



**THURBER** ENGINEERING LTD.

**PRELIMINARY  
FOUNDATION INVESTIGATION AND DESIGN REPORT  
HIGHWAY 17 TWINNING, RENFREW AREA  
DEEP CUTS IN SOILS, VARIOUS SITES  
WP 4068-09-00 / ASSIGNMENT NO. 4018-E-0009**

Geocres No.: 31F-232

Report to:

**Ministry of Transportation Ontario**

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## TABLE OF CONTENTS

### PART 1. FACTUAL INFORMATION

1	INTRODUCTION .....	1
2	SITE DESCRIPTION .....	1
2.1	General .....	1
2.2	Site Geology .....	2
3	SITE INVESTIGATION AND FIELD TESTING.....	3
4	LABORATORY TESTING.....	5
5	GENERAL DESCRIPTION OF SUBSURFACE CONDITIONS.....	5
5.1	Deep Cut B: Horton Sta. 18+650 to Sta. 19+025 EBL.....	6
5.1.1	Topsoil.....	6
5.1.2	Silty Sand (SM) to Sand (SW-SM) with Silt and Gravel .....	6
5.1.3	Clay (Cl) .....	6
5.1.4	Sand (SW-SM) to Silty Sand (SM) .....	7
5.1.5	Bedrock .....	8
5.1.6	Groundwater.....	10
5.2	Deep Cut K: McNab-Braeside Sta. 11+900 to Sta. 11+970 WBL.....	10
5.2.1	Topsoil.....	10
5.2.2	Silty Sand (SM) Till.....	11
5.2.3	Bedrock .....	11
5.2.4	Groundwater.....	12
5.3	Deep Cut L: McNab-Braeside Sta. 12+180 to Sta. 12+340 WBL .....	12
5.3.1	Topsoil.....	12
5.3.2	Sand (SW-SM to SP-SM) with Silt .....	12
5.3.3	Sand (SP-SM) with Silt and Gravel Till.....	13
5.3.4	Bedrock .....	13
5.3.5	Groundwater.....	15
5.4	Deep Cut M: McNab-Braeside Sta. 12+500 to Sta. 12+720 WBL .....	15



5.4.1	Topsoil.....	16
5.4.2	Silty Sand (SM) to Sand (SP-SM) with Silt and Gravel .....	16
5.4.3	Bedrock .....	16
5.4.4	Groundwater.....	18
5.5	Deep Cut N-DC: McNab-Braeside Sta. 12+900 to Sta. 13+020 WBL .....	19
5.5.1	Topsoil.....	19
5.5.2	Silty Sand (SM) to Sand (SP-SM) with Silt.....	19
5.5.3	Bedrock .....	20
5.5.4	Groundwater.....	22
6	MISCELLANEOUS .....	23
<b>PART 2. ENGINEERING DISCUSSION AND RECOMMENDATIONS</b>		
7	INTRODUCTION .....	24
7.1	Proposed Work .....	25
7.2	Applicable Codes and Design Considerations.....	26
8	SEISMIC CONSIDERATIONS.....	26
8.1	Spectral and Peak Acceleration Hazard Values .....	26
8.2	CHBDC Seismic Site Classification .....	27
8.3	Seismic Liquefaction Potential .....	27
9	DESIGN RECOMMENDATIONS.....	27
9.1	Rock Cuts .....	27
9.2	Earth Cuts.....	28
9.2.1	Cut Slope Stability .....	28
9.2.2	Erosion .....	29
9.2.3	Drainage.....	30
9.2.4	Material Re-Use .....	30
9.3	Transitional Areas.....	30
10	CONSTRUCTION CONCERNS .....	30
11	CLOSURE .....	32
	REFERENCES .....	33



## **APPENDICES**

- Appendix A. Borehole Location Plan and Stratigraphic Drawings
- Appendix B. Record of Borehole Sheets
- Appendix C. Laboratory Testing
- Appendix D. Site Photographs
- Appendix E. GSC Seismic Hazard Calculation
- Appendix F. Slope Stability Analysis Figures
- Appendix G. List of Referenced Specifications



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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.

This report addresses various deep cut areas along the proposed Highway 17 alignment. Part 1 of the report presents the factual findings obtained from foundation investigations completed within the proposed deep cut sections. Information from the pavement investigation has also been incorporated into this report to supplement the factual data. Thurber carried out the investigation under Ministry of Transportation (MTO) Assignment No. 4018 E 0009.

The purpose of this investigation was to explore the subsurface conditions at each site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions influencing design and construction of the deep cut areas was developed in the course of the investigation. No previous foundation information was available for these sites in the Geocres Library.

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**

Throughout this report, Highway 17 is described as oriented east-west. The posted speed limit within the project limits is 90 km/hr.

Deep cut locations were defined where the existing ground surface elevation at new centreline is 4.5 m or more higher than proposed profile elevation, as shown in in the 2004 Preliminary Design



Report for this project. Five different deep cut sections were identified and have been labelled B, K, L, M and N. A summary of the deep cut locations is presented in Table 2-1.

**Table 2-1: Deep Cut Location Summary**

Geographic Township	Location	Site	Approximate Stations (m)	Approximate Length (m)
Horton	EBL	B	18+650 to 19+025	375
McNab-Braeside	WBL	K	11+900 to 11+970	70
	WBL	L	12+180 to 12+340	160
	WBL	M	12+500 to 12+720	220
	WBL	N	12+900 to 13+020	120

Site B is located approximately 300 m east of the junction of Highway 17 and Bruce Street (Highway 20). In this section, Highway 17 is a two-lane, undivided highway with gravel shoulders. The Bruce Street eastbound on-ramp to Highway 17 is present at the west limit of this section. Traffic volumes on this section of Highway 17 are understood to have been 12,300 AADT (2016). The new eastbound alignment of Highway 17 in this section will be to the southwest of the existing highway (which will become the new westbound lanes). The land along the new alignment transitions from flat agricultural land at the northwest to vegetated land with coniferous and deciduous trees at the southwest. A bedrock outcrop is noted along the existing Highway 17 alignment from approximate Sta. 18+900 to 19+020.

Sites K, L, M and N are located approximately 240 m, 580 m, 980 m and 1,300 m east of the junction of Highway 17 and Goshen Road, respectively. In this section, Highway 17 is an undivided highway with gravel shoulders and metal guide rails on both sides of the road. At Site K, there is one westbound lane and two eastbound lanes. At Sites L and M, there are two lanes in both directions. At site N, there is one eastbound lane and two westbound lanes. Traffic volumes on this section of Highway 17 are understood to have been 13,900 AADT (2016). New westbound lanes are proposed to the north of the existing highway (which will become the eastbound lanes). The land along the new alignment is heavily vegetated with coniferous and deciduous trees. Various bedrock outcrops are noted along the existing Highway 17 alignment from approximate Sta. 11+900 to 13+100.

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

According to Crins et al. 2009<sup>i</sup> the project area is described as Ecoregion 6E (Lake Simcoe - Rideau) within the Ontario Shield Ecozone. According to Wester et al. 2018<sup>ii</sup> the ecoregion is subdivided into Ecodistrict 6E-16 (Pembroke). The Pembroke Ecodistrict is dominated by fine-textured glaciolacustrine deposits underlain by a mix of Precambrian and aleozoic bedrock. Prominent rock ridges and escarpments interrupt the gently rolling landscape.



The Ontario Geological Survey Map P.3784 for the Horton Area was referenced for Precambrian Geology at all of the sites. At Site B, geological mapping suggests the bedrock is comprised of calcitic carbonate metasedimentary bedrock including calcitic marble. At sites K, L, M and N the bedrock varied between:

- tholeiitic mafic to felsic metavolcanic rocks;
- felsic intrusive rocks ranging from Monzogranite to syenogranite to granodioritic gneiss;
- tholeiitic mafic rocks with N-MORB to Back-Arc; and
- syntectonic felsic intrusive rocks.

### 3 SITE INVESTIGATION AND FIELD TESTING

The foundation site investigation and field-testing program was carried out between November 2<sup>nd</sup>, 2020 and November 27<sup>th</sup>, 2020. The field investigation consisted of advancing 19 boreholes identified as Boreholes B-DC-1 through N-DC-3. 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 of the boreholes are shown on the Borehole Location and Soil Strata Drawings No. 1 through 11 in Appendix A, the individual Record of Borehole sheets in Appendix B, and in Table 3-1 to Table 3-5 below. The site is located within MTM Zone 9.

**Table 3-1: Borehole Summary; Deep Cut B Horton Sta. 18+650 to Sta. 19+025 EBL**

Borehole No.	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
B-DC-1	5 039 572.7 (45.495947)	291 490.1 (-76.670300)	154.2	11.3
B-DC-2	5 039 505.1 (45.495342)	291 518.7 (-76.669932)	153.7	12.8
B-DC-3	5 039 433.2 (45.494696)	291 542.9 (-76.669620)	153.9	3.7
B-DC-4	5 039 379.9 (45.494216)	291 551.8 (-76.669505)	159.1	17.2
B-DC-5	5 039 305.9 (45.493551)	291 587.6 (-76.669045)	150.6	6.0

**Table 3-2: Borehole Summary; Deep Cut K McNab-Braeside Sta. 11+900 to Sta. 11+970 WBL**

Borehole No.	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
K-DC-1	5 034 043.7 (45.446295)	298 404.4 (-76.581760)	181.5	7.5



Borehole No.	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
K-DC-2	5 034 046.1 (45.446317)	298 446.3 (-76.581224)	181.7	8.9

**Table 3-3: Borehole Summary; Deep Cut L McNab-Braeside Sta. 12+180 to Sta. 12+340 WBL**

Borehole No.	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
L-DC-1	5 034 064.4 (45.446484)	298 664.9 (-76.578430)	183.8	0.2
L-DC-2	5 034 067.0 (45.446508)	298 713.6 (-76.577807)	189.4	15.4
L-DC-3	5 034 071.8 (45.446551)	298 764.0 (-76.577163)	190.1	1.0
L-DC-4	5 034 079.2 (45.446618)	298 832.8 (-76.576283)	182.3	4.5

**Table 3-4: Borehole Summary; Deep Cut M McNab-Braeside Sta. 12+500 to Sta. 12+720 WBL**

Borehole No.	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
M-DC-1	5 034 090.6 (45.446722)	298 988.0 (-76.574299)	182.8	0.5
M-DC-2	5 034 094.1 (45.446754)	299 036.8 (-76.573676)	181.2	1.7
M-DC-3	5 034 100.4 (45.446811)	299 084.6 (-76.573065)	181.4	1.0
M-DC-4	5 034 099.2 (45.446801)	299 139.2 (-76.572367)	181.1	9.7
M-DC-5	5 034 106.8 (45.446870)	299 203.6 (-76.571543)	178.7	0.0

**Table 3-5: Borehole Summary; Deep Cut N McNab-Braeside Sta. 12+900 to Sta. 13+020 WBL**

Borehole No.	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
N-DC-1	5 034 128.4 (45.447066)	299 393.1 (-76.569121)	172.7	0.4
N-DC-2	5 034 129.4 (45.447075)	299 452.2 (-76.568366)	172.1	9.6
N-DC-3	5 034 129.2 (45.447074)	299 508.0 (-76.567652)	169.4	0.3



The investigations were carried out using a track-mounted CME 850 drill rig equipped with hollow-stem augers and rotary diamond drilling equipment.

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

Monitoring wells, 50 mm in diameter, were installed in Boreholes B-DC-2, B-DC-4, K-DC-2, L-DC-2, M-DC-4 and N-DC-2. A 25 mm piezometer was installed in Borehole B-DC-5. The piezometers and monitoring wells will be decommissioned by Thurber, as outlined in the Hydrogeological Investigation and Design Report.

The foundation 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 a member of Thurber's geotechnical staff. The drilling supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's Ottawa geotechnical laboratory for further examination and testing.

It is noted that pavement investigations were also completed throughout these locations; the results are compiled in the Pavement Design Report for this project. The observations concerning bedrock elevation from the pavement test pits have been incorporated into the results below.

#### **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 grain size distribution analysis and Atterberg limits tests, where appropriate. The testing was carried out to MTO and ASTM standards. Unconfined compressive strength (UCS) testing was carried out on select samples of bedrock core.

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 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 observations concerning bedrock elevation from the pavement test pits have been incorporated into the descriptions below and on the stratigraphic plots. The



locations of the relevant test pits are indicated on the Borehole location plans. Relevant pavement test holes are included in Appendix B.

### 5.1 Deep Cut B: Horton Sta. 18+650 to Sta. 19+025 EBL

In general terms, the site stratigraphy was found to consist of silty sand to sand overlying native clay deposit over silty sand, which is underlain by marble bedrock.

#### 5.1.1 Topsoil

Topsoil was encountered at the surface in all boreholes. The thickness ranged from 100 mm to 280 mm. The moisture content ranged from 22% to 26%. 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.

#### 5.1.2 Silty Sand (SM) to Sand (SW-SM) with Silt and Gravel

A layer of silty sand to sand was encountered in all boreholes below the topsoil. Trace to some organics was noted in this layer. The silty sand layer ranged in thickness from 0.6 to 1.3 m with base depths ranging from 0.8 m to 1.5 m (base elevation 158.1 m to 149.1 m). The SPT-N values in this layer ranged from 4 to 17 indicating a loose to compact relative density. An SPT-N value of 100 blows per 275 mm penetration was recorded in B-DC-4 and may have been influenced by a probable boulder at 0.3 m depth. An SPT value of 100 blows per 300 mm was recorded above the bedrock in Borehole B-DC-4.

The moisture content of the silty sand samples tested ranged from 4 to 24%. The results of three grain size analysis tests conducted on samples of this material are summarized below and are illustrated on Figures C1 in Appendix C.

#### Summary of Grain Size Distribution Testing – Silty Sand to Sand

Soil Particle	Percentage (%)
Gravel	0 – 41
Sand	47 – 77
Silt & Clay	12 – 30

#### 5.1.3 Clay (CI)

A layer of clay was encountered below the silty sand in boreholes B-DC-1 to B-DC-3. Where fully penetrated in Borehole B-DC-3, the clay was 1.4 m thick and had a base depth of 2.4 m (base elevation 151.5 m). Boreholes B-DC-1 and B-DC-2 were terminated in the clay layer at base depths of 11.3 m and 12.8 m, respectively (base elevations 142.9 m to 140.9 m, respectively). A weathered crust was identified in this layer that ranged in thickness from 1.4 m to 5.4 m with base depths ranging from 2.4 m to 6.2 m (base elevation 151.5 m to 147.6 m).



The SPT-N values in the clay ranged from 3 to 15 indicating a stiff to very stiff consistency.

The moisture content of the clay samples tested ranged from 20 to 46%. The results of five grain size analysis tests conducted on samples of this material are summarized below and are illustrated on Figure C2 in Appendix C.

**Summary of Grain Size Distribution Testing – Clay**

Soil Particle	Percentage (%)
Gravel	0
Sand	0 – 2
Silt	43 – 53
Clay	45 – 56

The results of Atterberg Limits testing carried out on five samples of the clay are summarized below and are illustrated on Figure C3 in Appendix C. The laboratory results indicate an intermediate plasticity (CI).

**Summary of Atterberg Limit Testing – Clay**

Parameter	Value
Liquid Limit	38 – 46
Plastic Limit	20 – 23
Plasticity Index	16 – 25

**5.1.4 Sand (SW-SM) to Silty Sand (SM)**

A layer of sand with silt to silty sand was encountered below the clay layer in borehole B-DC-3 and below the silty sand layer in Borehole B-DC-5. The layer was observed to range in thickness from 1.3 m to 4.5 m with a base elevation of 150.2 to 144.6 m.

The SPT-N values in this sandy layer ranged from 16 to 52 indicating a compact to dense material.

The moisture content of the samples tested ranged from 2 to 9%. The results of two grain size analysis tests conducted on samples of this material are summarized below and are illustrated on Figure C4 in Appendix C.

**Summary of Grain Size Distribution Testing – Silty Sand**

Soil Particle	Percentage (%)
Gravel	0 – 4
Sand	76 – 88
Silt & Clay	12 – 20

### 5.1.5 Bedrock

Bedrock or inferred bedrock was encountered in Boreholes B-DC-3, B-DC-4 and, B-DC-5; bedrock was cored in B-DC-4 and inferred from spoon refusal in Boreholes B-DC-3 and B-DC-5. The depth to bedrock ranged from 1.0 m to 6.0 m (Elev. 158.1 m to 144.6 m). The bedrock encountered consisted of moderately weathered to freshly jointed, medium grained, marble that is predominantly white and grey in colour. Bedrock logs are provided in Appendix B. In general, the discontinuities were rough cross joints ranging from planar to undulating. Photographs of the bedrock cores are provided in Appendix C. The rock core quality and strength are summarized in Table 5-1.

**Table 5-1: Deep Cut B; Summary of Bedrock Core Quality and Strength**

Parameter	Range	Average
Total Core Recovery (TCR), %	98 – 100	99
Solid Core Recovery (SCR), %	71 – 100	91
Rock Quality Designation (RQD), %	63 – 100	87
Fracture Index (fractures per 0.3m)	0 – >10	2
Unconfined Compressive Strength (UCS) <sup>(1)</sup> , MPa	30 – 98	67

Notes: <sup>(1)</sup> 11 samples tested from Borehole B-DC-4

Based on the RQD values, the bedrock is classified as fair to excellent quality. The results of unconfined compressive strength testing indicate the bedrock is medium strong to strong.

The depth to bedrock within this cut section was further explored as part of the pavement investigation (report provided under a separate cover). A summary of the inferred and cored bedrock depth/elevations from the current investigation supplemented with the pavement investigation is presented in Table 5-2. Pavement logs are provided in Appendix B.

**Table 5-2: Deep Cut B; Summary of Bedrock Depth/Elevation**

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-68C	18+800	15 RT CL	5039476.1	291510.8	153.3	7.2	146.1	TP
17B-69C	18+820	14.7 RT CL	5039456.7	291518.2	154.3	7.5	146.8	TP
17B-70B	18+840	1.6 LT CL	5039443.4	291540.4	153.4	4.9	148.5	TP
17B-70C	18+841	14.2 RT CL	5039437.8	291525.6	155.3	3.3	152.0	TP
B-DC-3	18+851	0.4 LT CL	5039433.2	291542.9	153.9	3.7	150.2	BH
17B-71C	18+860	13.7 RT CL	5039419.6	291532.8	156.2	0.7	155.5	TP



ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-72A	18+884	16 LT CL	5039407.1	291569.0	148.6	0	148.6	DOB
17B-72B	18+881	CL	5039404.5	291551.3	155.2	2.3	152.9	TP
17B-72C	18+880	16.7 RT CL	5039399.7	291536.9	158.4	1.1	157.3	TP
17B-73A	18+902	15.1 LT CL	5039389.7	291574.4	150.0	0	150	DOB
17B-73B	18+905	CL	5039381.4	291560.2	156.5	0.15	156.4	TP
B-DC-4	18+904	9.5 RT CL	5039379.9	291551.8	159.1	1.0	158.1	CB
17B-73C	18+904	15.8 RT CL	5039377.9	291545.8	159.9	0.5	159.4	TP
17B-74A	18+921	14.9 LT CL	5039371.8	291580.7	150.4	0	150.4	DOB
17B-74B	18+920	CL	5039367.5	291565.8	157.8	0	157.8	DOB
17B-74C	18+922	13.5 RT CL	5039361.6	291554.2	161.1	0	161.1	DOB
17B-75A	18+941	16.8 LT CL	5039353.9	291589.2	147.6	2	145.6	TP
17B-75B	18+941	2.4 RT CL	5039347.7	291571.0	155.5	2.7	152.8	TP
17B-75C	18+939	19.3 RT CL	5039343.3	291554.7	158.0	0	158	DOB
17B-76A	18+961	15.8 LT CL	5039335.2	291595.0	147.1	3.4	143.7	TP
17B-76B	18+961	CL	5039329.4	291579.3	153.7	5	148.7	TP
17B-76C	18+961	17 RT CL	5039324.2	291564.1	154.2	7.3	146.9	TP
17B-77A	18+981	15.7 LT CL	5039316.3	291601.8	146.5	1.7	144.8	TP
17B-77B	18+982	CL	5039308.9	291586.2	150.7	5.1	145.6	TP
17B-77C	18+977	16 RT CL	5039309.2	291570.6	152.2	5.9	146.3	TP
B-DC-5	18+986	1.2 RT CL	5039305.9	291587.6	150.6	6.0	144.6	BH
17B-78A	19+001	13 LT CL	5039296.5	291606.1	147.4	1.9	145.5	TP
17B-78C	19+000	13.3 RT CL	5039288.5	291581.0	149.7	1.0	148.7	TP
17B-78(2)B	19+021	CL	5039272.8	291600.5	144.1	2.1	142.0	TP
17B-78(2)A	19+024	12.1 LT CL	5039274.6	291613.1	143.3	0.8	142.5	TP
17B-78(2)C	19+019	12.6 RT CL	5039270.5	291588.3	142.5	0	142.5	DOB

Notes: <sup>(1)</sup> TP=Test Pit; PH=Pavement Hole; HD=Hydraulic Drill; DOB=Documentation of Bedrock; BH=Borehole (Bedrock Inferred); CB=Borehole (Cored Bedrock)



### 5.1.6 Groundwater

Groundwater levels recorded in the piezometer and monitoring wells installed at this site are presented in Table 5-3 below. The installation details are illustrated on the respective Record of Borehole sheet provided in Appendix B.

**Table 5-3: Deep Cut B; Summary of Groundwater Levels**

Borehole No. [Diameter]	Bottom of Screen Elevation (m)	Screened Material	Groundwater Depth (m)	Groundwater Elevation (m)	Date of Measurement
B-DC-2 [50 mm]	141.7	Clay	4.9	148.8	Dec 15, 2020
			5.7	148.0	Aug 04, 2021
			6.3	147.4	Sep 30, 2021
B-DC-4 [50 mm]	141.9	Bedrock	9.3	149.8	Dec 15, 2020
			10.9	148.2	Aug 04, 2021
			12.0	147.2	Sep 30, 2021
			6.3	152.8	Oct 20, 2021
B-DC-5 [25 mm]	145.0	Silty Sand	Dry	-	Dec 15, 2020
			5.6	145.0	Aug 04, 2021
			5.6	145.0	July 15, 2022

An unstabilized groundwater elevation of 145.1 m was observed in Borehole B-DC-1 upon completion of drilling. Borehole B-DC-3 was dry to elevation 150.2 m at completion of drilling.

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

### 5.2 Deep Cut K: McNab-Braeside Sta. 11+900 to Sta. 11+970 WBL

In general terms, the site stratigraphy was found to consist of silty sand till overlying inferred bedrock.

#### 5.2.1 Topsoil

A topsoil layer was encountered at the surface of Boreholes K-DC-1 and K-DC-2. The layer thickness ranged from 225 mm to 280 mm. One moisture content of 20% was measured in the topsoil. 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.



### 5.2.2 Silty Sand (SM) Till

A silty sand till layer was encountered in boreholes K-DC-1 and K-DC-2 below the topsoil. The silty sand till layer ranged in thickness from 7.3 m to 8.6 m with base depths ranging from 7.5 m to 8.9 m (base elevation 174.0 m to 172.8 m). The SPT-N values in the silty sand ranged from 5 to 100 blows per 100 mm penetration indicating a loose to very dense relative density. Two reported SPT-N values of 100 blows per 75 mm penetration and 100 blows per 25 mm penetration were likely influenced by the presence of bedrock.

The moisture content of the silty sand till samples tested ranged from 8% to 18%. The results of four grain size analysis tests conducted on samples of this material are summarized below and are illustrated on Figure C5 in Appendix C.

**Summary of Grain Size Distribution Testing – Silty Sand Till**

Soil Particle	Percentage (%)
Gravel	2 to 3
Sand	69 to 76
Silt & Clay	21 to 29

### 5.2.3 Bedrock

Bedrock was inferred in Boreholes K-DC-1 and, K-DC-2 from spoon refusal. The depth to inferred bedrock ranged from 7.5 m to 8.9 m (elevation 174.0 m to 172.8 m).

A summary of the inferred bedrock depth/elevations from the current investigation supplemented with the pavement investigation is presented in Table 5-4. Pavement logs are provided in Appendix B.

**Table 5-4: Deep Cut K; Summary of Inferred Bedrock Depth/Elevation**

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-236C	11+898	18.9 RT CL	5034023.2	298386.3	176.6	2.2	174.4	TP
17B-237C	11+916	13 RT CL	5034030.6	298404.3	180.0	5.7	174.3	TP
K-DC-1	11+917	0.1 LT CL	5034043.7	298404.4	181.5	7.5	174.0	BH
17B-238C	11+937	15 RT CL	5034030.3	298425.6	181.9	4.9	177.0	TP
K-DC-2	11+959	0.9 RT CL	5034046.1	298446.3	181.7	8.9	172.8	BH

Notes: <sup>(1)</sup> TP=Test Pit; PH=Pavement Hole; HD=Hydraulic Drill; DOB=Documentation of Bedrock; BH=Borehole (Bedrock Inferred); CB=Borehole (Cored Bedrock)



## 5.2.4 Groundwater

Groundwater levels recorded in the monitoring well installed at this site are presented in Table 5-5 below. The installation details are illustrated on the respective Record of Borehole sheets provided in Appendix B.

**Table 5-5: Deep Cut K; Summary of Groundwater Levels**

Borehole No. [Diameter]	Bottom of Screen Elevation (m)	Screened Material	Groundwater Depth (m)	Groundwater Elevation (m)	Date of Measurement
K-DC-2 [50 mm]	173.2	Silty Sand Till	7.4	174.3	Dec 15, 2020
			7.9	173.8	Sep 24, 2021

Borehole K-DC-1 was dry to elevation 174.0 m at completion of drilling.

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

## 5.3 Deep Cut L: McNab-Braeside Sta. 12+180 to Sta. 12+340 WBL

In general terms, the site stratigraphy was found to consist of sand with silt underlain by sand with silt and gravel till overlying shallow bedrock. Bedrock was at or near the ground surface in Boreholes L-DC-1 and L-DC-2.

### 5.3.1 Topsoil

Topsoil was encountered at the surface of Boreholes L-DC-1, L-DC-3 and L-DC-4. The thickness ranged from 30 mm to 170 mm. 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.

### 5.3.2 Sand (SW-SM to SP-SM) with Silt

A sand with silt layer was encountered in Boreholes L-DC-3 and L-DC-4 below the topsoil. Trace gravel, organics and rootlets were observed within this layer. The thickness of this layer ranged from 1.0 m to 1.9 m (base Elev. 189.1 m to 180.2 m). The SPT-N values in this layer ranged from 5 to 39 indicating a loose to dense relative density. One SPT-N value of 100 blows per 225 mm was recorded on inferred bedrock in Borehole L-DC-3.

The moisture content of the sand with silt samples tested ranged from 5 to 33%. The results of two grain size analysis tests conducted on samples of this material are summarized below and are illustrated on Figure C6 in Appendix C.

### Summary of Grain Size Distribution Testing – Sand with Silt

Soil Particle	Percentage (%)
Gravel	4 to 9
Sand	84 to 86
Silt & Clay	5 to 12

#### 5.3.3 Sand (SP-SM) with Silt and Gravel Till

A sand with silt and gravel till layer was encountered below the sand with silt in Borehole L-DC-4. The thickness of this layer was 2.4 m (base Elev. 177.8 m). The SPT-N values in this layer ranged from 88 to 100 blows per 125 mm penetration indicating a very dense relative density.

The moisture content of the till samples tested ranged from 1 to 9%. The results of a grain size analysis test conducted on one sample of this material are summarized below and are illustrated on Figure C7 in Appendix C.

### Summary of Grain Size Distribution Testing – Sand with Silt and Gravel Till

Soil Particle	Percentage (%)
Gravel	23
Sand	70
Silt & Clay	7

#### 5.3.4 Bedrock

Bedrock or inferred bedrock was encountered in Boreholes L-DC-1, L-DC-2, L-DC-3 and, L-DC-4; bedrock was cored in L-DC-2 and inferred from spoon refusal in Boreholes L-DC-1, L-DC-3 and L-DC-4. The depth to bedrock ranged from 0.0 m to 4.5 m (Elev. 189.4 m to 177.8 m). The bedrock encountered consisted of moderately weathered to freshly jointed, Phaneritic (coarse grained) texture, Monzogranite that is predominantly redish to pinky grey in colour. In general, the discontinuities were rough, undulating cross joints. Bedrock logs are provided in Appendix B. Photographs of the bedrock cores are provided in Appendix C. The rock core quality and strength are summarized in Table 5-6.

**Table 5-6: Deep Cut L; Summary of Bedrock Core Quality and Strength**

Parameter	Range	Average
Total Core Recovery (TCR), %	93 – 100	99
Solid Core Recovery (SCR), %	77 – 98	91
Rock Quality Designation (RQD), %	65 – 97	84
Fracture Index (fractures per 0.3m)	0 – >10	2
Unconfined Compressive Strength (UCS) <sup>(1)</sup> , MPa	79 – 226	128



Notes: <sup>(1)</sup> 10 samples tested from Borehole L-DC-2

Based on the RQD values, the bedrock is classified as fair to excellent quality. The results of unconfined compressive strength testing indicate the bedrock is strong to very strong.

The depth to bedrock within this cut section was further explored as part of the pavement investigation (report provided under a separate cover). A summary of the inferred and cored bedrock depth/elevations from the current investigation supplemented with the pavement investigation are presented in Table 5-7. Pavement logs are provided in Appendix B.

**Table 5-7: Deep Cut L; Summary of Bedrock Depth/Elevation**

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-250C	12+174	14.9 RT CL	5034049.2	298661.6	182.0	0.51	181.5	TP
17B-250A	12+178	10 LT CL	5034074.3	298663.2	184.7	0.32	184.4	TP
17B-250B	12+179	1.9 RT CL	5034062.5	298664.9	183.5	0.23	183.3	TP
L-DC-1	12+179	CL	5034064.4	298664.9	183.8	0.2	183.6	BH
17B-251B	12+202	CL	5034065.4	298688.2	186.0	0.23	185.8	TP
17B-252B	12+223	CL	5034067.7	298708.6	188.5	0.035	188.5	DOB
L-DC-2	12+227	1.3 RT CL	5034067.0	298713.6	189.4	0	189.4	CB
17B-252C	12+220	14.7 RT CL	5034053.0	298706.8	185.4	0.01	185.4	DOB
17B-252A	12+219	15 LT CL	5034082.6	298703.9	190.1	0.01	190.1	DOB
17B-253B	12+238	CL	5034069.4	298724.5	189.9	0.5	189.4	TP
17B-253C	12+239	16.2 RT CL	5034053.1	298726.4	187.0	1.7	185.3	TP
17B-253A	12+246	11.9 LT CL	5034081.7	298731.2	191.2	0.075	191.1	TP
17B-254B	12+261	3.2 RT CL	5034067.8	298747.3	189.9	0.51	189.4	TP
17B-254C	12+262	17.4 RT CL	5034053.7	298748.9	188.2	0.8	187.4	TP
L-DC-3	12+278	0.5 RT CL	5034071.8	298764.0	190.1	1.0	189.1	BH
17B-254A	12+266	9.5 LT CL	5034080.9	298751.4	191.0	0	191.0	DOB
17B-255B	12+285	CL	5034071.6	298770.8	189.7	0.03	189.7	DOB
17B-255A	12+289	11.8 LT CL	5034085.0	298774.0	190.5	0.5	190.0	TP
17B-255C	12+281	12.5 RT CL	5034060.1	298768.2	188.8	0.8	188.0	TP
17B-256B	12+297	CL	5034072.7	298782.6	189.3	0.06	189.2	TP
17B-256C	12+300	13.3 RT CL	5034060.8	298786.5	188.3	0.66	187.6	TP



ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-256A	12+298	10 LT CL	5034083.9	298782.7	190.0	0.22	189.8	TP
17B-257B	12+323	2.4 RT CL	5034073.5	298808.7	186.9	0.61	186.3	TP
17B-257A	12+323	10.4 LT CL	5034086.3	298807.8	186.7	0	186.7	DOB
17B-257C	12+320	15.6 RT CL	5034060.1	298807.2	187.2	2.5	184.7	TP
17B-258B	12+341	CL	5034077.0	298826.7	183.5	2.3	181.2	TP
17B-258C	12+344	14.6 RT CL	5034063.1	298831.2	184.5	1.9	182.6	TP
17B-258A	12+339	12.5 LT CL	5034089.7	298824.1	182.5	0	182.5	DOB
L-DC-4	12+347	1.4 LT CL	5034079.2	298832.8	182.3	4.5	177.8	BH

Notes: <sup>(1)</sup> TP=Test Pit; PH=Pavement Hole; HD=Hydraulic Drill; DOB=Documentation of Bedrock; BH=Borehole (Bedrock Inferred); CB=Borehole (Cored Bedrock)

### 5.3.5 Groundwater

Groundwater levels recorded in the monitoring well installed at this site are presented in Table 5-8 below. The installation details are illustrated on the respective Record of Borehole sheet provided in Appendix B.

**Table 5-8: Deep Cut L; Summary of Groundwater Levels**

Borehole No. [Diameter]	Bottom of Screen Elevation (m)	Screened Material	Groundwater Depth (m)	Groundwater Elevation (m)	Date of Measurement
L-DC-2 [50 mm]	174.0	Bedrock	14.0	175.4	Dec 15, 2020
			14.5	174.9	Sep 24, 2021

Borehole L-DC-4 was dry to elevation 177.8 m at completion of drilling.

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

### 5.4 Deep Cut M: McNab-Braeside Sta. 12+500 to Sta. 12+720 WBL

In general terms, the site was found to be underlain by silty sand to sand overlying shallow bedrock.



#### 5.4.1 Topsoil

A topsoil layer was encountered at the surface of Boreholes M-DC-1 to M-DC-4. The thickness ranged from 125 mm to 320 mm. 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.

#### 5.4.2 Silty Sand (SM) to Sand (SP-SM) with Silt and Gravel

A silty sand to sand with silt and gravel layer was encountered in Boreholes M-DC-1 to M-DC-4 below the topsoil. Trace gravel and organics were observed within this layer. The layer ranged in thickness from 0.2 to 1.5 m with base depths ranging from 0.5 m to 1.7 m (base Elev. 182.3 m to 179.5 m). The SPT-N values in the layer ranged from 2 to 22 indicating a very loose to compact relative density. SPT-N values ranging from 100 blows per 125 mm penetration to 100 blows per 225 mm penetration were recorded above inferred bedrock.

The moisture content of the silty sand to sand with silt and gravel samples tested ranged from 5% to 30%. The results of four grain size analysis tests conducted on samples of this material are summarized below and are illustrated on Figures C8 in Appendix C.

#### Summary of Grain Size Distribution Testing – Silty Sand to Sand with Silt and Gravel

Soil Particle	Percentage (%)
Gravel	1 to 32
Sand	63 to 82
Silt & Clay	5 to 29

#### 5.4.3 Bedrock

Bedrock or inferred bedrock was encountered in Boreholes M-DC-1, M-DC-2, M-DC-3, M-DC-4, and M-DC-5; bedrock was cored in M-DC-4 and inferred from spoon refusal in Boreholes M-DC-1, M-DC-2 and M-DC-3 and M-DC-5. The depth to bedrock ranged from 0 m to 1.7 m (Elev. 182.3 m to 178.7 m). The bedrock encountered consisted of moderately to highly weathered, Phaneritic (coarse grained) texture, Monzogranite that is predominantly reddish to pinky grey in colour. In general, the discontinuities were rough, undulating cross joints. Bedrock logs are provided in Appendix B. Photographs of the bedrock cores are provided in Appendix C. The rock core quality and strength are summarized in Table 5-9.

**Table 5-9: Deep Cut M; Summary of Bedrock Core Quality and Strength**

Parameter	Range	Average
Total Core Recovery (TCR), %	95 – 100	97
Solid Core Recovery (SCR), %	41 – 85	72
Rock Quality Designation (RQD), %	29 – 88	64
Fracture Index (fractures per 0.3m)	0 – >10	4



Parameter	Range	Average
Unconfined Compressive Strength (UCS) <sup>(1)</sup> , MPa	51 – 169	98

Notes: <sup>(1)</sup> 6 samples tested from Borehole M-DC-4

Based on the RQD values, the bedrock is classified as poor to good quality. The results of unconfined compressive strength testing indicate the bedrock is strong to very strong.

The depth to bedrock within this cut section was further explored as part of the pavement investigation (report provided under a separate cover). A summary of the inferred and cored bedrock depth/elevations from the current investigation supplemented with the pavement investigation are presented in Table 5-10. Pavement logs are provided in Appendix B.

**Table 5-10: Deep Cut M; Summary of Bedrock Depth/Elevation**

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-261A	12+500	15 LT CL	5034105.0	298984.3	183.8	0	183.8	DOB
17B-261C	12+500	11.8 RT CL	5034078.3	298986.3	182.7	0.62	182.1	TP
17B-261B	12+502	2.2 LT CL	5034092.4	298986.8	183.4	0.6	182.8	TP
M-DC-1	12+503	0.4 LT CL	5034090.6	298988.0	182.8	0.5	182.3	BH
17B-262B	12+522	CL	5034092.6	299007.0	183.2	0.11	183.1	TP
17B-262A	12+521	15.5 LT CL	5034107.1	299004.4	184.0	0	184.0	DOB
17B-262C	12+526	14.1 RT CL	5034078.0	299012.2	182.3	0.22	182.1	TP
17B-263B	12+542	2.5 RT CL	5034090.9	299027.3	182.1	0.28	181.8	TP
17B-263A	12+544	11.2 LT CL	5034104.7	299028.6	182.7	0.23	182.5	TP
17B-263C	12+549	16.5 RT CL	5034077.5	299035.6	181.5	0.61	180.9	TP
M-DC-2	12+552	CL	5034094.1	299036.8	181.2	1.7	179.5	BH
17B-264B	12+563	CL	5034096.3	299047.7	181.5	1.7	179.8	TP
17B-264C	12+561	13.4 RT CL	5034081.5	299046.9	182.5	1.7	180.8	TP
17B-264A	12+562	13.8 LT CL	5034108.7	299045.7	182.0	0.9	181.1	TP
17B-265B	12+580	CL	5034097.8	299064.9	181.7	0	181.7	DOB
17B-265A	12+576	13.3 LT CL	5034109.4	299060.2	182.0	0.06	181.9	TP
17B-265C	12+579	13.5 RT CL	5034082.9	299065.1	184.3	0	184.3	DOB
17B-266B	12+600	CL	5034099.5	299084.8	181.8	0	181.8	DOB
M-DC-3	12+600	2.4 LT CL	5034100.4	299084.6	181.4	1.0	180.4	BH

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-266C	12+597	16 RT CL	5034081.8	299083.0	183.1	0	183.1	DOB
17B-266A	12+599	15.8 LT CL	5034113.7	299082.6	181.7	1.5	180.2	TP
17B-267B	12+620	CL	5034098.9	299104.8	181.5	1.5	180.0	TP
17B-267C	12+622	18.1 RT CL	5034081.7	299108.3	181.7	0	181.7	DOB
17B-267A	12+623	14.2 LT CL	5034114.0	299106.4	182.3	0.11	182.2	TP
17B-268B	12+640	CL	5034100.5	299125.2	181.3	0	181.3	DOB
17B-268A	12+645	15 LT CL	5034116.5	299128.8	182.2	0.32	181.9	TP
17B-268C	12+638	14.8 RT CL	5034086.3	299124.4	181.1	0.34	180.8	TP
M-DC-4	12+654	3.1 RT CL	5034099.2	299139.2	181.1	0.6	180.5	CB
17B-270B	12+682	2 RT CL	5034102.6	299167.1	181.4	0.25	181.1	TP
17B-270A	12+675	11.5 LT CL	5034115.4	299159.0	181.8	0.15	181.6	TP
17B-270C	12+682	15.3 RT CL	5034089.2	299167.4	180.8	0.19	180.6	TP
17B-271B	12+702	1.1 RT CL	5034105.0	299186.6	180.1	0	180.1	DOB
17B-271A	12+700	14.1 LT CL	5034120.0	299183.1	180.3	0	180.3	DOB
17B-271C	12+706	15.4 RT CL	5034091.1	299191.8	179.2	0	179.2	DOB
M-DC-5	12+719	0.7 RT CL	5034106.8	299203.6	178.7	0	178.7	BH
17B-273ROA	12+725	CL	5034106.7	299209.2	177.4	0	177.4	DOB
17B-273ROC	12+722	15.2 RT CL	5034092.6	299208.2	177.6	0	177.6	DOB
17B-273ROA	12+723	15.9 LT CL	5034123.6	299205.8	176.6	0	176.6	DOB

Notes: <sup>(1)</sup> TP=Test Pit; PH=Pavement Hole; HD=Hydraulic Drill; DOB=Documentation of Bedrock; BH=Borehole (Bedrock Inferred); CB=Borehole (Cored Bedrock)

#### 5.4.4 Groundwater

Groundwater levels recorded in the monitoring well installed at this site are presented in Table 5-11 below. The installation details are illustrated on the respective Record of Borehole sheet provided in Appendix B.



**Table 5-11: Deep Cut M; Summary of Groundwater Levels**

Borehole No. [Diameter]	Bottom of Screen Elevation (m)	Screened Material	Groundwater Depth (m)	Groundwater Elevation (m)	Date of Measurement
M-DC-4 [50 mm]	171.4	Bedrock	3.9	177.2	Dec 15, 2020
			9.3	171.8	Sep 23, 2021
			8.6	172.5	Oct 01, 2021

Borehole M-DC-2 was dry to elevation 179.5 m at completion of drilling.

These observations are considered short term and it should be noted that the groundwater level at the time of construction may be different and seasonal fluctuations of the 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 Deep Cut N-DC: McNab-Braeside Sta. 12+900 to Sta. 13+020 WBL**

In general terms, the site stratigraphy was found to consist of sand with silt to silty sand overlying shallow bedrock.

**5.5.1 Topsoil**

Topsoil was encountered at the surface of Boreholes N-DC-1 and N-DC-3. The thickness was 50 mm. 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.

**5.5.2 Silty Sand (SM) to Sand (SP-SM) with Silt**

A silty sand to sand with silt layer was encountered in Boreholes N-DC-1 and N-DC-3 below the topsoil. Trace gravel and some organics was noted in this layer in Borehole N-DC-1. The thickness of this layer was 0.3 m (base Elev. 172.3 m to 169.1 m). The SPT-N values in this layer ranged from 100 blows per 150 mm penetration to 100 blows per 300 mm penetration and were likely influenced by the presence of bedrock. This layer was described as very loose based on an assessment of the soil above the bedrock.

The moisture content of the silty sand to sand with silt samples tested ranged from 12% to 33%. The results of two grain size analysis tests conducted on samples of this material are summarized below and are illustrated on Figure C9 in Appendix C.

**Summary of Grain Size Distribution Testing – Silty Sand**

<b>Soil Particle</b>	<b>Percentage (%)</b>
Gravel	0 to 5
Sand	74 to 92
Silt & Clay	8 to 21

**5.5.3 Bedrock**

Bedrock or inferred bedrock was encountered in Boreholes N-DC-1, N-DC-2, and N-DC-3; bedrock was cored in N-DC-2 and inferred from spoon refusal in Boreholes N-DC-1 and N-DC-3. The depth to bedrock ranged from 0 m to 0.4 m (Elev. 172.3 m to 169.1 m). The bedrock encountered consisted of moderately weathered to freshly jointed, Phaneritic (coarse grained) texture, Monzogranite that is predominantly redish to pinky grey in colour. In general, the discontinuities were rough, undulating cross joints. Bedrock logs are provided in Appendix B. Photographs of the bedrock cores are provided in Appendix C. The rock core quality and strength are summarized in Table 5-12.

