



GEMTEC

www.gemtec.ca

**Factual Geotechnical Report
Proposed Rehabilitation
Structures 401 & 402**

Lameque Wharf, New Brunswick



GEMTEC

www.gemtec.ca

Submitted to:

Public Services and Procurement Canada
1045 Main Street, Unit 100
Moncton, New Brunswick
E1C 1H1

Factual Geotechnical Report Proposed Rehabilitation Structures 401 & 402

Lameque Wharf, New Brunswick

February 27, 2018
Project: 10456.73

GEMTEC Consulting Engineers & Scientists Limited
77 Rooney Crescent
Moncton, NB, Canada
E1E 4M4

February 27, 2018

File: 10456.73 – R01

Public Services and Procurement Canada
1045 Main Street, Unit 100
Moncton, New Brunswick
E1C 1H1

Attention: Mr. Jean Girouard, P.Eng.

**Re: Factual Geotechnical Report – Proposed Rehabilitation, Structures 401 & 402
Lameque Wharf, Lameque, New Brunswick**

Enclosed is our factual geotechnical report for the above noted project. This report was prepared by Anna Shafiq, M.A.Sc., P.Eng. and reviewed by Corey Keats, M.Sc.E., P.Eng.

Do not hesitate to contact the undersigned if you have any questions or require additional information.

Regards,



Anna Shafiq, M.A.Sc., P.Eng.

Corey Keats, M.Sc.E., P.Eng.

Enclosures
N:\Files\10400\10456.73\Report\2018aes0223-R01.docx

EXECUTIVE SUMMARY

The following factual geotechnical report pertains to the proposed rehabilitation to structures 401 and 402 at the Lameque Wharf in Lameque, New Brunswick. Nine boreholes were advanced through the existing concrete deck at Petit-Shippagan Wharf to depths of 3.1 to 18.4 metres below top of deck elevation. The geotechnical investigation determined the subsurface conditions at the site generally consist of the wharf's concrete deck underlain by gravel fill, which in turn is underlain by sandstone fill. A thin layer of silty sand underlies the sandstone fill with bedrock underlying the silty sand layer.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	III
LIST OF TABLES.....	IV
1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	1
3.0 REVIEW OF GEOLOGY MAPS.....	1
4.0 SUBSURFACE INVESTIGATION.....	2
5.0 SUBSURFACE CONDITIONS	2
5.1 General.....	2
5.2 Asphaltic Concrete & Concrete Deck	3
5.3 Fill.....	3
5.4 Silty Sand	4
5.5 Glacial Till.....	4
5.6 Bedrock	4
6.0 CLOSURE.....	4

LIST OF TABLES

Table 5.1 – Summary of Subsurface Conditions	3
--	---

LIST OF APPENDICES

Appendix A	Borehole Layout & Site Features
Appendix B	Descriptive Terms and Borehole Logs
Appendix C	Laboratory Testing Results
Appendix D	Select Site & Rock Core Photos

1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by Public Services and Procurement Canada (PSPC) to undertake a geotechnical investigation in support of proposed rehabilitation to structures 401 and 402 along the Lameque Wharf in Lameque, New Brunswick (herein referred to as the “site”). This investigation was conducted according to the requirements of the Standing Offer Contract (EC373-180283/001/MCT) between PSPC and GEMTEC.

The purpose of this investigation was to identify the general subsurface conditions at the site. This report contains a general description of the area under investigation and a summary of the field work carried out. This report presents our findings for geotechnical purposes only; the investigation outlined in this report is strictly geotechnical in nature and should not be viewed as an environmental assessment of the site.

2.0 SITE DESCRIPTION

The Lameque is located near the south-eastern corner of Shippagan Harbour, in the town of Lameque, New Brunswick. The town of Lameque is located on Lameque Island at the north-eastern end of the Acadian Peninsula in New Brunswick. The wharf is accessed from Rue du Quai via NB Route 313.

Structures 401 and 402 are located to the south of the wharf. An armour stone breakwater is located west of the structures, with additional structures located north. An asphaltic concrete parking area is located to the east of Structures 401 and 402.

Structures 401 and 402 are Steel Sheet Pile (SSP) structures with a concrete deck. The investigated structures show visible signs of deterioration, including corrosion and perforation of the SSP walls, as well as cracking and settlement of the concrete slab, particularly at the edges of the wharf.

A borehole location plan showing site features is included in Appendix A.

3.0 REVIEW OF GEOLOGY MAPS

Digital surficial geology mapping of New Brunswick indicates that the area of the site generally consists of blankets and plains of Late Wisconsinan and/or Early Holocene aged marine sediments consisting of sand, silt, some gravel and clay generally 0.5 to 3.0 metres thick.

Digital bedrock geology mapping of New Brunswick indicates that these overburden soils rest on Late Carboniferous aged terrestrial sediments of red to grey sandstone, conglomerate and siltstone of the Pictou group.

4.0 SUBSURFACE INVESTIGATION

Nine boreholes (BH18-01 to BH18-10, excluding BH18-03) were advanced at the site between February 5 and 13, 2018 in the presence of GEMTEC geotechnical personnel. Due to ice cover at the time of investigation and the deteriorating condition of the wharf, boreholes could not be advanced from a barge nor advanced over the edge of the structure into the harbour. Therefore, boreholes were advanced through the existing concrete deck at structures 401 and 402. Borehole locations were selected by GEMTEC based on access and site features.

The boreholes were advanced to depths ranging from 3.1 to 18.4 metres below the top of deck elevation. The work was carried out using a track-mounted geotechnical drill rig provided and operated by Lantech Drilling Services Incorporated.

During borehole advancement, overburden soil samples were collected by GEMTEC personnel. Bedrock cores were collected from eight borehole locations using an HQ sized core barrel (63.5 mm diameter). Standard Penetration Test (SPT) N-Values and Rock Quality Designation (RQD) values were recorded during overburden soil and bedrock collection, respectively. Local soil and bedrock stratigraphy were visually catalogued throughout the investigation. Termination depth ranged between 0.8 and -14.6 metres, chart datum.

The borehole locations and elevations were surveyed by GEMTEC using our high precision GPS equipment. Elevations referenced in this report and on the attached logs are based on chart datum.

A site and borehole location plan is presented in Appendix A. Descriptive terms and detailed borehole logs are appended (Appendix B). Laboratory testing results are included in Appendix C and select site photos are presented in Appendix D.

5.0 SUBSURFACE CONDITIONS

5.1 General

The soil stratigraphy presented in the borehole logs are representative of subsurface conditions at the specific borehole locations only. Boundaries between soil and bedrock zones on the logs are often not distinct, but rather are transitional and have been interpreted. Subsurface conditions at locations other than the borehole locations may vary from the conditions reported in the borehole logs. The soil and bedrock descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgement and GEMTEC does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

The geotechnical investigation determined the subsurface conditions at the site generally consist of the wharf's concrete deck underlain by gravel fill, which in turn is underlain by sandstone fill. A thin layer of silty sand underlies the sandstone fill with bedrock underlying the silty sand layer.

A summary of the subsurface conditions encountered at the site are presented in Table 5.1.

Table 5.1 – Summary of Subsurface Conditions

Borehole	Borehole Elevation ¹	Borehole Depth	Concrete & Fill Thickness	Silty Sand Thickness	Glacial Till Thickness	Bedrock Elevation ¹
				(metres)		
18-01	3.9	12.3	6.9	0.2	0.8	-4.0
18-02	4.0	12.2	7.3	0.3	--	-3.6
18-04	3.9	10.8	5.8	0.6	--	-2.5
18-05	3.9	10.9	7.0	0.2	--	-3.3
18-06	3.9	12.4	7.2	0.9	--	-4.2
18-07	3.8	3.1	3.1 ²	--	--	--
18-08	3.8	14.6	7.9	--	0.6	-4.7
18-09	3.8	16.7	7.9	0.5	3.5	-8.1
18-10	3.8	18.4	9.1	2.3	2.4	-10.1

Notes: 1. Elevations reference chart datum.

