MERLEX ENGINEERING LTD.

CONSULTING GEOTECHNICAL ENGINEERS

FINAL
FOUNDATION INVESTIGATION REPORT

SITE B

CULVERT STATION 22+455 – TWP. OF FRANKLIN
GWP 5553-04-00

Highway 60, From 0.3 km West of Highway 35
Easterly 9.4 km To 0.6 km West of
the Oxtongue Lake Narrows Bridge

MEL Ref. No.: 08/07/08085B July 20, 2009

Submitted to:

AECOM Canada Ltd.
189 Wyld Street
North Bay, Ontario
P1B 1Z2

Geocres No.: 31E-289

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1.0 INTRODUCTION

Merlex Engineering Ltd. (MEL) has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at a culvert located at Station 22+455, Township of Franklin. The GWP 5553-04-00 on Highway 60 runs from 0.3 km west of Highway 35 easterly 9.4 km to 0.6 km west of the Oxtongue Lake Narrows Bridge (see Figure No. 1, Key Plan, in Appendix A). This project involves the replacement of a single 1.2 m diameter CSP culvert in a 5.1 m high embankment.

The foundation investigation location was specified by the MTO in the RFP/TPM documentation Agreement No. 5006-E-0037. The terms of reference for the scope of work are outlined in MEL's proposal P-05-029, dated April 2, 2008. The purpose of the investigation was to determine the subsurface conditions in the area of the culvert. MEL investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The CSP culvert is located on Highway 60, approximately 4.3 km east of Highway 35. The topography at the site is generally of moderate relief and the direction of flow in the culvert is from north to south. The existing highway embankment supports three undivided lanes of highway, running in an east west direction (ie. two main lanes) with an east bound passing lane. The existing road embankment is some 5.1 m higher than the grade elevation to the north and south sides of the road. The culvert discharges almost directly adjacent to a bedrock face at the south toe of embankment (see Photo No. 1, Appendix C).

2.1 Site Physiography and Surficial Geology

This Highway 60 project falls within the limits of the geomorphic sub-province known as the Algonquin Uplands. The topography at the site is generally rolling. There is exposed bedrock ridges present at many locations throughout the project and specifically within the area of the culvert under investigation. At other locations, significant layers of earth overlay the bedrock. Within the project area overburden conditions consist primarily of earth containing varying amounts of silt and sand. Organic terrain is also present.

Bedrock in the area is highly metamorphosed rocks of the Grenville Province of the Precambrian Shield. The high degree of metamorphism has changed the initial rock (siltstone, greywacke, arkoses, calcareous sandstone) mass fabric and structure resulting in a blocky, medium grained and very strong rock mass (OGS Map 2441).

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out during the period of October 28 to 31, 2008 and consisted of a total of eight (8) sampled boreholes.

The field investigation was carried out using a Bombardier mounted CME 45B drilling rig equipped with hollow stem augers, standard augers, and routine geotechnical sampling equipment. Soil samples were obtained at regular intervals of depth using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures at the borehole locations.

Groundwater conditions in the open boreholes were observed during and immediately following completion of the individual boreholes. All open boreholes were backfilled upon completion with

compacted auger cuttings, in the general order they were removed and, where necessary, additional granular backfill was added to the boreholes to grade. At the borehole through the embankment, the upper portion of the hole was backfilled with a cold patch to seal the existing asphalt surface.

The field work for this investigation was under the full time direction of a senior member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets in Appendix C (Figures L-1 and L-2).

The location of the individual boreholes were determined in the field using highway chainage (established by others) and offset relative to highway centerline. Elevations contained in this report are referenced to a geodetic datum.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. B-1 (Appendix C). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the results of non-continuous sampling, response to drilling progress, the results of SPT and Dynamic Cone Penetration Test (DCPT) plus field observations. Typically such boundaries

represent transitions from one zone to another and are not an exact demarcation of specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location.

4.1 Culvert, Station 22+455, Township of Franklin - SITE B

A plan and profile showing the borehole locations and stratigraphic sequences is shown on Figure No. B-1, Appendix C. During the course of the exploration program, eight (8) sampled boreholes were put down at this site, with Borehole No. B1 advanced from the surface of the existing highway embankment. Borehole Nos. B2 and B3 were advanced at the south and north ends of the existing culvert respectively. Borehole Nos. B4, B5, B6, B7, and B8 were advanced north of the existing embankment for a possible detour.

At the location of Borehole No. B1 embankment fill consisting of sands with some gravel and some fines (predominately silt) was encountered to a depth of 1.5 m. Below this depth the concentration of cobble/boulder/rock fill sizes, in the sand with gravel and trace of silt deposit, increased with refusal on the DCPT met at a depth of 2.1 m and auger refusal initially encountered at the borehole at a depth of 1.8 m. A second boring was advanced, at a location 1 m west of the original boring, and auger refusal was met at a depth of 2.9 m. Based on drill response and site topography and geology, it is considered that this refusal is due to the presence of rock fill/boulders in the embankment fill. Typical gradation curves of the portion of embankment fill which was retained in the 37 mm inside diameter of the spilt spoon sampler are found on Figures L-1 and indicate 25 to 44% gravel size particles, 50 to 71% sand size particles and 4 to 9% silt and clay size particles. Based on the SPT values, which ranged from 22 to 36 blows per 300 mm penetration, the compactness of the embankment fill was described as

compact to dense. The SPT values below a 1.5 m depth may be high due to the influence of cobbles and boulder sizes in the embankment fill.

