



**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  
Northeastern Region  
447 McKeown Avenue, Suite 301  
North Bay, ON P1B 9S9

3 Copies - Ministry of Transportation, North Bay, ON  
1 Copy - DST Consulting Engineers Inc., Thunder Bay, ON

**DST CONSULTING ENGINEERS INC.**  
605 Hewitson Street, Thunder Bay, Ontario P7B 5V5  
Phone: 1-807-623-2929 Fax: 1-807-623-1792

THIS PAGE INTENTIONALLY LEFT BLANK

## Table of Contents

1. INTRODUCTION .....	1
2. SITE DESCRIPTION .....	2
3. INVESTIGATION PROCEDURES AND LABORATORY TESTING.....	4
4. DESCRIPTION OF SUBSURFACE CONDITIONS .....	6
4.1 Asphalt.....	6
4.2 Fill- sand and crushed gravel .....	6
4.3 Fill- sand .....	6
4.4 Upper sand layer .....	7
4.5 Silt-clayey .....	7
4.6 Clay-silty .....	8
4.7 Silt .....	8
4.8 Lower sand layer .....	9
4.9 Bedrock .....	9
4.10 Groundwater .....	10
5. MISCELLANEOUS .....	10
6. LIMITATIONS OF REPORT .....	11

## Appendices

LIMITATIONS OF REPORT .....	'A'
DESCRIPTION OF TERMS .....	'B'
DRAWINGS .....	'C'
ENCLOSURES .....	'D'

## List of Tables

Table 3.1	Detail of borehole locations .....	5
Table 4.1	Summary of sand and crushed gravel fill sieve analyses.....	6
Table 4.2	Summary of Laboratory Test for Clayey Silt .....	8
Table 4.3	Summary of Laboratory Test for Silty Clay .....	8
Table 4.4	Summary of lower silt layer sieve analyses .....	9
Table 4.5	Summary of lower sand layer sieve analyses .....	9

## List of Figures

Figure 2.1	Bridge Embankment looking west .....	3
Figure 2.2	Trout Creek Bridge looking west.....	3

**TROUT CREEK BRIDGE  
HIGHWAY 522, TOWNSHIP OF SOUTH HIMSWORTH  
NORTH BAY  
AGREEMENT NO.: 5011-E-0035  
ASSIGNMENT NO.: 10  
GEOCRES NO.:31E-336**

**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 Himsworth, 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 Himsworth, 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 20<sup>th</sup> and April 7<sup>th</sup>, 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 20<sup>th</sup> and April 7<sup>th</sup>, 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





**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

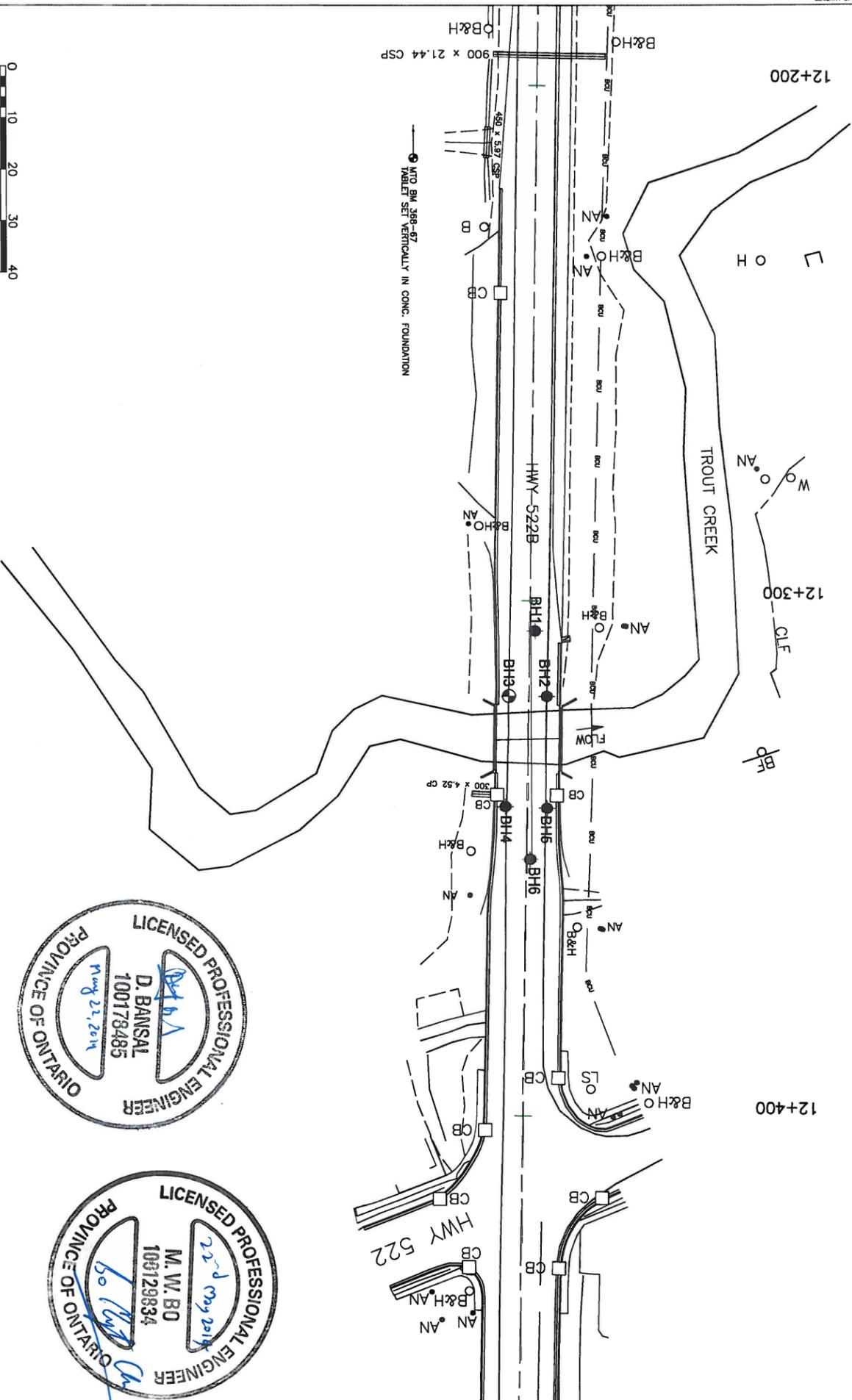
#### **LEGEND OF RECORDS FOR BOREHOLES: SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE**

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	$SENSITIVITY = \frac{UNDISTURBED\ SHEAR\ STRENGTH}{REMOLED\ SHEAR\ STRENGTH}$	

\*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**

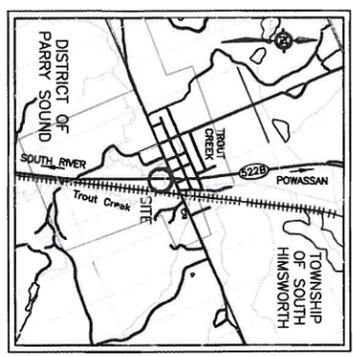
## **DRAWINGS**



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



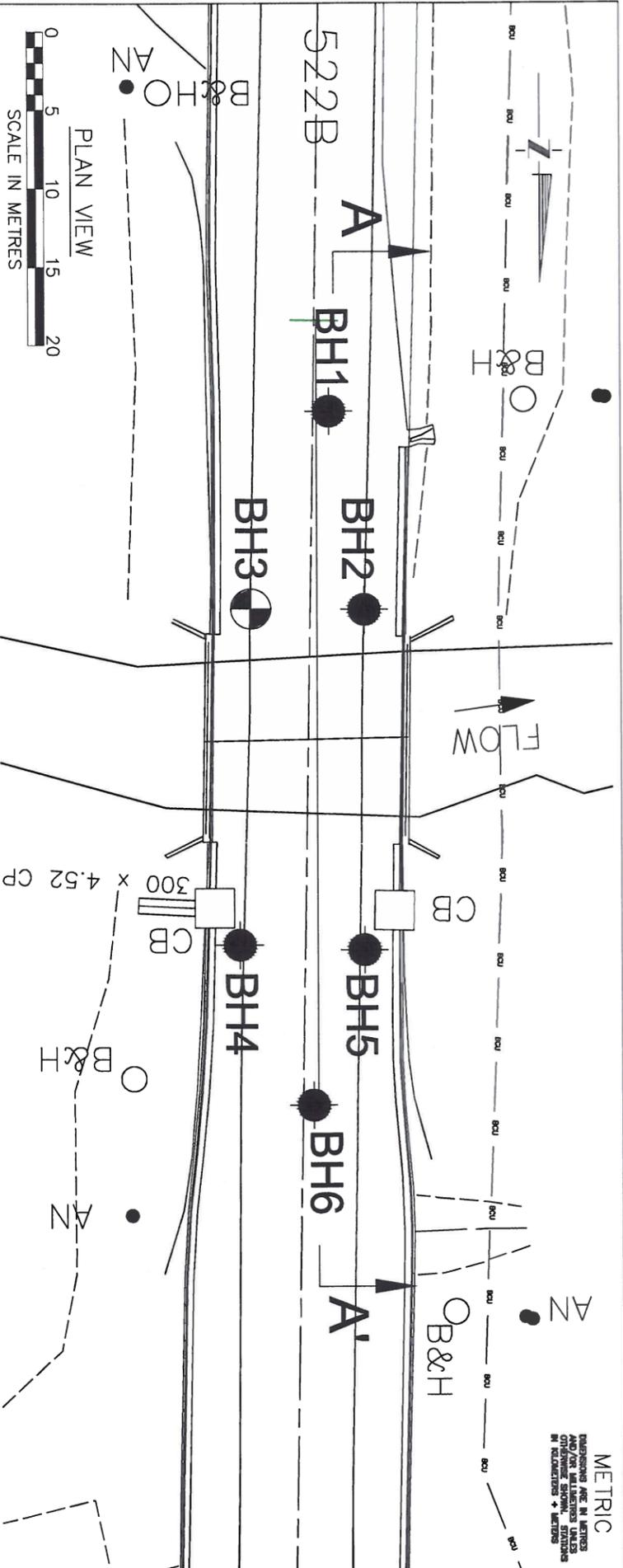
CONT No	5011-E-0035	
GWP No	5427-06-00	
GEORES No	31E-336	
BRIDGE REPLACEMENT TROUT CREEK BRIDGE		SHEET
STA	12+300 TO STA 12+350	
Survey	00-00 Revised	



