MERLEX ENGINEERING LTD.

CONSULTING GEOTECHNICAL ENGINEERS

FINAL
FOUNDATION INVESTIGATION REPORT
GWP 5086-06-00
Culvert Station 19+925, Twp. of Broder
Highway 17, From 1.0 km West of Highway 69, Easterly 12.1 km
MTO Sudbury Area

MEL Ref. No.: 08/11/08170 November 25, 2009

Submitted to:

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

Geocres No.: 41I-248

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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 19+925, Township of Broder. The GWP 5086-06-00 on Highway 17 runs from 1.0 km west of Highway 69 easterly 12.1 km (see Figure No. 1, Key Plan, in Appendix A). This section of road is known as the Sudbury south east bypass, and the westerly 1.8 km section of this portion of Highway 17 is a four lane facility, whereas the remaining easterly section is a two lane highway. The culvert is located in a 3.5 to 5.0 m high fill embankment, east bound and west bound lanes respectively, in the four lane section of the Highway. The pipe is a 900 mm diameter polyethylene culvert.

The foundation investigation location was specified by the MTO in the RFP/TPM documentation Agreement No. 5007-E-0026, Addendum # 1. The terms of reference for the scope of work are outlined in MEL's proposal P-08-056, dated May 26, 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 retrieved samples.

2.0 SITE DESCRIPTION

The 900 mm diameter polyethylene culvert is located on the four lane section of Highway 17, a short distance east of the Highway 69 intersection. The topography at the site is bedrock controlled with moderate relief and the direction of flow in the culvert is from south to north. The existing highway embankment supports two lanes of west bound traffic that is divided by a median from the two lanes of east bound traffic. The west bound embankment is some 5 m in height, whereas the east bound embankment is some 3.5 m in height. The catchment area to

the south is relatively small and controlled by bedrock. The culvert discharges to the north into a bedrock controlled low lying area (see Photos 1 and 2 on Enclosure No. 11, Appendix D).

2.1 Site Physiography and Surficial Geology

This Highway 17 project falls within the limits of the geomorphic sub-province known as the North Shore - Sudbury Ridges and Pockets. The topography at the site is generally rolling. There are exposed bedrock ridges present at many locations on the project. At some locations, significant layers of earth overlay the bedrock. Within the project area overburden conditions consist primarily of silt, and fine sand containing varying amounts of silt. Organic (peat) deposits are also present.

Based on Map 2506, as published by the Ontario Geological Survey, the site is located in the Superior Province of the Canadian Shield. The bedrock geology of the region is part of the Huronian Supergroup, consisting of the Elliot Lake, Hough Lake and Quirke Lake groups from the middle Precambrian and mafic igneous rocks of the late to middle Precambrian.

At the boreholes drilled on this site, bedrock was recorded at the ground surface (Borehole No. 9) and up to a depth of 10.4 m below embankment surface (Borehole No.1). The NQ size bedrock core retrieved from the boreholes was classified as a grey to black fine grained gabbro and tuff with faintly weathered joints.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out during the period of May 22 to June 4, 2009, and consisted of a total of nine (9) sampled boreholes.

The field investigation was carried out using a CME 850 mounted on an all terrain carrier, equipped with hollow stem augers, with NW and NQ casing and coring equipment. The drilling equipment was owned and operated by Landcore Drilling. Where possible, soil samples were obtained using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures at the borehole locations. To penetrate the rockfill embankments, NW size casing was advanced down to the surface of the first piece of rockfill, following which NQ size diamond core drilling was carried out until the piece of rock was penetrated. Following this, the casing was advanced through the piece of rock fill until the next piece of rockfill was encountered, at which point the NQ core barrel was employed to advance through the piece of rock fill. If soil/overburden appeared to be present between rockfill pieces, an attempt to retrieve a split spoon sample of the material was carried out however, these attempts were generally met with refusal on an underlying piece of rockfill, or boulder. Upon encountering bedrock, NQ size diamond core samples were taken of the bedrock for classification purposes and to determine the rock quality designation (RQD) and percent recovery (REC.)

The field work for this investigation was under the full time direction of a member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, observing 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 soil 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 to L-3).

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.

Following completion of the individual boreholes, all open boreholes were backfilled upon completion with cuttings and bentonite grout to surface.

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. 2 (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 diamond core drilling, 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 19+925, Twp. of Broder

A plan and profile showing the borehole locations and stratigraphic sequences is shown on Figure No. 2, Appendix C, for design purposes only. During the course of the exploration

program, nine (9) sampled boreholes were put down at this site. Borehole Nos. 7, 8, and 9 were advanced at the inlet, mid-point, and outlet of the existing 900 mm diameter polyethylene culvert. The remaining boreholes (Borehole Nos. 1 to 6 inclusive) were advanced through the existing embankment at, and 10 m up and down chainage from, the existing culvert for possible design of a roadway protection system.

At the location of Borehole No. 9 (outlet), bedrock was encountered at the existing ground surface and was identified as a grey fine grained gabbro of good to excellent quality based on the Rock Quality Designation (RQD) values, which ranged from 83% to 90%.

At Borehole No. 7 (culvert inlet), a thin layer of overburden, some 1.2 m in thickness, was present. This overburden deposit consisted of approximately 300 mm of black silty organics underlain by a grey silt with fine sand, trace of clay. Based on the SPT value of 21 blows per 300 mm penetration, the compactness of the deposit is described as compact. At a depth of 1.2 m, bedrock was encountered. The grey fine grained gabbro bedrock was of a good to excellent quality with RQD values ranging from 78% to 95%.

Borehole No. 8, which was advanced through the median, indicated some 3.3 m of rockfill overburden. This fill deposit consisted of approximately 300 mm of surficial organics mixed with fine sand and silt. Large rock pieces, some 1 m in diameter were penetrated, intermixed with pockets/layers of silt and fine sand fill. Between depths of 2.4 to 3.3 m a deposit of grey silt with some fine sand and clay was penetrated. A particle size analysis of a sample of this material indicated 1% gravel size particles, 15% sand size particles, 71% silt size particles, and 13% clay size particles. Based on the SPT values, which ranged from 0 (weight of hammer) to 1 blow per 300 mm of penetration, the compactness of this fill is described as very loose. At the location of

Borehole No. 8, bedrock was encountered at a depth of 3.3 m below existing grade and sampled to a depth of 6.4 m. The bedrock is classified as a fine grained gabbro of poor to excellent quality, based on the RQD values of 40% to 100%.

