

# DISPLAY THIS CARD ON PRINCIPAL FRONTAGE OF WORK CITY OF PORTLAND

Please Read Application And Notes, If Any, Attached

## BUILDING DEPARTMENT PERMIT

Permit Number: 031234

This is to certify that Gulf Of Maine Aquarium/Outlet Assoc

has permission to Foundation Only for Gulf of Maine Research Facility

AT 344 Commercial St 042 C001001

provided that the person or persons, firm or corporation accepting this permit shall comply with all of the provisions of the Statutes of Maine and of the Ordinances of the City of Portland regulating the construction, maintenance and use of buildings and structures, and of the application on file in this department.

Apply to Public Works for street line and grade if nature of work requires such information.

Notification of inspection must be given and when permission is procured before this building or part thereof is leased or occupied. CLOSED-IN. HOURS NOTICE IS REQUIRED.

A certificate of occupancy must be procured by owner before this building or part thereof is occupied.

### OTHER REQUIRED APPROVALS

Fire Dept. N/A

Health Dept. \_\_\_\_\_

Appeal Board \_\_\_\_\_

Other \_\_\_\_\_

Department Name

*[Signature]* 10/8/03  
Director - Building & Inspection Services

**PENALTY FOR REMOVING THIS CARD**



## ***SPECIAL INSPECTIONS - LIST OF AGENTS***

**PROJECT:** Gulf of Maine Research Institute

**LOCATION:** Portland, Maine

**STRUCTURAL**

**ENGINEER OF RECORD:** Andrew Bradley, P.E. SMRT, Inc.

Name Firm

144 Fore Street, Portland, ME 04104

Address

**ARCHITECT  
OF RECORD:**

Paul Stevens, A.I.A. SMRT, Inc.

Name Firm

144 Fore Street, Portland, ME 04104

Address

Following is the list of Agents selected for performance of Special Inspections for this project.

	Type	Name	Firm
1.	Special Inspector	Andrew Bradley, P.E.	SMRT, Inc.
2.	Agent	Jeff Giggey	SMRT, Inc.
3.	Agent	Tim McDonald	SMRT, Inc.
4.	Agent (Soils, Concrete Testing)	Charles Nickerson, P.E.	R.W. Gillespie and Assoc.
5.	Agent (Steel Testing)		Elite Inspection Services, Inc.
6.			
7.			
8.			
9.			
10.			

**City of Portland, Maine - Building or Use Permit**

389 Congress Street, 04101 Tel: (207) 874-8703, Fax: (207) 874-8716

<b>Permit No:</b> 03-1234	<b>Date Applied For:</b> 10/08/2003	<b>CBL:</b> 042 C001001
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<b>Location of Construction:</b> 344 Commercial St	<b>Owner Name:</b> Gulf Of Maine Aquarium	<b>Owner Address:</b> 400 Commercial St	<b>Phone:</b> ( ) 772-2321
<b>Business Name:</b>	<b>Contractor Name:</b> Ouellet Associates	<b>Contractor Address:</b> 56 Bibber Parkway Brunswick	<b>Phone</b> (207) 725-0100
<b>Lessee/Buyer's Name</b>	<b>Phone:</b>	<b>Permit Type:</b> Foundation Only/Commercial	

<b>Proposed Use:</b> Foundation Only for Gulf of Maine Research Facility	<b>Proposed Project Description:</b> Foundation Only for Gulf of Maine Research Facility
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<b>Dept:</b> Zoning	<b>Status:</b> Pending	<b>Reviewer:</b>	<b>Approval Date:</b>	<b>Ok to Issue:</b> <input type="checkbox"/>
<b>Note:</b>				
<b>Dept:</b> Building	<b>Status:</b> Approved with Conditions	<b>Reviewer:</b> Mike Nugent	<b>Approval Date:</b> 10/08/2003	<b>Ok to Issue:</b> <input checked="" type="checkbox"/>
<b>Note:</b>				
1) Special Inspections by R.W. Gillespie on soils, concrete, etc.				
<b>Dept:</b> Fire	<b>Status:</b> Pending	<b>Reviewer:</b>	<b>Approval Date:</b>	<b>Ok to Issue:</b> <input type="checkbox"/>
<b>Note:</b>				

**Comments:**  
10/08/2003-mjn: Lt. Mac and Marge signed primary permit #031067

**DEPARTMENT DIRECTOR**  
Lee D. Urban



**DIVISION DIRECTORS**  
Mark B. Adelson  
Housing & Neighborhood Services

Alexander Q. Jaegerman  
Planning

John N. Lufkin  
Economic Development

**DEPARTMENT OF PLANNING AND DEVELOPMENT**

October 1, 2003

David Lawrence  
Ouellet Associates  
56 Bibber Parkway  
Brunswick, ME 04011-7357

RE: Load test for pile foundation Gulf of Maine Research Institute (042 C001)

Dear David,

This is a response to your request to utilize dynamic load testing instead of static load testing for the proposed pile foundation. The following are the facts:

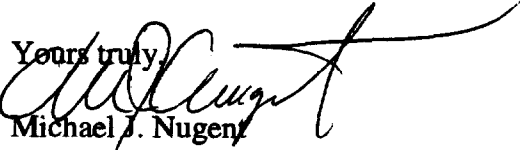
- 1) Charles Nickerson, P.E. has provided written documentation that both means of testing for this application provide comparable results and is a suitable alternative;
- 2) Staff engineers at the International Code Council (formerly BOCA) agree that dynamic testing is acceptable under the 2003 International Building Code.
- 3) The foundation system will be constructed in compliance with all other aspects of Chapter 18 of the 1999 BOCA code.

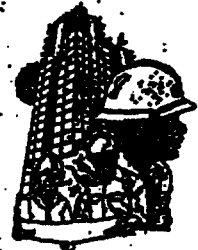
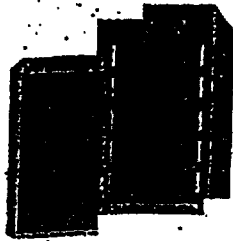
Based on this information and pursuant to Section 106.4 of the Code, this office hereby authorizes the use of dynamic load testing and authorized the commencement of piling placement. It is required that the tests and installation be performed in complete compliance with the construction documents submitted by R. W. Gillespie and associates and that a complete set of testing results and Special Inspection reports be submitted to this office for review.

Please advise of your grade beam/pile cap schedule to insure that we have appropriate permitting in place to avoid delays.

Thank you for your attention in this matter.

Yours truly,

  
Michael J. Nugent  
Manager of Inspection Services



**CITY OF PORTLAND  
BUILDING CODE CERTIFICATE**  
389 Congress St., Rm 315  
Portland, ME 04101

**TO:** Inspector of Buildings City of Portland, Maine  
Department of Planning & Urban Development  
Division of Housing & Community Service

**FROM:** PAUL STEVENS

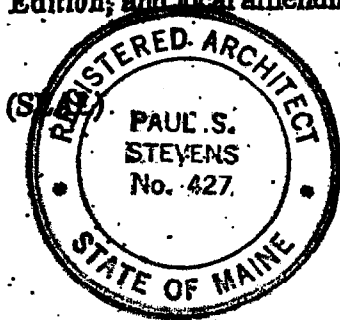
**RE:** Certificate of Design

**DATE:** 26 AUGUST, 2003

These plans and/or specifications covering construction work on:

THE GULF OF MAINE RESEARCH  
LABORATORY

Have been designed and drawn up by the undersigned, a Maine registered architect/engineer according to the BOCA National Building Code/1999 Fourteenth Edition; and local amendments.



Signature [Handwritten Signature]

Title PRINCIPAL

Firm SMRT, INC.

Address 144 FORE ST./P.O. BOX 68  
PORTLAND, ME 04104

As per Maine State Law:

\$50,000.00 or more in new construction; repair, expansion, addition, or modification for Building or Structures; shall be prepared by a registered design Professional.



CITY OF PORTLAND  
ACCESSIBILITY CERTIFICATE

Designer: PAUL STEVENS

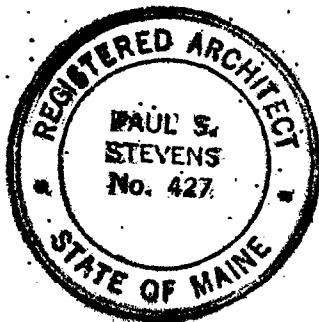
Address of Project 350 COMMERCIAL ST.

Nature of Project OFFICE & LABORATORY

Date 26 AUGUST 2003

The technical submissions covering the proposed construction work as described above have been designed in compliance with applicable referenced standards found in the Maine Human Rights Law and Federal Americans with Disability Act.

(SEAL)



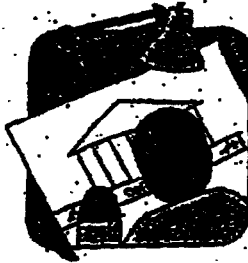
Signature [Handwritten Signature]

Title PRINCIPAL

Firm SMRT, INC.

Address 144 FORE ST / PO BOX 618  
PORTLAND, ME 04104

Telephone 207 772-9846



**CITY OF PORTLAND MAINE**

389 Congress St., Rm 315

Portland, ME 04101

Tel. - 207-874-8704

Fax - 207-874-8716

TO: Inspector of Buildings City of Portland, Maine  
Planning & Urban Development  
Division of Housing & Community Services

FROM DESIGNER: PAUL STEVENS

DATE: 26 AUGUST 2003

Job Name: GULF OF MAINE RESEARCH LABORATORY

Address of Construction: 350 COMMERCIAL STREET

**THE BOCA NATIONAL BUILDING CODE/1999 Fourteenth EDITION**

Construction project was designed according to the building code criteria listed below:

Building Code and Year: BOCA 1999 Use Group Classification(s): B & A3

Type of Construction: 2C Bldg. Height: RIDGE 59.6' Bldg. Sq. Footage: 19,562

Seismic Zone: A<sub>v</sub> = 0.12, A<sub>s</sub> = 0.12 Group Class: GROUP 1

Roof Snow Load Per Sq. Ft.: P<sub>s</sub> = 35 PSF Dead Load Per Sq. Ft.: ACTUAL + 5 PSF

Basic Wind Speed (mph): 100 MPH Effective Velocity Pressure Per Sq. Ft.: H<sub>w</sub> PS = +17, -14

Floor Live Load Per Sq. Ft.: VARIES, SEE DRAWINGS (100-250 PSF)

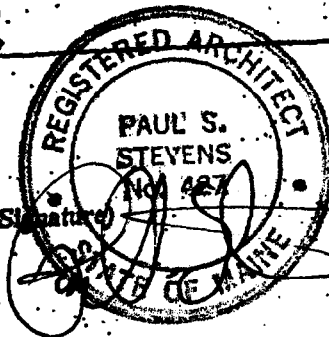
Structure has full sprinkler system? Yes X No \_\_\_\_\_ Alarm System? Yes X No \_\_\_\_\_  
Sprinkler & Alarm systems must be installed according to BOCA and NFPA Standards with approval from the Portland Fire Department.

