

**FOUNDATION INVESTIGATION REPORT
HARRIS RIVER ANIMAL CULVERTS
NORTH CULVERT SITE 44-453, WP 5390-06-01
SOUTH CULVERT SITE 44-454, WP 5389-06-01**

**HIGHWAY 69 FOUR-LANING
FROM THE SOUTH JUNCTION OF HIGHWAY 529 NORTHERLY 15 KM
G.W.P. 5076-06-00**

Geocres Number: 41H-120

Report to

MMM Group Limited

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for two proposed animal culverts where Highway 69 crosses Harris River. These animal culverts are a component of the Highway 69 four-laning project extending from the south junction of Highway 529 northerly approximately 15 km.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide record of borehole sheets, borehole location plans, stratigraphic profiles, laboratory test results, and a generalized description of the subsurface conditions. This information provides a model of the anticipated geotechnical conditions influencing design and construction of the structures.

Thurber carried out the investigation as a sub-consultant to MMM Group Limited (MMM) under the Ministry of Transportation Ontario (MTO) Agreement Number 5006-E-0030.

2 SITE DESCRIPTION

Highway 69 in the study section is currently a two lane undivided roadway. The proposed four-lane alignment will run parallel to the existing alignment, with the new southbound lanes on the existing highway platform. The site lies approximately at Latitude 45.68746 and Longitude -80.44801.

The roadway corridor typically has a rolling topography with frequent bedrock outcrops of generally low relief, separated by low-lying swamp areas, water bodies, and small streams. In general, the area is heavily wooded except in swamp areas.

The site lies within the physiographic region known as the Georgian Bay Fringe, characterized by very shallow soils and bare rock knobs and ridges. Where present, the overburden materials consist of sand, silt and clay. Recent organic deposits of peat and muck occur in abundance in bedrock hollows and valleys. The area is underlain by strongly foliated and highly to intermediately deformed rocks of Precambrian age, primarily migmatitic rocks and gneisses.

The highway crosses the Harris River on large concrete-arch culvert within a rock fill embankment. There are no other structures or development within the immediate vicinity of the site.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project took place between June 14 and 18, 2012 and consisted of drilling four boreholes (identified as HRAP-01 to HRAP-04). Two boreholes were drilled at the location of the proposed south culvert (HRAP-01 and HRAP-02) and two boreholes were drilled at the proposed north culvert (HRAP-03 and HRAP-04). The approximate borehole locations are shown on the Borehole Locations and Soil Strata drawing included in Appendix C.

The boreholes were advanced to depths of 8.8 to 15.0 m (Elevations 185.2 to 178.9 m). Boreholes HRAP-01 and HRAP-02 were terminated upon refusal on probable bedrock. Boreholes HRAP-03 and HRAP-04 were advanced 1.9 and 3.6 m into bedrock in order to confirm the transition from rock fill to bedrock.

The borehole locations were established by Thurber relative to the existing Harris River culvert. Ground elevations at the test locations were approximated from detailed topographic plans provided by MMM Group.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

A truck-mounted drill rig was used to drill these boreholes. Hollow stem augers and wash-boring methods were used to advance the boreholes through the existing highway embankment and native deposits to bedrock. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

Where practical, groundwater conditions were observed in the open boreholes during the drilling operations. No standpipe piezometers were installed. On completion of drilling, the boreholes were backfilled with bentonite and auger cuttings in accordance with O. Reg. 903 (as amended) and the surface was reinstated.

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

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to gradation analysis (sieve and hydrometer). The results of this testing are summarized on the Record of Borehole sheets included in Appendix A and on the figures included in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix A and on the Borehole Locations and Soil Strata drawing included in

Appendix C. A general description of the stratigraphy based on the conditions encountered in the boreholes is given in this section. However, the factual data presented in the borehole logs takes precedence over this general description and interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

In general, the subsurface stratigraphy encountered at the proposed south animal culvert consisted of a pavement structure (asphalt and granular road base) and rock fill overlying native sand to gravelly sand overlying probable bedrock. At the proposed north animal culvert, the subsurface stratigraphy consisted of a pavement structure (asphalt and granular road base) and rock fill overlying bedrock, which was confirmed by coring.

5.1 Pavement Structure and Embankment Fill

A pavement structure consisting of approximately 50 mm of asphalt overlying granular road base (sand to sand and gravel fill) was encountered in all four boreholes, all of which were drilled through the existing Highway 69 embankment. The granular fill consists of brown and grey sand to sand and gravel containing some silt.

