



**FOUNDATION INVESTIGATION REPORT
DILKE CREEK CULVERT
DILKE TOWNSHIP, RAINY RIVER
AGREEMENT NO.: 6013-E-0023
ASSIGNMENT NO.: 2
SITE NO.: 45-150/C
GEOCRES NO.: 52D-19**

**SEPTEMBER 19, 2014
GS-TB-018735**

PREPARED FOR:

Ministry of Transportation
Geotechnical Section
Northwestern Region Office
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**FOUNDATION INVESTIGATION REPORT
DILKE CREEK CULVERT
HIGHWAY 11
RAINY RIVER DISTRICT
AGREEMENT NO.: 6013-E-0023
ASSIGNMENT NO.: 2
SITE NO.: 45-150/C
GEOCRES NO.: 52D-19**

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 for Dilke Creek Culvert on Highway 11, 7.8 km west of Highway 617 in Township of Dilke in Rainy River District (Site No. 45-150/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 Dilke Creek Culvert is located on Highway 11, 7.8 km west of Highway 617 in Township of Dilke in Rainy River District.

It is understood that the existing timber box culvert has two barrels each culvert 30.9 m long with width of 2.1 m and height of 1.7 m. The fill height at the culvert location is approximately 3.8 m to 4.6 m and the side slope of the embankment is approximately 2H:1V. The surrounding area is moderately to heavily vegetated (Figure 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 low relief.



Figure 2.1 Culvert approach looking West

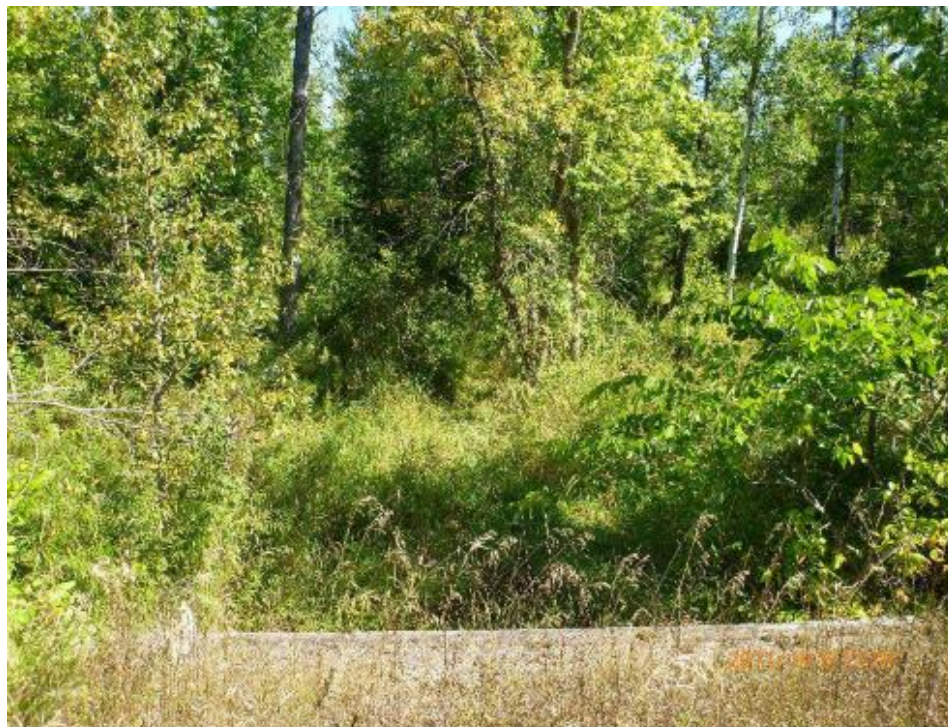


Figure 2.2 Culvert Opening Looking North



Figure 2.3 Culvert West Barrel Looking South



Figure 2.4 Culvert East Barrel Looking South

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out on May 1st, 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 9.6 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 section are shown on the Borehole Location Plan, Drawings 1 to 3 (Appendix C). Borehole 1 was advanced North of the existing culvert, at Station 20+351, 5.0 m left of centreline, and advanced to a depth of 9.6 m below surface. Borehole 2 was advanced South of the existing culvert, at Station 20+343, 5.0 m right of centreline, and advanced to a depth of 9.6 m below 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+347, 20.0 m left of centreline, and advanced to a depth of 3.0 m below surface. Borehole 4 was advanced West of the outlet, Station 20+347, 17.5 m right of centreline, and advanced to a depth of 3.1 m below surface.

The borehole locations are referenced to the MTO Station numbering system as indicated on the drawings provided by the Ministry. The ground surface elevations at the borehole locations were surveyed by DST personnel and referenced to the existing culvert at Station 20+345 RT. Top of 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.

