Appendix B
Historical Geotechnical Report Pinkney’s Point, 1989

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GEOTECHNICAL INVESTIGATION
PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT
YARMOUTH COUNTY, NOVA SCOTIA
PWC PROJECT NUMBER 704198

1.0 INTRODUCTION

At the request of Mr G. Webber, P.Eng., of Public Works Canada (PWC), Maritime Testing (1985) Limited (MTL) conducted a geotechnical site investigation at Pinkneys Point in Yarmouth County, Nova Scotia. The purpose of the investigation was to identify the subsurface soil conditions at the site and make recommendations regarding foundation design for the proposed floating wharf. This project has been completed in accordance with PWC Project Number 704198.

It is our understanding PWC proposes to place a floating wharf from the end of the existing marginal wharf towards the channel opening. The floating wharf will be approximately 80 metres in length.

2.0 FIELD AND LABORATORY WORK

Fieldwork for the investigation was carried out between March 10 and March 13, 1989, and consisted of four boreholes. The boreholes were drilled utilizing a skid mounted Acker drill rig equipped for water flush diamond drilling and rock coring. The drill rig was mounted on 12 ft x 12 ft barge and towed to the borehole locations using a small outboard powered boat.

The boreholes were advanced using a combination of a core barrel and casing, this being the most efficient method to penetrate the cobbles

and boulders at this site and obtain representative samples of the overburden soils. Samples of the overburden soils were taken using the split spoon sampler starting at the harbour bottom and generally at 1 metre intervals. Blow counts, N, for the standard penetration test were recorded for 0.3 m advancement of the split spoon sampler. Soil from the sampler was placed in rigid wall containers for future examination and testing. Cobbles and boulders encountered during the drilling were cored and the core samples retained. Photographs of the core samples are shown on Plates 14 to 16, inclusive, Appendix B.

The number and location of the boreholes were specified by Public Works Canada. Borehole locations and elevations were referenced in the field by MTL personnel. Harbour bottom elevations were referenced to a benchmark provided by PWC which was located on top of the concrete deck at the end of the existing north wharf. The benchmark has an elevation of + 6.1 m referenced to Chart Datum. A site plan showing the borehole locations and the benchmark is given in Plate 1, Appendix B.

As per the Public Works Canada project requirements, borings were advanced to a depth where the N values from the standard penetration test exceeded 20 for at least 6 continuous metres and/or a minimum of 3 m of bedrock was cored.

Field supervision and logging of the boreholes was carried out by Mr. K. Marvin, P.Eng., of Maritime Testing (1985) Limited.

Soil samples taken from the split spoon sampler were tested in MTL's Dartmouth laboratory to determine some of their engineering properties. Tests included natural moisture content and sieve analysis. The results of the testing are shown on the borehole logs and on the Sieve Analysis Reports, Plates 8 to 13, inclusive, Appendix B.

An explanation of terms and symbols used on the borehole logs and the text of this report is given in Appendix A.

3.0 SITE CONDITIONS

3.1 Site Geology

The Pinkneys Point site is located within the Carboniferous granite intrusives which may consist of granite, granodiorite, tonalite, alaskite or porphyry.

Surfical geological features have been modified by the late Wisconsian glaciation. The most notable features resulting from glaciation are cobble, boulder, and large erratic deposits exposed along the coastline.

3.2 Surface Conditions

The village of Pinkneys Point is approximately 15 km southeast from the town of Yarmouth. It is located at the tip of a narrow peninsula of land approximately 6 km long by 1 km wide that is oriented in a north-south direction. Industries in the village consist of fishing and boat building.

At this site the major existing structures consist of an 'L' shaped wharf, a small marginal wharf and an armour stone breakwater (See Plate 1, Appendix B). The wharfs and breakwater extend from the shoreline in an easterly direction and provide a well sheltered harbour. Additions to the public wharfs have been constructed and are used for storing lobster traps and other fishing equipment. Adjacent the marginal wharf there is a marine slip.

3.3 Subsurface Conditions

Soil conditions encountered in the boreholes were generally consistent, and comprised of a layer of silt beginning at the harbour bottom which was underlaid by two layers of sand differentiated by colour. In Borehole Nos. 1 and 3, however, granite bedrock was encountered underlying the second sand layer.

Borehole Nos. 1 and 3 were terminated in the bedrock while Borehole Nos. 2 and 4 were terminated in the second layer of sand.

A stratigraphic section based on the soil conditons encountered in the boreholes is given on Plate 2, Appendix B.

Silt (ML)

The silt encountered at the harbour bottom was soft to firm, with some sand to sandy, with a trace of clay, and dark grey to black in colour. Samples of the silt from Borehole Nos. 3 and 4 were observed to have a distinct organic odor. Blow counts (N) for the standard penetration test ranged from 7 to 12 with an average N value of 9 for 0.3m advancement of the split spoon sampler. Moisture contents ranged from 7 percent to 46 percent with an average moisture content of 31 percent. The silt ranged in depth below the harbour bottom from 0.6 to 2.7 metres. This material has been designated ML according to the Unified Soil Classification (USC) system.

Sand A (SM)

The sand layer underlying the silt was well graded and contained some gravel to gravelly, with a trace of silt, a trace of clay, and was grey to dark grey in color. The sand contained some cobbles and boulders. The boulders ranged in size from 300 mm to 600 mm in

diameter. It is estimated that 20 percent of the sand layer consisted of cobbles and boulders. Representative blow counts (N) for the standard penetration test ranged from 5 to 81 with an average N value of 40 for 0.3m advancement of the split spoon sampler. The sand layer had a dense to very dense consistency. Moisture contents ranged from 7 percent to 11 percent with an average moisture content of 9 percent. The sand was found between 0.6 and 2.7 metres depth below the harbour bottom and ranged from 1.3 to 3.4 metres in thickness. The results of sieve analyses carried out on samples of this material are given on Plates 8 and 10, Appendix B. This material has been designated SM in accordance to the USC system.

Sand B (SM)

The second sand layer was well graded, gravelly, with some silt, a trace of clay, and was brownish grey to olive grey in colour. The sand contained some cobbles and boulders. The boulder encountered in Borehole No. 4 was found to be 1000 mm in size. Representative blow counts (N) for the standard penetration test ranged in value from 20 to 75 with an average N value of 44 for 0.3m advancement of the split spoon sampler. The sand layer had a dense to very dense consistency. Moisture content ranged from 12 percent to 21 percent with an average moisture content of 14 percent. The sand was found between 2.7 and 4.0 metres depth below harbour bottom. Results of sieve analyses carried out on samples of this material are included on Plates 9, 11, 12 and 13, Appendix B. This material has been designated SM in accordance with the USC system.

Bedrock

Granite bedrock was encountered at a depth of 4.0 m and 4.9 m in Borehole Nos. 1 and 3, respectively. The bedrock was coarse grained, medium bedded, with moderately widely spaced joints, slightly

weathered and light grey in colour. Fractures were observed to be at approximately 35° to 40° to the axis of the boreholes. Slight oxidation staining was observed at the fracture surfaces. A modified Rock Quality Designation (RQD) value was determined from the core samples (the modified RQD value is calculated using BX size cores). The modified RQD ranged from 79 to 86 with an average value of 83, indicating good quality rock.

4.0 RECOMMENDATIONS

It is our understanding that a floating wharf at the end of the existing marginal wharf is proposed. The floating wharf will be able to move freely in a vertical direction to accomodate tides, etc. but horizontal movement will be restricted.

Lateral constraint of the floating wharf may be developed by structural designs utilizing bottom anchored cables or a pile type foundation utilized as vertical guides. Other structural design configurations are also possible.

4.1 Anchors

Anchors may consist of large dead weights set on the harbour bottom. If this system is employed, the design should take into account both the short term and long term settlement of the anchors into the silt soils. Settlement will depend on the weight and configuration of the anchors and can be estimated once these design parameters are known.

