Coastal and Social Resiliency Initiatives for the Tottenville Shoreline: Living Breakwaters and Tottenville Shoreline Protection Projects

STATEN ISLAND, RICHMOND COUNTY, NEW YORK

Revised Phase 1A Archaeological Documentary Study

Prepared for:

Governor's Office of Storm Recovery
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Management Summary

SHPO Project Review Number:	15PR00618
Involved Agencies:	Governor's Office of Storm Recovery New York State Homes and Community Renewal's Housing Trust Fund Corporation U.S. Department of Housing and Urban Development
Phase of Survey:	Phase 1A Documentary Study
Location Information	
Location:	Staten Island, New York
Minor Civil Division:	08501
County:	Richmond County
Survey Area	
Length:	Approximately 3,050 meters (10,000 feet)
Width:	Approximately 430 meters (1,400 feet)
Breakwaters APE Area:	230.72 acres
Shoreline APE Area (including Water Hub Potential Location 1):	36.39 acres
Water Hub Potential Location 2 APE Area:	7.15 acres
Shoreline Restoration Area:	3.8 acres (1.31 acres above mean high water)
USGS 7.5 Minute Quadrangle Map:	Arthur Kill
Report Author:	Elizabeth D. Meade, MA, RPA
Date of Report:	May 2017

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Chapter 1: Introduction and Project Description

A. INTRODUCTION

On behalf of the State of New York, the Governor's Office of Storm Recovery (GOSR)—serving under the auspices of the New York State Homes and Community Renewal's Housing Trust Fund Corporation, and acting under authority of the U.S. Department of Housing and Urban Development's (HUD) regulations at 24 CFR Part 58, and in cooperation with other involved, cooperating, interested agencies—is proposing initiatives (Proposed Actions) intended to enhance coastal and social resiliency along the Tottenville shoreline of the South Shore of Staten Island, NY (see **Figure 1**). These initiatives include the Living Breakwaters Project (Breakwaters Project) and the Tottenville Shoreline Protection Project (Shoreline Project). The proposed Breakwaters and Shoreline Projects are located along the southwestern coast of Staten Island (see **Figures 2** and **3**). The project sites included in this analysis are located in close proximity but outside of the mapped boundaries of the Ward's Point Archaeological Conservation Area, an archaeological historic district that is listed on the National Register of Historic Places and is also a National Historic Landmark.[1]

Staten Island is exposed to extreme wave action and coastal flooding during hurricanes and other severe storm events due to its location at the mouth of the New York Bight, which funnels and increases the intensity of storm-driven waves into New York Harbor, Raritan Bay, and the shoreline of Staten Island. The south shore of Staten Island is also vulnerable to event-based and gradual coastal erosion and land loss. On October 29, 2012, Superstorm Sandy approached New York City with tropical-storm-force winds, resulting in significant erosion in the vicinity of the proposed project sites, including at the area's protective bluffs and along the shoreline areas with already narrow beach conditions.

Consistent with the City's Coastal Protection Initiatives and planning studies for the Tottenville area, the goal of the Breakwaters and Shoreline Protection Projects is to reduce wave action and coastal erosion along the shoreline in Tottenville while enhancing ecosystems and shoreline access and use. This goal would be achieved using a layered approach that would address wave action, impacts of coastal flooding and event-based (i.e., short-term/storm-related) and gradual (long-term) shoreline erosion, while restoring and enhancing ecosystems, improving waterfront access and engaging with the community through educational programs directly related to the coastal resiliency actions. It is highly important that the actions provide both coastal protection and ecological enhancement, and at the same time serve as a means to engage and educate the public on local ecosystems and innovative coastal resiliency strategies in an era increasingly affected by climate change.

Specifically, the goals and objectives related to the proposed projects' purpose pertain to 1) risk reduction—attenuating wave energy, addressing both event-based and long-term shoreline erosion/preserving beach width, and addressing impacts of coastal flooding; 2) ecological enhancement—increasing diversity of aquatic habitats; and 3) social resiliency—fostering community education,

[1] The boundaries of the conservation area are not reproduced in this report to protect known locations of archaeological sensitivity.

increasing access to the water's edge enhancing community stewardship of local ecosystems and increasing access to recreational opportunities.

This Phase 1A Archaeological Documentary Study has been designed to assess the potential archaeological sensitivity of those locations that would be impacted by the construction of the Proposed Actions. This chapter, **"Chapter 1, Introduction and Project Description"** describes the Proposed Actions, summarizes the laws and regulations that apply to the project, identifies all involved agencies, and outlines the steps that have been taken thus far to meet all relevant environmental review requirements. In **Chapter 2, "Research Goals and Methodology**," the goals of this investigation are outlined and the methods that were used to satisfy those goals are summarized. **Chapter 3, "Previous Cultural Resources Investigations in the Vicinity"** summarizes the results of previous archaeological investigations that have occurred in the vicinity, including many within the limits of Conference House Park that resulted in the identification of archaeological sites. A review of these archaeological investigations was used to help inform this Phase 1A study. The landscape of the Project sites—including geology, topography, hydrology, soils, and current conditions—are summarized in **Chapter 4, "Environmental and Physical Settings**." **Chapter 5, "Precontact Period,"** provides a context for the Native American occupation of southwestern Staten Island and includes a synthesis of known information regarding archaeological sites in the region. **Chapter 6, "Geomorphological Analysis of the Bay Floor** presents the results of the geomorphological analysis of the floor of the Raritan Bay in the location of the proposed Breakwaters. **Chapter 7, "The Historic Period"** includes a summary of the historic period occupation and development of the project location, including a summary of map-documented structures within and in the vicinity of the project location. Finally, **Chapter 8, "Conclusions and Recommendations,"** presents a summary of documented disturbance, an assessment of the precontact and historic sensitivity of the APE, and recommendations for additional archaeological analysis where necessary.

B. PROJECT BACKGROUND

The implementation of the proposed Breakwaters and Shoreline Protection Projects may involve federal, state, and local approvals, and is subject to review under the National Environmental Policy Act (NEPA) and the New York State Environmental Quality Review Act (SEQRA) and their implementing regulations. In addition, the Proposed Actions are subject to Section 106 of the National Historic Preservation Act of 1966. GOSR is serving as lead agency for the environmental review. The Federal, State, and City agencies that may potentially be involved in the environmental review and permitting process for the Proposed Actions include the United States Department of Housing and Urban Development (HUD); the United States Army Corps of Engineers (USACE); the Environmental Protection Agency (EPA); the United States Coast Guard (USCG); the Federal Emergency Management Agency (FEMA); New York State Department of Environmental Conservation (NYSDEC); the New York State Department of State (NYSDOS); the New York State Office of Parks, Recreation, and Historic Preservation (OPRHP); the New York State Office of General Services (NYSOGS); the New York City Department of Parks and Recreation (NYCDPR); the New York City Department of Environmental Protection (NYCDEP); the New York City Planning Commission (NYCPC); the New York City Public Design Commission (NYCPDC); the New York City Department of Buildings (NYCDOB); and the New York City Department of Transportation (NYCDOT).

The Breakwaters and Shoreline Protection Projects each have independent utility, but both would be located in the same geographic region. The two projects would largely be funded through New York State's Community Development Block Grant-Disaster Recovery (CDBG-DR) grant program. Additional project funding would be leveraged as required by HUD for RBD projects.In addition to geographic location, the projects share certain synergies in terms of purpose and need, and design, and would

combine to create a layered approach to shoreline resilience within the study area. Thus, there is strong rationale for designing and implementing the Breakwaters and Shoreline Projects through one integrated planning process to improve coastal resiliency along Staten Island's south shoreline. To facilitate a thorough examination of cumulative effects and synergies between the projects, GOSR has determined that they should be analyzed as part of the same environmental review and a single Draft Environmental Impact Statement (DEIS) has been prepared for both projects.

An Environmental Impact Statement Final Scope of Work for the DEIS was issued in April 2016. As described in that document, the Project sites are located in areas of known archaeological sensitivity, and the archaeological sensitivity of a portion of the current Shoreline Protection Project site was previously analyzed in a Phase 1A Archaeological Documentary Study prepared for Conference House Park by archaeologist Arnold Pickman in 1997 (discussed in greater detail in **Chapter 3, "Previous Cultural Resources Investigations in the Vicinity"**). The Final Scope of Work therefore stated that a Phase 1A Archaeological Documentary Study would be completed to supplement Pickman's 1997 archaeological assessment and to determine if its conclusions are still valid with respect to the specific impacts of the Proposed Actions. An investigation of the bay floor was also determined to be necessary to ensure that the construction of the proposed Breakwaters Project would not impact any maritime archaeological resources (e.g., shipwrecks) or submerged prehistoric landforms with the potential to contain archaeological resources. A Draft Phase 1A was issued in October 2016 to satisfy the archaeological resources analysis tasks as outlined in the Final Scope of Work. Since the issuance of the October 2016 Phase 1A, an additional potential location for the Water Hub was included as part of the Breakwaters Project and analyzed in the DEIS that was published in March 2017. This revised Phase 1A has been amended to include an analysis of this additional potential location[1].

C. PROPOSED PROJECT DESCRIPTION

The DEIS analyzes a reasonable range of project alternatives. This Phase 1A Study focuses on Alternative 2 (Preferred Alternative) which reflects implementation of both the Living Breakwaters Project and the Tottenville Shoreline Protection Project.

PROJECT SETTING: CONFERENCE HOUSE PARK

Portions of the proposed project site—including most of the Shoreline APE—is situated within Conference House Park, a 265-acre park that contains four historic houses; a playground; a visitors center; paths and hiking trails; natural areas and beaches; and the "South Pole" marking the southernmost point of New York State. The southern portion of the park includes the Shoreline APE and contains woodland and meadow areas, walking trails, seating areas, temporary sand dunes, and roadways. The park was established in the immediate vicinity of the Conference House, a 17th century structure, in 1926 and was expanded in later years (Conference House Association 2016). While the park itself has not been identified as a historic resource, it contains several properties that have been identified as historically significant. The most notable of these is the Conference House itself, which is located at 7455 Hyland Boulevard and is also known as the Christopher Billopp House. The house was constructed in the 1680s and as described in **Chapter 7: The Historic Period**, was the site of failed peace talks during the Revolutionary War. The Conference House is a National Historic Landmark (NHL), a New York City Landmark (NYCL), and it is listed on the State and National Registers of Historic Places (S/NR). The park also contains several historic homes: the circa 1845 Henry Hogg Biddle House, (NYCL, S/NR-

[1] While the DEIS describes a possible water access option at the location of the existing Conference House Park pavilion, this option was eliminated from further consideration subsequent the issuance of the DEIS, and therefore it is not included in the analysis presented in this revised Phase 1A.

eligible); the circa 1850 Rutan-Beckett House (S/NR-eligible); and the circa 1830 Ward House, also known as the Sam and Hannah Woods House (S/NR-eligible) (City of New York Parks & Recreation n.d.).

LIVING BREAKWATERS PROJECT

IN-WATER COMPONENTS

One of the key components of the Breakwaters Project is an ecologically enhanced breakwater system designed to reduce wave energy at the shoreline, and prevent or reverse shoreline erosion while creating hard/structured marine habitat. The breakwater system as currently proposed (30 percent design) would have a total length of approximately 3,900 linear feet within Raritan Bay and would be located between 500 and 2,100 feet from the shoreline. (see **Figure 2**). The breakwaters would be positioned and designed to optimize reduction in both wave height and shoreline erosion, while enhancing habitat and minimizing habitat displacement and navigational impacts. The breakwater system will be located on the existing bay floor elevation and its construction will not require any dredging, anchoring devices, or piles.

The proposed breakwaters system would increase habitat diversity through the establishment of structural habitat, which is currently limited within Raritan Bay. The breakwater structures have been designed to have varying levels of elevation, inclination, bio-enhancing materials, textures, interstitial spaces, and grain sizes in order to create a diversity of habitat characteristics for aquatic biota. The breakwaters would be primarily constructed as rubble mound (rock) structures with a bedding layer, stone core and outer layers consisting of armor stone or bio-enhancing concrete armor units. In the subtidal and intertidal areas, up to one third of the armor stone would be bio-enhancing concrete units rather than stone, creating an "enhanced" habitat surface. The Breakwaters would also help to protect the proposed shoreline protection system described below.

The Breakwaters project will also include an area of shoreline restoration, where sand will be placed to restore the historic shoreline between Loretto Street and Manhattan Street, downdrift (southwest) of the outfall at Loretto Street. Building the beach in this location will have the most benefit in the vicinity of elements of the proposed Shoreline Project (see below), and where the beach is currently narrow and has experienced high rates of historic erosion (around 2 feet per year between 1978 to 2012). The proposed area of shoreline restoration would extend along approximately 806 feet of shoreline in a 3.8-acre area; approximately 2 acres would be below the level of high tide. This one-time placement of sand would approximate the historic 1978 shoreline position, augment the accretion potential that can be provided by the breakwaters and add sediment to the overall system, particularly contributing to one of the narrowest and most erosion-prone areas of beach in the site and generally enhancing overall beach growth potential.

ON-SHORE COMMUNITY WATER HUB/WATER ACCESS AND LANDSCAPE ELEMENTS

On-shore elements associated with the Living Breakwaters project would include the construction of a Water Hub and waterfront access points within Conference House Park. While the exact depth of the impacts is not yet known, it is presumed that the construction of these features will involve excavation and in-ground disturbance.

With the goal of promoting social resiliency, the proposed community Water Hub would provide access to the waterfront, orientation, education, information on shoreline resiliency, community gathering space, and equipment storage. In particular, the Water Hub programming could include classrooms and labs, engaging schools in waterfront education, citizen's science, oyster restoration and reef building, and cultivating long-term estuary stewardship. In addition to ecological engagement, the Water Hub facilities and programs are intended to educate residents on the risks and benefits of living in a coastal environment

and to build awareness, preparedness and stewardship within the community. The Water Hub may also include other elements, such as exhibition space, maintenance-related storage space and offices, and terrace space.

While the exact location has yet to be determined, two potential locations for the Water Hub are currently proposed. Water Hub Potential Location 1 is situated on the waterfront within Conference House Park at the southern end of Page Avenue. Water Hub Potential Location 2 is located in the northern portion of Conference House Park, where one of two historic houses currently under consideration would be adaptively reused for Water Hub programming. The two houses currently under consideration include the Henry Hogg Biddle House at 70 Satterlee Street (within Block 7966, Lot 75) and the Rutan-Beckett House, located at the western terminus of the build portion of Shore Road within a roadway easement that extends between Block 7966 Lot 75 and Block 7587, Lot 100. The Biddle House was constructed in the early 1850s[1] and is a New York City Landmark and is eligible for listing on the State and National Registers of Historic Places (S/NR). The Rutan-Beckett House was constructed circa 1848 and is also S/NR-eligible.. Should Water Hub programming be located at Potential Location 2, a small facility to provide seating, wayfinding and potential storage for kayaks and beach cleaning equipment would be constructed near the terminus of Page Avenue.

Both Potential Locations 1 and 2 would include access to the water. If sited near either the Biddle House or Rutan-Beckett house, water access would be provided with Americans with Disabilities Act (ADA) accessible pathways and ramps from the grounds of the house to the beach area, and a seasonally deployed temporary floating boat launch to the water.

TOTTENVILLE SHORELINE PROTECTION PROJECT (NY RISING COMMUNITY RECONSTRUCTION PROGRAM)

The Shoreline Project has been designed to respond to the changing character of the shoreline between approximately Carteret Street and Page Avenue. This includes a series of risk reduction measures including an earthen berm, a hybrid dune system, an eco-revetment, and a raised edge (revetment with trail), wetland enhancement and planting of native coastal plant species ADA-accessible pathways, access points and overlooks would be constructed along the shoreline protection system. As proposed in the current design concept, the area between Carteret Street and Brighton Street would include an earthen berm that would serve as a tie-in to a reinforced, planted dune system proposed from approximately Brighton Street to Loretto Street. The hardened dune system would be constructed with a stone core and sand cap.

At approximately Loretto Street, the proposed dune system would transition to an eco-revetment along Surf Avenue out to approximately Sprague Avenue. The proposed eco-revetment would then tie-in to of the proposed raised edge (revetment with trail) out to approximately Page Avenue. As mentioned above, various shoreline treatments including wetland enhancement and shoreline plantings may be proposed in locations along the entire stretch of shoreline from approximately Carteret Street to approximately Page Avenue.

Temporary dunes, constructed by the New York City Department of Parks and Recreation (NYCDPR) as interim protective measures post-Sandy, are currently in place from approximately Swinnerton Street to

[1] The LPC Landmark Designation Report for the Biddle House identifies its year of construction as the "late 1840s" (Zavin 1990: 1). Information provided by SHPO in an eligibility determination issued on DATE indicates that the home was constructed circa 1845 and an architectural survey of Tottenville completed by Shepherd, et al. in 2011 also suggests that the home was constructed in the late 1840s. However, as noted later in this study, the home does not appear on historic maps until between circa 1853 and 1856 and it therefore appears to date to circa 1853, which is supported by the research presented in Pickman (1997) and completed as part of this Phase 1A study.

Sprague Avenue. These temporary dunes would be replaced with the shoreline elements proposed along this stretch.

D. DELINEATION OF AREAS OF POTENTIAL EFFECT AND SECTION 106 CONSULTATION

2013 PROGRAMMATIC AGREEMENT

In May 2013—following to the damage caused by Superstorm Sandy and the development plans to redevelop damaged areas—a Programmatic Agreement (PA) was executed among the Federal Emergency Management Agency (FEMA), SHPO, the New York State Office of Emergency Management, the Delaware Nation, the Delaware Tribe of Indians, the Shinnecock Nation, the Stockbridge-Munsee Community Band of Mohicans, LPC, and ACHP. This Programmatic Agreement ensures that Federal disaster assistance programs in the State of New York are administered in accordance with certain stipulations to satisfy FEMA's Section 106 responsibilities. Other Federal agencies providing financial assistance for the type of disaster assistance programs covered by the Agreement may—with the concurrence of ACHP, FEMA, and SHPO—satisfy their Section 106 responsibilities by accepting and complying with the terms of the Agreement. Appendix D to the Programmatic Agreement specifically addresses the effects of undertakings and Section 106 responsibilities for the CDBG-DR program for activities in New York City.

PHASE 1A ARCHAEOLOGICAL DOCUMENTARY STUDY

This Phase 1A Archaeological Documentary Study of the Breakwaters and Shoreline Protection projects has been prepared as part of the EIS. The archaeological Areas of Potential Effect (APE) for both the Breakwaters and Shoreline Protection Projects as defined in this study include the maximum possible extent of the subsurface disturbance associated with both projects (see **Figures 2** and **3**). The APEs were initially defined in consultation with OPRHP, acting in its capacity as the New York State Historic Preservation Office (SHPO, Project Review Number 15PR00618). In comments submitted through the New York State Cultural Resources Information System (CRIS) on September 11, 2015, SHPO concurred with the APEs as originally defined at that time. The APEs were also approved by the New York City Landmarks Preservation Commission (LPC) in a comment letter dated September 10, 2015. Since that consultation occurred, the project design was advanced further, resulting in the refinement of the APEs for both the Breakwaters and Shoreline Protection Projects. While the Shoreline APE has remained largely the same, the Breakwaters APE is now significantly smaller (and is entirely included within the APE originally defined and approved by SHPO and LPC).

Pursuant to the Section 106 process, in addition to SHPO, other consulting parties were contacted regarding the proposed projects. These consulting parties included the LPC, and Tribal Nations representing Richmond County, including the Delaware Nation, the Delaware Tribe of Indians, the Shinnecock Nation, and the Stockbridge-Munsee Community Band of Mohicans (SMCBM). Each potential consulting party was provided with maps depicting the APEs as originally proposed, along with the Draft Scope of Work for the DEIS that was issued on April 1, 2015.

In a comment letter dated February 9, 2015, LPC requested that a Phase 1A Archaeological Documentary Study of the Breakwaters and Shoreline APEs be prepared to assess the site's potential to contain archaeological resources associated with the precontact occupation of the area. Of the Tribal Nations that were contacted. In a comment letter dated August 20, 2015, Bonney Hartley, the Tribal Historic Preservation Officer (THPO) for SMCBM, stated that they wished to serve as a consulting party for the projects and that they concurred with the proposed draft Scope of Work for the DEIS. SMCBM also

provided a "Policy for Treatment and Disposition of Human Remains and Cultural Items that May be Discovered Inadvertently During Planned Activities" and requested that the protocols outlined therein be incorporated into any archaeological testing plans that may be prepared subsequent to the preparation of this Phase 1A Archaeological Documentary Study. Comments were not received from the other Tribal Nations at that time, although the Delaware Tribe of Indians expressed their intention to review the draft Phase 1A study.

A draft of the Phase 1A Archaeological Documentary Study was submitted to the consulting parties in October 2016. In comments transmitted on October 20, 2016, the SMCBM concurred with the conclusions and recommendations of the Draft Phase 1A; comments were not received from the other Tribal Nations consulted. In a comment letter dated October 26, 2016, LPC concurred with the conclusions and recommendations of the draft Phase 1A study. In a comment letter dated November 1, 2016, SHPO concurred with the conclusions and recommendations of the draft Phase 1A study and also requested minor revisions to the draft. Following the submission of the Draft Phase 1A to the consulting parties, the proposed project design was revised to include an additional potential location for the Water Hub Potential Location 2 Archaeological APE. This additional potential location was analyzed in the DEIS that was published in March 2017. Section 106 consultation letters were subsequently transmitted to the consulting parties in connection with the issuance of the DEIS, including notification of the additional potential location and the need to include the new location in a revised Phase 1A. In response, the Delaware Nation also expressed an interest in consulting on the project in the future.

This revised Phase 1A Archaeological Documentary Study therefore reflects SHPO's comments on the October 2016 Draft Phase 1A and reflects the changes to the project site's design described above.

This revised and a final version of the Phase 1A will be submitted to SHPO, LPC, and the Tribal Nations for review and comment.

Chapter 2: Research Goals and Methodology

A. RESEARCH GOALS

The Phase 1A Archaeological Documentary Study of the Breakwaters APE, the Shoreline APE, and the Water Hub Potential Location 2 APE has been designed to satisfy the requirements of the LPC and the SHPO, while also following the guidelines of the New York Archaeological Council (NYAC). The study documents the development history of the proposed Project sites and their potential to yield archaeological resources, including both precontact and historic cultural resources. In addition, this report documents the current conditions of the Breakwaters and Shoreline APEs, as well as previous cultural resource investigations that have taken place in the vicinity.

This Phase 1A Archaeological Documentary Study has four major goals: (1) to determine the likelihood that the Breakwaters APE, the Shoreline APE, and the Water Hub Potential Location 2 APE were occupied during the precontact (Native American) and/or historic periods; (2) to determine the effect of subsequent development and landscape alteration on any potential archaeological resources that may have been located within the three APEs; (3) to make a determination of the APEs' potential archaeological sensitivity; and (4) to make recommendations for further archaeological analysis, if necessary. The steps taken to fulfill these goals are explained in greater detail below.

The first goal of this documentary study is to determine the likelihood that the APEs were inhabited during the precontact or historic periods, and identify any activities that may have taken place in the vicinity that would have resulted in the deposition of archaeological resources.

The second goal of this Phase 1A study is to determine the likelihood that archaeological resources could have survived intact within the APEs after development and landscape alteration (i.e., erosion, grading, filling, etc.). Potential disturbance—associated with paving, utility installation, and other previous construction impacts—was also considered. As described by NYAC in their Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State, published in 1994 and subsequently adopted by SHPO:

> *An estimate of the archaeological sensitivity of a given area provides the archaeologist with a tool with which to design appropriate field procedures for the investigation of that area. These sensitivity projections are generally based upon the following factors: statements of locational preferences or tendencies for particular settlement systems, characteristics of the local environment which provide essential or desirable resources (e.g., proximity to perennial water sources, well-drained soils, floral and faunal resources, raw materials, and/or trade and transportation routes), the density of known archaeological and historical resources within the general area, and the extent of known disturbances which can potentially affect the integrity of sites and the recovery of material from them* (NYAC 1994: 2).

The third goal of this study is to make a determination of the APEs' archaeological sensitivity. As stipulated by the NYAC standards, sensitivity assessments should be categorized as low, moderate, or high to reflect "the likelihood that cultural resources are present within the project area" (NYAC 1994: 10). For the purposes of this study, those terms are defined as follows:

- Low: Areas of low sensitivity are those where the original topography would suggest that Native American sites would not be present (i.e., locations at great distances from fresh and salt water resources), locations where no historic activity occurred before the installation of municipal water and sewer networks, or those locations determined to be sufficiently disturbed so that archaeological resources are not likely to remain intact.
- Moderate: Areas with topographical features that would suggest Native American occupation, documented historic period activity, and with some disturbance, but not enough to eliminate the possibility that archaeological resources are intact on the Project sites.
- High: Areas with topographical features that would suggest Native American occupation, documented historic period activity, and minimal or no documented disturbance.

As mentioned above, the fourth goal of this study is to make recommendations for additional archaeological investigations where necessary. According to NYAC standards, Phase 1B testing is generally warranted for areas determined to have moderate sensitivity or higher. Archaeological testing is designed to determine the presence or absence of archaeological resources that could be impacted by a proposed project. Should they exist on the Project sites, such archaeological resources could provide new insight into the precontact occupation of the southern tip of Staten Island, the transition from Native American to European settlement, or the historic period occupation of the Project sites.

B. METHODOLOGY

DOCUMENTARY RESEARCH

To satisfy the four goals as outlined above, documentary research was completed to establish a chronology of the APEs' development, landscape alteration, and to identify any individuals who may have owned the land or worked and/or resided there, and to determine if buildings were present there in the past. Data was gathered from various published and unpublished primary and secondary resources, such as historic maps, topographical analyses (both modern and historic), historic and current photographs (including aerial imagery), newspaper articles, local histories, and previously conducted archaeological surveys. These published and unpublished resources were consulted at various repositories, including the Main Research Branch of the New York Public Library (including the Local History and Map Divisions). File searches were conducted at LPC, SHPO, and the New York State Museum (NYSM). Information on previously identified archaeological sites and previous cultural resources assessments was accessed through the New York State Cultural Resource Information System (CRIS).[1] Online textual archives, such as Google Books and the Internet Archive Open Access Texts, were also accessed. Historic coastal charts published by the United States Coastal and Geodetic Survey were accessed through the digital map archive of the National Oceanic Atmospheric Administration.[2]

As described in **Chapter 3, "Previous Cultural Resources Investigations in the Vicinity**," the majority of the Shoreline APE was previously analyzed in a Phase 1A Archaeological study of Conference House Park that was prepared by archaeologist Arnold Pickman in 1997. Due to the fact that the report was prepared nearly 20 years ago, the areas studied by Pickman were reevaluated as part of this archaeological investigation. Modern advancements in mapping technology and geographic information systems (GIS) were used to more thoroughly analyze the topographic changes and erosion that have altered the waterfront areas in this portion of Staten Island. This effort was largely based on the georeferencing of

[1] https://cris.parks.ny.gov

[2] http://www.nauticalcharts.noaa.gov/csdl/ctp/abstract.htm

topographical surveys of the APEs that were produced by the Richmond County Topographical Bureau in 1909 and 1911 (see **Figure 4**).[1] The maps were aligned with the modern street grid so that analysis could be completed with respect to changes in the elevation/topography of the landscape; filling in or other modification of marshes and streams; the recession and expansion of the shoreline as a result of tidal activity; and the extent to which the construction of both historic and modern structures (including residences, recreational facilities, and waterfront structures such as docks, piers, and wharves) affected the landscapes. In addition, disturbance that may have occurred since Pickman's report was prepared—especially that resulting from the intense flooding experienced in southern Staten Island during Hurricane Irene in August 2011 and Superstorm Sandy in October 2012—has also been assessed in this analysis. Pickman's extensive research has been incorporated into this report as necessary. After identifying the likelihood that archaeological resources were deposited within the APEs and the likelihood that they could remain intact given subsequent development, erosion, and landscape alteration, a sensitivity determination was made for APEs for both precontact and historic period resources.

GEOMORPHOLOGICAL INVESTIGATION

As described in greater detail in **Chapter 6, "Geomorphological Analysis of the Bay Floor**,**"** the in-water portion of the Project sites was included within the study area of the New York and New Jersey Harbor Navigation Project, a large archaeological investigation completed by Geoarcheology Research Associates (GRA) in conjunction with Hunter Research, Inc. within New York Harbor in 2014. That study concluded that the location of the Breakwaters APE was highly sensitive for deeply buried submerged archaeological sites (GRA 2014).

In October 2015, as part of the proposed Living Breakwaters project design, a geo-bore soil boring program was completed within the Raritan Bay. Because of GRA's identification of this portion of the Bay as highly sensitive, it was determined that the geotechnical borings should be monitored by a geoarchaeologist to determine if potentially archaeologically sensitive terrestrial landforms or other intact archaeological resources have survived within the proposed Project sites. A total of 20 borings ranging between approximately 60 and 150 feet in depth were completed as part of the geotechnical investigation.

The borings were monitored by Kerry J. Lynch, Ph.D., a project archaeologist and geomorphologist with Archaeological Services at the University of Massachusetts Amherst. Dr. Lynch observed the borings from the drilling barge and monitored the cores, photographed sediments, and collected samples for off-site laboratory analysis. The laboratory analysis included macro-stratigraphic descriptions, fine screening/flotation of deposits that have potential to contain archaeological deposits, C-14 dating, and select botanical analysis. The results of Dr. Lynch's analysis are presented in **Chapter 6, "Geomorphological Analysis of the Bay Floor,"** and the final technical report summarizing this analysis is included as **Appendix A**.

[1] The survey covering all of Staten Island was completed between 1906 and 1913; however, the sheets that cover the APEs were issued in 1909 and 1911. When referring to specific locations within the APEs, the date of the sheet covering that location will be cited in this report.

Chapter 3: Previous Cultural Resources Investigations in the Vicinity

A. INTRODUCTION

This chapter discusses previous cultural resources assessments that have been prepared for terrestrial locations in southwestern Staten Island. The previously referenced geomorphological investigations of the submerged bay floor that were conducted by GRA in 2014 and UMASS in 2015 are discussed in greater detail in **Chapter 6, "Geomorphological Analysis of the Bay Floor,"** and are not addressed in this chapter. Portions of the Shoreline APE were previously analyzed as part of several previous archaeological assessments. The results of these investigations are summarized below. The majority of these studies have focused on the site of the Conference House and the area immediately surrounding it (e.g., Baugher, et al. 1991). For the purposes of this investigation, the summaries below only include those studies that were situated in the areas of Conference House Park immediately adjacent to the Shoreline and Breakwaters APEs along the Raritan Bay waterfront, or within the adjacent bay.

B. ARCHAEOLOGICAL INVESTIGATION OF CONFERENCE HOUSE PARK (1997)

In November 1997, archaeologist Arnold Pickman completed an extensive Phase 1A Archaeological Documentary Study of Conference House Park, including the majority of the Shoreline APE (Pickman 1997). This extensive report covered the 227-acre park in its entirety, and therefore assessed the archaeological sensitivity of the majority of the landward portion of the Ward's Point area. Pickman researched the park's precontact and historic period occupation and provided a thorough summary of the park's development, and also included census and historic deed research to document the area's historic owners and occupants. In the vicinity of the Shoreline APE, the report concluded that, with the exception of one small area, the entire beachfront area of Conference House Park along the Raritan Bay—including the now-submerged Ward's Point—was not archaeologically sensitive due to extensive erosion caused by tidal action. Pickman identified a small area of moderate archaeological sensitivity along the waterfront between a mapped—but not constructed—road referred to as "Low Street" and Page Avenue. Historic topographical maps identified this area as an elevated knoll and Pickman determined that it may therefore not have been subject to the same destructive tidal action that formed and re-shaped the beaches elsewhere along the Raritan Bay waterfront. Pickman identified areas of high archaeological sensitivity within the Ward's Point Archaeological Conservation Area—the upland bluffs that line the shores of the Arthur Kill, in the location of the Water Hub Potential Location 2 APE.

C. SUPPLEMENTAL TESTING WITHIN CONFERENCE HOUSE PARK (2004 AND 2005)

Archaeological testing occurred within portions of Conference House Park and was summarized in a report prepared by John Milner Associates, Inc. (JMA) in 2004. This testing occurred in the northwestern portion of the park, in the vicinity of Billop Ridge and the Conference House; along the southern side of Clermont Avenue between Massachusetts Street and Swinnerton Street (referred to in the report as "Area G1," the location of a proposed fence); and in an area northwest of the intersection of Swinnerton Street

and Billop Avenue (referred to in the report as "Area D1," the location of what is now the Lenape Playground), north of the proposed Shoreline APE. Dense shell deposits possibly representing the intact remnants of previously reported shell middens were observed beneath fill materials and a plow zone to the east and south of the Conference House (JMA 2004). However, testing in Areas D1 and G1 determined that the areas were disturbed and did not contain archaeological resources. An additional Phase 1B investigation of an area within the park was completed by JMA in 2005. This testing was focused on the sites of the Biddle House (a New York City Landmark) and the Wood/Leven House, both of which are located to the north of the Conference House within the park (JMA 2005).

D. SOUTH RICHMOND DRAINAGE/CONFERENCE HOUSE PARK WATERSHED ARCHAEOLOGICAL INVESTIGATION

Several archaeological investigations were completed in connection with the South Richmond Drainage/Conference House Park Watershed project, which was proposed to install new stormwater drainage infrastructure within many of the streetbeds in and around Conference House Park. A Phase 1A Archaeological Documentary Study of the site was completed by Historical Perspectives, Inc. (HPI) in 2001. The Phase 1A concluded that the project site had very high archaeological potential, but that disturbance as a result of historic and modern development had reduced the archaeological sensitivity of portions of the site. HPI concluded that the paved streets surrounding the park and the locations of two proposed Best Management Practice (BMP) stormwater infrastructure locations (referred to in the report as "BMP CHP-1" and "BMP CHP-2") had high precontact archaeological sensitivity (HPI 2001). No portion of the project site was identified as potentially sensitive for historic period archaeological resources (ibid).

In 2003, HPI completed a Phase 1B archaeological investigation of the sites of proposed BMPs CHP-1 and CHP-2 near the area bounded roughly by Clermont Avenue, Finlay Street, and Billop Avenue, to the north of the proposed Shoreline APE. This site is in the vicinity of the existing stream that runs through the park south of Finlay Street (discussed in greater detail in **Chapter 4, "Environmental and Physical Settings"**), which historically continued to the south through the westernmost portion of the Shoreline APE and drained into the Raritan Bay. The site was identified as having high sensitivity for precontact archaeological resources and no sensitivity for resources dating to the historic period. A site walkover resulted in the identification of "shell outcroppings…in wetland areas surrounding the stream or within the streambed" (HPI 2003: 3). The testing that HPI conducted revealed extensive disturbance, particularly in close proximity to the wetland areas. Some precontact artifacts were recovered through the testing, although HPI speculated that those artifacts were transported to the site and "redeposited by natural forces of alluviation from nearby areas" (ibid: 19). An area of archaeological sensitivity was designated within the project site in an elevated area at a distance from the disturbed streambed. HPI recommended that a barrier be installed to protect the archaeologically sensitive area from future grading or other disturbance (ibid).

HPI later completed Phase 1B and Phase 2 archaeological surveys as well as a Phase 3 investigation of the streetbed segments that had been identified as archaeologically sensitive in the 2001 Phase 1A (HPI 2006). In the immediate vicinity of the Shoreline APE, HPI's testing was located within the streetbed of Swinnerton Street between Clermont and Billop Avenues and within Clermont Avenue between Massachusetts and Main Streets. Shell fragments and fire-cracked rock were observed in testing locations near the western end of the testing area along Clermont Avenue; however, no intact features were observed. Similarly, shell deposits and fire-cracked rock were observed in a single test pit at the southern end of the Swinnerton Street testing area; no features were observed. Additional archaeological investigation was not recommended for either location. The testing did result in the identification of two archaeological sites further north within Conference House Park: the Satterlee Street Locus 2/Billops

Ridge site, a deeply stratified precontact site, and the Fence Line site, near the intersection of Hyland Boulevard and Massachusetts Street, which marked a fence location associated with the historic occupation of the Conference House (HPI 2006).

E. SURFSIDE VILLAGE

In 1987, Pickman prepared a Phase 1A Archaeological study of and subsequently conducted Phase 1B testing on the site of the proposed Surfside Village Development Project. The site was located on the block bounded by Hylan Boulevard, Sprague Avenue, Loretto Street, and Clermont Avenue, to the north of the proposed Shoreline APE. The site was identified as sensitive for archaeological resources dating to both the precontact and historic periods (Pickman 1987a). The Phase 1B survey resulted in the identification of precontact and historic period archaeological resources, however, all artifacts were observed within disturbed contexts and no additional investigation was recommended (Pickman 1987b).

F. BLOCK 7906; TOTTENVILLE, STATEN ISLAND (1987)

In 1987, Key Perspectives completed archaeological testing within numerous lots on Block 7906, which is immediately north of the Shoreline APE in the area bounded by Clermont and Billop Avenues and Swinnerton and Main Streets. The testing determined that the area that was investigated did not contain intact archaeological resource dating to either the precontact or historic periods (Key Perspectives 1987).