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 using MTO vane with dimensions of 152 mm (height) and 63 mm (width)

with height/weight ratio of 2.4 in the cohesive materials. Only peak shear strength were measured, no remould strength were measured. Hand push cone penetration testing (CPT's) was conducted in some boreholes. This involved advancing a cone shaped probe up to 10 cm into the soil and measuring the resistance to the cone. 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 eight (28) moisture contents, three (3) 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+351	102.5	9.6	5.0 Lt
BH 2	20+343	102.5	9.6	5.0 Rt
BH 3	20+347	98.4	3.0	20.0 Lt
BH 4	20+347	98.1	3.1	17.5 Rt

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 fill consisting of sand and crushed gravel, clay, silt and sand overlaying silty clay layer. The water level in the creek at the time of this investigation was at approximate elevations of 98.30 and 98.10 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 – layers of sand and crushed gravel, silt, clay and sand	0.8 to 3.8 0.8 to 4.6	102.4 to 101.7 102.4 to 97.9	
Clay –silty to Sandy	3.8 to 9.6	97.7 to 91.8	

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 0.2 m to 0.3 m 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 with thickness of 0.7 m (Elev. 102.4 to 101.7 m, and Elev. 102.4 to 101.8 m, respectively). The moisture contents of tested samples ranged from 4 to 8 %.

4.4 Fill- Silt

Fill layer of silt with some sand, trace gravel and trace clay was encountered in Borehole 2 at depth of 0.8 m with thickness of 1.7 m (Elev. 101.8 to 100.0 m).

SPT 'N' values obtained in this stratum range from 8 to 20 per 0.3 m penetration indicating loose to compact condition. The moisture contents of tested samples ranged from 10

to 30 %. The results of the sieve analyses are summarized in following table.

Table 4.2 Summary of silt fill sieve analyses

Laboratory Results – Sieve Analyses	
Gravel %	3
Sand %	11
Silt %	80
Clay	6

4.5 Fill- Clay

Fill silty clay layer with trace sand was encountered in Boreholes 1 at depth of 0.8 m with thickness of 2.3 m (Elev. 101.7 to 99.4 m). Pieces of wood were encountered within this stratum.

SPT 'N' values obtained in this stratum range from 6 to 18 per 0.3 m penetration indicating firm to very stiff consistency. The moisture contents of tested samples found to be 29 %. The results of the Atterberg Limit test are summarized in following Table.

Table 4.3 Summary of laboratory test for fill clay

Laboratory Results – Atterberg Limit	
Liquid Limit %	72
Plastic Limit %	23
Plasticity Index %	49

4.6 Fill-Sand

Fill sand with some silt and gravel was encountered in Borehole 1 and 2 at depth of 3.1 m and 2.5 m with thickness of 0.7 m (Elev. 99.4 to 98.7 m) and 2.1 m (Elev. 100.0 to 97.9 m) respectively.

SPT 'N' values obtained in this stratum range from 4 to 46 per 0.3 m penetration indicating loose to dense condition. The moisture contents of tested samples ranged from 9 to 18 %. The results of the sieve analyses are summarized in following table.

Table 4.4 Summary of sand fill sieve analyses

Laboratory Results – Sieve Analyses	
Gravel %	18
Sand %	67
Fines %	15

4.7 Clay

Clay with silt to silty, trace sand to sandy, trace gravel and trace organics was encountered in Boreholes 1, 2, 3 and 4 at depth of 3.8 m (Elev. 98.7 m), 4.6 m (Elev. 97.9 m), 0.3 m (Elev. 98.1 m) and 0.2 m (Elev. 97.9 m) respectively. Thickness of this stratum is not defined as boreholes terminus was reached within this stratum.

Field Vane Tests results were found to be 115 kPa, and the results from hand pushed CPT were in the range from 827 kPa to 1171 kPa, which both are indicating very stiff consistency. Moisture content of tested sample was around 18 to 55 %. The result of the laboratory tests are summarized in following table. Atterberg limit test results indicate clay of low to high plasticity.

Table 4.5 Summary of laboratory test for clay

Atterberg Limits	
Liquid Limit	25 to 53
Plastic Limit	3 to 20
Plasticity Index	13 to 33

Table 4.6 Summary of clay sieve analyses

Laboratory Results – Sieve Analyses	
Gravel %	9
Sand %	47
Silt %	28
Clay %	17

4.8 Groundwater

At the time of the field investigation groundwater was observed in Boreholes 3 and 4 at surface. 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 98.30 m and 98.10 m at the inlet and outlet respectively. The estimated groundwater table levels at the site during the field investigations are given in Table 4.5.

Table 4.7 Elevation of water table at boreholes

Borehole	May 2, 2014	
	Depth Measured (m)	Elevation (m)
BH 3	0.0	98.4
BH 4	0.0	98.1

5. MISCELLANEOUS

Site work was carried out between May 1st and May 2nd, 2014 utilizing a CME 55 drill rig that was operated by DST. Fieldwork was supervised on a full time basis by Joe Forgues 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 blue ink, appearing to read "Bernardo Villegas".

