



**TABLE A**  
**ROCK CORE DESCRIPTION**

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
C8a-1	1	0.0 – 1.5	92	66	0.0 – 4.5	GRANITIC GNEISS: Pink and grey, fine to medium crystalline, high strength, slightly weathered, close to moderate (locally very close) spaced flat to dipping cross joints, rough planar, tight to slightly altered with red oxidation on partings, numerous vertical single and multiple fissures, poor to fair becoming excellent quality.
	2	1.5 – 3.1	100	41		
	3	3.1 – 4.5	100	97		
C8a-2	1	0.4 – 1.9	100	100	0.0 – 4.5	MIGMATITE: Black medium to coarse crystalline in pink fine crystalline matrix, with garnetiferous zones, high strength, slightly weathered to unweathered, with layer of predominantly black mafic minerals between 2.0 and 2.7 m depth, medium strength, close to moderate (locally very close) spaced flat to dipping cross joints, rough planar, tight to slightly altered with red oxidation on partings, some vertical fissures, fair to excellent quality.
	2	1.9 – 3.4	96	59		
	3	3.4 – 5.0	100	81	4.5 – 5.0	PEGMATITE: Pink and black coarse crystalline, medium strength, unweathered, close spaced dipping cross joints, rough planar, tight, good quality.
C8a-3	1	0.4 – 1.9	98	79	0.4 – 4.9	GRANITIC GNEISS: Pink and grey, medium to coarse crystalline, with occasional concentrations of black biotite at depth, high strength, slightly weathered to unweathered, very close to close becoming close to moderate spaced flat to dipping cross joints, rough planar, tight to slightly altered with red oxidation and/or white scale on partings, good to excellent quality.
	2	1.9 – 3.3	100	100		
	3	3.3 – 4.9	97	88		

RQD – Rock Core Designation

Originated:	FP
Compiled:	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
W S	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
$u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	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
$C_\alpha$	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
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL












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

**RECORD OF BOREHOLE No C8a-1**

1 of 1

**METRIC**

W.P. 5269-05-01 and 5270-05-01 LOCATION Coords: 5 096 698.7 N; 221 560.3 E  
Hwy 69 (New), Sta. 20+764, o/s 21.3m Lt CL Med. ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Drilling COMPILED BY A.S.  
 DATUM Geodetic DATE June 10, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>		GR	SA	SI	CL
								<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>	<div><div></div></div>								
202.3	Ground Surface							20	40	60	80	100								
0.0	Granitic Gneiss bedrock						202													
	Slightly weathered																			
	High strength																			
	Poor to fair becoming excellent quality.																			
			1	RC NQ	REC 92%														RQD 66%	
							201													
																				
			2	RC NQ	REC 100%		200												RQD 41%	
																				
							199													
			3	RC NQ	REC 100%														RQD 97%	
197.8	End of borehole						198													
4.5																				
	* Borehole charged with drilling water																			

**METRIC**

**+<sup>7</sup>, ×<sup>5</sup>:** Numbers refer to Sensitivity

20  
15 — ○ — 5  
10

(%) STRAIN AT FAILURE

**RECORD OF BOREHOLE No C8a-3**

1 of 1

**METRIC**

W.P. 5269-05-01 and 5270-05-01 LOCATION Coords: 5 096 704.2 N; 221 607.2 E  
Hwy 69 (New), Sta. 20+764, o/s 25.8m Rt CL Med. ORIGINATED BY F.P.  
DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Rotary Diamond Coring COMPILED BY A.S.  
DATUM Geodetic DATE June 10, 2009 CHECKED BY C.N.

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							
204.2 0.0	Ground Surface						20	40	60	80	100						
204.0 0.2	Topsoil																
203.8 0.4	Sand, trace silt trace gravel, cobbles																
	Compact Brown Wet Granitic Gneiss bedrock		1	RC NQ	REC 98%											RQD 79%	
	Slightly weathered to unweathered																
	High strength																
	Good to excellent quality.		2	RC NQ	REC 100%											RQD 100%	
			3	RC NQ	REC 97%											RQD 88%	
199.3 4.9	End of borehole																
	* Borehole charged with drilling water																
	C.F.S.S.A. Denotes Continuous Flight Solid Stem Augers																

**RECORD OF BOREHOLE No C8a-P1 1 of 1 METRIC**

W.P. 5269-05-01 and 5270-05-01 LOCATION Coords: 5 096 697.8 N; 221 552.0 E ORIGINATED BY F.P.  
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probe COMPILED BY A.S.  
 DATUM Geodetic DATE June 23, 2009 CHECKED BY C.N.

