



**FOUNDATION INVESTIGATION REPORT
SITCH CREEK CULVERT # 2 REPLACEMENT
HIGHWAY 595
TOWNSHIP OF GILLIES, THUNDER BAY DISTRICT
AGREEMENT NO.: 6013-E-0021
ASSIGNMENT NO.: 4
SITE NO.: 48W-80/C
GEOCRES NO. 52A-195
GWP 6352-14-00**

**JANUARY 8, 2015
GS-TB-019501**

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 0.78 km North of Highway 588 (latitude 48.3017, longitude -89.6992), LHRs 62920, offset 0.780, Station 10+775, in the Township of Gillies, in the District of Thunder Bay.

It is understood that the existing 28.1 m long centreline culvert is a Structural Plate Corrugated Steel Pipe (SPCSP) approximately 4.88 m diameter, for the existing culvert (Figure 2.3 and 2.4). The original date of construction is unknown and inspection by others indicates there is light corrosion at the water level and slight sag at centreline and ponding within the barrel. The fill thickness above the culvert is approximately 1.0 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 clayey glaciolacustrine plain. The topography in the area is mainly low local relief; plain with dry 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 West)



Figure 2.4 Culvert outlet (looking East)

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out between August 25th and September 9th, 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 5.3 m to 12.8 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 10+778, 4.5 m right of centreline, and advanced to a depth of 11.8 m below existing surface. Borehole 2 was advanced South of the existing culvert at Station 10+772, 4.2 m left of centreline, and advanced to a depth of 12.8 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 outlet at station 10+777, 18.0 m right of centreline, and advanced to a depth of 5.3 m below existing surface. Borehole 4 was advanced at the inlet at station 10+777, 15.0 m Left of centreline, and advanced to a depth of 6.0 m below existing 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 10+775. A nail in a telephone pole on the north side of the culvert at station 10+796 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 analysis.

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 thirty nine (39) moisture contents, eight (8) sieve analyses ,and one (1) particle size analyses 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	10+778	101.3	11.8	4.5 m Rt
BH2	10+772	101.4	12.8	4.2 m Lt
BH3	10+777	97.9	5.3	18.0 m Rt
BH4	10+777	98.0	6.0	15.0 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, sand layer is overlying a silt layer which is again underlain by a lower sand layer. Asphalt road approximately up to 50 mm thick was noted during field investigation.

Table 4.1 Summary of soil strata at the culvert location

Layer	Depth (m)	Elevation (m)	Comments
Fill Sand	0.0 to 7.3	101.3 to 94.0	
	0.0 to 3.1	101.4 to 98.3	
Silt	7.3 to 8.5	94.0 to 92.8	
	3.1 to 7.6	98.3 to 93.8	
sand	8.5 to 11.8	92.8 to 89.5	
	7.6 to 12.8	93.8 to 88.6	

4.1 Topsoil

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

4.2 Fill- Sand

Upper sand layer with trace to some gravel, trace to with silt and cobbles was encountered in Boreholes 1 and 2 with a thickness of 7.3 m (Elev. 101.3 to 94.0 m) and 3.1 m (Elev. 101.4 to 98.3 m) respectively.

SPT 'N' values vary from 7 to 29, indicating a loose to compact condition. The moisture contents of samples tested range from 4 to 13 %. The results of laboratory tests are summarized in Table 4.2.

Table 4.2 Summary of fill sand layer sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	5 to 18
Sand %	50 to 72
Fines %	8 to 39

4.3 Silt

Silt with trace to some gravel, some sand to sandy was encountered in Boreholes 1, 2, 3 and 4 at a depths of 7.3 m, 3.1 m, 0.1 m, and 0.3 m respectively. The thickness of this stratum for Boreholes 1, 2, and 3 was found to be 1.2 m (Elev. 94 to 92.8 m), 4.5 m (Elev. 98.3 to 93.8 m) and 2.2 m (Elev. 97.8 to 95.6 m) respectively. For Borehole 4 the thickness of this stratum is not defined as borehole terminus was reached at depth of 6.0 m (Elev. 92.0 m) within this stratum.

