

**FOUNDATION INVESTIGATION REPORT
BLIND CREEK EAST CULVERT – WBL
HIGHWAY 11/17 - FOUR LANING
FROM 0.36 km EAST OF HIGHWAY 527 EASTERLY 12.6 km
TO 1 km WEST OF MACKENZIE STATION ROAD
G.W.P. 623-89-00, SITE 48C-213/C2**

Geocres Number: 52A-161

Report to

McCormick Rankin Corporation

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the proposed location of the Blind Creek East culvert under the new westbound lanes of Highway 11/17 in the Township of MacGregor, District of Thunder Bay. The new culvert is planned as part of the proposed Highway 11/17 four-laning project extending from 0.36 km east of Highway 527 to 1 km west of MacKenzie Station Road. The existing Highway 11/17 will become the new eastbound lanes of the four-lane divided highway.

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 sections, laboratory test results and written descriptions 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 McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 6009-E-0017.

2 SITE DESCRIPTION

The proposed Blind Creek East culvert is located approximately 11 km east of Thunder Bay, Ontario and approximately 7.2 km east of Highway 527. The new culvert will be situated approximately 30 m north of the existing Highway 11/17 alignment. The existing roadway embankment is approximately 1.5 to 3.5 m in height.

Blind Creek East flows within a small bedrock channel at the proposed culvert location. Lands surrounding the culvert site consist of forested areas with bedrock outcrops.

Photographs in Appendix C show the general nature of the site.

The site lies near the border of the Superior and Southern Geological Provinces of the Canadian Shield. According to bedrock geology maps produced by the Ontario Geological Survey, the culvert site is located near a boundary between mafic to intermediate metavolcanic bedrock and metasedimentary bedrock. Locally, the overburden consists of silt and sand overlying bedrock.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out on November 7, 2011 and consisted of drilling and sampling two boreholes, identified as BCEW-1 and BCEW-2, as well as manual excavation at four borehole locations identified as BCEW-3 to BCEW-6.

Boreholes BCEW-1 and BCEW-4 were located near the proposed culvert inlet, Boreholes BCEW-2 and BCEW-5 were located near the centre, and Boreholes BCEW-3 and BCEW-6 were located near the culvert outlet. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing included in Appendix D.

Boreholes BCEW-1 was advanced to refusal on bedrock at 1.2 m depth (elevation 232.8). Borehole BCEW-2 was drilled to bedrock at 1.2 m depth then advanced a further 3.5 m into bedrock to a total depth of 4.7 m (elevation 228.2) using rock coring equipment. Boreholes BCEW-3 to BCEW-6 were advanced by manual excavation to depths of 0.1 m to 1.2 m (elevations 233.3 to 230.7).

The borehole locations were marked in the field and utility clearances were obtained prior to drilling. Clearing and access preparation were required prior to commencement of the borehole drilling. Silt fencing was installed between the drill area and the creek to prevent migration of core water sediment into the adjacent creek.

A track mounted CME 45 drill rig was used at this site and a combination of hollow-stem augers, casing and NQ coring techniques were used to advance the boreholes. Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

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

Groundwater conditions were observed in the open boreholes upon completion of the drilling operations. The completion details of the boreholes are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Borehole	Borehole Depth/ Elevation (m)	Completion Details
BCEW-1	1.2 / 232.8	Backfilled with bentonite holeplug and cuttings to surface.
BCEW-2	4.7 / 228.2	Backfilled with bentonite holeplug to surface.
BCEW-3	0.1 / 230.7	Backfilled with cuttings
BCEW-4	0.3 / 233.3	Backfilled with cuttings
BCEW-5	1.2 / 231.3	Backfilled with cuttings.
BCEW-6	0.1 / 231.8	Backfilled with cuttings.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to gradation analysis. The results of these tests are summarized on the Record of Borehole sheets included in Appendix A and are presented on the figures included in Appendix B.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to evaluate the unconfined compressive strength (UCS) of the bedrock. The UCS values of the rock assessed from the point load data are reported on the borehole logs.

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” drawing 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.