A. GEOLOGY AND TOPOGRAPHY

The geographic province in which the project area is situated is known as the Atlantic Coastal Plain (Isachsen, et al 2000). The island's physical setting was shaped by massive glaciers up to 1,000 feet thick which retreated from the area toward the end of the Pleistocene. There were four major glaciations that began approximately 17,000 years ago and lasted until roughly 12,000 years ago when the Wisconsin period—the last glacial period—came to an end. During the Wisconsin ice age, a glacial moraine known as the "Terminal Moraine" traveled southwest across Staten Island. The progression of the Terminal Moraine resulted in the separation of the Atlantic Coastal Plain from the remainder of Staten Island to the northwest, which is characterized by hard bedrock rather than glacial deposits (Reeds 1925). As temperatures increased and the ice melted, sea levels rose by approximately 300 feet.

The southern coastline of Staten Island is subject to steady, often harsh tidal action that has dramatically reworked the landscape over the last few centuries. The shoreline was described as follows by Staten Island historians Leng and Davis in 1930:

> *Sand beaches occur all along the shores that are directly exposed to the waves; the greatest accumulation of sand is on the shore of the Lower Bay from South Beach to Ward's Point, Tottenville. These sands have originally resulted from the disintegration of rocks and have been carried by water down rivers emptying into the bays, and have also resulted in part from the direct disintegration of the coasts. The action of the currents in the Lower Bay, and the streams flowing into it, carries the sand along the coat until finally it is driven up on the beaches. The beaches thus formed are, however, not stable, but on the contrary are subject to constant change* (Leng and Davis 1930: 23).

The APEs were included within an extensive survey of Staten Island that was completed between 1909 and 1911 by the Richmond County Topographical Bureau (see **Figure 4**). The survey depicts the majority of the upland area of the Shoreline APE as a gently sloping beach that led down to the water from a maximum elevation of 6 to 8 feet above the Richmond Borough Datum.[1] Portions of the waterfront, particularly near the western end of the proposed Shoreline APE, were extensively marshy and divided by small streams that drained inland areas out into the Bay to the south. The coastline was generally similar to that seen today, although the reshaping of the coast by tidal action described above resulted in a recession of the coastline that is clearly visible across large areas. Ward's Point, a small peninsula that originally extended west from the southwestern tip of Staten Island, crossed through the northwestern portion of the proposed Breakwaters location, but has since eroded away as a result of tidal action (Pickman 1997). Other areas along the coastline have also been extensively modified by erosion, with some areas having receded by nearly 400 feet (see **Figure 4**).

[1] The elevations presented in the 1909 to 1911 Topographic Survey are relative to a datum based on "Richmond High Water." It is therefore assumed that this datum is consistent with sea level. Other maps may use elevations relative to the National Geodetic Vertical Datum of 1929 (NGVD29), an approximation of mean sea level. The Richmond Borough Datum is 3.192 feet above the NGVD29. Therefore, there may be a margin of error of more than 3 feet when comparing historic and modern topographic information depending on which datum each map is based.

However, in the northern portion of Conference House Park, the area of the beach appears to have been increased and it now extends further to the west. This portion of the park is characterized by elevated bluffs with steep declines down to the beach along the waterfront. With the exception of the expanded beachfront, the topography of the Water Hub Potential Location 2 APE is nearly identical to that seen on the 1907 topographical survey.

B. HYDROLOGY

As the glaciers receded, the ensuing runoff created streams, rivers, and lakes as well as thick tracts of marshland in the low-lying areas along Staten Island's coasts. As seen on the 1909-1911 topographical survey of Staten Island (see **Figure 4**), a thick tract of marshland occupied the western end of the Shoreline APE, south of what is now the line of Billop Avenue and west of the approximate line of Loretto Street. A large, marshy steam known as "Uncle Ed Wood's Brook" or "Ward's Brook" ran south along the approximate line of modern Finlay Street and drained into the Raritan Bay to the south (Davis 1896). North of the line of Clermont Avenue, this brook branched out into a network of smaller streams that ran through much of the southwestern end of Staten Island. Those locations where erosion has been the most significant along the coast of southwestern Staten Island have been in the area of the former marshes, as the beach formerly separating the wetland from the Bay have eroded and the Bay has inundated the marshland. A second stream ran in the vicinity of the Shoreline APE between modern Sprague Avenue and Bruno Lane, although this stream lacked the marshy boundary that was typical of the watercourses to the west along the shore of the Bay. To the northeast of the Water Hub Potential Location 2 APE was a large body of water known as "Elliott's Pond," which had formerly been a swamp, and a series of small ponds near Ed Wood's Brook known as the "Three Muskrats Ponds" (Davis 1896). A tract of marshy lowland known as "Christopher's Swamp" was also formerly located to the east of the Conference House (ibid).

SUMMARY OF CHANGES IN WATER DEPTHS AS SEEN ON HISTORIC COASTAL CHARTS

One of the first maps to include sounding depths in the vicinity of southwestern Staten Island is an 1841 nautical chart published by the United States Coast and Geodetic Survey. The map depicts shallow waters (with depths of 1 to 6 feet) immediately surrounding the island—including near the proposed Breakwaters APE—with deeper waters (15 to 30 feet) to the south and west, in the vicinity of the existing navigation channel. The bay floor in the shallower area is identified as hard, gray muddy sand. These approximate depths appear consistent on coastal charts issued through the 1880s, when the beginnings of a formalized navigation channel begin to appear on nautical charts. The channel was expanded and deepened during the earliest decades of the 20th century. Dredging associated with the construction of the channel, as well as changes in tidal action caused by the movement of increasingly larger ships, likely contributed to the erosion of Ward's Point and the adjacent beaches. Coastal charts suggest that the shallow waters adjacent to and north of the Point were deepened while the water depth within the Breakwaters APE has remained fairly consistent since the mid-19th century (see **Figure 5)**. Depths for the shallower waters in the vicinity of the Water Hub Potential Location 2 APE are not consistently depicted on coastal charts and therefore similar comparisons cannot be made.

C. SOILS

The *New York City Soil Reconnaissance Survey* published by the National Resource Conservation Service (New York City Soil Survey Staff 2005) indicates that the upland APEs are in the vicinity of five soil complexes:

- **Tide Flooded Beaches**: Level or gently sloping sandy/gravelly areas without vegetation that are adjacent to the Atlantic Ocean and are inundated/reworked by saltwater wave action at high tide;
- **Laguardia-Ebbets-Pavement and Buildings, Wet Substratum Complex**: Characterized by nearly level (0 to 8 percent slopes) former swamp, marshland, or water that has been filled with natural soils and construction debris;
- **Bigapple-Fortress Complex**: Characterized by nearly level (0 to 8 percent slopes) areas along coastal waterways that have been filled with dredged sand and fill;
- **Windsor-Verrazano-Pavement and Buildings Complex**: Nearly level (0 to 8 percent slopes) areas in Staten Island and Brooklyn that are represented by outwash plains and dunes that have been partially filled and at least 15 percent of which are covered with impervious pavement and buildings;
- **Pavement and Buildings-Foresthills-Wethersfield Complex**: Soils on Staten Island that are characterized by nearly level (0 to 8 percent slopes) areas of residential, urbanized till plains that have disturbed by cutting and filling with fill and red till and that are at least 80 percent covered with impervious pavement and buildings; and
- **Haledon-Hasbruck Complex**: Characterized by nearly level (0 to 8 percent slopes) wooded areas that are relatively undisturbed and are only found on Staten Island (NYC Soil Survey Staff 2005).

Summaries of the components of these soil complexes are provided in **Table 1**, below.

Table 1
Project Area Soils

Series Name	Soil Horizon Depth (in inches)	Color	Texture	Slope (%)	Drainage	Landform
Bigapple	**A**: 0 to 3	Dark Grayish Brown (10YR4/2)	Sandy dredge deposits	0 to 8	Well-drained	Anthropogenic fill areas near coastal waterways
	E: 3 to 8	Brown (10YR5/3)				
	Bw: 8 to 20	Yellowish Brown (10YR5/4)				
	C1: 20 to 28	Yellowish Brown (10YR6/4) and Grayish Brown (10YR5/2)				
	C2: 28 to 60	Grayish Brown (10YR5/2) and Gray (10YR5/1)				
Ebbets	**A**: 0 to 4	Very Dark Grayish Brown (10YR3/2)	Loamy fill with construction debris	0 to 8	Well-drained	Anthropogenic urban fill plains
	Bw: 4 to 8	Dark Yellowish Brown (10YR4/4)				
	C1: 8 to 60	Dark Yellowish Brown (10YR4/4)				
Foresthills	**A**: 0 to 2	Very Dark Grayish Brown	Loam with gravel and cobbles	0 to 8	Well drained	Anthropogenic fill on urbanized till plains
	Bw: 2 to 15	Brown/Yellowish Red/Black				
	Ab: 15 to17	Black				
	BAb: 17 to 28	Brown				
	Bwb: 28 to 42	Reddish Brown				
	Cd: 42 to 60	Yellowish Red				
Fortress	**A**: 0 to 8	Grayish Brown (2.5Y5/2)	Sandy Dredge Deposits; loamy fine sand	0 to 8	Moderately well-drained	Anthropogenic fill areas near coastal waterways
	Bw: 8 to 12	Light Olive Brown (2.5Y5/6)				
	C1: 12 to 48	Light Gray (2.5Y7/2)				
	C2: 48 to 65	Olive Gray (2.5Y5/2)				
Haledon	**A: 0 to 3**	Black (10YR2/1)	Loam	0 to 3	Somewhat poorly drained	Low positions on undulating till plains
	BE: 3 to 11	Yellowish Brown (10YR5/4)	Loam			
	Bt1: 11 to 17	Brownish Yellow (10YR5/8)	Loam			
	Bt2: 17 to 27	Brownish Yellow (10YR6/8)	Silty Loam			
	2Btx: 27 to 38	Yellowish Red (5YR4/6)	Loam			
	2Cd: 38 to 65	Yellowish Red (5YR4/6)	Loam			

Table 1 (continued)
Project Area Soils

Series Name	Soil Horizon Depth (in inches)	Color	Texture	Slope (%)	Drainage	Landform
Hasbruck	**A**: 0 to 8cm	Very Dark Gray (10YR3/1);Gray (10YR6/1)	Stony Silt Loam	0 to 3	Poorly drained	Depressions on uplands
	Eg: 8 to 25in	Grayish Brown (10YR5/2) and Dark Gray (10YR4/1)	Stony Silt Loam			
	BEg: 25 to 36 cm	Pinkish Gray (7.5YR6/2)	Gravelly Loam			
	Btg: 36 to 61 in	Gray (5YR6/1)	Sandy Clay Loam			
	Bx: 61 to 107 cm	Reddish Brown (5YR4/4)	Gravelly Sandy Loam			
	C: 107 to 183cm	Reddish Brown (5YR4/4)	Gravelly Sandy Loam			
LaGuardia	**A**: 0 to 8	Brown (10YR4/3)	Fill materials; gravelly sandy loam	0 to 8	Well-drained	Modified landscapes near urban centers
	Bw: 8 to 26					
	C: 26 to 79					
Verrazano	**Ap**: 0 to 3	Very Dark Gray (10YR3/1)	Sandy loam	0 to 8	Well-drained	Anthropogenic fill areas near coastal waterways
	Bw: 3 to 17	Very Dark Grayish Brown (10YR3/2)	Sandy loam			
	BC: 17 to 24	Very Dark Grayish Brown (10YR3/2)	Loam			
	2C1: 24 to 60	Light Yellowish Brown (2.5Y6/3) with Reddish Gray (5YE5/2)	Sand			
	2C2: 60 to 80	Light Olive Brown (2.5Y5/3)(	Sand			
Wethersfield	**A: 0 to 3**	Dark Brown (7.5YR3/2)	Loam	0 to 8	Well-drained	Till plains and hills
	Bw1: 3 to 13	Reddish Brown (5YR4/4)	Loam			
	Bw2: 13 to 27	Dark Reddish Brown (5YR3/3)	Gravelly Loam			
	Cd: 27 to 65	Reddish Brown (2.5YR4/4)	Gravelly Loam			
Windsor	**Oi**: 0 to 2	Black (10YR2/1)	Decomposed plant material	0 to 8	Excessively drained	Outwash Plains
	A: 2 to 3	Black (10YR2/1)	Loamy Sand			
	Bw1: 3 to 8	Brown (10YR4/3)	Loamy Sand			
	Bw2: 8 to 13	Yellowish Brown (10YR5/6)	Loamy Sand			
	Bw3: 13 to 27	Strong Brown (7.5YR5/6)	Loamy Sand			
	C: 27 to 60	Strong Brown (7.5YR5/6)	Loamy Sand			

Sources: New York City Soil Survey Staff (2005): *New York City Reconnaissance Soil Survey*. United States Department of Agriculture, Natural Resources Conservation Service, Staten Island, NY.

D. CURRENT CONDITIONS

PROPOSED SHORELINE APE

The proposed Shoreline Protection Project would be constructed along the southern shore of Tottenville, in a beachfront area that is adjacent to residential neighborhoods (see **Photographs** 1 through **16**). The Shoreline Protection Project would be located south of the mapped line of Surf Avenue, which has not been fully constructed across its entire mapped width. As such, portions of the Shorelines Protection Project APE extend across sandy beach while others include grassy lawns, paved driveways and streets, and wooded areas. Pathways lead to the beach from the termini of most of the streets within the residential neighborhoods to the north of the Shoreline APE. Because of the extensive erosion that has altered the water line in this area, decomposing remnants of historic piers and waterfront structures are located along the beach in the vicinity of the proposed Shoreline APE. In some locations, modern pier walls have been constructed along the waterfront to prevent flooding and erosion and the remnants of historic pier walls are visible in some areas along the beach.

PROPOSED BREAKWATERS APE

The proposed Breakwaters APE is located entirely within the waters of the Raritan Bay and the Arthur Kill adjacent to the southwestern end of Staten Island (see **Figure 2**). Modern bathymetric data shows that the bay floor in this area is at an elevation ranging between 0 and 10 feet above sea level. The

northwestern portion of the Breakwaters APE, adjacent to the Arthur Kill, is in the location of former Ward's Point, which eroded away as a result of tidal action in the first half of the 20th century. The bay floor in this area is generally shallower than the areas to the south and west. The Breakwaters APE is north of an existing navigation channel that was constructed in the 1920s and has been dredged and deepened over time (see **Figure 5**).

In June 2015, a survey of the bay floor was completed by Aqua Survey, Inc., that included magnetometry, side scan-sonar, sub-bottom reflection, and bathymetric analysis. This survey identified "a relatively smooth, shallow sand flat along the majority of the survey area between the navigation channel and the shoreline" with "scattered debris consisting of logs, tires, and small rocks" (Aqua Survey, Inc. 2015: 2). The survey identified a possible shipwreck or submerged bulkhead that was described as "one line (approximately 58.8 feet long) running parallel to the navigation channel and two lines (approximately 198.8 feet and 48.6 feet long) running perpendicular to the navigation channel, which converge at a corner" (ibid: 2). The coordinates provided for this potential shipwreck in the final technical report indicate that it is situated near the northwestern quadrant of the former Ward's Point, which has since eroded away. This is located to the northwest of the Breakwaters APE and would not be impacted or otherwise affected by the proposed project, however, the location of this shipwreck and any relevant information will be submitted to SHPO for inclusion in the Cultural Resources Information System (CRIS) database. Another submerged feature that was identified appeared to be a semicircular ring of stones in the general vicinity of a navigational light structure that was protected by riprap as depicted on coastal surveys (see **Figure 5**). No other potential archaeological features were observed on the bay floor; the sonar survey report is included as **Appendix B**.

PROPOSED WATER HUB POTENTIAL LOCATION 2 APE

The proposed potential second location for the Water Hub is situated at the extreme northern end of Conference House Park. This APE comprises four distinct landscape areas: an upland area west of Saterlee Street; an area of steeply sloping bluffs; a beach lining the Arthur Kill; and a portion of the Kill itself. The upland portion is developed with a number of structures, including the historic Biddle house (see **Photograph 17**). The APE is bisected by Shore Road, which terminates just east of the Rutan-Beckett House and paved pathways/hiking trails and parking areas are located in the vicinity of the buildings in the eastern half of the APE (see **Photograph 18**). To the south of the Biddle house is another home at 8 Shore Road, which was constructed circa 1917 (see **Photograph 18**). A small cinder block garage is located downhill to the southwest of this home. The Rutan-Beckett house is built into the slope to the west of the Biddle house and a small greenhouse is located to the south (see **Photograph 19**). The yard of the Rutan-Beckett house is separated from the adjacent paved pathway by a series of fieldstone retaining walls (see **Photograph 20**). The bluffs leading down to the beach are densely wooded and steeply sloped, with slopes greater than 10 to 15 percent across approximately the central portion of the project site (see **Photograph 21**). An existing pathway comprised of a series of winding stairs leads to the beach from the upland area to the north of the Biddle home (see **Photographs 22** and **23**). The historic Wood house is situated in the southeastern corner of the APE.

Chapter 5: Precontact Period

A. PRECONTACT CONTEXT

Archaeologists have divided the time between the arrival of the first humans in northeastern North America and the arrival of Europeans more than 10,000 years later into three periods: Paleo-Indian (11,000-10,000 BP), Archaic (10,000-2,700 BP), and Woodland (2,700 BP–AD 1500). These divisions are based on certain changes in environmental conditions, technological advancements, and cultural adaptations, which are observable in the archaeological record.

PALEO-INDIAN PERIOD

Human populations did not inhabit the Northeast until the glaciers retreated some 11,000 years ago. These new occupants included Native American populations referred to by archaeologists as Paleo-Indians, the forebears of the Delaware—also called the Lenape Indians—who would inhabit the land in later years. Archaeological evidence suggests that the Paleo-Indians were likely highly mobile hunters and gatherers who utilized a distinct style of lithic technology, typified by fluted points. They appear to have lived in small groups of fewer than 50 individuals (Dincauze 2000) and did not maintain permanent campsites. In addition, most of the Paleo-Indian sites that have been investigated were located near water sources. Because of the close proximity of Paleo-Indian sites to the coastline, few have been preserved in the New York City area. Of the few Paleo-Indian sites that have been discovered in New York City, nearly all have been found on Staten Island. One such site is that of Port Mobil, on Staten Island, approximately 3.5 miles north of the project area. Like most precontact sites, this location is situated on high ground overlooking the water. Because of heavy disturbance in the area—it is currently an oil tank farm—the site has yielded nothing more than a collection of fluted points and other stone tools characteristic of the period (Ritchie 1980). Paleo-Indian artifacts were also found along the eroding shoreline 500 yards south of the Port Mobil site, closer to the Shoreline APE, and at the Cutting site in the Rossville section of Staten Island (ibid). Recent excavations at the Old Place site in northwestern Staten Island by the Public Archaeology Laboratory (PAL) have yielded new evidence regarding the site's occupation during the Paleo-Indian period through the Late Woodland, though the majority of the collected artifacts date to the Archaic (PAL 2012).

ARCHAIC PERIOD

The Archaic period has been sub-divided into three chronological segments, based on trends identified in the archaeological record which reflect not only the ecological transformations that occurred during this period, but the cultural changes as well. These have been termed the Early Archaic (10,000–8,000 BP), the Middle Archaic (8,000–6,000 BP), and the Late Archaic (6,000–2,700 BP) (Cantwell and Wall 2001). The Late Archaic is sometimes further divided to include the Terminal Archaic (3,000-2,700 BP). The abundance of food resources that arose during this period allowed the Archaic Native Americans to occupy individual sites on a permanent or semi-permanent basis, unlike their nomadic Paleo-Indian predecessors. Fishing technology was developed during the Middle Archaic in response to an increasing dependence on the area's marine resources. Tools continued to be crafted in part from foreign lithic

materials, indicating that there was consistent trade among Native American groups from various regions in North America throughout the Archaic period.

Due to rising sea levels and to the rapid development of the area, as well as the dominance of coniferous forests at that time which generated a habitat ill-fit for human habitation (Boesch 1994), few Early Archaic sites have been identified in New York City. Most of those that have been identified are located on Staten Island, including Ward's Point—which is to the northwest of the Breakwaters APE—Richmond Hill, the H. F. Hollowell site, and the Old Place site. Sites such as Ward's Point—a domestic habitation location that due to lowered sea levels was originally inland—tend to be deep and stratified and have yielded stone tools related to cooking, woodworking, and hide processing. The many years of constant occupation caused the artifacts to be deeply buried under more recent debris deposits (Cantwell and Wall 2001). However, at the Old Place Site, the only artifacts that were discovered—stone tool assemblages—were found at relatively shallow depths of around 42 inches or 3.5 feet (Ritchie 1980).

There are also few Middle Archaic sites in the region. The majority of these tend to consist of large shell middens, which are often found near major watercourses such as the Hudson River, although stone points have also been found in such locations. These sites were in great danger of obliteration because of their proximity to the shrinking coastlines.

Unlike the Early and Middle periods, many Late Archaic sites have been found throughout the New York City area including many in Staten Island. Late Archaic habitation sites are often found in areas of low elevation near watercourses and temporary hunting sites are often located near sandy areas (Boesch 1994). Late Archaic sites identified in Staten Island include the Pottery Farm, Bowman's Brook, Smoking Point, Goodrich, Sandy Brook, Wort Farm, and Arlington Avenue sites, among others (ibid).

Finally, many Terminal Archaic sites from all across the city have provided examples of what archaeologists call the Orient culture, which is characterized by long fishtail stone points and soapstone bowls. Extremely elaborate Orient burial sites have been found on eastern Long Island, but none have been identified on Staten Island. Orient-style fishtail points have been discovered along the shores of Charleston, and it is assumed that they fell from eroding cliffs located nearby (Boesch 1994).

WOODLAND PERIOD

The Woodland period represents a cultural revolution of sorts for the Northeast. During this time, Native Americans began to alter their way of life, focusing on a settled, agricultural lifestyle rather than one of nomadic hunting and gathering. Social rituals become visible in the archaeological record at this time. Composite tools, bows and arrows, domesticated dogs, and elaborately decorated pottery were introduced to Native American culture; and burial sites grew increasingly complex. Woodland-era sites across North America indicate that there was an overall shift toward full-time agriculture and permanently settled villages. Archaic sites in New York City, however, suggest that the Native Americans there continued to hunt and forage on a part-time basis. This was most likely due to the incredibly diverse environmental niches that could be found across the region throughout the Woodland period (Cantwell and Wall 2001; Grumet 1995).

The Woodland period ended with the arrival of the first Europeans in the early 1500s. One Woodland period archaeological site that has been identified on Staten Island is the Bowman's Brook site, located along the island's northwest coastline. That site yielded a type of incised pottery, which has since become known as the Bowman's Brook Phase. Sites with this particular type of pottery are most often located near tidal streams or coves and are usually associated with large shell middens and refuse pits, indicating long periods of occupation (Ritchie 1980). The Bowman's Brook site also contained several human and dog graves, as well as bundle burials (Cantwell and Wall 2001). The Ward's Point site was also occupied

during the Woodland period, and many Native American artifacts and elaborate burials with varied grave offerings have been uncovered there (ibid). This site is discussed in greater detail below.

CONTACT PERIOD

The Woodland period ended with the arrival of the first Europeans in the early 1500s, and the beginning of the Contact Period. At that time, a division of the Munsee Indians known as the Raritan occupied southern Staten Island (Bolton 1975). They entered the area toward the end of the Woodland period (Boesch 1994). They referred to Staten Island as "Aquehonga Manacknong," possibly meaning "haunted woods," "bushnet fishing place," or "the high bank fort place" (Grumet 1981: 2). The name may have also referred to the village settlement at Ward's Point (ibid). In land transactions with the Europeans, the island was also referred to as "Matawucks" and "Eghquaous" (Boesch 1994).

In 1524, Giovanni de Verazzano became the first European to view what is now New York City. However, Henry Hudson's expedition to New York in 1609 marked the true beginning of European occupation in the area, and subsequently marked the beginning of violent encounters with the Native Americans as well. Shortly after Hudson's men explored Staten Island, a skirmish ensued with the local Indians, resulting in the death of one of Hudson's crewmen (Historical Records Survey 1942: xii). Because of this incident, the Native Americans of Staten Island were extremely wary of Europeans. They even set up lookouts on tall hills in an effort to spot approaching ships so as to prevent such vessels from landing (ibid). Although the land had been "sold" to the Europeans in 1630 (Grumet 1981), it was not until 1638 that a successful European colony, that of Olde Dorpe, in northeastern Staten Island, could be established on the island. Violence between the Native Americans and the Europeans would cause this village to be burned down and rebuilt several times throughout the contact period.

With the introduction of European culture into the indigenous society, the way of life once maintained by the Native Americans was thoroughly and rapidly altered. European guns, cloth, kettles, glass beads, and alcohol soon became incorporated into the Native American economy. The Native Americans began to suffer from the side effects of European colonialization: disease, alcoholism, and warfare. As land in other parts of New York City was sold off to the Europeans, many displaced Native Americans relocated to Staten Island to the point where "the Raritan consisted of a heterogeneous assortment" of Native Americans from all over the New York metropolitan area (Grumet 1981: 45).

Native Americans at first maintained the village sites they had established near water sources. As their trade with European settlers intensified, they became increasingly sedentary. However, as the European population grew and required more land, the relationship between the two groups suffered. Fierce wars broke out between the Dutch and the Indians. This was most intense during the early 1640s when Dutch Director-General William Kieft ordered many ferocious and unprovoked attacks on the Native population. While the Kieft war ended with a treaty signed in 1645, the Raritan did not agree to peace until 1649 (Grumet 1981).

The warfare abated somewhat when Kieft was replaced by Peter Stuyvesant, who brought some stability to the area. However, the "Peach War" of 1655 caused more inter-cultural violence on Staten Island. After that war ended, the land was re-sold to the Dutch in 1657. The Native Americans were no match for the growing numbers of armed European settlers, and the natives agreed to sell what was left of their land on Staten Island in 1670, although some Native American villages remained until the early 20th century (Grumet 1981). In the land transaction recorded in 1670, the Native Americans sold all of their holdings on Staten Island in exchange for "four hundred fathom of wampum, thirty match coats, eight coats of dozens made up, thirty shirts, thirty kettles, twenty gunnes, a ffirkin of powder, sixty barres of lead, thirty axes, thirty howes, [and] fifty knives" (Bolton 1975: 73). There are several Contact period archaeological

sites that have been identified in New York City, including the aforementioned Ward's Point site on Staten Island (Grumet 1995).

B. PREVIOUSLY IDENTIFIED NATIVE AMERICAN ARCHAEOLOGICAL SITES

Both the Breakwaters and Shoreline Protection Plan APEs are included within an area of generalized archaeological sensitivity as mapped by OPRHP's Cultural Resources Information System (CRIS).[1] Furthermore, the coastal areas of Staten Island in the vicinity of the APEs are identified as having potentially high archaeological sensitivity in LPC's predictive models for Staten Island (Boesch 1994). A search of OPRHP and NYSM site files indicates that nearly 30 precontact archaeological sites have been identified within or in the immediate vicinity of the Shoreline APE (see **Table 2**). The sites represent a variety of occupation site types, including campsites, villages, and shell middens. Several of these sites were discovered in the early 20th century by avocational archaeologists and were reported by authors such as Arthur C. Parker (1922), Alanson Skinner (1909), and Reginald P. Bolton (1922, 1934, 1975). Unfortunately, few of these sites are well documented and little is known about the precontact sites' exact locations, extent, or artifact collections.

Table 2
Previously Identified Precontact Archaeological Sites within 1 Mile of the APEs

Site Number	Site Name	Distance to Shoreline APE	Time Period	Site Type	Source
NYSM: 740	Sharrott Avenue	1 mile	Precontact	Unknown	Skinner 1909
NYSM: 741	Red Bank Area	.2 miles		Camp and Traces of Occupation	Skinner 1909
NYSM: 748	Hollowell	.3 miles	Early-Middle Archaic?	Lithic Point and other tools	
NYSM: 767	Tottenville Campsite 4A/4B	.3 miles		Campsites	
NYSM: 768	Page Avenue	.7 miles	Precontact	Unknown	
NYSM: 4609	Parker Site 19A (See also NYSM 8471)	Within APE	Precontact	Shell Midden	Parker 1922
NYSM: 4619	Unnamed Parker Site	Within APE	Precontact	Camp	Parker 1922
NYSM: 4620	Unnamed Parker Site	.1 miles	Precontact	Camp	Parker 1922
NYSM: 4621	Unnamed Parker Site	.9 miles	Precontact	Traces of Occupation	
NYSM: 8192	Burial Ridge/Tottenville/Ward's Point	.1 miles	Archaic/Woodland	Village/Cemetery/Middens	Parker 1922
NYSM: 8471	Parker Site 19C	.2 miles	Precontact	Middens/Camps/Traces of Occupation	Parker 1922
NYSM: 8484	Unnamed (Possibly the same as NYSM 741)	.3 miles	Precontact	Unknown	
NYSM: 8485	Unnamed	.2 miles	Precontact	Shell Midden	
NYSM: 8486	Unnamed	.1 miles	Precontact	Camp	
NYSM: 8487	Unnamed	Within APE	Precontact	Shell Midden	
NYSM: 8489	Unnamed	.1 miles	Precontact	Traces of Occupation	
NYSM: 8490	Unnamed	.4 miles	Precontact	Traces of Occupation	
NYSM: 8491	Unnamed	.7 miles	Precontact	Traces of Occupation	
NYSM: 8492	Unnamed	.9 miles	Precontact	Traces of Occupation	
NYSM: 9295 SHPO: 8501.000030	Ward's Point	Within/adjacent to APE	Early- to Mid-Archaic	Stratified Settlement	
SHPO: 8501.000017	Mount Loretto Site	.8 miles	Precontact	Buried Evidence	Pickman and Yamin 1984

[1] Accessible through: http://pwa.parks.ny.gov/nr/

Table 2 (continued)
Previously Identified Precontact Archaeological Sites within 1 Mile of the APEs

Site Number	Site Name	Distance to Shoreline APE	Time Period	Site Type	Source
SHPO: 8501.000018	Page Avenue Site	.4 miles	Precontact	Buried Evidence	Pickman and Yamin 1984
SHPO: 8501.000019	Bedell Avenue Site	.4 miles	Precontact	Buried Evidence	Pickman and Yamin 1984
SHPO: 8501.000022	Saterlee Street Site A	.4 miles	Precontact	Buried Evidence; Possible extension of Billop Ridge Site	Pickman and Yamin 1984
SHPO: 8501.000023	Saterlee Street Site B	.5 miles	Precontact	Buried Evidence; Possible extension of Billop Ridge Site	Pickman and Yamin 1984
SHPO: 8501.000024	Pittsville Avenue Site	.6 miles	Precontact	Buried Evidence	Pickman and Yamin 1984
SHPO: 8501.000025	Hopping Avenue Site	.8 miles	Precontact	Buried Evidence	Pickman and Yamin 1984
SHPO: 8501.000140	Tottenville	.3 miles	Middle-Late Woodland	Lithics and Ceramics	
SHPO: 8501.002376	Sprague Avenue Historic Site	.3 miles	Precontact to early 19th century	Precontact lithics and FCR; historic glass and ceramic	
SHPO: 8501.002377	Honey Blossom Site	.6 miles	Middle-Late Woodland	Lithic point: stray find in a plow zone	
SHPO: 8501.002379	Woodvale-by-the-sea Area A	.7 miles	Precontact	Camp	Pickman and Yamin 1984
SHPO: 8501.00238	Woodvale-by-the-sea Area B	.7 miles	Precontact	Camp	Pickman and Yamin 1984
SHPO: 8501.002707	PS 6R Prehistoric Site	.6 miles	Late Archaic	Lithic Workshop	HPI 1998
SHPO: 8501.002794	Conference House Bluebelt Prehistoric 1 Site	.3 miles	Precontact	Lithic Workshop disturbed by erosion	HPI 2003
SHPO: 8501.002842	Billops Ridge Site	.4 miles	Early to Middle Woodland	Shell middens with lithics and pottery	HPI 2006

Source: New York State Cultural Resource Information System (https://cris.parks.ny.gov).

As indicated by the CRIS files and reported in previously conducted archaeological surveys, all of the previously identified sites have been located in upland areas of higher elevation than that of the Shoreline APE. The landscapes on which sites have been identified include the bluffs and hilltops that overlook the Arthur Kill and Raritan Bay. The distances in the table above are relative to the Shoreline APE, however, several sites are dramatically closer to the Water Hub Potential Location 2 APE. For example, the Pittsville Avenue site is mapped approximately 100 feet east of the Water Hub Potential Location 2 APE and the Hopping Avenue and Woodvale-by-the-Sea sites are approximately 1,000 feet from the APE.

Many of the sites that have been identified are related to the occupation of the Ward's Point Archaeological Conservation Area, which is described in greater detail below. It does not appear that any sites have been identified on the beaches that line the waterfront although many of the NYSM sites—which are mapped based on non-specific site information published in the early 20th century—overlap with the beachfront areas. However, Leng and Davis (1930) refer to "paint pots" and flint (chert), quartz, and jasper tools including "cutting tools, knives, arrow points, spear heads, etc." being located on Tottenville's beaches (Leng and Davis 1930: 73 and 78). They further state that "wherever there are sand dunes, there is a chain of sites of former Indian habitations" (ibid: 80). As such, it is possible that precontact archaeological resources were once present on the beach within the Shoreline APE.

WARD'S POINT ARCHAEOLOGICAL CONSERVATION AREA

The Shoreline APE is in the immediate vicinity of the Ward's Point Archaeological Conservation Area. The archaeological historic district was listed on the National Register of Historic Places in 1982 and made a National Historic Landmark ten years later (Grumet 1995). The Area comprises at least eight individual sites, and mapped locations of sites linked to or associated with Ward's Point extend further to the south and east, overlapping with the Shoreline APE (Boesch 1994). In addition to the Area's significant precontact archaeological components, it is also sensitive for archaeological resources dating to the historic period, specifically those associated with the Conference House and its surrounding area. The Conservation Area is bounded roughly by Billop Ridge to the north (in the vicinity of Lima Street), Saterlee Avenue to the east, the Arthur Kill to the west, and a historic fence line near Surf and Clermont Avenues to the south.

The Area was initially identified and excavated by avocational archaeologists, and may have been first discovered during basement excavations in 1858 and again in 1863 (Florance 1982). The Area was more extensively investigated by groups representing the Natural Science Association and the American Museum of Natural History between the mid-19th and early-20th centuries (ibid). Additional amateur excavations and accidental finds continued within the area through the mid-20th century, with more modern, professional excavations taking place in the 1960s through the 1980s, most notably by Jerome Jacobson in the 1960s and by Shirley Zavin and Sherene Baugher between 1979 and 1980 (ibid). Jacobsen's research references a collection of deposits that were recovered at the western end of the perk near the former terminus of Hylan Boulevard and that "is known only from a collection of specimens by Herbert Reed and reported to Jacobsen…presumably [at] the foot of Hylan Boulevard on the shore" (Wapora, Inc. 1978: II-19). A complete list of archaeological finds and investigations is presented in the National Register nomination form prepared for the Area by Charles A. Florance in 1982. The majority of these investigations are focused on Burial Ridge and the site of the Conference House.

The Ward's Point Conservation Area is significant because its deposits contain archaeological resources dating between the Early Archaic and Contact Periods (Cantwell and Wall 2001). The site therefore provides information on the repeated occupation of the southwestern tip of Staten Island over a period of several thousand years, including the transition of the Native American population from the stone tools of the Early Archaic to the composite tools made with European goods that were seen in the Contact period (ibid). The Area has already contributed greatly to the archaeological record of the region and also possesses significant archaeological potential. The location around the previously identified sites has therefore been designated a Conservation Area/archaeological historic district in order to protect all remaining archaeological data (Florance 1982). Specifically, "the Ward's Point Conservation Area is a demonstrably and potentially rich zone for investigating research problems concerning prehistoric archaeology in New York and neighboring states" (ibid: 8-3). Parker (1922) refers to failed "clandestine attempts at digging" within the Area, suggesting that years of looting may also have occurred there (Parker 1922: 683). Such looting continued into the 20th century and as a result, the Area is marked with the sunken remnants of illegally excavated trenches and pits (Florance 1982). Looting and amateur archaeological investigation in the late-19th century have resulted in the most significant disturbance to the Area (Pickman 1997a).

According to Parker (1922), shells covered the entire point in the vicinity of Conference House and were still visible in the early 20th century. Shell deposits have been found across the Conservation Area in several of the previous excavations that have occurred there (Florance 1922). In addition, archaeological deposits associated with Ward's Point have been recovered from the tall bluffs that occupy the area and have typically been:

> *…overlain by black humus topsoils that extend from two to fourteen inches beneath the surface. A nine- to 12-inch-thick brown loam plow zone lies beneath this humus layer. The plow zone in turn is underlain by brown and yellow layers of sand* (Grumet 1995: 222).

A key component of the site is Burial Ridge, an elevated area to the south of the Conference House where at least 72 burials are known to have taken place (Boesch 1994).[1] One of the most notable burials was that of a child which dated to the Middle Woodland and contained numerous grave goods (Cantwell and Wall 2001). A Native American trail extended north from the site, running along the western coast of Staten Island, then turning east and running along the approximate line of modern Amboy Road (Bolton 1922). In addition to burials, more than 125 features, including hearths with fire-cracked rock and a variety of lithic tools, have been observed in the Area (Cantwell and Wall 2001; Grumet 1995). The evidence recovered from archaeological investigations in the Area indicate that it was occupied by members of the Munsee and that it was occupied in the warm months (Grumet 1995). The town of Perth Amboy is situated opposite Ward's Point on the eastern coast of New Jersey. Significant archaeological resources have also been identified there and it is likely that the two communities were connected by trade (Bolton 1922).

