



FOUNDATION INVESTIGATION REPORT
PROPOSED CULVERT REPLACEMENT
HWY 101, APPROXIMATELY 4.36KM EAST OF HIGHWAY 67
GERMAN TWP, ONTARIO
MTO NE REGION CONTRACT #5006-E-0070
ASSIGNMENT #6
GWP # 5056-03-00
GEOCRES #42A-72

Submitted to:

Ministry of Transportation
North East Region, Engineering Office
Geotechnical Section
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Submitted by:

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TB7206006-I

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1.0 INTRODUCTION

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC), Consulting Geotechnical, Construction Quality Control and Environmental Engineers, was retained by the Ministry of Transportation (North East Region) to conduct a foundation investigation and Detail Design for the replacement of a culvert on Highway 101, approximately 4.36 km east of Highway 67, in German Township, Ontario. Municipal Road (formerly Hwy 67) is located 15.6 km west of Highway 577, placing the culvert at 11.24 km west of Highway 577. The approximate site location is shown on Dwg. No. 1 in Appendix A.

Seven (7) boreholes, with a total drilling length of approximately 48 m in the vicinity of the existing culvert were specified by the MTO. Authorization to proceed with this investigation was signed by the Regional / Branch Director of MTO dated 2nd of January 2008 and faxed on January 4th, 2008. The work was carried out by AMEC according to the MTO Northeastern Region Terms of Reference Agreement #5006-E-0070 Assignment #6; Foundation Investigation and Design for Culvert replacement on Hwy 101, 4.3 km east of Hwy 67.

Subsurface information from previous projects that was available was reviewed prior to carrying out the fieldwork for this project. The following information was reviewed at the MTO Foundation Library (GEOCRES), in Downsview, and used in preparing this report wherever applicable.

- ***“Foundation Design Report, Temporary Detour Bridge, North Driftwood River Bridge, Site No. 39E-131 Highway 101, 14.2 km West of Hwy 11, District 53, New Liskeard, WP 316-85-02”***, AGRA Earth & Environmental, TZ97003, March 24, 1998.
- ***“Soil Investigation at Fredrickhouse Bridge Site, Highway No. 101, West of Matheska, New Liskeard District, Ont”***, Racey, MacCallum and Associates Limited, Reference S-500/T-1446, 26 January, 1959.
- ***“Foundation Investigation Report for North Driftwood Creek Bridge at Highway 101, WP316-85-02, Site 39E-131, District 53, New Liskeard”***, Shaheen & Peaker Limited, Project SP1538, December 16, 1996.
- ***“Foundation Investigation Report for Matheson Creek Bridge, WP316-85-03, Site 39E-85, District 53, New Liskeard”***, Ministry of Transportation Ontario, GeoCres 42A-47, April 03, 1997.

The investigation was carried out by means of a limited number of boreholes, in-situ tests and laboratory tests on selected samples. The factual results of the soil conditions encountered in the boreholes and laboratory tests are presented in this report. The detail design is presented in a separate report (i.e., Detail Design Report prepared by AMEC - Reference No. TB7206006-II dated 04 April 2008).

2.0 SITE DESCRIPTION

The site for the foundation investigation is on Highway 101, approximately 4.36 km east of Highway 67, in German Township. Hwy 67 (now Municipal Road) is located 15.6 km west of Highway 577, placing the culvert approximately 11.24 km west of Highway 577.

A 1000 mm diameter CSP culvert crosses under Hwy 101. The highway at this location runs on top of an embankment built up above the surrounding grade. The culvert lies across Hwy 101 near the base of the embankment. The fill height at the culvert location is approximately 5 m, Highway 101 at this location is two lane with gravel shoulders and a post and wire guardrail. The embankment slopes were sparsely treed and snow-covered at the time of the fieldwork. Typical photographs can be found in Appendix C.

The replacement culvert will be a 1000 mm diameter pipe culvert. At this location, a detour or temporary widening/staged excavation is not an option for replacement due to property and utility constraints. It is expected, according to MTO, that the culvert will be replaced either in the current location using roadway protection or by using jack and bore at a location adjacent to the existing culvert.

3.0 GEOLOGY

Surficial Geological mapping by Richard et al. (1985) indicates that the project site is underlain by deepwater glaciolacustrine deposits of the Barlow-Ojibway Formation. These deposits consist of laminated to varved silts and clays which were deposited in proglacial Lake Ojibway Barlow.

In the vicinity of the culvert, organic deposits comprising peat and muck are anticipated to overlie more recent stream or alluvial deposits of clayey silt to gravel.

Previous geotechnical investigations carried out to the east of the project site indicate the depth to bedrock to be in the order of 37 to 40 m, comprising Archean aged mafic metavolcanic rock and intermediate metavolcanic rock, described as massive flows. Previous geotechnical investigations carried out to the west of the project site indicate the depth to bedrock to be in the order of 15 m, comprising sandstone. The location of the contact between the rock types is unknown.

4.0 INVESTIGATION PROCEDURES

4.1 Field Investigation

In accordance with the Terms of Reference for this investigation, seven (7) borehole locations (BH 1 to BH 7) were staked and cleared.

Three boreholes were drilled through the existing road embankment and sampled from the top of the highway embankment to verify embankment fill material and soil conditions below the culvert for potential roadway protection should the culvert be replaced by open excavation at its current location. The three deep boreholes extended to between 12.2 m and 13.0 m below existing road grade.

Four additional shallow holes (extending to a depth of 3 m were drilled north and south of the existing roadway embankment, at the base of the embankment.

The boreholes were drilled at the locations indicated in Table 1 of the RFP, as shown below:

TABLE 1 – Field and Laboratory Testing Requirements								
Borehole	Location & Approximate Offset	Depth (m)	SPT	FVT *	LS-701	LS-702	LS-703 *	LS-704 *
JB-1	18+252	12.0	16 @ 0.75m	2	6	2	1	1
JB-2	18+262	12.0	16 @ 0.75m	2	6	2	1	1
JB-3	18+272	12.0	16 @ 0.75m	2	6	2	1	1
JB-4	18+252, 18.7m RT	3.0	N/A	0	2	1	0	0
JB-5	18+252, 17.7m LT	3.0	N/A	0	2	1	0	0
JB-6	18+262, 18.7m RT	3.0	N/A	0	2	1	0	0
JB-7	18+262, 17.7m LT	3.0	N/A	0	2	1	0	0
Totals	7	48	48	6	22	10	3	3

The fieldwork was performed over the period February 12th to March 24th, 2008. Prior to drilling, utility locates were carried out. Boreholes 1 through 3 were drilled by Abraflex Environmental and Geotechnical Drilling, using a track-mounted drilling rig. Boreholes 4 through 7 were advanced using hand augering equipment, supplied by AMEC, and auger samples were obtained. As well, split spoons were taken at depth in Boreholes 5 through 7.

Traffic control was provided by Levert Personnel Resources Inc.

The borehole locations are presented on Drawing No. 1 and 2 in Appendix A.

The borehole investigation was carried out under the full-time supervision of experienced geotechnical personnel from AMEC.

Soil samples were taken at 0.75m intervals in Boreholes 1, 2 and 3 during the performance of Standard Penetration Test (SPT) in accordance with ASTM D1586. This consisted of freely dropping a 63.5 kg (140 lbs.) hammer for a vertical distance of 0.76 m (30 inches) to drive a 51 mm (2 inches) diameter O.D. split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m (12 inches) was recorded as SPT 'N' value of the soil which indicated the consistency of cohesive soils or the relative density of non-cohesive soils.

One borehole (BH 3) encountered soft to very soft clay soils through which MTO Field Vane Testing was carried out.

In Boreholes 4 through 7, auger samples were taken from the boreholes to depths of between 1.8 m and 2.4 m below existing site grade. Below those depths, penetration testing was carried out to a depth of 3 m. The penetration tests were carried out using hand sampling equipment, driving a standard split spoon sampler with a 32 kg hammer. The N values were subsequently adjusted to reflect Standard Penetration test results.

Soil samples were normally collected from each soil layer exposed in the boreholes for laboratory inspection and testing.

Upon completion of drilling, the boreholes that were deeper than 3 m were backfilled with bentonite in accordance with the general requirements of Ministry of the Environment Regulation 903 as indicated on the Records of Boreholes.

The soil samples were transported to AMEC's Soil Laboratory in Hamilton for further examination and laboratory soil testing. The program of laboratory testing included grain size analysis, Liquid and Plastic Limits, and moisture content determination.

The results of the in-situ and laboratory tests are presented in the corresponding Records of Boreholes (Appendix A) and Laboratory Test Results (Appendix B).

AMEC will retain the soil samples for a period of one year after completion of the Project, unless otherwise advised in writing by the Ministry.

4.2 Laboratory Tests

In accordance with the Terms of Reference for this investigation representative soil samples were subjected to laboratory testing in AMEC's Soil Laboratory in Hamilton for soil classification. The following tests were conducted:

- In-situ water content determination (26);
- Grain size distribution analysis (10); and
- Liquid and Plastic Limits (3).

The results of the laboratory tests are included in the Record of Boreholes in Appendix A. The grain size distribution curves and Liquid / Plastic Limits are shown in Appendix B.

5.0 SUB-SURFACE CONDITIONS

The general soil profile through the road embankment consisted of sand and gravel over sand, silty sand, sandy silt and silt. Two of the three boreholes were terminated within these materials. Underlying the silty sand to sandy silt in the third borehole, very soft to firm clayey silt to clay was encountered, and extended to the maximum depth investigated.

To the north and south of the road embankment, three of the four boreholes encountered topsoil underlain by silt and sand. In the fourth borehole, peat was encountered to a depth of 1.8 m, underlain by silty sand.

Groundwater was encountered in all boreholes, the levels ranging from at grade to 1.9 m below existing grade.

The stratigraphic units and groundwater conditions at the borehole locations are discussed in the following sections. Detailed information is provided in the Record of Boreholes (Appendix A).

The following summary is to assist the designers of the project with an understanding of the anticipated soil conditions across the site. However, it should be noted that the soil and groundwater conditions may vary between the borehole locations.

