

**FOUNDATION INVESTIGATION REPORT
FOR
PINERIDGE ROAD UNDERPASS
W.P. 351-00-01, SITE 44-405
CONTRACT No. 2006-5156
G.W.P. No. 293-97-00**

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**FOUNDATION INVESTIGATION REPORT
FOR
PINERIDGE ROAD UNDERPASS
WP 351-00-01, SITE 44-405
G.W.P. 293-97-00
DISTRICT 52, TOWNSHIP OF McDOUGALL
HIGHWAY 69
NOBEL, ONTARIO**

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FOUNDATION INVESTIGATION REPORT

For
Pineridge Road Underpass
WP 351-00-01, Site 44-405
G.W.P. 293-97-00
District 52 Township of McDougall
Highway 69
Nobel, Ontario

1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for construction of the proposed Highway 69 underpass at Pineridge Road in Parry Sound (Nobel), Ontario. The investigation was carried out for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

The new alignment of Highway 69 will cross under Pineridge Road at approximate Station 19+000, Highway 69 chainage.

This report pertains to the proposed structure and approaches within 20 m of the abutments, between approximate stations 9+940 and 10+060, Pineridge Road chainage.

2. SITE DESCRIPTION

The site is located about 6.5 km north of Parry Sound in the Town of Nobel and about 350 m east of the existing Highway 69 alignment. The proposed underpass will provide a grade separation between new Highway 69 and the existing Pineridge Road. At the underpass, Highway 69 will run north south.

The structure location is presently an existing two-lane municipal road with residences to the north and wooded area to the south. The ground surface rises gently from west to east. Bedrock outcrops are evident immediately to the north and 30 m to the south of the underpass site.

The area is part of the Precambrian Laurentian peneplane. In general, the topography is relatively flat but quite irregular in detail with many small lakes separated by rocky ridges. The soil cover in the region is typically shallow, but can vary substantially in thickness over short distances. Swamp environments have developed in areas of poor drainage.

The bedrock formations are of Precambrian age and are largely composed of veined, banded, and homogeneous pink and grey gneisses produced by injection and granitization of metamorphic gneisses of various types.

3. INVESTIGATION PROCEDURES

The field work was carried out during the period August 9 to 14, 2001 and comprised twenty boreholes advanced to refusal on bedrock/probable bedrock at depths of 0.10 to 5.75 m at the locations shown on Drawing ST2-1. Eighteen boreholes were drilled at the locations of the proposed abutments and centre pier; two boreholes were drilled in the embankment approaches some 20 m beyond the abutments. The bedrock was proven by coring below the soil/bedrock interface in two boreholes located at opposite corners of each of the foundation elements. These cores were 3.05 to 3.60 m long, and extended to a maximum depth of 8.40 m below existing grades.

McCormick Rankin Corporation staked out the alignment of the abutments and centre pier. Peto MacCallum Ltd. selected the location of the boreholes. The ground surface elevations of the boreholes were determined by Peto MacCallum Ltd. and referred to a geodetic benchmark provided by McCormick Rankin Corporation.

The boreholes were advanced using continuous flight hollow stem augers through the soil cover and NQ rotary diamond drilling into the bedrock. The holes were advanced with a truck-mounted CME-75 drill rig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff.

The groundwater conditions in the boreholes were closely monitored during the course of the field work.

The recovered soil and rock core samples were returned to our laboratory for detailed visual examination, classification and moisture content determination. Grain size distribution analyses were conducted on three representative samples and compressive strength testing of three rock core specimens was carried out.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets and Table I for details of the subsurface conditions including soil classifications, inferred stratigraphy, rock core descriptions, natural moisture content determinations, results of grain size analyses and groundwater observations. The results of the laboratory grain size analyses are also shown on Figures 1 and 2; the rock core unconfined compressive strength test results are provided in Section 4.6 of this report. Stratigraphic profiles prepared from the borehole data are presented on Drawing ST2-1.

The stratigraphy revealed in the boreholes generally comprised a surficial asphalt pavement or a shallow layer of topsoil overlying discontinuous silty sand, fine to medium sand, and localized silty sand till deposits. Cobbles and/or boulders were detected in the sandy soil in some boreholes. The soils overlaid bedrock/probable bedrock in all boreholes. The strata encountered are described below.

4.1 Pavement Structure

The pavement structure was encountered in the boreholes drilled on Pineridge Road. It typically ranged in thickness from 900 to 1500 mm and comprised 50 to 100 mm of asphalt over 800 to 1450 mm of sand and gravel. In borehole ST-20 the pavement was 2.45 m thick. Cobbles/boulders were noted within the granular material in some boreholes. The pavement was constructed on probable bedrock at the west approach embankment, borehole ST2-19 and west abutment, borehole ST2-3.

