



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
WEST NOISE BARRIER WALL
HIGHWAY 417
OTTAWA, ONTARIO
G.W.P. 4097-12-00**

GEOCRES Number: 31G5-264

Submitted
To
MMM Group Limited

February 18, 2015

File: 19-5161-177

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**FOUNDATION INVESTIGATION REPORT
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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) at a proposed noise barrier wall site on Highway 417 in Ottawa, Ontario.

The purpose of this investigation was to obtain subsurface information at the site and, based on the data obtained, provide a comprehensive model of the subsurface conditions using borehole location plans, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber was retained by the MMM Group Limited to carry out this foundation investigation under MTO Agreement Number 4012-E-0037.

2 SITE DESCRIPTION

The site of the proposed west noise barrier is situated on the north side of Highway 417 from the existing berm approximately 600 m west of Holly Acres Road westerly for approximately 1010 metres (12+500 to 11+490). A second more easterly noise barrier has also been investigated as part of this project; the results are presented separately.

This site is located in a suburban area; about 100 m of forested land separates the Lakeview Park residential subdivision from Highway 417 to the south. Bedrock outcrops are present within two kilometres west of the western project limit along the highway. Local topography is generally flat with some low rolling hills.

The Urban Geology of the National Capital Area map released by the Geological Survey of Canada in 2008 (GSC Open File 5311, 2008) indicates that the soil conditions within the west noise barrier study area are offshore marine sediments primarily consisting of silt and clay overlying bedrock. The bedrock varies from more than 6 m below ground surface to approximately 1 m below ground surface at the west limit of the project.

Several relevant reports were available in the Geocres Library concerning the project site. Borehole records from the following reports are included in Appendix D as supplementary information:

- Report to the City of Ottawa – Geotechnical Investigation, West Transitway Extension, Bayshore Station to East of Moodie Drive, Ottawa, Ontario, Golder Associates Ltd., Project 09-1121-0008, 2011
- Report to the City of Ottawa – Geotechnical Investigation, Proposed West Transitway Extension and South-West Ramp, West of Bayshore Station to West of Acres Road, Nepean, Ontario, Golder Associates Ltd., Project 971-2058, 1998
- 31G05-163 – Hwy 417/416 Interchange High Mast Lighting
- 31G05-199 – Trichord Overhead Signs between Moodie Drive and Highway 416

It is noted that the locations of the boreholes provided in Golder Report 09-1121-0008 were not referenced to either coordinates or chainage and the locations of boreholes provided in Golder Report 971-2058 were referenced to historical transitway chainage that has since changed. The borehole locations as provided on Drawing No. 1 in Appendix A should be considered as approximate for those boreholes.

3 SITE INVESTIGATION AND FIELD TESTING

This borehole investigation and field testing program was carried out between August 17, 2014 and August 19, 2014. The program consisted of drilling and sampling 9 boreholes (numbered 14-1, 14-2A, 14-2B, 14-3, 14-4, 14-5, 14-6, 14-7 and 14-8) to depths ranging from 5.2 m to 6.7 m (elevations 58.6 m to 60.4 m).

Prior to the start of drilling, the borehole locations were staked in the field and utility clearances were obtained. The staked borehole locations were subsequently surveyed by Thurber Engineering.

A track-mounted drill rig was used to drill and sample the boreholes. Hollow stem augers were used to advance the boreholes through the overburden soil. Soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). In-situ shear vane testing was carried out using an MTO N-vane. Borehole 14-8 was advanced 2.9 m into bedrock using NQ-size coring equipment.

Results of the field drilling and sampling are presented on the Record of Borehole sheets in Appendix B.

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, secured the recovered soil samples in labelled containers, and transported the samples to Thurber's laboratory for further examination and testing.

Vibrating wire piezometers were installed in Boreholes 14-1 and 14-7 and then backfilled with bentonite for 0.6 m followed by auger cuttings to surface. All other boreholes were backfilled with auger cuttings and bentonite to surface.

4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification and to natural moisture content determination. Selected soil samples were subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg limit testing. The results of this laboratory testing program are shown on the Record of Borehole sheets in Appendix B and on the figures in Appendix C.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Reference is made to the Record of Borehole sheets in Appendix B for details of the soil stratigraphy encountered in the boreholes. An overall description of the stratigraphy is given in the following paragraphs based on the boreholes drilled as part of this assignment; however, the factual data presented in the record of boreholes governs any interpretation of the site conditions.

In general, the subsurface conditions encountered in the boreholes consisted of silty clay overlaying glacial till. Refusal on inferred sandstone bedrock was encountered below the overburden soils at two of the boreholes.

As the wall is more than 1 km in length, the following descriptions of subsurface conditions have been broken into four different sections from east to west.

5.2 Station 12+500 to 12+440

The stratigraphy for this section of the noise barrier wall as described herein is based on Thurber Borehole 14-1. Please also refer to the records for historic Boreholes 09-R and 09-S provided in Appendix D.

A 75 mm rootmat layer was encountered at the surface which was underlain by a 0.8 m thick layer of fill consisting of sand with silt and gravel with a top surface elevation of 66.1 m. The moisture content of a sample tested was 14%. A Standard Penetration Test (SPT) 'N' value of 6 was recorded indicating the fill to be in a loose state.

Beneath the fill material, a deposit of clay with a top surface elevation of 65.3 m was encountered that extended below the termination depth of 6.7 m in Borehole 14-1 at elevation 59.5 m. The SPT 'N' values ranged from weight of hammer (WH) to 7 blows per 0.3 m of penetration within this deposit. In-situ shear vane testing found undrained shear strength values ranging from 58 kPa to greater than 110 kPa indicating the clay to be in a stiff to very stiff state. The moisture content of this material ranged from 35% to 54%. Grain size distribution analysis carried out on a representative sample indicated 0% gravel, 2% sand, 49% silt and 49% clay. A plot of the grain size distribution curve is provided in Figure C1 in Appendix C.

Groundwater, where noted, was reported to range from 63.8 m to 64.0 m elevation in this section.

5.3 Station 12+440 to 12+175

The stratigraphy for this section of the noise barrier wall as described herein is based on Thurber Boreholes 14-2A, 14-2B, 14-3 and 14-4. Please also refer to the records for historic Boreholes 09-T, 09-U, 09-V, 09-W, 89-14 and 97-30 provided in Appendix D.

A 100 mm rootmat was encountered at ground surface in Boreholes 14-2A and 14-2B.

A deposit of clay was encountered immediately beneath the rootmat in Boreholes 14-2A and 14-2B and at the ground surface in Boreholes 14-3 and 14-4. The top surface elevation of this deposit ranged from 65.5 m to 65.3 m and it extended below the termination depth of the deepest borehole (6.7 m) in this section at elevation 58.6 m. The SPT 'N' values ranged from weight of hammer to 7 blows per 0.3 m of penetration. In-situ shear vane testing found undrained shear strength values ranging from 58 kPa to greater than 110 kPa indicating the clay to be in a stiff to very stiff state. The moisture content of this material ranged from 26% to 59%. Grain size distribution analyses carried out on four representative samples indicated 0% gravel, 0% to 3% sand, 43% to 48% silt and 49% to 57% clay. A plot of the grain size distribution curves is provided in Figure C1 in Appendix C. Atterberg Limit tests on three samples yielded a Liquid Limit ranging from 38% to 59% and a Plastic Limit from 18% to 19%. This information is plotted in Figure C4 in Appendix C. This material can be classified as clay of intermediate to high plasticity.

It is noted that historic Borehole 89-14 reports cone refusal at a depth of 7.2 m (elevation 59.0 m).

Groundwater, where noted, was reported to range from 61.2 m to 65.5 m elevation in this section.

5.4 Station 12+175 to 11+800

The stratigraphy for this section of the noise barrier wall as described herein is based on Thurber Boreholes 14-5, 14-6 and 14-7. Please also refer to the records for historic Boreholes 03-1, 97-31, 09-Z, 09-AA, 09-AB, 09-AC and 09-AD provided in Appendix D.

A rootmat ranging in thickness from 75 mm to 100 mm was encountered at ground surface in Boreholes 14-5, 14-6 and 14-7.

A 2.0 m to 2.1 m thick layer of clay crust material was encountered just below the rootmat in all Thurber boreholes. The top surface elevation of this deposit ranged from 65.5 m to 65.1 m. The SPT 'N' values ranged from 4 to 14 blows per 0.3 m of penetration. In-situ shear vane testing was not possible on this material due to the very stiff state. The moisture content of this deposit ranged from 28% to 50%. Grain size distribution analyses carried out on three representative samples indicated 0% gravel, 1% to 6% sand, 47% to 53% silt and 41% to 52% clay. Plots of the grain size distribution curves are provided in Figure C1 and C2 in Appendix C. Atterberg Limit testing on two samples of the clay crust material yielded Liquid Limit values of 53% and 54% with Plastic

Limits of 17% and 19%. Please see figure C4 in Appendix C. This material can be classified as a high plastic clay.

