

Foundation Investigation Report

Culvert #21 Highway 101

Station 11+882 Township of Muskego

GWP 5383-11-00

Geocres No.: 42B-9

Revision 1

SUBMITTED TO:

Hatch Mott MacDonald
200 South Syndicate
Thunder Bay, Ontario
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SUBMITTED BY:

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SUBMISSION DATE:

March 18, 2015



TBT ENGINEERING
CONSULTING GROUP

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Part A - FOUNDATION INVESTIGATION REPORT

1 Introduction

TBT Engineering Limited (TBTE) has been retained by Hatch Mott MacDonald (HMM) to provide foundation investigation and design services for the proposed culvert replacements on Highway 101 at four separate locations. These sites are a part of the Highway 101 Resurfacing, from 0.3 km west of Young Street in Foley Township, easterly for 20.9 km, to 0.7 km east of Horwood Lake Road in Muskego Township. The foundation investigations were conducted to provide subsurface data for the proposed culvert replacements.

This report addresses the conditions for Culvert #21 located at Sta. 11+882 in the Township of Muskego. The remaining foundation sites (Culvert 17, Culvert 34 and Culvert 48) are addressed under separate covers.

This investigation consisted of two midpoint boreholes drilled adjacent to the existing culvert and two boreholes drilled at the culvert openings, laboratory testing and geotechnical analysis of the data. This report (Part A) describes the subsurface conditions encountered during the investigation. The boreholes are labeled from 300 to 303.

The MTO Foundation section has assigned GEOCRE No. 42B-9 to this site.

2 Site Description

The foundation investigations were carried out to investigate subsurface conditions for Culvert #21 located at Sta. 11+882 along Hwy 101 in the Township of Muskego.

Highway 101 runs in an east-west direction at this location. The existing culvert located at this site is composed of a 900 mm centreline CSP which is to be replaced with a 1200 mm pipe culvert. The culvert services the Muskego River Tributary.

The culvert site is located in a rural area of moderate terrain relief. The area is generally tree covered with bedrock outcrops.

The road embankment at this location is approximately 5.0 m high with side slopes of approximately 2 horizontal to 1 vertical on the left side. The right side of road embankment has the top 2.0 m sloped at approximately 2 horizontal to 1 vertical which drops to a 1 horizontal to 1 vertical at 3.0 m before flattening out to approximately 3 horizontal to 1 vertical to the ground elevation. A low lying swamp area was encountered on the right side of the embankment at the culvert location.

Photo 2.1 – Looking Westerly from Culvert



2.1 Surficial Geology

Available surficial geology mapping (OGS NOEGTS Map 5102 . Foleyet) indicates the site is located in a terrain unit comprised of bedrock knob with a subordinate landform of sand and boulder till ground moraine. The surrounding terrain is of moderate local relief which is rolling to undulating.

3 Investigation Procedures

A geotechnical site investigation was undertaken from September 4 to 8, 2013 for Boreholes 300 . 302 and November 26, 2013 for Borehole 303. The borehole locations are illustrated on the Borehole Location and Soil Strata Drawing found in Appendix D.

The borehole locations were identified in the field by TBTE personnel and service clearances were completed prior to mobilizing the drill rig to site. The boreholes were advanced using an all-terrain 750 CME drill rig equipped with hollow stem augers and a automatic hammer used to carry out Standard Penetration Testing (SPT). Where auger drilling methods proved unsatisfactory, casing was advanced using wash boring techniques. Due to poor ground conditions swamp mats were used to gain access to drill the borehole at the culvert outlet (Borehole 303). Soil samples were obtained from the auger flights and using a split spoon sampler as a part of the Standard Penetration Testing.

Surveys were completed by HMM and were based on North American Datum 1983, MTM CSRS Zone 12. HMM has indicated control was established from existing published Horizontal Control Monuments and a Geodetic Benchmark using the Canadian Geodetic Vertical Datum 1928. The following horizontal control points and vertical control points were utilized throughout this project (as provided by HMM):

- HCM #00820020065, #00820020066, #00820020067, #00820020068, #00820020071, #00820020072 and #00820020073
- VCM (GBM) #00819728231 Elev. 329.411, #00819728232 Elev. 328.108, #00819728233 Elev. 343.051, #00819728235 Elev. 345.516, #00819728236 Elev. 349.557 and #00819728239 Elev. 336.635

All boreholes were backfilled with a bentonite mixture following drilling. Temporary standpipes have been removed and decommissioned.

4 Laboratory Testing

Samples which were obtained during the field investigation were subjected to routine laboratory testing. The routine testing included moisture content, Atterberg limits and grain size analysis (where appropriate). The results of this testing are shown on the Borehole Logs (Appendix A) and on the laboratory data reports (Appendix B).

5 Sub-Surface Conditions

Details of the subsurface conditions are provided on the borehole logs (Appendix A) and on the Soil Strata Drawing (Appendix D).

The subsurface soils through the embankment at this site typically consist of embankment fills which overlie native silt and sand. Clay and organic matter were encountered within the boreholes at the culvert openings. Occasional cobbles were present within the fill materials and silt and/or sand layers. All boreholes extended to practical refusal (100+ blows/0.3 m).

5.1 Asphalt

Asphalt was encountered at ground surface at Boreholes 301 and 302, which were drilled through the shoulder of the highway. The asphalt thickness is 45 mm.

5.2 Fill – Gravel

Sandy gravel with trace silt and numerous cobbles was encountered beneath the asphalt at Borehole 301. The fill was encountered at elevation 337.85 with a thickness of 5.4 m. Grain size analyses conducted on selected samples of the gravel fill indicate the layer consist of 70 - 72% gravel, 26 % sand and 2 - 4% silt/clay size particles. The material is compact to dense as indicated by N_{60} values of 21 to 47 blows/0.3 m.

5.3 Fill - Sand

Silty sand to sand with some silt fill with occasional cobbles was encountered beneath the asphalt at Borehole 302. The sand fill was encountered at elevation 337.8 with a

thickness of 5.8 m. Two samples were selected for grain size distribution testing. The fill consists of sand, some silt to silty with trace gravel. The test results indicate a grain size distribution of 0 to 9 % gravel, 76 to 77 % sand, and 15 to 23 % silt/clay sized particles. The sand is loose to compact as indicated by N_{60} values ranging from 11 to 29 blows/0.3 m.

