



THURBER ENGINEERING LTD.



**PRELIMINARY FOUNDATION INVESTIGATION REPORT
ROSSMERE CREEK CULVERT REPLACEMENT
HIGHWAY 11, SITE No. 48W-192/C
HAGEY TOWNSHIP, DISTRICT OF THUNDER BAY
ONTARIO
G.W.P. No. 6804-14-00, W.P. No. 6804-14-01
LATITUDE: 48.635823°, LONGITUDE: -90.185649°**

GEOCRES Number: 52B-32

Report

to

HATCH Corporation

Date: October 2, 2017
File: 15593

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1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the proposed replacement of the Rossmere Creek Culvert on Highway 11, located west of Shebandowan, in Hagey Township, District of Thunder Bay, Ontario.

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

Thurber was retained by Hatch Corporation (Hatch) to carry out this foundation investigation under the Ministry of Transportation Ontario (MTO) Agreement Number 6016-E-0012.

2. SITE DESCRIPTION

The site is located on Highway 11, approximately 2.9 km west of the intersection of Highway 586 and Highway 11 in Hagey Township, District of Thunder Bay, Ontario. The key plan showing the general location of the culvert site is presented on the Borehole Location and soil Strata Drawings in Appendix D.

Highway 11 runs in a general east-west direction with the culvert perpendicular to the centreline of the highway. The culvert allows Rossmere Creek to flow in a southerly direction and drain into Rossmere Bay, part of Middle Shebandowan Lake.

The Ontario Structural Inspection Manual (Inspection Form) prepared by MTO on December 16 2015 indicates that the existing structure is a 25 m long, three span (1.4 m, 1.4 m, 1.0 m) open

footing, timber structure culvert with an unknown construction date. The grade level of Highway 11 at the existing culvert is at an approximate Elevation of 452.2 m. The culvert invert is at approximately Elevation 449.3 m at the inlet (north end) and 449.2 m at the outlet (south end), and the culvert height is approximately 1.2 m. The existing road grade at the culvert location is approximately Elev. 452.2 m, which indicates approximately 1.8 m of fill above the culvert. The Rossmere water level (ice level) was measured by Thurber at Elevation 450.2 m on March 27, 2017, and was measured by others at 450.0 m in August, 2015.

The lands surrounding Rossmere Creek and the culvert at the site predominantly consist of heavily forested areas with occasional marsh lands and lakes. Local topography is generally of low relief and consists of organic terrain. Photographs of the culvert and surrounding area are presented in Appendix C.

Based on published geological information, the subsurface soils at the site generally consist of organic deposits of peat with nearby ground moraine deposits of silty to sand till. Bedrock in the area has been identified as mafic to intermediate metavolcanic bedrock, comprised of basaltic and andesitic flows.

3. INVESTIGATION PROCEDURES

The borehole investigation and field testing program for this project was carried out between March 25 and 27, 2017, and consisted of drilling and sampling seven (7) boreholes, designated as Boreholes 17-15, to 17-21, to depths ranging from 3.7 to 15.3 m below the existing ground surface. Boreholes 17-15 and 17-18 were drilled near the inlet and outlet of the existing culvert, and all other boreholes were drilled through the paved section of Highway 11. Boreholes 17-19 to 17-21 were drilled east of the existing culvert to assess the existence and extents of any frost taper near the culvert.

Utility clearances were obtained prior to the start of drilling. The ground surface elevations for the boreholes were derived from cross sections and topographic drawings provided to Thurber by Hatch. The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawing included in Appendix D.

The boreholes were drilled using a rubber tire buggy mounted drill rig equipped with continuous flight, hollow and solid stem augers. Samples of the overburden soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). A Dynamic Cone Penetration Test (DCPT) was carried out at 17-16 and 17-17 adjacent to the original auger hole to cone refusal depth of approximately 15.3 m in

both boreholes.

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 samples for transport to Thurber's laboratory for further examination and testing.

A piezometer was installed in Borehole 17-18 and a piezometer reading was taken on March 27, 2017. The piezometer was decommissioned after the water level reading was taken. The boreholes were backfilled in general accordance with Ontario Regulation 903.

Completion details of the boreholes are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
17-15	12.8 / 437.6	None installed	Borehole backfilled with bentonite holeplug and cuttings to surface.
17-16	15.3 / 436.9	None installed	Borehole backfilled with bentonite holeplug cuttings and concrete to surface.
17-17	15.3 / 436.8	None installed	Borehole backfilled with bentonite holeplug cuttings and concrete to surface.
17-18	12.8 / 437.4	12.2 / 438	Sand from 12.8 m to 10.7 m, and bentonite holeplug cuttings and concrete to surface.
17-19	3.7 / 448.4	None installed	Borehole backfilled with bentonite holeplug and concrete to surface.
17-20	3.7 / 448.4	None installed	Borehole backfilled with bentonite holeplug and concrete to surface.
17-21	3.7 / 448.4	None installed	Borehole backfilled with bentonite holeplug and concrete to surface.

4. LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and/or hydrometer) and plasticity testing (Atterberg Limits) where appropriate. The results of this laboratory testing program are shown on the Record of Borehole sheets included in Appendix A and on the figures included in Appendix B.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, two samples of the existing native soil, and a sample of the surface water from the creek upstream of the existing culvert were collected. The samples were submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 6 and are presented in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendices A and E. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and should be used for interpretation of site conditions. It must be recognized and expected that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions encountered in the boreholes below the existing embankment fill typically consist of peat, underlain by silty clay, and deposits of silt and sand. Auger refusal and cone refusal occurred in Boreholes 17-17 and 17-16 beneath the sand deposits on probable bedrock. Descriptions of the individual strata are presented below.

5.1 Asphalt

The boreholes that were drilled through the paved portion of Highway 11 encountered approximately 75 mm of asphalt at the ground surface (Elev. 452.1 to 452.2).

5.2 Embankment Fill

Embankment fill was encountered below the asphalt in all boreholes drilled on Highway 11. The embankment fill generally consisted of gravelly sand to sand, with trace to some silt and trace to some gravel and occasional cobbles and boulders in the upper portions of the fill, and sand and

silt in the lower portions of the embankment fill (below 1.5 m depth) in Boreholes 17-16 and 17-17. The embankment fill typically extended to depths of approximately 2.1 m to 3.0 m below existing road surface elevation (Elev 449.1 to Elev 450.0 m).

SPT 'N' values in the fill ranged from 8 to 46 blows for 0.3 m penetration, indicating a loose to dense relative density. A higher blow count of 100 blows for 25 mm was also recorded in Borehole 17-16, which is likely a result of cobbles or boulders within the fill. Measured moisture contents ranged from 2 to 21%.

The results of grain size distribution analyses conducted on samples of the fill are presented on the Record of Borehole sheets included in Appendix A and are summarized in the following table. The results are also presented on Figure B1 in Appendix B.

Gravel %	0 to 25
Sand %	60 to 70
Silt and Clay %	10 to 40

5.3 Peat

Peat was encountered beneath the embankment fill in all boreholes on Highway 11 and at the ground surface in the boreholes at the inlet and outlet of the existing culvert. The peat is described as black in colour and contains trace to some sand, some roots and rootlets. The peat ranged in thickness from 1.1 m to 1.7 m where fully penetrated. Beneath the road embankment in Boreholes 17-16 and 17-17 the peat extended to depths of approximately 4.1 m to 4.3 m below existing road surface (Elev. 448.1 and Elev 447.8 m), respectively, and at the inlet and outlet in Boreholes 17-15 and 17-18 the peat extended to depths of approximately 1.7 m to 1.4 m below existing ground surface (Elev. 448.7 and Elev. 448.8 m), respectively. In Boreholes 17-19 to 17-21 the peat extended to the maximum depth drilled of 3.7 m below existing road surface (Elev/ 448.4 m).