4.2 Fill

Loose to compact silty sand some gravel and local organics was encountered on the north end of the proposed east abutment, in boreholes ST2-13 and 14. Borehole ST2-13 was terminated on cored bedrock at 0.95 m depth, elevation 212.50. Borehole ST2-14 was terminated at 1.50 m depth due to underground service clearance limitations. Water content determinations ranged from 1 to 18%, indicating damp to wet conditions.

4.3 Topsoil

Topsoil was encountered at the surface north of the road pavement, in boreholes ST2-1, 2, 4, 14, and 16. The topsoil was 100 to 250 mm thick and extended to probable bedrock in borehole ST2-1.

4.4 Silty Sand/Sand

A discontinuous layer of loose to dense, typically compact, cohesionless silty sand and sand with varying amounts of silt, gravel and clay was encountered at the surface in boreholes ST2-7 and ST2-8, and below the pavement and topsoil units in the other boreholes. Cobbles/boulders were identified in the silty sand/sand units in some

boreholes. The silty sand/sand layers extended to 0.40 to 5.75 m depth and covered bedrock/probable bedrock. The grain distribution of a representative sample of the fine to medium sand is provided on Figure 1. Natural moisture content determinations in these materials ranged from 8 to 22%, indicating moist to wet conditions.

4.5 Glacial Till

Glacial till consisting of cohesionless compact silty sand and sand with some silt, trace of clay and variable gravel content was encountered in boreholes ST2-6 (west abutment) and ST2-9 (centre pier). The till extended to 2.00 and 2.20 m depths, elevations 211.25 and 212.35, respectively and mantled probable bedrock. The grain size distribution of two samples of this material is shown on Figure 2. Natural moisture content determinations of 8 to 14% indicated moist conditions.

4.6 Bedrock

Bedrock/probable bedrock was encountered at all borehole locations at depths of 0.10 to 5.75 m and proven by coring 3.05 to 3.60 m below the soil/bedrock interface in two boreholes located at opposite corners of each abutment and the centre pier (boreholes ST2-2 and 5 at the west abutment, ST2-7 and 12 at the centre pier and ST2-13 and 18 at the east abutment). These boreholes extended to depths of 3.95 to 8.40 m below the ground surface.

The interface between the soil and bedrock/probable bedrock was encountered at the following depths and elevations:

LOCATION	ELEVATION		DEPTH (m)		RELEVANT BOREHOLES
	LOWEST	HIGHEST	MINIMUM	MAXIMUM	
West Approach	211.45		1.05		ST2-19
West Abutment	211.20	213.00	0.10	2.00	ST2-1 to 6
Centre Pier	209.60	213.90	1.25	4.80	ST2-7 to 12
East Abutment	210.15	212.50	0.95	3.50	ST2-13 to 18
East Approach	207.65		5.75		ST2-20

The soil/bedrock interface generally follows the longitudinal ground surface topography. The interface generally slopes from north to south with relief of about 2 m at the abutments and 4 m at the centre pier.

It is noteworthy, however, that bedrock was encountered at depths of 1.25 to 2.20 m, elevations 212.35 to 213.90 in five of the six holes drilled at the centre pier.

The bedrock consists of granitic gneiss and pegmatite. Core recovery ranged from 70 to 100%. The RQD of the rock typically ranged from 57 to 100%, indicating fair to excellent quality. The initial 0.65 and 0.86 m long sections of two cores (boreholes ST2-2 and 12) had an RQD of 44%, indicating locally poor quality. The RQD of a 0.15 m long core section in borehole ST2-13 was 0% and is not considered to be representative of the bedrock quality due to equipment malfunction. A detailed description of the rock cores recovered from the boreholes is provided on attached Table I.

The results of unconfined compressive strength tests of selected core samples were as follows:

BOREHOLE NO.	SAMPLE NO.	DEPTH (m)	UNIT WEIGHT (kN/m ³)	COMPRESSIVE STRENGTH (MPa)
ST2-5	5	3.5	27.2	81.0
ST2-12	8	8.0	25.7	47.0
ST2-18	5	5.0	26.0	109.3

4.7 Groundwater

Groundwater was not observed in most boreholes during drilling. Groundwater was noted in five boreholes at the depths and elevations summarized in the following table.

LOCATION	BOREHOLE NO.	DEPTH (m)	ELEVATION
West Approach	ST2-19	No free water	-
West Abutment	ST2-5	1.20	211.80
Centre Pier	ST2-12	2.45	211.95
East Abutment	ST2-17	2.75	211.05
East Approach	ST2-20	4.10	209.30

The groundwater is perched in the sandy soils above the bedrock surface. Groundwater levels at the site are subject to seasonal fluctuations and rainfall patterns.