SPT 'N' values vary from 3 to more than 50, indicating a loose to very dense condition. The moisture contents of samples tested range from 17 to 28 %. The laboratory test results are summarized in following Tables 4.3

Table 4.3 Summary of silt layer sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	0 to 2
Sand %	18 to 24
Fines %	76 to 82

4.4 Sand

Lower sand layer with trace to some gravel, some silt to silty and cobbles was encountered in Boreholes 1, 2, 3 and 4 at depth of 8.5 m (Elev. 92.8 m), 7.6 m (Elev. 93.8 m) and 2.3 m (Elev. 95.6 m) and 0.1 m (Elev. 97.9 m) respectively. The thickness of this stratum is not defined for borehole 1, 2 and 3 as borehole terminus was reached within this stratum. Auger refusal on possible bedrock was encountered in Borehole 1 and 3 at depth of 11.8 m (Elev. 89.5 m) and 5.3 m (Elev. 92.6 m) respectively. For Borehole 4 the thickness of this stratum was found to be 0.3 m (Elev. 98.0 to 97.7 m).

SPT 'N' values vary from 11 to 42, indicating compact to dense condition. The moisture contents of samples tested range from 10 to 19 %. The results of laboratory tests are summarized

in Table 4.4.

Table 4.4 Summary of sand layer sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	5 to 14
Sand %	49 to 70
Fines %	16 to 46

4.5 Groundwater

At the time of the field investigation groundwater was observed in Boreholes 1, 3 and 4 and groundwater details are provided in Table 4.5. The groundwater levels can be expected to vary with the season and precipitation events.

Table 4.5 Groundwater depths

Borehole	Groundwater Depth	Groundwater Elevation
Borehole 1	8.5	92.8
Borehole 3	2.2	95.7
Borehole 4	2.4	95.6

5. MISCELLANEOUS

Site work was carried out between August 25th, 2014 and September 9th, 2014 utilizing a CME 750 all-terrain drill rig operated by DST personnel. 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:



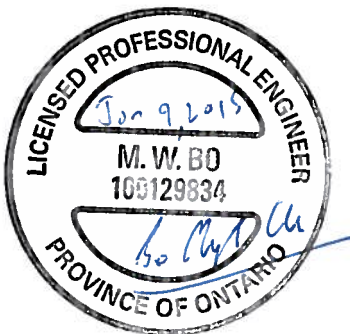
Deep Bansal, P. Eng
Geotechnical Engineer

Reviewed by:

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

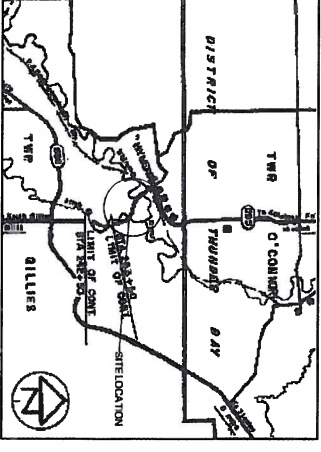
Appendix C

DRAWINGS

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

CONT	No	
GWP	No 6352-14-00	
SITE	No 48W-80/C	
GEOCRES	No 52A-195	

CULVERT REPLACEMENT SITCH CREEK CULVERT STA 10+770 TO STA 10+790 Survey _____ Revised _____	SHEET
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KEY PLAN
1.0 km 0 1.0 km

LEGEND

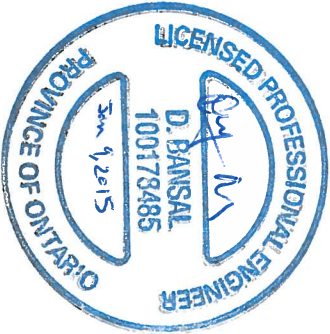
- Borehole
- Borehole with CPT
- Asphalt Core
- Rock Probe
- Blows/0.3m (Std. Pen Test, 475 J/blow)
- Water level at time of investigation.
- Fill
- Organics
- Topsoil
- Sand
- Silt
- Clay
- Sand & Gravel
- Boulders
- Bedrock

