

**FOUNDATION INVESTIGATION REPORT**  
**OVERHEAD SIGNS**  
**HIGHWAY 69 FOUR-LANING**  
**FROM THE SOUTH JUNCTION OF HIGHWAY 529 NORTHERLY 15 KM**  
**G.W.P. 5076-06-00**  
**Geocres Number: 41H-103**

**Report to**  
**MMM Group Limited**

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a geotechnical investigation conducted at the locations of four proposed overhead sign supports (OHS) to be constructed in connection with the proposed Highway 69 four-laning project, which extends from the south junction of Highway 529 northerly for 15 km in the Townships of Harrison and Wallbridge, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the OHS locations and, based on the data obtained, provide a borehole location plan, borehole logs, laboratory test results and a written description of the subsurface conditions.

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 is currently a two lane undivided roadway. 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 approximate locations of the four proposed overhead signs are described below:

Structure	Location
OHS 1	Station 19+200, Hwy 69 NBL, Harrison Township; approximately 1.6 km north of Moose Lake Rd. Connection
OHS 2	Station 20+750, Hwy 69 SBL, Harrison Township; approximately 140 m north of the Naiscoot Lake centreline.
OHS 3	Station 13+050, Hwy 69 NBL, Wallbridge Township; approximately 1.4 km north of Harris Lake Rd.
OHS 4	Station 14+550, Hwy 69 NBL, Wallbridge Township; approximately 2.9 km north of Harris Lake Rd.

The sites lie 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.

### 3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at the locations of the proposed OHS were carried out on February 12, 15 and 16, 2011. Two sampled boreholes were drilled near each proposed OHS location. A summary of the borehole designations and sampling termination depths/elevations is provided in Table 3.1.

**Table 3.1 – Borehole Designations and Depths**

Sign	Borehole	Sampled Borehole Termination		Rock Core
		Depth (m)	Elevation	Depth (m)
OHS 1	OHS1-01	0.9	200.7	0.9 - 4.1
	OHS1-02	0.3	200.9	0.3 - 3.7
OHS 2	OHS2-01	1.0	196.6	1.0 - 4.4
	OHS2-02	0.9	196.5	0.9 - 4.2
OHS 3	OHS3-01	1.2	200.7	1.2 - 4.6
	OHS3-02	0.1	202.6	0.1 - 3.1
OHS 4	OHS4-01	0.1	196.4	0.1 - 3.0
	OHS4-02	0.1	195.4	0.1 - 3.2

The approximate locations of the boreholes are shown on the Borehole Locations drawings in Appendix C. The coordinates and elevations of the boreholes are given on the drawing and on the individual Record of Borehole Sheets in Appendix A.

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

Hollow stem augers were used to advance the boreholes in the overburden. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). All the boreholes were advanced 2.9 m to 3.4 m into bedrock by NQ size diamond coring.

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

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

The boreholes were monitored throughout the drilling operations for the presence of groundwater.

Boreholes were backfilled with holeplug to 0.15 m, then auger cuttings to the ground surface. Completion of the boreholes was carried out in general accordance with the requirements of O. Reg. 903 (as amended by O.Reg. 372/07).

#### **4 LABORATORY TESTING**

All recovered soil and rock samples were subjected to Visual Identification (VI) and geological logging.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to assist in evaluation of the compressive strength of the bedrock. The results are shown in the Point Load Test Sheets included in Appendix B and on the Record of Borehole sheets in Appendix A.

#### **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. Overall descriptions of the stratigraphy are given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

In general terms, the soil stratigraphy encountered at these sites consists of topsoil underlain by native sand over bedrock, or an organic layer directly overlying bedrock. More detailed descriptions of the individual strata are presented below.

### 5.1 Topsoil

A surficial topsoil layer was identified in Boreholes OHS1-01 to OHS3-01. A layer of organics (moss) was encountered over the bedrock surface in Boreholes OHS3-02 to OHS4-02. The topsoil/organic thickness ranged from 100 mm to 250 mm.

The topsoil thickness may vary between and beyond the borehole locations.

### 5.2 Sand

Native brown sand containing trace to some gravel, trace to some silt and occasional rootlets, cobbles and boulders was contacted below the topsoil in five boreholes (Boreholes OHS1-01, OHS1-02, OHS2-01, OHS2-02 and OHS3-01).

The thickness of the sand varied from 100 mm to 900 mm.

Sampling and augering were terminated below the sand layer, upon refusal on bedrock at depths ranging from 0.3 m to 1.2 m.

### 5.3 Bedrock

The soils described in the boreholes were found to be underlain by granitic gneiss bedrock. The bedrock is described as slightly weathered to fresh. The bedrock was generally grey with occasional pink and white bands visible in most cores.

Table 5.1 summarizes depths and elevations to the top of bedrock in the boreholes.

**Table 5.1 – Depth and Elevation of Top of Bedrock**

Sign	Borehole	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
OHS 1	OHS1-1	0.9	200.7
	OHS1-2	0.3	200.9
OHS 2	OHS2-1	1.0	196.6
	OHS2-2	0.9	196.5
OHS 3	OHS3-1	1.2	200.7
	OHS3-2	0.1	202.6
OHS 4	OHS4-1	0.1	196.4
	OHS4-2	0.1	195.4

Total core recovery (TCR) in the bedrock was 100% in the boreholes.

Rock quality designation (RQD) values generally ranged from 78% to 100%, indicating a good to excellent rock quality. RQD values of 65% and 68% were observed in Boreholes OHS2-01 Runs 2 and 3 and OHS3-01 Run 3, indicating a fair rock quality. Lower RQD values of 33% and 49%, indicating a poor rock quality, were measured in Boreholes OHS1-02 Run 1 and OHS2-02 Run 3.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, generally ranged from 1 to 4 in the cores. Individual Fracture Indices ranging from 6 to 12 were observed in Boreholes OHS2-01 Run 3, OHS2-02 Run 3 and OHS3-01 Run 3.

