



**FOUNDATION INVESTIGATION REPORT
SITCH CREEK CULVERT # 3 REPLACEMENT
HIGHWAY 595
TOWNSHIP OF GILLIES, THUNDER BAY DISTRICT
AGREEMENT NO.: 6013-E-0021
ASSIGNMENT NO.: 4
SITE NO.: 48W-201/C
GEOCRES NO. 52A-191
GWP 6351-14-00**

**JANUARY 8, 2015
GS-TB-019502**

PREPARED FOR:
Ministry of Transportation
Geotechnical Section
Northwestern Region Office
615 South James Street
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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

DST Consulting Engineers Inc. (DST) has been retained by the Ministry of Transportation (MTO), Geotechnical Section, Northwestern Region to conduct a foundation investigation for the proposed culvert replacement on Highway 595. This work was carried out under Agreement No.: 6013-E-0021, Geotechnical Retainer, Assignment No. 4.

This report addresses the field investigation, laboratory test program, factual report on soils conditions at the culvert location.

2. SITE DESCRIPTION

The site is located on Highway 595, approximately 1.08 km North of Highway 588 (latitude 48.3044, longitude -89.7014), LHRS 62920, offset 1.080, Station 11+126, in the Township of Gillies, in the District of Thunder Bay.

It is understood that the existing 35.0 m long centreline culvert is a Structural Plate Corrugated Steel Pipe (SPCSP) approximately 4.88 m diameter. The existing culvert (Figure 2.3 and 2.4) was originally built in 1975 and inspection by others indicates there is light to moderate corrosion at the water level and the concrete cut off wall at the inlet has light to moderate corrosion, and moderate scaling. The fill thickness above the culvert is approximately 1.5 m and the side slope of the embankment is approximately 2H:1V. The surrounding area is moderately vegetated and wooded (Figure 2.1 and 2.2). Photographs were taken by others (Figures 2.1 to 2.4).

Geological information is available from published *Ontario Geological Survey Map #52ASW* by the *Ontario Ministry of Natural Resources* for the Gillies area. The map indicates that the local area landform is identified as a silty alluvial plain. The topography in the area is mainly low local relief; plain with wet drainage conditions.



Figure 2.1 Location of existing culvert at Highway 595 (looking North)



Figure 2.2 Location of existing culvert at Highway 595 (looking South)



Figure 2.3 Culvert inlet (looking East)



Figure 2.4 Culvert outlet (looking West)

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out on August 22nd and 25th, and September 8th, 2014 utilizing a CME 750 drill rig equipped for geotechnical drilling and operated by DST. A total of four boreholes were advanced to depths ranging from 1.5 m to 12.3 m. The minimum number and depth of the boreholes was specified by the Ministry of Transportation (MTO).

The borehole locations and stratigraphic sections are shown on the Borehole Location Plan and Drawings 2 to 3. Borehole 1 was advanced North of the existing culvert at Station 11+131, 4.0 m right of centreline, and advanced to a depth of 7.6 m below existing surface. Borehole 2 was advanced South of the existing culvert at Station 11+119, 1.7 m left of centreline, and advanced to a depth of 12.3 m below existing surface. The remaining two boreholes were advanced with portable hand equipment at the inlet and outlet of the existing culvert. Borehole 3 was advanced at the inlet at Station 11+124, 16.0 m right of centreline, and advanced to a depth of 1.5 m below existing surface. Borehole 4 was advanced at the outlet at Station 11+128, 13.0 m left of centreline, and advanced to a depth of 3.1 m below surface.

The borehole locations are referenced to the MTO Station numbering system as indicated on the drawings provided by the Ministry. The ground surface elevations at the borehole locations were surveyed by DST personnel and referenced to the existing culvert at Station 11+126. A nail in a utility pole on the Southeast side of the culvert at station 11+122, 12.0 m right was assigned as temporary benchmark with elevation of 100.0 m. Table 3.1 summarizes the detail of borehole locations and depths.

All boreholes were abandoned using suitable abandonment barrier as described in Ontario Regulation 903 and its amendments. Boreholes were decommissioned by backfilling to the bottom of the road base with cuttings and bentonite chips. From the bottom of the road base, granular materials were replaced to the bottom of the asphalt and the asphalt was sealed with a cold patch.

The fieldwork was supervised on a full-time basis by DST personnel who located the boreholes in the field, performed sampling, in-situ testing and logged the boreholes. Soil samples were obtained from the auger flights and from the split spoon sampler used for the standard penetration test (SPT). The SPT involves driving a 51 mm diameter thick-walled sampler into the soil under the energy of a 63.5 kg weight falling through 760 mm. The number of blows required to drive the sampler 305 mm is known as the standard penetration blow count (N) which provides an

indication of the condition or consistency of the soil. The soil samples collected during drilling were identified in the field, placed in labelled containers and transported to DST's laboratory in Thunder Bay for further analyses.

Classification and index tests were subsequently performed in the laboratory on samples collected from the boreholes to aid in the selection of engineering properties. Laboratory tests included moisture contents, particle size analyses and Atterberg limits including plastic limit and liquid limit. A total of twenty nine (29) moisture contents, ten (10) sieve analyses, two (2) particle size analyses and three (3) Atterberg limits have been carried out for this assignment. Laboratory test results are presented in the Boreholes Logs and graphical plots attached Appendix D (Enclosures).

Table 3.1 Detail of borehole locations

Borehole ID	Station	Elevation (m)	Depth (m)	Offset (m)
BH1	11+131	102.0	7.6	4.0 Rt
BH2	11+119	101.9	12.3	1.7 Lt
BH3	11+124	97.9	1.2	16.0 Rt
BH4	11+128	97.2	3.1	13.0 Lt

4. DESCRIPTION OF SUBSURFACE CONDITIONS

The subsurface conditions are presented based on the information obtained during power auger drilling and hand auger drilling.

The generalized stratigraphy of the existing embankment, based on the conditions encountered in Boreholes 1 and 2, consists of asphalt surface treatment overlying a granular sand fill which is underlain by a silt layer followed by a till layer.

Table 4.1 Summary of soil strata at the culvert location

Layer	Depth (m)	Elevation (m)	Comments
Asphalt	0.05	101.9 to 101.8	
Fill-Sand Fill-sand and Crushed gravel	0.0 to 6.2 0.05 to 3.8	102.0 to 95.8 101.9 to 98.1	
Silt	3.8 to 7.6	98.1 to 94.3	
Till	6.8 to 7.6 7.6 to 12.3	95.2 to 94.4 94.3 to 89.0	

4.1 Asphalt

Asphalt surface treatment was encountered at surface in Boreholes 2 with thickness of 50 mm.

4.2 Topsoil

Topsoil was encountered at surface in Borehole 3 and 4 with a thickness of approximately 0.1 m.

4.3 Fill – Sand and Crushed Gravel

Sand fill and crushed gravel, trace silt was encountered in Boreholes 2 below the asphalt with a thickness of 0.2 m at depths between 0.05 to 0.2 m (Elev. 101.9 to 101.7 m). The moisture contents of samples tested range found to be 3 %.