Borehole Nos. 1 and 2 were advanced from the top of the existing embankment, a short distance down chainage from the culvert, in the west bound and east bound lanes respectively.

At the location of Borehole No. 1, a 600 mm layer of crushed gravel fill (pavement structure) was encountered overlying rockfill. The rockfill at this location was penetrated to a depth of some 7 m below the top of the embankment. Underlying the rockfill a heterogeneous mixture of grey sandy silt, some gravel, clay, and frequent cobbles and boulders was penetrated. The particle size analysis of samples of this material indicate 22 to 42% gravel size particles, 15 to 23% sand size particles, 26 to 41% silt size particles, and 9 to 22% clay size particles. The presence of frequent boulder sizes required diamond core drilling and casing advance, and prevented retrieving additional samples using the conventional split spoon samples of the material. At Borehole No. 1, bedrock was encountered at a depth of 10.4 m below grade. NQ size diamond core drilling was carried out to a depth 13.5 m below the embankment surface and indicated the bedrock was a fine grained gabbro of good to excellent quality with RQD values of 86% and 100% for the two core runs.

At the location of Borehole No. 2, advanced slightly down chainage from culvert in the east bound lane, embankment fill was penetrated to a depth of 3.5 m below the embankment surface. The fill deposit consisted of a 600 mm layer of crushed gravel fill (pavement structure) underlain by rockfill. Diamond core drilling of the bedrock indicated a grey fine grained gabbro.

Borehole Nos. 3 and 4, advanced in the west bound lanes, and Borehole Nos. 6 and 5, advanced in the east bound lanes, were located some 10 m up and down chainage from the culvert. These boreholes were advanced to delineate sub-surface conditions for design of a roadway protection system.

Borehole No. 3 encountered embankment fill, consisting of 600 mm of crushed gravel/pavement structure fill overlying rock fill, to a depth of 5.5 m. Below the rockfill, a grey fine grained gabbro bedrock of good quality, based on RQD value of 82% to 80%, was proven over a 3 m depth to 8.5 below embankment surface. At Borehole No. 4, a 600 mm thick layer of crushed gravel (pavement structure) was underlain by rockfill to a depth of 6.1 m below grade. Below the rockfill, a ± 1 m thick layer of grey silt, with clay, trace of sands was penetrated. Based on particle size analysis, this deposit contained 0% gravel size particles, 3% sand size particles, 53% silt size particles, and 44% clay size particles. Based on the single SPT value of 19 blows per 300 mm penetration, the compactness of the deposit is described as compact. Between a depth of 7.1 and 9.3 m below grade, a heterogeneous mixture of sandy silt, with some gravel, clay, and frequent cobbles and boulders was penetrated. Due to the frequency of cobbles and boulders in this deposit, a split spoon sample could not be retrieved. At a depth of 9.3 m below grade, a grey fine grained gabbro bedrock was encountered and sampled to a depth of 12.3 m. Based on the RQD values, which ranged between 91 and 93%, the quality of the bedrock is described as excellent.

Borehole Nos. 5 and 6 were advanced from the surface of the existing embankment in the east bound lanes. At these boreholes, a layer of crushed gravel (pavement structure), some 400 to 600 mm in thickness, was penetrated overlying embankment fill, which comprised of rockfill. The rockfill extended to depths of 3 to 3.2 m below grade, where the underlying material was

proven as bedrock. Diamond core drilling over a length of some 3 m was carried out at these borehole locations and indicated that the bedrock was a grey fine grained gabbro of generally fair to excellent quality, based on RQD values of 67% to 93%. At the location of Borehole No. 5, a fractured zone was encountered in the bedrock between a depth of 4.8 to 5.1 m. Below this fractured zone, bedrock of excellent quality was sampled over a 1.5 m core run.

4.2 Groundwater Conditions

Due to the use of drilling mud and high volumes of water required for diamond core drilling through the rockfill embankments, stabilized groundwater levels had not developed at the completion of the boreholes. The boreholes were backfilled with a bentonite grout immediately upon completion for safety purposes and, as such, stabilized water levels were not recorded. The embankments are constructed of rockfill, which has a high permeability, and therefore, should not hold groundwater for sustained periods of time. In the east bound lane, the rockfill embankment is generally supported directly on or very close to the bedrock surface, however, in the west bound lanes the rockfill embankment was underlain by a pocket of silts and fine sands over a heterogeneous deposit of silts and fine sands with cobbles and boulders. It is likely that a perched water table would be encountered in the pockets of overburden present in depressions of the bedrock surface. These groundwater levels will fluctuate seasonally.

MERLEX ENGINEERING LTD.