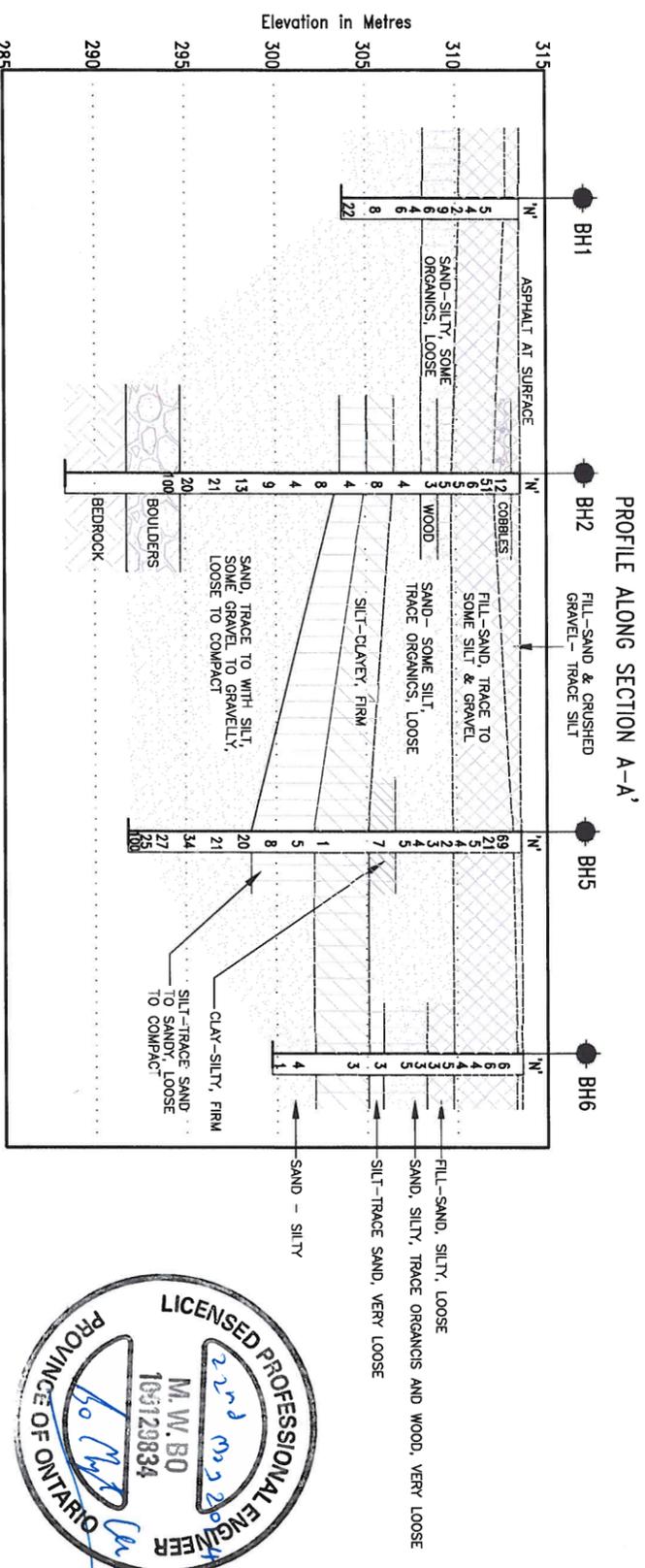
LEGEND	
	Borehole
	Borehole with DCP
	Asphalt Core
	Rock Probe
	Blow/3m (Std. Pen Test, 475 J/Blow)
	Water level at time of investigation.
	Fill
	Organics
	Topsoil
	Clay
	Sand & Gravel
	Bedrock
	Sand
	Silt
	Clay
	Boulders

NOTE:  
The boundaries between soil profile types have been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.  
Borehole coordinate system reference: UTM NAD83 Zone 17T

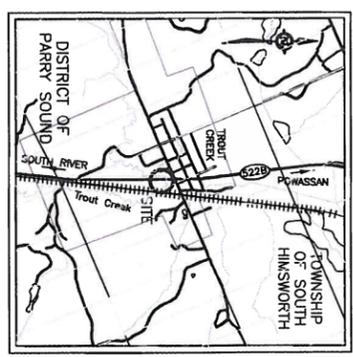
**DST** Consulting Engineers Inc.  
605 Hewitson Street  
Thunder Bay, ON P7B 5V5  
Ph: (807) 623-2529  
Fr: (807) 623-1732  
Email: thundersoy@dstgroup.com  
DRAWING 1



METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRE UNITS  
OTHERWISE SHOWN. STATISTICS  
IN PARENTHESES + METERS



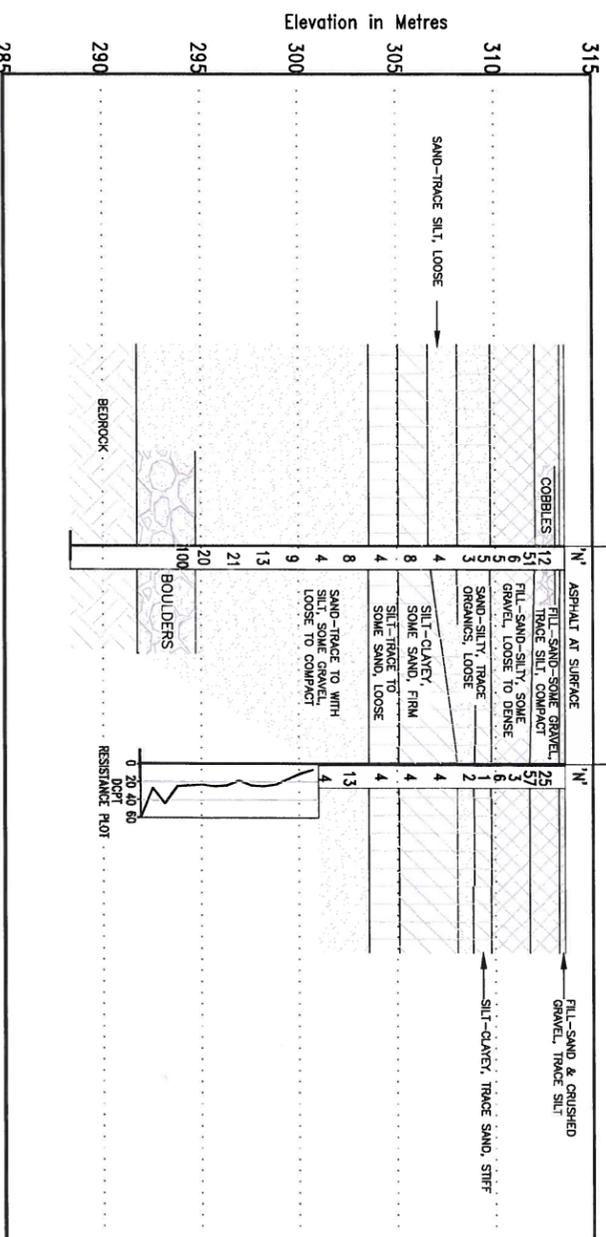
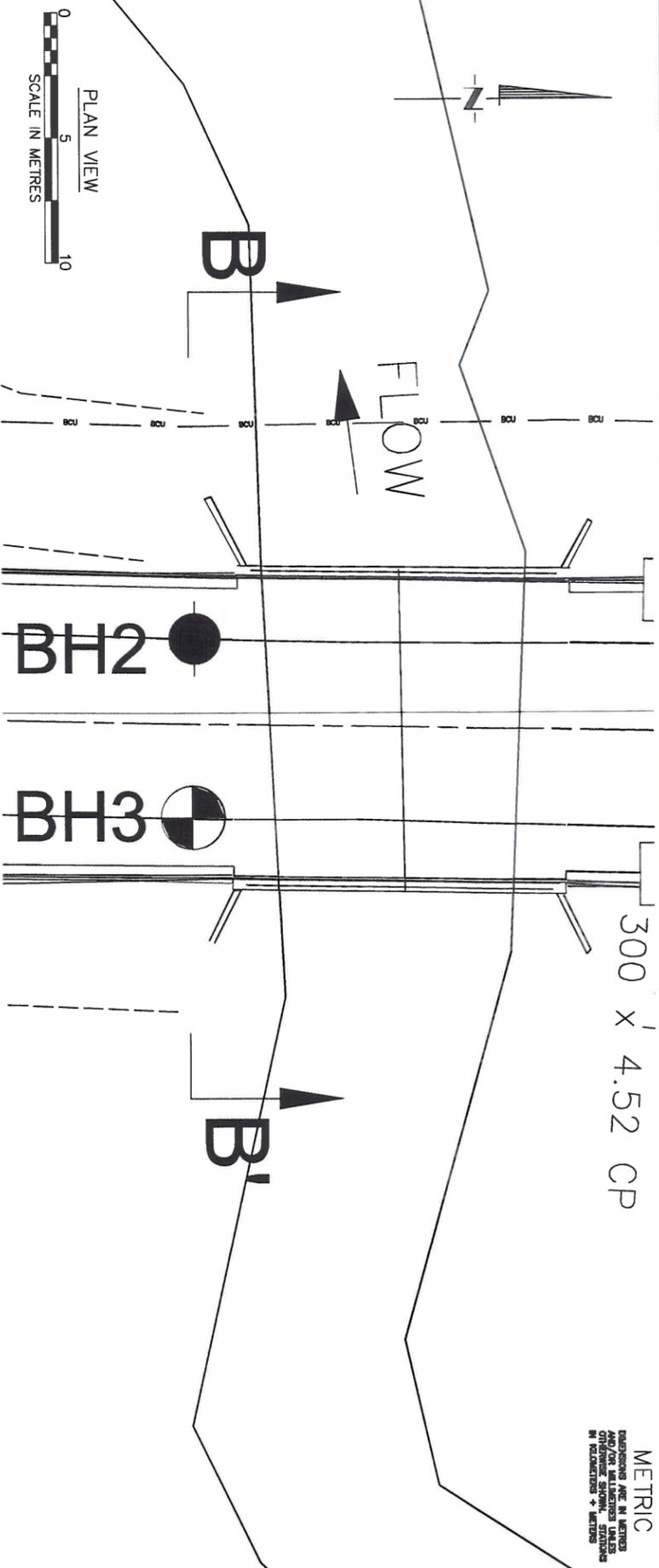
CONT	No	5011-E-0035	SHEET
GWP	No	5427-06-00	
GEORES	No	31E-336	
BRIDGE REPLACEMENT TROUT CREEK BRIDGE			
STA 12+300 TO STA 12+350			
Survey	00-00	Revised	