SPT 'N' values recorded in the peat ranged between 1 to 5 blows for 0.3 m penetration, indicating a very soft to firm consistency. Measured moisture contents in the peat ranged from 104% to 305%.

5.4 Silty Clay

A silty clay deposit was encountered beneath the peat in Boreholes 17-15 to 17-18. The silty clay generally contains trace to some sand and is brown in colour. The silty clay deposit was 1.5 to

5.6 m thick and extended to depths of 5.6 m to 7.3 m below existing ground surface (Elev 443.1 to Elev 446.6 m).

SPT 'N' values recorded in the silty clay ranged from 0 to 10 blows for 0.3 m penetration, indicating a very soft to stiff consistency. Measured moisture contents in the silty clay ranged from 31% to 84%.

The results of grain size analyses conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B2 of Appendix B. The results are summarized as follows:

Gravel %	0
Sand %	0 to 20
Silt %	20 to 35
Clay %	45 to 80

The results of Atterberg Limits tests conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix A and illustrated in Figure B5 of Appendix B. The results are summarized as follows:

Liquid Limit	41 to 79
Plastic Limit	18 to 27
Plasticity Index	23 to 52

The results of the Atterberg Limits testing indicate that the silty clay has an intermediate to high plasticity with group symbol CI to CH.

5.5 Silt

Silt was encountered in Boreholes 17-15 to 17-18 below the silty clay deposit with the exception of Borehole 17-18 where it was encountered below a silty sand deposit. The silt generally contains trace to some sand, trace clay and was grey in colour. The silt was 1.5 to 6.1 m thick and extended to depths of approximately 10.2 m to 11.7 m (Elev 438.7 to Elev. 441.9).

SPT 'N' values recorded in the silt ranged from 6 to 34 blows for 0.3 m penetration, indicating a loose to dense relative density. Measure moisture contents in the silt ranged from 10% to 34%.

The results of grain size analyses conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B3 of Appendix B. The results are summarized as follows:

Gravel %	0
Sand %	3 to 5
Silt %	89 to 93
Clay %	4 to 7

5.6 Sand to Sand and Silt

Sand to sand and silt was encountered in Boreholes 17-15 to 17-18 generally below the silt deposit and extended to probable bedrock contact in Boreholes 17-16 and 17-17 at depths of approximately 15.3 m (Elev 436.9 to Elev 436.8 m) or to the maximum depth drilled in Boreholes 17-15 and 17-18 of 12.8 m below existing ground surface elevation (Elev. 437.6 to Elev. 437.4 m). The thickness of the deposit ranged from at least 1.1 to 2.6 m in Boreholes 17-15 and 17-18, which were terminated in the deposit, and from 3.6 to 5.1 m where fully penetrated in Boreholes 17-16 and 17-17. The sand to sand and silt generally contains trace to some gravel, trace to some silt, trace clay, and is brown to grey in colour.

SPT 'N' values recorded in the sand to sand and silt ranged from 17 to 60 blows for 0.3 m penetration, indicating a compact to very dense relative density. Measure moisture contents ranged from 6% to 28%.

The results of grain size analyses conducted on samples of the sand to sand and silt are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B4 of Appendix B. The results are summarized as follows:

Gravel %	0 to 18
Sand %	36 to 84
Silt %	19 to 52
Clay %	4 to 11
Silt and Clay %	2

5.7 Auger Refusal on Probable Bedrock

Auger and/or split spoon refusal was encountered on probable bedrock at a depth of 15.3 m (Elev 436.8 to 436.9 m) in Boreholes 17-16 and 17-17.

5.8 Groundwater Conditions

Groundwater conditions were observed during drilling and in the open boreholes upon completion, and a piezometer was installed in Borehole 17-18. The groundwater levels measured in the open boreholes and the piezometers are summarised in Table 5.1 below. The piezometer was decommissioned on March 27, 2017.

Table 5.1 – Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
17-15	March 27, 2017	0.2	450.2	Open borehole
17-16	March 27, 2017	3.0	449.2	Open borehole
17-17	March 26, 2017	3.0	449.1	Open borehole
17-18	March 27, 2017	0.2	450.0	In piezometer
17-19	March 25, 2017	3.0	449.1	Open borehole
17-20	March 25, 2017	3.0	449.1	Open borehole
17-21	March 25, 2017	3.0	449.1	Open borehole

The creek was frozen at the time of the investigation and the top of ice level was recorded by Thurber at Elev. 450.2 m. The water level in the creek was also recorded by others, as shown on the topographic survey provided by Hatch, and was 450.0 m in August, 2015. The groundwater level should be assumed to reflect the local creek water level.

The above groundwater levels are short-term readings and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

6. CORROSIVITY AND SULPHATE TEST RESULTS

Two samples of the native silty clay from Boreholes 17-16 and 17-17, and a sample of the creek water were submitted for analytical testing of corrosivity parameters and sulphate. 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		
			17-16 SS#5, 4.6 m – 5.2 m	17-17 SS#5, 4.6 m – 5.2 m	Rossmere Creek
			(Silty Clay)	(Silty Clay)	(Creek Water)
Sulphide	%	mg/L	<0.02	<0.02	0.014
Chloride	µg/g	mg/L	16	30	24
Sulphate	µg/g	mg/L	150	22	1.1
pH	No unit	No unit	8.98	8.64	6.35
Electrical Conductivity	µS/cm	µS/cm	127	160	115
Resistivity	Ohms.cm	Ohms.cm	7870	6250	8700
Redox Potential	mV	mV	286	210	197

7. MISCELLANEOUS

Thurber obtained subsurface utility clearances prior to drilling. Thurber obtained the northing and easting coordinates and ground surface elevations from measurements taken in the field relative to the topographic plans provided by Hatch.

RPM Drilling Inc. of Thunder Bay, Ontario supplied and operated the drilling, sampling and in-situ testing equipment for the field investigation. The field investigation was supervised on a full time basis by Mr. Amir Fereidouni of Thurber. Overall supervision of the field program was provided by Mr. Cory Zanatta, B.A.Sc. of Thurber.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Analytical laboratory testing was carried out by SGS Canada Inc. Interpretation of the field data and preparation of this report was carried out by Mr. Cory Zanatta, B.A.Sc., EIT and Mr. Mark Farrant, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

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Review Principal, Designated MTO Contact

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.

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 17-15

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 618.3 E 291 128.0 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.27 - 2017.03.27 CHECKED BY CZ

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _P w w _L				GR	SA	SI	CL	
450.4	GROUND SURFACE							20	40	60	80	100							
0.0	PEAT , trace roots and rootlets Very Soft Dark Brown Wet		1	GS			450											163	
			1	SS	1		449												
448.7																			
1.7	Silty CLAY , some sand Very Soft to Stiff Brown Wet (CI)		2	SS	1		448												
			3	SS	4														
			4	SS	3		447												
			5	SS	10		446												
			6	SS	0		445												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-15

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 618.3 E 291 128.0 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.27 - 2017.03.27 CHECKED BY CZ

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					
								20 40 60 80 100					
	Continued From Previous Page												
							440						
			9	SS	6								
							439						
438.7													
11.7	SAND and SILT, trace clay, trace gravel Very Dense Grey Wet												
			10	SS	60		438						8 36 52 4
437.6													
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 0.2m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.												

