



**Final
FOUNDATION INVESTIGATION
REPORT
WOLSELEY CREEK CULVERT
REPLACEMENT, HWY 528
TOWNSHIP OF SCOLLARD
AGREEMENT No.: 5010-E-0007
WP: 5424-06-01
GWP: 5272-07-00
GEOCRES NO.: 41I-267**

December 22, 2011

Prepared for:

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1 Copy - Genivar, Ottawa, ON
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**FOUNDATION INVESTIGATION AND DESIGN REPORT
WOLSELEY CREEK CULVERT REPLACEMENT
HIGHWAY 528
TOWNSHIP OF SCOLLARD
AGREEMENT NO.: 5010-E-0007
WP: 5424-06-01
GWP: 5272-07-00
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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

DST Consulting Engineers Inc. (DST) has been subcontracted by Genivar who was retained by Ministry of Transportation (MTO), NorthEastern Region, to conduct a geotechnical investigation for the replacement a culvert on Highway 528. This work was carried out under Agreement No.: 5010-E-0007, Detailed Design for the Replacement/Rehabilitation of various culverts.

This report addresses the field investigation, laboratory test program, factual report on conditions (Part 1) and recommendations for the design and construction for the proposed culvert replacement (Part 2).

2. SITE DESCRIPTION

The proposed site is located on Highway 528, approximately 7.7 km east of Highway 7072, Township of Scollard, Sudbury Area. The structural site number is 46-379.

Existing culvert at this location is a corrugated steel plate structure (Figure 2.1) and it has about 0.6 m thick cover. The existing culvert has dimensions of 3.4 m x 2.5 m x 21.3 m. The existing structure was identified by MTO to be in fair condition and presents overall minor erosion and moderate corrosion and some perforation at the water surface. The culvert is located in the middle of a swamp area (Figures 2.2 and 2.3). The existing culvert will be replaced by a pre-cast box structure.

Both sides of the embankment are heavily vegetated (Figure 2.4). Photograph shown in Figure 2.1 was taken by MTO and photographs shown in Figures 2.2 to 2.4 were captured during DST's drilling activities on October 21, 2010.

Geological information is available from *Northern Ontario Geology Terrain Study* published by the Ontario Ministry of Natural Resources for the Sudbury Area, District of Nipissing, Parry sound, and Sudbury. This indicates that the local terrain for the area has been identified as a glaciolacustrine plain and primarily contains silt. The area is typically of low local relief with undulating to rolling terrain and has dry conditions. Rock knobs are a common subordinate landform in the area.



Figure 2.1 Corrugated steel plate structure (looking north)



Figure 2.2 Swamp (Looking south)



Figure 2.3 Swamp (looking north)



Figure 2.4 Vegetation (looking west)

3. INVESTIGATION PROCEDURES AND LABORATORY TESTING

Site work was carried out in the period of three days (October 20, 2010 to October 22, 2010) utilizing a CME 750 drill rig that was operated by DST personnel. Four (4) hydraulically powered boreholes and two (2) hand auger boreholes were put down for foundation design purpose. The hydraulically powered boreholes were put down using hollow stem augers.

According to the given specification in Request For Quotation (RFQ) by MTO, three boreholes (one at the inlet, one at the outlet, one at the embankment), were recommended for the purpose of the foundation design. However, the field investigation plan was slightly altered due to the inaccessibility to the inlet and outlet by the hydraulically powered drill rig.

Two boreholes were advanced through the road structure at Station 9+998 offset 3.2 m right and at Station 10+003 offset 4.3 m left. Two boreholes were advanced at 10 m interval from the culvert at stations 9+988 offset 3.2 m right and at station 10+013 offset 4.3 m left. Two hand auger boreholes were advanced close to the inlet and outlet at station 9+998 offset 10.5 m left and at station 10+003 offset 9.5 m right. Borehole locations and stratigraphic sections are shown on the Borehole Location Plans (Drawings 1 to 5).

The borehole locations are referenced to the MTO Station numbering system as indicated in the RFQ. The centreline of the existing culvert was assumed as Station 10+000. The ground surface elevations at the borehole locations were surveyed by DST personnel. At approximately Station 9+993 offset 8.0 m right a benchmark with an elevation of 99.0 m was placed in a nail in a hydro pole. Borehole locations, stationing and benchmark location are shown on the Borehole Location Plan, Drawings 1. Table 3.1 summarizes the detail of borehole locations and depths.

Table 3.1 Detail of borehole locations and depths

Borehole ID	Station	Elevation (m)	Depth (m)	Offset (m)
BH1	9+998	99.28	2.9	3.2 Rt
BH2	9+988	99.28	1.1	3.2 Rt
BH3	10+003	99.22	3.7	4.3 Lt
BH4	10+013	99.25	1.1	4.3 Lt
BH5	9+998	98.01	2.0	10.5 Lt
BH6	10+003	98.1	2.4	9.5 Rt

The fieldwork was supervised on a full-time basis by DST personnel who located the boreholes in the field, performed sampling and in-situ testing and logged the boreholes. In-situ tests included standard penetration test (SPT). The soil samples collected during drilling were identified in the field, placed in labelled containers and transported to DST's laboratory in Thunder Bay for further analysis.

