



## **Foundation Investigation Report**

# **Culvert Replacement at LaChappelle Creek**

**GWP 70-97-00**

**Highway 527  
106.5 km north of Highway 11/17**

**MTO Site No.: 48C-224C  
Geocres No.: 52H14**

**Prepared for  
Ministry of Transportation, Northwestern Region**

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October 2004

Ref. No. 02-134

## Table of Contents

Table of Contents .....	i
Appendix A, Borehole Logs .....	i
Appendix C, Photographs .....	i
1 Introduction .....	1
2 Site Description .....	2
3 Investigation Procedures .....	4
4 General Site Geology and Sub-Surface Conditions .....	7
4.1 Site Geology .....	7
4.2 Subsurface Conditions .....	7
4.2.1 Fill .....	8
4.2.2 Sand and Gravel .....	9
4.2.3 Bedrock .....	10
4.2.4 Ground Water .....	11
5 Limitations .....	12
6 Closure .....	12

Appendix A, Borehole Logs

Appendix B, Laboratory Test Data

Appendix C, Photographs

Appendix D, Drawings

## **Part A FOUNDATION INVESTIGATION REPORT**

### **1 Introduction**

TBT Engineering has been retained by The Ministry of Transportation, Northwestern Region to carry out a Total Project Management (TPM) design assignment for the upgrading of Hwy 527 from 97.5 km north of Highway 11/17 northerly for 25.0 km. As a part of this assignment TBT Engineering has provided Foundation Engineering services for the proposed culvert replacement at LaChappelle Creek, Site No. 48C-224C.

The site is located on Highway 527, approximately 106.5 km north of Highway 11/17.

Two existing culverts are to be replaced with a new culvert-type structure.

A foundation investigation was carried out to investigate subsurface conditions at the site. This investigation consisted of a number of boreholes drilled in the vicinity of the proposed new structure location, test pits to supplement the boreholes, laboratory testing and geotechnical analysis of the data. This report provides a summary of that work and of the conditions encountered.

The foundation section has assigned GEOCRES No. 52H-14 to this site.

## **2 Site Description**

The site is located on Highway 527, approximately 106.5 km north of Highway 11/17. At this location Highway 527 runs generally in a north-south direction. The LaChappelle Creek runs in a slightly skewed southwest to northeast direction through the culverts. The two existing CSP culverts are to be replaced with a single culvert.

The area surrounding the culvert site is isolated and generally covered with mixed forest. The terrain in the immediate surrounding area is bedrock controlled, with the Creek following a zone of low ground. The quaternary geology of the site is mapped as a zone of glacio-fluvial outwash deposits surrounded by large areas of undifferentiated pre-cambrian bedrock. (Ministry of Northern Development and Mines, Ontario Geological Survey, Map 2554).

The creek and its flood plain are about 6 m below the current road grade. Upstream of the culverts the creek is wider with shallow vegetated banks. Downstream the channel is better defined. The visible creek bed is made up of coarse sands, gravels and cobbles. Numerous large boulders are present at the site. The water level in the tributary was at approximately 443.5 m elevation at the time of our investigation (Summer 2003).

The road embankment is about six metres high with fore slopes close to 1.5 h:1v. The culvert is located at the base of a gully through the local undulating bedrock topography. The depth of the embankment decreases north and south of the culvert as the adjacent lands rise.

The road profile is in a cut section both north and south of the Creek embankment. The fill section across the creek is about 80 m in length.

Highway 527 is a two lane paved section through the culvert site. There is no known history of settlements or distortions at this embankment.





Culvert Site, From the West, Site No. 48C-224C (Upstream side)

### **3 Investigation Procedures**

A site investigation was undertaken in several phases between July 23 and September 18, 2003. Various investigation techniques were used depending on the conditions encountered.

A truck mounted CME 55 was used for geotechnical sampling and testing at locations accessible to the truck mounted rig. A track mounted CME 45 drill rig was used at boreholes that were not truck accessible. At Borehole 9, drilled through the top of the roadway embankment, a water well drill rig was used to advance a casing through the rock fill. The borehole was advanced from the bottom of the casing using the CME 55 drill.

Bedrock was sampled at three boreholes using NQ diamond core equipment to obtain the cores.

A number of test holes drilled to investigate embankment conditions encountered shallow refusal in the rock fill, coarse gravels or on bedrock. A large Caterpillar 219 LC track-mounted backhoe was mobilized to the site to excavate test pits through the coarse materials. A total of 11 test pits were excavated.

Soil samples were obtained at the boreholes with a split spoon sampler as a part of the Standard Penetration Testing (SPT). The SPT involves driving a thick walled sampler into the soils under a standardized energy (63.5 kg, falling 760 mm). The number of blows required to drive the sampler 0.3 m, known as the SPT blow count (N), was recorded.

Borehole locations and elevations were referenced from Plan B & C – 491892-527-6 and E-491892-527-1, Hwy 527, Un-surveyed Territory Sta. 19+880 to 19+980.

The borehole characteristics and drill techniques utilized are summarized in Table 1.



**Table 1. Drill Summary**

Location	Surface Elevation (metres)	Bedrock / Refusal (Elevation/Depth) (metres)	Bottom of Hole (Elevation/Depth) (metres)	Comments
BH 1	444.5	440.9/3.6	437.9/6.6	NQ Core obtained
BH 2	443.9	439.8/4.1	436.8/7.1	NQ Core obtained
BH 3	450.2	449.9/0.3	449.9/0.3	Refusal in rock fill
BH 4	452.0	451.1/0.9	451.1/0.9	Refusal on inferred bedrock
BH 5	453.3	451.5/1.8	451.5/1.8	Refusal on rock fill or fractured bedrock
BH 6	451.7	450.5/1.2	450.5/1.2	Refusal on boulder or possible bedrock
BH 7	449.8	447.5/2.3	447.5/2.3	Refusal in cobbles
BH 8	450.2	448.7/1.5	448.7/1.5	Refusal/Split Spoon "bouncing"
BH 9	449.8	440.5/9.3	432.8/17.0	8 m of NQ Core obtained

**Table 2. Test Pit Summary**

Location	Surface Elevation (metres)	Bedrock (Elevation/Depth) (metres)	Comments
TP 1	445.0	441.0/4.0	Refusal on bedrock
TP 2	451.2	449.4/1.8	Refusal on bedrock
TP 3	453.2		Excavation from shoulder rounding
TP 4	450.6	449.8/0.8	Refusal on bedrock
TP 5	444.0	442.3/1.7	Refusal on bedrock
TP 6	448.8	446.6/2.2	Refusal on bedrock
TP 7	449.8		Excavation from shoulder rounding
TP 8	451.6	450.7/0.9	Refusal on bedrock
TP 9	449.2	448.0/1.2	Refusal on bedrock
TP 10	444.6	441.3/3.3	Refusal on bedrock
TP 11	449.8		Excavation from shoulder rounding

The boreholes were backfilled at the completion of the investigations using a cement/bentonite backfill to ensure the environmental integrity of the site. Standpipe piezometers were removed.

Soil samples were transported to TBT Engineering's laboratory in Thunder Bay for testing. Routine testing included moisture content, grain size analysis and Atterberg

Limits. Bedrock samples were stored in core boxes for review with recovery and rock quality designation values determined. The results of this testing are shown on the Borehole Logs (Appendix A) and on the laboratory data reports (Appendix B).

Photographs of some of the test pits are provided in Appendix C.



