

GEOTECH No;
31E-122

**FOUNDATION
INVESTIGATION
REPORT**

CONTRACT NO. 98-47

TABLE OF CONTENTS

	Page No.
1.0 FOUNDATION INVESTIGATION REPORT	1
1.1 INTRODUCTION	1
1.2 SITE DESCRIPTION	1
1.3 INVESTIGATION PROCEDURES	2
1.4 SUBSURFACE CONDITIONS	3
1.4.1 Rock Fill	3
1.4.2 Topsoil	3
1.4.3 Organic Silt	4
1.4.4 Silt	4
1.4.5 Silty Sand to Sand	4
1.4.6 Bedrock	5
1.4.7 Groundwater	5
2.0 FOUNDATION DESIGN REPORT	6
2.1 GENERAL	6
2.2 FOUNDATION	6
2.3 LATERAL EARTH PRESSURE FOR ABUTMENTS/WING WALLS	9
2.4 APPROACH EMBANKMENT	9
2.5 EXCAVATION AND GROUNDWATER CONTROL	10
2.6 CLOSURE	11
 APPENDIX	
TABLE I	UNCONFINED COMPRESSIVE STRENGTH TEST REPORT ON BEDROCK CORE SPECIMEN
ENCLOSURE 1	PARTICLE SIZE DISTRIBUTION CHART
LOG OF BOREHOLE Sheets	
DRAWING NO'S 1 & 2	BOREHOLE LOCATION & SOIL PROFILE
OPSD-203.02 (MOD)	EMBANKMENTS OVER SWAMP

**1.0 FOUNDATION INVESTIGATION REPORT
FOR
W.P. 149-86-00
SITE # 42-192N AND SITE # 42-192S
HIGHWAY 11 AND HIGHWAY 141/MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE**

1.1 INTRODUCTION

This report contains the results of a foundation investigation carried out in connection with a proposed new interchange at the above captioned site. A Parclo 'A' interchange is proposed to replace the existing at grade intersection of Highway 11 and Highway 141/Muskoka Road 10. Two (2) overpass structures will be constructed to carry Highway 11 over proposed Highway 141/Muskoka Road 10. One (1) structure is for the northbound lanes (Site #42-192N) and the other is for the southbound lanes (Site #42-192S).

1.2 SITE DESCRIPTION

The site is located along Highway 11 about 150 m south of the existing at-grade crossing of Highway 11 and Highway 141/Muskoka Road 10, approximately 12 km south of the Town of Huntsville and 20 km north of the Town of Bracebridge.

The project site is included in the Algonquin highlands physiographic region which exhibits the irregular rock knob or ridge topography, typical of the Canadian Shield. Soil cover is generally sparse. Relatively low lying areas between rock ridges have been infilled with glacial and post glacial deposits including sand and gravel, sands, silts and clays. Swamp environments with relatively thick organic accumulations are developed in areas of poor drainage.

Throughout the area, Highway 11 is a divided rural highway with two northbound lanes and two southbound lanes, constructed through a series of rock cuts and fills. At the subject site, the existing highway is constructed on rock fill embankments up to 5 m high.

1.3 INVESTIGATION PROCEDURES

The fieldwork was carried out during the month of October, 1997, and comprised fifty three (53) boreholes designated S1 to S53, drilled at the locations shown on Drawing 1. Boreholes were drilled through the existing pavement and shoulders to refusal on the underlying rock fill embankment. Boreholes were drilled along the toe of both the northbound lane and southbound lane embankments to refusal on assumed bedrock, at depths of 0.25 to 9.0 m. To prove bedrock, six (6) of the boreholes (S7, S9, S11, S39, S41 and S43) were extended to depths of 2.40 to 10.04 m by coring, using conventional diamond drilling (BXL) techniques.

Cognizant of the variable depth to bedrock/assumed bedrock, a number of boreholes were advanced as unsampled auger probes to better define the bedrock surface, based on refusal criteria; the overburden was described by examining the auger cuttings. In the remaining boreholes, standard penetration tests (SPT) were conducted simultaneously with conventional split spoon sampling. Supplemental dynamic cone penetration tests were conducted where unreliable SPT values were recorded below the water table. Six (6) standpipes were installed to permit monitoring of the stabilised groundwater table.

The boreholes were advanced using both truck and track mounted drillrigs supplied and operated by a specialist drilling contractor. Some boreholes were advanced by hand augers or test pits.

Our technical staff logged the soil, bedrock and groundwater conditions encountered in the boreholes, under the overall supervision of a member of our engineering staff.

All recovered samples were returned to our laboratory for visual examination and detailed description. Moisture contents and grain size analyses were carried out on select soil samples. Moisture content results are plotted on the appended log sheets. The grain size analyses report is presented on Enclosure 1. Select rock core samples were subject to unconfined compressive strength tests and the results are presented on Table I.

1.4 SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for a description of the soils, inferred stratigraphy, standard penetration test 'N' values, depth to auger refusal on rock fill (existing highway embankment) depth to bedrock where cored, or assumed bedrock based on auger refusal, standpipe installation details, groundwater observations and laboratory moisture content determinations.

Visually, the existing highway is constructed on rock fill embankments. Along the toe of the rock fill embankments, the boreholes revealed topsoil, a localized organic silt and/or discontinuous silt over a sand deposit overlying bedrock/assumed bedrock at depths of 0.25 to 9.00 m.

Groundwater was near ground surface along the low lying west side of the highway. Groundwater was encountered only locally within the more elevated east side of the highway.

The following paragraphs summarises the stratigraphy.

1.4.1 Rock Fill

Visually, the existing highway is constructed on rock fill embankments. The boreholes drilled through the pavement and shoulders encountered the rock fill immediately below the road structure.

1.4.2 Topsoil

Beyond the existing road bed, the boreholes generally encountered a topsoil mantle which was typically about 100 mm thick (locally 200 mm) and comprised dark brown silt.

1.4.3 Organic Silt

A localised deposit of black organic silt was revealed along the west toe of the southbound lane embankment, in boreholes S4, S5, S7 to S11, S50 and S51, at depths of 0.8 to 3.0 m below grade. The organic silt was very loose and saturated with moisture contents in the 46 to 121% range.

1.4.4 Silt

A discontinuous silt unit was encountered beneath the topsoil in boreholes S1 to S3, S24 and S46 to S48. The silt was also encountered locally under the organic silt unit in borehole S4. The layer was usually less than 0.6 m thick and was moist to saturated with moisture contents of 15 to 39%.

1.4.5 Silty Sand to Sand

A major sand deposit was contacted under the above mentioned topsoil, silt and/or organic silt, and extended down to bedrock. The material generally ranged from silty fine sand to fine sand, as illustrated on the Particle Size Distribution Chart, Enclosure 1. On the east side of the highway, the sand in places contained varying amounts of gravel and cobbles.

The relative density ranged from loose to very dense with depth. On the west side of the site, the sand was saturated with moisture contents usually in the 15 to 25% range. On the east side, the sand was typically moist (moisture contents 5 to 12%) becoming saturated (moisture contents 15%) locally at depth.

1.4.6 Bedrock

Bedrock (cored in boreholes S7, S9, S11, S39, S41 and S43) or assumed bedrock, (based on auger refusal in remaining boreholes) was contacted at depths of 0.25 to 9.0 m or elevations 321.4 to 335.4.

The bedrock consists of pink and grey, sound, medium to high strength granitic gneiss. Spacing of discontinuities was close to wide, and rock quality was poor to excellent. Unconfined compressive strength of 44.2 to 83.2 MPa were measured on select rock core samples during laboratory compression tests (Table I enclosed).

1.4.7 Groundwater

During drilling groundwater was observed near ground level along the low lying west part of the site. Standpipe readings (BH SP7, SP9 and SP11) showed the stabilised groundwater table at elevation 329.7 to 330.4 m, at grade to 0.8 m below grade, at the time of the investigation.

Along the east, free water was generally not observed while drilling, although the soils were locally described as wet to saturated at depth. Standpipes in boreholes S39, S41, and S43 showed stabilised groundwater levels at elevations 330.7 to 333.2, some 0.9 to 3.8 m below grade at the time of the investigation.

The groundwater observations are considered to reflect trapped/perched water within bedrock valleys/depressions and would be subject to weather fluctuations.

**2.0 FOUNDATION DESIGN REPORT
FOR
W.P. 149-86-00
SITE # 42-192N AND SITE # 42-192S
HIGHWAY 11 AND HIGHWAY 141/MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE**

2.1 GENERAL

Two (2) overpass structures are proposed at Site #42-192N/Highway 11 northbound lanes, and Site # 42-192S/Highway 11 southbound lanes, as part of a new Parclo 'A' interchange with Highway 141/Muskoka Road 10.

Highway 11 is a divided rural highway with two northbound lanes and two southbound lanes, constructed on rock fill embankments up to about 5 m high, with centre median. Highway 11 will be maintain at the existing grade, approximate elevation 335.5 to 336.0. Proposed Highway 141/Muskoka Road 10 will be established under Highway 11 at about elevation 328.0 to 238.2. The two new structures are required to accommodate the proposed road profiles.

It is understood the structures will be single span. No other details were available at the time of this report.

2.2 FOUNDATIONS

Subsurface conditions generally comprised relatively a shallow soil cover over bedrock. Due to the shallow bedrock, integral type abutments are not feasible.

Finished grade for proposed Highway 141/Muskoka Road 10 is about elevation 328.0, which will control the abutment footing level. In this regard, footings founded on bedrock are recommended for both structures. The elevation of the bedrock (based on coring) and assumed bedrock (based on auger refusal) are as follows:

	West Toe Southbound Lanes	Centreline Median	East Toe Northbound Lanes
North Abutments	Borehole S11 Elevation 327.5	Borehole S26 Elevation 326.6	Borehole S43 Elevation 331.9
South Abutments	Borehole S7 Elevation 321.4	Borehole S24 Elevation 328.2	Borehole S39 Elevation 331.8

The bedrock is anticipated within normal footing level for both abutments of the northbound lane structure and for the north abutment of the southbound lane structure.

For the south abutment/southbound lanes, the bedrock surface appears to slope from elevation 328.2 in borehole S24 under the existing median, down to elevation 321.4 under the west toe of the existing southbound lane embankment. Within the limits of the proposed abutment, bedrock is interpolated to be between approximate elevations 323 and 325. (Refer to Section A-A, Drawing 2). However, steeply sloping bedrock is common and variations from the interpolated bedrock surface between boreholes could be anticipated. Consideration should be given to shifting the alignment to the east, to permit all footings to be founded at normal depth, avoid the localised "deep" rock condition and minimise construction difficulties relating to deep excavation below the groundwater table.

At the presently proposed location, it will be necessary to step the footings down from east to west to achieve the bedrock level. This may be achieved through the use of relatively short caissons designed as circular footings.

As an alternate consideration, the overburden can be excavated down to the bedrock and backfilled with bulk concrete on which the footings could bear. Consideration was given to the use of engineered granular fill in lieu of concrete fill. However, this is not recommended due to anticipated difficulty relating to the high groundwater table and potential for differential settlement.

The factored bearing resistance at ULS may be taken as 10,000 kPa, for design of footings or caissons (circular footings) founded on sound granitic gneiss bedrock. The same value may be used for footings founded on mass concrete provided the concrete compressive strength is minimum 20 MPa.

The bearing capacity at SLS will not govern footings founded on bedrock or mass concrete, since the loads required to produce detrimental settlement of the structure will be much larger than the recommended value for the factored resistance at ULS.

The bedrock footing surface must be benched, and caissons (circular footings) socketed into the bedrock to provide a level founding surface. Stepped footings on bedrock must be inclined at no steeper than 45°.

An unfactored coefficient of $\tan 30^\circ$ is recommended for assessing sliding resistance for concrete footings on bedrock or mass concrete.

It will likely be necessary to socket caissons into the bedrock to develop the required lateral resistance. The lateral capacity of caissons may be estimated using the following unfactored parameters:

Silty sand to sand	$\phi = 28^\circ$	Unit Weight $\gamma = 18 \text{ kN/m}^3$
Granitic Gneiss	$q_u = 40 \text{ Mpa}$	Unit Weight $\gamma = 25 \text{ kN/m}^3$

Frost penetration depth for this project is 1.6 m.

Footings bearing on bedrock should not require protection for frost or erosion.

2.3 LATERAL EARTH PRESSURE

Free draining granular backfill should be used behind retaining walls and the earth pressures for unrestrained and restrained structures computed in accordance with Sections 6-7.4.4. and 6-7.4.5 of the O.H.B.D.C. The following parameters are recommended for the granular backfill.

	Granular 'A'	Granular 'B'	Rockfill
Angle of Internal Friction	$\phi = 35^\circ$	$\phi = 30^\circ$	$\phi = 35^\circ$
Unit Weight (kN/m^3)	$\gamma = 22.8$	$\gamma = 21.2$	$\gamma = 18.0$

A drainage system such as weeping tiles or weepholes must be provided behind the wall to prevent the build up of hydrostatic pressure. The drainage should incorporate a properly designed filter to prevent clogging of the drainage system. The outlet should be protected against freezing.

2.4 APPROACH EMBANKMENT

The approach embankments will comprise rock fill of the existing highway embankments which is up to 5 m high constructed over native sand. A deposit of organic silt has been identified along the west toe of the existing southbound lane embankment, between approximate stations 16+275 and 16+425. The organic silt is localised and is unlikely to extend under the existing embankment since it would have been removed during the original construction in accordance with normal MTO practice. The existing embankments appear to be performing quite satisfactorily.

Widening on the west side of Highway 11 to accommodate the ramp should be carried out in accordance with OPSD-203-02 (Mod) appended. The swamp material along the toe of the existing embankment is expected to be up to 2.1 m deep and should be excavated to the native sand.

The embankment widening should comprise rockfill similar to the existing, with side slopes at 1.25:1.

2.5 EXCAVATION AND GROUNDWATER CONTROL

Excavation for the foundations will be carried down to bedrock through the existing rockfill embankment and underlying native soils comprising primarily silty sand to sand. Localised silt or organic silt may be encountered. Groundwater control will be required particularly for the southbound lane structure where the groundwater table was close to existing ground surface, approximate elevation 330, at the time of this investigation, and subject to weather fluctuations.

Temporary cut slopes in the rockfill and native overburden should be constructed at 1:1 and 3:1, respectively. Steeper slopes may be permitted in the native overburden subject to the effectiveness of the groundwater control measures, and geotechnical inspection. Shoring may be employed to permit vertical excavation. Shoring through steel sheet piles would also assist in cutting off the amount of groundwater entering the excavation. However, it should be noted that complete cut off is likely not possible due to open seams/joints in the sheetings, as well as difficulty in seating the piles into the bedrock.

Techniques for controlling groundwater inflow will be necessary during excavation (augering) for caissons (circular footings). This may include a steel liner socketed into the bedrock and/or the use of drilling mud.

2.6 CLOSURE

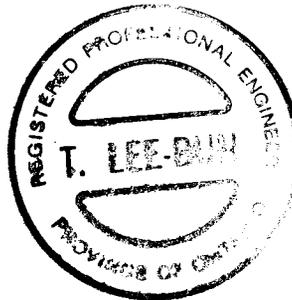
The fieldwork for this investigation was carried out under the overall supervision of Mr. J. F. Wright, Senior Geologist. The borehole logs were compiled by Mr. Wright and reviewed and approved by Mr. T. Lee-Bun, P.Eng., Manager, Geotechnical Engineering (Barrie Office). Mr. Lee-Bun prepared this report, which was reviewed by Mr. D.W. Kerr, P.Eng., Manager, Geotechnical Engineering (Hamilton Office).

Sincerely

PETO MacCALLUM LTD.



Turney Lee-Bun, P.Eng.
Manager, Geotechnical Engineering
(Barrie Office)



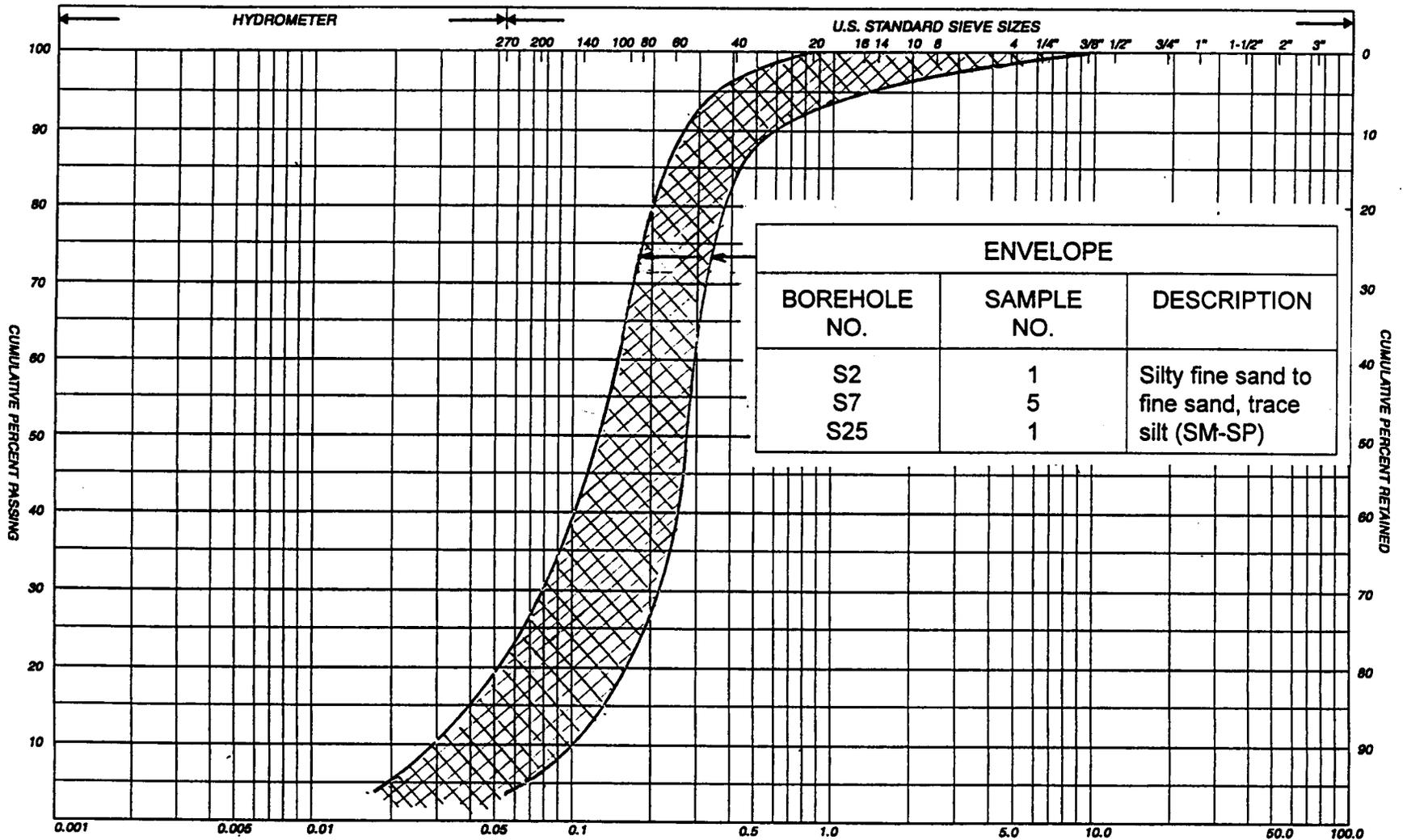
D.W. Kerr, P.Eng.
Manager, Geotechnical Engineering
(Hamilton Office)



TLB/DWK:ga

PARTICLE SIZE DISTRIBUTION CHART

OUR PROJECT NO. 97 BF 031
ENCLOSURE NO. 1



GRAIN SIZE IN MILLIMETERS											
SILT & CLAY			FINE SAND			MEDIUM SAND			COARSE SAND	GRAVEL	COBBLES
CLAY	FINE	MEDIUM SILT	COARSE	FINE	MEDIUM SAND	COARSE	GRAVEL			COBBLES	
		SILT		V. FINE	FINE SAND	MED	COARSE	GRAVEL			

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U.S. BUREAU

TABLE I

**UNCONFINED COMPRESSIVE STRENGTH TEST REPORT
ON BEDROCK CORE SPECIMEN**

W.P. 149-86-00
Site #42-192N and Site #42-192S
Highway 11 and Highway 141/Muskoka Road 10 Interchange
District 52, Huntsville

CORE NO.	1	2	3	4	5	6
BOREHOLE	S7	S9	S11	S39	S41	S43
DEPTH (m)	9.3-9.4	7.9-8.0	3.6-3.7	3.2-3.3	1.2-1.4	3.2-3.3
DENSITY (kg/m ³)	2.633	2.627	2.626	2.669	2.653	2.760
COMPRESSIVE STRENGTH (Mpa)	44.2	63.1	46.6	49.9	62.7	83.2

LOG OF BOREHOLE NO. S4

PROJECT	W.P. 149-86-00 Highway 11, District 52, Huntsville	OUR PROJECT NO. 97 BF 031
LOCATION	9+950 (Hwy 141) 14.0 m Rt	ENGINEER TLB
BORING METHOD	Continuous Flight Hollow Stem Augers	BORING DATE October 16, 1997
		TECHNICIAN DS

SOIL PROFILE			SAMPLES			SHEAR STRENGTH c_u				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST °				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
	GROUND ELEVATION 329.91													
	ORGANIC SILT: Black organic silt, saturated		329	1	AS								* =	
1.50	SILT: Brown silt, saturated		328	2	AS									
2.10	SAND: Brown silty sand, saturated		327	3	AS									
3.00														
4.00	grey with till-like inclusions		326											
4.50														
5.20			325	4	AS									
6.00	BOREHOLE TERMINATED AT 5.20 m upon refusal to auger on assumed bedrock.												*Upon completion of augering, water at 0.3 m.	