Is structure being considered unlimited area building: Yes \_\_\_\_\_ No X

If mixed use, what subsection of 313 is being considered 313.1.2

List Occupant loading for each room or space, designed into this Project.  
SEE ATTACHMENT

(Designers Stamp & Signature)





**REPORT  
of  
GEOTECHNICAL INVESTIGATION  
for the  
GULF OF MAINE RESEARCH INSTITUTE  
PORTLAND, MAINE**

**Prepared  
for  
GULF OF MAINE RESEARCH INSTITUTE  
PORTLAND, MAINE**

**Prepared  
by  
R. W. GILLESPIE & ASSOCIATES, INC.  
SACO, MAINE**

**RWG&A Project No. 235-741**

**June 2003**

# R. W. Gillespie & Associates, Inc.

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- Figure 1. Locus Map
- Figure 2. Exploration Location Plan

### APPENDICES

- Appendix A. Test Boring Logs
- Appendix B. Laboratory Test Results

## **1.0 INTRODUCTION**

### **1.01 Background**

The proposed project will be built on the former Naval Reserve Center site at 350 Commercial Street in Portland, Maine, as shown on Figure 1, *Locus Map*. The Reserve Center consisted of an approximately 25,000 square foot, one-story, concrete building located in the central part of the site with parking areas to the north and west of the building. The site is bounded by Commercial Street to the north, Hobson's Wharf to the west, Portland Harbor to the south, and the Portland Fish Pier to the east. Topography across the site is relatively level with ground surface gently sloping down and away from Commercial Street towards the harbor. The topographic information contained in this report was obtained from a drawing entitled *Land Title Survey* dated 10 December 2001 prepared by Survey & Geodetic Consultants, Inc. As-built drawings for the Reserve Center were also provided by the Navy.

### **1.02 Scope of Work**

This investigation was performed to develop site-specific soil information to make geotechnical evaluations for the proposed building and development of the site. RWG&A's scope of work, as completed, included the following items.

1. Drilled, logged, and sampled eleven test borings and two probes within the vicinity of the proposed Gulf of Maine Research Institute building.
2. Performed laboratory tests on selected soil samples recovered from the subsurface explorations to aid in soil description and for determination of engineering properties needed for foundation design and site development analyses.
3. Made engineering evaluations and analyses related to building foundations and site development issues associated with subsurface conditions at the site. Prepared a preliminary report of geotechnical investigation presenting the results of this study, and preliminary recommendations for project design and planning.
4. Made final soil and foundation engineering evaluations and analyses and prepared this report of geotechnical investigation presenting geotechnical recommendations for design and construction of the proposed Gulf of Maine Research Institute building.

## 2.0 SUBSURFACE EXPLORATION

The subsurface exploration program was conducted from 05 to 11 December 2001 to develop site-specific data for use in geotechnical engineering evaluations. The program consisted of eleven test borings, designated B-1 through B-11, and two auger probes, designated P-1 and P-2. Exploration locations are shown on Figure 2, *Exploration Location Plan*. As-drilled test boring locations and ground surface elevations shown on Figure 2 were surveyed by Survey & Geodetic Consultants, Inc., of Westbrook, Maine. Locations of the probes were added by RWG&A based on hand-taping and pacing from fixed physical features.

Drilling was performed by Great Works Pump & Test Boring, Inc., of Rollinsford, New Hampshire. The test borings were advanced by wash boring methods using a truck-mounted drill rig. Samples were taken at approximately 5-foot intervals in accordance with *ASTM D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*. Recovered samples were used to estimate soil properties, soil classification, and laboratory testing. Field vane tests were performed to determine the strength of medium stiff to soft cohesive soils.

The borings were terminated at depths ranging from 7 to 97 feet below ground surface. Refusal was encountered by borings B-1, B-3, B-7 through B-9, and B-11 at depths ranging from 24 to 76 feet. Borings B-1, B-7, and B-11 were extended below refusal depths with a roller bit. A 5-foot long rock core was taken in B-1 to verify that the refusal in that boring represented bedrock. Test boring B-4 was advanced to a depth of 97 feet without encountering refusal.

Drilling activities were monitored by an RWG&A Geologist who described the soils and bedrock and prepared the boring logs which are included as Appendix A. Stratification lines shown on the boring logs represent the approximate boundaries between soil types encountered; the actual transitions may be more gradual and will vary over short distances.

The logs of the borings made for the existing Naval Reserve Center were shown on that building's construction drawings and have been included in this report as Figures 2A and 2B, *Boring Data for Existing Naval Reserve Center*. Locations of the Naval Reserve Center borings are also shown on Figure 1, *Exploration Location Plan*. These borings were drilled on 30 December 1969 by Northeast Soil Services Soils Exploration of Brewer, Maine.

## 3.0 LABORATORY TESTING

Laboratory testing was performed on soil samples recovered from the test borings to assist in classification and estimation of engineering properties of the soils. The testing program included

grain-size sieve analyses and chemical testing to evaluate the corrosion potential of the soil. The chemical testing included pH and sulfate content. Resistivity testing was also performed to evaluate corrosion potential. The tests were performed in general accordance with the following methods and procedures:

- *ASTM D422, Standard Test Method for Particle-Size Analysis of Soils*
- *AASHTO Designation T 288, Standard Method of Test for Determining Minimum Laboratory Soil Resistivity*
- *AASHTO Designation T 289, Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing*
- *AASHTO Designation T 290, Standard Method of Test for Determining Water Soluble Sulfate Ion Content in Soil*

Results of the laboratory testing program are presented included in Appendix B, *Laboratory Test Results*.

#### **4.0 SUBSURFACE CONDITIONS**

##### **4.01 Subsurface Soils**

Four subsurface soil units were revealed by the explorations beneath ground cover that locally consisted of mowed grass and topsoil or asphalt. The four subsurface soil units proceeding from ground surface were described as: Fill, Organic Silt, Silty Clay, and layers of Silty to Gravelly Sand. Generalized soil descriptions with encountered thicknesses are provided below; please refer to the logs for detailed descriptions at specific exploration locations.

<b><u>Unit</u></b>	<b><u>Encountered Thickness (ft)</u></b>	<b><u>Description</u></b>
Topsoil/ Asphalt	0.1 to 1	Topsoil and organic material or asphalt. Encountered at ground surface in all of the explorations.
Fill	7 to 25.5	Loose to medium dense, coarse to fine sand, trace to little silt, trace to little gravel, varying amounts of wood, brick, ashes, coal, other debris, brown.

<u>Unit</u>	<u>Encountered Thickness (ft)</u>	<u>Description</u>
Organic Silt	4 to 8.5	Soft, organic silt (OL), trace fine sand, gray. Encountered in B-1, B-4, and B-9. The absence of organic silt at the other boring locations may be indicative of past dredging activities.
Silty Clay	24 to 53	Silty Clay (CL), medium stiff to soft, wet, gray. Encountered in B-2 through B-8 only.
Silty Sand	2 to 11	Medium dense, medium to fine sand and silt (SM), wet, gray.
Sand	4 to 11	Medium dense to dense, medium to fine sand (SP), trace gravel, wet, trace silt, brown.
Gravelly Sand	7 to 11	Medium dense to dense, coarse to fine sand (SW), some gravel, trace silt, occasional cobbles, brown.

The bedrock core from Boring B-1 was described as hard, fresh, fine grain, light gray, Quaritic Gneiss of the Cape Elizabeth Formation with low angle and high angle joints, high angle joints parallel to foliation; jointing was moderately spaced with fresh discolored surfaces. Recovery Ratio: 100 percent, Rock Quality Designation: 75 percent.

Based upon historic land uses and development in the project area, previous underground storage of petroleum fuel (#2 fuel oil/diesel) on the site, and the possibility of petroleum laden soils, samples from the test borings were screened in the field with an HNU-101 photoionization detector (PID). Test boring B-10, located adjacent to Commercial Street at the west end of the site, had visual, olfactory, and PID evidence of a petroleum substance at an exploration depth of about 5 to 7 ft below ground surface. None of the soil samples obtained from other RWG&A test borings had PID headspace screening results above ambient, background levels. Further investigation and subsequent removal and replacement of the petroleum laden soils were completed by the Department of Navy. RWG&A provided technical assistance to the Gulf of Maine Research Institute in support of the Navy's investigation and remediation activities. Results of that work were provided separately and are not presented in this report.

#### **4.02 Groundwater**

Free water was observed in all explorations (note: except B-10) at depths of approximately 8 to 10 feet below local ground surface. Groundwater levels at the site will fluctuate due to tide, season, temperature, rainfall, and construction activity in the area; therefore, water levels during and following construction will vary from those when the explorations were drilled. It is anticipated that groundwater levels along and near Commercial Street will occur at about seven and eight feet below

3. All excavation and filling within 4 feet of proposed piles, including excavation and filling associated with removal of obstructions, should be completed before the start of pile driving. Predrilling through the fill to detect obstructions should be performed prior to pile installation, especially at locations of multiple pile groups.
4. Site grading should provide positive drainage away from constructed facilities both during and after construction.
5. Surface runoff and infiltration of groundwater should be controlled so that excavation, filling, and foundation construction can be completed in-the-dry. It may be difficult to dewater excavations below the local groundwater level(s) by open pumping methods. It is anticipated that sheeting and wells may be needed where excavations extend below groundwater.
6. Only compacted granular fill is recommended for use as fill beneath the proposed building and as backfill for pile caps, tie-beams, and other foundation features. Granular fill should be a well-graded sand and gravel mixture meeting the following gradation:

Screen Number or Sieve Size	Percent Passing
6 inches	100
3 inches	75 to 100
Number 4	35 to 70
Number 40	5 to 35
Number 200	0 to 5

Based on the results of the laboratory testing, the on-site fill material is not suitable for use as granular fill. However, it may be used as common fill if the organic material and debris present are removed prior to use. Common fill should consist of inorganic mineral soil free of ice, loam, organic or other unsuitable material.