## **4 General Site Geology and Sub-Surface Conditions**

### **4.1 Site Geology**

The surficial geology of the area consists predominantly of glaciofluvial deposits – sand and gravel, till, and bedrock knobs, with an undulating to rolling surface relief. Pro-glacial and deltaic deposits are also mapped in the area (Quaternary Geology of Ontario, West-Central Sheet, Ontario Geological Survey, Map 2554).

The bedrock type observed in the area, and shown on published geological maps is a felsic igneous rock of the early Precambrian age. To the south of LaChappelle Creek mafic intrusive bedrock surfaces were observed in test pit excavations, identified on published geological maps as mafic igneous rocks of the middle to late Precambrian age.

### **4.2 Subsurface Conditions**

Details of the subsurface conditions are provided on the Borehole Logs, Appendix A, and on the Section Plans, Drawings 1 and 2. In general, the subsurface conditions at the site consist of coarse sands and gravels overlying sloping bedrock. The sands and gravels include both embankment fill materials and similar native soils.

Groundwater levels near the culvert were similar to the level of the LaChappelle Creek at the time of the investigation. North and south of the Creek, the ground water levels rose with the bedrock profile.

#### **4.2.1 Fill**

There is approximately 0.8 m of pavement structure across at this site. This is made up of about 45 mm of hot mix, 150 mm of crushed granular base and 0.6 m of granular sub-base. Investigations undertaken as part of the pavement design aspects of the project indicate that little of the structural fill meets current gradation specifications for base and sub-base granulars.

The pavement structure is underlain with coarse embankment fill. This fill is composed of a mixture of blasted shot rock and sands and gravels similar to the native soils. The

embankment was likely originally constructed of fills obtained from both earth and rock borrow areas.

The grain size distribution of the fill varies widely (Figures 1 and 2). The size fractions of the fill range from silt sizes to boulders in excess of 0.8 m in diameter. In most zones the fill is relatively well graded with a range of all size fractions present. In a few zones the fill is very poorly graded, consisting of heterogeneous mixtures of coarse gravels, cobbles and boulders with little fine graded matrix. Because of the wide variation in grain size distributions, the hydraulic conductivity of the fill is expected to vary from less than  $10^{-4}$  cm/sec to more than 10 cm/sec. Groundwater flows through the coarser fractions can be extremely rapid.

#### **4.2.2 Sand and Gravel**

In all boreholes and test pits, roadway fill materials were found overlying a deposit of sand and gravel (glacial till). The till typically consists of a heterogeneous mixture of sand and gravel, silts and clays, with frequent angular cobbles and boulders. The coarse fraction is angular (cobbles and boulders) and shows little evidence of weathering.

Within the vicinity of the culverts the till extends approximately to elevation 440 m, near 3 m below the culvert invert. Based on SPT data the till is in a compact to very dense condition.

Grain size analyses conducted on selected samples of the till (Figures 3-4) indicate a well graded material with a fines fraction (percent passing the 0.075 mm sieve) of 12 to 22 percent. In-situ hydraulic conductivities within the till are expected to be in the order of  $10^{-2}$  to  $10^{-5}$  cm/sec., based on grain size data. This material is considered susceptible to frost heave.

At Test Pits 5 and 10, a zone of very coarse gravel and cobbles (with boulders) was encountered with little finer grained soil matrix present. These materials may be shot rock fill zones resulting from earlier road building activities. Where these zones of

materials are present, in situ hydraulic conductivities will be very high and will be subject to rapid ground water flow.

Several test locations (BH 1, BH 2, TP 5, TP 10) encountered a thin (approximately 0.5 m thick) layer of very dense non-plastic sandy/clayey silt (hardpan) directly overlying bedrock. The layer was detected on both the west and east sides of Hwy 527. The dense 'hardpan' material is grey in colour and well graded with gradation fractions of 46 % silt, 33 % sand, 10 % clay, and 11% fine gravel sizes. As shown on the grain size distribution curve (Figure 5)

#### **4.2.3 Bedrock**

Bedrock outcrops can be observed throughout the ridges to the north and south of the site. Within the culvert and drainage channel area, no outcroppings of rock were evident at the time of investigation. The bedrock surface as interpreted from core data, refusals in the boreholes and test pit data, forms an east-west valley across the central part of the site.

Bedrock elevations in the vicinity of the proposed culvert range from 440.9 m at the east end (BH 1) to 439.7 at the west end (BH 2). Bedrock was encountered at elevation 440.5 m at Borehole 9 (south bound lane shoulder immediately south of the culverts), approximately 3 m below culvert invert.

Bedrock samples were collected using "NQ"-size diamond drill core. A minimum of three lineal metres of rock core was collected from each of Boreholes 1, 2, and 9. Rock cores were returned to our Thunder Bay laboratory for analysis. The following descriptive analysis of the rock mass within the immediate site area is based on MTO's *Guide to the Description of Rock for Engineering Purposes*:

The rock mass at the subject site is a hard, coarse grained, pink, massive felsic intrusive rock with an engineering rock quality of fair, based on RQD values. The intact rock material is expected to be of high to very high strength, however the mass has closely to moderately spaced discontinuities infilled with precipitated non-softening clays (< 5mm) which further reduces



the quality of the mass, with reference to engineering properties. Rock cores from the rock mass, indicate the mass contains both open and filled joints with apertures in the range of <1 mm to 2 mm. Open joints were noted to have rough faces.

#### **4.2.4 Ground Water**

The ground water levels at the site generally correspond to water levels within the LaChappelle Creek at the time of the investigation. (Elevation 443.5 m). Near the creek these levels are expected to reflect hydrostatic conditions in the Creek, with some time lag, and should be expected to fluctuate with changes in the seasons. The ground water level will rise to the north and south reflecting topographic and bedrock influences.



## **5 Limitations**

Conclusions and recommendations presented in this report are based on the information determined at the test hole 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.

Benchmarks and elevations referred to in this report are used primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

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 be 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.

## 6 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

Prepared by:



Wayne Hurley, P.Eng  
Vice-President, Engineering

Reviewed By

*K. D. Eigenbrod*, Oct. 19/04

A circular professional engineer seal for Dieter Eigenbrod, PhD., P.Eng. The seal features the text "LICENSED PROFESSIONAL ENGINEER" around the top and "PROVINCE OF ONTARIO" around the bottom. In the center, the name "K. EIGENBROD" is printed. A blue ink signature is written over the seal.

Dieter Eigenbrod, PhD., P.Eng

## References

1. Barnett, P.J., Henry, A.P., and Babuin, D., 1991, Quaternary Geology of Ontario, West Central Sheet, Ontario Geological Survey, Map 2554
2. Ontario Department of Mines and Northern Affairs, Ontario Geological Map, West Central Sheet, Map 2199
3. CSA International, Canadian Highway Bridge Design Code, CSA International, 2002, ISBN 1-55324-215-7
4. Ontario Ministry of Transportation, Surveys and Design Office, Pavement Design and Rehabilitation Manual, The Queens Printer for Ontario, 1990, ISBN 0-7729-6379-7
5. Canadian Geotechnical Society, Canadian Foundation Engineering Manual, Third Edition, BiTech Publishers Ltd., 1992, ISBN 0-920505-09-0
6. Hunt, Roy E., Geotechnical Engineering Analysis and Evaluation, McGraw Hill Inc, 1986, ISBN 0-07-031310-5
7. Magni, E., A Guide to the Description of Rock for Engineering Purposes, Ministry of Transportation and Communications, Engineering Materials Office, 1982