Classification and index tests were subsequently performed in the laboratory on samples collected from the boreholes to aid in the selection of engineering properties. Laboratory tests included moisture contents, particle size analyses and Atterberg limits including plastic limit and liquid limit. A total of fourteen (14) moisture contents, eight (8) sieve analyses, and one (1) Atterberg limits have been carried out for this assignment. Laboratory test results are presented in the Boreholes Logs (Enclosures 1 to 6), and Plots (Enclosures 7 to 9).

4. DESCRIPTION OF SUBSURFACE CONDITIONS

The subsurface conditions are presented based on the information obtained during field and laboratory testing.

The generalized stratigraphy of the existing embankment, based on the conditions encountered in boreholes, consists of surfacing (surface treatment) overlying a fill material that is underlain by boulders or bedrock. The fill consists of a sand and crushed gravel material that is underlain by a sand material. Table 4.1 summarizes the elevations and depths of boreholes at auger refusals on bedrock or boulders.

Table 4.1 Depths and elevations of auger refusals

Borehole ID	Depth of auger refusal at boulders or bedrock (m)	Elevation of auger refusal at boulders or bedrock (m)
BH1	2.9	96.4
BH2	1.1	98.2
BH3	3.7	95.5
BH4	1.1	98.2
BH5	2.0	96.0
BH6	2.4	95.7

4.1 Surface Treatment

Surface Treatment was encountered in Boreholes 1 and 2 with thickness varying between 50 to 60 mm.

4.2 Topsoil

Topsoil was encountered in Boreholes 5 and 6 with thickness of 0.3 m.

4.3 Embankment Fill

A fill material was identified in Boreholes 1 to 4 that were drilled on the embankment. The thickness of the fill is 2.9 and 2.2 m for Boreholes 1 and 3, with corresponding elevations of 96.4 and 97.1 m respectively. For Borehole 2 and 4 thickness of fill layer is about 1.1 m, with corresponding elevation

of 98.2 m respectively. Rockfill was noted in Borehole 4 during drilling process. Grain size distributions of the fill material are reported in borehole logs (Enclosures 1 and 3) and plots (Enclosures 7 and 8).

A base layer of sand and crushed gravel material was identified immediately below the surface treatment in Boreholes 1 and 2 and was identified at the surface in Boreholes 3 and 4. The thickness of this material was found to be 0.2, 0.2, 0.2 and 0.5 m for Borehole 1, 2, 3 and 4 with corresponding elevations of 99.2, 99.2, 99.2 and 99.3 m respectively. Gradation analyses conducted on samples from Borehole 2 indicates gravel, sand, and fines contents of approximately 50%, 43% and 7% respectively. This material classifies as Granular A meeting SSP110S13 requirements. The moisture content of samples was 3 to 8%.

A loose sand fill, based on main fraction of the material, was identified below the sand and crushed gravel. The sand fill was encountered at depth of 0.3, 0.3, 0.2, and 0.8 m for Boreholes 1, 2, 3 and 4 with thickness of 2.6, 0.8, 2.0 and 0.2 m, with corresponding elevations of 99.0, 99.0, 99.0 and 98.5 m respectively. Gradation analyses conducted on samples from Borehole 1 and 3 indicates gravel, sand, and fines contents of approximately 0 to 4%, 83 to 94% and 6 to 12% respectively. This material does not classify as Granular B meeting SSP110S13 requirements. The moisture content of samples was 4 to 21%. SPT values of this fill vary from 3 to 50 and indicate a compactness varying from very loose to dense.

4.4 Clay

A soft clay material was identified below topsoil in Borehole 6 at depth of 0.3 m, with corresponding elevation of 97.8 m. The thickness of the clay material is about 0.4 m. The Atterberg limit tests indicate that the clay has a liquid limit of 28% and plasticity index of 8%, indicating low plasticity (Enclosure 9). Given the borehole locations (close to the culvert) and given some of this layer is above the invert level, it is possible that some of this soil is fill.

4.5 Sand

A loose to compact sand material was encountered in Borehole 5 and 6 at depths of 0.3 and 0.7 m, with corresponding elevations of 97.7 and 97.5 m respectively. The thickness of the sand material is about 1.7 m. Gradation analyses conducted on a samples from Borehole 5 indicates gravel, sand, and fines contents of approximately 0 to 1%, 89 to 90% and 10% respectively

4.6 Bedrock or Boulders

Refusals to auger penetration were encountered at various elevations within and (likely) below the fill. The refusal material was not proven with diamond drilling methods, and may be on boulders or bedrock.

4.7 Groundwater

The groundwater table was identified below the ground surface during the field investigation and visual identification of soil samples. The estimated depth of groundwater level below the ground surface elevation is given in Table 4.2. The water level at the culvert was at an elevation of 98.0 m during the field investigation. The groundwater levels can be expected to vary with season and precipitation events.

Table 4.2 Interpreted depths of water table at borehole locations

Borehole ID	Depth of water table (m) below the ground surface	Water table elevation (m)
BH1	1.2	98.1
BH2	-	-
BH3	1.2	98.0
BH4	-	-
BH5	0.0	98.0
BH6	0.0	98.1

5. REFERENCES

Canadian Highway Bridge Design Code (2006), CAN/CSA-S6-06, A National Standard of Canada,
Canadian standards Association.

Special Provisions, Ontario Provincial Standards, SSP110S13.

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.