**6.02 Pile Foundations**

7. The building should be designed to withstand lateral, uplift and overturning forces due to earthquake. Fill materials encountered in the explorations may be susceptible to liquefaction. In accordance with *The BOCA National Building Code/ 1999*, the soil profile at the site is classified as S<sub>1</sub>, with a seismic coefficient "S" of 2.0.

#### **5.04 Foundation Considerations**

The site of the proposed Research Institute building is currently covered by 10 to 26 feet of fill. Analyses of the design bearing pressure for the Naval Reserve Center foundations and results of the explorations performed for this study indicate that total and differential settlements of the spread footings may be on the order of 1 to 2 inches. In addition, the loose density of the existing fill indicates it may be liquefaction susceptible (i.e., subject to densification and settlement in the event of an earthquake).

The fill is of variable composition and is underlain in most areas by organic silt and/or silty clay. Both of these materials are compressible and have relatively low load carrying capacity. It is anticipated that the organic silt and silty clay layers will settle excessively under the weight of the proposed fill to raise site grade and the building foundation loads. Therefore, deep foundations consisting of high-capacity end-bearing piles driven into the dense sand and gravelly sand or bedrock are considered the most practicable foundation type. The steel piles will need to be oversized to address loss of the pile cross section caused by corrosion over the design life of the building. Pile tips will be needed to minimize damage to piles during driving through the fill.

It is anticipated that piles will penetrate to the top of bedrock along Commercial Street, and might penetrate the lower sand layers encountered in the deeper borings on the order of twenty feet below the refusal depths. Anticipated pile lengths range from about 25 feet along Commercial Street to about 80 to 90 feet at the eastern end of the proposed building.

Based on discussions with SMRT, HP 12x74 structural steel H-piles (50 kips per square inch yield strength steel) with an allowable capacity of 80 tons have been selected. Section 1817.4 of *The BOCA National Building Code/1999* requires static pile load testing when design compressive load exceeds 40 tons. Minimum allowable uplift pile capacity, based on the shorter pile lengths, is 5 tons per pile.

#### **5.05 Corrosion Potential of On-Site Fill**

Soils are considered to be corrosive if one or more of the following conditions exist: if steel or concrete will be in contact with organic soils or if inorganic soils have a pH value less than 4.5, soil resistivity less than 2,000 ohm-centimeter, and/or if sulfates are present. The piles will need to be designed to withstand corrosion in the underlying organic silt. A comparison of guidance values for corrosive conditions are presented below along with the test results on samples from the Gulf of Maine Research Institute Building site.



<u>Indicator</u>	<u>Corrosive Limits</u>	<u>Test Boring Designation</u>					
		<u>Composite of B-2/S-1, B-3/S-1, B-6/S-1 &amp; B-7/S-1</u>					
moisture	--	9%	18%	27%	38%	43%	--
pH	< 4.5	--	--	--	--	--	6.9
Resistivity	< 2,000 ohm-cm	51,000	7,500	4,900	4,600	4,800	--
Sulfate	< 0.1 % (negligible)	--	--	--	--	--	0.016

The test results indicate the on-site soils are neutral to slightly acidic. Based on the above, the fill is not considered particularly corrosive to ductile iron or steel pipe. Even though the sulfate content was relatively low, the groundwater and surface water may be brackish to salty due to the marine waterfront location. The impact of these conditions on the used of Type I and II cement versus Type 5 (i.e., sulfate resistant cement) was beyond our scope of services but should be evaluated by the structural engineer.

**6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS**

Foundation design and construction are greatly influenced by subsurface conditions at the site. It is recommended that foundation design and construction be in compliance with the requirements of all applicable ordinances, regulations, and building code requirements.

**6.01 Site Preparation**

1. All topsoil, unwanted vegetation, asphalt, and underground structures should be removed from the area of new construction. The existing Naval Reserve Center building and associated foundations should be demolished and removed. Active and abandoned utilities within the proposed building limits should be removed and/or relocated.
2. All potential obstructions to pile driving should be removed from the areas to receive constructed facilities. Potential obstructions to pile installation that might be encountered at the site include but are not limited to: rubble fill, concrete foundations, piles that supported previous structures, cisterns, dry wells, and abandoned utilities. It is anticipated obstruction removal will be accomplished by excavation and that other methods, such as spudding, might be needed.

ground surface, and will fluctuate with tide level closer to the harbor. Mean tidal range in Portland Harbor is approximately 9.1 feet, and mean spring tidal range is about 10.4 feet.

## **5.0 GEOTECHNICAL ENGINEERING EVALUATIONS**

### **5.01 General**

Engineering evaluations for this project are based on the subsurface explorations, laboratory testing data, and conceptual construction information currently available to RWG&A. Should different information become known prior to or during construction, these evaluations should be reviewed by RWG&A to confirm their continued applicability.

### **5.02 Proposed Construction**

The proposed Research Institute building has been divided into two parts designated Phases I and II, with a total building footprint of about 40,000 square feet in plan. Construction is scheduled to begin during fall 2003. It is understood only Phase I may be constructed then; however, foundations for Phase II might be installed coincident with the Phase I construction. The building will be three stories high with an additional attic mezzanine housing mechanical equipment. The superstructure will be steel frame with architectural panels for the exterior and composite decks for the second and third floors. The first floor will be a cast-in-place concrete structural slab. Structural loading information was provided by the project structural engineer, SMRT of Portland, Maine. It is understood column loads will range from about 70 to 560 kips.

### **5.03 Previous Site Development**

Similar to other parts of the Portland waterfront, the site is known to have been developed and re-developed since about 1852 when Commercial Street was built. Past site development includes wharves, some with pile supported docks, piers and buildings; determining the locations of these past structures was beyond RWG&A's scope of work.

The site is currently occupied by the former Naval Reserve Center building which was built in the early 1970s. The Naval Reserve Center building is a one-story concrete structure supported on spread footing foundations bearing on the existing fill. This type of construction is characterized by relatively light foundation loads and it allows for significant differential settlement of the individual column footings without structural distress or cracking.

8. The proposed structure will be supported on a deep foundation system that will transmit the relatively high foundation loads through the in-place fill, organic silt, and silty clay to the underlying glacial till or bedrock. It is understood that the proposed pile section is HP 12x74 (50 kips per square in steel) with a design capacity of 80 tons. This design capacity is net and accounts for downdrag on the pile which would be caused by filling to reach finished grades. Design uplift capacity is 5 tons per pile.
9. Piles should be driven to refusal with a single or doubling-acting hammer delivering about 25,000 foot-pounds of energy. The minimum ultimate capacity at the end of driving should be 160 tons (geotechnical safety factor of 2.0) based on a static load test to be performed. A wave equation analysis shall be submitted by the contractor to demonstrate that his proposed pile hammer can drive the piles to the required minimum ultimate capacity and depth without over stressing or damaging the piles.
10. Driving stresses should be limited to a maximum compressive stress of 45 kips per square inch for the steel H-piles. Splices should not be allowed in the upper 10 feet of the embedded portion of the pile. Cast steel points should be provided to reduce damage while driving through debris in the fill. The pile points should be "Hard-Bite" pile points manufactured by American Pile Fittings of Clifton, New Jersey, or equivalent.
11. Since the allowable design capacity of the piles is more than 40 tons, the building code requires a static load test. A minimum of three test piles should be driven; one will be tested. Selection of the pile for load testing will be based on a review of the driving records. Pile specifications should require the contractor to submit details of the pile load test set up.
12. Each pile should be driven plumb at the prescribed location unless the pile is designed with a batter for lateral load resistance. A pile should be considered out of plumb if the inclination is greater than 6 inches in 10 feet from its design alignment.
13. For purposes of corrosion protection, the HP 12 X 74 pile section provides a minimum excess steel thickness of 1/8 inch beyond structural design requirements on all exposed steel surfaces.
14. Center-to-center pile spacing should be not less than 30 inches for groups of two or more piles. Recommended minimum design eccentricity between the columns and centroid of the supporting piles is 3 inches.
15. It is recommended that design bottom of exterior pile cap level be a minimum of 4 feet below lowest adjacent ground surface exposed to freezing. At heated interior locations, pile caps

may be designed to bear a minimum of 24 inches below top of ground floor slab. If exposure to freezing is anticipated, either during or following construction, then interior pile caps should be lowered in accordance with the recommendations for exterior pile caps.

### **6.03 Spread Footings**

16. Exterior canopies, entrance slabs, dumpster and utility pads, and other lightly-loaded, non-settlement sensitive structures may be supported on spread footings or mats bearing on fill compacted to 95 percent of the maximum dry density determined in accordance with *ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))*. These foundations may be proportioned for an allowable contact pressure of 1,500 pounds per square foot. Total settlements of 2 inches and differential settlements to about 1 inch should be anticipated. Structures supported on spread footings should not be structurally connected to the building, grade beams, or pile caps supported by deep foundations.

### **6.04 Lateral Load Resistance**

17. Lateral loads from wind and earthquake may be resisted by the lateral capacity of the pile foundations and by passive earth pressures against the sides of the pile caps and tie-beams. Individual piles may be designed with an allowable lateral resistance of 3 kips, which assumes an allowable deflection of about 1/4 inch. Piles can be battered to achieve additional lateral resistance; batter should not be steeper than 3H:12V.

Lateral loads may also be resisted by earth pressure against pile caps and tie beams. A lateral bearing pressure of 100 pounds per square foot per foot below finished grade may be used. It is recommended that pile caps and tie beams be backfilled with compacted granular fill extending a minimum of 4 feet laterally beyond the units.