## **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 (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

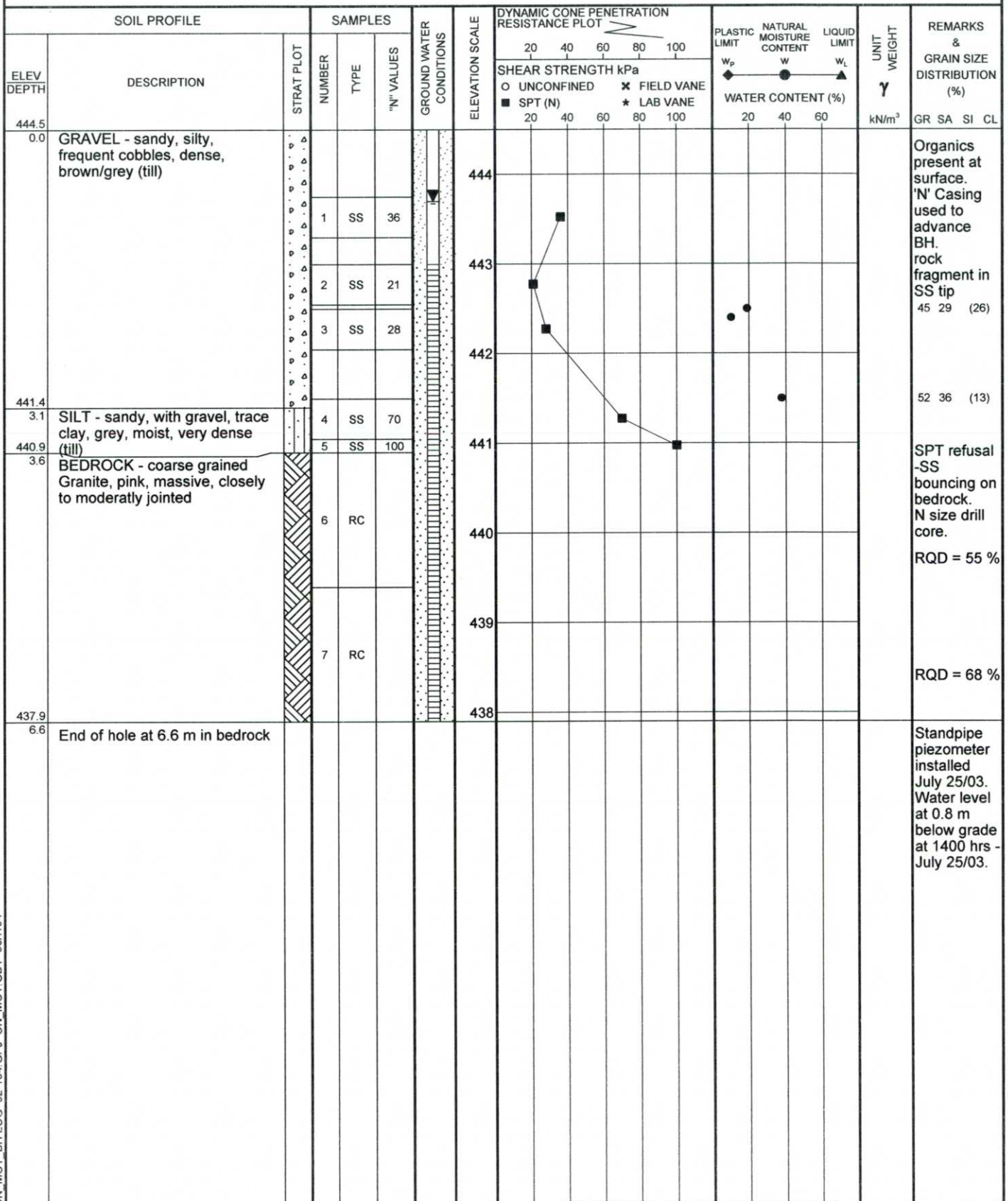
**JOINTING AND BEDDING:**

SPACING	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	$C_c$	COMPRESSION INDEX
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE	$C_s$	SWELLING INDEX
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY	$C_a$	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
				$T_v$	TIME FACTOR
				U	% DEGREE OF CONSOLIDATION
				$\sigma'_{vo}$	kPa EFFECTIVE OVERBURDEN PRESSURE
				$\sigma'_p$	kPa PRECONSOLIDATION PRESSURE
				$\tau_f$	kPa SHEAR STRENGTH
				$c'$	kPa EFFECTIVE COHESION INTERCEPT
				$\phi'$	-° EFFECTIVE ANGLE OF INTERNAL FRICTION
				$c_u$	kPa APPARENT COHESION INTERCEPT
				$\phi_u$	-° APPARENT ANGLE OF INTERNAL FRICTION
				$\tau_R$	kPa RESIDUAL SHEAR STRENGTH
				$\tau_f$	kPa REMOULDED SHEAR STRENGTH
				$S_t$	SENSITIVITY = $\frac{C_u}{\tau_f}$
STRESS AND STRAIN			PHYSICAL PROPERTIES OF SOIL		
$u_w$	kPa	PORE WATER PRESSURE	e	1, %	VOID RATIO
$u_o$	kPa	PORE PRESSURE RATIO	n	1, %	POROSITY
$\sigma$	kPa	TOTAL NORMAL STRESS	w	1, %	WATER CONTENT
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS	$S_r$	%	DEGREE OF SATURATION
$\tau$	kPa	SHEAR STRESS	$w_L$	%	LIQUID LIMIT
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES	$w_p$	%	PLASTIC LIMIT
$\epsilon$	%	LINEAR STRAIN	$w_s$	%	SHRINKAGE LIMIT
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$
E	kPa	MODULUS OF LINEAR DEFORMATION	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
G	kPa	MODULUS OF SHEAR DEFORMATION	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
$\mu$	1	COEFFICIENT OF FRICTION	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE
			$e_{min}$	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	$kn/m^3$	SEEPAGE FORCE
$\rho_s$	$kg/m^3$	DENSITY OF SOLID PARTICLES			
$\gamma_s$	$kn/m^3$	UNIT WEIGHT OF SOLID PARTICLES			
$\rho_w$	$kg/m^3$	DENSITY OF WATER			
$\gamma_w$	$kn/m^3$	UNIT WEIGHT OF WATER			
$\rho$	$kg/m^3$	DENSITY OF SOIL			
$\gamma$	$kn/m^3$	UNIT WEIGHT OF SOIL			
$\rho_d$	$kg/m^3$	DENSITY OF DRY SOIL			
$\gamma_d$	$kn/m^3$	UNIT WEIGHT OF DRY SOIL			
$\rho_{sat}$	$kg/m^3$	DENSITY OF SATURATED SOIL			
$\gamma_{sat}$	$kn/m^3$	UNIT WEIGHT OF SATURATED SOIL			
$\rho'$	$kg/m^3$	DENSITY OF SUBMERGED SOIL			
$\gamma'$	$kn/m^3$	UNIT WEIGHT OF SUBMERGED SOIL			

TBT Engineering		<b>RECORD OF BOREHOLE No 1</b>		1 OF 1	<b>METRIC</b>
W.P. <b>70-97-00</b>	PROJECT <b>Lachapelle Creek Culvert Replacement</b>	SITE NO. <b>SITE 48C-224C</b>	ORIGINATED BY <b>JM</b>		
DIST <b>103</b> HWY <b>527</b>	LOCATION <b>Sta 19+927 - 20.0m Rt. Dist. Thunder Bay</b>	TBTE JOB# <b>J02-134</b>	COMPILED BY <b>SP</b>		
DATE <b>23 July 2003</b>	BOREHOLE TYPE <b>Hollow Stem Auger - 100mm ID</b>	DATUM <b>Geodetic</b>	CHECKED BY <b>WH</b>		