No.	Elevation	Heading	Ending	Station	Depth
BH1	313.53	000804.70	027091.81	124300	1.0 m LT
BH2	313.80	000821.17	027093.04	124310	3.0 m LT
BH3	313.87	000821.15	027093.04	124310	3.0 m RT
BH4	313.60	000804.64	027093.13	124300	3.0 m RT
BH5	313.60	000804.64	027093.01	124300	3.0 m LT
BH6	313.53	000801.81	027093.05	124300	1.0 m LT

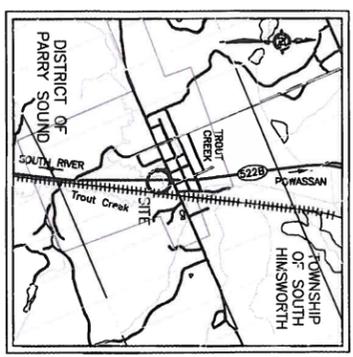
**NOTE:**  
The boreholes shown on this plan were installed by DST Engineering Inc. and may not represent actual conditions.  
Available coordinate system reference: UTM MADS Zone 17T

**DST** Consulting Engineers Inc.  
605 Hawkinson Street  
Thunder Bay, ON P7B 5V5  
Tel: (807) 623-2528  
Fax: (807) 623-2529  
Email: thunderbay@dstevp.com



METRIC  
 DIMENSIONS ARE IN METRES  
 AND/OR MILLIMETRE UNITS  
 UNLESS SHOWN OTHERWISE  
 IN DIMENSIONS + METERS

CONT No	5011-E-0035	SHEET
GWP No	5427-06-00	
GEOCRETS No	31E-336	
BRIDGE REPLACEMENT TROUT CREEK BRIDGE STA 12+300 TO STA 12+350		
Survey	00-00 Revised	



**LEGEND**

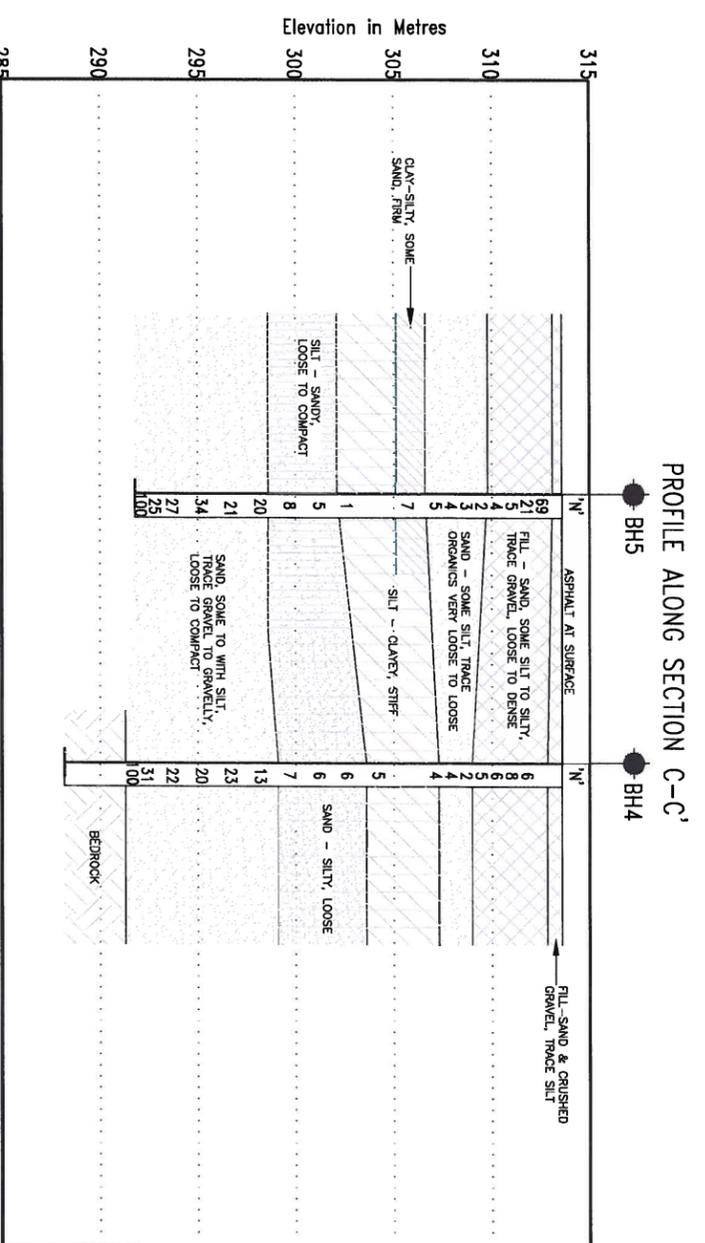
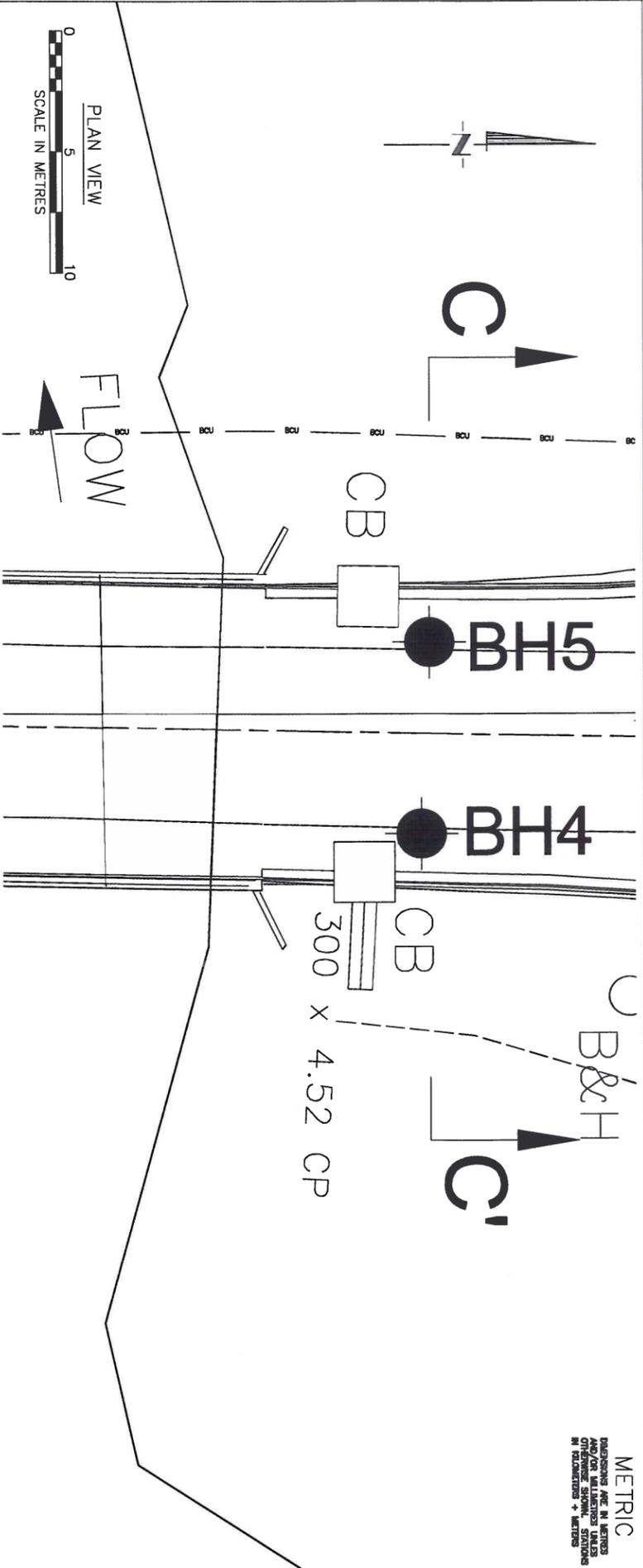
- Borehole
- ⊕ Borehole with DCP
- ⊕ Asphalt Core
- Rock Probe
- ⚡ Blows/3m (Std. Pen Test, 475 Jiblow)
- ▽ Water level at time of investigation.