5.1 Topsoil/Peat

In three of the four boreholes drilled off the road embankment (BH's 4 through 6, to the north and south of the embankment), between 150 mm and 300 mm of topsoil was encountered. Some peat was interlayered with the topsoil. In Borehole 7, 1.8 m of peat was encountered from grade. A trace of silty fine sand was observed within the peat layer below a depth of 1.0 m. **It should be noted that the thickness of topsoil/peat varied considerably across the project limits.**

5.2 Sand and Gravel / Sand Fill

From the existing road shoulder grade, the boreholes put down through the embankment encountered sand and gravel and sand fill. In Borehole 1, sand and gravel and sand fill were encountered to a depth of 4.5 m. In Boreholes 2 and 3 a distinct layer of sand and gravel fill extended to 0.8 m below road grade, and was underlain by sand fill to depths of 6.9 m and

5.3 m, respectively. A trace to some organic matter was noted within the fill, along with traces of silt

The SPT 'N' values of the sand and gravel / sand fill varied considerably from 2 blows for 0.3 m to 50 blows for no penetration, indicating very loose to very dense relative density. **The fill soils could contain some cobbles / boulders as some stone pieces were noticed in the recovered soil samples.**

The results of laboratory tests conducted on soil samples are as follows:

Moisture content (%):	3 to 33
Plastic Limit:	non-plastic
Liquid Limit:	non-plastic

The moisture contents are plotted on the Records of Boreholes in Appendix A.

5.3 Silty Sand / Sandy Silt / Sand / Silt

Underlying the sand fill in each of Boreholes 1, 2 and 3, and below the topsoil/peat in Boreholes 4 through 7, silty sand to sandy silt, silt and sand were encountered. These deposits extended to at least the maximum depths investigated in Boreholes 1 and 4 through 7, and to depths of 11.4 m and 9.9 m below grade in Boreholes 2 and 3, respectively.

The deposits ranged from brown to grey and contained traces to some clay at depth. The SPT 'N' values through the silty sand to sandy silt, silt and sand ranged from 5 to 17 blows for 0.3 m (loose to compact relative density).

The result of laboratory test conducted on one sample is as follows:

Natural moisture content (%):	18 to 31
Grain size (8 samples):	Gravel (%): 0
	Sand (%): 25 to 88
	Silt (%): 9 to 49
	Clay (%): 6 to 34

The moisture contents are plotted on the Records of Boreholes in Appendix A. The grain size distribution curves are presented in Figures B1 to B8 in Appendix B.

5.4 Silty Clay

Silty clay was encountered underlying the silty sand to sandy silt in Boreholes 2 and 3. Each of these boreholes was terminated within the silty clay.

The SPT 'N' values of the silty clay ranged from 0 to 3 blows per 0.3 m (very soft to soft consistency). Two MTO field vanes resulted in shear strengths of 12 and 21 kPa (soft consistency).

The results of laboratory tests conducted on soil samples are as follows:

Natural moisture content (%):	38 and 43
Plastic Limit (2 samples):	17 and 18
Liquid Limit (2 samples):	35 and 37
Grain size (2 samples):	Gravel (%): 0
	Sand (%): 3 and 11
	Silt (%): 14 and 26
	Clay (%): 71 and 75

The plasticity indices are plotted on Figure No. B11 in Appendix B and the grain size distribution curves are presented in Figures B9 and B10 in Appendix B.

5.5 Groundwater

The groundwater level in each open borehole was observed during drilling and measured upon completion of drilling. The measured groundwater levels are shown in the Record of Boreholes (Appendix A).

Groundwater levels were encountered in all the boreholes as follows:

Borehole No.	Groundwater Depth below Existing Ground Surface, m	Notes
1	5.3	caved at 6.4m
2	6.1	caved at 9.7m
3	11.9	open to depth
4	2.0	open to depth
5	1.7	caved at 2.4m
6	0	caved at 1.5m
7	0	caved at 2.1m

It should be noted that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events / water levels in the creek.

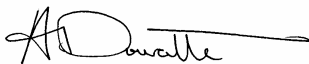
6.0 CLOSURE

The sub-soil information and recommendations contained in this report should be used solely for the purpose of foundation assessment of this site.

The attached Report Limitations is an integral part of this report.

Sincerely,

AMEC Earth & Environmental,
A division of AMEC Americas Limited



Jane Doucette, P.Eng.
Senior Geotechnical Engineer

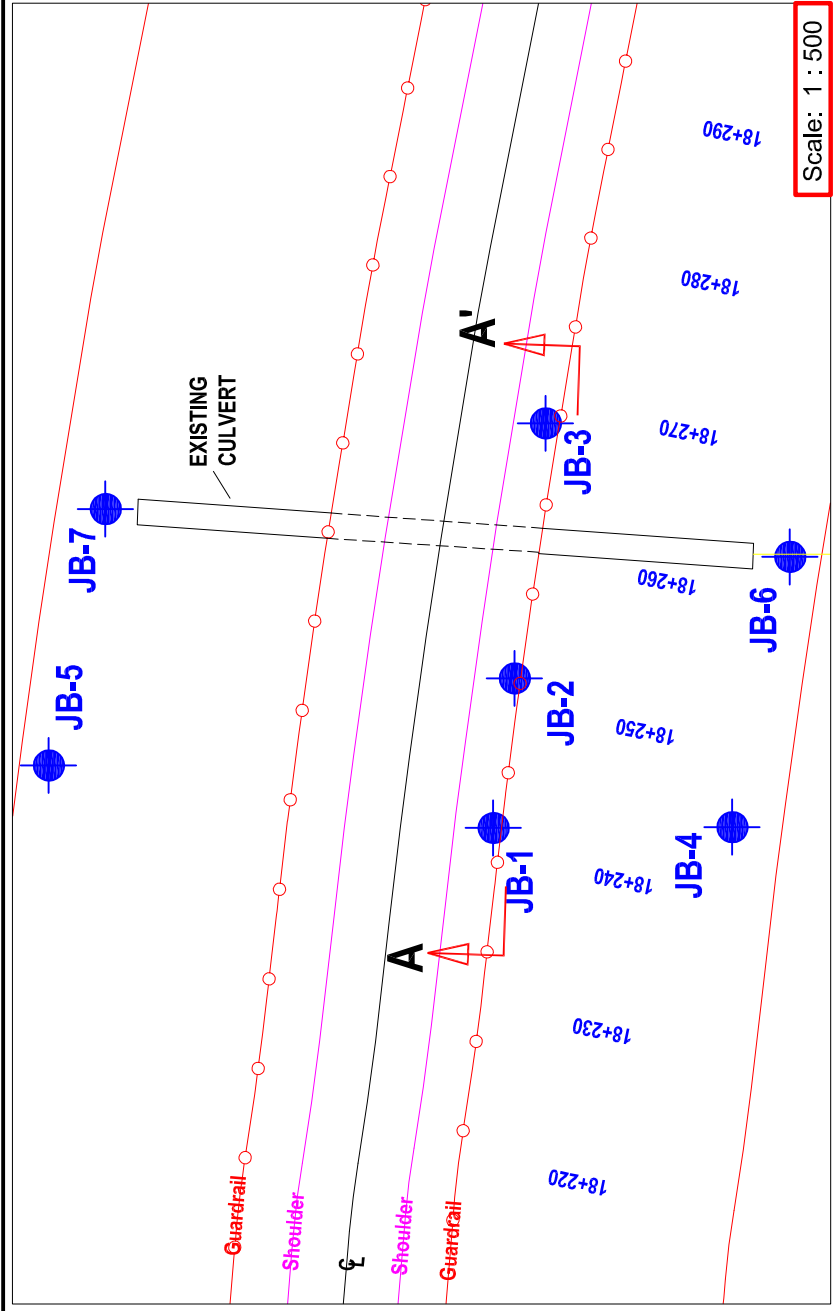


Prapote Boonsinsuk, Ph.D., P.Eng.
Project Reviewer



George Chow, P.Eng.
Designated Principal Contact

DRAWINGS



AGREEMENT No.
5006-E-0070

Geocres 42A-72

FOUNDATION INVESTIGATION
PROPOSED CULVERT REPLACEMENT
HWY 101, APPROX. 4.36 KM EAST OF HWY 67
GERMAN TWP. ONTARIO
ASSIGNMENT 6

Org. Title:
Borehole Location Plan / Cross Section A-A'

AMEC Earth & Environmental,
a Division of AMEC Americas Limited

1



LEGEND			
BOREHOLE LOCATION			
BOREHOLE	WATER LEVEL		ELEVATION (m)
	STATION	OFFSET	
JB-1	18 + 252	-	106.24
JB-2	18 + 262	-	105.94
JB-3	18 + 272	-	105.70
JB-4	18 + 252	18.7 m RT	102.59
JB-5	18 + 252	17.7 m LT	101.20
JB-6	18 + 262	18.7 m RT	101.89
JB-7	18 + 262	17.7 m LT	100.90

NOTES

1. The boundaries between soil strata have been established only at borehole locations. Between boreholes, the boundaries are assumed from geological evidence and may be subject to considerable error.

