GEMTEC

Geotechnical Investigation
Proposed Dartmouth CCC Facility

Dartmouth, Nova Scotia
November 18, 2013

Prepared for Public Works & Government Services Canada (PWGSC)
Project No. 4735.31 - R01

GEMTEC
Consulting Engineers and Scientists

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November 18, 2013

File: 4735.31 – R01

Public Works and Government Services Canada
A&ES Mgr. CSC Program
1045 Main Street, 3rd Floor
Moncton, NB
E1C 1H1

Attention: Mr. Robert Wheaton, P. Eng., Project Manager

Re: Geotechnical Investigation
Dartmouth CCC Facility, Dartmouth, Nova Scotia

Enclosed is our geotechnical investigation for the above noted site.

The fill soils, which average about 3.2 metres thick, comprise miscellaneous construction debris with a significant amount of large blasted/angular boulders. Due to the nature of this soil (loose state with many large voids) it is recommended that it be removed and replaced within the building and parking footprint.

This site is also the subject of an Unexploded Ordnance (UXO) clearance investigation and all excavation work is subject to the requirements of that investigation.

Please contact the undersigned if you have any questions or require additional information.

Corey G. Keats, P.Eng.
GEMTEC Limited

CK/pb

Enclosures

4735.31-R01 (Geotechnical Investigation).doc

Geotechnical Investigation
Dartmouth CCC Facility
Dartmouth, Nova Scotia

Table of Contents

Appendices

List of Figures

List of Tables

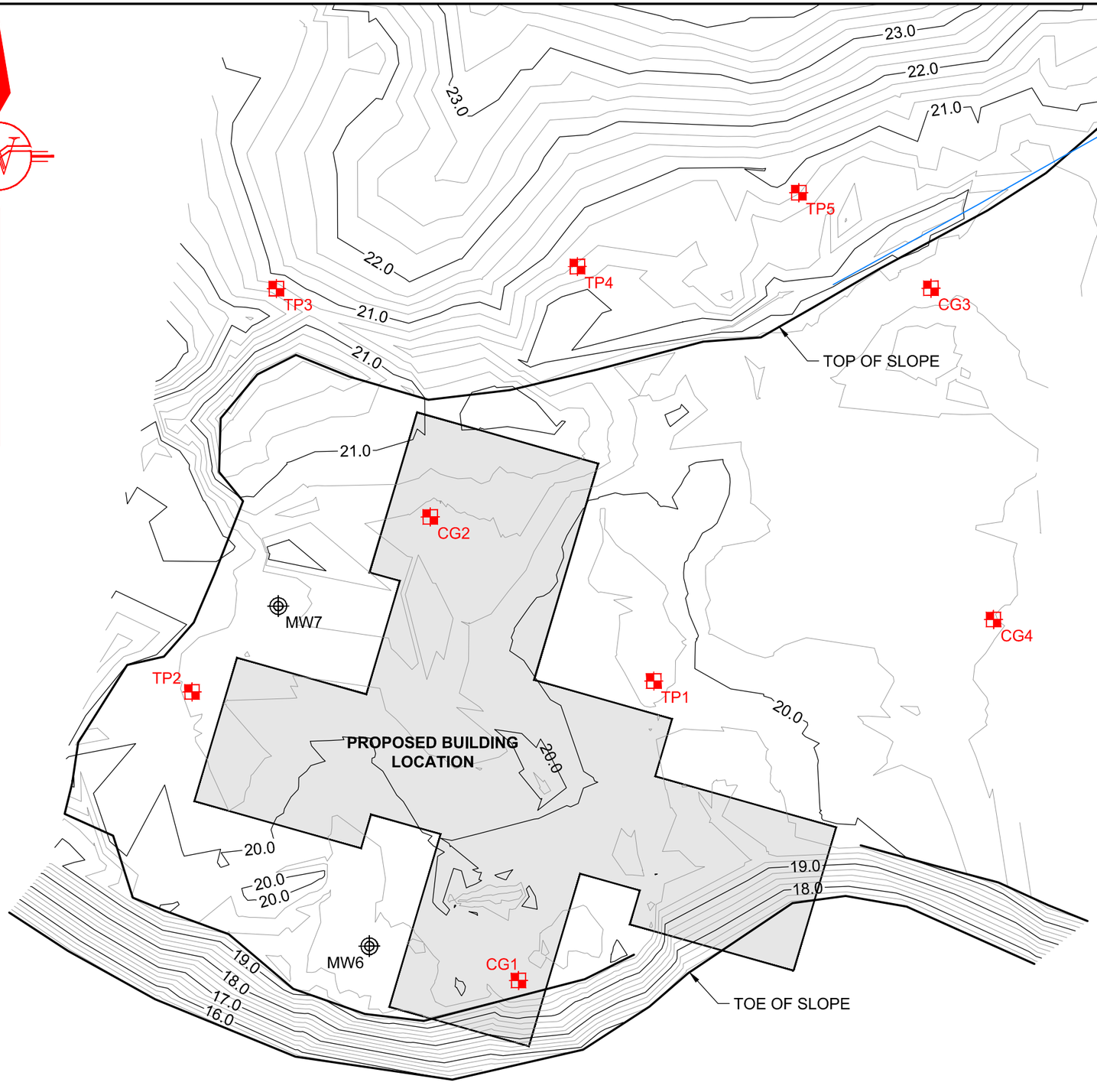
Geotechnical Investigation
Dartmouth CCC Facility
Dartmouth, Nova Scotia