As a general guideline it is estimated that anchor weight could settle into the soft silt soil by as much as 1 m. In addition, the silt soil is susceptible to erosion and tidal and current forces may promote additional settlement of anchor weights.

Installation of rock anchors set into the granite bedrock is feasibile but may prove to be an expensive alternative. Minimum embeddment depth in bedrock of 3 m has been estimated for rock anchors. If this type of of mooring system is used, rock anchor pullout strength should be confirmed by field tests.

It should be noted that bedrock was encountered in Boreholes 1 and 3 only. Bedrock was not encountered in the other two boreholes which were advanced to similar depths. Based on this, bedrock elevation is anticipated to be variable across the site.

4.2 Steel H Piles

Piles may be used to act as vertical guide rails for the floating wharf. Based on the soil conditions encountered in the boreholes at this site, the boulder-cobble content in the overburden soils is in the order of 20 percent. It is our understanding that Public Works Canada has successfully driven H piles in bouldery material and achieve penetration in the order of 3 m or greater in the sand soil. The silt soils should not be considered to provide any axial or lateral support for pile foundations. The pile foundation designer may wish to consider fixity starting to be achieved at a depth of 3 metres. Actual fixity may be required at greater depth. Determination of pile fixity, as discussed above, should not consider the silt soils to contribute to the pile capacity. In addition, the top 1 m of the sand soil should not be considered to contribute to pile capacity.

The ability of the pile to withstand lateral loading for the soil statigraphy encountered at the Pinkneys Point site is good. However, near the existing marginal wharf, lateral support may be reduced due to insufficient depth of overburden soil to the underlying bedrock. In view of this, lateral bracing between piles or battered piles should be considered to resist lateral loads in areas where pile penetration

is less than 3 metres.

Resistance to uplift forces by H pile type foundations driven a minimum of 3 m into the gravelly sand soil will be significant. Skin friction available to resist uplift forces has been estimated at 31 kPa (150 psf).

It is recommended that a special shoe designed to aid pile driving through bouldery soil be attached to the pile toe to reduce possible toe damage during the pile driving.

5.0 CLOSURE

We trust the above report fulfills your requirements for the above project. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

MARITIME TESTING (1985) LIMITED

REGISTERED PROFESSIONAL ENGINEER
PROVINCE OF NOVA SCOTIA
DATE Apr 10/89
T. K. MARVIN
4290

T. Kenneth Marvin, P.Eng.

REGISTERED PROFESSIONAL ENGINEER
PROVINCE OF NOVA SCOTIA
DATE
M. T. G. BROWN
4034

M.T.G. Brown, M.B.A., P.Eng.

APPENDIX A

EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of field investigation and subsequent laboratory testing are described in the following pages.

It should be noted that materials, boundaries, and conditions have been established only at the borehole locations, and are not necessarily representative of subsurface conditions elsewhere across the site.

TEST DATA

Data obtained from laboratory and field testing are shown on the grid at the appropriate depth interval.

The natural moisture (water) content of the soil at the time of drilling is plotted against depth, together with the plastic and liquid limits where determined.

Abbreviations, graphic symbols, and relevant test method designations are as follows:

⊙	w	natural moisture content (ASTM D 2216)
⊡	w_P	plastic limit (ASTM D 424)
△	w_L	liquid limit (ASTM D 423)
	NP	non plastic soil
——→		seepage
——▼		observed water level

Other abbreviations and symbols are as shown on the borehole log sheet.

DEPTH

The depth of borehole below existing ground surface is shown. Corresponding elevations sometimes are shown with respect to the datum given.

SOIL CLASSIFICATION AND DESCRIPTION

Soils are classified and described according to their engineering properties and behaviour.

The soil of each stratum is described using the Unified Soil Classification System[1] modified slightly so that an inorganic clay of "medium plasticity" is recognized.

The use of modifying adjectives may be employed to define the actual or estimated percentage range by weight of minor components. This is similar to a system developed by D.M. Burmister.[2]

The soil classification system is shown in greater detail on page 3.

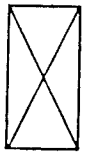
1. "Unified Soil Classification System", Technical Memorandum 3-357 prepared for Office, Chief of Engineering, by Waterways Experiment Station, Vicksburg, Mississippi, Corps. of Engineers, U.S. Army. Vol. 1, March 1953.

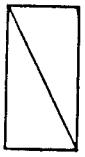
2. American Society for Testing and Materials. Procedures for Testing Soils, "Suggested Methods of Testing for Identification of Soils", 4th Ed; pp 221-233, Dec. 1964.

SOIL SAMPLES

CONDITION — This column graphically indicates the depth and condition of the sample:

 undisturbed

 disturbed

 not recovered

TYPE — The type of sample is indicated in this column as follows:

A auger sample
B block sample
C rock core, or frozen soil core
D drive sample
P Pitcher tube sample
U tube sample (usually thin-walled)
W wash or air return sample
O other (see report text)

PENETRATION RESISTANCE — Unless otherwise noted this column refers to the number of blows (N) of a 140 pound (63.5 kg) hammer freely dropping 30 inches (0.76 m) required to drive a 2 inch (50.8 mm) O.D. open-end sampler 0.5 feet (0.15 m) to 1.5 feet (0.45 m) into the soil, or until 100 blows have been applied, in which case, the penetration is stated. This is the standard penetration test referred to in ASTM D 1586.

OTHER TESTS

In this column are tabulated results of other laboratory tests as indicated by the following symbols:

*C	Consolidation test
Fines	Percentage by weight smaller than #200 sieve
D_R	Relative density (formerly specific gravity)
k	Permeability coefficient
*MA	Mechanical grain size analysis and hydrometer test (if appropriate)
pp	Pocket penetrometer strength
*q	Triaxial compression test
q_u	Unconfined compressive strength
*SB	Shearbox test
SO_4	Concentration of water-soluble sulphate
*ST	Swelling test
TV	Torvane shear strength
VS	Vane shear strength (undisturbed-remolded)
ε_f	Unit strain at failure
γ	Unit weight of soil or rock
γ_d	Dry unit weight of soil or rock
ρ	Density of soil or rock
ρ_d	Dry density of soil or rock

* The results of these tests usually are reported separately.

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

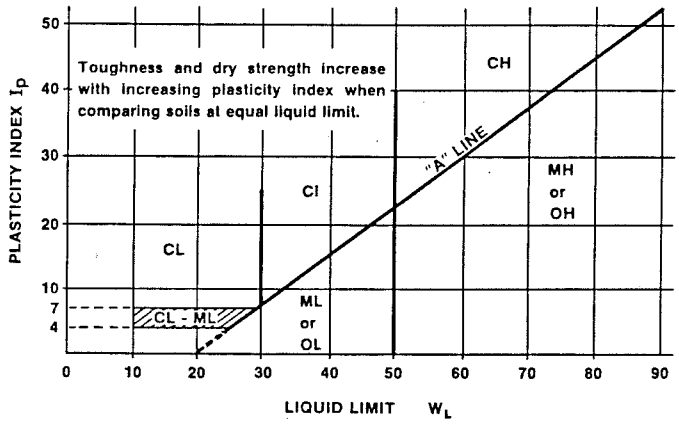
MAJOR DIVISION			GROUP SYMBOL	GRAPHIC SYMBOL	COLOR CODE	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
HIGHLY ORGANIC SOILS			Pt		ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS MORE THAN HALF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS	GW		RED	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, < 5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP		RED	POORLY-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, < 5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS
		DIRTY GRAVELS	GM		YELLOW	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES > 12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $I_p < 4$
			GC		YELLOW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES > 12% FINES	ATTERBERG LIMITS ABOVE "A" LINE, $I_p > 7$
	SANDS MORE THAN HALF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS	SW		RED	WELL-GRADED SANDS, GRAVELLY SANDS, < 5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			SP		RED	POORLY-GRADED SANDS, OR GRAVELLY SANDS, < 5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS
		DIRTY SANDS	SM		YELLOW	SILTY SANDS, SAND-SILT MIXTURES > 12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $I_p < 4$
			SC		YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES > 12% FINES	ATTERBERG LIMITS ABOVE "A" LINE OR $I_p > 7$
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE SIZE)	SILTS BELOW "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		ML		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	$W_L < 50$
			MH		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	$W_L > 50$
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		CL		GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	$W_L < 30$
			CI		GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY SILTY CLAYS	$W_L > 30$, < 50
			CH		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	$W_L > 50$
	ORGANIC SILTS & ORGANIC CLAYS BELOW "A" LINE ON PLASTICITY CHART		OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	$W_L < 50$
			OH		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	$W_L > 50$