No.	Elevation	Notations	Station	Overall
BH1	313.83	000808.70	02706.81	1.6 m LT
BH2	313.86	000821.17	02708.04	3.0 m LT
BH3	313.87	000821.15	02708.04	3.0 m RT
BH4	313.80	000804.04	02708.15	3.0 m RT
BH5	313.80	000804.04	02708.01	3.0 m LT
BH6	313.83	000851.81	02708.05	1.4 m LT

**NOTE:**  
 The borehole stations and depth have been established only at borehole and may not represent actual conditions.  
 Borehole coordinate system reference: UTM MGRS Zone 17T

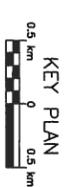
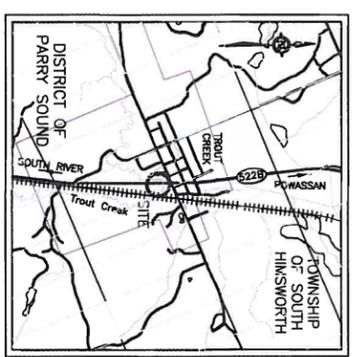


**DST** Consulting Engineers Inc.  
 605 Hamilton Street  
 Thunder Bay, ON P7B 5V5  
 P: (807) 623-2828  
 F: (807) 623-1782  
 Email: thundersbay@dstgroup.com  
 DRAWING 3



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

CONT No	5011-E-0035	SHEET
GMP No	5427-06-00	
GEOCONS No	31E-336	
BRIDGE REPLACEMENT TROUT CREEK BRIDGE STA 12+300 TO STA 12+350		
Survey	00-00 Revised	

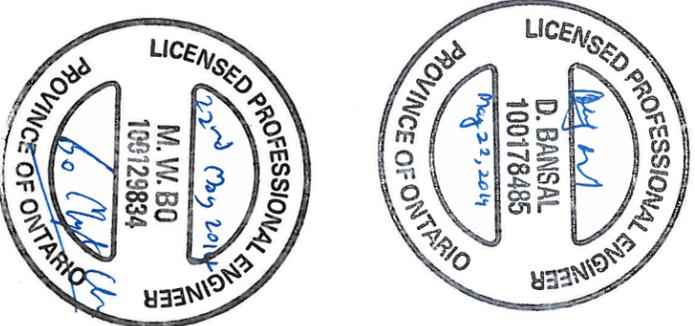


LEGEND

- ◆ Borehole
- ⊕ Borehole with DQPT
- ⊕ Asphalt Core
- Rock Probe
- ⊕ Blown, 3m (Std. Pen Test, 479 Jiblow)
- ▽ Water level at time of investigation.

No.	Elevation	Northing	Easting	Station	Ordnal
BH1	313.25	609806.70	627061.81	12+306	1.0 m LT
BH2	313.26	609821.17	627058.04	12+319	3.0 m LT
BH3	313.27	609821.15	627063.04	12+319	3.0 m RT
BH4	313.20	609806.15	627063.13	12+340	3.0 m RT
BH5	313.20	609806.04	627059.01	12+340	3.0 m LT
BH6	313.23	609801.91	627060.25	12+350	1.0 m LT

NOTE:  
The boundaries between our areas have been established only at borehole  
locations. The boundaries between our areas are shown on the drawings  
and may not represent actual conditions.  
Available coordinate system reference: UTM (NAD83) Zone 17T



**DST** Consulting Engineers Inc.  
605 Hawkeston Street  
Thunder Bay, ON P7B 5V5  
P: (807) 623-2828  
F: (807) 623-1752  
Email: [thunderbay@engrpro.com](mailto:thunderbay@engrpro.com)

DRAWING 4

**Appendix D**  
**ENCLOSURES**

**RECORD OF BOREHOLE No BH1**

1 OF 1

**METRIC**

W.P. 5427-06-00 LOCATION Trout Creek Bridge: 5093806.70 m N, 627061.61 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 <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										WATER CONTENT (%)	
							20	40	60	80	100		20	40	60	GR	SA	SI	CL
313.5	GROUND SURFACE																		
313.4	ASPHALT - 130 mm	[Hatched]																	
312.8	FILL - SAND & CRUSHED GRAVEL - trace silt, brown	[Cross-hatched]	AS1	AS															Ground water@4.5m 37 58 (5)
0.8	FILL - SAND - some gravel to gravelly, trace to some silt, brown, very loose to loose	[Dotted]	AS2	AS															
			SS3	SS	5														
			SS4	SS	4														
310.2			SS5	SS	2														
3.3	SAND - some organics and silt, brown, loose	[Dotted]	SS6	SS	9														0 80 (20)
309.4			SS7	SS	6														
4.1	SAND - Silty, some organics, brown/grey, loose	[Dotted]	SS8	SS	4														
308.2			SS9	SS	6														
5.3	SAND - some silt, trace gravel, grey, loose	[Dotted]	SS10	SS	8														2 80 (18)
			SS11	SS	22														
303.9																			
303.7	SILT - Clayey	[Horizontal lines]																	
9.8	End of Borehole at 9.8 m																		

ON\_MOT\_GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST\_MIN.GDT 5/13/14

NR = NO RECOVERY      +<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3</sup>% 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 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			20	40	60					
313.6	GROUND SURFACE														
313.4	ASPHALT - 130 mm														
313.2	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		SS1	SS	12										Ground water @ 6.1m
312.1	FILL - SAND - some gravel, trace silt, brown, compact - COBBLES		SS2	SS	51										
1.5	FILL - SAND - Silty, brown, loose		SS3	SS	6										
309.8			SS4	SS	5										0 49 (51)
308.1	SAND - Silty, trace wood and organics, brown/grey, loose - WOOD		SS5	SS	5										
308.1			SS6	SS	3										
306.6	SAND - trace silt, grey, loose														
306.6			SS7	SS	4										
305.1	SILT - Clayey, grey, firm														
305.1			SS8	SS	8										
303.6	SILT - trace sand, grey, loose														
303.6			SS9	SS	4										
303.6	SAND - trace to with silt, trace to with gravel, brown/grey, loose to compact														Start Washboring
303.6			SS10	SS	8										
			SS11	SS	4										0 94 (6)
			SS12	SS	9										
			SS13	SS	13										
			SS14	SS	21										
			SS15	SS	20										24 53 (23)
	- BOULDERS		SS16	SS	100+										SPT 25/100 mm
291.8	BEDROCK														
291.8			RC1	RC											
	RC1 - 1.50 m, TCR - 100%, RQD - 100%														
	RC2 - 1.50 m, TCR - 100%, RQD - 100%		RC2	RC											
288.4															
25.2	End of Borehole at 25.2 m														

ON\_MOT\_GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST\_MIN.GDT 5/13/14

NR = NO RECOVERY      +<sup>3</sup>, X<sup>3</sup>: 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 <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			20	40	60	80						100	20
313.6	GROUND SURFACE																	
313.4	ASPHALT		AS1	AS														
313.3	FILL - SAND & CRUSHED GRAVEL																	
	FILL - SAND - some gravel, trace silt, brown, compact		SS2	SS	25													24.65 (11) Ground Water @6.0m
311.8	FILL - SAND - Silty, trace gravel, brown, loose to dense		SS3	SS	57													0 45 (55)
			SS4	SS	3													
			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																	

ON\_MOT\_GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ\_DST\_MIN.GDT 5/13/14