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

RECORD OF BOREHOLE No 17-16

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 606.7 E 291 118.7 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.03.27 - 2017.03.27 CHECKED BY CZ

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	PLASTIC LIMIT W _P NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L				
452.2	GROUND SURFACE											
0.0 0.1	ASPHALT: (75mm)											
	SAND, some silt, trace gravel, occasional cobbles and boulders Compact Brown Moist (FILL)		1	GS								
			1	SS	100/							
			2	GS	0.025							
450.7												
1.5	SAND and SILT, trace clay Compact Brown Moist (FILL)		2	SS	14							
			3	SS	11							
449.2												
3.0	PEAT, trace sand, roots and rootlets Soft Dark Brown Wet		4	SS	4							
448.1												
4.1	Silty CLAY, trace sand Very Soft Brown Wet		5	SS	2							
446.6												
5.6	SILT, trace sand and clay Loose to Compact Grey Wet		6	SS	7							
			7	SS	11							
			8	SS	10							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-16

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 606.7 E 291 118.7 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.03.27 - 2017.03.27 CHECKED BY CZ

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 WATER CONTENT (%)	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					
	Continued From Previous Page							20 40 60 80 100					
	Becoming dense		9	SS	34		442						
440.5							441						
11.7	SAND, some gravel, trace silt Dense to Compact Grey Wet		10	SS	36		440						
							439						
			11	SS	27		438						
436.9			12	SS	100		437						
15.3	END OF BOREHOLE AT 15.3m ON AUGER REFUSAL ON PROBABLE BEDROCK. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, CUTTINGS AND CONCRETE TO SURFACE. DYNAMIC CONE PENETRATION TEST CONDUCTED ADJACENT TO BOREHOLE.				0.025								

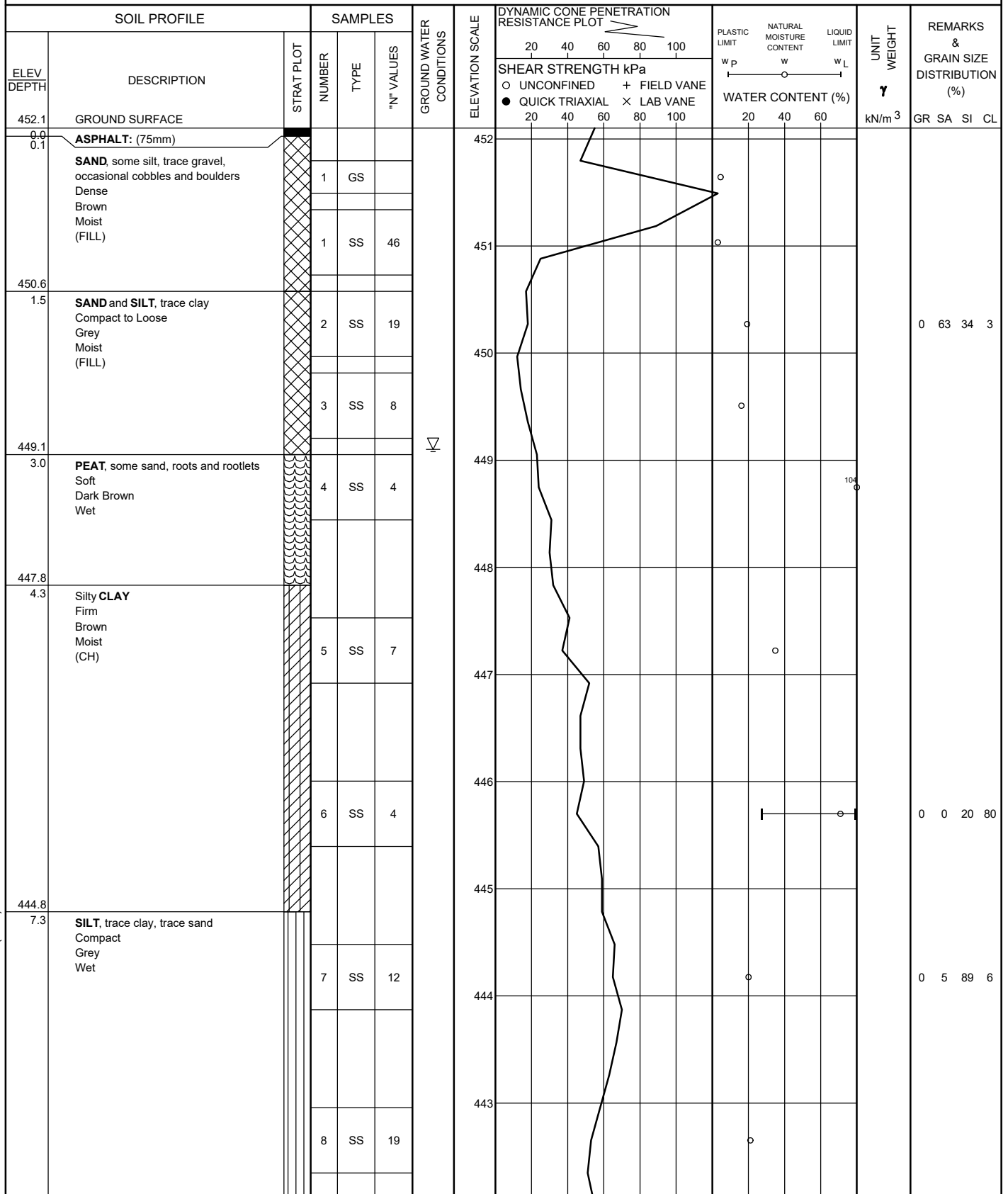
+³, ×³: Numbers refer to Sensitivity
 20
 15 10 5 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-17

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 602.7 E 291 128.2 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.26 CHECKED BY CZ



Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-17

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 602.7 E 291 128.2 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.26 CHECKED BY CZ

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 (%)				
								○ UNCONFINED + FIELD VANE				W P W W L			
Continued From Previous Page								20 40 60 80 100							
441.9							442								
10.2	SAND , some silt, some gravel, trace clay Compact Grey Wet		9	SS	17		441								
			10	SS	29		440								
			11	SS	20		439								






ONTMT4S MTO-15593.GPJ 2017TEMPLATE(MTO).GDT 10/3/17

RECORD OF BOREHOLE No 17-18

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 592.6 E 291 119.4 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.25 CHECKED BY CZ

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								WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE										
450.2	GROUND SURFACE																	
0.0	PEAT , some roots and rootlets, trace sand Very Soft Dark Brown Wet		1	GS			450											
			1	SS	1		449							305				
448.8	Silty CLAY , trace sand Very Soft to Firm Brown Wet (CH)																	
1.4																		
			2	SS	1			448										
			3	SS	1													
			4	SS	6			447										
							446											
			5	SS	4		445											
444.1	Silty SAND , some clay Compact Brown Wet						444											
6.1																		
							443											
			7	SS	24		442											
441.5	SILT , trace sand, trace clay Compact Grey Wet						441											
8.7																		
			8	SS	16													

Continued Next Page

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

RECORD OF BOREHOLE No 17-18

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 592.6 E 291 119.4 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.25 CHECKED BY CZ

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
Continued From Previous Page								20	40	60	80	100	WATER CONTENT (%)			
440.0							440									
10.2	Silty SAND , trace gravel Compact Grey Wet		9	SS	17		439									
							438									
437.4			10	SS	17											
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL IN OPEN BOREHOLE AT 0.2m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE. Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.03.27 0.2 450.0 Decommissioned															

RECORD OF BOREHOLE No 17-19

1 OF 1

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 605.8 E 291 136.1 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.03.25 - 2017.03.25 CHECKED BY CZ

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				
452.1	GROUND SURFACE							20 40 60 80 100				
0.0 0.1	ASPHALT: (75mm)						452					
	Gravelly SAND, some silt Brown Moist (FILL)		1	GS			451					25 65 10 (SI+CL)
450.0							450					
2.1	PEAT, some sand, trace roots and rootlets Soft Dark Brown Wet		2	GS			449				232	
			1	SS	3						235	
448.4												
3.7	END OF BOREHOLE AT 3.7m. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CONCRETE TO SURFACE.											

