



THURBER ENGINEERING LTD.

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

Geocres No.: 31F-231

Report to:

Ministry of Transportation Ontario

Latitude: 45.446790°
Longitude: -76.573125°

July 2022
Thurber File No.: 24726



TABLE OF CONTENTS

PART 1. FACTUAL INFORMATION

1	INTRODUCTION	1
2	SITE DESCRIPTION	2
2.1	General	2
2.2	Site Geology	3
2.3	Existing Rock Cuts	3
3	FOUNDATION SITE INVESTIGATION AND FIELD TESTING	4
4	LABORATORY TESTING	8
5	GENERAL DESCRIPTION OF SUBSURFACE CONDITIONS	8
5.1	Deep Cut B: Horton Sta. 18+650 to Sta. 19+025 EBL	8
5.1.1	Bedrock	9
5.1.2	Groundwater	11
5.2	Deep Cut K: McNab-Braeside Sta. 11+900 to Sta. 11+970 WBL	11
5.2.1	Bedrock	12
5.2.2	Groundwater	12
5.3	Deep Cut L: McNab-Braeside Sta. 12+180 to Sta. 12+340 WBL	13
5.3.1	Bedrock	13
5.3.2	Groundwater	15
5.4	Deep Cut M: McNab-Braeside Sta. 12+500 to Sta. 12+720 WBL	15
5.4.1	Bedrock	15
5.4.2	Groundwater	18
5.5	Deep Cut N: McNab-Braeside Sta. 12+900 to Sta. 13+020 WBL	18
5.5.1	Bedrock	18
5.5.2	Groundwater	20
5.6	Goshen Road Cut, McNab-Braeside, Station 9+960 to 10+110	21
5.6.1	Bedrock	21
5.6.2	Groundwater	23



6	BEDROCK DISCONTINUITY MAPPING	25
7	MISCELLANEOUS	26

PART 2. ENGINEERING DISCUSSION AND RECOMMENDATIONS

8	INTRODUCTION	27
8.1	Proposed Work	27
8.2	Applicable Codes and Design Considerations	28
9	DESIGN RECOMMENDATIONS	29
9.1	Rock Cut Assessment	29
9.1.1	Kinematic Analysis	31
9.1.2	Kinematic Sensitivity Analyses	36
9.1.3	Rock Fall Simulations	38
9.2	Rock Cut Recommendations	39
9.2.1	Rock Cut Geometry, Highway 17, Rock Cuts B, K, L, M and N	40
9.2.2	Rock Cut Geometry, Goshen Road	41
9.2.3	Material Re-Use	42
9.3	Earth Cuts	42
9.4	Transitional Areas	42
10	CONSTRUCTION CONCERNS	43
11	CLOSURE	44
	REFERENCES	45



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.	Analysis Outputs
Appendix F.	Preliminary GA
Appendix G.	List of Referenced Specifications
	Non-Standard Special Provisions



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

Geocres No.: 31F-231

PART 1. FACTUAL INFORMATION

1 INTRODUCTION

Thurber Engineering Ltd. (Thurber) has been engaged by the Ministry of Transportation Ontario (MTO) under Assignment No. 4018-E-0009 to carry out Rock Engineering 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 cuts areas along the proposed Highway 17 alignment where rock excavation is required. Part 1 of the report presents the factual findings obtained from investigations completed within the proposed deep cut sections; specifically highlighting the bedrock conditions. 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 borehole location plans, records of boreholes, stratigraphic profiles, laboratory test results and a written description of the subsurface conditions.

Historic foundation information from preliminary investigations at the Goshen Road intersection completed in 2003/2004 was available under Geocres 31F-134 and 31F-141. As part of the current assignment, additional Foundation Investigation Reports were prepared for the Goshen Road site (Geocres 31F-255) and the deep earth cuts sites (Geocres 31F-232). Further information is also available in the Pavement Investigation Report and the Rockfall Hazard Investigation Report.

It should be noted that the use of and reliance on Part 1 of this 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 elevation at centreline is 4.5 m or more higher than the proposed profile elevation, as shown in in the 2004 Preliminary Design Report for this project. Six different deep cut sections were identified and have been labelled B, K, L, M, N and Goshen. 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
	Goshen Road	Goshen	9+960 to 10+110	150

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 new eastbound lanes). The land along the new alignment is heavily vegetated with coniferous and deciduous trees. Various bedrock outcrops and rock cuts are noted along the existing Highway 17 alignment from approximate Sta. 11+900 to 13+100.



Goshen Road currently has an at-grade intersection with Highway 17. The existing highway in this area is in a rock cut in areas to 240 m east and 300 m west of Goshen Road. Small bedrock outcrops are present on Goshen Road in close proximity to Highway 17. Goshen Road is a low volume (2022 AADT projected to be less than 450), two-lane road with narrow, gravel shoulders. It is proposed to reconstruct Goshen Road with a lower profile on an alignment to the east and construct twin overpasses to carry Highway 17 over the sideroad. The area of the realignment is currently a mix of farm fields and low brush.

Photographs showing the existing conditions in the area of the sites at the time of the field investigations are included in Appendix D for reference.

2.2 Site Geology

According to Crins et al. 2009ⁱ the project area is described as Ecoregion 6E (Lake Simcoe - Rideau) within the Ontario Shield Ecozone. According to Wester et al. 2018ⁱⁱ 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, N and Goshen 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.

2.3 Existing Rock Cuts

The existing rock cuts at several locations on existing Highway 17 were inspected in the field for rockfall hazard risk in 2020. As part of that field investigation the rock faces were examined in detail in accordance with the August 2015 edition of the Ministry of Transportation of Ontario Report MERO-43, "RHRON: Ontario Rockfall Hazard Rating System – Field Procedures Manual". The results were reported in Rockfall Hazard Mitigation Design Report dated January 2021.

Of particular relevance to the present report are the conditions observed at existing rock cut Sites E-17-1, 17-2 and 17-3. Photographs are provided in Appendix D. The conditions are summarized in Table 2-1.

Table 2-2: Existing Rock Cut Summary

Site	Location (McNab-Braeside)	Side	CZW	Maximum Height	Typical Slope	Ditch Depth	Failure Mechanisms
E-17-1	12+588 to 12+740	North of Existing Hwy 17	5.2 m	6.5 m	Vertical to 1H:3V	1.0 m	Block, Ravelling, Overhang, Toppling
17-2	12+700 to 12+810	South of Existing Hwy 17	5.2 m	5.4 m	Vertical to 1H:3V	1.0 m	Block, Wedge, Overhang
17-3	12+200 to 12+400	North of Existing Hwy 17	5.3 m	6.0 m	Vertical to 1H:3V	1.0 m	Block, Wedge, Ice Jacking, Toppling

There were several locations identified at each of these sites where there was a specific risk of rockfall.

3 FOUNDATION SITE INVESTIGATION AND FIELD TESTING

The foundation site investigation and field-testing program for the deep cuts on Highway 17 was carried out between November 2nd, 2020 and November 27th, 2020. The field investigation consisted of advancing 19 boreholes identified as Boreholes B-DC-1 through N-DC-3. The site investigation and field-testing program at Goshen Road was carried out in two separate mobilizations; truck accessible locations were drilled between August 29 and September 18, 2019 and the off-road locations were drilled between July 6 and July 14, 2020. The field investigation consisted of advancing 13 boreholes identified as Boreholes GOS19-01 through GOS19-12 and GOS19-04W. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

Previously drilled Boreholes GOS-1 through GOS-4 were completed by Thurber in September and October 2003 as part of a preliminary investigation for the Goshen Road structures. Data from these boreholes has been fully incorporated into this report.

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 13 in Appendix A, the individual Record of Borehole sheets in Appendix B, and in Table 3-1 below. The site is located within MTM Zone 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
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

Table 3-6: Borehole Summary; Deep Cut Goshen Road Sta. 9+960 to 10+110

Borehole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
GOS19-05	North Cut 9+900	5 034 069.5 (45.446525)	298 128.7 (-76.585284)	167.1	10.7
GOS19-06	North Cut 9+925	5 034 052.3 (45.446371)	298 146.7 (-76.585054)	167.0	9.2
GOS19-01	Westbound West Approach	5 034 031.8 (45.446186)	298 158.4 (-76.584904)	166.9	13.5
GOS19-11	Westbound West Approach	5 034 022.8 (45.446105)	298 163.3 (-76.584842)	166.8	7.6
GOS-2	Westbound West Approach	5 034 015.8 (45.446042)	298 171.4 (-76.584738)	166.8	6.8
GOS-1	Westbound East Approach	5 034 036.7 (45.446230)	298 171.9 (-76.584732)	169.0	15.9

Borehole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
GOS19-12	Westbound East Approach	5 034 030.3 (45.446172)	298 178.4 (-76.584649)	169.1	12.5
GOS19-02	Westbound East Approach	5 034 023.0 (45.446106)	298 183.7 (-76.584581)	169.2	14.9
GOS19-07	Median Cut 10+000	5 034 002.5 (45.445922)	298 201.8 (-76.584349)	169.2	9.9
GOS19-08	Median Cut 10+000	5 033 993.8 (45.445845)	298 192.5 (-76.584467)	168.5	6.5
GOS19-03	Eastbound West Approach	5 033 975.0 (45.445675)	298 209.0 (-76.584256)	167.4	4.5
GOS-4	Eastbound West Approach	5 033 957.6 (45.445519)	298 222.5 (-76.584084)	167.2	5.9
GOS-3	Eastbound East Approach	5 033 977.5 (45.445698)	298 222.0 (-76.584090)	167.5	4.7
GOS19-04	Eastbound East Approach	5 033 961.5 (45.445554)	298 235.8 (-76.583914)	168.0	9.6
GOS19-04W	Eastbound Structure	5 033 952.0 (45.445471)	298 228.6 (-76.584001)	167.0	6.4
GOS19-09	South Cut 10+075	5 033 940.0 (45.445361)	298 244.1 (-76.583801)	167.3	8.5
GOS19-10	South Cut 10+100	5 033 923.0 (45.445201)	298 262.4 (-76.583601)	166.5	7.7

The investigations were carried out using a truck mounted CME-55 and track-mounted CME-75 and CME 850 drill rigs 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, N-DC-2, GOS19-01, GOS19-02, GOS19-04W, GOS19-06, GOS19-07 and GOS19-09. 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. It is noted that piezometers, approximately 19 mm in diameter, were installed in all historical boreholes (GOS-1 through GOS-4, inclusive).

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 Investigation 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 relevant 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 Drawings included in Appendix A. Detailed bedrock logs have also been included in Appendix B. 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 Drawings 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 from the 2019 and 2020 investigations 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 boreholes are included in Appendix B.

This section will focus on the bedrock and groundwater conditions encountered at each of the sites. For soil descriptions, see the FIRs for Deep Earth Cuts and Goshen Road, under separate covers.

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 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) ⁽¹⁾ , MPa	30 – 98	67

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



5.1.2 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
			6.0	147.7	Nov 01, 2021
			5.2	148.5	Jan 24, 2022
B-DC-4 [50 mm]	141.9	Bedrock	9.3	149.8	Dec 15, 2020
			10.9	148.2	Aug 04, 2021
			12.0	147.1	Sep 30, 2021
			11.8	147.3	Oct 20, 2021
			8.4	150.7	Dec 20, 2021
			11.3	147.8	Jan 24, 2022
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 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 ⁽¹⁾
						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: ⁽¹⁾ TP=Test Pit; PH=Pavement Hole; HD=Hydraulic Drill; DOB=Documentation of Bedrock; BH=Borehole (Bedrock Inferred); CB=Borehole (Cored Bedrock)

5.2.2 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
			8.4	173.3	Oct 03, 2021
			6.3	175.4	Jan 20, 2022
			6.6	175.1	Jan 26, 2022

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 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 reddish to pinkish 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) ⁽¹⁾ , MPa	79 – 226	128

Notes: ⁽¹⁾ 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 ⁽¹⁾
						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
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

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type ⁽¹⁾
						Depth (m)	Elev. (m)	
L-DC-4	12+347	1.4 LT CL	5034079.2	298832.8	182.3	4.5	177.8	BH

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

5.3.2 Groundwater

Groundwater levels recorded in the monitoring well 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 5-8: 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
			14.8	174.6	Oct 02, 2021
			14.5	174.9	Jan 20, 2022
			14.5	174.9	Jan 26, 2022

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 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 pinkish 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
Unconfined Compressive Strength (UCS) ⁽¹⁾ , MPa	51 – 169	98

Notes: ⁽¹⁾ 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 ⁽¹⁾
						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

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type ⁽¹⁾
						Depth (m)	Elev. (m)	
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
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: ⁽¹⁾ TP=Test Pit; PH=Pavement Hole; HD=Hydraulic Drill; DOB=Documentation of Bedrock; BH=Borehole (Bedrock Inferred); CB=Borehole (Cored Bedrock)

5.4.2 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
			5.0	176.1	Jan 20, 2022

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: 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 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 reddish to pinkish 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: Deep Cut N; Summary of Bedrock Core Quality and Strength

Parameter	Range	Average
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) ⁽¹⁾ , MPa	92 – 170	115

Notes: ⁽¹⁾ 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: Deep Cut N; Summary of Bedrock Depth/Elevation

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type ⁽¹⁾
						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

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type ⁽¹⁾
						Depth (m)	Elev. (m)	
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
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: ⁽¹⁾ TP=Test Pit; PH=Pavement Hole; HD=Hydraulic Drill; DOB=Documentation of Bedrock; BH=Borehole (Bedrock Inferred); CB=Borehole (Cored Bedrock)

5.5.2 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	167.8	Dec 15, 2020
			5.5	166.6	Sep 23, 2021
			5.2	166.9	Oct 01, 2021
			5.1	167.0	Oct 21, 2021
			5.0	167.1	Jan 24, 2022

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.

5.6 Goshen Road Cut, McNab-Braeside, Station 9+960 to 10+110

In general terms, the site was found to have a surficial layer of topsoil, asphalt or fill overlying native deposits of interlayered silty sand, clayey silt, sandy clay and/or sandy silt, which are underlain by a deposit of glacial till over bedrock.

5.6.1 Bedrock

Bedrock was proven by coring in all foundation boreholes at the Goshen site except GOS19-05 and GOS19-06. The depth to bedrock ranged from 0.8 m to 13.0 m (Elev. 166.6 m to 156.0 m). The bedrock encountered consisted of slightly weathered to fresh, strong to extremely strong granite/gneiss that is predominantly grey and pink in colour. In general, the discontinuities were rough, planar 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 5-15.

Table 5-15: Goshen Road Cut; Summary of Bedrock Core Quality and Strength

Parameter	Range	Average
Total Core Recovery (TCR), %	43 to 100	96
Solid Core Recovery (SCR), %	0 to 100	71
Rock Quality Designation (RQD), %	0 to 100	66
Fracture Index (fractures per 0.3m)	0 to >10	3
Unconfined Compressive Strength (UCS) ⁽¹⁾ , MPa	88 to 318	161

Notes: ⁽¹⁾ 1 sample tested from GOS19-01, GOS19-02, GOS19-03, GOS19-08, GOS19-10, GOS19-11 and GOS19-12, 5 samples tested from GOD19-04, 4 samples tested from GOS19-07, 5 samples tested from GOS19-09.

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 5-16. Pavement logs are provided in Appendix B.

Table 5-16: Goshen Road Cut; Summary of Bedrock Depth/Elevation

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type ⁽¹⁾
						Depth (m)	Elev. (m)	
GOS19-01	9+949	5.7 RT CL	5034031.8	298158.4	166.9	10.0	156.9	CB
GOS-1	9+954	7.7 LT CL	5034036.7	298171.9	169.0	13.0	156.0	CB
GOS19-11	9+959	8.0 RT CL	5034022.8	298163.3	166.8	4.2	162.6	CB
GOS19-12	9+963	8.3 LT CL	5034030.3	298178.4	169.1	9.4	159.7	CB
GOS-2	9+969	6.5 RT CL	5034015.8	298171.4	166.8	3.6	163.2	CB
GOS19-02	9+972	7.5 LT CL	5034023.0	298183.7	169.2	11.5	157.7	CB
GS-8B	9+979	CL	5034012.5	298183.0	168.9	5.8	163.1	HD
GOS19-07 GS-9A ⁽²⁾	9+999	7.6 LT CL	5034002.5	298201.8	169.2	4.2	165.0	CB
GS-9B-2	9+999	11.7 RT CL	5033990.2	298186.9	168.1	1.3	166.8	HD
GOS19-08 GS-9B-1 ⁽²⁾	10+000	5.1 RT CL	5033993.8	298192.5	168.5	2.7	165.8	CB
GS-10C	10+009	11.1 RT CL	5033983.1	298194.0	166.1	0.6	165.5	HD
GS-10B	10+010	CL	5033989.5	298203.2	168.1	1.1	167.0	HD
GS-10A	10+011	9.8 LT CL	5033995.3	298211.0	168.9	2.8	166.1	HD
GOS19-03 GOS19-3 ⁽²⁾	10+025	5.1 RT CL	5033975.0	298209.0	167.4	0.8	166.6	CB
GOS-3	10+031	6.3 LT CL	5033977.5	298222.0	167.5	1.7	165.8	CB
GOS-4	10+047	6.5 RT CL	5033957.6	298222.5	167.2	1.5	165.7	CB
GOS19-04 GOS19-4 ⁽²⁾	10+052	6.1 LT CL	5033961.5	298235.8	168.0	2.4	165.6	CB
GOS19-04W	10+055	5.6 RT CL	5033952.0	298228.6	167.0	2.8	164.2	CB
GS-13C	10+073	10.4 RT CL	5033934.9	298237.2	167.1	4.3	162.8	HD

ID	Station	Offset (m)	Northing (m)	Easting (m)	Surface Elevation (m)	Inferred Bedrock		Type ⁽¹⁾
						Depth (m)	Elev. (m)	
GOS19-09 GS-13B ⁽²⁾	10+074	1.9 RT CL	5033940.0	298244.1	167.3	3.1	164.2	CB
GS-13A	10+076	8.6 LT CL	5033945.7	298253.0	167.5	2.8	164.7	HD
GOS19-10 GS14-B ⁽²⁾	10+099	0.7 LT CL	5033923.0	298262.4	166.5	4.3	162.2	CB

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

⁽²⁾ Pavement hole at same location as foundation borehole; foundation borehole information to be used over pavement hole information.

5.6.2 Groundwater

Groundwater levels recorded in the monitoring well installed at this site are presented in

Table 5-17 below. The installation details are illustrated on the respective Record of Borehole sheet provided in Appendix B.

Table 5-17: Goshen Road Cut; Summary of Groundwater Levels

Borehole No. [Diameter]	Bottom of Screen Elevation (m)	Screened Material	Groundwater Depth (m)	Groundwater Elevation (m)	Date of Measurement
GOS-1 [19 mm]	153.4	Bedrock	5.7	163.3	Oct 22, 2003
			4.6	164.4	Dec 18, 2003
			4.8	164.2	Feb 5, 2004
GOS-2 [19 mm]	160.7	Bedrock	2.5	164.3	Oct 22, 2003
			2.0	164.8	Dec 18, 2003
			2.1	164.7	Feb 5, 2004
GOS-3 [19 mm]	162.8	Bedrock	2.9	164.6	Oct 22, 2003
			2.9	164.6	Dec 18, 2003
			-	Destroyed	Feb 5, 2004
GOS-4 [19 mm]	161.3	Bedrock	2.8	164.4	Oct 22, 2003
			2.8	164.4	Dec 18, 2003
			-	Destroyed	Feb 5, 2004

Borehole No. [Diameter]	Bottom of Screen Elevation (m)	Screened Material	Groundwater Depth (m)	Groundwater Elevation (m)	Date of Measurement
GOS19-01 [46 mm]	159.3	Till	0.6	166.3	Apr 21, 2020
			5.3	161.6	Sept 29, 2020
			3.7	163.2	Oct 18, 2021
			3.7	163.2	Oct 21, 2021
GOS19-02 [50 mm]	160.0	Sandy Silt/Till	4.2	165.0	July 10, 2020
			4.7	164.5	July 22, 2020
			5.0	164.2	Sept 29, 2020
			4.9	164.3	Dec 16, 2020
			5.3	163.9	Sept 27, 2021
			5.3	163.9	Oct 02, 2021
			5.4	163.8	Oct 20, 2021
			5.4	163.8	Jan 20, 2022
GOS19-04W [50 mm]	160.6	Bedrock	5.7	161.3	July 22, 2020
			4.9	162.1	Sept 29, 2020
			4.1	162.9	Dec 16, 2020
			4.2	162.8	Sept 28, 2021
			4.5	162.5	Oct 02, 2021
			5.0	162.0	Jan 20, 2022
GOS19-06 [46 mm]	157.8	Till	3.4	163.6	Sept 26, 2019
			0.6	166.4	Apr 21, 2020
			3.5	163.5	Sept 29, 2020
			3.7	163.3	Oct 22, 2021
GOS19-07 [50 mm]	159.3	Bedrock	4.4	164.8	July 10, 2020
			4.5	164.7	July 22, 2020
			5.1	164.1	Sept 29, 2020
			4.7	164.5	Dec 15, 2020
			5.2	164.0	Sept 27, 2021
			5.2	164.0	Oct 02, 2021
			5.3	163.9	Jan 20, 2022

Borehole No. [Diameter]	Bottom of Screen Elevation (m)	Screened Material	Groundwater Depth (m)	Groundwater Elevation (m)	Date of Measurement
GOS19-09 [51 mm]	158.8	Bedrock	6.1	161.2	Jul 15, 2020
			7.2	160.1	July 22, 2020
			7.4	159.9	Sept 29, 2020
			6.8	160.5	Dec 16, 2020
			7.5	159.8	Sept 28, 2021
			7.6	159.7	Oct 02, 2021
			7.3	160.0	Jan 20, 2022

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 BEDROCK DISCONTINUITY MAPPING

The existing rock cuts at several locations on existing Highway 17 were inspected in the field for rockfall hazard risk. As part of that field investigation the rock faces were examined in detail in accordance with the August 2015 edition of the Ministry of Transportation of Ontario Report MERO-43, "RHRON: Ontario Rockfall Hazard Rating System – Field Procedures Manual". Discontinuity orientation was documented at numerous locations by determining the poles of the discontinuity planes (defined by the trend and plunge of a line perpendicular to the plane) utilizing a mobile phone app called Rocklogger by RockGecko. In addition, the proposed new alignments for Highway 17 and Goshen Road were traversed and bedrock outcrops and rock cuts in the area were also investigated for discontinuity orientations. Over 350 measurements were taken to aid with rock slope stability assessments. The alignment of the discontinuities and roadway sections were recorded with respect to magnetic north thus declination adjustments were completed; the presented results are with respect to true north. The results are provided on stereo net plots in Appendix E. A stereo net allows projection of a line (such as the pole of a plane) as a point. Typically, the stereo net consists of the lower half of a reference sphere viewed from above with discontinuity poles indicated with points. It should be noted that geologic structure is not fixed and variations in discontinuity geometry should be anticipated.



7 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 and Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied and operated the drilling equipment and carried out the drilling, soil sampling, in-situ testing, piezometer installation and borehole decommissioning. The field investigations were supervised on a full-time basis by A. de Oliveira, S. O'Bryan and A. Chown 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. Unconfined Compressive Strength Testing of the bedrock was carried out by Stantec's laboratory 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 Muhammad Imran Khan, EIT, and Fred Griffiths, P.Eng. The report was reviewed by P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Dr. Muhammad Imran Khan
Geotechnical EIT



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



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



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

Geocres No.: 31F-231

PART 2. ENGINEERING DISCUSSION AND RECOMMENDATIONS

8 INTRODUCTION

This section of the report provides an interpretation of the factual data and also presents geotechnical recommendations for the design of various rock cuts 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 rock. Design recommendations for deep cuts in soil are presented under separate cover (Geocres 31F-232). Mitigation recommendations for treatment of rock fall hazards at existing rock cuts on Highway 17 are also provided under 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 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.

8.1 Proposed Work

Deep cut locations were defined where the existing 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 as well as three cross sections provided by Parsons on March 29, 2022. Six different deep cut sections were identified and have been labelled B, K, L, M, N and Goshen. Cross sections are provided on Drawings 1 through 13 in Appendix A. Table 8-1 summarizes the Deep Cut site properties at select cross sections.

Table 8-1: Summary of Deep Cut Site Properties

Deep Cut Site	Approximate Stations (m)	Reference Stations	Earth Excavation Depth (m)	Rock Excavation Depth (m)
B (EBL)	18+650 to 19+025	18+767(*) 18+925(*) 18+981(*)	5.4 1.0 6.0	- 17.0 1.2
K (WBL)	11+900 to 11+970	11+922(*) 11+943 11+960	7.8 7.5 8.9	2.0 3.0 0.5
L (WBL)	12+180 to 12+340	12+227(*) 12+338(*)	- 4.7	12.7 0.3
M (WBL)	12+500 to 12+720	12+525(*) 12+647(*)	- 0.6	5.8 4.4
N (WBL)	12+900 to 13+020	12+949 (*) 12+990	- -	2.6 4.3
Goshen Rd	9+960 to 10+110	9+963 10+000(*) 10+037	6.2 2.5 1.7	- 4.2 4.4

Notes: (*) Cross-section in Drawings 1 to 13 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 in rock may extend as deep as 1.2 m below the top of pavement centerline elevation to facilitate the required ditch depths as per OPSD 201.010 and OPSD 201.020. 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 2022 AADT for the Highway 17 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 525 mm for a rock cut subgrade for Highway 17.

The projected 2022 AADT for Goshen Road is less than 450. A posted speed of 60 km/hour has been assumed. A General Arrangement (GA) drawing for the Goshen Road site is presented in Appendix F. Although, the draft Pavement Design Report indicates a total pavement thickness of 540 mm for Goshen Road, it is anticipated that a reduction in the subbase layer to 150 mm will be incorporated where a bedrock subgrade is present. This would reduce the total pavement thickness to 390 mm for Goshen Road.

8.2 Applicable Codes and Design Considerations

The May 2020 Roadside Design Manual has been consulted. Tables 2-9 and 2-10 in that manual indicate that a minimum Desirable Rock Face Offset of 5 m and a Desirable Ditch Depth of 0.75 m



are recommended for rock cut heights of 10 m for both Highway 17 and Goshen Road. The minimum Desirable Rock Face Offset should be increased to 10 m for a rock cut height of 17 m.

Table 2-2 of the May 2020 Roadside Design Manual has also been consulted and indicates that for Highway 17, the desirable clear zone value on tangent is 10.5 m based on a design speed in excess of 110 km/hr, an AADT of 6,000 or greater and a 6H:1V foreslope. Similarly, Table 2-2 indicates a desirable clear zone value for Goshen Road on tangent of 3.5 m based on a design speed of 80 km/hr, an AADT of less than 750 and a 6H:1V foreslope.

Based on the High Rock Cut Design Guidelines presented in MTO Northern Region Engineering Directive NRE 2000-204 (NRE 2000-204), the design of rock cuts and ditches should result in 95% of rockfalls being retained before reaching the edge of pavement.

9 DESIGN RECOMMENDATIONS

Deep cut locations were defined where the existing 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 1.2 m below the top of pavement centerline elevation to facilitate the minimum required ditch depth of 250 mm as per OPSD 201.010 and OPSD 201.020. The OPSD drawings have been included in Appendix G for reference.

The final cut slopes will contain both native earth slopes and rock faces. Recommendations for earth cut geometry for Sites B, K, L M and N are contained in the Deep Cut Foundation Report (Geocres 31F-232). Recommendations for earth cut geometry for the Goshen Road Site are contained in the Foundation Report for Goshen Road (Geocres 31F-255).

9.1 Rock Cut Assessment

Rock cut geometry should consider OPSD 201.010 and OPSD 201.020. The rock cuts should also be designed in conformity with the Roadside Design Manual, and in accordance with the recommendations of this report.

Rock excavation work should be carried out in accordance with OPSS.PROV 206, Construction Specification for Grading as well as OPSS.PROV 202, Construction Specification for Rock Removal by Manual Scaling, Machine Scaling, Trim Blasting or Controlled Blasting, and OPSS.PROV 120 General Specification for Use of Explosives. The NSSPs provided in Appendix G should be considered for inclusion in the contract as well.

All exposed rock cut excavations adjacent to a roadway should include a rock face item. A finishing pass of scaling for all rock faces will be required to remove loose material. After excavation, permanently exposed rock cuts should be examined by a rock slope specialist to identify any areas of unstable rock requiring removal or stabilization.



The selection of the method of excavating and removing the bedrock is the responsibility of the contractor. Overburden should be removed prior to commencing drilling and blasting operations to accurately establish the bedrock surface. Rock excavation utilizing blasting should be carried out in accordance with OPSS.PROV 120, including blast design by a qualified Engineer/Firm, explosive use by a competent blasting contractor, monitoring by a blast monitoring consultant, preparation of pre-blast surveys, and notification of any nearby utility authorities. It is noted that there are buildings, utility lines (including a gas line) and other facilities within 150 m of rock excavation locations.

Carefully controlled excavation techniques will minimize face instabilities and long-term maintenance problems resulting from damage to the rock mass.

The design of temporary slopes is the responsibility of the contractor, however vertical slopes in the bedrock will remain stable in the short term. Workers should not approach the toe of rock cuts prior to completion of a finishing pass of scaling to remove loose material. In some instances, additional temporary measures (placement of mesh for example) may also be required to protect workers.

Special attention is required for rock excavation at and behind the proposed abutments and wing walls for the structures at Goshen Road. It is anticipated that a rock excavation slope of 1H:1V and with a 1.0 m wide horizontal offset between the toe of the excavated bedrock and the back of the foundation will be required in this location to protect workers from falling rock during construction of the foundations and installation of concrete formwork for the abutments. A rock face item is also required for the cut behind the abutments. Furthermore, bedrock excavation at and within 1 m horizontal distance of foundations should not incorporate a shatter zone. The final bedrock excavation near foundations should be completed mechanically to minimize disturbance to the bedrock which will support the footings.

Table 9-1 summarizes where bedrock was encountered above the proposed top of pavement at centerline at each of the sites.

Table 9-1: Bedrock Above Proposed Highway 17 Profile

Rock Cut Site	Stations	Length (m)
B	18+835 to 19+020	185
K	11+900 to 11+970	70
L	12+180 to 12+340	160
M	12+500 to 12+720	220
N	12+900 to 13+020	120
Goshen	9+965 to 10+110	145

The design approach for this project includes consideration of the following, sometimes conflicting criteria:

- Minimize the amount of rock fall debris that could accumulate in the ditch and affect drainage, this is discussed below based on the results of kinematic analysis
- Minimize the amount of rock fall debris that could reach the highway lanes. This is presented below based on rock fall simulations.
- Optimization of bedrock excavation and generation of rock fill.

9.1.1 Kinematic Analysis

The structural geology measurements obtained at existing rock cuts and within the deep cut sections were utilized to assess the conditions that would likely be present at the new highway alignment rock face. Kinematic analyses were carried out utilizing the commercially available software “Dips” developed by Rocscience with a cut slope of 76 degrees (1H:4V). The results are attached and summarized in the following tables.

The analyses examined the relative feasibility of failure for four general failure mechanisms:

- Planar Sliding failure can occur when a block of rock slides on a single plane dipping out of the face.
- Wedge Sliding occurs where a wedge of rock slides along the line of intersection of two planes.
- Flexural Toppling occurs where continuous columns of rock separated by steeply dipping and well developed discontinuities break in flexure as they bend forward.
- Direct Toppling occurs where continuous columns of rock are separated by steeply dipping discontinuities and a second set of orthogonal joints defines a column height. The shorter columns at the face are pushed forward by the longer overturning columns behind resulting a progressive loss of material working upslope.

It is noted that the assessment is based on regional data and that the identified joint sets were not consistently present at all observations points. Variations in strike, dip and frequency of joint sets should be anticipated.

The results presented in the following sub-sections have been extracted from the DIPS output sheets and present the Relative Feasibility of Failure (RFF). The RFF is determined based on the number of data points where failure is mathematically possible divided by the total number of data points. Based on NRE 2000-204, the design of rock cuts and ditches should result in 95% of rockfalls being retained (not reaching the edge of pavement). An RFF of less than 5% provides a screening tool for sites and mechanisms to be excluded.

The following sub-sections summarize the results of the kinematic analyses for each of the six rock cut sites. Analyses output figures for the rock slope at Site M are included in Appendix E as an example.

9.1.1.1 Rock Cut B: Horton Sta. 18+650 to Sta. 19+025 EBL

The Rock Mass Rating for the marble bedrock at Rock Cut B is estimated to be approximately 57. Application of the RocScience software, RocLab1, with a Uniaxial Compressive Strength of 67 MPa, a Geological Strength Index of 60, an intact rock parameter, m_i value of 9 for marble and a Disturbance Factor of 0.7 for a slope 17 m in height generates a Mohr-Coulomb ϕ value of 53 degrees. The kinematic analyses were completed based on a conservative ϕ value of 50 degrees.

The results of the kinematic analyses for Site B are summarized in Table 9-2 assuming a cut slope of 76 degrees (1H:4V).

Table 9-2: Kinematic Analyses for 0.25H:1V Rock Cut B

Mechanism		Relative Feasibility(*) of Failure	
		South Facing Rock Cut (North side of Hwy 17)	North Facing Rock Cut (South side of Hwy 17)
Planar Sliding	(all)	0%	0%
	(no limits)	2.8%	2.8%
Wedge Sliding		1.8%	1.8%
Flexural Toppling		2.8%	8.3%
Direct Toppling	Direct Toppling (Intersection)	10.5%	4.9%
	Oblique Toppling (Intersection)	5.7%	7.8%
	Base Plane (All)	13.9%	41.7%

Note: () based on structural geology measurements at rock cuts within Rock Cut B.*

The results indicate acceptable conditions (RFF of 5% or less) for 8 of the 14 cases analysed.

9.1.1.2 Rock Cut K: McNab-Braeside Sta. 11+900 to Sta. 11+970 WBL

The Rock Mass Rating for the bedrock at Rock Cut K has been estimated to be approximately 62 based on data from the adjacent Rock Cut L. Similarly, using data from Rock Cut L and application of the RocScience software, RocLab1, with a Uniaxial Compressive Strength of 128 MPa, a Geological Strength Index of 60, an intact rock parameter, m_i value of 32 for granite and a Disturbance Factor of 0.7 for a slope 10 m in height generates a Mohr-Coulomb ϕ value of 69 degrees. The kinematic analyses were completed based on a conservative ϕ value of 50 degrees.

The results of the kinematic analyses for Site K assuming a cut slope of 76 degrees (1H:4V) are summarized in Table 9-3.

Table 9-3: Kinematic Analyses for 0.25H:1V Rock Cut K

Mechanism		Relative Feasibility ^(*) of Failure	
		South Facing Rock Cut (North side of Hwy 17)	North Facing Rock Cut (South side of Hwy 17)
Planar Sliding	(all)	0%	0%
	(no limits)	0%	13.3%
Wedge Sliding		11.4%	18.1%
Flexural Toppling		0%	6.7%
Direct Toppling	Direct Toppling (Intersection)	21.9%	18.1%
	Oblique Toppling (Intersection)	8.6%	20.0%
	Base Plane (All)	20.0%	0%

Note: () based on structural geology measurements at rock cuts within Rock Cut K.*

The results indicate acceptable conditions (RFF of 5% or less) for 5 of the 14 cases analysed.

9.1.1.3 Rock Cut L: McNab-Braeside Sta. 12+180 to Sta. 12+340 WBL

The Rock Mass Rating for the monzogranite bedrock at Rock Cut L is estimated to be approximately 62. Application of the RocScience software RocLab1 with a Uniaxial Compressive Strength of 128 MPa, a Geological Strength Index of 60, an intact rock parameter, m value of 32 for granite and a Disturbance Factor of 0.7 for a slope 10 m in height generates a Mohr-Coulomb ϕ value of 69 degrees. The kinematic analyses were completed based on a conservative ϕ value of 50 degrees.

The results of the kinematic analyses for Site L assuming a cut slope of 76 degrees (1H:4V) are summarized in Table 9-4.

Table 9-4: Kinematic Analyses for 0.25H:1V Rock Cut L

Mechanism		Relative Feasibility ^(*) of Failure	
		South Facing Rock Cut (North side of Hwy 17)	North Facing Rock Cut (South side of Hwy 17)
Planar Sliding	(all)	13.3%	0.0%
	(no limits)	20.8%	5.0%
Wedge Sliding		19.0%	1.7%
Flexural Toppling		2.5%	22.5%
Direct Toppling	Direct Toppling (Intersection)	3.0%	9.0%
	Oblique Toppling (Intersection)	5.9%	24.1%
	Base Plane (All)	28.3%	15.8%

Note: () based on structural geology measurements at rock cuts within Rock Cut L.*

The results indicate acceptable conditions (RFF of 5% or less) for 4 of the 14 cases analysed.

9.1.1.4 Rock Cut M: McNab-Braeside Sta. 12+500 to Sta. 12+720 WBL

The Rock Mass Rating for the monzogranite bedrock at Rock Cut M is estimated to be approximately 56. Application of the RocScience software RocLab1 with a Uniaxial Compressive Strength of 98 MPa, a Geological Strength Index of 60, an intact rock parameter, m_i value of 32 for granite and a Disturbance Factor of 0.7 for a slope 10 m in height generates a Mohr-Coulomb ϕ value of 68 degrees. The kinematic analyses were completed based on a conservative ϕ value of 50 degrees.

The results of the kinematic analyses for Site M assuming a cut slope of 76 degrees (0.25H:1V) are summarized in Table 9-5.

Table 9-5: Kinematic Analyses for 0.25H:1V Rock Cut M

Mechanism		Relative Feasibility ^(*) of Failure	
		South Facing Rock Cut (North side of Hwy 17)	North Facing Rock Cut (South side of Hwy 17)
Planar Sliding	(all)	4.1%	3.4%
	(no limits)	8.2%	6.8%
Wedge Sliding		9.4%	6.8%
Flexural Toppling		7.5%	12.2%
Direct Toppling	Direct Toppling (Intersection)	4.7%	5.4%
	Oblique Toppling (Intersection)	14.4%	18.0%
	Base Plane (All)	19.7%	21.8%

Note: (*) based on structural geology measurements at rock cuts within Rock Cut M.

The results indicate acceptable conditions (RFF of 5% or less) for 3 of the 14 cases analysed.

9.1.1.5 Rock Cut N: McNab-Braeside Sta. 12+900 to Sta. 13+020 WBL

The Rock Mass Rating for the monzogranite bedrock at Rock Cut N is estimated to be approximately 58. Application of the RocScience software RocLab1 with a Uniaxial Compressive Strength of 115 MPa, a Geological Strength Index of 60, an intact rock parameter, m_i value of 32 for granite and a Disturbance Factor of 0.7 for a slope 10 m in height generates a Mohr-Coulomb ϕ value of 68 degrees. The kinematic analyses were completed based on a conservative ϕ value of 50 degrees.

The results of the kinematic analyses for Site N assuming a cut slope of 76 degrees (1H:4V) are summarized in Table 9-6.

Table 9-6: Kinematic Analyses for 0.25H:1V Rock Cut N

Mechanism		Relative Feasibility ^(*) of Failure	
		South Facing Rock Cut (North side of Hwy 17)	North Facing Rock Cut (South side of Hwy 17)
Planar Sliding	(all)	10.5%	5.3%
	(no limits)	10.5%	10.5%
Wedge Sliding		20.5%	16.4%
Flexural Toppling		0%	15.8%
Direct Toppling	Direct Toppling (Intersection)	13.5%	12.3%
	Oblique Toppling (Intersection)	19.3%	23.4%
	Base Plane (All)	10.5%	21.1%

Note: () based on structural geology measurements at rock cuts within Rock Cut N.*

The results indicate acceptable conditions (RFF of 5% or less) for 1 of the 14 cases analysed.

9.1.1.6 Goshen Road Rock Cut: Goshen Rd. Sta. 9+965 to 10+100

The Rock Mass Rating for the granite/gneiss bedrock at the Goshen Road Rock Cut is estimated to be approximately 58. Application of the RocScience software RocLab1 with a Uniaxial Compressive Strength of 161 MPa, a Geological Strength Index of 60, an intact rock parameter, m_i value of 32 for granite and a Disturbance Factor of 0.7 for a slope 10 m in height generates a Mohr-Coulomb ϕ value of 69 degrees. The kinematic analyses were completed based on a conservative ϕ value of 50 degrees.

The results of the kinematic analyses for Goshen Road assuming a cut slope of 76 degrees (1H:4V) are summarized in Table 9-7.

Table 9-7: Kinematic Analyses for 0.25H:1V the Goshen Road Rock Cut

Mechanism		Relative Feasibility ^(*) of Failure	
		West Facing Rock Cut (East side of Goshen)	East Facing Rock Cut (West side of Goshen)
Planar Sliding	(all)	25.0%	0%
	(no limits)	25.0%	0%
Wedge Sliding		35.0%	0%
Flexural Toppling		0%	12.5%
Direct Toppling	Direct Toppling (Intersection)	0%	16.7%
	Oblique Toppling (Intersection)	1.7%	16.7%
	Base Plane (All)	62.5%	0%

Note: () based on structural geology measurements at rock cuts within Goshen Road Cut.*

The results indicate acceptable conditions (RFF of 5% or less) for 7 of the 14 cases analysed.

9.1.2 Kinematic Sensitivity Analyses

The results of the initial kinematic analyses presented above indicate that acceptable conditions (Relative Feasibility of Failure, RFF, of 5% or less) for 33% of the 84 cases analysed. This suggests the orientation of the discontinuity sets with respect to the roadway are not favourable. The initial kinematic analyses were completed with a slope angle of 76 degrees (1H:4V). Additional analyses have been carried out to examine the impact the cut slope angle has on the relative feasibility of failure (RFF), ie would a flatter cut slope reduce the anticipated number of failures. Representative outputs of the sensitivity testing are provided in Appendix E for Site M.

The data presented in Table 9-8, Table 9-9 and Table 9-10 indicate the slope angle at which the RFF for a particular mechanism is 5% or less.

The results of the sensitivity analyses for Rock Cut B is presented in Table 9-8.

Table 9-8: Sensitivity Analyses for Slope Angle, Rock Cut B

Mechanism		Slope Angle (Degrees) to Achieve Relative Feasibility ^(*) of Failure of Less than 5%	
		South Facing Rock Cut (North side of Hwy 17)	North Facing Rock Cut (South side of Hwy 17)
Planar Sliding	(all)	76	76
	(no limits)	76	76
Wedge Sliding		76	76
Flexural Toppling		76	56
Direct Toppling	Direct Toppling (Intersection)	65	76
	Oblique Toppling (Intersection)	NP	NP
	Base Plane (All)	NP	NP

Note: () based on structural geology measurements at rock cuts within Rock Cut B. NP indicates those mechanisms which do not achieve an RFF of 5% or lower by adjusting the slope angle.*

The results of the sensitivity analyses for Rock Cut B suggest that there would be only minor improvements in performance with rock cut slopes flatter than 76 degrees.

The results of the sensitivity analyses for Rock Cuts K, L, M and N are all presented in Table 9-9 as they present similar discontinuity patterns and a similar highway orientation. Furthermore, as they are adjacent, they would typically be designed with a consistent cut slope angle.

Table 9-9: Sensitivity Analyses for Slope Angle, Rock Cuts K, L, M and N

Mechanism		Slope Angle (Degrees) to Achieve Relative Feasibility ^(*) of Failure of Less than 5%							
		South Facing Rock Cut (North side of Hwy 17)				North Facing Rock Cut (South side of Hwy 17)			
Rock Cut		<i>K</i>	<i>L</i>	<i>M</i>	<i>N</i>	<i>K</i>	<i>L</i>	<i>M</i>	<i>N</i>
Planar Sliding	(all)	76	65	76	66	76	76	76	57
	(no limits)	76	64	74	66	60	76	74	57
Wedge Sliding		73	64	72	66	61	76	73	57
Flexural Toppling		76	76	66	76	62	57	61	53
Direct Toppling	Direct Toppling (Intersection)	NP	76	76	NP	NP	NP	73	NP
	Oblique Toppling (Intersection)	NP	NP	NP	NP	NP	NP	NP	NP
	Base Plane (All)	NP	NP	NP	65	76	NP	NP	NP

Note: () based on structural geology measurements at rock cuts within each rock cut. NP indicates those mechanisms which do not achieve an RFF of 5% or lower by adjusting the slope angle.*

The results of the sensitivity analyses for Rock Cuts K, L, M and N suggest that there would be improvements in performance with rock cut slopes flatter than 76 degrees. A cut slope angle of 64 degrees for the south facing (outside) slopes would achieve the RFF target of 5% or lower for all improvable mechanisms. Similarly, a cut slope angle of 53 degrees would achieve the same criterion for the north facing (median) slopes.

The results of the sensitivity analyses for the Goshen Road Rock Cut is presented in Table 9-10.

Table 9-10: Sensitivity Analyses for Slope Angle, Goshen Road Rock Cut

Mechanism		Slope Angle (Degrees) to Achieve Relative Feasibility ^(*) of Failure of Less than 5%	
		West Facing Rock Cut (East side of Goshen)	East Facing Rock Cut (West side of Goshen)
Planar Sliding	(all)	55	76
	(no limits)	55	76
Wedge Sliding		57	76
Flexural Toppling		76	55
Direct Toppling	Direct Toppling (Intersection)	76	NP
	Oblique Toppling (Intersection)	76	NP
	Base Plane (All)	NP	76

Note: () based on structural geology measurements at rock cuts within Goshen Road Cut. NP indicates those mechanisms which do not achieve an RFF of 5% or lower by adjusting the slope angle.*

The results of the sensitivity analyses for the Goshen Road Rock Cut suggest that there could be improvements in performance with rock cut slopes flatter than 76 degrees. A cut slope angle of 55 degrees would achieve the RFF target of 5% or lower for all improvable mechanisms for the west facing slope. The east facing slope would only be marginally improved with a flatter slope.

9.1.3 Rock Fall Simulations

It is noted that Kinematic Analyses do not provide insight on the consequences of rock fall. Additional analysis has been completed to estimate the trajectory of possible rock falls and the ultimate resting place of the rock fall debris with respect to the edge of pavement. Rock fall simulations were carried out with the commercially available software “RocFall” developed by Rocscience. The first simulation was for Highway 17 Rock Cut B near Sta. 18+925 and a rock cut height of 17 m. A second assessment was completed incorporating the anticipated geometry from Rock Cut L near Sta. 12+227 and a rock cut height of 15 m. A third simulation was for Goshen Road and incorporated the anticipated geometry from near Sta. 10+000 and a conservative rock cut height of 7 m. A total of 1000 rock pieces were simulated for each section with the rock pieces having theoretical weights of 100 and 10 kg. The rock pieces were modeled using the various rock shapes offered within the software program, all falling from the crest of the rock face. The input geometry and the results of the simulations are presented in Appendix E.

The results of the Highway 17 Cut B simulations are summarized in Table 9-11 and indicate that more than 95% of the rock falls are retained in the ditch for the slope configuration assessed.

Table 9-11: RocFall Analysis Results for Highway 17 Cut B, 17 m Height

Location	Rock Face Slope		Lane Width (m)	Shoulder Width (m)	Ditch Depth (m)	CZW (m)	Percent Retention	
	Degrees	1H:XV					By Shoulder Edge	By Edge of Pavement
North Facing / RT of CL	76	1H:4V	3.75	3.0	0.75	10.5	100	100

The results of the Highway 17 Cut L simulations are summarized in Table 9-12 and indicate that more than 95% of the rock falls are retained in the ditch for all three slope configurations assessed.

Table 9-12: RocFall Analysis Results for Highway 17 Cut L, 15 m Height

Location	Rock Face Slope		Lane Width (m)	Shoulder Width (m)	Ditch Depth (m)	CZW (m)	Percent Retention	
	Degrees	1H:XV					By Shoulder Edge	By Edge of Pavement
South Facing / LT of CL	76	1H:4V	3.75	3.0	0.75	10.5	100	100
South Facing / LT of CL	64	1H:2V	3.75				>99	100
North Facing / RT of CL	53	1H:1.3 V	3.75	1.0			99	100

The results of the Goshen Road simulations are summarized in Table 9-13 and indicate that although all three of the sections assessed achieve the target of 95% retention, one is less successful with approximately 7% of rockfalls reaching the shoulder. Additional clear zone and ditch depth is recommended.

Table 9-13: RocFall Analysis Results for Goshen Road, 7 m Height

Location	Rock Face Slope		Lane Width (m)	Shoulder Width (m)	Ditch Depth (m)	CZW (m)	Percent Retention	
	Degrees	1H:XV					By Shoulder Edge	By Edge of Pavement
LT & RT of CL	76	1H:4V	3.25	2.0	0.25	5.9	>99	100
	55	1H:1.4V	3.25				87	>99
	55	1H:1.4V	3.25		0.5	6.9	98	100

9.2 Rock Cut Recommendations

The following recommendations are presented as achieving a best fit of minimizing rock fall debris accumulating in the ditch and minimizing rock fall debris reaching the roadways.

9.2.1 Rock Cut Geometry, Highway 17, Rock Cuts B, K, L, M and N

Rock cuts less than 5 m in height (bottom of ditch to top of cut), can be safely constructed using OPSD 201.020 and the following:

- The rock should be cut vertically.
- A ditch depth of at least 0.25 m should be provided over a 300 mm rock shatter layer.
- A 3.0 m wide bench should be provided between the top of the rock cut and the toe of the overburden slope.
- The slope of the earth cut should be as recommended in the Earth Cut Foundation Report.
- An interceptor ditch should be provided at the top of the overburden slope.
- The Clear Zone should be a minimum width of 10.5 m, in accordance with Tables 2-2 and 2-3 of the Roadside Design Manual.

The results of the kinematic analyses and rock fall simulations provided above indicate that the geometry for the rock cuts at Sites B, K, L, M and N can be safely constructed using OPSD 201.020 with the following adjustments for rock cuts between 5 m and 10m in height:

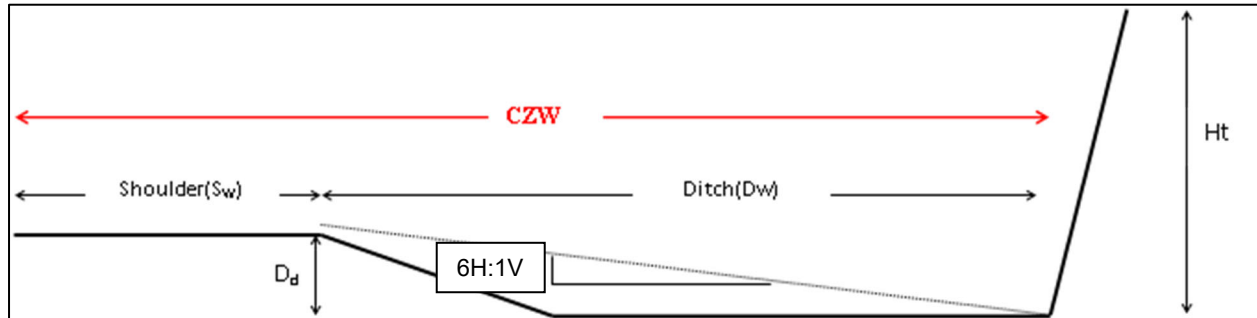
- The rock should be cut at the slopes indicated in Table 9-14.
- A ditch depth of at least 0.25 m should be provided over a 300 mm rock shatter layer.
- A 3.0 m wide bench should be provided between the top of the rock cut and the toe of the overburden slope.
- The slope of the earth cut should be as recommended in the Earth Cut Foundation Report.
- An interceptor ditch should be provided at the top of the overburden slope.
- The Clear Zone should be a minimum width of 10.5 m, in accordance with Tables 2-2 and 2-3 of the Roadside Design Manual.

Table 9-14: Recommended Rock Cut Slope Angle

Rock Cut	Side	Recommended Rock Cut Slope Angle	
		Degrees	Horizontal to Vertical
B	Right, North Facing	76	1H:4V
K, L, M, N	Left, South Facing	64	1H:2V
K, L, M, N	Right, North Facing	53	1H:1.3V

For rock cuts between 10 m and 17 m in height, the recommendations for cuts from 5 m to 10 m height should be employed provided the ditch depth is increased to 0.75 m depth and the ditch

geometry should include a 6H:1V slope from the edge of shoulder to toe of rock cut as indicated in NRE 2000-204, as shown below:



Where rock cuts exceed 17 m in height, they should be subject to further review with respect to clear zone width and ditch geometry.

9.2.2 Rock Cut Geometry, Goshen Road

Rock cuts less than 3 m in height (bottom of ditch to top of cut), can be safely constructed using OPSD 201.020 and the following:

- The rock should be cut vertically.
- A ditch depth of at least 0.25 m should be provided over a 300 mm rock shatter layer.
- A 3.0 m wide bench should be provided between the top of the rock cut and the toe of the overburden slope.
- The slope of the earth cut should be as recommended in the Goshen Road Overpasses Foundation Report.
- An interceptor ditch should be provided at the top of the overburden slope.
- A Clear Zone should be provided equal to the greater of 6 m or that indicated in Tables 2-2 and 2-3 of the Roadside Design Manual.

The results of the kinematic analyses and rock fall simulations provided above indicate that the geometry for the Goshen Road rock cut can be safely constructed using OPSD 201.010 with the following adjustments for rock cuts from 3 m to 7 m in height:

- The rock on the west facing slope should be cut at 1H:1.4V (ie 55 degrees). The east facing slope should be cut at 1H:4V (76 degrees) as it would only be marginally improved with a flatter slope.
- A ditch depth of at least 0.5 m should be provided over a 300 mm rock shatter layer for slopes cut at 1H:1.4V (ie 55 degrees). The ditch geometry should include a 6H:1V slope from the edge of shoulder to toe of rock cut as indicated in NRE 2000-204, see sketch above.



- A 3.0 m wide bench should be provided between the top of the rock cut and the toe of the overburden slope.
- The slope of the earth cut should be as recommended in the Goshen Road Foundation Investigation and Design Report.
- An interceptor ditch should be provided at the top of the overburden slope.
- A Clear Zone should be provided equal to the greater of 6 m or that indicated in Tables 2-2 and 2-3 of the Roadside Design Manual.

Where rock cuts on Goshen Road exceed 7 m in height, they should be subject to further review with respect to cut slope, clear zone width and ditch geometry.

Special attention is required for rock excavation behind the proposed abutments and wing walls for the structures at Goshen Road. A rock excavation slope of 1H:1V and with a 1.0 m wide horizontal offset between the toe of the excavated bedrock and the back of the foundation will be required in this location to protect workers from falling rock during construction of the foundations and installation of concrete formwork for the abutments. A rock face item is also required for the cut behind the abutments. Furthermore, bedrock excavation at and within 1 m horizontal distance of foundations should not incorporate a shatter zone. The final bedrock excavation near foundations should be completed mechanically to minimize disturbance to the bedrock which will support the footings.

9.2.3 Material Re-Use

It is anticipated that the excavated bedrock will be suitable for re-use for embankment construction. Additional details can be found in the Pavement Design Report and High Fills Foundation Report. In accordance with MERO-017, a bulking factor of 1.35 should be applied when converting from rock volumes in-situ to rock fill volumes. Harvesting additional bedrock should be considered to improve the cut-fill balance. It is recommended that rock be removed from median areas prior to expanding rock excavations to the outside.

The evaluation of the acceptability of using the excavated rock in the generation of aggregates, will require additional testing.

9.3 Earth Cuts

It is noted that recommendations for proposed deep cuts in earth are presented in a separate foundation report. Additional information is also available in the Pavement Design Report and the Foundation Investigation and Design Report for the Goshen Road Overpasses.

9.4 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.
- 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 specific locations only. These deposits may extend to greater depths/extents or be encountered at other locations between boreholes.
- Vibration monitoring of nearby structures and utilities will be required where rock drilling and blasting is carried out.
- Rock blasting must be carefully designed to minimize overbreak or shattering of rock below structure foundations.

After excavation, permanently exposed rock cuts should be examined by a rock slope specialist to identify any areas of unstable rock requiring removal or stabilization.



11 CLOSURE

Engineering analysis and preparation of this report was carried out by Dr. Muhammad Imran Khan. 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.

Thurber Engineering Ltd.

Report Prepared By:

Dr. Muhammad Imran Khan
Geotechnical EIT



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



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



References

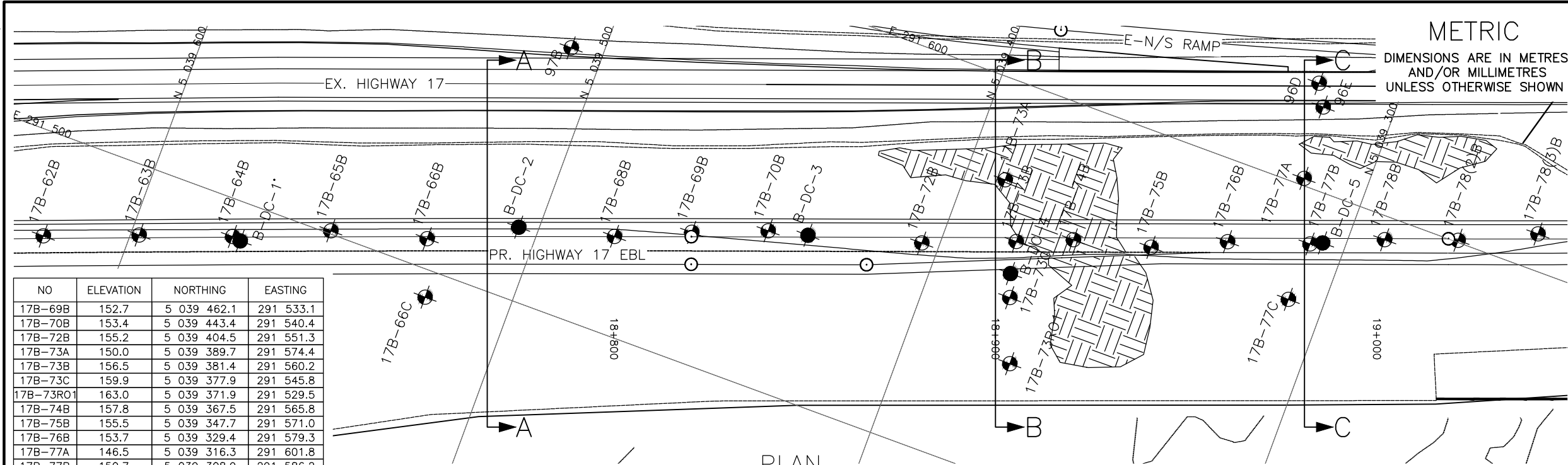
ⁱ Crins, William J., Paul A. Gray, Peter W.C. Uhlig, and Monique C. Wester. 2009. The Ecosystems of Ontario, Part I: Ecozones and Ecoregions. Ontario Ministry of Natural Resources, Peterborough Ontario, Inventory, Monitoring and Assessment, SIB TER IMA TR- 01, 71pp.

ii 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



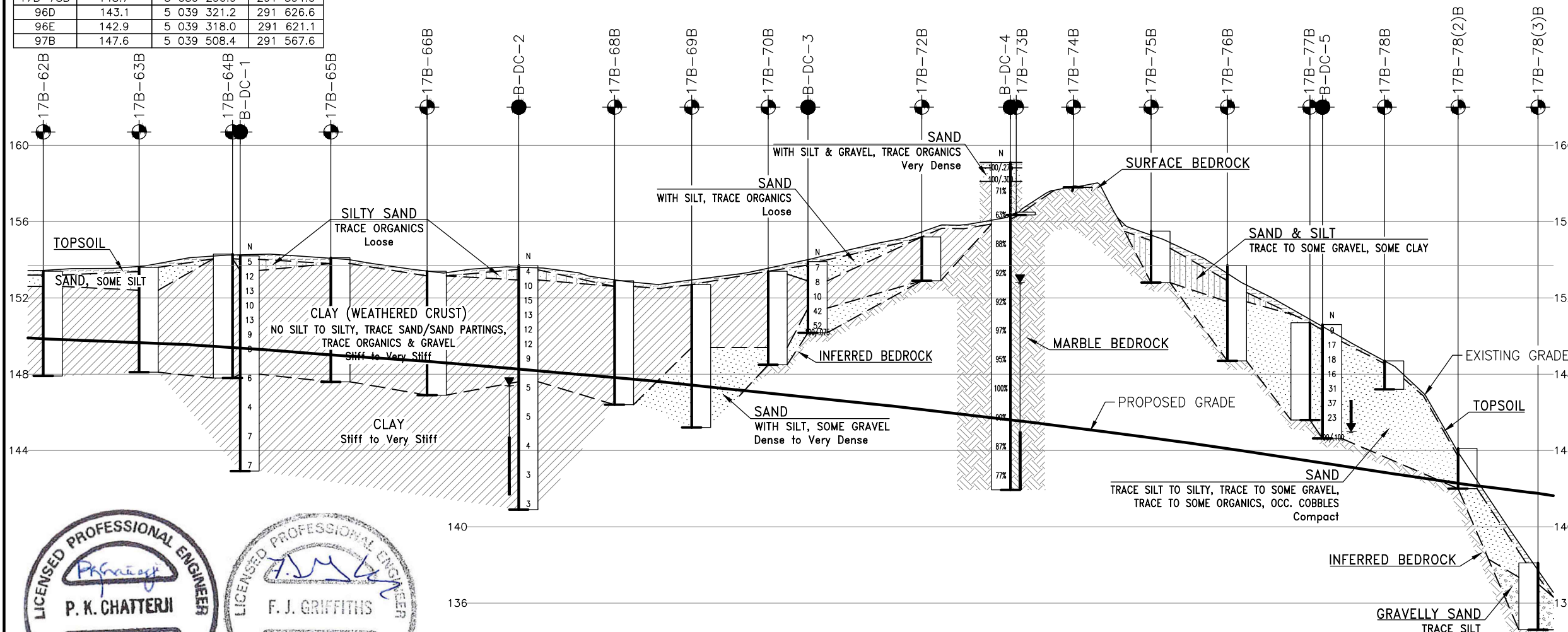
Appendix A.

Borehole Location Plan and Stratigraphic Drawings



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

PLAN
SCALE 1:1250



PROFILE ALONG \mathbb{Q} PROPOSED EBL

SCALE 1:250

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



CONT No
WP No

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

Ontario

SHEET



KEYPLAN

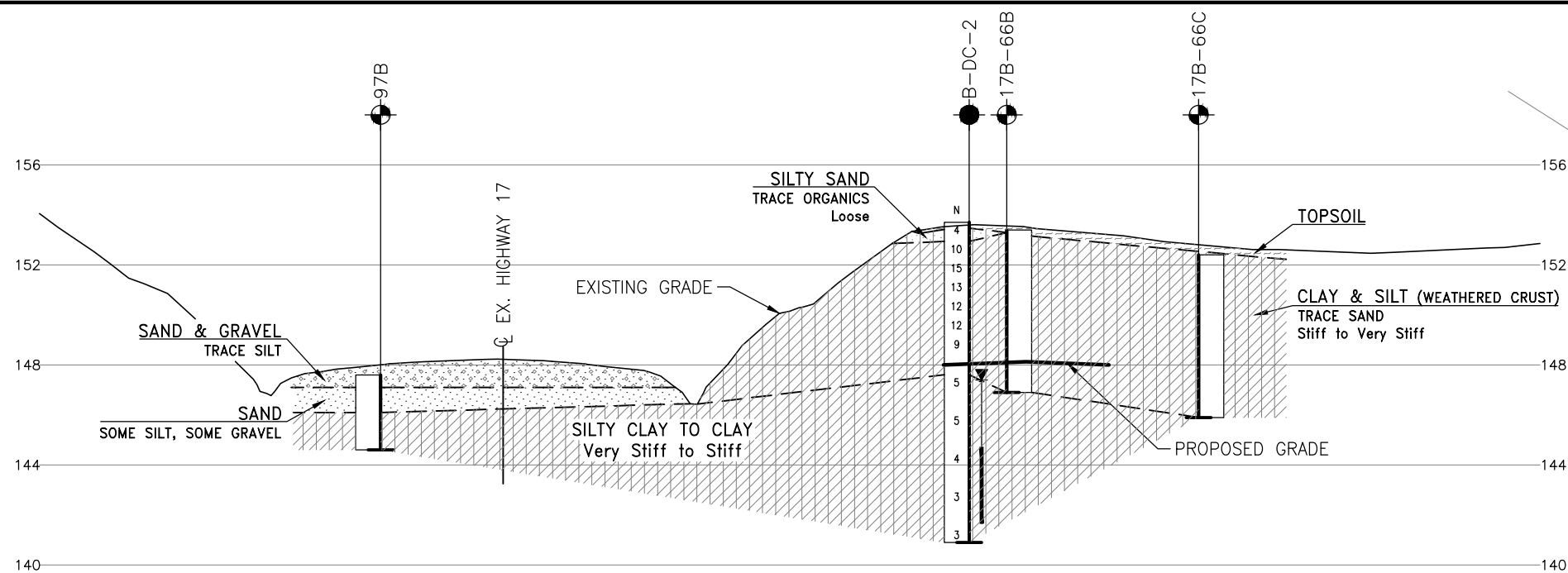
LEGEND			
●	Foundation Borehole		
○	Pavement Investigation Data Point		
N	Blows /0.3m (Std Pen Test, 475J/blow)		
CONE	Blows /0.3m (60° Cone, 475J/blow)		
PH	Pressure, Hydraulic		
W	Water Level		
W	Head Artesian Water		
P	Piezometer		
90%	Rock Quality Designation (RQD)		
A/R	Auger Refusal		

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

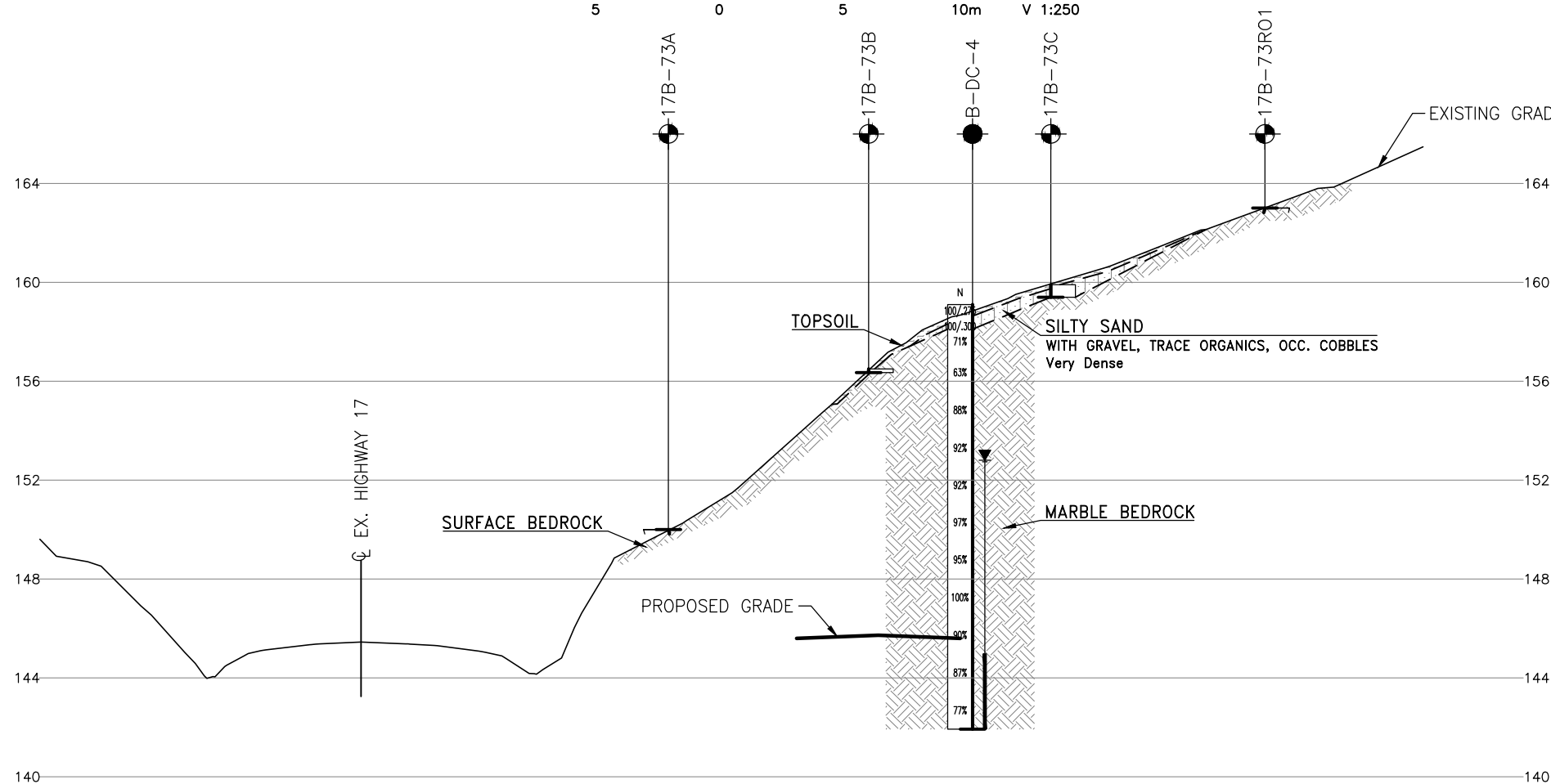
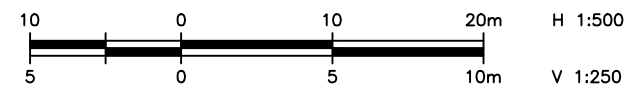
- NOTES-**
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
 - This drawing is for subsurface information only. Structural elements, surface details and features are for conceptual illustration.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

GEOCRES No. 31F-231

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



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



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

SHEET

Ontario



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

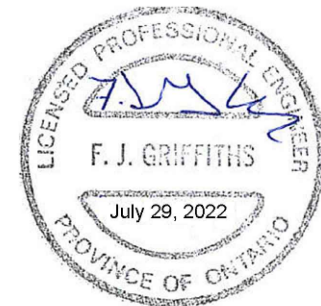
-NOTES-

- 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.

