



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
HIGHWAY 7 GRADE LOWERING FROM STN. 20+000 TO 20+450 AND  
NEW STRUCTURAL CULVERT AT STN. 20+320, SITE NO. 32-097  
MUNICIPALITY OF KAWARTHA LAKES  
AGREEMENT 4016-E-0034, ASSIGNMENT 6  
GWP 4094-17-00**

Geocres No.: 31D-746

Report to:

**WSP Canada Group Ltd.**

Latitude: 44.333587°  
Longitude: -78.708828°

March 2020  
Thurber File No.: 23770



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**PART 1. FACTUAL INFORMATION**

**1 INTRODUCTION**

This section of the report presents the factual findings obtained from a foundation investigation completed for the proposed grade lowering of Highway 7 from Station 20+000 to 20+450 and a new structural culvert at Station 20+320 (Site No. 32-097) where Highway 7 crosses the Victoria Rail Trail, located within the Municipality of Kawartha Lakes. The existing bridge crossing the Victoria Rail Trail is to be demolished as part of the project.

Thurber carried out the investigation as sub-consultant to WSP Canada Group Ltd. (WSP) under Ministry of Transportation (MTO) Retainer Agreement No. 4016-E-0034, Assignment No. 6, GWP 4094-17-00.

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 profiles, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions influencing design and construction was developed in the course of the current investigation. A Preliminary Foundation Investigation and Design Report for this site dated September 2007 (Geocres 31D-424) was reviewed as part of the current assignment.

**2 SITE DESCRIPTION**

The intersection of Highway 7 and the Victoria Rail Trail is located approximately 300 m west of the Highway 7 and County Road 36 intersection. The Victoria Rail Trail is a former railway that has been converted to a multi-use recreational trail. Highway 7 at the location is oriented east-west and the trail is oriented northeast to southwest. For project purposes, the existing trail and the proposed culvert are herein described as oriented north-south.

Highway 7 in this area consists of a two-lane undivided highway with the end of a west-bound speed change lane and paved shoulders at the structure and a rural cross-section beyond the approach fills. The elevation of the road surface at the centreline ranges from about 260 m at Station 20+000 to 268 m at the Victoria Rail Trail overpass. The terrain is relatively flat and the land adjacent to the highway occupied by residential properties, a golf course, and agricultural fields. The elevation of the ground surface at the trail level is approximately 259 m. The approach



fills are sloped at approximately 2H:1V. No evidence of settlement, erosion or slope instability were noted at the approach fills at the time of the field investigation.

It is understood that the existing approximately 12 m, single-span structure is supported on spread footings. The approach fills in all four quadrants are partially supported by stepped retaining walls which are also supported on spread footings. An existing CSP was observed at the south end of the wing wall on the west side of the trail. It is understood that the twin 914 mm diameter CSP pipes convey flow from the south to the north beneath the existing bridge and have an invert elevation of approximately 258 m.

The two borehole records from Geocres 31D-424 indicate that the subsurface materials consist of fill over loose to very dense sandy silt over very dense silty sand till at elevation 253.7 m. Based on published geological information in *The Physiography of Southern Ontario* by Chapman and Putnam (1984), the culvert site lies within the physiographic region known as the Schomberg Clay Plains. The Schomberg Clay Plains generally consist of varved clays and silts underlain by till. The overburden is underlain by limestone bedrock.

Photographs showing the existing conditions at the site at the time of the field investigation are included in Appendix D for reference.

### 3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing program was carried out between April 29 and May 16, 2019. The field investigation consisted of advancing seven boreholes (identified as Boreholes 19-1 through 19-7). Off-road Boreholes 19-1 and 19-2 were advanced at the Victoria Trail level at the proposed inlet and outlet of the structural culvert, and on-road Boreholes 19-3 through 19-7 were advanced through the Highway 7 embankment for the proposed grade lowering. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

The northing, easting and elevation of the boreholes are shown on the Borehole Location and Soil Strata Drawing No. 1 in Appendix A, the individual Record of Borehole sheets in Appendix B, and in Table 3-1 below. The site is located within MTM Zone 10.

**Table 3-1: Borehole Summary**

Borehole No.	Drilled Location	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth Below Ground Surface (m)
19-1	Culvert	4 910 717.2	367 878.6	259.1	10.6
19-2	Culvert	4 910 689.7	367 905.8	259.1	10.3
19-3	Hwy 7	4 910 573.8	367 615.5	260.2	7.1
19-4	Hwy 7	4 910 626.8	367 702.0	263.5	11.2
19-5	Hwy 7	4 910 656.3	367 787.2	265.6	12.8
19-6	Hwy 7	4 910 712.9	367 915.2	267.6	12.8
19-7	Hwy 7	4 910 721.2	367 975.6	267.3	12.8



The off-road drilling was carried out using a track-mounted CME 55 drill rig and the on-road drilling was carried out using a truck-mounted CME 55 drill rig. Both rigs were equipped with hollow-stem augers and rotary diamond drilling equipment.

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Upon achieving auger refusal, Boreholes 19-1 and 19-2 were cored into the bedrock while collecting NQ sized bedrock core.

A 19 mm diameter standpipe piezometer was installed in Borehole 19-1 to allow for measurements of the groundwater level after completion of drilling. The piezometer installation details are illustrated on the Record of Borehole sheet provided in Appendix B. The boreholes were backfilled in accordance with MOE requirements (O.Reg 903, as amended). The on-road boreholes were backfilled with granular material within the depth of pavement structure and topped with cold patch asphalt to reinstate the road surface. Upon completion of the groundwater measurements, the standpipe piezometer installed in Borehole 19-1 was decommissioned in accordance with O.Reg. 903 requirements.

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

#### **4 LABORATORY TESTING**

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all retained soil samples. Testing for grain size distribution and Atterberg Limits was also carried out on selected samples to MTO and ASTM standards. All rock cores were photographed and their total core recovery (TCR), solid core recovery (SCR) and rock quality designation (RQD) were measured. Chemical analysis for determination of pH, conductivity, resistivity, sulphide, sulphate and chloride concentrations was carried out on one soil sample.

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.

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

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and the Borehole Location and Soil Strata Drawing is 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 and groundwater conditions may vary between and beyond borehole locations.

Soil classification is in accordance with ASTM D2487 as modified per current MTO soil practice for cohesive soils.



In general terms, the site was found to be underlain by embankment fill overlying a native deposit of till. The overburden soils are underlain by limestone bedrock.

### 5.1 Asphalt

Boreholes 19-4, 19-6 and 19-7 were advanced from the travelled lanes of Highway 7. The thickness of the asphalt at these locations ranged from 175 to 200 mm.

### 5.2 Topsoil

A layer of topsoil was encountered at the ground surface at off-road Boreholes 19-1 and 19-2. The thickness of the topsoil at these locations ranged from 40 to 50 mm.

### 5.3 Fill

#### 5.3.1 Highway Embankment Fill

Heterogenous embankment fill consisting of a generally well-graded mixture of gravel, sand, silt, and clay was encountered from the ground surface in Boreholes 19-3 and 19-5, which were advanced from the shoulder of Highway 7, and below the asphalt in the remaining on-road boreholes. The grain size distribution of the fill is variable and the soils are described as ranging from sandy clay with gravel to silty gravel with sand. Organic silt was encountered at the base of the fill (7.9 m depth) in Borehole 19-5. Occasional cobbles and possible boulders were noted throughout the fill.

The underside of the fill was encountered at depths ranging from 2.8 to 10.7 m (elev. 256.9 to 259.5 m).

SPT tests conducted in this layer gave N-values ranging from 10 to 52 blows, indicating a compact to very dense relative density.

The results of grain size distribution testing carried out on nine samples of the fill are summarized in Table 5-1 below and are illustrated on Figures C1 and C2 in Appendix C.

**Table 5-1: Summary of Grain Size Distribution Testing – Fill**

Soil Particle	Percentage (%)	
Gravel	13 – 37	
Sand	25 – 39	
Silt	27 – 65	29 – 39
Clay		12 – 18

The results of Atterberg limit testing carried out on six samples of the fill are summarized in Table 5-2 below and are illustrated on Figures C6 and C7 in Appendix C. These results indicate that the fines within the fill are classified as clay of low plasticity (CL).



**Table 5-2: Summary of Atterberg Limit Testing – Fill**

Parameter	Value
Liquid Limit	18 – 24
Plastic Limit	10 – 12
Plasticity Index	8 – 12

Recorded moisture contents of the fill ranged from 2 to 19%.

### 5.3.2 Trail Embankment Fill

The trail embankment fill was observed in Boreholes 19-1 and 19-2 to consist of material ranging from clayey sand with gravel to sandy silt trace gravel. Trace organics were noted. The thickness of the fill was 1.4 m and 2.1 m with the underside of the unit at elevation 257.7 m and 257.0 m. SPT tests conducted in the fill yielded N-values of 7 to 12 indicating a loose to compact relative density.

The results of grain size distribution testing carried out on two samples of the fill are summarized in Table 5-3 below and are illustrated on Figure C1 in Appendix C.

**Table 5-3: Summary of Grain Size Distribution Testing – Railway Fill**

Soil Particle	Percentage (%)
Gravel	9 - 25
Sand	26 – 36
Silt	29 – 53
Clay	10 - 12

The results of Atterberg limit testing carried out on two samples of the fill are summarized in Table 5.4 below and are illustrated on Figure C6 in Appendix C. These results indicate that the fines within the fill are classified as silt (ML) to clay of low plasticity (CL).

**Table 5-4: Summary of Atterberg Limit Testing – Railway Fill**

Parameter	Value
Liquid Limit	18 – 27
Plastic Limit	15 – 17
Plasticity Index	3 - 10

Recorded moisture contents of the fill ranged from 10 to 19%.



#### 5.4 Clay (CI)

A native deposit of clay with sand was encountered beneath the embankment fill in Boreholes 19-4 and 19-5. The thickness of the deposit ranged from 0.9 to 1.5 m with an underside depth ranging from 7.3 to 8.8 m below ground surface (elev. 256.2 to 256.8 m).