2. Hole terminated due to encountering an unknown object; full thickness of fill layer is undetermined.

5.2 Asphaltic Concrete & Concrete Deck

Asphaltic concrete was encountered at the surface of two boreholes (BH18-01 and BH18-02) measuring approximately 100 millimetres thick.

The wharf's concrete deck surface was encountered at the surface of the remaining borehole locations. The thickness of the concrete deck surface is approximately 220 millimetres thick.

5.3 Fill

A thin layer of red to reddish-brown sand and gravel fill was encountered underlying the asphaltic concrete or concrete in all boreholes locations. The thickness of the sand and gravel fill measures approximately 100 to 200 millimetres thick.

Sandstone fill was encountered in all borehole locations underlying the sand and gravel fill. The thickness of the sandstone fill layer ranges from 5.5 (BH18-04) to 8.8 (BH18-10) metres. Based on the SPT N-values averaging 21, the compactness of the sandstone fill can be described as compact.

5.4 Silty Sand

A thin layer of grey to black silty sand with shell fragments was encountered underlying the sandstone fill in five borehole locations. The thickness of the silty sand ranges from 0.1 to 0.6 metres.

Grey to reddish-brown clayey silt was encountered in two borehole locations: BH18-06 and BH18-10. The clayey silt measures approximately 0.9 and 2.3 metres, respectively.

5.5 Glacial Till

Glacial till was encountered underlying the sandstone fill in BH18-08, underlying the silty sand of BH18-01 and BH18-09 and underlying the silt of BH18-10. Glacial till is a heterogeneous mixture of all grain sizes, but for this site may generally be described as reddish-brown silty sand and gravel with trace clay. SPT N-values recorded within the glacial till range from 18 to 48, averaging 27. Therefore, the glacial till can be described as compact. The glacial till was encountered at depths of 7.0 (BH18-01) to 11.4 (BH18-10) metres below top of concrete deck with the thickness of the glacial till layer ranging from 0.6 (BH18-08) to 3.5 (BH18-09) metres.

Laboratory index testing undertaken on two representative samples of the glacial till shows that the material comprises 6 to 30% gravel, 33 to 59% sand, and 11 to 60% silt and clay sized particles. The moisture contents of the glacial till ranges from approximately 13 to 17%.

5.6 Bedrock

Red to brown mudstone bedrock was encountered in all boreholes, except BH18-07 which was terminated prior to reaching bedrock elevations. Based on RQD values averaging 52%, the overall quality of the mudstone bedrock can be described as poor and severely fractured with close fracture spacing (60 to 200 millimetres).

Grey fine-grained sandstone bedrock was encountered overlying the mudstone bedrock of BH18-01 and underlying the mudstone bedrock of BH18-10. RQD values of 30 and 35%, respectively, indicate that the overall quality of the encountered sandstone bedrock is poor and severely fractured with close fracture spacing (60 to 200 millimetres).

Two rock cores were broken to determine the representative compressive strength of the encountered bedrock. The compressive strengths of 1.4 and 48.6 MPa indicate the mudstone can be described as very weak to moderately strong. Photos of select core photos are included in Appendix D. Rock cores will be available for viewing at the GEMTEC Moncton laboratory.

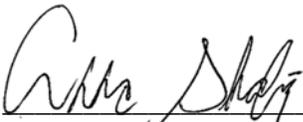
6.0 CLOSURE

This report is factual in nature and does not offer any geotechnical recommendations. Should recommendations be desired, GEMTEC would be pleased to offer them upon request.

This report has been prepared for the sole benefit of our client, PSPC. The report may not be relied upon by any other person or entity without the express written consent of both GEMTEC and our client, PSPC.

Any use that a third party makes of this report, or any reliance or decisions made based on it, is the responsibility of such third parties. GEMTEC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust this factual report provides sufficient information for your present purposes. If you have any questions concerning this report, do not hesitate to contact the undersigned.



Anna Shafiq, M.A.Sc., P.Eng.
Geotechnical Materials Engineer
GEMTEC



Corey Keats, M.Sc.E., P.Eng.
President
GEMTEC



APPENDIX A

Borehole Layout & Site Features

N:\DRAWINGS\10400\10456.73\1045673 - BOREHOLE LOCATION PLAN.DWG,11 X 17, 18/02/28 10:08:57 AM



Legend.

 BOREHOLE LOCATION

Notes.

1. All information computed in HT2 NAD83/(CSRS) format and referenced to monument 90B9023 with a chart datum elevation of 4.259m.

Drawn By	DGH	Checked By	
Calculations By		Checked By	

Date

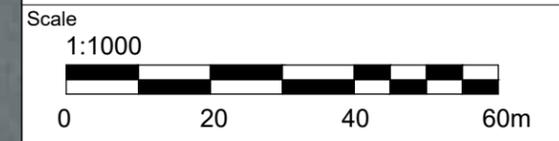
FEBRUARY 2018

Project

SOA EC373-180283/001/MTC - LAMEQUE WHARF STRUCTURE 401 AND 402 GEOTECHNICAL INVESTIGATION

Drawing

BOREHOLE LOCATION PLAN



File No.	Drawing	Revision No.
1045673	APPENDIX 1	0





APPENDIX B

Descriptive Terms and Borehole Logs

DESCRIPTIVE TERMS BOREHOLE / TEST PIT LOGS

SOILS	GRAIN SIZE																										
	DESCRIPTIVE TERMINOLOGY	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">TRACE</td> <td style="width: 10%;">SOME</td> <td style="width: 10%;">ADJECTIVE</td> <td colspan="3" style="width: 50%;">and > 35% noun > 35% and main fraction</td> </tr> <tr> <td>trace clay, etc.</td> <td>some gravel, etc.</td> <td>silty, etc.</td> <td colspan="3">sand and gravel, etc.</td> </tr> </table>						TRACE	SOME	ADJECTIVE	and > 35% noun > 35% and main fraction			trace clay, etc.	some gravel, etc.	silty, etc.	sand and gravel, etc.										
	TRACE	SOME	ADJECTIVE	and > 35% noun > 35% and main fraction																							
	trace clay, etc.	some gravel, etc.	silty, etc.	sand and gravel, etc.																							
COMPACTNESS GRANULAR SOILS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">SPT N-VALUES</td> <td style="width: 10%;">0 - 4</td> <td style="width: 10%;">4 - 10</td> <td style="width: 10%;">10 - 30</td> <td style="width: 10%;">30 - 50</td> <td style="width: 10%;">> 50</td> </tr> <tr> <td>DESCRIPTION</td> <td>VERY LOOSE</td> <td>LOOSE</td> <td>COMPACT</td> <td>DENSE</td> <td>VERY DENSE</td> </tr> </table>						SPT N-VALUES	0 - 4	4 - 10	10 - 30	30 - 50	> 50	DESCRIPTION	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE									
SPT N-VALUES	0 - 4	4 - 10	10 - 30	30 - 50	> 50																						
DESCRIPTION	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE																						
CONSISTENCY COHESIVE SOILS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">Cu, kPa</td> <td style="width: 10%;">0 - 12</td> <td style="width: 10%;">12 - 25</td> <td style="width: 10%;">25 - 50</td> <td style="width: 10%;">50 - 100</td> <td style="width: 10%;">100 - 200</td> <td style="width: 10%;">> 200</td> </tr> <tr> <td>SPT N-VALUES</td> <td>0 - 2</td> <td>2 - 4</td> <td>4 - 8</td> <td>8 - 15</td> <td>15 - 30</td> <td>> 30</td> </tr> <tr> <td>DESCRIPTION</td> <td>VERY SOFT</td> <td>SOFT</td> <td>FIRM</td> <td>STIFF</td> <td>VERY STIFF</td> <td>HARD</td> </tr> </table>						Cu, kPa	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200	SPT N-VALUES	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	> 30	DESCRIPTION	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD
Cu, kPa	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200																					
SPT N-VALUES	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	> 30																					
DESCRIPTION	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD																					