In general, the subsurface stratigraphy encountered at the site consisted of a layer of topsoil or silt and sand overlying bedrock. Bedrock is exposed along the creek channel. More detailed descriptions of the individual strata are presented below.

5.1 Topsoil

Topsoil was encountered at the ground surface at the locations of Boreholes BCEW-3, BCEW-4 and BCEW-6. The topsoil was described as black and silty to sandy. The thickness of the topsoil varied from 125 mm to 250 mm.

5.2 Silt and Sand

Native silt and sand was encountered at the ground surface in Boreholes BCEW-1, BCEW-2 and BCEW-5. The silt and sand was brown to reddish brown and contained trace to some gravel. Occasional cobbles and boulders were observed in Borehole BCEW-5.

The silt and sand layer was 1.2 m thick with a lower boundary on bedrock at elevation 232.8 to 231.3.

SPT N-values of 2 and 5 blows for 0.3 m penetration were recorded at the ground surface, indicating a very loose to loose condition. SPT N-values of 33 and 41 blows for 0.3 m penetration were obtained above the bedrock surface, indicating a dense condition.

The moisture content of three samples of the silt and sand ranged from 20% to 23%. A value of 8% was measured in one sample.

Selected samples of the silt and sand underwent laboratory gradation analysis, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and the grain size distribution curves for these samples are plotted on Figure B1, Appendix B.

Gravel%	0 to 13
Sand%	41 to 44
Silt%	43 to 49
Clay%	3 to 7

5.3 Bedrock

Bedrock was encountered below the topsoil or silt and sand in all boreholes. The depths to bedrock proven by coring or exposed by manual excavation are summarized in Table 5.1.

Table 5.1 – Depth to Bedrock at Borehole Locations

Borehole	Depth to Bedrock (m)	Top of Bedrock Elevation (m)	Proving Method
BCEW-1	1.2	232.8	Auger Refusal
BCEW-2	1.2	231.7	Cored
BCEW-3	0.1	230.7	Manual excavation
BCEW-4	0.3	233.3	Manual excavation
BCEW-5	1.2	231.3	Manual excavation
BCEW-6	0.1	231.8	Manual excavation

The bedrock recovered in the core samples from Borehole BCEW-2 was described as a greenish grey metasedimentary rock. Total core recovery was between 95% and 100%. RQD values of 46% and 18% were recorded, indicating poor to very poor rock quality.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to 7.

Unconfined compressive strengths (UCS) of 63 and 116 MPa were assessed from the results of point load tests conducted on two rock core samples (average per run), indicating a strong to very strong intact rock. The UCS results are included on the borehole logs in Appendix A.

5.4 Water Levels

Water was observed seeping over the bedrock surface at the location of Borehole BCEW-4 at the time of the fieldwork. Water was not observed in the other boreholes during drilling or manual excavation.

At the time of drilling, a relatively small volume of water was observed flowing within the exposed bedrock channel forming the creek (Photograph 1 in Appendix C).

The above observations are short-term and seasonal fluctuations of the groundwater level and stream flow are to be expected. In particular, the flow may be greater after the spring snowmelt or after periods of heavy rainfall.

6 MISCELLANEOUS

The borehole locations were selected by Thurber Engineering Ltd. and staked in the field by McCormick Rankin Corporation (MRC). The co-ordinates and ground surface elevations at the boreholes were surveyed by MRC. Where boreholes required relocation from the staked location, field measurements were recorded and the surveyed coordinates and elevations adjusted accordingly.

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

Eastern Ontario Diamond Drilling Ltd. from Hawkesbury, Ontario supplied a track mounted CME 45 drill rig and conducted the drilling, sampling and in-situ testing operations.

The field program was supervised on a full time basis by Mr. Ryan Kromer, E.I.T. of Thurber.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall supervision of the field program was conducted by Mr. Mark Farrant, P.Eng. Interpretation of the data and preparation of this report were carried out by Ms. Lindsey Blaine, E.I.T. and Ms. Mei T. Cheong, M.Phil.