1.0 Introduction

GEMTEC Limited was retained by Public Works and Government Services Canada (PWGSC) to undertake a geotechnical investigation at a site off Windmill Road in Dartmouth, Nova Scotia. We understand that a one storey building is proposed for the site along with a parking lot. At the time of our investigation the proposed building is believed to be a slab on grade structure. This report contains a detailed description of the subsurface conditions encountered in our investigation as well as a general description of the area under investigation.

In October 2013 nine test pits were excavated in the presence of one of our technicians. The investigation was carried out using a subcontracted 40 tonne excavator.

Test pit locations and elevations were surveyed by GEMTEC Limited personnel at the time of the investigation and are shown in Figure 1. Detailed test pit logs are appended (Appendix A).



LEGEND

- MONITORING WELL LOCATION
- TEST PIT / CONTROL GRID LOCATION

Drawn By: AGSD	Checked By: CGK
Calculations By:	Checked By:

Date: NOV, 2013

Project: GEOTECHNICAL SERVICES, DARTMOUTH CCC, DARTMOUTH, NS

Drawing: SITE PLAN

Scale: 1:400

0 8 16 24m

File No.	Drawing	Revision No.
47353101	FIGURE 1	0

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2.0 Site Conditions

The site of the proposed development is located at the end of Morris Drive in Dartmouth, Nova Scotia. The property slopes from north to south, with the central portion of the site being flat owing to a significant amount of fill having been placed in this area. The site is bordered to the east by commercial properties, to the south by Windmill Road and to the west and north by vacant wooded property.

3.0 Soil and Groundwater Conditions

The soils encountered, within the fill area, generally consist of miscellaneous fill soils underlain by a layer of organics, which is in turn underlain by a thin layer of glacial till. The glacial till is underlain by bedrock. Groundwater seepage was not encountered in the test pits. A summary of the soil conditions is presented in Table 3.1 below.

Table 3.1 Soil Stratigraphy

Test Pit	Ground Elevation (m)	Layer Thickness (metres)				
		Fill	Organics	Topsoil	Till	Total Overburden and Depth to Bedrock
TP1	19.7	3.05			1.37	4.42
TP2	20.2	5.5	0.03	0.28	0.3	6.11
TP3	20.6		0.05	0.25	1.83	2.13
TP4	20.4		0.1	0.5	2.44	3.04
TP5	20.6		0.1	0.81		0.91
CG1	19.8	3.2	0.05	0.3	1.68	5.23
CG2	20.4	2.06	0.05	0.3	1.39	3.8
CG3	20.4	1.9	0.05	0.05		2
CG4	20.5	3.2			0.15	3.35

A layer of miscellaneous construction fill was encountered at the test pits dug within the fill area (TP1, TP2, CG1, CG2, CG3 and CG4) ranging in thickness from 1.9 to 5.3 metres, averaging 3.2 metres. The fill generally consists of miscellaneous construction material with boulders, metal, concrete with debris and organics. A layer of roots and organic soil (root mat) was encountered beneath the fill in all six test pits, representing the original ground surface prior to the fill placement. The root mat is generally in the order of 0.3 metres thick.