SPT tests conducted in the clay gave N-values of 8 to 12 blows, indicating a stiff consistency.

The results of grain size distribution testing carried out on one sample of the clay indicated this material to consist of 1% gravel, 15% sand, 45% silt, and 39% clay. These results are illustrated on Figure C3 in Appendix C. The results of Atterberg limit testing conducted on one sample of the clay are shown on Figure C8 in Appendix C and indicated this material to have a liquid limit of 42, a plastic limit of 18, and a plasticity index of 24. These results indicate that the soil is classified as clay of intermediate plasticity (CI).

Recorded moisture contents of the clay ranged from 19 to 21%.

#### 5.5 Till

A native deposit of till consisting of a generally well-graded mixture clay, silt, sand, gravel, cobbles and boulders was encountered in all boreholes. The grain size distribution of the till is variable and the soils are described as ranging from silty clayey gravel to silty clay trace to some sand and gravel.

Where fully penetrated in Boreholes 19-1 and 19-2, the thickness of the till ranged from 4.8 to 6.1 m with an underside depth ranging from 6.9 to 7.5 m (elev. 251.6 to 252.2 m). The till was not fully penetrated in the other boreholes, but was proven to depths ranging from 7.1 to 12.8 m (elev. 252.3 to 254.8 m).

SPT tests conducted in this layer gave N-values ranging from 14 blows for 300 mm of penetration to 100 blows for 75 mm of penetration, indicating a very stiff to hard consistency for the cohesive till and a compact to very dense relative density for the non-cohesive till.

The results of grain size distribution testing carried out on 11 samples of the till are summarized in Table 5-5 below and are illustrated in Figures C4 and C5 in Appendix C.

**Table 5-5: Summary of Grain Size Distribution Testing – Till**

Soil Particle	Percentage (%)
Gravel	2 – 31
Sand	8 – 52
Silt	29 – 70
Clay	6 – 20



The results of Atterberg limit testing carried out on 10 samples of the till are summarized in Table 5-6 below and are illustrated on Figures C9 and C10 in Appendix C. These results indicate that the fines within the till are classified as silt (ML) to silty clay (CL-ML) to clay of low plasticity (CL). Testing on one sample from Borehole 19-3 (SS9) indicated that the soil was non-plastic.

**Table 5-6: Summary of Atterberg Limit Testing – Till**

Parameter	Value
Liquid Limit	14 – 21
Plastic Limit	11 – 14
Plasticity Index	3 – 9

Recorded moisture contents of the granular fill ranged from 3 to 26%.

## 5.6 Bedrock

Bedrock was encountered and proven by coring in Boreholes 19-1 and 19-2. A summary of the bedrock surface information is provided in Table 5- below:

**Table 5-7: Summary of Bedrock Depth/Elevation**

Borehole No.	Depth to Bedrock from Ground Surface (m)	Bedrock Surface Elevation (m)
19-1	7.5	251.6
19-2	6.9	252.2

The bedrock encountered in Boreholes 19-1 and 19-2 consisted of fresh, strong, horizontally bedded limestone with shale interbedding. The Total Core Recovery (TCR) measured on the recovered bedrock core was 100%, the Solid Core Recovery (SCR) ranged from 96 to 100%, and the Rock Quality Designation (RQD) ranged from 48 to 100% (but typically 86 to 100 %). Based on the measured RQD values, the bedrock is classified as poor to excellent (but typically good to excellent) quality. The bedrock is estimated to be strong. Photographs of the bedrock core are provided in Appendix C.

## 5.7 Groundwater

The groundwater water level measured in the standpipe piezometer installed in Borehole 19-1 at 2.2 m below the ground surface (elev. 256.9 m) on May 27, 2019 and at 1.5 m below the ground surface (elev. 257.6 m) on May 31, 2019. Water was noted in the ditch on April 22, 2019 in the southwest quadrant of the site at an approximate elevation of 258.3 m.

These observations are considered short term and it should be noted that the groundwater level at the time of construction may be different and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation.



## 5.8 Analytical Testing

One sample of the native soil was submitted for analysis of pH, water soluble sulphate, sulphide, chloride, conductivity and resistivity. The analysis results are provided in Appendix C and are summarized in Table 5-8 below.

**Table 5-8: Results of Chemical Analysis**

Borehole	19-1
Sample	SS3
Depth (m)	1.5 – 2.1
Chloride ( $\mu\text{g/g}$ )	70
Sulphate ( $\mu\text{g/g}$ )	8
Sulphide (%)	< 0.02
pH (-)	7.37
Resistivity (Ohm-cm)	4420
Conductivity ( $\mu\text{S/cm}$ )	226



## 6 MISCELLANEOUS

Borehole locations were selected by Thurber relative to existing site features and the existing Victoria Rail Trail bridge. 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 in reference to geodetic elevation benchmarks provided by the MTO.

Downing Drilling of Hawkesbury, Ontario supplied and operated the drilling equipment and carried out the drilling, soil sampling, in-situ testing, standpipe installation and borehole decommissioning. On Track Safety of Thornhill, Ontario supplied the traffic control signage and flag persons for the on-road drilling. The field investigation was supervised on a full-time basis by Mr. Richard Howarth of Thurber. Overall supervision of the investigation program was provided by Mr. Justin Gray, P.Eng.

Routine geotechnical laboratory testing was completed by Thurber's laboratory in Ottawa, Ontario. Analytical testing was completed by Paracel Laboratories in Ottawa, Ontario. Interpretation of the factual data and preparation of this report were carried out by Mr. Stephen Dunlop, P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng., a Designated Principal Contact for MTO Foundation Projects.



Stephen Dunlop, M.A.Sc., P.Eng.  
Senior Geotechnical Engineer

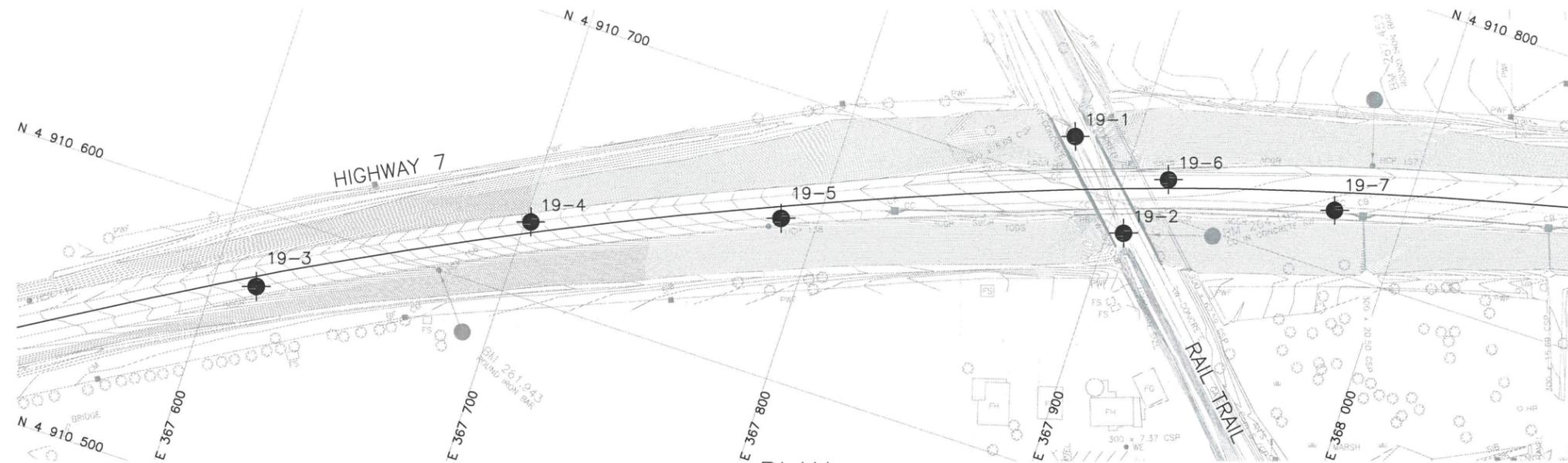


Fred Griffiths, Ph.D., P.Eng.  
MTO Review Principal,  
Senior Geotechnical Engineer