The report was reviewed by Mr. Murray R. Anderson, M.Eng., P.Eng. and Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd

Lindsey Blaine, E.I.T.
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July 31/12



Murray R. Anderson, P.Eng., M.Eng.
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P. K. Chatterji, P.Eng., Ph.D.
Review Principal

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

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


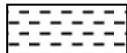



 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (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			

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No BCEW-1

1 OF 1

METRIC

W.P. 623-89-00 LOCATION N 5 374 713.3 E 375 311.2 Blind Creek East WBL ORIGINATED BY RK
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.11.07 - 2011.11.07 CHECKED BY LRB

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					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
234.0	SILT and SAND, trace to some clay, trace gravel Very Loose to Dense Brown Moist		1	SS	2												
			2	SS	33												
232.8																	
1.2	END OF BOREHOLE AT 1.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No BCEW-2

1 OF 1

METRIC

W.P. 623-89-00 LOCATION N 5 374 711.2 E 375 324.1 Blind Creek East WBL ORIGINATED BY RK
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2011.07.11 - 2011.07.11 CHECKED BY LRB

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											
								20 40 60 80 100											
232.9																			
0.0																			
231.7																			
1.2																			
228.2																			
4.7																			

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

DATUM Geodetic DATE 2011.11.07 - 2011.11.07 CHECKED BY LRB


+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No BCEW-4

1 OF 1

METRIC

G.W.P. 623-89-00 LOCATION N 5 374 726.3 E 375 316.2 Blind Creek East WBL ORIGINATED BY RK
 HWY 11/17 BOREHOLE TYPE Visual Assessment and Manual Excavation COMPILED BY AN
 DATUM Geodetic DATE 2011.11.07 - 2011.11.07 CHECKED BY LRB

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 (%)					
233.6								20	40	60	80	100	W _P	W	W _L	kN/m ³	GR SA SI CL	
0.0	TOPSOIL , silty: (250mm) Black Wet END OF BOREHOLE AT 0.3m ON BEDROCK. SEEPAGE OBSERVED ON BEDROCK SURFACE. EXCAVATION BACKFILLED WITH CUTTINGS.																	
233.3																		
0.3																		

ONTMT4S 1182.GPJ 6/7/12

RECORD OF BOREHOLE No BCEW-5

1 OF 1

METRIC

W.P. 623-89-00 LOCATION N 5 374 720.3 E 375 338.1 Blind Creek East WBL ORIGINATED BY RK
HWY 11/17 BOREHOLE TYPE Visual Assessment and Manual Excavation COMPILED BY AN
DATUM Geodetic DATE 2011.11.07 - 2011.11.07 CHECKED BY LRB

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	20 40 60 80 100			20 40 60 80 100	W _p W W _L	20 40 60							
232.5																		
0.0	SILT and SAND, some gravel, some cobbles/boulders Brown Moist						232											
231.3																		
1.2	END OF BOREHOLE AT 1.2m ON BEDROCK. BOREHOLE DRY UPON COMPLETION. EXCAVATION BACKFILLED WITH CUTTINGS.																	

RECORD OF BOREHOLE No BCEW-6

1 OF 1

METRIC

W.P. 623-89-00 LOCATION N 5 374 717.4 E 375 348.7 Blind Creek East WBL ORIGINATED BY RK
 HWY 11/17 BOREHOLE TYPE Visual Assessment and Manual Excavation COMPILED BY AN
 DATUM Geodetic DATE 2011.11.07 - 2011.11.07 CHECKED BY LRB