**Table 5-12: N-DC; Summary of Bedrock Core Quality and Strength**

<b>Parameter</b>	<b>Range</b>	<b>Average</b>
Total Core Recovery (TCR), %	98 – 100	99
Solid Core Recovery (SCR), %	56 – 95	81
Rock Quality Designation (RQD), %	44 – 98	73
Fracture Index (fractures per 0.3m)	0 – 8	2
Unconfined Compressive Strength (UCS) <sup>(1)</sup> , MPa	92 – 170	115

Notes: <sup>(1)</sup> 6 samples tested from Borehole N-DC-2

Based on the RQD values, the bedrock is classified as poor to excellent quality. The results of unconfined compressive strength testing indicate the bedrock is strong to very strong.

The depth to bedrock within this cut section was further explored as part of the pavement investigation (report provided under a separate cover). A summary of the inferred and cored bedrock depth/elevations from the current investigation supplemented with the pavement investigation are presented in Table 5-13. Pavement logs are provided in Appendix B.



**Table 5-13: N-DC; Summary of Bedrock Depth/Elevation**

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-276B	12+901	CL	5034121.6	299384.7	171.9	0.11	171.8	TP
17B-276C	12+903	12.6 RT CL	5034109.6	299387.9	172.2	0.12	172.1	TP
17B-276A	12+895	14.6 LT CL	5034136.0	299377.8	172.1	0.22	171.9	TP
N-DC-1	12+910	5.8 LT CL	5034128.4	299393.1	172.7	0.4	172.3	BH
17B-277B	12+921	CL	5034124.3	299405.2	173.9	0.32	173.6	TP
17B-277A	12+916	15.9 LT CL	5034139.0	299399.1	172.9	0	172.9	DOB
17B-277C	12+920	11.9 RT CL	5034111.6	299404.5	174.0	0	174.0	DOB
17B-278B	12+938	CL	5034123.4	299421.9	173.2	0.97	172.2	TP
17B-278A	12+939	13.7 LT CL	5034138.6	299421.6	172.4	0.32	172.1	TP
17B-278C	12+938	15.8 RT CL	5034109.1	299422.8	174.3	0.17	174.1	TP
17B-279B	12+960	CL	5034126.2	299443.5	172.3	0.31	172.0	TP
17B-279C	12+960	14.2 RT CL	5034112.5	299444.5	172.9	0.29	172.6	TP
17B-279A	12+960	13.4 LT CL	5034140.0	299442.5	172.0	0.19	171.8	TP
N-DC-2	12+969	2.1 LT CL	5034129.4	299452.2	172.1	0	172.1	CB
17B-280B	12+981	CL	5034127.5	299464.6	173.3	0	173.3	DOB
17B-280A	12+982	11.5 LT CL	5034139.9	299465.0	173.4	0	173.4	DOB
17B-280C	12+980	14.7 RT CL	5034113.6	299464.8	172.1	0.03	172.1	TP
17B-281B	13+001	CL	5034128.9	299484.2	172.6	0	172.6	DOB
17B-281C	13+001	16.2 RT CL	5034113.8	299485.8	173.0	0	173.0	DOB
17B-281A	13+002	9.2 LT CL	5034139.1	299484.4	172.3	0.03	172.3	DOB
17B-282B	13+018	CL	5034131.4	299501.8	169.3	0	169.3	DOB
17B-282A	13+020	15.2 LT CL	5034146.6	299502.2	168.9	0	168.9	DOB
17B-282C	13+019	15.6 RT CL	5034115.8	299503.5	169.8	0.19	169.6	TP
N-DC-3	13+024	2.6 RT CL	5034129.2	299508.0	169.4	0.3	169.1	BH
17B-283B	13+039	3.5 RT CL	5034129.4	299522.3	167.3	0.33	167.0	TP
17B-283A	13+040	11.6 LT CL	5034144.6	299522.8	168.0	0.19	167.8	TP
17B-283C	13+038	16.7 RT CL	5034116.2	299522.7	167.8	0.09	167.7	TP



ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type <sup>(1)</sup>
						Depth (m)	Elev. (m)	
17B-283(2)B	13+062	CL	5034133.4	299545.9	164.0	0	164.0	DOB
17B-283(2)A	13+063	13.9 LT CL	5034148.7	299544.9	164.5	0.32	164.2	TP
17B-283(2)C	13+066	20.4 RT CL	5034114.8	299551.5	163.7	0.31	163.4	TP

Notes: <sup>(1)</sup> TP=Test Pit; PH=Pavement Hole; HD=Hydraulic Drill; DOB=Documentation of Bedrock; BH=Borehole (Bedrock Inferred); CB=Borehole (Cored Bedrock)

#### 5.5.4 Groundwater

Groundwater levels recorded in the monitoring well installed at this site are presented in Table 5-14 below. The installation details are illustrated on the respective Record of Borehole sheet provided in Appendix B.

**Table 5-14: Deep Cut N; Summary of Groundwater Levels**

Borehole No. [Diameter]	Bottom of Screen Elevation (m)	Screened Material	Groundwater Depth (m)	Groundwater Elevation (m)	Date of Measurement
N-DC-2 [50 mm]	171.4	Bedrock	4.3	167.9	Dec 15, 2020
			5.5	166.7	Sep 23, 2021
			5.2	167.0	Oct 01, 2021

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



## 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 installation and borehole decommissioning. The field investigation was supervised on a full-time basis by 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. Analytical testing was completed by Paracel Laboratories in Ottawa.

Overall project management and direction of the field program was provided by Justin Gray, P.Eng. Interpretation of the factual data and preparation of this report were carried out by Deanna Pizycki, 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.

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**PRELIMINARY  
FOUNDATION INVESTIGATION AND DESIGN REPORT  
HIGHWAY 17 TWINNING, RENFREW AREA  
DEEP CUTS IN SOILS, VARIOUS SITES  
WP 4068-09-00 / ASSIGNMENT NO. 4018-E-0009**

**Geocres No.: 31F-232**

**PART 2. ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**7 INTRODUCTION**

Part 2 of this report provides an interpretation of the factual data and also presents geotechnical recommendations for the design of various deep cut sections required for the proposed Highway 17 Twinning Project which extends from Scheel Drive westerly to 3 km west of Bruce Street in the Renfrew area.

This report will focus on recommendations for deep cuts in soil on the new alignment. Design recommendations for deep cuts in rock will be presented under a separate cover.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of the Ministry of Transportation, and shall not be used or relied upon for any other purposes or by any other parties including the construction or design-build contractor. Contractors must make their own interpretation based on the factual data in Part 1 of the report. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of the Ministry of Transportation and shall not be used or relied upon for any other purposes or by any other parties including design-build contractors. 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. The Preferred Proponent must make their own interpretation based on the factual data in Part 1 of the report. The information included in Part 2 is not to be relied upon for design purposes and foundation design is the sole responsibility of the Preferred Proponent. No use shall be made of Part 2 or any part thereof. The Preferred Proponent must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

The following sections provide preliminary geotechnical recommendations for the construction of the deep soil cuts along the new alignment. The discussions and recommendations presented in



this report are based on the information provided by the Ministry of Transportation of Ontario (MTO) and on the factual data obtained during the course of this investigation.

## 7.1 Proposed Work

Deep cut locations were defined where the existing ground elevation at centreline is 4.5 m or more higher than proposed profile elevation, as shown in in the 2004 Preliminary Design Report for this project. Five different deep cut sections were identified and have been labelled B, K, L, M and N. Cross sections are provided on Drawings 1 through 11 in Appendix A. Table 7-1 summarizes the Deep Cut site properties at select cross sections.

**Table 7-1: Summary of Deep Cut Site Properties**

Site	Location	Approximate Stations (m)	Reference Stations	Earth Excavation Depth (m)	Rock Excavation Depth (m)
B	EBL	18+650 to 19+025	18+767(*)	5.4	-
			18+900(*)	1.0	12.4
			18+981(*)	6.0	1.2
K	WBL	11+900 to 11+970	11+922(*)	7.8	2.0
			11+943	7.5	3.0
			11+960	8.9	0.5
L	WBL	12+180 to 12+340	12+227(*)	-	12.7
			12+338(*)	4.7	0.3
M	WBL	12+500 to 12+720	12+525(*)	-	5.8
			12+647(*)	0.6	4.4
N	WBL	12+900 to 13+020	12+949(*)	-	2.6
			12+990	-	4.3

Notes: (\*) Cross-section in Drawings 1 to 11 in Appendix A.

It is noted that these areas were selected based on the difference between the existing grade and the proposed top of pavement centerline. Cuts may extend as deep as 1.5 m below the top of pavement centerline elevation to facilitate the required ditch depths as per OPSD 200.010 and OPSD 201.010. Roadway cross-sections have been developed based on the OPSD drawings as well as typical sections provided in the 2004 Preliminary Design Report and drawings provided by Parsons in December 2021.

It is understood that the projected one-way 2022 AADT for this freeway is in excess of 6,000 and that the design speed is greater than 110 km/hr. The draft Pavement Design Report indicates a total pavement thickness of 825 mm and 525 mm for earth cut and rock cut subgrades respectively.



## 7.2 Applicable Codes and Design Considerations

The geotechnical assessment presented below has been prepared based on the available data regarding the existing ground conditions, the proposed profiles and cross-sections and in accordance with the Canadian Highway Bridge Design Code, version CSA S6:19, (CHBDC).

In accordance with CHBDC, the analysis and design of geotechnical systems takes into consideration the importance of the system and the consequence associated with exceeding limit states. The importance category and consequence classification are defined by the Regulatory Authority, which in this case is the Ministry of Transportation, Ontario (MTO).

It is understood that Highway 17 has a “Major Route” importance category.

This project has been assigned Typical Consequence Classification, in accordance with Section 6.5.1 of the CHBDC. Accordingly, a consequence factor ( $\Psi$ ) of 1.0, as per Table 6.1 of the CHBDC, has been used in assessing factored geotechnical resistances.

The degree of site and prediction model understanding for this site has been assessed to be typical understanding (Section 6.5.3 of CHBDC).

The May 2020 Roadside Design Manual has been consulted. Table 2-2 indicates that a Desirable Clear Zone of 10.5 m is appropriate for sections of this highway on tangent. Table 2-5 indicates that a Foreslope Ratio of 6H:1V is appropriate for earth cuts and rock cuts. Tables 2-9 and 2-10 indicate that a minimum Desirable Rock Face Offset of 5 m and a Desirable Ditch Depth of 0.75 m are required for rock cut heights of 10 m.

## 8 SEISMIC CONSIDERATIONS

### 8.1 Spectral and Peak Acceleration Hazard Values

The seismic hazard data for the CHBDC is based on the fifth-generation seismic model developed by the Geological Survey of Canada (GSC). The seismic hazard for this site has been obtained from the GSC online calculator. The data includes a peak ground acceleration (PGA), peak ground velocity (PGV) and the 5% spectral response acceleration values ( $S_a(T)$ ) for the *reference* ground condition (Site Class C) for a range of periods (T) and for a range of return periods including 475-year, 975-year and 2475-year events. The GSC seismic hazard calculated data sheet for these sites is included in Appendix E.

The site coefficients used to determine the design spectral acceleration and displacement values are a function of the Site Class and the peak ground acceleration (PGA). The PGA at all sites (B, K, L, M and N) for a *reference* Site Class C with a 2% probability of exceedance in 50 years (2475-year event) is 0.228g. This value is to be scaled by the  $F(PGA)$  based on the site-specific Site Class.



## 8.2 CHBDC Seismic Site Classification

In accordance with the CHBDC, the selection of the seismic site classification is based on the soil conditions encountered in the upper 30 m of the stratigraphy. A summary of the Site Class, F(PGA) and PGA for each site is presented in Table 8-1. The Site Class and F(PGA)s were determined in accordance with Table 4.1 and Table 4.8 of the CHBDC, respectively.

**Table 8-1: Summary of Site Class, F(PGA) and PGA**

Site(s)	Site Class	F(PGA)	PGA
B, K	D	1.133	0.258
L	C	1.000	0.228
M, N	B	0.870	0.198

## 8.3 Seismic Liquefaction Potential

The susceptibility of the cohesive soils within the cuts slopes at Site B to experience cyclic mobility/softening was assessed following the Bray et al (2004)<sup>iii</sup> criteria using index properties. The results of the analysis indicate the clay above the proposed grade is generally not susceptible to moderately susceptible to cyclic mobility/softening.

The susceptibility of the cohesionless soils at sites B, K and L to experience liquefaction was assessed using the SPT data following the simplified method for cohesionless soil as outlined in Boulanger and Idriss (2014)<sup>iv</sup>. The cohesionless soils above the water table are not considered to be susceptible to liquefaction.

## 9 DESIGN RECOMMENDATIONS

Deep cut locations were defined where the existing ground elevation at centreline is 4.5 m or more higher than proposed profile elevation, as shown in the 2004 Preliminary Design Report for this project. It is noted that these areas were selected based on the difference between the existing grade and the proposed top of pavement centerline. Cuts may extend as deep as 1.5 m below the top of pavement centerline elevation to facilitate the required ditch depths as per OPSD 200.010 and OPSD 201.010. The OPSD drawings have been included in Appendix G for reference.

The final cut slopes will contain both native earth slopes and rock faces.

### 9.1 Rock Cuts

A separate Rock Engineering Report describes the analytic methodology employed to assess rock cut stability. Recommendations on rock cut geometry are provided in that report.



## 9.2 Earth Cuts

Earth cuts should be constructed in accordance with OPSS.PROV 206 and OPSD 200.020 unless otherwise specified. Where earth cuts are anticipated above a rock cut, the earth cut portion shall be completed as per OPSD 201.020. To maintain stability of the cut slopes, an interceptor ditch should be provided at the top of earth cuts as per both OPSD 200.010 and 201.010. Roadside ditches are expected to provide an adequate level of surface drainage.

### 9.2.1 Cut Slope Stability

Earth cuts or partial earth/rock cuts were identified at Sites B, K and L. The stability of the cut slopes was assessed to supplement OPSD 200.010 and OPSD 201.010.

The slope stability models considered Granular A fill as part of the pavement structure along the proposed Highway 17 alignment. Large scale direct shear box testing on samples of Granular A and Granular B Type II from numerous nearby aggregate sources was completed for this project. The results indicate that for design of structural backfill for this project, an internal angle of friction of 40 degrees and 42 degrees can be used for quarry-sourced Granular A and Granular B Type II, respectively, in this area provided the effective vertical pressure on the material is less than 150 kPa (Geocres Memorandum 31F-213). The material properties for quarry-sourced Granular A have been used in the slope stability analyses described herein, for consistency.

The slope stability analyses were carried out using GeoStudio 2020 Slope/W software for limit equilibrium analysis. Input parameters for the embankment fill and foundation soils for the analysis are based on the SPT N values, undrained shear strength and the results of laboratory testing and are summarized on the stability analyses output sheets provided in Appendix F. The following additional parameters and assumptions were used in the analysis:

- The soil stratigraphy is based on the nearest boreholes. A summary table of soil parameters specific to each model are shown on the stability analyses output figures provided.
- 2H:1V slope geometry in soil unless otherwise specified.
- A site adjusted PGA value equal to  $\frac{1}{2}$  of the site adjusted PGA value (See Table 8-1), was used for seismic analysis, as per Section 4.4.3.3, of the CHBDC (1/2 PGA at Site B and K is 0.129g; Site L = 0.114g).
- No traffic is anticipated on the upper slopes and therefore traffic loading was omitted from the analysis.

A temporary undrained case was not carried out as part of these analyses given there is a net unloading occurring at each site and the soils are not expected to experience an undrained state.

Note that the requirements of the CHBDC do not strictly apply for cut slopes (they are provided for embankment fills) however, we have utilized this information and a  $\Psi$  of 1.0 to generate a target minimum Factor of Safety of 1.5 for soil cut slopes on Highway 17 for a permanent condition



with a typical degree of understanding. The static results presented in Table 9-1 meet or exceed the target Factors of Safety.

**Table 9-1 Slope Stability Analysis Results for Deep Soil Cuts B, K and L**

Condition	Case	Factor of Safety			
		Site B <sup>(*)</sup> Sta. 18+767	Site B Sta. 18+981	Site K Sta. 11+922	Site L Sta. 12+338
Permanent	Long Term Static (Drained)	1.5 (Fig F1-1)	1.5 (Fig F2-1)	1.5 (Fig F3-1)	1.5 (Fig F4-1)
Temporary (seismic)	Pseudo-Static (Undrained)	1.5 (Fig F1-2)	1.1 (Fig F2-2)	1.1 (Fig F3-2)	1.1 (Fig F4-2)

Note: <sup>(\*)</sup>This earth cut slope is higher than 6 m so a mid-height 2 m wide bench has been incorporated into the analysis.

Table 6.3 in Section 6.14.4.1 of the CHBDC indicates a minimum seismic resistance factor of 0.95 for force-based design and 1.0 for performance-based design. Based on these values and  $\Psi$  of 1.0, a target Factor of Safety of 1.1 for this temporary condition with a typical degree of understanding is appropriate for the pseudo-static seismic analysis. The pseudo-static result presented in Table 9-1 above, exceeds the target Factor of Safety for seismic design. It is noted that some displacement of the slope can occur where the pseudo-static Factor of Safety is less than 1.3. However, since there are no travelled lanes at the top of the slope, the displacements will have negligible impact.

Horizontal mid-height benches shall be provided for surficial stability of earth cut slopes deeper than 6 m. Where cut slopes are 12 m, benches shall be provided at maximum 6 m vertical intervals.

## 9.2.2 Erosion

Slope protection and drainage measures will be required to ensure the long-term surficial stability of the earth cut slopes. The erodibility of the soil at each site was assessed using the Wischmeier Nomograph. The results are summarized in Table 9-2 below.

**Table 9-2 Slope Stability Analysis Results for Deep Cut B**

Site	Soil Type	Wischmeier Nomograph	Erodibility
B (Sta. 18+650 to 18+900)	Clay	0.29 to 0.34	Moderate
B (Sta. 18+900 to 19+025)	Silty Sand	0.15 to 0.17	Low
K	Silty Sand Till	0.16 to 0.23	Low to Moderate
L	Sand	<0.1	Low



The contractor should provide silt fences and erosion control blankets, as required, throughout the duration of the construction to prevent silt/sediments from running off the site as per OPSS.PROV 804.

Normally slope vegetation should be established as soon as possible after completion of the earth cut slopes in order to control surficial erosion in general accordance with OPSS.PROV 803.

The finished earth cut slopes should be inspected for ongoing seepage emerging from the cut slopes. Gravel sheeting or rock protection may be required to provide drainage of the seepage to prevent erosion of the slope face. It is anticipated that gravel sheeting will be needed for the lower portions of the cuts at Site B (from Station 18+650 to 18+860 and from 18+950 to 19+025) and K (Station 11+900 to 11+970).

### 9.2.3 Drainage

Prior dewatering of the site is not considered necessary; however, groundwater seepage is expected to enter the open excavation and may require action on the part of the contractor in order to proceed with construction. Some sloughing may occur as a result of groundwater seepage during excavation. The cut should begin at the low end of the highway and proceed up the profile to allow drainage as excavation progresses.

### 9.2.4 Material Re-Use

It is anticipated that portions of the excavated materials will be suitable for re-use where they meet the requirements stipulated in OPSS.PROV 1010 and elsewhere in the contract, and they can achieve optimum moisture content and compaction targets at the time of construction.

Sensitive marine clay shall not be re-used as structural or earth fill anywhere on the project. This material could be considered for slope flattening however, drainage gaps as per OPSD 201.010 and OPSD 201.020 would be required, nominally spaced at 250 m.

## 9.3 Transitional Areas

A transitional treatment is required between rock cuts and earth cuts (OPSD 205.050), rock cuts and earth fills (OPSD 205.030) and rock cuts and rock fills (OPSD 205.020). Please refer to the Pavement Design Report for additional comments.

## 10 CONSTRUCTION CONCERNS

Potential construction concerns include, but are not necessarily limited to:

- Excavation difficulties due to the presence of obstructions such as potential for cobbles and boulders in the overburden material. Provision must be made for the removal of cobbles and boulders. Suggested wording for a Contract Provision has been provided in Appendix G.
- Control of groundwater seepage during excavation and permanent drainage in the cut section.



- The thickness and presence of fill, topsoil and alluvial deposits were investigated at the borehole locations along the proposed embankment centerline only. These deposits may extend to greater depths/extents or be encountered at other locations between boreholes.
- Protection of pavement subgrade needs to be considered where an earth subgrade will be exposed. It is recommended that exposed subgrades be covered with the pavement subbase layer quickly to prevent degradation from weather. Furthermore, construction traffic should not travel on earth subgrades – haul roads may need to be constructed. Please refer to the Pavement Design Report for additional comments.



## 11 CLOSURE

Engineering analysis and preparation of this report was carried out by Deanna Pizycki, P.Eng. and Dr. Fred Griffiths, P.Eng.. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundation Projects.

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<sup>ii</sup> Wester, M.C., B.L. Henson, W.J. Crins, P.W.C. Uhlig and P.A. Gray. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26. 474 p. + appendices

<sup>iii</sup> Bray, J. D. et al. 2004b. Liquefaction susceptibility of fine-grained soils. Proc., 11th Int. Conf. on Soil Dynamics and Earthquake Engineering and 3rd Int. Conf. on Earthquake Geotechnical Engineering, D. Doolin et al., eds., Stallion Press, Singapore, 655–662

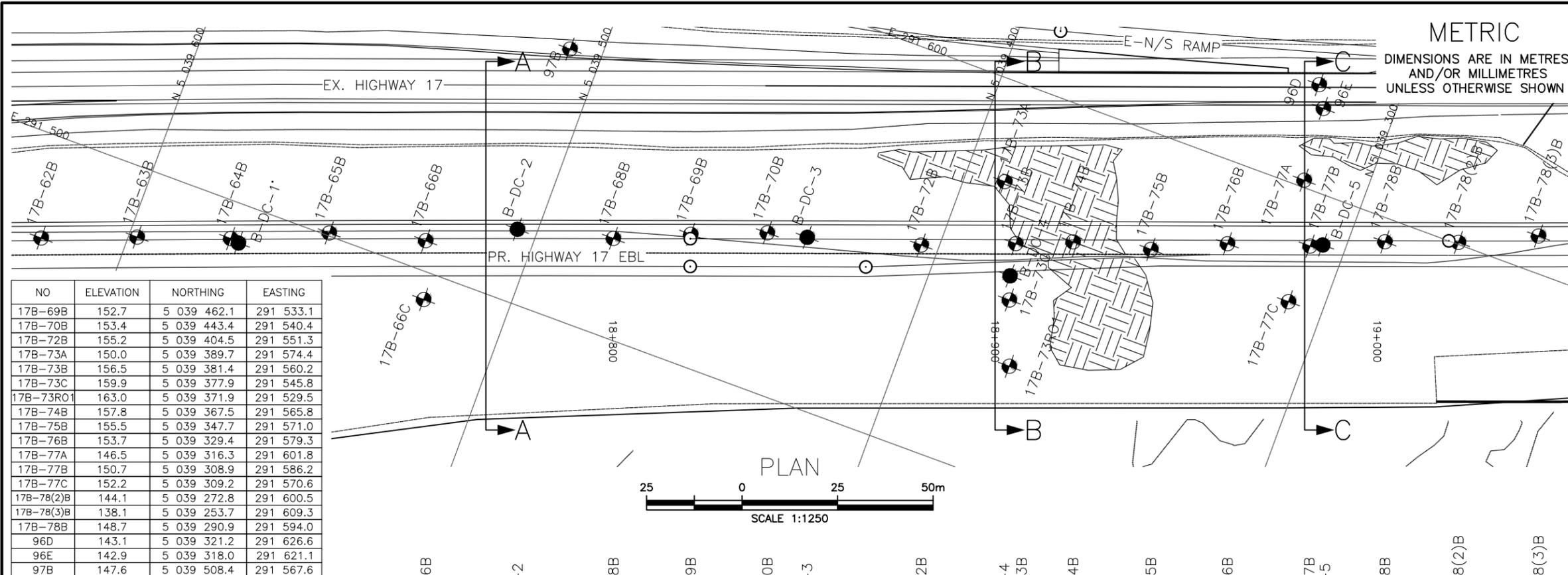
<sup>iv</sup> Boulanger, R. W., and Idriss, I. M. 2014. CPT and SPT based liquefaction triggering procedures, Report No. UCD/CGM-14/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, CA, 134 pp.



**Appendix A.**

**Borehole Location Plan and Stratigraphic Drawings**

MINISTRY OF TRANSPORTATION, Ontario



NO	ELEVATION	NORTHING	EASTING
17B-69B	152.7	5 039 462.1	291 533.1
17B-70B	153.4	5 039 443.4	291 540.4
17B-72B	155.2	5 039 404.5	291 551.3
17B-73A	150.0	5 039 389.7	291 574.4
17B-73B	156.5	5 039 381.4	291 560.2
17B-73C	159.9	5 039 377.9	291 545.8
17B-73R01	163.0	5 039 371.9	291 529.5
17B-74B	157.8	5 039 367.5	291 565.8
17B-75B	155.5	5 039 347.7	291 571.0
17B-76B	153.7	5 039 329.4	291 579.3
17B-77A	146.5	5 039 316.3	291 601.8
17B-77B	150.7	5 039 308.9	291 586.2
17B-77C	152.2	5 039 309.2	291 570.6
17B-78(2)B	144.1	5 039 272.8	291 600.5
17B-78(3)B	138.1	5 039 253.7	291 609.3
17B-78B	148.7	5 039 290.9	291 594.0
96D	143.1	5 039 321.2	291 626.6
96E	142.9	5 039 318.0	291 621.1
97B	147.6	5 039 508.4	291 567.6

METRIC  
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AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

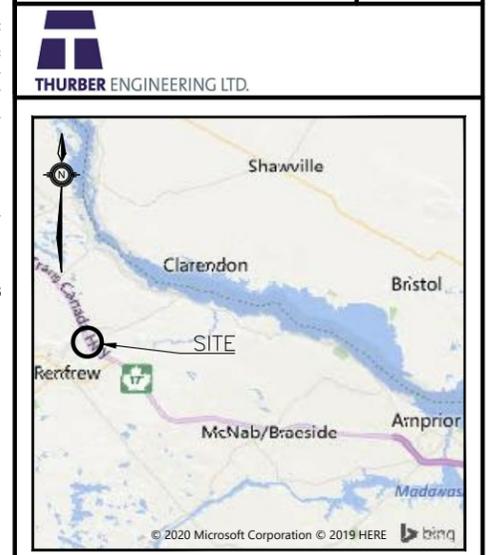
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DEEP CUTS  
DEEP CUT B  
BOREHOLE LOCATIONS AND SOIL STRATA

**Ontario**

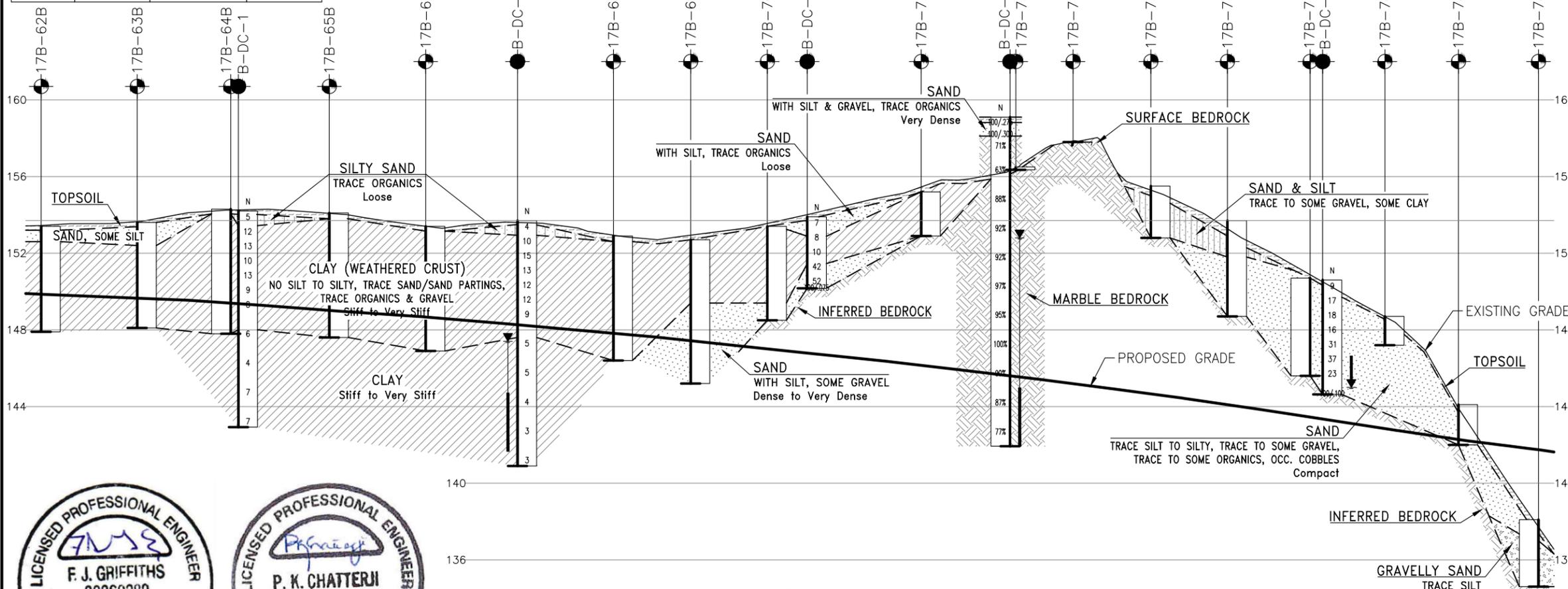
**THURBER ENGINEERING LTD.**

SHEET



**KEYPLAN**  
**LEGEND**

	Foundation Borehole
	Pavement Investigation Data Point
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
B-DC-1	154.2	5 039 572.4	291 490.1
B-DC-2	153.7	5 039 505.1	291 518.7
B-DC-3	153.9	5 039 433.2	291 542.9
B-DC-4	159.1	5 039 379.9	291 551.8
B-DC-5	150.6	5 039 305.9	291 587.6
17B-62B	153.4	5 039 621.3	291 473.5
17B-63B	153.6	5 039 597.8	291 482.4
17B-64B	154.3	5 039 574.7	291 490.5
17B-65B	154.1	5 039 551.0	291 500.8
17B-66B	153.4	5 039 526.6	291 507.6
17B-66C	152.4	5 039 521.8	291 493.0
17B-68B	152.9	5 039 480.7	291 525.1

- NOTES-**
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
  - This drawing is for subsurface information only. Structural elements, surface details and features are for conceptual illustration.
  - Coordinate system is MTM NAD 83 Zone 9.
- GEOCREs No. 31F-232**



PROFILE ALONG Q PROPOSED EBL



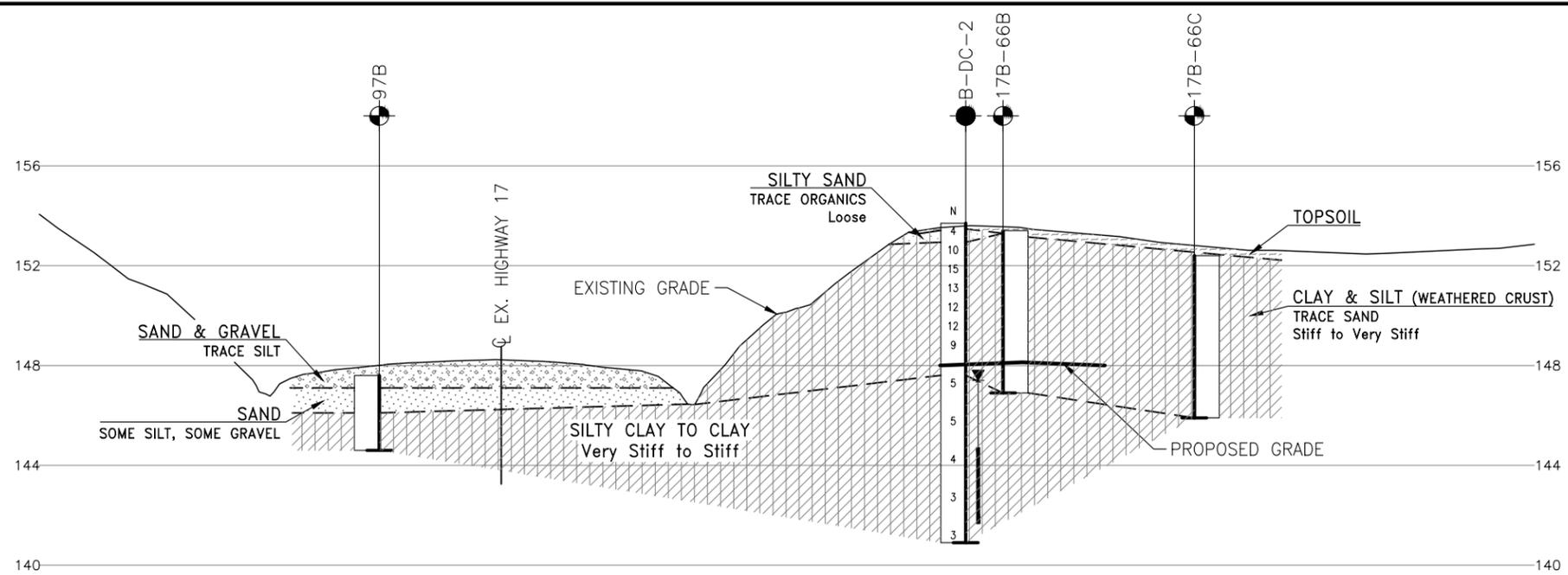
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V 1:250

Pavement logs have been modified for consistency with foundation naming conventions.

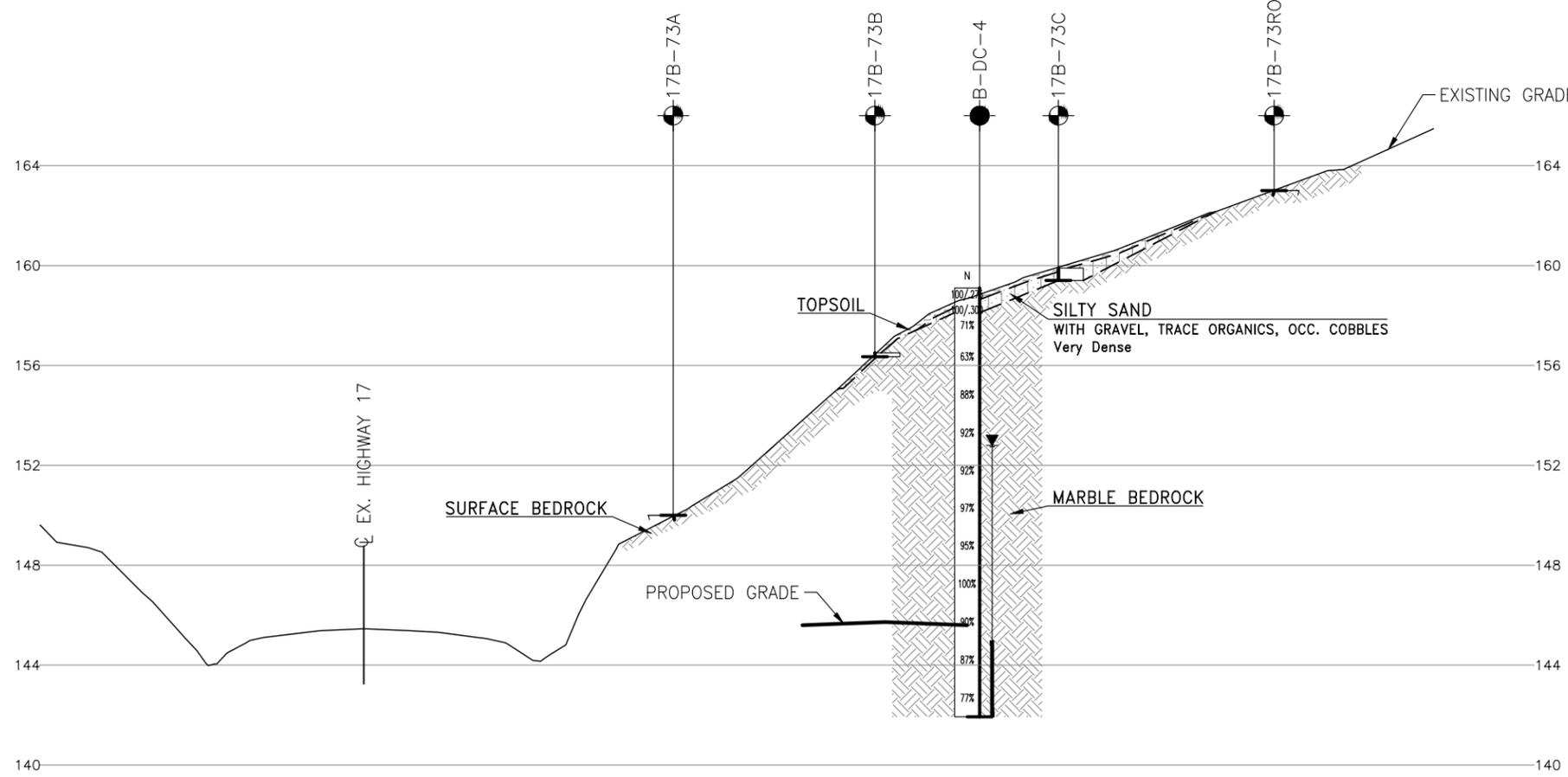
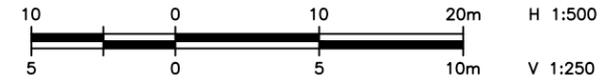
REVISIONS	DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	1

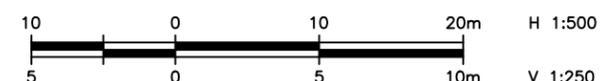
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PLOTDATE: 7/15/2022 10:08 AM



SECTION A-A (18+767)



SECTION B-B (18+900)



Pavement logs have been modified for consistency with foundation naming conventions.

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

LICENSED PROFESSIONAL ENGINEER  
F. J. GRIFFITHS  
90360280  
July 15/22  
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER  
P. K. CHATTERJI  
July 15, 2022  
PROVINCE OF ONTARIO

CONT No WP No	HIGHWAY 17 TWINNING DEEP CUTS DEEP CUT B BOREHOLE LOCATIONS AND SOIL STRATA	SHEET
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KEYPLAN

LEGEND

●	Foundation Borehole
○	Pavement Investigation Data Point
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
B-DC-2	153.7	5 039 505.1	291 518.7
B-DC-4	159.1	5 039 379.9	291 551.8
17B-66B	153.4	5 039 526.6	291 507.6
17B-66C	152.4	5 039 521.8	291 493.0
17B-73A	150.0	5 039 389.7	291 574.4
17B-73B	156.5	5 039 381.4	291 560.2
17B-73C	159.9	5 039 377.9	291 545.8
17B-73RO1	163.0	5 039 371.9	291 529.5
97B	147.6	5 039 508.4	291 567.6

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

GEOCREs No. 31F-232

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	2

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



CONT No  
WP No

HIGHWAY 17 TWINNING  
DEEP CUTS  
DEEP CUT B  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

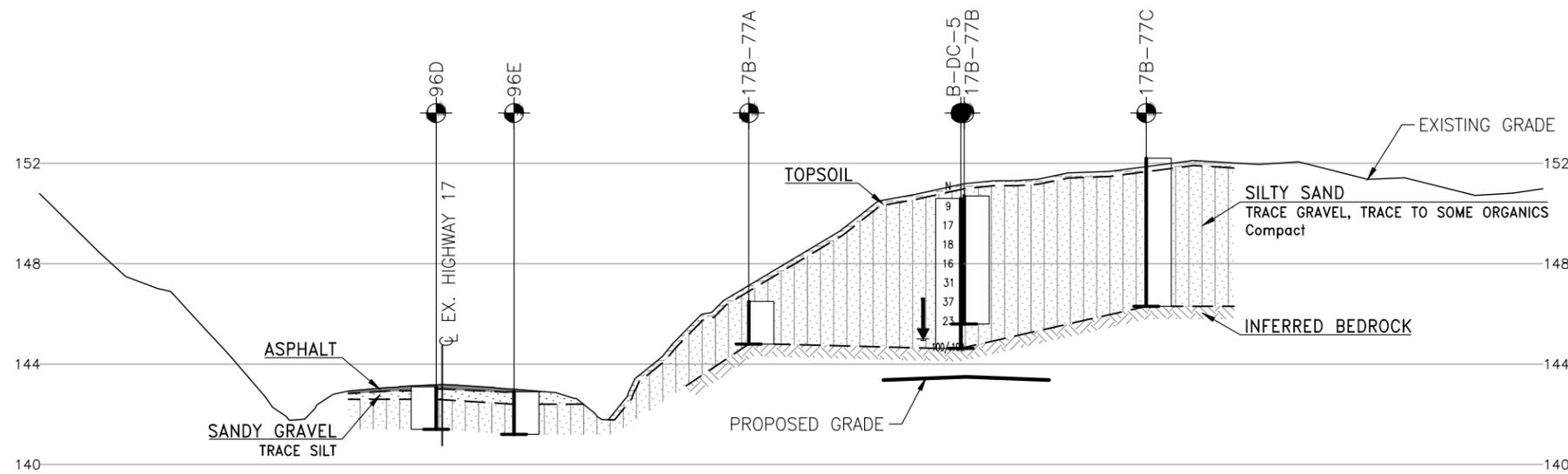
- Foundation Borehole
- ⊙ Pavement Investigation Data Point
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- ∇ Water Level
- ∇ Head Artesian Water
- ⊥ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
B-DC-5	150.6	5 039 305.9	291 587.6
17B-77A	146.5	5 039 316.3	291 601.8
17B-77B	150.7	5 039 308.9	291 586.2
17B-77C	152.2	5 039 309.2	291 570.6
96D	143.1	5 039 321.2	291 626.6
96E	142.9	5 039 318.0	291 621.1

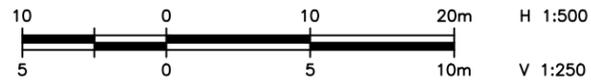
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
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- 3) Coordinate system is MTM NAD 83 Zone 9.