On a visual basis it was estimated that the fill comprised approximately 70% blasted/angular boulders (ranging in size from 0.6 to 2.5 metres diameter).

Outside the fill area (TP3, TP4 and TP5), the soils generally comprised a thin organic layer to native glacial till or bedrock.

Dense native glacial till (reddish brown gravelly silty sand with cobbles) or bedrock was encountered beneath the roots and organics at most of the test pits. The glacial till was noted to become stiffer and coarser with depth, becoming quite cobbley near the interface with the bedrock.

Groundwater was measured at two monitoring wells that were installed as part of a previous investigation and found to be at or below the original ground elevation (i.e. at the bottom of the present fill). Groundwater could be expected to fluctuate depending on antecedent conditions.

4.0 Discussion and Recommendations

4.1 Introduction

The insitu fill soils are not suitable to support the proposed building as they are loose with many voids and are underlain by a layer of organics. Given this, the miscellaneous fill must be removed from under the building and parking area, and replaced with engineered fill. Based on the fact that a large portion of the miscellaneous fill comprises boulders and blasted rock it may be possible to produce engineered fill using this rock.

4.2 Engineered Fill

All fill soils and organics within the zone of influence of the building would have to be removed down to the original glacial till or bedrock if no till is present.

- Excavation limits should be sufficient to allow for a 1 Horizontal to 1 Vertical (i.e., 45 degrees) bearing splay of engineered fill extending down from the outside limits of the footings to the glacial till subgrade.
- Subgrade soils must be approved by a geotechnical engineer prior to the placement of engineered fill material.
- Engineered fill should comprise 75 mm minus crushed quarried rock or gravel meeting the NSTIR Type 2 crushed rock limits, or an approved well graded pit run gravel. Engineered fill should be compacted to a minimum of 95% of the maximum dry density as determined by ASTM D1557 (Modified Proctor). Density of the engineered fill should be confirmed with a nuclear density gauge during placement. Alternate engineered fill materials could also be proposed for approval by a geotechnical engineer.
- Spread and strip footings may be proportioned on the engineered fill bearing on the glacial till at a serviceability limit state (SLS) bearing pressure of 200 kPa. Minimum footing widths of 0.6 and 1.0 metres are recommended for strip and square footings, respectively.
- For protection against frost action, a minimum foundation depth of 1.5 metres is recommended for heated structures. In areas where 1.5 metres of cover is not provided (e.g., in loading bays), the footings should be stepped down accordingly or a properly designed rigid insulation detail should be provided.
- The exterior below grade walls should be backfilled with properly filtered free-draining backfill leading to foundation drains. The ground surface should be capped with impervious soil or pavement to prevent infiltration of surface water. Finished grading adjacent to the building should be sloped at no less than 2% away from the foundations. Roof drains should be discharged away from the building.

- We recommend that the foundation drawings be reviewed by a geotechnical engineer prior to finalizing the drawings. Also, during construction, as the foundation excavation progresses, the foundation conditions and construction practices should be reviewed by a geotechnical engineer.

- Placing frozen fill or engineered fill on frozen subgrade is not permitted. If work is to continue during freezing conditions, care should be taken to heat and/or insulate the engineered fill prior to and after placement so as to keep it from freezing (some typical measures include heated box trucks, insulated tarps, bails of hay). Frozen subgrade soil and/or previously placed fill must be thawed or removed prior to placement of any engineered fill. Given the challenges that could arise during cold weather construction, it is recommended that the building contractor prepare an excavation and backfill plan outlining his proposed method of construction and indicating, in particular, his methodologies for dealing with groundwater, freezing temperatures and compaction.

- Groundwater should be anticipated above or near the root mat during foundation construction. Appropriate ditching and pumping techniques will be required to keep excavations free of water.

4.3 General

- It should also be noted that at this time the elevation of the proposed building and surrounding parking/landscaped areas are not known. The building should be placed at an elevation sufficient to provide gravity drainage for storm and sanitary sewers.

4.4 Pavement Structure

Given that large voids probably exist within the miscellaneous fill it is recommended that it also be removed from the parking lot area and replaced with engineered fill.

