



THURBER ENGINEERING LTD.



**FOUNDATION INVESTIGATION REPORT
BOSTON CREEK BRIDGE REPLACEMENT
HIGHWAY 564
NEW LISKEARD DISTRICT, ONTARIO
G.W.P. 5130-06-00, SITE NO. 47-021**

GEOCRES No. 32D-20

Report

to

MMM Group Limited

Date: June 16, 2017
File: 19-5161-251

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**FOUNDATION INVESTIGATION REPORT
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G.W.P 5130-06-00, SITE NO. 47-021**

GEOGRES No. 32D-20

PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the existing Boston Creek Bridge along Highway 564, in the District of New Liskeard, Ontario.

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

Thurber carried out the investigation as a sub-consultant to MMM Group Limited, under the Ministry of Transportation Ontario (MTO) Agreement Number 5014-E-0019.

2. SITE DESCRIPTION

The existing Boston Creek Bridge is located on Highway 564, approximately 5.8 km east of Highway 112. Built in 1954, the existing structure is a single-span steel bailey bridge with a span length of 18.3 m and a deck width of 4.3 m. The bridge superstructure is supported on rock-filled timber cribs at both east and west abutments. The approach embankment fill is retained by gabion baskets.

Boston Creek flows northerly at the bridge site. Natural ground at both approaches slope downwards towards the creek with the surrounding vegetation characterized by tall grass and shrubs interspersed with frequent trees. The local topography is of low relief with visible bedrock outcrops to the east of the site.

Photographs in Appendix C show the general nature of the site and the existing bridge.

The site lies within the physiographical area of Abitibi Subprovince. Surficial geology at the site is featured by bedrock outcrops and glacio-lacustrine deposits at low-lying areas. The bedrock consists typically of Precambrian mafic to intermediate metavolcanic rocks.

3. INVESTIGATION PROCEDURES

The site investigation and field testing for this project was carried out in three phases with the first from June 9 to June 10, 2015, the second from November 29 to December 10, 2015 and the third on February 19, 2016. A total of four boreholes, identified as BO-01 to BO-04, were drilled in conjunction with Standard Penetration Test (SPT) to depths ranging from 7.6 to 12.2 m below the ground surface. Boreholes BO-01 and BO-02 were drilled adjacent to the existing structure while Boreholes BO-03 and BO-04 were drilled along an alternate alignment to the south of the proposed replacement bridge. Boreholes BO-01, BO-02 and Borehole BO-04 were cored approximately 3.0 m into the bedrock. Borehole BO-03 was terminated upon Dynamic Cone Penetration Test (DCPT) refusal on probable bedrock.

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawings in Appendix D.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling operations. The borehole coordinates and ground surface elevations were estimated from a topographic plan provided to Thurber by MMM Group Limited.

A track-mounted CME 45 drill rig was used to advance Boreholes BO-01 and BO-04 in the overburden using solid stem augers and NW casing/wash boring techniques. A track-mounted D-25 drill rig was used to advance Borehole BO-02 in the overburden using a combination of solid stem augers and NQ coring methods to penetrate the rock fill. Borehole BO-03 was advanced using a portable tri-pod drilling rig in the overburden using NW casing/wash boring techniques. Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). NQ coring methods were used to core 3 m into the bedrock in Boreholes BO-01, BO-02 and BO-04.

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

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Groundwater conditions observed after completion of drilling were not representative of site conditions where water was used during wash boring/coring operations. A standpipe piezometer

was installed in Borehole BO-01 to monitor the groundwater level after drilling. The boreholes were backfilled in general accordance with MOE Regulation 903. Completion details of the piezometer and boreholes are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Boreholes	Piezometer Installation		Completion Details
	Screen Depth/Elev. (m)	Monitored Stratum	
BO-01	6.1 - 9.1 / 242.4 - 239.4	Sand and Gravel	Cuttings from 12.2 m to 9.1 m, sand from 9.1 m to 5.5 m, bentonite holeplug from 5.5 m to surface.
BO-02	None Installed		Bentonite holeplug and cuttings from 12.2 m to surface.
BO-03	None Installed		Bentonite holeplug and cuttings from 7.6 m to surface.
BO-04	None Installed		Bentonite holeplug and cuttings from 10.7 m to surface.

4. LABORATORY TESTING

All recovered soil samples were subjected to visual identification and natural moisture content determination. Selected samples were subjected to grain size distribution analyses (sieve and hydrometer). The results of this testing program are summarized on the Record of Borehole sheets included in Appendix A and on the figures presented in Appendix B.

In order to assess the potential for sulphate attack on foundation concrete and the potential for corrosion, a sample of the native soil and a sample of the surface water from the creek upstream of the bridge were collected. The samples were submitted to AGAT Laboratories in Mississauga, Ontario for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 6 below and are presented in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil stratigraphy are presented in these sheets and on the “Borehole Locations and Soil Strata” drawings included in Appendix D. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond the borehole locations.

The soil stratigraphy below the embankment fill typically comprises a discontinuous surficial layer of silty clay underlain by a sand and gravel deposit overlying sandy silt to silt above granitic bedrock. The sand and gravel deposit extends to bedrock in BO-01 near east abutment of the existing bridge. More detailed descriptions of individual strata are presented below.

5.1 Topsoil

Topsoil was encountered in Boreholes BO-01 to BO-03. The thickness of the topsoil ranged between 40 and 50 mm. Topsoil thickness may vary between and beyond borehole locations.

5.2 Embankment Fill

Sand and gravel fill containing cobbles was encountered below the topsoil in Boreholes BO-01 and BO-02. Rock fill was encountered below the sand and gravel fill in BO-02. The fill thickness ranged between 2.1 and 2.7 m with the lower boundary at Elev. 246.3 and 244.4. The thickness of the rock fill encountered in BO-02 was 1.2 m and was penetrated by coring.

SPT-N values recorded in the sand and gravel fill ranged typically from 28 to 44 blows per 0.3 m of penetration with exception of one value of 11 blows, indicating a compact to dense relative density. Moisture contents of the sand and gravel fill ranged from 4 to 6%.

The results of grain size analyses conducted on a sample of the fill is provided on the Record of Borehole sheets in Appendix A and plotted in Figure B1 of Appendix B. The results are summarized below.

Soil Particle	Percentage (%)
Gravel	46
Sand	52
Silt & Clay	2

5.3 Silty Clay

A thin layer of brown to grey silty clay with some sand was encountered below the sand and gravel fill in BO-01 and below the topsoil in BO-03. The silty clay contains occasional cobbles and trace roots and rootlets. The thickness of the silty clay ranged between 0.5 and 1.5 m with the lower boundary at Elev. 245.3 and 244.8.

