



TABLE A
ROCK CORE DESCRIPTIONS

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
C8-1	5	2.8 – 3.1	100	73	2.8 – 5.9	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping cross joints, rough planar with occasional horizontal slickensides, with some vertical fissures, tight to open to 1 mm, generally slightly altered with black silty infilling, occasional white scale, fair to excellent quality.
	6	3.1 – 4.3	100	70		
	7	4.3 – 5.9	100	99		
C8-3	7	4.9 – 6.0	98	15	4.9 – 8.1	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, very close to close spaced (moderate below 7.2 m) flat to dipping cross joints, rough planar with occasional horizontal slickensides, with numerous vertical fissures (some compound), tight to open (5 mm), generally slightly altered with black silty infilling, very poor to poor becoming excellent quality.
	8	6.0 – 7.6	100	29		
	9	7.6 – 8.1	100	100		
C8-5	7	5.2 – 6.3	100	100	5.2 - 8.3	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping (locally vertical) cross joints, rough planar, locally open (to 1 mm), tight to slightly altered with black silt infilling, occasional green scale on parting surface, good to excellent quality.
	8	6.3 – 7.2	100	85		
	9	7.2 – 8.3	100	95		

RQD = Rock Quality Designation

Originated: JFW
 Compiled: FP
 Checked: AS / CN

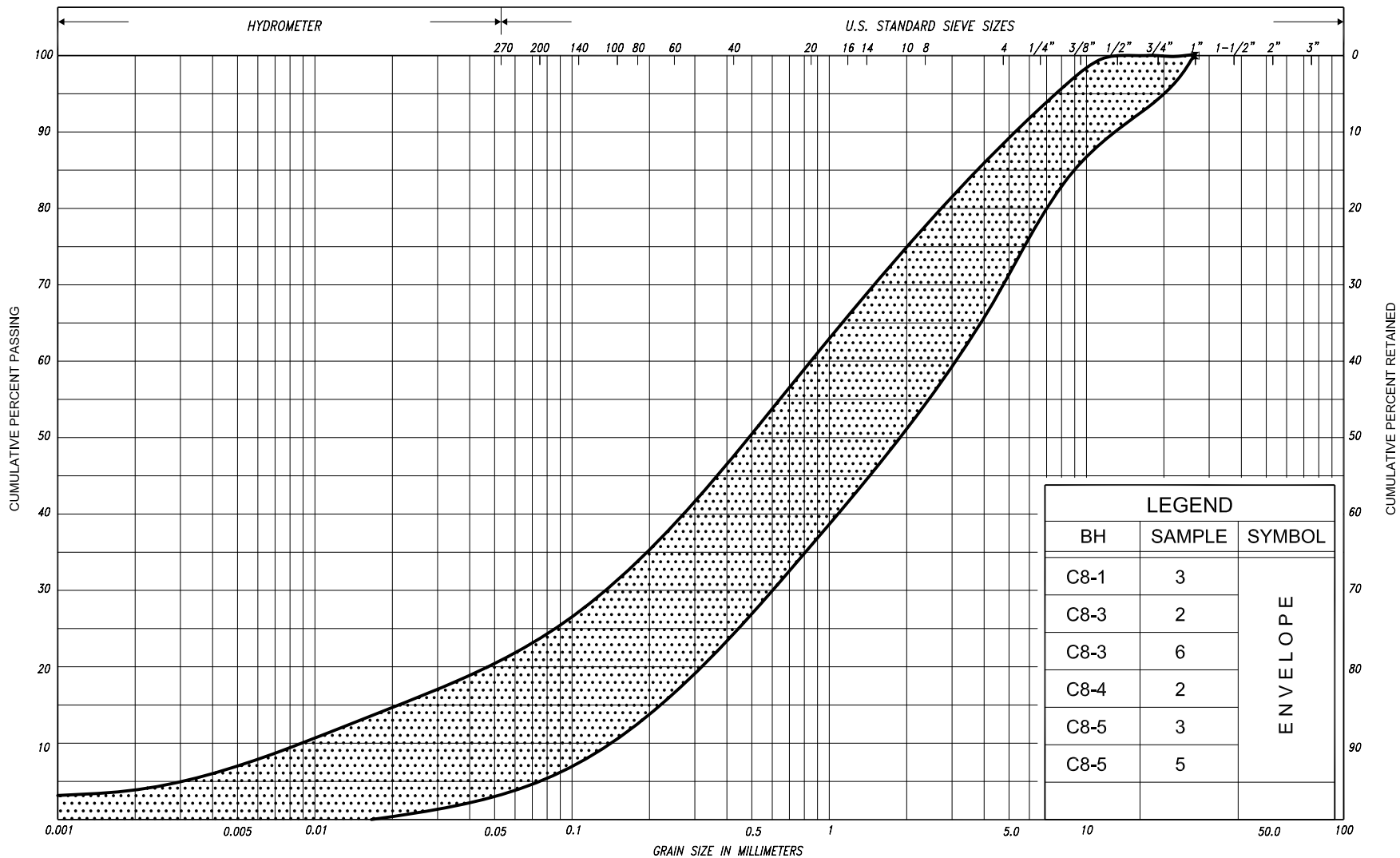


TABLE A
ROCK CORE DESCRIPTIONS

LOCATION (BH)	CORE RECOVERY				CORE DESCRIPTION	
	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
BRIDGE PIER - SBL Sta. 20+803, O/S 18.8 m LT CL	5	5.0 – 6.1	100	86	5.0 – 9.7	GABBRO: Dark green to black and grey, fine to medium crystalline, high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping cross joints, rough planar with occasional horizontal slickensides, with some vertical fissures, tight to open to 1 mm, generally slightly altered with black silty infilling, occasional white scale, good to excellent quality.
