



**FOUNDATION INVESTIGATION
REPORT
TROUT CREEK BRIDGE
HIGHWAY 522, TOWNSHIP OF SOUTH HIMSWORTH
NORTH BAY
AGREEMENT NO.: 5011-E-0035
ASSIGNMENT NO.: 10
GWP 5427-06-00
GEOCRES NUMBER: 31E-336**

**MAY 22, 2014
GS-TB-018036**

PREPARED FOR:

Ministry of Transportation
Geotechnical Section
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PART A: FOUNDATION INVESTIGATION REPORT

1. INTRODUCTION

DST Consulting Engineers Inc. (DST) has been retained by The Ministry of Transportation, Geotechnical Section Northeastern Region to conduct a geotechnical investigation to provide factual geotechnical information for design of a new bridge at the Trout Creek crossing on Highway 522, Township of South Himsforth, North Bay. This work was carried out under Agreement No.:5011-E-0035, Geotechnical Retainer, Northeastern Region Ontario.

This report addresses the field investigation, laboratory test program, and factual report on subsurface conditions.

2. SITE DESCRIPTION

The Trout Creek Bridge is located on Trout Creek crossing on Highway 522 in Township of South Himsforth, North Bay.

The photographs shown in Figures 2.1 to 2.2 were taken by DST during the site investigation.

Geological information is available from *Ontario Geological Survey Map* by the *Ontario Ministry of Natural Resources* for the trout creek area. The maps indicate that the modern alluvial deposit consisting on clay, silt, sand, and gravel and it may contain organics.



Figure 2.1 Bridge Embankment looking West



Figure 2.2 Trout Creek Bridge looking South

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out between February 20th and April 7th, 2014 utilizing a CME 750 or CME 55 drill rig that was operated by DST and by its sub-contractor Landcore Drilling. A total of six (6) boreholes were advanced for the purpose of foundation investigation at this site, using hollow stem augers. Boreholes were advanced to depths ranging from 9.8 to 25.4 m.

Six (6) boreholes were advanced at the near the bridge approach. A borehole location plan and stratigraphic section are shown in Appendix C. The number and locations of all boreholes and depths of boreholes were specified by MTO and agreed upon by DST.

The ground surface elevations at the borehole locations were surveyed by DST personnel. Geodetic elevations were measured for the borehole locations using MTO vertical BM # 0819678368 and nail on the south east section of the bridge as 314.124 m.

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.

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 and sieve analyses. A total of forty five (45) moisture contents, thirty (30) particle size analyses, six (6) Atterberg limit tests and two (2) consolidation tests have been carried out for this assignment. Laboratory test results are presented in Appendix D.

Table 3.1 Detail of borehole locations

Borehole ID	Borehole Elevation (m)	Depth Below Ground Surface (m)
BH 1	313.5	9.8
BH 2	313.6	10.0
BH 3	313.6	21.3
BH 4	313.6	25.4
BH 5	313.6	21.8
BH 6	313.6	13.9

4. DESCRIPTION OF SUBSURFACE CONDITIONS

The subsurface conditions at the culvert location are presented based on the data obtained during field and laboratory testing.

The generalized stratigraphy of the existing road embankment, based on the conditions encountered in Boreholes 1 through 6, consists of asphalt surface treatment underlain by a granular fill overlaying a layer of sand or silt with interbedded organics overlaying a layer of clayey silt which is again underlain by sand followed by bedrock.

Cross sectional profiles of the site along the roadway alignment can be found in Appendix C, Drawings 2, 3 and 4.

4.1 Asphalt

Asphalt surface treatment was encountered in Boreholes 1 to 6 with thickness between 130 mm to 200 mm at the surface.

4.2 Fill- sand and crushed gravel

Fill layer consisting of sand and crushed gravel with trace to some silt was encountered in Boreholes 1, 2, 3, 4, 5 and 6 below the asphalt layer with thicknesses of 0.7 m (Elev. 313.4 to 312.8 m), 0.1 m (Elev. 313.5 to 313.4 m), 0.1 m (Elev. 313.4 to 313.3 m), 0.7 m (Elev. 313.5 to 312.9 m), 0.3 m (Elev. 313.4 to 313.1 m) and 0.2 m (Elev. 313.5 to 313.4 m) respectively.

The moisture contents of tested samples ranged from 1 to 6 %. The results of the laboratory tests are summarized in Table 4.1.

Table 4.1 Summary of sand and crushed gravel fill sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	24 to 40
Sand %	53 to 65
Fines %	5 to 11

4.3 Fill- sand

Fill layer consisting of sand with some silt to silty, trace to with gravel was encountered in Boreholes 1, 2, 3, 4, 5 and 6 at depth of 0.8 m, 0.2 m, 0.3 m, 0.8 m, 0.5 m and 0.3 m with thicknesses of 2.5 m (Elev. 312.8 to 310.2 m), 3.6 m (Elev. 313.4 to 309.8 m), 3.5 m (Elev. 313.3 to 309.8 m), 3.8 m (Elev. 312.9 to 309.0 m), 3.3 m (Elev. 313.1 to 309.8 m) and 3.5 m (Elev. 313.4 to 308.3 m) respectively. Cobbles were also noted within this stratum.

SPT 'N' values obtained in this stratum range from 2 to 69 per 0.3 m penetration indicating very loose to very dense condition. The moisture contents of tested samples ranged from 3 to 29 %. The results of the laboratory tests are summarized in Table 4.2

Table 4.2 Summary of sand fill sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	0 to 21
Sand %	45 to 89
Fines %	7 to 55

4.4 Upper sand layer

Upper sand layer with trace silt to silty, trace gravel, trace organics, wood was encountered in Boreholes 1, 2, 3, 4, 5 and 6 at depth of 3.3 m, 3.8 m, 4.6 m, 4.6 m, 3.8 m and 5.3 m with thicknesses of approximately 6.3 m (Elev. 310.2 to 303.9 m), 3.2 m (Elev. 309.8 to 306.6 m), 0.9 m (Elev. 309.0 to 308.1 m), 1.7 m (Elev. 309.0 to 307.3 m), 3.2 m (Elev. 309.8 to 306.6 m), and 2.4 m (Elev. 308.3 to 305.9 m respectively).

SPT 'N' values obtained in this stratum range from 2 to 22 per 0.3 m penetration indicating very loose to compact condition. The moisture contents of tested samples ranged from 11 to 41 %. The results of the laboratory tests are summarized in Table 4.2

Table 4.2 Summary of upper sand layer sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	0 to 3
Sand %	61 to 89
Fines %	10 to 39

4.5 Silt-clayey

Clayey silt was encountered in Boreholes 1, 2, 3, 4, 5 and 6 at depths of 9.7 m (Elev. 303.9 m), 7.0 m (Elev. 306.6 m), 3.8 m (Elev. 309.8 m), 6.3 m (Elev. 307.3 m), 8.5 m (Elev. 305.1 m) and 8.5 m (Elev. 305.1 m) respectively. The thickness of this stratum for Boreholes 2, 4, 5 and 6 was found to be 1.5 m (Elev. 306.6 to 305.1 m), 3.7 m (Elev. 307.3 to 303.6 m), 3.0 m (Elev. 305.1 to 302.1 m) and 3.0 m (Elev. 305.1 to 302.1 m) respectively. For Borehole 3 the thickness of this stratum was found to be 4.7 m (Elev. 309.8 to 305.1 m) and interbedded layer of sand was

found with this stratum at depth of 4.6 m with thickness of 0.9 m (Elev. 309 to 308.1 m). For Borehole 1 the thickness of this stratum is not defined as borehole terminus was reached within this stratum.

