FOUNDATION INVESTIGATION REPORT
WESTOVER CREEK CULVERT
TOWNSHIP OF ROSEBERRY
IN DISTRICT OF RAINY RIVER
AGREEMENT NO.: 6013-E-0023
ASSIGNMENT NO.: 2
SITE NO.: 45-137/C
W.P. NO.: 6944-10-01
GEOCRES NO.: 52C-34

AUGUST 8, 2014
GS-TB-018738

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 foundation investigation of Westover Creek Culvert on Highway 11, 6.6km west of Highway 71 in Township of Roseberry in Rainy River District (Site No. 45-137/C). This work was carried out under Agreement No.: 6013-E-0023 - Geotechnical Retainer - Assignment No. 2.

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

2. SITE DESCRIPTION

The Westover Creek Culvert is located on Highway 11, 6.6km west of Highway 71 in Rainy River District.

It is understood that the existing culvert is a 37.7 m long Cast in place box culvert with width of 6.1 m and height of 1.5 m. The fill thickness above the culvert is approximately 1.8 m and the side slope of the embankment is approximately 2H:1V. The surrounding area is moderately vegetated (Figure 2.1 and 2.2). The photographs were taken by others (Figures 2.1 to 2.4).

Geological information is available from *Ontario Geological Survey Map* by the *Ontario Ministry of Natural Resources* for the Westover Creek area. The maps indicate that the Glaciolacustrine Fine-Grained Deposits consisting of silt and clay with minor sand.

Figure 2.1 Culvert approach looking West

Figure 2.2 Culvert Opening Looking North

Figure 2.3 Culvert Opening Looking South

Figure 2.4 Culvert Barrel Looking South

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out on May 2nd, 2014 utilizing a CME 55 drill rig and a portable drill that were operated by DST. A total of four (4) boreholes were advanced for the purpose of foundation investigation at this site. Boreholes were advanced to depths ranging from 3.0 to 9.7 m. The number and locations of all boreholes and depths of boreholes were specified by MTO and agreed upon by DST.

A borehole location plan and stratigraphic sections are shown on the Borehole Location Plan and Drawings 2 and 3 (Appendix C). Borehole 1 was advanced North of the existing culvert, at Station 20+501, 4.0 m left of centreline, and advanced to a depth of 9.7 m below existing ground surface. Borehole 2 was advanced South of the existing culvert, at Station 20+480, 4.0 m right of centreline, and advanced to a depth of 9.7 m below existing ground surface. The remaining two boreholes were advanced with portable hand equipment at the inlet and outlet of the existing culvert. Borehole 3 was advanced East of the inlet, at Station 20+475, 17.5 m right of centreline, and advanced to a depth of 3.1 m below surface. Borehole 4 was advanced West of the outlet, Station 20+505, 13.5 m left of centreline, and advanced to a depth of 3.0 m below surface.

The borehole locations are referenced to the MTO Station numbering system as indicated on the drawings provided by the Ministry. The ground surface elevations at the borehole locations were surveyed by DST personnel and referenced to the existing culvert at Station 20+500. A nail on a telephone pole southwest of the existing culvert 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. Field Vane Test (FVT) were performed in the cohesive materials. CPT tests were also carried out in the boreholes. 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 confirm our field description. Laboratory tests included moisture contents, sieve analyses and Atterberg limits tests. A total of twenty seven (27) moisture contents, four (4) particle size analyses, and six (6) Atterberg limit 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	Station	Borehole Elevation (m)	Depth Below Ground Surface (m)	Offset (m)
BH 1	20+501	101.5	9.7	4.0 Lt
BH 2	20+480	101.4	9.7	4.0 Rt
BH 3	20+475	97.4	3.1	17.5 Rt
BH 4	20+505	98.1	3.0	13.5 Lt

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 and 2, consists of asphalt surface treatment underlain by a granular fill overlaying a layer of sand which is underlain by a layer of clay. The water level in the creek at the time of this investigation was at approximate elevations of 98.0 and 97.7 at the inlet and outlet respectively.

Table 4.1 Summary of soil strata at the culvert location

Layer	Depth (m)	Elevation (m)	Comments
Asphalt			0.075 m thick
Fill - Sand	0.1 to 3.8	101.4 to 97.7	Occasional Cobbles noted during drilling
Clay –silty to Sandy	3.8 to 9.7	97.7 to 91.7	

4.1 Asphalt

Asphalt surface treatment was encountered in Boreholes 1 and 2 with thickness of 75 mm at the surface.

4.2 Topsoil

Topsoil was encountered in Boreholes 3 and 4 with thickness of 20 mm at the surface.

4.3 Fill- sand and crushed gravel

Fill layer consisting of brown sand and crushed gravel with trace silt was encountered in Boreholes 1 and 2 located at the edge of the road at the top of the embankment with thickness of 0.7 m (Elev. 101.4 to 100.7 m, and Elev. 101.3 to 100.7 m, respectively). The moisture contents of tested samples ranged from 4 to 6 %.