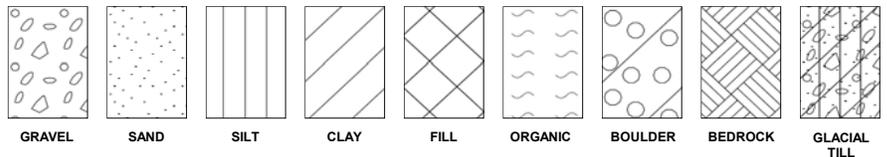
ROCK	RQD	OVERALL QUALITY	FRACTURE SPACING
	0 - 25	VERY POOR, VERY SEVERELY FRACTURED	VERY CLOSE 20 - 60 mm
	25 - 50	POOR, SEVERELY FRACTURED	CLOSE 60 - 200 mm
	50 - 75	FAIR, FRACTURED	MODERATE 200 - 600 mm
	75 - 90	GOOD, MODERATELY JOINTED	WIDE 600 - 2000 mm
	90 - 100	EXCELLENT, INTACT	VERY WIDE 2 -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

COMP. STRENGTH, MPa	1 - 5	5 - 25	25 - 50	50 - 100	100 - 250	> 250
DESCRIPTION	VERY WEAK	WEAK	MODERATE	STRONG	VERY STRONG	EXTREMELY STRONG

SAMPLE TYPES (location to scale on log)

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

LOG SYMBOLS



WELL SYMBOLS

ROCK CORES A (30 mm); B (41 mm);
N (54 mm); H (63 mm)



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

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

RECOVERY - sample recovery expressed as percentage or length

Cu - shear strength, kPa; vane Φ ; penetrometer \blacksquare ; unconfined \odot ; Uc unconfined compressive strength

Sr - shear strength, remoulded; vane \otimes ; penetrometer \square

Dd - dry density; t/m³

W - natural moisture content, percent *

PL - plastic limit; percent —

LL - liquid limit; percent —

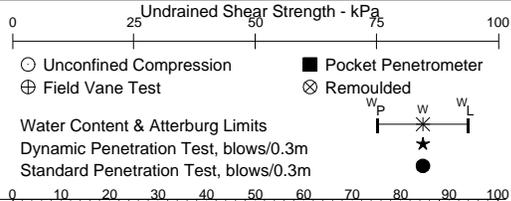
ND - non-detect, total petroleum hydrocarbons (TPH) not detected in soil

GROUNDWATER LEVEL \blacktriangledown

SEEPAGE ∇

Client	Public Works & Government Services Canada	Proj No.	10456.73	BOREHOLE BH18-01 Page 1 of 1
Project	Geotechnical Investigation	Date Drilled	13.Feb.2018	
Location	Lameque Wharf, Lameque NB			

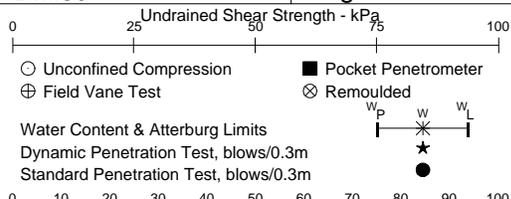
Ground Level, m	3.88	Datum:	Chart	Logged By	TD
-----------------	------	--------	-------	-----------	----



DEPTH m	SAMPLE				LOG	DESCRIPTION	
	No	TYPE	N (RQD)	REC (mm)			
0						0.10 ASHPHALTIC CONCRETE 3.78	
						p.30 FILL 3.58	
						Red to brown sand and gravel Sandstone fill, weak	
1							
2							
3							
4							
5	1	S	9	175			
6							
6	2	S	7	250			
7							
7	3	S	8	400		6.85 -2.97	
						7.01 SAND and SILT -3.13	
						Grey to black sand and silt, some shells	
						GLACIAL TILL	
						Red to brown silty sand and gravel, trace	
						7.87 clay -3.99	
8	5	HQ	30	1473		SANDSTONE BEDROCK	
						Grey fine-grained sandstone bedrock	
9						8.71 -4.83	
						MUDSTONE BEDROCK	
						Red to brown mudstone bedrock	
10	6	HQ	58	1520			
11							
11	7	HQ	50	1520			
12							
						12.34 -8.46	
						End of borehole at 12.3 metre below existing top of deck	

Client	Public Works & Government Services Canada	Proj No.	10456.73	BOREHOLE BH18-02 Page 1 of 1
Project	Geotechnical Investigation	Date Drilled	13.Feb.2018	
Location	Lameque Wharf, Lameque NB			

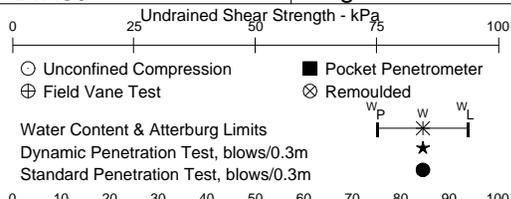
Ground Level, m	3.97	Datum:	Chart	Logged By	TD
-----------------	------	--------	-------	-----------	----



DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0					0.10	ASPHALTIC CONCRETE 3.87
					p.30	FILL 3.67
						Red to brown sand and gravel Sandstone fill, weak
1						
2	1	S	19	200		
	2	S	15	150		
3						
	3	S	3	150		
4	4	S	5	100		
5	5	S	6	200		
	6	S	6	300		
6						
	7	S	8	150		
7	8	S	6	450		
					7.31	-3.34
	9	HQ	0	200	7.57	-3.60
	10	HQ	83	1520		
						SAND and SILT Grey to black sand and silt, some shells
						MUDSTONE BEDROCK Red to brown mudstone bedrock
9						
	11	HQ	73	1520		
10						
	12	HQ	57	1194		
11						
12					12.19	-8.22
						End of borehole at 12.2 metres below existing top of deck

Client	Public Works & Government Services Canada	Proj No.	10456.73	BOREHOLE BH18-04 Page 1 of 1
Project	Geotechnical Investigation	Date Drilled	05.Feb.2018	
Location	Lameque Wharf, Lameque NB			

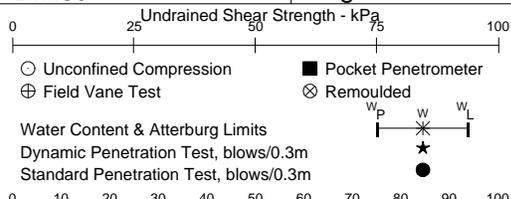
Ground Level, m	3.92	Datum:	Chart	Logged By	TD
-----------------	------	--------	-------	-----------	----



DEPTH m	SAMPLE				LOG	DESCRIPTION	SPT
	No	TYPE	N (RQD)	REC (mm)			
0					0.22 CONCRETE SLAB	3.70	
					0.32 FILL	3.60	
1	1	S	101	100	Red to brown sand and gravel Sandstone fill, weak		
2	2	S	31	400			
3	3	S	16	300			
4	4	S	10	350			
5	5	S	15	375			
6	6	S	6	375			
7	7	S	8	225			
8	8	S	6	400			
6					5.84 SAND and SILT	-1.93	
					6.40 Grey to black sand and silt, some shells	-2.49	
9	9	S	12	200	MUDSTONE BEDROCK		
					Red to brown mudstone bedrock		
10	10	S	87	300			
11	11	HQ	100	305			
12	12	HQ	53	1520			
13	13	HQ	97	1473			
10.84					End of borehole at 10.8 metres below existing top of deck	-6.93	