### **6.05 Ground Floors**

18. Due to the potential for post-construction settlement, a structural slab is recommended for the building ground floor.
19. An underslab passive foundation venting system is recommended to prevent the flow of petroleum and fugitive water vapors into the building. The vent openings should be above ground surface and face sideways or downward so as not to clog with snow, ice, or debris.

The passive foundation venting system should consist of a 10-mil waterproof membrane, 3/4-inch crushed stone, and 6-inch diameter perforated pipe; the waterproof membrane and perforated pipe must be chemically resistant to petroleum substances. The waterproof membrane should be placed below the concrete slab and over a 1-foot thick layer, minimum, of the 3/4-inch crushed stone. The perforated pipe should be located in the center of the stone layer along the length of the building. The perforated pipes should be spaced about 10 feet on-center, laterally, and vent freely to the atmosphere.

#### **6.06 Utilities**

20. Utilities within the site and beneath paved areas may be earth supported. Bedding placed between the utility and subgrade should meet the utility and manufacturer requirements for the type of conduit or pipe being installed.

Underground utilities beneath the building should be either entirely earth supported or entirely supported by pile caps, the structural slab ground floor, and /or tie beams so that the potential for abrupt differential settlement due to a mixed support system is minimized. Underground and at-grade utilities should be designed to allow for a minimum of 3 inches of differential movement where earth supported utilities connect to the pile supported foundation and building.

#### **6.07 Temporary Excavations**

21. Soils encountered within the anticipated depths of excavations consist of topsoil and fill. It is anticipated that foundation and utility excavations can typically be accomplished using sloped, open-cut techniques. It is also anticipated that dewatering can be accomplished using sumps and open pumping methods to a depth of 1 to 2 feet below groundwater. Regardless of the method, dewatering should be provided which allows excavation, foundation construction, utility installation and backfilling to be completed in-the-dry. Dewatering should be continuous from the time of excavation until the foundations are backfilled.

The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, earthwork, and utility subcontractors could be liable for substantial penalties.

As a safety measure, it is recommended that all vehicles and spoil piles be kept a minimum lateral distance from the top of excavations equal to no less than 100 percent of the slope height. Exposed slope faces should be protected against the elements.

### **6.08 Geotechnical Observation During Construction**

The geotechnical recommendations provided as the basis for design of this project were developed using limited numbers of observations and tests. The Owner should be sensitive to the potential need for adjustment in the field. It is recommended the Owner retain RWG&A to observe geotechnical construction aspects of the project. These services should include observing general compliance with the design concepts, specifications, and recommendations, and assisting in development of design changes should subsurface conditions differ from those anticipated prior to the start of construction. Observation improves the likelihood that the design intent will be carried out during construction and allows RWG&A to confirm its design recommendations. For this project, geotechnical observation of the following aspects is recommended:

- Site preparation including removal of prior foundations.
- Predrilling of pile locations and removal of obstructions.
- Pile installation and pile load testing.
- Fill placement and compaction testing.

In addition to geotechnical observation, RWG&A can provide full service construction inspection and materials testing. This would include soils, portland cement and asphaltic concrete, destructive and non-destructive testing, and special inspection services in fulfillment of building code requirements.

## **7.0 CLOSURE**

This report has been prepared for specific application to the proposed Gulf of Maine Research Institute Building in Portland, Maine and the exclusive use of the Gulf of Maine Research Institute. This work has been completed in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. In the event any changes are made in the nature, design, or location of the proposed structure, the conclusions and recommendations of this report should be reviewed by RWG&A.

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The recommendations presented are based on the results of widely spaced explorations. The nature of variations between the explorations may not become evident until construction has begun. If variations are encountered, it will be necessary for RWG&A to re-evaluate the recommendations presented in this report. RWG&A requests an opportunity for a general review of the final design and specifications in order to determine that earthwork and foundation recommendations have been interpreted in the manner in which they were intended.



0 2000 3000 4000

SCALE, FEET

FIGURE 1  
 LOCUS MAP  
 GULF OF MAINE RESEARCH INSTITUTE  
 PORTLAND, MAINE

JUNE 2003

PROJECT NO. 235-741

**SOURCE:**

USGS 7.5-MINUTE TOPOGRAPHIC QUADRANGLE OF  
 PORTLAND WEST (1978) AND PORTLAND EAST (1990), ME.



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**APPENDIX A**  
**EXPLORATION LOGS**

**Geotechnical Investigation**  
**Proposed Gulf of Maine Research Institute Building**  
**Portland, Maine**

# BORING LOG B-1

**Project:** Gulf of Maine Aquarium Research Facility  
**Location:** Portland, Maine

**Approximate Surface Elevation:** 11.5  
**Ground Water Depth:** 7.7

**Client:** Gulf of Maine Aquarium

**Date:** 12/5/01

**Project No.** 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT	Lab Tests
0	█		S-1	<b>TOPSOIL AND ORGANIC MATERIAL (10").</b> FILL: Sand, loose, moist, medium to fine sand, trace to little silt, trace to little gravel, brown.	12	1 15 12 6	27	< 1	
5	█		S-2	FILL: Clayey Silt, loose, wet, silt and clay mixture with trace to little medium to fine sand, gray.	16	3 3 2 2	5	22	
10	█		S-3	FILL: Sand, loose, wet, coarse to fine sand, trace silt, trace gravel, brown.	22	2 2 2 2	4	< 1	
15	█		S-4	ORGANIC SILT (OL); loose, wet, silt and organic mixture with trace fine sand, shells, gray.	24	2 2 3 2	5	< 1	
20	█		S-5	SAND (SP); medium dense, wet, medium to fine sand, trace to little silt, light-gray.	17	6 7 9 12	16	< 1	
25	█			Auger refusal, bedrock, roller bit and begin rock core at 30'.					
30	█		R-1	Hard, fresh, fine grain, light-gray, QUARTITIC GNEISS with low angle and high angle joints parallel to foliation, jointing is moderately spaced, with fresh to discolored surfaces and closed apertures.					
35	█			Depth (ft)      Time (min) 30.0 to 31.0      5.5					

## BORING LOG B-1

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 11.5  
 Ground Water Depth: 7.7

Client: Gulf of Maine Aquarium

Date: 12/5/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	MOISTURE CONTENT	Lab Tests
				31.0 to 32.0      4					
				32.0 to 33.0      3					
				33.0 to 34.0      3					
				34.0 to 35.0      4					
40				Recovery: 100%; RQD: 75% Bottom of Exploration at 35': boring terminated 10' into bedrock.					
45									
50									
55									
60									
65									
70									

## BORING LOG B-2

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.5  
 Ground Water Depth: 8'±

Client: Gulf of Maine Aquarium

Date: 12/9/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0		S-1	<b>TOPSOIL AND ORGANIC MATERIAL (6")</b> FILL: Silty Sand with gravel, medium dense, moist, medium to fine sand, little to some silt, little to trace gravel, trace ashes, coal, brick, brown.	18	2 4 15 9	19	<1	
5		S-2	Grades to gravelly sand, becomes loose, wet.	10	5 3 3 2	6	<1	
10		S-3	Becomes very loose.	5	3 2 1/ 12"	2	<1	
15		S-4	<b>SILTY CLAY (CL);</b> medium stiff, wet with trace organics and shells, gray.	20	2 1 1 2	2	<1	
20		S-5	Becomes soft.	24	WOH		<1	
25		S-6		24	WOH			
30		S-7		16	WOH /18 2			
35								

## BORING LOG B-2

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.5  
 Ground Water Depth: 8±

Client: Gulf of Maine Aquarium

Date: 12/9/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
			S-8	Becomes medium stiff.	24	WOH 1 2 2	3		
40			S-9		20	1 2 3 2	5		
45			S-10	GRAVELLY SAND (SW); medium dense to dense, wet, coarse to fine sand, some gravel, trace silt, occasional cobbles, brown.	15	2 12 15 16	27		
50			S-11			17	7 10 15 45	25	
55			S-12			22 27 26 30	53		
				Bottom of Exploration at 57': not refusal.					
60									
65									
70									

## BORING LOG B-3

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.1'  
 Ground Water Depth: 8'

Client: Gulf of Maine Aquarium

Date: 12/7/01

Project No. 235-741

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests	
0		S-1	<b>TOPSOIL AND ORGANIC MATERIAL (4")</b> FILL: Sand to Silty Sand (SP-SM): loose, moist, medium to fine sand, little to trace silt, trace gravel, trace ashes, bricks, coal, brown.	10	1 4 4 3	8	< 1		
5		S-2		16	4 8 5 1	13	< 1		
10		S-3		8	7 5 3 3	8	< 1		
15		S-4		2	4 1 1 2	2	< 1		
20		S-5		<b>SILTY CLAY (CL); stiff to soft, wet, gray.</b>	24	WOH		< 1	
25		S-6			24	WOH			
30		S-7		Becomes medium stiff.	24	WOH 12" 1 1	1		
35									

### BORING LOG B-3

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.1'  
 Ground Water Depth: 8'

Client: Gulf of Maine Aquarium

Date: 12/7/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
			S-8	Becomes medium stiff.	24	2 1 2 1	3		
40			S-9		24	1 2 2 1	4		
45			S-10	Becomes soft.	24	WOH			
50			S-11		24	WOH			
55			S-12	Becomes stiff.	24	1 3 4 4			
60			S-13		24	3 3 4 5	7		
65			S-14		24	2 3 5 7	8		
				SILTY SAND (SM); loose to dense, wet, fine sand and silt, gray.					
70			S-		16	13	46		

# BORING LOG B-3

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.1'  
 Ground Water Depth: 8'

Client: Gulf of Maine Aquarium

Date: 12/7/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
			15						
				SAND (SP); dense, wet, medium to fine sand, trace gravel, trace silt, brown.		24 22 18			
75			S-16	Becomes gravelly.	10	25 30 25/ 1"	55 +		
			16	Bottom of Exploration at 76': spoon refusal, probable cobble.					
80									
85									
90									
95									
100									
105									



## BORING LOG B-4

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.1  
 Ground Water Depth: 10±