4.4 Fill – Sand

Sand fill with some gravel to gravelly, trace to some silt, and cobbles was encountered in the Boreholes 1 and 2 at depths of 0.0 m and 0.2 m with a thickness of approximately 6.2 m

(Elev. 102.0 to 95.8 m) and 3.6 m (Elev. 101.7 to 98.1 m) respectively.

SPT 'N' values vary from 8 to 42, indicating a loose to dense condition. The moisture contents of the sand material vary from 4 to 9 %. The laboratory test results are summarized in Table 4.2.

Table 4.2 Summary of Sieve Analysis- Sand fill

Laboratory Results – Sieve Analysis	
Gravel %	15 to 43
Sand %	50 to 74
Fines %	7 to 14

4.5 Concrete

Concrete was encountered in Borehole 1 at depth of 6.2 m (Elev. 95.8 m) with thickness of 0.6 m (Elev. 95.8 to 95.2 m).

4.6 Silt

Silt with some sand to sandy, trace to some clay, trace gravel was encountered in Boreholes 2, 3 and 4 at a depths of 3.8 m (Elev. 98.1 m), 0.1 m (Elev. 97.8 m) and 0.1 m (Elev. 97.1 m) with thickness of 3.8 m, 0.5 m and 2.2 m respectively.

Atterberg limits tests carried out on samples from Boreholes 2, and 4 indicate that low to medium plastic silts. The moisture content of the silt ranges from 12 to 24 %. SPT 'N' values for silt range between 1 and 17 indicating very soft to very stiff consistency. The laboratory test results are summarized in following Tables 4.3

Table 4.3 Summary of Atterberg limits- silt

Laboratory Results – Atterberg Limits	
Liquid Limit %	20 to 44
Plastic Limit %	16 to 34
Plastic Index %	4 to 10

4.7 Clay

Silty clay with some gravel, cobbles was encountered in Borehole 3 at depth of 0.6 m (Elev. 97.3 m) with thickness of 0.6 m. The moisture content of the tested sample was found to be 20%.

4.8 Till

Till material with sand, gravel, some silt and trace clay was encountered in Borehole 1, 2, 3 and 4 at depth of 6.8 m (Elev. 95.2 m), 7.6 m (Elev. 94.3 m), 1.2 m (Elev. 96.7 m) and 2.3 m (Elev. 94.9 m) respectively. The thickness of this stratum is not defined as borehole terminus was reached within this stratum due to auger refusal on possible cobbles/boulders or bedrock.

SPT 'N' values vary from 17 to more than 100, indicating a compact to very dense condition. The moisture contents of the sand material vary from 14 to 18 %. The laboratory test results are summarized in Table 4.4.

Table 4.4 Summary of Sieve Analysis- Till

Laboratory Results – Sieve Analysis	
Gravel %	10 to 50
Sand %	35 to 66
Fines %	12 to 41

4.9 Auger refusal

Auger Refusal was encountered on possible bedrock or cobbles and boulders in Borehole 1, 2, 3 and 4 at depth of 7.6 m (Elev. 94.4 m), 12.3 m (Elev. 89.6 m), 1.5 m (Elev. 96.4 m) and 3.1 m (Elev. 94.1 m) respectively.

4.10 Groundwater

At the time of the field investigation groundwater was observed in Borehole 2 at depth of 6.2 m (Elev. 95.7 m). The groundwater levels can be expected to vary with the season and precipitation events.

Table 4.5 Groundwater Depths

Borehole	Groundwater Depth	Groundwater Elev.
Borehole 2	6.2	95.7

5. MISCELLANEOUS

Site work was carried out during the week of August 22nd, and 25th, 2014 utilizing a CME 750 all-terrain drill rig operated by DST personnel and the week of September 8th, 2014 utilizing a tripod. Fieldwork was supervised on a full time basis by Peter Raynak who located the boreholes in the field, performed sampling, in-situ testing and logged the boreholes. Soil samples collected during drilling were identified in the field, placed in labelled containers and transported to DST's laboratory in Thunder Bay for further analysis. Interpretation of the data and preparation of the report was completed by Deep Bansal, P.Eng and reviewed by Prof. Myint Win Bo, P.Eng a designated principal contact for MTO projects.

6. LIMITATIONS OF REPORT

A description of limitations which are inherent in carrying out site investigation studies is given in Appendix 'A', and this forms an integral part of this report.

For DST CONSULTING ENGINEERS INC.

Prepared by:

Reviewed by:



Deep Bansal, P. Eng
Geotechnical Engineer

A handwritten signature in blue ink, appearing to read "B. Villegas".

Bernardo Villegas, M.Sc
Manager

Reviewed By:



Dr. M W Bo, PhD., P. Eng, P.Geo, Int PE,
C.Geol, C. Eng, Eur Geol, Eur Eng
Senior Vice President / Senior Principal

APPENDIX 'A'
LIMITATIONS OF REPORT

LIMITATIONS OF REPORT

GEOTECHNICAL STUDIES

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that DST Consulting Engineers be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

Appendix B

DESCRIPTION OF TERMS

EXPLANATION OF TERMS USED IN REPORT

SPT 'N' VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE OF THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51 mm O.D. SPLIT BARREL SAMPLES TO PENETRATE 0.3 m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5 kg, FALLING FREELY A DISTANCE OF 0.76 m. FOR PENETRATION OF LESS THAN 0.3 m 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 (DCPT): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51 mm 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 0.3 m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

TEXTURAL CLASSIFICATION OF SOILS

BOULDERS	COBBLES	GRAVEL	SAND	SILT	CLAY
GREATER THAN 200 mm	75 TO 200 mm	4.75 TO 75 mm	0.075 TO 4.75 mm	0.002 TO 0.075 mm	LESS THAN 0.002 mm

COARSE GRAIN SOIL DESCRIPTION (50% GREATER THAN 0.075 mm)

TERMINOLOGY	TRACE OR OCCASIONAL	SOME	WITH	ADJECTIVE (e.g. SILTY OR SANDY)	AND (e.g. SAND AND SILT)
	LESS THAN 10%	10 TO 20%	20 TO 30%	30 TO 40%	40 TO 60%

CONSISTENCY*: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (C_u) AND SPT 'N' VALUES AS FOLLOWS

C_u (kPa)	0 – 12	12 – 25	25 – 50	50 - 100	100 - 200	> 200
N (BLOWS / 0.3 m)	<2	2 - 4	4 - 8	8 - 15	15 - 30	>30
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

N (BLOWS / 0.3 m)	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, 100 mm+ IN LENGTH EXPRESSED AS A PERCENTAGE 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