GEORES No. 31F-231

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

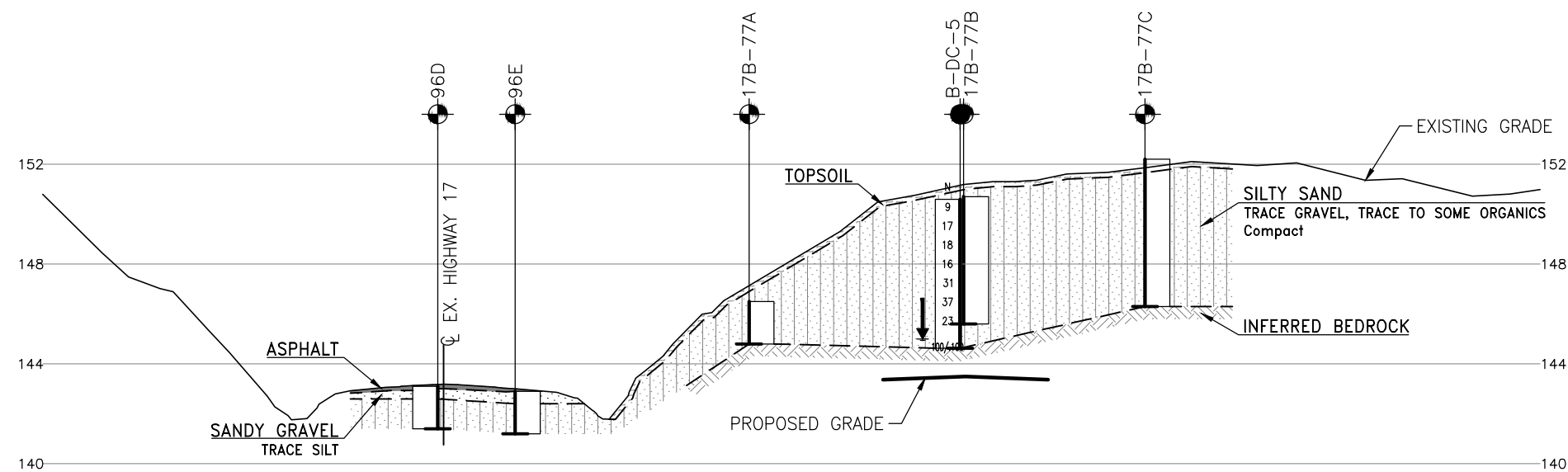
	Foundation Borehole
	Pavement Investigation Data Point
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

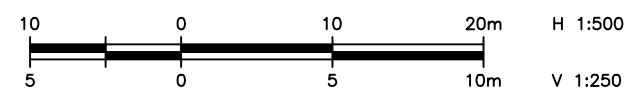
-NOTES-

- 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-231

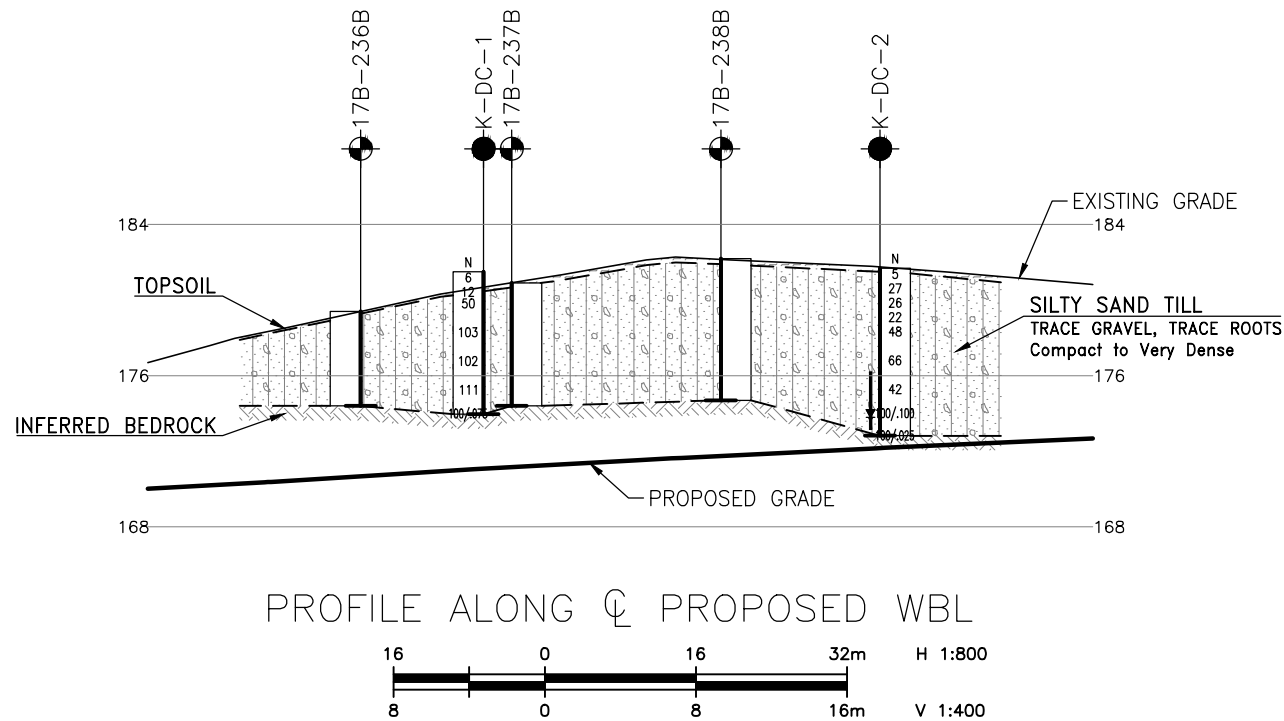
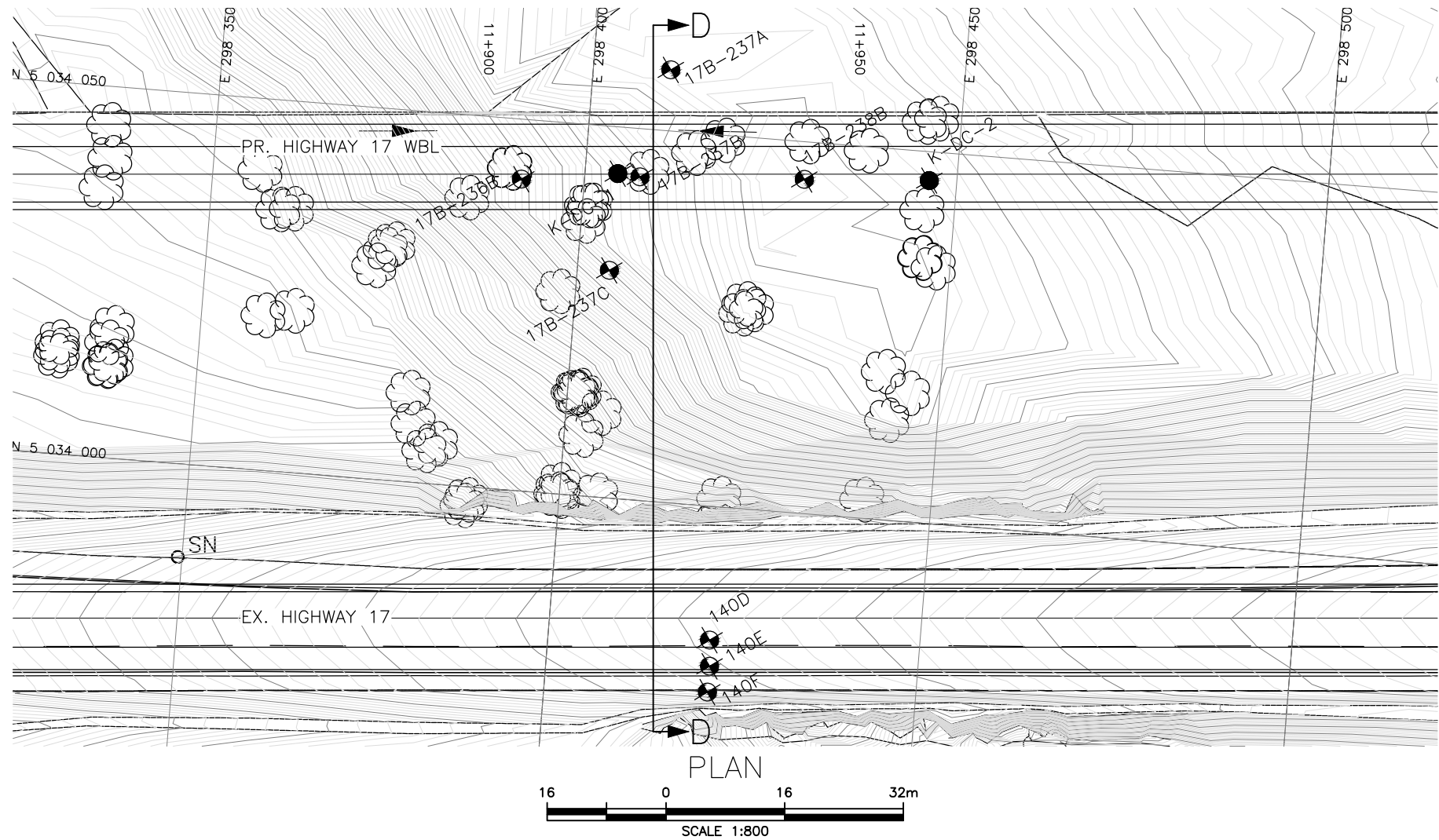


SECTION C-C (18+981)



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

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	DJP	CHK FG	LOAD				DATE	JUL 2022	
DRAWN	MFA	CHK PKC	SITE	STRUCT		DWG 3			



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

Ontario



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-

- 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-231

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

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK FG	CODE
DRAWN	MFA	CHK PKC	SITE
LOAD			DATE JUL 2022
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
Ontario	



KEYPLAN

LEGEND

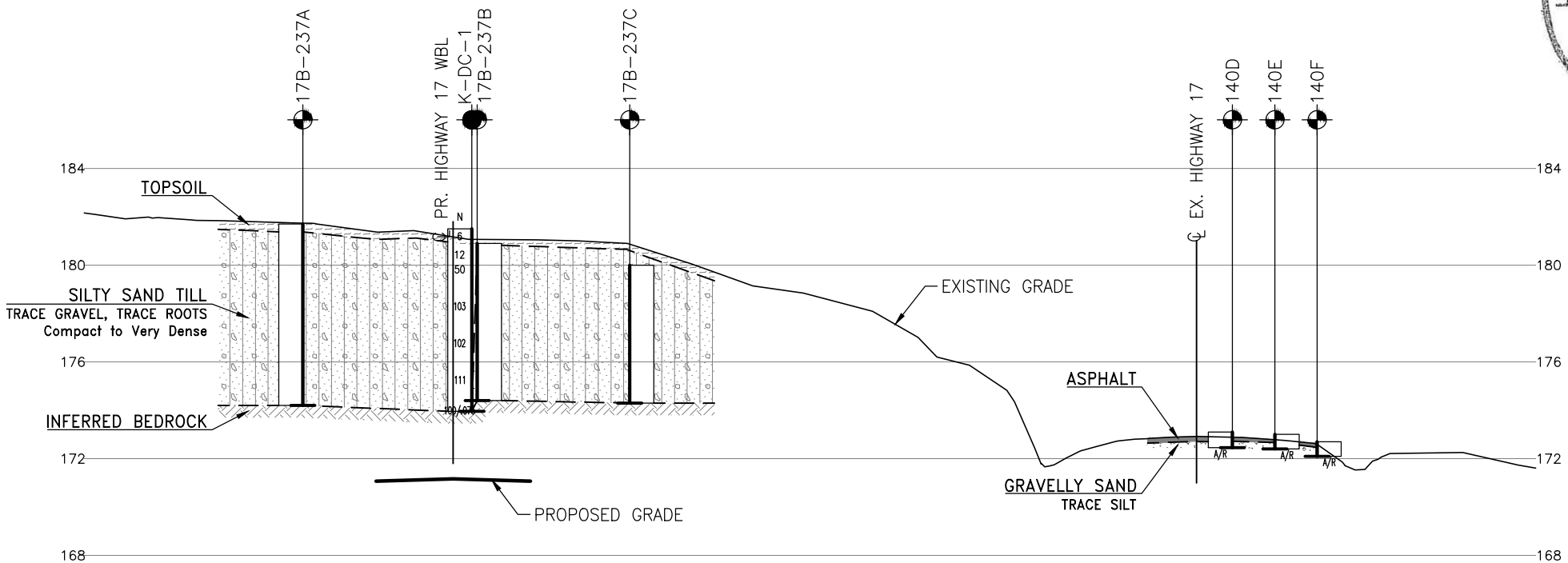
●	Foundation Borehole
○	Pavement Investigation Data Point
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
≡	Water Level
≡	Head Artesian Water
≡	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

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

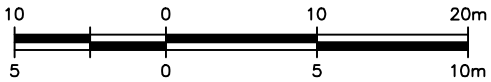
-NOTES-

- 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-231



SECTION D-D (11+922)

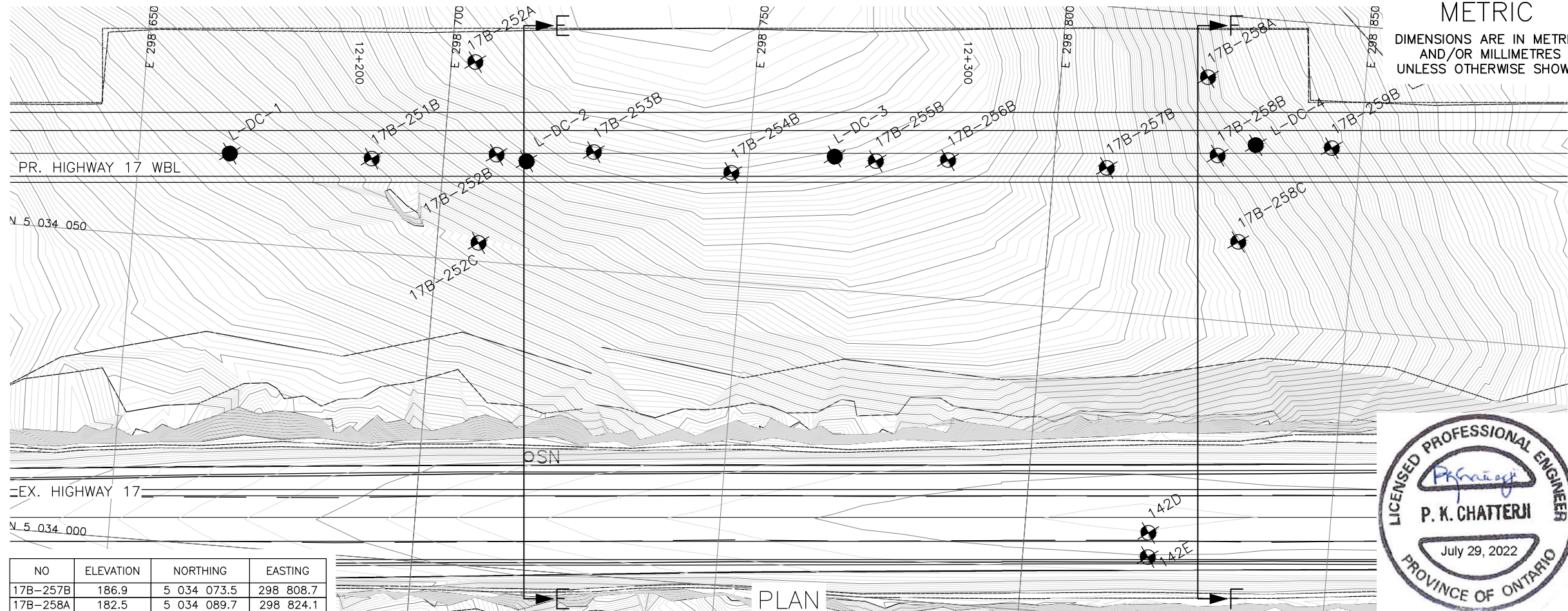


H 1:500

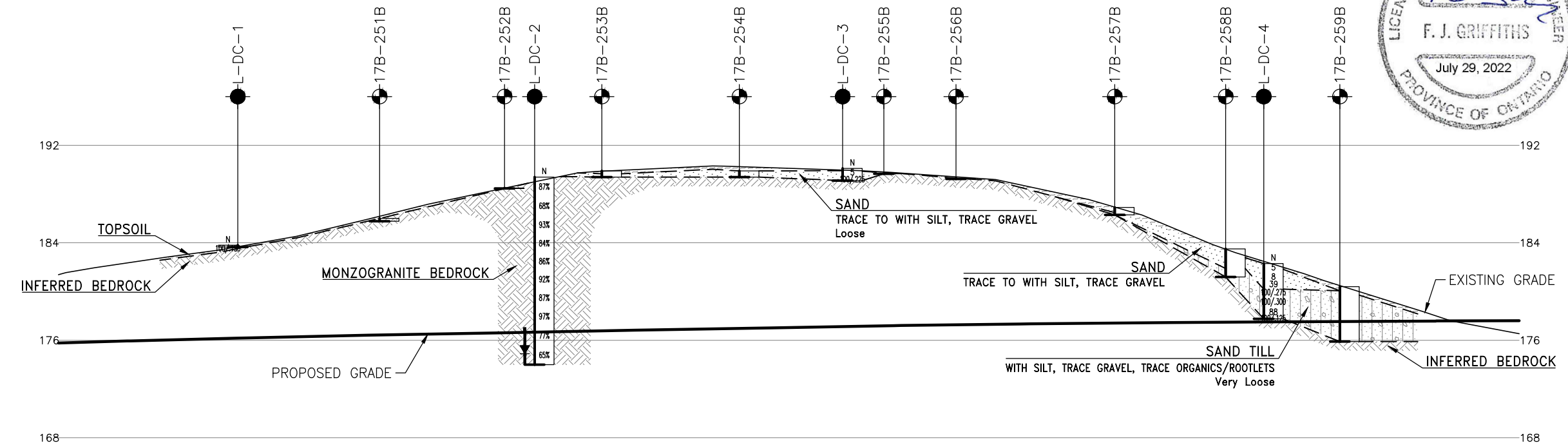
V 1:250

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

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK FG	CODE
DRAWN	MFA	CHK PKC	SITE
			LOAD
			DATE JUL 2022
			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



PROFILE ALONG Q PROPOSED WBL



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



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

Ontario



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
W	Water Level
HA	Head Artesian Water
P	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

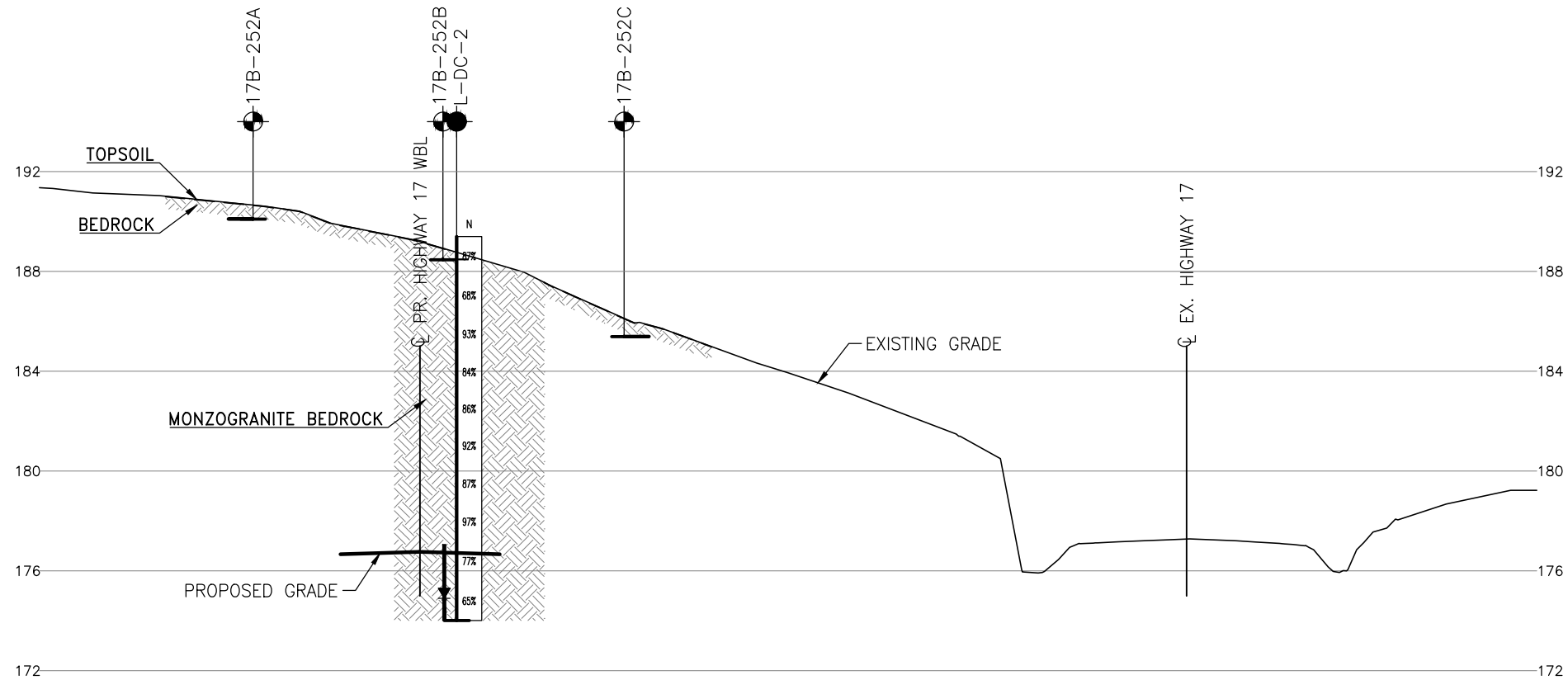
NO	ELEVATION	NORTHING	EASTING
L-DC-1	183.8	5 034 064.4	298 664.9
L-DC-2	189.4	5 034 067.0	298 713.6
L-DC-3	190.1	5 034 071.8	298 764.0
L-DC-4	182.3	5 034 079.2	298 832.8
17B-251B	186.0	5 034 065.4	298 688.2
17B-252A	190.1	5 034 082.6	298 703.9
17B-252B	188.5	5 034 067.7	298 708.6
17B-252C	185.4	5 034 053.0	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

NOTES

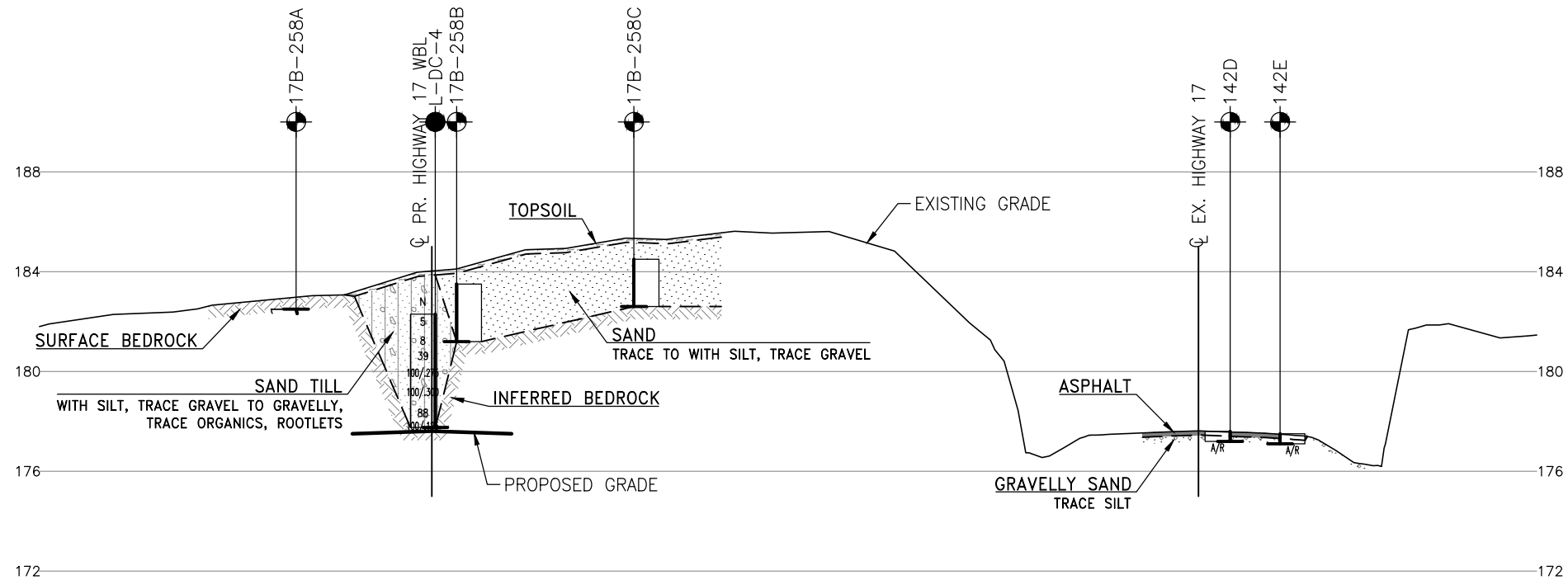
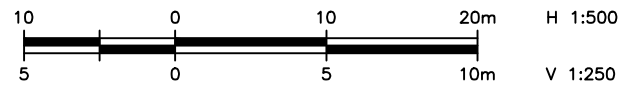
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Structural elements, surface details and features are for conceptual illustration.
- Coordinate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

GEOCRES No. 31F-231

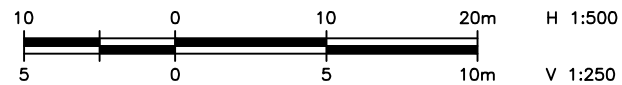
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK FG	CODE
DRAWN	MFA	CHK PKC	SITE
LOAD			
STRUCT			
DWG	6		
DATE	JUL 2022		



SECTION E-E (12+227)



SECTION F-F (12+338)



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

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
Ontario	



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
W	Water Level
HA	Head Artesian Water
P	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

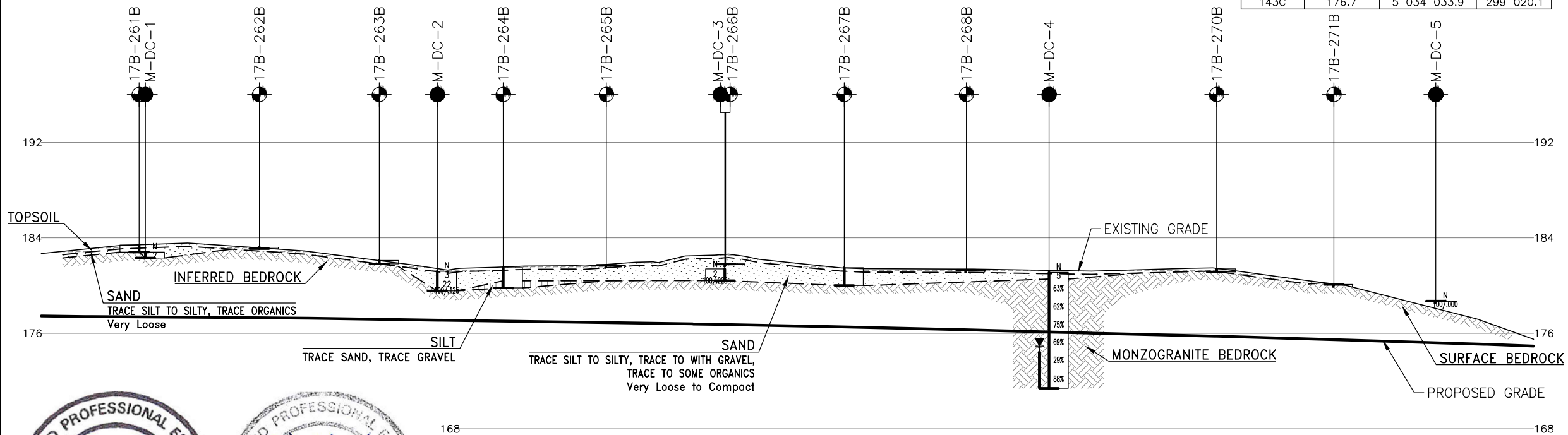
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Structural elements, surface details and features are for conceptual illustration.
- Coordinate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

GEORES No. 31F-231

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



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



PROFILE ALONG Q PROPOSED WBL



H 1:800
V 1:400

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

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

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

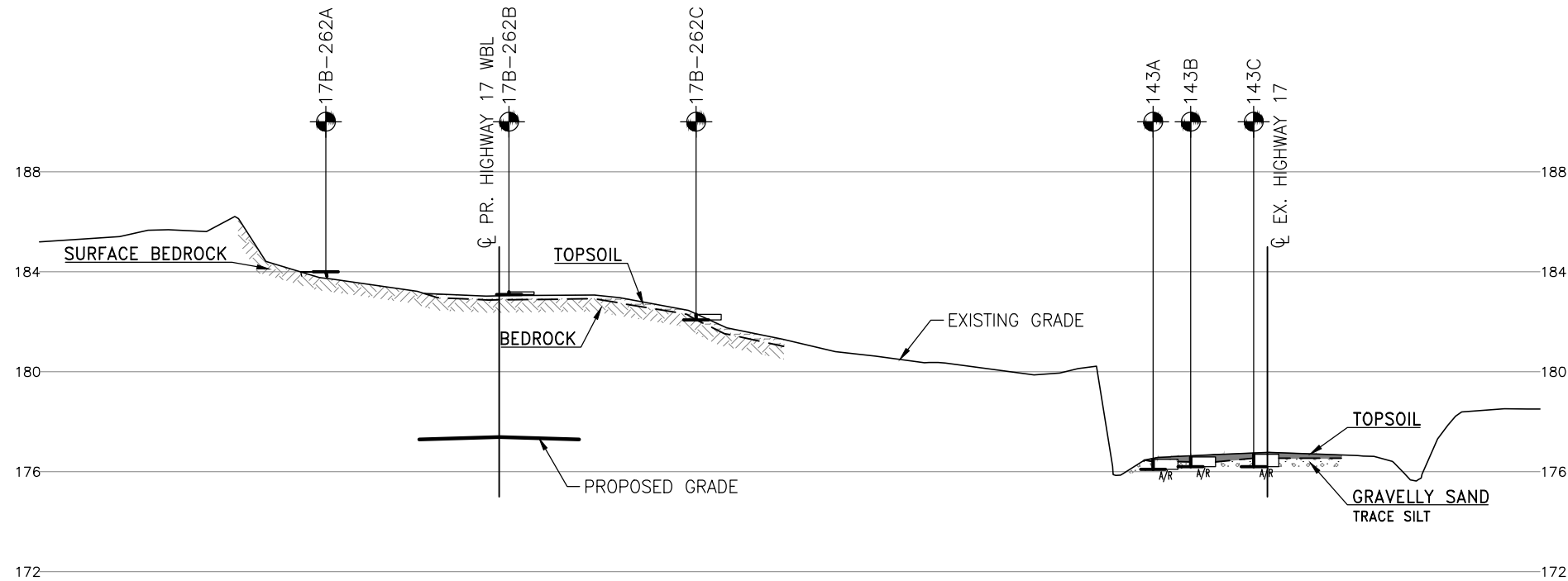
NO	ELEVATION	NORTHING	EASTING
M-DC-1	182.8	5 034 090.6	298 988.0
M-DC-2	181.2	5 034 094.1	299 036.8
M-DC-3	181.4	5 034 100.4	299 084.6
M-DC-4	181.1	5 034 099.2	299 139.2
M-DC-5	178.7	5 034 106.8	299 203.6
17B-261B	183.4	5 034 092.4	298 986.8
17B-262A	184.0	5 034 107.1	299 004.4
17B-262B	183.2	5 034 092.6	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

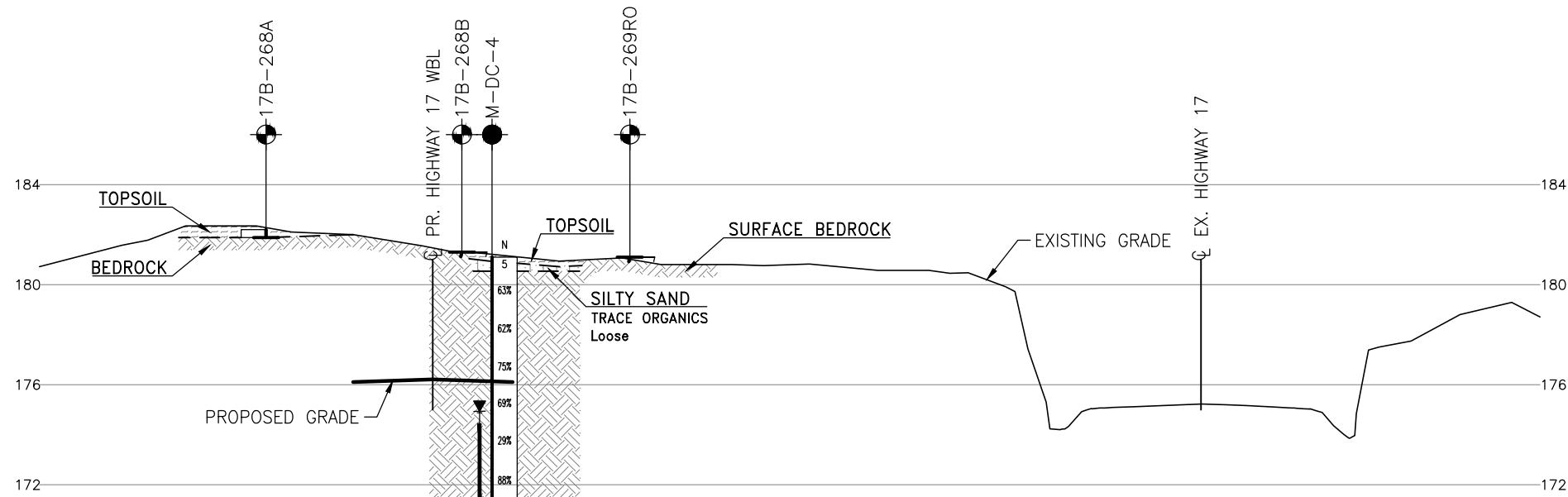
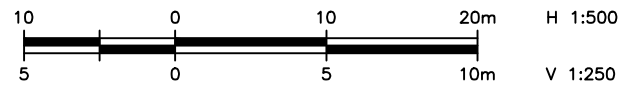
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Structural elements, surface details and features are for conceptual illustration.
- Coordinate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

GEOCRES No. 31F-231

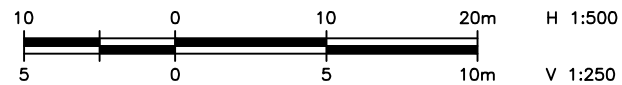
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK F6	CODE
DRAWN	MFA	CHK PKC	SITE
LOAD			
STRUCT			
DWG	8		
DATE	JUL 2022		



SECTION G-G (12+525)



SECTION H-H (12+647)



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

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

Ontario



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

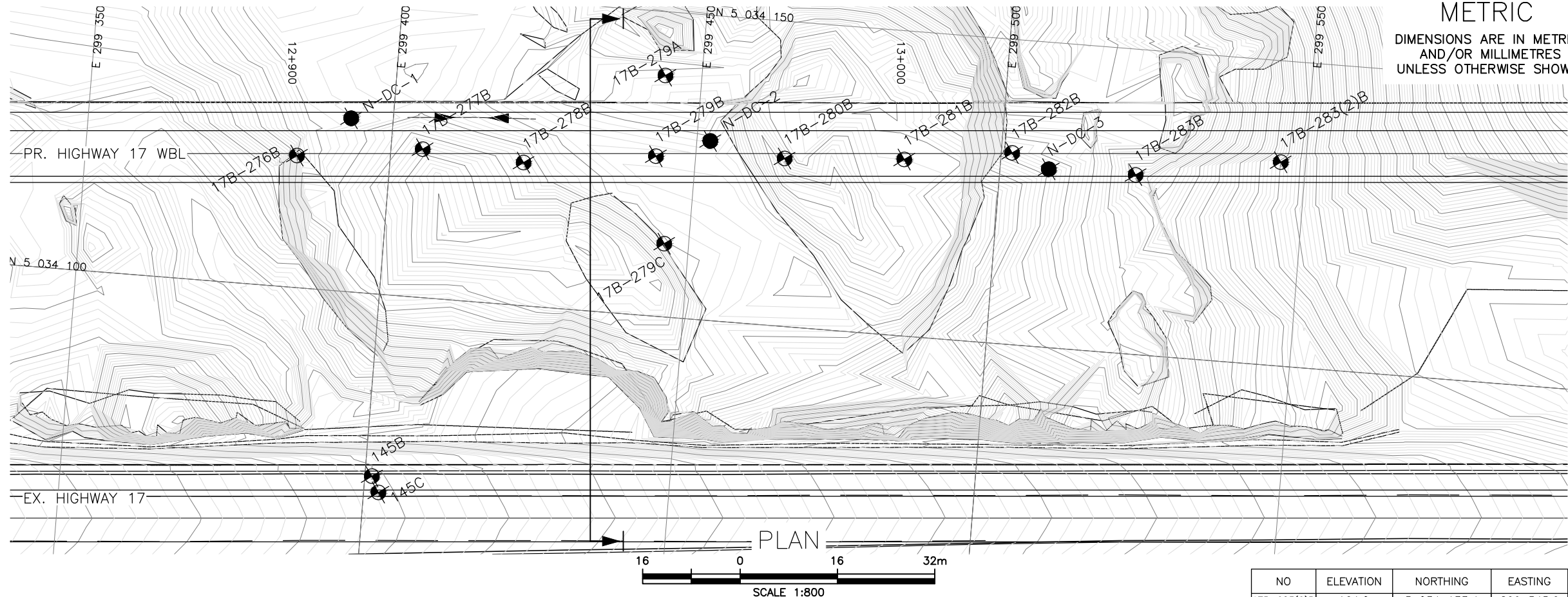
NO	ELEVATION	NORTHING	EASTING
M-DC-4	181.1	5 034 099.2	299 139.2
17B-262A	184.0	5 034 107.1	299 004.4
17B-262B	183.2	5 034 092.6	299 007.0
17B-262C	182.3	5 034 078.0	299 012.2
17B-268A	182.2	5 034 116.5	299 128.8
17B-268B	181.3	5 034 100.5	299 125.2
17B-269RO	181.1	5 034 087.4	299 129.8
143A	176.5	5 034 041.9	299 019.2
143B	176.6	5 034 038.9	299 019.3
143C	176.7	5 034 033.9	299 020.1

-NOTES-

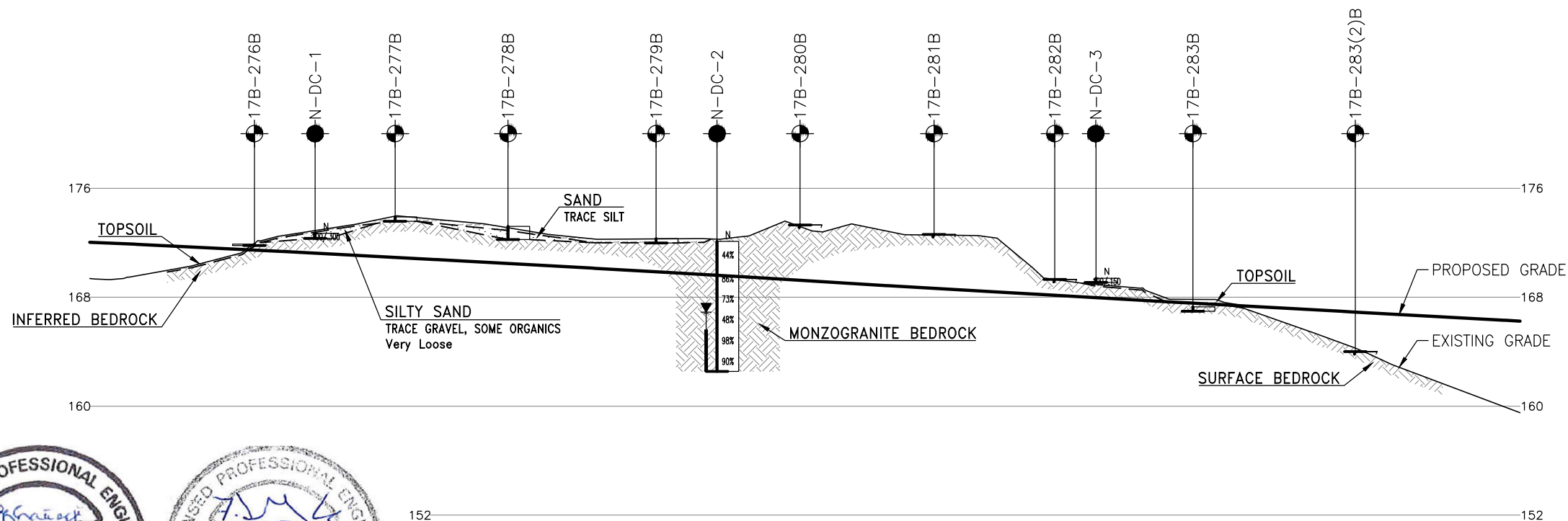
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Structural elements, surface details and features are for conceptual illustration.
- Coordinate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

GEORES No. 31F-231

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



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



PROFILE ALONG Q PROPOSED WBL



H 1:800
V 1:400

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

CONT No
WP No

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

Ontario



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
W	Water Level
HA	Head Artesian Water
P	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.

GEORES No. 31F-231

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK FG	CODE
DRAWN	MFA	CHK PKC	SITE
LOAD	DATE	JUL 2022	
STRUCT	DWG	10	

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
Ontario	



KEYPLAN

LEGEND

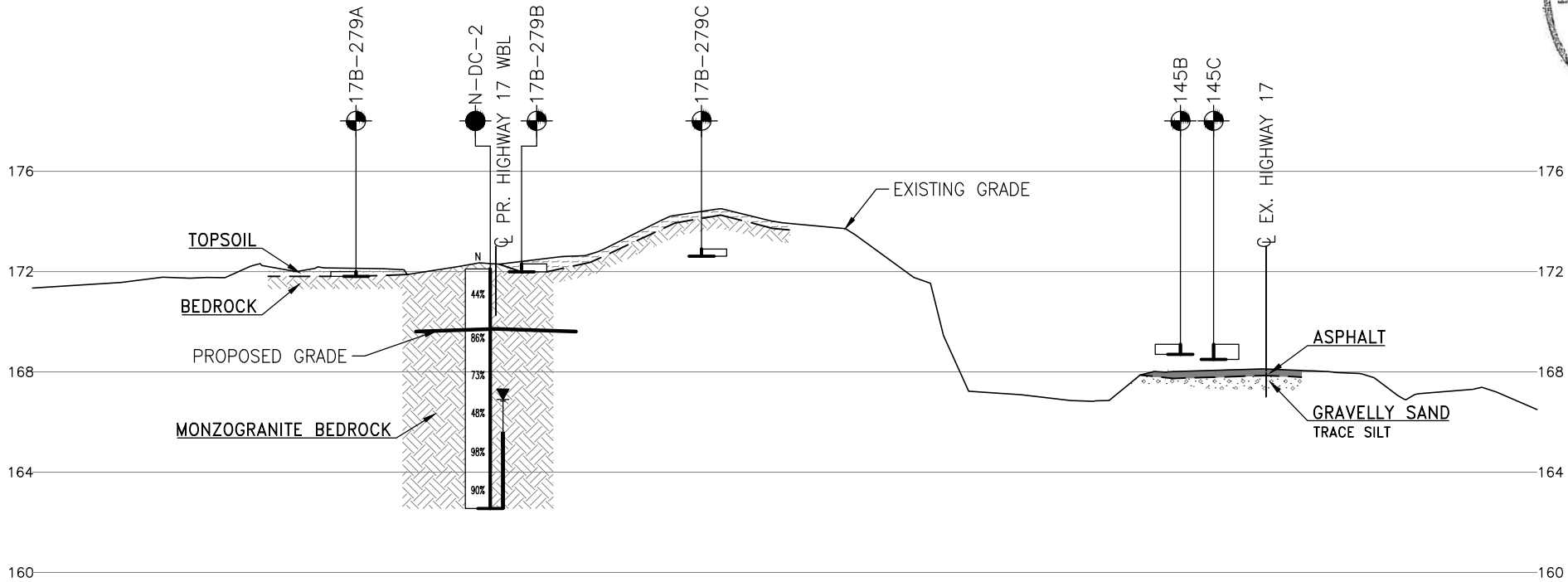
●	Foundation Borehole
○	Pavement Investigation Data Point
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
≡	Water Level
⌵	Head Artesian Water
⌵	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

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

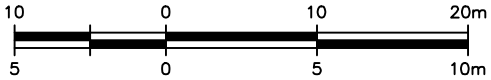
-NOTES-

- 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-231



SECTION I-I (12+949)

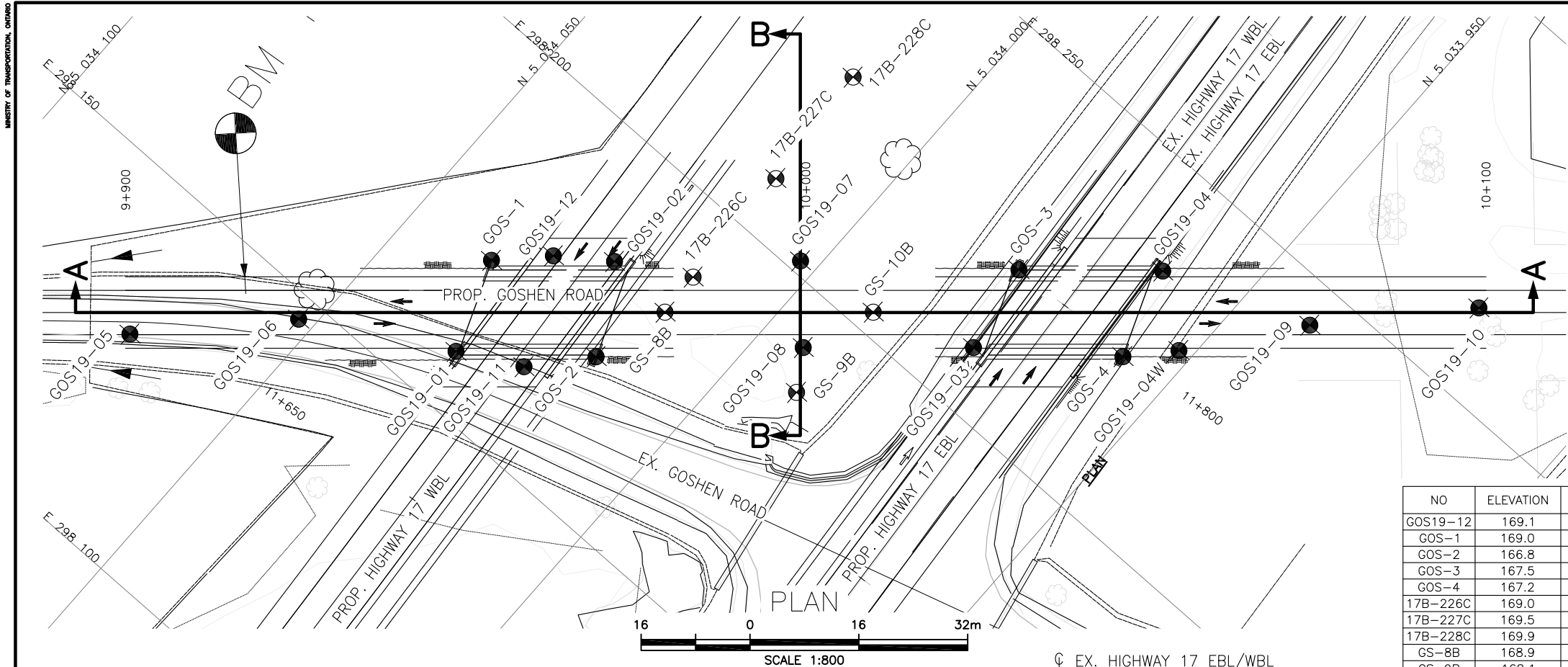


H 1:500

V 1:250

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

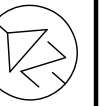
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK FG	CODE
DRAWN	MFA	CHK PKC	SITE
			LOAD
			DATE
			JUL 2022
			STRUCT
			DWG 11



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

CONT No
WP No 4068-09-00

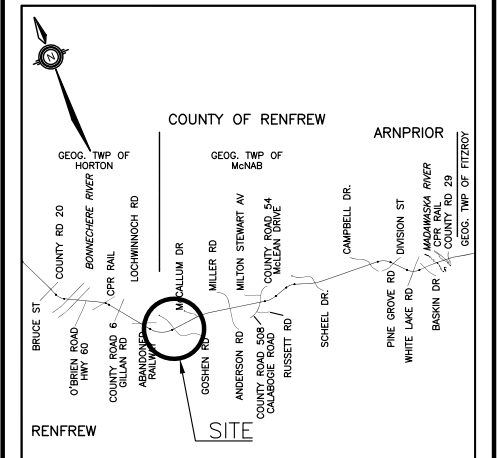
HIGHWAY 17 TWINNING
GOSHEN ROAD OVERPASS
DEEP CUT
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

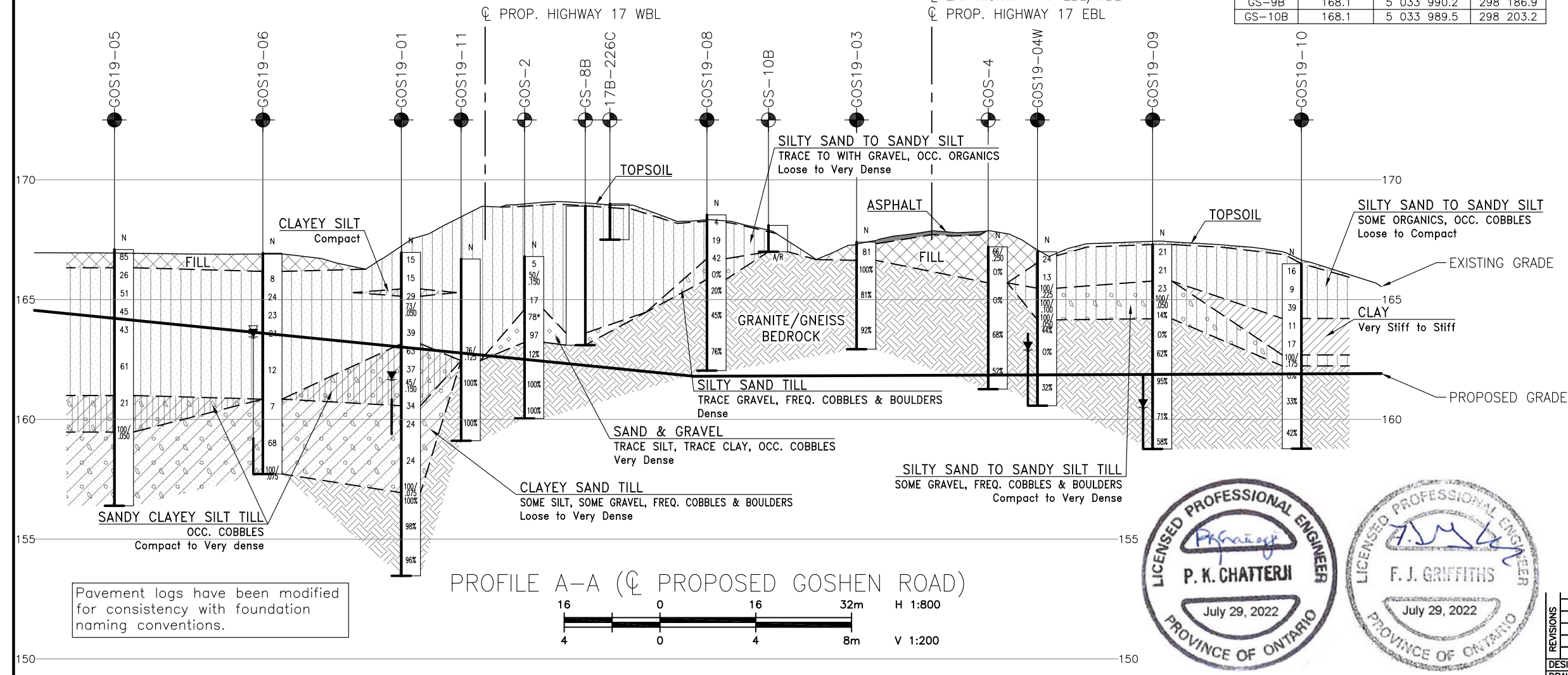
	Foundation Borehole
	Pavement Investigation Data Point
	Blows /0.3m (Std Pen Test, 475J/blow)
	Blows /0.3m (60' Cone, 475J/blow)
	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
	Rock Quality Designation (RQD)
	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
GOS19-01	166.9	5 034 031.8	298 158.4
GOS19-02	169.2	5 034 023.0	298 183.7
GOS19-03	167.4	5 033 975.0	298 209.0
GOS19-04	168.0	5 033 961.5	298 235.8
GOS19-04W	167.0	5 033 952.0	298 228.6
GOS19-05	167.1	5 034 069.5	298 128.7
GOS19-06	167.0	5 034 052.3	298 146.7
GOS19-07	169.2	5 034 002.5	298 201.8
GOS19-08	168.5	5 033 993.8	298 192.5
GOS19-09	167.3	5 033 940.0	298 244.1
GOS19-10	166.5	5 033 923.0	298 262.4
GOS19-11	166.8	5 034 022.8	298 163.3

-NOTES-

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

GEOCRES No. 31F-231

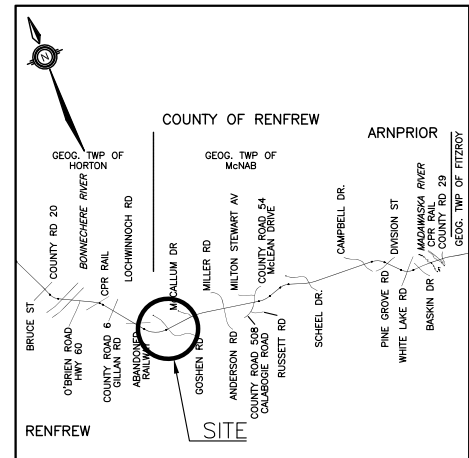


DATE	BY	DESCRIPTION
DESIGN	DJP	CHK -
DRAWN	MFA	CHK DJP
CODE	SITE 29-410	LOAD
DATE	JUL 2022	DATE
STRUCT	DWG 1	DATE

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

CONT No
WP No 4068-09-00
HIGHWAY 17 TWINNING
GOSHEN ROAD OVERPASS
DEEP CUT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

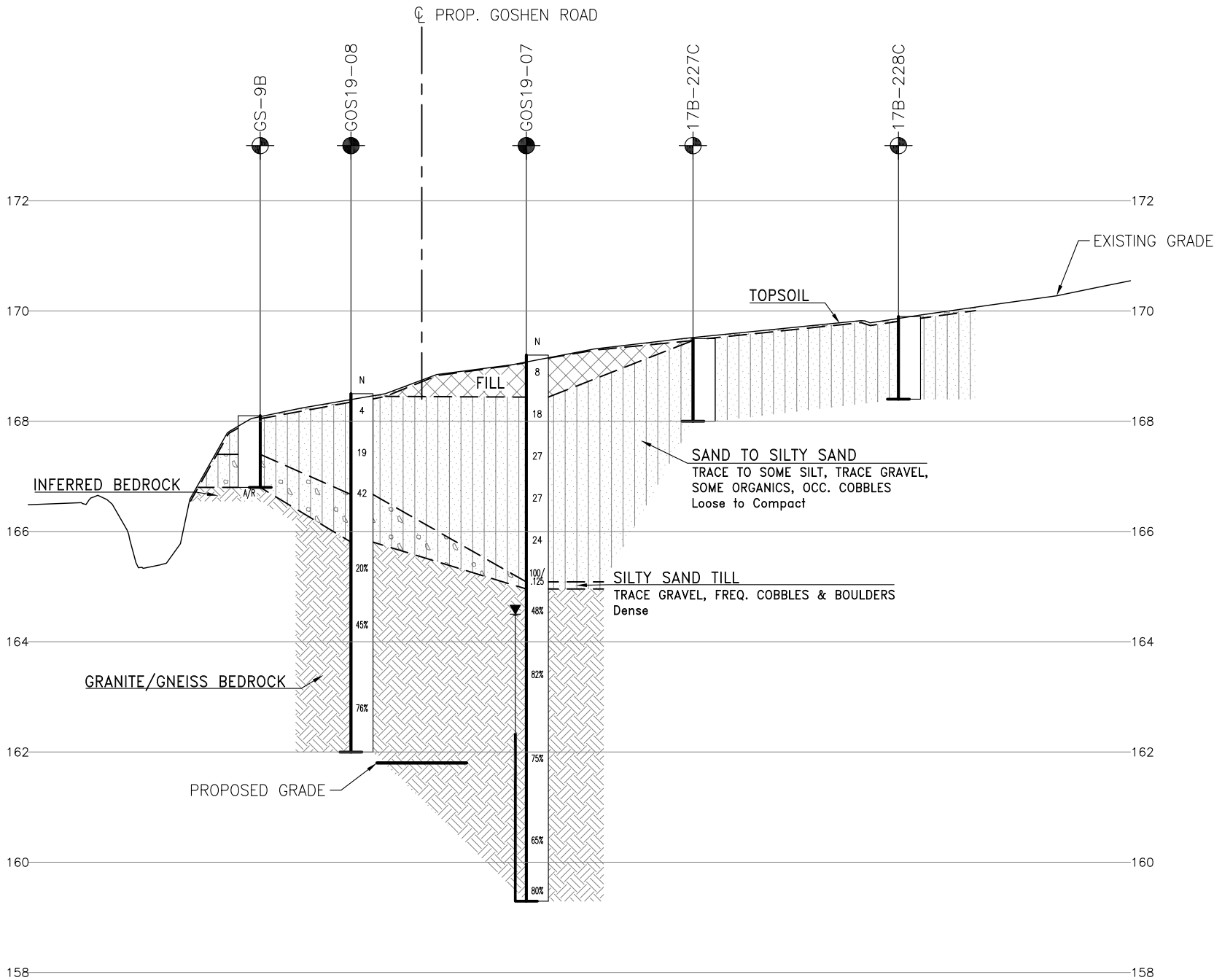
	Foundation Borehole
	Pavement Investigation Data Point
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
GOS19-07	169.2	5 034 002.5	298 201.8
GOS19-08	168.5	5 033 993.8	298 192.5
17B-227C	169.5	5 034 013.2	298 208.5
17B-228C	169.9	5 034 014.5	298 227.2
GS-9B	168.1	5 033 990.2	298 186.9

-NOTES-

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

GEOCRES No. 31F-231



SECTION B-B



H 1:400

V 1:100

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



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK	CODE
DRAWN	MFA	CHK	DJP
SITE	29-410	STRUCT	DWG 2



Appendix B.

Record of Borehole Sheets



SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

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

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

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

RECOVERY:

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

N-VALUE:

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

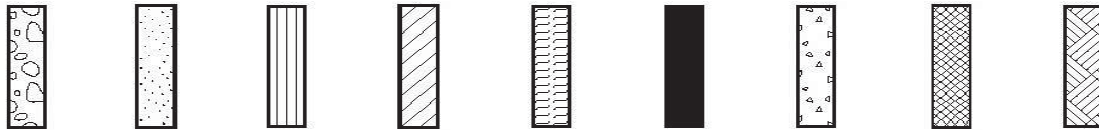
DYNAMIC CONE PENETRATION TEST (DCPT):

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



STRATA PLOT:

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



Boulders
Cobbles
Gravel Sand Silt Clay Organics Asphalt Concrete Fill Bedrock

TEXTURING CLASSIFICATION OF SOILS

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

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

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

SAMPLE TYPES

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

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

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

MODIFIED UNIFIED SOIL CLASSIFICATION

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

Note - W_L = Liquid Limit



EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

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

TERMS

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

DISCONTINUITY SPACING

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

STRENGTH CLASSIFICATION

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

RECORD OF BOREHOLE No 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 NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L	WATER CONTENT (%)				GR SA SI CL	
154.2	Ground Surface						154							0 77 23 (SI+CL)	
0.0	TOPSOIL (175 mm)														
0.2	SILTY SAND (SM), trace organics Loose Yellow-brown		1	SS	5										
153.4	CLAY (Cl), trace sand partings Very stiff Grey-brown (WEATHERED CRUST)														
			2	SS	12										
			3	SS	13										
			4	SS	10										

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

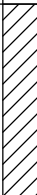
20
15
10
(%) STRAIN AT FAILURE

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 γ kN/m ³	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 _P W W _L							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
Continued From Previous Page																
142.9 11.3	CLAY (CI) Very stiff Grey						144									
			11	SS	7		143									
	End of Borehole Unstabilized water level at 9.1m below the ground surface upon completion of drilling.															

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) 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 NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
153.7	Ground Surface							20	40	60	80	100					
0.0	TOPSOIL (100mm)																
0.1	SILTY SAND (SM), trace organics Loose Yellow-brown		1	SS	4									○			
152.9																	
0.8	CLAY (CI), trace sand Stiff to very stiff Grey-brown (WEATHERED CRUST)		2	SS	10									○			
			3	SS	15									○			
			4	SS	13									○			
			5	SS	12									○			
			6	SS	12									○			
			7	SS	9									○			
147.6																	
6.1	CLAY (CI) Very stiff to stiff Grey		8	SS	5									○			
			9	SS	5									○			
			10	SS	4									○			

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
20
15
10
5
0 (%) 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	CLAY (Cl) Stiff Grey		11	SS	3		143									0 2 53 45	
							142										
			12	SS	3		141										
140.9 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 2021.11.01 6.0 147.7 2022.01.24 5.2 148.5 Borehole dry on completion of drilling.																