The joints/fractures in the rock were typically horizontal to sub-horizontal (up to 20° from horizontal), with isolated fractures oriented at inclinations of about 45° to 80° from horizontal. The fractures were described as slightly rough to rough, typically moderately rough.

The estimated uniaxial compressive strength of the rock cores generally ranges from 74 MPa to 218 MPa, indicating a strong to very strong rock. These estimated rock strength values are interpreted from point load tests that were conducted on rock cores recovered from the boreholes. The Point Load Test results are presented in Appendix B and summarized on the borehole logs.

#### **5.4 Water Levels**

Groundwater was not observed in the boreholes during or upon completion of drilling. Water is used in the rock coring process and therefore water levels in the boreholes upon completion of coring are not representative of site conditions.

## **6 MISCELLANEOUS**

MMM Group Limited staked the borehole locations in the field and determined the ground surface elevations and coordinates at the boreholes.

Thurber obtained utility clearances for the borehole locations prior to drilling.

Eastern Ontario Diamond Drilling Ltd. supplied a track mounted CME 75 drill rig and conducted the drilling, coring, sampling and in-situ testing operations.

The field program was supervised on a full time basis by Mr. Stephane Loranger, C.E.T. of Thurber Engineering Ltd.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall supervision of the field program was conducted by Ms. R. Palomeque Reyna, P.Eng. Interpretation of the data and preparation of the report were carried out by Ms. R. Palomeque Reyna, P.Eng. and Mr. Murray R. Anderson, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

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Overhead Signs

Hwy 69 – From the south junction of Hwy 529 northerly 15 km

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## **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 <sup>(1)</sup> '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

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


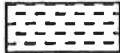



 Water Level  
 Shear Strength Determination by Pocket Penetrometer

- (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

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
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)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
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				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
TERMS					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
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 OHS1-1

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 055 208.7 E 235 070.0 ORIGINATED BY SLL  
 HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN  
 DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
201.6												
0.0	TOPSOIL, roots and rootlets: (150mm)											
0.2	SAND, trace to some gravel, occasional cobbles and bedrock fragments											
200.7	Brown											
0.9	Moist											
	BEDROCK, granitic gneiss, containing feldspathic layers, slightly weathered to fresh, grey, pink and white bands, occasional mechanical breaks		1	RUN								
	Moderately rough joints at 1.1m, 1.2m, 1.4m, 3.0m, 3.8m (horizontal to 20 degrees from horizontal)		2	RUN								
	Moderately rough fractures at 1.4m (50 degrees to horizontal) and at 1.7m (75 degrees to horizontal)											
	Moderately rough fracture at 3.6m (70 degrees from horizontal)		3	RUN								
197.5												
4.1	END OF BOREHOLE AT 4.1m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.											

**METRIC**[illegible]

RECORD OF BOREHOLE No OHS2-1

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 056 700.9 E 234 865.1 ORIGINATED BY SLL  
HWY 69 BOREHOLE TYPE Hollow Stem Augers/NW/NQ Coring COMPILED BY AN  
DATUM Geodetic DATE 2011.02.12 - 2011.02.12 CHECKED BY RPR

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)						
								○ UNCONFINED      + FIELD VANE			w <sub>p</sub> w      w <sub>L</sub>						
								● QUICK TRIAXIAL      × LAB VANE									
197.6							20	40	60	80	100						
0.0	TOPSOIL, roots and rootlets: (180mm)																
0.2	SAND, trace gravel, occasional rootlets, occasional cobbles Brown Moist																
196.6																	
1.0	BEDROCK, granitic gneiss, containing feldsphtic layers, slightly weathered to fresh, grey, pink and white bands, occasional mechanical breaks  Moderately rough horizontal joints at 2.0m, 2.3m, 2.4m  Moderately rough fractures at 1.6m, 2.1m, 2.5m (55 to 70 degrees from horizontal)		1	RUN													
			2	RUN													
			3	RUN													
193.1																	
4.4	END OF BOREHOLE AT 4.4m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No OHS2-2

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 056 708.1 E 234 683.8 ORIGINATED BY SLL  
HWY 69 BOREHOLE TYPE Hollow Stem Augers/NW/NQ Coring COMPILED BY AN  
DATUM Geodetic DATE 2011.02.12 - 2011.02.12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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 × LAB VANE							
197.4								20 40 60 80 100							
0.0	TOPSOIL, roots and rootlets Moist: (180mm)						197								
0.2	SAND, some gravel, trace silt, occasional cobbles and boulders Brown Moist														
196.5															
0.9	BEDROCK, granitic gneiss, containing feldspathic layers, slightly weathered to fresh, grey, pink and white bands, occasional mechanical breaks  Slightly to moderately rough joints at 1.4m, 1.6m, 2.1m, 3.1m (45 to 55 degrees from horizontal)		1	RUN			196							FI 2 4 3	RUN #1 TCR=100% SCR=89% RQD=78% UCS=162MPa (Average)
			2	RUN			195							0 3 0 1	RUN #2 TCR=100% SCR=87% RQD=78% UCS=188MPa (Average)
			3	RUN			194							12 2 0 6	RUN #3 TCR=100% SCR=63% RQD=49% UCS=218MPa (Average)
193.2	Moderately rough fracture at 3.8m (80 degrees from horizontal)														
4.2	END OF BOREHOLE AT 4.2m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.														