SEE CHART BELOW

1. All sieve sizes mentioned on this chart are U.S. Standard, ASTM E11.
2. Boundary classifications possessing characteristics of two groups are given combined group symbols eg GW-GC is a well-graded gravel-sand mixture with clay binder between 5% and 12%.
3. Soil fractions and limiting textural boundaries are in accordance with the Unified Soil Classification System, except that an inorganic clay of medium plasticity (CI) is recognized.
4. The following adjectives may be employed to define percentage ranges by weight of minor components:

and	50 - 36%
some	35 - 21%
little	20 - 11%
trace	10 - 1%

PLASTICITY CHART



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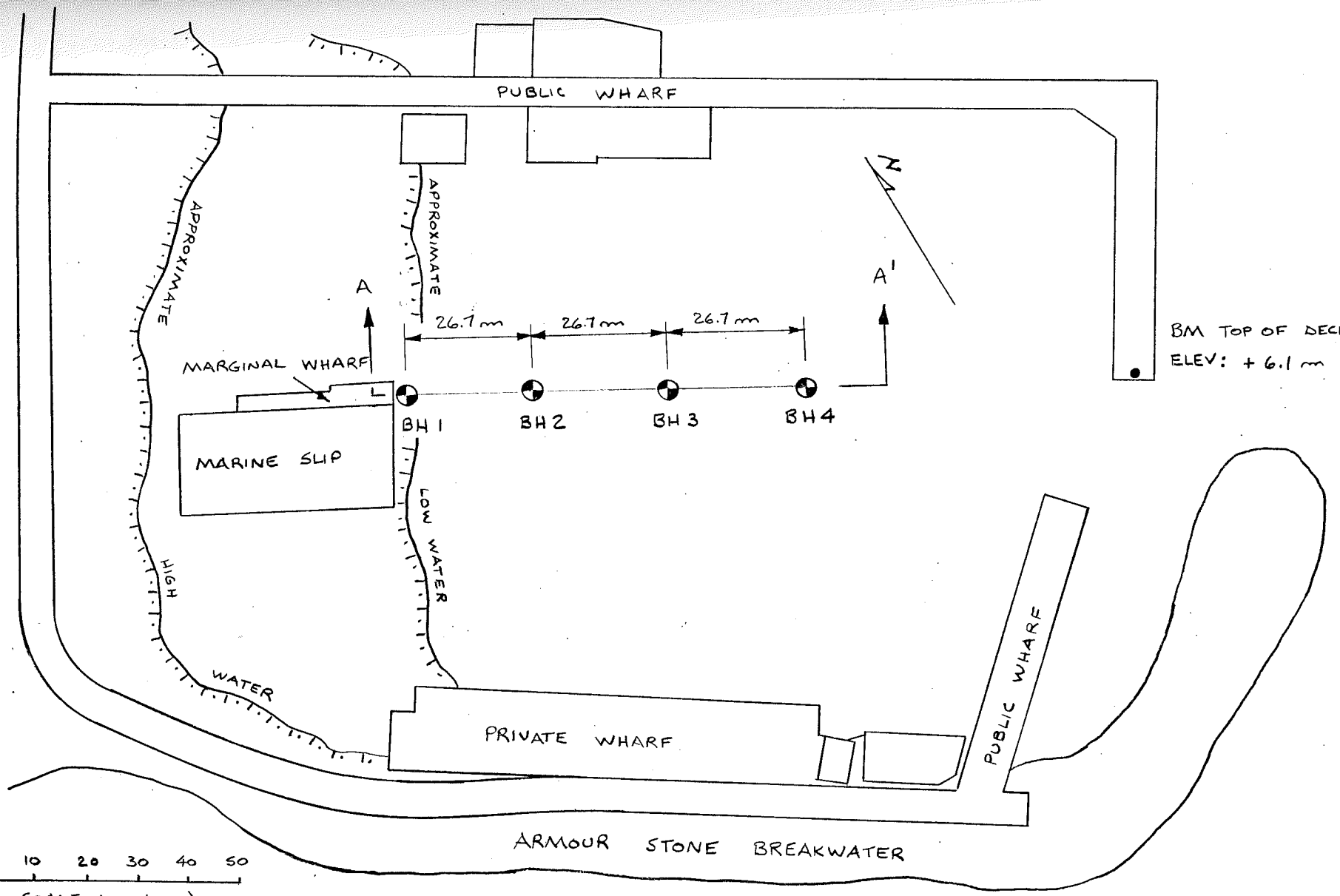
APPENDIX B



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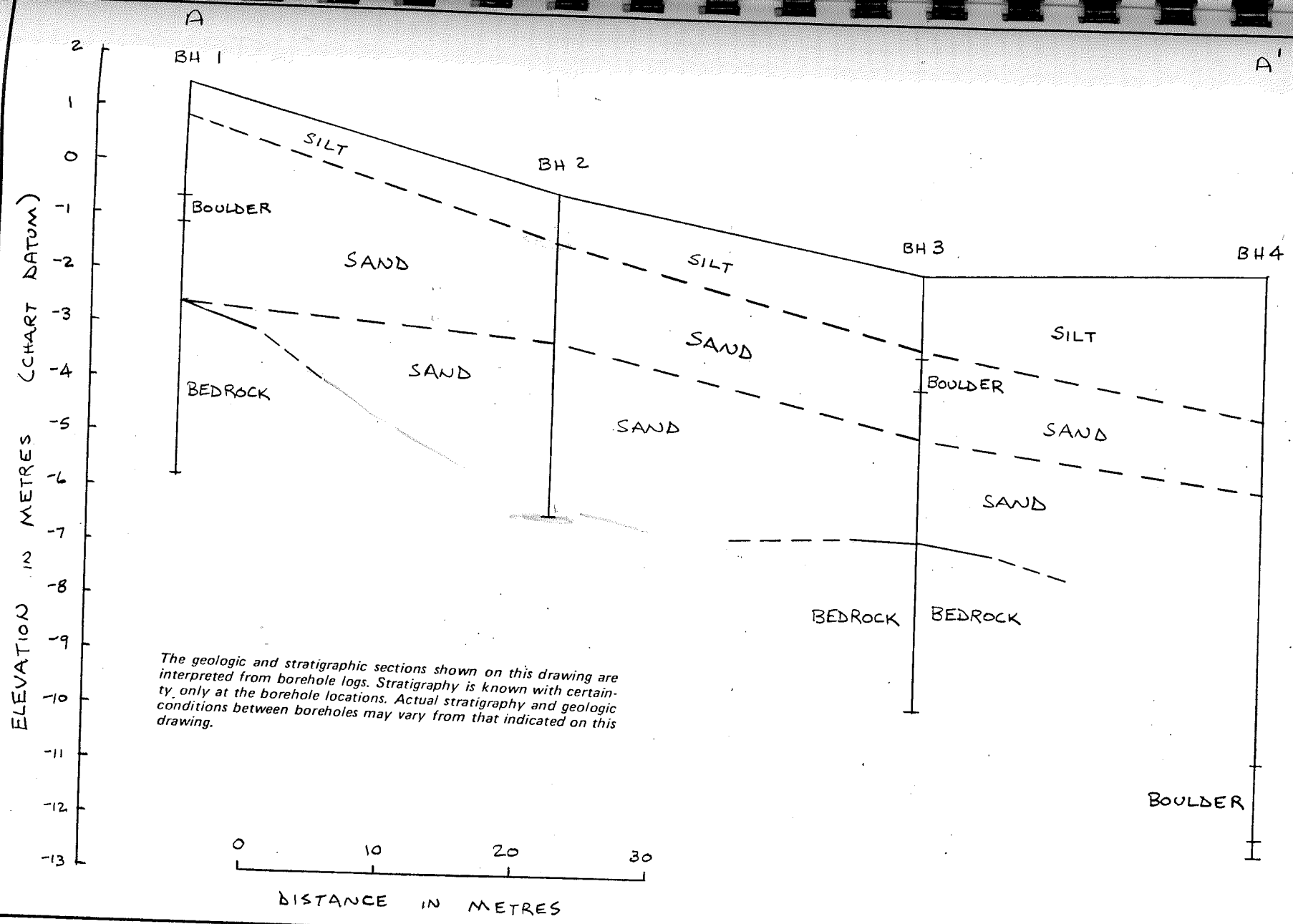
SITE PLAN AND BOREHOLE LOCATIONS
PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT, YARMOUTH CO., NOVA SCOTIA
PWC PROJECT NO. 704198