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 _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>									

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

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			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
159.1	Ground Surface							20 40 60 80 100							
0.0	TOPSOIL (280 mm)		1	SS	100/		159								
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	-		158								
							157								
			2	RUN	-										
							156								
			3	RUN	-		155								
							154								
							153								
							152								
			5	RUN	-										
							151								
							150								
			6	RUN	-										
													</		

Continued Next Page

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

RECORD OF DRILLHOLE B-DC-4

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 24
COMPLETED : 2020 November 24

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 039 379.9 E 291 551.8

Project No. 4068-09-00

SHEET 1 OF 6
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

WATER LEVEL UPON COMPLETION

2021 October 20

WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO

CHECKED :



RECORD OF DRILLHOLE B-DC-4

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 24
COMPLETED : 2020 November 24

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 039 379.9 E 291 551.8

Project No. 4068-09-00

SHEET 2 OF 6
DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test
5	Rotary Drill HQ Core	MARBLE BEDROCK Moderately weathered to freshly jointed White-grey Granoblastic texture Medium grained Massive structure Strong Metamorphic rock			3							J, RP			Bentonite
6	Rotary Drill HQ Core				4							J, RU J, RU J, RU J, RP			UCS 61.0 MPa
												J, RP			UCS 56.6 MPa
												J, RP J, RP			
												J, RP			

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
2021 October 20

▽ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
CHECKED :



RECORD OF DRILLHOLE B-DC-4

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 24
COMPLETED : 2020 November 24

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 039 379.9 E 291 551.8

Project No. 4068-09-00

SHEET 3 OF 6
DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test ▲ Diametral Point Load Test ■ Laboratory UCS Test
8	Rotary Drill HQ Core	MARBLE BEDROCK Moderately weathered to freshly jointed White-grey Granoblastic texture Medium grained Massive structure Strong Metamorphic rock			5										Bentonite
9	Rotary Drill HQ Core				6										UCS 77.2 MPa
															UCS 78.0 MPa

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION

2021 October 20



WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO

CHECKED :



RECORD OF DRILLHOLE B-DC-4

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 24
COMPLETED : 2020 November 24

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 039 379.9 E 291 551.8

Project No. 4068-09-00

SHEET 4 OF 6
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
2021 October 20

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
CHECKED :



RECORD OF DRILLHOLE B-DC-4

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 24
COMPLETED : 2020 November 24

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 039 379.9 E 291 551.8

Project No. 4068-09-00

SHEET 5 OF 6
DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test
14	Rotary Drill HQ Core	MARBLE BEDROCK Moderately weathered to freshly jointed White-grey Granoblastic texture Medium grained Massive structure Strong Metamorphic rock			9							J, RP			Bentonite
												J, RP J, RP			Sand
												J, RU			
												J, RP J, RP J, RU			UCS 72.2 MPa
												J, RP			
15	Rotary Drill HQ Core				10							J, RP J, RU			50mm Dia PVC 3m Slot Screen
												J, RU			
												J, RP			
												J, RU J, RU			UCS 77.4 MPa
												J, RU			

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION

2021 October 20



WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO

CHECKED :



RECORD OF DRILLHOLE B-DC-4

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 24
 COMPLETED : 2020 November 24

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 039 379.9 E 291 551.8

Project No. 4068-09-00

SHEET 6 OF 6
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	FR-FRACTURE	RU-ROUGH UNDULATING	T-TIGHT, HARD	HOR-HORIZONTAL	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test										
				DEPTH (m)					B-BEDDING	CL-CLEAVAGE	J-JOINT	SU-SMOOTH UNDULATING			SA-SLIGHTLY ALTERED, CLAY FREE	D-DIPPING	V-VERTICAL							
																		RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec
																		TOTAL CORE %	SOLID CORE %			DIP wrt Core Axis	TYPE AND SURFACE DESCRIPTION	
17	Rotary Drill HQ Core	MARBLE BEDROCK Moderately weathered to freshly jointed White-grey Granoblastic texture Medium grained Massive structure Strong Metamorphic rock			11																			
		End of Borehole		141.93 17.17																				
18																								

GROUNDWATER ELEVATIONS

∇ WATER LEVEL UPON COMPLETION
 2021 October 20

∇ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
 CHECKED :



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				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED		+ FIELD VANE						
								● QUICK TRIAXIAL		× LAB VANE						
							WATER CONTENT (%)									
							20 40 60 80 100				20 40 60					
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT									
							W P W W L									
	Continued From Previous Page															
141.9 17.2	MARBLE BEDROCK Moderately weathered to freshly jointed White-grey Granoblastic texture Medium grained Massive structure Strong Metamorphic rock		7	RUN	-		149						1	RUN #7 TCR=100% SCR=97% RQD=95% UCS=77.9MPa		
															0	
															0	
															1	
			8	RUN	-		148								4	RUN #8 TCR=100% SCR=100% RQD=100% UCS=97.6MPa
														2		
														0		
														1		
			9	RUN	-		147								0	RUN #9 TCR=98% SCR=97% RQD=90% UCS=72.2MPa
														1		
											0					
											1					
10	RUN	-		146								3	RUN #10 TCR=100% SCR=81% RQD=87% UCS=77.4MPa			
											2					
											1					
											0					
11	RUN	-		145								2	RUN #11 TCR=100% SCR=92% RQD=77% UCS=29.6MPa			
											>10					
											2					
											1					
							144						4			
							143						1			
							142						3			
	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 9.3 149.8															
	2021.08.04 10.9 148.2															
	2021.09.30 12.0 147.1															
	2021.10.20 11.8 147.3															
	2021.12.20 8.4 150.7															
	2022.01.24 11.3 147.8															

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

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					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
150.6	Ground Surface							20	40	60	80	100					
0.0	TOPSOIL (200mm)																
0.2	SILTY SAND (SM) Trace to some organics Compact Dark brown to yellow-brown		1	SS	9												1 69 22 8
			2	SS	17												
149.1																	
1.5	SILTY SAND (SM) Compact Light brown -Augers griding while advancing past 5.2m depth		3	SS	18												4 76 20 (SI+CL)
			4	SS	16												
			5	SS	31												
			6	SS	37												
			7	SS	23												
144.6			8	SS	100/												
6.0	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				100mm												


DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

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 _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)	
181.5	Ground Surface							20	40	60	80	100							
0.0	TOPSOIL (225 mm)							20	40	60	80	100							
0.2	SILTY SAND (SM), trace roots Compact to very dense Grey TILL		1	SS	6		181												
			2	SS	12														
			3	SS	50														
			4	SS	103														
			5	SS	102		177												
							176												
			6	SS	111		175												
174.0			7	SS	100/		174												
7.5	End of Borehole Spoon and auger refusal on inferred bedrock. Borehole dry on completion of drilling.				75mm														

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) 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 _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
181.7	Ground Surface							20	40	60	80	100					
0.0	TOPSOIL (280 mm)																
181.4																	
0.3	SILTY SAND (SM), trace roots Compact to very dense Grey TILL		1	SS	5												
			2	SS	27												
			3	SS	26												
			4	SS	22												
			5	SS	48												
			6	SS	66												
			7	SS	42												
			8	SS	100/												
					100mm												
											</						

Continued Next Page

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

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																										
	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> <tr> <td>2021.10.03</td> <td>8.4</td> <td>173.3</td> </tr> <tr> <td>2022.01.20</td> <td>6.3</td> <td>175.4</td> </tr> <tr> <td>2022.01.26</td> <td>6.6</td> <td>175.1</td> </tr> </tbody> </table>	Date	Depth (m)	Elev. (m)	2020.12.15	7.4	174.3	2021.09.24	7.9	173.8	2021.10.03	8.4	173.3	2022.01.20	6.3	175.4	2022.01.26	6.6	175.1															
Date	Depth (m)	Elev. (m)																																
2020.12.15	7.4	174.3																																
2021.09.24	7.9	173.8																																
2021.10.03	8.4	173.3																																
2022.01.20	6.3	175.4																																
2022.01.26	6.6	175.1																																

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
189.4	Ground Surface							20	40	60	80	100	W _P	W	W _L						
0.0	MONZOGRANITE BEDROCK Freshly jointed to moderately weathered Red-ish to pink grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong							20	40	60	80	100									
			1	RUN	-		189														
							188														
			2	RUN	-		187														
							186														
			3	RUN	-		185														
							184														
			4	RUN	-		183														
							182														
			5	RUN	-		181														
							180														
			6	RUN	-																
			7	RUN	-																

Continued Next Page

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

METRIC

SOIL PROFILE								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE			
			NUMBER	TYPE	"N" VALUES			
Continued From Previous Page								
	MONZOGRANITE BEDROCK Freshly jointed to moderately weathered Red-ish to pink grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong		8	RUN	-			
			9	RUN	-			
						10	RUN	-
174.0								
15.4	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	14.0	175.4						
2021.09.24	14.5	174.9						
2021.10.02	14.8	174.6						
2022.01.20	14.5	174.9						
2022.01.26	14.5	174.9						

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

+³, ×³: Numbers refer to Sensitivity

RECORD OF DRILLHOLE L-DC-2

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 5
 COMPLETED : 2020 November 9

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 067.0 E 298 713.6

Project No. 4068-09-00

SHEET 1 OF 6
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength MPa	FIELD/LABORATORY TESTING RESULTS ● Point Load Test ▲ Diametral Point Load Test ■ Laboratory UCS Test
		GROUND SURFACE		189.40											
		MONZOGRAHITE BEDROCK Freshly jointed to moderately weathered Red-ish to pink grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong		0.00											Bentonite
1	Rotary Drill HQ Core				1							J, RP J, RU J, RU J, RU J, RU J, RU J, RP J, RP J, RU		UCS 133.5 MPa	
2	Rotary Drill HQ Core				2							J, RU J, RU J, RU J, RU Broken Rock J, RU J, RU J, RU		UCS 114.4 MPa	

GROUNDWATER ELEVATIONS

∇ WATER LEVEL UPON COMPLETION
 2021 September 24

∇ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
 CHECKED :



RECORD OF DRILLHOLE L-DC-2

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 5
 COMPLETED : 2020 November 9

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 067.0 E 298 713.6

Project No. 4068-09-00

SHEET 2 OF 6
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength MPa	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test
4	Rotary Drill HQ Core	MONZOGRAHITE BEDROCK Freshly jointed to moderately weathered Red-ish to pink grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong			3										Bentonite
5	Rotary Drill HQ Core				4										UCS 154.8 MPa

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
 2021 September 24

▽ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
 CHECKED :



RECORD OF DRILLHOLE L-DC-2

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 5
 COMPLETED : 2020 November 9

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 067.0 E 298 713.6

Project No. 4068-09-00

SHEET 3 OF 6
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test
7	Rotary Drill HQ Core	MONZOGRANITE BEDROCK Freshly jointed to moderately weathered Red-ish to pink grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong			5							J, RU			UCS 106.0 MPa
8	Rotary Drill HQ Core				6							J, RU J, RU J, RU J, RU J, RU			UCS 226.1 MPa
												J, RU J, RU			UCS 99.7 MPa

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION



WATER LEVEL IN WELL/PIEZOMETER

2021 September 24

LOGGED : AO

CHECKED :



RECORD OF DRILLHOLE L-DC-2

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 5
COMPLETED : 2020 November 9

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 067.0 E 298 713.6

Project No. 4068-09-00

SHEET 4 OF 6
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
2021 September 24

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO

CHECKED :



ROCKM2 24726 DEEP CUT - ROCK.GPJ 22-7-26

RECORD OF DRILLHOLE L-DC-2

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 5
COMPLETED : 2020 November 9

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 067.0 E 298 713.6

Project No. 4068-09-00

SHEET 5 OF 6
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
2021 September 24

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
CHECKED :



ROCKM2 24726 DEEP CUT - ROCK.GPJ 22-7-26


RECORD OF DRILLHOLE L-DC-2

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 5
 COMPLETED : 2020 November 9

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 067.0 E 298 713.6

Project No. 4068-09-00

SHEET 6 OF 6
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR % RETURN	FR-FRACTURE RU-ROUGH UNDULATING T-TIGHT, HARD CL-CLEAVAGE RP-ROUGH PLANAR SA-SLIGHTLY ALTERED, D-DIPPING J-JOINT SU-SMOOTH UNDULATING CLAY FREE D-DIPPING B-BEDDING SP-SMOOTH PLANAR SC-SWELLING, SOFT CLAY V-VERTICAL										Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
				DEPTH (m)					RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
									TOTAL CORE %	SOLID CORE %			DIP wrt Core Axis	TYPE AND SURFACE DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
																-6 10	-5 10	-4 10			-3 10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
		MONZOGRANITE BEDROCK Freshly jointed to moderately weathered Red-ish to pink grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong		174.01 15.39																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								

GROUNDWATER ELEVATIONS

∇ WATER LEVEL UPON COMPLETION
 2021 September 24

∇ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
 CHECKED :



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 w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)				
								20	40	60	80	100						20	40	60		
190.1	Ground Surface																					
0.0	TOPSOIL (30 mm)						190															
	SAND (SW-SM) with silt Trace gravel Loose Dark brown to grey-brown		1	SS	5												9 86 5 (SI+CL)					
189.1																						
1.0	End of Borehole Auger and spoon refusal on inferred bedrock. Offset 1m and observed refusal at 75mm depth.				225mm																	

+³, ×³: 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					UNIT WEIGHT γ kN/m ³	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							PLASTIC LIMIT W _P NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L			
182.3	Ground Surface							20	40	60	80	100						
0.0	TOPSOIL (170 mm)							20	40	60	80	100						
0.2	SAND (SP-SM) with silt Trace gravel, organics, rootlets Loose to dense Grey-brown		1	SS	5		182											
			2	SS	8			181										
			3	SS	39													
180.2																		
2.1	SAND (SP-SM) with silt and gravel Trace organics, rootlets Very dense Grey TILL - Gravelly below 3.6m depth.		4	SS	100/ 275mm		180											
			5	SS	100/ 300mm			179										
			6	SS	88													
177.8																		
4.5	End of Borehole Spoon and auger refusal on inferred bedrock. Borehole dry on completion of drilling.																	

+³, ×³: Numbers refer to
Sensitivity

20
15
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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
182.8	Ground Surface							20	40	60	80	100					
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.																

+³, ×³: Numbers refer to
Sensitivity

20
15
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 _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
181.2	Ground Surface							20	40	60	80	100					
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		181										
		2	SS	22		180											
179.5	- Gravelly below 1.5m depth.																
1.7	End of Borehole Spoon refusal on inferred bedrock. Borehole dry on completion of drilling.		3	SS	100/ 125mm												


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

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 W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
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		181								o			
180.4			2	SS	100/									o			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 22-7-25

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 NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa			WATER CONTENT (%)			
181.1	Ground Surface						20 40 60 80 100							
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													
	MONZOGRAHITE BEDROCK													
	Moderately weathered to highly weathered													
	Red-ish to pink-grey		1	RUN										RUN #1
	Phaneritic (Coarse grained) texture													TCR=97%
	Massive structure													SCR=70%
	Igneous formation													RQD=63%
	Strong to very strong													UCS=144MPa
	- Rust colouration at diagonal fractures		2	RUN										
			3	RUN										RUN #2
														TCR=100%
														SCR=73%
														RQD=62%
														UCS=50.5MPa
			4	RUN										RUN #3
														TCR=95%
														SCR=82%
														RQD=75%
														UCS=169.4MPa
			5	RUN										RUN #4
														TCR=100%
														SCR=81%
														RQD=69%
														UCS=92.2MPa

Continued Next Page

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

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	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:																
	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																
	2022.01.20 5.0 176.1																

RECORD OF DRILLHOLE M-DC-4

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 10
 COMPLETED : 2020 November 10

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 099.2 E 299 139.2

Project No. 4068-09-00

SHEET 1 OF 4
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	SYMBOLIC LOG		PENETRATION RATE (mm/min)	FLUSH % RETURN	FR-FRACTURE		RU-ROUGH UNDULATING		T-TIGHT, HARD		HOR-HORIZONTAL		Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test								
					ELEV. DEPTH (m)	RUN No.			RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec											
									TOTAL CORE %	SOLID CORE %			DIP wrt Core Axis	TYPE AND SURFACE DESCRIPTION												
				180.54 0.56																						
1	Rotary Drill HQ Core	MONZOGRAHITE BEDROCK Moderately weathered to highly weathered Red-ish to pink-grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong		1								J, RU J, RU J, RU Broken Rock, Rootlets J, RU J, RU J, RP J, RU J, RP J, RP J, RU J, RU J, RU J, RU J, RU J, RU J, RU J, RU J, RU J, RU J, RU J, RU	UCS 144.0 MPa													
	2														Rotary Drill HQ Core	2								UCS 50.5 MPa		
3	Rotary Drill HQ Core	2								UCS 50.5 MPa																

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
 2021 October 1

▽ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
 CHECKED :



RECORD OF DRILLHOLE M-DC-4

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 10
COMPLETED : 2020 November 10

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 099.2 E 299 139.2

Project No. 4068-09-00

SHEET 2 OF 4
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
2021 October 1

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO

CHECKED :



ROCKM2 24726 DEEP CUT - ROCK.GPJ 22-7-26

RECORD OF DRILLHOLE M-DC-4

PROJECT	:	Highway 17 Twinning
LOCATION	:	Deep Cuts
STARTED	:	2020 November 10
COMPLETED	:	2020 November 10

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 099.2 E 299 139.2

Project No. 4068-09-00

SHEET 3 OF 4
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
2021 October 1

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO

CHECKED :



RECORD OF DRILLHOLE M-DC-4

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 10
 COMPLETED : 2020 November 10

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 099.2 E 299 139.2

Project No. 4068-09-00

SHEET 4 OF 4
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR % RETURN	FR-FRACTURE RU-ROUGH UNDULATING T-TIGHT, HARD CL-CLEAVAGE RP-ROUGH PLANAR SA-SLIGHTLY ALTERED, D-DIPPING J-JOINT SU-SMOOTH UNDULATING CLAY FREE D-DIPPING B-BEDDING SP-SMOOTH PLANAR SC-SWELLING, SOFT CLAY V-VERTICAL										HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
				DEPTH					RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		DIP wrt Core Axis	TYPE AND SURFACE DESCRIPTION	6 10	5 10				4 10	3 10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
				(m)					TOTAL CORE %	SOLID CORE %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION
 2021 October 1



WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO

CHECKED :



METRIC

[illegible]


+³, ×³: Numbers refer to Sensitivity

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 W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
172.7	Ground Surface		1	SS	100/ 300mm			20 40 60 80 100					20	40	60	kN/m ³	GR SA SI CL
0.0	TOPSOIL (50 mm)																
172.3	SILTY SAND (SM), trace gravel																
0.4	Some organics Very loose Dark brown End of Borehole Spoon and auger refusal on inferred bedrock.																

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

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			UNIT WEIGHT γ kN/m ³	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	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		GR SA SI CL
0.0	MONZOGRAHITE BEDROCK 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	-		172	20 40 60 80 100				FI 3	RUN #1 TCR=100% SCR=56% RQD=44% UCS=91.5MPa
			2	RUN	-		171	20 40 60 80 100				4	
			3	RUN	-		170	20 40 60 80 100				3	
			4	RUN	-		169	20 40 60 80 100				1	RUN #2 TCR=100% SCR=92% RQD=86% UCS=170.1MPa
			5	RUN	-		168	20 40 60 80 100				0	
			6	RUN	-		167	20 40 60 80 100				4	RUN #3 TCR=98% SCR=86% RQD=73% UCS=101MPa
			7	RUN	-		166	20 40 60 80 100				3	
			8	RUN	-		165	20 40 60 80 100				0	
			9	RUN	-		164	20 40 60 80 100				1	RUN #4 TCR=98% SCR=60% RQD=48% UCS=104.2MPa
			10	RUN	-		163	20 40 60 80 100				5	
			11	RUN	-		162	20 40 60 80 100				1	
			12	RUN	-		161	20 40 60 80 100				2	RUN #5 TCR=100% SCR=95% RQD=98% UCS=92.2MPa
			13	RUN	-		160	20 40 60 80 100				0	
			14	RUN	-		159	20 40 60 80 100				1	
			15	RUN	-		158	20 40 60 80 100				3	
			16	RUN	-		157	20 40 60 80 100				0	
			17	RUN	-		156	20 40 60 80 100				1	RUN #6 TCR=98% SCR=95% RQD=90% UCS=133.2MPa
			18	RUN	-		155	20 40 60 80 100				2	
			19	RUN	-		154	20 40 60 80 100				1	
			20	RUN	-		153	20 40 60 80 100				0	
162.5	End of Borehole												
9.6													

Continued Next Page

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

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

RECORD OF BOREHOLE No N-DC-2

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.447075°, Long: -76.568366° 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 _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)																	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100																						
	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>4.3</td> <td>167.8</td> </tr> <tr> <td>2021.09.23</td> <td>5.5</td> <td>166.6</td> </tr> <tr> <td>2021.10.01</td> <td>5.2</td> <td>166.9</td> </tr> <tr> <td>2021.10.21</td> <td>5.1</td> <td>167.0</td> </tr> <tr> <td>2022.01.24</td> <td>5.0</td> <td>167.1</td> </tr> </tbody> </table>	Date	Depth (m)	Elev. (m)	2020.12.15	4.3	167.8	2021.09.23	5.5	166.6	2021.10.01	5.2	166.9	2021.10.21	5.1	167.0	2022.01.24	5.0	167.1															
Date	Depth (m)	Elev. (m)																																
2020.12.15	4.3	167.8																																
2021.09.23	5.5	166.6																																
2021.10.01	5.2	166.9																																
2021.10.21	5.1	167.0																																
2022.01.24	5.0	167.1																																

DOUBLE LINE 24726 DEEP CUTS.GPJ 2012TEMPLATE(MTO).GDT 22-7-25

RECORD OF DRILLHOLE N-DC-2

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 13
 COMPLETED : 2020 November 16

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 129.4 E 299 452.2

Project No. 4068-09-00

SHEET 1 OF 4
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (mm/min)	COLOUR % RETURN	FLUSH % RETURN	FR-FRACTURE		RU-ROUGH UNDULATING		T-TIGHT, HARD		HOR-HORIZONTAL		Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS	
					DEPTH (m)					RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec				
										TOTAL CORE %	SOLID CORE %			DIP wrt Core Axis	TYPE AND SURFACE DESCRIPTION					
																	SC-SWELLING, SOFT CLAY			
			GROUND SURFACE		172.10															
			MONZOGRAHITE BEDROCK 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		0.00															
1	Rotary Drill HQ Core					1														Bentonite
																				UCS 91.5 MPa

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION



WATER LEVEL IN WELL/PIEZOMETER

2021 October 1

LOGGED : AO

CHECKED :



RECORD OF DRILLHOLE N-DC-2

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 13
COMPLETED : 2020 November 16

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 129.4 E 299 452.2

Project No. 4068-09-00

SHEET 2 OF 4
DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test
4	Rotary Drill HQ Core	MONZOGRAHITE BEDROCK 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			3							J, RU			Bentonite ■ UCS 170.1 MPa
5	Rotary Drill HQ Core				4							J, RU			■ UCS 101.0 MPa
	Rotary Drill HQ Core											J, RU J, RU J, RU J, RU J, RU J, RU J, RU J, RU			Sand

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
2021 October 1

▽ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
CHECKED :



RECORD OF DRILLHOLE N-DC-2

PROJECT : Highway 17 Twinning
LOCATION : Deep Cuts
STARTED : 2020 November 13
COMPLETED : 2020 November 16

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 129.4 E 299 452.2

Project No. 4068-09-00

SHEET 3 OF 4
DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	ELEV.		RUN No.	PENETRATION RATE (mm/min)	COLOUR % RETURN	FLUSH	FR-FRACTURE CL-CLEAVAGE J-JOINT B-BEDDING				RU-ROUGH UNDULATING RP-ROUGH PLANAR SU-SMOOTH UNDULATING SP-SMOOTH PLANAR				T-TIGHT, HARD SA-SLIGHTLY ALTERED, CLAY FREE SC-SWELLING, SOFT CLAY				HOR-HORIZONTAL D-DIPPING V-VERTICAL				Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
					DEPTH (m)	RECOVERY					R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA	HYDRAULIC CONDUCTIVITY k, cm/sec																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
																TOTAL CORE %	SOLID CORE %	TYPE AND SURFACE DESCRIPTION	-6 -5 -4 -3 10 10 10 10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					</

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION



WATER LEVEL IN WELL/PIEZOMETER

2021 October 1

LOGGED : AO

CHECKED :



RECORD OF DRILLHOLE N-DC-2

PROJECT : Highway 17 Twinning
 LOCATION : Deep Cuts
 STARTED : 2020 November 13
 COMPLETED : 2020 November 16

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 129.4 E 299 452.2

Project No. 4068-09-00

SHEET 4 OF 4
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR % RETURN	FR-FRACTURE										RU-ROUGH UNDULATING										T-TIGHT, HARD										HOR-HORIZONTAL										Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS
				DEPTH (m)					B-BEDDING				J-JOINT				CL-CLEAVAGE				SU-SMOOTH UNDULATING				SP-SMOOTH PLANAR				SA-SLIGHTLY ALTERED, CLAY FREE				D-DIPPING				V-VERTICAL				SC-SWELLING, SOFT CLAY									
									RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY k, cm/sec																																	
									TOTAL CORE %	SOLID CORE %			TYPE AND SURFACE DESCRIPTION																																					
									80 80																																									

Sand
 UCS
 133.2 MPa

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION
 2021 October 1



WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AO
 CHECKED :



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 _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
169.4	Ground Surface		1	SS	100/ 150mm			20 40 60 80 100					20 40 60					GR SA SI CL	
0.0	TOPSOIL (50mm)							○ UNCONFINED + FIELD VANE					○						0 92 8 (SI+CL)
169.1	SAND (SP-SM) with silt							● QUICK TRIAXIAL × LAB VANE											
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 22-7-25

RECORD OF BOREHOLE No GOS19-01

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446186°, Long: -76.584904°
Goshen Road MTM Zone 9: N 5 034 031.8 E 298 158.4 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY MW
DATUM Geodetic DATE 2019.09.03 - 2019.09.03 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
166.9	Ground Surface							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								</

Continued Next Page

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

RECORD OF BOREHOLE No GOS19-01

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446186°, Long: -76.584904°
Goshen Road MTM Zone 9: N 5 034 031.8 E 298 158.4 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY MW
DATUM Geodetic DATE 2019.09.03 - 2019.09.03 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											WATER CONTENT (%)			
								20 40 60 80 100											20 40 60			
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE															
Continued From Previous Page																						
10.0	GRANITE/GNEISS BEDROCK Fresh jointed, grey and pink, very strong, coarse grained, some foliation		12	SS	100/75mm		156										0	RUN #1 TCR=100% SCR=100% RQD=100%				
			1	RUN												0						
			2	RUN												0						
			155	154																		
153.4			3	RUN												1	RUN #2 TCR=100% SCR=90% RQD=98%					
13.5	End of Borehole Monitoring well consists of 46 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2020.04.21 0.6 166.3 2020.09.29 5.3 161.6 2021.10.18 3.7 163.2 2021.10.21 3.7 163.2															2						
																		0				
																		1				
																	0	RUN #3 TCR=100% SCR=96% RQD=96% UCS=108MPa				
																	0					
																	3					

RECORD OF BOREHOLE No GOS19-02

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446106°, Long: -76.584581°
Goshen Road MTM Zone 9: N 5 034 023.0 E 298 183.7 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.07 - 2020.07.07 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
169.2	Ground Surface							20 40 60 80 100					
0.0	TOPSOIL (50 mm)							20 40 60 80 100					
	SAND (SP-SM) with silt Loose to compact Brown to grey-brown		1	SS	8		169						
			2	SS	27		168						10 81 9 (SI+CL)
			3	SS	30		167						
166.9	CLAYEY SILT Compact Grey-brown		4	SS	12		166						
			5	SS	16		165						
165.3	SANDY SILT (ML) Compact to dense Grey-brown		6	SS	15		164						0 32 56 12 non-plastic
			7	SS	33		163						2 43 48 7 non-plastic
			8	SS	41		162						
			9	SS	32		161						
161.9	SILTY SAND (SM) some gravel Dense to very dense Grey-brown to grey (TILL)		10	SS	16		160						15 69 16 (SI+CL)
7.3			11	SS	34								
			12	SS	35								
			13	SS	37								

Continued Next Page

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

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

2 OF 2

WP#	4068-09-00	LOCATION	Lat: 45.446106°, Long: -76.584581° Goshen Road MTM Zone 9: N 5 034 023.0 E 298 183.7	ORIGINATED BY	AC
HWY	17	BOREHOLE TYPE	CME 75 Track, HW Casing/HQ Coring	COMPILED BY	MW
DATUM	Geodetic	DATE	2020.07.07 - 2020.07.07	CHECKED BY	JG

[illegible]

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No GOS19-03

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445675°, Long: -76.584256°
Goshen Road MTM Zone 9: N 5 033 975.0 E 298 209.0 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY JP
DATUM Geodetic DATE 2019.09.18 - 2019.09.18 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
								○ UNCONFINED + FIELD VANE												
								● QUICK TRIAXIAL × LAB VANE												
167.4	Pavement Surface						20	40	60	80	100		20	40	60		GR	SA	SI	CL
0.0	ASPHALT																			
0.2	SILTY SAND with gravel FILL Very Dense Brown		1	SS	81															
166.6																				
0.8	GRANITE/GNEISS BEDROCK Fresh, pink and grey, strong, coarse grained		1	RUN																
			2	RUN																
			3	RUN																
162.9																				
4.5	End of Borehole																			

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

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

RECORD OF DRILLHOLE GOS 19-03

PROJECT	:	Highway 17 Twinning
LOCATION	:	Goshen Road
STARTED	:	2019 September 18
COMPLETED	:	2019 September 18

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 033 975.0 E 298 209.0

Project No. 4068-09-00

SHEET 1 OF 2
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF DRILLHOLE GOS 19-03

PROJECT : Highway 17 Twinning
 LOCATION : Goshen Road
 STARTED : 2019 September 18
 COMPLETED : 2019 September 18

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 033 975.0 E 298 209.0

Project No. 4068-09-00

SHEET 2 OF 2
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	FR-FRACTURE				RU-ROUGH UNDULATING				T-TIGHT, HARD				HOR-HORIZONTAL				Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS
				DEPTH (m)					RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec											
									TOTAL CORE %	SOLID CORE %			DIP wrt Core Axis	TYPE AND SURFACE DESCRIPTION		-6 -5 -4 -3 10 10 10 10										
									80 80 80 80 40 40 40 40	80 80 80 80 40 40 40 40			80 80 80 80 40 40 40 40													
4		GRANITE/GNEISS BEDROCK Fresh Pinkish White and Grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong	+																							
			+																							
			+																							
			+																							
			+																							
			+																							
		End of Borehole		162.92 4.47																						
5																										
6																										

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION



WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF BOREHOLE No GOS19-04

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445554°, Long: -76.583914°
Goshen Road MTM Zone 9: N 5 033 961.5 E 298 235.8 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY JP
DATUM Geodetic DATE 2019.09.18 - 2019.09.18 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
168.0	Shoulder							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>					
0.0	SILTY SAND with gravel FILL Dense Brown		1	SS	41								44 47 9 (SI+CL)
167.1			2	SS	100/								
0.9	ROCK FILL -Gravel, cobbles and boulders				125mm		167						
			3	NQ			166						
165.6													
2.4	GRANITE/GNEISS BEDROCK Fresh, pink and grey, strong to very strong, coarse grained - Vertical Fracture from 3 m to 3.5 m		1	RUN			165						RUN #1 TCR=100% SCR=76% RQD=100% UCS=91MPa
							164						
			2	RUN			163						RUN #2 TCR=100% SCR=96% RQD=86% UCS=90MPa
							162						
			3	RUN			161						RUN #3 TCR=100% SCR=81% RQD=58% UCS=88MPa
							160						RUN #4 TCR=100% SCR=98% RQD=98% UCS=113MPa
			4	RUN			159						RUN #5 TCR=100% SCR=100% RQD=96% UCS=123MPa
158.4			5	RUN									
9.6	End of Borehole												

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

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

RECORD OF DRILLHOLE GOS 19-04

PROJECT	:	Highway 17 Twinning
LOCATION	:	Goshen Road
STARTED	:	2019 September 18
COMPLETED	:	2019 September 18

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 033 961.5 E 298 235.8

Project No. 4068-09-00

SHEET 1 OF 3
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



ROCKM2 24726 GOSHEN ROAD- ROCK.GPJ 22-7-25

RECORD OF DRILLHOLE GOS 19-04

PROJECT : Highway 17 Twinning
 LOCATION : Goshen Road
 STARTED : 2019 September 18
 COMPLETED : 2019 September 18

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 033 961.5 E 298 235.8

Project No. 4068-09-00

SHEET 2 OF 3
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DIP wrt Core Axis	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test
6	Rotary Drill NQ Core	GRANITE/GNEISS BEDROCK Fresh Pinkish White and Grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong	+									J, SP, tight			
												J, SP, tight			
												J, SP, tight			
												J, SP, tight			
												J, SP, tight			
												J, SP, tight			
												J, SP, tight			
												J, SP, tight with non-softening clay J, SP, oxidized J, SP, tight			
												J, SP, oxidized			
												J, SP, tight			
												J, SP, tight			
7	Rotary Drill NQ Core		+		3							J, SP, tight			
												J, SP, tight			
												J, SP, tight			
												J, SP, tight			
												J, SP, tight			
												J, SP, tight, oxidized			
												J, SP			
												J, SP, tight, oxidized			
8	Rotary Drill NQ Core		+		4										

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▽ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF DRILLHOLE GOS 19-04

PROJECT	:	Highway 17 Twinning
LOCATION	:	Goshen Road
STARTED	:	2019 September 18
COMPLETED	:	2019 September 18

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 033 961.5 E 298 235.8

Project No. 4068-09-00

SHEET 3 OF 3
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF BOREHOLE No GOS19-04W

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445471°, Long: -76.584001°
Goshen Road MTM Zone 9: N 5 033 952.0 E 298 228.6 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.14 - 2020.07.14 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
167.0	Ground Surface							20	40	60	80	100						
0.0	TOPSOIL (100 mm)							20	40	60	80	100						
0.1	SILTY SAND to SANDY SILT Compact Moist to wet Brown		1	SS	24													
			2	SS	13		166											
165.5																		
1.5	SILTY SAND (SM), some gravel Frequent cobbles Wet Dense Grey TILL		3	SS	100/ 225 mm		165										17 63 20 (SI+CL)	
			4	SS	100/ 100 mm													
			5	NQ														
164.2			6	SS	100/ 50 mm		164									FI		
2.8	GNEISS BEDROCK Slightly weathered to fresh Grey and pink Fine grained - Sub vertical fractures from 3.5 m to 5.7 m		1	RUN												2	RUN #1 TCR=100% SCR=44% RQD=44%	
			2	RUN			163									>10	RUN #2 TCR=100% SCR=5% RQD=0%	
																3		
							162									2		
			3	RUN			161									>10	RUN #3 TCR=100% SCR=35% RQD=32%	
160.6																3		
6.4	End of Borehole Monitoring well consists of 50 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen WATER LEVEL READINGS: Date Depth (m) Elev. (m) 2020.07.22 5.7 161.3 2020.09.29 4.9 162.1 2020.12.16 4.1 162.9 2021.09.28 4.2 162.8 2021.10.02 4.5 162.5 2022.01.20 5.0 162.0																	

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

RECORD OF BOREHOLE No GOS19-05

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446525°, Long: -76.585284°
Goshen Road MTM Zone 9: N 5 034 069.5 E 298 128.7 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, HSA/NW Casing COMPILED BY MW
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
167.1	Shoulder						20 40 60 80 100						
0.0	SILTY SAND, some gravel FILL Very Dense Brown		1	SS	85		○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
166.3							20 40 60 80 100						
0.8	SILTY SAND (SM) Compact to Dense Brown		2	SS	26		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _P w w _L						
							WATER CONTENT (%)						
			3	SS	51		20 40 60					0 78 22 (SI+CL)	
			4	SS	45								
			5	SS	43								
162.5													
4.6	SILTY SAND (SM) some gravel Very Dense Brown		6	SS	61							35 50 15 (SI+CL)	
161.0													
6.1	SANDY CLAYEY SILT (CL) Compact Brownish Grey (TILL)		7	SS	21							2 47 37 14	
159.5													
7.6	CLAYEY SAND (SC) , some gravel Frequent Cobbles and Boulders Very Dense Grey (TILL)		8	SS	100/ 50mm								
			9	NQ									
			10	NQ								14 41 32 13	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

DOUBLE LINE 24726 GOSHEN ROAD GINT GPJ 2012TEMPLATE(MTO) GDT 22-7-26

METRIC

SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER TYPE "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
					DYNAMIC CONE PENETRATION RESISTANCE PLOT <div><div></div><div>20406080100</div></div> SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE <div><div></div><div>20406080100</div></div>
					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _P w w _L WATER CONTENT (%)
					UNIT WEIGHT γ kN/m³
					REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
Continued From Previous Page					
CLAYEY SAND (SC), some gravel Frequent Cobbles and Boulders Very Dense, Grey (TILL)					157
End of Borehole					

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No GOS19-06

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446371°, Long: -76.585054°
Goshen Road MTM Zone 9: N 5 034 052.3 E 298 146.7 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, HSA/NW Casing COMPILED BY MW
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
167.0	Shoulder							20 40 60 80 100		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
0.0	SAND with silt and gravel FILL Compact Brown		1	GS				20 40 60 80 100		WATER CONTENT (%)			28 62 10 (SI+CL)
166.2													
0.8	SILTY SAND (SM) Loose to Compact Brown		2	SS	8		166						
			3	SS	24		165						
			4	SS	23		164						0 61 39 (SI+CL)
			5	SS	21		163						
			6	SS	12		162						
							161						
160.9													
6.1	CLAYEY SAND (SC), occasional cobble Loose to Very Dense Brown to Grey-Brown TILL		7	SS	7		160						
			8	NQ									
			9	SS	68		159						3 48 35 14
157.8			10	SS	100/		158						
9.2	End of Borehole				75mm								
	Monitoring well consists of 46 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No GOS19-06

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446371°, Long: -76.585054°
Goshen Road MTM Zone 9: N 5 034 052.3 E 298 146.7 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, HSA/NW Casing COMPILED BY MW
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
	Continued From Previous Page							20	40	60	80	100					
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2019.09.26 3.4 163.6 2020.04.21 0.6 166.4 2020.09.29 3.5 163.5 2022.10.22 3.7 163.3																

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF BOREHOLE No GOS19-07

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445922°, Long: -76.584349°
Goshen Road MTM Zone 9: N 5 034 002.5 E 298 201.8 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.08 - 2020.07.08 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
169.2	Ground Surface							20 40 60 80 100					
0.0	TOPSOIL (25 mm)												
	SILTY SAND FILL Loose Brown		1	SS	8		169						
168.4													
0.8	SAND (SP-SM)some silt Compact Grey-brown		2	SS	18		168						2 88 10 (SI+CL)
			3	SS	27		167						
			4	SS	27		166						
			5	SS	24		165						
165.1			6	SS	100/		164						
164.0	SILTY SAND trace gravel Dense, Brown (TILL)		1	RUN	125 mm		163						RUN #1 TCR=100% SCR=52% RQD=48% UCS=178MPa
4.2	GRANITE/GNEISS BEDROCK Slightly weathered to fresh , pink to grey, very strong, fine grained - Subvertical fractures (4.4 m to 4.5 m, 4.7 m to 4.8 m, 7.2 m to 7.5 m, and 9.2 m to 9.9 m)		2	RUN			162						RUN #2 TCR=100% SCR=87% RQD=82% UCS=189MPa
			3	RUN			161						RUN #3 TCR=100% SCR=78% RQD=75% UCS=163MPa
			4	RUN			160						RUN #4 TCR=100% SCR=68% RQD=65% UCS=105MPa
159.3			5	RUN									RUN #5 TCR=100% SCR=80% RQD=80%

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No GOS19-08

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445845°, Long: -76.584467°
Goshen Road MTM Zone 9: N 5 033 993.8 E 298 192.5 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.09 - 2020.07.09 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				W _P W W _L							
168.5	Ground Surface						20	40	60	80	100					GR	SA	SI	CL
0.0	TOPSOIL (50 mm)																		
	SILTY SAND (SM) to SANDY SILT (ML) Some organics Loose to compact Grey-brown		1	SS	4								○						
			2	SS	19								○						
166.7			3	SS	42								○						
1.8	SILTY SAND (SM) trace gravel Frequent cobbles and boulders Dense Grey-brown (TILL)												○						7 69 24 (SI+CL)
165.8			1	RUN															
2.7	GRANITE/GNEISS BEDROCK Slightly weathered to fresh, pink to grey, very strong , fine to medium grained - Fractured from 4 m to 4.6 m - Subvertical fractures from 5.6 m to 5.8 m		2	RUN															
			3	RUN															
			4	RUN															

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF BOREHOLE No GOS19-09

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445361°, Long: -76.583801°
Goshen Road MTM Zone 9: N 5 033 940.0 E 298 244.1 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.13 - 2020.07.13 CHECKED BY JG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa				WATER CONTENT (%)					
167.3	Ground Surface						20	40	60	80	100	W _P	W	W _L	kN/m ³	GR SA SI CL	
0.0	TOPSOIL (50 mm)																
	SILTY SAND (SM) trace gravel Compact Grey brown to grey Moist to wet		1	SS	21											8 67 25 (SI+CL)	
			2	SS	21												
165.8																	
1.5	SILTY SAND compact to very dense brown wet (TILL) - Frequent cobbles and boulders 2.3 m to 3.1 m		3	SS	23												
			4	SS	100/ 50 mm												
			1	RUN													
164.2																	
3.1	GRANITE/GNEISS BEDROCK Slightly weathered to fresh, pink and grey, very strong, fine to medium grained - Highly fractured from 3.4 m to 4.1 m		2	RUN													
			3	RUN													
			4	RUN													
			5	RUN													
			6	RUN													
158.8																	
8.5	End of Borehole Monitoring well consists of 51 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen WATER LEVEL READINGS: Date Depth (m) Elev. (m) 2020.07.15 6.1 161.2 2020.07.22 7.2 160.1 2020.09.29 7.4 159.9 2020.12.16 6.8 160.5																

Continued Next Page

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

RECORD OF BOREHOLE No GOS19-09

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445361°, Long: -76.583801°
Goshen Road MTM Zone 9: N 5 033 940.0 E 298 244.1 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.13 - 2020.07.13 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL											
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																				
	Continued From Previous Page																											
	<p>WATER LEVEL READINGS:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev. (m)</th> </tr> </thead> <tbody> <tr> <td>2021.09.28</td> <td>7.5</td> <td>159.8</td> </tr> <tr> <td>2021.10.02</td> <td>7.6</td> <td>159.7</td> </tr> <tr> <td>2021.01.20</td> <td>7.3</td> <td>160.0</td> </tr> </tbody> </table>	Date	Depth (m)	Elev. (m)	2021.09.28	7.5	159.8	2021.10.02	7.6	159.7	2021.01.20	7.3	160.0															
Date	Depth (m)	Elev. (m)																										
2021.09.28	7.5	159.8																										
2021.10.02	7.6	159.7																										
2021.01.20	7.3	160.0																										

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF BOREHOLE No GOS19-10

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445201°, Long: -76.583601°
Goshen Road MTM Zone 9: N 5 033 923.0 E 298 262.4 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.14 - 2020.07.14 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
166.5	Ground Surface							20	40	60	80	100					
0.0	TOPSOIL (100 mm)							20	40	60	80	100					
0.1	SILTY SAND, some organics, occasional cobbles Compact to loose Grey-brown to grey		1	SS	16		166							○			
			2	SS	9									○			
			3	SS	39		165										
164.2	CLAY (CI) Grey-brown Very stiff to stiff		4	SS	11		164							○			1 6 64 29
2.3			5	SS	17		163							○			
162.7	SANDY SILT (ML) some gravel Grey-brown, compact TILL		6	SS	100/ 175 mm									○			10 37 47 6
3.8	GRANITE/GNEISS BEDROCK Pink and grey Fine to medium grained Slightly weathered to fresh Frequent voids from 4.6 m to 4.9 m		1	RUN			162										RUN #1 TCR=47% SCR=0% RQD=0%
162.2	- Fractured zone at 5.1 m to 5.8 m		2	RUN			161										RUN #2 TCR=100% SCR=35% RQD=33% UCS=167MPa
4.3	- Fractured zone at 7.2 m to 7.3 m		3	RUN			160										RUN #3 TCR=100% SCR=50% RQD=42%
158.8	End of Borehole						159										
7.7																	

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

RECORD OF BOREHOLE No GOS19-11

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446105°, Long: -76.584842°
Goshen Road MTM Zone 9: N 5 034 022.8 E 298 163.3 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY MW
DATUM Geodetic DATE 2019.09.03 - 2019.09.03 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)							
166.8	Ground Surface							20	40	60	80	100		GR	SA	SI	CL
0.0	Advanced casing directly to 3.8 m																
163.0																	
3.8	SILTY SAND (SM) , some gravel		1	SS	76/												
162.6	Very Dense, Brown				125mm												
162.6	TILL																
4.2	GNEISS BEDROCK Fresh jointed, pink and grey , very strong, coarse grained, foliated		1	RUN													
			2	RUN													
159.2																	
7.6	End of Borehole																

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF DRILLHOLE GOS 19-11

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2019 September 3
COMPLETED : 2019 September 3

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 022.8 E 298 163.3

Project No. 4068-09-00

SHEET 1 OF 2
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF DRILLHOLE GOS 19-11

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2019 September 3
COMPLETED : 2019 September 3

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 022.8 E 298 163.3

Project No. 4068-09-00

SHEET 2 OF 2
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF BOREHOLE No GOS19-12

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446172°, Long: -76.584649°
Goshen Road MTM Zone 9: N 5 034 030.3 E 298 178.4 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.06 - 2020.07.06 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
169.1	Ground Surface													
0.0	Advanced casing directly to 6.1 m													
163.0														
6.1	SANDY SILT (ML) Compact to dense Grey-brown		1	SS	25									
162.2														
6.9	SILTY SAND (SM) trace gravel Very dense Grey-brown (TILL) Frequent cobbles and boulders		2	SS	82									
			3	SS	100/ 75 mm									
			4	SS	100/ 75 mm									
159.7														
9.4	GNEISS BEDROCK Slightly weathered to fresh jointed, grey and pink, very strong, medium grained		5	SS	95									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
5
0
(%) STRAIN AT FAILURE


DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF BOREHOLE No GOS19-12

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446172°, Long: -76.584649°
Goshen Road MTM Zone 9: N 5 034 030.3 E 298 178.4 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.06 - 2020.07.06 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)					
	Continued From Previous Page							20 40 60 80 100								
	GNEISS BEDROCK Slightly weathered to fresh jointed, grey and pink, very strong, medium grained -Sub-vertical fractures (9.9 m to 10.2 m and 10.9 m to 12 m)		1	RUN			159								RUN #1 TCR=100% SCR=57% RQD=57% UCS=122MPa	
			2	RUN												RUN #2 TCR=100% SCR=67% RQD=67%
			3	RUN				158								RUN #3 TCR=100% SCR=43% RQD=43%
156.6							157									
12.5	End of Borehole															

RECORD OF DRILLHOLE GOS 19-12

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2020 June 7
COMPLETED : 2020 June 7

Project No. 4068-09-00

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 030.3 E 298 178.4

SHEET 1 OF 2
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AC

CHECKED :



ROCKM2 24726 GOSHEN ROAD- ROCK.GPJ 22-7-25

RECORD OF DRILLHOLE GOS 19-12

PROJECT : Highway 17 Twinning
 LOCATION : Goshen Road
 STARTED : 2020 June 7
 COMPLETED : 2020 June 7

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 030.3 E 298 178.4

Project No. 4068-09-00

SHEET 2 OF 2
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (mm/min)	COLOUR % RETURN	FLUSH	FR-FRACTURE		RU-ROUGH UNDULATING		T-TIGHT, HARD		HOR-HORIZONTAL		Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS	
				DEPTH (m)					CL-CLEAVAGE		RP-ROUGH PLANAR		SA-SLIGHTLY ALTERED, CLAY FREE		D-DIPPING				
									J-JOINT		SU-SMOOTH UNDULATING		CLAY FREE		V-VERTICAL				
									B-BEDDING		SP-SMOOTH PLANAR		SC-SWELLING, SOFT CLAY						
RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec													
TOTAL CORE %	SOLID CORE %			TYPE AND SURFACE DESCRIPTION		-6 -5 -4 -3 10 10 10 10													
		End of Borehole	+	156.63 12.47															
13																			
14																			
15																			

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION



WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AC

CHECKED :



METRIC[illegible]

(%) STRAIN AT FAILURE

ONTMT4 7450GOS.GPJ 18/06/04

METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
						20	40	60	80	100	20	40	60	
157.8	SAND and SILT, trace gravel, trace clay, occasional cobbles Very Dense to Compact Grey Wet (TILL) (ML-nonplastic)	[Pattern]	10	SS	21									
11.2	SAND, coarse grained, some gravel Compact (inferred) Grey Wet	[Pattern]												
156.6			11	SS	105/ 254									
12.4	SAND and SILT, trace gravel, occasional cobbles Very Dense Grey Wet (TILL) (ML-nonplastic)	[Pattern]			FI									
156.0	GNEISS (BEDROCK) Slightly weathered, red and dark grey with black and white subvertical banding, extremely strong Vertical to subvertical joints at 12.7m, 12.8m, 13.2m, 15.2m Fractured zone from 15.1m to 15.3m	[Pattern]	1	RUN	2									
13.0			2	RUN	0									
			3	RUN	0									
			4	RUN	0									
153.2														
15.9	END OF BOREHOLE AT 15.85m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 2.13m slotted screen.													
	WATER LEVEL READINGS: DATE ELEVATION (m) 22/10/03 163.3 18/12/03 164.4 05/02/04 164.2													

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No GOS-2

1 OF 1

METRIC

G.W.P. 647-92-00 LOCATION N 5034015.8, E 298171.4 (Goshen Road WBL) ORIGINATED BY SL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 23.09.03 - 23.09.03 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
166.8	TOPSOIL (50mm)													
166.8	SAND , trace gravel, trace silt, trace rootlets Loose Brown Moist (SP)		1	SS	5		166							
			2	SS	50/ .150									
165.2	Sandy SILT , trace gravel Compact Brown Moist		3	SS	17		165							
164.6	SAND and GRAVEL , trace silt, trace clay, occasional cobbles Very Dense Brown Wet		4	SS	78*		164							37 52 9 2
			5	SS	97 FI									
163.2	* Sampler bouncing, probable cobbles Auger refusal at 3.6m. GNEISS (BEDROCK) Fresh to slightly weathered, red with black dots, extremely strong Subvertical joint from 4.9m to 5.3m Multiple fractures zone from 3.6m to 4.3m		1	RUN	>5 >5 >5		163							RUN 1# TCR=100%, SCR=55%, RQD=12%, UCS=258MPa
3.6			2	RUN	0 2 0 0 1		162							RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=262MPa
			3	RUN	0 3		161							RUN 3# TCR=100%, SCR=100%, RQD=100%, UCS=238MPa
160.0	END OF BOREHOLE AT 6.76m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													
6.8														
WATER LEVEL READINGS: DATE ELEVATION (m) 22/10/03 164.3 18/12/03 164.8 05/02/04 164.7														

RECORD OF BOREHOLE No GOS-3

1 OF 1

METRIC

G.W.P. 647-92-00 LOCATION N 5033977.5, E 298222.0 (Goshen Road EBL) ORIGINATED BY JL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 16.10.03 - 16.10.03 CHECKED BY SKP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
167.5 0.0	SAND and GRAVEL Compact Dark Brown to Black Moist (FILL)		1	SS	22								RUN 1# TCR=93%, SCR=43%, RQD=0%, UCS=216MPa RUN 2# TCR=100%, SCR=87%, RQD=53%, UCS=135MPa RUN 3# TCR=100%, SCR=95%, RQD=95%, UCS=212MPa
166.9 0.6	GRAVEL and ROCK FRAGMENTS probable cobbles and boulders (POSSIBLE ROCK FILL) Auger refusal at 1.32m.		1	GS	FI								
165.8			1	RUN	>5								
1.7	GNEISS BEDROCK Slightly weathered, pink with black and white subvertical banding, very strong to extremely strong Subvertical joints at 1.3m to 1.4m, 1.7m, 2.3m, 2.4m, 4.6m 50mm fractured zone at 3.6m.		2	RUN	0								
					0								
			3	RUN	>5								
					2								
					1								
					1								
162.8													
4.7	END OF BOREHOLE AT 4.72m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE ELEVATION (m) 22/10/03 164.6 18/12/03 164.6 05/02/04 Piezometer Destroyed												



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 (Soft)	Moist
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		

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		

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		

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

w @ 1.5m = 13%
 Percent Passing 4.75 mm = 98%
 75 µm = 53%
 5 µm = 32%
 Frost Susceptibility = LSFH
 W_L = 26%
 W_p = 14%
 P_I = 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		

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		

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		

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		

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		

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

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

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-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-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_L = 39%
W_p = 21%
P_I = 18%
MTC Soil Classification = CI
OMC = 28%
MDD = 1,547 kg/m³
Zone 9 N 5039597.8 E 291482.4 Elev 153.6 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-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

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

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-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-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_L = 47%
W_p = 22%
P_I = 25%
MTC Soil Classification = CI
OMC = 28%
MDD = 1,485 kg/m³

7.2- NFP (BR)
Zone 9 N 5039476.1 E 291510.8 Elev 153.3 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



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

17B-69C Station 18+820 EB 14.7m RT CL D0.8

0- 200 Tps
200- 2 Br Cl and Si Moist
2- 7.5 Br Sa Tr Gr Tr Si Moist
w @ 4.8m = 7%
Percent Passing 4.75 mm = 93%
75 µm = 6%
OMC = 14%
MDD = 1,868 kg/m³

7.5- NFP (BR)
Zone 9 N 5039456.7 E 291518.2 Elev 154.3 m
TP

17B-70B Station 18+840 EB 1.6m LT CL D 0

0- 150 Tps
150- 4 Br Si and Cl Moist
4- 4.9 Br Sa W Si Moist
4.9- NFP (BR)
Zone 9 N 5039443.4 E 291540.4 Elev 153.4 m
TP

17B-70C Station 18+841 EB 14.2m RT CL D0.7

0- 150 Tps
150- 1.8 Br Si W Sa Some Cl Moist
1.8- 3.3 Br Sa W Si Moist
3.3- NFP (BR)
Zone 9 N 5039437.8 E 291525.6 Elev 155.3 m
TP

17B-71C Station 18+860 EB 13.7m RT CL D1.1

0- 150 Tps
150- 700 Br Si(y) Sa Moist
700- NFP (BR)
Zone 9 N 5039419.6 E 291532.8 Elev 156.2 m
TP

17B-72C Station 18+880 EB 16.7m RT CL D2.5

0- 180 Tps
180- 1.1 Br Sa W Gr Tr Si Occ Cob Moist
w @ 0.6m = 8%
Percent Passing 4.75 mm = 71%
75 µm = 6%

1.1- NFP (BR)
Zone 9 N 5039399.7 E 291536.9 Elev 158.4 m
TP

17B-72B Station 18+881 EB CL

0- 200 Tps
200- 2.3 Br/Gry Si and Cl Moist
2.3- NFP (BR)
Zone 9 N 5039404.5 E 291551.3 Elev 155.2 m
TP

17B-72A Station 18+884 EB 16m LT CL D-6.5

0- Surf BR
Zone 9 N 5039407.1 E 291569 Elev 148.6 m
Doc. of BR

17B-73A Station 18+902 EB 15.1m LT CL D-5

0- Surf BR
Zone 9 N 5039389.7 E 291574.4 Elev 150 m
Doc. of BR

17B-73C Station 18+904 EB 15.8m RT CL D2

0- 150 Tps
150- 500 Br Si(y) Sa Occ Cob Moist
500- NFP (BR)
Zone 9 N 5039377.9 E 291545.8 Elev 159.9 m
TP

17B-73B Station 18+905 EB CL

0- 150 Tps
150- NFP (BR)
Zone 9 N 5039381.4 E 291560.2 Elev 156.5 m
TP

17B-73R01 Station 18+907 EB 25.4m RT CL D 0

0- Surf BR
Zone 9 N 5039371.5 E 291537.9 Elev 162.3 m
Doc. of BR

17B-74B Station 18+920 EB CL

0- Surf BR
Zone 9 N 5039367.5 E 291565.8 Elev 157.8 m
Doc. of BR

17B-74A Station 18+921 EB 14.9m LT CL D-4.5

0- Surf BR
Zone 9 N 5039371.8 E 291580.7 Elev 150.4 m
Doc. of BR

17B-74D Station 18+921 EB 25.5m RT CL D3

0- 100 Tps
100- 900 Br Si(y) Sa Moist
900- NFP (BR)
Zone 9 N 5039358.5 E 291542.5 Elev 161.9 m
TP

17B-74C Station 18+922 EB 13.5m RT CL D2.5

0- Surf BR
Zone 9 N 5039361.6 E 291554.2 Elev 161.1 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

17B-75R01 Station 18+931		EB 16.4m LT CL D-7		17B-76B Station 18+961	EB CL
0-	Surf BR			0- 400	Tps
	Zone 9 N 5039363.4 E 291585.3 Elev 149.1 m			400- 1.9	Br Si W Sa W Cl
	Doc. of BR				Moist
					w @ 1.2m = 19%
					Percent Passing 4.75 mm = 96%
					75 µm = 69%
					5 µm = 22%
					Frost Susceptibility = MSFH
					Soil Erodibility = 0.35
17B-74R01 Station 18+933	EB 2.1m RT CL			1.9- 5	Br Sa Tr Si Occ Cob
0-	Surf BR				Moist
	Zone 9 N 5039354.8 E 291568.8 Elev 156.9 m				w @ 3.5m = 8%
	Doc. of BR				Percent Passing 4.75 mm = 98%
					75 µm = 9%
					OMC = 13%
					MDD = 1,870 kg/m ³
17B-75R02 Station 18+937	EB 30m RT CL D 0			5-	NFP (BR)
0-	Surf BR				Zone 9 N 5039329.4 E 291579.3 Elev 153.7 m
	Zone 9 N 5039341.9 E 291543.8 Elev 158.4 m				TP
	Doc. of BR				
17B-75C Station 18+939	EB 19.3m RT CL D0.8			17B-76A Station 18+961	EB 15.8m LT CL D-6.5
0-	Surf BR			0- 300	Tps
	Zone 9 N 5039343.3 E 291554.7 Elev 158 m			300- 1.8	Br Sa W Si Tr Gr
	Doc. of BR			1.8- 3.4	Gry Sa W Si Occ Cob
				3.4-	NFP (BR)
17B-75A Station 18+941	EB 16.8m LT CL D-6.5				Zone 9 N 5039335.2 E 291595 Elev 147.1 m
0- 300	Tps				TP
300- 2	Br Sa W Si	Moist		17B-76C Station 18+961	EB 17m RT CL D0.2
2-	NFP (BR)			0- 200	Tps
	Zone 9 N 5039353.9 E 291589.2 Elev 147.6 m			200- 1.3	Br Si W Sa W Cl
	TP			1.3- 7.3	Br Sa Tr Si Occ Cob
17B-75B Station 18+941	EB 2.4m RT CL			7.3-	NFP (BR)
0- 280	Tps				Zone 9 N 5039324.2 E 291564.1 Elev 154.2 m
280- 1.2	Br Si(y) Sa Some Gr	Moist			TP
1.2- 2.7	Br/Gry Si and Sa Tr Gr	Moist		17B-77C Station 18+977	EB 16m RT CL D 0
2.7-	NFP (BR)			0- 200	Tps
	Zone 9 N 5039347.7 E 291571 Elev 155.5 m			200- 1	Br Sa
	TP				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%
				5.9-	NFP (BR)
					Zone 9 N 5039309.2 E 291570.6 Elev 152.2 m
					TP



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

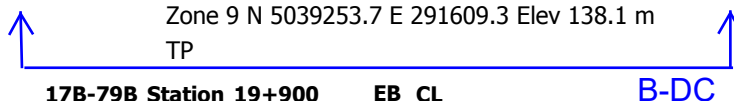
17B-78(2) Station 19+024 EB 12.1m LT CL D 0
A
 0- 150 Tps
 150- 800 Br Sa Some Gr Tr Si Occ Cob Moist
 800- NFP (BR)
 Zone 9 N 5039274.6 E 291613.1 Elev 143.3 m
 TP

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

17B-231C Station 11+796 WB 13.1m RT CL D-0.1

0- 200 Tps
200- 2.5 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034020.9 E 298284.3 Elev 172.8 m
TP

17B-232A Station 11+815 WB 19.3m LT CL D0.1

0- 175 Tps
175- 3 Br Si(y) Sa W Gr Occ Cob Moist
Zone 9 N 5034054.7 E 298300.9 Elev 174.5 m
TP

17B-232B Station 11+821 WB CL

0- 175 Tps
175- 3 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034036.2 E 298308.4 Elev 174.2 m
TP

17B-232C Station 11+821 WB 15m RT CL D-0.1

0- 200 Tps
200- 3 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034021 E 298309.6 Elev 173.7 m
TP

17B-233B Station 11+841 WB CL

0- 250 Tps
250- 3 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034037 E 298328.8 Elev 174.4 m
TP

17B-233A Station 11+841 WB 15.8m LT CL D 0

0- 450 Tps
450- 2.5 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034053.3 E 298326.9 Elev 175 m
TP

17B-233C Station 11+842 WB 15.3m RT CL D 0

0- 200 Tps
200- 2.5 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034022.4 E 298330.9 Elev 174.1 m
TP

17B-234A Station 11+859 WB 17.9m LT CL D0.1

0- 550 Br Sa Tr Si Tr Org Moist
w @ 0.3m = 8%
Percent Passing 4.75 mm = 99%
75 µm = 5%
550- 2 Gry Sa Tr Gr Tr Si Occ Cob Moist
w @ 1.3m = 8%
Percent Passing 4.75 mm = 91%
75 µm = 9%
Zone 9 N 5034056.8 E 298345.1 Elev 175.9 m
TP

17B-234C Station 11+860 WB 13.7m RT CL D 0

0- 350 Br Sa Tr Si Tr Org Moist
350- 2 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034025.4 E 298348.4 Elev 174.3 m
TP

17B-234B Station 11+861 WB CL

0- 250 Br Sa Tr Si Tr Org Moist
250- 1.3 Br Sa W Gr Tr Si Occ Cob Moist
1.3- 2 Gry Sa Tr Gr Tr Si Occ Cob Moist
Zone 9 N 5034038.6 E 298348.1 Elev 174.8 m
TP

17B-235B Station 11+879 WB CL

0- 250 Tps
250- 900 Br Sa W Gr Tr Si Occ Cob Moist
900- 2.5 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034039.1 E 298366.3 Elev 176.2 m
TP

17B-235A Station 11+879 WB 20.4m LT CL D-0.1

0- 450 Tps
450- 2.5 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034060.9 E 298364.7 Elev 178.5 m
TP

17B-235C Station 11+881 WB 15.1m RT CL D0.6

0- 400 Tps
400- 3 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034025.6 E 298368.9 Elev 175.1 m
TP

17B-236A Station 11+896 WB 20.8m LT CL D0.4

0- 400 Tps
400- 5 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034062.6 E 298381.1 Elev 181 m
TP

K-DC

17B-236C Station 11+898 WB 18.9m RT CL D-1.2

0- 400 Tps
400- 2.2 Gry Sa Some Si Tr Gr Moist
2.2- NFP (BR)
Zone 9 N 5034023.2 E 298386.3 Elev 176.6 m
TP

17B-236B Station 11+904 WB CL

0- 125 Tps
125- 5 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034041.9 E 298391.5 Elev 179.4 m
TP



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

17B-237C Station 11+916 WB 13m RT CL D-0.3

0- 300 Tps
300- 5.7 Gry Sa Some Si Tr Gr Moist
5.7- NFP (BR)
Zone 9 N 5034030.6 E 298404.3 Elev 180 m
TP

17B-237B Station 11+920 WB CL

0- 225 Tps
225- 6.5 Gry Sa Some Si Tr Gr Moist
w @ 3.4m = 9%
Percent Passing 4.75 mm = 94%
75 µm = 21%
OMC = 11%
MDD = 2,016 kg/m³
Zone 9 N 5034043.5 E 298407.4 Elev 180.9 m
TP

17B-237A Station 11+924 WB 14.1m LT CL D 0

0- 325 Tps
325- 7.5 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034058.2 E 298410.4 Elev 181.7 m
TP

17B-238C Station 11+937 WB 15m RT CL D-0.2

0- 275 Tps
275- 4.9 Gry Sa Some Si Tr Gr Moist
4.9- NFP (BR)
Zone 9 N 5034030.3 E 298425.6 Elev 181.9 m
TP

17B-238A Station 11+939 WB 11.7m LT CL D 0

0- 325 Tps
325- 7.5 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034057 E 298425.2 Elev 181.9 m
TP

17B-238B Station 11+942 WB CL

0- 300 Tps
300- 7.5 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034044.9 E 298429.5 Elev 182.2 m
TP

17B-239C Station 11+958 WB 18.1m RT CL D 0

0- 325 Tps
325- 7 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034028.8 E 298446.3 Elev 182 m
TP

17B-239A Station 11+961 WB 12.8m LT CL D 0

0- 425 Tps
425- 7 Gry Sa Some Si Tr Gr Moist
Zone 9 N 5034059.9 E 298447.1 Elev 181.3 m
TP

17B-240C Station 11+977 WB 14.3m RT CL D0.2

0- 320 Tps
320- 1.1 Gry Sa Tr Gr Tr Si Moist
1.1- 5.5 Gry Sa Tr Gr Tr Si Tr Cl Moist
Zone 9 N 5034034.1 E 298465.4 Elev 181.4 m
TP

17B-240B Station 11+980 WB CL

0- 210 Tps
210- 1.2 Gry Sa Tr Gr Tr Si Moist
1.2- 5.5 Gry Sa Tr Gr Tr Si Tr Cl Moist
Zone 9 N 5034047.9 E 298467.1 Elev 180.9 m
TP
OMC = 9%
MDD = 2,061 kg/m³

17B-240A Station 11+982 WB 12.2m LT CL D0.2

0- 310 Tps
310- 1.7 Br Sa Tr Si Tr Gr Moist
1.7- 5.5 Gry Sa Tr Gr Tr Si Tr Cl Moist
Zone 9 N 5034060.9 E 298467.4 Elev 180.5 m
TP

17B-241B Station 12+000 WB CL

0- 210 Tps
210- 1.8 Br Sa Tr Si Tr Gr Moist
1.8- 4 Gry Sa Tr Gr Tr Si Tr Cl Moist
Zone 9 N 5034048.4 E 298487.4 Elev 180.1 m
TP

17B-241C Station 12+001 WB 15.1m RT CL D0.2

0- 170 Tps
170- 960 Br Sa Tr Si Tr Gr Moist
960- 4 Gry Sa Tr Gr Tr Si Moist
Zone 9 N 5034035.2 E 298488.8 Elev 180.4 m
TP

17B-242B Station 12+021 WB 2.1m RT CL

0- 190 Tps
190- 1.6 Br Sa Tr Si Tr Gr Moist
1.6- 2.5 Gry Sa Tr Gr Tr Si Tr Cl Moist
Zone 9 N 5034049.7 E 298507.4 Elev 179.2 m
TP

K-DC

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

K-DC

<div> <div>↓</div> <div> 140E Station 12+000 EB 6.5m RT CL Lane 2 </div> <div> 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 </div> <div>↓</div> </div>				<div> <div>↓</div> <div> 143B Station 12+600 WB 6.5m LT CL Lane 2 </div> <div> 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 </div> <div>↓</div> </div>			
<div> <div>↓</div> <div> 140D Station 12+000 EB 2m RT CL Lane </div> <div> 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 </div> <div>↓</div> </div>				<div> <div>↓</div> <div> 143C Station 12+600 WB 2m LT CL Lane </div> <div> 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 </div> <div>↓</div> </div>			
<div> <div>↓</div> <div> 140F Station 12+000 EB 6m RT CL OSH D-0.2 </div> <div> 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 </div> <div>↓</div> </div>				<div> <div>↓</div> <div> 143A Station 12+600 WB 9m LT CL OSH D-0.2 </div> <div> 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 </div> <div>↓</div> </div>			
<div> <div>↑</div> <div> 141B Station 12+200 WB 6.5m LT CL Lane 2 </div> <div> 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 </div> <div>↑</div> </div>				<div> <div>↑</div> <div> 144E Station 12+800 EB 6.5m RT CL Lane 2 </div> <div> 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 </div> <div>↑</div> </div>			
<div> <div>↑</div> <div> 141C Station 12+200 WB 2m LT CL Lane </div> <div> 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 </div> <div>↑</div> </div>				<div> <div>↑</div> <div> 144D Station 12+800 EB 2m RT CL Lane </div> <div> 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 </div> <div>↑</div> </div>			
<div> <div>↑</div> <div> 142E Station 12+400 EB 6.5m RT CL Lane 2 </div> <div> 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 </div> <div>↑</div> </div>				<div> <div>↑</div> <div> 144F Station 12+800 EB 9m RT CL OSH D-0.2 </div> <div> 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 </div> <div>↑</div> </div>			
<div> <div>↑</div> <div> 142D Station 12+400 EB 2m RT CL Lane </div> <div> 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 </div> <div>↑</div> </div>				<div> <div>↑</div> <div> L-DC </div> <div>↑</div> </div>			

Note: Boreholes offsets referenced from staked centreline.