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S5

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 9+950 (Hwy 141) 3.0 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers BORING DATE October 10, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH G_u ▲				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST σ				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
	GROUND ELEVATION 329.60													
	ORGANIC SILT: Very loose black organic silt, saturated		329	1	AS								* =	
1.50	SAND: Reddish brown fine sand, with silt to silty, saturated		328											
			327	2	AS									
3.0			326	3	AS									
4.5			325	4	AS									
4.90	BOREHOLE TERMINATED AT 4.90 m upon refusal to auger on assumed bedrock.		324										* Upon completion of augering, water at 0.3 m.	

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S6

PROJECT	W.P. 149-86-00 Highway 11, District 52, Huntsville	OUR PROJECT NO. 97 BF 031
LOCATION	9+950 (Hwy 141) 18.5 m Lt	ENGINEER TLB
BORING METHOD	Continuous Flight Hollow Stem Augers	BORING DATE October 9, 1997
		TECHNICIAN DS

SOIL PROFILE		SAMPLES		SHEAR STRENGTH G ▲	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST °	WATER CONTENT %	
				BLOWS/0.3M		
	GROUND ELEVATION 329.75					
0.20	TOPSOIL: dark brown silt					
	SILT: Very loose brown silt, saturated		329			
0.90						
	SAND: Loose to compact brown to grey silty fine sand, saturated					
1.5			328	1 SS		
				2 SS		
2.10						
	reddish grey fine sand		327	3 SS		
3.0						
				4 SS		
3.50						
	BOREHOLE TERMINATED AT 3.50 m upon refusal to auger on assumed bedrock.		326	18 / 300 mm / bouncing		
4.5						
6.0						

* Upon completion of augering water at 0.3 m

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S7

PROJECT	W.P. 149-86-00 Highway 11, District 52, Huntsville	OUR PROJECT NO. 97 BF 031
LOCATION	9+957 (Hwy 141) 15.0 m Rt	ENGINEER TLB
BORING METHOD	Continuous Flight Hollow Stem Augers/ Rotary Diamond Coring	TECHNICIAN DS
	BORING DATE	October 10, 1997

SOIL PROFILE		SAMPLES		SHEAR STRENGTH G_c ▲	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w	GROUNDWATER OBSERVATIONS AND REMARKS *	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE		BLOWS/0.3m N-VALUES
				BLOWS/0.3M 20 40 60 80	WATER CONTENT % 10 20 30		
	GROUND ELEVATION 330.42						
	ORGANIC SILT: Very loose black organic silt, some roots, saturated	[Symbol]	330				
1.5			329	1	SS	0	
2.10			328	2	SS	1	
	SAND: Loose grey silty fine sand, saturated	[Symbol]	328	3	SS	2	
3.00			327	4	SS	0	
	fine sand, trace silt	[Symbol]	326				
4.50			325	5	SS	4	
	compact to very dense reddish brown fine sand, trace silt	[Symbol]	325				
6.0			324	6	SS	**	
			323				
7.5			322				
9.0			321				
	GRANITIC GNEISS: Sound pink and grey granitic gneiss over anorthosite, medium to high strength, very close to spacing of discontinuities with steeply dipping partings, poor quality	[Symbol]	321				
10.04			320	7	RC BX	1040 79 33 RUN REC ROD (mm)(%) (%)	
10.5	DRILLING TERMINATED AT 10.04 m						

13mm PVC pipe

Auger Cuttings

** After SS 6 sand heaved inside augers

Water Level Readings

Date	Depth (m)
Oct. 29/97	0.05

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S8

PROJECT	W.P. 149-86-00 Highway 11, District 52, Huntsville	OUR PROJECT NO.	97 BF 031
LOCATION	9+957 (Hwy 141) 7.5 m Rt	ENGINEER	TLB
BORING METHOD	Continuous Flight Hollow Stem Augers	BORING DATE	October 16, 1997
		TECHNICIAN	DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH q_c ▲	LIQUID LIMIT w_L	GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES		DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST ◊
								BLOWS/0.3m N-VALUES
GROUND ELEVATION 330.23					BLOWS/0.3m			WATER CONTENT %
					20 40 60 80		10 20 30	
	ORGANIC SILT: Very loose black organic silt, some roots, saturated		330					* ▽
1.5			329	1	AS			121%
				2	AS			
			328					
3.0			327	J	AS			50%
			326					
4.5				4	AS			
			325					
6.0				5	AS			
			324					
7.5								
			323					
7.90				6	AS			
			322					
9.0	BOREHOLE TERMINATED AT 7.90 m upon refusal to auger on assumed bedrock.							* Upon completion of augering, free water at 0.3 m.

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S9

PROJECT	W.P. 149-86-00 Highway 11, District 52, Huntsville	OUR PROJECT NO.	97 BF 031
LOCATION	9+957 (Hwy 141) 1.0 m Lt	ENGINEER	TLB
BORING METHOD	Continuous Flight Hollow Stem Augers/ Rotary Diamond Coring	BORING DATE	October 9, 1997
		TECHNICIAN	DS

DEPTH in METRES	SOIL PROFILE			SAMPLES			SHEAR STRENGTH C_u ▲ DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST ◊ BLOWS/0.3M	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_p — W — W_L WATER CONTENT %	GROUNDWATER OBSERVATIONS AND REMARKS
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES			
	GROUND ELEVATION 330.32								
	ORGANIC SILT: Very loose black organic silt, some roots, saturated		330						
1.5			329	1	SS	0			* 13mm PVC pipe
2.10				2	SS	2			
	SAND: Loose grey silty fine to medium sand, saturated		328	3	SS	0		45%	auger cuttings
3.0			327	4	SS	0		41%	
4.20			326						
4.5	compact to very dense grey fine sand, trace silt		325	5	SS	30			
6.0			324	6	SS	**			** After augering to 6.0 m, sand heaved inside augers.
7.5			323						
	GRANITIC GNEISS: Sound pink and grey, medium to high strength, close to moderate spacing of discontinuities, oblique partings, good quality		322						
9.0	DRILLING TERMINATED AT 9.02 m		321	7	RC BX		1520 RUN (mm)	97 REC (%)	75 RQD (%)

NOTES

Water Level Readings
Date: Oct. 29/97
Depth(m): 0.60

LOG OF BOREHOLE NO. S10

PROJECT	W.P. 149-86-00 Highway 11, District 52, Huntsville	OUR PROJECT NO.	97 BF 031
LOCATION	9+957 (Hwy 141) 7.5 m Lt	ENGINEER	TLB
BORING METHOD	Continuous Flight Hollow Stem Augers	BORING DATE	October 9, 1997
		TECHNICIAN	DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH G ▲	LIQUID LIMIT w_L	PLASTIC LIMIT w_p	WATER CONTENT w	GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST □		
							BLOWS/0.3M		
	GROUND ELEVATION: 330.34								
	ORGANIC SILT: Very loose black organic silt, some roots, saturated		330	1	SS	0			
1.50			329	2	SS	0		57%	
2.20	SAND: Loose grey silty fine sand, saturated		328	3	SS	9			
	dense brown to reddish brown			4	SS	30			
3.0			327	5	SS	41			
3.90									
4.5	grey fine sand		326						
5.35			325	6	SS	38			
6.0	BOREHOLE TERMINATED AT 5.35 m upon refusal to auger on assumed bedrock								* Upon completion of augering free water at 0.3 m

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S11

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 9+957 (Hwy 141) 18.5 m Lt

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers/
Rotary Diamond Coring

BORING DATE October 9, 1997

TECHNICIAN DS

SOIL PROFILE				SAMPLES		SHEAR STRENGTH q_c ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				w_p	w		w_L
	GROUND ELEVATION 330.48													
	ORGANIC SILT: Very loose black organic silt, saturated		330											
1.5	1.70		329	1	SS	0						46%	* 13 mm PVC Pipe	
	SAND: Loose grey to brown silty fine sand, saturated		328	2	SS	8						57%	Auger Cuttings	
3.0	2.95		327	3	SS	8								
	GRANETIC GNEISS: Sound pink and grey, medium to high strength close spacing of discontinuities good quality		326											
4.5	4.47		326		RC BX		1520	90	78					
	DRILLING TERMINATED AT 4.47 m						RUN (mm)	REC (%)	ROD (%)					
6.0														

Water Level Readings
Date Oct 29/97 Depth (m) 0.80

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S14

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+380 (Hwy 11) 28.0 m LI

ENGINEER TLB

BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE October 3, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES			SHEAR STRENGTH q_c ▲		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS			
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST †		WATER CONTENT %					
							BLOWS/0.3M		w_p	w		w_L		
	GROUND ELEVATION 335.40						20	40	60	80	10	20	30	
	SHOULDER: 300 mm compact brown gravelly sand, trace silt, over brown fine to medium sand, trace silt	⊗	335	1	SS	26								
0.73 0.90	ROCK FILL: Dense dark brown sand and gravel, some silt with numerous rock fragments	⊗		2	SS	37								
1.5	BOREHOLE TERMINATED AT 0.90 m upon refusal to auger on rock fill													
3.0														

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S15

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+400 (Hwy 11) 28.0 m Lt

ENGINEER TLB

BORING METHOD Continuous Flight Solid Stem Augers BORING DATE October 3, 1997

TECHNICIAN DS

SOIL PROFILE		SAMPLES			SHEAR STRENGTH G		LIQUID LIMIT W_L		GROUNDWATER OBSERVATIONS AND REMARKS					
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o			WATER CONTENT %				
							BLOWS/0.3M				WATER CONTENT %			
							20	40		60		80	10	20
	GROUND ELEVATION 335.20		335	1	SS	36								
0.75	SHOULDER: 300 mm compact brown gravelly sand, trace silt, over brown fine to medium sand, trace silt			2	SS	33								
0.90	ROCK FILL: Dense dark brown sand and gravel, some silt with numerous rock fragments													
1.5	BOREHOLE TERMINATED AT 0.90 m upon refusal to auger on rock fill													
3.0														

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S16

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville OUR PROJECT NO. 97 BF 031
 LOCATION 16+326 (Hwy 11) 22.0 m Lt ENGINEER TLB
 BORING METHOD Continuous Flight Solid Stem Augers BORING DATE October 3, 1997 TECHNICIAN DS

SOIL PROFILE			SAMPLES			SHEAR STRENGTH c_u ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST ◊				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
	GROUND ELEVATION 335.99													
0.73 0.91	PAVEMENT STRUCTURE: 280 mm asphaltic concrete over 150 mm brown gravelly sand over brown fine to medium sand (trace silt)	▣	335	1	SS	58								
1.5	ROCK FILL: Very dense dark brown sand and gravel, some silt with numerous rock fragments													
3.0	BOREHOLE TERMINATED AT 0.91 m upon refusal to auger on rock fill													

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S19

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+400 (Hwy 11) 22.0 m Lt

ENGINEER TLB

BORING METHOD Continuous Flight Solid Stem Augers BORING DATE October 3, 1997

TECHNICIAN DS

SOIL PROFILE				SAMPLES			SHEAR STRENGTH G ▲				LIQUID LIMIT W_L			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o				PLASTIC LIMIT W_P			
							BLOWS/0.3M				WATER CONTENT %			
							20	40	60	80	10	20	30	
	GROUND ELEVATION 335.27		335											
0.23	PAVEMENT STRUCTURE: 250 mm asphaltic concrete over 100 mm brown gravelly sand over	X		1	SS	27								
0.97	brown fine to medium sand trace silt	X												
1.5	ROCK FILL: Dark brown sand and gravel, some silt with numerous rock fragments													
3.0	BOREHOLE TERMINATED AT 0.97 m upon refusal to auger on rock fill													

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S31

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+323 (Hwy 11) 21.0 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE October 1, 1997

TECHNICIAN JFW

SOIL PROFILE			SAMPLES			SHEAR STRENGTH G ▲			LIQUID LIMIT _____ W _L PLASTIC LIMIT _____ W _P WATER CONTENT _____ W			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TESTS			WATER CONTENT x				
	GROUND ELEVATION 336.30						BLOWS/0.3M 20 40 60 80			WATER CONTENT x 10 20 30				
0.71	PAVEMENT STRUCTURE: 250 mm asphaltic concrete over 100 mm very dense brown gravelly sand, trace silt, over brown fine to medium sand, trace silt	X	336	1	SS	80								
1.5	BOREHOLE TERMINATED AT 0.71 m upon refusal to auger on rock fill													
3.0														

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S32

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+344.5 (Hwy 11) 22.0 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Solid Stem Augers BORING DATE October 1, 1997

TECHNICIAN JFW

SOIL PROFILE			SAMPLES			SHEAR STRENGTH G			LIQUID LIMIT W_L			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o			PLASTIC LIMIT W_P			
							BLOWS/0.3M			WATER CONTENT %			
						20	40	60	10	20	30		
	GROUND ELEVATION 336.14												
0.81	PAVEMENT STRUCTURE: 280 mm asphaltic concrete over very dense brown fine sand, over silty sand	XXXX	336	1	SS	50	150	mm				⊙	
1.5	BOREHOLE TERMINATED AT 0.81 m upon refusal to auger on rock fill												
3.0													

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S33

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+377.5 (Hwy 11) 21.0 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Solid Stem Augers BORING DATE October 1, 1997

TECHNICIAN JFW

SOIL PROFILE			SAMPLES			SHEAR STRENGTH C_u	LIQUID LIMIT w_L	PLASTIC LIMIT w_p	WATER CONTENT w	GROUNDWATER OBSERVATIONS AND REMARKS				
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST							
							BLOWS/0.3M				WATER CONTENT %			
	GROUND ELEVATION 335.85						20	40	60	80	10	20	30	
0.54	PAVEMENT STRUCTURE: 250 mm asphaltic concrete over very dense fine to medium sand, trace silt	[Cross-hatched legend symbol]	335	1	SS	50	150							
1.5	FILL: Compact brown gravelly sand to sand and gravel, trace silt, with numerous rock fragments		334	2	SS	20								
2.30	loose		333	3	SS	4								
3.0	very dense			4	SS	41	300 mm/bouncing							
3.50	BOREHOLE TERMINATED AT 3.50 m upon refusal to auger on rock fill													Upon completion of augering borehole caved at 2.1 m no free water

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S35

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+323 (Hwy 11) 25.0 m Rt

ENGINEER lib

BORING METHOD Continuous Flight Solid Stem Augers BORING DATE October 1, 1997

TECHNICIAN JFW

SOIL PROFILE			SAMPLES			SHEAR STRENGTH q_c ▲	LIQUID LIMIT w_L _____	PLASTIC LIMIT w_P _____	WATER CONTENT w _____	GROUNDWATER OBSERVATIONS AND REMARKS				
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST °							
							BLOWS/0.3M							
	GROUND ELEVATION 336.10						20	40	60	80	10	20	30	
0.75	SHOULDER: Dense brown gravelly sand, trace silt moist	⊗		1	SS	32								
1.20	ROCK FILL: Very dense grey sand and gravel with numerous rock fragments	⊗	335	2	SS	54								
1.5	BOREHOLE TERMINATED AT 1.20 m upon refusal to auger on rock fill													
3.0														

NOTES

LOG OF BOREHOLE NO. S38

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+398 (Hwy 11) 28.0 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Solid Stem Augers BORING DATE October 1, 1997

TECHNICIAN JFW

SOIL PROFILE			SAMPLES			SHEAR STRENGTH G ▲		LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W		GROUNDWATER OBSERVATIONS AND REMARKS			
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST ◊		WATER CONTENT x				
							BLOWS/0.3M		WATER CONTENT x				
							20	40	60	80	10	20	30
	GROUND ELEVATION 335.40												
	SHOULDER: 300 mm loose brown gravelly sand, trace silt, over compact brown fine to medium sand, trace silt	X	335	1	SS	7	150						
1.00				2	SS	25							
	BOREHOLE TERMINATED AT 1.00 m upon refusal to auger on rock fill		334	3	SS	50							
1.5													
3.0													

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S39

PROJECT W.P. 149-86-00 Highway 11, District 52 Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 10+033 (MR10) 18.0 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers/
Rotary Diamond Coring

BORING DATE October 8, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH q_c ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST °				WATER CONTENT %			
							BLOWS/0.3M				w_p		w	w_L
0.10	GROUND ELEVATION 334.42						20	40	60	80	10	20	30	
	TOPSOIL: Dark brown silt		334	1	SS	6								
1.5	SAND: Loose brown to reddish brown silty fine sand, trace gravel, moist		333	2	SS	9								
2.10				3	SS	29	/300 mm/bouncing							
2.60	compact, saturated		332											
3.0	GRANITIC GNEISS: Sound pink and grey, medium to high strength, moderate to wide spacing of discontinuities, excellent quality		331	4	RC		1520	100	98					
4.11	DRILLING TERMINATED AT 4.11 m		330		BX		RUN (mm)	REC (%)	ROD (%)					
4.5														
15.0														
16.5														