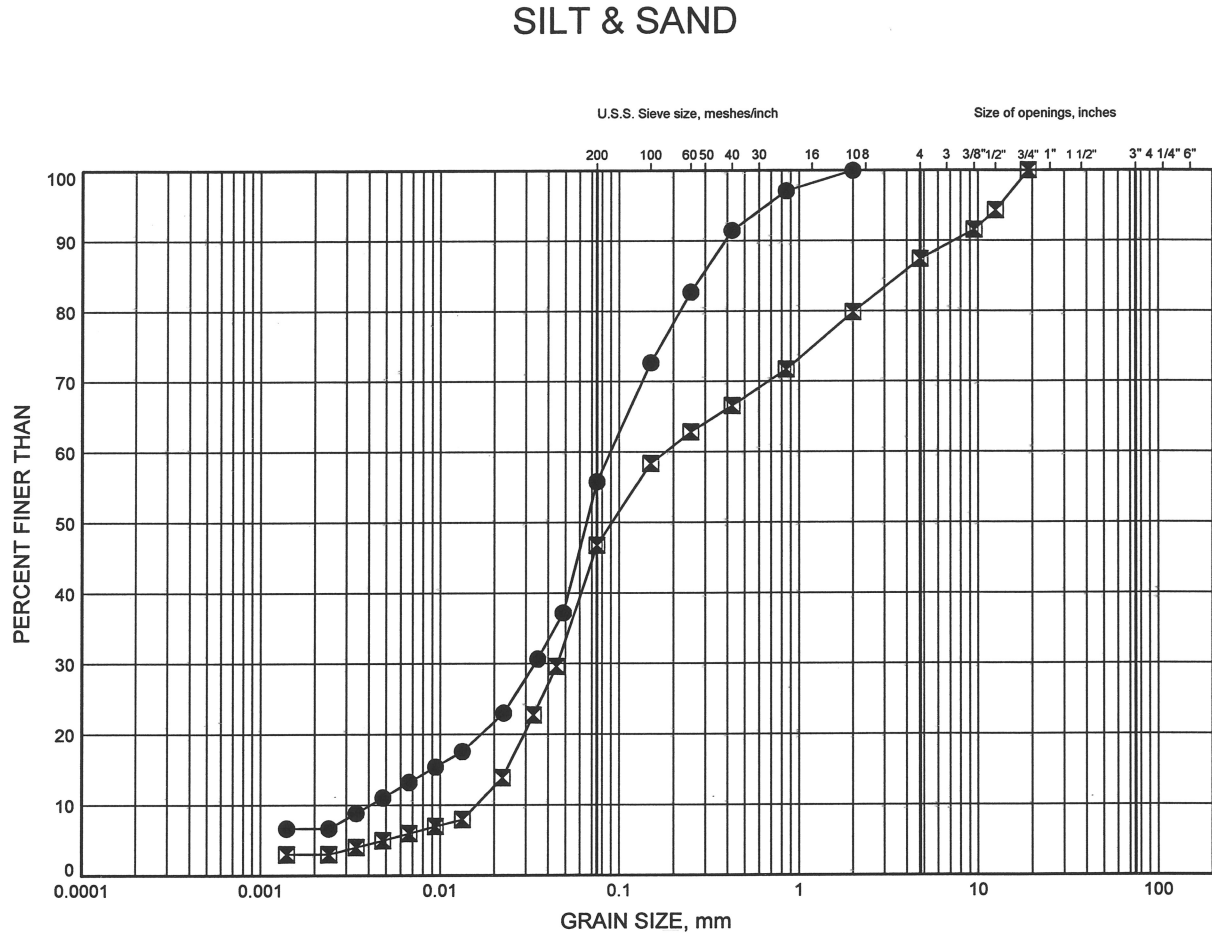
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
231.9														
0.0	TOPSOIL, sandy, rootlets: (125mm)													
0.1	Black Moist													
	END OF BOREHOLE AT 0.1m ON BEDROCK. EXCAVATION DRY UPON COMPLETION. EXCAVATION BACKFILLED WITH CUTTINGS.						231							

Appendix B

Laboratory Test Results

Hwy 17 - Hwy 527 easterly 12.6km GRAIN SIZE DISTRIBUTION

FIGURE B1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BCEW-1	0.30	233.65
×	BCEW-2	0.91	232.02