The granular fill extended to depths of 1.2 to 5.2 m (Elev. 192.9 to 189.3 m), at which depth the boreholes encountered rock fill. SPT 'N' values of 13 to 43 blows for 0.3 m penetration were recorded in the granular fill, indicating a compact to dense relative density. Moisture contents of 3 to 8% were measured in samples of the granular fill.

One sample of the gravelly sand fill underwent laboratory grain size analysis testing, the results of which are summarized below. The grain size distribution curve for this sample is presented on Figure B1 of Appendix B.

Gravel %	27
Sand %	67
Silt & Clay %	6

Coring techniques were required to advance the boreholes through the rock fill. Total core recovery within the rock fill ranged from 8 to 77%. The rock fill was 2.3 to 10.2 m thick, with the lower boundary of the rock fill encountered at depths of 6.9 to 11.4 m (Elev. 187.1 to 182.5 m).

5.2 Sand

Native brown sand was encountered below the rock fill in Boreholes HRAP-01 and HRAP-02. The sand contained trace gravel, and trace silt and clay. A silty zone was identified in Borehole HRAP-02 at 8.5 m and a gravelly zone was also identified in this borehole at 10.7 m.

The sand layer was 6.5 m thick in Borehole HRAP-01 and 3.3 m thick in Borehole HRAP-02. The lower boundary of the sand was encountered at depths of 13.8 and 10.8 m (Elev. 180.6 and 183.7 m).

SPT ‘N’ values recorded in the sand ranged from 5 to 95 blows for 0.3 m penetration, indicating a relative density ranging from loose to very dense. In general, ‘N’ values recorded in the sand ranged from 17 to 34 blows for 0.3 m penetration (compact to dense). SPT ‘N’ values of 100 blows for 0.1 m penetration were recorded in both boreholes upon refusal on probable bedrock.

Moisture contents of the sand ranged from 8 to 23%.

Three samples of the sand underwent laboratory grain size analysis testing, the results of which are summarized below. The grain size distribution curves for these samples are presented on Figure B2, Appendix B. The results of these tests are as follows:

Gravel %	0 to 7
Sand %	87 to 95
Silt and Clay %	5 to 8

5.3 Bedrock

The boreholes drilled for the south culvert (HRAP-01 and HRAP-02) were both terminated upon refusal on probable bedrock while the boreholes drilled for the north culvert (HRAP-03 and HRAP-04) were advanced 1.9 and 3.6 m into bedrock to confirm the transition from rock fill to bedrock. The depths and elevations of the probable bedrock surface at the borehole locations are summarized in Table 5.9.

Table 5.9 – Depth and Elevation of Probable Bedrock

Borehole	Probable Bedrock Surface	
	Depth below Ground Surface (m)	Elevation (m)
HRAP-01	13.8	180.6
HRAP-02	10.8	183.7
HRAP-03	6.9*	187.1
HRAP-04	11.4*	182.5

* Confirmed by coring.

The RQD values for BH HRAP-04 ranged from 90 to 97%, indicating excellent rock quality.

5.4 Groundwater Conditions

Where practical, water levels were observed in the open boreholes upon completion of drilling. The water levels observed during drilling are summarized in Table 5.10.

Table 5.10 – Water Level Observations

Borehole	Date	Water Level	
		Depth (m)	Elev. (m)
HRAP-01	June 16, 2012	7.2	187.2
HRAP-02	June 15, 2012	6.0	188.5

The above values are short-term observations and may have been influenced by water used in the drilling process. The depths to groundwater will vary depending upon seasonal fluctuations and rainfall patterns. In particular, water levels may be higher after the spring snowmelt or periods of heavy rainfall. However, the rock fill embankment is generally well-drained and high water tables are not anticipated.

6 MISCELLANEOUS

The borehole locations were established by measuring offset distances from the centreline of the existing Harris River culvert. The approximate ground surface elevations at the boreholes were interpreted from the contour plan provided by MMM Group Limited.

George Downing Estates Drilling Ltd. of Hawkesbury, Ontario supplied and operated the drilling and sampling equipment for the field program. Supervision of the field activities was carried out by Ms. Eckie Siu and Mr. Jason Mei of Thurber.