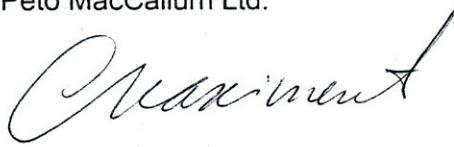
5. CLOSURE

The field work was carried out under the supervision of Mr. F. Portela, C.E.T. Marathon Drilling Inc. supplied the drilling equipment. This report was written by Mr. C.M.P. Nascimento, P. Eng., Senior Consultant and reviewed by Mr. D.W. Kerr, M.Eng., P.Eng., Manager of Geotechnical and Geo-Environmental Services, Hamilton. Mr. B.R. Gray, M.Eng, P.Eng., President of Peto MacCallum Ltd., conducted an independent review of the report.

Yours very truly

Peto MacCallum Ltd.

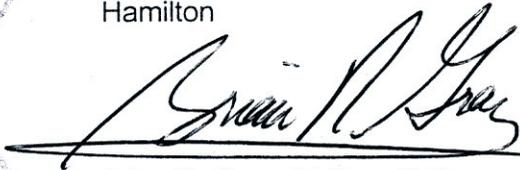



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TABLE I

**ROCK CORE DESCRIPTION
PINERIDGE ROAD UNDERPASS
WP 351-00-01, SITE 44-405
G.W.P. 293-97-00
DISTRICT 52, TOWNSHIP OF McDOUGALL
HIGHWAY 69
NOBEL, ONTARIO**

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	RUN NO.	DEPTH (m)	RECOVERY %	RQD %	DEPTH (m)	DESCRIPTION
ST2-2	2	0.75 – 1.40	75	44	0.75 – 3.95	GRANITIC GNEISS: grey; medium to coarse crystalline; medium strong to strong; unweathered; moderately spaced flat to dipping partings; smooth to rough planar; tight; poor to excellent quality.
	3	1.40 – 2.90	98	95		
	4	2.90 – 3.95	100	99		
ST2-5	3	1.80 – 3.04	90	71	1.80 – 5.00	GRANITIC GNEISS: pink and grey; medium to coarse crystalline; medium strong to strong; slightly to unweathered; close to moderately spaced flat to vertical partings; smooth to rough undulating planar; tight; fair to excellent quality.
	4	3.04 – 3.25	100	100		
	5	3.25 – 4.54	100	100		
	6	4.54 – 5.00	100	100		
ST2-7	3	1.25 – 2.76	93	85	1.25 – 4.30	GRANITIC GNEISS: pink, green to black; medium to coarse crystalline; medium strong to strong; unweathered; moderately spaced dipping to vertical partings; smooth to rough undulating planar; no water recovery after 2.65 m; good to excellent quality.
	4	2.76 – 4.30	99	98		
ST2-12	5	4.80 – 5.66	71	44	4.80 – 5.65	GRANITIC GNEISS: pink and green; fine to medium crystalline; medium strong to strong; slightly weathered to unweathered; closely spaced dipping to vertical partings; smooth planar; oxidized; poor quality.
	6	5.66 – 6.09	100	97	5.65 – 8.40	PEGMATITE: pink and grey; coarse crystalline; medium strong to strong; slightly weathered to unweathered; close to moderately spaced flat to vertical partings; smooth to undulating planar; tight; fair to excellent quality.
	7	6.09 – 7.62	97	68		
	8	7.62 – 8.40	97	57		

Originated: FP
Compiled: RS/JW
Checked: CN

TABLE I

ROCK CORE DESCRIPTION
PINERIDGE ROAD UNDERPASS
WP 351-00-01, SITE 44-405
G.W.P. 293-97-00
DISTRICT 52, TOWNSHIP OF McDOUGALL
HIGHWAY 69
NOBEL, ONTARIO

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	RUN NO.	DEPTH (m)	RECOVERY %	RQD %	DEPTH (m)	DESCRIPTION
ST2-13	2	0.95 – 1.75	93	70	0.95 – 2.20	PEGMATITE: pink and grey; coarse crystalline; medium strong to strong; slightly weathered to unweathered; closely spaced flat partings; smooth planar; tight; very poor to fair quality.
	3	1.75 – 1.90	70	0		
	4	1.90 – 3.42	88	87	2.20 – 4.35	GRANITIC GNEISS: pink and green; medium to coarse crystalline; slightly weathered to unweathered; vertical to dipping partings; smooth to rough planar; oxidized to tight; good quality.
	5	3.42 – 4.35	89	89		
	4	3.50 – 4.67	83	73	3.50 – 6.65	GRANITIC GNEISS: pink, grey; medium to coarse crystalline; medium strong to strong; slightly weathered to unweathered; close to moderately spaced flat partings; smooth planar; tight to oxidized; fair to excellent quality. Pegmatite zone near bottom of core.
5	4.67 – 6.19	100	100			
6	6.19 – 6.65	92	67			