RECORD OF BOREHOLE No OHS3-1

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 062 962.4 E 230 308.6 ORIGINATED BY SLL  
HWY 69 BOREHOLE TYPE Hollow Stem Augers/NW/NQ Coring COMPILED BY AN  
DATUM Geodetic DATE 2011.02.15 - 2011.02.15 CHECKED BY RPR

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 <sup>3</sup>	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    × LAB VANE						
201.9 0.0 201.7 0.3	<b>TOPSOIL</b> , roots and rootlets: (250mm)  <b>SAND</b> , some silt Very Dense Brown Moist						202							
			1	SS	53/ 0.175		201							
200.7 1.2	<b>BEDROCK</b> , granitic gneiss, containing feldspathic layers, fresh, grey, white bands, occasional mechanical breaks  Rough horizontal fractures at 1.4m, 1.7m, 2.2m, 2.4m, 2.9m  Rough fracture at 2.5m (30 degrees from horizontal)  50mm quartz vein at 3.0m  Moderately to slightly weathered Moderately rough horizontal joints at 3.2m, 3.3m, 3.5m, 3.6m, 3.7m, 3.8m  Slightly rough fracture at 3.1m (60 degrees from horizontal)		1	RUN			200						FI 1 1 0 2 3 4 6 7 1 1 0	RUN #1 TCR=100% SCR=100% RQD=100% UCS=149MPa (Average)  RUN #2 TCR=100% SCR=97% RQD=85% UCS=130MPa (Average)  RUN #3 TCR=100% SCR=97% RQD=68% UCS=117MPa (Average)
197.3 4.6	END OF BOREHOLE AT 4.6m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.						199   <							

RECORD OF BOREHOLE No OHS3-2

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 062 969.8 E 230 327.0 ORIGINATED BY SLL  
HWY 69 BOREHOLE TYPE NQ Coring COMPILED BY AN  
DATUM Geodetic DATE 2011.02.15 - 2011.02.15 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)								
202.7								20	40	60	80	100									
0.0								○ UNCONFINED	+	FIELD VANE											
0.1								● QUICK TRIAXIAL	×	LAB VANE											
								20	40	60	80	100	20	40	60						
	<b>ORGANICS:</b> (100mm)		1	RUN			202										FI 0 1 1 1	RUN #1 TCR=100% SCR=100% RQD=95% UCS=191MPa (Average)			
	Rough horizontal joints at 0.5m, 0.9m, 1.0m, 1.3m, 1.5m, 1.6m																				
	Rough to slightly rough fractures at 1.6m, 1.9m, 3.0m (60 degrees from horizontal)																				
	Moderately rough horizontal joints at 1.9m, 2.1m, 2.5m, 2.6m, 2.9m		2	RUN			201												3 3 3 0 2 2	RUN #2 TCR=100% SCR=100% RQD=93% UCS=173MPa (Average)	
199.5							200														
3.1	END OF BOREHOLE AT 3.1m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.																				

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS4-1

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 064 354.0 E 229 747.3 ORIGINATED BY SLL  
HWY 69 BOREHOLE TYPE NQ Coring COMPILED BY AN  
DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY RPR

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
196.5								20	40	60	80	100		
0.0	ORGANICS: (125mm)							○ UNCONFINED	+	FIELD VANE				
0.1	BEDROCK, granitic gneiss, containing feldspathic layers, fresh, dark grey, white bands, occasional mechanical breaks		1	RUN				● QUICK TRIAXIAL	×	LAB VANE				
	Slightly to moderately rough horizontal joints at 0.3m, 0.6m, 1.2m, 2.2m, 2.3m							20	40	60	80	100		
	Rough fracture at 1.0m (40 degrees to horizontal)		2	RUN										
193.5														
3.0	END OF BOREHOLE AT 3.0m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.													

+ 3, × 3:

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS4-2

1 OF 1

METRIC

W.P. 5076-06-00 LOCATION N 5 064 361.5 E 229 765.8 ORIGINATED BY SLL  
HWY 69 BOREHOLE TYPE NQ Coring COMPILED BY AN  
DATUM Geodetic DATE 2011.02.16 - 2011.02.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
195.5														
0.0	ORGANICS: (125mm)													
0.1	BEDROCK, granitic gneiss, containing feldspathic layers, slightly weathered to fresh, grey, pink and white bands, occasional mechanical breaks		1	RUN			195						FI	RUN #1 TCR=100% SCR=100% RQD=85% UCS=160MPa (Average)
	Slightly to moderately rough horizontal joints at 0.1m, 0.4m, 1.0m, 1.3m												2	
	Slightly to moderately rough horizontal joints at 1.7m, 1.9m, 2.1m, 2.2m, 2.3m, 2.6m, 2.7m						194						1	
	Slightly rough fracture at 0.3m (25 degrees from horizontal)		2	RUN			193						3	RUN #2 TCR=100% SCR=100% RQD=93% UCS=183MPa (Average)
192.3													1	
3.2	END OF BOREHOLE AT 3.2m. WATER WAS NOT OBSERVED DURING AUGERING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN AUGER CUTTINGS TO SURFACE.												3	
													2	
													2	
													0	

Overhead Signs

Hwy 69 – From the south junction of Hwy 529 northerly 15 km

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**Appendix B**  
**Laboratory Test Results**



## POINT LOAD TEST SHEET

**Job No :** 19-5161-21  
**Project Name :** Hwy 69 Four-Laning North of Hwy 529  
**BH No :** OHS1-1  
**Core Size :** NQ