Borehole No. B2 was advanced from the south toe of embankment at the outlet to the existing 1.2 m CSP culvert. The culvert discharges adjacent to a bedrock face (see Photo 1, Appendix C). At the location of Borehole No. B2, below a 100 mm depth of water, a thin 100 mm layer of sand was penetrated over bedrock. At the location of Borehole No. B3, a deposit of fine and medium sand with a trace of silt and some gravel was sampled to a depth of 1.2 m where auger refusal was met. The DCPT at this location penetrated to a depth of 1.8 m and two additional auger probes, in close proximity to the original borehole met refusal at depths of 0.9 and 1.1 m. A typical gradation curve of the sands is shown on Figure L-2 and indicates 21% gravel size particles, 75% sand size particles, 4% silt and clay size particles. Based on the SPT value, which was 4 blows per 300 mm penetration, and the DCPT values, the compactness of the deposit was described as loose to dense.

Borehole Nos. B4, B5, B6, B7, and B8 were advanced along the north toe of slope. At all the boreholes, except Borehole No. 6 auger refusal was met at depths less than 1.2 m along with adjacent auger probe which met auger refusal at similar depths. The overburden at these borehole locations consisted of sands with trace to some fines to a trace to with gravel. Typical gradation curves are shown on Figure L-2 and indicates 9 to 42% gravel size particles, 48 to 75% sand size particles, and 6 to 16% silt and clay size particles. Based on a single SPT value, which returned a value of 38 blows per 300 mm penetration and the DCPT data, the compactness of the deposit was described as loose to dense. At the location of Borehole B6, the overburden was sampled to a depth of 3.1 m below grade. The overburden at this location consisted of predominately fine and medium sands, with trace to gravelly and frequent

cobble/boulder sizes in the upper 1.5 m. A thin, 300 mm thick, layer of black silt with some organics was penetrated at a depth of 1.5 m. Based on the SPT values, which ranged from 8 to 18 blows per 300 mm penetration, the compactness of the embankment fill was described as loose to compact.

4.2 Groundwater Conditions

Groundwater and cave-in levels in the open boreholes were taken during the advance of the individual borings and upon completion. These levels were recorded on the individual Record of Borehole Log Sheets (Appendix B). At the culvert outlet (Borehole No 2), a water depth of 100 mm above grade was recorded. All other boreholes were dry upon completion. These groundwater levels will fluctuate seasonally.

MERLEX ENGINEERING LTD.

M. A. Merleau, P. Eng.
Principal

J. R. Berghamer, P. Eng.
Project Engineer

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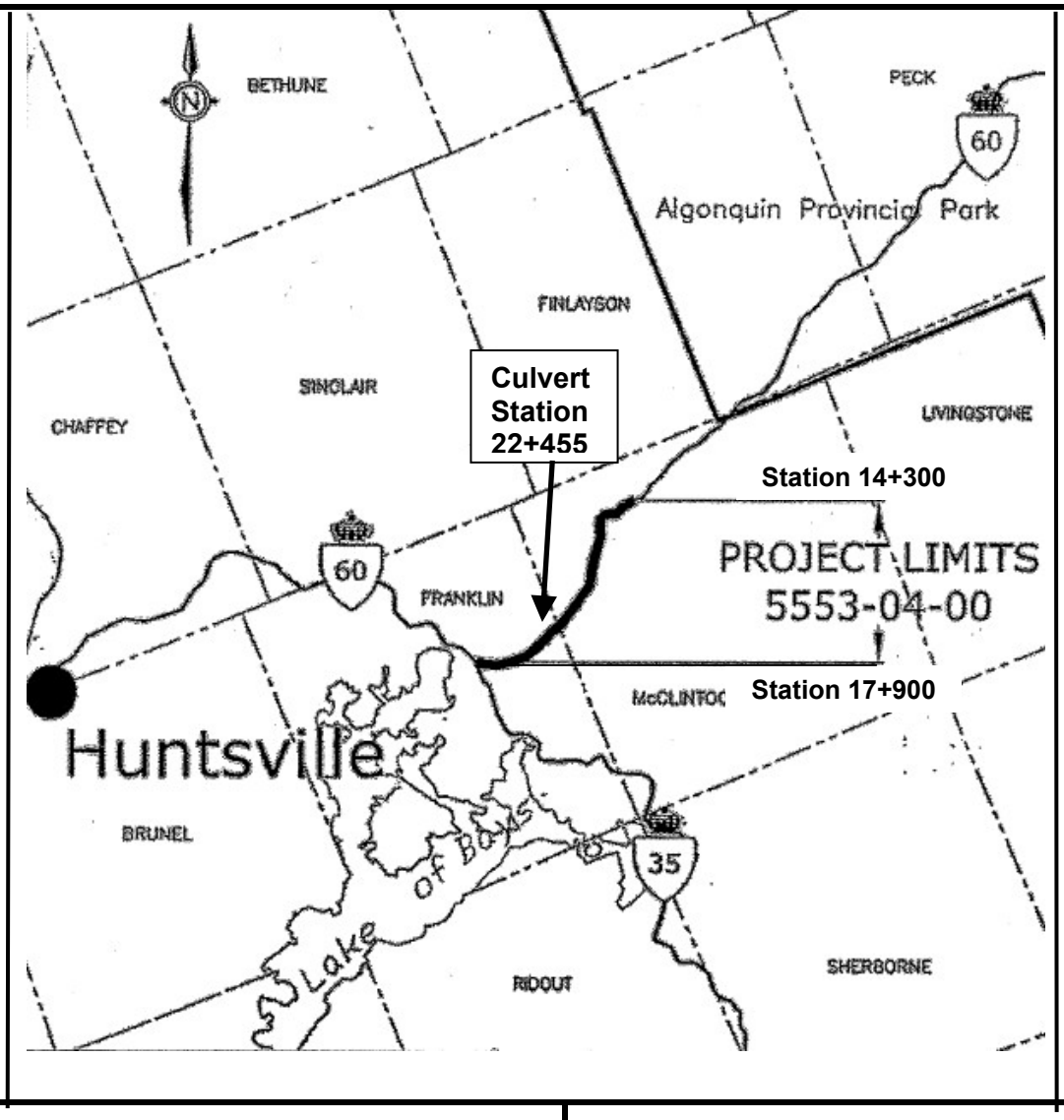
APPENDIX A