17B-249A Station 12+163 WB 11.1m LT CL D0.7

0- 160 Tps

160- 760 Br Sa Some Gr Tr Si Moist

w @ 0.5m = 9%

Percent Passing 4.75 mm = 87%

75 µm = 8%

760- NFP (BR)

-DC Zone 9 N 5034074.2 E 298647.9 Elev 183.4 m

TP

L7B-250C Station 12+174		WB 14.9m RT CL D-0.5	
0- 210	Tps		
210- 510	Br Sa Tr Si		Moist
510-	NFP (BR)		
	Zone 9 N 5034049.2 E 298661.6 Elev 182 m		
	TP		

17B-253B Station 12+238	WB CL
0- 230 Tps	
230- 500 Br Sa Tr Si	Moist
500- NFP (BR)	
Zone 9 N 5034069.4 E 298724.5 Elev 189.9 m	
TP	



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

17B-253C Station 12+239 WB 16.2m RT CL D-2

0- 300 Tps
300- 720 Br Sa Some Si Tr Gr Moist
w @ 0.5m = 14%
Percent Passing 4.75 mm = 91%
75 µm = 11%
720- 1.7 Br Sa W Gr Tr Si Moist
w @ 1.2m = 3%
Percent Passing 4.75 mm = 75%
75 µm = 9%
1.7- NFP (BR)
Zone 9 N 5034053.1 E 298726.4 Elev 187 m
TP

17B-253A Station 12+246 WB 11.9m LT CL D0.5

0- 75 Tps
75- NFP (BR)
Zone 9 N 5034081.7 E 298731.2 Elev 191.2 m
TP

17B-254B Station 12+261 WB 3.2m RT CL

0- 210 Tps
210- 510 Br Sa Tr Si Moist
510- NFP (BR)
Zone 9 N 5034067.8 E 298747.3 Elev 189.9 m
TP

17B-254C Station 12+262 WB 17.4m RT CL D-1.1

0- 230 Tps
230- 800 Br Sa Tr Si Moist
800- NFP (BR)
Zone 9 N 5034053.7 E 298748.9 Elev 188.2 m
TP

17B-254A Station 12+266 WB 9.5m LT CL D0.4

0- Surf BR
Zone 9 N 5034080.9 E 298751.4 Elev 191 m
Doc. of BR

17B-255C Station 12+281 WB 12.5m RT CL D-1

0- 210 Tps
210- 800 Br Sa Tr Si Tr Gr Moist
800- NFP (BR)
Zone 9 N 5034060.1 E 298768.2 Elev 188.8 m
TP

17B-255B Station 12+285 WB CL

0- 30 Tps
30- NFP (BR)
Zone 9 N 5034071.6 E 298770.8 Elev 189.7 m
Doc. of BR

17B-255A Station 12+289 WB 11.8m LT CL D0.4

0- 190 Tps
190- 500 Br Sa Tr Si Moist
500- NFP (BR)
Zone 9 N 5034085 E 298774 Elev 190.5 m
TP

17B-256B Station 12+297 WB CL

0- 60 Tps
60- NFP (BR)
Zone 9 N 5034072.7 E 298782.6 Elev 189.3 m
TP

17B-256A Station 12+298 WB 10m LT CL D0.4

0- 220 Tps
220- NFP (BR)
Zone 9 N 5034083.9 E 298782.7 Elev 190 m
TP

17B-256C Station 12+300 WB 13.3m RT CL D-0.5

0- 220 Tps
220- 660 Br Sa Tr Si Moist
660- NFP (BR)
Zone 9 N 5034060.8 E 298786.5 Elev 188.3 m
TP

17B-257C Station 12+320 WB 15.6m RT CL D 0

0- 190 Tps
190- 1.7 Br Sa Tr Si Moist
1.7- 2.5 Gry Sa W Si Tr Gr Moist
2.5- NFP (BR)
Zone 9 N 5034060.1 E 298807.2 Elev 187.2 m
TP

17B-257A Station 12+323 WB 10.4m LT CL D0.5

0- Surf BR
Zone 9 N 5034086.3 E 298807.8 Elev 186.7 m
Doc. of BR

17B-257B Station 12+323 WB 2.4m RT CL

0- 420 Tps
420- 610 Br Sa Tr Si Moist
610- NFP (BR)
Zone 9 N 5034073.5 E 298808.7 Elev 186.9 m
TP

17B-258A Station 12+339 WB 12.5m LT CL D 0

0- Surf BR
Zone 9 N 5034089.7 E 298824.1 Elev 182.5 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

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 Station 12+398 WB 14.6m LT CL D 0 L-DC

(2)A
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 Station 12+399 WB CL

(2)B
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 Station 12+402 WB 13.6m RT CL D 0

(2)C
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 Station 12+447 WB 11.4m RT CL D 0

(3)C
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 Station 12+449 WB CL

(3)B
0- 100 Tps
100- NFP (BR)
Zone 9 N 5034087 E 298934.1 Elev 177.7 m
HD

17B-259 Station 12+450 WB 12m LT CL D0.4

(3)A
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

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

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	

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

17B-261B Station 12+502 WB 2.2m LT CL
 0- 320 Tps
 320- 600 Br Sa Tr Si Moist
 600- NFP (BR)
 Zone 9 N 5034092.4 E 298986.8 Elev 183.4 m
 TP

17B-262A Station 12+521 WB 15.5m LT CL D0.3
 0- Surf BR
 Zone 9 N 5034107.1 E 299004.4 Elev 184 m
 Doc. of BR

17B-262B Station 12+522 WB CL
 0- 110 Tps
 110- NFP (BR)
 Zone 9 N 5034092.6 E 299007 Elev 183.2 m
 TP

17B-262C Station 12+526 WB 14.1m RT CL D-0.7
 0- 220 Tps
 220- NFP (BR)
 Zone 9 N 5034078 E 299012.2 Elev 182.3 m
 TP

17B-263B Station 12+542 WB 2.5m RT CL
 0- 280 Tps
 280- NFP (BR)
 Zone 9 N 5034090.9 E 299027.3 Elev 182.1 m
 TP

17B-263A Station 12+544 WB 11.2m LT CL D0.3
 0- 230 Tps
 230- NFP (BR)
 Zone 9 N 5034104.7 E 299028.6 Elev 182.7 m
 TP

17B-263C Station 12+549 WB 16.5m RT CL D0.3
 0- 210 Tps
 210- 610 Br Sa Tr Si Moist
 610- NFP (BR)
 Zone 9 N 5034077.5 E 299035.6 Elev 181.5 m
 TP

17B-264C Station 12+561 WB 13.4m RT CL D 0
 0- 170 Tps
 170- 1.1 Br Sa Tr Si Moist
 1.1- 1.7 Gry Si Tr Gr Tr Sa Moist
 1.7- NFP (BR)
 Zone 9 N 5034081.5 E 299046.9 Elev 182.5 m
 TP

17B-264A Station 12+562 WB 13.8m LT CL D0.4
 0- 190 Tps
 190- 900 Br Sa Tr Si Moist
 900- NFP (BR)
 Zone 9 N 5034108.7 E 299045.7 Elev 182 m
 TP

17B-264B Station 12+563 WB CL
 0- 220 Tps
 220- 1.1 Br Sa Tr Si Moist
 1.1- 1.7 Br Si Tr Sa Tr Gr Moist
 1.7- NFP (BR)
 Zone 9 N 5034096.3 E 299047.7 Elev 181.5 m
 TP

17B-265A Station 12+576 WB 13.3m LT CL D0.2
 0- 60 Tps
 60- NFP (BR)
 Zone 9 N 5034109.4 E 299060.2 Elev 182 m
 TP

17B-265C Station 12+579 WB 13.5m RT CL D0.4
 0- Surf BR
 Zone 9 N 5034082.9 E 299065.1 Elev 184.3 m
 Doc. of BR

17B-265B Station 12+580 WB CL
 0- Surf BR
 Zone 9 N 5034097.8 E 299064.9 Elev 181.7 m
 Doc. of BR

17B-266C Station 12+597 WB 16m RT CL D2.2
 0- Surf BR
 Zone 9 N 5034081.8 E 299083 Elev 183.1 m
 Doc. of BR

17B-266A Station 12+599 WB 15.8m LT CL D1
 0- 220 Tps
 220- 1.5 Br Sa W Si Some Gr Moist
 w @ 0.9m = 14%
 Percent Passing 4.75 mm = 90%
 75 µm = 27%
 1.5- NFP (BR)
 Zone 9 N 5034113.7 E 299082.6 Elev 181.7 m
 TP

17B-266B Station 12+600 WB CL
 0- Surf BR
 Zone 9 N 5034099.5 E 299084.8 Elev 181.8 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

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

N-DC

<div style="display: flex; justify-content: space-between;"> ↓ ↑ </div>							
145B	Station 13+000	WB 6.5m LT CL	Lane 2 D 0	148F	Station 13+600	EB 4.5m RT CL	OSH D-0.2
0- 240	Asph			0- 600	Br Sa and Gr Tr Si	Moist	
240- 400	Br Gr(y) Sa Tr Si	Moist		600-	NFP (RF)		
400-	NFP (RF)				Zone 9 N 5034103.8 E 300017.1 Elev 154.2 m		
	Partially Paved OSH Asphalt Thickness = 135mm				PH		
	Zone 9 N 5034070.4 E 299418.3 Elev 168.6 m						
	PH						
145C	Station 13+000	WB 2m LT CL	Lane	149B	Station 13+800	WB 6m LT CL	Lane 2
0- 155	Asph			0- 150	Asph		
155- 600	Br Gr(y) Sa Tr Si	Moist		150- 400	Br Sa and Gr Tr Si	Moist	
600-	NFP (RF)					w @ 0.3m = 8%	
	Zone 9 N 5034065.8 E 299418.5 Elev 168.6 m					Percent Passing 4.75 mm = 57%	
	PH					75 µm = 8%	
						Acceptable Granular A	
				400-	NFP (RF)		
					Partially Paved OSH Asphalt Thickness = 155mm		
					Zone 9 N 5034116.1 E 300216.3 Elev 152.4 m		
					PH		
146D	Station 13+200	EB 2m RT CL	Lane	149C	Station 13+800	WB 2m LT CL	Lane
0- 145	Asph			0- 175	Asph		
145- 400	Br Gr(y) Sa Tr Si	Moist		175- 400	Br Sa and Gr Tr Si	Moist	
400-	NFP (RF)			400-	NFP (RF)		
	Partially Paved OSH Asphalt Thickness = 150mm				Zone 9 N 5034112.3 E 300217 Elev 152.3 m		
	Zone 9 N 5034079.1 E 299618.6 Elev 163 m				PH		
	PH						
147B	Station 13+400	WB 6.5m LT CL	Lane 2	150D	Station 14+000	EB 2m RT CL	Lane
0- 225	Asph			0- 180	Asph		
225- 400	Br Gr(y) Sa Tr Si	Moist		180- 350	Br Gr(y) Sa Tr Si	Moist	
400-	NFP (RF)			350-	NFP (RF)		
	Partially Paved OSH Asphalt Thickness = 135mm				Partially Paved OSH Asphalt Thickness = 110mm		
	Zone 9 N 5034100.5 E 299818.2 Elev 157.5 m				Zone 9 N 5034098.4 E 300416.6 Elev 150.1 m		
	PH				PH		
147C	Station 13+400	WB 2m LT CL	Lane	151C	Station 14+200	WB 2m LT CL	Lane
0- 150	Asph			0- 190	Asph		
150- 450	Br Gr(y) Sa Tr Si	Moist		190- 400	Br Gr(y) Sa Tr Si	Moist	
450-	NFP (RF)			400- 600	Br Sa and Gr Tr Si Occ Cob	Moist	
	Zone 9 N 5034097.4 E 299818.6 Elev 157.5 m			600-	NFP (RF)		
	PH				Zone 9 N 5034081.2 E 300615.4 Elev 148 m		
					PH		
147A	Station 13+400	WB 9m LT CL	OSH D-0.2	151A	Station 14+200	WB 6.5m LT CL	OSH D-0.2
0- 135	Asph			0- 300	Br Sa(y) Gr	Moist	
135- 400	Br Gr(y) Sa Tr Si	Moist		300- 600	Br Sa and Gr Tr Si Occ Cob	Moist	
400-	NFP (RF)			600-	NFP (RF)		
	Zone 9 N 5034104.3 E 299818.6 Elev 157.4 m				Partially Paved OSH Asphalt Thickness = 125mm		
	PH				Zone 9 N 5034085.9 E 300615.3 Elev 148 m		
					PH		
148D	Station 13+600	EB 2m RT CL	Lane				
0- 170	Asph						
170- 450	Br Sa and Gr Tr Si	Moist					
450-	NFP (RF)						
	Partially Paved OSH Asphalt Thickness = 120mm						
	Zone 9 N 5034106.7 E 300016.8 Elev 154.3 m						
	PH						

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

N-DC

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-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-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

17B-280A	Station 12+982	WB 11.5m LT CL D 0
0-	Surf BR	
	Zone 9 N 5034139.9 E 299465 Elev 173.4 m	
	Doc. of BR	
17B-281B	Station 13+001	WB CL
0-	Surf BR	
	Zone 9 N 5034128.9 E 299484.2 Elev 172.6 m	
	Doc. of BR	
17B-281C	Station 13+001	WB 16.2m RT CL D0.3
0-	Surf BR	
	Zone 9 N 5034113.8 E 299485.8 Elev 173 m	
	Doc. of BR	
17B-281A	Station 13+002	WB 9.2m LT CL D0.2
0- 30	Tps	
30-	NFP (BR)	
	Zone 9 N 5034139.1 E 299484.4 Elev 172.3 m	
	Doc. of BR	
17B-282B	Station 13+018	WB CL
0-	Surf BR	
	Zone 9 N 5034131.4 E 299501.8 Elev 169.3 m	
	Doc. of BR	
17B-282C	Station 13+019	WB 15.6m RT CL D0.6
0- 190	Tps	
190-	NFP (BR)	
	Zone 9 N 5034115.8 E 299503.5 Elev 169.8 m	
	TP	
17B-282A	Station 13+020	WB 15.2m LT CL D 0
0-	Surf BR	
	Zone 9 N 5034146.6 E 299502.2 Elev 168.9 m	
	Doc. of BR	
17B-283C	Station 13+038	WB 16.7m RT CL D 0
0- 90	Tps	
90-	NFP (BR)	
	Zone 9 N 5034116.2 E 299522.7 Elev 167.8 m	
	TP	
17B-283B	Station 13+039	WB 3.5m RT CL
0- 330	Tps	
330-	NFP (BR)	
	Zone 9 N 5034129.4 E 299522.3 Elev 167.3 m	
	TP	
17B-283A	Station 13+040	WB 11.6m LT CL D 0
0- 190	Tps	
190-	NFP (BR)	
	Zone 9 N 5034144.6 E 299522.8 Elev 168 m	
	TP	

17B-283	Station 13+062	WB CL
(2)B		
0-	Surf BR	
	Zone 9 N 5034133.4 E 299545.9 Elev 164 m	
	Doc. of BR	
17B-283	Station 13+063	WB 13.9m LT CL D1.2
(2)A		
0- 320	Tps	
320-	NFP (BR)	
	Zone 9 N 5034148.7 E 299544.9 Elev 164.5 m	
	TP	
17B-283	Station 13+066	WB 20.4m RT CL D0.6
(2)C		
0- 310	Tps	
310-	NFP (BR)	
	Zone 9 N 5034114.8 E 299551.5 Elev 163.7 m	
	TP	
MP-257	Station 13+185	WB CL
0- 800	F Fib Org Matl	
800-	NFP (Firm)	
	Zone 9 N 5034144.3 E 299668.2	
	MP	
MP-255	Station 13+185	WB 25m LT CL D 0
0- 800	F Fib Org Matl	
800-	NFP (Firm)	
	Zone 9 N 5034168.9 E 299667.4	
	MP	
MP-256	Station 13+185	WB 15m LT CL D 0
0- 800	F Fib Org Matl	
800-	NFP (Firm)	
	Zone 9 N 5034159 E 299667.6	
	MP	
MP-258	Station 13+185	WB 8m RT CL D 0
0- 600	F Fib Org Matl	
600-	NFP (Firm)	
	Zone 9 N 5034136.4 E 299669	
	MP	
MP-260	Station 13+200	WB CL
0- 1.5	F Fib Org Matl	
1.5-	NFP (Firm)	
	Zone 9 N 5034146.1 E 299682.5	
	MP	
MP-259	Station 13+200	WB 20m LT CL D 0
0- 1.2	F Fib Org Matl	
1.2-	NFP (Firm)	
	Zone 9 N 5034165.2 E 299681.2	
	MP	

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-261 Station 13+200 WB 10m RT CL D 0
0- 600 F Fib Org Matl
600- NFP (Firm)
Zone 9 N 5034134.1 E 299683
MP

MP-263 Station 13+225 WB 10m LT CL D 0
0- 1.5 F Fib Org Matl
1.5- NFP (Firm)
Zone 9 N 5034158.4 E 299706.2
MP

MP-264 Station 13+225 WB 5m RT CL D 0
0- 1.1 F Fib Org Matl
1.1- NFP (Firm)
Zone 9 N 5034142.6 E 299708.7
MP

MP-265 Station 13+225 WB 12m RT CL D 0
0- 600 F Fib Org Matl
600- NFP (Firm)
Zone 9 N 5034135.4 E 299709.2
MP

MP-266 Station 13+250 WB 20m LT CL D 0
0- 1.5 F Fib Org Matl
1.5- NFP (Firm)
Zone 9 N 5034170.9 E 299731.3
MP

MP-267 Station 13+250 WB 10m LT CL
0- 1.5 F Fib Org Matl
1.5- NFP (Firm)
Zone 9 N 5034160 E 299731.7
MP

MP-268 Station 13+250 WB 5m RT CL D 0
0- 1.5 F Fib Org Matl
1.5- NFP (Firm)
Zone 9 N 5034144.5 E 299733.4
MP

MP-270 Station 13+265 WB 20m LT CL D 0
0- 1.7 F Fib Org Matl
1.7- NFP (Firm)
Zone 9 N 5034170.2 E 299745.9
MP

MP-271 Station 13+265 WB 12m LT CL D 0
0- 1.2 F Fib Org Matl
1.2- NFP (Firm)
Zone 9 N 5034161.4 E 299746.5
MP

MP-272 Station 13+265 WB 4m LT CL D 0
0- 800 F Fib Org Matl
800- NFP (Firm)
Zone 9 N 5034154.1 E 299747.8
MP

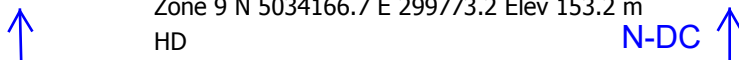
MP-273 Station 13+265 WB 6m RT CL D 0
0- 1 F Fib Org Matl
1- NFP (Firm)
Zone 9 N 5034144.8 E 299748.4
MP

17B-284C Station 13+289 WB 15.8m RT CL D4
0- 50 Tps
50- 2.1 Gry Sa W Si Tr Cl Moist
Zone 9 N 5034137.1 E 299773.1 Elev 157.6 m
HD

17B-284B Station 13+290 WB CL
0- 150 Tps
150- 2.4 Br Sa Tr Si Moist
Percent Passing 4.75 mm = 100%
75 µm = 5%
2.4- 5.2 Gry Sa W Si Tr Cl Wet
Percent Passing 4.75 mm = 98%
75 µm = 34%
5 µm = 9%
Frost Susceptibility = LSFH
Soil Erodibility = 0.17

Fr Wat @ 4600mm
Zone 9 N 5034153.2 E 299772.4 Elev 154.1 m
HD

17B-284A Station 13+292 WB 13.7m LT CL D-1
0- 50 Tps
50- 2.3 Br Sa Tr Si Moist
2.3- 5.2 Br Si(y) Sa Tr Gr Moist
Fr Wat @ 4000mm
Zone 9 N 5034166.7 E 299773.2 Elev 153.2 m
HD



17B-284 (2)C Station 13+307 WB 16.6m RT CL D3.5
0- 75 Tps
75- NFP (BR)
Zone 9 N 5034137.8 E 299791 Elev 157.1 m
HD



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

CR-31B Station 23+501 CL
 0- 200 Tps
 200- 700 Br Sa Some Gr Tr Si Moist
 700- 2.5 Gry Sa W Si Moist
 Zone 9 N 5036612.5 E 295029.5 Elev 140.6 m
 TP

CR-31A Station 23+501 9.8m LT CL D-0.1
 0- 200 Tps
 200- 500 Br Sa W Gr Some Si Moist
 500- 1.6 Br Sa Tr Si Moist
 1.6- 2.5 Br/Gry Sa Tr Si Moist
 Zone 9 N 5036610.8 E 295039.2 Elev 140.7 m
 TP

CR-32B Station 23+521 5m RT CL D 0
 0- 150 Tps
 150- 1.6 Br Sa Some Gr Moist
 1.6- 2.5 Br/Gry Si(y) Sa Moist
 Zone 9 N 5036591.8 E 295026.8 Elev 140.9 m
 TP

CR-33A Station 23+533 9.1m LT CL D 0
 0- 250 Tps
 250- 1.5 Br Sa Some Gr Moist
 Zone 9 N 5036579.7 E 295041.1 Elev 140.8 m
 TP

CR-33B Station 23+534 CL
 0- 250 Tps
 250- 1.3 Br Sa Some Gr Moist
 1.3- 1.5 Br/Gry Si(y) Sa Moist
 Zone 9 N 5036578.1 E 295031.5 Elev 140.9 m
 TP

CR-33C Station 23+534 10.6m RT CL D 0
 0- 200 Tps
 200- 1.4 Br Sa Some Gr Moist
 1.4- 1.5 Br/Gry Si(y) Sa Moist
 Zone 9 N 5036577.5 E 295021.5 Elev 141.1 m
 TP

CR-35A Station 23+573 9.6m LT CL D0.1
 0- 400 Br Sa and Gr Some Si Moist
 400- 900 Br Sa W Gr Some Si Moist
 w @ 0.7m = 9%
 Percent Passing 4.75 mm = 71%
 75 µm = 11%
 900- 1.5 Br/Gry Sa W Si Moist
 w @ 1.2m = 18%
 Percent Passing 4.75 mm = 100%
 75 µm = 25%
 Zone 9 N 5036546.2 E 295050.3 Elev 141 m
 TP

CR-35C Station 23+574 9.8m RT CL D 0
 0- 200 Tps
 200- 700 Br Sa W Gr Some Si Moist
 700- 1.5 Br/Gry Sa W Si Moist
 Zone 9 N 5036535.1 E 295034.3 Elev 141.1 m
 TP

CR-35B Station 23+575 CL
 0- 250 Tps
 250- 900 Br Sa W Gr Some Si Moist
 900- 1.5 Br/Gry Sa W Si Moist
 Zone 9 N 5036539.9 E 295042.8 Elev 141 m
 TP

CR-36C Station 23+595 7.8m RT CL D 0
 0- 200 Tps
 200- 700 Br Sa W Gr Some Si Moist
 700- 2 Br/Gry Sa W Si Moist
 Zone 9 N 5036518.5 E 295050.5 Elev 140.9 m
 TP

Goshen



G-5 Station 9+799 1.4m RT CL
 0- 20 PST
 20- 250 Br Sa and Gr Tr Si Moist
 250- 1.4 Br Sa W Gr Tr Si Occ Cob Moist
 1.4- NFP (Blds)
 Existing SB Lane
 Zone 9 N 5034147.3 E 298062.7 Elev 166.4 m
 PH

GS-2A Station 9+825 4.6m LT CL D 0
 0- 100 Tps
 100- 1.5 Br Si(y) Sa Tr Gr Moist
 Zone 9 N 5034131.4 E 298084.7 Elev 166.7 m
 HA



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

GS-2B Station 9+829 1.9m LT CL D-0.1
 0- 25 PST
 25- 200 Br Sa W Gr Tr Si Moist
 200- 2 Br Sa Tr Si Moist
 w @ 1.1m = 5%
 Percent Passing 4.75 mm = 74%
 75 µm = 7%
 Acceptable Granular B Type I
 OMC = 11%
 MDD = 1,995 kg/m³

Existing SB Lane
 Zone 9 N 5034123.9 E 298082.6 Elev 166.6 m
 PH

GS-2C Station 9+829 7.5m RT CL D-0.3
 0- 150 Tps
 150- 1.5 Br Si(y) Sa Tr Gr Moist
 Zone 9 N 5034120.4 E 298078.2 Elev 166 m
 HA

G-4 Station 9+849 .6m LT CL
 0- 20 PST
 20- 250 Br Sa and Gr Tr Si Moist
 250- 1.6 Br Sa W Gr Tr Si Occ Cob Moist
 Existing NB Lane
 Zone 9 N 5034110.9 E 298097.4 Elev 166.8 m
 PH

GS-3C Station 9+849 7.2m RT CL D 0
 0- 50 Tps
 50- 1.5 Br Si(y) Sa Tr Gr Wet
 Zone 9 N 5034106 E 298091.3 Elev 166 m
 HA

GS-3A Station 9+850 5.4m LT CL D-0.3
 0- 175 Tps
 175- 1.5 Br Si(y) Sa Tr Gr Wet
 w @ 0.8m = 23%
 Zone 9 N 5034113.3 E 298101.6 Elev 166.6 m
 HA

GS-4A Station 9+870 3.9m LT CL D-1
 0- 150 Tps
 150- 1.5 Br Si(y) Sa Tr Gr Wet
 Zone 9 N 5034096.9 E 298114.1 Elev 166.6 m
 HA

GS-4B Station 9+870 2.2m RT CL D-0.1
 0- 25 PST
 25- 900 Br Gr(y) Sa Some Si Moist
 900- 3.5 Br Sa W Gr Tr Si Moist

Existing SB Lane
 Zone 9 N 5034093.1 E 298109.3 Elev 167 m
 PH

GS-4C Station 9+870 7.5m RT CL D-1
 0- 50 Tps
 50- 1.5 Br Si(y) Sa Tr Gr Moist
 Zone 9 N 5034090 E 298105 Elev 166.2 m
 HA

GS-5C Station 9+899 8.9m RT CL D-1
 0- 50 Tps
 50- 1.5 Br Si(y) Sa Tr Gr Moist
 Zone 9 N 5034067.1 E 298123.2 Elev 166.6 m
 HA

G-3 Station 9+900 3.4m RT CL
 0- 20 PST
 20- 300 Br Gr(y) Sa Some Si Moist
 300- 1.5 Br Sa W Gr Tr Si Moist

Existing SB Lane
 Zone 9 N 5034070 E 298127.9 Elev 167.1 m
 PH

GS-5A Station 9+901 3.2m LT CL D-1
 0- 50 Tps
 50- 1.5 Br Si(y) Sa Tr Gr Wet
 Zone 9 N 5034073.5 E 298133.6 Elev 166.9 m
 HA

GS-6A Station 9+923 2.8m LT CL D-1
 0- 50 Tps
 50- 1.5 Br Si(y) Sa Tr Gr Moist
 w @ 0.8m = 4%

Existing Ditch
 Zone 9 N 5034056.4 E 298148.1 Elev 166.7 m
 HA

G-2 Station 9+924 1.9m RT CL
 0- 20 PST
 20- 260 Br Gr(y) Sa Some Si Moist
 260- 1.6 Br Sa W Gr Tr Si Moist

Existing NB Lane
 Zone 9 N 5034052.6 E 298145.2 Elev 167.1 m
 PH

GS-6C Station 9+924 11.2m RT CL D-1
 0- 50 Tps
 50- 1.5 Br Si(y) Sa Tr Gr Moist
 Zone 9 N 5034046.6 E 298138.1 Elev 166.1 m
 HA



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

G-1 Station 9+957 12.7m RT CL
0- 20 PST
20- 330 Br Gr(y) Sa Some Si Moist
Percent Passing 4.75 mm = 64%
75 µm = 14%
Slightly Finer Than Granular A
330- 1.6 Br Sa Some Si Tr Gr Moist
Existing NB Lane
Zone 9 N 5034020.7 E 298158.8 Elev 166.9 m
PH

GS-8B Station 9+979 CL
0- 50 Tps
50- 1.8 Br Si(y) Sa (Compact) Moist
Nvalue=18 blows / 300mm
w @ 0.9m = 12%
Percent Passing 4.75 mm = 99%
75 µm = 33%
1.8- 3 Br Sa(y) Si Some Cl (V.Stiff) Moist
Nvalue=21 blows / 300mm
3- 5.3 Br/Gry Sa and Si (Dense) Moist
Nvalue=35 blows / 300mm
5.3- 5.8 Br Sa and Gr Tr Si Occ Cob Wet
5.8- NFP (BR)
Zone 9 N 5034012.5 E 298183 Elev 168.9 m
HD

GS-9A Station 9+999 7.3m LT CL D0.4
0- 25 Tps
25- 760 Br Si(y) Sa Moist
760- 4.1 Gry Sa(y) Si Moist
4.1- 4.2 Br Si(y) Sa W Gr Wet
4.2- NFP (BR)
Zone 9 N 5034002.3 E 298201.6 Elev 169.1 m
HD

GS-9B Station 9+999 5.2m RT CL D0.2
0- 50 Tps
50- 1.8 Br/Gry Si(y) Sa Moist
1.8- 2.4 Br Si(y) Sa W Gr Moist
2.4- NFP (BR)
Zone 9 N 5033994.1 E 298192.2 Elev 168.4 m
HD

GS-9B Station 9+999 11.7m RT CL D0.2
0- 25 Tps
25- 700 Br/Gry Si(y) Sa Moist
700- 1.3 Br Si(y) Sa W Gr Moist
1.3- NFP (BR)
Zone 9 N 5033990.2 E 298186.9 Elev 168.1 m
HD

GS-10C Station 10+009 11.1m RT CL D-0.3
0- 600 Br Sa Some Si Tr Gr Moist
600- NFP (BR)
Zone 9 N 5033983.1 E 298194 Elev 166.1 m
HD

GS-10B Station 10+010 CL
0- 75 Tps
75- 800 Br Sa Some Si Tr Gr (Compact) Moist
Nvalue=14 blows / 300mm
800- 1.1 Br Gr(y) Sa Freq Cob Moist
1.1- NFP (BR)
Zone 9 N 5033989.5 E 298203.2 Elev 168.1 m
HD

GS-10A Station 10+011 9.8m LT CL D0.4
0- 75 Tps
75- 1.5 Br Sa Some Si Tr Gr (Loose) Moist
Nvalue=9 blows / 300mm
w @ 0.8m = 3%
Percent Passing 4.75 mm = 93%
75 µm = 13%
OMC = 12%
MDD = 1,816 kg/m³
1.5- 2.3 Br/Gry Sa and Si (Compact) Moist
Nvalue=23 blows / 300mm
2.3- 2.8 Br Gr(y) Sa Freq Cob Moist
2.8- NFP (BR)
Zone 9 N 5033995.3 E 298211 Elev 168.9 m
HD

GOS19-4 Station 10+052 5.9m LT CL D0.1
0- 900 Br Sa Some Si Tr Gr (Dense) Moist
Nvalue=41 blows / 300mm
900- 2.4 RF (V. Dense) Moist
Nvalue=100 blows / 10mm
2.4- NFP (BR)
Existing EB Highway 17 Shoulder
Zone 9 N 5033961.4 E 298235.6 Elev 167.9 m
HD

GS-13C Station 10+073 10.4m RT CL D-0.3
0- 100 Tps
100- 1.5 Br Sa Some Si Tr Gr (Compact) Moist
Nvalue=15 blows / 300mm
1.5- 4.3 Br Sa(y) Si (Dense) Moist
Nvalue=34 blows / 300mm
4.3- NFP (BR)
Zone 9 N 5033934.9 E 298237.2 Elev 167.1 m
HD

136



GS-20C	Station 10+300	10.5m RT CL D0.5
0- 50	Tps	
50- 1.5	Br Sa W Si	Moist
	Zone 9 N 5033764.8 E 298386.3 Elev 160.6 m	
	HA	

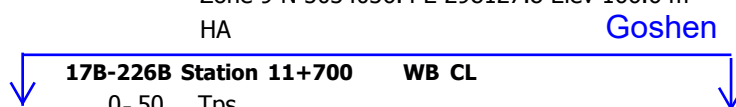
MC-4 Station 00+080		CL
0- 150	Br Sa and Gr Tr Si	Moist
150- 1.7	Br Sa Tr Si	Moist
Proposed Cul-Du-Sac		
Zone 9 N 5034222.9 E 299847.1 Elev 152.9 m		
PH		





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

MP-238 Station 11+575 WB 2m LT CL D 0 0- 1.6 F Fib Org Matl 1.6- NFP (Firm) Zone 9 N 5034019.7 E 298063.7 MP	17B-225C Station 11+640 WB 14.9m RT CL D-0.2 0- 150 Tps 150- 700 Br Sa W Gr Tr Si Occ Cob Moist 700- NFP (Cob) Zone 9 N 5034006.7 E 298129.1 Elev 165.4 m HA
MP-239 Station 11+575 WB 10m RT CL D 0 0- 1.7 F Fib Org Matl 1.7- NFP (Firm) Zone 9 N 5034007.7 E 298064.3 MP	17B-225B Station 11+641 WB CL 0- 150 Tps 150- 1.5 Br Sa W Gr Some Si Moist Zone 9 N 5034021.6 E 298128.5 Elev 166.1 m HA
MP-240 Station 11+575 WB 25m RT CL D 0 0- 1.6 F Fib Org Matl 1.6- NFP (Firm) Zone 9 N 5033993.1 E 298063.7 MP	17B-225A Station 11+641 WB 14.8m LT CL D 0 0- 150 Tps 150- 1.5 Br Sa W Gr Tr Si Occ Cob Moist Zone 9 N 5034036.4 E 298127.8 Elev 166.6 m HA
MP-241 Station 11+585 WB 5m LT CL D 0 0- 700 F Fib Org Matl 700- NFP (Firm) Zone 9 N 5034023.5 E 298073.7 MP	17B-226B Station 11+700 WB CL 0- 50 Tps 50- 1.5 Br Sa Some Si Some Gr Occ Moist Cob (Compact) Nvalue=11 blows / 300mm Zone 9 N 5034026 E 298187.8 Elev 169.3 m HD
17B-224B Station 11+600 WB CL 0- 125 F Fib Org Matl 125- 1.5 Br Sa W Gr Some Si Moist Zone 9 N 5034018.8 E 298088.5 Elev 161.6 m HA	17B-226A Station 11+700 WB 14.7m LT CL D0.1 0- 75 Tps 75- 1.5 Br Sa Some Si Some Gr Occ Moist Cob (Loose) Nvalue=7 blows / 300mm Zone 9 N 5034041 E 298186.6 Elev 169.6 m HD
17B-224A Station 11+600 WB 15.4m LT CL D 0 0- 125 Tps 125- 3 Br Sa W Gr Some Si Moist Zone 9 N 5034034.2 E 298087.5 Elev 162.6 m HA	17B-226Ax Station 11+700 WB .3m LT CL D 0 0- 150 Tps 150- 1.5 Br Sa W Gr W Si Moist Zone 9 N 5034026 E 298187.8 Elev 169.3 m HA
MP-242 Station 11+600 WB 10m RT CL D 0 0- 900 F Fib Org Matl 900- NFP (Firm) Zone 9 N 5034007.5 E 298089.6 MP	17B-226C Station 11+701 WB 13.6m RT CL D0.2 0- 75 Tps 75- 1.5 Br Sa Some Si Some Gr Occ Moist Cob (Loose) Nvalue=5 blows / 300mm Zone 9 N 5034012.8 E 298189.6 Elev 169 m HD
17B-224C Station 11+600 WB 14.9m RT CL D-0.3 0- 250 Tps 250- 1.9 Br Si(y) Sa W Gr Moist 1.9- NFP (Poss Blds and Cob) Zone 9 N 5034004 E 298089.3 Elev 160.7 m HA	
MP-243 Station 11+610 WB 25m RT CL D 0 0- 900 F Fib Org Matl 900- NFP (Firm) Zone 9 N 5033995 E 298100 MP	





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

17B-227B Station 11+720 WB CL

0- 50 Tps
50- 1.5 Br Sa Some Si Tr Gr (Loose) Moist
Nvalue=6 blows / 300mm
Zone 9 N 5034027.9 E 298207.8 Elev 169.6 m
HD

17B-227A Station 11+720 WB 15m LT CL D 0

0- 150 Tps
150- 1.5 Br Gr(y) Sa Moist
w @ 0.8m = 5%
Percent Passing 4.75 mm = 69%
75 µm = 4%
Zone 9 N 5034042.9 E 298206.8 Elev 169.8 m
HA

17B-227c Station 11+720 WB 14.7m RT CL D 0

0- 50 Tps
50- 1.5 Br Sa Some Si Tr Gr (Loose) Moist
Nvalue=7 blows / 300mm
Zone 9 N 5034013.2 E 298208.5 Elev 169.5 m
HD

17B-228C Station 11+738 WB 14.9m RT CL D0.2

0- 50 Tps
50- 1.5 Br Sa Tr Gr Tr Si Occ Cob Moist
(Loose)
Nvalue=9 blows / 300mm
Zone 9 N 5034014.5 E 298227.2 Elev 169.9 m
HD

17B-228B Station 11+739 WB CL

0- 50 Tps
50- 1.5 Br Sa Tr Si Tr Gr Occ Cob Moist
(Loose)
Nvalue=6 blows / 300mm
Percent Passing 4.75 mm = 92%
75 µm = 9%
Zone 9 N 5034029.3 E 298226.5 Elev 170.1 m
HD

17B-228A Station 11+740 WB 14.9m LT CL D 0

0- 150 Tps
150- 1.5 Br Sa W Gr W Si Moist
Zone 9 N 5034044.4 E 298226.9 Elev 170.5 m
HA

17B-229A Station 11+754 WB 16.7m LT CL D 0

0- 250 Tps
250- 1.5 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034047.2 E 298239.9 Elev 171 m
TP

17B-229B Station 11+754 WB 5.4m LT CL

0- 200 Tps
200- 1.5 Br Sa W Si Occ Cob Moist
Zone 9 N 5034036 E 298241.6 Elev 171 m
TP

17B-229C Station 11+754 WB 11.5m RT CL D-0.1

0- 250 Tps
250- 1.5 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034019.1 E 298242.2 Elev 170.6 m
TP

17B-230C Station 11+775 WB 9.6m RT CL D 0

0- 200 Tps
200- 2 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034022.7 E 298263.2 Elev 171.4 m
TP

17B-230A Station 11+776 WB 18.9m LT CL D0.2

0- 250 Tps
250- 900 Br Gr(y) Sa Tr Si Occ Cob Moist
w @ 0.6m = 9%
Percent Passing 4.75 mm = 70%
75 µm = 5%
OMC = 12%
MDD = 1,939 kg/m³
900- 2.5 Br Sa W Si Moist
w @ 1.7m = 5%
Percent Passing 4.75 mm = 100%
75 µm = 27%
Zone 9 N 5034051.2 E 298261.8 Elev 172.1 m
TP

17B-230B Station 11+776 WB 4m LT CL

0- 200 Tps
200- 2 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034036.3 E 298263.2 Elev 171.8 m
TP

17B-231A Station 11+794 WB 19.2m LT CL D0.1

0- 200 Tps
200- 2.5 Br Sa W Gr Tr Si Occ Cob Moist
Zone 9 N 5034052.9 E 298280.1 Elev 173.9 m
TP

17B-231B Station 11+795 WB CL

0- 175 Tps
175- 2.5 Br Sa W Gr Tr Si Occ Cob Moist
w @ 1.3m = 7%
Percent Passing 4.75 mm = 74%
75 µm = 5%
Zone 9 N 5034034 E 298282.5 Elev 172.9 m
TP



Appendix C.

Laboratory Testing

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



THURBER ENGINEERING LTD.

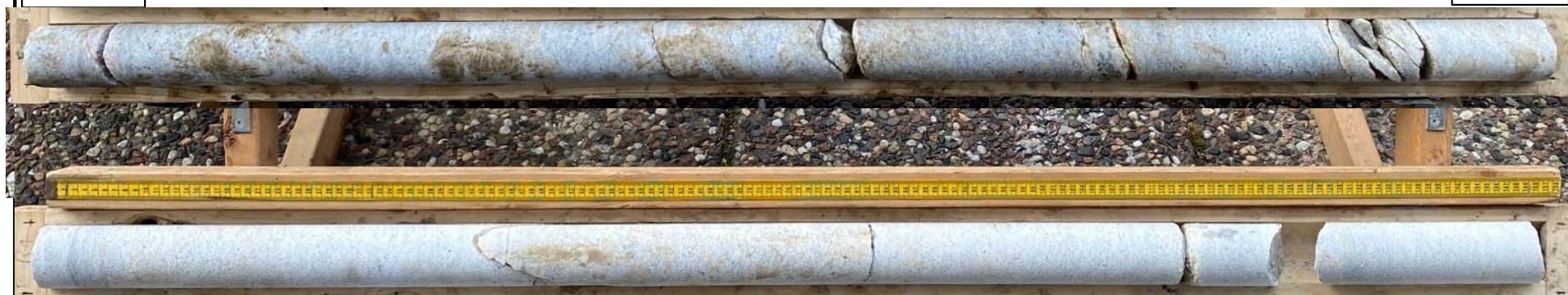
Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH B-DC4
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



THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH B-DC4
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



THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH B-DC4
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



THURBER ENGINEERING LTD.

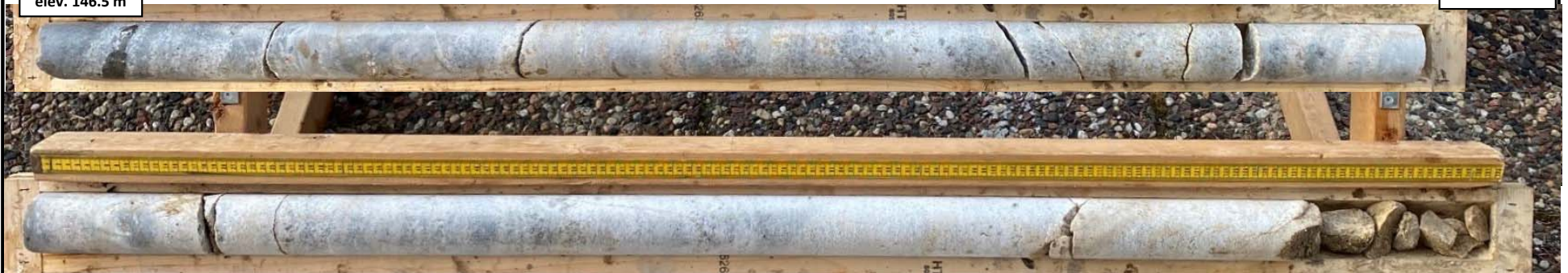
Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH B-DC4
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

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

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

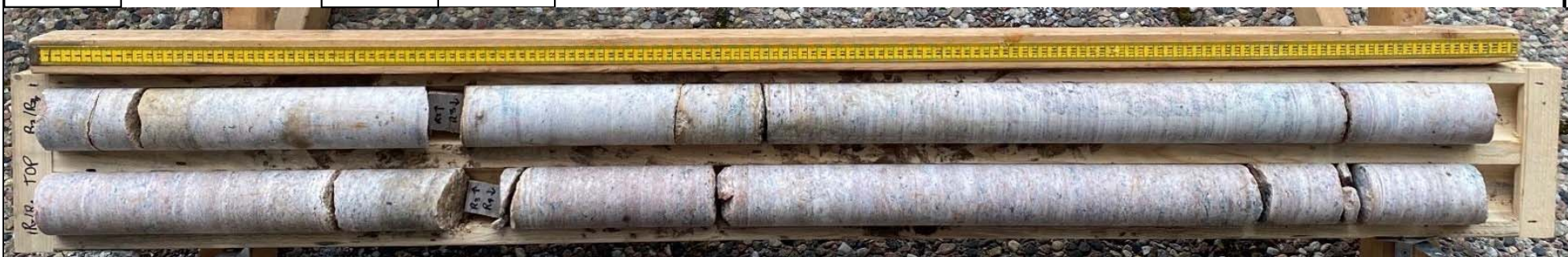
Run 2 Cont.
elev. 186.5 m

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

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
HWY 17 Twinning
Renfrew, Ontario

BH L-DC2
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

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

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

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



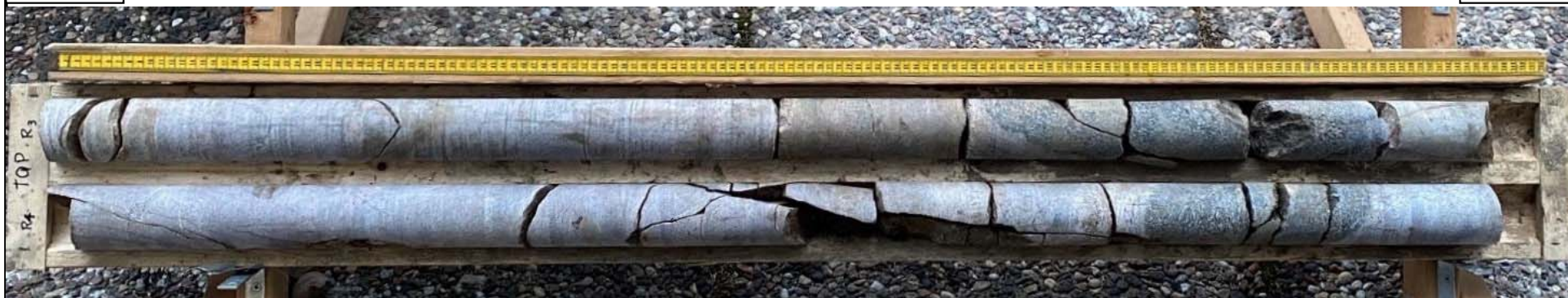
Run 2 Start
elev. 179.0 m

Run 2 End
elev. 177.5 m

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



THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH M-DC2
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



THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH M-DC2
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

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

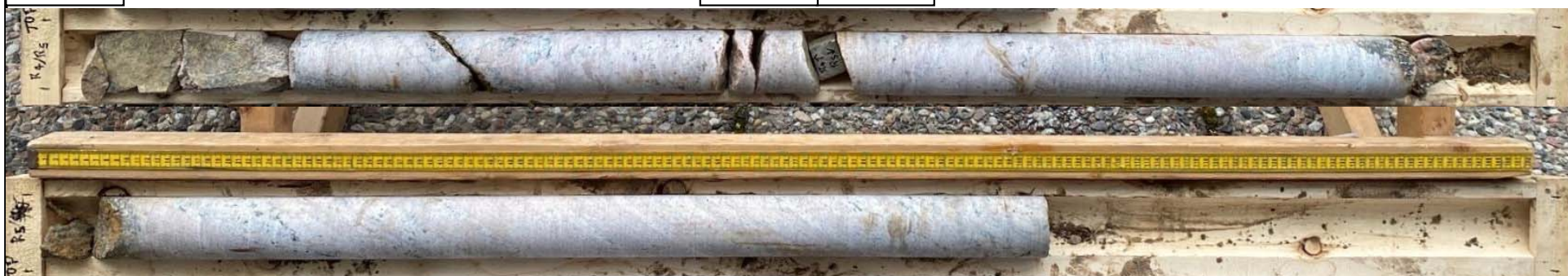
Run 4 Cont.
elev. 166.3 m

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

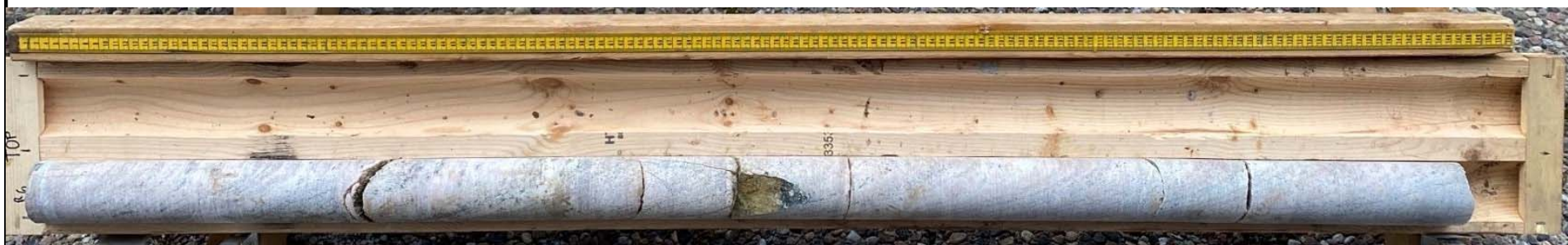


THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH N-DC2
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



THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH N-DC2
Project No.: 24726

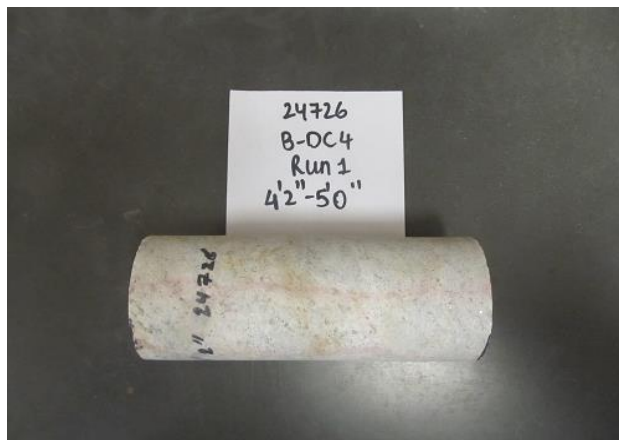
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

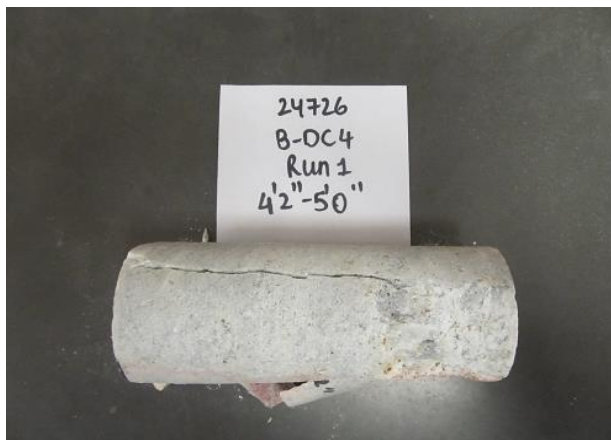
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 1		
SAMPLE DEPTH:	1.3-1.5 m		
DESCRIPTION:	Marble		

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

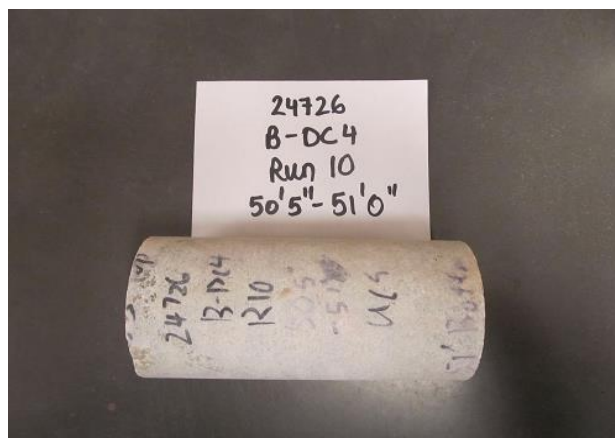
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

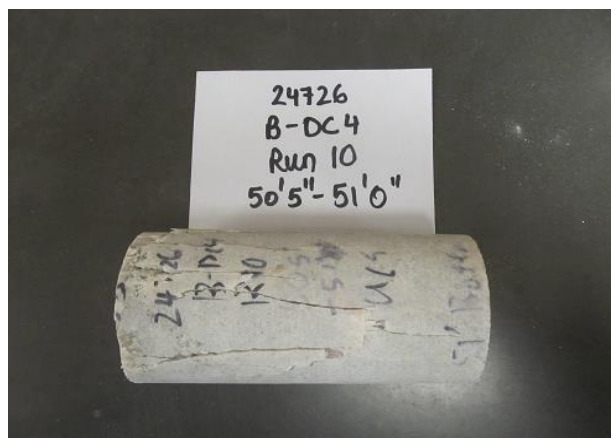
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 10		
SAMPLE DEPTH:	15.4-15.6 m		
DESCRIPTION:	Marble		

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

TEST DONE BY: BS
REVIEWED BY: WM

B-DC4 RUN 10

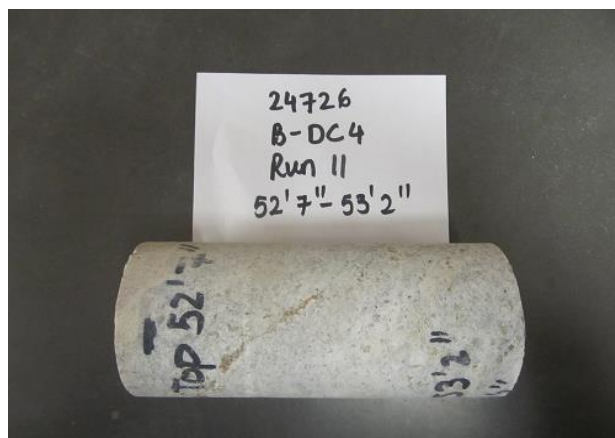
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

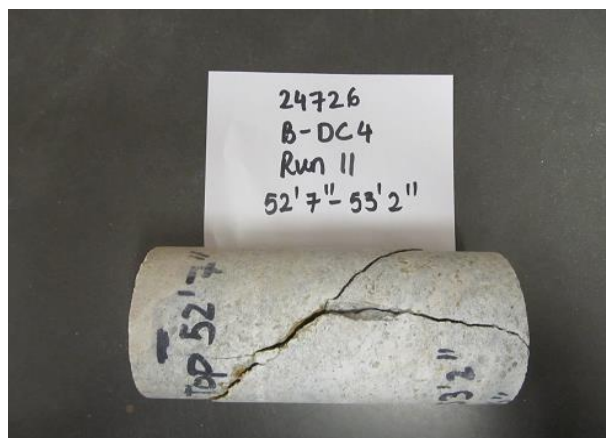
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 11		
SAMPLE DEPTH:	16.0-16.2 m		
DESCRIPTION:	Marble		

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

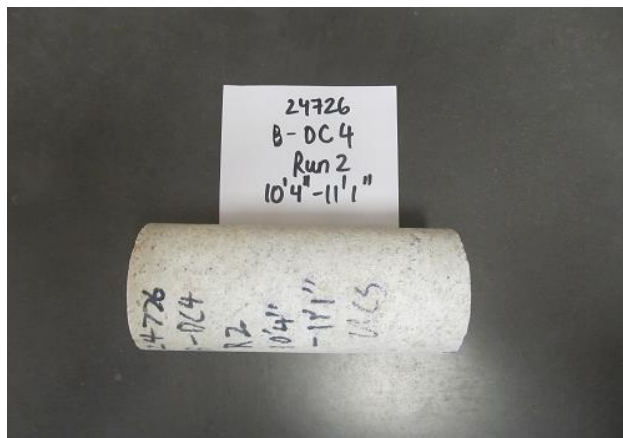
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

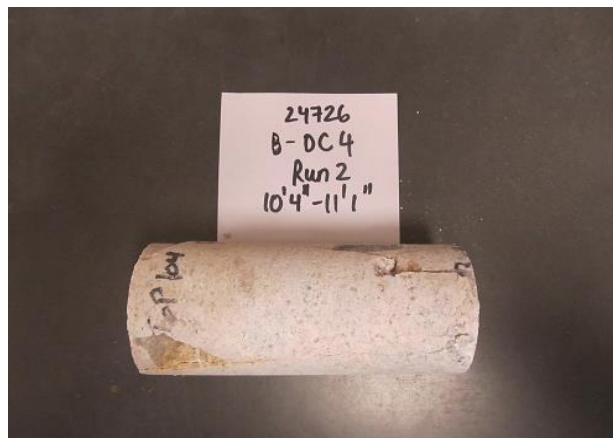
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 2		
SAMPLE DEPTH:	3.2-3.4 m		
DESCRIPTION:	Marble		

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

TEST DONE BY: BS
REVIEWED BY: WM

B-DC4 RUN 2

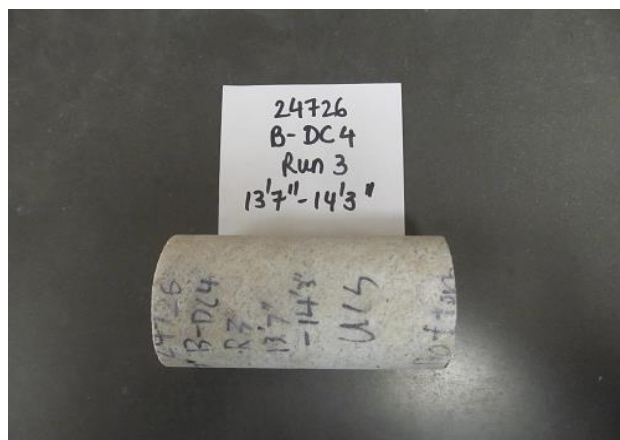
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

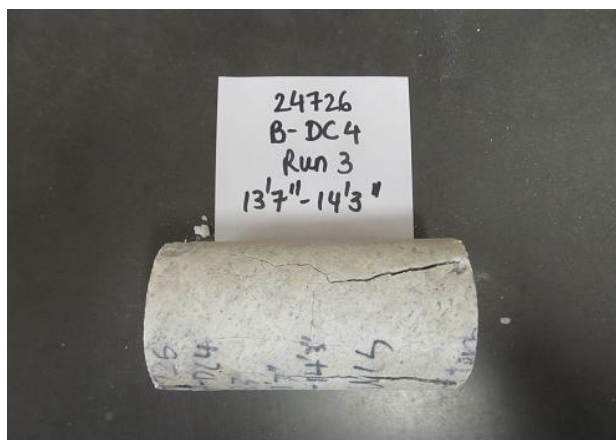
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 3		
SAMPLE DEPTH:	4.1-4.3 m		
DESCRIPTION:	Marble		

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

TEST DONE BY: BS
REVIEWED BY: WM

B-DC4 RUN 3

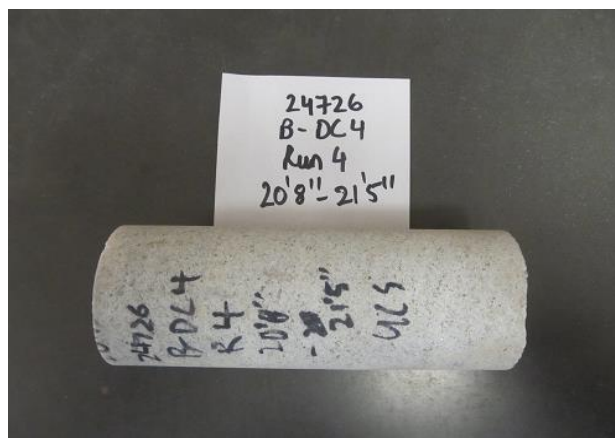
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

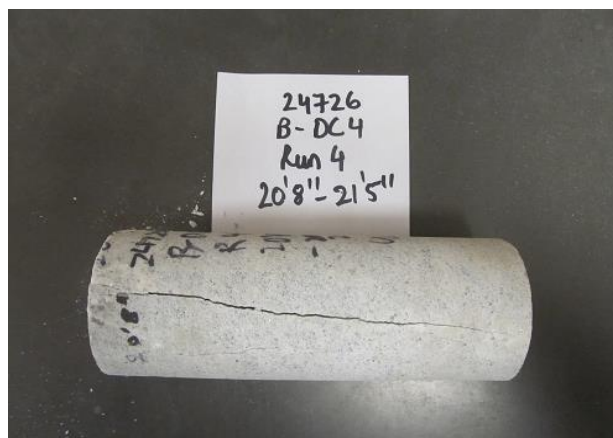
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 4		
SAMPLE DEPTH:	6.3-6.5 m		
DESCRIPTION:	Marble		

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

TEST DONE BY: BS
REVIEWED BY: WM

B-DC4 RUN 4

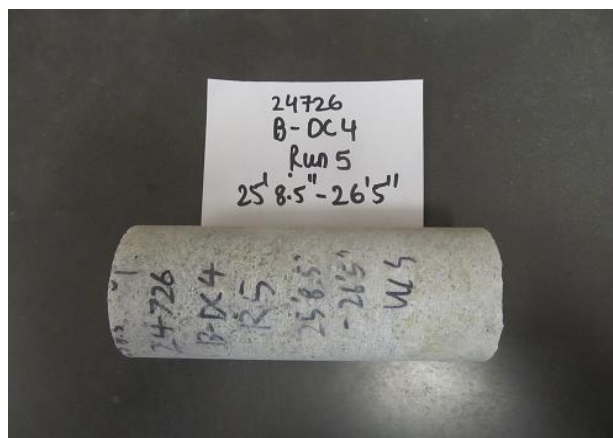
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

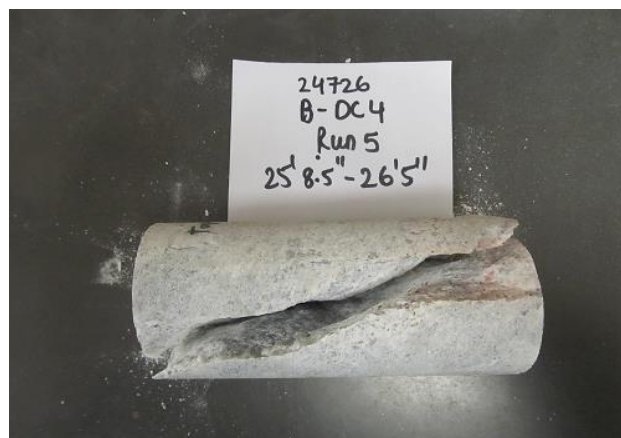
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 5		
SAMPLE DEPTH:	7.8-8.0 m		
DESCRIPTION:	Marble		

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

TEST DONE BY: BS
REVIEWED BY: WM

B-DC4 RUN 5

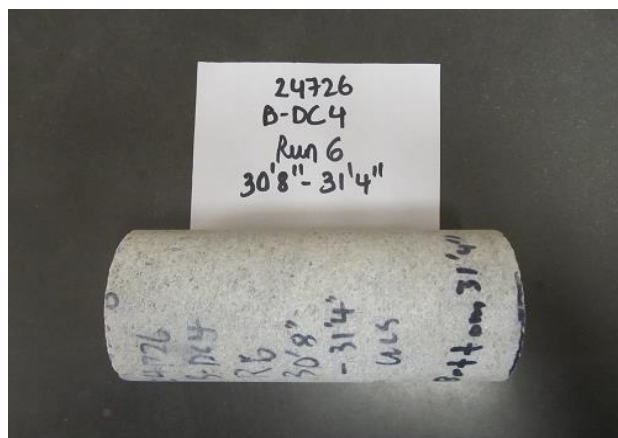
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

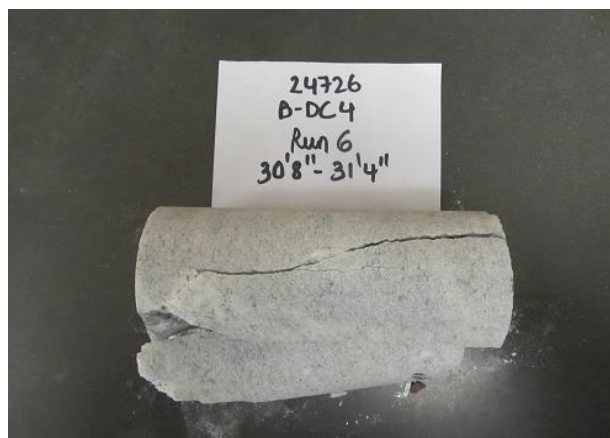
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 6		
SAMPLE DEPTH:	9.3-9.5 m		
DESCRIPTION:	Marble		

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

TEST DONE BY: BS
REVIEWED BY: WM

B-DC4 RUN 6

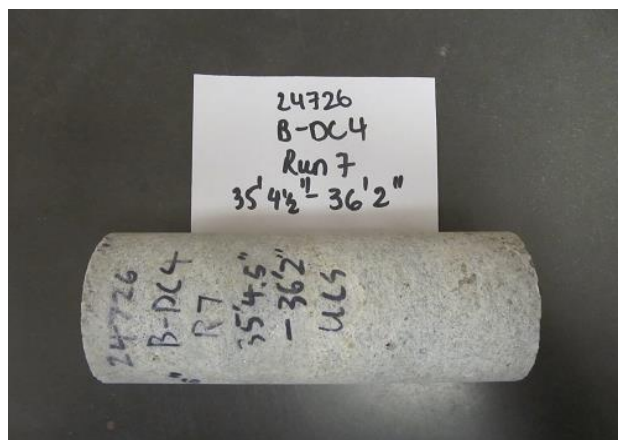
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

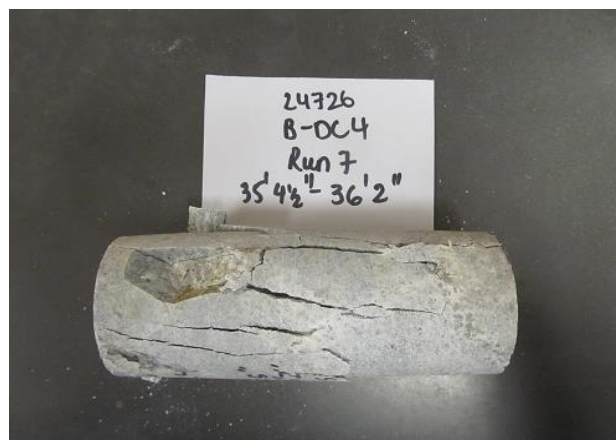
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 7		
SAMPLE DEPTH:	10.8-11.0 m		
DESCRIPTION:	Marble		

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

TEST DONE BY: BS
REVIEWED BY: WM

B-DC4 RUN 7

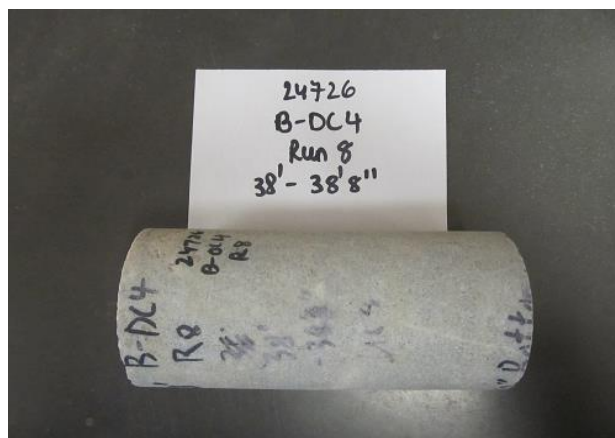
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

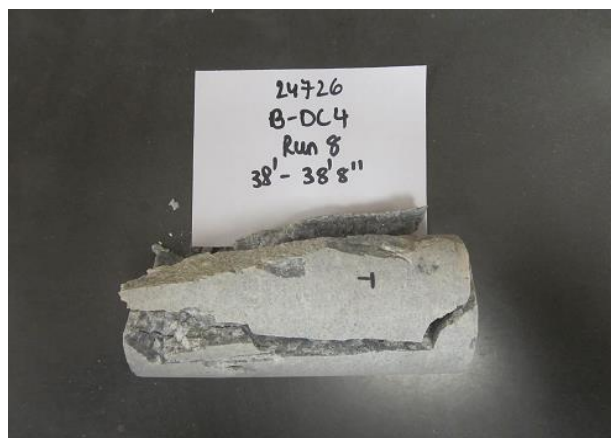
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 8		
SAMPLE DEPTH:	11.6-11.8 m		
DESCRIPTION:	Marble		

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

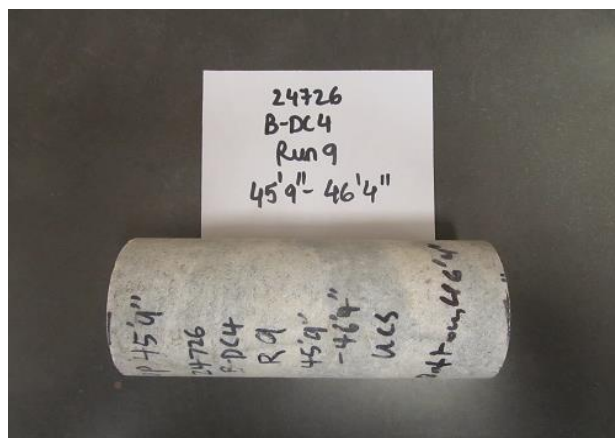
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

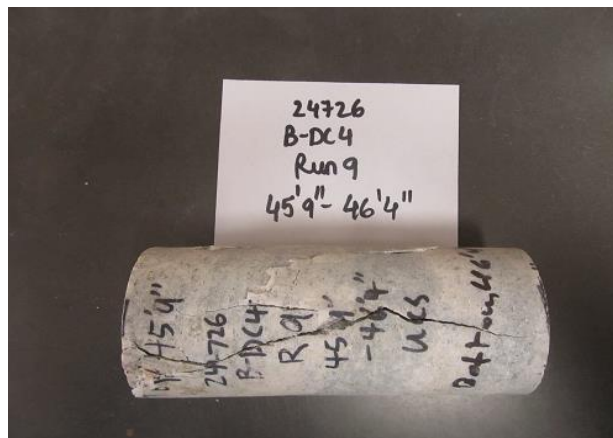
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	B-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 9		
SAMPLE DEPTH:	13.9-14.1 m		
DESCRIPTION:	Marble		