The following typical pavement structures for light and heavy traffic areas are provided:

Light traffic and car parking areas:

- Asphalt concrete surface course (NSTIR Type C - HF) 30 mm
- Asphalt concrete surface course (NSTIR Type B - HF) 50 mm
- Granular base 150 mm
- Granular subbase 300 mm

Heavy traffic areas (i.e. entrance and roadway areas):

- Asphalt concrete surface course (NSTIR Type C - HF) 40 mm
- Asphalt concrete surface course (NSTIR Type B - HF) 60 mm
- Granular base 150 mm
- Granular subbase 450 mm

All granular fill should be compacted to at least 95% of the maximum dry density as determined by the latest version of ASTM D1557 (Modified Proctor).

5.0 General

This report solely addresses the geotechnical aspects of the site and should not be regarded as an environmental assessment.

Although representative samples have been collected within the proposed building area, soil and bedrock conditions may vary between borehole locations.

Appendix A

Descriptive Terms and Detailed Test Pit Logs

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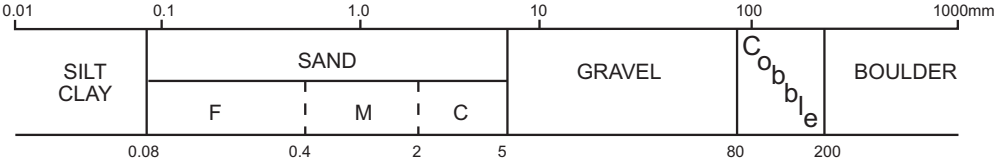
FREDERICTON, MONCTON, BATHURST, GRAND FALLS, SAINT JOHN, NB

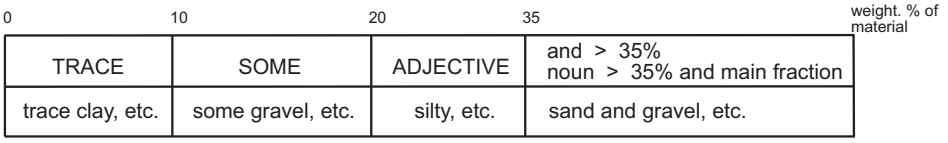
DESCRIPTIVE TERMS- BOREHOLE/TEST PIT LOG

SOILS

GRAIN SIZE



DESCRIPTIVE TERMINOLOGY



TRACE	SOME	ADJECTIVE	and > 35% noun > 35% and main fraction
trace clay, etc.	some gravel, etc.	silty, etc.	sand and gravel, etc.

COMPACTNESS gravels, sands, tills

N, RANGE	0 - 4	4 - 10	10 - 30	30 - 50	> 50
DENSITY	V. LOOSE	LOOSE	MEDIUM	DENSE	V. DENSE

CONSISTENCY silt, clay

S, KPa	< 12.5	12.5 - 25	25 - 50	50 - 100	100 - 200
CONSISTENCY	V. SOFT	SOFT	MEDIUM	STIFF	V. STIFF

ROCK

RQD	OVERALL QUALITY	FRACTURE SPACING
0 - 25	VERY POOR	VERY CLOSE 20 - 60 mm
25 - 50	POOR	CLOSE 60 - 200 mm
50 - 75	FAIR	MODERATE 200 - 600 mm
75 - 90	GOOD	WIDE 600 - 2000 mm
90 - 100	EXCELLENT	VERY WIDE 2 - 6 m

COMP. STR. MPa	1 - 5	5 - 25	25 - 50	50 - 100	100 - 250
DESCRIPTION	V. WEAK	WEAK	MODERATE	STRONG	V. STRONG

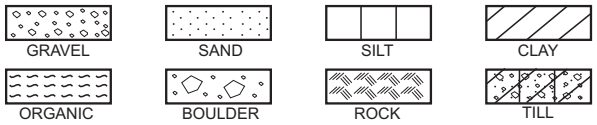
SAMPLE TYPES (location to scale on log)

S	SPLIT TUBE	G	SHOVEL
T	SHELBY TUBE	H	CARVED BLOCK
P	PISTON	K	SLOTTED
F	AUGER	V	IN SITU VANE
W	WASH	NR	NO RECOVERY

ROCK CORES

A(30mm); B(41mm); N(54mm)