GEOCRES No. 31F-232



SECTION C-C (18+981)

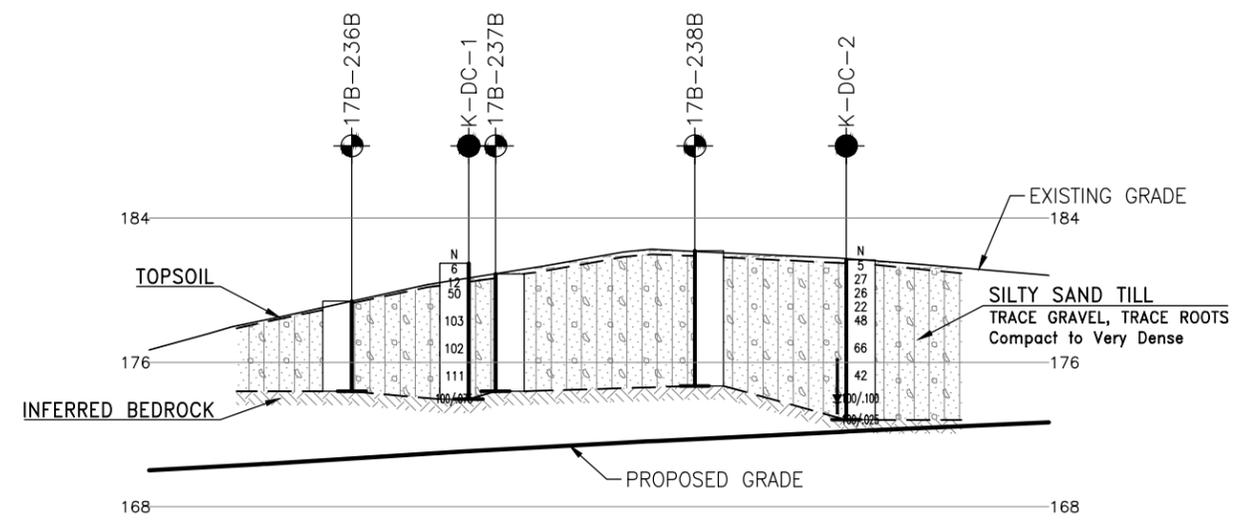
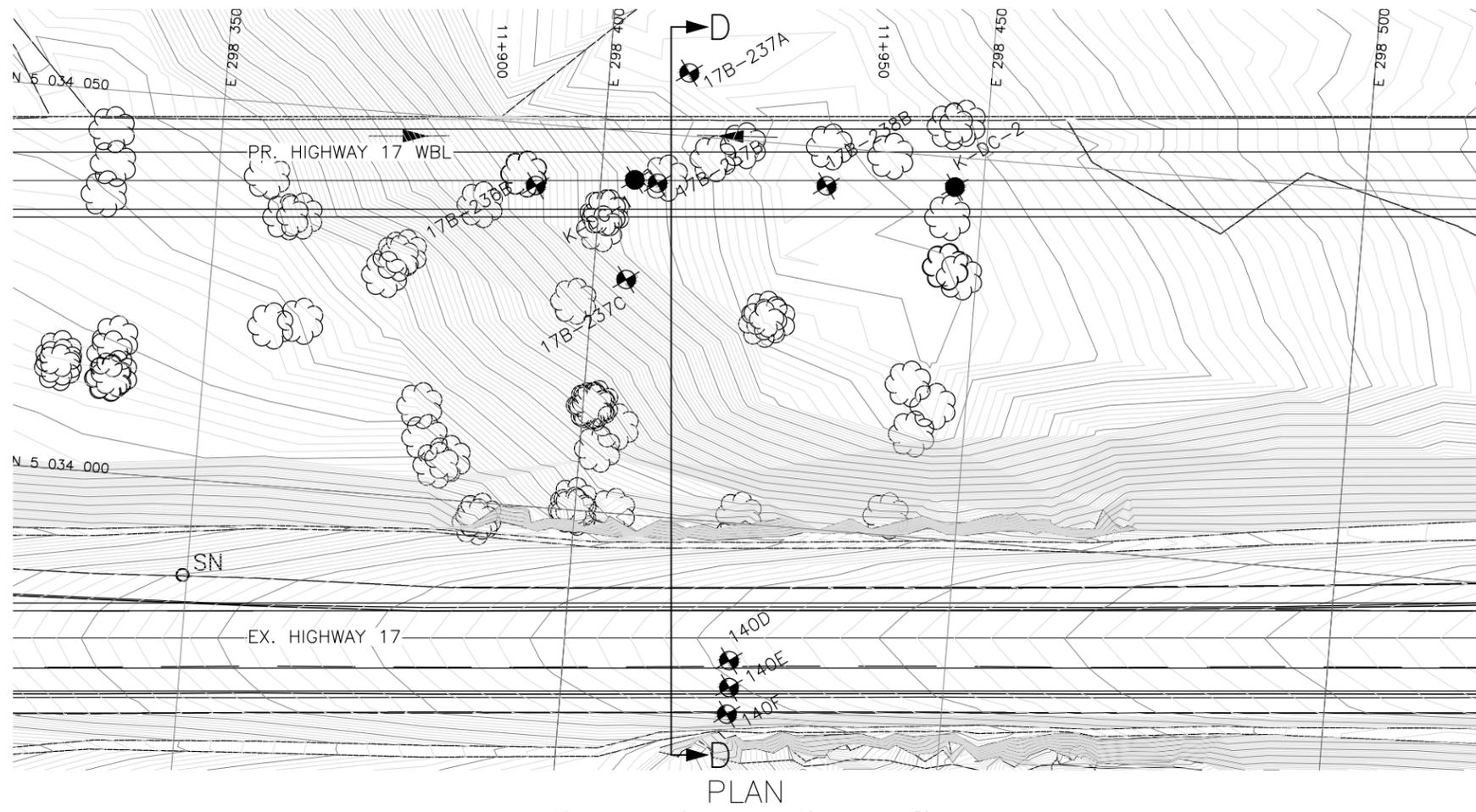


Pavement logs have been modified for consistency with foundation naming conventions.

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	3



PROFILE ALONG  $\varnothing$  PROPOSED WBL



Pavement logs have been modified for consistency with foundation naming conventions.

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

LICENSED PROFESSIONAL ENGINEER

*F. J. Griffiths*

F. J. GRIFFITHS  
90360280

July 15/22

PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER

*P. K. Chatterji*

P. K. CHATTERJI

July 15, 2022

PROVINCE OF ONTARIO

CONT No	
WP No	SHEET
HIGHWAY 17 TWINNING DEEP CUTS DEEP CUT K BOREHOLE LOCATIONS AND SOIL STRATA	
<b>Ontario</b>	

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND			
	Foundation Borehole		
	Pavement Investigation Data Point		
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
K-DC-1	181.5	5 034 043.7	298 404.4
K-DC-2	181.7	5 034 046.1	298 446.3
17B-236B	179.4	5 034 041.9	298 391.5
17B-237A	181.7	5 034 058.2	298 410.4
17B-237B	180.9	5 034 043.5	298 407.4
17B-237C	180.0	5 034 030.6	298 404.3
17B-238B	182.2	5 034 044.9	298 429.5
140D	173.1	5 033 982.0	298 421.7
140E	173.0	5 033 978.5	298 422.0
140F	172.7	5 033 975.0	298 422.0

- 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. Structural elements, surface details and features are for conceptual illustration.
  - 3) Coordinate system is MTM NAD 83 Zone 9.

**GEOCRES No. 31F-232**

REVISIONS		DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	4

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



CONT No	
WP No	
HIGHWAY 17 TWINNING DEEP CUTS DEEP CUT K BOREHOLE LOCATIONS AND SOIL STRATA	SHEET
<b>Ontario</b>	



**KEYPLAN**

**LEGEND**

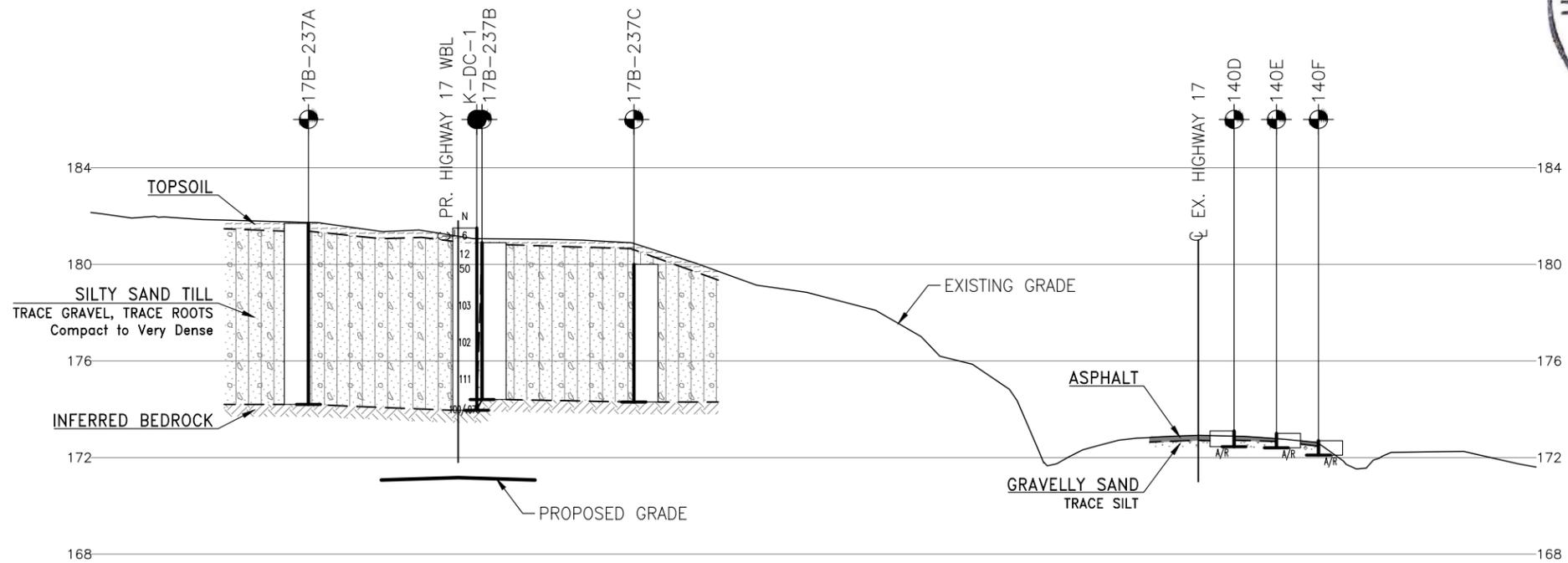
	Foundation Borehole
	Pavement Investigation Data Point
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
K-DC-1	181.5	5 034 043.7	298 404.4
17B-237A	181.7	5 034 058.2	298 410.4
17B-237B	180.9	5 034 043.5	298 407.4
17B-237C	180.0	5 034 030.6	298 404.3
140D	173.1	5 033 982.0	298 421.7
140E	173.0	5 033 978.5	298 422.0
140F	172.7	5 033 975.0	298 422.0

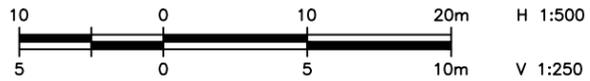
**-NOTES-**

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

**GEOCRES No. 31F-232**



**SECTION D-D (11+922)**

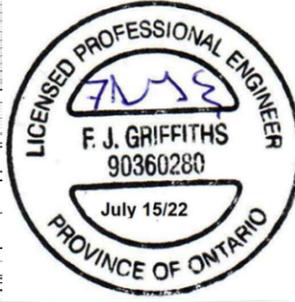
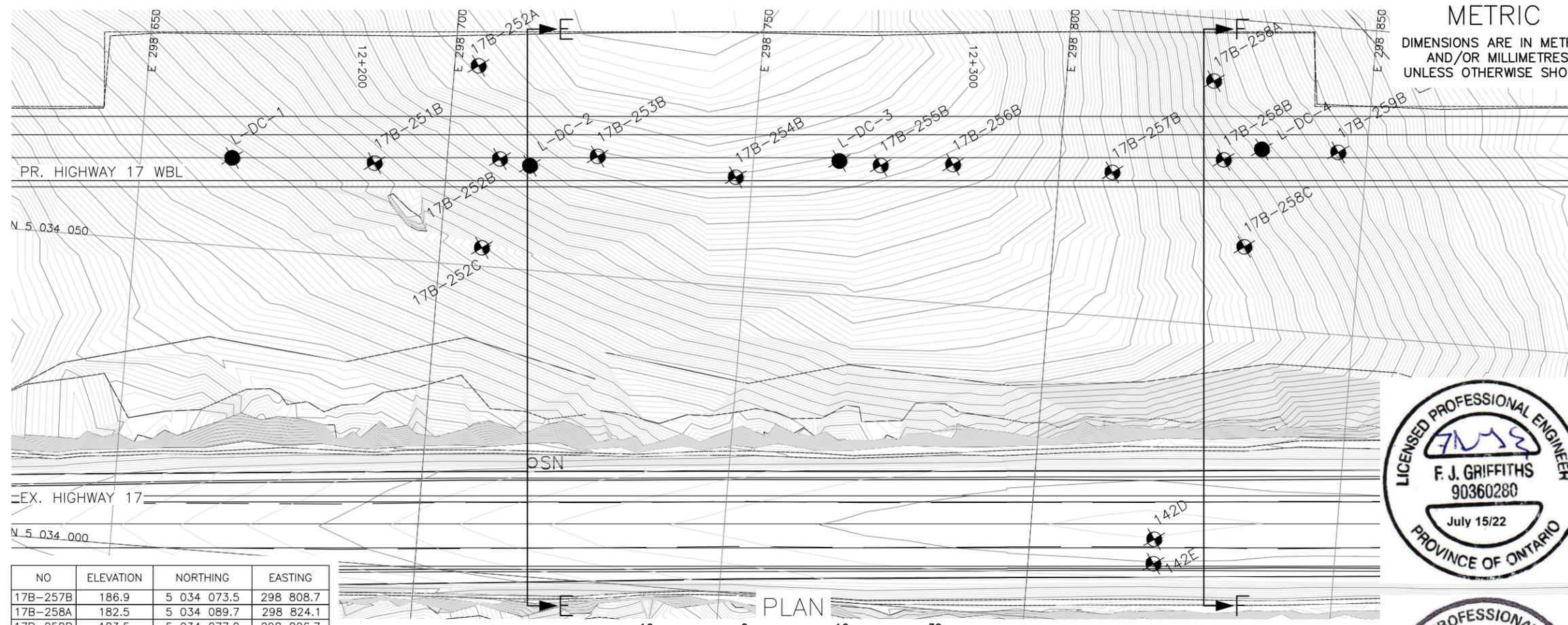


Pavement logs have been modified for consistency with foundation naming conventions.

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	5



NO	ELEVATION	NORTHING	EASTING
17B-257B	186.9	5 034 073.5	298 808.7
17B-258A	182.5	5 034 089.7	298 824.1
17B-258B	183.5	5 034 077.0	298 826.7
17B-258C	184.5	5 034 063.1	298 831.2
17B-259B	180.4	5 034 079.7	298 845.3
142D	177.6	5 034 014.3	298 820.3
142E	177.5	5 034 010.3	298 820.5



CONT No  
WP No

HIGHWAY 17 TWINNING  
DEEP CUTS  
DEEP CUT L  
BOREHOLE LOCATIONS AND SOIL STRATA

**Ontario**

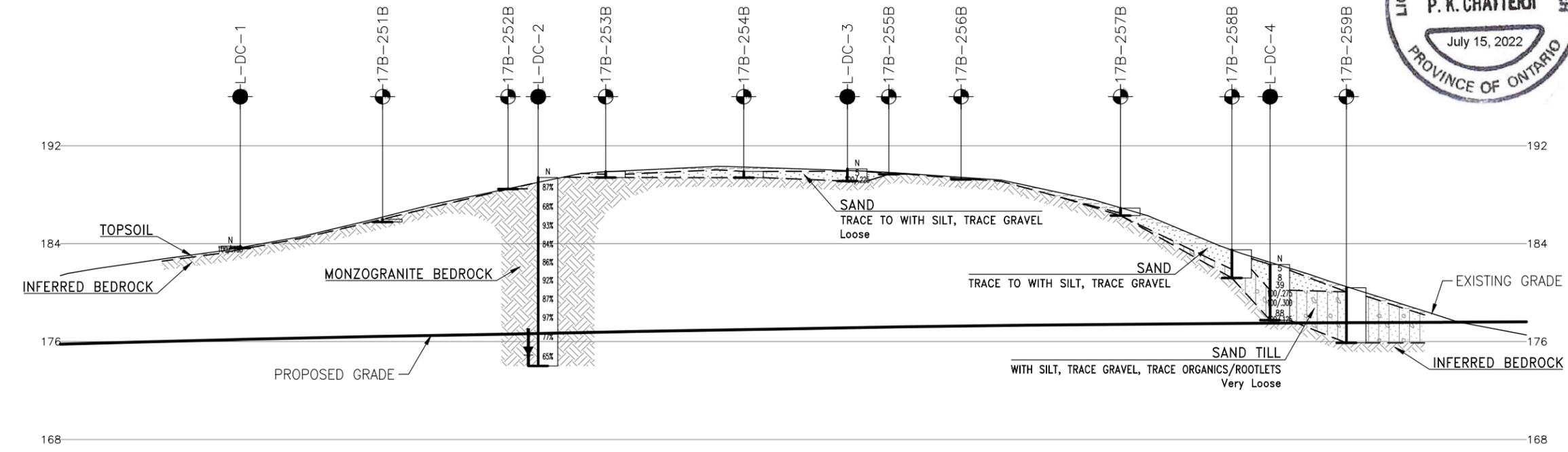
**THURBER ENGINEERING LTD.**

KEYPLAN

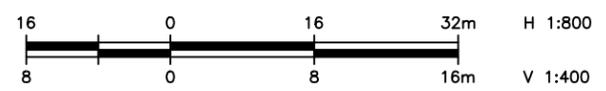
**LEGEND**

- Foundation Borehole
- Pavement Investigation Data Point
- 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
L-DC-1	183.8	5 034 064.4	298 664.9
L-DC-2	189.4	5 034 067.0	298 713.6
L-DC-3	190.1	5 034 071.8	298 764.0
L-DC-4	182.3	5 034 079.2	298 832.8
17B-251B	186.0	5 034 065.4	298 688.2
17B-252A	190.1	5 034 082.6	298 703.9
17B-252B	188.5	5 034 067.7	298 708.6
17B-252C	185.4	5 034 053.0	298 706.8
17B-253B	189.9	5 034 069.4	298 724.5
17B-254B	189.9	5 034 067.8	298 747.3
17B-255B	189.7	5 034 071.6	298 770.8
17B-256B	189.3	5 034 072.7	298 782.6



PROFILE ALONG Q PROPOSED WBL



Pavement logs have been modified for consistency with foundation naming conventions.

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  - This drawing is for subsurface information only. Structural elements, surface details and features are for conceptual illustration.
  - Coordinate system is MTM NAD 83 Zone 9.

**GEOCREs No. 31F-232**

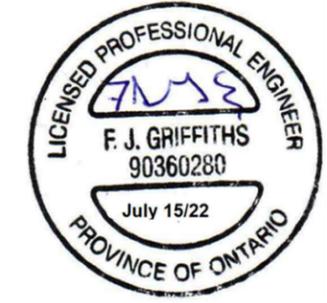
REVISIONS	DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	6

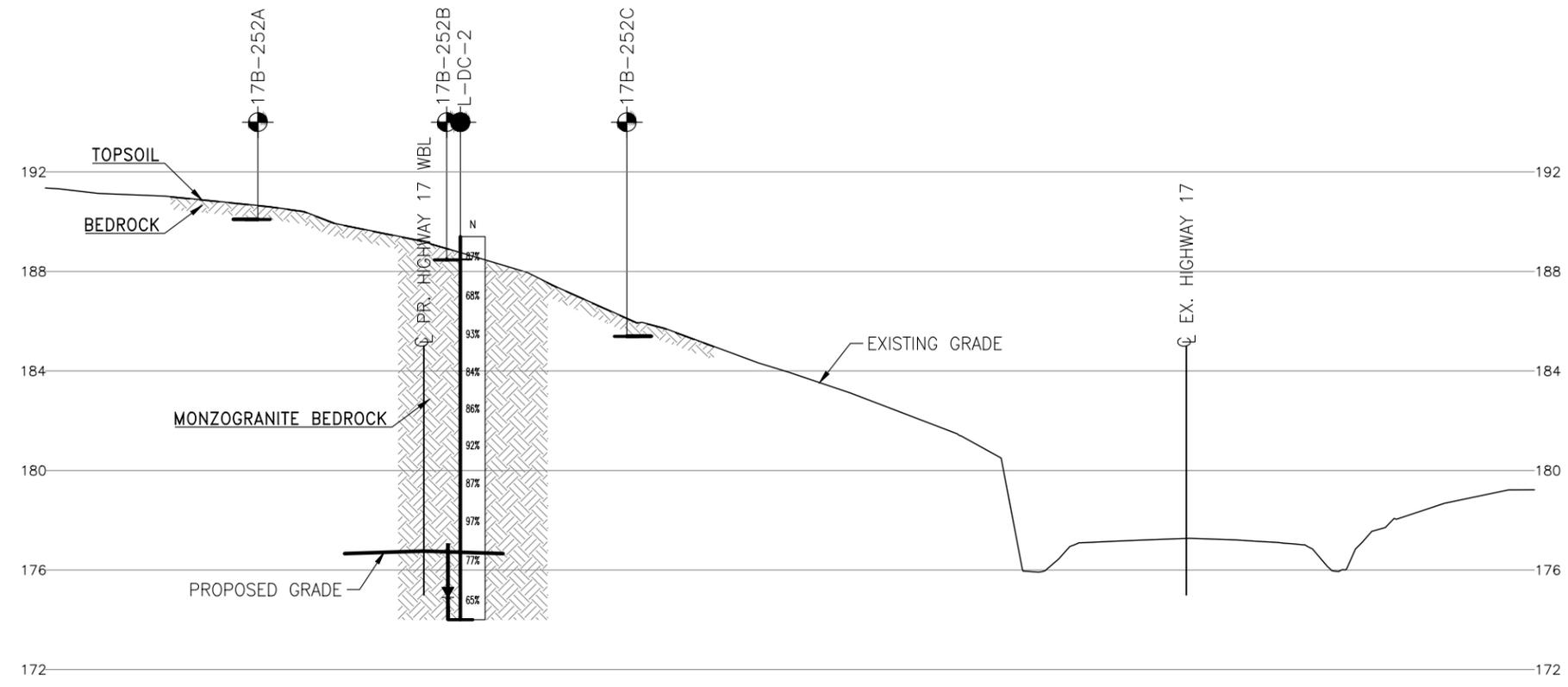
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No  
HIGHWAY 17 TWINNING  
DEEP CUTS  
DEEP CUT L  
BOREHOLE LOCATIONS AND SOIL STRATA

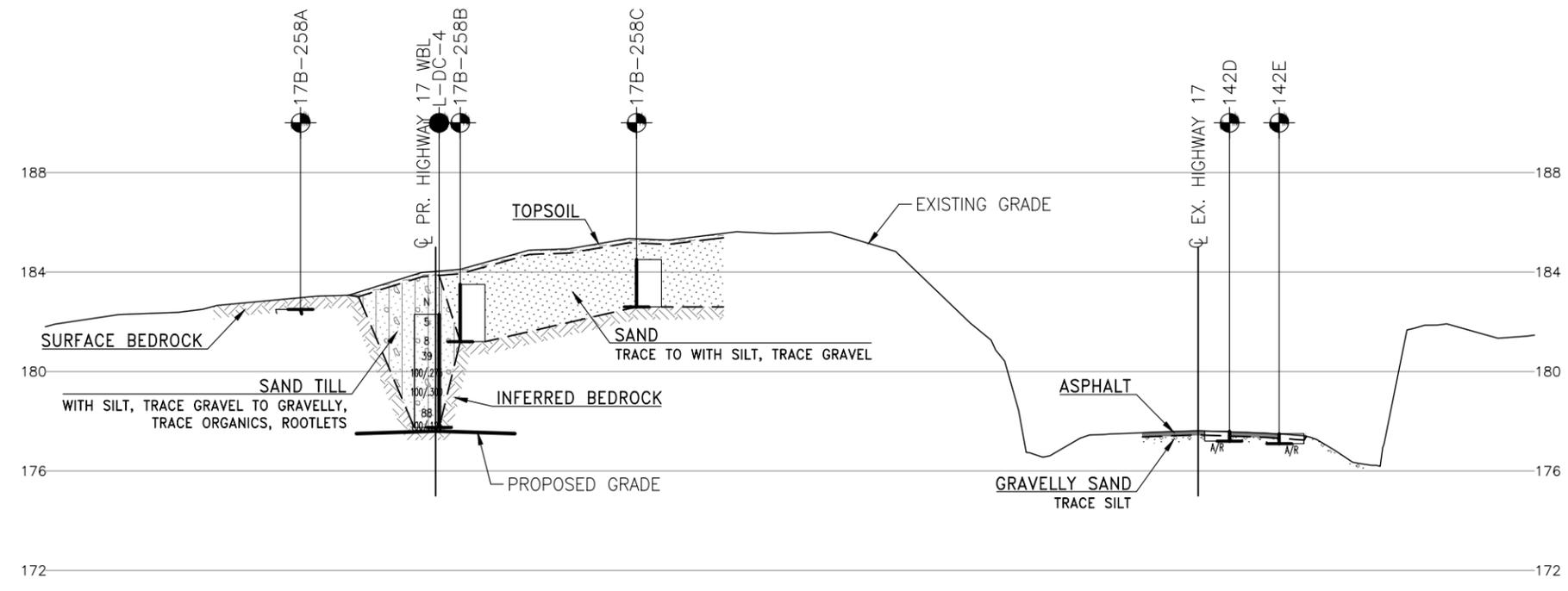
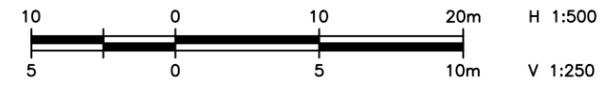
SHEET



KEYPLAN



SECTION E-E (12+227)



SECTION F-F (12+338)



LEGEND

- Foundation Borehole
- Pavement Investigation Data Point
- 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
L-DC-2	189.4	5 034 067.0	298 713.6
L-DC-4	182.3	5 034 079.2	298 832.8
17B-252A	190.1	5 034 082.6	298 703.9
17B-252B	188.5	5 034 067.7	298 708.6
17B-252C	185.4	5 034 053.0	298 706.8
17B-258A	182.5	5 034 089.7	298 824.1
17B-258B	183.5	5 034 077.0	298 826.7
17B-258C	184.5	5 034 063.1	298 831.2
142D	177.6	5 034 014.3	298 820.3
142E	177.5	5 034 010.3	298 820.5

-NOTES-

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- 3) Coordinate system is MTM NAD 83 Zone 9.

**GEOCRES No. 31F-232**

Pavement logs have been modified for consistency with foundation naming conventions.

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	7



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



NO	ELEVATION	NORTHING	EASTING
17B-266B	181.8	5 034 099.5	299 084.8
17B-267B	181.5	5 034 098.9	299 104.8
17B-268A	182.2	5 034 116.5	299 128.8
17B-268B	181.3	5 034 100.5	299 125.2
17B-269RO	181.1	5 034 087.4	299 129.8
17B-270B	181.4	5 034 102.6	299 167.1
17B-271B	180.1	5 034 105.0	299 186.6
143A	176.5	5 034 041.9	299 019.2
143B	176.6	5 034 038.9	299 019.3
143C	176.7	5 034 033.9	299 020.1

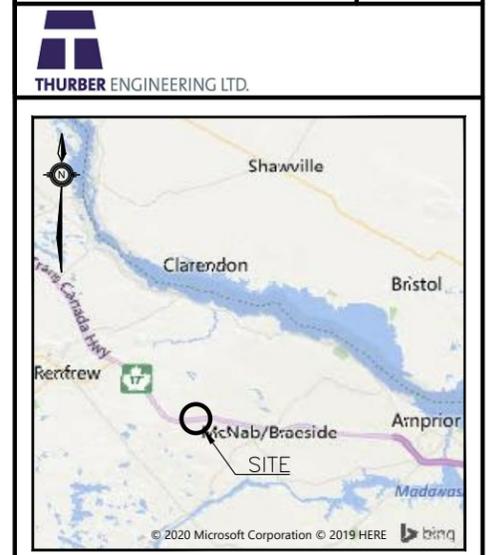
CONT No  
WP No

HIGHWAY 17 TWINNING  
DEEP CUTS  
DEEP CUT M  
BOREHOLE LOCATIONS AND SOIL STRATA

**Ontario**

**THURBER ENGINEERING LTD.**

SHEET



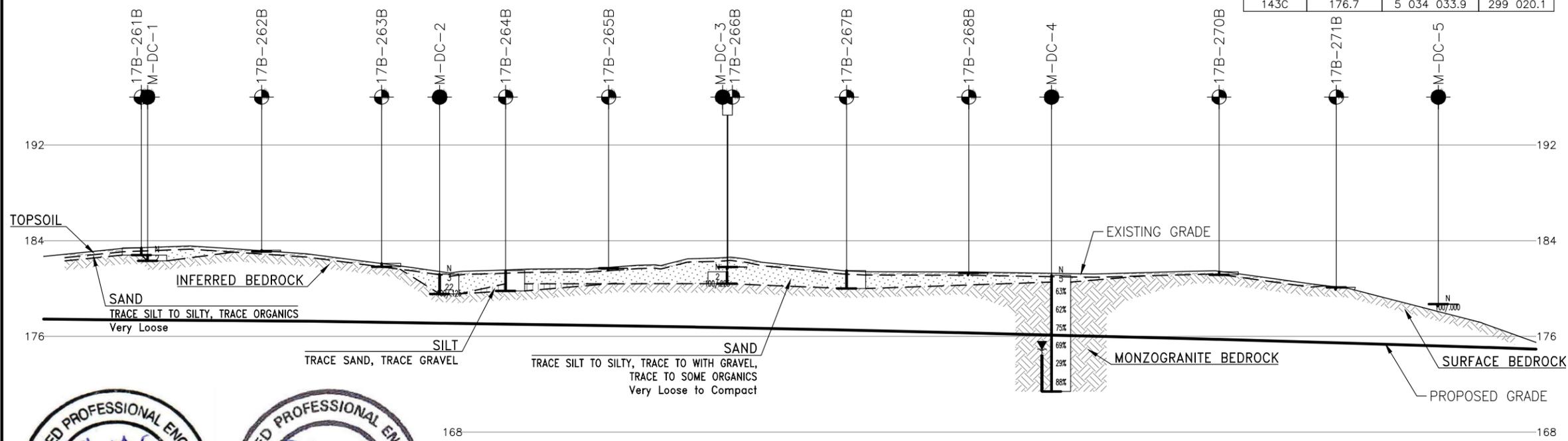
**KEYPLAN**  
**LEGEND**

- Foundation Borehole
- ⊙ Pavement Investigation Data Point
- 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
M-DC-1	182.8	5 034 090.6	298 988.0
M-DC-2	181.2	5 034 094.1	299 036.8
M-DC-3	181.4	5 034 100.4	299 084.6
M-DC-4	181.1	5 034 099.2	299 139.2
M-DC-5	178.7	5 034 106.8	299 203.6
17B-261B	183.4	5 034 092.4	298 986.8
17B-262A	184.0	5 034 107.1	299 004.4
17B-262B	183.2	5 034 092.6	299 007.0
17B-262C	182.3	5 034 078.0	299 012.2
17B-263B	182.1	5 034 090.9	299 027.3
17B-264B	181.5	5 034 096.3	299 047.7
17B-265B	181.7	5 034 097.8	299 064.9

- NOTES-**
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  - Coordinate system is MTM NAD 83 Zone 9.

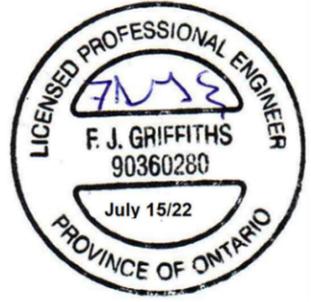
**GEOCREs No. 31F-232**



**PROFILE ALONG Q PROPOSED WBL**



Pavement logs have been modified for consistency with foundation naming conventions.



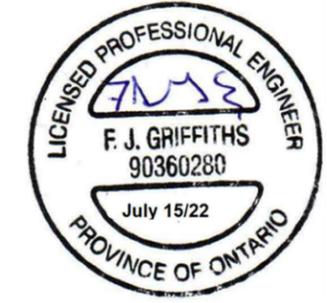
REVISIONS	DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	8

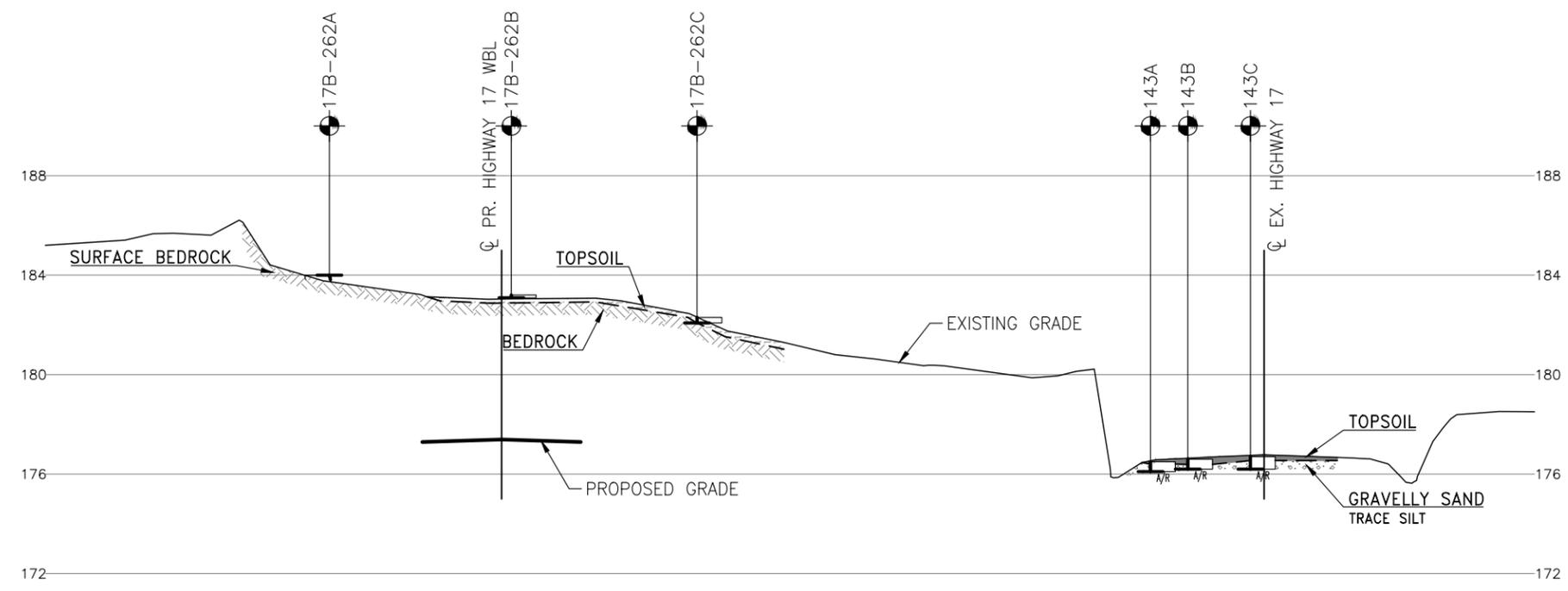
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No  
HIGHWAY 17 TWINNING  
DEEP CUTS  
DEEP CUT M  
BOREHOLE LOCATIONS AND SOIL STRATA

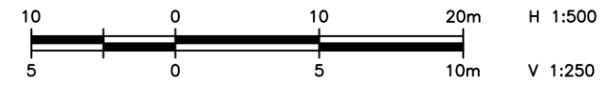
SHEET



KEYPLAN



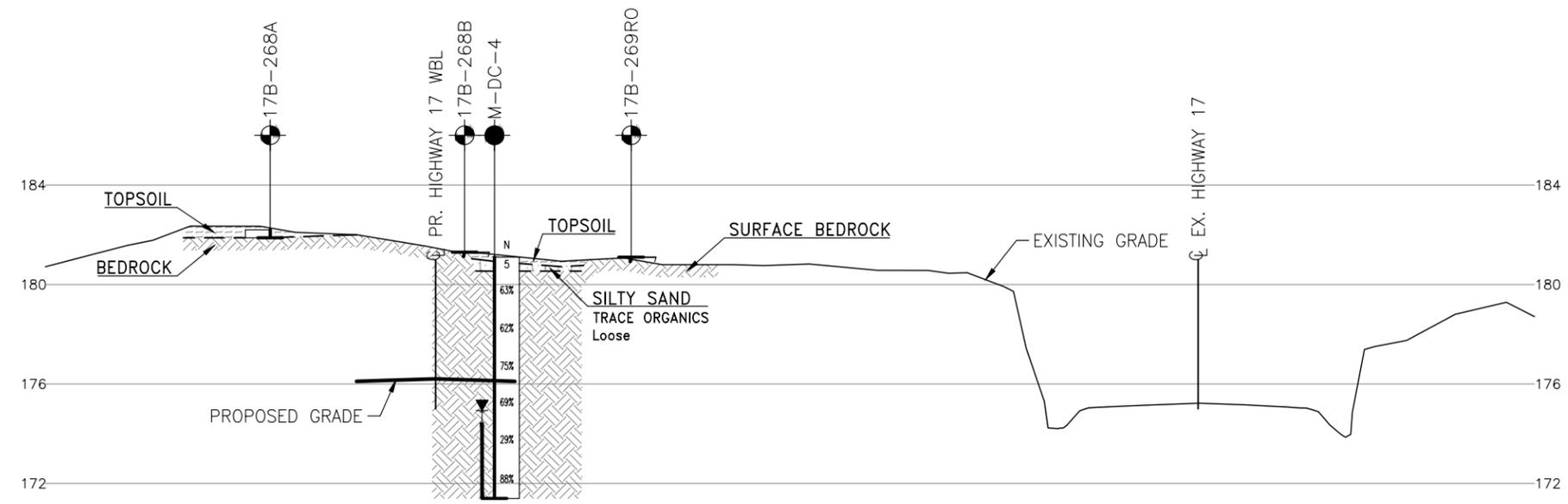
SECTION G-G (12+525)



LEGEND

- Foundation Borehole
- Pavement Investigation Data Point
- 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
M-DC-4	181.1	5 034 099.2	299 139.2
17B-262A	184.0	5 034 107.1	299 004.4
17B-262B	183.2	5 034 092.6	299 007.0
17B-262C	182.3	5 034 078.0	299 012.2
17B-268A	182.2	5 034 116.5	299 128.8
17B-268B	181.3	5 034 100.5	299 125.2
17B-269RO	181.1	5 034 087.4	299 129.8
143A	176.5	5 034 041.9	299 019.2
143B	176.6	5 034 038.9	299 019.3
143C	176.7	5 034 033.9	299 020.1



SECTION H-H (12+647)



Pavement logs have been modified for consistency with foundation naming conventions.

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  - Coordinate system is MTM NAD 83 Zone 9.

**GEOCRES No. 31F-232**

REVISIONS	DATE	BY	DESCRIPTION

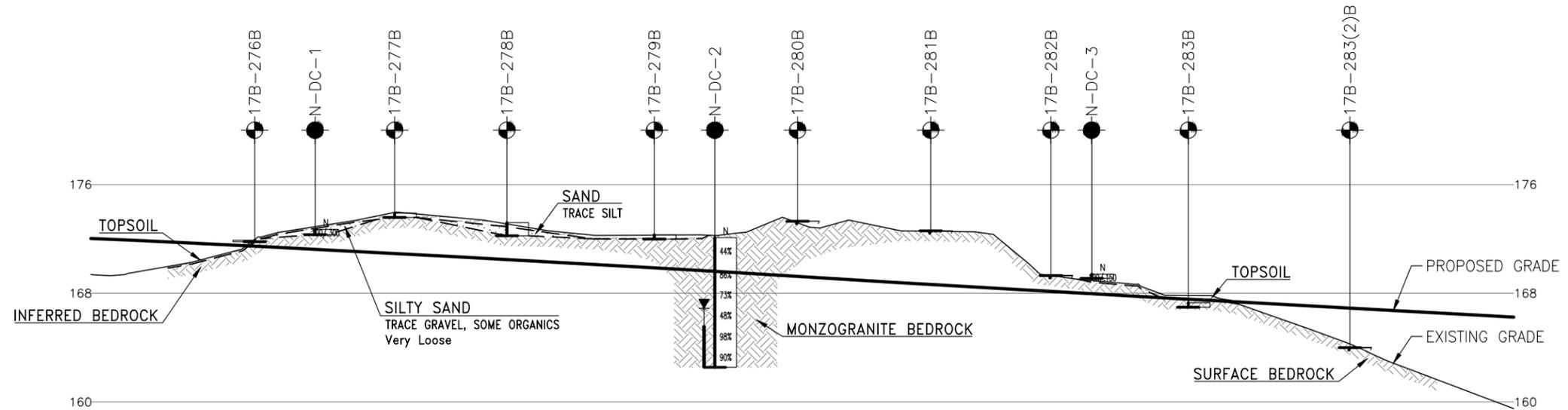
DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	9



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



NO	ELEVATION	NORTHING	EASTING
17B-283(2)B	164.0	5 034 133.4	299 545.9
17B-283B	167.3	5 034 129.4	299 522.3
145B	100.0	5 034 070.1	299 401.2
145C	169.1	5 034 067.5	299 402.4



CONT No  
WP No

HIGHWAY 17 TWINNING  
DEEP CUTS  
DEEP CUT N  
BOREHOLE LOCATIONS AND SOIL STRATA

**Ontario**

**THURBER ENGINEERING LTD.**



**KEYPLAN**  
**LEGEND**

- Foundation Borehole
- ⊙ Pavement Investigation Data Point
- 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

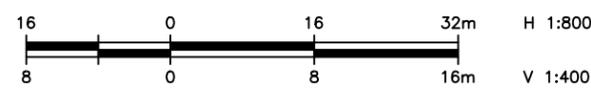
NO	ELEVATION	NORTHING	EASTING
N-DC-1	172.7	5 034 128.4	299 393.1
N-DC-2	172.1	5 034 129.4	299 452.2
N-DC-3	169.4	5 034 129.2	299 508.0
17B-276B	171.9	5 034 121.6	299 384.7
17B-277B	173.9	5 034 124.3	299 405.2
17B-278B	173.2	5 034 123.4	299 421.9
17B-279A	172.0	5 034 139.5	299 444.0
17B-279B	172.3	5 034 126.2	299 443.5
17B-279C	172.9	5 034 112.0	299 446.0
17B-280B	173.3	5 034 127.5	299 464.6
17B-281B	172.6	5 034 128.9	299 484.2
17B-282B	169.3	5 034 131.4	299 501.8

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

**GEOCREs No. 31F-232**



**PROFILE ALONG C PROPOSED WBL**



Pavement logs have been modified for consistency with foundation naming conventions.

