2	4.9	149.0
★	BRU23-2	7.9	146.0
⊙	BRU23-2	14.0	139.9

Date June 2024

WP# 4068-09-00

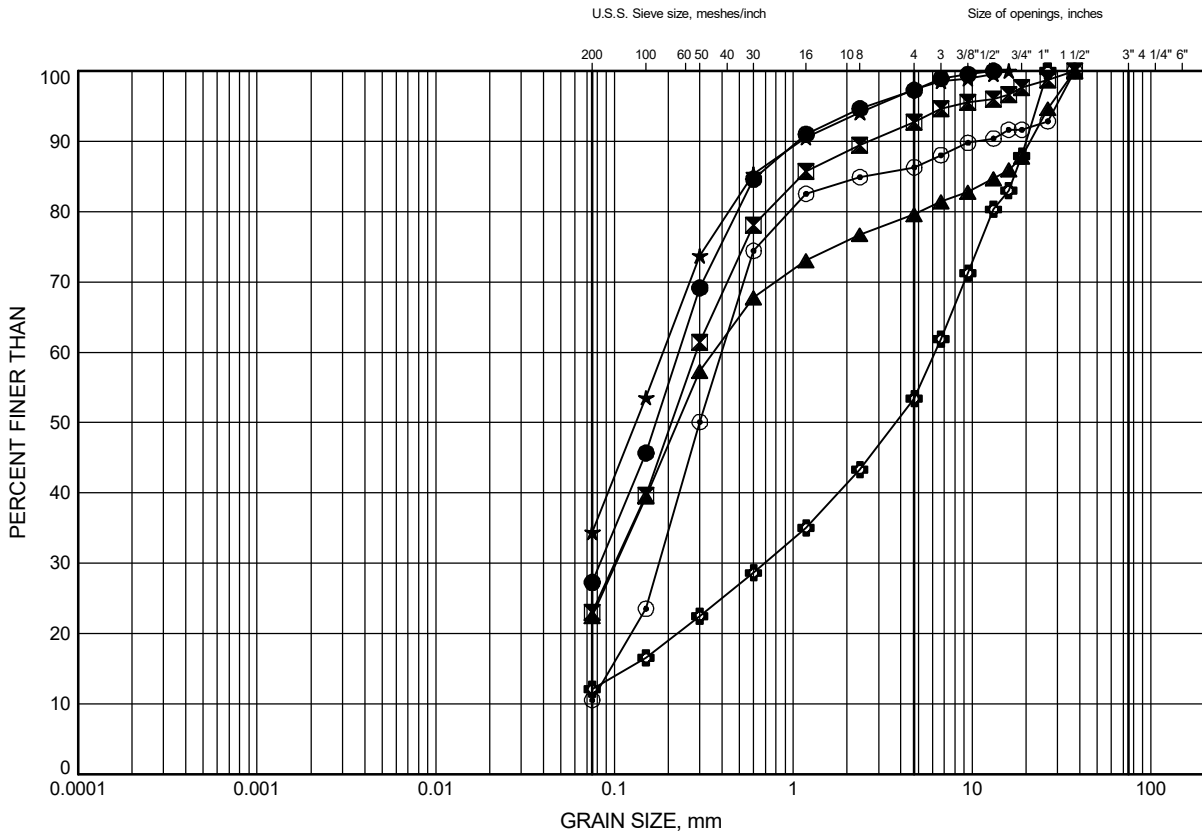


Prep'd RH

Chkd. MK

## GRAIN SIZE DISTRIBUTION

## Till Silty Sand and Gravel



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-01	44.3	106.9
⊠	BRU19-02	44.1	106.0
▲	BRU19-02	48.1	102.0
★	BRU19-03	48.9	100.9
⊙	BRU19-09	24.1	122.8
⊕	BRU19-10	10.7	135.5

Date June 2024

WP# 4068-09-00

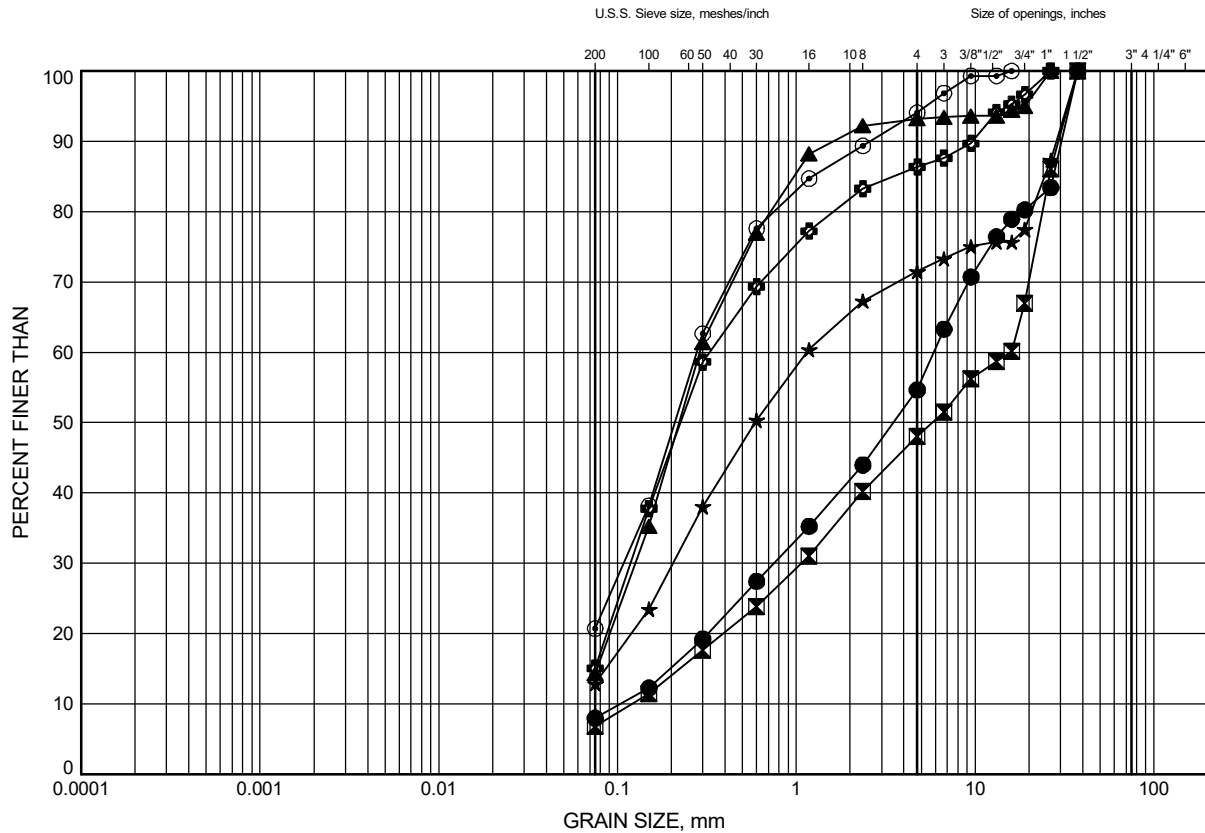


Prep'd RH

Chkd. MK

## GRAIN SIZE DISTRIBUTION

## Till Silty Sand and Gravel



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BRU19-13	36.3	116.2
⊠	BRU19-19	39.9	112.3
▲	BRU19-28	30.8	124.2
★	BRU19-29	35.4	119.3
⊙	BRU19-33	33.4	113.5
⊕	BRU23-4	4.1	145.0

Date June 2024

WP# 4068-09-00



Prep'd RH

Chkd. MK



## **Appendix C.2**

### **One-Dimensional Consolidation Test Results (Standard)**

## Consolidation Test Report

CLIENT: **Thurber Engineering (Ottawa)**

FILE NUMBER: **24726**

PROJECT: **Highway 17 Twinning - Renfrew**

REPORT DATE: **August 10, 2020**

TEST DATES: **April 01, 2020 - April 13, 2020**

SAMPLE: **BRU 19-1 ST10 35'-37'**  
**Clay, silty, trace sand, grey, moist.**  
**LL = 34.5, PL = 22.0, I<sub>p</sub> = 12.5**

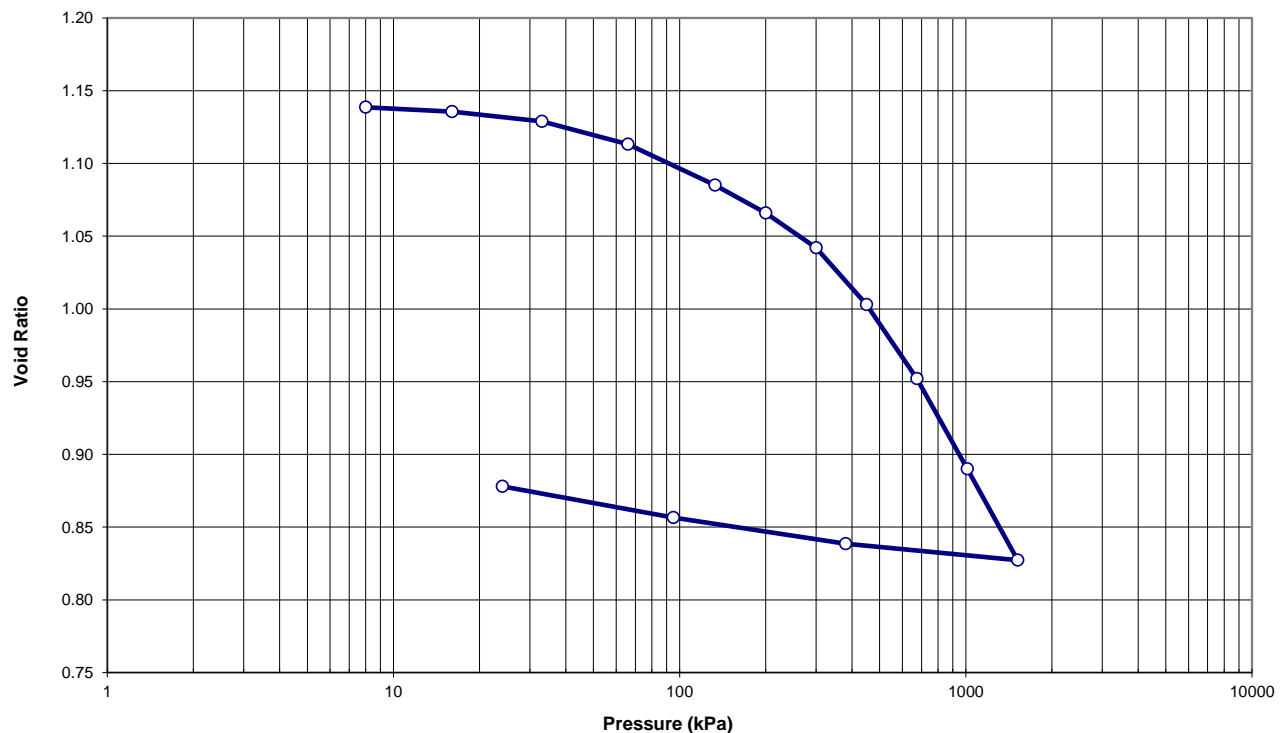
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-11, method B

	<u>Start of Test</u>	<u>End of Test</u>
Sample Height (mm)	25.40	22.32
Wet Dens. (kg/m <sup>3</sup> )	1778.5	1954.1
Dry Dens. (kg/m <sup>3</sup> )	1311.9	1493.0
Moisture Cont. (%)	35.6	30.9
Void Ratio	1.137	0.878
Saturation (%)	87.7	98.7

Note: A Specific Gravity (G<sub>s</sub>) of 2.803 was obtained for the void ratio and saturation calculations.

**Void Ratio vs. Pressure**

Project #: 24726  
 Client: Thurber Engineering (Ottawa)  
 Project Name: Highway 17 Twinning - Renfrew  
 Sample: BRU 19-1 ST10 35'-37'



## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-1 ST10 35'-37'

**TRIMMING:** The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer. The average moisture content of the trimmings was 34.5%.

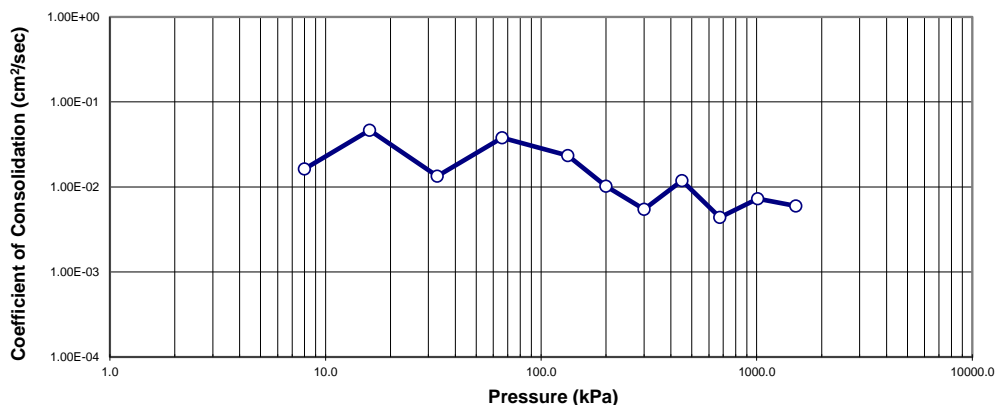
**LOADING:** A seating load of 8 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached at each load increment.

**CALCULATIONS:** Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	D <sub>90</sub> (mm)	t <sub>90</sub> (min)	c <sub>v</sub> (cm <sup>2</sup> /s)	Void Ratio	m <sub>v</sub> (m <sup>2</sup> /kN)	k (cm/s)
0.0	25.400					1.137		
8.0	25.419	25.409	-0.007	1.40	1.62E-02	1.139	-9.21E-05	-1.47E-07
16.0	25.383	25.401	-0.024	0.49	4.65E-02	1.136	1.78E-04	8.11E-07
33.0	25.305	25.344	-0.058	1.69	1.34E-02	1.129	1.80E-04	2.37E-07
66.0	25.118	25.212	-0.115	0.59	3.79E-02	1.113	2.23E-04	8.30E-07
133.0	24.783	24.951	-0.237	0.94	2.34E-02	1.085	1.99E-04	4.57E-07
200.0	24.556	24.669	-0.132	2.10	1.02E-02	1.066	1.37E-04	1.37E-07
300.0	24.271	24.413	-0.160	3.84	5.48E-03	1.042	1.16E-04	6.23E-08
450.0	23.806	24.038	-0.210	1.72	1.19E-02	1.003	1.28E-04	1.49E-07
675.0	23.202	23.504	-0.306	4.45	4.38E-03	0.952	1.13E-04	4.84E-08
1012.0	22.463	22.833	-0.310	2.53	7.29E-03	0.890	9.45E-05	6.75E-08
1518.0	21.718	22.090	-0.350	2.89	5.97E-03	0.827	6.56E-05	3.84E-08
380.0	21.852	21.785				0.839		
95.0	22.066	21.959				0.857		
24.0	22.320	22.193				0.878		

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-1 ST10 35'-37'

**Coefficient of Consolidation vs. Pressure**



Note: C<sub>v</sub> and k calculated using t<sub>90</sub> values (square root of time method)



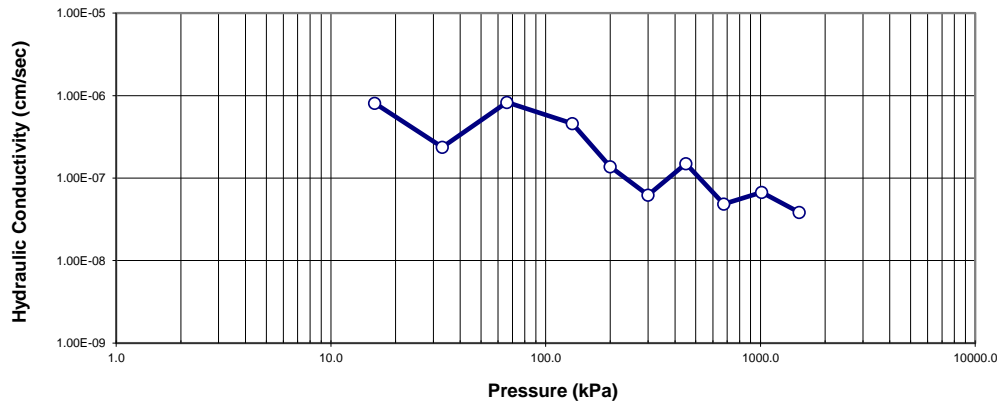
## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-1 ST10 35'-37'

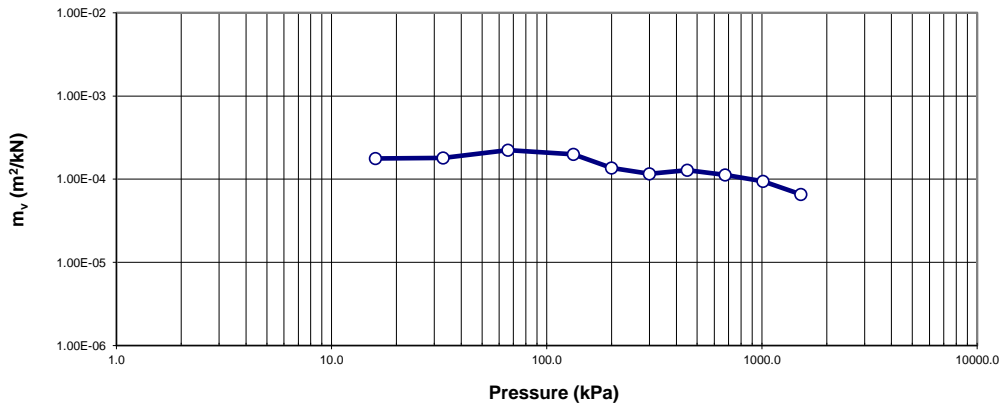
**Hydraulic Conductivity vs. Pressure**

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-1 ST10 35'-37'



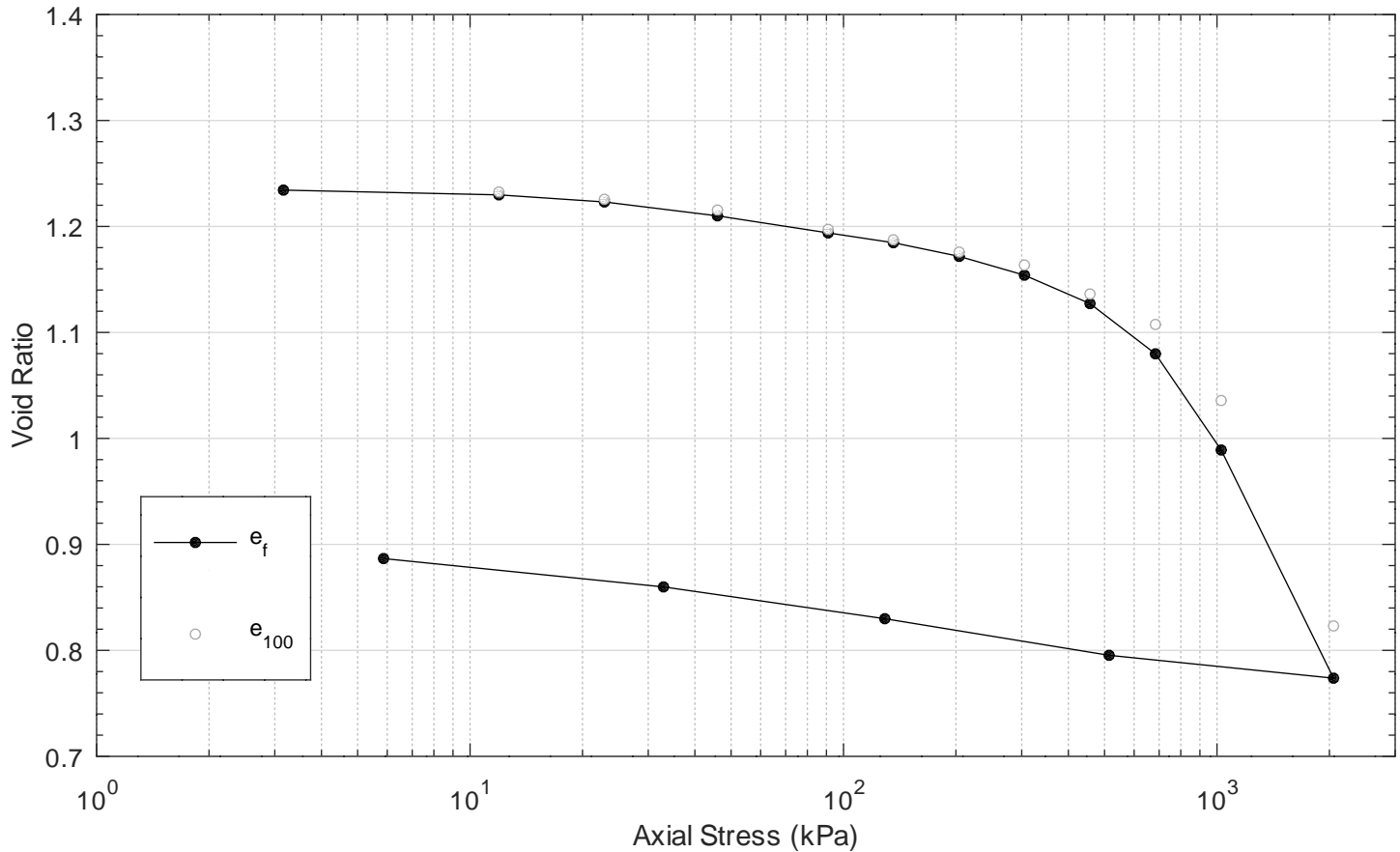
**$m_v$  vs. Pressure**

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-1 ST10 35'-37'





Project: 24726  
 Highway 17, Bruce Street  
 Borehole: BRU19-1-2  
 Sample: ST1  
 Depth: 4.9m  
 Client: Ontario Ministry of Transportation



Start of Test		2020-12-29	
Diameter of Sample	cm	D	6.349
Height of Sample	cm	$H_o$	2.537
Height of Solids	cm	$H_s$	1.136
Water Content	%	$w_o$	43.73
Dry Density	$g/cm^3$	$\rho_d$	1.23
Moist Unit Weight	$kN/m^3$	$\gamma$	17.3
Void Ratio	-	$e_o$	1.234
Degree of Saturation	-	$S_{ro}$	0.97
Specific Gravity	-	$G_s$	2.750
End of Test		2021-01-14	
Height of Sample	cm	$H_f$	2.143
Water Content	%	$w_f$	34.13
Void Ratio	-	$e_f$	0.887

TRIMMING: the specimen was manually trimmed to the size of the consolidation ring, then mounted in a fixed ring consolidometer

LOADING: the consolidometer was flooded with water with the seating load adjusted to limit swelling

CALCULATIONS: coefficients of consolidation were calculated by the square root time method

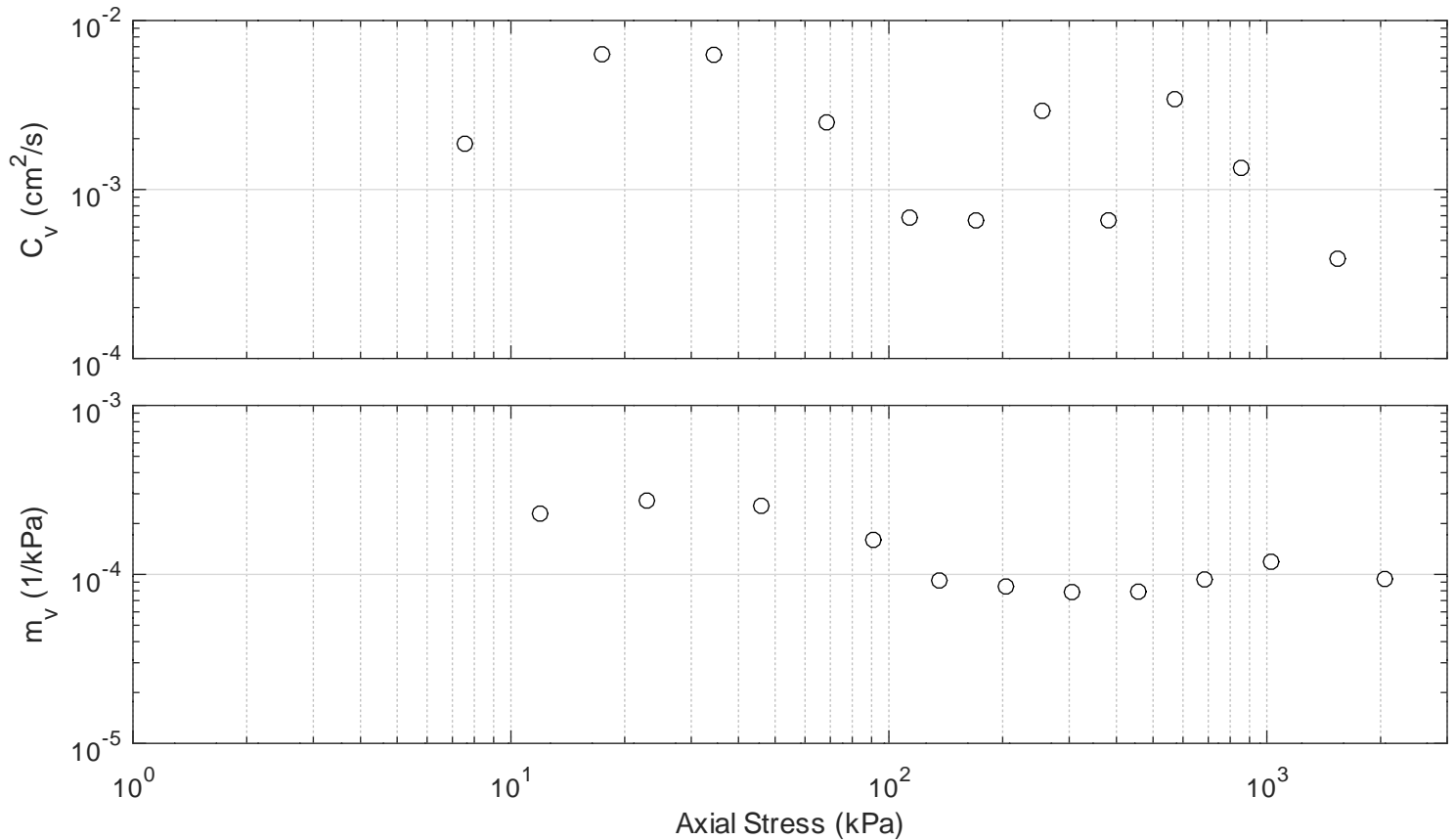
#### Interpreted Results

Recompression Index (reloading)	-	$C_r$	0.053
Compression Index	-	$C_c$	0.715
Recompression Index (unloading)	-	$C_r$	0.054
Preconsolidation Pressure	kPa	$p'_c$	666

Check: SP Review: PKC



Project: 24726  
 Highway 17, Bruce Street  
 Borehole: BRU19-1-2  
 Sample: ST1  
 Depth: 4.9m  
 Client: Ontario Ministry of Transportation



Load No.	Axial Stress	Load Duration	System Deflec.	Dial	Sample Height	Axial Strain	Void Ratio	Time U(0.99)	$C_v$	$k_v$	$C_{\alpha\epsilon}$
	kPa	min	mm	mm	cm	%	-	min	cm <sup>2</sup> /s	cm/s	-
0				10.000	2.537	0.00	1.234				
1	3.2	1440.2	0.011	9.997	2.538	-0.03	1.234				
2	11.9	1440.2	0.065	9.892	2.533	0.17	1.230	25.4	1.87e-03	4.19e-08	0.0007
3	22.9	1440.2	0.096	9.785	2.525	0.47	1.223	7.5	6.31e-03	1.69e-07	0.0005
4	46.0	1440.1	0.153	9.580	2.510	1.06	1.210	7.4	6.27e-03	1.57e-07	0.0012
5	91.0	1440.2	0.197	9.354	2.492	1.78	1.194	18.2	2.50e-03	3.92e-08	0.0008
6	136.0	1440.3	0.249	9.198	2.481	2.19	1.185	65.6	6.82e-04	6.16e-09	0.0011
7	204.0	1440.5	0.285	9.016	2.467	2.77	1.172	67.4	6.56e-04	5.46e-09	0.0017
8	305.0	1440.0	0.342	8.757	2.447	3.56	1.154	14.9	2.92e-03	2.25e-08	0.0022
9	457.1	1440.2	0.388	8.407	2.416	4.76	1.127	63.6	6.57e-04	5.09e-09	0.0034
10	684.2	1440.4	0.455	7.801	2.362	6.89	1.080	11.5	3.43e-03	3.14e-08	0.0064
11	1026.3	1440.1	0.521	6.704	2.259	10.95	0.989	24.8	1.34e-03	1.56e-08	0.0134
12	2051.7	1440.4	0.630	4.150	2.015	20.59	0.774	34.8	3.89e-04	3.59e-09	0.0146
13	514.2	1440.5	0.511	4.515	2.039	19.62	0.795				
14	129.0	1440.1	0.389	5.029	2.078	18.08	0.830				
15	33.0	1440.0	0.304	5.455	2.113	16.73	0.860				
16	5.9	1440.0	0.230	5.833	2.143	15.53	0.887				



**Stantec**

**Stantec Consulting Ltd**  
2781 Lancaster Rd, Suite 100 A&B  
Ottawa, ON K1B 1A7  
Tel: (613) 738-6075  
Fax: (613) 722-2799

---

January 22, 2021  
File: 122410864

**Attention:**      **Thurber Engineering, File #24726**

**Reference:**      **Thurber File #24726.200a.202, LS-705 Specific Gravity**

The following table summarizes two Specific Gravity results for Bruce Street.