The presence of cobbles encountered within the sand between elevations 336.3 to 335.5 resulted in N_{60} values of 100+blows/0.3m.

5.4 Organic Matter

Organic matter was encountered at the ground surface of Borehole 303 with a thickness of 0.2 m.

5.5 Clay

Silty clay with trace sand was encountered beneath the sand at Borehole 300. The silty clay was encountered at elevation 332.8 with a thickness of 1.6 m. Based on single Atterberg Limit test the silty clay has a natural moisture content approaching the liquid limit. The clay is stiff as indicated by N_{60} values ranging from 13 to 14 blows/0.3 m.

5.6 Silt and Sand

Silt and sand with trace gravel was encountered beneath the clay at Borehole 300 and beneath organic material at Borehole 303. This material was encountered at elevation 332.8 and 333.0 m. Borehole 300 terminated within this material at a depth of 11.5 m and it was 6.8 m thick at Borehole 303. Four samples were selected for grain size distribution testing. The test results from the selected samples of the native sand and silt indicate a grain size distribution of 4 to 10 % gravel, 43 to 55 % sand, and 41 to 50 % silt/clay size particles with numerous cobbles. The native sand and silt is very loose to very dense as indicated by N_{60} values ranging from 1 to 79 blows/0.3m.

5.7 Silt

Silt with trace to some gravel and trace sand was encountered beneath the fill at Borehole 301 and beneath the silt and sand at Borehole 303. Two samples were selected for grain size distribution testing. The test results indicate a grain size distribution 1 to 22 % gravel, 3 to 8 % sand, and 70 to 96 % silt/clay size particles. The silt layer is loose to dense as indicated by N_{60} values ranging from 8 to 50 blows/0.3 m.

Two Atterberg limit tests conducted on selected samples of this layer indicates the material is non plastic.

5.8 Sand

Sand was encountered on the ground surface at Borehole 300. The sand was encountered at elevation 333.4 with a thickness from 0.6 m. Silty sand to sand with some silt was encountered at Boreholes 301 (beneath the silt), Borehole 302 (beneath the fill), and at Borehole 303 (beneath the silt).

Three samples were selected for grain size distribution testing. The test results indicate a grain size distribution 0 % gravel, 79 to 86 % sand, and 14 to 22 % silt/clay size particles. Occasional cobbles to numerous cobbles were noted within the sand layer with the exception of Borehole 302. The sand layers are loose to dense as indicated by N_{60} values ranging from 6 to 32 blows/0.3 m.

5.9 Gravel

A gravel layer was encountered below the sand in Borehole 301. The gravel layer was encountered 11.6 m below the pavement at elevation 326.3 with a thickness of 0.7m. The gravel is very dense indicated by N_{60} value 100+ blow/0.3m.

5.10 Ground Water

The ground water level observed upon completion of drilling on November 26, 2013 is provided below. Ground water levels will vary from season to season and from the effects of heavy precipitation events.

Table 5.4: Ground Water Level

Borehole	Depth below Ground Surface (m)	Elevation
303	0.2	333

6 Miscellaneous

Laboratory testing was carried out at the TBT Engineering Limited laboratory in Thunder Bay. The drill equipment for this investigation was operated by TBT Engineering. The field operations were supervised by Alan Finke and Peter Pilgrim. Laboratory testing was supervised by T. Fummerton C.E.T. This report was prepared by Steven Seller,

P.Eng, and reviewed by W. Hurley, P.Eng (TBTE designated principal contact identified for MTO Foundation Engineering projects).

7 Limitations

Conclusions and recommendations presented in this report are based on the information determined at the borehole locations. Subsurface and groundwater conditions between and beyond these locations may differ from those encountered. Conditions may become apparent during construction that were not detected and could not be anticipated at the time of the site investigation.

Groundwater levels indicated are based on the information described within the report. The presence of all conditions that could affect the type and scope of dewatering procedures which may be considered cannot readily be determined from boreholes. These include local and seasonal fluctuations of the groundwater level, changes in soil conditions between test locations, thin and/or discontinuous layers of highly permeable soils, etc.

The information contained within this report in no way reflects any environmental aspect of the site or soil.

8 Closure

We trust the above addresses your project requirements at this time. Should you have any questions or comments, please do not hesitate to contact us at your convenience.

Yours truly,

For TBT ENGINEERING



Steven Seller, P.Eng.
Senior Project Engineer



Wayne Hurley, P.Eng.
Senior Engineer
Principal Contact for MTO Foundations

APPENDIX A

Borehole Logs

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING			MECHANICAL PROPERTIES OF SOIL		
S S	SPLIT SPOON	T P	THINWALL PISTON	m_v	kPa^{-1} COEFFICIENT OF VOLUME CHANGE
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE	C_c	1 COMPRESSION INDEX
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE	C_s	1 SWELLING INDEX
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY	C_a	1 RATE OF SECONDARY CONSOLIDATION
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY	C_v	m^2/s COEFFICIENT OF CONSOLIDATION
T W	THINWALL OPEN	F S	FOIL SAMPLE	H	m DRAINAGE PATH
STRESS AND STRAIN			T_v	1	TIME FACTOR
u_w	kPa		U	%	DEGREE OF CONSOLIDATION
r_u	1		σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ	kPa		σ'_p	kPa	PRECONSOLIDATION PRESSURE
σ'	kPa		τ_f	kPa	SHEAR STRENGTH
τ	kPa		c'	kPa	EFFECTIVE COHESION INTERCEPT
$\sigma_1, \sigma_2, \sigma_3$	kPa		ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
ϵ	%		C_u	kPa	APPARENT COHESION INTERCEPT
$\epsilon_1, \epsilon_2, \epsilon_3$	%		ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
E	kPa		τ_R	kPa	RESIDUAL SHEAR STRENGTH
G	kPa		τ_r	kPa	REMOULDED SHEAR STRENGTH
μ	1		S_i	1	SENSITIVITY = $\frac{C_u}{\tau_r}$
PHYSICAL PROPERTIES OF SOIL					
ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION
P	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	e_{min}	1, %	VOID RATIO IN DENSEST STATE
			I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
			D	mm	GRAIN DIAMETER
			D_n	mm	n PERCENT - DIAMETER
			C_u	1	UNIFORMITY COEFFICIENT
			h	m	HYDRAULIC HEAD OR POTENTIAL
			q	m^3/s	RATE OF DISCHARGE
			v	m/s	DISCHARGE VELOCITY
			i	1	HYDRAULIC GRADIENT
			k	m/s	HYDRAULIC CONDUCTIVITY
			j	kN/m^2	SEEPAGE FORCE