Water Level Readings
Date Depth (m)
* Oct 29/97 3.75

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S40

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 10+034 (MR10) 9.0 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers BORING DATE October 8, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH C_u ▲				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST °				WATER CONTENT %			
							BLOWS/0.3M				W_P		W	W_L
0.10	GROUND ELEVATION 334.25						20	40	60	80				
	TOPSOIL: Dark brown silt		334											
	SAND: Compact fine, moist		333	1	SS	10								
1.5			332	2	SS	18								
2.30	BOREHOLE TERMINATED AT 2.30 m upon refusal to auger on assumed bedrock.		332											
3.0														Upon completion of augering, no free water.
6.0														
7.5														
9.0														
10.5														
12.0														
13.5														
15.0														
16.5														

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S41

PROJECT W.P. 149-86-00, Highway 11, District 52 Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 10+034 (MR10) Centreline

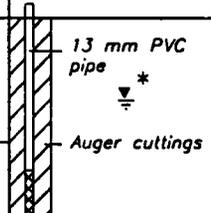
ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers/
Rotary Diamond Coring

BORING DATE October 8, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH c_u				LIQUID LIMIT w_L			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST σ				WATER CONTENT w			
							BLOWS/0.3M				WATER CONTENT %			
						20	40	60	80	w_L	w		w_P	
	GROUND ELEVATION 334.09													
0.10	TOPSOIL: Dark brown silt													
	SAND: Compact brown fine sand with gravel, moist													
0.90			333	1	SS	8	150 mm/pounding							
	GRANITIC GNEISS: Sound pink and grey, medium to high strength, close to moderate spacing of discontinuities, excellent quality													
1.5			332											
2.40				2	RC	1520	97	90						
	DRILLING TERMINATED AT 2.40 m				BX	RUN (mm)	REC (%)	RQD (%)						
3.0			331											



Water Level Readings

Date	Depth (m)
* Oct 29/97	0.90

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S42

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 10+034 (MR10) 7.5 m Lt

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers BORING DATE October 8, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH G ▲			LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			GROUNDWATER OBSERVATIONS AND REMARKS			
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o			WATER CONTENT %				
							BLOWS/0.3M			W_L		W_P	W	
0.10	GROUND ELEVATION 333.94						20	40	60	80	10	20	30	
	TOPSOIL: Dark brown silt		333	1	SS	14								
1.50	SAND: Compact fine sand, moist													
2.00	with cobbles		332	2	SS	15	150 mm/bouncing							
3.00	BOREHOLE TERMINATED AT 2.00 m upon refusal to auger on assumed bedrock.											Upon completion of augering, no free water		
3.50														
4.00														
4.50														
5.00														
5.50														
6.00														
6.50														
7.00														
7.50														
8.00														
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13.00														
13.50														
14.00														
14.50														
15.00														
15.50														
16.00														
16.50														

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S43

PROJECT W.P. 149-86-00, Highway 11, District 52 Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 10+035 (MR10) 14.0 m Lt

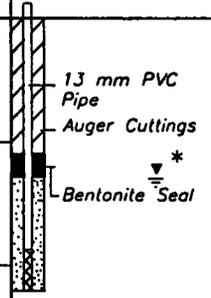
ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers/
Rotary Diamond Coring

BORING DATE October 8/9, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH q_c				LIQUID LIMIT w_L			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST				WATER CONTENT w			
							BLOWS/0.3M				WATER CONTENT %			
							20	40	60	80	w_p		w	w_L
	GROUND ELEVATION 333.69													
0.10	TOPSOIL: Dark brown silt													
	SAND: Loose brown fine sand, moist		333											
1.20				1	SS	7								
1.5	compact reddish brown fine sand, trace gravel and cobbles		332	2	SS	14	300	mm/bouncing						
1.80														
	GRANITIC GNEISS: Sound pink and grey, medium to high strength, moderate to wide spacing of discontinuities, excellent quality		331											
3.0														
3.30	DRILLING TERMINATED AT 3.30 m		330	3	RC		1520	100	100					
							RUN (mm)	REC (%)	RQD (%)					
4.5														



Water Level Readings
Date Depth (m)
* Oct 29/97 1.90

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S44

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 10+040 (MR10) 18.5 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers BORING DATE October 8, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH c_u				LIQUID LIMIT w_L			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST s_p				WATER CONTENT w			
							BLOWS/0.3M				WATER CONTENT %			
						20	40	60	80	10	20		30	
0.10	GROUND ELEVATION 335.44													
	TOPSOIL: Dark brown silt		335											
	SAND: Brown gravelly fine to medium sand, with cobbles, moist			1	SS	10	/300 mm/bouncing							
1.5	BOREHOLE TERMINATED AT 1.60 m upon refusal to auger on assumed bedrock.		334	2	SS	12	/150 mm/bouncing							
			333											
3.0														
4.5														
6.0														
7.5														
9.0														
10.5														
12.0														
13.5														
15.0														
16.5														

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S45

PROJECT W.P. 149-86-00, Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 10+040 (MR10) Centreline

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers BORING DATE October 9, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES			SHEAR STRENGTH C_u ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o				WATER CONTENT %			
							BLOWS/0.3M				w_L	w_P		w
0.10	GROUND ELEVATION 334.99						20	40	60	80	10	20	30	Upon completion of augering no free water
	TOPSOIL: Dark brown silt		334	1	SS	11								
1.5 1.60	SAND: Compact brown gravelly fine to medium sand, moist to wet BOREHOLE TERMINATED AT 1.60 m upon refusal to auger on assumed bedrock		333	2	SS	21/300	mm/bouncing							
3.0														

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S46

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 10+040 (MR10) 14.0 m Lt

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers BORING DATE October 8, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES			SHEAR STRENGTH C_u ▲			LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o			WATER CONTENT x			
							BLOWS/0.3M 20 40 60 80			WATER CONTENT x 10 20 30			
0.10	GROUND ELEVATION 334.84												
	TOPSOIL: Dark brown silt												
0.60	SILT: Brown silt, moist												
	BOREHOLE TERMINATED AT 0.60 m upon refusal to auger on assumed bedrock.		334									Upon completion of augering, no free water	
1.5													
3.0													
4.5													
6.0													
7.5													
9.0													
10.5													
12.0													
13.5													
15.0													
16.5													

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S48

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO: 97 BF 031

LOCATION 10+050 (MR10) Centreline

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers BORING DATE October 8, 1997

TECHNICIAN DS

SOIL PROFILE			SAMPLES		SHEAR STRENGTH C_u ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST °				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
0.10	GROUND ELEVATION 335.65													
0.25	TOPSOIL: Dark brown silt													
	SILT: Brown silt, moist		335											
	BOREHOLE TERMINATED AT 0.25 m on assumed bedrock.												Upon completion of augering, no free water	
1.5														
3.0														
4.5														
6.0														
7.5														
9.0														
10.5														
12.0														
13.5														
15.0														
16.5														

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S50

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville

OUR PROJECT NO. 97 BF 031

LOCATION 16+326 (Hwy 11) 43.0 m Lt

ENGINEER TLB

BORING METHOD Hand Augers

BORING DATE October 29, 1997

TECHNICIAN JFW

SOIL PROFILE			SAMPLES			SHEAR STRENGTH c_u ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST ◊				WATER CONTENT %			
	GROUND ELEVATION 331.10					BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
0.75	ORGANIC SILT: Soft dark brown organic silt	[Symbol]											
1.50	SAND: Compact reddish brown silty fine sand, saturated	[Symbol]	330										
	BOREHOLE TERMINATED AT 1.50 m		329										* Upon completion of augering water at 0.1 m
3.0													

NOTES

CHECKED BY: TLB

Peto MacCallum Ltd.

CONSULTING ENGINEERS

LOG OF BOREHOLE NO. S51

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville
 LOCATION 16+400 (Hwy 11) 43.0 m Lt
 BORING METHOD Hand Augers

OUR PROJECT NO. 97 BF 031
 ENGINEER TLB
 TECHNICIAN JFW

BORING DATE October 29, 1997

SOIL PROFILE			SAMPLES		SHEAR STRENGTH C_u ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST ◊				WATER CONTENT %			
						BLOWS/0.3M				w_p	w		w_L
						20	40	60	80	10	20	30	
	GROUND ELEVATION 329.95												*
0.55	FILL: Brown fine to medium sand, saturated	⊗											
	ORGANIC SILT: Very soft dark brown to black organic silt	⊕	329										
1.50	SAND: Compact brown fine sand, some silt, saturated	⊙	328										*
1.80	BOREHOLE TERMINATED AT 1.80 m												Upon completion of augering water at 0.1 m
3.0													

NOTES

CHECKED BY: TLB

LOG OF BOREHOLE NO. S52

PROJECT W.P. 149-86-00 Highway 11, District 52, Huntsville
 LOCATION 16+280 (Hwy 11) 35.0 m Lt
 BORING METHOD Hand Augers

OUR PROJECT NO. 97 BF 031
 ENGINEER TLB
 TECHNICIAN FR

SOIL PROFILE			SAMPLES		SHEAR STRENGTH C_u ▲				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST °				WATER CONTENT %			
						BLOWS/0.3M				W_P	W		W_L
						20	40	60	80	10	20	30	
	GROUND ELEVATION 334.30												
0.17	SILT: Brown silt		334										
	SAND: Brown fine sand												
1.20													
1.5	BOREHOLE TERMINATED AT 1.20 m												
3.0													

NOTES

CHECKED BY: TLB

W.P.149-86-00
 SITE# 42-192N AND SITE# 42-192S
 HIGHWAY 11 AND
 HIGHWAY 141/ MUSKOKA ROAD 10
 INTERCHANGE

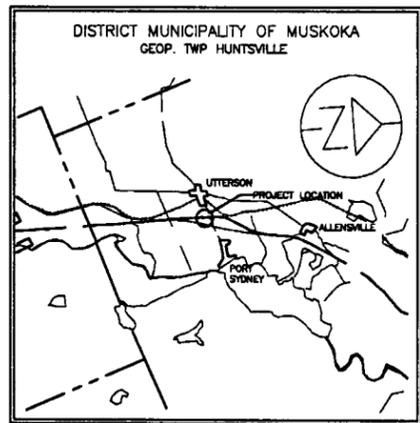
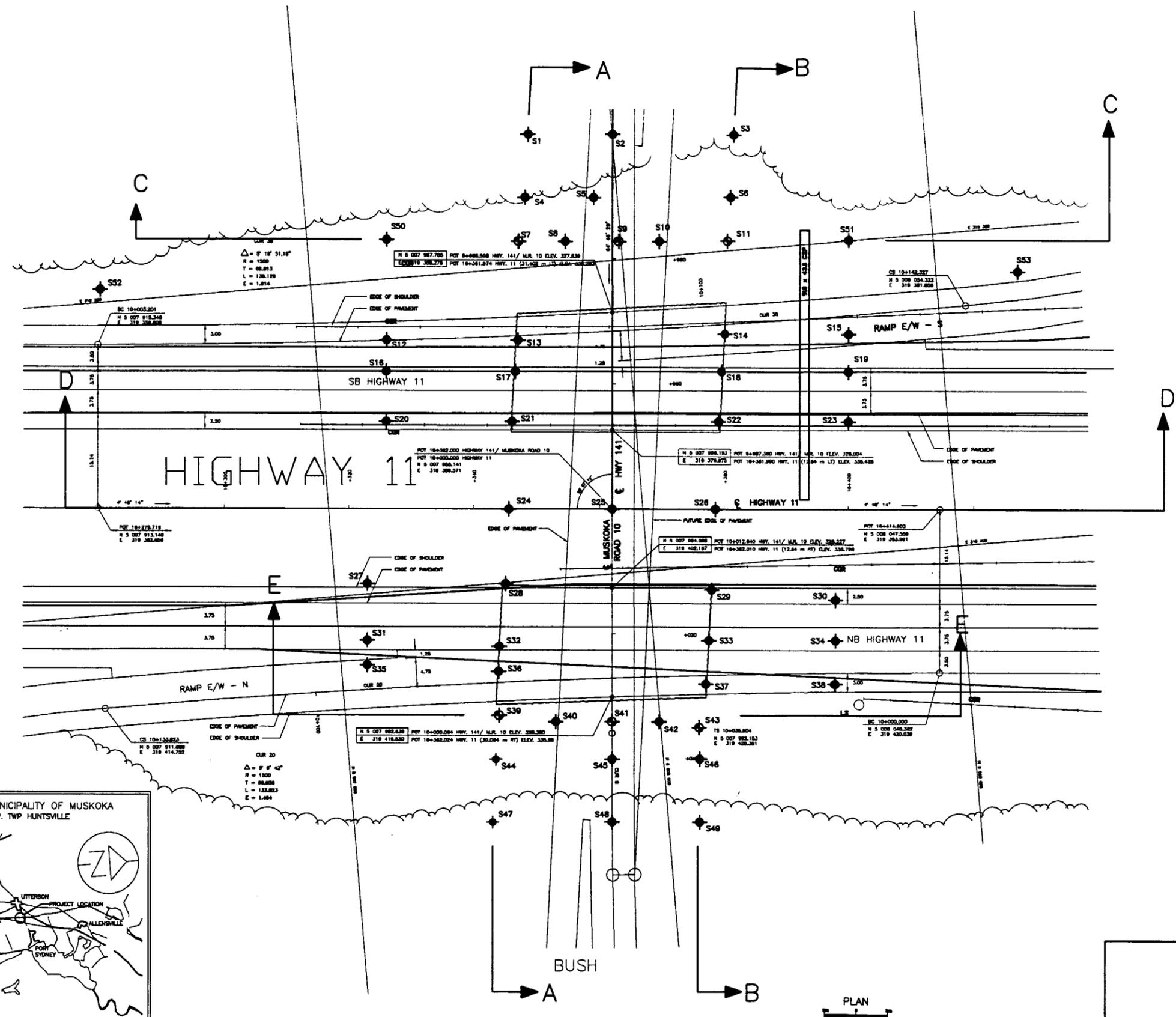


BOREHOLE LOCATION & SOIL STRATA
 REFER TO DRAWING #2 FOR SECTIONS

LEGEND

- ◆ BOREHOLE
- ⊕ BOREHOLE & ROCK CORE

BOREHOLE	LOCATION	ELEVATION
S1	9+940 (HWY 141)	13.5m Rt 330.08
S2	9+940 (HWY 141)	Centreline 329.19
S3	9+940 (HWY 141)	19.5m Lt 328.88
S4	9+950 (HWY 141)	14.0m Rt 329.81
S5	9+950 (HWY 141)	3.0 m Rt 329.80
S6	9+950 (HWY 141)	18.5 m Lt 329.75
S7	9+957 (HWY 141)	15.0 m Rt 330.42
S8	9+957 (HWY 141)	7.5 m Rt 330.23
S9	9+957 (HWY 141)	1.0 m Lt 330.32
S10	9+957 (HWY 141)	7.5 m Lt 330.34
S11	9+957 (HWY 141)	18.5 m Lt 330.48
S12	16+328 (HWY 11)	27.0 m Lt 335.86
S13	16+347 (HWY 11)	27.0 m Lt 335.70
S14	16+380 (HWY 11)	28.0 m Lt 335.40
S15	16+400 (HWY 11)	28.0 m Lt 335.20
S16	16+328 (HWY 11)	22.0 m Lt 335.99
S17	16+346.5 (HWY 11)	22.0 m Lt 335.75
S18	16+379.5 (HWY 11)	22.0 m Lt 335.49
S19	16+400 (HWY 11)	22.0 m Lt 335.27
S20	16+328 (HWY 11)	14.0 m Lt 335.80
S21	16+348 (HWY 11)	14.0 m Lt 335.70
S22	16+378 (HWY 11)	14.0 m Lt 335.30
S23	16+400 (HWY 11)	14.0 m Lt 335.10
S24	10+000 (HWY 141/MR10)	16.5 m Rt 331.15
S25	10+000 (HWY 141/MR10)	Centreline 329.81
S26	10+000 (HWY 141/MR10)	18.5 m Lt 329.43
S27	16+323 (HWY 11)	12.0 m Rt 335.90
S28	16+345 (HWY 11)	12.0 m Rt 335.80
S29	16+378 (HWY 11)	12.0 m Rt 335.80
S30	16+398 (HWY 11)	11.5 m Rt 335.40
S31	16+323 (HWY 11)	21.0 m Rt 336.30
S32	16+344.5 (HWY 11)	22.0 m Rt 336.14
S33	16+377.5 (HWY 11)	21.0 m Rt 335.85
S34	16+398 (HWY 11)	21.0 m Rt 335.89
S35	16+323 (HWY 11)	25.0 m Rt 336.10
S36	16+344 (HWY 11)	26.0 m Rt 336.00
S37	16+377 (HWY 11)	26.0 m Rt 335.80
S38	16+398 (HWY 11)	26.0 m Rt 335.40
S39	10+033 (MR10)	18.0 m Rt 334.42
S40	10+034 (MR10)	9.0 m Rt 334.25
S41	10+034 (MR10)	Centreline 334.09
S42	10+034 (MR10)	7.5 m Lt 333.94
S43	10+035 (MR10)	14.0 m Lt 333.89
S44	10+040 (MR10)	18.5 m Rt 335.44
S45	10+040 (MR10)	Centreline 334.90
S46	10+040 (MR10)	14.0 m Lt 334.84
S47	10+050 (MR10)	19.0 m Rt 335.77
S48	10+050 (MR10)	Centreline 335.85
S49	10+050 (MR10)	14.0 m Lt 335.79
S50	16+328 (HWY 11)	43.0 m Lt 331.10
S51	16+400 (HWY 11)	43.0 m Lt 329.95
S52	16+380 (HWY 11)	35.0 m Lt 334.30
S53	16+427 (HWY 11)	38.0 m Lt 330.30