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

TEST DONE BY: BS
REVIEWED BY: WM

B-DC4 RUN 9

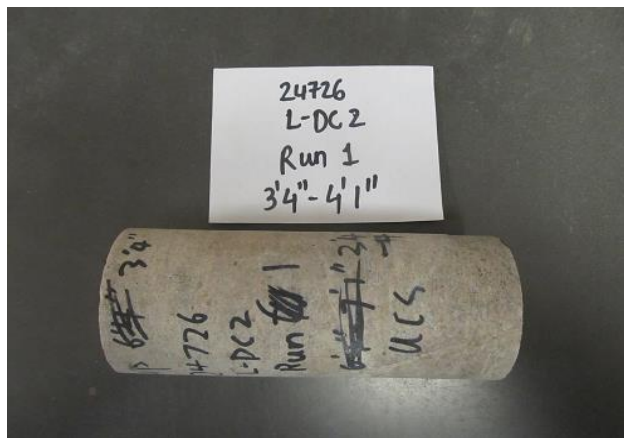
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

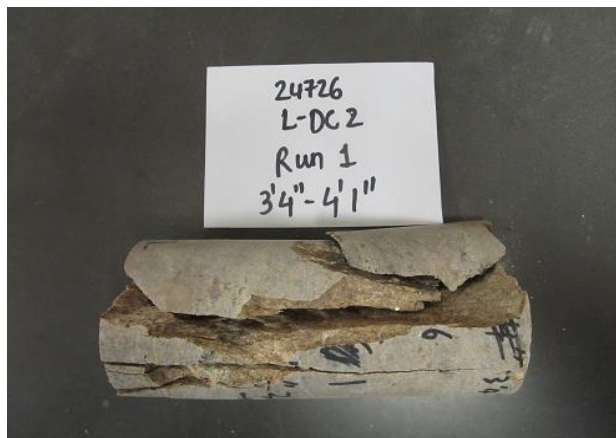
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 1		
SAMPLE DEPTH:	1.0-1.2 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 1

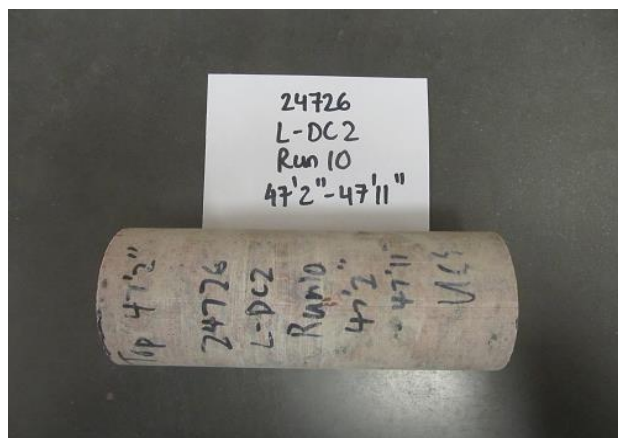
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

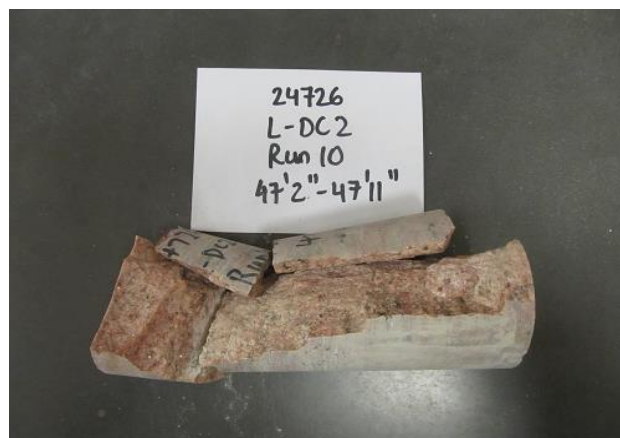
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 10		
SAMPLE DEPTH:	14.4-14.6 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 10

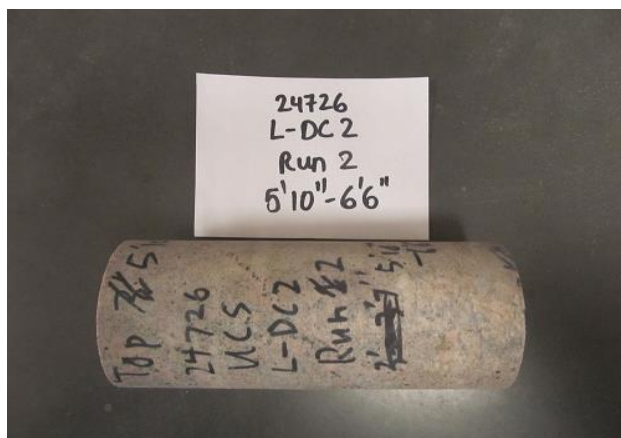
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

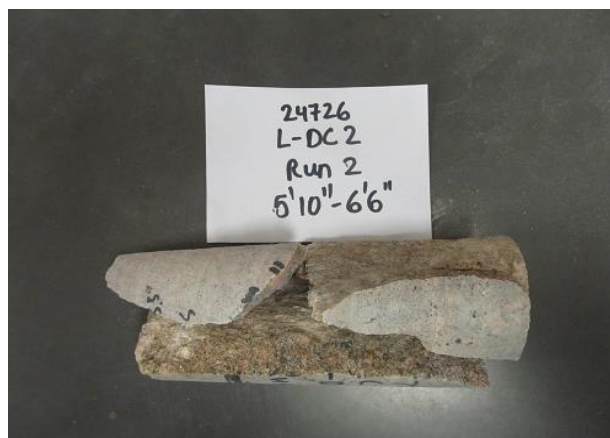
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 2		
SAMPLE DEPTH:	1.8-2.0 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 2

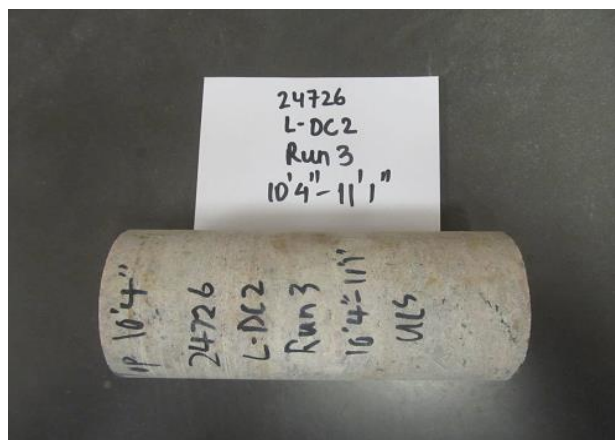
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

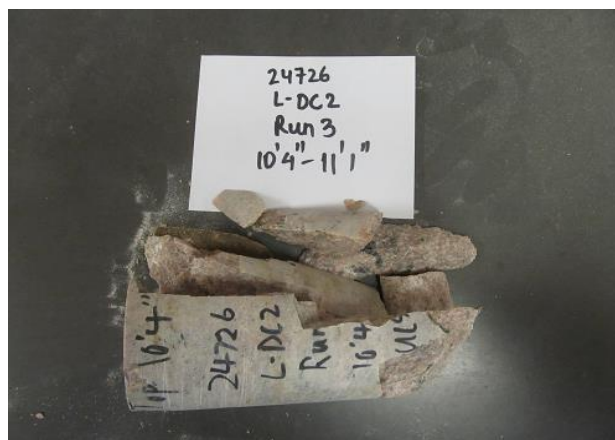
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 3		
SAMPLE DEPTH:	3.2-3.4 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 3

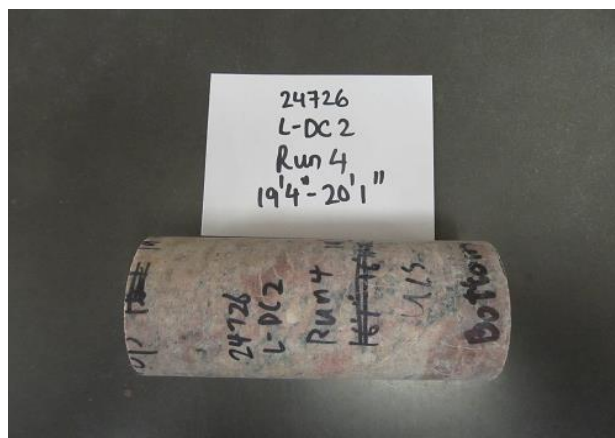
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

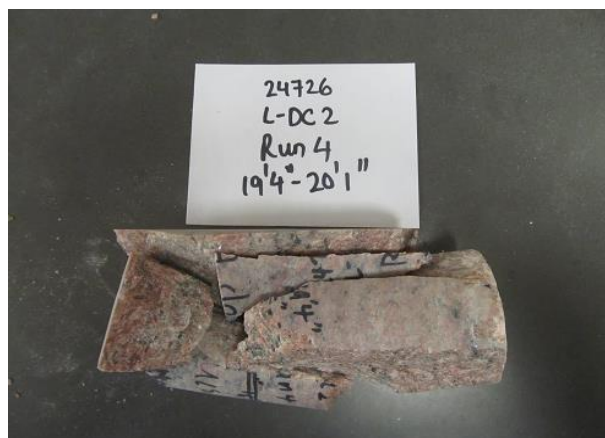
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 4		
SAMPLE DEPTH:	5.9-6.1 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 4

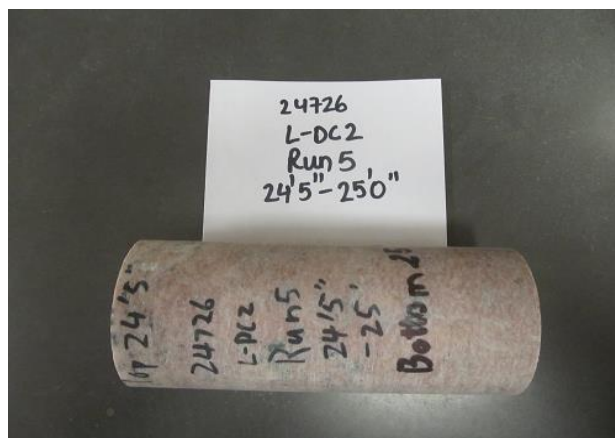
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

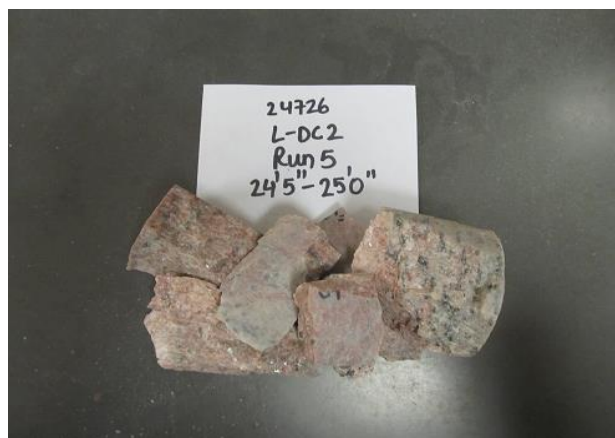
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 5		
SAMPLE DEPTH:	7.4-7.6 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 5

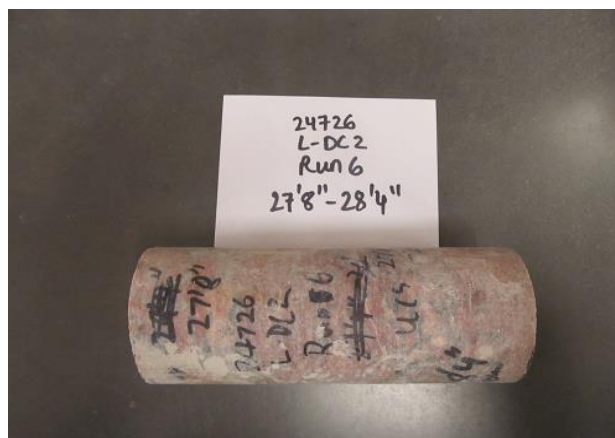
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

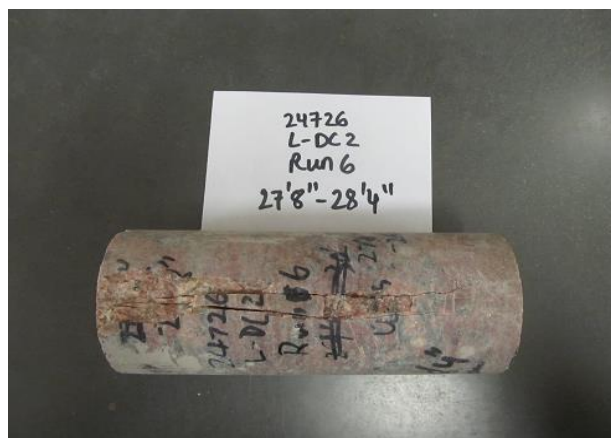
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 6		
SAMPLE DEPTH:	8.4-8.6 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 6

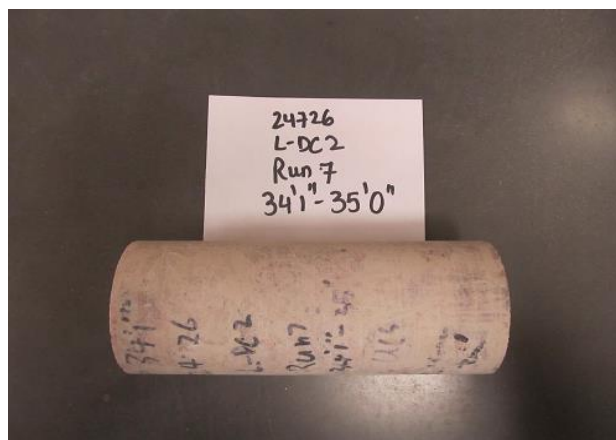
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

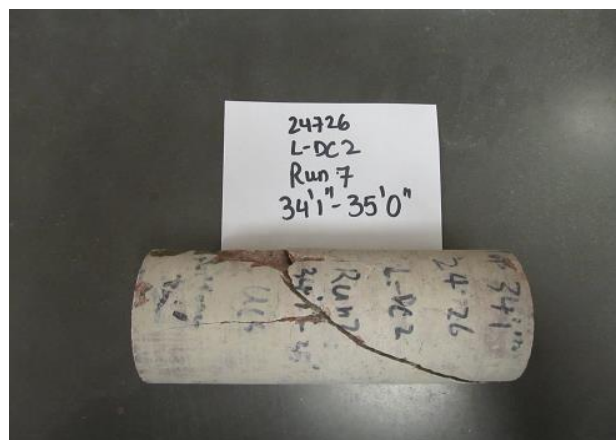
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 7		
SAMPLE DEPTH:	10.4-10.7 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 7

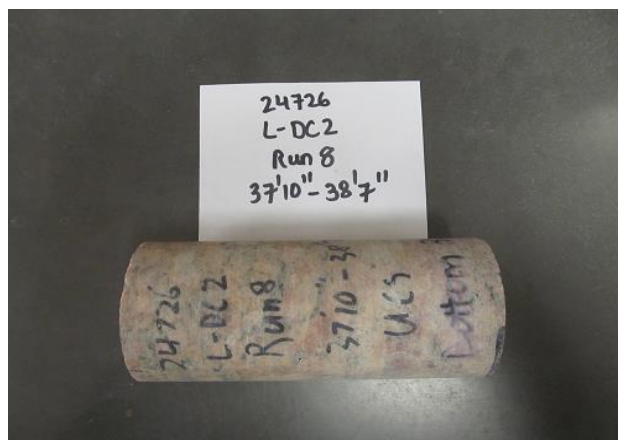
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

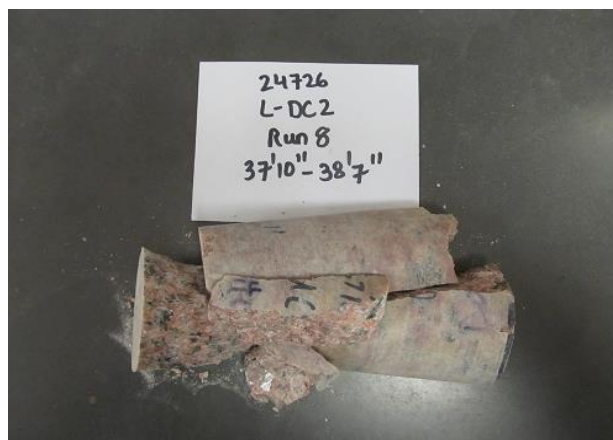
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 8		
SAMPLE DEPTH:	11.5-11.7 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 8

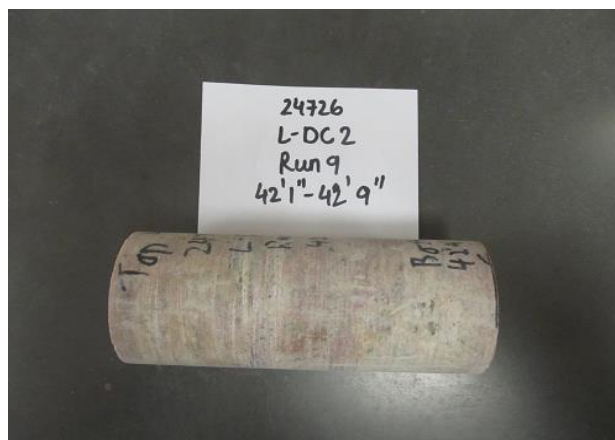
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

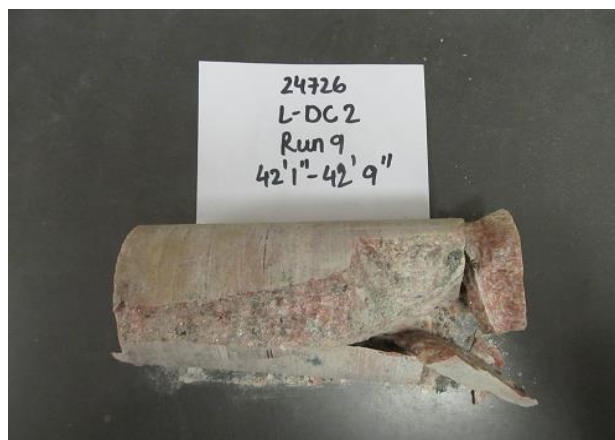
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	L-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 9		
SAMPLE DEPTH:	12.8-13.0 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

L-DC2 RUN 9

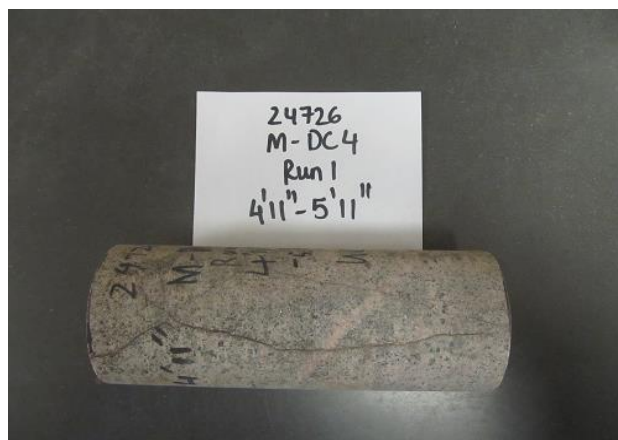
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

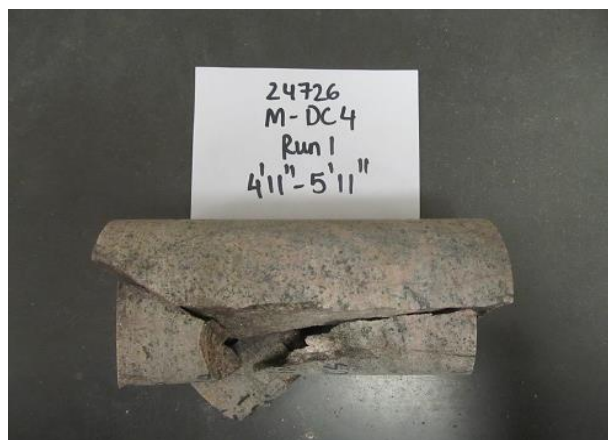
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 1		
SAMPLE DEPTH:	1.5-1.8 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

M-DC4 RUN 1

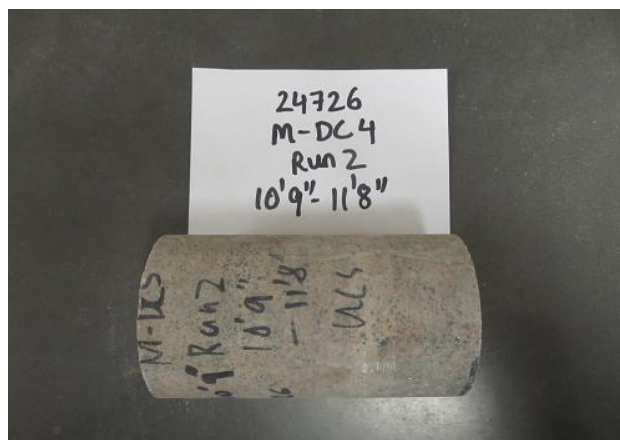
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

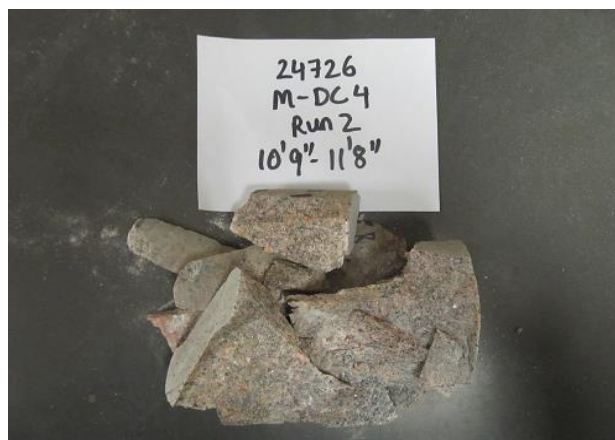
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 2		
SAMPLE DEPTH:	3.3-3.5 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

M-DC4 RUN 2

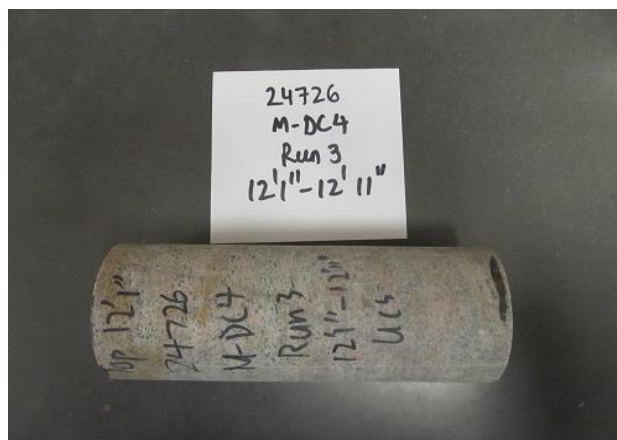
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

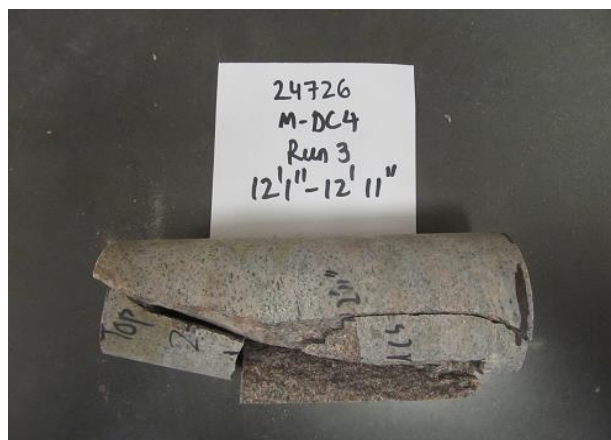
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 3		
SAMPLE DEPTH:	3.7-3.9 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

M-DC4 RUN 3

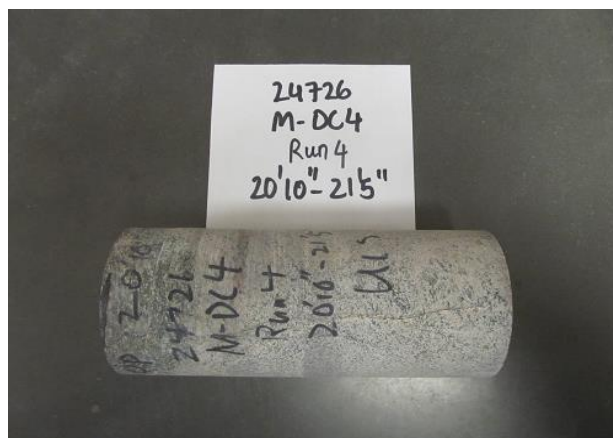
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

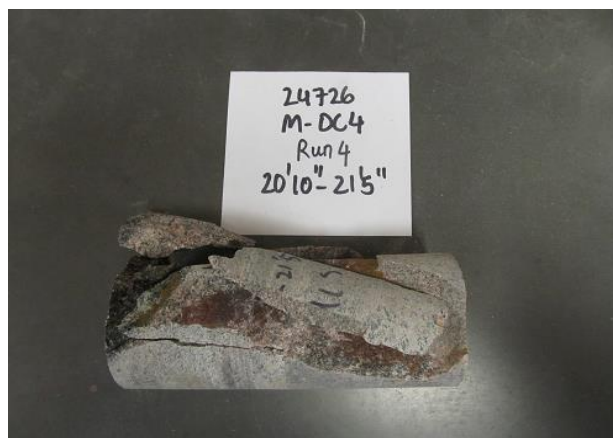
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 4		
SAMPLE DEPTH:	6.3-6.5 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

M-DC4 RUN 4

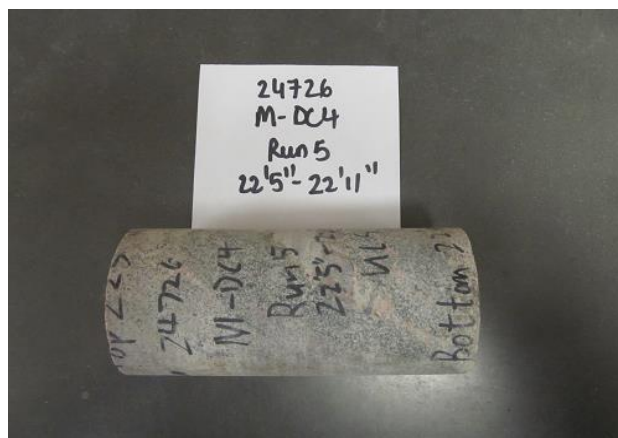
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

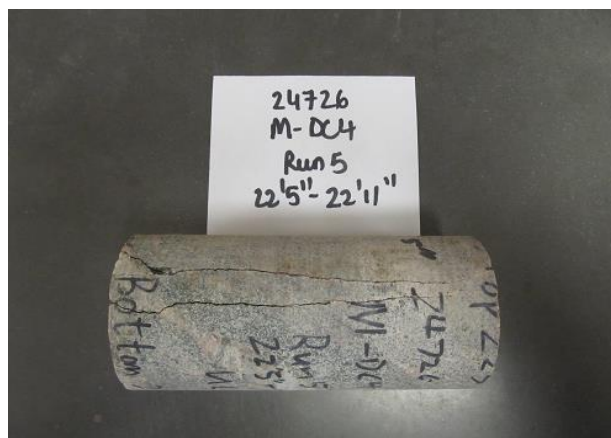
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 5		
SAMPLE DEPTH:	6.8-7.0 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

M-DC4 RUN 5

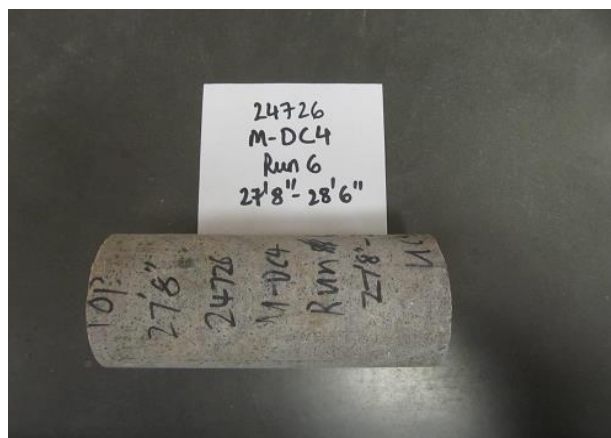
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

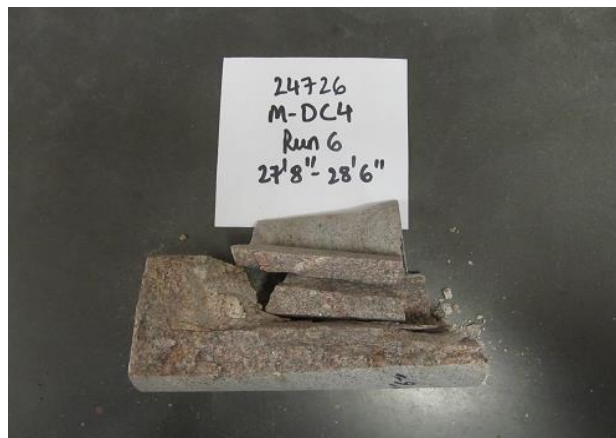
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	M-DC4	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 6		
SAMPLE DEPTH:	8.5-8.7 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

M-DC4 RUN 6

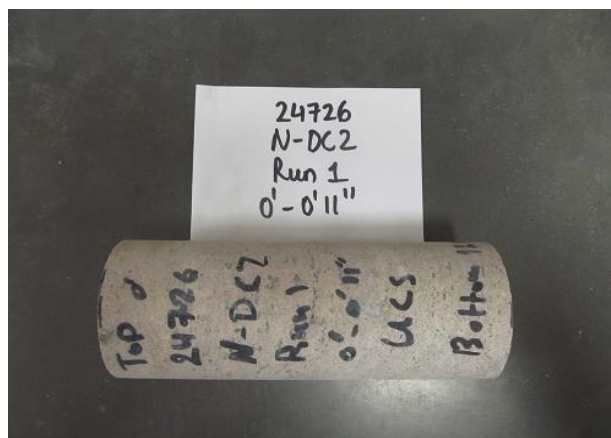
UNCONFINED COMPRESSION TEST REPORT

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 ³):	2,704
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m ³):	2,704
Cross Sectional Area (cm ²):	31.17	Moisture Content (%):	N/A
Sample Volume (cm ³):	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.

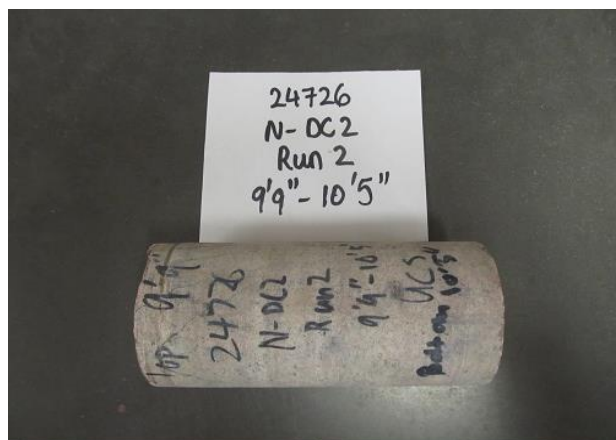
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

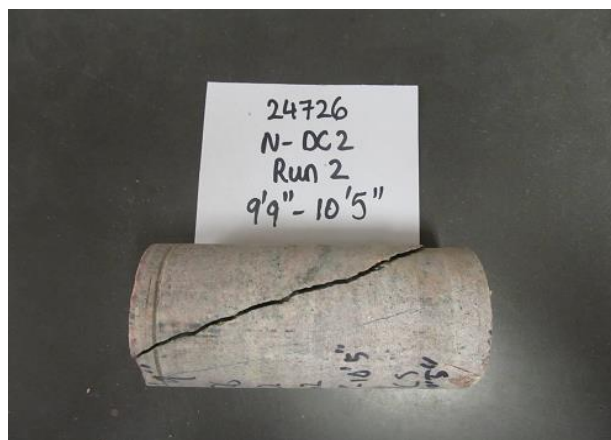
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 2		
SAMPLE DEPTH:	3.0-3.2 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

N-DC2 RUN 2

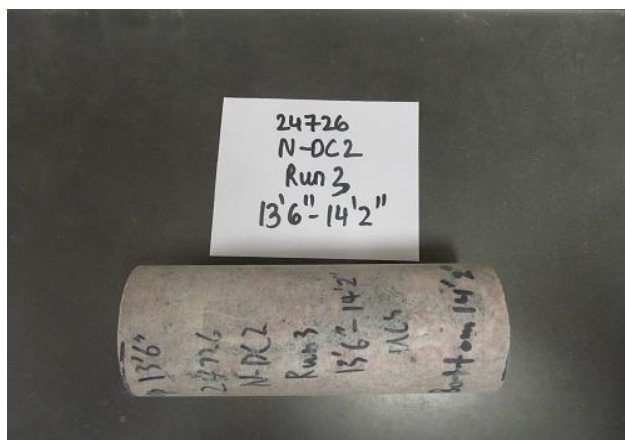
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

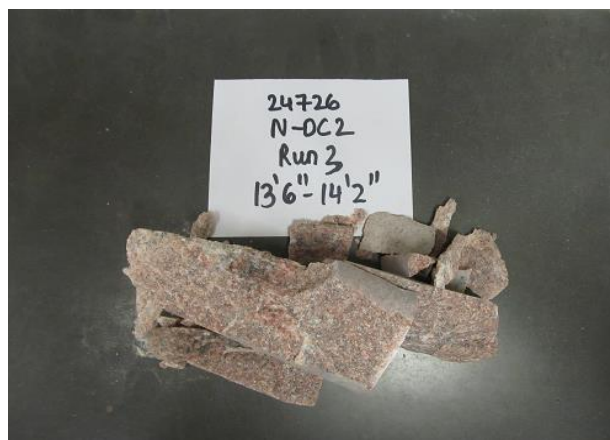
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 3		
SAMPLE DEPTH:	4.0-4.3 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

N-DC2 RUN 3

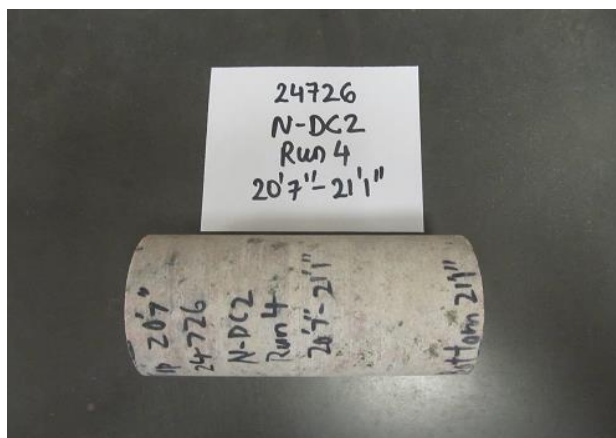
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

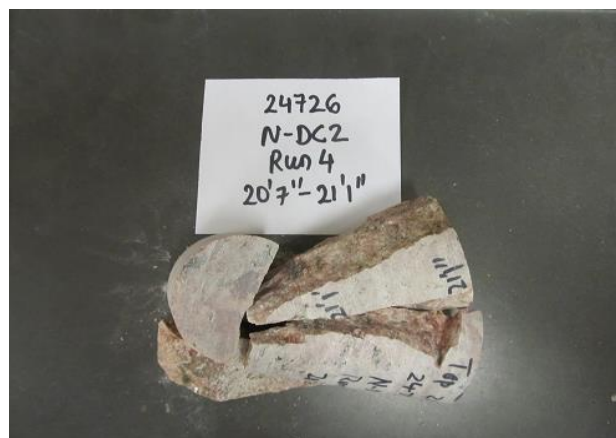
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 4		
SAMPLE DEPTH:	6.25-6.4 m		
DESCRIPTION:	Granite		

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

TEST DONE BY: BS
REVIEWED BY: WM

N-DC2 RUN 4

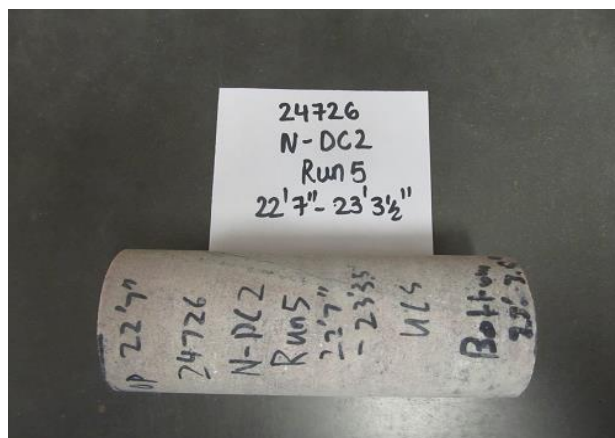
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

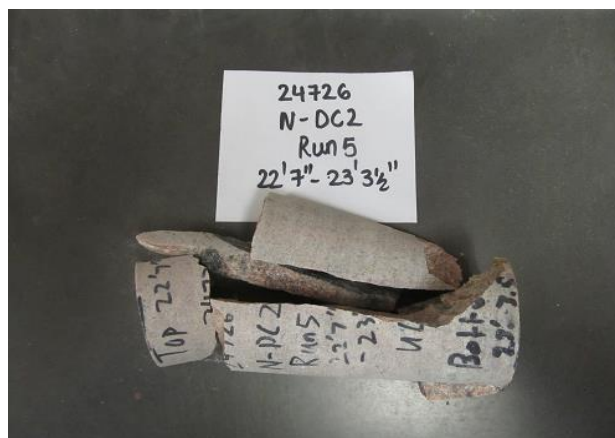
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 5		
SAMPLE DEPTH:	6.9-7.1 m		
DESCRIPTION:	Granite		

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

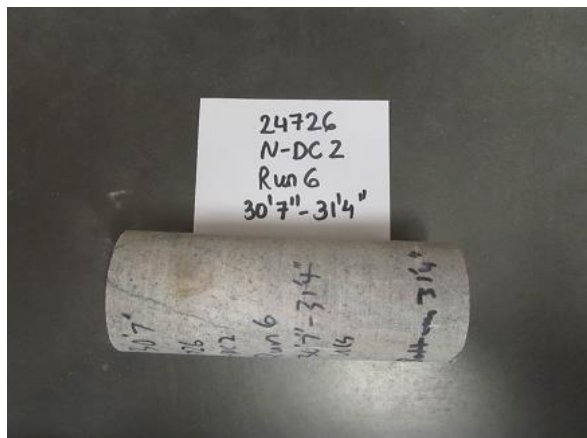
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

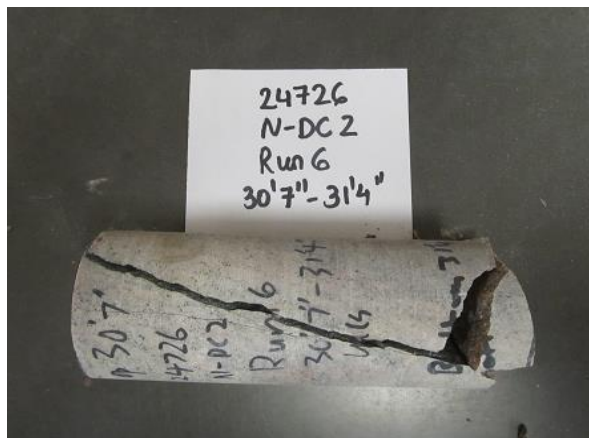
CLIENT:	Ministry of Transportation (MTO)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	29-Jan-21
BOREHOLE No.:	N-DC2	TEST DATE:	6-Jan-21
SAMPLE No.:	RUN 6		
SAMPLE DEPTH:	9.3-9.5 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	15.6	Weight (g):	1362.5
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,802
H. to Dia. Ratio*:	2.5:1	Dry Density (kg/m ³):	2,802
Cross Sectional Area (cm ²):	31.17	Moisture Content (%):	N/A
Sample Volume (cm ³):	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 GOS 19-01
Run 1 to 3 (of 3)
Elevation 156.9 m to 153.4 m

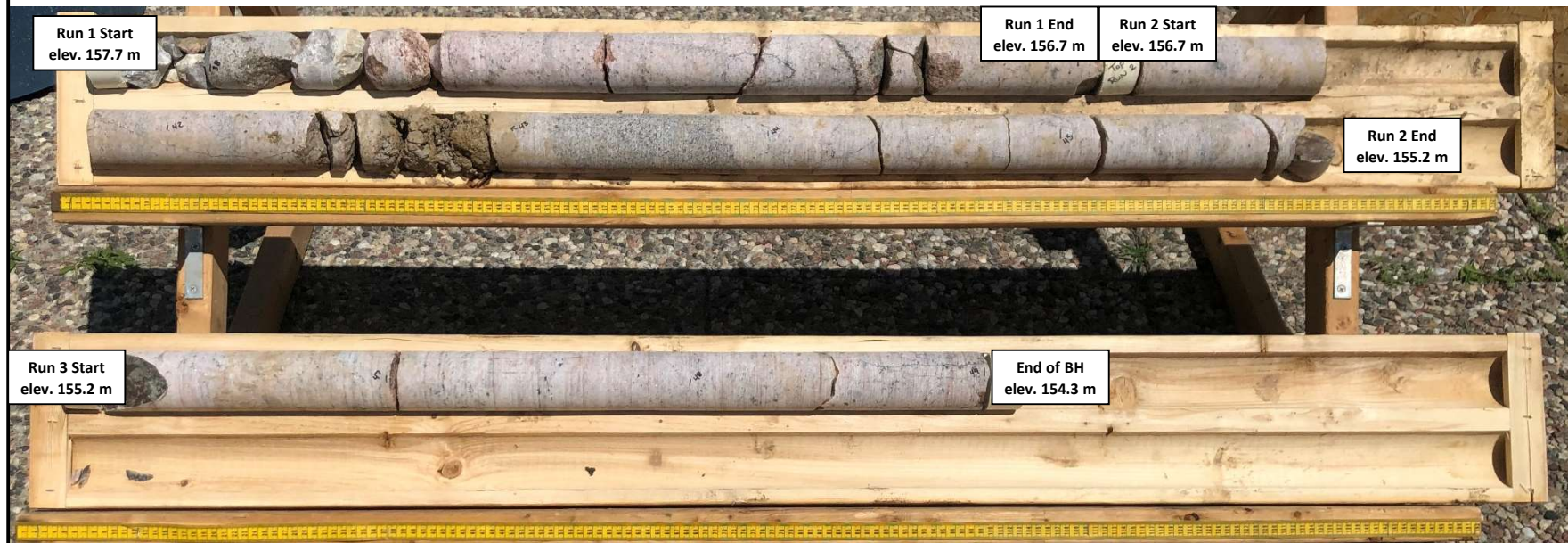


THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH GOS 19-01
Project No.: 24726

Borehole GOS 19-02
Run 1 to 3 (of 3)
Elevation 157.7 m to 154.3 m



THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH GOS 19-02
Project No.: 24726

Borehole GOS 19-03
Run 1 to 3 (of 3)
Elevation 166.6 m to 162.9 m



THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH GOS 19-03
Project No.: 24726

Borehole GOS 19-04
Run 1 to 2 (of 5)
Elevation 165.6 m to 162.0 m

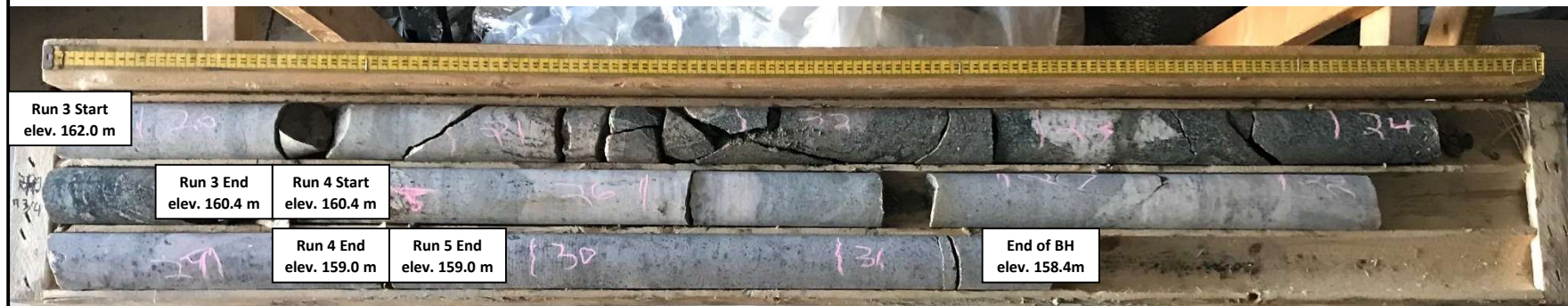


THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH GOS 19-04
Project No.: 24726

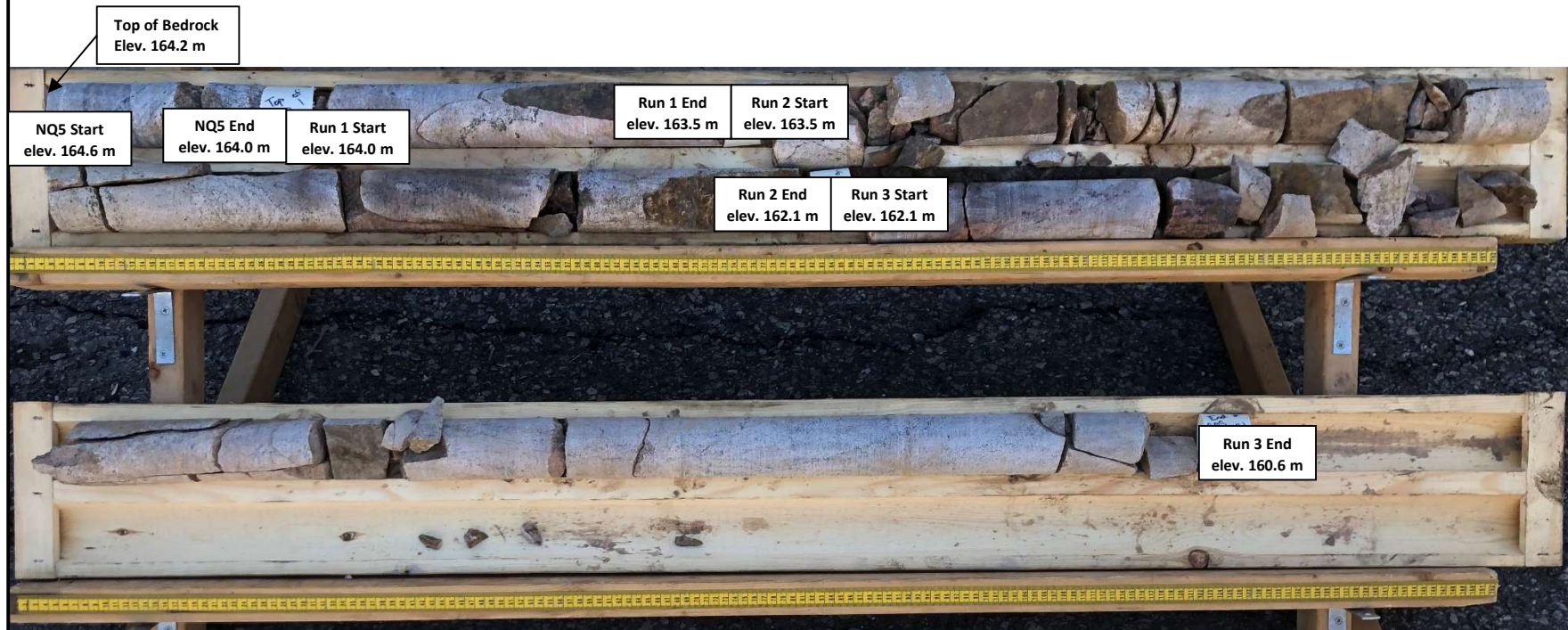
Borehole GOS 19-04
Run 3 to 5 (of 5)
Elevation 162.0 m to 158.4 m



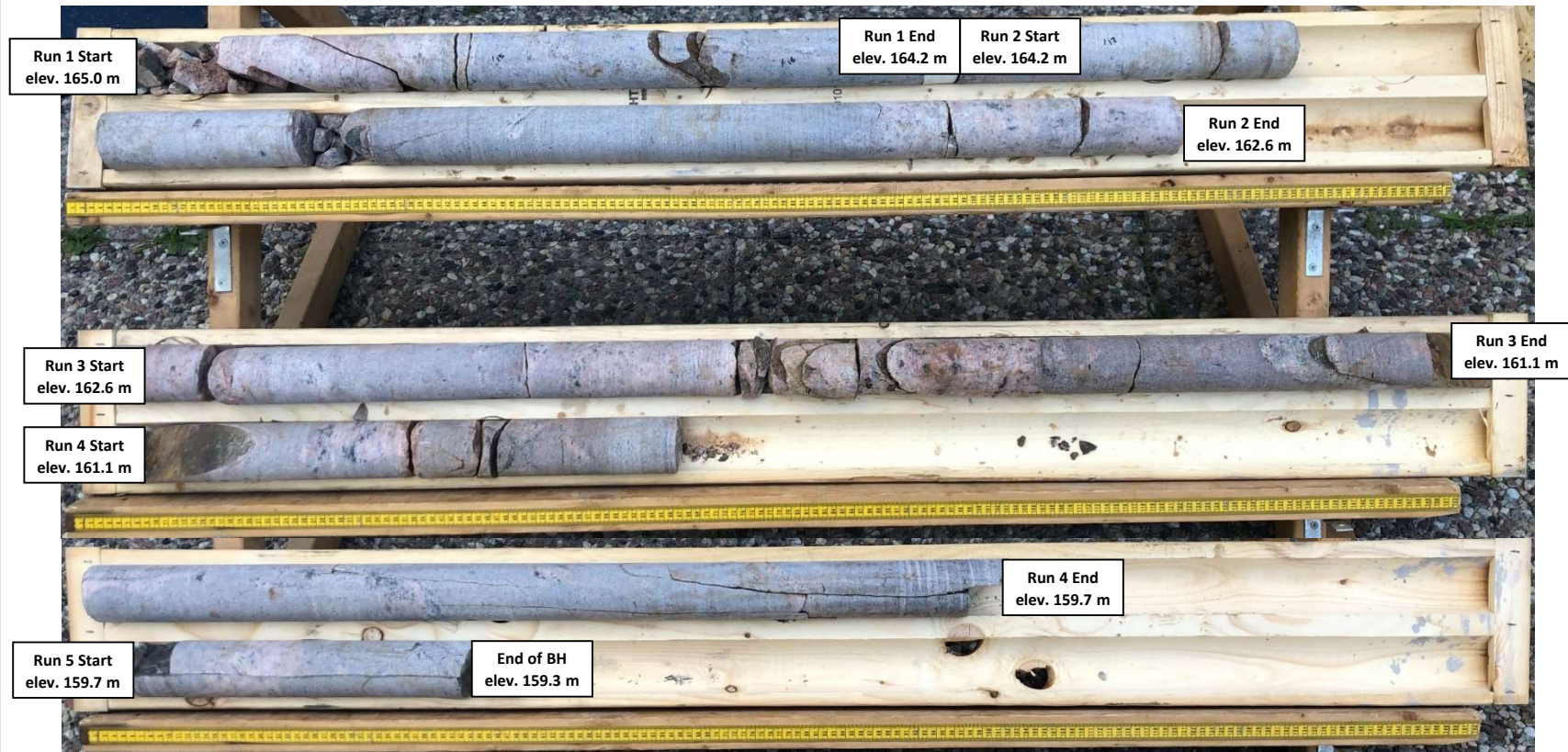
Borehole GOS 19-04W

Run 1 to 3 (of 3)

Elevation 164.6 m to 160.6 m



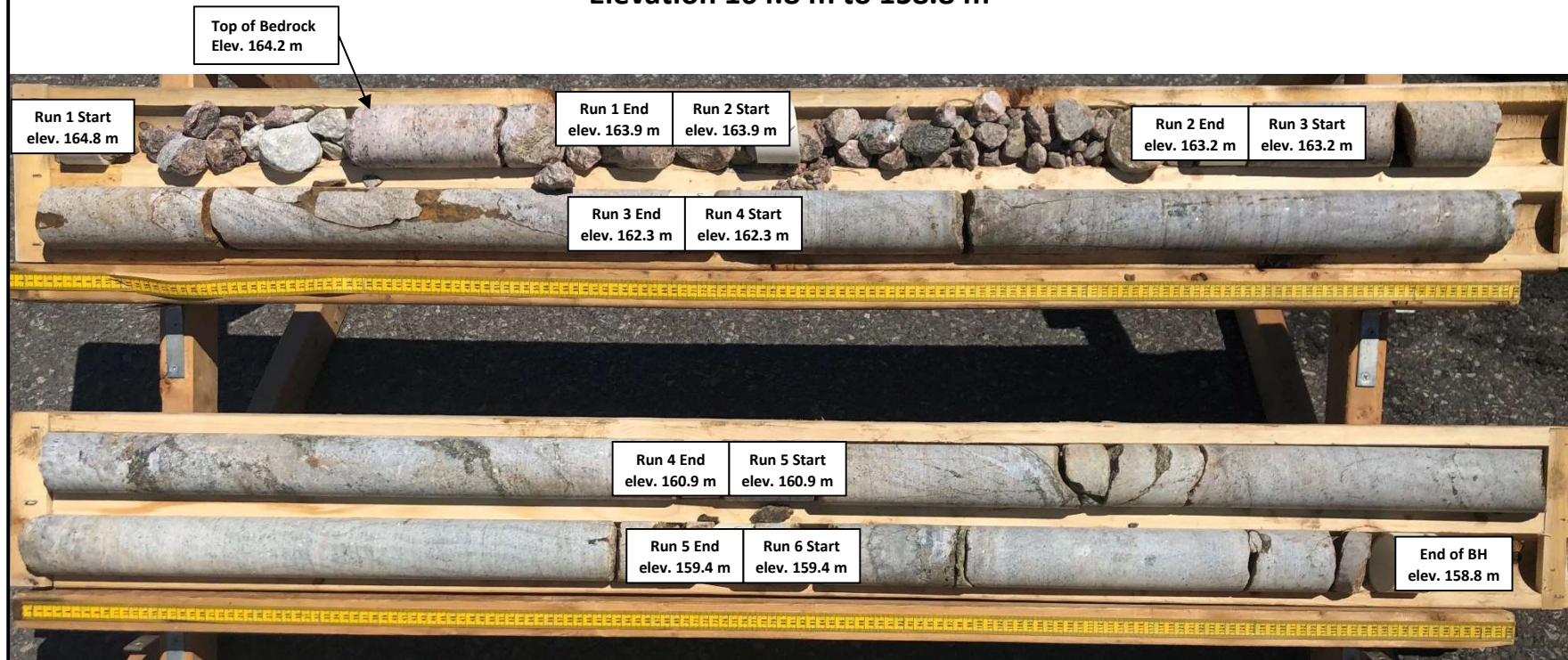
Borehole GOS 19-07
Run 1 to 5 (of 5)
Elevation 165.0 m to 159.3 m



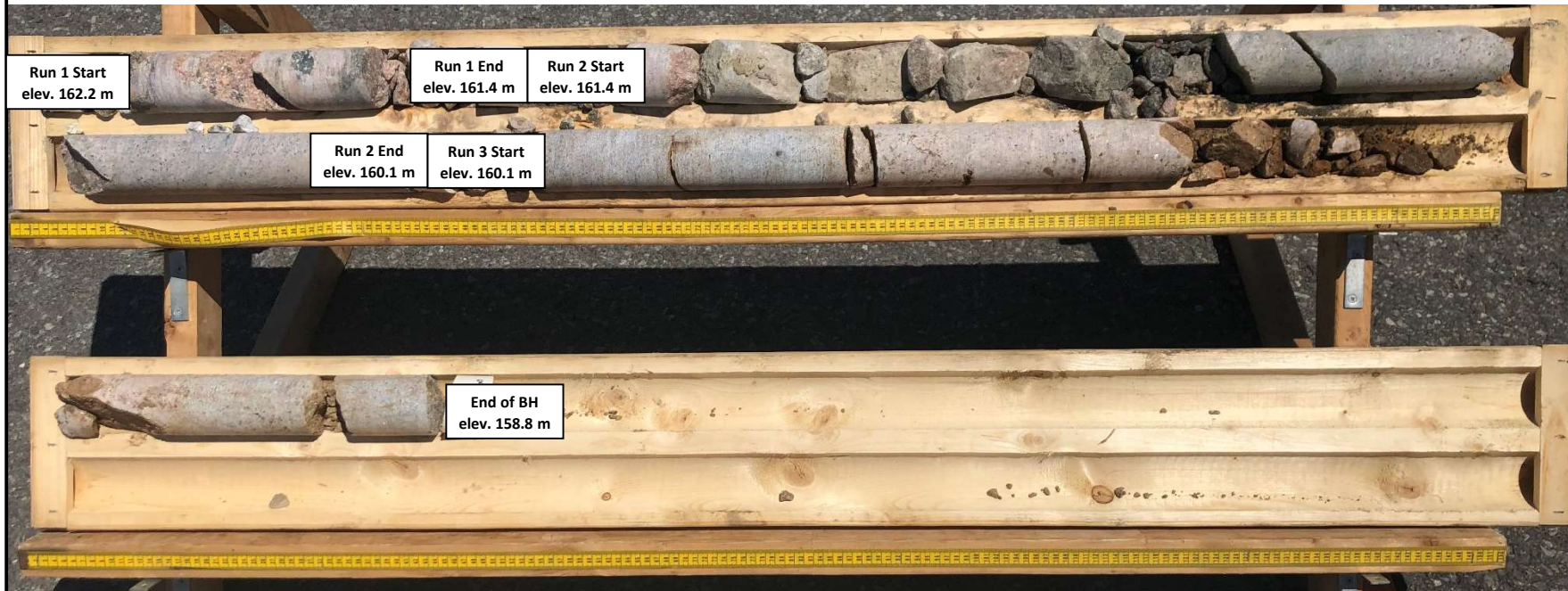
Borehole GOS 19-08
Run 1 to 4 (of 4)
Elevation 166.4 m to 162.0 m



Borehole GOS 19-09
Run 1 to 6 (of 6)
Elevation 164.8 m to 158.8 m



Borehole GOS 19-10
Run 1 to 3 (of 3)
Elevation 162.2 m to 158.8 m



Borehole GOS 19-11
Run 1 to 2 (of 2)
Elevation 162.5 m to 159.2 m



THURBER ENGINEERING LTD.

