Public Works and Government Services Canada
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Région de l'Ontario

VOLUME 6

Specification Devis

GRAVENHURST, ONTARIO
CORRECTIONAL SERVICE CANADA
NEW ONTARIO MEDIUM SECURITY INSTITUTION
GENERAL CONSTRUCTION & CORCAN PACKAGES

PROJECT NO: 686132-2&3 PWL-ENPW1-5-D086
FEBRUARY 1996

Canada

Project No. 686132-2 & -3
NEW ONTARIO MEDIUM
SECURITY INSTITUTION
General Construction Package

Specification
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16-Feb-96

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Geotechnical Investigations (in reverse chronological order)

GEOTECHNICAL INVESTIGATIONS
SECTION 'A'

REPORT NO. 6
Peto MacCallum Ltd.

Date: November 15, 1995

Peto MacCallum Ltd.
CONSULTING ENGINEERS

November 15, 1995

Our Project No. 95 B 235
Report No. 6

Mr. M. Seleanu, Project Manager
Moffat Kinoshita Architects Inc.
124 Merton Street
Toronto, Ontario
M4S 2Z2

Dear Mr. Seleanu

Underfloor Drains for Buildings
Muskoka Medium Security Institution
Gravenhurst, Ontario

As requested, we have reviewed Site Grading Plan Drawing B-1 and B-2, dated November 15, 1995, supplied by H.W.N.D and note that the proposed building finished floor levels have generally been raised since our Phase II Geotechnical Report dated May 1995. The revisions are as follows:

BUILDING	PREVIOUS F.F.	REVISED F.F.	CHANGE
A	273.15	273.15	-
B	272.10	272.15	+0.05
C	272.50	272.65	+0.15
D	271.50	271.50	-
E	268.65	269.10	+0.45
F	269.95	270.15	+0.20
G	269.00	269.70	+0.70
H	268.50	268.65	+0.15
J	269.50 (NW 270.50)	269.70 (NW 270.60)	+0.20(+0.1)
K	271.15	271.25	+0.10
L	272.15	272.20	+0.05
M	270.85	270.90	+0.05
N	272.50	273.20	+0.70
P	272.15	272.15	-
Future Residential	268.50	268.50	-

Water levels in the boreholes were observed in May 1995, and essentially follow closely below the existing ground surface. The water levels could be interpreted as representative of the seasonally (spring) high water table. However, variations in the high water levels from year to year should not be disregarded.

19 Churchill Drive, Barrie, Ontario L4M 6E7
Tel: (705) 734-3900 Fax: (705) 734-9911
OFFICES IN TORONTO, HAMILTON, KITCHENER, BARRIE, OSHAWA

The finished floor in Buildings B, C, D, E, J and K will be established primarily by filling, with minimal cut/fill in the north/northwest part of the buildings. This places the interpreted high groundwater table generally within 0.2 to 0.5 m below the finished floor in the north/northwest edges of these buildings, and increasing in depth below the finished floor in the south/southeasterly direction. In Building P, the finished floor will be established about 0.2 to 0.6 m below existing grade, which puts the floor within about 0.3 m of the groundwater table.

The floor is close enough to the water table, that we consider an underfloor drainage system should be provided under the northwest quadrant of Buildings B, C, J and K, and under the north portion of Buildings D and E. Underfloor drains should be placed under the entire floor of Building P.

Seepage from the weeping tiles is expected to be seasonal in nature, the quantity of which will depend on the actual rise in the water table.

Bedding under the floor should comprise a minimum 230 mm depth of 20 mm clear crushed stone. Weeping tiles along the inside of the perimeter walls and at 5 m centres should then be placed under the northwest quadrant of Buildings B, C, J and K, under the north portions of Buildings D and E, and entirely under Building P.

As a guide, weeping tiles should be placed under floor areas that are 0.3 m or less above existing ground level. The subgrade in these areas should be completely blanketed with synthetic filter fabric prior to placement of crushed stone to prevent *"silting in"* of the drainage system. The weeping tile should lead to a frost free sump or outlet.

Should you have any questions, please do not hesitate to contact our office.

Sincerely

PETO MacCALLUM LTD.

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

TLB:pmc

2 cc: Moffat Kinoshita Architects Inc. + Fax

GEOTECHNICAL INVESTIGATIONS
SECTION 'B'

CONTAMINATION TESTING
Peto MacCallum Ltd.

Date: July, 1995

Peto MacCallum Ltd.
CONSULTING ENGINEERS

CONTAMINATION TESTING
MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO
FOR
PUBLIC WORKS & GOVERNMENT SERVICES CANADA
C/O MOFFAT KINOSHITA ASSOCIATES INCORPORATED

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Our Ref: 94 BF 053A

July, 1995

Peto MacCallum Ltd.
CONSULTING ENGINEERS

July 17, 1995

Our Ref: 94 BF 053A

Public Works & Government Services Canada
c/o Mr. M. Seleanu, Project Manager
Moffat Kinoshita Associates Incorporated
124 Merton Street, 2nd Floor
Toronto, Ontario
M4S 2Z2

Dear Mr. Seleanu

Contamination Testing
Muskoka Medium Security Institution
Gravenhurst, Ontario

We are pleased to present our report concerning the results of contamination testing for the above noted project as authorized by Mr. M. Seleanu.

The purpose of this assignment was to collect and analyze representative samples to assess the chemical quality of the soils and groundwater on the subject property, in order to assess clean-up requirements if necessary.

SCOPE OF WORK

The scope of services provided by Peto MacCallum Ltd. in the course of this assignment included the following:

- Carry out site reconnaissance and conduct site background review to assess potential on-site and off-site sources of contamination.
- Recover ten (10) representative soil samples and three (3) groundwater samples for analysis.
- Prepare analytical protocols,review results and preparation of this report.

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Tel: (705) 734-3900 Fax: (705) 734-9911
OFFICES IN TORONTO, HAMILTON, KITCHENER, BARRIE, OSHAWA

SITE BACKGROUND REVIEW

The subject site is generally covered with mature mixed coniferous and deciduous vegetation. A few trails have been cleared in the past for wood lot management purposes. Some cinder fill is visible locally on these trails, apparently placed as surfacing material to improve trafficability. Earthfill associated with construction activities at the adjacent Beaver Creek Institution (BCI) has also been pushed/dumped in localized areas along the northerly limit of the subject site. These fill deposits are considered to represent potential on-site sources of contamination.

Based on the results of the groundwater investigation for this project, (Dixon Hydrogeology Limited, Report PO4W02, dated March 1, 1995), the subject site is located hydraulically downgradient from the adjacent BCI and Muskoka Airport. Any contaminants from either of these sites could move toward the proposed MI site. In this regard, Mr. J. Crook, Assistant Superintendent, was interviewed to assess the potential sources of contaminants from the BCI site.

The site was initially used as an R.C.A.F. Station known as Little Norway. The institution was opened in 1961 as a correctional work camp and has grown to the present minimum security correctional facility, involving some 17 separate structures. None of the original buildings remain. Most of the existing buildings have been constructed since 1974.

The operation and maintenance of the facility involves the former/present handling/storage of heating oil, gasoline, diesel fuels, solvents, paint and polychlorinated biphenyls as well as use of urea/salt for de-icing roads/sidewalks. The adjacent Muskoka Airport handles/stores aviation fuels and various de-icing agents. All of the aforementioned are considered to represent potential off-site sources of contamination.

FIELDWORK

The fieldwork for this investigation was carried out on April 24, 1995, and comprised a visual reconnaissance of the site, and recovery of seven (7) soil and three (3) water samples. Each of the samples was collected at/in the immediate vicinity of boreholes put down in connection with the geotechnical investigation for the project.

Subsequently, after the laboratory test results for the initial samples were received, three (3) additional soil samples were collected on July 5, 1995, for additional analyses.

The sample locations are shown on Drawing 1 and listed below:

April 24, 1995

Soil Samples		Water Samples
Borehole 1 at 0.3 m	Sand	Borehole 1 at 0.6 m
Borehole 28 at 0.3 m	Sand	Borehole 28 at 0.2 m
Borehole 46 at 0.3 m	Sand	Borehole 56 at 0.2 m
Borehole 56 at 0.3 m	Sand	
Fill A - Sand fill adjacent to borehole 4		
Fill B - Sand fill adjacent to borehole 2		
Fill C - Cinder fill from path (See Drawing 1)		

July 5, 1994

Soil Samples From Path (See Drawing 1)

Fill 1 - Cinder fill
Fill 2 - Mixed cinder and sand fill
Fill 3 - Mixed cinder, sand and topsoil fill

LABORATORY TESTING PROTOCOL

The recovered soil and water samples were submitted to Entech for the following chemical analyses:

- General phytotoxicological parameters listed under the Ontario Ministry of Environment and Energy (OMOEE) Guidelines for the Decommissioning and Clean-Up of Sites in Ontario, 1989, on seven (7) soil samples;

- benzene, toluene, ethylbenzene, xylenes (BTEX) on seven (7) soil samples and three (3) water samples;

- total petroleum hydrocarbons (TPH) on seven (7) soil samples and three (3) water samples;

- Polychlorinated Biphenyls (PCB's) on seven (7) soil and three (3) water samples;

- polyaromatic hydrocarbons (PAH) on three (3) samples of cinder fill or fill containing cinders, one (1) sample of native soil and one (1) water sample;

- OMOEE's Regulation 347, Schedule 4, inorganic parameters on three (3) samples of cinder or fill containing cinder;

- ethylene, diethylene and propylene glycol on four (4) soil samples and three (3) water samples.

- select parameters listed under Ontario Surface Water Guidelines on three (3) water samples.

CHEMICAL TEST RESULTS

The results of chemical analyses carried out on the soil and water samples are detailed on the appended Laboratory Certificates of Analyses and summarized in the following:

1) The chemical quality of the soils complied with the MOEE guideline values for the Decommissioning and Clean-Up of Sites in Ontario for phytotoxicolgical parameters with the following exception:

   - the concentration of cobalt measured in a soil sample from borehole 28 was about 70 ppm vs guideline value of 40 ppm in coarse textured soils for residential purposes.

2) Based on the results of analyses conducted on three (3) representative water samples, the chemical quality of the water does not comply with the criteria for a number of parameters listed under the Ontario Provincial Surface Water Guidelines as summarized below:

Parameters	Guideline Value (ppm)	Measured Concentration (Times Guideline Value)	Exceedance Frequency[1]
cadmium	0.0002	25 to 175	3
copper	0.005	2 to 4	2
iron	0.3	1 to 18	3
lead	0.25	1.6	2
mercury	0.0002	6 to 7	3
phosphorus	0.03[2]	7 to 13	2
zinc	0.03	1 to 4	2
phenols	0.001	9 to 12	2
sulphide	0.002	200 to 600	2

NOTES:
1. Number of samples with measured concentration exceeding guideline values.
2. For streams.

In addition, the pH values of the three (3) water samples ranged from 5.1 to 5.6 which is less than the recommended lower limit of 6.5.

3) Polyaromatic hydrocarbons (PAH) were detected in the cinder fill samples C and 2 (taken from existing path). PAH was also detected in a water sample from borehole 56; No PAH was detected in a soil sample from the same boreholes 56 or in Fill 3.

The measured concentrations of the various PAH where detected were less than the values listed in MOEE Proposed Guidelines for the Clean-Up of Contaminated Sites in Ontario, July, 1994, with the following exception:

- the concentration of benzo (b) fluoranthene in the water sample from borehole 56 was about 0.3 ppb vs guideline value of 0.2 ppb.

4. No benzene, toluene, ethybenzene, or xylene were detected in any of the seven (7) soil, or three (3) water samples analyzed.

5. No petroleum hydrocarbons were detected in any of the seven (7) soil samples analyzed.

6. No polychlorinated biphenyls (PCB's) were detected in any of the seven (7) soil samples or three (3) water samples analyzed.

7. No propylene glycol, ethylene glycol or diethylene glycol were detected in any of the four (4) soil samples or three (3) water samples tested.

8. The analyses for OMOEE's Regulation 347, Schedule 4, inorganic parameters, indicate fill samples 1, 2 and 3, to be non registerable waste.

DISCUSSIONS AND RECOMMENDATIONS

Based on the site background review, a number of potential off-site and on-site sources of contamination were identified and formed the basis of the analytical protocol developed for testing purposes. A discussion of the various test results are presented below for your consideration.

Potential off-site sources of contamination include:

- benzene, toluene, ethylene and xylenes (BTEX) and total petroleum hydrocarbons (TPH) associated with various former and existing oil/gasoline/diesel/aviation fuel/solvent and paint storage facilities at Beaver Creek Institution and Muskoka Airport;
- polychlorinated biphenols (PCB's) associated with the PCB storage facility at BCI;
- Ethylene, diethylene and propylene glycol associated with aircraft de-icing agents at Muskoka Airport.

Based on the potential off-site sources of contamination as outlined above, representative soil and water samples were tested for BTEX, TPH, PCB's and glycols. None of these parameters were detected in the samples tested.

Potential on-site sources of contamination include:

- earthfill of unknown quality along the northerly limit of site;
- polyaromatic hydrocarbons (PAH) associated with cinder fill along sections of existing trails.

Based on the potential on-site sources of contamination as outlined above, representative soil and water samples were tested for standard phytotoxicological parameters, surface water quality, and PAH. The tested samples conformed to the provincial guidelines except as noted in the following discussions.

Cobalt In Soil

The chemical quality of all soil samples tested complied with MOEE's Decommissioning/Clean-Up Guidelines except for Cobalt in one sample obtained from borehole 28, in the southwest corner of the site. The concentration of Cobalt was 70 ppm vs a guideline value of 40 ppm.

It is noteworthy that the concentration detected in this soil sample for a number of other heavy metal parameters, although less than the guideline values, were typically 5 to 10 times greater than that of the average value for other native soil samples.

This may be a natural or localized incident confined to the sampled location. It is recommended additional soil sampling and testing be carried out in the vicinity of borehole 28, to verify/further delineate the extent of the this incident.

PAH In Soil And Groundwater

The cinder fill observed along sections of the existing trails was considered to be a potential source of contamination. Analysis of representative samples of the cinder fill detected the presence of polyaromatic hydrocarbons (PAH). However, the concentrations were below the guideline values as presented in the OMOEE Proposed Guidelines for the Clean-Up of Contaminated Sites in Ontario, July, 1994.

PAH in exceedance of the OMOEE Proposed Guidelines was detected in a groundwater sample taken downstream from one of the cinder fill deposits. No PAH was detected in a soil sample at the same location. It is considered that the source of PAH in the groundwater is the cinder fill on the existing paths. Therefore, it is recommended that the cinder fill be removed. Once the cinder fill is removed, PAH in groundwater will be reduced by infiltrating precipitation and natural groundwater water flow beneath the site. Confirmatory testing of the groundwater should be conducted at periodic intervals following removal of the source cinder fill.

Three (3) samples of the cinder fill were analyzed in accordance with OMOEE Regulation 347, Schedule 4, inorganic parameters. The results indicate the cinder fill is a non registerable waste suitable for private landfill disposal where the material is consistent with the landfill license.

Groundwater Quality

Reference is made to Dixon Hydrogeology Limited Report PO4WO2, dated March, 1995 for the results of a groundwater investigation carried out in connection with the proposed development. The report includes the results of chemical analyses on a number of surface water samples taken in the vicinity of the subject property, primarily at the Muskoka Airport. The results of the analyses indicate the concentration of a number of the parameters tested exceed the criteria listed under Ontario Provincial Surface Water Guidelines.

In order to further investigate the quality of groundwater within the proposed MI site, additional samples were recovered and tested for select parameters listed under the Ontario Provincial Surface Water Guidelines. Based on the results of the analyses, the concentration of each of the following parameters exceeded the guideline value:

- cadmium
- copper
- iron
- lead
- mercury
- phosphorus
- zinc
- phenols
- sulphides

For comparative purposes, the guideline value, measured concentration, and exceedance frequency for each of these parameters for both the present study and the previous Dixon Hydrogeology Limited report have been summarized on Table I appended.

Based on a review of the data on this table, it appears:

- The concentration of cadmium, copper, iron, lead, mercury and zinc detected in samples from the MI site, were less than those of off-site samples, particularly with respect to off-site surface water;

- the concentration of phosphorus, phenols and sulphide were higher than the off-site values;

Since the concentration of heavy metals in groundwater on-site appear to be less than off-site values, we do not consider any specific clean-up measures will be required with respect to the observed exceedances. However, it is recommended that any water removed by construction groundwater control systems should not be discharged directly to Beaver Creek. Such waters should be discharged on land and allowed to percolate back into the ground and follow its natural path.

With respect to the phosphorous, phenols and sulfides, no specific sources/current activities were identified which would account for the observed exceedance on site.

The phosphorus and phenols may reflect previous on-site/off-site application of fertilizers/pesticides. The sulfides may be related to the on-site cinder fill previously discussed.

Although the concentration of these parameters exceeds the Provincial Surface Water Quality objectives, it does not exceed the MOEE proposed guidelines for site clean-up.

Therefore we do not consider any specific clean-up measures will be required with respect to the observed exceedance. However, as previously recommended, any water removed by construction groundwater control systems should not be discharged directly to Beaver Creek, but rather should be allowed to percolate back into the ground.

We trust this report is complete within our terms of reference. Should you have any queries, or when additional environmental testing is required, please do not hesitate to contact this office.

Sincerely
PETO MacCALLUM LTD.

John F. Wright, B.Sc.
Geologist

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

JFW/TLB:ga

PetoMacCallum Ltd.
CONSULTING ENGINEERS

TABLE I
SUMMARY OF WATER QUALITY
MUSKOKA MEDIUM SECURITY INSTITUTION

Parameter	Ontario Surface Water Objectives Guideline Value (ppm)	On-Site[1]		Off-Site Wells[2]		Off-Site Surface Water[2]	
		Measured Concentration (Times Guideline Value)	Exceedance[3] Frequency	Measured Concentration (Times Guideline Value)	Exceedance[3] Frequency	Measured Concentration (Times Guideline Value)	Exceedance[3] Frequency
Cadmium	0.0002	25 - 175	3/3	-	0/18	950	1/1
Copper	0.005	2 - 4	2/3	1 - 190	9/18	6	1/2
Iron	0.3	1 - 18	3/3	2 - 26	6/28	not measured	-
Lead	0.25	1 - 6	2/3	12	1/18	11 - 1160	8/8
Mercury	0.0002	6 - 7	3/3	-	0/5	75 - 8350	2/2
Phosphorus	0.03	7 - 13	2/3	3	1/7	-	0/1
Zinc	0.03	1 - 4	2/3	1 - 50	9/20	-	0/2
Phenols	0.001	9 - 12	2/3	-	0/11	-	0/2
Sulphide	0.002	200 - 600	2/3	-	0/2	-	0/1

NOTES:
1. Data from present study.
2. Data extracted from Dixon Hydrogeology Limited Report PO4W02, dated March, 1995.
3. Number of samples with measured concentration exceeding guideline values per number of samples tested.

Our Ref: 94 BF 053A

May, 1995

Client: Peto MacCallum

Project Number: 94-BF053A

P.O. Number:
Matrix: Soil
Attention: Turney Lee-Bun

Date Received: April 28/95
Date Reported: May 5/95

Sam Sanyal, M.Sc., C.Chem.

ENTECH
A division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit #4
Mississauga, ONT L6N 5M3

TEL: (905) 821-1112
FAX: (905) 821-2095

CHEMICAL ANALYSIS RESULTS - MOE CLEAN-UP GUIDELINES (PHYTO)

PARAMETER	Agriculture-Residential Parkland / Commercial-Industrial		Method Detection Limit (ppm)	CONTROL SAMPLE			SAMPLE DATA mg/kg (ppm) ~			
	Med.&Fine Textured Soils	Coarse** Textured Soils		Expected Level (ppm)	Found Level (ppm)	Recovery %	4358 Fill A	4359 Fill B	4360 Fill C	4361 BH1
Dry Matter (%)	-	-	-	-	-	-	76.75	90.64	80.75	73.67
pH (units)	6 to 8	6 to 8	-	-	-	-	6.8	6.1	6.5	6.0
E C (umhos/cm)	2000/4000	2000/4000	-	-	-	-	115	30	27	11
SAR (aqua regia)	5/12	5/12	-	-	-	-	0.38	0.6	0.95	0.85
Arsenic	25/50	20/40	1	67.7	64.5	95	<1	<1	2	<1
Cadmium	4/8	3/6	0.3	110	119	108	1.0	0.9	1.0	1.2
Chromium (VI)	10	8	0.5	0.5	0.51	102	<0.5	<0.5	<0.5	<0.5
Chromium (total)	1000	750	0.5	188	179	95	8.1	5.2	3.1	3.5
Cobalt	50/100	40/80	0.5	87	83.6	96	4.0	2.8	1.0	1.2
Copper	200/300	150/225	0.5	141	138	98	8.1	6.9	16.3	3.5
Lead	500/1000	375/750	1	100	105.5	106	12	10	126	3
Mercury	1/2	0.8/1.5	0.01	2.36	2.34	99	0.04	0.04	0.27	0.04
Molybdenum	5/40	5/40	1	124	117	94	<1	<1	<1	<1
Nickel	200	150	1	79.6	79.3	100	5	4	4	3
TKN (as N)	5000/6000	5000/6000	10	500	500	100	200	300	700	800
Oil & Grease	10000	10000	10	6160	5760	94	692	123	1605	55
Selenium	2/10	2/10	1	99.1	102	103	<1	<1	<1	<1
Silver	25/50	20/40	0.2	124	129	104	<0.2	<0.2	<0.2	<0.2
Zinc	800	600	0.3	197	188	95	46.5	27.7	29.6	16.2
Antimony*	25/50	20/40	1	27.8	28.5	103	<1	<1	<1	<1
Barium*	1000/2000	750/1500	0.5	187	182	97	41.4	20.8	21.4	8.1
Beryllium*	5/10	4/8	0.3	57.5	57.2	99	1.0	0.9	1.0	1.2
Vanadium*	250	200	0.3	84.8	80.3	95	18.2	13.0	8.2	8.1

(+ Exceeds Agriculture/Residential/Parkland Clean-Up Guidelines)
(++ Exceeds Commercial/Industrial/Clean-up Guidelines)
(~All units in the Guidelines are in ppm unless otherwise specified)

* Provisional Guidelines
** Defined as greater than 70% sand and less than 17% organic matter

Client:	Peto MacCallum	Date Received:	April 28/95
Project Number:	94-BF053A	Date Reported:	May 5/95
P.O. Number:			
Matrix:	Soil		
Attention:	Turney Lee-Bun		

Sam Sanyal, M.Sc., C.Chem.

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CHEMICAL ANALYSIS RESULTS - MOE CLEAN-UP GUIDELINES (PHYTO)

PARAMETER	Agriculture-Residential Parkland / Commercial-Industrial		Method Detection Limit (ppm)	CONTROL SAMPLE			SAMPLE DATA mg/kg (ppm) ~			
	Med.&Fine Textured Soils	Coarse** Textured Soils		Expected Level (ppm)	Found Level (ppm)	Recovery %	4362 BH28	4363 BH46	4364 BH66	
Dry Matter (%)	-	-	-	-	-	-	38.93	81.17	75.1	
pH (units)	6 to 8	6 to 8	-	-	-	-	6.1	6.2	6.2	
E C (umhos/cm)	2000/4000	2000/4000	-	-	-	-	20	17	13	
SAR (aqua regia)	5/12	5/12	-	-	-	-	1.02	0.73	0.74	
Arsenic	25/50	20/40	1	67.7	64.5	95	<1	<1	<1	
Cadmium	4/8	3/6	0.3	110	119	108	2.1	<0.3	<0.3	
Chromium (VI)	10	8	0.5	0.5	0.51	102	<0.5	<0.5	<0.5	
Chromium (total)	1000	750	0.5	188	179	95	22.6	3.6	2.3	
Cobalt	50/100	40/80	0.5	87	83.6	96	69.81+	1.2	<0.5	
Copper	200/300	150/225	0.5	141	138	98	6.2	4.7	1.1	
Lead	500/1000	375/750	1	100	105.5	106	33	2	2	
Mercury	1/2	0.8/1.5	0.01	2.36	2.34	99	0.15	0.02	0.01	
Molybdenum	5/40	5/40	1	124	117	94	<1	<1	<1	
Nickel	200	150	1	79.6	79.3	100	8	4	2	
TKN (as N)	5000/6000	5000/6000	10	500	500	100	500	700	700	
Oil & Grease	10000	10000	10	6160	5760	94	68	346	1546	
Selenium	2/10	2/10	1	99.1	102	103	<1	<1	<1	
Silver	25/50	20/40	0.2	124	129	104	<0.2	<0.2	<0.2	
Zinc	800	600	0.3	197	188	95	55.4	11.9	10.2	
Antimony*	25/50	20/40	1	27.8	28.5	103	<1	<1	<1	
Barium*	1000/2000	750/1500	0.5	187	182	97	57.5	10.7	9.0	
Beryllium*	5/10	4/8	0.3	57.5	57.2	99	<0.3	<0.3	<0.3	
Vanadium*	250	200	0.3	84.8	80.3	95	82.1	7.1	4.5	

(+ Exceeds Agriculture/Residential/Parkland Clean-Up Guidelines)
(++ Exceeds Commercial/Industrial/Clean-up Guidelines)
(~All units in the Guidelines are in ppm unless otherwise specified)

* Provisional Guidelines
** Defined as greater than 70% sand and less than 17% organic matter

ENTECH

A Division of
Agri-Service
Laboratory Inc.

Professional
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Services

6820 Kitimat Rd., Unit 4
Mississauga, Ontario
L5N 5M3

Tel: 905-821-1112
Fax: 905-821-2095

TOTAL PCB in SOIL by CAPILLARY GC-ECD

Preparation by Solvent Extraction, Florisil Cleanup

Client : Peto MacCallum
Client Reference : Job #: 94-BF053A
Attention : Turney Lee-Bun
Date Received : April 28, 1995
Reported : May 5, 1995

ENTECH #	Sample Identification	CONC (ug/g)
4358	Fill A	ND
4359	Fill B	ND
4360	Fill C	ND
4361	BH1	ND
4362	BH28	ND
4363	BH46	ND
4364	BH56	ND

MDL 0.05 ug/g
ug/g = ppm w/w
ND = < 0.05 ppm
Results have been adjusted to a dry weight basis.

E.Spalding B.Sc. , C. Chem.

ENTECH

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Services
6820 Kitimat Rd., Unit 4
Mississauga, Ontario
L5N 5M3
Tel: 905-821-1112
Fax: 905-821-2095

PAH in SOIL Analysis by GC-MSD

CLIENT: Peto MacCallum
CLIENT REF: 94-BF053A **Attn. :** T. Lee-Bun
DATE RECEIVED: April 28, 1995
DATE REPORTED: May 11, 1995, Final Report

UNITS ARE ng/g (ppb w/w)	ENTECH # >> MDL (ng/g)	4360 Fill C	4364 BH56	Matrix Blank
Naphthalene	7	2,600	<	<
Acenaphthylene	7	<	<	<
Acenaphthene	7	23	<	<
Fluorene	7	39	<	<
Phenanthrene	7	720	<	<
Anthracene	7	59	<	<
Fluoranthene	7	320	<	<
Pyrene	7	280	<	<
Benzo (a) anthracene	7	210	<	<
Chrysene	7	250	<	<
Benzo (b) fluoranthene	7	350	<	<
Benzo (k) fluoranthene	7	180	<	<
Benzo (a) pyrene	7	260	<	<
Indeno (1,2,3-cd) pyrene	7	260	<	<
Dibenzo (a,h) anthracene	7	120	<	<
Benzo (g,h,i) perylene	7	240	<	<
LOW MW PAH TOTAL		3,400	NIL	NIL
HIGH MW PAH TOTAL		2,500	NIL	NIL
Matrix Spike Recoveries (%)				
	Naphthalene-d8:	39	19	67
	Phenanth-d10:	57	73	84
	Chrysene-d12:	74	75	97
	Perylene-d12:	113	103	107

E.Spalding, B.Sc., C.Chem.

ENTECH

A Division of
Agri-Service
Laboratory Inc.

Professional
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Mississauga, Ontario
L5N 5M3

Tel: 905-821-1112
Fax: 905-821-2095

PAH in SOIL Analysis by GC-MSD

CLIENT: Peto MacCallum
CLIENT REF: 94BF053A Attn. : T. Lee-Bun
DATE RECEIVED: July 6, 1995
DATE REPORTED: July 14, 1995

UNITS ARE ng/g (ppb w/w)	ENTECH # >> MDL (ng/g)	7014 FILL SA 2	7015* FILL SA 3	Matrix Blank
Naphthalene	7	130	<	<
Acenaphthylene	7	<	<	<
Acenaphthene	7	<	<	<
Fluorene	7	<	<	<
Phenanthrene	7	140	<	<
Anthracene	7	8	<	<
Fluoranthene	7	34	<	<
Pyrene	7	33	<	<
Benzo (a) anthracene	7	20	<	<
Chrysene	7	15	<	<
Benzo (b) fluoranthene	7	32	<	<
Benzo (k) fluoranthene	7	10	<	<
Benzo (a) pyrene	7	<	<	<
Indeno (1,2,3-cd) pyrene	7	18	<	<
Dibenzo (a,h) anthracene	7	<	<	<
Benzo (g,h,i) perylene	7	8	<	<
LOW MW PAH TOTAL		280	NIL	NIL
HIGH MW PAH TOTAL		170	NIL	NIL
Matrix Spike Recoveries (%)				
	Naphthalene-d8:	N/A	N/A	76
	Phenanth-d10:	N/A	N/A	113
	Chrysene-d12:	N/A	N/A	120
	Perylene-d12:	N/A	N/A	88

N/A = surrogate recoveries not available due to required dilution

* Multiply Method Detection Limit (MDL) by 11

E.Spalding, B.Sc.,C.Chem.

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A Division of Agri-Service Laboratory, Inc.
6820 Kitimat Rd., Mississauga
Ontario, L5M 5N3

Client: Peto MacCallum
Attention: Turney Lee-Bun
Client Ref: 94-BF053A
Date Received: April 28 95
Date Reported: May 2 95

HYDROCARBONS in SOIL: ANALYSIS by P&T GC-MSD and GC-FID

All Units are ppm ug/g = ppm w/w	MDL	4358 Fill A	4359 Fill B	4360 Fill C	4361 BH1	4362 BH2B	4363 BH46	4364 BH56
Benzene	0.05	<	<	<	<	<	<	<
Toluene	0.05	<	<	<	<	<	<	<
Ethylbenzene	0.05	<	<	<	<	<	<	<
m&p-Xylenes	0.05	<	<	<	<	<	<	<
o-Xylene	0.05	<	<	<	<	<	<	<
Total Volatile Hydrocarbons	0.5	<	<	<	<	<	<	<
Total Extractable Hydrocarbons	20	<	<	<	<	<	<	<
Total Petroleum Hydrocarbons	20	<	<	<	<	<	<	<
Hydrocarbon Pattern *								

Results have been adjusted to a dry weight basis.
NOTE: Boiling point cutoff separating TVH and TEH is DECANE (C-10, b.p. 174 C).
MDL is Method Detection Limit; < means less than the MDL value is present

E. Spalding, B.Sc., C.Chem.

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A Division of Agri-Service Laboratory, Inc.
6820 Kitimat Rd., Mississauga
Ontario, L5N 5M3

Client: Peto MacCallum
Attention: Turney Lee-Bun
Client Ref: 94-BF053A
Date Received: April 28 95
Date Reported: May 8 95

GLYCOLS in SOIL: ANALYSIS by DIRECT AQUEOUS INJECTION GC FID

All Units are ug/g (ppm w/w)	MDL	4361 BH1	4362 BH28	4363 BH46	4364 BH56
Propylene Glycol	20	<	<	<	<
Ethylene Glycol	20	<	<	<	<
Diethylene Glycol	20	<	<	<	<

Results have been adjusted to a dry weight basis.
MDL is Method Detection Limit; < means less than the MDL value is present

E. Spalding, B.Sc., C.Chem.

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A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit#4
Mississauga, ONT L5N 5M3

TEL: (905) 821-1112
FAX: (905) 821-2095

Client: Peto MacCallum
Project Number: 94BF053A

P.O. Number:
Matrix: Soil

Attention: Turney Lee-Bun

Date Received: July 6/95
Date Reported: July 13/95

Sam Sanyal, M.Sc. C. Chem.

ONTARIO M.O.E. REGULATION 347 - LEACHATE CHEMISTRY

PARAMETER	Schedule 4 Concentration mg/L	Registerable Waste Concentration mg/L	Subject Waste Concentration mg/L	Method Detection Limit (ppm)	CONTROL SAMPLE Expected Level(ppm)	Found Level (ppm)	Recovery %	SAMPLE DATA mg/l (ppm) 7013 SA1 FILL	7014 SA2 FILL	7015 SA3 FILL	
Arsenic	0.05	0.5	5	0.005	1	0.954	95	0.028	0.064	<0.005	-
Barium	1	10	100	0.005	0.421	0.45	107	0.329	0.718	2.640	-
Boron	5	50	500	0.002	0.3	0.324	108	0.38	0.34	0.58	-
Cadmium	0.005	0.05	0.5	0.005	0.132	0.16	121	<0.005	0.008	<0.005	-
Chromium	0.05	0.5	5	0.01	0.405	0.45	111	<0.01	<0.01	<0.01	-
Cyanide Free	0.2	2	20	0.05	0.135	0.131	97	<0.05	<0.05	<0.05	-
Fluoride	2.4	24	240	0.5	10.9	11.4	105	<0.5	<0.5	<0.5	-
Lead	0.05	0.5	5	0.02	0.0916	0.12	131	0.08	0.07	0.13	-
Mercury	0.001	0.01	0.1	0.0001	4.85	5.2	107	0.0003	0.0002	0.0002	-
Nitrate+Nitrite-N	10	100	1000	0.5	7.6	7.41	98	<0.5	<0.5	<0.5	-
Nitrite-N	1	10	100	0.5	0.5	0.53	106	<0.5	<0.5	<0.5	-
Selenium	0.01	0.1	1	0.005	0.0884	0.09	102	<0.005	0.03	<0.005	-
Silver	0.05	0.5	5	0.005	0.189	0.18	95	<0.005	<0.005	<0.005	-

Notes:

1. Concentration <10 times Schedule 4 Concentration - Non-Registerable Waste Under Reg. 347 - Private Landfill disposal where material is consistent with the Landfill Licence

2. Concentration 10 - 100 times Schedule 4 Concentration - Registerable Waste Under Regulation 347 - Sanitary Landfill Disposal

3. Concentration > 100 times Schedule 4 Concentration - Subject Waste Under Regulation 347 - Hazardous Waste Disposal

4. + Exceeds 10 x Sch.4 (Note 2), ++ Exceeds 100 x Sch.4 (Note 3).

ENTECH
A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit #4
Mississauga, ONT L5N 5M3
TEL: (905) 821-1112
FAX: (905) 821-2095

Client: Peto MacCallum

Project Number: 94-BF053A

Date Received: April 28/95
Date Reported: May 5/95

P.O. Number:

Matrix: Water

Attention: Turney Lee-Bun

Sam Sanyal, M.Sc., C. Chem

MISC. SAMPLE TESTS

PARAMETER	Units	Method Detection Limit (ppm)	CONTROL SAMPLE			SAMPLE DATA			
			Expected Level (ppm)	Found Level (ppm)	Recovery %	4365 BH1	4366 BH28	4367 BH66	
Arsenic	ppm	0.005	0.0737	0.076	103	<0.005	<0.005	<0.005	
Beryllium	ppm	0.0025	0.0632	0.068	108	<0.0025	<0.0025	<0.0025	
Cadmium	ppm	0.0002	0.132	0.143	108	0.025	0.005	0.035	
Chromium	ppm	0.01	0.405	0.439	108	<0.01	<0.01	<0.01	
Copper	ppm	0.01	0.162	0.182	112	<0.01	0.01	0.02	
Cyanide (Free)	ppm	0.05	0.0813	0.082	101	<0.05	<0.05	<0.05	
Iron	ppm	0.01	0.468	0.518	111	0.61	5.53	0.36	
Lead	ppm	0.02	0.0916	0.095	104	0.04	0.04	<0.02	
Mercury	ppm	0.0001	2.36	2.34	99	0.0014	0.0012	0.0012	
Nickel	ppm	0.05	0.409	0.466	114	<0.05	<0.05	<0.05	
Phosphorus	ppm	0.1	10	10.1	101	<0.1	0.4	0.2	
Selenium	ppm	0.005	0.0884	0.091	103	<0.005	<0.005	<0.005	
Silver	ppm	0.0001	0.163	0.164	101	<0.0001	<0.0001	<0.0001	
Zinc	ppm	0.01	0.195	0.222	114	0.03	0.12	0.04	
pH			9.09	9.03	99	5.49	5.14	5.55	
Phenols	ppm	0.005	0.191	0.183	96	<0.005	0.012	0.009	
Sulphide	ppm	0.1	-	-	-	<0.10	0.40	1.20	

ENTECH

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Tel: 905-821-1112
Fax: 905-821-2095

PCB in WATER ANALYSIS by CAPILLARY GC-ECD

(Liq/Liq Extraction, Florisil Cleanup)

Client : Peto MacCallum
Client Reference : JOB #: 94-BF053A
Attention : Turney Lee-Bun
Date Received : April 28, 1995
Reported : May 8, 1995

ENTECH #	Sample Identification	CONC (ug/L)
4365	BH1	ND
4366	BH28	ND
4367	BH56	ND

MDL 0.05 ug/L
ug/L = ppb w/v
ND = < 0.05 ppb

E.Spalding B.Sc. , C. Chem.

ENTECH

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L5N 5M3
Tel: 905-821-1112
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PAH in Water Analysis by GC-MSD

CLIENT: Peto MacCallum
CLIENT REF: 94-BF053A **Attn. :** T. Lee-Bun
DATE RECEIVED: April 28, 1995
DATE REPORTED: May 11, 1995

UNITS ARE ng/ml (ppb w/v)	MDL (ng/ml)	ENTECH # 4367 BH56
Naphthalene	0.1	<0.1
Acenaphthylene	0.1	<0.1
Acenaphthene	0.1	<0.1
Fluorene	0.1	<0.1
Phenanthrene	0.1	<0.1
Anthracene	0.1	<0.1
Fluoranthene	0.1	0.1
Pyrene	0.1	<0.1
Benzo (a) anthracene	0.1	<0.1
Chrysene	0.1	<0.1
Benzo (b) fluoranthene	0.1	0.3
Benzo (k) fluoranthene	0.1	0.1
Benzo (a) pyrene	0.1	<0.1
Indeno (1,2,3-cd) pyrene	0.1	<0.1
Dibenzo (a,h) anthracene	0.1	0.1
Benzo (g,h,i) perylene	0.1	0.1
LOW MW PAH TOTAL		NIL
HIGH MW PAH TOTAL		0.7
Surrogate Recoveries (%)		
Naphthalene-d8		28
Phenanthrene-d10		61
Chrysene-d12		48
Perylene-d12		44

MDL = Method Detection Limit

E.Spalding, B.Sc.,C.Chem.

ENTECH
A Division of Agri-Service Laboratory, Inc.
6820 Kitimat Rd., Mississauga
Ontario, L5N 5M3

Client: Peto MacCallum
Attention: Turney Lee-Bun
Client Ref: 94-BF053A
Date Received: April 28 95
Date Reported: May 3 95

HYDROCARBONS in WATER: ANALYSIS by P&T GC-MSD

All Units are ppm ug/ml = ppm w/v	MDL	4365 BH1	4366 BH28	4367 BH56
Benzene	0.0002	<	<	<
Toluene	0.0002	<	<	<
Ethylbenzene	0.0002	<	<	<
m&p-Xylenes	0.0002	<	<	<
o-Xylene	0.0002	<	<	<

MDL=Method Detection Limit; ND=Not Detected (<MDL)

E. Spalding, B.Sc., C.Chem.

ENTECH
A Division of Agri-Service Laboratory, Inc.
6820 Kitimat Rd., Mississauga
Ontario, L5N 5M3

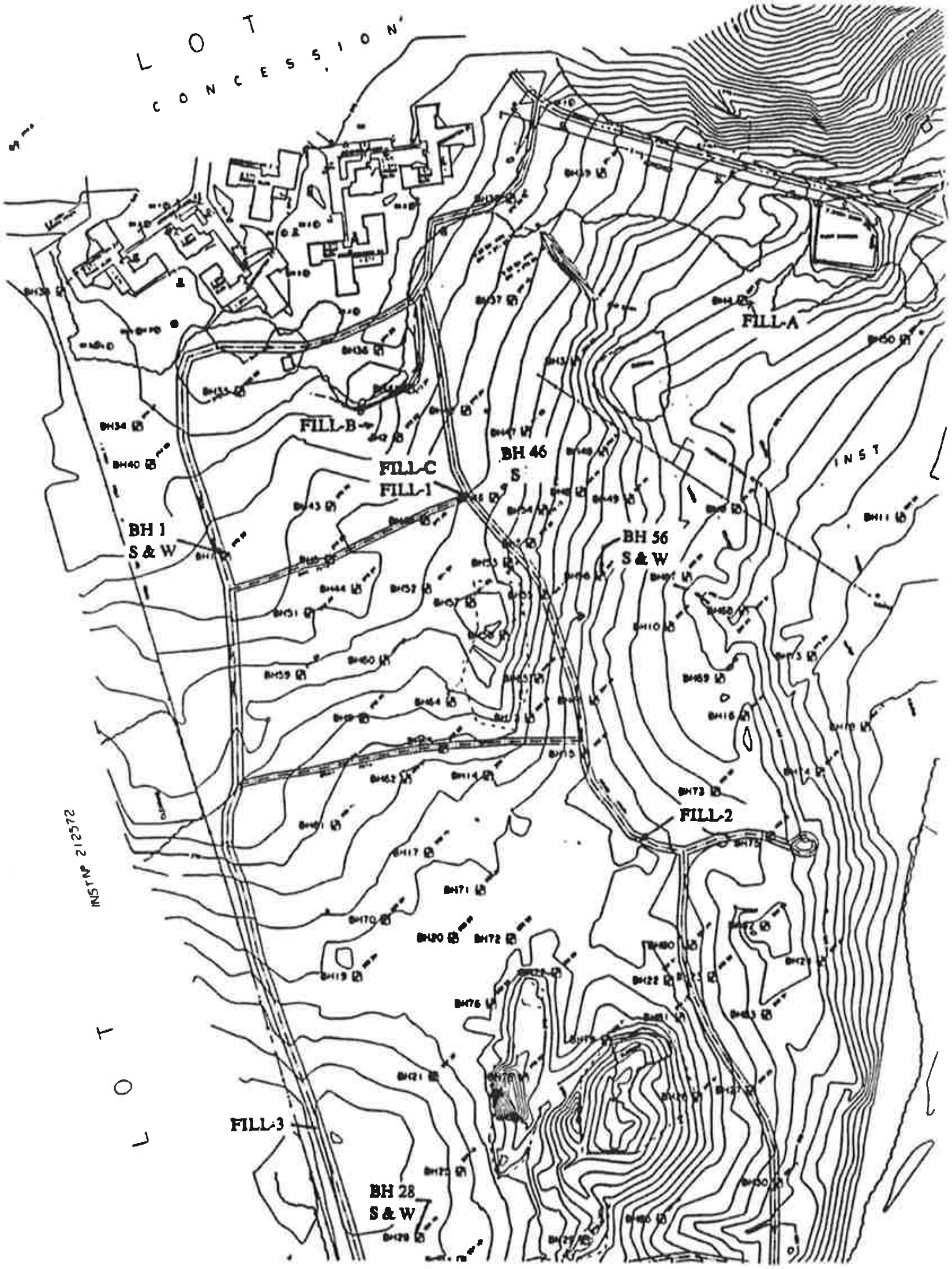
Client: Peto MacCallum
Attention: Turney Lee-Bun
Client Ref: 94-BF053A
Date Received: April 28 95
Date Reported: May 8 95

GLYCOLS in WATER: ANALYSIS by DIRECT AQUEOUS INJECTION GC FID

All Units are ppm ug/ml = ppm w/v	MDL	4365 BH1	4366 BH28	4367 BH56
Propylene Glycol	20	<	<	<
Ethylene Glycol	20	<	<	<
Diethylene Glycol	20	<	<	<

MDL=Method Detection Limit; ND=Not Detected (<MDL)

E. Spalding, ~~B.Sc.~~, C.Chem.



Refer to Geotechnical Report
94 BF 053A, dated May 16, 1995
for Detailed Boreholes and Plan

BH 1 S & W	Soil and Groundwater Sample at Borehole 1
FILL-A	Fill Sample

MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO

CONTAMINATION TESTING
SAMPLING LOCATION PLAN

PETO MacCALLUM LTD.

REF. 94 BF 053A July, 1995 Drawing 1

GEOTECHNICAL INVESTIGATIONS
SECTION 'C'

PHASE 2 GEOTECHNICAL INVESTIGATIONS

- Appendix 'A' - Laboratory Test Results
- Appendix 'B' - Groundwater Levels in Standpipes
- Appendix 'C' - Log of Boreholes
- Appendix 'D' - Ground Penetrating Radar Survey

Peto MacCallum Ltd.

Date: May, 1995

PetoMacCallum Ltd.
CONSULTING ENGINEERS

PHASE 2 GEOTECHNICAL INVESTIGATION
MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO
FOR
PUBLIC WORKS & GOVERNMENT SERVICES CANADA
C/O MOFFAT KINOSHITA ASSOCIATES INCORPORATED

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1 cc: Robert Halsall & Associates Ltd.

Our Ref: 94 BF 053A

May, 1995

Peto MacCallum Ltd.
CONSULTING ENGINEERS

Our Ref: 94 BF 053A

May 16, 1995

Public Works & Government Services Canada
c/o Mr. M. Seleanu, Project Manager
Moffat Kinoshita Associates Incorporated
124 Merton Street, 2nd Floor
Toronto, Ontario
M4S 2Z2

Dear Mr. Seleanu

Phase 2 Geotechnical Investigation
Muskoka Medium Security Institution
Gravenhurst, Ontario

We are pleased to present the results of the geotechnical investigation recently completed at the above noted project site. Authorization for this assignment was provided by Moffat Kinoshita Associates Incorporated in a memorandum dated April 27, 1995, revised May 1, 1995, on behalf of Public Works & Government Services Canada.

The proposed Muskoka Medium Security Institution (MI) will comprise fourteen (14) separate buildings for various residential, administrative, education, recreational, vocational and operational uses. The buildings were designated A to H, J to N, and P for identification purposes. A future residential building (Building 15) is also contemplated.

There will be a double perimeter fencing system and perimeter patrol road. Visitors and staff parking are scheduled north of the complex. Full servicing will be provided including piped water and sewers, the alignment of which will generally follow below the roadway system.

The subsurface investigation comprised a total of eighty five (85) boreholes (30 boreholes during Phase 1, and 55 boreholes during present Phase 2). A ground penetrating radar survey was also carried out to provide an interpretation of the bedrock profile over parts of the site (total 1.6 km of survey).

The field investigations have revealed an extremely variable and complex subsurface soil stratification and bedrock profile, compounded by a high groundwater table.

Bedrock outcrops occur in the central and south sections of the site. Bedrock was contacted at depths of 12 m or more in the east part of the site, and at 9 to 10 m depth in the southwest part of the property. Along the north, bedrock was not encountered at the 5 m termination depth of the boreholes.

...ii

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OFFICES IN TORONTO, HAMILTON, KITCHENER, BARRIE, OSHAWA

The overburden may generally be described as comprising a topsoil mantle, overlying a sand deposit and silt locally, followed by a discontinuous clay unit over bedrock. Localized layers of silt were sometimes found under the sand, and sometimes under the basal clay unit.

The sand was thickest (greater than 5 to 10.6 m) in the north and east part of the site. The relative density was variably very loose to dense, and was saturated for the most part.

The silt occurred discontinuously under the sand and mostly where bedrock was shallower. The silt was also variably very loose to dense and saturated.

The basal clay tended to occur in the east and southwest parts of the site, where it was thickest (3.0 to 6.0 m), and where bedrock is deepest. The clay was soft to stiff, and contained sand layers/seams to varying degree depending on location.

The groundwater table over most of the site was at grade to within 0.6 m below existing ground surface, and was ponded in the lowlying east and southwest parts of the site. To the north, north of the proposed Gatehouse Building A, groundwater table was usually 1.0 to 2.0 m below grade. The groundwater table was generally higher during Phase 2 (Spring, 1995) compared to the initial Phase 1 (November, 1994) investigation.

The design and construction of the proposed facility must contend with the variable and complex soil and bedrock conditions, and the high groundwater table.

It is recommended that the development concept involve elevated grades, filling rather than cutting. This is intended to maintain facilities above the groundwater table which is crucial to the proper performance of the pavements, floor slabs and general ground stability.

The high groundwater table and wet soil conditions must be fully recognized and particular attention given to the method of construction, selection of equipment, scheduling and groundwater control measures for ground stability purposes and to minimize disturbance to the subgrade during all aspects of earthworks operations.

It is anticipated that overburden during excavation for utility trenches and building foundations will comprise predominately sands. Silt would be encountered locally and underlying clay to lesser extent. Bedrock excavation will be required in the existing outcrop areas, and for some underground utilities where the bedrock is shallow.

Surface drainage improvements and lowering of the groundwater table will be required to facilitate earthworks, including stripping and installation of services and foundations.

Cognizant of the predominately relatively pervious sands, it is considered that dewatering through the use of well points should generally be satisfactory. Some special considerations will be required where there is a limited depth of sand over less pervious silt, clay or bedrock.

...iii

Open cut should be feasible for the relatively shallow excavations anticipated at the site and subject to effective groundwater control.

Where bedrock is to be removed, standard method of rock excavation including control blasting will be required. It is advisable that blasting of rock, to the maximum extent possible should be carried out early in the construction to minimise any potential adverse effects on existing structure or structures under construction.

Where site filling is required, this should be constructed as engineered fill to permit support of buildings, pavements and buried utilities.

The majority of on-site soils will be too wet for reuse as engineered fill. Materials imported for use as engineered fill should comprise Granular 'B' or equivalent.

Bedding for buried utilities should comprise compacted Granular 'A' or concrete. The use of clear crushed stone is not recommended for bedding or to assist in groundwater control, as this could lead to migration of the native fine soils into the open stone would result in settlement and loss of ground, and to prevent the creation of preferred seepage path which could adversely impact the groundwater regime.

Trench backfill should comprise imported Granular 'B' of equivalent, as much of the native excavated soils will be too wet.

It is understood that a proposed internal road and perimeter road system will be constructed early in the development to provide access for construction. It is important that a road be constructed above the groundwater table for satisfactory performance. The use of subdrains are not considered particularly effective given the high groundwater table and pervious sand conditions. Instead, maintaining higher grades, and the use of crushed rock for roadbases are recommended.

A thicker than normal pavement base is recommended cognizant of the construction traffic and high groundwater table.

A wearing course of asphaltic concrete could be provided during the construction period to protect the underlying base materials. Otherwise the upper base course should be considered sacrificial and will require subexcavation and replacement prior to placement of the final asphaltic concrete surface.

The report presents recommendations for the building foundations on a building by building bases.

Cognizant of the subsurface conditions and proposed finished floor grades, spread footings and floor slabs-on-grade are considered feasible for eight (8) of the buildings (Buildings B, C, D, E, L, M, N and P). These would generally involve footings on the native sand, or silt or engineered fill locally, with footings on bedrock for Building L.

There is a basement in Building A, and this building could be supported on the basement floor, designed as a mat foundation to resist hydrostatic uplift.

For Buildings G, H, and Future Residence, the site is underlain by soft clay and relatively deep bedrock, and an extensive amount of filling is to be carried out. Excessive settlements will dictate a foundation of piles driven to bedrock, with a structurally supported floor. Alternatively in these areas, a footing or mat foundation may be permitted if a surcharging program can be carried out prior to the building construction. This would involve placement of fill to design grade plus some, to preload the site for a period of at least 2 to 6 months, depending on the thickness of the clay, to allow consolidation settlement to take place prior to the building construction.