[1] Grumet (1995) suggests that at least 77 burials have been identified at Ward's Point.

A. GEOMORPHOLOGICAL AND ARCHAEOLOGICAL ASSESSMENT OF THE BAY FLOOR

2014 GEOMORPHOLOGICAL ANALYSIS COMPLETED BY GRA

As described previously, in 2014 GRA, in conjunction with Hunter Research, Inc., issued a report summarizing an extensive geomorphological and archaeological assessment of New York Harbor (GRA 2014). The New York and New Jersey Harbor Navigation Project (NYNJHNP) brought together a wide variety of environmental, geological, geomorphological, and archeological data to draw conclusions regarding the archaeological sensitivity of the submerged landforms lying beneath the Port of New York and New Jersey. This comprehensive study drew on many years of previous research in the Hudson River, along the coast of NJ, in the Long Island Sound, and over 10 years of research in the New York Bight itself. The primary components of that assessment were: 1) geomorphic and paleoenvironmental trends such as the changing rates of sea level rise and sedimentation; and 2) archaeological site geography such as changing stream valley morphologies, the stabilization of the shoreline of river systems, and inundation and burial of archaeological sites. GRA's study included the Breakwaters APE, which was identified as having high sensitivity for deeply buried archaeological sites (GRA 2014, see Figure 9.1).

A key component of GRA's work was the establishment of a relative sea level curve for the New York Bight, which was developed by GRA using basal peat samples taken from vibracores in Raritan Bay, Jamaica Bay, and the Upper New York Harbor, supplemented by radiocarbon dates from pertinent cores taken by other researchers in the past, as well as from cores taken by GRA during previous studies (GRA 2014). GRA calculated the relative rise of sea level in New York harbor as a smooth curve that extended over a period of 9,000 years. Their data:

> *…suggest a rising trend over the past 5,000 years at a rate of between 1.4 and 1.5 mm/yr. Prior to 5,000 years ago, the trend is more difficult to discern, largely due to the scarcity of earlier radiocarbon-dated stratigraphy* (GRA 2014: 44).

As part of the NYNJHNP, GRA collected primary data in the study area through the advancement of 20 split-spoon soil cores (GRA 2014). The cores were examined for a detailed description of their sediment lithology, Carbon-14 dating of several shell samples, and various types of biological evidence to identify changes in temperature and salinity, flora and fauna, and other indicators of past environmental conditions (ibid). This information was synthesized to identify those areas within the Harbor that could have been occupied prior to the rise of sea levels and to determine the probability that those sites would have been preserved beneath a protective layer of peat deposits.

The development of peat layers during the Holocene oceanic transgression are described in detail in Pekar, et al. (2004) and GRA (2014). Simply put, marshes grow upwards and landwards with the rising relative sea level, leading to the development of very thick peat layers over centuries. The interpretation of the stratigraphic development of these peat layers can be very complicated as the process works differently with transgression and sea level regression, leaving "an interfingered sequence of lithologic units containing a fossil record of marsh history" (GRA 2014:47).

GRA's analysis determined that landforms which are now deeply buried would have been exposed prior to the rise of sea levels thousands of years ago, and may therefore have been the site of prehistoric occupation and use. GRA's determination of high sensitivity was based on the area's lack of significant changes in the bathymetric depth of the bay floor in the vicinity of southwestern Staten Island as identified on historic maps and coastal charts published between 1844 and 1985 (ibid). As shown in Figure 9.1 of GRA's report, the area between the southern coast of Staten Island (north of the existing navigation channel lining the southern border of the Breakwaters APE) and the floor of the Arthur Kill (separating Staten Island and New Jersey) are the only two locations within New York Harbor that were determined to have high sensitivity. Geotechnical borings completed as part of the design process for the proposed Breakwaters provided a rare opportunity to collect data regarding this uniquely sensitive location.

B. 2015 GEOMORPHOLOGICAL ANALYSIS COMPLETED BY UNIVERSITY OF MASSACHUSETTS AT AMHERST

The geomorphological investigation conducted by UMass in 2015 (see **Appendix A**) involved the observation of 20 geotechnical borings ranging in depth between approximately 60 and 150 feet below the bay floor in and around the Breakwaters APE.[1] No intact buried ground surfaces (known as "A-horizons") were observed in any of the borings, though it was noted that they may have been "drilled through and unobservable" as a result of the drilling methodology (Lynch 2016: 6). Soil levels that were identified as "hypothesized B-horizons," or the subsoil layers immediately below presumed ground surfaces, were observed in some borings. In addition, no C-horizons—the soil layers beneath the subsoil that serve as the parent material from which the subsoil is formed—or developed peat layers suggesting inundation were observed. Overall, the soils were identified as similar to those observed by GRA during their prior boring program, which were determined to have been formed during the Cretaceous period between 66 and 144 million years ago (ibid; Isachsen, et al. 2000).

However, Lynch (2016) also report that many of the sediments seen by GRA in borings elsewhere in Raritan Bay were absent in the borings located within the Breakwaters APE. On the western side of the Breakwaters APE, Lynch identified a layer of mud "indicative of post-inundation deposition" in five boring locations near the western end of the Breakwaters APE, which was inconsistent with the borings observed by GRA in 2014 (Lynch 2016: 7). Remnants of charred and uncharred terrestrial botanicals were also observed in twelve boring locations near the western end of the APE and in two locations in the vicinity of the now-eroded Ward's Point. The borings suggest that during the Late Archaic period (circa 5,500 years before present), the soils currently situated approximately 35 feet below sea level were situated below what was then the exposed ground surface.

Borings B-10, B-12, and B-17, located in the central and eastern portions of the APE, contained low concentrations of chert and jasper precontact lithic material that were determined to not be in situ and which were not identified in the same context as botanical remains suggesting a former land surface, indicating that the artifacts may have been placed in their current contexts through naturally occurring tidal action and bioturbation (ibid).

[1] As shown in Appendix A, the locations of the monitored borings extended to the north, west, and east of the current Breakwaters APE and were used to help refine its boundaries.

C. POSSIBLE PRESERVATION OF PRECONTACT ARCHAEOLOGICAL SITES WITHIN SUBMERGED LANDFORMS

As mentioned above, using the models created as a result of their analysis, GRA identified the portion of the Raritan Bay in the vicinity of the Breakwaters APE as having high sensitivity for preserved, deeply buried archaeological sites (GRA 2014). The salt marshes that formerly lined portions of the waterfront adjacent to the Raritan Bay (within the Shoreline APE) would be expected to have low archaeological potential. However, as demonstrated in **Table 2, Chapter 5, "Precontact Period**,**"** areas of higher elevation adjacent to the marshes and nearby watercourses—those locations that make up the sites within Ward's Point Archaeological Conservation Area north and west of the APEs—were highly attractive habitation locations. There is a strong direct correlation between the presence of precontact sites and fresh water sources or other water features and dozens of precontact sites have been reported at the southwestern end of Staten Island.

The locational patterns of Native American sites can be projected back in time onto now-submerged offshore areas that were formerly dry, inhabitable land. As recently as a few thousand years ago, the sea level was 2 to 4 meters lower and the coastline of the landforms within New York Harbor was located further out into the bay hundreds of meters south of its present location (GRA 2014). Older landforms located beneath the peat deposits therefore could include what were formerly well-drained, inhabitable upland areas and, therefore, precontact archaeological sites. Accordingly, it is possible that if intact basal peat layers are present within the site of the proposed Breakwaters, intact Native American archaeological sites that pre-date the rise of sea level beginning approximately 5,000 years ago could be intact at great depths beneath the existing Bay Floor. However, the Breakwaters APE has been subject to disturbance as a result of significant erosion caused by tidal action and dredging that has occurred in an attempt to create shipping channels in the immediate vicinity.

The soil cores that were monitored as part of the UMass investigation appear to suggest that that during the late Archaic period (circa 5,500 years before present), the soils currently situated approximately 35 feet below sea level were located below what was then the exposed ground surface. Two borings (B-2 and B-4) were located in areas of shallower depth in the western portion of the site, where erosion has been extensive, leading to the submergence of Ward's Point itself. Sediments collected from various depths in both borings—27.8 to 28.3 feet in B-2 and 35.3 to 35.7 feet in B-4—contained evidence of terrestrial landscapes (Lynch 2016). Boring B-2, located closer to the former Ward's Point, included eel grass and marine fauna suggesting a "shallow, productive, marine habitat" though it was noted that goosefoot, a common weed, had intruded into the sediment layer (ibid: 6). Boring B-4 included a sample of charred wood that served as evidence of formerly exposed land (ibid).

The study tentatively concluded that the Breakwaters APE had experienced, "a long history of eroded, reworked deposition from currents and storm surge closer to shore adjacent to the middle and eastern end of the APE" (Lynch 2016: 10). However, this was considered speculative due to the fact that continuous soil cores along the extent of the APE were not part of the scope of the boring program (ibid). Nevertheless, the conclusion is consistent with historic descriptions of the naturally occurring modifications that have re-shaped the shoreline in the vicinity of the APE as seen on historic maps (see **Figure 4**).

Based on the above information, it appears that the Breakwaters APE has been extensively modified through tidal action, rising sea levels, and erosion, and that potentially sensitive soil deposits are buried at far greater depths than would be disturbed by the Proposed Actions.

Chapter 7: The Historic Period

A. HISTORICAL CONTEXT FOR SOUTHWESTERN STATEN ISLAND

As discussed in **Chapter 5, "Precontact Period,"** wars between European settlers and Native Americans prevented the formation of a successful European settlement on Staten Island until the late 1630s. Even afterwards, peaceful relations between the two groups were not established until after the British had seized the colony in 1664. The exodus of the bulk of the Native American population beginning in 1670 made it easier for Staten Island to become a thriving part of the New York economy (Leng and Davis 1930). Local lore claims that the island was won for New York by Captain Christopher Billop[1] in a sailboat race with a representative from New Jersey, but this is most likely false (Botkin 1956).

Under British rule, Staten Island's open farmland and vast coastline became essential for the production of agricultural products and collection of marine resources for export to the urban regions of the city, which were at the time largely confined to Manhattan. However, the majority of settlement and development in Staten Island occurred along the northern and eastern coasts. The southern portion of the island developed slowly, in part because a large portion of the land had been granted to Captain Christopher Billop in 1675 (Leng and Davis 1930). In 1676, Captain Christopher Billop built the dwelling know known as the Conference House and originally referred to as "The Manor of Bentley" within what is now Conference House Park (ibid). As shown on the Skene map of original land patents in Staten Island, Billop's estate initially covered more than 1,000 acres, although Billop and his heirs gradually sold off parcels to other families (Pickman and Yamin 1984). The southwestern peninsula later known as Ward's Point became known as "Billop's Point" (Burrows and Wallace 1999). One of the first major roads in the area, in the approximate location of modern Amboy Road, was constructed as the King's Highway in 1695, improving access to southern Staten Island (Shepherd 2008). However, Billop's occupation of the area appears to be the first settlement in the southern half of Staten Island, which had remained virtually empty throughout the 17th and early 18th centuries.

Staten Island's progress was both halted and facilitated in the mid-18th century during the French and Indian War, which concluded in 1763. Although the region experienced the economic side effects of being at war, thousands of British armed forces were stationed throughout the New York City area, bringing money to the region while at the same time increasing its population. During this time, New Yorkers were not completely loyal to the English crown, and goods were secretly (and illegally) traded to French colonies via Staten Island's more secluded ports (Burrows and Wallace 1999).

New York remained loyal to the British during the Revolutionary War, which began in 1776 and continued until 1783. Staten Island proved to be a key asset during that war. Earthen embankments were constructed on Ward's Point and mounted with cannon at the outset of the war (Shepherd 2008). The area was the scene of some fighting on July 25 of that year, when cannon fire was exchanged between American soldiers on Ward's Point and British troops across the water in Perth Amboy, New Jersey, resulting in one causality (ibid). Following the Battle of Brooklyn in August 1776, American troops

[1] Billop's name is frequently spelled "Billopp," however, as the formal name of the road in the vicinity of the APEs is designated by the City of New York as "Billop Avenue," that spelling is used for the purposes of this document.

retreated from New York City and the surrounding region and Staten Island was occupied by the British for the duration of the war.

On September 11, 1776, unsuccessful peace negotiations were held at Captain Billop's former house, giving it the name the "Conference House." Among the notable conference attendees were Benjamin Franklin, John Adams, and Edward Rutledge, representing the American colonists, and Lord Richard Howe, representing the British government (Leng and Davis 1930). The British continued to use Staten Island as a rudimentary home base due to its strategic location (Historical Records Survey 1942). It was sufficiently close to both New York and New Jersey that British soldiers could easily be dispatched in the event of an impending battle. And, reminiscent of the activities of the Raritan Indians, the island's tall hills provided views essential to tracking ships approaching the city. However, the British troops stationed in New York City caused a great deal of trouble by burning farms and homes and stealing from private citizens. This resulted in horrible and brutal living conditions for many New Yorkers during the war (Leng and Davis 1930; Burrows and Wallace 1999).

Despite New York City's loyalty to the British during the war, after the American victory, the transition to the new American democratic government was relatively smooth. Land that had been previously owned by British loyalists, including Billop, was divided and sold, which brought about a surge in population and development in the outer boroughs (Shepherd 2008). In 1788, Staten Island was officially divided into four townships, Castleton, Northfield, Southfield, and Westfield (Leng and Davis 1930). Westfield encompassed the southwestern quadrant and included the Project sites. Several maps depict the southwestern coastline of Staten Island in the late 18th century. A map created by Loring McMillan in 1933 incorporates data from the Taylor and Skinner map of 1781, the Hessian map of 1777, and a French map detailing English and Hessian camps on Staten Island between 1780 and 1783 and reflects general conditions in Staten Island during the course of the war. The map—like the maps on which it was based— depicts several homes along the coast of the Raritan Bay in the vicinity of the Project sites. However, the maps are not proper surveys and are therefore not detailed enough to determine the exact locations of these homes.

Between 1840 and 1880, the population of Staten Island nearly quadrupled. The neighborhood of Tottenville, the center of which was to the north of the Project sites along the shores of the Arthur Kill, had become the center of residential life in southern Staten Island in the mid-19th and early-20th centuries (Shepherd 2008). This surge was caused in part by the increasing population density in Manhattan, which drove many people to the outer boroughs. Shipbuilding became an important industry in southwestern Staten Island in the early 19th century and the Rutan Brothers shipyard was located in the vicinity of Conference House Park at that time (Pickman 1997). The region's prosperity caused the counties in the New York City region to become increasingly codependent, both economically and culturally. It was therefore suggested that the counties around New York Harbor be consolidated under the name New York City. Although there was some resistance from some Staten Island residents, it officially became a borough of New York City on New Year's Day, 1898 (Burrows and Wallace 1999).

As part of the city proper, Staten Island flourished throughout the 20th century. Increased mass transit connected all the boroughs and allowed more people to live outside of Manhattan while still having access to the city's varied resources. By the early 20th century, the shores of Tottenville were lined with resort communities and the area was a popular vacation destination. The remainder of the 20th century saw continued growth and increasing population density throughout Staten Island and a transition from resort community to a densely populated residential area.

B. THE DEVELOPMENT OF THE APES

EARLY COLONIAL DEVELOPMENT

As mentioned above, late 18th century maps depict homes along the waterfront along southern Staten Island between Prince's Bay and Ward's Point, but none of these maps are accurate surveys. However, they do indicate that some residential occupation in the vicinity of the Shoreline APE occurred in the late 18th century.

An 1835 Coastal Survey by Charles Renard is one of the first to accurately portray the development of Tottenville in the early 19th century. Though the map depicts the general locations of buildings, it represents structures with a black square and does not depict building footprints or exact locations. Few roads were constructed in southern Staten Island at that time, and the 1835 map only depicts precursors to Amboy Road and Page Avenue in the vicinity of the Shoreline APE. At that time, the southwestern tip of Staten Island was developed with the home of Samuel Ward, for whom Ward's Point was named. Ward is the only property owner identified by name on the 1835 map, though the location of the home, which is not included within either the Shoreline or Breakwaters APEs, appears to have been lost to erosion and is now inundated. The map shows additional homes along the waterfront to the east of the marshes that formerly occupied much of the western portion of the Shoreline APE. The homes appear to be separated from the adjacent beach by a small bluff. A similar landscape is depicted on the 1844 coastal survey completed by F.R. Hassler, though that map does not depict a bluff or elevation change near the waterfront (see **Figure 6**). That map suggests that the locations of some of the homes originally located along the waterfront are also currently inundated. At least eight buildings were located along the shoreline west of Page Avenue and two to the east. A series of round objects, possibly rocks or small hummocks, is depicted within the marshy area to the west of the Shoreline APE, adjacent to the waterfront. No houses appear to be depicted in the vicinity of the Water Hub Potential Location 2 APE. A single structure is depicted to the south of a precursor to what is now Amboy Road along the western shore of Staten Island. This was likely a tavern and ferry terminal that had been constructed in that location in the 18th century and that operated through 1866 when it was destroyed in a fire (Pickman 1997). The tavern and the Billop house continue to be the only structures depicted along the eastern shore of the Arthur Kill in the vicinity of Conference House Park on the 1844 Hassler coastal survey.

In the first half of the 19th century, southwestern Staten Island was the home to several maritime industries. The Butler shipyard was established on Ward's Point (outside of both APEs) by David C. Butler and was at some point also co-owned by James W. Sleight (Shepherd 2008). Butler resided in a home near the shipyard and the home was protected from the adjacent waters by a 10-foot bulkhead (ibid). The shipyard was located on Ward's Point 1850 and the early 20th century and some land was created to expand the shipyard property through landfilling (Pickman 1997). At least seven other shipyards were also in operation in the Tottenville area by the 1880s (ibid). The shores of Tottenville, particularly those along the more protected Arthur Kill to the north of Conference House Park, were the site of numerous shipyards in the 19th century (Leng and Davis 1930). An additional shipyard was established by brothers William H. and James M. Rutan circa 1848 near what is now the northern portion of Conference House Park. The shipyard is depicted on the 1853 Butler map of Staten Island to the south of the Water Hub Potential Location 2 APE. The Rutan family owned additional land within that APE to the north of the shipyard.

By the mid-19th century, Ward's Point had become a popular location "admirably adapted for the purpose" of oyster farming with "as many as half a million bushels of oysters…scattered…yearly" (*The New York Herald* 1853: 7). The Prince's Bay area, including Ward's Point, was also the only location where oyster farmers were required to pay a fee and were granted specific plots in which to farm (ibid).

The oyster farming area lined 10 miles of the coastline of southwestern Staten Island and extended 5 miles out into the Bay, where the depth of the water ranged from 8 to 25 feet (ibid).

EXPANSION OF THE TOTTENVILLE NEIGHBORHOOD IN THE MID-19TH CENTURY

Butler's 1853 map of Staten Island, though not an accurate survey, is the first to identify the names of the owners of the homes along the waterfront in the vicinity of the Shoreline APE. While the marshy western portion of the APE was entirely undeveloped, at least nine buildings were located along the waterfront west of Page Avenue. The owners are identified on the map as Cooley, Joline, W. Manee (whose property included three structures), A. Deckert, J. Lombert, and Dubois. East of Page Avenue were properties owned by A. Manee and S. Allison. The remoteness of the area may have been attractive to the residents of the southwestern coast of Staten Island in the mid-19th century. Within the northern portion of what is now Conference House Park, the map depicts several structures in the vicinity of the Water Hub Potential Location 2 APE. The Rutan brothers' shipyard is identified to the south of a small road that extended west from a precursor to modern Satterlee Street, which was originally constructed as a 12-foot-wide road by the Ward family to connect their property at Ward's Point with Amboy Road to the north (Pickman 1997). The Rutan family owned additional property to the north of the unnamed road which in 1853 was developed with two structures as seen on the Butler map. The map indicates that at that time, the neighborhood was known as "Unionville," an early name for what would later be known as Tottenville (Leng and Davis 1930).

While more developed neighborhoods had formed along Amboy Road to the north, the vicinities of Ward's Point and Prince's Bay remained largely undeveloped and were separated from the northern communities by vast tracts of farmland and undeveloped marsh. By the early 1850s, several houses had been constructed near the vicinity of the Water Hub Potential Location 2 APE, in part associated with the individuals adjacent ship yards to the south and the tavern to the north, though little residential development had occurred elsewhere (Pickman 1997). In 1855, Ward's Point was identified as a possible site for the re-location of the Quarantine Hospital, where immigrants showing signs of disease were sent after disembarking the ships on which they arrived in New York Harbor (*New York Daily Times* 1855). The hospital was originally located in northwestern Staten Island and because residents of that area disapproved of the hospital's presence, it was determined that the hospital should be placed in a more remote location (Leng and Davis 1930). However, Ward's Point was determined to be *too* remote as a result of its being "twenty miles from the Hook and the main ship channel; the channel to the Point is intricate and dangerous from shoals, the anchorage-ground so limited that a large ship can barely swing to her anchor, and twenty vessels would fill the whole bay, or rather roadstead, for it cannot be called a harbor" (*The New York Daily Times* 1855: 2). Prince's Bay to the east was deemed similarly remote (ibid).

A coastal survey published in 1856 and prepared by H.L. Whiting reflects the rural character of the area surrounding the Project APEs, which was accessed by only a few built roads—including precursors to Page Avenue and Sprague Avenues—stretched south toward the waterfront. The map depicts the Butler shipyard on the now-eroded protrusion of Ward's Point to the northwest of the Breakwaters APE and the Rutan shipyard to the southwest of the Water Hub Potential Location 2 APE. The majority of the western portion of the Shoreline APE continued to be inundated by marsh, although a stretch of beach is depicted along the waterfront adjacent to the marsh on the 1856 survey. The area to the east, between the marsh and Page Avenue was divided into small properties and farms, each of which featured one or more buildings. Additional developments are also depicted east of Page Avenue, where a greater number of developed properties are depicted than seen on previous maps. In addition, the survey includes topographic lines, which suggest that the entire coastline in the vicinity of the Project sites was generally flat and at the same low-lying elevation as the adjacent water. These homes were originally at a greater

distance from the shoreline, but as a result of erosion and rising sea levels, the locations of the map-documented structures are now closer to the waterfront. A series of homes were depicted at the top or near the top of the bluffs in the northern portion of what is now Conference House Park on either side of the aforementioned road that led to the Rutan shipyards.

By the publication of the 1859 Walling map of Staten Island, significant development had occurred as the communities to the north began to expand southward toward the Project sites. The map depicts three built roads extending south from Amboy Road: Beach Street, in the vicinity of what is now Page Avenue; Central Avenue, in the vicinity of what is now Joline Avenue; and an unnamed street in the vicinity of what is now Sprague Avenue. Informal or dirt roads are also depicted on the map (indicated by dashed lines) along other streets in the vicinity, including along the shoreline near what is now Surf Avenue. Many of the property owners identified on the map between the marshes and Page Avenue are the same as those identified on the 1853 Butler map, and include, from west to east, Mrs. E. Cooley, B. Joline, a basket shop. M.L. Joline, B.F. Joline, B. Joline (two structures); W. Manee; A. Decker; J. Lambert; and D. S. Dubois. However, the majority of these structures are located to the north of the Shoreline APE and are therefore outside of the study area for this investigation. In the location of the Water Hub Potential Location 2 APE, several buildings associated with the Rutan shipyard, including a store, were located to the north of the shipyard. Other homes were located to the east and southeast along Satterlee Street, including the home of S. Wood, which continues to stand at 96-98 Satterlee Street. Additional maps published by Walling in1860 and by Colton in 1866 are nearly identical to the 1859 Walling map.

F.W. Beers' 1874 atlas of Staten Island (see **Figure 7**) depicts the waterfront development in the vicinity of the APE in the same manner as previous maps, suggesting that the expansion of the neighborhood to the north did not involve extensive waterfront development. The map is the first to depict property boundaries in addition to the footprints of homes and the names of their owners. At that time, many of the properties lining the waterfront in the Shoreline APE were 2 to 7 acres in extent, while others were very large, long and narrow estates that stretched north from the water parallel to the streets that were established to separate estates, many of which still exist. The properties in the vicinity of the Water Hub Potential Location 2 APE were smaller in extent, ranging from approximately 1.5 to 2 acres.

The 1874 Beers atlas depicts several structures immediately adjacent to the waterfront along the shore of the Raritan Bay. These include the complex of buildings on Ward's Point, which was the home of the D.C. Butler shipyard. A small dock extended out into the water in the vicinity of the shipyard. Further to the east, east of the still-inundated marshes, several properties featured waterfront homes west of Page Avenue. Those were the homes of Mrs. E. Cooley, to the east of Sprague Avenue, and B. Joline, west of Joline Avenue (then known as Central Avenue). Both properties may have been partially situated within the Shoreline APE. Additional waterfront structures that were either within or adjacent to the APE were located near Page Avenue (then known as Beach Avenue). Those included the Laforge property west of Page Avenue and a building on the property of "Col. M" to the east of Page Avenue. These buildings and owners are all again depicted on the 1887 J.B. Beers atlas of Staten Island. To the north, along the shores of the Arthur Kill in the northern area of what is now Conference House Park, the 1874 map does not continue to depict the Rutan shipyard, though it identifies a building in the location of the shipyard as the property of "R. Christopher." Within the Water Hub APE to the north were the homes of the Biddle, Rutan, and Leven families to the west of Satterlee Street.

WARD'S POINT IN THE SPANISH AMERICAN WAR

Though fighting during the months-long Spanish-American War in 1898 occurred far from New York, Staten Island was identified as a critical point of entry into New York Harbor (Leng and Davis 1930). Ward's Point, until that point the home of the Butler shipyard, was selected as the location of a defensive battery to protect the waters and urban center of New York City to the north. Fortifications on Ward's

Point included, a "sand redoubt behind which a barrage of large caliber rapid-fire guns" could be mounted (ibid: 344). The construction of the sand battery began in May 1898, when at least 70 men working for the United States engineers began a construction effort that was expected to last only a few days (*The Washington Post* 1898).

Known as "Fort Lucas," up to three large cannon were mounted on the small redoubt (Tottenville Historical Society 2011). The guns sat on concrete foundations and the ships of the United States Navy were moored in the waters surrounding the area (ibid). A 1902 map published by the Staten Island Chamber of Commerce identifies the "U.S. Government Fort" near the southeastern end of Ward's Point. The 1909-1911 Topographical Survey of Staten Island (see **Figure 4**) identifies the "War Department" property on the northwestern side of the point, in the vicinity of a pier, though the fortifications are not explicitly depicted. In the years that followed, the United States Army considered continuing the placement of arms on Ward's Point, though it is unclear how long the battery was in active use. However, as the point was redeveloped with an amusement park in 1902, it does not appear that the site was used for military purposes for very long (US War Department 1902). The remnants of the battery were reported to have been visible for decades after the war; however, by the 1930s, as erosion wore away the point, the former battery was almost entirely underwater (Leng and Davis 1930).

TRANSFORMATION OF THE WATERFRONT IN THE 20TH CENTURY

By the early 20th century, the still-remote Tottenville neighborhood had become a waterfront resort community popular among city residents. Raritan Bay Park, located in the vicinity of the Shoreline APE, was a waterfront beach attraction and community where residents lived in tents with wooden platform floors later replaced by cottages, and participated in clam bakes on the beach (Tottenville Historical Society 2011). The urbanization of this part of Staten Island increased significantly at this time and as a result, large estates were divided into smaller development lots and streets were cut through previously undeveloped areas. Some of the family estates within the Water Hub Potential Location 2 APE began to be subdivided and redeveloped around this time (Pickman 1997).

In the late 1800 and early 1900s, plans were made to develop the area now occupied by Conference House Park. In 1892, a real estate developer named William W. Ziegler purchased a 92-acre tract of land formerly included within a farm owned by William Garretson (Shepherd 2008). After the purchase, streets were cut through the area—the 1907 Robinson atlas depicts the area west of Loretto Street—and the land was divided into blocks and lots for residential development (ibid). The neighborhood was renamed "Bentley Manor" around this time (ibid). In 1902, the Sea Breeze Amusement Park opened on Ward's Point by the Middlesex and Somerset Transaction Company of New Jersey, replacing the former Butler shipyard (Tottenville Historical Society 2011; Shepherd 2008). The 1907 Robinson atlas of Staten Island depicts the former marshes within the park near the Shoreline APE as divided into urban blocks and lots, though none are depicted as developed. A neat grid of streets was also proposed in the area at that time, though the streets were only partially constructed. Several docks were constructed out into the Raritan Bay at that time, likely as a result of the recreational activities that occurred in the summer resort community at the beginning of the century.

The waterfront of the Raritan Bay to the south of the newly developing neighborhoods became a popular summer destination. Many of the individuals who purchased the newly divided lots were residents of New Jersey or Manhattan who were establishing summer estates (Shepherd 2008). While many residents initially lived in tents, some with concrete foundations, a community of bungalows and small homes in addition to larger estates was soon established (Tottenville Historical Society 2011; Shepherd 2008). The beginnings of Surf Avenue between Chelsea and Loretto Streets are depicted on the map in the vicinity of the former Raritan Bay Park, which is not identified on the 1907 map. A pier was constructed at the foot of the line of what is now Yetman Avenue (then known as Bayway Street) near a small wood frame

building that may have been one of several volunteer lifeguard stations that were established by the United States Life Savings Corporation in the early 20th century (Tottenville Historical Society 2011; Shepherd 2008). This lifeguard station was saturated within the location of proposed shoreline restoration between Loretto and Manhattan Streets. The 1907 Robinson atlas also depicts a small section of "Reserved Beach" west of the foot of Loretto Street, a testament to the influx of wealthy vacationers.

The 1909-1911 Topographical Survey of this portion of Staten Island most accurately depicts the conditions of the waterfront in the early 20th century (see **Figure 4**). The majority of the Shoreline APE as shown on the map was occupied by sandy beaches and portions were adjacent to marshland. The beaches sloped gently up to the north, away from the Raritan Bay, though the areas of highest elevation within the Shoreline APE were 4 to 8 feet above sea level. Waterfront estates lined the bay, with many homes featuring private docks or bathing houses along the water's edge. The map depicts the Sea Breeze Amusement Park across Ward's Point, which included various resort facilities, including a dancing pavilion, bathhouses, a pier, and a boardwalk. After a murder at the resort in 1908-1909, its popularity began to wane and it soon closed (Pickman 1997). No buildings in the vicinity are depicted on the 1917 Bromley atlas of Staten Island. The 1917 map is similar to the 1907 Robinson and the 1909-1911 topographical survey and depicts the waterfront community that had become established in the area in the first decades of the 20th century. The resort community remained successful throughout the early decades of the 20th century, including during Prohibition. Ward's Point and the adjacent beaches were popular docking points for liquor-smuggling boats during the 1920s and 1930s (*New York Tribune* 1922; *New York Herald Tribune* 1930). Similar development did not occur along the shore of the Arthur Kill to the north. While the homes in the vicinity of the Water Hub Potential Location 2 were expanded and some additional buildings were constructed on the subdivided estates, this portion of southwestern Staten Island remained largely residential and was not developed at the same pace in the first decades of the 20th century.

INDUSTRIALIZATION AND ADVANCEMENTS IN SHIPPING

The industrialization of southwestern Staten Island began in the 19th century and intensified throughout the 20th. While the Shoreline APE was largely a seaside resort community, various industries were established to the north and to the east of the project location. In addition, the Arthur Kill became part of a major shipping route connecting New York Harbor with industrial and manufacturing facilities in New York City and in neighboring New Jersey. Coastal charts issued as early as 1841 depict an irregular channel of deeper water extending down the Arthur Kill, around Ward's Point, and out into the Raritan Bay. Coastal charts published throughout the 19th century depict the channel as increasingly wider and deeper, as the channel bottom was modified by dredging to accommodate increasingly large ships. A coastal chart published in 1889 is the first to use dashed lines to demarcate the formalized channel within the Arthur Kill to the northwest of the Project sites. The 1918 coastal chart reflects the dredging of the channel within the bay to a depth of 19 feet, which had occurred the year before. The channel was deepened to 20 feet and extended to the north, closer to the Breakwaters APE, as seen on the 1924 coastal chart. Portions of the channel were again dredged in the decades that followed, resulting in a depth of 25 feet in 1925 and 30 feet in 1927, as seen on the 1930 coastal chart (see **Figure 5**). In 1949, the United States Army Corps of Engineers completed an extensive dredging project that created a 500-foot-wide and 35-foot-deep channel through the Raritan Bay near Ward's Point (*New York Times* 1949). The dredging efforts were required to accommodate the increasingly large ships passing through the waters of New York Harbor (Fulbright 1949).

THE DECLINE OF THE RESORT COMMUNITY

Because of the area's rural, largely undeveloped nature, Sanborn insurance maps did not extensively cover the area throughout the first half of the 20th century with the exception of a portion of the Water Hub Potential Location 2 APE, which is covered in a 1917 Sanborn volume. Sanborn map volumes published in 1938 and 1951 depict only the waterfront areas west of Page Avenue and east of Swinnerton Street. Both sets of maps reflect the growing bayside resort community with recreational piers, boathouses, lifeguard stations, small cottages and bungalows. The maps also show that at least one property, the former Laforge estate west of Page Avenue, was protected by a concrete sea wall. The area experienced extensive damage after a hurricane that occurred in 1938 (Shepherd 2008). Beginning in the mid-20th century, the beach communities along the Raritan Bay began to decline, and aerial photographs from the 1950s and 1960s[1] reflect the demolition of the bungalows and bathhouses that formerly lined the beaches near the Shoreline APE, as well as the continued erosion of the beaches themselves. Coastal surveys published after 1975 begin to depict a large sewer extending into the bay from a point near the foot of Joline Avenue. A second major storm occurred in 1981 that resulted in the destruction of much of Surf Avenue (ibid). Maps prepared by the Federal Emergency Management Agency (FEMA) that depict flooding during more recent hurricanes[2] indicate that Hurricane Irene in August 2011 and Superstorm Sandy in October 2012 both resulted in significant flooding to the Shoreline APE and vicinity, causing extensive damage to the waterfront. Aerial photographs depict the ruined remnants of piers and docks in the shallow waters along the shore. Following Superstorm Sandy in 2012, flooding and subsequent erosion resulted in the exposure of 19th century brick "cesspools" and dock remnants that had been buried by rising sea levels (Tottenville Historical Society 2016).[3]

C. MAP-DOCUMENTED STRUCTURES WITHIN THE SHORELINE APE

The 1909-1911 Topographic Survey (see **Figure 4**) most accurately depicts structures within the Shoreline APE. Older maps depict many of the same structures, but with less accuracy. Additional map-documented structures were identified on the 1874 Beers (see **Figure 7**), 1907 Robinson, and 1917 Bromley (see **Figure 8**) atlases of Staten Island as well as limited mid-20th century Sanborn maps. Earlier maps and maps drawn at scales that prevent the accurate location of buildings (such as early- to mid-19th century maps and 19th and 20th century coastal charts) were not used for this purpose, but are referenced as appropriate in the section below. In addition, many of these structures were previously described in the Phase 1A study of Conference House Park that was completed by Arnold Pickman in 1997. Pickman's research is summarized here as necessary.

STRUCTURES ALONG SURF AVENUE BETWEEN MANHATTAN AND YETMAN AVENUES

Several buildings are depicted along this stretch of the beach on the 1938 Sanborn atlas and are depicted in a 1936 photograph taken by P.L. Sperr.[4] These included a large 1-story boathouse with an attached frame platform near the foot of Manhattan Avenue. On the same parcel of land was a 1- to 1.5-story

[1] Accessible at: http://www.historicaerials.com/.

[2] Accessible at: http://www.arcgis.com/home/webmap/viewer.html?webmap=82a2fa929168434dabb6a3970e1d38e0/.

[3] The Tottenville Historical Society website (2016) includes a photograph of "One hundred year old brick cesspools along the beach;" attempts were made to contact the Society to identify the location where these cesspools were observed, but a response was not received at the time of this writing. No evidence of the features included in the photograph or similar features was observed on the site or in aerial photographs taken over the last several years.

[4] Accessible at: http://digitalcollections.nypl.org/items/510d47dd-88b4-a3d9-e040-e00a18064a99.

dwelling located at 528 Surf Avenue.[1] To the east, at 523-526 Surf Avenue, was a largely vacant parcel that was developed with four small 1-story sheds along its northern and eastern sides. Finally, a large, 1-story store (with basement) was located to the east at 522 Surf Avenue. This structure was known as the Tottenville Democratic Club or as the Raritan Bay Park Improvement Association Building. Though historic maps identify the club as a 1-story building, a 1936 photograph of the structure taken by P.L. Sperr suggests that it was constructed on elevated footings to prevent water damage.[2] The photograph also identifies the small shack to the west of the clubhouse as a fish shack. The 1951 Sanborn map indicates that the large store and one of the sheds to the west had been demolished by that time. The remaining buildings were demolished at some point after 1951, and the ruined remnants of the boathouse's frame platform are visible in aerial photographs of the beach at the foot of Manhattan Avenue (see **Figure 3**).