1 OF 1

METRIC

W.P. 5383-11-00	PROJECT Culvert Investigation	SITE NO. Culvert #21	ORIGINATED BY C.H.
TWP Foleyet HWY 101	LOCATION MTM 12 N5346624.06, E202146.424	TBTE JOB# 13-121	COMPILED BY T.B.
DATE 2013 September 4	BOREHOLE TYPE Hollow Stem Auger/B Casing/Core	DATUM Geodetic	CHECKED BY S.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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		WATER CONTENT (%)			
							○ UNCONFINED ■ SPT (N)	✕ FIELD VANE ★ LAB VANE	W _p	W W _L		
333.4 0.0	SAND - grey		1	AS								
332.8 0.6	CLAY - Silty, trace sand, grey, stiff		2	SS	13							0 4 64 32
			3	SS	14							
331.2 2.2	SAND & SILT - trace gravel, grey, very loose		4	SS	1							4 46 (50) Non Plastic.
			5	SS	1							4 55 (41)
			6	SS	1							
			7	SS	59							
			8	SS	100+							
			9	SS	100+							
321.9 11.5	End of Borehole @ 11.5 m.		10	SS	100+							

- cobbles, very dense

Dynamic Cone Penetration Resistance Plot

Scale: 0 to 100 kPa

Shear Strength kPa

WATER CONTENT (%)

W_p W W_L

UNCONFINED SPT (N) FIELD VANE LAB VANE

Advanced 'B' Casing @ 5.4 m

ON MOT_BH_MTM 13-121 CULVERT 21.GPJ ON MOT.GDT 15/2/11

✕³, ★³: Numbers refer to Sensitivity
 NP Non Plastic
 ○^{3%} STRAIN AT FAILURE

TBT Engineering Consulting Group			RECORD OF Borehole No 301			1 OF 1		METRIC											
W.P. 5383-11-00			PROJECT Culvert Investigation			SITE NO. Culvert #21		ORIGINATED BY C.H.											
TWP Foleyet HWY 101			LOCATION MTM 12 N5346611.534, E202137.139			TBTE JOB# 13-121		COMPILED BY T.B.											
DATE 2013 September 8			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		SHEAR STRENGTH kPa		WATER CONTENT (%)		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	UNCONFINED	FIELD VANE	SPT (N)	LAB VANE	20 40 60	γ	GR SA SI CL
337.9	ASPHALT - 45 mm		1	AS															
330.8	FILL - GRAVEL - Sandy, trace silt, numerous cobbles, brown, compact to dense ----- - grey		2	SS	47		337												Advanced 'B' Casing @ 0.5 m. 70 26 (4)
			3	SS	21		336												
			4	SS	34		335												
			5	SS	22		334												
			6	SS	28		333												72 26 (2)
332.5	SILT - Gravelly, trace sand, trace organics, grey, loose		7	SS	8		332												22 8 (70) Non Plastic.
331.0	SAND - Silty, occasional cobbles, grey, loose to compact		8	SS	6		331												
			9	SS	11		330												
			10	SS	21		329												
			11	SS	100+		328												
326.3	GRAVEL - Sandy, grey						327												0 79 (22)
325.6	End of Borehole @ 12.3 m.						326												

x³, ★³: Numbers refer to Sensitivity
 NP Non Plastic
 ○ 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 13-121 CULVERT 21.GPJ ONL_MOT_GDT 15/2/11





TBT Engineering Consulting Group

RECORD OF Borehole No 302

1 OF 1

METRIC

W.P. **5383-11-00** PROJECT **Culvert Investigation** SITE NO. **Culvert #21** ORIGINATED BY **C.H.**
TWP **Foleyet** HWY **101** LOCATION **MTM 12 N5346610.007, E202127.552** TBTE JOB# **13-121** COMPILED BY **T.B.**
DATE **2013 September 8** BOREHOLE TYPE **Hollow Stem Auger/B Casing** DATUM **Geodetic** CHECKED BY **S.S.**

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								○ UNCONFINED ■ SPT (N)	✕ FIELD VANE ★ LAB VANE	WATER CONTENT (%) W _p W W _L		
337.8	ASPHALT - 45 mm		1	AS								
336.9	FILL - SAND - some silt to Silty, trace gravel, brown, loose to compact		2	SS	11							
			3	SS	100+							
			4	SS	100+							
			5	SS	9							
332.0	SAND - Silty, grey, compact to dense		6	SS	29							
5.8			7	SS	23							
			8	SS	32							
329.7	End of Borehole @ 8.1 m.		9	SS	100+							
8.1												

\times^3, \star^3 : Numbers refer to Sensitivity
NP Non Plastic
○ 3% STRAIN AT FAILURE