Client: Gulf of Maine Aquarium

Date: 12/5/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0			S-1	<b>TOPSOIL AND ORGANIC MATERIAL (4")</b> FILL: Sand and Coal, loose, moist, coarse to fine sand and coal, little silt, occasional cobbles, black.	8	1 4 3 4	7	< 1	
5			S-2	Becomes gravelly with several brick pieces and void space.	15	4 6 4 6	10	< 1	
10			S-3	Frequent cobbles and boulders, cuttings show both brick and granite present, cannot advance 4" casing past obstruction at 14'	16	10 11 12 12	23	< 1	
15				ORGANIC SILT (OL); soft, wet, silt and organic mixture with little medium to fine sand, shells, gray.					
20			S-4		8	2 2 2 1	4	< 1	
25			S-5	SILTY CLAY (CL); soft, wet, gray.	24	WOH/ 2" 1 1	1	< 1	
30			S-6		24	WOR		< 1	
35									

## BORING LOG B-4

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.1  
 Ground Water Depth: 10±

Client: Gulf of Maine Aquarium

Date: 12/5/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
			S-7		24	WOR			
40			S-8		24	WOR			
45			S-9		24	WOR			
55	FV			Undrained Shear Strength $S_u = 0.81$ ksf, Residual $S_u = 0.35$ ksf					
	FV			Undrained Shear Strength $S_u = 0.81$ ksf, Residual $S_u = 0.35$ ksf					
60	FV			Undrained Shear Strength $S_u = 0.81$ ksf, Residual $S_u = 0.35$ ksf					
	FV			Undrained Shear Strength $S_u = 0.92$ ksf, Residual $S_u = 0.46$ ksf					
65									
70			S-	SANDY SILTY CLAY (ML-CL); medium stiff, wet, gray.	24	1	4		

# BORING LOG B-4

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.1  
 Ground Water Depth: 10±

Client: Gulf of Maine Aquarium

Date: 12/5/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
75			11			1 3 4			
80	S-		12	SILTY SAND (SM); medium dense, medium to fine sand, little silt, thin silt seams, gray	24	9 7 10 12	17		
90	S-		13	GRAVELLY SAND (SW); medium dense to dense, wet, coarse to fine sand, little to some gravel, trace silt, brown.	17	10 12 13 15	25		
95	S-		14		10	18 16 15 16	31		
100				Bottom of Exploration at 97': not refusal.					
105									

## BORING LOG B-5

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.8'  
 Ground Water Depth: 10'±

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0			S-1	<b>TOPSOIL AND ORGANIC MATERIAL (6").</b> FILL: Coal and Silty Sand, loose, moist, black.	16	2 5 3 3	8		
5			S-2	FILL: Silty Sand with Gravel, medium dense, moist, coarse to fine sand, little silt, trace to little gravel, trace coal, black.  FILL: bricks and rubble, medium dense with voids, wet, red.	3	7 8 9 7	17		
10			S-3	FILL: Silty Sand with gravel, dense, wet, coarse to fine sand, little silt, little to trace gravel, occasional cobbles, trace wood, shells, brown.	8	20 23 12 13	23		
15			S-4	FILL: Silty Sand with gravel, dense, wet, coarse to fine sand, little silt, little to trace gravel, occasional cobbles, trace wood, shells, brown.	10	23 23 15 5	38		
20			S-5		1	20 11 23 20	34		
25			S-6		14	20 7 5 5	12		
30			S-7	SILTY CLAY (CL); stiff, wet, gray.	14	7 6 5 5	11		
35									

# BORING LOG B-5

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.8'  
 Ground Water Depth: 10'±

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
40			FV	Becomes soft. Undrained Shear Strength, $S_u = 0.83$ ksf, Residual = 0.11 ksf					
45									
50			FV S-8	Undrained Shear Strength, $S_u = \pm 1.09$ ksf Becomes medium stiff.	24	1 1 2 1	3		
55									
60			FV	Undrained Shear Strength, $S_u = 1.12$ ksf					
65									
70			FV	Undrained Shear Strength, $S_u = 1.24$ ksf					

## BORING LOG B-5

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9.8'  
 Ground Water Depth: 10'±

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
75	[Hatched Box]	S-9	Occasional sand seams.	24	7 8 6 7	14		
80	[Dotted Box]	S-10	SAND (SP); very dense, wet, medium to fine sand, trace gravel, trace silt, brown.	12	35 35 45 47	80		
85	[Dotted Box]	S-11	Becomes silty.	14	30 36 35 38	71		
90			Bottom of Exploration at 87': not refusal.					
95								
100								
105								

## BORING LOG B-6

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.4'  
 Ground Water Depth: 10'±

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0			S-1	<b>ASPHALTIC PAVEMENT (2").</b> FILL: Gravelly Sand, medium dense, moist, medium to fine sand, little gravel, trace silt, trace bricks, coal, brown.	16	7 15 10 9	25	2	
5			S-2	FILL: Sand, loose, moist then wet, medium to fine sand, little to trace silt, trace bricks, shells, brown.	12	3 3 3 4	6	<1	
10			S-3		8	4 1 2 3	3	<1	
15			S-4	Becomes silty, with traces of clay, gray.	4	5 2 2 3	4	<1	
20			S-5	SILTY CLAY (CL); soft, wet, gray.	16	1/ 12" 1/ 12"	1		
25		FV		Undrained Shear Strength, $S_u = 0.52$ ksf, Residual = 0.09 ksf					
		FV		Undrained Shear Strength, $S_u = 0.60$ ksf, Residual $S_u = 0.11$ ksf					
30		FV		Undrained Shear Strength, $S_u = 0.77$ ksf, Residual $S_u = 0.13$ ksf					
		FV		Undrained Shear Strength, $S_u = 0.84$ ksf, Residual $S_u = 0.15$ ksf					
35									

### BORING LOG B-6

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.4'  
 Ground Water Depth: 10'±

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
				Undrained Shear Strength, $S_u = 0.88$ ksf, Residual $S_u = 0.18$ ksf					
				Undrained Shear Strength, $S_u = 0.91$ ksf, Residual $S_u = 0.20$ ksf					
40				Undrained Shear Strength, $S_u = 1.06$ ksf, Residual $S_u = 0.12$ ksf					
				Undrained Shear Strength, $S_u = 0.84$ ksf, Residual $S_u = 0.12$ ksf					
45				Undrained Shear Strength, $S_u = 1.00$ ksf, Residual = 0.17 ksf					
				Undrained Shear Strength, $S_u = 1.19$ ksf, Residual $S_u = 0.23$ ksf					
50				Undrained Shear Strength: $S_u = 1.15$ ksf, Residual $S_u = 0.25$ ksf					
				Undrained Shear Strength $S_u = 1.09$ ksf, Residual $S_u = 0.20$ ksf					
55				Undrained Shear Strength = 1.30 ksf, Residual $S_u = 0.25$ ksf					
				Undrained Shear Strength $S_u = 1.43$ ksf, Residual $S_u = 0.25$ ksf					
60				Undrained Shear Strength = 1.36 ksf, Residual $S_u = 0.25$ ksf					
				Undrained Shear Strength, $S_u = 1.63$ ksf, Residual $S_u = 0.25$ ksf					
65			S-6	Becomes stiff.	24	2 3 5 4	8		
70			S-7		20	2	16		



## BORING LOG B-6

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.4'  
 Ground Water Depth: 10'±

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
				SILTY SAND (SM); medium dense, wet, fine sand and silt, gray.		7 9 16			
75			S-8	SAND (SP); dense, wet, medium to fine sand, trace silt, trace gravel, brown.	16	23 28 33 38	61		
80			S-9	Becomes gravelly.	17	20 19 20 30	39		
				Bottom of Exploration at 82': not refusal.					
85									
90									
95									
100									
105									

## BORING LOG B-7

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.6'  
 Ground Water Depth: 8'

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0			S-1	ASPHALTIC PAVEMENT (8") FILL: Gravelly Sand, medium dense to dense, moist, coarse to fine sand, some to little gravel, trace silt, brown. FILL: Sand, medium dense to loose, moist then wet, medium to fine sand, little to trace silt, trace gravel, brown.	16	7 15 17 17	32	<1	
5			S-2		16	6 6 7 7	13	<1	
10			S-3		20	4 2 1 1	3	<1	
15			S-4	CLAYEY SILTY SAND (SM); loose to medium dense, wet, medium to fine sand, little silt, little clay, trace shells, gray.	24	7 8 4 2	12	<1	
20			S-5	SILTY CLAY (CL); soft, wet, gray.	6	WOH		<1	
25			FV	Undrained Shear Strength, $S_u = 0.76$ ksf, Residual $S_u = 0.15$ ksf					
			FV	Undrained Shear Strength, $S_u = 0.74$ ksf, Residual $S_u = 0.13$ ksf					
30			S-6	Becomes medium stiff.	24	3 2 2 2	4		
35									

## BORING LOG B-7

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.6'  
 Ground Water Depth: 8'

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
			FV	Undrained Shear Strength, $S_u = \pm 1.09$ ksf					
40			S-7	SAND (SP); medium dense to dense, wet, medium to fine sand, little to trace silt, trace gravel, brown.	16	1 4 13 18	17		
45			S-8	Becomes dense, gravelly.	18	14 22 32 40	54		
50				Auger refusal at 49', bedrock, advanced hole to 55' with roller bit.					
55				Bottom of Exploration at 55'.					
60									
65									
70									

## BORING LOG B-8

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.5'  
 Ground Water Depth: 8'±

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0		S-1	ASPHALTIC PAVEMENT (3") FILL: Gravelly Sand, medium dense, moist, coarse to fine sand, little gravel, trace silt, brown. Coal, loose, moist, black	16	10 11 13 20	24	<1	
5		S-2	FILL: Silty Sand, loose to medium dense, moist, medium to fine sand, little to some silt, trace gravel, brown.	14	5 6 7 4	13	<1	
10		S-3	SILTY CLAY (CL); soft, wet, gray.	20	3 4 3 3	7	<1	
15		S-4	SILTY SAND (SM); loose, wet, medium to fine sand, some silt, little clay, clay lens, gray. SILTY CLAY (CL); soft, wet, gray.	24	2 3 5 3	8	<1	
20		S-5		24	WOH			
25		S-6			WOH			
30		S-7		24	WOH 2 1	2		
35								