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
199.6	Ground Surface					*											GR SA SI CL
0.0	Bedrock at surface																
	* Borehole dry																

# RECORD OF BOREHOLE No C8a-P2

1 of 1

**METRIC**

W.P. 5269-05-01 and 5270-05-01 LOCATION Coords: 5 096 698.1 N; 221 554.7 E  
Hwy 69 (New), Sta. 20+764, o/s 27.0m Lt CL Med. ORIGINATED BY F.P.

DIST 54 HWY 69 BOREHOLE TYPE Manual Probe COMPILED BY A.S.

DATUM Geodetic DATE June 23, 2009 CHECKED BY C.N.

[illegible]

# RECORD OF BOREHOLE No C8a-P3

1 of 1

**METRIC**

W.P. 5269-05-01 and 5270-05-01 LOCATION

Coords: 5 096 698.4 N; 221 557.7 E  
Hwy 69 (New), Sta. 20+764, o/s 24.0m Lt CL Med.

ORIGINATED BY F.P.

DIST 54 HWY 69 BOREHOLE TYPE Manual Probe

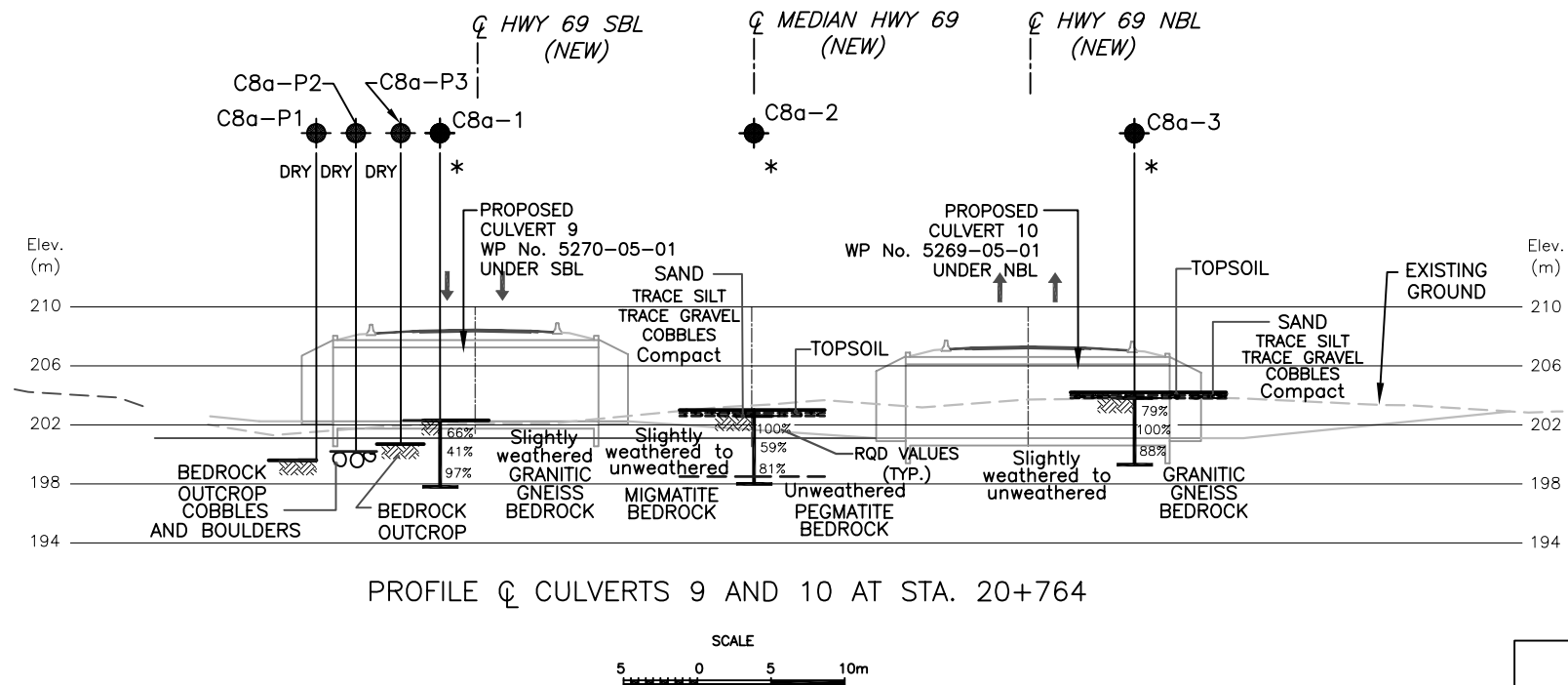
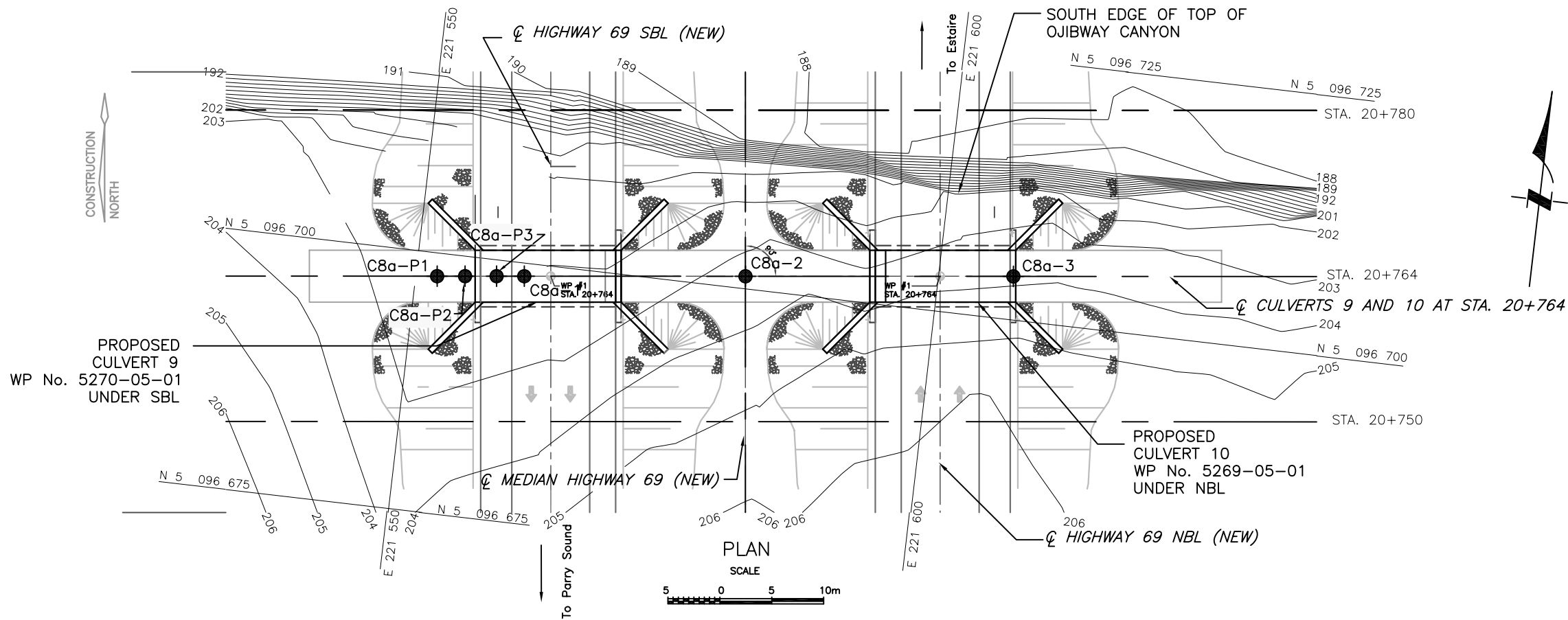
COMPILED BY A.S.