Client	Public Works & Government Services Canada	Proj No.	10456.73	BOREHOLE BH18-05 Page 1 of 1
Project	Geotechnical Investigation	Date Drilled	06.Feb.2018	
Location	Lameque Wharf, Lameque NB			

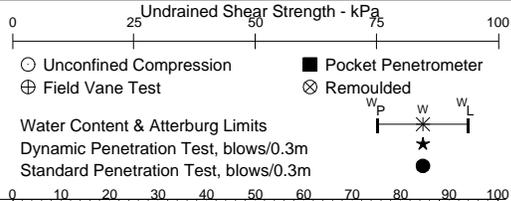
Ground Level, m	3.87	Datum:	Chart	Logged By	TD
-----------------	------	--------	-------	-----------	----



DEPTH m	SAMPLE				LOG	DESCRIPTION	Undrained Shear Strength - kPa
	No	TYPE	N (RQD)	REC (mm)			
0					0.22 CONCRETE SLAB	3.65	
					0.32 FILL	3.55	
1	1	S	101	75	Red to brown sand and gravel Sandstone fill, weak		
2	2	S	29	350			
3	3	S	10	300			
4	4	S	10	300			
5							
6	5	S	10	200			
7	6	S	6	325			
					7.01 SAND and SILT	-3.14	
					7.16 Grey to black sand and silt, some shells	-3.29	
					MUDSTONE BEDROCK		
8	8	HQ	63	1499	Red to brown mudstone bedrock		
9							
10	9	HQ	68	1520			
					10.90	-7.03	
					End of borehole at 10.9 metres below existing top of deck		

Client	Public Works & Government Services Canada	Proj No.	10456.73	BOREHOLE BH18-06 Page 1 of 1
Project	Geotechnical Investigation	Date Drilled	06.Feb.2018	
Location	Lameque Wharf, Lameque NB			

Ground Level, m	3.85	Datum:	Chart	Logged By	TD
-----------------	------	--------	-------	-----------	----



DEPTH m	SAMPLE				LOG	DESCRIPTION	Undrained Shear Strength - kPa
	No	TYPE	N (RQD)	REC (mm)			
0						0.22 CONCRETE SLAB 3.63	
						0.32 FILL 3.53	
						Red to brown sand and gravel Sandstone fill, weak	
1	1	S	83	575	[Cross-hatched pattern]		
	2	S	27	350			
2	3	S	13	350			
	4	S	15	425			
3							
	5	S	6	350			
4							
	6	S	10	250			
5							
	7	S	3	350			
6							
	8	S	33	0		7.19 SILT -3.34 Grey to brown clayey silt	
7							
	9	HQ	55	1346		8.08 MUDSTONE BEDROCK -4.23 Red to brown mudstone bedrock	
8							
	10	HQ	48	1473			
9							
	11	HQ	90	1520			
10							
	12					12.37 -8.52 End of borehole at 12.4 metres below existing top of deck	

Client Public Works & Government Services Canada

Proj No. 10456.73

BOREHOLE

Project Geotechnical Investigation

Date Drilled 06.Feb.2018

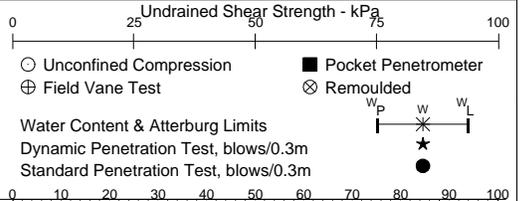
BH18-07
Page 1 of 1

Location Lameque Wharf, Lameque NB

Ground Level, m 3.81

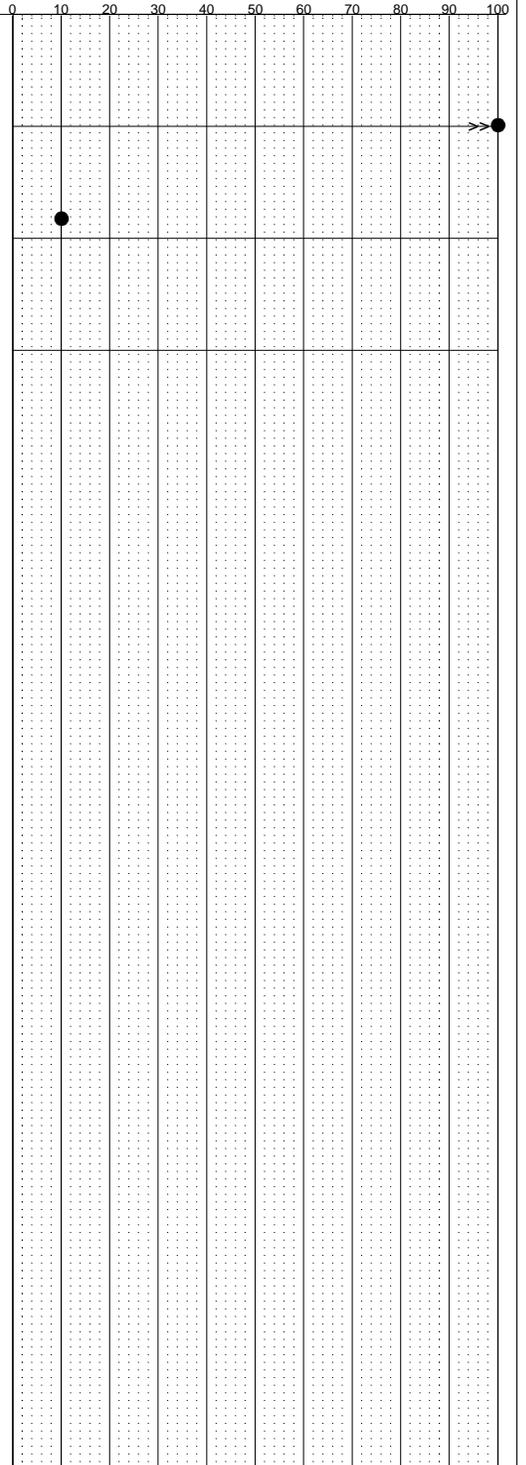
Datum: Chart

Logged By TD



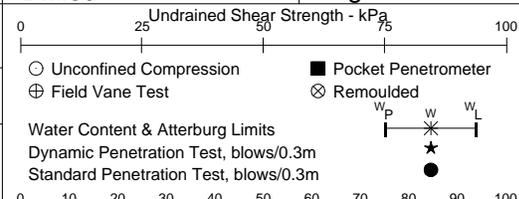
DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0					0.22	CONCRETE SLAB 3.59
					0.32	FILL 3.49
						Red to brown sand and gravel Sandstone fill, weak
1	1	S	101	120		
	2	S	10	300		
2						
3					3.05	0.76

End of borehole at 3.1 metres below existing top of deck
Borehole was terminated due to encountering an unknown object



Client	Public Works & Government Services Canada	Proj No.	10456.73	BOREHOLE BH18-08 Page 1 of 2
Project	Geotechnical Investigation	Date Drilled	07.Feb.2018	
Location	Lameque Wharf, Lameque NB			

Ground Level, m	3.82	Datum:	Chart	Logged By	TD
-----------------	------	--------	-------	-----------	----