SPT-N values recorded in the silty clay ranged from 3 to 24 blows per 0.3 m of penetration, indicating a soft to very stiff consistency. Natural moisture contents of the silty clay ranged between 9 and 33%.

The results of grain size analyses conducted on a sample of the silty clay is provided on the Record of Borehole sheets in Appendix A and plotted in Figure B2 of Appendix B. The results are summarized below.

Soil Particle	Percentage (%)
Gravel	0
Sand	39
Silt	30
Clay	31

5.4 Sandy Gravel to Sand and Gravel

A native sandy gravel to sand and gravel deposit was encountered below the silty clay in Boreholes BO-01 and BO-03, underlying the fill in Borehole BO-02 and at the surface in Borehole BO-04. The deposit contains occasional cobbles and boulders and trace silt. The thickness of the layer ranged from 1.4 to 5.6 m with the lower boundary at Elev. 243.0 to 239.2.

SPT-N values recorded in the deposit ranged from 30 to over 100 blows per 0.3 m of penetration, indicating a dense to very dense relative density. Natural moisture contents of the cohesionless deposit ranged from 10 to 21%.

The results of grain size analyses conducted on samples of the deposit are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B3 of Appendix B. The results are summarized below.

Soil Particle	Percentage (%)
Gravel	57 to 75
Sand	22 to 37
Silt & Clay	3 to 6

5.5 Sandy Silt to Silt

A compact sandy silt to silt deposit was encountered below the sandy gravel to sand and gravel in Boreholes BO-02, BO-03 and BO-04. This grey layer contained trace to some clay and gravel. Borehole BO-03 was terminated within the sandy silt upon refusal on probable bedrock at Elev. 238.3. The thickness of the deposit ranged between 4.7 and 5.0 m, with the lower boundaries at Elev. 238.2 and 238.0.

SPT-N values recorded in the deposit ranged from 4 to 120 blows and typically 4 to 23 blows per 0.3 m of penetration, indicating a loose to compact relative density. The SPT-N value of 120 blows per 0.3 m penetration was recorded immediately above the refusal in Borehole BO-03. Natural moisture contents ranged from 18 to 39%.

The results of grain size analyses conducted on samples of the deposit are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B4 of Appendix B. The results are summarized below.

Soil Particle	Percentage (%)
Gravel	0 to 27
Sand	11 to 32
Silt	46 to 76
Clay	4 to 13

5.6 Bedrock

Granite bedrock was encountered in Borehole BO-01 below the sandy gravel to sand and gravel, and underlying the sandy silt to silt in Boreholes BO-02 and BO-04, and was proven by coring. Borehole BO-03 was terminated upon auger refusal on probable bedrock. Table 5.1 summarizes the depth to bedrock and the bedrock surface elevations determined in the boreholes.

Table 5.1 – Depth to Bedrock at Borehole Locations

Borehole	Depth to Bedrock (m)	Top of Bedrock Elevation (m)	Comment
BO-01	9.3	239.2	Core 3 m
BO-02	9.1	238.0	Core 3 m
BO-03	7.8 (Inferred)	238.1 (Inferred)	DCPT Refusal
BO-04	7.6	238.2	Core 3 m

The bedrock is generally described as moderately weathered to fresh and red in colour with trace grey and white. Total Core Recovery (TCR) in the bedrock ranged from 95 to 100% with solid core recovery (SCR) ranging from 33 to 98%. The Rock Quality Designation (RQD) determined from the recovered cores generally ranged from 31 to 93%, indicating poor to excellent rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to greater than 25. Unconfined compressive strengths (UCS) of the rock ranged between 156 and 263 MPa based on correlations with the point load tests (PLT), indicating very strong to extremely strong rock strength.

5.7 Groundwater Conditions

Where possible, water levels were monitored in the open boreholes during drilling operations. Wash boring and/or coring methods were used to advance all boreholes and therefore water levels recorded during or upon completion of drilling may not reflect natural groundwater levels. A standpipe piezometer was installed in Borehole BO-01 to monitor the groundwater level after

completion. The water level measured in the piezometer and in open boreholes are shown in Table 5.2.

Table 5.2 – Water Level Measurements

Borehole	Date	Water Level		Comment
		Depth (m)	Elev. (m)	
BO-01	June 15, 2015	2.6	245.9	In piezometer
	June 27, 2015	1.8	246.7	
BO-02	November 30, 2015	2.4	244.7	In Open Borehole

In the preliminary GA provided by MMM, the creek level at the bridge location was reported at Elev. 245.6 on June 3, 2015. The water levels measured in the piezometer are short-term readings and seasonal fluctuations of the groundwater and river level are to be expected. In particular, the water level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

6. CORROSIVITY AND SULPHATE TEST RESULTS

A sample of the native sandy silt to silt and a sample of the surface water from the Boston creek were tested for corrosivity parameters and sulphate content. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix B.

Table 6.1 – Analytical Test Results

Parameter	Units (Soil)	Units (Water)	Test Results	
			BO-04 SS#5	Creek Water
Sulphide	%	mg/L	0.14	< 0.05
Chloride	µg/g	mg/L	83	1.94
Sulphate	µg/g	mg/L	44	14.5
pH	pH Units	pH Units	8.02	7.52
Electrical Conductivity	mS/cm	µS/cm	0.238	162
Resistivity	ohm.cm	ohm.cm	4200	6170
Redox Potential	mV	mV	312	316
Langlier Index	-	-	-	-0.55
Total Hardness (as CaCO ₃)	-	mg/L	-	80.3
Total Dissolved Solids	-	mg/L	-	104
Alkalinity (as CaCO ₃)	-	mg/L	-	63
Calcium	-	mg/L	-	23.2
Magnesium	-	mg/L	-	5.44

7. MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. The coordinates and the ground surface elevations for the boreholes were established based on topographic survey information provided by MMM Group Limited.

Thurber obtained utility clearances for the borehole locations prior to drilling.

Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied a track-mounted CME-45 drill rig, a track-mounted D-25 drill rig and a tripod drill rig, and conducted the drilling, sampling and in-situ testing operations for the boreholes. The drilling operations were supervised by Mr. Amir Fereidouni and Mr. George Azzopardi of Thurber.

Overall supervision of the field program and interpretation of the data were carried out by Mr. Stephane Loranger, CET and Ms. Deanna Pizycki, EIT.