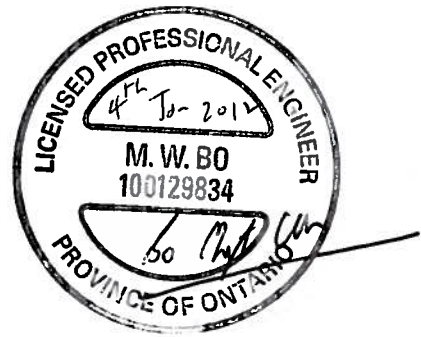
For DST CONSULTING ENGINEERS INC.

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Reviewed by:



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C. Geol, C. Eng, Eur Geol, Eur Eng
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Reviewed by:



Wesley Saunders, P. Eng.
Project Manager

APPENDIX 'A'
LIMITATIONS OF REPORT

LIMITATIONS OF REPORT

GEOTECHNICAL STUDIES

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that DST Consulting Engineers be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

A P P E N D I X 'B'

**DESCRIPTIVE TERMS FOR SOIL
CLASSIFICATION**

Descriptive Terms for soil classification:

As per the soil classification manual by MTO, the descriptive terms based on percent by mass of the whole sample, are described as per following table

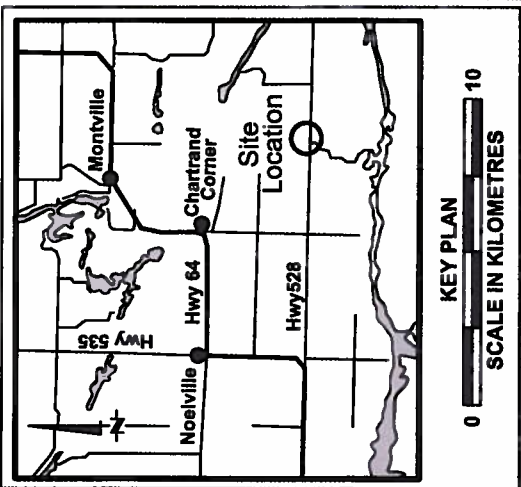
Descriptive Term	Example	Percent by Mass of Sample
And (with two major soil types)	Sand and gravel	40-60
Adjective (silty)	Silty	30-40
With	Silt with fine sand	20-30
Some	Silt, some fine sand	10-20
Trace	Sand, trace of gravel	0-10

DRAWINGS

CONT No 5010-E-0007
GWP No 5272-07-00
Site No 46-379
Geocres No 41-267

SHEET

CULVERT REPLACEMENT
AT WOLSELEY CREEK
Highway 528 - Scollard Twp.
BOREHOLE LOCATION PLAN



Legend

Borehole

Borehole with DCPT

Dynamic Cone Penetration Test (DCPT)

Rock Probe

'N' Blows/0.3m (Std. Pen Test, 475 J/Blow)

Water level at time of investigation

Benchmark

Fill

Organics

Topsoil

Till

Bedrock

Sand

Silt

Clay

Sand & Gravel

Boulders

No.	Elevation	Nothing	Station	Offset
BH1	98.280	5103916	9+988	3.2 m RT
BH2	98.285	5105915	9+988	3.2 m RT
BH3	98.230	5105926	10+003	4.3 m LT
BH4	98.255	5105924	10+013	4.3 m LT
BH5	98.010	5105930	9+998	10.5 m LT
BH6	98.100	5105930	10+003	9.5 m RT

NOTE:
The boundaries between soil strata have been established only at borehole locations. Interpolated boundaries are shown for convenience and may not represent actual conditions.

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

MINISTRY OF TRANSPORTATION, ONTARIO
PB-0-707 88-05

DRAWING 1

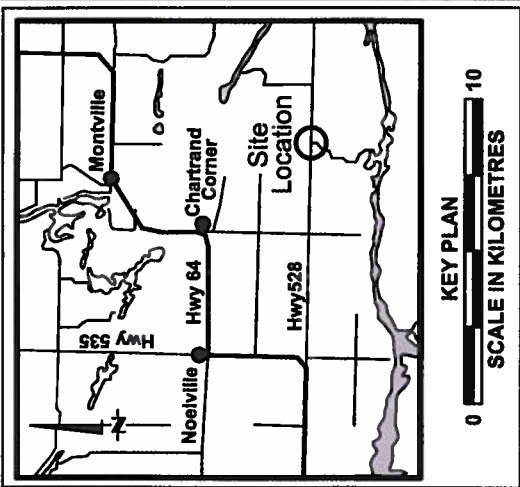
CONT No 5010-E-0007
GWP No 5272-07-00
Site No 46-379
Geocres No 411-267

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

17

SHEET

CULVERT REPLACEMENT
AT WOLSELEY CREEK
Highway 528 - Scollard Twp.
BOREHOLE LOCATION &
SOIL STRATIGRAPHY



LEGEND

Borehole

Borehole with DCPT

Dynamic Cone Penetration Test (DCPT)

Rock Probe

'N'

Blows/0.3m (Std. Pen Test, 475 J/Blow)

Water level at time of investigation.

Benchmark

Fill

Organics

Topsoil

Till

Bedrock

Sand

Silt

Clay

Sand & Gravel

Boulders

No.	Elevation	Nothing	Station	Offset
BH1	98.290	5105916	9+493	3.2 m RT
BH2	98.265	5105916	9+488	3.2 m RT
BH3	98.220	5105926	10+003	4.3 m LT
BH4	98.255	5105924	10+015	4.3 m LT
BH5	98.010	5105930	9+938	10.5 m LT
BH6	98.100	5105909	10+003	8.5 m RT

Note:

Auger refusal was encountered on possible boulders or bedrock at all borehole locations

NOTE:

Interpretation between soil type logs has been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.