NR = NO RECOVERY      +<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

**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				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			20	40	60	80						100	20
313.6	GROUND SURFACE																	
313.7	ASPHALT - 130 mm		AS1	AS														Ground water @ 6.1m
312.9	FILL - SAND & CRUSHED GRAVEL - trace silt, brown																	58 (42)
0.8	FILL - SAND - some to with silt, trace gravel, brown, loose		AS2	AS														
			SS3	SS	6													
			SS4	SS	8													
			SS5	SS	6													0 89 (11)
			SS6	SS	5													
309.0	SAND - some silt, trace organics, brown, very loose		SS7	SS	2													
4.6			SS8	SS	4													2 75 (23)
307.3	SILT - Clayey, trace sand, grey, loose		SS9	SS	4													
6.3			ST10	ST														58.6
			SS11	SS	5													
303.6	SAND - Silty, grey, loose																	
10.0			SS12	SS	6													
			SS13	SS	6													0 55 (45)
			SS14	SS	7													
299.1	SAND - with silt, trace to some gravel, brown/grey, compact		SS15	SS	13													
14.5			SS16	SS	23													12 65 (23)
			SS17	SS	20													
			SS18	SS	22													
	- COBBLES		SS19	SS	31													16 56 (28)
			SS20	SS	100+													
291.3	BEDROCK		RC1	RC														Start Washboring SPT 50/75 mm
22.3	RC1 - 1.50 m, TCR - 100%, RQD - 70%		RC2	RC														
	RC2 - 1.50 m, TCR - 100%, RQD - 98%																	
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 +<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity ○<sup>3</sup>% 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					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			20	40	60	80	100						20
313.6	GROUND SURFACE																	
313.4	ASPHALT - 200 mm		AS1	AS														
313.1	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		SS2	SS	69													40 53 (7) Ground water @5.3 m
312.5	FILL - SAND - some silt to silty, trace gravel, brown, loose to dense		SS3	SS	21													1 57 (42)
			SS4	SS	5													
			SS5	SS	4													
309.8			SS6	SS	2													
3.8	SAND - some silt, trace organics, grey, very loose to loose,		SS7	SS	3													0 82 (18)
			SS8	SS	4													
			SS9	SS	5													1 89 (10)
306.6			SS10	SS	7													
7.0	CLAY - Silty, some sand, grey, firm																	
305.1			ST11	ST														
8.5	SILT - Clayey, grey																	
			SS12	SS	1													
302.1																		
11.5	SILT - Sandy, grey, loose to compact		SS13	SS	5													0 45 (55)
			SS14	SS	8													
298.6																		
15.0	SAND - with gravel to gravelly, some silt, grey, compact to dense		SS15	SS	20													
			SS16	SS	21													24 63 (13)
			SS17	SS	34													
			SS18	SS	27													32 53 (15)
			SS19	SS	25													
			SS20	SS	100+													
291.8																		
21.8	End of Borehole at 21.8 m Refusal on Possible Bedrock																	SPT 50/100 mm

ON\_MOT\_GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST\_MIN.GDT 5/13/14

NR = NO RECOVERY      +<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

**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

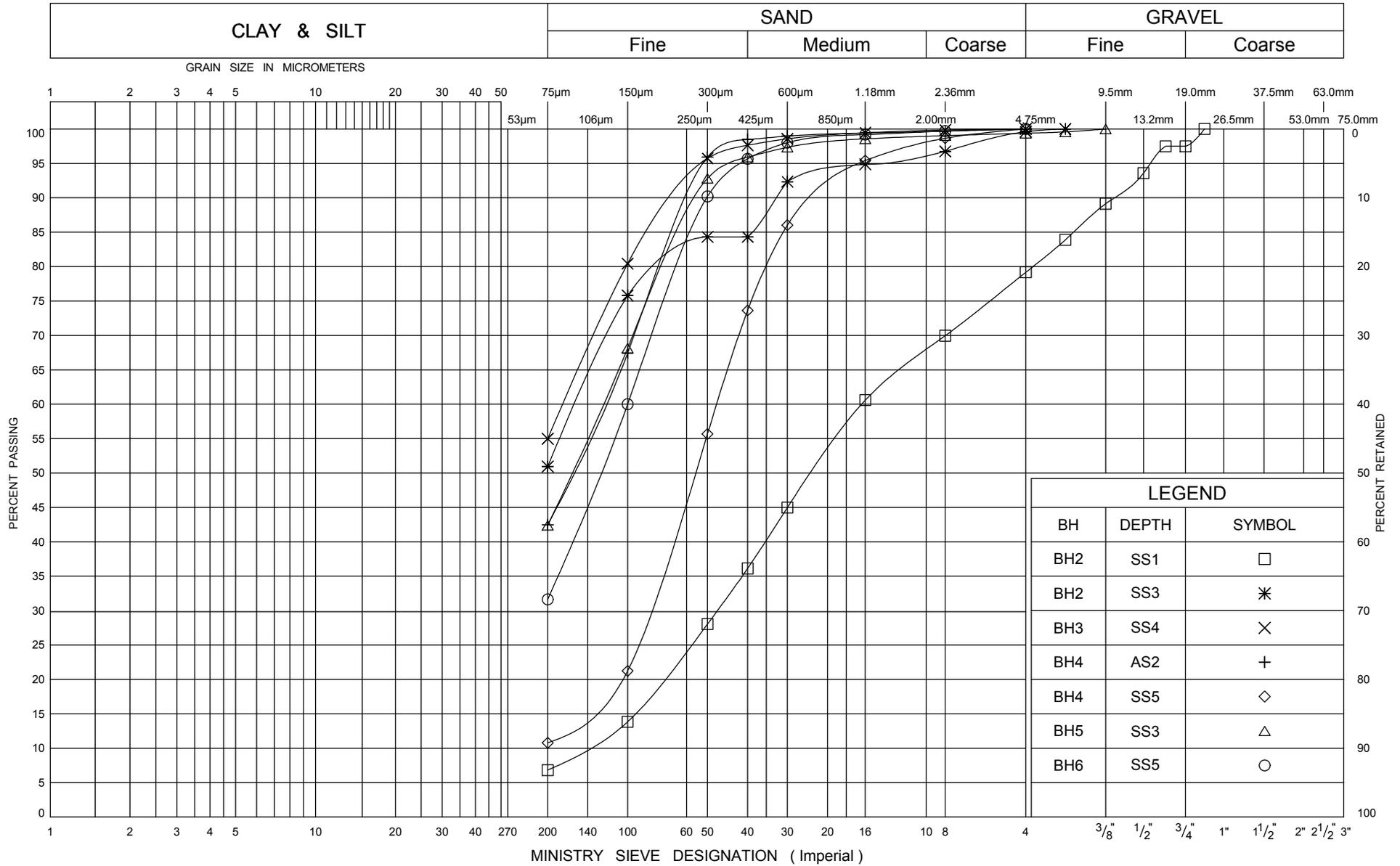
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20	40	60	80	100	PLASTIC LIMIT $w_p$	NATURAL MOISTURE CONTENT $w$	LIQUID LIMIT $w_L$	GR SA SI CL
											WATER CONTENT (%)			
											20	40	60	
313.6	GROUND SURFACE													
313.5	ASPHALT - 130 mm		AS1	AS										32 58 (10)
313.3	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		AS2	AS										Ground water @ 6.0 m
	FILL - SAND - some silt, trace gravel, brown, loose		SS3	SS	6									
			SS4	SS	6									
			SS5	SS	4									0 68 (32)
			SS6	SS	4									
309.8	FILL - SAND - Silty, grey, loose		SS7	SS	5									0 59 (41)
			SS8	SS	3									
308.3	SAND - with Silt, trace organics and wood, grey, very loose		SS9	SS	3									2 73 (25)
	- ORGANICS		SS10	SS	5									
305.9	SILT - trace sand grey, very loose		ST11	SS	3									
305.1	SILT - Clayey, grey, stiff to very stiff													
			SS12	SS	3									59.9 0 6 77 17
			SS13	ST										
302.1	SAND - Silty, grey, loose													
			SS14	SS	4									
299.7	End of Borehole at 13.9 m		SS15	SS	1									

ON\_MOT\_GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ\_DST\_MIN.GDT 5/13/14

NR = NO RECOVERY + <sup>3</sup>, X <sup>3</sup>: Numbers refer to Sensitivity ○ <sup>3</sup>% STRAIN AT FAILURE