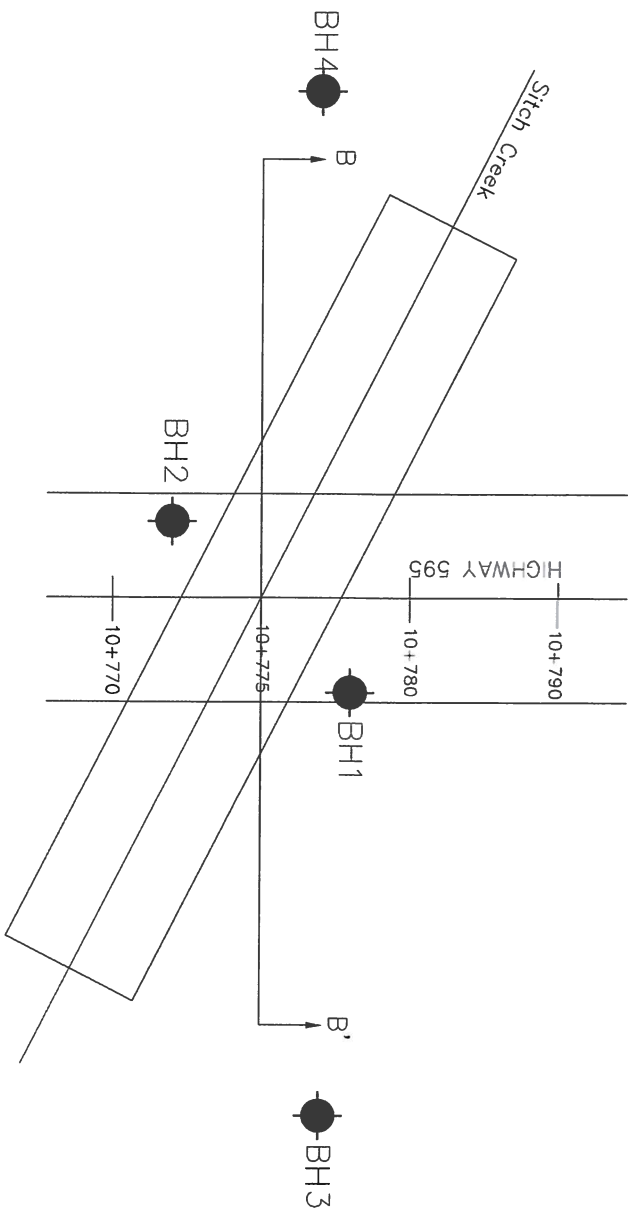
No.	Elevation	Northing	Easting	Station	Offset
BH1	101.3	5353250 m N	299797 m E	10+776	4.5 m RT
BH2	101.4	5353249 m N	299792 m E	10+772	4.2 m LT
BH3	97.9	5353250 m N	299816 m E	10+777	18.0 m RT
BH4	96.0	5353257 m N	299779 m E	10+777	15.0 m LT