Directly beneath the clay crust layer, a deposit of clay with occasional fine sand seams was encountered in all Thurber boreholes. The top surface elevation of this deposit ranged from 63.0 m to 63.4 m and it extended below the termination depth of the deepest borehole (6.7 m) in this section at elevation 58.6 m. The SPT 'N' values ranged from weight of hammer to 7 blows per 0.3 m of penetration. In-situ shear vane testing found undrained shear strength values ranging from 40 kPa to 98 kPa indicating the clay to be in a firm to stiff state. The moisture content of this material ranged from 24% to 46%. Grain size distribution analyses carried out on two representative samples of the clay indicated 0% gravel, 5% to 9% sand, 51% to 53% silt and 40% to 42% clay. A plot of the grain size distribution curves is provided in Figure C2 in Appendix C. A grain size distribution analysis carried out on one representative sample of fine sand seam material indicated 0% gravel, 33% sand, 49% silt and 18% clay. A plot of the grain size distribution curve is provided in Figure C3 in Appendix C.

Probable bedrock was inferred in Borehole 14-7 at a depth of 6.2 m with a surface elevation of 59.0 m and in historic Borehole 03-1 at a depth of 5.6 m corresponding to elevation 60.5 m.

Groundwater, where noted, was reported to range from 59.6 m to 64.6 m elevation in this section.

5.5 Station 11+800 to 11+490

The stratigraphy for this section of the noise barrier wall as described herein is based on Thurber Borehole 14-8. Please also refer to historic Boreholes 89-16, 89-17, 03-3, 03-4, 09-AE, 09-AF, 09-AG, 09-AH, 09-AI and 09-AJ provided in Appendix D.

A 75 mm rootmat was encountered at ground surface in Borehole 14-8.

A deposit of very stiff silty clay was encountered immediately beneath the rootmat in Borehole 14-8. The top surface elevation of this deposit was 64.9 m. The SPT 'N' values ranged from 6 to 10 blows per 0.3 m of penetration. In-situ shear vane testing was not possible on this material due to the very stiff state. The moisture content of this material ranged from 24% to 27%. Atterberg Limit testing on one sample of this layer yielded a Plastic Limit of 20% and a Liquid Limit of 48%, see Figure C4 in Appendix C. This material can be classified as a silty clay of intermediate plasticity.

Directly below the silty clay a layer of silty sand with gravel (till) was encountered. The top surface elevation of this deposit was 63.3 m. An SPT 'N' value of 6 blows per 0.3 m of penetration indicated the till to be in a loose state. The moisture content of this material ranged from 9% to 14%. A Grain size distribution analysis carried out on one representative sample indicated 15% gravel, 39% sand, 34% silt and 12% clay. A plot of the grain size distribution

curve is provided in Figure C3 in Appendix C. Glacial till frequently contains cobbles and boulders.

At the base of the till deposit, sandstone bedrock was encountered in Borehole 14-8 with a surface elevation of 62.4 m. The sandstone was classified as fresh, very thinly to thinly bedded and had RQD values of 70% and 92%.

The typical stratigraphy reported in historic Boreholes 89-16, 89-17, 03-3 and 03-4 is similar to that observed in Thurber Borehole 14-8. Silty clay overlaying silty sand with gravel (till) overlaying sandstone bedrock was noted. The silty clay pinches out to the west. The layer thicknesses in this section are highly variable as the sandstone bedrock rises from an elevation of 61.8 m at the eastern edge of the section (BH 89-16) to as shallow as elevation 64.2 m (BH 03-3) at the western limit of the section. The thickness of the silty clay and till layers also varies within this section.

Groundwater, where noted, was reported to range from 62.4 m to 64.9 m elevation in this section.

5.6 Bedrock

Inferred bedrock was encountered in Borehole 14-7 and sandstone bedrock was encountered and cored in Borehole 14-8; the surface elevations were 59.0 m and 62.4 m respectively. Based on this geotechnical investigation as well as historic borehole records, the surface of the bedrock tends to rise in elevation from the east to west within the study area of the proposed noise barrier.

5.7 Groundwater Conditions

Groundwater observations were made at the time of drilling in all boreholes and, if present, the observed ground water depths are noted on the Record of Borehole sheets in Appendix B. Vibrating wire piezometers were installed in Boreholes 14-1 and 14-7. Readings taken on September 10, 2014 indicated the piezometric level to be at elevation 64.0 m in Borehole 14-1 and at elevation 64.2 m in Borehole 14-7.

Where surface water is present, the groundwater level should be assumed to coincide with the local surface water level. Local high water levels and the effects of heavy rainfalls must also be taken into consideration.

13 CLOSURE

Preparation of this foundation design report was carried out by Mr. Christopher Murray, E.I.T.. The report was reviewed by Dr. Fred Griffiths and Dr. P.K. Chatterji, P.Eng.

Thurber Engineering Ltd.

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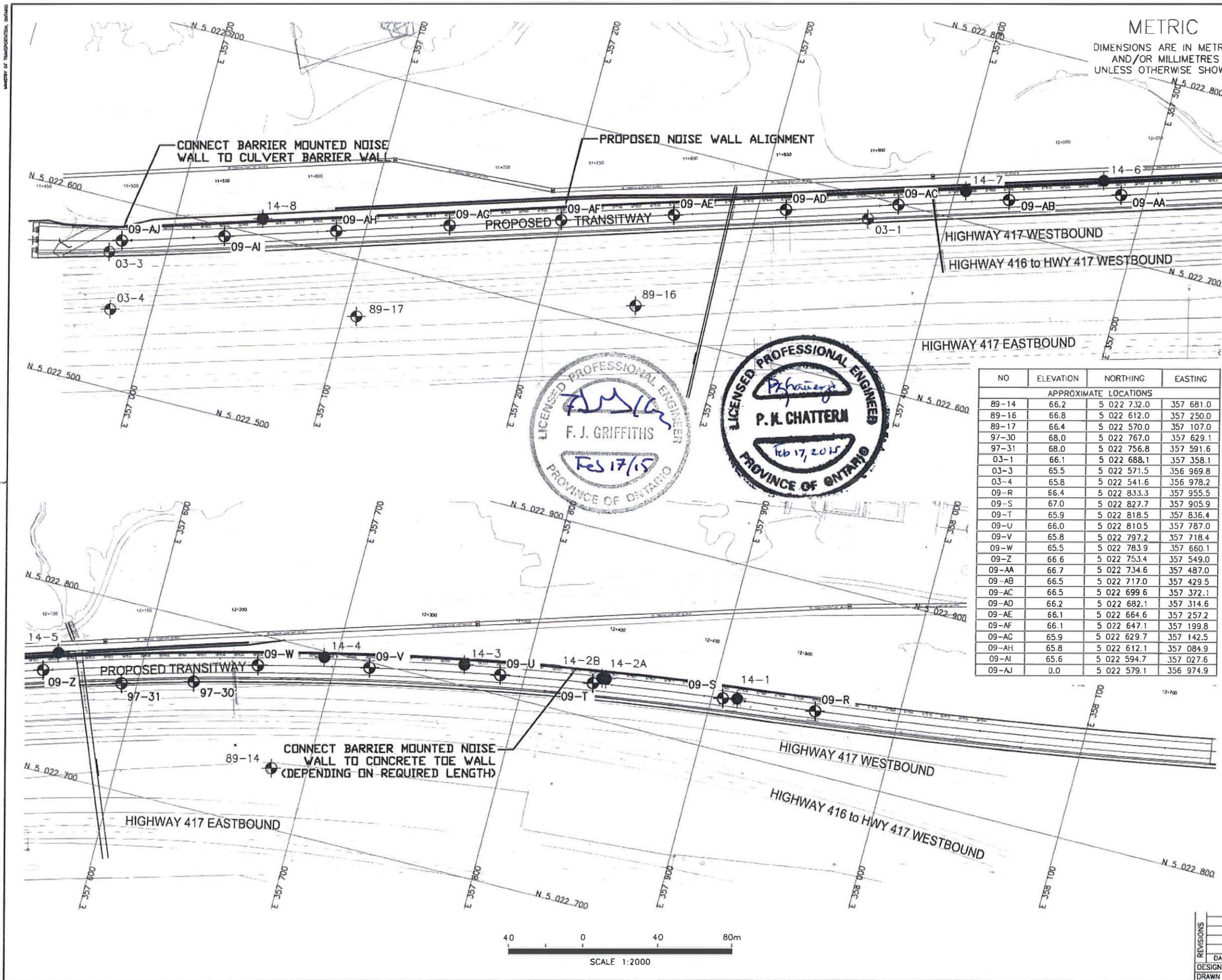
P. K. Chatterji, Ph.D., P.Eng.
Review Principal, Designated MTO Contact