ONTARIO MOT GRAIN SIZE GS-TB-018036 TROUT CREEK BRIDGE REPLACEMENT.GPJ DST\_MIN.GDT 5/14/14

## UNIFIED SOIL CLASSIFICATION SYSTEM

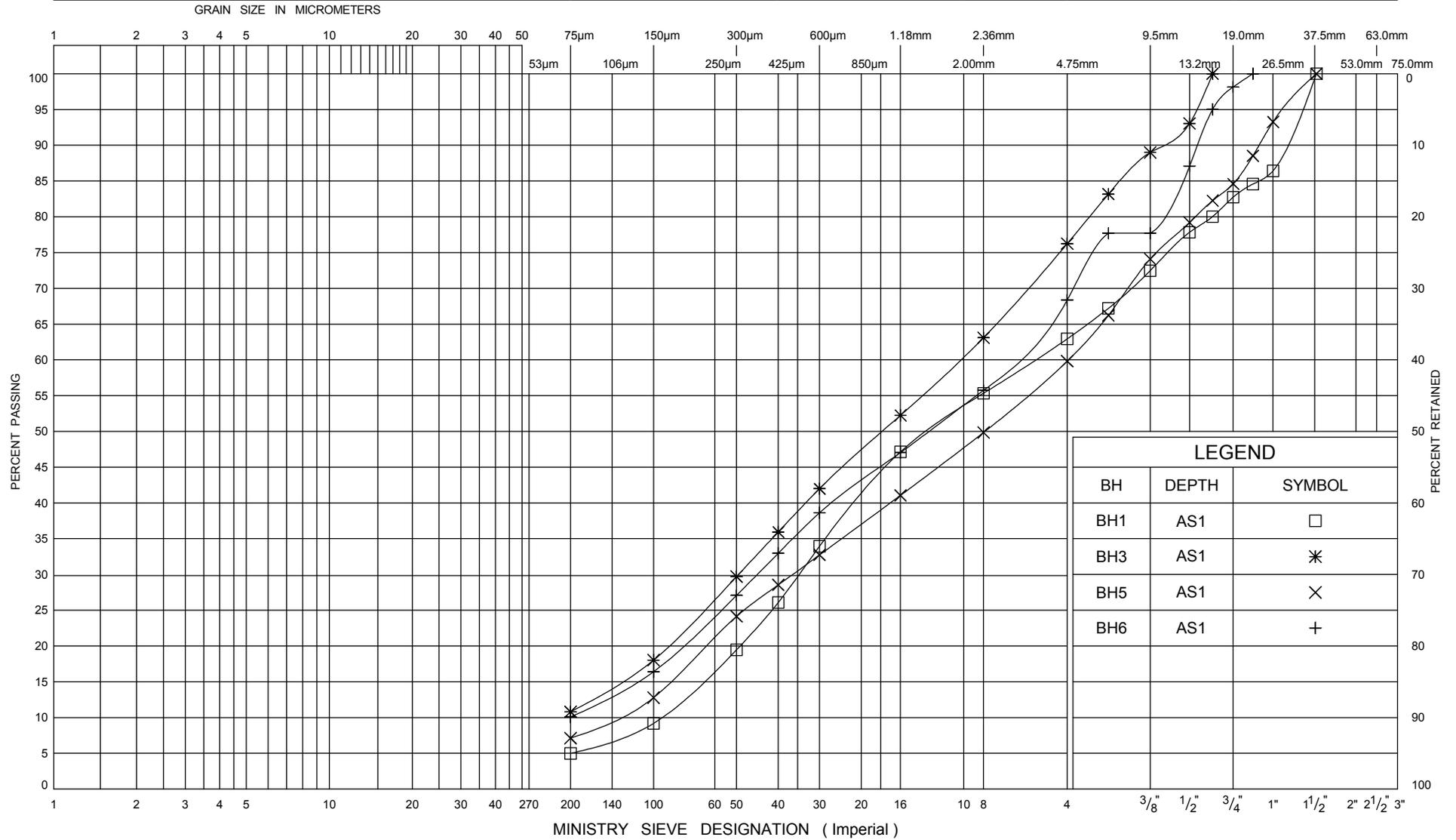


### GRAIN SIZE DISTRIBUTION Fill - Sand - trace silt to silty

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

## UNIFIED SOIL CLASSIFICATION SYSTEM

<b>CLAY &amp; SILT</b>	<b>SAND</b>			<b>GRAVEL</b>	
	Fine	Medium	Coarse	Fine	Coarse

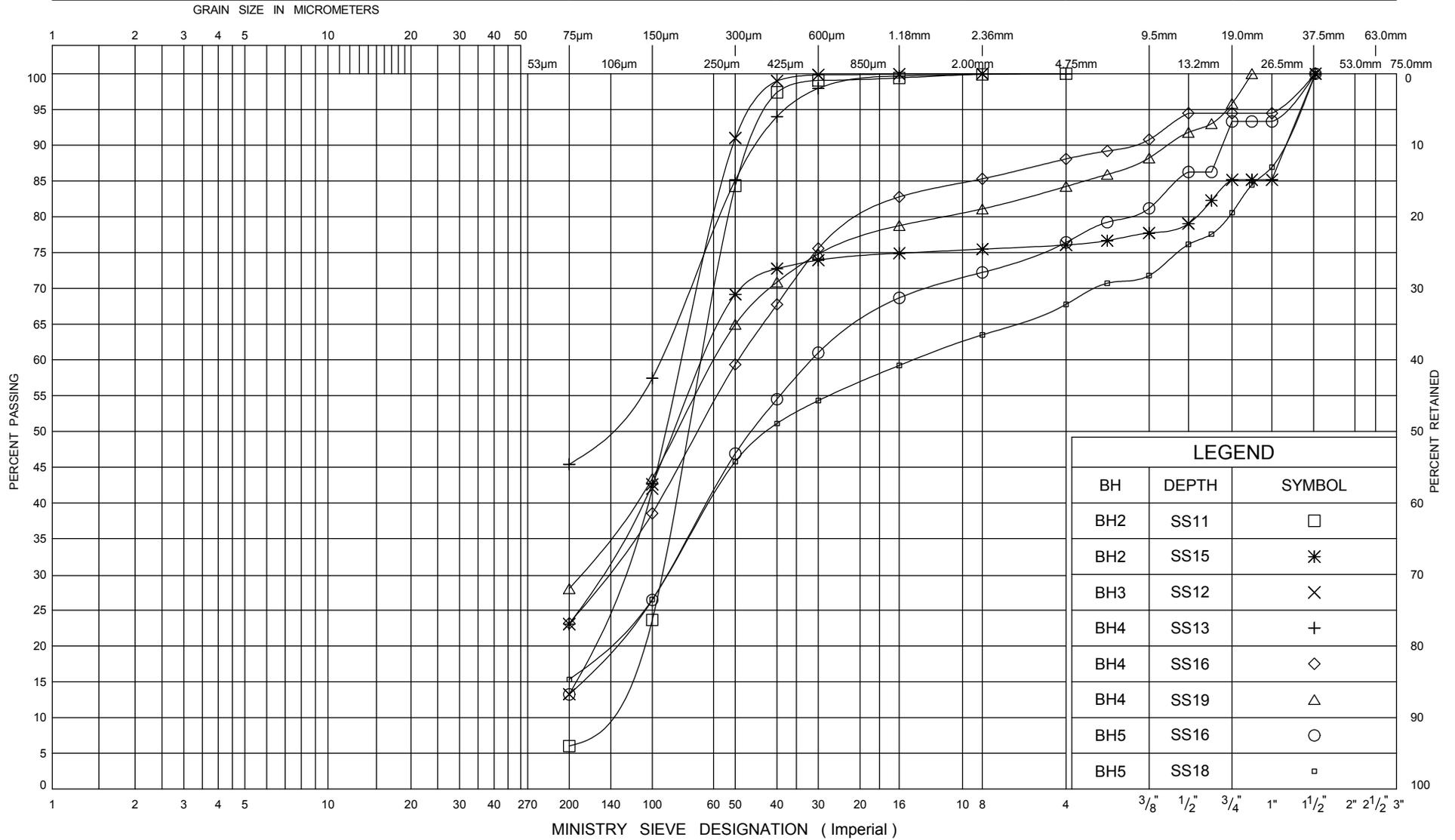


### GRAIN SIZE DISTRIBUTION Fill - Sand & Crushed Gravel

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

## UNIFIED SOIL CLASSIFICATION SYSTEM

<b>CLAY &amp; SILT</b>	<b>SAND</b>			<b>GRAVEL</b>	
	Fine	Medium	Coarse	Fine	Coarse