Field shear vane values obtained in the clayey silt range from 75 to 120 kPa indicating Stiff to very stiff consistency. Moisture contents of tested samples ranged from 24 to 28. The results of the laboratory test are summarized in Table 4.2. Atterberg limit test results indicate clayey silt of low plasticity.

Table 4.2 Summary of Laboratory Test for Clayey Silt

Atterberg Limits	
Liquid Limit	23 to 31
Plastic Limit	22 to 28
Plasticity Index	1 to 3

4.6 Clay-silty

Silty clay was encountered in Boreholes 5 at depth of 7.0 m with thickness of 1.5 m (Elev. 306.6 to 305.1 m).

SPT 'N' values obtained in the clay layer found to be 7 blows per 0.3 m penetration indicating firm condition. Moisture content of tested sample was around 40%. The result of the laboratory tests are summarized in Table 4.3. Atterberg limit test results indicate silty clay of low plasticity.

Table 4.3 Summary of Laboratory Test for Silty Clay

Atterberg Limits	
Liquid Limit	30
Plastic Limit	22
Plasticity Index	8

4.7 Silt

Loose to compact silt with trace sand to sandy was encountered in Borehole 2, 3, 5 and 6 at depth of 8.5 m, 8.5 m, 11.5 m and 7.7 m with thicknesses of approximately 1.5 m (Elev. 305.1 to 303.6 m), 1.5 m (Elev. 305.1 to 303.6 m), 3.0 m (Elev. 305.1 to 302.1 m) and 0.8 m (Elev. 305.9 to 305.1 m) respectively.

SPT 'N' values obtained in this stratum range from 2 to 8 per 0.3 m penetration

indicating loose to compact condition. The moisture contents of tested samples ranged from 19 to 25 %. The results of the laboratory tests are summarized in Table 4.4.

Table 4.4 Summary of lower silt layer sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	0
Sand %	11 to 45
Fines %	55 to 89

4.8 Lower sand layer

Lower sand layer with trace gravel to gravelly, trace silt to with silt, was encountered in Boreholes 2, 3, 4, 5 and 6 at depths of 10.0 m (Elev. 303.6 m), 10.0 m (Elev. 303.6 m), 10.0 m (Elev. 303.6 m), 15.0 m (Elev. 298.6 m) and 11.5 m (Elev. 302.1 m) respectively. The thickness of this stratum for Borehole 2 was found to be 11.8 m (Elev. 303.6 to 291.8 m). Thickness of this stratum was not defined for Borehole 3, 4, 5 and 6 as borehole terminus was reached within this stratum.

SPT 'N' values obtained in this stratum range from 1 to more than 100 per 0.3 m penetration indicating very loose to very dense condition. The moisture contents of tested samples ranged from 10 to 24 %. The results of the laboratory tests are summarized in Table 4.5.

Table 4.5 Summary of lower sand layer sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	0 to 32
Sand %	52 to 94
Fines %	6 to 45

4.9 Bedrock

Granite bedrock was encountered in Boreholes 2 and 4 at depth of 21.8 m (Elev. 291.8 m) and 22.3 m (Elev. 291.3 m) respectively. All cores were logged and assessed for Total Core Recovery (TCR) and Rock Quality Designation (RQD) values. The TCR values of the rock were found to be 100% and RQD values of the rock ranged from 70% to 100% indicating good to excellent rock quality.

For Borehole 3 and 5 cone and auger refusal on possible bedrock was encountered at depth of 21.3 m (Elev. 292.3 m) and 21.8 m (Elev. 291.8 m) respectively which is almost at similar elevation where bedrock is encountered in Boreholes 2 and 4.

4.10 Groundwater

Groundwater was observed in Boreholes 1, 2, 3, 4, 5 and 6 during the field investigation. Groundwater levels and water levels at the culvert can be expected to vary with season and precipitation events.

Table 4.6 Elevation of water table at boreholes

Borehole	Date	Depth of Ground water (m)	Ground water Elevation (m)
BH 1	February 2014	4.5	309.0
BH 2	March 2014	6.1	307.5
BH 3	March 2014	6.0	307.6
BH 4	February 2014	6.1	307.5
BH 5	April 2014	5.3	308.3
BH 6	February 2014	6.0	307.6

5. MISCELLANEOUS

Site work was carried out between February 20th and April 7th, 2014 utilizing a CME 750 or CME 55 drill rig that was operated by DST and by its sub-contractor (Landcore Drilling). Fieldwork was supervised on a full time basis by Joey Forgues and Spencer Haslehurst 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
Project Manager

A handwritten signature in black 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

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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



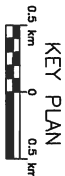
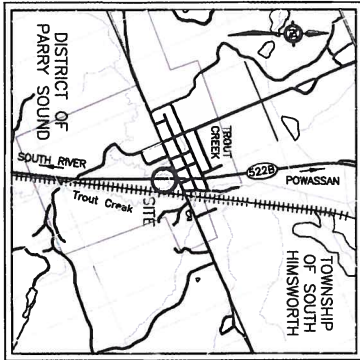
METRIC
DIMENSIONS ARE IN METERS
AND/OR MILLIMETER UNITS
OTHERWISE SHOWN. STATINGS
IN PARENTHESES + METERS

CONT No 5011-E-0035
GWP No 5427-06-00
GEOCRES No 31E-336



BRIDGE REPLACEMENT
TROUT CREEK BRIDGE
STA 12+300 TO STA 12+350
Survey 00-00 Revised

SHEET

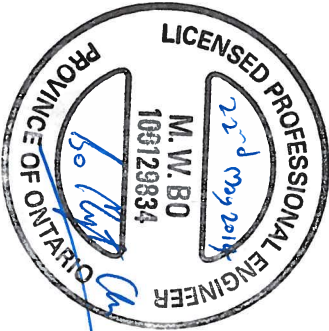
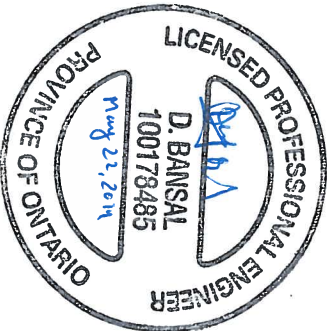


LEGEND

●	Borehole	■	Sand
○	Borehole with DCPT	■	Silt
⊕	Asphalt Core	■	Clay
●	Rock Probe	■	Sand & Gravel
⌵	Blows/0.3m (Std. Pen Test, 475 J/Blow)	■	Boulders
⌵	Water level at time of investigation.		
■	Fill		
■	Organics		
■	Topsoil		
■	Till		
■	Bedrock		

No.	Elevation	Heading	Station	Offset
BH1	313.23	5003040.70	627061.81	1.0 m LT
BH2	313.26	5003042.17	627059.04	3.0 m LT
BH3	313.27	5003042.15	627058.04	12.518
BH4	313.60	5003040.15	627053.15	3.0 m RT
BH5	313.60	5003040.04	627059.01	12.540
BH6	313.63	5003051.81	627060.95	3.0 m LT