Originated: FP
Compiled: RS/JW
Checked: CN

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
WS	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	e_{max}	1, %	VOID RATIO IN LOOSEST STATE
γ_s	kn/m^3	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	e_{min}	1, %	VOID RATIO IN DENSEST STATE
ρ_w	kg/m^3	DENSITY OF WATER	S_r	%	DEGREE OF SATURATION	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
γ_w	kn/m^3	UNIT WEIGHT OF WATER	w_L	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_p	%	PLASTIC LIMIT	D_n	mm	n PERCENT - DIAMETER
γ	kn/m^3	UNIT WEIGHT OF SOIL	w_s	%	SHRINKAGE LIMIT	C_u	1	UNIFORMITY COEFFICIENT
ρ_d	kg/m^3	DENSITY OF DRY SOIL	I_p	%	PLASTICITY INDEX = $\frac{w_L - w_p}{I_p}$	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kn/m^3	UNIT WEIGHT OF DRY SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m^3/s	RATE OF DISCHARGE
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kn/m^3	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kn/m^3	UNIT WEIGHT OF SUBMERGED SOIL	WTPL		WETTER THAN PLASTIC LIMIT	j	kn/m^3	SEEPAGE FORCE
e	1, %	VOID RATIO						

RECORD OF BOREHOLE No ST2-1 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 653.9 N; 260 696.2 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 09, 2001 CHECKED BY _____

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			"N" VALUES	20	40	60	80						100	20
213.10	Ground Surface																	
0.00 0.10	Topsoil				6/10cm**													
	End of borehole Refusal on probable bedrock																	
	* Borehole dry upon completion																	
	** Refusal to spoon																	

RECORD OF BOREHOLE No ST2-2 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 655.6 N; 260 701.0 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Hollow Stem Augers and Diamond Coring COMPILED BY FP/DH
 DATUM Geodetic DATE August 13, 2001 CHECKED BY _____

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			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
213.30	Ground Surface															
0.00 0.10	Topsoil		1	SS	22											
212.55	Silty sand															
0.75	Compact Brown Damp Granitic Gneiss Bedrock Fractured Sound		2	RC NQ	REC 75%										RQD 44%	
			3	RC NQ	REC 98%										RQD 95%	
			4	RC NQ	REC 100%										RQD 99%	
209.35 3.95	End of borehole * 2001 08 13 Borehole charged with drill water; Groundwater level not established															

RECORD OF BOREHOLE No ST2-3 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 649.8 N; 260 699.0 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 10, 2001 CHECKED BY _____

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			"N" VALUES	20	40	60	80					
213.20	Ground Surface															
0.00	50mm asphalt over sand and gravel	X	1	SS	29											
	Compact Brown Damp (PAVEMENT)	X														
211.80		X														
1.40	End of borehole Refusal on probable bedrock															
	* Borehole dry upon completion															

RECORD OF BOREHOLE No ST2-4 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 654.8 N; 260 698.6 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 13, 2001 CHECKED BY _____

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			"N" VALUES	20	40	60	80						100
213.20	Ground Surface																
0.00																	
212.80	Topsoil		1	SS	17/25cm**	213											
0.40	Silty sand Compact Brown Damp																
	End of borehole Refusal on probable bedrock																
	* Borehole dry upon completion																
	** Refusal to spoon																

RECORD OF BOREHOLE No ST2-7 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 667.1 N; 260 733.9 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Hollow Stem Augers and Diamond Coring COMPILED BY FP/DH
 DATUM Geodetic DATE August 13, 2001 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	GR	SA	SI
215.15 0.00	Ground Surface Silty sand Compact Brown Damp Boulders		1	SS	6/15cm**															
213.90 1.25	Granitic Gneiss Bedrock Sound		2	RC NQ*																
			3	RC NQ	REC 93%															RQD 85%
				4	RC NQ	REC 99%														
210.85 4.30	End of borehole																			

* 2001 08 13
Borehole charged with drill water;
Groundwater level not established

** Refusal to spoon

RC NQ* Cored through boulder

At 2.65 to 4.30 m, 0% drill water recovery indicating fracture in bedrock

RECORD OF BOREHOLE No ST2-8 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 668.8 N; 260 738.8 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 13, 2001 CHECKED BY _____

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			"N" VALUES	20	40	60	80						100	20
215.05 0.00	Ground Surface																	
	Silty sand Loose Brown Damp		1	SS	4													
213.40 1.65	End of borehole Refusal on probable bedrock		2	SS	7/15cm**													
	* Borehole dry upon completion ** Refusal to spoon																	

RECORD OF BOREHOLE No ST2-9 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 663.0 N; 260 736.8 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 10, 2001 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	w		
214.55	Ground Surface															
0.00	100mm asphalt over sand and gravel	X	1	SS	25											
213.65	Compact Brown Damp (PAVEMENT)	X														
0.90	Sand some silt some gravel trace clay	o														
212.35	Compact Brown Moist (TILL)	o	2	SS	25										12 72 14 2	
2.20	End of borehole Refusal on probable bedrock															
	* Borehole dry upon completion															