LIFEGUARD STATION NO. 7

As described previously, by the turn of the 20th century, the beach in the vicinity of the Shoreline APE had become a major tourist destination popular among summer travelers. A lifeguard station was constructed on the waterfront west of the foot of Yetman Avenue (formerly Bayway Street) after 1911, as it does not appear on the 1911 topographical survey. The 1917 Bromley atlas of Staten Island is the first to depict this long, rectangular structure. Photographs of the station depict a simple wood frame structure on a concrete slab (Tottenville Historical Society 2011). The "United States Volunteer Life Saving Corporation Station No. 7," was captured in a photograph taken by P.L. Sperr in 1936.[3] A smaller square structure with a front porch is depicted in nearly the same location, though slightly to the east, at the foot of Yetman Avenue, on the 1938 and 1951 Sanborn maps and identified as the "Raritan Bay Park Life Saving Station No. 1 (Volunteer)." No structures are visible in the vicinity on a 1951 aerial photograph of Staten Island.[4]

SHORE HOUSE HOTEL

A small, 1-story wood frame structure is depicted on the 1907 Robinson atlas at the southeast corner of Yetman and Surf Avenues; no structures are shown in this area on the 1898 Robinson atlas. The 1911 Topographical Survey (see **Figure 4**) depicts the structure as an L-shaped building with front and rear porches. A second, smaller outbuilding is depicted on the map to the east of the station and a large pier stretched out into the water to the southwest. These structures were part of the Wormland Hotel, one of the first hotels in the vicinity (Pickman 1997; Tottenville Historical Society 2016). The 1917 Bromley atlas depicts this structure as a 1-2 story wood frame hotel and depicts two additional outbuildings on either side of it. Known as the Shore House Hotel, this facility was a popular summer destination in part because of the large recreational pier and its large waterfront coverage (Shepherd 2008). The hotel was originally enlarged by proprietor Oscar Friedrich and was later managed by Charles Peters (Tottenville Historical Society 2016). The hotel was closed and demolished before the publication of the 1938 Sanborn map, which depicts only a small 1-story store along Surf Avenue in the hotel's former location. This store is not depicted on the 1951 Sanborn map. The site of the hotel has been lost to erosion and the building's location is now inundated (Pickman 1997).

[1] The map identifies the buildings as 428 Surf Avenue, which is inconsistent with the street numbers elsewhere on the block.

[2] Accessible at: http://digitalcollections.nypl.org/items/510d47dd-88ba-a3d9-e040-e00a18064a99

[3] Accessible at: http://digitalcollections.nypl.org/items/510d47dd-88bc-a3d9-e040-e00a18064a99

[4] Available at: http://maps.nyc.gov/doitt/nycitymap/

LIFE SAVING STATION/SANDWICH SHACK AT FOOT OF ROCKAWAY STREET

The 1917 Bromley atlas depicts a complex of two structures east of the foot of Rockaway Street that were owned by the US Volunteer Life Savings Corporation. The complex included a U-shaped structure made up of two 1-story wood frame buildings connected by a wood frame porch and a slightly larger 1-story wood frame building to the east. These structures were associated with the Raritan Bay Park Improvement Association (Pickman 1997). A 1936 photograph of the southern side of Surf Avenue at the foot of Rockaway Street taken by P.L. Sperr depicts three small shacks, a "Life Savers Club," the "Ocean View" sandwich shack, and a small structure marked "private beach."[1] These structures are depicted on the 1938 Sanborn map, which identifies the connected 1-story "private beach" buildings as bath houses, the sandwich shop as a store, and the lifesaving station as a club house. All of these structures were demolished before the publication of the 1951 Sanborn map and have since been inundated by the bay.

RESERVED BEACH BUILDING AT THE FOOT OF LORETTO STREET

The 1898 and 1907 Robinson atlases depict a "Reserved Beach" west of the foot of Loretto Street, though only the latter map indicates that a small wood frame structure was located in this area. A more substantial structure is depicted in this location on the 1911 topographical survey. This building was demolished before the publication of the 1917 Bromley atlas, which depicts four 1-story wood frame bungalows in the same location. The 1938 Sanborn map depicts a total of five small dwellings and one outbuilding on the same parcel, three along Surf Avenue (similar to that seen on the 1917 map) and two to the south, along the water. By 1951, only the three bungalows along Surf Avenue remained, with the two to the south presumably having been destroyed or demolished as a result of erosion and storm damage.

BISHOP'S COTTAGE AND BATH HOUSE

The property of Clennon Bishop, whose home was known as "Bishop's Cottage," was situated along the waterfront between Loretto Street and Sprague Avenue, as seen on the 1907 Robinson atlas. The house itself was just north of the location of the Shoreline APE (near the line of Billop Street) and a small bathhouse on the property was along the waterfront within the APE. The small wood frame structure is depicted on the 1907 Robinson Atlas and on the 1911 topographical survey. The bathhouse does not appear on any subsequent maps or atlases.

REILLEY'S BEACH HOUSES

The 1909 topographical survey depicts a small 1-story house with a front porch and a rear addition along the waterfront east of the foot of Sprague Lane. The same home is depicted on the 1917 Bromley atlas, which indicates that it was included within a bungalow compound owned by the "Rully Realty Company." Additional 1-story bungalows were constructed to the north and east of the previous home. Photographs of the waterfront were taken in 1936 by P.L. Sperr in this location that depict many small docks, some in ruins, and a bulkhead wall along the beach east of Sprague Avenue.[2] The 1938 Sanborn map identifies the complex as "Reilley's Beach" and suggests that the previous waterfront home had been demolished. Additional bungalows are depicted on the property on that map, as is a 1-story dwelling along the waterfront near the southeastern corner of the property. The 1951 Sanborn map depicts no changes to the property. The buildings have all been demolished and the area is now a wooded area.

[1] Accessible at: https://digitalcollections.nypl.org/items/510d47dd-88b6-a3d9-e040-e00a18064a99

[2] Accessible at: http://digitalcollections.nypl.org/items/510d47dd-afb9-a3d9-e040-e00a18064a99

COOLEY/ROBINSON HOME AND THE ROBINSON'S BEACH BUNGALOWS

The Cooley family was one of the first to reside in Tottenville after Phillip and Eliza Cooley, who were free individuals of African descent, moved to Staten Island from Virginia, where Philip established himself as an oysterman (Shepherd 2008). Philip purchase 30 acres of waterfront land from Abraham C. Totten in 1830 and died two years later (ibid). The Cooley's home is identified on many early- and mid-19th century maps of Staten Island, including those published by Butler in 1853 and Walling in 1860.

The Cooley's son, William, would purchase 5 acres of land in the northern portion of the estate in 1855 and his home at 132 Sprague Avenue is still extant (ibid). The 1874 Beers atlas (see **Figure 7**) depicts the long, narrow remnant of the estate of "Mrs. E. Cooley" along the water midway between Sprague and Joline Avenues. A small, square home was located at the southern end of the property as seen on the 1874 map. The 1898 and 1907 Robinson and 1917 Bromley atlases depict former Cooley property as divided into four narrow parcels. The parcel containing the 1-story wood frame home is identified on the 1898 atlas as the property of George Robinson and on the 1907 and 1917 maps as the property of the heirs of Mary Robinson. The small home, which had a rear addition, is depicted on the 1909 topographical survey (sheet 98), which also depicts what three angled bulkheads that extended out to the water to the south of the home, the remnants of the easternmost of these bulkheads appears to be visible on modern aerial photographs. By 1924, the Cooley home appears to have been demolished and replaced by a series of smaller buildings, as seen on an aerial photograph taken that year.[1] The Sanborn map published that year depicts the four narrow parcels as "Robinson's Beach," a bungalow community containing 24 small dwellings and other outbuildings. Nine of those buildings were located on the same parcel that formerly contained the Cooley home. The location of the Cooley home now appears to be included within a grassy lawn adjacent to a modern house west of the foot of what is now Bruno Lane. Pickman (1997) reported observing a "layer of shell" containing 19th century ceramics "eroding from the bank adjacent to the beach" in the vicinity of the former Cooley home (Pickman 1997: 106).

THE JOLINE ESTATE AND BUNGALOWS

East of the historic Cooley estate was a large parcel of land owned by the Joline family, another of southern Staten Island's founding families for whom Joline Avenue was named. The Joline home is identified on many early- and mid-19th century maps of Staten Island, including those published by Butler in 1853 and Walling in 1860. The 1874 Beers atlas depicts the B. Joline property to the west of Joline (formerly Central) Avenue, adjacent to the Cooley home. The property was developed with at least three structures, two of which, including what appears to have been the family's residence, along the waterfront within the vicinity of the Shoreline APE. Pickman (1997) suggests that these structures along the waterfront may have been bath or boathouses.

These structures are depicted on the 1887 Beers map, but do not appear on the 1898 and 1907 Robinson atlases, which identify the property as belonging to J.B. Kaiser. Both maps depict a smaller residence and a barn further to the north, near the southwest corner of what are now Joline Lane (formerly Prattle Place) and Joline Avenue, and a dock that extended out into the bay at the water's edge. The 1909 topographical survey depicts the property in the same manner; however, the 1917 Bromley atlas reflects the construction of four small bungalows or bathhouses along the waterfront expanse of this property, which was divided into smaller lots by that time. Similar small buildings and additional associated outbuildings are depicted on the 1938 Sanborn map, which also describes the dock at the eastern edge of the former Joline estate as a "wood pier on wood piles." The 1951 Sanborn map depicts additional 1-story bungalows along the

[1] Accessible at: http://maps.nyc.gov/doitt/nycitymap/.

western side of Joline Avenue, which are identified as bunk houses of the "Volunteers of America Newark Camp." This area is now developed with four large homes.

HENRY HACHENMEISTER ESTATE BATH HOUSE

As seen on the 1874 Beers atlas, the Joline estate originally extended east of Joline Avenue, however, no structures associated with that portion of the estate were located adjacent to the waterfront. No structures are shown in this area on the 1898 Robinson atlas, which indicates that the property was owned by Fred. Opperman at the time, though that map depicts a large dock at the southern end of the property. By the publication of the 1907 Robinson atlas, that property had been purchased by Henry Hachemeister, a former New York State Assemblyman (Tottenville Historical Society 2011). The 1907 Robinson atlas depicts a small wood frame structure along the waterfront at the southeastern corner of the property. The 1909 topographical survey identifies the building as a boathouse and identifies a small structure in what may be a fenced-in enclosure to the north. The map also indicates that the entire Hachemeister property was separated from the bay by a bulkhead wall. An extremely long dock extended out into the Bay along the line of a path that extended south from the home's southern wall to the north of the APE. By the publication of the 1938 Sanborn map, the former Hachemeister estate had been converted into a "fresh air camp" run by the Volunteers of America. The home and barn on the old estate continued to stand (now used as dormitories) and the bathhouse was demolished and the eastern side of the property was lined with a row of 1-story bungalows and a 1-story pavilion was constructed in the center of the property. The extended dock was replaced with a shorter wood pier on wooden piles. The 1951 Sanborn map depicts the parcel in the same way. This area is now located in the yard of large, modern houses that were constructed along the waterfront over the last few decades.

HOME WEST OF BEDELL AVENUE

The 1938 and 1951 Sanborn maps depict a 2-story dwelling along the waterfront west of Bedell Avenue. This structure is not depicted on previous atlases. The home was still visible on an aerial photograph taken in 1996.[1] It was demolished before 2006 and its former location is now south of the bulkhead wall that was constructed to protect several large, modern houses that now line the waterfront in this location.

WATERFRONT STRUCTURES EAST OF BEDELL AVENUE

To the east of Bedell Avenue was a large estate occupied in the early 20th century by the New York Fishing Club. All structures associated with this property were located to the north of the Shoreline APE, although a large pier extended south into the bay from this location. The 1909 topographical survey and the 1938 and 1951 Sanborn maps depict the pier as a very long (300 feet) wood pier on wooden piles extending out into the bay. The dock does not appear in the 1951 aerial photograph of the area with the exception of its L-shaped tip far out into the bay. The Sanborn maps also depict a concrete sea wall attached to a small wood pier extending into the bay. Remnants of the sea wall and the wooden pier are still visible in current aerial photographs (see **Figure 3**).

DUBOIS PROPERTY (FOWLER/CLARK/LAFORGE/DECKER HOMES)

The DuBois family was among the first residents of Tottenville and was granted a large estate along the water west of what is now Page Avenue in the early 19th century. The complicated ownership and residential history of this property is presented at length in Pickman's 1997 Phase 1A study (Figure 37 in Pickman's 1997 report depicts the various properties making up the former DuBois estate). By the

[1] Accessible at: http://maps.nyc.gov/doitt/nycitymap/.

publication of the 1874 Beers atlas, the property had been divided numerous times and three structures were in the vicinity of (but not within) the APE. These homes were owned by the Fowler, Clark, Decker, and Laforge families, as described below.

FOWLER AND CLARK HOMES

The Fowler home is depicted on the 1874 Beers atlas along the western side of Page Avenue. This is likely the former DuBois home as identified on several early maps of Staten Island, including the 1853 Beers and 1859 Walling maps. Elizabeth Lambert, a descendant of the family, married Thaddeus Fowler and acquired the land by the late-19th century (Pickman 1997). At this time, the property included the land that was later owned by the Clark family, as described below. Dr. Ottochur E. Kopeteschny (also spelled Kopetchny) purchased the Fowler property in 1884 and is identified as its owner on the 1887 Beers map (Pickman 1997).

Both the 1874 and 1887 Beers maps depict a single home in the center of a 2-acre property. Kopeteschny divided the property into two parcels, as seen on the 1898 Robinson atlas, and sold the newly created lot on the western side of the property to David Clark, who is identified as the owner on the 1898 map (Pickman 1997). Clark's property featured a home that was situated just north of the APE. To the east was the home of Dr. O.E. Kopetchny, which was further north and is still standing along Page Avenue to this day. Therefore, the buildings on both properties appear to have been immediately adjacent to, but not substantially within, the APE.

The 1907 Robinson atlas depicts these properties in the same manner, and identifies Josephine Hagerty as the owner of the home to the west and Dr. O. E. Kopetchny as the owner of the home to the east. Both homes are shown on the 1909 topographical survey of Staten Island, which depicts a small bathhouse within the APE along the waterfront south of the Kopetchny home. Bulkhead walls protruded out into the bay south of both homes, the remnants of which are still visible in aerial photographs. The 1917 Bromley atlas depicts the buildings in the same manner and does not identify the owner of the house to the west, but confirms that O. and E.F. Kopetchny continued to reside in the home along Page Avenue to the east. Both homes continue to be depicted on the 1938 and 1951 Sanborn maps, which also depict a wood pier on wooden piles extending south into the bat from the southwest corner of the former Hagerty property near the bulkhead identified on the 1909 topographical survey. The former Hagerty home was demolished between 1996 and 2006, as seen on aerial photographs.

LAFORGE AND DECKER ESTATES

The boundaries that defined the Laforge and Decker properties, as described in Pickman 1997, were irregular and changed over the years as properties were divided and purchased among various owners. The 1874 Beers map depicts the Laforge family's estate to the southwest of the corner of what is now Page (formerly Beach) Avenue and the Ottavio Promenade. The 1874 map depicts three structures on two parcels of land along the waterfront, including a large L-shaped parcel and a smaller parcel set into the first so that the two parcels combined formed a large rectangle. The 1874 atlas depicts the L-shaped parcel as belonging to the Laforge family. While buildings were located along the northern side of the parcel, one building was located in the southeast corner of the parcel, adjacent to the Shoreline APE. Two structures adjacent to or partially within the Shoreline APE were located on the smaller parcel to the west, which was formerly owned by Abraham Decker after he purchased the property from David Dorshay in 1848 (Pickman 1997). The Laforge property had previously been owned by members of the Lambert family; a well was located on that property to the north of the APE (ibid). Early maps, including the 1853 Butler and 1859 Walling maps, show the Decker (Deckert), Lambert, and Dubois houses in this general location.

The structures shown on both properties on the 1874 Beers atlas all appear on the 1887 Beers atlas as well. The 1898 Robinson atlas depicts a similar division of the property, but suggests that the boundaries were more irregular than those depicted in 1874. The map identifies Mary A. Laforge as the owner of the larger parcel and Paul Schaefer as the owner of the inset parcel, which is shown as two lots on this map, only the western of which was developed with a structure. Pickman suggests that the Laforge family may have rented out the house on the southern portion of their property as a vacation rental while the family resided in the former Lambert home to the north (Pickman 1997).

By 1907, only the wood frame structure at the southeast corner of the Laforge property was still standing. The 1907 atlas depicts the area formerly shown as the Laforge and Schaefer lots as a single parcel owned by Louise and John Laforge, although an undeveloped parcel along the waterfront to the south is identified as the property of Alice DuBois. As seen on the 1909 topographical survey, the main home on the estate was situated further to the northwest and the building along the water front was a smaller secondary structure, though its exact use is not legible on the 1909 map. This structure was adjacent to the APE to the north. The southern side of the property, within the Shoreline APE, was lined with a picket fence, as identified on the topographical survey, and two bulkhead walls extended out into the water from the beaches to the south. Additional bathhouses and a small shed were located near the waterfront to the south of this property (Pickman 1997). The 1917 Bromley map depicts the same buildings, though it indicates that the owners were J.H. and Mary Laforge and that a dock had been constructed at the southwest end of the property. Before the 1924 aerial photograph of the area was taken, all of the buildings on the property had been demolished and replaced. The 1938 and 1951 Sanborn maps depict the new buildings, including a 2-story home with a front porch along the waterfront within the Shoreline APE, a concrete sea wall lining the southern side of the property, a wood pier on wooden piles extending into the Bay at the center of the property. The remnants of the dock is still visible in aerial photographs, though the home was demolished after Superstorm Sandy in 2012, though the concrete pad on which it was located and a driveway that was used to access the building are still extant.

THE RARITAN BAY HOTEL

A structure is depicted at the northeast corner of Page Avenue and Surf Avenue—within the location of the proposed water hub—on the 1859 and 1860 Walling maps, which identify the building as "J.T. Butler's Shop." In 1865, Butler sold the property to Thaddeus Fowler, who owned the property on the western side of Page Avenue, who in turn sold it to David Mahen four years later (Pickman 1997). An 1872 Dripps map of Staten Island identifies the structure as the "Bay View House." The 1874 Beers map depicts a structure in this area within a 7-acre parcel of land owned by "Col. M."[1] The 1887 Beers map lists both "Col. M." and John Flynn as the owners of the property while the 1898 Robinson atlas identifies only the latter owner and also depicts and additional structure to the east of the home seen on the 1874 map. Flynn purchased the property in 1877 and if he and his family occupied the home, it was not on a full-time basis (Pickman 1997).

The land was purchased by Charles Stark in 1903, who converted it into a hotel property 1900 (Pickman 1997; Shepherd 2008). The 1907 Robinson map depicts the wood frame Raritan Bay Hotel in the location of the home seen on previous maps and several small outbuildings on the property to the north. The 1909 topographical survey depicts the 3-story frame hotel with several extensions to the east and a detached 1-story wood frame shed. A long dock extended out into the bay as seen on that map. The 1917 Bromley atlas depicts the hotel and the adjacent dock in the same manner. The 1938 Sanborn map only partially depicts the hotel, as the Sanborns do not cover the area to the east of Page Avenue. The 3-story main portion of the hotel is depicted on that map, as is a bulkhead wall that lined it to the south and is also

[1] Pickman (1997) states that David Mahen is "Col. M."

depicted on the 1909 topographical survey and the 1917 Bromley atlas. In 1921, the hotel was purchased by Saint Mary's Camp for Girls, associated with the Saint Mary's Roman Catholic Church of Bayonne, New Jersey (Shepherd 2008). The structure is not shown on the 1951 Sanborn map or on the 1951 aerial photograph, which also reflects the demolition of the dock to the south. The location of the former hotel is now occupied by a paved parking lot. Pickman described the site as, "graded" and having been subjected to "a substantial amount of disturbance" (Pickman 1997: 101).

D. MAP-DOCUMENTED STRUCTURES WITHIN THE WATER HUB POTENTIAL LOCATION 2 APE

Three historic properties were wholly or partially situated within the Water Hub Potential Location 2 APE: the Biddle estate; the Rutan estate; and the Leven/Wood estate. A portion of the former Rutan shipyards was also historically located within the APE. The history of these properties has been extensively documented in previous studies—most notably Pickman's 1997 Phase 1A of Conference House Park—and as such, the occupation of these homes will only be summarized here while greater focus will be placed on the development of these properties and the assessment of past disturbance across the site.

THE BIDDLE ESTATE

The property formerly owned by Henry Hogg Biddle is situated at the extreme northern end of Shore Road, which was historically known as Pittsville Avenue (Block 7966, Lot 75) and extended west from Satterlee Street to the shore. Though it is mapped between Satterlee Street and the shoreline, Shore Road (aka Stairway Street) is only constructed as far west as the existing Biddle House. What would come to be known as the Biddle property had been included within the portion of the Billop land grant that was later sold to Samuel Ward (Pickman 1997). The property was transferred to Isaac Butler in 1801 and was sold to Biddle, who was married to Butler's daughter Harriet, after Butler's death in 1831 (ibid). Like his father-in-law before him, Biddle was the proprietor of the tavern at the Amboy Road ferry landing until its destruction in an 1866 fire, appears to have resided to the north of the APE until the mid-19th century (Zavin 1990; Pickman 1997).

The 1850 Dripps map and 1853 Butler map are the first to depict structures in the vicinity of the APE in addition to the Billop/Conference house and the Amboy Road ferry, which are shown on maps dating back to the 18th century. The two maps are generally similar, and both depict two buildings owned by "H. Biddle" including the tavern at the waterfront south of Amboy Road and another building further to the north. Two structures are depicted along the unnamed road lining the southern side of the Rutan property to the south, on the Rutan estate, but no structures are depicted on either map in the vicinity of the existing Biddle House.

Biddle resided in this home with his wife, Harriet, who was the daughter of the previous landowner Isaac Butler, and their children as well as a servant of African descent (Pickman 1997). After the death of his wife, Biddle remarried his second wife, Margaret, in 1844 or 1845, and after her death he married his third and final wife, Sarah, in 1882 (ibid). Biddle appears to have constructed the existing house in the early 1850s after his second marriage and after rebounding from a period of financial destitution during which he nearly lost ownership of his real estate holdings (Zavin 1990). By the 1850s, the area surrounding the western terminus of Amboy Road had become known as "Biddle's Grove," a popular recreation spot (Leng and Davis 1930; Zavin 1990). In 1850, "some capitalists…desirous of erecting…a large hotel" on Biddle's Grove offered to purchase the property from Biddle (*Brooklyn Daily Eagle* 1850). In 1853, the property was described as "Mount Hermon (Biddle) Grove…recently purchased by

Dr. E. W. Hubbard" (*Brooklyn Daily Eagle* 1853:3). It seems likely that after making this sale, Biddle constructed a new home within what is now the northern portion of Conference House Park.

The existing Biddle house is first depicted on the 1856 Coastal survey of Staten Island, which shows the home at the top of the bluffs leading down to the shore to the west. No other structures are identified on the property at that time. A series of maps published by Walling in 1859 and 1860 and Colton in 1866 identify Biddle (also spelled Bedell) as the owner of the house. Beers' 1874 atlas of Staten Island (see **Figure 7**) identifies the entire H. Biddle property as a 2-acre tract of land, as does Beers' 1887 map of the area. Biddle himself died in 1887 and his son, Charles S. Biddle, inherited his land and continued to live there along with his widowed step-mother (Pickman 1997; Zavin 1990). C.S. Biddle is identified as the owner of the 2-acre estate on the 1898 Robinson atlas. That atlas is also the first to depict an outbuilding on the property. Identified as a wood frame barn or stable, the structure was located to the northwest of the Biddle house.

In 1904, the Biddle family sold the property to George T. Brewster, a sculptor who used the adjacent barn as a studio (Pickman 1997). Brewster was "an 1886 graduate of the École des Beaux-Arts...[and] was known for instituting life modeling classes at the Art Students League and the Rhode Island School of Design" in addition to teaching at the Cooper Union (Zavin 1990: 6). The 1907 Robinson and 1917 Bromley atlases (see **Figure 8**) identify Brewster as the owner of the property but otherwise does not depict any changes to the property. The 1911 topographical survey (sheet 97) refers to the barn to the north of the Biddle house as a 2-story frame barn (see **Figure 4D**). A well is depicted to the south of the home's southeastern corner, possible in the location of a current sinkhole (see **Photograph 17**). A small, approximately 6-foot-square outbuilding is also shown on the map to the southwest of and slightly downhill from the home. While it is likely that the home would have indoor plumbing by the early 20th century (although it is not expected that it would have been connected to sewer and water lines), it is possible that this small structure was an outhouse, whether functional or not. If it were an outhouse, its placement downslope from the well may have been a strategic attempt to not contaminate the water supply. The map also indicates that the property line of the Biddle estate was lined with a picket fence while its northern property line was bounded with a "high picket and wire fence." The 1917 Sanborn map identifies the barn to the northwest of the house as a 1.5-story wood frame auto garage. A 1924 aerial photograph[1] of the area shows a series of more than five ships that appear to be wrecked vessels along the eastern shore of the Arthur Kill northwest of the Biddle property. Wrecked vessels are not observed on any subsequent aerial photographs or nautical charts in this location although a coastal chart published in 1995 and in subsequent years indicate the presence of wrecks further to the north which are not visible on a 1996 aerial photograph.[1]

Brewster sold the property to Charles Peterson in 1933 and Peterson and his heirs continued to own the property through the late-20th century before it was purchased by NYCDPR. No changes to the property are depicted on the 1937 Sanborn map although the 1951 Sanborn map reflects the demolition of the barn and the construction of three new outbuildings to the east at the terminus of Wards Point Avenue, where two small buildings continued to stand.

THE RUTAN ESTATE AND SHIPYARDS

The property of William H. Rutan was situated immediately to the south of the Biddle estate and is situated along the waterfront between the lines of Shore Road/Pittsville Avenue, Satterlee Street, and the previously referenced unnamed road. Rutan and his brother, James, established a shipyard to the southwest circa 1848 and subsequently constructed a complex of buildings within and around the APE,

[1] Accessible through: http://maps.nyc.gov/doitt/nycitymap/.

adding additional tracts of land in subsequent years (Pickman 1997). The shipyard property was the western portion of the Samuel Wood estate (see below) before the Rutan brothers purchased it (ibid). The Rutan brothers' father had been a ship builder as well and their yard was constructed on a 1.5-acre plot purchased from Henry Hogg Biddle in 1847 (ibid).

The 1850 Dripps and 1853 Butler maps are the first to depict buildings in the area of the Rutan Property. The Butler map, which is more legible than Dripps' map, depicts the small neighborhood of "Unionville" as well as a precursor to Satterlee Street the previously mentioned unnamed road that ran through the area but which originally connected the shipyards with Satterlee Street. Two structures are depicted on the Butler map along the northern side of the unnamed road, one just northwest of its intersection with Satterlee Street and another further to the west, which is presumably the existing Rutan-Beckett house. Another structure was located near the southwest corner of Satterlee Street and the unnamed road as well as the main building of the shipyard—identified by Pickman (1997) as the shipyard's chandlery—further to the southwest. All four buildings are identified on the map only as "Shipyard." The 1856 Whiting coastal survey depicts a small building to the east of the Rutan-Beckett house, which may be the structure seen on earlier maps. Pickman (1997) speculates that the eastern home may have been occupied by James M. Rutan before he purchased a home on the eastern side of Satterlee Street in 1864.

The 1859 Walling map provides some additional detail on the Rutan shipyard complex. The home of "W.H. Rudan" (sic) is depicted to the north of the unnamed road (any outbuildings on the property are not depicted on that map). The map depicts two buildings along the south side of the unnamed road; one a store associated with the ship yard and the other identified as the home of S. Wood. Further to the southwest was a large building adjacent to a dock that was identified as "W.H. & J.M. Rudan's Ship Yard; W.H. Rudan Supervisor." Walling's 1860 map and Colton's 1866 map both depict the area in a similar manner.

William H. Rutan served as the supervisor of the town of Westfield from 1858 through 1861 and as a member of the New York State Assembly in 1864 (Leng and Davis 1930). He died in 1869 and the property was inherited by his widow, Mary J. Cole (Pickman 1997). Beers' 1874 atlas (see **Figure 7**) depicts only a single home on the property of "Mrs. Rutan." No buildings on the properties to the south are identified as part of a shipyard, although the former ship chandlery appears to be present and is identified as the property of "R. Christopher" (Pickman 1997) The Rutan home was later acquired by Mary and William Rutan's daughter, Mary Rutan Woglom, and her husband, William H. Felch, who was a part owner of the Rutan ship yards (Pickman 1997). The 1898 Robinson atlas, which depicts Felch as the property owner, depicts numerous changes to the property. In addition to the main Rutan home, a small L-shaped wood frame building had been constructed to the east. Two small wood frame barns or stables were located further to the east on the property and a large wood frame barn or stable was constructed along the beach to the east, at the foot of a pier that stretched out into the Arthur Kill. The property was by that time separated from the grounds of the former shipyard chandlery, which is identified on the map as the property of the heirs of David Forshay, who had purchased the Rutan shipyard property in 1880, though James Rutan continued to occupy the site for many years afterward (Pickman 1997). Pickman (1997) could not find any evidence that the building was actually occupied by Forshay or any of his heirs or that it was in use as a shipyard during that time. The 1907 Robinson map depicts the property in much the same way.

The 1911 topographical survey provides additional detail regarding the former Rutan property (see **Figure 4D**). The survey depicts a dock lining the northwestern edge of the property. Two small outbuildings, a barn and a shed, were constructed on the waterfront near the foot of the dock. The second structure depicted on the 1898 and 1907 Robinson atlases is not depicted on the 1911 survey, however, an attached 1-story wood frame rear wing constructed to the east of the Rutan home is shown on the survey, which Pickman (1997) suggests was the same structure seen on previous maps as a separate building.

However, the size and shape of the eastern building does not match that of the rear wing seen on the 1911 survey, and it is therefore possible that the eastern home was demolished after 1907. This wing is no longer extant and the grade of the rear yard rises steeply behind the house (see **Photographs 19** and **20**), suggesting that the landscape has been modified to the rear of the home. Two small outbuildings, each approximately 6-feet-square, were shown in the vicinity of the home, one approximately 12 feet to the north and the other approximately 40 feet to the southeast. The size of these buildings suggest that they might have been outhouses. The presence of two potential outhouses and the greater distance of the second from the Rutan home may indicate that it was originally associated with the former second home to the east. Three additional outbuildings are depicted in the eastern portion of the Rutan property: two small wood frame barns (seen on previous maps) and an unidentified 1-story frame building to the north, near the boundary between the Rutan and Biddle properties.

The line of the unnamed road seen along the southern side of the Rutan property on previous maps is not marked as a formal road on the 1911 survey, although irregular topographical lines in the location of the road suggest that grading occurred as a result of the constructed of a road surface. A fence lined the southern side of the road, separating it from the Leven/Wood property to the south. Within the former shipyard property to the south, the remnants of a pier associated with the "old shipyards" was extant to the south of the APE. A large, 1.5-story frame building with several rear additions that was formerly associated with the shipyards was located along the waterfront at the base of the bluffs southwest of the Rutan home. Two small outbuildings were located to the northwest of this structure.

The 1917 Bromley atlas depicts several changes to the former Rutan property (see **Figure 8**). Only the Rutan home and the barn at the foot of the dock remained on the residential estate at that time. The remainder of the property to the east had been divided into two lots, a smaller property to the east of the Rutan house and a larger lot extending west from Satterlee Street. This subdivision occurred after Mary Felch sold the property to James S. Graham in 1910 and he subsequently sold a portion to Helen M. Lindsay (Pickman 1997). The map does not identify any trace of the previously-referenced unnamed road, though it identifies Shore Road (aka Pittsville Avenue) as a built street extending through what is now Conference House Park between Satterlee Street and the water. The map also continues to depict the 1.5-story commercial building and ruined pier as the property of the heirs of David Forshay. Maps continue to depict Mary Felch as the owner of the property through 1917 although she appears to have purchased the Leven/Wood property to the south around the time that she sold the Rutan estate to Graham in 1910 (Pickman 1997).

The 1917 Sanborn map, though published the same year, reflects some critical differences in the development of the property. The former Rutan house is identified as the property of "Mrs. Felch" and the small lot shown to the east on the 1917 Bromley atlas is depicted as developed with a 2-story stuccoed wood frame dwelling occupied by "Mrs. Lindsay," which is the home now known as 8 Shore Road. No waterfront docks or piers are identified anywhere along the waterfront. The large building in the vicinity of the former ship yard is identified as the 1.5-story (with basement) home of "Mrs. D. Forshay." The Felch and Lindsay homes are all depicted in the same manner on the 1937 and 1951 Sanborn maps. Both maps depict an outbuilding, presumably a garage, to the south of the Lindsay home. While the former Forshay home is depicted on the 1937 Sanborn, it had been demolished before the publication of the 1951 map. In the 1950s, the home was purchased and renovated by the Beckett family (Conference House Park Association 2017). Pickman (1997) noted that midden deposits were observed on the Rutan property south of the area now developed with a cinder block garage and that features, midden deposits, and foundation remnants were visible in the vicinity of the former Rutan shipyard chandlery.

THE WOOD/LEVEN ESTATE

A portion of the former Wood/Leven estate is situated in the southern portion of the Water Hub Potential Location 2 APE. This tract extended east from Satterlee Place and was situated south of the Rutan property and west of the Rutan shipyards and as such, it did not extend all the way to the waterfront. The former Wood estate represents one of the oldest tracts of occupied land in the Tottenville area other than the Billop house. In 1834, a 1.5-acre tract was transferred from Caleb Ward, Jr.—the son of Samuel Ward, for whom Ward's Point was named—to his daughter and son-in-law, Hannah and Samuel Wood (Pickman 1997). Pickman (1997) suggests that census records indicate the Woods may have resided on the property even before the sale and were likely living there by 1840, however, the coastal surveys issued in 1835, 1841, 1844, and 1845 do not clearly depict any structures in the vicinity of this property. The 1850 Dripps and 1853 Butler maps depict the home of S. Wood along the western side of Satterlee Street, at the extreme southeastern corner of the APE.

The 1856 Whiting coastal survey depicts the Wood estate and appears to depict a property boundary (possibly lined with a fence or path) along the southern side of the estate. The unnamed road that lined the southern side of the Rutan property and led west to the shipyards marked the northern line of the Wood estate. The property appears to have been divided into two parcels at this time. The first, containing the Wood home which continues to stand at 96 Satterlee Street to this day, was situated along Satterlee Street and a small property boundary or fence line is depicted around the home, separating it from the rest of the property. A second, larger home was constructed further to the west within the APE. The 1859 and 1860 Walling maps indicate that at that time, the home along Satterlee Street was occupied by "T. Leven" while the home to the east was that of "S. Wood." Wood had sold the smaller property along Satterlee Street to Theodore and Ann Eliza Leven in 1849, though the Leven's ownership or occupation of the area is not depicted on the 1850 Dripps or 1853 Butler maps, although the home may be incorrectly depicted as part of the Rutan shipyard to the north (Pickman 1997). In 1859, after Wood's death, his heirs sold the western portion of the estate to the Leven family although they continued to reside in the home along Satterlee Street until some time before 1880, when one of the Leven children appears to have occupied the western home (ibid). The 1866 Colton map continues to depict Wood and Leven as the owners of the two homes on this parcel depict Wood's death and Leven's subsequent purchase of the land to the west.

The 1874 Beers atlas (see **Figure 7**) and the 1887 Beers atlas depict both homes on the 1.5-acre parcel as owned by T. Leven. Catherine S. Leven purchased her parents' home in 1883 and continued to live there alone or with tenants until 1910, during which time rental tenants may have been living in the home to the west (ibid). Catherine S. Leven is identified as the property owner on the 1898 Robinson and 1907 Robinson atlases of Staten Island. Both maps depict two wood frame structures on the property, the existing Wood/Leven house along Satterlee Street and a large, rectangular wood frame dwelling at the western side of the property. The 1911 topographical survey (see **Figure 4D**) provides additional information regarding the Wood/Leven property. The map identifies the eastern home along Satterlee Street as a 1.5-story wood frame dwelling with a 1-story frame rear addition that has since been demolished. Approximately 35 feet west of the Wood/Leven home were three adjacent 5-foot-square outbuildings, possibly outhouses, although Pickman (1997) notes that they may have been sheds that were identified on tax records describing the property. The western home is depicted as a frame house and the map may indicate that it was divided into two separate units. The home was located at the western edge of the bluffs lining the waterfront in the vicinity of this property.

As described previously, in 1910, the land was purchased by Mary Felch, the previous owner of the property to the north although it is unclear when Felch began to occupy the property (Pickman 1997). The 1917 Bromley atlas continues to show the two homes on the property and, like the 1911 topographical survey, suggests that the western home was divided into two homes. The atlas depicts a third building, a 1-story frame structure, to the northwest of the eastern Wood/Leven home, the footprint of which is

shown to be the same as that seem on previous maps. The 1917 Sanborn map, however, depicts numerous changes to the buildings on the parcel. The eastern Wood/Leven home is shown to have two separate 1-story food frame rear wings extending west from the northwestern and southwestern corners of the house. A small 1.5-story outbuilding was located to the northwest of the home, which may be the same as the building depicted on the Bromley atlas of the same year. The 1.5-story western dwelling is also depicted, and two small wood frame outbuildings are also mapped to the southwest of that home. One of the buildings is very small and would have been located slightly downhill from the home, suggesting that it may have been an outhouse. The 1917 Sanborn map identifies both homes as the property of "Mrs. Felch."

