THURBER ENGINEERING LTD.

PRELIMINARY
FOUNDATION INVESTIGATION REPORT
HIGHWAY 17 TWINNING, RENFREW AREA
COUNTY ROAD 6 INTERCHANGE
STA. 23+603, HORTON TOWNSHIP
COUNTY ROAD 6 UNDERPASS - SITE NO. 29X-0408/B0
DEIL'S CREEK CULVERTS - SITE NOS. 29X-0242/C1-C3
WP 4068-09-00 / ASSIGNMENT NO. 4018-E-0009

Geocres No.: 31F-230

Report to:

Ministry of Transportation Ontario

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Longitude: -76.622829°

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104, 2460 Lancaster Road, Ottawa ON K1B 4S5 T. 613 247 2121 F. 613 247 2185
thurber.ca

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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.

The existing Highway 17 alignment at this site will become the future Highway 17 eastbound lanes and new westbound lanes will be constructed to the north of the existing alignment. This proposed interchange includes four structures: the Highway 17 County Road 6 Underpass (Site No. 29X-0408/B0), the replacement of the existing culvert (Site No. 29X-0425/C1) under the proposed eastbound lanes of Highway 17 at Sta. 23+642, a new culvert under the proposed westbound lanes (Site No. 29X-0242/C3) around the same station and a new culvert under County Road 6 at Sta. 9+927 (Site No. 29X-0425/C2). The three culverts will convey Deil's Creek under Highway 17 and Country Road 6.

Previous foundation investigation information from boreholes completed in 2004 for the proposed underpass was available under Geocres 31F-137 and information from boreholes completed in 2018 for the rehabilitation of the existing Deil's Creek Culvert (Site No. 29-242/C1), 30 m east of the proposed underpass, was available under Geocres 31F-202.

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.

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 6 Intersection. For project purposes, Highway 17 is herein described as oriented east-west and Country Road 6, north-south. Within the project limits County Road 6 is also known as Gillan Road to the south and Lochwinnoch Road to the north of Highway 17. For clarity, County Road 6 will be used to reference the cross street.

The existing Highway 17 County Road 6 Intersection is an at-grade crossing. In the vicinity of the site, Highway 17 is an undivided highway with left and right turning lanes at County Road 6, gravel shoulders and a posted speed limit of 90 km/hr. The AADT for the section of Highway 17 near the site was reported to be 13,900 in 2016.

Near the intersection, County Road 6 is a two-lane roadway with gravel shoulders and a rural cross-section. An elevated and paved bull-nose is present at the southeast quadrant of the intersection, directing traffic flow through the eastbound on-ramp to Highway 17.

The Highway 17 road surface elevation is approximately 138.1 m at the intersection; the elevation decreases from east to west. The existing road surface of County Road 6 decreases in elevation from south to north.

Deil's Creek crosses existing Highway 17 approximately 30 m east of the intersection via a rigid frame open footing (RFO) culvert rehabilitated in 2004 (Site No. 29-242/C1). The existing RFO has a span of 3.7 m, a rise of 1.5 m and a length of 57.8 m. Flow through the culvert is from south to north. The streambed elevation is approximately 136.0 m. The asphalt surface of the highway is at approximate Elevation 138.6 m and the cover over the culvert from shoulder to the top of the culvert is approximately 0.8 m.

Twin corrugated steel pipe (CSP) culverts facilitate the flow of Deil's Creek under County Road 6 approximately 25 m north of the intersection (Site No. 29-242/C2). The twin CSP pipes have a diameter of 2.4 m and are 25.1 m long. The flow in the creek is from the south to the north under Highway 17 and east to west under County Road 6 (almost 90° bend north of Highway 17). The creek is approximately 4.5 m wide at the south side of Highway 17 and 2.0 m wide west of County Road 6. There was approximately 0.3 m of water in the creek on November 6, 2019.

The existing highway embankment side slopes near the existing Highway 17 Deil's Creek Culvert did not show any visible signs of distress at the time of the investigation. The embankment sides are sloped at approximately 2H:1V to 2.5H:1V.

Bedrock outcrops are visible on both sides of Highway 17 approximately 80 m west of the intersection and on both sides of County Road 6 approximately 60 m north of the intersection.

Photographs showing the existing conditions in the area of the site at the time of the field investigation are included in Appendix D 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 comprised of dolomitic and calcitic carbonate metasedimentary bedrock including dolomite and calcite marble.

3 SITE INVESTIGATION AND FIELD TESTING

The current site investigation and field-testing program was carried out in multiple phases; August 26, 2019 to September 6, 2019, May 4, 2020 to May 6, 2020 and April 28, 2021 and April 29, 2021. The current investigation consisted of advancing 33 boreholes, both on-road and off-road. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

The locations and elevations of the boreholes were surveyed by Thurber with a Trimble Catalyst DA1 antenna with centimeter accuracy. The northing, easting and elevation details 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, Table 3-2 and Table 3-3 below. The site is located within MTM Zone 9.

Table 3-1: Borehole Summary – County Road 6 Underpass

Borehole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
19-01	South Abutment	5036548.6 (45.468799)	295187.7 (-76.622930)	138.3	12.0
19-02	South Abutment	5036545.6 (45.468771)	295182.7 (-76.622994)	138.2	9.1
19-03	Central Pier	5036592.9 (45.469198)	295200 (-76.622773)	137.7	5.1
19-04	Central Pier	5036596.5 (45.469230)	295203 (-76.622735)	137.5	5.1

Borehole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
19-05	Central Pier	5036572.8 (45.469017)	295216.3 (-76.622565)	138.1	7.6
19-06	Central Pier	5036577.9 (45.469063)	295218.7 (-76.622534)	137.9	6.3
19-07	North Abutment	5036620.1 (45.469442)	295231.3 (-76.622374)	136.6	6.4
19-08	North Abutment	5036623.5 (45.469473)	295235.0 (-76.622326)	136.7	3.1
19-09	North Abutment	5036617.0 (45.469415)	295241.4 (-76.622244)	137.1	6.0
19-10	North Abutment	5036598.3 (45.469247)	295247.8 (-76.622162)	137.4	5.0
19-12	North Abutment	5036627.7 (45.469511)	295249.2 (-76.622145)	137.0	6.8
19-13	South Approach	5036482.5 (45.468203)	295100.7 (-76.624042)	139.4	9.8
19-14	South Approach	5036513.2 (45.468479)	295132.3 (-76.623637)	139.0	13.0
19-15	South Approach	5036546.8 (45.468782)	295162.9 (-76.623246)	137.8	10.2
19-17	North Approach	5036657.4 (45.469779)	295279.2 (-76.621762)	136.1	5.4
19-19	North Approach	5036725.0 (45.470388)	295350.9 (-76.620846)	131.9	4.4
19-20	North Approach	5036754.1 (45.470650)	295382.9 (-76.620438)	130.9	6.1
19-21	North Approach	5036778.9 (45.470874)	295416.7 (-76.620005)	130.3	7.7
19-22	North Approach	5036687.4 (45.470050)	295320.2 (-76.621237)	133.9	9.1

Table 3-2: Borehole Summary – High Fill Ramps

Borehole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
19-23	E-N/S Ramp	5036648.4 (45.469699)	295359.0 (-76.620741)	132.7	5.7

19-24	E-N/S Ramp	5036611.7 (45.469369)	295387.5 (-76.620376)	132.3	2.4
19-25	E-N/S Ramp	5036567.0 (45.468967)	295390.1 (-76.620342)	134.7	0.7
19-26	S-W Ramp	5036592.5 (45.469196)	295370.7 (-76.62059)	134.0	0.9
19-27	S-W Ramp	5036633.4 (45.469564)	295353.3 (-76.620814)	133.5	2.7
19-28	S-W Ramp	5036644.6 (45.469664)	295299.0 (-76.621509)	136.0	4.7
19-30	N-E Ramp	5036535.2 (45.468677)	295125.3 (-76.623727)	137.7	9.6
19-31	N-E Ramp	5036545.0 (45.468764)	295043.8 (-76.624770)	140.9	6.7

Table 3-3: Borehole Summary – Deil's Creek Culverts

Borehole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
CV-10	Deil's Creek Culvert (C1)	5036540.7 (45.468728)	295206.0 (-76.622695)	138.6	6.6
CV-11	Deil's Creek Culvert (C3)	5036586.3 (45.469139)	295252.0 (-76.622108)	137.3	5.3
CV-12	Deil's Creek Culvert (C3)	5036571.6 (45.469006)	295242.7 (-76.622227)	136.9	6.4
CV-13	Deil's Creek Culvert (C2)	5036620.1 (45.469443)	295272.0 (-76.621853)	137.7	4.1
CV-14	Deil's Creek Culvert (C2)	5036646.0 (45.469676)	295248.6 (-76.622153)	137.8	4.8
CV-15	Deil's Creek Culvert (C2)	5036629.5 (45.469527)	295262.3 (-76.621977)	136.8	5.1

Boreholes 19-01 through 19-06, 19-09, 19-12 though 19-15, 19-17, 19-19 through 19-22, CV-10 and CV-15 were advanced with a CME 55 truck-mount drill rig equipped with hollow stem augers, NW casing and HW casing. Boreholes 19-07, 19-08, 19-10, 19-23 through 19-28, 19-30, 19-31 and CV-11 through CV-14 were advanced with a CME 45 track-mount drill rig equipped with hollow stem augers, NW casing, NW casing and NQ coring.

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

Piezometers, 19 mm in diameter, were installed in Boreholes 19-01, CV-10 and CV-15. A piezometer, 25 mm in diameter, was installed in Borehole 19-23. Monitoring wells, 38 mm to 50 mm in diameter, were installed in Boreholes 19-06, 19-10, 19-30, CV-11. The installation details are illustrated on the respective Record of Borehole sheets provided in Appendix B. The piezometer in Borehole 19-23 was decommissioned on April 30, 2021. The remaining piezometers and monitoring wells 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.

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. Rock cores were logged and total core recovery (TCR), solid core recovery (SCR) and rock quality designation (RQD) were determined in the field. Point load and unconfined compression (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 five 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.

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 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. Cohesive soils are described per current MTO protocols.

The boreholes from Geocres 31F-137 and Geocres 31F-202 have been incorporated into the following sections. The historic Borehole Location and Soil Strata Drawings and Borehole Logs can be found in Appendix A and B, respectively.

For simplicity, this site has been separated into two areas:

- Area A – north of existing Highway 17
    - Shallow bedrock (generally less than 3 m below existing ground surface).
    - In general, the boreholes encountered fill directly over marble bedrock, till over marble bedrock or some combination of fill, silty sand/sand, clayey silt and till over marble bedrock.
    - Asphalt was encountered in the on-road boreholes; topsoil was encountered in some off-road boreholes.
- Area B – south of (and including) existing Highway 17
    - Deeper bedrock (generally 3 m or more below existing ground surface).
    - In general, the boreholes encountered fill, silty sand/sand, clayey silt and till over marble bedrock.
    - Asphalt was encountered in the on-road boreholes; topsoil was encountered in some off-road boreholes.

In plan, Area B consists of all holes southwest of the proposed median as well as 19-5 and 17-1 in the median and 19-20 and 19-21 at the northeast limit. Area A covers all the boreholes in the central portion of the site.

5.1 Area A – North of Highway 17 (Shallow Bedrock)

Area A generally extends about 200 m north of the northern limit of the existing intersection and includes Boreholes 19-03, 19-04, 19-06, 19-07, 19-08, 19-09, 19-10, 19-12, 19-17, 19-19, 19-22, 19-23, 19-24, 19-25, 19-26, 19-27, 19-28, CV-11, CV-12, CV-13, CV-14, CV-15, CR6-2 and CR6-3.

5.1.1 Asphalt

Asphalt ranging in thickness from 50 mm to 125 mm was encountered in Boreholes 19-09, 19-12, 19-17, 19-19 and 19-22. All of these boreholes are located on County Road 6 north of Highway 17.

5.1.2 Sand with Silt and Gravel to Silty Sand with Gravel to Gravel with Silt and Sand (Fill)

A fill layer consisting of sand with silt and gravel to silty sand with gravel to gravel with silt and sand was encountered below the asphalt in Boreholes 19-09, 19-12, 19-17, 19-19 and 19-22, and from the ground surface in Boreholes 19-03, 19-04, 19-06, CV-15, CR6-2 and CR6-3. The thickness of the layer ranges from 0.8 m to 2.3 m with base depths ranging from 0.9 m to 2.3 m (base elevations ranging from 136.3 m to 131.0 m).

The SPT N-values ranged from 13 to 100 blows per 76 mm; indicating a compact to very dense condition.

The moisture content of the samples tested ranged from 2% to 12%. The results of grain size analyses conducted on nine samples of the fill material are summarized below and are illustrated on Figures C1 and C2 in Appendix C.

Summary of Grain Size Distribution Testing - Fill

Soil Particle	Percentage (%)
Gravel	31 – 61
Sand	27 – 57
Silt & Clay	7 – 20

5.1.3 Topsoil / Rootmat

A layer of topsoil / rootmat was encountered at the ground surface in Boreholes 19-07, 19-23, 19-24, 19-25, 19-26, 19-27 and CV-13. The topsoil was observed to range in thickness from 130 mm to 460 mm in the boreholes. Recorded moisture contents ranged from 30% to 45%. One SPT-N value of 4 was recorded indicating a loose condition. One SPT-N value of 100 blows per 75 mm was recorded directly over bedrock and is therefore not indicative of the actual density.

It should be noted that the topsoil thickness may vary between boreholes and in other areas of the site. This limited data should not be used for estimating topsoil stripping quantities.

5.1.4 Silty Sand (SM) to Sand (SP), trace gravel

A deposit consisting of silty sand to sand was encountered below the topsoil in Borehole 19-07 and from the ground surface in Boreholes CV-11 and CV-12. This deposit was described as having trace gravel and trace to with organics. The thickness of this deposit ranged from 0.3 m to 1.5 m with base depths ranging from 0.6 m to 1.5 m (base elevations ranging from 136.3 m to 135.8 m).

The SPT-N values ranged from 1 to 6; indicating a very loose to loose condition.

The moisture content of the samples tested ranges from 8% to 36%. The results of grain size analyses conducted on one sample of the deposit are summarized below and are illustrated on Figure C3 in Appendix C.

Summary of Grain Size Distribution Testing – Silty Sand to Sand

Soil Particle	Percentage (%)
Gravel	6
Sand	90
Silt & Clay	4

5.1.5 Clayey Silt (CL) with Sand to Clayey Silt (CL-ML)

A deposit of non-cohesive clayey silt with sand was encountered below the topsoil in Borehole 19-23 and below the silty sand in Borehole CV-12. The thickness of this deposit ranged from 1.1 m to 1.7 m with base depths ranging from 1.2 m to 2.3 m (base elevations ranging from 134.6 m to 131.5 m).

The SPT-N values ranged from 2 to 48; indicating a very loose to dense condition. It is noted that the till underlying this deposit in Borehole 19-23 likely influenced the SPT-N value of 48.

The moisture content of the samples tested ranged from 20% to 33%. The results of two grain size analysis tests conducted on samples of this deposit are summarized below and are illustrated on Figure C4 in Appendix C.

Summary of Grain Size Distribution Testing – Clayey Silt

Soil Particle	Percentage (%)
Gravel	0
Sand	17 – 23
Silt	54 – 61
Clay	22 – 23

The results of Atterberg Limits testing carried out on two samples of this deposit are summarized below and are illustrated on Figure C7 in Appendix C. The laboratory results indicate that the tested samples could generally be classified as clayey silt of low plasticity (CL-ML to CL), however this deposit was generally considered to exhibit non-cohesive behaviour.

Summary of Atterberg Limit Testing – Clayey Silt

Parameter	Value
Liquid Limit	20 – 26
Plastic Limit	13 – 18
Plasticity Index	7 – 8

5.1.6 Silty Sand (SM) to Silty Sand (SM) with Gravel to Silty Gravel (GM) with Sand to Gravel (GW-GM) with Silt and Sand Till

A deposit of silty sand to silty sand with gravel to silty gravel with sand to gravel with silt and sand till was encountered from the surface in Boreholes 19-08, 19-10, 19-28 and CV-14, below the fill in Borehole 19-06, below the topsoil in Boreholes 19-24 to 19-27, below the silty sand to sand in in Boreholes 19-07 and CV-11, and below the clayey silt in Boreholes 19-23 and CV-12. The thickness of this deposit ranged from 0.1 m to 2.6 m with base depths ranging from 0.1 m to 2.8 m

(base elevations ranging from 136.9 m to 129.9 m). Cobbles and boulders were encountered in this deposit.

The SPT-N values ranged from 2 to 100 blows per 150 mm penetration; indicating a very loose to very dense condition. It is noted that the SPT-N values obtained in this deposit directly over the bedrock were impacted by the bedrock.

The moisture content of the samples tested ranged from 2% to 35%. The results of eight grain size analysis tests conducted on samples of this deposit are summarized below and are illustrated on Figures C5 and C6 in Appendix C.

Summary of Grain Size Distribution Testing – Till

Soil Particle	Percentage (%)	
Gravel	10 - 61	
Sand	31 - 75	
Silt	27 - 33	8 - 27
Clay	5 - 8	

5.2 Area B – South of Highway 17 (Deeper Bedrock)

Area B generally extends south of the northern limit of Highway 17 (i.e. including the intersection) as well as the portion of County Road 6 located greater than 200 m north of Highway 17 and includes Boreholes 19-01, 19-02, 19-05, 19-13, 19-14, 19-15, 19-20, 19-21, 19-30, 19-31, CV-10, 17-1, 17-2 and CR6-1.

5.2.1 Asphalt

Asphalt ranging in thickness from 50 mm to 175 mm was encountered in Boreholes 19-01, 19-02, 19-20, 19-21 and CV-10. It is noted that a 225 mm concrete layer was noted below the asphalt in 19-21. Borehole CV-10 is located on the south shoulder of Highway 17. The remaining boreholes mentioned above are on County Road 6.

5.2.2 Topsoil / Rootmat

A layer of topsoil / rootmat was encountered at the ground surface in Boreholes 17-1, 19-30 and CR6-1. The topsoil / rootmat was observed to range in thickness from 50 mm to 125 mm in the boreholes. Recorded moisture contents ranged from 5% to 71%.

It should be noted that the topsoil thickness may vary between boreholes and in other areas of the site. This limited data should not be used for estimating topsoil stripping quantities.

5.2.3 Sand with Silt and Gravel to Silty Sand, some Gravel to Gravel with Silt and Sand to Clay with Sand to Clayey Silt (Fill)

A fill layer consisting of sand with silt and gravel to silty sand, some gravel to gravel with silt and sand was encountered below the asphalt in Boreholes 19-01, 19-02, 19-20, 19-21 and CV-10,

and from the ground surface in Boreholes 19-05, 19-13, 19-14, and 19-15, and below the topsoil/rootmat in Borehole CR6-1. Occasional cobbles were observed in the fill. The thickness of the layer ranges from 0.6 m to 3.0 m with base depths ranging from 0.6 m to 3.0 m (base elevations ranging from 137.8 m to 128.8 m). The SPT N-values recorded in the non-cohesive fill ranged from 7 to 59 blows per 0.3 m of penetration, indicating a loose to very dense condition.

At the boreholes put down in 2018 near the existing Deil's Creek culvert that crosses Highway 17, a fill layer consisting of clay with sand to clayey silt was encountered at the ground surface at the inlet (Borehole 17-2) and beneath a 100 mm thick rootmat at the outlet (Borehole 17-1) at the time of that investigation. The thickness of the fill at the inlet and outlet was 0.6 m and 1.4 m (base elevations of from 136.1 m to 135.6 m), respectively. The SPT N-values recorded in the clayey fill ranged from 9 to 21 blows per 0.3 m of penetration, indicating a generally stiff to very stiff consistency.

The moisture content of the fill samples tested ranged from 2% to 39%. The results of grain size analyses conducted on eight samples of this fill material are summarized below and are illustrated on Figures C8 and C9 in Appendix C.

Summary of Grain Size Distribution Testing - Fill

Soil Particle	Percentage (%)	
Gravel	0 – 56	
Sand	26 – 67	
Silt	53	4 – 74
Clay	21	

The results of Atterberg Limits testing carried out on one sample of the cohesive part of the fill are summarized below and are illustrated on Figure C16 in Appendix C. The laboratory results indicate that the material is of low plasticity (CL).

Summary of Atterberg Limit Testing – Fill

Parameter	Value
Liquid Limit	33
Plastic Limit	18
Plasticity Index	15

5.2.4 Silty Sand (SM) to Silty Sand (SM) with Gravel to Sandy Silt (ML), trace to some gravel

A deposit consisting of silty sand to sandy silt was encountered from the ground surface in Borehole 19-31, below the topsoil in Borehole 19-30 and below the fill in Boreholes 19-01, 19-02, 19-05, 19-13, 19-14 and 19-15. This deposit was described as having trace to some gravel and trace clay. The thickness of this deposit ranged from 1.5 m to more than 6.7 m with base depths

ranging from 2.3 m to 6.9 m (base elevations ranging from 135.4 m to 132.1 m). Borehole 19-31 was terminated in this deposit at a depth of 6.7 m (base elevation 134.2 m).

The SPT-N values ranged from 2 to 82; indicating a very loose to very dense condition.

The moisture content of the samples tested ranges from 12% to 24%. The results of grain size analyses conducted on ten samples of the deposit are summarized below and are illustrated on Figures C10 and C11 in Appendix C.

Summary of Grain Size Distribution Testing – Silty Sand to Sandy Silt

Soil Particle	Percentage (%)	
Gravel	0 – 19	
Sand	39 – 86	
Silt	32 – 50	8 – 61
Clay	4 – 11	

The results of Atterberg Limits testing carried out on five samples from this deposit yielded five non-plastic results.

5.2.5 Clayey Silt (CL to CL-ML) to Clayey Silt (CL) with Sand to Sandy Silt (ML) with Clay to Sandy Clayey Silt (CL-ML), trace gravel

A deposit of non-cohesive clayey silt to sandy silt to sandy clayey silt was encountered below the fill in Boreholes 19-20, 19-21, CV-10, 17-1 and CR6-1, and below the silty sand in Boreholes 19-01, 19-13, 19-14, 19-15 and 19-30. The deposit was noted to have trace gravel and occasional organic inclusions (only in Borehole CR6-1). The thickness of this deposit ranged from 0.3 m to 4.6 m with base depths ranging from 2.2 m to more than 9.8 m (base elevations ranging from 136.3 m to 127.4 m).

The SPT-N values ranged from 2 to 42; indicating a very loose to dense condition. It is noted that the till underlying this deposit in Borehole 19-20 likely influenced the SPT-N value of 100 blows per 275 mm.

Summary of Grain Size Distribution Testing – Clayey Silt to Sandy Clayey Silt

Soil Particle	Percentage (%)
Gravel	0 – 7
Sand	3 – 44
Silt	43 – 67
Clay	15 – 30

The moisture content of the samples tested ranged from 11% to 36%. The results of twelve grain size analysis tests conducted on samples of this deposit are summarized above and are illustrated on Figures C12 and C13 in Appendix C. The results of Atterberg Limits testing carried out on ten samples of this deposit are summarized below and are illustrated on Figures C18 and C19 in Appendix C. The laboratory results indicate that the tested samples could generally be classified as silt to a clayey silt of low plasticity (ML to CL), however this deposit was generally considered to exhibit non-cohesive behaviour.

Summary of Atterberg Limit Testing – Clayey Silt

Parameter	Value
Liquid Limit	16 – 28
Plastic Limit	12 – 17
Plasticity Index	4 – 12

5.2.6 Sandy Silt (ML), trace gravel to Silty Sand (SM) with Gravel to Silty Gravel with Sand to Gravel, some Sand Till

A deposit of sandy silt to silty sand with gravel to silty gravel with sand to gravel till was encountered below the fill in Borehole 17-2, below the silty sand to sandy silt in Boreholes 19-02 and 19-05, and below the clayey silt in Boreholes 19-01, 19-14, 19-15, 19-20, 19-21, 19-30, CV-10 and 17-1. The thickness of this deposit ranged from 0.3 m to 5.3 m with base depths ranging from 3.0 m to 9.6 m (base elevations ranging from 135.5 m to 125.9 m). Frequent cobbles and boulders were encountered in this deposit. Coring was required to get though this layer at some locations.

The SPT-N values ranged from 3 to 100 blows per 50 mm penetration: indicating a very loose to very dense condition. It is noted that the refusal SPT-N values obtained in this deposit directly over the bedrock were impacted by the bedrock.

The moisture content of the samples tested ranged from 6% to 18%. The results of seven grain size analysis tests conducted on samples of this deposit are summarized below and are illustrated on Figures C14 and C15 in Appendix C.

Summary of Grain Size Distribution Testing – Till

Soil Particle	Percentage (%)	
Gravel	3 – 46	
Sand	35 – 58	
Silt	31 – 51	13 – 21
Clay	7 – 12	

5.3 Bedrock

Bedrock (cored or inferred) was encountered in all boreholes except Boreholes 19-13 and 19-31. The bedrock encountered consisted of moderately weathered to fresh, fine to large grained, marble that is predominantly white 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:

Table 5-1: Summary of Bedrock Core Quality

Summary of Rock Core Quality Parameter	Range	Average
Total Core Recovery (TCR), %	38 – 100	96
Solid Core Recovery (SCR), %	0 – 100	68
Rock Quality Designation (RQD), %	0 – 100	45
Fracture Index (fractures per 0.3m)	0 – >10	5

Based on the RQD values, the bedrock is classified as very poor to excellent quality. The RQD values did not show a clear delineation between an upper portion of lower-quality and more sound bedrock below.

Unconfined compressive strength (UCS) testing was carried out on five samples of the bedrock in Boreholes 19-01, 19-03, 19-06 and 19-09. The UCS values ranged from 35 MPa to 81 MPa with an average of 57 MPa. Based on the unconfined compressive strength testing the bedrock is classified as medium strong to strong. Point loads tests were conducted on seven bedrock samples from Boreholes CR6-1, CR6-2 and CR6-3; yielding estimated UCS values ranging from 55 MPa to 152 MPa with an average of 110 MPa. These values should be used with caution. It is noted that within the rock cores a silt seam was present in 19-01, 19-05, 19-20 and CV-10. Fractured zones and vertical and sub-vertical fractures were present in most boreholes.

A summary of the bedrock surface information is provided in Table 5-2 below.

Table 5-2: Summary of Bedrock Depth/Elevation

Borehole No.	Depth to Bedrock Surface (mbgs)	Bedrock Surface Elevation (m)	Comments
Area A – North of Highway 17[a]			
19-03	1.4	136.3	Cored Bedrock
19-04	1.3	136.2	Cored Bedrock
19-06	2.8	135.1	Cored Bedrock
19-07	2.4	134.2	Cored Bedrock
19-08	0.1	136.6	Cored Bedrock
19-09	1.5	135.6	Cored Bedrock

Borehole No.	Depth to Bedrock Surface (mbgs)	Bedrock Surface Elevation (m)	Comments
19-10	2.0	135.4	Cored Bedrock
19-12	1.2	135.8	Cored Bedrock
19-17	1.3	134.8	Cored Bedrock
19-19	0.9	131.0	Cored Bedrock
19-22	2.2	131.7	Cored Bedrock
19-23	2.1	130.6	Cored Bedrock
19-24	2.4	129.9	Spoon / Auger Refusal
19-25	0.7	134.0	Spoon / Auger Refusal
19-26	0.9	133.1	Spoon / Auger Refusal
19-27	2.7	130.8	Auger Refusal
19-28	0.6	135.4	Cored Bedrock
CV-11	1.9	135.4	Cored Bedrock
CV-12	2.8	134.1	Cored Bedrock
CV-13	0.2	137.5	Cored Bedrock
CV-14	0.9	136.9	Cored Bedrock
CV-15	1.5	135.3	Cored Bedrock
CR6-2	1.6	136.2	Cored Bedrock
CR6-3	1.8	134.9	Cored Bedrock
Area B – South of Highway 17[b]			
17-1	5.2	132.0	Cored Bedrock
17-2	4.2	132.5	Cored Bedrock
19-01	8.1	130.2	Cored Bedrock
19-02	9.1	129.1	Spoon / Auger Refusal
19-05	4.3	133.8	Cored Bedrock
19-13	n/a	n/a	Not Cored
19-14	9.1	129.9	Cored Bedrock
19-15	6.9	130.9	Cored Bedrock
19-20	3.0	127.9	Cored Bedrock
19-21	4.4	125.9	Cored Bedrock
19-30	9.6	128.1	DCPT Refusal
19-31	n/a	n/a	Not Cored

Borehole No.	Depth to Bedrock Surface (mbgs)	Bedrock Surface Elevation (m)	Comments
CV-10	3.1	135.5	Cored Bedrock
CR6-1	5.3	132.2	Cored Bedrock

Notes: [a] refer to Section 5.1 for description of Area A
[b] refer to Section 5.2 for description of Area B

5.4 Groundwater

Groundwater levels recorded in the piezometer and monitoring wells are presented in Table 5-3.