M. A. Merleau, P. Eng.
Principal

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

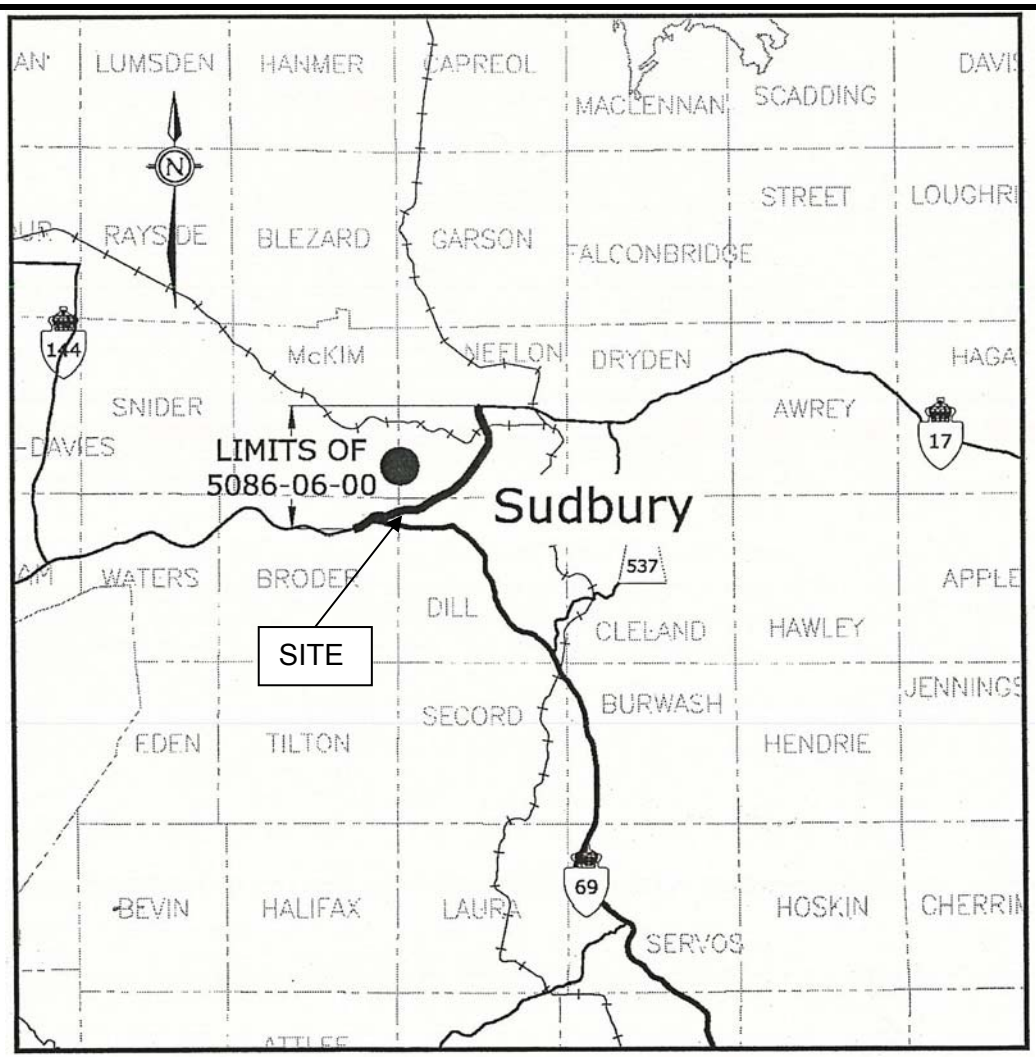
APPENDIX A

Figure No. 1: Key Plan

FIGURE NO. 1

KEY PLAN

NOT TO SCALE



FINAL
FOUNDATION INVESTIGATION REPORT

GWP 5086-06-00

Highway 17, From 1.0 km
West Of Highway 69, Easterly 12.1 km
Culvert Station 19+925 – Twp. Of Broder

MEL Ref. No.: 08/11/08170 November 2009

MERLEX ENGINEERING LTD.
CONSULTING GEOTECHNICAL ENGINEERS

APPENDIX B

Enclosure No. 1: List of Abbreviations and Symbols

Enclosure Nos. 2 to 10: 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 2)

METRIC

RECORD OF BOREHOLE NO. 1

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+926 25m Lt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 29 TIME 1:10:00 PM CHECKED BY MAM

DATE (Completed) 2009 June 1

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
281.1	Ground Surface						281
0.0	Crushed Gravel - FILL						
280.5							280
0.6	FILL Embankment Rock Fill		See Note				279
							278
							277
							276
274.1							275
7.0	Heterogenius Mixture Sandy silt, some gravel trace to some clay		1	SS	8		274
	boulders/cobbles		2	SS	15/0mm		
	Continued Next Page			NQ	RC		

Approx. Culvert Invert - ±276.0 m

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × 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/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	(SI	CL)
1	22	15	41	22
2	42	23	26	9

COMMENTS

Note: Ran NW casing with NQ core from 0.6 m to 10.4 m depth through rock fill and overburden.

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)	-	-
2)	-	-
3)	-	-

MEL-GEO 08170 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/11/26

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

METRIC

RECORD OF BOREHOLE NO. 1

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+926 25m Lt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 29 TIME 1:10:00 PM CHECKED BY MAM

DATE (Completed) 2009 June 1

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)
273.0	Continued from Previous Page										
8.1	Heterogenius mixture Grey sandy silt some gravel, clay			NQ	RC		273				
	frequent cobbles and boulders			NQ	RC		272				
	(compact)			NQ	RC		271				
270.7											
10.4	BEDROCK Grey fine grained Gabbro - Good Quality		Run 1	NQ	Rec - 97% RQD - 86%		270				
	Grey fine grained Gabbro -Excellent Quality		Run 2	NQ	Rec - 100% RQD - 100%		269				
							268				
267.6											
13.5	End of Borehole										

MEL-GEO 08170 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/11/26

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

METRIC

RECORD OF BOREHOLE NO. 2

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+924 17m Rt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 22 TIME 11:32:00 AM CHECKED BY MAM

DATE (Completed) 2009 May 22

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
281.3	Ground Surface						
0.0	Crushed Gravel - FILL		1	AS			281
280.7							
0.6	FILL Embankment Rock Fill						280
							279
							Approx. Culvert Invert - ±278.1 m
277.8							278
3.5	BEDROCK Grey, fine grained Gabbro		Run 1	NQ	Rec - 100% RQD - 100%		
277.3							
4.0	End of Borehole						

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)
○	41	53		(6)

COMMENTS

Note: Ran NW casing and NQ core throung rock fill.

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

+³, ×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)	-	-
2)	-	-
3)	-	-

MEL-GEO 08170 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/11/26

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ENCLOSURE NO.: 4 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. 3

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+936 26m Lt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 27 DATE (Completed) 2009 May 27 TIME 2:30:00 PM CHECKED BY MAM

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, ● QUICK TRIAXIAL, + FIELD VANE, × 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)
281.0	Ground Surface										
0.0	Crushed Gravel - FILL		1	AS							31 14 42 13
280.4											
0.6	FILL Embankment Rock Fill		See Note				280				
							279				
							278				
							277				
							276				
275.5							275				
5.5	BEDROCK Grey, fine grained Gabbro - Good Quality		Run 1	NQ	Rec - 100% RQD - 82%						
							274				
	Grey, fine grained Gabbro - Good Quality		Run 2	NQ	Rec - 96% RQD - 80%						
	Continued Next Page										

COMMENTS

Note: Ran NW casing with NQ core from 0.6 m to 5.5 m depth through rock fill.