# BORING LOG B-8

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.5'  
 Ground Water Depth: 8'±

Client: Gulf of Maine Aquarium

Date: 12/10/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
38			S-8		24	5 5 4 5	9		
40			S-9	SAND (SP); dense, wet, medium to fine sand, trace silt, trace gravel, brown.	12	17 18 14 18	32		
45			S-10	Becomes very dense, gravelly.	4	55 50/ 3"	00+		
46				Bottom of Exploration at 46': spoon refusal, probable cobbles, possible bedrock.					
50									
55									
60									
65									
70									

## BORING LOG B-9

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 11.2'  
 Ground Water Depth: 8'

Client: Gulf of Maine Aquarium

Date: 12/11/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0		S-1	TOPSOIL AND ORGANIC MATERIAL (8"). FILL: coal, loose, moist, black.	15	1	11	<1	
			FILL: Sand, loose, moist, medium to fine sand, little to trace silt, brown.		4			
				7				
5		S-2		20	6	12	<1	
					6			
					6			
10		S-3		24	13	7	<1	
			ORGANIC SILT (OL); loose, wet, organic matter and silt, trace shells, wood, gray.		5			
					2			
15		S-4	SAND (SP); loose to medium dense, wet, coarse to fine sand, little gravel, trace to some silt, gray.	2	13	11	<1	
					8			
					3			
					4			
20		S-5	Becomes silt, dense to medium dense.	20	10	29		
					24			
					5			
					6			
25			Bottom of Exploration at 24': roller bit refusal, possible bedrock or boulder.					
30								
35								

## BORING LOG B-10

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.3'  
 Ground Water Depth: NFGWE

Client: Gulf of Maine Aquarium

Date: 12/11/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0			S-1	ASPHALTIC PAVEMENT (2.5") FILL: Gravelly Sand, medium dense, moist, coarse to fine gravel, some gravel, trace silt, brown. FILL: Sand, loose, moist, medium to fine sand, little gravel, little silt, brown.	12	6 11 9 11	20	< 1	
5			S-2	16	4 2 4 2	6	325		
10				Bottom of Exploration at 7': not refusal. Boring terminated due to high reading with HNU.					
15									
20									
25									
30									
35									

## BORING LOG B-11

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.4  
 Ground Water Depth: 7.5'

Client: Gulf of Maine Aquarium

Date: 12/11/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests				
0	#1	S-1	S-1	ASPHALTIC PAVEMENT (2.5")	4	5	16	< 1					
				FILL: Gravelly Sand, loose to medium dense, moist, coarse to fine sand, little gravel, trace silt, brown.		11							
				FILL: Silty Sand, loose, moist then wet, medium to fine sand, little silt, trace gravel, trace organics, brown.		5							
						11							
5				S-2						2	2	3	< 1
										2	2		
			1										
			2										
10		S-3		SAND AND SILTY SAND (SM-SP); loose to medium dense, wet, interlayered coarse to fine sand and silt, trace gravel, gray.	18	6	10	< 1					
						5							
						5							
						2							
15		S-4		SAND (SP); loose, wet, medium to fine sand, trace silt, trace gravel, gray.	1	3	4	< 1					
						2							
						2							
						2							
20		S-5		Becomes medium dense, brown.	22	5	16						
						8							
						8							
						12							
25		S-6		GRAVELLY SAND with silt (SM); medium dense to dense, wet, coarse to fine sand, some gravel, trace to little silt, gray.	16	12	29						
						15							
						14							
						18							
30				Approximately 1' boulder at 30'									
				Possible Top of bedrock, advanced hole to 35' with roller bit.									
35													



# BORING LOG B-11

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 10.4  
 Ground Water Depth: 7.5'

Client: Gulf of Maine Aquarium

Date: 12/11/01

Project No. 235-741

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests	
40				Bottom of Exploration at 35'; boring terminated 3' into bedrock on large boulder.						
45										
50										
55										
60										
65										
70										

## BORING LOG P-1

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 11.5'  
 Ground Water Depth: NFGWE

Client: Gulf of Maine Aquarium

Date: 12/11/01

Project No. 235-741

DEPTH, FT.	SYMBOL SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0			<b>TOPSOIL AND ORGANIC MATERIAL (8")</b> FILL: Sand with cobbles, loose, moist, brick, granite, concrete, with voids and coarse to fine sand in matrix space, brown.					
5			Bottom of Exploration at 5': auger refusal.					
10								
15								
20								
25								
30								
35								

# BORING LOG P-2

Project: Gulf of Maine Aquarium Research Facility  
 Location: Portland, Maine

Approximate Surface Elevation: 9'  
 Ground Water Depth: NFGWE

Client: Gulf of Maine Aquarium

Date: 12/11/01

Project No. 235-741

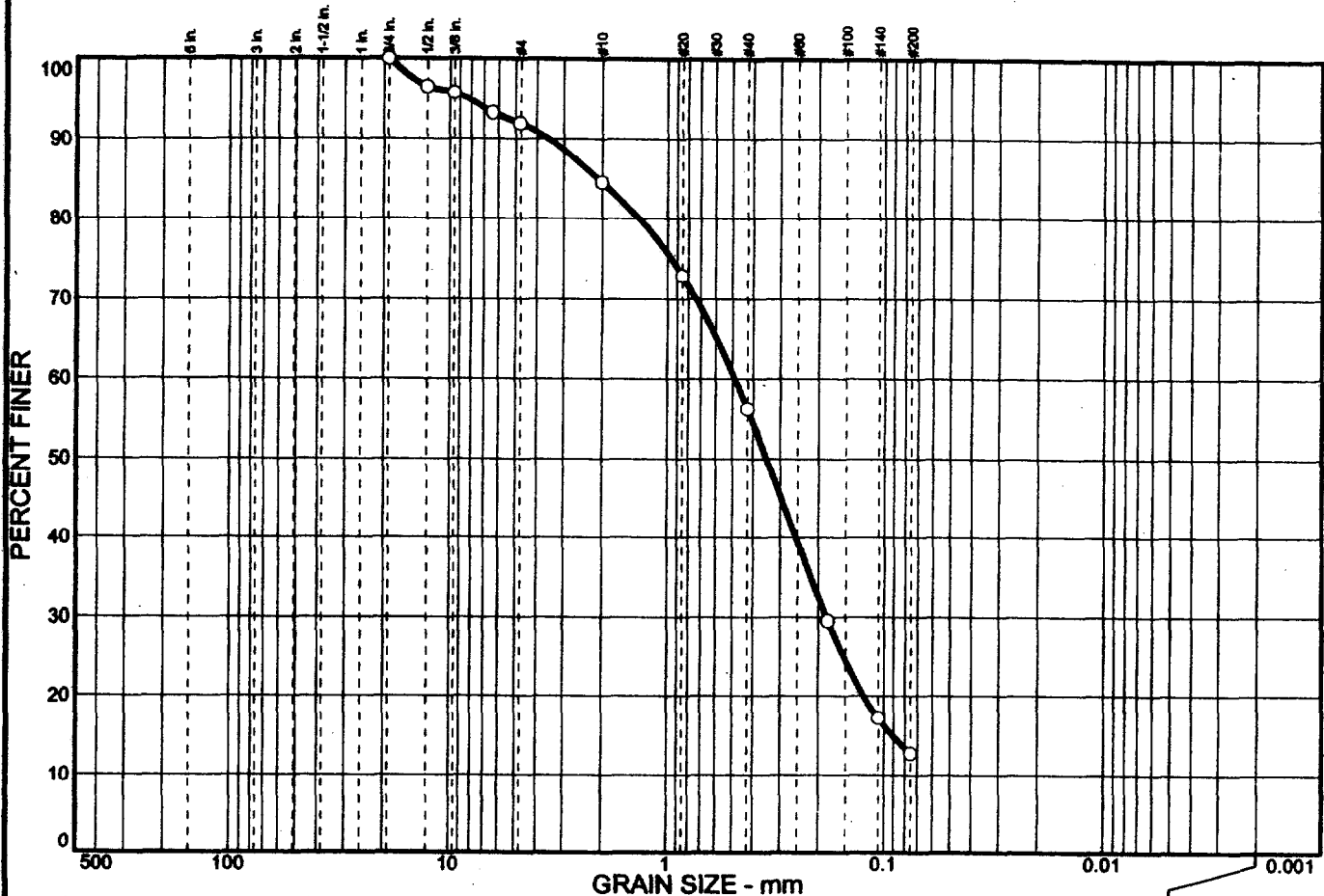
DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE #	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N BLOWS PER FT.	HNU	Lab Tests
0				<b>TOPSOIL AND ORGANIC MATERIAL (6").</b> <b>FILL: Gravelly Sand to bricks and rubble with void space.</b>					
5									
10									
				<b>Bottom of Exploration at 11': auger refusal.</b>					
15									
20									
25									
30									
35									

**APPENDIX B**

**LABORATORY TESTING**

**Geotechnical Investigation  
Proposed Gulf of Maine Research Institute Building  
Portland, Maine**

# Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	8.1	7.4	28.3	43.5	12.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	96.5		
3/8 in.	95.7		
1/4 in.	93.2		
#4	91.9		
#10	84.5		
#20	72.9		
#40	56.2		
#80	29.5		
#140	17.2		
#200	12.7		

**Soil Description**

**Atterberg Limits**  
 PL=                      LL=                      PI=

**Coefficients**  
 D<sub>85</sub>= 2.10                      D<sub>60</sub>= 0.486                      D<sub>50</sub>= 0.347  
 D<sub>30</sub>= 0.183                      D<sub>15</sub>= 0.0911                      D<sub>10</sub>=  
 C<sub>u</sub>=                                      C<sub>c</sub>=