Source	Depth (m)	Specific Gravity
BRU19-1.2 ST1	4.9	2.750
BRU19-1.2 ST5	17.7	2.755

Sincerely,

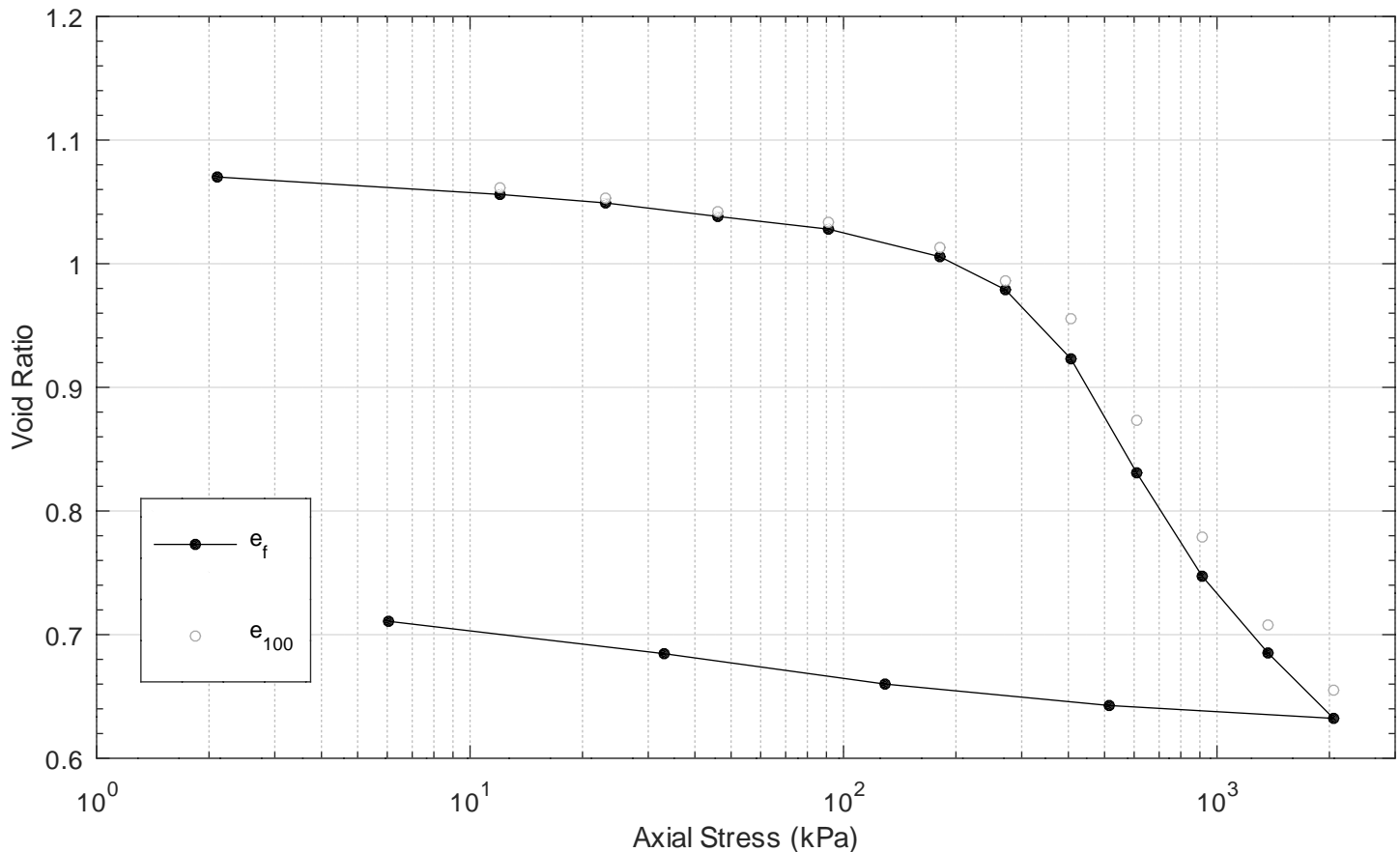
**Stantec Consulting Ltd**

*Brian Prevost*

Brian Prevost  
Laboratory Supervisor  
Tel: 613-738-6075  
Fax: 613-722-2799  
[brian.prevost@stantec.com](mailto:brian.prevost@stantec.com)



Project: 24726  
 Highway 17, Bruce Street  
 Borehole: BRU19-1-2  
 Sample: ST5  
 Depth: 17.7m  
 Client: Ontario Ministry of Transportation



Start of Test		2020-12-29	
Diameter of Sample	cm	D	6.347
Height of Sample	cm	H <sub>o</sub>	2.535
Height of Solids	cm	H <sub>s</sub>	1.225
Water Content	%	w <sub>o</sub>	38.37
Dry Density	g/cm <sup>3</sup>	ρ <sub>d</sub>	1.33
Moist Unit Weight	kN/m <sup>3</sup>	γ	18.1
Void Ratio	-	e <sub>o</sub>	1.069
Degree of Saturation	-	S <sub>ro</sub>	0.99
Specific Gravity	-	G <sub>s</sub>	2.755
End of Test		2021-01-14	
Height of Sample	cm	H <sub>f</sub>	2.096
Water Content	%	w <sub>f</sub>	26.54
Void Ratio	-	e <sub>f</sub>	0.711

TRIMMING: the specimen was manually trimmed to the size of the consolidation ring, then mounted in a fixed ring consolidometer

LOADING: the consolidometer was flooded with water with the seating load adjusted to limit swelling

CALCULATIONS: coefficients of consolidation were calculated by the square root time method

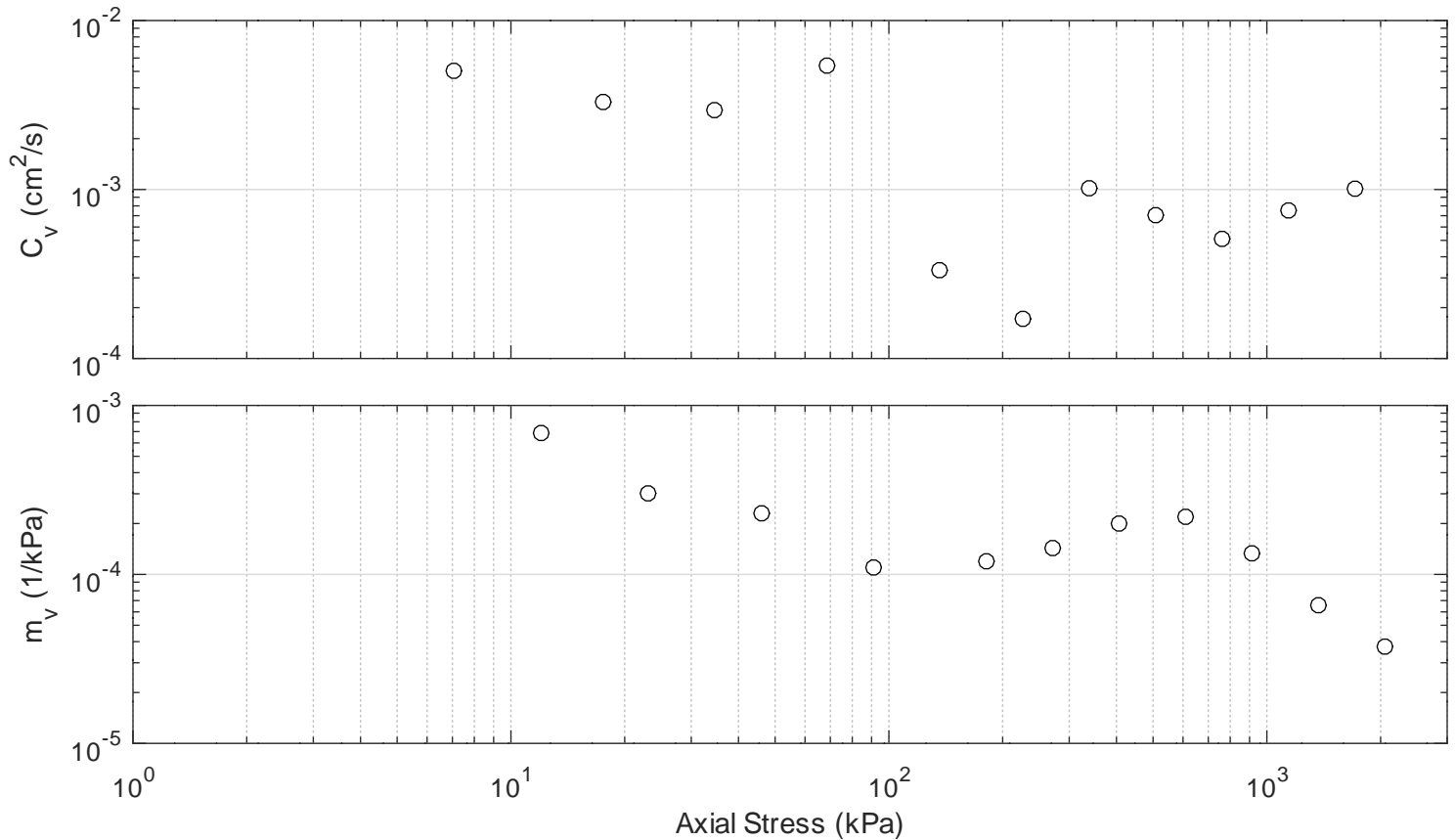
#### Interpreted Results

Recompression Index (reloading)	-	C <sub>r</sub>	0.036
Compression Index	-	C <sub>c</sub>	0.500
Recompression Index (unloading)	-	C <sub>r</sub>	0.035
Preconsolidation Pressure	kPa	p' <sub>c</sub>	282

Check: SP Review: PKC



Project: 24726  
 Highway 17, Bruce Street  
 Borehole: BRU19-1-2  
 Sample: ST5  
 Depth: 17.7m  
 Client: Ontario Ministry of Transportation



Load No.	Axial Stress	Load Duration	System Deflec.	Dial	Sample Height	Axial Strain	Void Ratio	Time U(0.99)	$C_v$	$k_v$	$C_{\alpha\epsilon}$
	kPa	min	mm	mm	cm	%	-	min	cm <sup>2</sup> /s	cm/s	-
0				10.000	2.535	0.00	1.069				
1	2.1	1440.5	0.005	10.003	2.536	-0.03	1.070				
2	12.0	1440.0	0.031	9.805	2.519	0.65	1.056	9.3	5.04e-03	3.40e-07	0.0013
3	23.1	1440.0	0.093	9.658	2.510	0.98	1.049	14.1	3.30e-03	9.75e-08	0.0010
4	46.1	1440.4	0.152	9.467	2.497	1.51	1.038	15.5	2.95e-03	6.65e-08	0.0009
5	91.1	1440.3	0.218	9.275	2.484	2.00	1.028	8.3	5.41e-03	5.83e-08	0.0013
6	181.2	1440.2	0.318	8.902	2.457	3.08	1.006	130.4	3.33e-04	3.91e-09	0.0044
7	271.3	1440.4	0.368	8.525	2.424	4.37	0.979	237.7	1.72e-04	2.41e-09	0.0051
8	406.4	1440.2	0.440	7.768	2.356	7.07	0.923	37.9	1.02e-03	2.00e-08	0.0111
9	609.6	1440.1	0.503	6.576	2.243	11.53	0.831	44.7	7.05e-04	1.52e-08	0.0149
10	913.0	1440.2	0.594	5.461	2.140	15.57	0.747	53.8	5.10e-04	6.67e-09	0.0118
11	1369.3	1440.0	0.671	4.623	2.064	18.57	0.685	35.8	7.52e-04	4.85e-09	0.0081
12	2052.9	1440.0	0.801	3.845	2.000	21.12	0.632	26.1	1.01e-03	3.71e-09	0.0075
13	514.5	1440.2	0.595	4.178	2.012	20.62	0.643				
14	129.2	1440.0	0.473	4.512	2.034	19.78	0.660				
15	33.1	1440.1	0.353	4.932	2.064	18.60	0.685				
16	6.0	1440.1	0.251	5.357	2.096	17.33	0.711				



**Stantec**

**Stantec Consulting Ltd**  
2781 Lancaster Rd, Suite 100 A&B  
Ottawa, ON K1B 1A7  
Tel: (613) 738-6075  
Fax: (613) 722-2799

---

January 22, 2021  
File: 122410864

**Attention:**      **Thurber Engineering, File #24726**

**Reference:**      **Thurber File #24726.200a.202, LS-705 Specific Gravity**

The following table summarizes two Specific Gravity results for Bruce Street.

Source	Depth (m)	Specific Gravity
BRU19-1.2 ST1	4.9	2.750
BRU19-1.2 ST5	17.7	2.755

Sincerely,

**Stantec Consulting Ltd**

*Brian Prevost*

Brian Prevost  
Laboratory Supervisor  
Tel: 613-738-6075  
Fax: 613-722-2799  
[brian.prevost@stantec.com](mailto:brian.prevost@stantec.com)

## Consolidation Test Report

CLIENT: **Thurber Engineering (Ottawa)**

FILE NUMBER: **24726**

PROJECT: **Highway 17 Twinning - Renfrew**

REPORT DATE: **August 10, 2020**

TEST DATES: **April 02, 2020 - April 14, 2020**

SAMPLE: **BRU 19-3 ST14 45'-47'**  
**Clay, silty, trace sand, grey, moist.**  
**LL = 38.9, PL = 24.8, I<sub>p</sub> = 14.1**

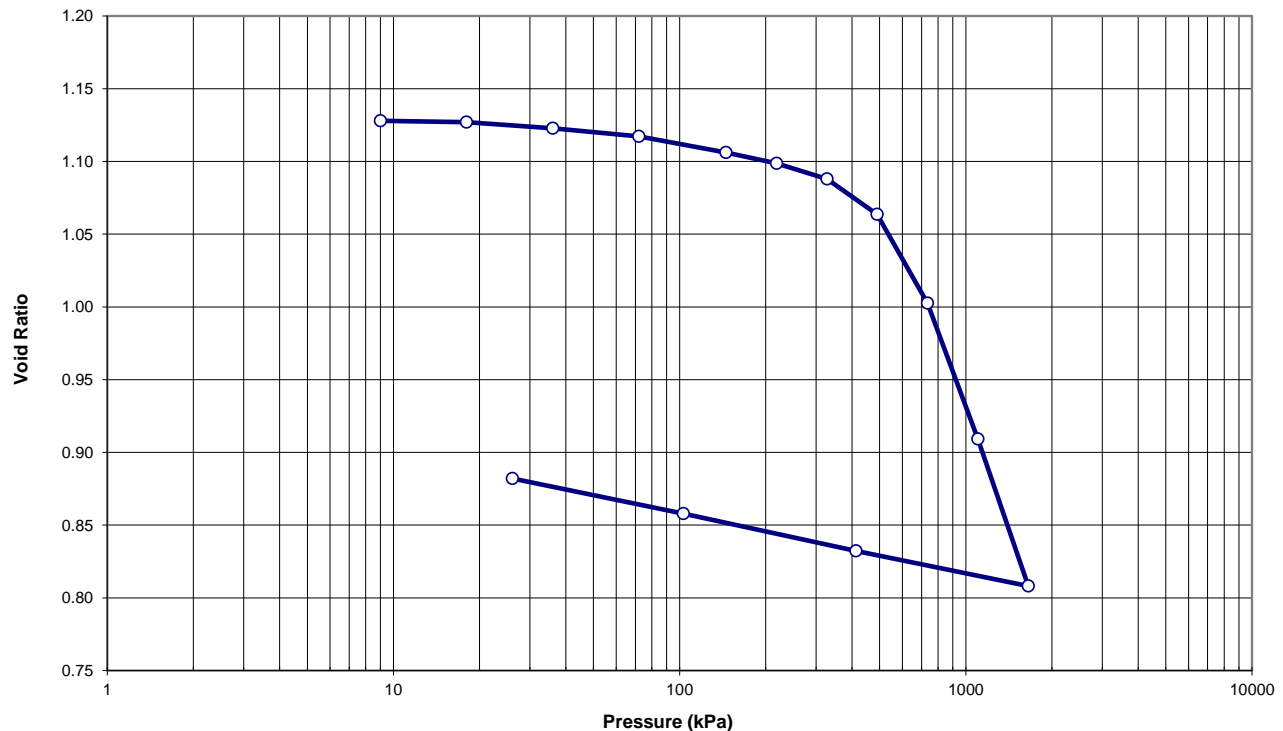
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-11, method B

	<u>Start of Test</u>	<u>End of Test</u>
Sample Height (mm)	25.40	22.46
Wet Dens. (kg/m <sup>3</sup> )	1784.1	1933.5
Dry Dens. (kg/m <sup>3</sup> )	1309.0	1480.2
Moisture Cont. (%)	36.3	30.6
Void Ratio	1.128	0.882
Saturation (%)	89.6	96.8

Note: A Specific Gravity (G<sub>s</sub>) of 2.785 was obtained for the void ratio and saturation calculations.

**Void Ratio vs. Pressure**

Project #: 24726  
 Client: Thurber Engineering (Ottawa)  
 Project Name: Highway 17 Twinning - Renfrew  
 Sample: BRU 19-3 ST14 45'-47'





## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-3 ST14 45'-47'

**TRIMMING:** The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer. The average moisture content of the trimmings was 36.1%.

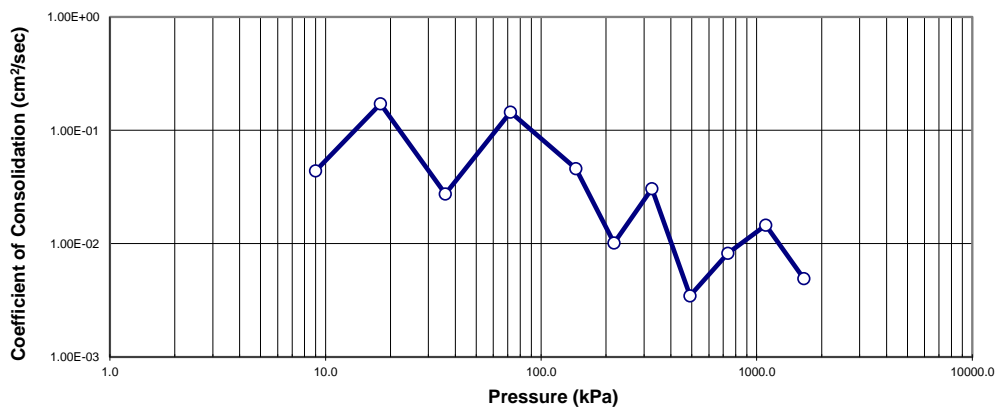
**LOADING:** A seating load of 9 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached at each load increment.

**CALCULATIONS:** Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	D <sub>90</sub> (mm)	t <sub>90</sub> (min)	c <sub>v</sub> (cm <sup>2</sup> /s)	Void Ratio	m <sub>v</sub> (m <sup>2</sup> /kN)	k (cm/s)
0.0	25.400					1.128		
9.0	25.399	25.400	-0.002	0.52	4.40E-02	1.128	3.02E-06	1.30E-08
18.0	25.389	25.394	-0.011	0.13	1.71E-01	1.127	4.50E-05	7.55E-07
36.0	25.338	25.363	-0.035	0.83	2.74E-02	1.123	1.12E-04	3.02E-07
72.0	25.273	25.305	-0.056	0.16	1.45E-01	1.117	7.15E-05	1.02E-06
145.0	25.139	25.206	-0.074	0.49	4.58E-02	1.106	7.24E-05	3.25E-07
218.0	25.049	25.094	-0.053	2.19	1.02E-02	1.099	4.92E-05	4.90E-08
327.0	24.923	24.986	-0.071	0.72	3.05E-02	1.088	4.60E-05	1.38E-07
490.0	24.632	24.777	-0.144	6.25	3.47E-03	1.064	7.16E-05	2.44E-08
735.0	23.902	24.267	-0.270	2.53	8.23E-03	1.003	1.21E-04	9.76E-08
1102.0	22.789	23.346	-0.412	1.32	1.46E-02	0.909	1.27E-04	1.81E-07
1653.0	21.581	22.185	-0.580	3.53	4.92E-03	0.808	9.62E-05	4.64E-08
413.0	21.870	21.725				0.832		
103.0	22.176	22.023				0.858		
26.0	22.463	22.320				0.882		

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-3 ST14 45'-47'

**Coefficient of Consolidation vs. Pressure**



Note: C<sub>v</sub> and k calculated using t<sub>90</sub> values (square root of time method)

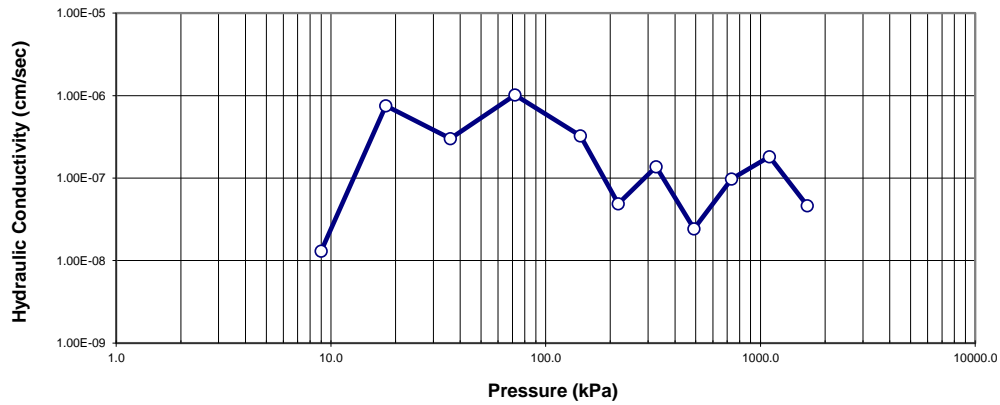
## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-3 ST14 45'-47'

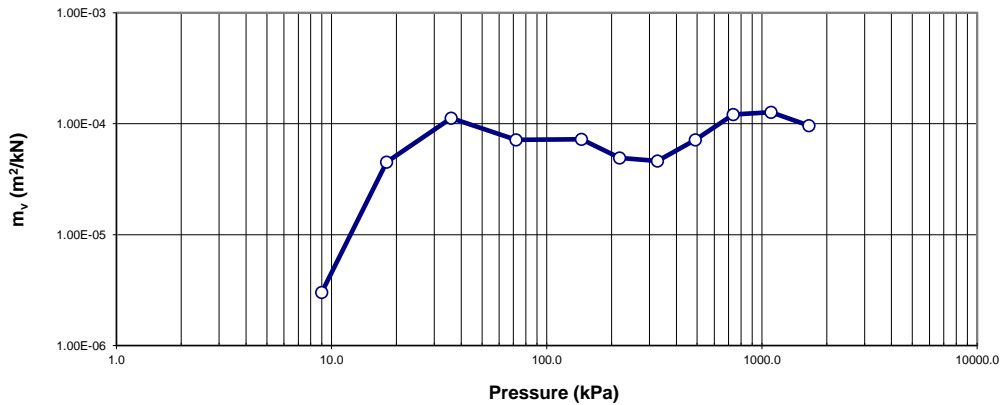
**Hydraulic Conductivity vs. Pressure**

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-3 ST14 45'-47'



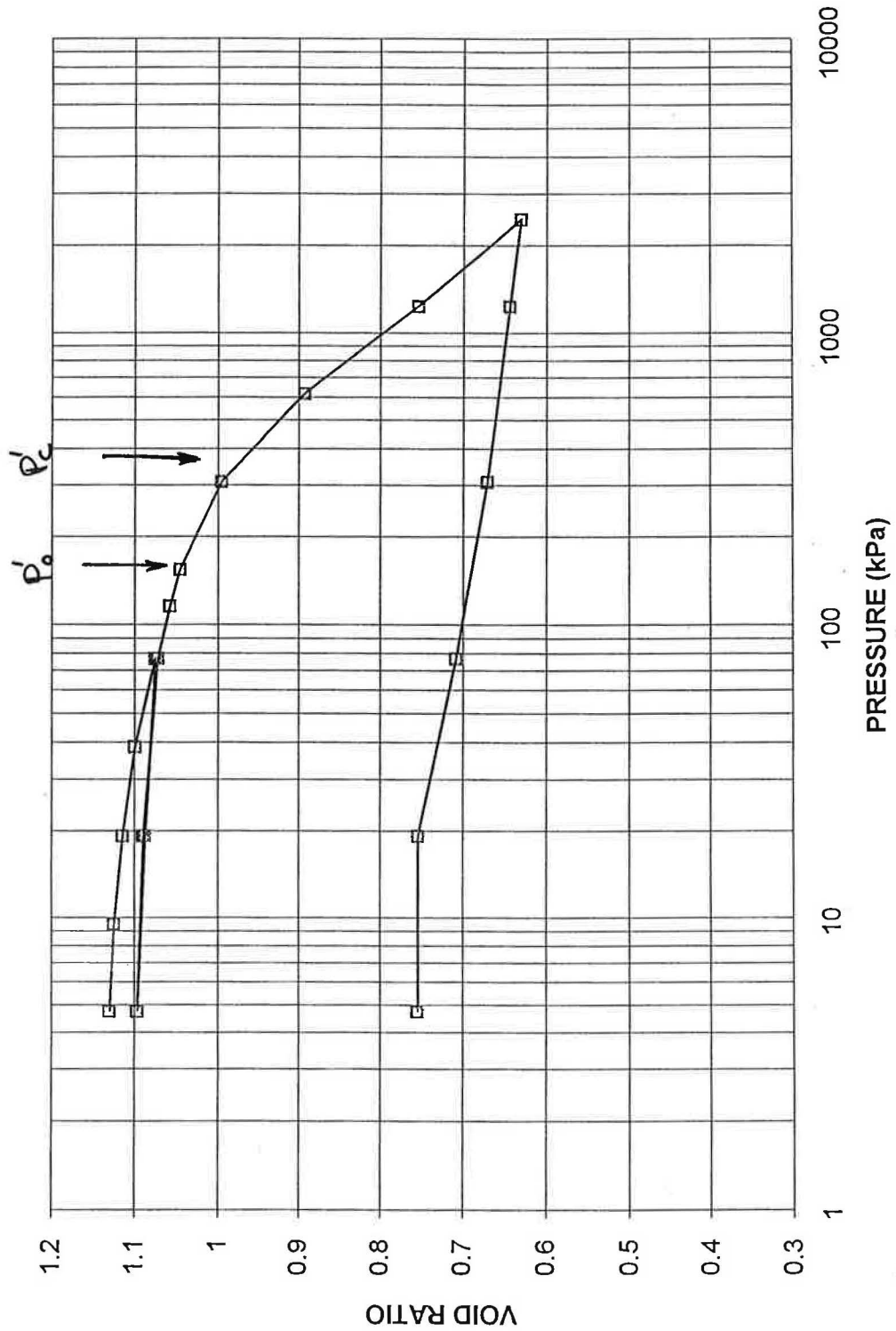
**$m_v$  vs. Pressure**

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-3 ST14 45'-47'



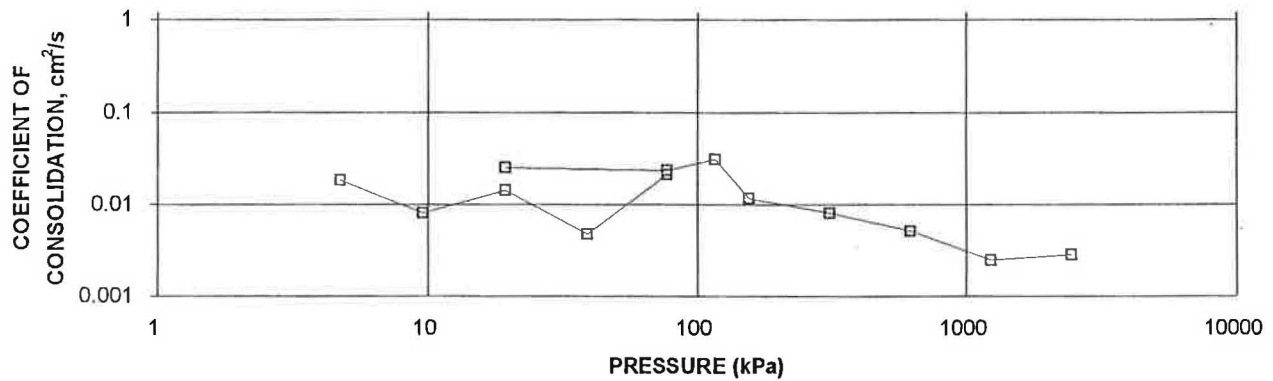
# CONSOLIDATION TEST VOID RATIO VS. LOG PRESSURE

CONSOLIDATION TEST  
VOID RATIO vs PRESSURE  
BH BRU-1 SA TW1

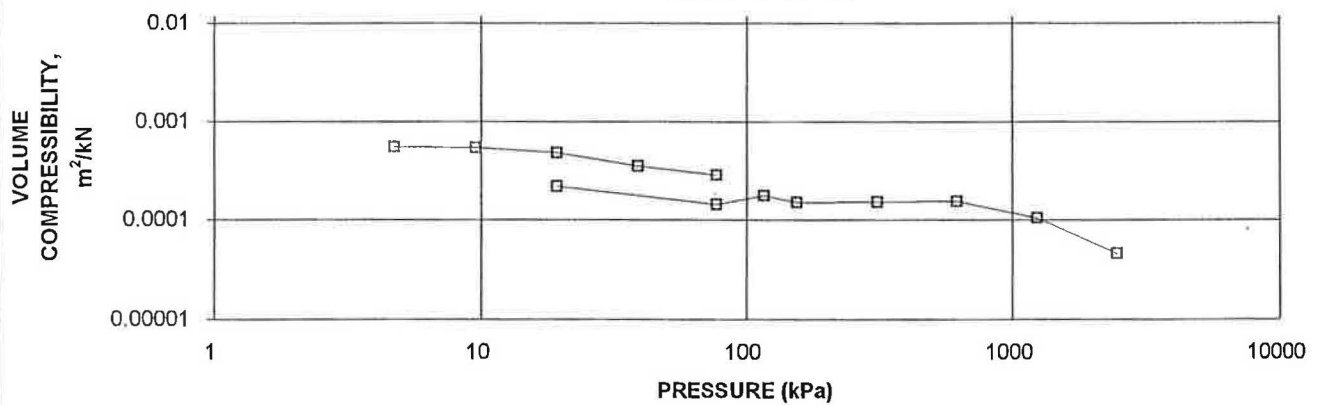


# OEDOMETER CONSOLIDATION SUMMARY

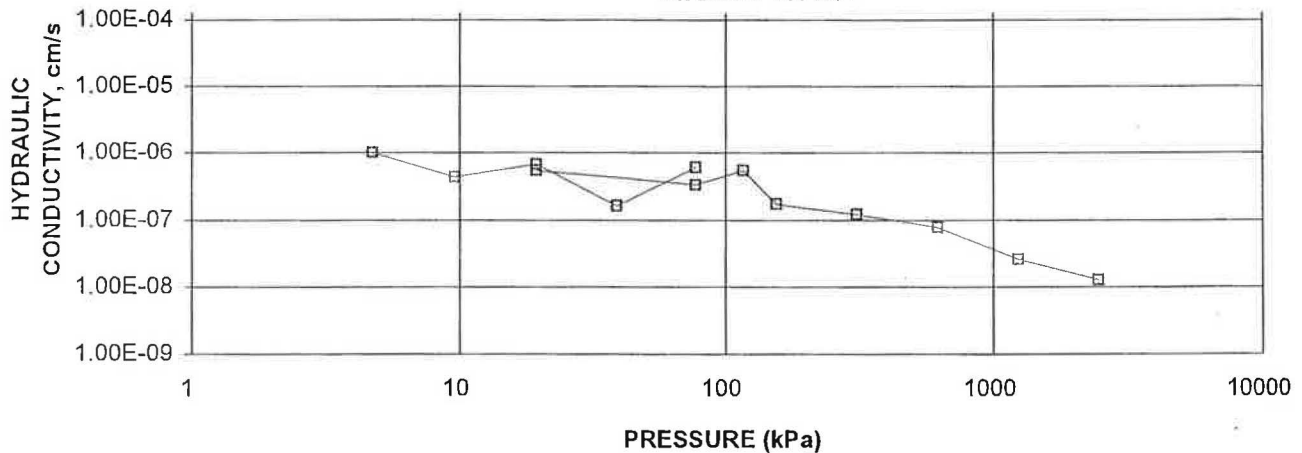
CONSOLIDATION TEST  
CV cm<sup>2</sup>/s VS PRESSURE (kPa)  
BH BRU-1 SA TW1



CONSOLIDATION TEST  
MV m<sup>2</sup>/kN vs PRESSURE (kPa)  
BH BRU-1 SA TW1



CONSOLIDATION TEST  
HYDRAULIC CONDUCTIVITY vs PRESSURE  
BH BRU-1 SA TW1



## OEDOMETER CONSOLIDATION SUMMARY

### SAMPLE IDENTIFICATION

Project Number	04-1116-011	Sample Number	TW1
Borehole Number	BRU-1	Sample Depth, m	11.6-12.2

### TEST CONDITIONS

Test Type	Standard	Load Duration, hr	(0.7-24)
Oedometer Number	6		
Date Started	1/30/2004		
Date Completed	2/12/2004		

### SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m <sup>3</sup>	18.03
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m <sup>3</sup>	12.81
Area, cm <sup>2</sup>	31.67	Specific Gravity, measured	2.79
Volume, cm <sup>3</sup>	60.17	Solids Height, cm	0.890
Water Content, %	40.70	Volume of Solids, cm <sup>3</sup>	28.18
Wet Mass, g	110.62	Volume of Voids, cm <sup>3</sup>	31.99
Dry Mass, g	78.62	Degree of Saturation, %	100.0

### TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t <sub>90</sub> sec	cv, cm <sup>2</sup> /s	mv m <sup>2</sup> /kN	k cm/s
0.00	1.900	1.135	1.900				
4.75	1.895	1.130	1.898	41	1.86E-02	5.54E-04	1.01E-06
9.54	1.890	1.124	1.893	94	8.08E-03	5.49E-04	4.35E-07
19.25	1.881	1.114	1.886	53	1.42E-02	4.88E-04	6.80E-07
38.68	1.868	1.099	1.875	158	4.71E-03	3.52E-04	1.63E-07
77.38	1.847	1.076	1.858	34	2.15E-02	2.86E-04	6.02E-07
19.25	1.857	1.087	1.852				
4.75	1.866	1.097	1.862				
19.25	1.860	1.090	1.863	29	2.54E-02	2.18E-04	5.42E-07
77.38	1.844	1.072	1.852	31	2.35E-02	1.45E-04	3.33E-07
116.07	1.831	1.058	1.838	23	3.11E-02	1.77E-04	5.39E-07
154.68	1.820	1.045	1.826	60	1.18E-02	1.50E-04	1.73E-07
309.16	1.775	0.995	1.798	85	8.06E-03	1.53E-04	1.21E-07
618.45	1.684	0.893	1.730	124	5.11E-03	1.55E-04	7.76E-08
1237.35	1.560	0.753	1.622	225	2.48E-03	1.05E-04	2.56E-08
2472.95	1.451	0.631	1.506	171	2.81E-03	4.64E-05	1.28E-08
1237.35	1.463	0.644	1.457				
309.16	1.487	0.671	1.475				
77.38	1.520	0.708	1.504				
19.25	1.560	0.753	1.540				
4.75	1.561	0.754	1.561				

Notes:

k calculated using cv based on t<sub>90</sub> values.

### SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.56	Unit Weight, kN/m <sup>3</sup>	20.41
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m <sup>3</sup>	15.60
Area, cm <sup>2</sup>	31.67	Specific Gravity, measured	2.79
Volume, cm <sup>3</sup>	49.44	Solids Height, cm	0.890
Water Content, %	30.87	Volume of Solids, cm <sup>3</sup>	28.18
Wet Mass, g	102.89	Volume of Voids, cm <sup>3</sup>	21.26
Dry Mass, g	78.62		



### **Appendix C.3**

#### **One-Dimensional Consolidation Test Results (Constant Rate of Strain)**

## Constant Rate of Strain (CRS) Test Report

CLIENT: Ministry of Transportation (MTO)

FILE NUMBER: 24726

PROJECT: Twinning of Hwy 17 from Arnprior to Haley Station

REPORT DATE: May 10, 2021

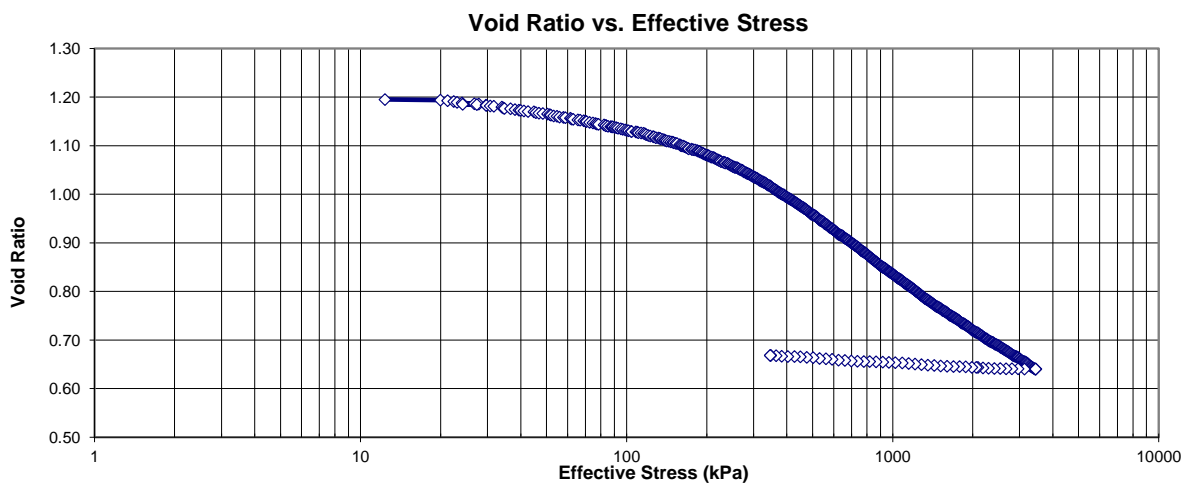
TEST DATES: November 27, 2020 - November 30, 2020

SAMPLE: BRU19-1 ST14 55'-57'  
Clayey silt, grey, moist

PROCEDURE: Test carried out in general accordance with Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading, ASTM D4186.

Sample Characteristics		
	Initial	Final
Sample Height (mm):	25.40	19.27
Sample Diameter (mm):	50.70	50.70
Wet Dens. (kg/m <sup>3</sup> ):	1773	2108
Dry Dens. (kg/m <sup>3</sup> ):	1262	1664
Moisture Content (%):	40.1	26.7
Void Ratio:	1.20	0.67

Test Conditions	
Back Pressure (kPa):	400
Seating Pressure (kPa):	12.35
Strain After Seating (%):	0.12
Strain Rate - Loading (%/hr):	0.8
Strain Rate - Unloading (%/hr):	0.1
R <sub>u</sub> at end of loading:	0.003



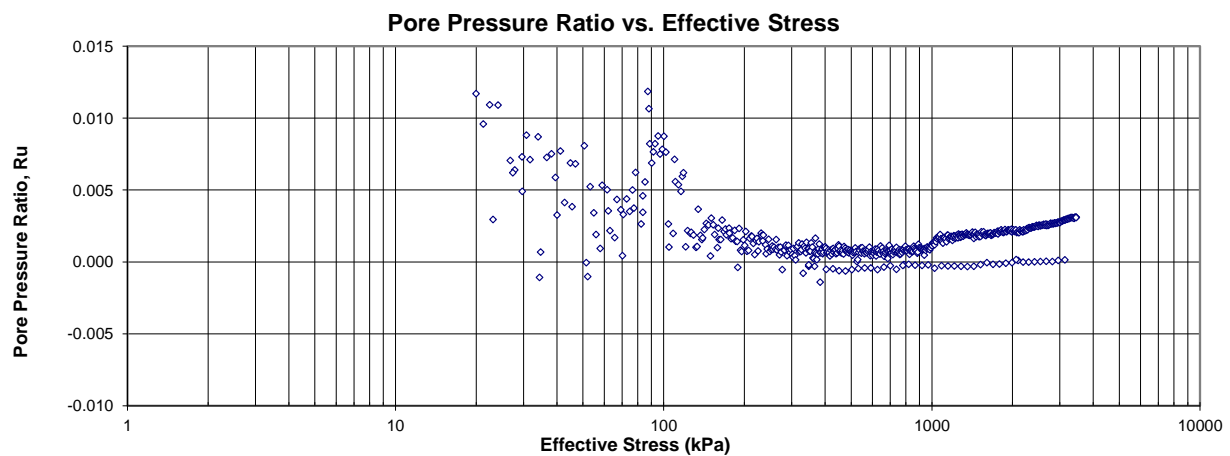
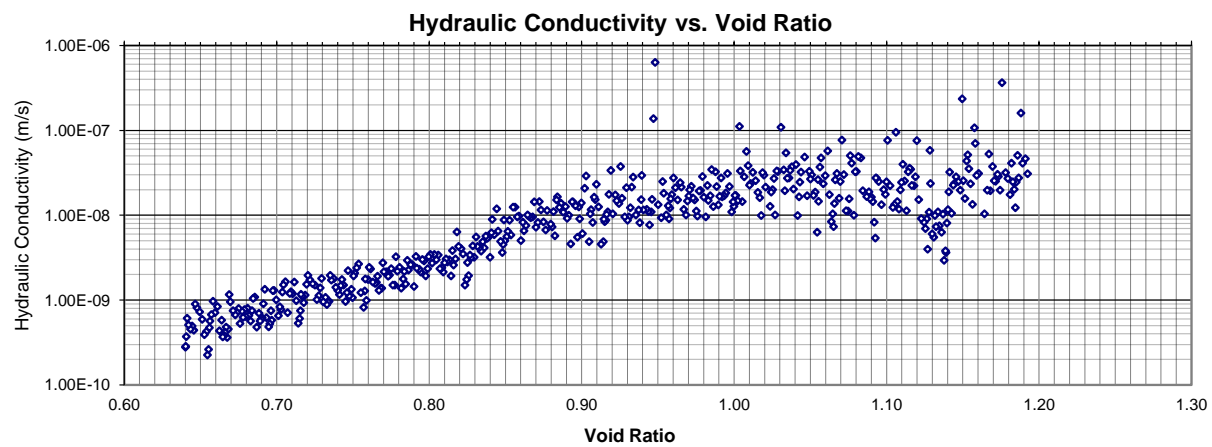
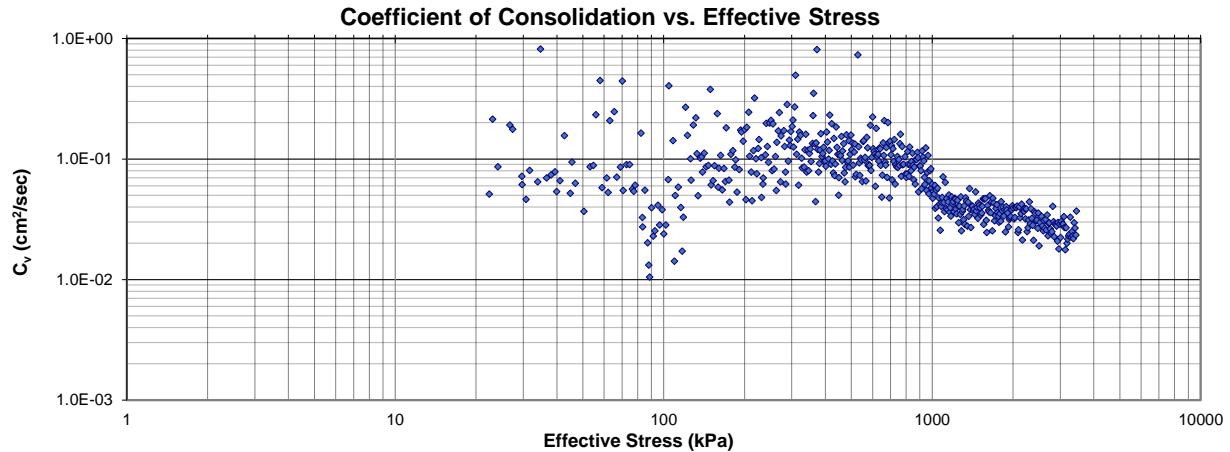
Note: A Specific Gravity (Gs) of 2.769 was measured for the void ratio calculations.

## Constant Rate of Strain (CRS) Test Report

24726

BRU19-1 ST14 55'-57'

Twinning of Hwy 17 from Arnprior to Haley Station



Note: Only data from loading stage are shown in coefficient of consolidation vs. effective stress, and hydraulic conductivity vs. void ratio plots.



## Constant Rate of Strain (CRS) Test Report

CLIENT: Ministry of Transportation (MTO)

FILE NUMBER: 24726

PROJECT: Twinning of Hwy 17 from Arnprior to Haley Station

REPORT DATE: May 19, 2021

TEST DATES: November 24, 2020 - November 26, 2020

SAMPLE: BRU19-1 ST20 85'-87'

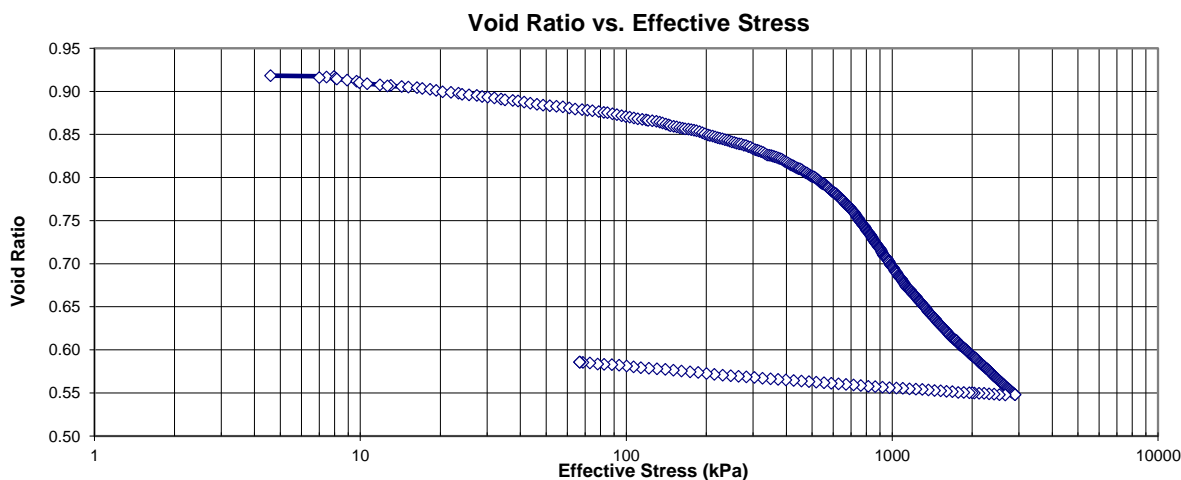
Silty clay, grey, moist

LL = 29.3, PL = 14.2

PROCEDURE: Test carried out in general accordance with Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading, ASTM D4186.

Sample Characteristics		
	Initial	Final
Sample Height (mm):	25.40	20.96
Sample Diameter (mm):	63.50	63.50
Wet Dens. (kg/m <sup>3</sup> ):	1895	2151
Dry Dens. (kg/m <sup>3</sup> ):	1451	1758
Moisture Content (%):	29.7	22.3
Void Ratio:	0.92	0.59

Test Conditions	
Back Pressure (kPa):	400
Seating Pressure (kPa):	4.60
Strain After Seating (%):	0.17
Strain Rate - Loading (%/hr):	0.8
Strain Rate - Unloading (%/hr):	0.1
R <sub>u</sub> at end of loading:	0.01



Note: A Specific Gravity (Gs) of 2.783 was measured for the void ratio calculations.

TESTED BY: BT, AA

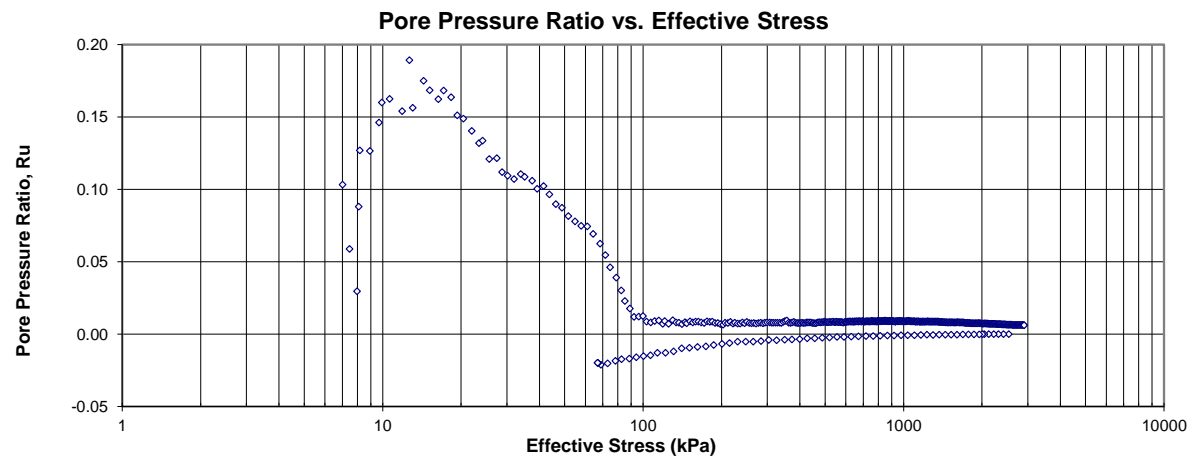
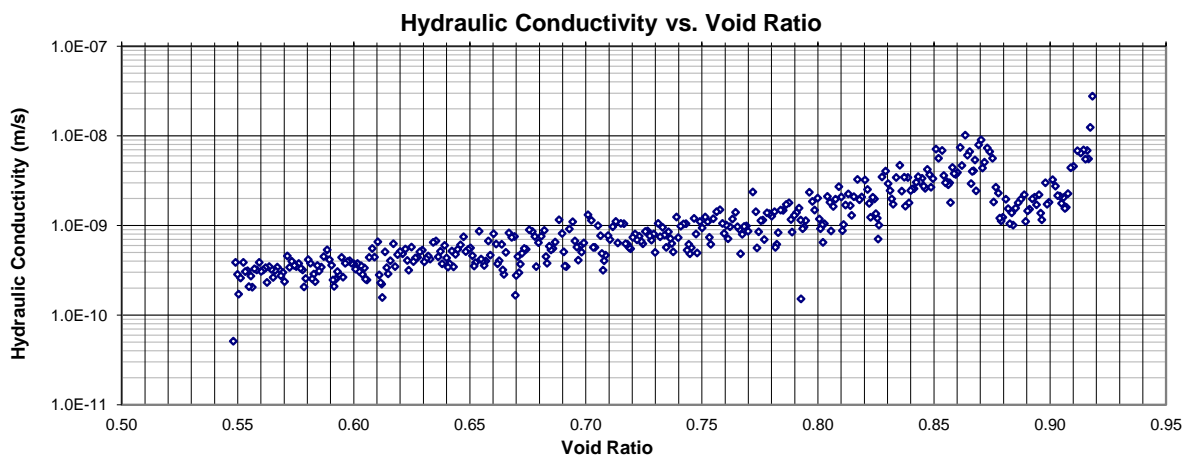
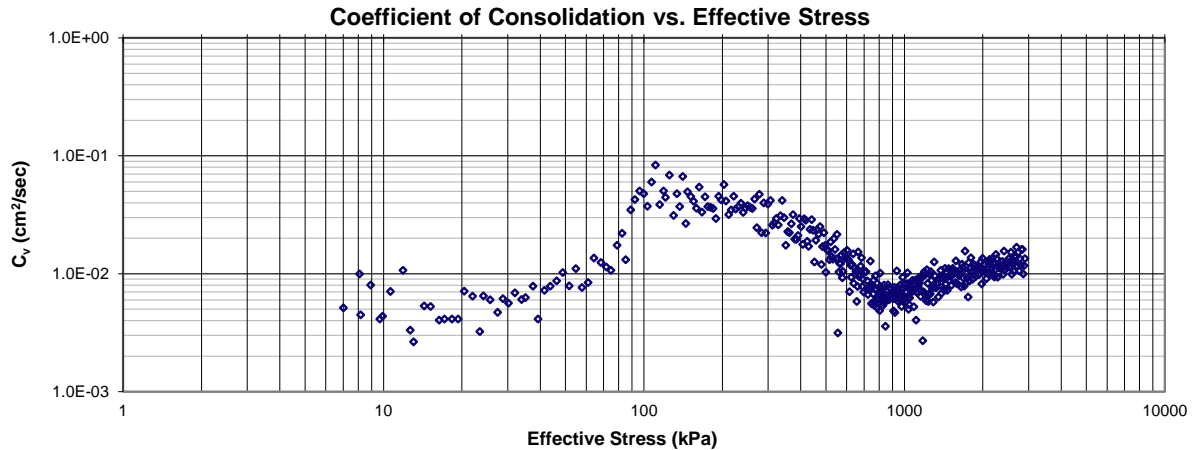
REVIEWED BY: JL

## Constant Rate of Strain (CRS) Test Report

24726

BRU19-1 ST20 85'-87'

Twinning of Hwy 17 from Arnprior to Haley Station



Note: Only data from loading stage are shown in coefficient of consolidation vs. effective stress, and hydraulic conductivity vs. void ratio plots.

## Constant Rate of Strain (CRS) Test Report

CLIENT: Ministry of Transportation (MTO)

FILE NUMBER: 24726

PROJECT: Twinning of Hwy 17 from Arnprior to Haley Station

REPORT DATE: May 19, 2021

TEST DATES: January 20, 2021 - January 22, 2021

SAMPLE: BRU19-1.2 ST2 25'-27'

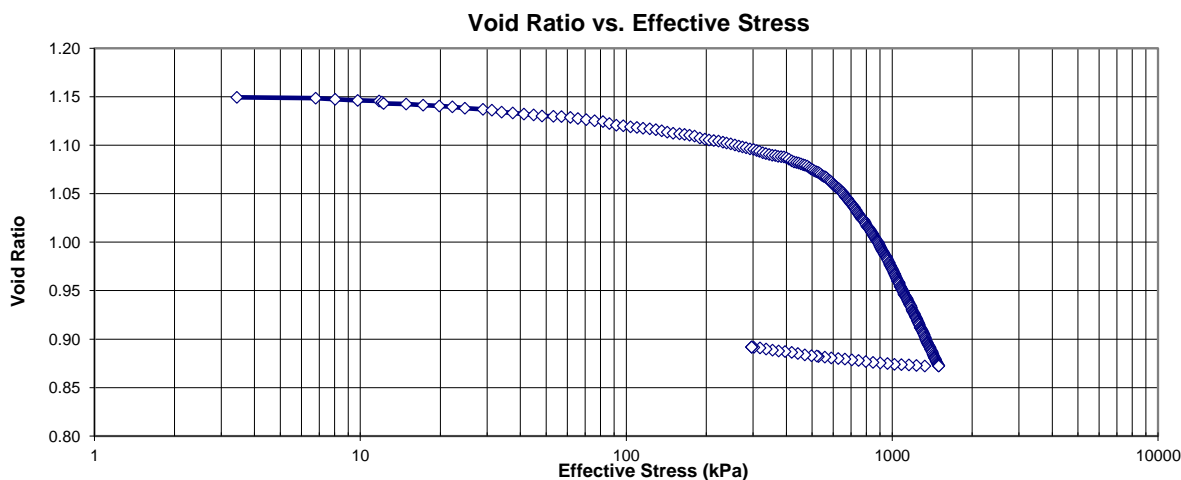
Silty clay, grey, moist

LL = 36.6, PL = 21.2

PROCEDURE: Test carried out in general accordance with Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading, ASTM D4186.

Sample Characteristics		
	Initial	Final
Sample Height (mm):	25.40	22.32
Sample Diameter (mm):	63.50	63.50
Wet Dens. (kg/m <sup>3</sup> ):	1806	1967
Dry Dens. (kg/m <sup>3</sup> ):	1282	1458
Moisture Content (%):	41.3	34.9
Void Ratio:	1.15	0.89

Test Conditions	
Back Pressure (kPa):	400
Seating Pressure (kPa):	3.45
Strain After Seating (%):	0.15
Strain Rate - Loading (%/hr):	0.8
Strain Rate - Unloading (%/hr):	0.1
R <sub>u</sub> at end of loading:	0.0002



Note: A Specific Gravity (Gs) of 2.754 was measured for the void ratio calculations.

TESTED BY: BT, AA

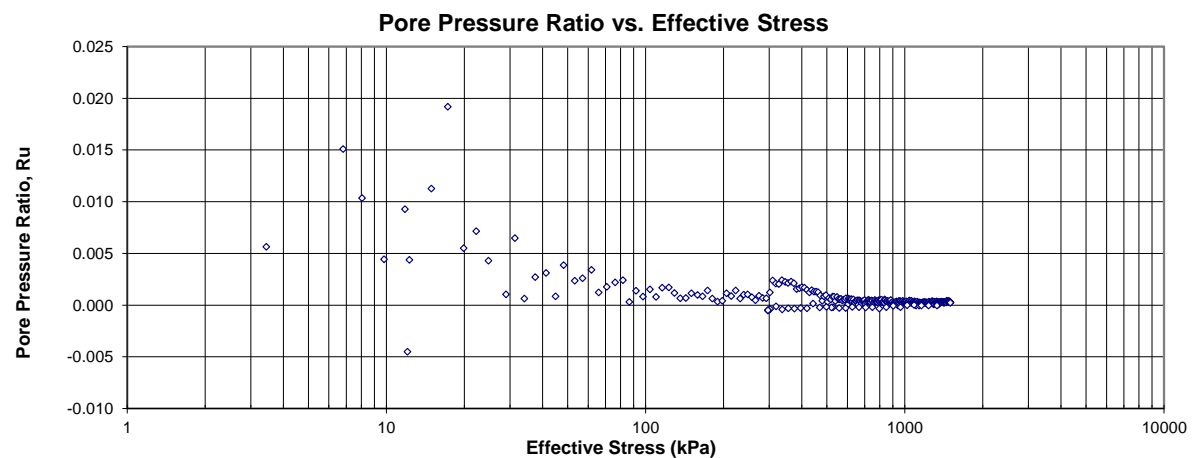
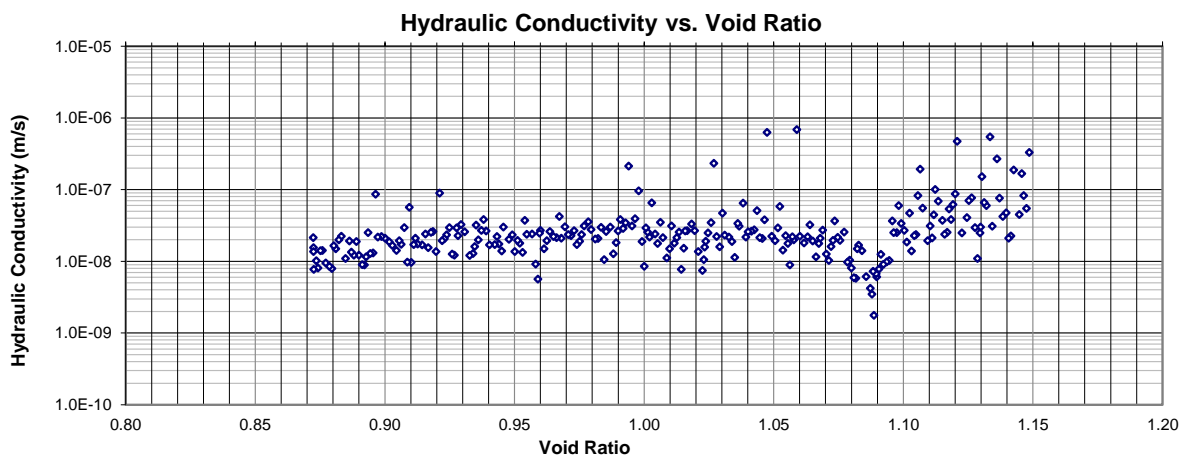
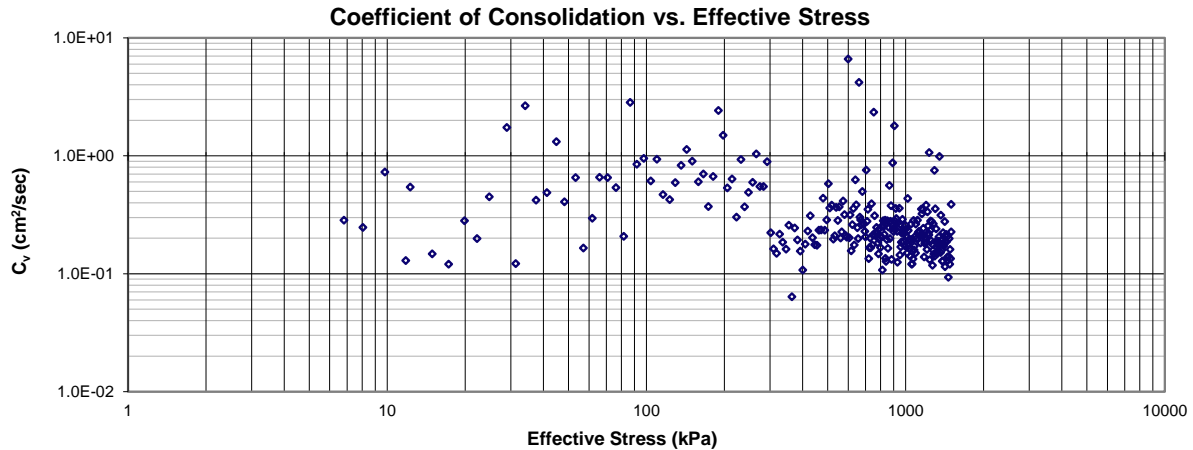
REVIEWED BY: JL

## Constant Rate of Strain (CRS) Test Report

24726

BRU19-1.2 ST2 25'-27'

Twinning of Hwy 17 from Arnprior to Haley Station



Note: Only data from loading stage are shown in coefficient of consolidation vs. effective stress, and hydraulic conductivity vs. void ratio plots.