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

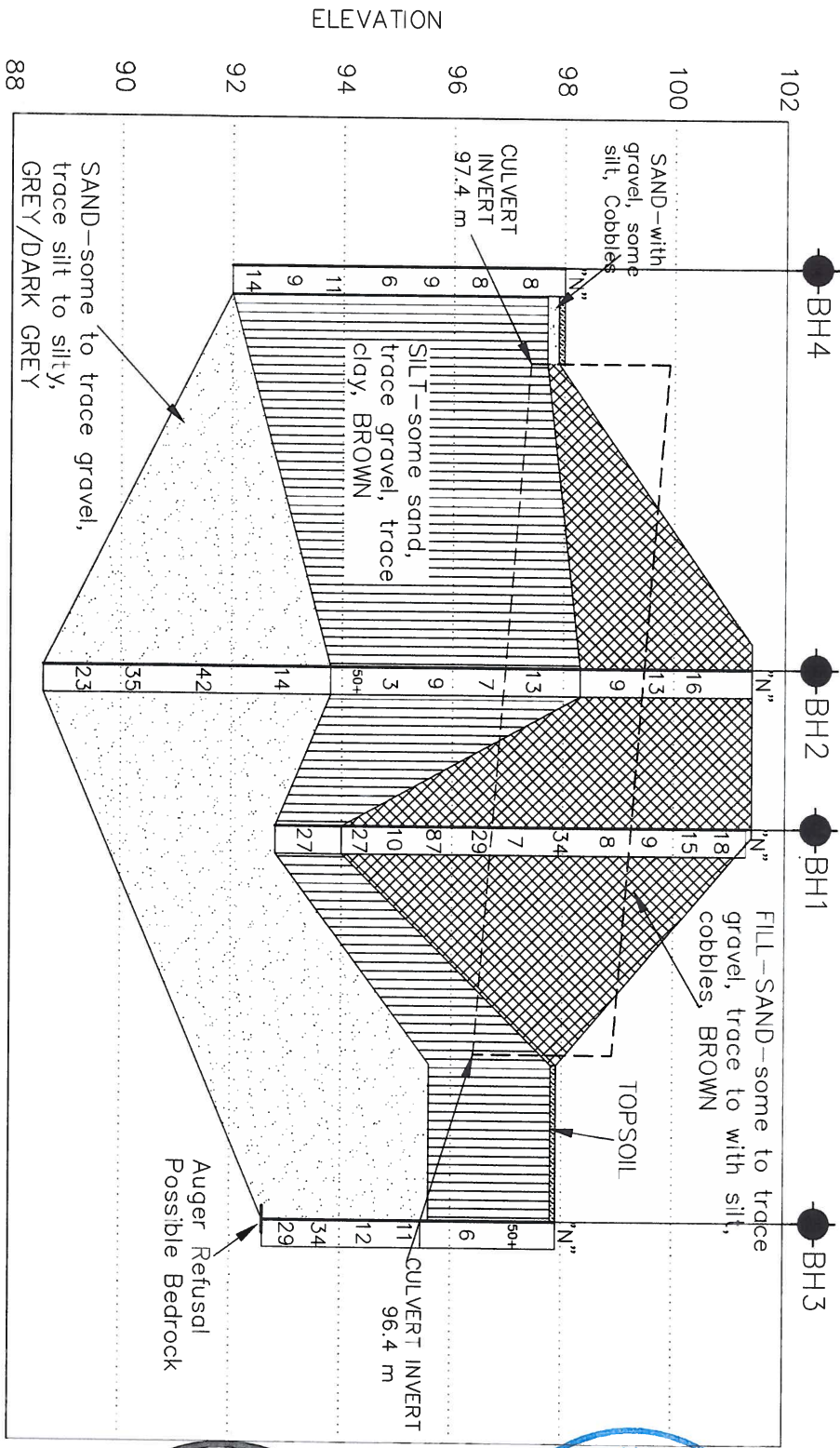
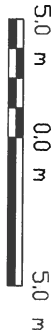


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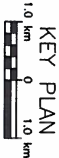
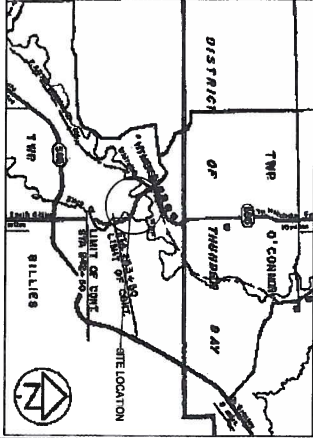
PROFILE ALONG SECTION B-B'



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SPECIFIED
DIMENSIONS IN KILOMETRES * METRES

CONT	No	
GWP	No 6352-14-00	
SITE	No 48W-80/C	
GEORES	No 52A-195	

CUL VERT REPLACEMENT SITCH CREEK CULVERT STA 10+770 TO STA 10+790 Survey _____ Revised _____	SHEET
---	-------



LEGEND

- Borehole
- Borehole with CPT
- Asphalt Core
- Rock Probe
- Blow/0.3m (Std. Pen Test, 475 J/Blow)
- Water level at time of investigation.