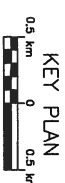
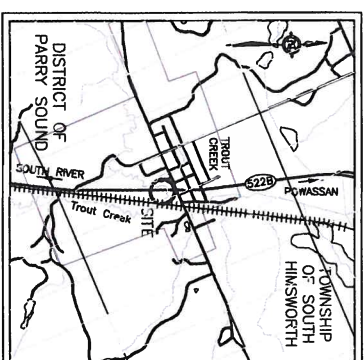
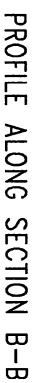
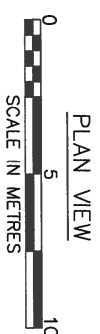
NOTE:
The boundaries between soil and gravel layers have not been established by laboratory
investigation. Between boreholes the boundaries are assumed by interpolation
and may not represent actual conditions.
Borehole coordinates system reference: UTM WAD83 Zone 17T



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DRAWING 1





LEGEND					
◆	Bornhole				
◆	Bornhole with DCR				
◆	Asphalt Core				
●	Rock Probe				
W	Borehole 3m (Std. Pen Test, 475 JIBLOW)				
▼	Water level at time of Investigation.				
		Fill	Organics	Topsoil	Till
		Bedrock			
No.	Elevation	Heading	Ending	Station	Notes
BH1	313.23	590826.70	627851.81	12+306	1.0 m L.A.
BH2	313.35	590826.17	627859.04	12+318	2.0 m L.A.
BH3	313.57	590826.15	627833.18	12+318	2.0 m RT
BH4	313.57	590826.04	627833.13	12+340	2.0 m RT
BH5	313.50	590844.04	627829.01	12+340	1.0 m L.A.
BH6	313.53	590851.81	627830.25	12+350	2.0 m L.A.

NOTE: The boundaries between roll areas have been established only at benchmark locations. Between benchmarks the boundaries are assumed by interpolation and may not represent actual conditions.

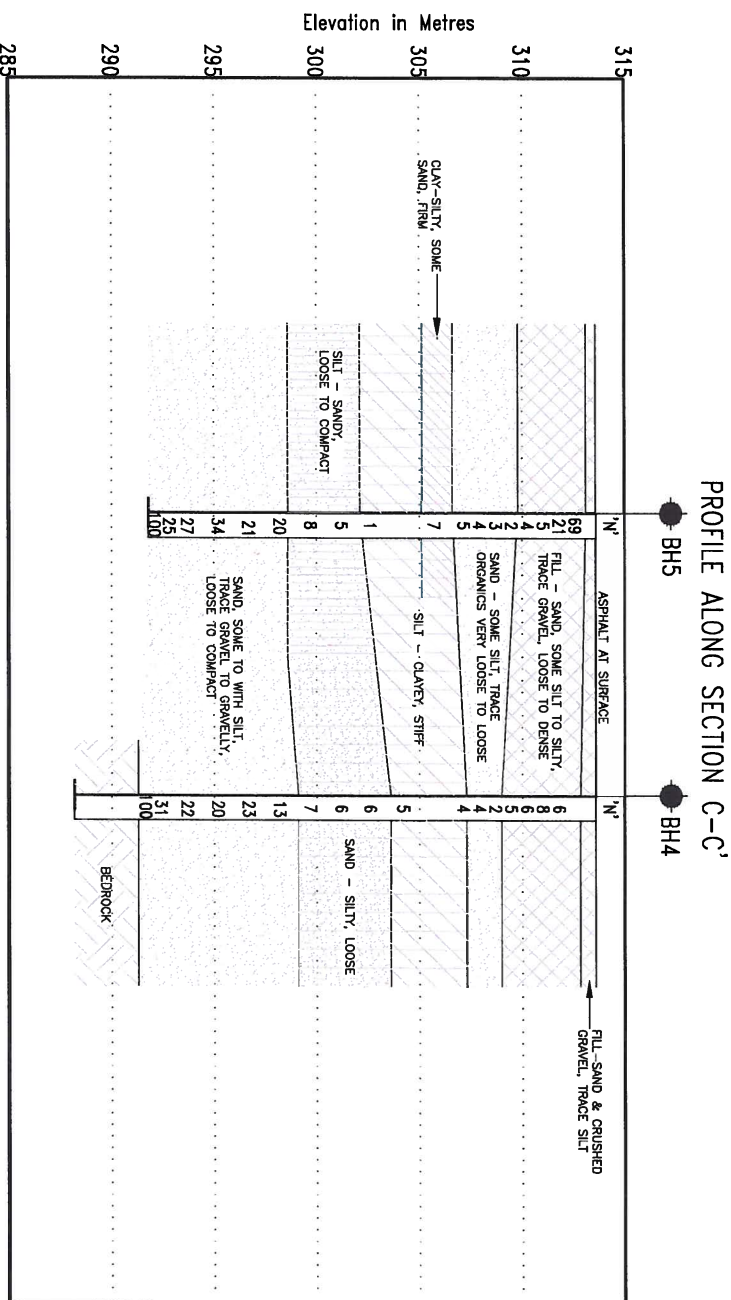
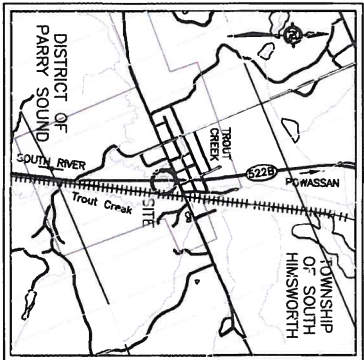
Benchmark coordinates system reference: UTM MGRS Zone 17T



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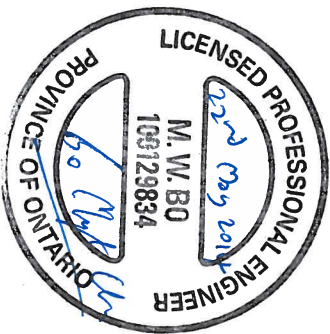
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DRAWING 3



LEGEND					
	Borehole				
	Borehole with DGPT				
	Alphal Core				
	Rock Probe				
	Blow/0.3m (Std. Pen Test, 475 g/Blow)				
	Water level of Case of Investigation.				
	Fill				
	Organics				
	Topsoil				
	Till				
	Bedrock				
	Sand				
	Silt				
	Clay				
	Sand & Gravel				
	Boulders				
No.	Elevation	Noting	Earing	Station	Orical
BH1	313.23	5092836.70	627895.41	12-300	1.0 m LT
BH2	313.26	5092831.17	627859.04	12-318	3.0 m LT
BH3	313.57	5092831.17	627833.04	12-318	3.0 m RT
BH4	313.00	5092840.43	627833.13	12-340	3.0 m RT
BH5	313.00	5092840.44	627839.21	12-340	3.0 m LT
BH6	5092835.51	627862.25	12-350		1.0 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.
Borehole coordinates system reference: UTM MADS Zone 17T



Appendix D
ENCLOSURES

METRIC

DATUM	GEODETIC	DATE	2014 02 20	CHECKED BY	DB
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ON MOT GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST_MIN.GDT 5/13/14

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. 5427-06-00 LOCATION Trout Creek Bridge: 5093821.17 m N, 627059.04 m E ORIGINATED BY JF
 DIST HWY HIGHWAY 522B BOREHOLE TYPE Hollow Stem Auger (80 mm ID)/Washbore COMPILED BY ML
 DATUM GEODETIC DATE 2014 03 22 CHECKED BY DB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L	WATER CONTENT (%)	GR SA SI CL			
313.6	GROUND SURFACE						312						Ground water @ 6.1m 21 72 (7)		
313.4	ASPHALT - 130 mm														
313.2	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		SS1	SS	12										
312.1	FILL - SAND - some gravel, trace silt, brown, compact		SS2	SS	51										
1.5	- COBBLES														
	FILL - SAND - Silty, brown, loose		SS3	SS	6										
			SS4	SS	5										
309.8															
3.8	SAND - Silty, trace wood and organics, brown/grey, loose		SS5	SS	5										
	- WOOD		SS6	SS	3										
308.1															
5.5	SAND - trace silt, grey, loose														
			SS7	SS	4										
306.6															
7.0	SILT - Clayey, grey, firm														
			SS8	SS	8										
305.1															
8.5	SILT - trace sand, grey, loose														
			SS9	SS	4										
303.6															
10.0	SAND - trace to with silt, trace to with gravel, brown/grey, loose to compact														
			SS10	SS	8										
			SS11	SS	4										
			SS12	SS	9										
			SS13	SS	13										
			SS14	SS	21										
			SS15	SS	20										
	- BOULDERS		SS16	SS	100+										