SCALE Above	DATE 17 Mar 89	MADE TKM	CHKD.	JOB: NGO-0158	PLATE 1



The geologic and stratigraphic sections shown on this drawing are interpreted from borehole logs. Stratigraphy is known with certainty only at the borehole locations. Actual stratigraphy and geologic conditions between boreholes may vary from that indicated on this drawing.

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STRATIGRAPHIC SECTION A-A'
PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT, YARMOUTH CO., NOVA SCOTIA
PWC PROJECT NO. 704198

SCALE Above	DATE 31 Mar 89	MADE TKM	CHKD.	JOB: NGO-0158	PLATE 2

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BOREHOLE LOG

PROJECT: PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT, YARMOUTH CO., N.S.

LOGGED/DWN.	CKD.	DATE OF INVEST.	JOB NO.	HOLE NO.
TKM/TKM		10 Mar 89	NGO-0158	1

DRILL TYPE: Water Flush Diamond

CASING RESISTANCE blows/foot (0.3m)
WATER CONTENT % Wp- □ W- ○ W_l- Δ
10 20 30 40 50 60

DEPTH m	SOIL SYMBOL	SOIL DESCRIPTION	SOIL SAMPLE CONDITION	SOIL SAMPLE TYPE	SOIL SAMPLE PENETRATION RESISTANCE	OTHER TESTS
		DATUM PWC Benchmark on Existing Wharf. Elev: + 6.1 m LNT SURFACE ELEVATION + 1.4m				
	ML	SILT-soft, some sand, trace of clay, black ELEV: +0.8m		D	N=12	
1		SAND-dense, gravelly, some silt, trace of clay, cobbles, boulders, grey		D	N= 5	
2	SM			D	50 blows for 3 "	Sampler on Cobble
		- 300mm dia boulder		C		
3				D	N=31	
		ELEV: -2.6m				
4		BEDROCK-granite, coarse grained, medium bedded, moderately widely spaced joints, slightly weathered, light grey. Fractures 35 to 40 degrees with borehole axis.		C		Modified Rock Quality Designation (RQD) 79
5						
6		Note: The modified Rock Quality Designation (RQD) value is based on BX size core samples.		C		Modified RQD 86
7		ELEV: -5.8m		C		Modified RQD 86
		End of borehole at 7.24 metres				
8						

Plate 3

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BOREHOLE LOG

PROJECT: PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT, YARMOUTH CO., N.S.

LOGGED/DWN.	CKD.	DATE OF INVEST.	JOB NO.	HOLE NO.
TKM/TKM		11 Mar 89	NGO-0158	2

DRILL TYPE: Water Flush Diamond

CASING RESISTANCE blows/foot (0.3m)
WATER CONTENT % Wp- □ W- ○ W_l- △
10 20 30 40 50 60

DATUM PWC Benchmark on Existing Wharf. Elev: + 6.1 m LNT
SURFACE ELEVATION -0.5m

DEPTH m	SOIL SYMBOL	SOIL DESCRIPTION	SOIL SAMPLE CONDITION	SOIL SAMPLE TYPE	SOIL SAMPLE PENETRATION RESISTANCE	OTHER TESTS
	ML	SILT-soft to firm, some sand to sandy, track of clay, dark grey to black		D	N=10	
		ELEV:-1.4m				
1	SM	SAND-dense to very dense, some gravel to gravelly, trace of silt, trace of clay, cobbles, dark grey		D	N=48	Sieve, See Plate 7
2				D	N=37	
		ELEV:-3.2m				
3		SAND-dense, gravelly, some silt, trace of clay, cobbles, olive grey		D	N=75	Sieve, See Plate 8
4	SM					
5						
		ELEV:-6.4m				
6		End of borehole at 5.9 metres Note: At 3.3m casing could not be advanced further due to worn shoe. Core barrel used to advance remainder of borehole. Soil stratigraphy from 3.3m to 5.9m based on cuttings observed on return water.				
7						
8						

Plate 4

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BOREHOLE LOG

PROJECT: PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT, YARMOUTH CO., N.S.

LOGGED/DWN.	CKD.	DATE OF INVEST.	JOB NO.	HOLE NO.
TKM/TKM		12 Mar 89	NGO-0158	3

CASING RESISTANCE blows/foot (0.3m)
WATER CONTENT % Wp- □ W- O W_l- Δ
10 20 30 40 50 60

DATUM PWC Benchmark on Existing Wharf. Elev: + 6.1 m LNT
SURFACE ELEVATION -1.8m

DEPTH m	SOIL SYMBOL	SOIL DESCRIPTION	SOIL SAMPLE CONDITION	SOIL SAMPLE TYPE	SOIL SAMPLE PENETRATION RESISTANCE	DRILL TYPE: Water Flush Diamond / OTHER TESTS
1	ML	SILT-soft to firm, some sand to sandy, trace of clay, dark grey to black. Organic odor from sample		D	N= 0	Sampler Sank 0.8m under weight of hammer
				D	N= 7	
		ELEV:-3.2m				
2		SAND-dense to very dense, some gravel to gravelly, trace to some silt, trace of clay, cobbles, boulders, grey to dark grey		C		
	SM			D	45/	50 blows for 3" Sampler on Cobble Sieve, See Plate 9
3		ELEV:-4.8m				
		SAND-dense, gravelly, some silt, trace of clay, cobbles, brownish grey to olive grey		D	26/	50 blows for 1" Sampler on Cobble
4	SM					
		ELEV:-6.7m		D	N=39	Sieve, See Plate 10
5		BEDROCK-granite, coarse grained, medium bedded, moderately widely spaced joints, slightly weathered, light grey. Fractures 35 to 40 degrees with borehole axis.				Modified Rock Quality Designation (RQD) 86
			C			
6		Note: The modified Rock Quality Designation (RQD) value is based on BX size core samples.				
7			C			Modified RQD 80
		ELEV:-9.8m				
8		End of borehole at 8.0m				

Plate 5

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BOREHOLE LOG

PROJECT
PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT, YARMOUTH CO., N.S.