The report was prepared by Mr. Keli Shi, P.Eng., and reviewed by Mr. Alastair Gorman, M.Sc., P.Eng., and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

EXPLANATION OF ROCK LOGGING TERMS


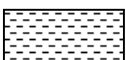

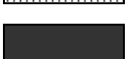

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
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 structure are preserved.

DISCONTINUITY SPACING

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

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
	(MPa)	(psi)	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

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 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index:(FI)	Frequency of natural fractures per 0.3m of core run.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	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	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and 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. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

RECORD OF BOREHOLE No BO-01

1 OF 2

METRIC

GWP# 5130-06-00 LOCATION Boston Creek Bridge N 5 319 589.0 E 383 222.5 ORIGINATED BY AHF
 HWY 564 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.09 - 2015.06.10 CHECKED BY MEF

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									
248.5	GROUND SURFACE							20	40	60	80	100					
0.9	TOPSOIL: (50mm)							20	40	60	80	100					
	Silty SAND and GRAVEL , occasional cobbles, trace roots and rootlets Compact to Dense Brown Moist (FILL)		1	SS	11		248										
			2	SS	28												
	boulder fragments Reddish Grey		3	SS	35		247										
246.3																	
2.2	Silty CLAY , some sand, trace gravel, occasional cobbles, trace roots and rootlets Soft to Very Stiff Grey Wet		4	SS	3		246										0 39 30 31
			5	SS	24												
244.8							245										
3.7	SAND and GRAVEL , trace silt, occasional cobbles and boulders Dense to Very Dense Grey Wet		6	SS	68		244										
							243										
			7	SS	95/ 0.100		242										
							241										
			8	SS	30		240										
239.2			9	SS	82/ 0.075												
9.3	GRANITE strong to extremely strong, greyish red highly fractured zones at 9.32 to 9.53 and 10.01 to 10.16m						239										RUN #1 TCR=100% SCR=68% RQD=55%

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BO-01

2 OF 2

METRIC

GWP# 5130-06-00 LOCATION Boston Creek Bridge N 5 319 589.0 E 383 222.5 ORIGINATED BY AHF
 HWY 564 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.09 - 2015.06.10 CHECKED BY MEF

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								
								20	40	60	80					
	Continued From Previous Page		1	RUN											>25	
	subvertical fractures at 9.53 to 9.55, 9.58 to 9.63 and 9.83 to 9.93m						238								0	
	horizontal fracture at 10.59m subhorizontal fractures at 10.72 to 10.74 and 10.77 to 10.80m subvertical fractures at 10.90 to 11.13, 11.23 to 11.25, 11.28 to 11.30, 11.33 to 11.35, 11.73 to 11.79, 11.91 to 11.94 and 11.96 to 12.09m highly fractured zones at 11.13 to 11.18 and 12.14 to 12.19m horizontal fractures at 11.58 and 11.73m vertical fractures at 11.66 to 11.73 and 12.06 to 12.14m		2	RUN			237							1		
236.3														5		
12.2														6		
														3		
														4		
														>25		
	END OF BOREHOLE AT 12.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2015.06.15 2.6 245.9 2015.06.27 1.8 246.7															

RECORD OF BOREHOLE No BO-02

1 OF 2

METRIC

GWP# 5130-06-00 LOCATION Boston Creek Bridge N 5 319 587.0 E 383 193.5 ORIGINATED BY GA
 HWY 564 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2015.11.29 - 2015.11.30 CHECKED BY AMP

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 (%)				
247.1	GROUND SURFACE					▽	20 40 60 80 100	20 40 60 80 100	20 40 60				GR SA SI CL	
0.0	TOPSOIL: (40mm)		1	SS	30									46 52 2 (SH+CL)
	SAND and GRAVEL, trace silt, occasional cobbles Dense Brown Moist (FILL)		2	SS	44									
245.6	ROCKFILL, mixed with sand													
1.5														
244.4														
2.7	SAND and GRAVEL, trace silt Dense Grey Wet		3	SS	34									
243.0														
4.1	Sandy SILT, trace to some clay, occasional cobbles Compact Grey Wet		4	SS	11									0 27 64 9
			5	SS	11									
			6	SS	23									
	Coring from 8.5m													
238.0												FI		
9.1	GRANITE fresh, coarse grained, strong to extremely strong, red/black/white		1	RUN								>5 >5 0	RUN #1 TCR=100% SCR=77% RQD=72% UCS=263MPa (Average)	

Continued Next Page

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

RECORD OF BOREHOLE No BO-02

2 OF 2

METRIC

GWP# 5130-06-00 LOCATION Boston Creek Bridge N 5 319 587.0 E 383 193.5 ORIGINATED BY GA
HWY 564 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2015.11.29 - 2015.11.30 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL 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						237							0	RUN #2 TCR=100% SCR=98% RQD=93% UCS=156MPa (Average)	
	Highly broken zone from 9.1m to 9.5m													0		
	Horizontal joint at 9.4m, 9.5m and 9.7m													0		
	Horizontal joint at 11.0m						236							3		
	Sub-horizontal joint at 10.9m and 11.1m		2	RUN										0		
	Highly broken zone at 11.0m													0		
234.9							235							0		
12.2	END OF BOREHOLE AT 12.2m BOREHOLE OPEN TO 12.2m AND WATER LEVEL AT 2.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.															

+³, ×³: Numbers refer to
Sensitivity





20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BO-03

1 OF 1

METRIC

GWP# 5130-06-00 LOCATION Boston Creek Bridge N 5 319 565.7 E 383 220.1 ORIGINATED BY AHF
 HWY 564 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2015.12.10 - 2015.12.10 CHECKED BY AMP

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						
245.9	GROUND SURFACE							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>						
0.0	TOPSOIL: (50mm)		1	SS	8									
245.3	Silty CLAY , some sand, trace gravel, trace roots and rootlets		2	SS	76/ 0.250		245							
0.6	Firm Grey Wet													
	SAND and GRAVEL , trace silt, occasional cobbles		3	SS	132		244							57 37 6 (SI+CL)
	Dense to Very Dense Brown to Grey Wet		4	SS	45									
242.9							243							
3.0	Sandy SILT , some gravel, trace clay, occasional cobbles		5	SS	15		242							
	Compact to Very Dense Grey Wet													
			6	SS	15		241							
			7	SS	10		240							16 32 48 4
			8	SS	11									
			9	SS	120		239							27 22 46 5
238.3														
7.6	END OF BOREHOLE AT 7.6m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE. DCPT REFUSAL AT 7.8m UPON PROBABLE BEDROCK.													