DATUM Geodetic DATE June 23, 2009

           CHECKED BY            C.N.

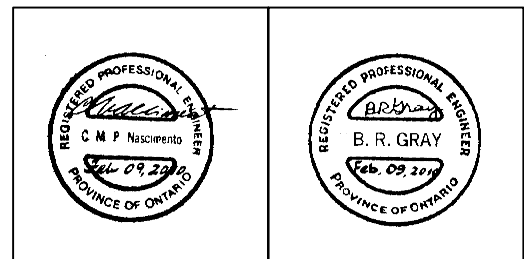
[illegible]





NOTES:

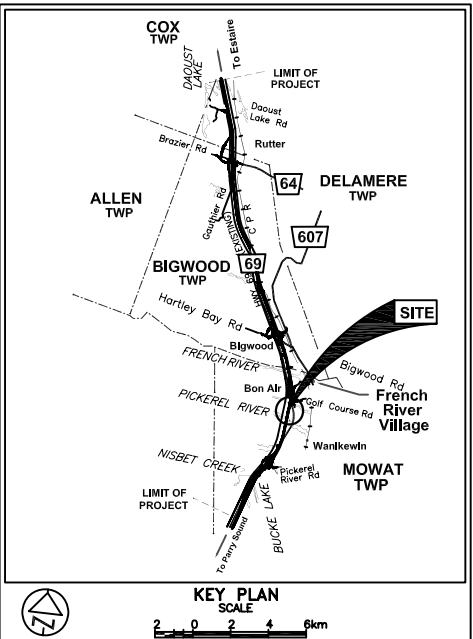
- DRAWING C8a-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- CULVERTS 9 AND 10 AT STA. 20+764 UNDER SBL AND NBL RESPECTIVELY, WERE DESIGNATED AS CULVERT C8a FOR THE INVESTIGATION.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



REF.: MRC DRAWINGS  
S6454-330-001GA.dwg; H6454\_PHASE3\_XA01.dwg;  
H6454\_PHASE3\_XN01.dwg; H6454xb2 contours zone 10.dwg

CONT No  
WP No 5269-05-01  
WP No 5270-05-01  
**CULVERTS 9 AND 10 (C8a)**  
HIGHWAY 69 FOUR-LANING  
STA. 20+764 - MOWAT TWP  
**BOREHOLE LOCATIONS AND SOIL STRATA**

**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)		
*	Water level not established		
	W L at time of investigation		
	Head ARTESIAN WATER Encountered		
	PIEZOMETER		
BH No	ELEVATION	CO-ORDS	
		NORTHING	EASTING
C8a-1	202.3	N 5 096 698.7	E 221 560.3
C8a-2	203.0	N 5 096 701.2	E 221 581.2
C8a-3	204.2	N 5 096 704.2	E 221 607.2
C8a-P1	199.6	N 5 096 697.8	E 221 552.0
C8a-P2	200.2	N 5 096 698.1	E 221 554.7
C8a-P3	200.7	N 5 096 698.4	E 221 557.7

— 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	DESCRIPTION

Geocres No. 411-251

HWY No	69	DIST	54
SUBM'D AS	CHECKED NR	DATE FEB. 09, 2010	SITE 44-431
DRAWN NA	CHECKED CN	APPROVED BRG	DWG C8a-1



## **APPENDIX A**

### Rock Core Photographs



**Photograph 1:** Culvert C8a, borehole C8a-1, samples RC-1 to RC-3. The RQD value ranged from 41 to 97%. Rock quality ranged from poor to fair becoming excellent.



**Photograph 2:** Culvert C8a, borehole C8a-2, samples RC-1 to RC-3. The RQD value ranged from 59 to 100%. Rock quality ranged from fair to excellent.





**Photograph 3:** Culvert C8a, borehole C8a-3, samples RC-1 to RC-3. The RQD value ranged from 79 to 100%. Rock quality ranged from good to excellent.