At Buildings F, J and K, bedrock is at or near surface to 3 m or more deep. Parts of these buildings could be on footings on shallow bedrock, with a pile foundation system where bedrock is deep. Shifting Building F to the south and east should permit more desirable footings on bedrock and slab-on-grade throughout.

For eight of the buildings an underfloor drainage system is recommended under the entire floor or part of the floor, where the slabs-on-grade are to be constructed at or slightly below existing ground surface. Raising the floor is recommended for the Buildings N and P, to minimize the amount of water to be handled by the underfloor drains.

It is recommended that the design drawings be reviewed by Peto MacCallum Ltd. to ensure the recommendations contained in this report are properly interpreted and implemented.

We trust the information contained in this report are sufficient for your present purposes. If you have any questions, or when we may be of further service, please do not hesitate to call our office.

Sincerely

PETO MacCALLUM LTD.

Brian R. Gray, P.Eng.
Vice President
Manager Geotechnical Engineering
Geo-Environmental Services

TLB/BRG:ga

PetoMacCallum Ltd.
CONSULTING ENGINEERS

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

1. INTRODUCTION

1.1 Authorization and Purpose of Work

Peto MacCallum Ltd. was retained by Moffat Kinoshita Associates Incorporated (MKA) in a memorandum dated April 27, 1995, revised May 1, 1995, on behalf of Public Works & Government Services Canada, to carry out a geotechnical investigation at the site of the proposed Muskoka Medium Security Institution (MI) in Gravenhurst, Ontario.

An initial Phase 1 preliminary geotechnical investigation was carried out and a report dated December 9, 1994, prepared, describing the generalized subsurface conditions together with comments and preliminary geotechnical recommendations for design and planning considerations. The purpose of the present Phase 2 geotechnical investigation was to gather further data to better define the subsurface conditions, in order to assist in final design and preparation of contract documents.

1.2 Site Description and Proposed Development

The site of the proposed MI is approximately 40 hectares in size and comprises the southwest portion of a 132 hectare crown land property in the Town of Gravenhurst, in the District Municipality of Muskoka. The MI site is located immediately south of the existing Beaver Creek Correctional Institution (BCI).

The proposed MI facility will comprise 14 separate buildings for various residential, administrative, educational, recreational, vocational and operational uses. The buildings are designated A to H, J to N, and P as illustrated on Drawing 1. A future residential building (building 15) is also contemplated. The building layout and finished floor grades discussed in the report are based on MKA Drawing SK-139D.

It is understood that the buildings will be residential in character, with light steel framed structures for some of the larger buildings. The buildings will be one or two stories. There will be no basement in any of the buildings except for the Gatehouse Building A.

There will be a double perimeter fencing system and perimeter patrol road. Visitors and staff parking are scheduled north of the complex, immediately south of the existing BCI. Access to the new facility will be provided through a new road constructed along an easement immediately west of the existing BCI. Full servicing will be provided including piped water and sewers, the alignment of which will generally follow below the roadway system.

1.3 Previous Studies

As mentioned earlier, an initial Phase 1 preliminary geotechnical investigation was carried out at the site and the results presented in the report, reference 94 BF 053, dated December 9, 1994.

A groundwater investigation report, titled, Part 1 Aquifer Delineation and Assessment, was prepared by Dixon Hydrogeology Limited, referenced DHL File No. PO4WO2, dated March 1, 1995. This report was reviewed as part of the overall subsurface assessment.

1.4 Scope of Work

The scope of services provided by Peto MacCallum Ltd. in the course of this investigation included:

- Drill, sample, test, and log fifty five (55) boreholes across the site. These boreholes are designated boreholes 31 through 85, sequentially with the initial Phase I boreholes 1 to 30.

- Install four (4) standpipes, to supplement the eight (8) standpipes previously installed during Phase 1, to permit monitoring of the stabilized groundwater table.

- Geophysical survey using ground penetrating radar techniques, to provide an interpretation of the bedrock profile along select lines (total 1.6 km of survey data). This work was conducted by Hyd-End Geophysics Inc.

- J. D. Barnes Limited was retained for surveying services. Initially, the proposed borehole locations were staked in the field in relation to the building footprint and development features. After the boreholes were completed, the as drilled locations of the boreholes were established.

- Laboratory testing for physical parameters including moisture contents, grain size analyses, Atterberg Limits and consolidation tests.

- Analyses of topsoil samples for parameters as requested by Hough Stansbury Woodland Limited.

- Review of Dixon Hydrogeology Limited report March 1, 1995.

- Engineering analysis of field and laboratory data, and preparation of this report, documenting the factual aspects of the investigation and providing comments and geotechnical engineering recommendations pertinent to the proposed development.

2. FIELD INVESTIGATIONS

2.1 Boreholes

During the period March 23 to May 1, 1995, fifty-five (55) boreholes were drilled at the locations shown on Drawing 1. These boreholes were numbered 31 through 85, sequentially with the previously drilled Phase I boreholes 1 to 30. Locations of all boreholes as surveyed by J.D. Barnes Limited are shown on Drawing 1.

All boreholes within the building areas were advanced to refusal on assumed bedrock. Bedrock was at surface to within 0.3 m of surface in four (4) of the boreholes, ranging to as deep as 12.8 m below existing grade. Boreholes along the utility corridors were terminated at 5.0 m or shallower where refusal was encountered.

The boreholes were advanced using a track mounted CME-55 drillrig, equipped with continuous flight solid and hollow stem augers, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff.

Representative samples of the overburden were recovered at frequent depth intervals for identification purposes, using a conventional split spoon sampler. Relatively undisturbed samples of the clay were also recovered using thin walled Shelby tubes. Standard penetration tests were conducted simultaneously with the sampling operations to assess the strength characteristics of the substrata. The undrained shear strength of cohesive soils were measured by insitu vane tests. Dynamic cone penetration tests were conducted at depth in five (5) of the boreholes.

The groundwater conditions in the boreholes were closely monitored during the course of the fieldwork. Eight (8) standpipes were previously installed during Phase I to permit monitoring of the stabilised groundwater levels. An additional four (4) standpipes were installed during the Phase 2 works.

2.2 Geophysical Survey

A geophysical survey was conducted by Hyd-Eng Geophysics Inc. to provide an interpretation of the bedrock profile along select lines. The survey was conducted utilizing ground radar penetrating techniques, for a total of 1.6 km of survey data. Results of the geophysical survey, including field results and interpretation of the groundwater table and bedrock profile are presented in Appendix D.

2.3 Laboratory Testing

2.3.1 Physical Tests

All recovered soil samples were returned to our laboratory for detailed examination. The following tests were conducted:

- Natural moisture content determinations on all recovered soil samples (shown on log sheets).
- Grain size analyses on twelve (12) representative samples (Figures A1, A2 and A3).
- Consolidation tests on two (2) clay samples (Figures A4 and A5).
- Atterberg Limits on eight (8) samples of clay (shown on Log sheets).

2.3.2 Topsoil Analyses

Analyses were conducted on ten (10) samples of topsoil recovered from the site, in accordance with parameters requested by Hough Stansbury Woodland Limited. The results are presented on Table A1.

3. SUMMARISED SUBSURFACE CONDITIONS

Reference is made to Appendix C, containing the Log of Boreholes sheets, for details of the subsurface conditions, including soil classifications, inferred stratigraphy, depth to refusal on assumed bedrock, standard penetration and dynamic cone penetration test "N" values, details of standpipe installations, groundwater observations and the results of laboratory moisture content and Atterberg Limit determinations. Logs of the Phase 1 boreholes 1 to 30, as well as the present Phase 2 boreholes 31 to 85, are appended.

Reference is also made to the results of the geophysical survey contained in Appendix D for the interpreted bedrock profile along selected lines.

Bedrock outcrops occur near the central portion of the site, and in the south section of the property. Based on refusal criteria, bedrock was contacted at depths of 12 m or more in the east part of the site, and at 9 to 10 m depth in the southwest part of the property. Boreholes along the north part of the site did not encounter bedrock at the termination depth of 5 m. Drawing 2 has been prepared to illustrate the general trend in the depth to bedrock. The bedrock comprises Precambrian granitic gneiss.

The overburden may generally be described as comprising a topsoil mantle overlying a sand deposit and silt locally, followed by a discontinuous clay unit over bedrock. Localized layers of silt were sometimes found under the sand, and sometimes under the basal clay unit. Fill was encountered locally in the north part of the site.

The topsoil was typically 100 to 250 mm thick (range 80 to 450 mm) and comprised mainly black silty sand.

The sand was thickest (greater than 5 to 10.6 m) in the north and east parts of the site. The relative density was variably very loose to dense, usually loose to compact, and was saturated for the most part. The sand was mostly fine/fine to medium grained, becoming silty locally (refer to Figure A1).

The silt occurred discontinuously under the sand, and mostly where bedrock was shallower. The silt was also variably very loose to dense, and saturated. Grain size charts for the silts are shown on Figure A2.

The basal clay unit tended to occur in the east and southwest part of the site, where it was thickest (3.0 to 6.0 m) and where bedrock is deepest. The clay was soft to stiff and contained sand layers/seams to varying degrees depending on location. The clay was low to medium plastic and wetter than the plastic limit to wetter than liquid limit. Typical grain size charts for the clay are shown on Figure A3. Laboratory consolidation tests on two (2) samples of the clay are presented on Figures A4 and A5.

Sand or sand and gravel fill was encountered to depths of 1.7, 1.4 and 0.2 m in boreholes 4, 36 and 7, respectively. Stockpiling of the fill was in progress in the area north of borehole 4, during Phase 1. An old pile of fill, some 1 to 1.5 m high was noted north of borehole 2. Scattered sections of cinder fill were noted as surfacing material along the existing east pathway and along the central section of the west pathway.

At the time of the investigation, the groundwater table over most of the site was at grade to within 0.6 m below existing ground surface, and was ponded in the lowlying east and southwest parts of the site. To the north, north of the proposed Gatehouse Building A, the groundwater table was usually 1 to 2 m below grade. Table B1 provides a tabulation of the groundwater levels measured in the standpipes. The observations indicate some pressurised water bearing zones in the subsurface. The groundwater table will be subject to seasonal fluctuations; the water levels during the Phase 2 work (April/May, 1995) tended to be generally higher than the observations during the Phase 1 work (November, 1995).

4. ENGINEERING CONSIDERATIONS

4.1 General

The design and construction of the proposed facility must contend with an extremely variable and complex subsurface soil stratification and bedrock profile, compounded by a high groundwater table. Within the normal depth of excavation, it is expected that the soils to be encountered would comprise primarily sand, with silt to a lesser degree, and clay sometimes locally at depth. Bedrock outcrops exist in the central and southern parts of the site.

During the Phase 2 investigation, the groundwater table over most of the site was typically at grade to within 0.6 m below existing ground surface, and was generally higher than the Phase 1 (November, 1994) observations. Water was ponded at the surface in the lowing east and southwest parts of the site. Along the northern edge of the site, north of the proposed Gatehouse Building A, the groundwater table tended to 1 to 2 m below existing grade.

It is recommended that the finished site grading, pavements and building floor elevations be established above existing grade. This is intended to maintain facilities above the groundwater table, which is crucial to the proper performance of pavements, floor slabs and general ground stability. Elevated grades will minimize the extent and sophistication of groundwater control/dewatering during the construction period, as well as the need for long term drainage requirements, which in turn will minimizing potential adverse impact on the regional groundwater system, (refer to the Dixon Hydrogeology report).

It should be fully recognized, that the wet soils would be particularly susceptible to disturbance and loss of strength. Particular attention must be given to the method of construction, selection of equipment, scheduling and groundwater control measures for ground stability purposes and to minimize disturbance to the subgrade during all aspects of earthworks operations.

Construction during the Summer is recommended, when the weather is driest, and the groundwater table usually the lowest.

4.2 Stripping

Topsoil thicknesses range widely between 80 and 450 mm (typically 150 to 250 mm). Some generalised form of site perimeter and internal drainage must be implemented at least two (2) weeks prior to and during stripping operations because the groundwater table is close to or at existing ground grade and sometimes ponded. Heavy earth moving equipment/scrappers should not be used for stripping, to minimize punching of the topsoil into the underlying subgrade, and therefore minimize the potential for over excavation.

It is considered that groundwater control and stripping operations may be more manageable, if constructed in smaller sections/areas at a time.

It will likely be necessary to install a construction road into the work area and stage the stripping using a backhoe or similar equipment operating from the construction road platform, or similar methods. Subject to field review, the use of a geotextile containment membrane may be required to optimise the thickness of the construction road.

Similar considerations would be required during grubbing operations to minimize disturbance to the subgrade.

4.3 Rough Grading and Engineered Fill

Rough grading of the site should be established with consideration to surface run-off and storm water control requirements, in the interim and long term basis.

It is recommended that the site development should involve filling to achieve elevated grades, because the groundwater table is at or close to existing grade. Rock excavation is anticipated for the Chapel Building L and part of the Non-Secure Residence Building F.

Where bedrock is to be removed, standard method of rock excavation including controlled blasting will be required. The fine grained subgrade soils are susceptible to disturbance due to ground vibrations. It is advisable to conduct the rock blasting early in the construction to minimize any potential adverse effects of the blasting operation on existing structures or structures under construction.

Earth fill should be constructed as engineered fill, for purposes of supporting slabs-on-grade, pavements and utilities. The following guidelines are provided for construction of engineered fill:

- Prior to placement of engineered fill, the subgrade must be prepared by stripping all topsoil, organics, existing fill and/or other obviously deleterious materials.

- General surface drainage improvements and implementation of groundwater control will be required during stripping and filling operations, to minimize disturbance to the subgrade, and for satisfactory placement and compaction of the engineered fill.

- Engineered fill should comprise select on-site sand and/or imported granular material conforming to the Ontario Provincial Standards (OPS) specifications for Granular 'B' or equivalent. The material should be placed in maximum 200 mm thick lifts with a target compaction of 98% Standard Proctor maximum dry density.

  Much of the on-site excavated material is expected to be too wet for reuse as engineered fill. Some of the sand at shallower depths above the groundwater table, particularly in the north part of the site, should be suitable for reuse as engineered fill. The excavated wetter materials may be reused in non-critical areas where settlement is not a concern.

  It is expected that the majority of the fill required for grading purposes will comprise imported OPS Granular 'B' material or equivalent.

  It may be necessary due to the wet conditions to utilize a crusher run material for the initial lift of engineered fill.

- The engineered fill must extend beyond the envelope of the structure/facility to be supported. For planning purposes the minimum extent should be 2 m beyond the envelope in all directions at design subgrade/founding level, and sloping downward to the native subgrade at 45°.

  Accurate survey control is essential to ensure that the boundaries of the engineered fill extend sufficiently beyond the structure/facility to be supported.

- Fills are generally more susceptible to the effects of weather than are natural soils. Measures must be incorporated to protect the fill from excessive wetting, erosion or freezing. Where the finished fill is left exposed for extended periods, particularly over a winter/spring season, it may be necessary to rework/recompact the upper portion of the fill to engineered fill standards.

- The Contractor should be aware of the high groundwater conditions and its effect on the selection/performance of compaction equipment. Only static units will be permitted for the initial several lifts. Vibratory equipment must not be used until the compacted fill height is well above the water table.

- Uniform thorough compaction is crucial to the performance of the fill and the facility/structure to be supported. Hence engineered fill construction should be inspected on a full-time basis by Peto MacCallum Ltd. to approve subgrade preparation, backfill materials, ensure satisfactory placement and compaction procedures, and verify the specified degree of compaction is achieved uniformly throughout.

- It is recommended that the Contractor conduct a full scale field test section to fully evaluate/substantiate the proposed construction procedures including lift thickness, compaction effort, equipment type and placement procedures.

- Final details of proposed engineered fill areas must be reviewed by Peto MacCallum Ltd. to ensure the intent of these guidelines are satisfied.

4.4 Site Services

Due to the relatively high groundwater table and shallow bedrock in places, it is advisable to maintain service utilities as high as possible to minimize groundwater control requirements and associated difficulties, and the amount of rock excavation. Prefabricated insulated pipes and/or the use of polystyrene insulation encasement may be considered for frost protection, where the normal earth cover is not provided.

For your information, the levels at which bedrock was contacted are shown on the borehole log sheets, Appendix C. The results of the geophysical survey, Appendix D, provide an interpretation of the bedrock profile along parts of the site. Drawing 2 has also been prepared showing the interpolated general trend of bedrock depths across the site.

The following comments and recommendations are provided with regard to service installation:

- Groundwater control/dewatering is expected over most of the site for purposes of trench stability and to provide relatively dry working conditions.

- Bedding material should comprise Granular 'A' material compacted to a minimum 95% Standard Proctor maximum dry density in accordance with the OPS specifications. Concrete cradle bedding may be substituted in areas of bedrock subgrade or areas where groundwater control is not totally effective.

  Overblast during rock excavation should be made up with granular or concrete bedding material.

- The use of clear crushed stone is not recommended for bedding material or to assist in groundwater control. The reasons for this are,

  1. to prevent migration of the native fine materials into the voids of the open stone, which may otherwise lead to settlement and loss of ground;
  2. to prevent the creation of preferred seepage paths which may otherwise adversely impact on the groundwater regime, as discussed in the Dixon's Hydrogeological report.

- Granular bedding material compacted to 95% Standard Proctor maximum dry density should be carried up as backfill to at least 300 mm above the pipe.

- Trench backfill should comprise select material placed in maximum 200 mm thick lifts and uniformly compacted to at least 95% Standard Proctor maximum dry density to minimize post construction settlement in the trench backfill.

Much of the excavated materials are expected to be too wet to achieve adequate compaction, and therefore will not be generally suitable for reuse back into the trenches. Select portions of the sand excavated above the groundwater table in the northern part of the site may be suitable for reuse.

Imported material for trench backfill should be no more pervious than the on-site native sand, so as not to create preferred seepage paths in consideration of minimizing the impact on the groundwater regime. In this regard, it is considered that imported trench backfill material should comprise OPS Granular 'B' material or equivalent.

- Trenching and backfilling operation should be carried out in such a manner as to minimize the length of trench exposed at any given time, yet accommodate efficient pipe laying, backfilling and compaction activities.
- As a further guard against impacting the groundwater regime, it is recommended that relatively impervious clayey soil or concrete seepage control collars be incorporated at regular intervals of about 50 m spacing along buried conduits. These seepage control collars should extend the full width of the trench, from the bottom of the trench to at least 500 mm above the pipe obvert.
- The use of flexible pipes, joints and connections must be considered in view of the anticipated settlement in areas where large amounts of fill are required as discussed for various buildings later in the report.

4.5 Pavements

It is anticipated that the pavement subgrade for the most part will comprise native sand. Bedrock subgrade is anticipated along part of the south perimeter road.

While the sand is a quite favourable material, the high groundwater table (typically 0 to 0.6 m of ground surface, and ponded in the east and southwest sections of the site) will dictate a thicker than normal pavement section. Ideally, the pavement should be established at least 600 mm above the groundwater table or at least 600 mm above existing grade over most of the site, and above the level of the ponded water in the east and southwest sections of the property.

In addition, because of the wet conditions, it is recommended that the pavement granular bases comprise processed crushed rock, which are less susceptible to weakening under saturated conditions.

It is understood that the proposed internal road and perimeter road systems will be constructed early in the development to provide access for construction traffic. With this in mind, the following minimum pavement base and subbase thicknesses are recommended:

150 mm thick base of 20 mm crusher run
800 mm thick subbase of 50 mm crusher run

Bedrock subgrade is anticipated over part of the south perimeter road. For bedrock subgrade, the subbase may be deleted and the base increased to 300 mm thickness.

Two options are available for the construction period:

<u>Option 1</u>

- provide 75 mm wearing course of asphaltic concrete to protect the base material from contamination during the construction period. This initial layer of asphaltic concrete can then be reviewed prior to finalizing the pavement. Depending on the condition, the final asphaltic concrete wearing surface can be placed, or if necessary the existing asphaltic concrete can be milled and mixed in placed with the underlying granular base course, upon which the new asphalt concrete surface can be constructed.

<u>Option 2</u>

- During the construction period, the road may be maintained with a gravel surface. However, as the upper material is likely to be contaminated, the 150 mm base course should be considered sacrificial, and will require subexcavation and replacement prior to placement of the final asphalt surface.

For the visitors and staff parking as well as the main access road in the north part of the site, sand subgrade is expected with the groundwater table generally 1 m or more below existing grade. Provided the ground grades are not lowered, it is considered that the pavement requirements could be reduced as follows:

150 mm base thickness of OPS Granular 'A'
300 mm subbase thickness of OPS Granular 'B'

For the final pavement, a minimum 75 and 100 mm thickness of asphaltic concrete is recommended for light duty passenger car parking areas, and heavy duty road and truck traffic areas, respectively.

The granular pavement courses should conform to OPS specifications for select granular materials, and should be placed in maximum 200 mm thick lifts and compacted to a minimum 98% Standard Proctor maximum dry density. Asphaltic concrete should be compacted to at least 96% Marshall density.

Pavement construction should involve subgrade preparation and the necessary groundwater control as discussed earlier in the report.

It is recommended that provisions be made for continued review of the actual subgrade conditions exposed during construction, to evaluate the need for additional subbase material and/or the use of synthetic geotextile fabric/reinforcing membrane, particularly in the lowlying east and southwest parts of the site.

The use of subdrains or drainage for the pavement structure is not considered particularly effective, given the pervious sand conditions and high groundwater table. Instead, elevated grades and the use of crusher run road base materials are recommended.

4.6 <u>Excavation and Groundwater Control</u>

Groundwater occurs in the upper unconfined sand deposit. The land north of the MI site is a recharge area, with groundwater discharge to the MI site. Accordingly, the groundwater levels of the MI site will be particularly affected during rainy periods.

The high groundwater conditions must be fully recognized and considered in the selection of construction methods, equipment and scheduling.

Surface drainage improvements will be required to enhance conditions with respect to equipment mobility and to permit grubbing, stripping and filling operations without undue disturbance to the subgrade. Temporary lowering of the groundwater table will be required during trenching for underground service installation and excavation for footing/foundation construction.

Although, general lowering of the groundwater table across the site by pumping from a series of relatively deep wells may be technically feasible, this is not a desirable option because of the potential impact, albeit short term, on the existing wells in the area.

It is envisioned that site drainage improvements may be achieved through a series of temporary shallow ditches, berms and/or pumping from a series of selectively located shallow keg wells.

It is anticipated that the overburden during excavation for utility trenches and building foundations would comprise predominately sands, with silt locally and underlying clay to a lesser extent. The groundwater table should be lowered to at least 600 mm below the anticipated depth of excavation. Cognizant of the predominant relatively pervious sands, it is considered that the groundwater table may be lowered through the use of a well point system.

In areas where there is a limited depth of sand over the less pervious silt or clay, a closer spacing of well points would be required; the tips of the well points should penetrate into the underlying silt/clay, and sand wicks provided around the well points to permit more effective draining of the groundwater table. These areas, and particularly for excavations to bedrock below the groundwater table, will need supplementary pumping from within the excavation, and may require steel sheet pile to assist in seepage cutoff.

Excavation should be carried out sequentially in short sections/smaller areas, before proceeding to other areas, so that the groundwater lowering at any one time is isolated, thereby minimize the impact on the groundwater system.

It is recommended that prospective contractors solicit independent specialists advice on groundwater control/dewatering requirements and that the proposed methods of groundwater control/dewatering, and dewatering discharge options are satisfactory to the regulatory authorities.

Subject to effective groundwater control, and cognizant of the relatively shallow excavations for this development, the soils at the site may be considered as Type 3 soils, in accordance with the Occupational Health and Safety Act. In this regard, trench sidewalls should be established at no steeper than 1 horizontal to 1 vertical from the base of the excavation. Flattening of the side slopes may be required in areas where groundwater control is not totally effective and concentrated seepage occurs.

Where bedrock is to be removed, standard methods of rock excavations, including controlled blasting will be required. It is advisable that blasting of rock, to the extent possible, should be carried out early in the construction to minimise any potential adverse effects on existing structures, or structures under construction.

It is recommended that a test dig be conducted for the benefit of prospective contractors to view the conditions to be encountered, and assess equipment requirements, preferred method of construction and scheduling.

4.7 Suitability of On-Site Excavated Materials for Reuse

Because of the high groundwater table, most of the excavated soils will be too wet for reuse under buildings and pavement areas, where engineered fill standards must be achieved to adequately support these structures. However, the wetter materials may be permitted in landscaped areas, where surface settlement may not be as crucial.

In the north part of the site, in the area of the proposed visitor's and staff parking, the groundwater table is typically 1 to 2 m below grade. The sand above the groundwater table in this area is considered suitable for reuse as engineering fill.

Blast rock may be processed to select aggregates for reuse on site. However, the quantity of bedrock to be excavated may not economically warrant an on-site crusher plant or transportation to an off-site processing plant. It may be possible to utilize blast rock into the landscaping features.

It is considered waste rock may be placed in non-structural areas, subject to geotechnical review for maximum rock gradation and layer thickness.

4.8 Buildings

4.8.1 General

Cognizant of the variable subsurface conditions and proposed finished floor grades, spread footings and floor slabs-on-grade are feasible for some buildings.

Where an extensive amount of fill is required and the building site underlain by soft clay, anticipated excessive settlement will dictate a pile foundation with structurally supported floor. Alternatively in these areas, footings or a mat foundation may be permitted if a surcharging program can carried out, schedule permitting.

The following subsections provide recommendations for various aspects of the building design/construction that may be common to more than one building.

4.8.1.1 Pile Foundation

A pile foundation is recommended for some of the buildings because of anticipated excessive settlement resulting from placement of fill to achieve a level floor, over areas underlain by soft compressive clay.

It is considered that H piles or concrete filled pipe piles driven to bedrock will be most suitable. Due to variable bedrock profile, timber piles are not favourable because of difficulty of splicing, and potential damage when driving on bedrock.

Steel H piles or concrete filled pipe piles driven to refusal on bedrock may be designed based on 50% of the allowable structural capacity of the pile section. The pile section should be selected to provide a minimum pile working load of 300 kN (allowable structural capacity of 600 kN). This provides a pile less susceptible to damage during installation and takes into consideration the effects of negative skin friction.

Pile load tests are recommended to verify the pile design capacity and driving/set criteria.

Sloping bedrock is typical of the Muskoka region and this has been confirmed during the present study. There is a real possibility of piles deflecting during driving on sloping bedrock and this must be fully recognized. It will be necessary to review the acceptability of each pile during construction, and subject to this review, it may be necessary for additional/substitute piles.

The piles should be fitted with rock points to minimize damage during driving, and to improve "seating" on the bedrock.

In consideration of lateral stability, piles should have a minimum 2 m embedment in soil. In this regard, where filling is required, this should be carried out prior to pile installation.

4.8.1.2 Surcharging Option

In lieu of piles, provided the schedule permits, consideration may be given to preloading/surcharging the site to allow consolidation of the underlying soft clay to take place prior to building construction.

With this option the building site is filled as engineered fill to the design floor level, then surcharged with an additional 1.5 m of earth fill. Each lift of fill should be spread over the area to be surcharged, prior to proceeding with subsequent lifts, while maintaining a fill slope of no steeper than 2 horizontal to 1 vertical. This is intended to prevent overstressing under the edges of the fill and potential edge failure. The fill is left in place for an estimated minimum 2 to 6 months, depending on the thickness of the underlying clay.

It will be necessary to install piezometers and monuments to monitor the progress of consolidation/settlement. Subject to monitoring and confirmation that primary settlement is essentially completed, the excess fill can be removed. The building may then be supported on footing (with floor slab-on-grade) or a mat foundation founded on the native soil/engineered fill and designed using a maximum bearing pressure of 35 kPa.

4.8.1.3 Exposed Foundation Walls

For some buildings, elevated floors are achieved by fill contained within the perimeter foundation walls. Where there is an unbalanced height of earth, the foundation walls must be designed as retaining walls to resist the lateral earth pressure, due to the unbalanced height of earth. Cognizant of fill within building areas constructed using granular material compacted to engineered fill standards, the following parameters may be used to compute the lateral earth pressure:

coefficient of earth pressure,	K	= 0.5
bulk unit weight of granular backfill		= 21.2 kN/m^3

These exposed foundation walls must be insulated to guard against frost action.

As an alternative to exposed foundation walls, earth berms could be constructed around the perimeter of the building, sloping at no more than 2 horizontal to 1 vertical to match the surrounding exterior grade. This could also serve as frost protection, and may permit footings/mat foundation founded higher up in the engineered fill.

4.8.1.4 Frost Protection for Foundations

A minimum 1.5 m of earth cover or thermal equivalent should be provided for frost protection of building foundations.

Cognizant of the high groundwater table, consideration should be given to maintaining footings as high as possible to minimise the depth of excavation and the extent of groundwater control. In this regard, frost protection may be provided through the use of polystyrene sheet insulation (25 mm thickness of high density polystyrene is equivalent to 600 mm of earthcover). The sheet insulation should extend at least 1.5 m horizontally away from the building, and sloped to provide drainage away from the building.

Restrictions will be needed for tree planting/landscaping or other excavation activities after the insulation is installed to avoid damage to the polystyrene sheet insulation.

4.8.1.5 Foundation Subgrade Protection

Due to the anticipated wet conditions, it is recommended that earthen founding surfaces be protected with a minimum 50 mm thick layer of lean concrete immediately following geotechnical inspection and approval.

Where bedrock excavation is required, any overbreak should be made up with lean concrete.

4.8.1.6 Floor Slab-On-Grade

Where floor slab-on-grade construction is consider feasible as outlined for the individual buildings later in the report, the following recommendations should be considered in the design construction:

- Subgrade preparation should involve stripping of topsoil, organics and other deleterious materials and provision of engineered fill (Section 4.3) where required to achieve design grade.
- A minimum 150 mm thick bedding layer of 20 mm clear crushed stone is recommended as a moisture barrier under the floor slab. A vapour barrier should be incorporated under the floor slab, where a vapour sensitive floor finish is to be used.
- Prior to placement of the bedding layer, the subgrade should ideally be compacted to ensure at least 98% Standard Proctor maximum dry density. Over compaction should be avoided in areas of wet subgrade.
- Existing grades should be established to promote surface run-off away from the building.

4.8.1.7 Underfloor Drainage

Wherever an underfloor drainage system is recommended, the bedding under the slab should comprise a minimum 230 mm depth of 20 mm clear crushed stone. Weeping tiles should be placed at maximum 5 m centres leading to a frost free sump or outlet. The subgrade should be completely blanketed with synthetic filter fabric prior to placement of the clear crushed stone, to prevent migration of the subgrade material and "silting in" of the drainage system.

4.8.1.8 Inspection

Subsurface conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the investigation. Therefore, it is recommended that subgrade conditions, including all founding surfaces for footings, be inspected by Peto MacCallum Ltd. to confirm that the subsurface conditions are in accordance with the design assumptions, that the subgrade has not been unduly disturbed by construction activities, and that the specified bearing capacities are available throughout.

4.8.2 Gatehouse Building A

The following information was considered:

- Pertinent boreholes 41 and 42.
- Anticipated subgrade is a major compact sand deposit, with clay below 9.4 m and bedrock at 10.2 to 12.9 m depth.
- Groundwater table was near elevation 271.7, some 0.6 to 1.6 m below existing grade.
- Existing ground approximate elevation 273.5 to 272.5 from the northwest to southeast.
- Finished floor elevation 273.15.
- Proposed basement assumed 3.0 m deep, near elevation 270.15 (2.3 to 3.2 m below existing grade).

Compact sand is anticipated at the proposed basement level (approximate elevation 270.15). It is considered that the building may be supported on the basement floor designed as a mat foundation founded on the compact sand, where an allowable bearing capacity of 150 kPa should be available for design purposes.

The basement will be below the groundwater table. Therefore, the basement/floor slab system should be designed as a water tight box to resist hydrostatic uplift. For design purposes the groundwater table may be assumed to be elevation 272.7, minimum 1.0 m above the observed level.

Basement walls must be designed for the water pressure as well as the earth pressure due to the retained earth. The following geotechnical parameters are recommended:

coefficient of earth pressure, K = 0.5

backfill adjacent to the foundation wall
bulk unit weight, γ = 21.2 kN/m^3
submerged unit weight, γ' = 11.4 kN/m^3

wall backfill = free draining OPS Granular 'B' material or equivalent placed in maximum 200 mm thick lifts and uniformly compacted to a minimum 95% Standard Proctor maximum dry density. The wall must be adequately braced and compaction operations restricted to light equipment to prevent damage of the foundation wall and ensure high lateral pressure acting on the wall are not developed.

4.8.3 Visit/Correspondence Building B

The following information was considered in our assessment:

- Pertinent boreholes 46 and 47.
- Anticipated subgrade comprises sand to 4.4 to 7.0 m depth, underlain by firm to stiff layered clay, with bedrock at 7.2 and 10.7 m depth.
- Groundwater table was near 0.6 to 0.9 m depth, approximate elevation 270.4 to 270.8.
- Existing ground elevation 272.0 in the northwest, dropping to elevation 270.5.

- Finished floor elevation 272.1, requiring 0.1 to 1.6 m of fill.

It is considered that the building may be supported on spread footings founded on the compact sand at about 0.8 m below existing grade. A net allowable bearing capacity of 100 kPa is recommended for design (minimum 600 mm wide footing). Total settlement is expected to be on the order of 25 mm, with differential settlement of about 75% of this value.

Fill under the building must be constructed as engineered fill.

Floor slab-on-grade is considered feasible on the native sand and the engineered fill. Underfloor drains are recommended in the northwest part of the building where the floor grade is near existing ground level.

4.8.4 Health Care Building C

The following information was considered:

- Pertinent boreholes 5, 43, 44 and 45
- Subgrade comprises very loose to compact sand to 1.5 to 3.7 m, over discontinuous deposits of silt/clay/layered sand and clay/sand and gravel, over bedrock at 2.0 to 5.2 m depth.
- The groundwater table was near 0.6 to 0.8 m depth, elevation 271.5 to 272.2 in boreholes 43 to 45.
- Existing ground elevation 272.2 to 272.8.
- Finished floor elevation 272.50, requiring some minor (about 0.3 m) of cut and fill.

It is considered that footings may be founded on the native loose to compact sand (below the upper very loose zone) at minimum 0.6 m below existing grade (minimum 1.2 m at borehole 43) approximate elevation 271.5 to 272.0.

Footings founded as outlined above may be designed based on an allowable bearing capacity of 50 kPa, (minimum 600 mm wide). Total settlement should not exceed 25 mm with differential settlement of about 75% of this value.

Floor slab-on-grade construction is considered feasible. An underfloor drainage system is recommended.

4.8.5 Industries Building D

The following information was considered:

- Pertinent boreholes 9, 59, 60, 61 and 62.
- The subsurface stratigraphy comprises sand to 0.7 to 1.4 m depth in the north, increasing to 3.6 to 5.5 m depth in the south, underlain by silt/clay/layered clay and sand/sand and gravel. Bedrock was contacted at depths of 2.5 to 2.7 m in the north increasing to depths of 5.2 to 9.5 m in the south.
- The groundwater table in boreholes 59 to 62 was 0.1 to 0.6 m below grade, elevation 269.4 to 271.1.
- Existing ground elevation 272.0 in the north dropping to elevation 269.5 in the south.
- Proposed finished floor elevation 271.5, requiring some 0.5 m cut in the north, and 2.0 m fill in the south.

Compact to dense sand (silt locally) is anticipated at minimum 0.6 to 0.9 m below existing grade. A net allowable bearing capacity of 150 kPa should be available for design of footings (minimum 600 mm wide).

Total settlement of about 25 mm is anticipated with differential settlement of about 75% of this value. The largest settlement would occur in the south part of the building.

Fill under the buildings should be constructed as engineered fill. It is considered that slab-on-grade construction would be feasible, on the native soil (north) and engineered fill (south).

An underfloor drainage system is recommended over the north part of the site, where the floor will be established at or below the existing ground surface.

4.8.6 Non-Secure Residences Building E

The following data was considered:

- Pertinent boreholes 17, 20, 70 and 71.
- The subgrade comprises sand to depths of 1.4 to 5.5 m underlain by clay and silt locally, with bedrock at depths of 3.0 to 9.7 m below grade.
- The groundwater table was at, to within 0.4 m of surface, corresponding to approximate elevation 268.4 in the north and central portions of the building, and elevation 267.8 in the south end.
- Existing ground is about elevation 268.3 in the south, rising to elevation 269.0 in the north.
- Proposed finished floor elevation 268.65, requiring minor (about 0.4 m) cut and fill.

It is considered the proposed building may be supported on the compact sand anticipated at depths of 0.6 to 1.0 m below existing grade, where a net allowable bearing capacity of 100 kPa is recommended for design (minimum 600 mm wide footings).

Total and differential settlements should not exceed 25 and 15 mm, respectively, provided the subgrade is not unduly disturbed during construction.

Some minor cut and fill (less than 0.4 m) are required to establish the proposed finished floor. Slab-on-grade construction is considered feasible, together with an underfloor drainage system. It is recommended that the finished floor be raised somewhat, to minimize the amount of groundwater that the underfloor drainage system would have to handle.

4.8.7 Non-Secure Residences Building F

The following data was considered:

- Pertinent boreholes 76, 77, 78 and 79.
- Bedrock is at or close to surface as revealed in boreholes 78 and 79, and as shown by the ground radar penetration survey, (GPR). There

is a discrepancy where the GPR indicated bedrock at about 3 m depth, elevation 265.8, whereas borehole 77 encountered refusal at 0.3 m depth, possibly on a boulder. In the northwest quadrant, borehole 76 showed relatively loose sand and soft clay down to bedrock at 3.5 m depth, elevation 265.0.

- Groundwater was noted near the 0.3 m depth, elevation 268.2 in borehole 76 located in the lowerlying part of the building site.
- Existing ground elevation 268.5 to 271.0 (bedrock outcrop within building area).
- Proposed finished floor elevation 269.95, requiring some minor amount of rock cut, and up to 1.5 m of fill.

Cognizant of the exposed/relatively shallow bedrock anticipated over most of the site, it is considered that most of the building may be supported on spread footings founded on the bedrock. A conservative design bearing capacity of 1000 kPa should be available in the bedrock for design purposes.

Footings on sloping bedrock (maximum 3 horizontal and 1 vertical slope) should be pinned to the bedrock using shear pins/dowels. Steeper sloping rock, where encountered, should be flattened.

For slab-on-grade construction, the overburden should be stripped down to bedrock, then built up as required as engineered fill. A partition wall will be required to contain and isolate the engineered fill from the northwest and northeast building wings, where a structurally supported floor is recommended as discussed below.

In the northwest quadrant, borehole 76, there is relatively loose sand and soft clay overlying bedrock at the 3.5 m depth, elevation 265.0. Also in the northeast wing, bedrock could be about 3 m below grade, elevation 265.8 based on the GPR results. In these quadrants, some 1.5 m of fill is required above existing grade to achieve the proposed finished floor. It is anticipated that the weight of this fill could cause some 25 mm or more of settlement in the floor slab-on-grade and footings due to consolidation of the underlying overburden. This would be the amount of differential settlement that would be expected, compared with the major part of the building supported on bedrock.

Because of the anticipated differential settlement and excavation difficulties, these portions of the building should be supported on piles driven to bedrock, with a structurally supported floor slab.

Alternatively, it is recommended that the building be shifted to the south and east, where the available data suggests the bedrock is higher. This would render the more desirable spread footings on bedrock and slab-on-grade feasible throughout. It will be prudent to finalize the building location during construction depending on the actual bedrock conditions encountered.

4.8.8 Non-Secure Residences Building G

The following data was considered:

- Pertinent boreholes 23, 80, 81, 82 and 83.
- In the west part of the building site the subsurface stratigraphy comprises silt and sand over bedrock at depths of 1.9 to 2.8 m below grade, elevation 263.8 to 266.2 (boreholes 23, 80 and 81). In the east section, the stratigraphy comprises sand to 2.9 to 4.3 m depth underlain by soft clay over bedrock at depths of 6.6 to 7.3 m, elevation 259.3 to 259.6 (boreholes 82 and 83).
- Groundwater occurred near elevation 266.5 to 266.9 in the west, sloping down to elevation 265.3 in the east, some 0.5 to 1.7 m below existing grade.
- Existing ground ranges from elevation 268.5 in the west, dropping to elevation 265.0 in the east.
- The proposed finished floor is elevation 269.0, some 0.5 to 4.0 m above existing grade.

Some 0.5 to 4.0 m of fill is required to achieve the proposed finished floor level. Settlement under this weight of fill is estimated to be on the order of 50 to 75 mm in the east part of the building (boreholes 82 and 83), and less than 15 mm in the west section (boreholes 80 and 81).

Cognizant of the anticipated total and differential settlements, a pile foundation system and structurally supported floor are recommended.

Alternatively, the use of spread footings (and floor slab-on-grade) or a mat foundation may be considered subject to a preloading/surcharging program.

4.8.9 Secure Residences Building H

The following data was considered:

- Pertinent boreholes 16, 73, 74 and 75.
- The subgrade comprises generally loose sand to 2.9 to 5.5 m depth, over soft clay to bedrock at depths of 7.0 to 11.2 m, elevation 255.2 to 258.3.
- The groundwater table was some 0.4 to 1.0 m below grade, elevation 266.0 in the west, dropping to elevation 263.4 in the east.
- Existing ground is elevation 266.8 in the west, dropping to elevation 264.5 in the east.
- Proposed finished floor elevation 268.5, some 1.7 to 4.0 m above existing grade.

The 1.7 to 4.0 m of fill required to achieve the proposed finished floor level will cause consolidation settlement on the order of 50 to 100 mm in the underlying loose sand and soft clay.

Cognizant of the anticipated settlement, it is recommended that this building be supported on a pile foundation system, with a structurally supported floor.

Alternatively, spread footings (with floor slab-on-grade) or mat foundation may be considered, subject to a preloading/surcharging program.

4.8.10 Programs Building J

The following data was considered:

- Pertinent boreholes 12, 14, 15, 63, 64, 65 and 66.
- Bedrock is exposed over the northwest part of the building site. Elsewhere, the stratigraphy generally comprises sand to depths of 0.6 to 1.5 m, overlying silt or clay with bedrock at depths of 1.4 to 5.0 m below grade. The bedrock surface ranges from a high of about elevation 271.8 on the bedrock knoll in the northwest part of the site, down to about elevation 262 to 264, some 4 to 5 m below grade in the southeast section (boreholes 15 and 66).
- Based on observations in the boreholes and the high moisture content of the soil, the groundwater table was typically 0.6 to 1.2 m below existing grade, ranging from about elevation 270.5 in the northwest to elevation 266 to 267 in the southeast.
- Existing ground ranges from elevation 271.8 (bedrock knoll) in the northwest dropping to elevation 267.2 in the southeast.
- Proposed finished floor elevation 269.5. Bedrock removal and some earth cut will be required in the northwest, with some 2.3 m of fill in the southeast.

Bedrock subgrade will be encountered in the northwest quadrant, with increasing depth of variable overburden towards the southeast. It is recommended that the building foundation be supported on bedrock throughout, to minimize otherwise excessive differential settlement if the building were supported partly on bedrock and partly on overburden.

In the northwest quadrant, footings could be supported on the exposed bedrock or where the bedrock is relatively shallow, a net allowable bearing capacity of at least 1000 kPa is available in the bedrock.

Elsewhere, particularly in the southeast, bedrock is as low as elevation 262, as much as 5 m below existing grade, and a pile foundation is warranted.

Slab-on-grade construction could be utilized in the northwest part of the building where bedrock subgrade or relatively shallow overburden subgrade is expected, without undue concern of settlement. In the southeast section however, some 25 to 40 mm of settlement would be anticipated because of the site filling requirements. A structurally supported floor system should be provided, or the site surcharged prior to slab-on-grade construction.

An underfloor drainage system is recommended in the northwest portion of the site where the floor is established below the existing ground grade.

4.8.11 Administration Building K

The following information was considered:

- Pertinent boreholes 7, 53, 54, 55 and 56.
- Bedrock was contacted as high as elevation 270.0, some 0.8 m below grade in the west (borehole 53) sloping down to elevation 261.7 to 263.4, some 6.1 to 6.7 m below grade in the east part of the site (boreholes 54 and 56). The shallower overburden in the west comprised relatively competent sand or silt. The deeper overburden in the east comprised relatively loose sand underlain by soft clay.
- The groundwater table was close to existing ground grade, elevation 270.8 in the west, dropping to about elevation 267 in the southeast.
- Existing ground is about elevation 271.3 in the northwest dropping to elevation 267.5 in the southeast.
- The proposed finished floor is elevation 271.15, requiring minor cut in the northwest, and up to 3.7 m of fill in the southeast.

Cognizant of the fill requirements and the subsurface conditions revealed in the boreholes, it is anticipated that settlement on the order of 25 to 50 mm may be expected in the east/southeast part of the building site, with minimal settlement in the west/northwest.

Based on the anticipated total and differential settlement, it is considered that the proposed building should be supported on piles driven to bedrock with a structurally supported floor.

Along the west at boreholes 53 and 55, bedrock is about 0.8 and 1.2 m below the existing ground level, near elevation 270.0 and 268.5, respectively. Footings carried down to the shallow bedrock in these areas warrant consideration.

If the site is surcharged/preloaded, then it is considered that the building may be supported on footings (with slab-on-grade) or a mat foundation.

Subdrains are recommended under the northwest section of the floor to be established at or below existing ground level.

4.8.12 Chapel Building L

The following data was considered:

- Pertinent boreholes 57 and 58.
- The majority of the building is located on a bedrock outcrop. In the northwest, borehole 57 showed shallow sand over bedrock at the 0.8 m depth, elevation 271.1
- No free water was noted in any of the boreholes during drilling; however, the soil was wet.
- The surface of the bedrock outcrop is about elevation 271.5 to 272.5.
- The proposed finished floor is elevation 272.15, requiring rock cut in the south and filling in the north to level the site.

The building can be supported on footings bearing on bedrock where a conservative net allowable bearing capacity of 1000 kPa is available for design. Any overbreak during bedrock excavation should be made up with concrete fill.

Slab-on-grade construction will be feasible. Subgrade preparation should involve removal of localized overburden, and cleaning of the bedrock surface. Filling under the building should be carried out as engineered fill.

4.8.13 Family Visits Building M

The following data was considered:

- Pertinent boreholes 48 and 49.
- The subsurface stratigraphy comprises compact to loose sand to 5.5 to 8.5 m depth, underlain by clay with bedrock at about 12 m depth at elevation 255.7 to 256.9.
- The groundwater table was noted near 0.4 m depth, elevation 268.5 in the northwest to elevation 267.3 in the southeast.
- Existing ground is elevation 269.3 in the northwest dropping to elevation 268.0 in the southeast.
- The proposed finished floor is elevation 270.85, some 1.6 to 2.9 m above existing grade.

Due to the 1.6 to 2.9 m of fill requirement, the weight of this fill will cause an estimated total 25 to 50 mm of settlement (differential settlement of 25 mm) in both footings and floor slab-on-grade, from north to south across the building.

If this is acceptable, then the building may be supported on footings (minimum 600 mm wide), founded on native sand (minimum 0.6 m) below existing grade, or on engineered fill required to raise the site grade. A net allowable bearing capacity of 50 kPa should be available for design of footings.

The use of a concrete mat may be considered, which tends to reduce the amount of differential settlement.

Much of the settlement can be avoided if a preloading/surcharging program can be carried out before the building construction.

4.8.14 Co-Generation Building N

The following data was considered:

- The location of this building was established following completion of the field investigation. The closest boreholes are boreholes 1, 5 and 51.
- Subsurface conditions typically comprises sand overlying bedrock at a depth of 1.5 to 3.7 m below grade, elevation 269.7 to 270.9.
- The groundwater table in the boreholes was typically 0.5 to 1.0 m below grade, sloping south easterly from elevation 272.5 to elevation 271.4.
- Existing ground is fairly level, elevation 273.0 to 273.3.
- Proposed finished floor elevation 272.50, some 0.5 to 0.8 m below existing grade.

It is considered the proposed building may be supported on spread footings founded on the sand at minimum 0.6 to 0.9 m below existing grade, where a net allowable bearing capacity of 150 kPa is recommended for design (minimum 600 mm wide footings).

Slab-on-grade construction is considered feasible in conjunction with an underfloor drainage system. The design floor elevation is close to or at the groundwater table. Raising the finished floor is recommended to minimise the amount of water the underfloor drainage system has to handle.

4.8.15 Garages Building P

The data considered was as follows:

- Pertinent borehole 51.
- Subsurface stratigraphy comprises sand over bedrock at 1.5 m below existing grade, elevation 270.9.
- The groundwater table was interpreted to be about 0.5 m below existing grade, elevation 271.9.
- Existing ground is about elevation 272.3 to 272.8.
- The proposed finished floor is elevation 272.15, about 0.2 to 0.6 m below existing grade.

It is considered the proposed building may be supported on spread footings founded on compact sand at about 1.0 m below existing grade, or bedrock anticipated at about 1.5 m below existing grade. An allowable bearing capacity of 200 kPa (minimum 600 mm wide footing) should be available in the sand. The allowable bearing capacity of the bedrock is at least 1000 kPa.

Floor slab-on-grade is considered feasible in conjunction with an underfloor drainage system. Raising the floor is recommended to minimise the amount of water that the underfloor drainage system must handle.

4.8.16 Future Residential Building

The following data was considered:

- The location of this building was shifted southerly since the completion of the field investigation.
- Pertinent boreholes are 16, 68 and 69.
- Subsurface conditions comprise typically loose sand to 5.5 to 8.2 m depth underlain by relatively soft clay down to bedrock at 9.8 to 12.8 m depth, elevation 251.4 to 255.5.
- The groundwater table was a ground surface.
- Existing ground ranges from about elevation 266.0 in the west dropping to elevation 264.0 in the east.
- The proposed finished floor is elevation 268.5, some 2.5 to 4.5 m above existing grade.

Excessive settlements on the order of 50 to 100 mm are expected due to the weight of the required filling (2.5 to 4.5 m of fill). Accordingly it is recommended the building be supported on piles driven to bedrock, together with a structurally supported floor.

Alternatively, spread footings with floor slab-on-grade, or a reinforced concrete mat foundation founded on the engineered fill may be considered following a preloading/surcharging program.

4.9 **Hydrogeological Considerations**

The comments and recommendations contained in this report have been provided in consideration of minimising potential adverse impact on the groundwater regime as discussed in the Dixon Hydrogeological report, and include:

- Maintaining finished grades above the existing ground to minimise depth of excavation below the groundwater table. This would minimise the extent of construction dewatering and long term drainage requirements.
- Staging/scheduling construction so that groundwater control/dewatering is implemented in short sections/small areas at a time. This would reduce the zone of influence and result in only localized drawdown. This would also reduce the length of construction dewatering in any single area.
- Provide groundwater control/dewatering for temporary periods only, to facilitate construction.
- Utilizing OPS Granular 'A' or concrete for pipe bedding. Clear crushed stone should not be use, which would otherwise create preferred seepage paths.
- Installing clayey soil or concrete seepage control collars at regular intervals along buried pipes.
- Utilizing native soil or OPS Granular 'B' or equivalent as trench backfill to simulate the natural sandy soils conditions as much as possible.

Sincerely

PETO MacCALLUM LTD.