ONTMT4S 19-5161-251.GPJ 2015TEMPLATE(MTO).GDT 8/15/16

+³, ×³: Numbers refer to
Sensitivity




20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BO-04

1 OF 2

METRIC

GWP# 5130-06-00 LOCATION Boston Creek Bridge N 5 319 563.7 E 383 189.6 ORIGINATED BY AHF
 HWY 564 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2016.02.19 - 2016.02.19 CHECKED BY DJP

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							
245.8	GROUND SURFACE							20	40	60	80	100			
0.0	Sandy GRAVEL to SAND and GRAVEL , trace silt, occasional cobbles and boulders Dense to Very Dense Grey Wet Cobbles (225mm) at 1.2m		1	SS	31		245								75 22 3 (SI+CL)
			2	SS	50/ 0.075										
			1	NQ	-		244								
			3	SS	39		243								
242.9															
2.9	Sandy SILT to SILT , some sand, trace to some clay Loose to Compact Grey Wet		4	SS	11		242								
			5	SS	6		241								
			6	SS	5		240								
			7	SS	4		239								0 11 76 13
238.2															
7.6	GRANITE with trace quartz, very to extremely strong, red/grey/white Highly broken zone 150mm at 7.6m and 350mm at 8.0m Sub-vertical fracture at 50mm at 7.6m and 150mm at 8.4m 75mm vertical fracture at 8.2m Sub-horizontal fracture (25mm to 50mm) at 7.8m, 8.0m and 8.2m Horizontal fracture (25mm) at 7.9m, 8.0m, 8.1m 8.4m, 8.6m and 8.7m Sub-horizontal fracture (25mm to 75mm) at 9.5m, 9.6m and 9.9m		1	RUN			238								RUN #1 TCR=95% SCR=33% RQD=32% UCS=244MPa (Average)
			2	RUN			237								RUN #2 TCR=98% SCR=59% RQD=57% UCS=240MPa (Average)
							236								

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE



ONTMT4S 19-5161-251.GPJ 2015TEMPLATE(MTO).GDT 8/15/16

RECORD OF BOREHOLE No BO-04

2 OF 2

METRIC

GWP# 5130-06-00 LOCATION Boston Creek Bridge N 5 319 563.7 E 383 189.6 ORIGINATED BY AHF
 HWY 564 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2016.02.19 - 2016.02.19 CHECKED BY DJP

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									
	Continued From Previous Page							20	40	60	80	100					
	75mm horizontal fracture at 10.2m																
	275mm highly broken zone at 10.4m															5	
235.1																>10	
10.7	END OF BOREHOLE AT 10.7m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																