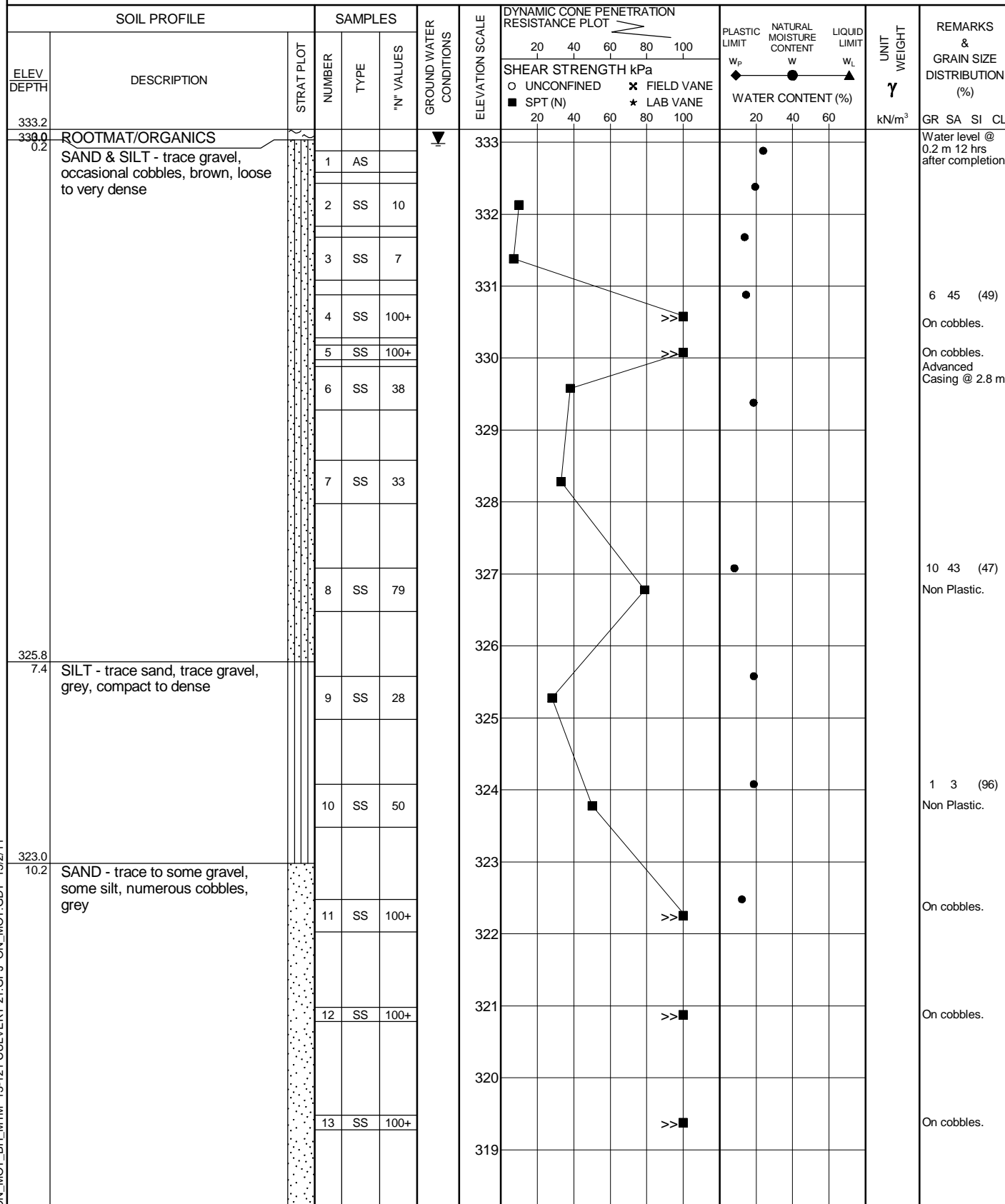
TBT Engineering Consulting Group

RECORD OF Borehole No 303

1 OF 2

METRIC

W.P. **5383-11-00** PROJECT **Culvert Investigation** SITE NO. **Culvert #21** ORIGINATED BY **C.H.**
TWP **Foleyet** HWY **101** LOCATION **MTM 12 N5346591, E202132** TBTE JOB# **13-121** COMPILED BY **T.B.**
DATE **2013 November 26** BOREHOLE TYPE **N Casing/Core** DATUM **Geodetic** CHECKED BY **S.S.**