Supervision of the field program was carried out by Ms. Lindsey Blaine, E.I.T. Interpretation of the field data and preparation of the report was performed by Ms. Lindsey Blaine, E.I.T. and Mr. Alastair Gorman, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Lindsey Blaine, E.I.T.
Geological Engineer-in-Training



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Review Principal

Appendix A
Record of Borehole sheets

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.

EXPLANATION OF ROCK LOGGING TERMS


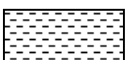

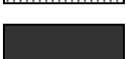

ROCK WEATHERING CLASSIFICATION

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

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
	(MPa)	(psi)	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

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
Rock Quality Designation:(RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index:(FI)	Frequency of natural fractures per 0.3m of core run.

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			

RECORD OF BOREHOLE No HRAP-01

1 OF 2

METRIC

WP# 5076-06-00 LOCATION N 5 061 257.8 E 230 961.1 ORIGINATED BY JM
HWY 69 BOREHOLE TYPE Hollow Stem Augers/Washboring COMPILED BY AN
DATUM Geodetic DATE 2012.06.16 - 2012.06.16 CHECKED BY LRB

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						
								20 40 60 80 100						
194.4	Pavement													
0.0	ASPHALT: (50mm)													
	SAND, some gravel, some silt Grey Moist (FILL)		1	GS			194							
			1	SS	43		193							
192.9														
1.5	ROCK FILL		1	CS			192							
			2	CS			191							
			3	CS			190							
			4	CS			189							
							188							
187.1							187							
7.3	SAND, trace gravel, trace silt and clay Compact to Very Dense Brown Moist		2	SS	19		186							
			3	SS	27		185							
			4	SS	28									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HRAP-01

2 OF 2

METRIC

WP# 5076-06-00 LOCATION N 5 061 257.8 E 230 961.1 ORIGINATED BY JM
HWY 69 BOREHOLE TYPE Hollow Stem Augers/Washboring COMPILED BY AN
DATUM Geodetic DATE 2012.06.16 - 2012.06.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
Continued From Previous Page					20 40 60 80 100					20 40 60													
	SAND, trace gravel, trace silt and clay Very Dense to Compact Brown Moist to Wet		5	SS	95		184							○									
															○								
					7	SS	17		182							○							
180.6							181																
13.8	END OF BOREHOLE AT 13.8m UPON REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 13.8m AND WATER LEVEL AT 7.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG FROM 13.8m TO 1.5m, SAND AND GRAVEL FROM 1.5m TO 0.1m, THEN ASPHALT TO SURFACE.		8	SS	100/ 0.100																		

ONTMT4S 6121(CULVERTS).GPJ 2015TEMPLATE(MTO).GDT 1/24/17

RECORD OF BOREHOLE No HRAP-02

1 OF 2

METRIC

WP# 5076-06-00 LOCATION N 5 061 257.8 E 230 971.8 ORIGINATED BY JM/ES
 HWY 69 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.15 - 2012.06.16 CHECKED BY LRB

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			SHEAR STRENGTH kPa				WATER CONTENT (%)					GR	SA	SI	CL	
194.5	Pavement																				
0.0	ASPHALT: (50mm)																				
194.0	SAND , some gravel Dark Brown to Grey Damp (FILL)		1	GS			194														
0.5	Gravelly SAND , trace silt and clay, occasional cobbles Dense to Compact Brown Damp (FILL)		1	SS	34		193										27	67	6 (SI+CL)		
			2	SS	13		192														
			3	SS	15		191														
	No recovery		4	SS	39		190														
189.3	ROCK FILL		1	RUN			189												RUN #1 TCR=67%		
5.2			2	RUN			188												RUN #2 TCR=45%		
187.0	SAND , trace gravel, trace silt and clay Compact Brown Wet		5	SS	24		187														
7.5	Silty zone		6	SS	5		186														
			7	SS	24		185												7	87	6 (SI+CL)

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HRAP-02

2 OF 2

METRIC

WP# 5076-06-00 LOCATION N 5 061 257.8 E 230 971.8 ORIGINATED BY JM/ES
 HWY 69 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2012.06.15 - 2012.06.16 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W P W W L				GR SA SI CL			
	Continued From Previous Page							20	40	60	80	100								