ON MOT BH LOG 02-134 GPJ ON MOT GDT 30/7/04

<b>TBT Engineering</b>		<b>RECORD OF BOREHOLE No 2</b>		1 OF 1		<b>METRIC</b>	
W.P.	<b>70-97-00</b>	PROJECT	<b>Lachapelle Creek Culvert Replacement</b>	SITE NO.	<b>SITE 48C-224C</b>	ORIGINATED BY	<b>JM</b>
DIST	<b>103</b>	HWY	<b>527</b>	LOCATION	<b>Sta 19+900 - 20.0m Lt. Dist. Thunder Bay</b>	TBTE JOB#	<b>J02-134</b>
DATE	<b>29 July 2003</b>	BOREHOLE TYPE	<b>Hollow Stem Auger - 100mm ID</b>	DATUM	<b>Geodetic</b>	CHECKED BY	<b>WH</b>

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
443.9													
443.9 0.2	FILL - boulders, cobbles (shotrock) SAND & GRAVEL - silty, frequent cobbles, compact to very dense, grey/brown (till)	0	1	SS	25		443						
			2	SS	15		442						
			3	SS	23		441						
			4	SS	60		440						
440.3 3.6	SILT - sandy, with gravel, trace clay, grey, moist, very dense (till)	5	5	SS	100		440						
439.8 4.1	BEDROCK - coarse grained Granite, pink, massive, closely to moderately spaced joints, potassium alterations at surface	6	6	RC			439						
			7	RC			438						
436.8 7.1	End of hole at 7.1 m in bedrock						437						



TBT Engineering		<b>RECORD OF BOREHOLE No 3</b>				1 OF 1		<b>METRIC</b>					
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>JM</b>							
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+825 - 9.0m Lt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>							
DATE <b>5 August 2003</b>		BOREHOLE TYPE <b>Hollow Stem Auger - 100mm ID</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>							
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
450.2													
0.0	Angular rock fill	o				450							4 attempts
449.9		D											made, NFP
0.3	Auger refusal - NFP												

ON MOT\_BH LOG 02-134.GPJ ON MOT.GDT 30/7/04



Numbers refer to Sensitivity

TBT Engineering		RECORD OF BOREHOLE No 5				1 OF 1		METRIC	
W.P. <b>70-97-00</b>		PROJECT <b>Lachapelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>JM</b>			
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 20+005 - 4.5m Lt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>			
DATE <b>5 August 2003</b>		BOREHOLE TYPE <b>Hollow Stem Auger - 100mm ID</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>			

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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 <sub>p</sub>	w		
453.3 0.0	FILL - sand, with gravel, trace silt, brown-grey, dry												
452.6 0.7	SAND and GRAVEL - with silt, brown, dense (till)		1	SS	34								
451.5 1.8	End of hole at 1.8 m Auger refusal @ 1.5 m on rock fill/fractured bedrock		2 3	SS SS	37 100								

ON MOT. BH LOG 02-134.GPJ ON MOT.GDT 307/04

x<sup>3</sup>, \*<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

TBT Engineering		RECORD OF BOREHOLE No 6				1 OF 1		METRIC					
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>JM</b>							
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+965 - 4.5m Lt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>							
DATE <b>5 August 2003</b>		BOREHOLE TYPE <b>Hollow Stem Auger - 100mm ID</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
451.7 0.0	FILL - sand & gravel, trace silt												Granular fill - shoulder of hwy  11 60 (30)
451.1 0.6	SAND - silty, with gravel, brown		1	SS	35								
450.5 1.2	Auger refusal @ 1.2 m on rock fragments End of hole at 1.85 m		2	SS	100								

ON MOT\_BH LOG 02-134.GPJ ON MOT.GDT 30/7/04






TBT Engineering		RECORD OF BOREHOLE No 7				1 OF 1		METRIC					
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>JM</b>							
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+885 - 4.5m Lt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>							
DATE <b>5 August 2003</b>		BOREHOLE TYPE <b>Hollow Stem Auger - 100mm ID</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
449.8 0.0	FILL - sand & gravel, trace silt												Granular fill - shoulder of hwy 3 70 (27)  Rock fragments in SS tip
449.1 0.8	FILL - sand, gravelly, with silt, numerous cobbles & boulders (angular), brown, dry Gravel/Cobble fraction increases with depth grey-brown, Wet Auger refusal at 1.5m (cobbles)		1	SS	10								
			2	SS	24								
			3	SS	34								
447.5 2.3	End of hole at 2.3 m												

ON MOT BH LOG 02-134.GPJ ON MOT.GDT 30/7/04



TBT Engineering		RECORD OF BOREHOLE No 8				1 OF 1		METRIC	
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>JM</b>			
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+850 - 4.5m Lt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>			
DATE <b>5 August 2003</b>		BOREHOLE TYPE <b>Hollow Stem Auger - 100mm ID</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>			

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80			100
450.2 0.0	FILL - sand & gravel, trace silt													
449.5 0.8	SAND - silty, with gravel, brown, compact		1	SS	15									
448.7 1.5	Auger refusal at 1.5 m		2	SS	100									
	End of hole at 1.5 m													

ON MOT\_BH LOG 02-134.GPJ ON MOT.GDT 30/7/04

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

$\bigcirc$  3% STRAIN AT FAILURE

TBT Engineering		RECORD OF BOREHOLE No 9				1 OF 2		METRIC	
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>JM</b>			
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+913 - 4.5m Lt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>			
DATE <b>25 August 2003</b>		BOREHOLE TYPE <b>Hollow Stem Auger - 100mm ID</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	W <sub>p</sub>	W	W <sub>L</sub>			
449.8 0.0	FILL - sand and gravel, with silt, brown, compact												Water well rig used to advance BH.	
449.0 0.8	FILL - sand and gravel, with silt, occasional cobble, brown, dry, compact													
	sandy, numerous cobbles and boulders (rock fill), compact to dense													200mm casing installed to 8m below grade.
442.8 7.0	Gravel - sandy, numerous cobbles, occasional boulder, wet, compact to very dense (till)												N casing from 8m	
440.5 9.3	BEDROCK - Granite, coarse grained, pink, closely spaced joints												N size drill core used to advance BH.  RQD = 10%	

Continued Next Page

$\times^3, \star^3$ : Numbers refer to Sensitivity     
  $\bigcirc^3$ : STRAIN AT FAILURE

ON MOTI BH LOG 02-134.GPJ ON MOT GDT 307/04

<b>TBT Engineering</b>		<b>RECORD OF BOREHOLE No 9</b>		2 OF 2		<b>METRIC</b>	
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>JM</b>	
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+913 - 4.5m Lt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>	
DATE <b>25 August 2003</b>		BOREHOLE TYPE <b>Hollow Stem Auger - 100mm ID</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
			5	RC											RQD = 0		
			6	RC											RQD = 12%		
			7	RC											RQD = 0		
			8	RC											RQD = 50%		
			9	RC											RQD = 56%		
432.8 17.0																	

ON MOT\_BH LOG 02-134.GPJ ON MOT.GDT 30/7/04



[illegible]



TBT Engineering		RECORD OF TESTPIT No TP02				1 OF 1		METRIC					
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>SP</b>							
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+990 - 18.0m Rt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>							
DATE <b>18 September 2003</b>		BOREHOLE TYPE <b>Caterpillar 219 LC Trackhoe</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>							
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
451.2 450.9 0.1	TOPSOIL - rootlets, organics (100 mm) FILL - sand, gravelly, silty, numerous cobbles, dry, brown		1	BS									26 42 (22)
450.2 1.0	GRAVEL - sandy, with silt, numerous cobbles, occ. boulder, grey/brown, moist (till)												
449.4 1.8	End of hole at 1.8 m, backhoe refusal on bedrock Bedrock - Granite, pink, surface fractured												