Felch sold the western portion of the property in 1923 (Pickman 1997). The 1937 Sanborn map depicts the property in a similar man as the 1917 Sanborn map. An additional outbuilding was constructed to the south of the eastern Wood/Leven house, southeast of the APE, and the outbuilding to the northwest of the home was identified as an auto garage. A second 1-story dwelling was constructed on the parcel to the north of the home at 90 Satterlee Street by that time. No outbuildings are depicted in association with the western home at that time. The western house was demolished before the publication of the 1951 Sanborn map. The dwelling at 90 Satterlee Street was constructed after the 1924 aerial photograph was taken and was demolished at some point after Pickman's 1997 Phase 1A was completed and 2006, when another aerial photograph depicts only the Wood/Leven house in the area. Pickman (1997) notes that archaeological investigations at the western end of the Wood/Leven home identified "artifacts, bone, and a dense deposit of shell…eroding from a shallow, recently dug drainage channel on the rear lawn" that contained 19th century artifacts (Pickman 1997: 69). Additional midden deposits were reported "at the base of the slop west of the second Wood/Leven house and south of the existing Rutan garage" that contained 19th century artifacts and presented signs of looting (ibid: 70).

Chapter 8: Conclusions and Recommendations

A. CONCLUSIONS

As part of the background research for this Phase 1A Archaeological Documentary Study, various primary and secondary resources were analyzed, including historic maps and atlases, historic photographs and lithographs, newspaper articles, and local histories. The information provided by these sources was analyzed to reach the following conclusions.

PREVIOUS DISTURBANCE

SHORELINE APE

The Shoreline APE has been extensively disturbed as a result of erosion and tidal activity over the last century. The locations of many former homes and other waterfront structures are now underwater or buried by layers of sand. Action has been taken to restore or defend the waterfront from continued erosion, including the deposition of sand and the construction of sandbag barricades, which are visible in aerial photographs taken in recent years. The construction and demolition of houses, concrete and wood sea walls, piers, boat and bathhouses, paved parking areas, and other developments along the waterfront would also have resulted in additional disturbance.

BREAKWATERS APE

The floor of the Raritan Bay has been impacted by tidal activity over the last century. The construction of underwater structures, such as foundations for buoys and other nautical navigation equipment may have resulted in additional disturbance to the upper surface of the bay floor. Dredging activity took place to the south and west of the Breakwaters APE, where navigation channels were created, but the full extent of dredging within the APE itself is unclear. The accumulation of soils over the past several thousand years could have effectively preserved landforms previously exposed to the air and therefore habitable during prehistory.

WATER HUB POTENTIAL LOCATION 2 APE

The location of the Water Hub Potential Location 2 APE was historically developed with numerous residential buildings as well as a 19th century shipyard. Disturbance would have been generated by the construction and demolition of buildings and landscape modification associated with residential and commercial use.

PRECONTACT SENSITIVITY ASSESSMENT

The precontact sensitivity of project sites in New York City is generally evaluated by a site's proximity to level slopes, watercourses, well-drained soils, and previously identified precontact archaeological sites. As described in **Chapter 5, "Precontact Period,"** the Ward's Point Archaeological Conservation Area, which is listed on the State and National Registers of Historic Places, is located adjacent to the Shoreline APE to the west, along the upland bluffs that line the shores of the Arthur Kill to the north of the

Breakwaters and Shoreline APEs. The Ward's Point site represents several periods of continuous occupation lasting thousands of years and has been designated a conservation area to protect remaining archaeological data located in the vicinity. The majority of the previously identified archaeological sites within the Conservation Area have been identified on the high bluffs in the northern and western portions of Conference House Park. However, in 2003, HPI conducted a Phase 1B survey along a stream to the northwest of the Shoreline APE in the lowland area roughly bounded by Aspinwall, Finlay, Clermont Streets and Billop Avenue. The study determined that the areas in the vicinity of the streambed and associated marshes were disturbed but that "elevated land areas away from the disturbed stream corridor are possibly sensitive for precontact materials" (HPI 2003: 19).

SHORELINE APE

As described previously, Leng and Davis (1930) reference the presence of precontact archaeological resources along the beaches of Tottenville. Furthermore, in other areas within southwestern Staten Island, such resources have been deposited onto beaches after eroding from overhanging cliffs and bluffs (Boesch 2009). However, the waterfront within the Shoreline and Breakwaters APEs has been extensively modified as a result of the construction of waterfront resort communities, waterfront structures (including docks and pier walls), and the significant erosion that has shaped and re-shaped the coastline of southwestern Staten Island. As such, it is not likely that intact archaeological deposits would be located within the sandy beaches of the APE. It is possible that undisturbed grassy and wooded areas may retain some archaeological sensitivity. As such, the portion of the Shoreline APE that is situated along the beach to the east of Brighton Street is determined to have no sensitivity for precontact archaeological resources as a result of disturbance associated with tidal action/erosion, development, and the restoration and reconstruction of the beach, including the construction of sea walls.

As described previously, Pickman (1997) identified an isolated area of moderate archaeological sensitivity near a knoll located to the west of Page Avenue. This appears to be in the general location of the former Laforge property, now identified as the potential western site for the proposed water hub. Current topographic information suggests that the landscape of this area may not have been significantly modified; however, there has been disturbance associated with the construction and demolition of houses and driveways. This area is therefore determined to have low to moderate sensitivity for precontact archaeological resources.

The portion of the Shoreline APE bounded by Brighton Street, Finlay Street, Billop Avenue, and the Raritan Bay includes three different historic landscape areas as shown on the 1909-1911 Topographical Survey (see **Figure 4**). These landscape areas include: 1) the beach immediately adjacent to the waterfront; 2) an area of filled marsh occupying much of the southern and eastern portion of this part of the APE; and 3) an upland area adjacent to the streambed that was partially explored by HPI in 2003. As with the remainder of the APE to the east, the beach front in this portion of the APE has been heavily damaged as a result of erosion and flooding and is not considered to have precontact sensitivity. Much of the former marsh locations have since been filled or are still inundated by the southern extent of the streambed included in HPI's 2003 investigation. These areas are determined to have low sensitivity for precontact archaeological resources. Because of the presence of fill throughout much of this area, the potentially sensitive levels are likely buried beneath a layer of protective fill. Finally, the upland areas adjacent to the stream, south of those elevated areas that were identified as potentially sensitive by HPI in 2003, are identified as having moderate sensitivity for precontact archaeological resources. Excavation associated with the construction of the Shoreline Project is expected to impact soil levels that are potentially archaeologically senesitive.

BREAKWATERS APE

As described in **Chapter 6, "Geomorphological Investigations of the Bay Floor,"** a geomorphological analysis of the floor of the Raritan Bay in the vicinity of the Breakwaters APE was completed by Dr. Kerry Lynch of Archaeological Services at the University of Massachusetts Amherst (see **Appendix A**). This analysis shows that during the Late Archaic period (circa 5,500 years before present), sea levels were significantly lower than they are today and currently submerged and deeply buried soil horizons were exposed to the air and habitable. This once habitable buried ground surface is now inundated and situated near a depth of approximately 25 to 35 feet below the present sea level. Although no direct evidence of human habitation was recovered during the geomorphological investigation, the presence of this habitable ground surface in an area of demonstrated sensitivity for prehistoric occupation indicates that the Breakwaters APE has low to moderate sensitivity for precontact archaeological resources at depths between 25 and 35 feet below the bay floor. The upper level of the sensitive deposits varies across the APE. However, these depths would not be impacted as a result of the Proposed Actions, which will only involve impacts to the bay floor.

Four landscape components are present within the Water Hub Potential Location 2 APE: the waters of the Arthur Kill, beaches along the waterfront, steep bluffs, and upland areas at the top of the bluffs. In-water areas have the potential to contain deeply-buried archaeological resources, however, as currently planned, impacts associated with the construction of the water access points would be restricted to the beach along the waterfront and therefore no impacts would affect potentially deeply-buried precontact landscape elements. Similar to the Shoreline APE, the beach along the waterfront within the Water Hub Potential Location 2 APE has been modified since the 19th century as a result of both natural erosion and historic period development, including the construction of docks and other waterfront structures. As a result, the sandy beaches are determined to have low sensitivity for precontact archaeological resources. Similarly, the slope of the bluffs within the APE is greater than 10 to 15 percent. As described previously, Native American archaeological sites typically are not located within areas with slopes greater than 10 to 12 percent (NYAC 1994). The steeply sloped areas are therefore considered to have low sensitivity for precontact resources. However, the upland areas east of the beach and the bluffs within the Water Hub Potential Location 2 APE are similar to the landscapes of the Ward's Point Archaeological Conservation Area to the south. While some disturbance has occurred as a result of the construction and demolition of houses, outbuildings, and paved drive/pathways, level areas in the eastern portion of the APE are determined to have moderate to high sensitivity for precontact archaeological resources.

The areas where the shoreline restoration would occur along the shoreline between Loretto and Manhattan Streets would involve the deposition of fill to reconstruct the late-20th century shoreline and prevent further erosion. This deposition, which would not involve excavation or grading, would in fact serve to better protect potential precontact resources located both along the upland areas as well as in the vicinity of potentially submerged landforms.

HISTORIC SENSITIVITY ASSESSMENT

SHORELINE APE

The majority of the historic structures that were located within or in the immediate vicinity of the Shoreline APE were temporary or insubstantial structures that were associated with the seasonal and recreational use of the Raritan Bay waterfront. Only a few of the map-documented structures within the Shoreline APE were present before the mid-19th century, and these former locations are largely inundated or were covered with sandy beach deposits as a result of erosion. These include the former Cooley, Joline, Laforge, and Mahen homes. These homes all appear to have been constructed by the late-19th century and presumably pre-dated the installation of water and sewer networks in this area. Therefore, the residents of

these early homes would have relied on domestic shaft features (e.g., privies, cisterns, and wells) for the purposes of water gathering and sanitation. Though there has been significant disturbance to the area, largely as a result of tidal action, sturdy subsurface shaft features could have survived, especially in upland areas like the two potential sites for the proposed Water Hub. Therefore, those locations are identified as having moderate sensitivity for archaeological resources dating to the historic period. The remainder of the APE is determined to have low sensitivity for historic period archaeological resources.

BREAKWATERS APE

The Breakwaters APE has been inundated throughout the entire historic period. In addition, sonar surveys did not indicate the presence of any potential submerged resources (e.g., shipwrecks) on the bay floor. Furthermore, as described above, only 20th century recreational structures were located within the location of the proposed shoreline restoration between Loretto and Manhattan Streets. The Breakwaters APE is therefore determined to have no historic period archaeological sensitivity.

WATER HUB POTENTIAL LOCATION 2 APE

The Water Hub Potential Location 2 APE is located near three historic properties containing multiple historic homes as well as a 19th century shipyard. The upland areas east of the bluffs within the APE are determined to have high sensitivity for archaeological resources associated with the occupation of historic homes on the Biddle, Rutan, and Wood/Leven properties. These resources are expected to include shaft features used for the purposes of water-gathering and sanitation (e.g., privies, cisterns, and wells) as well as midden deposits similar to those observed during previous archaeological investigations (Pickman 1997).

The steeply sloped bluffs and adjacent beaches were not developed for residential use in the same manner as the upland areas with the exception of the former Rutan shipyard building that was later identified as a dwelling owned by the Forshay family. The location of the former shipyard is determined to have moderate sensitivity for archaeological resources and the adjacent beach is determined to have low sensitivity for archaeological resources dating to the historic period.

B. RECOMMENDATIONS

The locations of potential precontact archaeological sensitivity for the Shoreline APE include upland areas north of the beach that lines the Raritan Bay, as depicted on **Figure 9A**. The locations of historic period archaeological sensitivity (also depicted on **Figure 9A**) are located in the vicinity of the former Cooley, Joline, Laforge, and Mahen homes. The in-water portion of the Water Hub Potential Location 2 APE is similarly sensitive for buried precontact landforms and portions of the upland areas and bluffs are also sensitive for both precontact and historic period archaeological resources (see **Figure 9B**).

The construction of the proposed Shoreline Project and proposed Water Hub and water access locations are expected to result in subsurface impacts, although the exact location of each of these elements and the extent to which disturbance will be necessary to construct them is not yet known. Phase 1B archaeological testing is therefore recommended in the locations of archaeological sensitivity to determine the presence or absence of archaeological resources. A Phase 1B Archaeological Testing Protocol must be prepared in consultation with SHPO, LPC, and the Tribal Nations. This consultation would be completed pursuant to the Programmatic Agreement executed in May 2013 among the Federal Emergency Management Agency (FEMA), SHPO, the New York State Office of Emergency Management, the Delaware Nation, the Delaware Tribe of Indians, the Shinnecock Nation, the Stockbridge-Munsee Community Band of Mohicans, LPC, and ACHP and specifically pursuant to

Appendix D to the Programmatic Agreement, which pertains to the CDBG-DR program for activities in New York City.

References

Aqua Survey, Inc.
2015 "Technical Report: Magnetometer, Side Scan, Sub-Bottom Reflection, and Bathymetric Survey, Living Breakwaters, Tottenville, New York." Prepared for: Hill International, Inc., New York, NY. June 5, 2015.

Baugher, Sherene, Edward J, Lenik; Robert W. Venables; Kate T. Morgan; and Judith M. Guston
1991 *An Archaeological Investigation: The Conference House Park Site, Staten Island, New York*. Prepared for the Landmarks Preservation Commission.

Beers, F.W.
1874 *Atlas of Staten Island, Richmond County, New York*. New York: J.B. Beers & Co.

Beers, J.B.
1887 *Atlas of Staten Island, Richmond County.* New York: J.B. Beers & Co.

Bien, J.R. and C.C. Vermule
1891 *Atlas of the Metropolitan District and Adjacent County comprising the Counties of New York, Kings, Richmond, Westchester, and part of Queens in the State of New York*. New York: Julius Bien & Co.

Boesch, Eugene
1994 *Archaeological Evaluation and Sensitivity Assessment of Staten Island, New York*. For: The New York City Landmarks Preservation Commission.
2009 "Phase IA Archaeological Investigation of the Area of Potential Effect for the Charleston Towers Project Area: 55 Androvette Street (Formerly 53, 65, and 83 Androvette Street); Block 7407, Lots 1, 82, and 80; Staten Island/Richmond County, New York City, New York." Prepared for: 65 Androvette Street, LLC; New York, NY.

Bolton, Reginald Pelham
1922 "Indian Paths in the Great Metropolis." In *Indian Notes and Monographs*. Miscellaneous #22. New York: Museum of the American Indian, Heye Foundation.
1934 *Indian life of long ago in the city of New York*. New York: J. Graham.
1975 *New York City in Indian Possession.* Museum of the American Indian, Heye Foundation, New York.

Botkin, H.A.
1956 *New York City Folklore*. New York: Random House.

Bromley, G.W. and W. S.
1917 *Atlas of the City of New York, Borough of Richmond.* Philadelphia, PA: G.W. Bromley & Co.

Brooklyn Daily Eagle
1850 "Biddle's Grove." *The Brooklyn Daily Eagle*. September 5, 1850: page 2. Brooklyn, NY.
1853 "Mount Hermon (Biddle) Grove, Staten Island." May 23, 1853: page 3. Brooklyn, NY.

Burrows, Edwin G. and Mike Wallace
1999 *Gotham*. New York: Oxford University Press.

Butler, James, CE and Surveyor
1853 *Map of Staten Island or Richmond County, New York*. Published by the surveyor.

Cantwell, Anne-Marie and Diana diZerega Wall
2001 *Unearthing Gotham: The Archaeology of New York City*. New Haven: Yale University Press.

City of New York Parks & Recreation
n.d. "Conference House Park, Staten Island." Accessed December 2016: https://www.nycgovparks.org/parks/R006/map/ConferenceHousebrochure.pdf.

Colton, G.W. and C.B.
1866 *Map of Staten Island, Richmond County, State of New York*. New York: G.W. and C.B. Colton.

Conference House Association
2016 "About: The Conference House." Accessed December 2016: http://www.theconferencehouse.org/
2017 "The Rutan-Beckett House." Accessed April 2017: http://conferencehouse.org/gallery/historic-houses/the-rutan-beckett-house/

Davis, William T.
1896 "Staten Island Nicknames: ye olde names and nicknames (with map by Charles W. Leng)." *Proceedings of the Natural Science Association of Staten Island* 5 (5).

Dincauze, Dena F.
2000 "The Earliest Americans: The Northeast." *Common Ground: Archaeology and Ethnography in Public Interest*. Washington, D.C.: National Park Service.

Dripps, M.
1872 *Map of Staten Island (Richmond Co.), NY*. New York: M. Dripps.

Florance, Charles A.
1982 "National Register of Historic Places Inventory—Nomination Form: Ward's Point Conservation Area (A085-01-0030." United State Department of the Interior, National Park Service.

Fulbright, Newton H.
1949 "Keeping the Port Open." In, *The New York Herald Tribune*. February 20, 1949: page A1. New York, NY.

Geoarcheology Research Associates (GRA)
2014 *Geomorphology/Archaeological Borings and GIS Model of the Submerged Paleoenvironment in the New York and New Jersey Harbor and Bight in Connection with the New York and New Jersey Harbor Navigation Project, Port of New York and New Jersey, Under contract to U.S. Army Corps of Engineers New York District CENAN-PL-EA, 26 Federal Plaza New York, New York 10278-0900*. March 2014. Prepared under subcontract to and in conjunction with Hunter Research, Inc., Trenton, NJ. Prepared for: Tetra Tech, Portland, ME; under contract to the US Army Corps of Engineers, New York, NY.

Grumet, Robert S.
1981 *Native American Place Names in New York City*. New York: Museum of the City of New York.
1995 *Historic Contact*. Norman, OK: University of Oklahoma Press.

Hassler F.R.
1844-5 *Map of New-York Bay and Harbor and the Environs*. United States Coastal Survey.

Historical Perspectives, Inc.
1998 New York State Prehistoric Archaeological Site Inventory Form A08501.002707. On files at SHPO.

2001 "Phase 1A Cultural Resources Sensitivity Evaluation: South Richmond Drainage Plans: Conference House Park Watershed, South Richmond, Staten Island, New York." Principal authors: Edward J. Lenik and Nancy L. Gibbs.

2003 "New York City Department of Environmental Protection South Richmond Drainage Plan, Conference House Park Watershed: Phase 1B Archaeological Field Testing of CHP-1 and CHP-2, Conference House Park, Staten Island, New York; CEQR No. 01DEP004R." Prepared for: Allee King Rosen & Fleming, New York, NY.

2006 "Phase 1B/2 Archaeological Reconnaissance Survey and Phase 3 Archaeological Mitigation/Monitoring: South Richmond Drainage-Conference House Park Watershed: Installation of Storm Water Drains, Sanitary Sewers, and Water Mains along Swinnerton Street, Clermont Avenue, Massachusetts Street, Hylan Boulevard, and Satterlee Street, Richmond County, New York." Prepared for: Cruz Construction; Holmdel, NJ.

Historical Records Survey, Service Division, Work Projects Administration
1942 *The earliest volume of Staten Island records, 1678-1813*. New York: The Survey.

Isachsen, Y.W., E. Landing, J.M. Lauber, L.V. Rickard, W.B. Rogers, editors.
2000 *Geology of New York: A Simplified Account*. Second Edition. New York: New York State Museum Educational Leaflet 28.

John Milner Associates, Inc.
2004 "Archeological Investigations: Conference House Park; Staten Island, New York." Prepared for Padilla Construction Services, Inc.; Staten Island, NY and the New York City Department of Parks and Recreation; Flushing, NY.

2005 "Archeological Investigations: Conference House Park; Staten Island, New York: Addendum Report: Biddle House and Wood/Leven House Landscape Improvements." Prepared for Padilla Construction Services, Inc.; Staten Island, NY and the New York City Department of Parks and Recreation; Flushing, NY.

Key Perspectives
1987 "Tottenville, Staten Island; Block 7906, Lots 1, 3, 4, 5, 6, 8, 15, 17, 21, 31, 32, 34, 36, 37, 38, 39, 41, 42, 44, 47, 48, 49, 52, 60, 61, 63, 64, 66, 72, 73, 75, 76, 79, 80, 83, 85, 91, 92, 100, 115, 117, 121, 125, 127, 133, 135: Report of Test Excavations." Prepared for: the City of New York Department of General Services, Division of Real Property; New York, NY.

Leng, Charles W. and William T. Davis
1930 *Staten Island and its People: A History 1609-1929*. (5 Volumes) New York: Lewis Historical Publication Company, Inc.

Lynch, Kerry J., Ph.D.
2016 "Archaeological Phase I Geo-Bore Monitoring Project for the Living Breakwaters Project, Staten Island, New York." Prepared by Archaeological Services, University of Massachusetts, Amherst, MA. Prepared for: AKRF, New York, NY.

McMillen, Loring
1933 *A Map of Staten Island During the Revolution, 1775-1783*.

New York Archaeological Council
1994 *Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State*. The New York Archaeological Council.

New York City Soil Survey Staff
2005 *New York City Reconnaissance Soil Survey*. United States Department of Agriculture, Natural Resources Conservation Service, Staten Island, New York.

The New York Daily Times
1855 "Quarantine: Shall Quarantine be Removed to Sandy Hook?" In, *The New York Daily Times*. March 10, 1855: page 2. New York, NY.

The New York Herald
1853 "The Oyster Trade of New York: Where do all the Hard Shells Come From?" In, *The New York Herald*. March 12, 1853: page 7. New York, NY.

The New York Herald Tribune
1930 "Crew Burns Rum Boat, Coast Guard Sinks Another." In, *The New York Herald Tribune*. May 23, 1930: page 9. New York, NY.

The New York Times
1949 "80th Harbor Job Keeps Army Busy." In, *The New York Times*. January 29, 1949: page 27. New York, NY.

The New York Tribune
1922 "Police in Battle with Rum Runners in 2 Motor Boats." In, *The New York Tribune*. April 7, 1922: page 7. New York, NY.

Parker, Arthur C.
1922 *The Archaeological History of New York.* Albany: The University of the State of New York.

Pekar, Stephen F., Cecilia M.G. McHugh, Nicholas Christie-Blick, Miriam Jones, Suzanne M. Carbotte, Robin E. Bell, and Jean Lynch-Stieglitz
2004 "Estuarine processes and their stratigraphic record: paleosalinity and sedimentation changes in the Hudson Estuary (North America)." In, *Marine Geology* 209 (1-4): 113–129.

Pickman, Arnold
1987a "Phase IA Historical/Archaeological Sensitivity Evaluation of the Surfside Village Development Project, Staten Island, New York." Prepared for: Raritan Bay Development Corp., Staten Island, NY.
1987b "Phase IB Archaeological Survey of the Surfside Village Development Project, Staten Island, New York." Prepared for: Raritan Bay Development Corp., Staten Island, NY.
1997 "Archaeological and Historical Intensive Documentary Research: Conference House Park, Staten Island, New York; NYC Parks/Pre-CEQR R." Prepared for Jackson & Kihn/South Street Design Company.

Pickman, Arnold and Rebecca Yamin
1984 *Oakwood Beach Water Pollution Control Project Phase I Cultural Resources Survey Appendix: Hylan Boulevard at Richmond Avenue to Arthur Kill Road at Kreischer Street*. Prepared for: Woodward-Clyde Consultants; Wayne, New Jersey.

Public Archaeology Laboratory (PAL)
2012 "Clearance Memorandum: Old Place Neck Site (OPRHP No. A08501.002971), Phase III Data Recovery, Staten Island, New York." Prepared for: Spectra Energy Transmission; Jersey City, NJ.

Reeds, Chester A.
1925 *The Geology of New York City and Vicinity*. New York: The American Museum of Natural History Guide Leaflet Series No. 56.

Renard, Charles
1835-6 "Sheet No 9." United States Coastal Survey.

Richmond County Topographical Bureau
1906-1913 *Borough of Richmond Topographical Survey*. On file at the Richmond County Topographical Bureau.

Ritchie, William A.
1980 *The Archaeology of New York State: Revised Edition*. Harrison, New York: Harbor Hill Books.

Robinson, Elisha
1898 *Atlas of the Borough of Richmond, City of New York*. New York: E. Robinson and Co.
1907 *Atlas of the Borough of Richmond, City of New York*. New York: E. Robinson and Co.

Sanborn Map Company
1938 *Insurance Maps of the City of New York*. New York: Sanborn Map Co.
1951 *Insurance Maps of the City of New York*. New York: Sanborn Map Co.

Schuberth, Christopher J.
1968 *The Geology of New York City and Environs*. Garden City, New York: The American Museum of Natural History, the Natural History Press.

Shepherd, Barnett
2008 *Tottenville: The Town the Oyster Built*. Staten island, New York: Preservation League of Staten Island and the Tottenville Historical Society.

Shepherd, Barnett and Linda Houck; with editing by Kathy Howe
2011 "National Register of Historic Places Multiple Property Documentation Form: The Historic and Architectural Resources of Tottenville, Staten Island, Richmond County, New York." On file at the New York State Historic Preservation Office.

Skinner, Alanson
1909 "The Lenape Indians of Staten Island." In, *Anthropological Papers of the American Museum of Natural History*. Volume III. Clark Wissler, ed. New York: Published by Order of the Trustees of the Museum.

Tottenville Historical Society
2011 *Images of America: Tottenville.* Charleston, SC: Arcadia Publishing.
2016 "History of Tottenville Beach." Accessed July 2016: http://www.tottenvillehistory.com/timeline-tottenville-beach.html.

United States Coast and Geodetic Survey
1930 *United States-East Coast: New York Harbor No. 369*. Washington, DC: United States Coast and Geodetic Survey.

United States War Department
1902 *Annual Departs of the War Department for the Fiscal Year Ended June 30, 1902*. Part 1. Washington, DC: Government Printing Office.

Walling, H.F.
1859 *Map of Staten Island, Richmond County, New York / from surveys under the direction of H.F. Walling.* New York: D.A. Fox.
1860 *Map of New York and its Environs*. New York: S.F. Tilden.

Wapora, Inc.
1978 "EIS Background Document: Preliminary Cultural Resources Assessment: Literature Search and Windshield Survey: Oakwood Beach Water Pollution Control Project, Phase III and Future Phases." Prepared for: USEPA Region II, New York, NY.

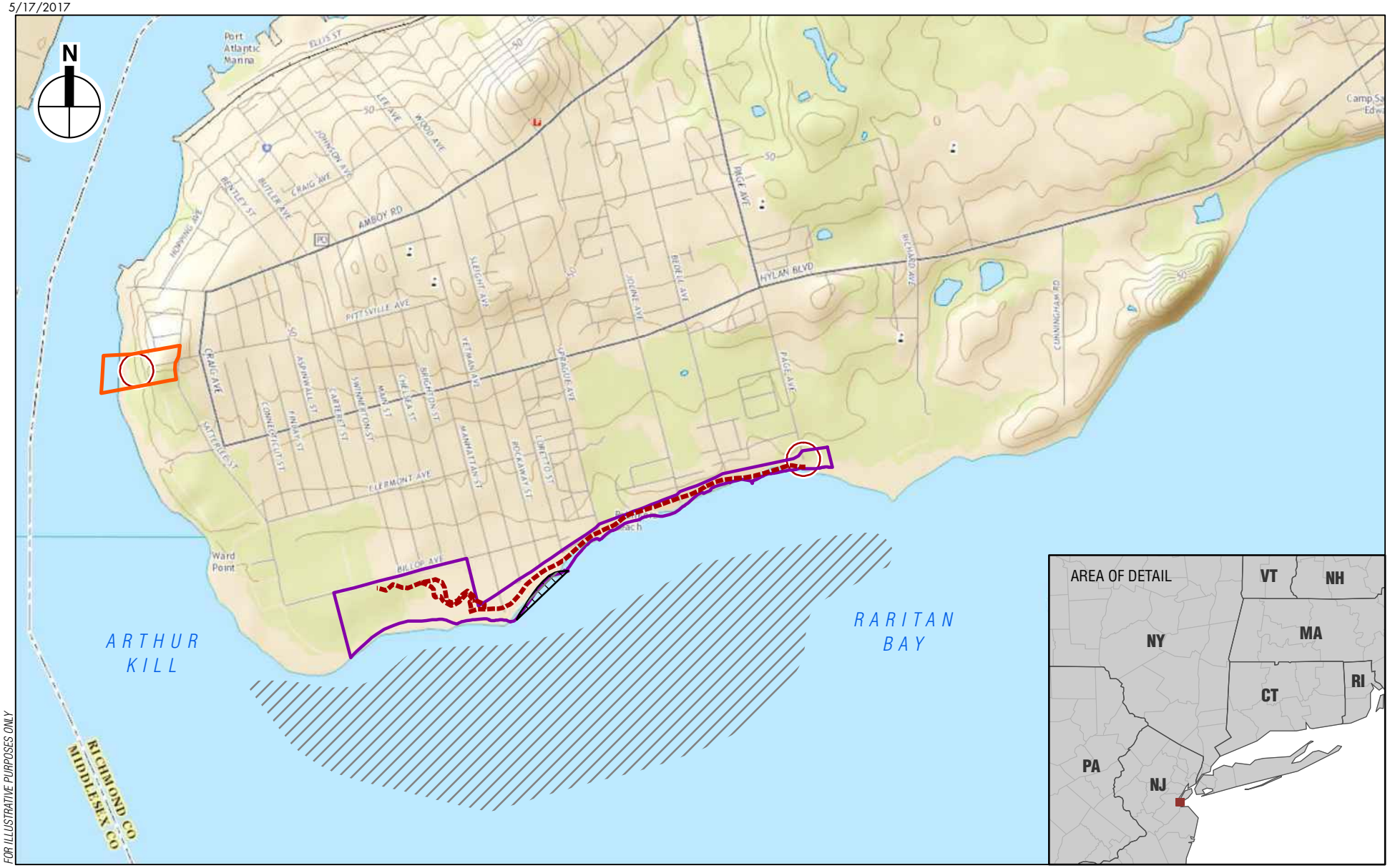
Washington Post
1898 "Sand Battery at Ward's Point." In, *The Washington Post*. May 14, 1898: page 3. Washington, DC.

Whiting, H.L.
1856 *Staten Island, New York Harbor from New Brighton to Fresh Kills.* Washington, DC: US Coast Survey. A.D. Bache, Superintendent.

Zavin, Shirley
1990 "Henry Hogg Biddle House, 70 Satterlee Street, Borough of Staten Island." New York City Landmarks Preservation Commission Designation Report LP-1707, issued May 1, 1990.

Figures

5/17/2017



FOR ILLUSTRATIVE PURPOSES ONLY

Breakwaters Area of Potential Effect (APE)

Potential Location of Proposed Water Hub (exact location to be determined)

Proposed Shoreline Project Elements

Shoreline APE

Water Hub Potential Location 2 APE

Proposed Shoreline Restoration Area

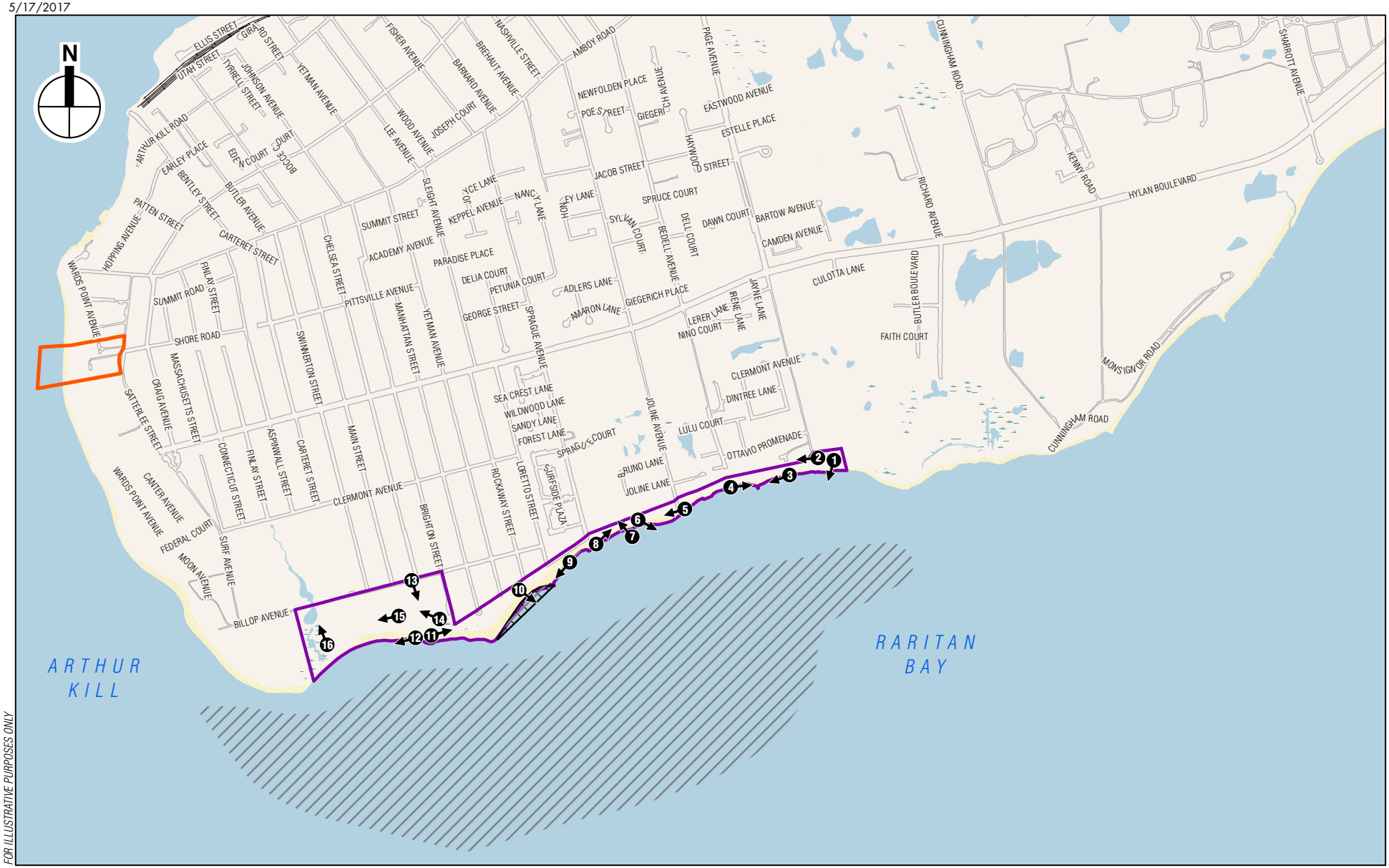
0 2,000 FEET

USGS Topographic Map

Figure 1

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

5/17/2017



FOR ILLUSTRATIVE PURPOSES ONLY

Breakwaters Area of Potential Effect (APE)

Shoreline APE

Water Hub Potential Location 2 APE

Proposed Shoreline Restoration Area

Photograph View Direction and Reference Number

NOTE: See Figure 3B for references for Photographs 17 through 23

0 1,000 FEET

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Project Location

Figure 2

5/17/2017

FOR ILLUSTRATIVE PURPOSES ONLY

Breakwaters Area of Potential Effect (APE)

Proposed Shoreline Restoration Area

Shoreline APE

0 1,000 FEET

Aerial Photograph of the Shoreline APE
(including Water Hub Potential Location 1)

Figure 3a

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

5/17/2017

FOR ILLUSTRATIVE PURPOSES ONLY

Water Hub Potential Location 2 APE

17 Photograph View Direction and Reference Number

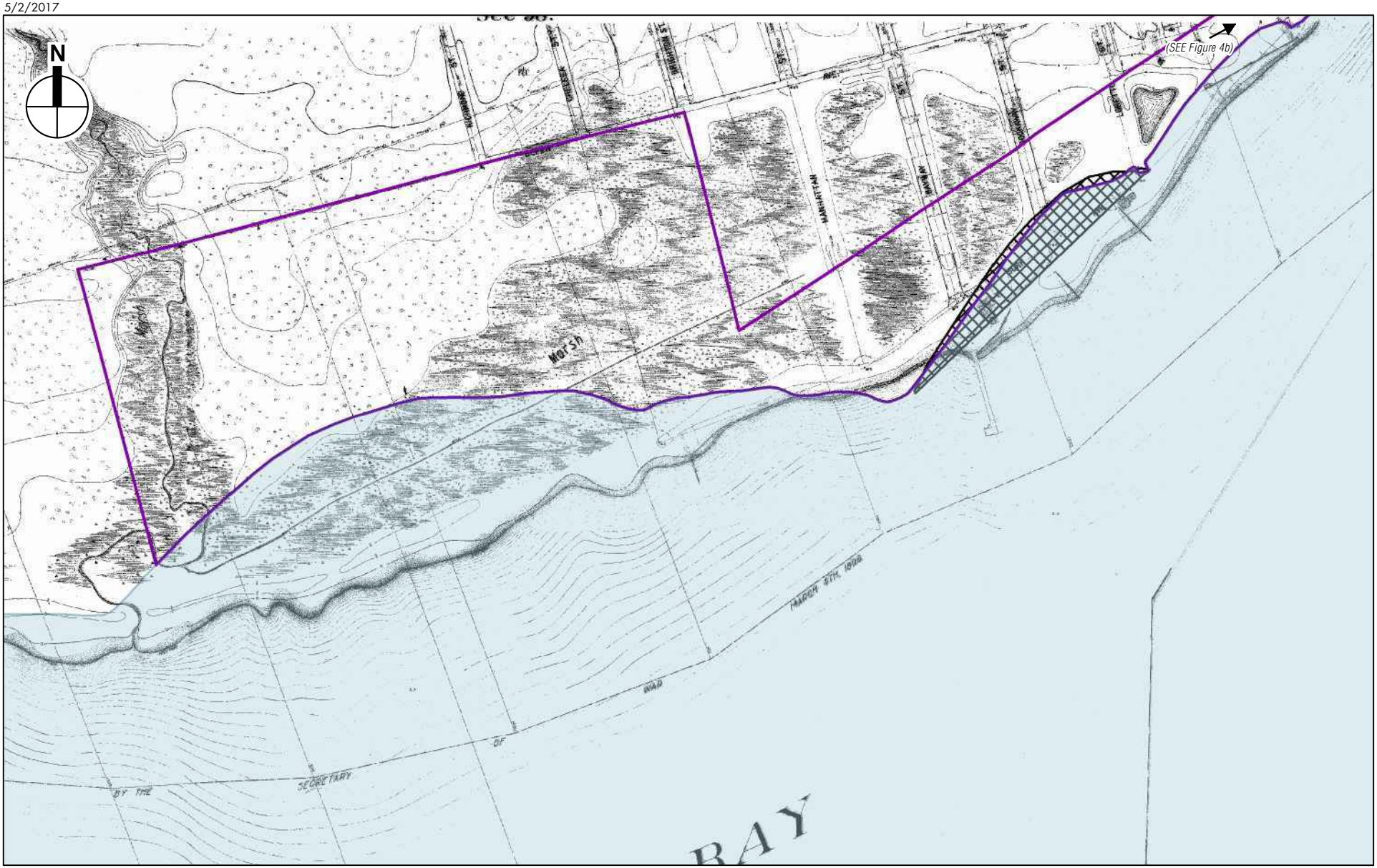
0 500 FEET

Aerial Photograph of the Water Hub Potential Location 2 APE

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Figure 3b

5/2/2017



Shoreline Area of Potential Effect (APE)