Figure No. 1 Key Plan

KEY PLAN

NOT TO SCALE



FINAL
FOUNDATION INVESTIGATION REPORT
SITE B – CULVERT STATION 22+455
GWP 5553-04-00

Highway 60, From Highway 35
Easterly 9.1 km To 0.6 km West Of
The Oxtongue Lake Narrows Bridge

MEL Ref. No.: 08/07/08085B July 2009

MERLEX ENGINEERING LTD.

CONSULTING GEOTECHNICAL ENGINEERS

APPENDIX B

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 9	Record of Borehole Sheets

LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS Auger Sample
CS Chunk Sample
DS Denison type sample
FS Foil Sample
HB Hammer Bouncing
NFP No Further Progress
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
RC Rock core with size & percentage of recovery
SS Split Spoon
ST Slotted Tube
TO Thin-walled, open
TP Thin-walled, piston
WH Sampler Advanced by static weight (weight of hammer and/or rods)
WS Wash Sample

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 90° point cone driven by a 63 kg hammer falling 760 mm.

Plotted as 

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	*Relative Density*
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

3. SOIL DESCRIPTION (Cont'd)

b) *Cohesive Soils:*

Undrained Shear Strength (kPa)	*Consistency*
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

c) *Method of Determination of Undrained Shear Strength of Cohesive Soils:*

+ 3.2 - Field Vane test in borehole. The number denotes the sensitivity to remoulding.

D - Laboratory Vane Test

¨ - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

5. LABORATORY TESTS

P Standard Proctor Test
A Atterberg Limit Test
GS Grain Size Analysis
H Hydrometer Analysis
C Consolidation

SAMPLE DESCRIPTION NOTES:

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as 'fill'. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.

2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.

3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled 'possibly' or 'probable' etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients' request, through a series of closely positioned unsampled auger probes combined with core drilling.

4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.

ENCLOSURE NO.: 2 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. B1

REFERENCE 08/07/08085 DATUM Geodetic LOCATION Site B - Culvert Station 22+455, Franklin Twp. (See Plan) ORIGINATED BY JL

PROJECT GI & FDN - Highway 60, GWP 5553-04-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY MCM/RG

CLIENT AECOM Canada Ltd. DATE (Started) October 29, 2008 TIME 2:50:00 PM CHECKED BY MAM

DATE (Completed) October 29, 2008

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS
370.9	Ground Surface					
0.0	SAND Brown Fine and Medium Sand Trace Silt Trace Gravel (dense)		1	AS		
			2	SS	36	
369.4						
1.5	Increase in cobbles and boulders / rock fill (dense / compact) DCPT Refusal		3	SS	36	
			4	SS	22	
368.0						
2.9	Auger Refusal - boulders End of Borehole					

ELEVATION SCALE: 370, 369, 368

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	(SI CL)
1			
2	25	71	(4)
3	44	50	(6)
4	27	64	(9)

COMMENTS

1) Initial boreholes met refusal at 1.8 m depth, changed to standard augers, moved 1 m west and advanced boring to 2.9 m where refusal on boulders

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ $^{3\%}$ STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 10/29/08 2:50:00 PM	DRY	2.6
2)	-	-
3)	-	-