TBT Engineering		RECORD OF TESTPIT No TP03				1 OF 1		METRIC					
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>				SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>SP</b>					
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+988 - 5.0m Rt. Dist. Thunder Bay</b>				TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>					
DATE <b>18 September 2003</b>		BOREHOLE TYPE <b>Caterpillar 219 LC Trackhoe</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>					
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)			
453.2 0.0	FILL - sand and gravel, with silt, brown, dry, compact						20 40 60 80 100	20 40 60				Upper 300 mm of fill contained crushed aggregate.  Excavation starting at shoulder rounding	
452.4 0.8	FILL - sand, gravelly, with silt, numerous cobbles & boulders (angular), brown, dry						20 40 60 80 100	20 40 60					
451													
450.5 2.7	End of hole at 2.7 m												

ON MOT TESTPIT 02-134.GPJ ON MOT.GDT 18/10/04



TBT Engineering

RECORD OF TESTPIT No TP04

1 OF 1

METRIC

W.P. **70-97-00** PROJECT **Lachappelle Creek Culvert Replacement** SITE NO. **SITE 48C-224C** ORIGINATED BY **SP**  
 DIST **103** HWY **527** LOCATION **Sta 19+961 - 11.0m Lt. Dist. Thunder Bay** TBTE JOB# **J02-134** COMPILED BY **SP**  
 DATE **18 September 2003** BOREHOLE TYPE **Caterpillar 219 LC Trackhoe** DATUM **Geodetic** CHECKED BY **WH**

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
450.6														
450.1	TOPSOIL - rootlets, organics													
450.1	FILL - sand & gravel, with silt, numerous cobbles, occ.													
450.1	boulder, brown, dry, compact													
0.5	GRAVEL - sandy, with silt, fractured bedrock pieces (till)						450							
449.8														
0.8	End of Hole at 0.8 m, backhoe refusal on bedrock Bedrock - Granite, pink, surface fractured													

✕<sup>3</sup>, ★<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE





TBT Engineering

# RECORD OF TESTPIT No TP06

1 OF 1

METRIC

W.P. **70-97-00** PROJECT **Lachappelle Creek Culvert Replacement** SITE NO. **SITE 48C-224C** ORIGINATED BY **SP**  
 DIST **103** HWY **527** LOCATION **Sta 19+849 - 12.5m Lt. Dist. Thunder Bay** TBTE JOB# **J02-134** COMPILED BY **SP**  
 DATE **18 September 2003** BOREHOLE TYPE **Caterpillar 219 LC Trackhoe** DATUM **Geodetic** CHECKED BY **WH**

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
448.8	TOPSOIL - rootlets, organics GRAVEL & SAND - with silt, numerous cobbles & boulders, grey brown, dry, dense (till)													
448.0 0.1														
			1	BS										
446.6 2.2	End of hole at 2.2 m, backhoe refusal on bedrock													

TBT Engineering		RECORD OF TESTPIT No TP07				1 OF 1		METRIC			
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>SP</b>					
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+875 - 5.5m Lt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>					
DATE <b>18 September 2003</b>		BOREHOLE TYPE <b>Caterpillar 219 LC Trackhoe</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>					
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa	W <sub>p</sub> W W <sub>L</sub>		
449.8 0.0	FILL - sand and gravel, with silt, brown, compact										Excavation starting at shoulder rounding  Upper 300 mm of fill contained crushed aggregate.
449.0 0.8	FILL - sand, gravelly, with silt, numerous cobbles & boulders (angular), brown, dry						449				
							448				
							447				
446.8 3.0	End of hole at 3.0 m										

ON MOT TESTPIT 02-134.GPJ ON MOT.GDT 18/10/04



TBT Engineering

# RECORD OF TESTPIT No TP08

1 OF 1

METRIC

W.P. **70-97-00** PROJECT **Lachappelle Creek Culvert Replacement** SITE NO. **SITE 48C-224C** ORIGINATED BY **SP**  
 DIST **103** HWY **527** LOCATION **Sta 19+790 - 9.0m Lt. Dist. Thunder Bay** TBTE JOB# **J02-134** COMPILED BY **SP**  
 DATE **18 September 2003** BOREHOLE TYPE **Caterpillar 219 LC Trackhoe** DATUM **Geodetic** CHECKED BY **WH**

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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 <sub>p</sub> W W <sub>L</sub>	20 40 60			
451.6 450.0 0.1	TOPSOIL - rootlets, organics (100 mm) GRAVEL - sandy, with silt, numerous cobbles & boulders, grey.brown, dry, dense (till)						451							
450.7 0.9	End of hole at 0.9 m, backhoe refusal on bedrock Bedrock - Mafic Intrusive, med. grained, dark grey													


ON MOT TESTPIT 02-134.GPJ ON MOT GDT 18/10/04

TBT Engineering		<b>RECORD OF TESTPIT No TP09</b>		1 OF 1 <b>METRIC</b>	
W.P. <b>70-97-00</b>	PROJECT <b>Lachappelle Creek Culvert Replacement</b>	SITE NO. <b>SITE 48C-224C</b>	ORIGINATED BY <b>SP</b>		
DIST <b>103</b> HWY <b>527</b>	LOCATION <b>Sta 19+860 - 9.0m Rt. Dist. Thunder Bay</b>	TBTE JOB# <b>J02-134</b>	COMPILED BY <b>SP</b>		
DATE <b>18 September 2003</b>	BOREHOLE TYPE <b>Caterpillar 219 LC Trackhoe</b>	DATUM <b>Geodetic</b>	CHECKED BY <b>WH</b>		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
449.2														
449.0 0.1	TOPSOIL - rootlets, organics GRAVEL - sandy, with silt, numerous cobbles & boulders, grey.brown, dry, dense (till)						449							
448.0 1.2	End of hole at 1.2 m, backhoe refusal on bedrock Bedrock - Mafic Intrusive, med. grained, dark grey						448							