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-20

1 OF 1

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 605.5 E 291 146.1 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.25 CHECKED BY CZ

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				
452.1	GROUND SURFACE							20 40 60 80 100				
0.0 0.1	ASPHALT: (75mm)						452					
	SAND , some silt, trace gravel Brown Moist (FILL)		1	GS								7 70 23 (SI+CL)
							451					
450.0							450					
2.1	PEAT , some sand, trace roots and rootlets Soft Dark Brown Wet		2	GS							275	
							449				195	
448.4			1	SS	3							
3.7	END OF BOREHOLE AT 3.7m. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CONCRETE TO SURFACE.											

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-21

1 OF 1

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 605.1 E 291 156.1 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.25 CHECKED BY CZ

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _P w w _L				
452.1	GROUND SURFACE							20	40	60	80	100			
0.0 0.1	ASPHALT: (75mm)						452								
	SAND , some silt, some gravel Brown Moist (FILL)		1	GS											15 68 17 (SI+CL)
							451								
							450							85	
449.7															
2.4	PEAT , some roots and rootlets, trace sand Dark Brown Wet Firm		2	GS											
			1	SS	5		449							208	
448.4															
3.7	END OF BOREHOLE AT 3.7m. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CONCRETE TO SURFACE.														

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

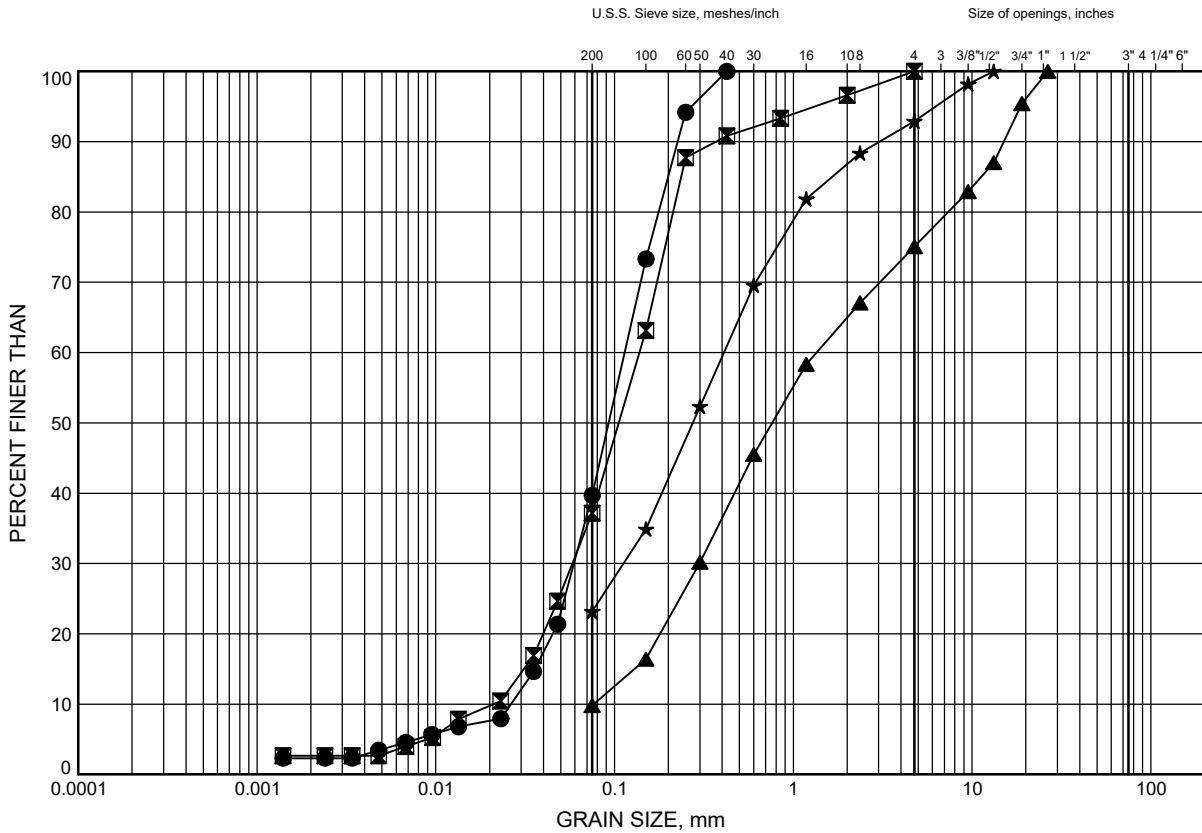
Appendix B

Geotechnical and Analytical Laboratory Test Results

Rossmere Creek Culvert GRAIN SIZE DISTRIBUTION

FIGURE B1

Embankment FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-16	2.6	449.6
⊠	17-17	1.8	450.3
▲	17-19	0.5	451.6
★	17-20	0.5	451.6