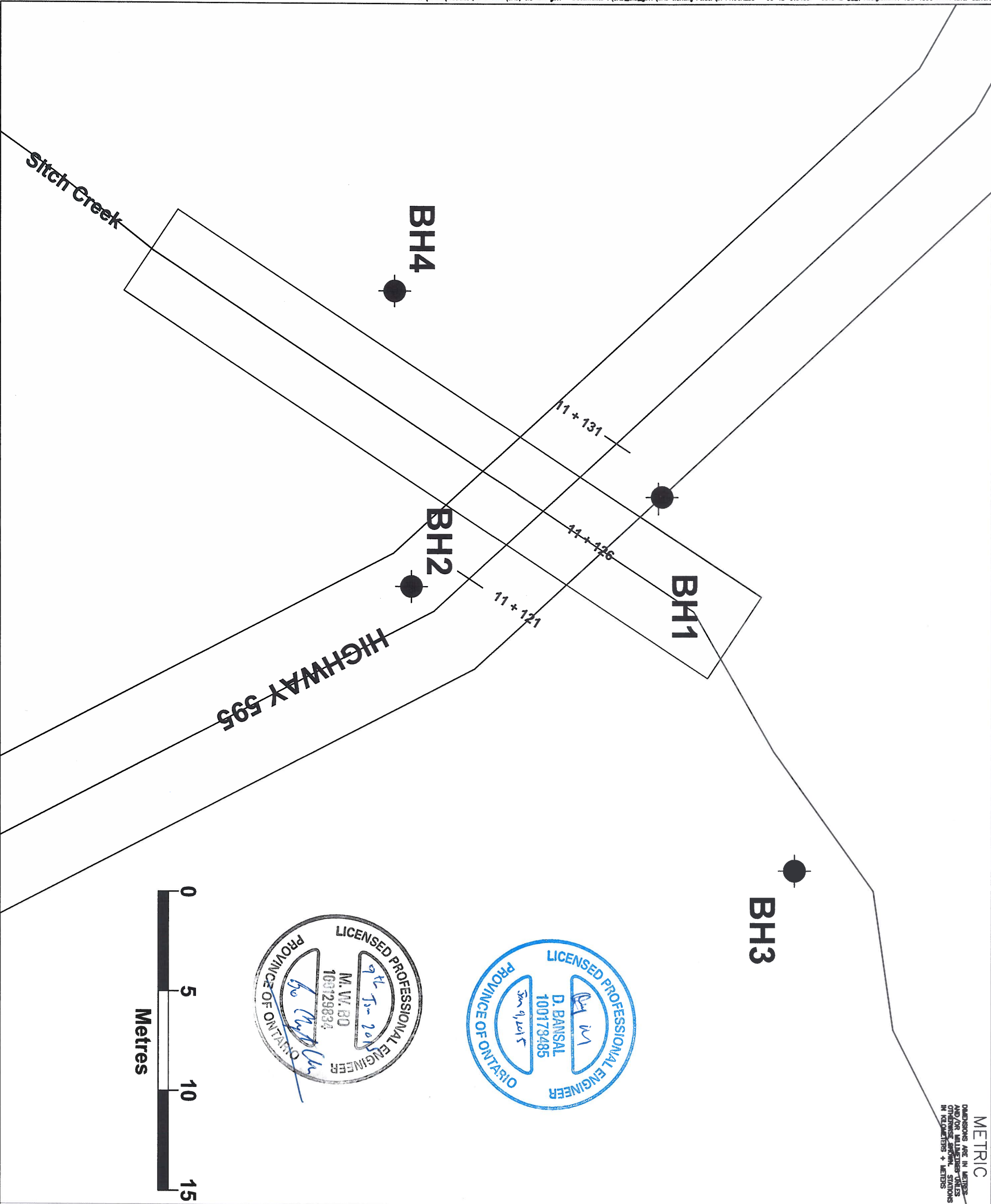
LEGEND OF RECORDS FOR BOREHOLES: SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE

SS	SPLIT SPOON SAMPLE	WS	WASH SAMPLE
TW	THIN WALL SHELBY TUBE SAMPLE	AS	AUGER (GRAB) SAMPLE
PH	SAMPLER ADVANCED BY HYDRAULIC PRESSURE	TP	THIN WALL PISTON SAMPLE
WH	SAMPLER ADVANCED BY SELF STATIC WEIGHT	PM	SAMPLER ADVANCED BY MANUAL PRESSURE
SC	SOIL CORE	RC	ROCK CORE
	WATER LEVEL	$SENSITIVITY = \frac{UNDISTURBED\ SHEAR\ STRENGTH}{REMOLDED\ SHEAR\ STRENGTH}$	

*HIERARCHY OF SOIL STRENGTH PREDICTION: **1)** LABORATORY TRIAXIAL TESTING. **2)** FIELD INSITU VANE TESTING. **3)** LABORATORY VANE TESTING. **4)** SPT VALUES. **5)** POCKET PENETROMETER.

Appendix C

DRAWINGS

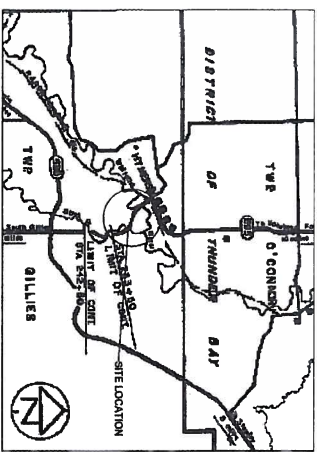


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETER UNITS
OTHERWISE SHOWN. STATIONS
IN METERS + METERS

CONT	No	
GWP	No 6351-14-00	
SITE	No 48W-201/C	
GEOCRES	No 52A-191	



CULVERT REPLACEMENT SITCH CREEK CULVERT STA 11+119 TO STA 11+131 Survey _____ Revised _____	SHEET
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KEY PLAN
1.0 km 0 1.0 km