KEY PLAN
 0.5m 0 1km

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 CONSULTING ENGINEERS

DRAWN: CADDGROUP	DATE: NOV 10/97.	SCALE: 1:750	JOB No: 97BF031	DRAWING No: 1
CHECKED: TLB				
APPROVED: DWK				

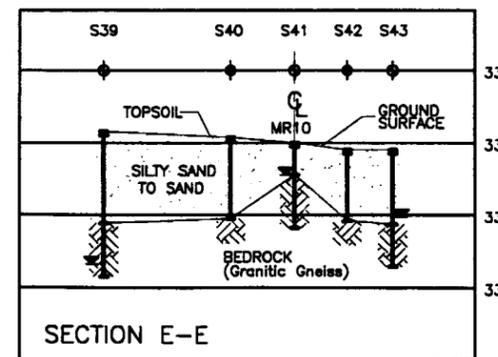
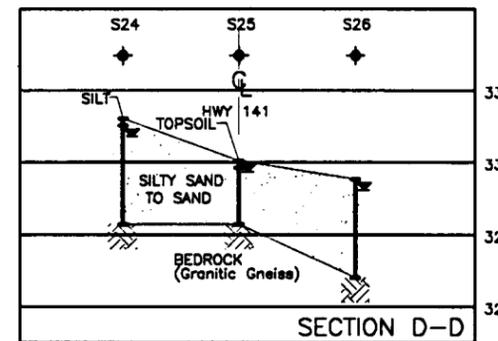
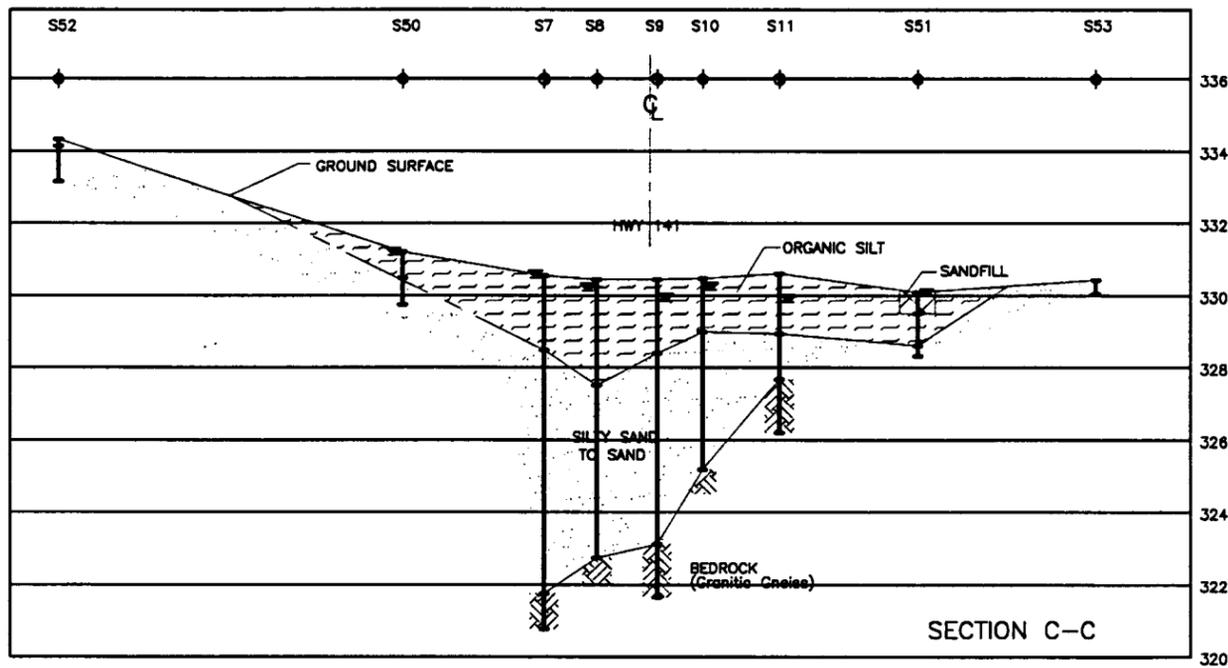
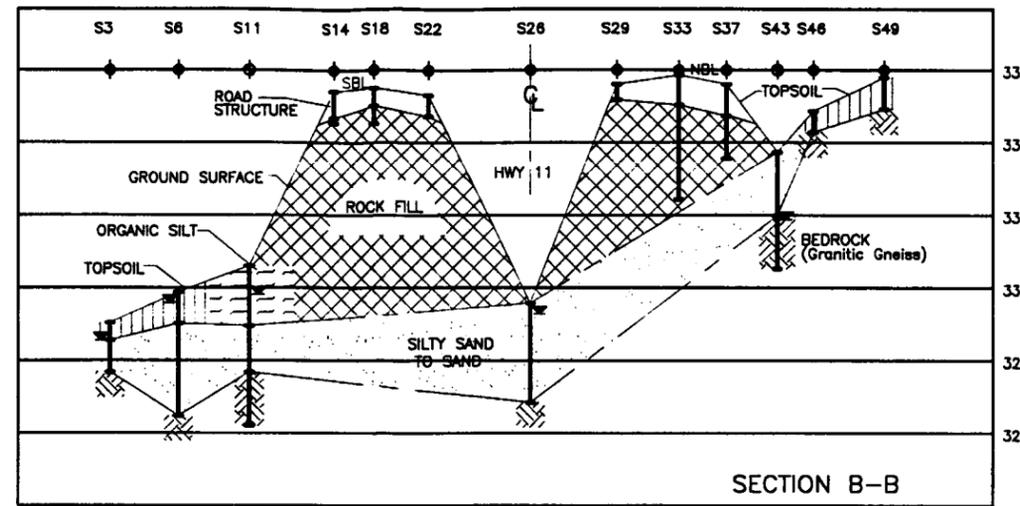
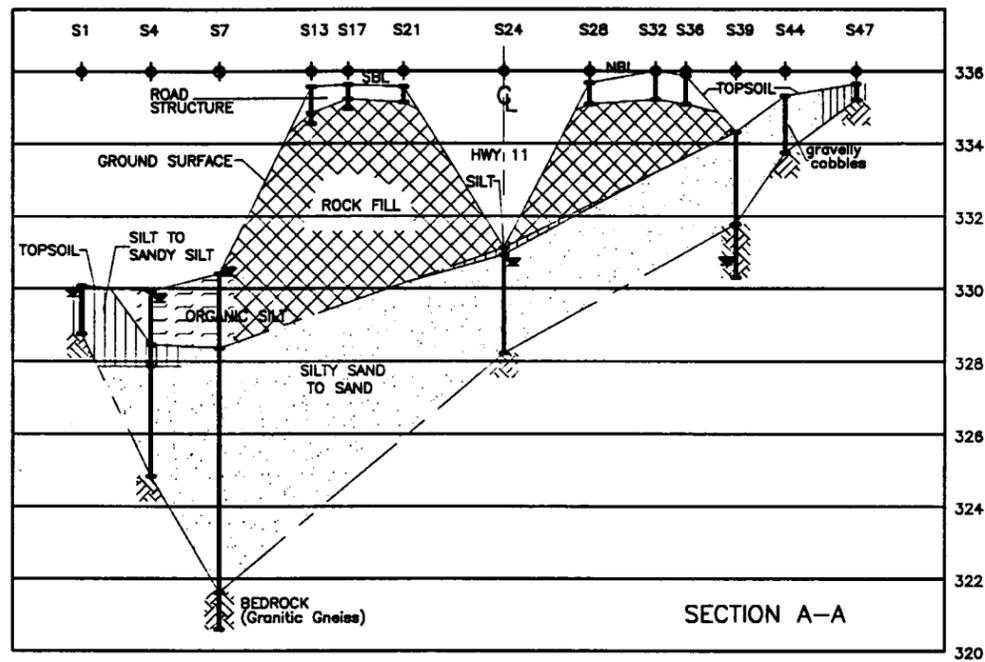
W.P.149-86-00
 SITE# 42-192N AND SITE# 42-192S
 HIGHWAY 11 AND
 HIGHWAY 141/ MUSKOKA ROAD 10
 INTERCHANGE
 DISTRICT 52 HUNTSVILLE
 BOREHOLE LOCATION & SOIL STRATA

LEGEND

- ◆ BOREHOLE
- ◆ BOREHOLE & ROCK CORE
- ▨ FILL
- ▧ SILTY SAND TO SAND
- ▩ SILT TO SANDY SILT
- ORGANIC SILT
- ▤ BEDROCK/ (CORED BOREHOLE)
ASSUMED BEDROCK/ (AUGER REFUSAL)
- ▽ WATER LEVEL (UPON COMPLETION OF AUGERING IN BOREHOLES)
(IN STANDPIPE BH'S S7, S9, S11, S39, S41, S43)

NOTES

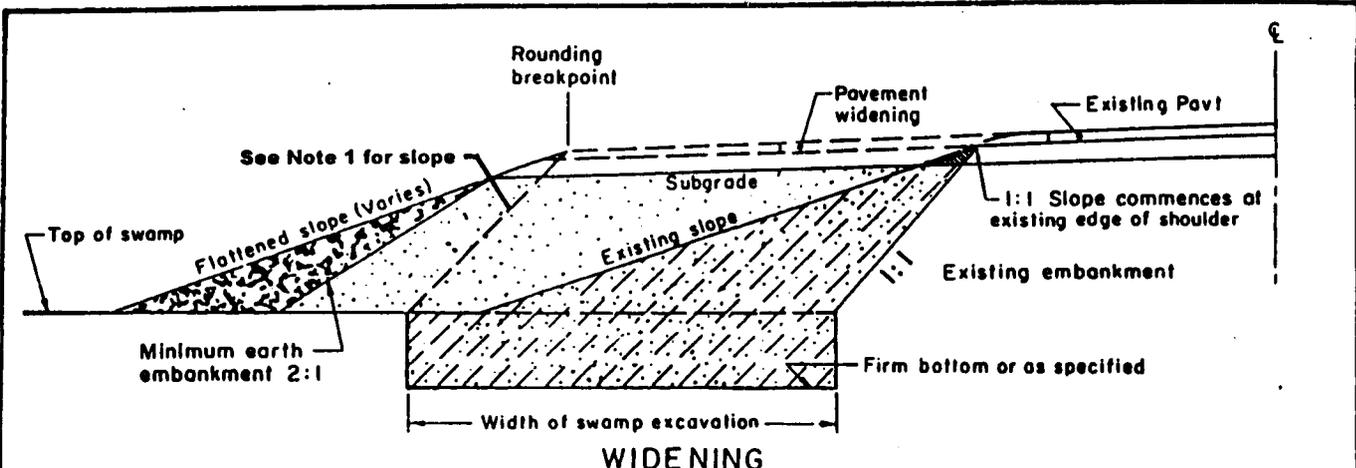
- REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SURFACE CONDITIONS
- THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS BETWEEN BOREHOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE
- REFER TO DRAWING No. 1 FOR BOREHOLE AND SECTION LOCATIONS.



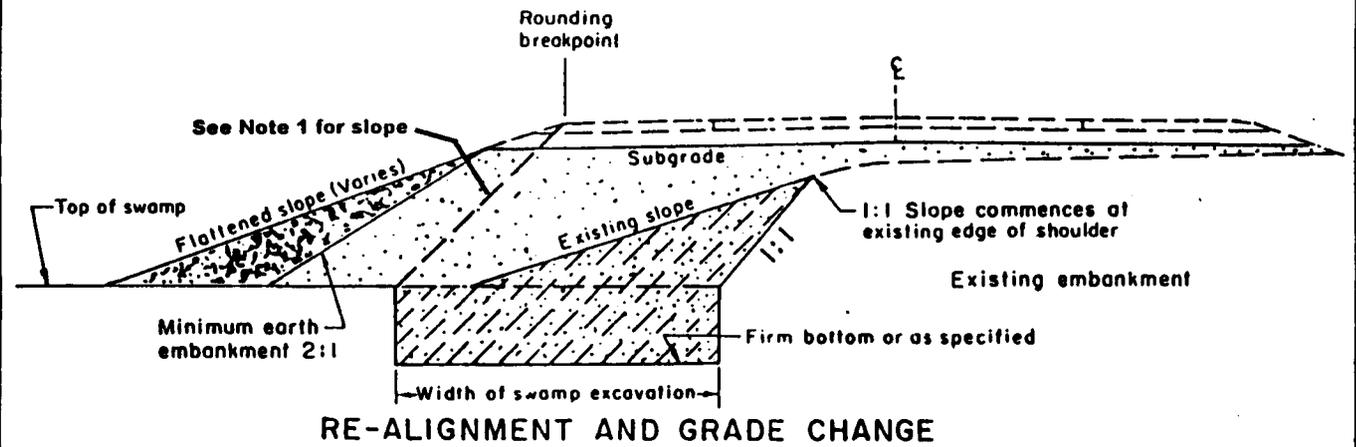
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 HORIZONTAL 1:1000
 VERTICAL 1:200

Peto MacCallum Ltd.
 CONSULTING ENGINEERS

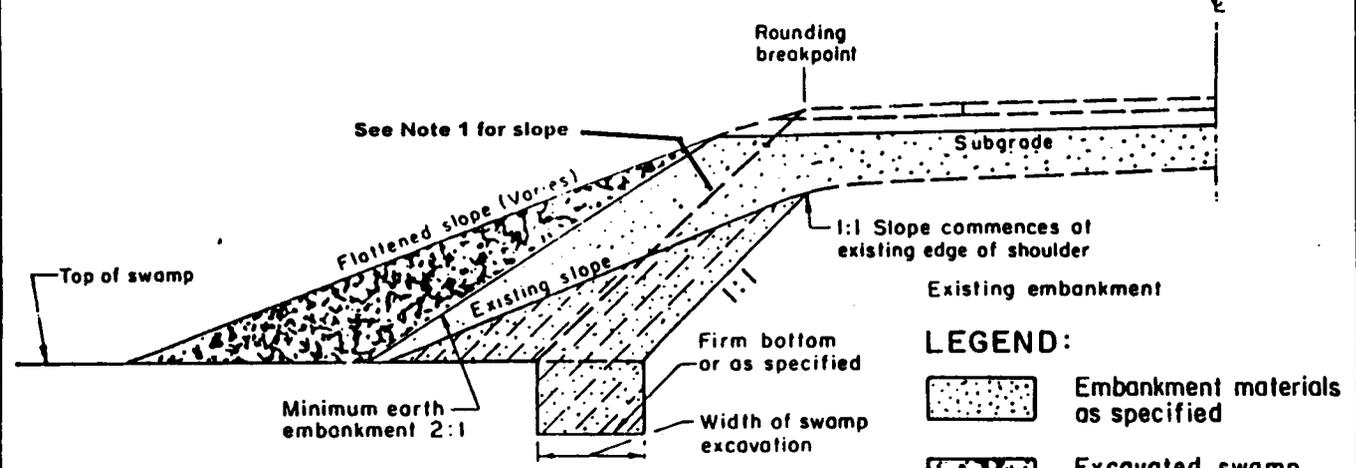
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CHECKED: TLB				
APPROVED: DWK				



WIDENING



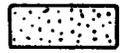
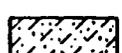
RE-ALIGNMENT AND GRADE CHANGE



GRADE CHANGE

Existing embankment

LEGEND:

-  Embankment materials as specified
-  Excavated swamp material
-  Excavate and backfill
-  Excavate

NOTES:

1. To determine width of excavation
 use 1.5:1 slope for rock fill
 use 2:1 slope for earth fill

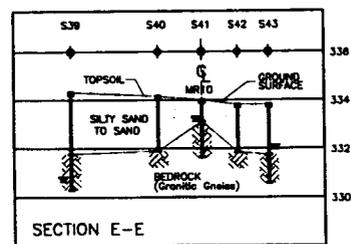
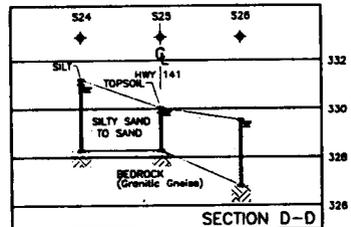
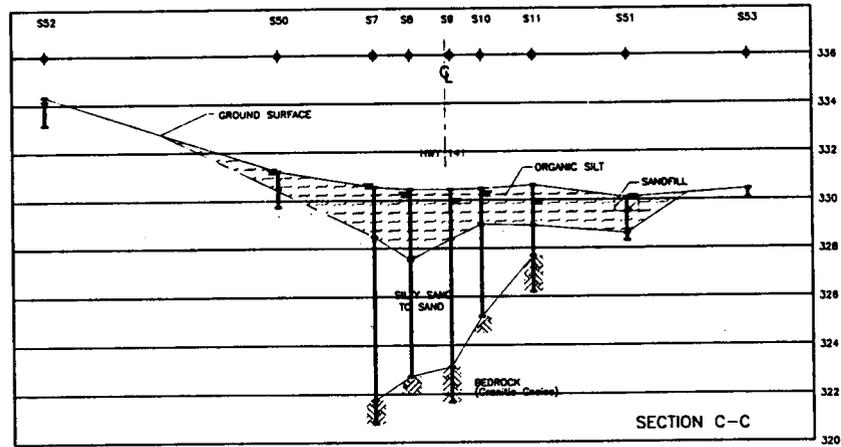
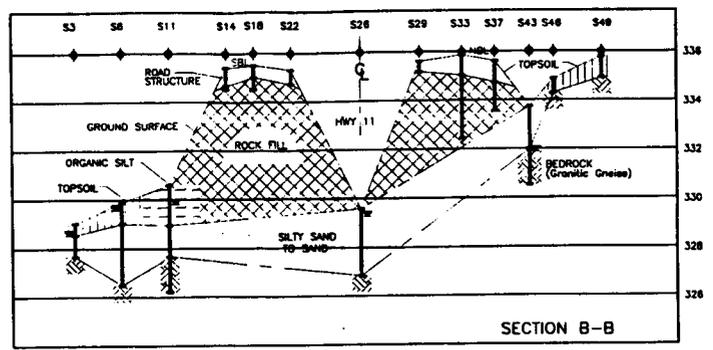
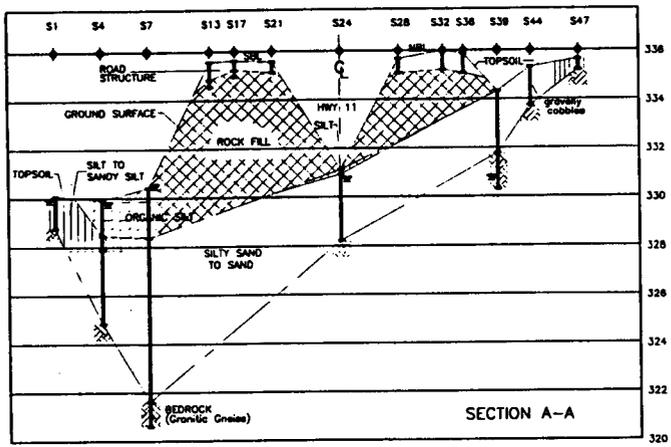
ONTARIO PROVINCIAL STANDARD DRAWING				Date	1990 04 02	Rev	1
EMBANKMENTS OVER SWAMP EXISTING SLOPE EXCAVATED TO 1:1				Date _____			
				OPSD - 203.02 (MOD)			

W.P.149-86-00
 SITE# 42-192N AND SITE# 42-192S
 HIGHWAY 11 AND
 HIGHWAY 141/ MUSKOKA ROAD TO
 INTERCHANGE
 DISTRIC 52 HUNTSVILLE
 BOREHOLE LOCATION & SOIL STRATA

LEGEND

- ◆ BOREHOLE
- ◆ BOREHOLE & ROCK CORE
- ▨ FILL
- ▩ SILTY SAND TO SAND
- ▧ SILT TO SANDY SILT
- ▦ ORGANIC SILT
- ▤ BEDROCK/ (CORED BOREHOLE)
 ASSUMED BEDROCK/ (AUGER REFUSAL)
- ▽ WATER LEVEL (UPON
 COMPLETION OF AUGERING IN BOREHOLES)
 (IN STANDPIPE BH'S S7, S9,
 S11, S39, S41, S43)

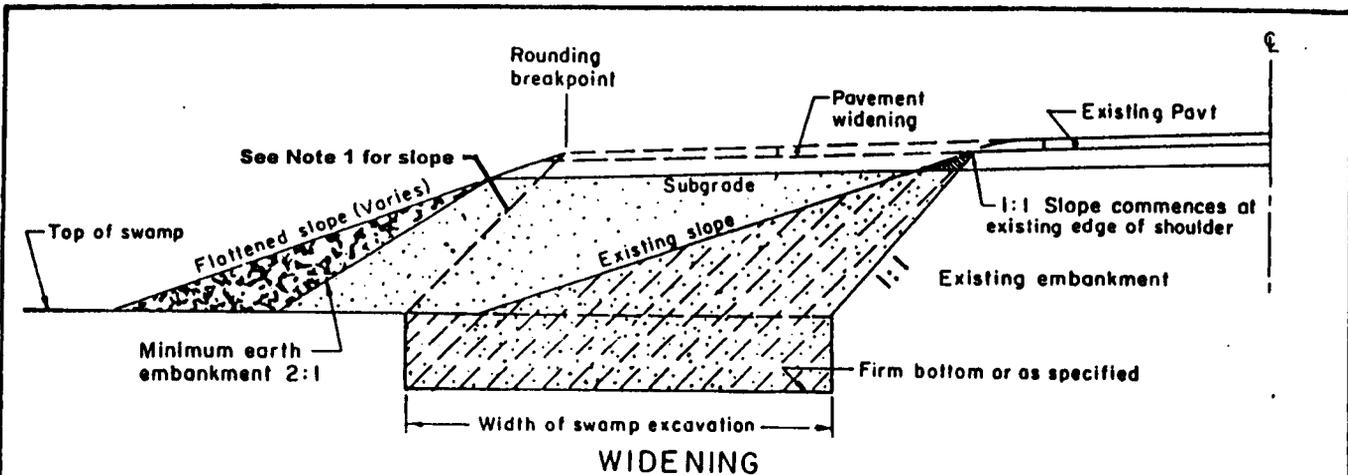
- NOTES**
- REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SURFACE CONDITIONS
 - THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS BETWEEN BOREHOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE
 - REFER TO DRAWING No. 1 FOR BOREHOLE AND SECTION LOCATIONS.