MEL-GEO 08085 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/2/09

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ENCLOSURE NO.: 3 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. B2

REFERENCE 08/07/08085 DATUM Geodetic LOCATION Site B - Culvert Station 22+455, Franklin Twp. ORIGINATED BY JL

PROJECT GI & FDN - Highway 60, GWP 5553-04-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY MCM/RG

CLIENT AECOM Canada Ltd. DATE (Started) October 29, 2008 TIME ____ CHECKED BY MAM

DATE (Completed) October 29, 2008

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
366.0	Ground Surface										
0.0	100 mm Water										
365.8	100 mm Brown Fine Sand										
0.2	Auger Refusal - Bedrock										

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 10/29/08	DRY	-
2)	-	-
3)	-	-

MEL-GEO 08085 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/2/09

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ENCLOSURE NO.: 4 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. B3

REFERENCE 08/07/08085 DATUM Geodetic LOCATION Site B - Culvert Station 22+455, Franklin Twp. (See Plan) ORIGINATED BY JL

PROJECT GI & FDN - Highway 60, GWP 5553-04-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY MCM/RG

CLIENT AECOM Canada Ltd. DATE (Started) October 28, 2008 TIME 3:15:00 PM CHECKED BY MAM

DATE (Completed) October 28, 2008

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
367.3	Ground Surface						
0.0	SAND Brown fine Medium Sand Trace Silt Trace Gravel (loose / dense)		1	AS			367
			2	SS	4		
366.1	150 mm layer organics and sand						
1.2	Auger Refusal End of Sampling Continutation of DCPT						366
365.5							
1.8	Refusal on DCPT, probably bedrock End of Borehole Auger Probe 2.5 m West Auger Refusal @ 0.9 m Auger Probe 2.0 m West Auger Refusal @ 1.1 m						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%)
20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	(SI CL)
1	21	75	(4)

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3, \times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1)	DRY	-
2)	-	-
3)	-	-

MEL-GEO 08085 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/2/09

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ENCLOSURE NO.: 5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. B4

REFERENCE 08/07/08085 DATUM Geodetic LOCATION Site B - Culvert Station 22+455, Franklin Twp. (See Plan) ORIGINATED BY JL

PROJECT GI & FDN - Highway 60, GWP 5553-04-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY MCM/RG

CLIENT AECOM Canada Ltd. DATE (Started) October 30, 2008 TIME 1:50:00 PM CHECKED BY MAM

DATE (Completed) October 30, 2008

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
369.5	Ground Surface										
0.0	SAND Brown Fine Medium Sand Trace Gravel Occasional Cobble		1	AS			369		○		
368.3			2	SS	38				○		35 59 (6)
1.2	Auger Refusal Refusal on DCPT End of Borehole Auger Probe @ 22+428 Auger Refusal @ 1.3 m										

COMMENTS

Note: Exposed bedrock north of borehole

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1)	DRY	-
2)	-	-
3)	-	-

MEL-GEO 08085 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/2/09

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ENCLOSURE NO.: 6 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. B5

REFERENCE 08/07/08085 DATUM Geodetic LOCATION Site B - Culvert Station 22+455, Franklin Twp. (See Plan) ORIGINATED BY JL

PROJECT GI & FDN - Highway 60, GWP 5553-04-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY MCM/RG

CLIENT AECOM Canada Ltd. DATE (Started) October 30, 2008 TIME 2:45:00 PM CHECKED BY MAM

DATE (Completed) October 30, 2008

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
366.1	Ground Surface										
0.0	SAND Brown Fien to Medium Sand Trace Silt Trace Organics Trace Silt		1	AS			366				
365.2			2	SS	30/120mm						
0.9	Auger Refusal Refusal on DCPT End of Borehole Auger Probe 1 m East Auger Refusal @ 0.9 m										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

WATER CONTENT (%): 20 40 60

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1)	DRY	-
2)	-	-
3)	-	-

MEL-GEO 08085 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/2/09

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ENCLOSURE NO.: 7 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. B6

REFERENCE 08/07/08085 DATUM Geodetic LOCATION Site B - Culvert Station 22+455, Franklin Twp. (See Plan) ORIGINATED BY JL

PROJECT GI & FDN - Highway 60, GWP 5553-04-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY MCM/RG

CLIENT AECOM Canada Ltd. DATE (Started) October 28, 2008 TIME 4:00:00 PM CHECKED BY MAM

DATE (Completed) October 28, 2008

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
368.9	Ground Surface						
0.0	SAND Brown Fine Medium Sand Trace Silt Trace Gravel Frequent cobble/boulder sizes (Compact)		1	AS			
			2	SS	17		368
367.4							
1.5	SILT						
367.1	Black Silt With Some Organics		3	SS	8		
1.8	SANDS Grey Fine to Medium Sand Some Gravel to Gravelly (Loose/Compact)						367
			4	SS	18		
365.8							366
3.1	DCPT Refusal Auger Refusal - Bedrock Auger Probe 2.5 m West Auger Refusal @ 3.3 m		5	SS	50/80mm		

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	(SI CL)
20	64	(16)
9	75	(16)
42	48	(10)

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3, \times^3$: Numbers on right refer to Sensitivity. Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 10/28/08 4:00:00 PM	DRY	1.1
2)	-	-
3)	-	-

MEL-GEO 08085 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/2/09

MERLEX ENGINEERING LTD.