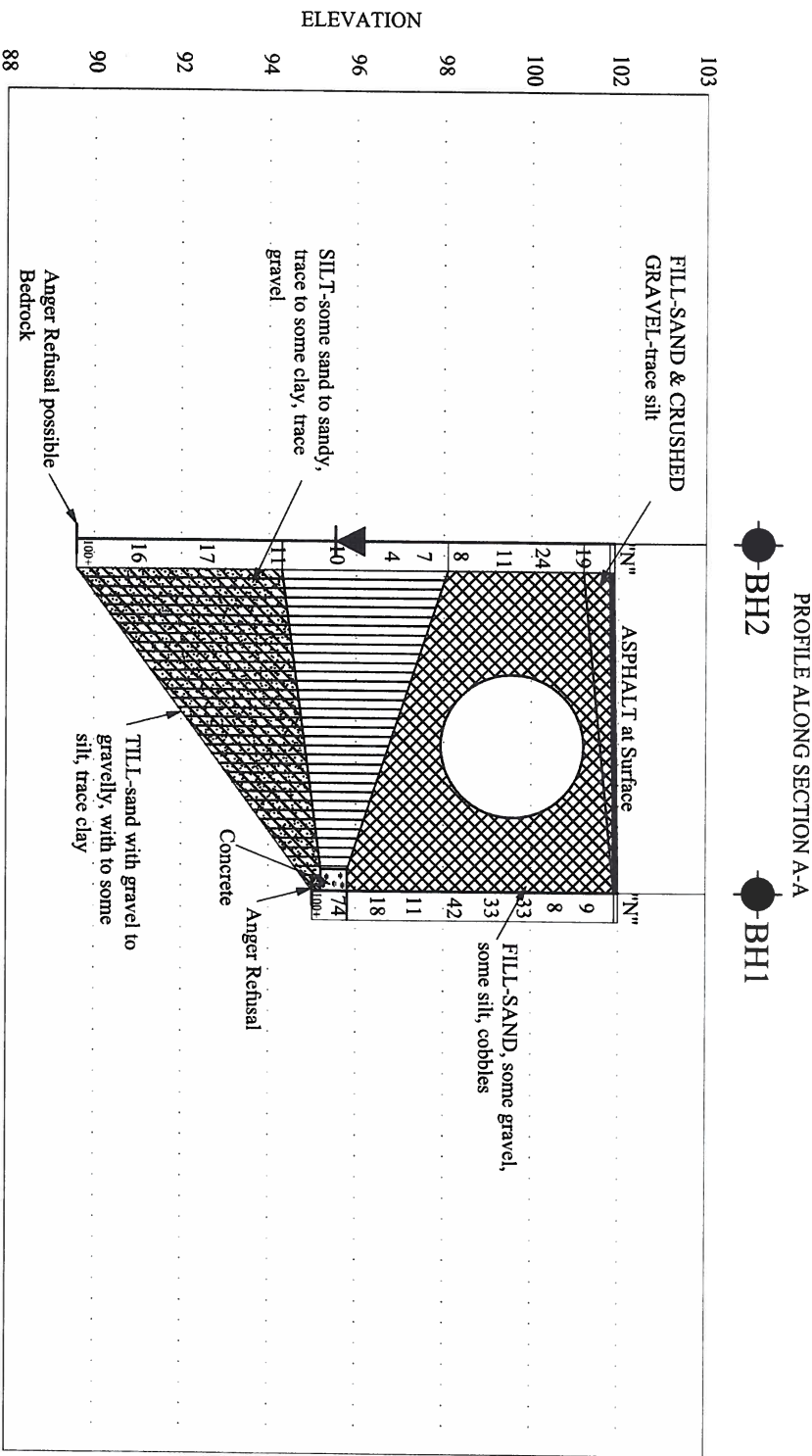
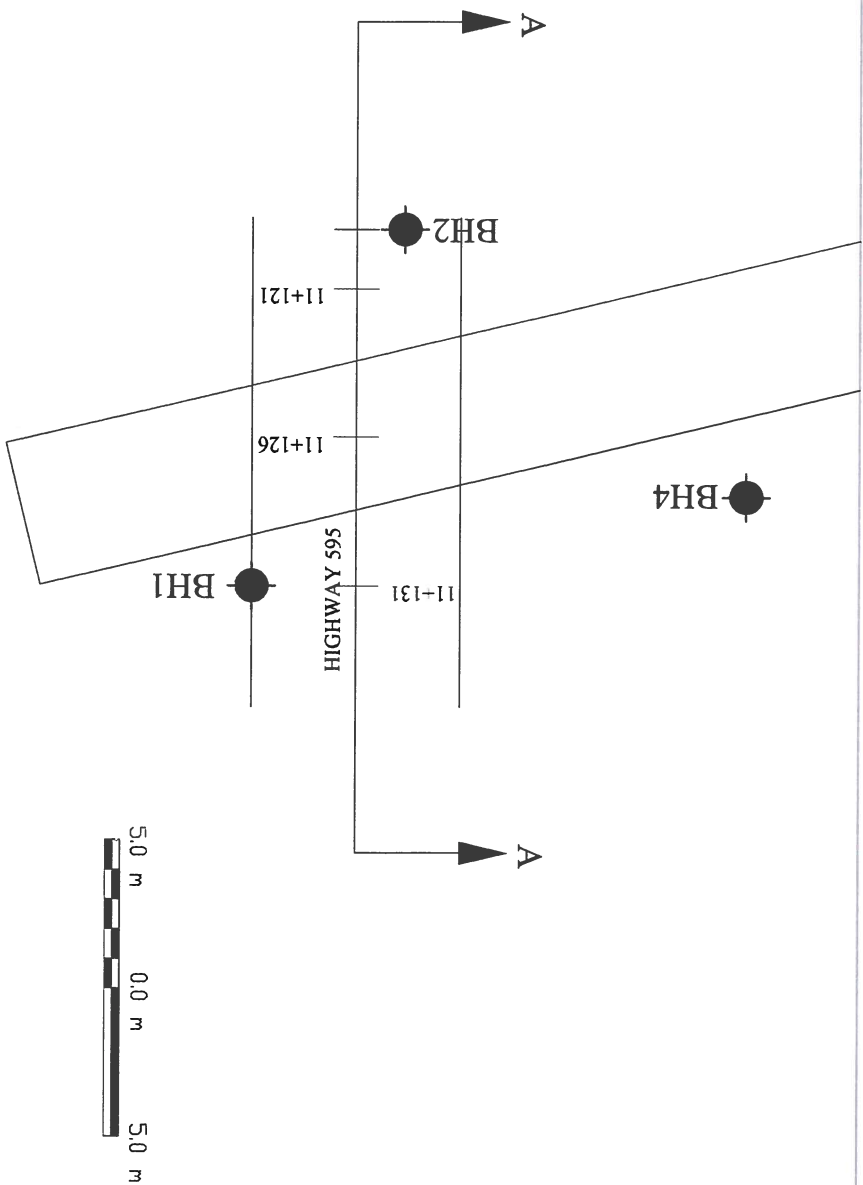
LEGEND

- Borehole
- ⊕ Borehole with CPT
- ⊙ Asphalt Core
- Rock Probe
- ⚡ Blows/0.3m (Std. Pen Test, 475 J/Blow)
- ⚡ Water level at time of investigation.
- ▨ Fill
- ▨ Organics
- ▨ Topsoil
- ▨ Till
- ▨ Bedrock
- ▨ Sand
- ▨ Silt
- ▨ Clay
- ▨ Sand & Gravel
- ▨ Boulders

No.	Elevation	Northing	Easting	Station	Offset
BH1	102.0	5353590 m N	298719 m E	11+131	4.0 m RT
BH2	101.8	5353582 m N	298719 m E	11+119	1.7 m LT
BH3	97.9	5353597 m N	298735 m E	11+124	16.0 m RT
BH4	97.2	5353577 m N	298706 m E	11+128	13.0 m LT

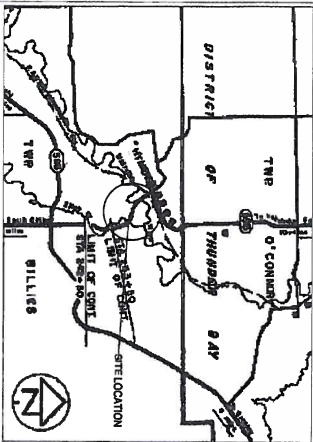
NOTE:
1. All boring locations and depths have been established by 11 borehole locations. Borehole locations are assumed by interpolation and may not represent actual conditions.

















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

CONT	No	
GWP	No 6351-14-00	
SITE	No 48W-201/C	
GEOGRES	No 52A-191	
CULVERT REPLACEMENT SITCH CREEK CULVERT		SHEET
STA 11+119 TO STA 11+131		
Survey	Revised	



LEGEND						
	Borehole					
	Borehole with CPT					
	Asphalt Core					
	Rock Probe					
	Blows/0.3m (Std. Pen Test, 475 J/Blow)					
	Water level at time of investigation.					
	Fill		Sand			
	Organics		Silt			
	Topsoil		Clay			
	Till		Sand & Gravel			
	Bedrock		Boulders			
No.	Elevation	Nothing	Easting	Station	Offset	
BH1	102.0	5353586 m N	289719 m E	11+131	4.0 m RT	
BH2	101.8	5353582 m N	289719 m E	11+119	1.7 m LT	
BH3	87.9	5353587 m N	289725 m E	11+124	16.0 m RT	
BH4	97.2	5353587 m N	289706 m E	11+128	13.0 m LT	

NOTE:
The boundaries between soil types have been established only at borehole
locations and may not represent actual conditions.
and may not represent actual conditions.