4.4 Fill- sand

Fill layer consisting of sand with some gravel and silt was encountered in Boreholes 1 and 2 at depth of 0.8 m with thickness of 3.0 m (Elev. 100.7 to 97.7 m, and Elev. 100.7 to 97.6 m, respectively). Cobbles were also noted within this stratum at depth of 3.4 m in Borehole 2.

SPT 'N' values obtained in this stratum range from 27 to +100 per 0.3 m penetration indicating compact to very dense condition. SPTs +100 could be due to content of cobbles within the formation. The moisture contents of tested samples ranged from 1 to 13 %. The results of the sieve analyses are summarized in Table 4.2

Table 4.2 Summary of sand fill sieve analyses

Laboratory Results - Sieve Analyses	
Gravel %	15 to 19
Sand %	62 to 72
Fines %	13 to 26

4.5 Clay-silty

Silty clay with trace sand to sandy, trace gravel and silt was encountered in all boreholes. The depth to the clay formation in Boreholes 1 and 2 was 3.8 m with thickness of 5.9 m (Elev. 97.7 to 91.8 m, and Elev. 97.6 to 91.7 m, respectively). The clay was encountered in Boreholes 3 and 4 at depth 0.2 m with thickness of 2.9 m and 2.8 m (Elev. 97.2 m to 94.3 m, and Elev. 97.9 to 95.1 m), respectively.

Field Vane Tests results were found to vary between 65 kPa to 135 kPa, and the results from CPT were in the range from 964 kPa to 1378 kPa, which both are indicating firm to very stiff consistency. Moisture content of tested sample was around 17 to 43 %. The result of the laboratory tests are summarized in Table 4.3. Atterberg limit test results indicate clay of low to high plasticity.

Table 4.3 Summary of Laboratory Test for Clay

Atterberg Limits	
Liquid Limit	32 to 54
Plastic Limit	15 to 18
Plasticity Index	15 to 39

4.6 Groundwater

At the time of the field investigation groundwater was observed in Boreholes 1 and 2 at depths of 3.5 m (Elev. 98.5) and 3.5 m (Elev. 97.6 m) respectively. The groundwater levels can be expected to vary with the season and precipitation events. During the time of investigation, water levels in creek were at 98.0 m and 97.7 m at the inlet and outlet respectively. The estimated groundwater table levels at the site during the field investigations are given in Table 4.4.

Table 4.4 Elevation of water table at boreholes

Borehole	May 2, 2014	
	Depth Measured (m)	Elevation (m)
BH 1	3.5	98.5
BH 2	3.5	97.6

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:

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Project Manager

Reviewed by:

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

L I M I T A T I O N S O F R E P O R T

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 Ñ.

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 ABBREVATIONS 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

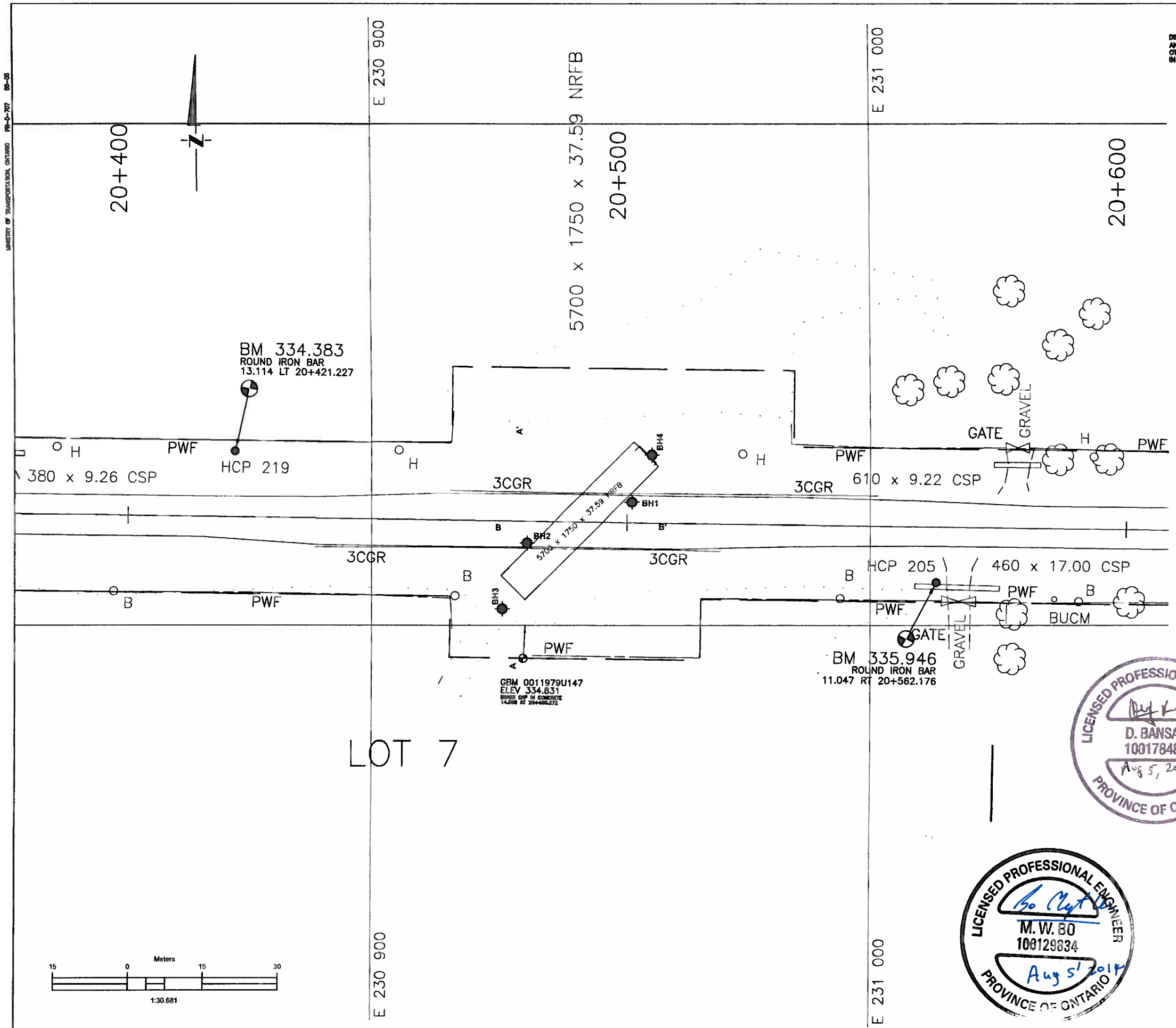
MINISTRY OF TRANSPORTATION, ONTARIO FR-0-707 09-05