**Client :** MMM Group Limited  
**Date Drilled :** 2/16/2011  
**Date Tested :** 2/18/2011  
**Tester :** SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	1.04	D	8.0	47.14	80.77	84.14	Granitic gneiss	Strong
2	1	1.35	D	11.1	47.15	76.52	116.71	Granitic gneiss	Very Strong
3	1	1.65	D	7.2	47.13	69.84	75.75	Granitic gneiss	Strong
4	2	1.98	D	12.2	47.13	83.11	128.36	Granitic gneiss	Very Strong
5	2	2.29	D	16.8	47.13	80.93	176.76	Granitic gneiss	Very Strong
6	2	2.59	D	17.0	47.15	91.76	178.74	Granitic gneiss	Very Strong
7	2	2.90	D	12.0	47.15	75.38	126.17	Granitic gneiss	Very Strong
8	3	3.30	D	11.0	47.13	80.41	115.73	Granitic gneiss	Very Strong
9	3	3.53	D	16.1	47.14	79.35	169.34	Granitic gneiss	Very Strong
10	3	3.94	D	14.9	47.14	85.53	156.71	Granitic gneiss	Very Strong
11									

- \* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$   
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- \* Diametral Test should have  $0.7 \times D$  on either side of test point.



## POINT LOAD TEST SHEET

Job No : 19-5161-21  
Project Name : Hwy 69 Four-Laning North of Hwy 529  
BH No : OHS1-2  
Core Size : NQ

Client : MMM Group Limited  
Date Drilled : 2/16/2011  
Date Tested : 2/18/2011  
Tester : SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	0.41	D	7.0	47.11	99.36	73.70	Granitic gneiss	Strong
2	2	0.81	D	18.2	47.13	79.31	191.49	Granitic gneiss	Very Strong
3	2	1.12	D	12.2	47.13	81.13	128.36	Granitic gneiss	Very Strong
4	2	1.37	D	19.3	47.13	80.08	203.06	Granitic gneiss	Very Strong
5	3	1.70	D	15.3	47.14	78.30	160.92	Granitic gneiss	Very Strong
6	3	2.03	D	14.9	47.14	76.15	156.71	Granitic gneiss	Very Strong
7	3	2.34	D	19.3	47.13	73.48	203.06	Granitic gneiss	Very Strong
8	3	2.62	D	12.0	47.14	69.89	126.21	Granitic gneiss	Very Strong
9	3	3.02	D	0.0	47.13	59.85	3.00	Granitic gneiss	Very Weak
10	4	3.25	D	13.8	47.13	79.45	145.19	Granitic gneiss	Very Strong
11	4	3.56	D	16.90	47.13	74.52	177.81	Granitic gneiss	Very Strong

- \* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$   
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing  
\* Diametral Test should have  $0.7 \times D$  on either side of test point.



## POINT LOAD TEST SHEET

**Job No :** 19-5161-21  
**Project Name :** Hwy 69 Four-Laning North of Hwy 529  
**BH No :** OHS2-1  
**Core Size :** NQ

**Client :** MMM Group Limited  
**Date Drilled :** 2/15/2011  
**Date Tested :** 3/10/2011  
**Tester :** SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	1.30	D	13.8	47.13	86.38	145.19	Granitic gneiss	Very Strong
2	2	1.57	D	15.0	47.13	78.12	157.82	Granitic gneiss	Very Strong
3	2	1.91	D	17.1	47.14	83.98	179.85	Granitic gneiss	Very Strong
4	2	2.13	D	12.3	47.13	66.01	129.41	Granitic gneiss	Very Strong
5	2	2.77	D	18.0	47.13	63.31	189.38	Granitic gneiss	Very Strong
6	3	3.05	A	8.8	47.14	75.50	53.28	Granitic gneiss	Strong
7	3	3.30	D	21.9	47.14	81.32	230.34	Granitic gneiss	Very Strong
8	3	3.63	D	21.3	47.13	78.14	224.10	Granitic gneiss	Very Strong
9	3	3.96	D	19.5	47.13	86.31	205.16	Granitic gneiss	Very Strong
10									
11									

- \* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$   
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing  
\* Diametral Test should have  $0.7 \times D$  on either side of test point.





## POINT LOAD TEST SHEET

**Job No :** 19-5161-21  
**Project Name :** Hwy 69 Four-Laning North of Hwy 529  
**BH No :** OHS2-2  
**Core Size :** NQ

**Client :** MMM Group Limited  
**Date Drilled :** 2/15/2011  
**Date Tested :** 3/10/2011  
**Tester :** SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	1.19	D	15.7	47.13	80.36	165.18	Granitic gneiss	Very Strong
2	1	1.35	D	15.2	47.13	78.70	159.92	Granitic gneiss	Very Strong
3	2	1.83	D	19.7	47.14	90.08	207.20	Granitic gneiss	Very Strong
4	2	2.08	D	17.8	47.13	82.20	187.28	Granitic gneiss	Very Strong
5	2	2.39	D	7.0	47.13	86.13	73.65	Granitic gneiss	Strong
6	2	2.69	D	26.9	47.14	78.03	282.93	Granitic gneiss	Extremely Strong
7	2	3.00	D	18.1	47.14	80.34	190.37	Granitic gneiss	Very Strong
8	3	3.40	D	19.5	47.13	70.84	205.16	Granitic gneiss	Very Strong
9	3	3.66	D	22.0	47.13	78.51	231.47	Granitic gneiss	Very Strong
10									
11									

- \* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$   
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- \* Diametral Test should have  $0.7 \times D$  on either side of test point.