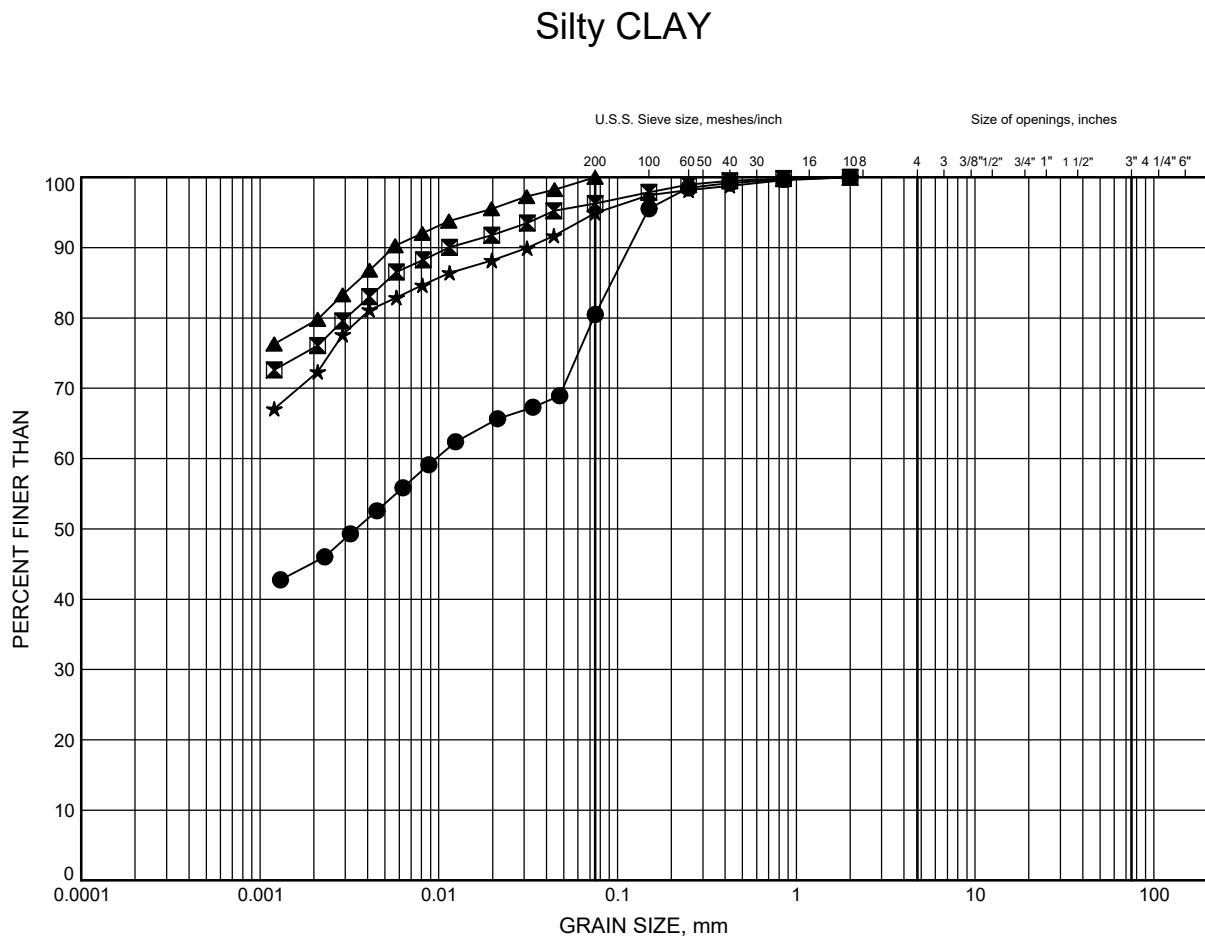
Date May 2017
W.P. 6804-14-01



Prep'd AN
Chkd. CZ

Rossmere Creek Culvert GRAIN SIZE DISTRIBUTION

FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-15	2.6	447.8
⊠	17-16	4.9	447.3
▲	17-17	6.4	445.7
★	17-18	3.4	446.8

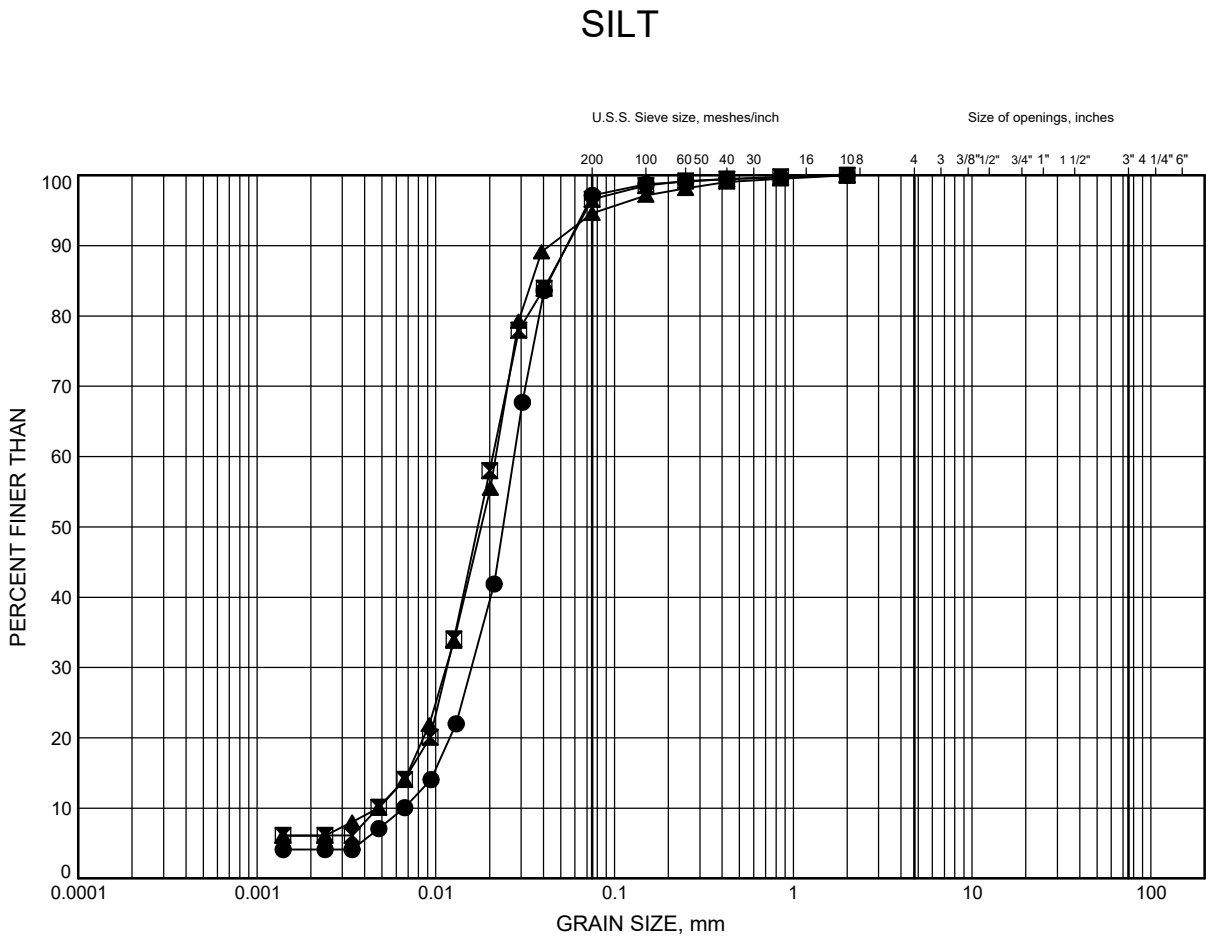
Date May 2017
W.P. 6804-14-01



Prep'd AN
Chkd. CZ

Rossmere Creek Culvert GRAIN SIZE DISTRIBUTION

FIGURE B3



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-15	7.9	442.5
⊠	17-16	9.4	442.8
▲	17-17	7.9	444.2