W.P.# 623-89-00
Prepared By AN
Checked By LRB

Appendix C

Site Photographs



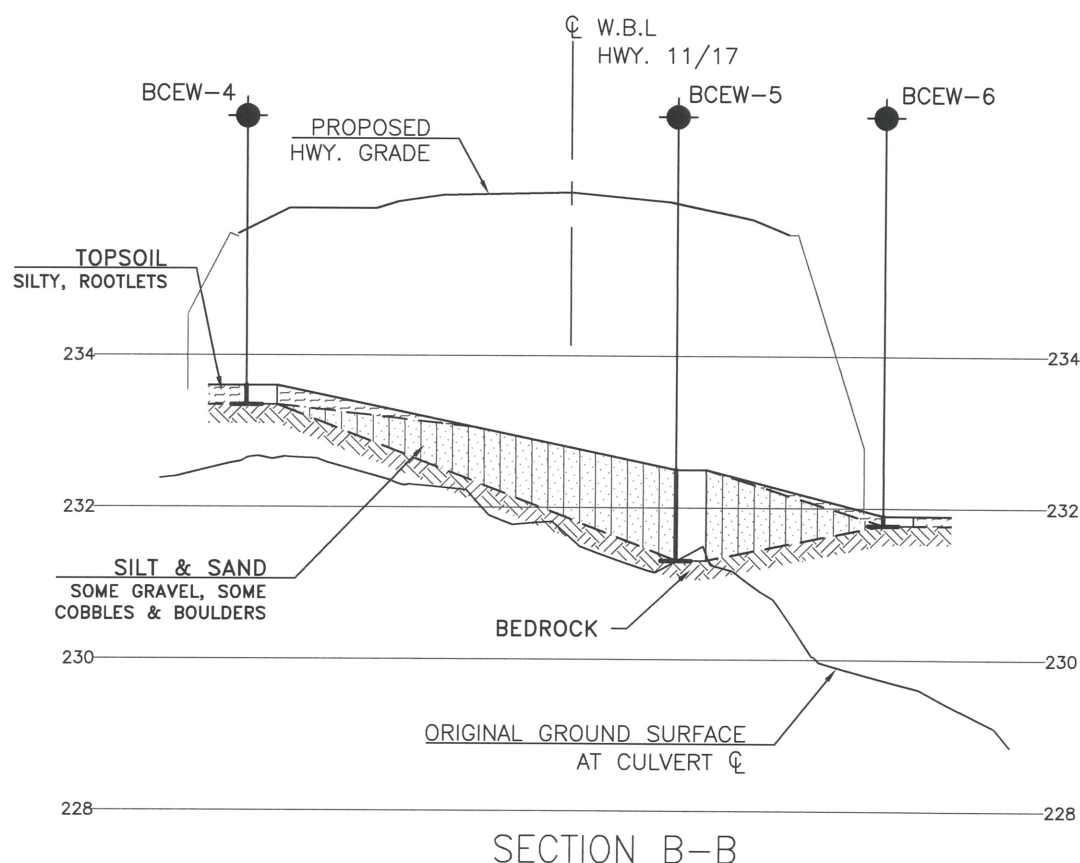
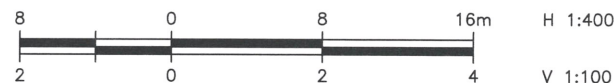