ON MOT TESTPIT 02-134.GPJ ON MOT.GDT 18/10/04



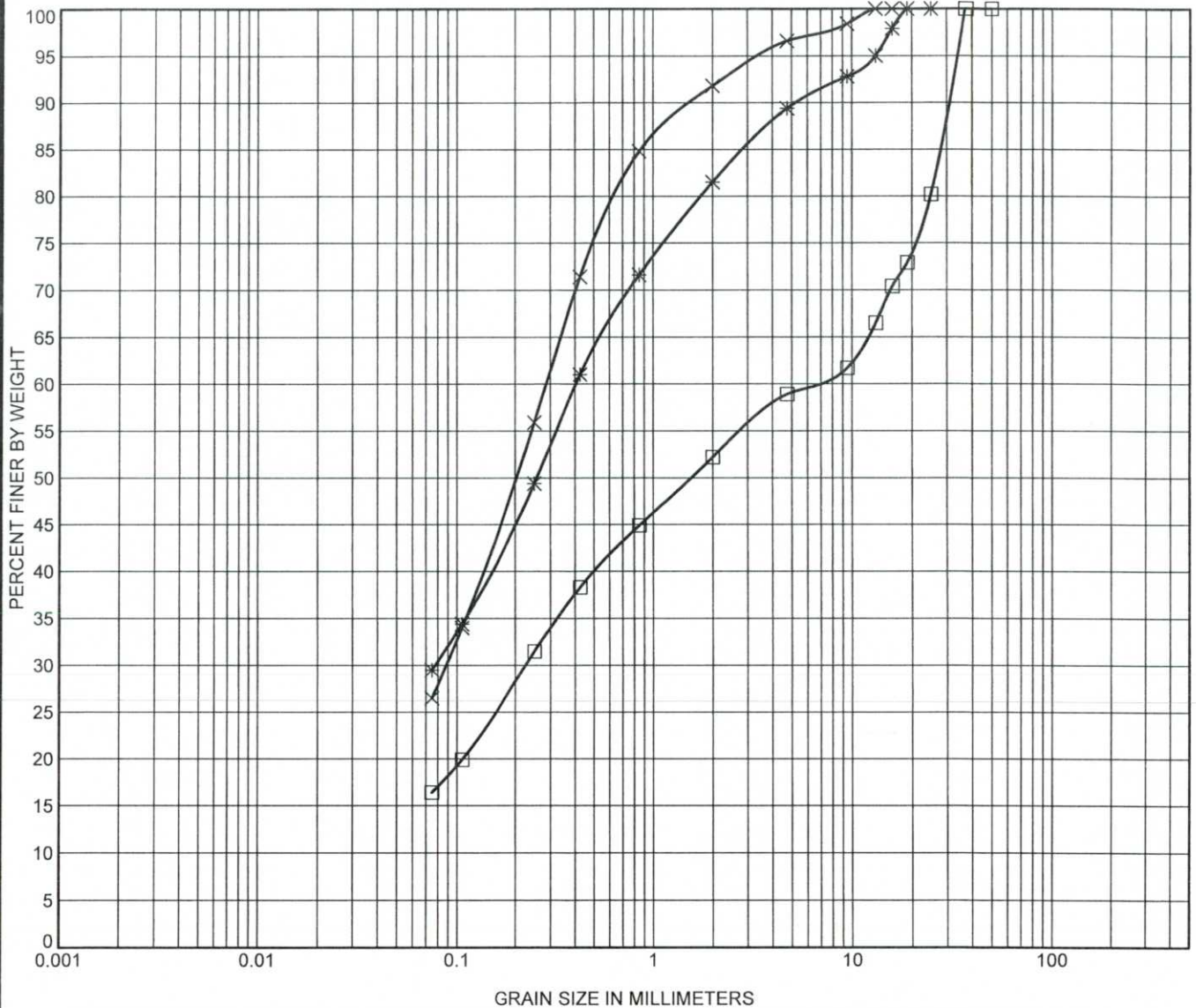
TBT Engineering		RECORD OF TESTPIT No TP10				1 OF 1		METRIC			
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>SP</b>					
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+914 - 18.0m Rt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>					
DATE <b>18 September 2003</b>		BOREHOLE TYPE <b>Caterpillar 219 LC Trackhoe</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>					
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED    × FIELD VANE ■ SPT (N)        ★ LAB VANE	W <sub>p</sub> W    W <sub>L</sub> WATER CONTENT (%)		
444.6 0.1	TOPSOIL - rootlets, organics (100 mm) FILL - sand, gravelly, with silt, brown, dry  Rock fill (angular), to 300 mm dia, little fines						444				Water table at 0.9 m below grade
441.8 2.8	SILT - sandy, traces gravel & clay, grey, wet, very dense (till)						443				
441.3 3.3	End of hole at 3.3 m, backhoe refusal on bedrock						442				

TBT Engineering		RECORD OF TESTPIT No TP11				1 OF 1		METRIC							
W.P. <b>70-97-00</b>		PROJECT <b>Lachappelle Creek Culvert Replacement</b>		SITE NO. <b>SITE 48C-224C</b>		ORIGINATED BY <b>SP</b>									
DIST <b>103</b> HWY <b>527</b>		LOCATION <b>Sta 19+893 - 6.0m Rt. Dist. Thunder Bay</b>		TBTE JOB# <b>J02-134</b>		COMPILED BY <b>SP</b>									
DATE <b>18 September 2003</b>		BOREHOLE TYPE <b>Caterpillar 219 LC Trackhoe</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>WH</b>									
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
449.8 0.0	FILL - sand and gravel, with silt, dry, brown, compact														Upper 300 mm of fill contained crushed aggregate.   22 29 (12)  Excavation starting at shoulder rounding
449.0 0.8	FILL - sandy, gravelly, with silt, numerous cobbles & boulders (angular), max dia. 300 mm														
			1	BS											
446.8 3.0	End of hole at 3.0 m														

ON MOT TESTPIT 02-134.GPJ ON MOT.GDT 18/10/04

## **APPENDIX B**

### **Laboratory Test Data**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Material:

**FILL**

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 5	1.50	50	6.237	0.224		41.1	42.5	16.4	
* 6	1.05	25	0.406	0.078		10.6	59.9	29.5	
× 7	0.75	16	0.288	0.088		3.4	70.1	26.5	



**TBT Engineering**  
Suite 314-101 Syndicate Ave. N  
Thunder Bay, ON P7C 3V4  
Telephone: (807) 624-5160  
Fax: (807) 624-5161