2. All elevations shown are referred to a temporary benchmark of 100.00 m (Invert of culvert on north side of Hwy 101)

SOIL STRATIGRAPHY

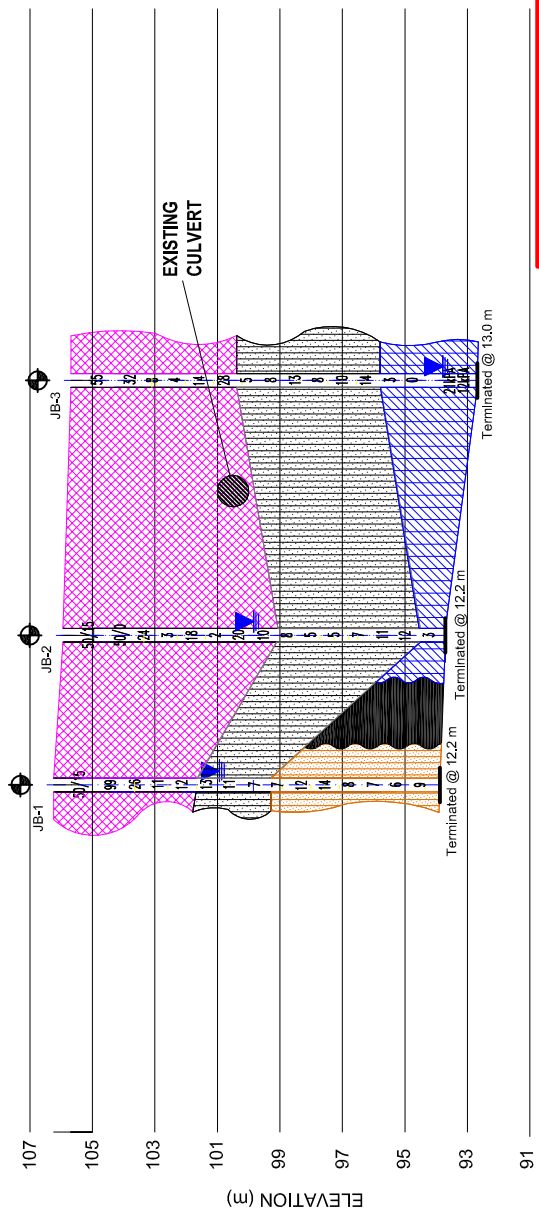
Sand & Gravel to Sand Fill

Silty Clay

Unknown

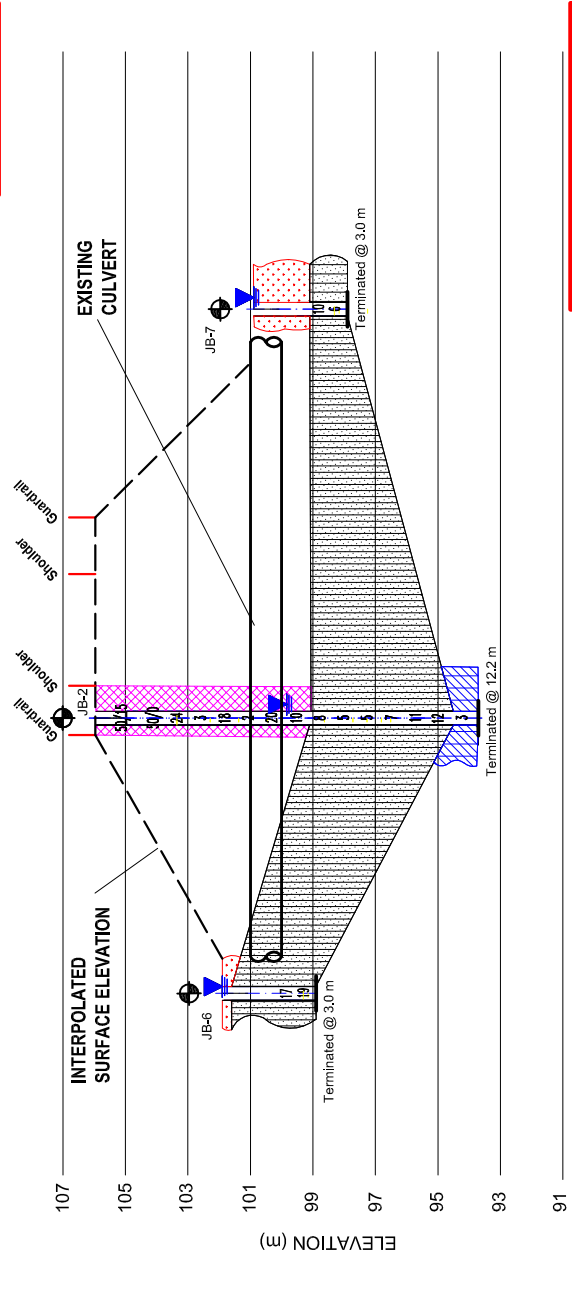
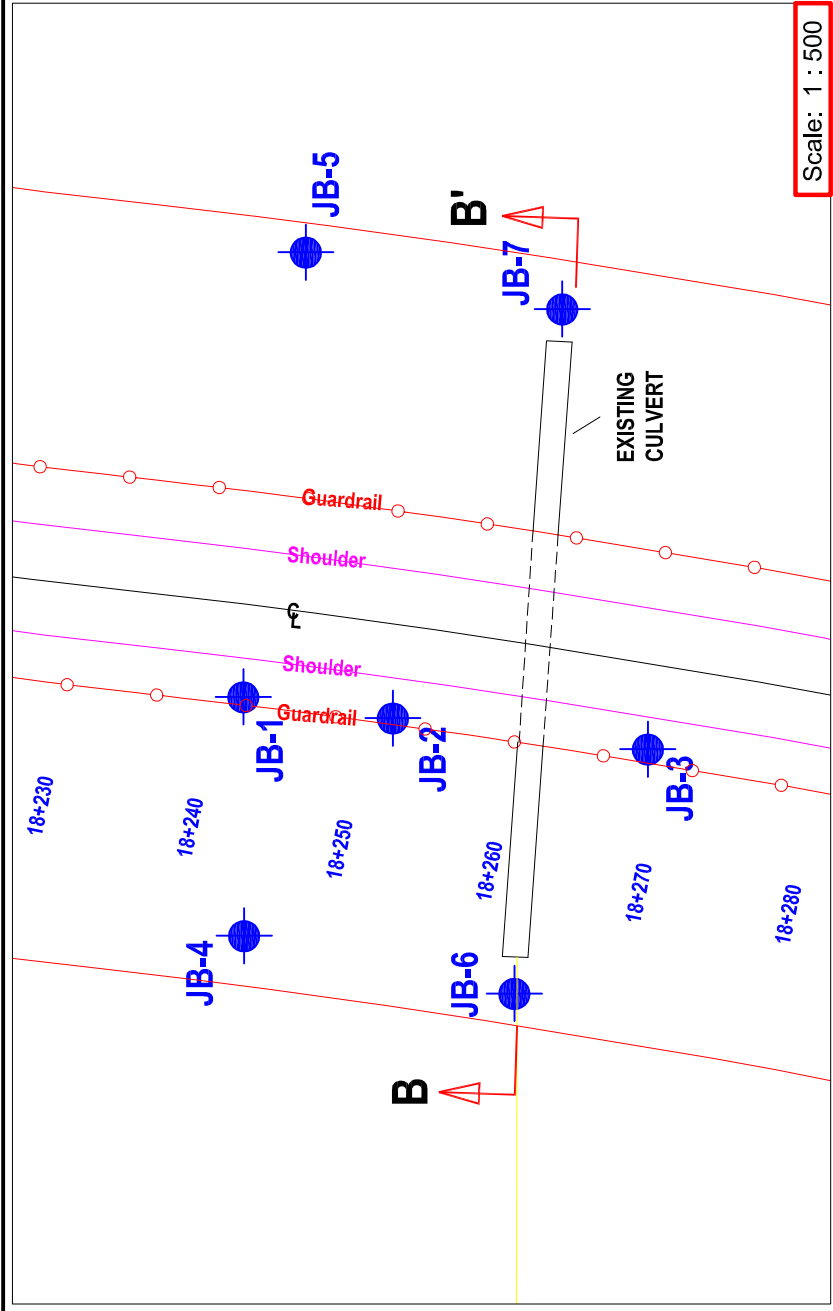
Silt and Sand

Silty Sand



Scale: Horizontal 1 : 500
Vertical 1 : 250

PROFILE



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

AGREEMENT No. **5006-E-0070**

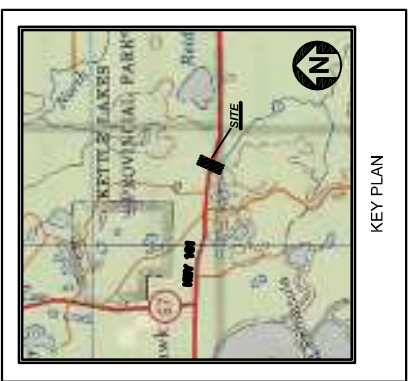
Geocres 42A-72

FOUNDATION INVESTIGATION
PROPOSED CULVERT REPLACEMENT
HWY 101, APPROX. 4.36 KM EAST OF HWY 67
GERMAN TWP. ONTARIO
ASSIGNMENT 6

Dwg. Title:
Borehole Location Plan / Cross Section B-B'

amec
AMEC Earth & Environmental,
a Division of AMEC Americas Limited

TB7206006
DRAWING
2



LEGEND			
BOREHOLE LOCATION			
BOREHOLE	LOCATION		ELEVATION (m)
	STATION	OFFSET	
JB-1	18 + 252	-	106.24
JB-2	18 + 262	-	105.94
JB-3	18 + 272	-	105.70
JB-4	18 + 252	18.7 m RT	102.59
JB-5	18 + 252	17.7 m LT	101.20
JB-6	18 + 262	18.7 m RT	101.89
JB-7	18 + 262	17.7 m LT	100.90

NOTES

1. The boundaries between soil strata have been established only at borehole locations. Between boreholes, the boundaries are assumed from geological evidence and may be subject to considerable error.

2. All elevations shown are referred to a temporary benchmark of 100.00 m (Invert of culvert on north side of Hwy 101)

SOIL STRATIGRAPHY

	Topsoil / Peat		Silt and Sand
	Sand & Gravel to Sand Fill		Silty Clay
	Sandy Silt / Silty Sand		Unknown

**Scale: Horizontal 1 : 500
Vertical 1 : 250**





PROFILE

APPENDIX A

RECORD OF BOREHOLE No JB-1

1 OF 1





PROJECT Culvert Replacement - Hwy 101, German Twp, ON LOCATION Strn. 18+252; approx 3m south of centreline ORIGINATED BY as
 CLIENT Ministry of Transportation Ontario Geocres 42A-72 COMPILED BY lc
 JOB NO. TB7206006 DATE 21 February 2008 CHECKED BY hs

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST <input type="checkbox"/> DYNAMIC PENETRATION TEST <input checked="" type="checkbox"/>					WATER CONTENT (%)	OBSERVATIONS & REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)								
								10	20	30	40	50			○ UNCONFINED	▲ FIELD VANE
106.2 0.0	SAND & GRAVEL TO SAND FILL Brown, moist, very dense to compact.		1	AU												
			2	SS	50/15cm											
			3	SS	99											
			4	SS	26											
			5	SS	11											
			6	SS	12											
101.7 4.5	SANDY SILT TO SILTY SAND Brown, moist to wet, compact to loose.		7	SS	13											
			8	SS	11											
			9	SS	7											
99.4 6.8	SAND Brown, some silt at approximately 9.1mbgs, wet, loose to compact.		10	SS	7											
			11	SS	12											
			12	SS	14											
			13	SS	8											
96.3 9.9	SILT AND SAND Grey, some clay, wet, loose.		14	SS	7											
			15	SS	6											
			16	SS	9											
94.0 12.2	BOREHOLE TERMINATED														Upon completion: Borehole caved to 6.4 mbgs and water to 5.3 mbgs. Borehole backfilled with bentonite.	