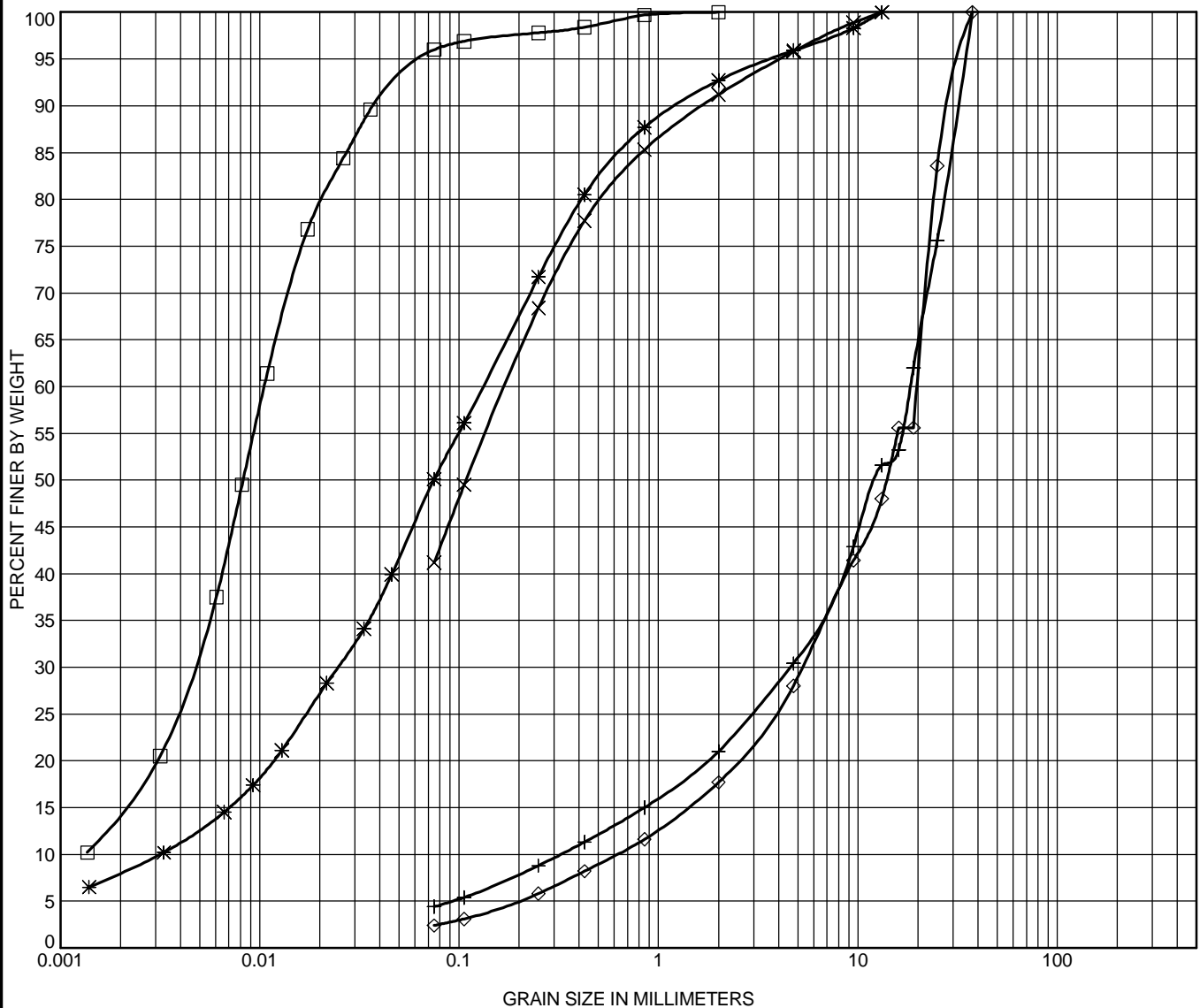
Continued Next Page

3, 3: Numbers refer to Sensitivity
NP Non Plastic
O 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 13-121 CULVERT 21.GPJ ONL_MOT_GDT 15/2/11

APPENDIX B

Laboratory Test Data



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
TILL - SILTS & SANDS & GRAVELS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 300	0.75	2	0.011	0.005		0.0	4.0	96.0	
* 300	2.50	13.2	0.131	0.025	0.003	4.1	45.8	50.1	
× 300	3.00	13.2	0.171			4.2	54.6	41.2	
+ 301	0.75	37.5	18.272	4.578	0.323	69.6	26.0	4.4	
◇ 301	4.50	37.5	19.837	5.268	0.613	72.0	25.6	2.4	



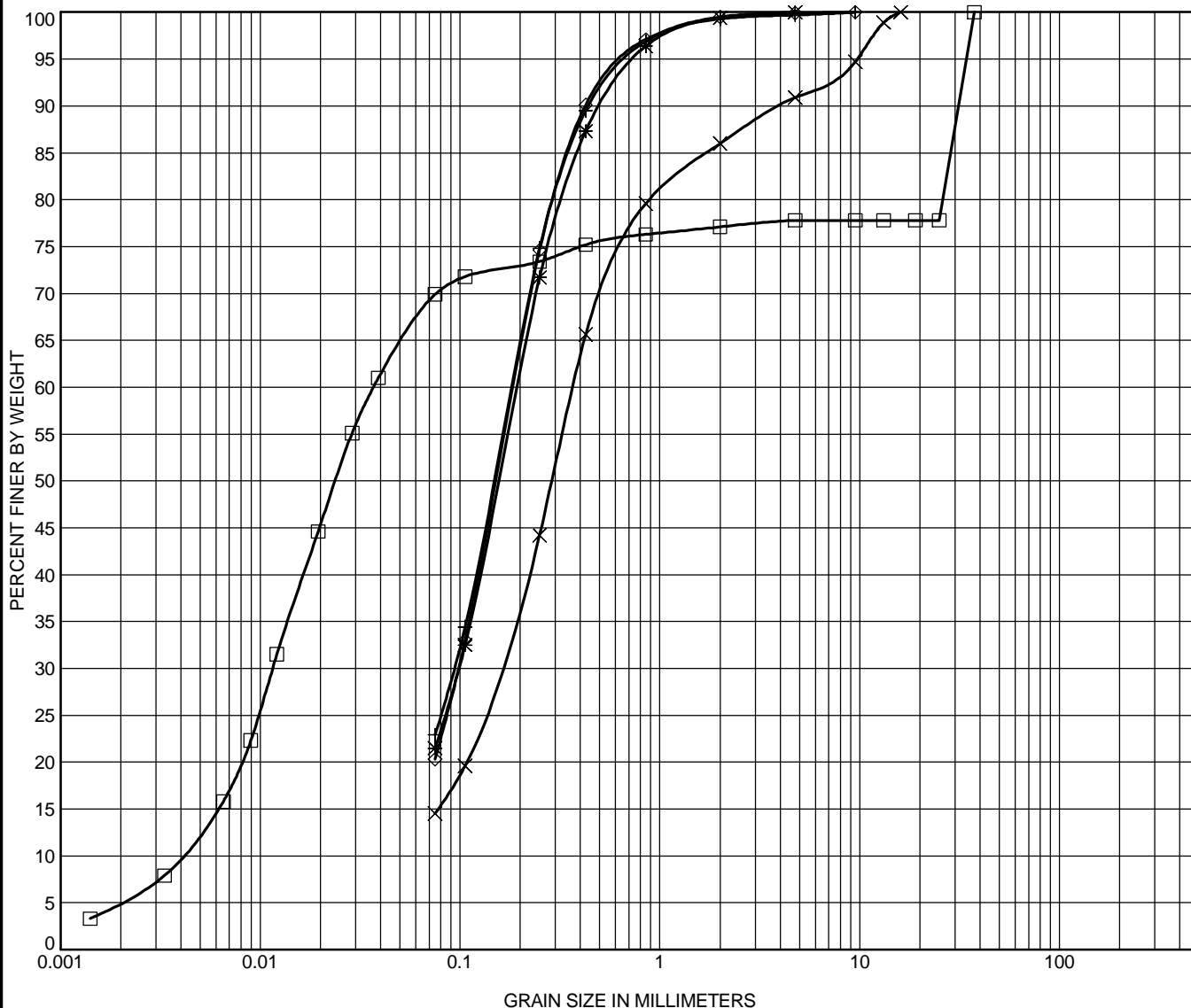
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GRAIN SIZE DISTRIBUTION

Project: Culvert Investigation

W P: 5383-11-00

DIST: Foleyet HWY: 101



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
TILL - SILTS & SANDS & GRAVELS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 301	6.00	37.5	0.037	0.012	0.004	22.2	7.9	69.9	
* 301	10.50	4.75	0.194	0.098		0.0	78.5	21.5	
× 302	0.75	16	0.37	0.152		9.1	76.4	14.5	
+ 302	3.00	9.5	0.183	0.093		0.3	76.8	22.9	
◇ 302	7.50	9.5	0.185	0.098		0.1	79.6	20.3	