Bernardo Villegas, M.Sc
Manager

Reviewed By:



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

APPENDIX 'A'
LIMITATIONS OF REPORT

LIMITATIONS OF REPORT

GEOTECHNICAL STUDIES

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the client. More than no scope of work, no matter how exhaustive, can identify all conditions below ground surface and groundwater conditions between and beyond the test holes. They 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 DOT Consulting Engineers be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the test holes. The bench mark and elevations used in this report are primarily to establish relative elevation differences between the test hole 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 report 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 recommendations given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g., the thickness of critical 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 DOT Consulting Engineers cannot warrant their accuracy. Similarly, DOT cannot warrant the accuracy of information supplied by the client.

APPENDIX 'B'
DESCRIPTION OF TERMS

EXPLANATION OF TERMS USED IN REPORT

SPT 'N' VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE OF THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51 mm O.D. SPLIT BARREL SAMPLES TO PENETRATE 0.3 m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5 kg, FALLING FREELY A DISTANCE OF 0.76 m. FOR PENETRATION OF LESS THAN 0.3 m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST (DCPT): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51 mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3 m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

TEXTURAL CLASSIFICATION OF SOILS

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

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

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

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

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

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

N (BLOWS / 0.3 m)	0 – 5	5 – 10	10 – 30	30 – 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100 mm+ IN LENGTH EXPRESSED AS A PERCENTAGE OF THE LENGTH OF THE CORING RUN.

THE **ROCK QUALITY DESIGNATION (R.Q.D)** FOR MODIFIED RECOVERY IS:

R.Q.D (%)	0 – 25	25 – 50	50 – 75	75 – 90	90 – 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

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

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

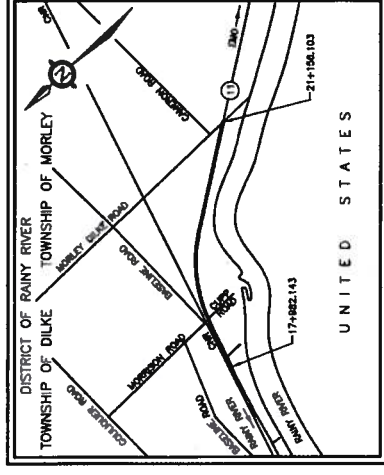
*HIERARCHY OF SOIL STRENGTH PREDICTION: **1)** LABORATORY TRIAXIAL TESTING. **2)** FIELD INSITU VANE TESTING. **3)** LABORATORY VANE TESTING. **4)** SPT VALUES. **5)** POCKET PENETROMETER.

APPENDIX 'C'

DRAWINGS

APPENDIX 'D'