2014 Shoreline and Bay/Ocean

Proposed Shoreline Restoration Area

0 1,000 FEET

Borough of Richmond Topographic Survey, 1911
Sheets 97 and 101

Figure 4a

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

5/2/2017

Shoreline Area of Potential Effect (APE)

2014 Shoreline and Bay/Ocean

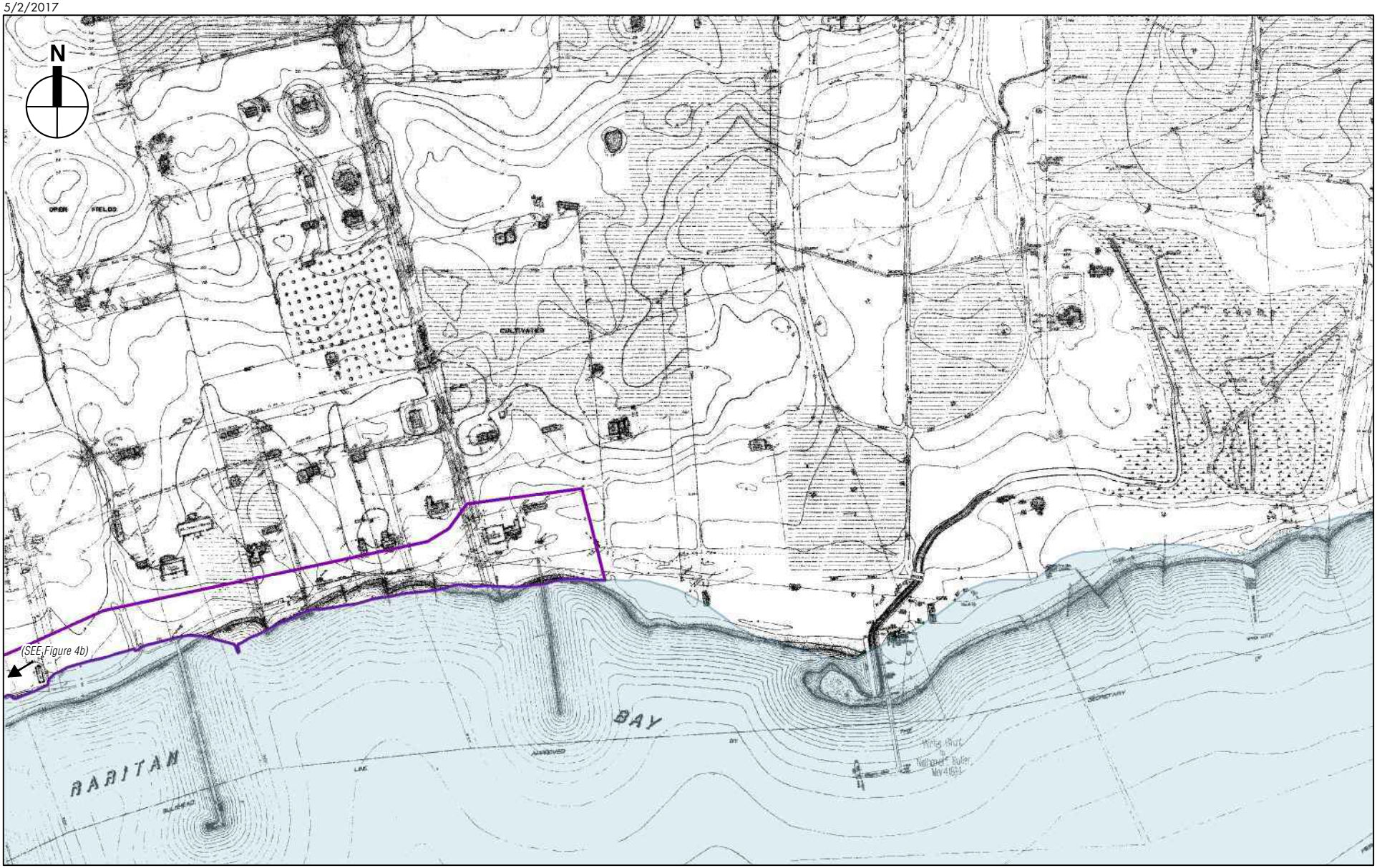
0 1,000 FEET

Borough of Richmond Topographic Survey, 1909
Sheet 98

Figure 4b

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

5/2/2017



Shoreline Area of Potential Effect (APE)

2014 Shoreline and Bay/Ocean

0 1,000 FEET

Borough of Richmond Topographic Survey, 1911
Sheet 99 and 100

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Figure 4c

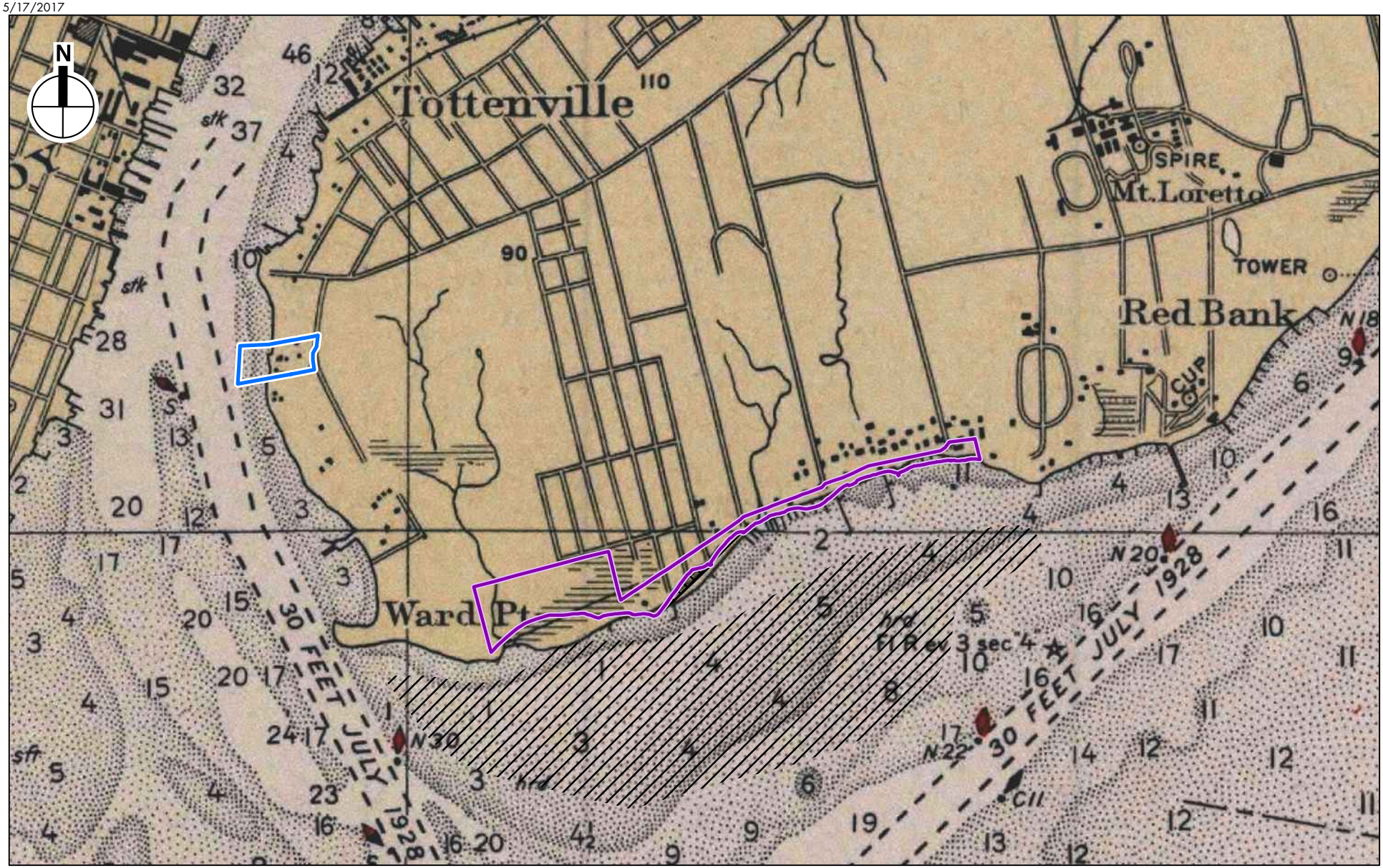
5/17/2017

Borough of Richmond Topographic Survey, 1911
Sheet 97

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Figure 4d

5/17/2017

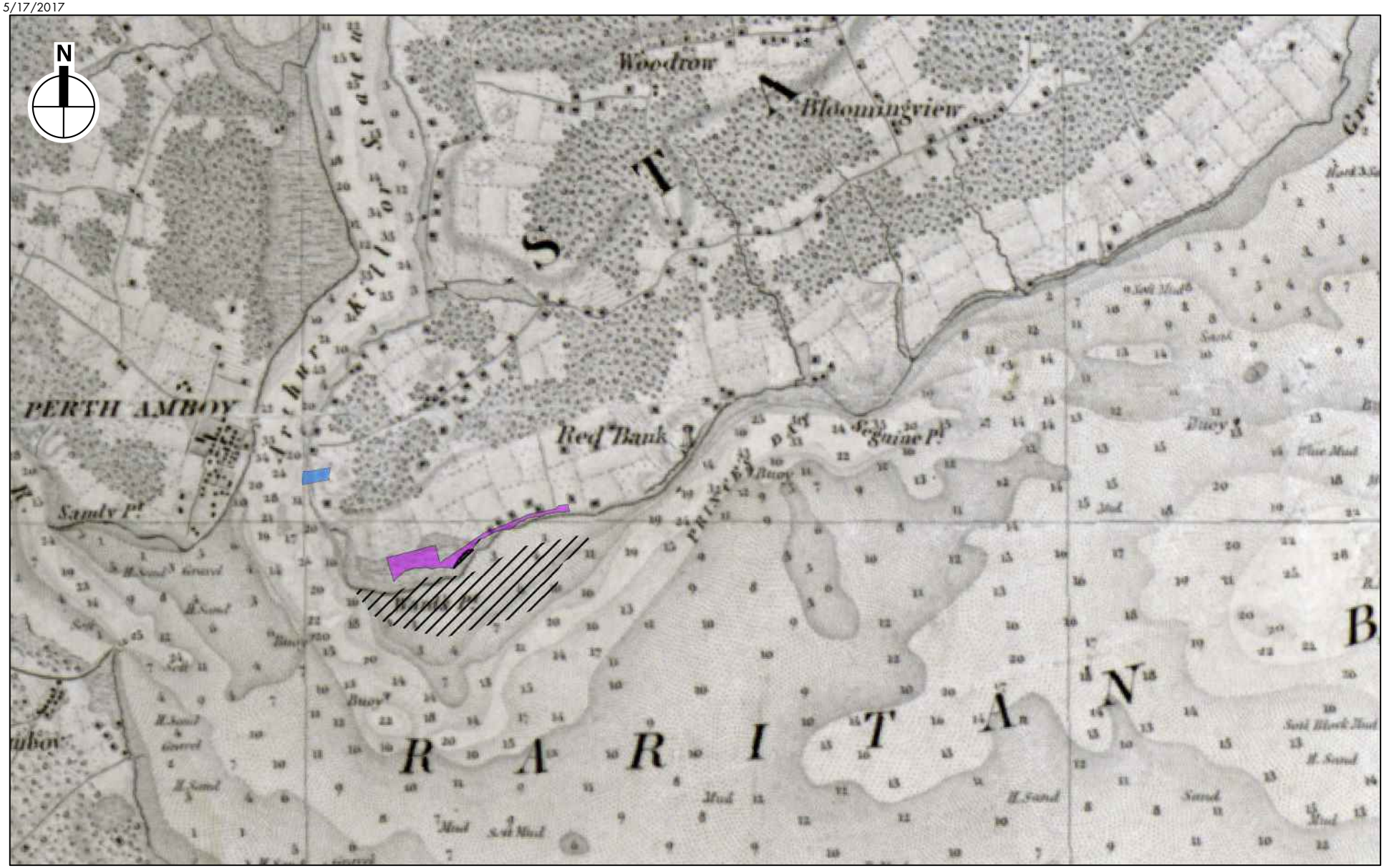


1930 Coastal Chart

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Figure 5

5/17/2017



Breakwaters Area of Potential Effect (APE)

Shoreline Area of Potential Effect (APE)

Proposed Shoreline Restoration Area

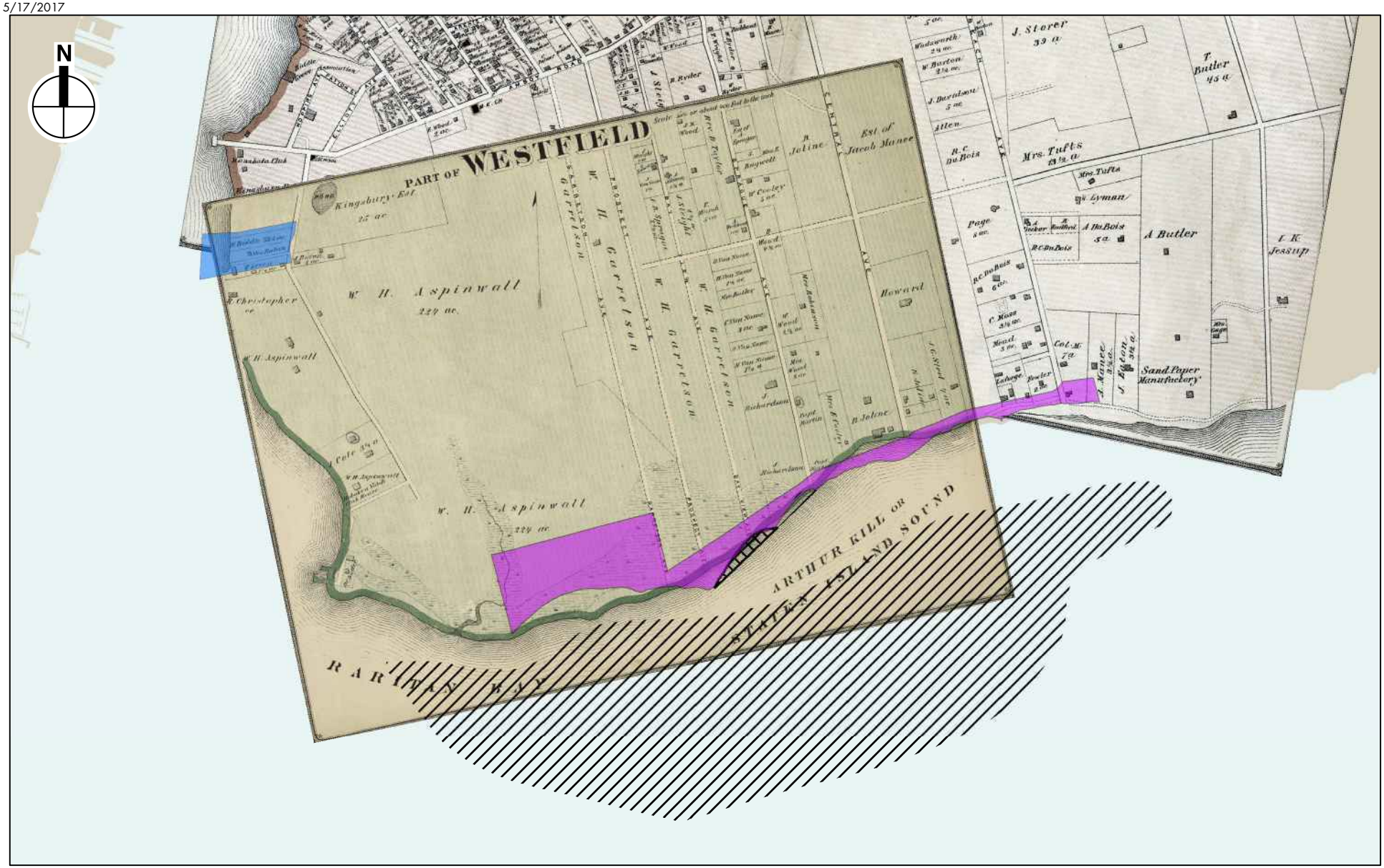
Water Hub Potential Location 2 APE

1844-1845 Hassler

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Figure 6

5/17/2017



Breakwaters Area of Potential Effect (APE)

Proposed Shoreline Restoration Area

Shoreline Area of Potential Effect (APE)

Water Hub Potential Location 2 APE

Note: This map was georeferenced to align with the modern street grid; inaccuracies in the placement of the APE may be due to inaccuracies in the original map.

0 1,000 FEET

1874 Beers

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Figure 7

5/17/2017

Breakwaters Area of Potential Effect (APE)

Proposed Shoreline Restoration Area

Shoreline Area of Potential Effect (APE)

Water Hub Potential Location 2 APE

0 1,000 FEET

1917 Bromley Atlas

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Figure 8

5/19/2017

Upland Areas with Potential Precontact Sensitivity

Shoreline Area of Potential Effect (APE)

Proposed Shoreline Restoration Area

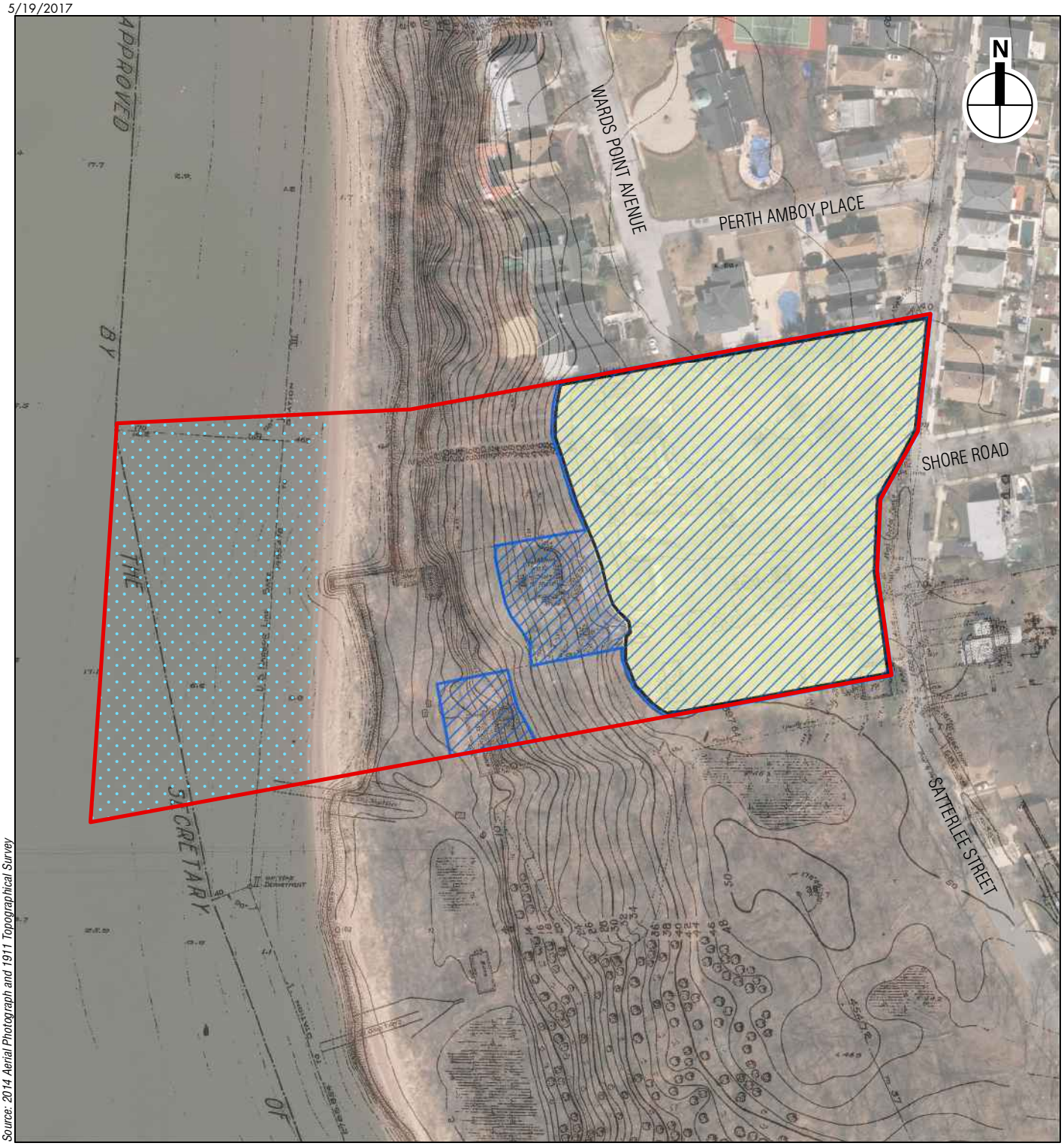
Locations of Potentially Sensitive Historic Map Documented Structures

0 1,000 FEET

Archaeological Sensitivity Map:
Shoreline APE (Including Water Hub Potential Location 1)

Figure 9a

5/19/2017



Source: 2014 Aerial Photograph and 1911 Topographical Survey

0 200 FEET

Areas of Precontact Archaeological Sensitivity

Water Hub Potential Location 2 APE

Historic Archaeological Sensitivity

Areas with Potential Sensitivity for Submerged Precontact Landforms

Areas of Archaeological Sensitivity

Figure 9b

Coastal and Social Resiliency Initiatives for Tottenville Shoreline

Photographs

View of the southern limits of the possible eastern site of the proposed Water Hub, just east of Page Avenue. **1**

The northern portion of the possible eastern Water Hub location, showing the driveway that leads to Page Avenue. **2**

The beach lining the Shoreline APE west of Page Avenue. **3**

View east of drainage structures and rip-rap walls lining the beach near the food of Bedell Avenue. **4**

View west along the beach near the foot of Joline Avenue. **5**

Remnants of a waterfront structure near the southern end of what was once the Cooley and Robinson property. **6**

Stone seawall located near the foot of Sprague Avenue. **7**

View east along the beach near the terminus of Loretto Street, showing sandbags and stone and concrete sea walls constructed along the waterfront. **8**

View west of the beach from a point near the terminus of Rockaway; the utility pole at the right of the photograph is at the foot of Yetman Avenue. **9**

Remnants of a wooden platform extant along the beach near the foot of Yetman Avenue. **10**

View of the beach looking east from the foot of Main Street. **11**

View of the beach looking west from the foot of Main Street. **12**

The wooded area south of the intersection of Main Street and Billop Avenue. **13**

The interior of the wooded area within the Shoreline APE west of Brighton Street. **14**

5.17.17

The interior of the wooded area within the Shoreline APE. **15**

Wetlands near the western end of the Shoreline APE. **16**

The Henry Hogg Biddle House within the Water Hub Potential Location 2 APE. **17**

Looking west along the steep slope of the built section of Shore Road, showing the house at 8 Shore Road at left and the Rutan-Beckett House in the distance. **18**

The rear of the Rutan-Beckett house, looking west toward the Arthur Kill and showing the steep slope that leads down to the water. **19**

The front (western) lawn of the Rutan-Beckett house, looking east towards a small greenhouse, cinder block garage, and field stone retaining walls to the south of the house. **20**

Looking south at the steep slope between the house at 8 Shore Road (at left) and the Rutan-Beckett House (at right). **21**

The existing stairs that lead from a point north of the Biddle house down to the beach at the northern end of Conference House Park. **22**

The beach at the northern end of the park, showing the existing stairs and the Biddle house (at left) and Rutan-Beckett house (at right) in the distance behind the trees. **23**

Appendix A: Geomorphological Analysis

ARCHAEOLOGICAL PHASE I GEO-BORE MONITORING FOR THE LIVING BREAKWATERS PROJECT STATEN ISLAND, NEW YORK

By
Kerry J. Lynch, Ph.D.

Presented to: AKRF
440 Park Avenue South, 7th Floor
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UM-748

Presented by:
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March 2016

Director
Eric S. Johnson

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LIST OF FIGURES

ABSTRACT

Archaeological monitoring of the Living Breakwaters geophysical soil sampling program in Raritan Bay, Staten Island, NY was conducted between September 23 and October 29, 2015. The soil sampling was monitored at twenty bore locations within the Area of Potential Effect (APE). The boring program took place aboard a barge containing a drill rig, operated by personnel from Warren George Inc. of Jersey City, NJ. Archaeological monitoring of bore samples was undertaken to identify the presence or absence of intact terrestrial landforms and/or archaeological deposits that were exposed prior to being submerged and buried post sea-level rise. The first 12 feet at every location was sampled with continuous two foot, split spoon bores. The remaining samples were collected at five foot intervals. Therefore, three feet of every five was drilled through and not observed. A total of 342 two-foot-long split spoon samples from the twenty bore locations were opened and documented in the field. Thirty sediment samples—taken if color, texture, or inclusions suggested deposits may have been part of a terrestrial environment prior to being inundated by sea-level rise—were collected from 12 bore locations in addition to lithic samples, organic samples, and worked chert fragments. Most of the collected samples were hypothesized to be from potential B-horizon or shallow C-horizon deposits. Flotation processing of the sediment samples revealed both charred and uncharred botanical evidence indicative of shallow marine environments or terrestrial settings in four samples from two bore locations. The remaining 26 sediment samples did not include any botanical evidence. Two charred botanical samples were submitted for radiocarbon dating. One sample was dated to 5500 +/-30 BP. The second organic sample appeared to be mineralized with possible pyrite (shiny, gold flecks) after pre-processing; this sample was found to have low 14C activity. The date of this second sample could not be determined with confidence beyond >43,500 BP, and as such does not indicate a former intact terrestrial landform occupied by Native Americans. The worked chert fragments were not observed in *in-situ* former terrestrial deposits, but rather in redeposited, eroded sand and gravel washed into the marine environment post-sea level rise. The bore locations containing the best evidence of possible intact, former terrestrial deposits were close to the southwest promontory of Wards Point at the western end of the project area. Because non-continuous sampling did not allow for the observation of all deposits, it is possible submerged intact surfaces exist in this vicinity and that the charred botanicals are the result of human activity. The remainder of the project area seems to be more dynamic, and is less likely to contain these potential resources.

MANAGEMENT SUMMARY

Archaeological Services at the University of Massachusetts Amherst completed Phase I Geo-bore monitoring of twenty marine locations in Raritan Bay, Staten Island, New York for the Living Breakwaters project. The project area is located at the southern end of Staten Island. A predictive model identifying areas of archaeological sensitivity in the offshore environment was completed by Geoarcheology Research Associates in 2014 (Schuldenrein et al. 2014). The Living Breakwaters project area was located within an area deemed to have high sensitivity for archaeological resources by the predictive model (Schuldenrein et al. 2014). AKRF of New York City, NY retained Archaeological Services to monitor the geo-bore program due to the potential of the APE to contain preserved terrestrial surfaces and potential archaeological resources.

Monitoring was conducted between September 23 and October 29, 2015 at twenty offshore bore locations. Sixteen locations were sampled to a target drilling depth of 18.9 m (62 ft), three were sampled to a target drilling depth of 31.1 m (102 ft), and one was sampled to a drilling depth of 24.1 m (79 ft). These drilling depths translate to elevations of between 19.8 and 35.4 m (64.8 and 116 ft) below mean sea level (bmsl). The first 12 feet at every location was sampled with six continuous two foot, split spoon bores. The remaining samples were collected at five foot intervals. Therefore three feet of every five was drilled through and not observed. A total of 342 two foot split spoon samples were opened, described, and if appropriate sampled and photographed.

Flotation processing of sediment sampled revealed both charred and uncharred botanical evidence indicative of shallow marine environments or terrestrial settings in four samples from two bore locations. The remaining sampled sediments did not include any botanical evidence. Most of the collected samples were hypothesized to be from potential B-horizon or shallow C-horizon deposits as no clearly organic A-horizon or developed peat layers were identified. Two charred botanical samples were submitted for radiocarbon dating from two bore locations. One sample was dated to 5500 +/-30 BP, corresponding to the inundation of Raritan Bay between 5000 and 2000 years ago (Schuldenrein et al2014). The second organic sample appeared to be mineralized with possible pyrite (shiny, gold flecks) after radiocarbon pre-processing; it was found to have low 14C activity. The date of this second sample could not be determined with confidence beyond >43,500 BP, and as such does not indicate a former intact terrestrial landform occupied by Native Americans.

Native American lithic cultural material was recovered from two bore locations. They are angular, not waterworn, and differ considerably from the rounded sand and gravel matrix surrounding them. The sand and gravel deposits are most likely redeposited from storm surge and erosion of the shoreline that previously contained sites of human occupation. The cultural material is not considered to be *in-situ*.

ACKNOWLEDGMENTS

The following people contributed the successful completion of this project: Kirstin Leiendecker and Michelle Chen of Parsons Brinckerhoff, Linda Kung and Brenden Baitch of Hill International, Inc., and the drilling crew Cesar Moreira and Sam Colon of Warren George Inc. Thanks also to Tonya Largy and Thomas W. French for botanical analysis and Kit Curran for the report graphics.

INTRODUCTION

Project Description

The Living Breakwaters project consists of a chain of individual, artificial breakwaters along the southwestern shore of Staten Island designed to reduce the risk of storm damage to the island such as that experienced during Hurricane Sandy in 2012 (Figure 1). Raritan Bay was assessed by Geoarcheology Research Associates (GRA) with the objective of developing a predictive model of the archaeological sensitivity of its submerged paleoenvironment prior to navigation improvements proposed by the U.S. Army Corps of Engineers unrelated to the Living Breakwaters project (Schuldenrein et al. 2014). GRA presented a paleoenvironmental reconstruction for the Late Quaternary of the Raritan Bay area in this study. The assessment concluded that the Living Breakwaters Area of Potential Effect (APE) had a high sensitivity to contain intact terrestrial land surfaces and embedded archaeological sites (Figure 2).

AKRF of New York City, NY subcontracted Dr. Kerry J. Lynch of Archaeological Services at the University of Massachusetts to identify the presence or absence of intact terrestrial landforms and/or archaeological deposits that had been aerially exposed prior to being submerged and buried post sea-level rise within the APE. This included monitoring a scheduled geophysical sampling program for the engineering firm Parsons Brinckerhoff, including twenty (20) subsurface borings in Raritan Bay.

On behalf of Grantee the State of New York, the Governor's Office of Storm Recovery (GOSR), serving under the auspices of the New York State Homes and Community Renewal's Housing Trust Fund Corporation and acting under authority of the U.S. Department of Housing and Urban Development's (HUD) regulations at 24 CFR Part 58, and in cooperation with other involved, cooperating, interested agencies, will prepare an environmental impact statement (EIS) to analyze potential impacts of one or more proposed initiatives intended to enhance coastal and social resiliency along the Tottenville shoreline of the South Shore of Staten Island, NY. These initiatives include the Living Breakwaters Project and the Tottenville Shoreline Protection Project (Shoreline Project).As GOSR's on-call consultant, AKRF, Inc. is preparing the environmental review for the project, in accordance with the requirements of the National Environmental Policy Act and the New York Stage Environmental Quality Review Act.

Authority for Survey

Archaeological Services conducts archaeological investigations in accordance with federal and state legislation and regulations concerning the impact to archaeological properties from federally funded or permitted activities. Legislation and regulations include the National Historic Preservation Act of 1966 as amended (PL 89-665); the National Environmental Policy Act of 1969 (PL 91-190, 42 USC 4321); Executive Order 11593 of 1971 (16 USC 470); Procedures for the Protection of Historic and Cultural Properties (36 CFR 800); and the Archaeological and Historical Preservation Act of 1974 (PL 93-291). State legislation dealing with the protection of historical and archaeological resources includes the New York State Historic Preservation Act of 1980, Section 14.09, the State Education Law Section 233, and the State Environmental Quality Review Act (6NYCRR Part 617). Projects involving the discovery of human remains or

cemeteries are conducted in compliance with State Historic Preservation Office/New York State Office of Parks, Recreation and Historic Preservation Human Remains Discovery Protocol (November 28, 2008).

Personnel

Staff of Archaeological Services involved in the Living Breakwaters project included Kerry J. Lynch, Project Archaeologist. Kathryn Curran prepared the report graphics. Christopher Douyard edited the report. Eric S. Johnson is the Director and Goldie McCarty is Business Manager.

METHODOLOGY

Archaeological monitoring of the Living Breakwaters geophysical soil sampling program in Raritan Bay, Staten Island, NY was conducted between September 23 and October 29, 2015. A total of twenty bore locations within the APE were monitored over the course of 24 field days. On occasion, completing the sampling at a single location required more than one day. The boring program took place aboard a barge containing a drill rig which was operated by personnel from Warren George Inc. of Jersey City, NJ. Also present were engineers from the New York and New Jersey offices of Parsons Brinckerhoff, and personnel from the Long Island office of Hill International, Inc.

The bore locations were designated B-1 through B-20. GPS coordinates for the 20 bore locations were pre-determined, and are shown in Figure 3. The barge was maneuvered as close as possible to these coordinates at 19 locations (B-2 through B-20) prior to retrieving the samples. Location B-1 had to be refigured from its proposed location due to shallow water depth, even at high tide. Table 1 contains the actual GPS coordinates of each bore location as recorded on the barge once it was maneuvered into position.

Table 1. GPS coordinates of geo-bore sample locations, Living Breakwaters project

BORE LOCATION	GPS COORDINATES
B-1	40° 29' 857N, 074° 15' .187W
B-2	40° 29' 695N, 074° 15' .033W
B-3	40° 29' 614N, 074° 14' .900W
B-4	40° 29' 641N, 074° 14' .730W
B-5	40° 29' 571N, 074° 14' .697W
B-6	40° 29' 675N, 074° 14' .585W
B-7	40° 29' 714N, 074° 14' .461W
B-8	40° 29' 700N, 074° 14' .360W
B-9	40° 29' 650N, 074° 14' .262W
B-10	40° 29' 774N, 074° 14' .202W
B-11	40° 29' 877N, 074° 14' .091W
B-12	40° 29' 823N, 074° 14' .000W
B-13	40° 29' 917N, 074° 13' .929W
B-14	40° 29' 988N, 074° 13' .809W
B-15	40° 29' 896N, 074° 13' .694W
B-16	40° 30' 037N, 074° 13' .648W
B-17	40° 29' 964N, 074° 13' .536W
B-18	40° 29' 923N, 074° 13' .385W
B-19	40° 30' 049N, 074° 13' .386W
B-20	40° 30' 047N, 074° 13' .197W

The proposed target depth for 17 bores was 18.9 m (62 ft), two were proposed to extend to 31.1 m (102 ft), and one was proposed to extend to 46.3 m (152 ft). Measurement of the bore sample depth was calculated by the drill rig operators based on the length of rod used and accounting for water column depth. The water column depth was measured by periodically dropping the end of a weighted measuring tape off the deck of the barge throughout the day. The distance between the deck of the barge and the water surface was subtracted, giving the depth of the water column.

Field and sediment conditions resulted in 16 bores extending to the target depth of 18.9 m (62 ft), three bores extending to the target depth of 31.1 m (102 ft), and one bore extending to a depth of 24.1 m (79 ft), based on the length of rod used and accounting for water depth. Parsons Brinckerhoff engineers also recorded tidal ranges and converted the depth of sampling based on the length of rod to elevation data accounting for tidal fluctuations. The field data recording the depth of each two foot split spoon bore segment based on length of rod, the amount of recovery in inches, and a corresponding elevation range are shown in table form in Appendix A.