RECORD OF BOREHOLE No ST2-10 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 658.0 N; 260 737.2 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 09, 2001 CHECKED BY _____

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			"N" VALUES	20	40	60	80						100
214.35	Ground Surface																
0.00	50mm asphalt over sand and gravel	X	1	SS	7												
	Loose <u>Brown</u> <u>Damp</u> (PAVEMENT) Boulders	X															
212.85																	
1.50																	
212.50	Fine to medium sand trace gravel		2	SS	32/30cm**												
1.85	Dense <u>Brown</u> <u>Moist</u>																
	End of borehole Refusal on probable bedrock																
	* Borehole dry upon completion																
	** Refusal to spoon																

RECORD OF BOREHOLE No ST2-11 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 657.2 N; 260 734.7 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 09, 2001 CHECKED BY _____

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			"N" VALUES	20	40	60	80					
214.35	Ground Surface															
0.00	50mm asphalt over sand and gravel, organic inclusions	X	1	SS	10											
	Compact Brown Damp (PAVEMENT)	X														
213.15																
1.20	Fine to medium sand trace gravel	.	2	SS	37											
212.50	Dense Brown Moist															
1.85	End of borehole Refusal on probable bedrock															
	* Borehole dry upon completion															

RECORD OF BOREHOLE No ST2-12 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 658.9 N; 260 739.6 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Hollow Stem Augers and Diamond Coring COMPILED BY FP/DH
 DATUM Geodetic DATE August 09, 2001 CHECKED BY _____

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			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
214.40 0.00	Ground Surface															
	50mm asphalt over sand and gravel Compact Brown Damp (PAVEMENT)		1	SS	14						o					
213.20 1.20	Fine to medium sand trace silt trace gravel Dense Brown Moist Boulders		2	SS	28/20cm**						o					
	Compact Grey Wet		3	SS	12						o					
209.60 4.80	Granitic Gneiss Bedrock Fractured		4	SS	25/25cm**						o					
208.75 5.65	Pegmatite Bedrock Sound		5	RC	REC 71%											RQD 97%
			6	RC NQ	REC 100%											RQD 68%
			7	RC NQ	REC 97%											RQD 57%
206.00 8.40	End of borehole		8	RC NQ	REC 97%											
	* 2001 08 09 ∇ Water level observed during drilling ** Refusal to spoon															

RECORD OF BOREHOLE No ST2-13 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 680.4 N; 260 771.7 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Hollow Stem Augers and Diamond Coring COMPILED BY FP/DH
 DATUM Geodetic DATE August 13, 2001 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	w			W _L	GR
213.45	Ground Surface																	
0.00	Silty sand, organics Loose Brown Damp (FILL)		1	SS	6													
212.50	Pegmatite Bedrock		2	RC NQ	REC 93%													RQD 70%
0.95	Fractured Sound		3	RC NQ	REC 70%													RQD 0%
211.25	Granitic Gneiss Bedrock		4	RC NQ	REC 88%													RQD 87%
2.20			5	RC NQ	REC 89%													RQD 89%
209.10	End of borehole																	
4.35																		

RECORD OF BOREHOLE No ST2-14 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 682.1 N; 260 776.5 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 14, 2001 CHECKED BY _____

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	20	40	60	80					
213.10	Ground Surface															
0.00	Topsoil	X	1	SS	10											
0.20	Sand some gravel Compact Brown Damp (FILL)															
211.60																
1.50	End of borehole															
	* Borehole dry upon completion Borehole terminated at 1.50m due to proximity to water main.															

RECORD OF BOREHOLE No ST2-15 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 676.2 N; 260 774.5 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 10, 2001 CHECKED BY _____

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			"N" VALUES	20	40	60	80						100
213.65 0.00	Ground Surface																
	100mm asphalt over sand and gravel	⊗	1	SS	20												
	Compact Brown Damp (PAVEMENT)																
212.60 1.05	Fine to medium sand trace gravel																
	Loose Brown Wet		2	SS	1												
210.65 3.00	End of borehole Refusal on probable bedrock																
	* 2001 08 10																
	∇ Water level observed during drilling																
	▼ Water level measured after drilling																

RECORD OF BOREHOLE No ST2-16 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 681.2 N; 260 774.1 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 14, 2001 CHECKED BY _____

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	20	40	60	80					
213.25	Ground Surface															
0.00																
0.25	Topsoil		1	SS	4											
212.25	Silty sand															
1.00	Loose Brown Damp															
1.00	End of borehole Refusal on probable bedrock															
	* Borehole dry upon completion															

RECORD OF BOREHOLE No ST2-17 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 670.3 N; 260 772.5 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 09, 2001 CHECKED BY _____