LOGGED/DWN. TKM/TKM	CKD.	DATE OF INVEST. 13 Mar 89	JOB NO. NGO-0158	HOLE NO. 4

CASING RESISTANCE blows/foot (0.3m)
WATER CONTENT % Wp- □ W- O W_l- Δ
10 20 30 40 50 60

DRILL TYPE: Water Flush Diamond

DEPTH m	SOIL SYMBOL	SOIL DESCRIPTION	SOIL SAMPLE CONDITION	TYPE	PENETRATION RESISTANCE	OTHER TESTS
		DATUM PWC Benchmark on Existing Wharf. Elev: + 6.1 m LNT SURFACE ELEVATION -1.6m				
1	ML	SILT-soft to firm, some sand, trace of clay, dark grey to black, Organic odor from samples		D	N= 0	Sampler Sank 1m under weight of hammer
				D	N= 8	
2		ELEV:-4.3m				
3	SM	SAND-dense to very dense, some gravel to gravelly, some silt, trace of clay, cobbles, grey to dark grey		D	N=81	
4		ELEV:-5.6m				
		SAND-dense, gravelly, some silt to silty, trace of clay, cobbles, boulders, olive grey		D	40/	50 blows for 3" Rock in Sampler Sieve, See Plate 11
5						
6	SM			D	N=40	
7				D	N=20	Sieve See Plate 12
8						

Plate 6

MARITIME TESTING (1985) LIMITED
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

BOREHOLE LOG

PROJECT
PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT, YARMOUTH CO., N.S.

LOGGED/DWN. TKM/TKM	CKD.	DATE OF INVEST. 13 Mar 89	JOB NO. NGO-0158	HOLE NO. 4 contd

CASING RESISTANCE blows/foot (0.3m)
WATER CONTENT % Wp- □ W- O W_l- Δ
10 20 30 40 50 60

DEPTH m	SOIL SYMBOL	SOIL DESCRIPTION	SOIL SAMPLE CONDITION	SOIL SAMPLE TYPE	SOIL SAMPLE PENETRATION RESISTANCE	DRILL TYPE / OTHER TESTS
		DATUM PWC Benchmark on Existing Wharf. Elev: + 6.1 m LNT SURFACE ELEVATION -1.6m				DRILL TYPE: Water Flush Diamond
8		SAND-continued				
			X	D	18/	50 blows for 5" Sampler on Cobble
9	SM					
		-1.5m dia boulder				
10				C		
		ELEV:-12.3m				
11		End of borehole at 10.7 metres				

Plate 7

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SIEVE ANALYSIS REPORT
10 20 40 SERIES

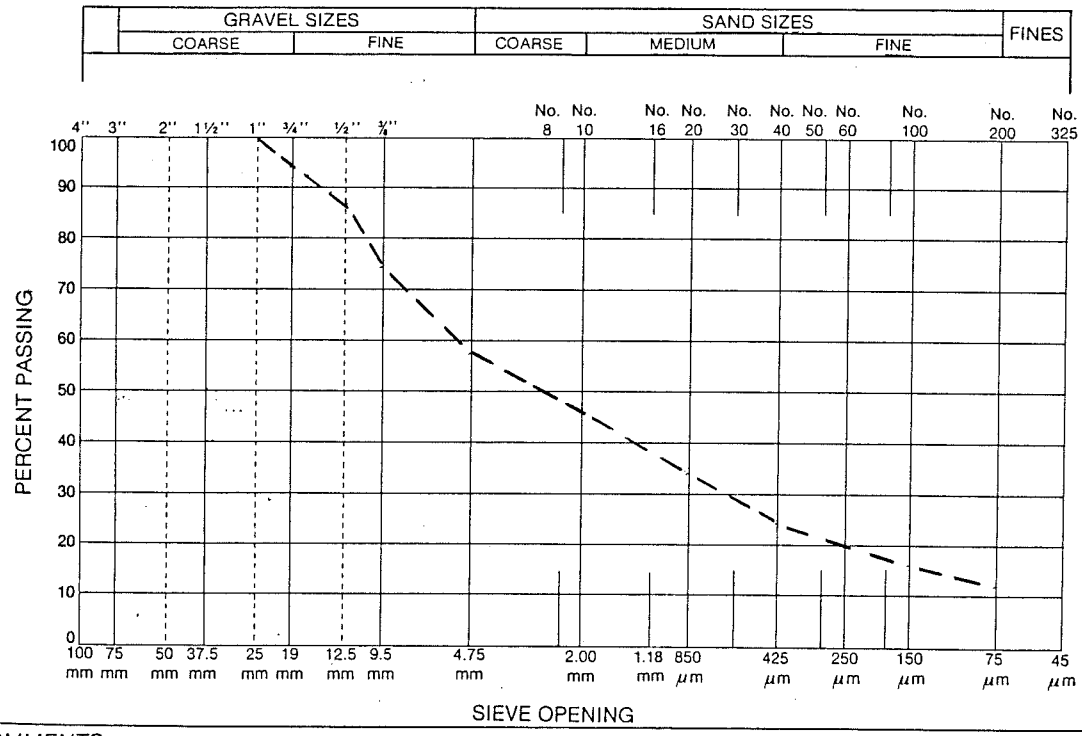
TO: PUBLIC WORKS CANADA

OFFICE
PROJECT NO. NGO-0158
DATE March 31, 1989
CLIENT P.O.
CC

PROJECT Proposed Marine Improvements, Pinkneys Point, Yarmouth County, N.S.

SOURCE BH2 1.2m TYPE OF SAMPLE SPT SAMPLED BY K. Marvin

TEST NO. DATE SAMPLED 11 Mar 89 DATE REC'D 16 Mar 89 DATE TESTED 20 Mar 89



SIEVE SIZE	PERCENT PASSING
37.5 mm (1½")	
25 mm (1")	100
19 mm (¾")	94
12.5 mm (½")	87
9.5 mm (⅜")	74
4.75 mm (No. 4)	58
2.00 mm (No. 10)	47
850 µm (No. 20)	34
425 µm (No. 40)	24
250 µm (No. 60)	20
150 µm (No. 100)	16
75 µm (No. 200)	11.2

COMMENTS

SAND (SM) - gravelly, some silt and clay

Gravel	42%
Sand	46%
Silt & Clay	12%

REPORT CERTIFIED TECHNICIAN

MARITIME TESTING (1985) LIMITED
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SIEVE ANALYSIS REPORT
10 20 40 SERIES

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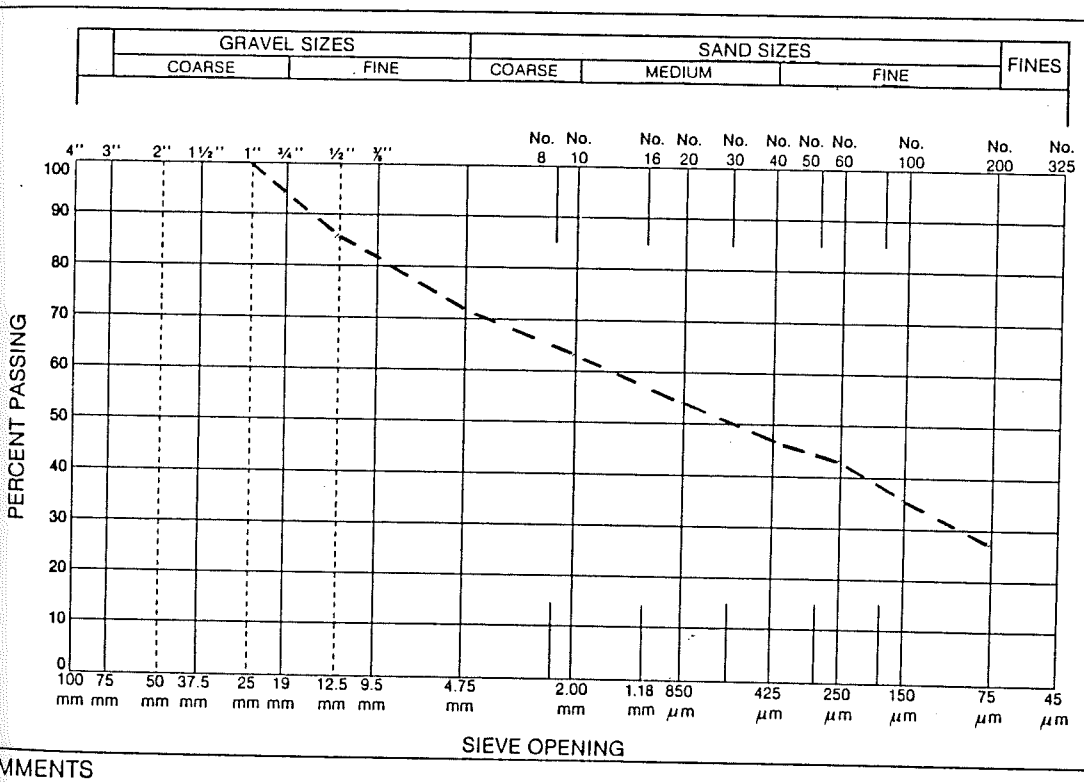
OFFICE
PROJECT NO. NGO-0158
DATE March 31, 1989
CLIENT P.O.
CC

PROJECT Proposed Marine Improvements, Pinkneys Point, Yarmouth County, N.S.