DEPTH m	SAMPLE				LOG	DESCRIPTION	SPT
	No	TYPE	N (RQD)	REC (mm)			
0					0.22	CONCRETE SLAB	3.60
					0.32	FILL	3.50
						Red to brown sand and gravel Sandstone fill, weak	
1	1	S	101	200			
	2	S	9	400			
2							
	3	S	22	300			
3							
	4	S	7	225			
4							
	5	S	6	250			
5							
	6	S	8	200			
6							
	7	S	11	200			
7							
	8	S	33	300	7.92	GLACIAL TILL	-4.10
8					8.53	Red to brown silty sand and gravel, trace clay	-4.71
						MUDSTONE BEDROCK	
						Red to brown mudstone bedrock	
9							
	9	S	15	400			
10							
	10	HQ	10	151			
11							
	11	HQ	20	965			
12							
	12	HQ	0	200			
13							

Client Public Works & Government Services Canada

Proj No. 10456.73

BOREHOLE

Project Geotechnical Investigation

Date Drilled 07.Feb.2018

BH18-08
Page 2 of 2

Location Lameque Wharf, Lameque NB

Ground Level, m 3.82

Datum: Chart

Logged By TD

0 25 50 75 100
Undrained Shear Strength - kPa

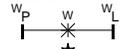
○ Unconfined Compression ■ Pocket Penetrometer

⊕ Field Vane Test ⊗ Remoulded

Water Content & Atterburg Limits

Dynamic Penetration Test, blows/0.3m

Standard Penetration Test, blows/0.3m



DEPTH m SAMPLE LOG DESCRIPTION

No TYPE N (RQD) REC (mm)

13

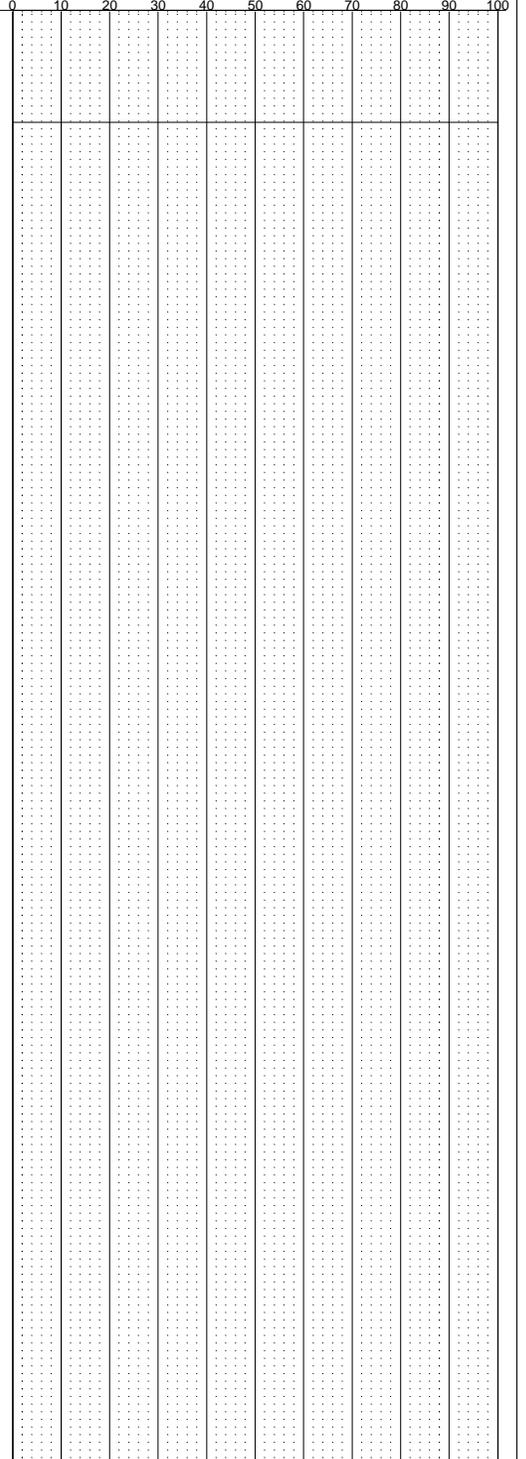
14

13 HQ 63 1520



14.55 -10.73

End of borehole at 14.6 metres below existing top of deck



Client: Public Works & Government Services Canada

Proj No.: 10456.73

BOREHOLE

Project: Geotechnical Investigation

Date Drilled: 07.Feb.2018

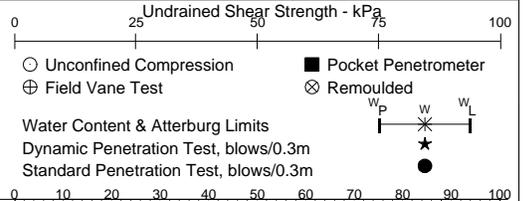
BH18-09
Page 1 of 2

Location: Lameque Wharf, Lameque NB

Ground Level, m: 3.84

Datum: Chart

Logged By: TD



DEPTH m	SAMPLE				LOG	DESCRIPTION	SPT	
	No	TYPE	N (RQD)	REC (mm)				
0					0.22 CONCRETE SLAB	3.62		
					0.32 FILL	3.52		
					Red to brown sand and gravel Sandstone fill, weak			
1	1	S	101	100				
	2	S	7	250				
2								
3	3	S	19	350				
						Lab Testing: Gravelly sand, some silt (AASHTO A-1-b)		
4								
5	4	S	6	250				
6								
7								
8	5	S	7	150				
9	6	S	3	200				
10								
11	7	S	14	175		7.92 SILTY SAND	-4.09	
					8.38 Grey to black silty sand	-4.55		
12	8	S	20	550	GLACIAL TILL			
					Red to brown sandy silt, some gravel, trace clay			
13	9	S	32	400				
					Lab Testing: Sandy silt, trace gravel (AASHTO A-4 to A-7)			
14	10	S	36	400				
15	11	S	26	0				
16	12	S	48	0				
17					11.88 MUDSTONE BEDROCK	-8.05		
18	13	HQ	0	787	Red to brown mudstone bedrock			

Client Public Works & Government Services Canada

Proj No. 10456.73

BOREHOLE
BH18-09
Page 2 of 2

Project Geotechnical Investigation

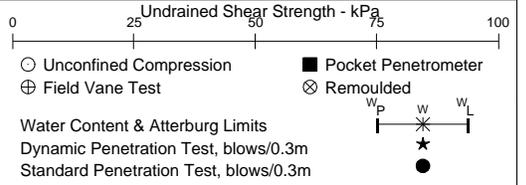
Date Drilled 07.Feb.2018

Location Lameque Wharf, Lameque NB

Ground Level, m 3.84

Datum: Chart

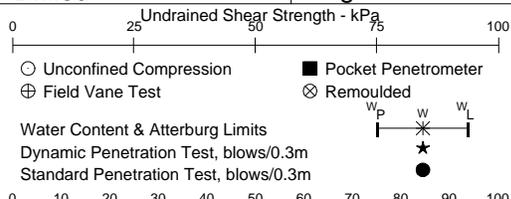
Logged By TD



DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
13						
14	14	HQ	60	1520		
15						
16	15	HQ	72	1520		
						16.69 -12.86
						End of borehole at 16.7 metres below existing top of deck

Client	Public Works & Government Services Canada	Proj No.	10456.73	BOREHOLE BH18-10 Page 1 of 2
Project	Geotechnical Investigation	Date Drilled	08.Feb.2018	
Location	Lameque Wharf, Lameque NB			

Ground Level, m	3.84	Datum:	Chart	Logged By	TD
-----------------	------	--------	-------	-----------	----



DEPTH m	SAMPLE				LOG	DESCRIPTION	SPT
	No	TYPE	N (RQD)	REC (mm)			
0					0.22 CONCRETE SLAB	3.62	
					0.32 FILL	3.52	
					Red to brown sand and gravel Sandstone fill, weak		
1							
2	1	S	9	250			
3							
4	2	S	4	100			
5							
6	3	S	8	300			
7							
8	4	S	9	225			
9	5	S	5	200			
10	6	S	5	200			
11	7	S	5	300			
12	8	S	2	250	9.14	-5.31	
13	9	S	10	500			
14	10	S	16	300			
15	11	S	20	400	11.43	-7.60	
16					GLACIAL TILL		
17	12	S	18	0	Red to brown silty sand and gravel, trace clay		
18	13	S	19	350			