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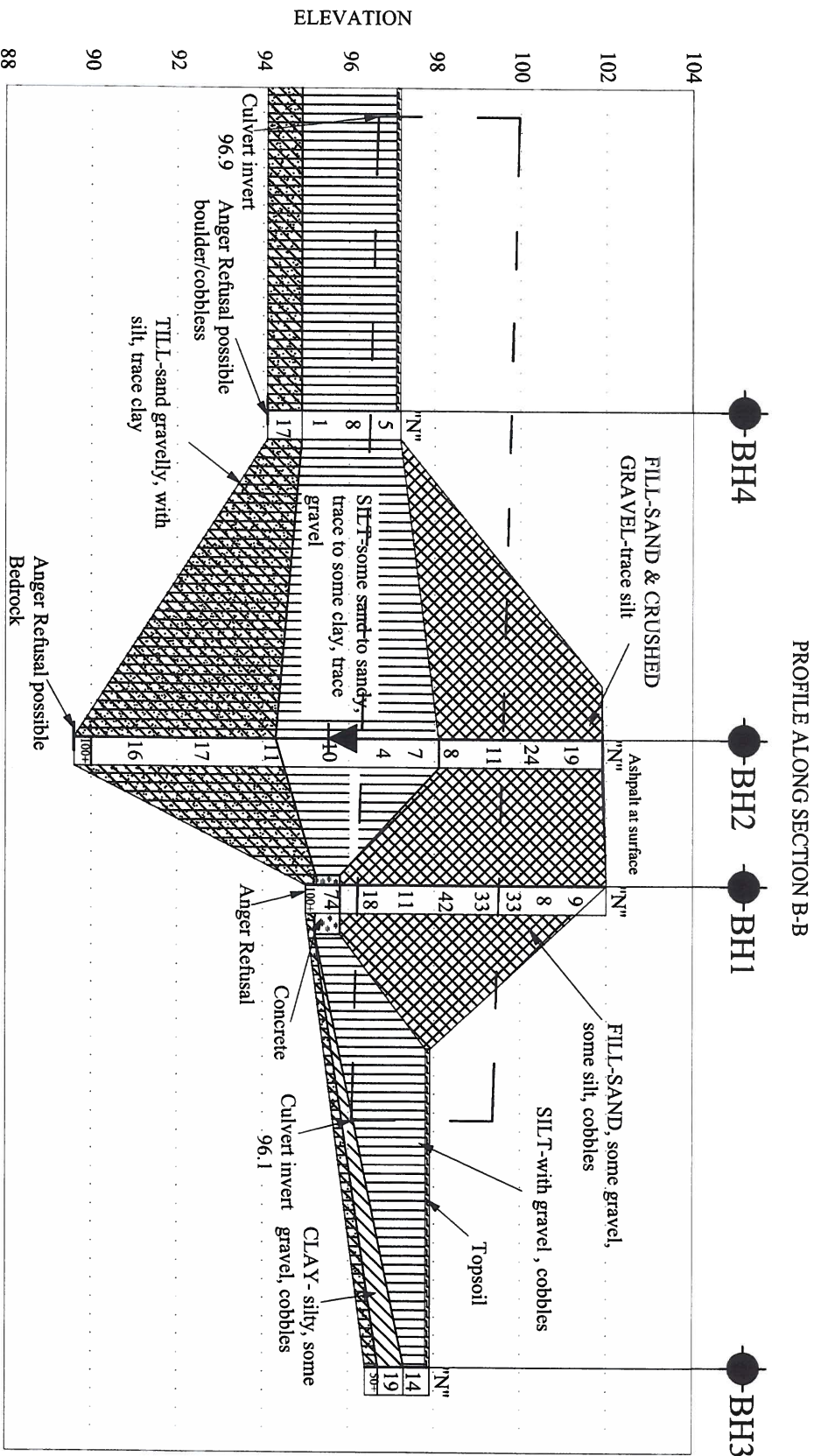
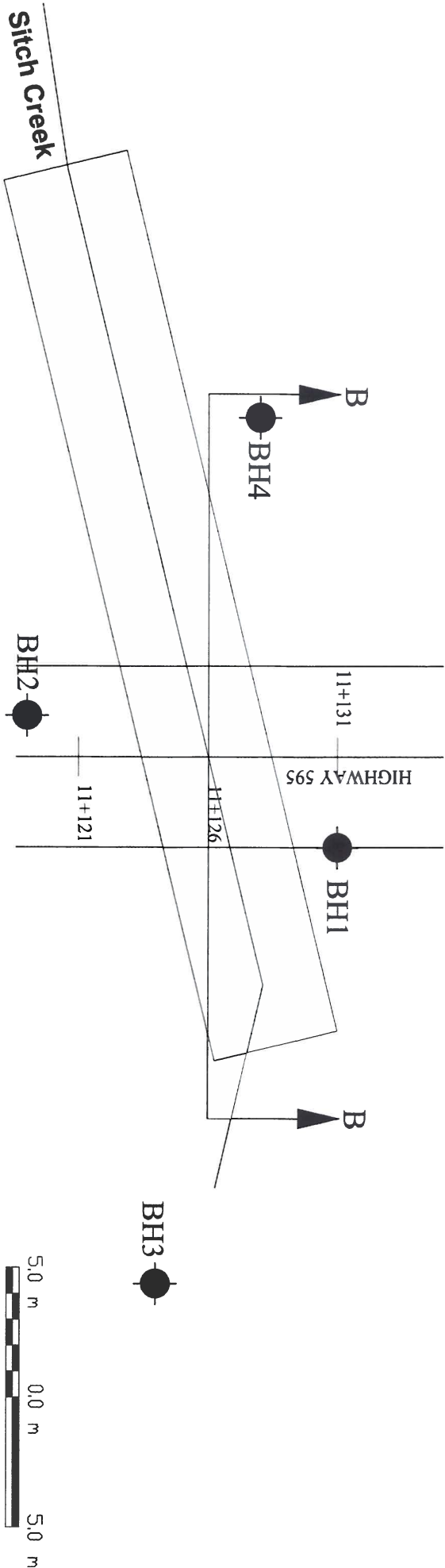
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DRAWING 2





METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METERS

CONT No
GWP No 6.351-14-00
SITE No 48W-201/C
GEOCREs No 52A-191



CULVERT REPLACEMENT
SITCH CREEK CULVERT
STA 11+119 TO STA 11+131
Survey _____ Revised _____

SHEET



KEY PLAN
1.0 km 0 1.0 km

LEGEND

⊕	Borehole		
⊕	Borehole with CPT		
⊕	Asphalt Core		
●	Rock Probe		
▼	Blows/0.3m (Std. Pen Test, 475 J/Blow)		
▼	Water level at time of investigation.		
	Fill		
	Organics		
	Topsoil		
	Till		
	Bedrock		
	Sand		
	Silt		
	Clay		
	Sand & Gravel		
	Boulders		
No.	Elevation	Nothing	Station
BH1	102.0	5353580 m N	2887719 m E
BH2	101.8	5353582 m N	2887719 m E
BH3	97.9	5353587 m N	289735 m E
BH4	97.2	5353577 m N	289708 m E
			11+128
			13.0 m LT

NOTE:
The boundaries between soil types have been established only at borehole
locations. Between boreholes the boundaries are assumed by interpolation
and may not represent actual conditions.