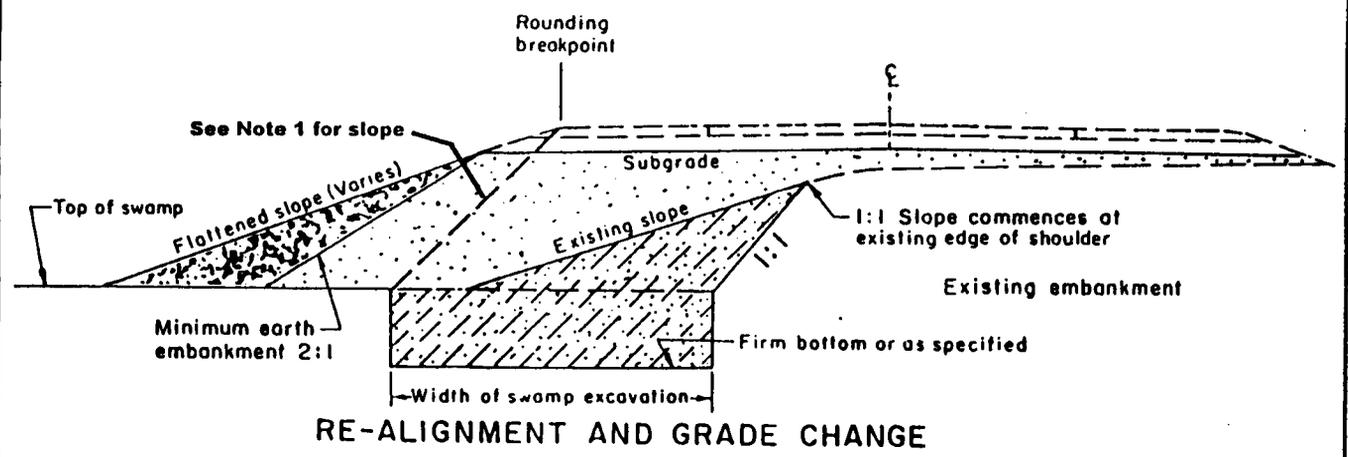
SCALE
 HORIZONTAL 1:1000
 VERTICAL 1:200

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 CONSULTING ENGINEERS

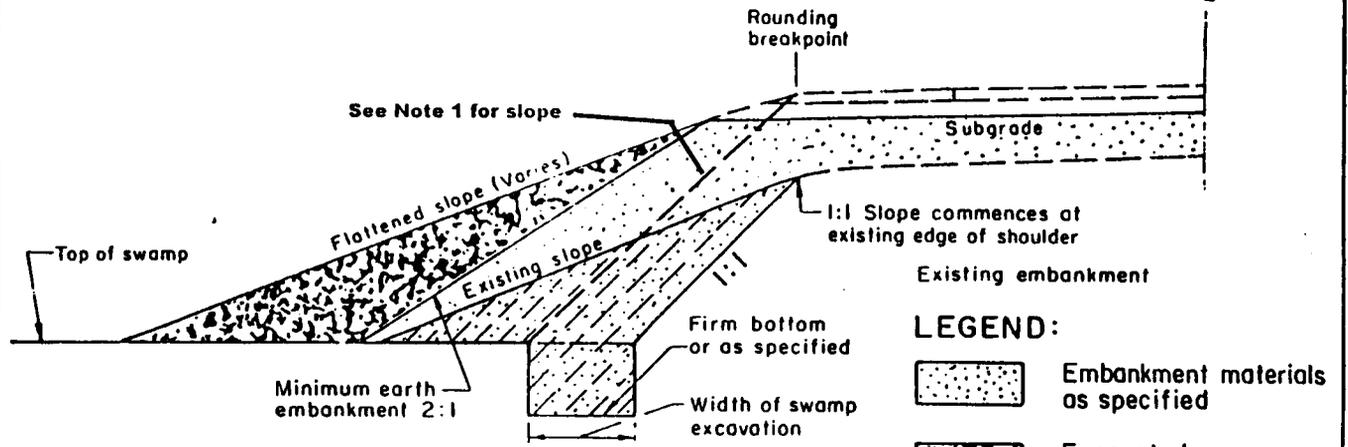
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CHECKED: TLB				
APPROVED: DWK				



WIDENING



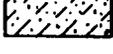
RE-ALIGNMENT AND GRADE CHANGE



GRADE CHANGE

NOTES:
 1. To determine width of excavation
 use 1.5:1 slope for rock fill
 use 2:1 slope for earth fill

LEGEND:

-  Embankment materials as specified
-  Excavated swamp material
-  Excavate and backfill
-  Excavate

ONTARIO PROVINCIAL STANDARD DRAWING		Date	1990 04 02	Rev	1
EMBANKMENTS OVER SWAMP		Date			
EXISTING SLOPE EXCAVATED TO 1:1		OPSD - 203.02 (MOD)			

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N', - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3 m INTO THE SUBSOIL, DRIVEN BY MEANS OF A 63.5 kg HAMMER FALLING FREELY A DISTANCE OF 0.76 m.

DYNAMIC PENETRATION RESISTANCE:-THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51 mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 0.3 m INTO THE SUBSOIL. THE DRIVING ENERGY BEING 475 J PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>'N' BLOWS/0.3 m</u>	<u>c kPa</u>	<u>DENSENESS</u>	<u>'N' BLOWS/0.3 m</u>
VERY SOFT	0 - 2	0 - 12	VERY LOOSE	
SOFT	2 - 4	12 - 25	LOOSE	0 - 4
FIRM	4 - 8	25 - 50	COMPACT	4 - 10
STIFF	8 - 15	50 - 100	DENSE	10 - 30
VERY STIFF	15 - 30	100 - 200	VERY DENSE	30 - 50
HARD	> 30	> 200		> 50

W.T.P.L. WETTER THAN PLASTIC LIMIT

D.T.P.L. DRIER THAN PLASTIC LIMIT

A.P.L. ABOUT PLASTIC LIMIT

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL		

SUPPLEMENTARY FOUNDATION INVESTIGATION
CONTRACT NO. 98-47
SITE # 42-192N AND SITE # 42-192S
HIGHWAY 11 AND HIGHWAY 141/MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE

DISTRIBUTION:

12 cc: D. M. Wills Associates Limited
1 cc: PML Barrie
1 cc: PML Toronto

PML Ref: 97 BF 031A

November, 1998

Peto MacCallum Ltd.

C O N S U L T I N G E N G I N E E R S

November 23, 1998

PML Ref: 98 BF 031A

Mr. Peter Baldasaro
D. M. Wills Associates Limited
451 Charlotte Street
Peterborough, Ontario
K9J 2W3

Dear Mr. Baldasaro

Supplementary Foundation Investigation
Contract No. 98-49
Site # 42-192N and Site # 41-192S
Highway 11 and Highway 141/Muskoka Road 10 Interchange
District 52, Huntsville

As requested, we have completed the supplementary foundation investigation at the above site, and the results are provided in the attached factual report.

We trust this submission is satisfactory. If you have any questions, please do not hesitate to call our office.

Sincerely

PETO MacCALLUM LTD.



Turney Lee-Bun, P.Eng.
Manager, Geotechnical Engineering
(Barrie Office)

TLB:ga

SUPPLEMENTARY FOUNDATION INVESTIGATION
For
Contract No. 98-47
Site # 42-192N and Site # 42-192S
Highway 11 and Highway 141/Muskoka Road 10 Interchange
District 52, Huntsville

INTRODUCTION

A Foundation Investigation Report Reference 97 BF 031, dated March 27, 1997 was previously prepared for the site. During initial excavation, it became apparent that bedrock across the site varies substantially over short distances, with relatively deep buried valleys and near vertical rock faces.

This report contains the results of a supplementary foundation investigation carried out to better define the subsurface conditions, in particular the bedrock profile.

INVESTIGATION PROCEDURES

The fieldwork was carried out during the period November 9 to 21, 1998, and consisted of the following:

- ▶ Eight (8) boreholes with core 3 m into rock (S13, S14, S21, and S22 in the SBL and S28A, S29A, S36 and S37 in the NBL).
- ▶ Eight (8) probes to 3 m into rock (S17, S18, RP1 and RP2 in the SBL and S28B, S32A, S33A and S36A in the NBL).
- ▶ Three (3) auger probes to refusal (S32, S33 and S37A in the NBL).
- ▶ Two (2) boreholes to auger refusal (101 and 102 in median area).
- ▶ Test pit using a hydraulic backhoe at auger probe S32 to confirm bedrock.

The boreholes were advanced by wash boring methods in the overburden and rotary diamond coring in the bedrock, using track mounted CME-55 and CME-75 drillrigs, supplied and operated by a specialist drilling contractor, Boart Longyear Inc., working under the full-time supervision of a member of our engineering staff.

The probes were completed using a Ranger 700 Tamrock drillrig provided by Bot Construction, who was also responsible for drilling and installation of casings through the existing SBL rockfill embankment. The boreholes on the SBL were subsequently advanced through these upper casings.

Bot Construction also provided the necessary traffic control for work on the existing SBL.

As the overburden in the NBL was disturbed by prior excavation and exploratory test pits, boreholes in this area were advanced without sampling and testing of the overburden.

For boreholes in the SBL, representative samples of the overburden under the rockfill were recovered at frequent depth intervals using a conventional split spoon sampler. Standard penetration tests were conducted simultaneously with the sampling operations to assess the strength characteristics of the material.

Boreholes 101 and 102 located in the median area were advanced to refusal using continuous flight hollow stem augers. Split spoon sampling and standard penetration tests were conducted together with dynamic cone penetration tests in borehole 102.

Horizontal and vertical survey controls were provided by D. M. Wills Associates Limited:

Recovered soil samples and bedrock cores were returned to our laboratory for detailed examination and classification. Grain size analyses were carried out on seven (7) representative soil samples.

Some additional information, described below, were provided by D. M. Wills Associates Limited and used to supplement this investigation.

- ▶ Thirty (30) probes were previously carried out using an air track provided by Bot Construction. These probes were drilled 1 m into rock, and were located approximately along the west edge of the NBL, along the centreline median and along the east toe of the SBL embankment.
- ▶ Spot elevations on the exposed bedrock along the east edge of the NBL.

SUMMARIZED SUBSURFACE CONDITIONS

The logs for the boreholes are appended, which include soil descriptions, standard penetration test "N" values, dynamic cone penetration test results, depth to bedrock and bedrock classification.

The stratigraphy revealed in the boreholes comprised rockfill embankment in the SBL (NBL was excavated at the time of investigation) and variable depths of sand over bedrock.

The Grain Size Distribution Charts for representative samples of the sand are provided on Figure No. 1, appended, which show the material to be predominately fine sand trace silt to fine sand with silt. Cobbles and boulders were noted in the overburden while drilling, and were also visibly evident from previous excavations. Based on standard penetration test "N" values, the sand under the existing SBL was compact to very dense, except for the upper 3 m in borehole S21 which was very loose.

The bedrock surface varies significantly across the site, ranging between about elevation 301 and elevation 333 at the investigated locations. Reference is made to Drawing No. 3, which compiles the rock contact elevations in the boreholes and probes, and from the survey of exposed rock areas. The rock contact in boreholes and probes drilled along the abutments are shown on Drawing Nos. 2A and 2B.

The bedrock consisted of generally pink and grey/black, medium to high (locally low) strength granitic gneiss with local diorite gneiss and migmatite. Spacing of discontinuities was very close to wide, and the rock quality was typically very poor to fair becoming good to excellent with depth.

Groundwater observations were not possible in the boreholes that were advanced by wash boring method. Based on observations in the other boreholes, observation of standing water in the excavation for the NBL north abutment, and standing water on the west side of the SBL, the stabilised groundwater table is believed to be around elevation 229 to 230. Groundwater levels are subject to seasonal fluctuations and rainfall patterns.

CLOSURE

The fieldwork was carried out under the supervision of J. F. Wright, Senior Geologist. Boart Longyear Inc. provided the drillrigs and crew for advancing the boreholes. This report was prepared by T. Lee-Bun, Manager, Geotechnical Engineering (Barrie Office), and reviewed by B. R. Gray, Vice President, Geotechnical Engineering and Geo-Environmental Services.

Respectfully Submitted

PETO MacCALLUM LTD.



Turney Lee-Bun, P.Eng.
Manager, Geotechnical Engineering



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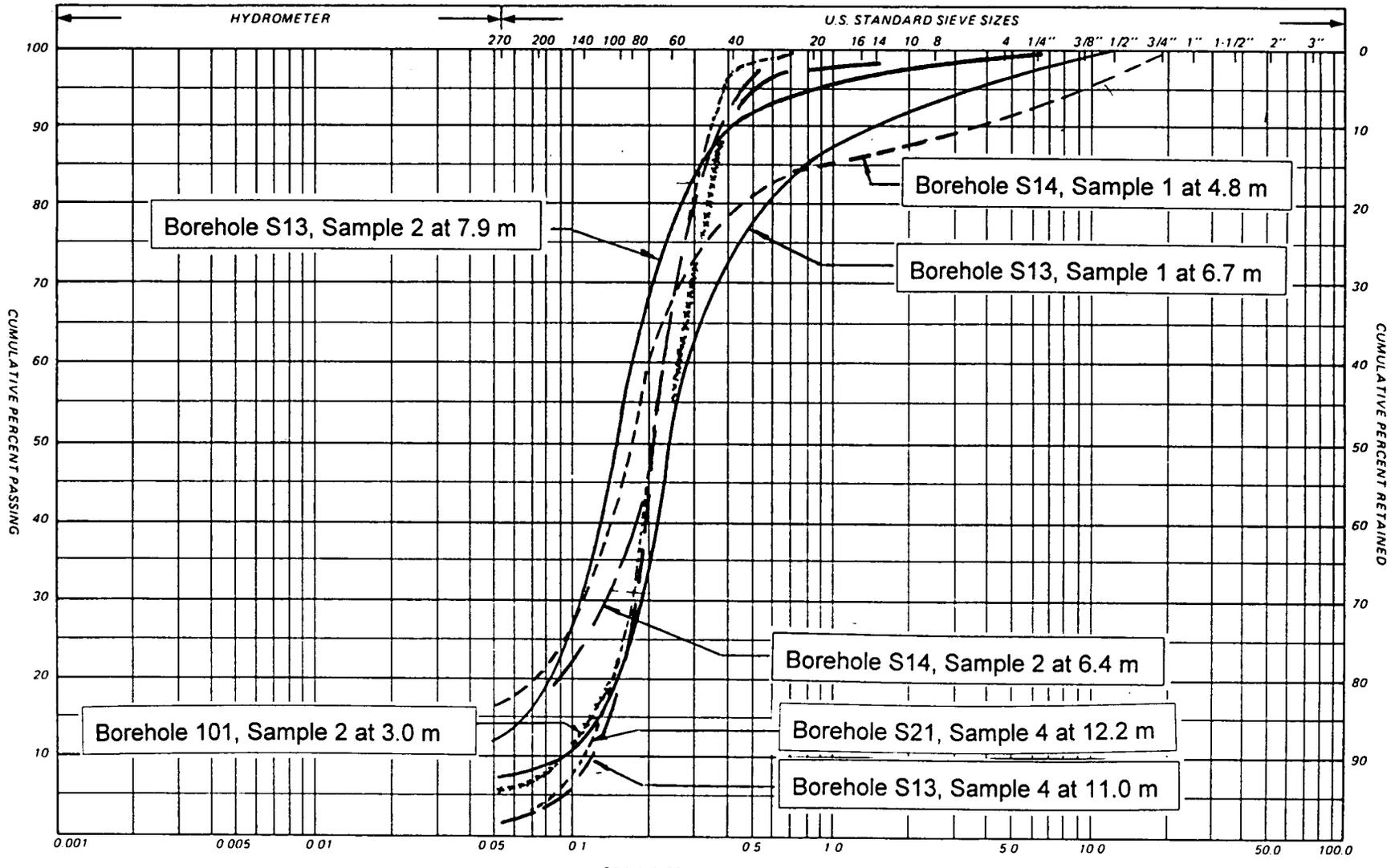
TLB/BRG:ga

APPENDIX

PARTICLE SIZE DISTRIBUTION CHART

FIGURE NO. 1
OUR PROJECT NO. 97 BF 031A

PML-117-S



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

REMARKS Predominantly FINE SAND, TRACE SILT TO FINE SAND WITH SILT

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N', - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3 m INTO THE SUBSOIL, DRIVEN BY MEANS OF A 63.5 kg HAMMER FALLING FREELY A DISTANCE OF 0.76 m.

DYNAMIC PENETRATION RESISTANCE:-THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51 mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 0.3 m INTO THE SUBSOIL. THE DRIVING ENERGY BEING 475 J PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>'N' BLOWS/0.3 m</u>	<u>c kPa</u>	<u>DENSENESS</u>	<u>'N' BLOWS/0.3 m</u>
VERY SOFT	0 - 2	0 - 12	VERY LOOSE	0 - 4
SOFT	2 - 4	12 - 25	LOOSE	4 - 10
FIRM	4 - 8	25 - 50	COMPACT	10 - 30
STIFF	8 - 15	50 - 100	DENSE	30 - 50
VERY STIFF	15 - 30	100 - 200	VERY DENSE	> 50
HARD	> 30	> 200		

W.T.P.L. WETTER THAN PLASTIC LIMIT

D.T.P.L. DRIER THAN PLASTIC LIMIT

A.P.L. ABOUT PLASTIC LIMIT

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL		

LOG OF BOREHOLE NO. S13 (1 of 2)

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange
 LOCATION 16+347 (Hwy 11) 27.0 m Lt.