SOURCE BH 2 3.1m TYPE OF SAMPLE SPT SAMPLED BY K. Marvin

TEST NO. DATE SAMPLED 11 Mar 89 DATE REC'D 16 Mar 89 DATE TESTED 20 Mar 89



SIEVE SIZE	PERCENT PASSING
37.5 mm (1½")	
25 mm (1")	100
19 mm (¾")	94
12.5 mm (½")	86
9.5 mm (⅜")	81
4.75 mm (No. 4)	71
2.00 mm (No. 10)	62
850 µm (No. 20)	54
425 µm (No. 40)	48
250 µm (No. 60)	42
150 µm (No. 100)	36
75 µm (No. 200)	27.6

COMMENTS

SAND (SM) - gravelly, some silt and clay

Gravel	29%
Sand	43%
Silt & Clay	28%

REPORT CERTIFIED TECHNICIAN

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SIEVE ANALYSIS REPORT
10 20 40 SERIES

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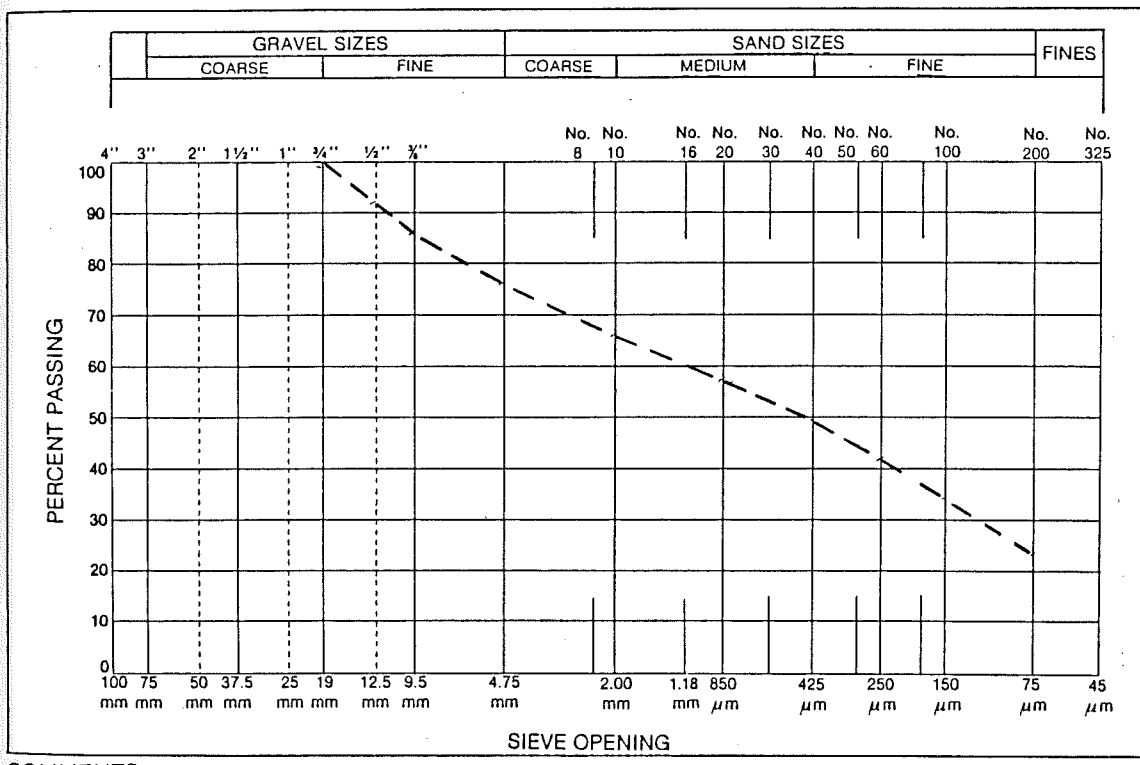
PROJECT Proposed Marine Improvements, Pinkneys Point, Yarmouth County, N.S.

SOURCE BH3 2.1m TYPE OF SAMPLE SPT SAMPLED BY K. Marvin

TEST NO. DATE SAMPLED 12 Mar 89 DATE REC'D 16 Mar 89 DATE TESTED 20 Mar 89



SIEVE SIZE	PERCENT PASSING
37.5 mm (1½")	
25 mm (1")	
19 mm (¾")	100
12.5 mm (½")	92
9.5 mm (⅜")	86
4.75 mm (No. 4)	76
2.00 mm (No. 10)	67
850 µm (No. 20)	58
425 µm (No. 40)	50
250 µm (No. 60)	41
150 µm (No. 100)	33
75 µm (No. 200)	23.0