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

T. LEE-BUN

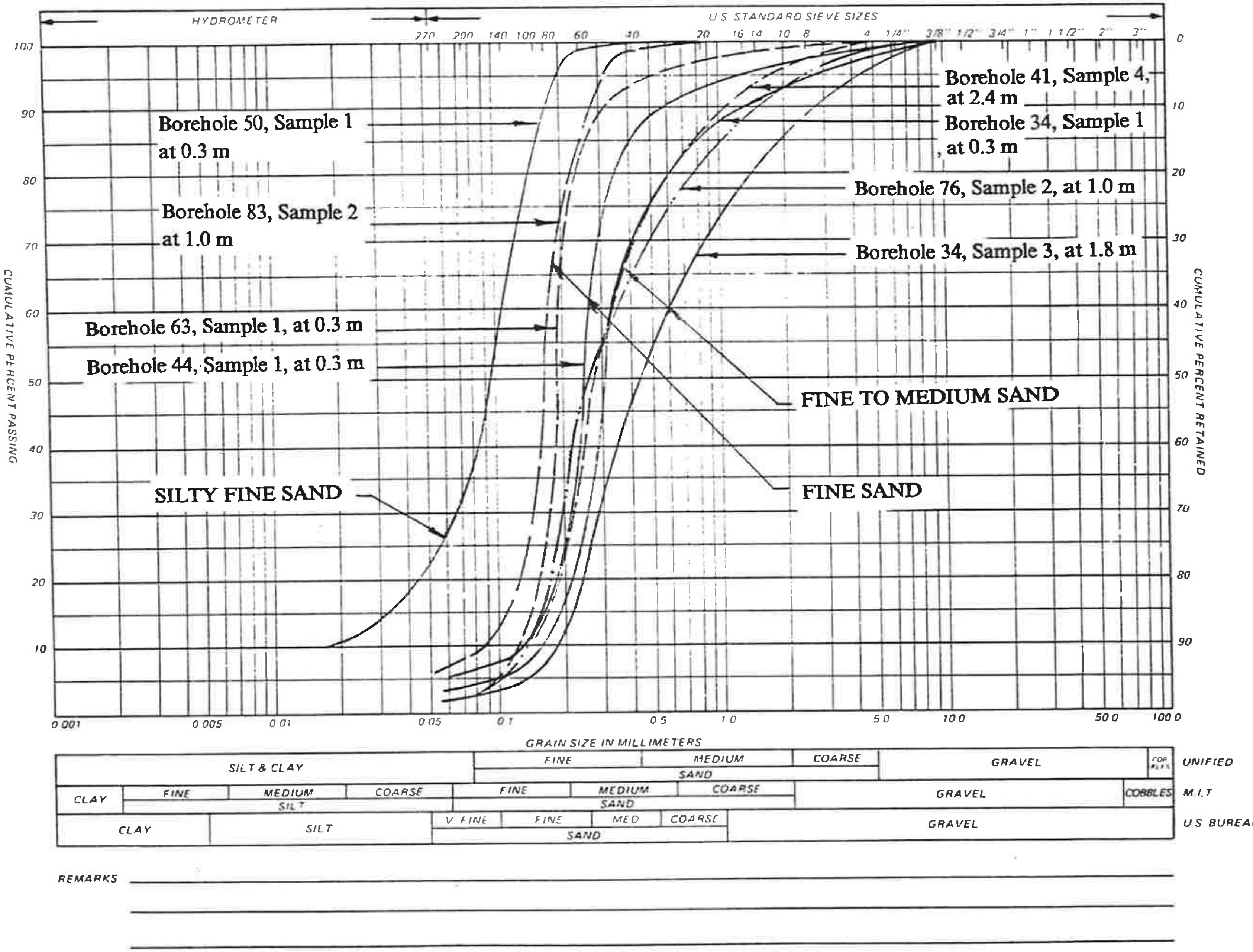
Brian R. Gray, P.Eng.
Vice President
Geotechnical Engineering
Geo-Environmental Services

TLB/BRG:ga

PetoMacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

FIGURE A1
OUR PROJECT NO. 94 BF 053A

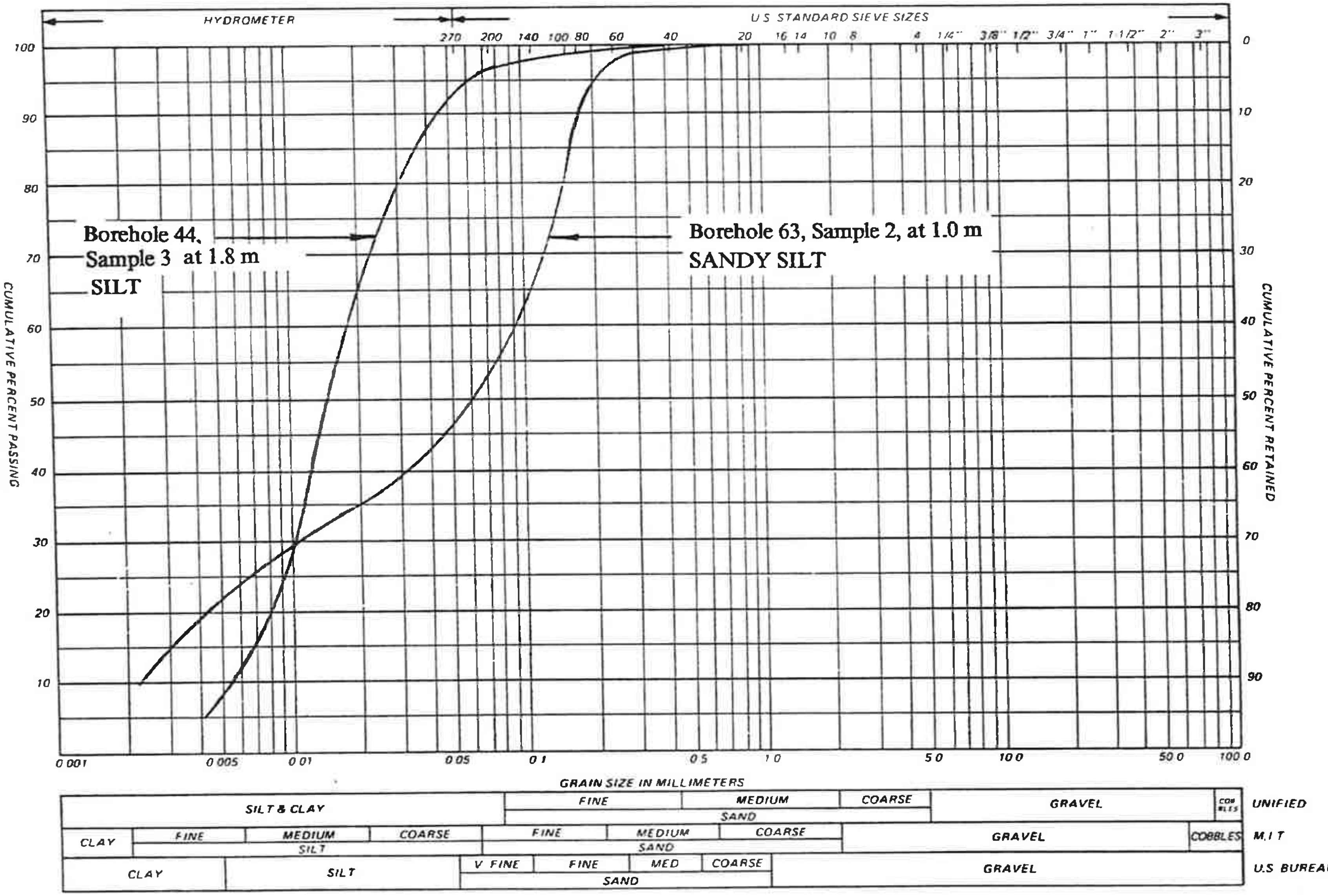


PML-117-S

PetoMacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

FIGURE A2
OUR PROJECT NO. 94 BF 053A



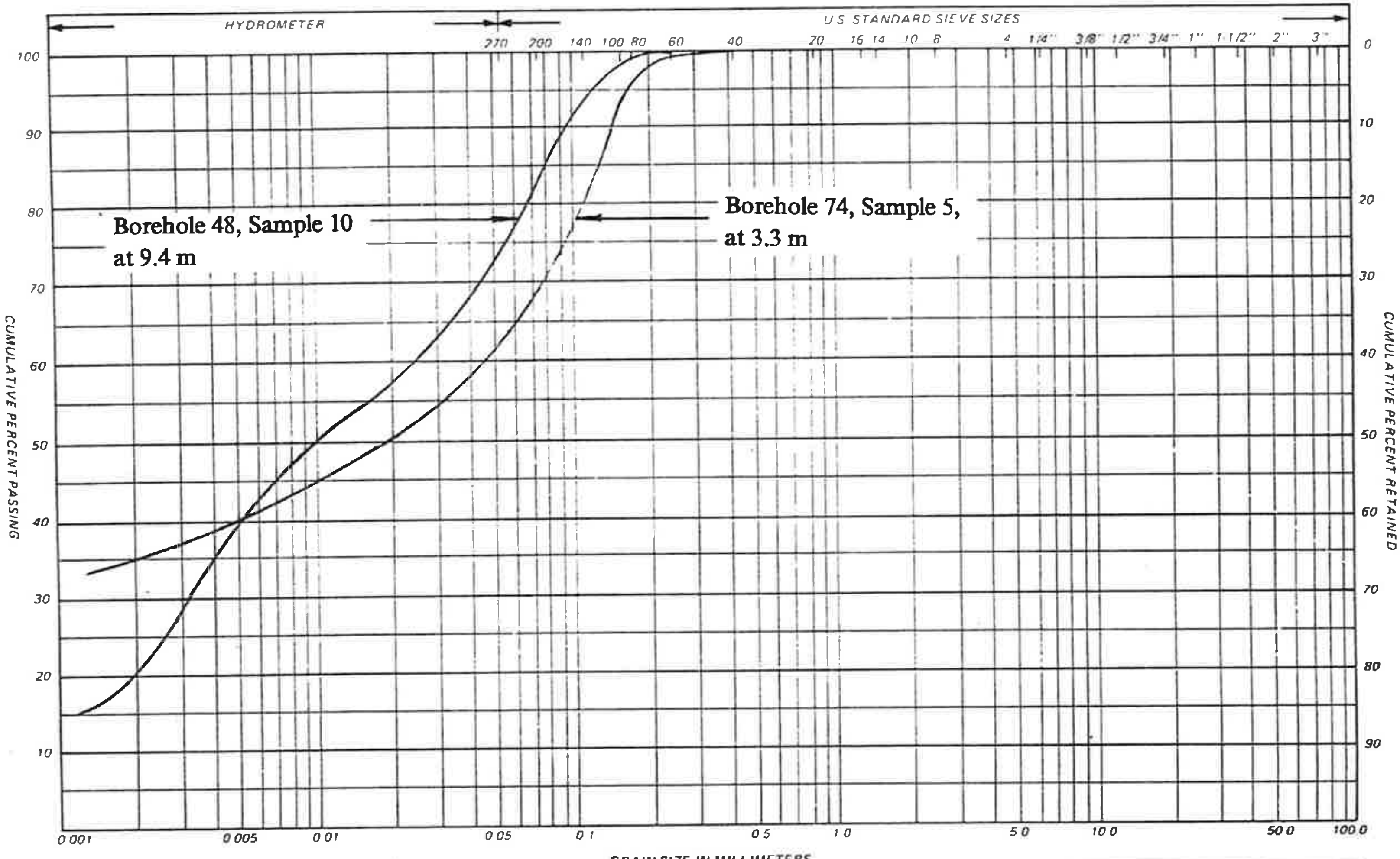
REMARKS

PML-117-S

PetoMacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

FIGURE A3
OUR PROJECT NO. 94 BF 053A



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

REMARKS . SILTY CLAY

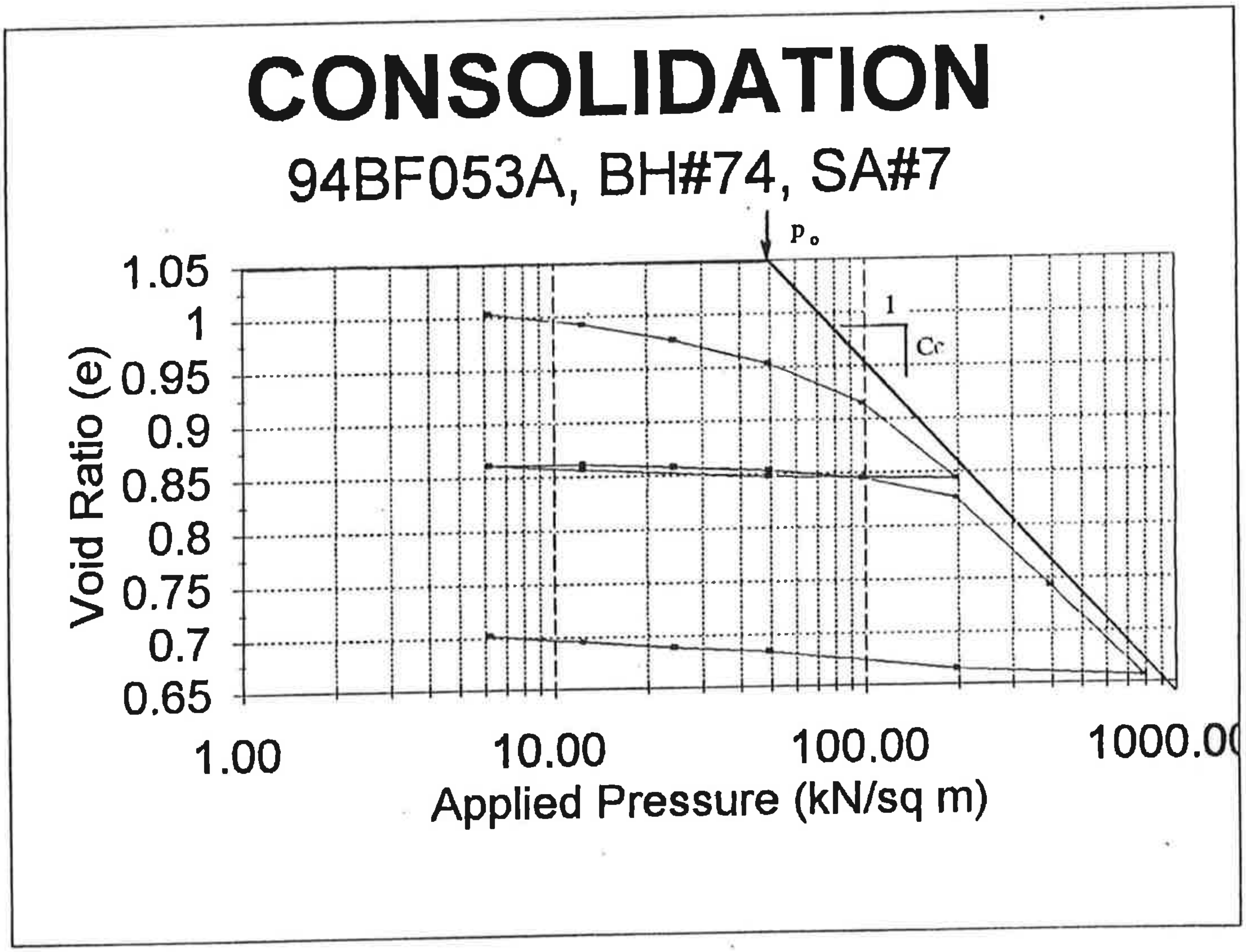
PML-117-S

PetoMacCallumLtd.
CONSULTING ENGINEERS

Our Ref: 94 BF 053A

FIGURE A4

CONSOLIDATION TEST RESULTS
MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO



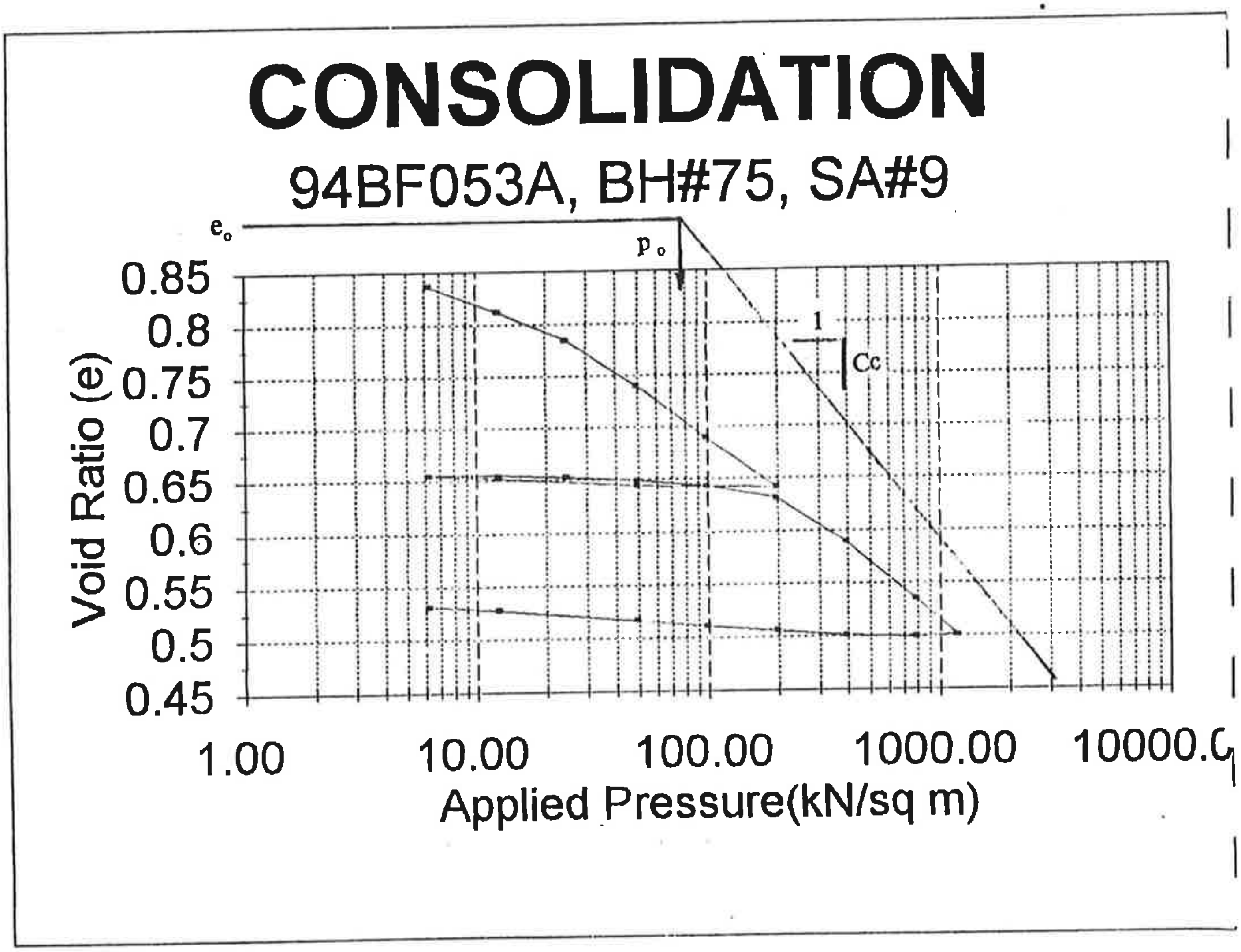
Depth = 5.5 m
Wet Density, γ = 1868 kg/m^3
Water Content, w = 39%
Initial Void Ratio, e_o = 1.05
Effective overburden pressure, p_o = 49 kPa
Consolidation Index, Cc = 0.35

PetoMacCallum Ltd.
CONSULTING ENGINEERS

Our Ref: 94 BF 053A

FIGURE A5

CONSOLIDATION TEST RESULTS
MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO



Depth = 8.7 m
Wet Density, γ = 1904 kg/m^3
Water Content, w = 33%
Initial Void Ratio, e_o = 0.9
Effective overburden pressure, p_o = 76 kPa
Consolidation Index, Cc = 0.28

APPENDIX A

LABORATORY TEST RESULTS

Our Ref: 94 BF 053A

May, 1995

ENTECH
A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit #4
Mississauga, ONT L5N 5M3
TEL: (905) 821-1112
FAX: (905) 821-2095

Client: Peto MacCallum

Project Number: 94-BF053A

TABLE A1 (1 of 3)
RESULTS OF TOPSOIL ANALYSIS

P.O. Number:

Date Received: April 28/95
Date Reported: May 5/95

Matrix: Soil

Attention: Turney Lee-Bun

Sam Sanyal, M.Sc., C. Chem

MISC. SAMPLE TESTS

PARAMETER	Units	Method Detection Limit (ppm)	CONTROL SAMPLE			SAMPLE DATA			
			Expected Level (ppm)	Found Level (ppm)	Recovery %	4348 BH27	4349 BH28	4350 BH34	4351 BH39
Dry Matter	%		-	-	-	80.80	63.39	80.42	77.55
pH			-	-	-	6.10	6.53	6.03	7.60
Organic Matter	%		-	-	-	8.26	25.79	4.13	5.07
Phosphorus	ppm	5	10	10.1	101	291	383	232	934
Potassium	ppm	5	2130	2071	97	320	275	155	531
Magnesium	ppm	2	2050	1892	92	792	636	558	1059
Calcium	ppm	0.5	10	10.2	102	935.7	1038.0	409.7	2645.3
			-	-	-				
			-	-	-				
			-	-	-				
			-	-	-				
			-	-	-				

A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit #4
Mississauga, ONT L5N 5M3
TEL: (905) 821-1112
FAX: (905) 821-2095

TABLE A2 (2 of 3)
RESULTS OF TOPSOIL ANALYSIS

Client: **Peto MacCallum**

Project Number: **94-BF053A**

P.O. Number:

Date Received: **April 28/95**
Date Reported: **May 5/95**

Matrix: **Soil**

Attention: **Turney Lee-Bun**

Sam Sanyal, M.Sc., C. Chem

MISC. SAMPLE TESTS

PARAMETER	Units	Method Detection Limit (ppm)	CONTROL SAMPLE			SAMPLE DATA			
			Expected Level (ppm)	Found Level (ppm)	Recovery %	4352 BH47	4353 BH50	4354 BH59	4365 BH63
Dry Matter	%		-	-	-	71.51	71.99	76.14	63.76
pH			-	-	-	6.12	7.01	6.18	6.37
Organic Matter	%		-	-	-	7.16	14.59	3.61	7.08
Phosphorus	ppm	5	10	10.1	101	383	232	282	152
Potassium	ppm	5	2130	2071	97	217	195	244	200
Magnesium	ppm	2	2050	1892	92	537	618	633	277
Calcium	ppm	0.5	10	10.2	102	855.3	1384.2	632.0	637.3
			-	-	-				
			-	-	-				
			-	-	-				
			-	-	-				
			-	-	-				

6670 Kitimat Rd., Unit #4
Mississauga, ONT L5N 5M3
TEL: (905) 821-1112
FAX: (905) 821-2095

Client: Peto MacCallum

Project Number: 94-BF053A

TABLE A3 (3 of 3)
RESULTS OF TOPSOIL ANALYSIS

P.O. Number:

Date Received: April 28/95
Date Reported: May 5/95

Matrix: Soil

Attention: Turney Lee-Bun

Sam Sanyal, M Sc., C. Chem

MISC. SAMPLE TESTS

PARAMETER	Units	Method Detection Limit (ppm)	CONTROL SAMPLE			SAMPLE DATA			
			Expected Level (ppm)	Found Level (ppm)	Recovery %	4356 BH69	4357 BH75		
Dry Matter	%		-	-	-	800.00	77.45		
pH			-	-	-	6.66	6.20		
Organic Matter	%		-	-	-	4.92	3.38		
Phosphorus	ppm	5	10	10.1	101	169	167		
Potassium	ppm	5	2130	2071	97	219	111		
Magnesium	ppm	2	2050	1892	92	280	532		
Calcium	ppm	0.5	10	10.2	102	765.8	282.7		
			-	-	-				
			-	-	-				
			-	-	-				
			-	-	-				
			-	-	-				

APPENDIX B

GROUNDWATER LEVELS IN STANDPIPES

Our Ref: 94 BF 053A

May, 1995

PetoMacCallum Ltd.
CONSULTING ENGINEERS

TABLE B1

GROUNDWATER LEVELS IN STANDPIPES
MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO

Borehole	Nov. 15/94	Dec. 6/94	May 8/95		
1	1.07/272.32	0.90/272.49	0.85/272.54		
3	0.53/269.79	0.50/269.82	0.60/269.72		
4	7.01/260.73	0.80/266.94	+1.06/268.8*		
16	1.30/265.19	1.30/265.19	1.01/265.48		
17	0.53/268.2	0.40/268.33	0.23/268.50		
23	0.51/266.05	0.50/266.06	0.46/266.1		
28A (Deep)	0.00/266.78	0.00/266.78	+0.10/266.88*		
28B (Shallow)	0.15/266.63	0.00/266.78	0.20/266.58		
30	1.45/263.8	1.20/264.05	1.12/264.13		
40			1.25/272.83		
41			1.55/271.79		
67			0.00/266.69		
82			1.40/265.45		

NOTES: 1.07/272.32 = Depth (m)/Elevation of water level in standpipe.

* Water level in standpipe above ground level, indicating pressurized zones of water in subsurface.

APPENDIX C

LOG OF BOREHOLES

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

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

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

CONSISTENCY	'N' BLOWS/0.3m	c kPa	DENSENESS	'N' BLOWS/0.3m
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
- W.S. WASHED SAMPLE
- S.B. SCRAPER BUCKET SAMPLE
- A.S. AUGER SAMPLE
- C.S. CHUNK SAMPLE
- S.T. SLOTTED TUBE SAMPLE
- T.W. THINWALL OPEN
- T.P. THINWALL PISTON
- O.S. OESTERBERG SAMPLE
- F.S. FOIL SAMPLE
- R.C. ROCK CORE
- P.H. SAMPLE ADVANCED HYDRAULICALLY
- P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

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

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LOG OF BOREHOLE NO. 1 and 2

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE Nov. 10/94
OUR PROJECT NO 94 BF 053
ENGINEER JFW
TECHNICIAN JFW

Column headings: SOIL PROFILE (DEPTH in METRES, DESCRIPTION, LEGEND, ELEVATION); SAMPLES (NUMBER, TYPE, BLOWS/0.3m N - VALUES); SHEAR STRENGTH C_u •; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST • (BLOWS/0.3M: 20, 40, 60, 80); LIQUID LIMIT — W_L, PLASTIC LIMIT — W_P, WATER CONTENT — W (W_P, W, W_L; WATER CONTENT %: 10, 20, 30); GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 1
GROUND ELEVATION 273.39

Depth (m)	Description	Elevation	Sample No.	Type	N-Value	Ground Water Observations and Remarks
0.15	TOPSOIL: dark brown sandy silt	273				bentonite seal
1.00	SAND: compact brown fine sand, some silt, with rust brown layers, moist	272	1	SS	14	12 mm PVC pipe
1.80	saturated		2	SS	13	native backfill
2.90	SILT: compact grey silt to sandy silt, saturated	271	3	SS	21	
3.65	SAND: compact grey silty fine to medium sand, trace gravel, saturated	270	4	SS	18	sampler wet after SS 2
	BOREHOLE TERMINATED AT 3.65 m on refusal to auger on assumed bedrock	269				Upon completion of augering water at 1.2 m

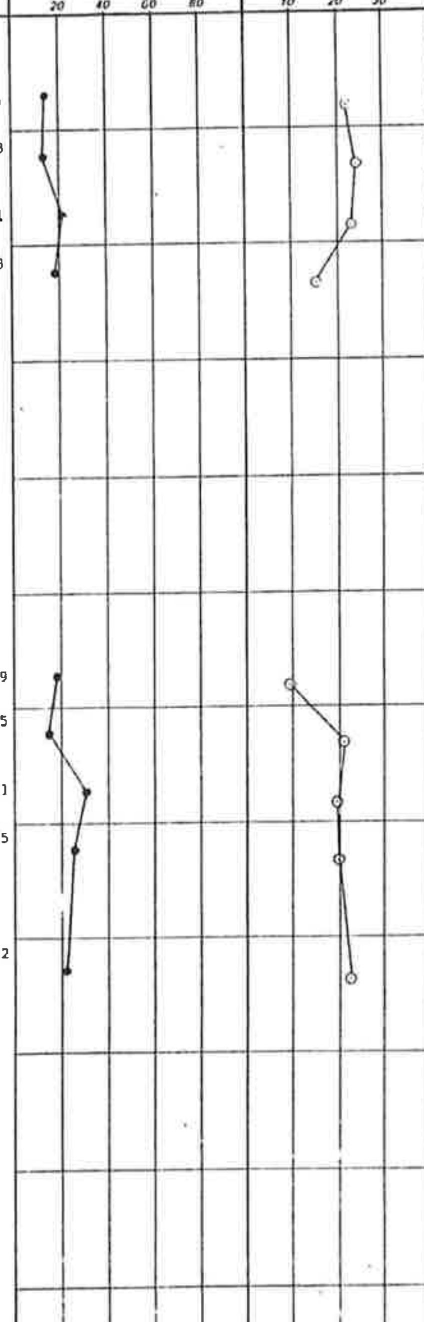
WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	1.07
Dec. 6	0.90

BOREHOLE 2
GROUND ELEVATION: 273.09

Depth (m)	Description	Elevation	Sample No.	Type	N-Value	Ground Water Observations and Remarks
0.15	TOPSOIL: black humus					
	SAND: compact brown fine sand, moist	272	1	SS	19	
		271	2	SS	15	
2.10	dense, fine to coarse, saturated	270	3	SS	31	sample wet after SS 3
2.90	compact, fine sand, stratified		4	SS	25	
3.50	silty fine sand	269				
5.00		268	5	SS	22	
	BOREHOLE TERMINATED AT 5.00 m Borehole 2 adjacent to fill pile					Upon completion of augering water at 2.1 m water sampled

Depth scale: 1.5, 3.0, 4.5 (Borehole 1); 1.5, 3.0, 4.5, 6.0 (Borehole 2)



NOTES

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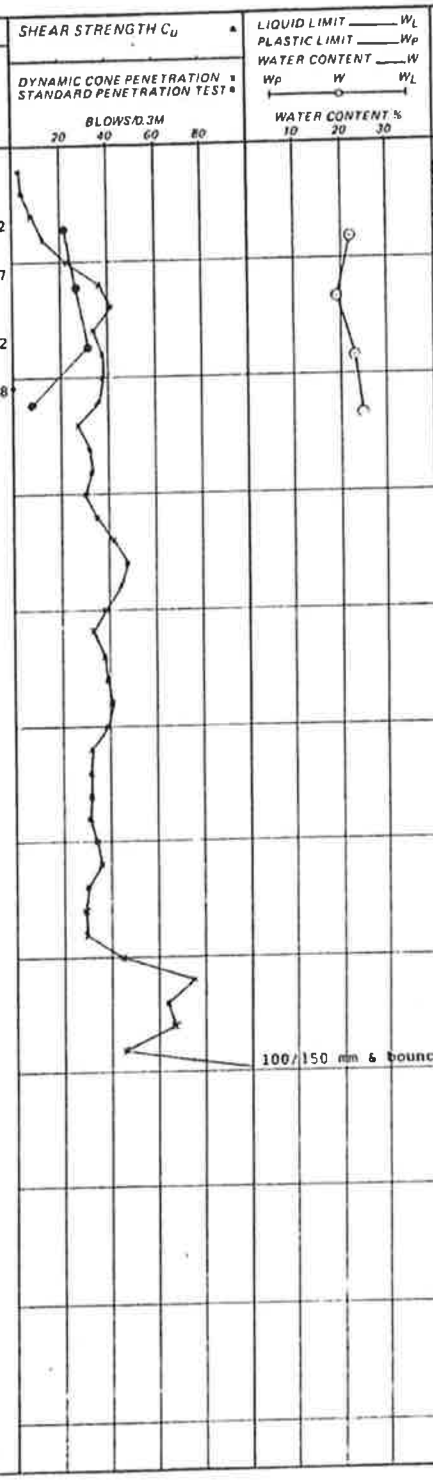
LOG OF BOREHOLE NO. 3

PROJECT	Muskoka Medium Security Institution	OUR PROJECT NO	94 BF 053
LOCATION	Gravenhurst, Ontario	BORING DATE Nov. 10/94	ENGINEER JFW
BORING METHOD	Continuous Flight Hollow Stem Augers		TECHNICIAN JFW

GROUND ELEVATION 270.32

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20	TOPSOIL: black sandy silt	270				bentonite seal
	SAND: compact brown fine to medium sand, saturated	269	1	SS	22	native backfill
1.5			2	SS	27	12 mm PVC pipe
2.10	dense, stratified	268	3	SS	32	
3.0		267	4	SS	8*	
		266				
4.5 / 4.60	BOREHOLE TERMINATED AT 4.60 m moved over and conducted dynamic cone penetration test	265				sampler wet after SS1 After drilling to 4.6 m sand heaved to 1.5 m inside augers water at 0.7 m
6.0		264				
		263				
7.5		262				
9.0		261				
		260				
10.5		259				
12.0 / 12.10	Dynamic cone penetration test terminated at 12.10 m on refusal on assumed bedrock	258				
13.5						
15.0						
16.5						



WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	0.53
Dec. 6	0.50

NOTES * Suspect low N value due to hydrostatic pressure.

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LOG OF BOREHOLE NO. 4

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 15/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

GROUND ELEVATION: 267.74

Depth (m)	Description	Elevation	Sample No.	Type	N-Values	Water Content / Remarks
0.00–1.70	FILL: loose brown sand and gravel, random cobbles, pieces of asphaltic concrete, concrete, brick, timber	267	1	SS	5	bentonite seal; native backfill
		266	2	SS	17*	
1.70	SAND: loose to very loose brown fine sand, some silt, saturated					cave
2.10	grey	265	3	SS	7	
			4	SS	0	12 mm PVC pipe
		264				
4.00	brown	263	5	SS	5	
5.60	grey	262				
			6	SS	1	53%
6.30	CLAY: very soft grey clay, W.T.P.L. with thin layers/seams of fine sand, saturated	261				
		260	7	SS	0	48%
		259				
		258	8	FV	-	
10.50	BOREHOLE TERMINATED AT 10.50 m on refusal to auger on assumed bedrock	257				

Sampler wet after SS2

Upon completion of augering water at 1.5 m, cave at 1.8 m

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	7.01
Dec. 6	0.80

NOTES

* High N value due to piece of wood.
▲ Undisturbed shear strength } based on insitu vane test
△ Remoulded shear strength }
■ Shear strength based on pocket penetrometer

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LOG OF BOREHOLE NO. 5 and 6

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE Nov. 10/94
OUR PROJECT NO 94 BF 053
ENGINEER JFW
TECHNICIAN JFW

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 5 – GROUND ELEVATION 272.60					
0.10	TOPSOIL: dark brown sandy silt	272				
	SAND: compact brown fine sand, moist		1	SS	24	
1.20	dense, stratified with rust brown layers, saturated	271	2	SS	33	sampler wet after SS 2
2.10	BOREHOLE TERMINATED AT 2.10 m on refusal to auger on assumed bedrock	270				Upon completion of augering water at 1.2 m
	BOREHOLE 6 – GROUND ELEVATION: 269.42					
0.45	TOPSOIL: black peat	269				
	SAND: compact brown fine sand, saturated	268	1	SS	18	after augering to 0.8 m, water at 0.3 m
			2	SS	10	
2.60	dense, silty	267	3	SS	30	
		266				after augering to 3.0 m sand heaved to 1.2 m, water at 0.3 m
4.60		265				after augering to 4.6 m sand heaved to 2.9 m, water at 0.3 m
	BOREHOLE TERMINATED AT 4.60 m	264				

SHEAR STRENGTH C_u •
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ■
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W
WATER CONTENT % 10 20 30

Depth scale: 1.5, 3.0 / 1.5, 3.5, 4.5, 6.0

NOTES

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LOG OF BOREHOLE NO. 7 and 8

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 10/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SHEAR STRENGTH C_u ▲ — DYNAMIC CONE PENETRATION ▪ — STANDARD PENETRATION TEST ● — BLOWS/0.3M: 20, 40, 60, 80

LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W; W_P — W — W_L; WATER CONTENT %: 10, 20, 30

BOREHOLE 7 — GROUND ELEVATION 270.35

DEPTH (METRES)	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20	FILL: brown sand	270				
0.50	TOPSOIL: black sandy silt					
	SAND: compact stratified brown and rust brown fine sand, some silt, saturated	269	1	SS	18	
1.5			2	SS	23	sampler wet after SS 2
		268				
2.60	SILT: compact/stiff brown to grey silt with seams and layers of fine sandy silt and clayey silt		3	SS	19	
3.0		267	4	SS	11	
		266				
4.5 / 4.55	BOREHOLE TERMINATED AT 4.55 m on refusal to auger on assumed bedrock	265				Upon completion of augering water at 1.2 m cave at 1.5 m

BOREHOLE 8 — GROUND ELEVATION: 265.70

DEPTH (METRES)	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20	TOPSOIL: black sandy silt					
	SAND: compact brown fine sand, some silt, saturated	265	1	SS	12	
1.5		264	2	SS	14	sampler wet after SS 1
2.10	very loose					
		263	3	SS	2/150 mm	
3.0			4	SS	4	after SS 4, water at 0.9 m, sand heaved to 1.7 m
		262				
		261				
4.5 / 4.60	BOREHOLE TERMINATED AT 4.60 m					Upon completion of augering water at 0.9 m
6.0						

NOTES

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LOG OF BOREHOLE NO. 9 and 10

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Holoow Stem Augers
BORING DATE: Nov. 11/94
OUR PROJECT NO.: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

BOREHOLE 9
GROUND ELEVATION 270.49

Depth (metres)	Description	Elevation	Sample Number	Type	N-Values (Blows/0.3m)	Ground Water Observations and Remarks
0.10	TOPSOIL: black sandy silt	270				
	SAND: dense brown fine to some silt, moist		1	SS	33	
1.40	SILT: compact brown silt to fine sandy silt, moist to saturated, with layers of silt to clayey silt, W.T.P.L.	269	2	SS	25	
		268	3	SS	14	
3.30	SAND: compact brown fine sand, saturated	267	4	SS	21	
3.90	BOREHOLE TERMINATED AT 3.90 m on refusal to auger on assumed bedrock	266				Upon completion of augering, water at 3.0 m

BOREHOLE 10
GROUND ELEVATION: 265.88

Depth (metres)	Description	Elevation	Sample Number	Type	N-Values (Blows/0.3m)	Ground Water Observations and Remarks
0.25	TOPSOIL: black silt					
	SAND: loose brown to grey fine sand to silty fine sand, saturated	265	1	SS	8	sampler wet after SS 1
		264	2	SS	10	
		263	3	SS	8	after drilling to 3.0 m, sand heaved inside augers
		262	4	AS	-	after drilling to 4.6 m, water at 1.8 m sand heaved to 2.8 m
4.60	BOREHOLE TERMINATED AT 4.60 m	261				Upon completion of augering water at 0.9 m

Chart columns: SHEAR STRENGTH C_u; DYNAMIC CONE PENETRATION; STANDARD PENETRATION TEST (BLOWS/0.3M: 20, 40, 60, 80); LIQUID LIMIT W_L; PLASTIC LIMIT W_P; WATER CONTENT W (WATER CONTENT %: 10, 20, 30)

Depth scale: 1.5, 3.0, 4.5, 6.0

NOTES

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LOG OF BOREHOLE NO. 11 and 12

PROJECT	Muskoka Medium Security Institution	OUR PROJECT NO	94 BF 053
LOCATION	Gravenhurst, Ontario	ENGINEER	JFW
BORING METHOD	Continuous Flight Hollow Stem Augers	TECHNICIAN	JFW
BORING DATE	Nov.11/94		

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 11 GROUND ELEVATION 263.06					water at grade
0.30	TOPSOIL: black silt and root mat					
0.60	SAND: saturated	262				
	Borehole 11 could not be accessed with tracked drillrig due to excessively wet ground conditions. Description based on manual probing					
	BOREHOLE 12 GROUND ELEVATION: 269.45					
0.10	TOPSOIL: dark brown sandy silt	269				
	SAND: very dense brown fine sand, some silt, trace gravel, moist	268	1	SS	68	
1.45	BOREHOLE TERMINATED AT 1.45 m on refusal to auger on assumed bedrock. Bedrock outcrop visible approximately 10 m west of borehole 12					Upon completion of augering no free water

Depth scale: 1.5, 3.0, 4.5, 6.0

SHEAR STRENGTH C_u ▲; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; BLOWS/0.3M 20 40 60 80

LIQUID LIMIT W_L; PLASTIC LIMIT W_P; WATER CONTENT W; WATER CONTENT % 10 20 30

NOTES

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LOG OF BOREHOLE NO. 13 and 14

PROJECT: Muskoka Medium Security Institutiion
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov.11 & 15/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	WATER CONTENT	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 13 GROUND ELEVATION 263.20						
0.15	TOPSOIL: black sandy silt and roots	263					
	SAND: compact grey silty fine sand, some silt, saturated	262	1	SS	19		sample wet after SS 1 augers sinking
1.50	very loose to loose		2	SS	3		
		261	3	SS	8		
3.00		260					after drilling to 3.0 m sand heaved inside augers
		259 – 253					
10.50	CLAY: soft grey clay, W.T.P.L.	252					Upon completion of augering water at grade cave at 1.5 m
		251	4	AS	-		
12.20	BOREHOLE TERMINATED AT 12.20 m						
	BOREHOLE 14 GROUND ELEVATION: 269.11						
0.15	TOPSOIL: dark brown sandy silt						
1.00	SAND: compact layered grey and rust brown fine sand, some silt, moist	268	1	SS	25		
1.50	SILT: compact brown sandy silt, with seams of silt or clayey silt		2	SS	17		
	grey silt, dilatent, saturated	267	3	SS	12/150 mm/bouncing		
2.45	BOREHOLE TERMINATED AT 2.45 m on refusal to auger on assumed bedrock	266					Upon completion of augering water at 1.6 m

SHEAR STRENGTH C_u ▲; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; BLOWS/0.3M 20 40 60 80
LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W; WATER CONTENT % 10 20 30

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 1.5, 3.0

NOTES

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LOG OF BOREHOLE NO. 15 and 16

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 11 & 15/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u kPa • 25 50 75 100 | DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST • BLOWS/0.3M 20 40 60 80 | LIQUID LIMIT —— W_L, PLASTIC LIMIT —— W_P, WATER CONTENT —— W (W_P — W — W_L), WATER CONTENT % 10 20 30 | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 15 — GROUND ELEVATION 268.00

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.05	FILL: black cinders					Borehole located in laneway
	SILT: compact brown to rust brown fine sandy silt with seams and layers of silt or clayey silt, moist	267				
1.20			1	SS	19	
	loose, saturated	266	2	SS	8	sampler wet after SS 2
2.10						
			3	SS	2	
2.90	CLAY: soft grey clay, W.T.P.L.	265				
3.30	stiff		4	SS	11	
		264				
4.10	SAND: compact grey fine sand, saturated					Upon completion of augering water at 1.2 m
	BOREHOLE TERMINATED AT 4.10 m on refusal to auger on assumed bedrock	263				

BOREHOLE 16 — GROUND ELEVATION: 266.49

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: dark brown sandy silt	266				bentonite seal
	SAND: compact brown fine sand some silt, with rust brown seams, moist		1	SS	26	12 mm PVC pipe
1.50	grey, saturated	265	2	SS	24	native backfill
2.10	loose, brown	264	3	SS	8	
3.00	compact	263	4	SS	16	
		262	5	AS	-	
4.60	BOREHOLE TERMINATED AT 4.60 m					sampler wet after SS 2 after drilling to 4.6 m, sand heaved to 3.7 m inside augers water at 1.7 m

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	1.30
Dec. 6	1.30

NOTES
■ Undrained shear strength based on pocket penetrometer test on recovered sample

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LOG OF BOREHOLE NO. 17 and 18

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 14 & 15/94
OUR PROJECT NO: 94 BF 051
ENGINEER: JFW
TECHNICIAN: JFW

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u kPa ▲ (25, 50, 75, 100) | DYNAMIC CONE PENETRATION × / STANDARD PENETRATION TEST ● BLOWS/0.3M (20, 40, 60, 80) | LIQUID LIMIT — W_L, PLASTIC LIMIT — W_P, WATER CONTENT — W, WATER CONTENT % (10, 20, 30) | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 17
GROUND ELEVATION 268.73

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.20	TOPSOIL: black sandy silt				
0.60	SAND: reddish brown silty fine sand	268	1	SS	12
1.40	SAND: compact reddish brown, to grey mottled silty fine sand, with seams of silt	267	2	SS	7
2.10	CLAY: firm grey clay, W.T.P.L.	266	3	SS	18
3.05	SILT: compact grey silt, dilatent, saturated	265			

BOREHOLE TERMINATED AT 3.05 m on refusal to auger on assumed bedrock

Ground water observations and remarks:
- 12 mm PVC pipe
- bentonite seal
- native backfill
- sampler wet after SS 1
- Upon completion of augering water at 2.7 m

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	0.53
Dec. 6	0.40

BOREHOLE 18
GROUND ELEVATION: 262.13

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.25	TOPSOIL: black silt/muck	262			
	SAND: compact grey fine sand, some silt, saturated	261	1	SS	12
1.50	loose to very loose		2	SS	9
		260	3	SS	1/400 mm
2.90	CLAY: soft grey clay W.T.P.L.	259	4	SS	P.H.
		258	5	FV	-
4.40	SAND: very loose grey silty fine sand, saturated		6	SS	P.M.
5.00		257			

BOREHOLE TERMINATED AT 5.00 m

Conducted dynamic cone penetration test from bottom of borehole

7.65	Dynamic cone penetration test terminated at 7.65 m on refusal on assumed bedrock	254

Elevations 256, 255 marked.

Ground water observations and remarks:
- sampler wet after SS 1
- 46%
- Upon completion of augering water at 0.6 m

NOTES
- Undrained shear strength
- ▲ Undisturbed value based on insitu field vane test
- △ Remould value based on insitu field vane stest
- ■ Based on pocket penetrometer test on recovered sample

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LOG OF BOREHOLE NO. 19

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE Nov.14/94
OUR PROJECT NO 94 BF 053
ENGINEER JFW
TECHNICIAN JFW

GROUND ELEVATION 268.30

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: dark brown sandy silt	268				after augering to 0.8 m, water at 0.6 m
	SAND: compact brown fine sand, saturated	267	1	SS	13	
1.50	stratified		2	SS	18	
2.10	medium to coarse sand	266	3	SS	14	after drilling to 3.0 m, sand heaved in augers
		265				
		264				
4.50	CLAY: soft grey clay, W.T.P.L.	263				
6.10	BOREHOLE TERMINATED AT 6.10 m	262	4	AS	-	Upon completion of augering water at 0.6 m

SHEAR STRENGTH C_u ▲
DYNAMIC CONE PENETRATION •
STANDARD PENETRATION TEST ■
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W
W_P W W_L
WATER CONTENT % 10 20 30

NOTES

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LOG OF BOREHOLE NO. 20

OUR PROJECT NO 94 BF 053
ENGINEER JFW
TECHNICIAN JFW

PROJECT Muskoka Medium Secvurity Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE Nov. 14/94

GROUND ELEVATION 268.23

DEPTH (METRES)	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: dark brown sandy silt					after augering to to 0.8 m, water at 0.6 m
	SAND: compact brown to grey fine sand, saturated	267	1	SS	13	
			2	SS	17	
2.10	loose, stratified, silty fine sand	266				after drilling to 2.3 m, sand heaved inside augers
			3	SS	10	
		265	4	SS	9	
		264				
4.50	CLAY: soft grey clay, W.T.P.L.	263				after drilling to 4.6 m, sand heaved to 2.7 m
			5	AS	-	
6.10	BOREHOLE TERMINATED AT 6.10 m moved over and conducted dynamic cone penetration test	262				Upon completion of augering water at 0.4 m
		261				
		260				
		259				
9.70	Dynamic cone penetration test terminated at 9.70 m on refusal on assumed bedrock	258				

SHEAR STRENGTH C_u ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M: 20 40 60 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W
WATER CONTENT %: 10 20 30

bouncing

Depth scale: 1.5, 3.0, 4.5, 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. 21 and 22

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 11 & 14/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

Column headings: SOIL PROFILE (DEPTH in METRES, DESCRIPTION, LEGEND, ELEVATION); SAMPLES (NUMBER, TYPE, BLOWS/0.3m N - VALUES); SHEAR STRENGTH C_u kPa ▲ 25 50 75 100; DYNAMIC CONE PENETRATION •, STANDARD PENETRATION TEST ■, BLOWS/0.3M 20 40 60 80; LIQUID LIMIT — W_L, PLASTIC LIMIT — W_P, WATER CONTENT — W, W_P W W_L, WATER CONTENT % 10 20 30; GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 21
GROUND ELEVATION 267.38

Depth (m)	Description	Elevation	Sample No.	Type	N-Values	Remarks
0.1	TOPSOIL: dark brown sandy silt	267				
1.00	SAND: very loose stratified brown and rust brown sand and sandy silt	266	1	SS	3	
1.80	loose, grey		2	SS	5	
	CLAY: very soft grey clay, W.T.P.L.	265	3	SS	1/600 mm	
		264	4	SS	0	
		263				
			5	SS	3	
		262				
6.05	BOREHOLE TERMINATED AT 6.05 m on refusal to auger on assumed bedrock	261				Upon completion of augering water at 0.8 m

BOREHOLE 22
GROUND ELEVATION: 268.21

Depth (m)	Description	Elevation	Sample No.	Type	N-Values	Remarks
0.10	TOPSOIL: dark brown sandy silt					
	SILT: dense brown and grey mottled silt, with silty fine sand layers, moist	267	1	SS	30	
1.40	with clayey silt layers		2	SS	17/150 mm/bouncing	
1.70		266				
1.85	SAND: dense stratified silty fine sand, saturated	265				
	BOREHOLE TERMINATED AT 1.85 m on refusal to auger on assumed bedrock	264				Upon completion of augering no free water

Depth scale: 1.5, 3.0, 4.5, 6.0 (Borehole 21); 1.5, 3.0, 4.5, 6.0 (Borehole 22, handwritten)

NOTES
■ Undrained shear strength based on pocket penetrometer test on recovered sample

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LOG OF BOREHOLE NO. 23 and 24

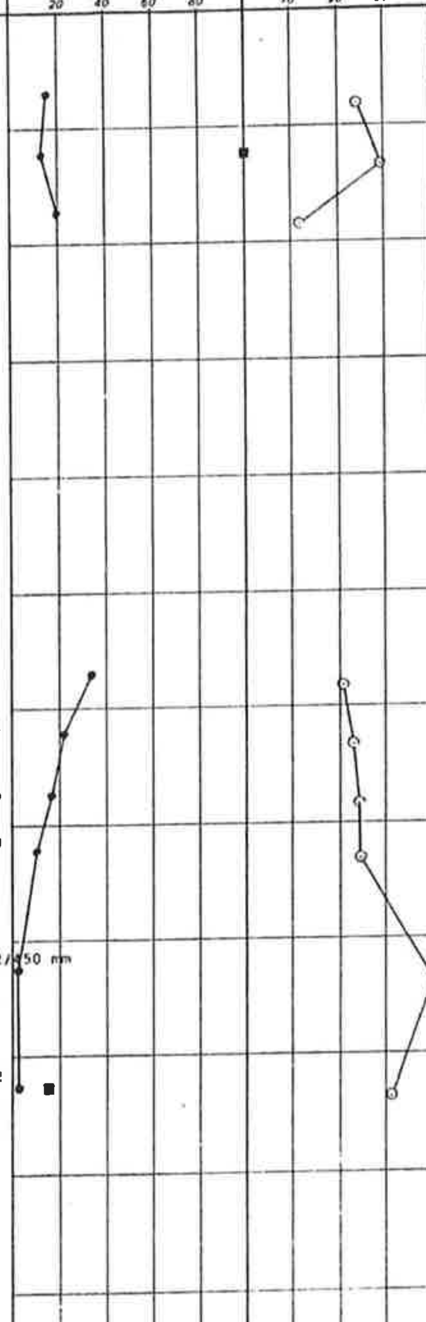
PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: NOV. 14/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SHEAR STRENGTH C_u kPa ● 25 50 75 100
DYNAMIC CONE PENETRATION ▪ / STANDARD PENETRATION TEST ● — BLOWS/0.3M 20 40 60 80
LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W — WATER CONTENT % 10 20 30

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 23 GROUND ELEVATION 266.56					
0.20	TOPSOIL: dark brown clayey silt	266				bentonite seal; 12 mm PVC pipe
0.60	SILT: brown silt to sandy silt		1	SS	16	
1.50	CLAYEY SILT: very stiff brown mottled grey clayey silt, varved, W.T.P.L.	265	2	SS	13	native backfill; sample wet after SS 1
2.40	stiff, grey, with rust mottling, with silt inclusions	264	3	SS	20	after SS 3 no free water inside augers
2.75	SILT: compact sandy silt, saturated	263				Upon completion of augering water at 2.1 m
	BOREHOLE TERMINATED AT 2.75 m on refusal to auger on assumed bedrock					
	BOREHOLE 24 GROUND ELEVATION: 265.64					
0.15	TOPSOIL: dark brown sandy silt	265				
	SILT: dense brown to grey mottled reddish brown fine sandy silt, moist		1	SS	34	
1.40	SAND: compact brown fine sand, stratified, with thin layers of silt, sandy silt, saturated	264	2	SS	22	sampler wet after SS 2
		263	3	SS	16	
		262	4	SS	10	
4.00	CLAY: very soft grey clay W.T.P.L. with layers of silt and fine sand, saturated	261	5	SS	2/450 mm	40%
		260				
6.55		259	6	SS	2	after SS 6 no free water inside augers
	BOREHOLE TERMINATED AT 6.55 m					Upon completion of augering water at 1.8 m seepage at 0.6 m

WATER LEVEL READINGS (Borehole 23)

DATE	DEPTH (m)
Nov. 15	0.51
Dec. 6	0.50



NOTES
■ Undrained shear strength based on pocket penetrometer test on recovered sample.