OUR PROJECT NO. 97 BF 031A

ENGINEER ILB

BORING METHOD NW Wash Boring and Rotary Diamond
 Coring

BORING DATE November 12/19, 1998

TECHNICIAN JFW

SOIL PROFILE		SAMPLES			SHEAR STRENGTH G_c ▲		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST °		WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80		10 20 30			
GROUND ELEVATION 335.6												
ROCK FILL (Unsampled)												
1.5		X	335									
		X	334									
		X	333									
3.0		X	332									
		X	331									
4.5		X	330									
6.0		X	329	1	SS	100/125 mm					* N value suspect	
6.40		X	328	2	SS	15						
		X	327									
9.0		X	326	3	SS	29						
		X	325	4	SS	23						
10.00		X	324									
10.5		X	323									
		X	322	5	SS	20						
15.0		X	321									
15.00		X	320									
16.5		X	319									

NOTES

continued on next page

CHECKED BY *MCS*

LOG OF BOREHOLE NO. S13 (continued) (2 of 2)

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+347 (Hwy 11) 27.0 m Lt. ENGINEER TLB
 BORING METHOD NW Wash Boring and Rotary Diamond BORING DATE November 12/19, 1998 TECHNICIAN JFW
 Coring

SOIL PROFILE		SAMPLES			SHEAR STRENGTH G_s ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
	GROUND ELEVATION 335.6													
	(continued from previous page)													
	SAND:		320											
16.5	16.50 cobble/gravel		319	6	RC	-								
	17.40 sand and gravel		318											
18.0	18.00 750 mm diameter boulder		317											
	18.95													
19.5	19.50 GRANITIC GNEISS: Red and grey, medium strength, close spaced discontinuities		316	7	RC		1520	100	37					
	19.80 red, friable, low strength, very close spaced oblique partings with grey clay or scale on partings, very poor to poor quality		315	8	RC		660	100	0					
21.0	21.00 medium to high strength, close spaced partings, poor quality		314	9	RC		860	100	41					
	22.20		314	10	RC		790	100	26					
22.5	22.50 DRILLING TERMINATED AT 22.20 m													

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LOG OF BOREHOLE NO. S14

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+380 (Hwy 11) 28.5 m Lt ENGINEER TLB
 BORING METHOD NW Wash Boring and Rotary Diamond BORING DATE November 12, 1998 TECHNICIAN JFW
 Coring

SOIL PROFILE		SAMPLES			SHEAR STRENGTH q_c ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST σ				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
	GROUND ELEVATION 335.33													
	ROCKFILL: (Unsampled)	[X-pattern]	335											
1.5	(Pneumatic drill used to drill and lower casing to bottom of rockfill)		334											
3.0			333											
4.26			332											
4.5			331											
	SAND: Dense brown silty fine sand trace gravel, occasional cobbles, wet	[Vertical lines]	330	1	SS	48								
5.70	compact brown fine sand, some silt, wet		329	2	SS	15								
6.0			328											
7.5			327	3	SS	76	RUN (mm)	REC (%)	ROD (%)					
7.90 8.08	SILT: Very dense brown fine sandy silt, wet	[Diagonal lines]	326	4	RC		1260	92	80					
9.0	GRANITIC GNEISS: Unweathered, pink and black, high strength, close to wide spaced discontinuities, occasional oblique partings with red scaling on partings surface, good to excellent quality		325	5	RC		1520	100	100					
10.5			324	6	RC		430	100	100					
11.20		DRILLHOLE TERMINATED AT 11.20 m												
12.0														
13.5														
15.0														
16.5														

NOTES

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LOG OF BOREHOLE NO. S21 (1 of 3)

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+343 (Hwy 11) 14.0 m Lt. ENGINEER TLB
 BORING METHOD NW Wash Boring and Rotary Diamond BORING DATE November 19/20, 1998 TECHNICIAN JFW
 Coring

SOIL PROFILE			SAMPLES			SHEAR STRENGTH G ▲				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT %			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST O							
							BLOWS/0.3M				WATER CONTENT %			
							20	40	60	80	10	20	30	
	GROUND ELEVATION 335.6													
	PAVEMENT STRUCTURE ROCK FILL (Unsampled)		335											
1.5			334											
3.0	(Pneumatic drill used to drill to bottom of rockfill. Hole stayed open, uncased)		333											
4.5			332											
6.0			331											
6.70			330											
7.5	SAND: Very loose brown fine sand, trace silt, with inclusions of peat, wet		329											
			328	1	SS		3	450	mm					
			327											
9.0	9.00 stratified brown and rust brown		326	2	SS		1							
10.5	10.00 compact		325	3	SS		25							
12.0	rust brown and red layers		324											
			323	4	SS		24							
13.5	13.50 very dense grey fine sand, trace to some silt, trace to some gravel, wet		322	5	SS		55	150	mm					
15.0	15.00		321											
16.5	continued on next page													

NOTES

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LOG OF BOREHOLE NO. S21 (continued) (2 of 3)

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+343 (Hwy 11) 14.0 m Lt. ENGINEER TLB
 BORING METHOD NW Wash Boring and Rotary Diamond BORING DATE November 19/20, 1998 TECHNICIAN JFW
 Coring

SOIL PROFILE		SAMPLES				SHEAR STRENGTH G_c ▲				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST ◊				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
15.0	GROUND ELEVATION 335.6													
	(continued from previous page)			6	SS	*								* Sand heaved inside casing
	SAND: occasional cobbles		320											
16.5			319											
17.40			318	7	RC	-								
18.0	SILT: Very dense brown silt, trace sand, moist													
18.60			317											
	SAND: Brown fine sand, trace silt													
19.5			316	8	WS	-								
			315											
21.0			314											
			313											
22.5			312	9	WS	-								
			311											
24.0			310	10	WS	-								
			309											
25.5			308											
			307	11	WS	-								
27.0			306											
28.5														
29.00														
	very dense based on resistance to advance casing													
30.0														
	(continued on next page)													

NOTES

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LOG OF BOREHOLE NO. S21 (continued) (3 of 3)

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+343 (Hwy 11) 14.0 m Lt. ENGINEER TLB
 BORING METHOD NW Wash Boring and Rotary Diamond BORING DATE November 19/20, 1998 TECHNICIAN JFW
 Coring

DEPTH in METRES	SOIL PROFILE DESCRIPTION	LEGEND	ELEVATION	SAMPLES		BLOWS/0.3M N-VALUES	SHEAR STRENGTH c_u ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS
				NUMBER	TYPE		DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o				WATER CONTENT %			
	GROUND ELEVATION 335.6						BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
30.0	(continued from previous page) SAND: (continued)		305											
31.5			304	12	WS	-								
			303											
33.0			302											
34.24														
34.5	GRANITIC GNEISS: Red and grey, weathered, low to medium strength, very close spaced discontinuities, very poor quality		301	13	RC	-	RUN (mm)	REC (%)	RQD (%)					
35.10	unweathered, medium to high strength, close to moderate spaced oblique partings with grey scaling on surface, good to excellent quality		300											
36.0			299	14	RC	-	1520	100	100					
37.5			298	15	RC	-	1520	100	83					
38.15	DRILLING TERMINATED AT 38.15 m													
39.0														

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LOG OF BOREHOLE NO. S22

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange

OUR PROJECT NO. 97 BF 031A

LOCATION 16+382 (Hwy 11) 15.0 m Lt.

ENGINEER TLB

BORING METHOD NW Wash Boring and Rotary Diamond

BORING DATE November 21, 1998

TECHNICIAN SN

Coring

SOIL PROFILE		SAMPLES				SHEAR STRENGTH C_u ▲				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
	GROUND ELEVATION 335.38													
	PAVEMENT STRUCTURE ROCKFILL Unsampled	X	335											
1.5	(Pneumatic drill used to drill to bottom of rockfill)	X	334											
		X	333											
3.0		X	332											
		X	331											
4.5		X	330											
5.50		X	329											
6.0	SAND: Dense brown to grey sand, trace to some silt, trace gravel, wet		329											
			328											
7.5			328	1	SS	38								
			327											
9.0			326	2	SS	90/280 mm								
9.40	very dense fine sand, some silt to silty, some gravel occasional cobbles/boulders		326	2	SS	90/280 mm								
			325				RUN (mm)	REC (%)	ROD (%)					
10.5			325											
10.60			325											
	GRANITIC GNEISS: Pink unweathered medium to high strength, close to medium spaced discontinuities, excellent quality	H	324	3	RC	-	880	100	100					
11.70		H	324	3	RC	-	880	100	100					
	with oblique partings, grey to green scale on parting surface, fair quality	H	323											
12.0		H	323											
		H	322	4	RC	-	1520	100	57					
13.5		H	322	4	RC	-	1520	100	57					
		H	321	5	RC	-	920	100	58					
14.02	DRILLING TERMINATED AT 14.02 m		321											
15.0														
16.5														

NOTES

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LOG OF BOREHOLE NO. S28A

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+345 (Hwy 11) 10.5 m Rt ENGINEER TLB
 BORING METHOD NW Wash Boring and Rotary Diamond BORING DATE November 10, 1998 TECHNICIAN JFW
 Coring

SOIL PROFILE		SAMPLES		SHEAR STRENGTH c_u				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST o					WATER CONTENT % w_p w w_L
							BLOWS/0.3m 20 40 60 80					
	GROUND ELEVATION 330.83											
	SILTY FINE SAND TO FINE SAND: Occasional cobbles and boulders (unsampled)		330									
1.5			329									
3.0			328									
4.5			327									
6.0			326									
6.30	boulders		325									
7.47			324									
				1	RC		RUN (mm)	REC (%)	RCD (%)			
7.5			323				640	80	24			
8.80	MIGMATITE: Black unweathered migmatite, medium to high strength, close to moderate spaced discontinuities, fair quality		322									
9.0			321									
	GRANITIC GNEISS: Pink unweathered medium to high strength, close to moderate spaced discontinuities some near vertical partings, oxidized on surface, good to excellent quality			2	RC		1520	100	80			
10.43				3	RC		1170	100	91			
10.5	DRILLING TERMINATED AT 10.43 m											
12.0												
13.5												
15.0												
16.5												

NOTES Borehole located 1.5 m west of S28 due to access constraints.

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LOG OF BOREHOLE NO. S32

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+344.5 (Hwy 11) 22.0 m Rt ENGINEER TLB
 BORING METHOD Continuous Flight Solid Stem Augers BORING DATE November 10, 1998 TECHNICIAN JFW

SOIL PROFILE		SAMPLES				SHEAR STRENGTH c_u ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST °				w_p w w_L WATER CONTENT %			
						BLOWS/0.3M				WATER CONTENT %			
						20	40	60	80	10	20	30	
	GROUND ELEVATION 329.63												
	SILTY FINE SAND TO FINE SAND: (unsampled)		329										
1.17													
1.5	BOREHOLE TERMINATED AT 1.17 m upon refusal to auger.		328										
	Moved 0.6 m north of initial location, encountered refusal to auger at 1.47 m depth.												
3.0	Moved 1.3 m east of initial location, encountered refusal to auger at 1.07 m depth.												
4.5	Test pit excavated at this location November 11, 1998 revealed flat lying bedrock surface at borehole location. Just south and west of borehole bedrock drops off steeply/near vertical; overburden is cobbly/ bouldery and no bedrock to Elevation 324.5												
6.0													
7.5													
9.0													
10.5													
12.0													
13.5													
15.0													
16.5													

NOTES

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LOG OF BOREHOLE NO. S33

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+377.5 (Hwy 11) 21.0 m Rt ENGINEER TLB
 BORING METHOD Continuous Flight Solid Stem Augers BORING DATE November 11, 1998 TECHNICIAN JFW

SOIL PROFILE			SAMPLES			SHEAR STRENGTH q_c ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3M N-VALUES	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST σ				WATER CONTENT %			
							BLOWS/0.3M 20 40 60 80				WATER CONTENT % 10 20 30			
	GROUND ELEVATION 330.07													
1.5	SILTY FINE SAND TO FINE SAND (FILL): Occasional cobbles and boulders (unsampled) (POSSIBLE NATIVE)	X	329											
			328											
3.0			327											
4.5			326											
5.33			325											
6.0	BOREHOLE TERMINATED AT 5.33 m augers grinding and starting to slide off to the west													
7.5														
9.0														
10.5														
12.0														
13.5														
15.0														
16.5														

NOTES

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LOG OF BOREHOLE NO. S36

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+344 (Hwy 11) 26.0 m Rt ENGINEER TLB
 BORING METHOD NW Wash Boring and Rotary Diamond BORING DATE November 9, 1998 TECHNICIAN JFW
 Coring

SOIL PROFILE		SAMPLES		SHEAR STRENGTH q_c ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST ◊				WATER CONTENT %			
						BLOWS/0.3M N-VALUES				WATER CONTENT %			
GROUND ELEVATION 329.84				20 40 60 80				10 20 30					
SILTY FINE SAND TO FINE SAND (FILL) (unsampled)						RUN (mm)	REC (%)	RQD (%)					
0.97			329										
1.5	GRANITIC GNEISS: Unweathered dark grey to black, medium strength, very close to close spaced oblique and horizontal partings with oxidation staining, some clay infiling poor quality, becoming fair to good	[Hatched Pattern]	328	1	RC	710	100	39					
3.0			327	2	RC	1520	100	70					
4.11			326	3	RC	915	94	78					
4.5			DRILLING TERMINATED AT 4.11 m										
6.0													
7.5													
9.0													
10.5													
12.0													
13.5													
15.0													
16.5													

▼ Nov. 10/98
 water at 1.35 m
 EL. 328.49

NOTES

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LOG OF BOREHOLE NO. S37

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+377 (Hwy 11) 28.0 m Rt ENGINEER TLB
 BORING METHOD NW Wash Boring and Rotary Diamond BORING DATE November 10, 1998 TECHNICIAN JFW
 Coring

SOIL PROFILE		SAMPLES		SHEAR STRENGTH G_s ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS			
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST σ				WATER CONTENT %				
						BLOWS/0.3M				w_p		w	w_L	
	GROUND ELEVATION 330.06					20	40	60	80	10	20	30		
1.5	SILTY FINE SAND TO FINE SAND (FILL): Occasional cobbles and boulders (unsampled)	[Cross-hatched pattern]	329											
			328											
3.0			327											
	GRANITIC GNEISS: Sound pink and dark grey, medium strength, very close to close spaced oblique and horizontal partings with oxidation stains, very poor to poor quality	[Diagonal hatched pattern]	326	1	RC	1520	83	16						
4.5			325											
6.0			324	2	RC	1520	100	33						
6.22	DRILLHOLE TERMINATED AT 6.22 m													
7.5														
9.0														
10.5														
12.0														
13.5														
15.0														
16.5														

NOTES

CHECKED BY 

LOG OF BOREHOLE NO. S37A

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange
 LOCATION 16+380 (Hwy 11) 28.0 m Rt.
 BORING METHOD Continuous Flight Solid Stem Augers

OUR PROJECT NO. 97 BF 031A
 ENGINEER TLB
 TECHNICIAN SN

BORING DATE November 21, 1998

SOIL PROFILE			SAMPLES				SHEAR STRENGTH c_u				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION \times STANDARD PENETRATION TEST \circ				WATER CONTENT %				
						BLOWS/0.3M N-VALUES				WATER CONTENT %				
						20	40	60	80	10	20	30		
	GROUND ELEVATION 330.4													
	SAND/FILL: Fine sand, trace silt, occasional cobbles, moist to wet (unsampled)		330											
1.5			329											
	2.74 auger grinding		328											
3.0	Augers grinding at 2.74 m then continued down at slight angle assumed following steeply dipping rock surface as exposed south of borehole location		327											
4.5	4.27 BOREHOLE TERMINATED AT 4.27 m upon refusal to auger		326											
6.0														
7.5														
9.0														
10.5														
12.0														
13.5														
15.0														
16.5														

NOTES

CHECKED BY 

LOG OF BOREHOLE NO. 101

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange

OUR PROJECT NO. 97 BF 031A

LOCATION 16+345 (Hwy 11) 5 m Rt

ENGINEER TLB

BORING METHOD Continuous Flight Hollow Stem Augers

BORING DATE November 18, 1998

TECHNICIAN JFW

SOIL PROFILE			SAMPLES				SHEAR STRENGTH C_u ▲				LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST †				WATER CONTENT %			
							BLOWS/0.3m 20 40 60 80				w_L	w_P	w	
	GROUND ELEVATION 330.8													
0.90	SAND: Loose brown fine sand, trace silt, moist		330											
1.5	grey fine sand, trace to some silt, wet													
1.80			329	1	SS	6								
	very loose, mottled rust to brown fine sand, trace silt													
3.0			328											
3.30				2	SS		0/300 mm							
	compact with cobbles		327				10/150 mm							
4.5														
4.88			326	3	SS	21	300 mm							
	BOREHOLE TERMINATED AT 4.88 m upon refusal to auger						Sampler bouncing							
6.0														
7.5														
9.0														
10.5														
12.0														
13.5														
15.0														
16.5														

Upon completion of augering water at 0.9 m

NOTES

CHECKED BY *M*

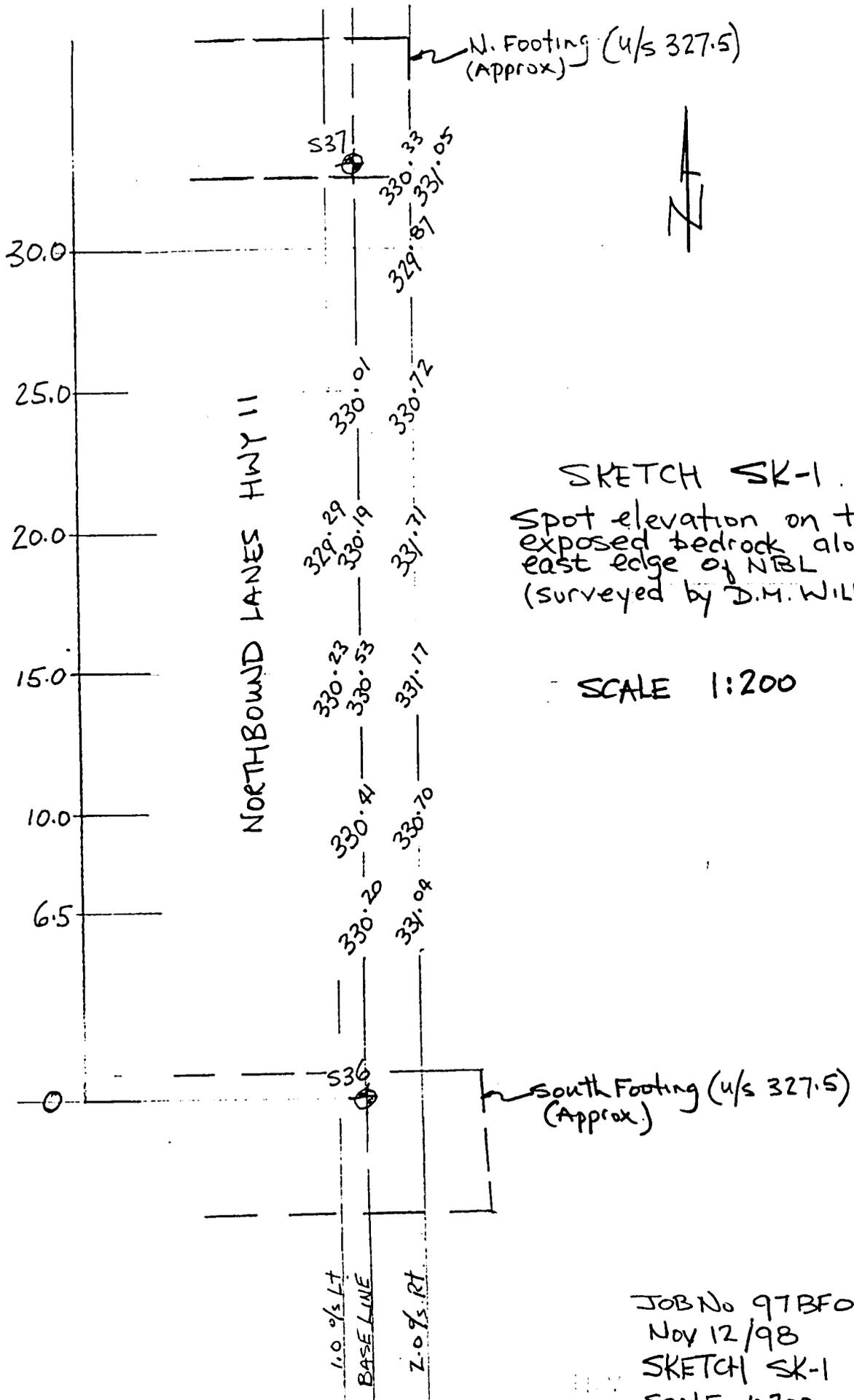
LOG OF BOREHOLE NO. 102

PROJECT Highway 11 and Highway 141/Muskoka Road 10 Interchange OUR PROJECT NO. 97 BF 031A
 LOCATION 16+350 (Hwy 11) 5 m Rt ENGINEER TLB
 BORING METHOD Continuous Flight Hollow Stem Augers BORING DATE November 14, 1998 TECHNICIAN MR