2-120 Progress Court, North Bay, Ontario, P1B-8G4 Phone: (705) 476-2550 Fax: (705) 476-8882 Email: merlex@merlex.ca

ENCLOSURE NO.: 8 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. B7

REFERENCE 08/07/08085 DATUM Geodetic LOCATION Site B - Culvert Station 22+455, Franklin Twp. (See Plan) ORIGINATED BY JL

PROJECT GI & FDN - Highway 60, GWP 5553-04-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY MCM/RG

CLIENT AECOM Canada Ltd. DATE (Started) October 31, 2008 TIME 8:10:00 AM CHECKED BY MAM

DATE (Completed) October 31, 2008

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
371.8	Ground Surface										
0.0	SAND Brown Fine to Medium Sand trace Silt trace Gravel some Cobbles and Boulders		1	AS					○		
371.3											
0.5	DCPT Refusal Auger Refusal - Possibly Boulders End of Boreholes						371				
	Auger Probe 1.0 m West Auger Refusal @ 475 mm										
	Auger Probe1.0 m East Auger Refusal @ 525 mm										
	Auger Probe 2.0 m East Auger Refusal @ 475 mm										

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1)	DRY	-
2)	-	-
3)	-	-

MEL-GEO 08085 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/2/09

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ENCLOSURE NO.: 9 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. B8

REFERENCE 08/07/08085 DATUM Geodetic LOCATION Site B - Culvert Station 22+455, Franklin Twp. (See Plan) ORIGINATED BY JL

PROJECT GI & FDN - Highway 60, GWP 5553-04-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY MCM/RG

CLIENT AECOM Canada Ltd. DATE (Started) October 31, 2008 TIME ____ CHECKED BY MAM

DATE (Completed) October 31, 2008

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
373.0	Ground Surface										
0.0	50 mm Grass and Organics SAND Brown Fine to Medium Sand trace Silt trace Gravel		1	AS					o		
372.1											
0.9	Refusal on Augers Refusal on DCPT End of Borehole Auger Probe 1.0 m West Auger Refusal @ 0.9 m Auger Probe 1.0 m East Auger Refusal @ 0.9 m										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: 20 40 60 80 100

o UNCONFINED + FIELD VANE

● QUICK TRIAXIAL × LAB VANE

WATER CONTENT (%): 20 40 60

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity. Numbers on left refer to values greater than 120 kPa

$o^{3\%}$ STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1)	DRY	-
2)	-	-
3)	-	-

MEL-GEO 08085 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/2/09

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APPENDIX C

Figure B-1	Borehole Locations & Soil Strata
Figures L-1 and L-2	Summary Grain Size Analysis Graph
Enclosure No. 10	Photo Essay