	6	6.1 – 7.6	95	91		
	7	7.6 – 9.1	100	88		
	8	9.1 – 9.7	96	85		

RQD = Rock Quality Designation

Originated: JFW
 Compiled: FP
 Checked: AS / CN



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COBBLES	UNIFIED			
				SAND														
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL		COBBLES	M.I.T.		
	SILT																	
CLAY			SILT			V. FINE		FINE		MED.		COARSE		GRAVEL				U.S. BUREAU
						SAND												

GRAIN SIZE DISTRIBUTION

SAND, some to with gravel
trace to some silt, trace clay

FIG No. C8-GS-1

HWY: 69

G.W.P. No. 5203-06-00

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
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 = $w_L - w_p$	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						

METRIC

Hwy 69 (New), Sta. 20+807.3, o/s 58m Lt CL Med.

ORIGINATED BY F.P.

COMPILED BY A.S.

____ CHECKED BY B.R.G.

20
15 —○— 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C8-2

1 of 1

METRIC

G.W.P. 5203-06-00 LOCATION Coords: 5 096 738.2 N; 221 538.6 E
Hwy 69 (New), Sta. 20+805.7, o/s 38.3m Lt CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY A.S.
DATUM Geodetic DATE March 02, 2009 CHECKED BY B.R.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa											WATER CONTENT (%)		
								○ UNCONFINED			+ FIELD VANE								● QUICK TRIAXIAL		
188.5 0.0	Top of Ice Snow and Ice							20	40	60	80	100	20	40	60						
187.8 0.7	Peat, coarse fibrous		1	CS	-	▼*	▽*														
187.3 1.2	Dark brown End of borehole																				
	Refusal on probable boulders																				
	* 2009 03 02																				
	▽ Water level observed during drilling																				
	▼ Water level measured after drilling																				