RECORD OF BOREHOLE No JB-2

1 OF 1




PROJECT Culvert Replacement - Hwy 101, German Twp, ON LOCATION Strn. 18+255; approx 3m south of centreline ORIGINATED BY as
 CLIENT Ministry of Transportation Ontario Geocres 42A-72 COMPILED BY lc
 JOB NO. TB7206006 DATE 20 February 2008 CHECKED BY hs

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST □ DYNAMIC PENETRATION TEST ■					WATER CONTENT (%)	OBSERVATIONS & REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)						
								○ UNCONFINED	● QUICK TRIAXIAL	▲ FIELD VANE	✚ LAB VANE			
105.9 0.0	SAND & GRAVEL FILL Brown, moist.		1	AS										
105.2 0.8			2	SS	50/15cm									
	SAND FILL Brown, trace gravel, cobbles?, trace organics at approximately 4.6mbgs, moist to wet, very dense to very loose.		3	SS	50/0cm									
			4	SS	24									
			5	SS	3									
			6	SS	18									
			7	SS	2									
			8	SS	20									
			9	SS	10									
			99.1 6.9	SILTY SAND Grey, wet, very loose to compact.		10	SS	8						
			11	SS	5									
			12	SS	5									
			13	SS	7									
			14	SS	11									
			15	SS	12									
94.6 11.4	SILTY CLAY Grey, some Sand, wtpl, soft.		16	SS	3									
93.7 12.2	BOREHOLE TERMINATED													Upon completion: Borehole caved to 9.7 mbgs and water to 6.1 mbgs. Borehole backfilled with bentonite.

RECORD OF BOREHOLE No JB-3

1 OF 1

PROJECT Culvert Replacement - Hwy 101, German Twp, ON LOCATION Strn. 18+272; approx 3m south of centreline ORIGINATED BY as
 CLIENT Ministry of Transportation Ontario Geocres 42A-72 COMPILED BY lc
 JOB NO. TB7206006 DATE 12 February 2008 CHECKED BY hs

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST □ DYNAMIC PENETRATION TEST ■				WATER CONTENT (%)	OBSERVATIONS & REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)					
								○ UNCONFINED	● QUICK TRIAXIAL	▲ FIELD VANE	✚ LAB VANE		
105.7 0.0	SAND & GRAVEL FILL Brown, moist.		1	AS									
104.9 0.8	SAND FILL Brown, trace silt and organics at approximately 3.8mbgs, moist to wet, very dense to very loose.		2	SS	55								
			3	SS	32								
			4	SS	8								
			5	SS	4								
			6	SS	14								
			7	SS	28								
100.5 5.3	SILTY SAND TO SANDY SILT Grey to Brown, wet, trace clay, loose to compact.		8	SS	5								
			9	SS	8								
			10	SS	13								
			11	SS	8								
			12	SS	10								
			13	SS	14								
			14	SS	3								
95.9 9.9	SILTY CLAY Grey, apl to wtpl, very soft to firm.		15	SS	0								
				VANE									
				VANE									
92.7 13.0	BOREHOLE TERMINATED												Upon completion: Borehole open and water to 11.9 mbgs. Borehole backfilled with bentonite.

SS#11
 75 µm to
 4.75 mm -- 25 %
 2 µm to
 75 µm -- 49 %
 <2 µm -- 26 %

SS#15
 75 µm to
 4.75 mm -- 3 %
 2 µm to
 75 µm -- 26 %
 <2 µm -- 71 %

LL - 37 %
 PL - 18 %
 PI - 19 %

RECORD OF BOREHOLE No JB-4

1 OF 1



PROJECT Culvert Replacement - Hwy 101, German Twp, ON LOCATION Strn. 18+252; approx 18m south of ORIGINATED BY jf
 CLIENT Ministry of Transportation Ontario centreline Geocres COMPILED BY jdo
 JOB NO. TB7206006 DATE 24 March, 2008 42A-72 CHECKED BY hs

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST <input type="checkbox"/> DYNAMIC PENETRATION TEST <input checked="" type="checkbox"/>					WATER CONTENT (%)			OBSERVATIONS & REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH (kPa)							
							10	20	30	40	50				
							○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✱ LAB VANE								
							100	200	300			20	40	60	
102.6 0.0	150 mm TOPSOIL , over yellow-brown to light grey SILT AND FINE SAND trace of clay below 1.8 m±, wet.		1	AS											
			2	AS											
			3	AS											
			4	AS											
			5	AS											
			6	AS											
			7	AS											
99.6 3.0	BOREHOLE TERMINATED														SS#7 75 µm to 4.75 mm -- 72 % 2 µm to 75 µm -- 21 % <2 µm -- 7%
															Upon completion: Borehole open; water level to 2.0 mbgs.

RECORD OF BOREHOLE No JB-5

1 OF 1

PROJECT Culvert Replacement - Hwy 101, German Twp, ON LOCATION Strn. 18+252; approx 18m north of centreline ORIGINATED BY jf
 CLIENT Ministry of Transportation Ontario Geocres 42A-72 COMPILED BY jdo
 JOB NO. TB7206006 DATE 24 March, 2008 CHECKED BY hs

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST <input type="checkbox"/> DYNAMIC PENETRATION TEST <input checked="" type="checkbox"/>					WATER CONTENT (%)			OBSERVATIONS & REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH (kPa)								
						10 20 30 40 50 ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✱ LAB VANE 100 200 300					20	40	60			
101.2 0.0	200 mm TOPSOIL/PEAT over yellow-brown to light grey SILTY FINE SAND occasional roots to 1.0 m±, trace clay below 1.0 m±, wet.		1	AS			1									SS#6 75 µm to 4.75 mm -- 88 % 2 µm to 75 µm -- 14 % <2 µm -- 8 %
2			AS													
3			AS													
4			AS													
5			AS													
6			SS	13												
98.2 3.0	BOREHOLE TERMINATED						3								Upon completion: Borehole caved to 2.4 mbgs; water level to 1.7 mbgs.	

RECORD OF BOREHOLE No JB-6

1 OF 1

PROJECT Culvert Replacement - Hwy 101, German Twp, ON LOCATION Strn. 18+262; approx 18m south of ORIGINATED BY jf
 CLIENT Ministry of Transportation Ontario centreline Geocres COMPILED BY jdo
 JOB NO. TB7206006 DATE 24 March, 2008 42A-72 CHECKED BY hs

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST <input type="checkbox"/> DYNAMIC PENETRATION TEST <input checked="" type="checkbox"/>					WATER CONTENT (%)			OBSERVATIONS & REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH (kPa)							
							10	20	30	40	50				
101.9 0.0	300 mm TOPSOIL with PEAT and ROOTS over dark brown to grey SILTY SAND to SILT and SAND trace to some peat in upper 0.6 m±, trace of Gravel and coarse Sand, wet, compact.		1	AS											
			2	AS											
			3	AS											
			4	AS											
			5	SS	17										
			6	SS	19										
98.9 3.0	BOREHOLE TERMINATED														SS#6 75 µm to 4.75 mm -- 66 % 2 µm to 75 µm -- 28 % <2 µm -- 6 % Upon completion: Borehole caved to 1.5 mbgs; water level at ground surface.

APPENDIX B

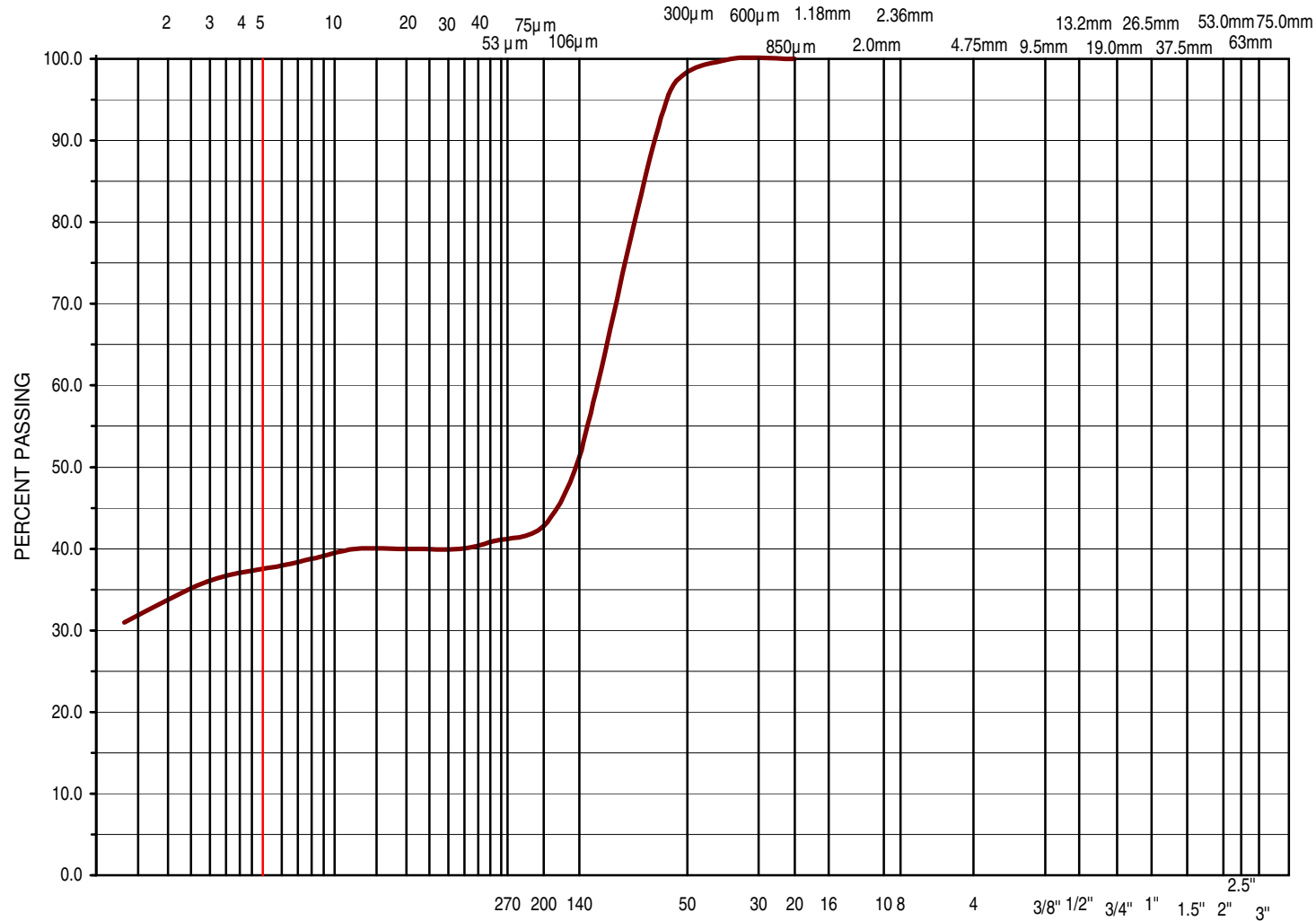
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B1