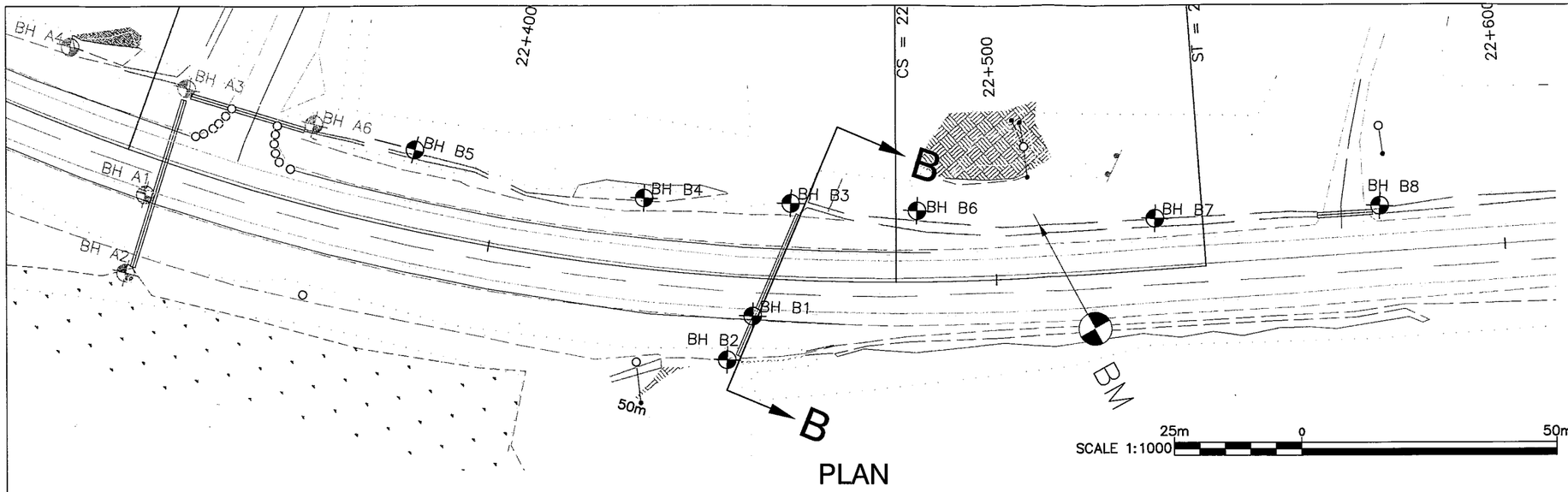
CONT No

WP No 5553-04-00

HWY 60 Twp. of Franklin
Foundation Area Site B
Culvert 22+455
BOREHOLE LOCATIONS & SOIL STRATA

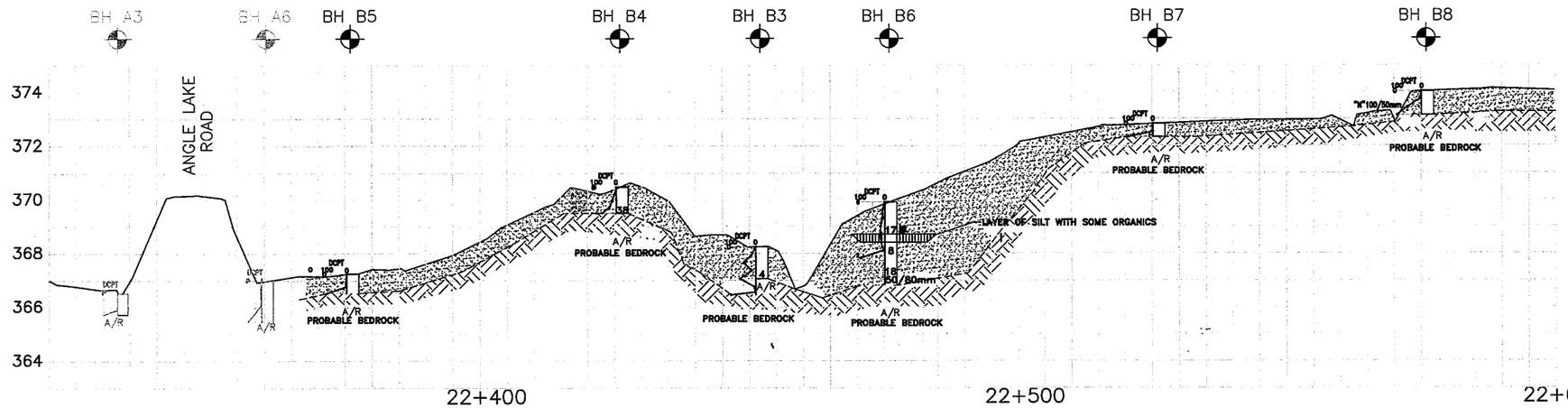
Figure B-1

MERLEX ENGINEERING LTD.
Consulting Geotechnical Engineers



SCALE 1:1000 25m 0 50m

PLAN

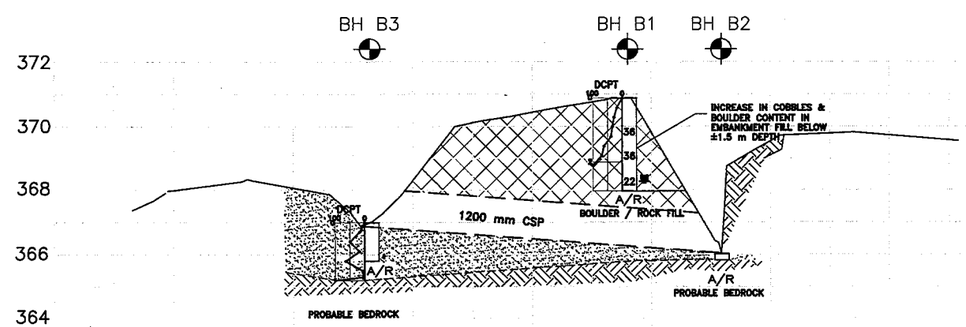


PROFILE - POSSIBLE DETOUR

SCALE HORT 1:1000 25m 0 50m
SCALE VERT 1:200 5m 0 10m

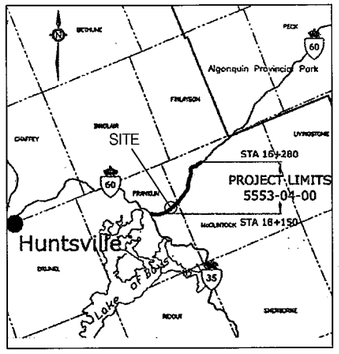
STRATIGRAPHY LEGEND

- FILL, SAND
  trace gravel, trace silt
  occasional/frequent cobbles and boulders
- SANDS
  trace silt, trace to some gravel
- BEDROCK