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DRAWING 3

Appendix D
ENCLOSURES

RECORD OF BOREHOLE No BH1

1 OF 1

METRIC

W.P. 6013-E-0021 LOCATION Stich Creek # 3 STA 11+131 4.0 m RT ORIGINATED BY PR
DIST Thunder Bay HWY 595 BOREHOLE TYPE Hollow Stem Auger 80 mm COMPILED BY DB
DATUM Local DATE 2014 08 22 CHECKED BY DM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED + FIELD VANE								
								□ QUICK TRIAXIAL × LAB VANE								
				WATER CONTENT (%)												
102.0	GROUND SURFACE						20	40	60	80	100					
	FILL-SAND-some gravel to gravelly, trace to some silt, cobbles, BROWN		AS1	AS												24 67 (9)
			SS2	SS	9		101									43 50 (7)
			SS3	SS	8		100									
			SS4	SS	33											
			SS5	SS	33		99									37 53 (10)
			SS6	SS	42		98									
			SS7	SS	11		97									14 71 (15)
			SS8	SS	18											
95.8							96									18 69 (13)
6.2	Concrete		SS9	SS	74											
95.2																
6.8	TILL- sand, with gravel, some silt, trace clay		SS10	SS	100+		95									
94.4																
7.6	END OF BOREHOLE Auger Refusal															22 66 (12)

ON_MOT-HIGH VANES GS-TB-019502 STICH CREEK #3 GPJ DST_MIN GDT 11/24/14

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. 6013-E-0021 LOCATION Stich Creek # 3 STA 11+119 1.7 m LT ORIGINATED BY PR
DIST Thunder Bay HWY 595 BOREHOLE TYPE Hollow Stem Auger 80 mm COMPILED BY DB
DATUM Local DATE 2014 08 25 CHECKED BY DM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								○ UNCONFINED	+ FIELD VANE	□ QUICK TRIAXIAL		
			WATER CONTENT (%)									
101.9	GROUND SURFACE											
100.9	ASHPALT											
100.2	FILL-SAND & CRUSHED GRAVEL-trace silt		AS1	AS								
	FILL-SAND-some gravel, some silt, cobbles, BROWN		SS2	SS	19							
			SS3	SS	24							
			SS4	SS	11							
			SS5	SS	8							
98.1												
3.8	SILT- clayey, some sand to sandy, trace to some clay, trace gravel, BROWN		SS6	SS	7							
			SS7	SS	4							
			SS8	SS	10							
94.3												
7.6	TILL-sand, gravelly, with silt, trace clay, DARK GREY		SS9	SS	11							
			SS10	SS	17							
			SS11	SS	16							
89.6			SS12	SS	100+							
12.3	END OF BOREHOLE Auger Refusal on Possible Bedrock											

ON MOT-HIGH VANES GS-TB-019502 STICH CREEK #3 GPJ DST_MIN GDT 11/24/14

+ 3, x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH3

1 OF 1

METRIC

W.P. 6013-E-0021 LOCATION Stich Creek # 3 STA 11+124 16 m RT ORIGINATED BY PR
DIST Thunder Bay HWY 595 BOREHOLE TYPE Hollow Stem Auger 80 mm COMPILED BY DB
DATUM Local DATE 2014 09 08 CHECKED BY DM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE												
97.9	GROUND SURFACE							20	40	60	80	100					GR SA SI CL			
97.8	TOPSOIL		SS1	SS	14			50	100	150	200	250		20						
97.3	SILT-with gravel, cobbles, BROWN																			
0.6	CLAY-silty, some gravel, cobbles		SS2	SS	19		97													
96.7																				
96.4	TILL-gravel, with sand, some silt, trace clay, DARK GREY		SS3	SS	50+												46 39 (15)			
1.5	END OF BOREHOLE Auger Refusal possible boulder/cobbles																			

ON_MOT-HIGH VANES GS-TB-019502 STICH CREEK #3 GPJ DST_MIN GDT 11/24/14

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 3

RECORD OF BOREHOLE No BH4

1 OF 1

METRIC

W.P. 6013-E-0021 LOCATION Stich Creek # 3 STA 11+128 13.0 m LT ORIGINATED BY PR
DIST Thunder Bay HWY 595 BOREHOLE TYPE Hollow Stem Auger 80 mm COMPILED BY DB
DATUM Local DATE 2014 09 08 CHECKED BY DM

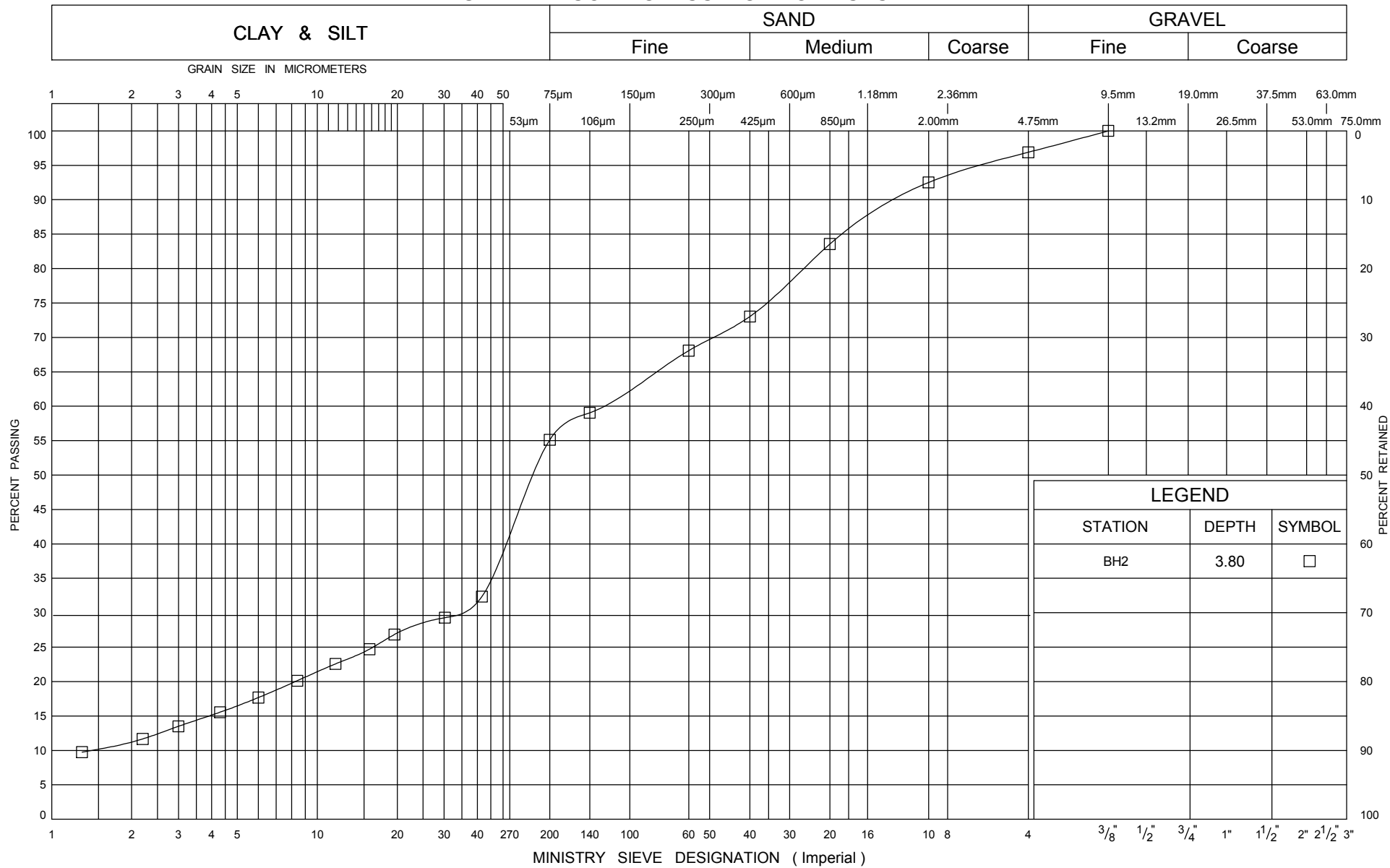
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	□ QUICK TRIAXIAL	× LAB VANE	20						40	60	80
97.2	GROUND SURFACE																GR SA SI CL			
97.4	TOPSOIL		SS1	SS	5															
	SILT-some gravel, some sand, trace clay		SS2	SS	8															
	—roots and wood		SS3	SS	1															
94.9																				
2.3	TILL- gravel, with sand, some silt, trace clay, cobbles		SS4	SS	17												50 35 (15)			
94.1																				
3.1	END OF BOREHOLE Auger refusal possible cobbles/Boulders																			