REVISIONS	DATE	BY	DESCRIPTION

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



CONT No	
WP No	
HIGHWAY 17 TWINNING DEEP CUTS DEEP CUT N BOREHOLE LOCATIONS AND SOIL STRATA	SHEET
<b>Ontario</b>	



**KEYPLAN**

**LEGEND**

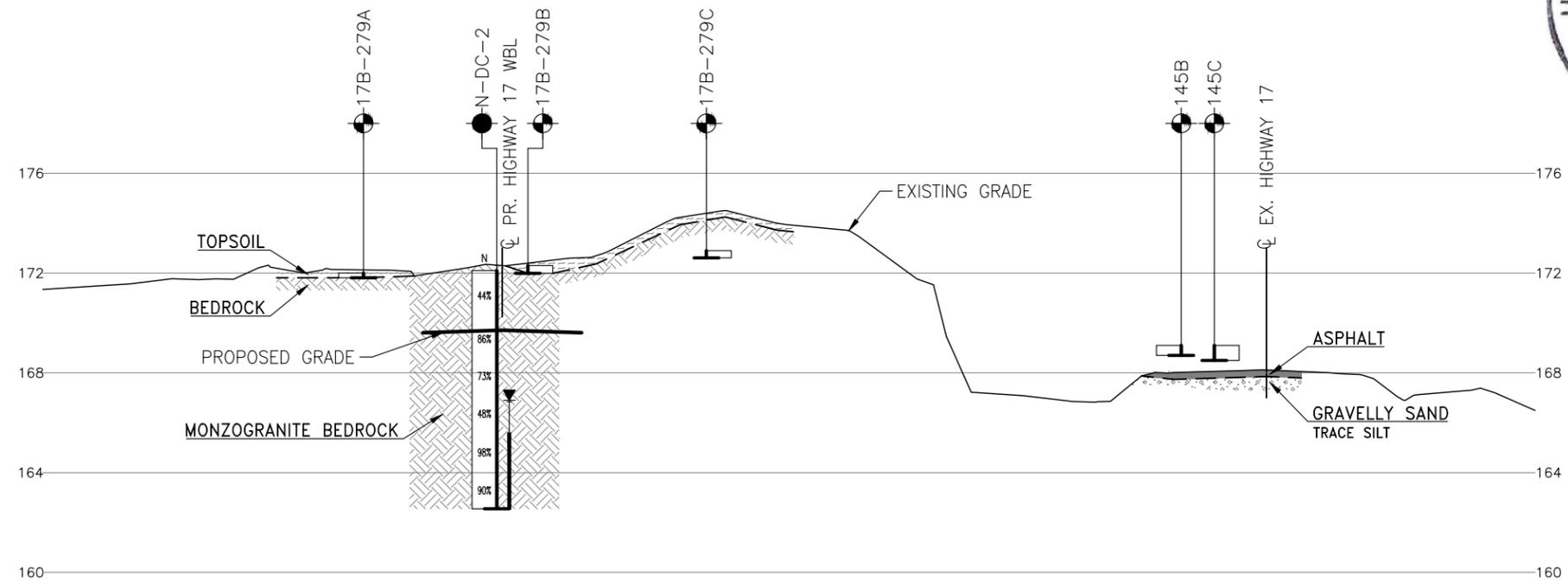
	Foundation Borehole
	Pavement Investigation Data Point
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
N-DC-2	172.1	5 034 129.4	299 452.2
17B-279A	172.0	5 034 139.5	299 444.0
17B-279B	172.3	5 034 126.2	299 443.5
17B-279C	172.9	5 034 112.0	299 446.0
145B	100.0	5 034 070.1	299 401.2
145C	169.1	5 034 067.5	299 402.4

**-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. Structural elements, surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 9.

**GEOCRES No. 31F-232**



SECTION I-I (12+949)



Pavement logs have been modified for consistency with foundation naming conventions.

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	DJP	CHK	FG	CODE	LOAD	DATE	JUL 2022
DRAWN	MFA	CHK	PKC	SITE	STRUCT	DWG	11



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



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

### TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

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

### TERMINOLOGY DESCRIBING SOIL STRUCTURE:

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

### RECOVERY:

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

### N-VALUE:

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

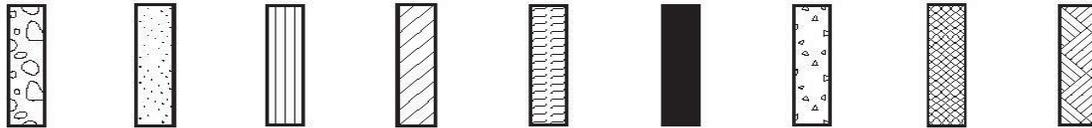
### DYNAMIC CONE PENETRATION TEST (DCPT):

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



**STRATA PLOT:**

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



Boulders  
Cobbles  
Gravel      Sand      Silt      Clay      Organics      Asphalt      Concrete      Fill      Bedrock

**TEXTURING CLASSIFICATION OF SOILS**

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

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

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

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

**SAMPLE TYPES**

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

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

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



### MODIFIED UNIFIED SOIL CLASSIFICATION

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

Note -  $W_L$  = Liquid Limit



## EXPLANATION OF ROCK LOGGING TERMS

### ROCK WEATHERING CLASSIFICATION

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

### TERMS

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

### DISCONTINUITY SPACING

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

### STRENGTH CLASSIFICATION

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

### RECORD OF BOREHOLE No B-DC-1

1 OF 2

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.495947° Long: -76.6703°  
Deep Cuts MTM Zone 9: N 5 039 572.4 E 291 490.1 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.23 - 2020.11.23 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa 20 40 60 80 100							WATER CONTENT (%) 20 40 60
154.2	Ground Surface														
0.0	TOPSOIL (175 mm)														
0.2	SILTY SAND (SM), trace organics Loose Yellow-brown		1	SS	5	154								0 77 23 (SI+CL)	
153.4	CLAY (CI), trace sand partings Very stiff Grey-brown (WEATHERED CRUST)		2	SS	12	153									
0.8			3	SS	13	152									
			4	SS	10	151									
			5	SS	13	150									
			6	SS	9	149									
			7	SS	8	148									
			8	SS	6	147									
148.0	CLAY (CI) Very stiff Grey		9	SS	4	146									
6.2			10	SS	7	145									

DOUBLE LINE 24726 DEEP CUTS.GPJ, 2012TEMPLATE(MTO).GDT 22-7-15

Continued Next Page

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

### RECORD OF BOREHOLE No B-DC-1

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.495947°, Long: -76.6703°  
Deep Cuts MTM Zone 9: N 5 039 572.4 E 291 490.1 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
DATUM Geodetic DATE 2020.11.23 - 2020.11.23 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
142.9	CLAY (Cl) Very stiff Grey		11	SS	7		144										
11.3	End of Borehole Unstabilized water level at 9.1m below the ground surface upon completion of drilling.						143										

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No B-DC-2

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.495342° Long: -76.669932°  
 Deep Cuts MTM Zone 9: N 5 039 505.1 E 291 518.7 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.24 - 2020.11.24 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
153.7	Ground Surface														
0.0	TOPSOIL (100mm)														
0.1	SILTY SAND (SM), trace organics Loose Yellow-brown		1	SS	4							○			
152.9	CLAY (CI), trace sand Stiff to very stiff Grey-brown (WEATHERED CRUST)		2	SS	10							○			
0.8			3	SS	15							○			
			4	SS	13							○			0 2 49 49
			5	SS	12							○			
			6	SS	12							○			
			7	SS	9							○			
			8	SS	5							○			
147.6	CLAY (CI) Very stiff to stiff Grey		9	SS	5							○			0 0 49 51
6.1			10	SS	4							○			

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

Continued Next Page

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

### RECORD OF BOREHOLE No B-DC-2

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.495342°, Long: -76.669932°  
Deep Cuts MTM Zone 9: N 5 039 505.1 E 291 518.7 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
DATUM Geodetic DATE 2020.11.24 - 2020.11.24 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>				
	Continued From Previous Page																
	<b>CLAY (Cl)</b> Stiff Grey																
			11	SS	3											0 2 53 45	
140.9			12	SS	3												
12.8	End of Borehole  Monitoring well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen  WATER LEVEL READINGS:  Date      Depth (m)      Elev. (m) 2020.12.15      4.9      148.8 2021.08.04      5.7      148.0 2021.09.30      6.3      147.4 Borehole dry on completion of drilling.																

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No B-DC-3

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.494696°, Long: -76.66962°  
Deep Cuts MTM Zone 9: N 5 039 433.2 E 291 542.9 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
DATUM Geodetic DATE 2020.11.24 - 2020.11.24 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
153.9	Ground Surface															
0.0	TOPSOIL (275 mm)															
153.6																
0.3	SAND with silt, trace organics Loose Dark brown to yellow-brown		1	SS	7											
152.9																
1.0	CLAY (CI), trace organics and gravel Very stiff Grey-brown (WEATHERED CRUST)		2	SS	8											
151.5																
2.4	SAND (SW-SM) with silt Dense to very dense Yellow-brown to light brown		4	SS	42											
150.2																
3.7	End of Borehole Spoon refusal on inferred bedrock. Borehole dry on completion of drilling.				75mm										0 88 12 (SI+CL)	

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

### RECORD OF BOREHOLE No B-DC-4

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.494216°, Long: -76.669505°  
 Deep Cuts MTM Zone 9: N 5 039 379.9 E 291 551.8 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA, HQ Coring COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.24 - 2020.11.24 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
					20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
					WATER CONTENT (%)								
					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	W <sub>p</sub>	W	W <sub>L</sub>			
159.1	Ground Surface												
0.0	TOPSOIL (280 mm)	1	SS	100/									
158.8				275mm									
0.3	SAND (SW-SM) with silt and gravel Trace organics Very dense Beige to white-grey -Spoon refusal on probable boulder at 0.3m	2	SS	100/									
158.1				300mm									
1.0	MARBLE BEDROCK Moderately weathered to freshly jointed White-grey Granoblastic texture Medium grained Massive structure Strong Metamorphic rock	1	RUN	-									
		2	RUN	-									
		3	RUN	-									
		4	RUN	-									
		5	RUN	-									
		6	RUN	-									

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

Continued Next Page

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

### RECORD OF BOREHOLE No B-DC-4

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.494216°, Long: -76.669505°  
Deep Cuts MTM Zone 9: N 5 039 379.9 E 291 551.8 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA, HQ Coring COMPILED BY AO  
DATUM Geodetic DATE 2020.11.24 - 2020.11.24 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60	kn/m <sup>3</sup>	GR SA SI CL	
Continued From Previous Page																
141.9	<b>MARBLE BEDROCK</b> Moderately weathered to freshly jointed White-grey Granoblastic texture Medium grained Massive structure Strong Metamorphic rock		7	RUN	-									1	RUN #7 TCR=100% SCR=97% RQD=95% UCS=77.9MPa	
			8	RUN	-									1	RUN #8 TCR=100% SCR=100% RQD=100% UCS=97.6MPa	
			9	RUN	-									1	RUN #9 TCR=98% SCR=97% RQD=90% UCS=72.2MPa	
			10	RUN	-									1	RUN #10 TCR=100% SCR=81% RQD=87% UCS=77.4MPa	
			11	RUN	-									1	RUN #11 TCR=100% SCR=92% RQD=77% UCS=29.6MPa	
142	End of Borehole													3		
17.2	Monitoring well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen															
	WATER LEVEL READINGS:															
	Date      Depth (m)      Elev. (m)															
	2020.12.15      9.3      149.8															
	2021.08.04      10.9      148.2															
	2021.09.30      12.0      147.2															
	2021.10.20      6.3      152.8															

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

### RECORD OF BOREHOLE No B-DC-5

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.493551°, Long: -76.669045°  
 Deep Cuts MTM Zone 9: N 5 039 305.9 E 291 587.6 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.27 - 2020.11.27 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
150.6	Ground Surface																	
0.0	TOPSOIL (200mm)																	
0.2	SILTY SAND (SM) Trace to some organics Compact Dark brown to yellow-brown		1	SS	9													
			2	SS	17												1 69 22 8	
149.1	SILTY SAND (SM) Compact Light brown		3	SS	18													
1.5			4	SS	16													
			5	SS	31													
			6	SS	37													
			7	SS	23												4 76 20 (SI+CL)	
	-Augers griding while advancing past 5.2m depth																	
144.6	End of Borehole Spoon bouncing on inferred bedrock.  Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen  WATER LEVEL READINGS:  Date      Depth (m)      Elev. (m) 2020.12.15      Dry      - 2021.08.04      5.6      145.0 2022.07.15      5.6      145.0		8	SS	100/													
6.0			100mm															

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No K-DC-1

1 OF 1

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.446295°, Long: -76.58176°  
Deep Cuts MTM Zone 9: N 5 034 043.7 E 298 404.4 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.02 - 2020.11.03 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa 20 40 60 80 100										WATER CONTENT (%) 20 40 60	
181.5	Ground Surface																	
0.0	TOPSOIL (225 mm)																	
0.2	SILTY SAND (SM), trace roots Compact to very dense Grey TILL	1	SS	6														
		2	SS	12														
		3	SS	50												3	70	27 (SI+CL)
		4	SS	103														
		5	SS	102														
		6	SS	111														
		7	SS	100/														
174.0	End of Borehole Spoon and auger refusal on inferred bedrock. Borehole dry on completion of drilling.			75mm														
7.5																		

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No K-DC-2

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446317°, Long: -76.581224°  
 Deep Cuts MTM Zone 9: N 5 034 046.1 E 298 446.3 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.03 - 2020.11.04 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60						80
181.7	Ground Surface														
0.0	TOPSOIL (280 mm)														
181.4															
0.3	SILTY SAND (SM), trace roots Compact to very dense Grey TILL  - Gravelly below 7.6m depth - Augers grinding while advancing	1	SS	5											
		2	SS	27											
		3	SS	26											
		4	SS	22											
		5	SS	48											2 69 29 (SI+CL)
		6	SS	66											
		7	SS	42											3 76 21 (SI+CL)
		8	SS	100/											
172.8	End of Borehole														
8.9	Spoon refusal on inferred bedrock. Borehole dry on completion of drilling.														

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

Continued Next Page

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

### RECORD OF BOREHOLE No K-DC-2

2 OF 2

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.446317°, Long: -76.581224°  
Deep Cuts MTM Zone 9: N 5 034 046.1 E 298 446.3 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.03 - 2020.11.04 CHECKED BY FG

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL								
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						W <sub>p</sub>	W	W <sub>L</sub>					
	Continued From Previous Page																								
	Monitoring well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen																								
	WATER LEVEL READINGS:																								
	<table border="1"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev. (m)</th> </tr> </thead> <tbody> <tr> <td>2020.12.15</td> <td>7.4</td> <td>174.3</td> </tr> <tr> <td>2021.09.24</td> <td>7.9</td> <td>173.8</td> </tr> </tbody> </table>	Date	Depth (m)	Elev. (m)	2020.12.15	7.4	174.3	2021.09.24	7.9	173.8															
Date	Depth (m)	Elev. (m)																							
2020.12.15	7.4	174.3																							
2021.09.24	7.9	173.8																							

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No L-DC-1

1 OF 1

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.446484°, Long: -76.57843°  
Deep Cuts MTM Zone 9: N 5 034 064.4 E 298 664.9 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.04 - 2020.11.04 CHECKED BY FG

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
183.8	Ground Surface																
0.0	TOPSOIL (150mm)		1	SS	100/												
0.2	End of Borehole Auger and spoon refusal on inferred bedrock.				150mm												

DOUBLE LINE 24726 DEEP CUTS.GPJ, 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No L-DC-2

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446508°, Long: -76.577807°  
Deep Cuts MTM Zone 9: N 5 034 067.0 E 298 713.6 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HQ Coring COMPILED BY AO  
DATUM Geodetic DATE 2020.11.05 - 2020.11.09 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
189.4	Ground Surface					20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		GR SA SI CL	
0.0	<b>MONZOGRANITE BEDROCK</b> Freshly jointed to moderately weathered Red-ish to pink grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong		1	RUN	-										1	RUN #1 TCR=100% SCR=94% RQD=87% UCS=133.5MPa
			2	RUN	-										3	RUN #2 TCR=100% SCR=89% RQD=68% UCS=114.4MPa
			3	RUN	-										1	RUN #3 TCR=98% SCR=96% RQD=93% UCS=154.8MPa
			4	RUN	-										1	RUN #4 TCR=100% SCR=98% RQD=84% UCS=106MPa
			5	RUN	-										6	RUN #5 TCR=93% SCR=89% RQD=86% UCS=226.1MPa
			6	RUN	-										0	RUN #6 TCR=100% SCR=92% RQD=92% UCS=99.7MPa
			7	RUN	-										3	RUN #7

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

Continued Next Page

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

### RECORD OF BOREHOLE No L-DC-2

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446508°, Long: -76.577807°  
Deep Cuts MTM Zone 9: N 5 034 067.0 E 298 713.6 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HQ Coring COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.05 - 2020.11.09 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	Continued From Previous Page					20 40 60 80 100										
						○ UNCONFINED + FIELD VANE										
						● QUICK TRIAXIAL × LAB VANE										
						20 40 60 80 100										
174.0	<b>MONZOGANITE BEDROCK</b> Freshly jointed to moderately weathered Red-ish to pink grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong														0	TCR=100% SCR=95% RQD=87% UCS=79.2MPa
			8	RUN	-										1	
															0	
															0	
			9	RUN	-										2	RUN #8 TCR=100% SCR=98% RQD=97% UCS=131MPa
															2	
															0	
															6	
															0	
															7	RUN #9 TCR=100% SCR=77% RQD=77% UCS=92.1MPa
															6	
															2	
															>10	
															6	
			10	RUN	-										1	RUN #10 TCR=100% SCR=77% RQD=65% UCS=142.7MPa
															0	
															1	
174.0	End of Borehole															
15.4	Monitoring well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen															
	WATER LEVEL READINGS:															
	Date      Depth (m)      Elev. (m)															
	2020.12.15      14.0      175.4															
	2021.09.24      14.5      174.9															

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

+ 3, x 3: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

### RECORD OF BOREHOLE No L-DC-3

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446551°, Long: -76.577163°  
Deep Cuts MTM Zone 9: N 5 034 071.8 E 298 764.0 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HAS COMPILED BY AO  
DATUM Geodetic DATE 2020.11.09 - 2020.11.09 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>				
190.1	Ground Surface																
0.0	TOPSOIL (30 mm)																
	SAND (SW-SM) with silt Trace gravel Loose Dark brown to grey-brown		1	SS	5							o				9 86 5 (SI+CL)	
189.1			2	SS	100/						o	o					
1.0	End of Borehole Auger and spoon refusal on inferred bedrock.  Offset 1m and observed refusal at 75mm depth.				225mm												

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No L-DC-4

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446618°, Long: -76.576283°  
 Deep Cuts MTM Zone 9: N 5 034 079.2 E 298 832.8 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.09 - 2020.11.09 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
						20 40 60 80 100					W <sub>p</sub>	W	W <sub>L</sub>	kn/m <sup>3</sup>	GR SA SI CL			
182.3	Ground Surface																	
0.0	TOPSOIL (170 mm)																	
0.2	SAND (SP-SM) with silt Trace gravel, organics, rootlets Loose to dense Grey-brown		1	SS	5													
			2	SS	8											4	84 12 (SI+CL)	
			3	SS	39													
180.2	SAND (SP-SM) with silt and gravel Trace organics, rootlets Very dense Grey TILL  - Gravelly below 3.6m depth.		4	SS	100/ 275mm													
			5	SS	100/ 300mm													
			6	SS	88												23	70 7 (SI+CL)
			7	SS	100/125mm													
177.8	End of Borehole Spoon and auger refusal on inferred bedrock.  Borehole dry on completion of drilling.																	

DOUBLE LINE 24726 DEEP CUTS.GPJ, 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No M-DC-1

1 OF 1

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.446722°, Long: -76.574299°  
Deep Cuts MTM Zone 9: N 5 034 090.6 E 298 988.0 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.11 - 2020.11.11 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>	KN/m <sup>3</sup>	GR SA SI CL	
182.8	Ground Surface															
0.0	TOPSOIL (320 mm)		1	SS	2										3	68 29 (SI+CL)
182.5																
182.3	SILTY SAND (SM), trace organics															
0.5	Very loose Brown  End of Borehole Spoon and auger refusal on inferred bedrock.															

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

**RECORD OF BOREHOLE No M-DC-2**

1 OF 1

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.446754°, Long: -76.573676°  
Deep Cuts MTM Zone 9: N 5 034 094.1 E 299 036.8 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.09 - 2020.11.09 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100							
181.2	Ground Surface																
0.0	TOPSOIL (250 mm)																
0.2	SAND (SP-SM) with silt and gravel Some to trace organics Very loose to compact Brown		1	SS	3												
179.5	- Gravelly below 1.5m depth.		2	SS	22											32 63 5 (SI+CL)	
179.5			3	SS	100/												
1.7	End of Borehole Spoon refusal on inferred bedrock.  Borehole dry on completion of drilling.					125mm											

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

### RECORD OF BOREHOLE No M-DC-3

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45,446811°, Long: -76,573065°  
Deep Cuts MTM Zone 9: N 5 034 100.4 E 299 084.6 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.11 - 2020.11.11 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
181.4	Ground Surface																
0.0	TOPSOIL (125 mm)																
0.1	SAND (SW-SM) with silt Trace gravel and organics Loose Brown		1	SS	2												
180.4			2	SS	100/											6 82 12	(SH+CL)
1.0	End of Borehole Spoon and auger refusal on inferred bedrock.				225mm												

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No M-DC-4

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446801°, Long: -76.572367°  
 Deep Cuts MTM Zone 9: N 5 034 099.2 E 299 139.2 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA, HQ Coring COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.10 - 2020.11.10 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	20	40	60	GR SA SI CL
181.1	Ground Surface													
0.0	TOPSOIL (250 mm)													
0.2	SILTY SAND (SM), trace organics		1	SS	5									1 78 21 (SI+CL)
180.5	Loose													
0.6	Dark brown to brown													
	<b>MONZOGRANITE BEDROCK</b> Moderately weathered to highly weathered Red-ish to pink-grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong - Rust colouration at diagonal fractures		1	RUN										RUN #1 TCR=97% SCR=70% RQD=63% UCS=144MPa
			2	RUN										RUN #2 TCR=100% SCR=73% RQD=62% UCS=50.5MPa
			3	RUN										RUN #3 TCR=95% SCR=82% RQD=75% UCS=169.4MPa
			4	RUN										RUN #4 TCR=100% SCR=81% RQD=69% UCS=92.2MPa
			5	RUN										RUN #5 TCR=95% SCR=41% RQD=29% UCS=81MPa
			6	RUN										RUN #6 TCR=97% SCR=85% RQD=88% UCS=50.5MPa
171.4														
9.7	End of Borehole													

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

Continued Next Page

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

**RECORD OF BOREHOLE No M-DC-4**

2 OF 2

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.446801°, Long: -76.572367°  
Deep Cuts MTM Zone 9: N 5 034 099.2 E 299 139.2 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA, HQ Coring COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.10 - 2020.11.10 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL											
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)										
						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>														
	Continued From Previous Page																										
	Monitoring well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen																										
	WATER LEVEL READINGS:																										
	<table border="1"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev. (m)</th> </tr> </thead> <tbody> <tr> <td>2020.12.15</td> <td>3.9</td> <td>177.2</td> </tr> <tr> <td>2021.09.23</td> <td>9.3</td> <td>171.8</td> </tr> <tr> <td>2021.10.01</td> <td>8.6</td> <td>172.5</td> </tr> </tbody> </table>	Date	Depth (m)	Elev. (m)	2020.12.15	3.9	177.2	2021.09.23	9.3	171.8	2021.10.01	8.6	172.5														
Date	Depth (m)	Elev. (m)																									
2020.12.15	3.9	177.2																									
2021.09.23	9.3	171.8																									
2021.10.01	8.6	172.5																									

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

**RECORD OF BOREHOLE No M-DC-5**

1 OF 1

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.44687°, Long: -76.571543°  
Deep Cuts MTM Zone 9: N 5 034 106.8 E 299 203.6 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.13 - 2020.11.13 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
178.7	Ground Surface															
0.0	<b>SURFACE BEDROCK</b>		1	SS	100/ 0mm											

DOUBLE LINE 24726 DEEP CUTS.GPJ\_2012TEMPLATE(MTO).GDT 22-7-15

### RECORD OF BOREHOLE No N-DC-1

1 OF 1

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.447066°, Long: -76.569121°  
Deep Cuts MTM Zone 9: N 5 034 128.4 E 299 393.1 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.13 - 2020.11.13 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		GR	SA	SI	CL	
172.7	Ground Surface																		
0.0	TOPSOIL (50 mm)		1	SS	100/300mm							o				5	74	21	(SI+CL)
172.3	SILTY SAND (SM), trace gravel Some organics Very loose Dark brown																		
0.4	End of Borehole Spoon and auger refusal on inferred bedrock.																		

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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

### RECORD OF BOREHOLE No N-DC-2

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.447075°, Long: -76.568366°  
Deep Cuts MTM Zone 9: N 5 034 129.4 E 299 452.2 ORIGINATED BY AO  
HWY 17 BOREHOLE TYPE CME 850 Trackmount, HQ Coring COMPILED BY AO  
DATUM Geodetic DATE 2020.11.13 - 2020.11.16 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
172.1	Ground Surface					20	40	60	80	100	20	40	60	kN/m <sup>3</sup>	GR SA SI CL
0.0	<b>MONZOGRANITE BEDROCK</b> Moderately weathered to fresh jointed Red-ish to pink-grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong Medium to Coarse Grained		1	RUN	-									3	RUN #1 TCR=100% SCR=56% RQD=44% UCS=91.5MPa
			2	RUN	-									3	RUN #2 TCR=100% SCR=92% RQD=86% UCS=170.1MPa
			3	RUN	-									0	RUN #3 TCR=98% SCR=86% RQD=73% UCS=101MPa
			4	RUN	-									4	RUN #4 TCR=98% SCR=60% RQD=48% UCS=104.2MPa
			5	RUN	-									0	RUN #5 TCR=100% SCR=95% RQD=98% UCS=92.2MPa
			6	RUN	-									2	RUN #6 TCR=98% SCR=95% RQD=90% UCS=133.2MPa
162.5	End of Borehole													0	

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

Continued Next Page

+ 3, x 3. Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No N-DC-2**

2 OF 2

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.447075°, Long: -76.568366°  
Deep Cuts MTM Zone 9: N 5 034 129.4 E 299 452.2 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HQ Coring COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.13 - 2020.11.16 CHECKED BY FG

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL											
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						W <sub>p</sub>	W	W <sub>L</sub>								
	Continued From Previous Page																											
	Monitoring Well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen																											
	WATER LEVEL READINGS:																											
	<table border="1"> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev. (m)</th> </tr> <tr> <td>2020.12.15</td> <td>4.3</td> <td>167.9</td> </tr> <tr> <td>2021.09.23</td> <td>5.5</td> <td>166.7</td> </tr> <tr> <td>2021.10.01</td> <td>5.2</td> <td>167.0</td> </tr> </table>	Date	Depth (m)	Elev. (m)	2020.12.15	4.3	167.9	2021.09.23	5.5	166.7	2021.10.01	5.2	167.0															
Date	Depth (m)	Elev. (m)																										
2020.12.15	4.3	167.9																										
2021.09.23	5.5	166.7																										
2021.10.01	5.2	167.0																										

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

### RECORD OF BOREHOLE No N-DC-3

1 OF 1

**METRIC**

WP# 4068-09-00 LOCATION Lat: 45.447074°, Long: -76.567652°  
Deep Cuts MTM Zone 9: N 5 034 129.2 E 299 508.0 ORIGINATED BY AO  
 HWY 17 BOREHOLE TYPE CME 850 Trackmount, HSA COMPILED BY AO  
 DATUM Geodetic DATE 2020.11.16 - 2020.11.16 CHECKED BY FG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
169.4	Ground Surface															
0.0	TOPSOIL (50mm)		1	SS	100/										0 92 8	
169.1	SAND (SP-SM) with silt				150mm										(S+CL)	
0.3	Very Loose Yellow-brown End of Borehole Spoon and auger refusal on inferred bedrock.															

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-15

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



# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

**90Cx Station 18+400 EB 2m LT CL Lane**  
 0- 330 Asph  
 330- 850 Br Sa and Gr Tr Si Moist  
 850- 1.5 Br Sa W Gr Tr Si Moist  
 Zone 9 N 5039879.8 E 291419.9 Elev 151.1 m  
 PH

**95B Station 19+200 WB 5.5m LT CL OSH D-0.2**  
 0- 70 Asph  
 70- 400 Br Sa(y) Gr Tr Si Moist  
 400- 1.5 Br Gr(y) Sa Some Si Moist  
 Zone 9 N 5039134.1 E 291711.6 Elev 136.7 m  
 PH

**99B Station 18+400 EB 11m LT CL OSH D-0.2**  
 0- 400 Br Sa and Gr Tr Si Moist  
 400- 1.7 Br Sa Some Gr Tr Si Occ Cob Moist  
 (Soft)  
 1.7- 1.8 Gry Sa(y) Si (Firm) Moist  
 Zone 9 N 5039881.1 E 291424.8 Elev 150.8 m  
 PH

**94D Station 19+400 EB 2m RT CL Lane**  
 0- 255 Asph  
 255- 650 Br Sa(y) Gr Tr Si Moist  
 650- 1.7 Br Gr(y) Sa Some Si Moist  
 Zone 9 N 5038968.2 E 291820.3 Elev 131.1 m  
 PH

**B-DC**

**97B Station 18+800 WB 12m LT CL OSH D-0.2**  
 0- 500 Br Sa(y) Gr Tr Si Moist  
 500- 1.5 Br Sa Some Si Some Gr Moist  
 1.5- 3 Br Si(y) Cl (Soft) Moist  
 3- 3.1 Br Si(y) Cl (Firm) Moist  
 Partially Paved EB OSH Asphalt Thickness =  
 90mm  
 Zone 9 N 5039506.3 E 291566.7 Elev 147.6 m  
 PH

**94E Station 19+400 EB 5.5m RT CL OSH D0.2**  
 0- 300 Br Sa(y) Gr Tr Si Moist  
 300- 1.7 Br Gr(y) Sa Some Si Moist  
 Zone 9 N 5038966.6 E 291818.5 Elev 131.1 m  
 PH

**93C Station 19+600 WB 1.5m LT CL Lane**  
 0- 285 Asph  
 285- 500 Br Sa(y) Gr Tr Si Moist  
 500- 1.5 Br Sa Some Si Moist  
 Zone 9 N 5038839.6 E 291973.1 Elev 124.9 m  
 PH

**96D Station 19+000 EB 1.5m RT CL Lane B-DC**  
 0- 165 Asph  
 165- 500 Br Sa(y) Gr Tr Si Moist  
 500- 1.7 Br Sa Some Gr Some Si Moist  
 Zone 9 N 5039315.2 E 291625.7 Elev 142.8 m  
 PH

**93B Station 19+600 WB 5m LT CL OSH D-0.2**  
 0- 75 Asph  
 75- 450 Br Sa(y) Gr Tr Si Moist  
 450- 1.6 Br Sa Some Si Moist  
 Zone 9 N 5038842.8 E 291975.1 Elev 124.7 m  
 PH

**96E Station 19+000 EB 6m RT CL OSH D-0.2**  
 0- 500 Br Sa(y) Gr Tr Si Moist  
 500- 1 Br Sa Some Gr Some Si Moist  
 1- 1.7 Br Sa W Si Tr Gr Moist  
 Zone 9 N 5039312.9 E 291621.1 Elev 142.7 m  
 PH

**92D Station 19+800 EB 1.8m RT CL Lane**  
 0- 250 Asph  
 250- 500 Br Sa(y) Gr Tr Si Moist  
 500- 1.3 Br Sa W Gr Tr Si Occ Cob Moist  
 1.3- 1.6 Br Cl(y) Sa W Si (Soft) Moist

**95C Station 19+200 WB 1.5m LT CL Lane**  
 0- 265 Asph  
 265- 500 Br Sa(y) Gr Tr Si Moist  
 w @ 0.4m = 1%  
 Percent Passing 4.75 mm = 42%  
 75 µm = 7%  
 Acceptable Granular A  
 500- 1.7 Br Gr(y) Sa Some Si Moist  
 w @ 1.1m = 2%  
 Percent Passing 4.75 mm = 68%  
 75 µm = 11%  
 Finer Than Granular A  
 Zone 9 N 5039132.9 E 291708 Elev 136.9 m  
 PH

w @ 1.5m = 13%  
 Percent Passing 4.75 mm = 98%  
 75 µm = 53%  
 5 µm = 32%  
 Frost Susceptibility = LSFH  
 W<sub>L</sub> = 26%  
 W<sub>P</sub> = 14%  
 P<sub>I</sub> = 12%  
 MTC Soil Classification = CL  
 1.6- 1.7 Br Cl(y) Sa W Si (Firm) Moist  
 Zone 9 N 5038735.5 E 292143.6 Elev 118.9 m  
 PH



# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

**17B-61B Station 18+626 EB .7m LT CL D 0**  
 0- 200 Tps  
 200- 1.5 Br Sa Some Si Moist  
 1.5- 3.5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039643.9 E 291465 Elev 153.1 m  
 TP

**17B-65B Station 18+726 EB 1.5m LT CL D 0**  
 0- 300 Tps  
 300- 6.5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039551 E 291500.8 Elev 154.1 m  
 TP

B-DC



**17B-62B Station 18+650 EB .6m LT CL D 0**  
 0- 200 Tps  
 200- 800 Br Sa Some Si Moist  
 800- 5.5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039621.3 E 291473.5 Elev 153.4 m  
 TP

**17B-66C Station 18+750 EB 15.9m RT CL D-1**  
 0- 300 Tps  
 300- 6.5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039521.8 E 291493 Elev 152.4 m  
 TP

**17B-62C Station 18+651 EB 16.5m RT CL D-0.1**  
 0- 200 Tps  
 200- 5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039614.9 E 291457.6 Elev 153.6 m  
 TP

**17B-66B Station 18+751 EB CL**  
 0- 250 Tps  
 250- 6.5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039526.6 E 291507.6 Elev 153.4 m  
 TP

**17B-63B Station 18+675 EB .7m LT CL D 0**  
 0- 220 Tps  
 220- 1.2 Br Sa Some Si Moist  
 w @ 0.7m = 10%  
 Percent Passing 4.75 mm = 99%  
 75 µm = 13%  
 1.2- 5.5 Br/Gry Si(y) Cl Tr Sa Moist  
 w @ 3.4m = 33%  
 Percent Passing 4.75 mm = 100%  
 75 µm = 95%  
 5 µm = 59%  
 Frost Susceptibility = LSFH  
 Soil Erodibility = 0.2  
 W<sub>L</sub> = 39%  
 W<sub>p</sub> = 21%  
 P<sub>I</sub> = 18%  
 MTC Soil Classification = CI  
 OMC = 28%  
 MDD = 1,547 kg/m<sup>3</sup>  
 Zone 9 N 5039597.8 E 291482.4 Elev 153.6 m  
 TP

**17B-68B Station 18+800 EB CL**  
 0- 300 Tps  
 300- 6.5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039480.7 E 291525.1 Elev 152.9 m  
 TP

**17B-68C Station 18+800 EB 15m RT CL D 0**  
 0- 200 Tps  
 200- 7.2 Br Cl and Si Moist  
 w @ 3.7m = 39%  
 Percent Passing 4.75 mm = 100%  
 75 µm = 100%  
 5 µm = 56%  
 Frost Susceptibility = MSFH  
 Soil Erodibility = 0.23  
 W<sub>L</sub> = 47%  
 W<sub>p</sub> = 22%  
 P<sub>I</sub> = 25%  
 MTC Soil Classification = CI  
 OMC = 28%  
 MDD = 1,485 kg/m<sup>3</sup>  
 7.2- NFP (BR)  
 Zone 9 N 5039476.1 E 291510.8 Elev 153.3 m  
 TP

**17B-64B Station 18+700 EB .2m LT CL D6**  
 0- 250 Tps  
 250- 6.5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039574.7 E 291490.5 Elev 154.3 m  
 TP

**17B-69B Station 18+820 EB 1.1m LT CL D 0**  
 0- 200 Tps  
 200- 3.3 Br/Gry Cl and Si Moist  
 3.3- 7.5 Br Sa W Gr Some Si Moist  
 Zone 9 N 5039462.1 E 291533.1 Elev 152.7 m  
 TP

**17B-64C Station 18+700 EB 16m RT CL D-0.5**  
 0- 250 Tps  
 250- 6.5 Br/Gry Cl and Si Moist  
 Zone 9 N 5039568.8 E 291475.4 Elev 153.6 m  
 TP

Note: Boreholes offsets referenced from staked centreline.





**HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST  
OF MILLER / ANDERSON ROAD TO 3KM WEST OF  
BRUCE STREET  
COUNTY OF RENFREW**

<p><b>17B-75RO1 Station 18+931 EB 16.4m LT CL D-7</b> 0- Surf BR Zone 9 N 5039363.4 E 291585.3 Elev 149.1 m Doc. of BR</p>	<p><b>17B-76B Station 18+961 EB CL</b> 0- 400 Tps 400- 1.9 Br Si W Sa W Cl Moist w @ 1.2m = 19% Percent Passing 4.75 mm = 96% 75 µm = 69% 5 µm = 22% Frost Susceptibility = MSFH Soil Erodibility = 0.35</p>
<p><b>17B-74RO1 Station 18+933 EB 2.1m RT CL</b> 0- Surf BR Zone 9 N 5039354.8 E 291568.8 Elev 156.9 m Doc. of BR</p>	<p>1.9- 5 Br Sa Tr Si Occ Cob Moist w @ 3.5m = 8% Percent Passing 4.75 mm = 98% 75 µm = 9% OMC = 13% MDD = 1,870 kg/m<sup>3</sup></p>
<p><b>17B-75RO2 Station 18+937 EB 30m RT CL D 0</b> 0- Surf BR Zone 9 N 5039341.9 E 291543.8 Elev 158.4 m Doc. of BR</p>	<p>5- NFP (BR) Zone 9 N 5039329.4 E 291579.3 Elev 153.7 m TP</p>
<p><b>17B-75C Station 18+939 EB 19.3m RT CL D0.8</b> 0- Surf BR Zone 9 N 5039343.3 E 291554.7 Elev 158 m Doc. of BR</p>	<p><b>17B-76A Station 18+961 EB 15.8m LT CL D-6.5</b> 0- 300 Tps 300- 1.8 Br Sa W Si Tr Gr 1.8- 3.4 Gry Sa W Si Occ Cob 3.4- NFP (BR) Zone 9 N 5039335.2 E 291595 Elev 147.1 m TP</p>
<p><b>17B-75A Station 18+941 EB 16.8m LT CL D-6.5</b> 0- 300 Tps 300- 2 Br Sa W Si 2- NFP (BR) Zone 9 N 5039353.9 E 291589.2 Elev 147.6 m TP</p>	<p><b>17B-76C Station 18+961 EB 17m RT CL D0.2</b> 0- 200 Tps 200- 1.3 Br Si W Sa W Cl 1.3- 7.3 Br Sa Tr Si Occ Cob 7.3- NFP (BR) Zone 9 N 5039324.2 E 291564.1 Elev 154.2 m TP</p>
<p><b>17B-75B Station 18+941 EB 2.4m RT CL</b> 0- 280 Tps 280- 1.2 Br Si(y) Sa Some Gr 1.2- 2.7 Br/Gry Si and Sa Tr Gr 2.7- NFP (BR) Zone 9 N 5039347.7 E 291571 Elev 155.5 m TP</p>	<p><b>17B-77C Station 18+977 EB 16m RT CL D 0</b> 0- 200 Tps 200- 1 Br Sa Moist w @ 0.6m = 7% Percent Passing 4.75 mm = 99% 75 µm = 3% 1- 5.9 Br Sa Some Gr Tr Si Occ Cob Moist w @ 3.5m = 4% Percent Passing 4.75 mm = 86% 75 µm = 5%</p>
	<p>5.9- NFP (BR) Zone 9 N 5039309.2 E 291570.6 Elev 152.2 m TP</p>



# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

**17B-77A Station 18+981 EB 15.7m LT CL D-5**  
 0- 250 Tps  
 250- 700 Br Sa Some Gr Moist  
 700- 1.7 Gry Sa W Si Occ Cob Moist  
 1.7- NFP (BR)  
 Zone 9 N 5039316.3 E 291601.8 Elev 146.5 m  
 TP

**17B-77B Station 18+982 EB CL**  
 0- 200 Tps  
 200- 700 Br Sa W Si Tr Gr Moist  
 700- 5.1 Br Sa Tr Si Tr Gr Moist  
 5.1- NFP (BR)  
 Zone 9 N 5039308.9 E 291586.2 Elev 150.7 m  
 TP

**17B-78C Station 19+000 EB 13.3m RT CL D0.3**  
 0- 150 Tps  
 150- 400 Br Sa Occ Cob Moist  
 400- 1 Br Sa W Si Occ Cob Moist  
 1- NFP (BR)  
 Zone 9 N 5039288.5 E 291581 Elev 149.7 m  
 TP

**17B-78A Station 19+001 EB 13m LT CL D-0.4**  
 0- 150 Tps  
 150- 1.9 Br Sa W Si Moist  
 1.9- NFP (BR)  
 Zone 9 N 5039296.5 E 291606.1 Elev 147.4 m  
 TP

**17B-78B Station 19+002 EB CL**  
 0- 150 Tps  
 150- 400 Br Sa Moist  
 400- 1.5 Br Sa W Si Occ Cob Moist  
 Zone 9 N 5039290.9 E 291594 Elev 148.7 m  
 TP

**17B-78(2) Station 19+018 EB 11.4m LT CL D-0.5**  
**RO1**  
 0- Surf BR  
 Zone 9 N 5039279.9 E 291610.5 Elev 145.6 m  
 Doc. of BR

**17B-78(2) Station 19+019 EB 12.6m RT CL D-1.5**  
**C**  
 0- Surf BR  
 Zone 9 N 5039270.5 E 291588.3 Elev 142.5 m  
 Doc. of BR

**17B-78(2) Station 19+021 EB CL**  
**B**  
 0- 200 Tps  
 200- 2.1 Gry Sa Tr Gr Tr Si Occ Cob Moist  
 2.1- NFP (BR)  
 Zone 9 N 5039272.8 E 291600.5 Elev 144.1 m  
 TP

**17B-78(2) Station 19+022 EB 15.3m LT CL D-2.5**  
**RO2**  
 0- Surf BR  
 Zone 9 N 5039277.2 E 291615.6 Elev 144.2 m  
 Doc. of BR

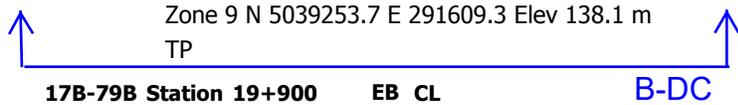
**17B-78(2) Station 19+024 EB 12.1m LT CL D 0**  
**A**  
 0- 150 Tps  
 150- 800 Br Sa Some Gr Tr Si Occ Cob Moist  
 800- NFP (BR)  
 Zone 9 N 5039274.6 E 291613.1 Elev 143.3 m  
 TP

**17B-78(3) Station 19+042 EB CL**  
**B**  
 0- 300 Tps  
 300- 1 Br Sa Some Gr Tr Si Occ Cob Moist  
 w @ 0.7m = 11%  
 Percent Passing 4.75 mm = 84%  
 75 µm = 7%  
 1- 1.1 Br Sa Tr Org Moist  
 1.1- 3.5 Br Gr(y) Sa Tr Si Moist  
 w @ 2.3m = 4%  
 Percent Passing 4.75 mm = 61%  
 75 µm = 5%  
 Zone 9 N 5039253.7 E 291609.3 Elev 138.1 m  
 TP

**17B-79B Station 19+900 EB CL**  
 0- 4.4 Br/Gry Si(y) Cl Tr Sa (Stiff) Moist  
 Nvalue=8 blows / 300mm  
 Zone 9 N 5038664.9 E 292197.7 Elev 112.4 m  
 HD

**17B-80B Station 19+950 EB CL**  
 0- 2.1 Br/Gry Si(y) Cl Tr Sa (Stiff) Moist  
 Nvalue=8 blows / 300mm  
 Zone 9 N 5038641.2 E 292241.7 Elev 114.1 m  
 HD

**17B-80A Station 19+950 EB 15m LT CL D0.6**  
 0- 1.5 Br/Gry Si(y) Cl Tr Sa (Stiff) Moist  
 Zone 9 N 503865.6 E 292249.8 Elev 114.7 m  
 HA









# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

K-DC

<p><b>140E Station 12+000    EB 6.5m RT CL    Lane 2</b></p> <p>0- 185 Asph</p> <p>185- 600 Br Gr(y) Sa Tr Si                      Moist</p> <p>600-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5033978.5 E 298422 Elev 173 m</p> <p style="padding-left: 20px;">PH</p> <p><b>140D Station 12+000    EB 2m RT CL            Lane</b></p> <p>0- 165 Asph</p> <p>165- 650 Br Gr(y) Sa Tr Si                      Moist</p> <p>650-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5033981.7 E 298421.7 Elev 173 m</p> <p style="padding-left: 20px;">PH</p> <p><b>140F Station 12+000    EB 6m RT CL            OSH D-0.2</b></p> <p>0- 120 Asph</p> <p>120- 600 Br Gr(y) Sa Tr Si                      Moist</p> <p>600-        NFP (RF)</p> <p style="padding-left: 20px;">Partially Paved OSH Asphalt Thickness = 120mm</p> <p style="padding-left: 20px;">Zone 9 N 5033975 E 298422 Elev 172.7 m</p> <p style="padding-left: 20px;">PH</p> <p><b>141B Station 12+200    WB 6.5m LT CL    Lane 2</b></p> <p>0- 135 Asph</p> <p>135- 600 Br Gr(y) Sa Tr Si                      Moist</p> <p>600-        NFP (RF)</p> <p style="padding-left: 20px;">Partially Paved OSH Asphalt Thickness = 120mm</p> <p style="padding-left: 20px;">Zone 9 N 5034006.1 E 298620.4 Elev 176.3 m</p> <p style="padding-left: 20px;">PH</p> <p><b>141C Station 12+200    WB 2m LT CL            Lane</b></p> <p>0- 160 Asph</p> <p>160- 300 Br Gr(y) Sa Tr Si                      Moist</p> <p>300-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5034002.5 E 298621.2 Elev 176.4 m</p> <p style="padding-left: 20px;">PH</p> <p><b>142E Station 12+400    EB 6.5m RT CL    Lane 2</b></p> <p>0- 185 Asph</p> <p>185- 400 Br Gr(y) Sa Tr Si                      Moist</p> <p>400-        NFP (RF)</p> <p style="padding-left: 20px;">Partially Paved OSH Asphalt Thickness = 70mm</p> <p style="padding-left: 20px;">Zone 9 N 5034010.3 E 298820.5 Elev 177.5 m</p> <p style="padding-left: 20px;">PH</p> <p><b>142D Station 12+400    EB 2m RT CL            Lane</b></p> <p>0- 165 Asph</p> <p>165- 400 Br Gr(y) Sa Tr Si                      Moist</p> <p>400-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5034014.3 E 298820.3 Elev 177.6 m</p> <p style="padding-left: 20px;">PH</p>	<p><b>143B Station 12+600    WB 6.5m LT CL    Lane 2</b></p> <p>0- 210 Asph</p> <p>210- 400 Br Gr(y) Sa Tr Si                      Moist</p> <p>400-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5034038.9 E 299019.3 Elev 176.6 m</p> <p style="padding-left: 20px;">PH</p> <p><b>143C Station 12+600    WB 2m LT CL            Lane</b></p> <p>0- 155 Asph</p> <p>155- 500 Br Gr(y) Sa Tr Si                      Moist</p> <p>500-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5034033.9 E 299020.1 Elev 176.7 m</p> <p style="padding-left: 20px;">PH</p> <p><b>143A Station 12+600    WB 9m LT CL            OSH D-0.2</b></p> <p>0- 100 Asph</p> <p>100- 400 Br Gr(y) Sa Tr Si                      Moist</p> <p>400-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5034041.9 E 299019.2 Elev 176.5 m</p> <p style="padding-left: 20px;">PH</p> <p><b>144E Station 12+800    EB 6.5m RT CL    Lane 2</b></p> <p>0- 200 Asph</p> <p>200- 600 Br Gr(y) Sa Tr Si                      Moist</p> <p style="padding-left: 40px;">w @ 0.4m = 5%</p> <p style="padding-left: 40px;">Percent Passing 4.75 mm = 61%</p> <p style="padding-left: 40px;">75 µm = 8%</p> <p style="padding-left: 40px;">Acceptable Granular A</p> <p>600-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5034042.7 E 299219.4 Elev 173.7 m</p> <p style="padding-left: 20px;">PH</p> <p><b>144D Station 12+800    EB 2m RT CL            Lane</b></p> <p>0- 145 Asph</p> <p>145- 600 Br Gr(y) Sa Tr Si                      Moist</p> <p>600-        NFP (RF)</p> <p style="padding-left: 20px;">Zone 9 N 5034046.6 E 299219.3 Elev 173.7 m</p> <p style="padding-left: 20px;">PH</p> <p><b>144F Station 12+800    EB 9m RT CL            OSH D-0.2</b></p> <p>0- 120 Asph</p> <p>120- 600 Br Gr(y) Sa Tr Si                      Moist</p> <p>600-        NFP (RF)</p> <p style="padding-left: 20px;">Partially Paved OSH Asphalt Thickness = 120mm</p> <p style="padding-left: 20px;">Zone 9 N 5034040.1 E 299219.4 Elev 173.7 m</p> <p style="padding-left: 20px;">PH</p>
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Note: Boreholes offsets referenced from staked centreline.









# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

M-DC

**140E Station 12+000 EB 6.5m RT CL Lane 2**  
 0- 185 Asph  
 185- 600 Br Gr(y) Sa Tr Si Moist  
 600- NFP (RF)  
 Zone 9 N 5033978.5 E 298422 Elev 173 m  
 PH

**140D Station 12+000 EB 2m RT CL Lane**  
 0- 165 Asph  
 165- 650 Br Gr(y) Sa Tr Si Moist  
 650- NFP (RF)  
 Zone 9 N 5033981.7 E 298421.7 Elev 173 m  
 PH

**140F Station 12+000 EB 6m RT CL OSH D-0.2**  
 0- 120 Asph  
 120- 600 Br Gr(y) Sa Tr Si Moist  
 600- NFP (RF)  
 Partially Paved OSH Asphalt Thickness = 120mm  
 Zone 9 N 5033975 E 298422 Elev 172.7 m  
 PH

**141B Station 12+200 WB 6.5m LT CL Lane 2**  
 0- 135 Asph  
 135- 600 Br Gr(y) Sa Tr Si Moist  
 600- NFP (RF)  
 Partially Paved OSH Asphalt Thickness = 120mm  
 Zone 9 N 5034006.1 E 298620.4 Elev 176.3 m  
 PH

**141C Station 12+200 WB 2m LT CL Lane**  
 0- 160 Asph  
 160- 300 Br Gr(y) Sa Tr Si Moist  
 300- NFP (RF)  
 Zone 9 N 5034002.5 E 298621.2 Elev 176.4 m  
 PH

**142E Station 12+400 EB 6.5m RT CL Lane 2**  
 0- 185 Asph  
 185- 400 Br Gr(y) Sa Tr Si Moist  
 400- NFP (RF)  
 Partially Paved OSH Asphalt Thickness = 70mm  
 Zone 9 N 5034010.3 E 298820.5 Elev 177.5 m  
 PH

**142D Station 12+400 EB 2m RT CL Lane**  
 0- 165 Asph  
 165- 400 Br Gr(y) Sa Tr Si Moist  
 400- NFP (RF)  
 Zone 9 N 5034014.3 E 298820.3 Elev 177.6 m  
 PH

M-DC

**143B Station 12+600 WB 6.5m LT CL Lane 2**  
 0- 210 Asph  
 210- 400 Br Gr(y) Sa Tr Si Moist  
 400- NFP (RF)  
 Zone 9 N 5034038.9 E 299019.3 Elev 176.6 m  
 PH

**143C Station 12+600 WB 2m LT CL Lane**  
 0- 155 Asph  
 155- 500 Br Gr(y) Sa Tr Si Moist  
 500- NFP (RF)  
 Zone 9 N 5034033.9 E 299020.1 Elev 176.7 m  
 PH

**143A Station 12+600 WB 9m LT CL OSH D-0.2**  
 0- 100 Asph  
 100- 400 Br Gr(y) Sa Tr Si Moist  
 400- NFP (RF)  
 Zone 9 N 5034041.9 E 299019.2 Elev 176.5 m  
 PH

**144E Station 12+800 EB 6.5m RT CL Lane 2**  
 0- 200 Asph  
 200- 600 Br Gr(y) Sa Tr Si Moist  
 w @ 0.4m = 5%  
 Percent Passing 4.75 mm = 61%  
 75 µm = 8%  
 Acceptable Granular A  
 600- NFP (RF)  
 Zone 9 N 5034042.7 E 299219.4 Elev 173.7 m  
 PH

**144D Station 12+800 EB 2m RT CL Lane**  
 0- 145 Asph  
 145- 600 Br Gr(y) Sa Tr Si Moist  
 600- NFP (RF)  
 Zone 9 N 5034046.6 E 299219.3 Elev 173.7 m  
 PH

**144F Station 12+800 EB 9m RT CL OSH D-0.2**  
 0- 120 Asph  
 120- 600 Br Gr(y) Sa Tr Si Moist  
 600- NFP (RF)  
 Partially Paved OSH Asphalt Thickness = 120mm  
 Zone 9 N 5034040.1 E 299219.4 Elev 173.7 m  
 PH

M-DC



# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

**17B-258B Station 12+341 WB CL**  
 0- 170 Tps  
 170- 1.6 Br Sa Tr Si Moist  
 1.6- 2.3 Gry Sa W Si Tr Gr Moist  
 2.3- NFP (BR)  
 Zone 9 N 5034077 E 298826.7 Elev 183.5 m  
 TP

**17B-258C Station 12+344 WB 14.6m RT CL D0.2**  
 0- 230 Tps  
 230- 1.9 Br Sa Tr Si Moist  
 1.9- NFP (BR)  
 Zone 9 N 5034063.1 E 298831.2 Elev 184.5 m  
 TP

**17B-259B Station 12+360 WB CL**  
 0- 340 Tps  
 340- 4.5 Gry Sa W Si Tr Gr Moist  
 Zone 9 N 5034079.7 E 298845.3 Elev 180.4 m  
 TP

**17B-259 (2)A Station 12+398 WB 14.6m LT CL D 0**  
 0- 700 Tps  
 700- 3.7 Gry Sa W Si Tr Gr Moist  
 Zone 9 N 5034096.5 E 298882.4 Elev 176.1 m  
 HD

**17B-259 (2)B Station 12+399 WB CL**  
 0- 1.1 Br Sa W Si Tr Org  
 w @ 0.6m = 31%  
 Percent Passing 4.75 mm = 99%  
 75 µm = 22%  
 1.1- 3.7 Gry Sa W Si Tr Gr Moist  
 w @ 2.4m = 8%  
 Percent Passing 4.75 mm = 94%  
 75 µm = 26%  
 Zone 9 N 5034081.9 E 298884.8 Elev 176 m  
 HD

**17B-259 (2)C Station 12+402 WB 13.6m RT CL D 0**  
 0- 150 Tps  
 150- 690 Br Sa W Si Tr Gr Moist  
 690- 3.7 Br Si(y) Sa Tr Gr Moist  
 Zone 9 N 5034068.7 E 298888.5 Elev 176.2 m  
 HD

**17B-259 (3)C Station 12+447 WB 11.4m RT CL D 0**  
 0- 220 Tps  
 220- 760 Br Si(y) Sa Moist  
 760- NFP (BR)  
 Zone 9 N 5034074.4 E 298933 Elev 177 m  
 HD

**17B-259 (3)B Station 12+449 WB CL**  
 0- 100 Tps  
 100- NFP (BR)  
 Zone 9 N 5034087 E 298934.1 Elev 177.7 m  
 HD

**17B-259 (3)A Station 12+450 WB 12m LT CL D0.4**  
 0- 710 Tps  
 710- 2.1 Gry Sa W Si Tr Gr Moist  
 Zone 9 N 5034098 E 298934.8 Elev 178.2 m  
 HD

**17B-260B Station 12+472 WB CL**  
 0- Surf BR  
 Zone 9 N 5034089 E 298956.7 Elev 180.7 m  
 Doc. of BR

**17B-260C Station 12+473 WB 11.7m RT CL D-0.5**  
 0- 300 Tps  
 300- NFP (BR)  
 Zone 9 N 5034076.2 E 298959.1 Elev 179.6 m  
 HA

**17B-260A Station 12+475 WB 12.1m LT CL D-1**  
 0- 229 Tps  
 229- NFP (BR)  
 Zone 9 N 5034100.1 E 298959.4 Elev 181.2 m  
 HA

M-DC

↓ **17B-261A Station 12+500 WB 15m LT CL D-1.1** ↓

0- Surf BR  
 Zone 9 N 5034105 E 298984.3 Elev 183.8 m  
 Doc. of BR

**17B-261C Station 12+500 WB 11.8m RT CL D-0.5**  
 0- 620 Tps  
 620- NFP (BR)  
 Zone 9 N 5034078.3 E 298986.3 Elev 182.7 m  
 TP





# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

<p><b>17B-267B Station 12+620 WB CL</b>            0- 220 Tps            220- 1.5 Br Sa W Si              Moist            w @ 0.9m = 7%            Percent Passing 4.75 mm = 98%            75 µm = 24%</p> <p>1.5- NFP (BR)            Zone 9 N 5034098.9 E 299104.8 Elev 181.5 m            TP</p>	<p><b>17B-270C Station 12+682 WB 15.3m RT CL D-0.8</b>            0- 190 Tps            190- NFP (BR)            Zone 9 N 5034089.2 E 299167.4 Elev 180.8 m            TP</p>
<p><b>17B-267C Station 12+622 WB 18.1m RT CL D 0</b>            0- Surf BR            Zone 9 N 5034081.7 E 299108.3 Elev 181.7 m            Doc. of BR</p>	<p><b>17B-271A Station 12+700 WB 14.1m LT CL D0.5</b>            0- Surf BR            Zone 9 N 5034120 E 299183.1 Elev 180.3 m            Doc. of BR</p>
<p><b>17B-267A Station 12+623 WB 14.2m LT CL D 0</b>            0- 110 Tps            110- NFP (BR)            Zone 9 N 5034114 E 299106.4 Elev 182.3 m            TP</p>	<p><b>17B-271B Station 12+702 WB 1.1m RT CL</b>            0- Surf BR            Zone 9 N 5034105 E 299186.6 Elev 180.1 m            Doc. of BR</p>
<p><b>17B-268C Station 12+638 WB 14.8m RT CL D 0</b>            0- 340 Tps            340- NFP (BR)            Zone 9 N 5034086.3 E 299124.4 Elev 181.1 m            TP</p>	<p><b>17B-271C Station 12+706 WB 15.4m RT CL D-0.9</b>            0- Surf BR            Zone 9 N 5034091.1 E 299191.8 Elev 179.2 m            Doc. of BR</p>
<p><b>17B-268B Station 12+640 WB CL</b>            0- Surf BR            Zone 9 N 5034100.5 E 299125.2 Elev 181.3 m            Doc. of BR</p>	<p><b>17B-273ROC Station 12+722 WB 15.2m RT CL D 0</b>            0- Surf BR            Zone 9 N 5034092.6 E 299208.2 Elev 177.6 m            Doc. of BR</p>
<p><b>17B-268A Station 12+645 WB 15m LT CL D0.3</b>            0- 320 Tps            320- NFP (BR)            Zone 9 N 5034116.5 E 299128.8 Elev 182.2 m            TP</p>	<p><b>17B-273ROA Station 12+723 WB 15.9m LT CL D 0</b>            0- Surf BR            Zone 9 N 5034123.6 E 299205.8 Elev 176.6 m            Doc. of BR</p>
<p><b>17B-269RO Station 12+657 WB 19.3m RT CL D 0</b>            0- Surf BR            Zone 9 N 5034083.3 E 299143.4 Elev 180.4 m            Doc. of BR</p>	<p><b>17B-273ROA Station 12+725 WB CL</b>            0- Surf BR            Zone 9 N 5034106.7 E 299209.2 Elev 177.4 m            Doc. of BR</p>
<p><b>17B-270A Station 12+675 WB 11.5m LT CL D0.6</b>            0- 150 Tps            150- NFP (BR)            Zone 9 N 5034115.4 E 299159 Elev 181.8 m            TP</p>	<p><b>17B-274A Station 12+744 WB 15.6m LT CL D 0 M-DC</b>            0- 310 Tps            310- NFP (BR)            Zone 9 N 5034125 E 299226.8 Elev 173.7 m            TP</p>
<p><b>17B-270B Station 12+682 WB 2m RT CL</b>            0- 250 Tps            250- NFP (BR)            Zone 9 N 5034102.6 E 299167.1 Elev 181.4 m            TP</p>	<p><b>17B-274B Station 12+746 WB 2.7m LT CL</b>            0- 320 Tps            320- NFP (BR)            Zone 9 N 5034112.3 E 299229.9 Elev 173.7 m            TP</p>

Note: Boreholes offsets referenced from staked centreline.





# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

**MP-252 Station 12+865 WB 5m RT CL D 0**  
 0- 600 F Fib Org Matl  
 600- NFP (Firm)  
 Zone 9 N 5034124.9 E 299348.6  
 MP

**MP-249 Station 12+875 WB 29m LT CL D 0**  
 0- 300 F Fib Org Matl  
 300- NFP (Firm)  
 Zone 9 N 5034148.6 E 299356.2  
 MP

**MP-253 Station 12+875 WB 18m RT CL D 0**  
 0- 400 F Fib Org Matl  
 400- NFP (Firm)  
 Zone 9 N 5034101.9 E 299361.2  
 MP

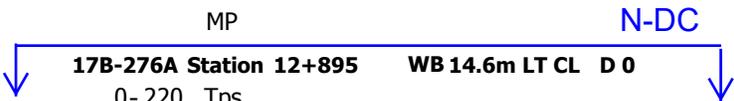
**MP-254 Station 12+880 WB 28m RT CL D 0**  
 0- 400 F Fib Org Matl  
 400- NFP (Firm)  
 Zone 9 N 5034092.8 E 299368  
 MP

**17B-277B Station 12+921 WB CL**  
 0- 320 Tps  
 320- NFP (BR)  
 Zone 9 N 5034124.3 E 299405.2 Elev 173.9 m  
 TP

**17B-278B Station 12+938 WB CL**  
 0- 310 Tps  
 310- 970 Br Sa Tr Si Moist  
 970- NFP (BR)  
 Zone 9 N 5034123.4 E 299421.9 Elev 173.2 m  
 TP

**17B-278C Station 12+938 WB 15.8m RT CL D 0**  
 0- 170 Tps  
 170- NFP (BR)  
 Zone 9 N 5034109.1 E 299422.8 Elev 174.3 m  
 TP

**17B-278A Station 12+939 WB 13.7m LT CL D 0**  
 0- 320 Tps  
 320- NFP (BR)  
 Zone 9 N 5034138.6 E 299421.6 Elev 172.4 m  
 TP



**17B-276A Station 12+895 WB 14.6m LT CL D 0**  
 0- 220 Tps  
 220- NFP (BR)  
 Zone 9 N 5034136 E 299377.8 Elev 172.1 m  
 TP

**17B-276B Station 12+901 WB CL**  
 0- 110 Tps  
 110- NFP (BR)  
 Zone 9 N 5034121.6 E 299384.7 Elev 171.9 m  
 TP

**17B-276C Station 12+903 WB 12.6m RT CL D0.5**  
 0- 120 Tps  
 120- NFP (BR)  
 Zone 9 N 5034109.6 E 299387.9 Elev 172.2 m  
 TP

**17B-277A Station 12+916 WB 15.9m LT CL D 0**  
 0- Surf BR  
 Zone 9 N 5034139 E 299399.1 Elev 172.9 m  
 Doc. of BR

**17B-277C Station 12+920 WB 11.9m RT CL D1.2**  
 0- Surf BR  
 Zone 9 N 5034111.6 E 299404.5 Elev 174 m  
 Doc. of BR

**17B-279B Station 12+960 WB CL**  
 0- 310 Tps  
 310- NFP (BR)  
 Zone 9 N 5034126.2 E 299443.5 Elev 172.3 m  
 TP

**17B-279A Station 12+960 WB 13.4m LT CL D1**  
 0- 190 Tps  
 190- NFP (BR)  
 Zone 9 N 5034140 E 299442.5 Elev 172 m  
 TP

**17B-279C Station 12+960 WB 14.2m RT CL D0.6**  
 0- 290 Tps  
 290- NFP (BR)  
 Zone 9 N 5034112.5 E 299444.5 Elev 172.9 m  
 TP

**17B-280C Station 12+980 WB 14.7m RT CL D-0.6**  
 0- 30 Tps  
 30- NFP (BR)  
 Zone 9 N 5034113.6 E 299464.8 Elev 172.1 m  
 TP

**17B-280B Station 12+981 WB CL**  
 0- Surf BR  
 Zone 9 N 5034127.5 E 299464.6 Elev 173.3 m  
 Doc. of BR



# HIGHWAY 17 TWINNING - PART 1B FROM 1 KM WEST OF MILLER / ANDERSON ROAD TO 3KM WEST OF BRUCE STREET COUNTY OF RENFREW

<p><b>17B-280A Station 12+982      WB 11.5m LT CL    D 0</b> 0-      Surf BR          Zone 9 N 5034139.9 E 299465 Elev 173.4 m          Doc. of BR</p>	<p><b>17B-283 Station 13+062      WB CL</b> <b>(2)B</b> 0-      Surf BR          Zone 9 N 5034133.4 E 299545.9 Elev 164 m          Doc. of BR</p>
<p><b>17B-281B Station 13+001      WB CL</b> 0-      Surf BR          Zone 9 N 5034128.9 E 299484.2 Elev 172.6 m          Doc. of BR</p>	<p><b>17B-283 Station 13+063      WB 13.9m LT CL    D1.2</b> <b>(2)A</b> 0- 320    Tps 320-      NFP (BR)          Zone 9 N 5034148.7 E 299544.9 Elev 164.5 m          TP</p>
<p><b>17B-281C Station 13+001      WB 16.2m RT CL    D0.3</b> 0-      Surf BR          Zone 9 N 5034113.8 E 299485.8 Elev 173 m          Doc. of BR</p>	<p><b>17B-283 Station 13+066      WB 20.4m RT CL    D0.6</b> <b>(2)C</b> 0- 310    Tps 310-      NFP (BR)          Zone 9 N 5034114.8 E 299551.5 Elev 163.7 m          TP</p>
<p><b>17B-281A Station 13+002      WB 9.2m LT CL      D0.2</b> 0- 30      Tps 30-      NFP (BR)          Zone 9 N 5034139.1 E 299484.4 Elev 172.3 m          Doc. of BR</p>	<p><b>MP-257 Station 13+185      WB CL</b> 0- 800    F Fib Org Matl 800-      NFP (Firm)          Zone 9 N 5034144.3 E 299668.2          MP</p>
<p><b>17B-282B Station 13+018      WB CL</b> 0-      Surf BR          Zone 9 N 5034131.4 E 299501.8 Elev 169.3 m          Doc. of BR</p>	<p><b>MP-255 Station 13+185      WB 25m LT CL      D 0</b> 0- 800    F Fib Org Matl 800-      NFP (Firm)          Zone 9 N 5034168.9 E 299667.4          MP</p>
<p><b>17B-282C Station 13+019      WB 15.6m RT CL    D0.6</b> 0- 190    Tps 190-      NFP (BR)          Zone 9 N 5034115.8 E 299503.5 Elev 169.8 m          TP</p>	<p><b>MP-256 Station 13+185      WB 15m LT CL      D 0</b> 0- 800    F Fib Org Matl 800-      NFP (Firm)          Zone 9 N 5034159 E 299667.6          MP</p>
<p><b>17B-282A Station 13+020      WB 15.2m LT CL    D 0</b> 0-      Surf BR          Zone 9 N 5034146.6 E 299502.2 Elev 168.9 m          Doc. of BR</p>	<p><b>MP-258 Station 13+185      WB 8m RT CL        D 0</b> 0- 600    F Fib Org Matl 600-      NFP (Firm)          Zone 9 N 5034136.4 E 299669          MP</p>
<p><b>17B-283C Station 13+038      WB 16.7m RT CL    D 0</b> 0- 90      Tps 90-      NFP (BR)          Zone 9 N 5034116.2 E 299522.7 Elev 167.8 m          TP</p>	<p><b>MP-260 Station 13+200      WB CL</b> 0- 1.5    F Fib Org Matl 1.5-      NFP (Firm)          Zone 9 N 5034146.1 E 299682.5          MP</p>
<p><b>17B-283B Station 13+039      WB 3.5m RT CL</b> 0- 330    Tps 330-      NFP (BR)          Zone 9 N 5034129.4 E 299522.3 Elev 167.3 m          TP</p>	<p><b>MP-259 Station 13+200      WB 20m LT CL      D 0</b> 0- 1.2    F Fib Org Matl 1.2-      NFP (Firm)          Zone 9 N 5034165.2 E 299681.2          MP</p>
<p><b>17B-283A Station 13+040      WB 11.6m LT CL    D 0</b> 0- 190    Tps 190-      NFP (BR)          Zone 9 N 5034144.6 E 299522.8 Elev 168 m          TP</p>	

Note: Boreholes offsets referenced from staked centreline.





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

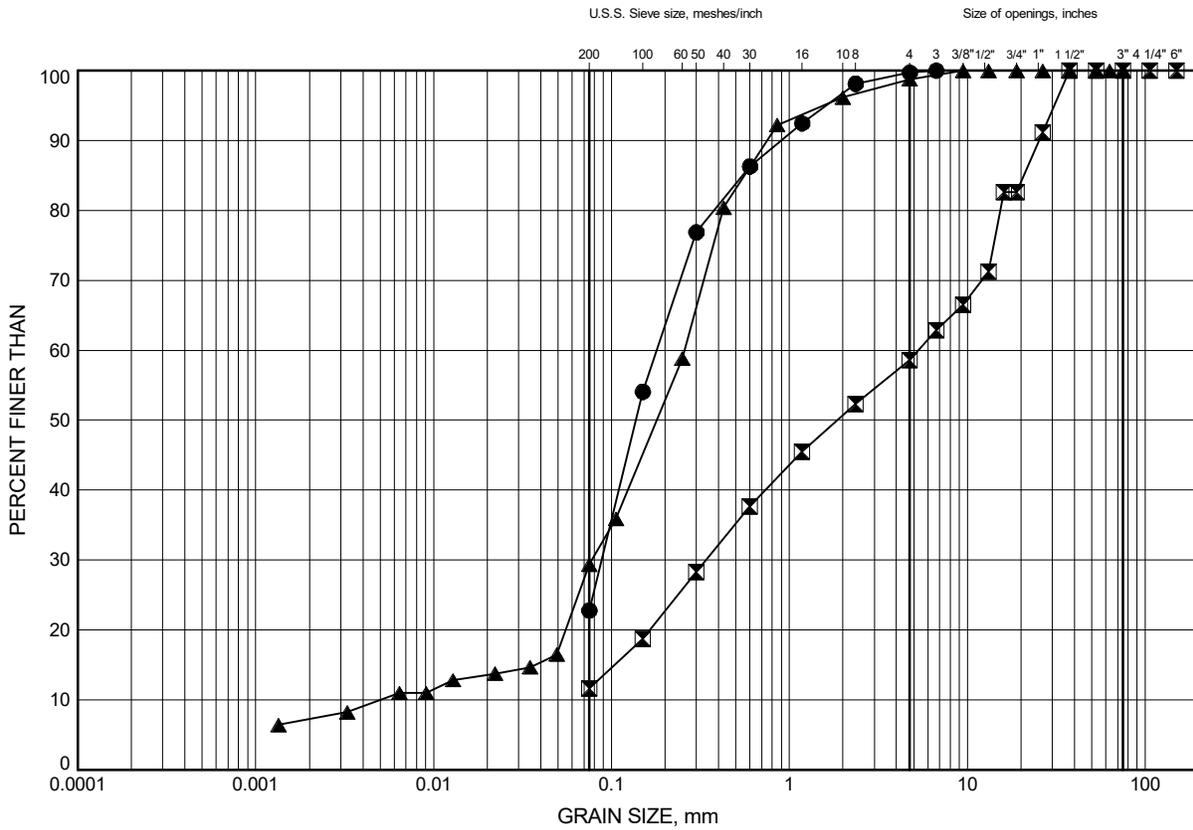


**Appendix C.1**  
**Particle Size Analysis Figures**  
**Atterberg Limit Test Results**

Highway 17 Twinning  
**GRAIN SIZE DISTRIBUTION**

FIGURE C1

**Silty Sand (SM) to Sand (SW-SM) with Silt and Gravel**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	B-DC-1	0.4	153.8
⊠	B-DC-4	1.0	158.1
▲	B-DC-5	0.9	149.7

GRAIN SIZE DISTRIBUTION - THURBER 24726 DEEP CUTS.GPJ 21-12-13

Date .. December 2021 ..  
 WP# .. 4068-09-00 ..

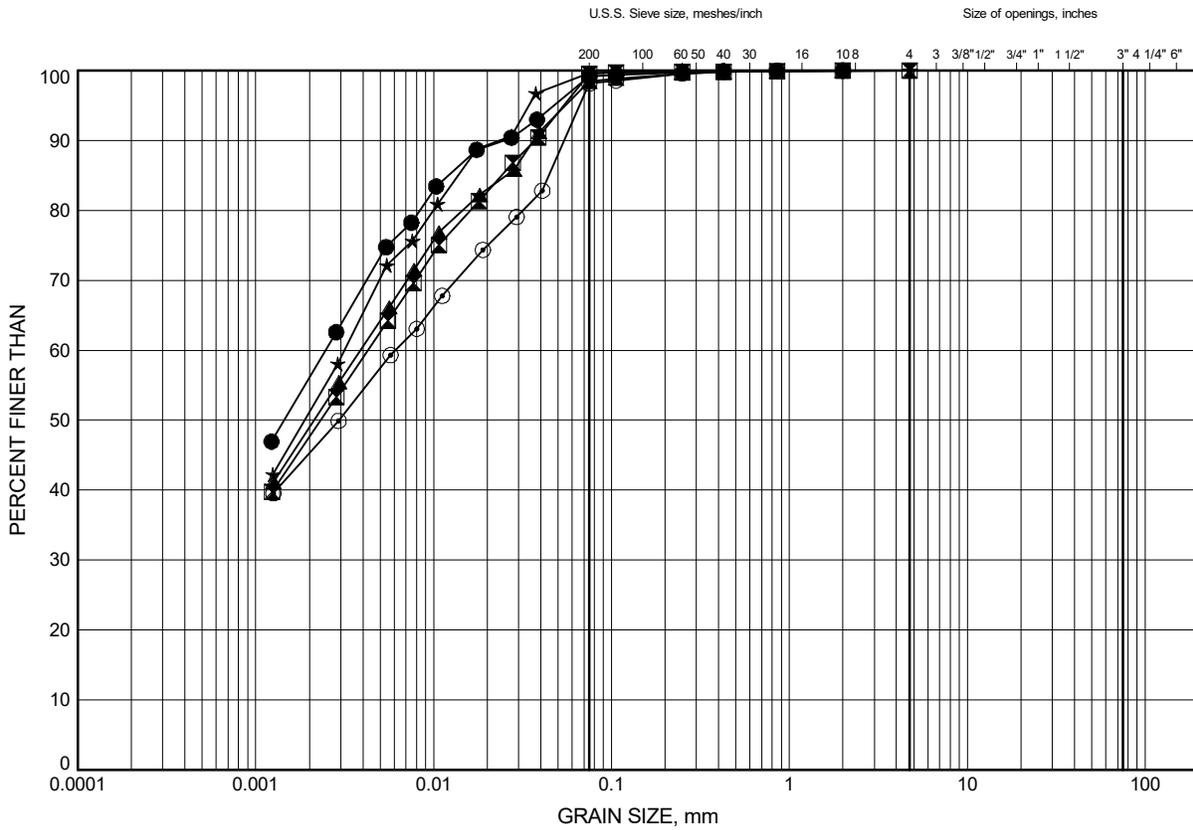


Prep'd .. AO ..  
 Chkd. .... DP ..

# Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C2

## Clay (Cl)



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	B-DC-1	4.1	150.1
⊠	B-DC-1	9.4	144.8
▲	B-DC-2	2.6	151.1
★	B-DC-2	7.9	145.8
⊙	B-DC-2	11.0	142.7

GRAIN SIZE DISTRIBUTION - THURBER 24726 DEEP CUTS.GPJ 21-12-13

Date ..December 2021.....  
 WP# ..4068-09-00.....

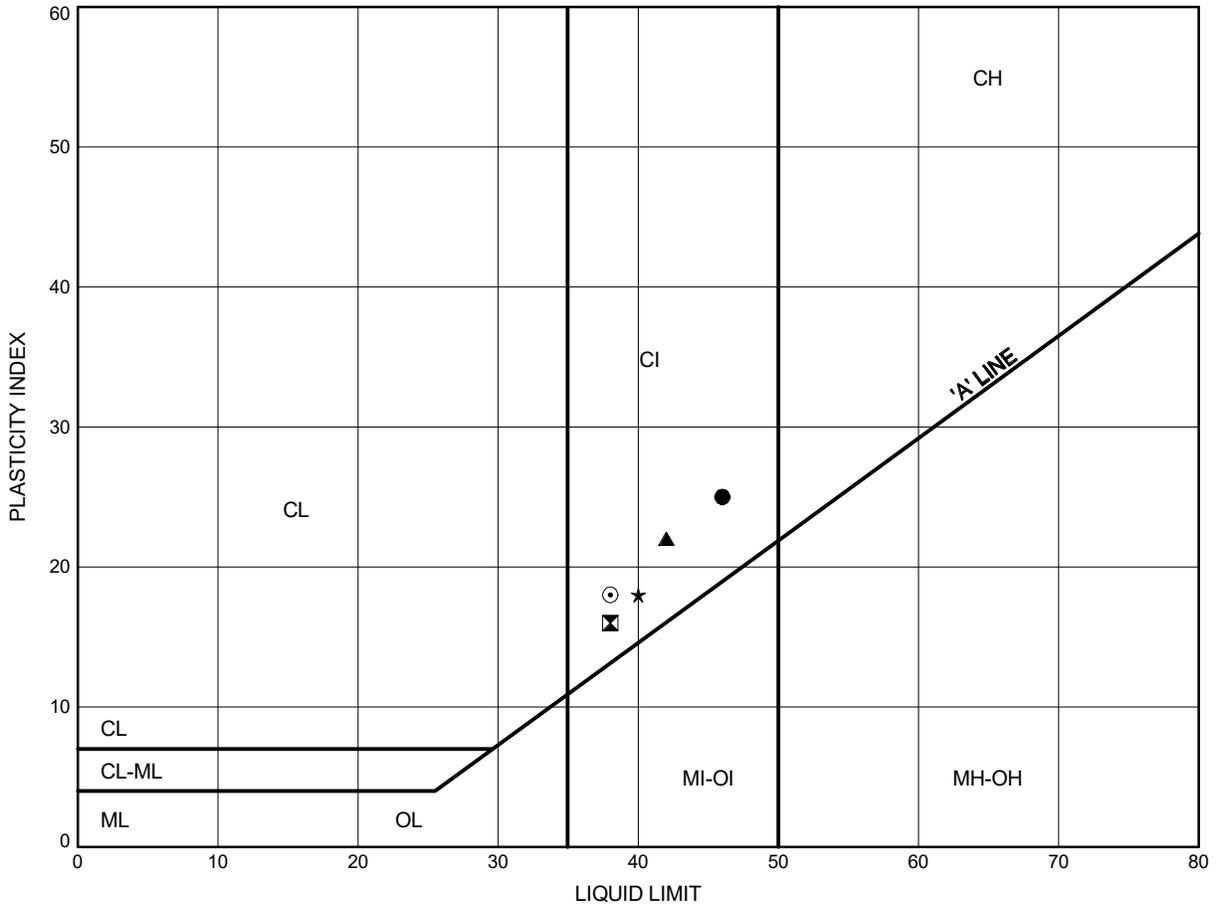


Prep'd .....AO.....  
 Chkd. ....DP.....

Highway 17 Twinning  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C3

Clay (Cl)



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	B-DC-1	4.1	150.1
⊠	B-DC-1	9.4	144.8
▲	B-DC-2	2.6	151.1
★	B-DC-2	7.9	145.8
⊙	B-DC-2	11.0	142.7

Date ..December 2021.....  
 WP# ..4068-09-00.....

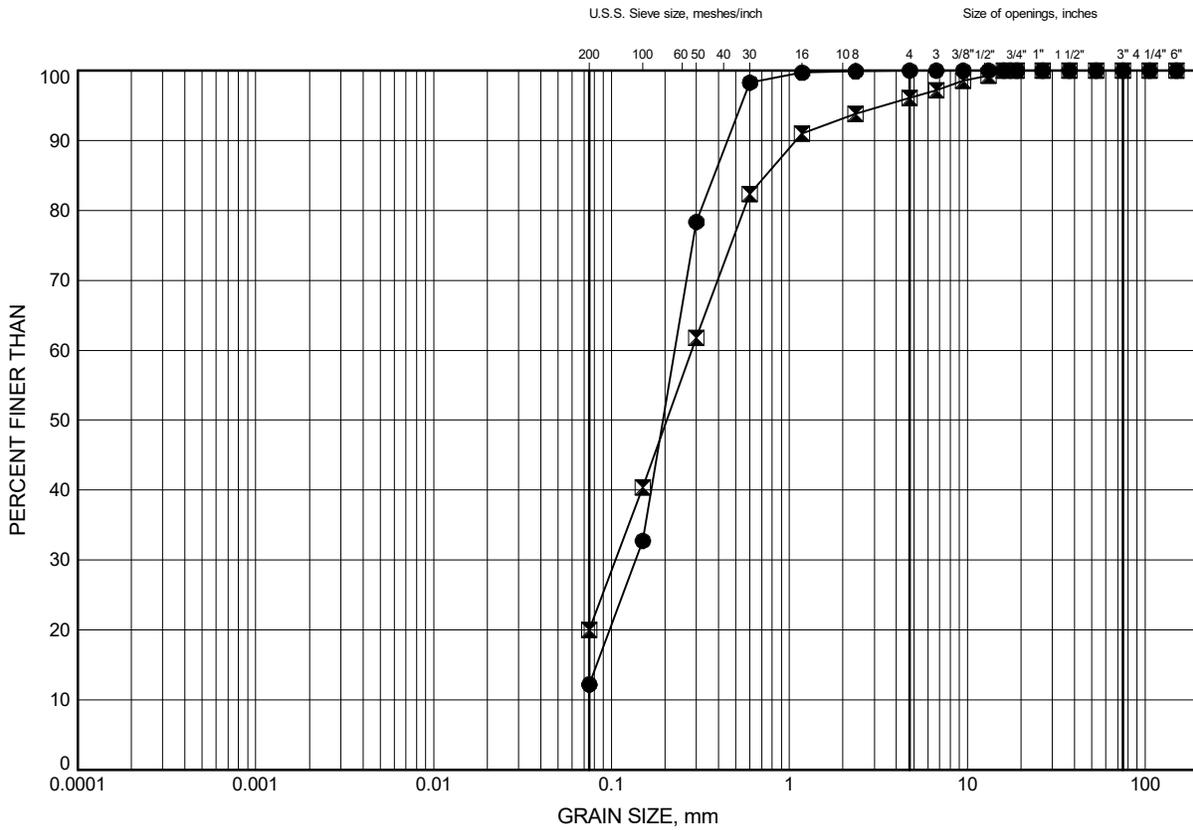


Prep'd .....AO.....  
 Chkd. ....DP.....

Highway 17 Twinning  
**GRAIN SIZE DISTRIBUTION**

FIGURE C4

**Sand (SW-SM) to Silty Sand (SM)**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	B-DC-3	3.4	150.5
⊠	B-DC-5	4.9	145.7

GRAIN SIZE DISTRIBUTION - THURBER 24726 DEEP CUTS.GPJ 21-12-13

Date .. December 2021 ..  
 WP# .. 4068-09-00 ..

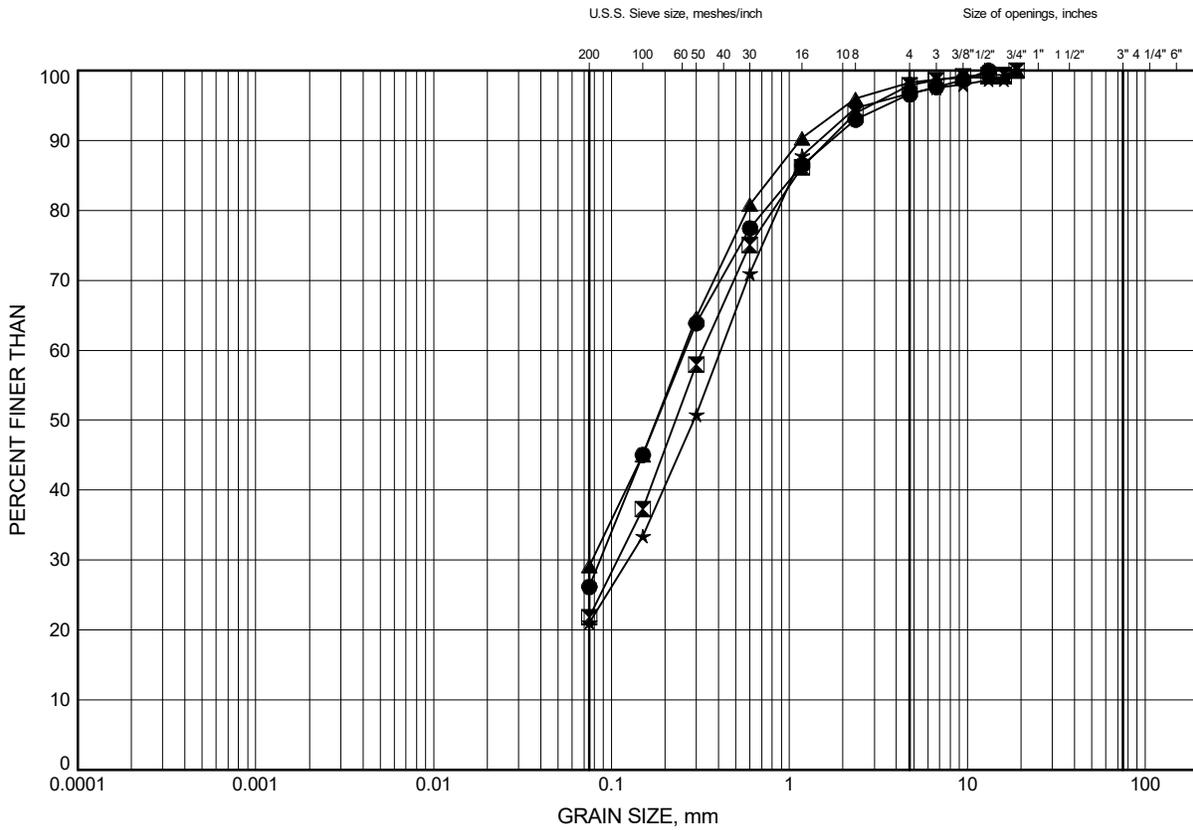


Prep'd .. AO ..  
 Chkd. .... DP ..