Appendix A

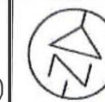
Borehole Location Drawing

19-5161-177



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

CONT No
GWP No 4097-12-00

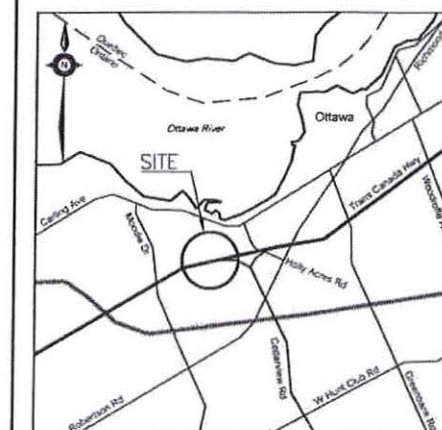


HIGHWAY 417
PROPOSED
NOISE BARRIER WALL
BOREHOLE LOCATIONS

SHEET








THURBER ENGINEERING LTD



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

NO	ELEVATION	NORTHING	EASTING
14-1	66.2	5 022 829.4	357 913.5
14-2A	65.6	5 022 822.3	357 842.6
14-2B	65.6	5 022 822.3	357 840.6
14-3	65.5	5 022 811.1	357 766.9
14-4	65.3	5 022 796.8	357 693.5
14-5	65.3	5 022 764.4	357 554.5
14-6	65.6	5 022 739.7	357 476.0
14-7	65.2	5 022 715.8	357 405.7
14-8	65.0	5 022 608.9	357 045.1

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31G5-264

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	CM	CHK	PC	CODE	LOAD	DATE FEB 2015			
DRAWN	MEA	CHK	CM	SITE	ISTRUCT	IFWIG	1		

Appendix B

Record of Borehole Sheets

19-5161-177

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level


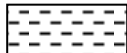



C_{pen} Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.				
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No 14-1

1 OF 1

METRIC

GWP# 4097-12-00 LOCATION 417 Noise Barrier Wall N 5 022 829.4 E 357 913.5 ORIGINATED BY CAM
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM
 DATUM Geodetic DATE 2014.08.17 - 2014.08.17 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								20 40 60 80 100	w _P w w _L							
66.2																
0.0																
0.1	Rootmat (75 mm)		1	SS	6		66									
	Sand with Silt and Gravel Loose Brown Moist (FILL)															
65.3																
0.9	Clay (CH) Very Stiff to Stiff Grey		2	SS	7		65									
			3	SS	5											
			4	SS	2		64									
							63									
			5	SS	WH		62									
			6	GS			61									
			7	SS	WH											
			8	SS	WH		60									
59.5																
6.7	End of Borehole at 6.7 m VWP Installed at 5.3 m Piezometric level on Sept. 10, 2014 = 64.0 m															

ONTMT4S 19-5161-177 - WEST BARRIER GPJ 2012TEMPLATE(MTO).GDT 11/2/15

RECORD OF BOREHOLE No 14-2A

1 OF 1



METRIC

GWP# 4097-12-00 LOCATION 417 Noise Barrier Wall N 5 022 822.3 E 357 842.6 ORIGINATED BY CAM
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM
 DATUM Geodetic DATE 2014.08.17 - 2014.08.17 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL × LAB VANE								
65.6							20	40	60	80	100					
0.0							20	40	60	80	100					
0.1	Rootmat (100 mm)		1	SS	7											
	Clay (CH), some gravel near surface Very Stiff to Stiff Grey															
			2	SS	2											
			3	GS												
			4	SS	2											
			5	GS												
	- Probable Boulder at 3.4 m															
			6	SS	2											
60.4																
5.2	Unable to proceed as boulder pushed HSA too far out of line End of Borehole at 5.2 m															

ONTMT4S 19-5161-177 - WEST BARRIER.GPJ 2012TEMPLATE(MTO).GDT 11/2/15

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)				
65.6							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						

[illegible]

ONTMT4S 19-5161-177 - WEST BARRIER.GPJ 2012TEMPLATE(MTO).GDT 11/2/15

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 14-3

1 OF 1

METRIC

GWP# 4097-12-00 LOCATION 417 Noise Barrier Wall N 5 022 811.1 E 357 766.9 ORIGINATED BY CAM
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM
 DATUM Geodetic DATE 2014.08.18 - 2014.08.18 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE				w _p w w _L				
								● QUICK TRIAXIAL × LAB VANE								
65.5							20	40	60	80	100	20	40	60		
0.0	Clay (CH) , some gravel near surface Very Stiff to Stiff Grey <															

ONTMT4S 19-5161-177 - WEST BARRIER.GPJ 2012TEMPLATE(MTO).GDT 11/2/15

RECORD OF BOREHOLE No 14-4

1 OF 1

METRIC

GWP# 4097-12-00 LOCATION 417 Noise Barrier Wall N 5 022 796.8 E 357 693.5 ORIGINATED BY CAM
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM
 DATUM Geodetic DATE 2014.08.18 - 2014.08.18 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
65.3							20 40 60 80 100					W _p W W _L				
0.0	Clay (CH), some gravel near surface Very Stiff to Stiff Brown to Grey		1	SS	5											
			2	SS	4											
			3	SS	2											
			4	SS	WH											
			5	SS	2											
			</													



ONTMT4S 19-5161-177 - WEST BARRIER.GPJ 2012TEMPLATE(MTO).GDT 11/2/15

RECORD OF BOREHOLE No 14-5

1 OF 1

METRIC

GWP# 4097-12-00 LOCATION 417 Noise Barrier Wall N 5 022 764.4 E 357 554.5 ORIGINATED BY CAM
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM
 DATUM Geodetic DATE 2014.08.18 - 2014.08.18 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
65.3								20	40	60	80	100								
0.0	Rootmat (100 mm)																			
0.1			Clay (CH) Very Stiff Brown	1	SS	7		65												
	2	SS		6		64														
			3	SS	4															
63.2																				
2.1	Clay (CH) Stiff Grey		4	SS	4		63													
			5	SS	3		62													

ONTMT4S 19-5161-177 - WEST BARRIER GPJ 2012TEMPLATE(MTO).GDT 11/2/15

RECORD OF BOREHOLE No 14-6

1 OF 1

METRIC

GWP# 4097-12-00 LOCATION 417 Noise Barrier Wall N 5 022 739.7 E 357 476.0 ORIGINATED BY CAM
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM
 DATUM Geodetic DATE 2014.08.19 - 2014.08.19 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
<div><div><div>20406080100</div><div>UNCONFINED</div></div><div><div>20406080100</div><div>QUICK TRIAXIAL</div></div><div><div>6080</div><div>FIELD VANE</div></div><div><div>6080</div><div>LAB VANE</div></div></div> <div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div> <div><div>W_P</div><div>W</div><div>W_L</div></div> <div>WATER CONTENT (%)</div>														
65.6														
0.0														
0.1	Rootmat (100 mm)													
	Clay (CH) Very Stiff Brown		1	SS	9		65							
			2	SS	13									
			3	SS	7		64						0 6 53 41	
63.4														
2.2	Clay (CH) Stiff Grey - fine sand seams around 2.3 m		4	SS	2		63							
			5	SS	3		62							
								9.3						
									9.0					
							61						0 5 53 42	
			6	SS	WH									
	- fine sand seams around 5.3 m													
			7	SS	3		60							
								7.3						
59.2														
6.4	End of borehole at 6.4 m Water surface at 6 m after drilling													

ONTMT4S 19-5161-177 - WEST BARRIER GPJ 2012TEMPLATE(MTO).GDT 11/2/15

RECORD OF BOREHOLE No 14-7

1 OF 1

METRIC

GWP# 4097-12-00 LOCATION 417 Noise Barrier Wall N 5 022 715.8 E 357 405.7 ORIGINATED BY CAM
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM
 DATUM Geodetic DATE 2014.08.19 - 2014.08.19 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
65.2								20	40	60	80	100		
0.0								20	40	60	80	100		
0.1	Rootmat (75 mm)													
	Clay (CH) Very Stiff Brown		1	SS	10		65							
			2	SS	14		64							
			3	SS	7									
63.0							63							
2.2	Clay (CH) Stiff Grey		4	SS	7									
							62	6.0						
								7.3						
	- fine sand seams around 3.8 m		5	SS	4		61							
								14.0						
							60	11.0						
			6	SS	2									
59.0			7	SS	100/									
6.2	End of borehole at 6.2 m Refusal on Probable Bedrock Water surface at 5.3 m after drilling VWP installed at 5.3 m Piezometric level on Sept. 10, 2014 = 64.2 m				75mm									

