FOUNDATION INVESTIGATION REPORT
CARIBUS LAKE CULVERT REPLACEMENT
HIGHWAY 11
DISTRICT OF RAINY RIVER, ONTARIO

G.W.P. 6930-10-00, SITE No. 45-260/C

Geocres Number: 52B-13

Report to

Hatch Mott MacDonald

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TABLE OF CONTENTS

Appendices

FOUNDATION INVESTIGATION REPORT
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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the location of a culvert at the Highway 11 crossing of the Caribus Lake in the District of Rainy River, 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, a stratigraphic profile, 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 Hatch Mott MacDonald, under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0010.

2 SITE DESCRIPTION

The Caribus Lake culvert is located on Highway 11, approximately 5 km west of the intersection of Highway 622 and Highway 11. This site is located in the Rainy River District of Ontario.

The existing Caribus Lake culvert is a 2-cell timber culvert. The cells are 2.1 m wide each and the total length of the culvert is 28 m. As observed in the field, an extension has been added to the south end (inlet) of the existing culvert. The extension consists of a 2-m diameter CSP including a shaped beaver and debris trap. The water flows through the culvert from south to north.

The road embankment is approximately 3.0 m to 4.0 m high above Caribus Lake. The surrounding lands are undeveloped, heavily treed and relatively flat. Bedrock outcroppings and small creeks/water bodies are visible along the existing Highway 11 right-of-way.

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

The site lies within the physiographic region known as the Quetico Subprovince of the Superior Province of the Canadian Shield. The region is characterized by Precambrian meta-volcanic and meta-sedimentary rocks intruded by later stage diabase dykes. In some areas the Precambrian rocks are covered by sedimentary rocks of the Huronian Supergroup. The bedrock is mantled by glaciolacustrine varved clays and sand and gravel deposits.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project was carried out on January 27 and 28, 2011 and February 16, 2011 and consisted of drilling and sampling two boreholes (identified as CAR11-01 and CAR11-02) in the area of the existing culvert, through the existing highway embankment. Borehole CAR11-01 was located on the Highway 11 eastbound shoulder, northwest of the existing culvert and Borehole CAR11-02 was located on the Highway 11 westbound shoulder, southeast of the existing culvert. Boreholes were advanced within the overburden to 2.9 m and 3.7 m depth (Elevations 406.6 and 406.3) where the drill rig encountered refusal. Bedrock was proved in both boreholes by NQ size diamond coring. Borehole CAR11-01 was advanced 2.5 m into bedrock and terminated at 6.2 m depth (Elevation 403.7). Borehole CAR11-02 was advanced 0.5 m into bedrock and terminated at 3.4 m depth (Elevation 406.1).

The boreholes were supplemented by three Dynamic Cone Penetration Tests (DCPTs), identified as DCPT1, DCPT2, and DCPT3. DCPT1 and DCPT2 were conducted near the culvert outlet and DCPT3 was conducted near the culvert inlet. TheDCPTs were terminated at 0.3 m and 1.1 m depth (Elevations 404.7 to 407.8), upon refusal on probable bedrock or boulder.

The approximate borehole and DCPTs locations are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix D.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling.

Drilling was carried out using a truck-mounted CME 75 drill rig and the boreholes were advanced with hollow-stem augers and NQ coring techniques. Overburden samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). The DCPTs were conducted using portable equipment.

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

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Upon completion of drilling, boreholes were backfilled with sand and auger cuttings to 0.12 m, then asphalt to surface.

4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification (VI) and moisture content determination and rock samples to geological logging. Selected samples were also 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.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to assist in evaluation of the compressive strength of the bedrock. Results of point load tests on the rock core samples are shown in Table 1 included in Appendix B and on the Record of Borehole sheets in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil and rock 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 terms, the overburden encountered at this site consists of pavement structure overlying sand and gravel fill. Granitic gneiss bedrock was encountered directly below the fill at depths ranging from 2.9 m to 3.7 m. More detailed descriptions of the individual strata are presented below.

5.1 Pavement structure

Pavement structure was encountered in the two boreholes drilled at this site. Both boreholes were drilled through the existing Highway 11 shoulders. The pavement structure consists of approximately 75 mm to 100 mm of asphalt overlying granular fill.

5.2 Fill

Brown sand and gravel fill containing some silt and trace clay was encountered below the pavement structure in both boreholes. The thickness of the fill ranged from 2.8 m to 3.6 m.