**Appendix A.**

**Borehole Location Plan and Stratigraphic Drawings**



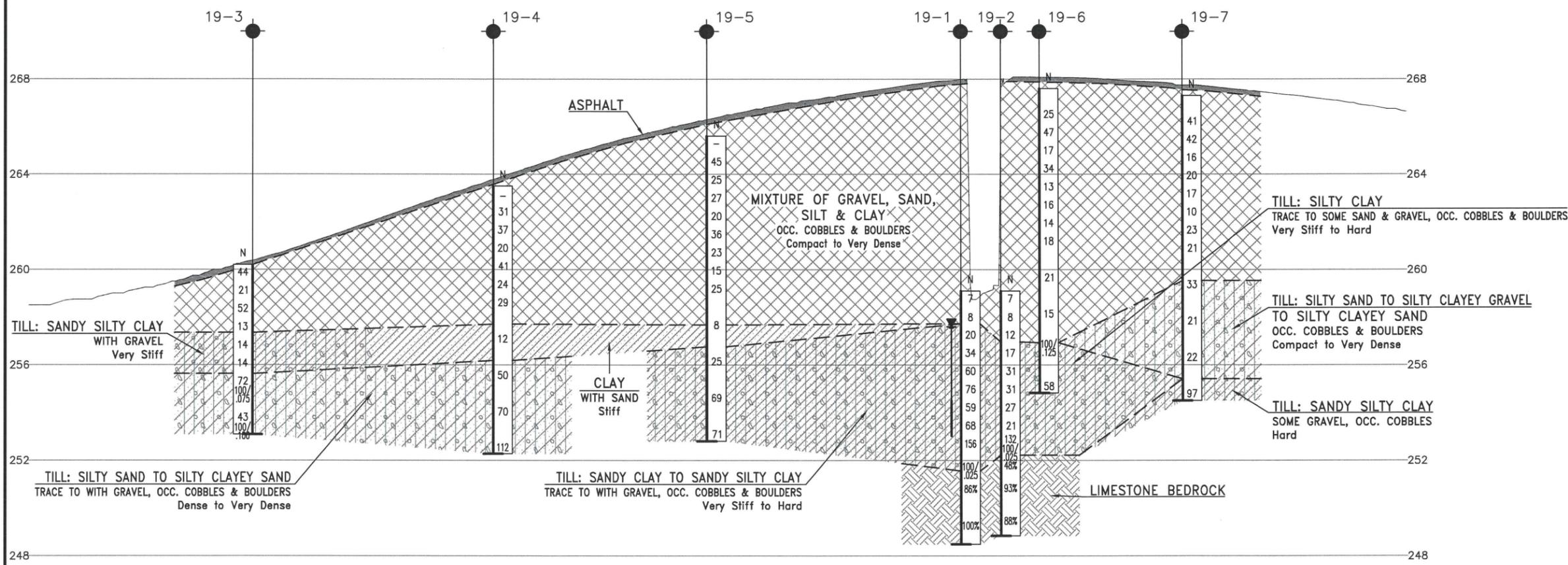
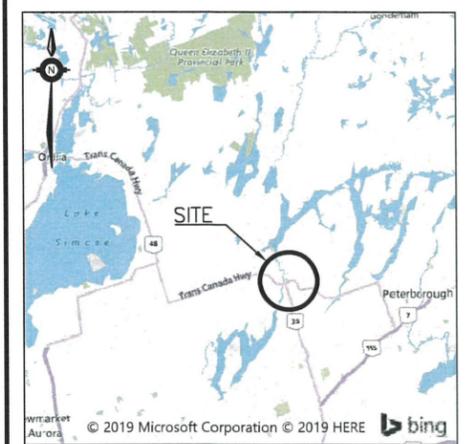
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DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No  
WP No 4094-17-00

HIGHWAY 7  
GRADE LOWERING  
STATION 20+000 TO 20+450  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND

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

NO	ELEVATION	NORTHING	EASTING
19-1	259.1	4 910 717.2	367 878.6
19-2	259.1	4 910 689.7	367 905.8
19-3	260.2	4 910 573.8	367 615.5
19-4	263.5	4 910 626.8	367 702.0
19-5	265.6	4 910 656.3	367 787.2
19-6	267.6	4 910 712.9	367 915.2
19-7	267.3	4 910 721.2	367 975.6

- 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 10.

GEOCRES No. 31D-746

REVISIONS

DATE	BY	DESCRIPTION
DESIGN	JG	CHK SD
DRAWN	MFA	CHK JG

LOAD DATE MAR 2020  
STRUCT DWG 1



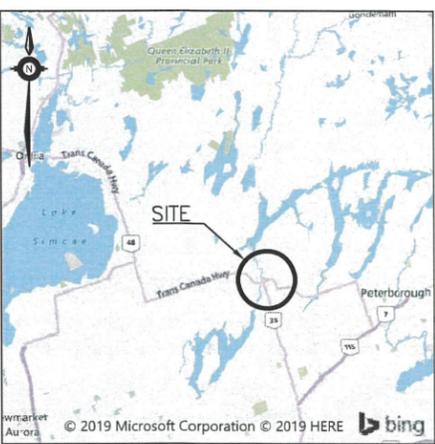
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 4094-17-00

HIGHWAY 7  
STRUCTURAL CULVERT  
AT STATION 20+300  
BOREHOLE LOCATIONS AND SOIL STRATA



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

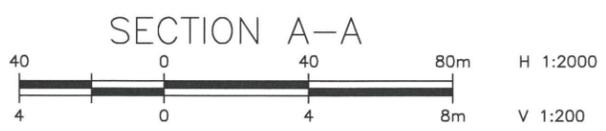
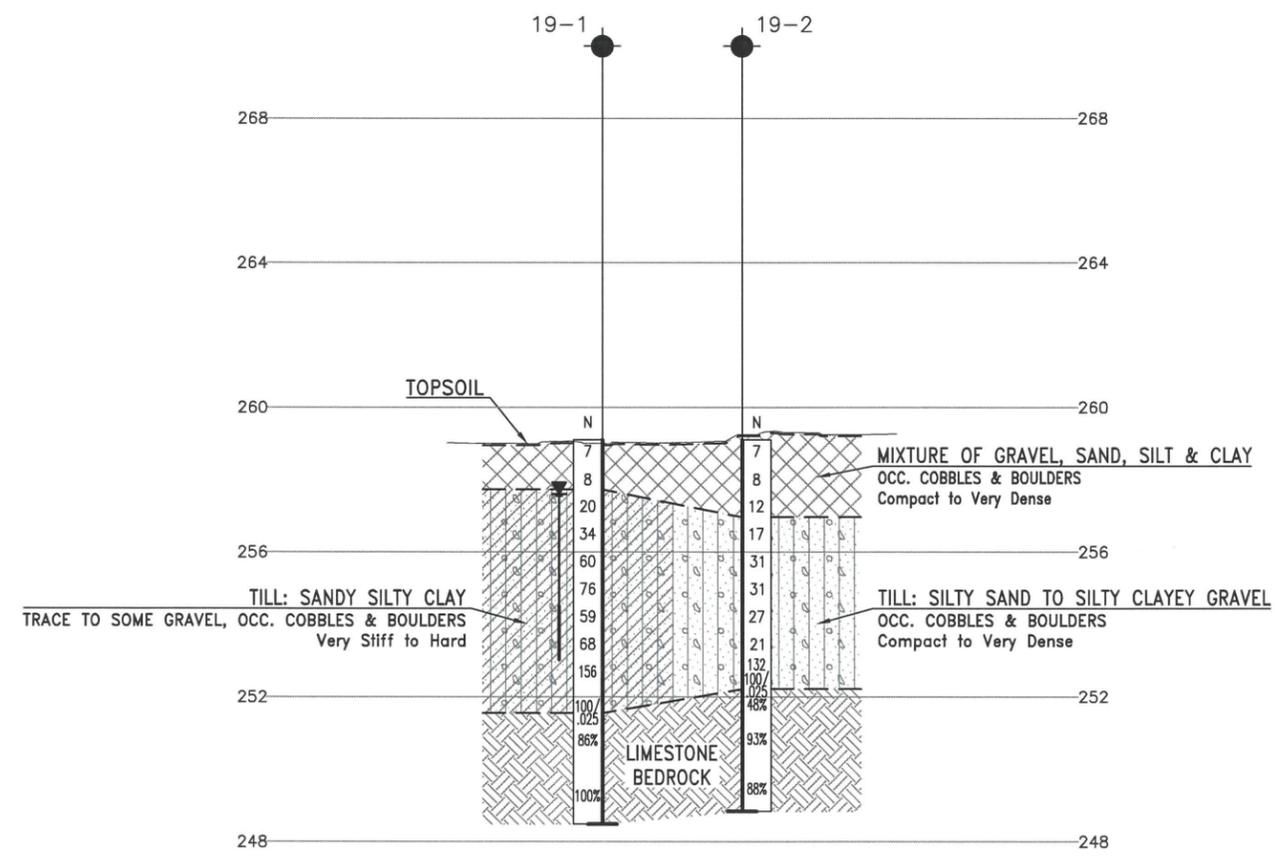
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
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GEORES No. 31D-746



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	JG	CHK	SD	CODE	LOAD	DATE	MAR 2020
DRAWN	MFA	CHK	JG	SITE	STRUCT	DWG	2



**Appendix B.**  
**Record of Borehole Sheets**



## SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

### TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

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

### TERMINOLOGY DESCRIBING SOIL STRUCTURE:

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

### RECOVERY:

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

### N-VALUE:

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

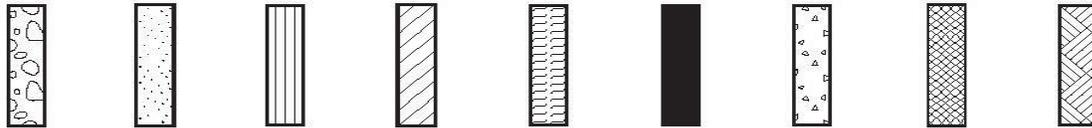
### DYNAMIC CONE PENETRATION TEST (DCPT):

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



**STRATA PLOT:**

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



Boulders  
Cobbles  
Gravel      Sand      Silt      Clay      Organics      Asphalt      Concrete      Fill      Bedrock

**TEXTURING CLASSIFICATION OF SOILS**

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

**TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)**

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

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

**SAMPLE TYPES**

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

**TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)**

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



**MODIFIED UNIFIED SOIL CLASSIFICATION**

Major Divisions		Group Symbol	Typical Description
<b>COARSE GRAINED SOIL</b>	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.
<b>FINE GRAINED SOILS</b>	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 or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
<b>HIGHLY ORGANIC SOILS</b>		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 19-1**

2 OF 2

**METRIC**

WP# 4094-17-00 LOCATION Lat: 44.333722°, Long: -78.709021°  
MTM z10: N 4 910 717.2 E 367 878.6 ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA/NQ Coring COMPILED BY JG  
 DATUM Geodetic DATE 2019.04.30 - 2019.04.30 CHECKED BY SD

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								
	Continued From Previous Page															
248.5 10.6	<p><b>LIMESTONE BEDROCK</b> with shale interbedding fresh strong horizontally bedded grey</p> <p>End of Borehole WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) 2019.05.27      2.2      256.9 2019.05.31      1.5      257.6</p>															

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

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

### RECORD OF BOREHOLE No 19-2

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333472°, Long: -78.708682° ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA/NQ Coring COMPILED BY JG  
 DATUM Geodetic DATE 2019.04.29 - 2019.04.29 CHECKED BY SD