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

+³, ×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)	-	-
2)	-	-
3)	-	-

MEL-GEO 08170 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/11/26

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ENCLOSURE NO.: 4 (Pg. 2 of 2)

METRIC

RECORD OF BOREHOLE NO. 3

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+936 26m Lt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 27 TIME 2:30:00 PM CHECKED BY MAM

DATE (Completed) 2009 May 27

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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
	Continued from Previous Page										
272.5	Bedrock										
8.5	End of Borehole										

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ENCLOSURE NO.: 5 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. 4

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+918 25m Lt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 June 3 TIME 10:41:00 AM CHECKED BY MAM

DATE (Completed) 2009 June 4

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 ● QUICK TRIAXIAL + FIELD VANE × 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)
281.1	Ground Surface										
0.0	Crushed Gravel - FILL						281				
280.5											
0.6	FILL Embankment Rock Fill		See Note 2				280				
							279				
							278				
							277				
							276				
275.0							275				
6.1	SILT - grey silt with clay trace of sand (compact)		1	SS	19				○		0 3 63 34
274.0							274				
7.1	Heterogenius Mixture Sandy silt, some gravel, clay, boulders and cobbles Continued Next Page										

COMMENTS

Note 1: Initially commenced hole at Sta. 19+915 25 m Lt, broke off casing shoe, grouted then abandoned hole. Note 2: Ran NW casing with NQ core from 0.6 m to 6.1 m depth through rock fill

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)	-	-
2)	-	-
3)	-	-

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ENCLOSURE NO.: 5 (Pg. 2 of 2)

METRIC

RECORD OF BOREHOLE NO. 4

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+918 25m Lt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 June 3 TIME 10:41:00 AM CHECKED BY MAM

DATE (Completed) 2009 June 4

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 (%)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						GR SA (SI CL)
	Continued from Previous Page										
	Heterogenius Mixture Sandy silt, some gravel, clay, frequent boulders and cobbles						273				
271.8											
9.3	BEDROCK Grey fine grained Gabbro -Excellent Quality		Run 1	NQ	Rec - 93% RQD - 93%		272 271				
	Grey fine grained Gabbro -excellent quality		Run 2	NQ	Rec - 90% RQD - 91%		270 269				
268.8											
12.3	End of Borehole										

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

METRIC

RECORD OF BOREHOLE NO. 5

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+913 18m Rt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 25 TIME 4:22:00 PM CHECKED BY MAM

DATE (Completed) 2009 May 25

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
281.5	Ground Surface						
0.0 / 281.1	Crushed Gravel - FILL						
0.4 / 278.2	FILL Embankment Rock Fill						281
3.3 / 276.7	BEDROCK Grey fine grained Gabbro -Fair Quality		Run 1	NQ	Rec - 95% RQD - 67%		280
4.8 / 276.4	Fracture Zone		Run 2	NQ	Rec - 100% RQD - 0%		279
5.1 / 274.9	BEDROCK Grey fine grained Gabbro - Excellent Quality		Run 3	NQ	Rec - 93% RQD - 93%		278
6.6	End of Borehole						277
							276
							275

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/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)

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)	-	-
2)	-	-
3)	-	-

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

METRIC

RECORD OF BOREHOLE NO. 6

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+935 16m Rt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 26 TIME 11:51:00 PM CHECKED BY MAM

DATE (Completed) 2009 May 26

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
281.2	Ground Surface						
0.0	Crushed Gravel - FILL						281
280.6							
0.6	FILL Embankment Rock Fill		See Note				280
278.0							279
3.2	BEDROCK Grey, fine grained Gabbro - Fair Quality		Run 1	NQ	Rec - 91% RQD - 73%		278
							277
	Grey, fine grained Gabbro - Fair Quality		Run 2	NQ	Rec - 88% RQD - 63%		276
275.0							275
6.2	End of Borehole						

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)

COMMENTS

Note: Ran NW casing with NQ core through rock fill.

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

$\circ$ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

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

MEL-GEO 08170 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/11/26

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

METRIC

RECORD OF BOREHOLE NO. 7

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+926 25m Rt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 26 TIME 2:22:00 PM CHECKED BY MAM

DATE (Completed) 2009 May 26

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
278.6	Ground Surface						
0.0 278.3	300 mm Black Silty Organics						
0.3	SILT - Grey silt with fine sand trace clay		1	AS	3		
	(compact)		2	AS	21		278
277.4							
1.2	BEDROCK						
	Grey, fine grained Gabbro - Good Quality		Run 1	NQ	Rec - 97% RQD 78%		277
							276
	Grey, fine grained Gabbro - Excellent Quality		Run 2	NQ	Rec - 97% RQD - 95%		275
274.3							
4.3	End of Borehole						

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)

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)	-	-
2)	-	-
3)	-	-

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

METRIC

RECORD OF BOREHOLE NO. 8

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+922 3m Rt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 21 TIME 5:07:00 PM CHECKED BY MAM

DATE (Completed) 2009 May 21

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 (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	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)
280.2	Ground Surface										
0.0 / 279.9	300 mm Organic Fine Sand and Silt		1	DO	12		280		○ at 20		1 68 29 2
0.3 / 277.8	FILL Rock Fill, ±1 m diameter, with pockets/layers of silt and fine sand						279				
2.4 / 276.9	SILT - grey silt some fine sand and clay (very loose)		2	DO	WH		278		○ at 40		1 15 71 13
			3	DO	1			Approx. Culvert Invert - ±277.2 m	○ at 20		
3.3	BEDROCK						277				
	Grey, fine grained Gabbro -poor Quality		Run 1	NQ	Rec - 83% RQD - 40%		276				
	Grey, fine grained Gabbro - Fair Quality		Run 2	NQ	Rec - 81% RQD - 59%		275				
	Grey, fine grained Gabbro -Excellent Quality		Run 3	NQ	Rec - 100% RQD - 100%		274				
272.3							273				
7.9	End of Borehole										

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)	-	-
2)	-	-
3)	-	-

MEL-GEO 08170 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/11/26

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ENCLOSURE NO.: 10 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 9

REFERENCE 08/11/08170 DATUM Geodetic LOCATION Twp. of Broder Sta. 19+927 39m Lt ORIGINATED BY TA

PROJECT Hwy. 17 SE Bypass - GWP 5086-06-00 BOREHOLE TYPE CME 850 - Hollow Stem / NW Casings COMPILED BY MCM

CLIENT AECOM Inc. DATE (Started) 2009 May 29 TIME 12:00:00 PM CHECKED BY MAM

DATE (Completed) 2009 May 29

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 (%)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						GR SA (SI CL)
275.6	Bedrock Surface - Existing Grade										
0.0	BEDROCK Grey, fine grained Gabbro -Good Quality		Run 1	NQ	Rec - 100% RQD - 83%		275				
	Grey, fine grained Gabbro -Excellent Quality		Run 2	NQ	Rec - 97% RQD - 90%		274 273				
272.5											
3.1	End of Borehole										