Table 5-3: Summary of Groundwater Levels

Borehole No. [Diameter]	Elevation (m)		Screened Material	Groundwater Level		Date of Measurement
	Ground Surface[a]	Screen Bottom		Depth (m)	Elevation (m)	
19-01 [19mm]	138.3	130.5	Clayey SILT / Silty SAND TILL	1.9	136.4	September 26, 2019
				1.4	136.9	April 21, 2020
				1.4	136.9	June 3, 2020
				1.8	136.5	September 29, 2020
				1.5	136.8	December 15, 2021
19-06 [38mm]	137.9	131.6	Bedrock	1.9	136.0	September 26, 2019
				0.5	137.4	April 21, 2020
				1.7	136.2	September 29, 2020
19-10 [50mm]	137.4	132.4	Bedrock	1.7	135.7	June 3, 2020
				1.9	135.5	September 29, 2020
				1.9	135.5	September 23, 2021
				1.5	135.9	October 3, 2021
				1.8	135.6	January 20, 2022
19-23 [25mm]	132.7	130.5	Clayey SILT / Sand TILL	0.8[b]	131.9	April 30, 2021
19-30 [50mm]	137.7	130.8	Sandy Clayey SILT	0.6	137.1	September 29, 2020
				0.2	137.5	June 3, 2020
				0.7	137.0	September 23, 2021
				0.9	136.8	October 3, 2021
				0.8	136.9	January 20, 2022

Borehole No. [Diameter]	Elevation (m)		Screened Material	Groundwater Level		Date of Measurement
	Ground Surface[a]	Screen Bottom		Depth (m)	Elevation (m)	
CV-10 [19mm]	138.6	135.5	FILL / Sandy SILT / GRAVEL TILL	2.2	136.4	September 26, 2019
				1.8	136.8	April 21, 2020
				1.8	136.8	June 3, 2020
				2.2	136.4	September 29, 2020
				1.9	136.7	September 23, 2021
				1.9	136.7	November 4, 2021
CV-11 [50mm]	137.3	132.0	Bedrock	1.3	136.0	September 29, 2020
				0.9	136.4	June 3, 2020
				1.5	135.8	September 23, 2021
				1.2	136.1	October 3, 2021
				1.0	136.3	January 20, 2022
CV-15 [19mm]	136.8	131.7	Bedrock	2.2	134.6	September 26, 2019
				2.0	134.8	April 21, 2020
				2.1	134.7	September 29, 2020
				0.5	136.3	November 24, 2021
CR6-1 [19mm]	137.5	128.4	Bedrock	1.4	136.1	October 16, 2003
				1.2	136.3	October 22, 2004
				Piezometer destroyed		December 16, 2003
CR6-2 [19mm]	137.8	133.3	Bedrock	1.7	136.1	October 16, 2003
				1.6	136.2	October 22, 2004
				1.7	136.1	December 16, 2003
				1.7	136.1	February 4, 2004
				0.4	137.4	March 11, 2004
CR6-3 [19mm]	136.6	132.4	Bedrock	1.7	134.9	October 16, 2003
				1.6	135.0	October 22, 2004
				Piezometer destroyed		December 16, 2003

Notes: [a] ground surface elevation at the time of borehole survey
[b] final reading prior to decommissioning

On November 6, 2019, the water level in Deil's creek was reported to be apt elevation 136.4 m.

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

5.5 Analytical Testing

Five 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 Table 5-4. Copies of the test results are provided in Appendix C.

Table 5-4: Results of Chemical Analysis

Borehole	Sample (Soil Type)	Depth (m)	Chloride (μg/g)	Sulphate (μg/g)	Sulphide (%)	pH (-)	Resistivity (Ohm-cm)
19-01	SS4 (Silty Sand)	2.3 – 2.9	291	65	0.11	7.34	1,430
19-05	SS4 (Silty Sand)	2.3 – 2.9	455	109	0.10	7.57	973
19-09	SS1 (Sand Fill)	0.0 – 0.7	569	26	0.05	7.96	842
CV-10	SS2 (Sand Fill)	0.8 – 1.4	87	38	0.03	7.81	1,720
CV-15	SS2 (Sand Fill)	0.8 – 1.4	60	6	<0.02	8.21	4,990

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.

Marathon Underground of Greely, Ontario supplied and operated the drilling equipment and carried out the drilling, soil sampling, in-situ testing, piezometer/monitoring well installation and borehole decommissioning. The field investigation was supervised on a full-time basis by Sean O'Bryan, Jamil Pirani and Anderson de Oliveira 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. UCS testing was completed by Thurber's laboratory in Oakville, Ontario. 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 Deanna Pizycki, P.Eng., 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

LICENSED PROFESSIONAL ENGINEER
F. J. GRIFFITHS
Sep 13, 2022
PROVINCE OF ONTARIO

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

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Sep 13, 2022
PROVINCE OF ONTARIO

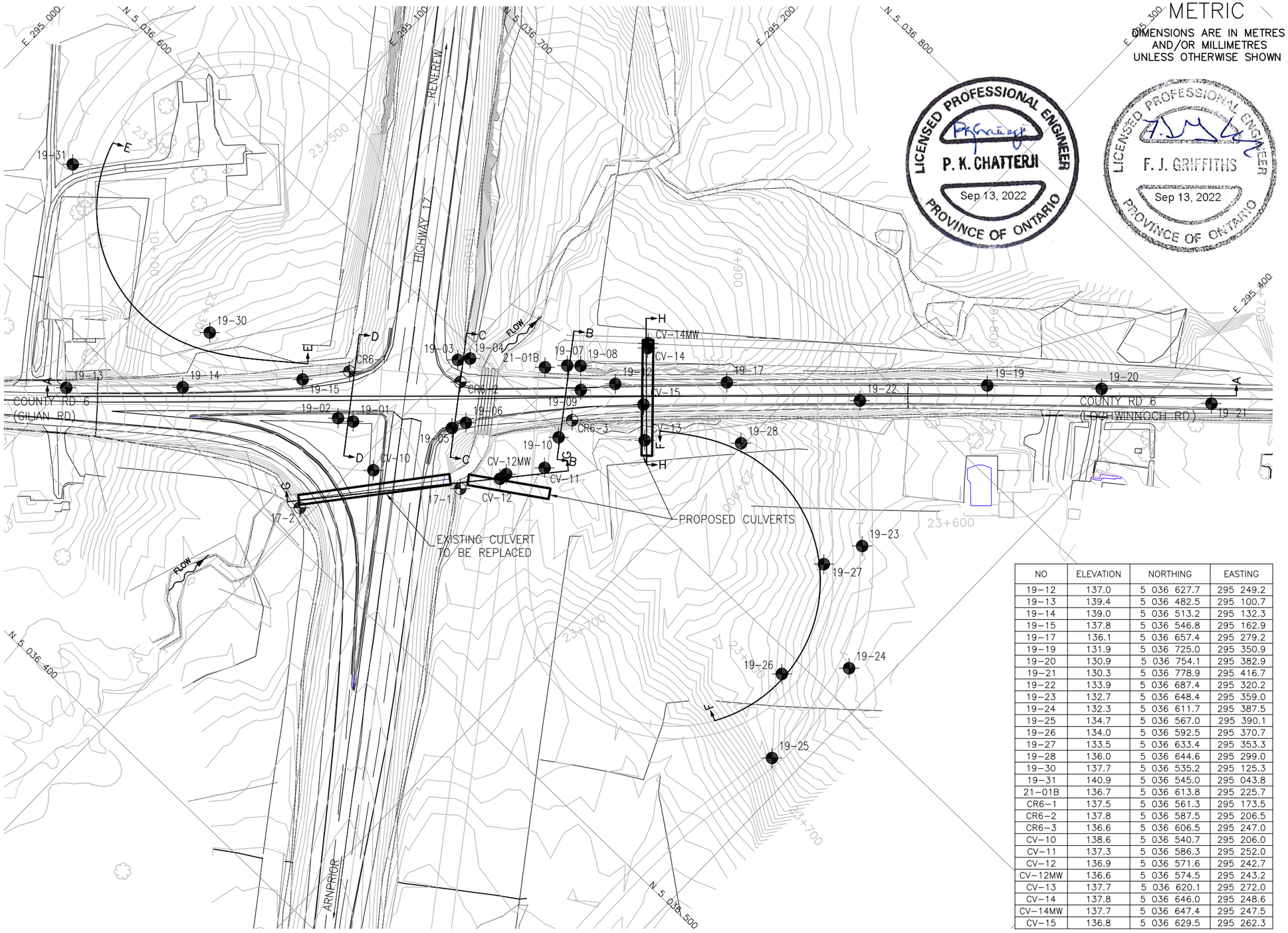
Dr. P.K. Chatterji, P.Eng.
MTO Review Principal,
Senior Geotechnical Engineer

THURBER

Appendix A.

Borehole Location Plan and Stratigraphic Drawings

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN OF COUNTY ROAD 6

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5 0 5 10m V 1:250

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Sep 13, 2022
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
F. J. GRIFFITHS
Sep 13, 2022
PROVINCE OF ONTARIO

NO	ELEVATION	NORTHING	EASTING
19-12	137.0	5 036 627.7	295 249.2
19-13	139.4	5 036 482.5	295 100.7
19-14	139.0	5 036 513.2	295 132.3
19-15	137.8	5 036 546.8	295 162.9
19-17	136.1	5 036 657.4	295 279.2
19-19	131.9	5 036 725.0	295 350.9
19-20	130.9	5 036 754.1	295 382.9
19-21	130.3	5 036 778.9	295 416.7
19-22	133.9	5 036 687.4	295 320.2
19-23	132.7	5 036 648.4	295 359.0
19-24	132.3	5 036 611.7	295 387.5
19-25	134.7	5 036 567.0	295 390.1
19-26	134.0	5 036 592.5	295 370.7
19-27	133.5	5 036 633.4	295 353.3
19-28	136.0	5 036 644.6	295 299.0
19-30	137.7	5 036 535.2	295 125.3
19-31	140.9	5 036 545.0	295 043.8
21-01B	136.7	5 036 613.8	295 225.7
CR6-1	137.5	5 036 561.3	295 173.5
CR6-2	137.8	5 036 587.5	295 206.5
CR6-3	136.6	5 036 606.5	295 247.0
CV-10	138.6	5 036 540.7	295 206.0
CV-11	137.3	5 036 586.3	295 252.0
CV-12	136.9	5 036 571.6	295 242.7
CV-12MW	136.6	5 036 574.5	295 243.2
CV-13	137.7	5 036 620.1	295 272.0
CV-14	137.8	5 036 646.0	295 248.6
CV-14MW	137.7	5 036 647.4	295 247.5
CV-15	136.8	5 036 629.5	295 262.3

CONT No
WP No

HIGHWAY 17 TWINNING
COUNTY ROAD 6

BOREHOLE LOCATION

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
▼	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
17-1	137.2	5 036 558.5	295 234.5
17-2	136.7	5 036 511.2	295 195.8
19-01	138.3	5 036 548.6	295 187.7
19-02	138.2	5 036 545.6	295 182.7
19-03	137.7	5 036 592.9	295 200.0
19-04	137.5	5 036 596.5	295 203.0
19-05	138.1	5 036 572.8	295 216.3
19-06	137.9	5 036 577.9	295 218.7
19-07	136.6	5 036 620.1	295 231.3
19-08	136.7	5 036 623.5	295 235.0
19-09	137.1	5 036 617.0	295 241.4
19-10	137.4	5 036 598.3	295 247.8

-NOTES-

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

GEOCRES No. 31F-230

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MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

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CONT No
WP No

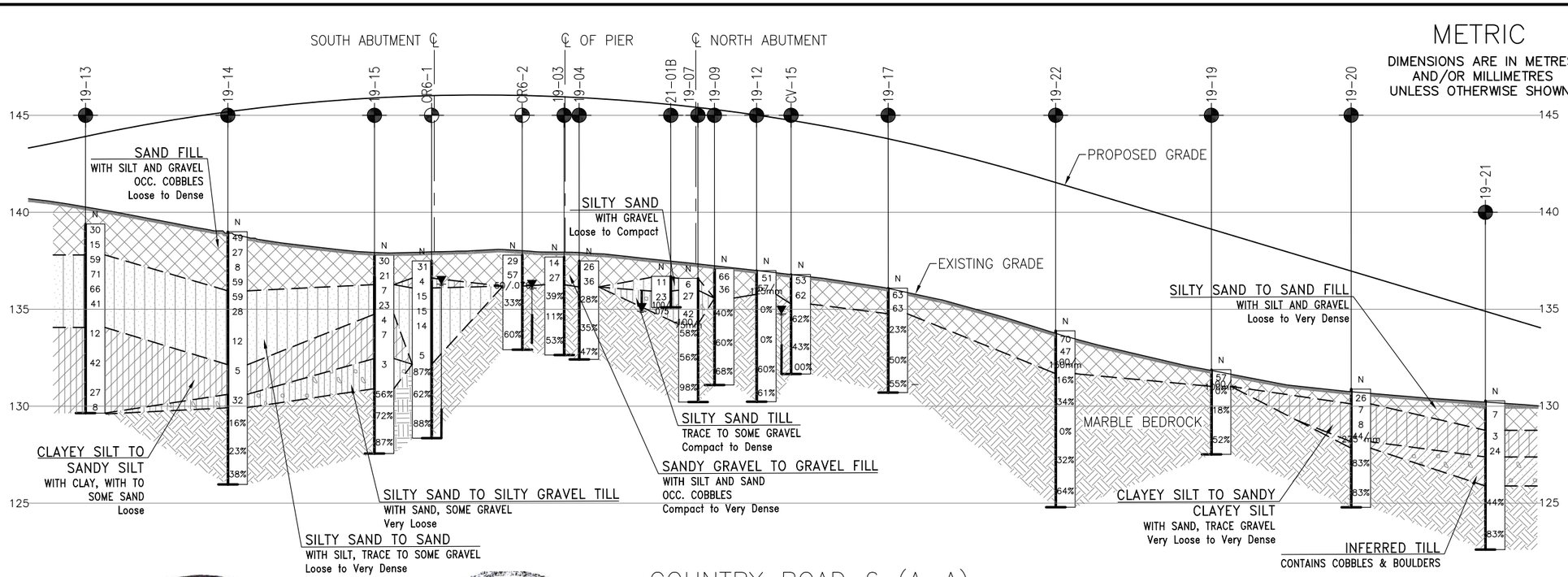
HIGHWAY 17 TWINNING
COUNTY ROAD 6

BOREHOLE SOIL STRATA

SHEET

Ontario

THURBER ENGINEERING LTD.



COUNTRY ROAD 6 (A–A)

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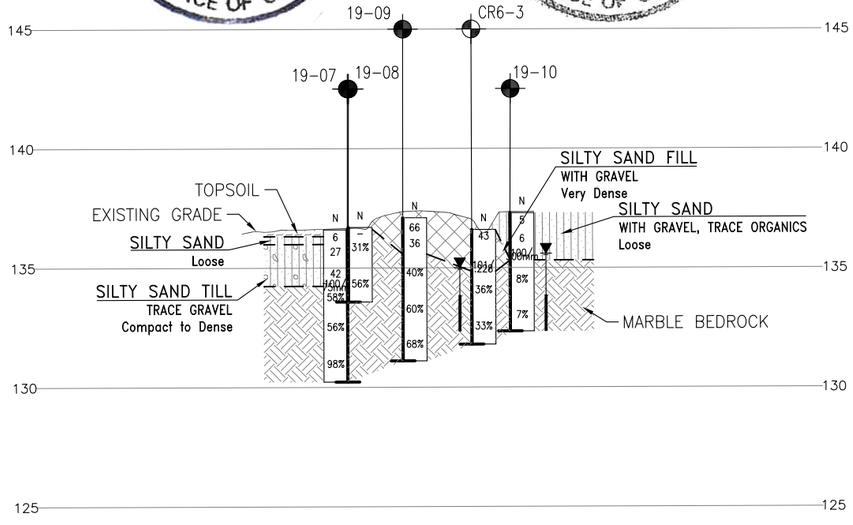
NO	ELEVATION	NORTHING	EASTING
19–17	136.1	5 036 657.4	295 279.2
19–19	131.9	5 036 725.0	295 350.9
19–20	130.9	5 036 754.1	295 382.9
19–21	130.3	5 036 778.9	295 416.7
19–22	133.9	5 036 687.4	295 320.2
21–01B	136.7	5 036 613.8	295 225.7
CR6–1	137.5	5 036 561.3	295 173.5
CR6–2	137.8	5 036 587.5	295 206.5
CR6–3	136.6	5 036 606.5	295 247.0
CV–15	136.8	5 036 629.5	295 262.3



NORTH ABUTMENT (B–B)

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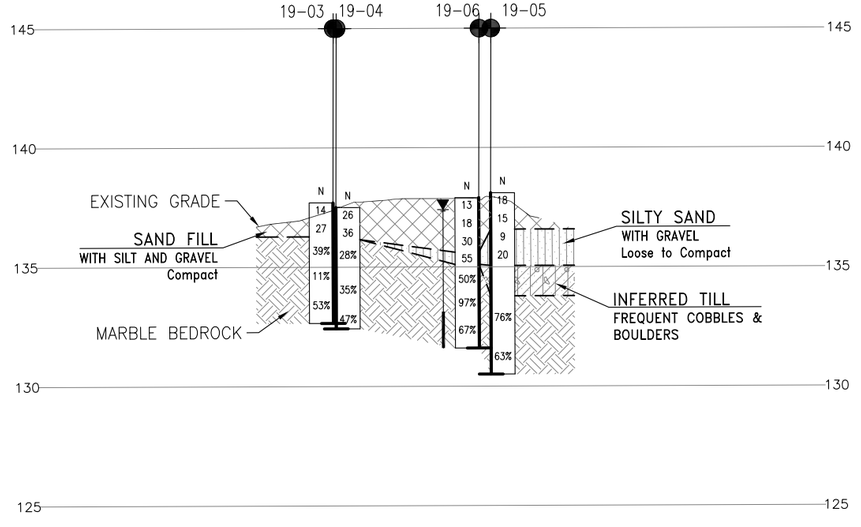

PIER (C–C)

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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
▼	Head Artesian Water
▮	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
19–03	137.7	5 036 592.9	295 200.0
19–04	137.5	5 036 596.5	295 203.0
19–05	138.1	5 036 572.8	295 216.3
19–06	137.9	5 036 577.9	295 218.7
19–07	136.6	5 036 620.1	295 231.3
19–08	136.7	5 036 623.5	295 235.0
19–09	137.1	5 036 617.0	295 241.4
19–10	137.4	5 036 598.3	295 247.8
19–12	137.0	5 036 627.7	295 249.2
19–13	139.4	5 036 482.5	295 100.7
19–14	139.0	5 036 513.2	295 132.3
19–15	137.8	5 036 546.8	295 162.9

-NOTES-

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3) Coordinate system is MTM NAD 83 Zone 9.

GEOCRES No. 31F-230

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F. J. GRIFFITHS — LICENSED PROFESSIONAL ENGINEER — Sep 13, 2022 — PROVINCE OF ONTARIO

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MINISTRY OF TRANSPORTATION, ONTARIO

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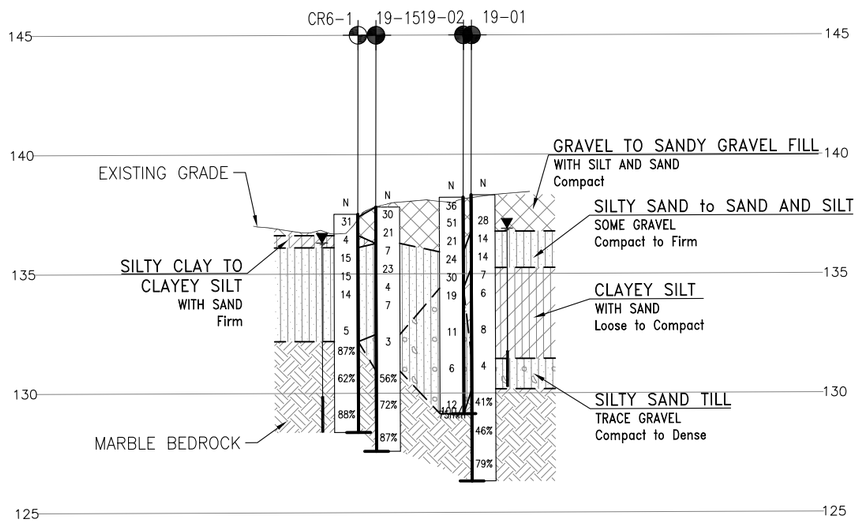

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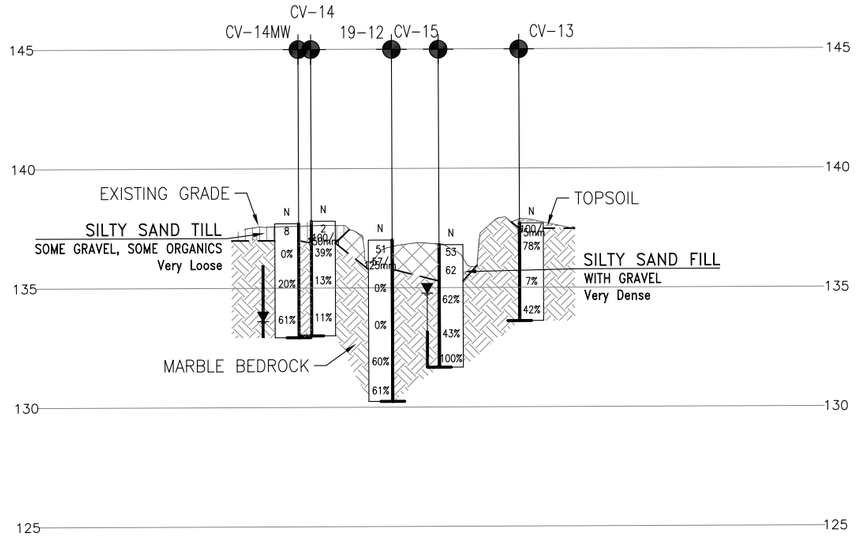

COUNTY ROAD 6 CULVERT (H-H)

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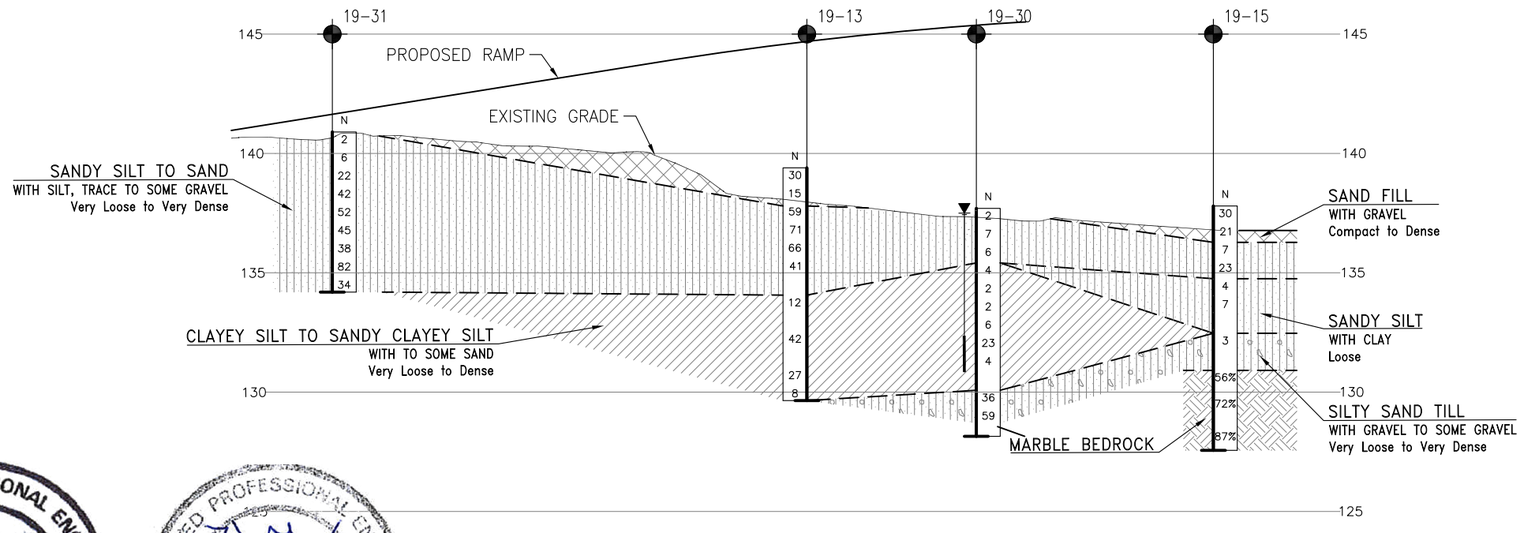

N-E RAMP (E-E)

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LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Sep 13, 2022
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
F. J. GRIFFITHS
Sep 13, 2022
PROVINCE OF ONTARIO

CONT No
WP No

HIGHWAY 17 TWINNING
COUNTY ROAD 6

BOREHOLE 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
▼	Head Artesian Water
▮	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
19-01	138.3	5 036 548.6	295 187.7
19-02	138.2	5 036 545.6	295 182.7
19-12	137.0	5 036 627.7	295 249.2
19-13	139.4	5 036 482.5	295 100.7
19-15	137.8	5 036 546.8	295 162.9
19-30	137.7	5 036 535.2	295 125.3
19-31	140.9	5 036 545.0	295 043.8
CR6-1	137.5	5 036 561.3	295 173.5
CV-13	137.7	5 036 620.1	295 272.0
CV-14	137.8	5 036 646.0	295 248.6
CV-14MW	137.7	5 036 647.4	295 247.5
CV-15	136.8	5 036 629.5	295 262.3

-NOTES-

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GEOCRES No. 31F-230

REVISIONS		
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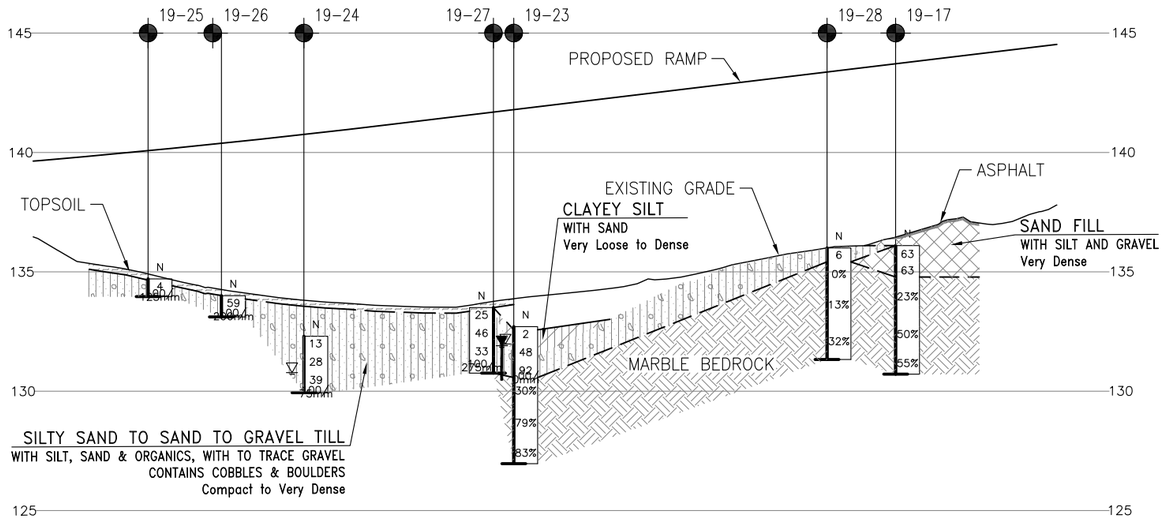
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



S-W RAMP (F-F)