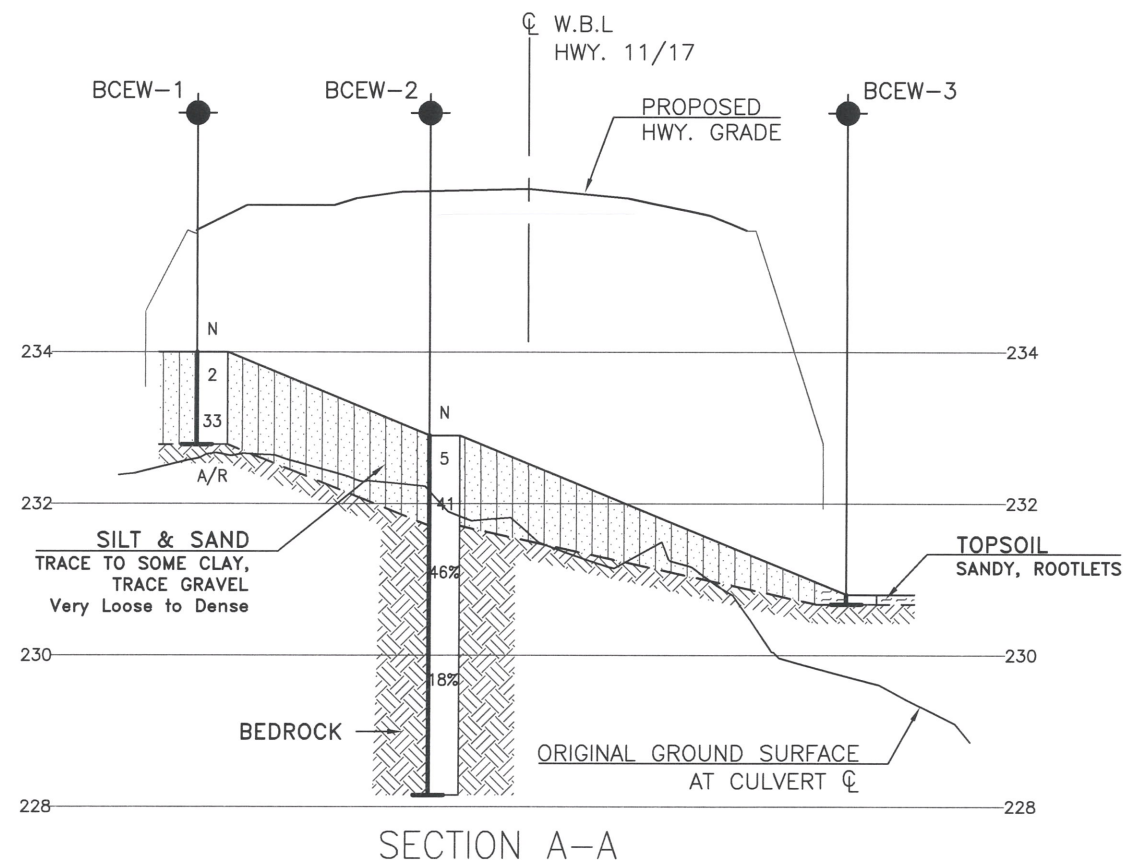
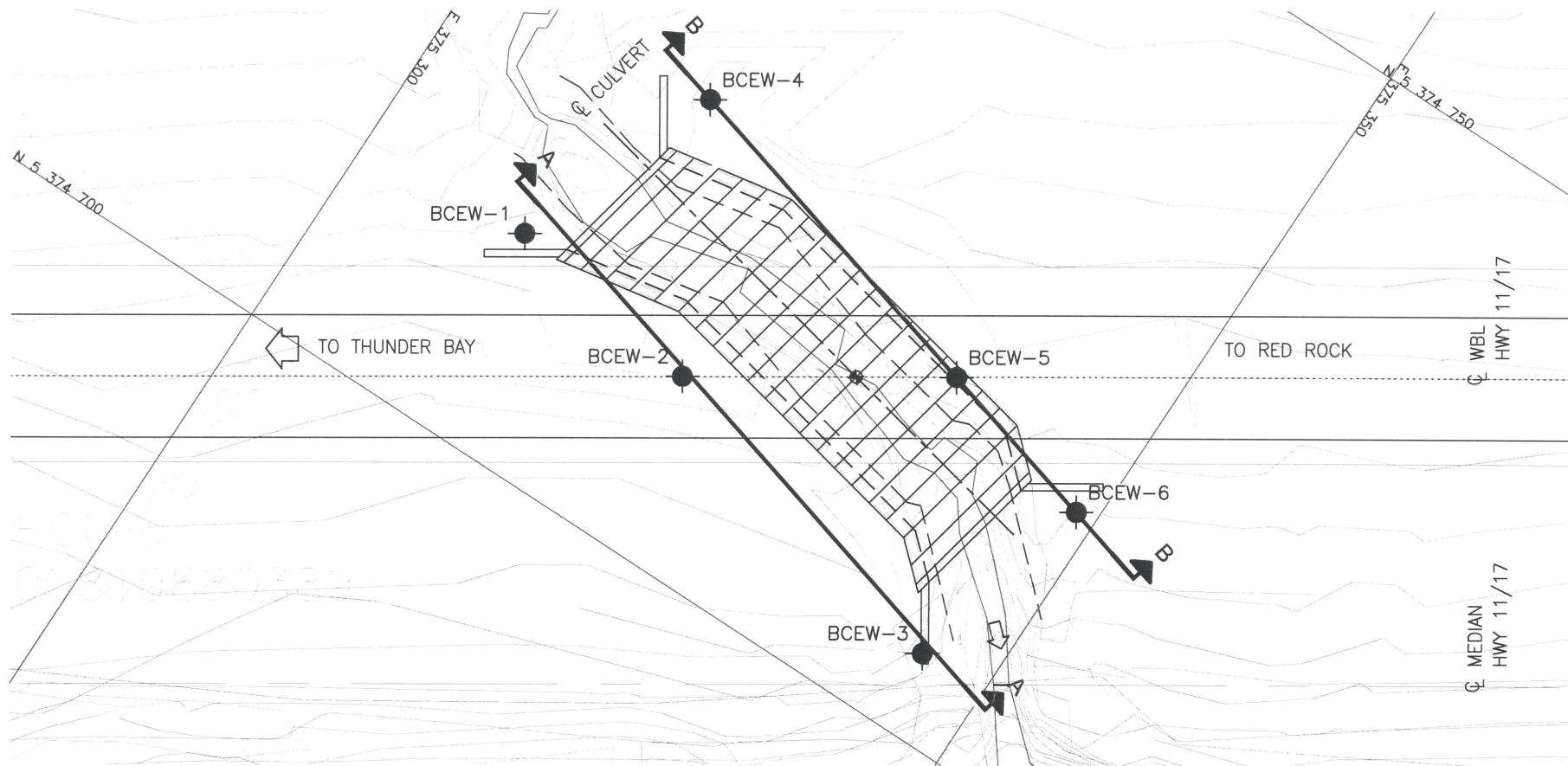
Photograph 1 – Blind Creek East WBL looking north