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)	-	-
2)	-	-
3)	-	-

MEL-GEO 08170 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/11/26

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APPENDIX C

Figure 2	Borehole Locations & Soil Strata
Figure L-1 to L-3	Summary Grain Size Analysis Graph
Figure SK-2	Culvert Replacement in High Rock Fills

CONT No

WP No 5086-06-00

N

HWY 17 - S.E. Bypass Twp. of Broder

Foundation Area - Culvert 19+925

BOREHOLE LOCATIONS & SOIL STRATA

Figure 2

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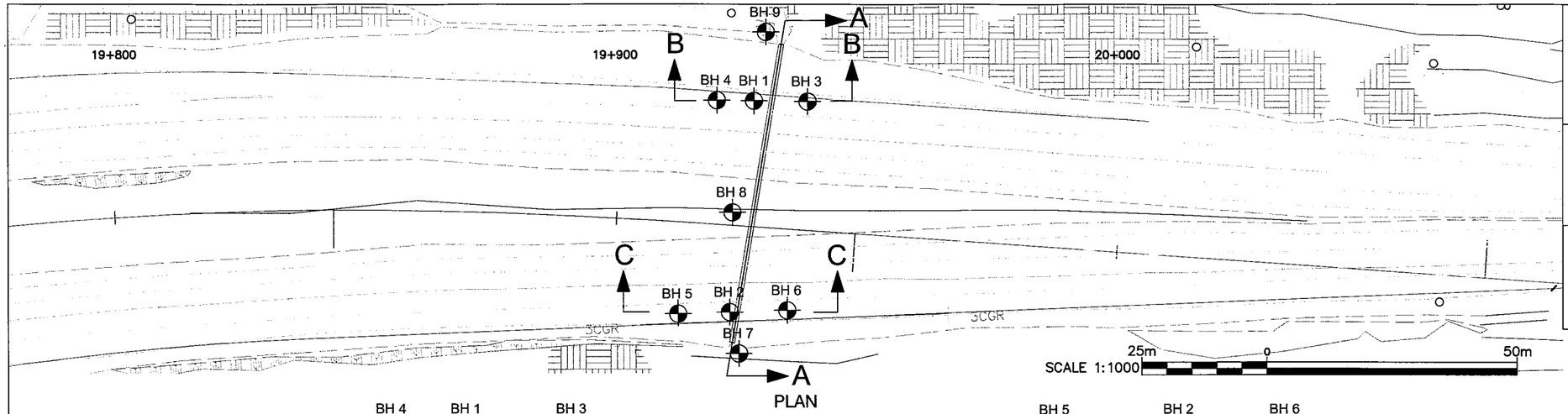
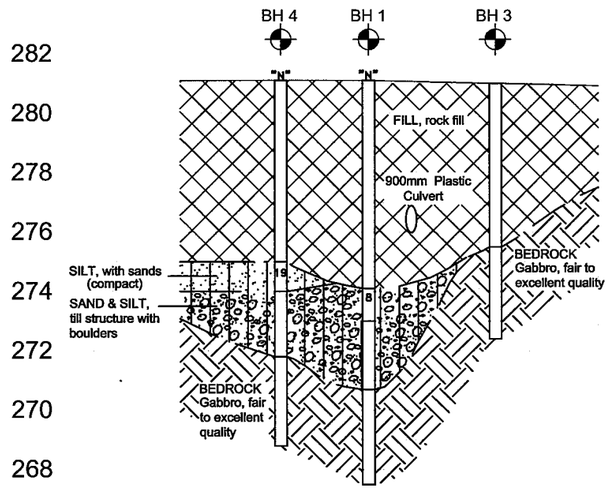
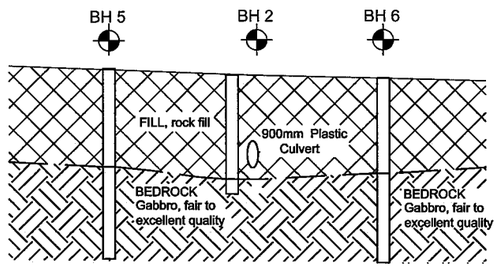
Consulting Geotechnical Engineers