ENCLOSURES



KEY PLAN

1.0 km 0 1.0 km

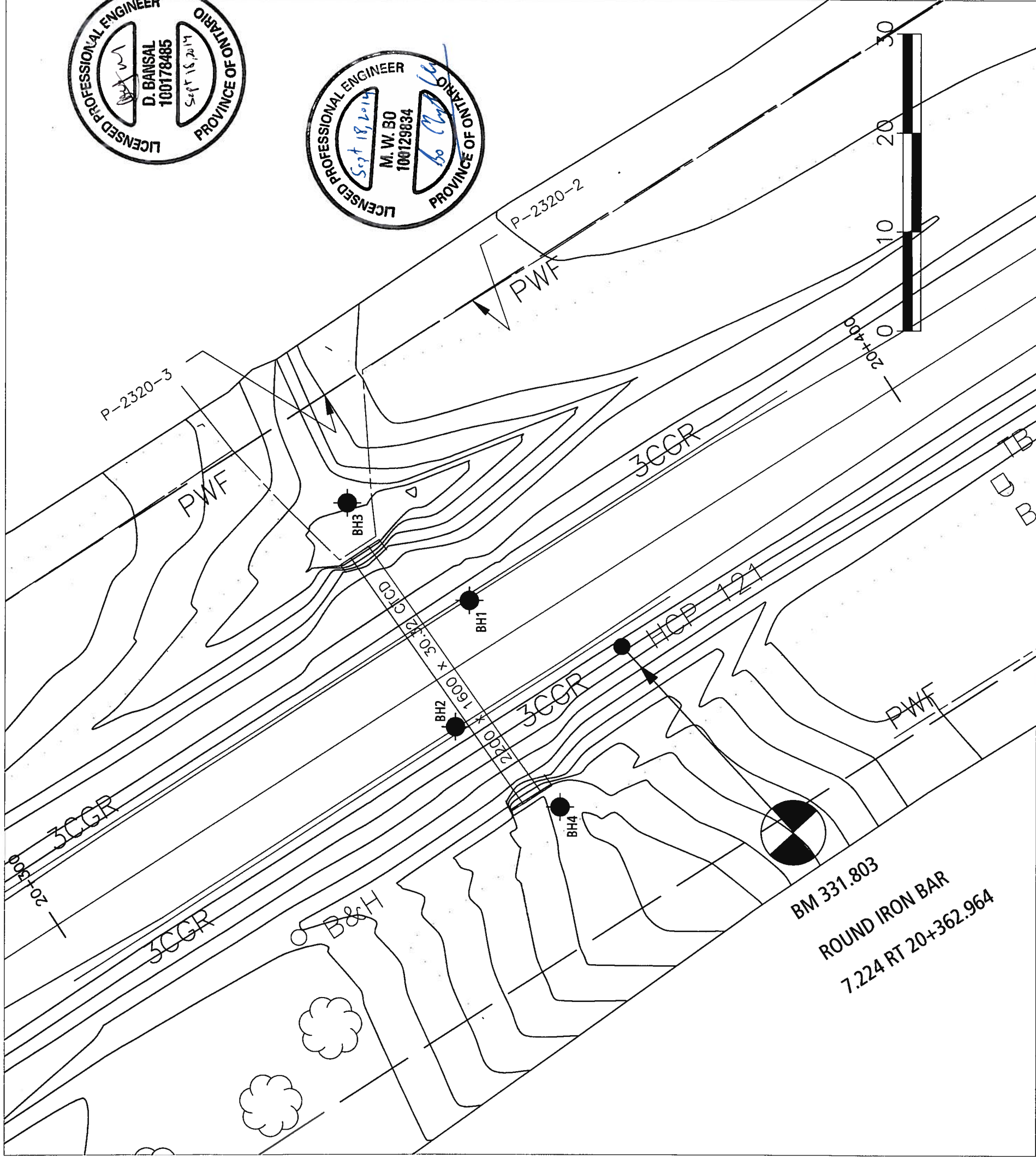
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LEGEND						
Borehole		Borehole with CPT				
Asphalt Core		Rock Probe				
'N'		Blows/0.3m (Std. Pen Test, 475 J/blow)				
Water level at time of investigation.						
Fill		Organics				
Topsoil		Till				
Bedrock		Sand				
		Silt				
		Clay				
		Sand & Gravel				
		Boulders				
No.	Elevation	Northing	Easting	Station	Offset	
BH1	102.5	5385090 m N	212270 m E	20+351	5.0 m LT	
BH2	102.5	5385092 m N	212257 m E	20+343	5.0 m RT	
BH3	96.4	5385103 m N	212280 m E	20+347	20.0 m LT	
BH4	96.1	5385081 m N	212240 m E	20+347	17.5 m RT	

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

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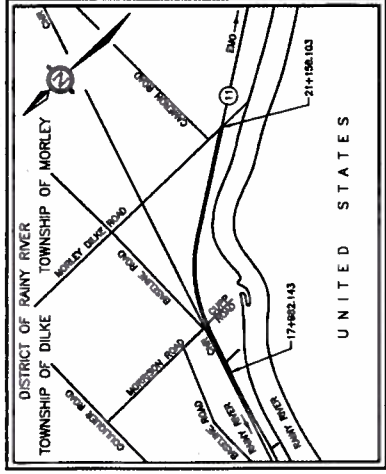
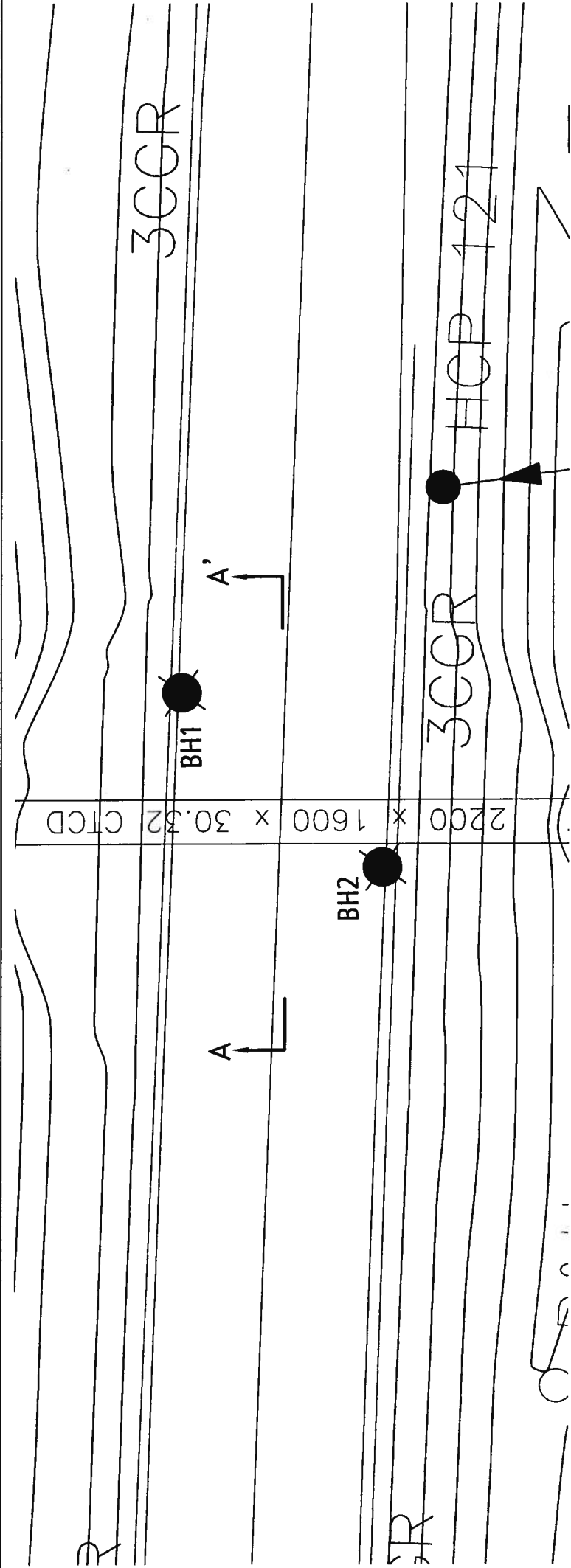
DRAWING 1