## POINT LOAD TEST SHEET

**Job No :** 19-5161-21  
**Project Name :** Hwy 69 Four-Laning North of Hwy 529  
**BH No :** OHS3-1  
**Core Size :** NQ

**Client :** MMM Group Limited  
**Date Drilled :** 2/15/2011  
**Date Tested :** 2/18/2011  
**Tester :** SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	1.37	D	14.2	47.13	80.00	149.40	Granitic gneiss	Very Strong
2	2	1.70	D	14.5	47.13	81.31	152.56	Granitic gneiss	Very Strong
3	2	1.96	D	16.0	47.14	79.91	168.28	Granitic gneiss	Very Strong
4	2	2.29	D	12.2	47.13	88.65	128.36	Granitic gneiss	Very Strong
5	2	2.59	D	9.0	47.13	82.23	94.69	Granitic gneiss	Strong
6	2	3.00	D	10.0	47.14	79.13	105.18	Granitic gneiss	Very Strong
7	3	3.35	D	14.5	47.14	80.03	152.51	Granitic gneiss	Very Strong
8	3	3.96	D	9.0	47.13	78.61	94.69	Granitic gneiss	Strong
9	3	4.32	D	9.9	47.13	76.34	104.16	Granitic gneiss	Very Strong
10	3	4.57	D	11.0	47.14	79.91	115.69	Granitic gneiss	Very Strong
11									

- \* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$   
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- \* Diametral Test should have  $0.7 \times D$  on either side of test point.



## POINT LOAD TEST SHEET

**Job No :** 19-5161-21  
**Project Name :** Hwy 69 Four-Laning North of Hwy 529  
**BH No :** OHS3-2  
**Core Size :** NQ

**Client :** MMM Group Limited  
**Date Drilled :** 2/15/2011  
**Date Tested :** 2/28/2011  
**Tester :** SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	0.25	D	20.0	47.13	101.11	210.42	Granitic gneiss	Very Strong
2	1	0.53	D	17.7	47.13	90.36	186.22	Granitic gneiss	Very Strong
3	1	0.84	D	17.1	47.14	83.14	179.85	Granitic gneiss	Very Strong
4	1	1.14	D	16.9	47.13	78.31	177.81	Granitic gneiss	Very Strong
5	1	1.50	D	8.0	47.13	59.03	84.17	Granitic gneiss	Strong
6	1	0.53	A	25.9	47.14	31.82	306.34	Granitic gneiss	Extremely Strong
7	2	1.85	D	17.1	47.14	80.81	179.85	Granitic gneiss	Very Strong
8	2	2.21	D	16.8	47.13	78.71	176.76	Granitic gneiss	Very Strong
9	2	2.54	D	16.6	47.13	69.56	174.65	Granitic gneiss	Very Strong
10	2	2.77	D	15.2	47.14	86.48	159.87	Granitic gneiss	Very Strong
11									

\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.



## POINT LOAD TEST SHEET

**Job No :** 19-5161-21  
**Project Name :** Hwy 69 Four-Laning North of Hwy 529  
**BH No :** OHS4-1  
**Core Size :** NQ

**Client :** MMM Group Limited  
**Date Drilled :** 2/16/2011  
**Date Tested :** 2/18/2011  
**Tester :** SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	0.20	D	16.0	47.13	150.00	168.34	Granitic gneiss	Very Strong
2	1	0.71	D	12.1	47.15	101.31	127.22	Granitic gneiss	Very Strong
3	1	1.12	D	15.5	47.11	90.31	163.19	Granitic gneiss	Very Strong
4	1	1.37	D	10.5	47.14	83.11	110.44	Granitic gneiss	Very Strong
5	2	1.65	D	16.2	47.13	84.91	170.44	Granitic gneiss	Very Strong
6	2	2.01	D	18.1	47.13	81.31	190.43	Granitic gneiss	Very Strong
7	2	2.34	D	17.2	47.13	103.48	180.96	Granitic gneiss	Very Strong
8	2	2.62	D	16.4	47.16	90.38	172.38	Granitic gneiss	Very Strong
9	2	2.92	D	15.3	47.13	85.76	160.97	Granitic gneiss	Very Strong
10									
11									

- \* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$   
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing  
\* Diametral Test should have  $0.7 \times D$  on either side of test point.



## POINT LOAD TEST SHEET

**Job No :** 19-5161-21  
**Project Name :** Hwy 69 Four-Laning North of Hwy 529  
**BH No :** OHS4-2  
**Core Size :** NQ

**Client :** MMM Group Limited  
**Date Drilled :** 2/16/2011  
**Date Tested :** 2/18/2011  
**Tester :** SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	0.25	D	14.7	47.13	80.93	154.66	Granitic gneiss	Very Strong
2	1	0.56	D	12.0	47.14	78.30	126.21	Granitic gneiss	Very Strong
3	1	0.86	D	12.2	47.15	76.31	128.27	Granitic gneiss	Very Strong
4	1	1.12	D	16.3	47.15	68.81	171.38	Granitic gneiss	Very Strong
5	1	1.40	D	20.7	47.15	75.41	217.64	Granitic gneiss	Very Strong
6	2	1.70	D	17.4	47.13	69.96	183.07	Granitic gneiss	Very Strong
7	2	2.03	D	21.0	47.13	73.82	220.94	Granitic gneiss	Very Strong
8	2	2.31	D	16.5	47.15	78.40	173.49	Granitic gneiss	Very Strong
9	2	2.69	D	17.4	47.15	69.38	182.95	Granitic gneiss	Very Strong
10	2	2.92	D	14.8	47.15	80.09	155.61	Granitic gneiss	Very Strong
11									

- \* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$   
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- \* Diametral Test should have  $0.7 \times D$  on either side of test point.