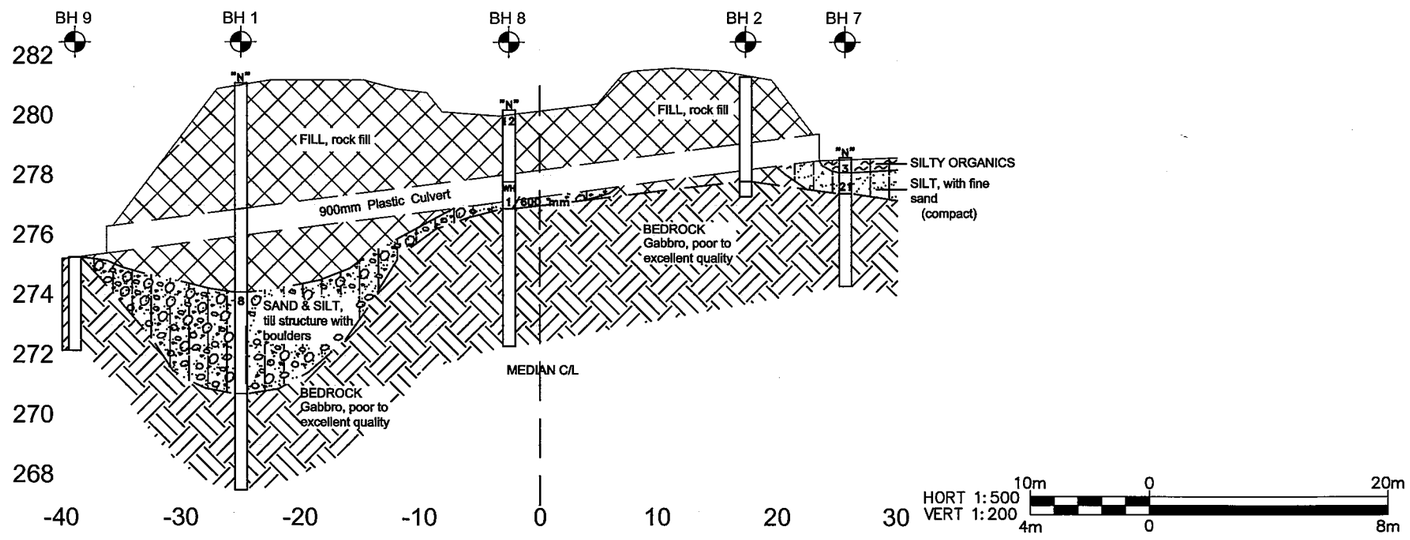
19+925
WEST BOUND PROFILE - B-B



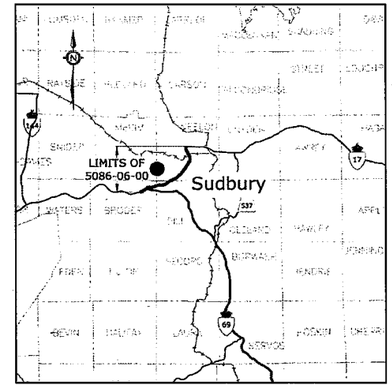
19+925
EAST BOUND PROFILE - C-C

STRATIGRAPHY LEGEND

- FILL, ROCKFILL
- SILTY ORGANICS
- SILT, with sands
- SAND & SILT till structure with boulders
- BEDROCK



CROSS SECTION - A-A



KEY PLAN - NOT TO SCALE

LEGEND

- Borehole
- 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
- E/S End of Sampling

Borehole No.	Co-ordinates Station	Co-ordinates Offset	Elevation
Borehole No. 1	19+926	25m Lt	281.1
Borehole No. 2	19+924	17m Rt	281.3
Borehole No. 3	19+936	26m Lt	281.0
Borehole No. 4	19+918	25m Lt	281.1
Borehole No. 5	19+913	18m Rt	281.5
Borehole No. 6	19+935	16m Rt	281.2
Borehole No. 7	19+926	25m Rt	278.6
Borehole No. 8	19+922	3m Rt	280.2
Borehole No. 9	19+927	39m Lt	275.6

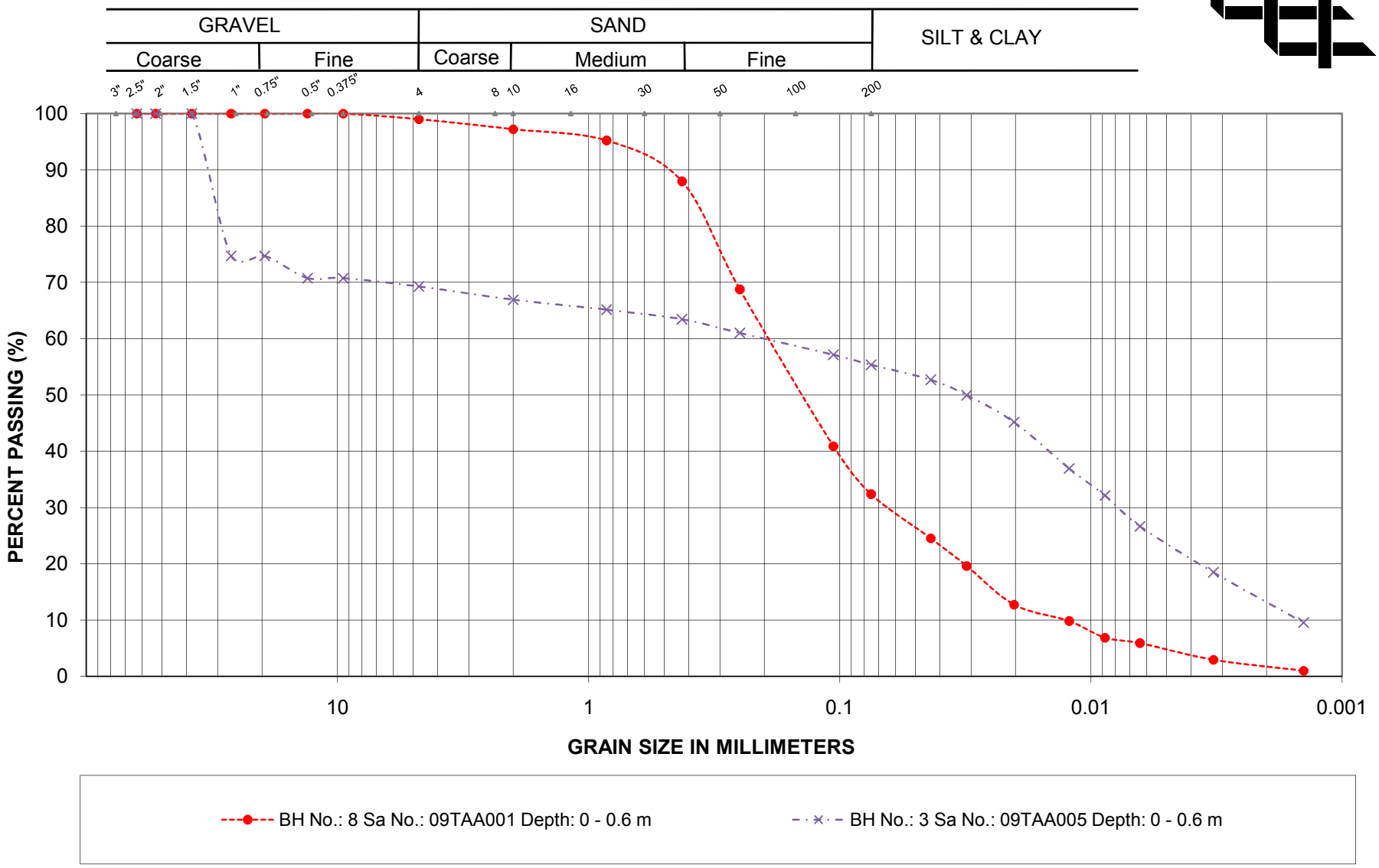
NOTE 1:
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.

REVISIONS	DATE	BY	DESCRIPTION

HWY No. 17 CULVERT 19+925			DIST
SUBM'D		DATE 00/00/00	SITE
DRAWN RG	CHK MAM	DATE 09/08/21	FIG 1

Reference No.: 08170
Date: September 2009

GRAIN SIZE ANALYSIS



PROJECT: Hwy. 17, S.E. Bypass
LOCATION: Culvert - Sta. 19+925, Broder Twp.