ONTMT4S 19-5161-177 - WEST BARRIER GPJ 2012TEMPLATE(MTO).GDT 11/2/15

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 14-8

1 OF 1

METRIC

GWP# 4097-12-00 LOCATION 417 Noise Barrier Wall N 5 022 608.9 E 357 045.1 ORIGINATED BY CAM
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM
 DATUM Geodetic DATE 2014.08.19 - 2014.08.19 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL
65.0								20	40	60	80	100								
0.0																				
0.1	Rootmat (75 mm)																			
	Silty Clay (Cl) Very Stiff Brown		1	SS	10															
			2	SS	6		64													
63.3																				
1.7	Silty Sand with Gravel Loose Grey (TILL)		3	SS	6		63													
			4	SS	100/ 200mm															
62.4																				
2.6	Sandstone Bedrock Fresh Very thinly to thinly bedded Grey		1	RUN			62											15 39 34 12		
			2	RUN			61													
							60													

ONTMT4S 19-5161-177 - WEST BARRIER.GPJ 2012TEMPLATE(MTO).GDT 11/2/15

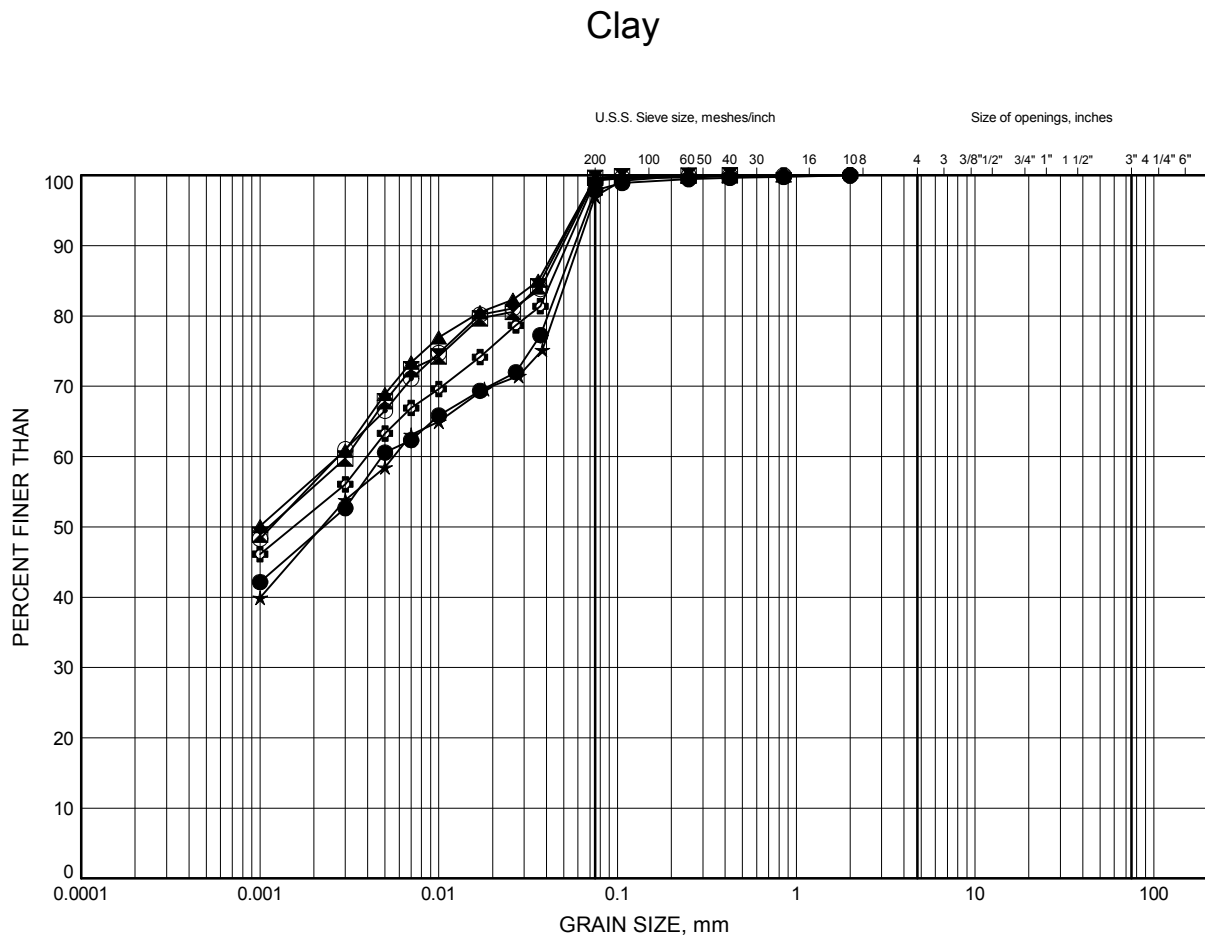
Appendix C

Laboratory Test Results

19-5161-177

417 Noise Barrier Wall GRAIN SIZE DISTRIBUTION

FIGURE C1



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-1	4.11	62.09
⊠	14-2A	1.07	64.53
▲	14-3	1.07	64.43
★	14-3	5.64	59.86
⊙	14-4	1.83	63.47
⊕	14-5	1.83	63.47

Date February 2015

GWP# 4097-12-00

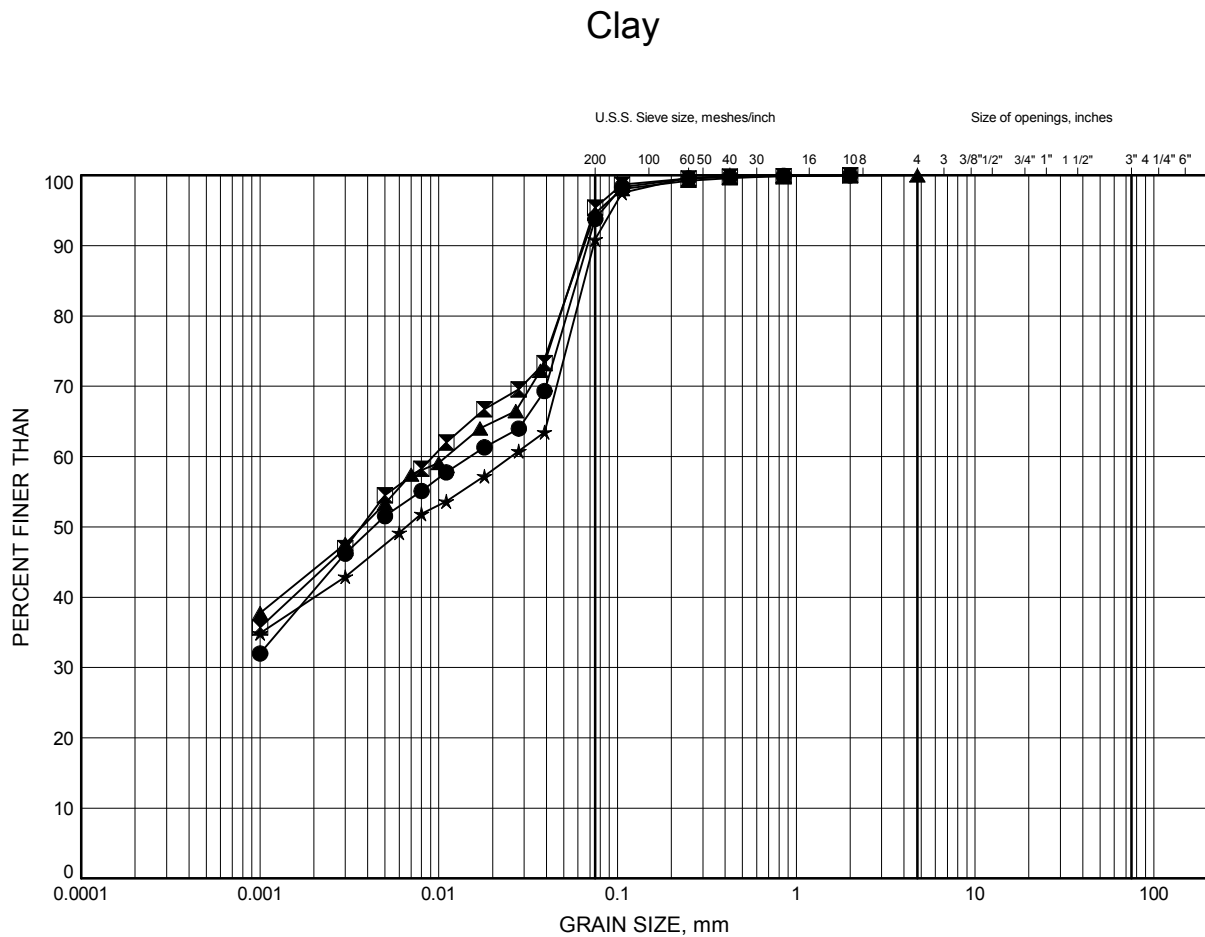


Prep'd CM

Chkd. FJG

417 Noise Barrier Wall GRAIN SIZE DISTRIBUTION

FIGURE C2



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-6	1.83	63.77
⊠	14-6	4.88	60.72
▲	14-7	1.07	64.13
★	14-7	2.59	62.61