- Fill
- Organics
- Topsoil
- Sand
- Silt
- Clay
- Sand & Gravel
- Boulders
- Bedrock

No.	Elevation	Nothing	Easting	Station	Offset
BH1	101.3	553326 m N	289787 m E	10+778	4.5 m RT
BH2	101.4	553326 m N	289782 m E	10+772	4.2 m LT
BH3	97.9	553326 m N	289816 m E	10+777	16.0 m RT
BH4	98.0	553327 m N	289779 m E	10+777	16.0 m LT

NOTE:
The boundaries between soil strata 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 #2 STA 10+778 RT 4.5 m 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			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								20 40 60 80 100										
								50 100 150 200 250										
101.3	GROUND SURFACE																	
FILL-SAND-some to trace gravel, trace to with silt, cobbles, BROWN			AS1	AS			101											
			SS2	SS	18		100											
			SS3	SS	15		99										11 50 (39)	
			SS4	SS	9		98										5 87 (8)	
			SS5	SS	8		97											
			SS6	SS	34	96												
			SS7	SS	7	95												
			SS8	SS	29	94												
	--concrete at tip		SS9	SS	87	93												
94.0																		
7.3	SILT-some sand, trace gravel, BROWN		SS10	SS	10	92												
92.8																		
8.5	SAND-some gravel, trace to with silt, GREY		SS11	SS	27	91												
			SS12	SS	27	90												
89.5																		
11.8	END OF BOREHOLE Auger Refusal Possible Bedrock																	

ON_MOT-HIGH VANES GS-TB-019502 STICH CREEK 2.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 #2 STA 10+772 LT 4.2 m ORIGINATED BY PR
DIST Thunder Bay HWY 595 BOREHOLE TYPE Hollow Stem Auger 80 mm COMPILED BY DB
DATUM Local DATE 2014 08 26 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/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED	+ FIELD VANE						
								□ QUICK TRIAXIAL	× LAB VANE						
101.4	GROUND SURFACE						20 40 60 80 100								
	FILL-SAND-some gravel, some silt, cobbles, BROWN		AS1	AS			50 100 150 200 250								
			SS2	SS	16									18 69 (13)	
			SS3	SS	13										
			SS4	SS	9										
98.3															
3.1	SILT-some sand, trace gravel, trace clay, BROWN		SS5	SS	13									2 18 73 7	
			SS6	SS	7										
			SS7	SS	9										
			SS8	SS	3										
			SS9	SS	50+										
93.8															
7.6	SAND-some gravel, some silt, cobbles, DARK GREY -cobbles		SS10	SS	14									14 70 (16)	
			SS11	SS	42										
			SS12	SS	35										
			SS13	SS	23										
88.6															
12.8	END OF BOREHOLE														

ON_MOT-HIGH VANES GS-TB-019502 STICH CREEK 2.GPJ DST_MIN.GDT 11/24/14

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

ENCLOSURE 2

RECORD OF BOREHOLE No BH3

1 OF 1

METRIC

W.P. 6013-E-0021 LOCATION Stich Creek #2 STA 10+777 RT 18.0 m ORIGINATED BY PR
DIST Thunder Bay HWY 595 BOREHOLE TYPE Hollow Stem Auger 80 mm COMPILED BY DB
DATUM Local DATE 2014 09 09 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 (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED + FIELD VANE							
								□ QUICK TRIAXIAL x LAB VANE							
							WATER CONTENT (%)								
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT								
							W _p W W _L								
97.9	GROUND SURFACE						20	40	60	80	100	20	40	60	
96.8	TOPSOIL SILT-trace gravel, trace clay, BROWN		AS1	AS											
			SS2	SS	50+										
			SS3	SS	6										
95.6															
2.3	SAND- silty, trace gravel, DARK GREY		SS4	SS	11										
			SS5	SS	12										
			SS6	SS	34										
			SS7	SS	29										
92.6															
5.3	END OF BOREHOLE Auger Refusal on Possible Bedrock														

ON_MOT-HIGH VANES GS-TB-019502 STICH CREEK 2.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 #2 STA 10+777 LT 15.0 m ORIGINATED BY PR
DIST Thunder Bay HWY 595 BOREHOLE TYPE Hollow Stem Auger 80 mm COMPILED BY DB
DATUM Local DATE 2014 09 09 CHECKED BY DM