Client Public Works & Government Services Canada

Proj No. 10456.73

BOREHOLE

Project Geotechnical Investigation

Date Drilled 08.Feb.2018

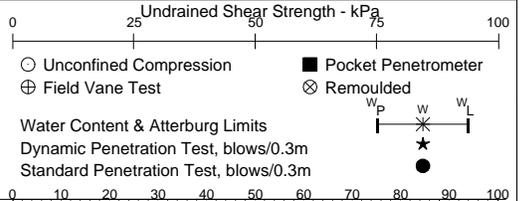
BH18-10
Page 2 of 2

Location Lameque Wharf, Lameque NB

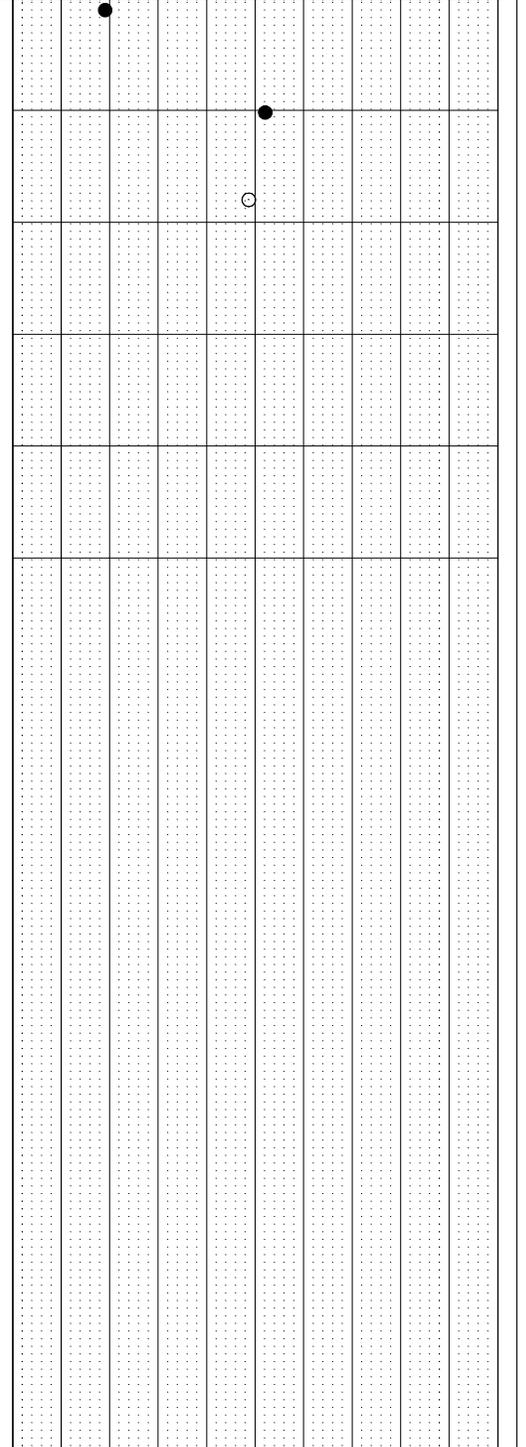
Ground Level, m 3.84

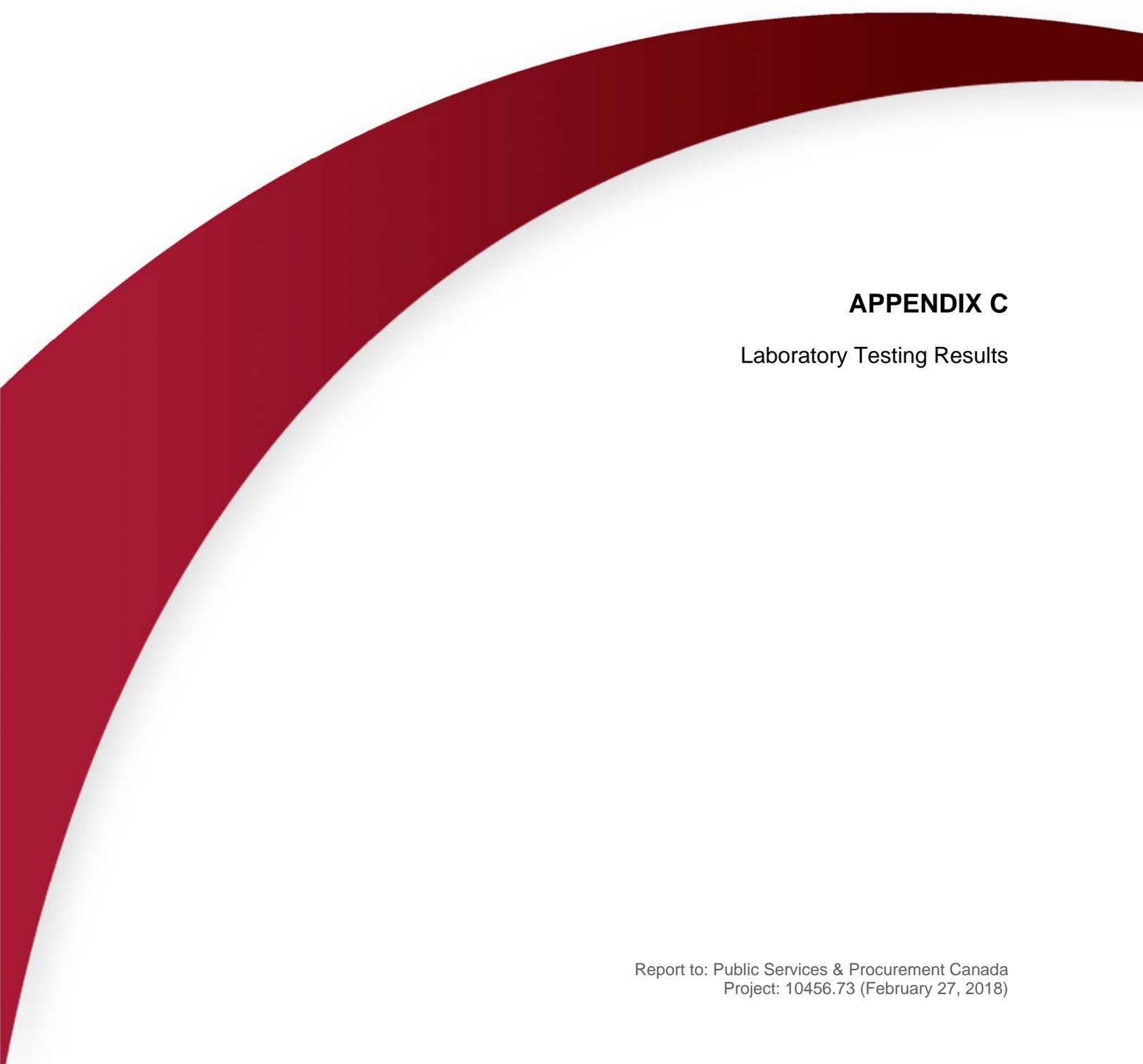
Datum: Chart

Logged By TD



DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
13						
14	14	S	52	150		13.97 -10.14 MUDSTONE BEDROCK Red to brown mudstone bedrock
15	15	HQ	42	1346		
16	16	HQ	82	1520		
17	17	HQ	35	1473		16.69 -12.86 SANDSTONE BEDROCK Grey fine-grained sandstone bedrock
18						18.39 -14.56 End of borehole at 18.4 metres below existing top of deck