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	GR SA SI CL
259.1	Grass												
0.0	Topsoil (50 mm)												
	Sandy SILT, trace gravel trace organics loose to compact brown FILL		1	SS	7								9 26 53 12
			2	SS	8								
			3	SS	12								
257.0													
2.1	SILTY SAND (SM) with gravel to SILTY CLAYEY GRAVEL (GC-GM) with sand (TILL) occasional cobbles and boulders compact to very dense brown		4	SS	17								
			5	SS	31								26 31 34 9
	- grey below 3.8 m		6	SS	31								
			7	SS	27								
			8	SS	21								31 30 29 10
			9	SS	132								
252.2			10	SS	100								
6.9	LIMESTONE BEDROCK with shale interbedding fresh strong thinly bedded grey		1	RUN	25mm								RUN #1 TCR=100% SCR=96% RQD=48%
			2	RUN									RUN #2 TCR=100% SCR=100% RQD=93%
			3	RUN									RUN #3 TCR=100% SCR=100% RQD=88%

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

Continued Next Page

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

**RECORD OF BOREHOLE No 19-2**

2 OF 2

**METRIC**

WP# 4094-17-00 LOCATION Lat: 44.333472°, Long: -78.708682° ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA/NQ Coring COMPILED BY JG  
 DATUM Geodetic DATE 2019.04.29 - 2019.04.29 CHECKED BY SD

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	20			40	60	80					
248.8 10.3	Continued From Previous Page  <b>LIMESTONE BEDROCK</b> with shale interbedding fresh strong thinly bedded grey End of Borehole						249									

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

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

### RECORD OF BOREHOLE No 19-3

1 OF 1

METRIC

WP# 4094-17-00 LOCATION Lat: 44.332454°, Long: -78.712336°  
MTM z10: N 4 910 573.8 E 367 615.5 ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA COMPILED BY JG  
 DATUM Geodetic DATE 2019.05.14 - 2019.05.14 CHECKED BY SD

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								
260.2							20	40	60	80	100					
0.0	SILTY SAND with gravel occasional cobbles and possible boulders compact to very dense grey FILL		1	SS	44											
			2	SS	21											25 39 36 (SI+CL)
			3	SS	52											
			4	SS	13											
257.4																
2.8	SANDY SILTY CLAY (CL-ML) with gravel (TILL) very stiff brown		5	SS	14											17 32 36 15
			6	SS	14											
255.6																
4.6	SILTY SAND (SM) trace to some gravel (TILL) occasional cobbles and boulders dense to very dense brown		7	SS	72											
			8	SS	100/ 75mm											
			9	SS	43											8 52 34 6 non-plastic
			10	SS	100/ 100mm											
253.1																
7.1	End of Borehole															

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

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

### RECORD OF BOREHOLE No 19-4

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.332923°, Long: -78.711245° ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA COMPILED BY JG  
 DATUM Geodetic DATE 2019.05.15 - 2019.05.15 CHECKED BY SD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)				
						20	40	60	80	100	20	40	60	GR	SA	SI	CL		
263.5																			
0.0	200mm Asphalt																		
0.2	SILTY SAND with gravel occasional cobbles and possible boulders compact to dense grey-brown to brown FILL		1	BS	-														
			2	SS	31														
			3	SS	37														
			4	SS	20														
			5	SS	41											19	32	49	(SI+CL)
			6	SS	24														
			7	SS	29														
257.7	CLAY (CI) with sand stiff brown		8	SS	12									1	15	45	39		
256.2	SILTY CLAYEY SAND (SC-SM) with gravel (TILL) occasional cobbles and boulders dense to very dense brown		9	SS	50									21	34	35	10		
7.3																			
			10	SS	70														

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

Continued Next Page

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

### RECORD OF BOREHOLE No 19-4

2 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.332923°, Long: -78.711245°  
MTM z10: N 4 910 626.8 E 367 702.0 ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA COMPILED BY JG  
 DATUM Geodetic DATE 2019.05.15 - 2019.05.15 CHECKED BY SD

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								
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>		
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)				
							20	40	60	80	100	20	40	60		
252.3	SILTY CLAYEY SAND (SC-SM) with gravel (TILL) occasional cobbles and boulders dense to very dense brown		11	SS	112											
11.2	End of Borehole															

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

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

### RECORD OF BOREHOLE No 19-5

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333181°, Long: -78.710173° ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA MTM z10: N 4 910 656.3 E 367 787.2 COMPILED BY JG  
 DATUM Geodetic DATE 2019.05.14 - 2019.05.14 CHECKED BY SD

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	20
265.6																		
0.0	SILTY SAND with gravel dense grey-brown FILL		1	BS	-													
			2	SS	45													
264.2																		
1.4	SILTY SAND to CLAYEY SAND to SANDY CLAY with gravel occasional cobbles and possible boulders compact to dense brown -alternating fill layers/mixed fill FILL		3	SS	25													
			4	SS	27										29	30	29	12
			5	SS	20													
			6	SS	36													
			7	SS	23													
			8	SS	15													
			9	SS	25										20	27	36	17
257.7	-trace organics/organic silt at 7.9m																	
7.9	CLAY (CI) with sand stiff brown	10	SS	8														
256.8																		
8.8	SANDY CLAY (CL) with gravel (TILL) occasional cobbles and boulders stiff to hard grey-brown	11	SS	25														

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

Continued Next Page

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

**RECORD OF BOREHOLE No 19-5**

2 OF 2

**METRIC**

WP# 4094-17-00 LOCATION Lat: 44.333181°, Long: -78.710173°  
MTM z10: N 4 910 656.3 E 367 787.2 ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA COMPILED BY JG  
 DATUM Geodetic DATE 2019.05.14 - 2019.05.14 CHECKED BY SD

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		
	Continued From Previous Page													
252.8	SANDY CLAY (CL) with gravel (TILL) occasional cobbles and boulders stiff to hard grey-brown		12	SS	69									
254														
253			13	SS	71									22 25 38 15
12.8	End of Borehole													

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

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



### RECORD OF BOREHOLE No 19-6

2 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333681°, Long: -78.708561° ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA COMPILED BY JG  
 DATUM Geodetic DATE 2019.05.15 - 2019.05.15 CHECKED BY SD

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									
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
Continued From Previous Page																	
256.9	SANDY CLAY some gravel to with gravel occasional cobbles and possible boulders compact brown <b>FILL</b>  SILTY CLAY (CL-ML) trace to some sand and gravel (TILL) occasional cobbles and boulders very stiff to hard grey brown to grey		12	SS	100/ 125mm		257										
10.7																	
254.8			13	SS	58		255										2 8 70 20
12.8	End of Borehole																

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

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

### RECORD OF BOREHOLE No 19-7

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333749°, Long: -78.707802° ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA MTM z10: N 4 910 721.2 E 367 975.6 COMPILED BY JG  
 DATUM Geodetic DATE 2019.05.16 - 2019.05.16 CHECKED BY SD

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					
267.3	200 mm Asphalt														
0.0															
0.2	SAND with gravel dense brown-grey FILL		1	BS	-										
			1	SS	41										
265.9															
1.4	CLAYEY SAND with gravel to SANDY CLAY with gravel to CLAYEY GRAVEL with sand occasional cobbles and possible boulders compact to dense brown FILL		2	SS	42										
			3	SS	16										
			4	SS	20									22 28 34 16	
			5	SS	17										
			6	SS	10										
			7	SS	23										
			8	SS	21									29 25 31 15	
259.5	- trace organic silt at 7.8m														
7.8	SILTY CLAYEY SAND (SC-SM) with gravel (TILL) occasional cobbles and boulders compact to dense brown		9	SS	33										
			10	SS	21										

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

Continued Next Page

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

### RECORD OF BOREHOLE No 19-7

2 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333749°, Long: -78.707802°  
MTM z10: N 4 910 721.2 E 367 975.6 ORIGINATED BY RH  
 HWY 17 BOREHOLE TYPE HSA COMPILED BY JG  
 DATUM Geodetic DATE 2019.05.16 - 2019.05.16 CHECKED BY SD

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							
	Continued From Previous Page						20 40 60 80 100								
255.4	<b>SILTY CLAYEY SAND (SC-SM)</b> with gravel ( <b>TILL</b> ) occasional cobbles and boulders compact to dense brown		11	SS	22									27 31 30 12	
256															
11.9	<b>SANDY SILTY CLAY (CL-ML)</b> some gravel ( <b>TILL</b> ) occasional cobbles hard grey		12	SS	97									13 29 45 13	
254.5															
12.8	End of Borehole														