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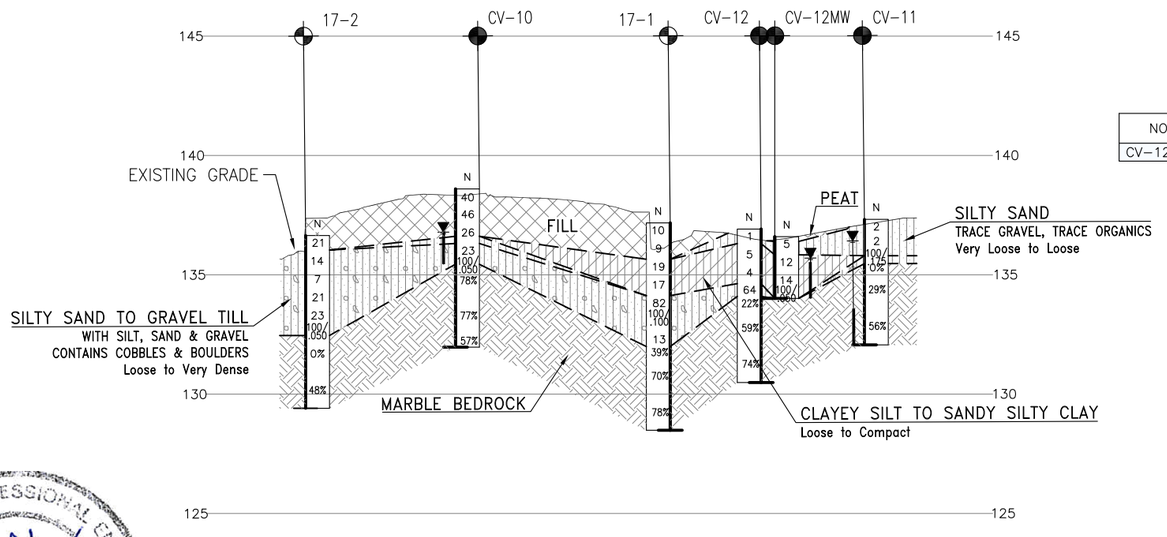
5 0 5 10m V 1:250



HIGHWAY 17 CULVERT (G-G)

20 0 20 40m H 1:1000

5 0 5 10m V 1:250

NO	ELEVATION	NORTHING	EASTING
CV-12MW	136.6	5 036 574.5	295 243.2

CONT No
WP No

HIGHWAY 17 TWINNING
COUNTY ROAD 6

BOREHOLE 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
▼	Head Artesian Water
▮	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
17-1	137.2	5 036 558.5	295 234.5
17-2	136.7	5 036 511.2	295 195.8
19-17	136.1	5 036 657.4	295 279.2
19-23	132.7	5 036 648.4	295 359.0
19-24	132.3	5 036 611.7	295 387.5
19-25	134.7	5 036 567.0	295 390.1
19-26	134.0	5 036 592.5	295 370.7
19-27	133.5	5 036 633.4	295 353.3
19-28	136.0	5 036 644.6	295 299.0
CV-10	138.6	5 036 540.7	295 206.0
CV-11	137.3	5 036 586.3	295 252.0
CV-12	136.9	5 036 571.6	295 242.7

-NOTES-

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

GEOCRES No. 31F-230

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Sep 13, 2022
PROVINCE OF ONTARIO

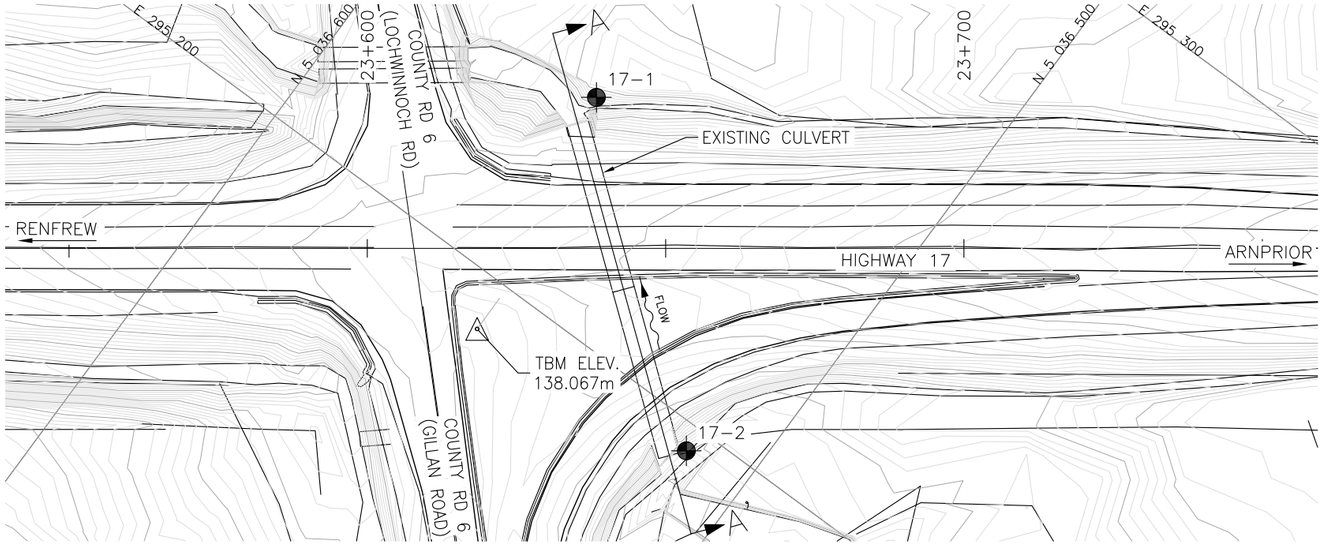
LICENSED PROFESSIONAL ENGINEER
F. J. GRIFFITHS
Sep 13, 2022
PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	DP	CHK –	CODE	LOAD	DATE SEP 2022
DRAWN	BH	CHK DP	SITE	STRUCT	DWG 4

FILENAME: H:\Drafting\24000\24726\TED-24726-BHPP-CR6.dwg
PLOTDATE: 2/16/2022 8:32 AM

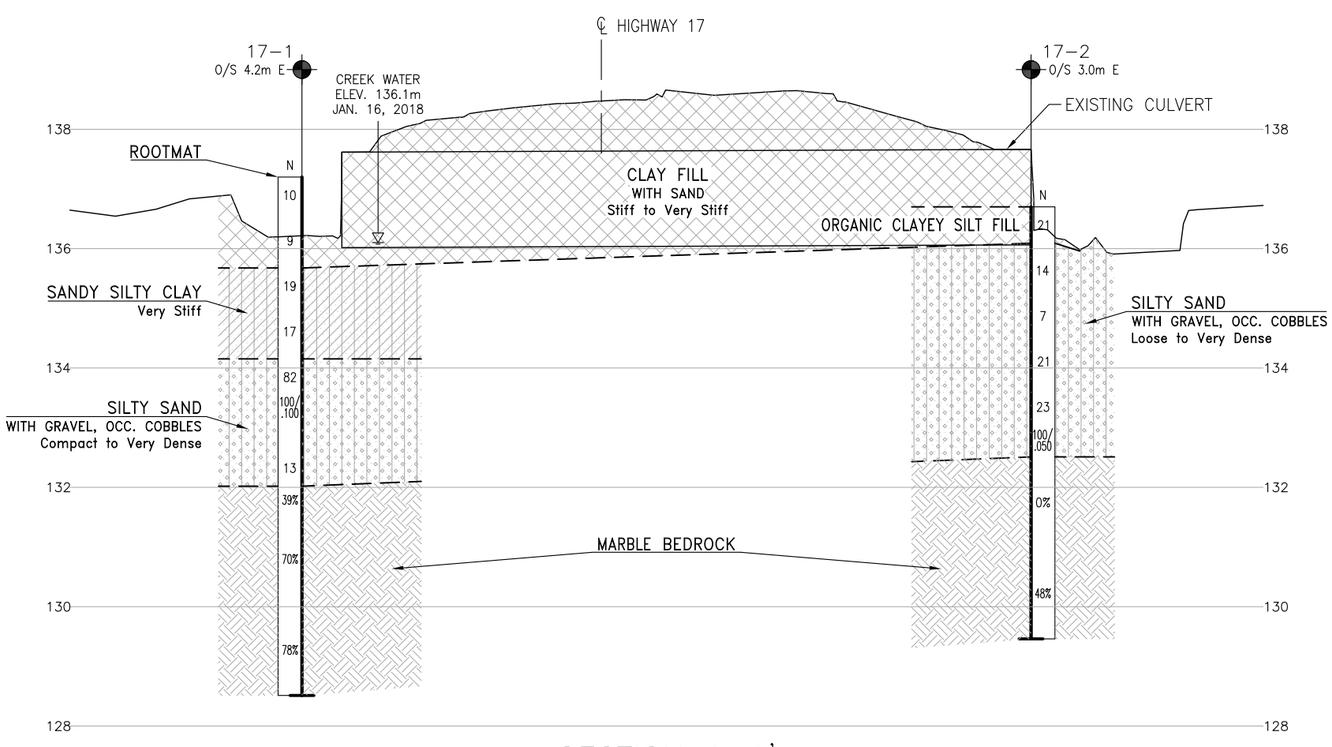
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

20 0 20 40m

SCALE 1:1000



SECTION A–A'

10 0 10 20m H 1:500

2 0 2 4m V 1:100

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
K. T. C. POWER
100130652
2018/06/08
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
6/6/18
PROVINCE OF ONTARIO

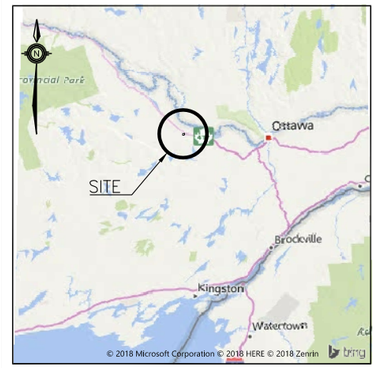
CONT No
GWP No 4076–13–00

SHEET

HIGHWAY 17
DEIL'S CREEK
CULVERT REHABILITATION
BOREHOLE LOCATIONS AND SOIL STRATA

McINTOSH PERRY

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

⊕	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
△	Temporary Benchmark
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
17–1	137.2	5 036 558.5	295 234.5
17–2	136.7	5 036 511.2	295 195.8

-NOTES-

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

GEOCRES No. 31F-202

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	KP	CHK	–	CODE	LOAD	DATE	JUN 2018
DRAWN	MFA	CHK	KP	SITE	STRUCT	DWG	1

FILENAME: H:\Drafting\20000\20479\TED–20479–BHPP–DC.dwg
PLOTDATE: 6/5/2018 4:42 PM

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

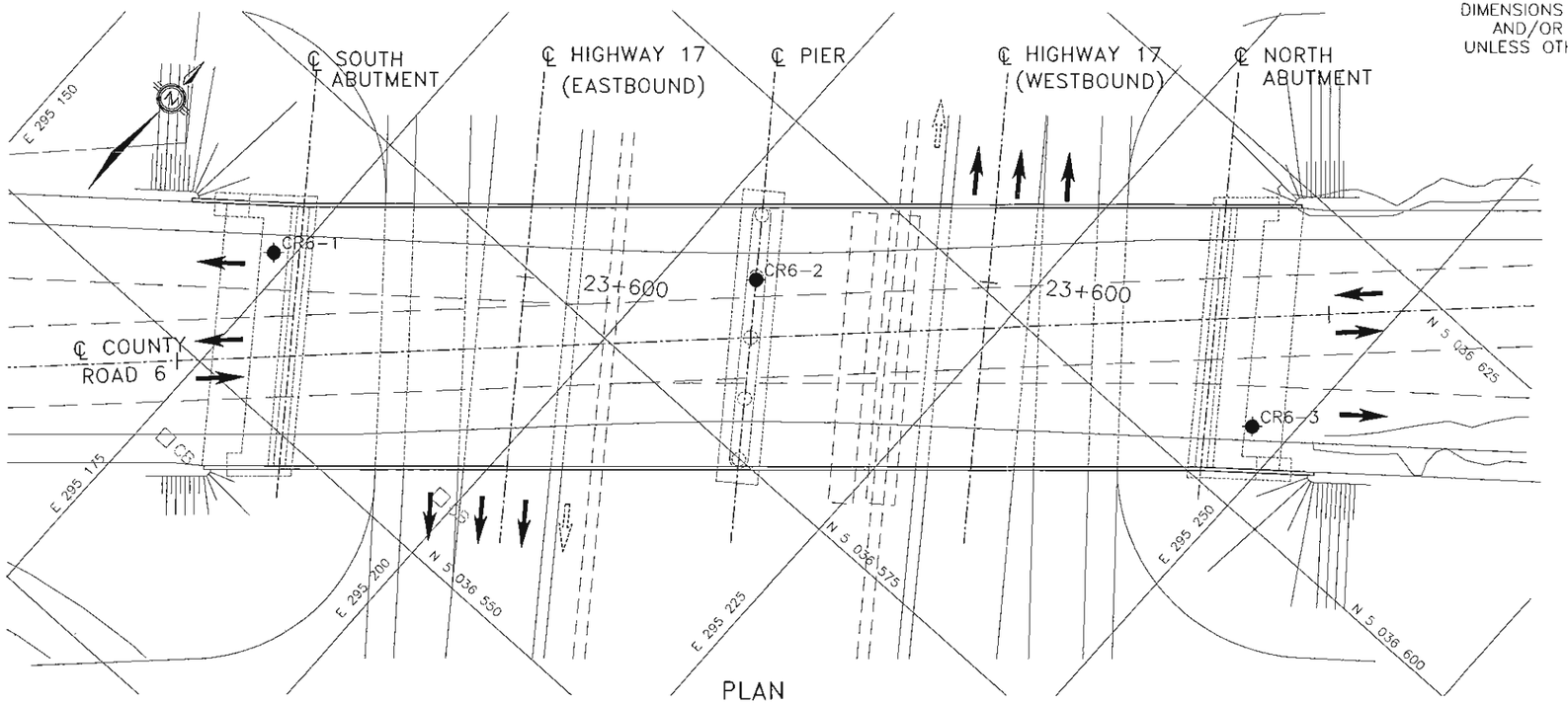
HWY.17
GWP NO. 647-92-00

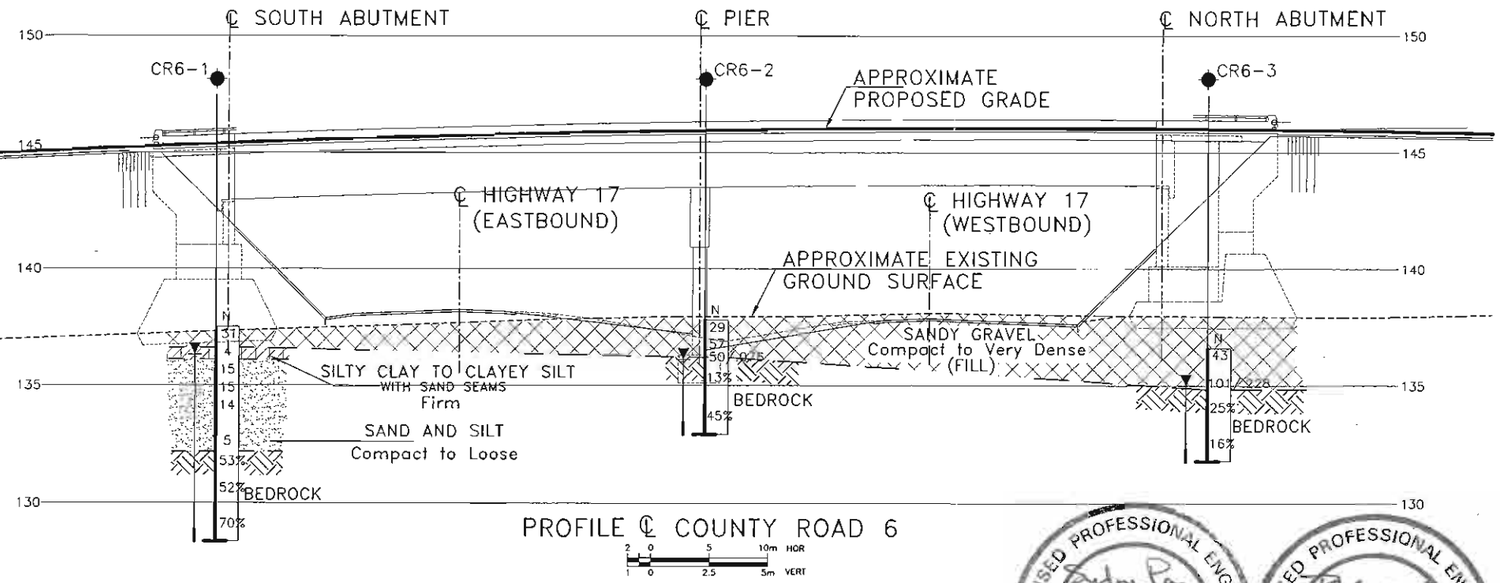
HIGHWAY 17 TWINNING
COUNTY ROAD 6 UNDERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

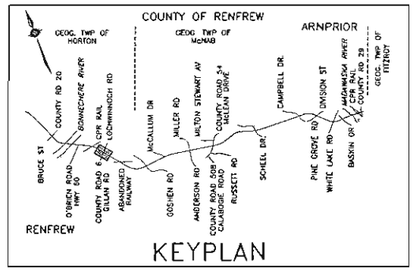
SHEET

engineers architects planners

THURBER ENGINEERING LTD.







LEGEND

●	Bore Hole
⊕	Dynamic Cone Penetration Test (cone)
◈	Bore Hole & Cone
N	Blows/ 0.3m (Std Pen Test, 475 J/blow)
CONE	Blows/ 0.3m (60° Cone, 475 J/blow)
PH	Pressure, Hydraulic
▼	WL at Time of Investigation
▼	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
CR6-1	137.5	5 036 561.3	295 173.5
CR6-2	137.8	5 036 587.5	295 206.5
CR6-3	136.6	5 036 606.5	295 247.0

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations . Between Bore Holes the boundaries are assumed from geological evidence .

LICENSED PROFESSIONAL ENGINEER
S. PANG
May 28/04
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
May 28/04
PROVINCE OF ONTARIO

REVISIONS		
MAY. 04	SP	ISSUED AS DRAFT FOR REVIEW
DATE	BY	DESCRIPTION

DESIGN SP	CHK PKC	CHBDC 2000	LOAD	DATE MAY.2004	
DRAWN SS	CHK SP	SITE 29-408	STRUCT	DWG.	

THURBER

Appendix B.

Record of Borehole Sheets

THURBER

SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

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

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

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

RECOVERY:

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

N-VALUE:

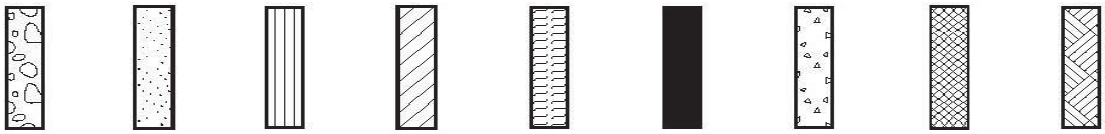
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented,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

DYNAMIC CONE PENETRATION TEST (DCPT):

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

THURBER

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



Boulders
Cobbles
Gravel

Sand

Silt

Clay

Organics

Asphalt

Concrete

Fill

Bedrock

TEXTURING CLASSIFICATION OF SOILS

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

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

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

SAMPLE TYPES

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

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

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

THURBER

MODIFIED UNIFIED SOIL CLASSIFICATION

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

Note - W_L= Liquid Limit

THURBER

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

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

TERMS

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

DISCONTINUITY SPACING

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

STRENGTH CLASSIFICATION

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-01 1 OF 2 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468799°, Long: -76.62293° Country Road 6 MTM Zone 9: N 5 036 548.6 E 295 187.7 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, HSA, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.09.04 - 2019.09.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
138.3	**Pavement Surface**										
0.0 / 0.1	**ASPHALT (50mm)**										
	GRAVEL with silt and sand Compact Brown Dry **(FILL)**		1	GS			138				49 46 5 (SI+CL)
			2	SS	28		137				
136.8											
1.5	**Silty SAND (SM)**, some gravel Compact Brownish Grey Moist		3	SS	14						11 70 19 (SI+CL)
			4	SS	14		136				
135.3											
3.0	**Clayey SILT (CL-ML)**, with sand Loose to Compact Grey		5	SS	7		135				
			6	SS	6						0 23 62 15
							134				
	- silty sand seam at 5.5 m		7	SS	8		133				
131.4							132				
6.9	**Silty SAND (SM)**, some gravel Very Loose Grey Wet **(TILL)**		8	SS	4		131				12 42 39 7 -non-plastic
130.2										FI	
8.1	**MARBLE BEDROCK** Slightly Weathered Large Grain Smooth Strong White and Black		1	RUN			130			8	RUN #1 TCR=100% SCR=100% RQD=41%
										4	
										8	
							129			1	RUN #2 TCR=100% SCR=69% RQD=46%
			2	RUN						>10	
										4	

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-01 2 OF 2 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468799°, Long: -76.62293° Country Road 6 MTM Zone 9: N 5 036 548.6 E 295 187.7 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, HSA, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.09.04 - 2019.09.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	MARBLE BEDROCK Slightly Weathered Large Grain Smooth Strong White and Black Silt seam at 10.4 m to 10.5						128			>10	
										2	RUN #3 TCR=65% SCR=93% RQD=79% UCS=64.4MPa UCS=81.1MPa
			3	RUN						1	
							127			4	
126.3										2	
										4	
12.0	End of Borehole Piezometer consists of 19 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen WATER LEVEL READING: DATE DEPTH (m) ELEV. (m) 2019.09.26 1.9 136.4 2020.04.21 1.4 136.9 2020.06.03 1.4 136.9 2020.09.29 1.8 136.5 2021.12.15 1.5 136.8										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-02 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468771°, Long: -76.622994° Country Road 6 MTM Zone 9: N 5 036 545.6 E 295 182.7 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing COMPILED BY MW

DATUM Geodetic DATE 2019.09.04 - 2019.09.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
138.2	**Ground Surface**										
0.0 / 0.1	**ASPHALT (50mm)**						138				
	Silty SAND, some gravel Dense to Compact Brown **(FILL)**		1	SS	36				○		
			2	SS	51		137				
135.9			3	SS	21				○		16 67 17 (SI+CL)
2.3	**Silty SAND (SM)** Compact Grey		4	SS	24		136		○		0 53 40 7 -non-plastic
134.4			5	SS	30		135		○		
3.8	**Sandy SILT (ML)**, trace gravel, occasional boulders/cobbles Compact Grey **(TILL)** -200mm boulder between 4.4m and 5.3m		6	SS	19		134		○		3 35 51 11 -non-plastic
			7	SS	11		133		○		
			8	SS	6		132				
			9	SS	12		131		○		
129.1			10	SS	100/ 75mm		130		○		
9.1	End of Borehole Spoon refusal and difficult casing advacement on inferred bedrock.										

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-03 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469198°, Long: -76.622773° Country Road 6 MTM Zone 9: N 5 036 592.9 E 295 200.0 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.30 - 2019.08.30 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.7	**Ground Surface**										
0.0	SAND with silt and gravel Compact Brown **(FILL)**		1	SS	14				○		41 52 7 (SI+CL)
			2	SS	27		137		○		
136.3										FI	
1.4	**MARBLE BEDROCK** Slightly Weathered Large Grain Medium Strong Pinkish Grey - Fractures from 1.7 m to 1.8 m - Fractures from 2.0 m to 2.2 m		1	RUN			136			4 6 >10 5	RUN #1 TCR=100% SCR=67% RQD=39%
			2	RUN			135			4 5 6	RUN #2 TCR=100% SCR=97% RQD=11%
			3	RUN			134			3 2 4	RUN #3 TCR=100% SCR=90% RQD=53% UCS=34.5MPa
							133			4	
132.6										8	
5.1	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-04 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.46923°, Long: -76.622735° Country Road 6 MTM Zone 9: N 5 036 596.5 E 295 203.0 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.30 - 2019.08.30 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.5	**Ground Surface**										
0.0	GRAVEL with silt and sand Compact to Dense Brown **(FILL)**		1	SS	26		137	○			
			2	SS	36			○			56 36 8 (SI+CL)
136.2										FI	
1.3	**MARBLE BEDROCK** Slightly Weathered Large Grain Pinkish Grey - Highly fractured from 1.4 m to 2.1 m		1	RUN			136			>10	RUN #1 TCR=100% SCR=64% RQD=28%
										4	
										4	
							135			6	
			2	RUN						5	RUN #2 TCR=100% SCR=65% RQD=35%
										8	
							134			3	
										5	
										4	
			3	RUN			133			2	RUN #3 TCR=100% SCR=72% RQD=47%
										3	
132.4										3	
5.1	End of Borehole										

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-05 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469017°, Long: -76.622565° Country Road 6 MTM Zone 9: N 5 036 572.8 E 295 216.3 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.30 - 2019.08.30 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
138.1	**Ground Surface**						138				
0.0	SAND with silt and gravel Compact Brown **(FILL)**		1	SS	18			○			
			2	SS	15		137	○			33 60 7 (SI+CL)
136.6											
1.5	**Silty SAND (SM)** with gravel Loose to Compact Grey		3	SS	9			○			19 64 17 (SI+CL)
			4	SS	20		136	○			
135.1											
3.0	Frequent Boulders and Cobbles **(Inferred TILL)**		5	NQ			135				
133.8							134			FI	
4.3	**MARBLE BEDROCK** Fresh Small Grain Smooth White		1	RUN						3 0 3 1 1	RUN #1 TCR=100% SCR=91% RQD=76%
							133				
	- Vertical fractures from 6.2 m to 6.5 m		2	RUN			132			2 4 2 1	RUN #2 TCR=100% SCR=64% RQD=63%
							131			3	
130.5	- Silt seam from 7.3 m to 7.5 m									2	
7.6	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-06 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469063°, Long: -76.622534° Country Road 6 MTM Zone 9: N 5 036 577.9 E 295 218.7 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, HW Casing, HQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.09.04 - 2019.09.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.9	**Ground Surface**										
0.0	Silty SAND, some gravel to GRAVEL, some sand Compact to Dense Brown **(FILL)**		1	SS	13				○		
			2	SS	18		137		○		
			3	SS	30		136		○		
135.6											
2.3	**Silty SAND** with gravel Very Dense Grey		4	SS	55				○		16 57 27 (SI+CL)
135.1	**(TILL)**									FI	
2.8	**MARBLE BEDROCK** Slightly Weathered Large Grain Smooth Medium Strong White		1	RUN			135			>10 >10 5 6	RUN #1 TCR=100% SCR=42% RQD=50%
			2	RUN			134			3 1	RUN #2 TCR=100% SCR=97% RQD=97%
			3	RUN			133			1 2 3 3	RUN #3 TCR=100% SCR=87% RQD=67% UCS=42.2MPa
							132			1	
131.6										3	
6.3	End of Borehole Monitoring well consists of 38 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2019.09.26 1.9 135.9 2020.04.21 0.5 137.3 2020.09.29 1.7 136.1										