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION

GRAIN SIZE IN MICROMETERS



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	100.00
0.425	99.80
0.25	95.60
0.106	51.20
0.075	42.80
0.0470	40.98
0.0334	39.98
0.0211	39.98
0.0122	39.98
0.0086	38.98
0.0061	37.98
0.0029	35.98
0.0013	30.98



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72
Clayey Sand, Trace Silt

BH 1-16

Lab No. S104

TB7206006

March 28, 2008

Prepared: K. Zavitz

Checked: T. Hawkins

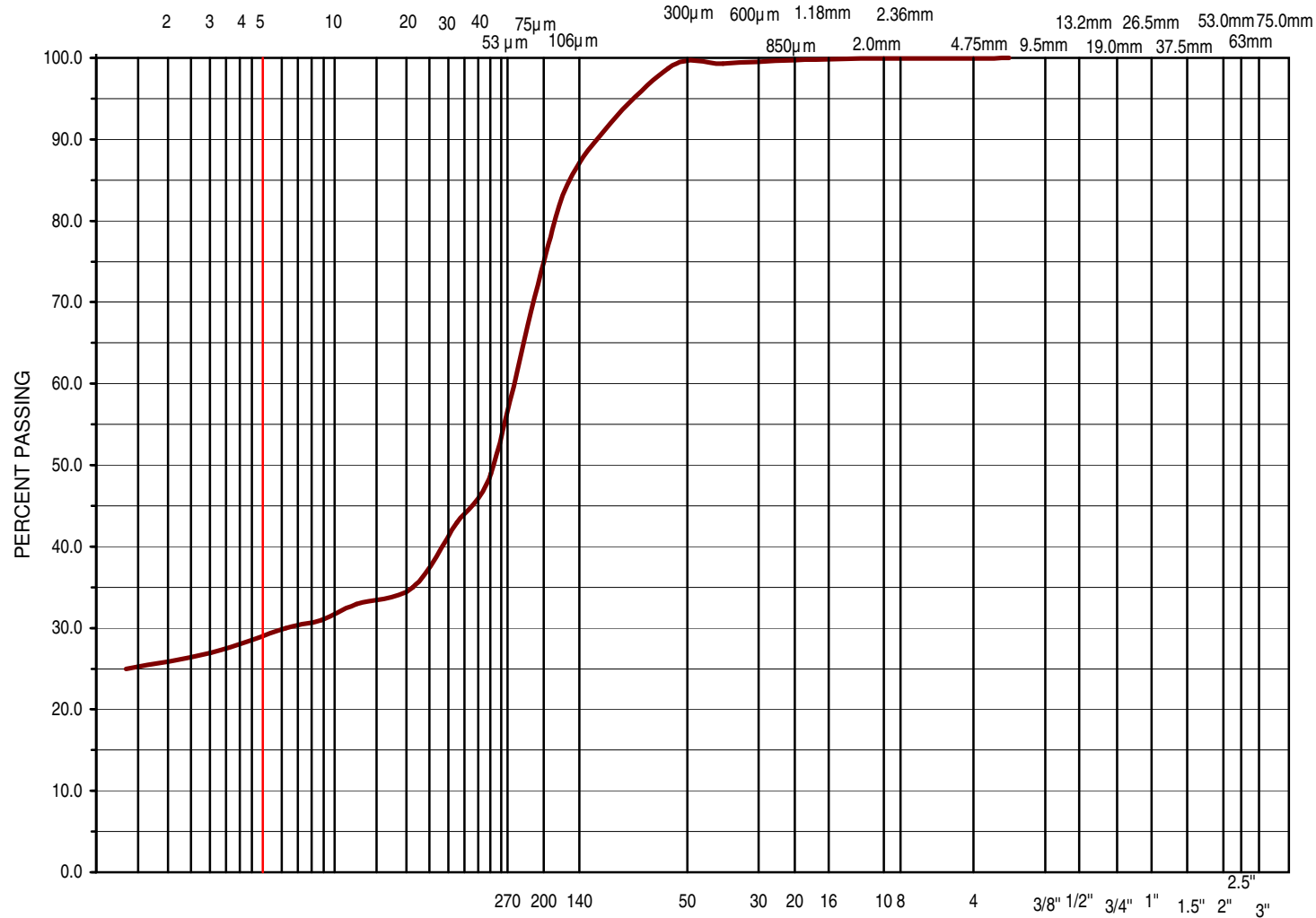
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B2

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION

GRAIN SIZE IN MICROMETERS



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	99.9
2	99.9
0.85	99.70
0.425	99.30
0.25	98.70
0.106	87.12
0.075	74.93
0.0452	48.93
0.0326	42.94
0.0212	34.95
0.0123	32.95
0.0088	30.95
0.0062	29.96
0.0030	26.96
0.0013	24.96



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72

Sandy, Clayey Silt

BH 3-11

Lab No. S104

TB7206006

March 28, 2008

Prepared: K. Zavitz

Checked: T. Hawkins

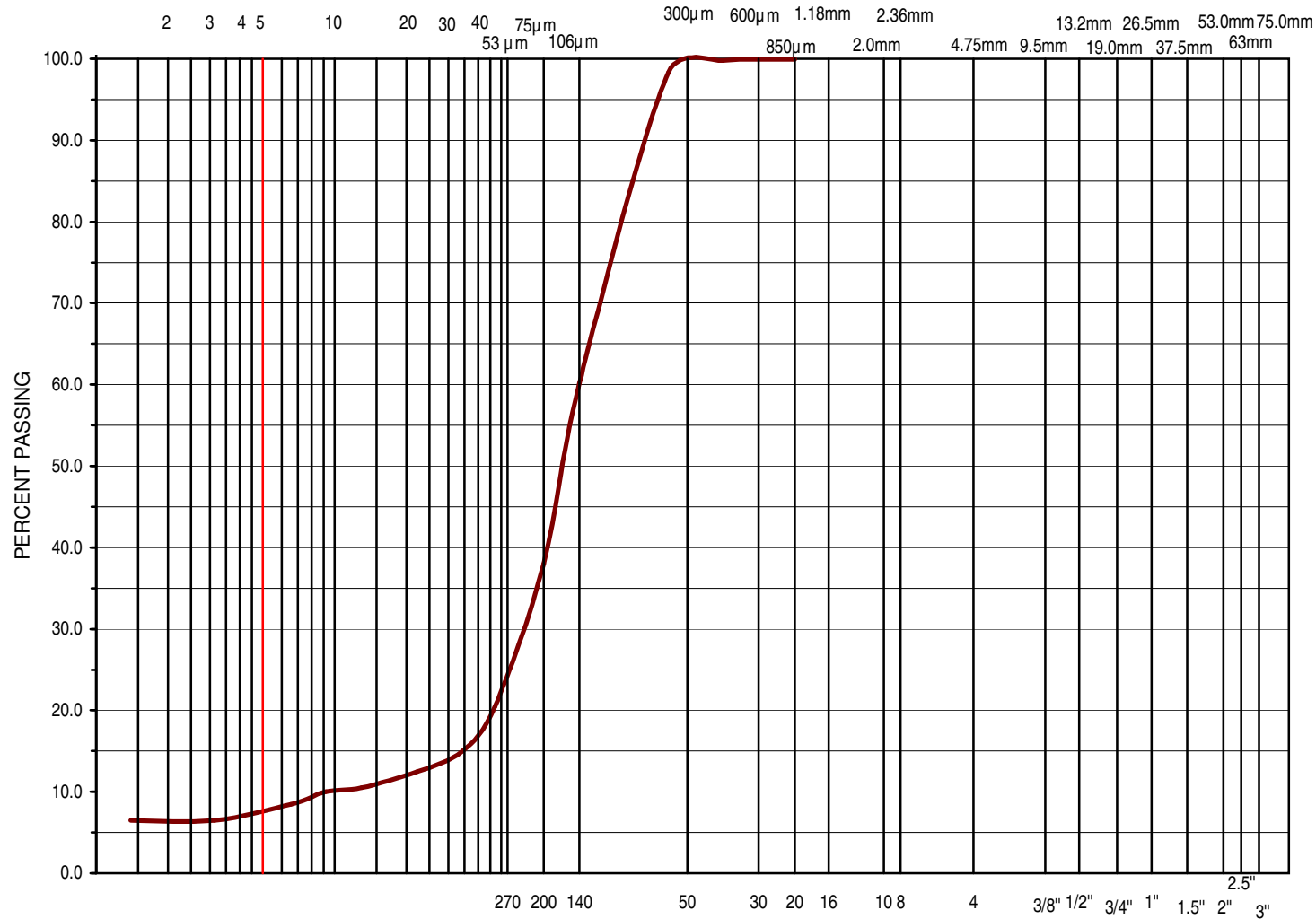
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B3

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION

GRAIN SIZE IN MICROMETERS



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	99.95
0.425	99.78
0.25	98.28
0.106	60.19
0.075	37.99
0.0470	20.49
0.0345	14.99
0.0222	12.49
0.0129	10.49
0.0092	9.99
0.0066	8.49
0.0031	6.50
0.0014	6.50



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72

Silty Sand, Trace Clay

BH 2-10

Lab No. S104

TB7206006

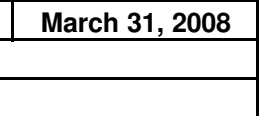
March 28, 2008

Prepared: K. Zavitz

Checked: T. Hawkins

Enclosure: B4

Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	99.88
0.425	99.57
0.25	90.00
0.106	32.60
0.075	19.40
0.0488	10.99
0.0347	9.99
0.0220	9.99
0.0127	9.99
0.0092	9.50
0.0055	8.50
0.0032	7.00
0.0013	6.50