ON_MOT-HIGH VANES GS-TB-019502 STICH CREEK #3 GPJ DST_MIN GDT 11/24/14

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 4

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION CLAY-Silty

ENCLOSURE 5

W P 6013-E-0021

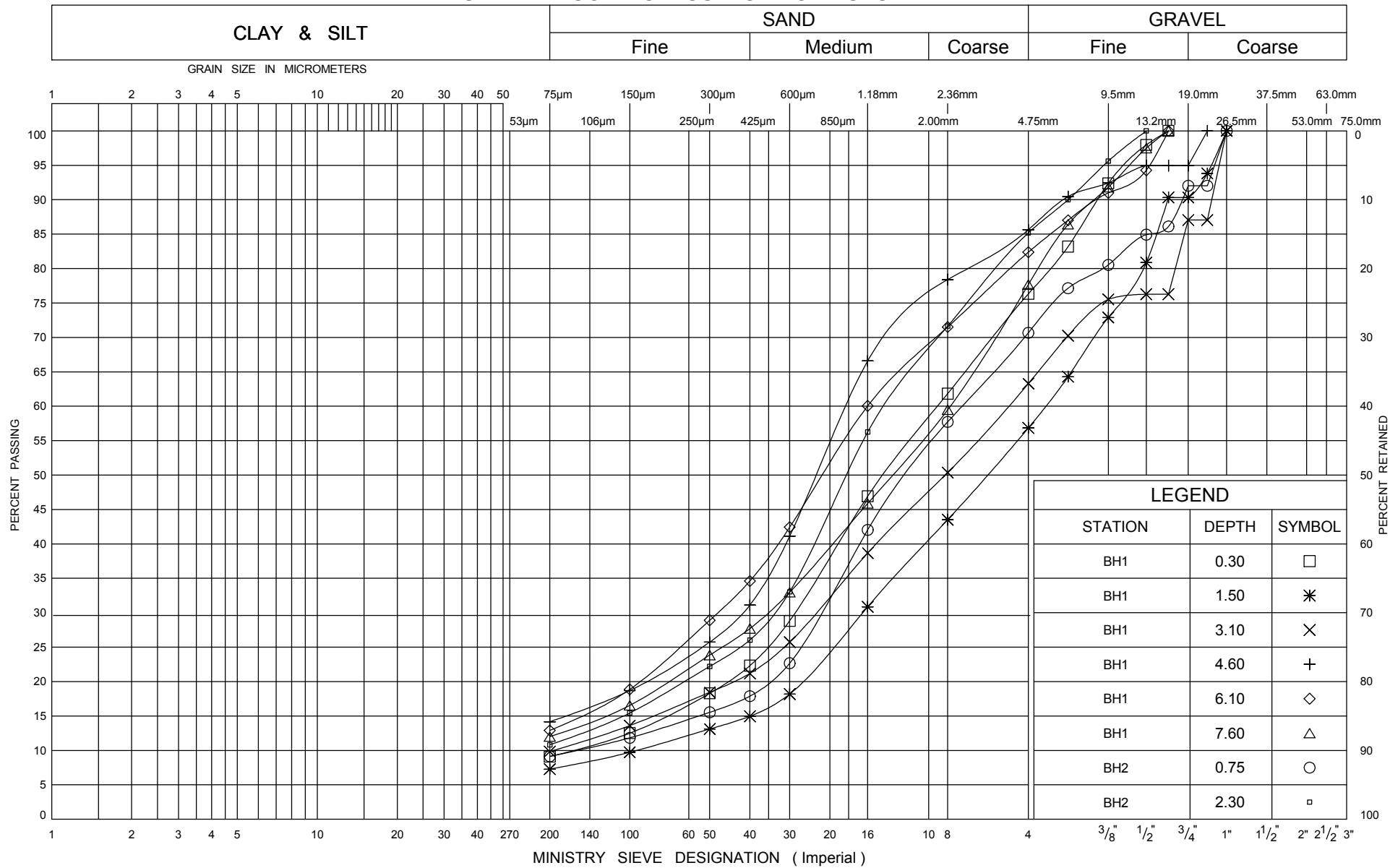
HWY 595

GRAIN SIZE DISTRIBUTION TILL



HWY 595

UNIFIED SOIL CLASSIFICATION SYSTEM

GRAIN SIZE DISTRIBUTION
FILL-SAND