+ ³, × ³: Numbers refer to Sensitivity

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

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Ontario

THURBER

RECORD OF BOREHOLE No 19-07 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469442°, Long: -76.622374° Country Road 6 MTM Zone 9: N 5 036 620.1 E 295 231.3 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2020.05.05 - 2020.05.05 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
136.6	**Ground Surface**										
0.0 / 136.3	**TOPSOIL (270 mm)**		1	SS	6		136				
0.3 / 136.0	**Silty SAND** Loose Grey-Brown										
0.6	**Silty SAND (SM)**, trace gravel Compact to Dense Grey **(TILL)**		2	SS	27		135				10 52 33 5 -non-plastic
			3	SS	42						
134.2			4	SS	100/ 75mm					FI	
2.4	**MARBLE BEDROCK** Fresh Jointed Large Grain Rough Grey		1	RUN			134			5	RUN #1 TCR=100% SCR=92% RQD=58%
										2	
										3	
			2	RUN			133			6	RUN #2 TCR=100% SCR=89% RQD=56%
										2	
										2	
										1	
							132			5	
			3	RUN						2	RUN #3 TCR=100% SCR=100% RQD=98%
										2	
							131			2	
130.2										2	
										1	
6.4	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-08 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469473°, Long: -76.622326° Country Road 6 MTM Zone 9: N 5 036 623.5 E 295 235.0 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2020.05.05 - 2020.05.05 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
136.7	**Ground Surface**										
0.0			1	GS	-					FI	
0.1	**Silty SAND**, trace gravel Brown **(TILL)**									8	RUN #1 TCR=100% SCR=64% RQD=31%
	MARBLE BEDROCK Slightly Weathered to Fresh Jointed Large Grain Rough Grey to Grey-Pink		1	RUN			136			6 7 3 3	
							135			2 2	RUN #2 TCR=100% SCR=95% RQD=56%
			2	RUN						3	
							134			4	
133.6										3	
3.1	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-09 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469415°, Long: -76.622244° Country Road 6 MTM Zone 9: N 5 036 617.0 E 295 241.4 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.26 - 2019.08.26 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.1	**Pavement Surface**										
0.0	**ASPHALT (100mm)**						137				
0.1	Silty SAND with gravel Very Dense Brown **(FILL)**		1	SS	66				○		
			2	SS	36		136		○		31 49 20 (SI+CL)
135.6										FI	
1.5	**MARBLE BEDROCK** Slightly Weathered Small Grain Strong Grey to Grey-Pink - Very fractured from 1.5 m to 1.9 m		1	RUN			135			>10 >10 1	RUN #1 TCR=100% SCR=55% RQD=40%
	- Very fractured from 2.5 m to 2.8 m									>10 3	
	- Very fractured from 3.0 m to 3.7 m		2	RUN			134			6 6	RUN #2 TCR=100% SCR=80% RQD=60%
							133			4 4 2	
			3	RUN			132			2 2 2 2	RUN #3 TCR=100% SCR=82% RQD=68% UCS=62.2MPa
131.1										1	
6.0	End of Borehole										

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-10 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469247°, Long: -76.622162° Country Road 6 MTM Zone 9: N 5 036 598.3 E 295 247.8 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HW Casing, HQ Coring COMPILED BY MW

DATUM Geodetic DATE 2020.05.04 - 2020.05.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.4	**Ground Surface**										
0.0	**Silty SAND (SM)** with gravel, trace organics Loose Brown to Grey-Brown **(TILL)**		1	SS	5		137				
			2	SS	6						17 48 27 8 -non-plastic
							136				
135.4	- contains weathered bedrock at 1.8m		3	SS	100/ 300mm					FI	
2.0	**MARBLE BEDROCK** Slightly Weathered to Fresh Jointed Large Grain Rough Grey-Pink		1	RUN			135			6 >10	RUN #1 TCR=100% SCR=60% RQD=8%
										6 4	
							134			5	
			2	RUN						6 6	RUN #2 TCR=100% SCR=45% RQD=7%
							133			6 3	
132.4										>10	
5.0	End of Borehole Monitoring well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.5-m slotted screen WATER LEVEL READING: DATE DEPTH (m) ELEV. (m) 2020.06.03 1.7 135.7 2020.09.29 1.9 135.5 2021.09.23 1.9 135.5 2021.10.03 1.5 135.9 2022.01.22 1.8 135.6										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-12 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469511°, Long: -76.622145° Country Road 6 MTM Zone 9: N 5 036 627.7 E 295 249.2 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.26 - 2019.08.26 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.0	**Pavement Surface**										
0.0	**ASPHALT (75mm)**										
0.1	Silty SAND with gravel Very Dense Brown to Grey **(FILL)** - contains weathered bedrock at 0.8 m		1	SS	51				○		32 55 13 (SI+CL)
135.8			2	SS	100/ 125mm		136		○	FI	
1.2	**MARBLE BEDROCK** Slightly Weathered Large Grain Rough Strong White		1	RUN			135			>10 >10 >10 >10 >10	RUN #1 TCR=77% SCR=10% RQD=0%
			2	RUN			134			>10 >10 >10 >10	RUN #2 TCR=100% SCR=28% RQD=0%
			3	RUN			133 132			5 2 3 1 4 2	RUN #3 TCR=100% SCR=97% RQD=60%
			4	RUN			131			>10 >10	RUN #4 TCR=100% SCR=78% RQD=61%
130.2										2	
6.8	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-13

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.468203°, Long: -76.624042° Country Road 6 MTM Zone 9: N 5 036 482.5 E 295 100.7 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing COMPILED BY MW

DATUM Geodetic DATE 2019.09.06 - 2019.09.06 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
139.4	**Ground Surface**										
0.0	SAND with gravel, occasional cobbles Compact Brown with red and black gravel **(FILL)**		1	SS	30		139	○	○		
			2	SS	15						
137.8							138				
1.6	**Silty SAND (SM)** to **SAND (SP-SM)** with silt, trace gravel Dense to Very Dense Grey to Brown		3	SS	59				○ ○		
			4	SS	71		137		○		3 71 26 (SI+CL)
			5	SS	66		136		○		
			6	SS	41				○		6 86 8 (SI+CL)
134.1							135				
5.3	**Clayey SILT (CL-ML)** with sand to **Clayey SILT (CL)**, some sand Loose to Dense Brown		7	SS	12		134		⊖		0 28 56 16
	- higher silt content from 6.9 m to 9.0 m		8	SS	42		133		○		
			9	SS	27		132		○		
	- becoming grey		10	SS	8		131		⊖		0 12 58 30
129.6							130				
9.8	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-14 1 OF 2 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468479°, Long: -76.623637° Country Road 6 MTM Zone 9: N 5 036 513.2 E 295 132.3 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.09.05 - 2019.09.05 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
139.0	**Ground Surface**										
0.0	SAND with silt and gravel Loose to Dense Brown **(FILL)**		1	SS	49				○		32 57 11 (SI+CL)
	- very low recovery below 0.8 m		2	SS	27		138				
			3	SS	8		137				
			4	SS	59						
136.0							136				
3.0	**Silty SAND (SM)** Compact to Very Dense Brown		5	SS	59				○		0 64 32 4 -non-plastic
			6	SS	28		135		○		
			7	SS	12		134		○		
132.1							133				
6.9	**CLAYEY SILT (CL)** Loose Brown		8	SS	5		132		⊢○⊣		0 3 67 30
130.6							131				
8.4	**Silty GRAVEL** with sand Dense Brown **(TILL)**		9	SS	32				○		46 41 13 (SI+CL)
129.9							130				
9.1	**MARBLE BEDROCK** Slightly Weathered Highly Fractured Large Grain Grey		1	RUN							RUN #1 TCR=61% SCR=16% RQD=16%
							129				

Continued Next Page

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-14 2 OF 2 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468479°, Long: -76.623637° Country Road 6 MTM Zone 9: N 5 036 513.2 E 295 132.3 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.09.05 - 2019.09.05 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
	MARBLE BEDROCK Slightly Weathered Highly Fractured Large Grain Grey									
			2	RUN			128			RUN #2 TCR=85% SCR=23% RQD=23%
			3	RUN			127			RUN #3 TCR=100% SCR=62% RQD=38%
126.0							126			
13.0	End of Borehole									

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-15 1 OF 2 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468782°, Long: -76.623246° Country Road 6 MTM Zone 9: N 5 036 546.8 E 295 162.9 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.09.05 - 2019.09.05 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.8	**Ground Surface**										
0.0	SAND with gravel Compact to Dense Brown **(FILL)**		1	SS	30				○		
			2	SS	21		137		○		
136.3											
1.5	**Silty SAND**, some gravel Loose Brown		3	SS	7		136		○		
			4	SS	23		135				
134.8											
3.0	**Sandy SILT (ML)** with clay Loose Grey		5	SS	4				H ○		0 32 51 17
			6	SS	7		134		○		
132.5							133				
5.3	**Silty SAND (SM)**, some gravel Very Loose Grey **(TILL)**		7	SS	3				○		14 48 31 7 -non-plastic
130.9			8	SS	100/75mm		132			FI	
6.9	**MARBLE BEDROCK** Slightly Weathered Large Grain Smooth White-Yellow		1	RUN			131			>10 0	RUN #1 TCR=100% SCR=72% RQD=56%
			2	RUN			130			1 1 1	RUN #2 TCR=100% SCR=95% RQD=72%
							129			4 3	
			3	RUN						2 1	RUN #3 TCR=100% SCR=93% RQD=87%
	- 50 mm silt seam at 9.7 m						128			3	

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-15 2 OF 2 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468782°, Long: -76.623246° Country Road 6 MTM Zone 9: N 5 036 546.8 E 295 162.9 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.09.05 - 2019.09.05 CHECKED BY FG

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 w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
127.6	**MARBLE BEDROCK**									2	
10.2	End of Borehole										

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-17 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469779°, Long: -76.621762° Country Road 6 MTM Zone 9: N 5 036 657.4 E 295 279.2 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.27 - 2019.08.27 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
136.1	**Pavement Surface**										
0.0 / 0.1	**ASPHALT (50mm)**						136				
	SAND with silt and gravel Very Dense Brown **(FILL)** - contains weathered bedrock		1	SS	63				○		36 53 11 (SI+CL)
			2	SS	63		135		○	FI	
134.8 / 1.3	**MARBLE BEDROCK** Slightly Weathered Large Grain Grey		1	RUN			134			>10 >10 >10 >10 1	RUN #1 TCR=86% SCR=41% RQD=23%
			2	RUN			133			3 >10 3 3	RUN #2 TCR=100% SCR=75% RQD=50%
			3	RUN			132 131			>10 >10 1 3	RUN #3 TCR=100% SCR=67% RQD=55%
130.7 / 5.4	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-19 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.470388°, Long: -76.620846° Country Road 6 MTM Zone 9: N 5 036 725.0 E 295 350.9 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.28 - 2019.08.28 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
131.9	**Pavement Surface**										
0.0	**ASPHALT (100mm)**										
0.1	SAND with silt and gravel Very Dense Brown **(FILL)** - contains weathered bedrock		1	SS	57				○		32 57 11 (SI+CL)
131.0			2	SS	100/ 100mm					FI	
0.9	**MARBLE BEDROCK** Slightly Weathered Small Grain Grey-Yellow		1	RUN			131		○	>10	RUN #1 TCR=100% SCR=50% RQD=0%
										>10	
			2	RUN			130			7	RUN #2 TCR=100% SCR=60% RQD=18%
										>10	
										>10	
										4	
										2	
			3	RUN			129			3	RUN #3 TCR=100% SCR=60% RQD=52%
										4	
										3	
										5	
							128			1	
127.5										2	
4.4	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-20 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.47065°, Long: -76.620438° Country Road 6 MTM Zone 9: N 5 036 754.1 E 295 382.9 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.28 - 2019.08.28 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
130.9	**Pavement Surface**										
0.0	**ASPHALT (150mm)**										
0.2	SAND, some gravel Compact Brown		1	SS	26						
130.1	**(FILL)**						130				
0.8	**Clayey SILT (CL)** with sand to **Sandy Clayey SILT (CL-ML)**, trace gravel Loose to Very Dense Brown		2	SS	7						
			3	SS	8		129				0 18 59 23
128.2			4	SS	100/ 275 mm						8 41 39 12
2.7	**(inferred TILL)**						128			FI	
127.9											
3.0	**MARBLE BEDROCK** Slightly Weathered Large Grain Rough Grey-White - 50 mm silt seam at 3.6 m		1	RUN			127			>10 2 2 0 2	RUN #1 TCR=97% SCR=55% RQD=83%
			2	RUN			126			1 0 3 2	RUN #2 TCR=100% SCR=93% RQD=83%
124.8							125			1	
6.1	End of Borehole										

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

(%) STRAIN AT FAILURE

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-21

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.470874°, Long: -76.620005° Country Road 6 MTM Zone 9: N 5 036 778.9 E 295 416.7 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.28 - 2019.08.28 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
130.3	**Pavement Surface**										
0.0	**ASPHALT (175mm)**						130				
0.2 / 129.9	**CONCRETE (225mm)**										
0.4	Silty SAND Loose Brown **(FILL)**		1	SS	7						1 66 33 (SI+CL)
128.8							129				
1.5	**Clayey SILT (CL)** with sand, trace gravel Very Loose to Compact Brown		2	SS	3						7 18 55 20
			3	SS	24		128				
127.4											
2.9	Frequent Cobbles and Boulders **(Inferred TILL)**		4	NQ			127				
125.9											
4.4	**MARBLE BEDROCK** Slightly Weathered Large Grain Grey - Very fractured from 4.4 m to 5.2 m		1	RUN			126			FI >10 >10 >10 0 1 1	RUN #1 TCR=82% SCR=53% RQD=44%
			2	RUN			125			2 2 3 1	RUN #2 TCR=100% SCR=94% RQD=83%
							124				
122.6							123			3	
7.7	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-22 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.47005°, Long: -76.621237° Country Road 6 MTM Zone 9: N 5 036 687.4 E 295 320.2 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.27 - 2019.08.27 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
133.9	**Pavement Surface**										
0.0	**ASPHALT (125mm)**										
0.1	SAND with silt and gravel Dense to Very Dense Brown **(FILL)**		1	SS	70				○		41 50 9 (SI+CL)
			2	SS	47		133		○		
	- contains weathered bedrock		3	SS	100/ 150mm				○		
131.7							132			FI	
2.2	**MARBLE BEDROCK** Slightly Weathered Large Grain Grey		1	RUN						>10	RUN #1 TCR=100% SCR=28% RQD=16%
										>10	
			2	RUN			131			>10	RUN #2 TCR=91% SCR=42% RQD=34%
										>10	
										1	
							130			>10	
										4	
			3	RUN						>10	RUN #3 TCR=38% SCR=22% RQD=0%
							129			>10	
										>10	
										>10	
			4	RUN			128			>10	RUN #4 TCR=100% SCR=55% RQD=32%
										>10	
										>10	
							127			8	
										>10	
			5	RUN						>10	RUN #5 TCR=88% SCR=76% RQD=64%
							126			2	
										4	
										1	
124.8							125			5	
9.1	End of Borehole										

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-23 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469699°, Long: -76.620741° Country Road 6 MTM Zone 9: N 5 036 648.4 E 295 359.0 ORIGINATED BY AO

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HSA, NQ Coring COMPILED BY AO

DATUM Geodetic DATE 2021.04.28 - 2021.04.28 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
132.7	**Ground Surface**										
0.0	**TOP SOIL (130 mm)**										
0.1	**Clayey SILT (CL)**, with sand Very Loose to Dense Grey-brown		1	SS	2						
			2	SS	48		132				0 17 61 22
131.5											
1.2	**SAND** with silt and gravel Grey-brown Very dense **(TILL)** - contains cobbles and boulders		3	SS	92		131				35 54 11 (SI+CL)
130.6			4	SS	100/ 0mm					FI	
2.1	**MARBLE BEDROCK** Moderately Weathered to Fresh Jointed Medium Grain Grey-white to Yellowish-Grey		1	RUN			130			5 5 >10 2	RUN #1 TCR=100% SCR=28% RQD=30%
			2	RUN			129			1 2	RUN #2 TCR=100% SCR=83% RQD=79%
							128			2 6 2	
			3	RUN						2 3	RUN #3 TCR=97% SCR=83% RQD=83%
127.0							127			1	
5.7	End of Borehole Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.5-m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2021.04.30 0.8 131.9										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-24

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.469369°, Long: -76.620376° Country Road 6 MTM Zone 9: N 5 036 611.7 E 295 387.5 ORIGINATED BY AO

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HSA COMPILED BY AO

DATUM Geodetic DATE 2021.04.29 - 2021.04.29 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
132.3	**Ground Surface**										
0.0	**TOP SOIL (250 mm)**										
0.2	**Silty GRAVEL (GM)** with sand Contains clayey silt seams Yellowish-white Compact to dense **(TILL)** - contains weathered bedrock		1	SS	13		132		○		
			2	SS	28		131		○		
			3	SS	39	▼			○		44 42 14 (SI+CL)
129.9			4	SS	100/ 75mm		130		○		
2.4	End of borehole Auger and spoon refusal on inferred bedrock.										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-25 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468967°, Long: -76.620342° Country Road 6 MTM Zone 9: N 5 036 567.0 E 295 390.1 ORIGINATED BY AO

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HSA COMPILED BY AO

DATUM Geodetic DATE 2021.04.29 - 2021.04.29 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
134.7	**Ground Surface**										
0.0 134.2	**TOP SOIL (460 mm)**		1	SS	4				○		
0.5 134.0	**Silty GRAVEL (GM)** with sand Contains clayey silty sand seams Yellowish-white **(TILL)**		2	SS	100/		134		○		
0.7	End of borehole Auger and spoon refusal on inferred bedrock.				125mm						

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

15 20 10 5 (%) STRAIN AT FAILURE

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-26 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469196°, Long: -76.62059° Country Road 6 MTM Zone 9: N 5 036 592.5 E 295 370.7 ORIGINATED BY AO

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HSA COMPILED BY AO

DATUM Geodetic DATE 2021.04.29 - 2021.04.29 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
134.0	**Ground Surface**										
0.0	**TOP SOIL (150 mm)**										
0.2	**SAND (SW)** with gravel Yellowish-white Very dense		1	SS	59				○		
133.1	**(TILL)** - contains weathered bedrock		2	SS	100/200mm				○		
0.9	End of borehole Auger and spoon refusal on inferred bedrock.										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-27 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469564°, Long: -76.620814° Country Road 6 MTM Zone 9: N 5 036 633.4 E 295 353.3 ORIGINATED BY AO

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HSA COMPILED BY AO

DATUM Geodetic DATE 2021.04.29 - 2021.04.29 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
133.5	**Ground Surface**										
0.0	**TOP SOIL (150 mm)**										
0.1	**GRAVEL (GW-GM)** with silt and sand Yellowish-white Dense to very dense **(TILL)** - contains weathered bedrock		1	SS	25		133				
			2	SS	46						61 31 8 (SI+CL)
			3	SS	33		132 ▼				
			4	SS	100/275mm		131				
130.8											
2.7	End of borehole Auge refusal on inferred bedrock.										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-28 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469664°, Long: -76.621509° Country Road 6 MTM Zone 9: N 5 036 644.6 E 295 299.0 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2020.05.05 - 2020.05.05 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
136.0	**Ground Surface**										
0.0	**Silty SAND** with organics, trace gravel Loose Brown		1	SS	6				○	FI	
135.4	**(TILL)**										
0.6	**MARBLE BEDROCK** Moderately Weathered to Fresh Jointed Large Grain Rough Grey-Pink - brown stain in fracture from 0.6 m to 1.7m - Vertical fracture from 1.0 m to 1.7 m - Vertical fracture from 1.7 m to 2.1 m		1	RUN			135			>10	RUN #1 TCR=90% SCR=13% RQD=0%
										>10	
										7	
			2	RUN			134			4	RUN #2 TCR=100% SCR=70% RQD=13%
										5	
										4	
										5	
							133			4	
			3	RUN						4	RUN #3 TCR=100% SCR=87% RQD=32%
	- Weathered section from 3.8 m to 4 m									2	
										4	
							132			>10	
										5	
131.3										6	
4.7	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-30 1 OF 2 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468677°, Long: -76.623727° Country Road 6 MTM Zone 9: N 5 036 535.2 E 295 125.3 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HSA COMPILED BY MW

DATUM Geodetic DATE 2020.05.06 - 2020.05.06 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.7	**Ground Surface**										
0.0	**TOPSOIL (125mm)**										
0.1	**Silty SAND (SM)**, trace gravel Very Loose to Loose Brown to Grey		1	SS	2		137				
			2	SS	7						
			3	SS	6		136				0 76 24 (SI+CL)
135.4											
2.3	**Sandy CLAYEY SILT (CL-ML)** Very Loose to Compact Grey to Grey-Brown		4	SS	4		135				
			5	SS	2				H		1 34 46 19
			6	SS	2		134				
			7	SS	6		133				
			8	SS	23		132				
			9	SS	4						
130.8							131				
6.9	**Silty SAND (SM)** with gravel Dense to Very Dense Grey-Brown **(TILL)** -augers grinding from 6.9 m		10	SS	36		130				38 43 19 (SI+CL)
			11	SS	59		129				
128.7											
9.0	DCPT from 29'6"										
128.1											
9.6	End of Borehole DCPT refusal on inferred bedrock.										

Continued Next Page

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-30 2 OF 2 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468677°, Long: -76.623727° Country Road 6 MTM Zone 9: N 5 036 535.2 E 295 125.3 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HSA COMPILED BY MW

DATUM Geodetic DATE 2020.05.06 - 2020.05.06 CHECKED BY FG

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 w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
	Monitoring well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.5-m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2020.09.29 0.6 137.1 2020.06.03 0.2 137.5 2021.09.23 0.7 137.0 2021.10.03 0.9 136.8 2022.01.20 0.8 136.9										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 19-31 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468764°, Long: -76.62477° Country Road 6 MTM Zone 9: N 5 036 545.0 E 295 043.8 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HSA COMPILED BY MW

DATUM Geodetic DATE 2020.05.05 - 2020.05.05 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
140.9	**Ground Surface**										
0.0	**Sandy SILT (ML)** Very Loose to Very Dense Brown Moist to Wet		1	SS	2				○		
			2	SS	6		140		○		1 39 49 11 -non-plastic
			3	SS	22		139		○		
			4	SS	42		138		○		
			5	SS	52				○		
			6	SS	45		137		○		
135.7			7	SS	38		136		○		0 39 50 11 -non-plastic
5.2	**Silty SAND (SM)** Very Dense Brown Wet		8	SS	82		135		○		
134.2			9	SS	34				○		1 56 34 9 -non-plastic
6.7	End of Borehole										

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

$\overset{20}{15\text{-}\oplus\text{-}5}$ $\underset{10}{}$ (%) STRAIN AT FAILURE

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CV-10 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.468728°, Long: -76.622695° Country Road 6 (Culvert) MTM Zone 9: N 5 036 540.7 E 295 206.0 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.08.27 - 2019.08.27 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (UNCONFINED, QUICK TRIAXIAL, FIELD VANE, LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
138.6	**Ground Surface**										
0.0 / 0.1	**ASPHALT (50mm)**										
	SAND with gravel to GRAVEL with silt and sand Compact to Dense Brown **(FILL)**		1	SS	40		138				36 60 4 (SI+CL)
			2	SS	46						
136.6			3	SS	26		137				56 38 6 (SI+CL)
2.0 / 136.3	**Sandy SILT** with clay Compact										
2.3	Grey										
135.5	**GRAVEL**, some sand Compact Brown **(TILL)**		4	SS	23		136				
3.1	**MARBLE BEDROCK** Slightly Weathered Large Grain Smooth White - 75 mm silt seam at 3.9 m		5	SS	100/50mm					FI	
			1	RUN			135			1 2 2 2	RUN #1 TCR=94% SCR=76% RQD=78%
			2	RUN			134			1 3 2 2	RUN #2 TCR=100% SCR=95% RQD=77%
			3	RUN			133			2 2	RUN #3 TCR=100% SCR=86% RQD=57%
132.0							132			4	
6.6	End of Borehole Piezometer consists of 19 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2019.09.29 2.2 136.4 2020.04.21 1.8 136.8 2020.06.03 1.8 136.8 2020.09.29 2.2 136.4 2021.09.23 1.9 136.7 2021.11.04 1.9 136.7										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CV-11 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469139°, Long: -76.622108° Country Road 6 (Culvert) MTM Zone 9: N 5 036 586.3 E 295 252.0 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, HW Casing, HQ Coring COMPILED BY MW

DATUM Geodetic DATE 2020.05.04 - 2020.05.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.3	**Ground Surface**										
0.0	**SAND (SP)** to **Silty SAND**, trace gravel, trace organics Very Loose Brown		1	SS	2		137		○		6 90 4 (SI+CL)
			2	SS	2	▽			○		
135.8							136				
1.5	**GRAVEL** with silt and sand Very Dense Grey-Brown **(TILL)**		3	SS	100/ 175mm				○	FI	
135.4											
1.9	**MARBLE BEDROCK** Moderately Weathered to Fresh Jointed Large Grain Rough Grey-Pink		1	RUN						>10	RUN #1 TCR=100% SCR=23% RQD=0%
							135			>10	RUN #2 TCR=100% SCR=75% RQD=29%
			2	RUN						2	
										3	
							134			>10	
										3	
			3	RUN						4	RUN #3 TCR=100% SCR=92% RQD=56%
							133			3	
										1	
132.0										2	
5.3	End of Borehole Monitoring well consists of 50 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2020.09.29 1.3 136.0 2020.06.03 0.9 136.4 2021.09.23 1.5 135.8 2021.10.03 1.2 136.1 2022.01.22 1.0 136.3										

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

15 20 10 5 (%) STRAIN AT FAILURE

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CV-12 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469006°, Long: -76.622227° Country Road 6 (Culvert) MTM Zone 9: N 5 036 571.6 E 295 242.7 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2020.05.04 - 2020.05.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
136.9	**Ground Surface**										
0.0 136.3	**Silty SAND**, trace to with organics Very Loose to Loose Brown to Grey-Brown		1	SS	1						
0.6	**Clayey SILT (CL-ML)** Loose Grey Brown		2	SS	5		136				
			3	SS	4		135				0 23 54 23
134.6											
2.3 134.1	**GRAVEL** with silt and sand Very Dense Grey **(TILL)**		4	SS	64					FI	54 35 11 (SI+CL)
2.8	**MARBLE BEDROCK** Moderately Weathered to Fresh Jointed Large Grain Rough Grey - Highly Fractured from 2.8 m to 3.4 m		1	RUN			134			>10 >10	RUN #1 TCR=100% SCR=22% RQD=22%
			2	RUN			133			1 5 1 3 3	RUN #2 TCR=100% SCR=90% RQD=59%
			3	RUN			132			2 1 2 4	RUN #3 TCR=100% SCR=89% RQD=74%
130.5							131			3	
6.4	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CV-13 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469443°, Long: -76.621853° Country Road 6 (Culvert) MTM Zone 9: N 5 036 620.1 E 295 272.0 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2020.05.04 - 2020.05.04 CHECKED BY FG

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 w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
137.7	**Ground Surface**										
0.0	**TOPSOIL (220mm)**		1	SS	100/ 75mm					FI	
0.2	**MARBLE BEDROCK** Slightly Weathered to Fresh Jointed Coarse-Medium Grain Grey-White to Grey-Pink		1	RUN			137			1 0 1 1 5	RUN #1 TCR=90% SCR=81% RQD=78%
			2	RUN			136			4 2 4	RUN #2 TCR=100% SCR=17% RQD=7%
			3	RUN			135 134			4 1 5 6	RUN #3 TCR=100% SCR=89% RQD=42%
133.6										1	
4.1	End of Borehole										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CV-14 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469676°, Long: -76.622153° Country Road 6 (Culvert) MTM Zone 9: N 5 036 646.0 E 295 248.6 ORIGINATED BY JP

HWY 17 BOREHOLE TYPE CME 45 Trackmount, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2020.05.05 - 2020.05.05 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
137.8	**Ground Surface**										
0.0	**Silty SAND (SM)**, some gravel, some organics Very Loose Brown **(TILL)**		1	SS	2				○		
136.9			2	SS	100/ 150mm		137		○	FI	11 75 14 (SI+CL)
0.9	**MARBLE BEDROCK** Fresh to Fresh Jointed Large Grain Rough Grey		1	RUN						3	RUN #1 TCR=80% SCR=68% RQD=39%
							136			2	
			2	RUN						3	RUN #2 TCR=100% SCR=97% RQD=13%
										4	
							135			5	
										4	
										4	
			3	RUN						5	RUN #3 TCR=100% SCR=97% RQD=11%
							134			3	
										2	
										2	
										4	
133.0							133			1	
4.8	End of Borehole										

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CV-15 1 OF 1 METRIC

WP# 4068-09-00 LOCATION Lat: 45.469527°, Long: -76.621977° Country Road 6 (Culvert) MTM Zone 9: N 5 036 629.5 E 295 262.3 ORIGINATED BY SOB

HWY 17 BOREHOLE TYPE CME 55 Truckmount, NW Casing, NQ Coring COMPILED BY MW

DATUM Geodetic DATE 2019.09.05 - 2019.09.05 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
136.8	**Ground Surface**							20 40 60 80 100	20 40 60		
0.0	Silty SAND with gravel Very Dense Brown to White-brown **(FILL)**		1	SS	53			○	○		34 53 13 (SI+CL)
			2	SS	62		136		○		
135.3										FI	
1.5	**MARBE BEDROCK** Slightly Weathered Large Grain Smooth Grey		1	RUN		▽	135			6 4 1 3	RUN #1 TCR=100% SCR=87% RQD=62%
							134			3	
	-Very fractured from 3.0 m to 3.8 m		2	RUN						>10 >10	RUN #2 TCR=100% SCR=57% RQD=43%
							133			7 4 2	
			3	RUN			132			1 2	RUN #3 TCR=100% SCR=90% RQD=100%
131.7										2	
5.1	End of Borehole Monitoring well consists of 19 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2019.09.26 2.2 134.6 2020.04.21 2.0 134.8 2020.09.29 2.1 134.7 2021.11.24 0.5 136.5										