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SPECIFIED
IN METERS → METERS

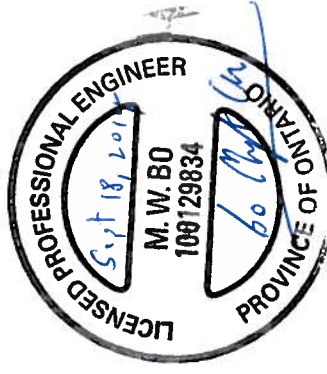
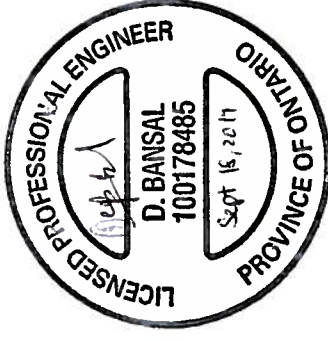
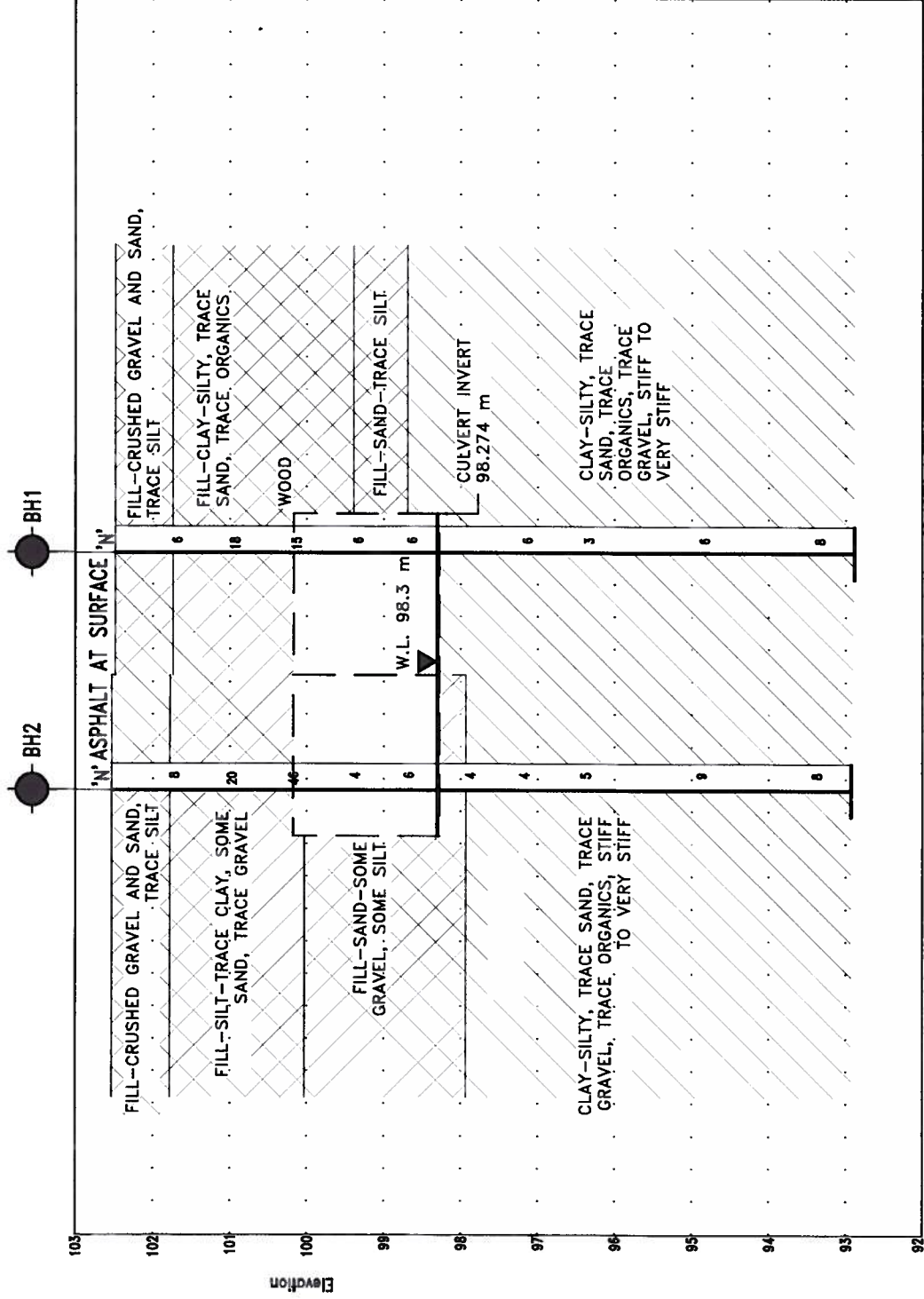
CONT No	6013-E-0023	
WP No	XXX-XX-XX	
SITE No	45-138/C	
GEORES No	52D-19	
CULVERT REPLACEMENT DILKE CREEK CULVERT		
STA 20+343 TO STA 20+351		
Survey	13-06	Revised