ON MOT GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST_MIN.GDT 5/13/14

NR = NO RECOVERY

+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH3

1 OF 1

METRIC

W.P. 5427-06-00 LOCATION Trout Creek Bridge: 5093821.15 m N, 627063.04 m E ORIGINATED BY JF
 DIST HWY HIGHWAY 522B BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML
 DATUM GEODETIC DATE 2014 03 23 CHECKED BY DB

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						
	GROUND SURFACE							20 40 60 80 100						GR SA SI CL
313.6	ASPHALT		AS1	AS										24.65 (11) Ground Water @6.0m
313.4	FILL - SAND & CRUSHED GRAVEL		SS2	SS	25									
313.3	FILL - SAND - some gravel, trace silt, brown, compact		SS3	SS	57									
311.8	FILL - SAND - Silty, trace gravel, brown, loose to dense		SS4	SS	3									0 45 (55)
			SS5	SS	6									
309.8	SILT - Clayey, trace sand, grey, very stiff		SS6	SS	1									
309.0	SAND - Silty, trace organics, grey, very loose		SS7	SS	2									0 61 (39)
308.1	SILT - Clayey, some sand, grey, firm		SS8	SS	4									
			SS9	SS	4									
305.1	SILT - some sand, grey, loose		SS10	SS	4									0 11 (89)
303.6	SAND - some silt, brown/grey, compact		SS11	SS	13									
301.0	End of Borehole at 12.6 m Start Dynamic Cone Penetration Test (DCPT)		SS12	SS	4									0 87 (13)
292.3	End of DCPT at 21.3 m on Possible Bedrock													
21.3														

ON_MOT GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST_MIN.GDT 5/13/14

NR = NO RECOVERY

+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ENCLOSURE 3

RECORD OF BOREHOLE No BH4

1 OF 1

METRIC

W.P. 5427-06-00 LOCATION Trout Creek Bridge: 5093840.13 m N, 627063.13 m E ORIGINATED BY JF
 DIST HWY HIGHWAY 522B BOREHOLE TYPE Hollow Stem Auger (80 mm ID)/Washbore COMPILED BY ML
 DATUM GEODETIC DATE 2014 02 20 CHECKED BY DB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
313.6	GROUND SURFACE							20 40 60 80 100					
313.9	ASPHALT - 130 mm		AS1	AS									
312.9	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		AS2	AS									Ground water @ 6.1m
0.8	FILL - SAND - some to with silt, trace gravel, brown, loose		SS3	SS	6								0 58 (42)
			SS4	SS	8								
			SS5	SS	6								0 89 (11)
			SS6	SS	5								
309.0			SS7	SS	2								
4.6	SAND - some silt, trace organics, brown, very loose		SS8	SS	4								2 75 (23)
307.3			SS9	SS	4								
6.3	SILT - Clayey, trace sand, grey, loose		ST10	ST									
			SS11	SS	5								
303.6													
10.0	SAND - Silty, grey, loose		SS12	SS	6								
			SS13	SS	6								0 55 (45)
			SS14	SS	7								
299.1													
14.5	SAND - with silt, trace to some gravel, brown/grey, compact		SS15	SS	13								
			SS16	SS	23								12 65 (23)
			SS17	SS	20								
			SS18	SS	22								
			SS19	SS	31								16 56 (28)
	- COBBLES		SS20	SS	100+								
291.3													
22.3	BEDROCK		RC1	RC									Start Washboring SPT 50/75 mm
	RC1 - 1.50 m, TCR - 100%, RQD - 70%												
	RC2 - 1.50 m, TCR - 100%, RQD - 98%		RC2	RC									
288.2													
25.4	End of Borehole at 25.4 m												

ON MOT GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST_MIN.GDT 5/13/14

NR = NO RECOVERY

+ ³, X ³: Numbers refer to
Sensitivity

○ ³% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH5

1 OF 1

METRIC

W.P. 5427-06-00 LOCATION Trout Creek Bridge: 5093840.04 m N, 627059.01 m E ORIGINATED BY JF
 DIST HWY HIGHWAY 522B BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML
 DATUM GEODETIC DATE 2014 04 07 CHECKED BY DB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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ON_MOT_GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST_MIN.GDT 5/13/14

NR = NO RECOVERY

+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ENCLOSURE 5

RECORD OF BOREHOLE No BH6

1 OF 1

METRIC

W.P. 5427-06-00 LOCATION Trout Creek Bridge: 5093851.81 m N, 627060.95 m E ORIGINATED BY JF
 DIST HWY HIGHWAY 522B BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML
 DATUM GEODETIC DATE 2014 02 20 CHECKED BY DB

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						
								20 40 60 80 100						
								20 40 60 80 100						

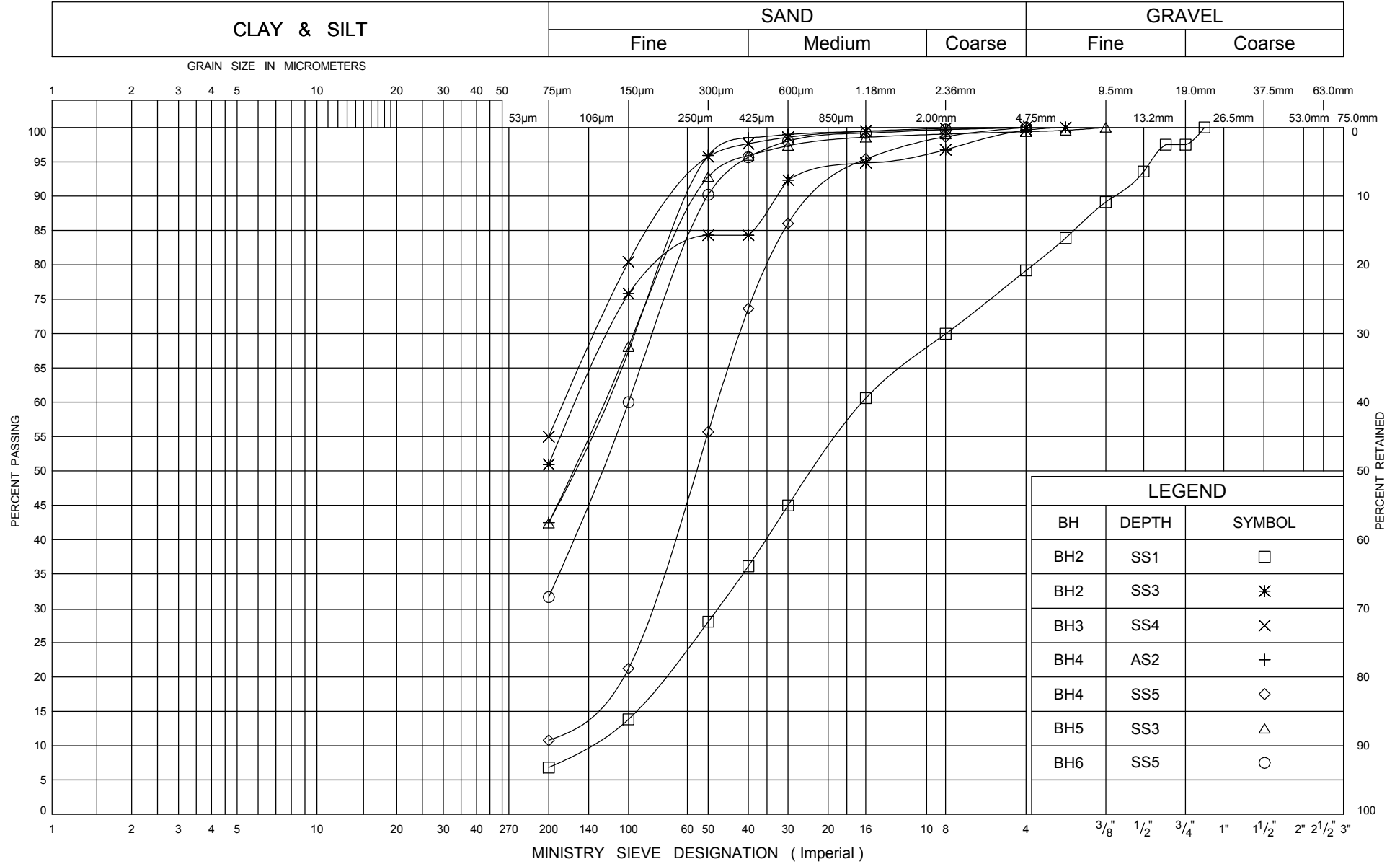
ON_MOT_GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST_MIN.GDT 5/13/14