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LOG OF BOREHOLE NO. 25 and 26

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 11 & 14/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SHEAR STRENGTH C_u kPa ▲ 25 50 75 100
DYNAMIC CONE PENETRATION × / STANDARD PENETRATION TEST ● — BLOWS/0.3M 20 40 60 80
LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W; WATER CONTENT % 10 20 30

BOREHOLE 25 — GROUND ELEVATION 267.18

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: dark brown sandy silt					
0.90	SAND: loose brown fine sand, some silt, moist	266	1	SS	13	
1.50	CLAY: stiff greyish brown clay, with seams of fine sand	265	2	SS	2	sampler wet after SS 1 45%
	very soft, grey, W.T.P.L.	264	3	SS	0	
3.20	SILT: loose grey silt, dilatent, saturated	263	4	SS	7	
4.70	BOEHOLE TERMINATED AT 4.70 m on refusal to auger on assumed bedrock	262	5	SS	0/150 mm/bouncing	Upon completion of augering water at 0.4 m

BOREHOLE 26 — GROUND ELEVATION: 268.51

DEPTH in METRES	DESCRIPTION	ELEVATION	GROUND WATER OBSERVATIONS AND REMARKS
0.30	TOPSOIL:	268	no free water
	Auger refusal at 0.3 m hand dug to expose bedrock		

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 15, 30, 45, 60

NOTES
■ Undrained shear strength based on pocket penetrometer test on recovered sample

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LOG OF BOREHOLE NO. 27 and 28

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov.11 & 14/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

Column headings: SOIL PROFILE (DEPTH in METRES, DESCRIPTION, LEGEND, ELEVATION); SAMPLES (NUMBER, TYPE, BLOWS/0.3m N - VALUES); SHEAR STRENGTH C_u kPa ■ 25 50 75 100; DYNAMIC CONE PENETRATION ▪ STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80; LIQUID LIMIT — W_L, PLASTIC LIMIT — W_P, WATER CONTENT — W, W_P W W_L, WATER CONTENT % 10 20 30; GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 27
GROUND ELEVATION 266.63

Depth (m)	Description	Elevation	Number	Type	N-Values
0.10	TOPSOIL: dark brown sandy silt	266			
1.25	SILT: dense brown mottled grey silt, moist, to silt some clay	265	1	SS	41
	BOREHOLE TERMINATED AT 1.25 m on refusal to auger on assumed bedrock				

BOREHOLE 28
GROUND ELEVATION: 266.78

Depth (m)	Description	Elevation	Number	Type	N-Values
0.15	TOPSOIL: dark brown sandy silt				
0.60	SAND: compact rust brown to brown fine sand, some silt,	266			
1.00	moist		1	SS	18
1.50	saturated	265	2	SS	3
	stratified with clayey silt layers				
2.10	CLAY: soft grey clay, W.T.P.L. with layers of fine sand, saturated	264	3	SS	0
	very soft clay W.T.P.L.		4	SS	0
		263			
4.00	SILT: very loose grey dilatent silt, saturated	262	5	SS	2
5.50	BOREHOLE TERMINATED AT 5.50 m on refusal to auger on assumed bedrock	261			

Water content (Borehole 28, sample 2): 51%

GROUND WATER OBSERVATIONS AND REMARKS

Borehole 27:
sampler wet after SS 1
Upon completion of augering no free water

Borehole 28 (standpipes A, B):
bentonite seal
12 mm PVC pipe
native backfill

sampler wet after SS 1
Upon completion of augering water at 0.6 m

WATER LEVEL READINGS

DATE	DEPTH (m) A	DEPTH (m) B
Nov. 15	0.00	0.15
Dec. 6	0.00	0.00

NOTES
■ Undrained shear strength based on pocket penetromer test

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LOG OF BOREHOLE NO. 29 and 30

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov.11 & 14/94
OUR PROJECT NO. 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SHEAR STRENGTH C_u ▲ — DYNAMIC CONE PENETRATION × / STANDARD PENETRATION TEST ● — BLOWS/0.3M: 20, 40, 60, 80
LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W — WATER CONTENT %: 10, 20, 30

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 29 — GROUND ELEVATION 270.34						
0.15	TOPSOIL: dark brown sandy silt		270				
	Bedrock exposed at 0.15 m depth						
	BOREHOLE 30 — GROUND ELEVATION: 265.25						
0.20	TOPSOIL: dark brown sandy silt		265				bentonite seal
	SAND: compact brown stratified fine sand, moist, with seams of silt and clayey silt		264	1	SS	15	12 mm PVC pipe
1.40	LAYERED SILT AND CLAY: very stiff brown mottled grey layered silt, clayey silt and clay		263	2	SS	16	native backfill
2.10				3	SS	3/bouncing	
2.75	very loose dilatent silt, saturated		262				sampler wet after SS 2
	BOREHOLE TERMINATED AT 2.75 m on refusal to auger on assumed bedrock						Upon completion of augering no free water

Depth scale: 1.5, 3.0, 4.5, 6.0

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	1.45
Dec. 6	1.20

NOTES

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LOG OF BOREHOLE NO. 31 and 32

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 29, 1995
OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u ▲ | LIQUID LIMIT ——— W_L / PLASTIC LIMIT ——— W_P / WATER CONTENT ——— W | GROUND WATER OBSERVATIONS AND REMARKS

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M: 20 40 60 80
WATER CONTENT %: 10 20 30

BOREHOLE 31

GROUND ELEVATION 278.17

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES
0.15	TOPSOIL: Black silty sand	278			
0.60			1	SS	6
	SAND: loose reddish brown fine sand, trace silt, moist	277	2	SS	15
1.5	compact, brown fine sand, moist				
		276	3	SS	15
	grey, saturated		4	SS	20
3.0		275			
			5	SS	20
		274			
4.5					
5.00			6	SS	14
	BOREHOLE TERMINATED AT 5.00 m	273			
6.0					

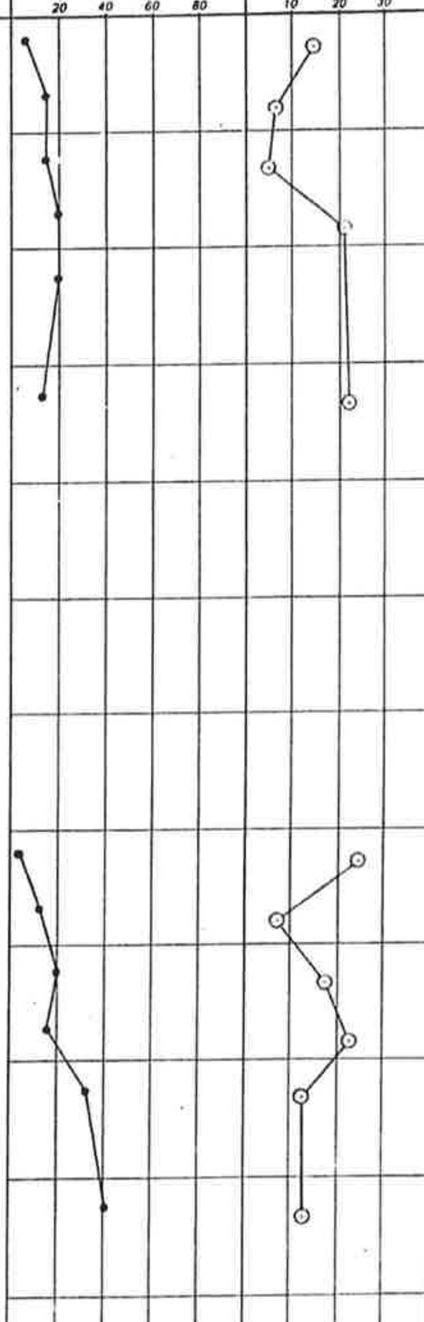
Upon completion of augering, wet cave at 1.8 m

BOREHOLE NO. 32

GROUND ELEVATION: 274.61

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES
0.15	TOPSOIL: Black silty sand				
0.70		274	1	SS	4
	SAND: loose reddish brown fine sand, trace silt, moist		2	SS	13
1.5	compact, brown fine sand, moist to saturated	273	3	SS	20
2.10	grey fine to medium sand, saturated	272	4	SS	17
3.0			5	SS	33
		271			
4.5		270	6	SS	41
5.00	BOREHOLE TERMINATED AT 5.00 m				

Upon completion of augering, cave at 2.1 m, free water at 1.7 m



NOTES

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LOG OF BOREHOLE NO. 33 and 34

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE April 27, 1995

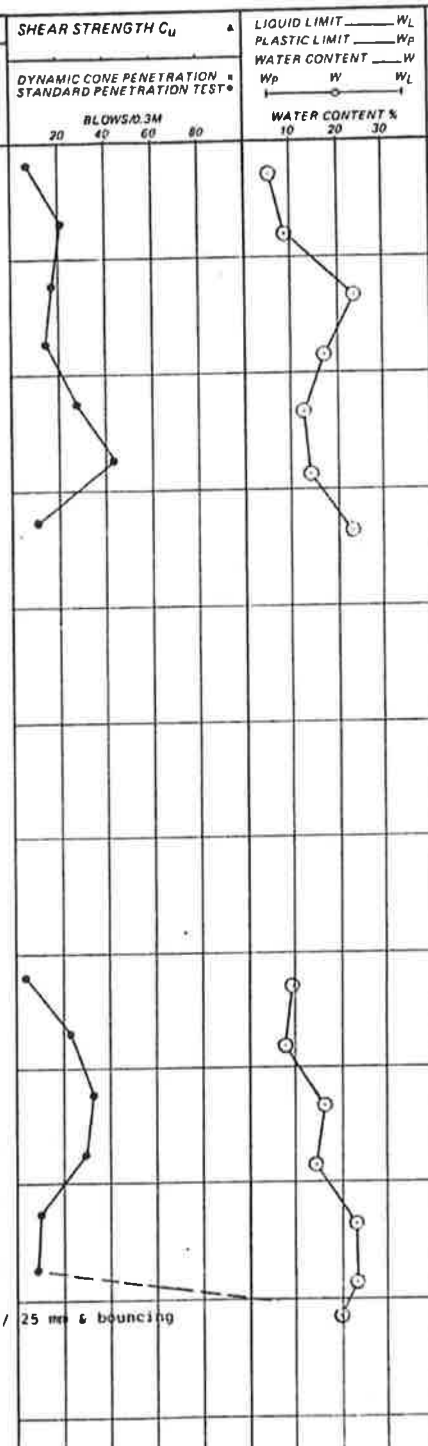
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN B.G.

BOREHOLE 33 — GROUND ELEVATION 274.19

DEPTH (metres)	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: Black silty sand	274				
0.60			1	SS	7	
	SAND: loose brown fine sand, moist	273	2	SS	21	
1.5	compact grey fine to medium sand saturated		3	SS	17	
		272				
	medium sand		4	SS	15	
3.0		271	5	SS	28	
			6	SS	44	
	dense	270				
4.5	compact fine sand		7	SS	12	Upon completion of augering, wet cave at 1.2 m
5.00	BOREHOLE TERMINATED AT 5.0 m	269				
6.0						

BOREHOLE NO. 34 — GROUND ELEVATION 274.24

DEPTH (metres)	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: Black silty sand	274	1	SS	4	
	SAND: loose to compact brown fine sand, moist	273	2	SS	23	
1.5 / 1.40	dense, grey fine to medium sand saturated		3	SS	33	
		272	4	SS	30	
2.90 / 3.0	compact grey fine sand	271	5	SS	10	
3.50	SILT: compact grey silt, dilatent, saturated, clay seams	270	6	SS	19	
4.5 / 4.70	BOREHOLE TERMINATED AT 4.70 m UPON REFUSAL TO SPLIT SPOON ON ASSUMED BEDROCK	269	7	SS	50/ 25 mm & bouncing	Upon completion of augering, wet cave at 1.3 m.
6.0						



NOTES

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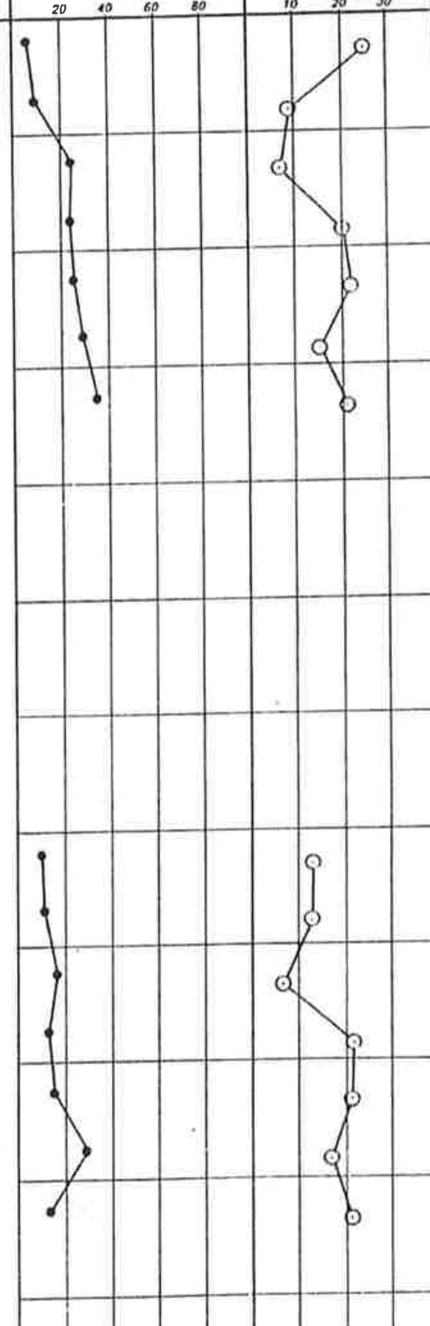
LOG OF BOREHOLE NO. 35 and 36

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Solid Stem Augers
BORING DATE: April 27, 1995
OUR PROJECT NO: 94BF053A
ENGINEER: TLB
TECHNICIAN: BG

SHEAR STRENGTH C_u ▲ — DYNAMIC CONE PENETRATION ■ / STANDARD PENETRATION TEST ● — BLOWS/0.3M 20 40 60 80
LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W; WATER CONTENT % 10 20 30



BOREHOLE 35 — GROUND ELEVATION 275.0

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.23	TOPSOIL: Black silty sand			1	SS	6
0.60	SAND: loose reddish brown silty fine sand, moist		274	2	SS	9
	loose to compact brown fine sand, moist		273	3	SS	23
2.10	compact grey fine to medium sand, saturated		272	4	SS	22
				5	SS	26
			271	6	SS	29
			270	7	SS	35
5.00	BOREHOLE TERMINATED AT 5.00 m					

GROUND WATER OBSERVATIONS AND REMARKS: Upon completion of augering, wet cave at 2.6 m

BOREHOLE NO. 36 — GROUND ELEVATION 274.61

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
	FILL: compact, dark grey fine sand, some gravel, moist		274	1	SS	10
				2	SS	11
1.40	SAND: compact, brown fine sand, moist		273	3	SS	17
2.10	grey, saturated		272	4	SS	13
			271	5	SS	16
				6	SS	29
	medium sand		270	7	SS	13
5.00	BOREHOLE TERMINATED AT 5.00 m		269			

GROUND WATER OBSERVATIONS AND REMARKS: Upon completion of augering, wet cave at 2.3 m.

Depth scale: 1.5, 3.0, 4.5, 6.0

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LOG OF BOREHOLE NO. 37 and 38

PROJECT Muskoka Medium Security Institution
OUR PROJECT NO. 84BF053A

LOCATION Gravenhurst, Ontario
BORING DATE April 28, 1995
ENGINEER TLB

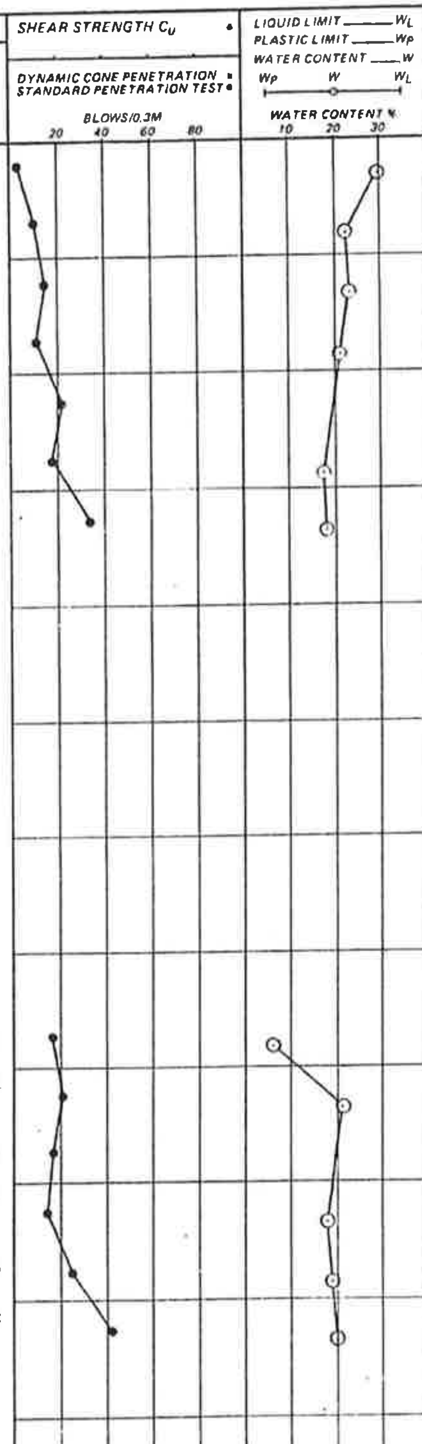
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN BG

BOREHOLE 37 — GROUND ELEVATION 272.16

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: black silty sand					
	SAND: loose to compact reddish brown to brown fine sand, moist		1	SS	4	
		271	2	SS	11	
1.5	grey saturated		3	SS	15	
2.10		270				
	fine to medium sand		4	SS	11	
3.0		269	5	SS	22	
3.70	medium sand	268	6	SS	18	
4.30	fine sand, dense					
4.5			7	SS	34	
5.00	BOREHOLE TERMINATED AT 5.00 m	267				Upon completion of augering cave at 1.4 m free water at 1.2 m
6.0						

BOREHOLE 38 — GROUND ELEVATION: 272.83

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: black silty sand		1	GS		
0.80		272				
	SAND: loose reddish brown fine sand, moist		2	SS	17	
1.5	compact grey, fine sand moist to saturated	271	3	SS	21	
2.10	compact fine to medium sand					
		270	4	SS	17	
3.0			5	SS	14	
		269				
			6	SS	25	
4.40	dense fine sand					
4.5		268	7	SS	42	
5.00	BOREHOLE TERMINATED AT 5.00 m					Upon completion of augering wet cave at 1.7 m
6.0						



NOTES

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LOG OF BOREHOLE NO. 39 and 40

OUR PROJECT NO 94BF053A

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 20&27, 1995 ENGINEER TLB
TECHNICIAN BG

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u | DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST (BLOWS/0.3M: 20, 40, 60, 80) | LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W (WATER CONTENT %: 10, 20, 30) | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 39

GROUND ELEVATION 271.64

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.23	TOPSOIL: Black silty sand	271	1	GS	
1.10	SAND: loose, reddish brown fine sand, very moist		2	SS	10
	compact brown fine/fine to medium sand, saturated	270	3	SS	14
	dense	269	4	SS	32
2.90	compact grey fine sand		5	SS	19
		268	6	SS	16
		267	7	SS	14
5.00	BOREHOLE TERMINATED AT 5.00 m	266			

Upon completion of augering, wet cave at 0.8 m.

BOREHOLE NO. 40

GROUND ELEVATION 274.08

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.23	TOPSOIL: Black silty sand		1	SS	3
0.60	SAND: loose, reddish brown fine sand, some silt, moist	273	2	SS	18
1.40	compact, brown fine sand		3	SS	30
	dense, grey fine to medium sand, saturated	272	4	SS	21
2.90	LAYERED CLAY AND SILT: stiff, grey layered silty clay, clayey silt, and silt, wet becoming predominantly dilatent silt and sandy silt saturated	271	5	SS	11
		270	6	SS	11
4.50	BOREHOLE TERMINATED AT 4.50 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK.	269			

native backfill
12 mm Ø CPVC

Upon completion of augering, wet cave at 1.1 m

Standpipe Readings	
May 8	1.25

NOTES

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 41

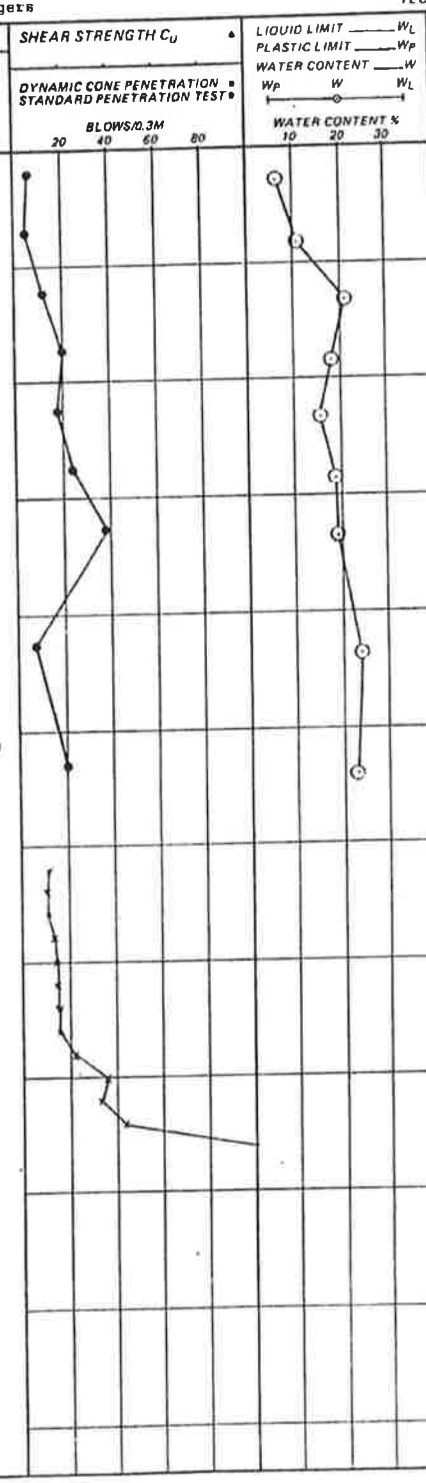
PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Solid and Hollow Stem Augers
BORING DATE: April 27, 1995
OUR PROJECT NO: 94BF053A
ENGINEER: TLB
TECHNICIAN: BG

GROUND ELEVATION: 273.34

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.30	TOPSOIL: Black silty sand	1	SS	6
	SAND: loose reddish brown to brown fine sand, moist	2	SS	5
1.50		3	SS	12
2.10	compact, grey, fine sand, saturated			
	compact grey fine to medium sand, saturated	4	SS	20
		5	SS	18
	medium sand	6	SS	24
4.40	fine to medium sand			
	dense fine sand	7	SS	38
	loose	8	SS	8
7.00	compact, medium sand	9	SS	20
9.10	Dynamic Cone Penetration Test			
12.90	CONE ENDED AT 12.90 m UPON REFUSAL ON ASSUMED BEDROCK.			

Elevations: 273, 272, 271, 270, 269, 268, 267, 266, 265, 264, 263, 262, 261, 260

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5



GROUND WATER OBSERVATIONS AND REMARKS

native backfill

12 mm Ø CPVC

After augering to 9.10 m, augers sanded in.

Upon completion of augering, cave at 2.1 m. Free water at 1.6 m.

Standpipe	Reading
May 8	1.55

NOTES

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LOG OF BOREHOLE NO. 42

PROJECT Muskoka Medium Security Institution

OUR PROJECT NO 94BF053A

LOCATION Gravenhurst, Ontario

BORING DATE April 20, 1995

ENGINEER TLB

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN BG

SOIL PROFILE

GROUND ELEVATION 272.44

DEPTH in METRES	DESCRIPTION
0.00	TOPSOIL: black silty sand with rootlets
0.60	SAND: loose, reddish brown fine sand, mosit
1.40	compact, brown fine sand, moist
	compact grey fine to medium sand, saturated
5.50	compact, grey fine sand
7.00	compact, grey silty fine sand with clay seams
8.60	medium sand, saturated
9.40	CLAY: stiff grey silty clay, W.T.P.L.
10.20	BOREHOLE TERMINATED AT 10.20 M UPON REFUSAL TO AUGER ON ASSUMED BEDROCK

ELEVATION: 272, 271, 270, 269, 268, 267, 266, 265, 264, 263, 262

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5

SAMPLES

NUMBER	TYPE	BLOWS/0.3m N – VALUES
1	SS	6
2	SS	13
3	SS	17
4	SS	34
5	SS	26
6	SS	14
7	SS	14
8	SS	15
9	SS	19
10	SS	12

SHEAR STRENGTH C_u •

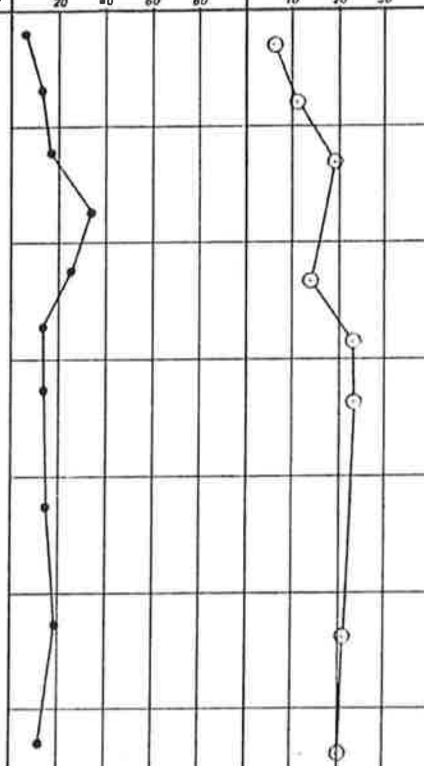
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •

BLOWS/0.3M: 20 40 60 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W

W_P W W_L

WATER CONTENT %: 10 20 30



GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering wet cave at 0.7 m

NOTES

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LOG OF BOREHOLE NO. 43 and 44

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE April 21, 1995

OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u kPa ● 25 50 75 100 | DYNAMIC CONE PENETRATION ■ | STANDARD PENETRATION TEST ● | BLOWS/0.3M 20 40 60 80 | LIQUID LIMIT —— W_L | PLASTIC LIMIT —— W_P | WATER CONTENT —— W | W_P W W_L | WATER CONTENT % 10 20 30 | GROUND WATER OBSERVATIONS AND REMARKS

DEPTH in METRES: 1.5, 3.0, 4.5, 6.0

BOREHOLE 43
GROUND ELEVATION 272.76

DEPTH	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.08	TOPSOIL: black silty sand with rootlets	272	1	SS	2	
	SAND: very loose to loose reddish brown fine sand, saturated		2	SS	6	
1.70	compact, brown/grey fine sand	271	3	SS	16	
		270	4	SS	13	
			5	SS	10	
3.70	LAYERED CLAY AND SILT: firm grey silty clay	269	6	SS	4	
				FV		
	becoming layered with clayey silt and silt	268	7	SS	18	
5.20	BOREHOLE TERMINATED AT 5.20 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	267				Upon completion of augering wet cave at 0.6 m

BOREHOLE 44
GROUND ELEVATION: 272.27

DEPTH	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.08	TOPSOIL: black silty sand with rootlets	272	1	SS	3	
0.70	SAND: very loose reddish brown fine sand, some silt, very moist	271	2	SS	39	
1.50	compact to dense, saturated		3	SS	24	
2.00	SILT: compact to grey silt, becoming clayey with clay seams	270				
	BOREHOLE TERMINATED AT 2.00 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	269				Upon completion of augering wet cave at 0.8 m

1.5
3.0

NOTES

Undrained shear strength based on insitu field vane test.
▲ Undisturbed value
△ Remoulded value

CHECKED BY [illegible]

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LOG OF BOREHOLE NO. 45

PROJECT Muskoka Medium Security Institution

LOCATION Gravenhurst, Ontario

BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE April 20, 1995

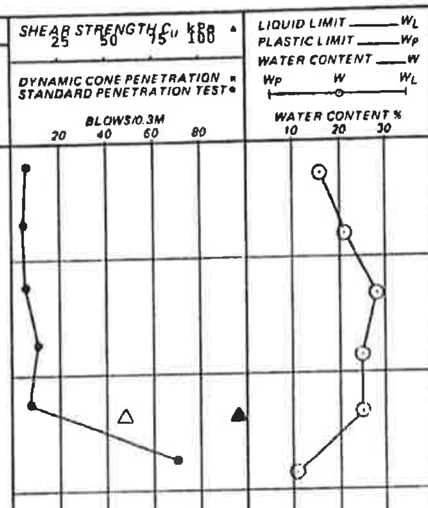
OUR PROJECT NO 94BF053A

ENGINEER TLB

TECHNICIAN BG

GROUND ELEVATION 272.48

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.10	TOPSOIL: black silty sand with rootlets	272	1	SS	6
	SAND: very loose to loose, reddish brown to brown fine sand, very moist to saturated		2	SS	5
1.5		271	3	SS	6
		270	4	SS	11
2.90 / 3.0	CLAY: stiff, grey silty clay low plastic, W.T.P.L.		5	SS	8
		269		FV	
4.00	SAND AND GRAVEL: very dense grey sand and gravel, saturated		6	SS	70
4.40 / 4.5		268			
	BOREHOLE TERMINATED AT 4.40 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK				
6.0					



GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering wet cave at 0.7 m

NOTES

Undrained shear strength based on insitu field vane test.

▲ Undisturbed value

△ Remoulded value

CHECKED BY

PetoMacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 46

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE April 20, 1995

OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 271.68

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.00	TOPSOIL: black silty sand					
		271	1	SS	4	
0.80	SAND: loose reddish brown fine sand, moist		2	SS	10	
1.5	compact brown to grey fine to medium sand, saturated	270	3	SS	23	
2.10		269	4	SS	20	
3.0	fine sand		5	SS	13	
		268				
			6	SS	6	
4.40	loose with clay seams					
4.5	LAYERED CLAY AND SAND: layered firm grey silty clay and loose fine sand	267	7	SS	7	
		266				
6.0	very stiff/compact		8	SS	23 (no recovery)	
		265				
7.20	BOREHOLE TERMINATED AT 7.20 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering wet cave at 0.9 m
7.5		264				
9.0						
10.5						
12.0						
13.5						
15.0						
16.5						

SHEAR STRENGTH C_u ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W
WATER CONTENT % 10 20 30

NOTES

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LOG OF BOREHOLE NO. 47

PROJECT: Muskoka Medium Security Institution
OUR PROJECT NO: 94BF053A
LOCATION: Gravenhurst, Ontario
BORING DATE: April 20, 1995
ENGINEER: TLB
BORING METHOD: Continuous Flight Solid Stem Augers
TECHNICIAN: BG

GROUND ELEVATION: 271.05

DEPTH (METRES)	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.15	TOPSOIL: black silty sand		1	SS	4
1.10	SAND: loose reddish brown to brown fine sand, saturated	270	2	SS	11
	compact grey fine sand	269	3	SS	18
		268	4	SS	16
		267	5	SS	12
		266	6	SS	8
		265	7	SS	8
	clay seams	264	8	SS	11
7.00	CLAY: firm, grey silty clay, medium plastic, W.T.P.L.	263	9	SS, FV	7
	stiff layered clay, clayey silt and silt, occasional sand seams	262, 261	10	SS	9
10.70	BOREHOLE TERMINATED AT 10.70 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	260			

SHEAR STRENGTH C_u kPa ▲ (25, 50, 75, 100)
DYNAMIC CONE PENETRATION ▪ / STANDARD PENETRATION TEST ● — BLOWS/0.3M (20, 40, 60, 80)
LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W — WATER CONTENT % (10, 20, 30)

Depth scale (metres): 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5

GROUND WATER OBSERVATIONS AND REMARKS: Upon completion of augering wet cave at 0.6 m

NOTES
Undrained shear strength based on insitu field vane test
▲ Undisturbed value
△ Remoulded value

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 48

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 28, 1995
OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 268.91

SOIL PROFILE

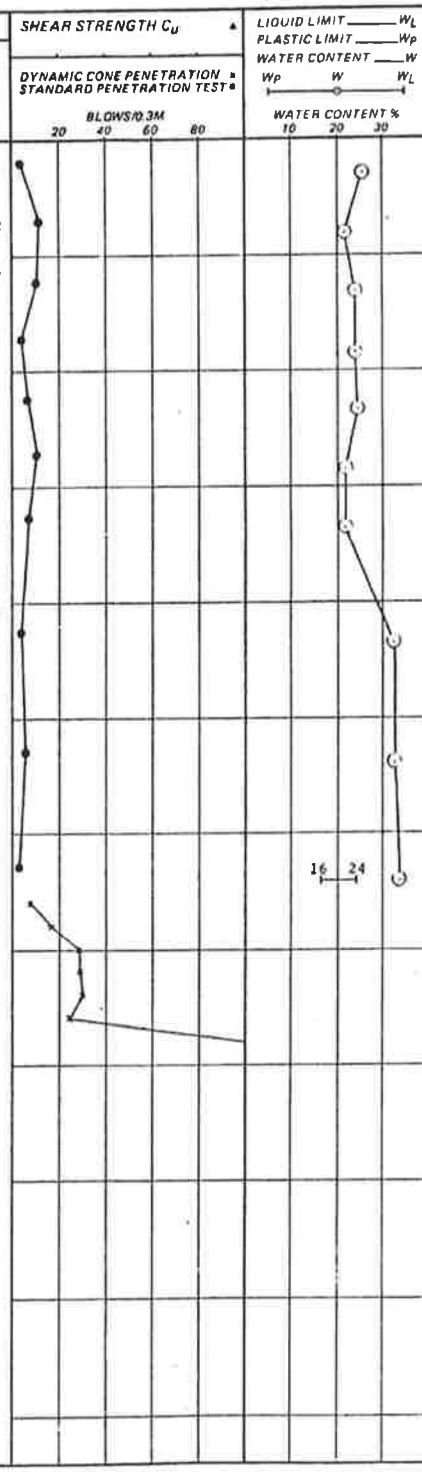
DEPTH in METRES	DESCRIPTION
0.18	TOPSOIL: black silty sand
	SAND: loose to compact brown fine sand, saturated
	grey
5.50	LAYERED CLAY AND SAND: layered soft grey silty clay and fine sand, saturated
7.00	CLAY: firm to soft grey silty clay, low to medium plastic W.T.P.L., sand seams
9.60	Dynamic Cone Penetration Test
12.00	CONE ENDED AT 12.00 m UPON REFUSAL ON ASSUMED BEDROCK

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5

Elevation: 268, 267, 266, 265, 264, 263, 262, 261, 260, 259, 258, 257, 256

SAMPLES

NUMBER	TYPE	BLOWS/0.3m N - VALUES
1	SS	4
2	SS	12
3	SS	10
4	SS	4
5	SS	7
6	SS	11
7	SS	7
8	SS	4
9	SS	6
10	SS	3



GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering wet cave at 0.4 m

NOTES

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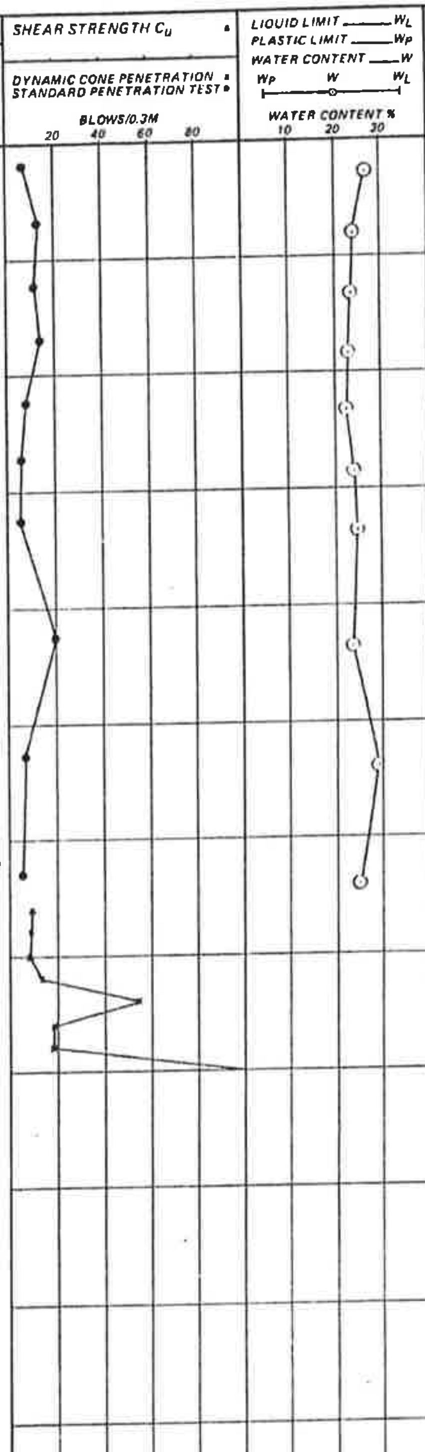
LOG OF BOREHOLE NO. 49

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 28, 1995
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 267.74

DEPTH IN METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: black silty sand		1	SS	7	
0.70		267				
	SAND: loose grey fine sand saturated		2	SS	14	
1.5		266	3	SS	12	
	compact brown to grey fine to medium sand, saturated	265	4	SS	14	
3.0	loose		5	SS	8	
		264	6	SS	6	
4.5	silty, occasional clay seams	263	7	SS	5	
		262				
6.0	compact		8	SS	20	
		261				
7.5		260	9	SS	7	
8.50	LAYERED CLAY AND SAND: Layered firm grey silty clay and silty sand, saturated	259				
9.0			10	SS	6	
9.60	Dynamic Cone Penetration Test	258				
10.5		257				
		256				
12.0 / 12.00	CONE ENDED AT 12.00 m UPON REFUSAL ON ASSUMED BEDROCK	255				Upon completion of augering wet cave at 0.4 m
13.5						
15.0						
16.5						



NOTES

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 50 and 51

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 29, 1995
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u • | DYNAMIC CONE PENETRATION ▸ / STANDARD PENETRATION TEST • (BLOWS/0.3M: 20, 40, 60, 80) | LIQUID LIMIT —— W_L / PLASTIC LIMIT —— W_P / WATER CONTENT —— W (W_P — W — W_L), WATER CONTENT % (10, 20, 30) | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 50
GROUND ELEVATION 264.17

DEPTH (METRES)	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: black silty sand	264	1	SS	11	
	SAND: compact reddish brown fine sand, silty to some silt, saturated	263	2	SS	16	
1.40	compact brown fine sand saturated		3	SS	12	
		262	4	SS	6	
	loose to very loose	261	5	SS	2	
		260	6	SS	8	
	compact		7	SS	11	
5.00	BOREHOLE TERMINATED AT 5.00 m	259				Upon completion of augering cave at 0.4 m free water at 0.2 m

BOREHOLE 51
GROUND ELEVATION: 272.40

DEPTH (METRES)	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.08	TOPSOIL: black silty sand with rootlets	272	1	SS	2	
0.90	SAND: very loose reddish brown fine sand, wet	271	2	SS	33	
1.50	compact brown	270				
	BOREHOLE TERMINATED AT 1.50 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering borehole open no free water

Depth scale: 1.5, 3.0, 4.5, 6.0 (Borehole 50); 1.5, 3.0, 4.5 (Borehole 51)

NOTES

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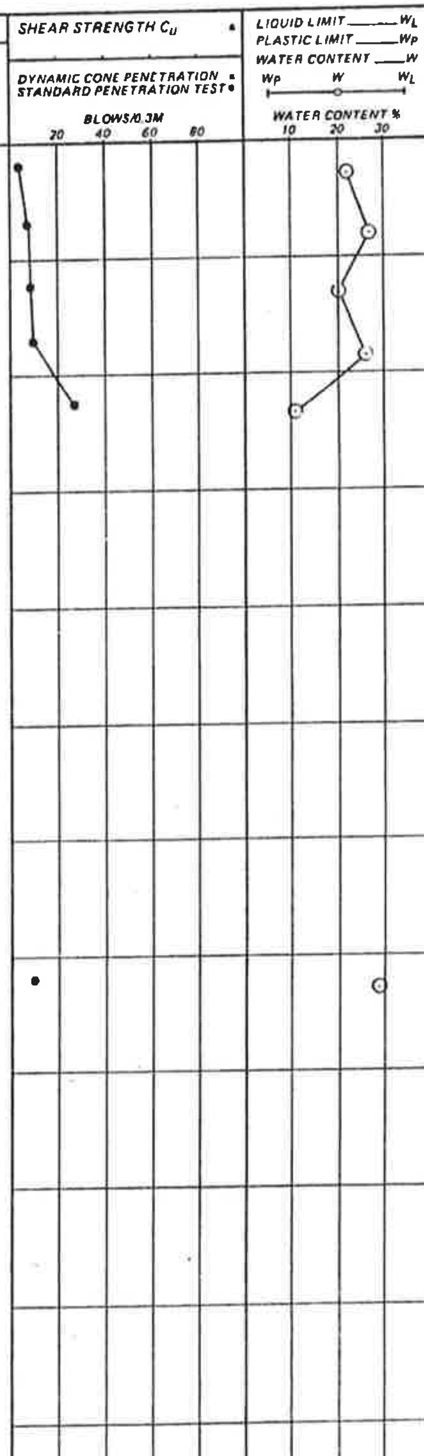
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 52 and 53

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 20/28,95
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

DEPTH IN METRES	SOIL PROFILE DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 52 GROUND ELEVATION 271.94					
0.00	TOPSOIL: black silty sand with rootlets		1	SS	4	
	SAND: loose reddish brown to brown fine sand, very moist to saturated	271	2	SS	8	
1.5		270	3	SS	9	
2.08	SILT: compact grey silt, clay seams, saturated, dilatent	269	4	SS	10	
3.0 / 3.30			5	SS	27	
3.50	SAND AND GRAVEL: Compact sand and gravel, saturated	268				
4.5	BOREHOLE TERMINATED AT 3.50 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering wet cave at 0.6 m
6.0						
	BOREHOLE 53 GROUND ELEVATION: 270.76					
0.35	TOPSOIL: black silty sand with rootlets	270	1	SS	10	
0.75	SAND: compact dark brown fine fine to medium sand, saturated					
1.5	BOREHOLE TERMINATED AT 0.75 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering borehole open water at surface
3.0						
4.5						



NOTES

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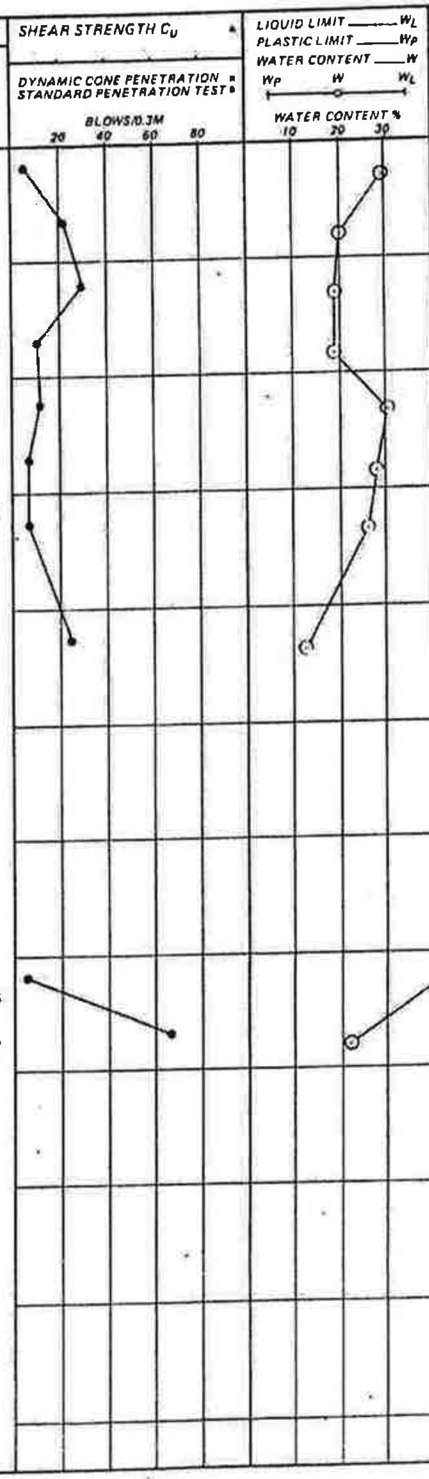
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 54 and 55

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE Apr.27&28/95
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 54 GROUND ELEVATION 270.13	270				
0.25	TOPSOIL: black silty sand with rootlets		1	SS	5	
	SAND: loose to compact brown fine sand, saturated	269	2	SS	22	
1.5			3	SS	30	
		268	4	SS	11	
3.0	becoming silty fine sand	267	5	SS	12	
		266	6	SS	7	
4.30 / 4.5	LAYERED CLAY AND SAND: layered firm grey silty clay and silty fine sand, saturated	265	7	SS	7	
6.0		264	8	SS	25	
6.40						
6.70	sand	263				
	BOREHOLE TERMINATED AT 6.70 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering wet cave at 0.6 m
	BOREHOLE 55 GROUND ELEVATION: 269.73					
0.15	TOPSOIL: black silty sand	269	1	SS	6	49%
1.20	SILT: loose brown sandy silt to very dense silt, very moist	268	2	SS	67	
	BOREHOLE TERMINATED AT 1.20 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering borehole open no free water



NOTES

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 56 and 57

OUR PROJECT NO. 94BF053A

PROJECT Muskoka Medium Security Institution

LOCATION Gravenhurst, Ontario

BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE Apr.21&28/95

ENGINEER TLB

TECHNICIAN BG

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 56 GROUND ELEVATION 267.79					
0.10	TOPSOIL: black silty sand with rootlets	267	1	SS	7	
0.70	SAND: loose dark brown silty sand, moist		2	SS	12	
1.5	compact to loose brown fine sand, some to trace silt, saturated	266	3	SS	5	
		265	4	SS	5	
3.0	clay seams		5	SS	5	
3.70	LAYERED CLAY AND SAND: layered soft grey silty clay and silty fine sand, saturated	264	6	SS	4	
4.40 / 4.5	CLAY: soft, grey silty clay, low plastic W.T.P.L., sand seams	263	7	SS	3	
		262				
6.10 / 6.0	BOREHOLE TERMINATED AT 6.10 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	261				Upon complation of augering wet cave at 1.2 m
	BOREHOLE 57 GROUND ELEVATION: 271.89					
0.20	TOPSOIL: black silty sand with rootlets		1	SS	3	
0.80	SAND: loose reddish brown fine sand, wet	271				
1.5	BOREHOLE TERMINATED AT 0.80 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering borehole open no free water
3.0						
4.5						

SHEAR STRENGTH C_u ●

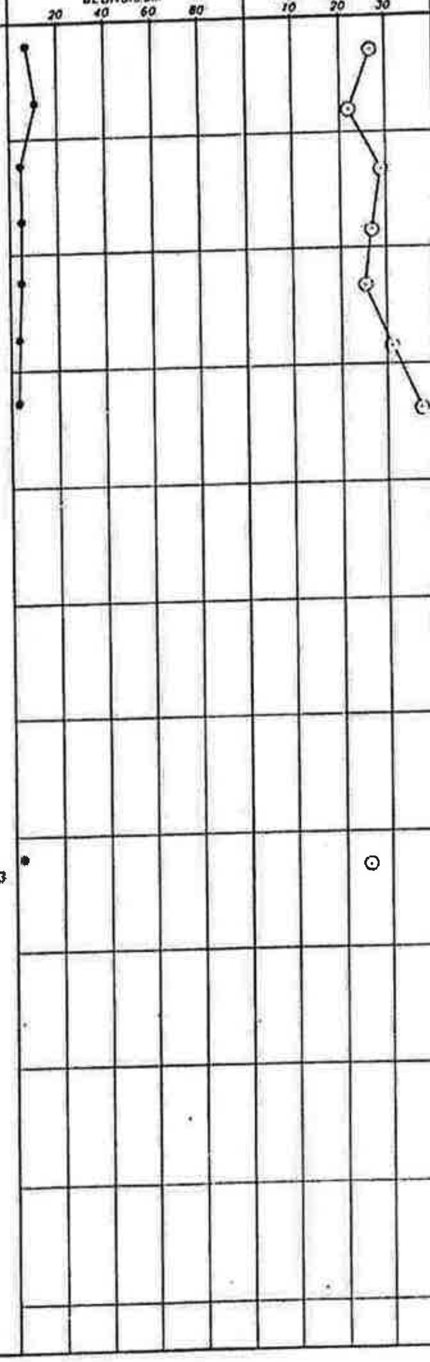
DYNAMIC CONE PENETRATION ● STANDARD PENETRATION TEST ●

BLOWS/0.3M 20 40 60 80

LIQUID LIMIT —— W_L PLASTIC LIMIT —— W_P WATER CONTENT —— W

W_P W W_L

WATER CONTENT % 10 20 30



NOTES

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 58 and 59

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE Apr. 20&24/95
OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u | DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST • BLOWS/0.3M 20 40 60 80 | LIQUID LIMIT — W_L, PLASTIC LIMIT — W_P, WATER CONTENT — W; WATER CONTENT % 10 20 30 | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 58
GROUND ELEVATION 271.81

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
	BEDROCK: at ground surface	271			

BOREHOLE 59
GROUND ELEVATION: 271.65

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.18	TOPSOIL: black silty sand	271	1	SS	2
0.90	SAND: very loose reddish brown fine sand, trace silt		2	SS	20
1.40	compact brown fine sand, saturated	270	3	SS	14
2.10	SILT: compact grey silt, clay seams, saturated, dilatent	269	4	SS	50/100 mm
2.50	SAND AND GRAVEL: grey, silty saturated	268			

BOREHOLE TERMINATED AT 2.50 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK

Upon completion of augering wet cave at 0.6 m

NOTES

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PetoMacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 60 and 61