APPENDIX C

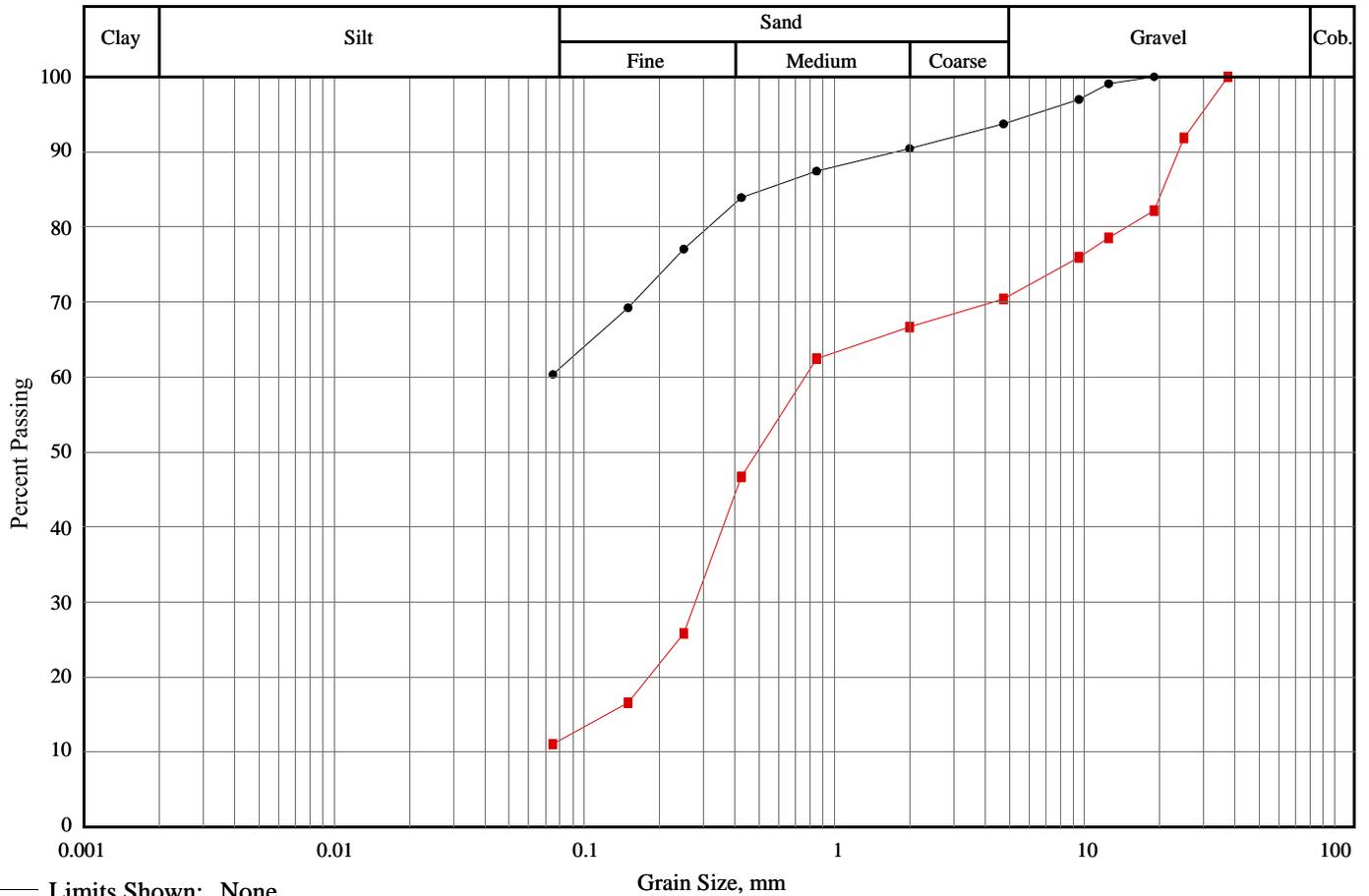
Laboratory Testing Results



GEMTEC
CONSULTING ENGINEERS
AND SCIENTISTS

Client: Public Services and Procurement Canada (PSPC)
Project: SOA EC373-180283/001/MTC - Lameque wharf Structu
Project #: 1045673

Soils Grading Chart



Line Symbol	Description	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay	Date Sampled
—●—	GLACIAL TILL	BH18-09	S10	10.0-10.6m	6.3	33.4	60.3		18/02/15
—■—	SANDSTONE FILL	BH18-09	S3	3.0-3.6m	29.6	59.4	11.0		18/02/15

Line Symbol	Sample Description	AASHTO	D ₁₀	D ₁₅	D ₅₀	D ₈₅	% 5-75µm
—●—	Sandy silt , trace gravel	A-4 to A-7	---	---	---	0.53	---
—■—	Gravelly sand , some silt	A-1-b	---	0.12	0.49	20.59	---



GEMTEC
CONSULTING ENGINEERS
AND SCIENTISTS

Client	Public Services and Procurement Canada (PSPC)
Project:	SOA EC373-180283/001/MTC - Lameque wharf Structu
Project #:	1045673