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M. W. BO

100129834

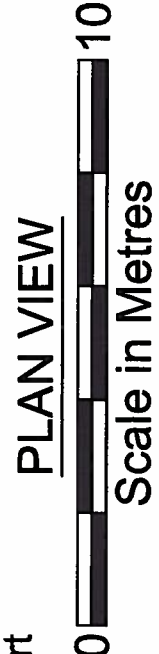
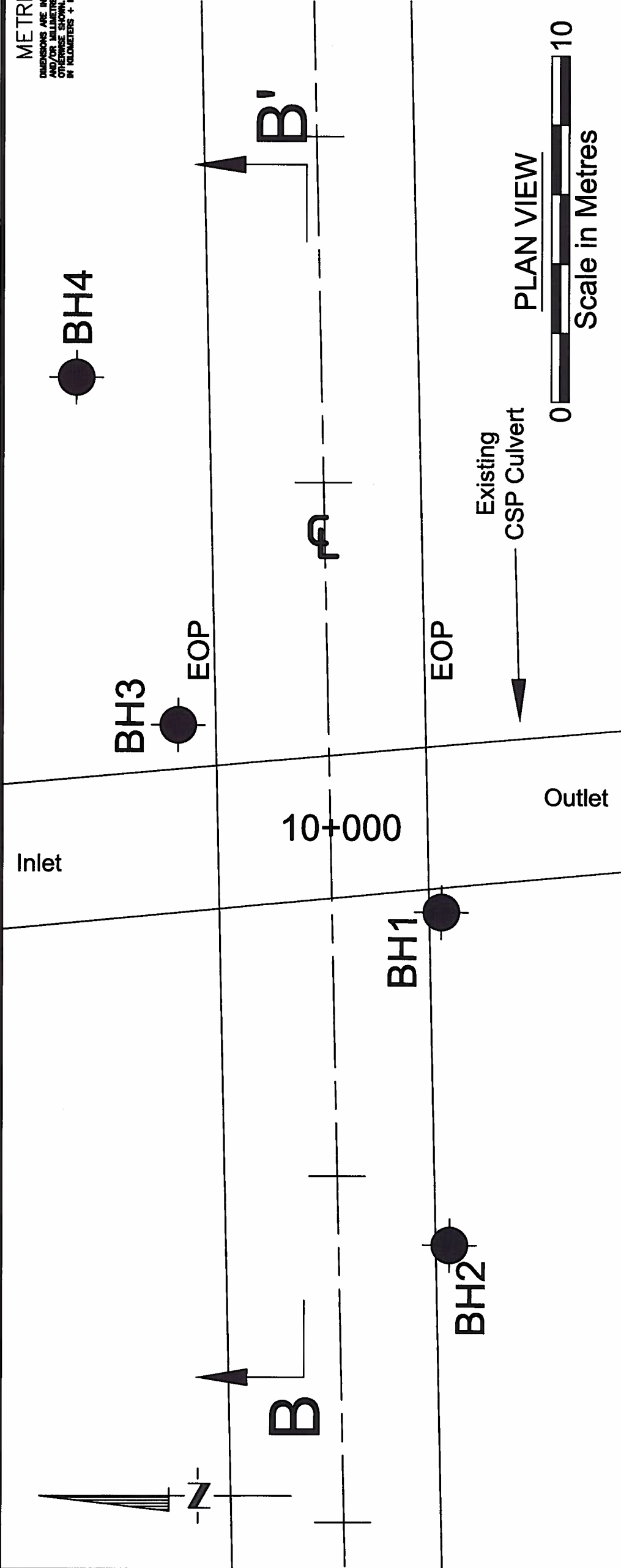
PROVINCE OF ONTARIO

Distance H:1 to V:1

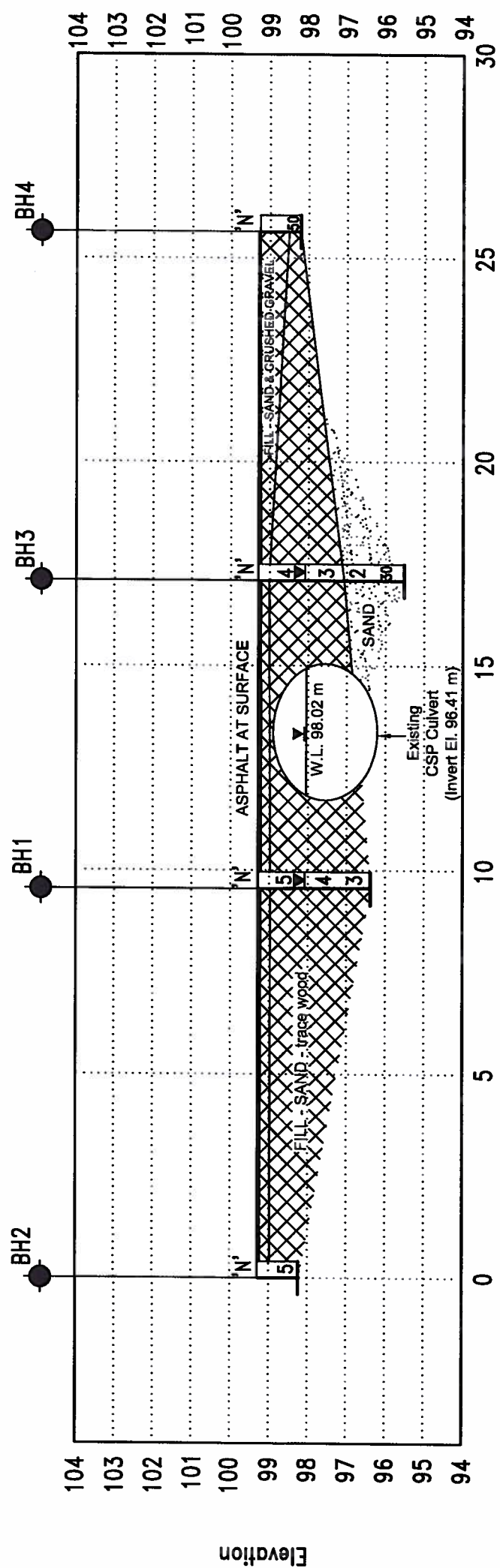
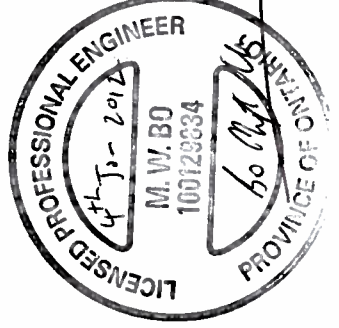
DRAWING 2