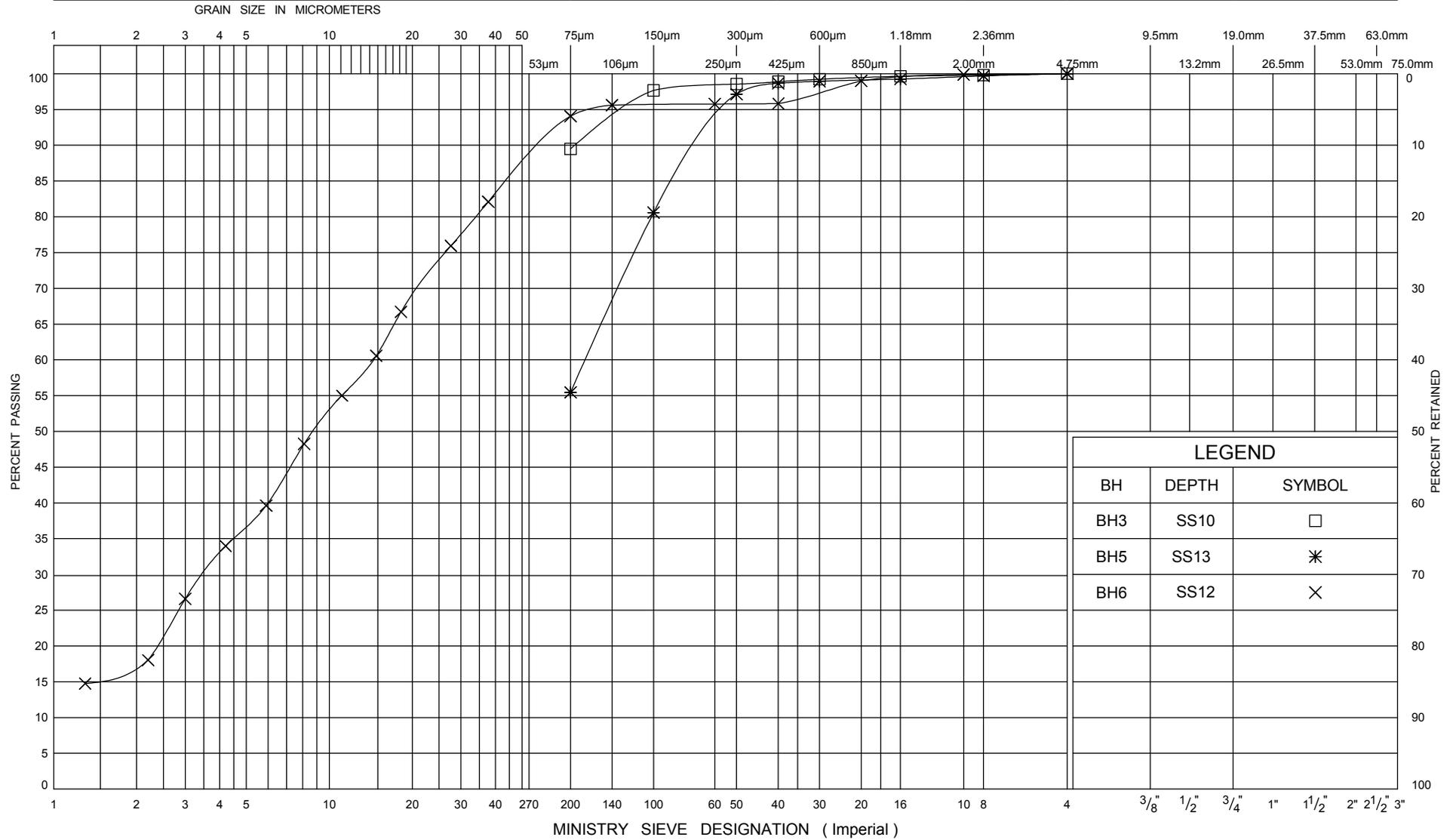


**GRAIN SIZE DISTRIBUTION**  
Lower Sand Layer - trace silt to silty

**ENCLOSURE 9**  
W P 5427-06-00  
HIGHWAY 522B

### UNIFIED SOIL CLASSIFICATION SYSTEM

<b>CLAY &amp; SILT</b>	<b>SAND</b>			<b>GRAVEL</b>	
	Fine	Medium	Coarse	Fine	Coarse