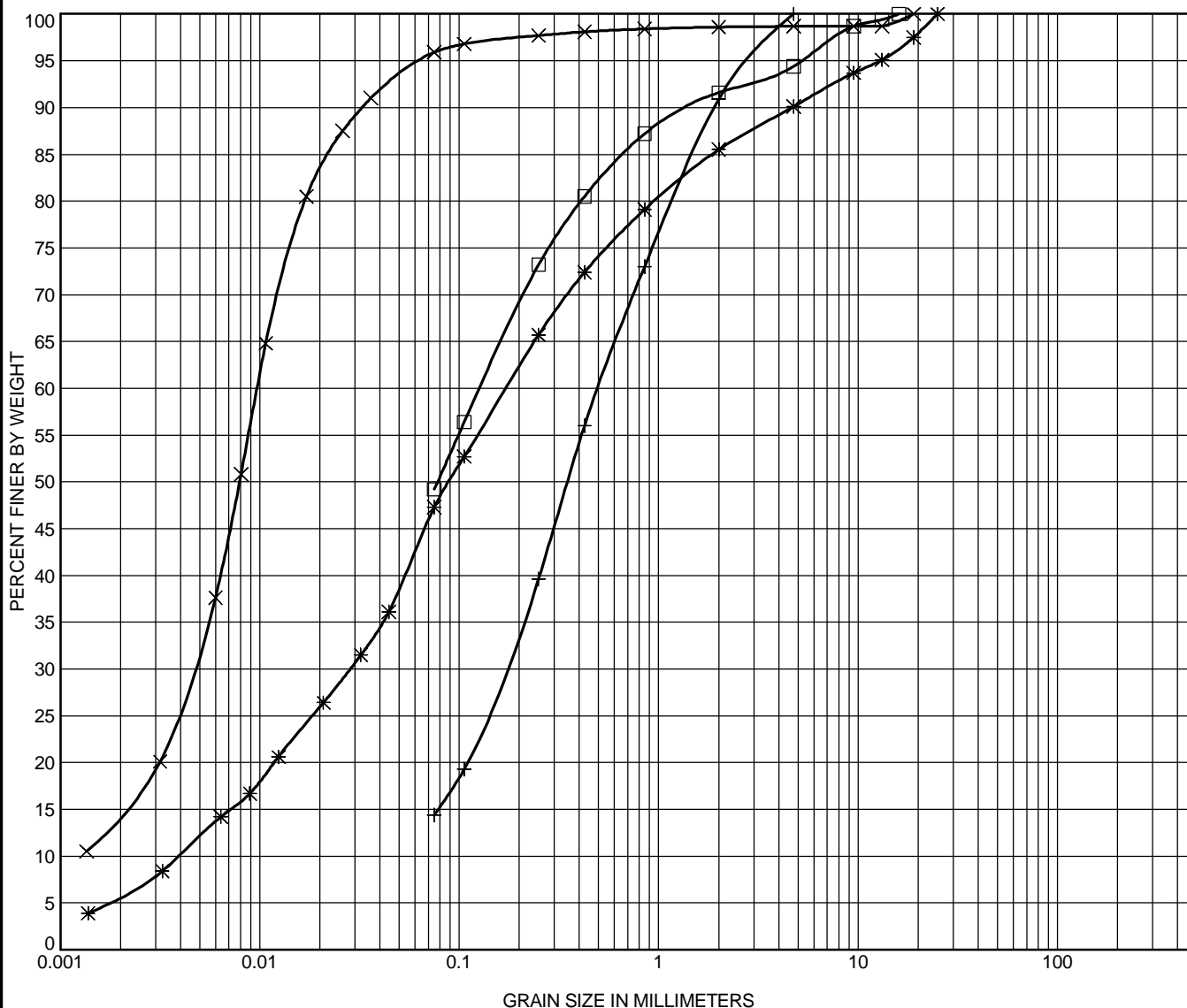
TBT Engineering Ltd.
1918 Yonge Street
Thunder Bay, Ontario P7E 6T9
PH: 807-624-5160
FX: 807-624-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Culvert Investigation

W P: 5383-11-00

DIST: Foleyet HWY: 101



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
TILL - SILTS & SANDS & GRAVELS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 303	2.30	16	0.127			5.6	45.2	49.2	
* 303	6.10	25	0.172	0.028	0.004	9.9	42.8	47.3	
× 303	9.10	19	0.01	0.005		1.3	2.8	95.9	
+ 303	18.30	4.75	0.5	0.167		0.0	85.6	14.4	



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GRAIN SIZE DISTRIBUTION

Project: Culvert Investigation

W P: 5383-11-00

DIST: Foleyet HWY: 101

[illegible]