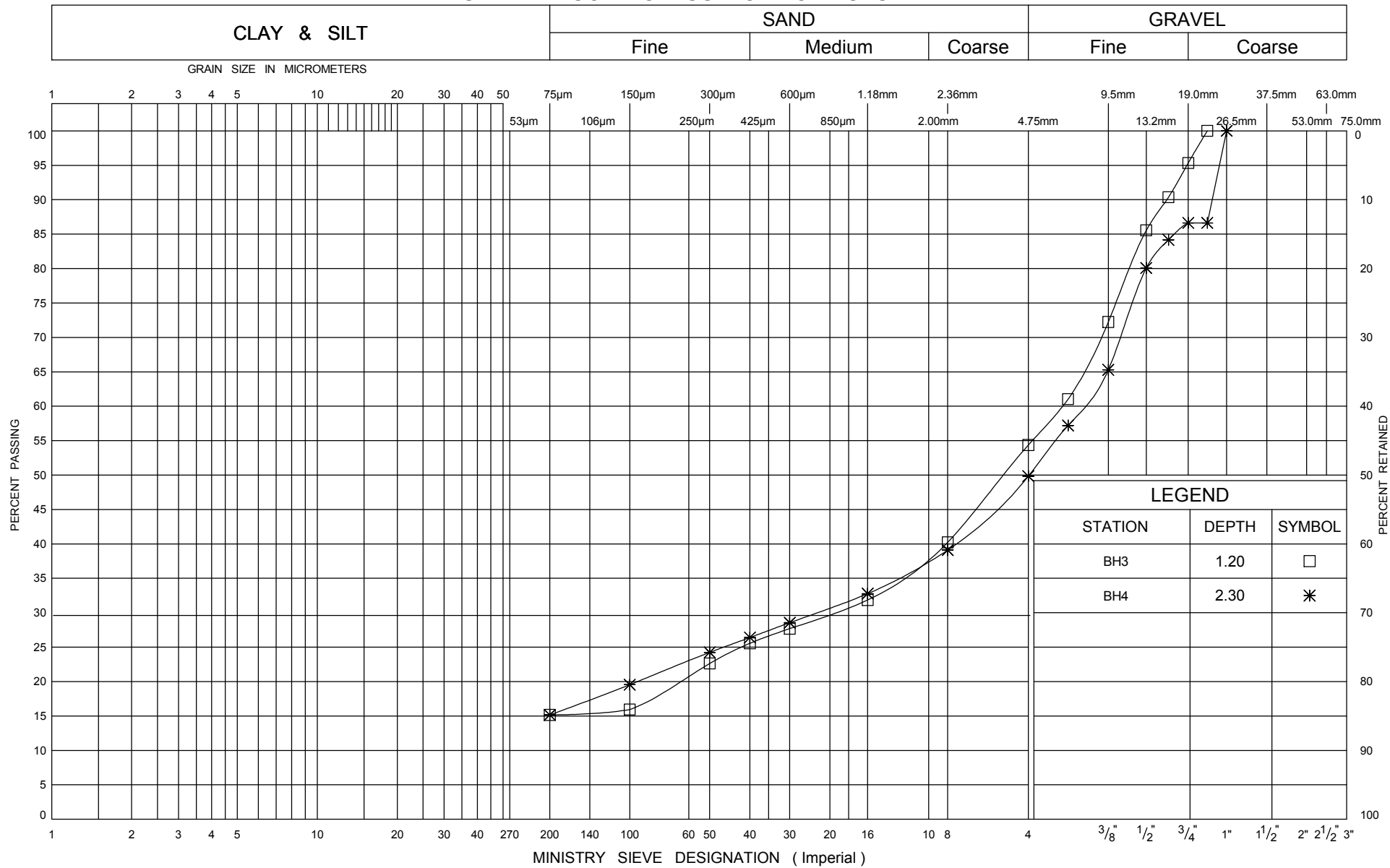
ENCLOSURE 7

W P 6013-E-0021

HWY 595

Ministry of
Transportation
Ontario

UNIFIED SOIL CLASSIFICATION SYSTEM



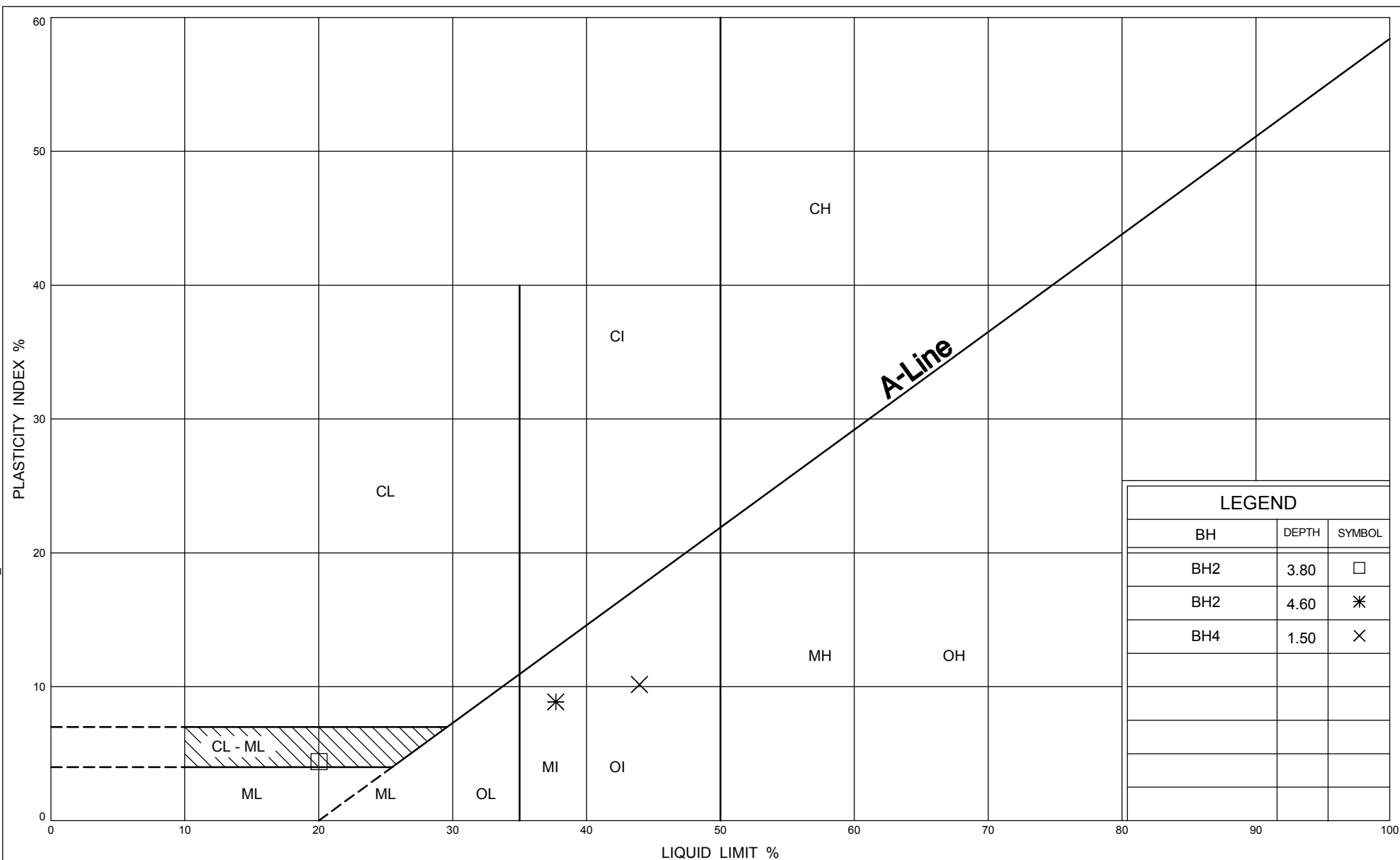
Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION SOIL DESCRIPTION

ENCLOSURE 2

W P 6013-E-0021

595



Ministry of
Transportation
Ontario

PLASTICITY CHART LOW-INTERMEDIATE-HIGH PLASTIC

ENCLOSURE 8

W P 6013-E-0021

HWY 595