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			"N" VALUES	20	40	60	80					
213.80	Ground Surface															
0.00	50mm asphalt over sand and gravel Compact Brown Damp (PAVEMENT)	⊗	1	SS	28											
212.60																
1.20	Fine to medium sand Compact Brown Wet	⋯	2	SS	16											
210.70																
3.10	End of borehole Refusal on probable bedrock		3	SS	2/5ctu**											

RECORD OF BOREHOLE No ST2-18 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 672.0 N; 260 777.4 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Hollow Stem Augers and Diamond Coring COMPILED BY FP/DH
 DATUM Geodetic DATE August 10, 2001 CHECKED BY _____

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			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100	○ UNCONFINED + FIELD VANE						
						20	40	60	80	100	● QUICK TRIAXIAL × LAB VANE						
213.65 0.00	Ground Surface																
	50mm asphalt over sand and gravel	[X-hatched]	1	SS	12						○						
	Compact Brown Damp (PAVEMENT)																
212.45 1.20	Fine to medium sand trace silt trace clay	[Dotted]	2	SS	23							○				0 95 4 1	
	Compact Brown Moist																
	Grey			3	SS	18/23cm**						○					
210.15 3.50	Granitic Gneiss Bedrock	[Diagonal hatched]	4	RC NQ	REC 83%											RQD 73%	
	Sound			5	RC NQ	REC 100%											RQD 100%
				6	RC NQ	REC 92%											RQD 67%
207.00 6.65	End of borehole																

* Borehole charged with drill water; Groundwater level not established

** Refusal to spoon

RECORD OF BOREHOLE No ST2-19 1 of 1 METRIC

G.W.P. 351-00-01 LOCATION Co-ords. 5 029 643.2 N; 260 680.1 E. ORIGINATED BY FP
 DIST 52 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP/DH
 DATUM Geodetic DATE August 10, 2001 CHECKED BY _____

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	20	40	60	80	100	W _p	w			W _L	GR
212.50	Ground Surface																	
0.00	100mm asphalt over sand and gravel	X	1	SS	17													
211.45	Compact Brown Damp (PAVEMENT)	X																
1.05	End of borehole Refusal on probable bedrock																	
	* Borehole dry upon completion																	

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

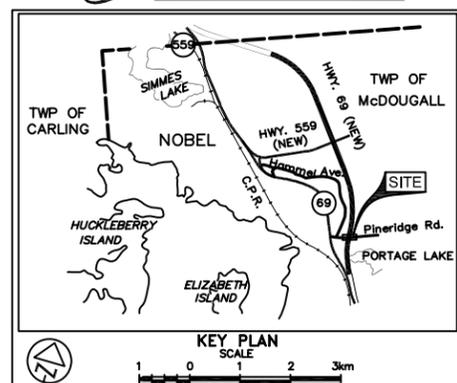
CONT No 2006-5156
GWP No 293-97-00



HIGHWAY 69 FOUR-LANING
(2.6 km North of Hwy 124, Northerly 4.8 km)
PINERIDGE ROAD UNDERPASS
BOREHOLE LOCATIONS & SOIL STRATA

SHEET
193

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- CONE Blows/0.3m (60° Cone, 475 J / blow)
- W L at time of investigation Aug 2001
- Head
- ARTESIAN WATER Encountered