SOIL PROFILE		SAMPLES		SHEAR STRENGTH c_u ▲	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w	GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	
	GROUND ELEVATION 330.8					
1.5	SAND: Loose to very loose brown mottled rust fine sand with silt, trace gravel, wet		330			
			329	1	SS	2/450 mm
3.0	BOREHOLE TERMINATED AT 3.00 m upon refusal to auger Dynamic cone penetration test to refusal at 3.20 m		328			
4.5			327			
6.0						
7.5						
9.0						
10.5						
12.0						
13.5						
15.0						
16.5						

NOTES

CHECKED BY



SKETCH SK-1
Spot elevation on top of exposed bedrock along east edge of NBL (surveyed by D.M. WILLS)

SCALE 1:200

JOB No 97BFO31A
Nov 12/98
SKETCH SK-1
SCALE 1:200

NOTES

- S7, S9, S11, S39, S41 & S43 ARE PREVIOUS BOREHOLE WITH ROCK CORE
- X-ROCK PROBE ELEVATION PROVIDED BY D. M. WILLS. LOCATION APPROXIMATE ONLY.
- SURVEY CONTROL BY D. M. WILLS.

CONTRACT No. 98-47

SITE# 42-192N AND SITE# 42-192S
HIGHWAY 11 AND
HIGHWAY 141/ MUSKOKA ROAD 10
INTERCHANGE



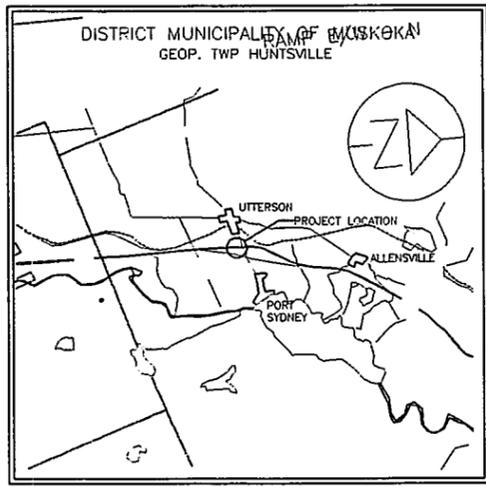
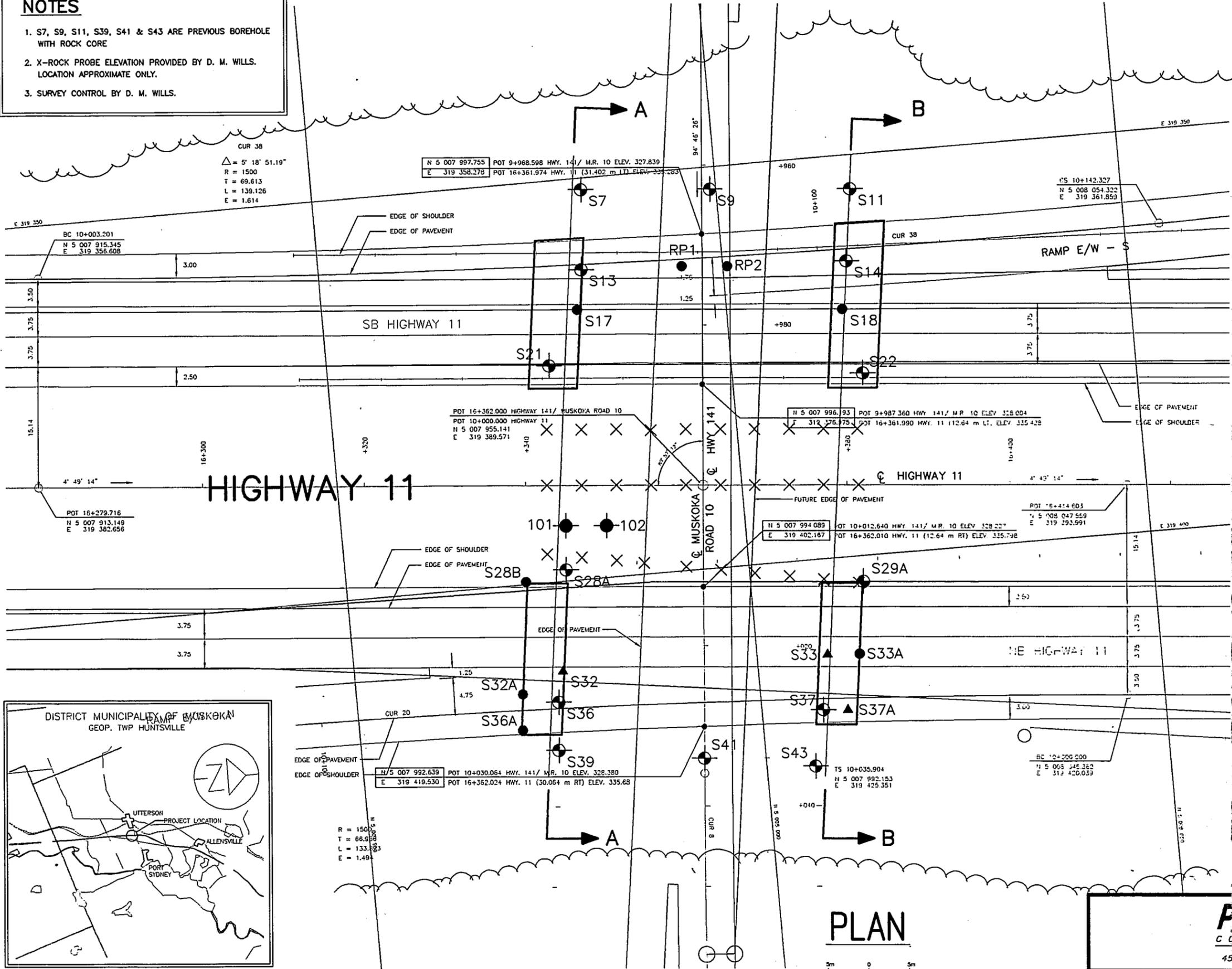
BOREHOLE LOCATION

REFER TO DRAWING 2A & 2B FOR SECTIONS
REFER TO DRAWING #3 FOR SUMMARY OF
ROCK ELEVATIONS

LEGEND

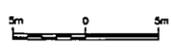
- BOREHOLE
- ⊙ BOREHOLE & ROCK CORE
- × PROBE 1m INTO ROCK (AIR TRACK)
- PROBE 3m INTO ROCK (AIR TRACK)
- ▲ UNSAMPLED AUGER PROBE TO REFUSAL

BOREHOLE	LOCATION	ELEVATION
S7	9+957 (HWY 141)	15.0 m Rt 330.42
S9	9+957 (HWY 141)	1.0 m Lt 330.32
S11	9+957 (HWY 141)	18.5 m Lt 330.48
S13	16+347 (HWY 11)	27.0 m Lt 335.60
S14	16+380 (HWY 11)	28.0 m Lt 335.33
S17	16+346.5 (HWY 11)	22.0 m Lt 335.75
S18	16+379.5 (HWY 11)	22.0 m Lt 335.44
S21	16+343 (HWY 11)	14.0 m Lt 335.60
S22	16+382 (HWY 11)	15.0 m Lt 335.38
S28A	16+345 (HWY 11)	10.5 m Rt 330.83
S28B	16+340 (HWY 11)	12.0 m Rt 334.24
S29A	16+382 (HWY 11)	12.0 m Rt 329.74
S32	16+344.5 (HWY 11)	24.0 m Rt 329.63
S32A	16+339.5 (HWY 11)	26.0 m Rt 330.63
S33	16+377.5 (HWY 11)	21.0 m Rt 330.07
S33A	16+381.5 (HWY 11)	21.0 m Rt 329.93
S36	16+344 (HWY 11)	28.0 m Rt 329.84
S36A	16+339 (HWY 11)	30.5 m Rt 330.18
S37	16+377 (HWY 11)	28.0 m Rt 330.06
S37A	16+380 (HWY 11)	28.0 m Rt 330.40
S39	10+033 (MR10)	18.0 m Rt 334.42
S41	10+034 (MR10)	Centreline 334.09
S43	10+035 (MR10)	14.0 m Lt 333.69
RP1	16+358 (HWY 11)	27.5 m Lt 335.56
RP2	16+366 (HWY 11)	27.5 m Lt 335.49
101	16+345 (HWY 11)	5.0 m Lt 330.8
102	16+350 (HWY 11)	5.0 m Lt 330.8



KEY PLAN
0.5km 0 1 km

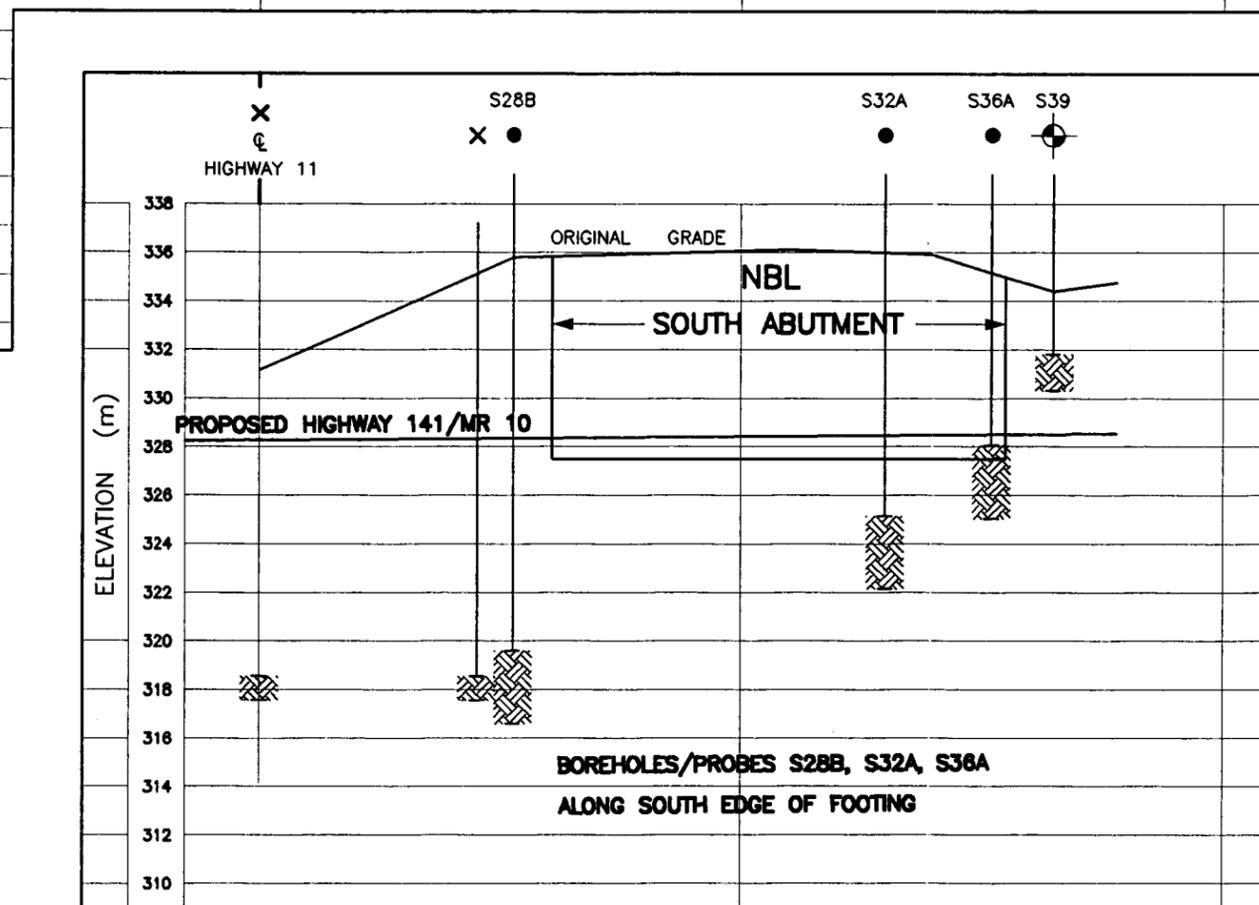
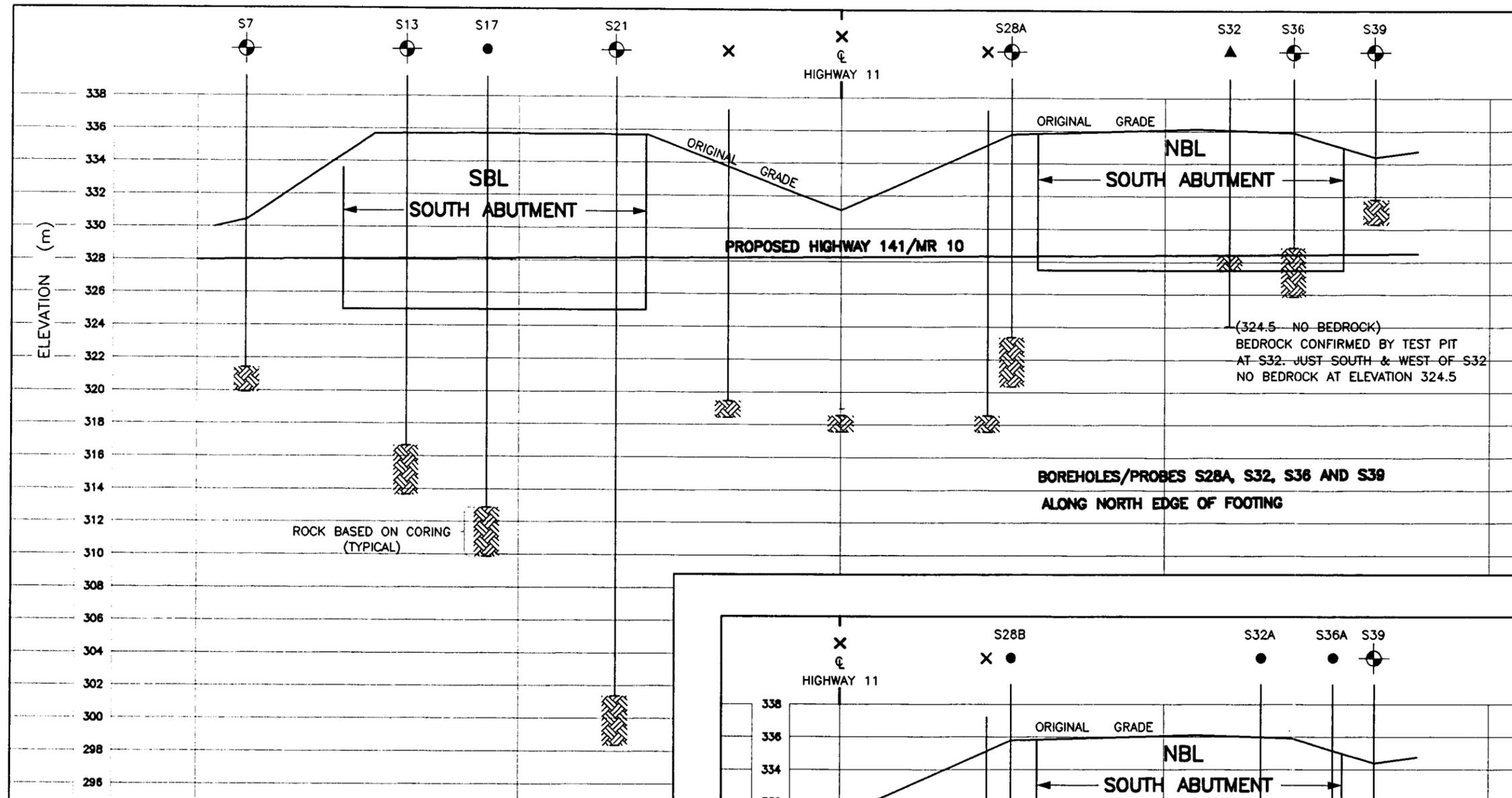
PLAN



Peto MacCallum Ltd.
CONSULTING ENGINEERS

45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3G6

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CHECKED	TLB	NOV. 22/98	1:500	97BF031A	1
APPROVED	BRG				