RECORD OF BOREHOLE No C8-3										1 of 1		METRIC					
G.W.P. 5203-06-00			LOCATION			Coords: 5 096 739.8 N; 221 577.1 E Hwy 69 (New), Sta. 20+803 CL Med.			ORIGINATED BY F.P.								
DIST 54 HWY 69			BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring						COMPILED BY A.S.								
DATUM Geodetic			DATE February 26 and 28, 2009						CHECKED BY B.R.G.								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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		ELEVATION SCALE	SHEAR STRENGTH kPa									
187.7 0.0	Top of Snow						20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
187.3 0.4	Snow and ice						20 40 60 80 100										
186.9 0.8	Peat, coarse fibrous		1	SS	20/5cm	187											
	Dark brown Wet																
	Sand, with gravel some silt, trace clay cobbles and boulders		2	SS	15	186										30 52 15 3	
	Loose to Grey Wet compact		3	SS	4	185											
			4	SS	16	184											
			5	SS	24	183											
182.8 4.9	with silt, some gravel		6	SS	12/17cm	182										15 61 20 4	
	Gabbro bedrock		7	RC NQ	REC 98%	181										RQD 15%	
	Slightly weathered to unweathered		8	RC NQ	REC 100%	180										RQD 29%	
	Hight strength		9	RC NQ	REC 100%											RQD 100%	
179.6 8.1	End of borehole																
	Samples 1 & 6: Sampler bouncing																
	* 2009 02 28																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																
	C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers																

RECORD OF BOREHOLE No C8-4 1 of 1 METRIC																
G.W.P. 5203-06-00		LOCATION		Coords: 5 096 740.9 N; 221 615.5 E Hwy 69 (New), Sta. 20+799.5, o/s 38.4m Rt CL Med.				ORIGINATED BY F.P.								
DIST 54 HWY 69		BOREHOLE TYPE		Continuous Flight Hollow Stem Augers				COMPILED BY A.S.								
DATUM Geodetic		DATE		March 01, 2009				CHECKED BY B.R.G.								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa									
187.7	Top of Snow						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					20 40 60 WATER CONTENT (%)				
0.0	Snow and ice															
187.3																
0.4	Peat, coarse fibrous															
186.9	Dark brown Wet															
0.8	Organic clayey silt		1	SS	21											
186.6	Dark grey Wet															
1.1																
	Sand some gravel, trace silt cobbles and boulders		2	SS	31											
	Compact to Grey Wet dense		3	SS	32											
			4	SS	23											
			5	SS	20/25cm											
183.3	End of borehole															
4.4	Refusal on probable bedrock															
	Sample 5: Sampler bouncing															
	* 2009 03 01															
	▽ Water level observed during drilling															
	▼ Water level measured after drilling															

RECORD OF BOREHOLE No C8-5										1 of 1		METRIC					
G.W.P. 5203-06-00			LOCATION			Coords: 5 096 741.7 N; 221 635.2 E Hwy 69 (New), Sta. 20+798, o/s 58m Rt CL Med.			ORIGINATED BY F.P.								
DIST 54 HWY 69			BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring						COMPILED BY A.S.								
DATUM Geodetic			DATE February 26, 2009						CHECKED BY B.R.G.								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
187.5 0.0	Top of Snow						20	40	60	80	100						
187.1 0.4	Snow and ice																
186.9 0.6	Peat, coarse fibrous Dark brown																
	Sand some gravel, trace silt cobbles and boulders Compact Grey Wet		1	SS	30												
			2	SS	21							○					
			3	SS	15							○				11 83 (6)	
	with gravel some silt, trace clay		4	SS	13							○					
			5	SS	27							○				24 61 12 3	
			6	SS	25							○					
182.3 5.2	Gabbro bedrock		7	RC NQ	REC 100%												RQD 100%
	Slightly weathered to unweathered Hight strength Good to excellent quality		8	RC NQ	REC 100%												RQD 85%
			9	RC NQ	REC 100%												RQD 95%
179.2 8.3	End of borehole																
<p>* 2009 02 28</p> <p>▽ Water level observed during drilling</p> <p>▼ Water level measured after drilling</p> <p>C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers</p>																	