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE Apr. 28&29/95
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 60 GROUND ELEVATION 271.56					
0.10	TOPSOIL: black silty sand	271	1	SS	4	
0.70	SAND: loose reddish brown fine sand, some silt, wet		2	SS	38	
		270	3	SS	14	
	SILT: dense mottled brown/ grey silt, moist, becoming compact with clayey silt and silty clay seams					
2.10		269	4	SS	20/150 mm then refusal	
2.70	SAND: dense, grey saturated					
		268				
	BOREHOLE TERMINATED AT 2.70 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering cave at 1.2 m free water at 0.6 m
	BOREHOLE 61 GROUND ELEVATION: 269.71					
0.15	TOPSOIL: black silty sand	269	1	SS	4	
0.70	SAND: loose, reddish brown fine sand, wet		2	SS	22	
	compact brown to grey fine sand, saturated	268	3	SS	17	
		267	4	SS	17	
	loose to compact		5	SS	5	
		266	6	SS	10	
	silty, occasional clay seams	265	7	SS	9	
5.30	LAYERED CLAY AND SAND: layered stiff/compact, grey silty clay and fine sand, saturated	264				
			8	SS	15	
		263				
	becoming firm/loose	262	9	SS	7	
		261				
9.50	becoming layered silt with clay seams		10	SS	16/150 mm then refusal	
		260				
	BOREHOLE TERMINATED AT 9.50 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering cave at 1.8 m free water at 0.2 m

SHEAR STRENGTH C_U ▲
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT —— W_L
PLASTIC LIMIT —— W_P
WATER CONTENT —— W
WATER CONTENT % 10 20 30

NOTES

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LOG OF BOREHOLE NO. 62 and 63

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Solid Stem Augers
BORING DATE: Apr. 28 & 29/95
OUR PROJECT NO. 94BF053A
ENGINEER: TLB
TECHNICIAN: BG

Column headings: SOIL PROFILE (DEPTH in METRES; DESCRIPTION; LEGEND; ELEVATION) | SAMPLES (NUMBER; TYPE; BLOWS/0.3m N-VALUES) | SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST (BLOWS/0.3M 20 40 60 80) | LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (WATER CONTENT % 10 20 30) | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 62

GROUND ELEVATION 269.54

Depth (m)	Description	Elevation	Sample No.	Type	N-Value
0.13	TOPSOIL: black silty sand	269	1	SS	2
0.60	SAND: very loose, reddish brown fine sand some silt, saturated		2	SS	42
	dense to compact, brown fine sand, saturated occasional clay seams	268	3	SS	18
		267	4	SS	11
			5	SS	10
3.60	CLAY: soft, grey silty clay, occasional sand and silt seams low plastic, W.T.P.L.	266	6	SS	4
4.40	LAYERED SILT: layered compact grey silt, clayey silt, with clay seams, wet	265	7	SS	11
5.20		264			

BOREHOLE TERMINATED AT 5.20 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK

Upon completion of augering cave at 2.1 m free water at 0.1 m

BOREHOLE 63

GROUND EELVATION: 269.66

Depth (m)	Description	Elevation	Sample No.	Type	N-Value
0.15	TOPSOIL: black silty sand	269	1	SS	10
0.60	SAND: compact, reddish brown fine sand, wet		2	SS	12
		268	3	SS	28
	SILT: compact mottled brown/grey sandy silt and silt, wet becoming very stiff clayey silt				
2.60		267	4	SS	10/150 mm then refusal
		266			

BOREHOLE TERMINATED AT 2.60 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK

Upon completion of augering cave at 2.1 m free water at 0.9 m

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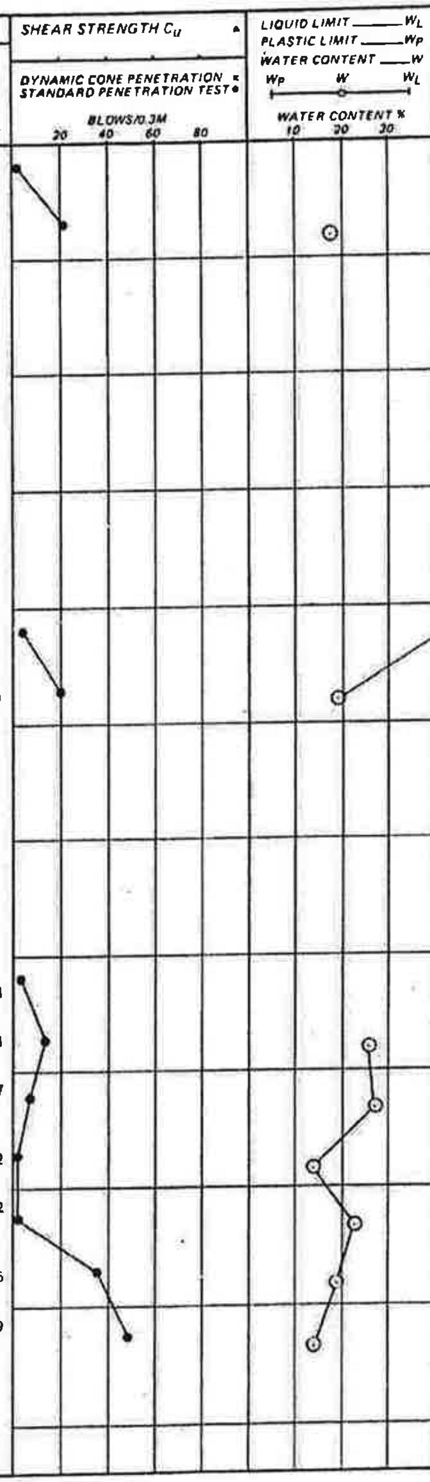
LOG OF BOREHOLE NO. 64, 65 and 66

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Solid Stem Augers
BORING DATE: Apr. 28 & 29/95
OUR PROJECT NO.: 94BF053A
ENGINEER: TLB
TECHNICIAN: BG

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 64 — GROUND ELEVATION 271.11					
0.13	TOPSOIL: black silty sand		1	SS	2	
	SAND: very loose to compact reddish brown fine sand, some silt, very moist to saturated	270	2	SS	21	
1.40		269				
	BOREHOLE TERMINATED AT 1.40 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering wet cave at 0.6 m
	BOREHOLE 65 — GROUND ELEVATION: 269.35					
0.15	TOPSOIL: black silty sand	269	1	SS	4	
0.60	SAND: loose reddish brown silty fine sand, wet		2	SS	20	
1.40	SILT: loose to compact brown silt, moist	268				
		267				
	BOREHOLE TERMINATED AT 1.40 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering borehole open no free water
	BOREHOLE 66 — GROUND ELEVATION: 267.29					
0.25	TOPSOIL: black silty sand	267	1	SS	4	
	SAND: loose brown fine sand, some silt, very mosit compact, with clay seems	266	2	SS	14	
1.40	CLAY: firm to soft grey silty clay, low plastic, W.T.P.L.		3	SS	7	
		265	4	SS	2	
		264	5	SS	2	
3.70	SILT: dense grey silt, clay seams, dilatent, saturated	263	6	SS	35	
4.30	SAND: very dense grey silty fine sand, silt seams saturated		7	SS	49	
5.00		262				
	BOREHOLE TERMINATED AT 5.00 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering cave at 3.0 m free water at 1.2 m



NOTES

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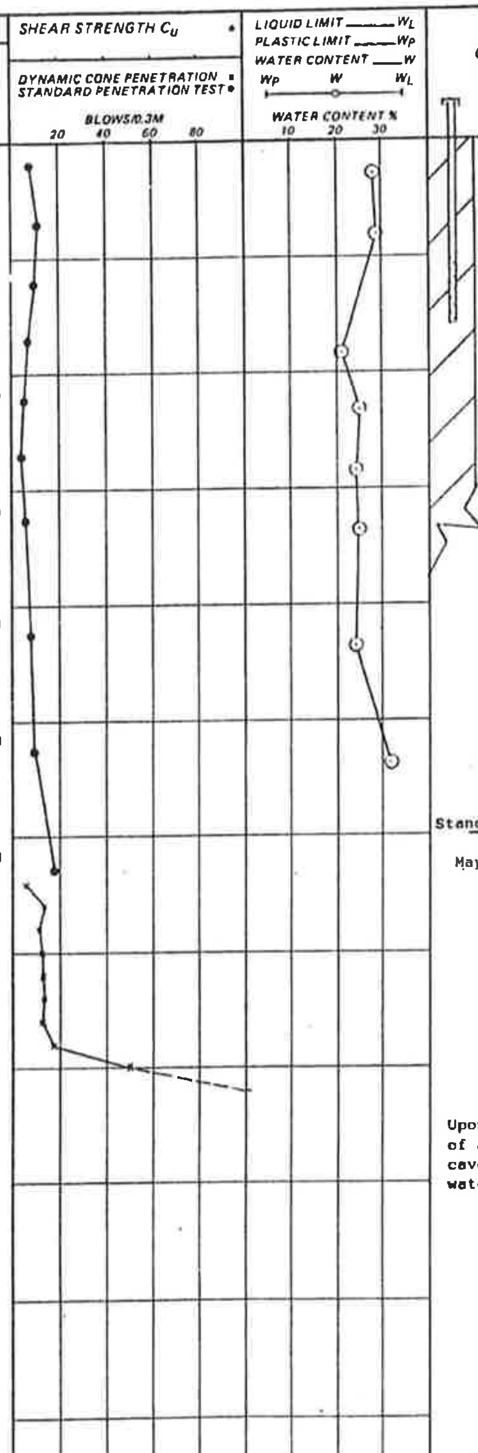
LOG OF BOREHOLE NO. 67

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 25, 1995
OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 265.69

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.36	TOPSOIL: peaty silty sand				
	SAND: loose to compact brown fine sand, saturated	265	1	SS	8
			2	SS	12
1.5		264	3	SS	10
2.10	loose				
		263	4	SS	7
3.0			5	SS	6
		262			
			6	SS	4
4.5		261	7	SS	6
		260			
6.0			8	SS	8
		259			
7.00	compact, grey silty fine sand, with clay seams saturated				
7.5		258	9	SS	10
		257			
9.0			10	SS	18
9.60	Dynamic Cone Penetration Test	256			
10.5		255			
		254			
12.0					
12.50	CONE ENDED AT 12.50 m UPON REFUSAL ON ASSUMED BEDROCK	253			
13.5					
15.0					
16.5					



GROUND WATER OBSERVATIONS AND REMARKS

12 mm ø PVC

native backfill

Standpipe Readings

May 8	0.00

Upon completion of augering cave at 0.7 m water at surface

NOTES

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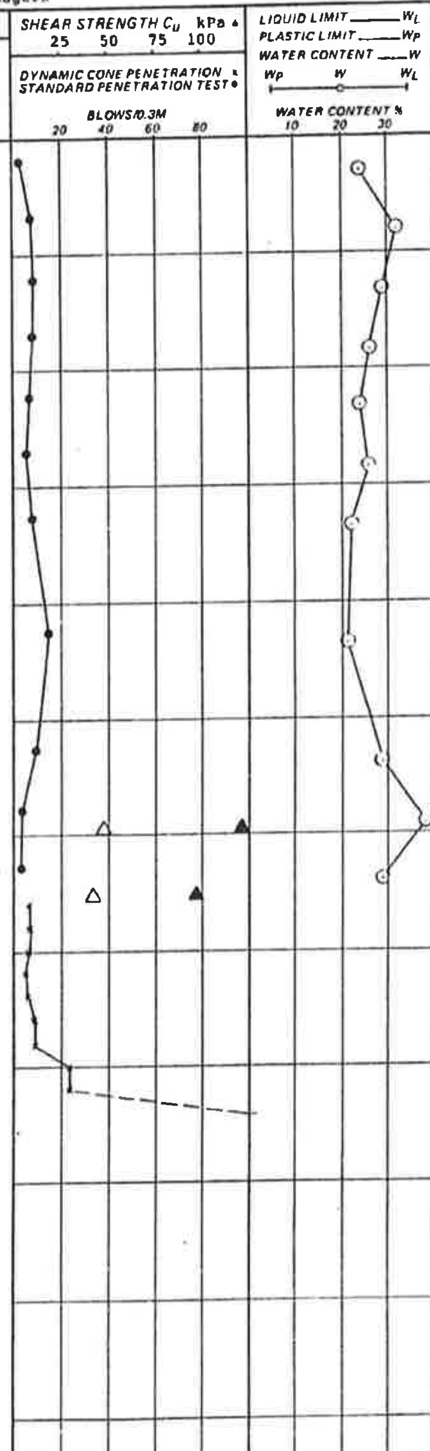
LOG OF BOREHOLE NO. 6B

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid and Hollow Stem Augers
BORING DATE April 25, 1995
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 264.23

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.20	TOPSOIL: black silty sand	264			
	SAND: loose brown to grey fine sand, saturated trace silt		1	SS	3
		263	2	SS	8
1.5			3	SS	9
		262			
			4	SS	8
3.0		261	5	SS	7
		260	6	SS	6
4.5			7	SS	8
		259			
6.0	compact	258	8	SS	15
		257			
7.5	with clay layers		9	SS	9
8.20		256			
	CLAY: soft grey silty clay low plastic, W.T.P.L. with sand seams/layers		10	SS	4
				FV	
9.0		255	11	SS	3
				FV	
10.05		254			
10.5	Dynamic Cone Penetration Test				
		253			
12.0		252			
12.80	CONE ENDED AT 12.80 m UPON REFUSAL ON ASSUMED BEDROCK				
13.5					
15.0					
16.5					



GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering
cave at 0.6 m
water at surface

NOTES

Undrained shear strength based on insitu field vane test.
▲ Undisturbed value.
△ Remoulded value.

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LOG OF BOREHOLE NO. 69

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Solid Stem Augers
BORING DATE: April 24 & 25/95
OUR PROJECT NO: 94BF053A
ENGINEER: TLB
TECHNICIAN: BG

GROUND ELEVATION: 265.32

DEPTH (m)	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	WATER CONTENT / LIMITS	GROUND WATER OBSERVATIONS AND REMARKS
0.20	TOPSOIL: black silty sand	265					
	SAND: loose, brown/grey fine sand, saturated		1	SS	6		
		264	2	SS	6		
			3	SS	8		
		263	4	SS	4		
		262	5	SS	4		
		261	6	SS	15		
			7	SS	9		
		260					
5.50	CLAY: firm, grey silty clay, medium plastic, W.T.P.L. with sand layers	259	8	SS	6	Wp 21, WL 43, w 42	
				FV			
		258					
	occasional sand seams		9	SS	4	Wp 16, WL 23	
		257					
	with sand and silt layers	256	10	TW	PM		
9.80	BOREHOLE TERMINATED AT 9.80 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	255					Upon completion of augering cave at 0.6 m water at surface

SHEAR STRENGTH C_u kPa: 25, 50, 75, 100
DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST — BLOWS/0.3M: 20, 40, 60, 80
LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W — WATER CONTENT %: 10, 20, 30

NOTES
Undrained shear strength based on insitu field vane test
▲ Undisturbed value
△ Remoulded value

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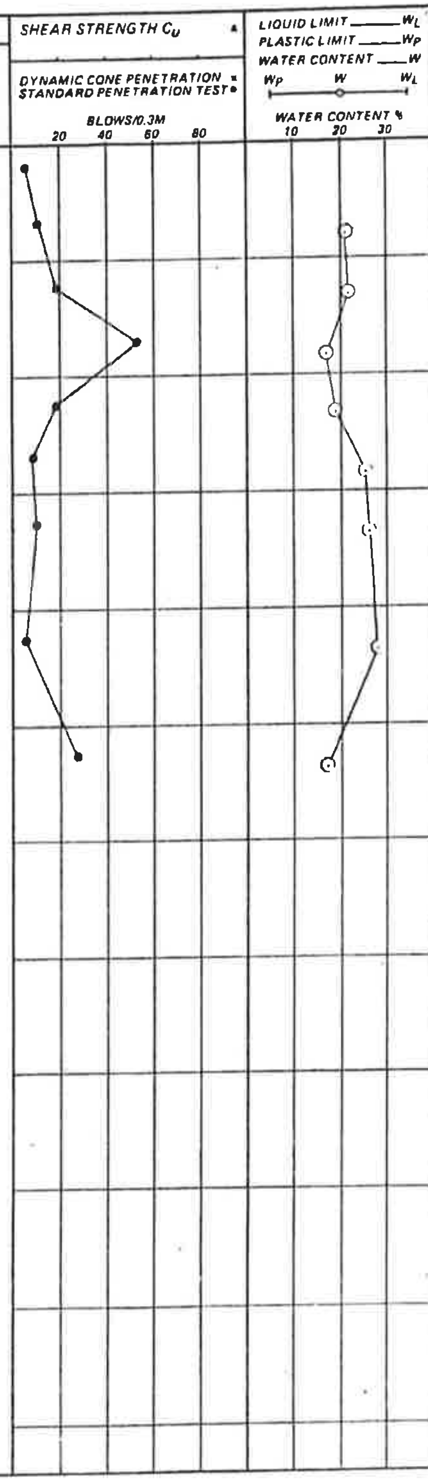
LOG OF BOREHOLE NO. 70

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 29, 1995
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 268.68

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.13	TOPSOIL: black silty sand					
0.70	SAND: loose brown fine sand, saturated	268	1	SS	6	
			2	SS	11	
1.5	compact brown fine to medium/ fine sand, saturated	267	3	SS	19	
	grey, very dense	266	4	SS	53	
3.0			5	SS	18	
		265				
			6	SS	8	
4.5	silty fine sand	264	7	SS	10	
5.50	LAYERED SILT: layered firm/ loose grey silty clay, clayey silt and silt,	263				
6.0			8	SS	6	
		262				
7.5	becoming compact silt, saturated dilatent occasional clay seams	261	9	SS	27	
		260				
8.80	BOREHOLE TERMINATED AT 8.80 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	259				Upon completion of augering cave at 0.8 m free water at 0.3 m
10.5						
12.0						
13.5						
15.0						
16.5						



NOTES

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LOG OF BOREHOLE NO. 71

PROJECT Muskoka Medium Security Institution

LOCATION Gravenhurst, Ontario

BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE April 29, 1995

OUR PROJECT NO 94BF053A

ENGINEER TLB

TECHNICIAN BG

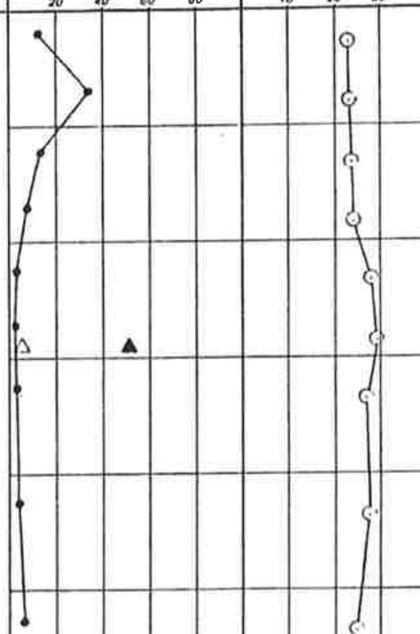
GROUND ELEVATION 268.37

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N – VALUES
0.20	TOPSOIL: black silty sand	268			
0.60	SAND: compact reddish brown fine sand, saturated		1	SS	13
		267	2	SS	34
	dense to compact, brown to grey fine sand		3	SS	13
		266	4	SS	7
	loose	265	5	SS	3
3.70	CLAY: soft grey silty clay with sand layers	264	6	SS	2
				FV	
		263	7	SS	3
	silty clay with silt seams	262	8	SS	4
		261			
7.80	SILT: loose layered silt, with clay seams, saturated	260	9	SS	7
8.85	BOREHOLE TERMINATED AT 8.85 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	259			

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5

SHEAR STRENGTH C_u kPa ▲ 25 50 75 100
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W
W_P W W_L
WATER CONTENT % 10 20 30



GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering
cave at 1.0 m
water at surface

NOTES

Undrained shear strength based on insitu field vane tests
▲ Undisturbed value
△ Remoulded value

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LOG OF BOREHOLE NO. 72

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 29, 1995
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 268.52

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: black silty sand	268	1	SS	5	43%
0.70	SAND: loose, reddish brown fine sand, some silt, very moist		2	SS	12	
1.5		267	3	SS	7	
	compact to loose brown to grey fine sand, saturated	266	4	SS	3	
	clay seams					
3.0 / 3.30		265	5	SS	26	
3.50	SILT: compact silt, moist					
4.5	BOREHOLE TERMINATED AT 3.50 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	264				Upon completion of augering wet cave at 0.4 m

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5

SHEAR STRENGTH C_u ▲
DYNAMIC CONE PENETRATION ■
STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT —— W_L
PLASTIC LIMIT —— W_P
WATER CONTENT —— W
W_P W W_L
WATER CONTENT % 10 20 30

NOTES

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LOG OF BOREHOLE NO. 73

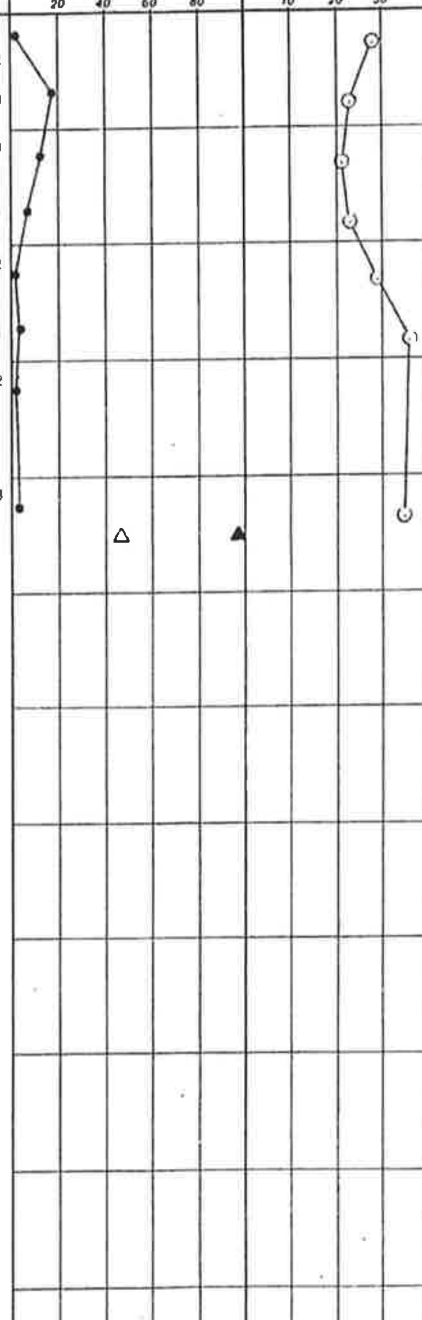
PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid .and Hollow Stem Augers
BORING DATE April 24, 1995
OUR PROJECT NO. 84BF053A
ENGINEER TLB
TECHNICIAN BG

DEPTH in METRES	SOIL PROFILE – DESCRIPTION (GROUND ELEVATION 266.50)	ELEVATION	SAMPLES NUMBER	TYPE	BLOWS/0.3m N – VALUES	GROUND WATER OBSERVATIONS AND REMARKS
~~0.10~~	TOPSOIL: black silty sand	266	1	SS	2	
0.80	SAND: very loose reddish brown fine sand, wet		2	SS	18	
	compact brown fine sand, saturated	265	3	SS	13	
	loose	264	4	SS	7	
2.90	very loose, grey silty fine sand with clay layers, saturated		5	SS	2	
		263	6	SS	4	
		262	7	SS	2	
~~5.50~~	CLAY: soft, grey silty clay, low to medium plastic W.T.P.L. occasional sand seams	261				
		260	8	SS	3	
				FV		
		259				
~~8.20~~	BOREHOLE TERMINATED AT 8.20 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	258				Upon completion of augering wet cave at 0.6 m

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5

SHEAR STRENGTH C_u kPa ▲ 25 50 75 100
DYNAMIC CONE PENETRATION ■
STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT —— W_L
PLASTIC LIMIT —— W_P
WATER CONTENT —— W
W_P W W_L
WATER CONTENT % 10 20 30



NOTES
Undrained shear strength based on insitu field vane tests.
▲ Undisturbed value
△ Remoulded value

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LOG OF BOREHOLE NO. 74

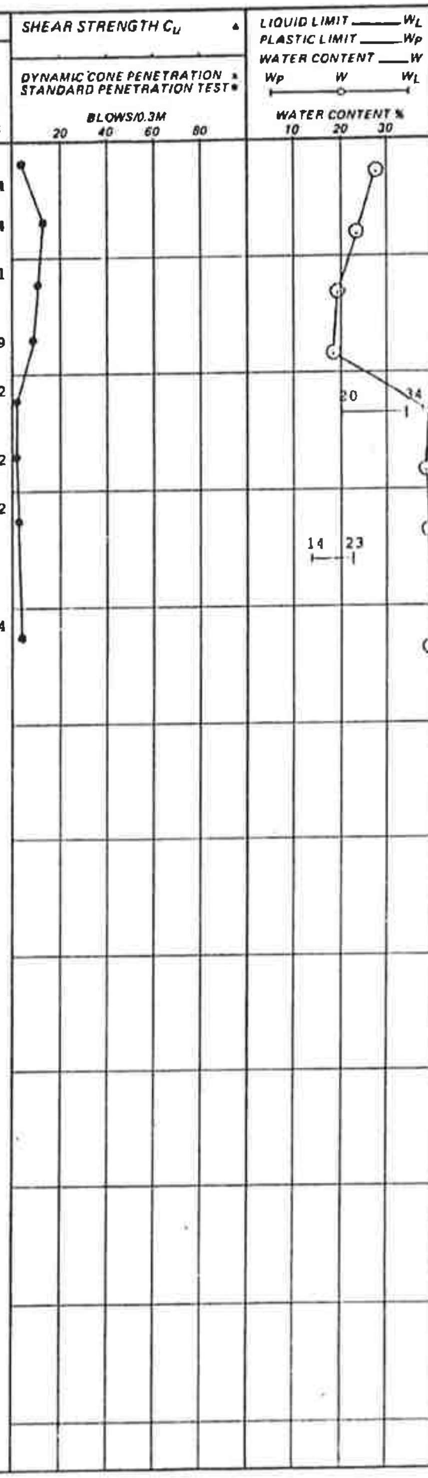
PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 27, 1995
OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 264.[illegible]3

Depth (m)	Description	Elevation
[illegible]	TOPSOIL: black silty sand	264
	SAND: loose to compact reddish brown fine sand, saturated	263
1.40 / 2.10	with clay layers	262
2.90	loose, grey silty sand, saturated	261
	CLAY: soft, grey silty clay, low to medium plastic, W.T.P.L.	260, 259, 258
7.00	BOREHOLE TERMINATED AT 7.00 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	257

SAMPLES

Number	Type	Blows/0.3m N-Values
1	SS	4
2	SS	14
3	SS	11
4	SS	9
5	SS	2
6	SS	2
7	SS	2
7A	TW	
8	SS	4



DEPTH IN METRES: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5

GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering wet cave at 0.8 m

NOTES

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LOG OF BOREHOLE NO. 75

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 26, 1995
OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 266.36

DEPTH in METRES	DESCRIPTION	ELEVATION
0.23	TOPSOIL: black silty sand	266
	SAND: loose to compact reddish brown fine sand, saturated; brown	265, 264, 263, 262, 261
5.50	LAYERED CLAY AND SAND: layered firm grey silty clay and silty fine sand, saturated	260
7.00	CLAY: soft grey silty clay with sand seams, low plastic, W.T.P.L.	259, 258, 257, 256
11.20	BOREHOLE TERMINATED AT 11.20 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	255

SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	REMARKS
1	SS	8	
2	SS	12	
3	SS	20	
4	SS	9	(no recovery)
5	SS	14	
6	SS	6	
7	SS	4	
8	SS	6	
9	SS	4	
9A	TW	PM	W_P 15, W_L 24
10	SS		(no recovery)

Depth scale (metres): 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5

SHEAR STRENGTH C_u ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M: 20, 40, 60, 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W
WATER CONTENT %: 10, 20, 30

GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering
cave at 5.2 m
free water at 0.8 m

NOTES

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LOG OF BOREHOLE NO. 76 and 77

PROJECT Muskoka Medium Security Institution

LOCATION Gravenhurst, Ontario

BORING METHOD Continuous Flight Solid Stem Augers

BORING DATE April 29, 1995

OUR PROJECT NO 94BF053A

ENGINEER TLB

TECHNICIAN BG

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	WATER CONTENT % (approx.)	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 76 GROUND ELEVATION 268.50						
0.15	TOPSOIL: black silty sand	268	1	SS	8		
0.60	SAND: loose brown medium sand, saturated	267	2	SS	15		
			3	SS	4		
2.10	compact to loose, brown to grey fine sand, saturated	266	4	SS	3		
	CLAY: soft, grey silty clay low to medium plastic W.T.P.L. sand seams	265	5	SS	14/300 mm then refusal		
3.50	becoming layered silty clay clayey silt and silt, saturated						
	BOREHOLE TERMINATED AT 3.50 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK						Upon completion of augering wet cave at 0.5 m
	BOREHOLE 77 GROUND ELEVATION: 268.83						
0.10 / 0.30	TOPSOIL: black silty sand	268					no free water
	SAND: brown fine sand						
	Bedrock or possible boulder						

Depth scale: 1.5, 3.0, 4.5, 6.0

Chart headings: SHEAR STRENGTH C_u ▲; DYNAMIC CONE PENETRATION ■; STANDARD PENETRATION TEST ●; BLOWS/0.3M 20 40 60 80; LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W; WATER CONTENT % 10 20 30

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 78 and 79

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 29, 1995
OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

DEPTH in METRES	SOIL PROFILE DESCRIPTION	LEGEND	ELEVATION	SAMPLES NUMBER	TYPE	BLOWS/0.3m N-VALUES	SHEAR STRENGTH C_u ▲ / DYNAMIC CONE PENETRATION ■ / STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT — W_L / PLASTIC LIMIT — W_P / WATER CONTENT — W (W_P W W_L) WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 78								
	GROUND ELEVATION 270.62								
0.10	TOPSOIL: black silty sand								no free water
0.30	SAND: brown fine sand		270						
1.5									
	Bedrock								
	BOREHOLE 79								
	GROUND ELEVATION: 270.41								
0.05	TOPSOIL: black silty sand		270						no free water
	Bedrock								
1.5									

NOTES

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 80 and 81

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Solid Stem Augers
BORING DATE: April 27, 1995
OUR PROJECT NO: 94BF053A
ENGINEER: TLB
TECHNICIAN: BG

BOREHOLE 80

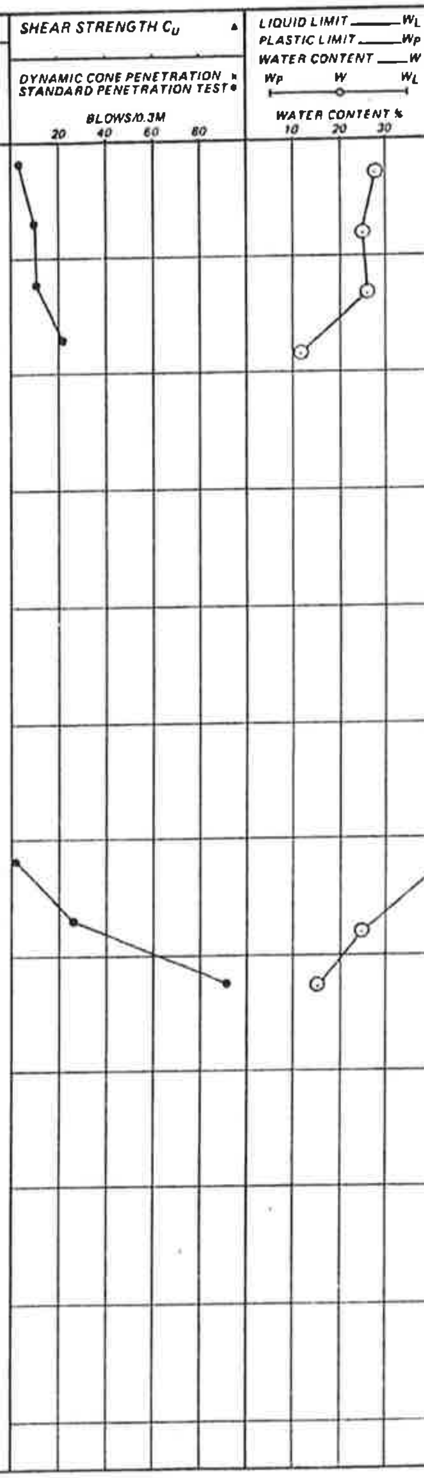
GROUND ELEVATION: 267.44

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20	TOPSOIL: black silty sand	267	1	SS	4	
0.60	SAND: loose brown fine sand, wet	266	2	SS	10	
	LAYERED SILT AND SAND: Compact brown layered silt and silty fine sand, wet with clayey silt layers, saturated	265	3	SS	11	
2.70			4	SS	22	
	BOREHOLE TERMINATED AT 2.70 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	264				Upon completion of augering wet cave at 2.1 m

BOREHOLE 81

GROUND ELEVATION: 268.13

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.23	TOPSOIL: black silty sand	268	1	SS	2	47%
	SILT: very loose to compact brown silt, moist	267	2	SS	26	
1.38	dense		3	SS	92	
	SAND: dense grey fine sand, saturated	266				
	BOREHOLE TERMINATED AT 1.90 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK					Upon completion of augering wet cave at 1.7 m



NOTES

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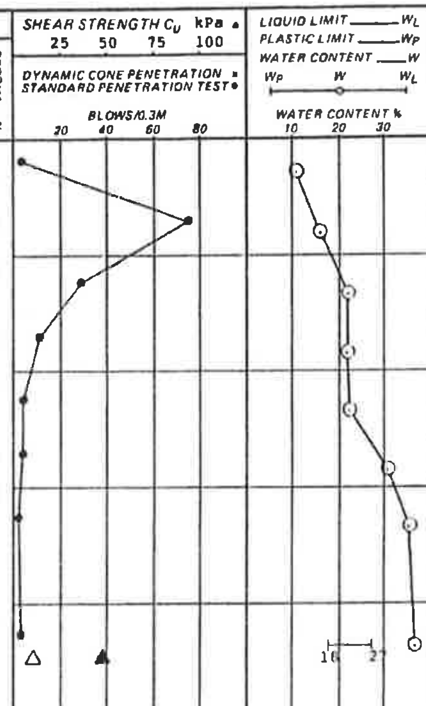
PetoMacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 82

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 27, 1995
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 266.85

Depth (m)	Description	Elevation	Sample No.	Type	Blows/0.3m N-Values
0.23	TOPSOIL: black silty sand				
			1	SS	4
	SAND: loose reddish brown	266			
	very dense brown		2	SS	75
		265	3	SS	29
	compact, grey very moist				
	saturated		4	SS	12
		264			
			5	SS	4
	loose, occasional clay layers	263			
			6	SS	4
4.30	LAYERED CLAY AND SAND: layered soft grey silty clay and silty fine sand, saturated		7	SS	2
		262			
5.50	CLAY: soft silty clay low to medium plastic W.T.P.L.	261			
			8	SS / FV	3
		260			
7.25	BOREHOLE TERMINATED AT 7.25 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	259			



GROUND WATER OBSERVATIONS AND REMARKS

native backfill
12 mm ø CPVC

Standpipe Reading	
May 8	1.40

NOTES
Undrained shear strength based on insitu field vane tests.
▲ Undisturbed value.
△ Remoulded value.

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PetoMacCallum Ltd.
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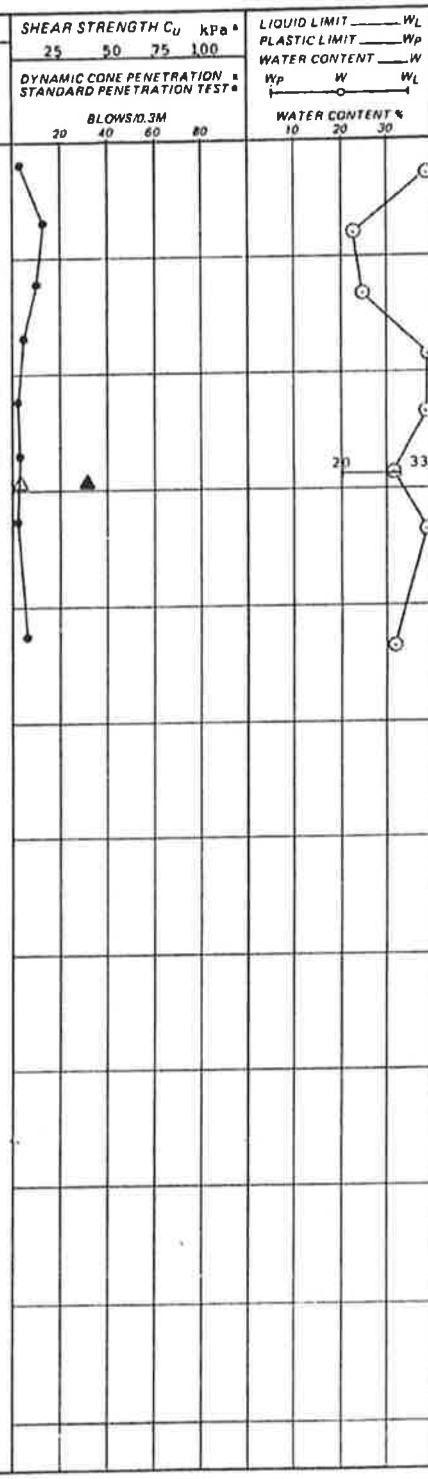
LOG OF BOREHOLE NO. 83

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 27, 1995
OUR PROJECT NO 94BF053A
ENGINEER TLB
TECHNICIAN BG

GROUND ELEVATION 265.91

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.23	TOPSOIL: black silty sand					
	SAND: loose to compact reddish brown fine sand trace silt, saturated	265	1	SS	4	
1.40			2	SS	14	
1.5		264	3	SS	10	
	with clay layers		4	SS	5	
2.90		263				
3.0	CLAY: soft, grey silty clay occasional sand layers low to medium plastic W.T.P.L		5	SS	2	
		262	6	SS	3	
4.5				FV		
		261	7	SS	2	
		260				
6.0	firm layered clay and silt		8	SS	7	Upon completion of augering cave at 3.0 m free water at 0.6 m
6.60	BOREHOLE TERMINATED AT 6.60 m UPON REFUSAL TO AUGER ON ASSUMED BEDROCK	259				
7.5						
9.0						
10.5						
12.0						
13.5						
15.0						
16.5						



NOTES

Undrained shear strength based on insitu field vane tests.
▲ Undisturbed value.
△ Remoulded value.

CHECKED BY

PetoMacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 84 and 85

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE April 29, 1995
OUR PROJECT NO. 94BF053A
ENGINEER TLB
TECHNICIAN BG

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u ▲ | DYNAMIC CONE PENETRATION ▪ / STANDARD PENETRATION TEST ● (BLOWS/0.3M: 20, 40, 60, 80) | LIQUID LIMIT —— W_L / PLASTIC LIMIT —— W_P / WATER CONTENT —— W (WATER CONTENT %: 10, 20, 30) | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 84
GROUND ELEVATION 267.19

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: black silty sand	267				
0.60	SAND: very loose brown silty fine sand, clay seams		1	SS	2	
		266	2	SS	10	
1.5	CLAY: stiff to firm grey silty clay, low plastic W.T.P.L., with sand layers/seams		3	SS	5	45%
		265	4	SS	2	
3.0	layered soft clay/loose sand	264	5	SS	3	
	silty clay with sand seams	263	6	SS	2	
4.5	layered hard silty clay and dense silt		7	SS	36	
5.00	BOREHOLE TERMINATED AT 5.00 m	262				Upon completion of augering cave at 0.6 m water at surface
6.0						

BOREHOLE 85
GROUND ELEVATION: 267.48

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20	TOPSOIL: black silty sand					
0.60	SAND: loose, reddish brown fine sand, some silt moist	267	1	SS	5	
			2	SS	34	
1.5		266	3	SS	23	
2.10	SILT: dense to compact, brown sandy silt, moist	265	4	SS	5	
3.0	CLAY: firm grey silty clay, with sand seams, becoming layered soft silty clay and silt	264	5	SS	3	
3.70	SAND: compact to dense grey silty fine sand, saturated		6	SS	12	
4.5		263	7	SS	44	
5.00	BOREHOLE TERMINATED AT 5.00 m	262				Upon completion of augering wet cave at 0.9 m
6.0						

NOTES

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APPENDIX D

GROUND PENETRATING RADAR SURVEY

Our Ref: 94 BF 053A

May, 1995

GROUND PENETRATING RADAR SURVEY
at the
Muskoka Medium Security Institution
near Gravenhurst, Ontario

for
Peto MacCallum Ltd.

Hyd-Eng Geophysics Inc.
Project No.: G143

Hyd-Eng
GEOPHYSICS INC.

May 12, 1995

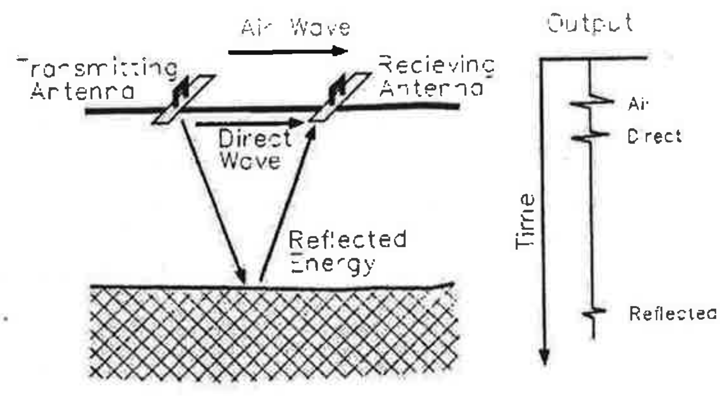
Mr. Turney Lee-Bun P.Eng.
Peto MacCallum Ltd.
19 Churchill Drive,
Barrie, Ontario
L4M 6E7

Dear Sir;

This letter reports the results of the ground penetrating radar (GPR) survey conducted at the Muskoka Medium Security Institution, near Gravenhurst, Ontario. The GPR survey was undertaken in order to define irregularities in the bedrock surface to a depth of 5 metres. This work was undertaken in support of a larger construction design project. The geophysical field work was conducted between April 25 and 27, 1995.

Equipment and Theory

For this survey a Sensors and Software Pulse Echo IV GPR system was used to detect variations in the dielectric properties of the subsurface. The system uses two antennas, one to transmit radar pulses and another to detect the signals reflected back from boundaries existing between materials of varying dielectric constants (see Sketch 1). These reflective boundaries usually coincide with changes in geologic materials. The attenuation of the radar signal will increase dramatically as the conductivity of the underlying material increases. Hence the presence of a conductive material, such as clay, will strongly attenuate the signal, creating a zone, or "shadow" after which no, or only weak, reflections would appear.



Sketch 1: Radar Events

The time required for a radar pulse to travel to a reflector and back to the antenna is a function of the velocity of radar propagation and thickness of the overlying material. The velocity will vary with the frequency of the signal and the dielectric constant of the material. By moving the transmitter-receiver pair laterally,

HEAD OFFICE: 170 Ambassador Drive, Unit 11, Mississauga, Ontario L5T 2H9 Tel: (905) 564-7355 Fax: (905) 564-7359
MARITIME OFFICE: 21 Old Cobequid Road, P.O. Box 395, Waverley, Nova Scotia B0N 2S0 Tel: (902) 860-0860 Fax: (902) 860-0869
1-800-HYD-R-ENG

changes in reflector depth are displayed as changes in the time required for the reflected pulse to return to the receiver. Repeated measurements along a line produce a cross sectional view, or pseudo-section, of the radar reflectors below.

The system was used in both the "Profiling" and the "Common Mid Point"(CMP) modes. The profiling mode provides a cross section along the line while the CMP mode is used to estimate the velocity of the radar signal propagation. This calculated velocity can then be used to convert interpreted signal times into relative depth estimates. It is important to note however, that depth calculations are based on the velocity calculated from the CMP data in conjunction with the borehole logs. These velocity values are extrapolated to all locations. Lateral and vertical variations in the velocity will therefore create discrepancies in depth estimates.

Survey Details

The area of the survey is heavily treed. The topography varies over 7 metres with the north end of the survey area being slightly topographically higher and the ground dryer. The bedrock is granitic and has a highly irregular surface. The overburden material is reported to be primarily sand with some silt and an occasional clay rich layer. A number of rainfall events occurred during the survey period, causing variations in near surface saturation and likely a number of "wetting" fronts in the subsurface.

Thirteen individual lines of radar data, totaling approximately 1.6 kilometers, were collected (see Figure 1). The pattern of data lines was specified by Peto MacCallum. The location of each line was referenced to surveyed, borehole location stakes. Some line cutting was undertaken to allow access.

Two different signal frequencies, 50 and 100 MHz, were tested in the field and it was determined that the 100 MHz antennas provided the best resolution while still providing the required depth penetration. The transmitter and receiver antennas were oriented perpendicular to the line and separated by 2 metres (centre to centre distance). The antenna array was manually moved and the station separation measured with a tape measure. At each station the radar data was stacked 64 times over a time window of 500 nanoseconds.

Data Processing

The radar data for all lines were processed in an identical manner. First the CMP and borehole data was used to estimate a velocity for the underlying material. Overburden material velocities vary significantly and systematically across the survey area. In the northern portion of the site, the overburden velocities are interpreted to be approximately .07 metres per nanosecond (Ns). While in the southern portion of the survey area an overburden radar velocity of approximately .14 metres per nanosecond appears to apply.

Table 1 shows the boreholes intersected, lengths of the individual lines and the velocities used in subsequent interpretation.

Line	Figure	Boreholes	Length metres	Velocity m/nsec
62-82	2a, 2b	17, 20, 23, 62, 76, 79, 81, 82	308	0.14
84-30	3	29, 30, 84, 85	200	0.14
80-83	4	23, 80, 83	70	0.14
63-80	5a, 5b	63, 71, 72, 77, 80	305	0.07, 0.14
77-78	6	77,78	75	0.14
63-66	7	12, 63, 66	105	0.07, 0.14
58-12	8	12, 58	150	0.07
55-56	9	55, 56	65	0.07
44-60	10	5, 44, 60	75	0.07
59b	11		40	0.07
59	12	59	45	0.07
34-40	13	34, 40	128	0.07
44-51	14	44, 51	50	0.07

Table 1: Line Information

The data were then filtered and plotted in pseudo-section form using a constant gain. The time window and scale was varied based on the velocity so that most reflectors can be compared between lines. A constant gain was chosen for each section to allow relative reflector strengths to be differentiated. Although other types of gains were tested to strengthen reflectors at depth, differentiation of the signal strength was considered of prime importance for presentation.

The final processed radar data are presented in Figures 2 through 14. The data is presented in a grey scale, with the darkness of the plot varying with the relative strength of the receiver output. The lines are labeled by the first and last borehole on the section.

The interpreted geologic boundaries were chosen using a consistent methodology. Initially well logs provided by Peto MacCallum were used to correlate radar reflectors with assumed bedrock depths. These boundaries were then extrapolated along the radar sections by following the most continuous reflector that exhibits similar appearance and characteristics. The time of the various radar reflectors were converted to depths using the most appropriate velocity for that section. These boundaries are plotted as schematic cross-sections below the radar traces in Figures 2 through 14.

A schematic of the borehole records as provided by Peto MacCallum are plotted along each interpreted section. These are located based on the stakes observed in the field and the survey map provided. Any minor variations between planned and actual borehole locations are unaccounted for in the report.

Note that in addition to "bedrock" reflectors both "shallow" and "medium" reflectors have also been identified to aid in the presentation of the layering. These likely represent variations in the overburden geology, and zones with varying degrees of saturation. Note that although the water table can, and usually does, create a distinct radar reflector, rainfall during the survey period will likely have caused wetting fronts that precludes the interpretation of water table depth from this data.

Sources of Error

The quality of the radar sections is assessed based on the clarity and continuity of the reflectors of interest, while the accuracy of the interpretation is assessed relative to ground truthing with boreholes. In general the quality of the radar sections is excellent, and strong continuous bedrock reflectors are resolvable on all sections.

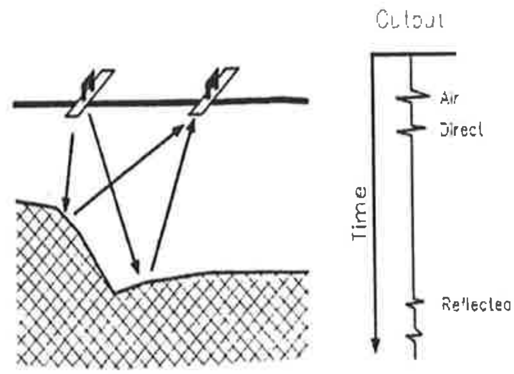
Locally, when the bedrock is particularly deep, the reflectors become faint. These areas are limited to where bedrock depth is beyond 5 metres. In addition there are also some areas where boulders at depth and irregularities in the bedrock surface make it difficult to define which, of a series of reflectors, represents bedrock.

Comparison of the borehole results with the interpretation of the radar section generally indicates a close correlation. Some discrepancies do exist, and these likely result from one or combination of reasons:

- Lateral changes in overburden velocity likely occur at this site. The data is collected relative to time and subsequently converted to depth (see above). Lateral changes in the porosity and degree of saturation can drastically vary the velocity of the overburden and consequently the accuracy of the interpretation. The velocity used in the interpretation has been varied systematically along the lines to best represent the sections. However, velocities have only been varied laterally where a reasonable mechanism exists to facilitate the change (i.e. a bedrock knoll, pinching layering, etc.).

- Although the bedrock reflectors may be distinct, in areas of extreme bedrock relief, the reflections may not be occurring immediately below the antennas and/or more than one event might occur. The radar signal is a 1 dimensional measurement of a 3 dimensional space. By combining the traces a 2 dimensional representation is produced, however events can be shifted slightly along the section and/or be influenced by the shape of the reflector off to the sides of the radar line (see Sketch 2).

- The proposed locations of most of the boreholes were staked at the site at the time of the radar survey were "intended". Practical, "in field", minor changes to the location of the boreholes to facilitate drilling may have occurred. In areas of steep changes in bedrock depth, even minor offsets between where the boreholes are plotted and where they exist can cause discrepancies in the comparison.



Sketch 2: Offsets in position of reflection

- The bedrock depth reported in the borehole logs is described as "assumed" because refusal may have occurred at a boulder. A boulder would typically cause a parabolic reflector in the radar section. Along Line 63-80 at Borehole 77 (Figure 5b), such a parabolic reflection occurs at the reported bedrock depth, and the continuous reflector interpreted to be bedrock occurs below.

The fact that the bedrock is shallow and relatively variable in depth accentuates many of these discrepancies. In deeper bedrock environments local variability in overburden is usually removed by the averaging resulting from the large amount of material sampled. In these instances the geometric effects become inconsequential.

Although the data interpretation is displayed on an expanded scale this is not intended to imply that minor irregularities can be resolved. The average discrepency between the boreholes is 0.4 metres (0.2 metres without Bh72 and Bh77). However, **it is unlikely that estimates of bedrock depth are any better than 1 metre from actual values.**

Notable Observations

Specific features that are of particular note are summarized below:

Line 62-82 (Figure 2a): The bedrock elevation beneath this section is extremely variable. A distinct knoll or ridge appears to exist within an otherwise broad bedrock depression. The radar signal appears to attenuate where the overburden is thickest and the bedrock reflector is difficult to define. A distinct offset appears to exist in the deep reflectors which suggests a sharp displacement may exist in the bedrock. A similar feature exists along Line 4 to the east.

(Figure 2b): This figure is a continuation of Line 62-82. Along all but the southern (eastern) end of this section the bedrock depth is 2 metres or less. A sharp decrease in bedrock elevation occurs at -260. A number of reflectors arrived after the interpreted bedrock event, one of these (near Bh 81) appears as a steep inclined surface which may represent a fracture.

Line 84-30 (Figure 3): This line exhibits a highly irregular bedrock surface. A distinct narrow depression has been intersected with Borehole 85. Whether some, or all, of the distinct changes in bedrock elevation result from fractures cannot be determined from this data.

Line 80-83 (Figure 4): A sharp change in bedrock depth occurs at 22 metres along this line. The apparent "draping" of overburden layering into the depression at the south end of this line may in part result from phantom reflections of the side of the depression.