The depth to the base of the fill was 3.7 m and 2.9 m (Elevations 406.3 and 406.6) in Boreholes CAR11-01 and CAR11-02, respectively.

SPT N-values recorded in the sand and gravel fill were quite variable and ranged from 6 blows for 0.3 m penetration to 50 blows for less than 0.3 m penetration, indicating a loose to very dense condition. However, frost was observed in the ground to an approximate depth of 1.4 m and is therefore likely the cause of the high SPT N-values. Though not

encountered in the boreholes, the fill may contain cobbles and boulders. The moisture content of the fill samples ranged from 3% and 16%.

Selected samples of the fill underwent laboratory grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix A. The grain size distribution curves for these samples are shown on Figure B1 of Appendix B.

Soil Particles	Percentage (%)
Gravel	24 to 36
Sand	38 to 57
Silt	11 to 22
Clay	4 to 7

5.3 Bedrock

The overburden soils described above are underlain by dark grey granitic gneiss bedrock. The bedrock is slightly weathered near the surface. Occasional mechanical breaks and sub-vertical fractures were observed in the rock cores.

Bedrock was proved by coring at each borehole. Table 5.1 summarizes depths and elevations to the top of bedrock in the boreholes.

Table 5.1 – Depths and Elevations of Top of Bedrock

Borehole	Top of Bedrock	
	Depth (m)	Elevation (m)
CAR11-01	3.7	406.3
CAR11-02	2.9	406.6

Core recovery in the bedrock was 100% in all cores except in Borehole CAR11-01 Run 2 where recovery was only 42%. The RQD values were quite variable and ranged from 0% to 83%, indicating very poor to good rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, generally ranged from 0 to 5.

The estimated unconfined compressive strength of the rock cores ranged from 192 MPa to 201 MPa, indicating a very strong to extremely strong rock. These estimated rock strength values are interpreted from point load tests that were conducted on rock cores recovered from the boreholes. A summary of the Point Load Test Results is presented in Appendix B.

5.4 Water Levels

Water levels were observed in the open boreholes upon completion of drilling operations. The water levels observed in the open boreholes are summarized in Table 5.2.

Table 5.2 – Water Level Measurements

Borehole	Date	Water Level		Comment
		Depth (m)	Elev. (m)	
CAR11-01	January 27, 2011	2.8	407.2	Open borehole
DCPT1	February 16, 2011	0.3	405.6	Open DCPT

The water level in the Caribus Lake culvert was measured at Elevation 406.5 on July 6, 2006.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

6 MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. Surveyors retained by Hatch Mott MacDonald provided data and drawings to obtain the co-ordinates and the ground surface elevations for the boreholes and DCPTs.

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

Eastern Ontario Diamond Drilling Ltd. from Hawkesbury, Ontario supplied a truck mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations. Portable DCPT equipment was also supplied and operated by Eastern Ontario Diamond Drilling Ltd. The drilling operations were supervised by Mr. Ryan Kromer, of Thurber.

Overall supervision of the field program was conducted by Mr. Tony Harte. Interpretation of the data and preparation of the report were carried out by Ms. Lindsey Blaine, E.I.T. and Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd

L. Blaine
Jan. 10/12

Lindsey Blaine, E.I.T.
Project Manager

Rocío Palomeque Reyna, P.Eng.
Geotechnical Engineer

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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

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

$\blacktriangledown$ Water Level

C_{pen} 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

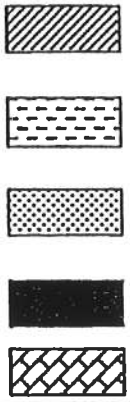
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, 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

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.

SYMBOLS



CLAYSTONE

SILTSTONE

SANDSTONE

COAL

Bedrock (general)

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

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 percentage 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.