NR = NO RECOVERY

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM

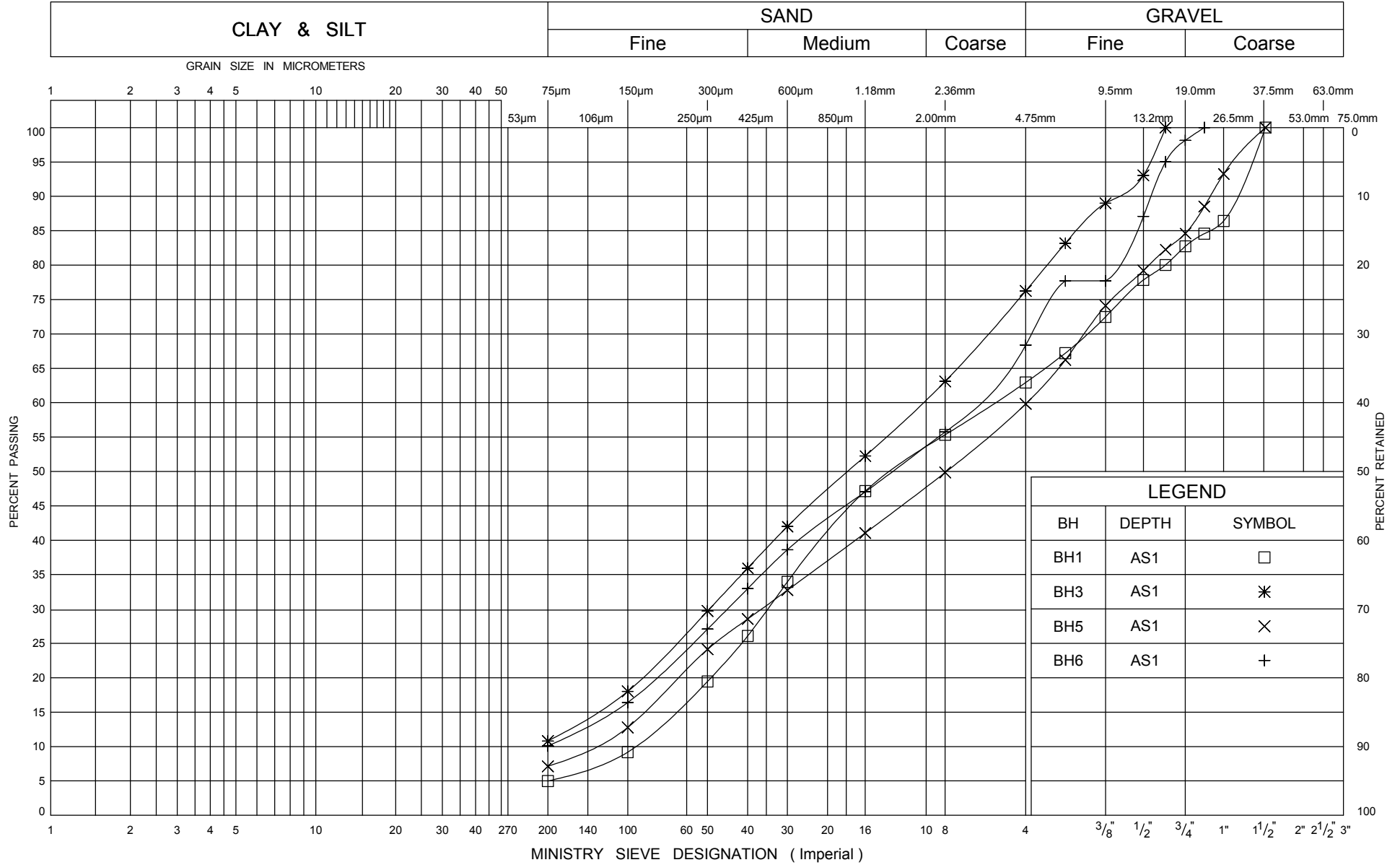


Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION
Fill - Sand - trace silt to silty