CONT	No	5010-E-0007
GWP	No	5272-07-00
Site	No	46-379
Geocres	No	411-267
CULVERT REPLACEMENT AT WOLSELEY CREEK Highway 528 - Scollard Twp. BOREHOLE LOCATION & SOIL STRATIGRAPHY		
SHEET		

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



PLAN VIEW
Scale in Metres



Distance H:1 to V:1

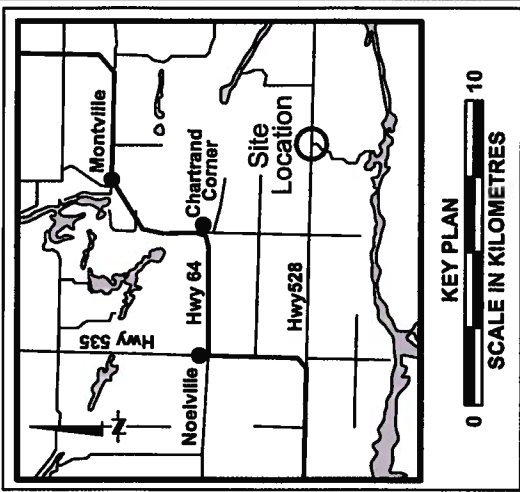
LEGEND			
●	Borehole		
⊕	Borehole with DCPT		
⊕	Dynamic Cone Penetration Test (DCPT)		
●	Rock Probe		
'N'	Blows/0.3m (Std. Pen Test, 475 J/Blow)		
≡	Water level at time of investigation.		
⊕	Benchmark		
⊕	Fill	⊕	Sand
⊕	Organics	⊕	Silt
⊕	Topsoil	⊕	Clay
⊕	Till	⊕	Sand & Gravel
⊕	Bedrock	⊕	Boulders

Note:
Auger refusal was encountered on possible
boulders or bedrock at all borehole locations

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

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CONT	No 5010-E-0007	METRIC
GWP	No 5272-07-00	DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METERS
Site	No 46-379	
Geocres	No 411-267	
CULVERT REPLACEMENT AT WOLSELEY CREEK Highway 528 - Scollard Twp. BOREHOLE LOCATION & SOIL STRATIGRAPHY		
SHEET		