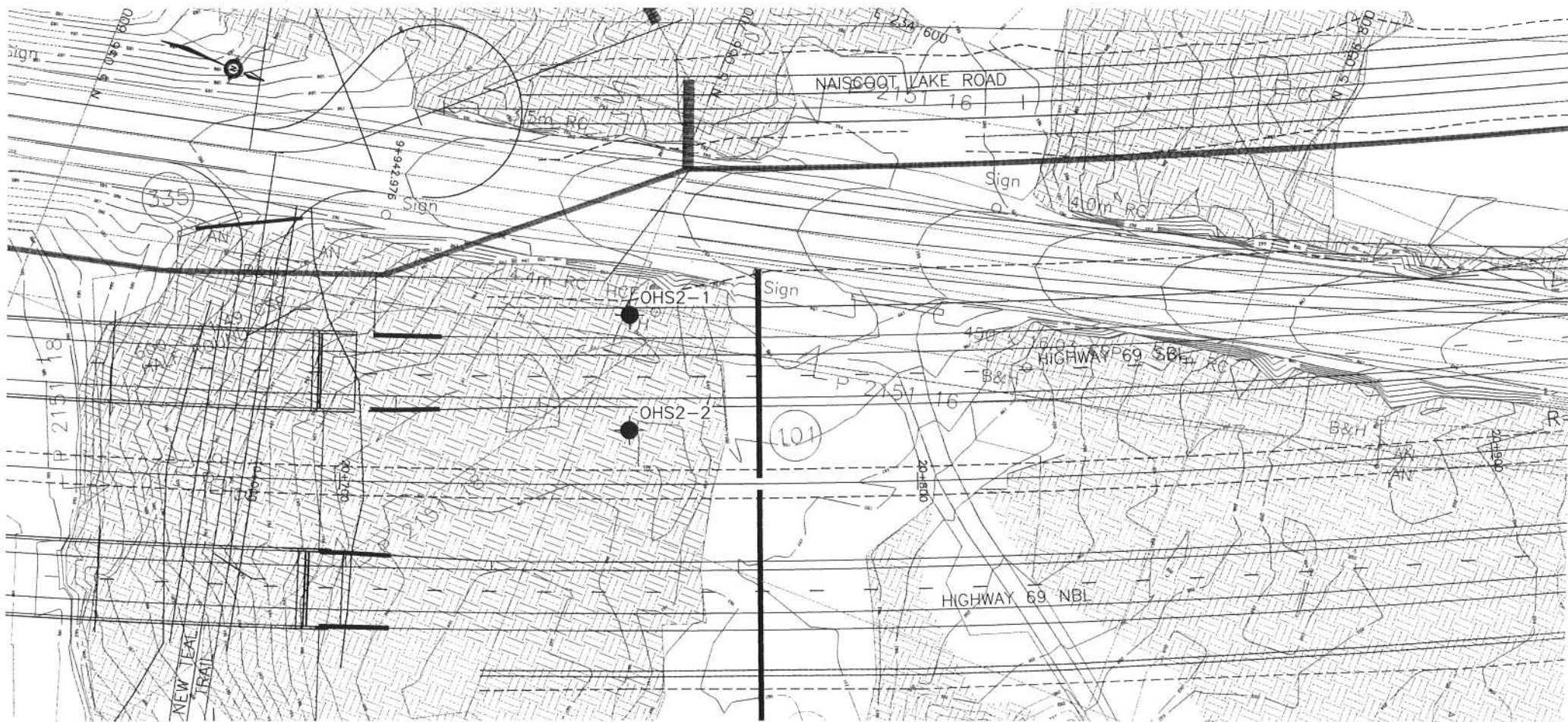
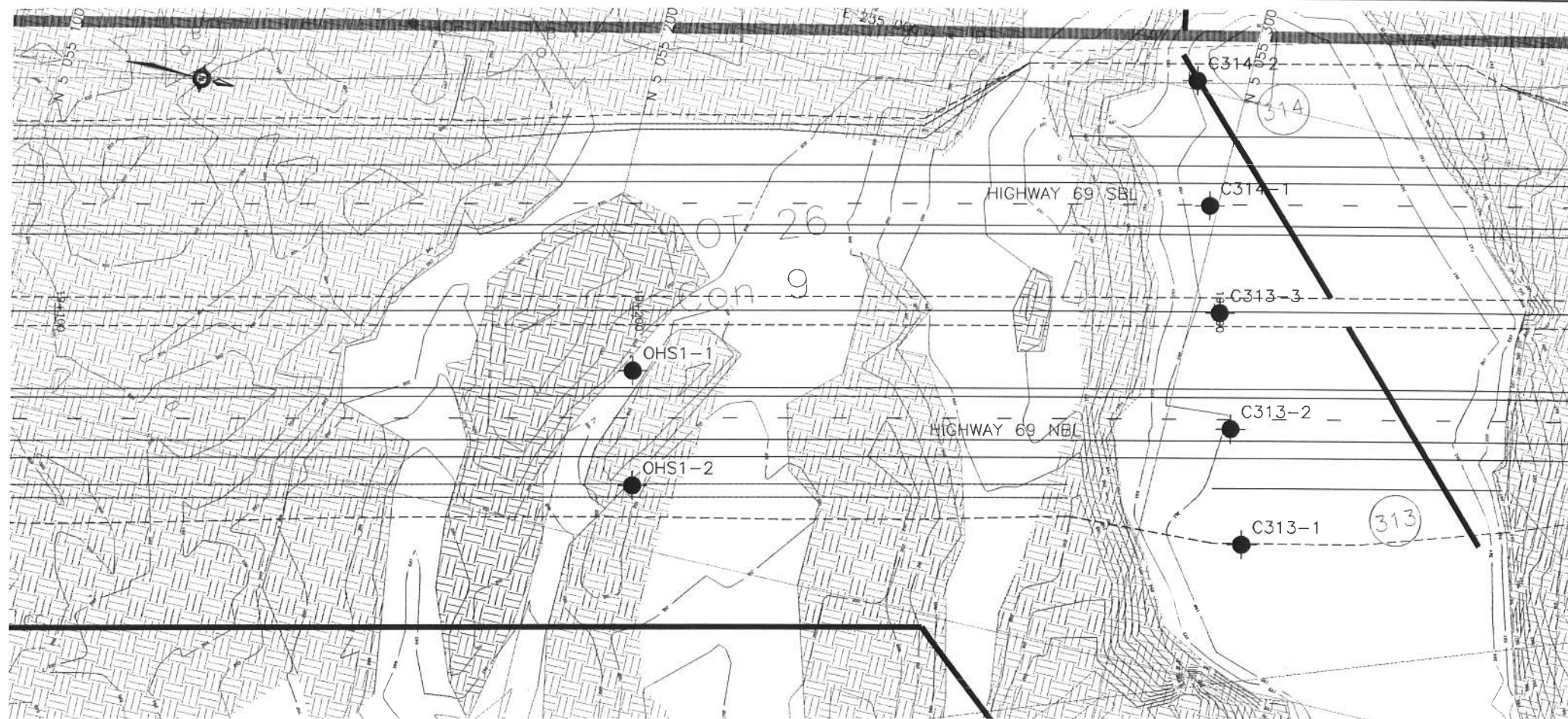
Overhead Signs