CROSS SECTION B-B

SCALE HORT 1:500 10m 0
SCALE VERT 1:200 4m 0



KEY PLAN - NOT TO SCALE

LEGEND

- Borehole and Dynamic Cone Penetration Test
- N Blows/0.3 m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3 m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R Auger Refusal at Elevation

Borehole No.	Co−ordinates Station	Offset	Elevation
Borehole No. B1	22+452.5	8m Rt	370.9
Borehole No. B2	22+451	16m Rt	366.0
Borehole No. B3	22+455	14m Lt	367.3
Borehole No. B4	22+426	14m Lt	369.5
Borehole No. B5	22+376	15m Lt	366.1
Borehole No. B6	22+476	14m Lt	368.9
Borehole No. B7	22+526	10m Lt	371.8
Borehole No. B8	22+576	9m Lt	373.0

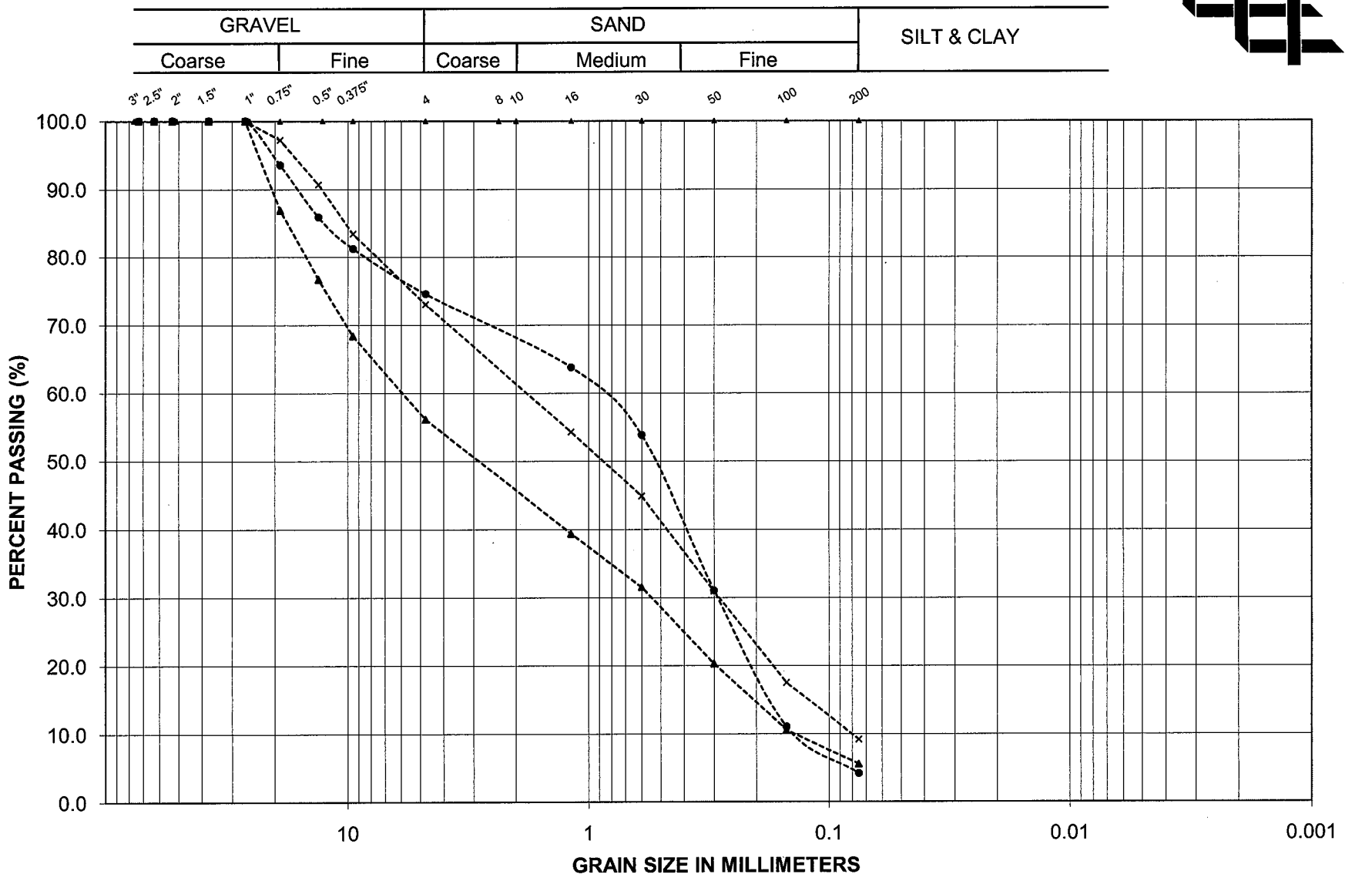
NOTE 1:
The boundaries between soil strata have been established at the borehole locations only. The boundaries between boreholes are assumed based on borehole data.