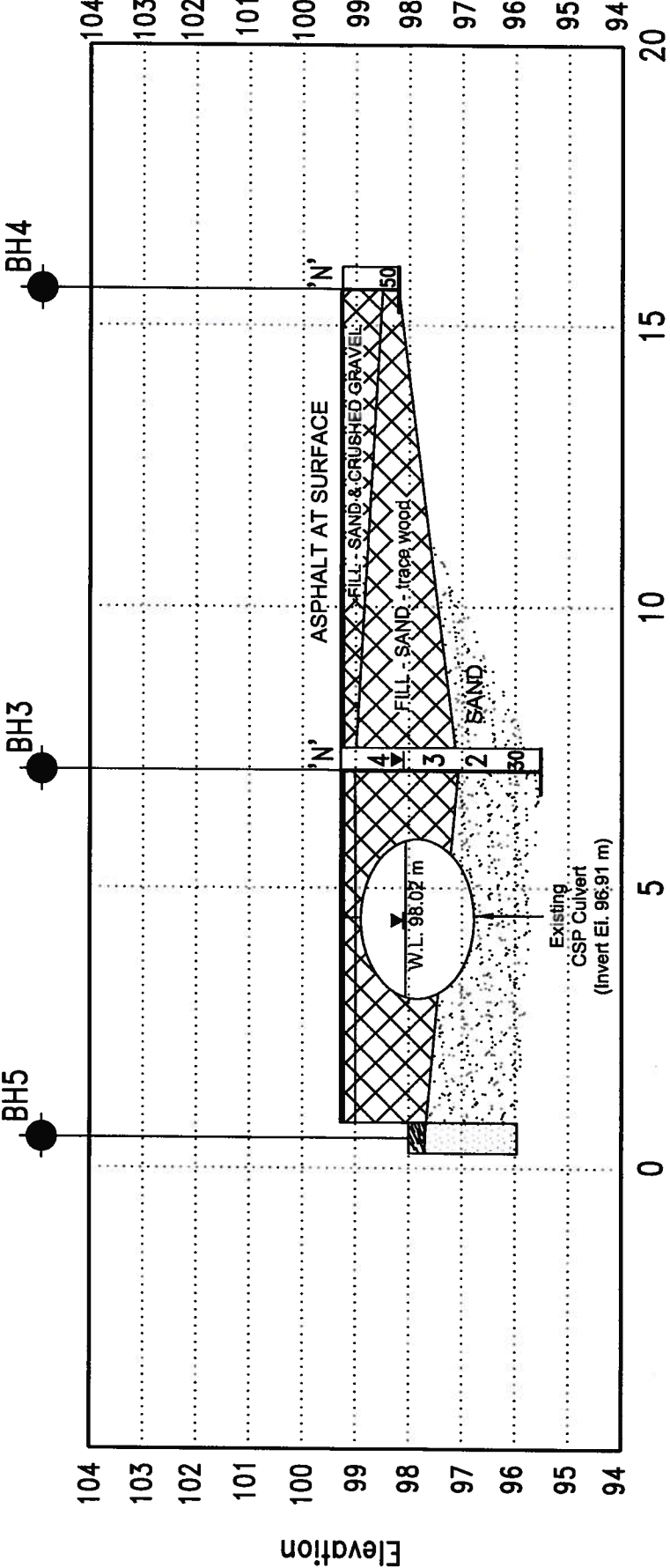
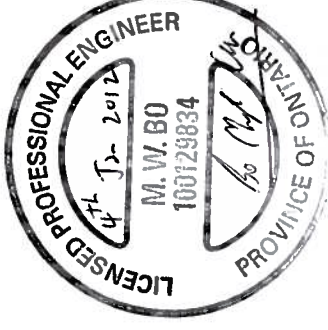
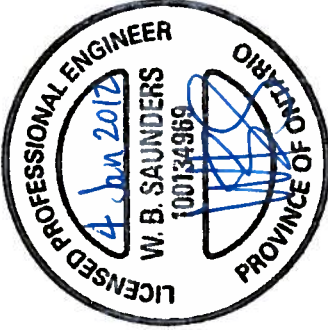
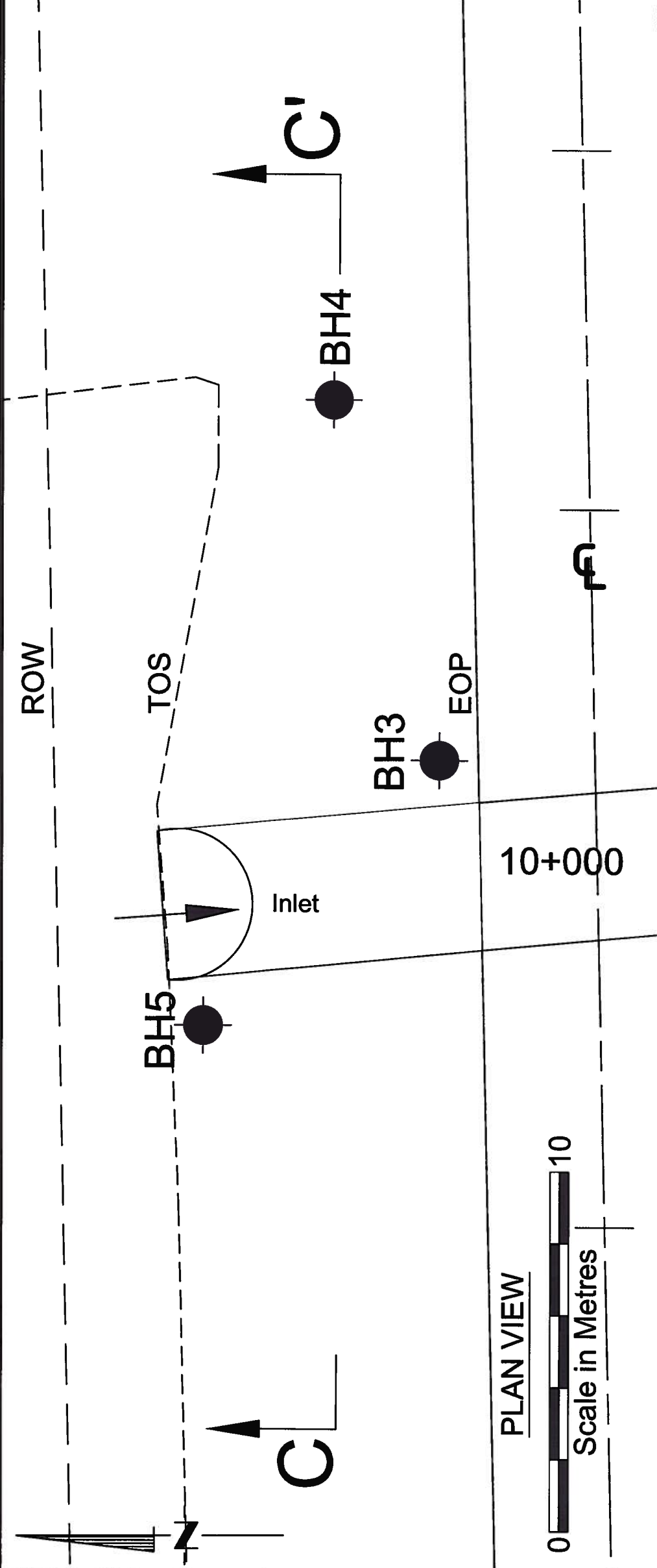
LEGEND			
◆	Borehole		
●	Borehole with DCPT		
⊕	Dynamic Cone Penetration Test (DCPT)		
●	Rock Probe		
●	Blows/0.3m (Std. Pen Test, 475 J/Blow)		
≡	Water level at time of investigation.		
⊕	Benchmark		
⊗	Fill	⊗	Sand
⊗	Organics	⊗	Silt
⊗	Topsoil	⊗	Clay
⊗	Till	⊗	Sand & Gravel
⊗	Bedrock	⊗	Boulders