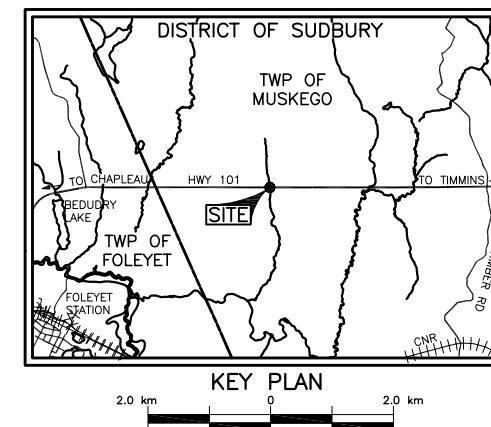
ATTERBERG LIMIT RESULTS


Highway: 101

APPENDIX C

Borehole Locations and Soil Strata Drawing

SHEET
•



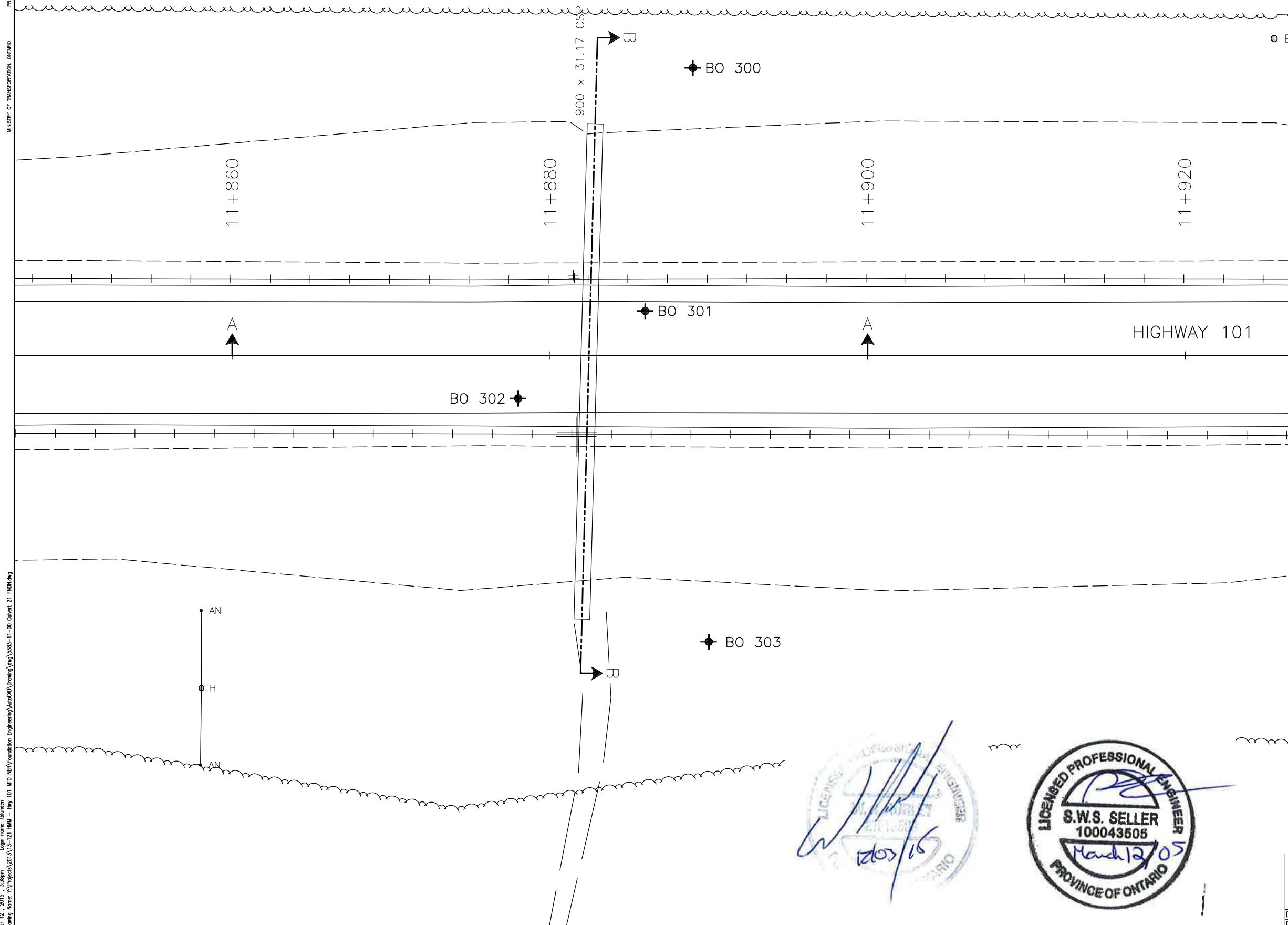
LEGEND			
 Borehole			
No	ELEVATION	CO-ORDINATES (MTM)	
		NORTH	EAST
300	333.4	12 5 346 624	202 146
301	337.9	12 5 346 612	202 137
302	337.8	12 5 346 610	202 128
303	331.2	12 5 346 591	202 132

-NOTE-

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVIEWS									
	13/12/10	WH	ISSUED IN DRAFT						
						DESCRIPTION			
DESIGN	SS	CHK	WH	CODE	XXXXX-XX	LOADXX-XXX-XXX	DATE	2013/12/2	
DBAWN	JB	CHK	V/H	SUF	N/A		DWG		1

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



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

GEOCREs No. 42B-9

CONT No. .

GWP No. 5383-11-00

CULVERT 21
AT HWY 101
CULVERT INVESTIGATION
BOREHOLE LOCATIONS AND SOIL STRATA

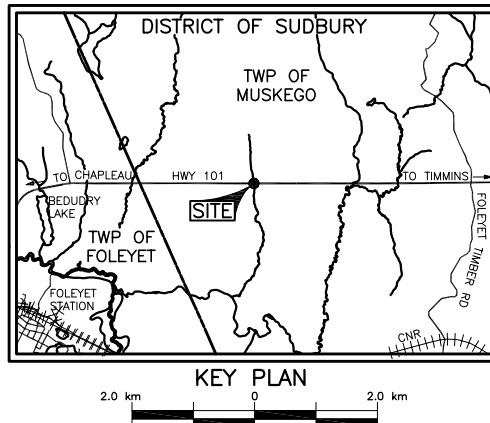
SHEET .




Ontario





TBT ENGINEERING
CONSULTING GROUP





SOIL STRATA SYMBOLS


 ROOTMAT/
ORGANICS

 SILT


 FILL

 GRAVEL

 SAND


 SAND & SILT

LEGEND

 Borehole

'N'

Std Pen Test (Blows/0.3m)