RECORD OF BOREHOLE No P1-SBL 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Coords: 5 096 737.8 N; 221 558.4 E
 DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and NQ Diamond Coring ORIGINATED BY F.P.
 DATUM Geodetic DATE February 18 and 24, 2009 COMPILED BY A.S.
 CHECKED BY B.R.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	● QUICK TRIAXIAL	✕ LAB VANE	✚ FIELD VANE									
187.7	Ground Surface							20	40	60	80	100								
0.0	Peat, coarse fibrous		1	CS	-															
187.4	Dark brown		2	SS	10/8cm															
0.3	Sand, with silt trace clay, trace gravel cobbles and boulders																			
	Compact Brown Moist		3	CS	-															
			4	CS	-															
182.7	Gabbro bedrock																			
5.0	Slightly weathered to unweathered		5	RC NQ	REC 100%												RQD 86%			
	High strength		6	RC NQ	REC 95%												RQD 91%			
	Good to excellent quality		7	RC NQ	REC 100%												RQD 88%			
			8	RC NQ	REC 96%												RQD 85%			
178.0	End of borehole																			
9.7	Sample 2: Sampler bouncing on cobbles and boulders, Numerous cobbles and boulders detected during drilling																			
	* 2009 02 24																			
	▽ Water level observed during drilling																			
	▼ Water level measured after drilling																			
	C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers																			

1 of 1

METRIC

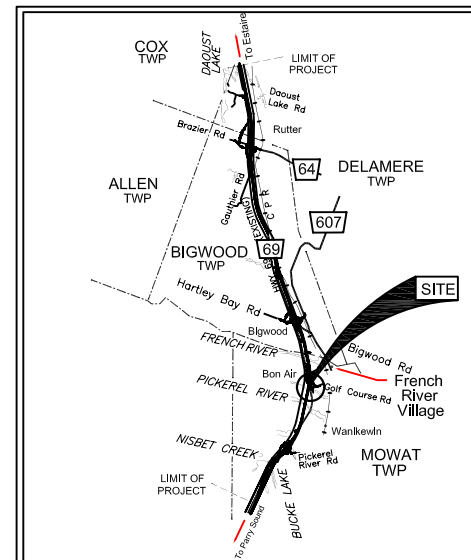
Foundation Design

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SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN
SCALE
2 0 2 4 6 km

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 Feb-Mar 2009
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	CO-ORDS	
		NORTHING	EASTING
C8-1	188.0	N 5 096 737.5	E 221 518.9
C8-2	188.5	N 5 096 738.2	E 221 538.6
C8-3	187.7	N 5 096 739.8	E 221 577.1
C8-4	187.7	N 5 096 740.9	E 221 615.5
C8-5	187.5	N 5 096 741.7	E 221 635.2
P1-SBL	187.7	N 5 096 737.8	E 221 558.4
BH No	ELEVATION	STA	o/s CL MED
315-6	187.7	20+800	18.8m Rt.