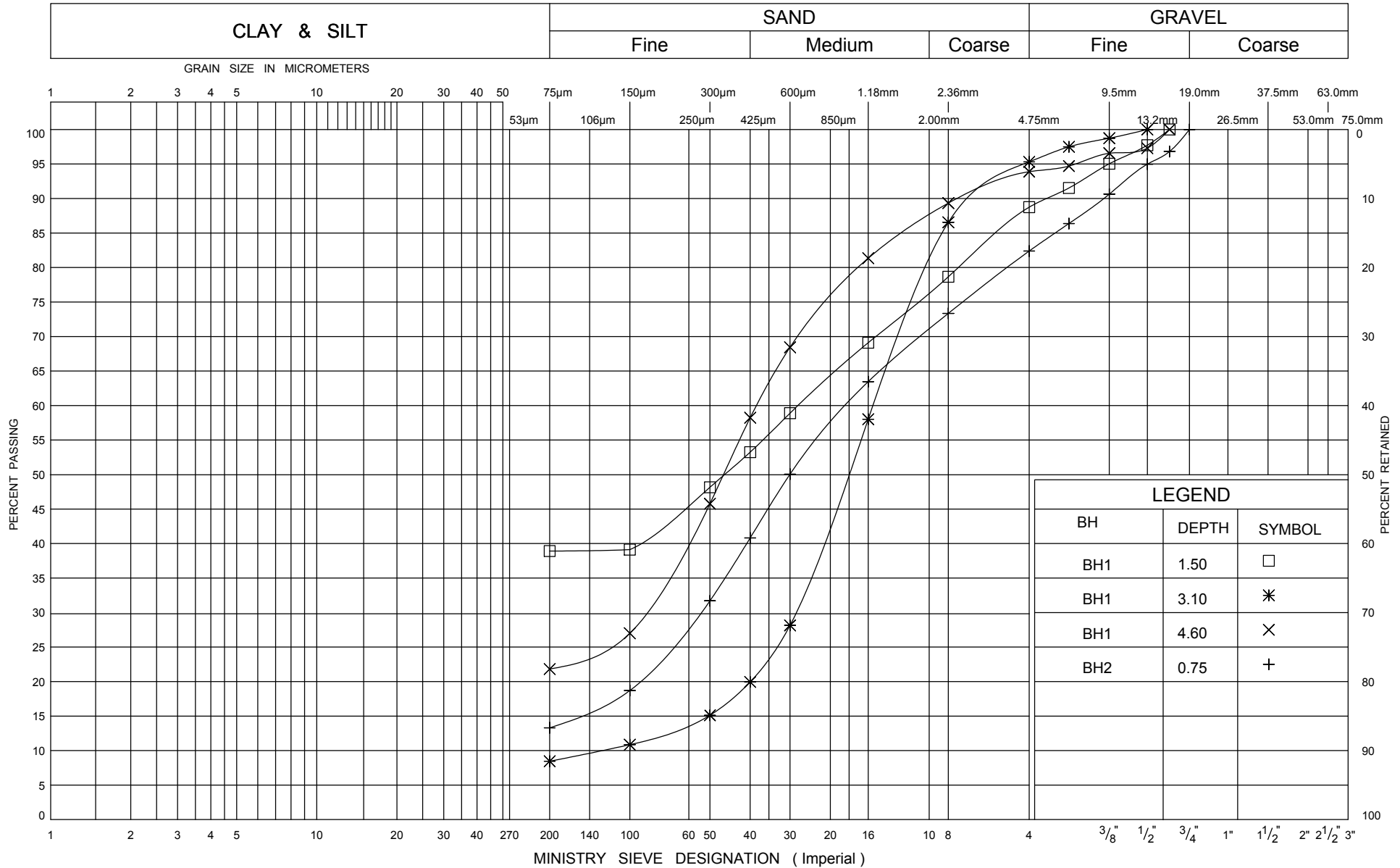
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE	□ QUICK TRIAXIAL	× LAB VANE					
								WATER CONTENT (%)								
98.0	GROUND SURFACE					20	40	60	80	100	20	40	60			
96.0	TOPSOIL		AS1	AS												
97.7	SAND-with gravel, some silt, cobbles SILT-with sand to sandy, trace clay, cobbles, BROWN/ DARK GREY															
97.3																
		SS2	SS	8												
		SS3	SS	8												
		SS4	SS	9												
			SS5	SS	6											
			SS6	SS	11											
			SS7	SS	9											
			SS8	SS	14											
92.0	END OF BOREHOLE															
6.0																