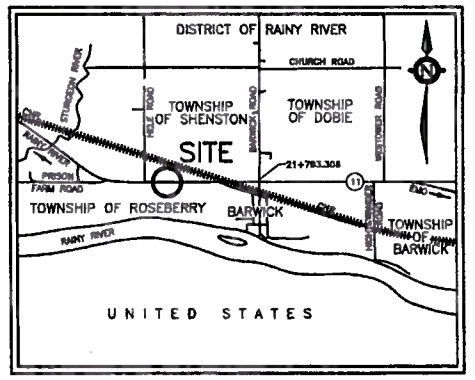
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLES OTHERWISE SHOWN. STATIONS IN KILOMETERS + METERS

CONT	No	6013-E-0023
WP	No	6944-10-01
SITE	No	45-137/C
GEOCRES No		52C-34

WESTOVER CREEK
CULVERT REPLACEMENT HWY 11
STA 20+400 TO STA 20+600
Survey 00-00 Revised

SHEET





KEY PLAN
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SCALE 1:50,000

LEGEND

- Borehole
- Borehole with DCPT
- Pavement Hole
- Rock Probe
- 'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)
- Water level at time of investigation.

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

No.	Elevation	Northing	Easting	Station	Offset
BH1	101.481	5390524	230952	20+501	4.0 m LT
BH2	101.414	5390516	230931	20+480	4.0 m RT
BH3	97.379	5390503	230926	20+475	17.5 m RT
BH4	98.089	5390533	230956	20+505	13.5 m LT