Hwy 69 – From the south junction of Hwy 529 northerly 15 km

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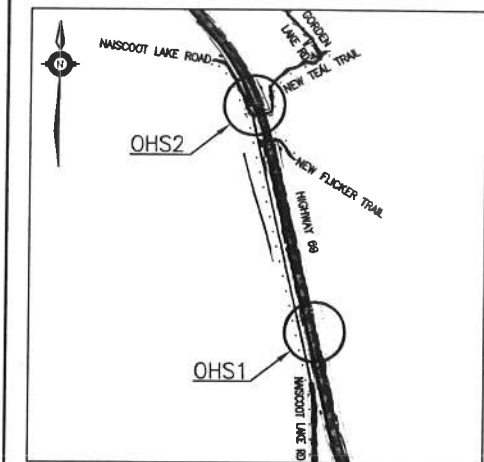
## **Appendix C**

**Drawings titled “Borehole Locations”**



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

CONT No  
WP No 5196-06-01  
HIGHWAY 69 FOUR-LANING  
OVERHEAD SIGNS  
OHS1(19+200)/OHS2(20+750)  
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN  
LEGEND

- Borehole
- Borehole and Cone
- 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
OHS1-1	201.6	5 055 208.7	235 070.0
OHS1-2	201.2	5 055 213.2	235 089.5
OHS2-1	197.6	5 056 700.9	234 665.1
OHS2-2	197.4	5 056 708.1	234 683.8

NOTES

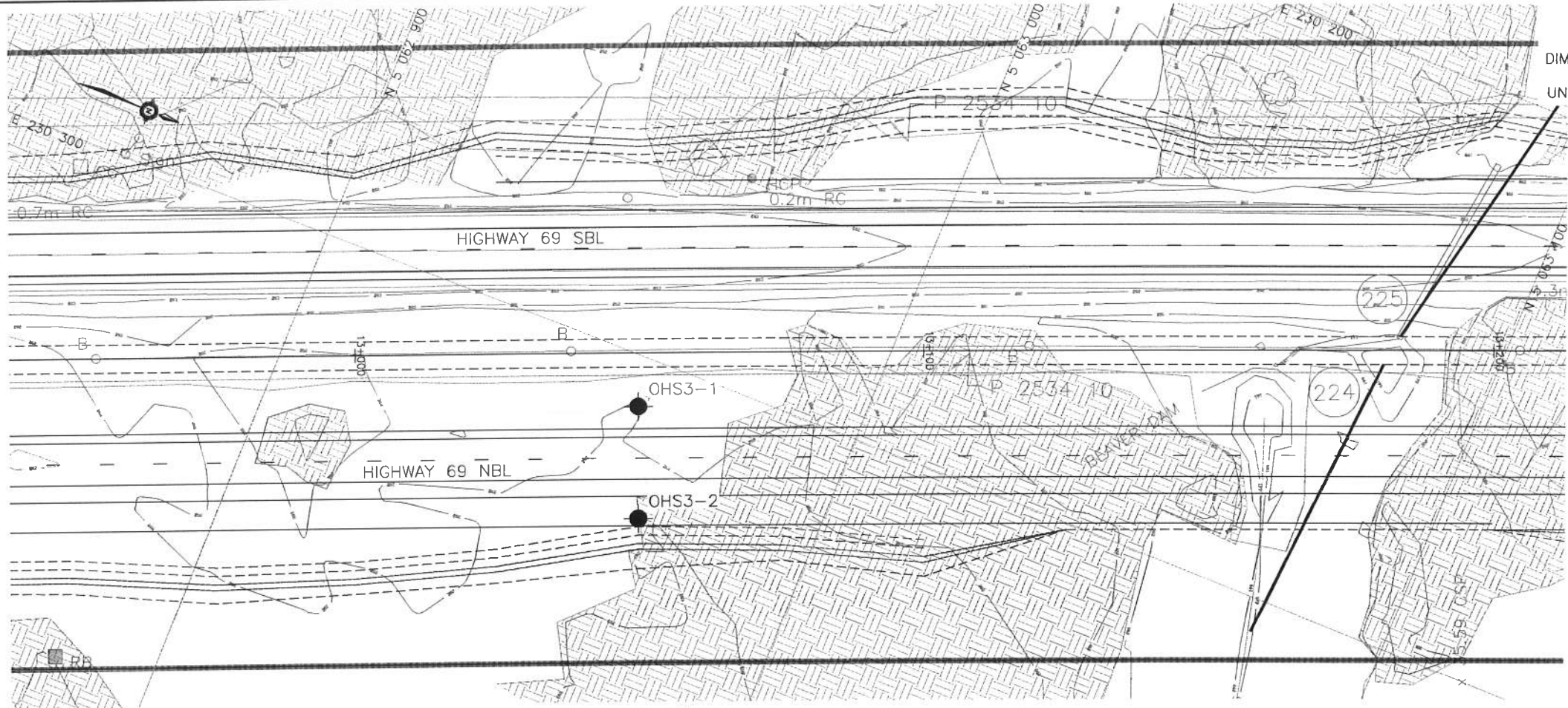
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 41H-103