ENCLOSURE 7
W P 5427-06-00
HIGHWAY 522B

UNIFIED SOIL CLASSIFICATION SYSTEM

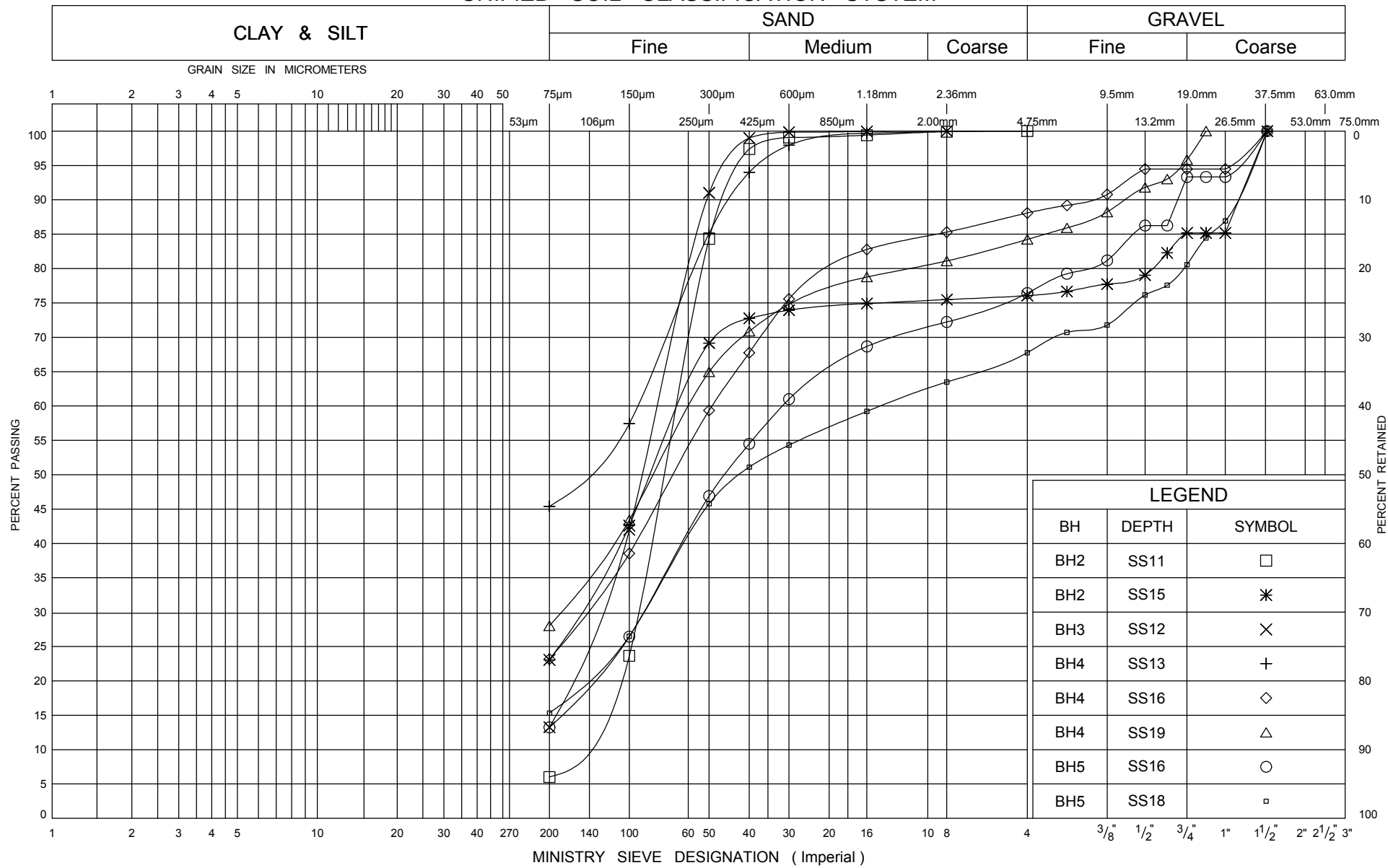


Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION
Fill - Sand & Crushed Gravel

ENCLOSURE 8
W P 5427-06-00
HIGHWAY 522B

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

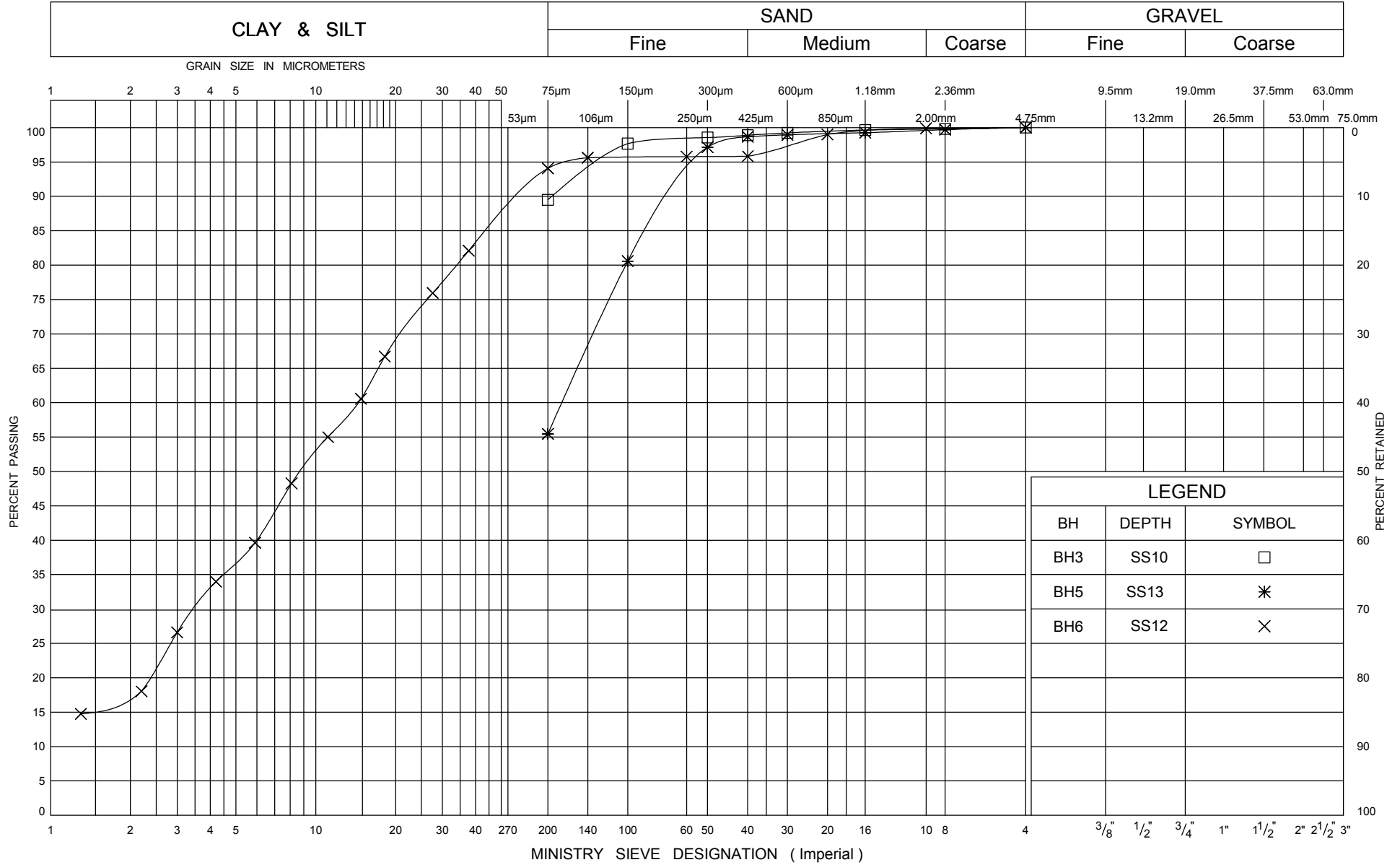
GRAIN SIZE DISTRIBUTION
Lower Sand Layer - trace silt to silty