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NOTE:
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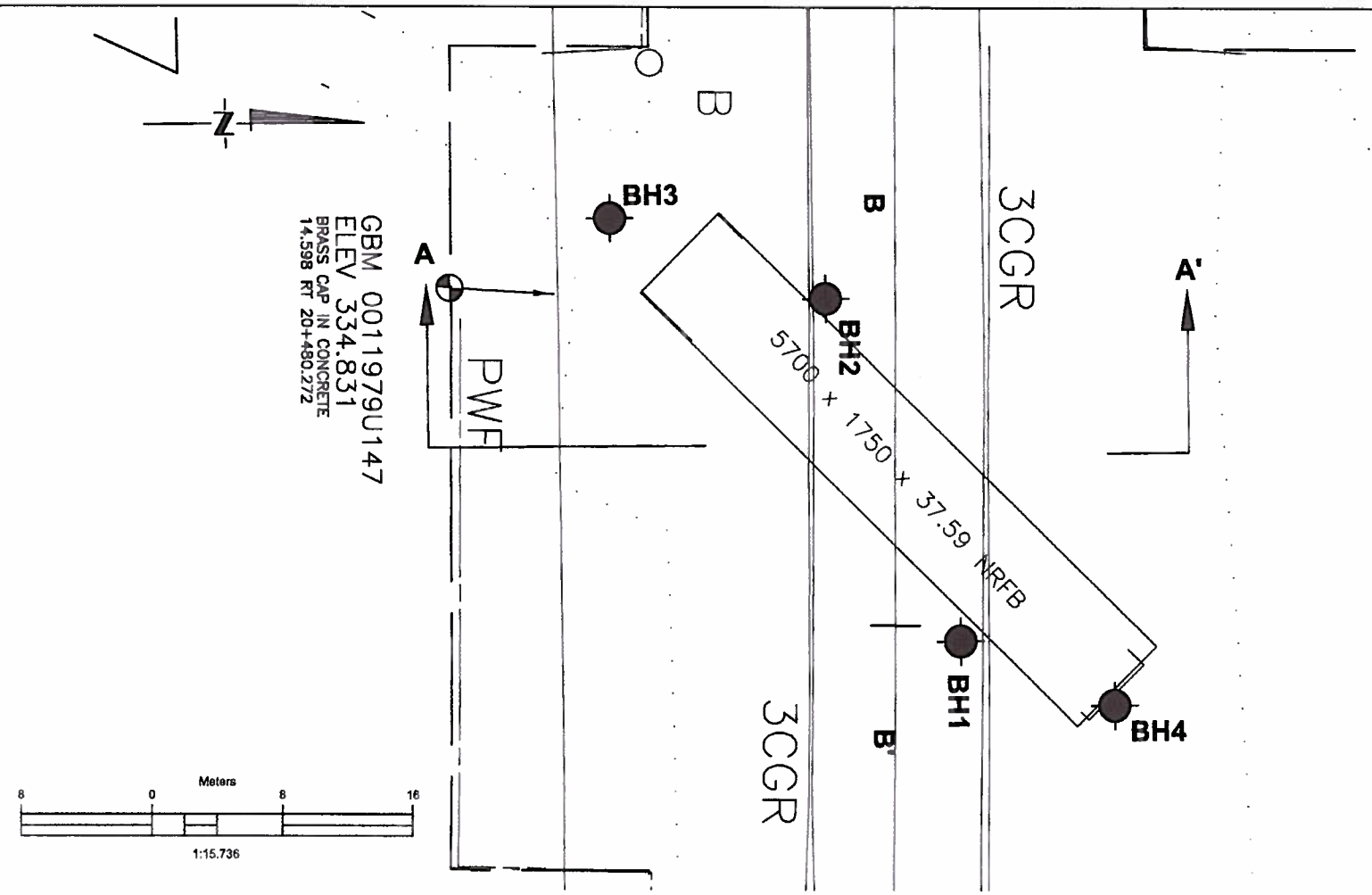

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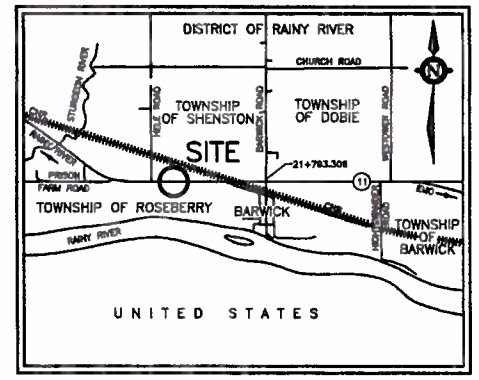

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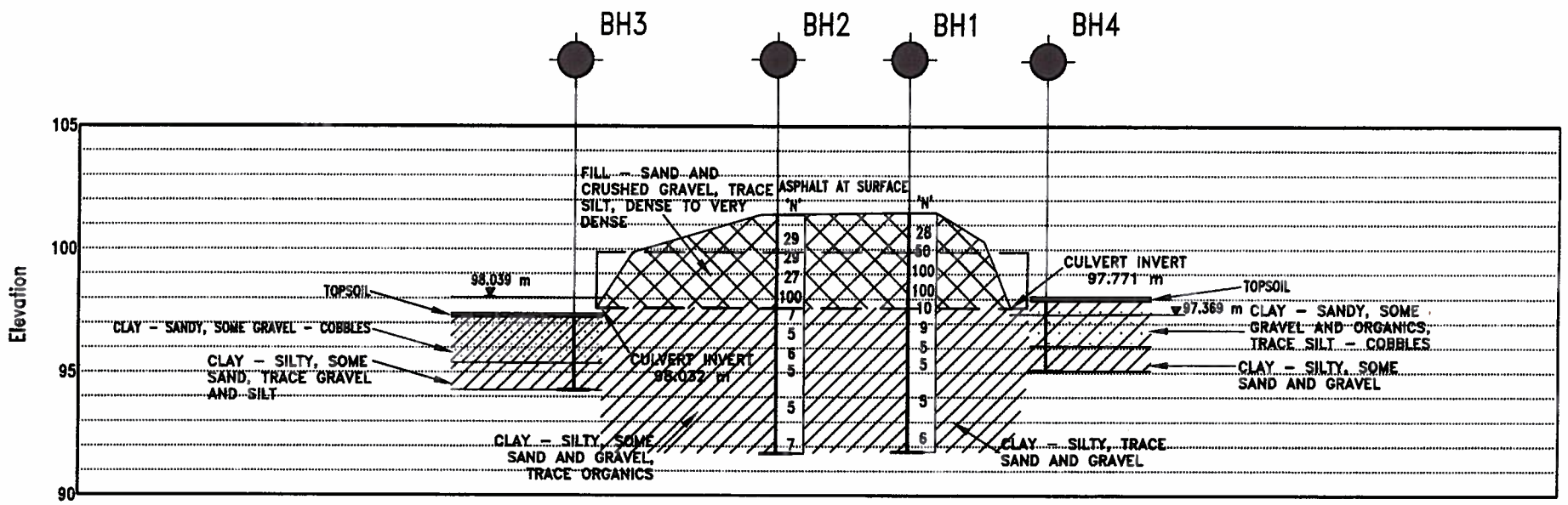
PROFILE ALONG SECTION A-A'