ONTMT4S 6121(CULVERTS)GPJ 2015TEMPLATE(MTO)GDT 1/24/17

RECORD OF BOREHOLE No HRAP-03

1 OF 1

METRIC

WP# 5076-06-00 LOCATION N 5 061 305.6 E 230 941.9 ORIGINATED BY JM/ES
 HWY 69 BOREHOLE TYPE Hollow Stem Augers/Washboring COMPILED BY AN
 DATUM Geodetic DATE 2012.06.18 - 2012.06.18 CHECKED BY LRB

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			SHEAR STRENGTH kPa				WATER CONTENT (%)				
												w P w w L				
194.0	Pavement															
0.0	ASPHALT: (50mm)															
	SAND and GRAVEL , some silt Dense Grey to Brown Moist (FILL)		1	GS												
			1	SS	41											
191.7																
2.3	ROCK FILL , cobbles and boulders, some gravel and sand		1	CS											RUN #1 TCR=77%	
															RUN #2 TCR=55%	
			2	CS												
			3	CS											RUN #3 TCR=55%	
			2	SS	100/ 0.125										RUN #4 TCR=65%	
			4	CS												
187.1																
6.9	BEDROCK , granitic gneiss, grey														RUN #5 TCR=100%	
			5	CS												
185.2																
8.8	END OF BOREHOLE AT 8.8m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.9m, CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE. BOREHOLE DRY ON COMPLETION.															

ONTMT4S 6121(CULVERTS).GPJ 2015TEMPLATE(MTO).GDT 1/24/17

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No HRAP-04

2 OF 2

METRIC

WP# 5076-06-00 LOCATION N 5 061 305.5 E 230 952.7 ORIGINATED BY ES/GM
HWY 69 BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY AN
DATUM Geodetic DATE 2012.06.14 - 2012.06.15 CHECKED BY LRB

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			SHEAR STRENGTH kPa						
	Continued From Previous Page						20 40 60 80 100							
182.5			7	CS			183							RUN #7 TCR=45%
11.4	BEDROCK, granitic gneiss, occasional quartz seams, grey						182							RUN #1 TCR=100% SCR=97% RQD=97%
			1	RUN			181							
							180							RUN #2 TCR=100% SCR=90% RQD=90%
178.9			2	RUN										
15.0	END OF BOREHOLE AT 15.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.6m, CUTTINGS TO 1.2m, HOLEPLUG TO 0.1m, THEN ASPHALT TO SURFACE. BOREHOLE DRY ON COMPLETION.						179							

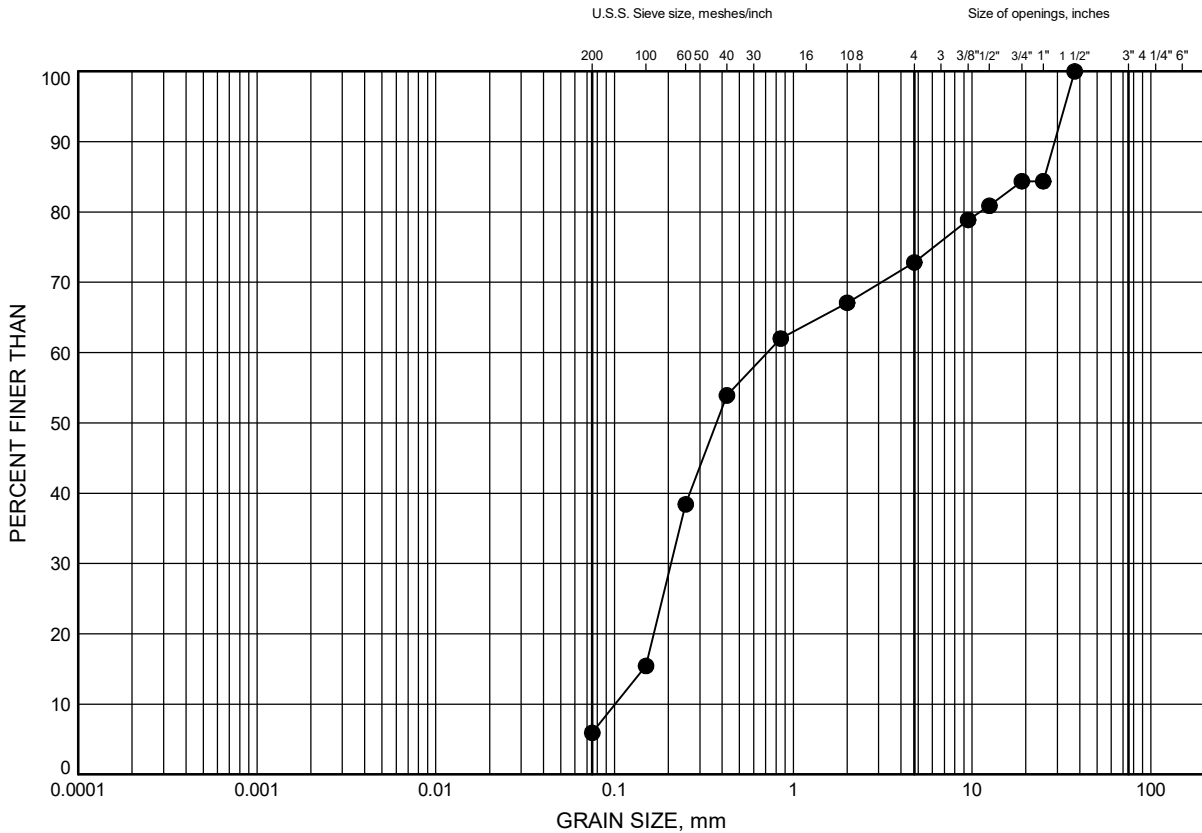
ONTMT4S 6121(CULVERTS).GPJ 2015TEMPLATE(MTO).GDT 1/24/17