MINISTRY OF TRANSPORTATION, ONTARIO
PB-2-707 08-00



KEY PLAN
1.0 km 0 1.0 km
SCALE 1:50,000

PROFILE ALONG SECTION A-A'

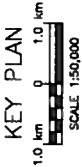
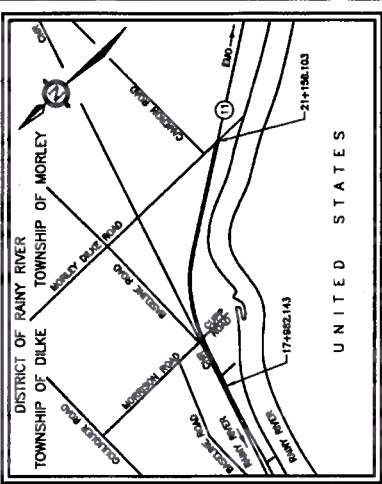


LEGEND				
	Borehole		Borehole with CPT	
	Asphalt Core		Rock Probe	
	N'		Blows/0.3m (Std. Pen Test, 475 J/Blow)	
	Water level at time of investigation		Fill	
	Organics		Silt	
	Topsoil		Clay	
	Till		Sand & Gravel	
	Bedrock		Boulders	
No.	Elevation	Nothing	Eastings	Station
BH1	102.5	5398090 m N	212270 m E	20+351
BH2	102.5	5398092 m N	212257 m E	20+343
BH3	98.4	5398103 m N	212280 m E	20+347
BH4	98.1	5398081 m N	212248 m E	20+347
				5.0 m LT
				5.0 m RT
				20.0 m LT
				17.5 m RT

NOTE:
This document is a summary of the data collected during the investigation and is not intended to be used as a basis for design or construction. The data is provided for information only and is not intended to be used as a basis for design or construction. The data is provided for information only and is not intended to be used as a basis for design or construction.

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CONT No	6013-E-0023		SHEET
WP No	XXX-XX-XX		
SITE No	45-138/C		
GEOGRES No	52D-19		
CULVERT REPLACEMENT DILKE CREEK CULVERT			
STA 20+343 TO STA 20+351			
Survey 13-06			Revised