ON_MOT-HIGH VANES GS-TB-019502 STICH CREEK 2.GPJ DST_MIN.GDT 11/24/14

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

ENCLOSURE 4

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

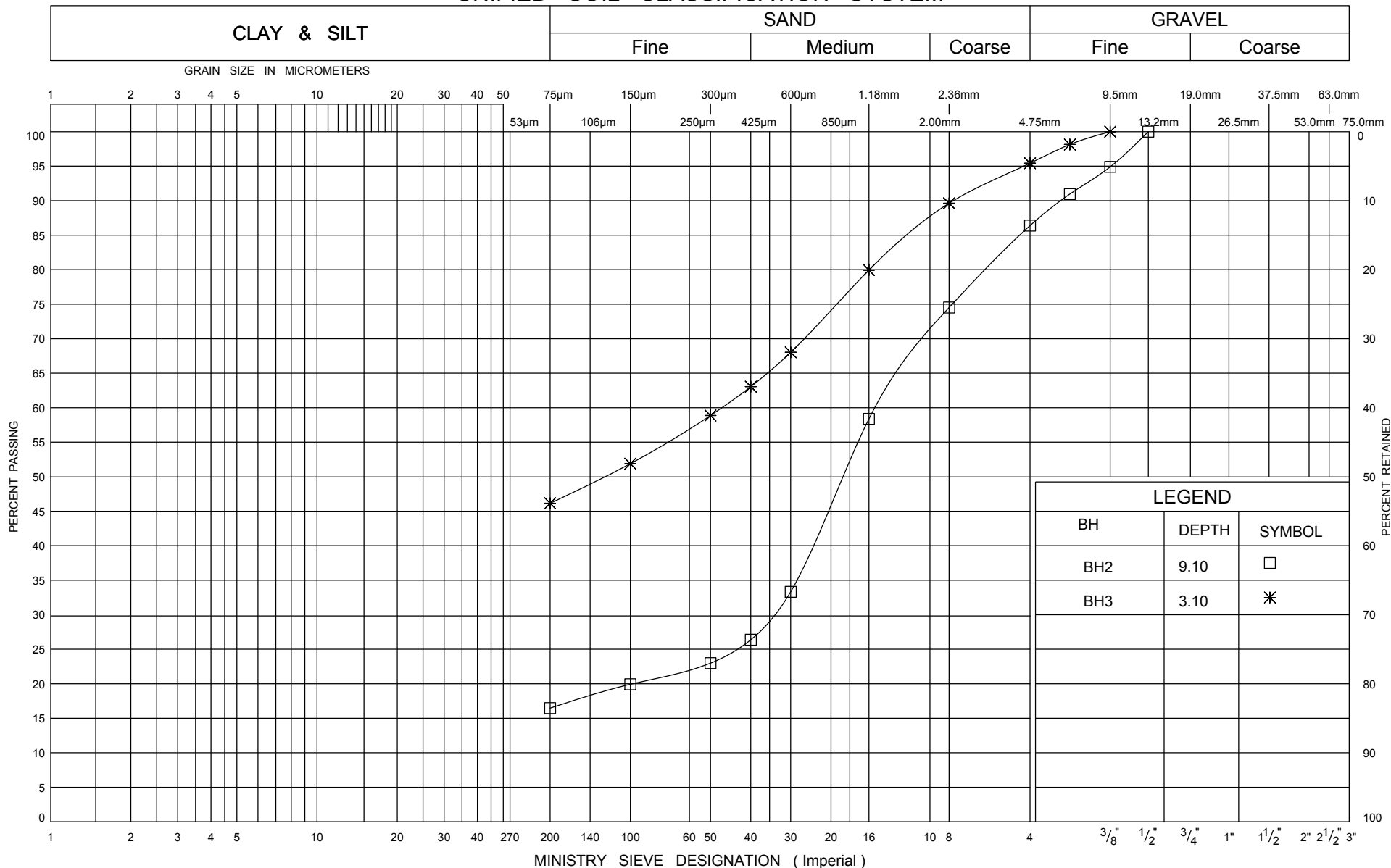
GRAIN SIZE DISTRIBUTION FILL-SAND

ENCLOSURE 5