Date May 2017
W.P. 6804-14-01

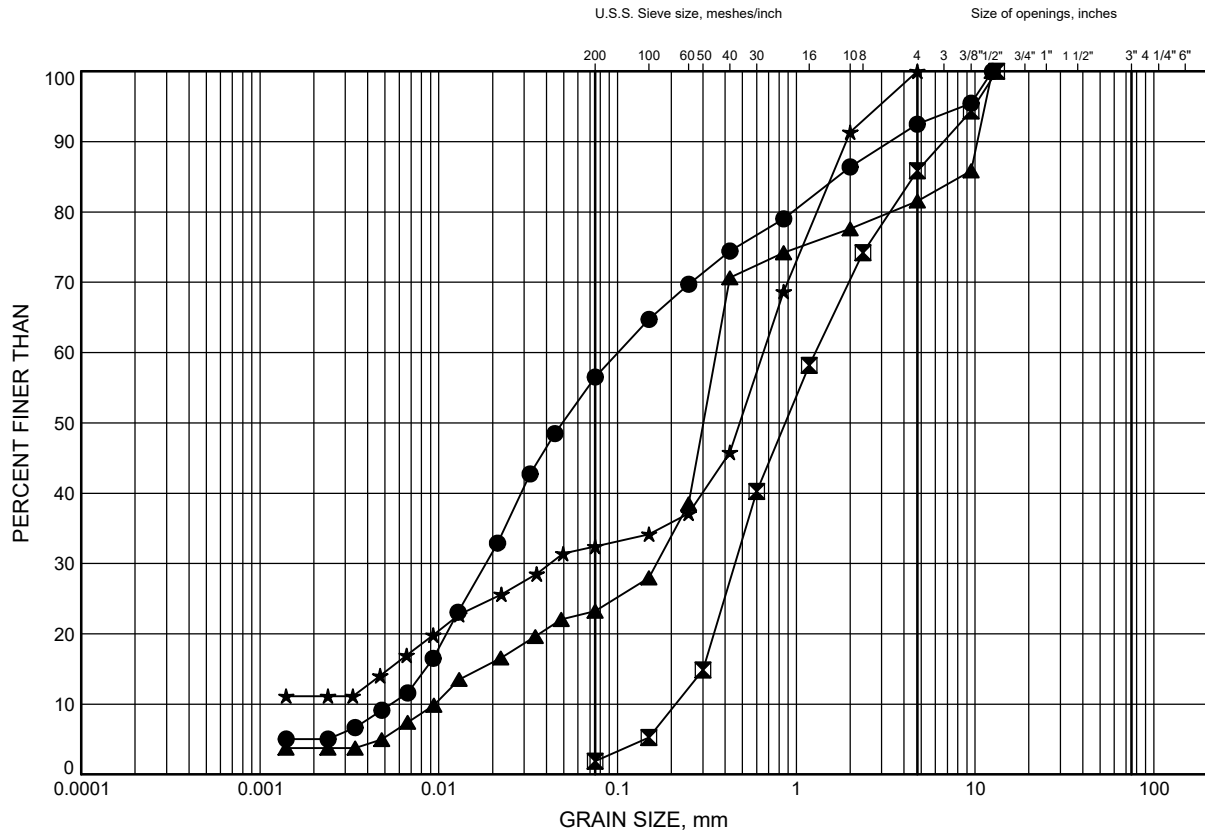


Prep'd AN
Chkd. CZ

Rossmere Creek Culvert GRAIN SIZE DISTRIBUTION

FIGURE B4

SAND to SAND and SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-15	12.5	437.9
⊠	17-16	12.5	439.7
▲	17-17	12.5	439.6
★	17-18	7.9	442.3

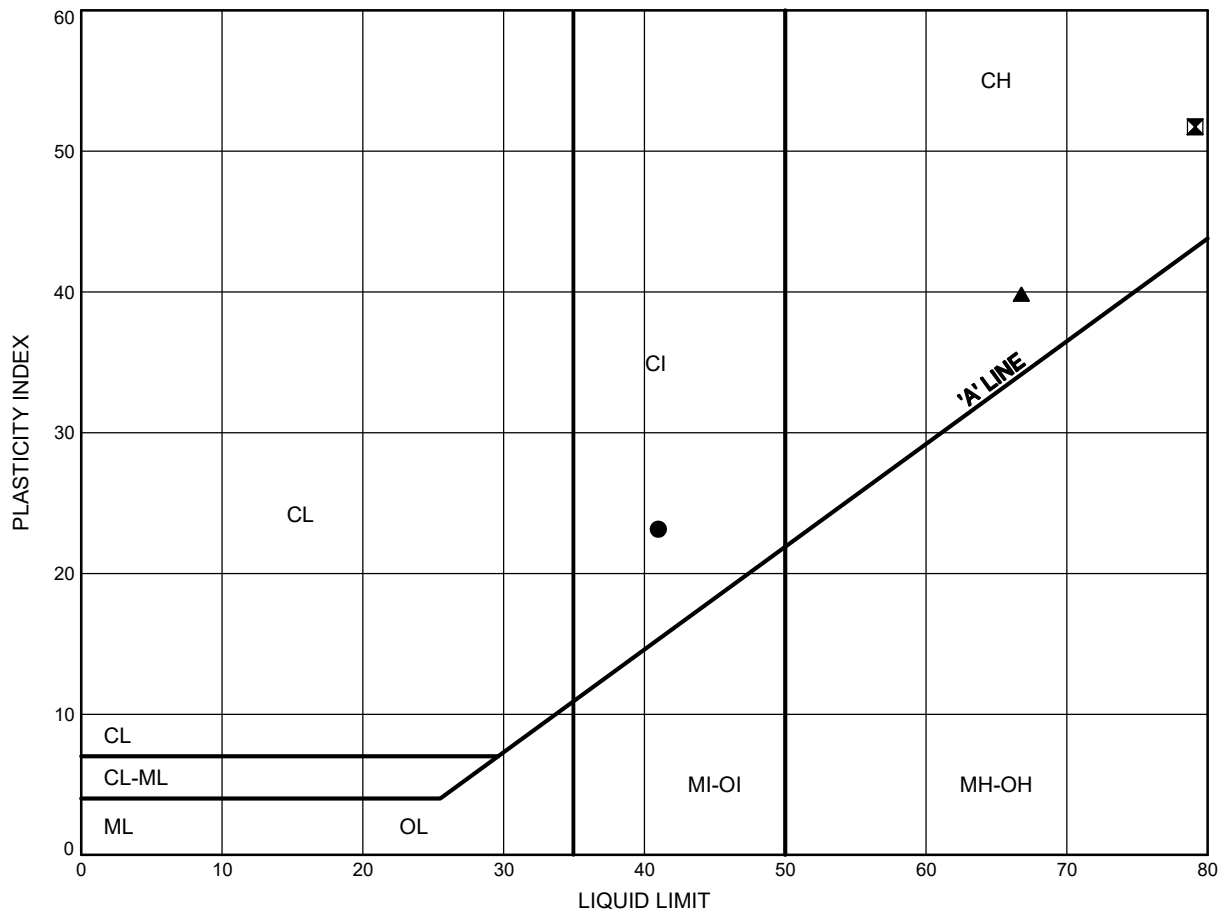
Date May 2017
W.P. 6804-14-01



Prep'd AN
Chkd. CZ

Rossmere Creek Culvert
ATTERBERG LIMITS TEST RESULTS

FIGURE B5



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-15	2.6	447.8
⊠	17-17	6.4	445.7
▲	17-18	3.4	446.8

Date May 2017
W.P. 6804-14-01



Prep'd AN
Chkd. CZ



SGS Canada Inc.

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

Thurber Engineering Ltd

Attn : Cory Zanatta

2010 Winston Park Dr
Oakville, ON
L6H 5R7,

Phone: 905-829-8666 x 240

Fax:

Project : 15593

08-May-2017

Date Rec. : 02 May 2017

LR Report: CA14060-MAY17

Reference: 15593 Cory Zanatta

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	9: 17-16 SS5	10: 17-17 SS5
Sample Date & Time					26-Mar-17	26-Mar-17
Temperature Upon Receipt [°C]	---	---	---	---	6.0	6.0
Corrosivity Index [none]	08-May-17	14:35	08-May-17	14:35	5.0	5.0
Soil Redox Potential [mV]	03-May-17	16:33	04-May-17	14:12	286	210
Sulphide [%]	05-May-17	13:47	05-May-17	15:54	< 0.02	< 0.02
% Moisture (wet wt) [%]	04-May-17	13:57	04-May-17	14:37	31.6	30.3
pH [no unit]	03-May-17	15:41	05-May-17	09:17	8.98	8.64
Chloride [µg/g]	05-May-17	17:42	08-May-17	14:40	16	30
Sulphate [µg/g]	05-May-17	17:42	08-May-17	14:40	150	22
Conductivity [uS/cm]	03-May-17	15:41	05-May-17	09:17	127	160
Resistivity (calculated) [Ohms.cm]	03-May-17	15:41	08-May-17	14:21	7870	6250

Temperature of Sample upon Receipt: 12 degrees C

Cooling Agent Present: Yes

Custody Seal Present: No

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.