Date February 2015

GWP# 4097-12-00



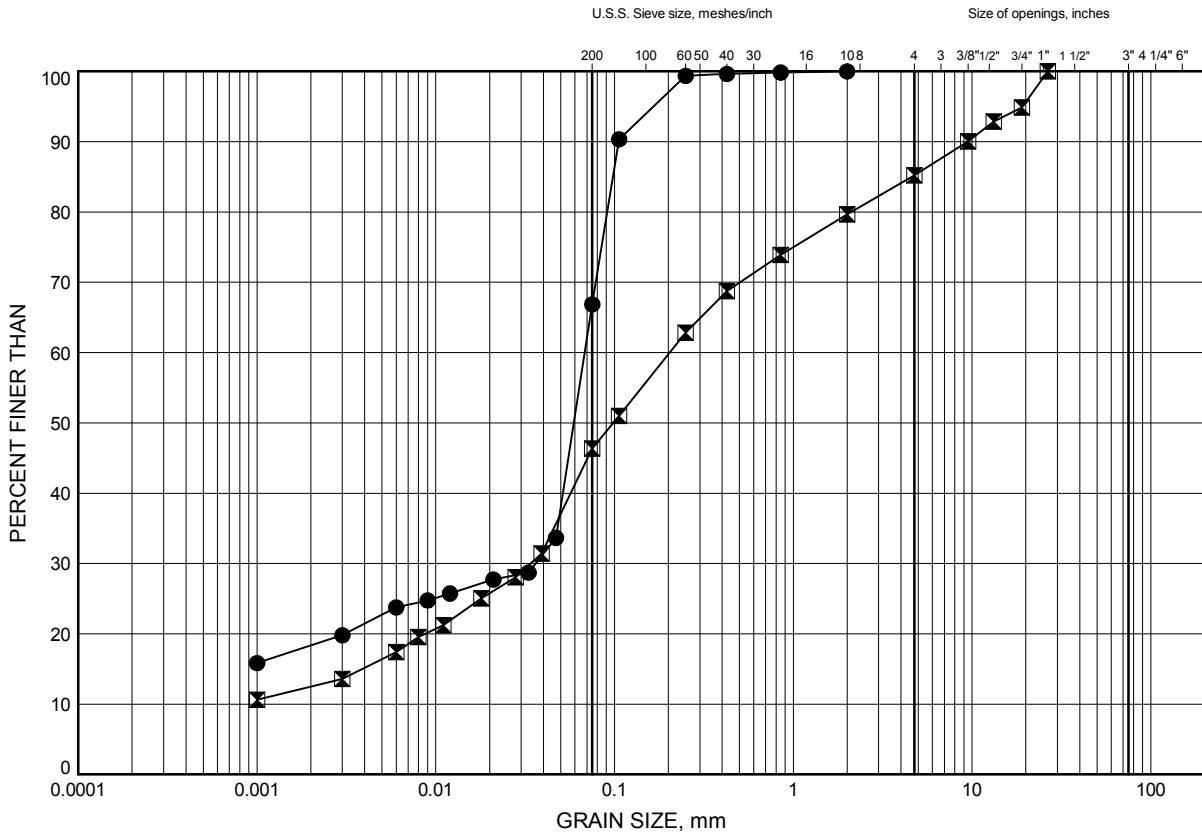
Prep'd CM

Chkd. FJG

417 Noise Barrier Wall GRAIN SIZE DISTRIBUTION

FIGURE C3

Silty Sand to Silty Sand with Gravel



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-5	5.64	59.66
⊠	14-8	2.59	62.41

Date February 2015
GWP# 4097-12-00



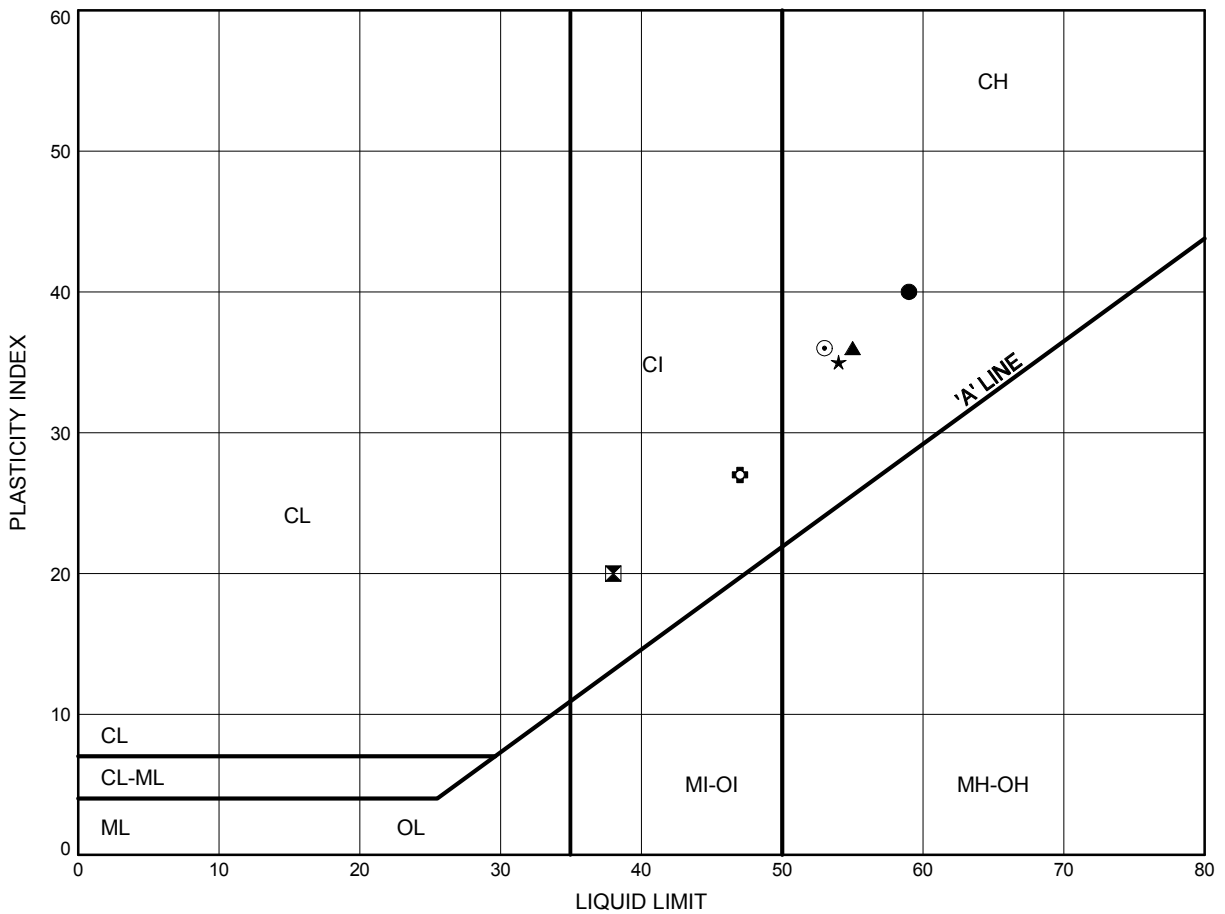
Prep'd CM
Chkd. FJG

417 Noise Barrier Wall

ATTERBERG LIMITS TEST RESULTS

FIGURE C4

Silty Clay to Clay



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-2A	1.07	64.53
⊠	14-3	5.64	59.86
▲	14-4	1.83	63.47
★	14-5	1.83	63.47
⊙	14-7	1.07	64.13
⊕	14-8	0.34	64.66

Date February 2015
GWP# 4097-12-00



Prep'd CM
Chkd. FJG

Appendix D

Historic Borehole Records

19-5161-177



RECORD OF BOREHOLE No 89-14

METRIC

W P 120-87-00 LOCATION Co-ords N 5,022,507.0; E 357,656.0 (HML C-22) ORIGINATED BY R.H.
DIST 9 HWY 417 @ 416 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY R.H.
DATUM Geodetic DATE July 15, 1989 CHECKED BY G.J.K.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			VALUES	SHEAR STRENGTH kPa					
66.2	Ground Surface												GR SA SI CL
0.0	Inferred Silty clay.												
60.3													
5.9	Inferred Sand												
59.0													
7.2	End of Dynamic Cone Penetration Test (Cone Refusal on inferred Bedrock)							100/0 cm					