## Constant Rate of Strain (CRS) Test Report

CLIENT: Ministry of Transportation (MTO)

FILE NUMBER: 24726

PROJECT: Twinning of Hwy 17 from Arnprior to Haley Station

REPORT DATE: May 10, 2021

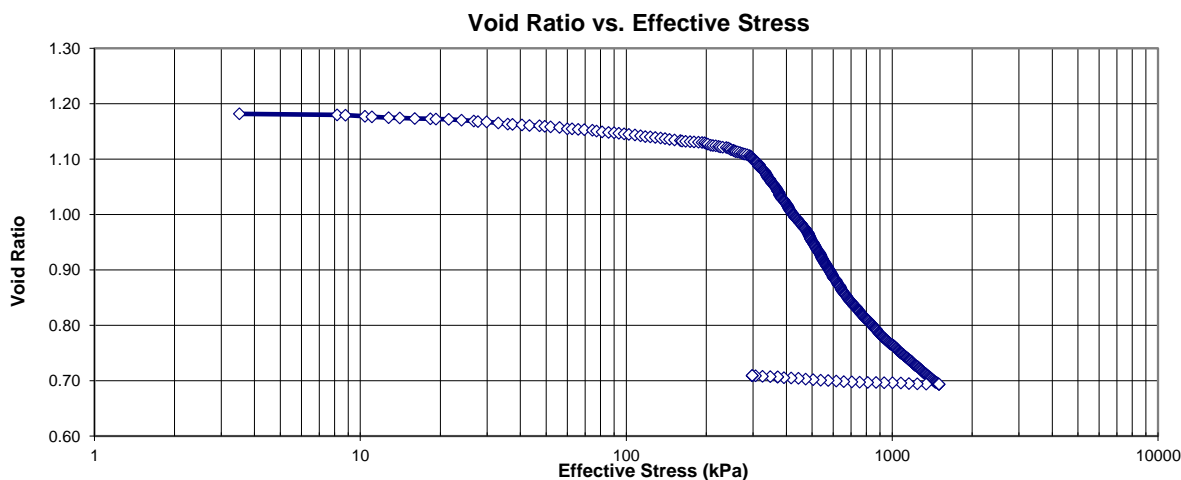
TEST DATES: January 22, 2021 - January 25, 2021

SAMPLE: BRU19-1.2 ST6 65'-67'  
Clayey silt, grey, moist  
LL = 17.5, PL = 13.7

PROCEDURE: Test carried out in general accordance with Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading, ASTM D4186.

Sample Characteristics		
	Initial	Final
Sample Height (mm):	25.40	19.87
Sample Diameter (mm):	63.50	63.50
Wet Dens. (kg/m <sup>3</sup> ):	1789	2064
Dry Dens. (kg/m <sup>3</sup> ):	1263	1615
Moisture Content (%):	37.4	27.8
Void Ratio:	1.19	0.71

Test Conditions	
Back Pressure (kPa):	400
Seating Pressure (kPa):	3.51
Strain After Seating (%):	0.17
Strain Rate - Loading (%/hr):	0.8
Strain Rate - Unloading (%/hr):	0.1
R <sub>u</sub> at end of loading:	0.0163



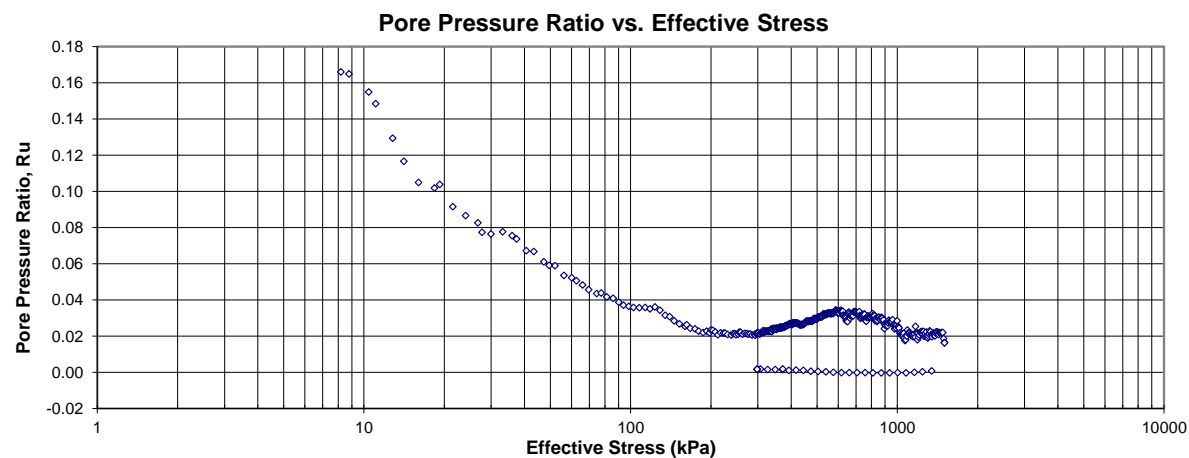
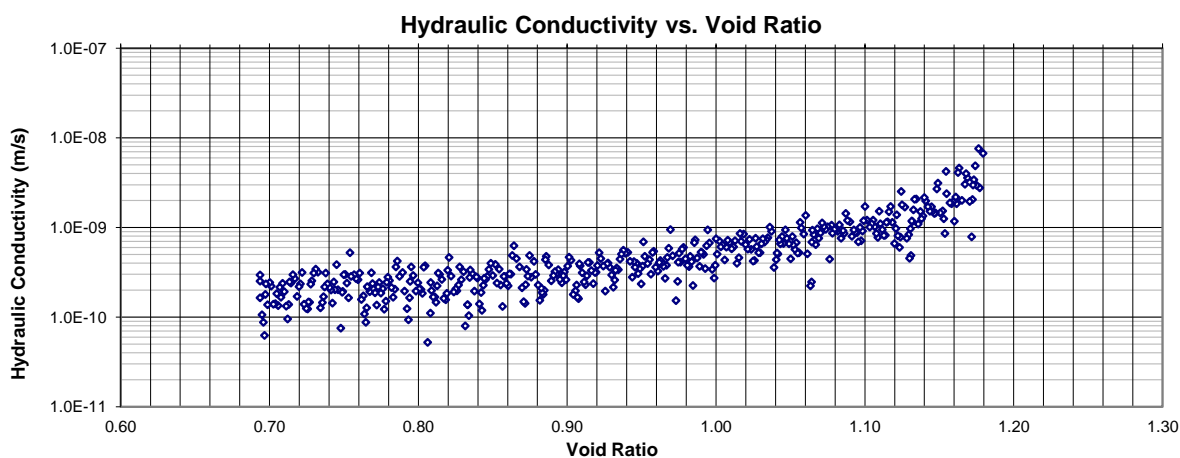
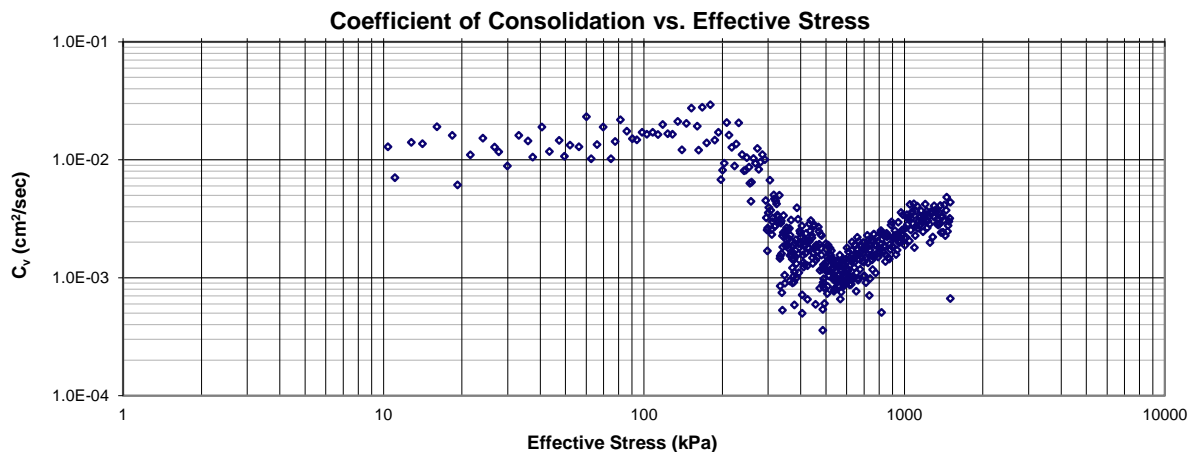
Note: A Specific Gravity (Gs) of 2.755 was measured for the void ratio calculations.

## Constant Rate of Strain (CRS) Test Report

24726

BRU19-1.2 ST6 65'-67'

Twinning of Hwy 17 from Arnprior to Haley Station



Note: Only data from loading stage are shown in coefficient of consolidation vs. effective stress, and hydraulic conductivity vs. void ratio plots.

## Constant Rate of Strain (CRS) Test Report

CLIENT: Ministry of Transportation (MTO)

FILE NUMBER: 24726

PROJECT: Twinning of Hwy 17 from Arnprior to Haley Station

REPORT DATE: May 10, 2021

TEST DATES: January 18, 2021 - January 19, 2021

SAMPLE: BRU19-3.2 ST3 45'-47'

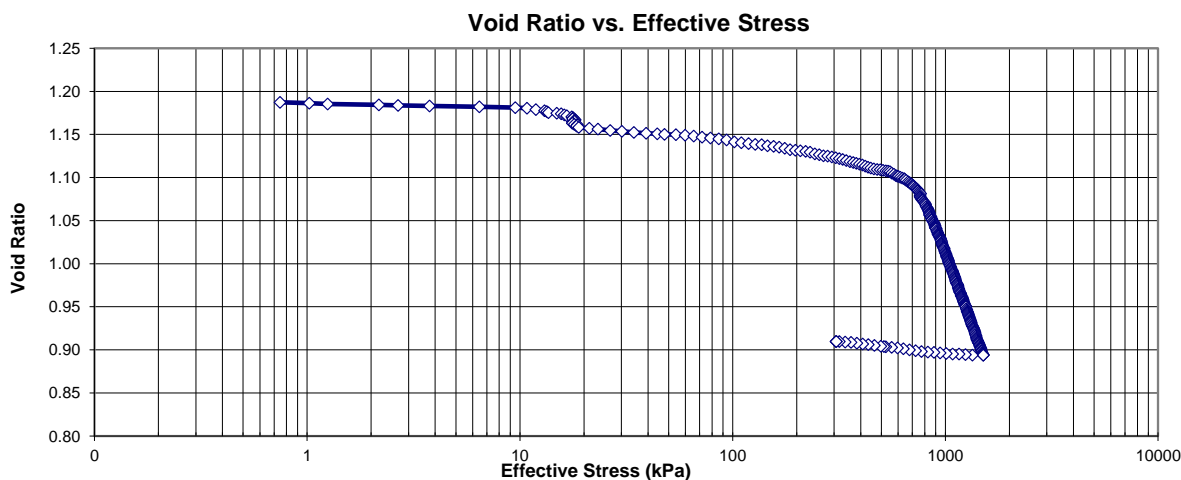
Silty clay, grey, moist

LL = 31.3, PL = 20.8

PROCEDURE: Test carried out in general accordance with Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading, ASTM D4186.

Sample Characteristics		
	Initial	Final
Sample Height (mm):	25.40	22.08
Sample Diameter (mm):	63.50	63.50
Wet Dens. (kg/m <sup>3</sup> ):	1778	1976
Dry Dens. (kg/m <sup>3</sup> ):	1266	1456
Moisture Content (%):	38.8	35.7
Void Ratio:	1.20	0.91

Test Conditions	
Back Pressure (kPa):	400
Seating Pressure (kPa):	0.78
Strain After Seating (%):	0.42
Strain Rate - Loading (%/hr):	0.8
Strain Rate - Unloading (%/hr):	0.1
R <sub>u</sub> at end of loading:	0.0002



Note: A Specific Gravity (Gs) of 2.775 was measured for the void ratio calculations.

TESTED BY: BT, AA

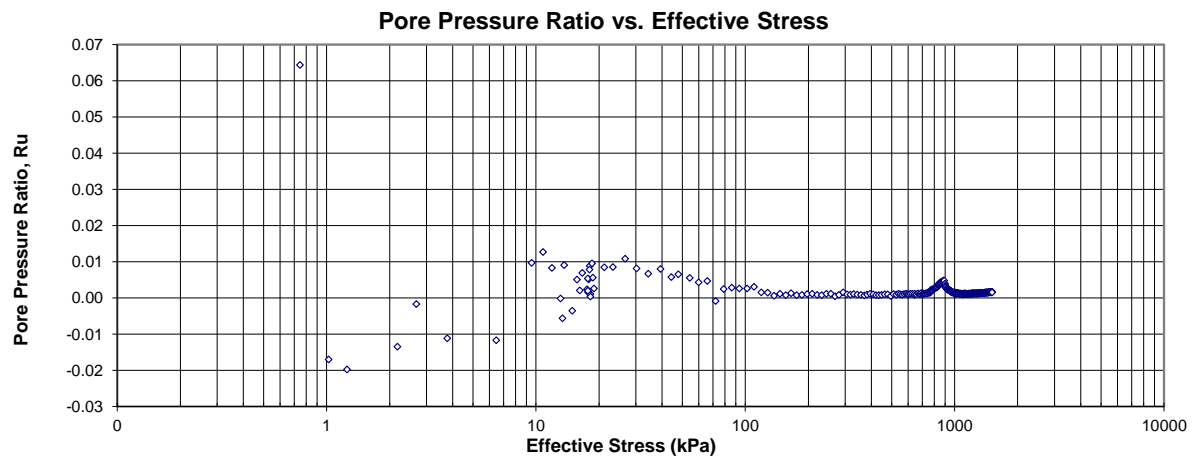
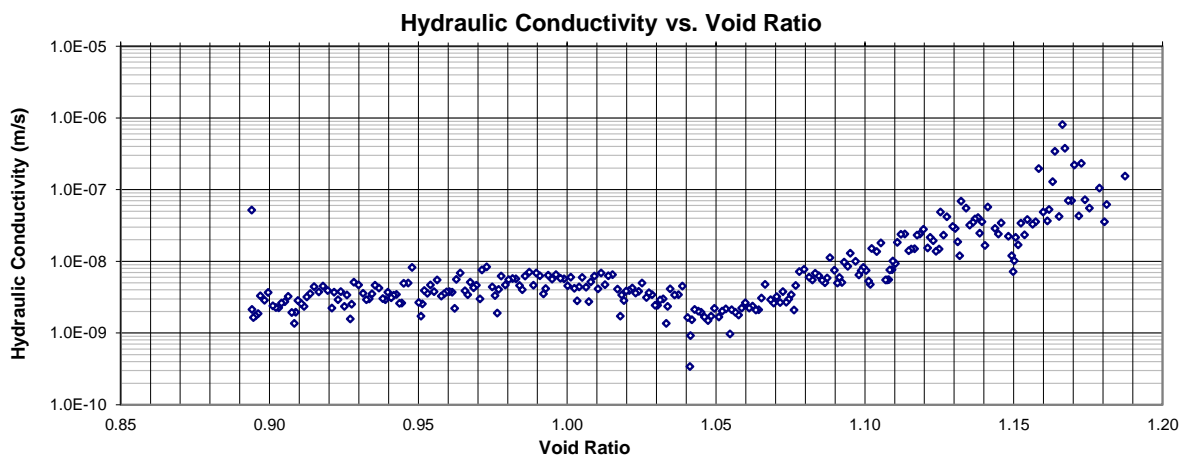
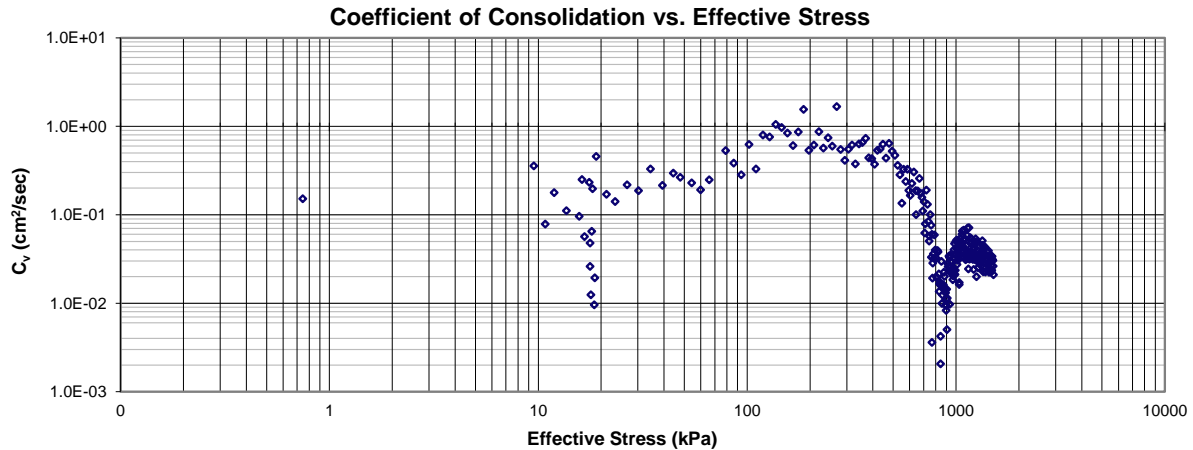
REVIEWED BY: JL

## Constant Rate of Strain (CRS) Test Report

24726

BRU19-3.2 ST3 45'-47'

Twinning of Hwy 17 from Arnprior to Haley Station



Note: Only data from loading stage are shown in coefficient of consolidation vs. effective stress, and hydraulic conductivity vs. void ratio plots.



## Constant Rate of Strain (CRS) Test Report

CLIENT: Ministry of Transportation (MTO)

FILE NUMBER: 24726

PROJECT: Twinning of Hwy 17 from Arnprior to Haley Station

REPORT DATE: May 10, 2021

TEST DATES: January 8, 2021 - January 9, 2021

SAMPLE: BRU19-3.2 ST8 100'-102'

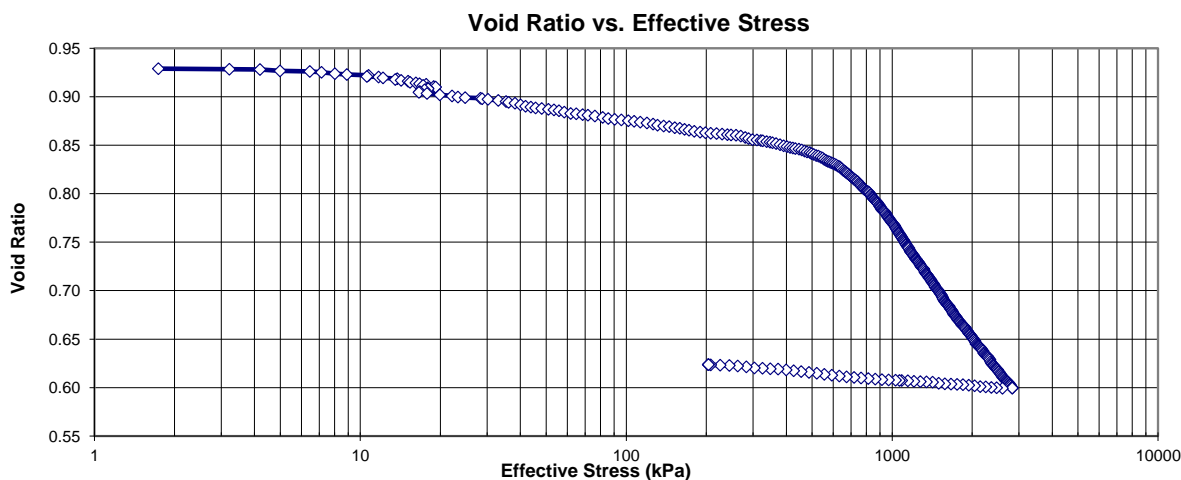
Silty clay, grey, moist

LL = 19.8, PL = 13.0

PROCEDURE: Test carried out in general accordance with Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading, ASTM D4186.

Sample Characteristics		
	Initial	Final
Sample Height (mm):	25.40	21.31
Sample Diameter (mm):	63.50	63.50
Wet Dens. (kg/m <sup>3</sup> ):	1893	2126
Dry Dens. (kg/m <sup>3</sup> ):	1428	1703
Moisture Content (%):	29.8	24.8
Void Ratio:	0.94	0.62

Test Conditions	
Back Pressure (kPa):	400
Seating Pressure (kPa):	2.77
Strain After Seating (%):	0.35
Strain Rate - Loading (%/hr):	0.8
Strain Rate - Unloading (%/hr):	0.1
R <sub>u</sub> at end of loading:	-0.0040



Note: A Specific Gravity (Gs) of 2.76 was measured for the void ratio calculations.

TESTED BY: BT, AA

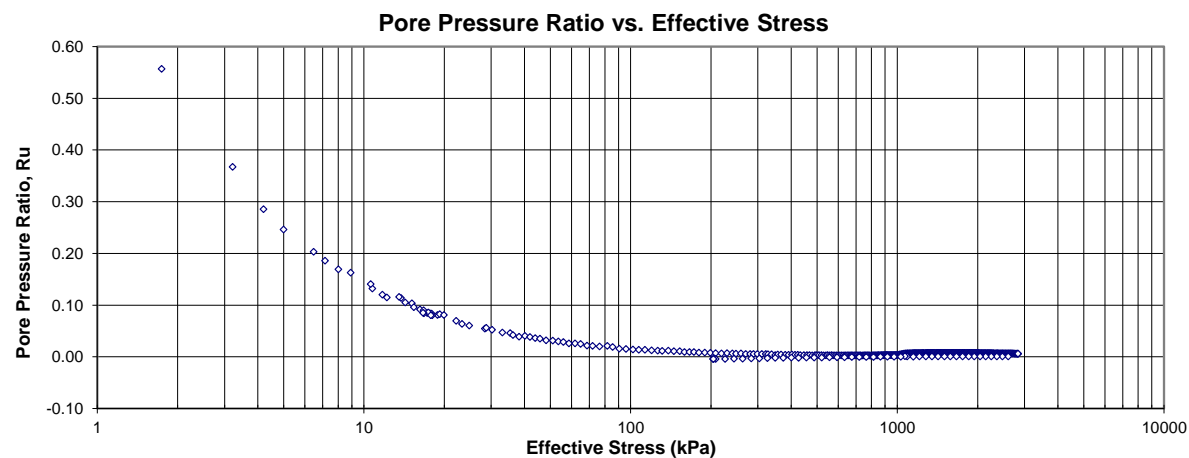
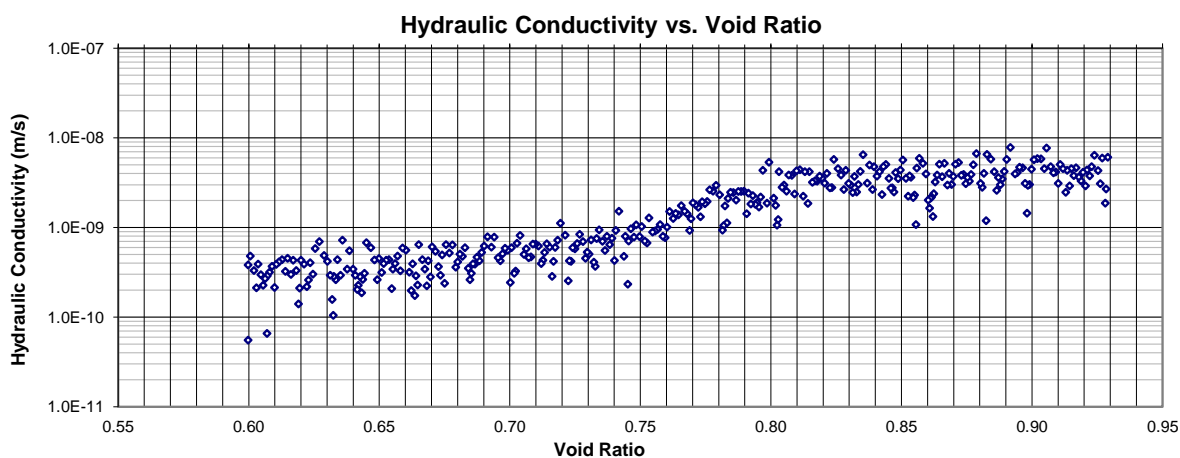
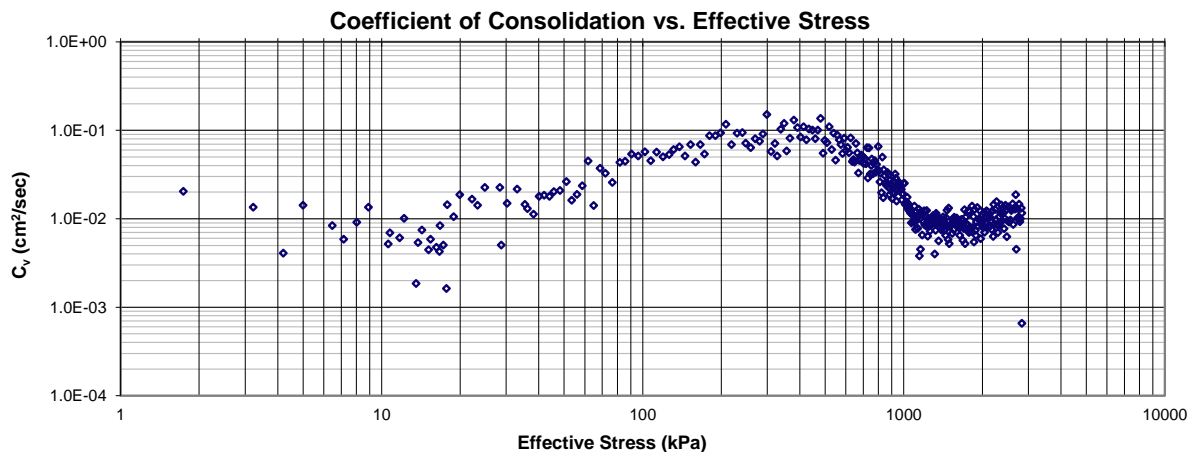
REVIEWED BY: JL

## Constant Rate of Strain (CRS) Test Report

24726

BRU19-3.2 ST8 100'-102'

Twinning of Hwy 17 from Arnprior to Haley Station



Note: Only data from loading stage are shown in coefficient of consolidation vs. effective stress, and hydraulic conductivity vs. void ratio plots.



#### **Appendix C.4**

##### **One-Dimensional Consolidation Test Results (Creep)**

## Consolidation Test Report

CLIENT: **Thurber Engineering (Ottawa)**

FILE NUMBER: **24726**

PROJECT: **Highway 17 Twinning - Renfrew**

REPORT DATE: **September 15, 2020**

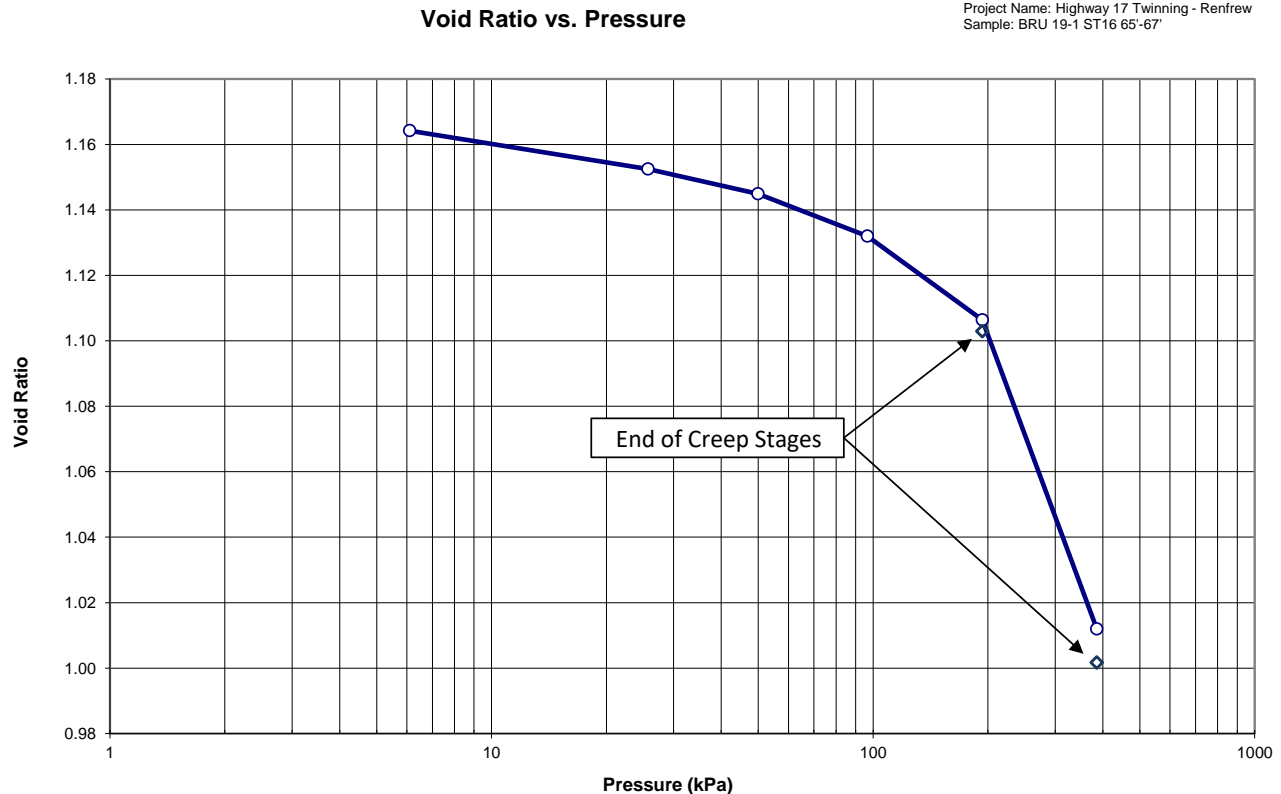
TEST DATES: **May 20, 2020 - June 07, 2020**

SAMPLE: **BRU 19-1 ST16 65'-67'**  
**Clay, silty, trace sand, brown, moist.**  
**LL = 31.2, PL = 18.3, I<sub>p</sub> = 12.9**

PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-11, method B

	<u>Start of Test</u>	<u>End of Test</u>
Sample Height (mm)	25.40	23.46
Wet Dens. (kg/m <sup>3</sup> )	1772.5	1892.0
Dry Dens. (kg/m <sup>3</sup> )	1285.6	1391.7
Moisture Cont. (%)	37.9	35.9
Void Ratio	1.167	1.002
Saturation (%)	90.4	100.0

Note: A Specific Gravity (Gs) of 2.786 was obtained for the void ratio and saturation calculations.



## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-1 ST16 65'-67'

**TRIMMING:** The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer. The average moisture content of the trimmings was 34.9%.

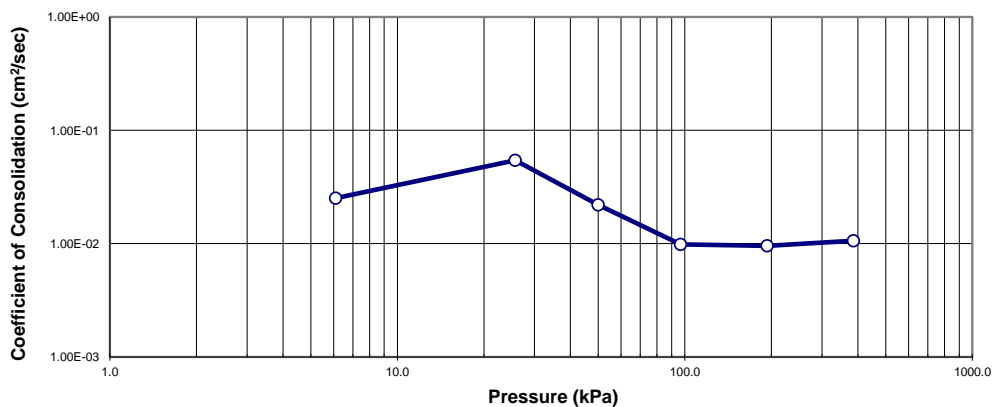
**LOADING:** A seating load of 6.1 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after a constant load increment duration of 24 hours. Creep stages were conducted at 193.2 kPa and 385.7 kPa; and were maintained for 7 and 8 days, respectively.