Lab No. S104

TB7206006

March 31, 2008

Sand, Some Silt, Trace Clay

Prepared: K. Zavitz

BH 1-10

Checked: T. Hawkins

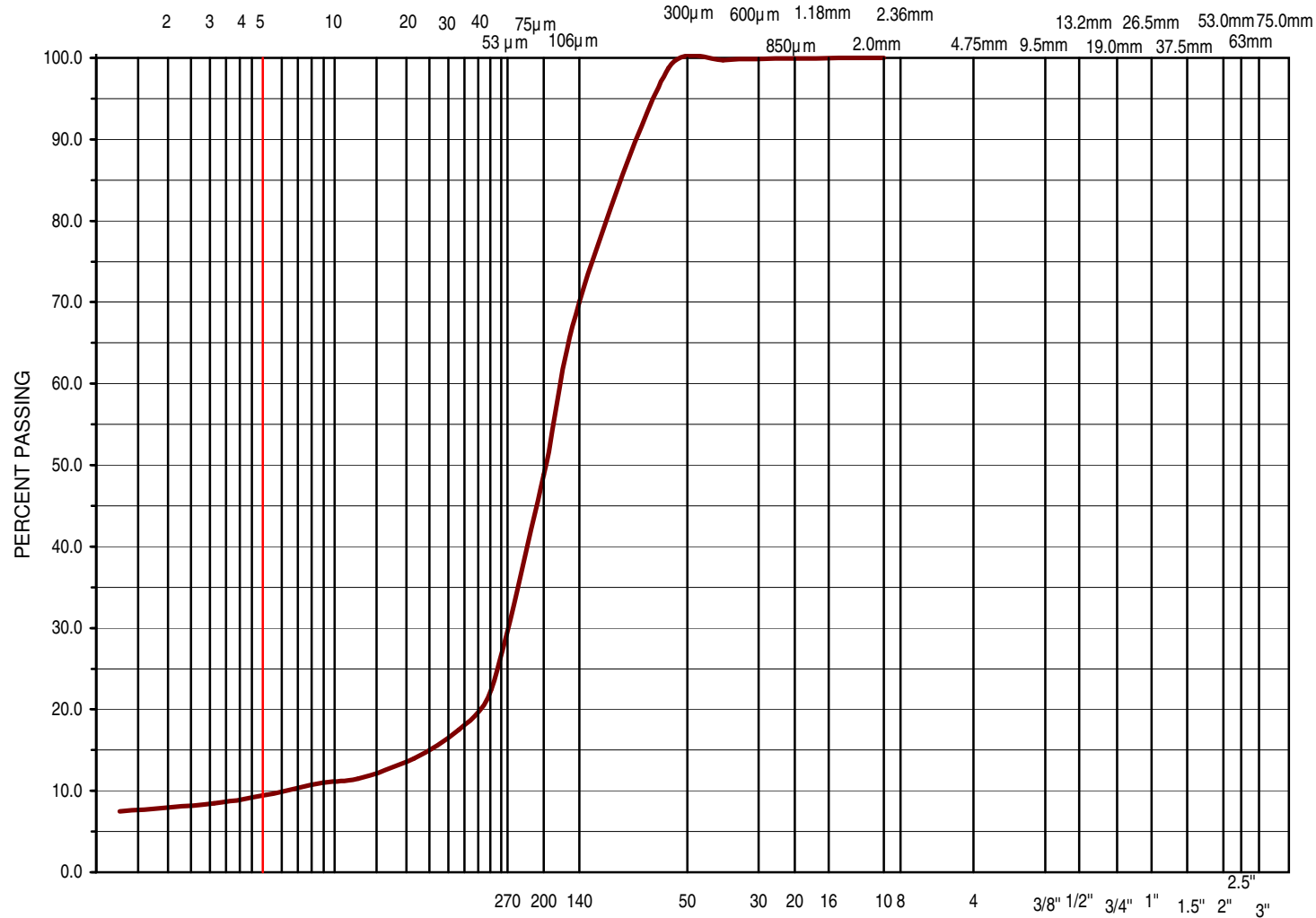
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B5

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION

GRAIN SIZE IN MICROMETERS



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	99.94
0.425	99.72
0.25	98.75
0.106	70.00
0.075	48.80
0.0453	22.49
0.0331	17.49
0.0214	13.99
0.0126	11.49
0.0089	10.99
0.0052	9.50
0.0031	8.50
0.0013	7.50



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72

Silt and Sand, Trace Clay

BH 7-7

Lab No. S104

TB7206006

March 31, 2008

Prepared: K. Zavitz

Checked: T. Hawkins

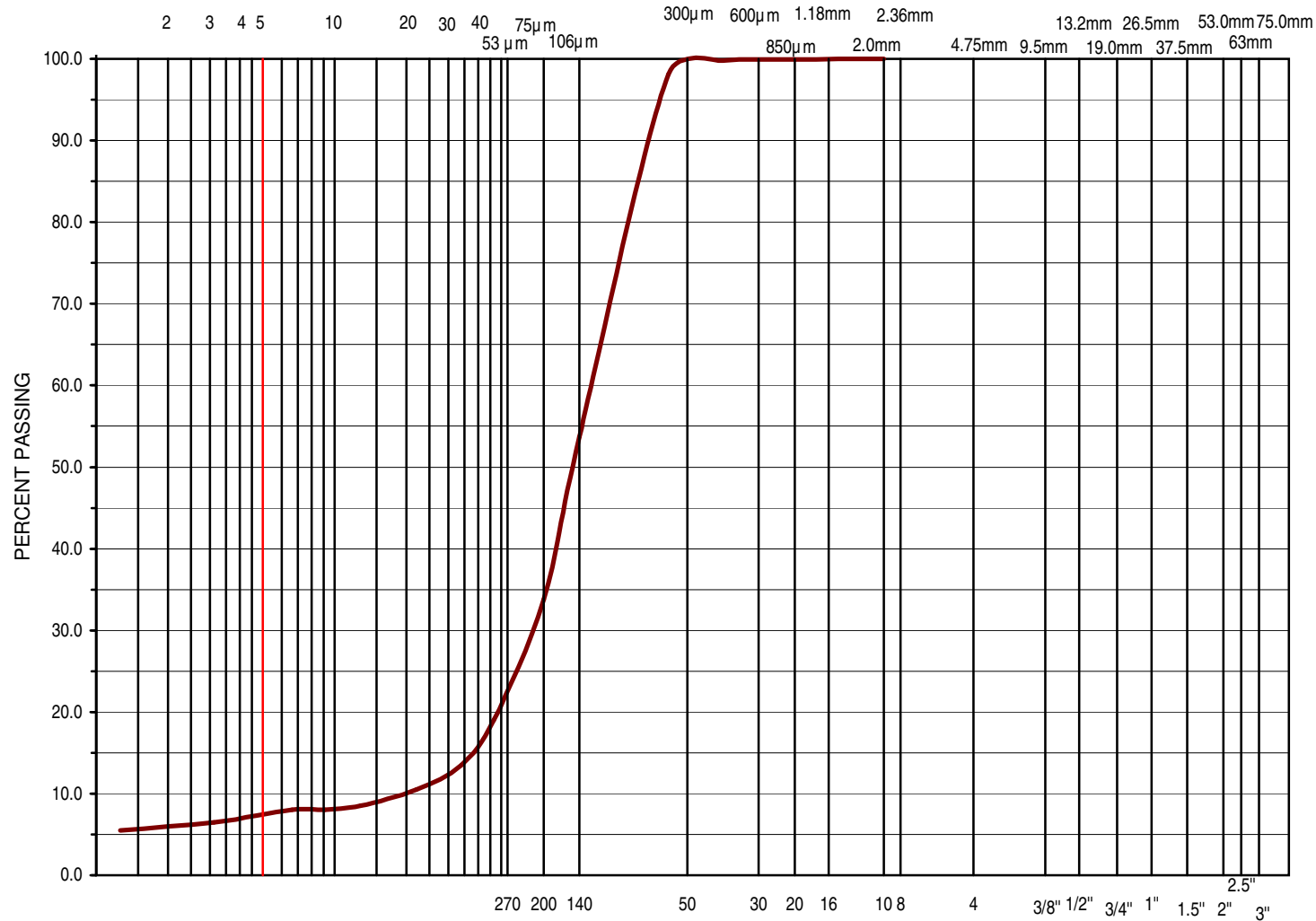
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B6

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION

GRAIN SIZE IN MICROMETERS



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	99.95
0.425	99.81
0.25	98.10
0.106	53.70
0.075	33.80
0.0464	18.99
0.0340	13.49
0.0219	10.49
0.0128	8.50
0.0091	8.00
0.0066	8.00
0.0031	6.50
0.0013	5.50