**Classification**  
 USCS= SM                                      AASHTO=

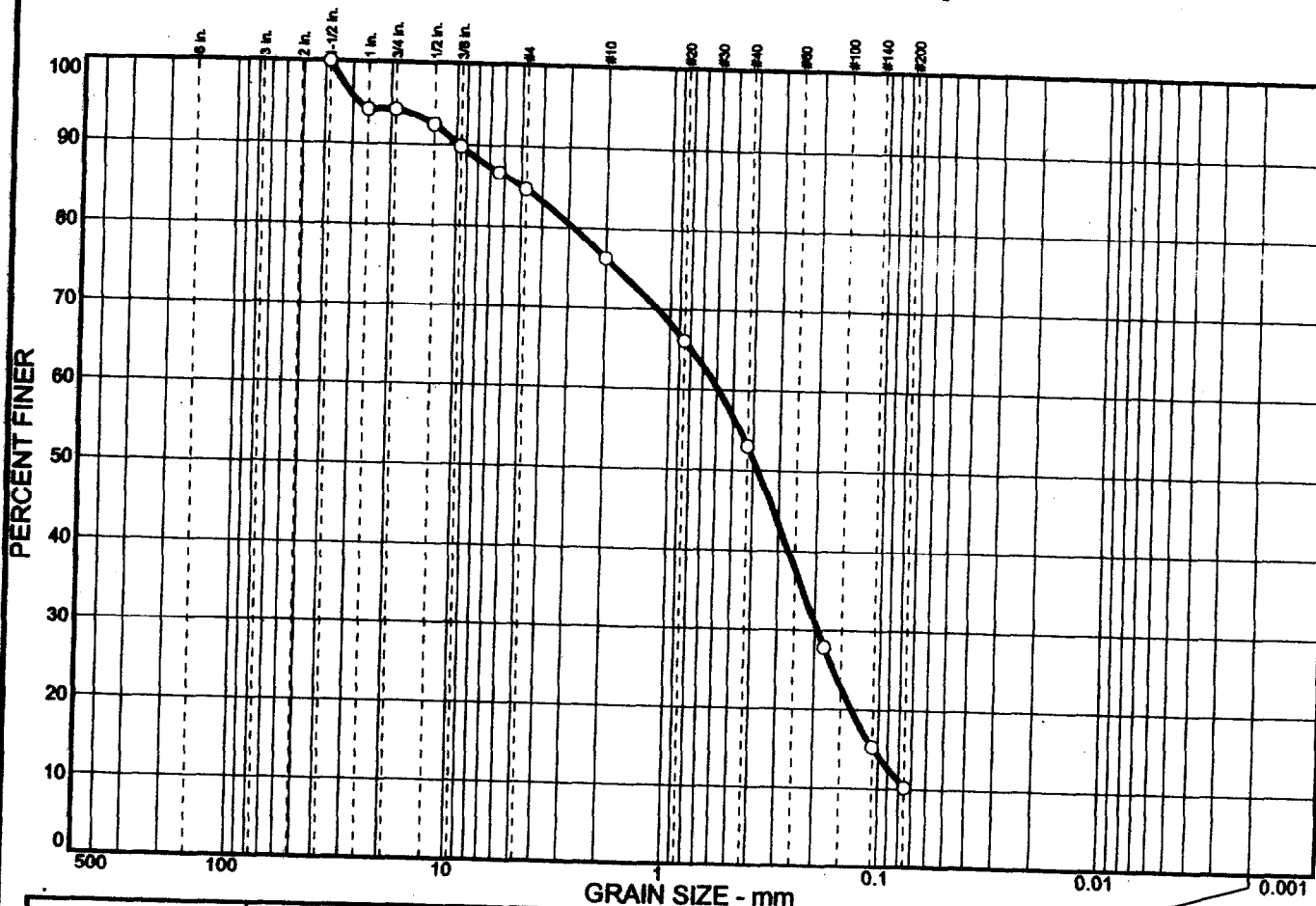
**Remarks**  
 Moisture Content 4.3%  
 Tested by AMA

(no specification provided)

Sample No.: 2                      Source of Sample: B-1                      Date: 12/10/01  
 Location: Portland, ME                      Elev./Depth: 5-7'

<b>R.W. Gillespie &amp; Associates, Inc.</b>	Client: Gulf of Maine Aquarium Project: Research Facility Project No: 235-741	Sample No. 6589A <span style="font-size: 2em; font-family: cursive;">GPT</span>
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# Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	5.8	9.5	8.5	23.2	42.8	10.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	94.2		
3/4 in.	94.2		
1/2 in.	92.4		
3/8 in.	89.8		
1/4 in.	86.7		
#4	84.7		
#10	76.2		
#20	66.1		
#40	53.0		
#80	27.9		
#140	15.2		
#200	10.2		

(no specification provided)

### Soil Description

**Atterberg Limits**  
 PL=                      LL=                      PI=

**Coefficients**  
 D<sub>85</sub>= 4.95                      D<sub>60</sub>= 0.586                      D<sub>50</sub>= 0.379  
 D<sub>30</sub>= 0.193                      D<sub>15</sub>= 0.105                      D<sub>10</sub>=  
 C<sub>u</sub>=                                      C<sub>c</sub>=

**Classification**  
 USCS= SP-SM                      AASHTO=

**Remarks**  
 Moisture Content 9.15%  
 Tested by AMA

Sample No.: 2  
 Location: Portland, ME

Source of Sample: B-3

Date: 12/10/01  
 Elev./Depth: 5-7'

**R.W. Gillespie  
 &  
 Associates, Inc.**

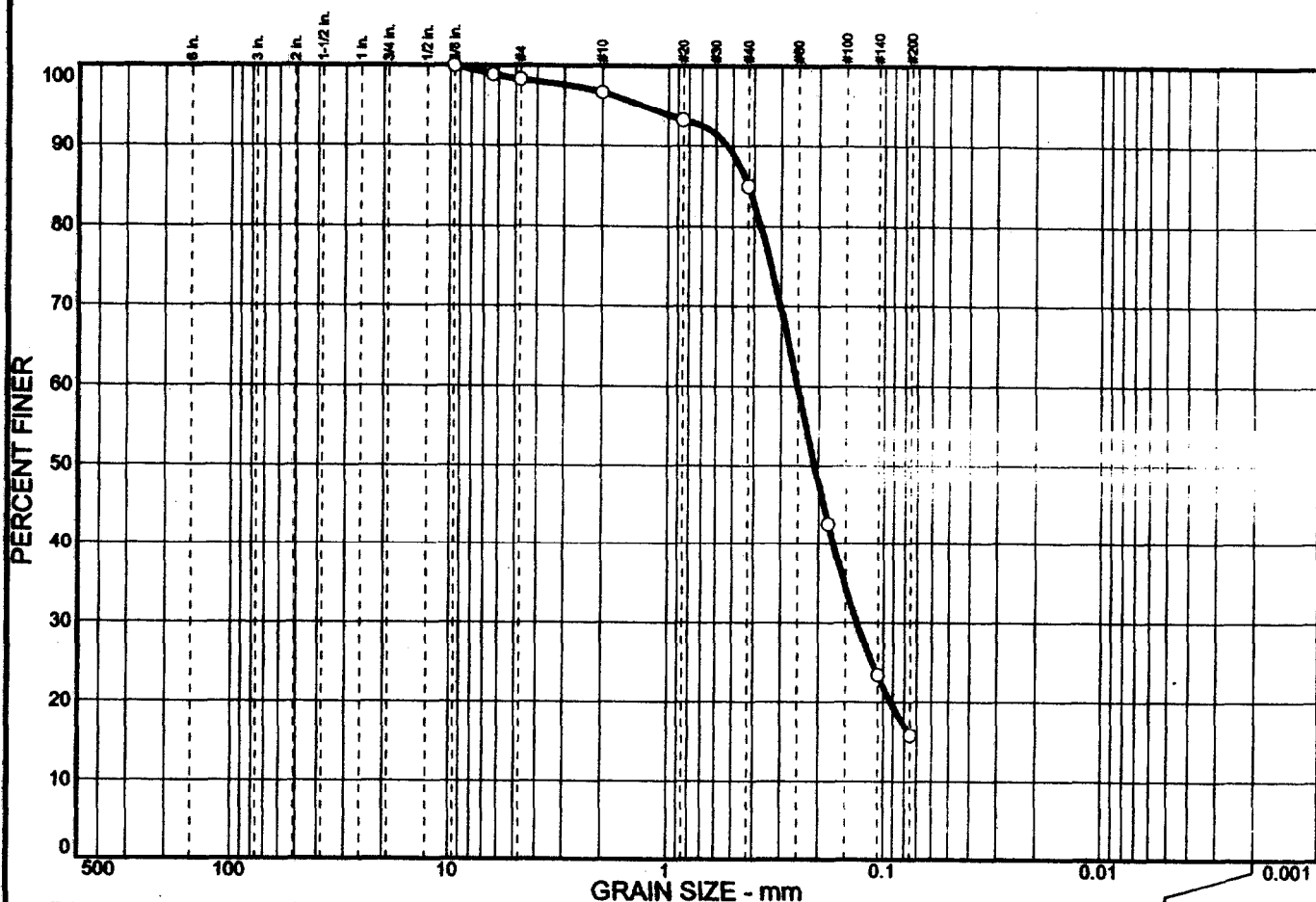
Client: Gulf of Maine Aquarium  
 Project: Research Facility

Project No: 235-741

Sample No. 6589B

*GSM*

# Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	1.7	1.6	11.8	69.2	15.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
1/4 in.	98.9		
#4	98.3		
#10	96.7		
#20	93.2		
#40	84.9		
#80	42.5		
#140	23.4		
#200	15.7		

(no specification provided)

**Soil Description**

**Atterberg Limits**  
 PL=                      LL=                      PI=

**Coefficients**  
 D<sub>85</sub>= 0.426                      D<sub>60</sub>= 0.250                      D<sub>50</sub>= 0.209  
 D<sub>30</sub>= 0.132                      D<sub>15</sub>=                      D<sub>10</sub>=  
 C<sub>u</sub>=                      C<sub>c</sub>=