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	(psi)	Field Estimation of Hardness*
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

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Ontario

RECORD OF BOREHOLE No CAR11-01 1 OF 1 METRIC

W.P. 19-1605-121 LOCATION Caribus Lake Culvert ORIGINATED BY RK

HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.01.27 - 2011.01.27 CHECKED BY TJH

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
410.0											
0.0	**ASPHALT:** (100mm)						410				
0.1	**SAND** and **GRAVEL**, some silt to silty, trace clay Dense to Compact Brown Moist to Wet (FILL)		1	AS					○		24 57 13 6
			1	SS	50						
			2	SS	35		409		○		
			3	SS	26	▽	408		○		33 38 22 7
			4	SS	7		407		○		
406.3	Loose									FI	
3.7	**BEDROCK**, granitic gneiss, slightly weathered, dark grey, some joints, filled with quartz, occasional mechanical breaks		1	RUN			406			3 1	RUN #1 TCR=100% SCR=60% RQD=60%
			2	RUN			405			1 1	RUN #2 TCR=42% SCR=24% RQD=14% UCS=201MPa
			3	RUN						1 0	RUN #3 TCR=100% SCR=83% RQD=83%
403.7							404			2	UCS=197MPa (Average)
6.2	END OF BOREHOLE AT 6.2m. WATER LEVEL AT 2.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND SAND TO 0.12m, THEN ASPHALT COLD PATCH TO SURFACE.										

$+^3, \times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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THURBER

RECORD OF BOREHOLE No CAR11-02 1 OF 1 METRIC

W.P. 19-1605-121 LOCATION Caribus Lake Culvert ORIGINATED BY RK

HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.01.28 - 2011.01.28 CHECKED BY TJH

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
409.5											
0.0 / 0.1	**ASPHALT:** (75mm)		1	SS	50/						
	SAND and **GRAVEL**, some silt to silty, trace clay Loose to Very Dense Brown Moist (FILL)		1	AS	0.025		409		○		36 49 11 4
			2	SS	50/ 0.075				○		
			3	SS	6		408		○		
			4	SS	75		407		○	FI	
406.6											
2.9 / 406.1	**BEDROCK**, granitic gneiss, slightly weathered, dark grey, occasional sub-vertical fractures, quartz infilling		1	RUN						5 2	RUN #1 TCR=100% SCR=38% RQD=0%
3.4	END OF BOREHOLE AT 3.3m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTINGS AND SAND TO 0.12m, THEN ASPHALT COLD PATCH TO SURFACE.										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No DCPT1 1 OF 1 METRIC

W.P. 19-1605-121 LOCATION Caribus Lake Culvert ORIGINATED BY RK

HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
405.9											
0.0 / 405.4	SAND, some gravel, some organics,					▽					
0.4 / 404.7	Start DCPT at 0.4m						405				
1.1	END OF DCPT AT 1.1m. WATER OBSERVED AT 0.3m.										

$+^3, \times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No DCPT2 1 OF 1 METRIC

W.P. 19-1605-121 LOCATION Caribus Lake Culvert ORIGINATED BY RK

HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH 408.1	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
0.0 / 407.8	**SAND** Brown						408				
0.3	BEDROCK AT 0.3m.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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RECORD OF BOREHOLE No DCPT3 1 OF 1 METRIC

W.P. 19-1605-121 LOCATION Caribus Lake Culvert ORIGINATED BY RK

HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa o UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
406.4											
0.0 406.1	**SAND**, some gravel, occasional cobbles & boulders										
0.3	Brown										
	Start DCPT at 0.3m						406				
405.3											
1.1	END OF DCPT AT 1.1m.										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 5121.GPJ 6/24/11