Geotechnical Investigation
HWY 17 Twinning
Renfrew, Ontario

BH GOS 19-11
Project No.: 24726

Borehole GOS 19-12
Run 1 to 3 (of 3)
Elevation 159.4 m to 156.6 m



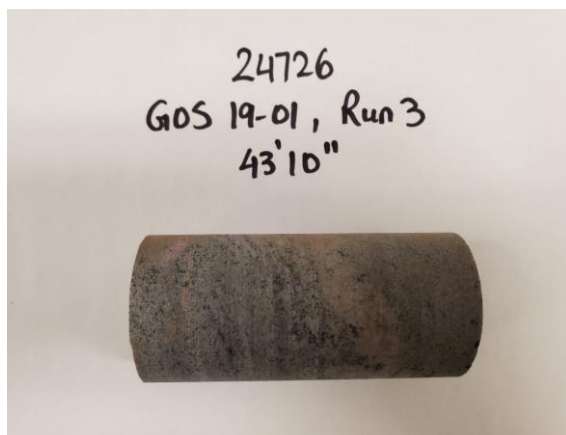
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

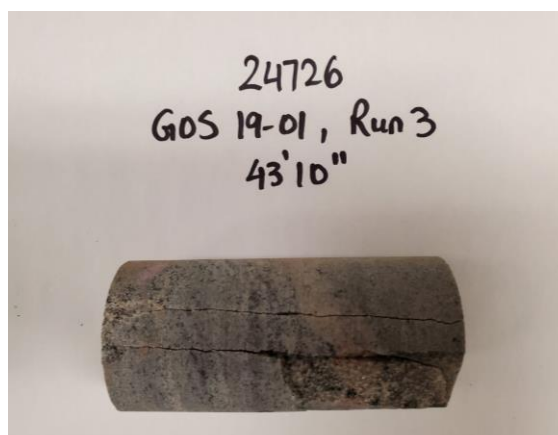
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-01	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 3		
SAMPLE DEPTH:	13.4m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.6	Weight (g):	465.1
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,677
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,677
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	173.72		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.6% / min
MAXIMUM COMPRESSIVE LOAD:	195.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	107.8 MPa

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

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-01 UCS Run 3, 43'10

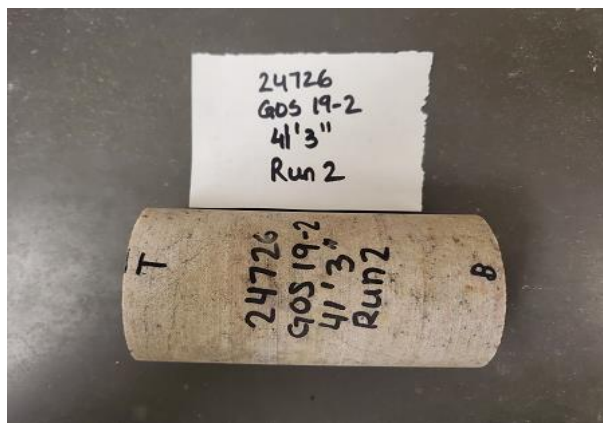
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

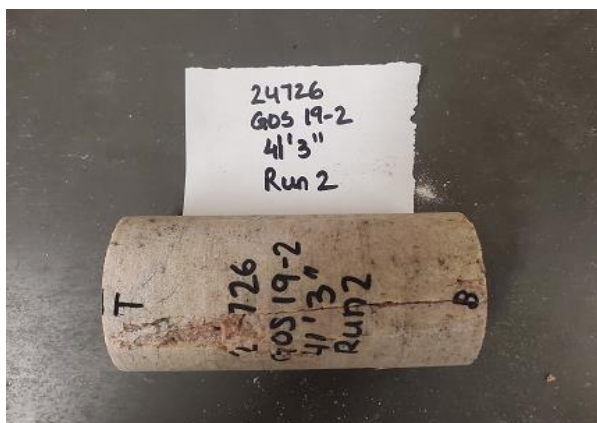
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-02	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 2		
SAMPLE DEPTH:	12.57 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.5	Weight (g):	991.5
Avg. Diameter (cm):	6.2	Wet Density (kg/m ³):	2,627
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,627
Cross Sectional Area (cm ²):	30.19	Moisture Content* (%):	0.0
Sample Volume (cm ³):	377.38		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	350.6 kN
UNCONFINED COMPRESSIVE STRENGTH:	116.1 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-02 Run 2

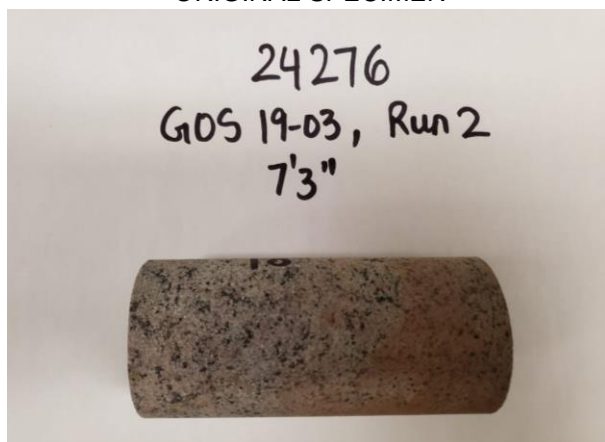
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

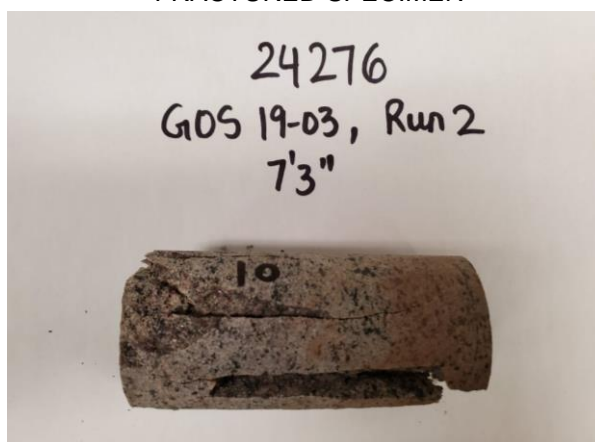
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-03	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	2.2m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.8	Weight (g):	476.9
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,689
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,689
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	177.34		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	161.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	89.5 MPa

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

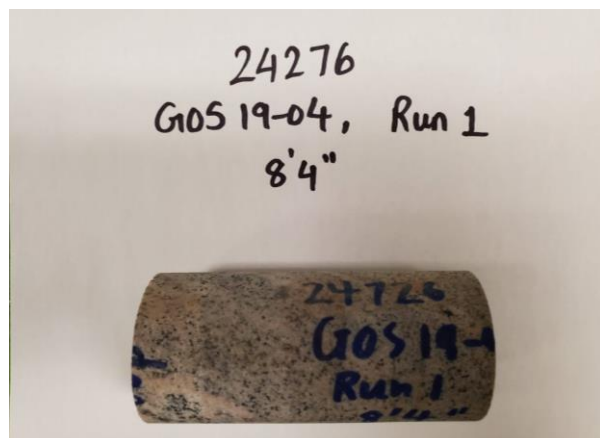
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

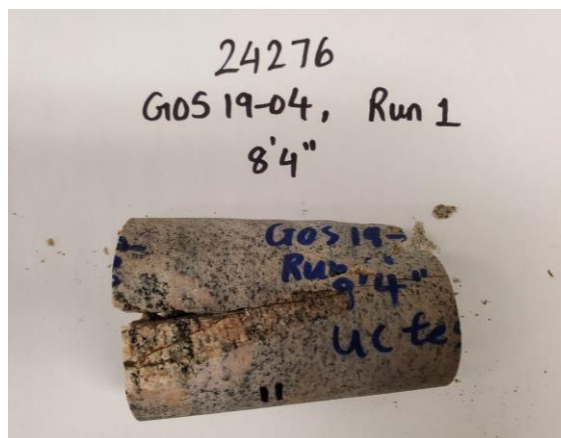
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 1		
SAMPLE DEPTH:	2.5m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.7	Weight (g):	464.4
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,646
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,646
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	164.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	90.7 MPa

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

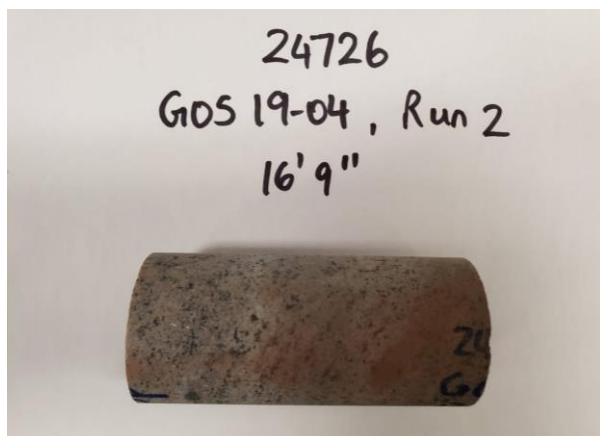
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

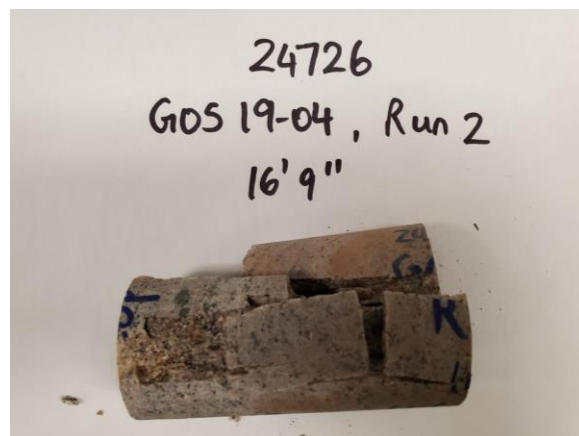
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	5.1m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.7	Weight (g):	468.6
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,670
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,670
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	164.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	90.6 MPa

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

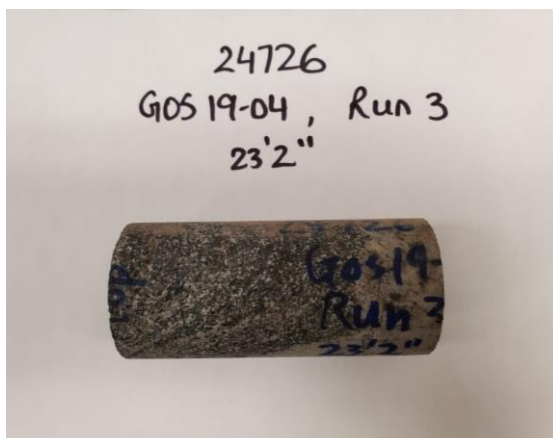
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

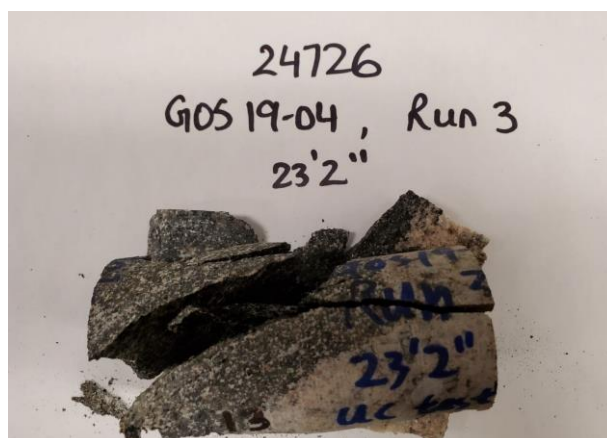
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 3		
SAMPLE DEPTH:	7.1m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.7	Weight (g):	493.8
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,813
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,813
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	159.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	88.0 MPa

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

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-04 UCS Run 3, 23'2

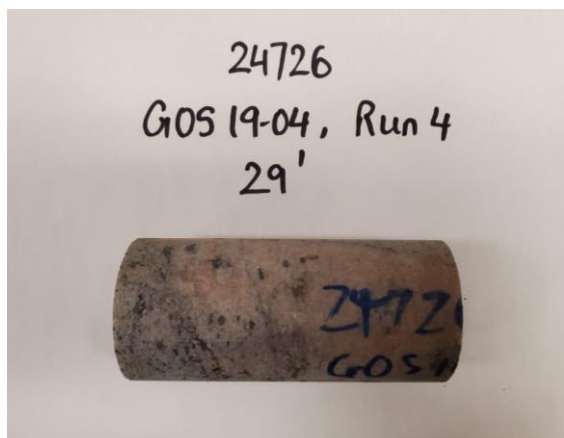
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

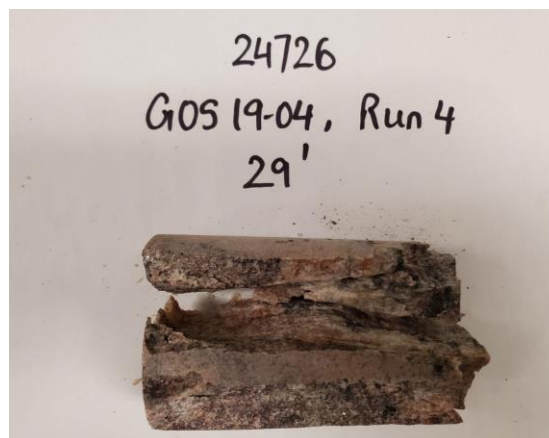
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 4		
SAMPLE DEPTH:	8.8m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.8	Weight (g):	467.9
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,638
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,638
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	177.34		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	205.1 kN
UNCONFINED COMPRESSIVE STRENGTH:	113.3 MPa

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

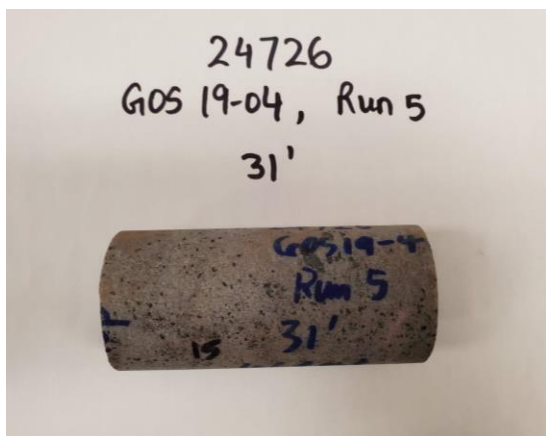
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

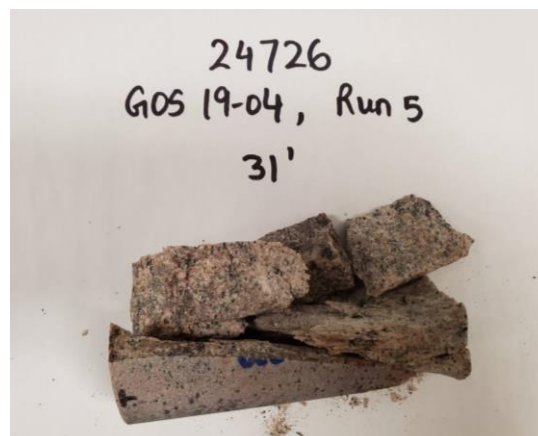
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 5		
SAMPLE DEPTH:	9.4m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.8	Weight (g):	471.2
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,657
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,657
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	177.34		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	222.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	123.1 MPa

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

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-04 UCS Run 5, 31'0

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

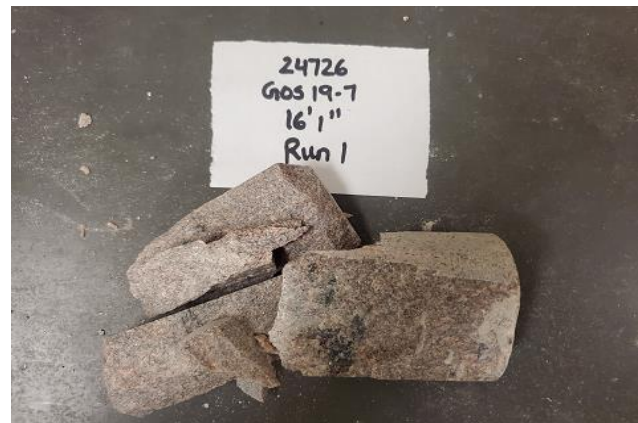
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-07	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 1		
SAMPLE DEPTH:	4.90 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	13.0	Weight (g):	1112.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,746
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,746
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	554.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	177.7 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-07 Run 1

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-07	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 2		
SAMPLE DEPTH:	5.49 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1106.4
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,773
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,773
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	399.01		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	589.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	189.0 MPa

Note: * The moisture content was obtained before the test.
** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

GOS 19-07 Run 2

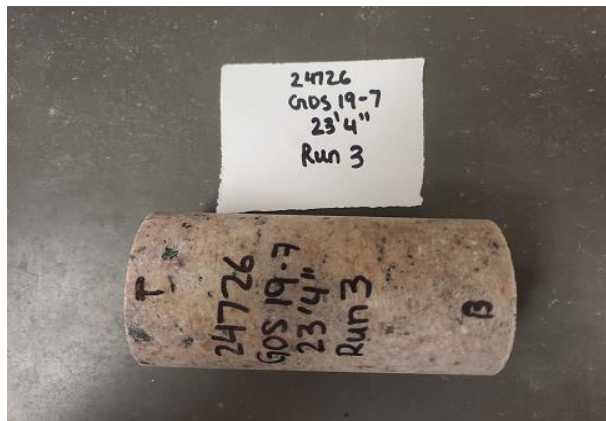
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-07	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 3		
SAMPLE DEPTH:	7.11 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.7	Weight (g):	1045.3
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,640
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,640
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	395.89		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	506.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	162.6 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-07 Run 3

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

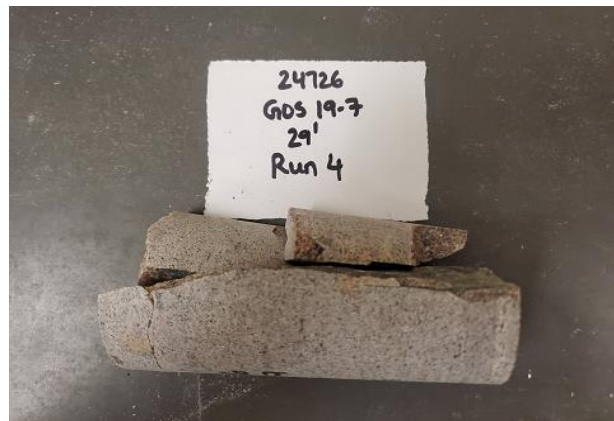
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-07	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 4		
SAMPLE DEPTH:	8.84 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1089.1
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,730
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,730
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	399.01		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	327.5 kN
UNCONFINED COMPRESSIVE STRENGTH:	105.1 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-07 Run 4

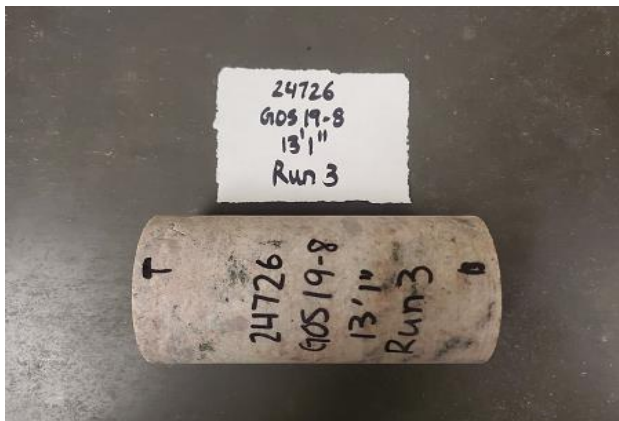
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

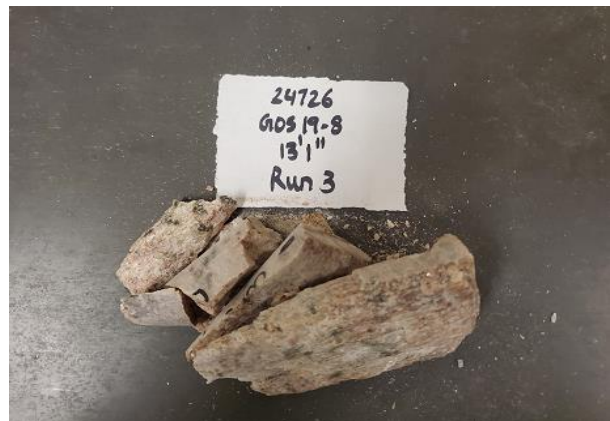
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-08	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 3		
SAMPLE DEPTH:	3.99 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1049.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,630
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,630
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	399.01		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	487.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	156.5 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-08 Run 3

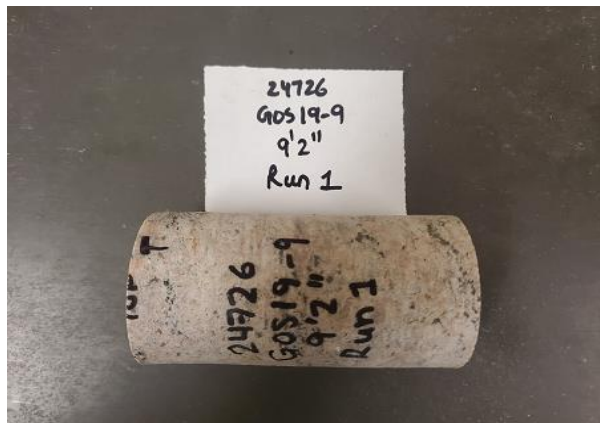
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

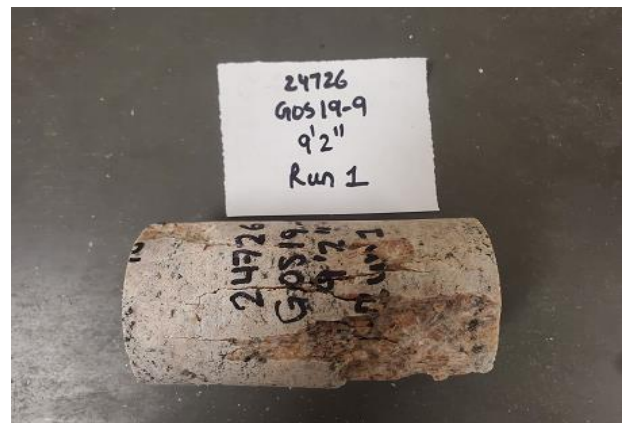
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 1		
SAMPLE DEPTH:	2.79 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	11.6	Weight (g):	930.7
Avg. Diameter (cm):	6.2	Wet Density (kg/m ³):	2,658
H. to Dia. Ratio**:	1.9:1	Dry Density (kg/m ³):	2,658
Cross Sectional Area (cm ²):	30.19	Moisture Content* (%):	0.0
Sample Volume (cm ³):	350.21		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.3% / min
MAXIMUM COMPRESSIVE LOAD:	330.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	109.4 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen do not conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-09 Run 1

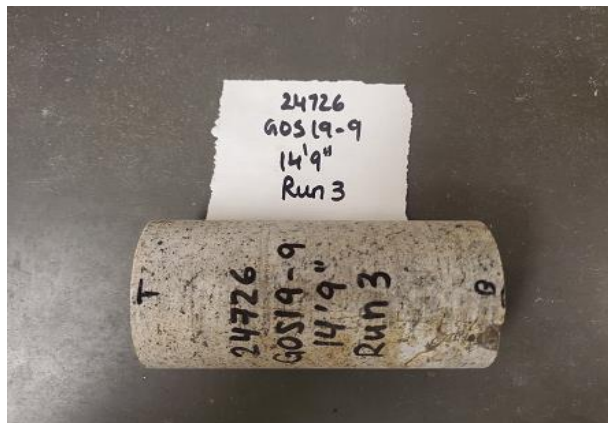
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 3		
SAMPLE DEPTH:	4.5 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.9	Weight (g):	1067.3
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,654
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,654
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	402.12		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	495.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	158.9 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-09 Run 3

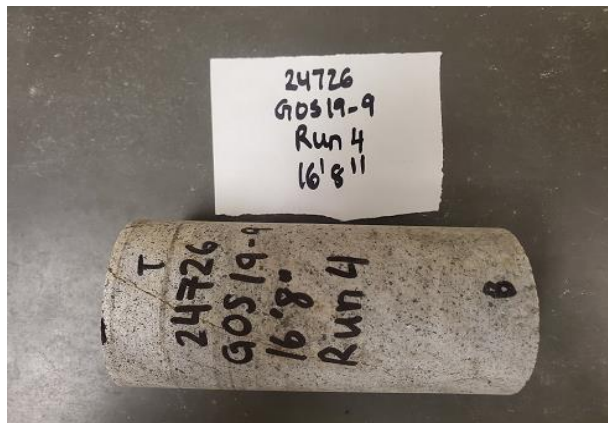
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

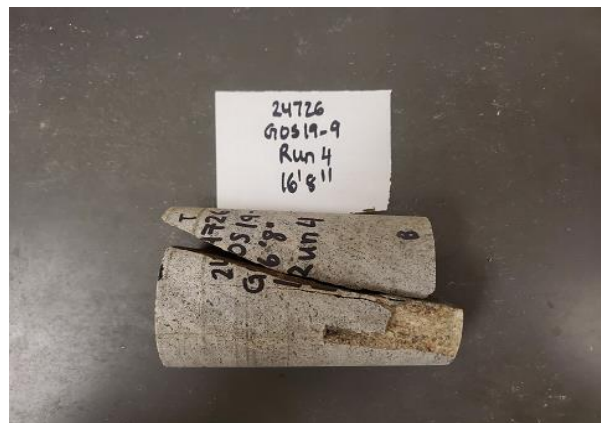
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 4		
SAMPLE DEPTH:	5.08 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	13.0	Weight (g):	1095.8
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,704
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,704
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	367.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	118.0 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-09 Run 4

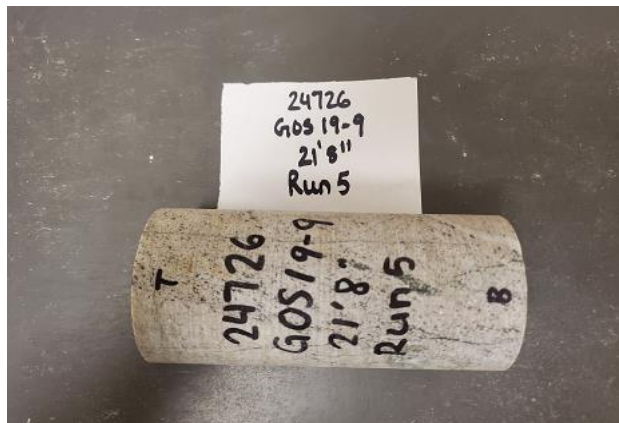
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 5		
SAMPLE DEPTH:	6.60 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.9	Weight (g):	1069.1
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,659
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,659
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	402.12		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	376.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	120.8 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-09 Run 5

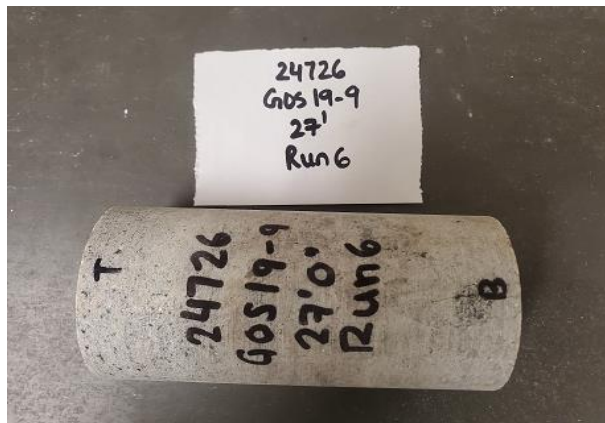
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

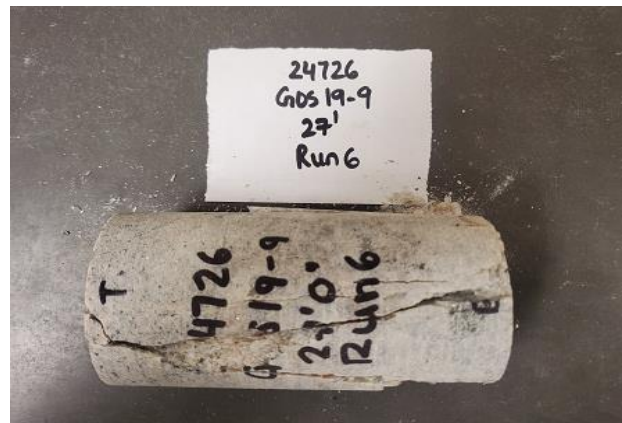
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 6		
SAMPLE DEPTH:	8.23 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1044.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,617
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,617
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	399.01		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	384.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	123.4 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-09 Run 6

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-10	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 2		
SAMPLE DEPTH:	6.25 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	13.0	Weight (g):	1096.7
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,706
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,706
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	521.4 kN
UNCONFINED COMPRESSIVE STRENGTH:	167.3 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-10 Run 2

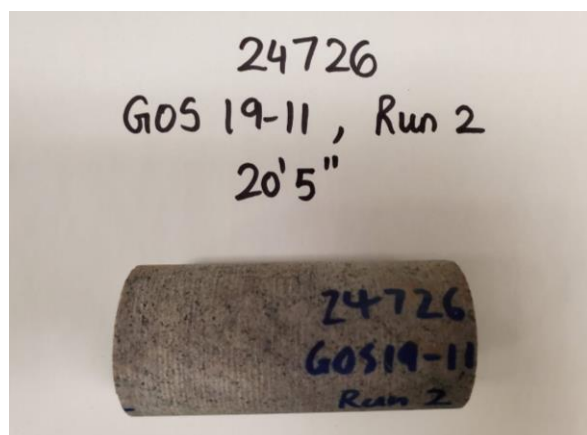
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

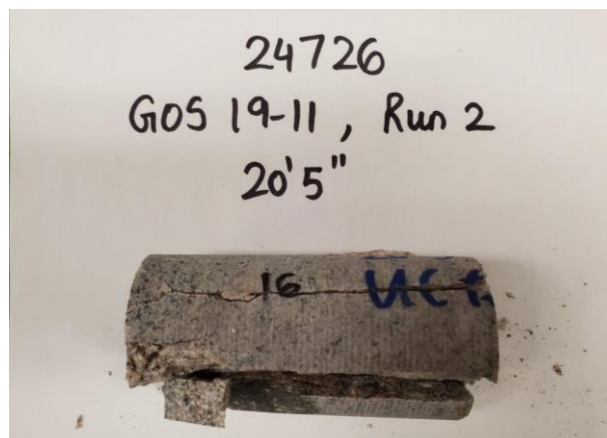
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-11	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	6.2m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.7	Weight (g):	464.7
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,647
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,647
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	205.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	113.8 MPa

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

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-11 UCS Run 2, 20'5

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

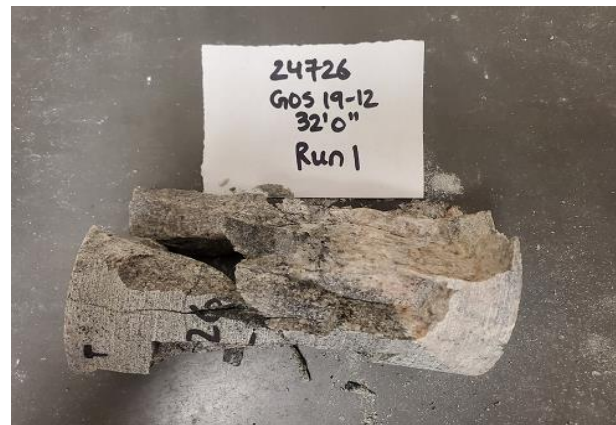
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-12	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 1		
SAMPLE DEPTH:	9.75 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1051.4
Avg. Diameter (cm):	6.2	Wet Density (kg/m ³):	2,721
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,721
Cross Sectional Area (cm ²):	30.19	Moisture Content* (%):	0.0
Sample Volume (cm ³):	386.44		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	366.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	121.5 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-12 Run 1



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)



Photo 11. Looking east on Goshen Rd., north of Highway 17 (2020/07/02)



Photo 12. Looking west on Goshen Rd., north of Highway 17 (2020/07/02)



Photo 13. Existing Rock Cut Site 17-3, near 12+355 Left (2020/06/09)

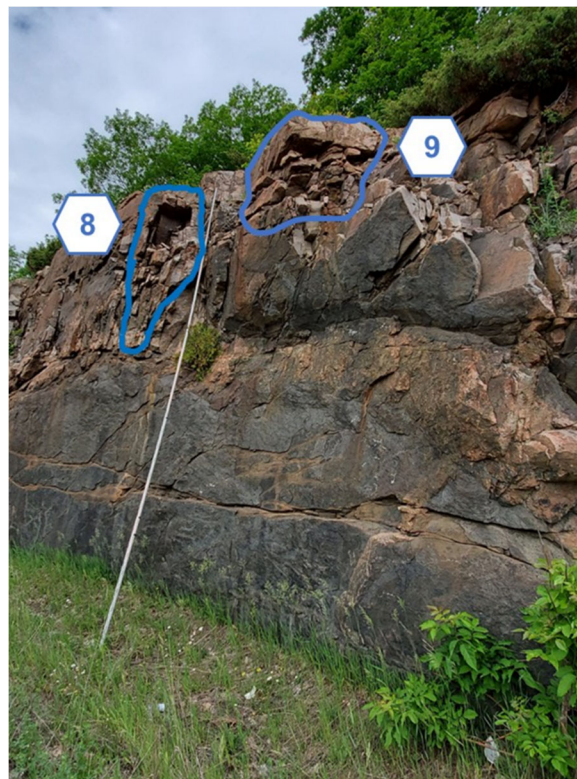


Photo 14. Existing Rock Cut Site 17-3, near 12+355 Left (2020/06/09)

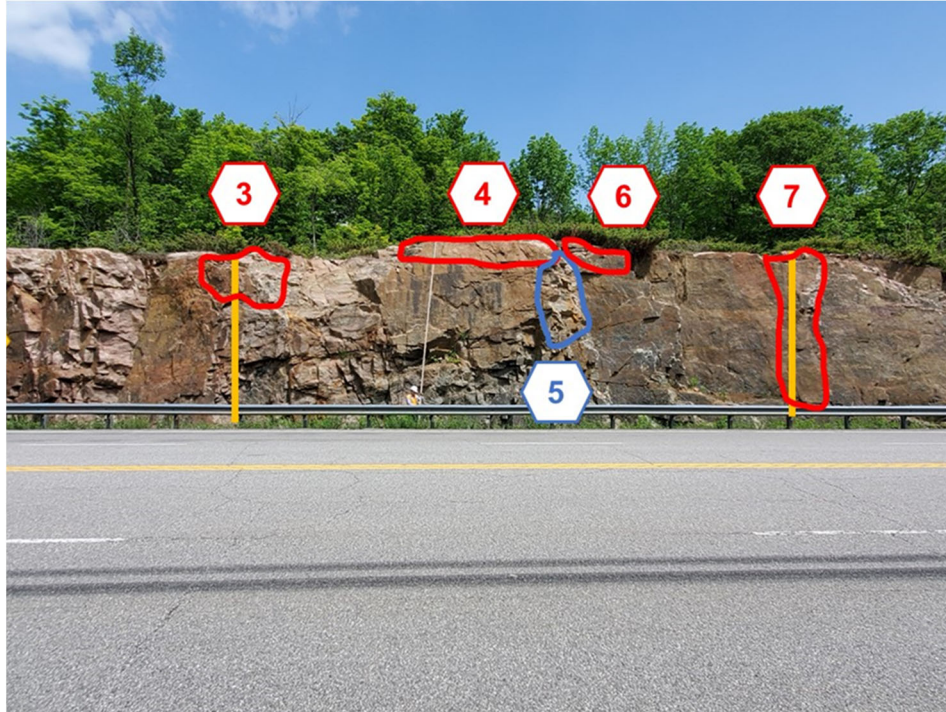


Photo 15. Existing Rock Cut Site E-17-1, near 12+640 Left (2020/06/09)

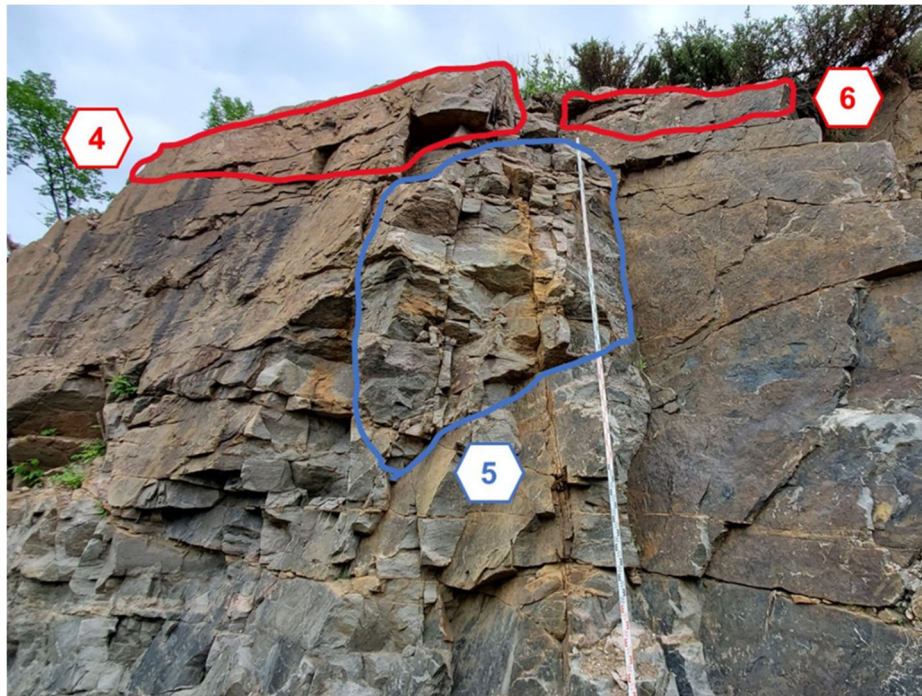


Photo 16. Existing Rock Cut Site E-17-1, near 12+640 Left (2020/06/09)



Photo 17. Existing Rock Cut Site E-17-1, near 12+680 Left (2020/06/09)

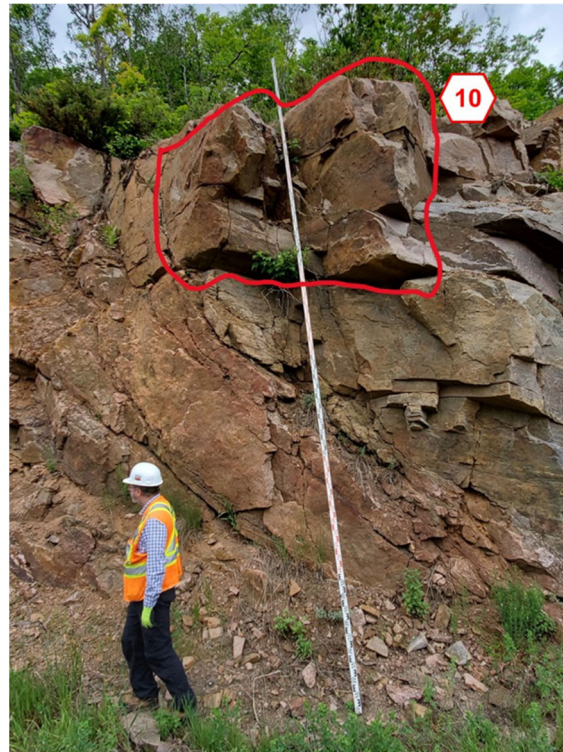


Photo 18. Existing Rock Cut Site E-17-1, near 12+680 Left (2020/06/09)

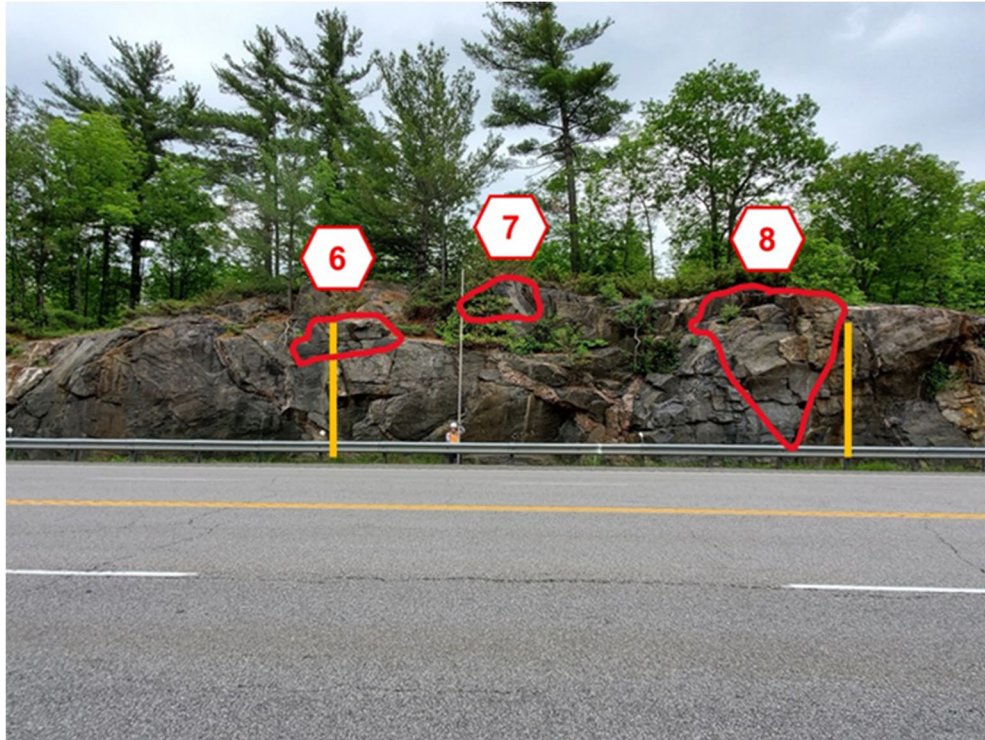


Photo 19. Existing Rock Cut Site 17-2, near 12+750 Right (2020/06/09)

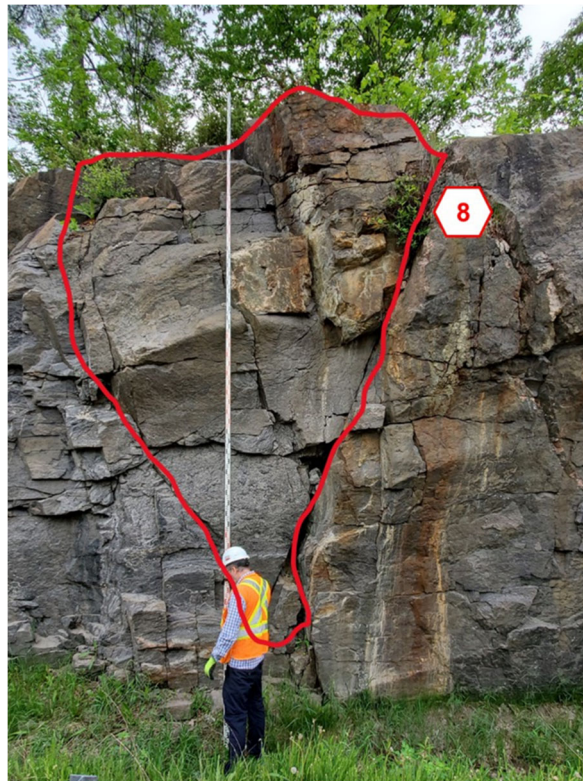
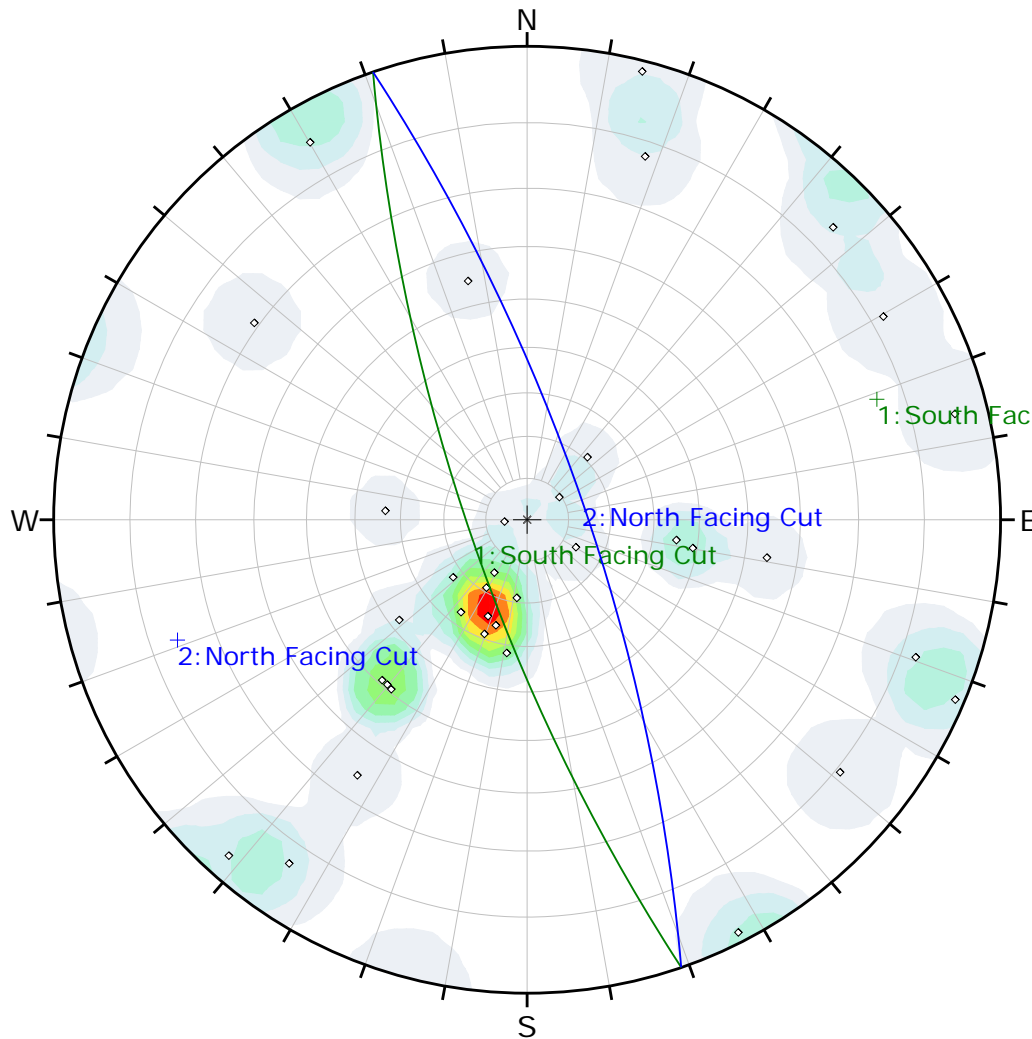


Photo 20. Existing Rock Cut Site 17-2, near 12+750 Right (2020/06/09)



Appendix E.

Analysis Outputs



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.50
	1.50 - 3.00
	3.00 - 4.50
	4.50 - 6.00
	6.00 - 7.50
	7.50 - 9.00
	9.00 - 10.50
	10.50 - 12.00
	12.00 - 13.50
	13.50 - 15.00

Contour Data	Pole Vectors
Maximum Density	14.91%
Contour Distribution	Fisher
Counting Circle Size	1.0%

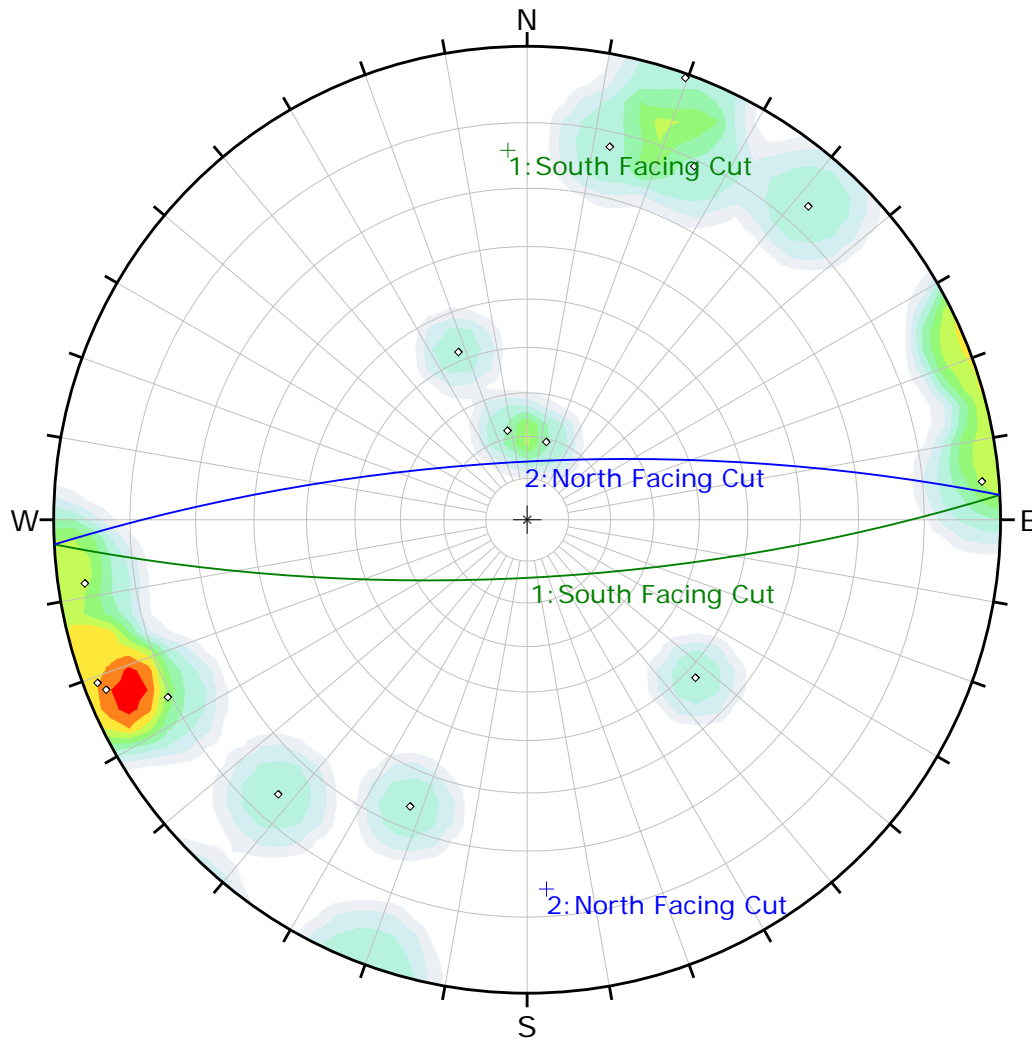
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	251	South Facing Cut
2	■	76	71	North Facing Cut

Plot Mode	Pole Vectors
Vector Count	36 (36 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site B		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	B-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.90
	1.90 - 3.80
	3.80 - 5.70
	5.70 - 7.60
	7.60 - 9.50
	9.50 - 11.40
	11.40 - 13.30
	13.30 - 15.20
	15.20 - 17.10
	17.10 - 19.00

Contour Data	Pole Vectors
Maximum Density	18.40%
Contour Distribution	Fisher
Counting Circle Size	1.0%

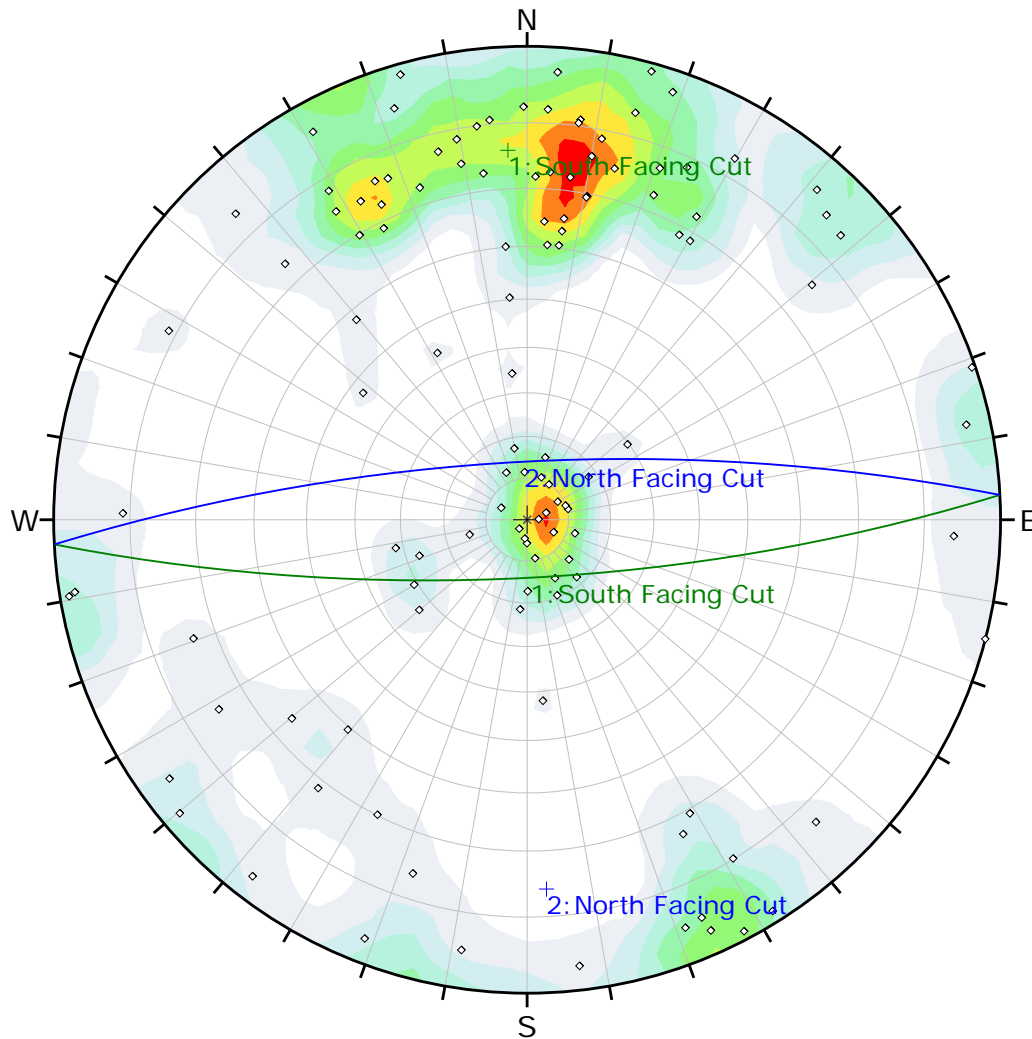
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Cut
2	■	76	357	North Facing Cut

Plot Mode	Pole Vectors
Vector Count	15 (15 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site K		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	K-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.76%
Contour Distribution	Fisher
Counting Circle Size	1.0%

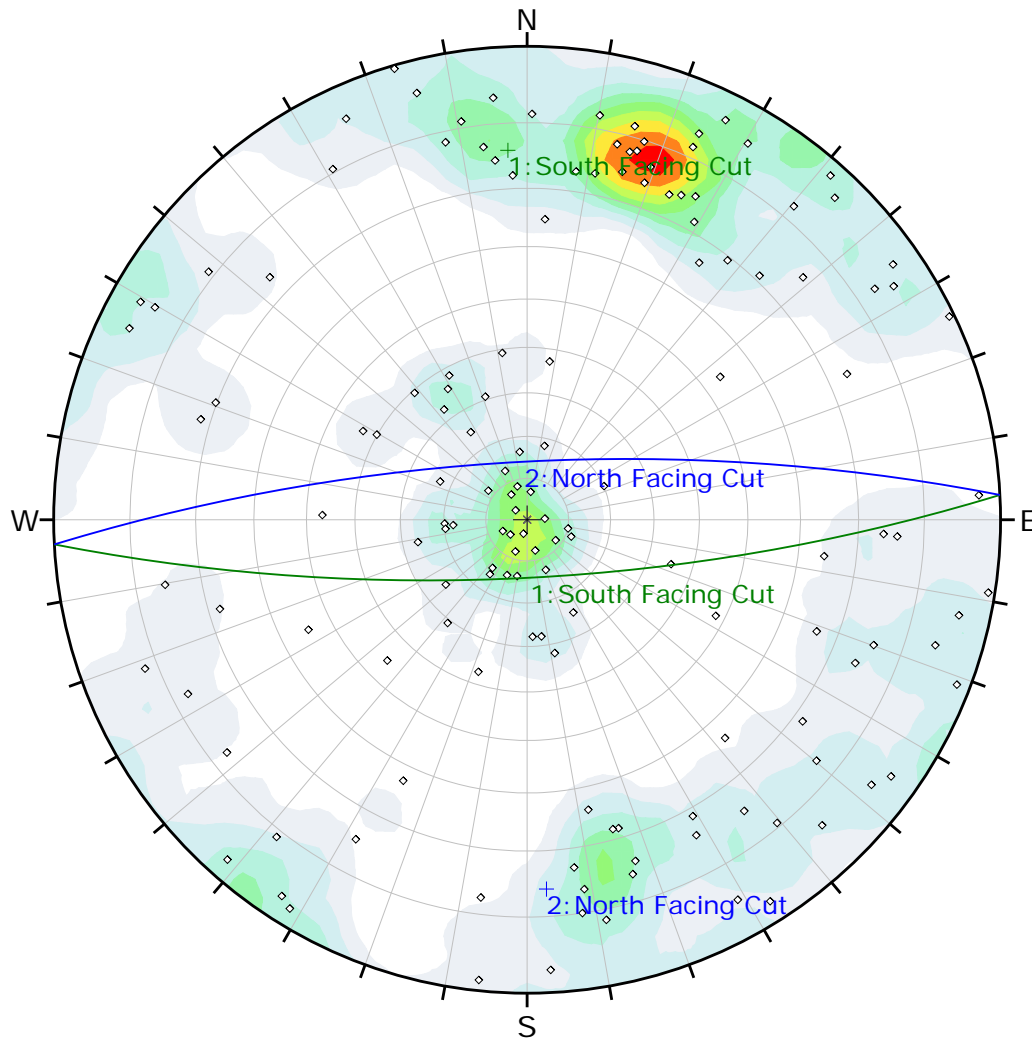
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Cut
2	■	76	357	North Facing Cut

Plot Mode	Pole Vectors
Vector Count	120 (120 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site L		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	L-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

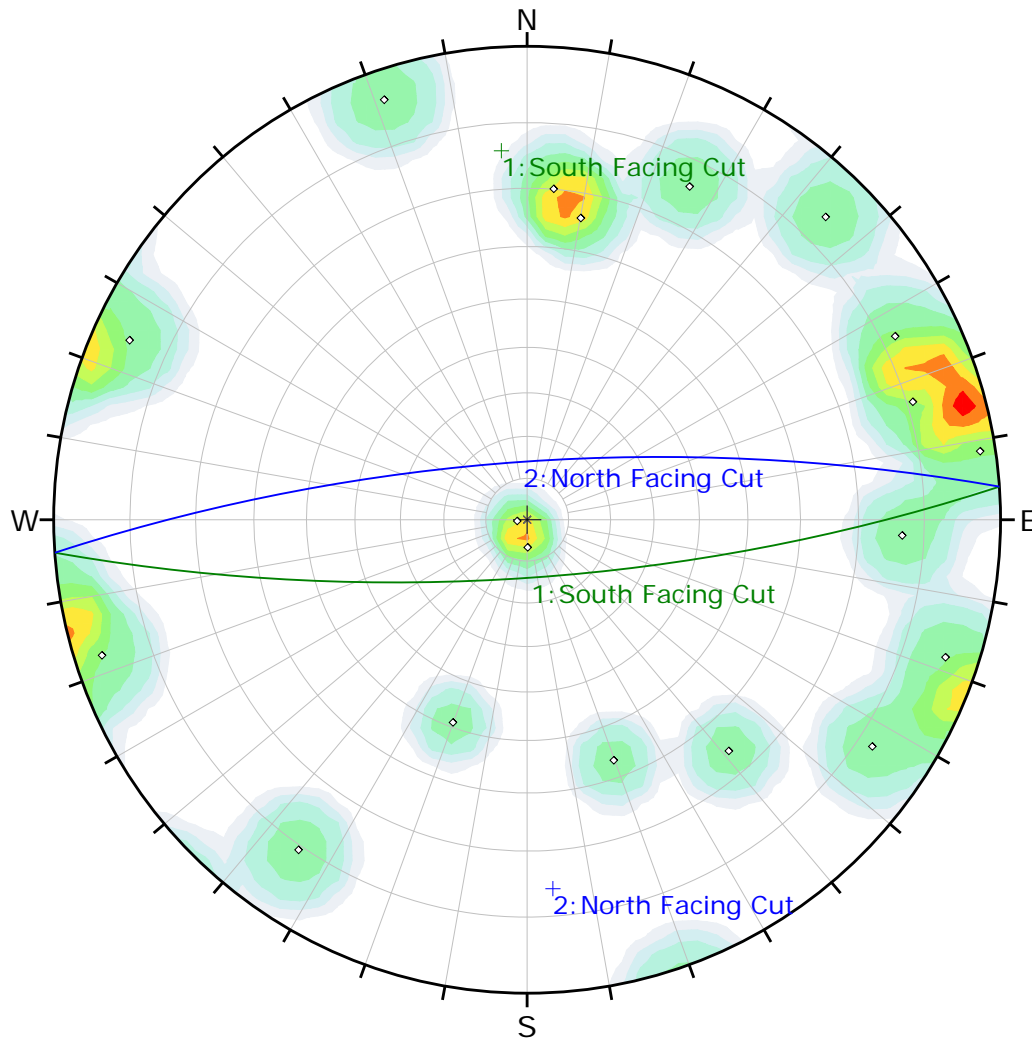
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Cut
2	■	76	357	North Facing Cut

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.20
	1.20 - 2.40
	2.40 - 3.60
	3.60 - 4.80
	4.80 - 6.00
	6.00 - 7.20
	7.20 - 8.40
	8.40 - 9.60
	9.60 - 10.80
	10.80 - 12.00

Contour Data	Pole Vectors
Maximum Density	11.84%
Contour Distribution	Fisher
Counting Circle Size	1.0%

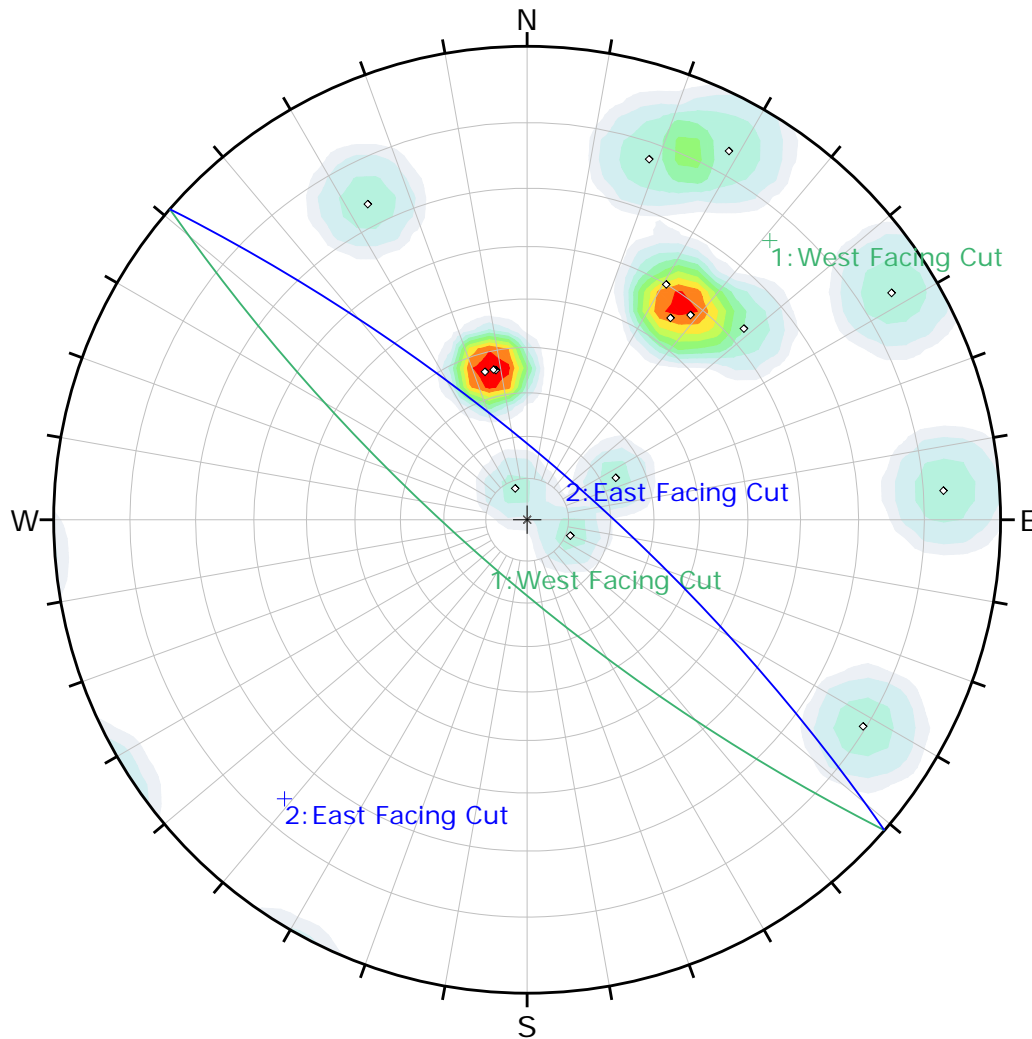
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	176	South Facing Cut
2	■	76	356	North Facing Cut

Plot Mode	Pole Vectors
Vector Count	19 (19 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site N		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	N-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.90
	1.90 - 3.80
	3.80 - 5.70
	5.70 - 7.60
	7.60 - 9.50
	9.50 - 11.40
	11.40 - 13.30
	13.30 - 15.20
	15.20 - 17.10
	17.10 - 19.00

Contour Data	Pole Vectors
Maximum Density	18.61%
Contour Distribution	Fisher
Counting Circle Size	1.0%

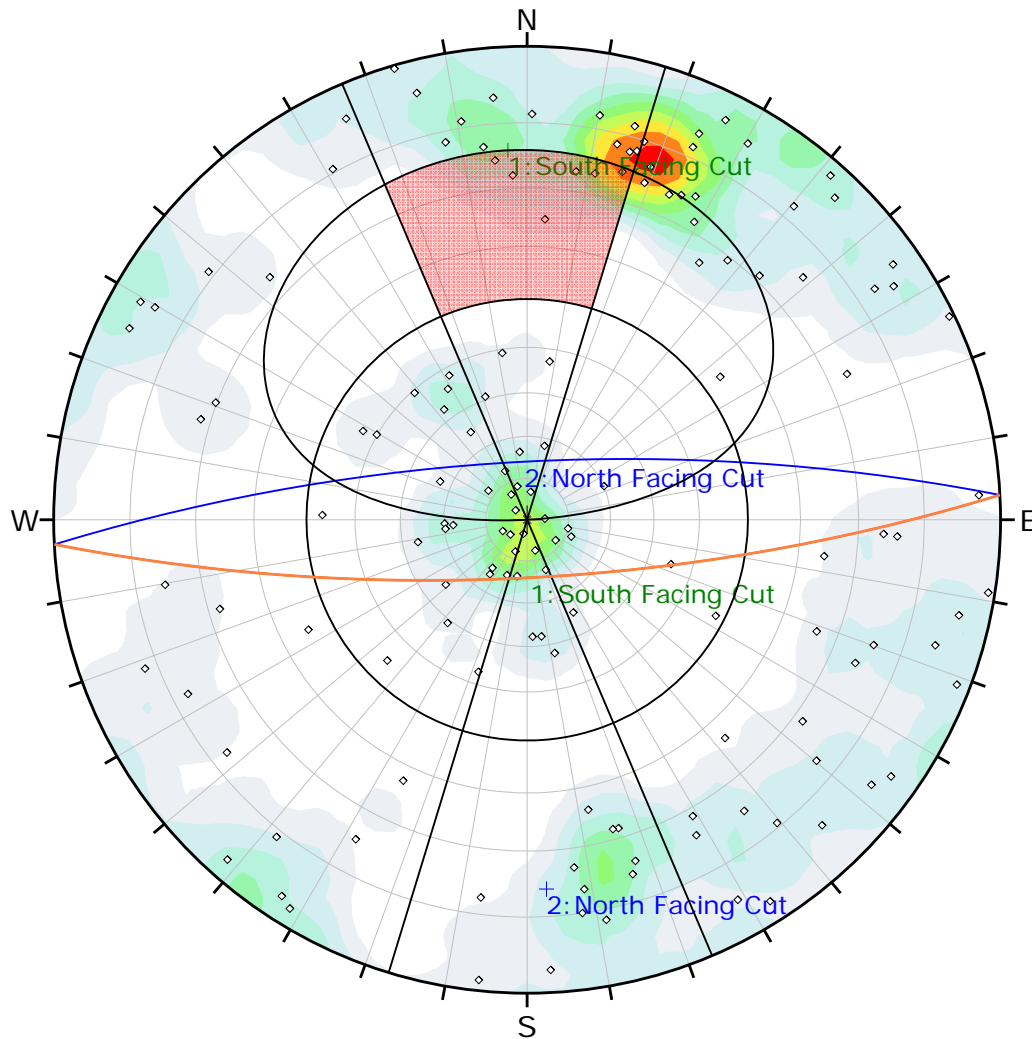
	Color	Dip	Dip Direction	Label
User Planes				
1		76	221	West Facing Cu
2		76	41	East Facing Cut

Plot Mode	Pole Vectors
Vector Count	16 (16 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

<i>Project</i>	Highway 17 Twinning		
<i>Analysis Description</i>	Goshen Road		
<i>Drawn By</i>	DP	<i>Company</i>	Thurber Engineering Ltd.
<i>Date</i>	7/8/2020, 8:49:17 AM	<i>File Name</i>	Goshen Rd.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding		
Slope Dip	76		
Slope Dip Direction	177		
Friction Angle	50°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	6	147	4.08%

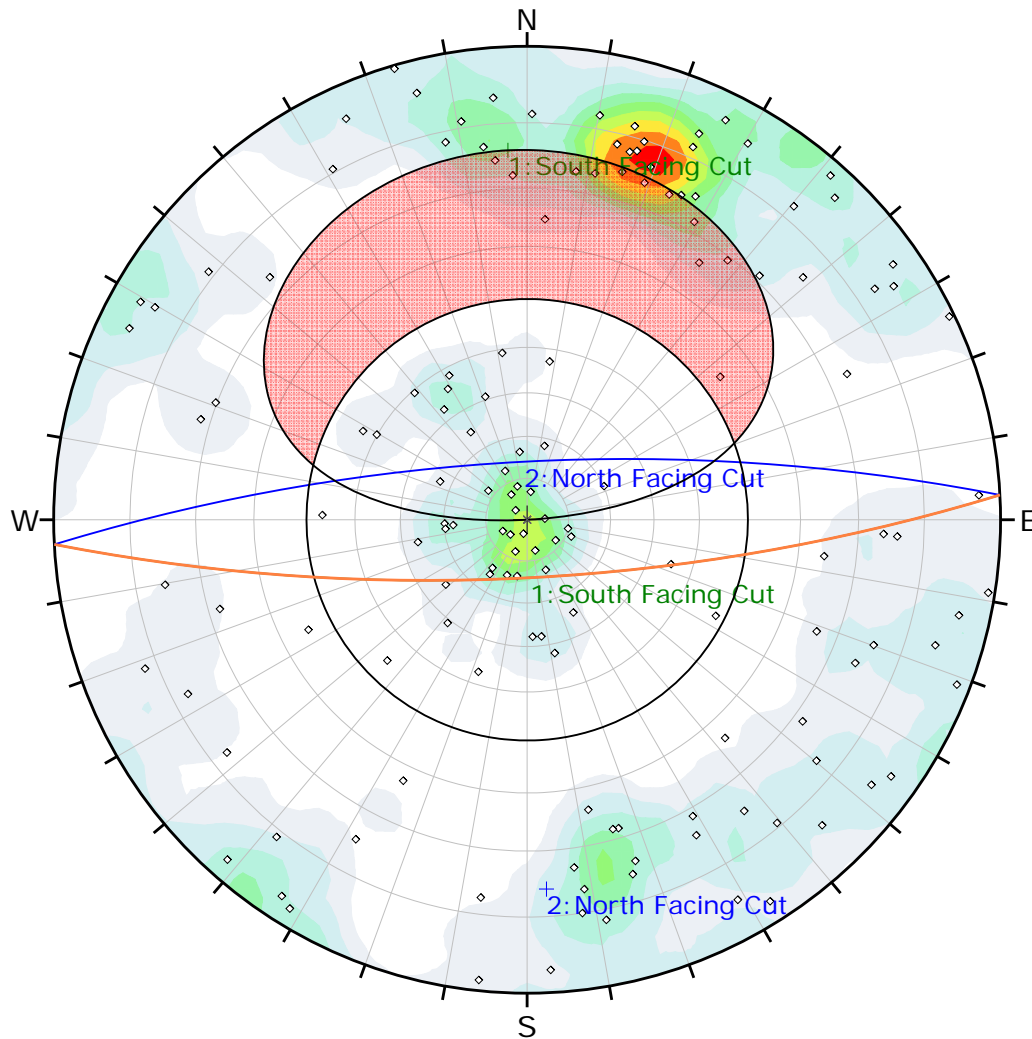
	Color	Dip	Dip Direction	Label
User Planes				
1		76	177	South Facing Cu
2		76	357	North Facing Cu

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	76
Slope Dip Direction	177
Friction Angle	50°

	Critical	Total	%
Planar Sliding (All)	12	147	8.16%

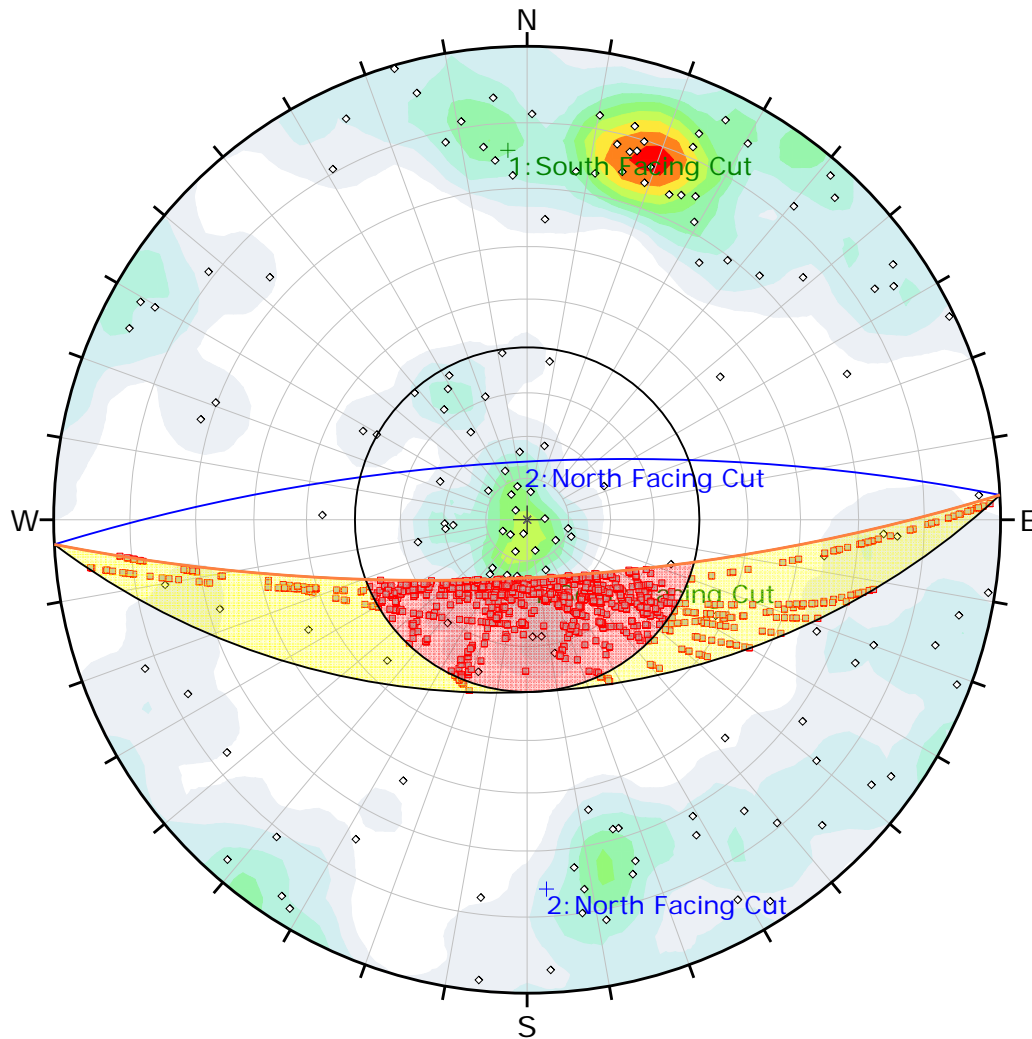
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Cut
2	■	76	357	North Facing Cut

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	76
Slope Dip Direction	177
Friction Angle	50°