COMMENTS

SAND (SM) - gravelly, some silt and clay

Gravel	24%
Sand	53%
Silt & Clay	23%

REPORT CERTIFIED TECHNICIAN

MARITIME TESTING (1985) LIMITED
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SIEVE ANALYSIS REPO
10 20 40 SERIES

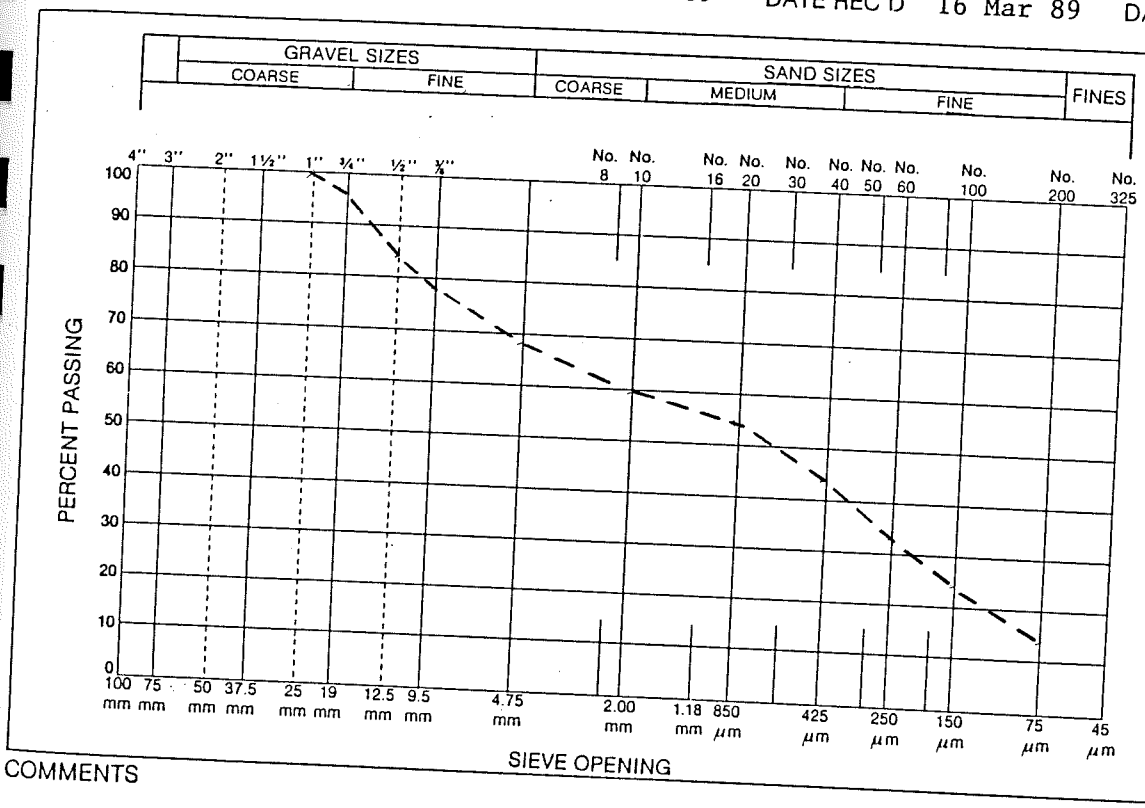
TO: PUBLIC WORKS CANADA

OFFICE
PROJECT NO. NGO-0158
DATE March 31, 1989
CLIENT P.O.
CC

PROJECT Proposed Marine Improvements, Pinkneys Point, Yarmouth County, N.S.

SOURCE BH3 4.9m TYPE OF SAMPLE SPT SAMPLED BY K. Marvin

TEST NO. DATE SAMPLED 12 Mar 89 DATE REC'D 16 Mar 89 DATE TESTED 20 Mar 89



SIEVE SIZE	PERCENT PASSING
37.5 mm (1½")	
25 mm (1")	100
19 mm (¾")	96
12.5 mm (½")	84
9.5 mm (⅜")	79
4.75 mm (No. 4)	69
2.00 mm (No. 10)	60
850 µm (No. 20)	53
425 µm (No. 40)	43
250 µm (No. 60)	32
150 µm (No. 100)	23
75 µm (No. 200)	13.3

COMMENTS

SAND (SM) - gravelly, some silt and clay

Gravel	31%
Sand	56%
Silt & Clay	13%

REPORT CERTIFIED

TECHNICIAN

MARITIME TESTING (1985) LIMITED
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SIEVE ANALYSIS REPORT
10 20 40 SERIES

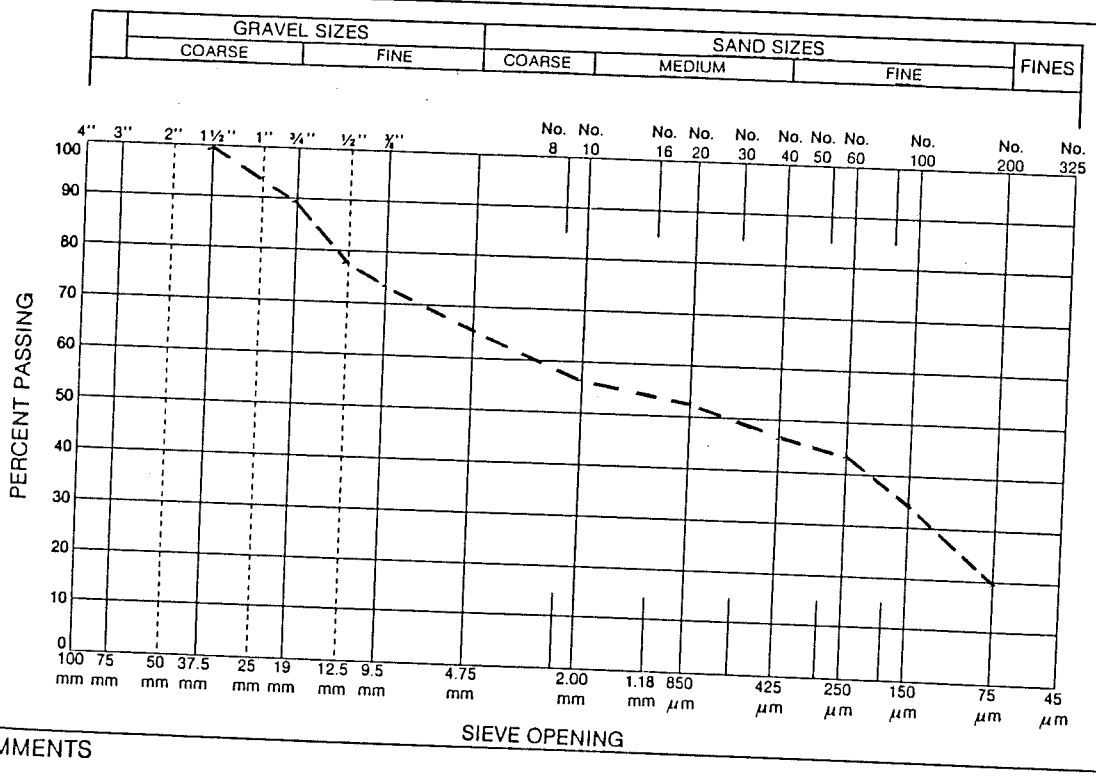
TO: PUBLIC WORKS CANADA

OFFICE
PROJECT NO. NGO-0158
DATE March 31, 1989
CLIENT P.O.
CC

PROJECT Proposed Marine Improvements, Pinkneys Point, Yarmouth County, N.S.

SOURCE BH4 4.5m TYPE OF SAMPLE SPT SAMPLED BY K. Marvin

TEST NO. DATE SAMPLED 13 Mar 89 DATE REC'D 16 Mar 89 DATE TESTED 20 Mar 89



SIEVE SIZE	PERCENT PASSING
37.5 mm (1½")	100
25 mm (1")	94
19 mm (¾")	90
12.5 mm (½")	77
9.5 mm (⅜")	78
4.75 mm (No. 4)	66
2.00 mm (No. 10)	57
850 µm (No. 20)	52
425 µm (No. 40)	47
250 µm (No. 60)	43
150 µm (No. 100)	34
75 µm (No. 200)	20.0

COMMENTS

SAND (SM) - gravelly, some silt and clay

Gravel	34%
Sand	46%
Silt & Clay	20%

REPORT CERTIFIED

TECHNICIAN

MARITIME TESTING (1985) LIMITED
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