No.	Elevation	Nothing	Station	Offset
BH1	98.230	5105916	9+988	3.2 m RT
BH2	98.265	5105916	9+988	3.2 m RT
BH3	99.220	5105926	10+003	4.3 m LT
BH4	98.285	5105924	51007	4.3 m LT
BH5	98.010	5105930	9+988	10.5 m LT
BH6	98.100	5105906	10+003	8.5 m RT

Note:
Auger refusal was encountered on possible boulders or bedrock at all borehole locations

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NOTE:
Boundaries between all sample types have been established only at borehole locations. Between boreholes the boundaries are assumed by interpolation and may not represent actual conditions.



Distance H:1 to V:1

ENCLOSURES

RECORD OF BOREHOLE No BH1

1 OF 1

METRIC

W.P. 5424-06-01 LOCATION STA. 9+998, 3.2 m RT (17U 5105916 m N, 550992 m E) ORIGINATED BY PR
 DIST HWY 528 BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML
 DATUM Local DATE 2010 10 21 CHECKED BY LP/MWB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20	40	60	80	100						20	40	60
99.3	GROUND SURFACE																GR SA SI CL			
99.2	ASPHALT - 60 mm																			
0.1	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		1	AS													Water level at 1.2 m on completion. Cave at 1.2 m.			
99.0																				
0.3	FILL - SAND - some silt, trace gravel and wood, brown, very loose to loose																			

✕³, ★³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 1

ON MOT CS-TB-012143 - GENIVAR - WOLSELY CREEK CULVERT.GPJ DST_MIN.GDT 4/1/12

RECORD OF BOREHOLE No BH2

1 OF 1

METRIC

W.P. 5424-06-01 LOCATION STA. 9+988, 3.2 m RT (17U 5105918 m N, 550982 m E) ORIGINATED BY PR
 DIST HWY 528 BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML
 DATUM Local DATE 2010 10 21 CHECKED BY LP/MWB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
99.3	GROUND SURFACE							20	40	60	80	100					
99.2 0.1	ASPHALT - 50 mm FILL - SAND & CRUSHED GRAVEL - trace silt, brown		1	AS													50 43 (7)
99.0 0.3	FILL - SAND - trace silt, brown, loose																Dry on completion. Cave at 1.0 m.
98.2			2	SS	5												
1.1	End of Borehole at 1.05 m Auger Refusal																

✕³, ★³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 2

RECORD OF BOREHOLE No BH3

1 OF 1

METRIC

W.P. 5424-06-01 LOCATION STA. 10+003, 4.3 m LT (17U 5105926 m N, 550998 m E) ORIGINATED BY PR
DIST HWY 528 BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML
DATUM Local DATE 2010 10 21 CHECKED BY LP/MWB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
99.2	GROUND SURFACE						20	40	60	80	100						
	FILL - SAND & CRUSHED GRAVEL - trace silt, brown					▽										Water level at 1.2 m on completion. Cave at 1.2 m.	
99.0	FILL - SAND - trace gravel and silt, brown, very loose																0 94 (6)
0.2		1	AS														
			2	SS	4												
			3	SS	3											3 88 (9)	
97.1	SAND - some gravel, some silt, brown, very loose to compact - cobbles																
2.2		4	SS	2													
			5	SS	30											12 76 (12)	
95.5																	
3.7	End of Borehole at 3.7 m Auger Refusal																

✕³, ★³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH4

1 OF 1

METRIC

W.P. 5424-06-01 LOCATION STA. 10+013, 4.3 m LT (17U 5105924 m N, 551007 m E) ORIGINATED BY PR
DIST HWY 528 BOREHOLE TYPE Hollow Stem Auger (80 mm ID) COMPILED BY ML
DATUM Local DATE 2010 10 21 CHECKED BY LP/MWB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L			
99.3	GROUND SURFACE																
	FILL - SAND & CRUSHED GRAVEL - trace silt, brown		1	AS													Dry on completion.
98.5																	
0.8	FILL - SAND - with rockfill, trace silt and gravel, brown, dense		2	SS	50												
98.2																	
1.1	End of Borehole at 1.05 m Auger Refusal																

✕³, ★³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ENCLOSURE 4

RECORD OF BOREHOLE No BH5

1 OF 1

METRIC

W.P. 5424-06-01 LOCATION STA. 9+998, 10.5 m LT (17U 5105930 m N, 550989 m E) ORIGINATED BY PR
DIST HWY 528 BOREHOLE TYPE Hand Auger COMPILED BY ML
DATUM Local DATE 2010 10 21 CHECKED BY LP/MWB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
98.0	GROUND SURFACE																GR SA SI CL
	TOPSOIL			AS													Wet at Surface.
97.7 0.3	SAND - trace gravel and silt, brown																
			1	AS													1 89 (10)
			2	AS													0 90 (10)
96.0 2.0	End of Borehole at 2.0 m Auger Refusal																