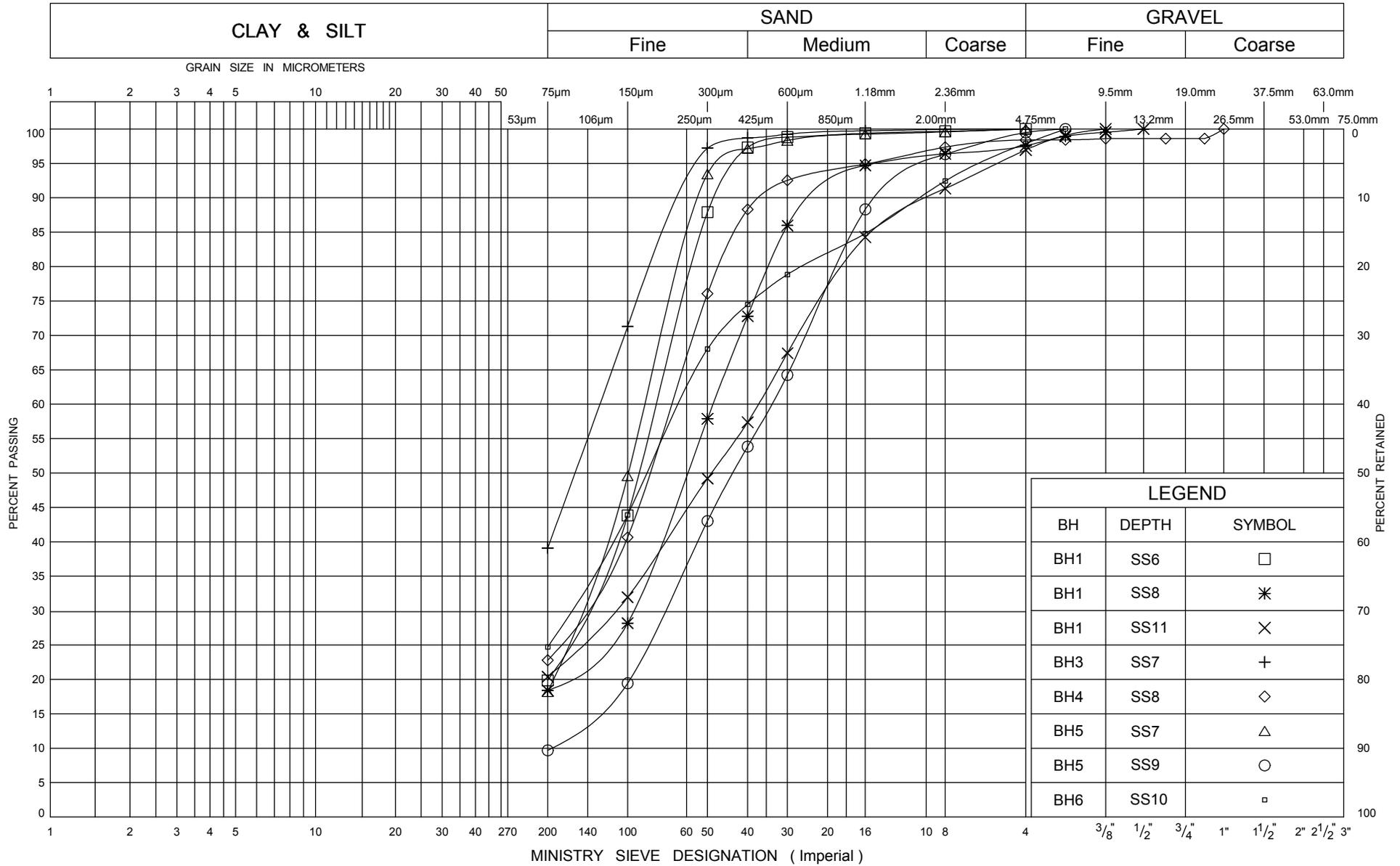
## GRAIN SIZE DISTRIBUTION

### Silt - trace sand to sandy



ENCLOSURE 10
W P 5427-06-00
HIGHWAY 522B

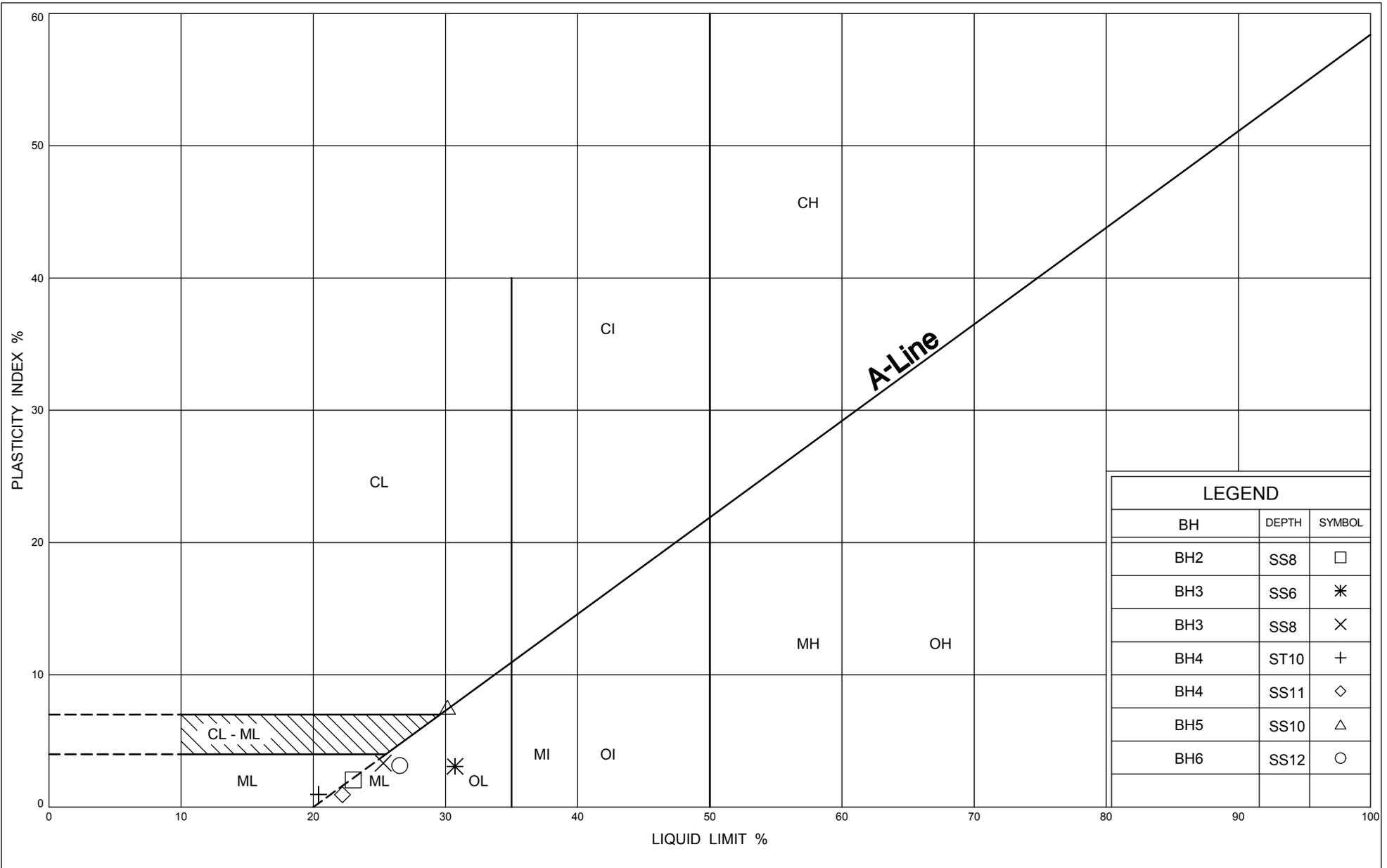
## UNIFIED SOIL CLASSIFICATION SYSTEM



### GRAIN SIZE DISTRIBUTION Upper Sand Layer - some silt to silty

ENCLOSURE 11  
W P 5427-06-00  
HIGHWAY 522B



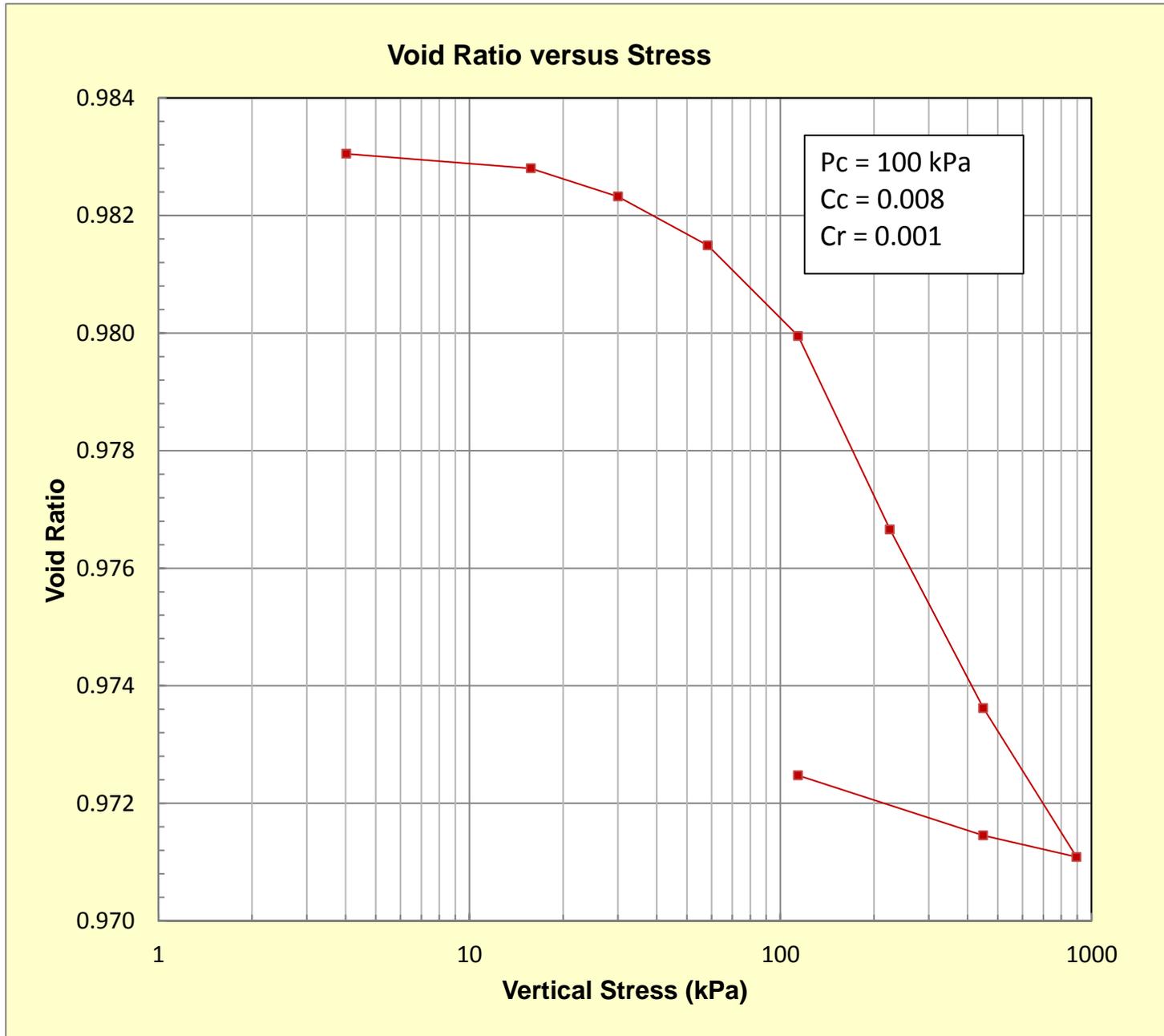


## PLASTICITY CHART



ENCLOSURE 12  
 W P 5427-06-00  
 HIGHWAY 522B

# Consolidation Test

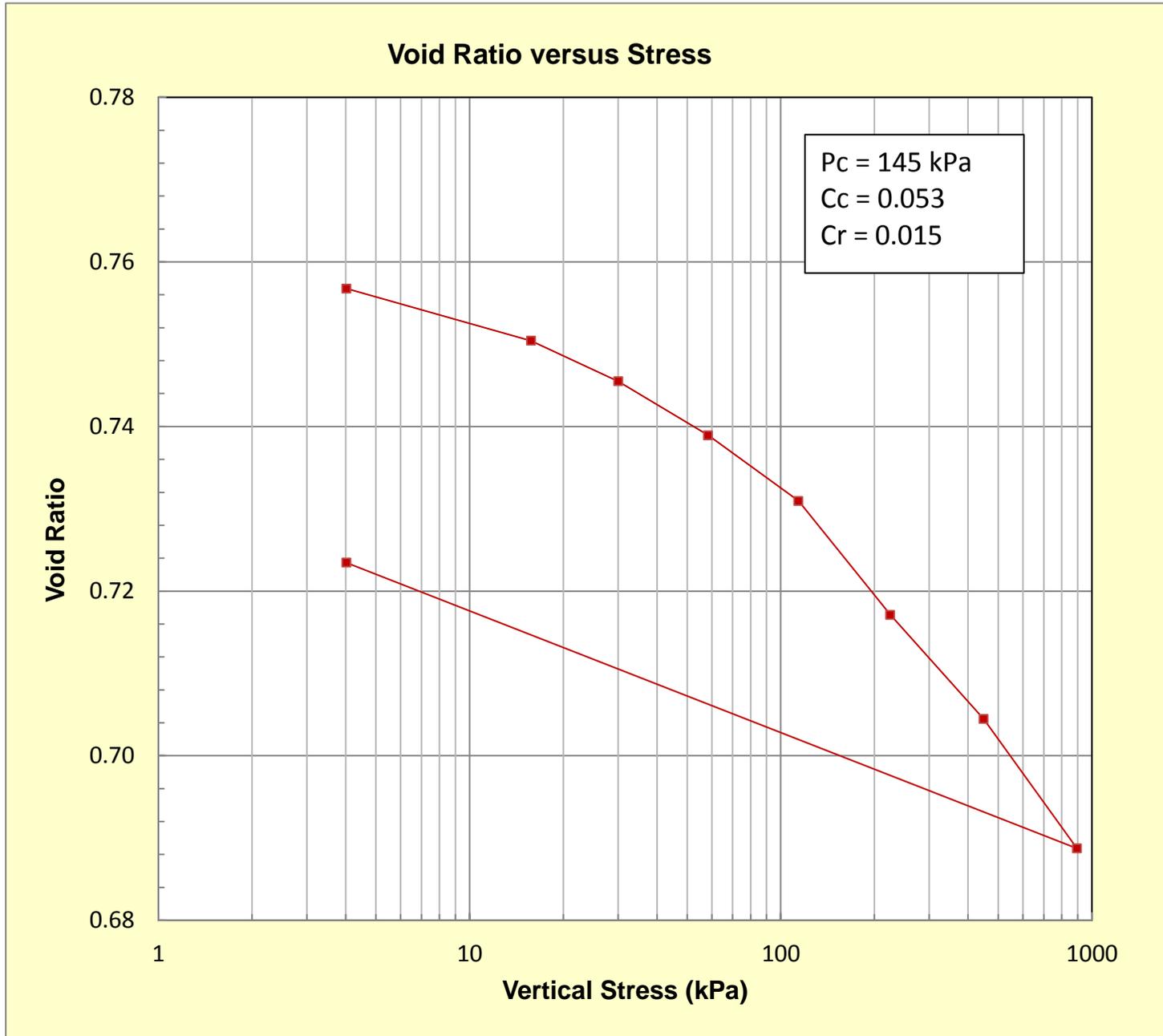


Reference No. GS-TB-018036

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