Appendix B
Laboratory Test Results

Hwy 69 Four-Laning North of Hwy 529
GRAIN SIZE DISTRIBUTION

FIGURE B1

Gravelly Sand Fill



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HRAP-02	1.07	193.43

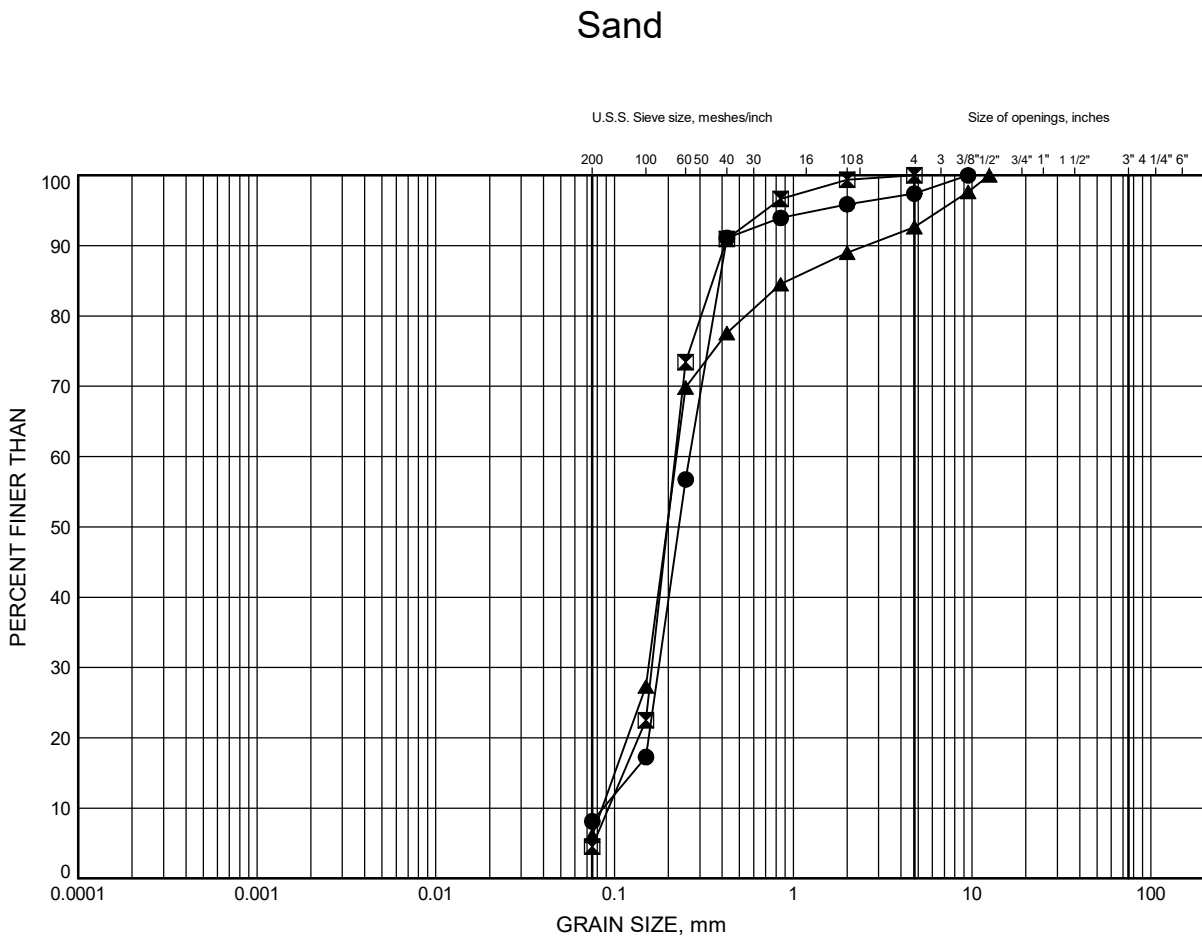
Date January 2017
 WP# 5076-06-00



Prep'd MFA
 Chkd. AEG

Hwy 69 Four-Laning North of Hwy 529 GRAIN SIZE DISTRIBUTION

FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HRAP-01	7.92	186.48
⊠	HRAP-01	12.50	181.90
▲	HRAP-02	9.45	185.05