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72

Silty Sand, Trace Clay

BH 6-6

Lab No. S104

TB7206006

March 31, 2008

Prepared: K. Zavitz

Checked: T. Hawkins

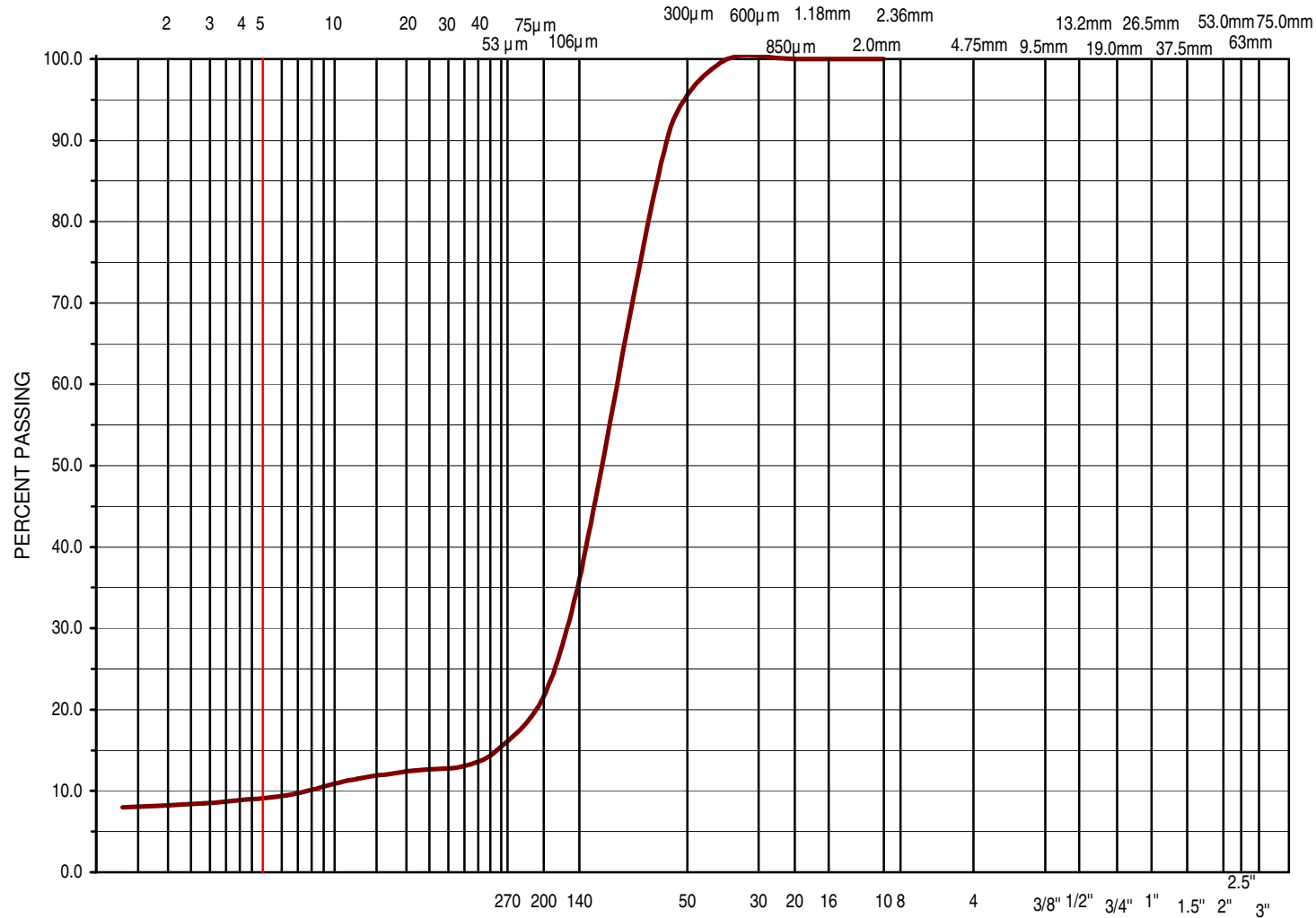
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B7

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION

GRAIN SIZE IN MICROMETERS



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	99.97
0.425	99.70
0.25	90.70
0.106	36.00
0.075	21.60
0.0476	14.99
0.0341	12.99
0.0216	12.49
0.0126	11.49
0.0089	10.49
0.0063	9.50
0.0028	8.50
0.0013	8.00



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72

Sand, Some Silt, Trace Clay

BH 5-6

Lab No. S104

TB7206006

March 31, 2008

Prepared: K. Zavitz

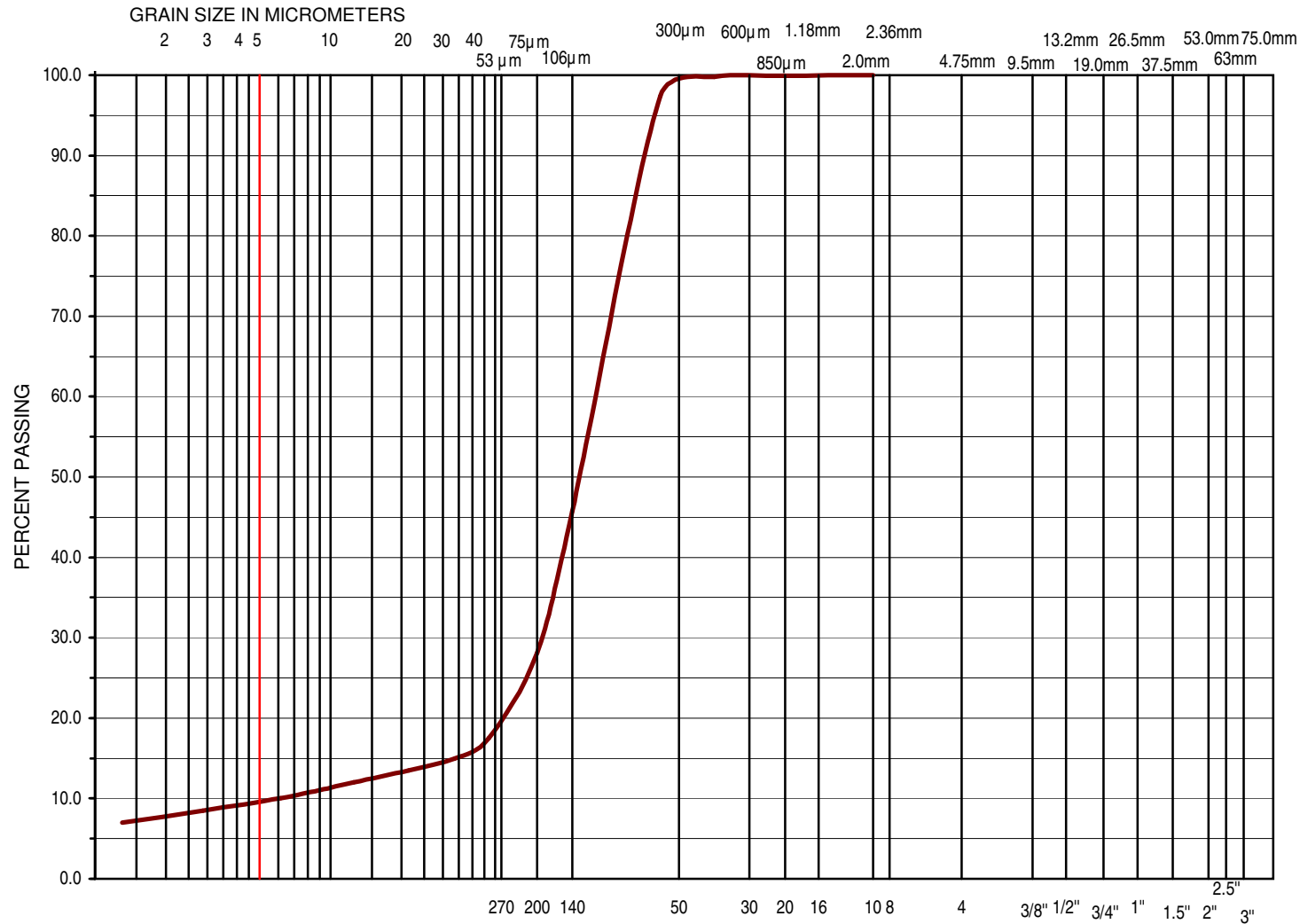
Checked: T. Hawkins

UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B8

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	99.94
0.425	99.79
0.25	97.39
0.106	45.79
0.075	28.10
0.0469	17.49
0.0337	14.99
0.0215	13.49
0.0125	11.99
0.0089	10.99
0.0061	9.99
0.0029	8.49
0.0013	7.00



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72

Silty Sand, Trace Clay

BH 4-7

Lab No. S104

TB7206006

March 31, 2008

Prepared: K. Zavitz

Checked: T. Hawkins

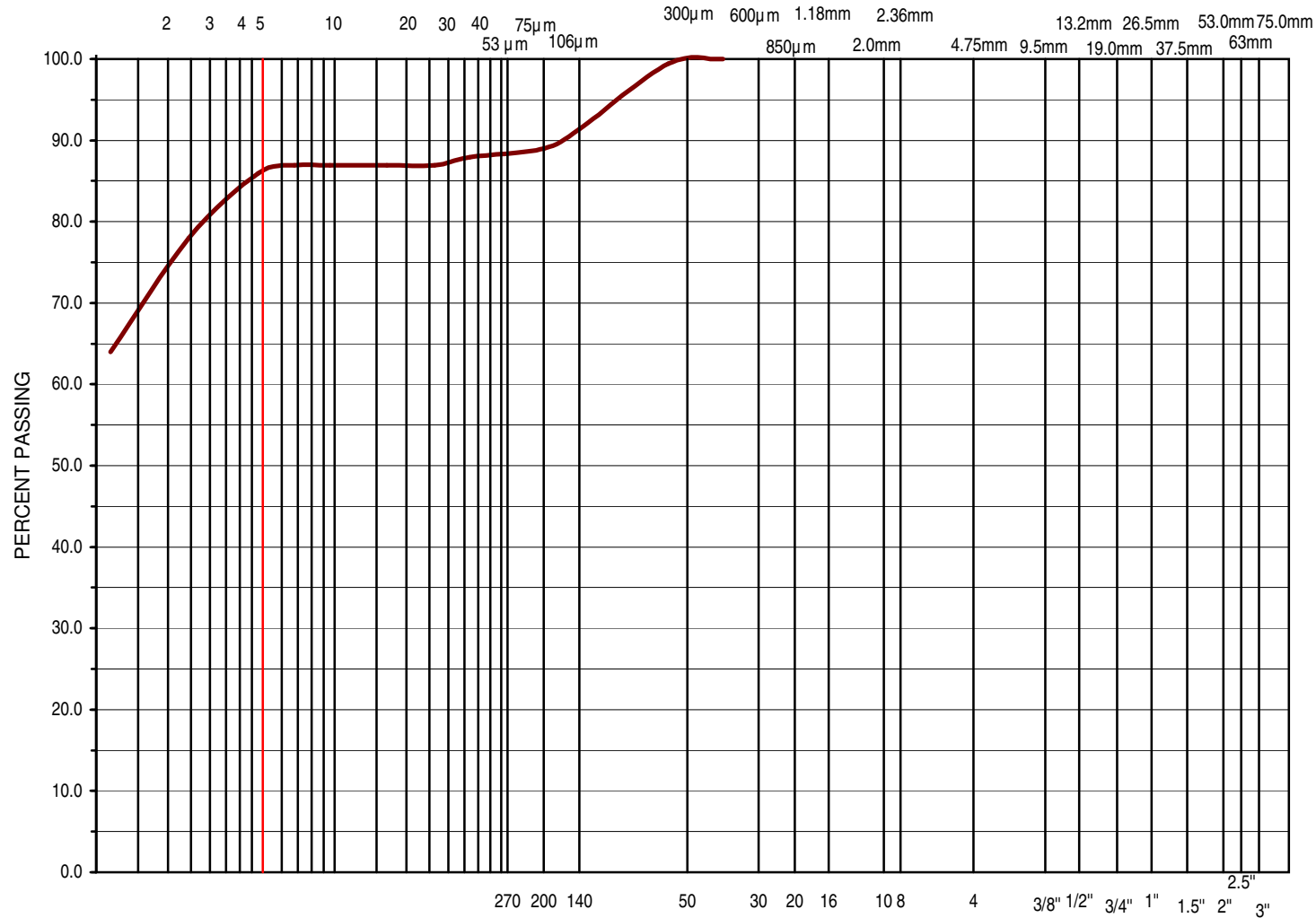
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B9