Appendix B

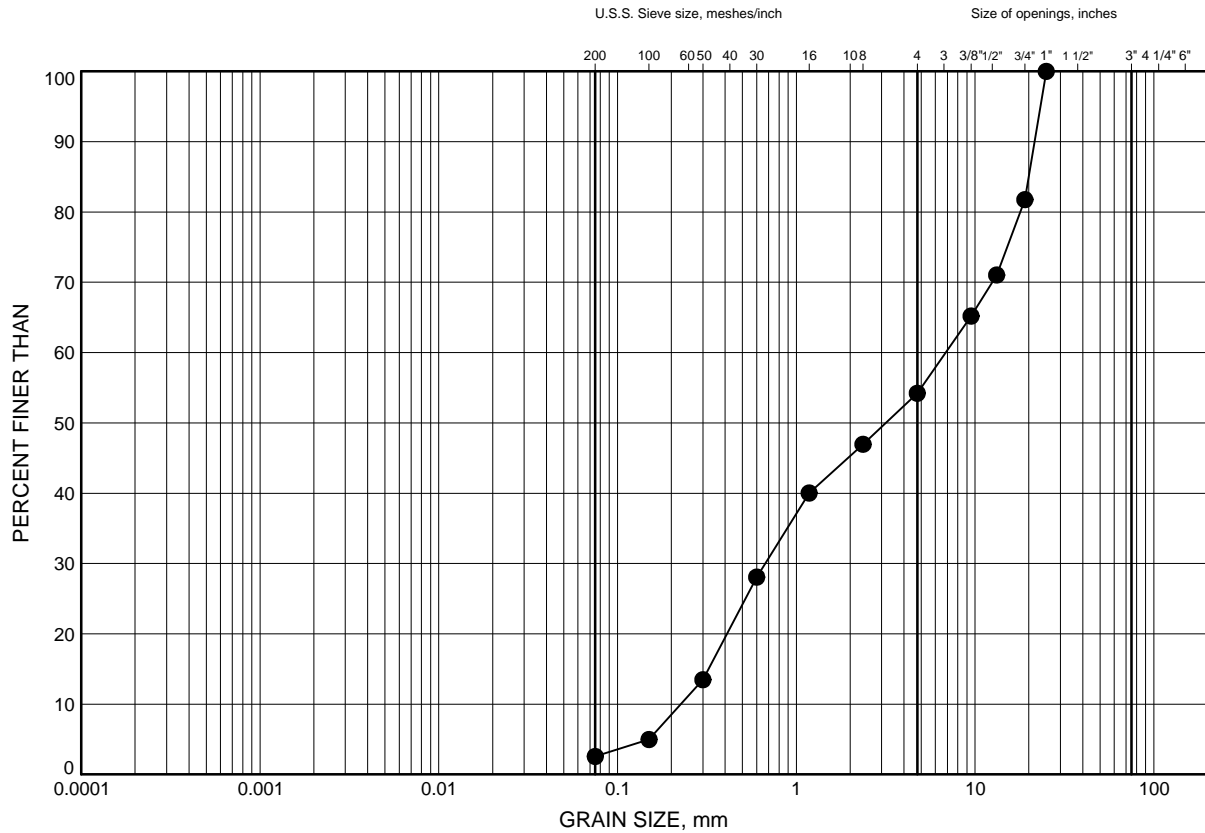
Laboratory Test Results

Boston Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BO-02	0.30	246.80

Date March 2016
GWP# 5130-06-00



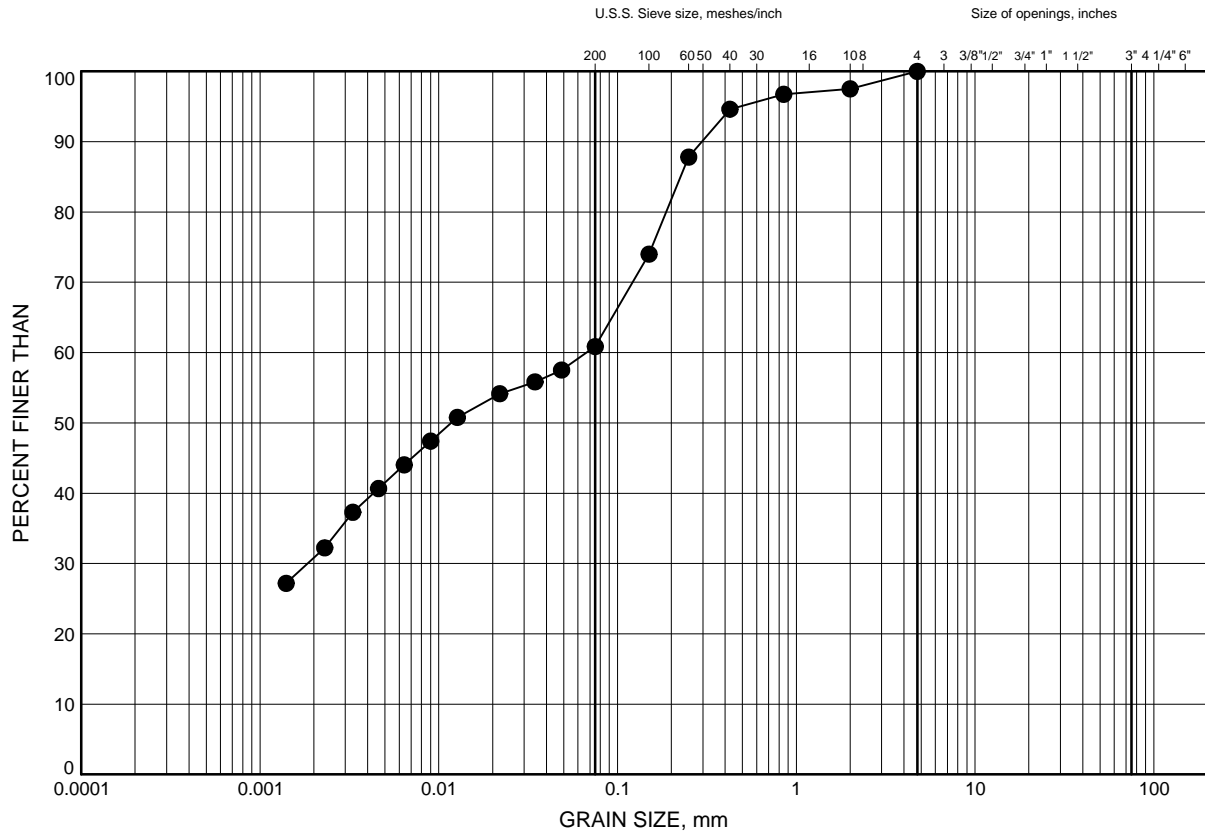
Prep'd AN
Chkd. DJP

Boston Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BO-01	2.59	245.91

Date March 2016
GWP# 5130-06-00



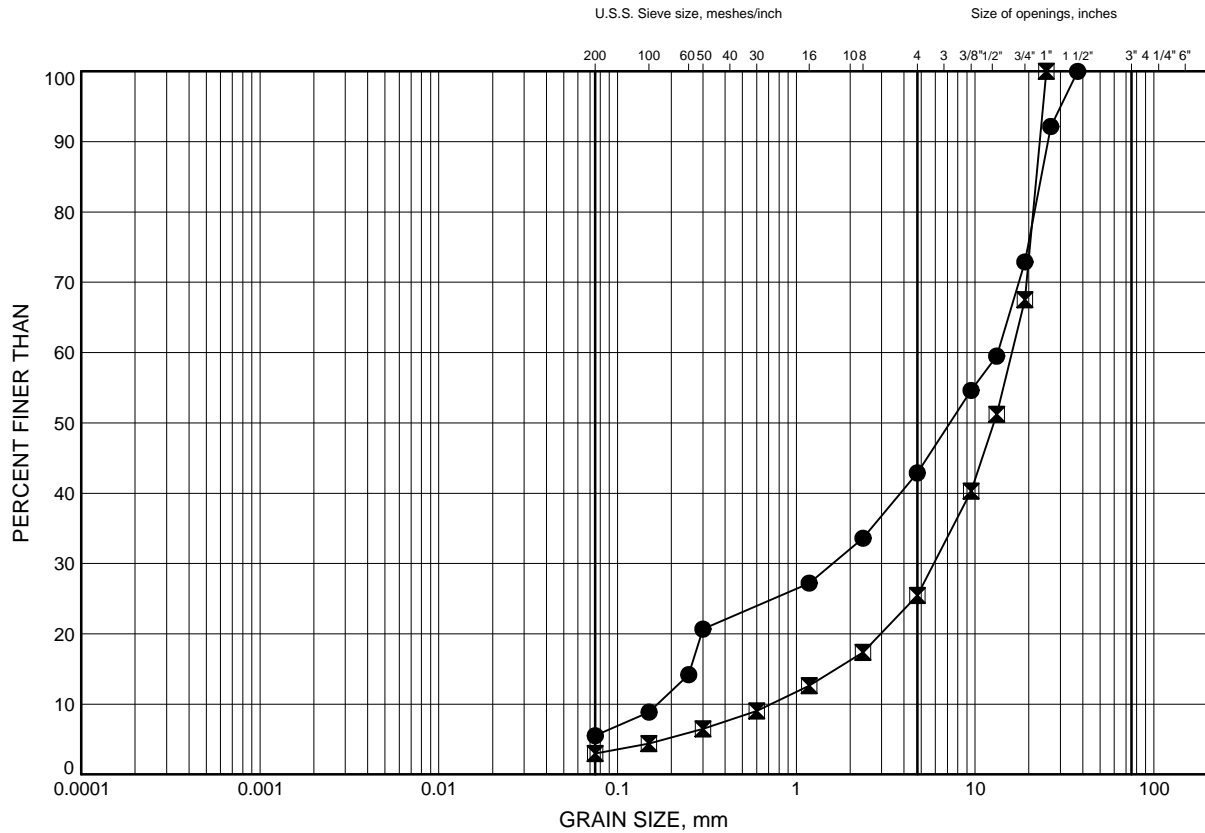
Prep'd AN
Chkd. DJP

Boston Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B3

Sandy GRAVEL to SAND & GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BO-03	1.52	244.38
⊠	BO-04	0.30	245.50