Line 63-80 (Figure 5a): a lateral change in overburden velocity is interpreted to exist along this section. A number of reflectors appear to exist after the bedrock event. Whether these are features within bedrock or artifacts of surface reflectors is uncertain.

(Figure 5b): This section is a continuation of the data on Line 63-80. The section can be divided into two parts, with the southern half uniform and the northern half with a variable and deep bedrock surface. Two distinct, sharp irregularities are interpreted to exist in the bedrock surface. Similar features were also observed along Line 62-82 immediately to the west.

The correlation of the radar section with the observed bedrock depth in the boreholes varies. The bedrock depth interpreted from the radar data correlates well with both Boreholes 71 and 80. However discrepancies of approximately 2 metres exist at Boreholes 72 and 77. At borehole 77 a parabolic reflector, indicative of a localized "point" reflector exists, which implies a boulder may be present.

Although a similar strong parabolic reflector does not exist at Borehole 72, a distinct radar reflector does exist. This reflector is a horizontal continuation of the bedrock that is interpreted to have dropped off 14 metres to the south. The correlation of the interpretation of the bedrock with Borehole 71 supports the geophysical interpretation. A number of minor parabolic reflectors do exist along this feature which could represent boulders. Subsequent surveying of the borehole locations has not indicated a significant change in the location of the borehole.

Line 77-78 (Figure 6): This line includes a unique second reflector at the south end below the depth of bedrock indicated in the log of Borehole 78. A shallow reflector also exists at the depth indicated in the borehole data. Whether this deeper event is within bedrock, off the section laterally, or whether the borehole was terminated on a boulder is uncertain. This zone coincides with a late event on Line 62-82.

Line 63-66 (Figure 7): The radar data along this line indicates a area of shallow bedrock exists near the center of this line. At the east end of the line the bedrock the radar signal attenuates notably with depth.

Line 58-12 (Figure 8): This line crosses a bedrock knoll. Bedrock elevation appears to decrease distinctly at the north end of the line. The data correlates well with the borehole data.

Line 55-56 (Figure 9): This data line extends to the eastern limit of the geophysical survey. The bedrock appears to be dipping towards the east and the radar signal attenuates with depth at that end of the line. Distinct inclined reflectors exist towards the eastern limit of the resolvable bedrock reflector.

Line 44-60 (Figure 10): A distinct, irregular reflector crosses this section at an intermediate depth. Another, slightly weaker and locally slightly deeper reflector is interpreted to represent bedrock. A shallow, comparatively flat reflector truncates against either side of the distinct reflector. Correlation between the radar interpretation and the borehole data is good.

Line 59b (Figure 11): This line is the only section not to cross a borehole. Therefore the closest borehole, Borehole 59 has been used to designate this section. The data along this line correlates well with nearby sections.

Line 59 (Figure 12): Along this line bedrock varies irregularly between 2 and 4 metres.

Line 34-40 (Figure 13): Bedrock varies from near surface to 6 metres at the north end. Towards the north end the "bedrock" reflector becomes notably weaker with depth. A fairly continuous overburden reflector which may represent a clay/silt exists at approximately 2 metres.

Line 51-44 (Figure 14): The data indicates bedrock along this section is approximately 2 metres deep with a slight eastward dip.

Hyd-Eng
GEOPHYSICS INC.

In summary, the ground penetrating radar appears to have been successful in mapping bedrock topography while also identifying continuous reflectors that may represent the boundaries of intermediate geologic units. Although the relatively shallow, irregular bedrock surface has likely accentuated the difficulties of assigning an accurate depth to the reflector, correlation with the borehole observations is also very good. In addition, a number of narrow features which could be indicative of fractures exist within the bedrock surface.

I trust that this information will be useful to you in your investigation and if any questions arise, please do not hesitate to call.

Sincerely,

R. Freymond B.A.Sc.
Geophysicist
G143.doc

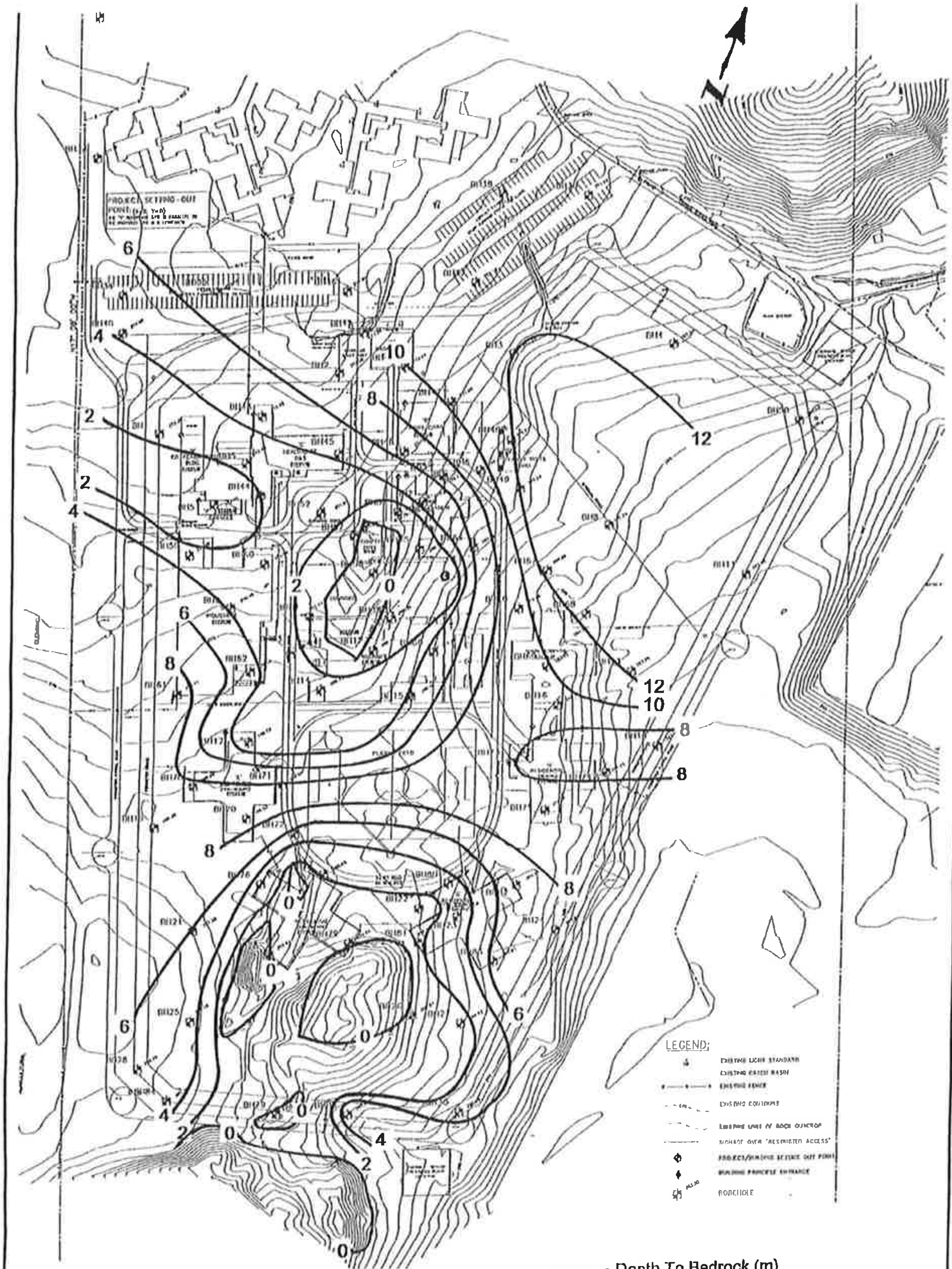
P.Pehme, M.Sc.
Pres., Hyd-Eng Geophysics™ Inc.

APPENDIX E

DRAWINGS

Our Ref: 94 BF 053A

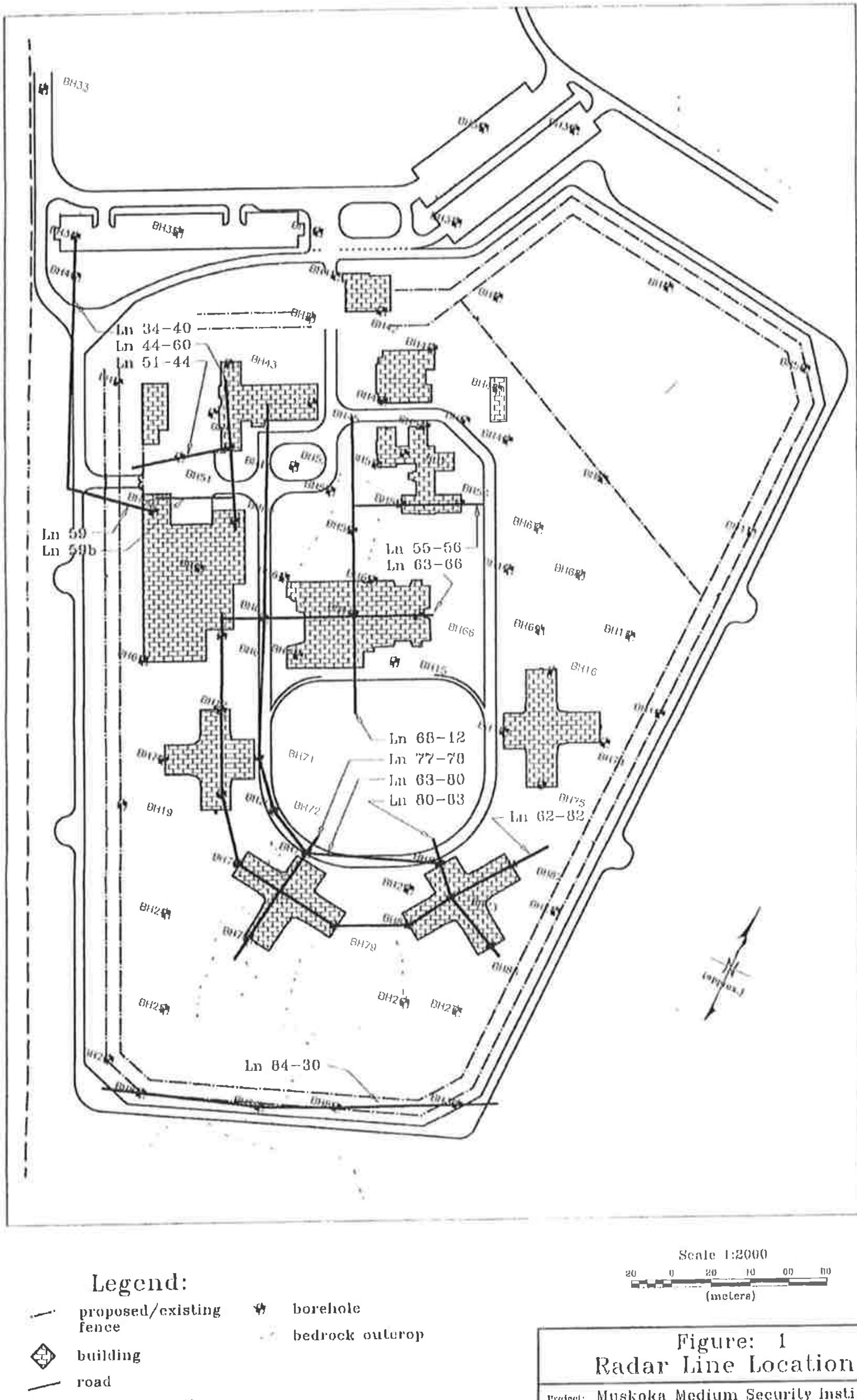
May, 1995



——— Depth To Bedrock (m)

This drawing is prepared only to illustrate the general trends in the depth to bedrock, and cannot be relied upon for quantity estimation.

DEPTH TO BEDROCK	**PetoMacCallum Ltd.** CONSULTING ENGINEERS			
MUSKOKA MEDIUM SECURITY INSTITUTION GRAVENHURST, ONTARIO	DRAWN / CHECKED / APPROVED	DATE: MAY 95	SCALE: 1:2000	JOB NO.: 94 BF 053A, DRAWING NO.: 2

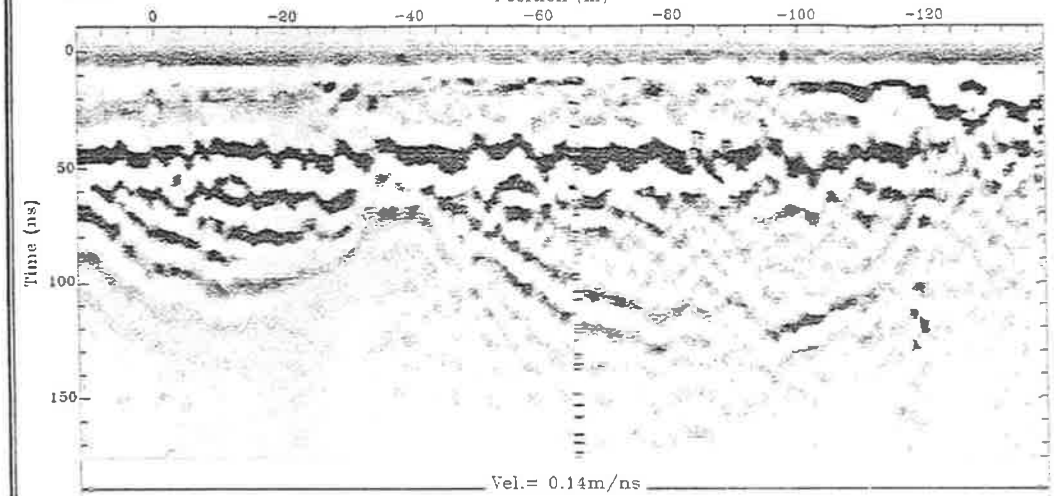


Note: Modified from drawing No. SK-139D provided by Peto MacCallum Ltd.

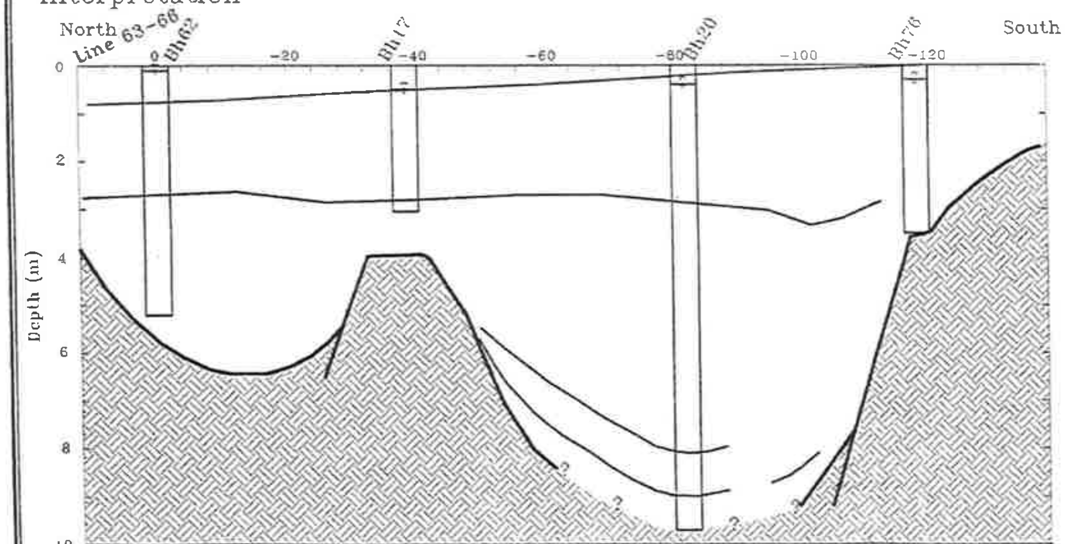
Figure: 1
Radar Line Locations

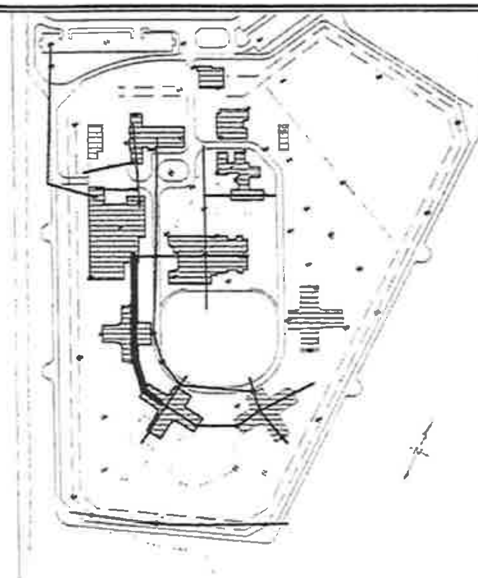
Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: C143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	

Radar Section



Interpretation





Legend

Interpretation
- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

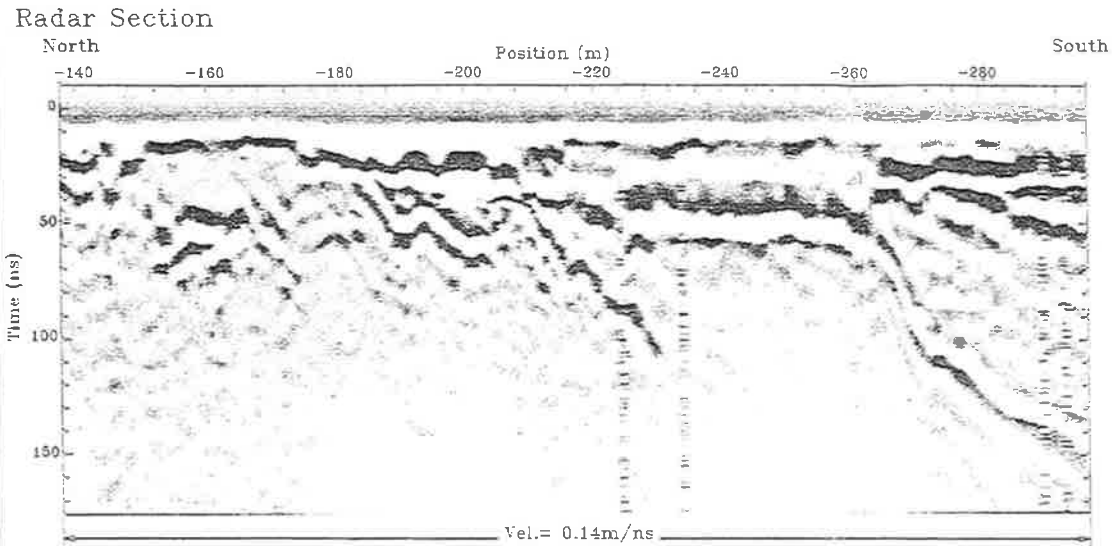
Horizontal Scale 1:750

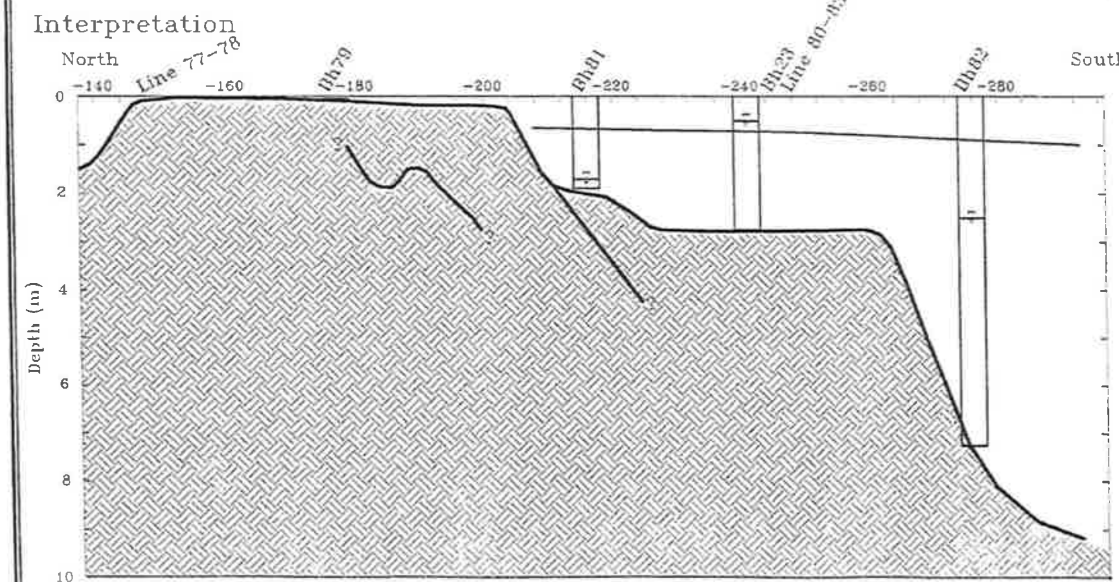
10 0 10 20 30 40

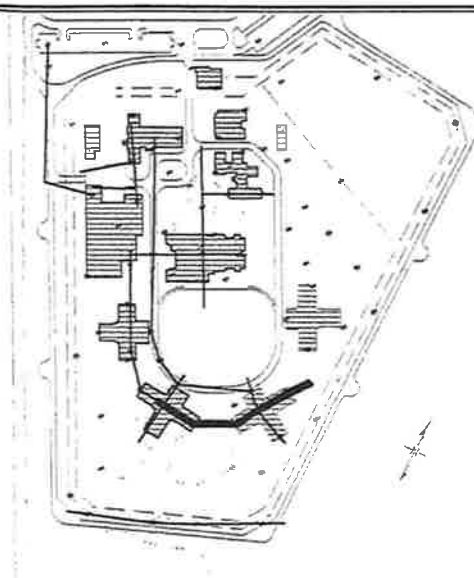
(meters)

Figure: 2a
Line 62-82

Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	







Legend

Interpretation
- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

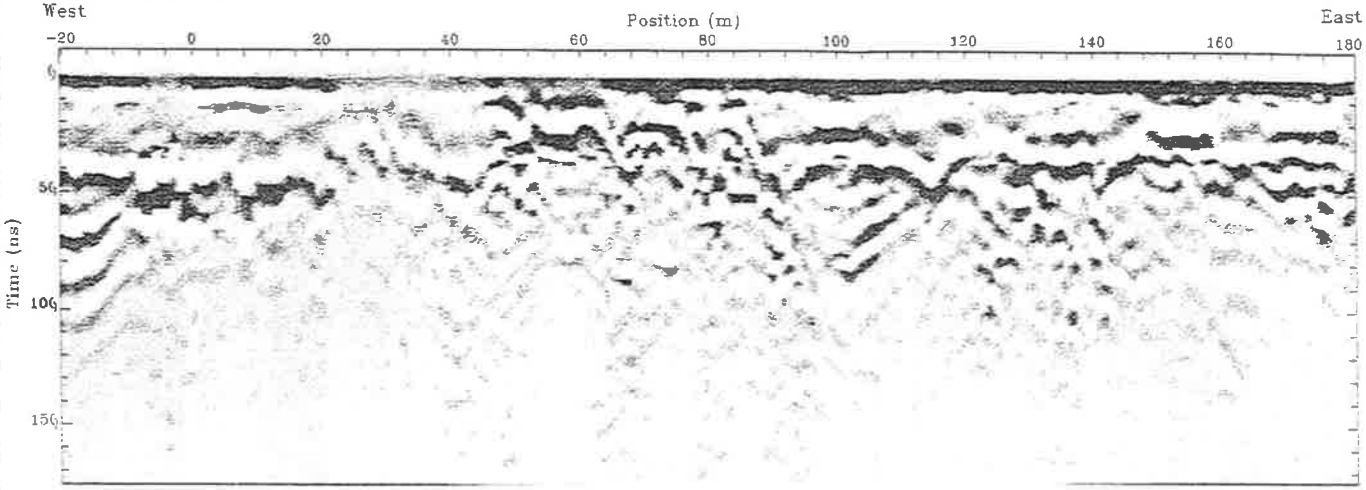
Horizontal Scale 1:750
10 0 10 20 30 40
(meters)

Figure: 2b
Line 62-82

Project: Muskoka Medium Security Institution
Location: Gravenhurst, Ontario
Project No.: G143
Client: Peto MacCallum Ltd.
Survey Date: 25-27 April 1995
Instrument: Pulse Ekko IV GPR

Hyd-Eng
GEOPHYSICS INC.

Radar Section



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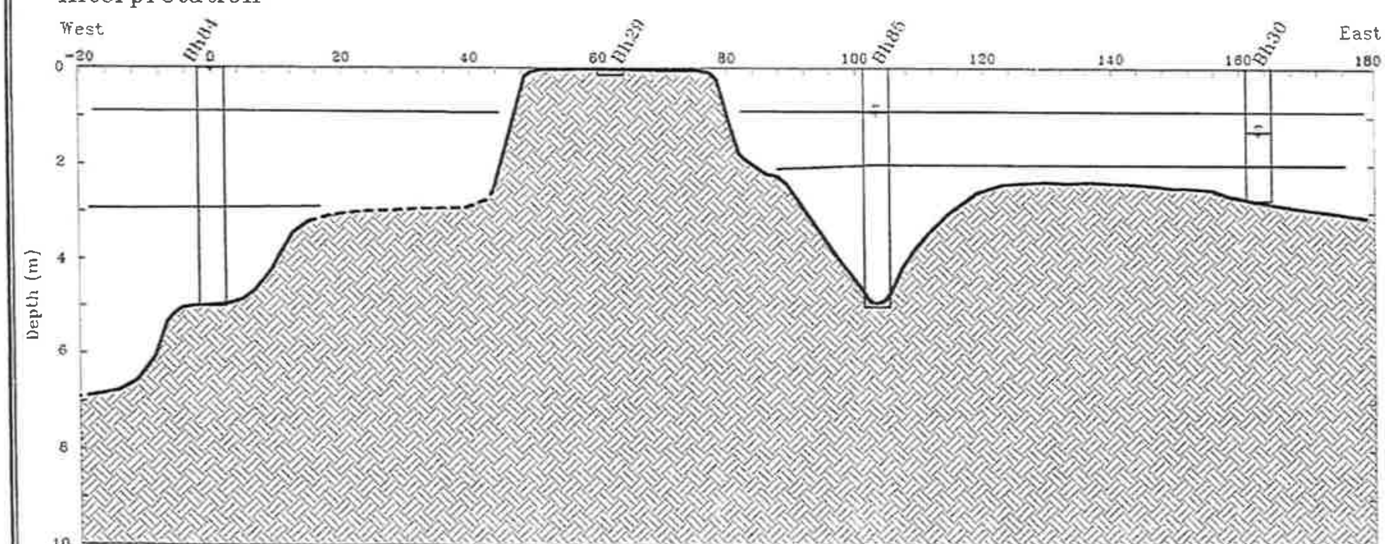
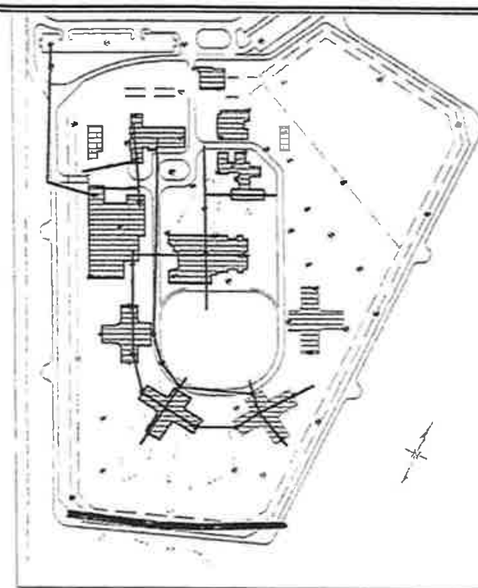




Legend

Interpretation

- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information (provided by Peto MacCallum Ltd)

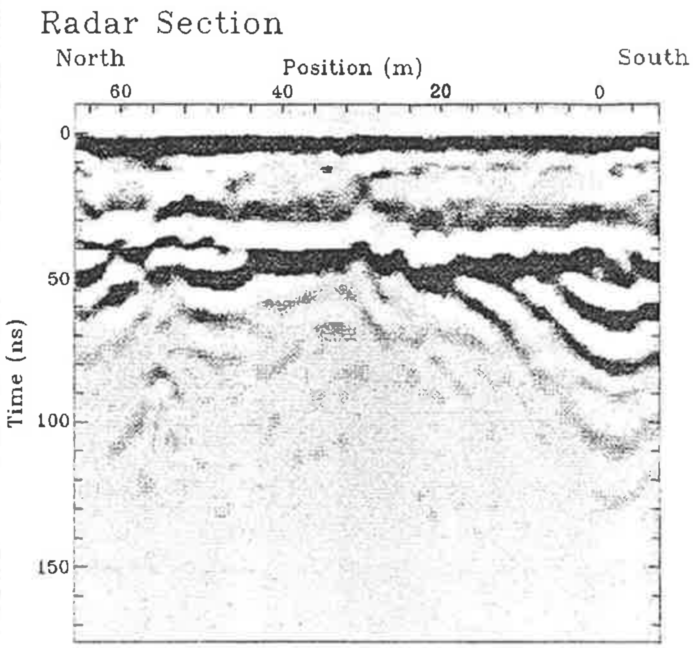
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

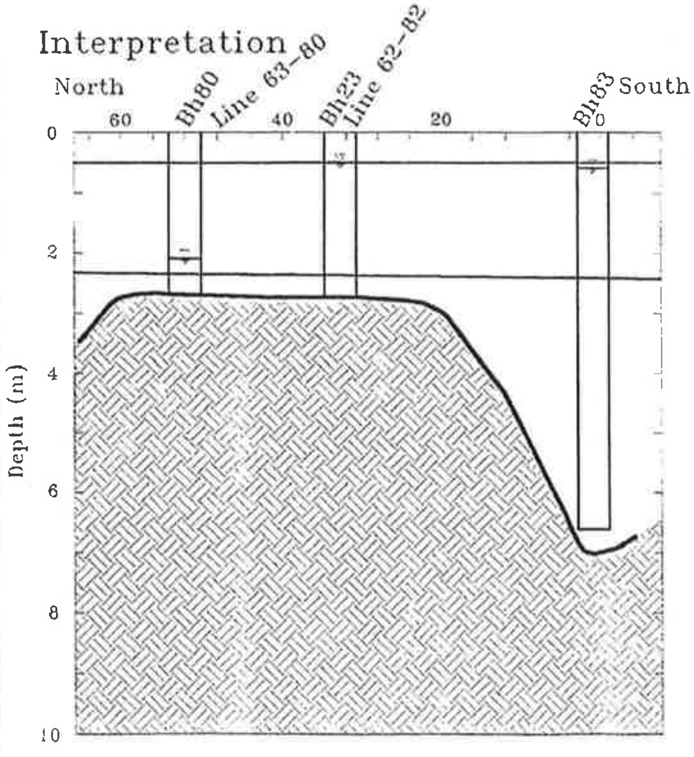
Horizontal Scale 1:750

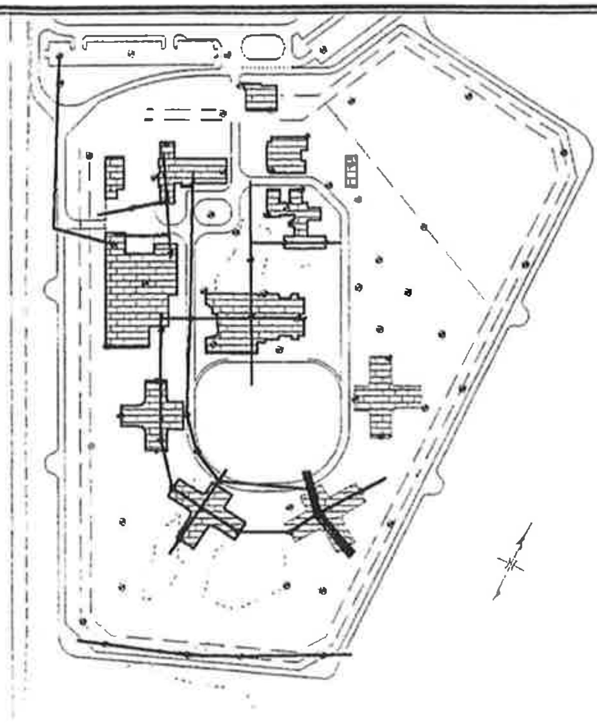
10 0 10 20 30 40 (meters)

Figure: 3
Line 84-30

Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	







Legend

Interpretation

- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information (provided by Peto MacCallum Ltd)

- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

Horizontal Scale 1:750

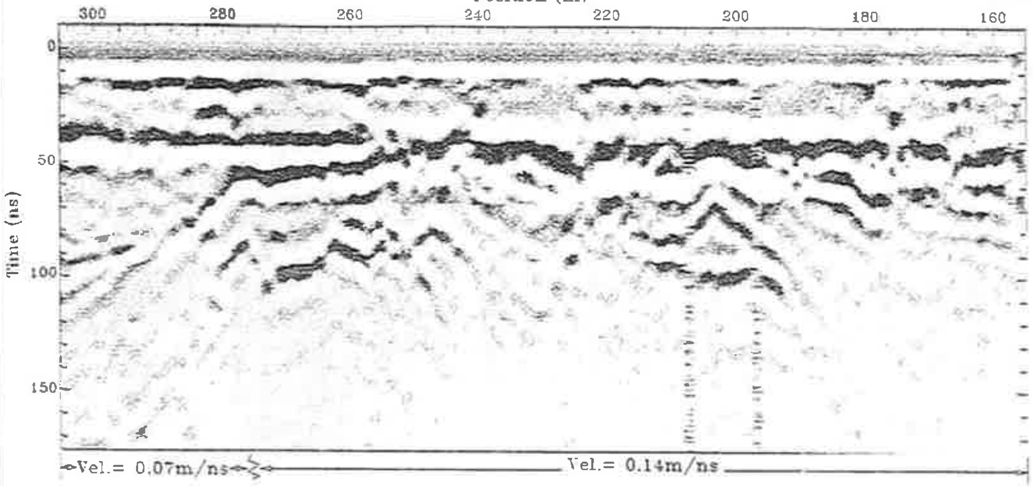
10 0 10 20 30 40

(meters)

Figure: 4
Line 80–83

Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng™ GEOPHYSICS INC.
Survey Date: 25–27 April 1995	
Instrument: Pulse Ekko IV GPR	

Radar Section



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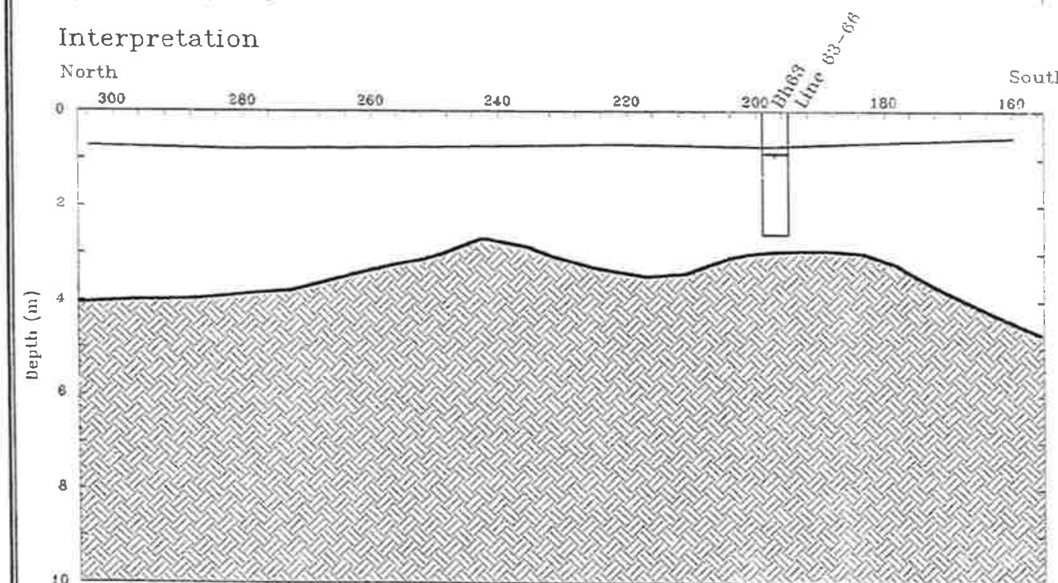
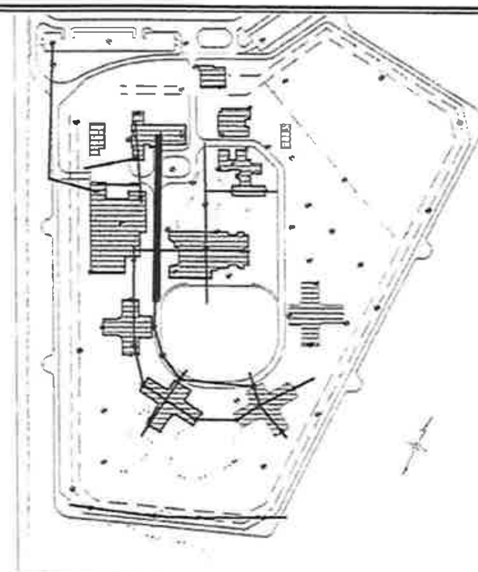




Legend

Interpretation
- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

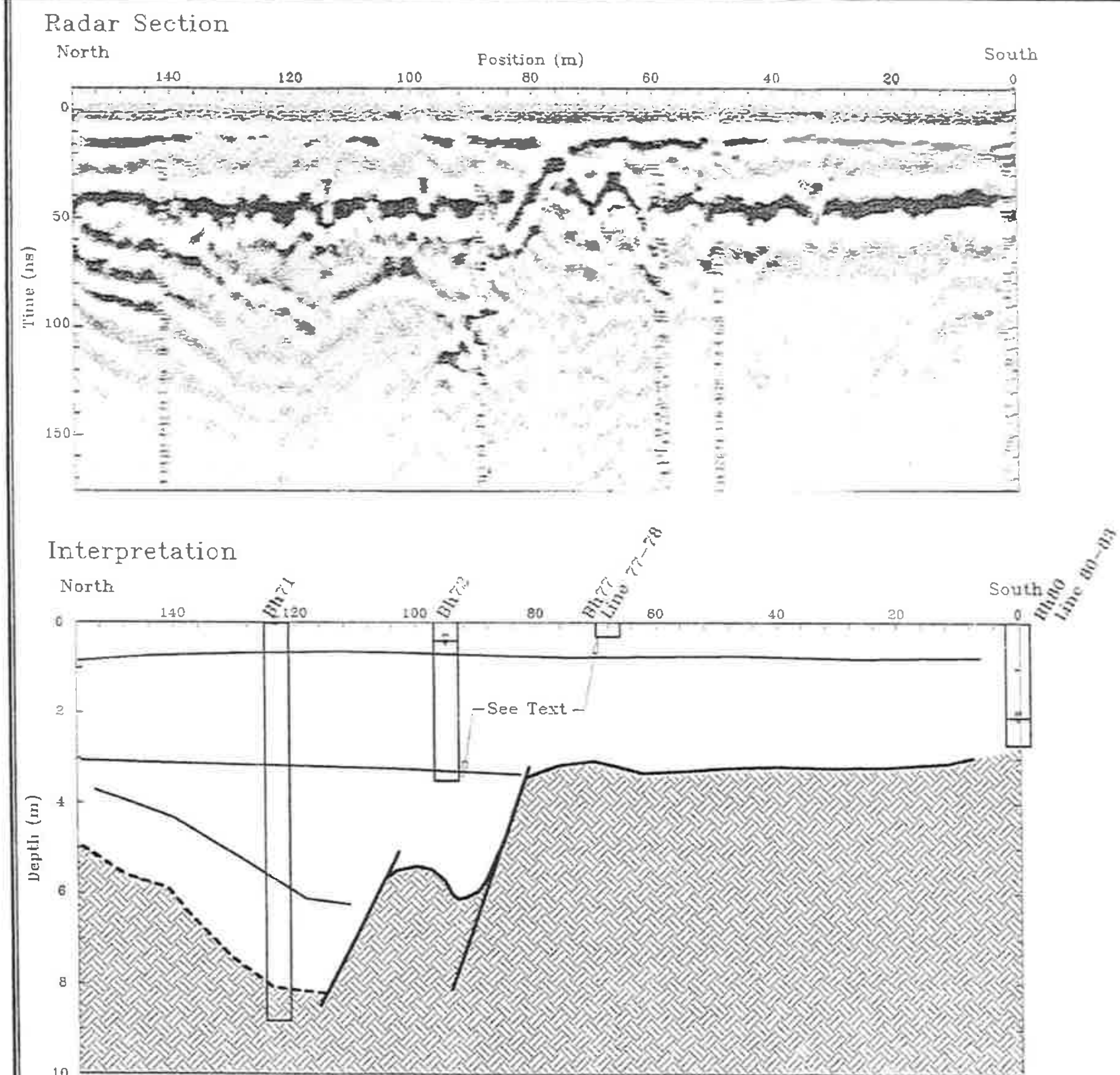
Horizontal Scale 1:750

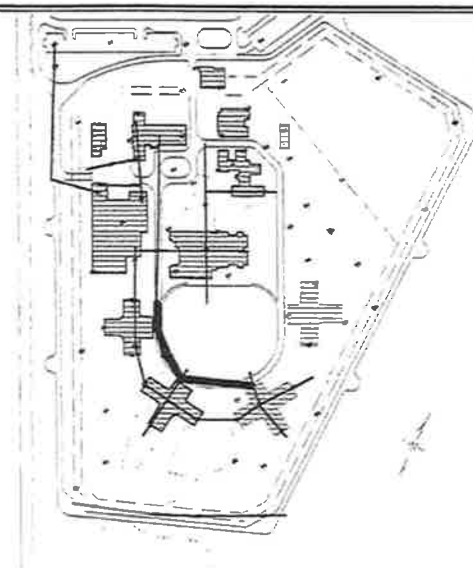
10 0 10 20 30 40
(meters)

Figure: 5a
Line 63-80

Project	Muskoka Medium Security Institution
Location	Gravenhurst, Ontario
Project No.	G143
Client	Peto MacCallum Ltd.
Survey Date	25-27 April 1995
Instrument	Pulse Ekko IV GPR

Hyd-Eng GEOPHYSICS INC.





Legend

Interpretation
- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

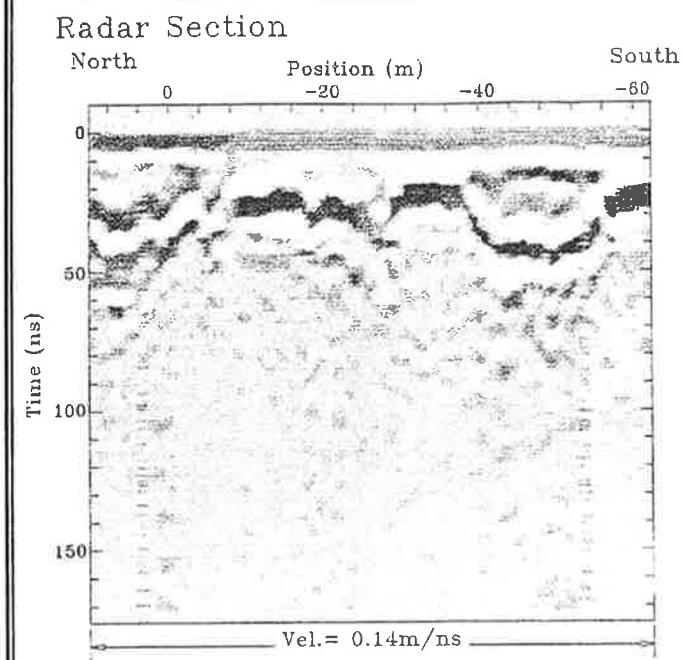
Borehole Information
(provided by Peto MacCallum Ltd)
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

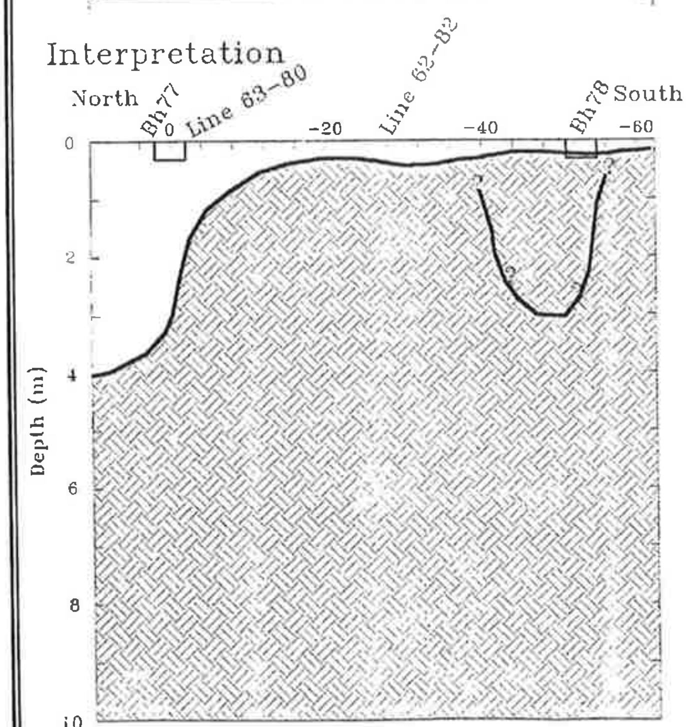
Horizontal Scale 1:750
10 0 10 20 30 40
(meters)

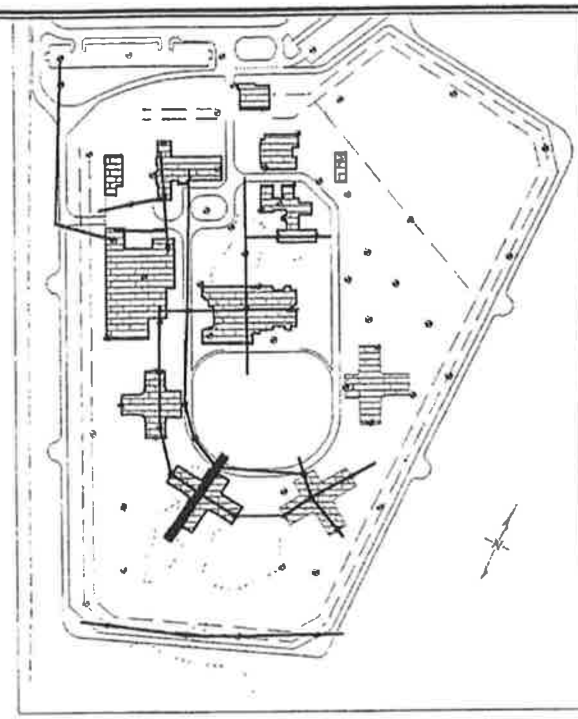
Figure: 5b
Line 63-80

Project: Muskoka Medium Security Institution
Location: Gravenhurst, Ontario
Project No.: G143
Client: Peto MacCallum Ltd.
Survey Date: 25-27 April 1995
Instrument: Pulse Ekko IV GPR

Hyd-Eng GEOPHYSICS INC.







Legend

Interpretation

- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)

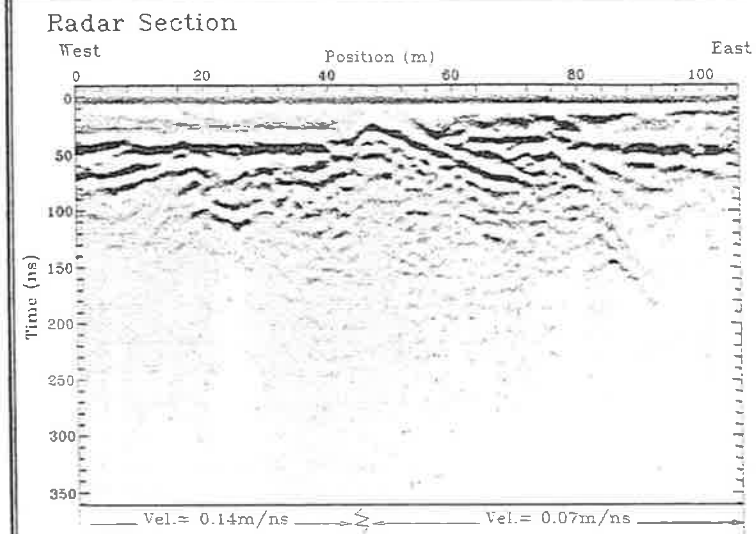
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

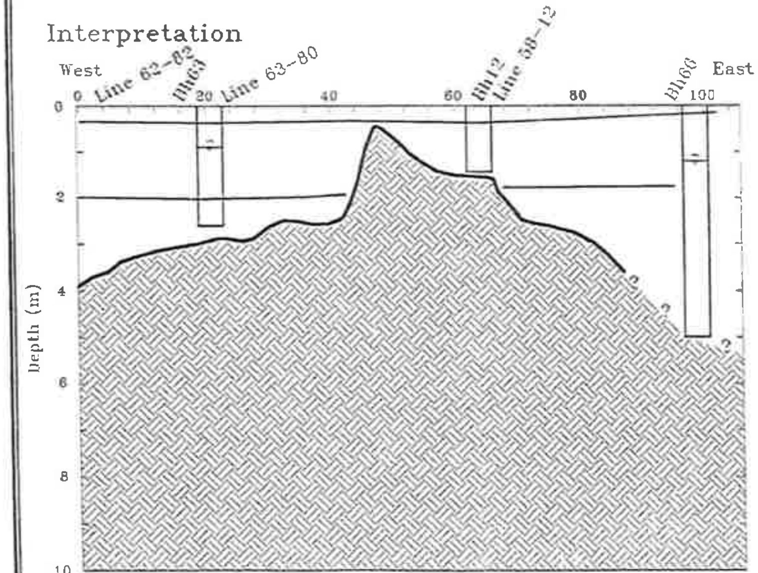
Horizontal Scale 1:750

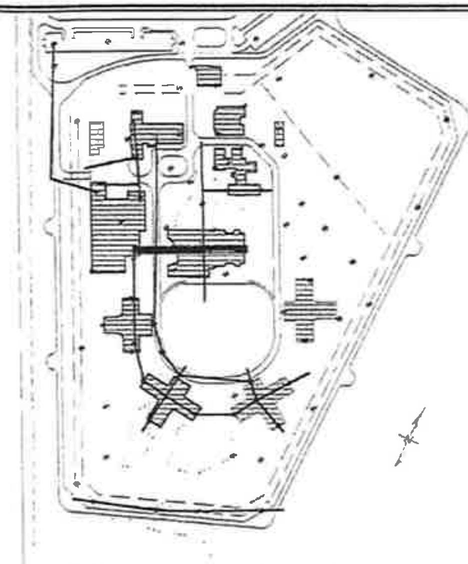
10 0 10 20 30 40
(meters)

Figure: 6
Line 77–78

Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25–27 April 1995	
Instrument: Pulse Ekko IV GPR	







Legend

Interpretation
- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

Horizontal Scale 1:750

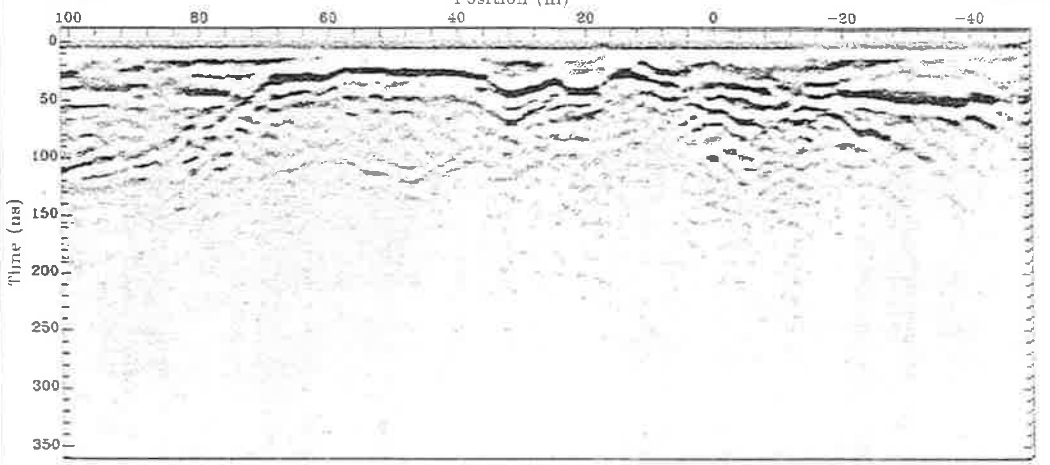
10 0 10 20 30 40 (meters)

Figure: 7
Line 63-66

Project	Muskoka Medium Security Institution
Location	Gravenhurst, Ontario
Project No.	G143
Client	Peto MacCallum Ltd.
Survey Date	25-27 April 1995
Instrument	Pulse Ekko IV GPR

Hyd-Eng GEOPHYSICS INC.