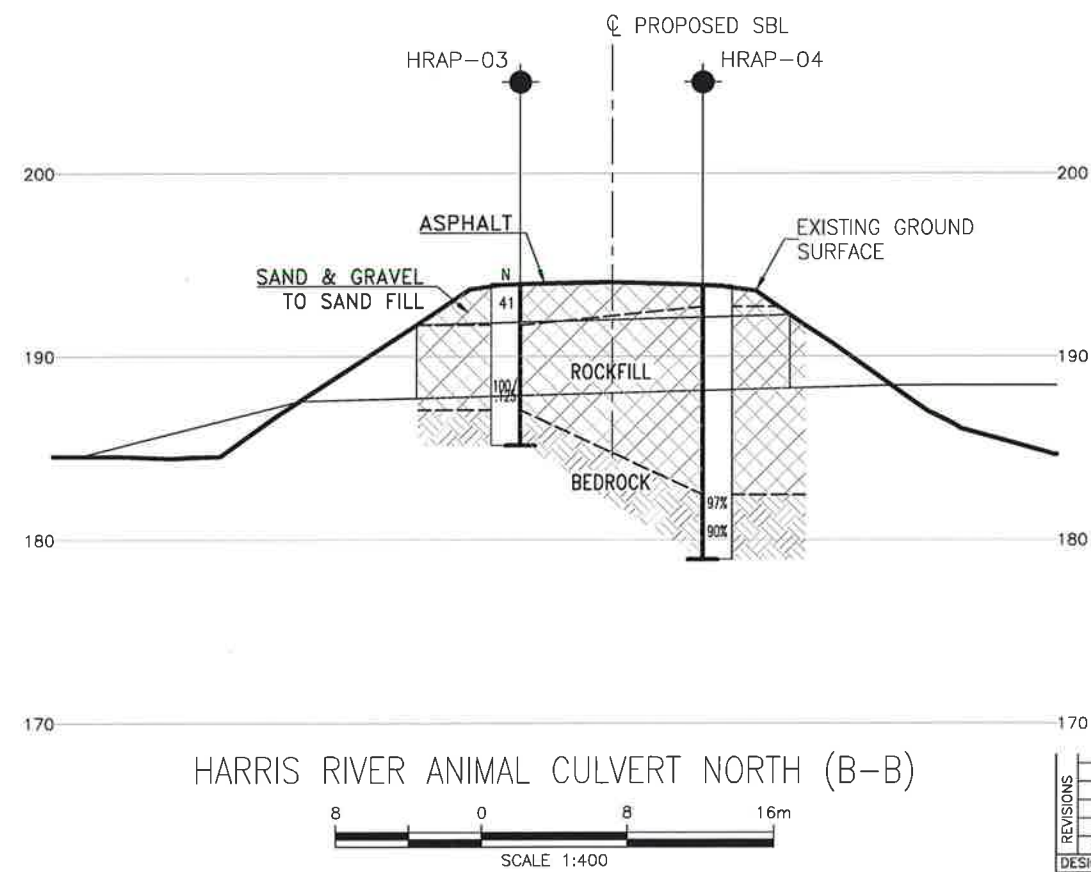
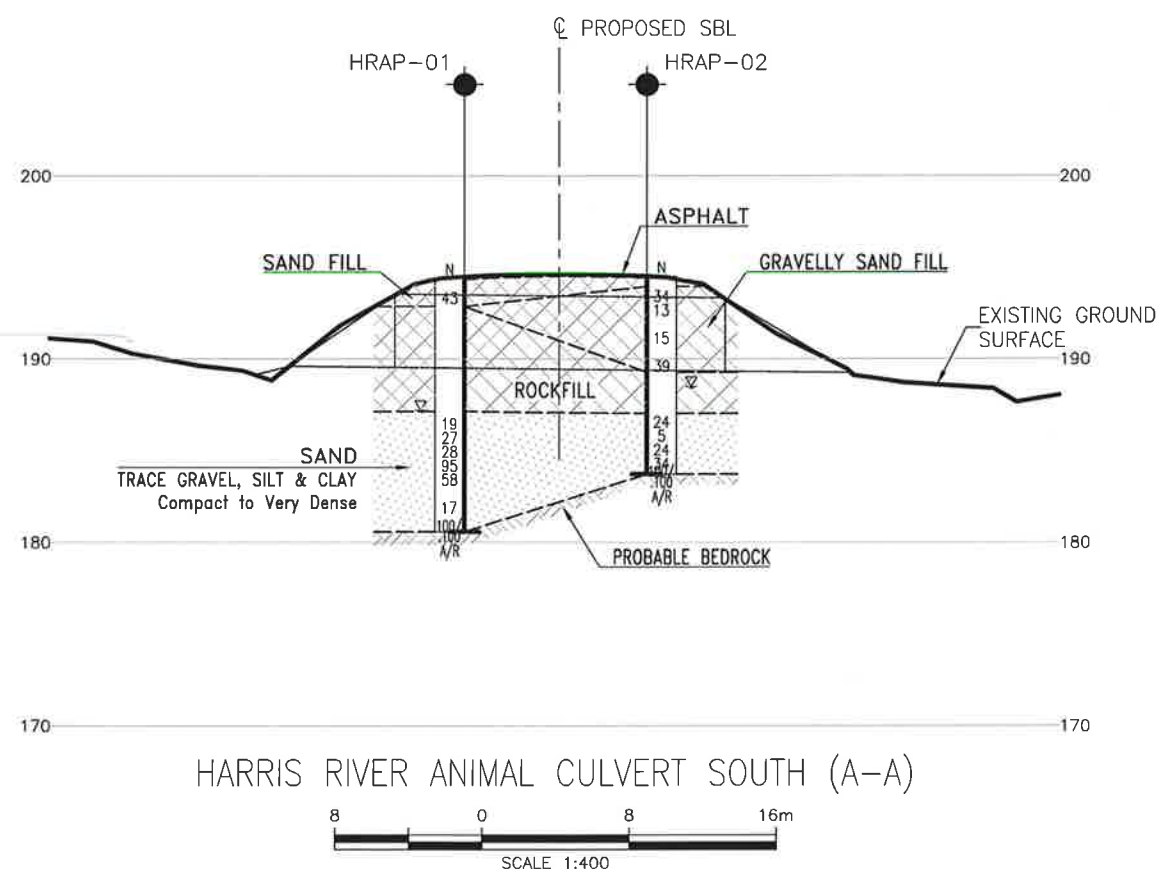