Highway 17 Twinning  
**GRAIN SIZE DISTRIBUTION**

FIGURE C5

**Silty Sand (SM) Till**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	K-DC-1	1.7	179.8
⊠	K-DC-1	6.2	175.3
▲	K-DC-2	3.4	178.3
★	K-DC-2	6.4	175.3

GRAIN SIZE DISTRIBUTION - THURBER 24726 DEEP CUTS.GPJ 21-12-13

Date .. December 2021 ..  
 WP# .. 4068-09-00 ..

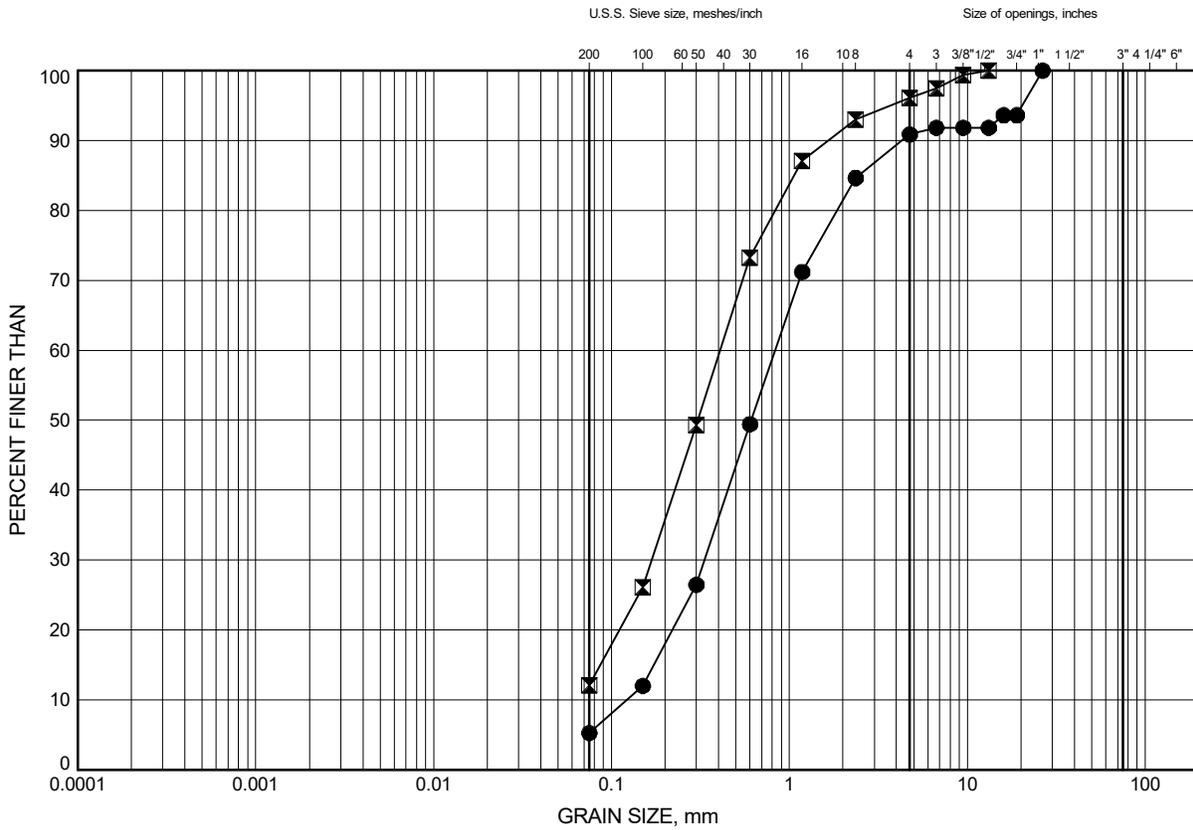


Prep'd .. AO ..  
 Chkd. .... DP ..

Highway 17 Twinning  
**GRAIN SIZE DISTRIBUTION**

FIGURE C6

**Sand (SW-SM to SP-SM) with Silt**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	L-DC-3	0.3	189.8
⊠	L-DC-4	1.1	181.2

GRAIN SIZE DISTRIBUTION - THURBER 24726 DEEP CUTS.GPJ 21-12-13

Date .. December 2021 ..  
 WP# .. 4068-09-00 ..

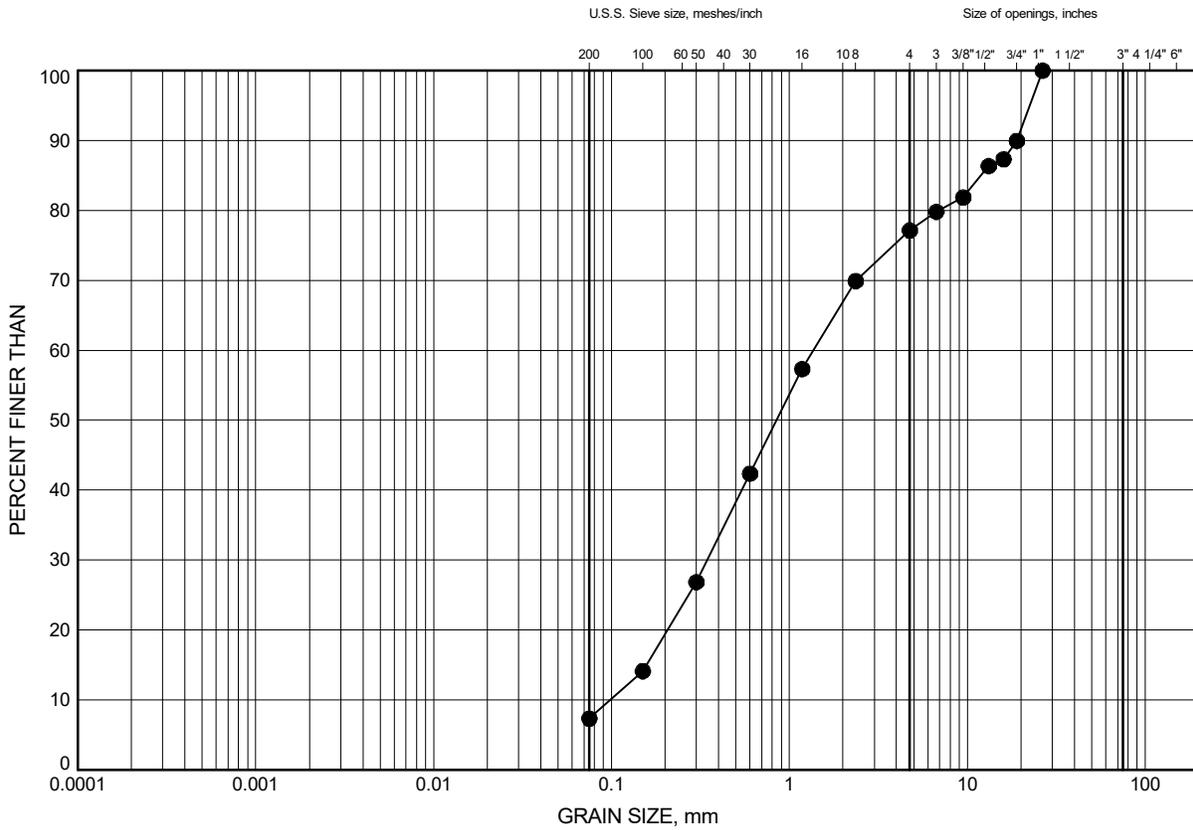


Prep'd .. AO ..  
 Chkd. .... DP ..

Highway 17 Twinning  
**GRAIN SIZE DISTRIBUTION**

FIGURE C7

**Sand (SP-SM) with Silt and Gravel Till**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	L-DC-4	4.0	178.3

GRAIN SIZE DISTRIBUTION - THURBER 24726 DEEP CUTS.GPJ 21-12-13

Date ..December 2021.....  
 WP# ..4068-09-00.....



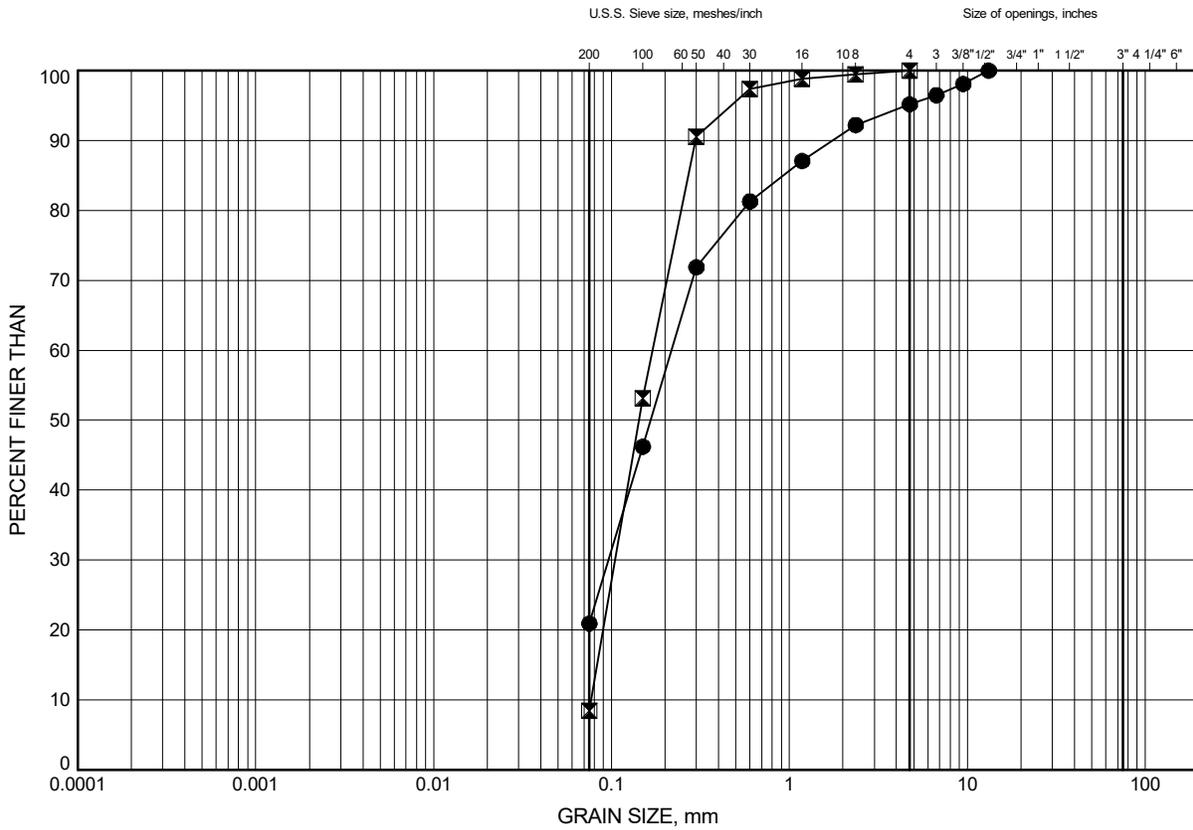
Prep'd .....AO.....  
 Chkd. ....DP.....



# Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C9

## Silty Sand (SM) to Sand (SP-SM) with Silt



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	N-DC-1	0.2	172.5
⊠	N-DC-3	0.2	169.2

GRAIN SIZE DISTRIBUTION - THURBER 24726 DEEP CUTS.GPJ 21-12-13

Date .. December 2021 ..  
 WP# .. 4068-09-00 ..



Prep'd .. AO ..  
 Chkd. .... DP ..



**Appendix C.2**  
**UCS Test Results**  
**Rock Core Photographs**

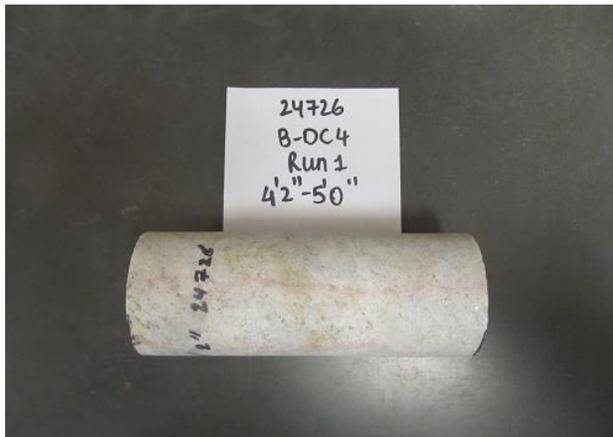
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

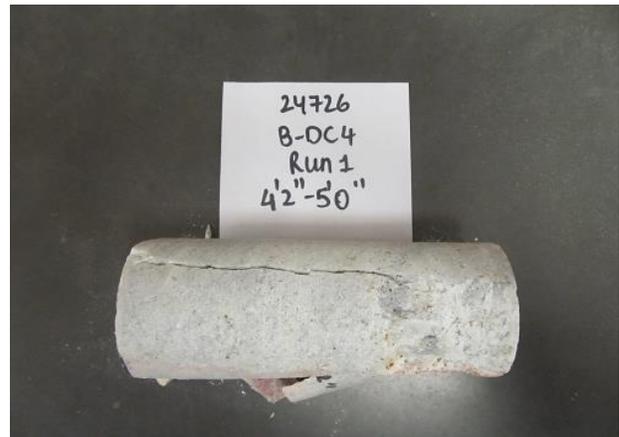
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 1		
SAMPLE DEPTH:	1.3-1.5 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	15.4	Weight (g):	1329.7
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,770
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,770
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	480.06		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	148.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	47.8 MPa

Note:

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

TEST DONE BY: BS  
REVIEWED BY: WM

B-DC4 RUN 1

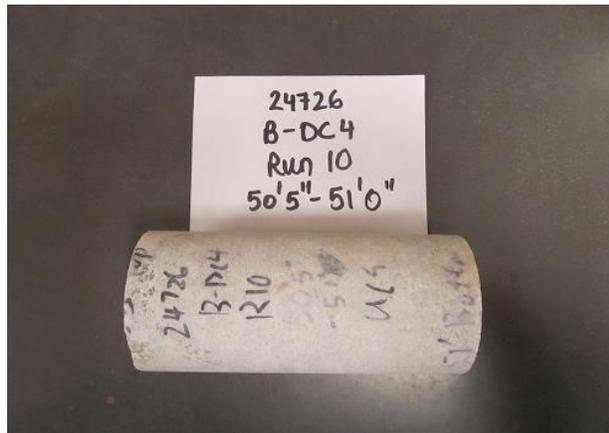
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

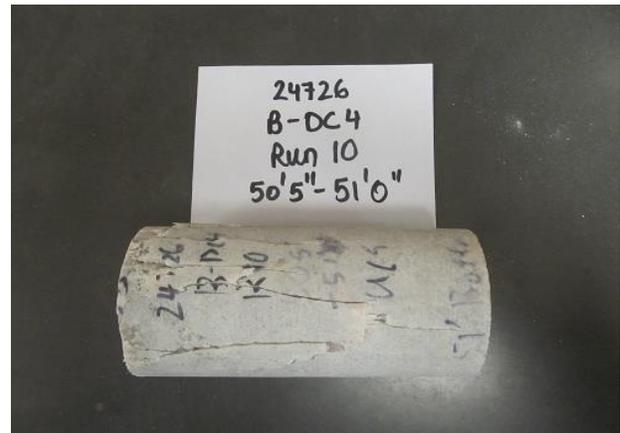
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 10		
SAMPLE DEPTH:	15.4-15.6 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	13.4	Weight (g):	1134.6
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,716
H. to Dia. Ratio*:	2.1:1	Dry Density (kg/m <sup>3</sup> ):	2,716
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	417.71		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.1% / min
MAXIMUM COMPRESSIVE LOAD:	241.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	77.4 MPa

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

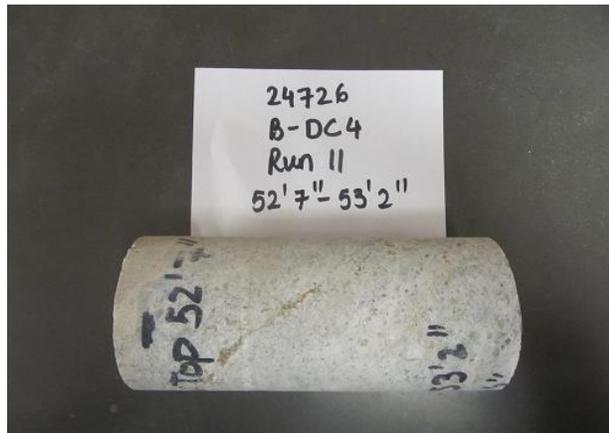
## UNCONFINED COMPRESSION TEST REPORT

### ASTM D7012-14

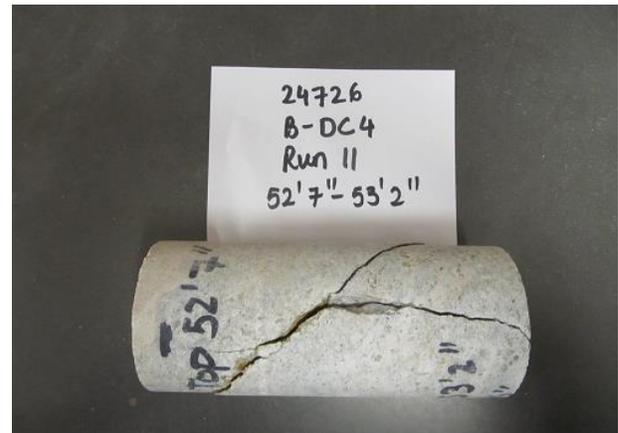
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 11		
SAMPLE DEPTH:	16.0-16.2 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	13.8	Weight (g):	1155.0
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,685
H. to Dia. Ratio*:	2.2:1	Dry Density (kg/m <sup>3</sup> ):	2,685
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	430.18		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.1% / min
MAXIMUM COMPRESSIVE LOAD:	92.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	29.6 MPa

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

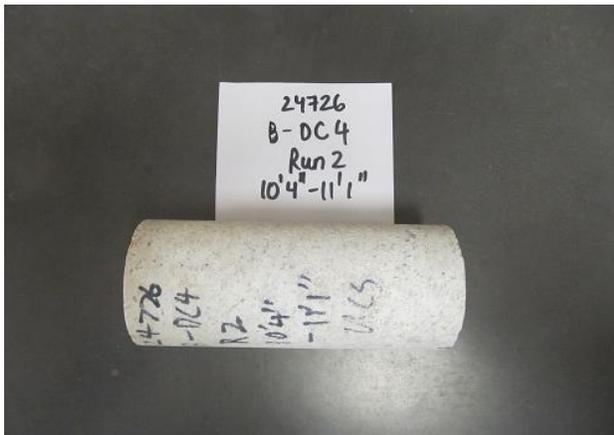
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

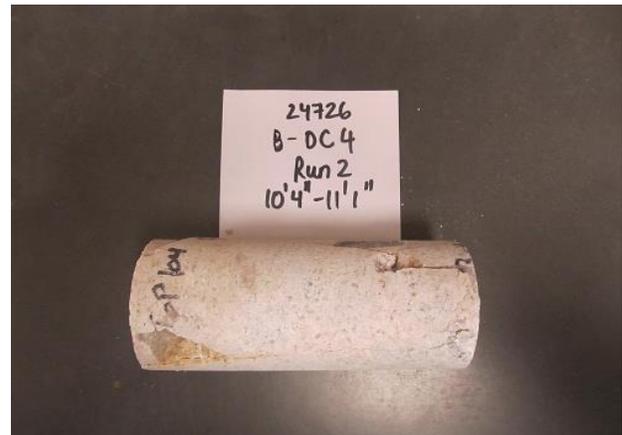
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 2		
SAMPLE DEPTH:	3.2-3.4 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	14.4	Weight (g):	1222.6
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,724
H. to Dia. Ratio*:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	2,724
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	448.88		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	181.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	58.4 MPa

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

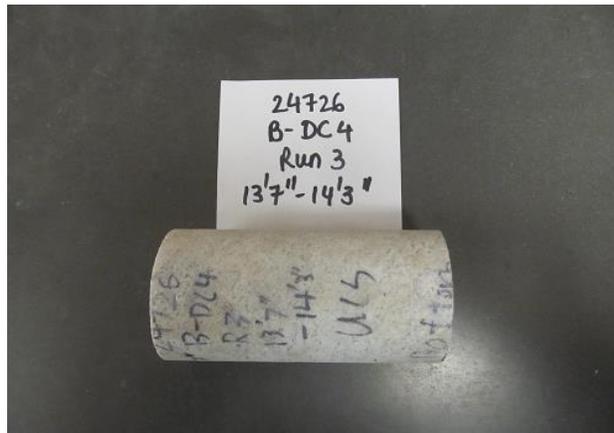
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

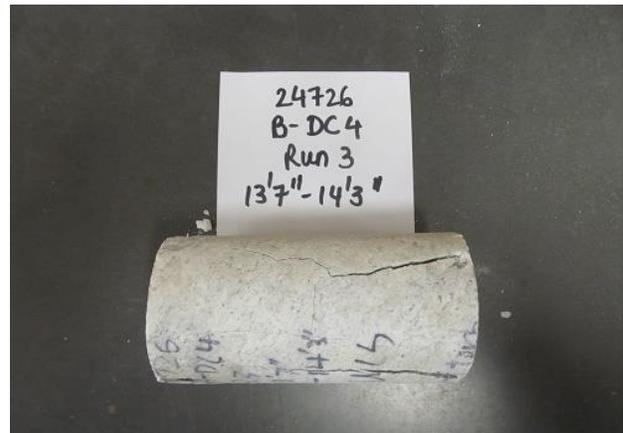
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 3		
SAMPLE DEPTH:	4.1-4.3 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	12.1	Weight (g):	1029.0
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,728
H. to Dia. Ratio*:	1.9:1	Dry Density (kg/m <sup>3</sup> ):	2,728
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	377.19		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	190.1 kN
UNCONFINED COMPRESSIVE STRENGTH:	61.0 MPa

Note: \* Dimensions of Specimen do not conform to ASTM D 4543-04.

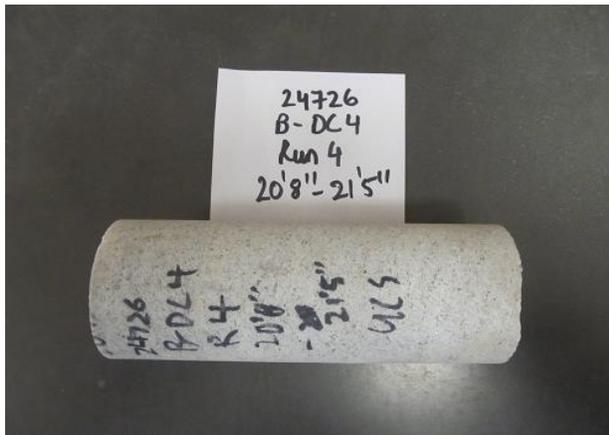
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

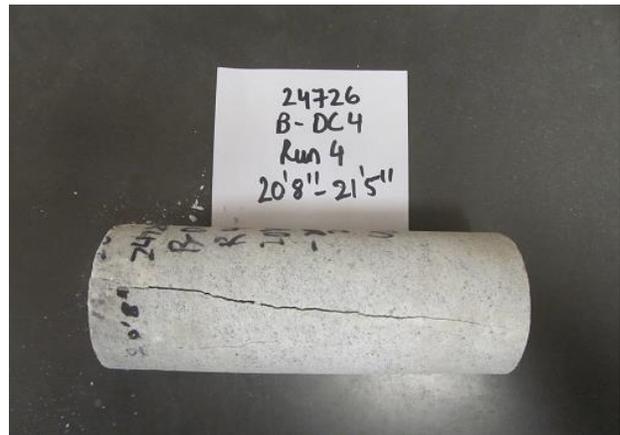
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 4		
SAMPLE DEPTH:	6.3-6.5 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	15.4	Weight (g):	1390.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,897
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,897
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	480.06		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	176.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	56.6 MPa

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

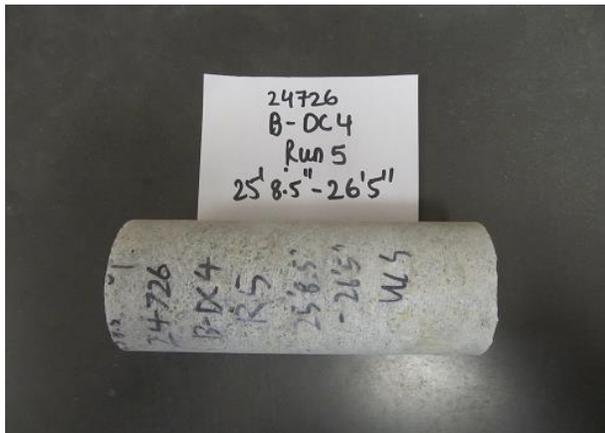
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

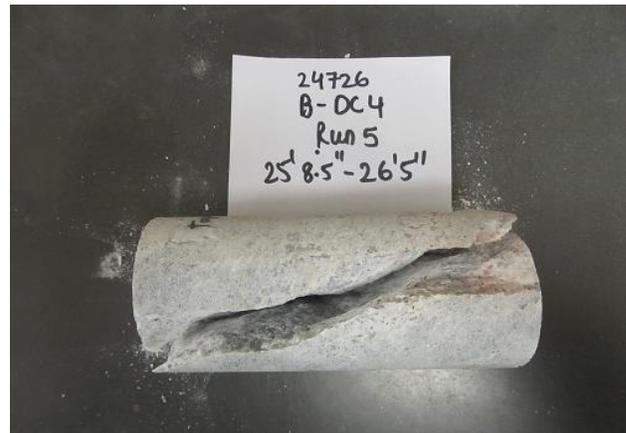
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 5		
SAMPLE DEPTH:	7.8-8.0 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	15.4	Weight (g):	1339.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,790
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,790
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	480.06		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	240.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	77.2 MPa

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

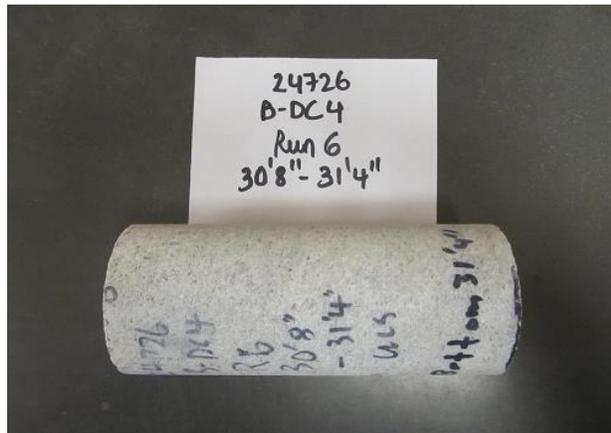
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

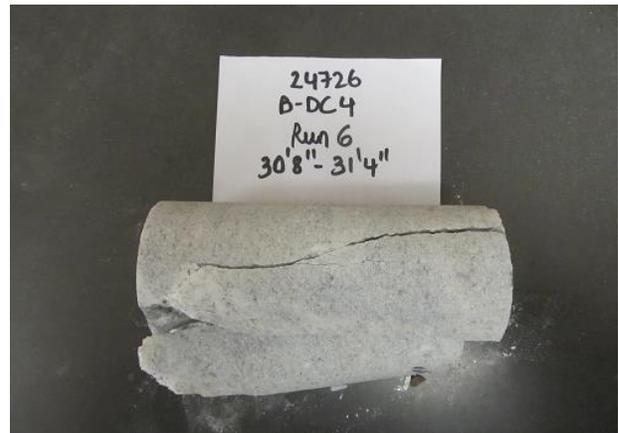
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 6		
SAMPLE DEPTH:	9.3-9.5 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	14.4	Weight (g):	1226.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,732
H. to Dia. Ratio*:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	2,732
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	448.88		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	243.1 kN
UNCONFINED COMPRESSIVE STRENGTH:	78.0 MPa

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

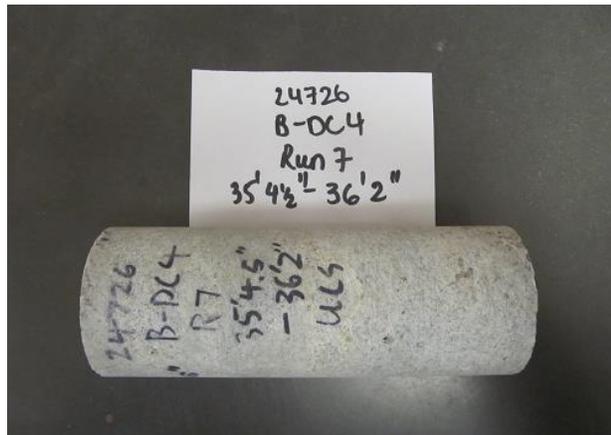
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

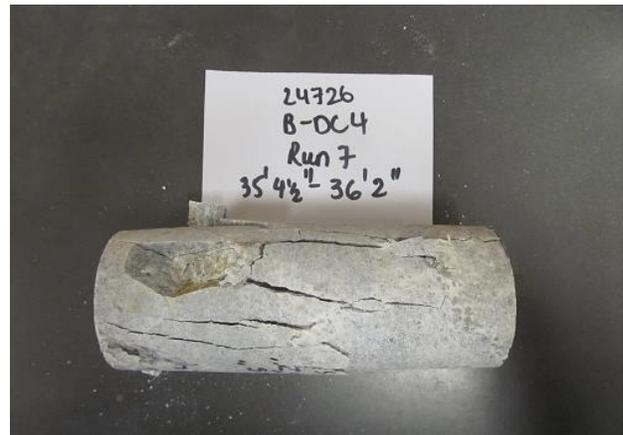
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 7		
SAMPLE DEPTH:	10.8-11.0 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	15.5	Weight (g):	1389.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,877
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,877
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	483.17		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	242.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	77.9 MPa

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



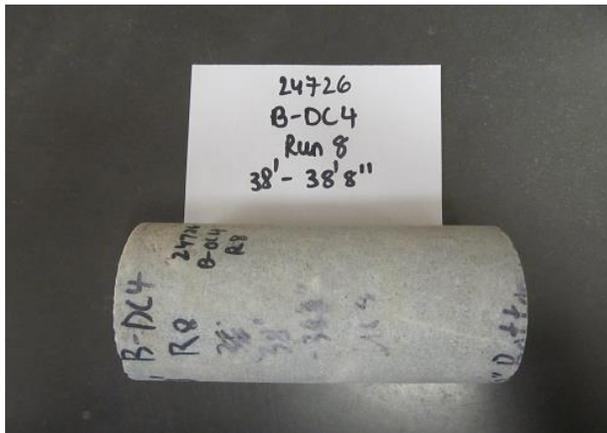
## UNCONFINED COMPRESSION TEST REPORT

### ASTM D7012-14

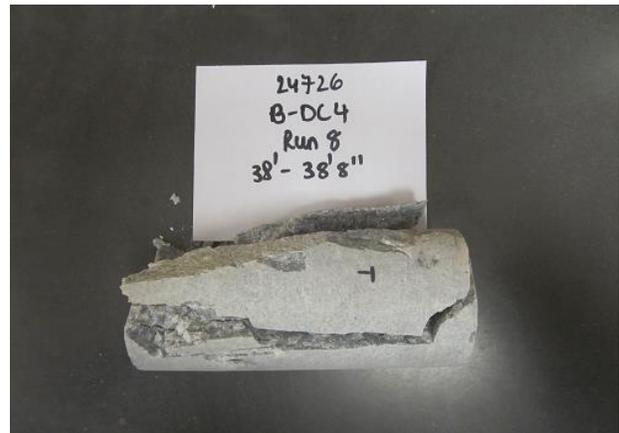
CLIENT: Ministry of Transportation (MTO) FILE NUMBER: 24726  
PROJECT NAME: Hwy 17 Twinning Renfrew to Haley Sta. Part 1B REPORT DATE: 29-Jan-21  
BOREHOLE No.: B-DC4 TEST DATE: 6-Jan-21  
SAMPLE No.: RUN 8  
SAMPLE DEPTH: 11.6-11.8 m  
DESCRIPTION: Marble

Avg. Height (cm):	13.5	Weight (g):	1200.3
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,852
H. to Dia. Ratio*:	2.1:1	Dry Density (kg/m <sup>3</sup> ):	2,852
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	420.83		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.1% / min
MAXIMUM COMPRESSIVE LOAD:	304.1 kN
UNCONFINED COMPRESSIVE STRENGTH:	97.6 MPa

Note:

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

TEST DONE BY: BS  
REVIEWED BY: WM

B-DC4 RUN 8

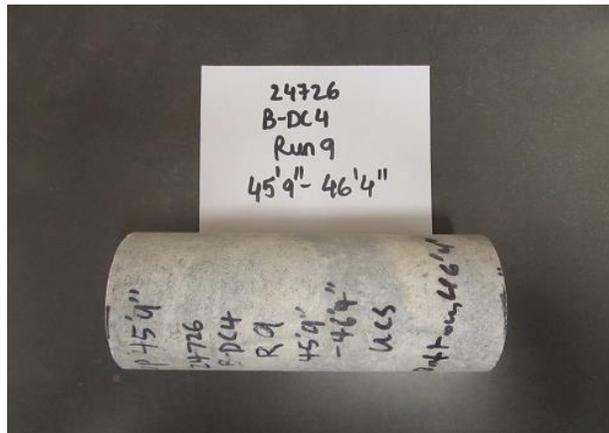
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

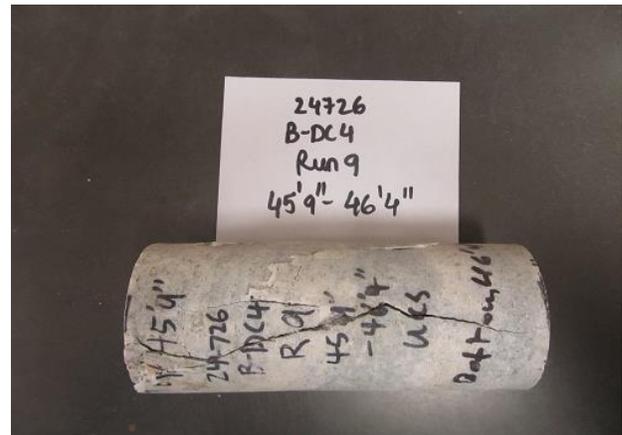
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 9		
SAMPLE DEPTH:	13.9-14.1 m		
DESCRIPTION:	Marble		

Avg. Height (cm):	15.3	Weight (g):	1338.0
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,805
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,805
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	476.94		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	225.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	72.2 MPa

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

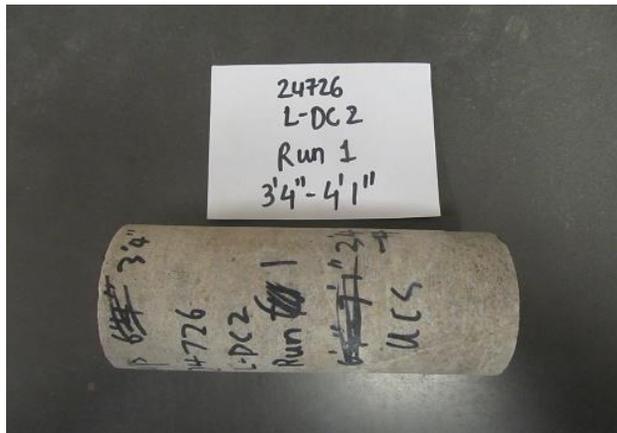
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

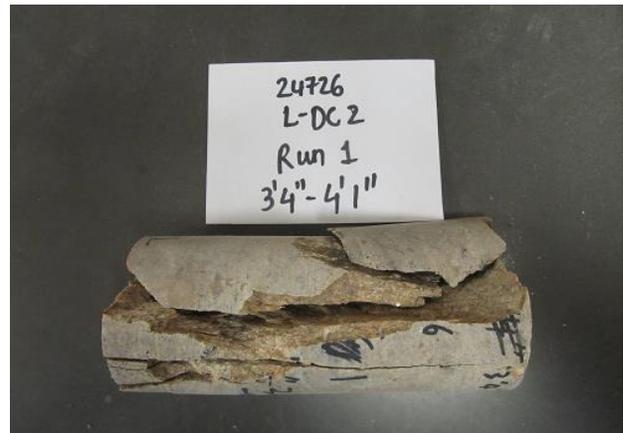
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 1		
SAMPLE DEPTH:	1.0-1.2 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.3	Weight (g):	1236.0
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,592
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,592
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	476.94		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	416.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	133.5 MPa

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

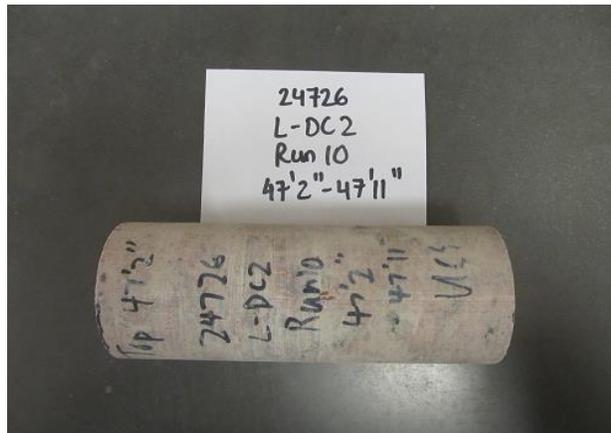
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

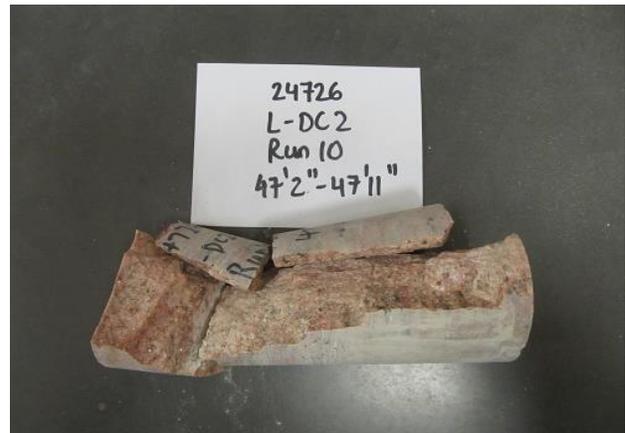
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 10		
SAMPLE DEPTH:	14.4-14.6 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.4	Weight (g):	1319.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,749
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,749
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	480.06		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	444.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	142.7 MPa

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

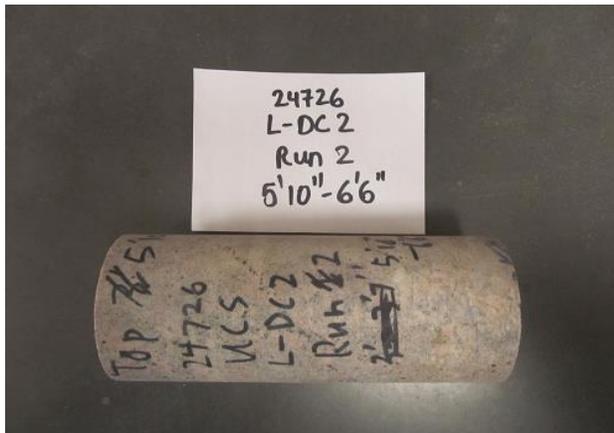
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

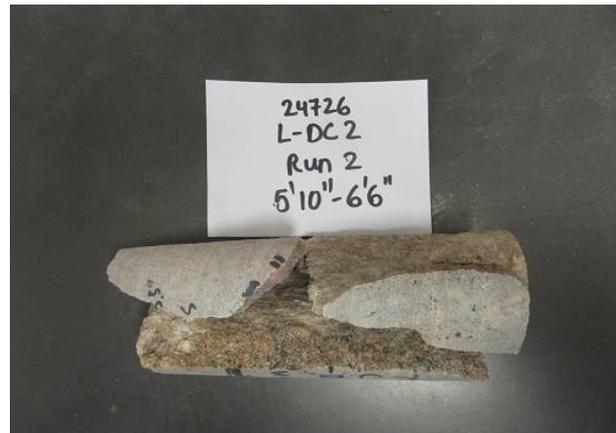
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 2		
SAMPLE DEPTH:	1.8-2.0 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.3	Weight (g):	1292.0
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,709
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,709
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	476.94		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	356.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	114.4 MPa

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

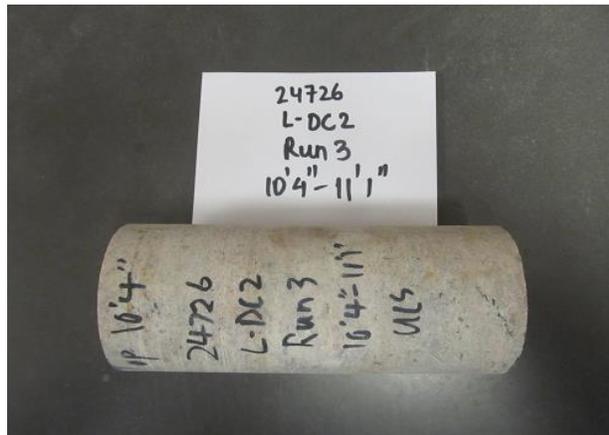
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

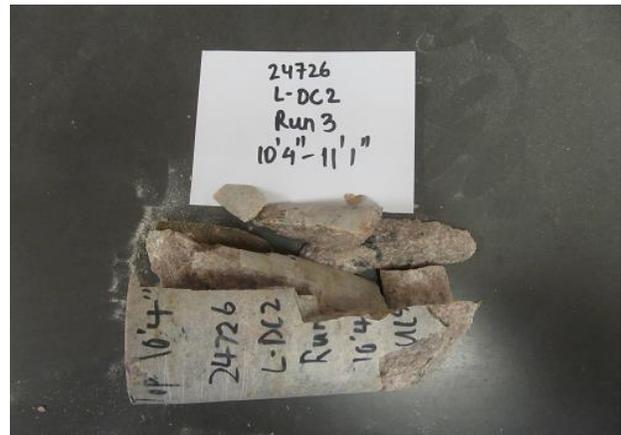
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 3		
SAMPLE DEPTH:	3.2-3.4 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.3	Weight (g):	1241.4
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,603
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,603
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	476.94		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	482.6 kN
UNCONFINED COMPRESSIVE STRENGTH:	154.8 MPa

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

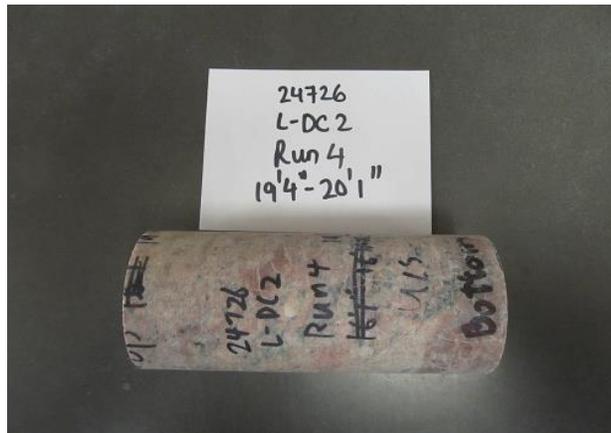
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