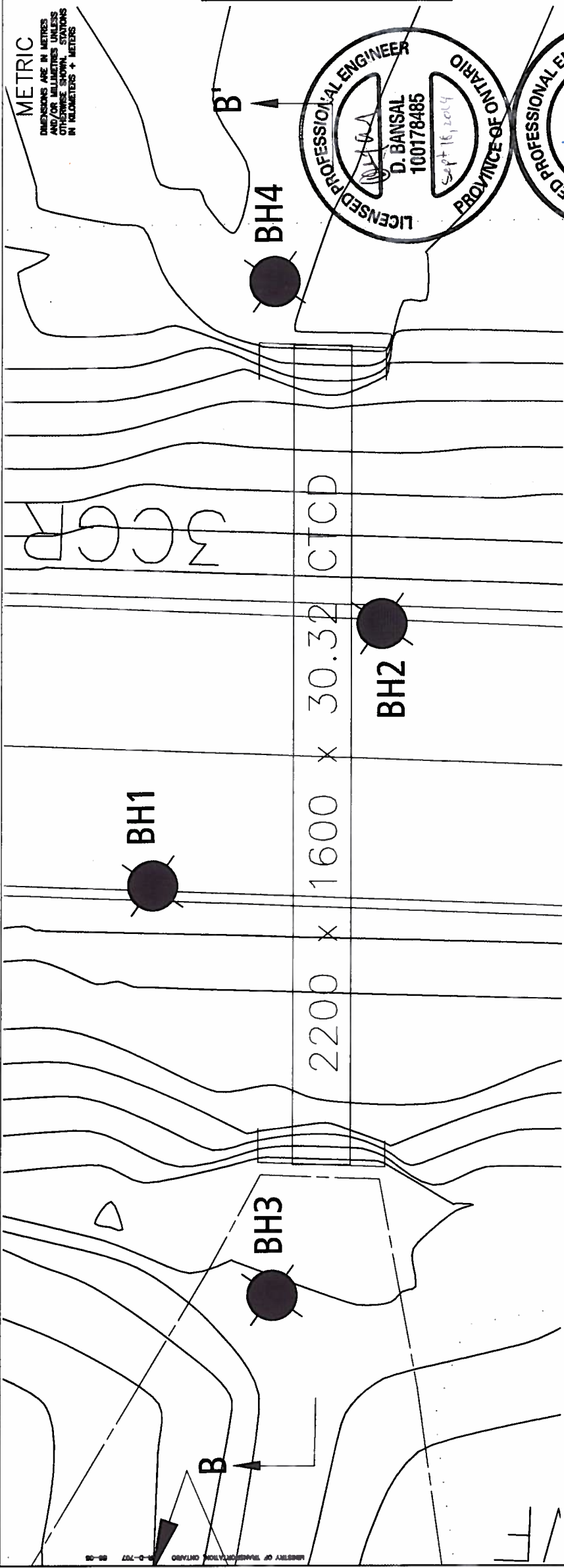


LEGEND			
	Borehole		Borehole with CPT
	Asphalt Core		Rock Probe
	Blows/0.3m (Std. Pen Test, 475 J/Blow)		Water level at time of investigation
	Fill		Organics
	Topsoil		Sand & Gravel
	Till		Boulders
	Bedrock		
No.	Ellevation	Station	Offset
BH1	102.5	5386090 m N 212270 m E	20+351
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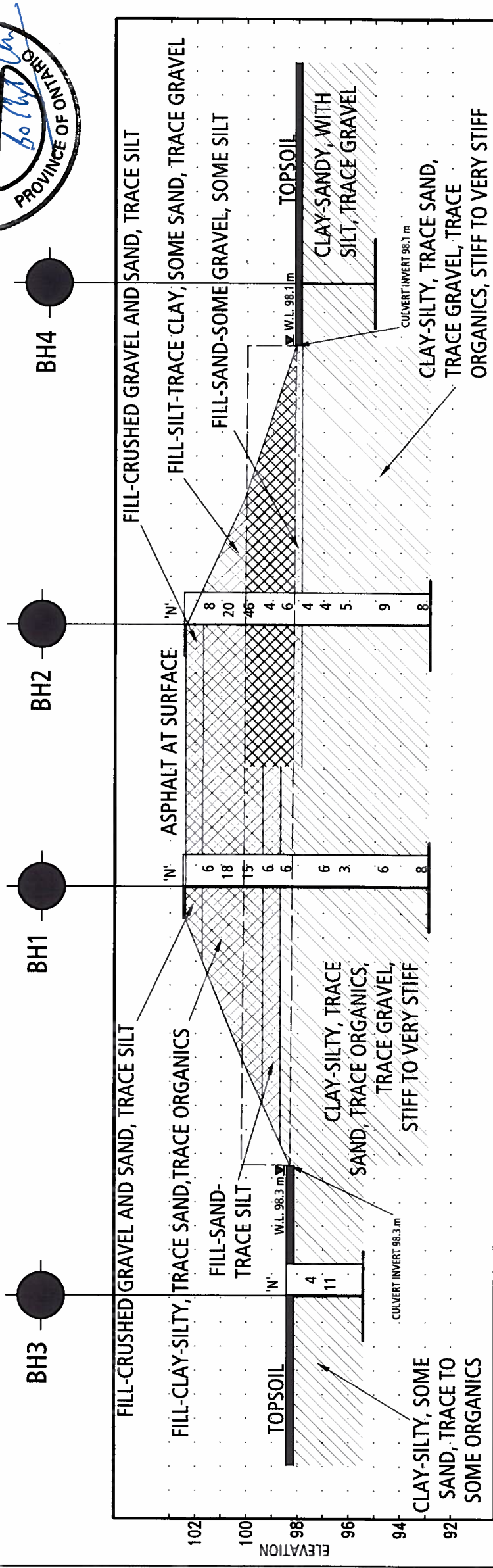
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DRAWING 3