Appendix B

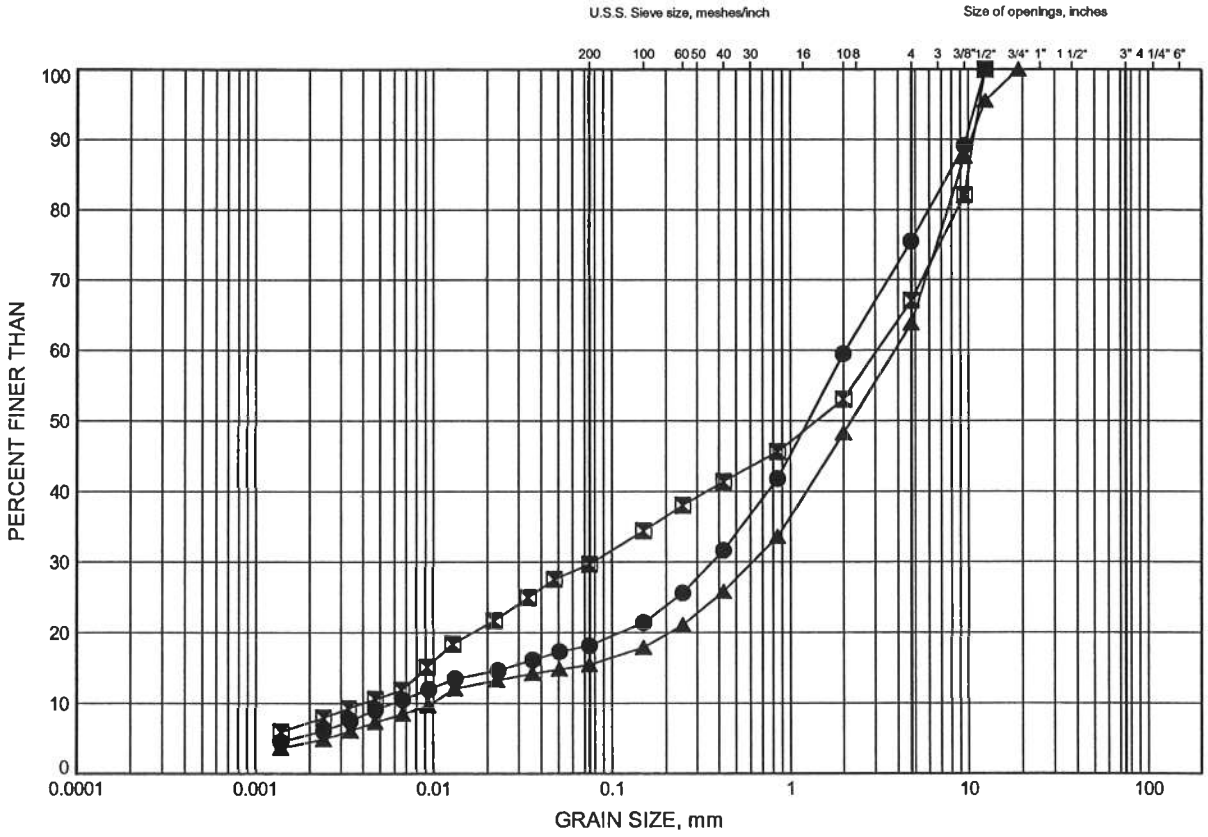
Laboratory Test Results

6010-E-0010 Bridge and Culvert Rehabs NWR

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)
●	CAR11-01	0.35	409.64
⊠	CAR11-01	2.59	407.40
▲	CAR11-02	0.30	409.20

W.P.# 19-1605-121
Prepared By AN
Checked By LRB

THURBER

GRAIN SIZE DISTRIBUTION - THURBER 5121.GPJ 6/24/11

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POINT LOAD TEST SHEET

Job No :	19-1605-121	**Client :**	HATCH
		Date Drilled :	1/28/2011
Project Name :	Caribus Lake Culvert	**Date Tested :**	6/24/2011
Core Size :	NQ **BH No :** CAR11-01	**Tester :**	DB

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	2		D	19.3	47.3	124.2	201.5		Very Strong
2	3		D	18.4	47.3	50.9	192.6		Very Strong
3	3		D	19.4	47.3	73.7	202.5		Very Strong
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
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17									
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22									
23									
24									
25									
26									
27									
28									
29									
30									

* 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 x D on either side of test point.