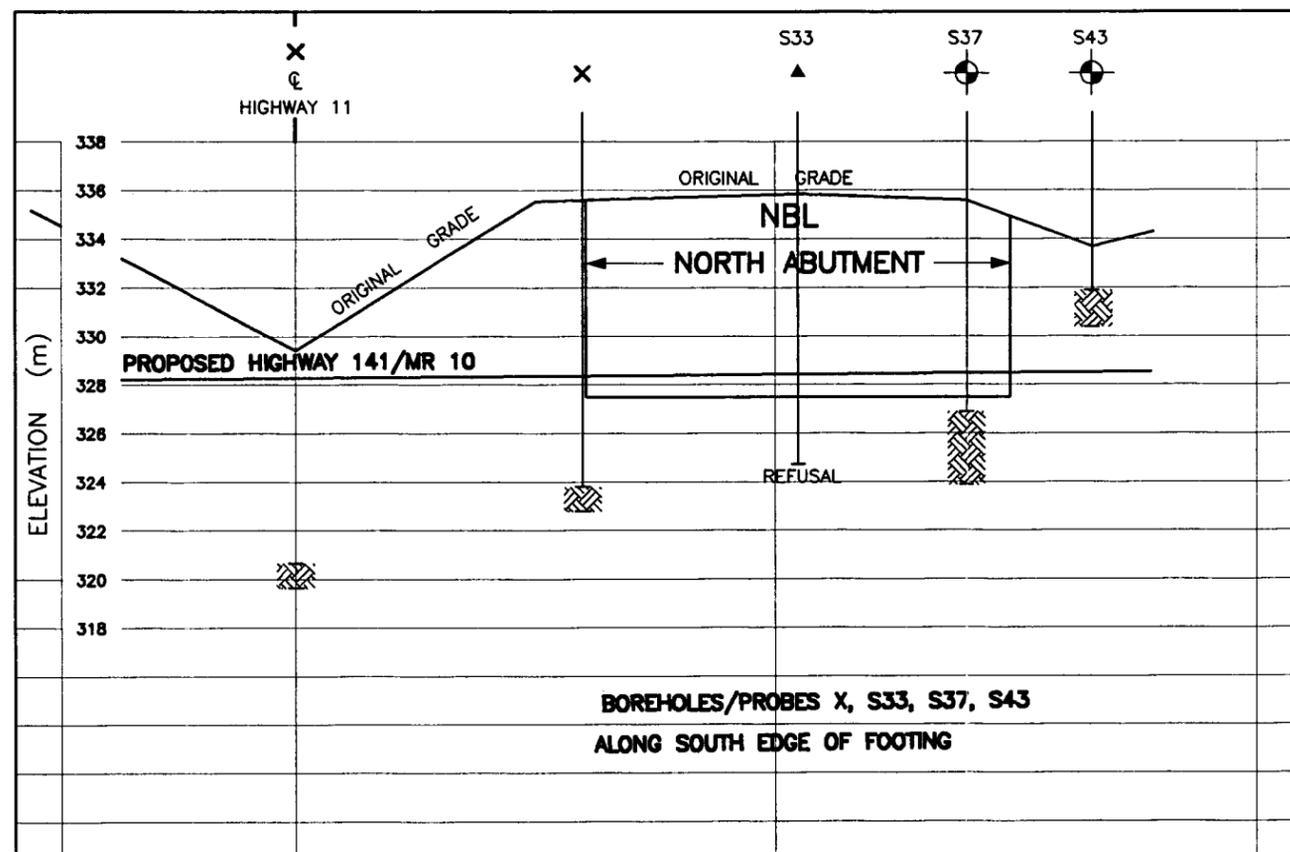
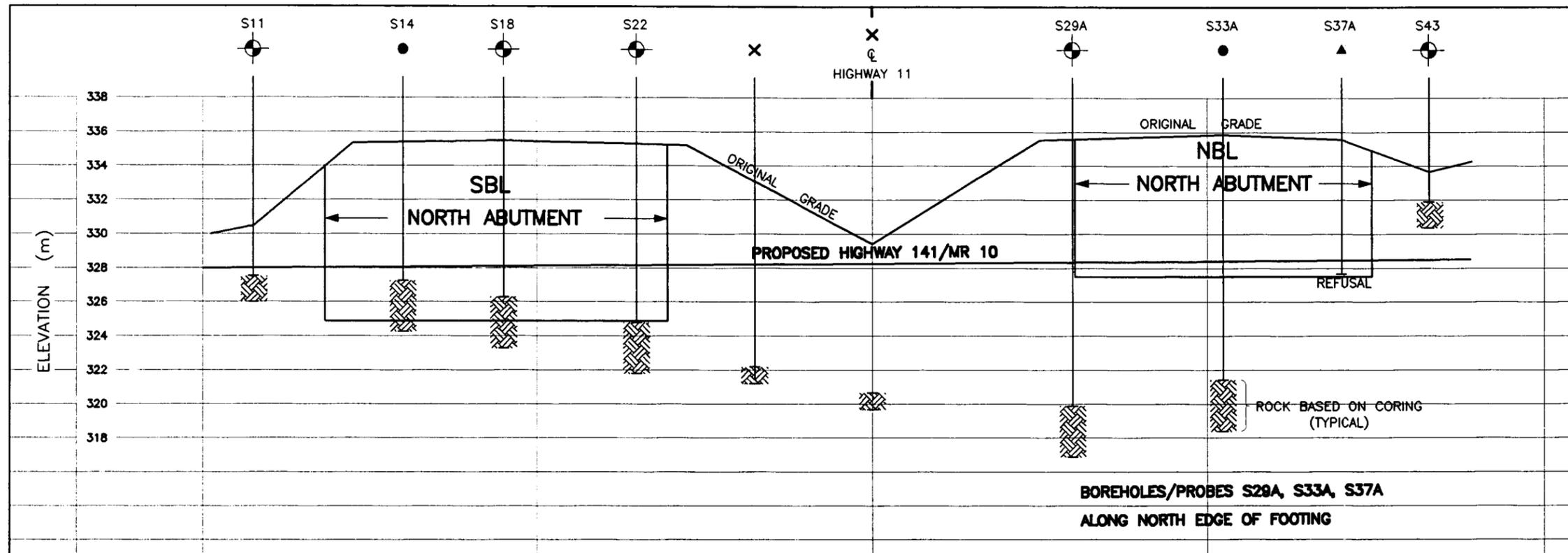


CONTRACT NUMBER 98-47
 SITE # 42-192N & SITE # 42-192S
 HIGHWAY 11 & HIGHWAY 141/MUSKOKA ROAD 10

ROCK PROFILE SECTION A-A SOUTH ABUTMENTS

Peto MacCallum Ltd.
 CONSULTING ENGINEERS
 45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C6

DRAWN	CB	DATE	SCALE	JOB NO.	DRAWING NO.
CHECKED	TLB	NOV. 22/98	1:300	97BF031A	2A
APPROVED	BRG				



CONTRACT NUMBER 98-47
SITE # 42-192N & SITE # 42-192S
HIGHWAY 11 & HIGHWAY 141/MUSKOKA ROAD 10

ROCK PROFILE SECTION B-B NORTH ABUTMENTS

Peto MacCallum Ltd.
CONSULTING ENGINEERS

45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C6

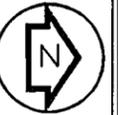
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APPROVED	BRG				

NOTES

- S7, S9, S11, S39, S41 & S43 ARE PREVIOUS BOREHOLE WITH ROCK CORE
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- SURVEY CONTROL BY D. M. WILLS.

CONTRACT No. 98-47

SITE# 42-192N AND SITE# 42-192S
HIGHWAY 11 AND
HIGHWAY 141/ MUSKOKA ROAD 10
INTERCHANGE



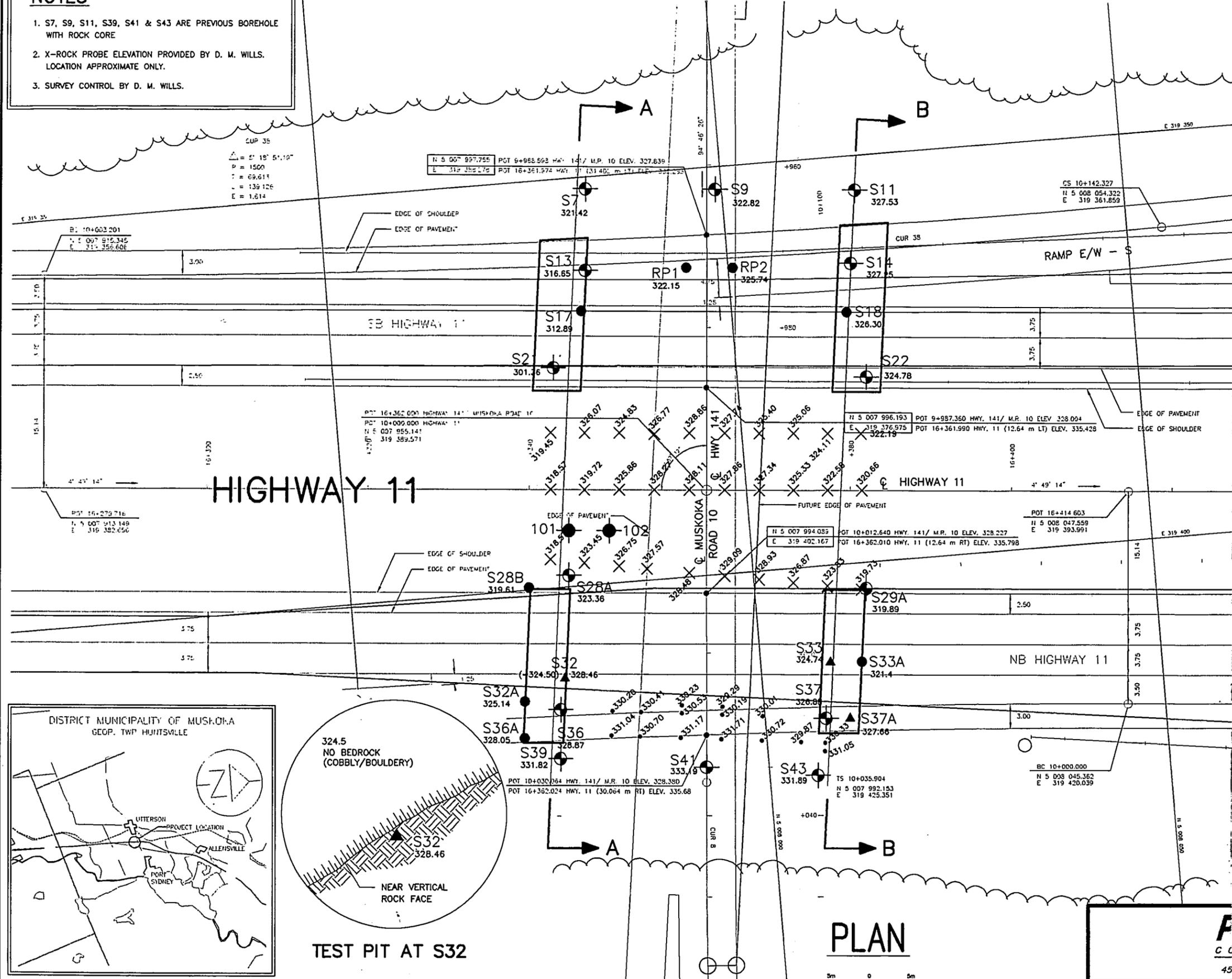
BOREHOLE LOCATION

SUMMARY OF ROCK ELEVATION FROM BOREHOLES AND PROBES AND FROM SURVEY OF EXPOSED BEDROCK

LEGEND

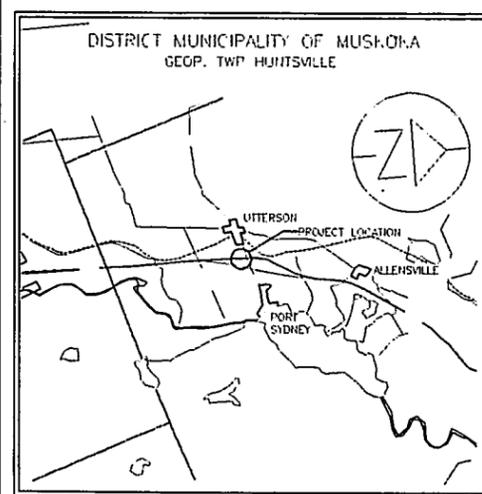
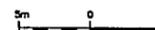
- BOREHOLE
- ⊕ BOREHOLE & ROCK CORE
- × PROBE 1m INTO ROCK (AIR TRACK)
- PROBE 3m INTO ROCK (AIR TRACK)
- ▲ UNSAMPLED AUGER PROBE TO REFUSAL

BOREHOLE	LOCATION		ELEVATION
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S9	9+957 (HWY 141)	1.0 m Lt	330.32
S11	9+957 (HWY 141)	18.5 m Lt	330.48
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S14	16+380 (HWY 11)	28.0 m Lt	335.33
S17	16+346.5 (HWY 11)	22.0 m Lt	335.75
S18	16+379.5 (HWY 11)	22.0 m Lt	335.44
S21	16+343 (HWY 11)	14.0 m Lt	335.60
S22	16+382 (HWY 11)	15.0 m Lt	335.38
S28A	16+345 (HWY 11)	10.5 m Rt	330.83
S28B	16+340 (HWY 11)	12.0 m Rt	334.24
S29A	16+382 (HWY 11)	12.0 m Rt	329.74
S32	16+344.5 (HWY 11)	24.0 m Rt	329.63
S32A	16+339.5 (HWY 11)	28.0 m Rt	330.63
S33	16+377.5 (HWY 11)	21.0 m Rt	330.07
S33A	16+381.5 (HWY 11)	21.0 m Rt	329.93
S36	16+344 (HWY 11)	28.0 m Rt	329.84
S36A	16+339 (HWY 11)	30.5 m Rt	330.18
S37	16+377 (HWY 11)	28.0 m Rt	330.06
S37A	16+380 (HWY 11)	28.0 m Rt	330.40
S39	10+033 (MR10)	18.0 m Rt	334.42
S41	10+034 (MR10)	Centreline	334.09
S43	10+035 (MR10)	14.0 m Lt	333.69
RP1	16+358 (HWY 11)	27.5 m Lt	335.56
RP2	16+366 (HWY 11)	27.5 m Lt	335.49
101	16+345 (HWY 11)	5.0 m Lt	330.8
102	16+350 (HWY 11)	5.0 m Lt	330.8



TEST PIT AT S32

PLAN



KEY PLAN
0.5km 0 1km

Peto MacCallum Ltd.

CONSULTING ENGINEERS
45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C6

DRAWN	CB	DATE	SCALE	JOB NO.	DRAWING NO.
CHECKED	TLB	NOV. 22/98	1:500	97BF031A	3
APPROVED	BRG				

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE



Photo 1: November 5, 1998. View from existing Highway 11 northbound, north of proposed new northbound bridge, looking south showing:

1. New northbound detour;
2. New rockfill on bedrock supporting detour;
3. Exposed bedrock in former ditch area;
4. South abutment area for new northbound bridge;
5. North abutment area for new northbound bridge;
6. Existing southbound rockfill embankment.

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE



Photo 2: November 5, 1998. View from north abutment area for northbound bridge looking to the east showing:

7. New northbound detour;
8. New rockfill on bedrock supporting detour;
9. Exposed bedrock in former ditch area;
10. Steeply dipping bedrock at east end of proposed north abutment northbound structure.

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE



Photo 3: November 5, 1998. View along former east ditch of northbound highway embankment looking south showing:

- 11. Exposed bedrock in former ditch area;
- 12. Steeply dipping bedrock at east end of proposed north abutment northbound structure.

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE



Photo 4:

November 5, 1998.
View of west slope of
southbound rock fill
embankment from mid
slope looking north
showing:

- 13. Location of west
end of proposed
south abutment of
southbound
structure;
- 14. Location of west
end of proposed
north abutment of
southbound
structure.

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE



Photo 5: November 11, 1998. View from existing Highway 11 northbound, north of proposed new northbound bridge, looking south showing:

- 15. New northbound detour;
- 16. New rockfill on bedrock supporting detour;
- 17. Exposed bedrock in former ditch area;
- 18. South abutment area for new northbound bridge;
- 19. Drill rig at borehole S29A at west end of proposed north structure abutment;
- 20. Existing southbound rockfill embankment.

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE



Photo 6: November 11, 1998. View centreline former Highway 11 northbound at intersection with new Highway 141 looking east showing:

- 21. Northbound detour and rockfill on bedrock;
- 22. Steeply dipping bedrock to be removed to accommodate relocated Highway 141.

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE



Photo 7: November 11, 1998. View at base of exposed bedrock in former east ditch area of northbound embankment looking south showing:

- 23. Steeply dipping bedrock;
- 24. Backhoe digging at east end of south abutment for northbound structure.

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE



Photo 8: November 11, 1998. View of backhoe digging to expose bedrock ledge at east end of abutment area for northbound structure looking north from shoulder area showing:

- 25. Backhoe bucket on rock ledge at east end of south abutment northbound structure;
- 26. Rock outcrop and steeply dipping rock in former east ditch area northbound road;
- 27. Drill rig set up at Borehole S29A, west end of north abutment to northbound structure.

SITE PHOTOS
SUPPLEMENTAL FOUNDATION INVESTIGATION
HIGHWAY 11 AND HIGHWAY 141
MUSKOKA ROAD 10 INTERCHANGE
DISTRICT 52, HUNTSVILLE

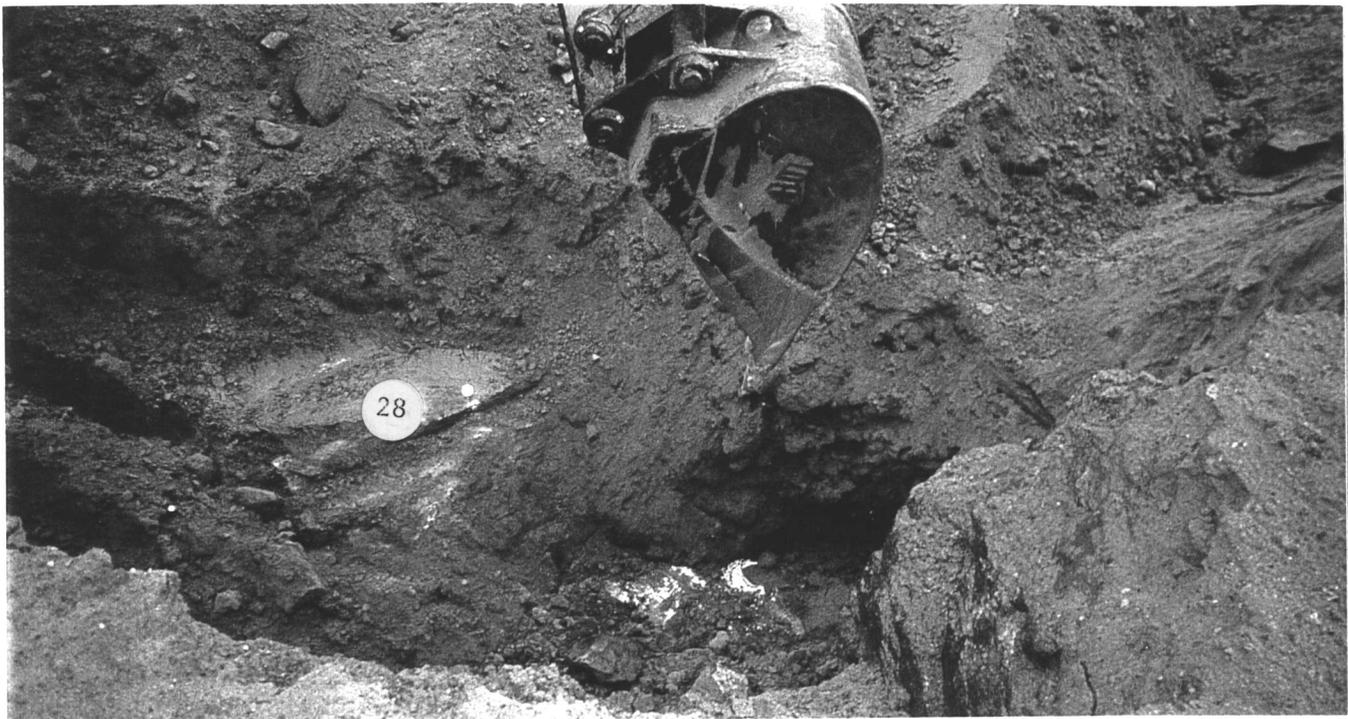


Photo 9: November 11, 1998. View of rock ledge showing:
28. East end of south abutment area to northbound structure.