NOTE

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

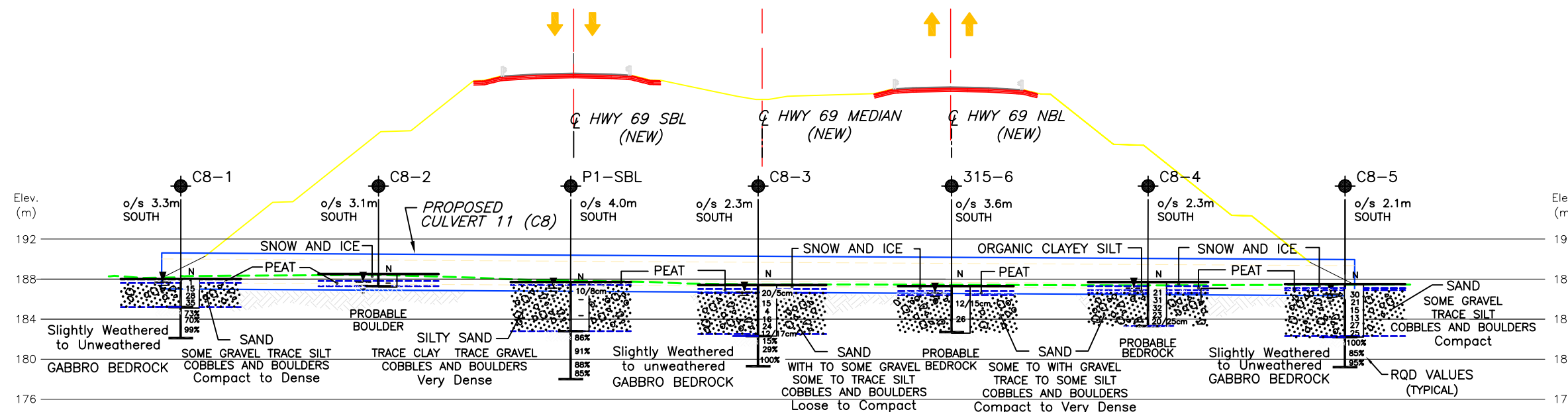
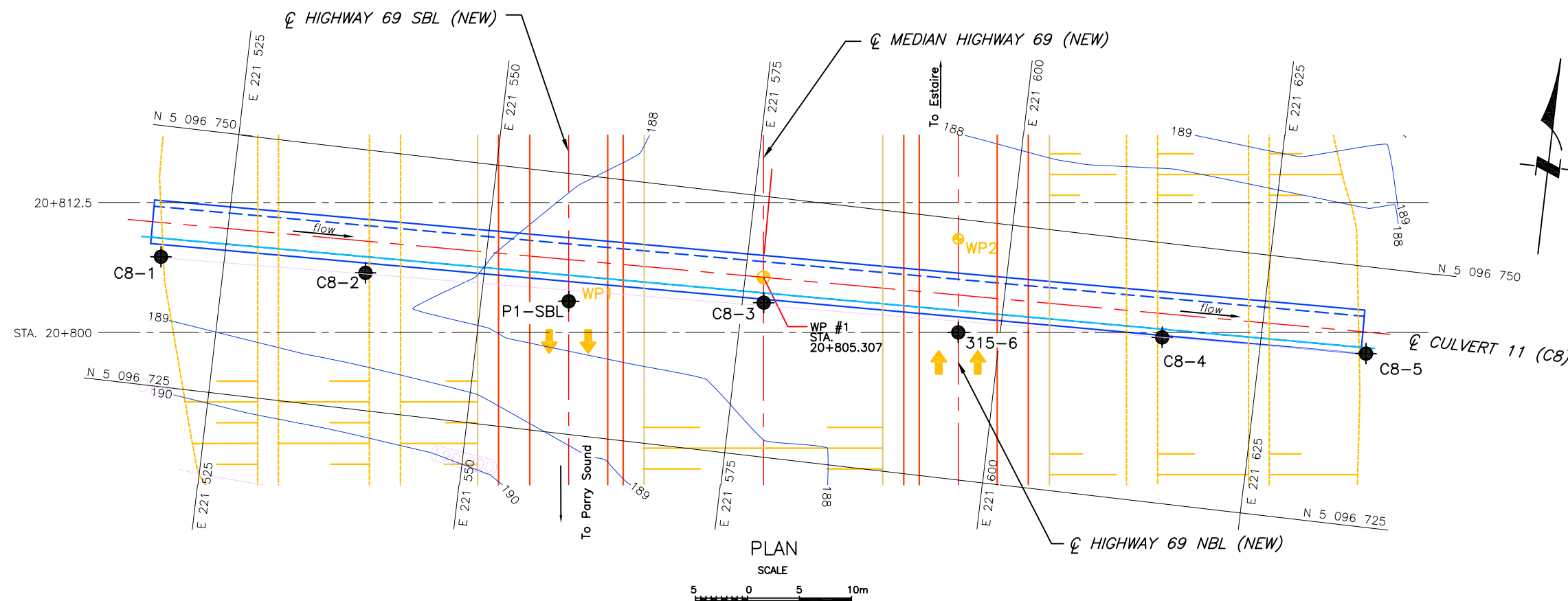
REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-250