FILL

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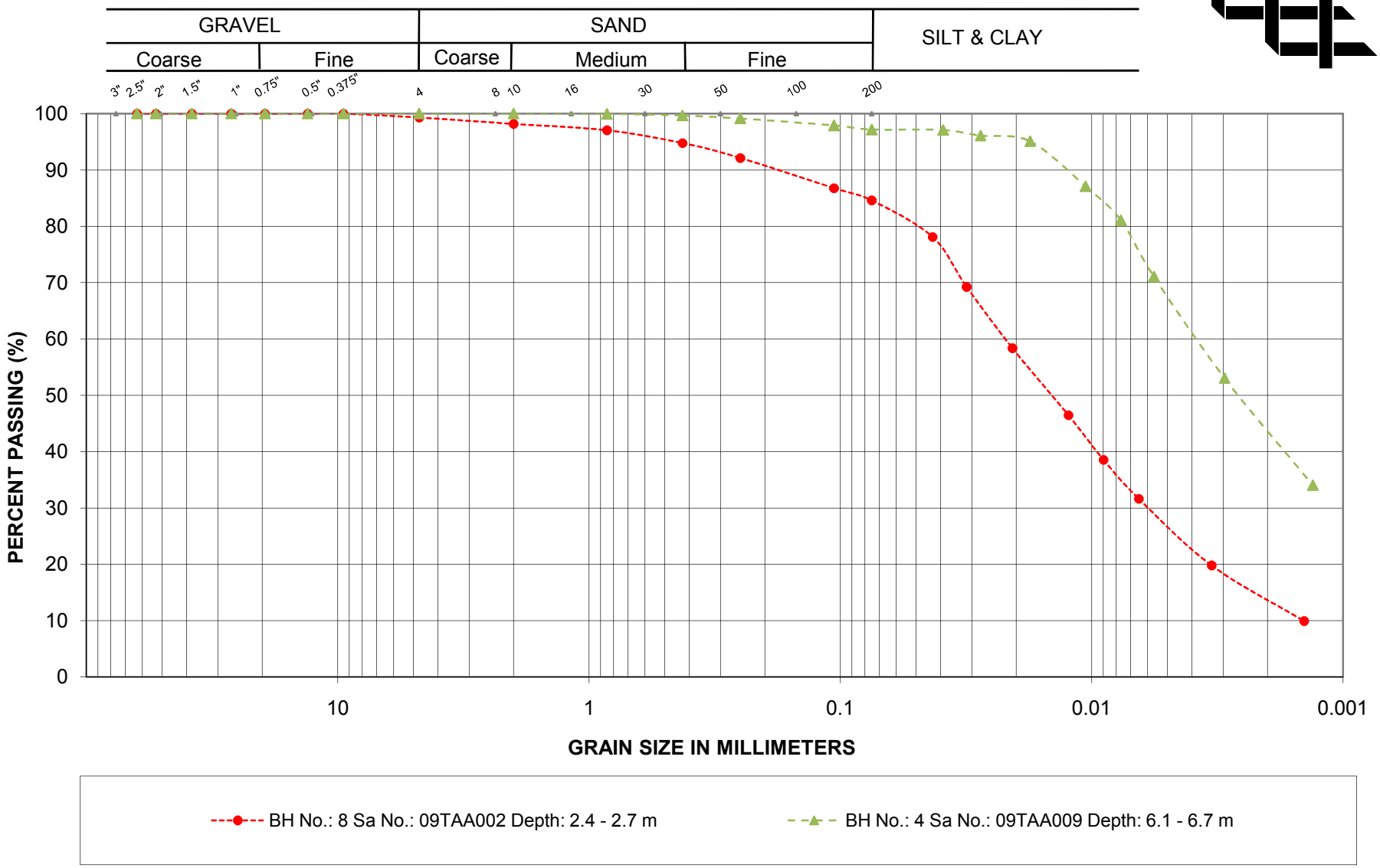
FIGURE L-1

Reference No.: 08170
Date: September 2009

GRAIN SIZE ANALYSIS



SILT, some fine sand and clay
(Naitve)

PROJECT: Hwy. 17, S.E. Bypass
LOCATION: Culvert - Sta. 19+925, Broder Twp.

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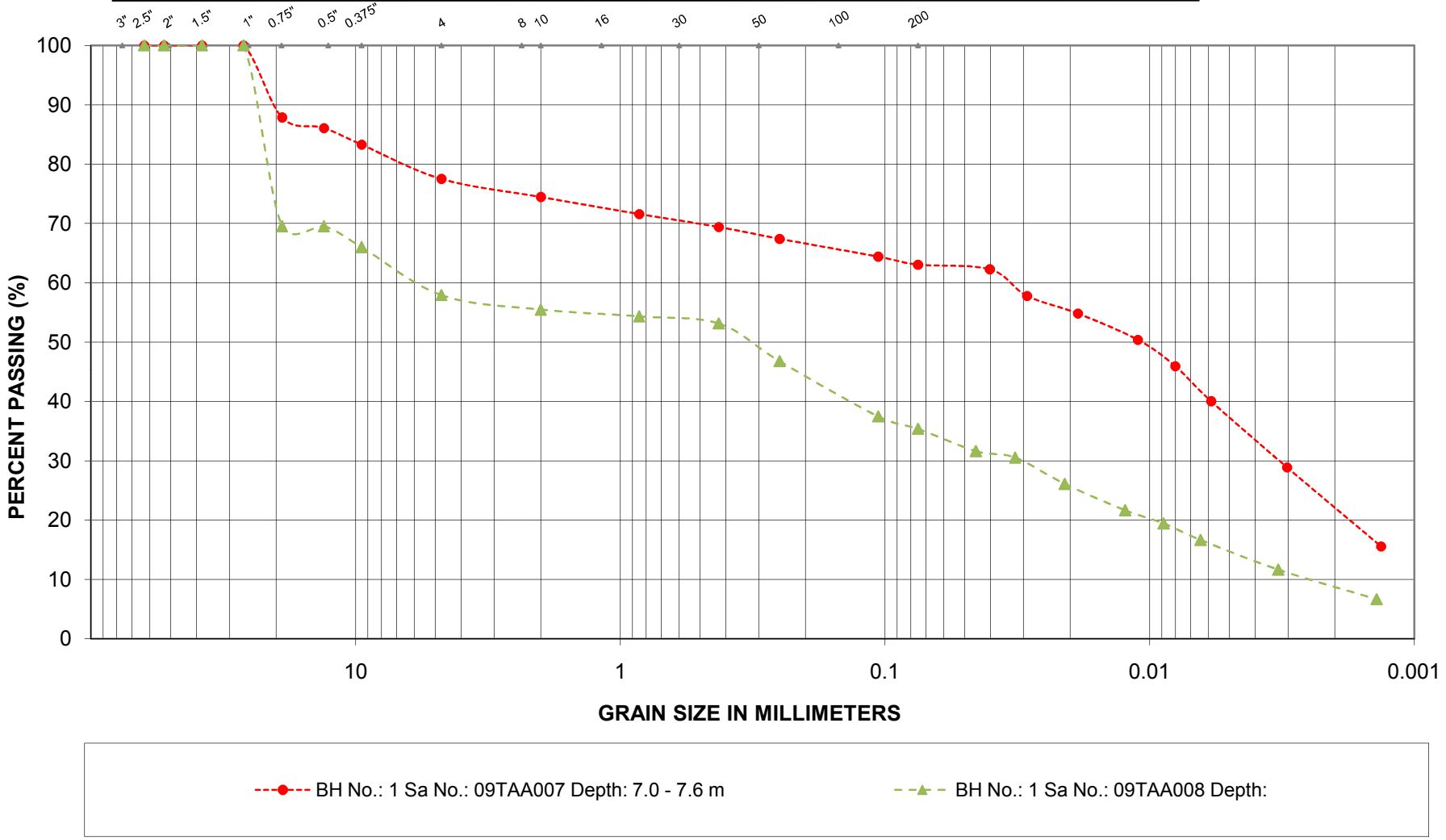
FIGURE L-2