Photograph 2 – Blind Creek East WBL looking south towards existing Highway 11/17

Appendix D

Borehole Locations and Soil Strata Drawing



SECTION B-B

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



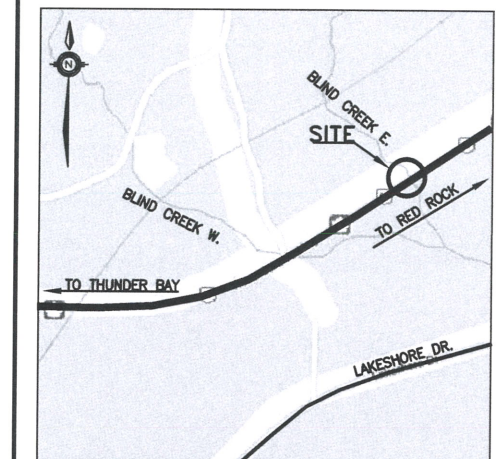
CONT No 2012-6010
WP No 623-89-00

HIGHWAY 11/17 FOUR LANEING
BLIND CREEK EAST
CULVERT WESTBOUND LANES
BOREHOLE LOCATION AND SOIL STRATA

SHEET
246

MRC
McCORMICK RANKIN
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MMM GROUP

THURBER ENGINEERING LTD.



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
BCEW-1	234.0	5 374 713.3	375 311.2
BCEW-2	232.9	5 374 711.2	375 324.1
BCEW-3	230.8	5 374 705.1	375 345.6
BCEW-4	233.6	5 374 726.3	375 316.2
BCEW-5	232.5	5 374 720.3	375 338.1
BCEW-6	231.9	5 374 717.4	375 348.7

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. 52A-161

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	LRB	CHK	LRB
DRAWN	AN	CHK	LRB
CODE	CAN/CSA	S6-06	LOAD
CL-625-ONT	DATE	JULY	2012
SITE	48C-213/c2	STRUCT	DWG 2