**CALCULATIONS:** Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	D <sub>90</sub> (mm)	t <sub>90</sub> (min)	c <sub>v</sub> (cm <sup>2</sup> /s)	Void Ratio	m <sub>v</sub> (m <sup>2</sup> /kN)	k (cm/s)
0.0	25.400					1.167		
6.1	25.367	25.384	-0.026	0.90	2.52E-02	1.164	2.13E-04	5.27E-07
25.7	25.230	25.299	-0.097	0.42	5.44E-02	1.152	2.76E-04	1.47E-06
49.9	25.141	25.186	-0.046	1.02	2.20E-02	1.145	1.46E-04	3.14E-07
96.6	24.990	25.066	-0.086	2.25	9.87E-03	1.132	1.29E-04	1.24E-07
193.2	24.690	24.840	-0.161	2.28	9.56E-03	1.106	1.24E-04	1.17E-07
193.2 (Creep)	24.649	24.670				1.103		
385.7	23.583	24.116	-0.483	1.93	1.06E-02	1.012	2.25E-04	2.34E-07
385.7 (Creep)	23.462	23.523				1.002		

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-1 ST16 65'-67'

**Coefficient of Consolidation vs. Pressure**



Note: C<sub>v</sub> and k calculated using t<sub>90</sub> values (square root of time method)

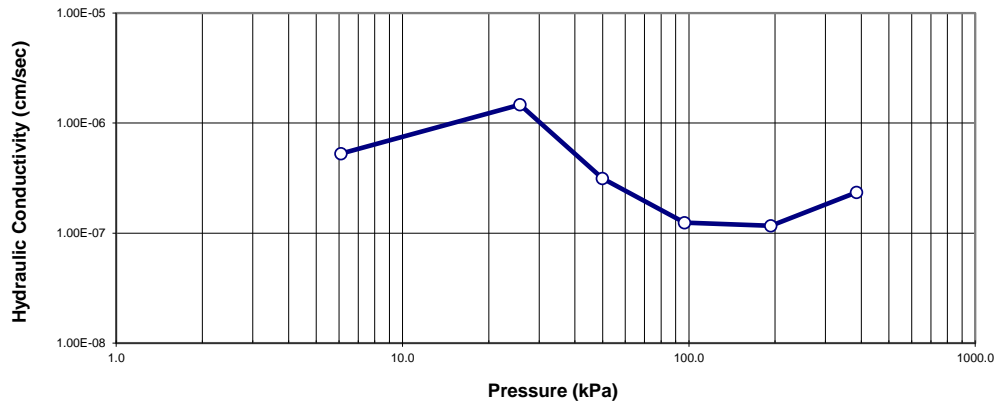
## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-1 ST16 65'-67'

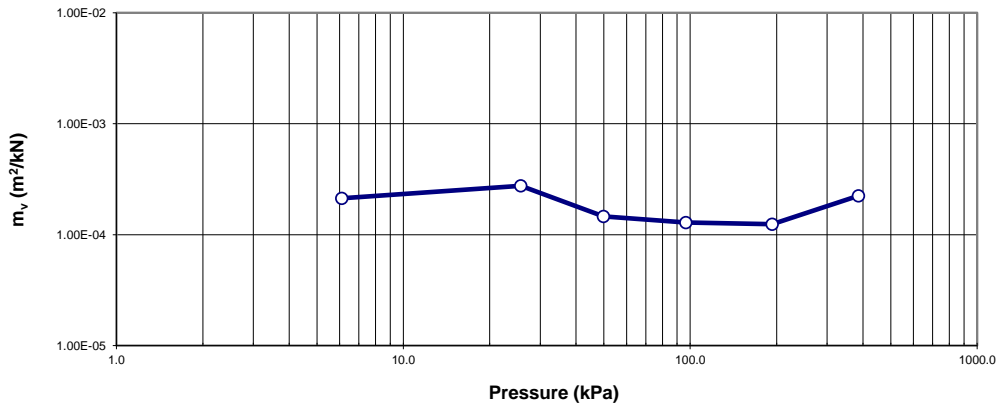
**Hydraulic Conductivity vs. Pressure**

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-1 ST16 65'-67'



**$m_v$  vs. Pressure**

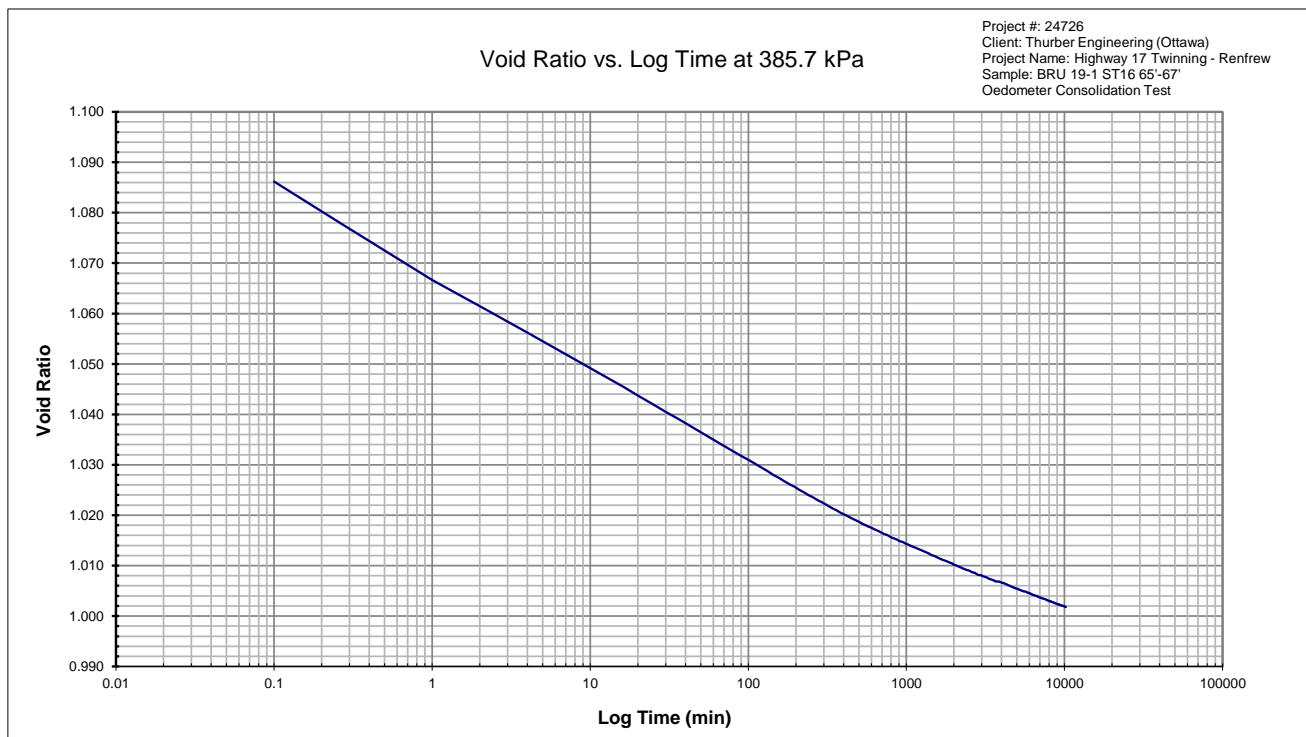
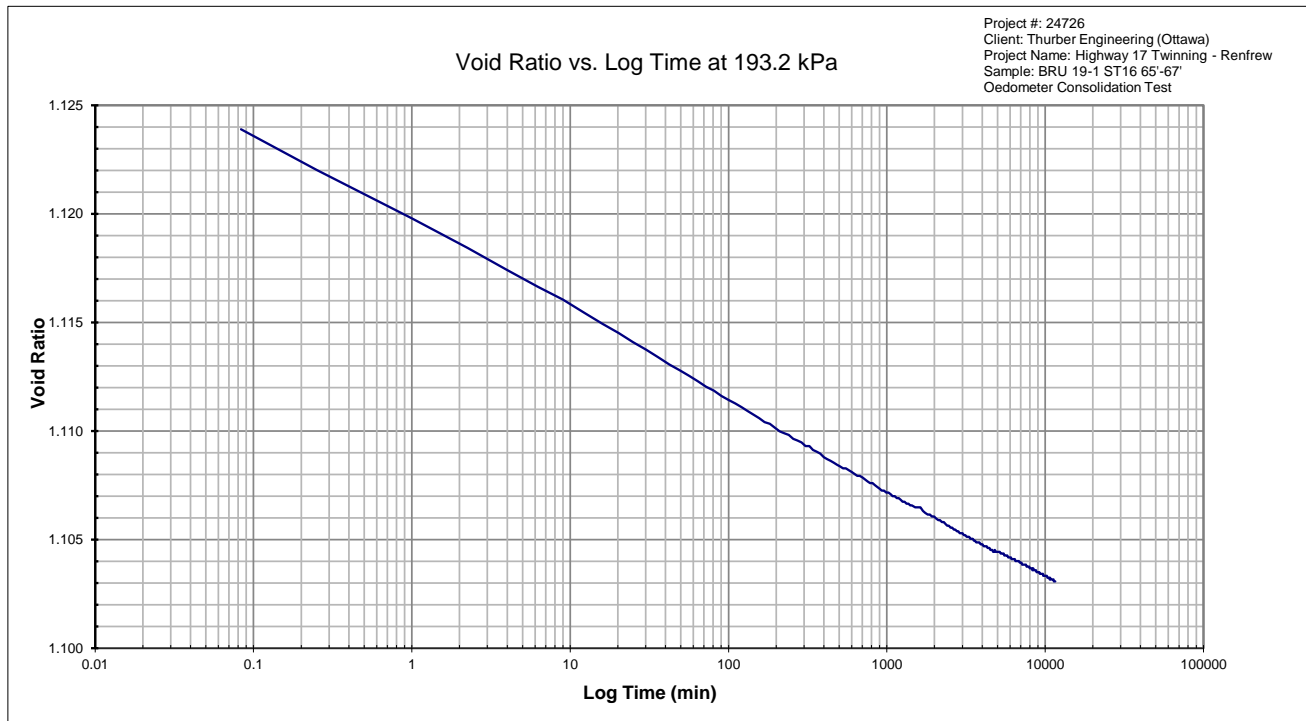
Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-1 ST16 65'-67'



## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-1 ST16 65'-67'



## Consolidation Test Report

CLIENT: **Thurber Engineering (Ottawa)**

FILE NUMBER: **24726**

PROJECT: **Highway 17 Twinning - Renfrew**

REPORT DATE: **September 15, 2020**

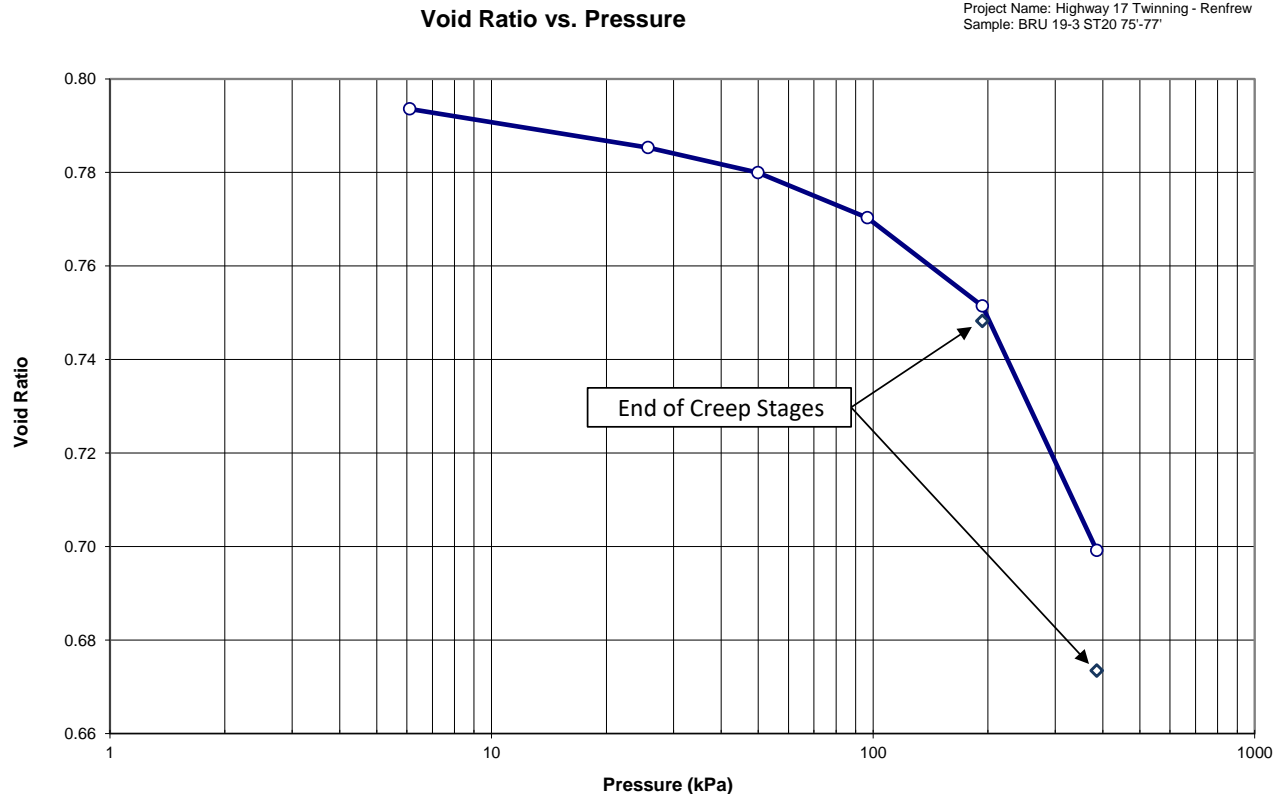
TEST DATES: **July 22, 2020 - August 13, 2020**

SAMPLE: **BRU 19-3 ST20 75'-77'**  
**Clay, silty, trace sand, grey, moist.**  
**LL = 24.1, PL = 14.8, I<sub>p</sub> = 9.3**

PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-11, method B

	<u>Start of Test</u>	<u>End of Test</u>
Sample Height (mm)	25.40	23.68
Wet Dens. (kg/m <sup>3</sup> )	1952.6	2042.2
Dry Dens. (kg/m <sup>3</sup> )	1528.7	1639.8
Moisture Cont. (%)	27.7	24.5
Void Ratio	0.795	0.673
Saturation (%)	95.7	100.0

Note: A Specific Gravity (Gs) of 2.744 was obtained for the void ratio and saturation calculations.





## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-3 ST20 75'-77'

**TRIMMING:** The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer. The average moisture content of the trimmings was 28.5%.

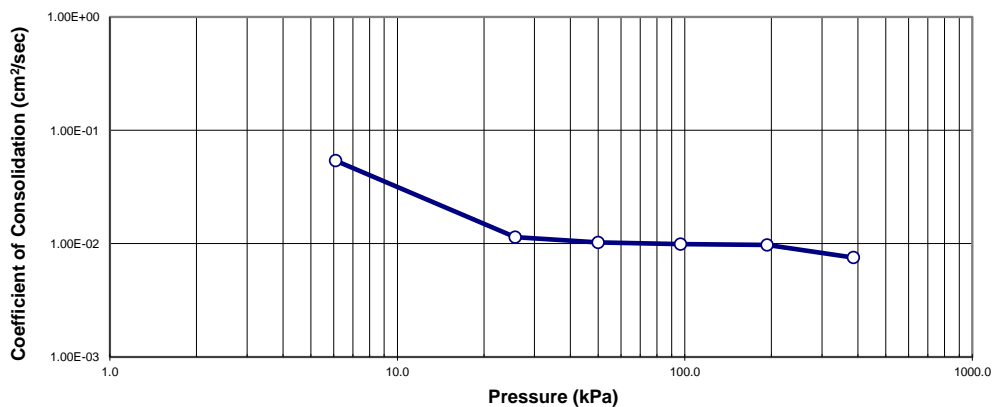
**LOADING:** A seating load of 6.1 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after a constant load increment duration of 24 hours. Creep stages were conducted at 193.2 kPa and 385.7 kPa; and were maintained for 9 and 10 days, respectively.

**CALCULATIONS:** Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	$D_{90}$ (mm)	$t_{90}$ (min)	$c_v$ (cm <sup>2</sup> /s)	Void Ratio	$m_v$ (m <sup>2</sup> /kN)	$k$ (cm/s)
0.0	25.400					0.795		
6.1	25.380	25.390	-0.019	0.42	5.39E-02	0.794	1.29E-04	6.82E-07
25.7	25.263	25.322	-0.085	1.99	1.14E-02	0.785	2.35E-04	2.63E-07
49.9	25.187	25.225	-0.043	2.19	1.03E-02	0.780	1.24E-04	1.25E-07
96.6	25.051	25.119	-0.078	2.25	9.91E-03	0.770	1.16E-04	1.12E-07
193.2	24.784	24.918	-0.150	2.25	9.75E-03	0.751	1.10E-04	1.05E-07
193.2 (Creep)	24.738	24.761				0.748		
385.7	24.044	24.391	-0.303	2.79	7.54E-03	0.699	1.46E-04	1.08E-07
385.7 (Creep)	23.680	23.862				0.673		

**Coefficient of Consolidation vs. Pressure**

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-3 ST20 75'-77'  
Oedometer Consolidation Test



Note:  $C_v$  and  $k$  calculated using  $t_{90}$  values (square root of time method)

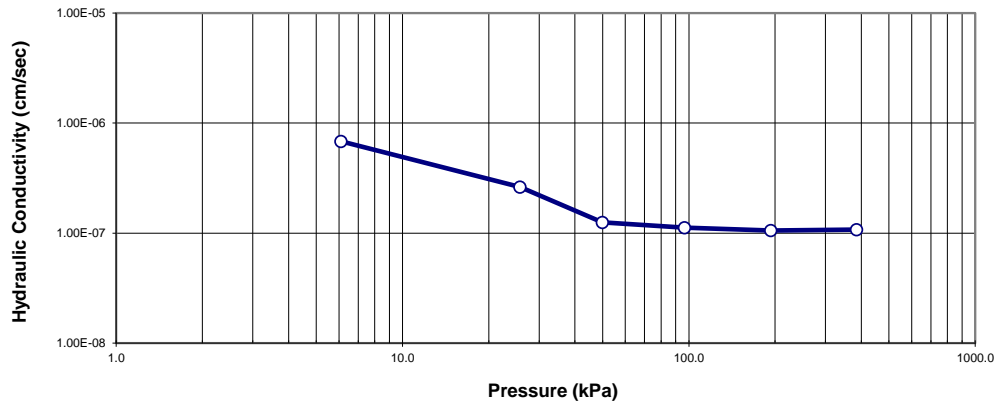
## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-3 ST20 75'-77'

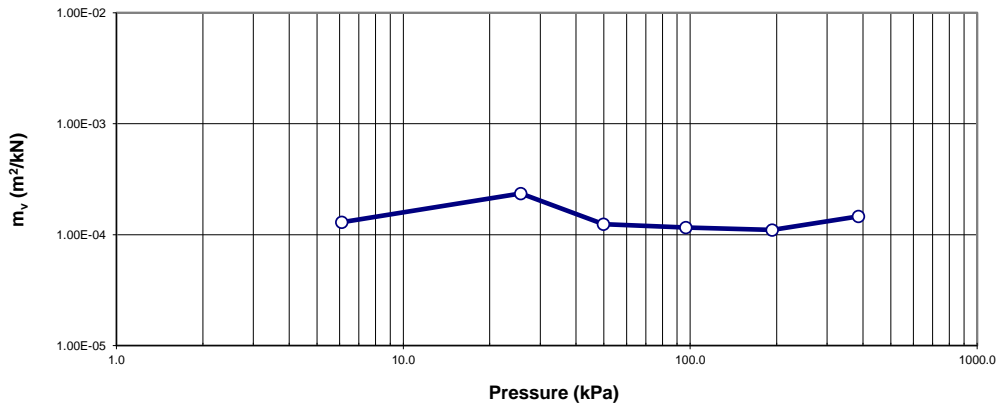
**Hydraulic Conductivity vs. Pressure**

Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-3 ST20 75'-77'



**$m_v$  vs. Pressure**

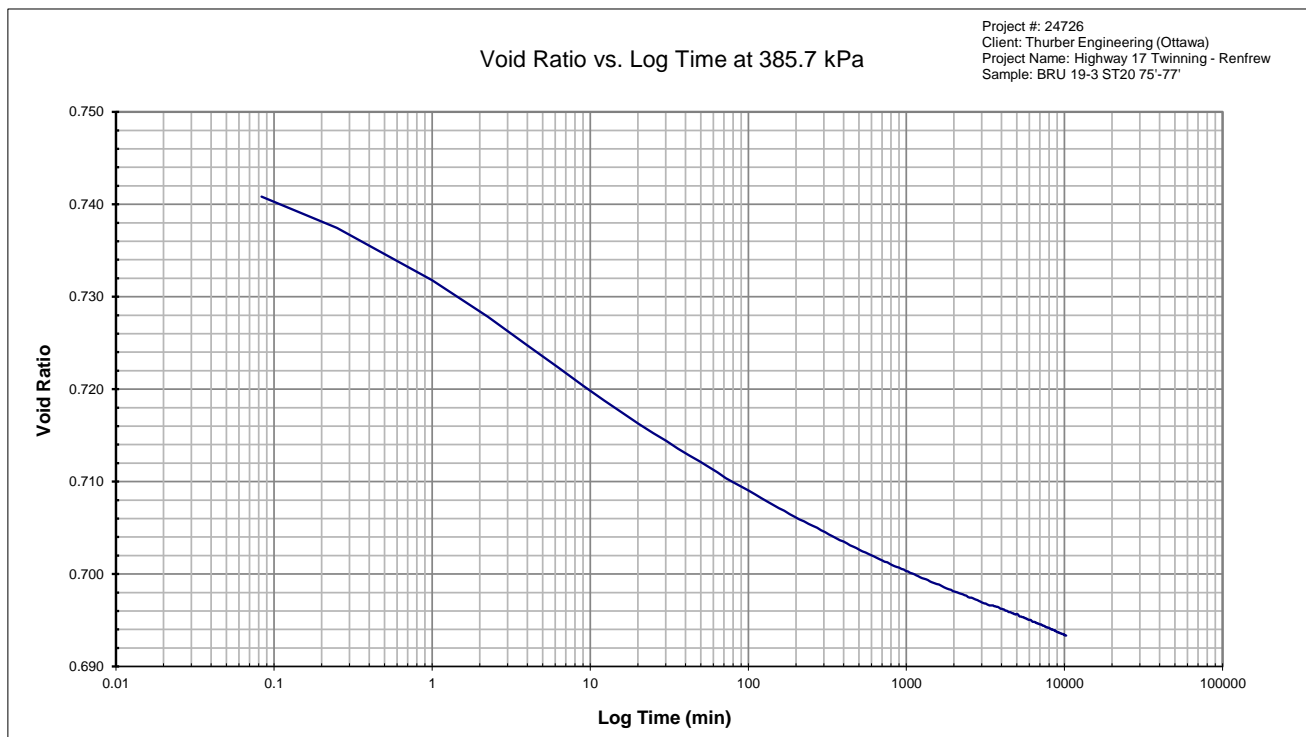
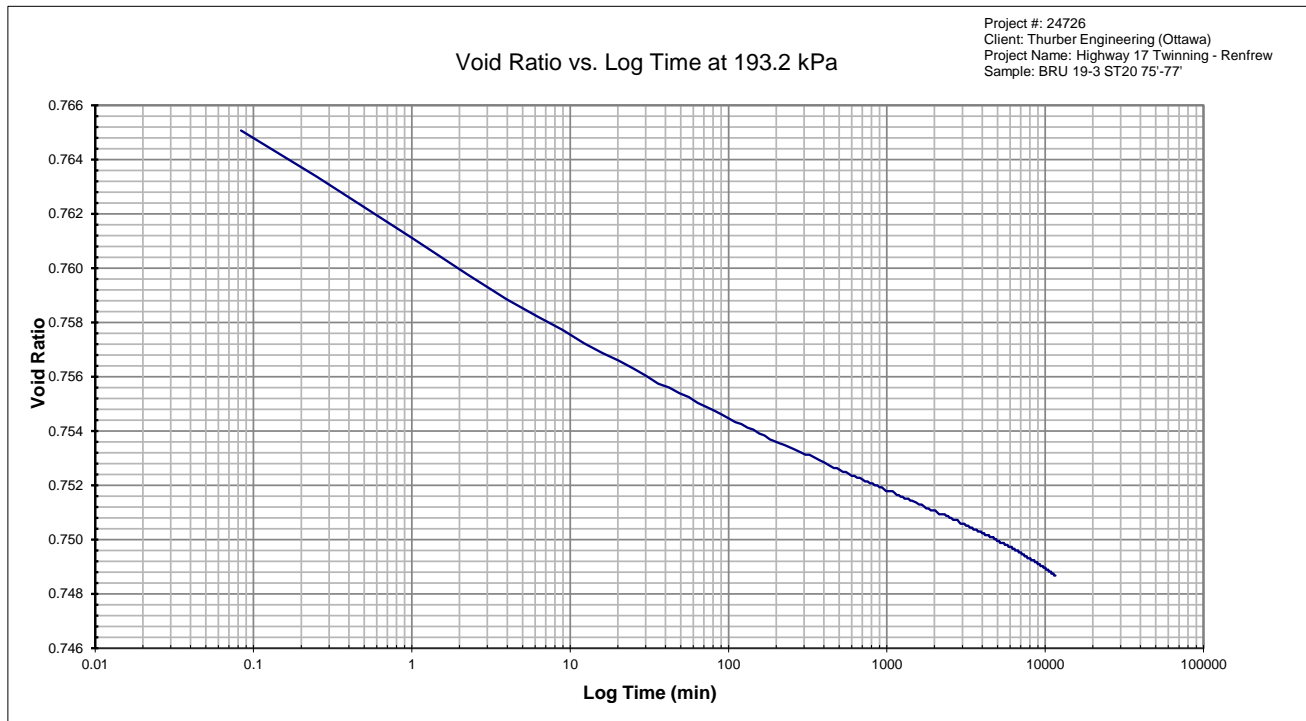
Project #: 24726  
Client: Thurber Engineering (Ottawa)  
Project Name: Highway 17 Twinning - Renfrew  
Sample: BRU 19-3 ST20 75'-77'



## Consolidation Test Report

Highway 17 Twinning - Renfrew  
24726

BRU 19-3 ST20 75'-77'





## **Appendix C.5**

### **Triaxial Test Results**

#### **Unconfined Compressive Strength Test Results**

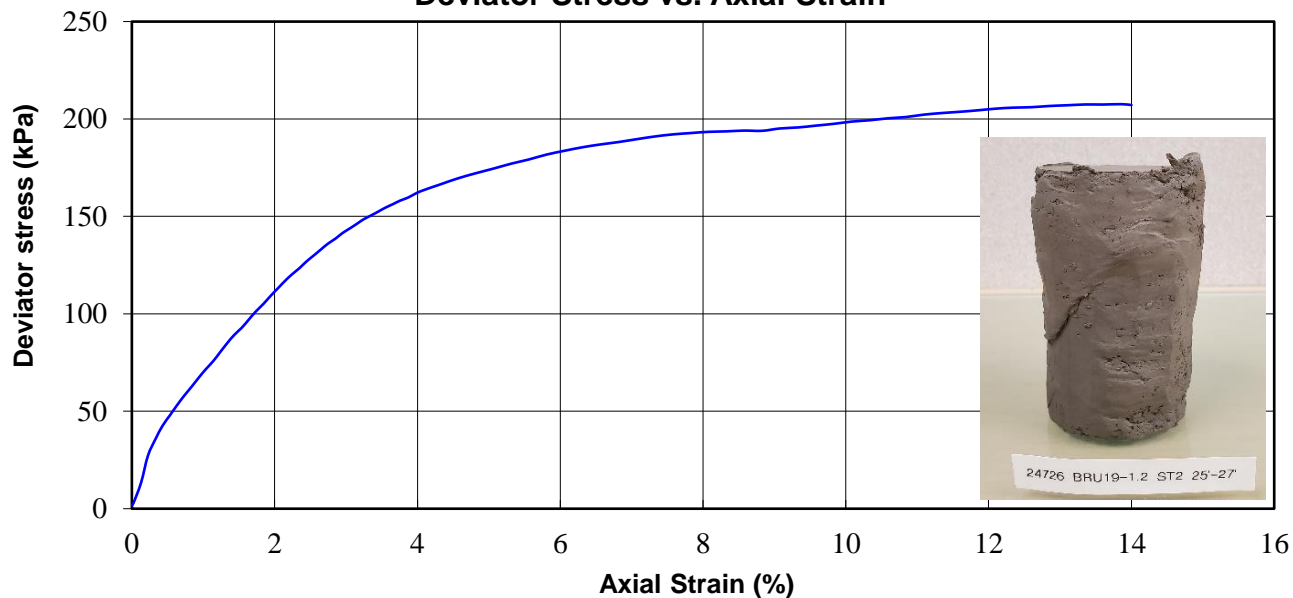
## UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST REPORT

### ASTM D2850

CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 - Twinning	REPORT DATE:	17-May-21
BOREHOLE No.:	BRU19-1.2	TEST DATE:	14-May-21
SAMPLE No.:	ST2	ATTERBERG LIMITS:	LL = 36.6, PL = 21.2
SAMPLE DEPTH:	25'-27'	PARTICLE SIZES:	CL = 49%, SI = 51%
DESCRIPTION:	Silty clay, grey, moist		SA = 0%, GR = 0%
Avg. Height (mm):	108.7	Weight (g):	400.2
Avg. Diameter (mm):	50.4	Wet Density (kg/m <sup>3</sup> ):	1,845
H. to Dia. Ratio:	2.2:1	Dry Density (kg/m <sup>3</sup> ):	1,347
Cross Sectional Area (mm <sup>2</sup> ):	1995.0	Moisture Content* (%):	37.0
G <sub>s</sub> (Measured):	2.754	Void Ratio:	1.045

Rate of Strain to Failure (% / min):	1
Minor principal stress, $\sigma_3$ (kPa)	110
Major principal stress, $\sigma_1$ (kPa)	318
Deviator Stress at failure (kPa)	208
Vertical Strain at failure (%)	13.9

**Deviator Stress vs. Axial Strain**



Note: \* Moisture content was obtained from the entire specimen after the test  
 \*\* Type of Failure: Diagonal Shear