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20



**Appendix C.**  
**Laboratory Testing**

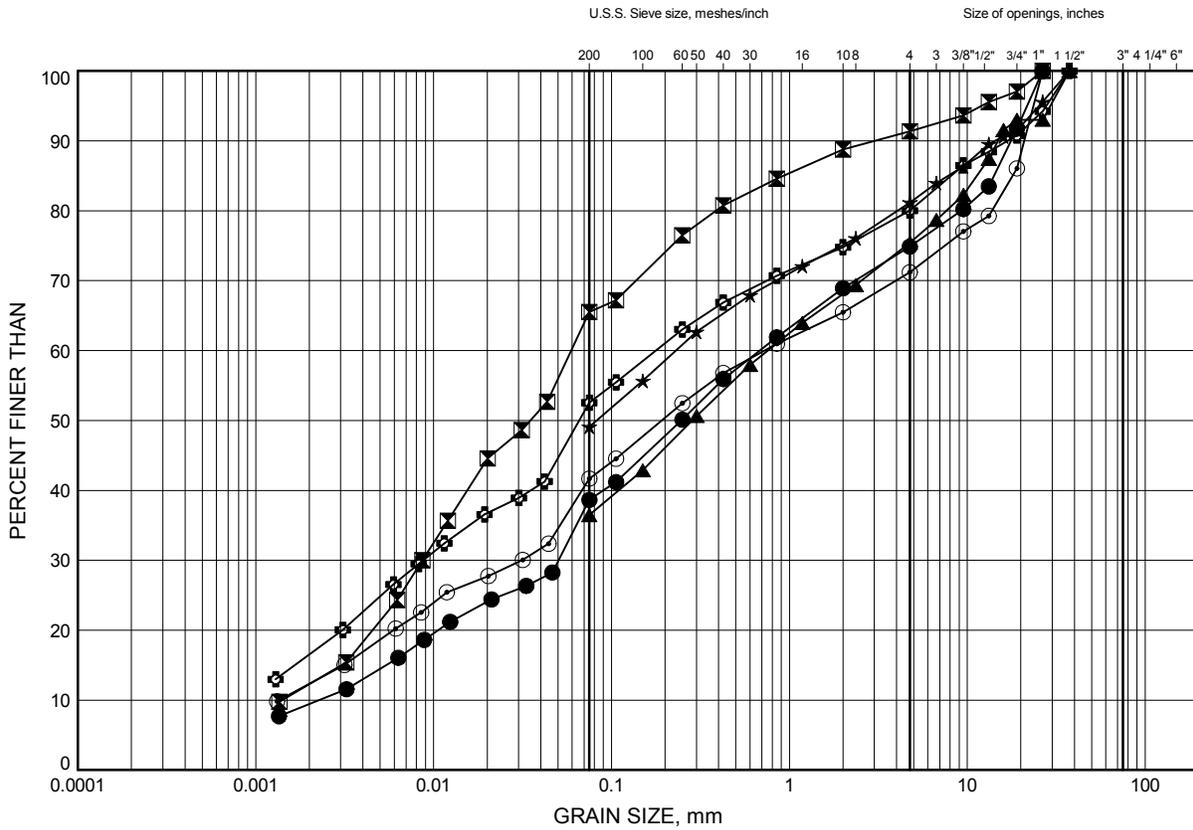


**Appendix C.1**  
**Particle Size Analysis Figures**  
**Atterberg Limit Test Results**

# Hwy 7 Lindsay Rail Trail Culvert GRAIN SIZE DISTRIBUTION

FIGURE C1

## Fill



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-1	0.3	258.8
⊠	19-2	1.1	258.0
▲	19-3	1.1	259.1
★	19-4	3.4	260.1
⊙	19-5	2.6	263.0
⊠	19-5	6.4	259.2

Date .. October 2019 ..  
 WP# .. 4094-17-00 ..



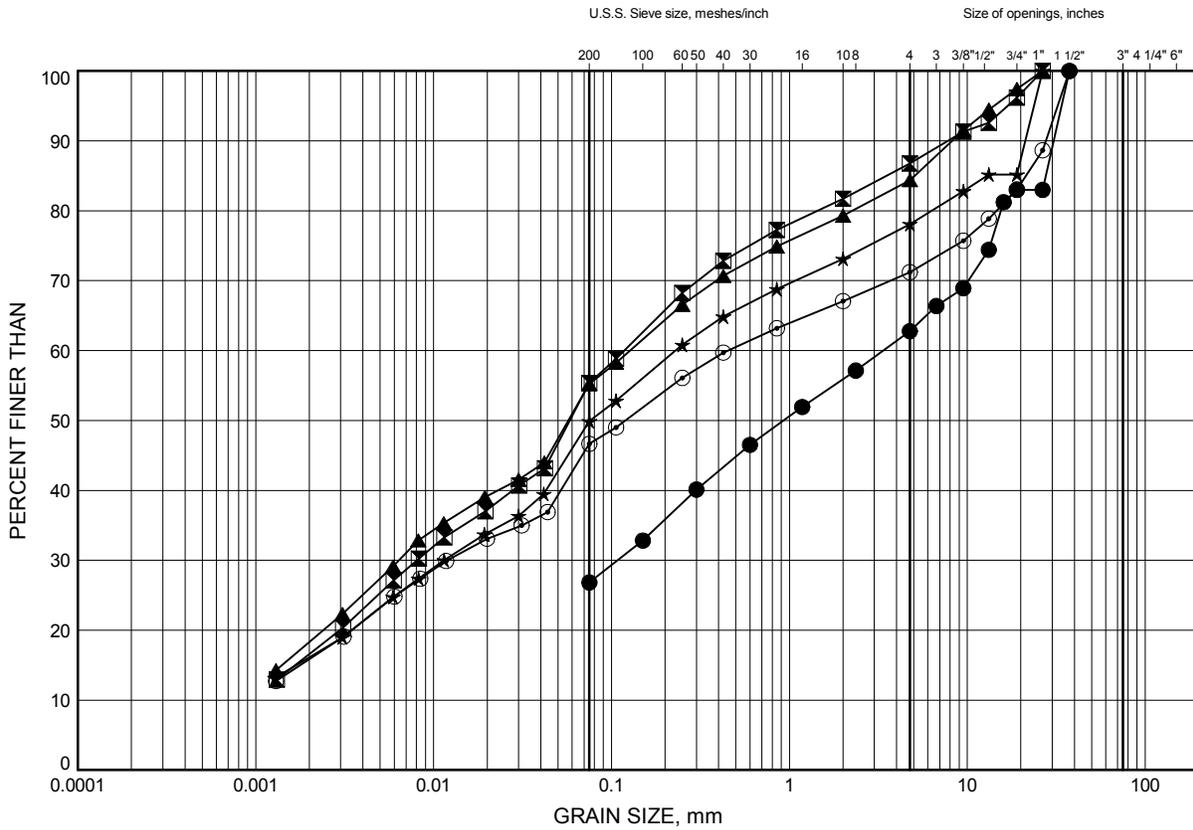
Prep'd .. AC ..  
 Chkd. .. SD ..

GRAIN SIZE DISTRIBUTION - THURBER 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2/10/19

# Hwy 7 Lindsay Rail Trail Culvert GRAIN SIZE DISTRIBUTION

FIGURE C2

## Fill



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-6	2.6	265.0
⊠	19-6	4.9	262.7
▲	19-6	7.9	259.7
★	19-7	3.4	263.9
⊙	19-7	6.4	260.9

Date .. October 2019 ..  
 WP# .. 4094-17-00 ..



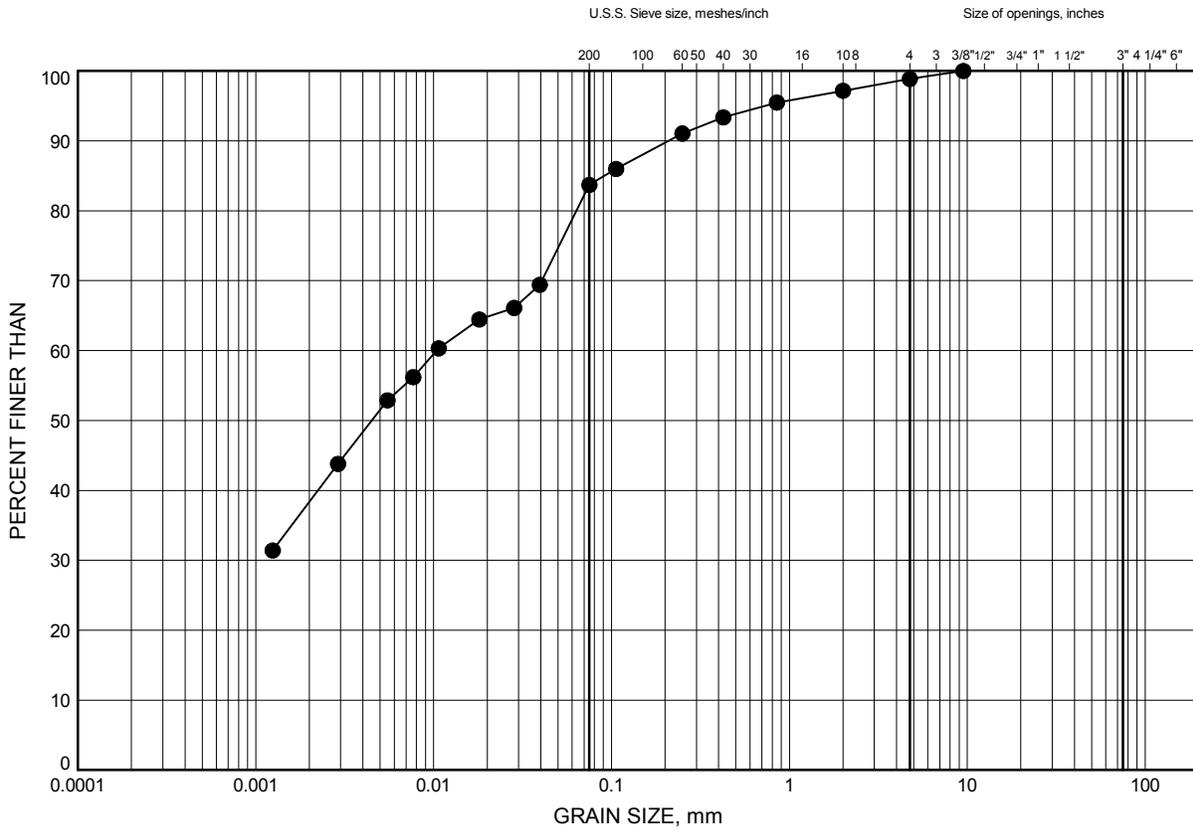
Prep'd .. AC ..  
 Chkd. .. SD ..

GRAIN SIZE DISTRIBUTION - THURBER 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2/10/19

Hwy 7 Lindsay Rail Trail Culvert  
**GRAIN SIZE DISTRIBUTION**

FIGURE C3

Clay (CI) with sand



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-4	6.4	257.1

Date .. October 2019 ..  
 WP# .. 4094-17-00 ..