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DRAWING 2

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

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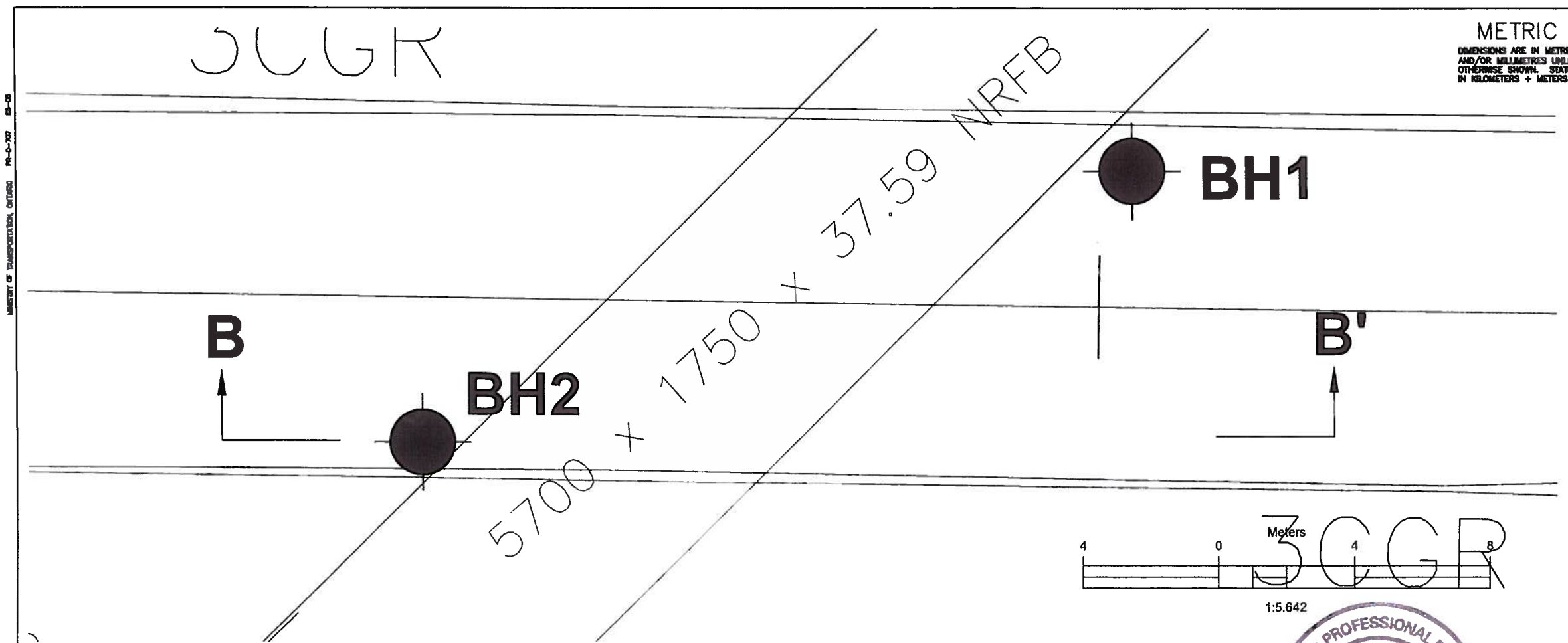