## GRAIN SIZE DISTRIBUTION

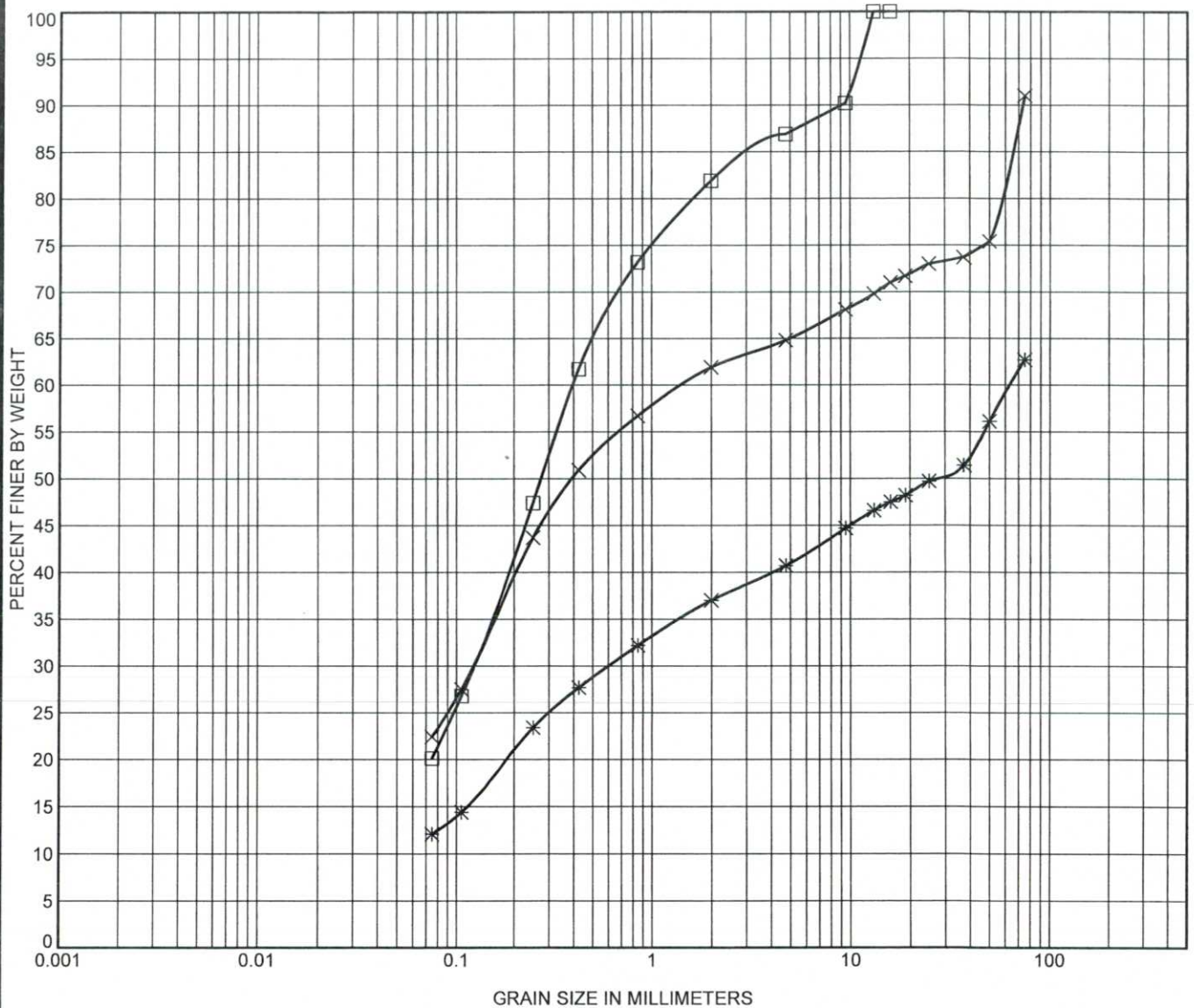
Project: Hwy 527 - Culvert Replacement

Location: 527

Number: 70-97-00

**FIGURE 1**





SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Material:  
FILL

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 8	0.75	16	0.399	0.121		13.1	66.8	20.1	
* TP11	1.50	75	63.537	0.606		22.0	28.6	12.1	
× TP2	0.60	75	1.463	0.121		26.2	42.4	22.4	

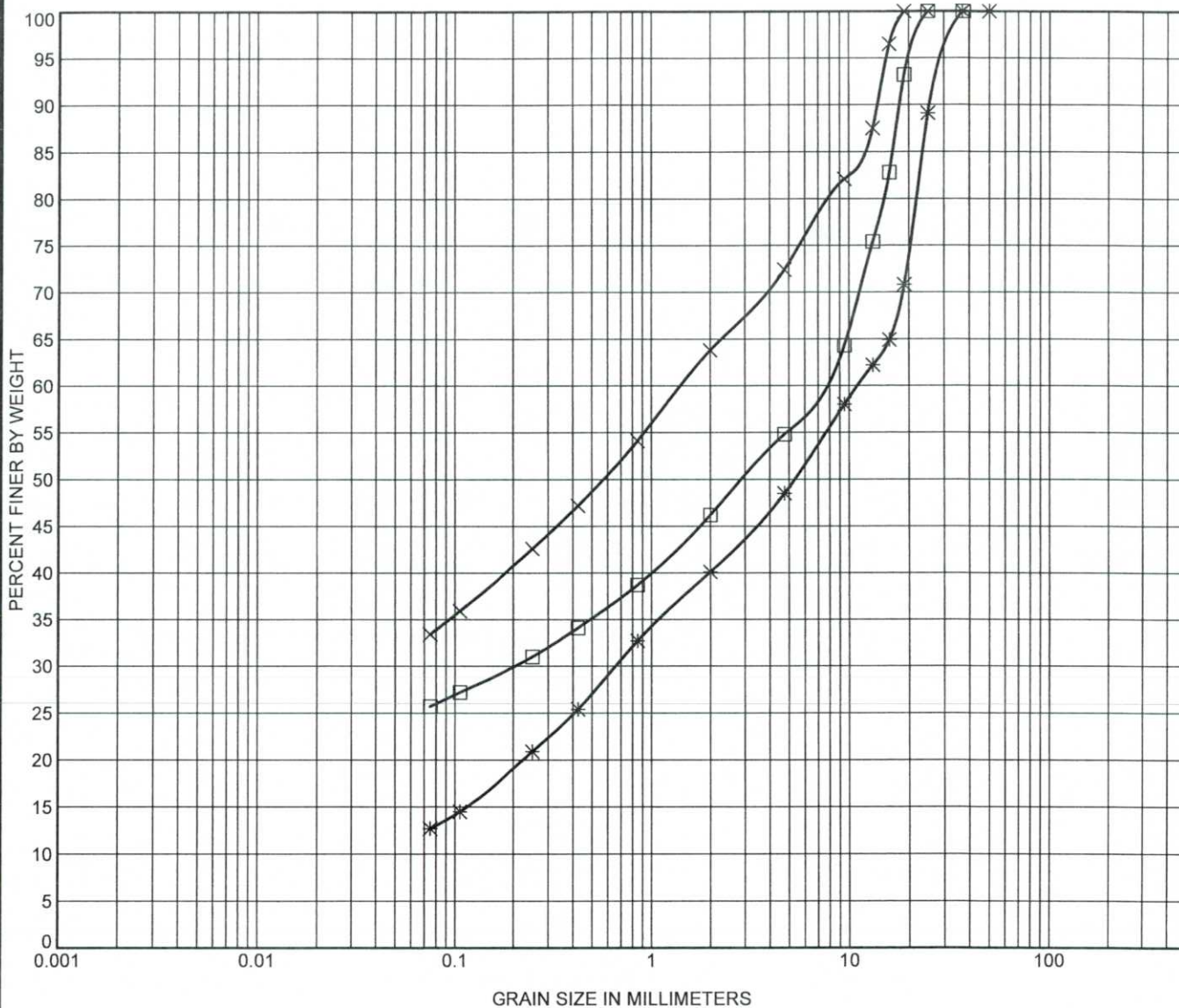


**TBT Engineering**  
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Telephone: (807) 624-5160  
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## GRAIN SIZE DISTRIBUTION

Project: Hwy 527 - Culvert Replacement  
Location: 527  
Number: 70-97-00

FIGURE 2



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Material:

**Sand and Gravel (till)**

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1	2.00	37.5	6.942	0.199		45.2	29.1	25.7	
* 1	3.00	50	11.111	0.658		51.5	35.8	12.7	
x 2	3.00	25	1.43			27.6	39.0	33.4	