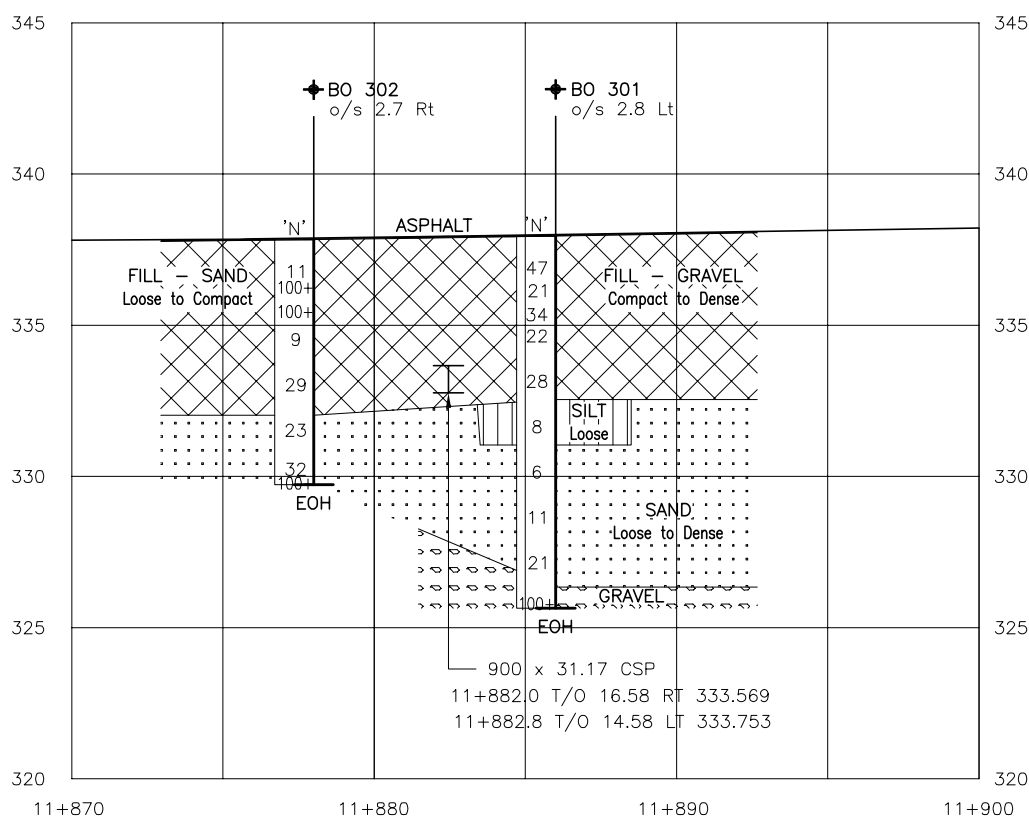
 Water Level

EOH

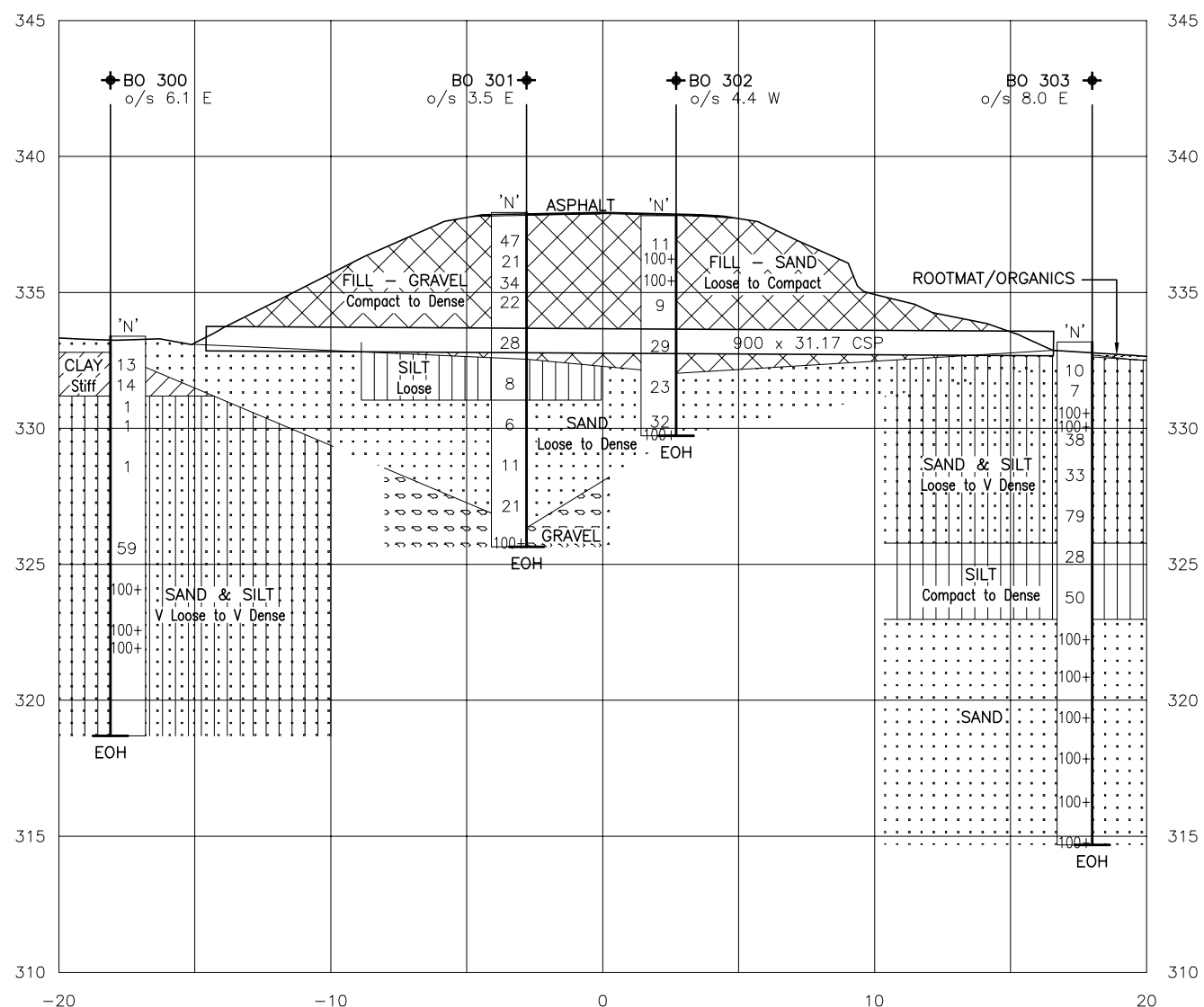
End of Hole

No	ELEVATION	CO-ORDINATES (MTM)	
		NORTH	EAST
300	333.4	12 5 346 624	202 146
301	337.9	12 5 346 612	202 137
302	337.8	12 5 346 610	202 128
303	331.2	12 5 346 591	202 132

-NOTE-
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.



SECTION A - A
SCALE
5 0 10 m



SECTION B - B
SCALE
5 0 10 m





REVISIONS	13/12/10		WH		ISSUED IN DRAFT		DESCRIPTION	
	DESIGN	SS	CHK	WH	CODE	XXXXX-XX	LOAD XX-XX-XX	DATE 2013/12/23
	DRAWN	TB	CHK	WH	SITE	N/A		DWG 2