	Critical	Total	%
Wedge Sliding	1004	10731	9.36%

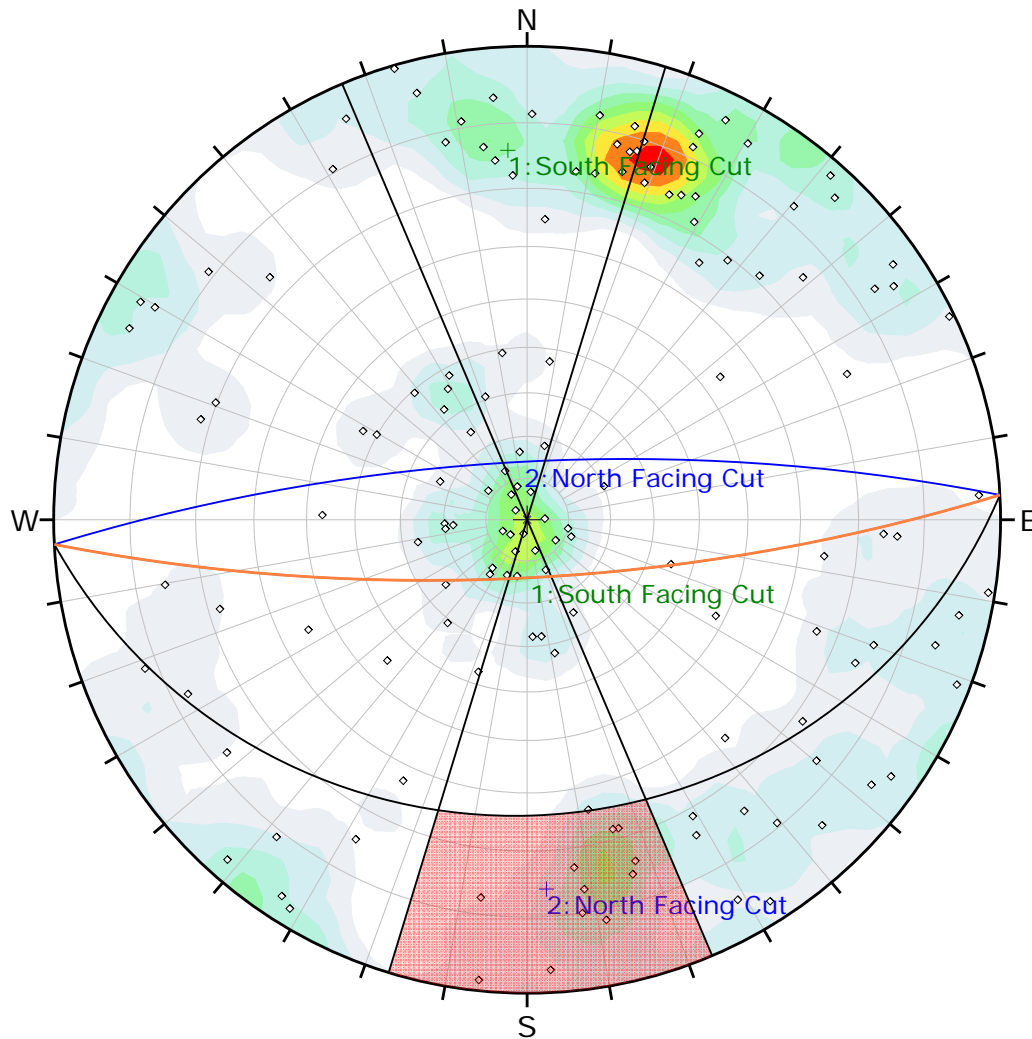
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Ci
2	■	76	357	North Facing Cu

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	10731
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Flexural Toppling		
Slope Dip	76		
Slope Dip Direction	177		
Friction Angle	50°		
Lateral Limits	20°		
	Critical	Total	%
Flexural Toppling (All)	11	147	7.48%

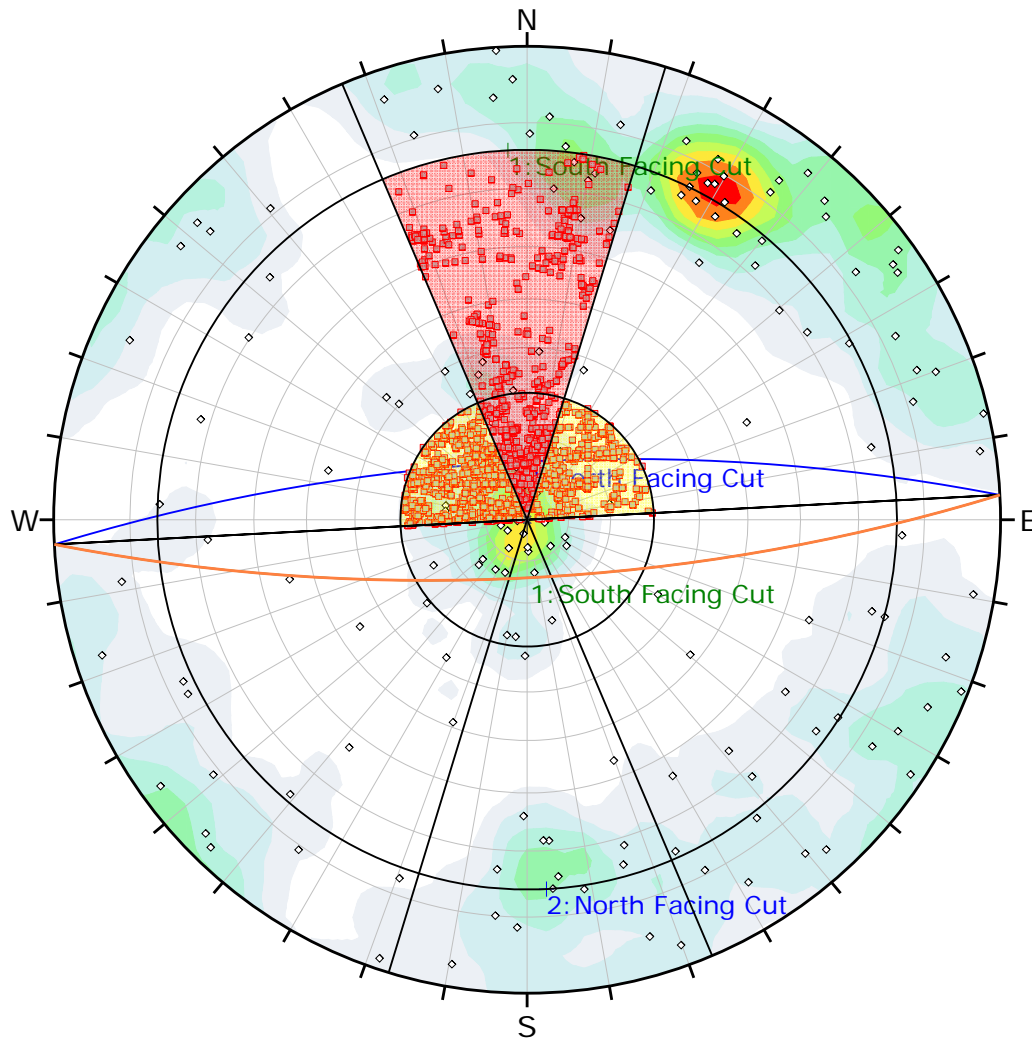
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Cu
2	■	76	357	North Facing Cu

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
	0.00 - 0.75
	0.75 - 1.50
	1.50 - 2.25
	2.25 - 3.00
	3.00 - 3.75
	3.75 - 4.50
	4.50 - 5.25
	5.25 - 6.00
	6.00 - 6.75
	6.75 - 7.50

Contour Data	Pole Vectors
Maximum Density	7.05%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Direct Toppling		
Slope Dip	76		
Slope Dip Direction	177		
Friction Angle	30°		
Lateral Limits	20°		
	Critical	Total	%
Direct Toppling (Intersection)	707	13695	5.16%
Oblique Toppling (Intersection)	1299	13695	9.49%
Base Plane (All)	25	166	15.06%

	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Cut
2	■	76	357	North Facing Cut

Plot Mode	Pole Vectors
Vector Count	166 (166 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	13695
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project

Highway 17 Twinning

Analysis Description

Site M-DC: McNab-Braeside Sta. 12+500 to Sta. 12+720 WBL

Drawn By

DP

Company

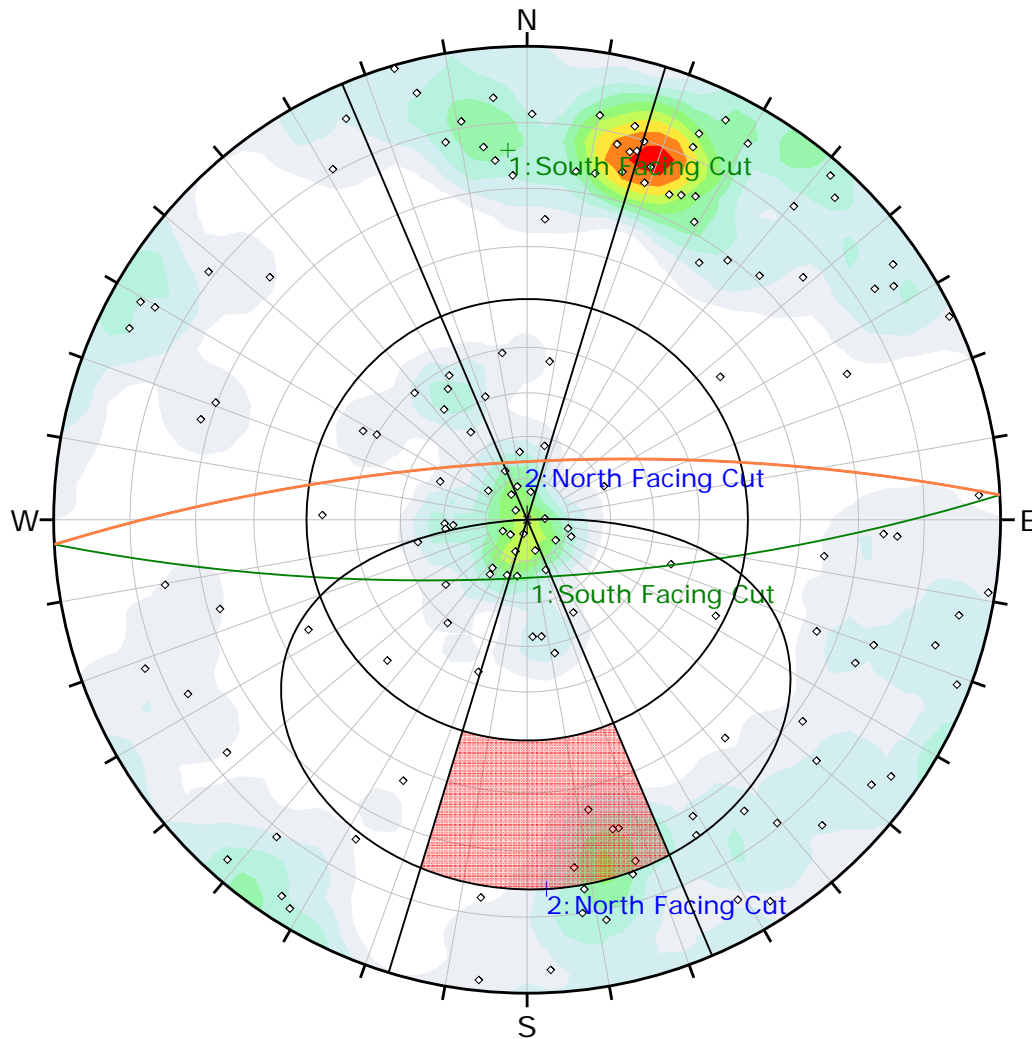
Thurber Engineering Ltd.

Date

2021-11-10, 8:17:10 AM

File Name

M-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding		
Slope Dip	76		
Slope Dip Direction	357		
Friction Angle	50°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	5	147	3.40%

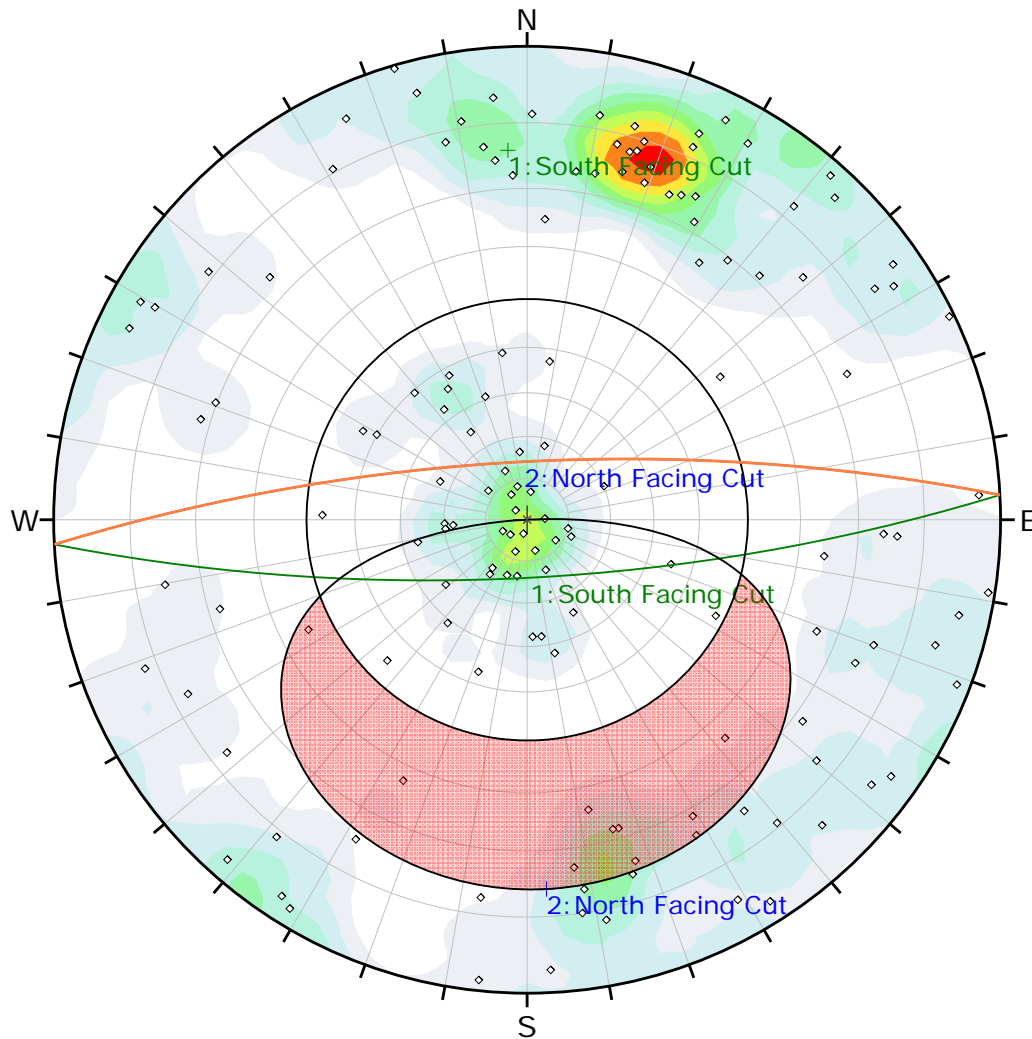
	Color	Dip	Dip Direction	Label
User Planes				
1		76	177	South Facing Cu
2		76	357	North Facing Cu

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding		
Slope Dip	76		
Slope Dip Direction	357		
Friction Angle	50°		
	Critical	Total	%
Planar Sliding (All)	10	147	6.80%

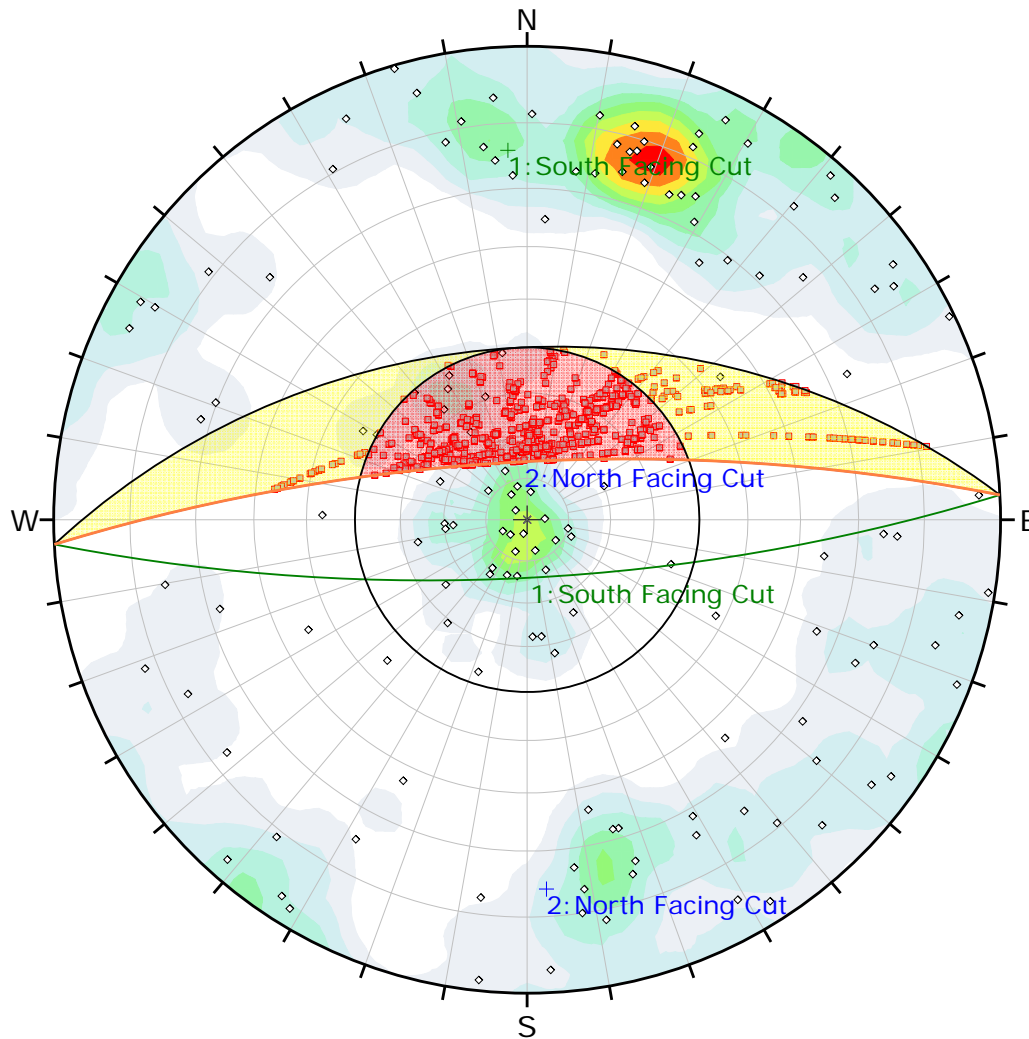
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Cut
2	■	76	357	North Facing Cut

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	76
Slope Dip Direction	357
Friction Angle	50°

	Critical	Total	%
Wedge Sliding	734	10731	6.84%

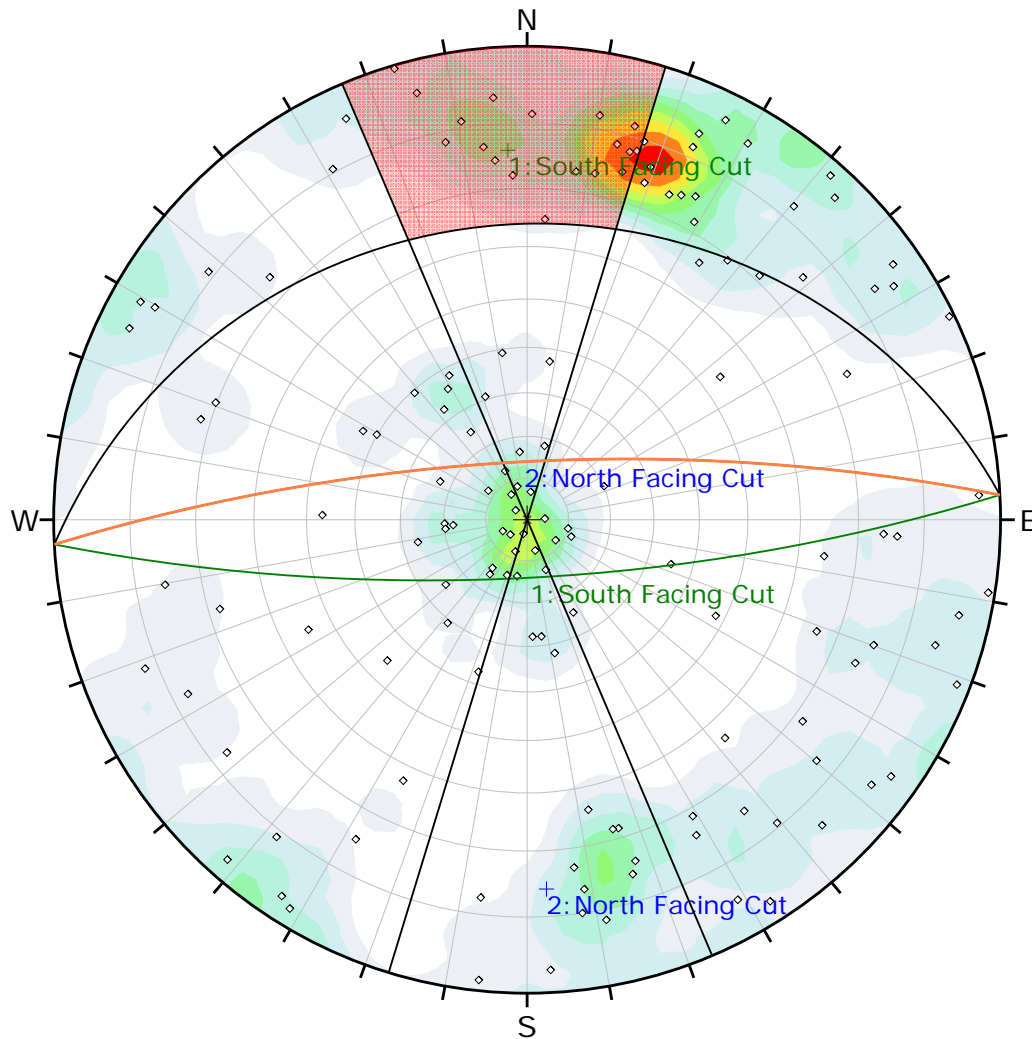
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Ci
2	■	76	357	North Facing Cu

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	10731
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Flexural Toppling		
Slope Dip	76		
Slope Dip Direction	357		
Friction Angle	50°		
Lateral Limits	20°		
	Critical	Total	%
Flexural Toppling (All)	18	147	12.24%

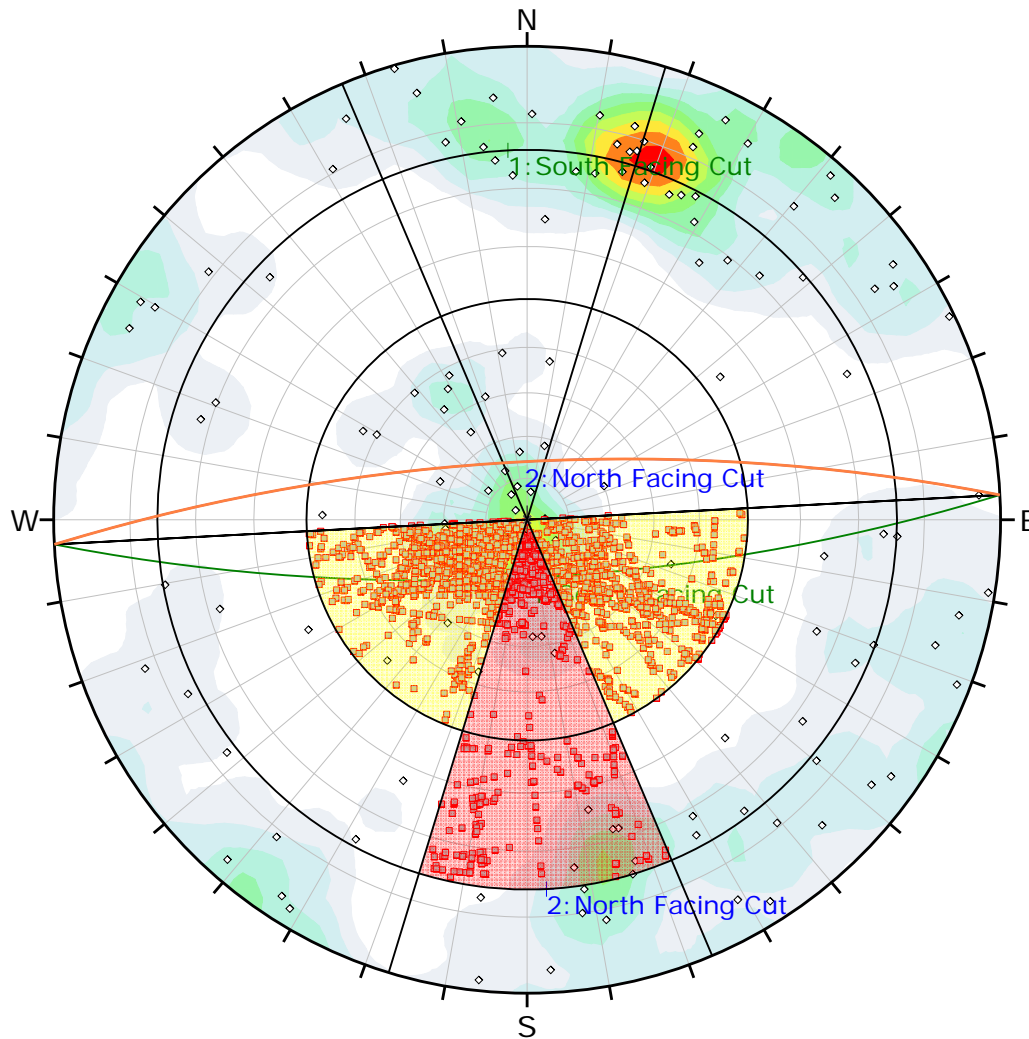
	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Ci
2	■	76	357	North Facing Cu

Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



Symbol	Feature
◇	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
	0.00 - 0.80
	0.80 - 1.60
	1.60 - 2.40
	2.40 - 3.20
	3.20 - 4.00
	4.00 - 4.80
	4.80 - 5.60
	5.60 - 6.40
	6.40 - 7.20
	7.20 - 8.00

Contour Data	Pole Vectors
Maximum Density	7.78%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Direct Toppling		
Slope Dip	76		
Slope Dip Direction	357		
Friction Angle	50°		
Lateral Limits	20°		
	Critical	Total	%
Direct Toppling (Intersection)	578	10731	5.39%
Oblique Toppling (Intersection)	1935	10731	18.03%
Base Plane (All)	32	147	21.77%

	Color	Dip	Dip Direction	Label
User Planes				
1	■	76	177	South Facing Cut
2	■	76	357	North Facing Cut

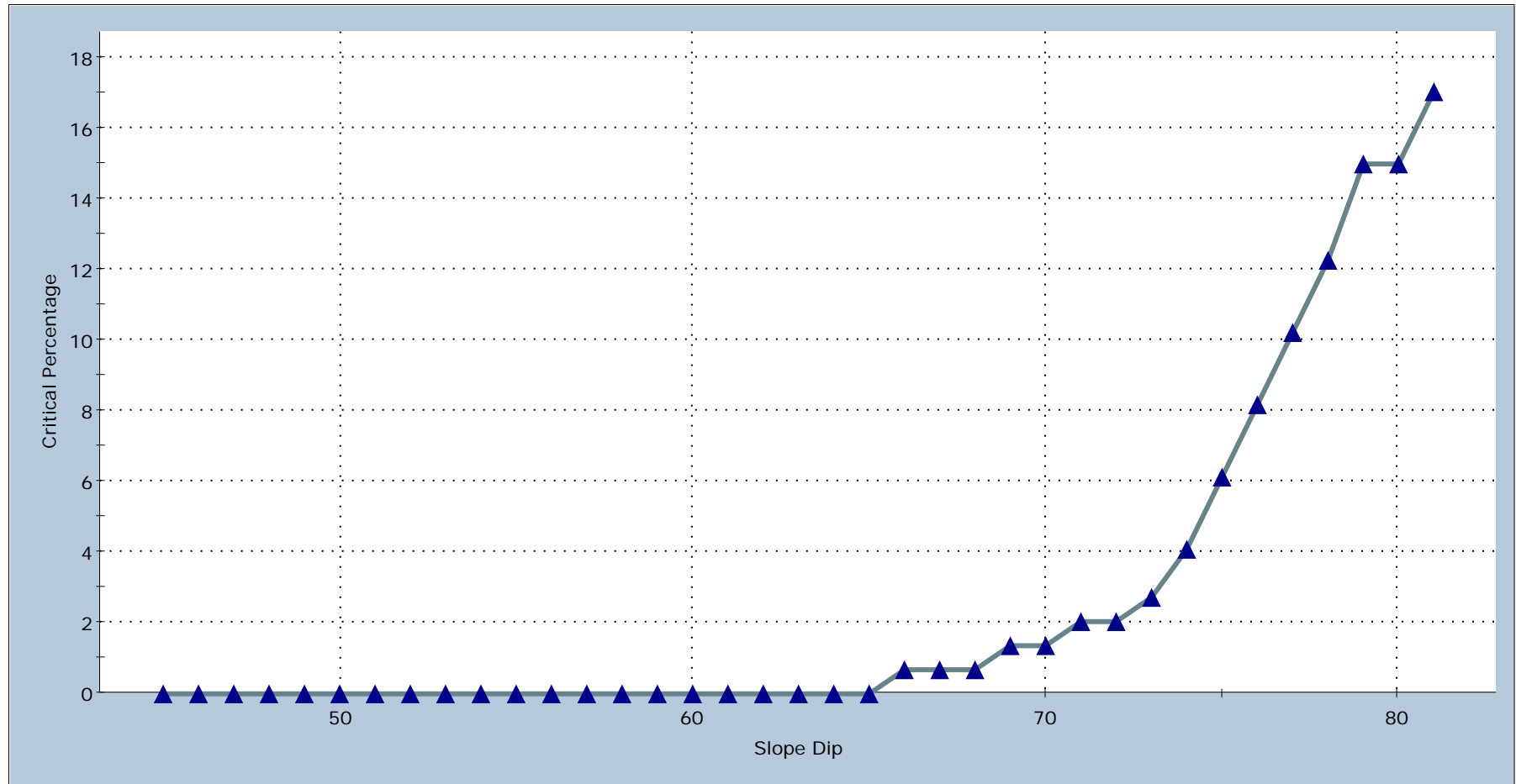
Plot Mode	Pole Vectors
Vector Count	147 (147 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	10731
Hemisphere	Lower
Projection	Equal Angle



THURBER ENGINEERING LTD.
DIPS 8.016

Project	Highway 17 Twinning		
Analysis Description	Deep Cut Site M		
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8

Planar Sliding (No Limits): Critical Percentage vs. Slope Dip



Mean Values

Slope Dip = 76

Slope Dip Direction = 177

Friction Angle = 50

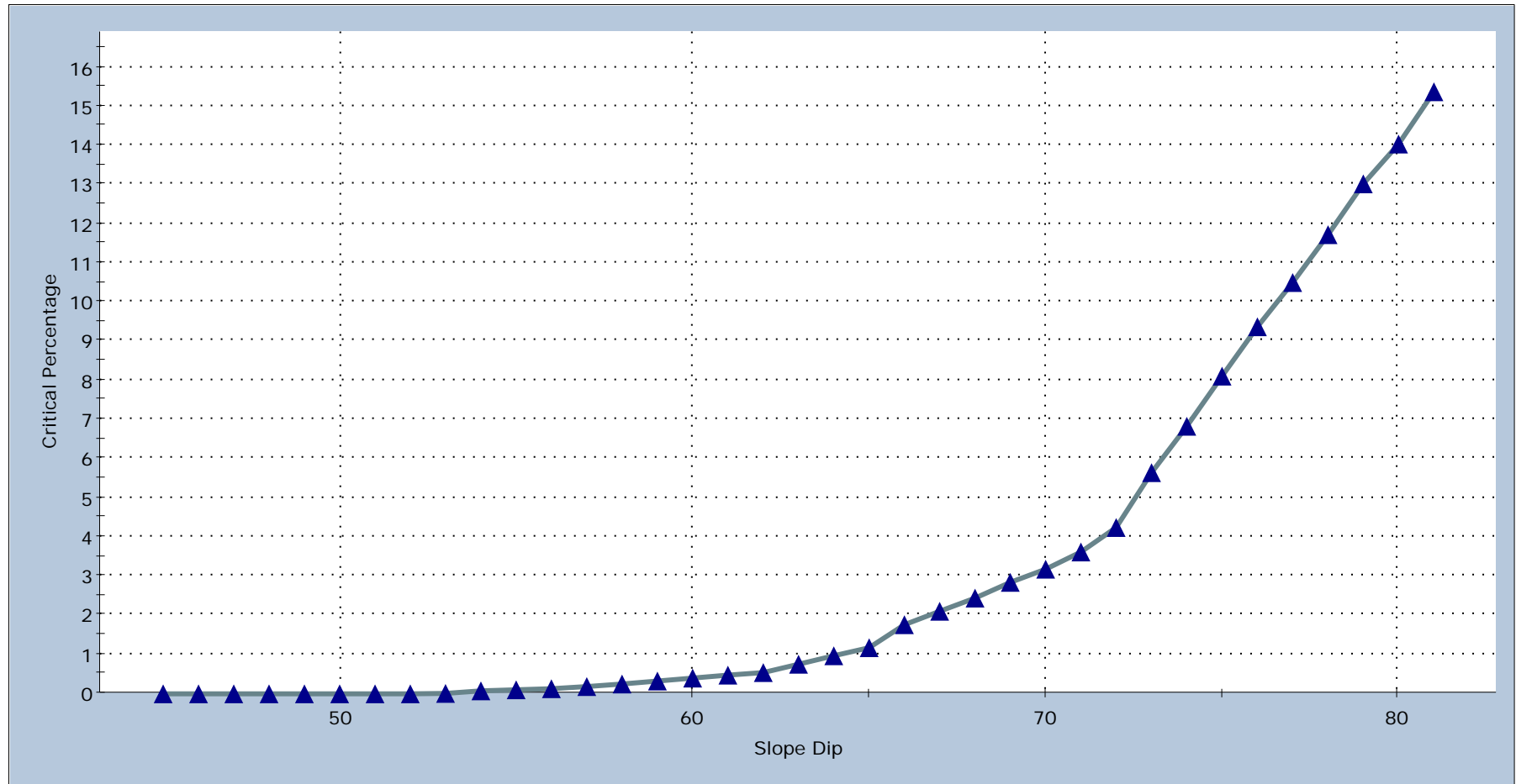
Lateral Limit = 20



THURBER ENGINEERING LTD.
DIPS 8.016

Project		Highway 17 Twinning	
Analysis Description		Deep Cut Site M	
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8

Wedge Sliding: Critical Percentage vs. Slope Dip



Mean Values

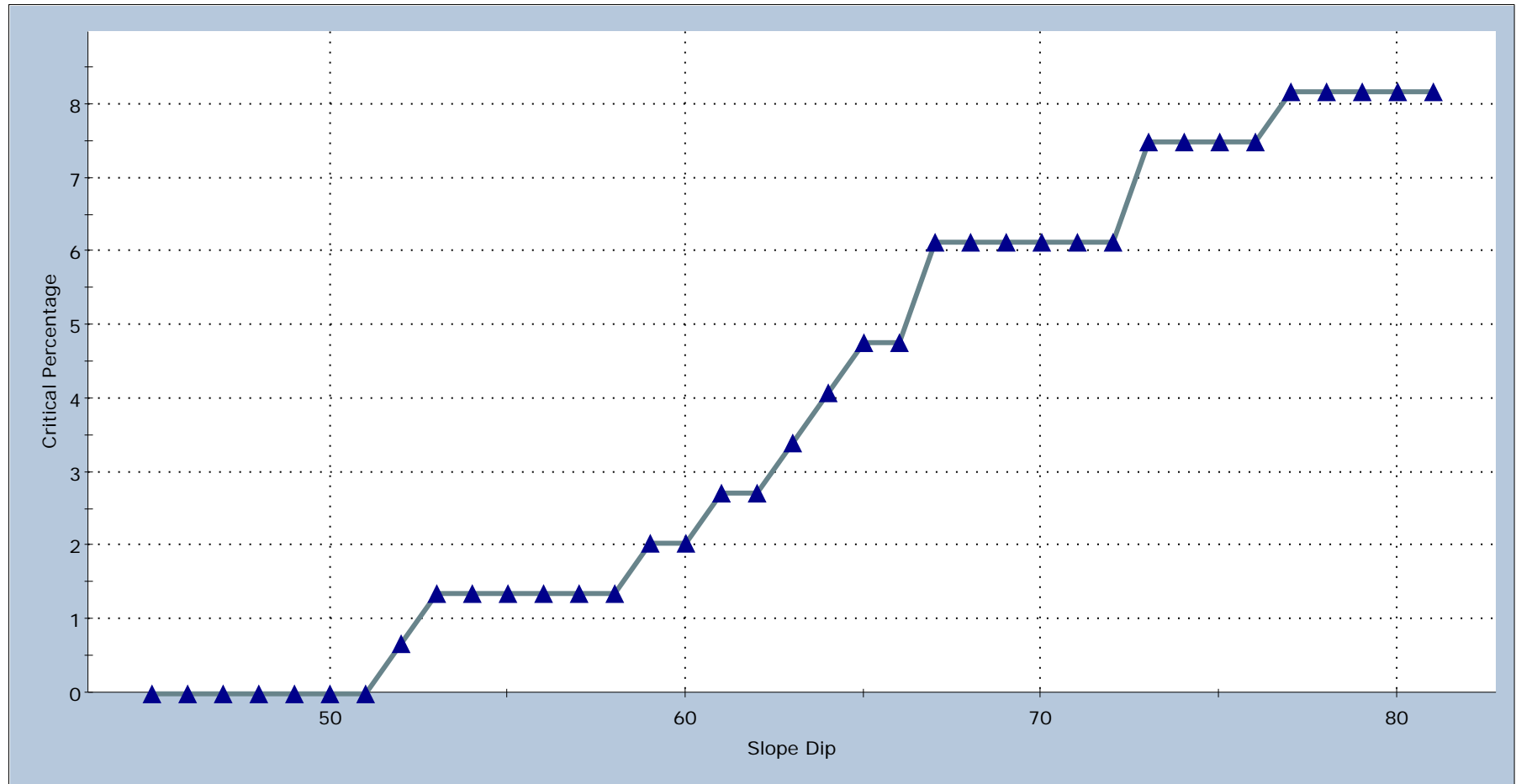
Slope Dip = 76 Slope Dip Direction = 177 Friction Angle = 50 Lateral Limit = 20



THURBER ENGINEERING LTD.
DIPS 8.016

<i>Project</i>		Highway 17 Twinning	
<i>Analysis Description</i>		Deep Cut Site M	
<i>Drawn By</i>	DP	<i>Company</i>	Thurber Engineering Ltd.
<i>Date</i>	2021-11-10, 8:17:10 AM	<i>File Name</i>	M-DC.dips8

Flexural Toppling: Critical Percentage vs. Slope Dip



Mean Values

Slope Dip = 76

Slope Dip Direction = 177

Friction Angle = 50

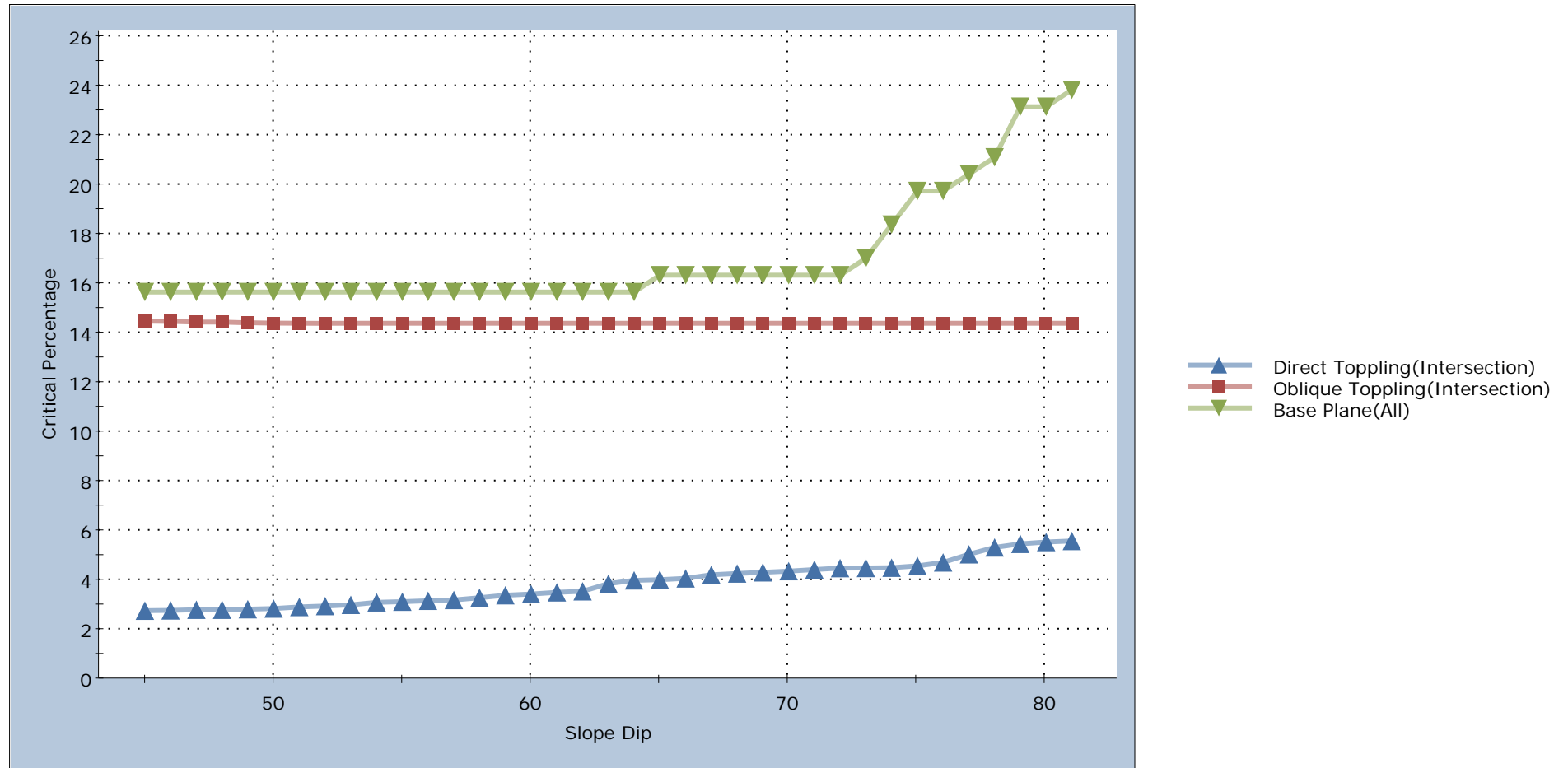
Lateral Limit = 20



THURBER ENGINEERING LTD.
DIPS 8.016

Project		Highway 17 Twinning	
Analysis Description		Deep Cut Site M	
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8

Direct Toppling: Critical Percentage vs. Slope Dip



Mean Values

Slope Dip = 76

Slope Dip Direction = 177

Friction Angle = 50

Lateral Limit = 20



THURBER ENGINEERING LTD.
DIPS 8.016

Project		Highway 17 Twinning	
Analysis Description		Deep Cut Site M	
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8

Planar Sliding (No Limits): Critical Percentage vs. Slope Dip



Mean Values

Slope Dip = 76

Slope Dip Direction = 357

Friction Angle = 50

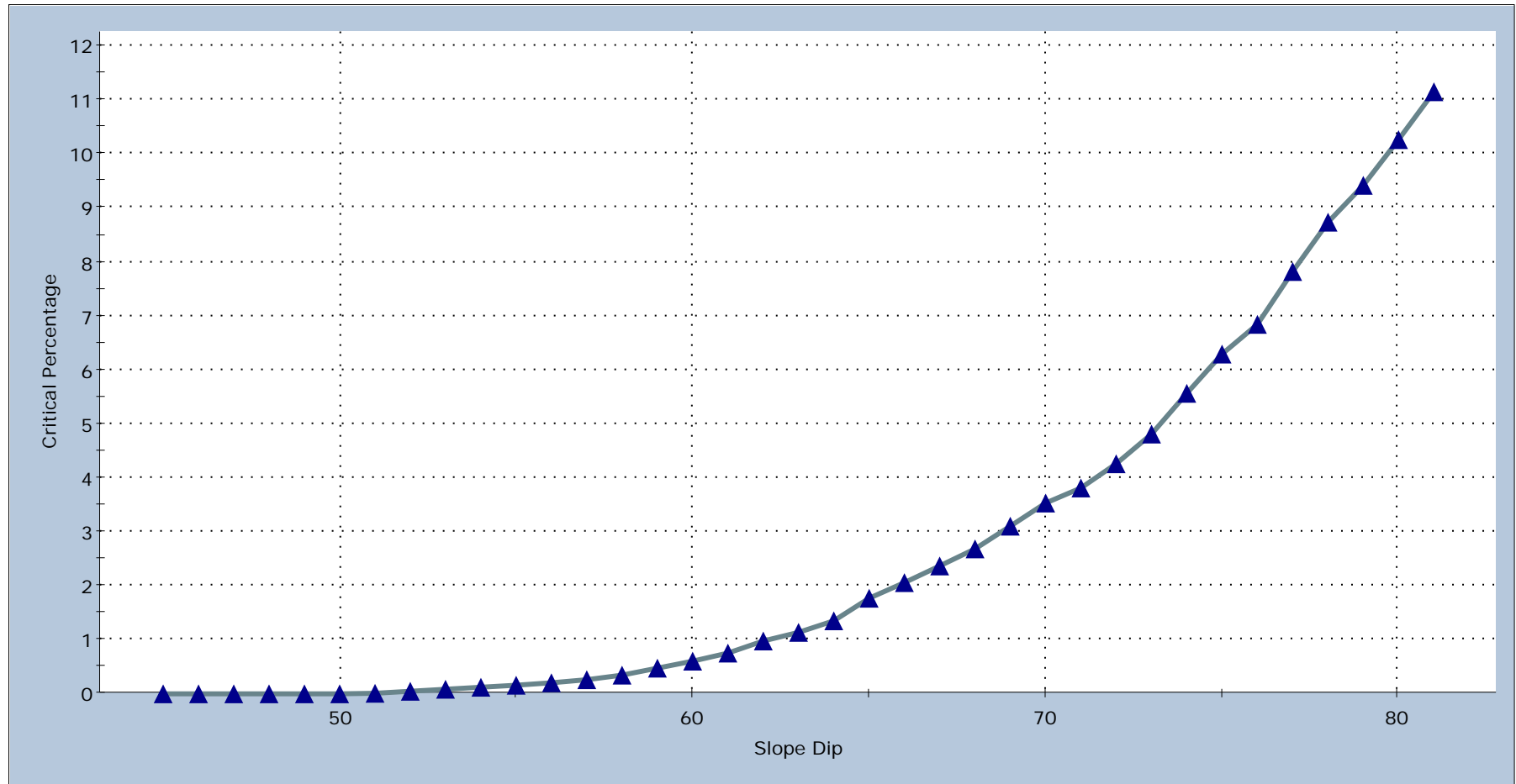
Lateral Limit = 20



THURBER ENGINEERING LTD.
DIPS 8.016

Project		Highway 17 Twinning	
Analysis Description		Deep Cut Site M	
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8

Wedge Sliding: Critical Percentage vs. Slope Dip



Mean Values

Slope Dip = 76

Slope Dip Direction = 357

Friction Angle = 50

Lateral Limit = 20



THURBER ENGINEERING LTD.
DIPS 8.016

Project

Highway 17 Twinning

Analysis Description

Deep Cut Site M

Drawn By

DP

Company

Thurber Engineering Ltd.

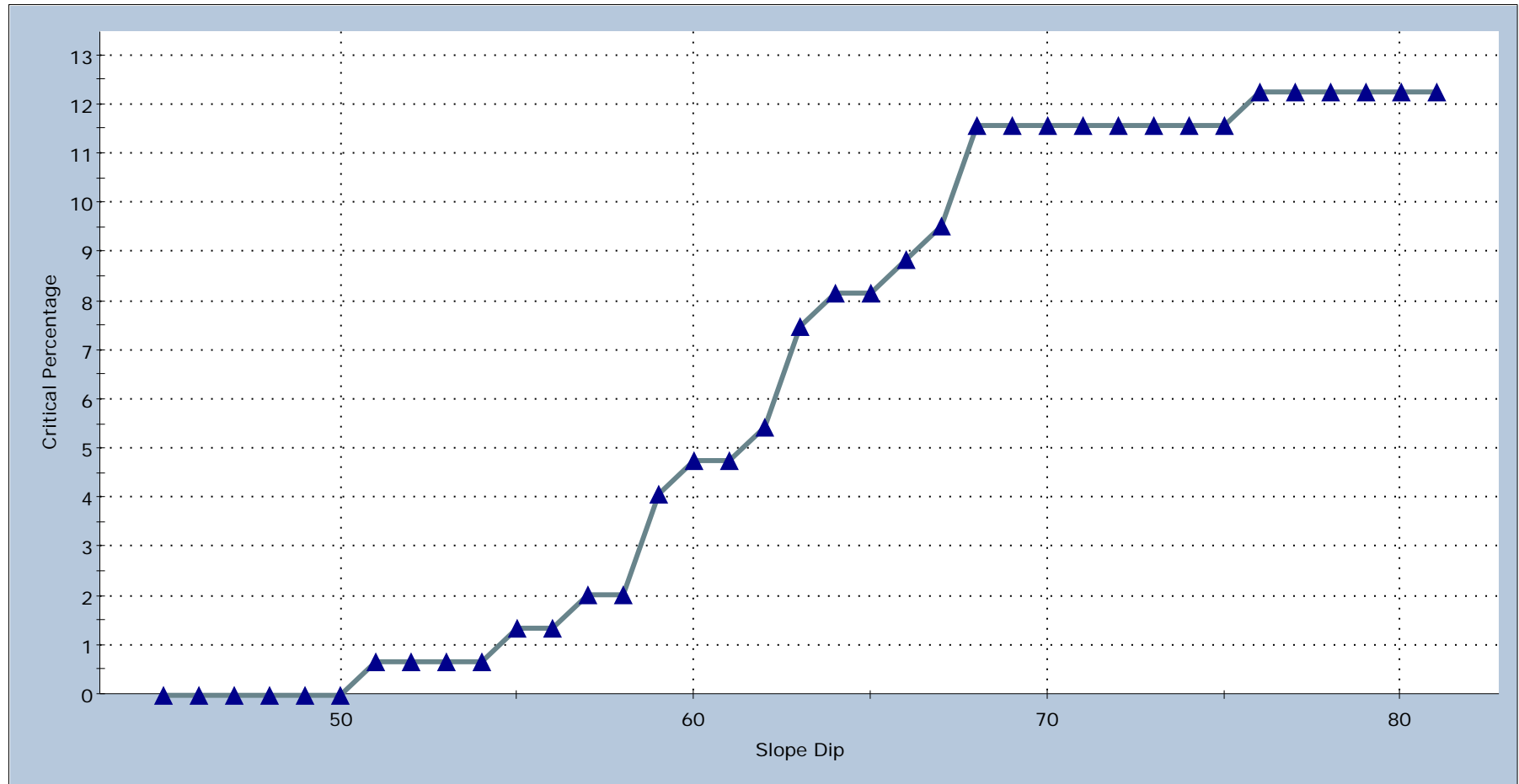
Date

2021-11-10, 8:17:10 AM

File Name

M-DC.dips8

Flexural Toppling: Critical Percentage vs. Slope Dip



Mean Values

Slope Dip = 76

Slope Dip Direction = 357

Friction Angle = 50

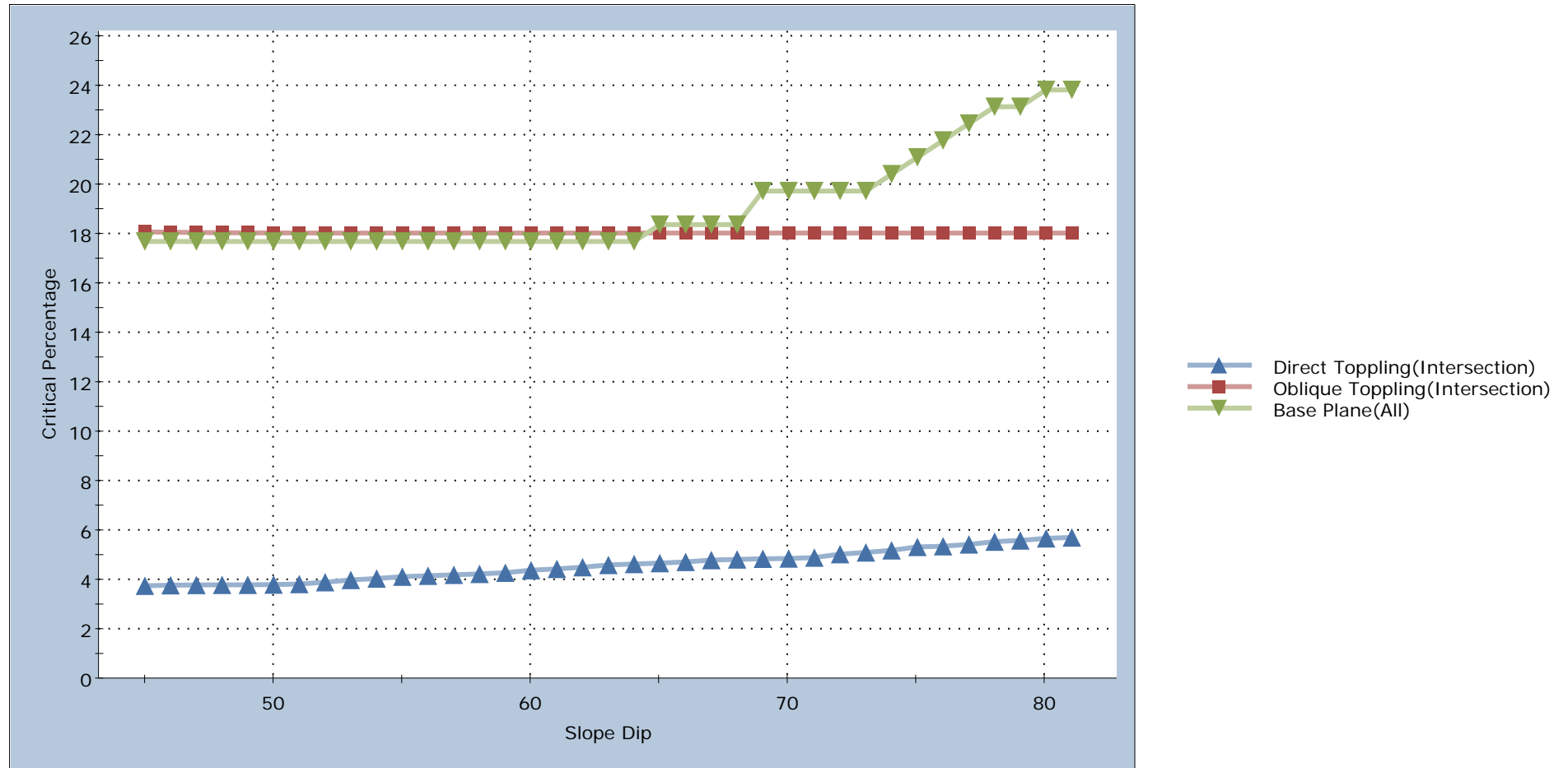
Lateral Limit = 20



THURBER ENGINEERING LTD.
DIPS 8.016

Project		Highway 17 Twinning	
Analysis Description		Deep Cut Site M	
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8

Direct Toppling: Critical Percentage vs. Slope Dip



Mean Values

Slope Dip = 76

Slope Dip Direction = 357

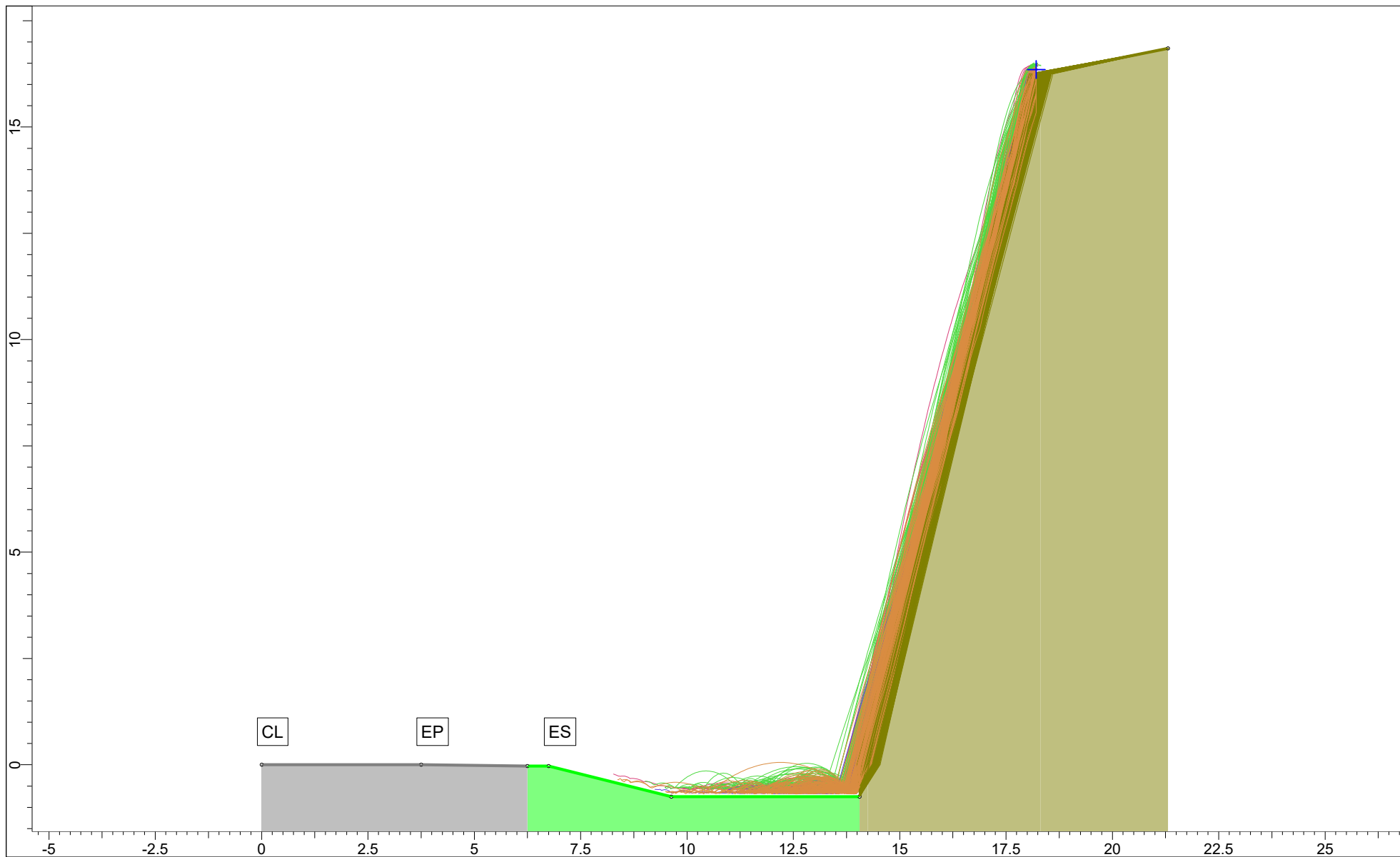
Friction Angle = 50

Lateral Limit = 20



THURBER ENGINEERING LTD.
DIPS 8.016

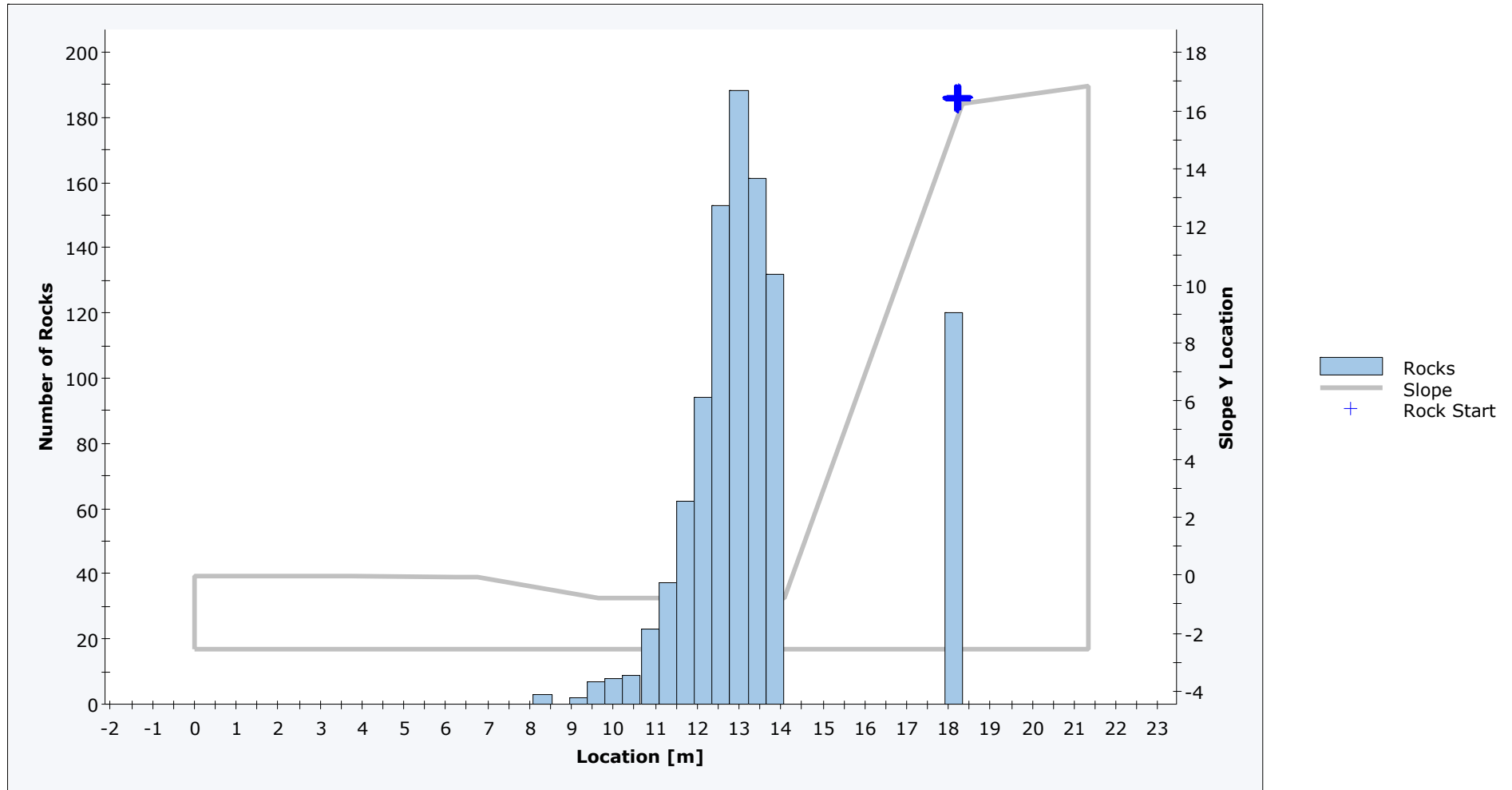
Project		Highway 17 Twinning	
Analysis Description		Deep Cut Site M	
Drawn By	DP	Company	Thurber Engineering Ltd.
Date	2021-11-10, 8:17:10 AM	File Name	M-DC.dips8



ROCFALL 8.018

Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Cut B, 0.25H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Cut B_0.25H1V.fal8
12/22/2021, 4:10:56 PM			

Distribution of Rock Path End Locations

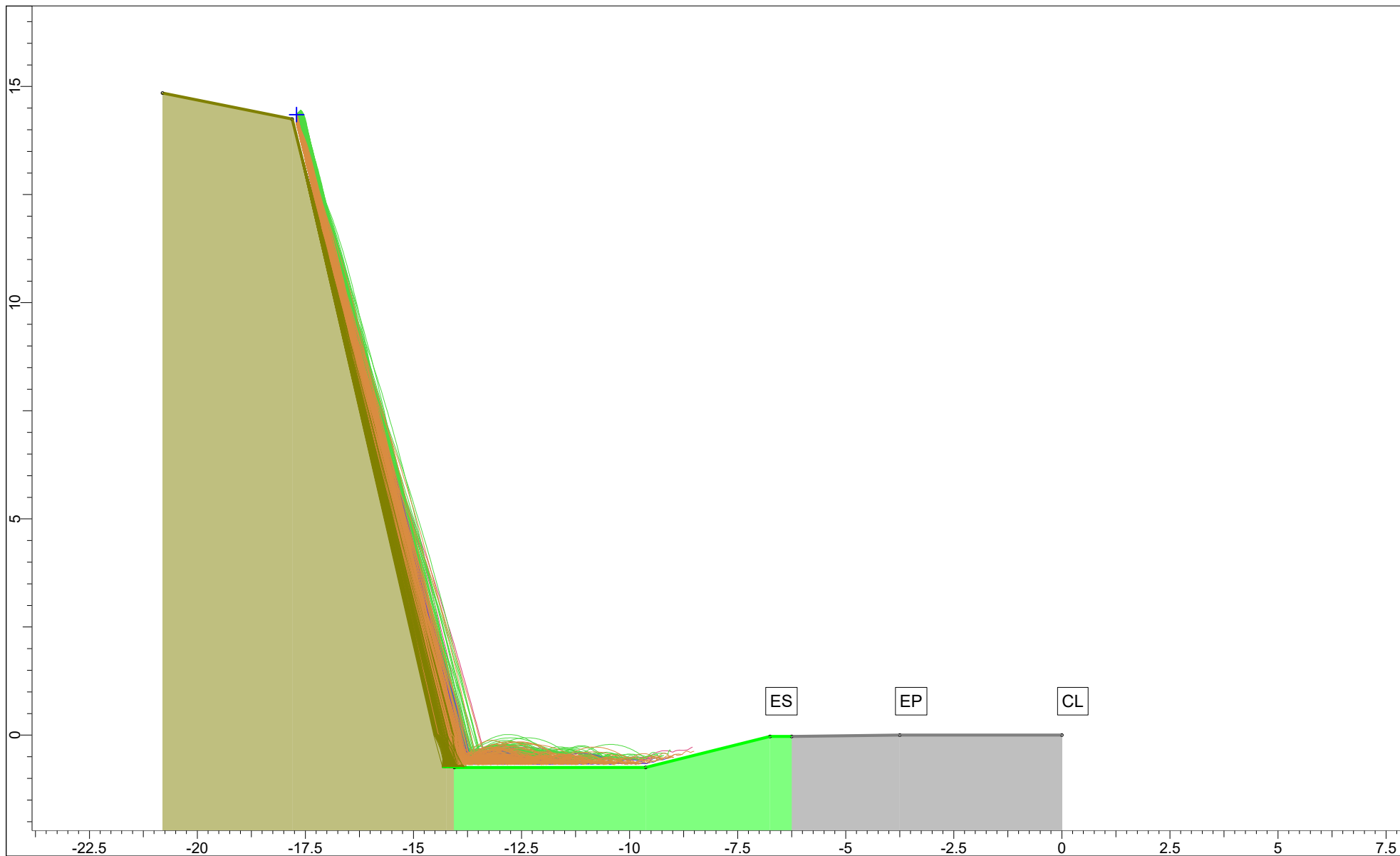


Total number of rock paths: 999



ROCFALL 8.018

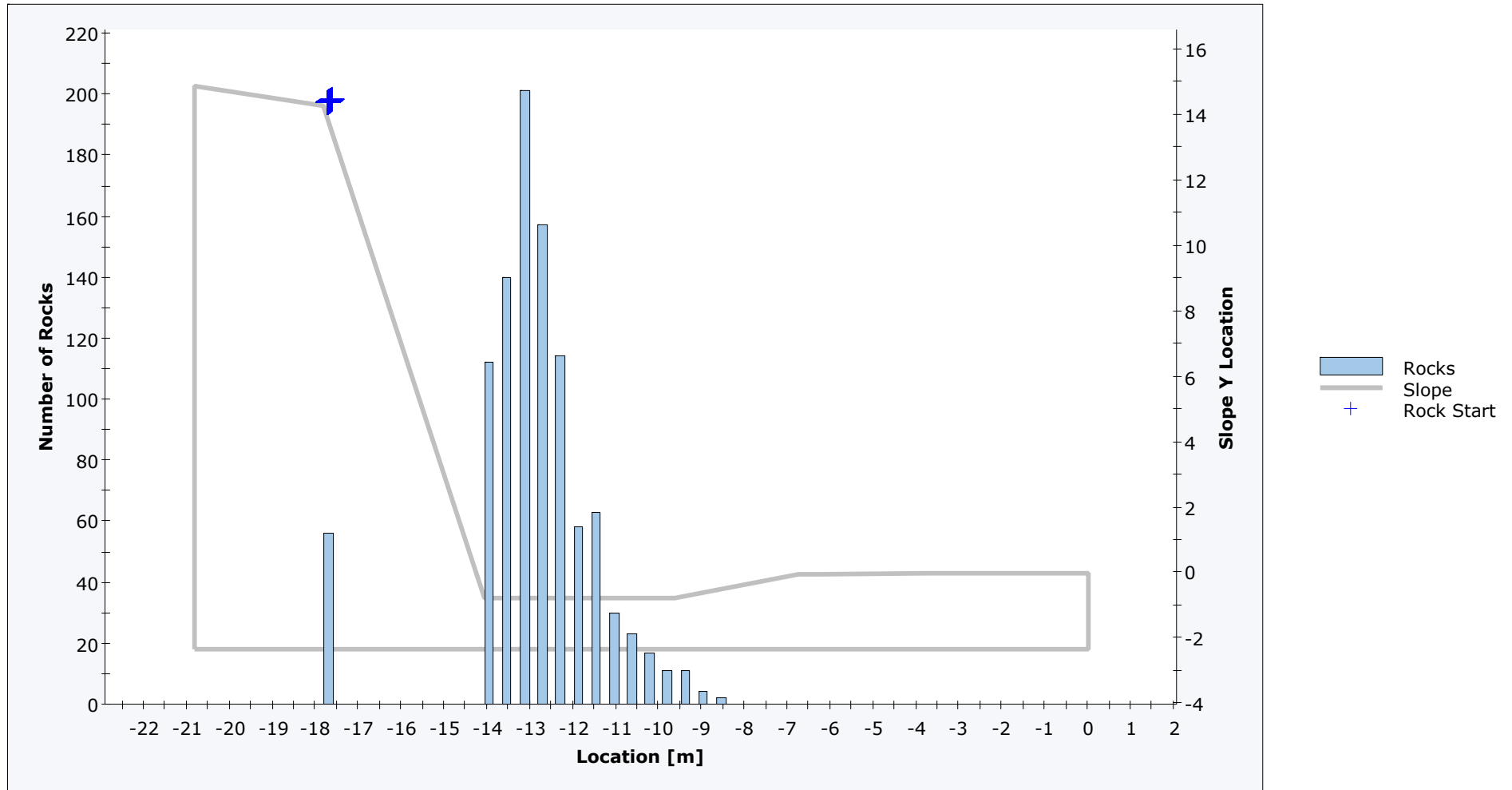
Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Cut B, 0.25H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Cut B_0.25H1V.fal8
12/22/2021, 4:10:56 PM			