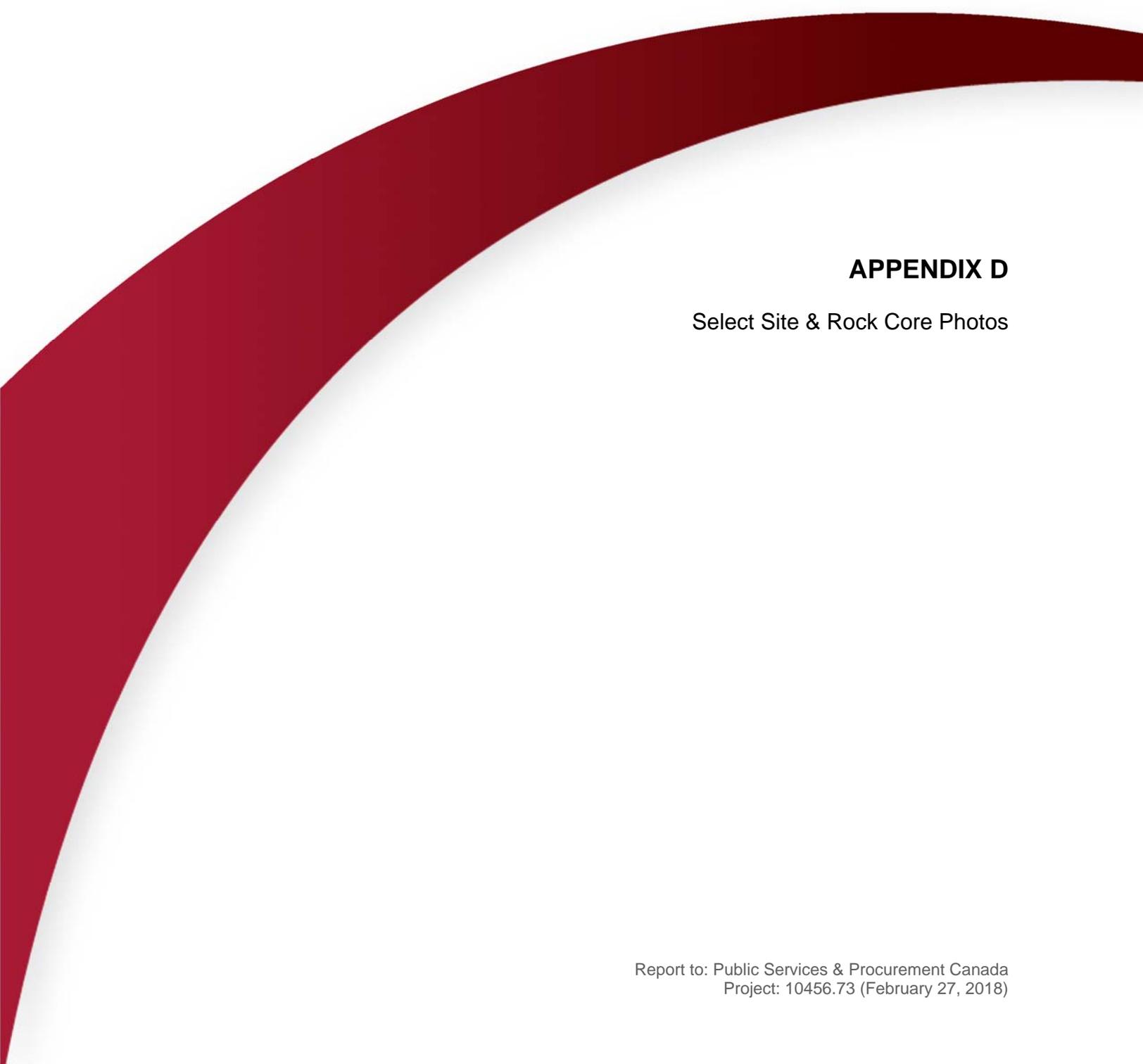
Moisture Content and Density

Borehole: BH18-09	Date/Time Sampled: 18/02/15 10:10:00 AM	Mass of Cont. + Wet Soil, g:	701.70
Depth: 10.0-10.6m	Date/Time Tested: 18/02/26 10:11:46 AM	Mass of Cont. + Dry Soil, g:	638.70
Sample: S10		Mass of Container, g:	171.90
Description: GLACIAL TILL		Moisture Content, %:	13.50
		Sample Length, mm:	
		Sample Diameter, mm:	
		Sample Mass, g:	
		Sample Volume, mm ³	
		Wet Density, kg/m ³	
		Dry Density, kg/m ³	
Borehole: BH18-09	Date/Time Sampled: 18/02/15 10:11:00 AM	Mass of Cont. + Wet Soil, g:	910.30
Depth: 3.0-3.6m	Date/Time Tested: 18/02/26 10:11:46 AM	Mass of Cont. + Dry Soil, g:	803.60
Sample: S3		Mass of Container, g:	168.70
Description: SANDSTONE FILL		Moisture Content, %:	16.81
		Sample Length, mm:	
		Sample Diameter, mm:	
		Sample Mass, g:	
		Sample Volume, mm ³	
		Wet Density, kg/m ³	
		Dry Density, kg/m ³	

	Client: Public Services and Procurement Canada (PSPC)	<h2>Rock Core Compressive Strength</h2>
	Project: SOA EC373-180283/001/MTC - Lameque wharf Structure 401 and 402, Geotechnic	
	Project #: 1045673	

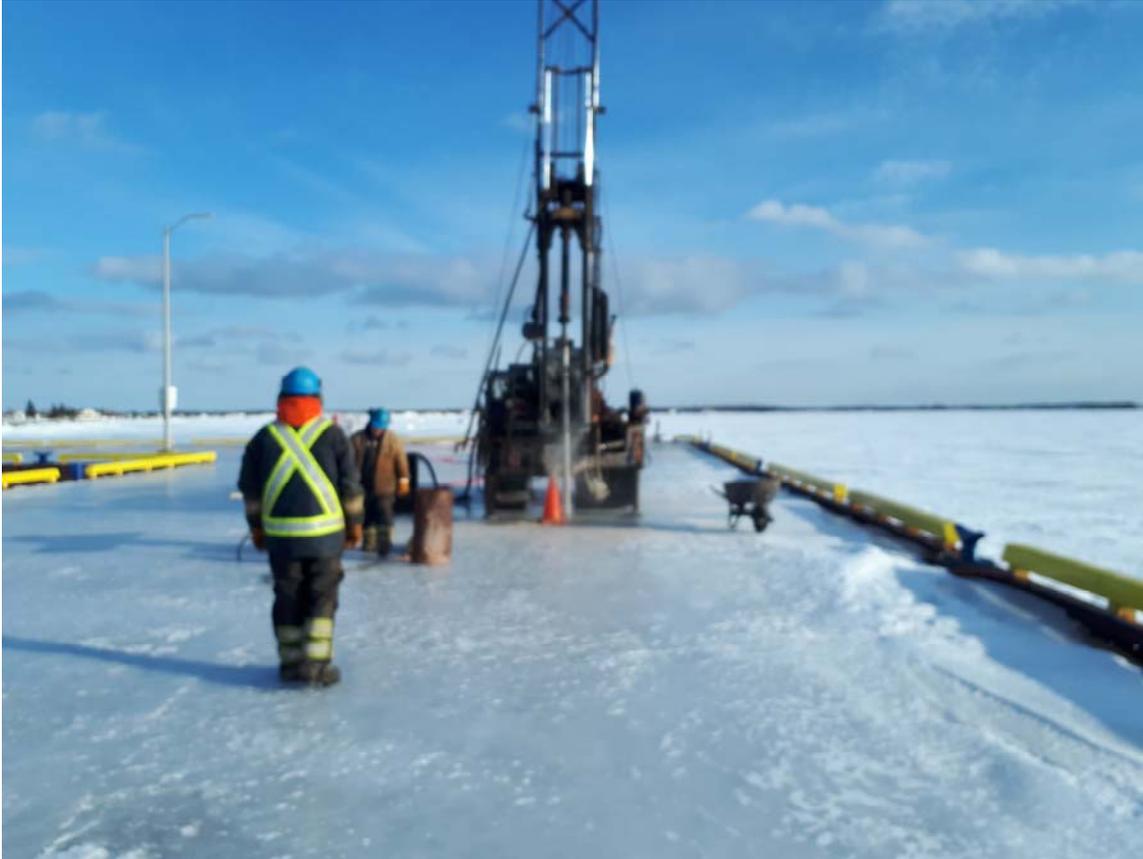
Date/Time Sampled: 18/02/26 8:49:00 AM	Date/Time Tested: 18/02/26 8:50:48 AM
--	---------------------------------------

BH	Sample No	Depth	Description	Diameter, mm	Area, mm ²	Length After Capping, mm	L/D	Load, kN	Comp. Str., MPa
BH18-02	HQ10	9.0m	MUDSTONE BEDROCK	46.0	1662	89	1.93	2.380	1.4
BH18-10	HQ15	14.8m	MUDSTONE BEDROCK	62.0	3019	81	1.31	147.490	48.6



APPENDIX D

Select Site & Rock Core Photos



Overview of the site.



Mudstone bedrock extracted from BH18-04. 6.4 to 10.4 metres below existing top of deck.



Mudstone bedrock extracted from BH18-05. 7.2 to 10.9 metres below existing top of deck.



Mudstone bedrock extracted from BH18-06. 8.1 to 12.4 metres below existing top of deck.

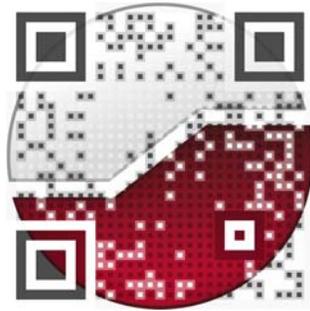


Mudstone bedrock extracted from BH18-09. 11.9 to 16.7 metres below existing top of deck.



Bedrock extracted from BH18-10. Mudstone: 14.0 to 16.7 metres below existing top of deck. Sandstone: 16.7 to 18.4 metres below existing top of deck.

experience • knowledge • integrity



civil
geotechnical
environmental
field services
materials testing

civil
géotechnique
environnementale
surveillance de chantier
service de laboratoire des matériaux

expérience • connaissance • intégrité