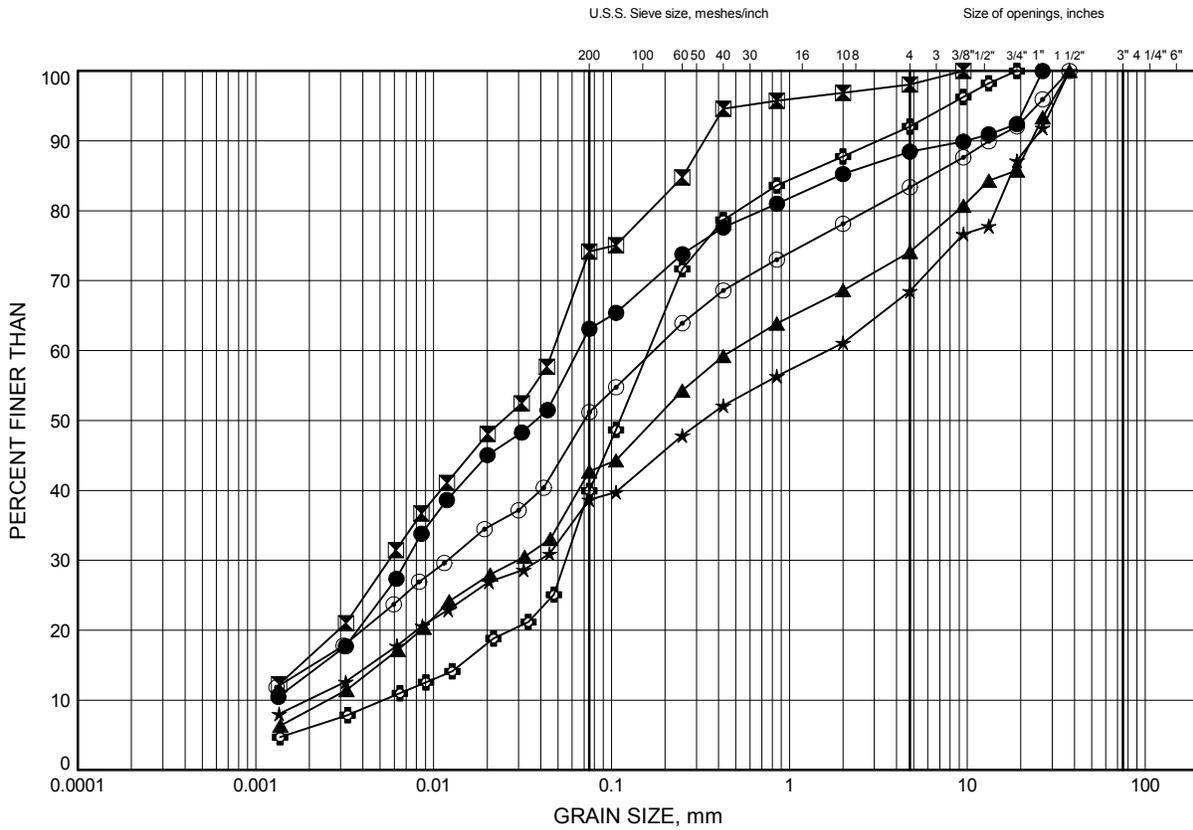
Prep'd .. AC ..  
 Chkd. .. SD ..

GRAIN SIZE DISTRIBUTION - THURBER 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2/10/19

# Hwy 7 Lindsay Rail Trail Culvert GRAIN SIZE DISTRIBUTION

FIGURE C4

## Glacial Till



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-1	2.6	256.5
⊠	19-1	5.6	253.5
▲	19-2	3.4	255.7
★	19-2	5.6	253.5
⊙	19-3	3.4	256.8
⊠	19-3	6.4	253.8

Date ..October 2019.....  
WP# ..4094-17-00.....

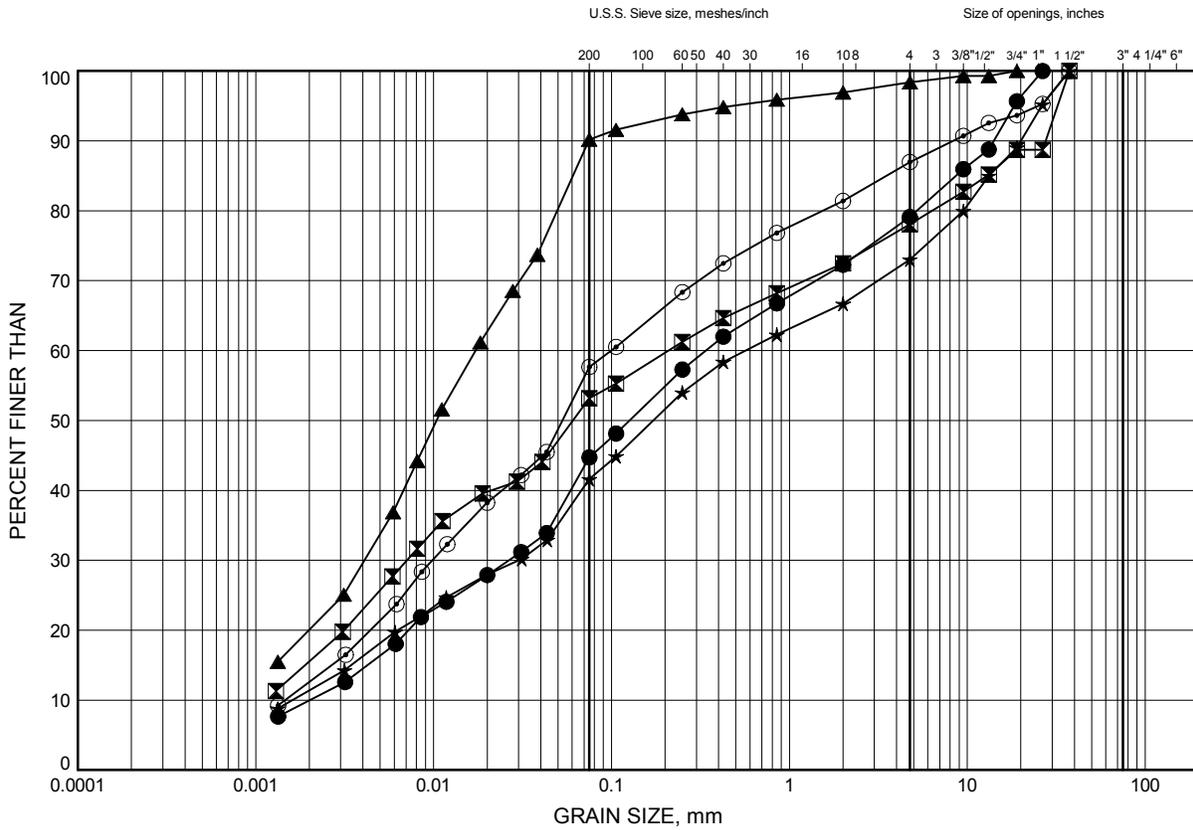


Prep'd ..AC.....  
Chkd. ..SD.....

# Hwy 7 Lindsay Rail Trail Culvert GRAIN SIZE DISTRIBUTION

FIGURE C5

## Glacial Till



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-4	7.9	255.6
⊠	19-5	12.5	253.1
▲	19-6	12.5	255.1
★	19-7	11.0	256.3
⊙	19-7	12.5	254.8

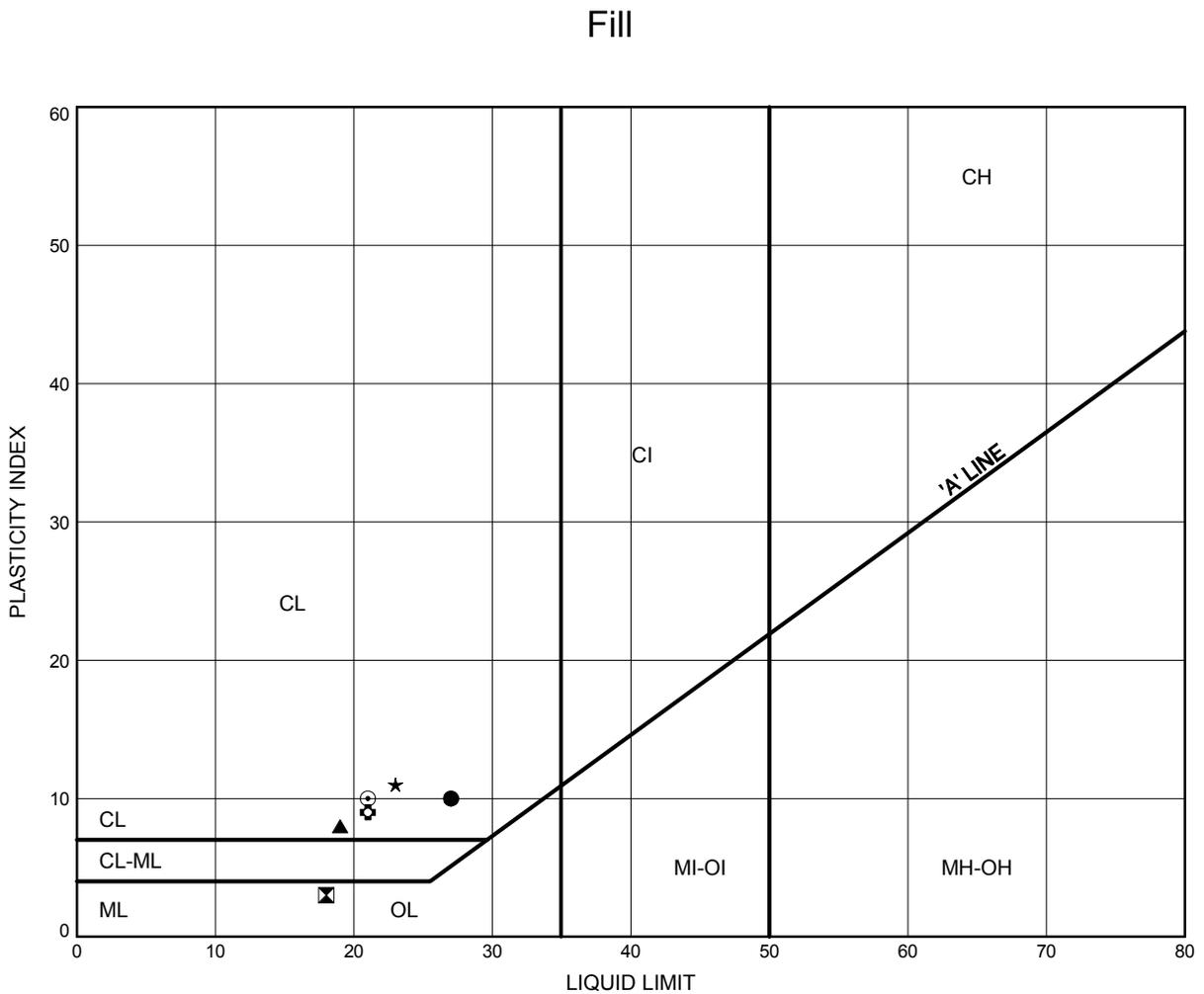
Date .. October 2019 ..  
WP# .. 4094-17-00 ..