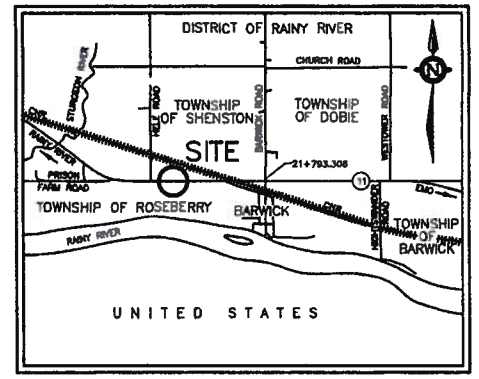

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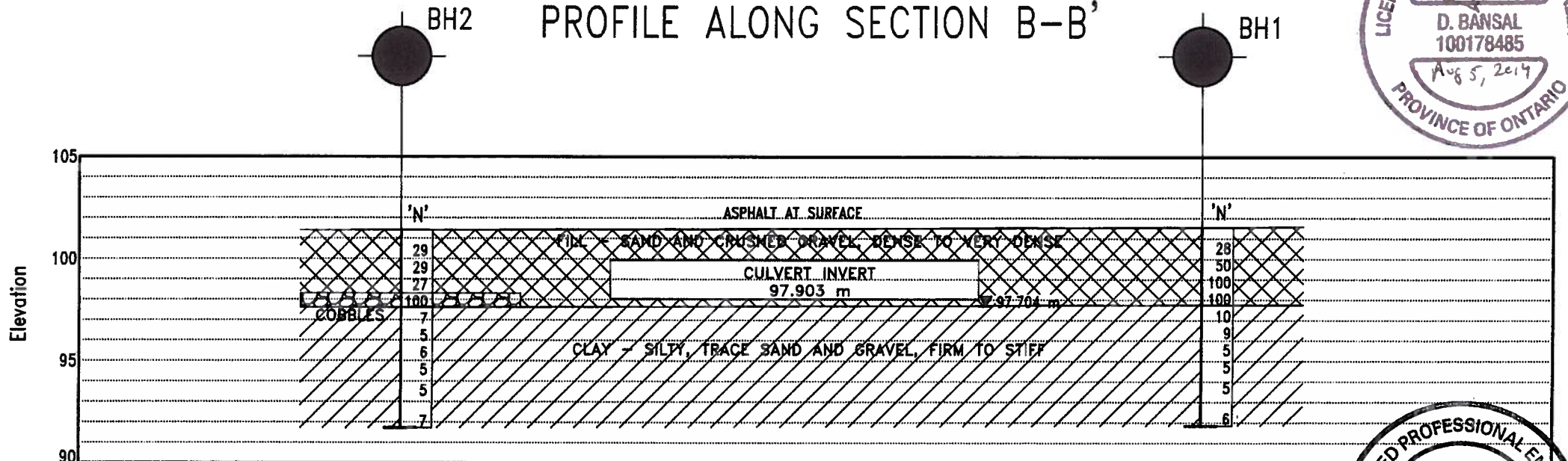
SCALE 1:50,000

PROFILE ALONG SECTION B-B'



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Fill, Organics, Topsoil, Till, Bedrock
Sand, Silt, Clay, Sand & Gravel, Boulders

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DRAWING 3

APPENDIX ‘D’

ENCLOSURES

RECORD OF BOREHOLE No BH1

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION Westover Creek Culvert: STA. 20+501 - 4.0 m LT ORIGINATED BY JF

DIST HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ML

DATUM LOCAL DATE 2014 05 02 CHECKED BY DB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE) (50 100 150 200 250)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
101.5	GROUND SURFACE										
101.4 / 0.1	ASPHALT - 75 mm										
	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		AS1	AS							
100.7											
0.8	FILL - SAND - some gravel and silt, brown, dense to very dense		SS2	SS	28						
			SS3	SS	50+						19 62 (19)
	- COBBLES		SS4	SS	100+						
97.7			SS5	SS	100+	▽					
3.8	CLAY - Silty, trace sand and gravel, grey, firm to stiff		SS6	SS	10						
			SS7	SS	9						
			SS8	SS	5						
			SS9	SS	5						
			SS10	SS	5						
91.8			SS11	SS	6						
9.7	End of Borehole at 9.7 m										

ELEVATION SCALE: 101, 100, 99, 98, 97, 96, 95, 94, 93, 92

Water level at 3.5 m on completion

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

ON_MOT-HIGH VANES GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST_MIN.GDT 6/11/14

ENCLOSURE 1

RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION Westover Creek Culvert: STA. 20+480 - 4.0 m RT ORIGINATED BY JF

DIST HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ML

DATUM LOCAL DATE 2014 05 02 CHECKED BY DB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE) (50 100 150 200 250)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
101.4	GROUND SURFACE										
101.3 / 0.1	ASPHALT - 75 mm										
100.7	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		AS1	AS							Water level at 3.5 m on completion
0.8	FILL - SAND - with silt, some gravel, brown, dense to very dense		SS2	SS	29		101				18 69 (13)
			SS3	SS	29		100				
			SS4	SS	27		99				17 62 (21)
	- COBBLES		SS5	SS	100+	▽	98				
97.6											
3.8	CLAY - Silty, some sand and gravel, trace organics, grey, firm to stiff		SS6	SS	7		97	+			
			SS7	SS	5		96				
			SS8	SS	6		95				
			SS9	SS	5		94	+			
			SS10	SS	5		93				
91.7			SS11	SS	7		92				
9.7	End of Borehole at 9.7 m										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 2

RECORD OF BOREHOLE No BH3

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION Westover Creek Culvert: STA. 20+475 - 17.5 m RT ORIGINATED BY JF