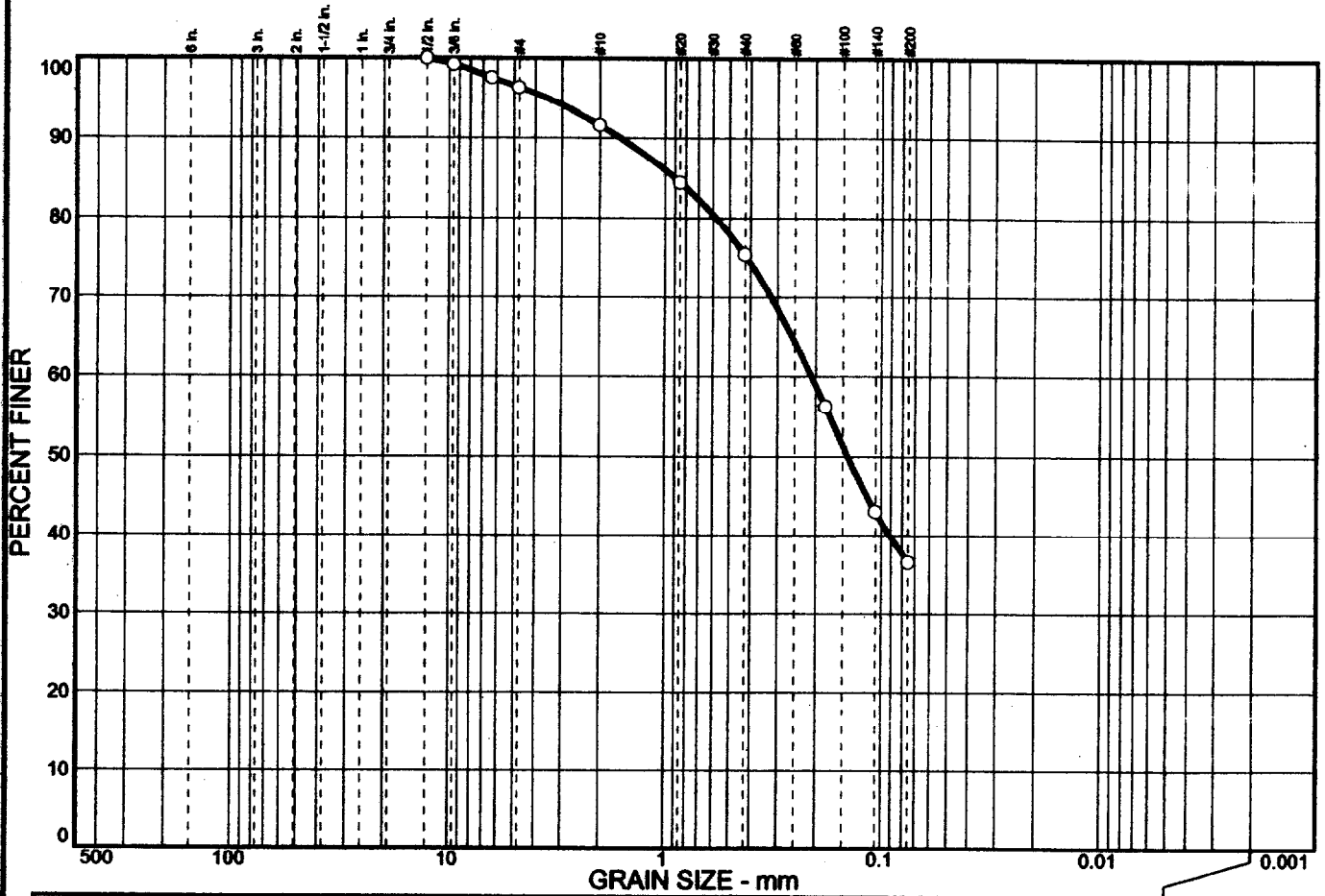
**Classification**  
 USCS= SM                      AASHTO=

**Remarks**  
 Moisture Content 11.8%  
 Tested by AMA

**Sample No.:** 2                      **Source of Sample:** B-6                      **Date:** 12/10/01  
**Location:** Portland, ME                      **Elev./Depth:** 5-7'

<b>R.W. Gillespie &amp; Associates, Inc.</b>	<b>Client:</b> Gulf of Maine Aquarium <b>Project:</b> Research Facility  <b>Project No:</b> 235-741	GSM <b>Sample No.</b> 6589C
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# Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	3.7	4.7	16.2	38.8	36.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.2		
1/4 in.	97.5		
#4	96.3		
#10	91.6		
#20	84.4		
#40	75.4		
#80	56.2		
#140	43.0		
#200	36.6		

(no specification provided)

**Soil Description**

**Atterberg Limits**  
 PL=                      LL=                      PI=

**Coefficients**  
 D<sub>85</sub>= 0.902              D<sub>60</sub>= 0.209              D<sub>50</sub>= 0.142  
 D<sub>30</sub>=                      D<sub>15</sub>=                      D<sub>10</sub>=  
 C<sub>u</sub>=                      C<sub>c</sub>=

**Classification**  
 USCS= SM                      AASHTO=

**Remarks**  
 Moisture Content 9.7%  
 Tested by AMA

Sample No.: 2  
 Location: Portland, ME

Source of Sample: B-8

Date: 12/10/01  
 Elev./Depth: 5-7'

R.W. Gillespie  
 &  
 Associates, Inc.

Client: Gulf of Maine Aquarium  
 Project: Research Facility

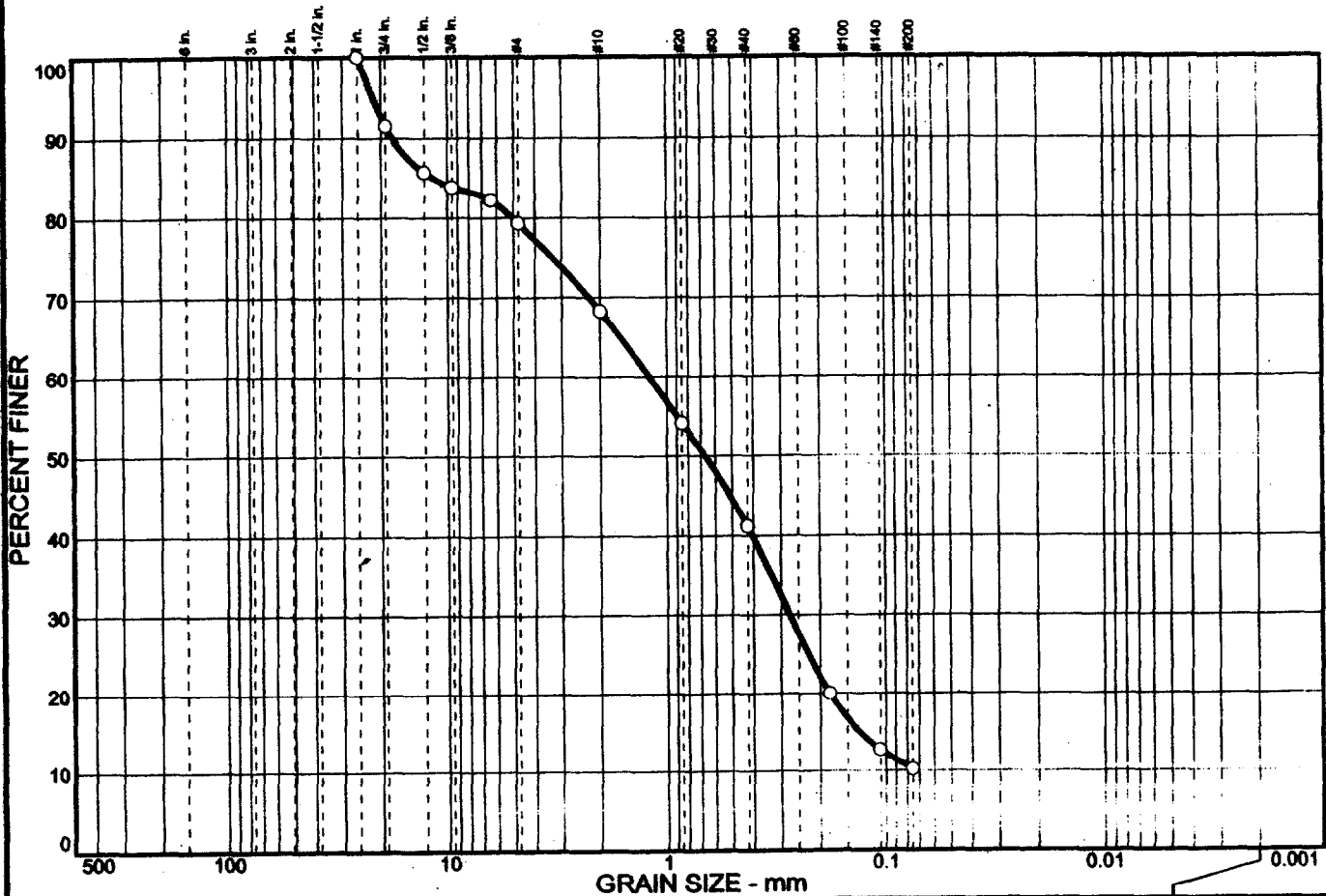
Project No: 235-741

Sample No. 6589D

GSM



# Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	8.4	12.3	11.0	27.1	31.0	10.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	91.6		
1/2 in.	85.7		
3/8 in.	83.8		
1/4 in.	82.2		
#4	79.3		
#10	68.3		
#20	54.1		
#40	41.2		
#80	20.0		
#140	12.7		
#200	10.2		

**Soil Description**

**Atterberg Limits**  
 PL=                      LL=                      PI=

**Coefficients**  
 D<sub>85</sub>= 11.7                      D<sub>60</sub>= 1.20                      D<sub>50</sub>= 0.667  
 D<sub>30</sub>= 0.274                      D<sub>15</sub>= 0.132                      D<sub>10</sub>=  
 C<sub>u</sub>=                                      C<sub>c</sub>=

**Classification**  
 USCS= SP-SM                      AASHTO=

**Remarks**  
 Moisture Content 4.7%  
 Tested by AMA

\* (no specification provided)

Sample No.: 1  
 Location: Portland, ME

Source of Sample: B-11

Date: 12/10/01  
 Elev./Depth: 0-2'

**R.W. Gillespie  
 &  
 Associates, Inc.**

Client: Gulf of Maine Aquarium  
 Project: Research Facility

Project No: 235-741

Sample No. 6589E

GSM