LOG SYMBOLS



WELL SYMBOLS

N - standard penetration test; blows by 475 J drop hammer to advance Std. 50mm O.D. split tube sampler 0.3m

RQD - percent of core consisting of hard, sound pieces in excess of 100mm long (excluding machine breaks)

RECOVERY - sample recovery expressed as percent or length

S - shear strength , kPa; vane ⊕ ; penetrometer ■; unconfined ○ ; Uc unconfined compressive strength

Sr - shear strength, remoulded; vane ⊗ ; penetrometer □

Dd - dry density; t/m^3

W - natural moisture content, percent ✳

PL - plastic limit, percent ⊢

LL - liquid limit, percent ⊣

ND - non detect, total petroleum hydrocarbons (TPH) not detected in soil

Groundwater Level ▼ ; Seepage ▽

Revised Oct, 2009

BHDESCRM-2009.CDR

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit TP1
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 19.70	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC mm	LOG	DESCRIPTION
0						Fill
3.05						16.65
3						Till
4.42						15.28
						End of TP @ 4.42m on BEDROCK

TEST PIT WITH GRAPH 473531.GPJ GEMTEC 2004.GDT 13/11/18

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit TP2
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 20.20	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC mm	LOG	DESCRIPTION	
0						FILL	
5.50							14.70
5.53						ORGANICS	14.67
5.81						TOPSOIL	14.39
						TILL	
6.11							14.09
						End of TP @ 6.11m on BEDROCK	

TEST PIT WITH GRAPH 473531.GPJ GEMTEC 2004.GDT 13/11/18

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit TP3
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 20.60	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC mm	LOG	DESCRIPTION	
0						0.05 ORGANICS	20.55
						0.30 TOPSOIL	20.30
1						TILL	
2						2.13	18.47
						End of TP @ 2.13m on BEDROCK	

TEST PIT WITH GRAPH 473531.GPJ GEMTEC 2004.GDT 13/11/18

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit TP4
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 20.40	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC mm	LOG	DESCRIPTION	
0					0.10	ORGANICS TOPSOIL	20.30
					0.60	TILL	19.80
1							
2							
3					3.04	End of TP @ 3.04m on BEDROCK	17.36

TEST PIT WITH GRAPH 473531.GPJ GEMTEC 2004.GDT 13/11/18

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit TP5
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 20.60	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC mm	LOG	DESCRIPTION	
0						0.10 ORGANICS TOPSOIL	20.50
						0.91	19.69
						End of TP @ 0.91m on BEDROCK	

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit CG1
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 19.80	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC mm	LOG	DESCRIPTION
0						FILL
3.20						16.60
3.25						ORGANICS / TOPSOIL 16.55
3.55						16.25
						TILL
5.23						14.57
						End of TP @ 5.23m on BEDROCK

TEST PIT WITH GRAPH 473531.GPJ GEMTEC 2004.GDT 13/11/18

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit CG2
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 20.40	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC mm	LOG	DESCRIPTION		
0						FILL		
1								
2							2.06	18.34
						ORGANICS	2.11	18.29
						TOPSOIL	2.41	17.99
3						TILL		
							3.80	16.60
						End of TP @ 3.80m on BEDROCK		

TEST PIT WITH GRAPH 473531.GPJ GEMTEC 2004.GDT 13/11/18

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit CG3
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 20.40	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC mm	LOG	DESCRIPTION	
0						FILL	
1							
2					1.90		18.50
					1.95	ORGANICS	18.45
					2.00	TOPSOIL	18.40
						End of TP @ 2.00m on BEDROCK	

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TEST PIT LOG

Client	Public Works & Government Services Canada	Proj No. 4735.31	Test pit CG4
Project	Geotechnical Investigation, Proposed CCC Facility	Date End 2013/10/11	Page 1 of 1
Location	Dartmouth, NS		
Ground Level, m 20.50	Datum: Geodetic	Logged By MW	

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC mm	LOG	DESCRIPTION
0						FILL
3.20						17.30
3.35						TILL 17.15
						End of TP @ 3.35m on BEDROCK

TEST PIT WITH GRAPH 473531.GPJ GEMTEC 2004.GDT 13/11/18