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

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

DOUBLE LINE 24726 CR6.GPJ 2012TEMPLATE(MTO).GDT 22-8-24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-1 1 OF 1 METRIC

GWP# 4076-13-00 LOCATION Site 29-242/C1 Deil's Creek Culvert, MTM Zone 9: N 5 036 558.5 E 295 234.5 ORIGINATED BY NW

HWY 17 BOREHOLE TYPE NW Casing / NQ Coring COMPILED BY CM

DATUM Geodetic DATE 2018.01.16 - 2018.01.17 CHECKED BY KP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.2											
0.0 / 0.1	**50 mm ROOTMAT**						137				
	Clay with sand Stiff to very stiff Brown **FILL**		1	SS	10						
			2	SS	9		136				0 26 53 21
135.6											
1.5	**SANDY SILTY CLAY (CL-ML)** Very stiff Brown to grey		3	SS	19		135				
			4	SS	17						1 38 43 18
134.1											
3.0	**SILTY SAND (SM) with gravel** - occasional cobbles Compact to very dense Grey		5	SS	82		134				32 47 21 (SI+CL)
			6	SS	100/ 100mm						
	- 180 mm Cobble at 3.9 m						133				
			7	SS	13						
132.0											
5.2	**MARBLE BEDROCK** Slightly weathered Poor to good quality Medium grained White		1	RUN			132				RUN #1 TCR=100% SCR=100% RQD=39%
			2	RUN			131				RUN #2 TCR=100% SCR=72% RQD=70%
			3	RUN			130				RUN #3 TCR=100% SCR=100% RQD=78%
128.5							129				
8.7	End of Borehole										

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

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

ONTMT4S 20479 DEIL'S CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 5/6/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-2 1 OF 1 METRIC

GWP# 4076-13-00 LOCATION Site 29-242/C1 Deil's Creek Culvert, MTM Zone 9: N 5 036 511.2 E 295 195.8 ORIGINATED BY NW

HWY 17 BOREHOLE TYPE NW Casing / NQ Coring COMPILED BY CM

DATUM Geodetic DATE 2018.01.17 - 2018.01.17 CHECKED BY KP

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 w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
136.7											
0.0	Organic clayey silt - frozen Brown		1	SS	21						
136.1	**FILL**										
0.6	**SILTY SAND (SM) with gravel** Loose to very dense Brown to grey		2	SS	14		136				
			3	SS	7		135				29 58 13 (SI+CL)
			4	SS	21		134				
			5	SS	23		133				
132.5	- 175 mm Cobble at 4.0 m		6	SS	100/ 50mm						
4.2	**MARBLE BEDROCK** Slightly weathered Poor to good quality Medium grained White		1	RUN			132				RUN #1 TCR=97% SCR=0% RQD=0% *vertical fracture throughout Run#1
			2	RUN			131				RUN #2 TCR=70% SCR=67% RQD=48%
129.5							130				
7.2	End of Borehole										

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

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

ONTMT4S 20479 DEIL'S CREEK CULVERT.GPJ 2012TEMPLATE(MTO).GDT 5/6/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CR6-1 1 OF 2 METRIC

G.W.P. 647-92-00 LOCATION N 5 036 561.3 E 295 173.5 (County Road 6) ORIGINATED BY JL
HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NO Coring COMPILED BY SS
DATUM Geodetic DATE 14.10.03 - 14.10.03 CHECKED BY SKP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.5											
136.6	**TOPSOIL** (125mm)										
0.1	Sandy **GRAVEL**, occasional organic inclusions Compact Brown Moist (FILL)		1	SS	31		137		○ ○		
136.1	Silty **CLAY** to clayey **SILT**, with sand seams, occasional organic inclusions Firm Grey Moist		2	SS	4		136		○		0 21 61 18
1.4	**SAND and SILT** Compact Grey Moist to Wet (SP)		3	SS	15				○		
			4	SS	15		135		○		
	occasional clay lumps seams and partings		5	SS	14		134		○		0 44 56 (SI+CL)
	Loose		6	SS	5		133		○		
132.2	Auger refusal at 5.33m.				FI						
5.3	**CRYSTALLINE LIMESTONE (BEDROCK)** Slightly weathered, very thinly bedded, grey and partially light brown with white and dark grey, horizontal and subvertical banding, strong to very strong, horizontal and subvertical banding Subvertical joints from 6.02m to 6.1m, 6.32m to 6.45m, 6.55m to 6.6m, 6.78m to 6.83m, 6.68m to 6.96m, 7.24m to 7.26m, 8.08m to 8.13m, 8.59m to 8.66m Vertical joint from 6.1m to 6.32m		1	RUN	3 2 1		132				RUN 1# TCR=100%, SCR=87%, RQD=53%, UCS=152MPa
			2	RUN	>10 >10 >10 2 2		131				RUN 2# TCR=100%, SCR=62%, RQD=52%, UCS=132MPa
			3	RUN	3 3 0 3 2		130 129				RUN 3# TCR=98%, SCR=88%, RQD=70%, UCS=141MPa
128.4											
9.1	END OF BOREHOLE AT 9.14m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

Continued Next Page

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

(%) STRAIN AT FAILURE

ONTMT4 7450CR6.GPJ 28/05/04

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CR6-1 2 OF 2 METRIC

G.W.P. 647-92-00 LOCATION N 5 036 561.3 E 295 173.5 (County Road 6) ORIGINATED BY JL

HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS

DATUM Geodelic DATE 14.10.03 - 14.10.03 CHECKED BY SKP

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 w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	WATER LEVEL READINGS: DATE ELEVATIQN (m) 16/10/2003 136.1 22/10/2003 136.3 16/12/2003 destroyed										

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

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

ONTMT4 7450CR6.GPJ 27/05/04

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CR6-2 1 OF 1 METRIC

G.W.P. 647-92-00 LOCATION N 5 036 567.5 E 295 206.5 (County Road 6) ORIGINATED BY JL

HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NO Coring COMPILED BY SS

DATUM Geodetic DATE 14.10.03 - 14.10.03 CHECKED BY SKP

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
137.8											
0.0	Sandy **GRAVEL**, occasional cobbles Compact to Very Dense Brown Moist (FILL)		1	SS	29				○		
			2	SS	57		137		○		
136.2	SAMPLER REFUSAL AT 1.6m.		3	SS	50/.07				○		
1.6	**CRYSTALLINE LIMESTONE (BEDROCK)** Slightly to moderately weathered, very thinly to thinly bedded, grey, brown and occasional red with dark grey and white horizontal and subvertical banding, moderately strong to very strong Subvertical joints from 1.98m to 2.08m, 2.24m to 2.26m, 2.31m to 2.72m, 2.79m to 2.92m, 2.97m to 3.02m, 3.25m to 3.3m, 3.4m to 3.45m Vertical joints from 1.65m to 1.78m, 2.41m to 2.57m, 2.92m to 2.97m, 3.12m to 3.2m, 3.75m to 3.64m, 4.22m to 4.32m Multiple fractures from 3.91m to 4.22m, 4.32m to 4.37m		1	RUN	>10 >10 >10 >10 >10 >10		136 135				RUN 1# TCR=100%, SCR=33%, RQD=13%, UCS=87MPa
132.9			2	RUN	>10 >10 >10 >10 2		134 133				RUN 2# TCR=100%, SCR=60%, RQD=45%, UCS=147MPa
4.9	END OF BOREHOLE AT 4.88m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE ELEVATION (m) 16/10/2003 136.1 22/10/2003 136.2 16/12/2003 136.1 04/02/2004 136.1 11/03/2004 137.4				FI						

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

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

ONTMT4 7450CR6.GPJ 28/05/04

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CR6-3 1 OF 1 METRIC

G.W.P. 647-92-00 LOCATION N 5 036 606.5 E 295 247.0 (County Road 6) ORIGINATED BY JL

HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS

DATUM Geodetic DATE 14.10.03 - 14.10.03 CHECKED BY SKP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
136.6											
0.0	Sandy **GRAVEL**, trace silt, frequent cobbles Dense Brown Moist (FILL)		1	SS	43		136		o		
			1	GS					o		
134.9	SAMPLER REFUSAL AT 1.75m.		2	SS	101/ FI 228		135		o o		61 27 12 (SI+CL)
1.8	**CRYSTALLINE LIMESTONE (BEDROCK)** Slightly to moderately weathered, very thinly to thinly bedded, light grey and light brown with white and black horizontal and subvertical banding, moderately strong to strong Subvertical joints from 2.41m to 2.49m, 3.35m to 3.43m, 3.86m, 4.06m to 4.27m Vertical joints from 2.11m to 2.21m, 2.49m to 2.57m, 2.74m to 2.97m, 3.0m to 3.12m, 3.28m to 3.43m, 3.53m to 3.58m, 4.24m to 4.75m Multiple fracture from 1.75m to 1.98m		1	RUN	>10 >10 >10 >10 >10		134				RUN 1# TCR=100%, SCR=36%, RQD=25%, UCS=60MPa
			2	RUN	3 >10 >10 >10 >10		133 132				RUN 2# TCR=100%, SCR=33%, RQD=16%, UCS=55MPa
131.8											
4.8	END OF BOREHOLE AT 4.8m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE ELEVATION (m) 16/10/2003 134.9 22/10/2003 135.0 16/12/2003 destroyed										

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

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

ONTMT4 7450CR6.GPJ 27/05/04

THURBER

Appendix C.

Laboratory Testing

THURBER

Appendix C.1

Particle Size Analysis Figures

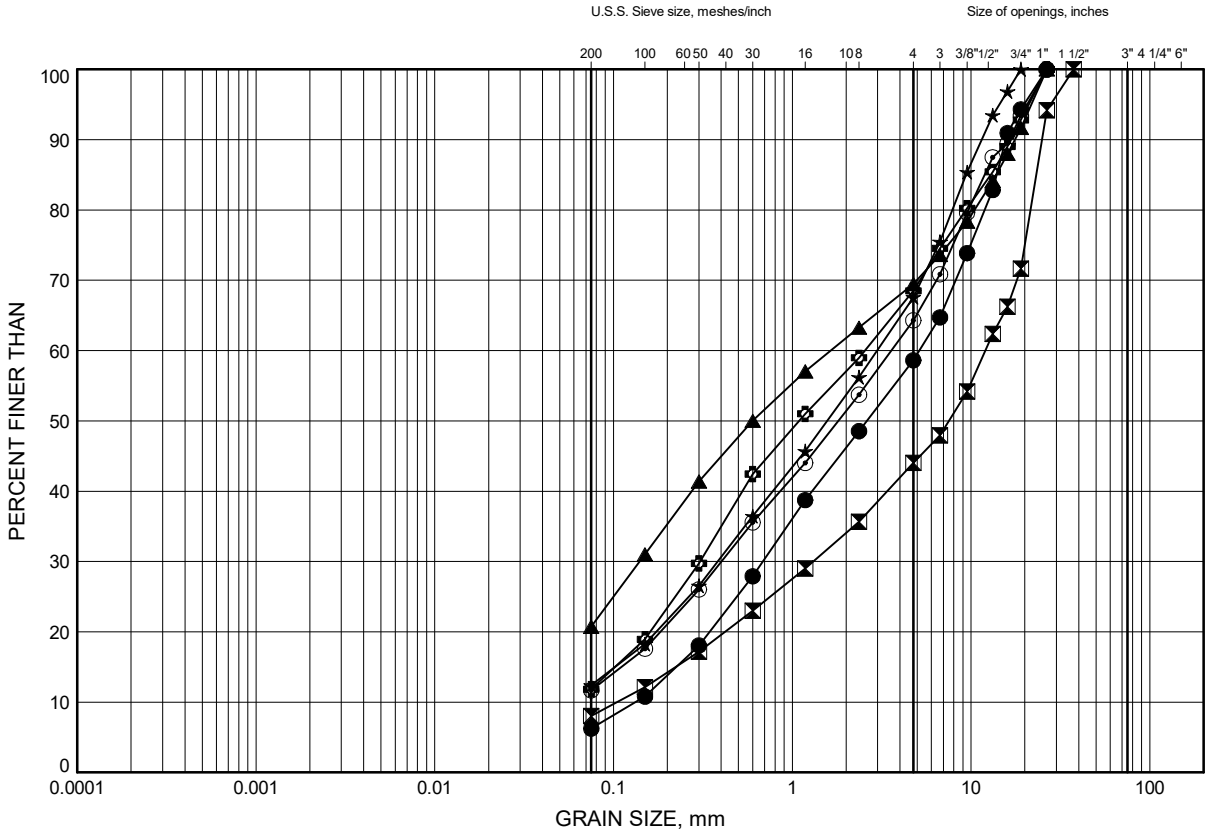
Atterberg Limit Test Results

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C1

Sand with Silt and Gravel to Silty Sand with Gravel to Gravel with Silt and Sand (Fill)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-03	0.3	137.4
⊠	19-04	1.1	136.4
▲	19-09	1.1	136.0
★	19-12	0.4	136.6
⊙	19-17	0.4	135.7
✿	19-19	0.4	131.5

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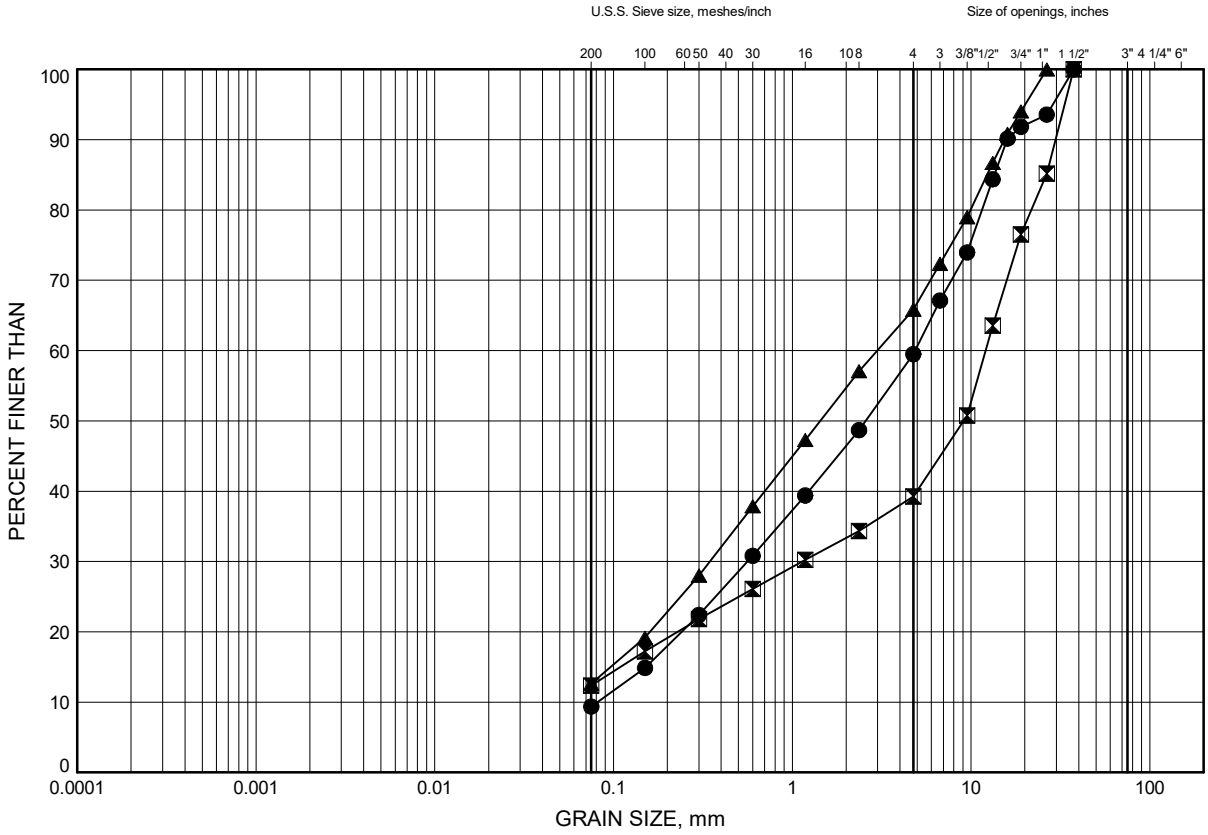
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C2

Sand with Silt and Gravel to Silty Sand with Gravel to Gravel with Silt and Sand (Fill)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-22	0.4	133.5
⊠	CR6-3	1.5	135.1
▲	CV-15	0.3	136.5

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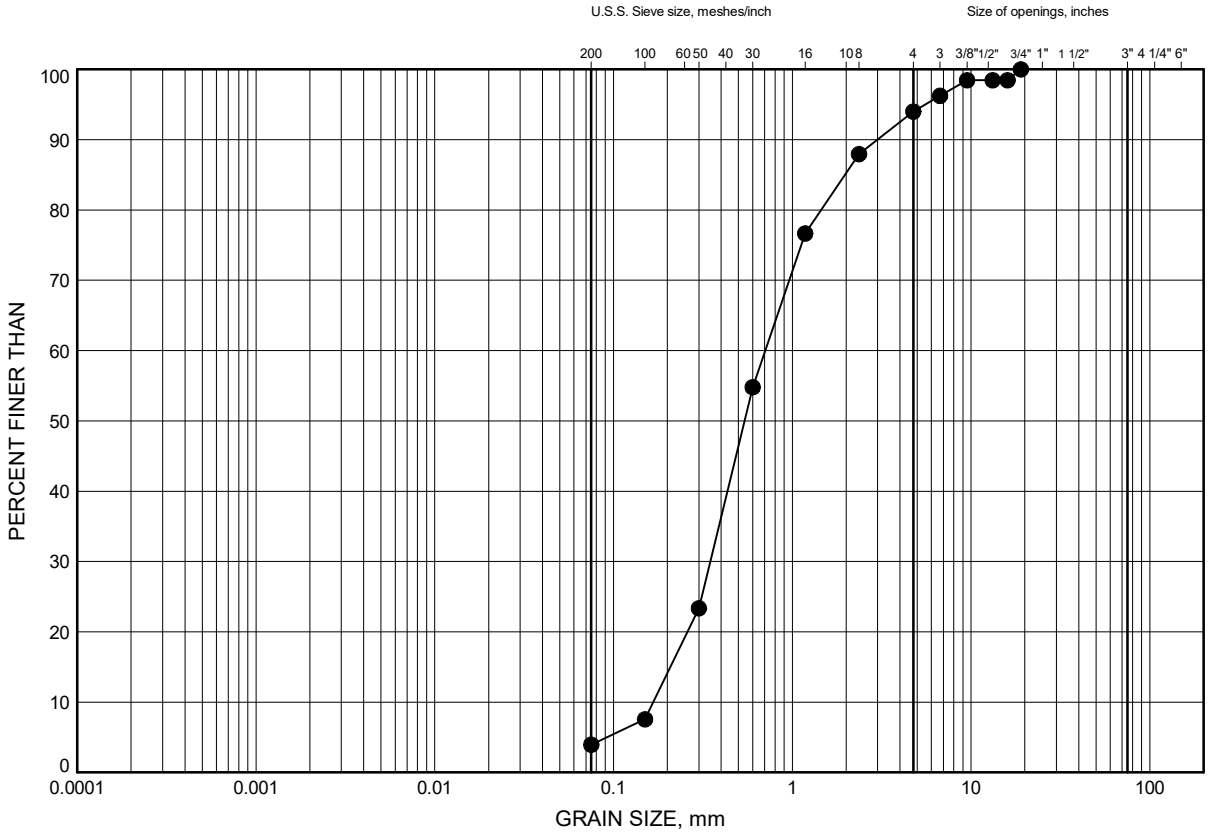
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C3

Silty Sand (SM) to Sand (SP), trace gravel



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CV-11	0.3	137.0

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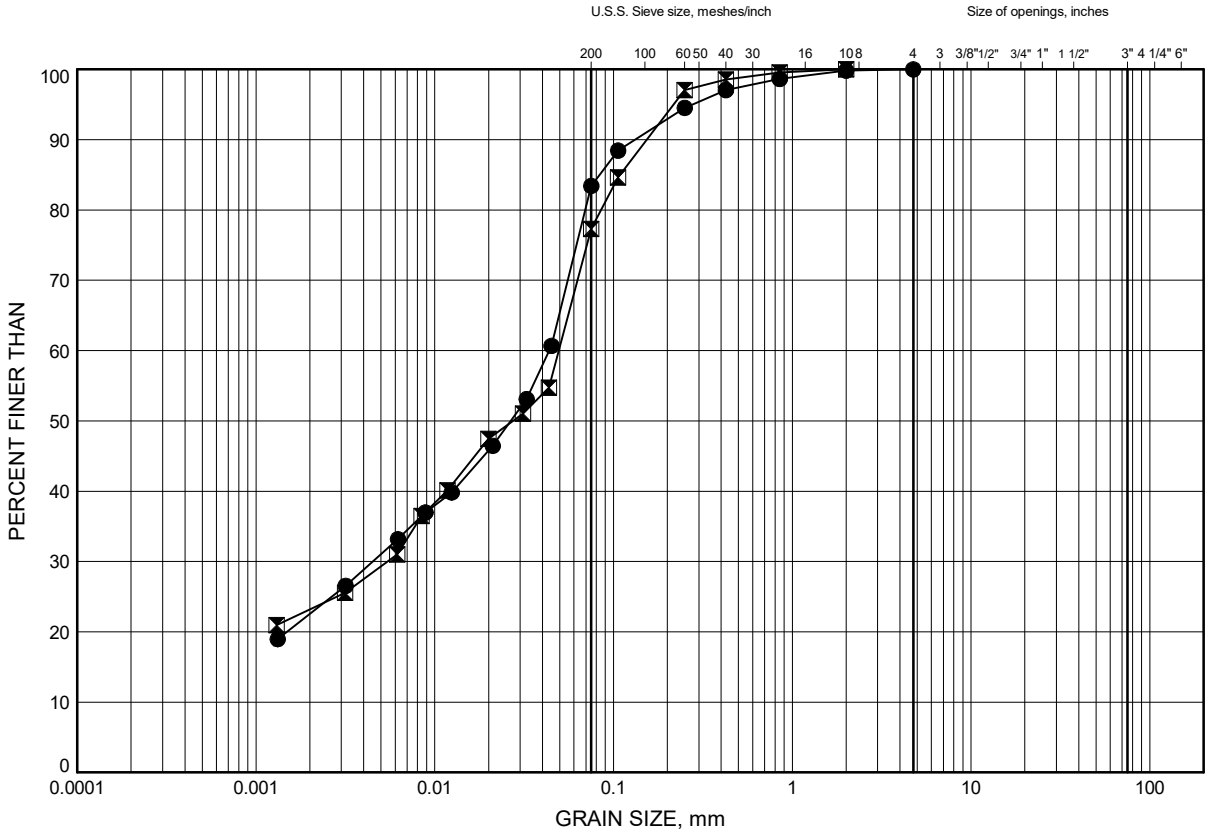
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C4

Clayey Silt (CL) with Sand to Clayey Silt (CL-ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-23	0.9	131.8
⧓	CV-12	1.8	135.1

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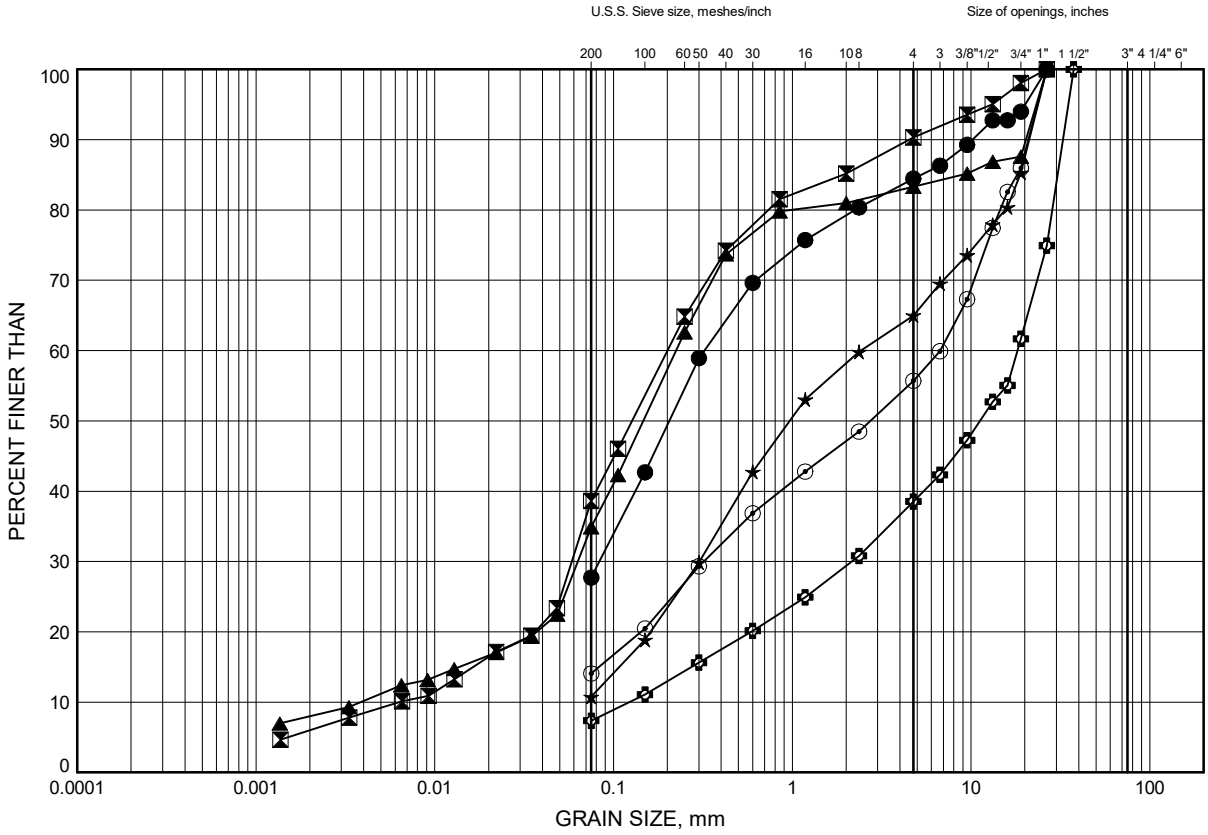
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C5

Silty Sand (SM) to Gravel (GW-GM) with Silt and Sand Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-06	2.6	135.3
⊠	19-07	0.9	135.7
▲	19-10	1.1	136.3
★	19-23	1.8	130.9
⊙	19-24	1.8	130.5
✿	19-27	1.1	132.4