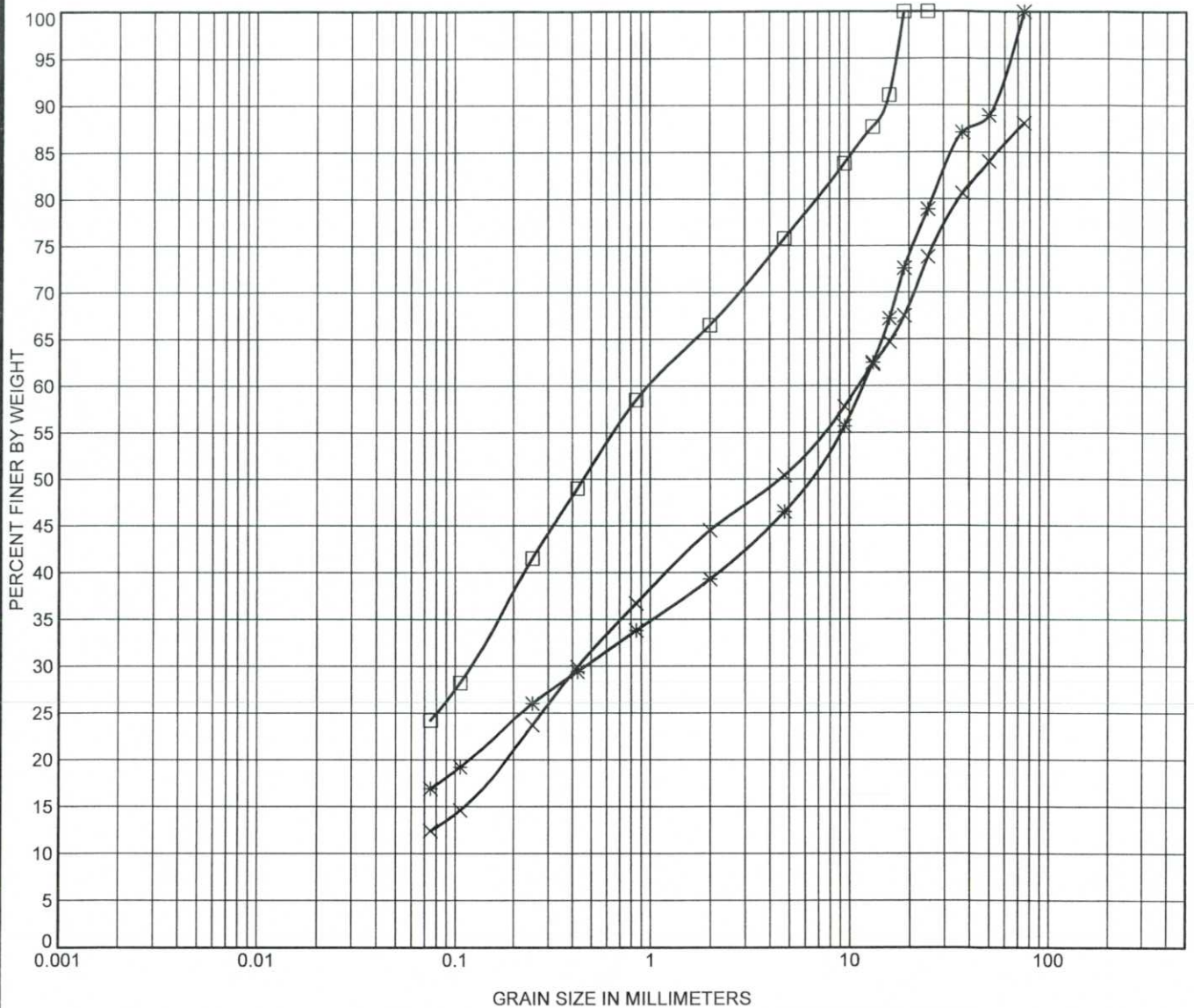
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Fax: (807) 624-5161

## GRAIN SIZE DISTRIBUTION

Project: Hwy 527 - Culvert Replacement  
Location: 527  
Number: 70-97-00

**FIGURE 3**





SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Material:

**Sand and Gravel (till)**

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 4	0.60	25	0.998	0.119		24.2	51.6	24.2	
* TP1	3.60	75	11.696	0.467		53.5	29.6	16.9	
X TP6	1.20	75	11.157	0.429		37.7	38.0	12.4	



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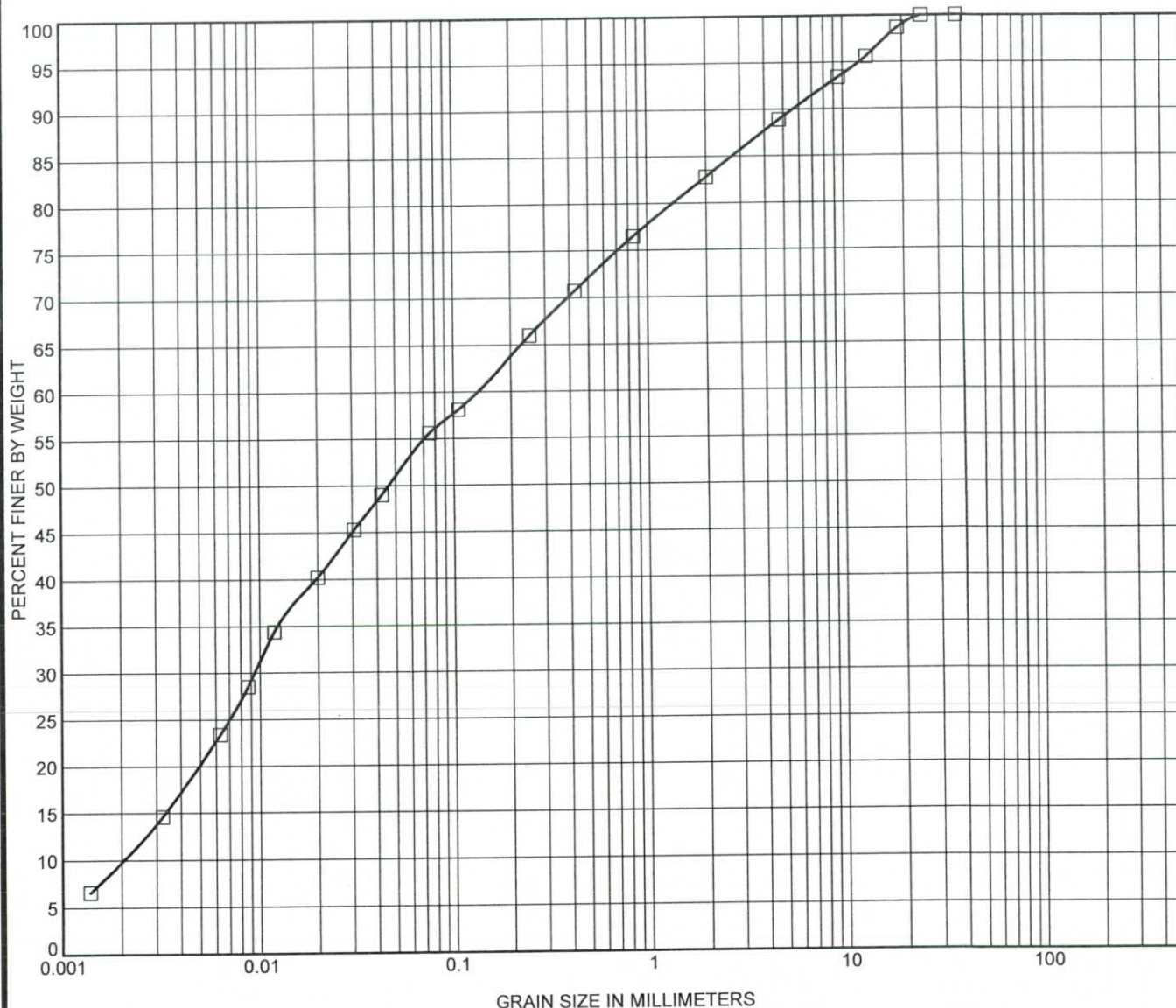
## GRAIN SIZE DISTRIBUTION

Project: Hwy 527 - Culvert Replacement

Location: 527

Number: 70-97-00

**FIGURE 4**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Material:  
Silt (till)

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
TP5	1.30	37.5	0.13	0.009	0.002	11.1	33.3	45.5	10.1



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## GRAIN SIZE DISTRIBUTION

Project: Hwy 527 - Culvert Replacement  
Location: 527  
Number: 70-97-00

FIGURE 5



## **APPENDIX C**

### **Photographs**



**Photo: South side of Culvert**



**Photo: Exposed Boulders South West of Culvert**



**MINISTRY OF TRANSPORTATION - NORTHWEST REGION**  
**LaChappelle Creek Culvert Replacement - Site No.: 48C-224C**

**TBT ENGINEERING**

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 Agreement No.: 6005-A-000171





**Photo: Test Pit 5**

**Rock Fill over Silt**



**Photo: Test Pit 7**

**Embankment Fill**



**MINISTRY OF TRANSPORTATION - NORTHWEST REGION**  
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Photos: Test Pit 10

(both photos)



MINISTRY OF TRANSPORTATION - NORTHWEST REGION  
LaChappelle Creek Culvert Replacement - Site No.: 48C-224C

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## **APPENDIX D**

### **DRAWINGS**