HWY No	69	DIST	Sudbury Area
SUBM'D	AS	CHECKED	AS
DRAWN	NA	CHECKED	CN
DATE	MAR. 4, 2010	APPROVED	BRG
SITE	--	DWG	C8-1



REF.: MRC DRAWINGS: 6454-300-001GA.DWG.dwg;
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dated DECEMBER 07, 2009



PROFILE CULVERT 11 (C8) AT STATION 20+805

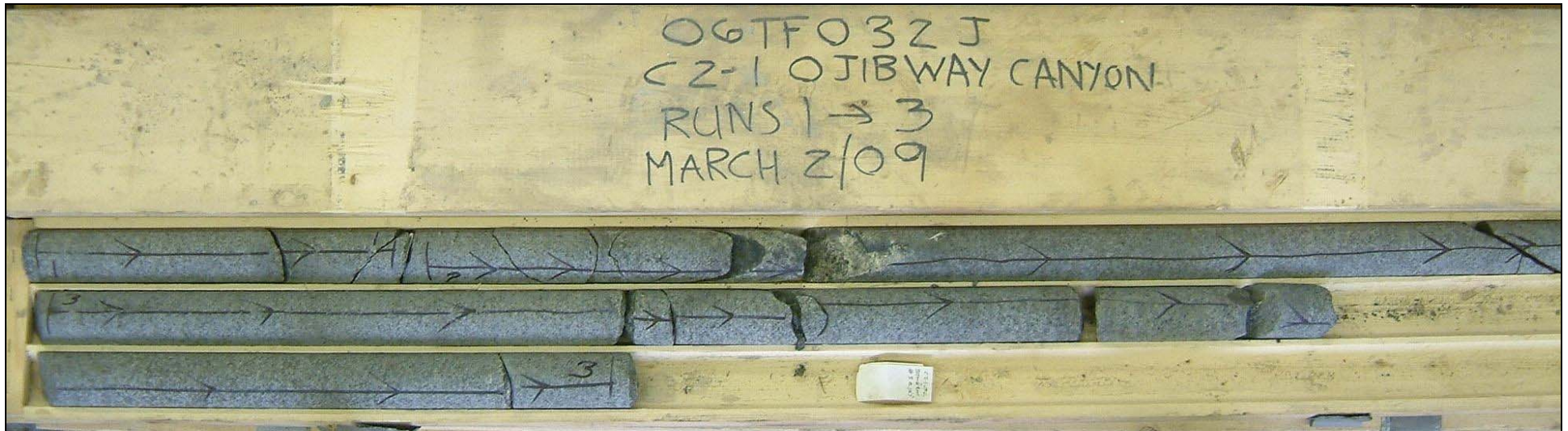
NOTES:

- DRAWING C8-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- CULVERT C11 WAS DESIGNATED AS CULVERT C8 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.