PROFILE ALONG SECTION B-B'



RECORD OF BOREHOLE No BH1

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION DILKE CREEK CULVERT - STA 20 + 351.5m, LT ORIGINATED BY Joe
DIST HWY HWY 11 BOREHOLE TYPE HOLLOW STEM AUGER (80 mm ID) COMPILED BY MD
DATUM Geodetic DATE - 5.2.14 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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
102.5	GROUND SURFACE							20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
102.4	ASPHALT - 70 mm		1	AS			102						
101.7	FILL - CRUSHED GRAVEL AND SAND, trace silt, brown												
0.8	FILL- CLAY - Silty, trace sand, trace organics, brown/grey		2	SS	6								
	-Wood		3	SS	18		101						
				SS	15		100						
99.4													
3.1	FILL-SAND - trace silt, brown		4	SS	6		99						
98.7													
3.8	CLAY - Silty, trace sand, trace organics, trace gravel, grey, stiff to very stiff		5	SS	6		98						
			6	SS	6		97						
			7	SS	3		96						
			8	SS	6		95						
							94						
			9	SS	8		93						
92.9													
9.6	End of borehole @ 9.6 m												

ON_MOT-HIGH VANES GS-TB-018735 DILKE CREEK LOGS.GPJ DST_MIN.GDT 6/24/14

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

ENCLOSURE 1

RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION DILKE CREEK CULVERT - STA 20 + 343.5m, RT ORIGINATED BY Joe
DIST HWY HWY 11 BOREHOLE TYPE HOLLOW STEM AUGER (80 mm ID) COMPILED BY MD
DATUM Geodetic DATE - 5.2.14 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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L
								20	40	60	80	100					
102.5	GROUND SURFACE																
102.5	ASPHALT - 75 mm		1	AS			102										
101.8	FILL - CRUSHED GRAVEL AND SAND, trace silt, brown																
101.8	FILL-SILT - trace clay, some sand, trace gravel, grey		2	SS	8												
			3	SS	20		101										3 11 80 6
100.0	FILL-SAND - some gravel, some silt, brown		4	SS	46		100										
			5	SS	4												
			6	SS	6		99										18 67 (15)
97.9	CLAY - Silty, trace sand, trace gravel, trace organics, grey, stiff to very stiff		7	SS	4		98										
			8	SS	4		97										
			9	SS	5		96										
			10	SS	9		95										
							94										
92.9			11	SS	8		93										
9.6	End of Borehole @ 9.6 m.																

ON_MOT-HIGH VANES GS-TB-018735 DILKE CREEK LOGS.GPJ DST_MIN.GDT 6/24/14

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

RECORD OF BOREHOLE No BH3

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION DILKE CREEK CULVERT - STA 20 + 347 20m, LT ORIGINATED BY JM
 DIST HWY HWY 11 BOREHOLE TYPE HOLLOW STEM AUGER (80 mm ID) COMPILED BY MD
 DATUM Geodetic DATE - 5.2.14 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			20	40					
98.4	GROUND SURFACE													
98.1	TOPSOIL													Water at surface
0.3	Clay-Silty, some sand, trace to some organics, grey		1	AS			98							
			2	SS	4									
			3	SS	11		97							
			4	AS			96							
95.4														CPT 827 kPa
3.0	End of Borehole @ 3.0 m.													

ON_MOT-HIGH VANES GS-TB-018735 DILKE CREEK LOGS.GPJ DST_MIN.GDT 6/24/14

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

RECORD OF BOREHOLE No BH4

1 OF 1

METRIC

W.P. 6013-E-0023 LOCATION DILKE CREEK CULVERT - STA 20 + 347 17.5m, RT ORIGINATED BY JM
 DIST HWY HWY 11 BOREHOLE TYPE HOLLOW STEM AUGER (80 mm ID) COMPILED BY MD
 DATUM Geodetic DATE - 5.2.14 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			20	40	60	80	100					
98.1	GROUND SURFACE																
97.9	TOPSOIL																
0.3	CLAY - Sandy, with silty fine gravel, grey		1	AS													
			2	AS													
			3	AS													
			4	AS													
95.0																	
3.1	End of borehole @ 3.1 m.																

ON_MOT-HIGH VANES GS-TB-018735 DILKE CREEK LOGS.GPJ DST_MIN.GDT 6/24/14

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

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