W P 6013-E-0021

HWY 595

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

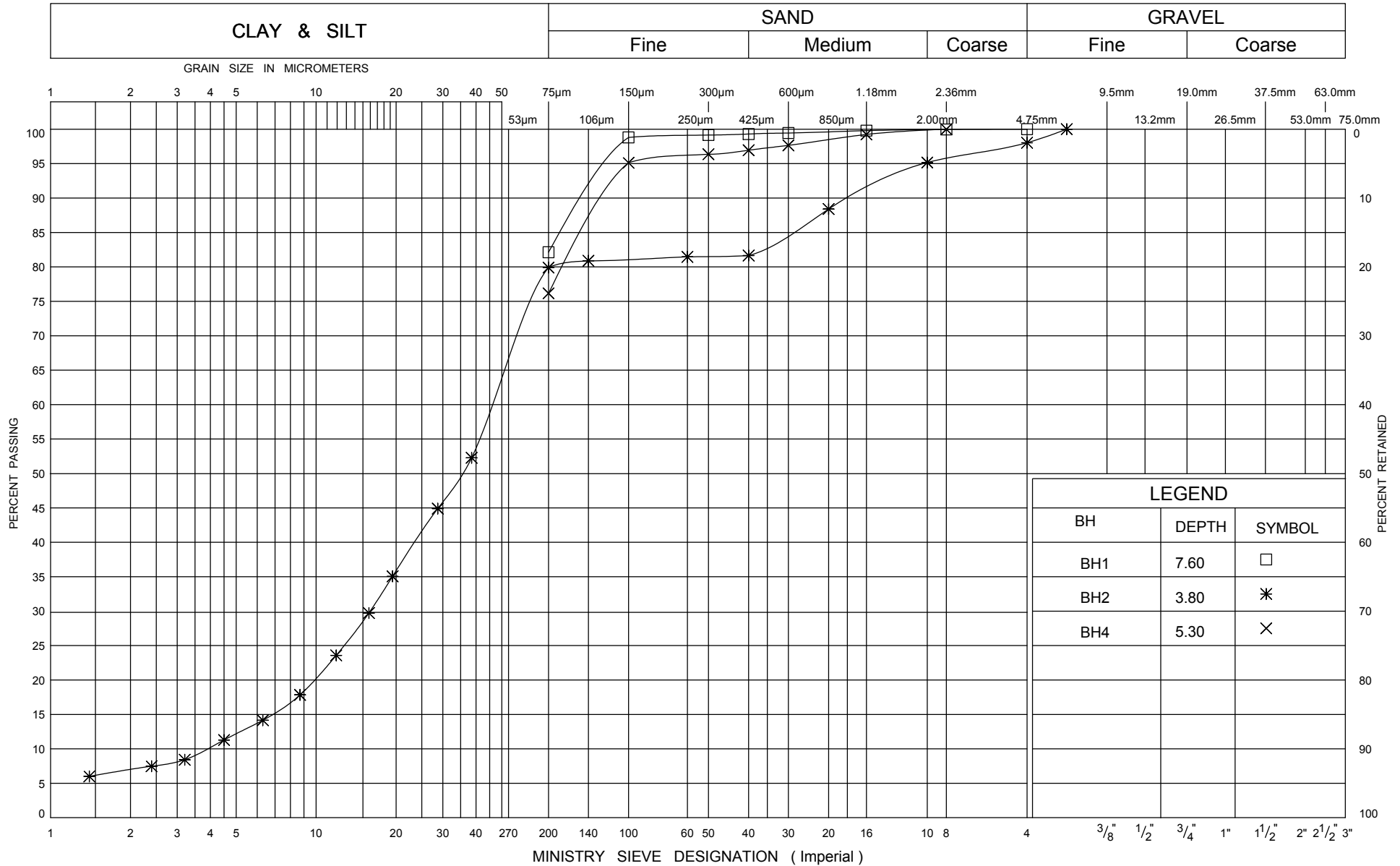
GRAIN SIZE DISTRIBUTION SAND

ENCLOSURE 6

W P 6013-E-0021

HWY 595

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION
SILT

ENCLOSURE 7

W P 6013-E-0021

HWY 595