DIST HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ML

DATUM LOCAL DATE 2014 05 02 CHECKED BY DB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE) (50 100 150 200 250)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
97.4	GROUND SURFACE										
97.2 / 0.2	TOPSOIL										
	CLAY - Sandy, some gravel, grey, very stiff - COBBLES		AS1	AS			97				15 59 (26)
											CPT 964 kPA
			AS2	AS			96	+¹			CPT 1378 kPA
95.4											
2.0	CLAY - Silty, some sand, trace gravel and silt, grey, very stiff						95				
			AS3	AS				+¹			CPT 1102 kPA
94.3											CPT 1205 kPA
3.1	End of Borehole at 3.1 m										

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

ON_MOT-HIGH VANES GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST_MIN.GDT 6/11/14

ENCLOSURE 3

RECORD OF BOREHOLE No BH4

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION Westover Creek Culvert: STA. 20+505 - 13.5 m LT ORIGINATED BY JF

DIST HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ML

DATUM LOCAL DATE 2014 05 02 CHECKED BY DB

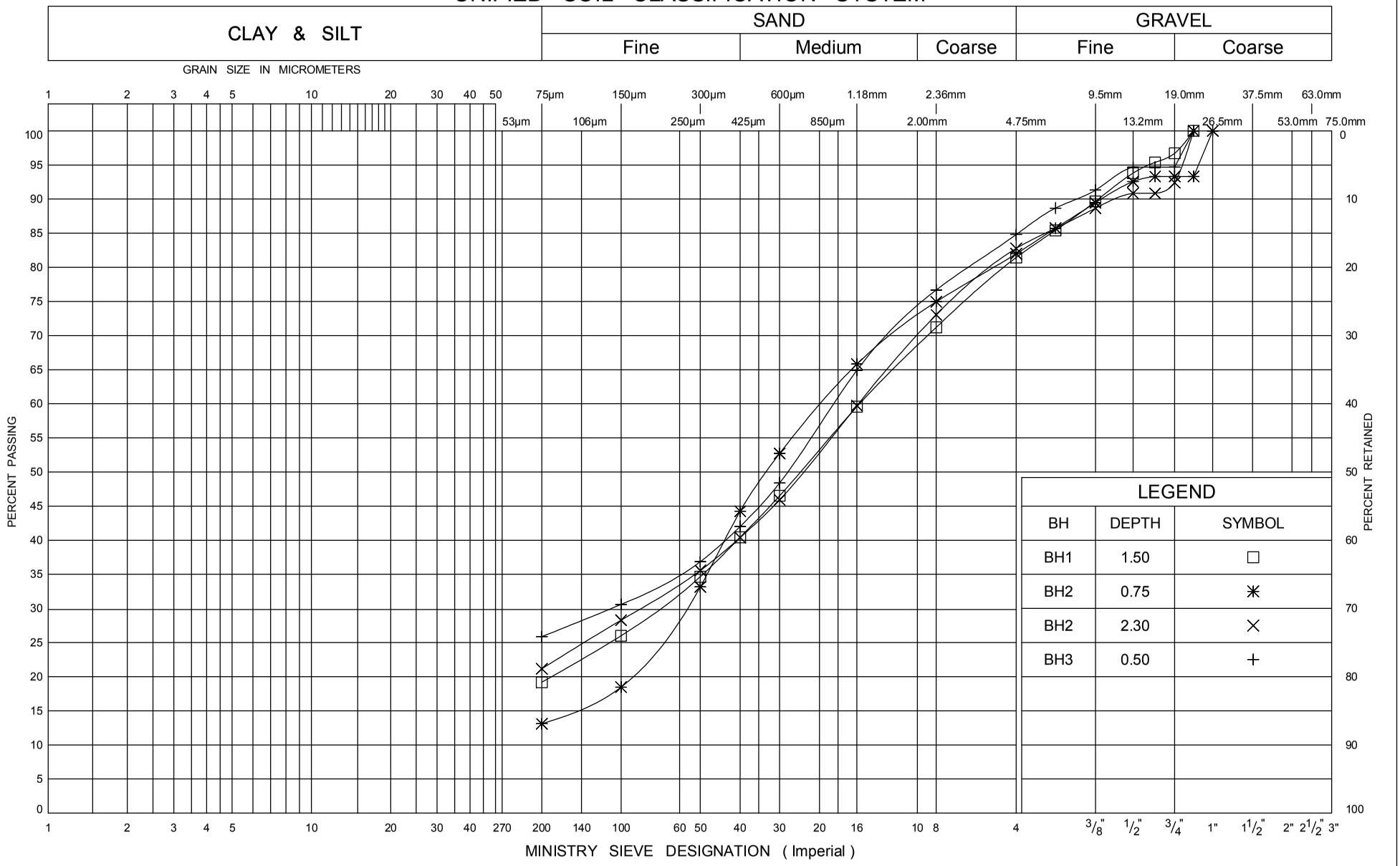
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE) (50 100 150 200 250)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
98.1	GROUND SURFACE						98				
97.9	TOPSOIL										
0.2	CLAY - Sandy, some gravel and organics, trace silt, grey, very stiff - COBBLES						97	+ 1	●		CPT 1033 kPA CPT 1378 kPA
96.1											
2.0	CLAY - Silty, some sand and gravel, grey, very stiff						96	+ 1	◆ ● ▲		
95.1											
3.0	End of Borehole at 3.0 m										