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION

GRAIN SIZE IN MICROMETERS



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	100.00
0.425	100.00
0.25	99.40
0.106	91.40
0.075	89.00
0.0368	87.95
0.0262	86.95
0.0166	86.95
0.0096	86.95
0.0068	86.95
0.0048	85.95
0.0024	77.96
0.0011	63.97



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72

Clay, Some Silt & Sand

BH 2-16

Lab No. S104

TB7206006

March 28, 2008

Prepared: K. Zavitz

Checked: T. Hawkins

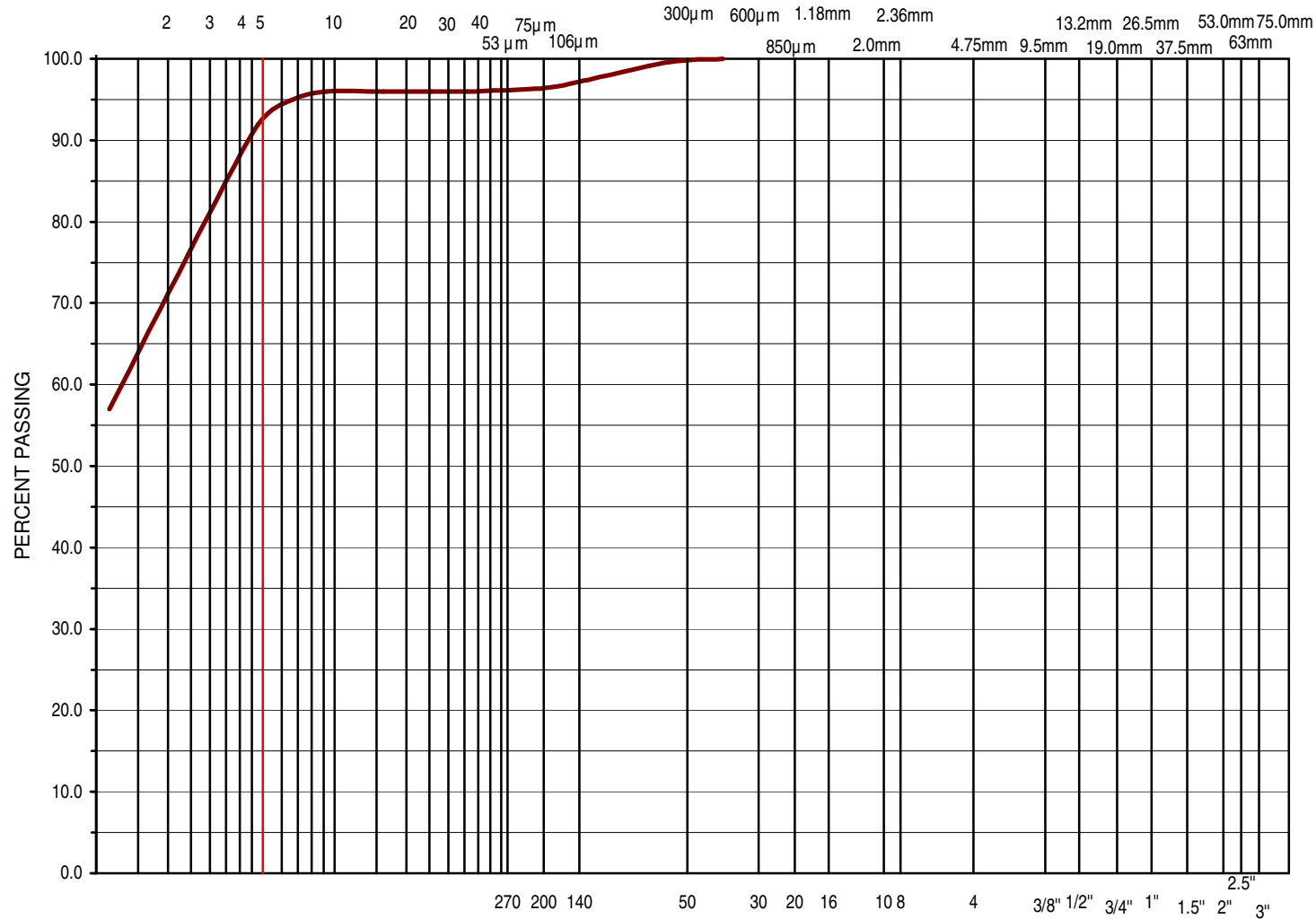
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: B10

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION

GRAIN SIZE IN MICROMETERS



Particle Size (mm)	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	100.00
0.425	100.00
0.25	99.60
0.106	97.20
0.075	96.40
0.0359	95.95
0.0254	95.95
0.0160	95.95
0.0093	95.95
0.0066	94.95
0.0048	91.95
0.0024	75.96
0.0011	56.97



Culvert Replacement - Hwy 101 German Twp, ON GEOCRETS 42A-72

Silty Clay

BH 3-15

Lab No. S104

TB7206006

March 28, 2008

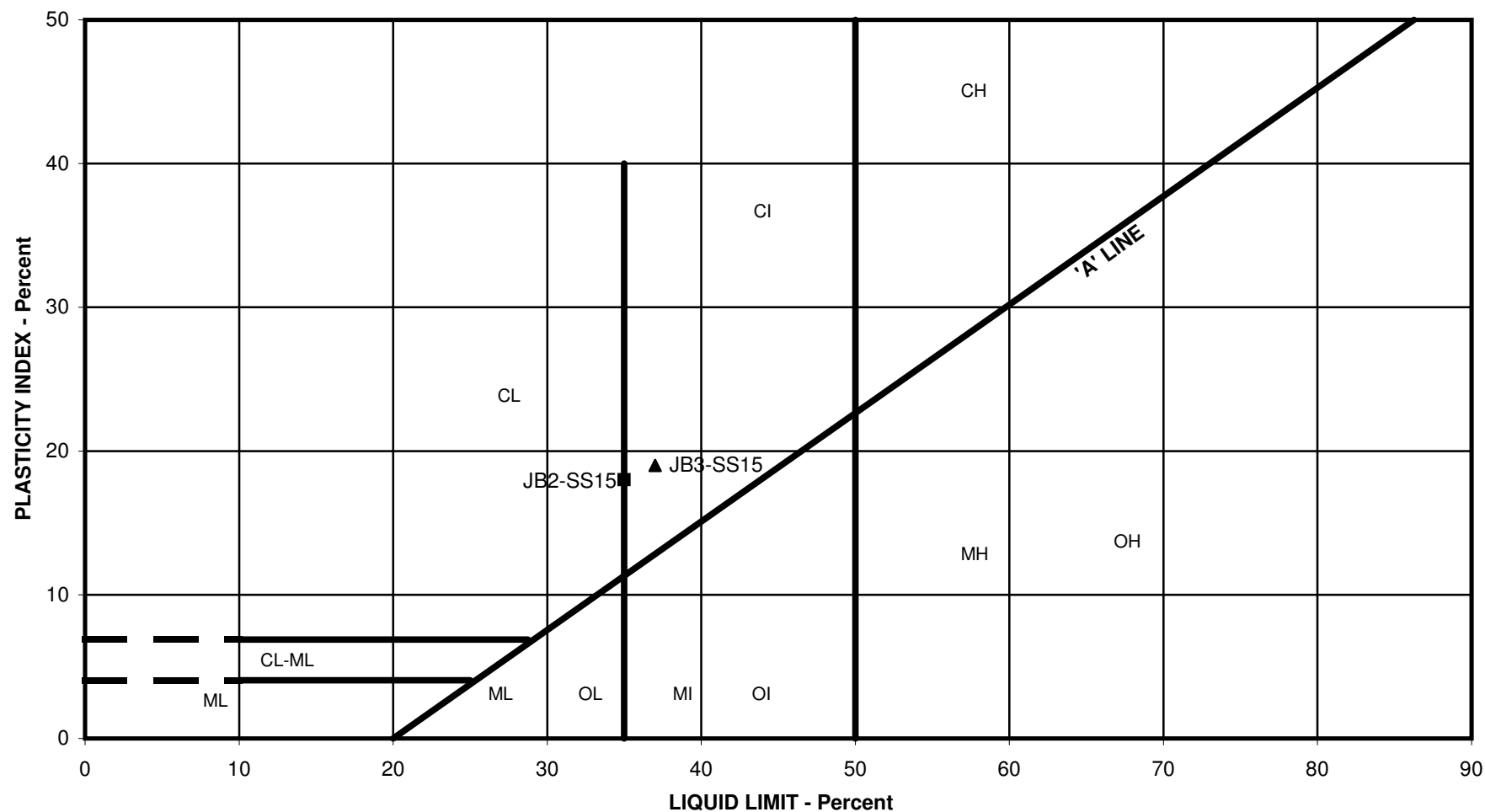
Prepared: K. Zavitz

Checked: T. Hawkins

PLASTICITY CHART - S104

BH2-SS15: LL = 35, PL = 17, PI = 18 BH3-15: LL = 37, PL = 18, PI = 19

JB1-SS6: Non-plastic



Project Number: TB7206006
 Culvert Replacement - Hwy 101, German Twp, ON
 Date: 04 March 2008



APPENDIX C

APPENDIX C - PHOTOGRAPHIC RECORD

PROJECT NO. TB7206006

PROJECT Culvert Replacement, MTO NE Region Agreement #5006-E-0070

LOCATION Hwy. 101, 4.3km East of Hwy 67, German Twp., ON

Page C1

	PHOTOGRAPH	1
	Description	
	<u>Hwy 101 - Looking East</u>	

	PHOTOGRAPH	2
	Description	
	<u>Hwy 101 - Looking West</u>	

APPENDIX C - PHOTOGRAPHIC RECORD

PROJECT NO. TB7206006

PROJECT Culvert Replacement, MTO NE Region Agreement #5006-E-0070

LOCATION Hwy. 101, 4.3km East of Hwy 67, German Twp., ON

Page C2



PHOTOGRAPH

3

Description

Hwy 101 - North Slope



PHOTOGRAPH

4

Description

Hwy 101 - South Slope