Appendix C

Site Photographs

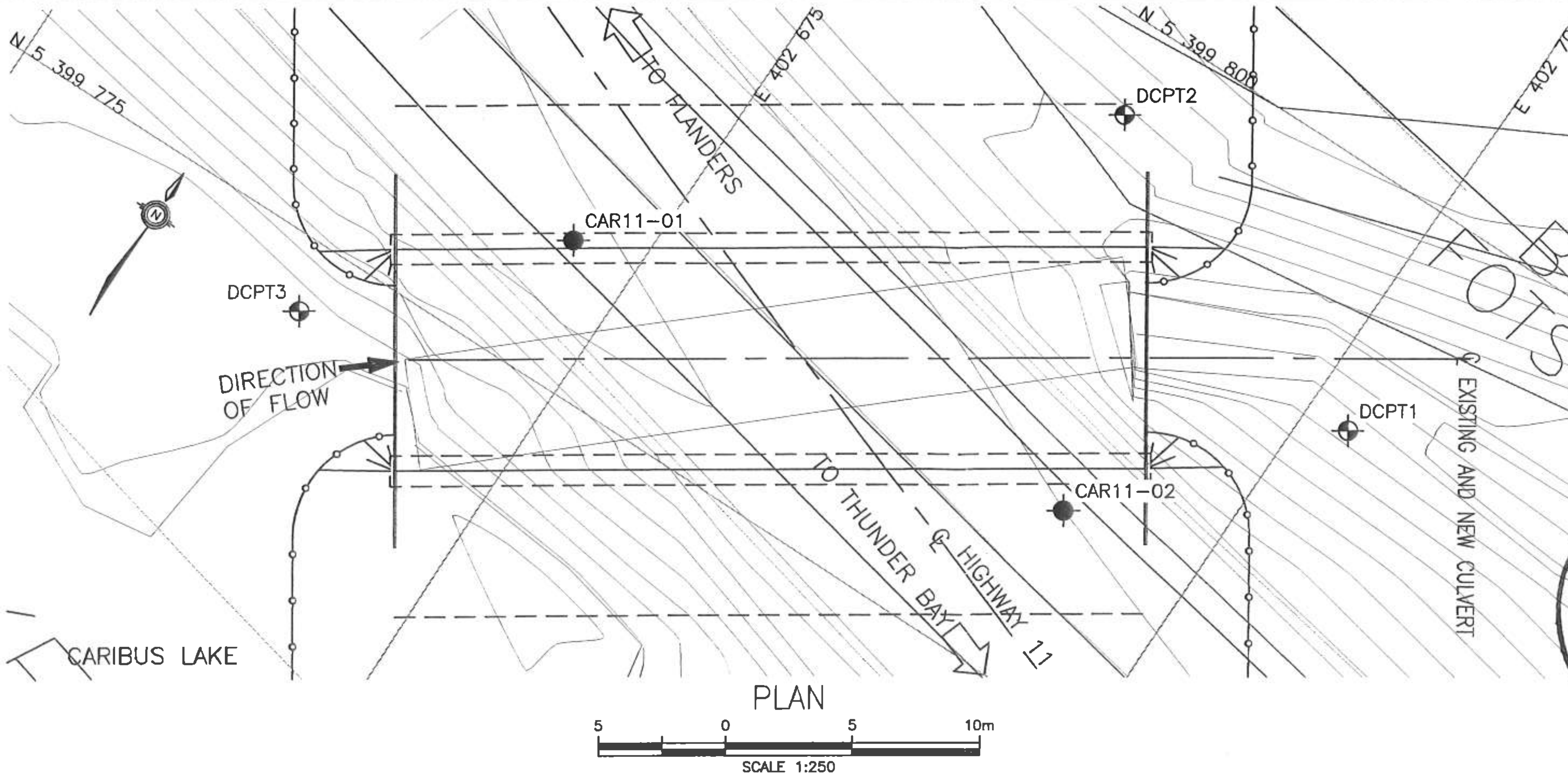
Photograph 1 – Highway 11 and Caribus Lake Culvert crossing