Reference No.: 08170
Date: September 2009

GRAIN SIZE ANALYSIS



PROJECT: Hwy. 17, S.E. Bypass Hetrogenious Mixture - Sands and silts some gravel and clay
LOCATION: Culvert - Sta. 19+925, Broder Twp.

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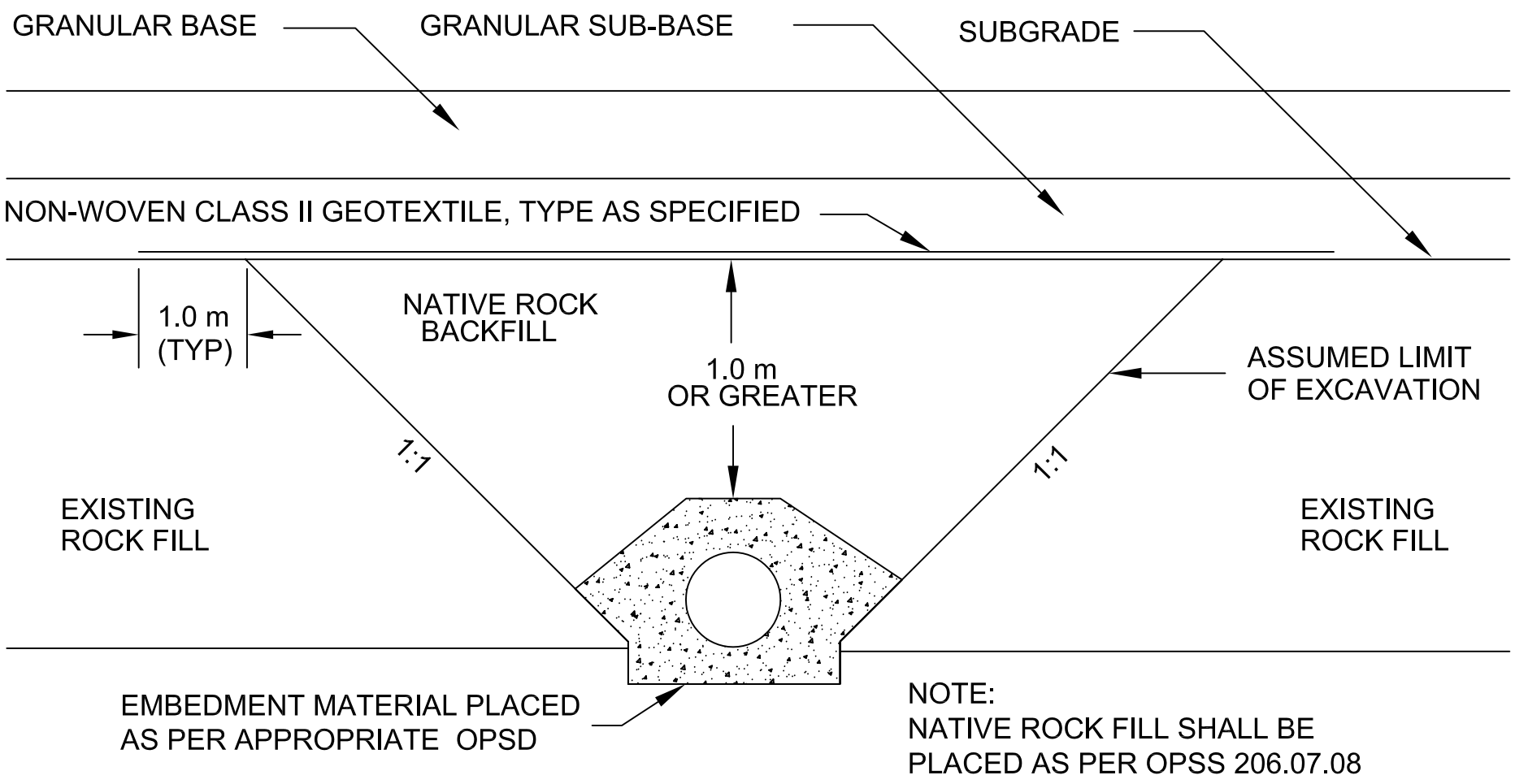
FIGURE L-3

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE INDICATED.

NOT TO SCALE

CULVERT REPLACEMENT IN HIGH ROCKFILLS

FIGURE: SK-2



APPENDIX D

Enclosure No. 11: Photo Essay

Top: Outlet from 900 mm polyethylene culvert. – Area of Borehole No. 9 Bottom: Inlet to 900 mm polyethylene culvert. – Area of Borehole No. 7	Photos: 1 - 2

Reference No.: 08/11/08170 Project: Foundation Investigation and Design Report, Highway 17, Culvert Station 19+925, Twp. of Broder, Highway 17, From 1.0 km West of Highway 69, Easterly 12.1 km. GWP 5086-06-00	Provided By: MEL Date: June 4, 2009