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK AEG	CODE
DRAWN	MFA	CHK PKC	SITE
LOAD			DATE FEB. 2013
STRUCT			JDWG 1





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

CONT No  
WP No 5196-06-01

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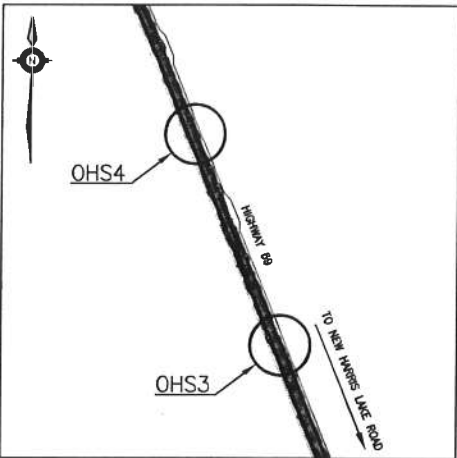
HIGHWAY 69 FOUR-LANING  
OVERHEAD SIGNS  
OHS3(13+050)/OHS4(14+550)  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET








**THURBER ENGINEERING LTD.**



## KEYPLAN

### LEGEND

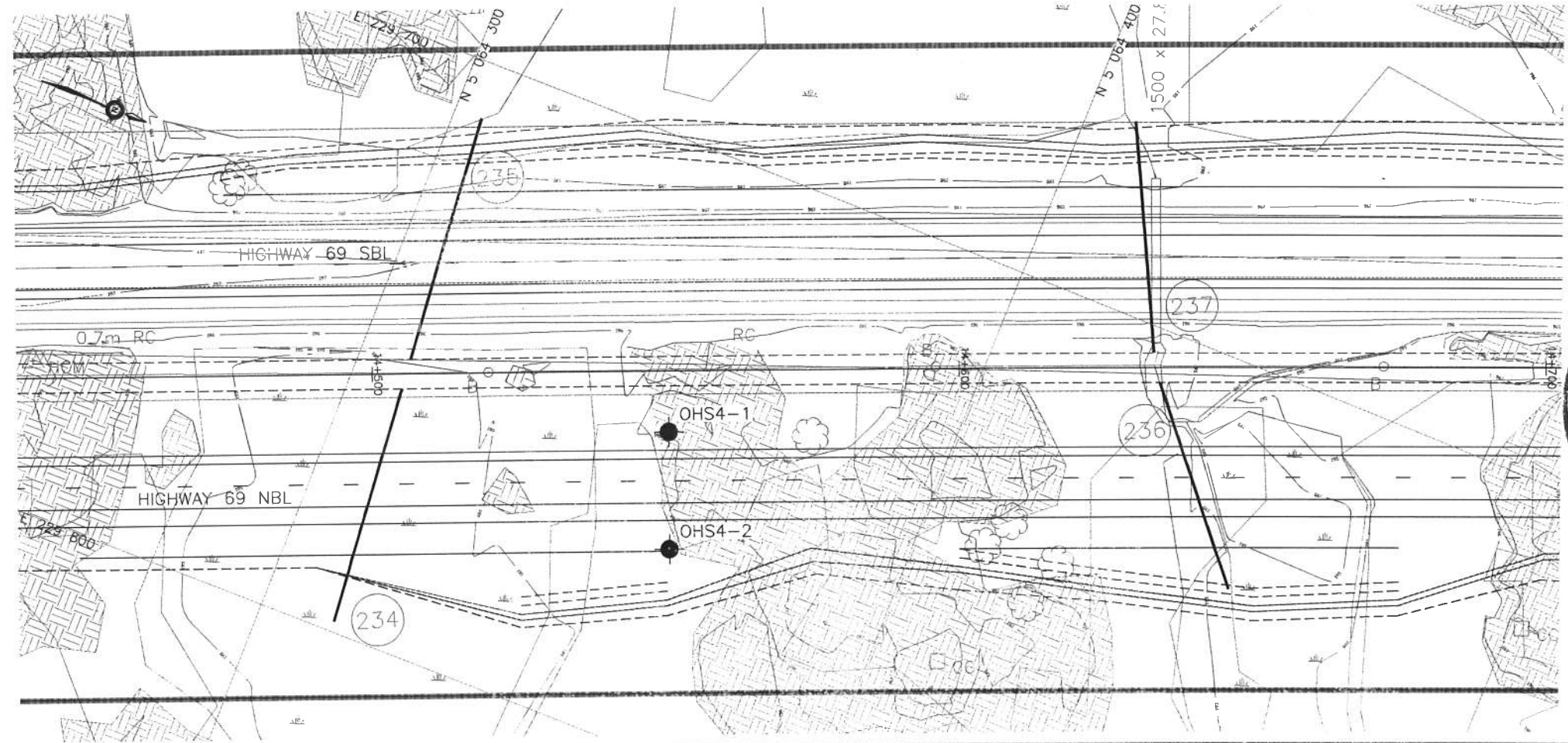
- |   |                                       |
|---|---------------------------------------|
|  | Borehole                              |
|  | Borehole and Cone                     |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60' Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic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

[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-103**

[illegible]