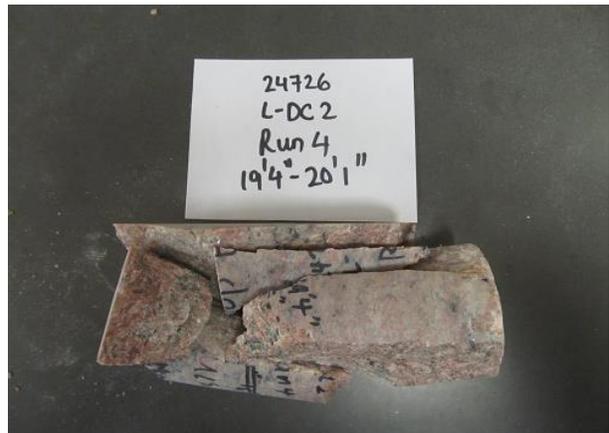
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 4		
SAMPLE DEPTH:	5.9-6.1 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	14.6	Weight (g):	1208.3
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,655
H. to Dia. Ratio*:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	2,655
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	455.12		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	330.5 kN
UNCONFINED COMPRESSIVE STRENGTH:	106.0 MPa

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

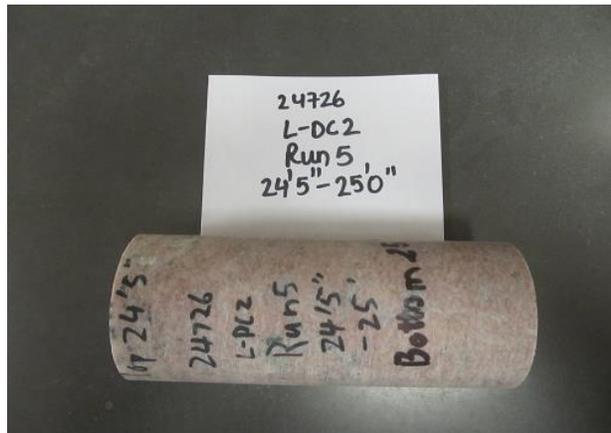
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

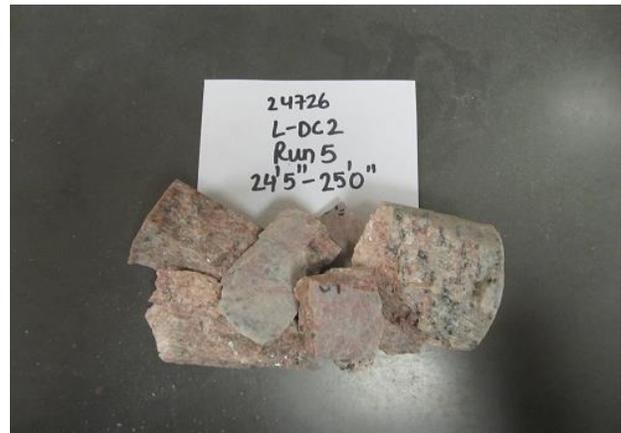
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 5		
SAMPLE DEPTH:	7.4-7.6 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.3	Weight (g):	1246.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,614
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,614
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	476.94		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	704.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	226.1 MPa

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

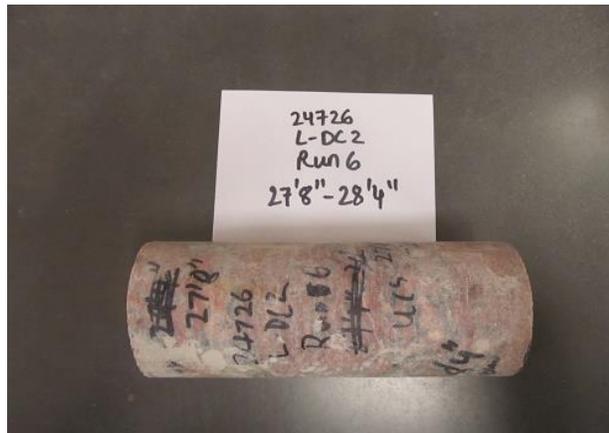
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

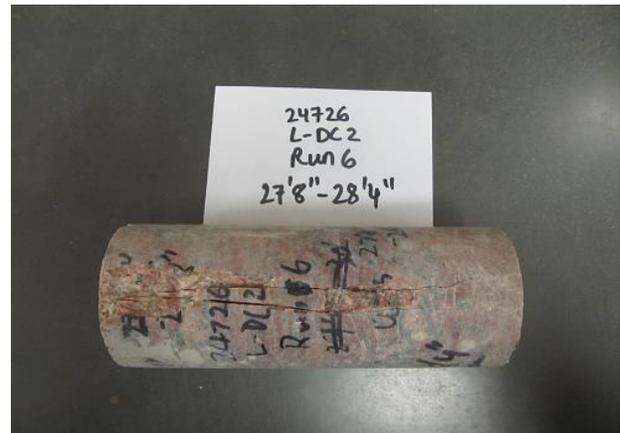
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 6		
SAMPLE DEPTH:	8.4-8.6 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.3	Weight (g):	1314.6
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,756
H. to Dia. Ratio*:	2.4:1	Dry Density (kg/m <sup>3</sup> ):	2,756
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	476.94		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	310.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	99.7 MPa

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

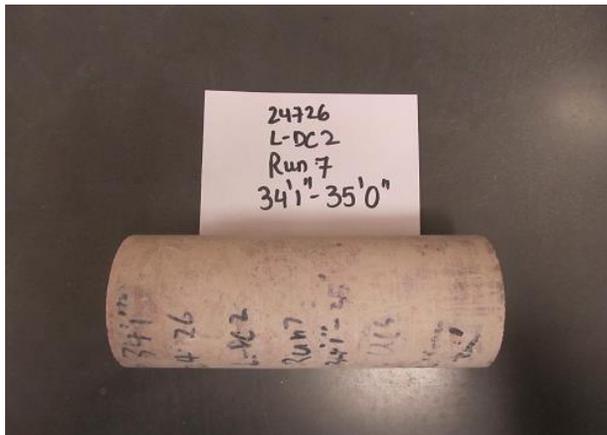
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

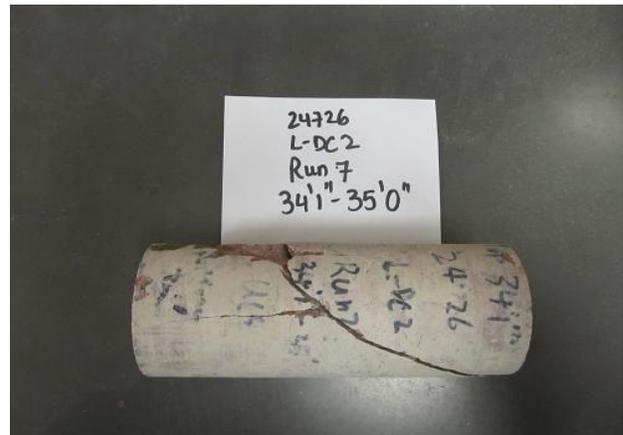
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 7		
SAMPLE DEPTH:	10.4-10.7 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.5	Weight (g):	1311.5
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,714
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,714
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	483.17		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	246.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	79.2 MPa

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

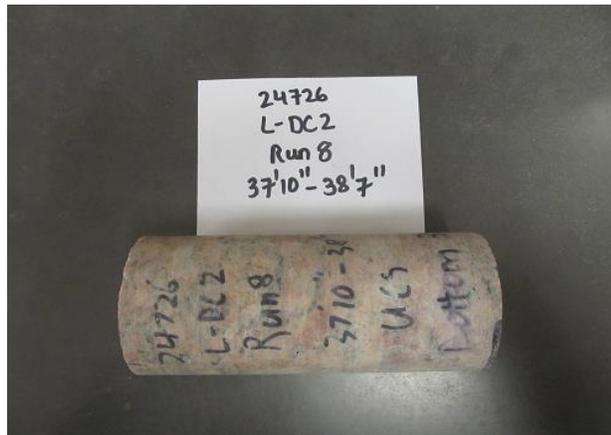
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

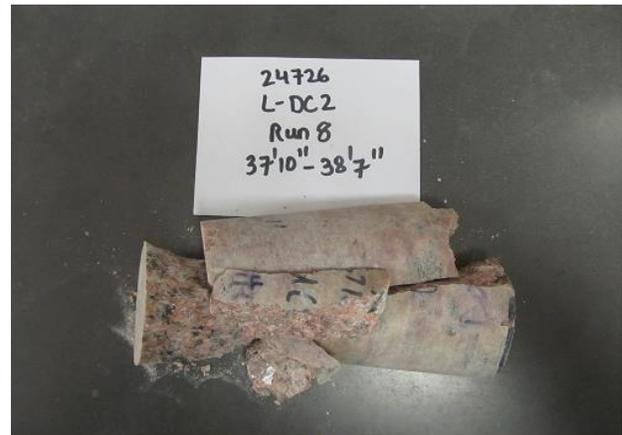
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 8		
SAMPLE DEPTH:	11.5-11.7 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	14.6	Weight (g):	1203.1
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,643
H. to Dia. Ratio*:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	2,643
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	455.12		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	408.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	131.0 MPa

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

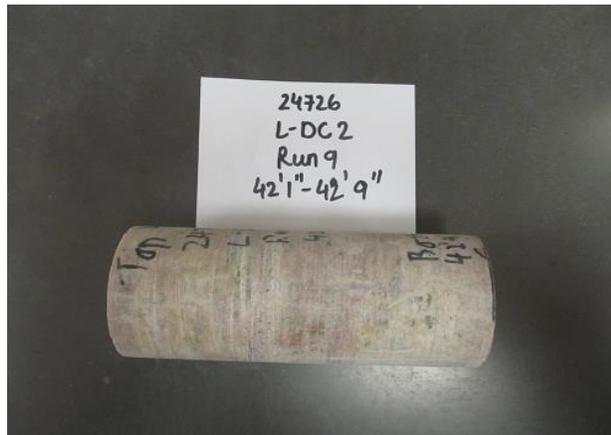
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

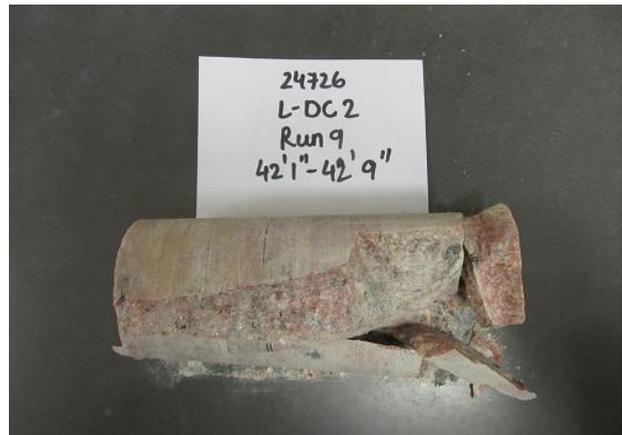
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 9		
SAMPLE DEPTH:	12.8-13.0 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	14.6	Weight (g):	1251.3
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,749
H. to Dia. Ratio*:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	2,749
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	455.12		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	287.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	92.1 MPa

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

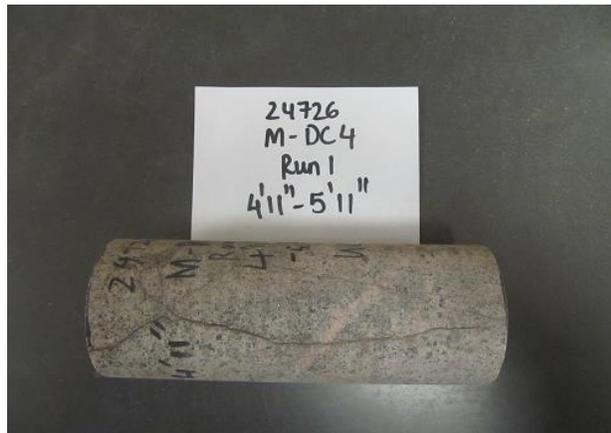
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

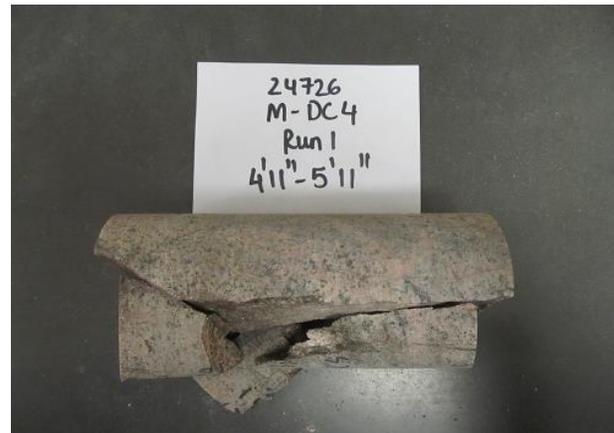
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 1		
SAMPLE DEPTH:	1.5-1.8 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.5	Weight (g):	1348.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,790
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,790
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	483.17		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	448.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	144.0 MPa

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

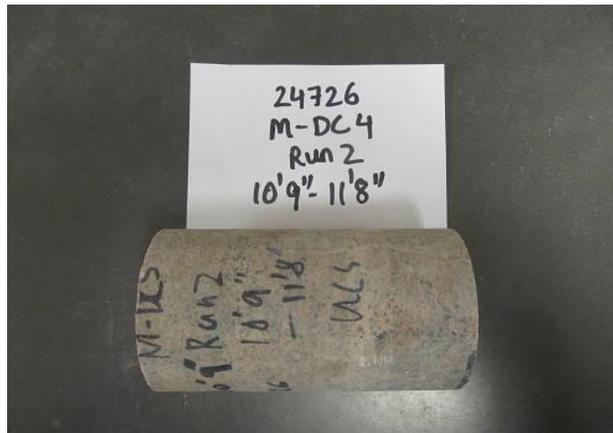
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

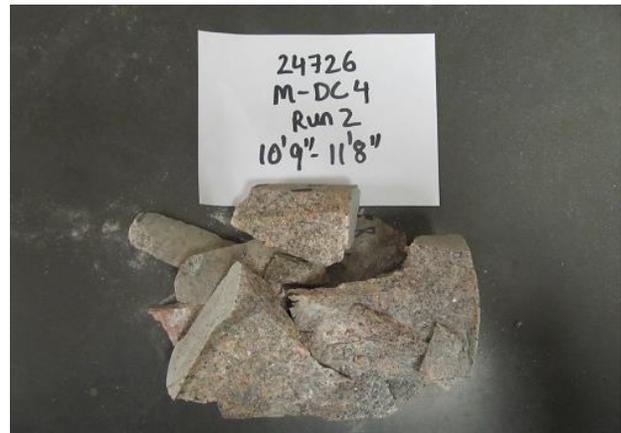
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PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 2		
SAMPLE DEPTH:	3.3-3.5 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	10.8	Weight (g):	925.7
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,750
H. to Dia. Ratio*:	1.7:1	Dry Density (kg/m <sup>3</sup> ):	2,750
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	336.66		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.4% / min
MAXIMUM COMPRESSIVE LOAD:	157.5 kN
UNCONFINED COMPRESSIVE STRENGTH:	50.5 MPa

Note: \* Dimensions of Specimen do not conform to ASTM D 4543-04.

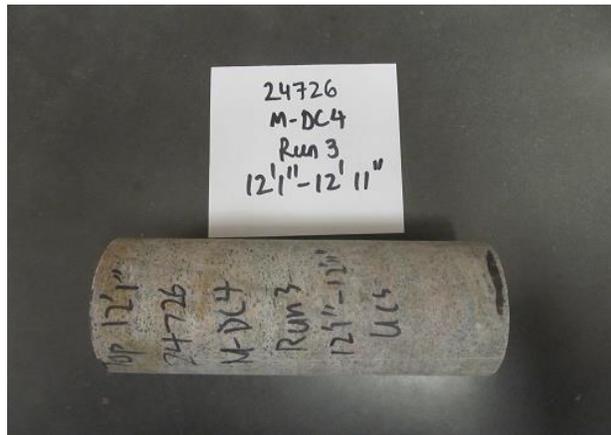
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

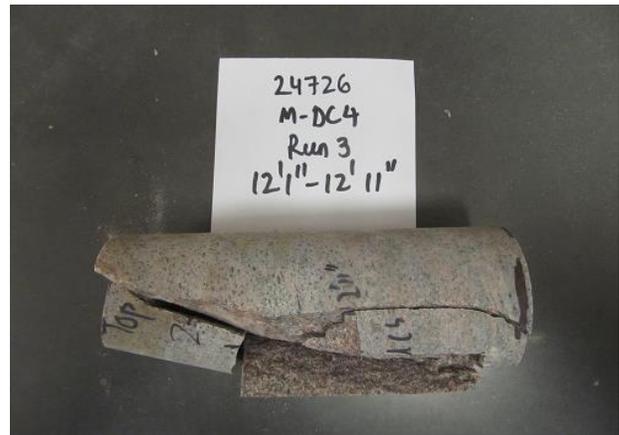
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PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 3		
SAMPLE DEPTH:	3.7-3.9 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.6	Weight (g):	1397.0
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,873
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,873
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	486.29		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	528.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	169.4 MPa

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

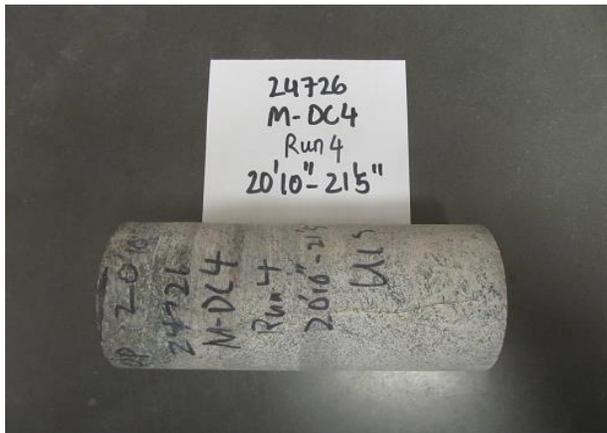
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

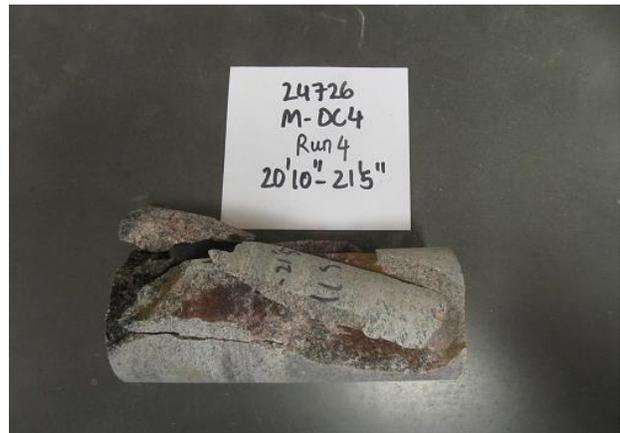
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 4		
SAMPLE DEPTH:	6.3-6.5 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	14.6	Weight (g):	1224.7
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,691
H. to Dia. Ratio*:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	2,691
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	455.12		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	287.4 kN
UNCONFINED COMPRESSIVE STRENGTH:	92.2 MPa

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

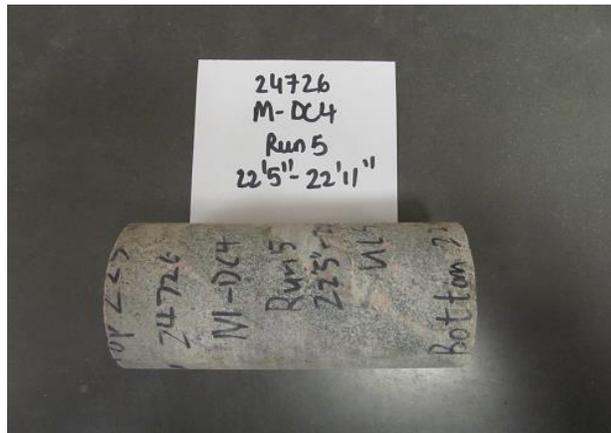
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

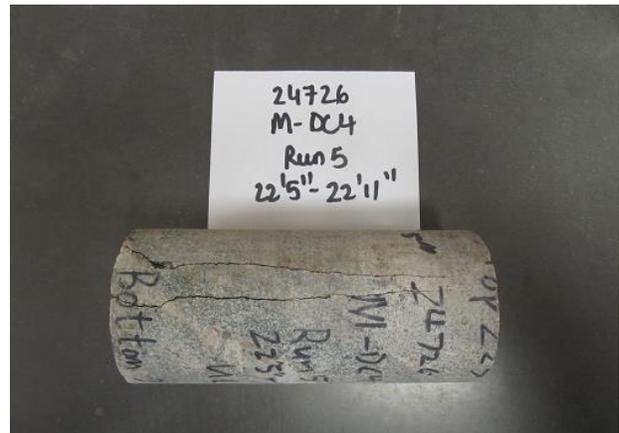
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 5		
SAMPLE DEPTH:	6.8-7.0 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	13.5	Weight (g):	1122.1
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,666
H. to Dia. Ratio*:	2.1:1	Dry Density (kg/m <sup>3</sup> ):	2,666
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	420.83		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.1% / min
MAXIMUM COMPRESSIVE LOAD:	252.6 kN
UNCONFINED COMPRESSIVE STRENGTH:	81.0 MPa

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

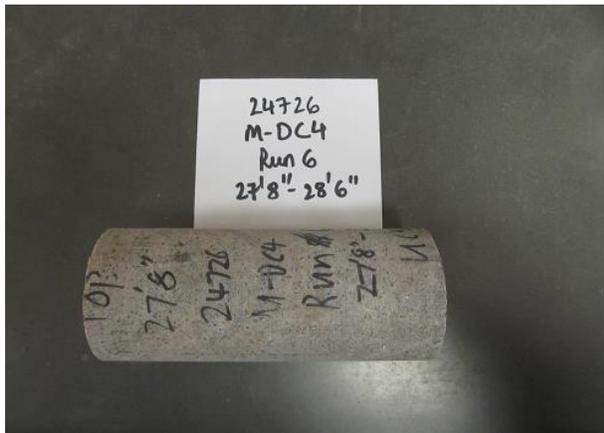
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

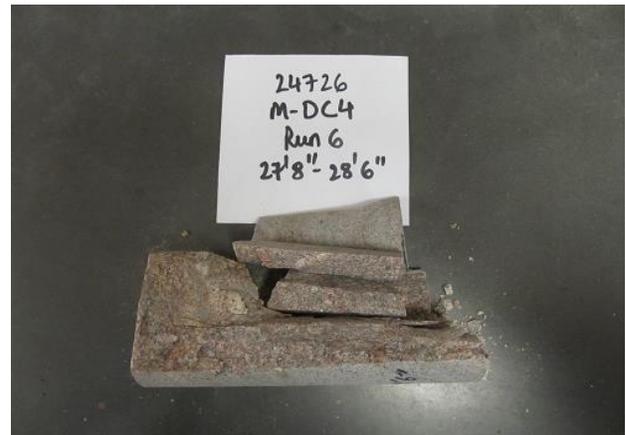
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 6		
SAMPLE DEPTH:	8.5-8.7 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	14.5	Weight (g):	1237.0
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,737
H. to Dia. Ratio*:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	2,737
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	452.00		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	157.5 kN
UNCONFINED COMPRESSIVE STRENGTH:	50.5 MPa

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

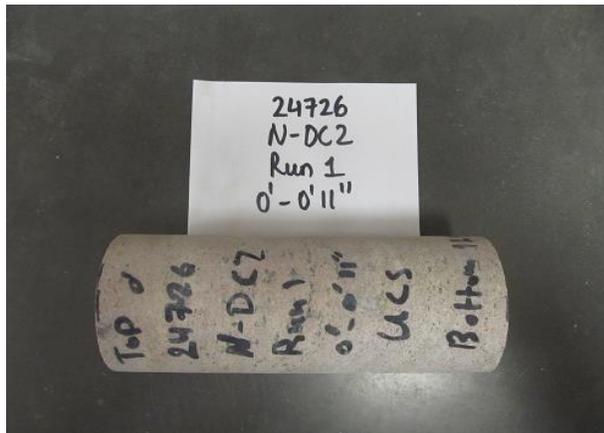
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

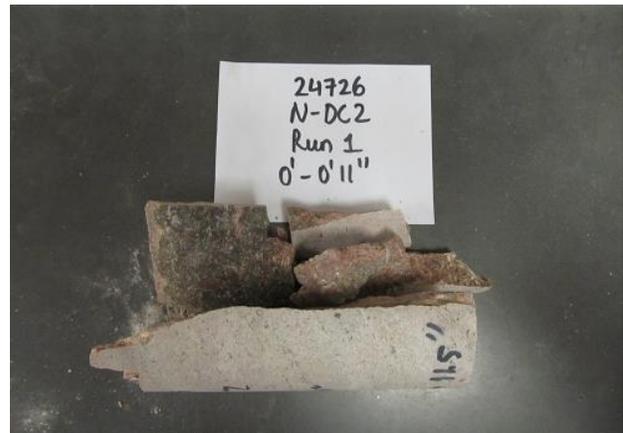
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 1		
SAMPLE DEPTH:	0.0-0.3 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.6	Weight (g):	1314.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,704
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,704
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	486.29		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	285.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	91.5 MPa

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

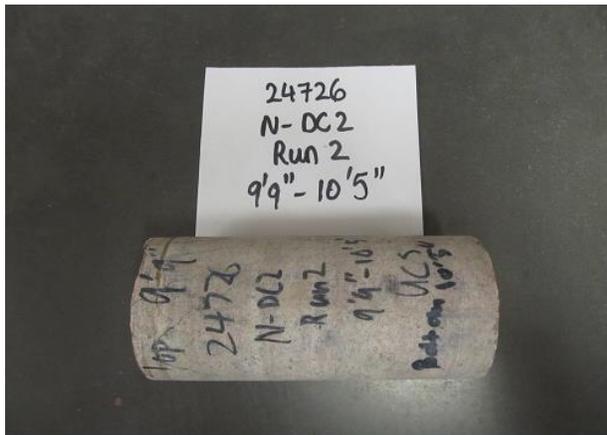
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

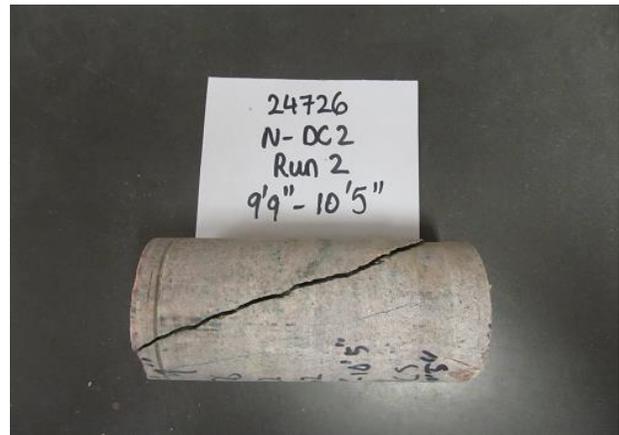
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 2		
SAMPLE DEPTH:	3.0-3.2 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	13.6	Weight (g):	1114.4
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,629
H. to Dia. Ratio*:	2.2:1	Dry Density (kg/m <sup>3</sup> ):	2,629
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	423.95		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.1% / min
MAXIMUM COMPRESSIVE LOAD:	530.1 kN
UNCONFINED COMPRESSIVE STRENGTH:	170.1 MPa

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

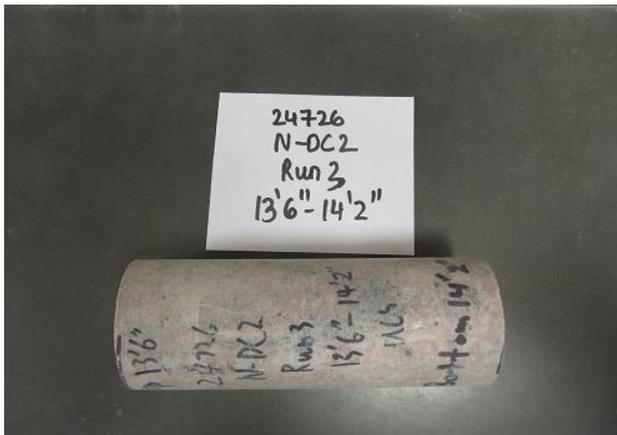
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

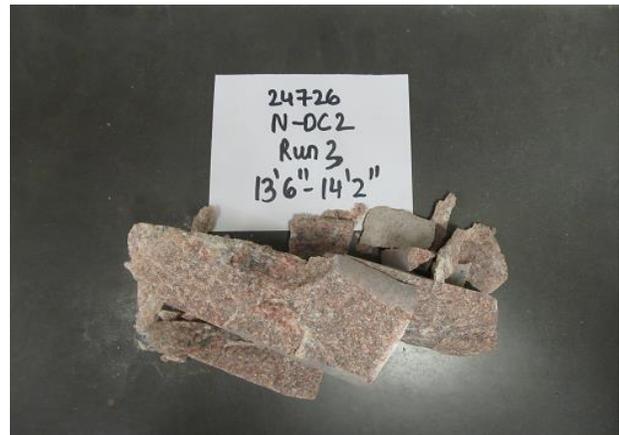
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 3		
SAMPLE DEPTH:	4.0-4.3 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.6	Weight (g):	1351.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,780
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,780
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	486.29		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	314.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	101.0 MPa

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

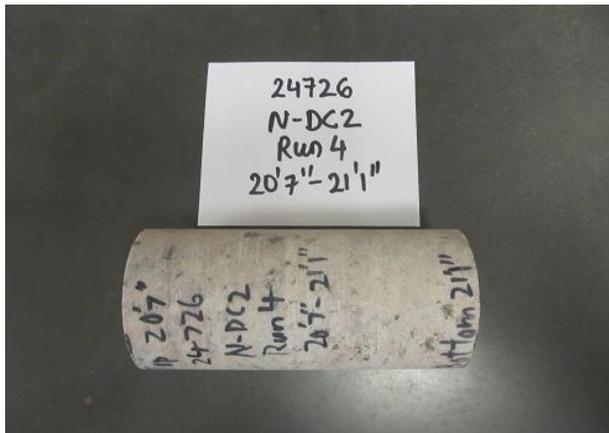
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

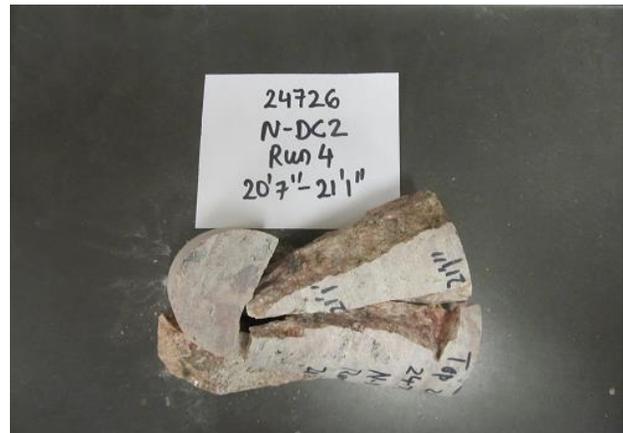
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 4		
SAMPLE DEPTH:	6.25-6.4 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	13.5	Weight (g):	1102.8
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,621
H. to Dia. Ratio*:	2.1:1	Dry Density (kg/m <sup>3</sup> ):	2,621
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	420.83		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.1% / min
MAXIMUM COMPRESSIVE LOAD:	324.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	104.2 MPa

Note:

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

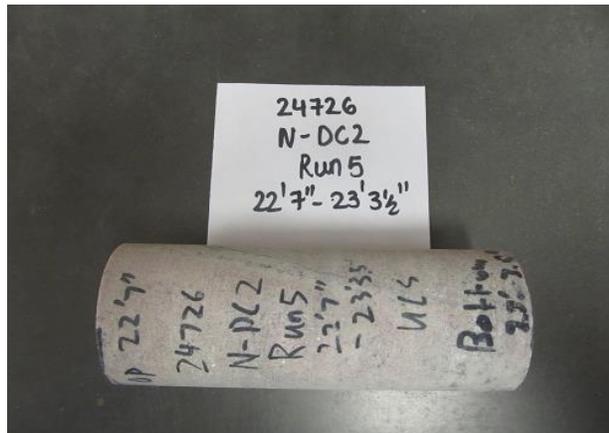
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

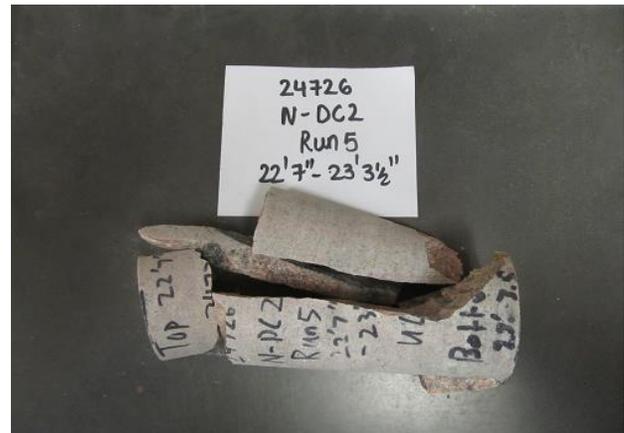
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 5		
SAMPLE DEPTH:	6.9-7.1 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.6	Weight (g):	1354.8
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,786
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,786
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	486.29		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	287.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	92.2 MPa

Note:

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

TEST DONE BY: BS  
REVIEWED BY: WM

N-DC2 RUN 5

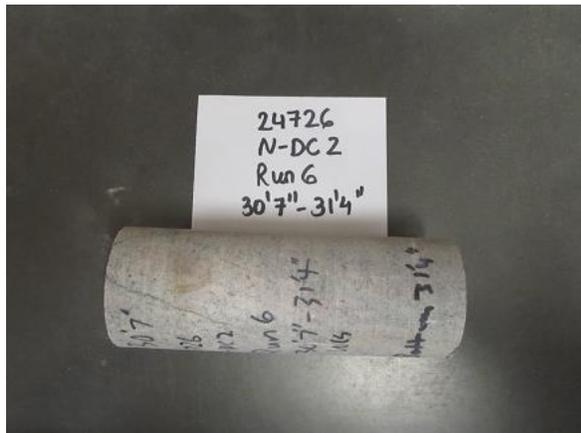
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

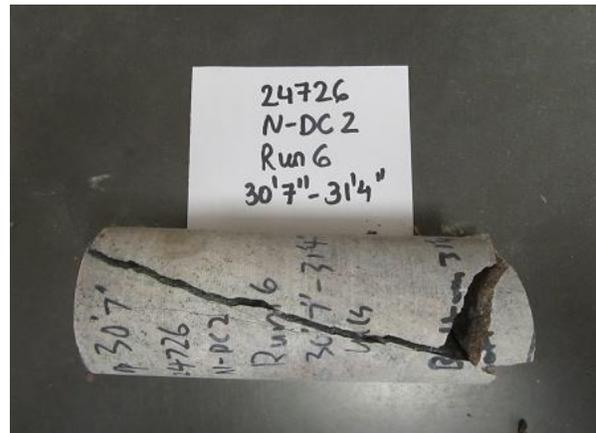
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 6		
SAMPLE DEPTH:	9.3-9.5 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.6	Weight (g):	1362.5
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,802
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,802
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content (%):	N/A
Sample Volume (cm <sup>3</sup> ):	486.29		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	415.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	133.2 MPa

Note:

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

TEST DONE BY: BS  
REVIEWED BY: WM

N-DC2 RUN 6

**Borehole B-DC4**  
**Run 1 to 2 (of 11)**  
**Elevation 158.1 m to 155.6 m**

Run 1 Start  
elev. 158.1 m

Run 1 End  
elev. 157.1 m



Run 2 Start  
elev. 157.1 m

Run 2 End  
elev. 155.6 m



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**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole B-DC4**  
**Run 3 to 4 (of 11)**  
**Elevation 155.6 m to 152.6 m**

Run 3 Start  
elev. 155.6 m

Run 3 End  
elev. 154.1 m



Run 4 Start  
elev. 154.1 m

Run 4 End  
elev. 152.6 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole B-DC4**  
**Run 5 to 6 (of 11)**  
**Elevation 152.6 m to 149.6 m**

Run 5 Start  
elev. 152.6 m

Run 5 End  
elev. 151.1 m



Run 6 Start  
elev. 151.1 m

Run 6 End  
elev. 149.6 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole B-DC4**  
**Run 7 to 8 (of 11)**  
**Elevation 149.6 m to 146.5 m**

Run 7 Start  
elev. 149.6 m

Run 7 End  
elev. 148.1 m



Run 8 Start  
elev. 148.1 m

Run 8 End  
elev. 146.5 m



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**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole B-DC4**  
**Run 9 to 10 (of 11)**  
**Elevation 146.5 m to 143.9 m**

Run 9 Start  
elev. 146.5 m

Run 9 End  
elev. 145.0 m



Run 10 Start  
elev. 145.0 m

Run 10 Cont.  
elev. 143.9 m



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

**Borehole B-DC4**  
**Run 10 to 11 (of 11)**  
**Elevation 143.9 m to 141.9 m**

Run 10 Cont.  
elev. 143.9 m

Run 10 End  
elev. 143.5 m



Run 11 Start  
elev. 143.5 m

Run 11 End  
elev. 141.9 m

End of  
Borehole



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole L-DC2**  
**Run 1 to 2 (of 10)**  
**Elevation 189.4 m to 186.5 m**

Run 1 Start  
elev. 189.4 m



Run 1 End  
elev. 187.9 m

Run 2 Start  
elev. 187.9 m

Run 2 Cont.  
elev. 186.5 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole L-DC2**  
**Run 2 to 4 (of 10)**  
**Elevation 186.5 m to 183.8 m**

Run 2 Cont.  
elev. 186.5 m

Run 2 End  
elev. 186.3 m

Run 3 Start  
elev. 186.3 m



Run 3 End  
elev. 184.8 m

Run 4 Start  
elev. 184.8 m

Run 4 Cont.  
elev. 183.8 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole L-DC2**  
**Run 4 to 6 (of 10)**  
**Elevation 183.8 m to 180.8 m**

Run 4 Cont.  
elev. 183.8 m

Run 4 End  
elev. 183.2 m

Run 5 Start  
elev. 183.2 m



Run 5 End  
elev. 181.8 m

Run 6 Start  
elev. 181.8 m

Run 6 Cont.  
elev. 180.8 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole L-DC2**  
**Run 6 to 8 (of 10)**  
**Elevation 180.8 m to 178.2 m**

Run 6 Cont.  
elev. 180.8 m

Run 6 End  
elev. 180.3 m

Run 7 Start  
elev. 180.3 m



Run 7 End  
elev. 178.8 m

Run 8 Start  
elev. 178.8 m

Run 8 Cont.  
elev. 178.2 m



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**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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**Project No.: 24726**

**Borehole L-DC2**  
**Run 8 to 9 (of 10)**  
**Elevation 178.2 m to 175.6 m**

Run 8 Cont.  
elev. 178.2 m

Run 8 End  
elev. 177.2 m

Run 9 Start  
elev. 177.2 m



Run 9 End  
elev. 175.6 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole L-DC2**  
**Run 10 to 10 (of 10)**  
**Elevation 175.6 m to 174.0 m**

Run 10 Start  
elev. 175.6 m



Run 10 End  
elev. 174.0 m

End of  
Borehole



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole M-DC4**  
**Run 1 to 2 (of 6)**  
**Elevation 180.5 m to 177.5 m**

Run 1 Start  
elev. 180.5 m

Run 1 End  
elev. 179.0 m



Run 2 Start  
elev. 179.0 m

Run 2 End  
elev. 177.5 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole M-DC4**  
**Run 3 to 4 (of 6)**  
**Elevation 177.5 m to 174.6 m**

Run 3 Start  
elev. 177.5 m

Run 3 End  
elev. 176.0 m



Run 4 Start  
elev. 176.0 m

Run 4 End  
elev. 174.6 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole M-DC4**  
**Run 5 to 6 (of 6)**  
**Elevation 174.6 m to 171.4 m**

Run 5 Start  
elev. 174.6 m

Run 5 End  
elev. 173.0 m



Run 6 Start  
elev. 173.0 m

Run 6 End  
elev. 171.4 m

End of  
Borehole



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole N-DC2**  
**Run 1 to 2 (of 6)**  
**Elevation 172.1 m to 169.1 m**

Run 1 Start  
elev. 172.1 m



Run 1 End  
elev. 170.1 m

Run 2 Start  
elev. 170.1 m

Run 2 Cont.  
elev. 169.1 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

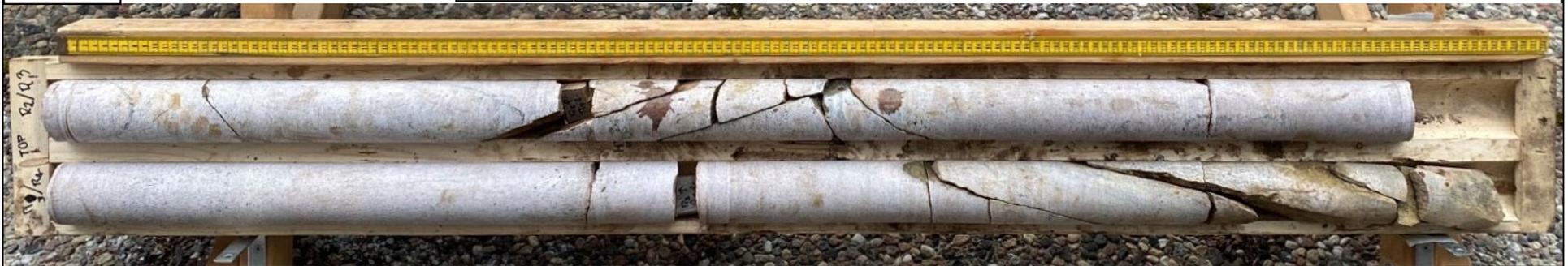
**W.P. 4068-09-00**  
**Project No.: 24726**

**Borehole N-DC2**  
**Run 2 to 4 (of 6)**  
**Elevation 169.1 m to 166.3 m**

Run 2 Cont.  
elev. 169.14 m

Run 2 End  
elev. 168.7 m

Run 3 Start  
elev. 168.7 m



Run 3 End  
elev. 167.2 m

Run 4 Start  
elev. 167.2 m

Run 4 Cont.  
elev. 166.3 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole N-DC2**  
**Run 4 to 5 (of 6)**  
**Elevation 166.3 m to 164.1 m**

Run 4 Cont.  
elev. 166.3 m

Run 4 End  
elev. 165.6 m

Run 5 Start  
elev. 165.6 m



Run 5 End  
elev. 164.1 m



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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