TEST DONE BY: BT  
 REVIEWED BY: JPL

24726 BRU19-1.2 ST2 25'-27' UU

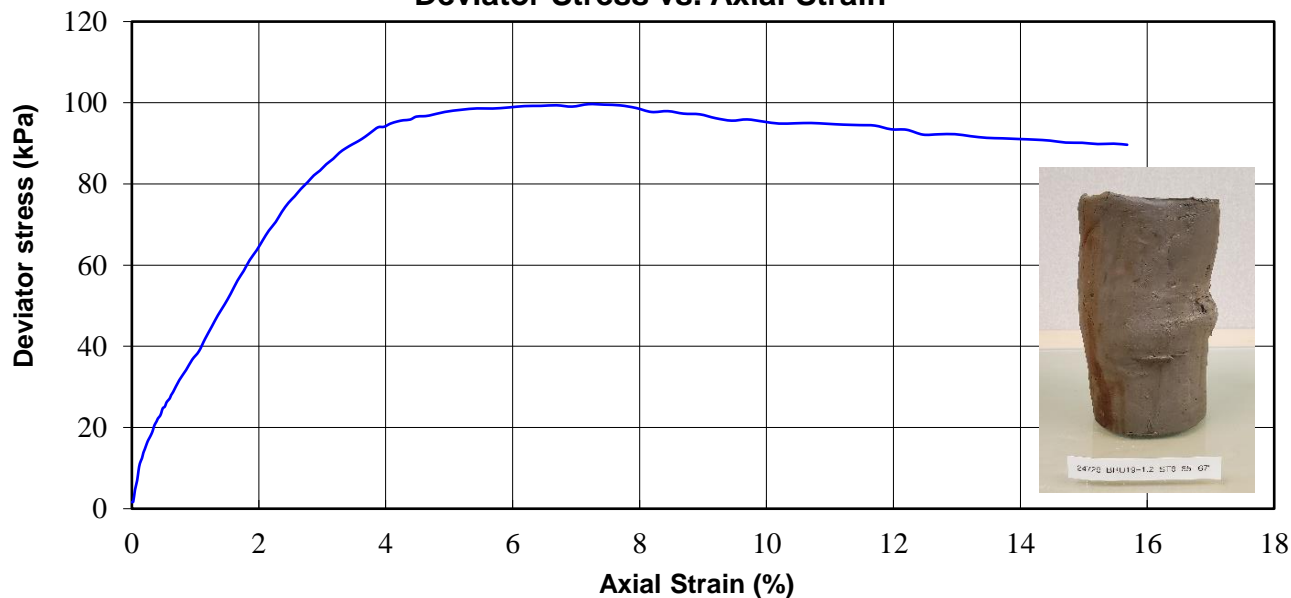
## UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST REPORT

### ASTM D2850

CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 - Twinning	REPORT DATE:	9-Jun-21
BOREHOLE No.:	BRU19-1.2	TEST DATE:	12-May-21
SAMPLE No.:	ST6	ATTERBERG LIMITS:	LL = 17.5, PL = 13.7
SAMPLE DEPTH:	65'-67'	PARTICLE SIZES:	CL = 33%, SI = 66%
DESCRIPTION:	Silty clay, grey, moist		SA = 1%, GR = 0%
Avg. Height (mm):	154.5	Weight (g):	1052.0
Avg. Diameter (mm):	66.9	Wet Density (kg/m <sup>3</sup> ):	1,937
H. to Dia. Ratio:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	1,418
Cross Sectional Area (mm <sup>2</sup> ):	3515.1	Moisture Content* (%):	36.6
G <sub>s</sub> (Measured):	2.755	Void Ratio:	0.943

Rate of Strain to Failure (% / min):	1
Minor principal stress, $\sigma_3$ (kPa)	201
Major principal stress, $\sigma_1$ (kPa)	301
Deviator Stress at failure (kPa)	100
Vertical Strain at failure (%)	7.2

**Deviator Stress vs. Axial Strain**



Note: \* Moisture content was obtained from the entire specimen after the test  
 \*\* Type of Failure: Bulge

TEST DONE BY: BT  
 REVIEWED BY: JPL

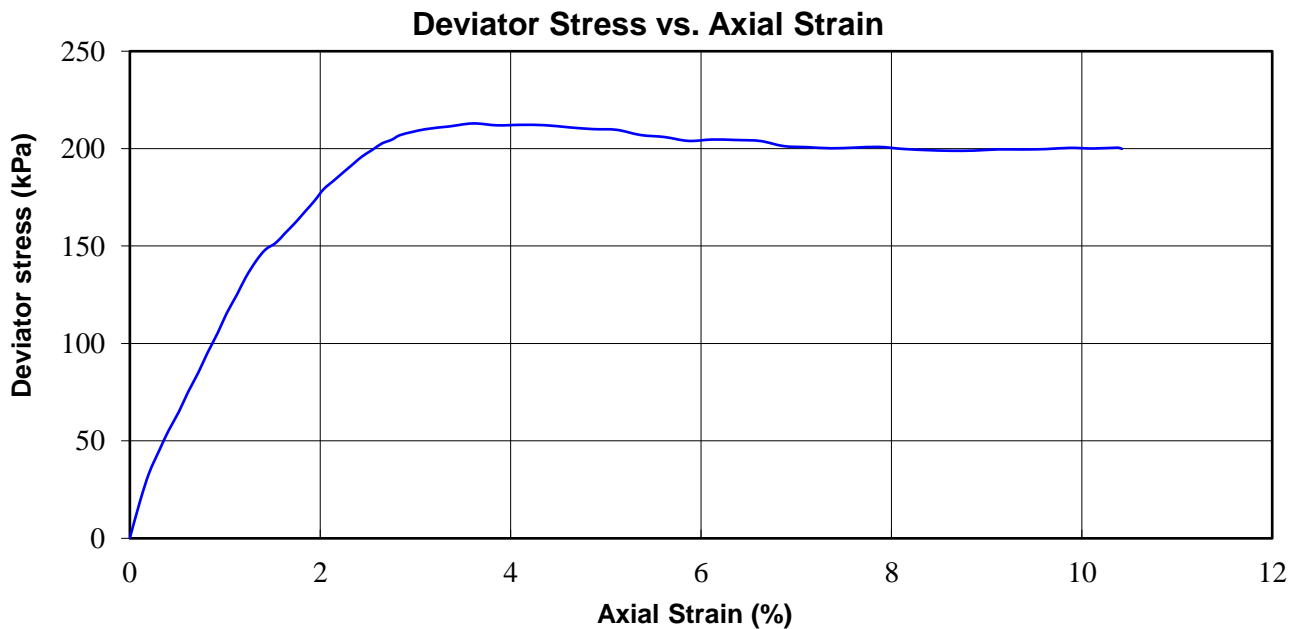
24726 BRU19-1.2 ST6 65'-67' - UU

## UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST REPORT

### ASTM D2850

CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 - Twinning	REPORT DATE:	11-Feb-21
BOREHOLE No.:	BRU19-3.2	TEST DATE:	27-Jan-21
SAMPLE No.:	ST3	ATTERBERG LIMITS:	LL = 31.3, PL = 20.8
SAMPLE DEPTH:	45'-47'	PARTICLE SIZES:	CL = 43%, SI = 57%
DESCRIPTION:	Silty clay, grey, moist		SA = 0%, GR = 0%
Avg. Height (mm):	151.8	Weight (g):	1041.0
Avg. Diameter (mm):	69.5	Wet Density (kg/m <sup>3</sup> ):	1,808
H. to Dia. Ratio:	2.2:1	Dry Density (kg/m <sup>3</sup> ):	1,303
Cross Sectional Area (mm <sup>2</sup> ):	3793.7	Moisture Content* (%):	38.7
G <sub>s</sub> (Measured):	2.775	Void Ratio:	1.129

Rate of Strain to Failure (% / min):	1
Minor principal stress, $\sigma_3$ (kPa)	305
Major principal stress, $\sigma_1$ (kPa)	518
Deviator Stress at failure (kPa)	213
Vertical Strain at failure (%)	3.6



Note: \* Moisture content was obtained from the entire specimen after the test  
 \*\* Type of Failure: Diagonal shear

TEST DONE BY: BT  
 REVIEWED BY: JPL

24726 BRU19-3.2 ST3 45'-47' - UU

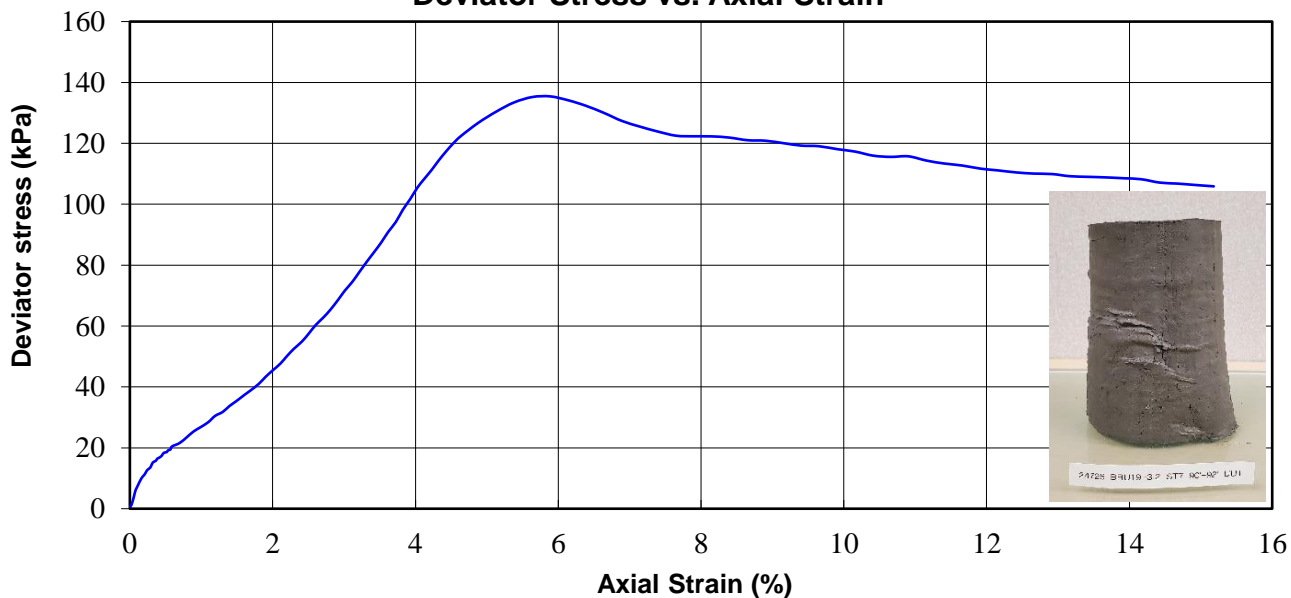
## UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST REPORT

### ASTM D2850

CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 - Twinning	REPORT DATE:	9-Jun-21
BOREHOLE No.:	BRU19-3.2	TEST DATE:	18-May-21
SAMPLE No.:	ST7	ATTERBERG LIMITS:	LL = 20.5, PL = 17.4
SAMPLE DEPTH:	90'-92'	PARTICLE SIZES:	CL = 23%, SI = 77%
DESCRIPTION:	Silt, clayey, grey, moist		SA = 0%, GR = 0%
Avg. Height (mm):	144.9	Weight (g):	1041.9
Avg. Diameter (mm):	67.9	Wet Density (kg/m <sup>3</sup> ):	1,986
H. to Dia. Ratio:	2.1:1	Dry Density (kg/m <sup>3</sup> ):	1,533
Cross Sectional Area (mm <sup>2</sup> ):	3621.0	Moisture Content* (%):	29.5
G <sub>s</sub> (Measured):	2.773	Void Ratio:	0.808

Rate of Strain to Failure (% / min):	1
Minor principal stress, $\sigma_3$ (kPa)	240
Major principal stress, $\sigma_1$ (kPa)	375
Deviator Stress at failure (kPa)	135
Vertical Strain at failure (%)	5.9

**Deviator Stress vs. Axial Strain**



Note: \* Moisture content was obtained from the entire specimen after the test  
 \*\* Type of Failure: Diagonal Shear

TEST DONE BY: BT  
 REVIEWED BY: JPL

24726 BRU19-3.2 ST7 90'-92' UU



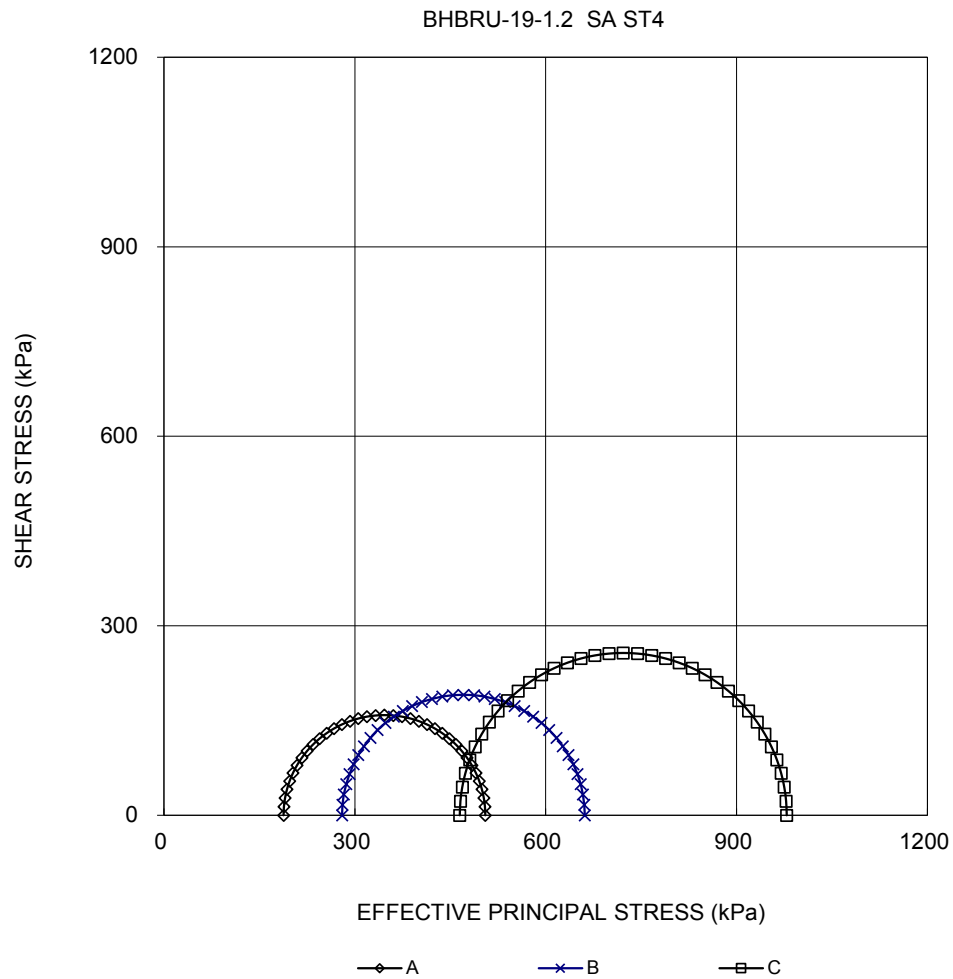
CONSOLIDATED DRAINED TRIAXIAL ASTM D7181 SHEET 1 OF 4		FIGURE	
TEST STAGE	A	B	C
BOREHOLE NUMBER	BRU19-1.2		
SAMPLE NUMBER	ST4		
DEPTH, m	14.63-14.94		
SPECIMEN DIAMETER, cm	6.96	7.00	7.02
SPECIMEN HEIGHT, cm	14.03	13.91	14.01
NATURAL WATER CONTENT, %	45.2	46.9	43.6
DRY DENSITY, Mg/m <sup>3</sup>	1.19	1.19	1.24
WATER CONTENT BEFORE CONSOLIDATION, %	43.7	43.7	40.3
CELL PRESSURE, $\sigma_3$ , kPa	458.0	550.0	735.0
BACK PRESSURE, kPa	270.0	270.0	270.0
PORE PRESSURE PARAMETER "B"	0.96	0.96	0.96
CONSOLIDATION PRESSURE, $\sigma_c$ , kPa	188.0	280.0	465.0
VOLUMETRIC STRAIN DURING CONSOLIDATION, %	3.1	4.9	6.2
WATER CONTENT AFTER CONSOLIDATION, %	41.1	39.6	35.3
AVERAGE RATE OF STRAIN, %/hr	0.5	0.5	0.5
TIME TO FAILURE, HOURS	12	16	30
WATER CONTENT AFTER TEST, %	39.5	36.9	34.4
MAX. DEVIATOR STRESS, $(\sigma_1 - \sigma_3)$ , kPa	317.1	381.5	513.9
AXIAL STRAIN AT $(\sigma_1 - \sigma_3)$ MAXIMUM, %	6.0	7.8	15.0
MAX PRINCIPAL STRESS RATIO, $(\sigma'_1 / \sigma'_3)$ maximum	2.7	2.4	2.2
FILTER DRAINS USED, y/n	y	y	y
TEST NOTES:			
Specimen A taken 0-15 cm from top of tube.			
Specimen B taken 15-35.5cm from top of tube.			
Specimen C taken 35.5-52cm from top of tube.			
FAILURE PLANE NUMBER	-	1.0	-
ANGLE OF FAILURE, DEGREES	Bulged	55.0	Bulged
Date: 4/01/2021			
Project No. 21453742(3000)		Prepared By: LH	
Golder Associates		Checked By: MM	

CONSOLIDATED DRAINED TRIAXIAL

ASTM D7181

SHEET 2 OF 4

FIGURE



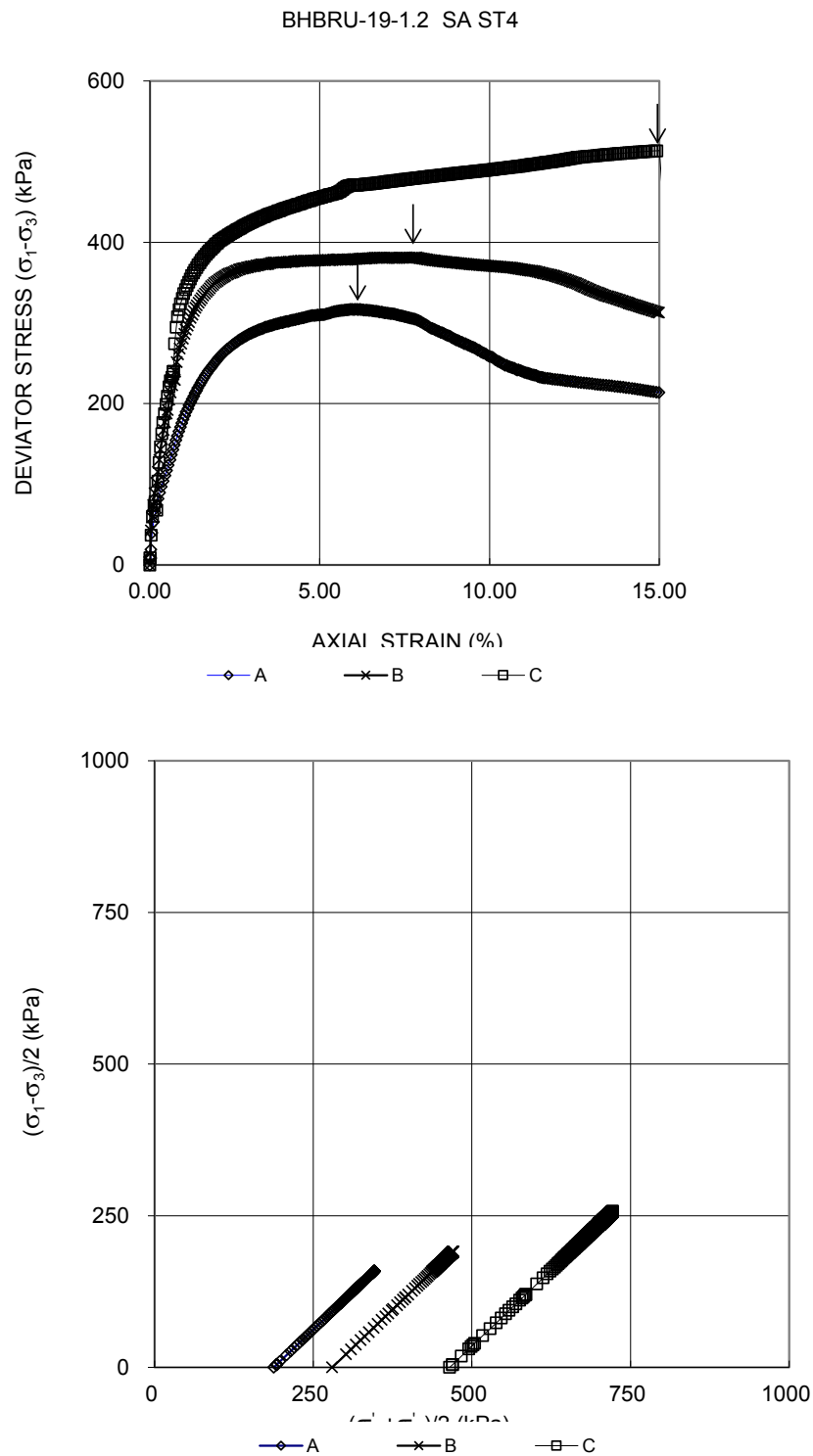
Date: 4/01/2021  
Project No. 21453742(3000)

**Golder Associates**

Prepared By: LH  
Checked By: MM

**CONSOLIDATED DRAINED TRIAXIAL**  
**ASTM D7181**  
**SHEET 3 OF 4**

**FIGURE**



Date: 4/01/2021  
 Project No. 21453742(3000)

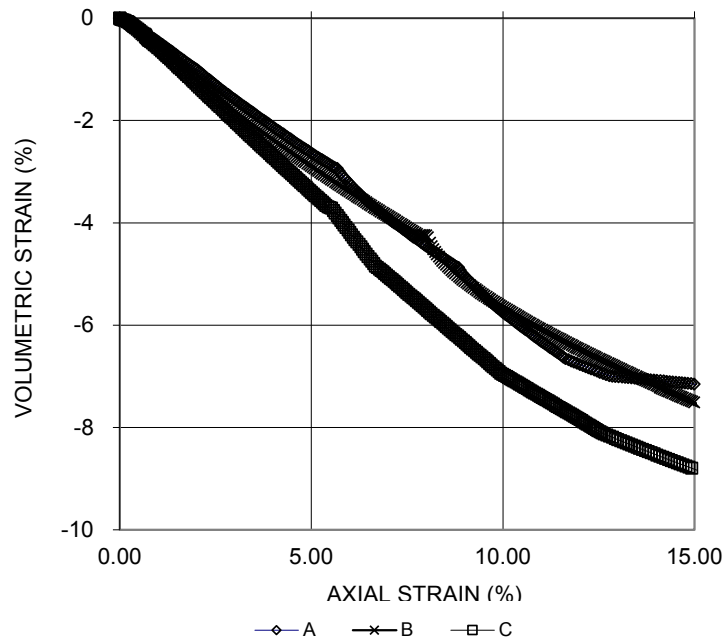
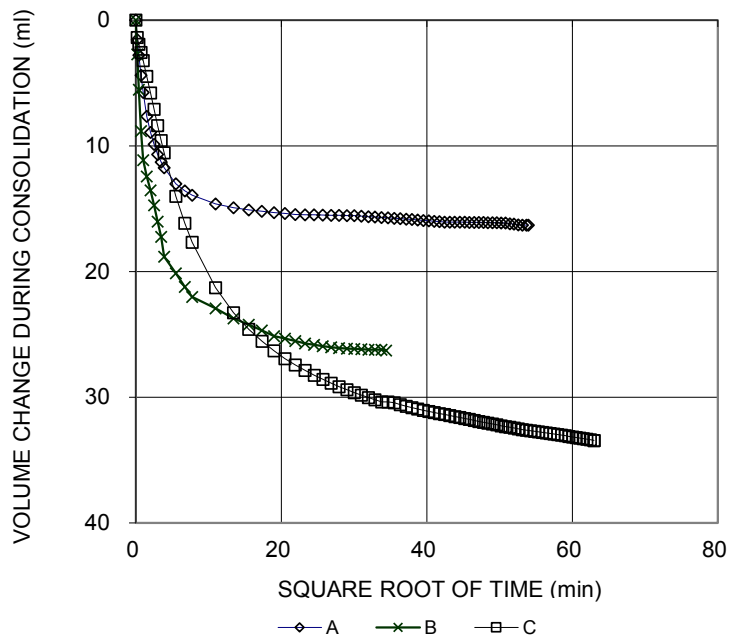
**Golder Associates**

Prepared By: LH  
 Checked By: MM

CONSOLIDATED DRAINED TRIAXIAL  
ASTM D7181  
SHEET 4 OF 4

FIGURE

BHBRU-19-1.2 SA ST4



NOTES: POSITIVE (+) VOLUMETRIC STRAIN = SAMPLE VOLUME DECREASING  
NEGATIVE ( - ) VOLUMETRIC STRAIN = SAMPLE VOLUME INCREASING

Date: 4/01/2021  
Project No. 21453742(3000)

**Golder Associates**

Prepared By: LH  
Checked By: MM

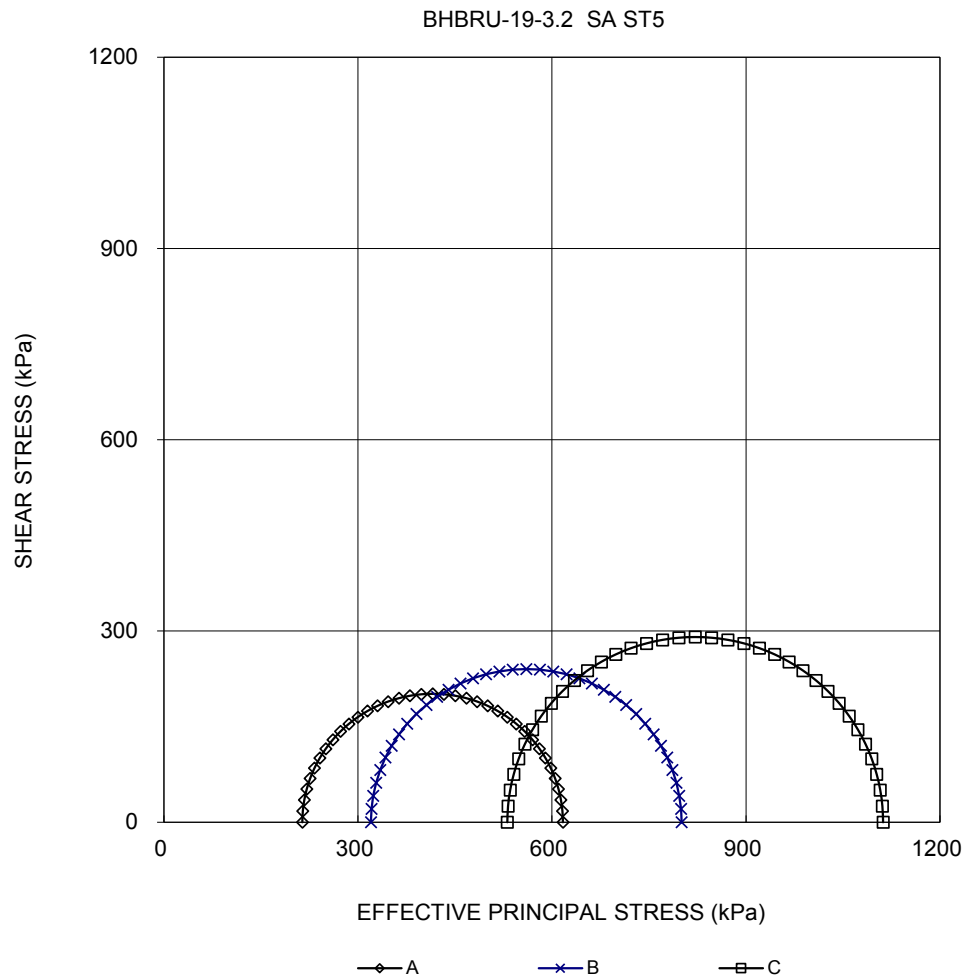
<b>CONSOLIDATED DRAINED TRIAXIAL</b> <b>ASTM D7181</b> <b>SHEET 1 OF 4</b>		<b>FIGURE</b>	
TEST STAGE	A	B	C
BOREHOLE NUMBER	BRU19-3.2		
SAMPLE NUMBER	ST5		
DEPTH, m	18.29-18.90		
SPECIMEN DIAMETER, cm	6.97	6.97	6.97
SPECIMEN HEIGHT, cm	14.01	14.00	14.01
NATURAL WATER CONTENT, %	34.3	35.5	38.2
DRY DENSITY, Mg/m <sup>3</sup>	1.41	1.38	1.32
WATER CONTENT BEFORE CONSOLIDATION, %	33.2	33.6	36.4
CELL PRESSURE, $\sigma_3$ , kPa	414.0	590.0	731.0
BACK PRESSURE, kPa	200.0	270.0	200.0
PORE PRESSURE PARAMETER "B"	0.96	0.96	0.96
CONSOLIDATION PRESSURE, $\sigma_c$ , kPa	214.0	320.0	531.0
VOLUMETRIC STRAIN DURING CONSOLIDATION, %	2.7	3.4	7.2
WATER CONTENT AFTER CONSOLIDATION, %	31.3	31.2	31.0
AVERAGE RATE OF STRAIN, %/hr	0.5	0.5	0.5
TIME TO FAILURE, HOURS	10	30	27
WATER CONTENT AFTER TEST, %	31.1	27.9	30.1
MAX. DEVIATOR STRESS, $(\sigma_1 - \sigma_3)$ , kPa	403.0	480.5	581.1
AXIAL STRAIN AT $(\sigma_1 - \sigma_3)$ MAXIMUM, %	5.0	15.0	13.3
MAX PRINCIPAL STRESS RATIO, $(\sigma'_1 / \sigma'_3)$ maximum	2.9	2.5	0.0
FILTER DRAINS USED, y/n	y	y	y
TEST NOTES:	<p>Specimen A taken 0-15 cm from top of tube.</p> <p>Specimen B taken 15-33cm from top of tube.</p> <p>Specimen C taken 33-51cm from top of tube.</p>		
FAILURE PLANE NUMBER	1.0	-	-
ANGLE OF FAILURE, DEGREES	65.0	Bulged	Bulged
<div> <div>Date: 3/31/2021</div> <div>Project No. 21453742(3000)</div> </div> <div> <b>Golder Associates</b> </div> <div> <div>Prepared By: LH</div> <div>Checked By: MM</div> </div>			

CONSOLIDATED DRAINED TRIAXIAL

ASTM D7181

SHEET 2 OF 4

FIGURE



Date: 3/31/2021  
Project No. 21453742(3000)