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

ON_MOT-HIGH VANES GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST_MIN.GDT 6/11/14

ENCLOSURE 4

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation Ontario

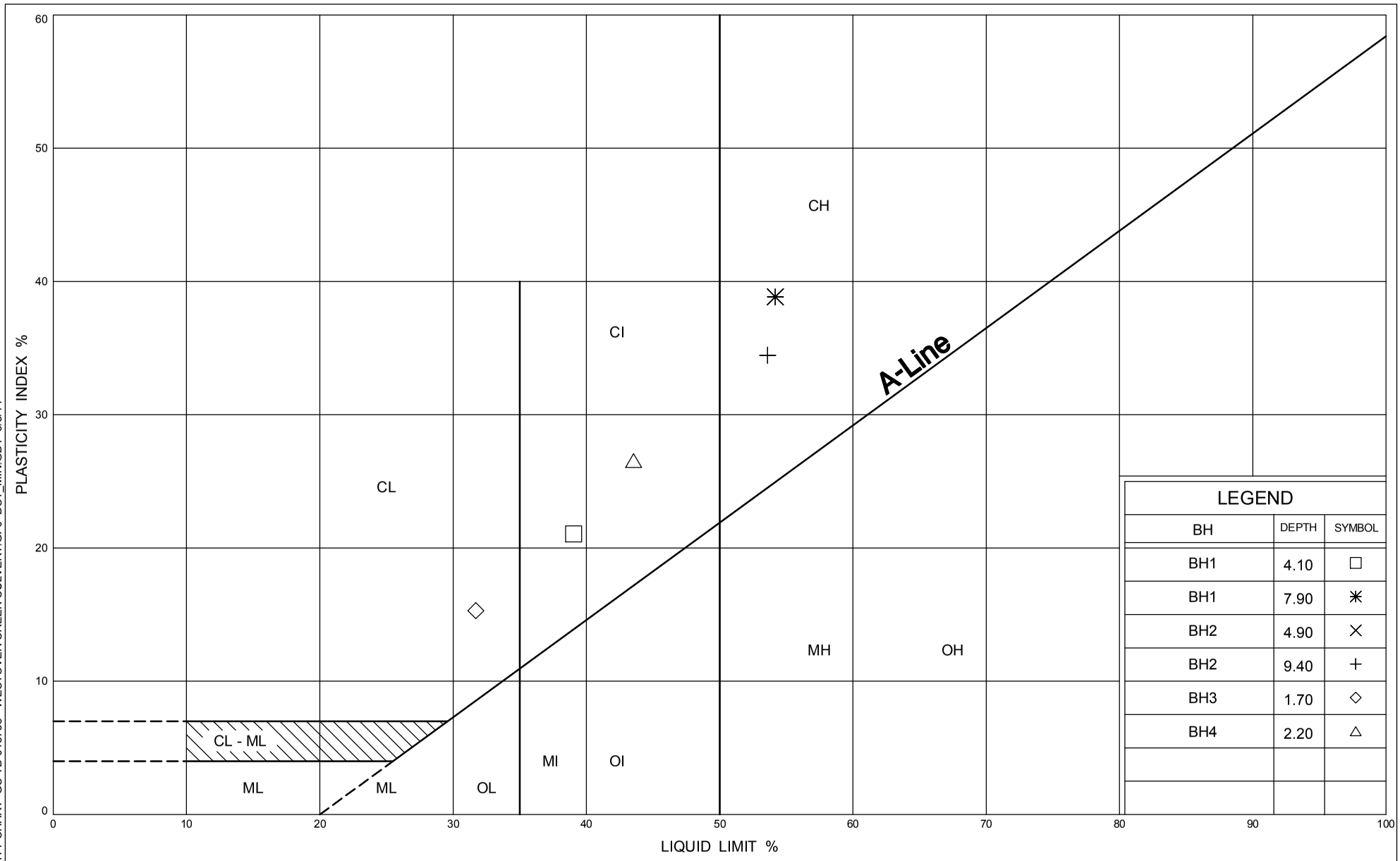
GRAIN SIZE DISTRIBUTION

ENCLOSURE 5

W P 6013-E-0023

Highway 11, Roseberry Twsp

ONTARIO MOT GRAIN SIZE GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST_MIN.GDT 6/5/14



ONTARIO MOT PLASTICITY CHART GS-TB-018738 - WESTOVER CREEK CULVERT.GPJ DST_MIN.GDT 6/5/14

Ministry of Transportation Ontario

PLASTICITY CHART
Clay-silty

ENCLOSURE 6

W P 6013-E-0023

Highway 11, Roseberry Twsp