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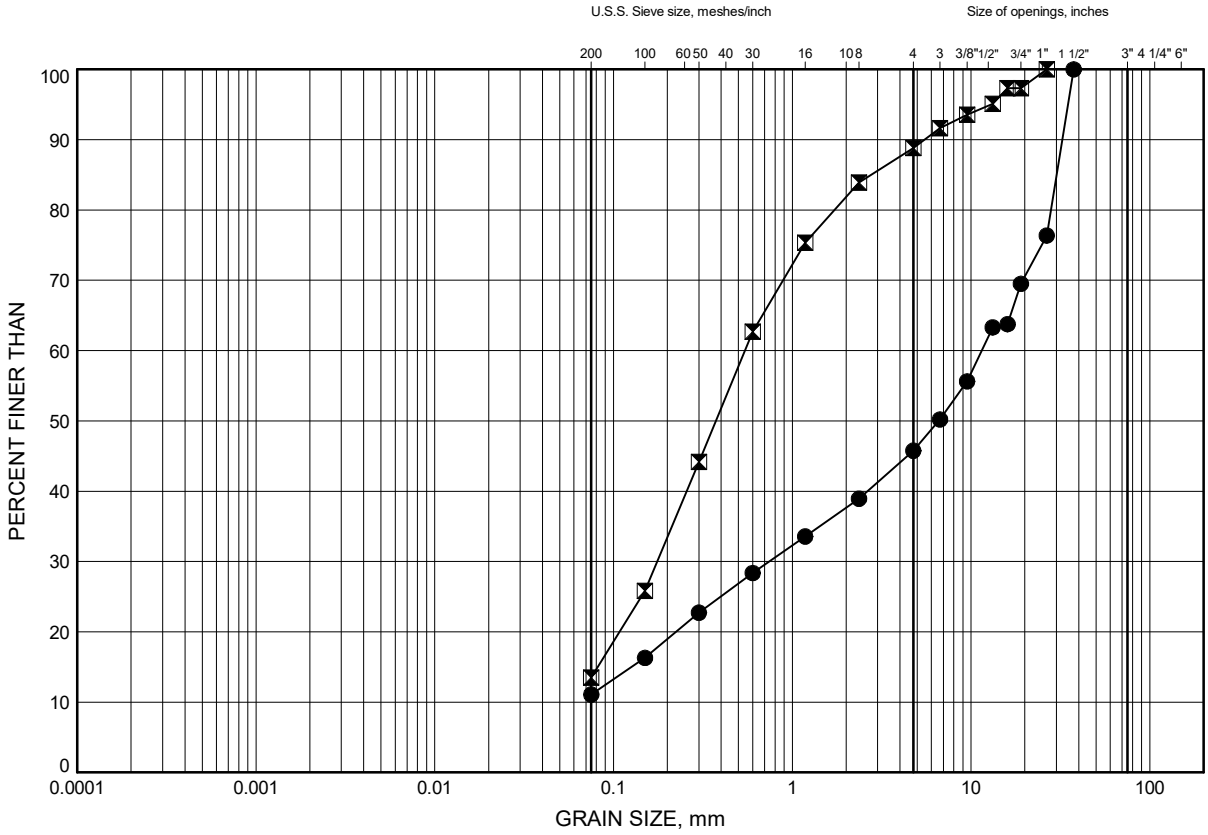
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C6

Silty Sand (SM) to Gravel (GW-GM) with Silt and Sand Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CV-12	2.6	134.3
⧓	CV-14	0.8	137.0

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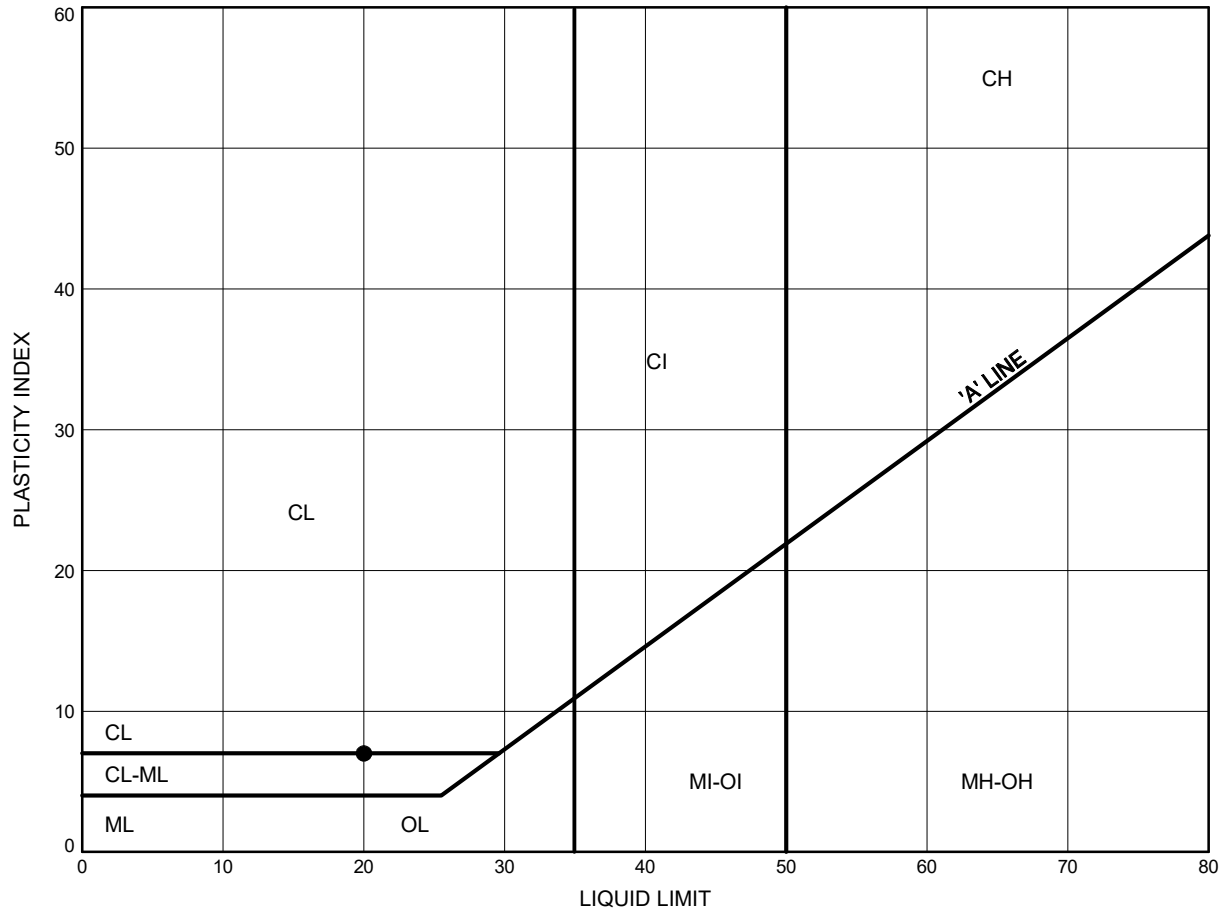
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

ATTERBERG LIMITS TEST RESULTS

FIGURE C7

Clayey Silt (CL) with Sand to Clayey Silt (CL-ML)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CV-12	1.8	135.1

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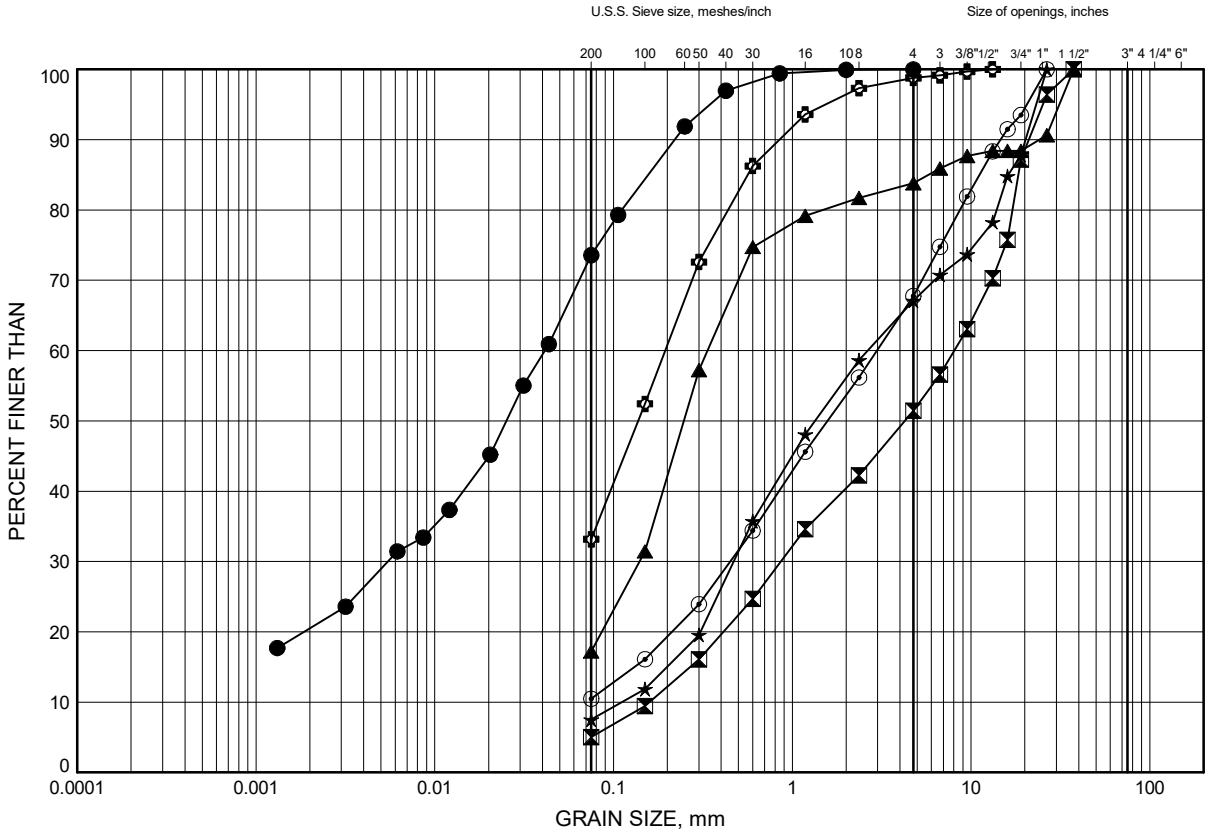
THURBALT 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C8

Sand w Silt & Gravel to Silty Sand to Gravel w Silt & Sand to Clay w Sand to Clayey Silt (Fill)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-1	1.1	136.1
⊠	19-01	0.4	137.9
▲	19-02	1.8	136.4
★	19-05	1.1	137.0
⊙	19-14	0.3	138.7
✿	19-21	0.7	129.6

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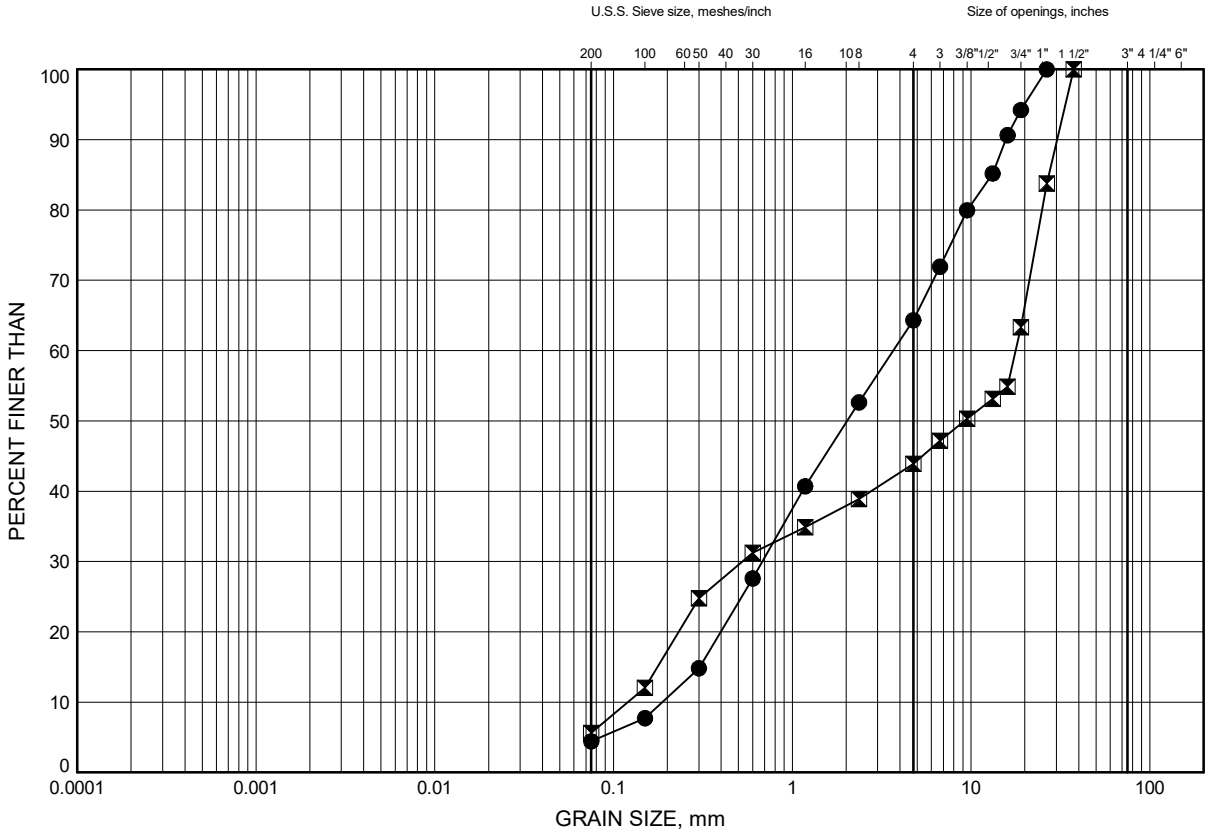
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C9

Sand w Silt & Gravel to Silty Sand to Gravel w Silt & Sand to Clay w Sand to Clayey Silt (Fill)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CV-10	0.4	138.2
⧓	CV-10	1.8	136.8

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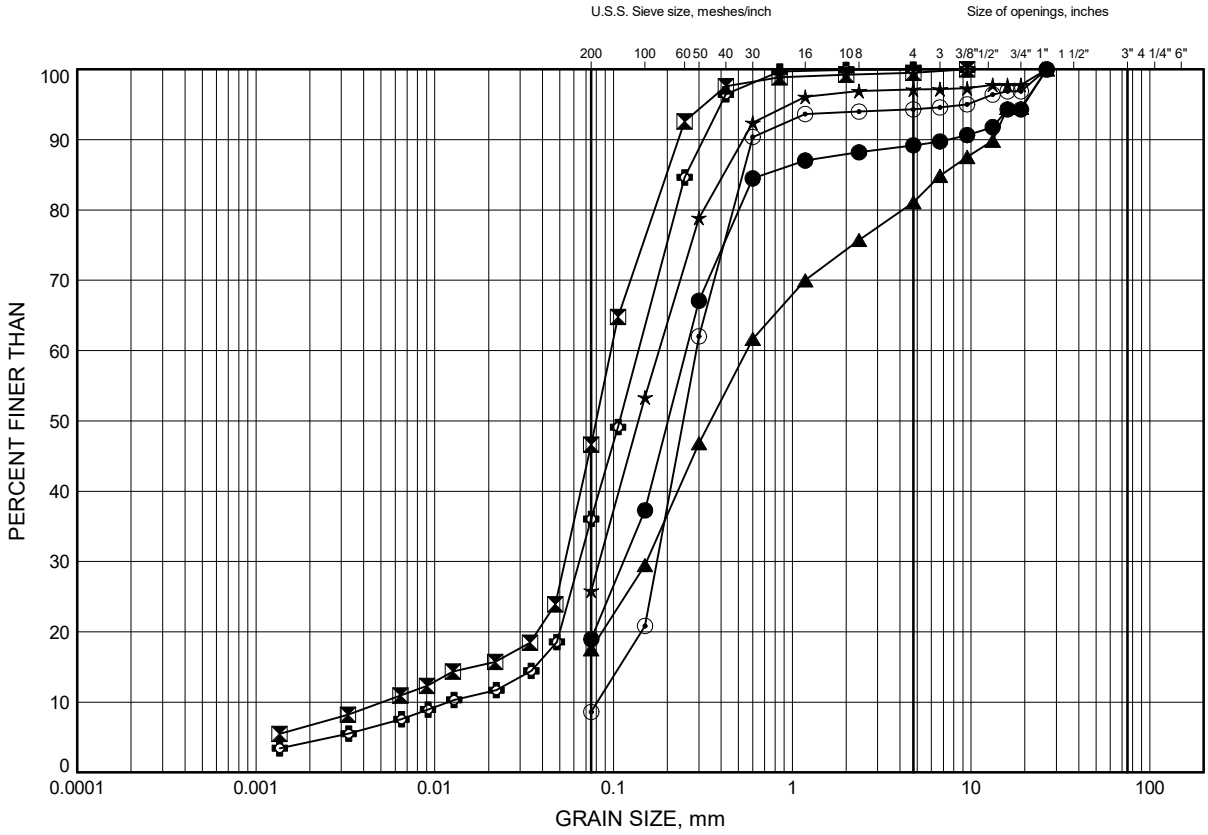
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C10

Silty Sand (SM) to Silty Sand (SM) with Gravel to Sandy Silt (ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-01	1.8	136.5
⊠	19-02	2.6	135.6
▲	19-05	1.8	136.3
★	19-13	2.6	136.8
⊙	19-13	4.1	135.3
✿	19-14	3.4	135.6

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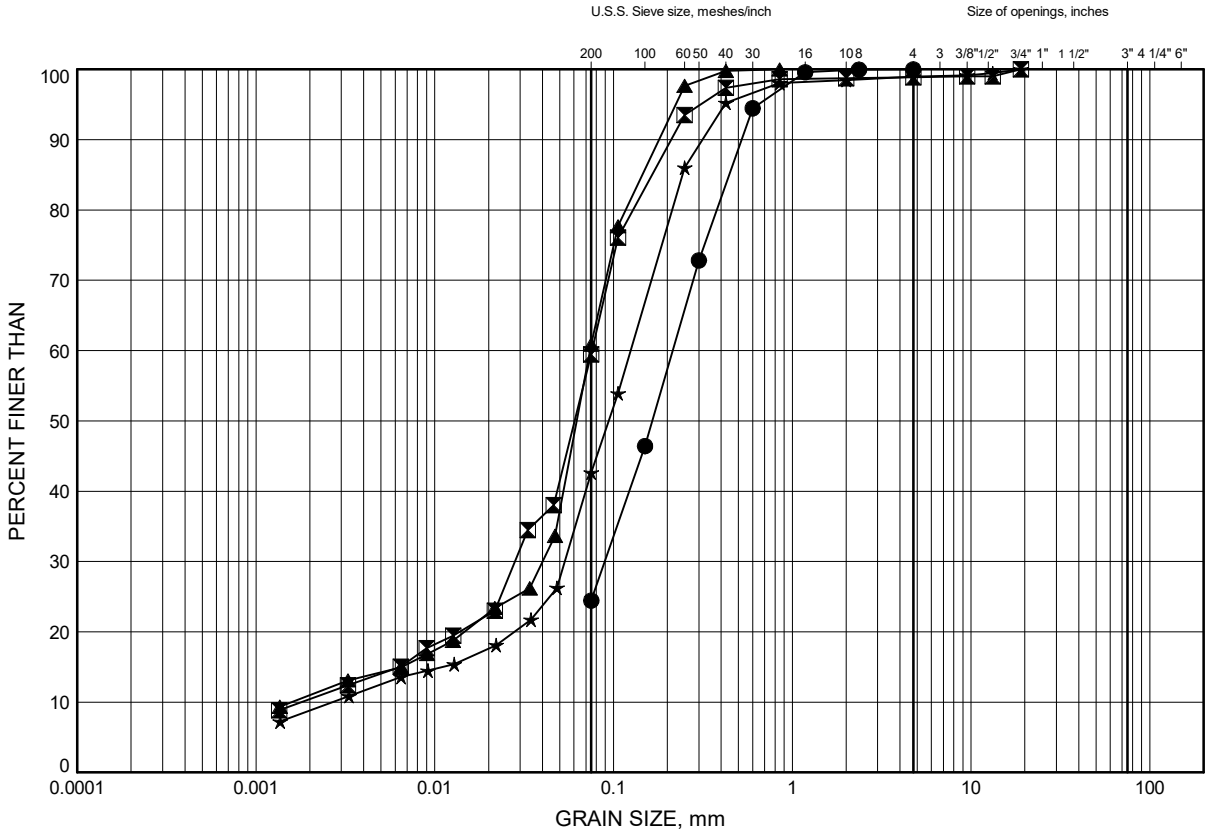
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C11

Silty Sand (SM) to Silty Sand (SM) with Gravel to Sandy Silt (ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-30	1.8	135.9
⊠	19-31	1.1	139.8
▲	19-31	4.9	136.0
★	19-31	6.4	134.5

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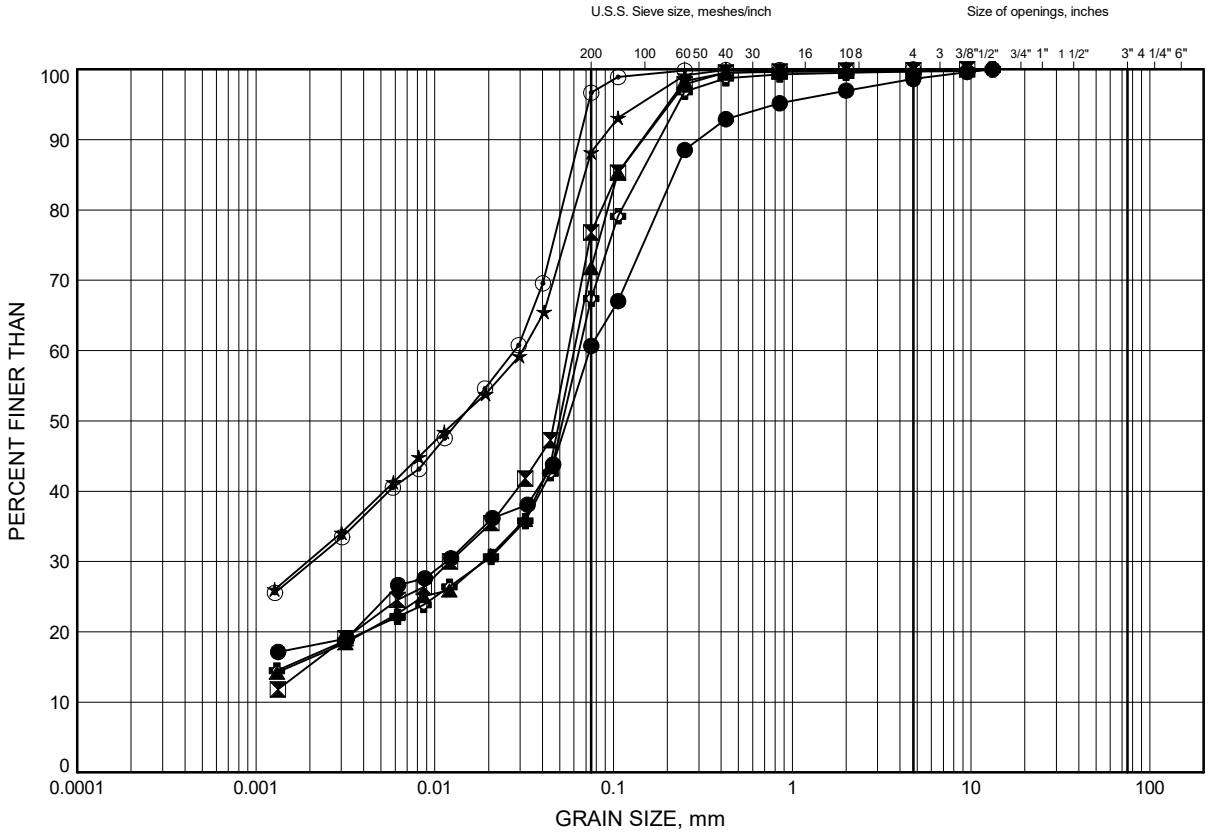
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 24/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C12

Clayey Silt (CL to CL-ML) to Clayey Silt (CL) with Sand to Silt (ML) with Clay to Sandy Clayey Silt (CL-ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-1	2.6	134.6
⊠	19-01	4.1	134.2
▲	19-13	5.6	133.8
★	19-13	9.5	129.9
⊙	19-14	7.2	131.8
✿	19-15	3.4	134.4

Date September 2021

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THURBER

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Chkd. FG

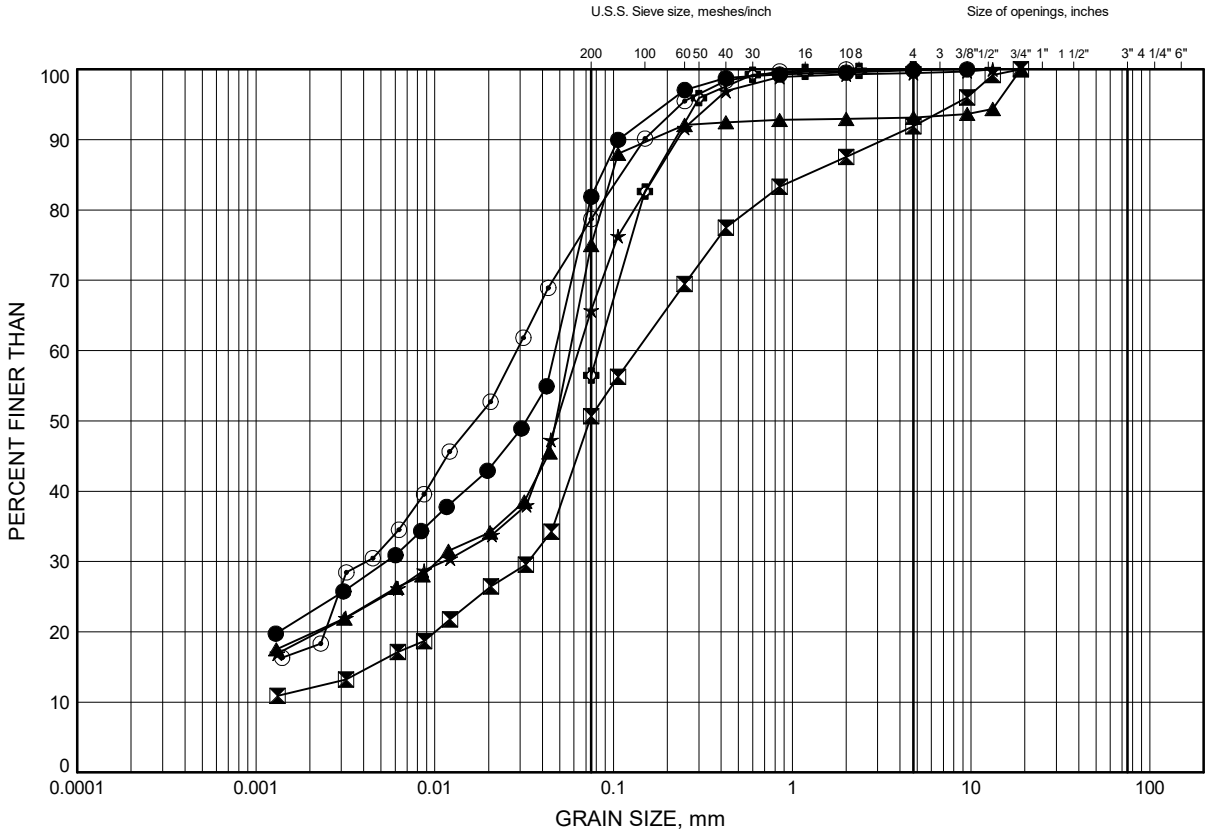
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 24/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C13

Clayey Silt (CL to CL-ML) to Clayey Silt (CL) with Sand to Silt (ML) with Clay to Sandy Clayey Silt (CL-ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-20	1.8	129.1
⊠	19-20	2.5	128.4
▲	19-21	1.8	128.5
★	19-30	3.4	134.3
⊙	CR6-1	1.1	136.4
✿	CR6-1	3.4	134.1