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 89-16

METRIC

W P 120-87-00 LOCATION Co-Ords. N 5,022,387.0; E 357,225.0 (HML C-25) ORIGINATED BY K.C.
 DIST 9 HWY 417 @ 416 BOREHOLE TYPE Hollow Stem Auger, BX Rock Core COMPILED BY R.H.
 DATUM Geodetic DATE July 11, 1989 CHECKED BY G.J.K.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	W _p W W _L	20 40 60	20 40 60		
66.8	Ground Surface												
0.0	Fill, Clay, trace debris. Brown Firm		1	SS	17								
65.7													
1.1	Silty Clay, interbedded with sandy silt. Grey Stiff		2	SS	10								0 2 (98)
63.4			3	SS	13								8 48 (44)
3.4	Clayey Sand, some gravel; Till. Grey Compact		4	SS	20								
61.8													
5.0	Bedrock Sandstone Light grey Fair to excellent		5	RC BX	REC 97%								RQD=64%
			6	RC BX	REC 100%								RQD=100%
			7	RC BX	REC 100%								RQD=100% *(153)
59.0													
7.8	End of Borehole *q _u (MPa) obtained from point load test.												

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 89-17

METRIC

W P 120-87-00 LOCATION Co-Ords. N 5,022,345.0; E 357,082.0 (HML C-26) ORIGINATED BY R.H.
DIST 9 HWY 417 G 416 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY R.H.
DATUM Geodetic DATE July 15, 1989 CHECKED BY G.J.K.

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 x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
66.4	Ground Surface										
0.0	Inferred Silty Clay.						66				
63.1							65				
3.3	Inferred Till						64				
62.6							63				
3.8	End of Dynamic Cone Penetration Test (Refusal on inferred Bedrock)										

OFFICE REPORT ON SOIL EXPLORATION

PROJECT: 971-2058

RECORD OF BOREHOLE 97-30

SHEET 1 OF 1

LOCATION: STA. 15+345, 13.9m LL

BORING DATE: Aug. 1, 1997

DATUM: Geodetic

SAMPLER HAMMER, 63.6kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.6kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, K, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT, PERCENT					
								Cu, kPa	nat.V - rem.V -	+ ⊕	○ - ● U - ○	Wp	W	Wi			
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		67.96 0.00													
1		Grey brown silty clay with cobbles (FILL)			1	50 DO	9						○				
2					2	50 DO	24						○				
3		Very stiff grey brown SILTY CLAY, occasional rootlets (Weathered Crust)		65.67 2.29	3	50 DO	12						○				
4		Stiff grey brown SILTY CLAY (Weathered Crust)			64.81 3.05	4	50 DO	5						○			
5																	
6		Stiff grey SILTY CLAY			63.39 4.57	5	50 DO	WH	⊕		+				○		
7																	
8		End of Hole			62.17 5.79				⊕		+						
9																	
10																	

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: D.J.S

CHECKED:

DATA INPUT: 0:9730-058.dj/s.L

PROJECT: 971-2058

RECORD OF BOREHOLE 97-31

SHEET 1 OF 1

LOCATION: STA. 15+310, 13.2m Lt.

BORING DATE: Aug. 1, 1997

DATUM: Geodetic

SAMPLER HAMMER, 63.6kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.6kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT, PERCENT					
								Cu, kPa	nat. V - + rem. V - ⊕	U - ● U - ○	Wp	W	W				
								20	40	60	80						
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		87.85 0.00													
1		Grey brown silty clay with cobbles (FILL)			1	SO DO	12						○	—			
				86.43 1.52													
2		Grey brown silty clay, sand, gravel (FILL)			2	SO DO	7						○				
				85.36 2.59													
3		Stiff to very stiff grey brown SILTY CLAY (Weathered Crust)			3	SO DO	10						○				
					4	SO DO	4						○				
4					63.38 4.57				⊕		+						
					63.07 4.88				⊕		+						
5		Stiff grey SILTY CLAY			5	SO DO	1						○				
	Stiff grey SILTY CLAY with sand layers																
				62.16 5.79				⊕		+							
6		End of Hole															
7																	
8																	
9																	
10																	

DATA INPUT: C:\9731-056.d\78.L

DATA INPUT: 0:9731-058.d79/L

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: D.J.S

CHECKED:

PROJECT		021-1155-11		RECORD OF BOREHOLE No 03-1		1 OF 1 METRIC								
W.P.		458-98-00		LOCATION		N 5022688.1 ;E 357358.1								
DIST		HWY 417		BOREHOLE TYPE		CME 55 Bombardier								
DATUM		Geodetic		DATE		Dec. 9-10, 2003								
				ORIGINATED BY		P.A.H.								
				COMPILED BY		T.M.S.								
				CHECKED BY		L.C.C.								
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	γ	GR SA SI CL	
66.1	Ground Surface													
0.0	Sand, trace gravel (FILL)						66							
65.9	Brown													
0.3	Silty sand and clayey silt, some gravel, containing organics (FILL) Loose/Stiff Grey Moist		1	SS	9		65							
64.6														
1.5	Clayey Silt, containing organics Very stiff Grey-brown to dark brown Moist		2	SS	17		64							
64.0														
2.1	Silty Clay Very stiff to stiff Grey-brown Moist to wet		3	SS	21		63							
61.5														
4.6	Silty Sand Loose Grey Wet		4	SS	7		62							
61.2														
4.9	Silty Clay Soft to firm Grey Wet		5	SS	3		61							
60.8														
5.3	Sand and Silt, some gravel, trace clay (TILL) Grey		6	SS	1									
60.5														
5.6	End of Borehole Auger Refusal on Probable Bedrock													
Note: Water level in open borehole at 1.5 m depth (Elev. 64.6 m) on completion of drilling.														

+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

PROJECT <u>021-1155-11</u>		RECORD OF BOREHOLE No 03-3		1 OF 1 METRIC	
W.P. <u>458-98-00</u>		LOCATION <u>N 5022571.5 ;E 356969.8</u>		ORIGINATED BY <u>P.A.H.</u>	
DIST <u>HWY 417</u>		BOREHOLE TYPE <u>CME 55 Bombardier</u>		COMPILED BY <u>T.M.S.</u>	
DATUM <u>Geodetic</u>		DATE <u>Dec. 10, 2003</u>		CHECKED BY <u>L.C.C.</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) W _p W W _L				
65.5	Ground Surface																
0.0	Silty sand, some gravel (FILL)		1	AS	-												
65.2	Brown Moist																
0.3	Sand and Silt, some gravel, containing cobbles and organics (FILL) Compact Dark grey Moist																
64.2			2	SS	21												
1.3	End of Borehole Auger Refusal on Probable Bedrock Note: Borehole dry on completion of drilling.																

PROJECT <u>021-1155-11</u>		RECORD OF BOREHOLE No 03-4		1 OF 1 METRIC	
W.P. <u>458-98-00</u>		LOCATION <u>N 5022541.6 ; E 356978.2</u>		ORIGINATED BY <u>P.A.H.</u>	
DIST <u>HWY 417</u>		BOREHOLE TYPE <u>CME 55 Bombardier</u>		COMPILED BY <u>T.M.S.</u>	
DATUM <u>Geodetic</u>		DATE <u>Dec. 10, 2003</u>		CHECKED BY <u>L.C.C.</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
65.8	Ground Surface																
0.0 65.6	Topsoil																
0.2	Clayey Silt, some sand Grey-brown Moist		1	AS	-												
65.1																	
0.7	Sand and Silt, some gravel, trace clay (TILL) Compact Grey-brown Wet		2	SS	13												
64.6																	
1.3	Sandstone (BEDROCK) Slightly weathered to fresh Medium strong Very thinly to thickly bedded Grey Bedrock cored between 1.3 m and 4.4 m depth. For bedrock coring details refer to Record of Drillhole 03-4.																
61.4																	
4.4	End of Borehole Note: Water level in open borehole at 0.9 m depth (Elev. 64.9 m) during overburden drilling.																