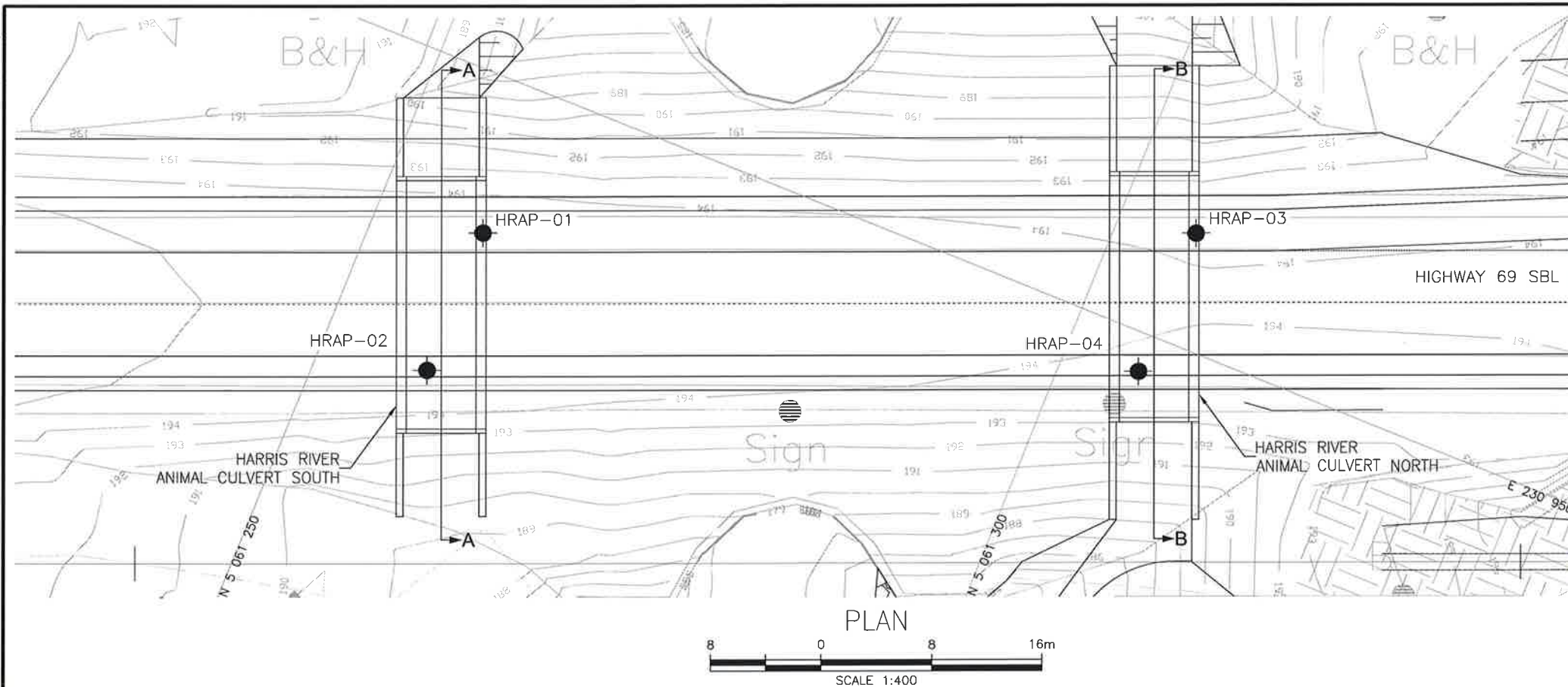
Date January 2017
WP# 5076-06-00