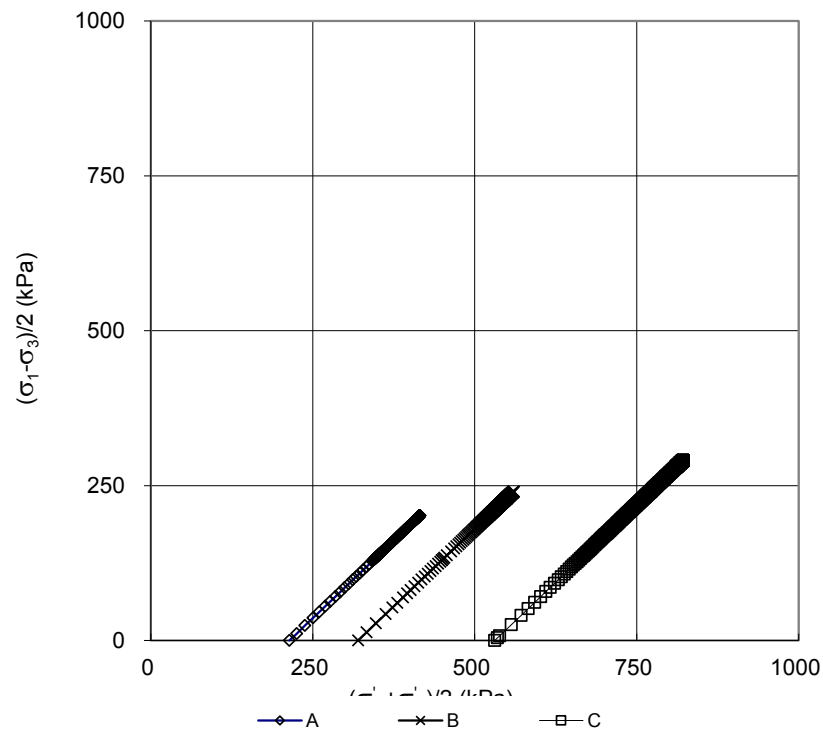
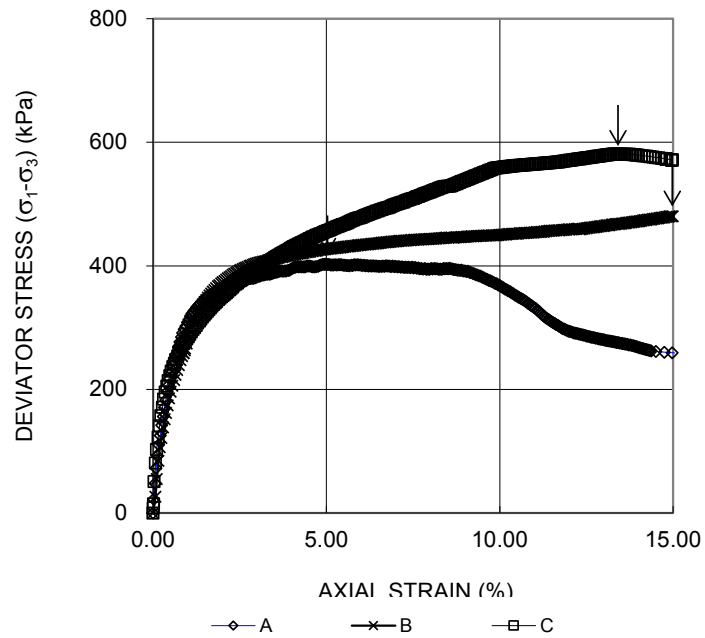
**Golder Associates**

Prepared By: LH  
Checked By: MM

**CONSOLIDATED DRAINED TRIAXIAL**  
**ASTM D7181**  
**SHEET 3 OF 4**

**FIGURE**

BHBRU-19-3.2 SA ST5



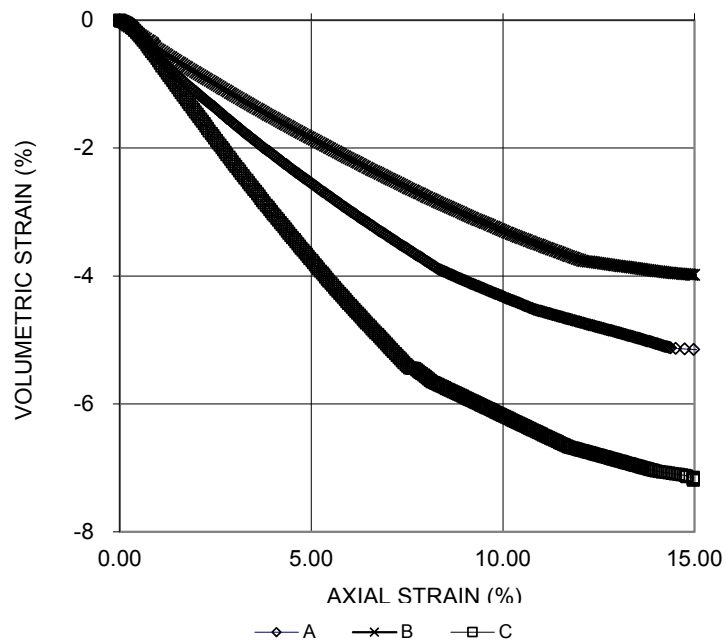
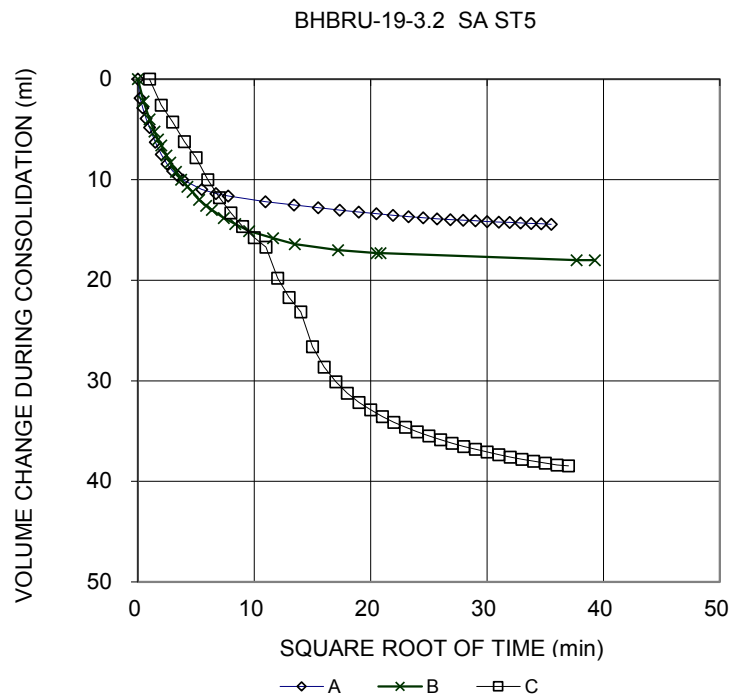
Date: 3/31/2021  
 Project No. 21453742(3000)

**Golder Associates**

Prepared By: LH  
 Checked By: MM

**CONSOLIDATED DRAINED TRIAXIAL  
ASTM D7181  
SHEET 4 OF 4**

**FIGURE**



NOTES: POSITIVE (+) VOLUMETRIC STRAIN = SAMPLE VOLUME DECREASING  
 NEGATIVE ( - ) VOLUMETRIC STRAIN = SAMPLE VOLUME INCREASING

Date: 3/31/2021  
 Project No. 21453742(3000)

**Golder Associates**

Prepared By: LH  
 Checked By: MM



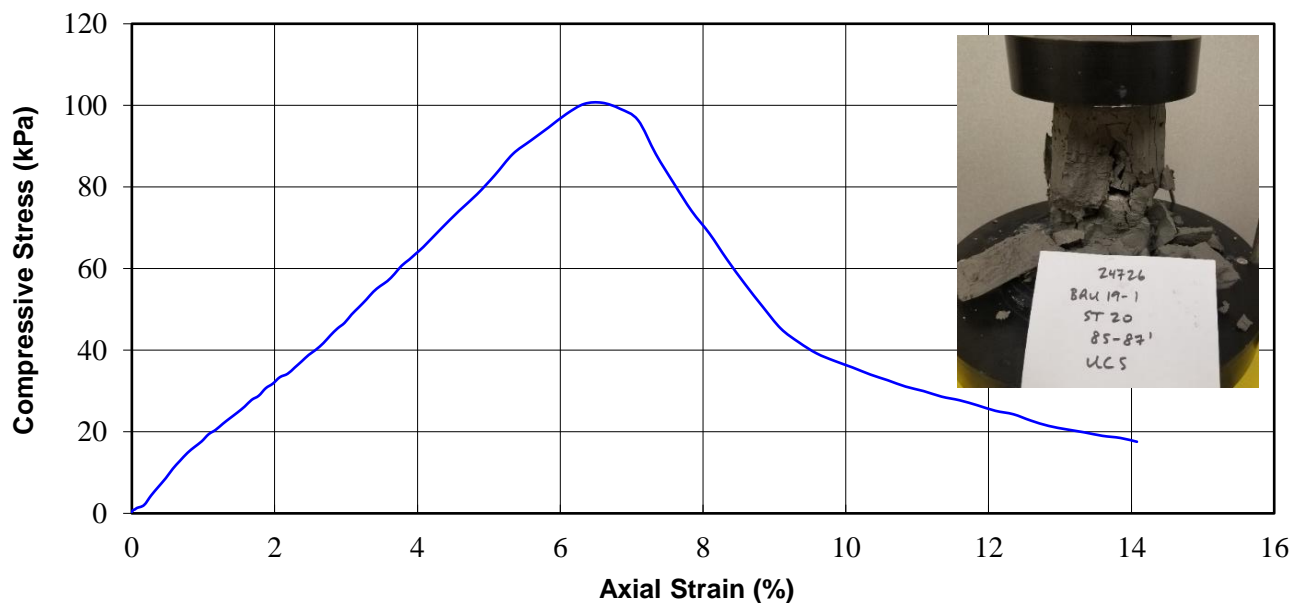
## UNCONFINED COMPRESSIVE STRENGTH TEST REPORT

### ASTM D2166 - 16

CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 - Twinning	REPORT DATE:	11-Feb-21
BOREHOLE No.:	BRU19-1	TEST DATE:	18-Nov-20
SAMPLE No.:	ST20	ATTERBERG LIMITS:	LL = 29.3, PL = 14.2
SAMPLE DEPTH:	85'-87'	PARTICLE SIZES:	CL = 36%, SI = 58%
DESCRIPTION:	Silty clay, trace sand, grey, moist		SA = 6%, GR = 0%
Avg. Height (mm):	140	Weight (g):	999.3
Avg. Diameter (mm):	69	Wet Density (kg/m <sup>3</sup> ):	1,909
H. to Dia. Ratio:	2:1	Dry Density (kg/m <sup>3</sup> ):	1,404
Cross Sectional Area (mm <sup>2</sup> ):	3739.3	Moisture Content* (%):	36.0

Avg. Rate of Strain to Failure:	1 % / min
Unconfined Compressive Strength:	100.6 kPa @ 6.6 % strain
Shear Strength:	50.3 kPa

### Compressive Stress vs. Axial Strain



Note: \* Moisture content was obtained from the entire specimen after the test  
 \*\* Type of Failure: Multiple sub-vertical splits

TEST DONE BY: BT  
 REVIEWED BY: JPL

24726 BRU19-1 ST20 85'-87' UCS

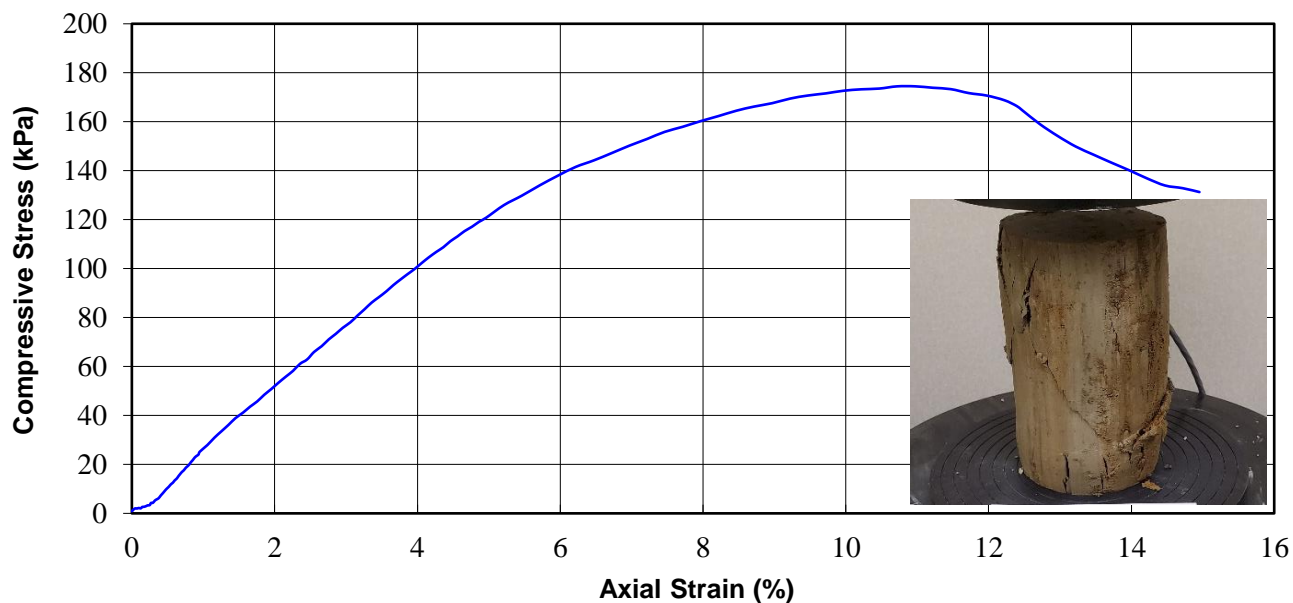
## UNCONFINED COMPRESSIVE STRENGTH TEST REPORT

### ASTM D2166 - 16

CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 - Twinning	REPORT DATE:	11-Feb-21
BOREHOLE No.:	BRU19-3	TEST DATE:	24-Nov-20
SAMPLE No.:	ST7	ATTERBERG LIMITS:	LL = 62.3, PL = 22.3
SAMPLE DEPTH:	15'-17'	PARTICLE SIZES:	CL = 54%, SI = 45%
DESCRIPTION:	Silty clay, trace sand, grey, moist		SA = 1%, GR = 0%
Avg. Height (mm):	150	Weight (g):	1041.6
Avg. Diameter (mm):	69	Wet Density (kg/m <sup>3</sup> ):	1,857
H. to Dia. Ratio:	2.2:1	Dry Density (kg/m <sup>3</sup> ):	1,339
Cross Sectional Area (mm <sup>2</sup> ):	3739.3	Moisture Content* (%):	38.7

Avg. Rate of Strain to Failure:	1 % / min
Unconfined Compressive Strength:	174.5 kPa @ 11 % strain
Shear Strength:	87.2 kPa

**Compressive Stress vs. Axial Strain**



Note: \* Moisture content was obtained from the entire specimen after the test  
 \*\* Type of Failure: Diagonal shear

TEST DONE BY: BT  
 REVIEWED BY: JPL

24726 BRU19-3 ST7 15'-17' UCS

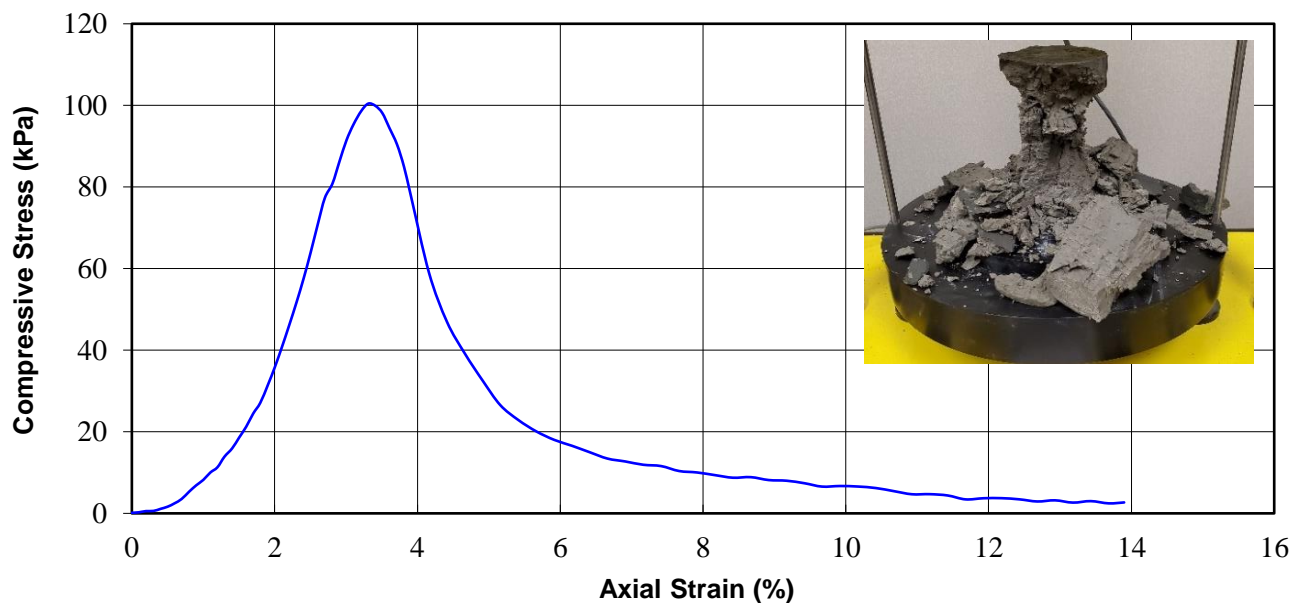
## UNCONFINED COMPRESSIVE STRENGTH TEST REPORT

### ASTM D2166 - 16

CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 - Twinning	REPORT DATE:	11-Feb-21
BOREHOLE No.:	BRU19-3	TEST DATE:	23-Nov-20
SAMPLE No.:	ST25	ATTERBERG LIMITS:	LL = 32.7, PL = 16.2
SAMPLE DEPTH:	100'-102'	PARTICLE SIZES:	CL = 37%, SI = 61%
DESCRIPTION:	Silty clay, trace sand, grey, moist		SA = 2%, GR = 0%
Avg. Height (mm):	135	Weight (g):	978.2
Avg. Diameter (mm):	69	Wet Density (kg/m <sup>3</sup> ):	1,938
H. to Dia. Ratio:	2:1	Dry Density (kg/m <sup>3</sup> ):	1,433
Cross Sectional Area (mm <sup>2</sup> ):	3739.3	Moisture Content* (%):	35.2

Avg. Rate of Strain to Failure:	1 % / min
Unconfined Compressive Strength:	100.4 kPa @ 3.3 % strain
Shear Strength:	50.2 kPa

### Compressive Stress vs. Axial Strain



Note: \* Moisture content was obtained from the entire specimen after the test  
 \*\* Type of Failure: Multiple sub-vertical splits

TEST DONE BY: BT  
 REVIEWED BY: JPL

24726 BRU19-3 ST25 100'-102' UCS



## **Appendix C.6**

### **Analytical Test Results**

## Certificate of Analysis

### Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104  
Ottawa, ON K1B 4S5  
Attn: Justin Gray

Client PO: 24726  
Project: Hwy 17, Bruce Street Interchange  
Custody: 49179

Report Date: 20-Oct-2019  
Order Date: 16-Oct-2019

**Order #: 1942188**

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

**Paracel ID**

1942188-01  
1942188-02  
1942188-03

**Client ID**

BRU19-1, SS4 (7'6" - 9'6")  
BRU19-2, SS3 (5' - 7')  
BRU19-3, SS5 (10' - 12')

Approved By:



Mark Foto, M.Sc.  
Lab Supervisor

Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 24726

Report Date: 20-Oct-2019

Order Date: 16-Oct-2019

Project Description: Hwy 17, Bruce Street Interchange

### Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	17-Oct-19	17-Oct-19
Conductivity	MOE E3138 - probe @25 °C, water ext	17-Oct-19	18-Oct-19
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	18-Oct-19	19-Oct-19
Resistivity	EPA 120.1 - probe, water extraction	17-Oct-19	18-Oct-19
Solids, %	Gravimetric, calculation	17-Oct-19	17-Oct-19

Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 24726

Report Date: 20-Oct-2019

Order Date: 16-Oct-2019

Project Description: Hwy 17, Bruce Street Interchange

<b>Client ID:</b>	BRU19-1, SS4 (7'6" - 9'6")	BRU19-2, SS3 (5' - 7')	BRU19-3, SS5 (10' - 12')	-
<b>Sample Date:</b>	07-Oct-19 09:00	15-Oct-19 09:00	27-Sep-19 09:00	-
<b>Sample ID:</b>	1942188-01	1942188-02	1942188-03	-
<b>MDL/Units</b>	Soil	Soil	Soil	-

**Physical Characteristics**

% Solids	0.1 % by Wt.	71.4	71.2	75.6	-
----------	--------------	------	------	------	---

**General Inorganics**

Conductivity	5 uS/cm	206	1910	1110	-
pH	0.05 pH Units	7.78	7.91	7.50	-
Resistivity	0.10 Ohm.m	48.5	5.24	9.02	-

**Anions**

Chloride	5 ug/g dry	9	1280	662	-
Sulphate	5 ug/g dry	9	55	38	-

Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 24726

Report Date: 20-Oct-2019

Order Date: 16-Oct-2019

Project Description: Hwy 17, Bruce Street Interchange

### Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
<b>General Inorganics</b>									
Conductivity	ND	5	uS/cm						
Resistivity	ND	0.10	Ohm.m						



Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 24726

Report Date: 20-Oct-2019

Order Date: 16-Oct-2019

Project Description: Hwy 17, Bruce Street Interchange

### Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	120	5	ug/g dry	123			3.1	20	
Sulphate	323	5	ug/g dry	332			2.8	20	
<b>General Inorganics</b>									
Conductivity	114	5	uS/cm	117			2.6	5	
pH	7.30	0.05	pH Units	7.33			0.4	2.3	
Resistivity	87.7	0.10	Ohm.m	85.5			2.6	20	
<b>Physical Characteristics</b>									
% Solids	87.2	0.1	% by Wt.	87.5			0.4	25	

Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 24726

Report Date: 20-Oct-2019

Order Date: 16-Oct-2019

Project Description: Hwy 17, Bruce Street Interchange

### Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	215	5	ug/g	123	91.2	82-118			
Sulphate	421	5	ug/g	332	88.8	80-120			

Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 24726

Report Date: 20-Oct-2019

Order Date: 16-Oct-2019

Project Description: Hwy 17, Bruce Street Interchange

**Qualifier Notes:**

None

**Sample Data Revisions**

None

**Work Order Revisions / Comments:**

None

**Other Report Notes:**

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

## Subcontracted Analysis

**Thurber Engineering Ltd.**

2460 Lancaster Rd, Suite 104  
Ottawa, ON K1B 4S5  
Attn: Justin Gray

Tel: (613) 408-6795  
Fax: (613) 247-2185

Paracel Report No **1942188**  
Client Project(s): **Hwy 17, Bruce Street Interchange**  
Client PO: **24726**  
Reference: **Standing Offer**  
CoC Number: **49179**

Order Date: 16-Oct-19  
Report Date: 20-Oct-19

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Paracel ID	Client ID	Analysis
1942188-01	BRU19-1, SS4 (7'6" - 9'6")	Sulphide, solid
1942188-02	BRU19-2, SS3 (5' - 7')	Sulphide, solid
1942188-03	BRU19-3, SS5 (10' - 12')	Sulphide, solid

**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.  
Lakefield - Ontario - K0L 2H0  
Phone: 705-652-2000 FAX: 705-652-6365

**Paracel Laboratories**

Attn : Dale Robertson

300-2319 St.Laurent Blvd.  
Ottawa, ON  
K1G 4K6, Canada

Phone: 613-731-9577  
Fax:613-731-9064

23-October-2019

**Date Rec. :** 17 October 2019  
**LR Report:** CA15380-OCT19  
**Reference:** Project#: 1942188

**Copy:** #1

## CERTIFICATE OF ANALYSIS

### Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		23-Oct-19
2: Analysis Start Time		14:17
3: Analysis Completed Date		23-Oct-19
4: Analysis Completed Time		14:33
5: QC - Blank		< 0.02
6: QC - STD % Recovery		113%
7: QC - DUP % RPD		4%
8: RL		0.02
9: BRU19-1, SS4 (7'6"-9'6")	07-Oct-19	0.02
10: BRU19-2, SS3 (5'-7')	15-Oct-19	< 0.02
11: BRU19-3, SS5 (10'-12')	27-Sep-19	< 0.02

RL - SGS Reporting Limit

Note: Sample BRU19-3, SS5 (10' -12' ) was received past the 14 day holding time; result may be unreliable.

Kimberley Didsbury  
Project Specialist,  
Environment, Health & Safety



## **Appendix C.7**

### **Uniaxial Compressive Strength Test Results**

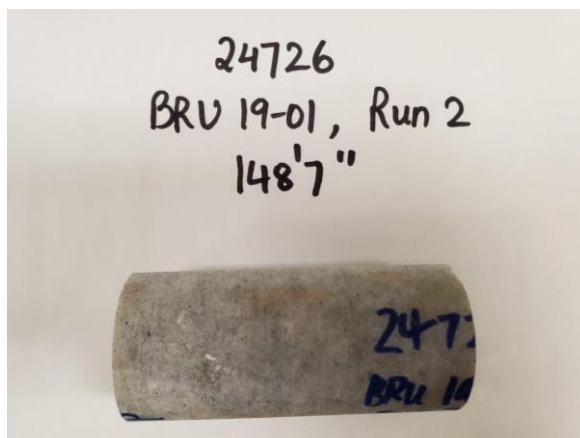
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

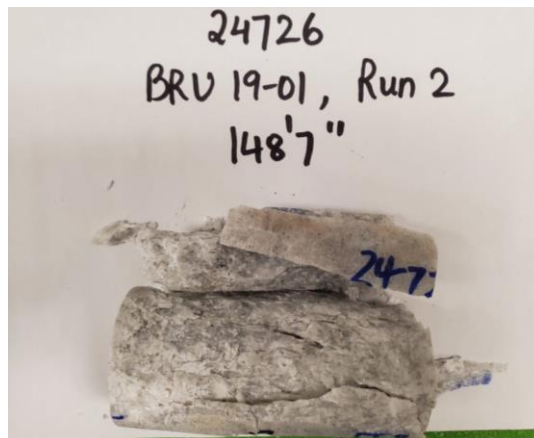
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	BRU 19-1	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	45.3m		
DESCRIPTION:	Marble		

Avg. Height (cm):	9.8	Weight (g):	471.2
Avg. Diameter (cm):	4.7	Wet Density (kg/m <sup>3</sup> ):	2,772
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m <sup>3</sup> ):	2,772
Cross Sectional Area (cm <sup>2</sup> ):	17.35	Moisture Content* (%):	N/A
Sample Volume (cm <sup>3</sup> ):	170.02		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	80.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	46.6 MPa

Note: \* Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS  
REVIEWED BY: WM

24726 - BRU 19-1 UCS Run 2, 148'7"

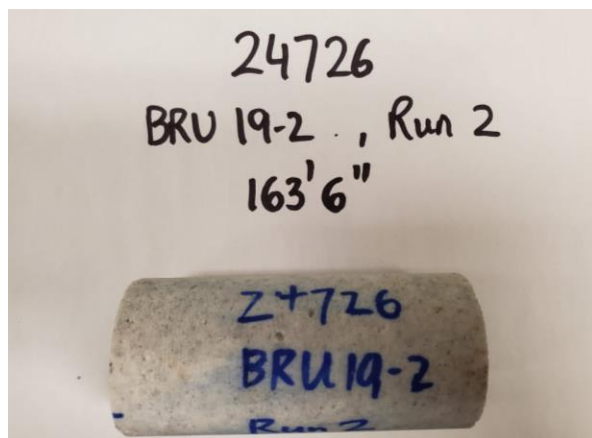
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

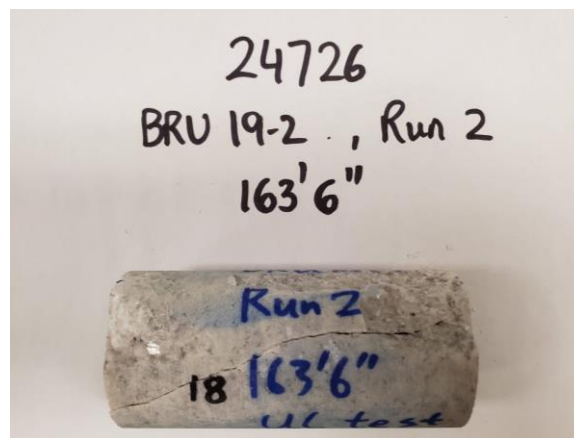
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	BRU 19-2	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	49.8m		
DESCRIPTION:	Marble		

Avg. Height (cm):	9.6	Weight (g):	473.9
Avg. Diameter (cm):	4.7	Wet Density (kg/m <sup>3</sup> ):	2,845
H. to Dia. Ratio**:	2:1	Dry Density (kg/m <sup>3</sup> ):	2,845
Cross Sectional Area (cm <sup>2</sup> ):	17.35	Moisture Content* (%):	N/A
Sample Volume (cm <sup>3</sup> ):	166.55		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.6% / min
MAXIMUM COMPRESSIVE LOAD:	72.4 kN
UNCONFINED COMPRESSIVE STRENGTH:	41.7 MPa

Note: \* Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS  
REVIEWED BY: WM

24726 - BRU 19-2 UCS Run 2, 163'6"



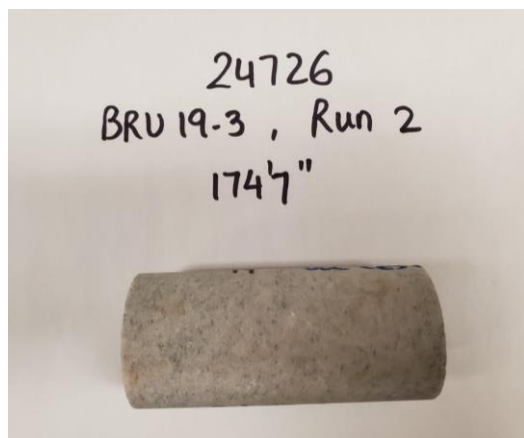
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

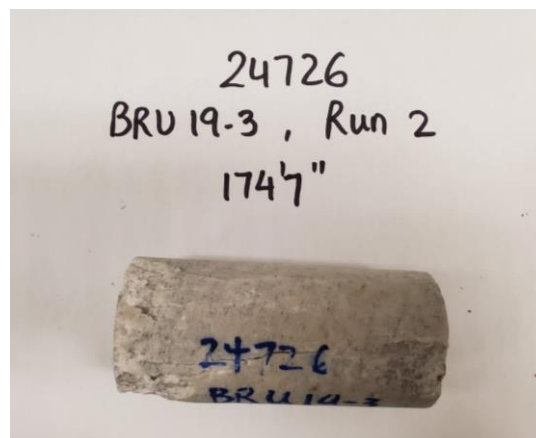
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	BRU 19-3	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	53.2m		
DESCRIPTION:	Marble		