Radar Section



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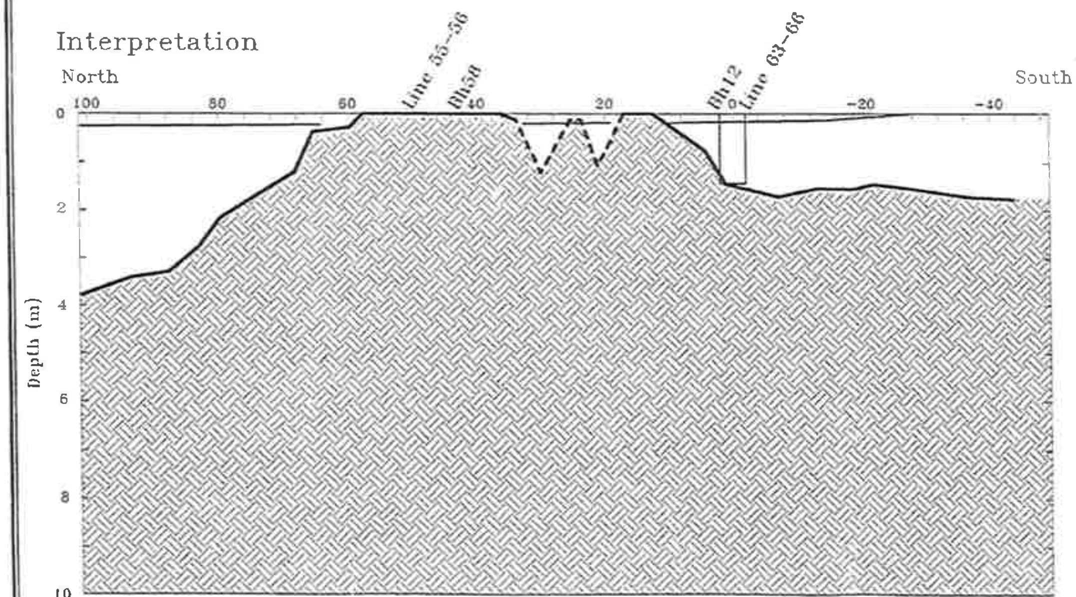
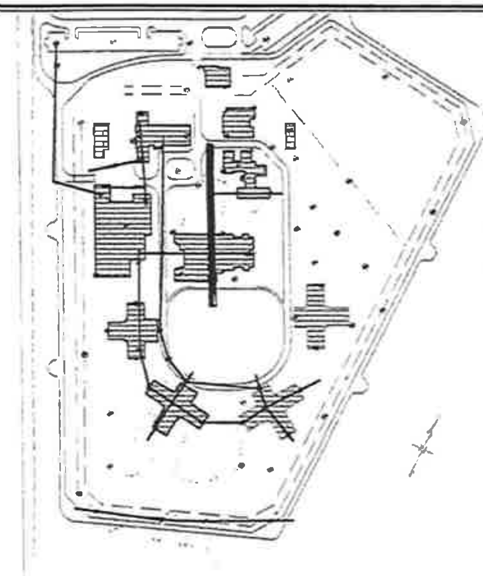




Legend

Interpretation
- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

Horizontal Scale 1:750

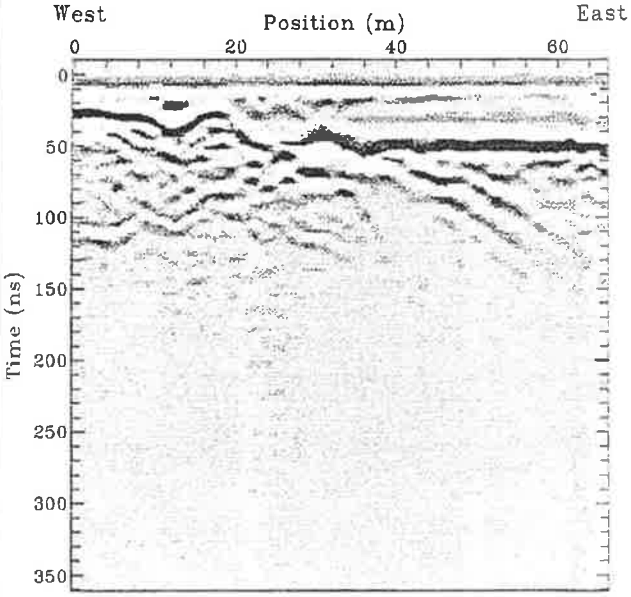
10 0 10 20 30 40
(meters)

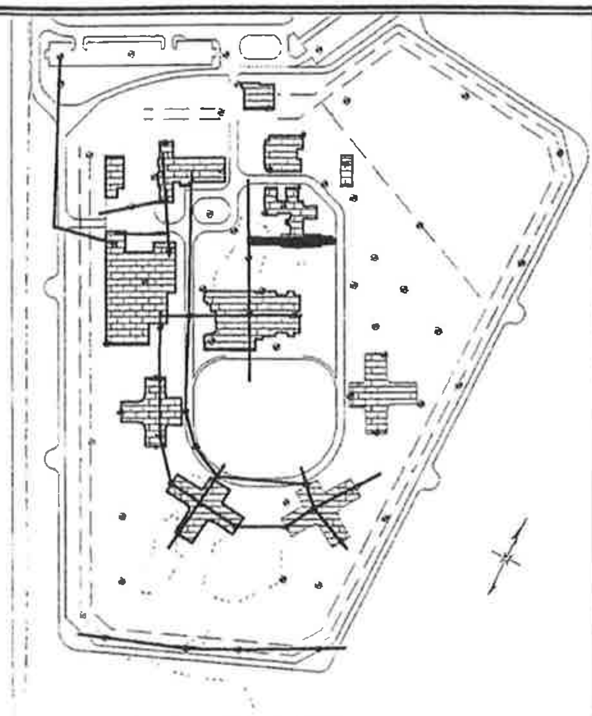
Figure: 8
Line 58-12

Project	Muskoka Medium Security Institution
Location	Gravenhurst, Ontario — Project No.: G143
Client	Peto MacCallum Ltd.
Survey Date	25-27 April 1995
Instrument	Pulse Ekko IV GPR

Hyd-Eng GEOPHYSICS INC.

Radar Section





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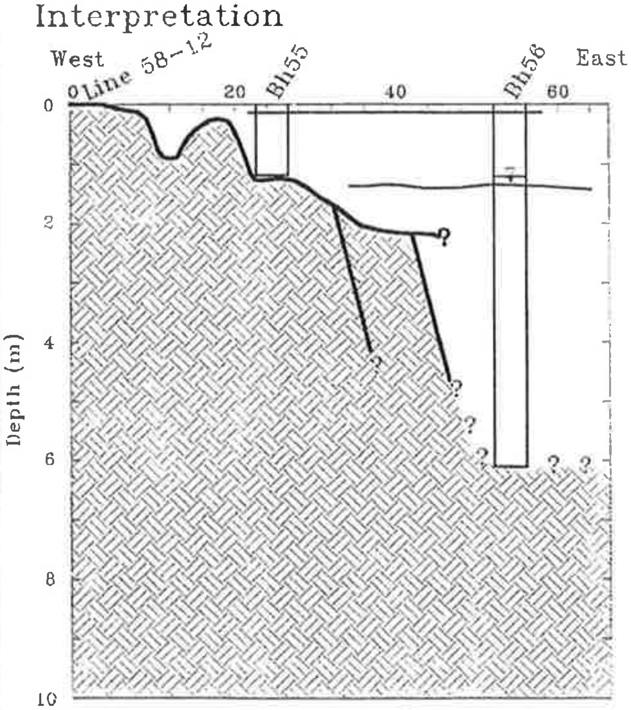


Legend

Interpretation

- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)

- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

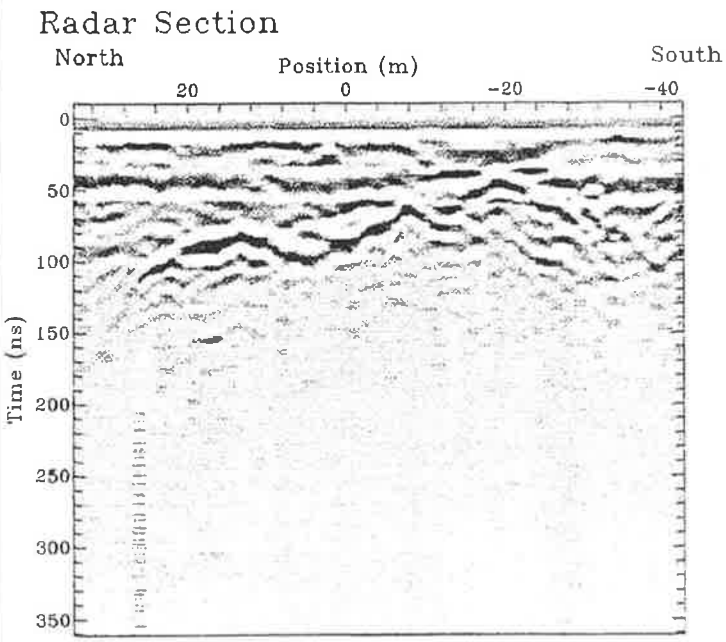
Horizontal Scale 1:750

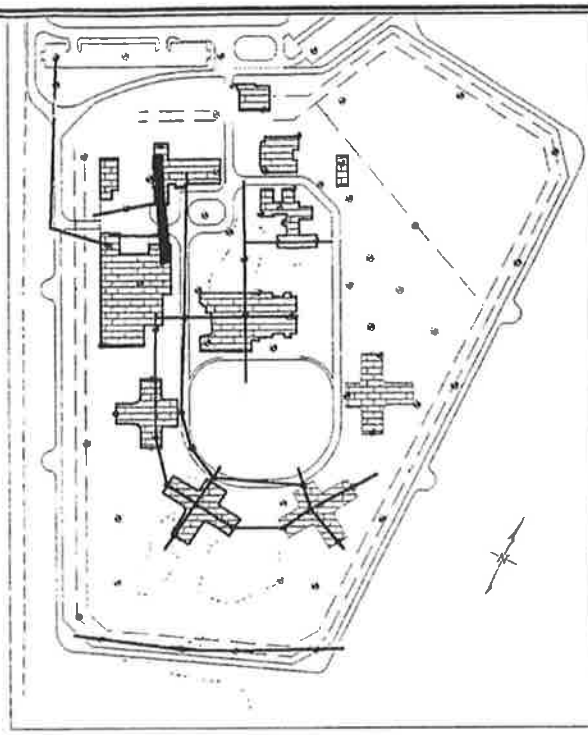
10 0 10 20 30 40

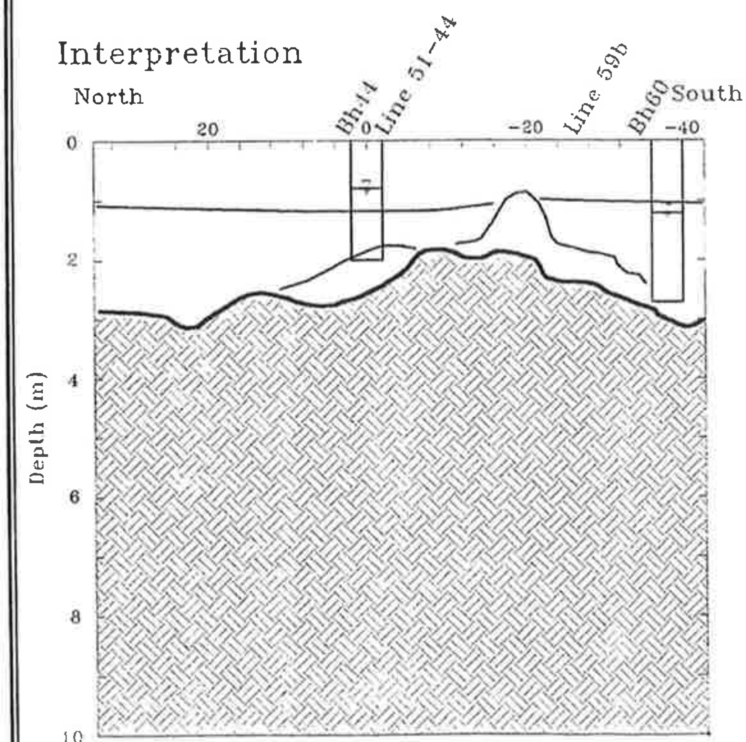
(meters)

Figure: 9
Line 55-56

Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	







Legend

Interpretation

- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)

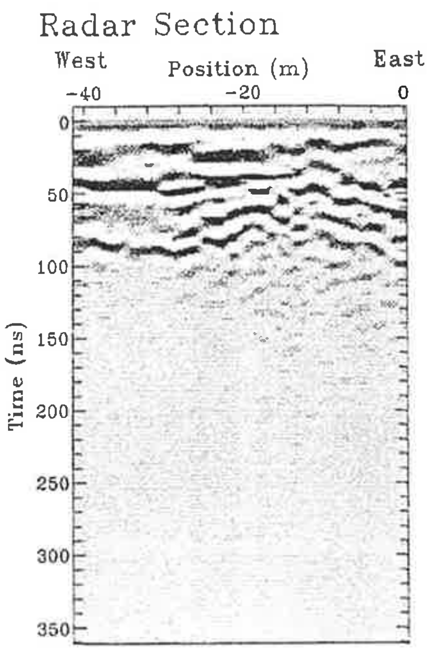
Water level upon completion of auguering

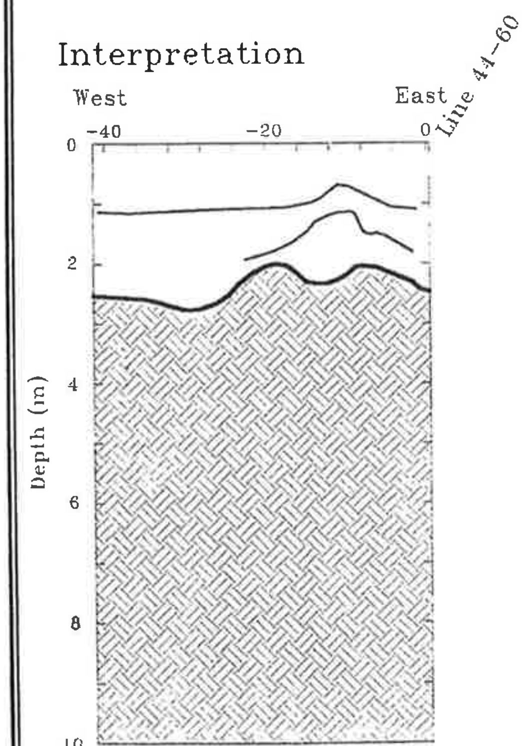
Refusal to auger on assumed Bedrock

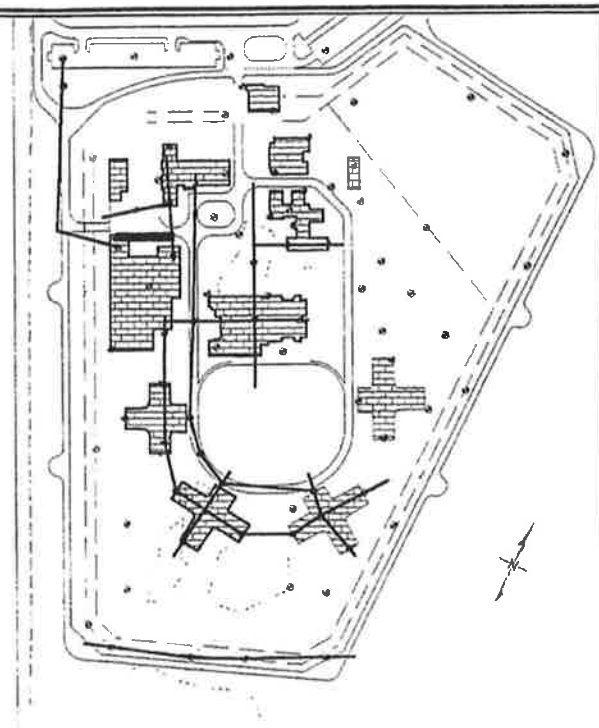
Horizontal Scale 1:750

10 0 10 20 30 40
(meters)

Figure: 10 Line 44-60	
Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	







Legend

Interpretation

- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)

- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

Horizontal Scale 1:750

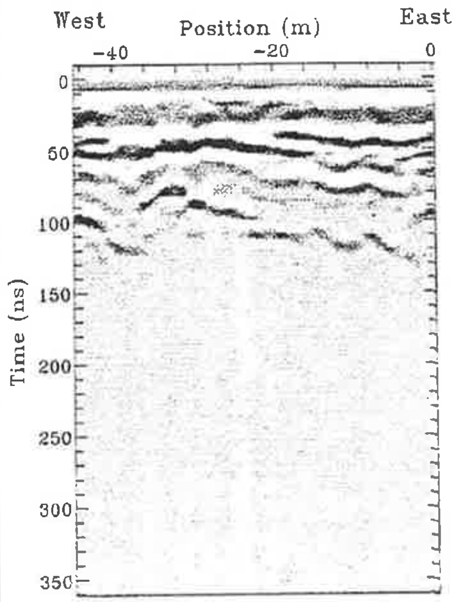
10 0 10 20 30 40

(meters)

Figure: 11
Line 59b

Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	

Radar Section



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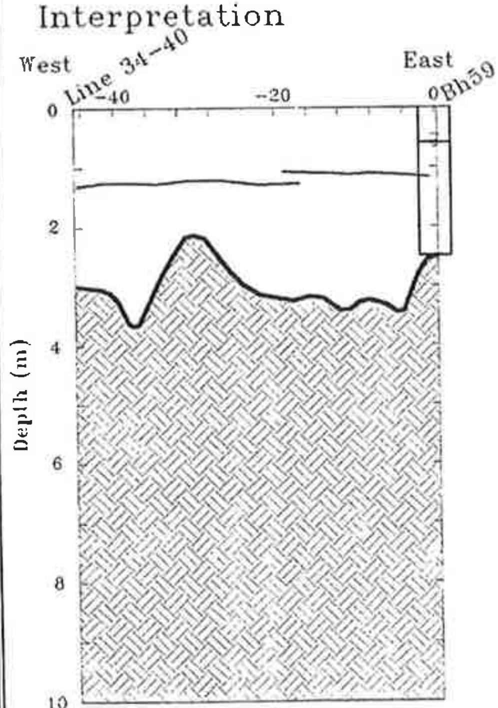
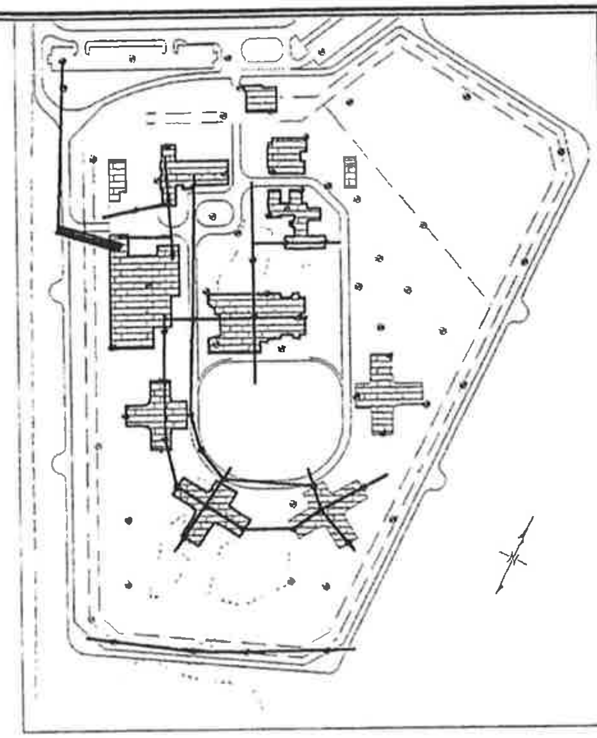




Legend

Interpretation

—— Shallow Reflector

—— Medium Reflector

—— Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)

Water level upon completion of auguering

Refusal to auger on assumed Bedrock

Horizontal Scale 1:750

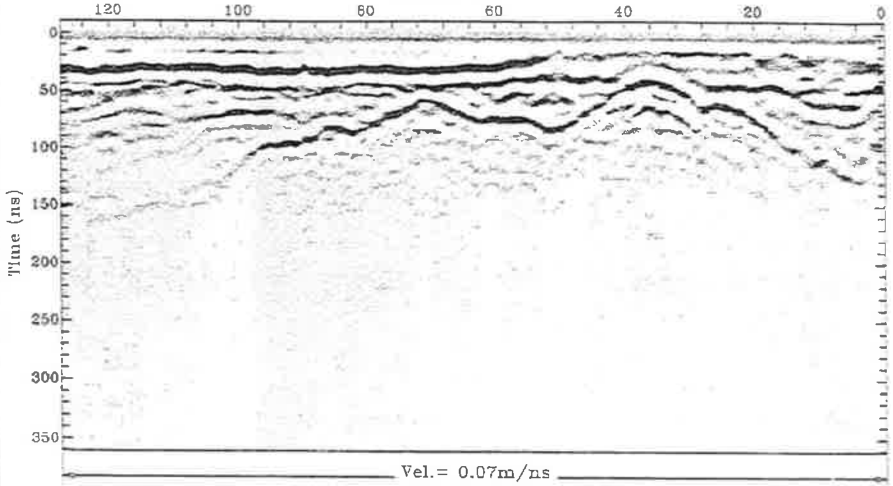
10 0 10 20 30 40

(meters)

Figure: 12
Line 59

Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	

Radar Section



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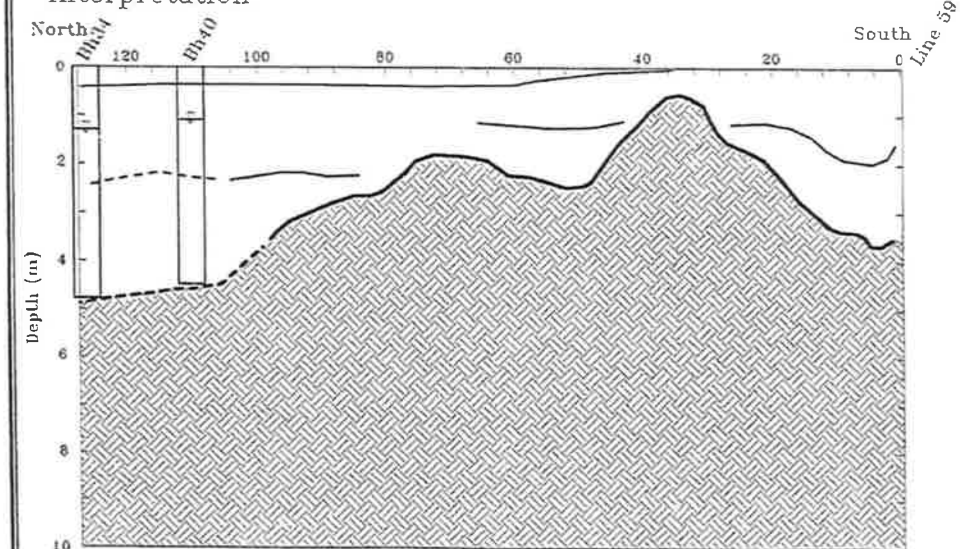
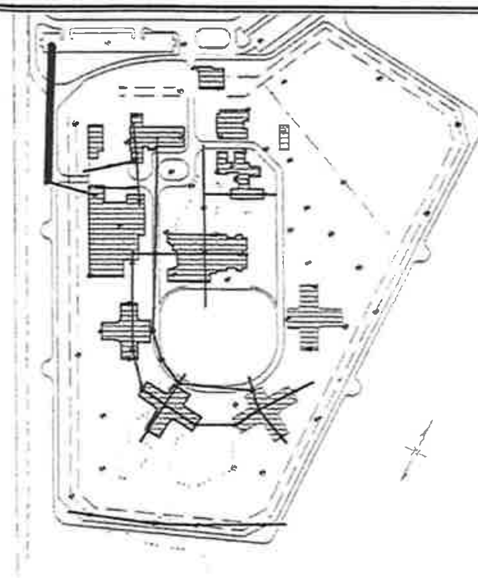




Legend

Interpretation
- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

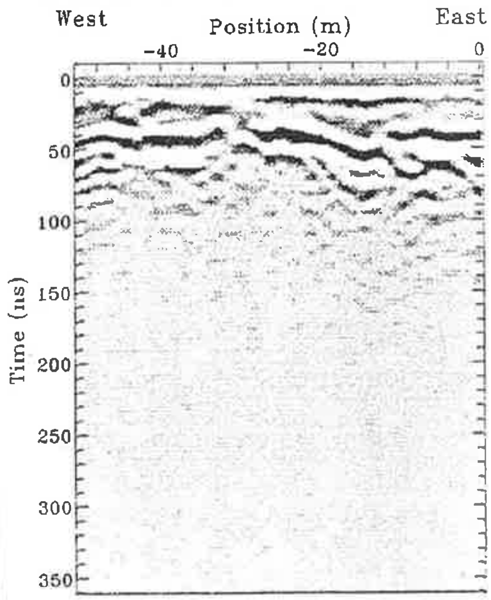
Borehole Information
(provided by Peto MacCallum Ltd)
- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

Horizontal Scale 1:750

10 0 10 20 30 40
(meters)

Figure: 13 Line 34-40	
Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	

Radar Section



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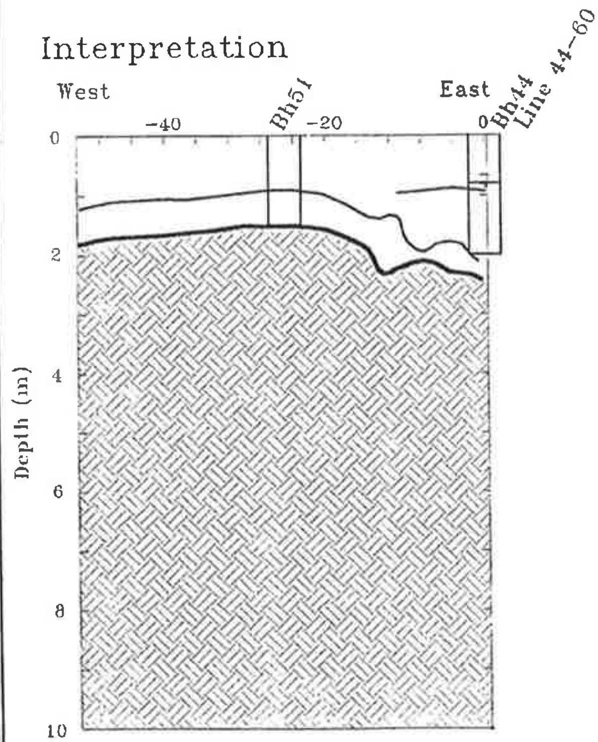

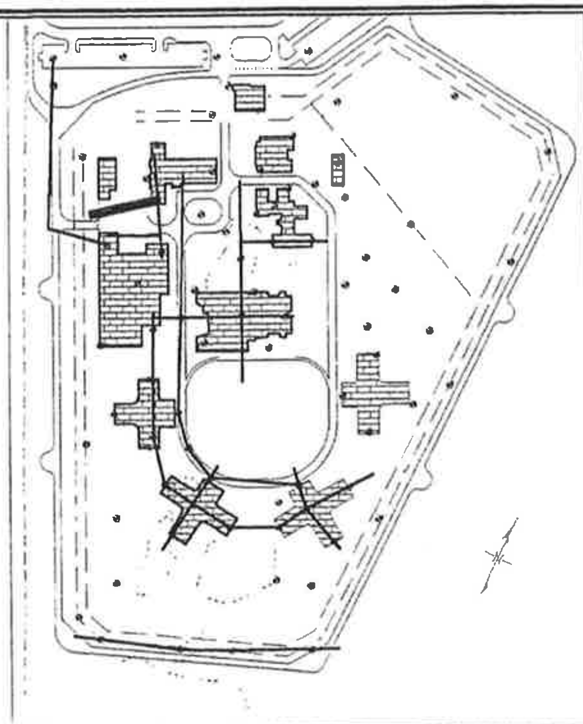

Legend

Interpretation

- Shallow Reflector
- Medium Reflector
- Deep (Bedrock) Reflector

Borehole Information
(provided by Peto MacCallum Ltd)

- Water level upon completion of auguering
- Refusal to auger on assumed Bedrock

Horizontal Scale 1:750

10 0 10 20 30 40
(meters)

Figure: 14
Line 51-44

Project: Muskoka Medium Security Institution	
Location: Gravenhurst, Ontario	Project No.: G143
Client: Peto MacCallum Ltd.	Hyd-Eng GEOPHYSICS INC.
Survey Date: 25-27 April 1995	
Instrument: Pulse Ekko IV GPR	

GEOTECHNICAL INVESTIGATIONS
SECTION 'D'

PHASE 1 GEOTECHNICAL INVESTIGATIONS
Peto MacCallum Ltd.

Date: December, 1994

PetoMacCallum Ltd.
CONSULTING ENGINEERS

PHASE I -

PRELIMINARY GEOTECHNICAL INVESTIGATION
MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO
FOR
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
C/O MOFFAT KINOSHITA ASSOCIATES INCORPORATED

DISTRIBUTION:

1 cc: PWGSC: Mr. R. Dhar
1 cc: MKAI: Mr. M. Seleanu
1 cc: Robert Halsall & Associates Ltd.: Mr. D. Thomson
1 cc: Hanscomb Consultants Inc.: Mr. P. Mason
1 cc: Dixon Hydrogeology Limited (Logs & Drawing Only)
1 cc: PML Barrie
1 cc: PML Toronto

Our Ref: 94 BF 053

December, 1994

Peto MacCallum Ltd.
CONSULTING ENGINEERS

December 9, 1994 Our Ref: 94 BF 053

Public Works and Government Service Canada
c/o Mr. M. Seleanu
Moffat Kinoshita Associates Incorporated
124 Merton Street, 2nd Floor
Toronto, Ontario
M4S 2Z2

Dear Mr. Seleanu

Preliminary Geotechnical Investigation
Muskoka Medium Security Institution
Gravenhurst, Ontario

We are pleased to present the results of the preliminary geotechnical investigation recently carried out at the above noted site. Authorization for this work was provided in our Engineering Services Agreement Reference 94 BF 053, signed November 17, 1994, by Mr. M. Seleanu of Moffat Kinoshita Associates Incorporated.

Thirty (30) boreholes were drilled during the period November 10 to 15, 1994, to investigate the subsurface conditions over the approximate 40 ha site. The available borehole information revealed variable soil and bedrock conditions with the groundwater table typically within 0 to 1 m of existing grade. In general, there are three main stratigraphic conditions:

1. Areas where a fairly thick competent upper sand (silt locally) exist or is underlain by bedrock.
2. Areas where the upper sand becomes very loose at depth, or is thin and underlain by soft clay.
3. Areas of shallow bedrock/bedrock outcrop.

In general, it is considered that the proposed buildings may be supported on spread footings. The design concept should involve maintaining footings as high as possible in the upper sand, to minimize difficulties associated with the high groundwater table, or minimise stressing/consolidation settlement in areas underlain by soft clay. In this regard, artificial insulation should be considered for frost protection of footings to reduce the foundation depth.

Bearing capacities in the range of 100 to 300 kPa are usually available for preliminary design of footings founded in the upper sand/silt. A conservative bearing capacity of 1000 kPa is available in the bedrock.

...ii

19 Churchill Drive, Barrie, Ontario L4M 6E7
Tel: (705) 734-3900 Fax: (705) 734-9911
OFFICES IN TORONTO, HAMILTON, KITCHENER, BARRIE, OSHAWA

Locally, in the southwest corner of the site/proposed residence a preliminary design bearing capacity of 25 kPa is suggested because of the proximity of underlying very loose sand or soft clay. This may warrant consideration of a raft or pile foundation, or building relocation.

It is envisioned that the development will involve elevated grades because of the high groundwater table. However, excessively raised grades should be avoided, as this will induce consolidation settlement in areas of underlying soft clay.

Subject to site grading requirements, it is considered that floor slabs-on-grade should be feasible.

Normal pavement design should be satisfactory, subject to adequate drainage measures. Localized areas of highly frost susceptible silt soils will warrant a thicker pavement.

Much of the excavated site material will be too wet for reuse as structural fill. However, the sand from above the groundwater table should be suitable for reuse.

The groundwater table was usually 0 to 1 m below existing grade. Groundwater control will be required during site preparation and excavation. Dewatering through the use of well point or similar means should be feasible in the predominant fine sand.

Excavation should be straightforward, provided effective dewatering is employed. Bedrock excavation will be required at some locations depending on final grades.

We trust the information contained in this preliminary report is sufficient for your present purposes. It is recommended that detailed investigations be carried out to confirm the subsurface conditions on a building by building basis, including confirmation of the strength/consolidation characteristics of the sand and underlying clay, and bedrock elevations.

Please call our office if you have any questions.

Sincerely

PETO MacCALLUM LTD.

Brian R. Gray, P.Eng.
Vice President
Geotechnical Engineering
Geo-Environmental Services

TLB\BRG:ga

PetoMacCallum Ltd.
CONSULTING ENGINEERS

TABLE OF CONTENT

1. INTRODUCTION

The subject site comprises an approximate 40 ha land parcel immediately south of the existing Beaver Creek Correctional Institution, in Gravenhurst, Ontario.

The proposed facility will comprise a number of separate buildings, including several residential complexes, Administration Building, Community/Education Centre, Family Visit Unit, Health Care Centre, Chapel, Visit/Correspondence Building and Industries building. It is understood the buildings will be largely residential in character, with light steel framed structures for some of the larger buildings. The buildings will be one or two stories with no level of basement.

The final building locations and finished grades were not established at the time of this investigation.

The purpose of this investigation was to obtain general geotechnical information on the subsurface conditions at the site. Based on this information, preliminary comments and geotechnical engineering recommendations were to be provided to assist in the planning and design of the proposed facility.

2. INVESTIGATION PROCEDURES

Thirty (30) boreholes were drilled at the site during the period November 10 to 15, 1994. The borehole locations were in general accordance with the appended Drawing 1 provided by the Architect, (November 7, 1994). The actual locations and elevations of the boreholes were established in the field by J. D. Barnes Limited; a diskette of the borehole survey was provided separately to the Architect.

Twenty-one (21) of the boreholes were advanced to refusal on assumed bedrock, at depths of 0.15 to 12.1 m below existing grade. Eight (8) boreholes were terminated in overburden at depths of 4.6 to 12.2 m. Borehole 11 was not accessible by the drillrig due to the wet ground conditions; this borehole was manually probed to a depth of 0.6 m.

The boreholes were advanced using a track mounted CME-55 drillrig, equipped with continuous flight hollow stem augers, supplied and operated by a specialist drilling contractor working under the full-time supervision of a member of our engineering staff. Three (3) of the boreholes were extended by dynamic cone penetration tests driven to refusal on assumed bedrock.

Representative samples of the overburden were recovered at frequent depth intervals for identification purposes, using a conventional split spoon sampler. Standard penetration tests were conducted simultaneously with the sampling operations, to assess the strength characteristics of the substrata. The undrained shear strength of cohesive soils was measured by pocket penetrometer tests and insitu vane tests. Dynamic cone penetration tests were conducted in three (3) boreholes to supplement the strength data.

The groundwater conditions in the boreholes were closely monitored during the course of the fieldwork. Standpipes (12 mm diameter PVC) were installed in eight (8) boreholes to permit monitoring of the stabilized groundwater levels. Groundwater samples were collected for analyses.

All recovered soil samples were returned to our laboratory for detailed examination. The following tests were conducted:

- Natural moisture content determinations in all soil samples (log sheet);
- Grain size analyses on six (6) representative soil samples (Figures 1 and 2);
- pH Value, Sulphate and Chloride content on four (4) groundwater samples (Table I).

3. SITE DESCRIPTION

The subject property is located within the Laurentian Highland area of the Precambrian shield (known locally as Algonquin Highlands). This physiographic area is typified by rugged relief with frequent outcrops of Precambrian bedrock/granitic gneiss. Relatively flat lying fluvial and locustrine sediments occur between outcrops, and bogs/swamps are characteristic.

The subject site is undeveloped and is presently wooded with few cleared pathways. The topography is relatively flat with the ground generally sloping down to south and west. The existing grade is at about elevation 275 in the northwest corner, sloping down to about elevation 266 to 267 in the southwest corner and elevation 265 along the east boundary. Bedrock outcrops are visible in the south part of the site. A bedrock knoll also occurs in the central part of the site. Generally wet ground conditions occur in the low lying east central and southwest parts of the site.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions including soil classification, inferred stratigraphy, depth to refusal on assumed bedrock, standard penetration and dynamic cone penetration tests "N" values, details of standpipe installation, groundwater observations and the results of laboratory moisture content determinations.

The stratigraphic sequence revealed in the boreholes may generally be described as comprising a topsoil mantle overlying a sand deposit, followed by a discontinuous clay unit, over bedrock. Localized layers of silt were found bedded in the upper sand deposit and sometimes under the basal clay unit. Fill was also found locally.

Fill

Some 1.7 m of sand and gravel fill containing construction rubble was encountered in borehole 4. Stockpiling of fill in this area was in progress during this investigation.

In borehole 7, a 200 mm thick layer of sand fill was exposed at surface. A thin (50 mm) layer of black cinder fill exists on the pathway as revealed in borehole 15.

Topsoil

Other than the fill noted above, a topsoil mantle was encountered at the boreholes. This layer was usually 100 to 300 mm thick (450 mm locally) and comprised dark brown to black silt, and humus/peat locally.

Sand

An upper sand unit was generally contacted under the topsoil and localized fill. The sand was predominately fine grained (refer to Figure 1), with zones of silty sand and fine to coarse sand. The sand extended the full 1.5 to 5.0 m depth of exploration in boreholes 1 to 3, 5, 6, 8 to 10, 12 and 16. The sand unit was fully penetrated near depths of 0.9 to 10.5 m in boreholes 4, 7, 13, 14, 17 to 21, 24, 25, 28 and 30.

The relative density of the sand ranged form very loose to very dense but was usually compact. Moisture contents in the sand were typically 20 to 25%, indicating saturated conditions.

Silt

Localized layers of silt, sandy silt, and clayey silt (refer to Figure 2 for grain size chart) were encountered in boreholes 1, 7, 9, 14, 15, 17, 22 to 25, 27, 28 and 30. This layer was often found above or below the upper sand, and occasionally below the clay unit described later. The silt layer ranged from 1.0 to 2.8 m in thickness. This material was usually compact/stiff (loose and very dense locally). Moisture contents were in the 20 to 30% range.

Clay

A clay deposit was contacted under the sand or localized silt in boreholes 4, 13, 15, 17 to 21, 24, 25 and 28 at depths of 0.9 to 10.5 m below grade. The particle size distribution chart for a representative clay sample is presented on Figure 2. The clay was usually very soft to soft based on standard penetration test "N" values, pocket penetrometer and/or insitu vane tests. Moisture contents were typically in the 30 to 50% range.

The clay unit where penetrated usually extended to bedrock, although thin sand or silt layers were sometimes encountered immediately over the bedrock surface.

Bedrock

Based on auger refusal or refusal to dynamic cone penetration, bedrock was assumed at depths of 0.15 to 12.1 m in boreholes 1, 3 to 5, 7, 9, 12, 14, 15, 17, 18, 20 to 23 and 25 to 30. Bedrock was not contacted at the termination depth in the remaining boreholes.

Bedrock outcrops were visible in the south part of the site, and also in the central area. The limits of bedrock outcrops are highlighted on Drawing 1, based on the J.D. Barnes Topographical Survey.

The bedrock comprises Precambrian granitic gneiss.

Groundwater

Groundwater was encountered in most boreholes. Although no free water was noted in a few boreholes during drilling, soil moisture contents suggested that with time the water level would have risen. Based on observations in the boreholes, in standpipes and considering the soil moisture content profile, the groundwater table was interpreted to be at grade to generally within 1 m depth (locally up to 1.7 m depth), and is subject to seasonal fluctuations.

5. ENGINEERING CONSIDERATION

5.1 Foundations

The limited number of boreholes drilled at the site indicate variable soil and bedrock conditions, and a high groundwater table at grade to generally within 1 m of present ground level. In general, it is considered that the proposed relatively lightly loaded buildings may be supported on spread footings. However, a wide range of bearing capacities is available for design, depending on location.

Table II appended, summarizes on a borehole by borehole basis, the general soil types, depth to bedrock, groundwater levels, and preliminary bearing capacities for foundation considerations. On Table II, the boreholes are grouped to relate to the closest proposed building, as illustrated on the "Preliminary Massing Study Option H 1", dated November 21, 1994, provided by the Architect. The boreholes along the fence line are also listed and evaluated, to illustrate the overall geotechnical conditions.

In general, there are three (3) main stratigraphic conditions affecting the foundation design:

1. Areas where the upper sand (localized silt) layer is fairly thick or is underlain by bedrock.

   - Boreholes 1 to 3, 5 to 7, 9, 10, 12, 14 and 16 in the north half of the site.
   - Boreholes 19, 20, 22 to 24 and 30, representing parts within the south half of the site.

   In these areas the proposed buildings may be supported on conventional spread footings. Net allowable bearing capacities in the range of 100 to 300 kPa are available for proportioning footings, depending on location.

2. Areas where the upper sand becomes very loose at depth, or is thin and underlain by soft clay.

   - Boreholes 4, 8, 13 and 18 in the lowlying northeast quadrant of the site.
   - Boreholes 21, 25 and 28 in the lowlying southwest corner of the site.
   - Boreholes 15 and 17, locally in the central section of the site.

   In these areas, it may be possible to maintain footings as high as possible in the upper sand, to minimize stressing and consolidation settlement in the underlying soft clay.

   The available data indicate a net allowable bearing capacity of 100 kPa may be considered for preliminary design of footings maintained in the upper sand at boreholes 8, 13, 15, 17, 18 and 28.

   At boreholes 21 and 25 (southwest residence), an allowable bearing capacity of 25 kPa may be considered. A raft or pile foundation or building relocation may be warranted. Similar considerations apply to borehole 4, along the north fence line.

3. Areas of shallow bedrock/bedrock outcrop.

Bedrock outcrops occur in the south end of the site and also in the central part of the site, as illustrated on Drawing 1. Bedrock was contacted at less than 1.5 m depth in borehole 12 (central part of site) and boreholes 26, 27 and 29 (south part of site). In boreholes 5, 14, 22, 23 and 30 bedrock was contacted within 3 m of grade and the possibility of shallow bedrock in these general areas should not be disregarded.

An allowable bearing capacity of at least 1000 kPa is available for supporting footings founded on bedrock. However, minimum footing width must be in accordance with the Ontario Building Code.

Footings on sloping bedrock should be provided with shear pins/dowels into the bedrock to prevent sliding.

It should be pointed out that combinations of the three above described subsurface conditions may occur within individual buildings, as indicated, for example, in boreholes 12, 14 and 15 in the proposed Community/Education Centre. More detailed investigation will be required to assess the preferred foundation scheme, once the building locations and site grading plans are finalized.

Where bedrock is shallow, it is preferable that all footings be founded on bedrock to minimize potential differential settlements arising from footings founded partly on unyielded bedrock and footings partly on overburden. Alternatively, considering the buildings to be relatively light, a conservative design bearing capacity may be adapted, cognizant of the soil strength relative to bedrock.

In general, it is considered that foundations should be kept as high as practically possible for the following reasons:

- to minimize difficulties associated with excavation below the groundwater table;
- to take advantage of the upper sand and minimize stressing/consolidation settlement in the underlying soft clay.

A minimum 1.5 m of earth cover or thermal equivalent should be provided over footings founded on overburden for frost protection. In view of the high groundwater table, the use of thermally equivalent insulation would minimize the foundation depth. The normal frost cover may be reduced for footings founded on sound massive bedrock, subject to geotechnical inspection.

The bearing capacities discussed above are generally intended to limit total settlement to 25 mm, provided the subgrade is not unduly disturbed during construction. This does not take into consideration the site grading requirements, whereby excess filling may induce additional unacceptable settlement in areas underlain by soft clay. Review of site filling/grading will be required.

The site soils, in conjunction with the high groundwater table, will be sensitive to disturbance by even light traffic. Effective dewatering will be required, and construction procedures and schedule adopted to minimize subgrade disturbance. The use of a concrete mud slab to protect founding surfaces is recommended.

5.2 Foundation Factor

Based on the stratigraphy revealed in the boreholes, generally comprising sand overlying soft clay and bedrock less than 15 m depth, a foundation factor F = 1.3 is recommended for use to compute earthquake forces.

5.3 Slab-On-Grade

Cognizant of the high groundwater table, it is expected the finished floor will be established at or slightly above existing grade. The site grades should not be excessively raised, which may lead to unacceptable settlement in the underlying soft clay. Subject to further investigation and review of final grading plans, conventional slab-on-grade construction should be feasible. General guidelines for subgrade preparation for slab-on-grade construction are as follows:

1. Strip topsoil, existing fill and other deleterious materials down to native subgrade.

2. Proofroll exposed native subgrade with a heavy static compactor. Any deleterious zones identified during this process should be further excavated and replaced with well compacted granular material.

- Excessive proofrolling should be avoided in areas where the groundwater table is at or close to the bottom of the excavation.

3. Following subgrade approval, the design grades can be achieved using engineered fill. The engineered fill should comprise select on-site sand or imported granular material (OPS Granular 'B' or equivalent), placed in maximum 200 mm thick lifts and uniformly compacted to at least 95% Standard Proctor maximum dry density.

4. Appropriate groundwater control must be implemented to permit stripping and filling operations.

5. Inspection and testing by Peto MacCallum Ltd. will be required to approve subgrade preparation, engineered fill placement, and verify the specified compaction is achieved throughout.

It is recommended a drainage system be incorporated under the floor slabs-on-grade. Such a system may comprise weeping tiles embedded in a minimum 230 mm thick layer of 20 mm clear crushed stone. The stone layer should be underlain with synthetic filter fabric to prevent contamination of the stone.

Where a vapour sensitive floor finish is to be employed, then a vapour barrier such as polyethylene sheeting should be considered.

A modulus of subgrade reaction k_s = 15,000 kN/m^3 may be assumed for design of slabs-on-grade founded on native sand or engineered fill subgrade.

5.4 <u>Pavement</u>

It is anticipated the pavement subgrade for the most part will comprise native sand or engineered fill in areas where the site is raised. Subgrade preparation and engineered fill construction should be carried out in accordance with the guidelines provided for slab-on-grade in Section 5.3 of this report.

Based on the estimated strength and frost susceptibility characteristics of the sand/engineered fill subgrade, the following minimum pavement thicknesses are recommended:

	Light Duty Passenger Car Parking (mm)	Heavy Duty Access Road & Truck Traffic Areas (mm)
Asphaltic Concrete	75	100
Granular 'A' Base	150	150
Granular 'B' Subbase	150	300

Locally, highly frost susceptible silt subgrade may be encountered. In these areas it is recommended the Granular 'B' subbase be increased by 300 mm. Additional boreholes and inspection during construction would be required to identify the extend of this requirement.

The granular pavement courses should conform to the Ontario Provincial Standard specifications for select granular materials and should be compacted to a minimum 98% Standard Proctor maximum dry density. Asphaltic concrete should be compacted to at least 96% Marshall density.

The pavement design considers that the subgrade is stable, not heaving under construction equipment. Depending on grades, it is likely that wet, unstable subgrade conditions would be encountered. In this regard, additional granular subbase or the use of synthetic geotextile fabric and reinforcing membrane may be required.

For the pavement to function properly, provision must be made for water to drain out of, and not collect in the granular base courses. In this regard, it is noted the groundwater table is generally within 1 m of existing grade and therefore the pavement should be elevated, and subdrains incorporated particularly in silt subgrade areas. Overall grading should be established to promote positive drainage away from the pavement.

5.5 Reusability of Site Soils as Backfill

The native sand that occurs over much of the site is considered suitable for reuse as engineered fill under slab-on-grade and pavements, on a select basis only. Portions of the sand above the groundwater table should be suitable, while sands excavated from below the groundwater table would be too wet to achieve adequate compaction.

Based on the grain size charts, Figure 1, the majority of the sand is relatively free draining and may also be utilized as backfill to exterior walls on a select basis, subject to ongoing field evaluation.

Topsoil, excessively wet and/or frozen materials or rubble should not be incorporated in structural backfill.

5.6 Excavation and Groundwater Control

The site generally comprises sand and localized silt, over discontinuous clay deposit over bedrock, with outcrops occurring locally. Considering excavation only to establish footing frost cover (no basement involved) then excavation for this development is expected to be relatively shallow and for the most part will occur within the upper sand unit and localized silt. Standard method of rock excavation, including controlled blasting would be required where bedrock is encountered.

All work should be carried out in accordance with the Occupational Health and Safety Act.

Subject to effective groundwater control, it is considered that the anticipated shallow excavations in overburden may be carried out as open cuts, with side walls constructed at no steeper than 1 horizontal to 1 vertical, subject to geotechnical inspection. Near vertical side wall in rock cuts should be stable.

As noted earlier, the groundwater table was generally recorded at or close to ground surface, and is subject to seasonal fluctuations. Lowering of the groundwater table to at least 600 mm below the anticipated bottom of excavation is recommended, to permit construction under relatively dry conditions, and for purposes of excavation side wall stability, as well as to prevent instability in the bottom of the excavation (particularly for foundation support).

Based on the predominately fine sand anticipated within the influenced depth of construction, it is believed that dewatering through the use of well points or similar means should be feasible. Reference is made to Figure 1, for the grain size distribution charts for representative samples of the sand.

It should be pointed out that there is a particular concern regarding stability of deep excavations in areas of underlying soft clay. In this regard, deep excavation requirements should be reviewed by our office to identify any special consideration that may be necessary.

5.7 Sulphate Attack on Buried Concrete

The results of analysis for pH value, sulphate and chloride content on four (4) groundwater samples are enclosed on Table I.

In accordance with Canadian Standard Association, CSA-A23.1, the sulphate contents of 11 to 49 ppm measured in the groundwater samples, indicate a negligible potential degree of sulphate attack on buried concrete. Accordingly, the use of normal portland cement is indicated.

5.8 Detailed Investigation and Review

The preliminary investigation has revealed variable subsurface conditions. A detailed investigation on a building by building basis is recommended for final design purposes:

1. to delineate the thickness and strength/consolidation characteristics of the sand and underlying clay to confirm the available bearing capacity for footing design and settlement analysis.

   This will include detailed insitu and laboratory strength testing, and may also involve sophisticated consolidation tests to evaluate potential long term settlement.

2. to delineate bedrock profile which can be achieved through a series of sample boreholes, auger probes and/or geophysical survey. This will assist in finalizing building locations to optimize foundation design and rock excavation quantities.

It is recommended that details of the investigation be established after review and discussion of building locations and final grading plans.

Sincerely

PETO MacCALLUM LTD.

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

REGISTERED PROFESSIONAL ENGINEER
T. LEE-BUN
PROVINCE OF ONTARIO

Brian R. Gray, P.Eng.
Vice President
Geotechnical Engineering
Geo-Environmental Services

BRG\TLB:ga

TO : PETO Mac.(Barrie PHONE NO. : 17057349911 NOV.25.1994 4:55PM P 1
FROM : ENTECH A Division of Agri-Service Laboratory Inc. PHONE NO. : 1 905 821 2095

ENTECH
A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit 94
Mississauga, ONT L5N 5M3
TEL: (905) 821-1112
FAX: (905) 821-2095

Client: Peto MacCallum Ltd.