Prep'd MFA
Chkd. AEG

Appendix C

Borehole Locations and Soil Strata Drawing



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



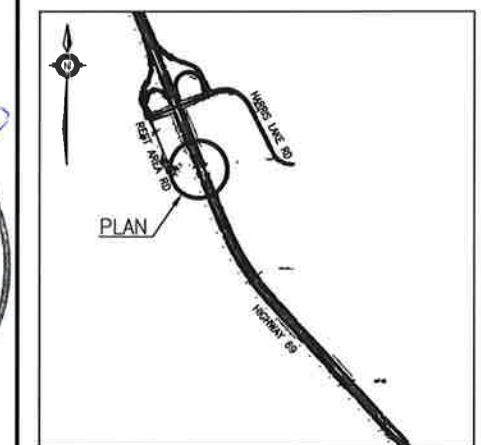
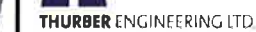
WP No 5389-06-01
WP No 5390-06-01

WP No 5390-06-01

HIGHWAY 69 FOUR-LANING
HARRIS RIVER
ANIMAL CULVERTS
BOREHOLE LOCATIONS AND SOIL STRATA








— 100 —



KEYPLAN

LEGEND

	Culvert Report Borehole / Cone
	Other Borehole / Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level During Drilling
	Water Level in
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

-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. 41H-120

REV	REVISIONS									
	DATE	BY	DESCRIPTION							DATE
	DESIGN	LRB	CHK	AEG	SITE 44-453	LOAD				JAN. 2017
	DRAWN	MFA	CHK	LRB	SITE 44-454	STRUCT		DWG 1		