Prep'd .. AC ..  
Chkd. .. SD ..

Hwy 7 Lindsay Rail Trail Culvert  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C6



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-1	0.3	258.8
⊠	19-2	1.1	258.0
▲	19-5	2.6	263.0
★	19-5	6.4	259.2
⊙	19-6	4.9	262.7
⊕	19-6	7.9	259.7

Date .. October 2019 ..  
 WP# .. 4094-17-00 ..

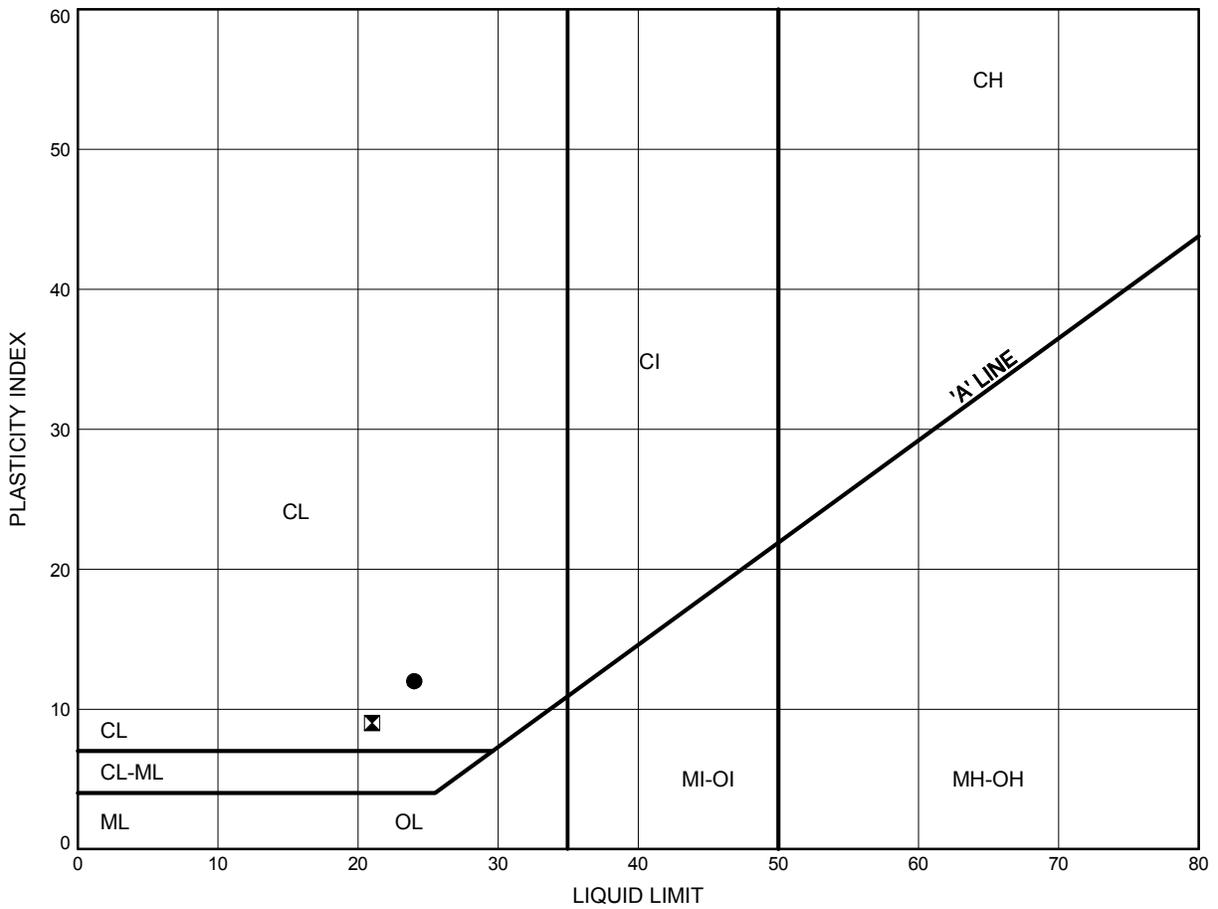


Prep'd .. AC ..  
 Chkd. .. SD ..

Hwy 7 Lindsay Rail Trail Culvert  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C7

Fill



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-7	3.4	263.9
⊠	19-7	6.4	260.9

THURBALT 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2/10/19

Date ..October 2019.....  
 WP# ..4094-17-00.....

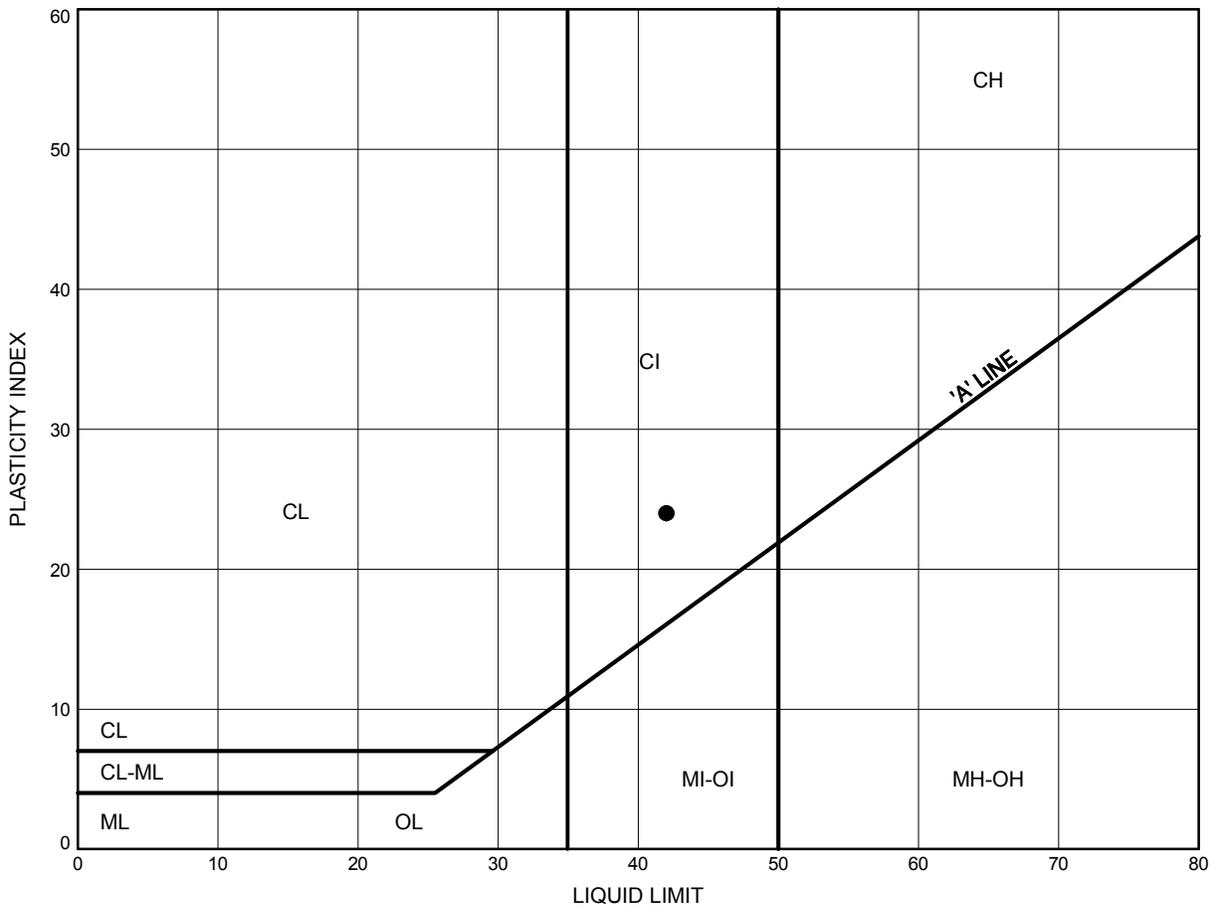


Prep'd ..AC.....  
 Chkd. ....SD.....

Hwy 7 Lindsay Rail Trail Culvert  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C8

Clay (CI) with sand



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-4	6.4	257.1

Date .. October 2019 ..  
 WP# .. 4094-17-00 ..