Project Number: 94BF053

P.O. Number:

Date Received: November 16/94
Date Reported: November 25/94

Matrix: Water

Attention: J.F. Wright

Sam Sanyal, M.Sc., C. Chem

MISC. SAMPLE TESTS

PARAMETER	Units	Method Detection Limit (ppm)	CONTROL SAMPLE			SAMPLE DATA			
			Expected Level (ppm)	Found Level (ppm)	Recovery %	8153 BH2	8154 BH4	8155 BH10	8156 BH29
pH			.	.	.	6.69	7.30	6.57	6.87
Sulphate	ppm	0.5	254	253.4	100	49.0	25.7	16.8	11.2
Chloride	ppm	0.5	195	194.4	100	12.0	9.8	12.6	2.6
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TABLE I

pH Value, Sulphate and Chloride Content of Groundwater Samples
Muskoka Medium Security Institution
Gravenhurst, Ontario

PetoMacCallum Ltd.
CONSULTING ENGINEERS

Our Ref: 94 BF 053
December, 1994

TABLE II (1 of 3)

SUMMARY OF SOIL, BEDROCK AND GROUNDWATER OBSERVATIONS
AND PRELIMINARY BEARING CAPACITY FOUNDATION

MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO

BUILDING	BOREHOLE	SOIL	BEDROCK Depth (m)/Elev	GROUNDWATER Depth (m)/Elev.		BEARING CAPACITY (kPa)
(1)	(2)	(3)	(4)	(5A)	(5B)	(6)
Gatehouse/Visit Correspondence	2	sand	5.0+		1.6/271-5	150 kPa at minimum 0.6 m depth
Family Unit	3	sand	12.1/258.2	0.5/269.8		200 kPa at minimum 0.9 m depth
	6	sand	4.6+		0.3/269.1	150 kPa at nominal 0.6 m depth
Healthcare	5	sand	2.1/270.5		1.2/271.4	200 kPa at minimum 0.6 m depth 1000 kPa bedrock at 2.1 m depth
Administration	7	sand	4.55/265.8		1.0/269.4	200 kPa at minimum 0.6 m depth
Residential (Future)	8	sand	4.6+		0.9/264.8	100 kPa at maximum 1.0m depth (significantly reduced bearing below due to underlying very loose sand)
	10	sand	4.6+		0.9/265.0	100 kPa at minimum 0.6 m depth
	13	sand	12.2+		0.5/262.7	100 kPa at maximum 1.0 m depth (significantly reduced bearing capacity below due to underlying very loose sand)
	16	sand	4.6+	1.3/265.2		200 kPa at maximum 1.5 m depth 100 kPa below 1.5 m depth

PetoMacCallum Ltd.
CONSULTING ENGINEERS

Our Ref: 94 BF 053
December, 1994

TABLE II (2 of 3)

SUMMARY OF SOIL, BEDROCK AND GROUNDWATER OBSERVATIONS AND PRELIMINARY BEARING CAPACITY FOUNDATION

MUSKOKA MEDIUM SECURITY INSTITUTION GRAVENHURST, ONTARIO

BUILDING	BOREHOLE	SOIL	BEDROCK Depth (m)/Elev	GROUNDWATER Depth (m)/Elev.		BEARING CAPACITY (kPa)
(1)	(2)	(3)	(4)	(5A)	(5B)	(6)
Industries	9	sand/silt	3.9/266.6		1.5/269.0	250 kPa at minimum 0.6 m depth
Community/ Education	12	sand	1.45/268.0			300 kPa at minimum 0.6 m depth 1000 kPa on bedrock at 1.45 m depth
	14	sand/silt	2.45/266.7		0.8/268.3	200 kPa at minimum 0.6 1000 kPa on bedrock at 2.45 m depth
	15	silt	4.1/263.9		1.2/266.8	100 kPa at maximum 1.0 m depth (substantially reduced bearing below due to underlying soft clay)
Residential (west central)	17	sand	3.05/265.7	0.4/268.3		100 kPa at maximum 1.0 m depth (possible reduced bearing due to underlying clay)
	19	sand	6.1+		0.6/267.7	150 kPa at minimum 0.6 m depth
	20	sand	9.7/258.5		0.4/267.8	150 kPa at minimum 0.6 m depth
Residential (southwest)	21	sand	6.05/261.31		0.8/266.6	25 kPa at maximum 0.8 m depth (raft or pile foundation or relocation of building requires consideration subject to further investigation)
	25	sand	4.7/262.5		0.4/266.8	25 kPa at maximum 0.5 m depth (raft or pile foundation or relocation of building requires consideration subject to further investigation

Our Ref: 94 BF 053
December, 1994

TABLE II (3 of 3)

SUMMARY OF SOIL, BEDROCK AND GROUNDWATER OBSERVATIONS AND PRELIMINARY BEARING CAPACITY FOUNDATION
MUSKOKA MEDIUM SECURITY INSTITUTION
GRAVENHURST, ONTARIO

BUILDING (1)	BOREHOLE (2)	SOIL (3)	BEDROCK Depth (m)/Elev (4)	GROUNDWATER Depth (m)/Elev. (5A)	(5B)	BEARING CAPACITY (kPa) (6)
Residential (southeast)	22	silt	1.85/266.4		1.7/266.5	250 kPa at minimum 0.6 m depth 1000 kPa on bedrock at 1.85 m depth
	23	silt	2.75/263.8	0.5/266.1		150 kPa at minimum 0.6 m depth 1000 kPa on bedrock at 2.75 m depth
	26		0.3/268.2			1000 kPa on bedrock at 0.3 m depth
	27	silt	1.25/265.4		0.8/265.8	300 kPa at minimum 0.6 m depth 1000 kPa on bedrock at 1.25 m depth
Along Fence Line	1	sand	3.65/269.7	0.9/272.5		150 kPa at minimum 0.6 m depth
	4	fill over sand	10.5/257.1	0.8/266.9		25 kPa at 1.7 m depth (below fill) (substantially reduced bearing below due to underlying very loose sand) (raft or pile foundation requires consideration subject to further investigation)
	18	sand	7.65/254.5		0.6/261.5	100 kPa at maximum 1.0 m depth (substantially reduced bearing below due to underlying very loose sand)
	24	silt/sand	6.55+		0.6/265.0	250 kPa at minimum 0.6 m to maximum 1.4 m depth
	28	sand	5.5/261.3		at grade/266.8	100 kPa at maximum 0.5 m depth (substantially reduced bearing below, due to underlying soft clay)
	29		0.15/270.15			1000 kPa on bedrock at 0.15 m depth
	30	sand over silt/clay	2.75/262.5	1.2/264.0		150 kPa at minimum 0.5 m depth

NOTES:

1. Building: Proposed building closest to borehole (based on Preliminary Massing Study, Option H1, November 21, 1994).
2. Borehole: Borehole closest to proposed building/fence line.
3. Soil: Anticipated soil type.
4. Bedrock: Depth to assumed bedrock based on auger refusal or refusal to dynamic cone penetration.

5A. Groundwater: Based on measurements in standpipes.

5B. Groundwater: Interpreted based on observation during drilling in open boreholes, and/or moisture content profile.

6. Bearing Capacity: Preliminary evaluation of available bearing capacity at specified depth.

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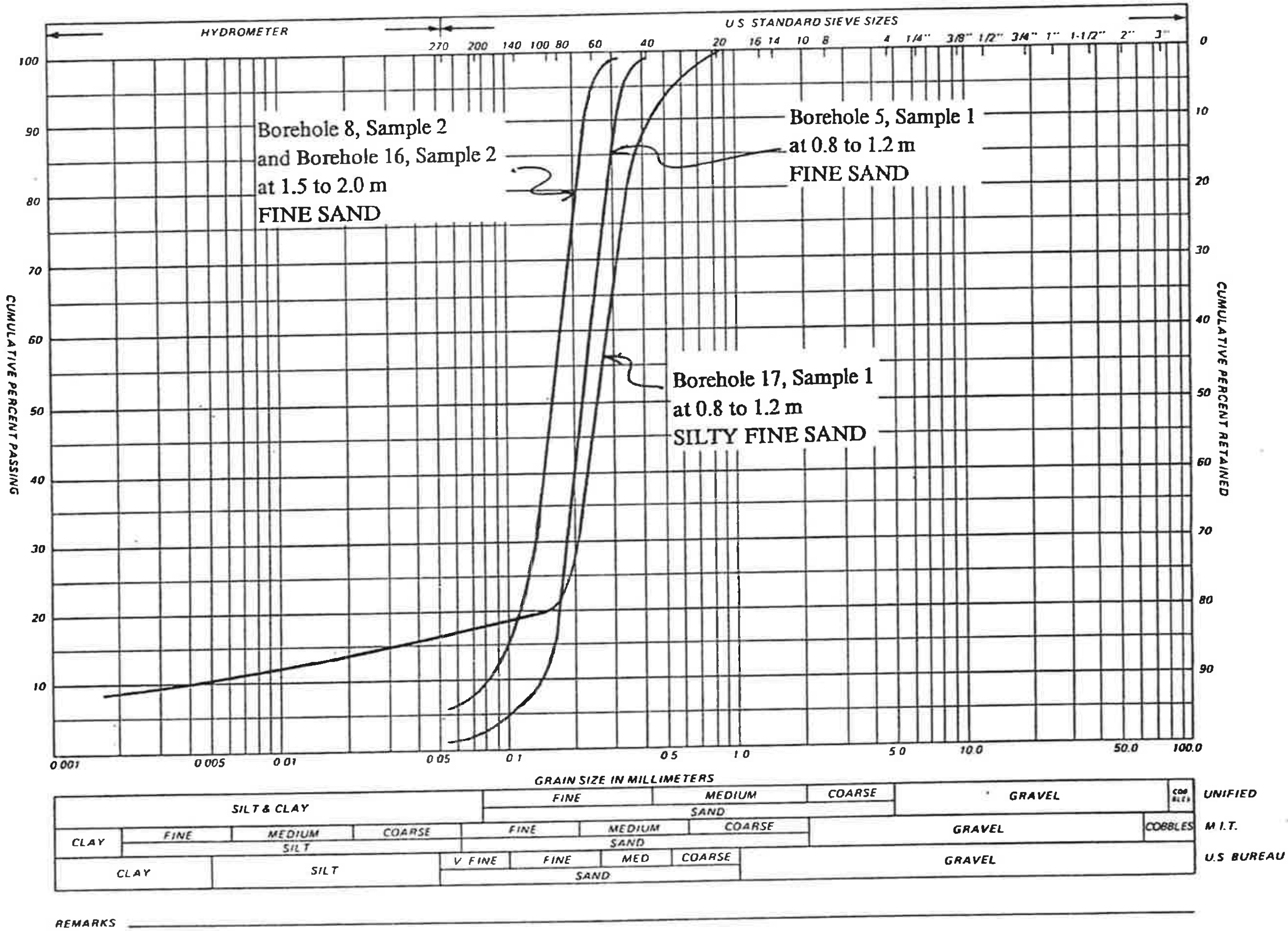
PARTICLE SIZE DISTRIBUTION CHART

FIGURE 1

OUR PROJECT NO. 94 BF 053

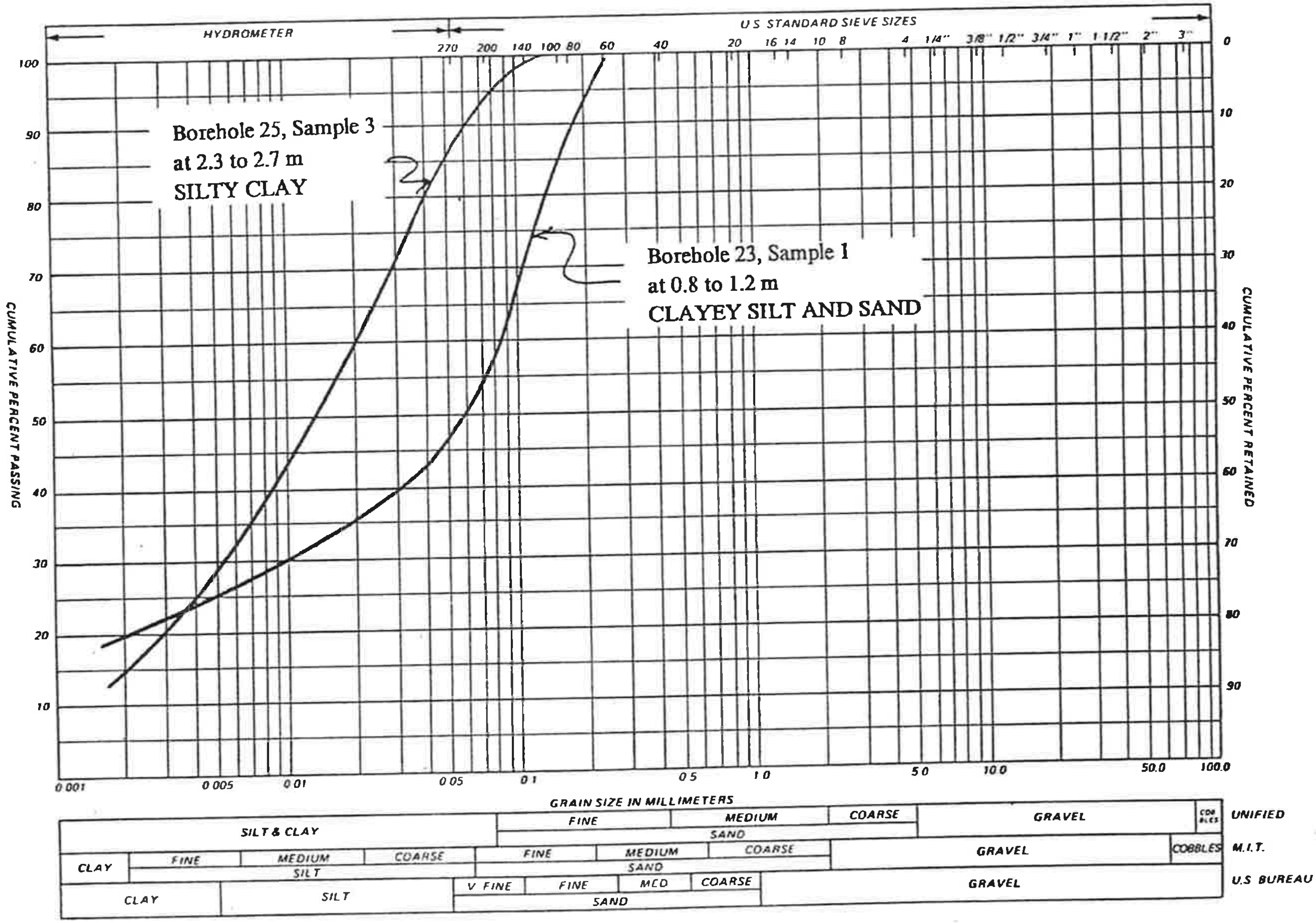


PetoMacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

FIGURE 2

OUR PROJECT NO. 94 BF 053



REMARKS

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

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

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

CONSISTENCY	'N' BLOWS/0.3m	c kPa	DENSENESS	'N' BLOWS/0.3m
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
W.S. WASHED SAMPLE
S.B. SCRAPER BUCKET SAMPLE
A.S. AUGER SAMPLE
C.S. CHUNK SAMPLE
S.T. SLOTTED TUBE SAMPLE
T.W. THINWALL OPEN
T.P. THINWALL PISTON
O.S. OESTERBERG SAMPLE
F.S. FOIL SAMPLE
R.C. ROCK CORE
P.H. SAMPLE ADVANCED HYDRAULICALLY
P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

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

PetoMacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 1 and 2

PROJECT Muskoka Medium Security Institution
OUR PROJECT NO 94 BF 053
LOCATION Gravenhurst, Ontario
BORING DATE Nov. 10/94
ENGINEER JFW
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN JFW

SHEAR STRENGTH C_u ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M: 20, 40, 60, 80

LIQUID LIMIT —— W_L
PLASTIC LIMIT —— W_P
WATER CONTENT —— W
W_P W W_L
WATER CONTENT %: 10, 20, 30

BOREHOLE 1
GROUND ELEVATION 273.39

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: dark brown sandy silt	273				bentonite seal
1.00	SAND: compact brown fine sand, some silt, with rust brown layers, moist		1	SS	14	12 mm PVC pipe
1.5		272				
1.80	saturated		2	SS	13	native backfill
	SILT: compact grey silt to sandy silt, saturated	271	3	SS	21	
2.90 (3.0)	SAND: compact grey silty fine to medium sand, trace gravel, saturated	270	4	SS	18	
3.65	BOREHOLE TERMINATED AT 3.65 m on refusal to auger on assumed bedrock	269				sampler wet after SS 2; Upon completion of augering water at 1.2 m
4.5						

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	1.07
Dec. 6	0.90

BOREHOLE 2
GROUND ELEVATION: 273.09

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: black humus					
	SAND: compact brown fine sand, moist	272	1	SS	19	
1.5		271	2	SS	15	
2.10	dense, fine to coarse, saturated	270	3	SS	31	sample wet after SS 3
2.90	compact, fine sand, stratified		4	SS	25	
3.50	silty fine sand	269				
4.5			5	SS	22	
5.00	BOREHOLE TERMINATED AT 5.00 m Borehole 2 adjacent to fill pile	268				Upon completion of augering water at 2.1 m water sampled
6.0						

NOTES

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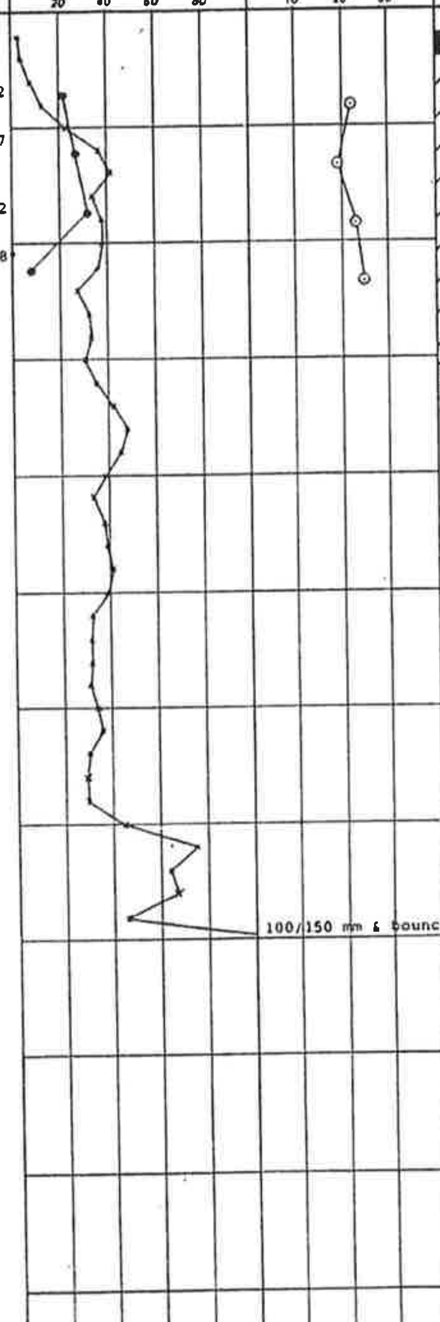
LOG OF BOREHOLE NO. 3

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE Nov. 10/94
OUR PROJECT NO. 94 BF 053
ENGINEER JFW
TECHNICIAN JFW

GROUND ELEVATION 270.32

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20	TOPSOIL: black sandy silt	270				bentonite seal
	SAND: compact brown fine to medium sand, saturated	269	1	SS	22	native backfill
			2	SS	27	12 mm PVC pipe
2.10	dense, stratified	268	3	SS	32	
		267	4	SS	8*	
4.60	BOREHOLE TERMINATED AT 4.60 m moved over and conducted dynamic cone penetration test	266 / 265				sampler wet after SS1. After drilling to 4.6 m sand heaved to 1.5 m inside augers water at 0.7 m
12.10	Dynamic cone penetration test terminated at 12.10 m on refusal on assumed bedrock	258				

Depth scale: 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0, 16.5
Elevations: 270, 269, 268, 267, 266, 265, 264, 263, 262, 261, 260, 259, 258



WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	0.53
Dec. 6	0.50

NOTES. * Suspect low N value due to hydrostatic pressure.

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LOG OF BOREHOLE NO. 4

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 15/94
OUR PROJECT NO.: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

GROUND ELEVATION: 267.74

Depth (m)	Description	Elevation	Sample No.	Type	N-Value (blows/0.3 m)	Ground Water Observations and Remarks
0	FILL: loose brown sand and gravel, random cobbles, pieces of asphaltic concrete, concrete, brick, timber	267	1	SS	5	bentonite seal; native backfill
1.70		266	2	SS	17*	
	SAND: loose to very loose brown fine sand, some silt, saturated					cave
2.10	grey	265	3	SS	7	
			4	SS	0	12 mm PVC pipe
		264				
4.00	brown	263	5	SS	5	
5.60	grey	262				
			6	SS	1	
6.30	CLAY: very soft grey clay, W.T.P.L. with thin layers/seams of fine sand, saturated	261				
		260	7	SS	0	
		259				
			8	FV	-	
		258				
10.50	BOREHOLE TERMINATED AT 10.50 m on refusal to auger on assumed bedrock	257				

Water content (%): approx. 23 (SS1), 27 (SS2), 27 (SS3), 25 (SS4), 31 (SS5), 53% (SS6), 48% (SS7).

Sampler wet after SS2

Upon completion of augering water at 1.5 m, cave at 1.8 m

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	7.01
Dec. 6	0.80

NOTES:
- * High N value due to piece of wood.
- ▲ Undisturbed shear strength } based on insitu vane test
- △ Remoulded shear strength }
- ■ Shear strength based on pocket penetrometer

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LOG OF BOREHOLE NO. 5 and 6

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 10/94
OUR PROJECT NO. 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u ▲ | DYNAMIC CONE PENETRATION ■ / STANDARD PENETRATION TEST ● (BLOWS/0.3M: 20, 40, 60, 80) | LIQUID LIMIT — W_L, PLASTIC LIMIT — W_P, WATER CONTENT — W (WATER CONTENT %: 10, 20, 30) | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 5 — GROUND ELEVATION 272.60

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: dark brown sandy silt	272				
	SAND: compact brown fine sand, moist		1	SS	24	
1.20	dense, stratified with rust brown layers, saturated	271	2	SS	33	sampler wet after SS 2
2.10	BOREHOLE TERMINATED AT 2.10 m on refusal to auger on assumed bedrock	270				Upon completion of augering water at 1.2 m

BOREHOLE 6 — GROUND ELEVATION: 269.42

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.45	TOPSOIL: black peat	269				
	SAND: compact brown fine sand, saturated	268	1	SS	18	after augering to 0.8 m, water at 0.3 m
1.5			2	SS	10	
		267	3	SS	30	
2.60	dense, silty	266				after augering to 3.0 m sand heaved to 1.2 m, water at 0.3 m
		265				after augering to 4.6 m sand heaved to 2.9 m, water at 0.3 m
4.60	BOREHOLE TERMINATED AT 4.60 m	264				

Depth scale: 1.5, 3.0, 4.5, 6.0

NOTES

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LOG OF BOREHOLE NO. 7 and 8

PROJECT	Muskoka Medium Security Institution	OUR PROJECT NO	94 BF 053
LOCATION	Gravenhurst, Ontario	BORING DATE	Nov. 10/94
BORING METHOD	Continuous Flight Hollow Stem Augers	ENGINEER	JFW
		TECHNICIAN	JFW

SOIL PROFILE / SAMPLES / SHEAR STRENGTH C_u ▲ / DYNAMIC CONE PENETRATION ▪ / STANDARD PENETRATION TEST ● / BLOWS/0.3M 20 40 60 80 / LIQUID LIMIT — W_L / PLASTIC LIMIT — W_P / WATER CONTENT — W / WATER CONTENT % 10 20 30 / GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 7
GROUND ELEVATION 270.35

DEPTH IN METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20	FILL: brown sand	270				
0.50	TOPSOIL: black sandy silt		1	SS	18	
1.5	SAND: compact stratified brown and rust brown fine sand, some silt, saturated	269	2	SS	23	sampler wet after SS 2
2.60	SILT: compact/stiff brown to grey silt with seams and layers of fine sandy silt and clayey silt	268	3	SS	19	
3.0		267	4	SS	11	
		266				
4.5 / 4.55	BOREHOLE TERMINATED AT 4.55 m on refusal to auger on assumed bedrock	265				Upon completion of augering water at 1.2 m cave at 1.5 m

BOREHOLE 8
GROUND ELEVATION: 265.70

DEPTH IN METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20	TOPSOIL: black sandy silt	265				
	SAND: compact brown fine sand, some silt, saturated		1	SS	12	sampler wet after SS 1
1.5		264	2	SS	14	
2.10	very loose	263	3	SS	2/150 mm	
3.0		262	4	SS	4	after SS 4, water at 0.9 m, sand heaved to 1.7 m
4.5 / 4.60	BOREHOLE TERMINATED AT 4.60 m	261				Upon completion of augering water at 0.9 m
6.0						

NOTES

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LOG OF BOREHOLE NO. 9 and 10

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Holoow Stem Augers
BORING DATE: Nov. 11/94
OUR PROJECT NO.: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

BOREHOLE 9 — GROUND ELEVATION 270.49

DEPTH (m)	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	N-VALUES (BLOWS/0.3 m)	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: black sandy silt	270				
	SAND: dense brown fine to some silt, moist		1	SS	33	
1.40	SILT: compact brown silt to fine sandy silt, moist to saturated, with layers of silt to clayey silt, W.T.P.L.	269	2	SS	25	
		268	3	SS	14	
			4	SS	21	
3.30	SAND: compact brown fine sand, saturated	267				
3.90	BOREHOLE TERMINATED AT 3.90 m on refusal to auger on assumed bedrock	266				Upon completion of augering, water at 3.0 m

BOREHOLE 10 — GROUND ELEVATION: 265.88

DEPTH (m)	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	N-VALUES (BLOWS/0.3 m)	GROUND WATER OBSERVATIONS AND REMARKS
0.25	TOPSOIL: black silt					
	SAND: loose brown to grey fine sand to silty fine sand, saturated	265	1	SS	8	sampler wet after SS 1
		264	2	SS	10	
		263	3	SS	8	after drilling to 3.0 m, sand heaved inside augers
		262	4	AS	-	after drilling to 4.6 m, water at 1.8 m sand heaved to 2.8 m
4.60	BOREHOLE TERMINATED AT 4.60 m	261				Upon completion of augering water at 0.9 m

SHEAR STRENGTH C_u ▲ — DYNAMIC CONE PENETRATION × / STANDARD PENETRATION TEST • — BLOWS/0.3M: 20 40 60 80

LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W; WATER CONTENT %: 10 20 30

Depth scale: 1.5, 3.0, 4.5, 6.0

NOTES:

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LOG OF BOREHOLE NO. 11 and 12

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE Nov.11/94
OUR PROJECT NO 94 BF 053
ENGINEER JFW
TECHNICIAN JFW

DEPTH in METRES	SOIL PROFILE: DESCRIPTION	ELEVATION	SAMPLES: NUMBER	TYPE	BLOWS/0.3m N-VALUES	SHEAR STRENGTH C_u / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST (BLOWS/0.3M 20 40 60 80)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (WATER CONTENT % 10 20 30)	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 11 GROUND ELEVATION 263.06							water at grade
0.30	TOPSOIL: black silt and root mat							
0.60	SAND: saturated	262						
1.5	Borehole 11 could not be accessed with tracked drillrig due to excessively wet ground conditions. Description based on manual probing							
3.0								
	BOREHOLE 12 GROUND ELEVATION: 269.45							
0.10	TOPSOIL: dark brown sandy silt	269						
	SAND: very dense brown fine sand, some silt, trace gravel, moist	268	1	SS	68	●	⊙	
1.45	BOREHOLE TERMINATED AT 1.45 m on refusal to auger on assumed bedrock Bedrock outcrop visible approximately 10 m west of borehole 12							Upon completion of augering no free water
3.0								
4.5								
6.0								

NOTES

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LOG OF BOREHOLE NO. 13 and 14

PROJECT: Muskoka Medium Security Institutiion
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov.11 & 15/94
OUR PROJECT NO. 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SHEAR STRENGTH C_u •
DYNAMIC CONE PENETRATION ▪ / STANDARD PENETRATION TEST • (BLOWS/0.3M: 20, 40, 60, 80)
LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W (WATER CONTENT %: 10, 20, 30)

BOREHOLE 13
GROUND ELEVATION 263.20

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: black sandy silt and roots	263				
	SAND: compact grey silty fine sand, some silt, saturated	262	1	SS	19	sample wet after SS 1
1.50	very loose to loose		2	SS	3	augers sinking
		261	3	SS	8	
3.00		260				after drilling to 3.0 m sand heaved inside augers
		259				
		258				
		257				
		256				
		255				
		254				
		253				
10.50	CLAY: soft grey clay, W.T.P.L.	252				Upon completion of augering water at grade cave at 1.5 m
		251	4	AS	-	
12.20	BOREHOLE TERMINATED AT 12.20 m					

BOREHOLE 14
GROUND ELEVATION: 269.11

DEPTH in METRES	DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15	TOPSOIL: dark brown sandy silt					
1.00	SAND: compact layered grey and rust brown fine sand, some silt, moist	268	1	SS	25	
1.50	SILT: compact brown sandy silt, with seams of silt or clayey silt	267	2	SS	17	
	grey silt, dilatent, saturated		3	SS	12/150 mm/bouncing	
2.45	BOREHOLE TERMINATED AT 2.45 m on refusal to auger on assumed bedrock	266				Upon completion of augering water at 1.6 m

NOTES:

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LOG OF BOREHOLE NO. 15 and 16

PROJECT	Muskoka Medium Security Institution	OUR PROJECT NO	94 BF 053
LOCATION	Gravenhurst, Ontario	ENGINEER	JFH
BORING METHOD	Continuous Flight Hollow Stem Augers	TECHNICIAN	JFH
BORING DATE	Nov. 11 & 15/94		

SOIL PROFILE — SAMPLES — SHEAR STRENGTH C_u kPa ▲ (25, 50, 75, 100) — DYNAMIC CONE PENETRATION × / STANDARD PENETRATION TEST ● BLOWS/0.3M (20, 40, 60, 80) — LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W — WATER CONTENT % (10, 20, 30) — GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 15

GROUND ELEVATION 268.00

DEPTH IN METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.05	FILL: black cinders					Borehole located in laneway
1.20	SILT: compact brown to rust brown fine sandy silt with seams and layers of silt or clayey silt, moist	267	1	SS	19	
		266	2	SS	8	sampler wet after SS 2
2.10	loose, saturated		3	SS	2	
2.90	CLAY: soft grey clay, W.T.P.L.	265	4	SS	11	
3.30	stiff	264				
4.10	SAND: compact grey fine sand saturated	263				Upon completion of augering water at 1.2 m

BOREHOLE TERMINATED AT 4.10 m on refusal to auger on assumed bedrock

BOREHOLE 16

GROUND ELEVATION: 266.49

DEPTH IN METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: dark brown sandy silt	266				bentonite seal
	SAND: compact brown fine sand some silt, with rust brown seams, moist	265	1	SS	26	12 mm PVC pipe
1.50	grey, saturated		2	SS	24	native backfill
2.10	loose, brown	264	3	SS	8	
3.00	compact	263	4	SS	16	
		262	5	AS	-	
4.60						

BOREHOLE TERMINATED AT 4.60 m

sampler wet after SS 2
after drilling to 4.6 m, sand heaved to 3.7 m inside augers
water at 1.7 m

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	1.30
Dec. 6	1.30

NOTES
■ Undrained shear strength based on pocket penetrometer test on recovered sample

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LOG OF BOREHOLE NO. 17 and 18

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 14 & 15/94
OUR PROJECT NO.: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u kPa (25, 50, 75, 100) | DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST, BLOWS/0.3M (20, 40, 60, 80) | LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W, WATER CONTENT % (10, 20, 30) | GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 17

GROUND ELEVATION 268.73

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.20	TOPSOIL: black sandy silt				
0.60	SAND: reddish brown silty fine sand	268	1	SS	12
1.40	SAND: compact reddish brown, to grey mottled silty fine sand, with seams of silt	267	2	SS	7
2.10	CLAY: firm grey clay, W.T.P.L.	266	3	SS	18
3.05	SILT: compact grey silt, dilatent, saturated	265			
	BOREHOLE TERMINATED AT 3.05 m on refusal to auger on assumed bedrock				

Ground water observations and remarks (Borehole 17):

- 12 mm PVC pipe
- bentonite seal
- native backfill

sampler wet after SS 1

Upon completion of augering water at 2.7 m

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	0.53
Dec. 6	0.40

BOREHOLE 18

GROUND ELEVATION: 262.13

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES
0.25	TOPSOIL: black silt/muck	262			
	SAND: compact grey fine sand, some silt, saturated	261	1	SS	12
1.50	loose to very loose		2	SS	9
		260	3	SS	1/400 mm
2.90	CLAY: soft grey clay W.T.P.L.	259	4	SS	P.M.
		258	5	FV	-
4.40	SAND: very loose grey silty fine sand, saturated		6	SS	P.M.
5.00	BOREHOLE TERMINATED AT 5.00 m. Conducted dynamic cone penetration test from bottom of borehole	257, 256, 255			
7.65	Dynamic cone penetration test terminated at 7.65 m on refusal on assumed bedrock	254			

Water content: 46%

Ground water observations and remarks (Borehole 18):

sampler wet after SS 1

Upon completion of augering water at 0.6 m

NOTES

Undrained shear strength
▲ Undisturbed value based on insitu field vane test
△ Remould value based on insitu field vane test
■ Based on pocket penetrometer test on recovered sample

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LOG OF BOREHOLE NO. 19

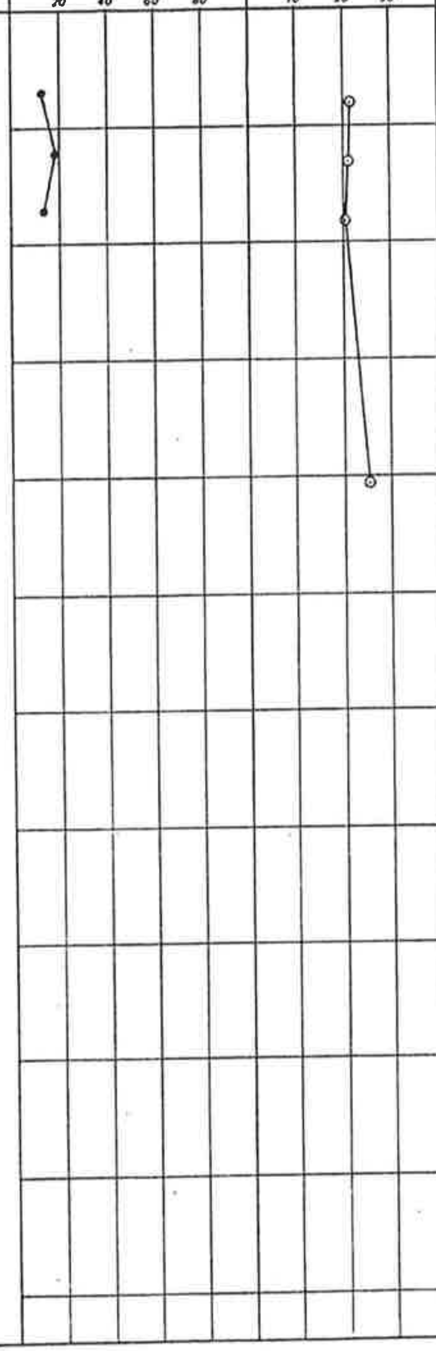
PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE Nov.14/94
OUR PROJECT NO 94 BF 05[illegible]
ENGINEER JFW
TECHNICIAN JFW

DEPTH in METRES	DESCRIPTION (SOIL PROFILE)	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 268.30					
0.15	TOPSOIL: dark brown sandy silt	268				after augering to 0.8 m, water at 0.6 m
	SAND: compact brown fine sand, saturated	267	1	SS	13	
1.50	stratified		2	SS	18	
2.10	medium to coarse sand	266	3	SS	14	after drilling to 3.0 m, sand heaved in augers
		265				
		264				
4.50	CLAY: soft grey clay, W.T.P.L.	263				
6.10	BOREHOLE TERMINATED AT 6.10 m	262	4	AS	-	Upon completion of augering water at 0.6 m

Depth scale: 1.5, 3.0, 4.5, 6.0

SHEAR STRENGTH C_u •
DYNAMIC CONE PENETRATION ▪
STANDARD PENETRATION TEST •
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W
W_P W W_L
WATER CONTENT % 10 20 30



NOTES

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LOG OF BOREHOLE NO. 20

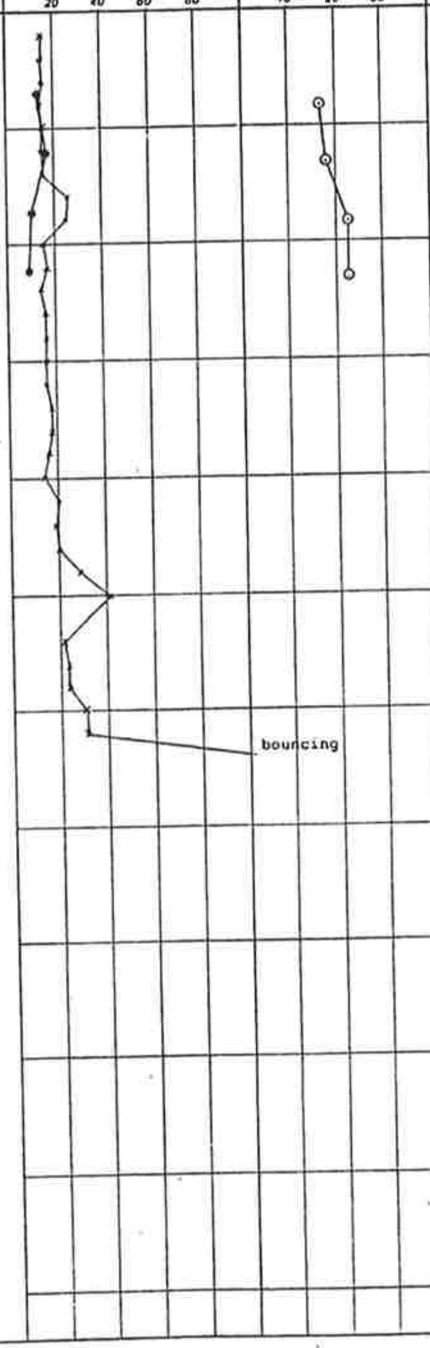
PROJECT: Muskoka Medium Secvurity Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 14/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

GROUND ELEVATION: 268.23

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.10	TOPSOIL: dark brown sandy silt					after augering to to 0.8 m, water at 0.6 m
	SAND: compact brown to grey fine sand, saturated	267	1	SS	13	
1.5			2	SS	17	
2.10	loose, stratified, silty fine sand	266				after drilling to 2.3 m, sand heaved inside augers
			3	SS	10	
3.0		265	4	SS	9	
		264				
4.5 / 4.50	CLAY: soft grey clay, W.T.P.L.	263				after drilling to 4.6 m, sand heaved to 2.7 m
			5	AS		
6.0 / 6.10	BOREHOLE TERMINATED AT 6.10 m moved over and conducted dynamic cone penetration test	262				Upon completion of augering water at 0.4 m
		261				
7.5		260				
9.0		259				
9.70	Dynamic cone penetration test terminated at 9.70 m on refusal on assumed bedrock	258				
10.5						
12.0						
13.5						
15.0						
16.5						

SHEAR STRENGTH C_u •
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/0.3M: 20 40 60 80

LIQUID LIMIT — W_L
PLASTIC LIMIT — W_P
WATER CONTENT — W
W_P W W_L
WATER CONTENT %: 10 20 30



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LOG OF BOREHOLE NO. 21 and 22

PROJECT Muskoka Medium Security Institution
LOCATION Gravenhurst, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE Nov. 11 & 14/94
OUR PROJECT NO. 94 BF 053
ENGINEER JFW
TECHNICIAN JFW

SOIL PROFILE

BOREHOLE 21
GROUND ELEVATION 267.38

DEPTH IN METRES	DESCRIPTION	ELEVATION
0.1	TOPSOIL: dark brown sandy silt	267
1.00	SAND: very loose stratified brown and rust brown sand and sandy silt	266
1.80	loose, grey	265
	CLAY: very soft grey clay, W.T.P.L.	264, 263, 262
6.05	BOREHOLE TERMINATED AT 6.05 m on refusal to auger on assumed bedrock	261

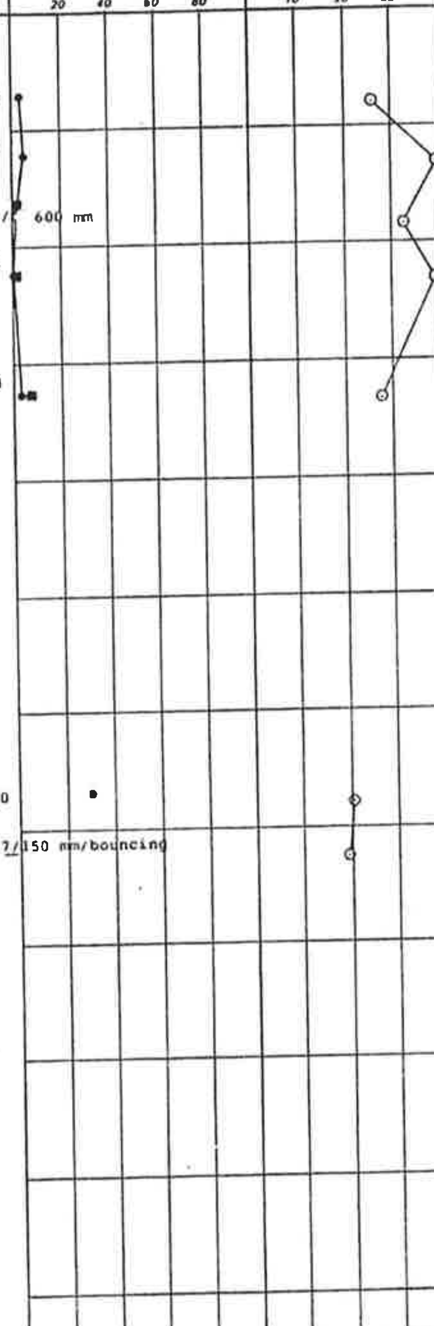
BOREHOLE 22
GROUND ELEVATION: 268.21

DEPTH IN METRES	DESCRIPTION	ELEVATION
0.10	TOPSOIL: dark brown sandy silt	
1.40	SILT: dense brown and grey mottled silt, with silty fine sand layers, moist with clayey silt layers	267
1.70		
1.85	SAND: dense stratified silty fine sand, saturated	266
	BOREHOLE TERMINATED AT 1.85 m on refusal to auger on assumed bedrock	265, 264

SAMPLES

Borehole	NUMBER	TYPE	BLOWS/0.3m N-VALUES
21	1	SS	3
21	2	SS	5
21	3	SS	1/600 mm
21	4	SS	0
21	5	SS	3
22	1	SS	30
22	2	SS	17/150 mm/bouncing

SHEAR STRENGTH C_u kPa ■ 25 50 75 100
DYNAMIC CONE PENETRATION ▲ STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80
LIQUID LIMIT —— W_L PLASTIC LIMIT —— W_P WATER CONTENT —— W; WATER CONTENT % 10 20 30



GROUND WATER OBSERVATIONS AND REMARKS

Borehole 21: Upon completion of augering water at 0.8 m

Borehole 22: Upon completion of augering no free water

NOTES
■ Undrained shear strength based on pocket penetrometer test on recovered sample

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LOG OF BOREHOLE NO. 23 and 24

PROJECT: Muskoka Medium Security Institution

LOCATION: Gravenhurst, Ontario

BORING METHOD: Continuous Flight Hollow Stem Augers

BORING DATE: Nov. 14/94

OUR PROJECT NO: 94 BF 053

ENGINEER: JFW

TECHNICIAN: JFW

Column headings: SOIL PROFILE (DEPTH in METRES; DESCRIPTION; LEGEND; ELEVATION) · SAMPLES (NUMBER; TYPE; BLOWS/0.3m N-VALUES) · SHEAR STRENGTH C_u kPa ▲ 25 50 75 100 · DYNAMIC CONE PENETRATION × · STANDARD PENETRATION TEST ● · BLOWS/0.3M 20 40 60 80 · LIQUID LIMIT —— W_L · PLASTIC LIMIT —— W_P · WATER CONTENT —— W · W_P W W_L · WATER CONTENT % 10 20 30 · GROUND WATER OBSERVATIONS AND REMARKS

BOREHOLE 23

GROUND ELEVATION 266.56

Depth (m)	Description	Elevation	Sample No.	Type	N-Value
0.20	TOPSOIL: dark brown clayey silt	266			
0.60	SILT: brown silt to sandy silt		1	SS	16
1.50	CLAYEY SILT: very stiff brown mottled grey clayey silt, varved, W.T.P.L.	265	2	SS	13
2.40	stiff, grey, with rust mottling, with silt inclusions	264	3	SS	20
2.75	SILT: compact sandy silt, saturated	263			

BOREHOLE TERMINATED AT 2.75 m on refusal to auger on assumed bedrock

Ground water observations and remarks:

- bentonite seal
- 12 mm PVC pipe
- native backfill
- sample wet after SS 1
- after SS 3 no free water inside augers
- Upon completion of augering water at 2.1 m

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	0.51
Dec. 6	0.50

BOREHOLE 24

GROUND ELEVATION: 265.64

Depth (m)	Description	Elevation	Sample No.	Type	N-Value
0.15	TOPSOIL: dark brown sandy silt	265			
1.10	SILT: dense brown to grey mottled reddish brown fine sandy silt, moist	264	1	SS	34
			2	SS	22
4.00	SAND: compact brown fine sand, stratified, with thin layers of silt, sandy silt, saturated	263	3	SS	16
		262	4	SS	10
6.55	CLAY: very soft grey clay W.T.P.L. with layers of silt and fine sand, saturated	261	5	SS	2/450 mm
		260			
		259	6	SS	2

BOREHOLE TERMINATED AT 6.55 m

Ground water observations and remarks:

- sampler wet after SS 2
- 40%
- after SS 6 no free water inside augers
- Upon completion of augering water at 1.8 m seepage at 0.6 m

1.5 3.0 4.5 6.0 7.5

NOTES

■ Undrained shear strength based on pocket penetrometer test on recovered sample.

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LOG OF BOREHOLE NO. 25 and 26

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov. 11 & 14/94
OUR PROJECT NO. 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 25 GROUND ELEVATION 267.18					
0.10	TOPSOIL: dark brown sandy silt					
0.90	SAND: loose brown fine sand, some silt, moist	266	1	SS	13	sampler wet after SS 1
1.50	CLAY: stiff greyish brown clay, with seams of fine sand		2	SS	2	-45%
		265				
	very soft, grey, W.T;P.L.		3	SS	0	
3.20	SILT: loose grey silt, dilatent, saturated	264	4	SS	7	
		263				
4.70	BOEHOLE TERMINATED AT 4.70 m on refusal to auger on assumed bedrock	262	5	SS	0/150 mm/bouncing	Upon completion of augering water at 0.4 m
	BOREHOLE 26 GROUND ELEVATION: 268.51					no free water
0.30	TOPSOIL:	268				
	Auger refusal at 0.3 m hand dug to expose bedrock					

SHEAR STRENGTH C_u kPa • 25 50 75 100
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST •
BLOWS/0.3M 20 40 60 80

LIQUID LIMIT —— W_L
PLASTIC LIMIT —— W_P
WATER CONTENT —— W
WATER CONTENT % 10 20 30

NOTES
■ Undrained shear strength based on pocket penetrometer test on recovered sample

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 27 and 28

PROJECT: Muskoka Medium Security Institution

LOCATION: Gravenhurst, Ontario

BORING METHOD: Continuous Flight Hollow Stem Augers

BORING DATE: Nov.11 & 14/94

OUR PROJECT NO. 94 BF 053

ENGINEER: JFW

TECHNICIAN: JFW

DEPTH in METRES	SOIL PROFILE – DESCRIPTION	ELEVATION	SAMPLE NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 27 — GROUND ELEVATION 266.63					
0.10	TOPSOIL: dark brown sandy silt	266				
1.25	SILT: dense brown mottled grey silt, moist, to silt some clay	265	1	SS	41	sampler wet after SS 1
	BOREHOLE TERMINATED AT 1.25 m on refusal to auger on assumed bedrock					Upon completion of augering no free water
	BOREHOLE 28 — GROUND ELEVATION: 266.78					
0.15	TOPSOIL: dark brown sandy silt					
0.60	SAND: compact rust brown to brown fine sand, some silt, moist	266				bentonite seal
1.00	saturated		1	SS	18	12 mm PVC pipe
1.50	stratified with clayey silt layers	265	2	SS	3	native backfill
2.10	CLAY: soft grey clay, W.T.P.L. with layers of fine sand, saturated	264	3	SS	0	
	very soft clay W.T.P.L.		4	SS	0	
		263				
4.00	SILT: very loose grey dilatent silt, saturated	262	5	SS	2	sampler wet after SS 1
5.50	BOREHOLE TERMINATED AT 5.50 m on refusal to auger on assumed bedrock	261				Upon completion of augering water at 0.6 m

SHEAR STRENGTH C_u kPa ▲: 25, 50, 75, 100
DYNAMIC CONE PENETRATION ■ / STANDARD PENETRATION TEST ●
BLOWS/0.3M: 20, 40, 60, 80

LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W
W_P — W — W_L
WATER CONTENT %: 10, 20, 30

51%

Handwritten depth marks: 1.5, 15, 30, 45, 60

A B

WATER LEVEL READINGS

DATE	DEPTH (m) A	DEPTH (m) B
Nov. 15	0.00	0.15
Dec. 6	0.00	0.00

NOTES
■ Undrained shear strength based on pocket penetromer test

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LOG OF BOREHOLE NO. 29 and 30

PROJECT: Muskoka Medium Security Institution
LOCATION: Gravenhurst, Ontario
BORING METHOD: Continuous Flight Hollow Stem Augers
BORING DATE: Nov.11 & 14/94
OUR PROJECT NO: 94 BF 053
ENGINEER: JFW
TECHNICIAN: JFW

SOIL PROFILE | SAMPLES | SHEAR STRENGTH C_u ▲ | DYNAMIC CONE PENETRATION ✕ | STANDARD PENETRATION TEST ● | BLOWS/0.3M: 20, 40, 60, 80 | LIQUID LIMIT — W_L | PLASTIC LIMIT — W_P | WATER CONTENT — W | W_P — W — W_L | WATER CONTENT %: 10, 20, 30 | GROUND WATER OBSERVATIONS AND REMARKS

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	BOREHOLE 29 GROUND ELEVATION 270.34					
0.15	TOPSOIL: dark brown sandy silt	270				
	Bedrock exposed at 0.15 m depth					
	BOREHOLE 30 GROUND ELEVATION: 265.25					
0.20	TOPSOIL: dark brown sandy silt	265				bentonite seal
	SAND: compact brown stratified fine sand, moist, with seams of silt and clayey silt	264	1	SS	15	12 mm PVC pipe
1.40	LAYERED SILT AND CLAY: very stiff brown mottled grey layered silt, clayey silt and clay	263	2	SS	16	native backfill
2.10			3	SS	3/bouncing	
2.35	very loose dilatent silt, saturated	262				sampler wet after SS 2
	BOREHOLE TERMINATED AT 2.75 m on refusal to auger on assumed bedrock					Upon completion of augering no free water

Depth scale: 1.5, 3.0, 4.5, 6.0

WATER LEVEL READINGS

DATE	DEPTH (m)
Nov. 15	1.45
Dec. 6	1.20

NOTES

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