The first 12 feet at every location was continuously sampled with consecutive two footsplit spoon bore segments (6 in total). The remaining samples were collected at five foot intervals. Therefore three feet of every five was drilled through and not observed. After each split spoon bore was opened; the recovery of sediment was recorded from the bottom of the segment (in inches) and the sediment was described and documented as a stratigraphic unit. A trowel was used to break up the soil and look for artifacts, and if warranted, samples were taken for flotation analysis. If sediment samples were collected, photographs were taken of the split spoon segment prior to collection.

Photographs were also taken of every two foot, split spoon bore sample at three locations as representative examples of deposits (B-2, B-9, and B-20). These photographs are presented in Appendix B. Bore location B-2 was located in the western end of the APE, bore B-9was in the center, and bore B-20 was at the eastern end (see Figure 3). A total of 350 geo-physical samples were recovered. Of these, 342 were split spoon samples that were opened immediately. Eight were closed, undisturbed samples taken in Shelby tubes that were transported to a lab to be opened. Shelby tube sampling was only used in areas where soft, cohesive marine clay was identified. These post-sea level rise marine deposits are not considered archaeologically sensitive and therefore opening the Shelby tubes did not require monitoring.

Descriptions of all split spoon bore samples are presented in Appendix C. Appendix C data for each bore location is presented as an approximate, discontinuous stratigraphic profile, taking into account the recovery within each two foot split spoon bore segment and the three feet drilled-through samples below 12 feet. (The data is presented using the elevations below mean sea level (bmsl) computed by Parsons Brinckerhoff to account for tidal range and, as a result, may not reflect expected three foot long breaks between samples.) The amount of recovery within each two foot split spoon segment was converted to an elevation data range and recorded on the profiles in Appendix C. Blank white spaces reflect areas of no sediment recovery within bore segments, while areas drilled through are represented by jagged lines with arrows separating each bore segment.

It is important to note that this geo-physical soil sampling process is not optimal for archaeological inquiry as overlying and underlying deposits relating to each two foot split spoon segment were not examined and often recovery was not an entire two feet. In most cases the soil samples collected for flotation analysis were from hypothesized B-horizons. If there had been intact A-horizons overlying the deposits, or recognizable B-C horizon color or texture gradation

below the deposit, they were drilled through and unobservable.

FIELD RESEARCH RESULTS

Depositional Setting

The sediment observed in the split spoon bores collected within the Living Breakwaters APE was highly variable and complex. While generating a paleoenvironmental reconstruction of the APE is beyond the scope of this project, there was some disparity between the horizons observed at the western end, and those present in the middle and east. While many of the deposits were generally similar to those reported by GRA (Schuldenrein et al.2014), others were not. GRA collected vibratory cores in Raritan Bay during their assessment and observed sediments were grouped within four broad categories; IV. reworked, sandy marine sediments; III. Truncated Pleistocene glacio-fluvial sands and gravels; II. poorly sorted glacial till; and I. highly weathered Cretaceous clays and sands (Schuldenrein et al. 2014). These are presented in stratigraphic order from top (IV) to bottom (I). No intact, former aerially-exposed landforms were identified during GRA's study.

One vibratory core was collected by GRA just north of the Living Breakwaters APE on the eastern side of what is both a relic river channel and the modern navigation channel (Figure 2). The Living Breakwaters APE lies on the west side of this channel. This particular core (Core A-0) recorded reworked marine deposits to about ¾ of a meter (2.5 ft) overlying 5.75 m (19 ft) of glacio-fluvial sands and gravels (Schuldenrein et al. 2014). Core A-0 is reproduced in this report as Figure 4. Figure 4 illustrates GRA's descriptions of the core profile which is summarized as; dark gray, reworked sandy marine sediments (IV) overlying a fairly homogeneous red-brown, poorly sorted sequence of Pleistocene sands and gravel (III).Glacial till and Cretaceous deposits were not encountered in this core. Underlying similar glacio-fluvial sands and gravels in additional vibratory cores placed across the bay by GRA were Cretaceous deposits that were generally described as dark gray highly weathered clays and sands with laminations and oxidation mottling.

The colors and textures of these Cretaceous deposits described by GRA are somewhat similar to deposits observed during the Living Breakwaters project. In addition, reworked marine sediments and red-brown glacio-fluvial deposits were observed across the Living Breakwaters APE similar to deposits recorded in Core A-0. Glacial till was not identified in any bore location testing within the APE. Light to dark gray sands and clays were recorded deep in many bore sample locations. It is unclear if the light gray deposits in the APE are fluvial or eolian in nature, or if they are associated with the Pleistocene glaciers or the Cretaceous period.

There were some depositional differences observed in the Living Breakwaters APE that do not seem to directly correlate with deposits recorded by Shuldenrein et al. (2014) for Raritan Bay. One deposit was identified primarily at the western end of the APE in B-1, B-2, and B-4 (Figure 3). This deposit consisted of gray silt clay that variably contained inclusions of peat flecking and shell and constitutes common marine "mud" indicative of post-inundation deposition. The thickest horizons were observed in B-1 and B-2. The mud extended from approximately 5.8 to 29.5 m (17.3 to 96.75 ft) bmsl in B-1 and from approximately 9.8 to 24.6 m (32.3 to 80.8 ft) bmsl in B-2 (Appendix C), at 24.4 and 15 m (80 and 50 ft) thick respectively. In B-4 it was observed between 6.8 and 9.3 m (22.4 and 30.5 ft) bmsl as an approximately 3.7 m (12 foot) thick horizon.

This mud appears in only four other bore locations as much thinner horizons; B-3, B-13, B-16, and B-19 (Figure 3). The observed mud horizon in these locations range from a few inches to a few feet and are all overlaid with eroded, reworked sands and gravels indicating a dynamic setting. It is possible that thin horizons of this marine mud are present at other bore locations but were drilled through and unobserved.

Also unique to the western end of the APE were bore locations containing sediment deposits with visible terrestrial botanicals. These sediments were bagged as soil samples, as were any deposits within the APE identified as possible former, aerially exposed surface deposits based on colors and textures common to terrestrial horizons known to contain archaeological resources. A total of 30 soil samples were collected from split spoon bores at 12 bore locations. Most of the collected samples were hypothesized to be from potential B-horizon or shallow C-horizon deposits as no classic, organic A-horizons or developed peat layers were identified.

Following flotation processing of all the soil samples, flora and/or faunal material was recovered from two bore locations at the western end of the APE. These included a combination of charred and uncharred terrestrial botanicals, marine flora and fauna indicative of a shallow marine environment, and charcoal. These elements were not identified at any of the remaining eighteen bore locations. The two locations that contained terrestrial botanical material are B-2 and B-4, close to the southwest promontory of Wards Point (Figures 2 and 3). In bore locations B-2 and B-4, terrestrial botanical evidence was underlying the marine mud horizon, consistent with an intact land surface prior to the inundation of Raritan Bay. The two bore locations within the Living Breakwaters APE where potential former aerially exposed landforms were observed are described below.

Bore Location Descriptions of Potential Intact Landforms

Bore location B-2 (Figure 3 and Appendix C).B-2contained what appears to be about 7.6 m (25 ft) of reworked, alternating black, red-brown, and gray silts and sand/sand gravel deposits overlying the soft, gray silt clay marine mud mentioned above. This soft, gray mud was observed to 24.6 m (80.8 ft) bmsl, at approximately 15 m (50 ft) thick. The bottom 4.5 m (15 ft) or so of this mud contained peat inclusions. Underlying the mud were deposits of light gray silt clay and laminated gray clay and very light gray very fine sand.

Bands of black silty coarse sands were sampled when they were observed in three different bore segments between 6 and 8.6 m (19.8 and 28.3 ft) bmsl (Appendix C) due to their color and the texture. Following flotation of each soil sample, only the bottom sample between 8.5 to 8.6 m (7.8 to 28.3 ft) bmsl contained organic material. This material consisted of an uncharred goosefoot seed, eel grass fragments, and a variety of marine fauna. These are presented in Appendix D. The eel grass and the marine fauna are closely associated, and represent a shallow, productive, marine habitat. This environment developed over the thick deposit of mud, likely as sea level stabilized. The goosefoot seed is probably intrusive.

A soil sample was also collected at the very bottom of a bore segment at 24.6 m (80.8 ft) bmsl because its color and texture differed from the preceding thick deposit of soft gray marine clay. It resembled a potential terrestrial A/B-horizon (Figure 5). This sample contained terrestrial botanicals including uncharred sedge and knotweed seeds, charred oak, and fragments of unidentifiable charred hardwood and a resin droplet (Appendix D). No marine flora or fauna was recovered from this sample.

The next bore segment collected (after drilling three feet) contained the light gray fine sandy clay that likely pre-dates any human occupation of the area. However, one final soil sample was

recovered from these deposits between 25.1-25.2 m (82.45-82.6 ft) bmsl. This was due to clearly visible charred wood inclusions identified as a species of dicot wood (Appendix D). The charred material was hypothesized to be intrusive in the deposit, possibly through bioturbation, and was radiocarbon dated as it provided the largest organic sample from deposits below the marine mud. The terrestrial botanical material from above the dicot wood at 24.6 m (80.8 ft) bmsl was not dated.

Interestingly, the charred sample was unable to be dated by accelerator mass spectrometry (AMS) with any confidence beyond >43,500 BP. In addition, staff at the Beta Analytic Inc. radiocarbon dating lab observed that after pretreatment the sample appear to be mineralized with tiny, gold flecks hypothesized to be pyrite (Chris Patrick, personal communication, March 4, 2016). The report of radiocarbon dating analysis is presented in Appendix E. Figure 6 shows the bore segment, a close up of the charred inclusions, the fragment remaining following flotation at the bottom of a two gallon bucket, and an example of the charred material after being pretreated for radiocarbon dating at the Beta Analytic lab in Miami, Florida.

The early date range of this organic material, unfortunately, does not have archaeological significance, nor does it help date the terrestrial botanicals from approximately four feet above it. Bore location B-4, however, had a similar deposit with terrestrial botanicals underlying the marine mud and overlying light gray fine sands and clay.

Bore Location B-4 (Figure 3 and Appendix C).B-4 contained what appears to be about 6 m (20 ft) of reworked, alternating red-gray, red-brown, and gray silts and sand/sand gravel deposits overlying the soft, gray silt clay marine mud mentioned above. This soft, gray mud was observed to 9.3 m (30.5 ft) bmsl, at approximately 3.7 m (12 ft) thick. The entirety of this mud contained peat inclusions. Underlying the mud was a horizon of brown silty sand with visible wood inclusions. This horizon consisted of the total recovery of one bore segment and was only about five inches thick. Underlying this horizon were deposits of mottled yellowish brown and brown sandy silt, then very light gray very fine sand with traces of silt and some clay.

Two soil samples were collected from B-4. The brown silty sand with visible wood inclusions from 10.8-10.9 m (35.3-35.7 ft) bmsl, and a second horizon of mottled brown sandy silt from 12.2-12.5 m (39.9-40.9 ft) bmsl (Appendix C). Both were hypothesized to be potential B-horizon deposits. The top sample yielded one charred knotweed seed and one unidentifiable seed; charred oak; and charred conifer fragments including wood, bark, needles, and a fascicle (Appendix D).No marine flora or fauna was recovered. No botanicals were recovered from the bottom horizon.

Charred wood fragments from the top sample were AMS dated to 5500 +/- 30 BP (Appendix E). This date corresponds to a period when sea level was lower, and the vicinity of B-4 would have been aerially exposed and suitable for Native American occupation. Graphic representation of the estimated sea level at ca. 4,500 BP presented in Schuldenrein et al. (2014) and reproduced as Figure 7 illustrates this. This time period corresponds to the Native American Late Archaic culture period which is well represented in the archaeological record of the area. The charred botanical material recovered from B-4 may be proxy evidence of an archaeological site in the immediate vicinity, possibly within the three feet that was drilled through overlying the dated material.

Cultural Material

Native American lithic cultural material was recovered from bore locations B-10, B-12, and

B-17 positioned within the middle and eastern end of the APE. The lithics are angular, not waterworn, and differed considerably from the rounded sand and gravel matrix surrounding them. The lithics are shown in Figure 8. Bore location B-12 and B-17 yielded chert artifacts that show evidence of manufacture and pressure flaking. The chert fragment from B-12 was recovered from red tan very coarse sand and gravel at approximately 7.9 m (26 ft) bmsl, and the chert nodule from B-17 was recovered from gray brown very coarse sand and gravel at approximately 12.8 m (42 ft) bmsl. Both chert fragments show evidence of flake scars. No other chert was identified during the project.

Bore location B-10 yielded angular nodules of fractured jasper with cortex. Jasper is used as a raw material for the manufacture of Native American stone tools, and is found as nodules on Staten Island (Michael Pappalardo, personal communication, November 16, 2015). The jasper nodules in B-10 were recovered from dark red-brown coarse sand at 10.5 m (34.6 ft) bmsl. No other jasper was identified during the project.

There was no evidence that these lithics were *in-situ*. No botanical material was recovered from any of the soil samples taken from any bore locations in the middle and eastern portions of the APE, including the samples containing these lithics. It is likely that the sand and gravel horizons containing the cultural material were eroded and redeposited from areas of the Staten Island shoreline that previously contained sites of human occupation.

The recovery of these lithics from deposits that were similar to those identified as glacio-fluvial in origin suggests that the near shore environment on the west side of the paleo river/navigation channel may be more dynamic than further out into the bay on the east side of the channel (Shuldenrein et al. 2014). The red-brown Pleistocene deposit in Core A-0 looks thick and fairly homogeneous in color (Figure 4). Much of the glacio-fluvial deposits in the Living Breakwaters APE are bedded and of various colors and textures. This may indicate a long history of eroded, reworked deposition from currents and storm surge closer to shore adjacent to the middle and eastern end of the APE. A large, eroded bluff of red-brown sand and gravel in the vicinity of the Princes Bay Lighthouse was clearly visible from the barge while operating on the eastern end of the APE. However, without data from continuous soil profiles this hypothesis remains speculative.

CONCLUSIONS

Archaeological monitoring of the Living Breakwaters geophysical sampling program in Raritan Bay, Staten Island, New York identified charred and uncharred botanical remains in terrestrial deposits at two bore locations. Both locations, B-2 and B-4, were close to the southwest promontory of Wards Point at the western end of the project area. These terrestrial deposits indicate the preservation of an intact, former land surface available for Native American occupation. This land surface is now submerged. Identifying submerged land surfaces as intact horizons refines our understanding of localized, post glacial sea level rise as well as confirming the potential preservation of Native American settlements within these horizons.

One terrestrial deposit in B-4, underlying post-sea level rise marine sediment, was AMS dated to 5500 +/- 30 BP. This date fits well with the model of sea level rise and inundation proposed by Schuldenrein et al. (2014) for Raritan Bay. At 5500 +/-30 BP the coastline was projected to be east of Sandy Hook, New Jersey, and the Living Breakwaters project area would have been dry. The charred botanicals recovered from the dated sample included oak, pine, and knotweed, all terrestrial plants which may be proxy evidence of a cultural deposit. Archaeological vibratory coring in Salem Harbor, Salem, Massachusetts also recovered charred botanicals in a submerged terrestrial horizon during a Phase 1 investigation. Following recommendations for additional Phase 2 coring based on this proxy evidence, an intact Native American site was identified in a submerged, preserved horizon (Lynch et al. 2010).

Native American lithic cultural material was recovered from two bore locations within the middle and eastern end of the project area. They are angular, not waterworn, and differ considerably from the rounded sand and gravel matrix surrounding them. These sand and gravel deposits are most likely redeposited from storm surge and erosion of the shoreline that previously contained sites of Native American occupation. The cultural material, therefore, is not considered to be *in-situ* and does not constitute an intact archaeological site.

While intact terrestrial land forms were identified at two bore locations, the geo-physical soil sampling process monitored for the Living Breakwaters project was not optimal for archaeological inquiry. Because overlying and underlying deposits relating to each two foot split spoon segment were not examined, and often recovery was not an entire two feet, less than fifty percent of each bore location was observed. In most cases the soil samples collected for flotation analysis were from hypothesized B-horizons. If there had been intact A-horizons overlying the deposits, or recognizable B-C horizon color or texture gradation below the deposit, they were drilled through and unobservable. Because this non-continuous sampling did not allow for the observation of all deposits, it is possible that the area off Ward's Point at the western end of the project area contains preserved terrestrial land surfaces. These surfaces may have been drilled through at bore locations in the vicinity surrounding B-2 and B-4. The remainder of the project area seems to be more dynamic, and is less likely to contain these potential resources.

REFERENCES CITED

Lynch, Kerry J., Sheila Charles, and Mitchell T. Mulholland
2010 Archaeological Phase 2 Site Examination of Three Maritime Sites, Salem Port Expansion Project Salem, Massachusetts. Archaeological Services at the University of Massachusetts Amherst.Submitted to Bourne Consulting Engineering, Franklin, Massachusetts.

Schuldenrein, Joseph, Curtis E. Larsen, Michael Aiuvaslasit, and Mark A. Smith
2014 *Geomorphology/Archaeological Borings and GIS Model of the Submerged Paleoenvironment in the New York and New Jersey Harbor and Bight in Connection with the New York and New Jersey Harbor Navigation Project, Port of New York and New Jersey*. Geoarchaeology Research Associates.Submitted to Tetra Tech, Portland, Maine.

FIGURES

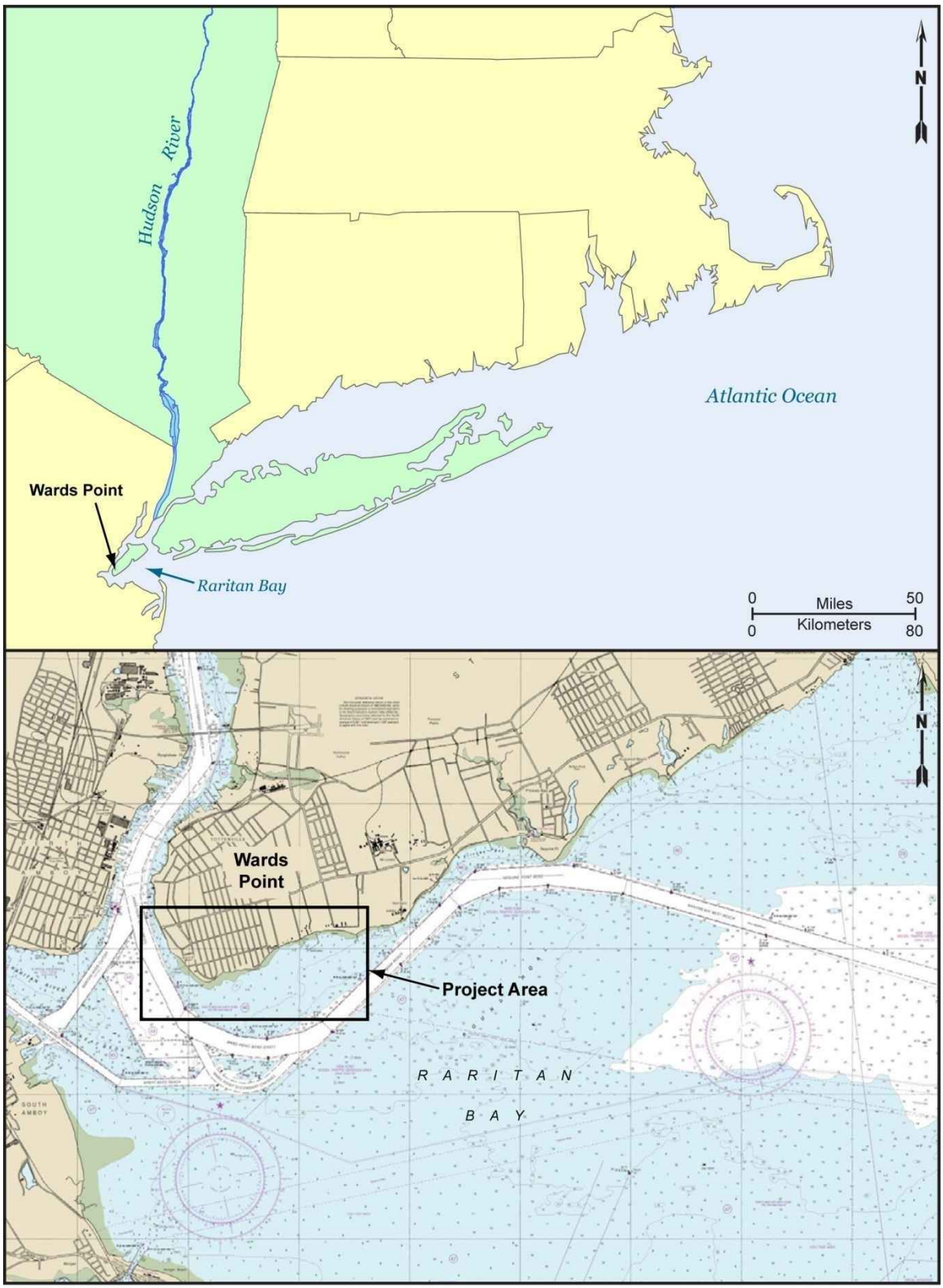


Figure 1. Project area location in New York State and Raritan Bay (top), and on NOAA chart 12331 (bottom).

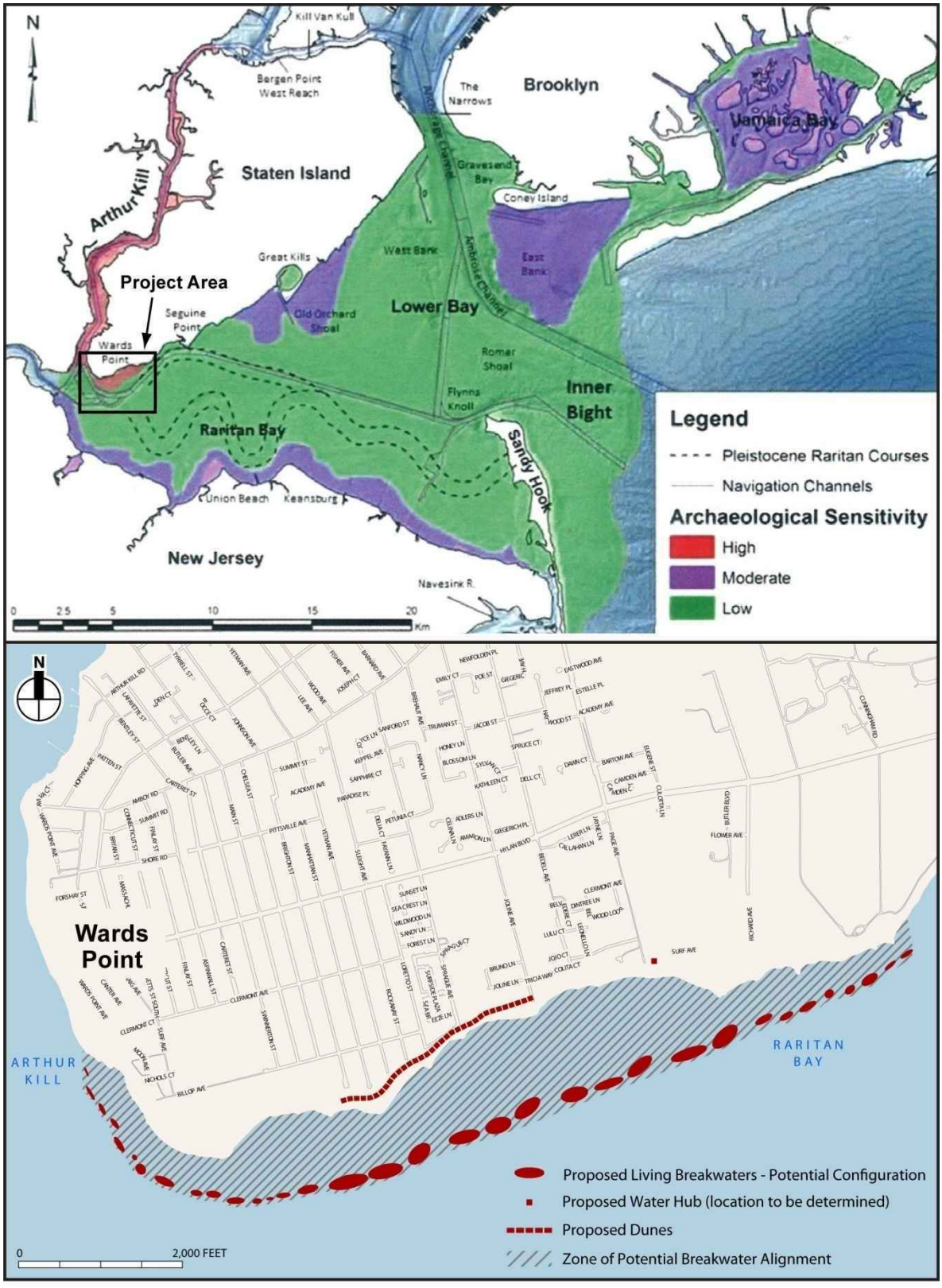


Figure 2. Archaeological sensitivity assessment of Raritan Bay from Schuldenrein et al. 2014 showing the project area (top), and the project APE (bottom).

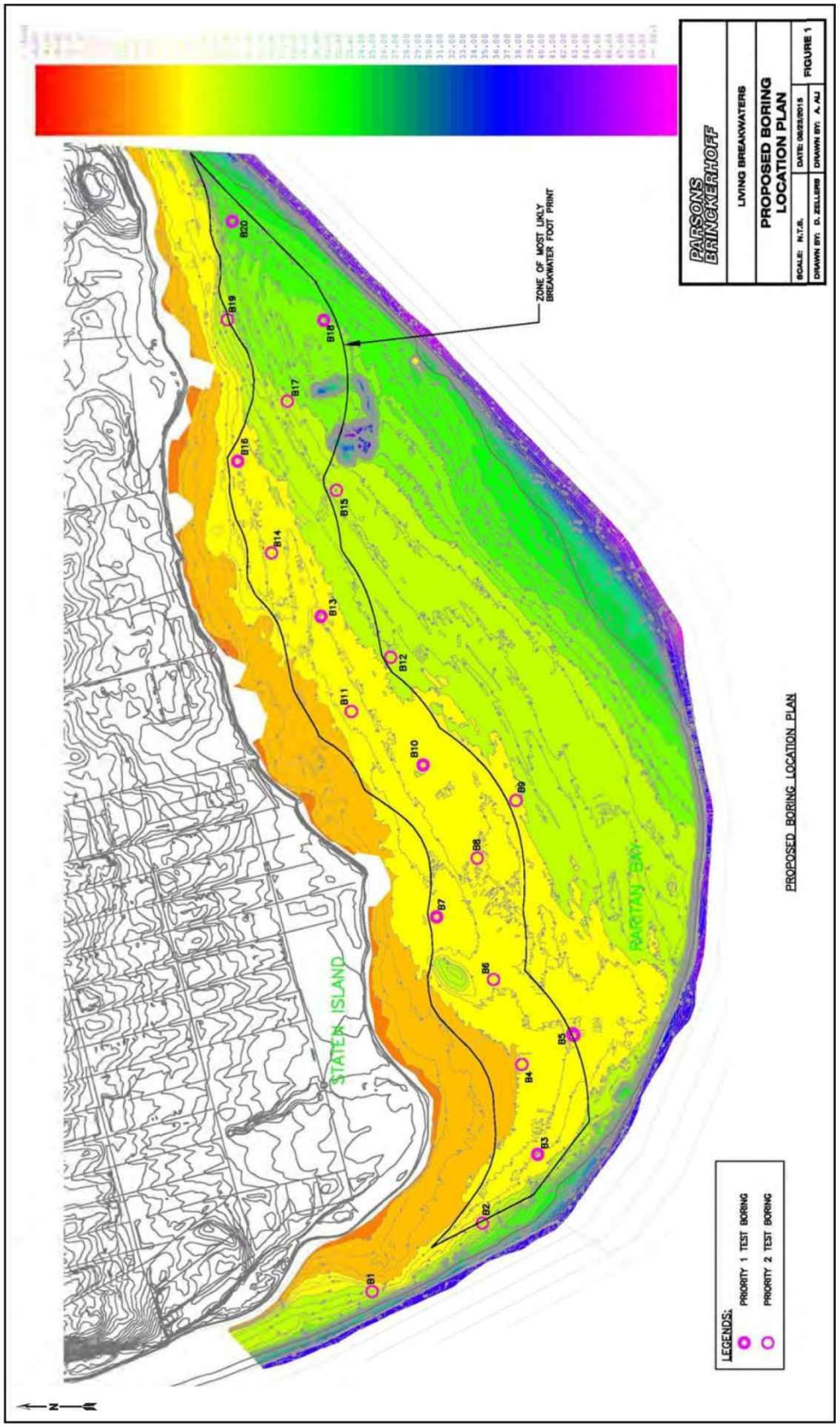
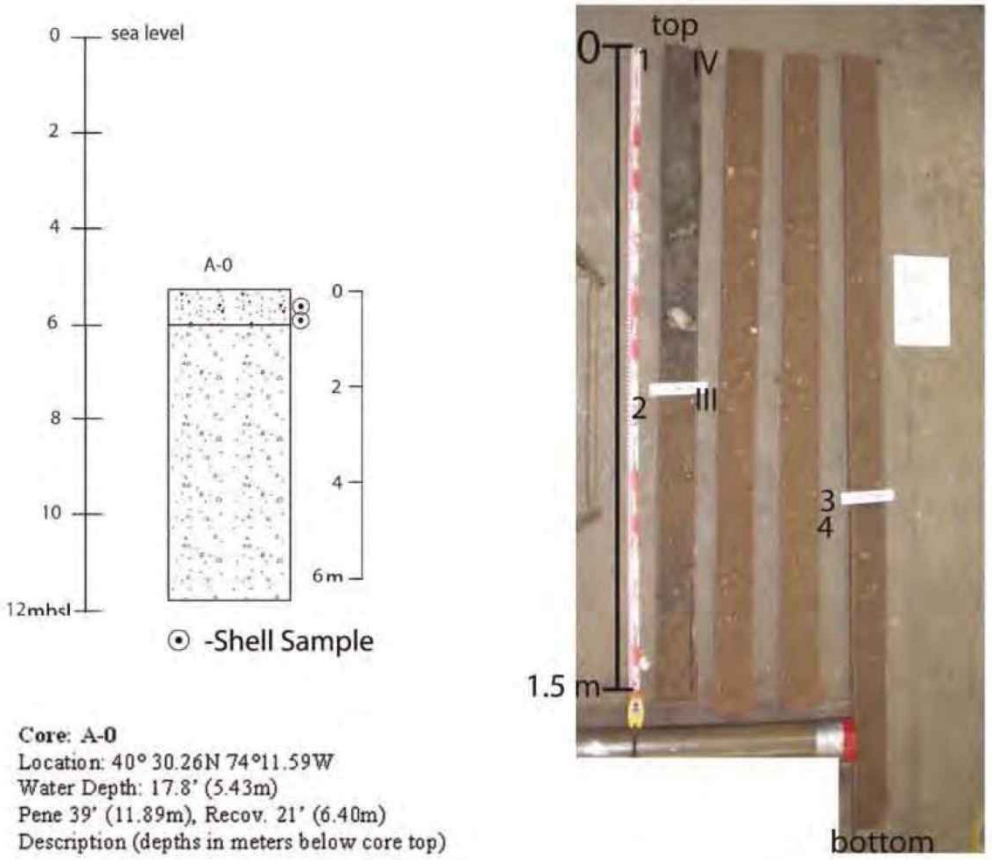


Figure 3. Living Breakwaters proposed boring location plan for B-1 through B-20, Raritan Bay, Staten Island, NY.

Core A-0



Core: A-0
Location: 40° 30.26N 74°11.59W
Water Depth: 17.8' (5.43m)
Pene 39' (11.89m), Recov. 21' (6.40m)
Description (depths in meters below core top)

Stratum	Lab Stratum	Depth (m)	Munsell Color	Description
IV	1	0-0.75	10YR3/1	clayey silty fine to coarse sand, with intact clam shells and broken shells with greatest concentration in upper 0-15 cm, abrupt lower boundary
III	2	0.75-5.75	7.5YR4/2	clean poorly sorted gravelly fine to coarse angular to subangular sand, with well rounded to subrounded gravels to 5-10 cm, abrupt lower boundary
	3	5.75-5.78	7.5YR3/1	silty fine sand, abrupt lower boundary
	4	5.78-6.50	7.5YR4/3	slightly poorly sorted gravelly silty fine to coarse sand with rounded to subrounded gravel to 5-10 cm

Figure 4. Core A-0 reproduced from Shuldenrein et al. 2014, page 171.

Figure 5. Photograph of bore segment 72-74 ft (79.2-81.2 ft bmsl) at bore location B-2 (top), and a close up photograph of grayish brown clay silt with botanical inclusions 80.8-81.2 ft bmsl (bottom).

Figure 6. Photographs of bore segment 74-76 ft (81.2-83.2 ft bmsl) at bore location B-2 (top left), a close up of the charred inclusions in-situ (top right), the fragment remaining following flotation at the bottom of a two gallon bucket (bottom left), and an example of the charred material after being pretreated for radiocarbondating at the Beta Analytic lab showing mineralized flecking (bottom right).

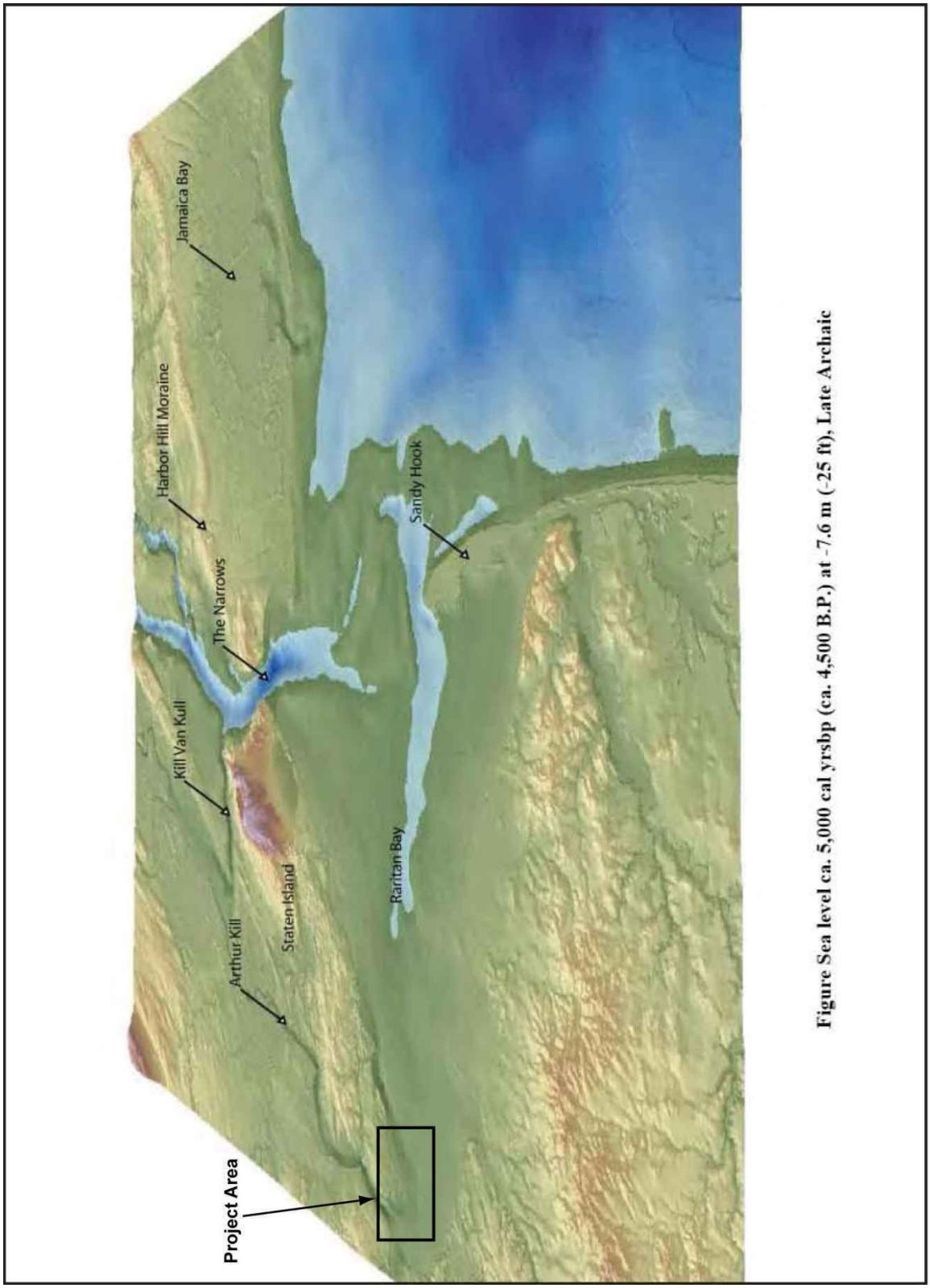


Figure 7. Project area correlated with sea level ca. 4.500 BP at -7.6 m (-25 ft) reproduced from Shuldenrein et al. 2014, page 116.