SGS Canada Inc.

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Project : 15593

LR Report : CA14060-MAY17

Method Descriptions

Parameter	SGS Method Code
Anions by IC	ME-CA-[ENV]IC-LAK-AN-001
Carbon/Sulphur	ME-CA-[ENV]ARD-LAK-AN-020
Conductivity	ME-CA-[ENV]EWL-LAK-AN-006
Metals Prep	ME-CA-[ENV]ARD-LAK-AN-013
pH	ME-CA-[ENV]EWL-LAK-AN-001

Deanna Edwards, B.Sc, C.Chem

Project Specialist

Environmental Services, Analytical



SGS Canada Inc.

P.O. Box 4300 - 185 Concession St.

Lakefield - Ontario - KOL 2H0

Phone: 705-652-2000 FAX: 705-652-6365

Project : 15593

LR Report : CA14060-MAY17

Quality Control Report

Inorganic Analysis												
Parameter	Reporting Limit	Unit	Method Blank				LCS / Spike Blank			Matrix Spike / Reference Material		
					RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
						%		Low	High		Low	High
Anions by IC - QCBatchID: DIO0108-MAY17												
Chloride	0.4	µg/g	<0.4		3	20	101	80	120	105	75	125
Sulphate	0.4	µg/g	<0.4		2	20	97	80	120	87	75	125
Carbon/Sulphur - QCBatchID: ECS0006-MAY17												
Sulphide	0.02	%	<0.02		ND	20	113	80	120			
Conductivity - QCBatchID: EWL0047-MAY17												
Conductivity	2	uS/cm	< 2		2	10	93	90	110	NA		
pH - QCBatchID: EWL0047-MAY17												
pH	0.05	no unit	NA		0		100			NA		



SGS Canada Inc.

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Thurber Engineering Ltd

Attn : Cory Zanatta

2010 Winston Park Dr
Oakville, ON
L6H 5R7,

Phone: 905-829-8666 x 240

Fax:

Project : 17840/17792

02-June-2017

Date Rec. : 10 May 2017

LR Report: CA14294-MAY17

Reference: 17840/17792 Cory Zanatta

Copy: #2

CERTIFICATE OF ANALYSIS

Final Report - Reissue

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: MDL	6: Rossmere Creek
Sample Date & Time						25-Apr-17
Temperature Upon Receipt [°C]	---	---	--	--	---	9.0
pH [no unit]	11-May-17	10:30	15-May-17	10:54	0.05	6.35
Conductivity [µS/cm]	11-May-17	10:41	15-May-17	10:51	2	115
Resistivity (calculated) [ohms.cm]	---	---	---	---	---	8700
Redox Potential [mV]	11-May-17	13:57	15-May-17	10:32	---	197
Chloride [mg/L]	15-May-17	18:20	16-May-17	13:24	0.04	24
Sulphate [mg/L]	15-May-17	18:20	16-May-17	13:24	0.04	1.1
Sulphide [mg/L]	11-May-17	12:10	12-May-17	16:01	0.006	0.014



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Phone: 705-652-2000 FAX: 705-652-6365

Project : 17840/17792

LR Report : CA14294-MAY17

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present: yes

Custody Seal Present: no

Deanna Edwards, B.Sc, C.Chem

Project Specialist

Environmental Services, Analytical



SGS Canada Inc.

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Lakefield - Ontario - K0L 2H0

Phone: 705-652-2000 FAX: 705-652-6365

Project : 17840/17792

LR Report : CA14294-MAY17

Method Descriptions

Parameter	SGS Method Code	Reference Method Code
Anions by IC	ME-CA-[ENV]IC-LAK-AN-001	EPA300/MA300-Ions1.3
Conductivity	ME-CA-[ENV]EWL-LAK-AN-006	SM 2510
pH	ME-CA-[ENV]EWL-LAK-AN-006	SM 4500
Redox Potential		SM 2580
Sulphide by SFA	ME-CA-[ENV]SFA-LAK-AN-008	SM 4500



SGS Canada Inc.

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Phone: 705-652-2000 FAX: 705-652-6365

Project : 17840/17792

LR Report : CA14294-MAY17

Quality Control Report

Inorganic Analysis												
Parameter	Reporting Limit	Unit	Method Blank				LCS / Spike Blank			Matrix Spike / Reference Material		
					RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
						%		Low	High		Low	High
Anions by IC - QCBatchID: DIO0256-MAY17												
Chloride	0.04	mg/L	<0.04		2	20	97	80	120	100	75	125
Sulphate	0.04	mg/L	<0.04		0	20	96	80	120	89	75	125
Anions by IC - QCBatchID: DIO0269-MAY17												
Chloride	0.04	mg/L	<0.04		0	20	100	80	120	119	75	125
Sulphate	0.04	mg/L	<0.04		0	20	97	80	120	102	75	125
Conductivity - QCBatchID: EWL0183-MAY17												
Conductivity	2	µS/cm	< 2		0	10	99	90	110	NA		
pH - QCBatchID: EWL0182-MAY17												
pH	0.05	no unit	NA		1		100			NA		
Redox Potential - QCBatchID: EWL0192-MAY17												
Redox Potential	no	mV	NA		0	20	103	80	120	NA		
Sulphide by SFA - QCBatchID: SKA0095-MAY17												
Sulphide	0.006	mg/L	<0.006		ND	20	80	80	120	NV	75	125
Sulphide by SFA - QCBatchID: SKA0105-MAY17												
Sulphide	0.006	mg/L	0.009		ND	20	96	80	120	125	75	125