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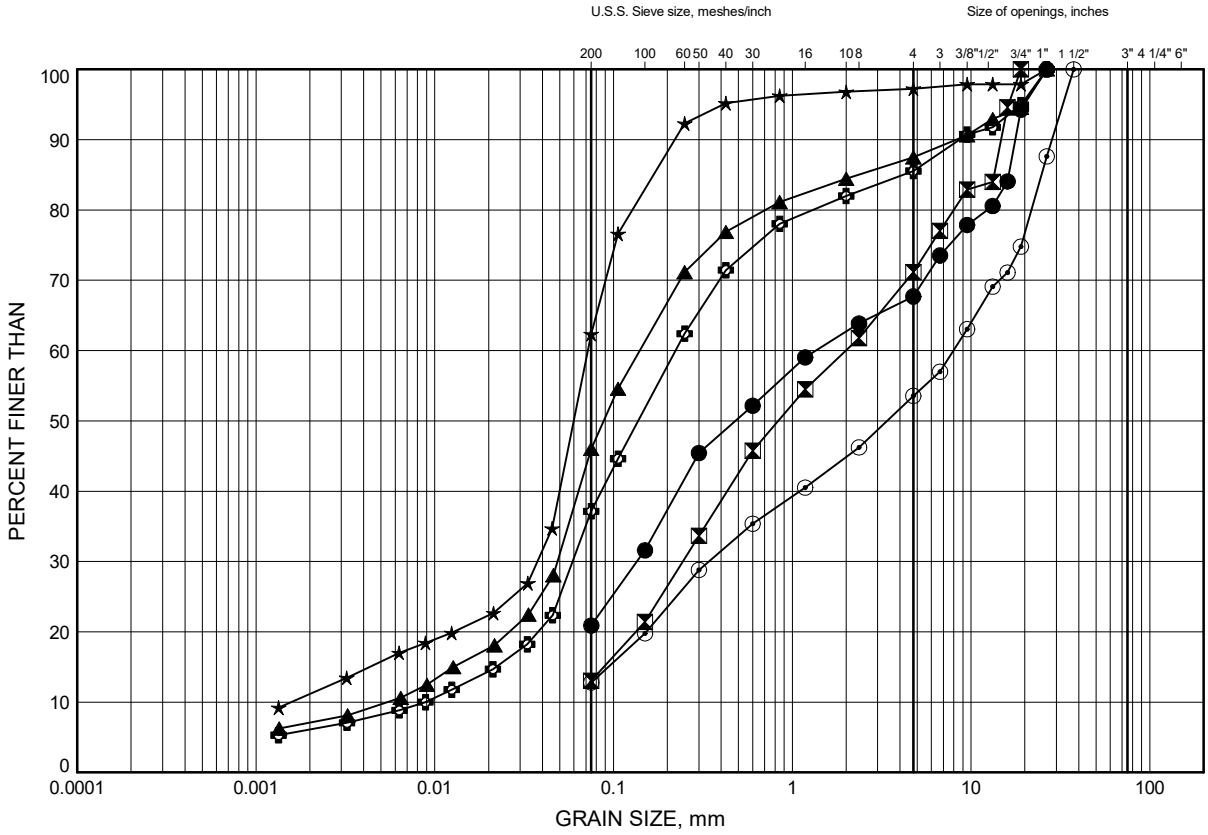
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 24/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C14

Sandy Silt (ML) to Silty Sand (SM) with Gravel to Silty Gravel with Sand to Gravel (Till)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-1	3.4	133.8
⊠	17-2	1.8	134.9
▲	19-01	7.2	131.1
★	19-02	4.1	134.1
⊙	19-14	8.7	130.3
✿	19-15	5.6	132.2

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Chkd. FG

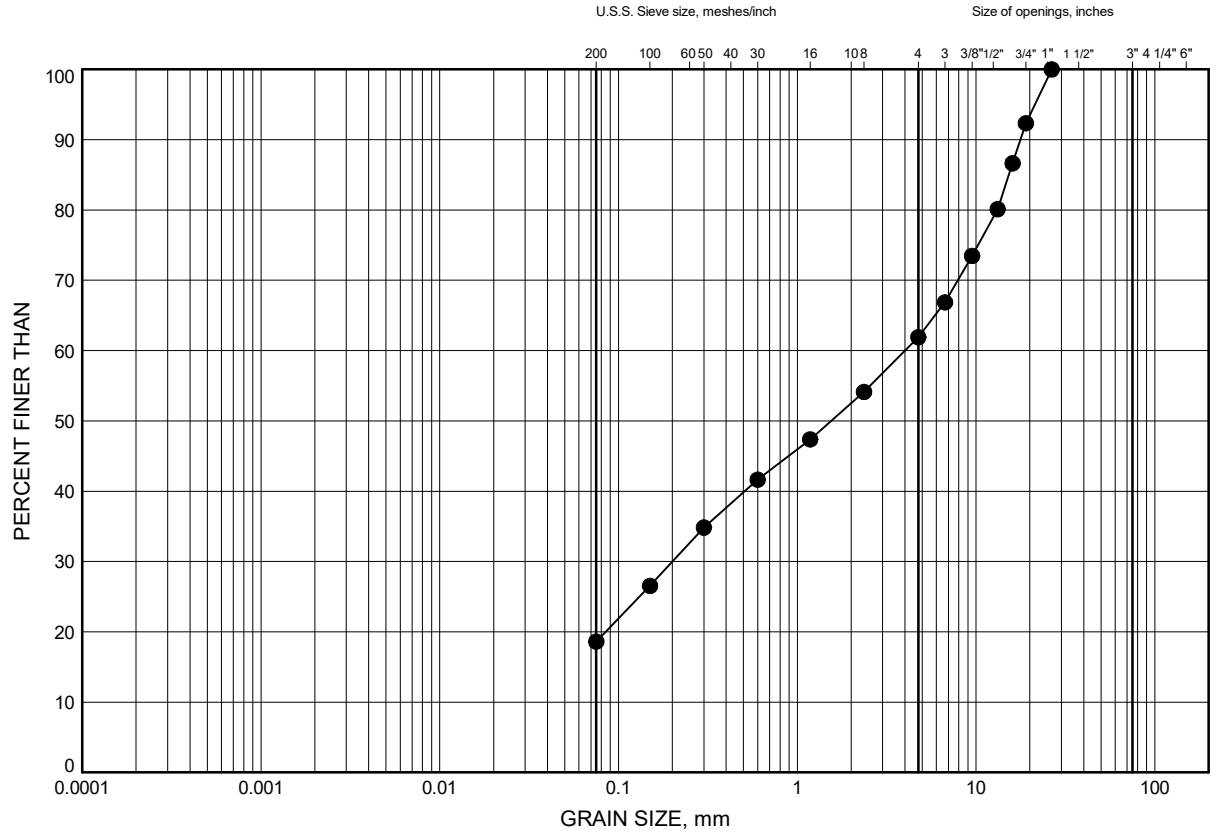
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C15

Sandy Silt (ML) to Silty Sand (SM) with Gravel to Silty Gravel with Sand to Gravel (Till)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-30	7.9	129.8

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Prep'd DP

Chkd. FG

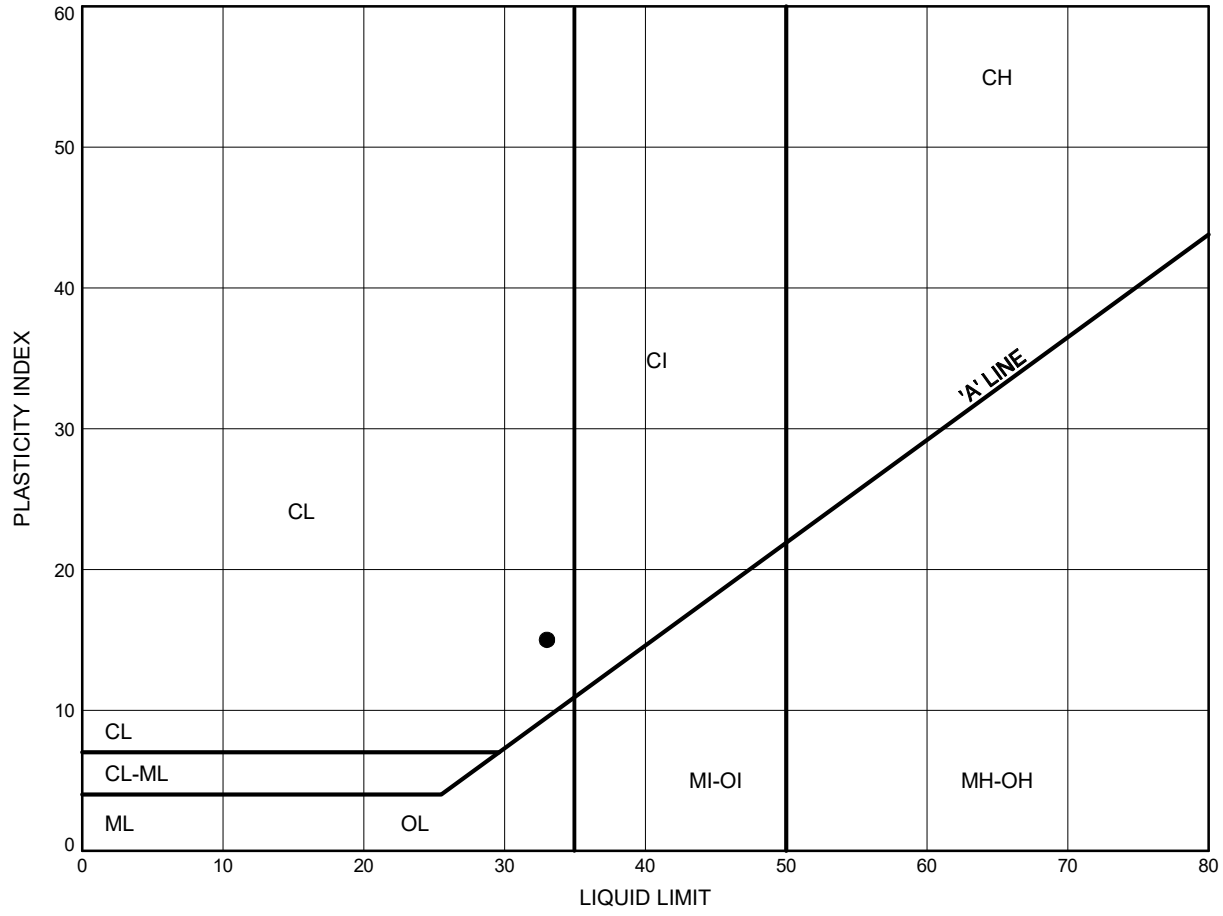
GRAIN SIZE DISTRIBUTION - THURBER 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

ATTERBERG LIMITS TEST RESULTS

FIGURE C16

Sand w Silt & Gravel to Silty Sand to Gravel w Silt & Sand to Clay w Sand to Clayey Silt (Fill)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-1	1.1	136.1

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THURBER

Prep'd DP

Chkd. FG

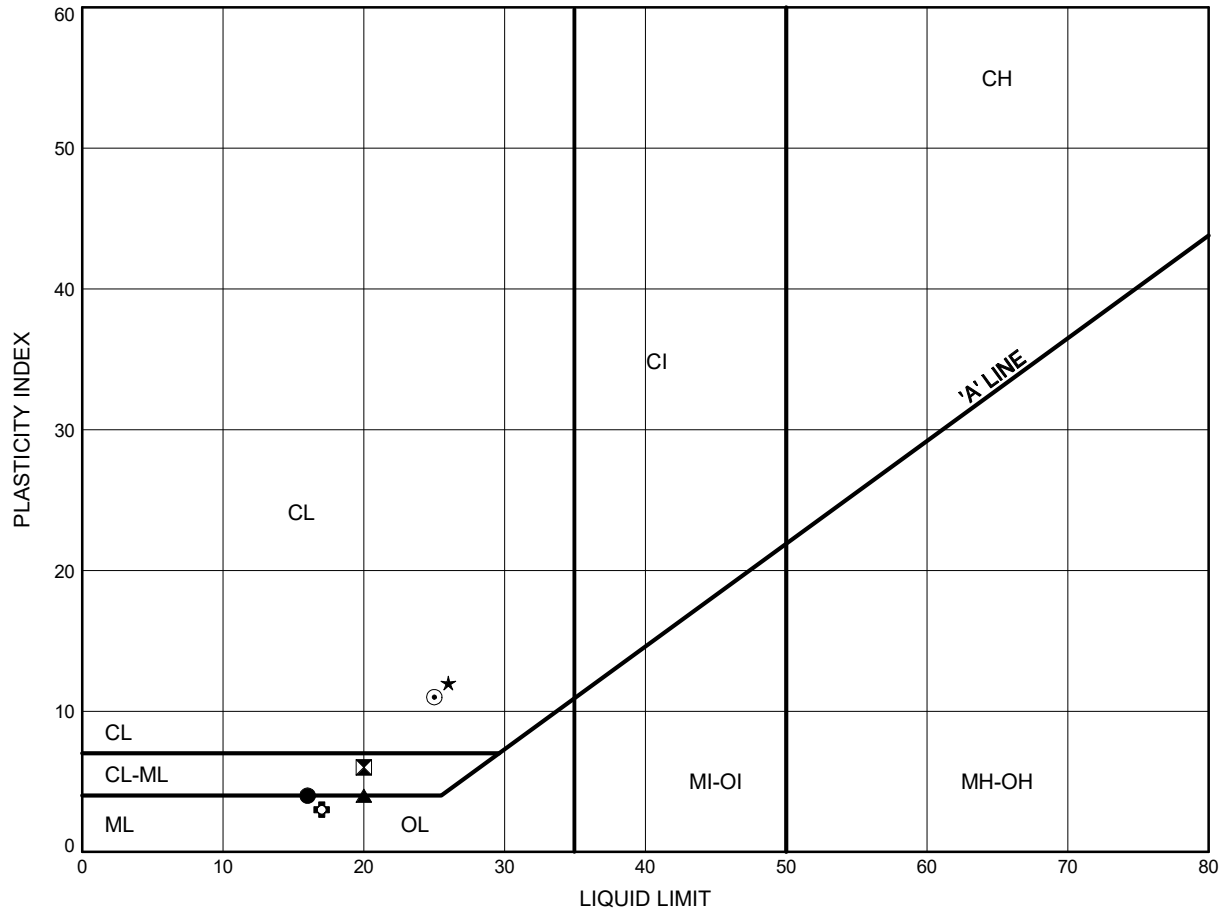
THURBALT 24726 CR6.GPJ 7/9/21

Highway 17 Twinning

ATTERBERG LIMITS TEST RESULTS

FIGURE C17

Clayey Silt (CL to CL-ML) to Clayey Silt (CL) with Sand to Silt (ML) with Clay to Sandy Clayey Silt (CL-ML)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-1	2.6	134.6
⊠	19-01	4.1	134.2
▲	19-13	5.6	133.8
★	19-13	9.5	129.9
⊙	19-14	7.2	131.8
✿	19-15	3.4	134.4

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Prep'd DP

Chkd. FG

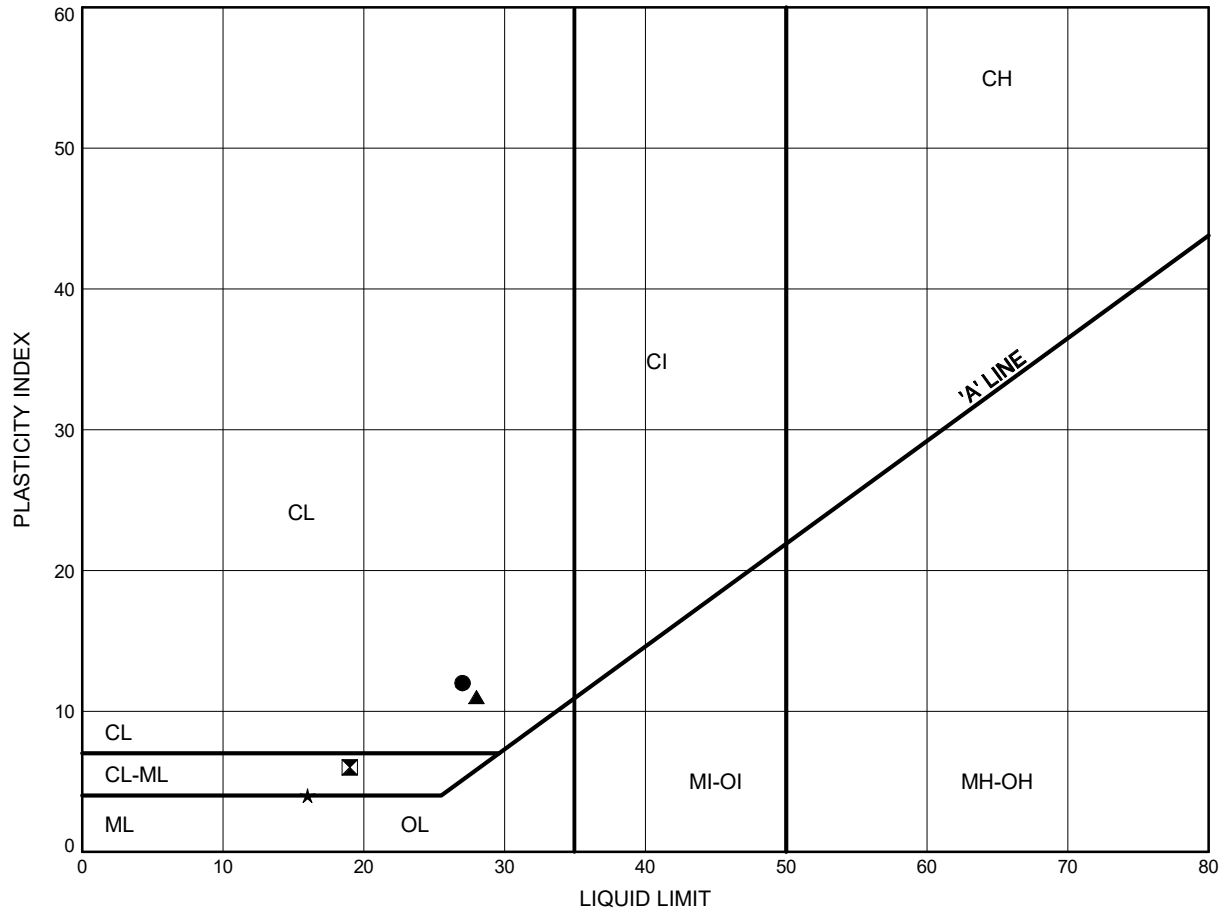
THURBALT 24726 CR6.GPJ 24/9/21

Highway 17 Twinning

ATTERBERG LIMITS TEST RESULTS

FIGURE C18

Clayey Silt (CL to CL-ML) to Clayey Silt (CL) with Sand to Silt (ML) with Clay to Sandy Clayey Silt (CL-ML)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-20	1.8	129.1
⊠	19-20	2.5	128.4
▲	19-21	1.8	128.5
★	19-30	3.4	134.3

Date September 2021

WP# 4068-09-00

THURBER

Prep'd DP

Chkd. FG

THURBALT 24726 CR6.GPJ 24/9/21

THURBER

Appendix C.2

Analytical Testing Results

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Certificate of Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Client PO:
Project: 24726
Custody: 40227

Report Date: 20-Sep-2019
Order Date: 16-Sep-2019

Order #: 1938128

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1938128-01	CR6 19-01, SS4 (7'6-9'6)
1938128-02	CR6 19-05, SS4 (7'6-9'6)
1938128-03	CR6 19-09, SS1 (0'4"-2'4")

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

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

Report Date: 20-Sep-2019
Order Date: 16-Sep-2019
Project Description: 24726

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	18-Sep-19	18-Sep-19
Conductivity	MOE E3138 - probe @25 °C, water ext	19-Sep-19	20-Sep-19
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	19-Sep-19	19-Sep-19
Resistivity	EPA 120.1 - probe, water extraction	19-Sep-19	20-Sep-19
Solids, %	Gravimetric, calculation	17-Sep-19	17-Sep-19

Certificate of Analysis

Client: Thurber Engineering Ltd.

Client PO:

Report Date: 20-Sep-2019

Order Date: 16-Sep-2019

Project Description: 24726

	Client ID:	CR6 19-01, SS4 (7'6-9'6)	CR6 19-05, SS4 (7'6-9'6)	CR6 19-09, SS1 (0'4"-2'4")	-
	Sample Date:	04-Sep-19 09:00	30-Aug-19 09:00	26-Aug-19 09:00	-
	Sample ID:	1938128-01	1938128-02	1938128-03	-
	MDL/Units	Soil	Soil	Soil	-
Physical Characteristics					
% Solids	0.1 % by Wt.	85.1	85.2	94.7	-
General Inorganics					
Conductivity	5 uS/cm	698	1030	1190	-
pH	0.05 pH Units	7.34	7.57	7.96	-
Resistivity	0.10 Ohm.m	14.3	9.73	8.42	-
Anions					
Chloride	5 ug/g dry	291	455	569	-
Sulphate	5 ug/g dry	65	109	26	-

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

Report Date: 20-Sep-2019
Order Date: 16-Sep-2019
Project Description: 24726

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
General Inorganics									
Conductivity	ND	5	uS/cm						
Resistivity	ND	0.10	Ohm.m						

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

Report Date: 20-Sep-2019
Order Date: 16-Sep-2019
Project Description: 24726

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	21.0	5	ug/g dry	21.5			2.6	20	
Sulphate	ND	5	ug/g dry	ND			0.0	20	
General Inorganics									
Conductivity	97.4	5	uS/cm	101			3.2	5	
pH	7.39	0.05	pH Units	7.50			1.5	2.3	
Physical Characteristics									
% Solids	90.4	0.1	% by Wt.	90.3			0.1	25	

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

Report Date: 20-Sep-2019
Order Date: 16-Sep-2019
Project Description: 24726

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	114	5	ug/g	21.5	92.9	82-118			
Sulphate	108	5	ug/g	ND	108	80-120			

Qualifier Notes:

Login Qualifiers :

Received at temperature > 25C

Applies to samples: CR6 19-01, SS4 (7'6-9'6), CR6 19-05, SS4 (7'6-9'6), CR6 19-09, SS1 (0'4''-2'4'')

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.

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Subcontracted Analysis

Thurber Engineering Ltd.
2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Tel: (613) 247-2121
Fax: (613) 247-2185

Paracel Report No	**1938128**
Client Project(s):	**24726**
Client PO:	
Reference:	**Standing Offer**
CoC Number:	**40227**

Order Date:	16-Sep-19
Report Date:	23-Sep-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
1938128-01	CR6 19-01, SS4 (7'6-9'6)	Sulphide, solid
1938128-02	CR6 19-05, SS4 (7'6-9'6)	Sulphide, solid
1938128-03	CR6 19-09, SS1 (0'4"-2'4")	Sulphide, solid

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

23-September-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. : 18 September 2019
LR Report: **CA13702-SEP19**
Reference: Project#: 1938128

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		20-Sep-19
2: Analysis Start Time		12:49
3: Analysis Completed Date		20-Sep-19
4: Analysis Completed Time		14:35
5: QC - Blank		< 0.02
6: QC - STD % Recovery		113%
7: QC - DUP % RPD		3%
8: RL		0.02
9: CR6 19-01, SS4 (7'6-9'6)	04-Sep-19	0.11
10: CR6 19-05, SS4 (7'6-9'6)	30-Aug-19	0.10
11: CR6 19-06, SS1 (0'4"-2'4")	26-Aug-19	0.05

RL - SGS Reporting Limit

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0001900502

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Certificate of Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Client PO:
Project: 24726
Custody:

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019

Order #: 1938293

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1938293-01	CV10, SS2 (2'6"-4'6")

Approved By:

Dale Robertson, BSc
Laboratory Director

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

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019
Project Description: 24726

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	23-Sep-19	23-Sep-19
Conductivity	MOE E3138 - probe @25 °C, water ext	24-Sep-19	24-Sep-19
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	19-Sep-19	19-Sep-19
Resistivity	EPA 120.1 - probe, water extraction	24-Sep-19	24-Sep-19
Solids, %	Gravimetric, calculation	18-Sep-19	18-Sep-19

Certificate of Analysis

Client: Thurber Engineering Ltd.

Client PO:

Report Date: 24-Sep-2019

Order Date: 18-Sep-2019

Project Description: 24726

	Client ID:	CV10, SS2 (2'6"-4'6")	-	-	-
	Sample Date:	05-Sep-19 09:00	-	-	-
	Sample ID:	1938293-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	90.3	-	-	-
General Inorganics					
Conductivity	5 uS/cm	581	-	-	-
pH	0.05 pH Units	7.81	-	-	-
Resistivity	0.10 Ohm.m	17.2	-	-	-
Anions					
Chloride	5 ug/g dry	87	-	-	-
Sulphate	5 ug/g dry	38	-	-	-

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

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019
Project Description: 24726

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
General Inorganics									
Conductivity	ND	5	uS/cm						
Resistivity	ND	0.10	Ohm.m						

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

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019
Project Description: 24726

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	275	5	ug/g dry	277			0.9	20	
Sulphate	34.2	5	ug/g dry	34.6			1.3	20	
General Inorganics									
pH	7.39	0.05	pH Units	7.50			1.5	2.3	
Resistivity	18.2	0.10	Ohm.m	17.2			5.6	20	
Physical Characteristics									
% Solids	77.6	0.1	% by Wt.	79.2			2.1	25	

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

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019
Project Description: 24726

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	372	5	ug/g	277	94.1	82-118			
Sulphate	142	5	ug/g	34.6	108	80-120			

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.

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Subcontracted Analysis

Thurber Engineering Ltd.
2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Tel: (613) 247-2121
Fax: (613) 247-2185

Paracel Report No **1938293**
Client Project(s): **24726**
Client PO:
Reference: **Standing Offer**
CoC Number:

Order Date: 18-Sep-19
Report Date: 23-Sep-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
1938293-01	CV10, SS2 (2'6"-4'6")	Sulphide, solid

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

23-September-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. : 19 September 2019
LR Report: **CA13706-SEP19**
Reference: Project#: 1938293

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		20-Sep-19
2: Analysis Start Time		12:49
3: Analysis Completed Date		20-Sep-19
4: Analysis Completed Time		14:35
5: QC - Blank		< 0.02
6: QC - STD % Recovery		113%
7: QC - DUP % RPD		3%
8: RL		0.02
9: CV10. SS2 (2'6"-4'6")	05-Sep-19	0.03

RL - SGS Reporting Limit

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0001900512

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Certificate of Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Client PO:
Project: 24726
Custody: 49914

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019

Order #: 1938296

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1938296-01	CV15, SS2 (2'6"-4'6")

Approved By:

Dale Robertson, BSc
Laboratory Director

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

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019
Project Description: 24726

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	23-Sep-19	24-Sep-19
Conductivity	MOE E3138 - probe @25 °C, water ext	24-Sep-19	24-Sep-19
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	19-Sep-19	19-Sep-19
Resistivity	EPA 120.1 - probe, water extraction	24-Sep-19	24-Sep-19
Solids, %	Gravimetric, calculation	18-Sep-19	18-Sep-19

Certificate of Analysis

Client: Thurber Engineering Ltd.

Client PO:

Report Date: 24-Sep-2019

Order Date: 18-Sep-2019

Project Description: 24726

	Client ID:	CV15, SS2 (2'6"-4'6")	-	-	-
	Sample Date:	27-Aug-19 09:00	-	-	-
	Sample ID:	1938296-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	95.3	-	-	-
General Inorganics					
Conductivity	5 uS/cm	201	-	-	-
pH	0.05 pH Units	8.21	-	-	-
Resistivity	0.10 Ohm.m	49.9	-	-	-
Anions					
Chloride	5 ug/g dry	60	-	-	-
Sulphate	5 ug/g dry	6	-	-	-

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

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019
Project Description: 24726

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
General Inorganics									
Conductivity	ND	5	uS/cm						
Resistivity	ND	0.10	Ohm.m						

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

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019
Project Description: 24726

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	275	5	ug/g dry	277			0.9	20	
Sulphate	34.2	5	ug/g dry	34.6			1.3	20	
General Inorganics									
pH	7.39	0.05	pH Units	7.50			1.5	2.3	
Resistivity	18.2	0.10	Ohm.m	17.2			5.6	20	
Physical Characteristics									
% Solids	77.6	0.1	% by Wt.	79.2			2.1	25	

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

Report Date: 24-Sep-2019
Order Date: 18-Sep-2019
Project Description: 24726

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	372	5	ug/g	277	94.1	82-118			
Sulphate	142	5	ug/g	34.6	108	80-120			

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.