SIEVE ANALYSIS REPORT
10 20 40 SERIES

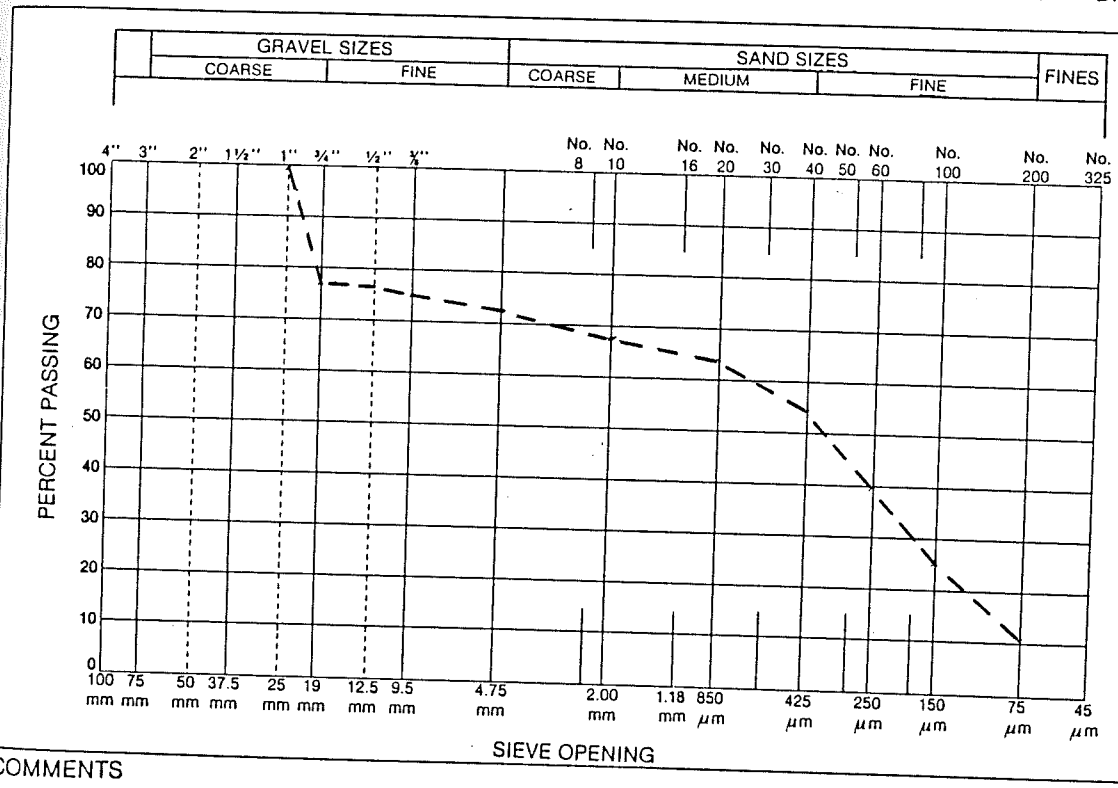
TO: PUBLIC WORKS CANADA

OFFICE
PROJECT NO. NGO-0158
DATE March 31, 1989
CLIENT P.O.
CC

PROJECT Proposed Marine Improvements, Pinkneys Point, Yarmouth County, N.S.

SOURCE BH4 6.7m TYPE OF SAMPLE SPT SAMPLED BY K. Marvin

TEST NO. DATE SAMPLED 13 Mar 89 DATE REC'D 16 Mar 89 DATE TESTED 20 Mar 89



SIEVE SIZE	PERCENT PASSING
37.5 mm (1½")	
25 mm (1")	100
19 mm (¾")	77
12.5 mm (½")	77
9.5 mm (⅜")	75
4.75 mm (No. 4)	71
2.00 mm (No. 10)	68
850 µm (No. 20)	64
425 µm (No. 40)	54
250 µm (No. 60)	40
150 µm (No. 100)	25
75 µm (No. 200)	10.5

COMMENTS

SAND (SM) - gravelly, some silt and clay

Gravel	29%
Sand	60%
Silt & Clay	11%

REPORT CERTIFIED

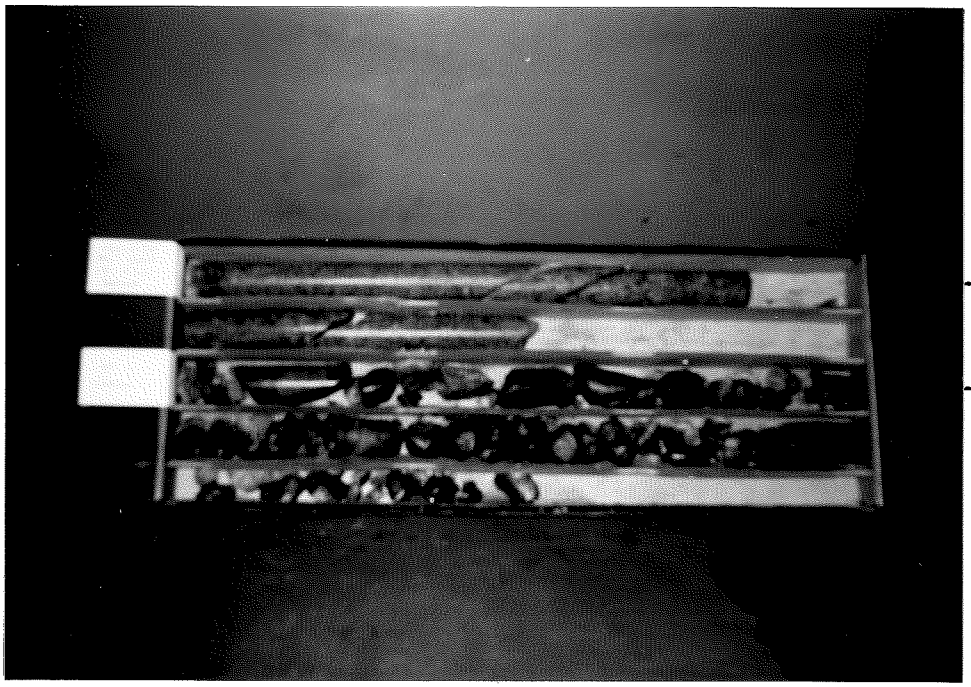
TECHNICIAN

BH 1

2.2 - 2.7m Boulder

2.7 - 3.9m Cobbles

3.9 - 7.2m Bedrock



BH 1 CONT'D

3.9 - 7.2m Bedrock

BH 2

Cobbles

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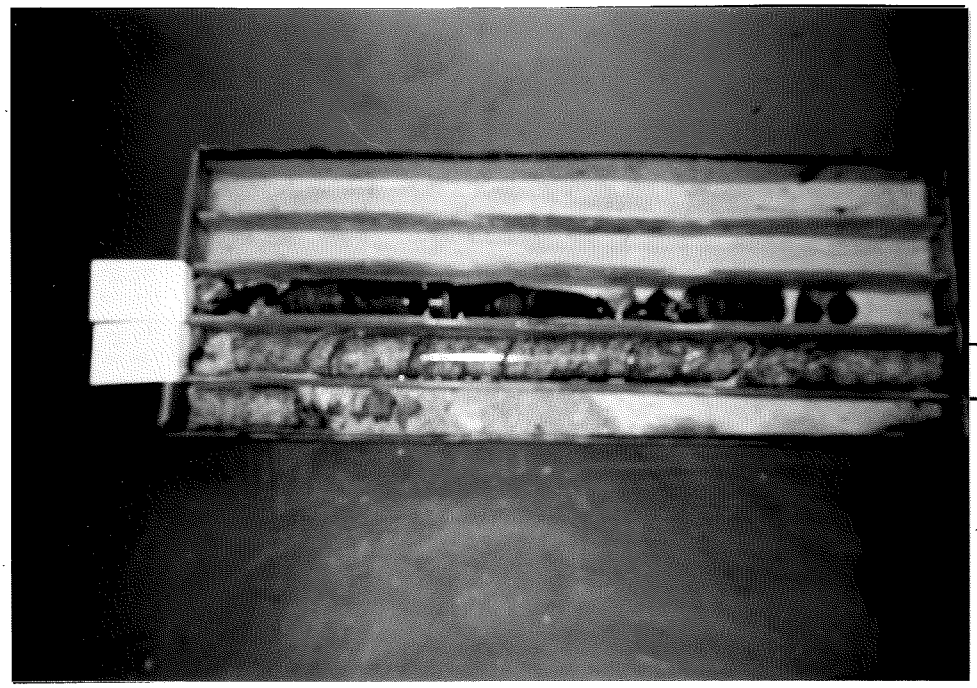
PHOTOGRAPHS OF CORE SAMPLES
PROPOSED MARINE IMPROVEMENTS
PINKNEYS POINT, YARMOUTH CO., NOVA SCOTIA
PWC PROJECT NO. 704198

SCALE	DATE 31 Mar 89	MADE TKM	CHKD.	JOB: NGO-0158	PLATE 14



BH 4

3.7 - 4.9 Cobbles

9.0 - 10.5 Boulder

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PHOTOGRAPHS OF CORE SAMPLES
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PINKNEYS POINT, YARMOUTH CO., NOVA SCOTIA
PWC PROJECT NO. 704198

SCALE	DATE 31 Mar 89	MADE TKM	CHKD.	JOB: NGO-0158	PLATE 16