ENCLOSURE 9

W P 5427-06-00

HIGHWAY 522B

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation
Ontario

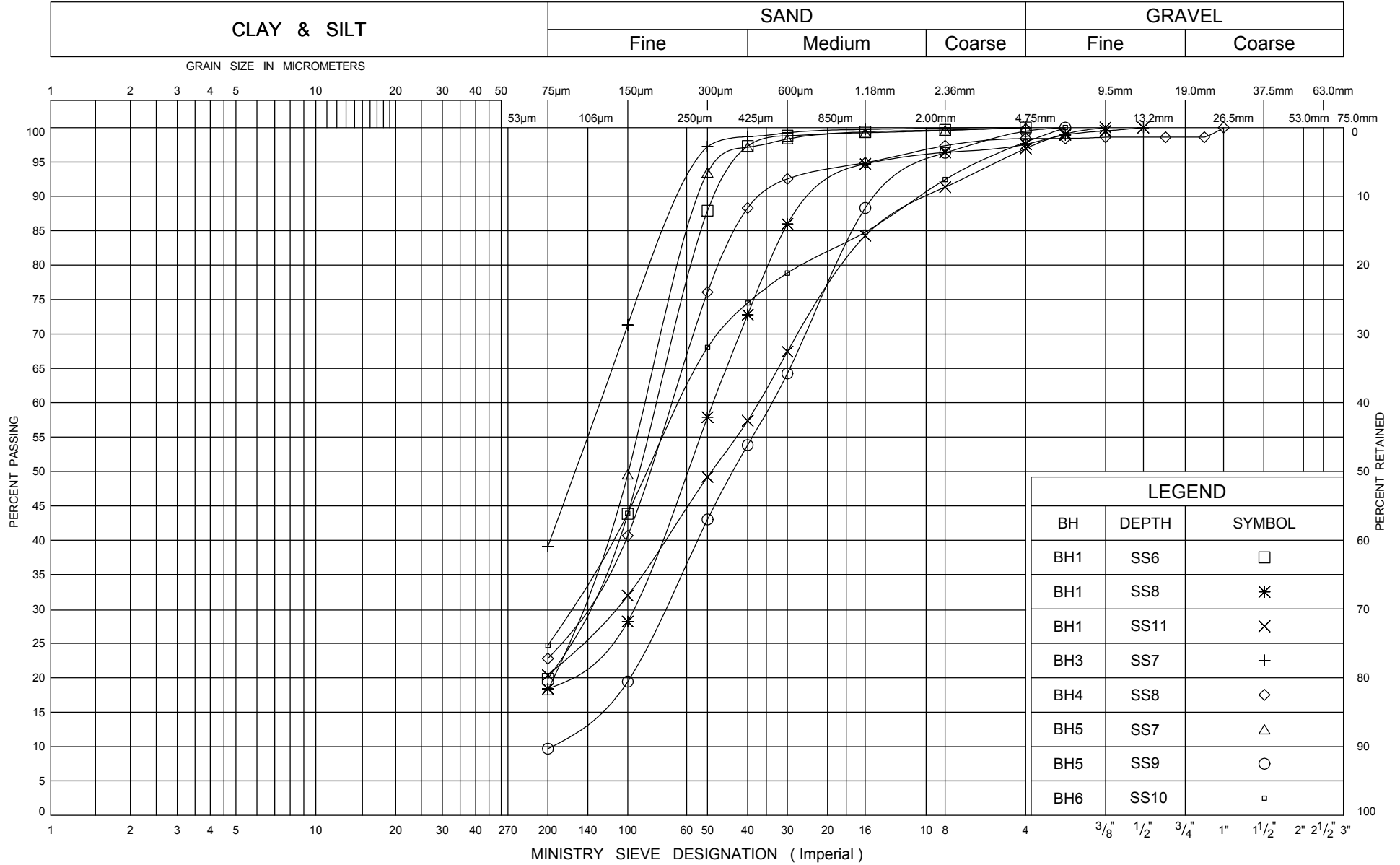
GRAIN SIZE DISTRIBUTION
Silt - trace sand to sandy