APPENDIX A

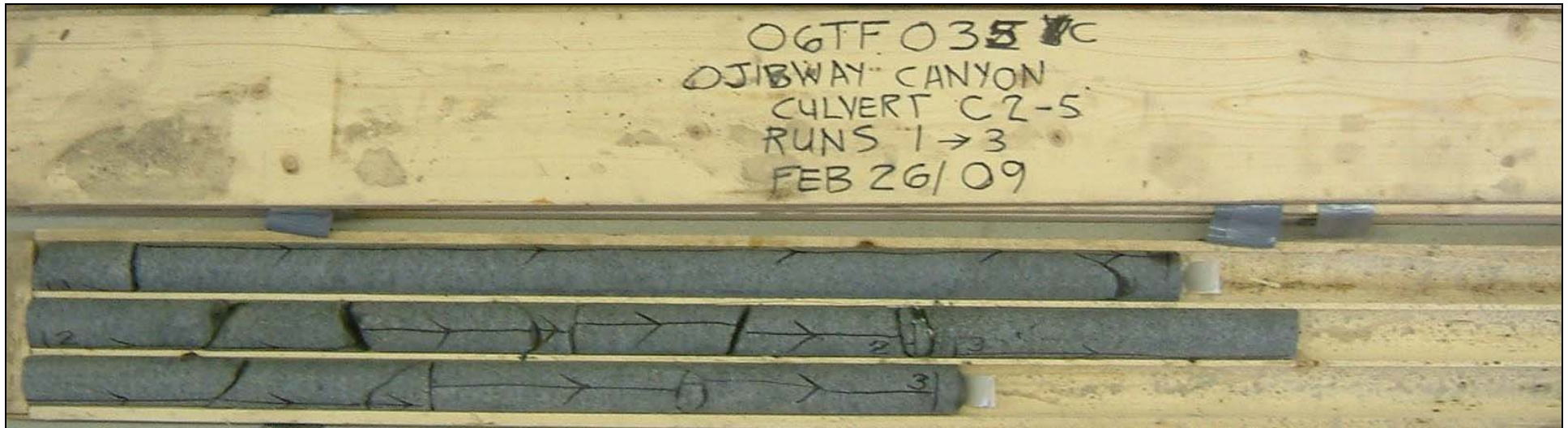
ROCK CORE PHOTOGRAPHS



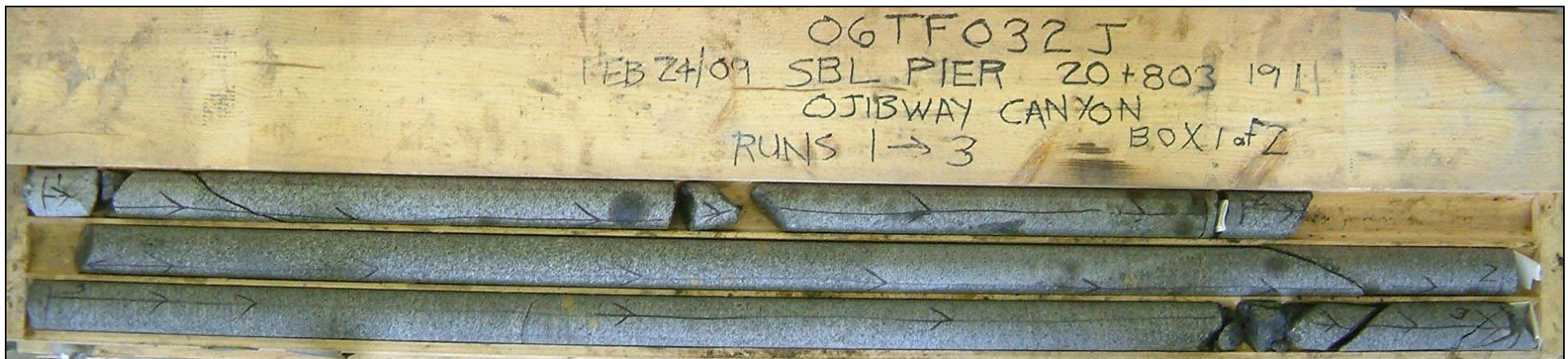
Photograph 1: Culvert C8, borehole C8-1, RC-5 to RC-7.



Photograph 2: Culvert C8, borehole C8-3, RC-7 to RC-9.



Photograph 3: Culvert C8, borehole C8-5, RC-7 to RC-9



Photograph 4: Bridge Pier 1 at station 20+803 (SBL), borehole P1-SBL, samples RC-5 to RC-8.