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Subcontracted Analysis

Thurber Engineering Ltd.
2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Tel: (613) 247-2121
Fax: (613) 247-2185

Paracel Report No **1938296**
Client Project(s): **24726**
Client PO:
Reference: **Standing Offer**
CoC Number: **49914**

Order Date: 18-Sep-19
Report Date: 23-Sep-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
1938296-01	CV15, SS2 (2'6"-4'6")	Sulphide, solid

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

23-September-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. : 19 September 2019
LR Report: **CA13705-SEP19**
Reference: Project#: 1938296

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		20-Sep-19
2: Analysis Start Time		12:49
3: Analysis Completed Date		20-Sep-19
4: Analysis Completed Time		14:35
5: QC - Blank		< 0.02
6: QC - STD % Recovery		113%
7: QC - DUP % RPD		3%
8: RL		0.02
9: CV15, SS2 (2'6"-4'6")	27-Aug-19	< 0.02

RL - SGS Reporting Limit

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0001900508

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Appendix C.3

Rock Core Photos and UCS Results

Borehole CR6 19-01

Run 1 to 3 (of 3)

Elevation 130.2 m to 126.3 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-03

Run 1 to 3 (of 3)

Elevation 136.3 m to 132.6 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-04

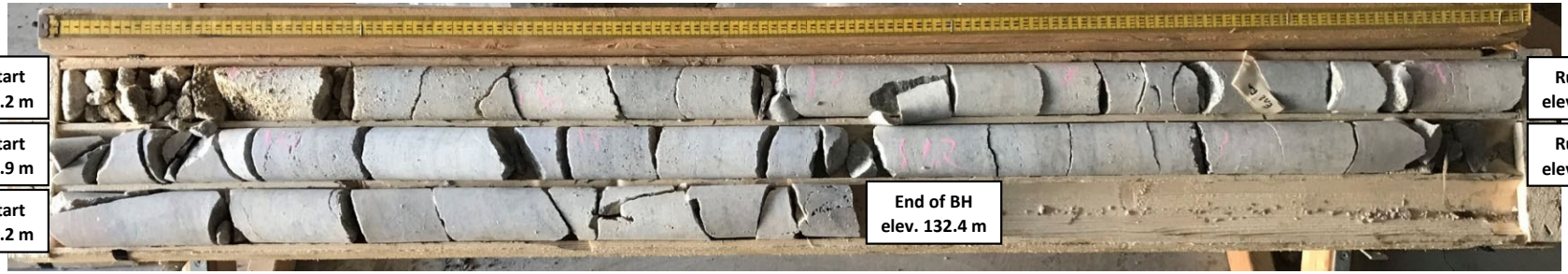
Run 1 to 3 (of 3)

Elevation 136.2 m to 132.4m

Run 1 Start elev. 136.2 m

Run 2 Start elev. 134.9 m

Run 3 Start elev. 133.2 m



End of BH elev. 132.4 m

Run 1 End elev. 134.9 m

Run 2 End elev. 133.2 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-05

Run 1 to 2 (of 2)

Elevation 133.8 m to 138.1 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-06

Run 1 to 3 (of 3)

Elevation 135.1 m to 131.6 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-07

Run 1 to 3 (of 3)

Elevation 134.2 m to 130.2 m

Run 1 Start elev. 134.2 m

Run 2 Start elev. 133.3 m

Run 3 Start elev. 131.7 m

Run 1 End elev. 133.3 m

Run 2 End elev. 131.7 m

End of BH elev. 130.2m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-08

Run 1 to 2 (of 2)

Elevation 136.6 m to 133.6 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-09

Run 1 to 3 (of 3)

Elevation 135.6 m to 131.1 m

Run 1 Start elev. 135.6 m

Run 2 Start elev. 134.1 m

Run 3 Start elev. 132.5 m

Run 1 End elev. 134.1 m

Run 2 End elev. 132.5 m

End of BH elev. 131.1m

THURBER ENGINEERING LTD.

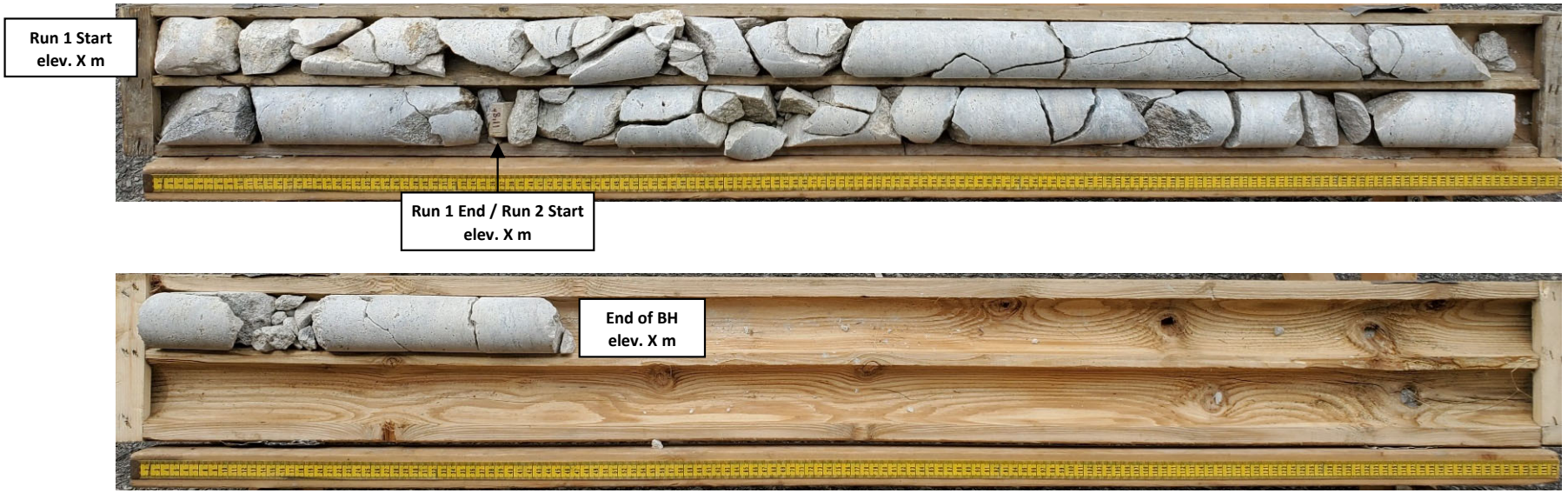
Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-10

Run 1 to 3 (of 3)

Elevation X m to X m



THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-12

Run 1 to 4 (of 4)

Elevation 135.8 m to 130.2 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-14

Run 1 to 3 (of 3)

Elevation 129.9 m to 126.0 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-15

Run 1 to 3 (of 3)

Elevation 130.9 m to 127.6 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-17

Run 1 to 3 (of 3)

Elevation 134.8 m to 130.7m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-19

Run 1 to 3 (of 3)

Elevation 131.0 m to 127.5 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-20

Run 1 to 2 (of 2)

Elevation 127.9 m to 124.8 m

Run 1 Start elev. 127.9 m

Run 2 Start elev. 126.3 m

Run 1 End elev. 126.3 m

End of BH elev. 124.8 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-21

Run 1 to 2 (of 2)

Elevation 125.9 m to 122.6 m

THURBER ENGINEERING LTD.

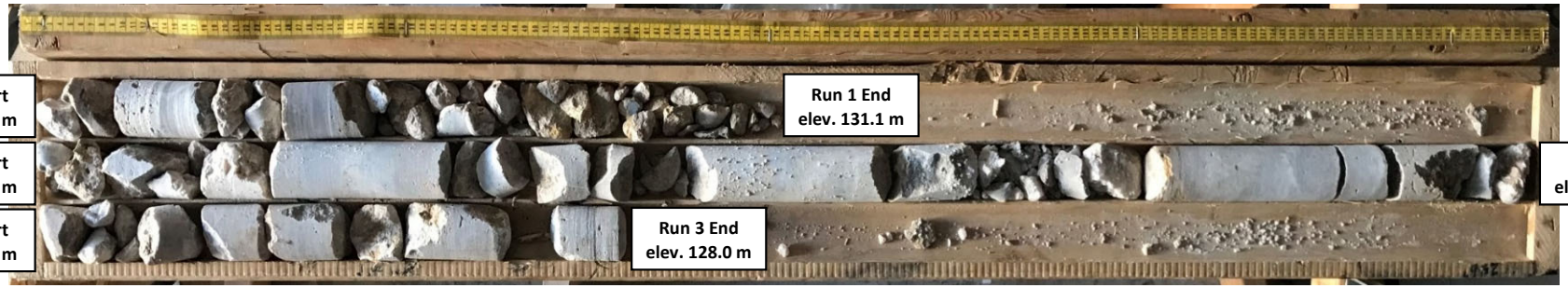
Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-22

Run 1 to 5 (of 5)

Elevation 131.7 m to 124.8 m



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Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-23

Run 1 to 3 (of 3)

Elevation 130.6 m to 127.0 m

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Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 19-28

Run 1 to 3 (of 3)

Elevation 135.4 m to 131.2 m

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Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 CV-10

Run 1 to 3 (of 3)

Elevation 135.5 m to 132.0 m

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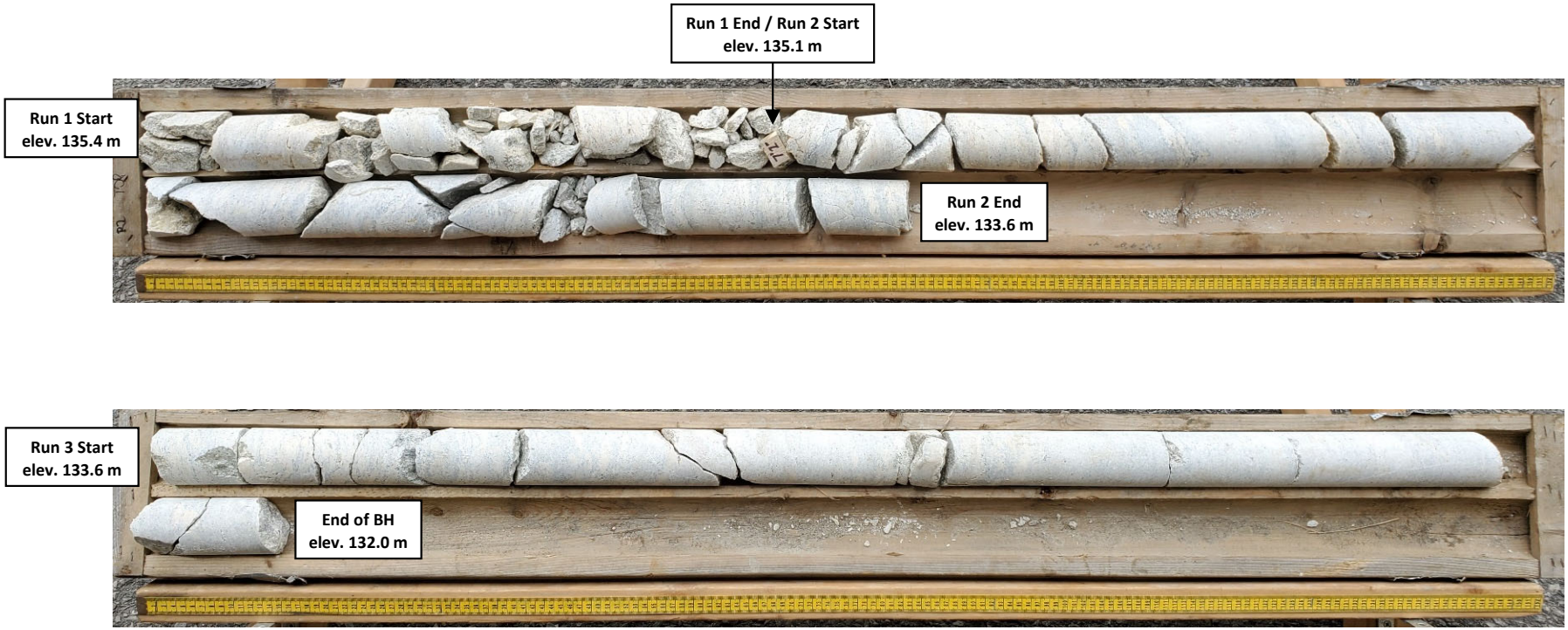
Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 CV-11

Run 1 to 3 (of 3)

Elevation 135.4 m to 132.0 m



THURBER ENGINEERING LTD.

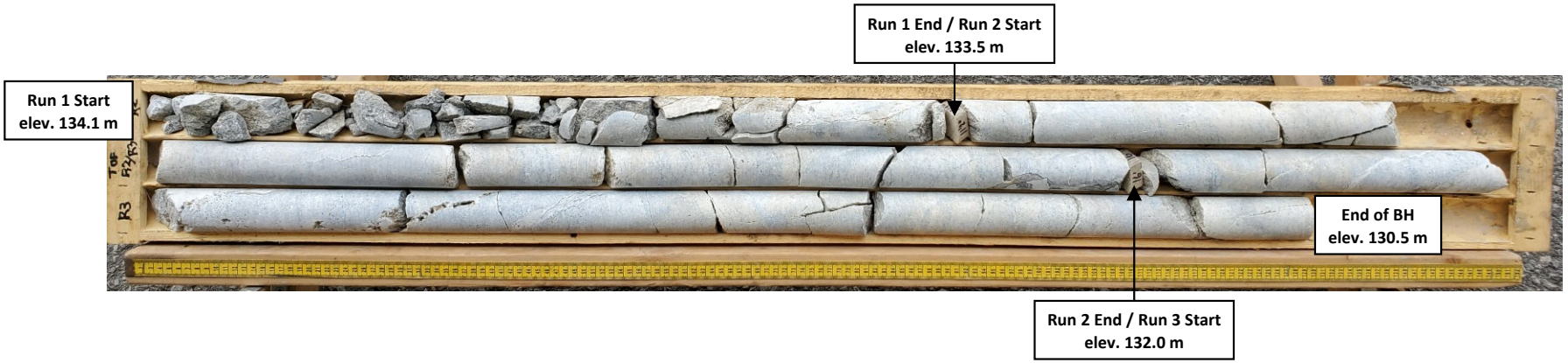
Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 CV-12

Run 1 to 3 (of 3)

Elevation 134.1 m to 130.5 m



THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 CV-13

Run 1 to 3 (of 3)

Elevation 137.5 m to 133.6 m

THURBER ENGINEERING LTD.

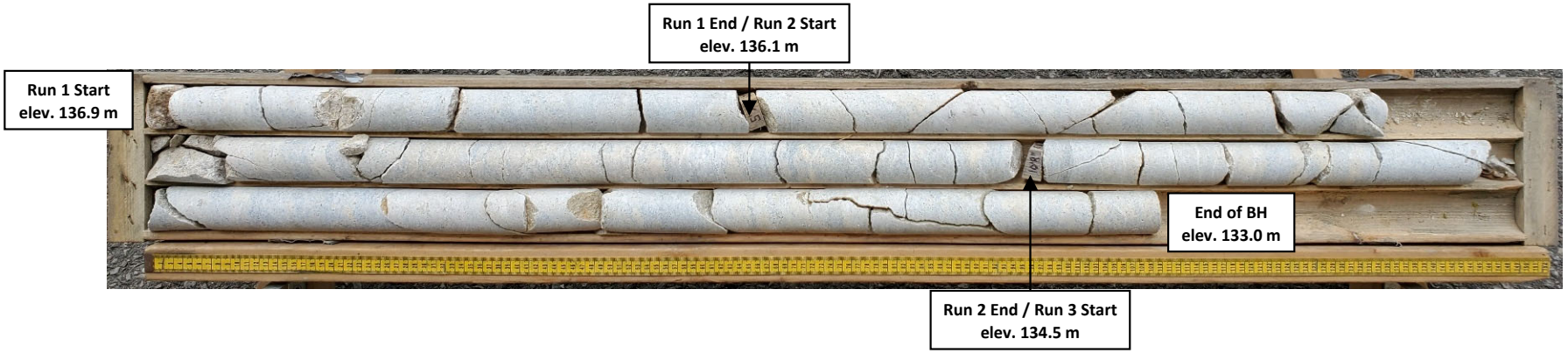
Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 CV-14

Run 1 to 3 (of 3)

Elevation 136.9 m to 133.0 m



THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole CR6 CV-15

Run 1 to 3 (of 3)

Elevation 135.3 m to 131.7 m

THURBER ENGINEERING LTD.

Foundation Investigation
County Road 6 Interchange
Renfrew County, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole 17-1

Box 1 (of 2)

Elevation 132.0 m to 129.6 m

THURBER ENGINEERING LTD.

Foundation Investigation
Site 29-242/C1 Deil's Creek Culvert
Highway 17
Renfrew County, Ontario

G.W.P. No.: 4076-13-00

Project No.: 20479

Borehole 17-1

Box 2 (of 2)

Elevation 129.6 m to 128.5 m

THURBER ENGINEERING LTD.

Foundation Investigation
Site 29-242/C1 Deil's Creek Culvert
Highway 17
Renfrew County, Ontario

G.W.P. No.: 4076-13-00

Project No.: 20479

Borehole 17-2

Box 1 (of 1)

Elevation 132.6 m to 129.5 m

THURBER ENGINEERING LTD.

Foundation Investigation
Site 29-242/C1 Deil's Creek Culvert
Highway 17
Renfrew County, Ontario

G.W.P. No.: 4076-13-00

Project No.: 20479

THURBER ENGINEERING LTD.

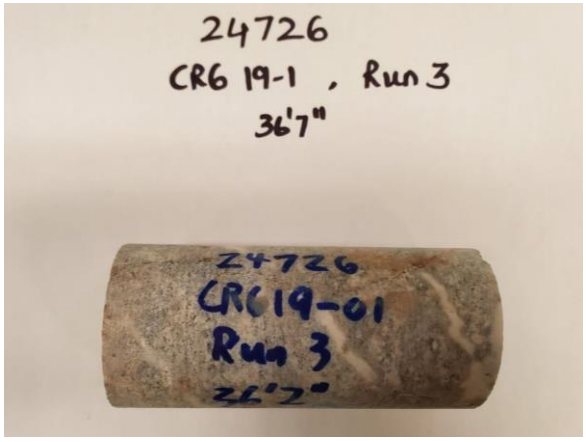
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

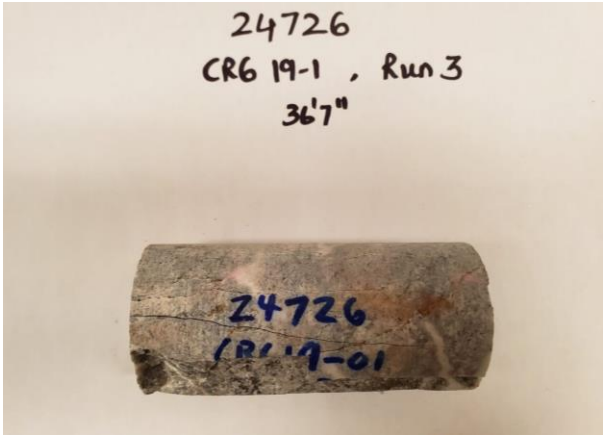
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	CR6 19-01	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 3		
SAMPLE DEPTH:	11.2m		
DESCRIPTION:	Marble		

Avg. Height (cm):	9.7	Weight (g):	484.9
Avg. Diameter (cm):	4.8	Wet Density (kg/m^3):	2,763
H. to Dia. Ratio**:	2:1	Dry Density (kg/m^3):	2,763
Cross Sectional Area (cm^2):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm^3):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5%	/ min
MAXIMUM COMPRESSIVE LOAD:	116.5	kN
UNCONFINED COMPRESSIVE STRENGTH:	64.4	MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

THURBER ENGINEERING LTD.

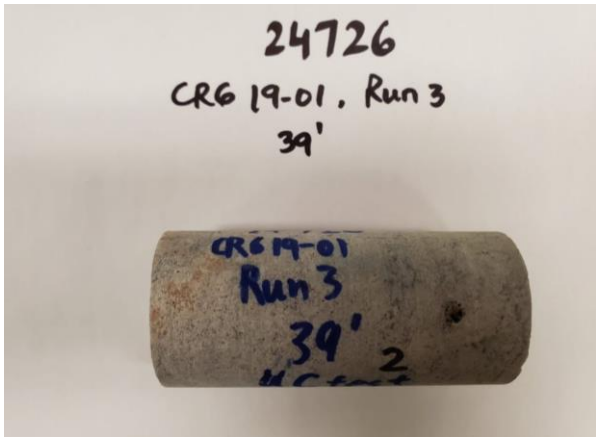
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

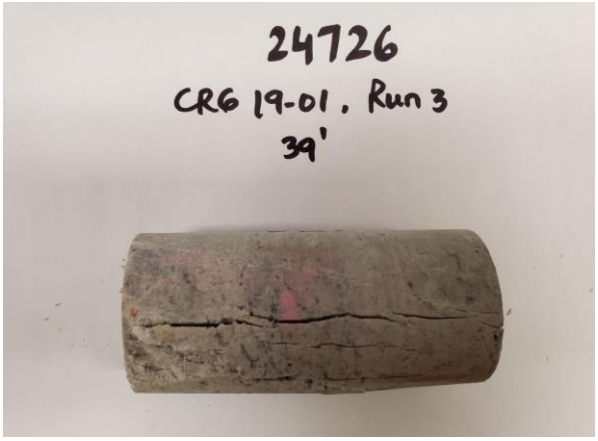
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	CR6 19-01	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 3		
SAMPLE DEPTH:	11.9m		
DESCRIPTION:	Marble		

Avg. Height (cm):	9.8	Weight (g):	474.9
Avg. Diameter (cm):	4.8	Wet Density (kg/m^3):	2,678
H. to Dia. Ratio**:	2:1	Dry Density (kg/m^3):	2,678
Cross Sectional Area (cm^2):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm^3):	177.34		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5%	/ min
MAXIMUM COMPRESSIVE LOAD:	146.8	kN
UNCONFINED COMPRESSIVE STRENGTH:	81.1	MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

THURBER ENGINEERING LTD.

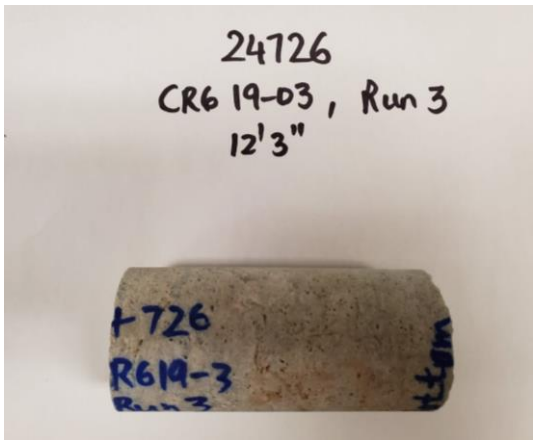
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

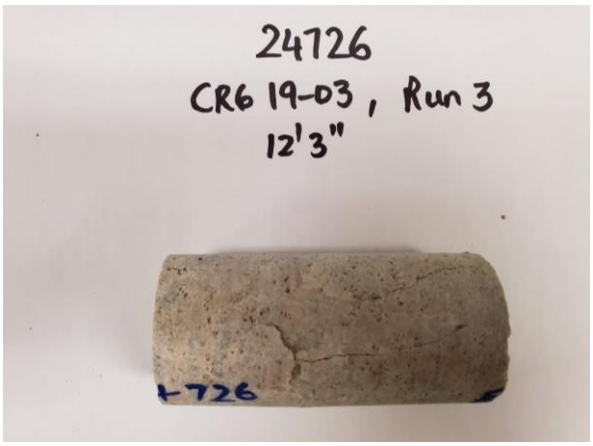
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	CR6 19-03	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 3		
SAMPLE DEPTH:	3.7m		
DESCRIPTION:	Marble		

Avg. Height (cm):	9.7	Weight (g):	461.1
Avg. Diameter (cm):	4.8	Wet Density (kg/m^3):	2,627
H. to Dia. Ratio**:	2:1	Dry Density (kg/m^3):	2,627
Cross Sectional Area (cm^2):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm^3):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5%	/ min
MAXIMUM COMPRESSIVE LOAD:	62.4	kN
UNCONFINED COMPRESSIVE STRENGTH:	34.5	MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

THURBER ENGINEERING LTD.

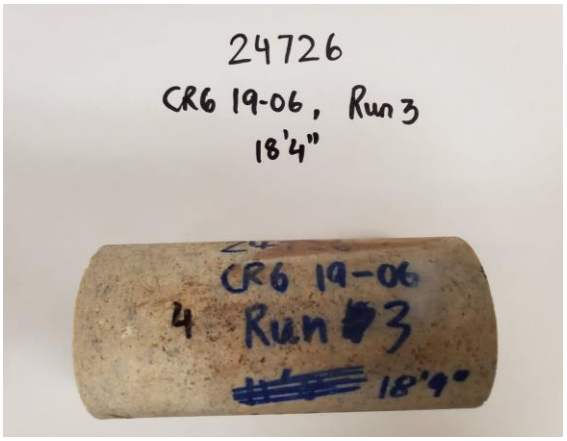
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

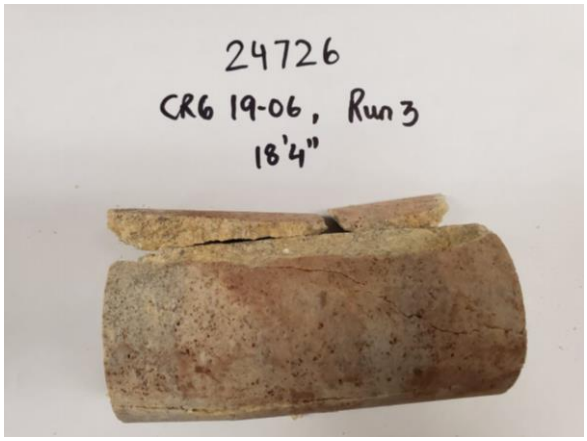
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	CR6 19-06	TEST DATE:	12-Dec-19
SAMPLE No.:	HQ RUN 3		
SAMPLE DEPTH:	5.6m		
DESCRIPTION:	Marble		

Avg. Height (cm):	12.6	Weight (g):	1057.6
Avg. Diameter (cm):	6.3	Wet Density (kg/m^3):	2,693
H. to Dia. Ratio**:	2:1	Dry Density (kg/m^3):	2,693
Cross Sectional Area (cm^2):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm^3):	392.77		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2%	/ min
MAXIMUM COMPRESSIVE LOAD:	131.5	kN
UNCONFINED COMPRESSIVE STRENGTH:	42.2	MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

THURBER ENGINEERING LTD.

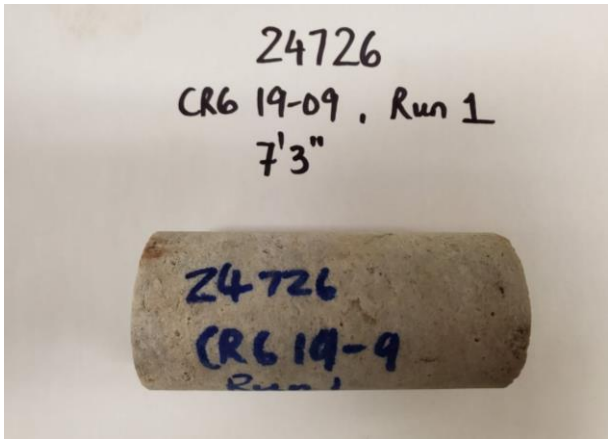
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

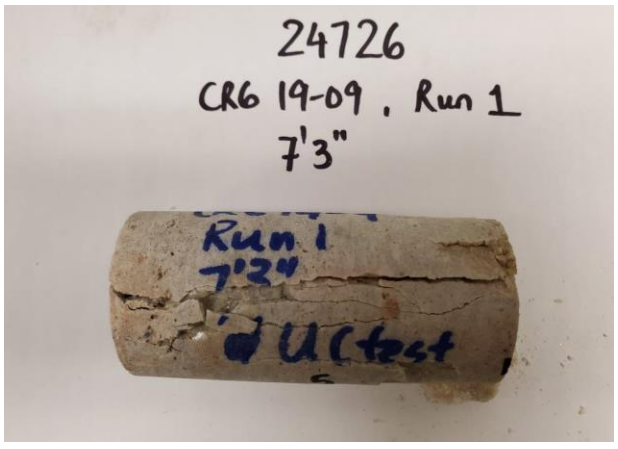
CLIENT:	Thurber Engineering (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	CR6 19-09	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 1		
SAMPLE DEPTH:	2.2m		
DESCRIPTION:	Marble		

Avg. Height (cm):	9.8	Weight (g):	481.7
Avg. Diameter (cm):	4.7	Wet Density (kg/m^3):	2,833
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m^3):	2,833
Cross Sectional Area (cm^2):	17.35	Moisture Content* (%):	N/A
Sample Volume (cm^3):	170.02		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5%	/ min
MAXIMUM COMPRESSIVE LOAD:	107.9	kN
UNCONFINED COMPRESSIVE STRENGTH:	62.2	MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

THURBER

Appendix D.

Site Photographs

Photo 1. Highway 17 Country Road 6 at-grade crossing looking west (2020/04/22)
Elevated asphalt bull-nose under light pole to south.

Photo 2. County Road 6 looking south (2020/04/22)
Elevated asphalt bull-nose under light pole to south.

Photo 3. Culvert crossing County Road 6 north of Highway 17 looking west (2020/04/22)
Looking at culvert inlets.

Photo 4. Culvert crossing County Road 6 north of Highway 17 looking east towards box culvert crossing Highway 17 (2020/04/22)
Looking at box culvert outlet and twin CSP inlet.

Photo 5. Looking north along County Road 6 (2020/04/22)
Inlet of twin CSPs evident to east. Bedrock outcrops visible to north.