ENCLOSURE 10

W P 5427-06-00

HIGHWAY 522B

UNIFIED SOIL CLASSIFICATION SYSTEM



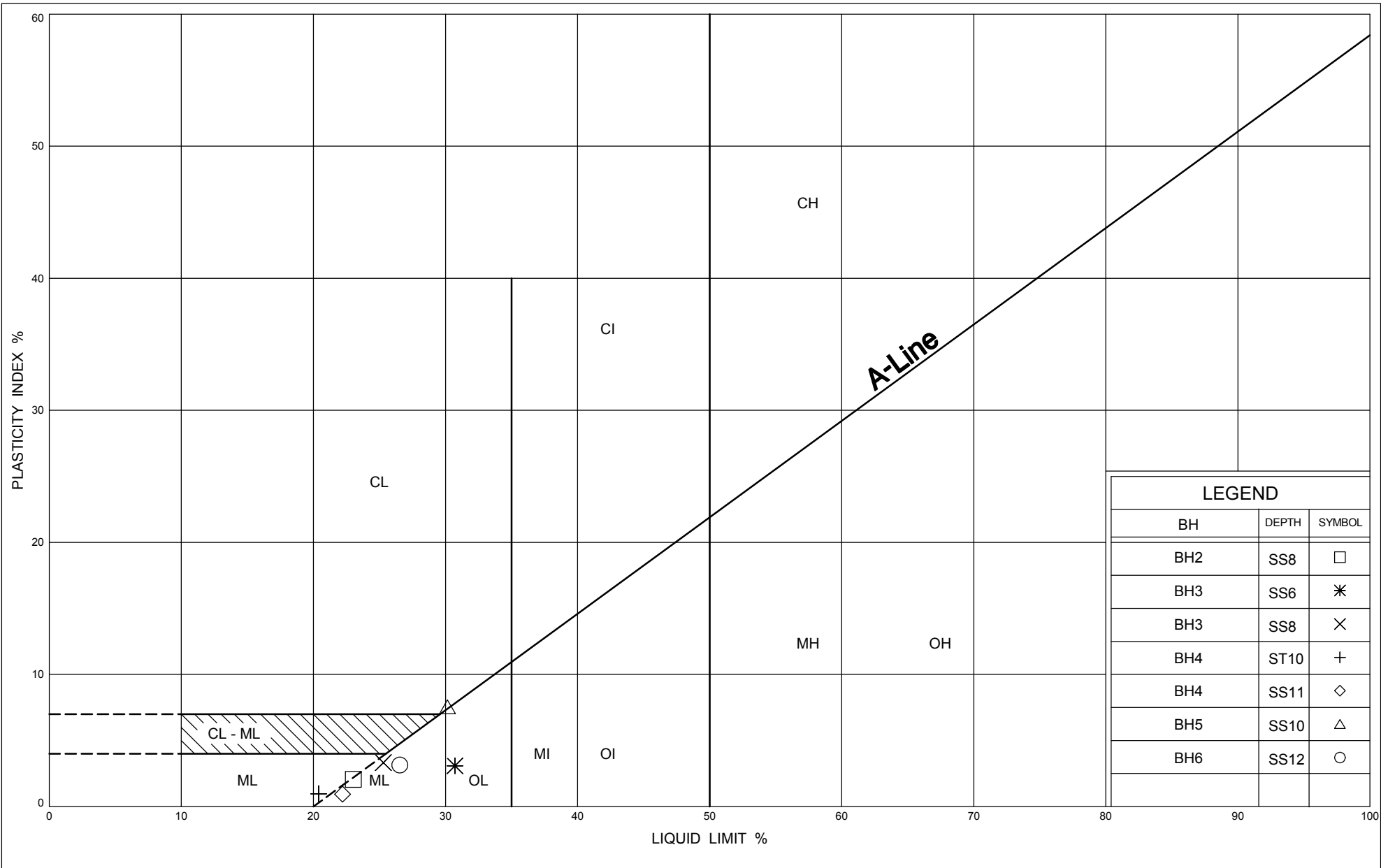
Ministry of
Transportation
Ontario

GRAIN SIZE DISTRIBUTION
Upper Sand Layer - some silt to silty

ENCLOSURE 11

W P 5427-06-00

HIGHWAY 522B



Ministry of
Transportation
Ontario

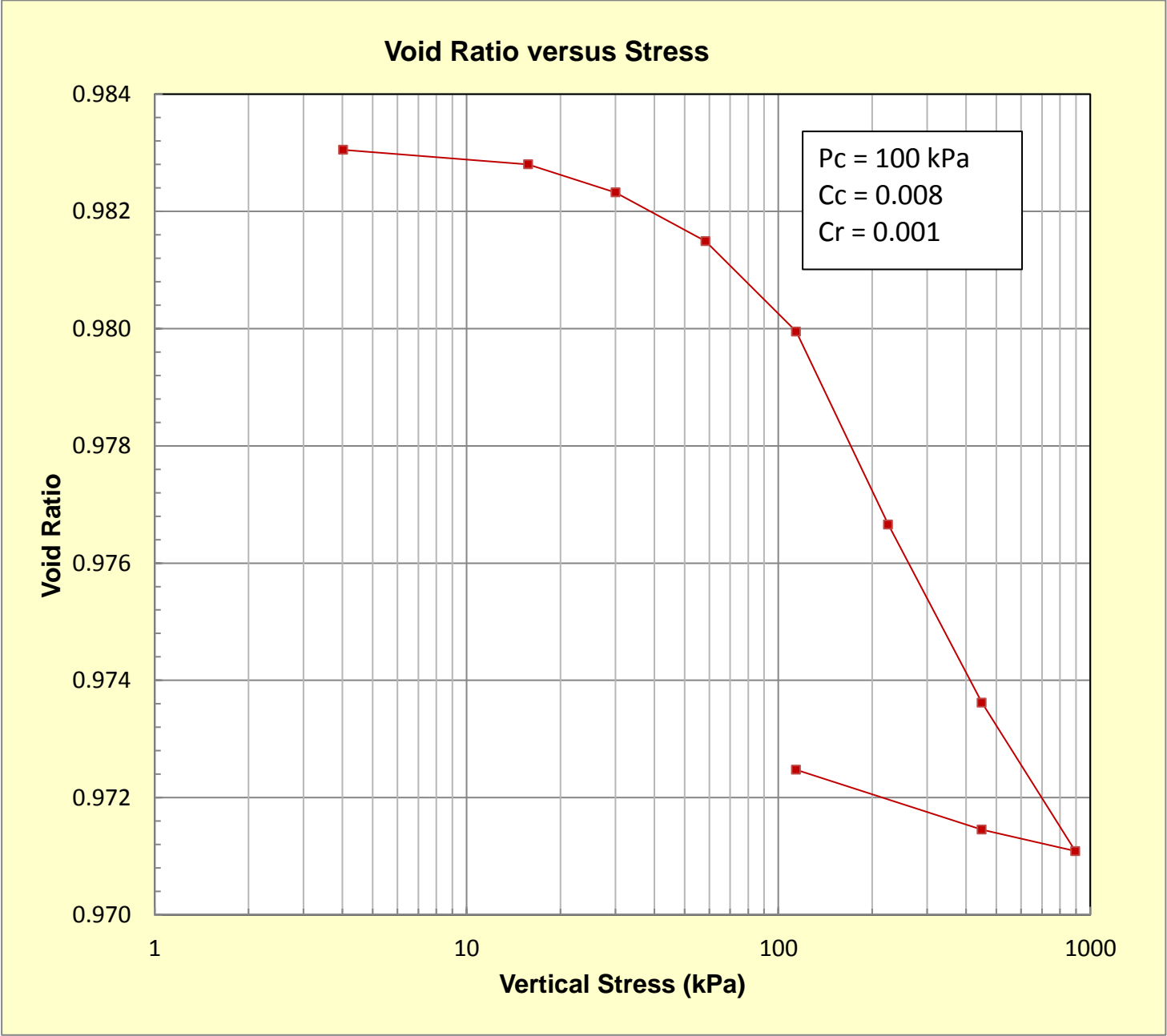
PLASTICITY CHART

ENCLOSURE 12

W P 5427-06-00

HIGHWAY 522B

Consolidation Test

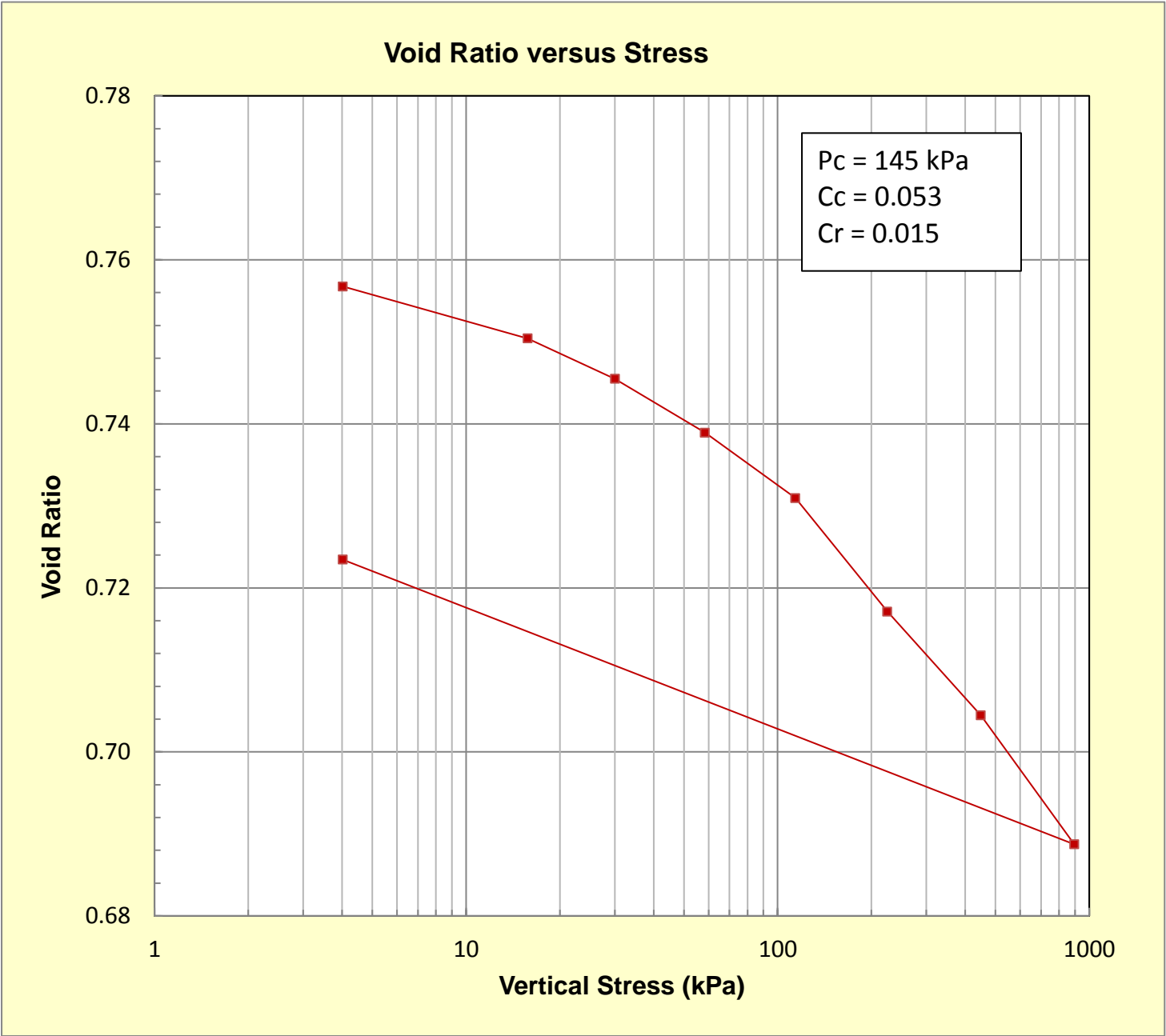


Reference No. GS-TB-018036

Borehole BH4 Depth 7.6 m

Trout Creek Bridge Replacement

Consolidation Test



Reference No. GS-TB-018036

Borehole BH6 depth 9.1 m

Trout Creek Bridge Replacement