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-S

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Dec. 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION									
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH				WATER CONTENT PERCENT													
								20		40		60		80			10 ⁻⁶		10 ⁻⁵		10 ⁻⁴		10 ⁻³		
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - ● U - ○		Wp			W		WI						
								20	40	60	80	20	40	60	80										
0		GROUND SURFACE		67.02																					
		Topsoil (FILL)		0.00																					
		Brown silty sand, some gravel, trace clay, with cobbles (FILL)		0.13																					
1	Power Auger 200mm Diam. (Hollow Stem)																								
2		Very stiff grey brown SILTY CLAY (Weathered Crust)		65.50 1.52	1	50 DO	4																		
3		Stiff grey SILTY CLAY		64.12 2.90	2	50 DO	1																		
4																									
5		End of Borehole		62.45 4.57																					
6																									
7																									
8																									
9																									
10																									

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008 GPJ GAL-MIS.GDT 06/28/13 JUL/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-T

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Dec. 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH		nat V. + Q - ● rem V. ⊕ U - ○		WATER CONTENT PERCENT					
								Cu, kPa	20	40	60	80	Wp	W			WI
0	Power Auger 200mm Diam. (Hollow Stem)	GROUND SURFACE		65.91													
		Topsoil (FILL)		65.73													
		Grey brown sandy silt, some clay, trace gravel, with cobbles (FILL)		0.18													
		Very stiff grey brown SILTY CLAY (Weathered Crust)		65.30													
				0.61													
1																	
					1	50 DO	2										
2																	
3		Stiff grey SILTY CLAY		63.01													
				2.90													
					2	50 DO	3										
4																	
5		End of Borehole		61.34													
				4.57													
6																	
7																	
8																	
9																	
10																	

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JJJ/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-U

SHEET 1 OF 1




LOCATION: See Site Plan

BORING DATE: Dec. 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	RESISTANCE, BLOWS/0.3m				WATER CONTENT PERCENT							
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - U - ⊙		Wp ———— W ———— WI					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³	20	40
0		GROUND SURFACE		65.98															
	Power Auger 200mm Diam. (Hollow Stem)	Topsoil (FILL)		0.00															
		Grey brown silty clay, trace sand, with cobbles (FILL)		0.13															
				65.29															
		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		0.69															
1																			
2				1	50 DO	1													
3		Stiff grey SILTY CLAY		62.93															
				3.05															
4					2	50 DO	2												

Open borehole dry upon completion of drilling

DEPTH SCALE

1:50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JJJ/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-V

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Dec. 21, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE				DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION										
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH				WATER CONTENT PERCENT													
								20		40		60				80		10 ⁻⁶		10 ⁻⁵		10 ⁻⁴		10 ⁻³	
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - ● U - ○				Wp		W		WI					
0		GROUND SURFACE		65.77																					
		Topsoil (FILL)		0.00																					
		Dark grey brown sandy silt, some clay, trace gravel (FILL)		0.13																					
				65.26																					
		Stiff grey brown SILTY CLAY (Weathered Crust)		0.51																					
1																									
	Power Auger 200mm Diam. (Hollow Stem)				1	50 DO	2							○											
2		Stiff grey SILTY CLAY, with silty fine sand seams		63.79																					
				1.98																					
3																									
					2	50 DO	1							○											
4																									
					3	50 DO	3							○											
		End of Borehole		61.20																					
				4.57																					
5																									
6																									
7																									
8																									
9																									
10																									

Open borehole dry
upon completion of
drilling

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JUL/PLG

[illegible]

DEPTH SCALE

1 : 50

LOGGED: R.I.

CHECKED: T.M.S.

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-Z

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 4, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION									
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH				WATER CONTENT PERCENT													
								20		40		60		80			10 ⁻⁶		10 ⁻⁵		10 ⁻⁴		10 ⁻³		
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - ● U - ○		Wp			W		WI						
								20	40	60	80	20	40	60	80										
0		GROUND SURFACE		66.63																					
	Power Auger 200mm Diam. (Hollow Stem)	Topsoil (FILL)		66.45																					
		Brown silty clay, some sand, trace gravel (FILL)		0.18																					
1		Very stiff to stiff grey brown SILTY CLAY, with silty fine sand seams (Weathered Crust)		65.66																					
				0.97																					
					1	50 DO	6																		
2																									
3					2	50 DO	WH																		
4								⊕		+															
								⊕			+														
								⊕			+														
								⊕			+														
		End of Borehole		62.06																					
				4.57																					
5																									
6																									
7																									
8																									
9																									
10																									

W.L. in open hole at 2.59m depth below ground surface upon completion of drilling

▽

W.L. in open hole
at 2.59m depth
below ground
surface upon
completion of
drilling

DEPTH SCALE

1: 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JUL/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AA

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Dec. 22, 2009

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m										
								SHEAR STRENGTH		nat V. + Q - ● rem V. ⊕ U - ○		WATER CONTENT PERCENT					
								Cu, kPa				Wp					WI
								20	40	60	80	20	40	60	80		
0		GROUND SURFACE		66.72													
		Topsoil (FILL)		66.54													
		Grey brown sandy silt, some clay, trace gravel, with cobbles and boulders (FILL)		0.18													
1				65.70													
		Very stiff to stiff grey brown SILTY CLAY, with silty fine sand seams (Weathered Crust)		1.02													
2	Power Auger 200mm Diam. (Hollow Stem)				1	50 DO	9										
3					2	50 DO	2										
4																	
5																	
		End of Borehole		62.15													
				4.57													
6																	
7																	
8																	
9																	
10																	

W.L. in open hole
at 2.74m depth
below ground
surface upon
completion of
drilling

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JJJ/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AB

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 4, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION									
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH				WATER CONTENT PERCENT													
								20		40		60		80			10 ⁻⁶		10 ⁻⁵		10 ⁻⁴		10 ⁻³		
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - ● U - ○		Wp			W		WI						
								20	40	60	80	20	40	60	80										
0		GROUND SURFACE		66.48																					
		Topsoil (FILL)		0.00																					
		Brown silty clay, some sand, trace gravel and organic matter (FILL)		66.30																					
				0.18																					
1		Very stiff to stiff grey brown SILTY CLAY, with silty fine sand seams (Weathered Crust)		65.67																					
				0.81																					
	Power Auger 200mm Diam. (Hollow Stem)				1	50 DO	9																		
2																									
3					2	50 DO	3																		
4								⊕																	
								⊕		+															
								⊕			+														
5		End of Borehole		61.91																					
				4.57																					
6																									
7																									
8																									
9																									
10																									

W.L. in open hole
at 3.35m depth
below ground
surface upon
completion of
drilling

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JJJ/PLG

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AC

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 5, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	RESISTANCE				CONDUCTIVITY					
								SHEAR STRENGTH		nat V. + Q - ● rem V. ⊕ U - ○		WATER CONTENT PERCENT					
								Cu, kPa				Wp	W	WI			
								20	40	60	80	20	40	60	80		
0	Power Auger 200mm Diam. (Hollow Stem)	GROUND SURFACE		66.50													
		Topsoil (FILL)		0.00 66.30													
		Grey brown sandy silt, some gravel, trace clay and organic matter (FILL)		0.20													
1				65.53 0.97													
		Dark grey silty clay, some sand, trace gravel and organic matter (FILL)															
2				64.75 1.75	1	50 DO	13										
		Very stiff grey brown SILTY CLAY (Weathered Crust)															
3				63.60 2.90													
		Grey brown layered SILTY CLAY, CLAYEY SILT, and SILTY fine SAND				2	50 DO	5									
4				61.93 4.57													
		Grey layered SILTY CLAY, CLAYEY SILT, and SILTY fine SAND			3	50 DO	5										
5			61.93 4.73														
		End of Borehole			4	50 DO	4										
6																	
7																	
8																	
9																	
10																	

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008 GPJ GAL-MIS.GDT 06/28/13 JUL/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AD

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 5, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION				
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH				WATER CONTENT PERCENT								
								20	40	60	80	nat V. rem V. ⊕	+ ⊕	Q - ● U - ○			10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³			
																	Cu, kPa	nat V. rem V. ⊕	+ ⊕	Q - ● U - ○
								20	40	60	80	20	40	60	80					
0	Power Auger 200mm Diam. (Hollow Stem)	GROUND SURFACE		66.17																
		Topsoil (FILL)		0.00																
		Brown sandy silt, some clay (FILL)		0.15																
				65.71																
		TOPSOIL		0.51																
		Very stiff grey brown SILTY CLAY, with silty fine sand seams (Weathered Crust)																		
1																				
2						1	50 DO	8												
3																				
			Stiff grey brown CLAYEY SILT, with silty fine sand seams		62.97 3.20	2	50 DO	3												
4								⊕		+										
								⊕			+									
											+									
											+									
		End of Borehole		61.60 4.57																
5														Open borehole dry upon completion of drilling						
6																				
7																				
8																				
9																				
10																				