Appendix C

Selected Site Photographs



Photo 1: View looking east along the south embankment of Highway 11



Photo 2: View looking west along Highway 11



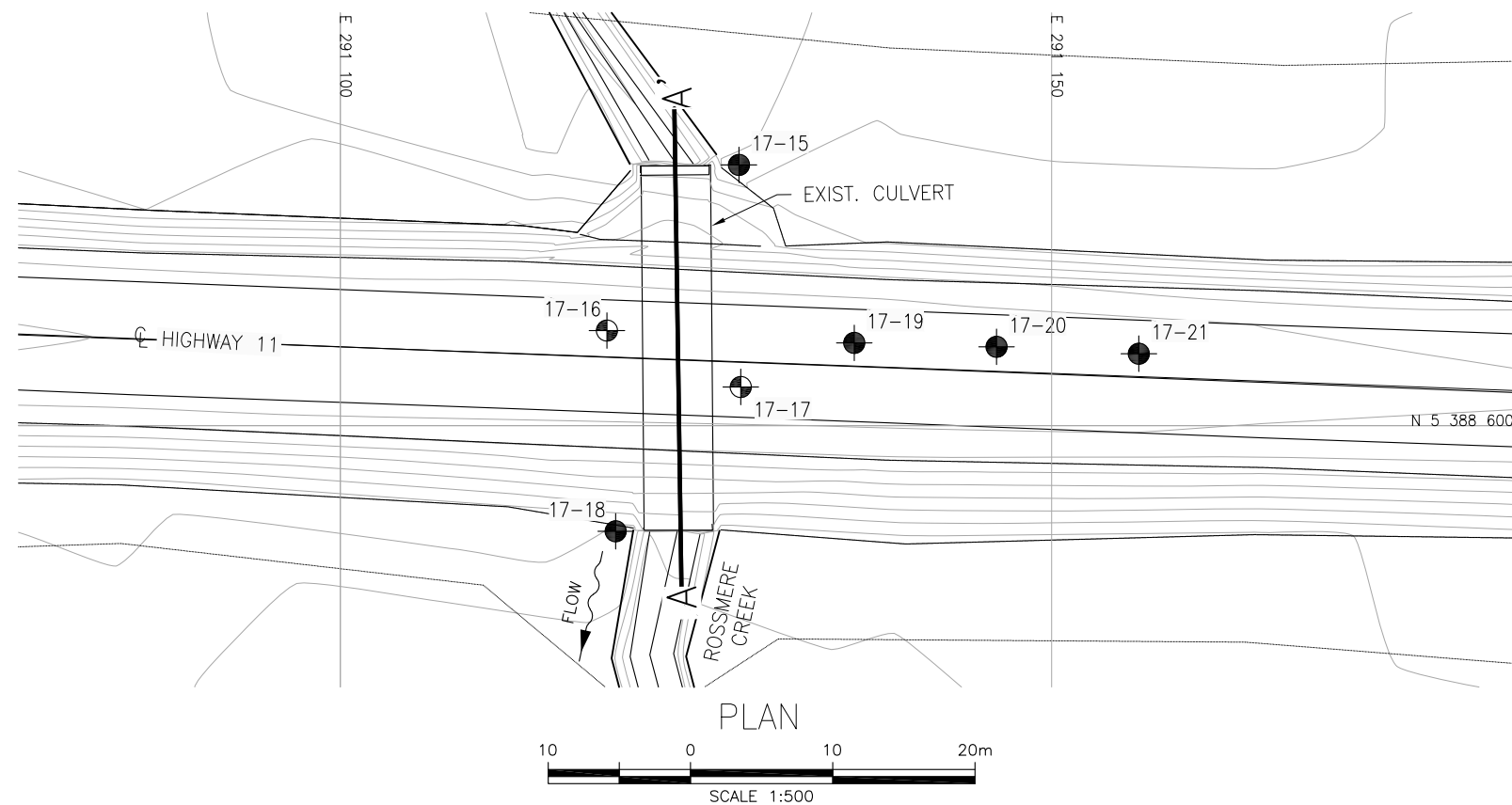
Photo 3: South Side of Rossmere Creek Culvert



Photo 4: North Side of Rossmere Creek Culvert

Appendix D

Borehole Locations and Soil Strata Drawing



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



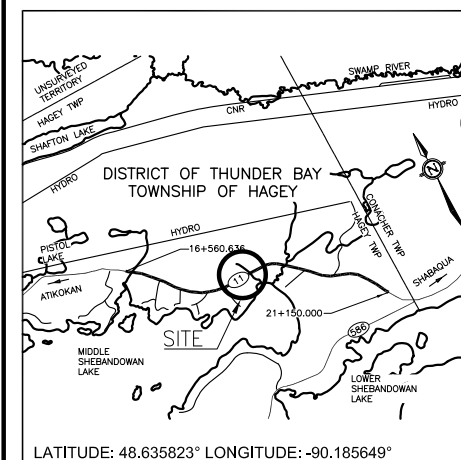
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WP No 6804-14-01

SHEET

HATCH








THURBER ENGINEERING LTD.



LATITUDE: 48.635823° LONGITUDE: -90.185649°

KEYPLAN

LEGEND

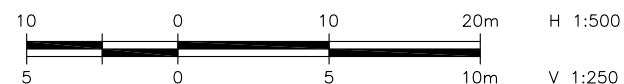
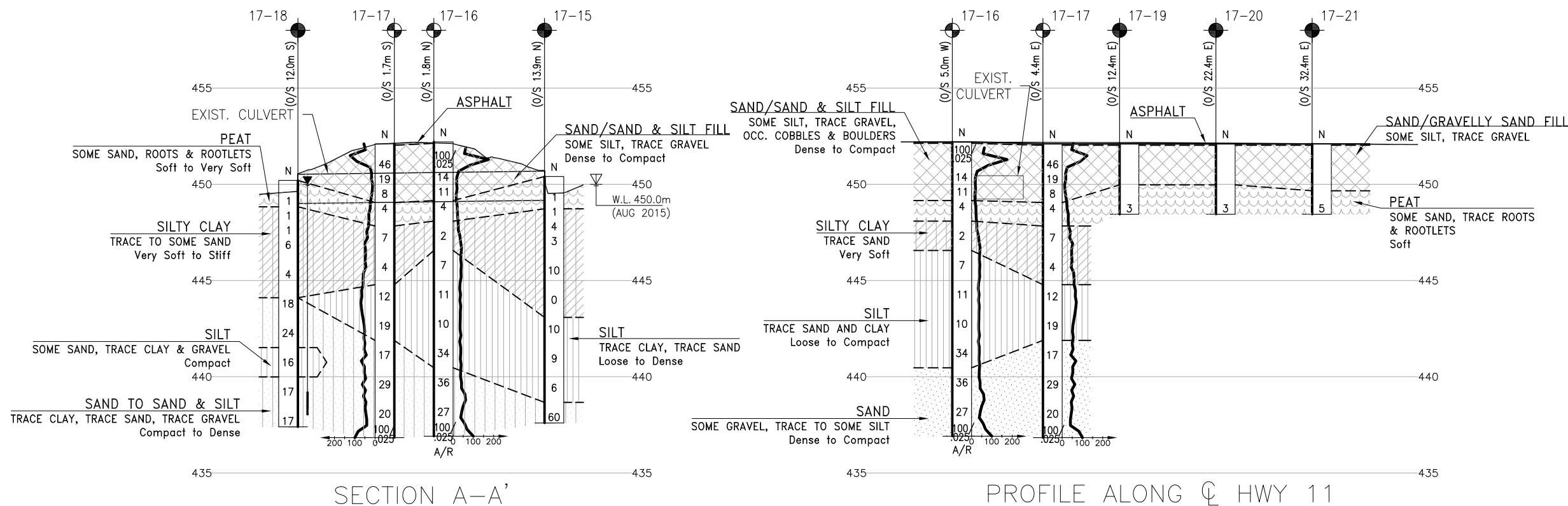
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
17-15	450.4	5 388 618.3	291 128.0
17-16	452.2	5 388 606.7	291 118.7
17-17	452.1	5 388 602.7	291 128.2
17-18	450.2	5 388 592.6	291 119.4
17-19	452.1	5 388 605.8	291 136.1
17-20	452.1	5 388 605.5	291 146.1
17-21	452.1	5 388 605.1	291 156.1

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15

GEOCRES No. 52B-32



REVISIONS									
	DATE	BY				DESCRIPTION			
DESIGN	CZ	CHK	MEF	CODE		LOAD		DATE	OCT 2017
DRAWN	AN	CHK	CZ	SITE	48W-192/C	STRUCT		DWG	1