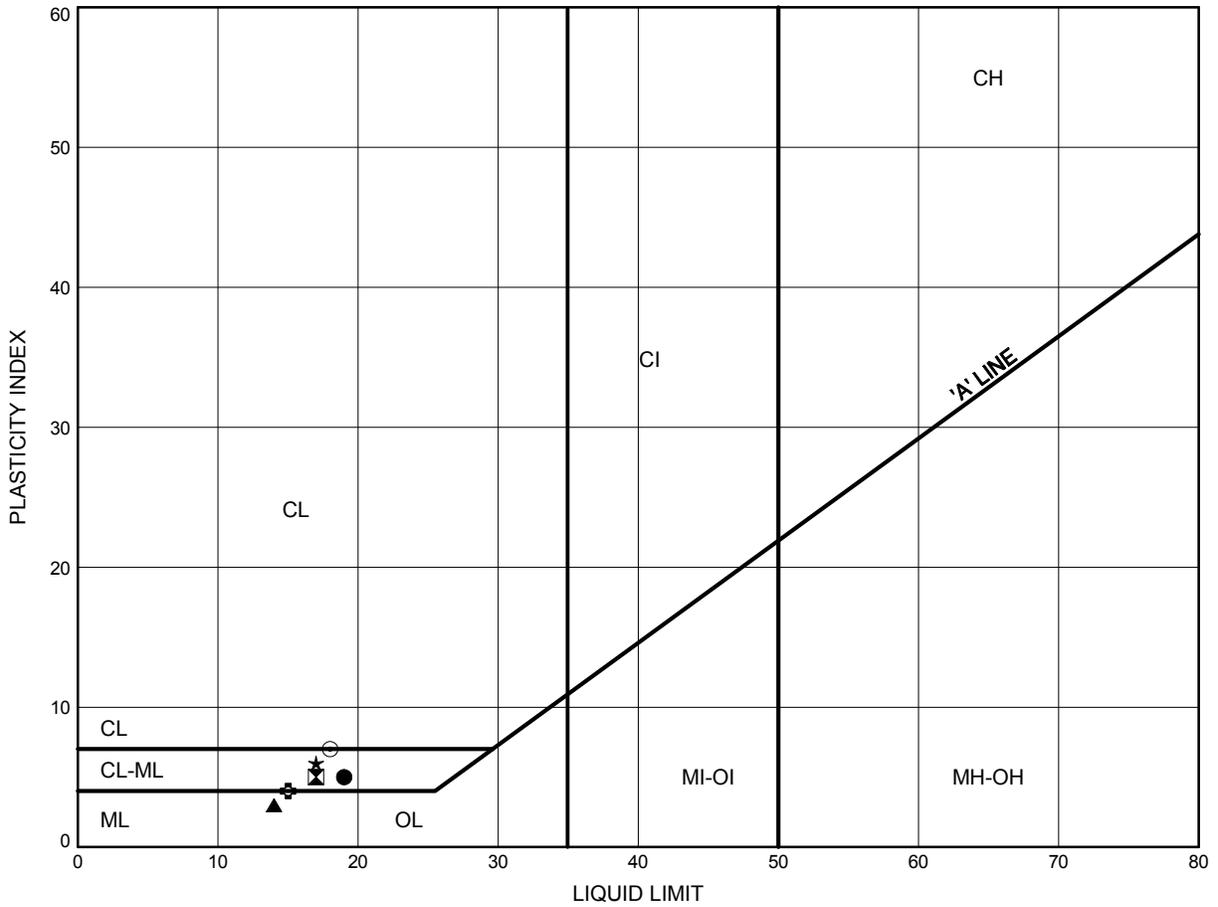


Prep'd .. AC ..  
 Chkd. .. SD ..

Hwy 7 Lindsay Rail Trail Culvert  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C9

Glacial Till



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-1	2.6	256.5
⊠	19-1	5.6	253.5
▲	19-2	3.4	255.7
★	19-2	5.6	253.5
⊙	19-3	3.4	256.8
⊕	19-4	7.9	255.6

Date .. October 2019 ..  
 WP# .. 4094-17-00 ..

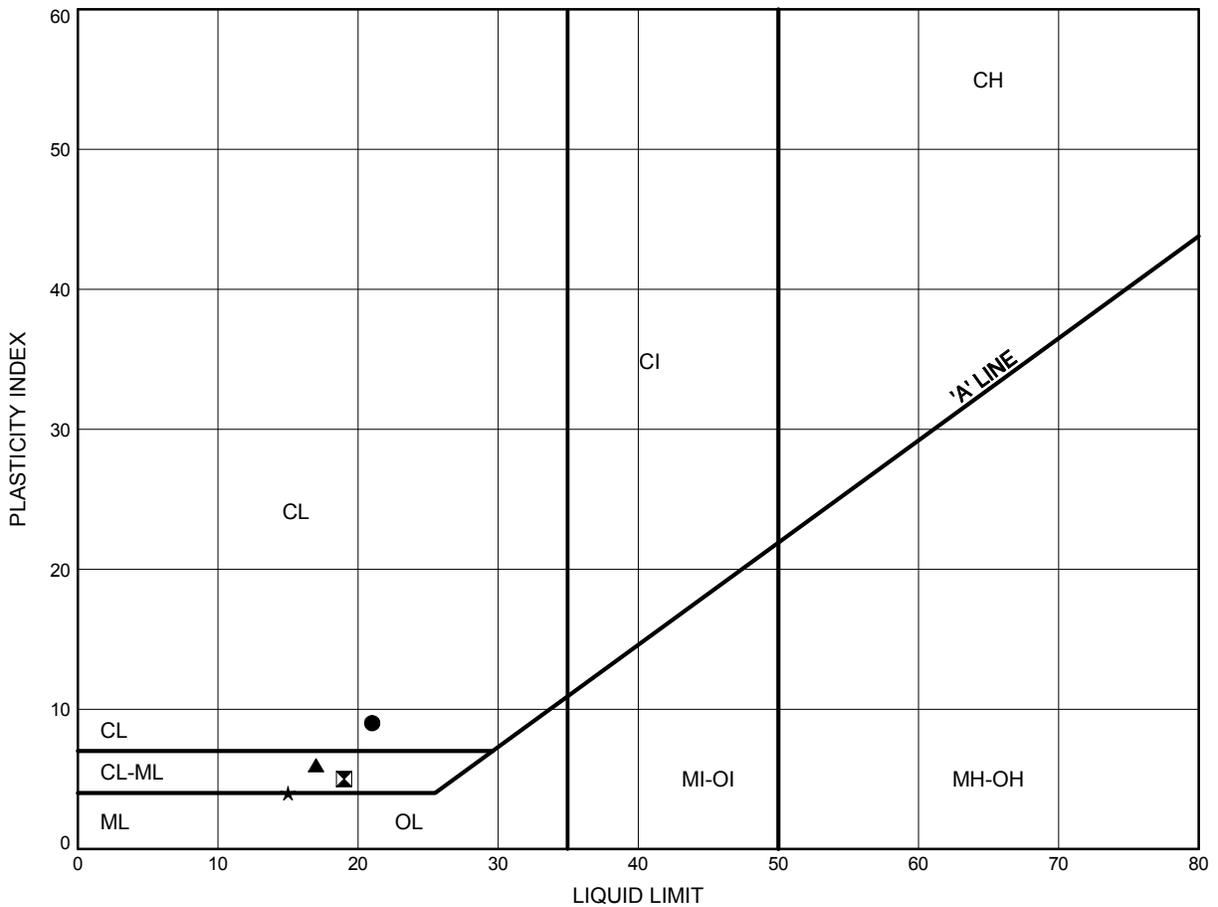


Prep'd .. AC ..  
 Chkd. .. SD ..

Hwy 7 Lindsay Rail Trail Culvert  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C10

Glacial Till



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-5	12.5	253.1
⊠	19-6	12.5	255.1
▲	19-7	11.0	256.3
★	19-7	12.5	254.8

Date ..October 2019.....  
 WP# ..4094-17-00.....



Prep'd ..AC.....  
 Chkd. ..SD.....



**Appendix C.2**  
**Analytical Testing Results**

Certificate of Analysis  
**Client: Thurber Engineering Ltd.**  
**Client PO: 23770**

Report Date: 22-May-2019

Order Date: 13-May-2019

**Project Description: Hwy 7, Culvert 20+300**

<b>Client ID:</b>	19-1, SS3, 5'-7'	-	-	-
<b>Sample Date:</b>	30-Apr-19 09:00	-	-	-
<b>Sample ID:</b>	1920149-01	-	-	-
<b>MDL/Units</b>	Soil	-	-	-

**Physical Characteristics**

% Solids	0.1 % by Wt.	88.2	-	-	-
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**General Inorganics**

Conductivity	5 uS/cm	226	-	-	-
pH	0.05 pH Units	7.37	-	-	-
Resistivity	0.10 Ohm.m	44.2	-	-	-

**Anions**

Chloride	5 ug/g dry	70	-	-	-
Sulphate	5 ug/g dry	8	-	-	-



**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.  
Lakefield - Ontario - K0L 2H0  
Phone: 705-652-2000 FAX: 705-652-6365

23-May-2019

**Paracel Laboratories**

Attn : Dale Robertson

300-2319 St.Laurent Blvd.  
Ottawa, ON  
K1G 4K6, Canada

Phone: 613-731-9577  
Fax:613-731-9064

**Date Rec. :** 15 May 2019  
**LR Report:** CA12710-MAY19  
**Reference:** Project#: 1920149

**Copy:** #1

# CERTIFICATE OF ANALYSIS

## Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		22-May-19
2: Analysis Start Time		15:02
3: Analysis Completed Date		22-May-19
4: Analysis Completed Time		16:14
5: QC - Blank		< 0.02
6: QC - STD % Recovery		118%
7: QC - DUP % RPD		ND
8: RL		0.02
9: 19-1, SS3, 5'7	30-Apr-19 09:00	< 0.02

RL - SGS Reporting Limit

Note: Sample was past the 14 day holding time upon receipt; result may be unreliable.

Kimberley Didsbury  
Project Specialist,  
Environment, Health & Safety



**Appendix C.3**  
**Bedrock Core Photographs**

**Borehole 19-1**  
**Run 1 to 2 (of 2)**  
**Elevation 251.6 m to 248.5 m**



**Foundation Investigation**  
**Highway 7 Lindsay – Culvert 23+000**  
**Kawartha Lakes, Ontario**

**WP 4094-17-00**  
**Project No.: 23770**

**Borehole 19-2**  
**Run 1 to 3 (of 3)**  
**Elevation 252.2 m to 248.8 m**



**Foundation Investigation**  
**Highway 7 Lindsay – Culvert 22+039**  
**Kawartha Lakes, Ontario**

**WP 4094-17-00**  
**Project No.: 23770**



**Appendix D.**

**Site Photographs**



**Photo 1. Looking north towards Victoria Trail Bridge (2019/04/22)**



**Photo 2. Looking south towards Victoria Trail Bridge (2019/04/22)**



**Photo 3. Looking east along Hwy 7 from Victoria Trail Bridge (2019/04/22)**



**Photo 4. Looking west along Hwy 7 from Victoria Trail Bridge (2019/04/22)**