ROCFALL 8.018

Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Cut L, 0.25H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Cut L_0.25H1V.fal8
12/22/2021, 4:10:56 PM			

Distribution of Rock Path End Locations

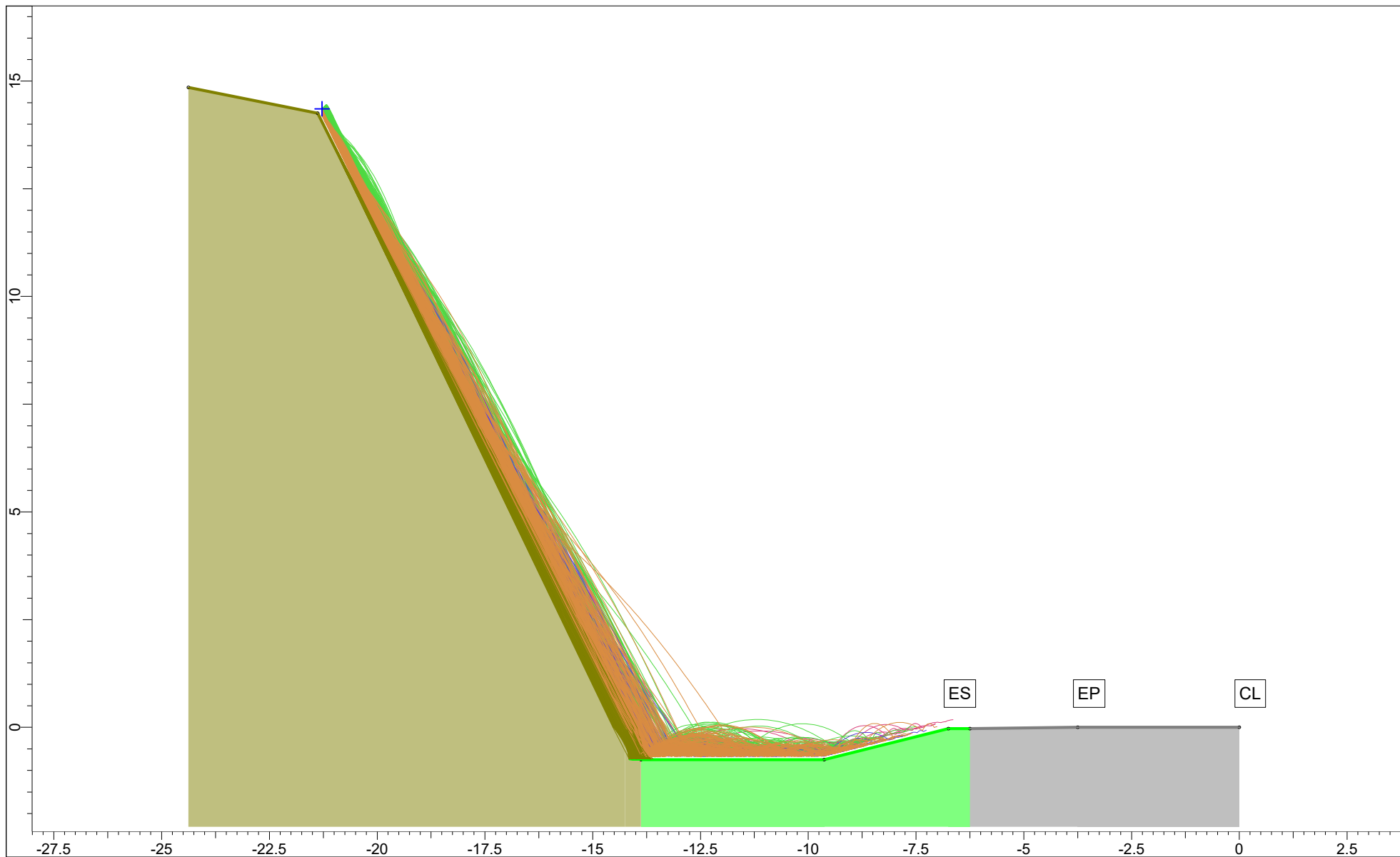


Total number of rock paths: 999



ROCFALL 8.018

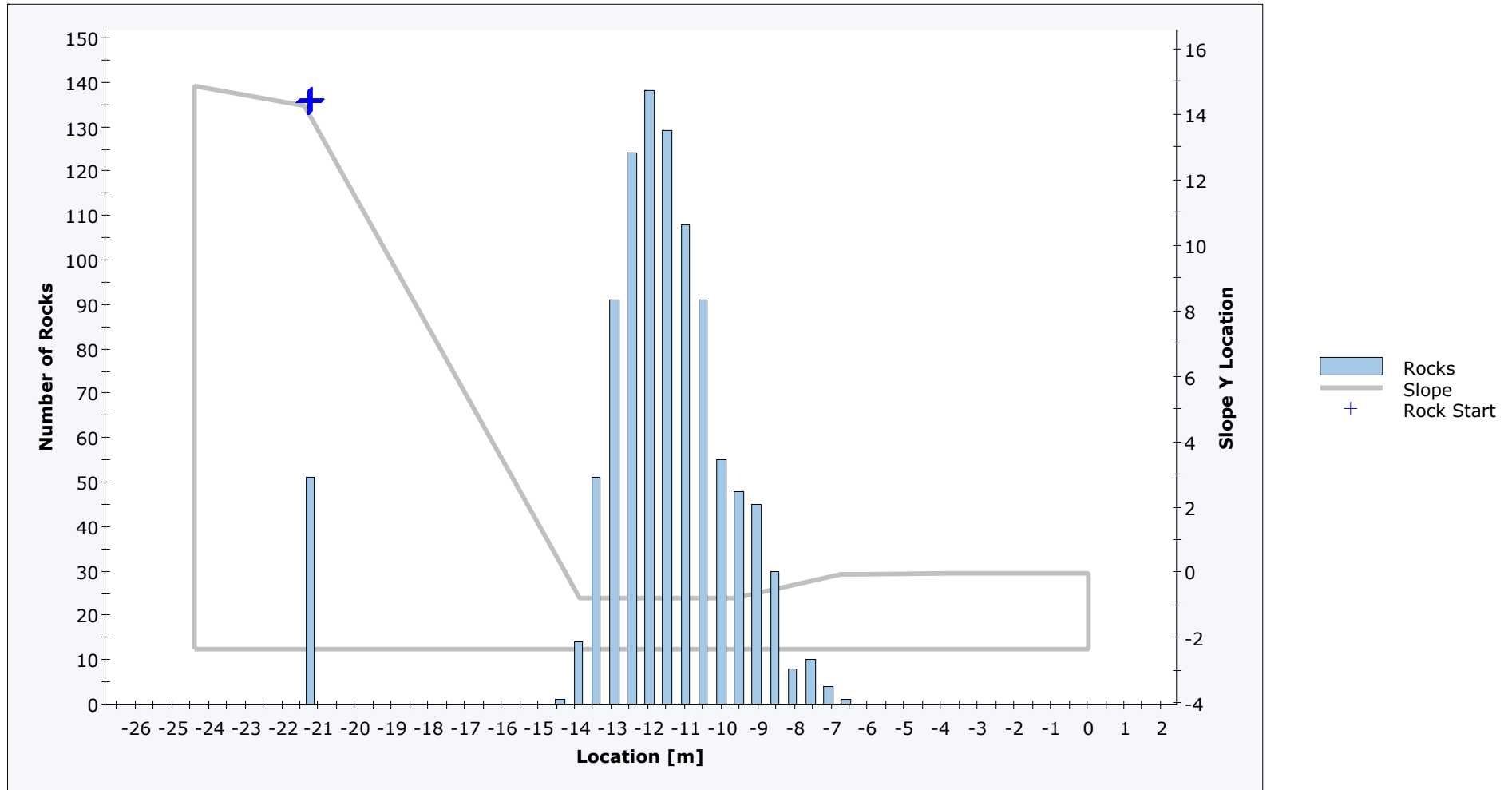
<i>Project</i>		Highway 17 Twinning	
<i>Analysis Description</i>		Rockfall Simulation - Cut L, 0.25H:1V	
<i>Drawn By</i>		<i>Company</i>	Thurber Engineering Ltd.
<i>Date</i>		<i>File Name</i>	Hwy 17 Cut L_0.25H1V.fal8
12/22/2021, 4:10:56 PM			



ROCFALL 8.018

Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Cut L, 0.50H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Cut L_0.50H1V.fal8
12/22/2021, 4:10:56 PM			

Distribution of Rock Path End Locations

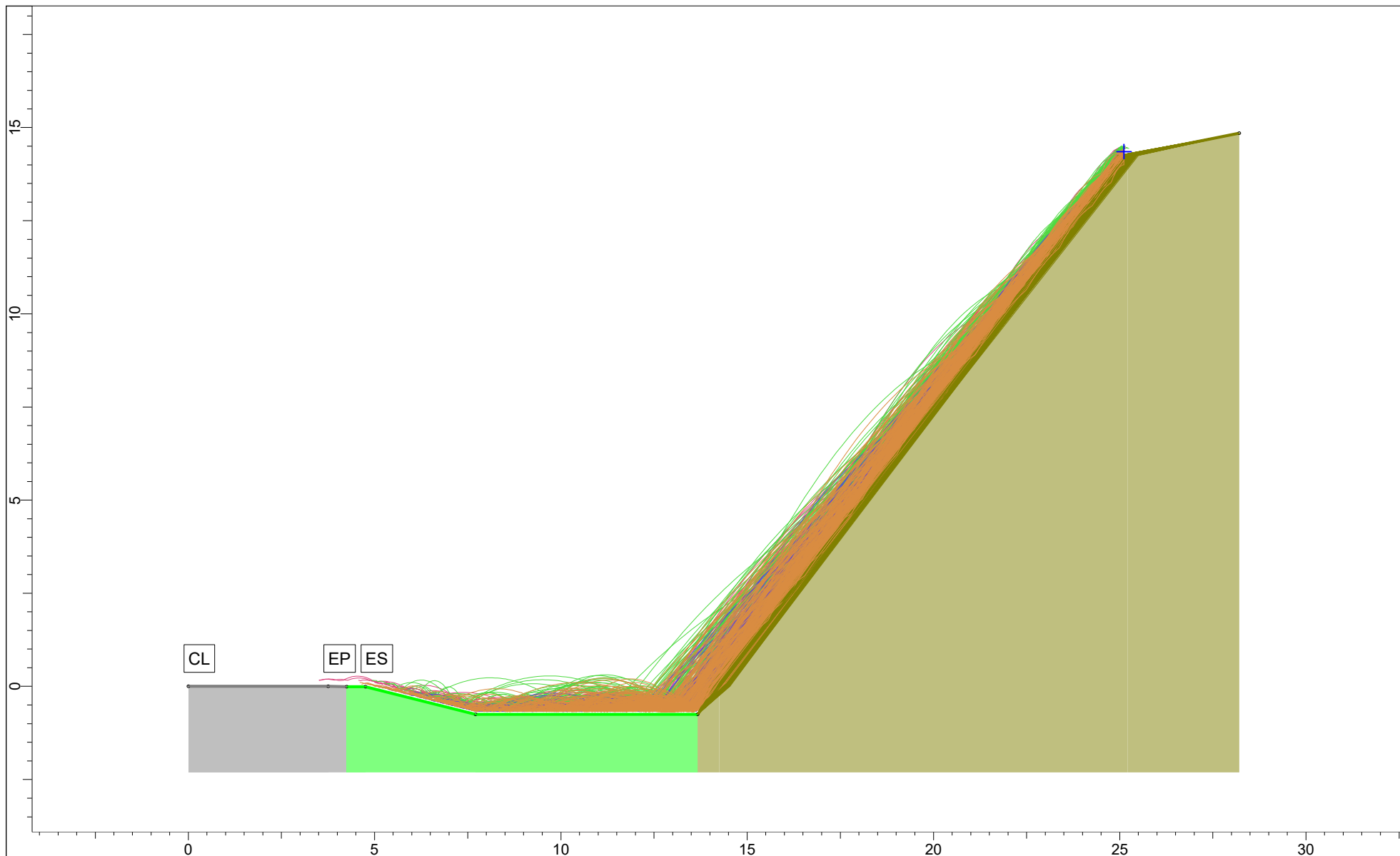


Total number of rock paths: 999



ROCFALL 8.018

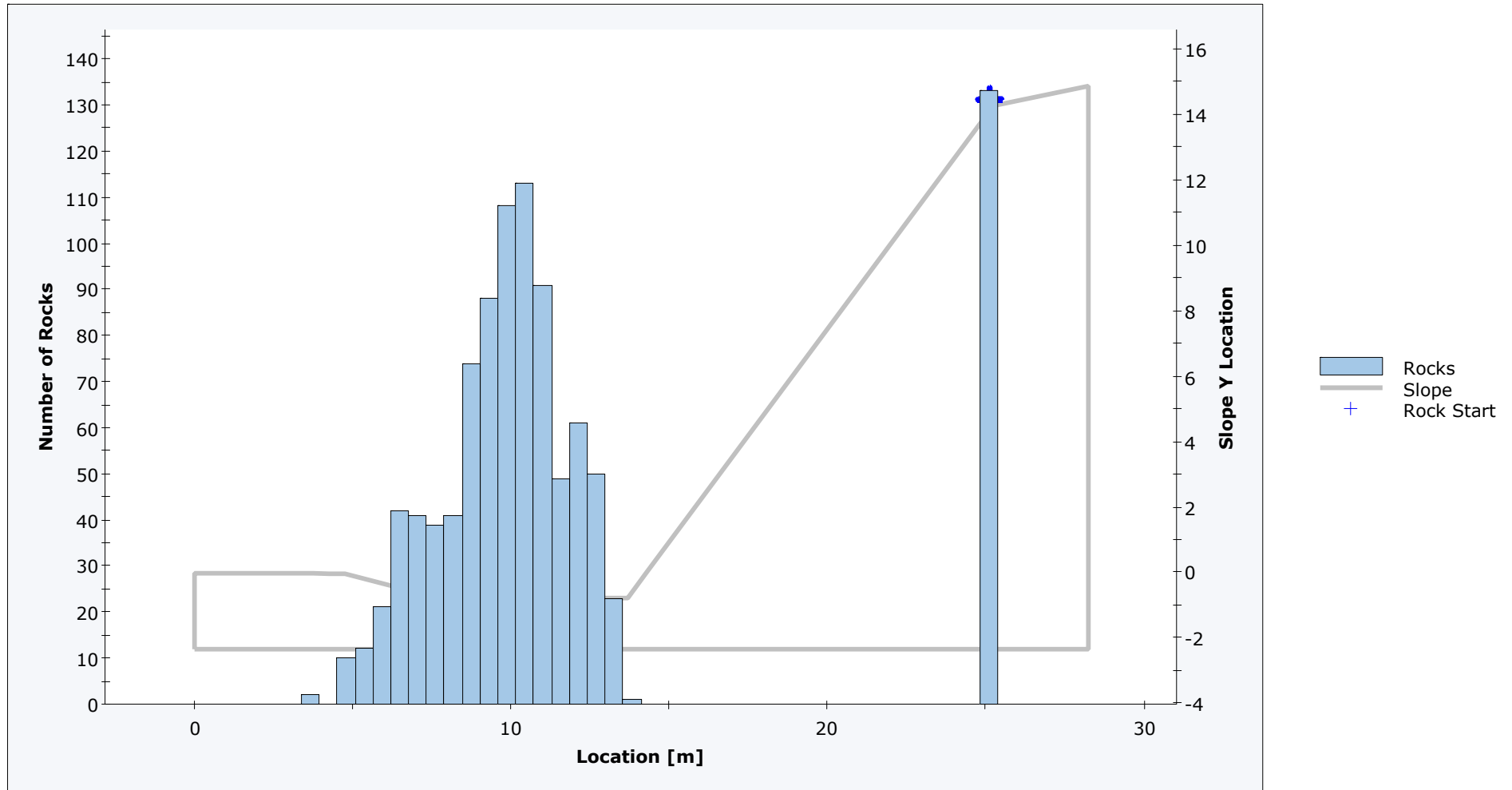
Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Cut L, 0.50H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Cut L_0.50H1V.fal8
12/22/2021, 4:10:56 PM			



ROCFALL 8.018

<i>Project</i>		Highway 17 Twinning	
<i>Analysis Description</i>		Rockfall Simulation - Cut L, 0.77H:1V	
<i>Drawn By</i>		<i>Company</i>	Thurber Engineering Ltd.
<i>Date</i>		<i>File Name</i>	Hwy 17 Cut L_0.77H1V.fal8
12/22/2021, 4:10:56 PM			

Distribution of Rock Path End Locations

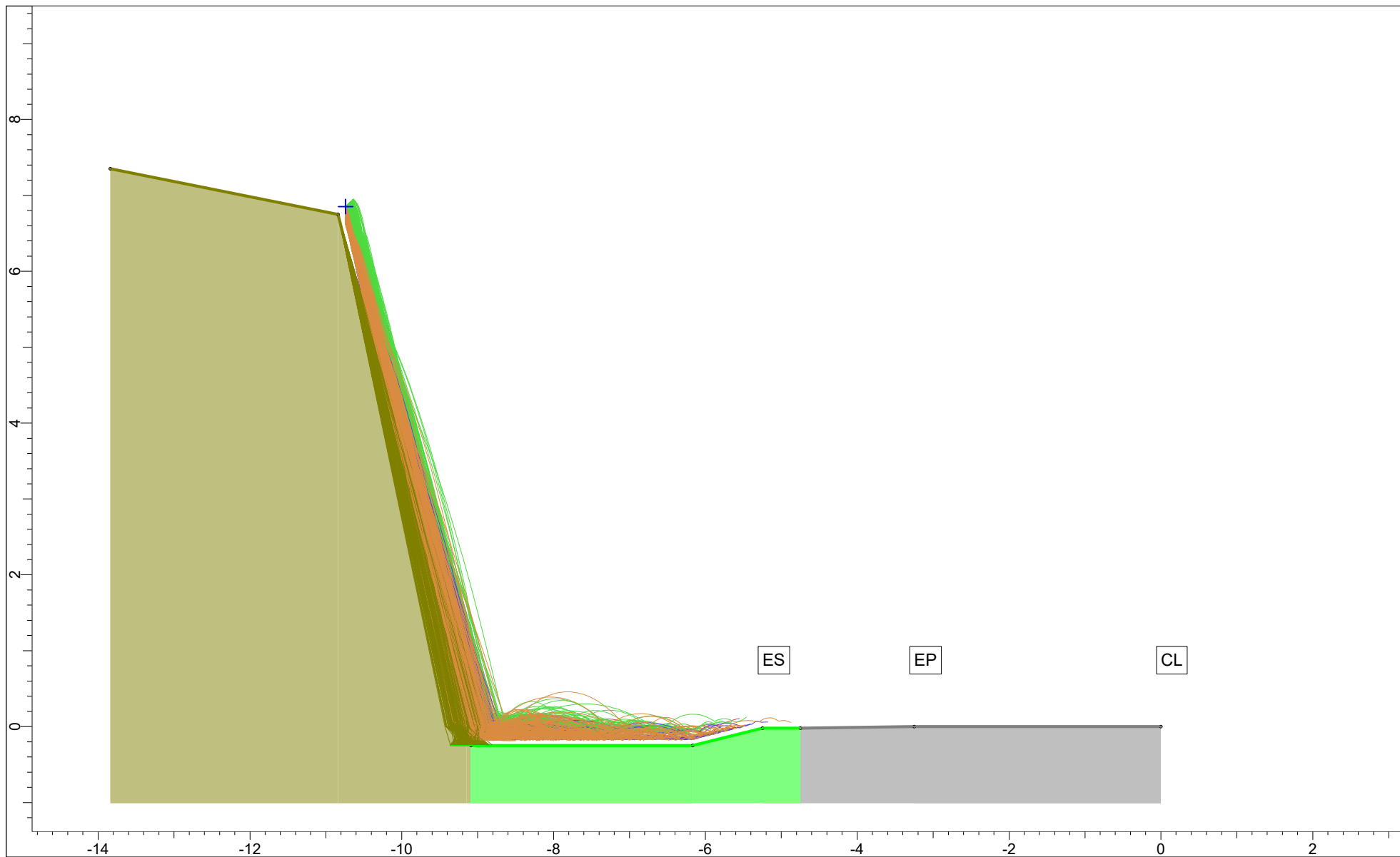


Total number of rock paths: 999



ROCFALL 8.018

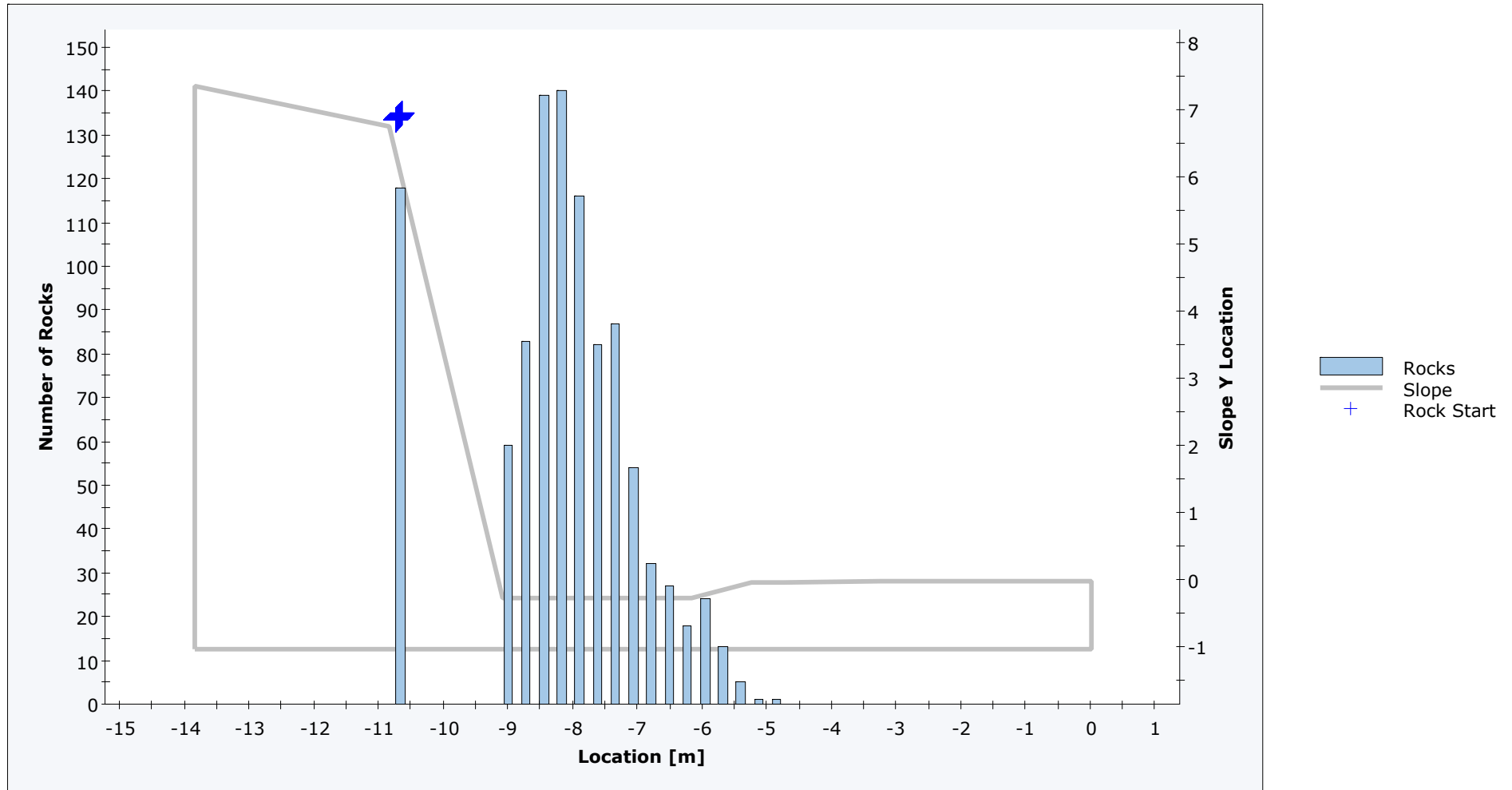
<i>Project</i>		Highway 17 Twinning	
<i>Analysis Description</i>		Rockfall Simulation - Cut L, 0.77H:1V	
<i>Drawn By</i>		<i>Company</i>	Thurber Engineering Ltd.
<i>Date</i>		<i>File Name</i>	Hwy 17 Cut L_0.77H1V.fal8
12/22/2021, 4:10:56 PM			



ROCFALL 8.018

Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Goshen Road, 0.25H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Goshen_0.25H1V.fal8
12/22/2021, 4:10:56 PM			

Distribution of Rock Path End Locations

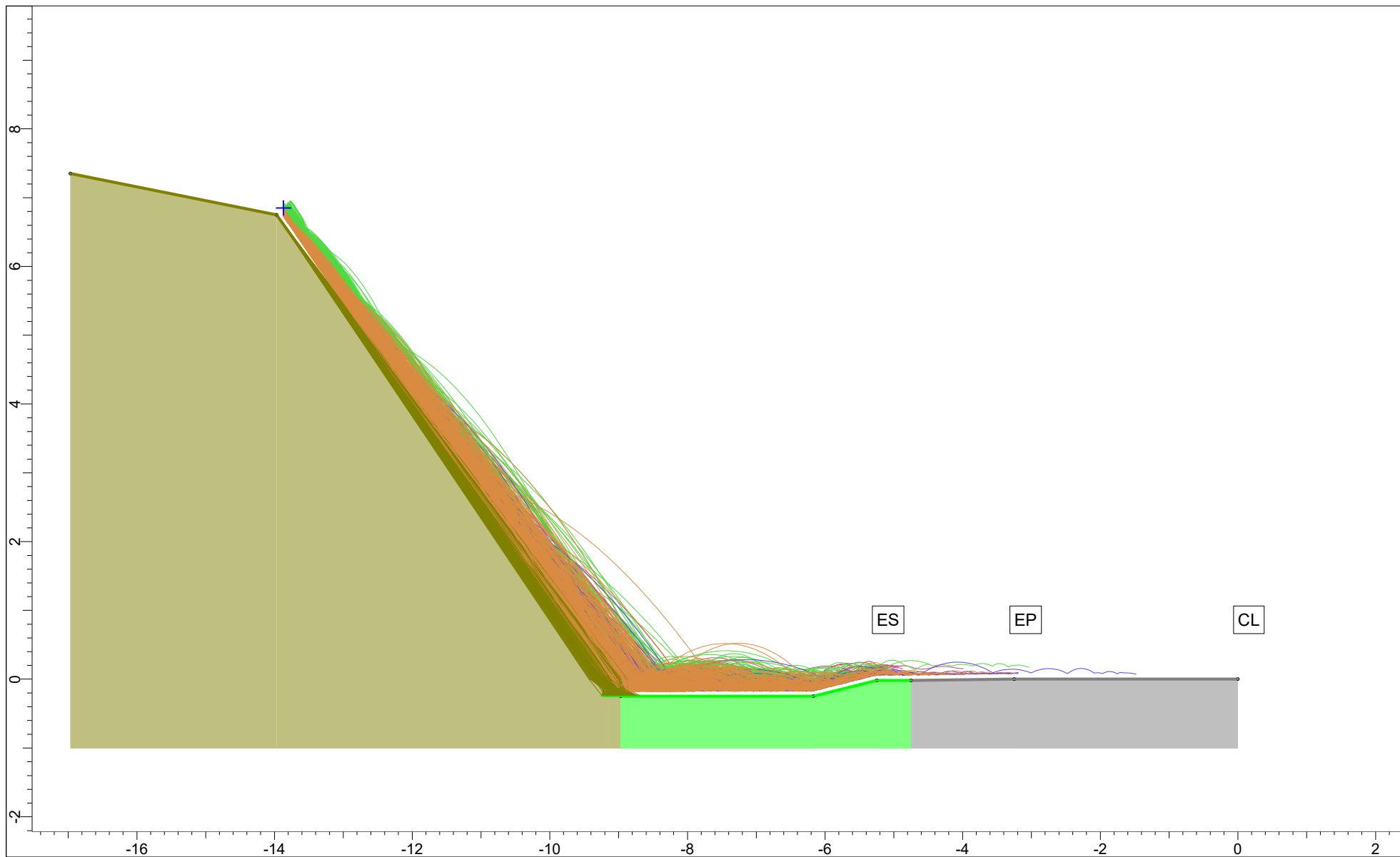


Total number of rock paths: 999



ROCFALL 8.018

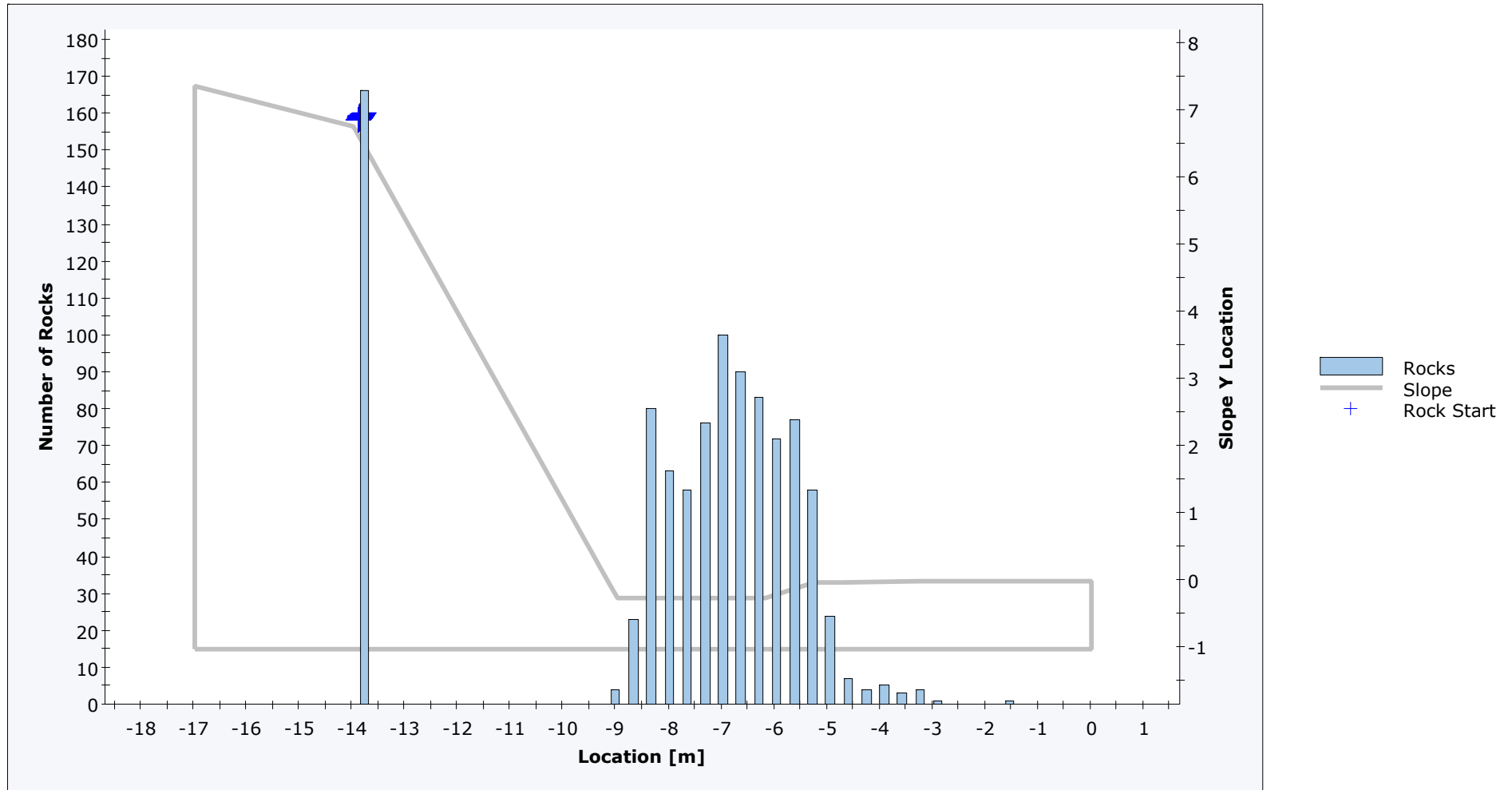
Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Goshen Road, 0.25H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Goshen_0.25H1V.fal8
12/22/2021, 4:10:56 PM			



ROCFALL 8.018

Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Goshen Road, 0.71H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Goshen_0.71H1V_0.25.fal8
12/22/2021, 4:10:56 PM			

Distribution of Rock Path End Locations

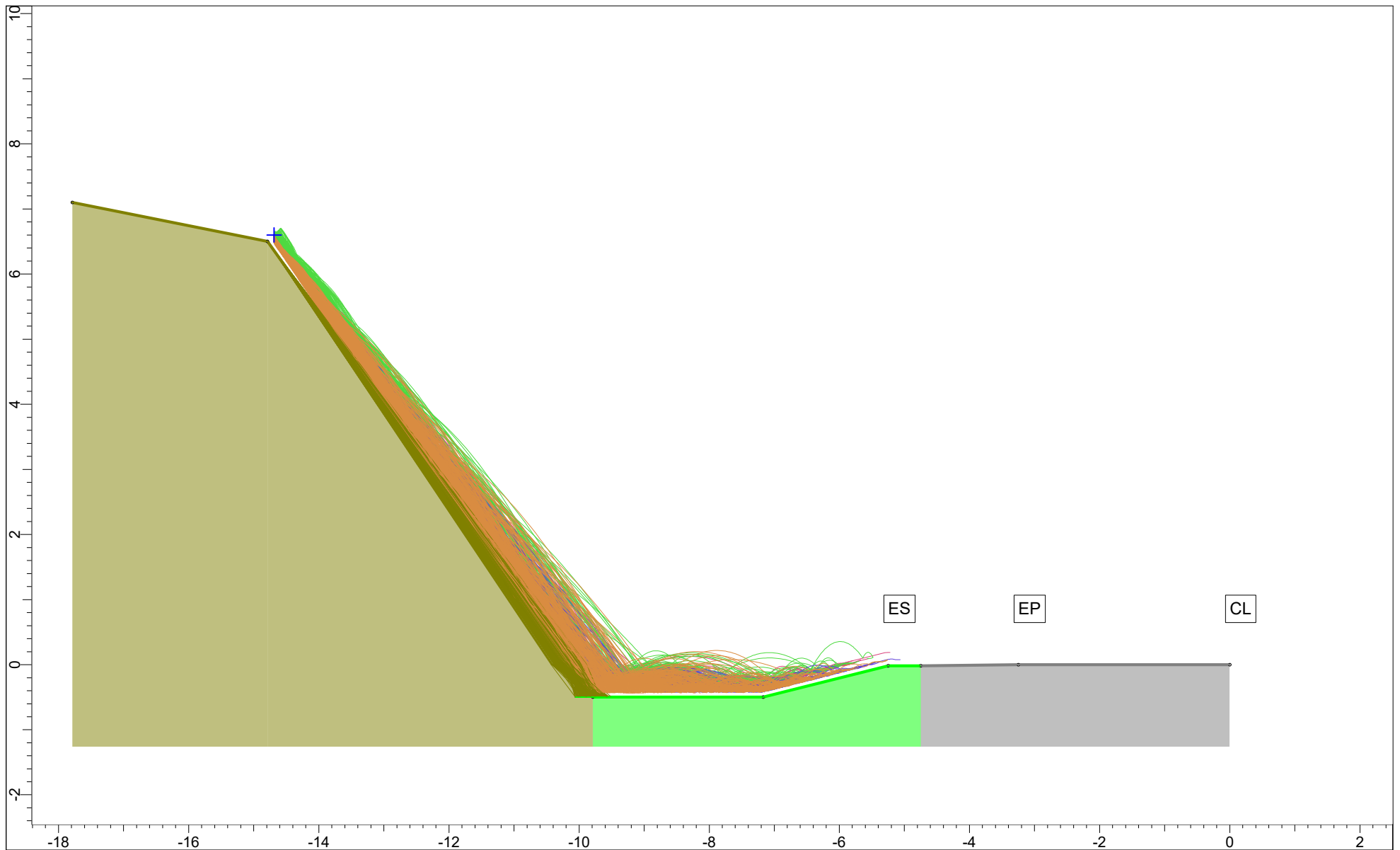


Total number of rock paths: 999



ROCFALL 8.018

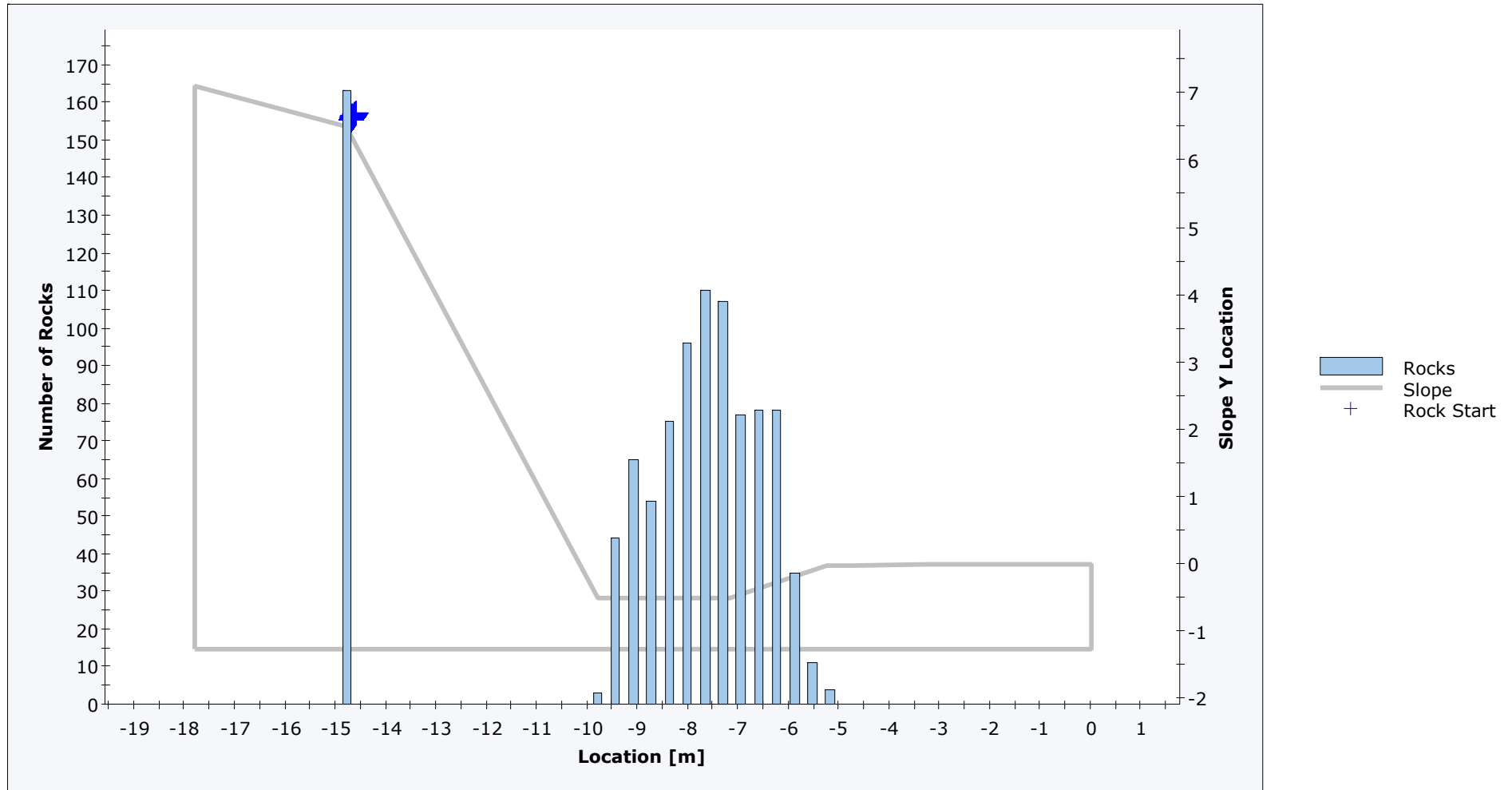
<i>Project</i>		Highway 17 Twinning	
<i>Analysis Description</i>		Rockfall Simulation - Goshen Road, 0.71H:1V	
<i>Drawn By</i>		<i>Company</i>	Thurber Engineering Ltd.
<i>Date</i>		<i>File Name</i>	Hwy 17 Goshen_0.71H1V_0.25.fal8
12/22/2021, 4:10:56 PM			



ROCFALL 8.018

Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Goshen Road, 0.71H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Goshen_0.71H1V_0.50.fal8
12/22/2021, 4:10:56 PM			

Distribution of Rock Path End Locations



Total number of rock paths: 1000

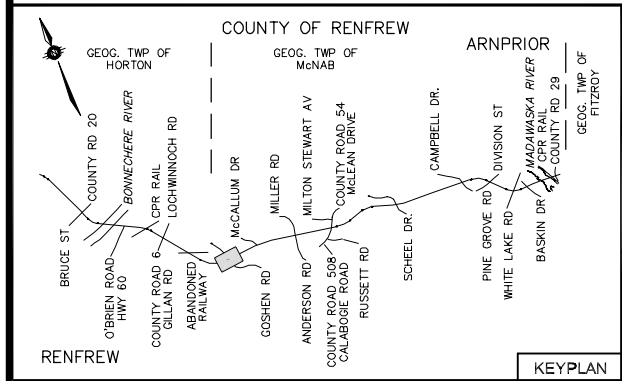
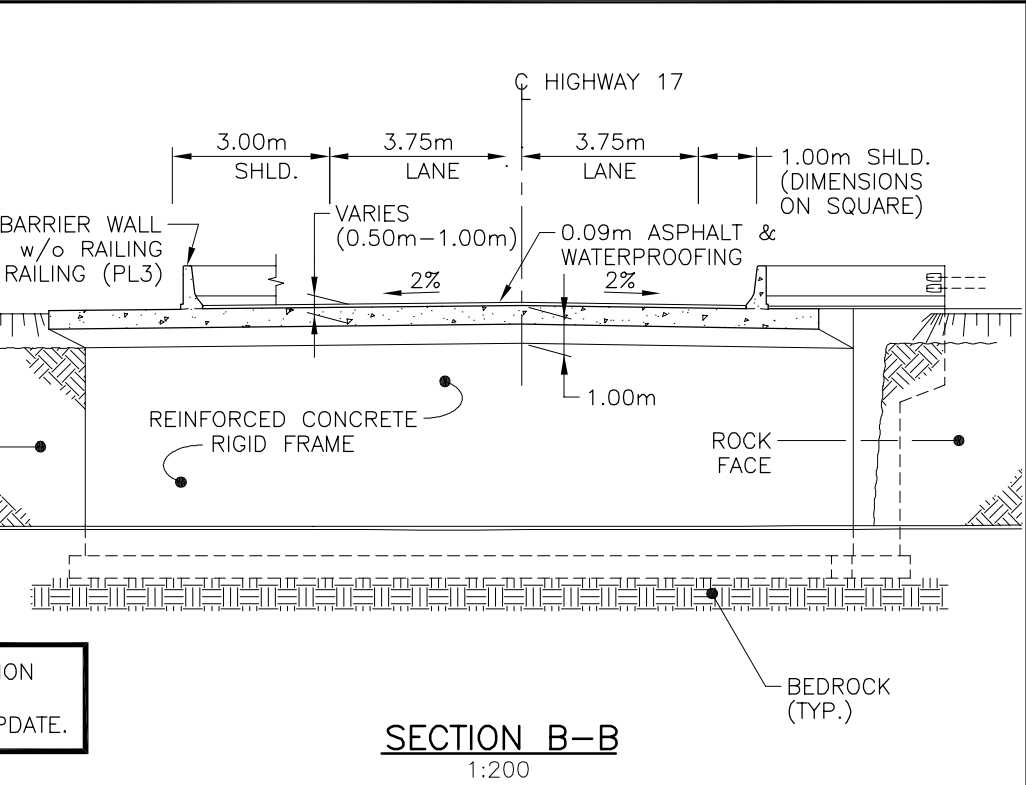
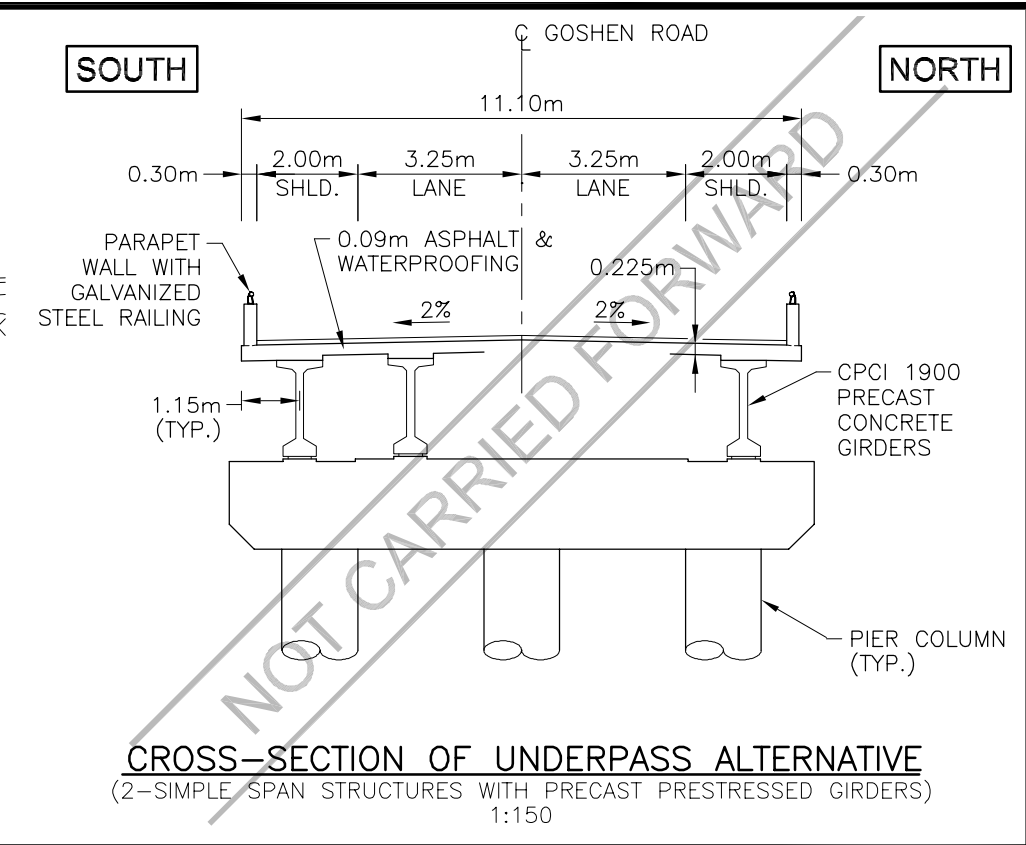
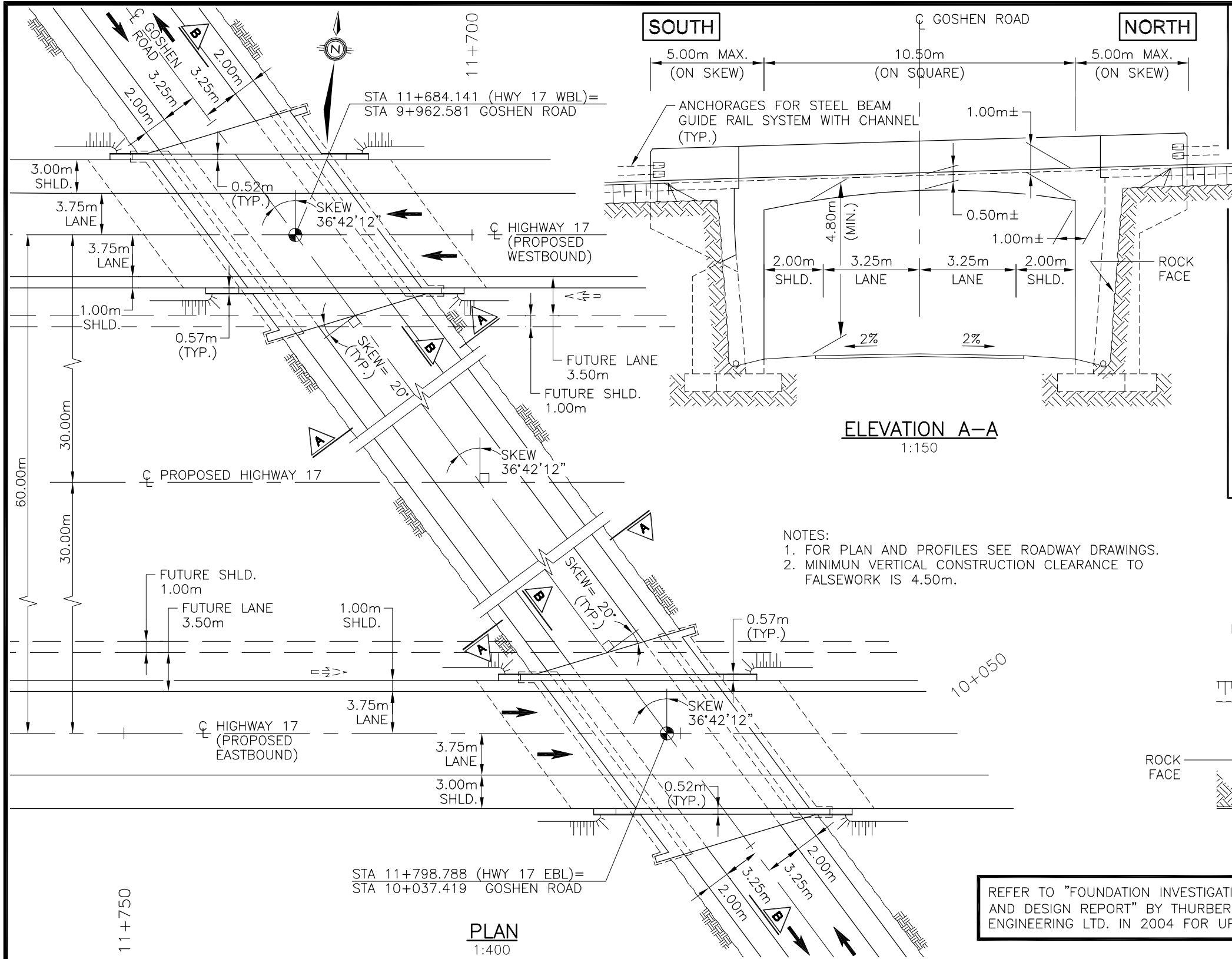


ROCFALL 8.018

Project		Highway 17 Twinning	
Analysis Description		Rockfall Simulation - Goshen Road, 0.71H:1V	
Drawn By		Company	Thurber Engineering Ltd.
Date		File Name	Hwy 17 Goshen_0.71H1V_0.50.fal8
12/22/2021, 4:10:56 PM			



Appendix F.
Preliminary GA



<h1>TWIN RIGID FRAME STRUCTURES ALTERNATIVE (RECOMMENDED)</h1>	
<h2>GOSHEN ROAD OVERPASS</h2>	
<p>HIGHWAY 17 TWINNING, COUNTY ROAD 29 TO 3.0 km WEST OF BRUCE STREET PRELIMINARY DESIGN/ ENVIRONMENTAL ASSESSMENT STUDY WP 647-92-00</p>	

SCALE:	AS NOTED



Appendix G.

List of Referenced Specifications Non-Standard Special Provisions



1. The following Special Provisions and OPSS Documents are referenced in this report:

OPSS.PROV 120	General Specification for the Use of Explosives
OPSS.PROV 202	Construction Specification for Rock Removal by Manual Scaling, Machine Scaling, Trim Blasting, or Controlled Blasting
OPSS.PROV 206	Construction Specification for Grading
OPSD 201.010	Rock Grading, Undivided Rural
OPSD 201.020	Rock Grading, Divided Rural

NOTICE TO CONTRACTOR – Rock Excavation, Machine Scaling

Special Provision

All rock identified for rock scaling shall be removed in accordance with OPSS 202 to the limits specified in the Rock Hazard Report.

The Rock Hazard Report is included in the tender documents and is available on RAQS, as per the Instructions to Bidders.

ROCK EXCAVATION, MACHINE SCALING - Item No.
ROCK EXCAVATION, MANUAL SCALING - Item No.

Special Provision

Amendment to OPSS.PROV 202, November 2013

202.07 CONSTRUCTION

202.07.02 Scaling

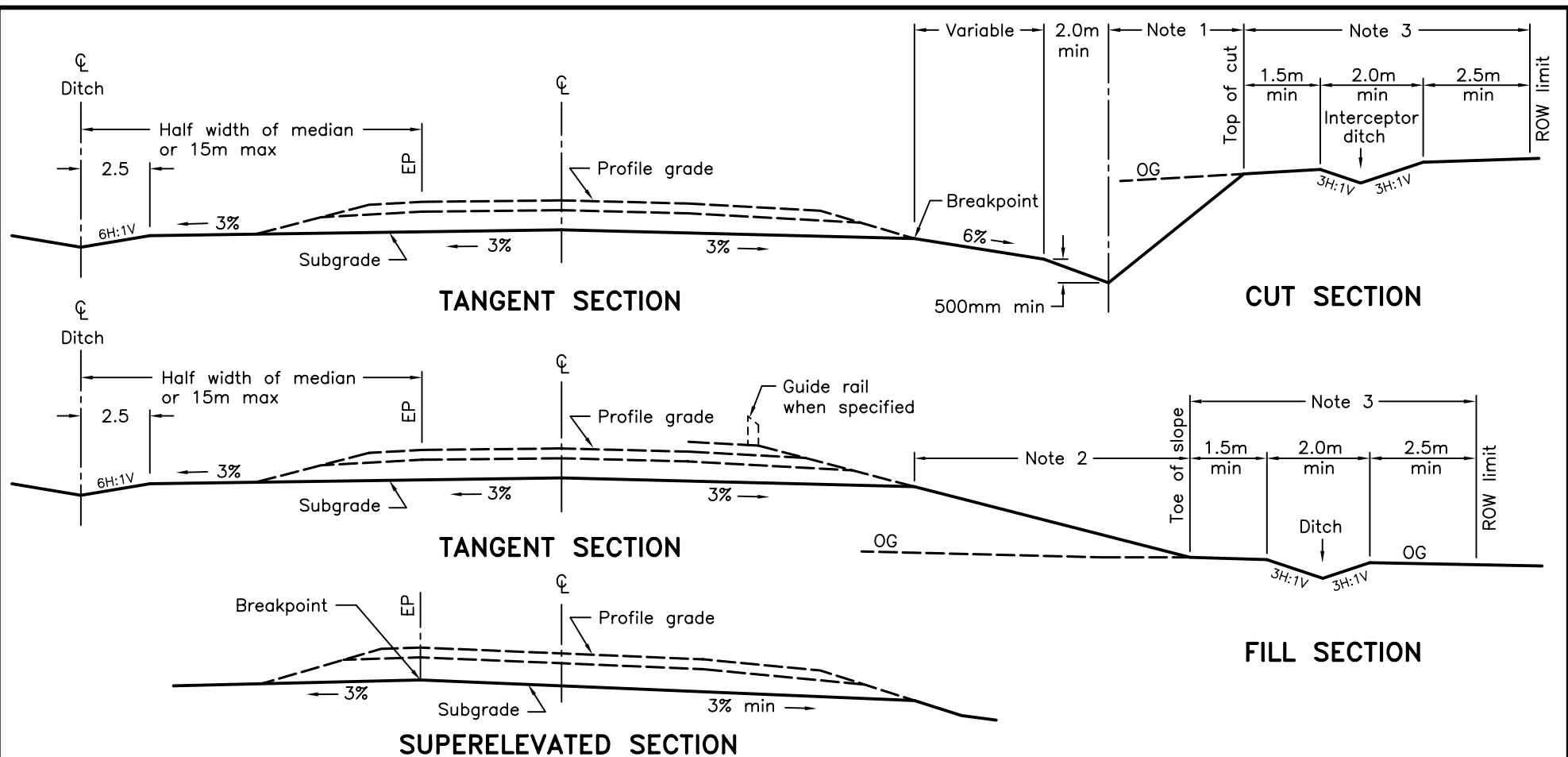
202.07.02.01 General

Clause 202.07.02.01 of OPSS.PROV 202 is amended by the addition of the following paragraphs:

All locations identified for scaling shall be inspected by the Owner prior to demobilization of scaling equipment and labourers.

A Request to Proceed shall be submitted to the Contract Administrator upon completion of scaling operations.

The demobilization of scaling equipment shall not proceed until a Notice to Proceed has been received from the Contract Administrator.



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

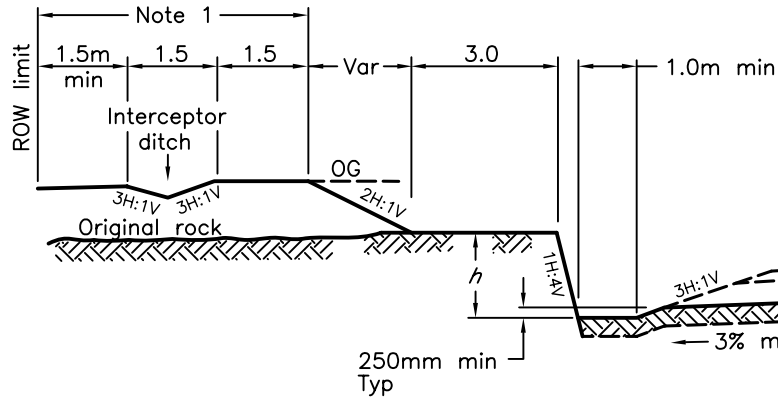
EARTH/SHALE GRADING

DIVIDED RURAL

OPSD 200.020

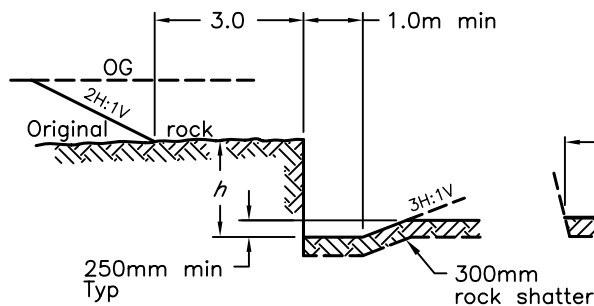


CUT SECTION

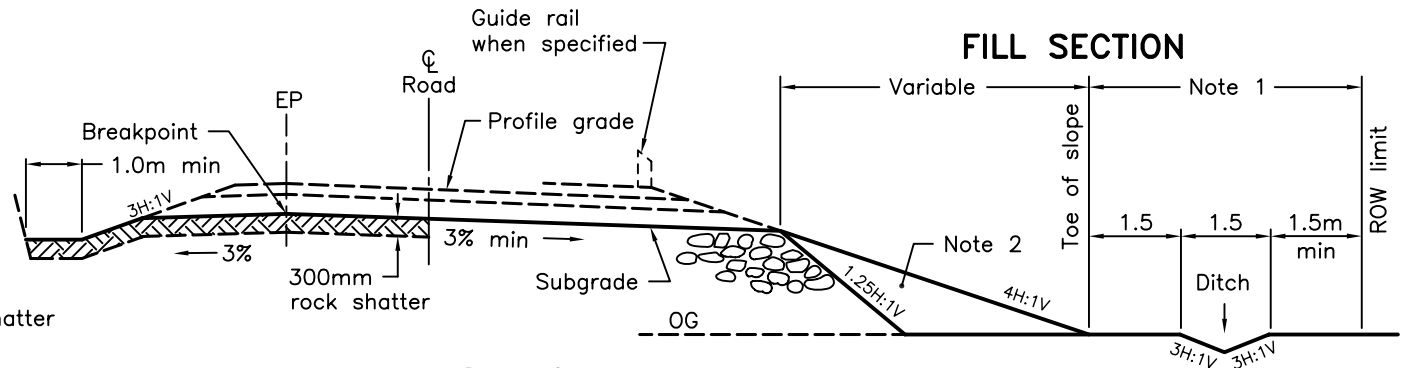


FILL SECTION

TANGENT SECTION



ALTERNATIVE DETAIL WHERE SPECIFIED



SUPERELEVATED SECTION

NOTES:

- 1 Distance shall be 1.5m minimum when ditch is not required.
- 2 Where 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

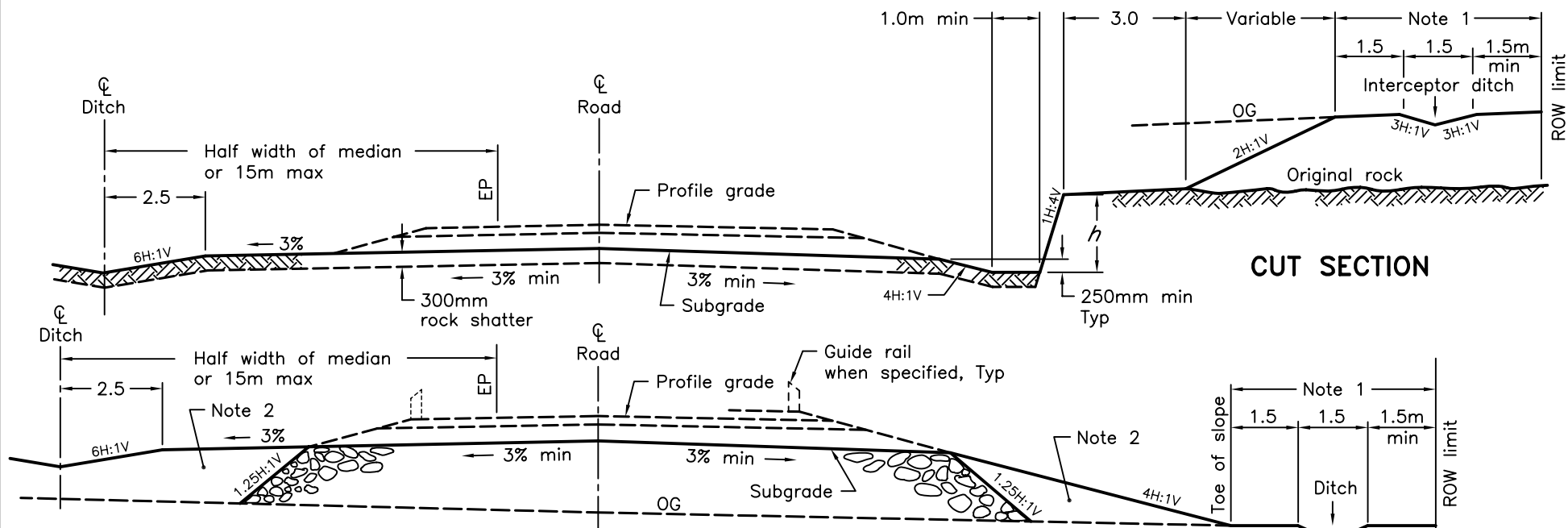
Rev 2

ROCK GRADING

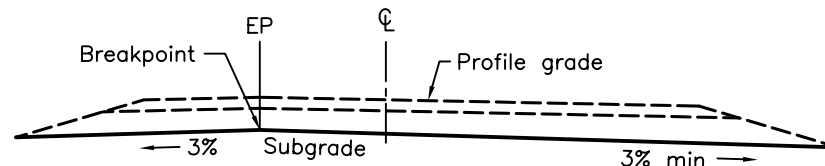
UNDIVIDED RURAL

OPSD 201.010





TANGENT SECTIONS



SUPERELEVATED SECTION

NOTES:

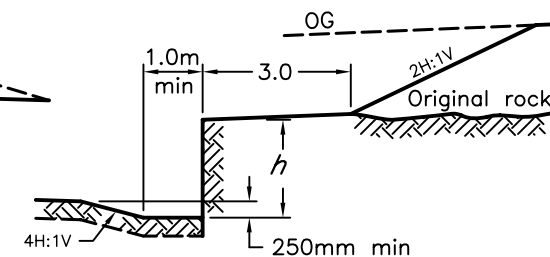
- 1 Distance shall be 1.5m minimum when ditch is not required.
- 2 Where the top of rock fill embankment is less than 2.0m above original ground, flatten slope with surplus excavated material.

- 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

FILL SECTION



ALTERNATIVE DETAIL WHERE SPECIFIED

ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2009	Rev	2
ROCK GRADING DIVIDED RURAL		-----		

		OPSD 201.020		