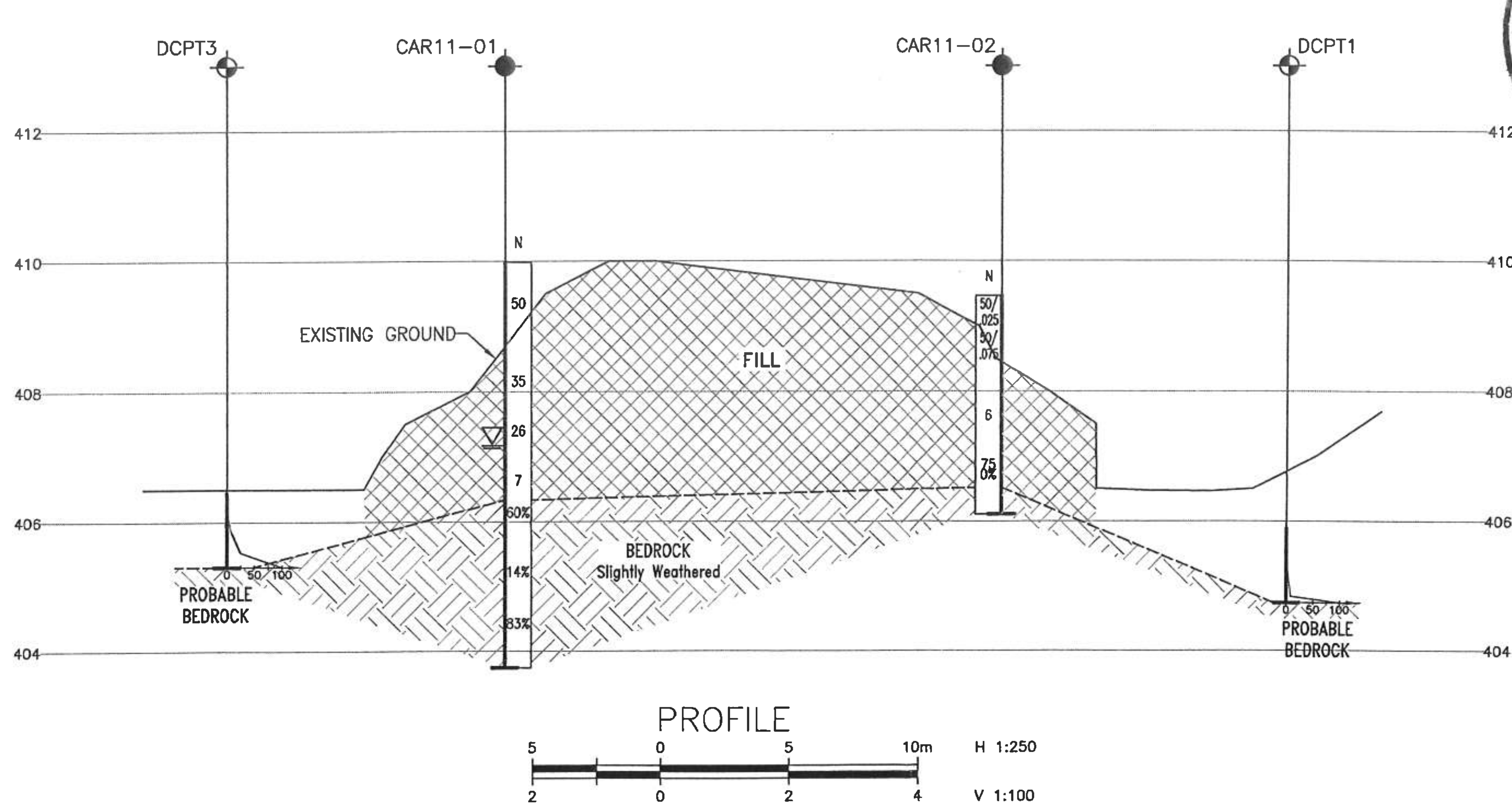
Photograph 2 – Existing conditions of north end of Caribus Lake Culvert (looking south)

Photograph 3– Existing conditions of south end of Caribus Lake Culvert (looking west)

Appendix D

Drawing
Borehole Locations and Soil Strata





METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
GWP No 6930-10-00

HIGHWAY 11
CARIBUS LAKE CULVERT
STRUCTURAL REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Hatch Mott MacDonald

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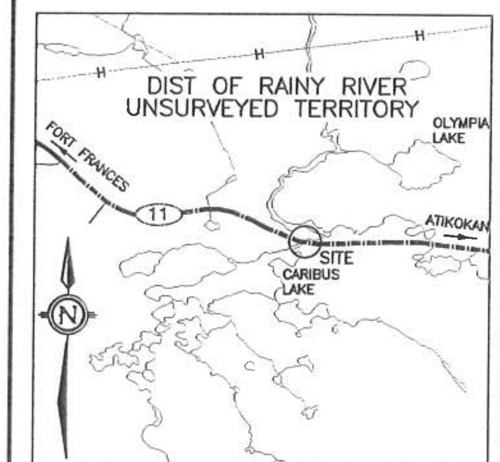

KEYPLAN

LEGEND

Symbol	Description
●	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
CAR11-01	410.0	5 399 780.5	402 672.3
CAR11-02	409.5	5 399 782.1	402 694.3
DCPT1	405.9	5 399 790.8	402 701.8
DCPT2	408.1	5 399 796.5	402 687.6
DCPT3	406.4	5 399 772.3	402 664.8

-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. 52-B13

REVISIONS	DATE	BY	DESCRIPTION		
DESIGN TJH	CHK	CODE	LOAD	DATE NOV. 2011	
DRAWN MFA	CHK AEG	SITE	STRUCT	DWG 2	

FILENAME: H:\Drafting\19\1605\121\tw5121-Bridge&CulvertBoreholeWR.dwg
PLOTDATE: 11/28/2011 2:00 PM