Avg. Height (cm):	9.8	Weight (g):	480.9
Avg. Diameter (cm):	4.7	Wet Density (kg/m <sup>3</sup> ):	2,828
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m <sup>3</sup> ):	2,828
Cross Sectional Area (cm <sup>2</sup> ):	17.35	Moisture Content* (%):	N/A
Sample Volume (cm <sup>3</sup> ):	170.02		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	121.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	70.2 MPa

Note: \* Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS  
REVIEWED BY: WM

24726 - BRU 19-3 UCS Run 2, 174'7



**Appendix C.8**  
**Bedrock Core Photographs**

**Borehole BRU19-01**  
**Run 1 to 3 (of 3)**  
**Elevation 106.2 m to 103.0 m**



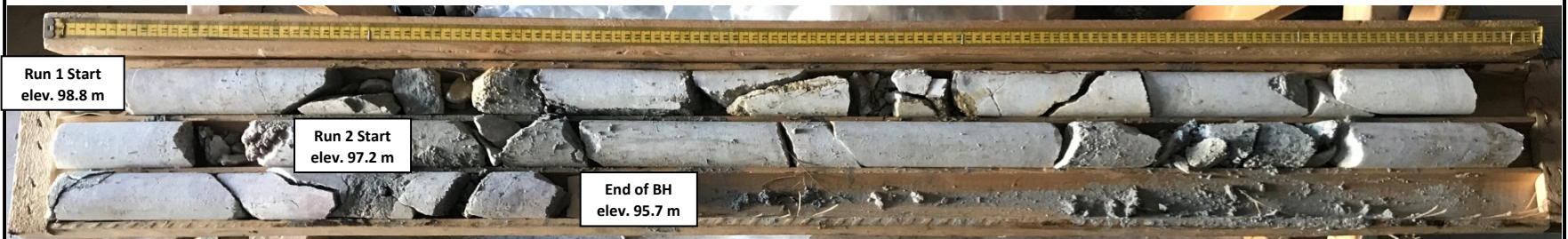
**Borehole BRU19-02**  
**Run 1 to 2 (of 2)**  
**Elevation 101.8 m to 97.7 m**



## Borehole BRU19-03

Run 1 to 2 (of 2)

Elevation 98.8 m to 95.7 m



**THURBER** ENGINEERING LTD.

Foundation Investigation  
Bruce Street (County Road 20) Interchange  
Renfrew County, Ontario

W.P. 4068-09-00  
Project No.: 24726



## **Appendix D.**

### **Laboratory Testing**

#### **Previous (2003) Investigation**



## **Appendix D.1**

### **Particle Size Analysis Figures**

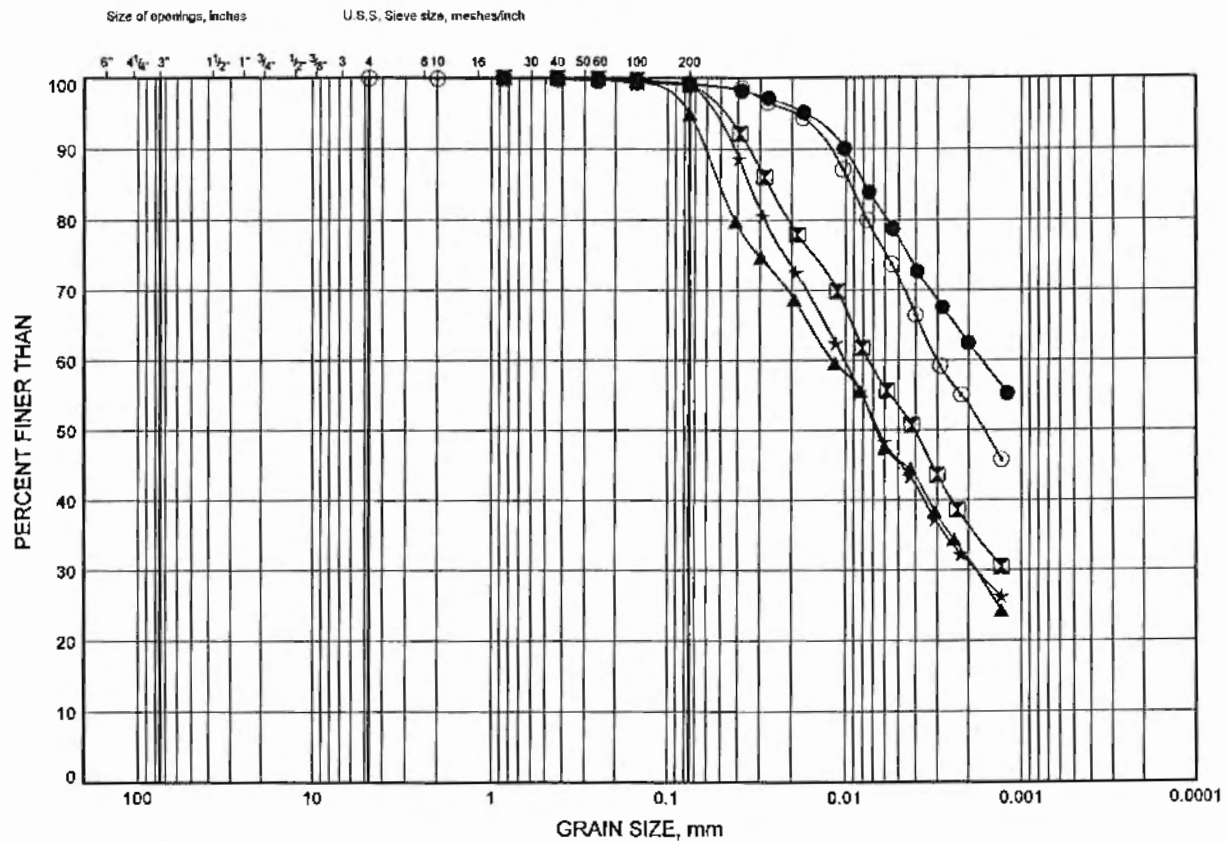
### **Atterberg Limit Test Results**

### **One-Dimensional Consolidation Test Results**

# HWY 17 Twinning, Arnprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE D1.1

## SILTY CLAY TO CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BRU-1	2.59	149.01
⊠	BRU-1	10.97	140.63
▲	BRU-1	20.73	130.87
★	BRU-1	27.13	124.47
⊙	BRU-2	2.59	147.71

Date May 2004  
Project 647-92-00



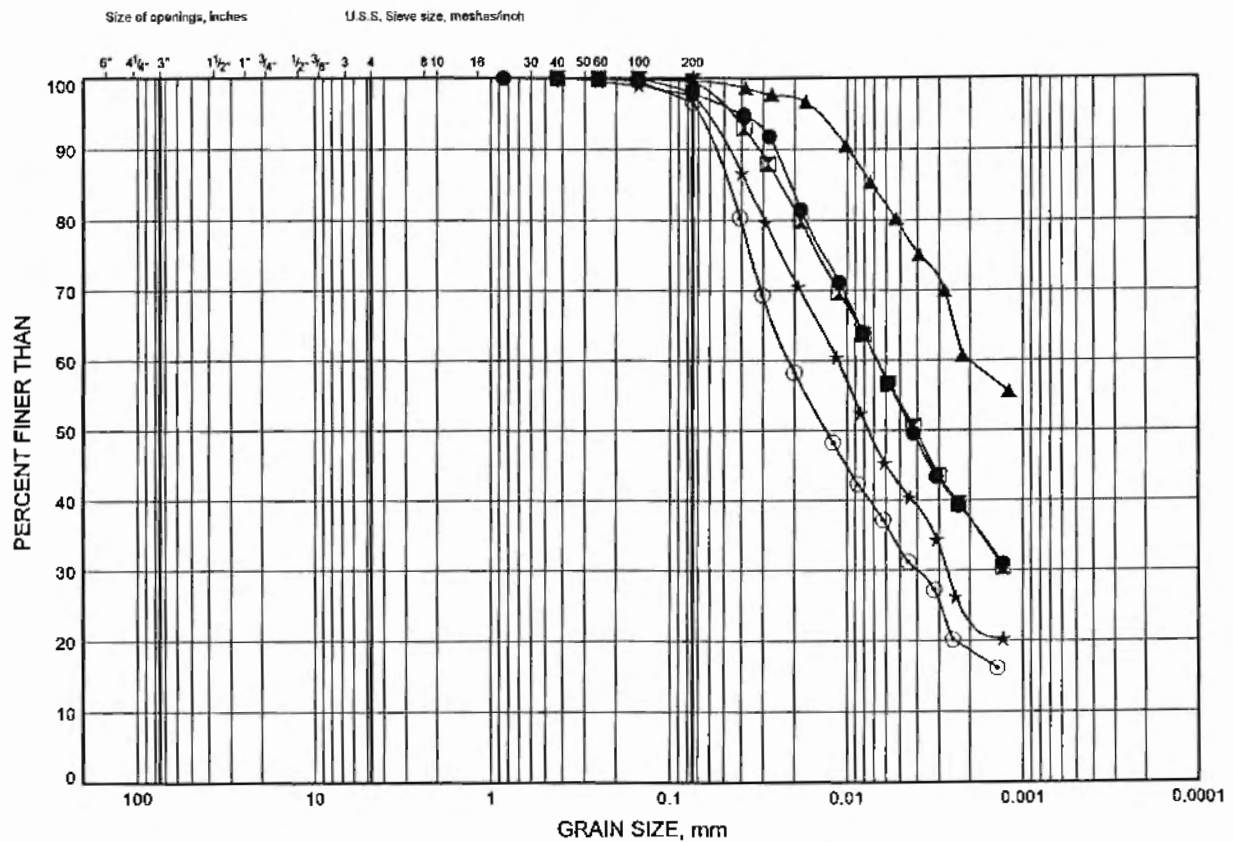
Prep'd SS  
Chkd. SP



# HWY 17 Twinning, Arnprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE D1.2

## SILTY CLAY TO CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BRU-2	10.97	139.33
⊠	BRU-2	24.69	125.61
▲	BRU-3	2.59	146.71
★	BRU-3	15.54	133.76
⊙	BRU-3	28.65	120.65

Date May 2004  
Project 647-92-00

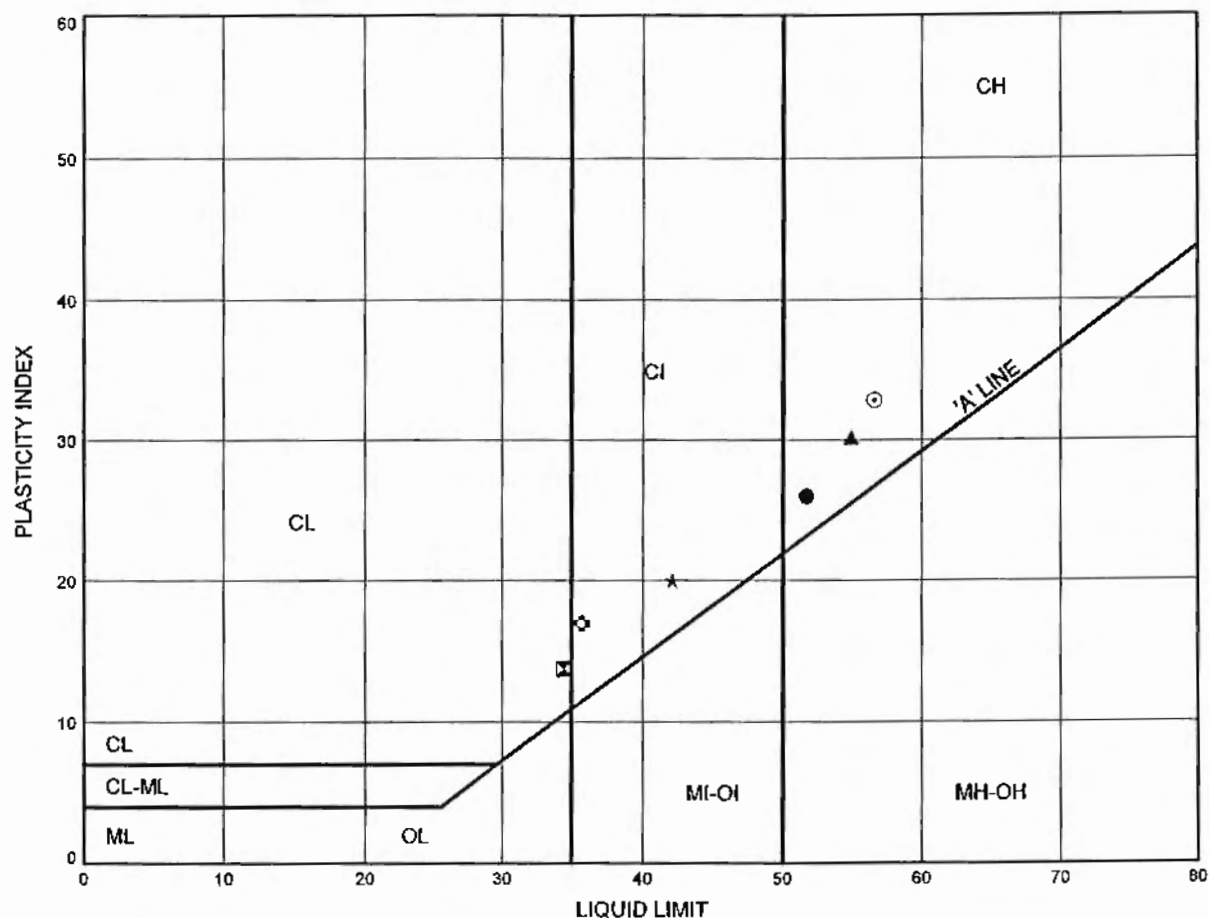


Prep'd SS  
Chkd. SP

HWY 17 Twinning, Arnprior to Renfrew  
**ATTERBERG LIMITS TEST RESULTS**

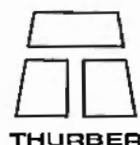
FIGURE D2

**SILTY CLAY TO CLAY**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BRU-1	2.59	149.01
⊠	BRU-1	10.97	140.63
▲	BRU-2	2.59	147.71
★	BRU-2	10.97	139.33
⊙	BRU-3	2.59	146.71
⊛	BRU-3	15.54	133.76

Date May 2004  
 Project 647-92-00



Prep'd SS  
 Chkd. SP

## FIGURE D3

Grain size distribution curve

Grain Size (mm)	Percent Finer Than (%)
100	100
60	100
40	100
30	100
16	100
8	100
4	100
2	100
1	100
0.75	100
0.6	100
0.425	100
0.3	100
0.25	100
0.2	100
0.15	100
0.106	100
0.075	100
0.06	98
0.0425	93
0.03	88
0.025	85
0.02	82
0.015	78
0.0106	72
0.0075	65
0.006	55
0.00425	48
0.003	42
0.0025	38
0.002	35
0.0015	32
0.00106	28
0.00075	25
0.0006	23
0.000425	22
0.0003	22
0.00025	22
0.0002	22
0.00015	22
0.000106	22
0.000075	22
0.00006	22
0.0000425	22
0.00003	22
0.000025	22
0.00002	22
0.000015	22
0.0000106	22
0.0000075	22
0.000006	22
0.00000425	22
0.000003	22
0.0000025	22
0.000002	22
0.0000015	22
0.00000106	22
0.00000075	22
0.0000006	22
0.000000425	22
0.0000003	22
0.00000025	22
0.0000002	22
0.00000015	22
0.000000106	22
0.000000075	22
0.00000006	22
0.0000000425	22
0.00000003	22
0.000000025	22
0.00000002	22
0.000000015	22
0.0000000106	22
0.0000000075	22
0.000000006	22
0.00000000425	22
0.000000003	22
0.0000000025	22
0.000000002	22
0.0000000015	22
0.00000000106	22
0.00000000075	22
0.0000000006	22
0.000000000425	22
0.0000000003	22
0.00000000025	22
0.0000000002	22
0.00000000015	22
0.000000000106	22
0.000000000075	22
0.00000000006	22
0.0000000000425	22
0.00000000003	22
0.000000000025	22
0.00000000002	22
0.000000000015	22
0.0000000000106	22
0.0000000000075	22
0.000000000006	22
0.00000000000425	22
0.000000000003	22
0.0000000000025	22
0.000000000002	22
0.0000000000015	22
0.00000000000106	22
0.00000000000075	22
0.0000000000006	22
0.000000000000425	22
0.0000000000003	22
0.00000000000025	22
0.0000000000002	22
0.00000000000015	22
0.000000000000106	22
0.000000000000075	22
0.00000000000006	22
0.0000000000000425	22
0.00000000000003	22
0.000000000000025	22
0.00000000000002	22
0.000000000000015	22
0.0000000000000106	22
0.0000000000000075	22
0.000000000000006	22
0.00000000000000425	22
0.000000000000003	22
0.0000000000000025	22

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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BRU-2	36.88	113.42
⊗	BRU-3	33.83	115.47

Date June 2004  
Project 647-92-00

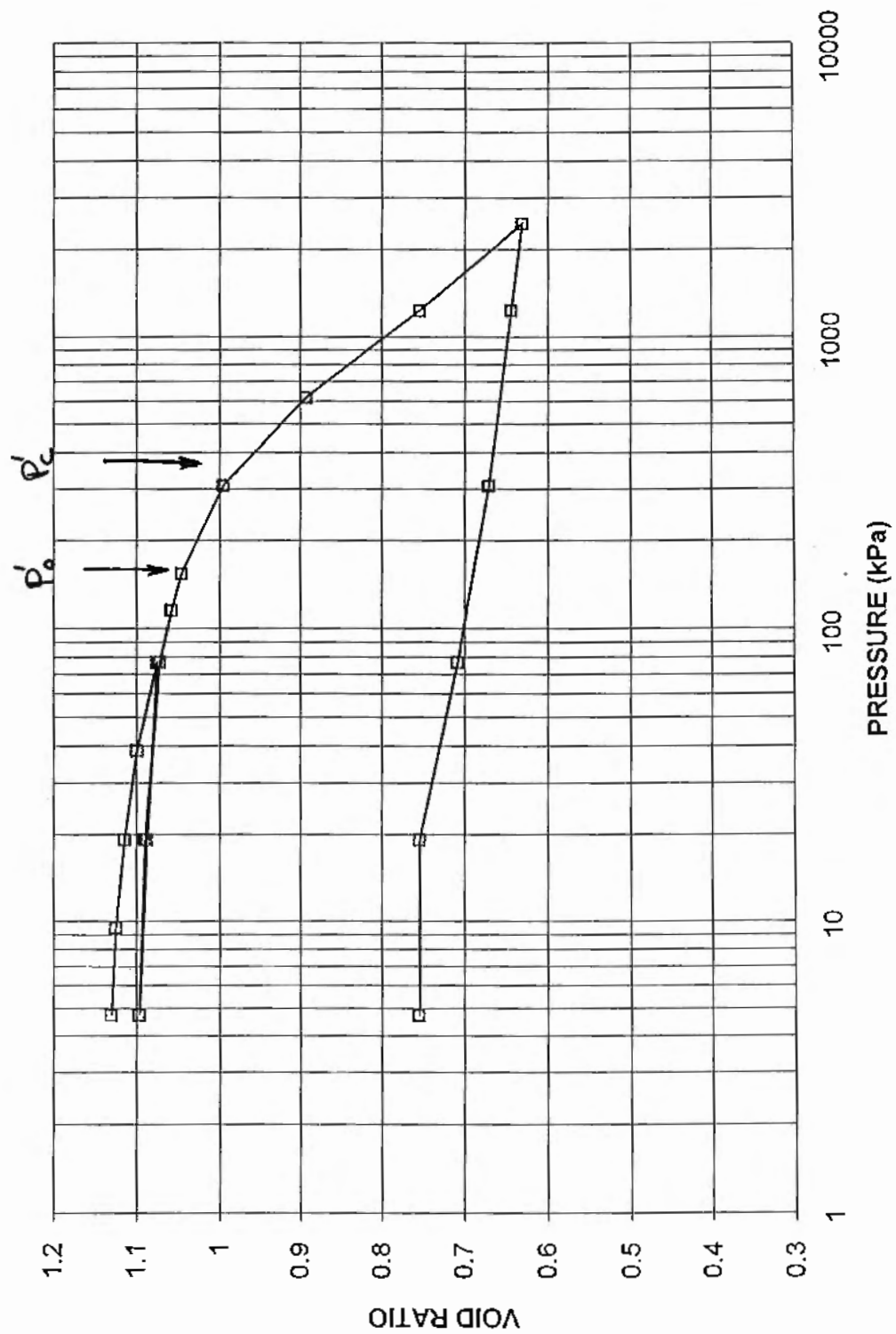


Prep'd .....SS.....  
Chkd. ....SP.....

CONSOLIDATION TEST  
VOID RATIO VS. LOG PRESSURE

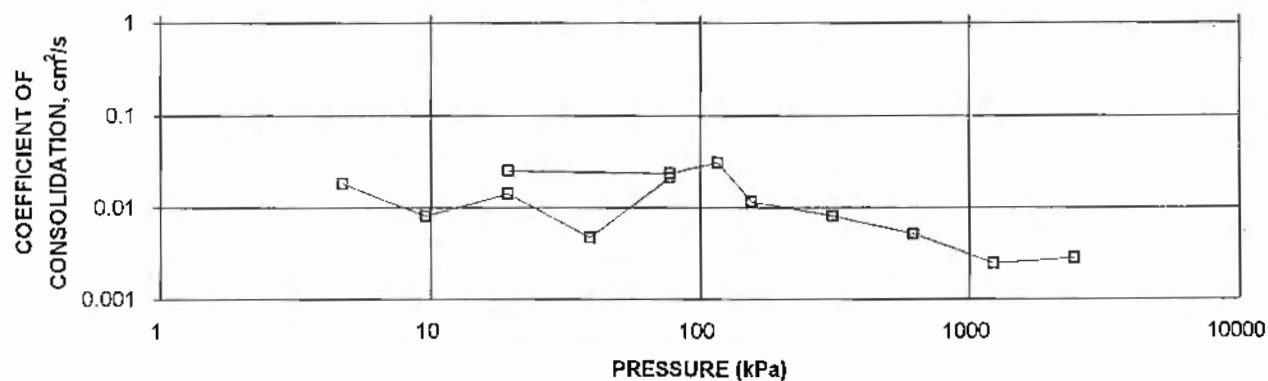
FIGURE D4

CONSOLIDATION TEST  
VOID RATIO vs PRESSURE  
BH BRU-1 SA TW1

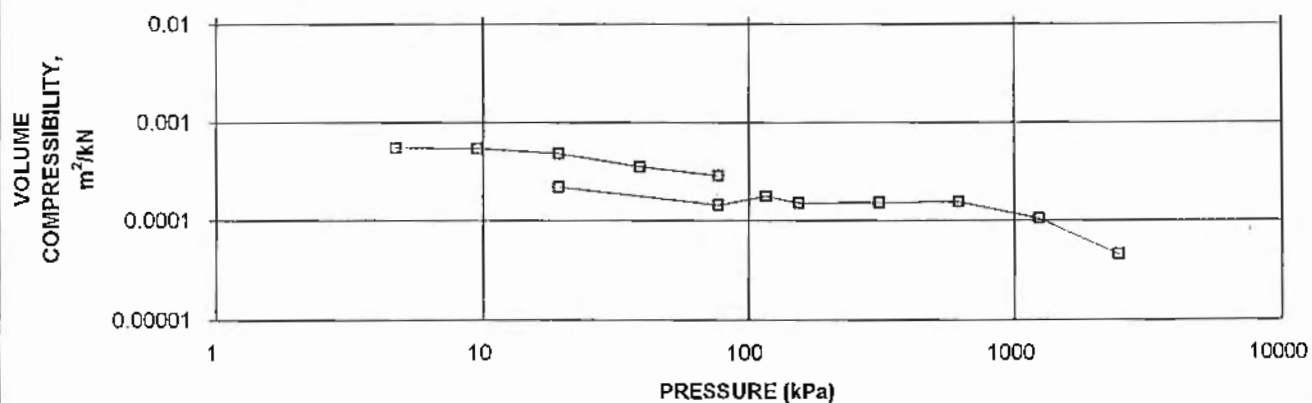


# OEDOMETER CONSOLIDATION SUMMARY

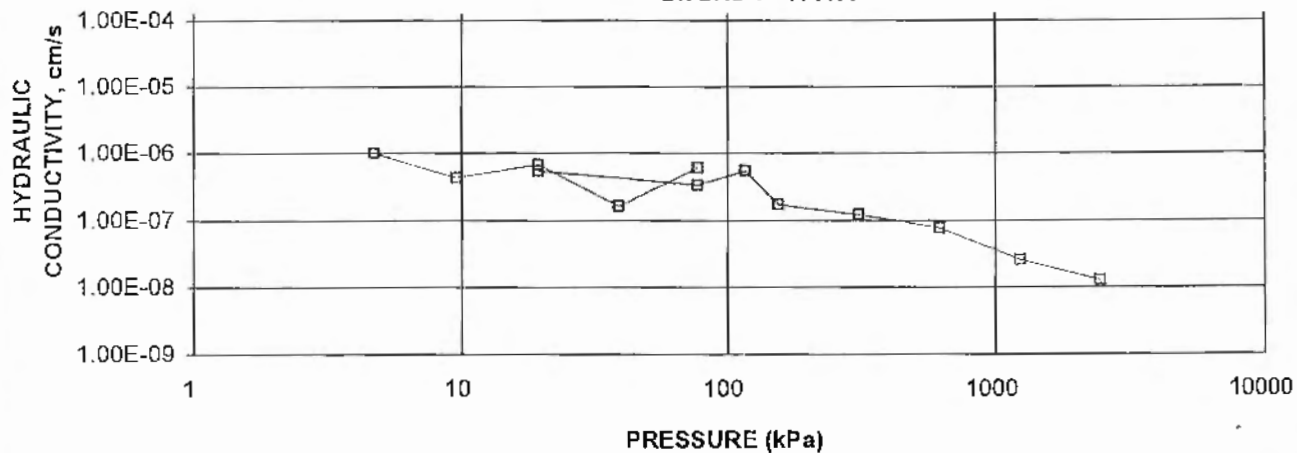
CONSOLIDATION TEST  
CV cm<sup>2</sup>/s VS PRESSURE (kPa)  
BH BRU-1 SA TW1



CONSOLIDATION TEST  
MV m<sup>2</sup>/kN vs PRESSURE (kPa)  
BH BRU-1 SA TW1



CONSOLIDATION TEST  
HYDRAULIC CONDUCTIVITY vs PRESSURE  
BH BRU-1 SA TW1



## OEDOMETER CONSOLIDATION SUMMARY

### SAMPLE IDENTIFICATION

Project Number	04-1116-011	Sample Number	TW1
Borehole Number	BRU-1	Sample Depth, m	11.6-12.2

### TEST CONDITIONS

Test Type	Standard	Load Duration, hr	(0.7-24)
Oedometer Number	6		
Date Started	1/30/2004		
Date Completed	2/12/2004		

### SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m <sup>3</sup>	18.03
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m <sup>3</sup>	12.81
Area, cm <sup>2</sup>	31.67	Specific Gravity, measured	2.79
Volume, cm <sup>3</sup>	60.17	Solids Height, cm	0.890
Water Content, %	40.70	Volume of Solids, cm <sup>3</sup>	28.18
Wet Mass, g	110.62	Volume of Voids, cm <sup>3</sup>	31.99
Dry Mass, g	78.62	Degree of Saturation, %	100.0

### TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t <sub>90</sub> sec	cv, cm <sup>2</sup> /s	mv m <sup>2</sup> /kN	k cm/s
0.00	1.900	1.135	1.900				
4.75	1.895	1.130	1.898	41	1.86E-02	5.54E-04	1.01E-06
9.54	1.890	1.124	1.893	94	8.08E-03	5.49E-04	4.35E-07
19.25	1.881	1.114	1.886	53	1.42E-02	4.88E-04	6.80E-07
38.68	1.868	1.099	1.875	158	4.71E-03	3.52E-04	1.63E-07
77.38	1.847	1.076	1.858	34	2.15E-02	2.86E-04	6.02E-07
19.25	1.857	1.087	1.852				
4.75	1.866	1.097	1.862				
19.25	1.860	1.090	1.863	29	2.54E-02	2.18E-04	5.42E-07
77.38	1.844	1.072	1.852	31	2.35E-02	1.45E-04	3.33E-07
116.07	1.831	1.058	1.838	23	3.11E-02	1.77E-04	5.39E-07
154.68	1.820	1.045	1.826	60	1.18E-02	1.50E-04	1.73E-07
309.16	1.775	0.995	1.798	85	8.06E-03	1.53E-04	1.21E-07
618.45	1.684	0.893	1.730	124	5.11E-03	1.55E-04	7.76E-08
1237.35	1.560	0.753	1.622	225	2.48E-03	1.05E-04	2.56E-08
2472.95	1.451	0.631	1.506	171	2.81E-03	4.64E-05	1.28E-08
1237.35	1.463	0.644	1.457				
309.16	1.487	0.671	1.475				
77.38	1.520	0.708	1.504				
19.25	1.560	0.753	1.540				
4.75	1.561	0.754	1.561				

Notes:

k calculated using cv based on  $\log_0$  values.

### SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.56	Unit Weight, kN/m <sup>3</sup>	20.41
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m <sup>3</sup>	15.60
Area, cm <sup>2</sup>	31.67	Specific Gravity, measured	2.79
Volume, cm <sup>3</sup>	49.44	Solids Height, cm	0.890
Water Content, %	30.87	Volume of Solids, cm <sup>3</sup>	28.18
Wet Mass, g	102.89	Volume of Voids, cm <sup>3</sup>	21.26
Dry Mass, g	78.62		



**Appendix E.**  
**Site Photographs**



**Photo 1. Looking southwest from Castleford Road across Highway 17 towards Bruce Street. (2019/11/05)**



**Photo 2. Looking southeast towards Highway 17 and Bonnechere River valley. (2019/11/05)**





**Photo 3. Looking southwest along proposed Castleford Road alignment and towards Highway 17 intersection. Existing Castleford Road pictured to the left. (2019/11/26)**



**Photo 4. Looking southeast across Castleford Road towards existing Dugald Road and proposed E-N/S Ramp. (2019/11/26)**





**Photo 5. Looking northeast along proposed Bruce Street alignment and towards Highway 17 intersection. Existing Bruce Street pictured to the right. (2019/09/04)**



**Photo 6. Looking northeast along proposed Bruce Street alignment and towards Highway 17. (2019/09/04)**





**Photo 7. Looking northeast towards Garden of Eden Road and Highway 17 across proposed N-E Ramp site. (2020/11/19)**



**Photo 8. Looking northeast across Highway 17 toward proposed E-N/S Ramp alignment. (2020/11/19)**