REVISIONS	DATE	BY	DESCRIPTION
	09/06/25	RG	Add stratigraphy to profile

HWY No. 60 CULVERT 22+455			DIST
SUBM'D		DATE 00/00/00	SITE
DRAWN RG	CHK MAM	DATE 09/03/17	FIG B−1

Reference No.: 08085-B
Date: Mar 17, 2009

GRAIN SIZE ANALYSIS



PROJECT: Hwy 60 - Culvert Station 22+455
LOCATION: Franklin Twp

EMBANKMENT FILL
SAND, some gravel to gravelly with trace of fines.

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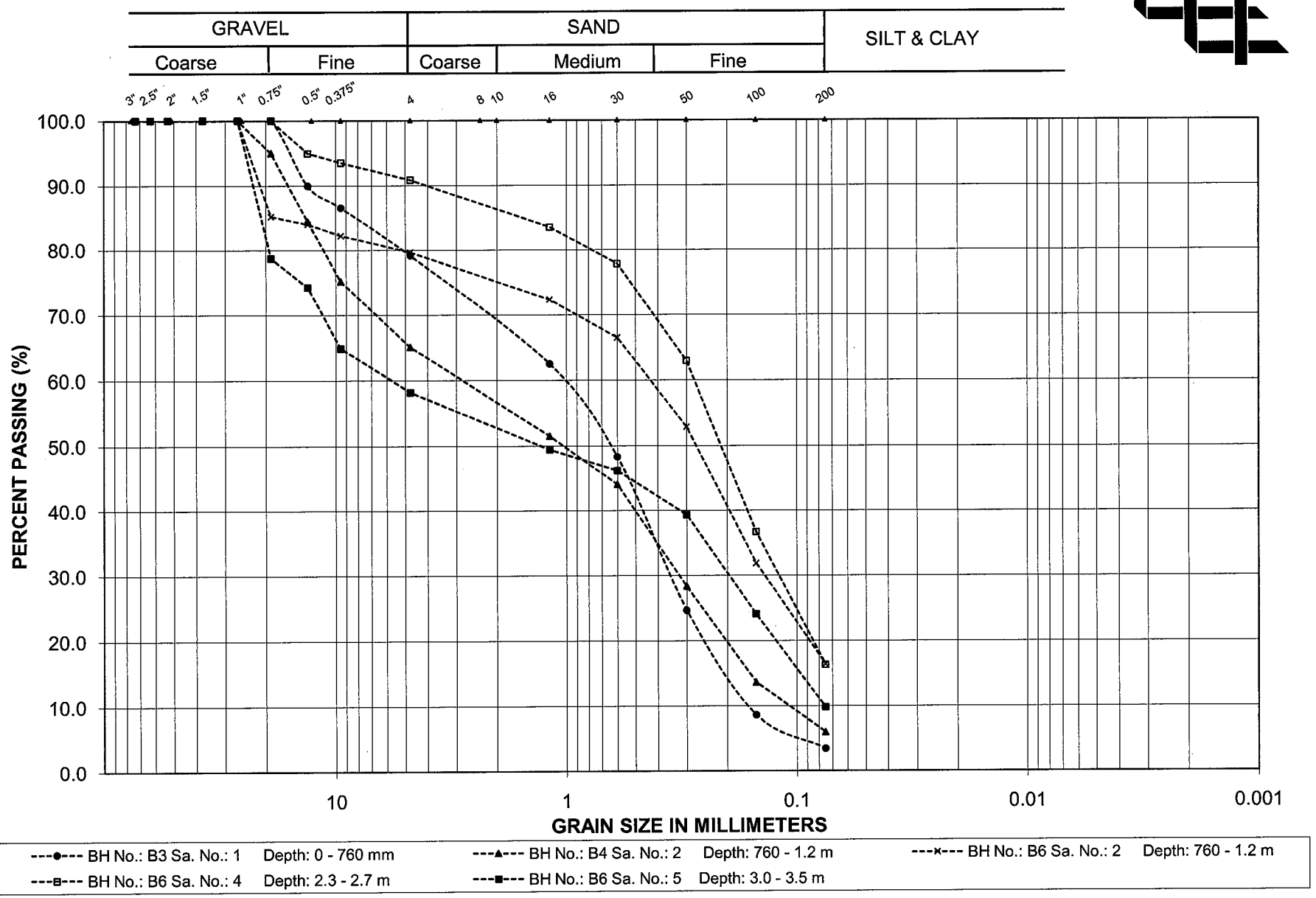
FIG L-1

Reference No.: 08085-B
Date: Mar 17, 2009

GRAIN SIZE ANALYSIS



PROJECT: Hwy 60 - Culvert Station 22+455
LOCATION: Franklin Twp

NATIVE OVERBURDEN
SAND, trace to gravelly with trace to some silt

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FIG L-2

Enclosure No. 10

Top: Culvert outlet at Station 22+455 adjacent to bedrock face. Bottom: Inlet to Culvert Station 22+455	Photos: 1 - 2

Reference No.: 08/07/08085B Project: Foundation Investigation and Design Report, Highway 60, From Highway 35 Easterly 9.1 km To 0.6 km West Of The Oxtongue Lake Narrows Bridge, GWP 5553-04-00	Provided By: MEL Date: October & November 2008