ON_MOT_CS-TB-012143 - GENIVAR - WOLSELY CREEK CULVERT.GPJ DST_MIN.GDT 4/1/12




✕³, ★³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH6

1 OF 1

METRIC

W.P. 5424-06-01 LOCATION STA. 10+003, 9.5 m RT (17U 5105909 m N, 550988 m E) ORIGINATED BY PR
 DIST HWY 528 BOREHOLE TYPE Hand Auger COMPILED BY ML
 DATUM Local DATE 2010 10 21 CHECKED BY LP/MWB

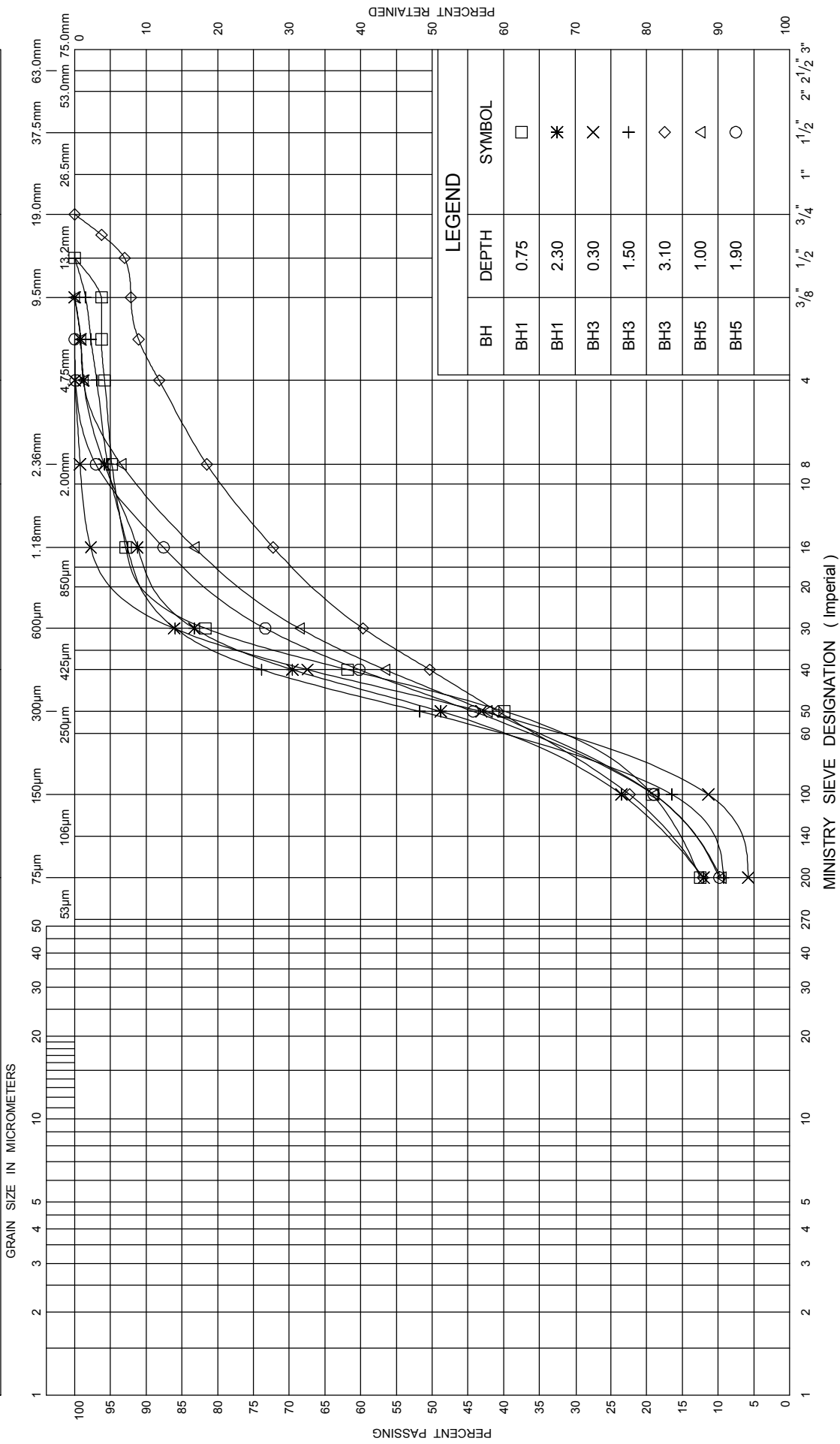
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED × FIELD VANE □ QUICK TRIAXIAL ★ LAB VANE								
98.1	GROUND SURFACE						20	40	60	80	100					
	TOPSOIL						98									Wet at Surface.
97.8 0.3	CLAY - Silty, trace gravel, grey, soft		3	AS												
97.5 0.7	SAND - trace gravel and silt, brown															
							97									
							96									
95.7 2.4	End of Borehole at 2.4 m Auger Refusal															

ON_MOT_CS-TB-012143 - GENIVAR - WOLSELY CREEK CULVERT.GPJ DST_MIN.GDT 4/1/12

✕³, ★³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine		Medium	Coarse	Fine	Coarse



GRAIN SIZE DISTRIBUTION
SAND

ENCLOSURE 7
WP 5424-06-01
HIGHWAY 528