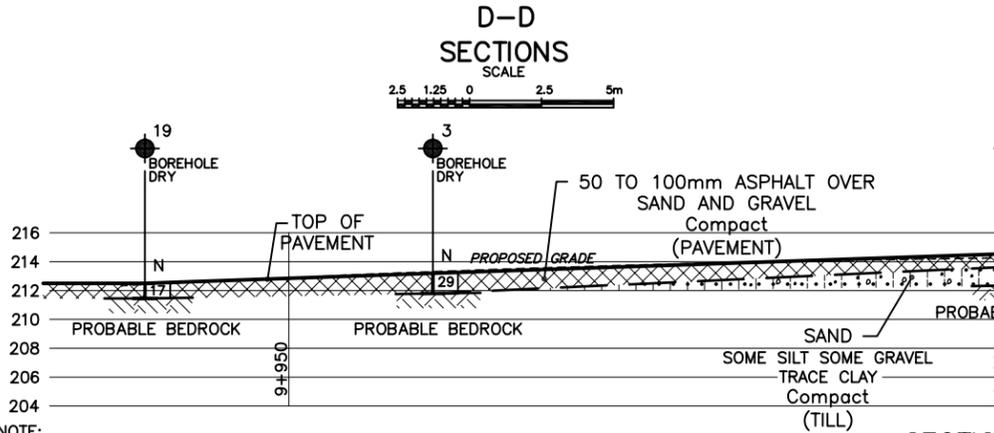
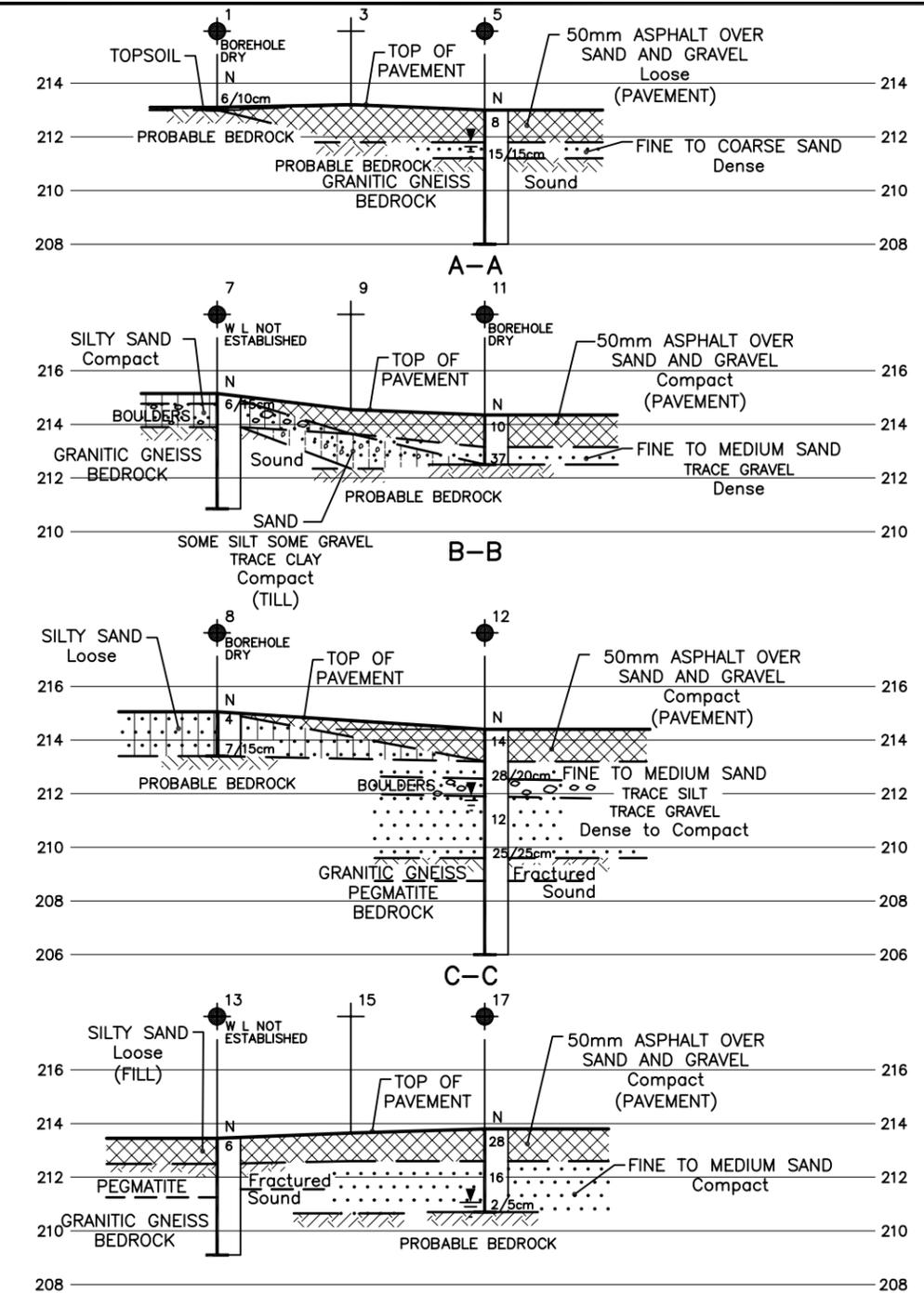
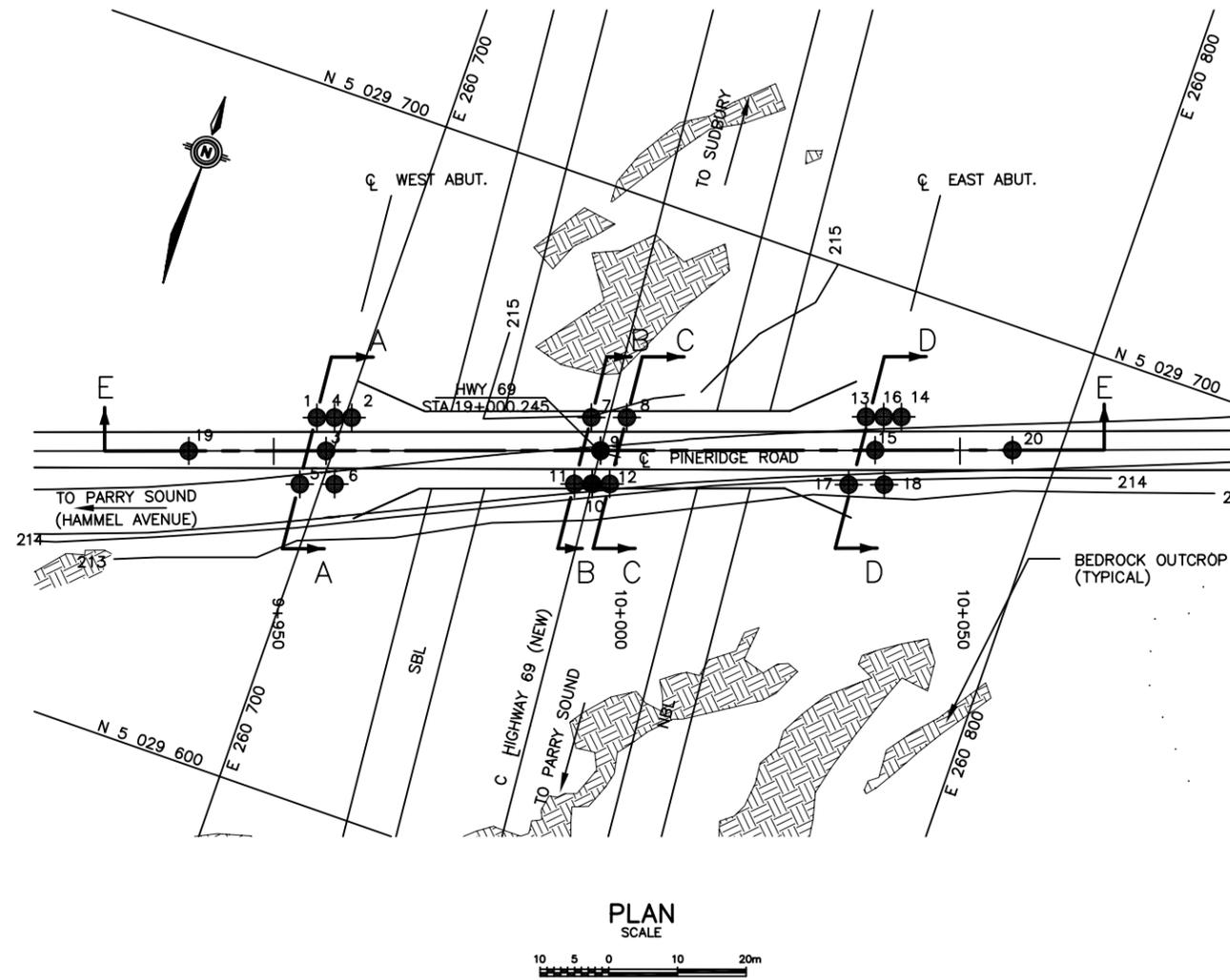
BH No	ELEVATION	CO-ORDINATES NORTH	EAST
ST2-1	213.10	5 029 653.9	260 696.2
ST2-2	213.30	5 029 655.6	260 701.0
ST2-3	213.20	5 029 649.8	260 699.0
ST2-4	213.20	5 029 654.8	260 698.6
ST2-5	213.00	5 029 644.0	260 697.0
ST2-6	213.25	5 029 645.7	260 701.9
ST2-7	215.15	5 029 667.1	260 733.9
ST2-8	215.05	5 029 668.8	260 738.8
ST2-9	214.55	5 029 663.0	260 736.8
ST2-10	214.35	5 029 658.0	260 737.2
ST2-11	214.35	5 029 657.2	260 734.7
ST2-12	214.40	5 029 658.9	260 739.6
ST2-13	213.45	5 029 680.4	260 771.7
ST2-14	213.10	5 029 682.1	260 776.5
ST2-15	213.65	5 029 676.2	260 774.5
ST2-16	213.25	5 029 681.2	260 774.1
ST2-17	213.80	5 029 670.3	260 772.5
ST2-18	213.65	5 029 672.0	260 777.4
ST2-19	212.50	5 029 643.2	260 680.1
ST2-20	213.40	5 029 682.9	260 793.4

NOTE
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	Contract No. Added	DESCRIPTION
	19/04/08	CN		

Geocres No. 41H-40

HWY No	69	DIST	52
SUBM'D	DH	CHECKED	CN
DATE	JULY 4, 2002	SITE	44-405
DRAWN	MM	CHECKED	CN
APPROVED	DWK	DWG	ST2-1



NOTE:
SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

SECTION E-E SCALE
5 2.5 0 5 10m

REF No E-01-020 Base; H4545c03.dwg; H4545xB1.dwg; H4545xB2.dwg; March, 2001
B04520069001.dwg; B04520069002.dwg; E04520069001.dwg; E04520069002.dwg; September, 2001