**Borehole N-DC2**  
**Run 6 to 6 (of 6)**  
**Elevation 164.1 m to 162.6 m**



Run 6 Start  
elev. 164.1 m

Run 6 End  
elev. 162.5 m

End of  
Borehole



**Geotechnical Investigation**  
**Highway 17 Twinning, Deep Cuts**  
**Renfrew, Ontario**

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



**Appendix D.**  
**Site Photographs**



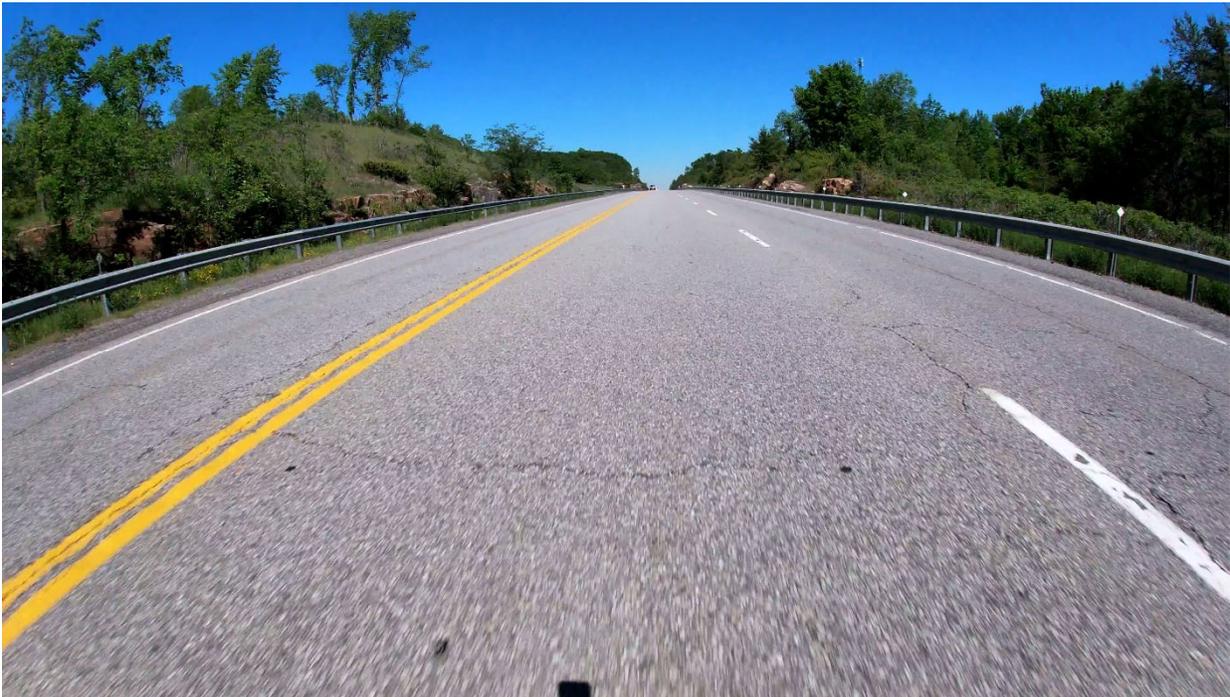
**Photo 1. Looking south west along existing alignment at B-DC (2019/11/06)**



**Photo 2. Looking east along new alignment at B-DC (2021/08/04)**



**Photo 3. Looking along new alignment at K-DC (2019/07/08)**



**Photo 4. Looking east along existing alignment at K-DC (2020/06/18)**



**Photo 5. 12+250 looking east along new alignment at L-DC (2020/07/02)**



**Photo 6. Looking north-east along existing alignment at L-DC (2020/06/09)**



**Photo 7. Looking west along new alignment at M-DC (2020/07/02)**



**Photo 8. Looking north east along existing alignment at M-DC (2020/06/09)**



**Photo 9. Looking south along new alignment at N-DC (2020/07/02)**



**Photo 10. Looking east along existing alignment at N-DC (2020/06/18)**



## **Appendix E.**

### **GSC Seismic Hazard Calculation**

# 2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836  
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.495N 76.669W

User File Reference: Site B

2021-12-01 20:27 UT

Requested by: Thurber Engineering Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.360	0.184	0.105	0.031
Sa (0.1)	0.426	0.229	0.138	0.045
Sa (0.2)	0.356	0.198	0.123	0.043
Sa (0.3)	0.270	0.154	0.098	0.035
Sa (0.5)	0.193	0.112	0.072	0.026
Sa (1.0)	0.098	0.059	0.038	0.013
Sa (2.0)	0.047	0.028	0.018	0.005
Sa (5.0)	0.013	0.007	0.004	0.001
Sa (10.0)	0.005	0.003	0.002	0.001
PGA (g)	0.228	0.125	0.076	0.024
PGV (m/s)	0.161	0.090	0.055	0.017

**Notes:** Spectral ( $S_a(T)$ , where  $T$  is the period in seconds) and peak ground acceleration (PGA) values are given in units of  $g$  ( $9.81 \text{ m/s}^2$ ). Peak ground velocity is given in  $\text{m/s}$ . Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity  $450 \text{ m/s}$ ). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

## References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)  
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites [www.EarthquakesCanada.ca](http://www.EarthquakesCanada.ca) and [www.nationalcodes.ca](http://www.nationalcodes.ca) for more information

# 2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836  
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.446N 76.575W

User File Reference: Sites K, L, M and N

2021-12-01 20:28 UT

Requested by: Thurber Engineering Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.358	0.183	0.105	0.032
Sa (0.1)	0.424	0.228	0.138	0.045
Sa (0.2)	0.354	0.198	0.123	0.043
Sa (0.3)	0.269	0.155	0.098	0.036
Sa (0.5)	0.192	0.113	0.073	0.026
Sa (1.0)	0.098	0.059	0.038	0.013
Sa (2.0)	0.048	0.028	0.018	0.005
Sa (5.0)	0.013	0.007	0.004	0.001
Sa (10.0)	0.005	0.003	0.002	0.001
PGA (g)	0.228	0.125	0.076	0.025
PGV (m/s)	0.161	0.091	0.056	0.018

**Notes:** Spectral ( $S_a(T)$ , where  $T$  is the period in seconds) and peak ground acceleration (PGA) values are given in units of  $g$  ( $9.81 \text{ m/s}^2$ ). Peak ground velocity is given in  $\text{m/s}$ . Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity  $450 \text{ m/s}$ ). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

## References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)  
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

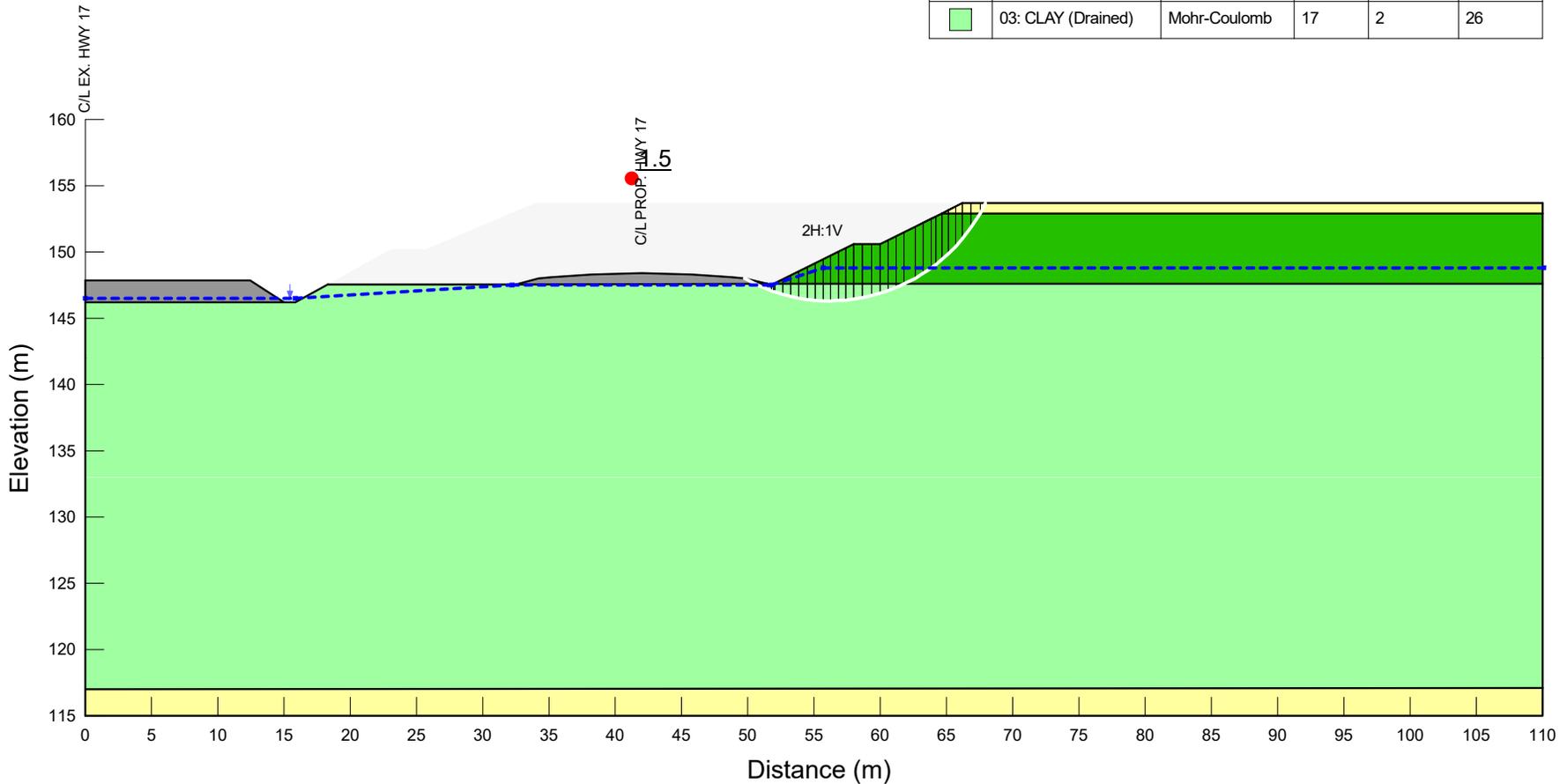
See the websites [www.EarthquakesCanada.ca](http://www.EarthquakesCanada.ca) and [www.nationalcodes.ca](http://www.nationalcodes.ca) for more information



**Appendix F.**

**Slope Stability Analysis Figures**

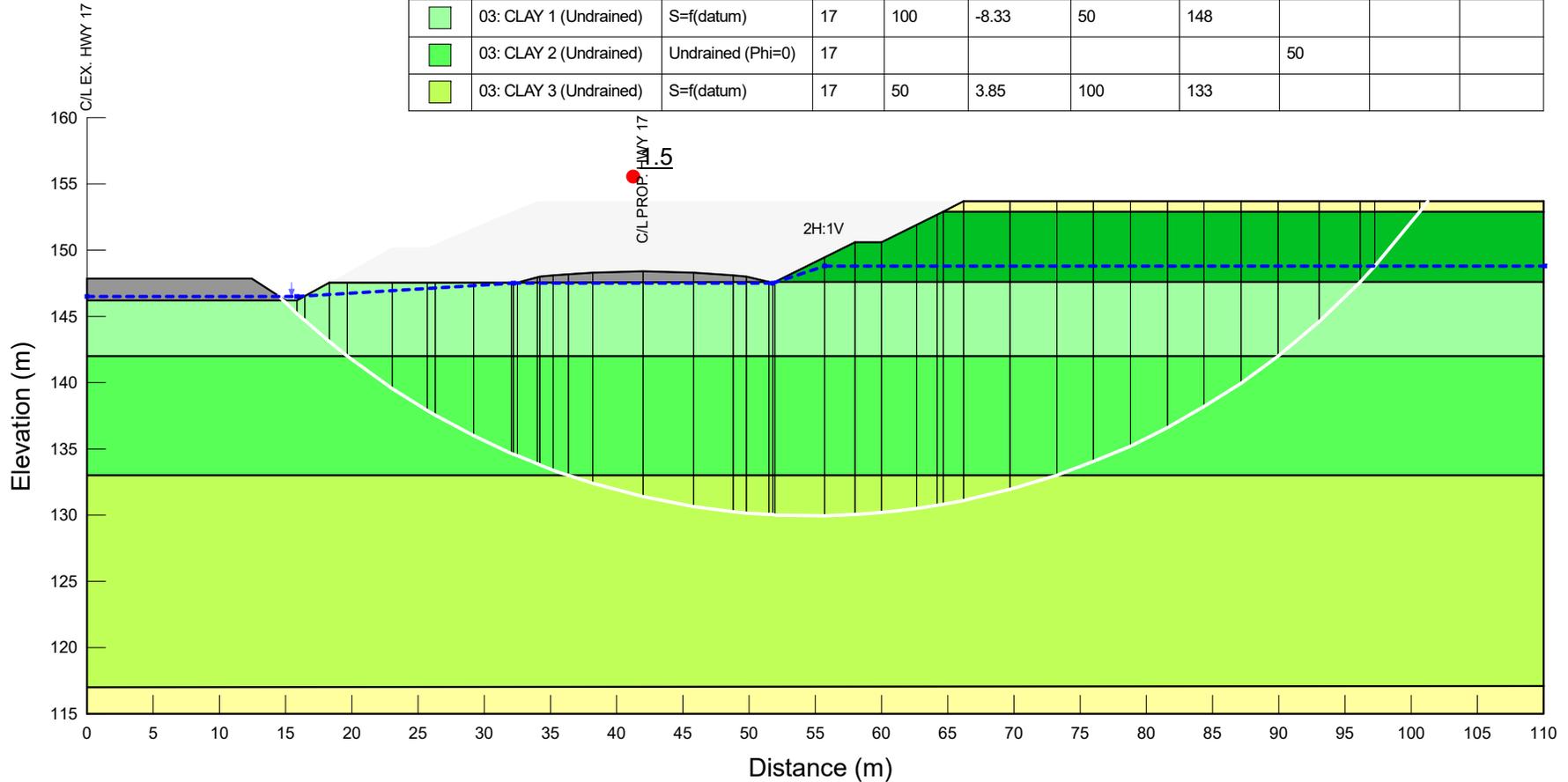
Color	Name	Slope Stability Material Model	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)
Grey	00: FILL (Gran A)	Mohr-Coulomb	22.8	0	40
Yellow	01: SILTY SAND TO SAND	Mohr-Coulomb	19	0	32
Dark Green	02: WEATHERED CRUST (Drained)	Mohr-Coulomb	17	5	27
Light Green	03: CLAY (Drained)	Mohr-Coulomb	17	2	26



Project <b>Highway 17 Twinning</b>	
Analysis <b>B1 - 1- Static; Long Term (Drained) (2H:1V Bench)</b>	
Seismic Coefficient H: g, V: g	Last Run 2022/07/12, 10:26:43 AM
Scale 1:500	

Additional Details Name: B-DC: Horton Sta. 18+767 (2H:1V Bench) Comments: Method: Morgenstern-Price, Half-Sine Minimum Slip Surface Depth: 1.5 m Entry: (67.952, 153.7) m, Exit: (49.749742, 148.00503) m Center: (56.184743, 159.37398) m, Radius: 13.063782 m	<b>Figure F1-1</b>
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Color	Name	Slope Stability Material Model	Unit Weight (kN/m <sup>3</sup> )	C-Datum (kPa)	C-Rate of Change ((kN/m <sup>2</sup> )/m)	C-Maximum (kPa)	Datum (Elevation) (m)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
Grey	00: FILL (Gran A)	Mohr-Coulomb	22.8						0	40
Yellow	01: SILTY SAND TO SAND	Mohr-Coulomb	19						0	32
Dark Green	02: WEATHERED CRUST (Undrained)	Undrained (Phi=0)	17					100		
Light Green	03: CLAY 1 (Undrained)	S=f(datum)	17	100	-8.33	50	148			
Medium Green	03: CLAY 2 (Undrained)	Undrained (Phi=0)	17					50		
Lightest Green	03: CLAY 3 (Undrained)	S=f(datum)	17	50	3.85	100	133			

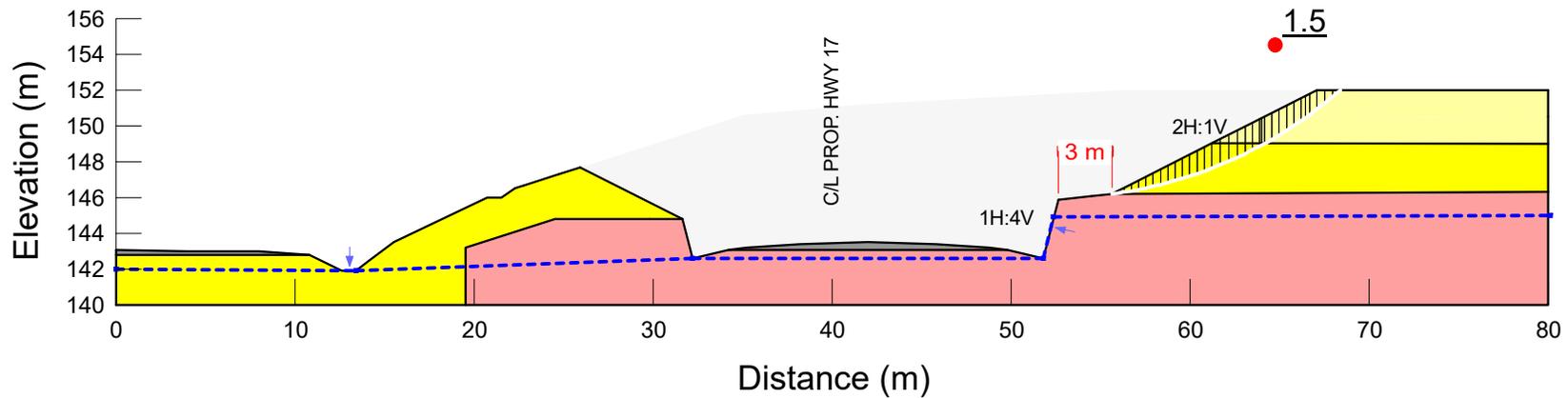


Project <b>Highway 17 Twinning</b>	
Analysis <b>B1 - 3-Seismic; Short Term (Undrained) (2H:1V Bench)</b>	
Seismic Coefficient H: 0.129g, V: 0g	Last Run 2022/07/12, 10:26:51 AM
Scale 1:500	

Additional Details	Name: B-DC: Horton Sta. 18+767 (2H:1V Bench)
Comments:	Method: Morgenstern-Price, Half-Sine
	Minimum Slip Surface Depth: 1.5 m
	Entry: (101.24, 153.7) m, Exit: (14.470064, 146.5457) m
	Center: (54.794388, 187.24343) m, Radius: 57.291854 m

**Figure F1-2**

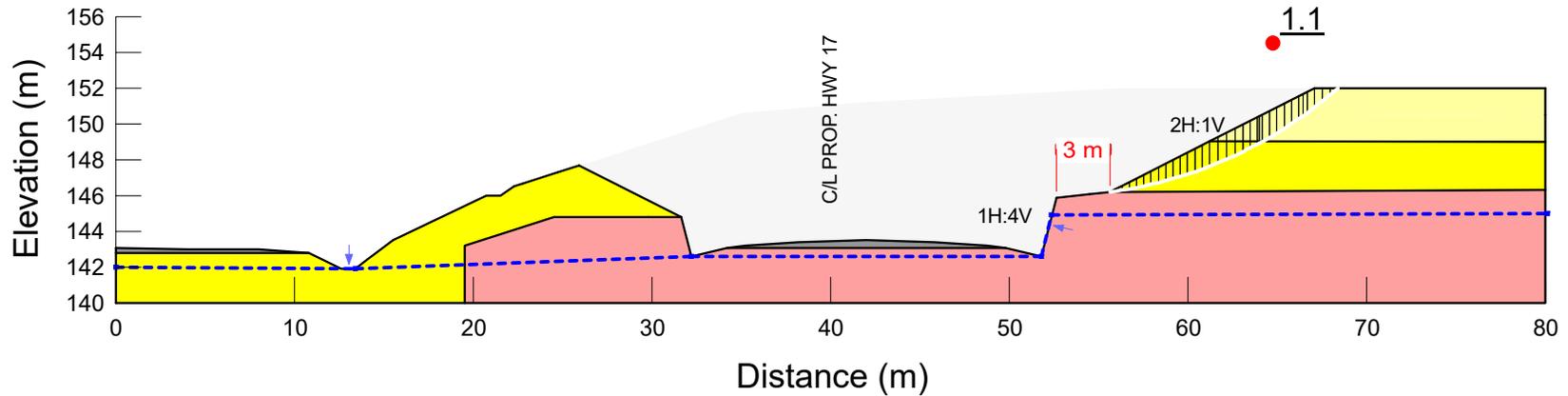
Color	Name	Slope Stability Material Model	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
■	00: FILL (Gran A)	Mohr-Coulomb	22.8	0	40	1
■	01: SILTY SAND TO SAND	Mohr-Coulomb	19	0	32	1
■	02: SILTY SAND TO SAND (dense)	Mohr-Coulomb	19	0	35	1
■	05: BEDROCK	Bedrock (Impenetrable)				1



Project <b>Highway 17 Twinning</b>		Additional Details	
Analysis <b>B2 - 1- Static; Long Term (Drained)</b>		Name: B-DC: Horton Sta. 18+981	
Seismic Coefficient	Last Run	Comments:	
H: g, V: g	2022/07/12, 10:26:35 AM	Method: Morgenstern-Price, Half-Sine	
Scale		Minimum Slip Surface Depth: 1.5 m	
1:400		Entry: (68.39, 152) m, Exit: (55.624338, 146.2107) m	
		Center: (52.458353, 170.16091) m, Radius: 24.158561 m	

**Figure F2-1**

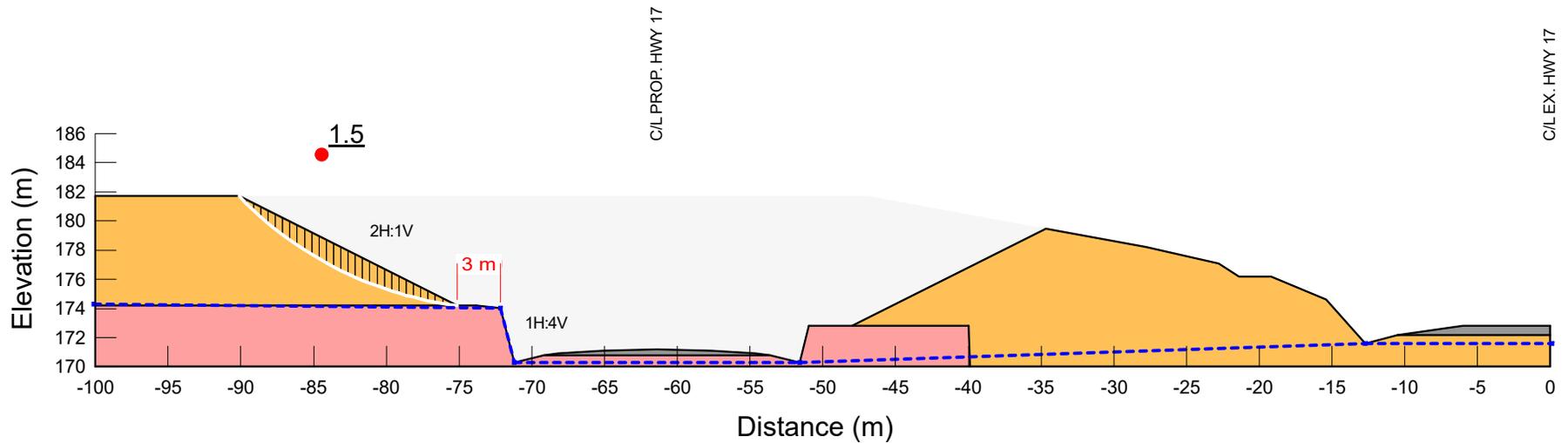
Color	Name	Slope Stability Material Model	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
■	00: FILL (Gran A)	Mohr-Coulomb	22.8	0	40	1
■	01: SILTY SAND TO SAND	Mohr-Coulomb	19	0	32	1
■	02: SILTY SAND TO SAND (dense)	Mohr-Coulomb	19	0	35	1
■	05: BEDROCK	Bedrock (Impenetrable)				1



Project <b>Highway 17 Twinning</b>		
Analysis <b>B2 - 3- Seismic; Short Term (Undrained)</b>		
Seismic Coefficient H: 0.129g, V: 0g	Last Run 2022/07/12, 10:26:36 AM	Scale 1:400

Additional Details Name: B-DC: Horton Sta. 18+981 Comments: Method: Morgenstern-Price, Half-Sine Minimum Slip Surface Depth: 1.5 m Entry: (68.39, 152) m, Exit: (55.624338, 146.2107) m Center: (52.458353, 170.16091) m, Radius: 24.158561 m	<b>Figure F2-2</b>
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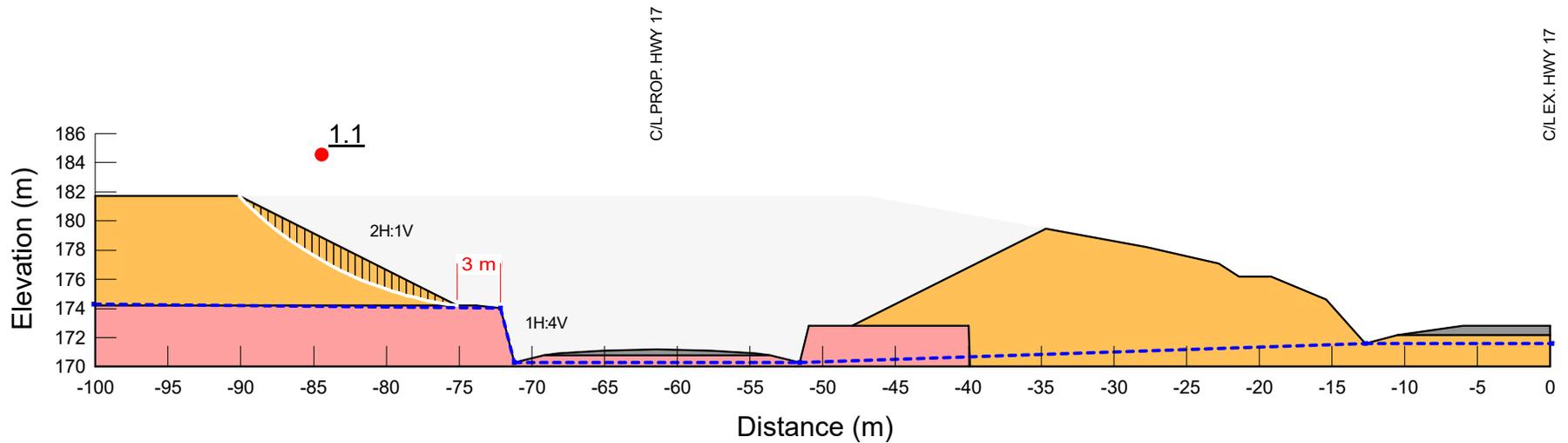
Color	Name	Slope Stability Material Model	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
■	00: FILL (Gran A)	Mohr-Coulomb	22.8	0	40	1
■	04: TILL	Mohr-Coulomb	21	0	35	1
■	05: BEDROCK	Bedrock (Impenetrable)				1



Project <b>Highway 17 Twinning</b>		Additional Details	
Analysis <b>K1 - 1- Static; Long Term (Drained)</b>		Name: K-DC: McNab Sta. 11+922	
Seismic Coefficient	Last Run	Comments:	
H: g, V: g	2022/07/12, 10:26:36 AM	Method: Morgenstern-Price, Half-Sine	
		Minimum Slip Surface Depth: 1.5 m	
		Entry: (-90.13215, 181.7) m, Exit: (-75.13324, 174.2) m	
		Center: (-71.91895, 199.37593) m, Radius: 25.380293 m	
		Scale	
		1:450	

**Figure F3-1**

Color	Name	Slope Stability Material Model	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
■	00: FILL (Gran A)	Mohr-Coulomb	22.8	0	40	1
■	04: TILL	Mohr-Coulomb	21	0	35	1
■	05: BEDROCK	Bedrock (Impenetrable)				1

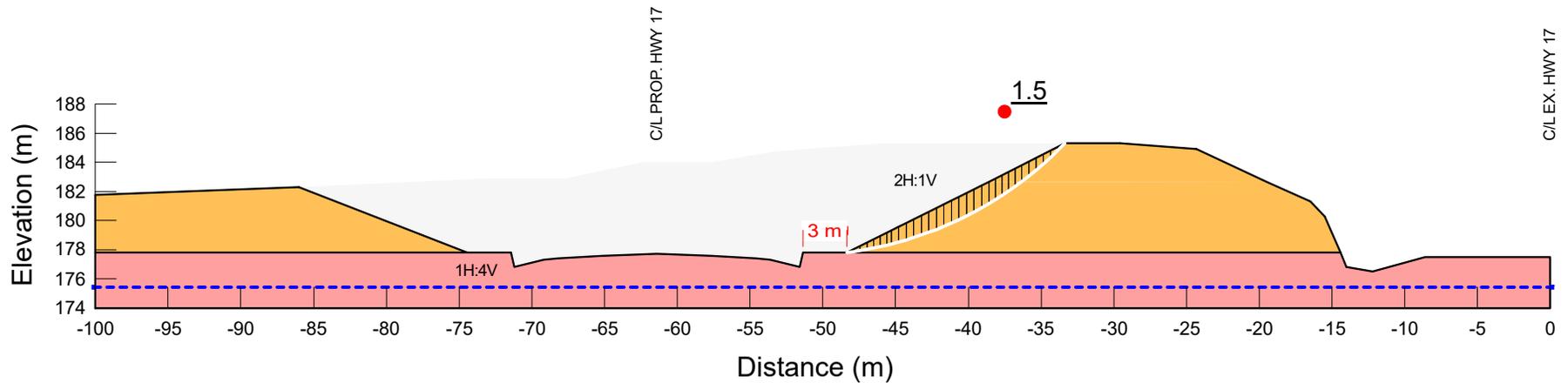


Project		Highway 17 Twinning	
Analysis		K1 - 3- Seismic; Short Term (Undrained)	
Seismic Coefficient	Last Run	Scale	
H: 0.129g, V: 0g	2022/07/12, 10:26:36 AM	1:450	

Additional Details  
Name: K-DC: McNab Sta. 11+922  
Comments:  
Method: Morgenstern-Price, Half-Sine  
Minimum Slip Surface Depth: 1.5 m  
Entry: (-90.13215, 181.7) m, Exit: (-75.13324, 174.2) m  
Center: (-71.91895, 199.37593) m, Radius: 25.380293 m

**Figure F3-2**

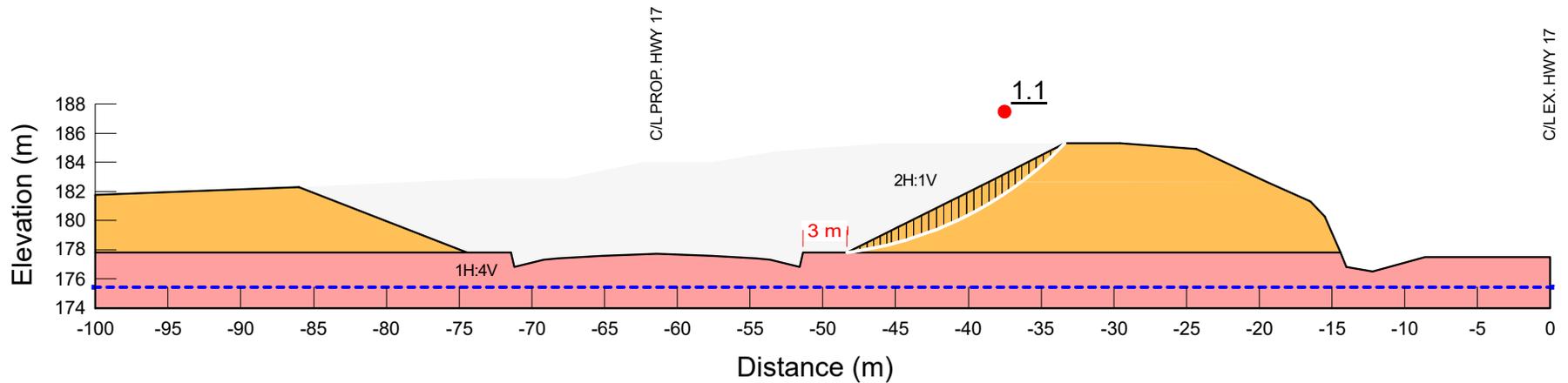
Color	Name	Slope Stability Material Model	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
Orange	04: TILL	Mohr-Coulomb	21	0	35	1
Red	05: BEDROCK	Bedrock (Impenetrable)				1



Project <b>Highway 17 Twinning</b>		Additional Details	
Analysis <b>L1 - 1- Static; Long Term (Drained) (S Side)</b>		Name: L-DC: McNab Sta. 12+338 (S Side)	
Seismic Coefficient	Last Run	Comments:	
H: g, V: g	2022/07/12, 10:26:36 AM	Method: Morgenstern-Price, Half-Sine	
Scale	1:450	Minimum Slip Surface Depth: 1.5 m	
		Entry: (-33.35374, 185.3) m, Exit: (-48.34987, 177.8) m	
		Center: (-51.566491, 202.97384) m, Radius: 25.378516 m	

**Figure F4-1**

Color	Name	Slope Stability Material Model	Unit Weight (kN/m <sup>3</sup> )	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
Orange	04: TILL	Mohr-Coulomb	21	0	35	1
Pink	05: BEDROCK	Bedrock (Impenetrable)				1



Project <b>Highway 17 Twinning</b>		Additional Details	
Analysis <b>L1 - 3- Seismic; Short Term (Undrained) (S Side)</b>		Name: L-DC: McNab Sta. 12+338 (S Side)	
Seismic Coefficient	Last Run	Comments:	
H: 0.114g, V: 0g	2022/07/12, 10:26:36 AM	Method: Morgenstern-Price, Half-Sine	
	Scale	Minimum Slip Surface Depth: 1.5 m	
	1:450	Entry: (-33.35374, 185.3) m, Exit: (-48.34987, 177.8) m	
		Center: (-51.566491, 202.97384) m, Radius: 25.378516 m	

**Figure F4-2**



## **Appendix G.**

### **List of Referenced Specifications**

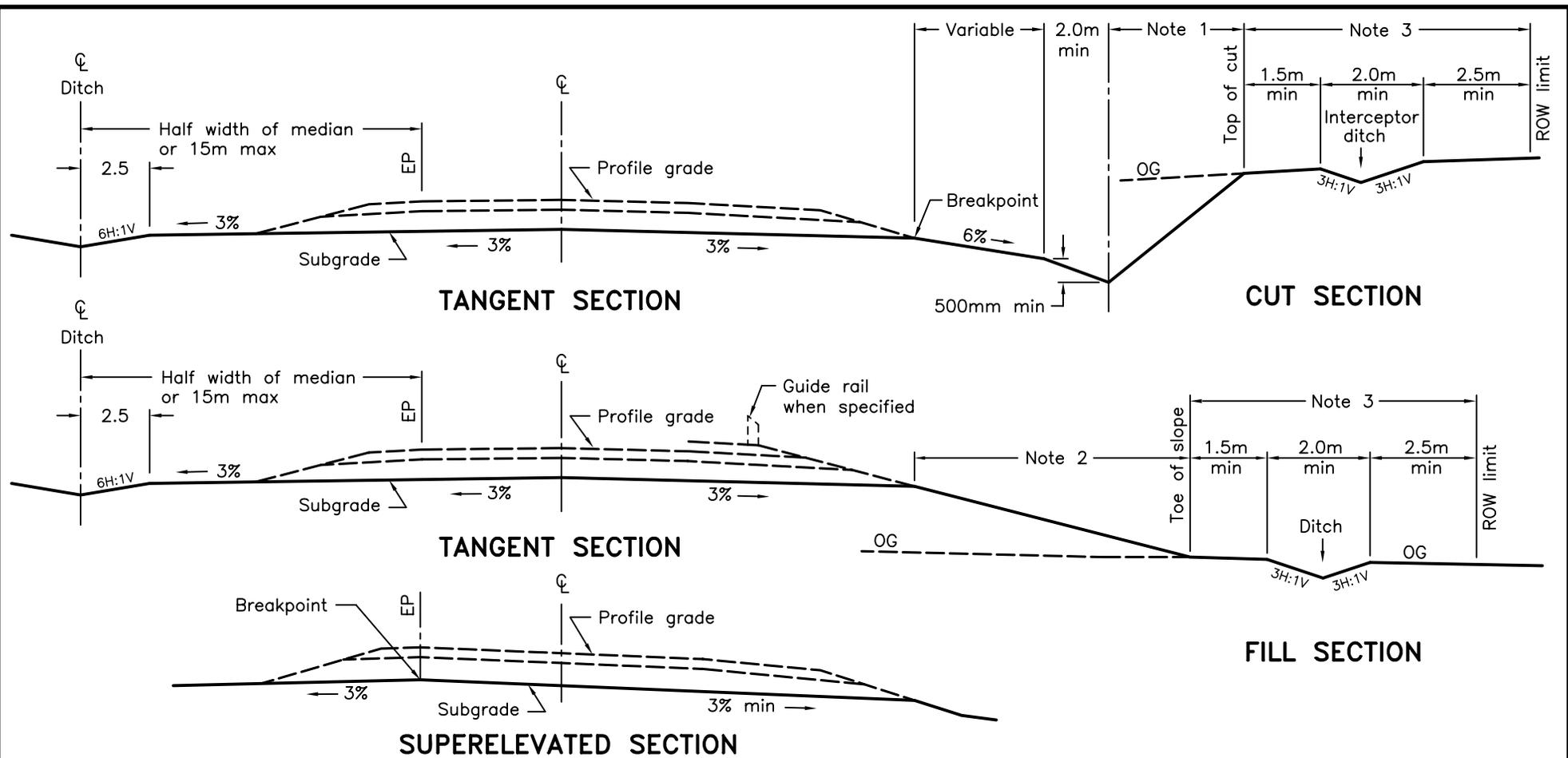


1. The following Special Provisions and OPSS Documents are referenced in this report:

OPSS.PROV 206	Construction Specification for Grading
OPSS.PROV 804	Construction Specification for Seed and Cover
OPSS.PROV 805	Construction Specification for Temporary Sediment Control
OPSS.PROV 1010	Material Specification for Aggregates, Base, Subbase, Select Subgrade and Backfill Material
OPSD 200.020	Earth / Shale Grading, Divided Rural
OPSD 201.020	Rock Grading, Divided Rural
OPSD 202.010	Slope Flattening Using Surplus Excavated Material on Earth or Rock Embankment
OPSD 202.020	Drainage Gap for Slope Flattening on Rock or Granular Embankment

**Contract Provision: “Obstructions”**

The Contractor is hereby notified that the native tills at the site should be expected to contain cobbles and boulders. Considerations of these obstructions must be made in the selection of appropriate equipment and procedures for excavations.



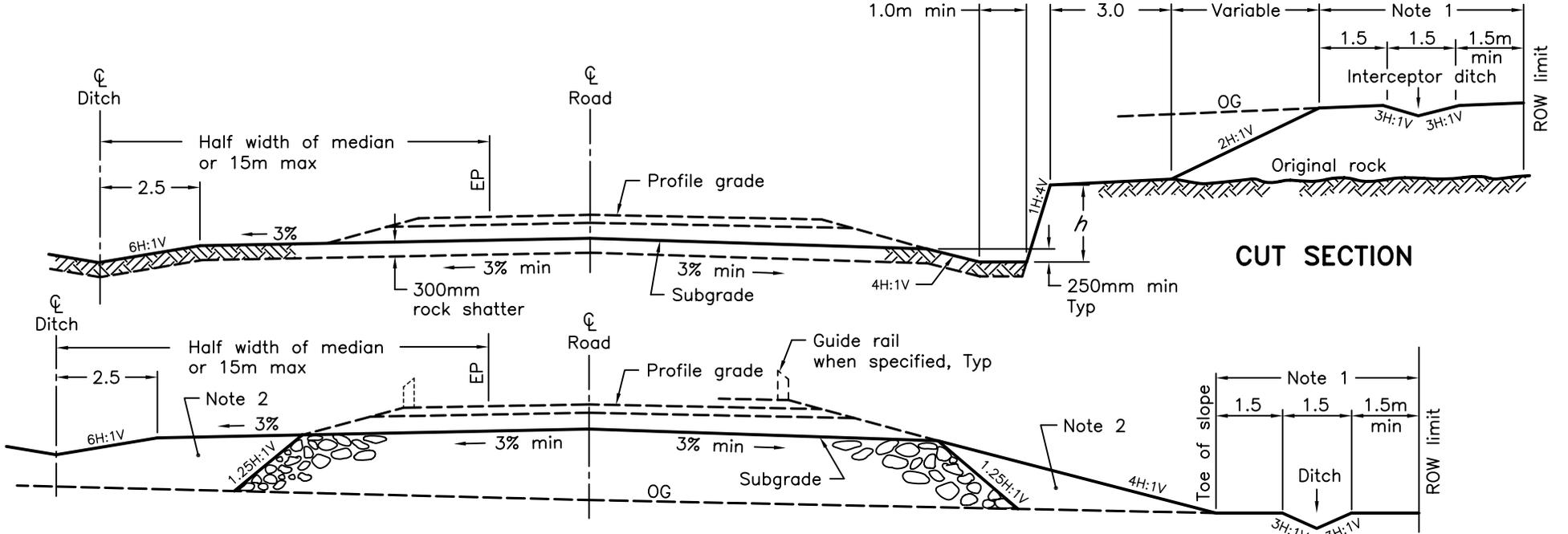
**NOTES:**

- 1 Cut slope shall be 3H:1V or steeper when specified.
- 2 Fill slope shall be 4H:1V or flatter when specified.
- 3 Distance shall be 2.5m minimum when ditch is not required.

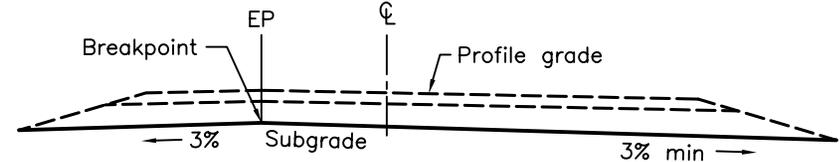
A This OPSD to be read in conjunction with OPSD 202.010 and OPSD 202.020.

B All dimensions are in metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2009	Rev	2	
<b>EARTH/SHALE GRADING</b>				
DIVIDED RURAL				
<b>OPSD 200.020</b>				



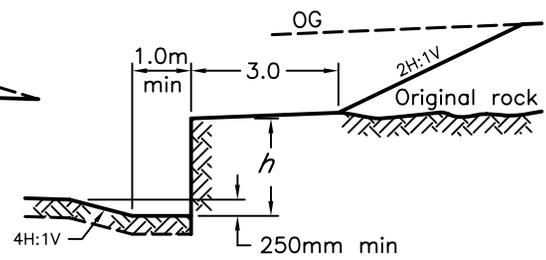
**TANGENT SECTIONS**



**SUPERELEVATED SECTION**

**CUT SECTION**

**FILL SECTION**



**NOTES:**

- 1 Distance shall be 1.5m minimum when ditch is not required.
- 2 Where the top of rock fill embankment is less than 2.0m above original ground, flatten slope with surplus excavated material.

- A Shale shall be treated according to earth grading standards.
- B This OPSD to be read in conjunction with OPSD 202.010 and OPSD 202.020.
- C All dimensions are in metres unless otherwise shown.

**LEGEND:**

*h* - Height of rock face

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2009	Rev	2
<b>ROCK GRADING</b> DIVIDED RURAL		-----		
		-----		
<b>OPSD 201.020</b>				
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