Open borehole dry
upon completion of
drilling

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JUL/PLC

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AE

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 6, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	20 40 60 80				10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³					
								SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa				nat V. + Q - ● rem V. ⊕ U - ○					
0		GROUND SURFACE		66.07													
	Power Auger 200mm Diam. (Hollow Stem)	Topsoil (FILL)		0.00													
		Brown silty clay, some sand, trace gravel and organic matter (FILL)		0.10													
				65.38													
		Very stiff to stiff grey brown SILTY CLAY, with silty fine sand seams (Weathered Crust)		0.69													
1																	
2					1	50 DO	11										
3																	
4			Grey brown layered SILTY CLAY, CLAYEY SILT, and SILTY fine SAND		62.56 3.51	2	50 DO	3									
5			Compact brown to grey SANDY SILT and SILTY SAND, some gravel, trace clay (GLACIAL TILL)		61.65 4.42 61.37 4.70	3 4	50 DO	5 15									
6			End of Borehole Sampler Refusal														
7																	
8																	
9																	
10																	

W.L. in open hole
at 2.59m depth
below ground
surface upon
completion of
drilling

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JUL/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AF

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 6, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	20 40 60 80				10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³					
								SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT Wp — W — Wl					
		GROUND SURFACE		66.05				20	40	60	80						
0	Power Auger 200mm Diam. (Hollow Stem)	Topsoil (FILL)		0.00													
		Brown silty clay, some sand, trace gravel (FILL)		0.15													
		CONCRETE		0.41													
		Brown sandy silt, some clay, trace gravel (FILL)		0.51													
		Grey silty clay and clayey silt, trace to some sand and organic matter (FILL)		0.74													
1																	
		Very stiff to stiff grey SILTY CLAY, trace gravel, with sand seams and black organic mottling (Weathered Crust)		64.47 1.58	1	50 DO	8										
2																	
3																	
		Loose to dense brown SILTY SAND, some gravel, trace clay (GLACIAL TILL)		62.80 3.25	2	50 DO	2										
4		End of Borehole Auger Refusal		62.14 3.91	3	50 DO	>50										
5																	
6																	
7																	
8																	
9																	
10																	

W.L. in open hole
at 3.66m depth
below ground
surface upon
completion of
drilling

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JJJ/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AG

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: Jan. 6-8, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m				WATER CONTENT PERCENT					
							20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³
						SHEAR STRENGTH Cu, kPa				Wp — W — Wi						
						nat V. + Q - ● rem V. ⊕ U - ○										
						20 40 60 80				20 40 60 80						
0	Power Auger 200mm Diam. (Hollow Stem)	GROUND SURFACE		65.88												
		Topsoil (FILL)		0.00												
		Brown silty clay, some sand, trace to some gravel, with cobbles (FILL)		0.10												
				65.14												
		Grey brown silty clay, some sand, trace gravel (FILL)		0.74												
1				64.20												
		TOPSOIL		1.68	1	50 DO										
				63.90												
		Grey CLAYEY SILT to SILTY CLAY, some sand and roots		1.98												
				62.96												
2	Rotary Drill NQ Core			2.92	2	50 DO										
		Fresh light grey SANDSTONE BEDROCK, with shaley partings														
3																
4																
5																
6		End of Borehole		59.96												
				5.92												
7																
8																
9																
10																

Native Backfill

Bentonite Seal

Native Backfill

Silica Sand

Standpipe

Bentonite Seal

W.L. in standpipe
at Elev. 63.64m on
May 12, 2010

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JJJ/PLG

PROJECT: 09-1121-0008-3000

RECORD OF DRILLHOLE: 09-AG

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: Jan. 6-8, 2010

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY K, cm/sec	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	Diameter Point Load Index (MPa)	RMC -Q AVG.
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	DIP w.r.t. CORE AXIS								
							FLUSH	FLUSH			FLUSH	FLUSH	FLUSH								
		BEDROCK SURFACE		62.96																	
3		Fresh light grey SANDSTONE BEDROCK, with shaley partings		2.92																	
4	Rotary Drill NQ Core				1																
5					2																
6		End of Borehole		59.96																	
7				5.92																	
8																					
9																					
10																					
11																					
12																					

Standpipe

Bentonite Seal

W.L. in standpipe
at Elev. 63.64m on
May 12, 2010

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-RCK 004 0911210008.GPJ GAL-MISS.GDT 06/28/13 JUL/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AH

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 6, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION								
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	SHEAR STRENGTH				WATER CONTENT PERCENT													
								20		40		60		80				10 ⁻⁶		10 ⁻⁵		10 ⁻⁴		10 ⁻³	
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - ● U - ○		Wp				W		WI					
								20	40	60	80	20	40	60	80										
0	Power Auger 200mm Diam. (Hollow Stem)	GROUND SURFACE		65.80																					
		Topsoil (FILL)		0.00																					
		Brown silty clay, trace gravel and sand (FILL)		0.13																					
		Very stiff grey brown SILTY CLAY, with silty sand seams (Weathered Crust)		0.30																					
1																									
2					1	50 DO	7																		
		Grey brown SANDY SILT to SILTY SAND, some gravel, trace clay (GLACIAL TILL)		63.51 2.29																					
3		End of Borehole Auger Refusal		62.88 2.92																					
4																									
5																									
6																									
7																									
8																									
9																									
10																									

Open borehole dry
upon completion of
drilling

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JUL/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AI

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 7, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION									
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	RESISTANCE, BLOWS/0.3m				k, cm/s													
								20		40		60		80			10 ⁻⁶		10 ⁻⁵		10 ⁻⁴		10 ⁻³		
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - ● U - ○		WATER CONTENT PERCENT				Wp ———— W ———— WI							
								20	40	60	80	20	40	60	80										
0	Power Auger 200mm Diam. (Hollow Stem)	GROUND SURFACE		65.62																					
		Topsoil (FILL)		0.00																					
		Grey brown silty clay, some sand, trace gravel (FILL)		0.10																					
		Grey brown SILTY CLAY, with sand seams (Weathered Crust)		65.21																					
				0.41																					
1		Loose brown to grey brown SILTY SAND to SANDY SILT, some gravel, trace clay, with cobbles and boulders (GLACIAL TILL)		64.63																					
				0.99																					
2					1	50 DO	4																		
				63.05																					
				2.57																					
3		End of Borehole Auger Refusal																							
4																									
5																									
6																									
7																									
8																									
9																									
10																									

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS-001_0911210008.GPJ GAL-MIS-GDT_0628/13 JJL/PLG

PROJECT: 09-1121-0008-3000

RECORD OF BOREHOLE: 09-AJ

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: Jan. 7, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	RESISTANCE, BLOWS/0.3m				k, cm/s							
								SHEAR STRENGTH		nat V. + rem V.		Q - U		WATER CONTENT PERCENT			10 ⁻⁵ 10 ⁻⁴ 10 ⁻³		
								Cu, kPa		⊕	⊖	●	○	Wp			WI		
								20	40	60	80								
0	Power Auger 200mm Diam. (H.S.)	GROUND SURFACE		65.33															
Topsoil (FILL)			65.15																
Brown sandy silt, some gravel, trace clay, with cobbles and boulders (FILL)			0.18																
1					1	GRAB													
		TOPSOIL		64.34															
				0.99															
	Rotary Drill NQ Core	Slightly weathered light grey SANDSTONE BEDROCK, with shaley partings		1.14	C1	NQ RC	DD												
				63.63															
		Fresh grey SANDSTONE BEDROCK, with shaley partings		1.70															
					C2	NQ RC	DD												
2																			
3																			
4																			
5		End of Borehole		60.78															
				4.55															
6																			
7																			
8																			
9																			
10																			

Native Backfill

Bentonite Seal

Silica Sand

Standpipe

W.L. in standpipe
at Elev. 63.29m on
May 12, 2010

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-BHS 001 0911210008.GPJ GAL-MIS.GDT 06/28/13 JJJ/PLG

PROJECT: 09-1121-0008-3000

RECORD OF DRILLHOLE: 09-AJ

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: Jan. 7, 2010

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH	RECOVERY	R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA	HYDRAULIC CONDUCTIVITY K, cm/sec	DIP w.r.t. CORE AXIS	DIP Angle °	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	Diameter mm	Point Load Index (MPa)	RMC AVG.	BR - Broken Rock
		BEDROCK SURFACE		64.19																	
		Slightly weathered light grey SANDSTONE BEDROCK, with shaley partings		1.14	1																
		Fresh grey SANDSTONE BEDROCK, with shaley partings		63.63																	
2				1.70	2																
3	Rotary Drill NQ Core																				
4					3																
5		End of Borehole		60.78																	
				4.55																	
6																					
7																					
8																					
9																					
10																					
11																					

Bentonite Seal

Silica Sand

Standpipe

W.L. in standpipe
at Elev. 63.29m on
May 12, 2010

DEPTH SCALE

1 : 50



LOGGED: R.I.

CHECKED: T.M.S.

MIS-RCK 004 0911210008.GPJ GAL-MISS.GDT 06/28/13 JUL/PLG