Date March 2016
GWP# 5130-06-00



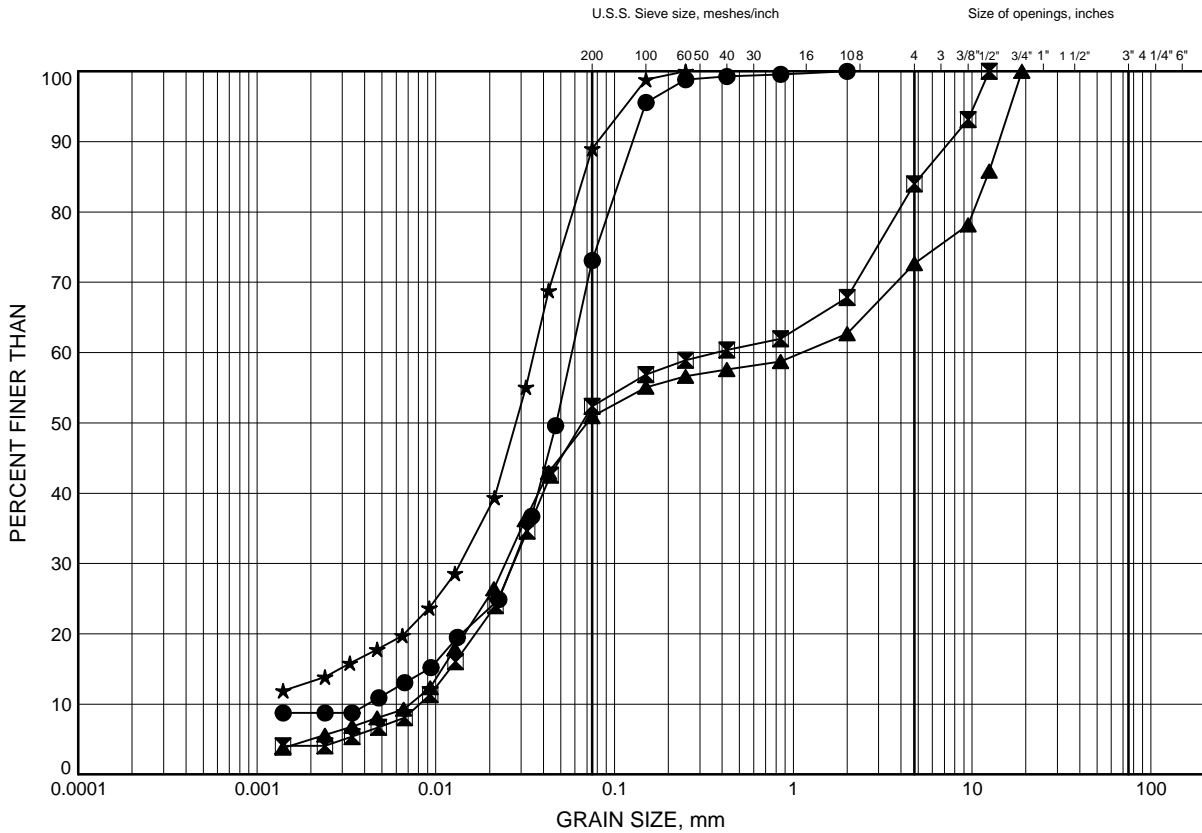
Prep'd AN
Chkd. DJP

Boston Creek Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B4

Sandy SILT to SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BO-02	4.88	242.22
⊠	BO-03	5.49	240.41
▲	BO-03	7.32	238.58
★	BO-04	6.40	239.40

Date March 2016
GWP# 5130-06-00



Prep'd AN
Chkd. DJP



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

Job No : 19-5161-251 Client : MMM Group Limited
Date Drilled : 19-Feb-16
Project Name : Highway 564 Boston Creek Bridge Replacement Date Tested : 01-Mar-16
Core Size : NQ BH No : BO-02 Tester : OA/BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	9.9	D	28.5	47.4	142.8	234.8	Granite	Very Strong
2	1	10.4	D	35.1	47.3	151.2	290.1	Granite	Extremely Strong
3	2	11.3	D	11.6	47.5	151.3	95.3	Granite	Strong
4	2	11.9	D	26.3	47.4	151.2	216.7	Granite	Very Strong
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
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28									
29									
30									
31									
32									
33									
34									
35									

- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
* Diametral Test should have $0.7 \times D$ on either side of test point.



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

Job No : 19-5161-251 Client : MMM Group Limited
Date Drilled : 19-Feb-16
Project Name : Highway 564 Boston Creek Bridge Replacement Date Tested : 01-Mar-16
Core Size : NQ BH No : BO-04 Tester : OA/BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	7.8	D	21.5	47.4	122.8	212.4	Granite	Very Strong
2	1	9.0	D	27.9	47.4	97.9	276.3	Granite	Extremely Strong
3	2	9.2	D	20.5	47.6	92.1	201.5	Granite	Very Strong
4	2	9.7	D	22.3	47.5	79.7	219.3	Granite	Very Strong
5	2	10.0	D	20.9	47.4	87.8	206.1	Granite	Very Strong
6	2	10.2	D	34.0	47.5	67.2	334.9	Granite	Extremely Strong
7									
8									
9									
10									
11									
12									
13									
14									
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31									
32									
33									
34									
35									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 16T078548

PROJECT: 19-5161-251

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE: Temiskaming Structures

ATTENTION TO: Deanna Pizycki

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2016-03-18

DATE REPORTED: 2016-03-30

		SAMPLE DESCRIPTION:		BO-04 SS5
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		2/19/2016
Parameter	Unit	G / S	RDL	7450212
Sulphide*	%		0.05	0.14
Chloride (2:1)	µg/g		2	83
Sulphate (2:1)	µg/g		2	44
pH (2:1)	pH Units		NA	8.02
Electrical Conductivity (2:1)	mS/cm		0.005	0.238
Resistivity (2:1)	ohm.cm		1	4200
Redox Potential (2:1)	mV		5	312

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7450212 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Certified By:

Amanjot Bhela



Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 19-5161-251

SAMPLING SITE: Temiskaming Structures

AGAT WORK ORDER: 16T078548

ATTENTION TO: Deanna Pizycki

SAMPLED BY:

Soil Analysis

RPT Date: Mar 30, 2016			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Sulphide*	7444756		< 0.05	< 0.05	NA	< 0.05	95%	80%	120%	NA			NA		
Chloride (2:1)	7443948		70	69	1.4%	< 2	98%	80%	120%	100%	80%	120%	95%	70%	130%
Sulphate (2:1)	7443948		337	336	0.3%	< 2	97%	80%	120%	102%	80%	120%	96%	70%	130%
pH (2:1)	7449192		7.50	7.62	1.6%	NA	102%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	7443948		0.531	0.536	0.9%	< 0.005	97%	90%	110%	NA			NA		
Redox Potential (2:1)	7449192		381	380	0.3%	< 5	109%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

Amanjot Bhela

Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T078548

PROJECT: 19-5161-251

ATTENTION TO: Deanna Pizycki

SAMPLING SITE: Temiskaming Structures

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulphide*	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

Certificate of Analysis

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 19-5161-251

SAMPLING SITE:

AGAT WORK ORDER: 15T990315

ATTENTION TO: MARK FARRANT

SAMPLED BY:

Inorganic Chemistry (Water)							
SAMPLE TYPE: Water		SAMPLE ID: 6699728			DATE RECEIVED: Jun 29, 2015		
DATE SAMPLED: Jun 27, 2015				DATE REPORTED: Jul 07, 2015			
SAMPLE DESCRIPTION: Boston Creek Bridge							
PARAMETER	UNIT	RESULT	G / S	RDL	DATE ANALYZED	INITIAL	DATE PREPARED
Electrical Conductivity	uS/cm	162		2	Jul 03, 2015	JC	Jul 03, 2015
pH	pH Units	7.52		NA	Jul 03, 2015	JC	Jul 03, 2015
Langelier Index		-0.55			Jul 06, 2015	SYS	Jul 06, 2015
Total Hardness (as CaCO3)	mg/L	80.3		0.5	Jul 03, 2015	SYS	Jul 03, 2015
Total Dissolved Solids	mg/L	104		20	Jul 06, 2015	AP	Jul 03, 2015
Alkalinity (as CaCO3)	mg/L	63		5	Jul 03, 2015	JC	Jul 03, 2015
Chloride	mg/L	1.94		0.10	Jul 03, 2015	WZ	Jul 03, 2015
Sulphate	mg/L	14.5		0.10	Jul 03, 2015	WZ	Jul 03, 2015
Calcium	mg/L	23.2		0.05	Jul 03, 2015	PB	Jul 03, 2015
Magnesium	mg/L	5.44		0.05	Jul 03, 2015	PB	Jul 03, 2015
Resistivity	ohms.cm	6170			Jul 03, 2015	SYS	Jul 03, 2015
Sulphide	mg/L	<0.05		0.05	Jul 02, 2015	SN	Jul 02, 2015
Redox Potential	mV	316		5	Jul 06, 2015	BG	Jul 06, 2015

COMMENTS:

RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:





Appendix C

Site Photographs



Photograph 1 – South Elevation Looking West



Photograph 2 – North Elevation Looking East



Photograph 3 – East Abutment

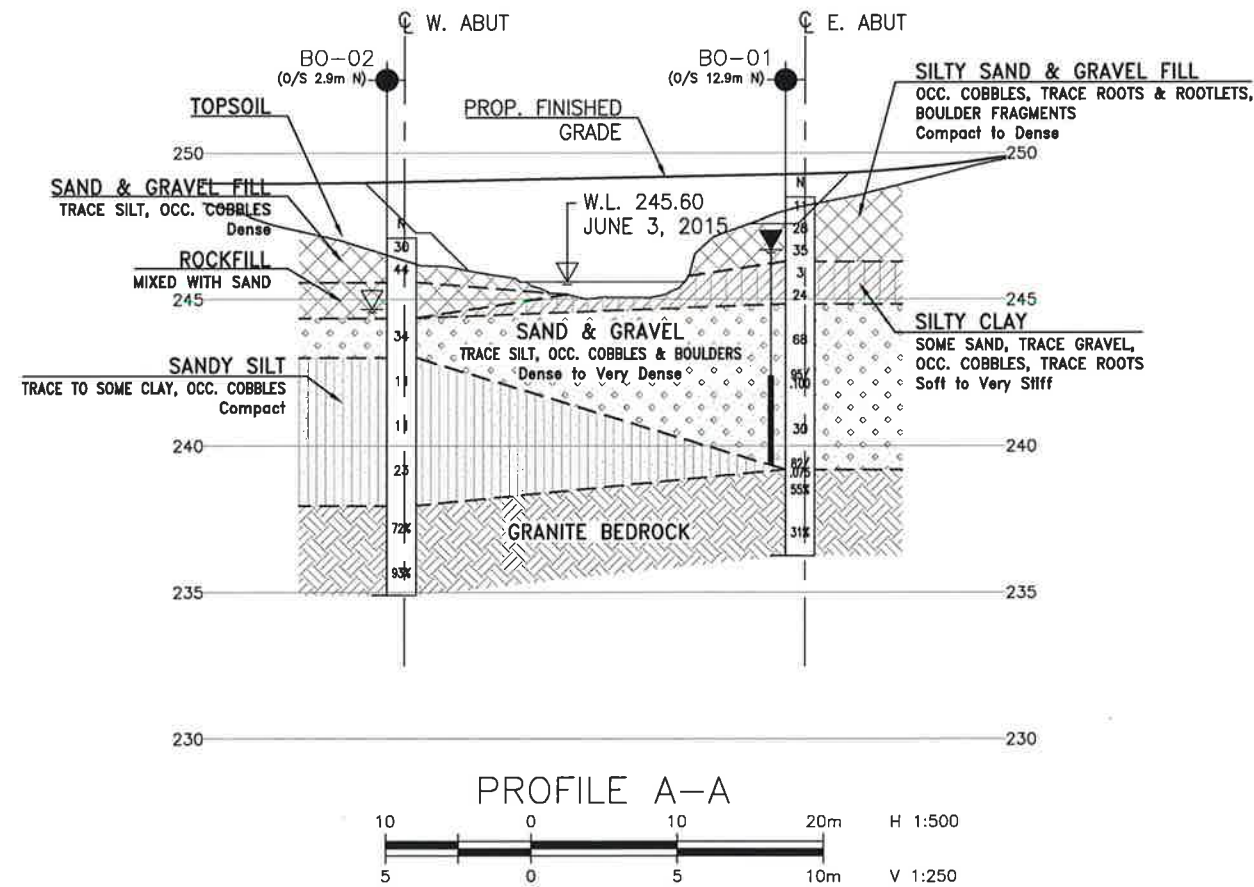
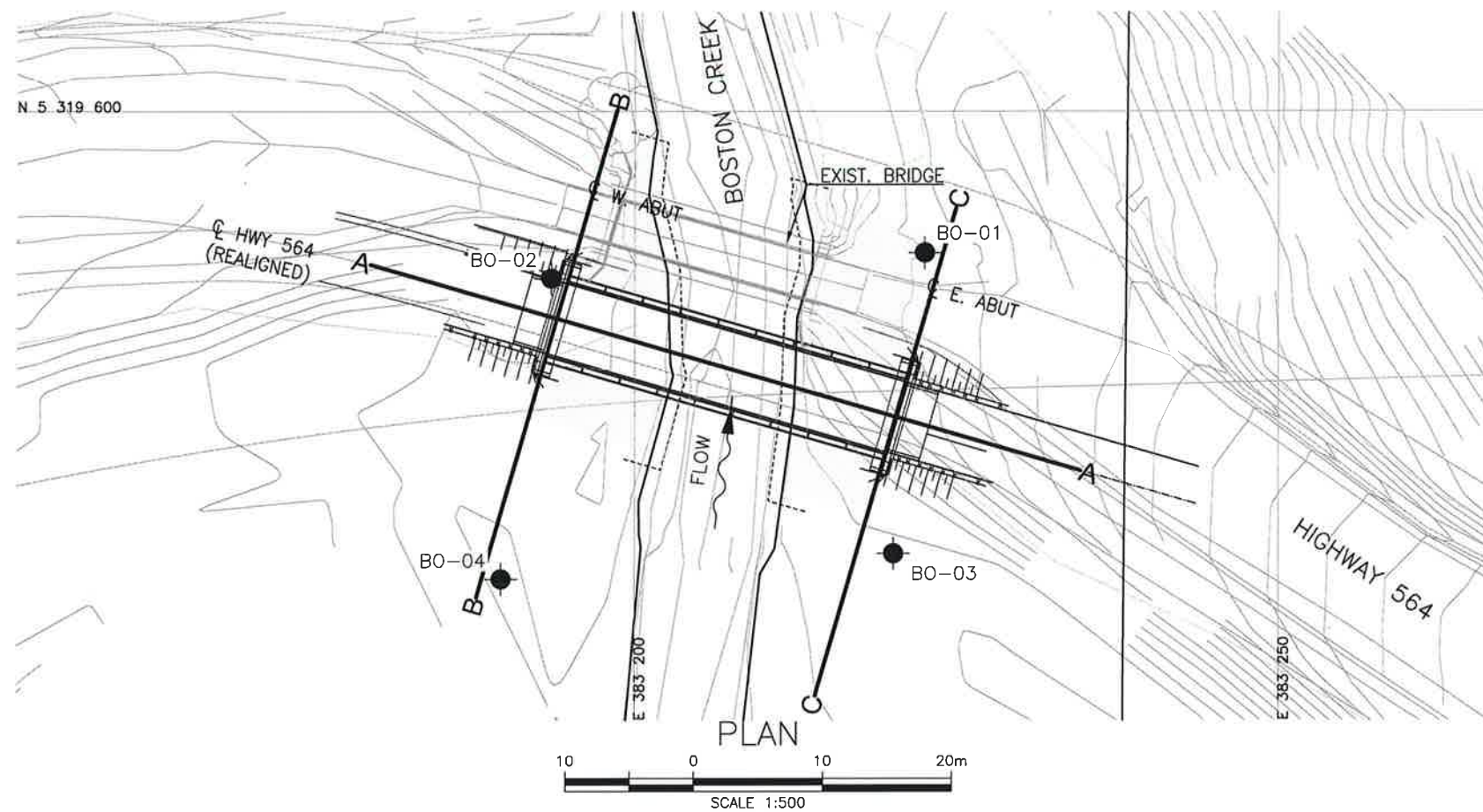


Photograph 4 – West Abutment



Appendix D

Borehole Locations and Soil Strata Drawings



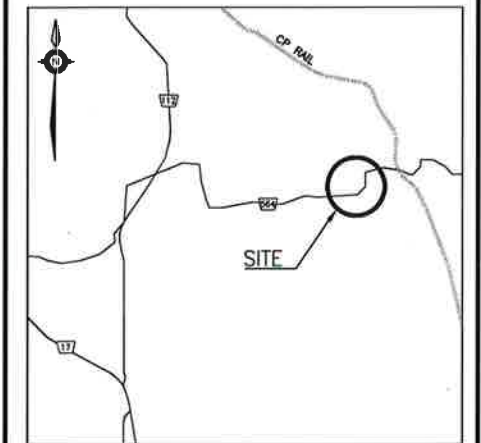
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 5130-06-00



HIGHWAY 564
BOSTON CREEK BRIDGE
REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
BO-01	248.5	5 319 589.0	383 222.5
BO-02	247.1	5 319 587.0	383 193.5
BO-03	245.9	5 319 565.7	383 220.1
BO-04	245.8	5 319 563.7	383 189.6

NOTES

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

GEOCRES No. 32D-20



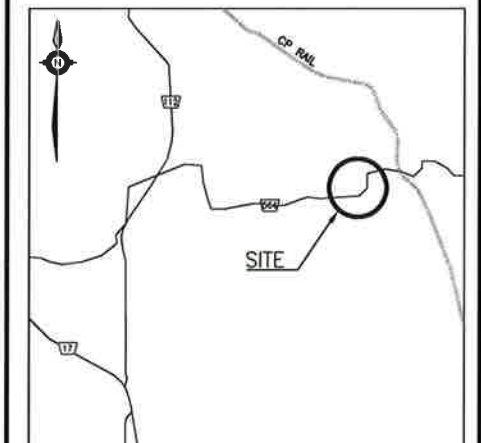
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	KS	CHK PKC	CODE
DRAWN	MFA	CHK KS	SITE
LOAD	DATE	AUG 2016	
STRUCT	DWG	1	

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

CONT No
GWP No 5130-06-00

HIGHWAY 564
BOSTON CREEK BRIDGE
REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING (MTM)	EASTING (MTM)
BO-01	248.5	5 319 589.0	383 222.5
BO-02	247.1	5 319 587.0	383 193.5
BO-03	245.9	5 319 565.7	383 220.1
BO-04	245.8	5 319 563.7	383 189.6

NOTES

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

GEOCRES No. 32D-20

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