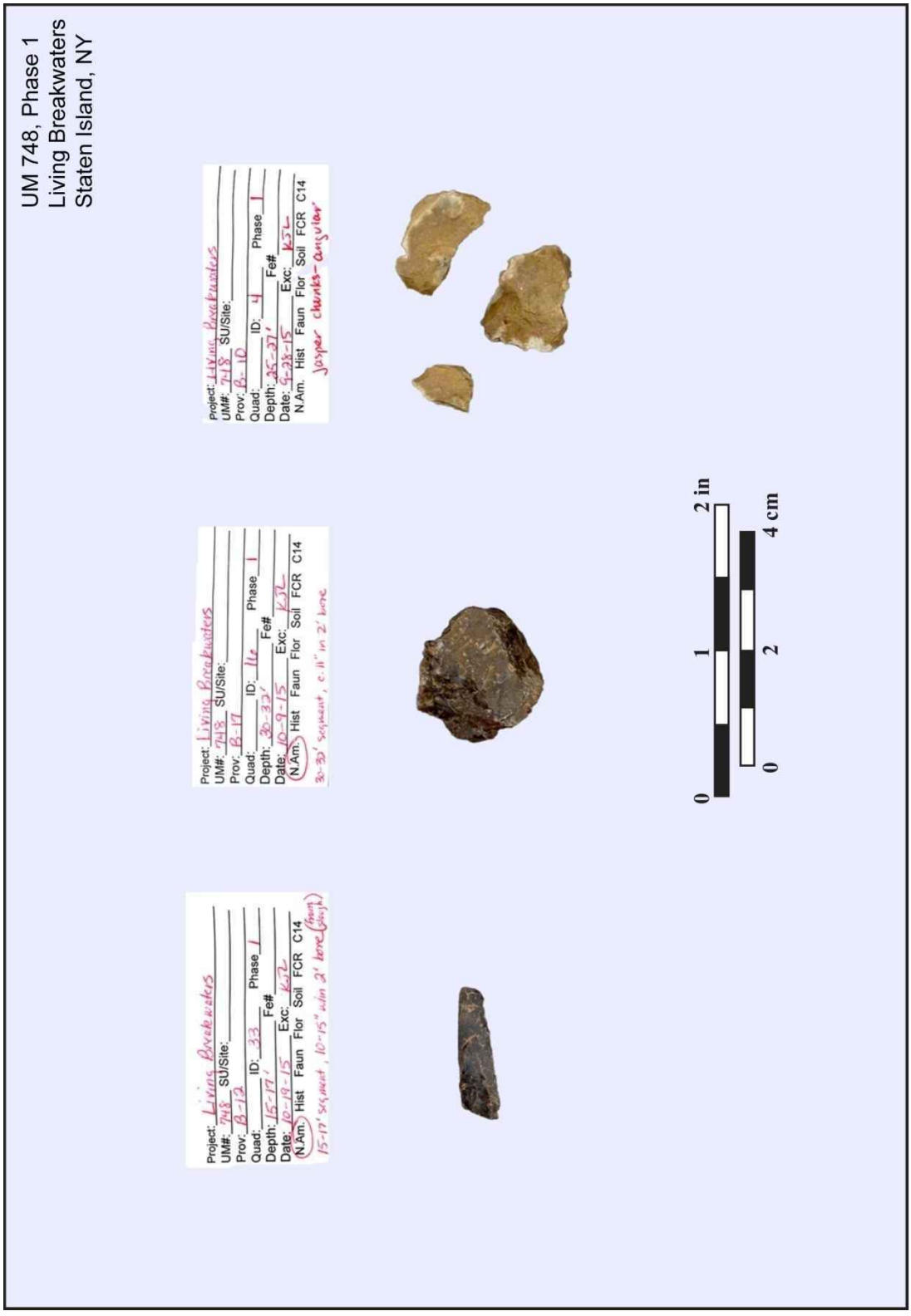


Figure 8. Lithic material recovered from Living Breakwaters bore segments; bore location B-12, chert fragment from approximately 26 ft bmsl (left); bore location B-17, chert fragment from approximately 42 ft bmsl (center); and bore location B-10, jasper nodule fragments from 34.6 ft bmsl (right).

APPENDIX A

Split Spoon Bore Segments and Sample Recovery as Raw Field Data (depth not adjusted for tidal range) and Elevation Data (adjusted for tidal range)

Split Spoon Bore Segments and Sample Recovery as Raw Field Data (depth not adjusted for tidal range) and Elevation Data (adjusted for tidal range)

SAMPLE DEPTH IN FEET	BORE LOCATION AND TOTAL RECOVERY IN INCHES AND AS A RANGE OF ELEVATION DATA IN FEET (BELOW MEAN SEA LEVEL)																			
	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20
0-2	11" 11.1-12	9" 8.05-8.8	18" 7.7-9.2	10" 6.7-7.5	9" 8.2-9	16" 7.2-8.5	14" 7.8-9	13" 8.9-10	9" 11.2-12	10" 9-9.7	16" 8.7-10	8" 11.3-12	14" 8.9-10.1	12" 10-11	12" 13-14	18" 7.8-9.3	no recovery	no recovery	8" 12.8-13.5	6" 20-20.5
2-4	24" 12-14	13" 9.7-10.8	16" 9.7-11.1	15" 8.1-9.3	24" 9-11	19" 8.2-9.8	24" 9-11	18" 10.6-12	22" 12.2-14	24" 9.7-11.7	24" 10-12	11" 13.1-14	18" 10.6-12.1	21" 11.2-13	22" 14.2-16	24" 9.3-11.3	24" 15-17	12" 19-20	18" 13.4-14.9	20" 19.3-21
4-6	6" 15.5-16	10" 11.9-12.8	19" 11.3-12.9	20" 9.5-11.2	24" 11-13	13" 9.9-11	24" 11-13	19" 12.4-14	24" 14-16	24" 11.7-13.7	17" 12.6-14	21" 14.2-16	0" ST 12.1-14.1	24" 13-15	17" 16.6-18	0" ST 11.3-13.3	20" 17.3-19	20" 20.3-22	0" ST 14-16	24" 21-23
6-8	24" 16-18	10" 13.9-14.8	13" 14.1-15.2	14" 12-13.2	9" 14.25-15	16" 11.7-13	24" 13-15	24" 14-16	12" 17-18	20" 14.7-16.5	24" 14-16	24" 16-18	24" 14.1-16.1	16" 15.7-17	24" 18-20	24" 13.3-15.3	10" 20.1-20.9	18" 22.5-24	24" 16.1-18.1	16" 23.7-25
8-10	0" ST 18-20	18" 15.3-16.8	14" 16.3-17.5	16" 13.9-15.2	12" 16-17	24" 13-15	20" 15.3-17	21" 16.2-18	22" 18.2-20	24" 16.2-18.2	24" 16-18	11" 19.1-20	24" 16.1-18.1	24" 17-19	21" 20.2-22	19" 15.7-17.3	15" 22-23.3	16" 24.6-26	6" 19.8-20.3	24" 25-27
10-12	24" 20-22		11" 17.8-19.8	24" 17.2-19.2	12" 18-19	24" 15-17	8" 18.3-19	21" 18.2-20	11" 21.1-22	22" 17.9-19.7	6" 19.5-20	19" 20.4-22	20" 18.4-20.1	24" 19-21	24" 22-24	24" 17.3-19.3	14" 24.3-25.5	24" 26.5-28	24" 20.5-22.5	20" 26.6-28.3
12-14											12" 21-22									
13-15		10" 20.9-21.8				14" 17.1-18.3									12" 26-27					
14-16														16" 23.7-25						
15-17		20" 22.1-23.8	24" 22.5-24.5	21" 18.9-20.7	13" 20.3-21.2	16" 18.5-19.8	16" 22.1-23.4		10" 26.2-27			15" 25.7-27	12" 22.1-23.1			21" 22.1-23.9	7" 27-27.6	16" 30-31.3	18" 25.1-26.6	9" 32.2-33
16-18								15" 24.7-26			no recovery									
18-20						rock									9" 31.2-32					
19-21						12" 25.5-26.5														
20-22	23" 30.1-32	18" 26.8-28.3	11" 28.2-29.1	20" 22.1-24.1	14" 25.2-26.4		16" 27.3-28.6		14" 30.8-32	17" 29-30.4		10" 28.2-29	14" 27-28.2	6" 30.5-31		15" 27.8-29.1	no recovery	12" 35-36	17" 30.3-31.7	15" 36.5-37.8
21-23								15" 29.7-31	13" 32.9-34		13" 29.9-31									
22-24				0" ST 22.1-24.1																
23-25												12" 34-35			13" 35.9-37					
24-26				24" 25.8-27.8		20" 30.8-32.5														
25-27	24" 35-37	24" 32.3-34.3	16" 32.5-33.8		20" 29.9-31.6		11" 32.9-33.8			13" 34.6-35.7			17" 31.9-33.3	12" 35-36		24" 32.3-34.3	2" 37.4-37.6	16" 40.5-41.8	17" 35.2-36.6	6" 42.5-43
26-28				19" 28.9-30.5				11" 35.1-36			15" 34.7-36									

(1 of 4)

Split Spoon Bore Segments and Sample Recovery as Raw Field Data (depth not adjusted for tidal range) and Elevation Data (adjusted for tidal range)

	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20
27-29		0" ST										11" 38.1-39								
28-30				5" 35.3-35.7					12" 39-40						12" 41-42					
29-31						no recovery														
30-32	24" 40-42	24" 36.3-38.3	24" 36.5-38.5		24" 35.1-37.1		15" 37.7-39			16" 39.7-41			3" 39.2-39.5	15" 39.7-41		18" 39.5-41	11" 42-42.9	8" 45.5-47.2	12" 40.4-41.4	15" 44.7-46
31-33								7" 40.4-41			12" 40-41									
32-34	14" 42.8-44														12" 45-46					
33-35		17" 40.4-41.8		24" 38.9-40.9					14" 43.8-45			12" 44-45								
34-36						24" 39.7-41.7														
35-37		0" ST 41.8-43.8	12" 42.3-43.3		24" 40.5-42.5		20" 42.1-43.8			24" 44.5-46.5			9" 42.9-43.7	9" 45.2-46		16" 43.3-44.6	15" 46.8-48.1	17" 51.1-52.5	13" 45-46.1	18" 50-51.5
36-38								21" 44.2-46			15" 44.7-46									
37-39	11" 48.1-49	24" 43.8-45.8										15" 47.7-49			12" 50-51					
38-40				21 44.6-46.4		20" 44.1-45.8			24" 48-50											
39-41		24" 45.8-47.8																		
40-42			24" 46.3-48.3		22" 46.4-48.2		24" 46.8-48.8			24" 50.9-52.9			14" 47.6-48.8	12" 50-51		13" 48.8-49.9	17" 51.8-53.2	24" 56-58	20" 48.7-50.4	22" 54.3-56.1
41-43		0" ST 48-50						no recovery			15" 49.7-51									
42-44	24" 52-54											8" 52.3-54			9" 55.2-56					
43-45		8" 51.3-52				17" 50.2-51.6			24" 53-55											
44-46				24" 49.7-51.7										5" 54.6-55						
45-47		24" 52-54	19" 50.8-52.4		24" 51.4-53.4		18" 51.9-53.4			24" 56.2-58.2	14" 53.8-55		15" 52.8-54.1			17" 53.6-55	17" 56.3-58.3		18" 52.8-54.3	24" 59.2-61.2
46-48								21" 54.2-56												
47-49	14" 58.8-60											17" 55.7-59			13" 59.9-61					
48-50									16" 58.7-60		16" 56.7-58									

Split Spoon Bore Segments and Sample Recovery as Raw Field Data (depth not adjusted for tidal range) and Elevation Data (adjusted for tidal range)

	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20
49-51														13" 58.9-60						
50-52		17" 56.9-58.9	22" 55.4-57.2	17" 55.6-57	19" 57-58.6	17" 57-58.4	24" 56.1-58.1			24" 61.4-63.4			19" 57.3-58.9			24" 57.7-59.7	24" 62.3-64.3	24" 66.9-68.6	24" 57.2-59.2	24" 64-66
51-53								21" 59.2-61												
52-54	22" 62.2-64														24" 64-66					
53-55									15" 63.7-65					15" 62.7-64						
55-57			24" 60-62	12" 61.5-62.5	24" 61.8-63.8	no recovery	24" 60.8-62.8	18" 63.5-65		24" 66.7-68.7			4" 62.9-63.3				24" 67.2-69.2	24" 72-74	20" 62.3-64	19" 68.6-70.2
56-58		24" 63.3-65.3									7" 59.4-61									
57-59												10" 68.2-69			21" 69.2-71					
58-60	24" 68-70																			
59-61														15" 66.7-68						
60-62		24" 67.7-69.7	24" 64.8-66.8	24" 65.9-67.9	24" 67-69	24" 66.6-67.9	24" 65.5-67.5			24" 72.2-74.2			16" 69.1-70.4				24" 72.2-74.2	24" 77.5-79.5	24" 67-69	2" 75.3-75.5
62-64								19" 70.4-72				13" 72.9-74		5" 72.6-73						
64-66	16" 74.7-76																			
65-67																			24" 75.1-77.1	
66-68		20" 73.6-75.3																		
67-69												13" 78-79								
70-72	24" 80-82																		24" 79.9-81.9	
71-73		24" 77.9-79.9										18" 81.5-83								
72-74		15" 79.2-81.2																		
74-76		17" 81.2-83.2																		
75-77	24" 85-87																		24" 84.7-86.7	
77-79												16" 87.7-89								

(3 of 4)

Split Spoon Bore Segments and Sample Recovery as Raw Field Data (depth not adjusted for tidal range) and Elevation Data (adjusted for tidal range)

	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20
80-82	17" 90.6-92																		24" 90.2-92.2	
81-83		17" 88.8-90.2																	24" 95.2-97.2	
85-87																			24" 95.2-97.2	
87-89		19" 94.7-96.3																		
86-88	24" 96-98																			
90-92	15" 100.75-102																		24" 100.1-102.1	
92-94		18" 99.4-101.4																		
93-95	12" 104-105																			
95-97																			24" 104.7-106.7	
97-99	22" 107.2-109																			
100-102																			24" 109.3-111.3	
104-106	13" 114.9-116																			

(4 of 4)

ST: Shelby Tube, closed sample not opened in field

APPENDIX B

Photographs of two foot bore segments from test locations B-2, B-9, and B-20

BORE B-2

0-2

Split spoon bore segment 0- 2;
recovery 9 inches/elevation range between 8.05-8.8 feet bmsl.

2-4

Split spoon bore segment 2-4;
recovery 13 inches/elevation range between 9.7-10.8 feet bmsl.

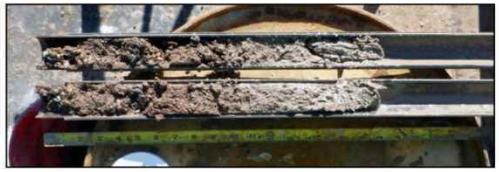
4-6

Split spoon bore segment 4-6;
recovery 10 inches/elevation range between 11.9-12.8 feet bmsl.

6-8

Split spoon bore segment 6-8;
recovery 10 inches/elevation range between 13.9-14.8 feet bmsl.

8-10



Split spoon bore segment 8-10;
recovery 18 inches/elevation range between 15.3-16.8 feet bmsl.

13-15

Split spoon bore segment 13-15;
recovery 10 inches/elevation range between 20.9-21.8 feet bmsl.

15-17

Split spoon bore segment 15-17;
recovery 20 inches/elevation range between 22.1-23.8 feet bmsl.

20-22

Split spoon bore segment 20-22;
recovery 18 inches/elevation range between 26.8-28.3 feet bmsl.

25-27

Split spoon bore segment 25-27;
no photograph.

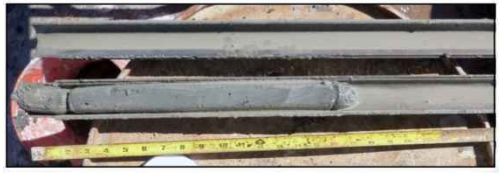
27-29

Split spoon bore segment 27-29;
Shelby tube, no photograph

30-32

Split spoon bore segment 30-32;
recovery 24 inches/elevation range between 36.3-38.3 feet bmsl.

33-35



Split spoon bore segment 33-35;
recovery 17 inches/elevation range between 40.4-41.8 feet bmsl.

1 of 3

BORE B-2

35-37

Split spoon bore segment 35-37;
Shelby tube, no photograph

37-39

Split spoon bore segment 37-39;
recovery 24 inches/elevation range between 43.8-45.8 feet bmsl.

39-41

Split spoon bore segment 39-41;
recovery 24 inches/elevation range between 45.8-47.8 feet bmsl.

41-43

Split spoon bore segment 41-43;
Shelby tube, no photograph

43-45

Split spoon bore segment 43-45;
recovery 8 inches/elevation range between 51.3-52 feet bmsl.

45-47

Split spoon bore segment 45-47;
recovery 24 inches/elevation range between 52-54 feet bmsl.

50-52

Split spoon bore segment 50-52;
recovery 17 inches/elevation range between 56.9-58.9 feet bmsl.

56-58

Split spoon bore segment 56-58;
recovery 24 inches/elevation range between 63.3-65.3 feet bmsl.

60-62

Split spoon bore segment 60-62;
recovery 24 inches/elevation range between 67.7-69.7 feet bmsl.

66-68

Split spoon bore segment 66-68;
recovery 20 inches/elevation range between 73.6-75.3 feet bmsl

71-73

Split spoon bore segment 71-73;
recovery 24 inches/elevation range between 77.9-79.9 feet bmsl.

72-74

Split spoon bore segment 72-74;
recovery 15 inches/elevation range between 79.2-81.2 feet bmsl.

BORE B-2

74-76

Split spoon bore segment 74-76;
recovery 17 inches/elevation range between 81.2-83.2 feet bmsl.

81-83

Split spoon bore segment 81-83;
recovery 17 inches/elevation range between 88.8-90.2 feet bmsl.

87-89

Split spoon bore segment 87-89;
recovery 19 inches/elevation range between 94.7-96.3 feet bmsl.

92-94

Split spoon bore segment 92-94;
recovery 18 inches/elevation range between 99.4-101.4 feet bmsl.

BORE B-9

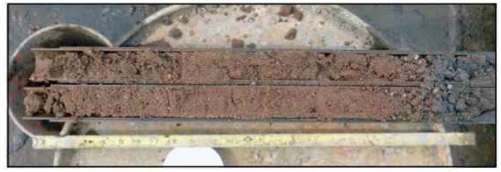
0-2

Split spoon bore segment 0-2;
recovery 9 inches/elevation range between 11.2-12 feet bmsl.

2-4

Split spoon bore segment 2-4;
recovery 22 inches/elevation range between 12.2-14 feet bmsl.

4-6

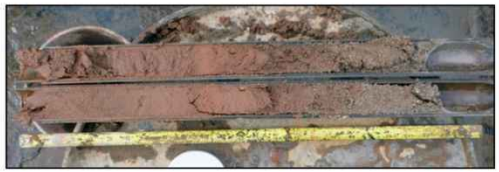


Split spoon bore segment 4-6;
recovery 24 inches/elevation range between 14-16 feet bmsl.

6-8

Split spoon bore segment 6-8;
recovery 12 inches/elevation range between 17-18 feet bmsl.

8-10



Split spoon bore segment 8-10;
recovery 22 inches/elevation range between 18.2-20 feet bmsl.

10-12

Split spoon bore segment 10-12;
recovery 11 inches/elevation range between 21.1-22 feet bmsl.

15-17

Split spoon bore segment 15-17;
recovery 10 inches/elevation range between 26.2-27 feet bmsl.

20-22

Split spoon bore segment 20-22;
recovery 14 inches/elevation range between 30.8-32 feet bmsl.

21-23

Split spoon bore segment 21-23;
recovery 13 inches/elevation range between 32.9-34 feet bmsl.

28-30

Split spoon bore segment 28-30;
recovery 12 inches/elevation range between 39-40 feet bmsl.

33-35

Split spoon bore segment 33-35;
recovery 14 inches/elevation range between 43.8-45 feet bmsl.

38-40

Split spoon bore segment 38-40
recovery 24 inches/elevation range between 48-50 feet bmsl.

1 of 2

BORE B-9

43-45

Split spoon bore segment 43-45;
recovery 24 inches/elevation range between 53-55 feet bmsl.

48-50

Split spoon bore segment 48-50;
recovery 16 inches/elevation range between 58.7-60 feet bmsl.

53-55

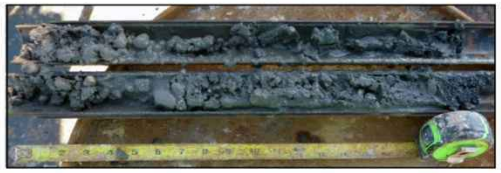
Split spoon bore segment 53-55;
recovery 15 inches/elevation range between 63.7-65 feet bmsl.

BORE B-20

0-2

Split spoon bore segment 0-2;
recovery 6 inches/elevation range between 20-20.5 feet bmsl.

2-4



Split spoon bore segment 2-4;
recovery 20 inches/elevation range between 19.3-21 feet bmsl.

4-6

Split spoon bore segment 4-6;
recovery 24 inches/elevation range between 21-23 feet bmsl.

6-8

Split spoon bore segment 6-8;
recovery 16 inches/elevation range between 23.7-25 feet bmsl.

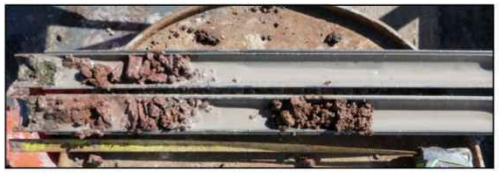
8-10

Split spoon bore segment 8-10;
recovery 24 inches/elevation range between 25-27 feet bmsl.

10-12

Split spoon bore segment 10-12;
recovery 20 inches/elevation range between 26.6-28.3 feet bmsl.

15-17



Split spoon bore segment 15-17;
recovery 9 inches/elevation range between 32.2-33 feet bmsl.

20-22

Split spoon bore segment 20-22;
recovery 15 inches/elevation range between 36.5-37.8 feet bmsl.

25-27

Split spoon bore segment 25-27;
recovery 6 inches/elevation range between 42.5-43 feet bmsl.

30-32

Split spoon bore segment 30-32;
recovery 15 inches/elevation range between 44.7-46 feet bmsl.

35-37

Split spoon bore segment 35-37;
recovery 18 inches/elevation range between 50-51.5 feet bmsl.

40-42

Split spoon bore segment 40-42;
recovery 22 inches/elevation range between 54.3-56.1 feet bmsl.

1 of 2

BORE B-20

45-47

Split spoon bore segment 45-47;
recovery 24 inches/elevation range between 59.2-61.2 feet bmsl.

50-52

Split spoon bore segment 50-52;
recovery 24 inches/elevation range between 64-66 feet bmsl.

55-57

Split spoon bore segment 55-57;
recovery 19 inches/elevation range between 68.6-70.2 feet bmsl.

60-62

Split spoon bore segment 60-62;
recovery 2 inches/elevation range between 75.3-75.5 feet bmsl.

APPENDIX C

Test bore profiles

Test Bore: B-1 Elevation Range: -10 ft (3.05 m) to -116 ft (35.36 m)

Elevation (feet)		Profile	Sampled	Description
-10 to -12	-11.1			**-11.1 to -12**; black clay silt, some shell, odor (sludge)
-12 to -14	-14			**-12 to -14**; black clay silt, flecks of peat at top, odor (sludge)
-14 to -16	-15.5			**-15.5 to -16**; black clay silt, odor (sludge)
-16 to -18	-17.3			**-16 to -17.3**; black clay silt, odor **-17.3 to -18**; black clay silt with trace sand, odor (sludge)
-18 to -20				Shelby tube, unobserved
-20 to-22				**-20 to -22**; gray clay with trace shell hash at top, soft
-30 to -32				**-30 to -32**; gray clay, soft
-35 to -37				**-35 to -37**; gray clay with trace shell hash, soft
-40 to -42				**-40 to -42**; gray clay with trace shell hash, soft

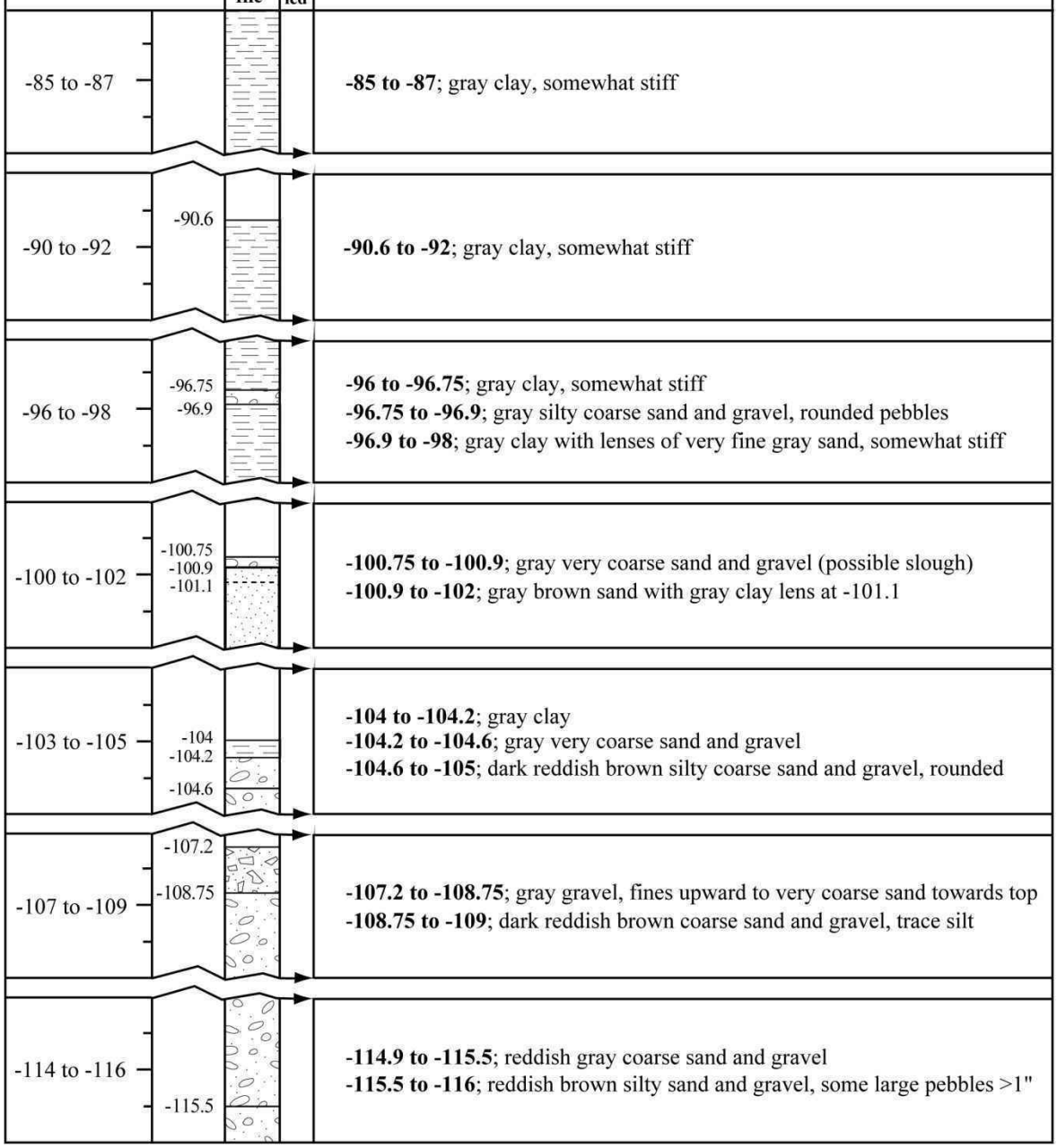
B-1 (1 of 3)

Test Bore: B-1 Elevation Range: -10 ft (3.05 m) to -116 ft (35.36 m)

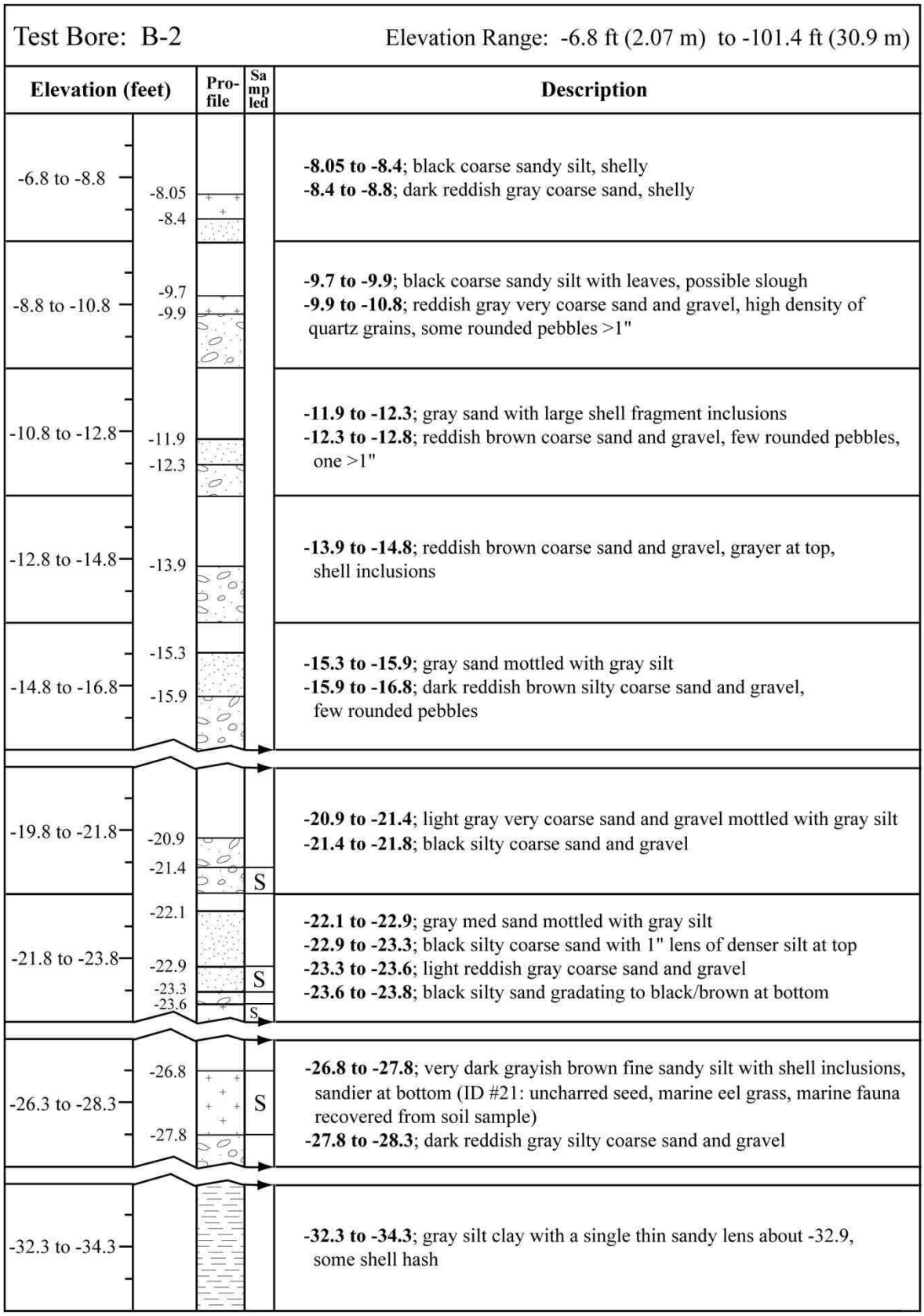
Elevation (feet)		Profile	Sampled	Description
-42 to -44	-42.8			**-42.8 to -44**; gray clay with some shell hash, soft
-47 to -49	-48.1			**-48.1 to -49**; gray clay with some shell hash, soft
-52 to -54				**-52 to -54**; gray clay with some shell hash, soft, less saturated than overlying levels
-58 to -60	-58.8			**-58.8 to -60**; gray clay, soft
-62 to -64	-62.2			**-62.2 to -64**; gray clay with some shell hash, soft
-68 to -70	-69.3			**-68 to -69.3**; gray clay, soft **-69.3 to -70**; gray clay silt fine sand, rounded pebble at -69.7
-74 to -76	-74.7			**-74.7 to -76**; gray clay, soft
-80 to -82				**-80 to -82**; gray clay, soft

B-1 (2 of 3)

Test Bore: B-1 Elevation Range: -10 ft (3.05 m) to -116 ft (35.36 m)



B-1 (3 of 3)

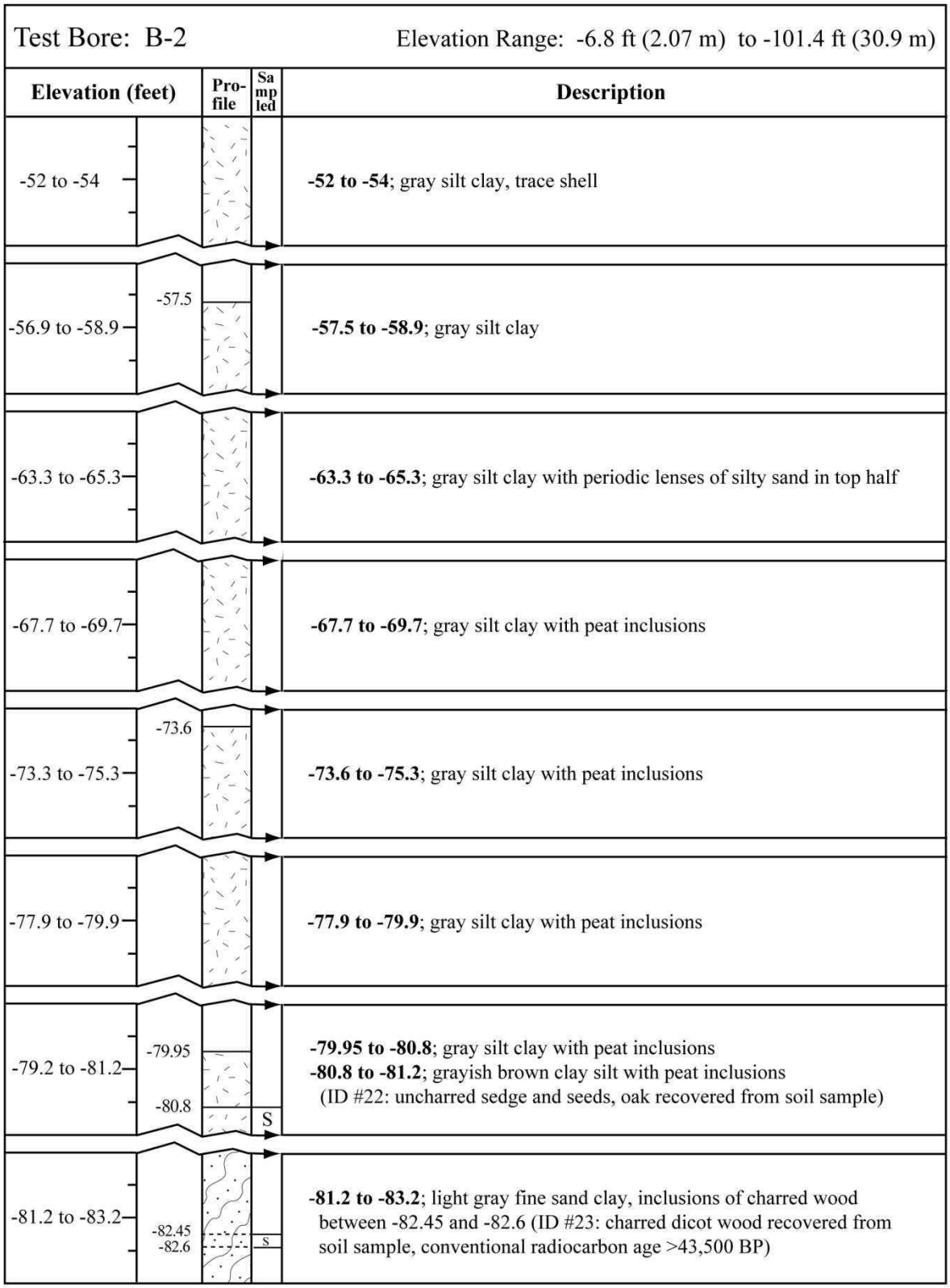

Test Bore: B-2
Elevation Range: -6.8 ft (2.07 m) to -101.4 ft (30.9 m)
Elevation (feet)
Pro-file
Sampled
Description
-6.8 to -8.8
-8.05
-8.4
-8.05 to -8.4; black coarse sandy silt, shelly
-8.4 to -8.8; dark reddish gray coarse sand, shelly
-8.8 to -10.8
-9.7
-9.9
-9.7 to -9.9; black coarse sandy silt with leaves, possible slough
-9.9 to -10.8; reddish gray very coarse sand and gravel, high density of quartz grains, some rounded pebbles >1"
-10.8 to -12.8
-11.9
-12.3
-11.9 to -12.3; gray sand with large shell fragment inclusions
-12.3 to -12.8; reddish brown coarse sand and gravel, few rounded pebbles, one >1"
-12.8 to -14.8
-13.9
-13.9 to -14.8; reddish brown coarse sand and gravel, grayer at top, shell inclusions
-14.8 to -16.8
-15.3
-15.9
-15.3 to -15.9; gray sand mottled with gray silt
-15.9 to -16.8; dark reddish brown silty coarse sand and gravel, few rounded pebbles
-19.8 to -21.8
-20.9
-21.4
S
-20.9 to -21.4; light gray very coarse sand and gravel mottled with gray silt
-21.4 to -21.8; black silty coarse sand and gravel
-21.8 to -23.8
-22.1
-22.9
-23.3
-23.6
S
S
S
-22.1 to -22.9; gray med sand mottled with gray silt
-22.9 to -23.3; black silty coarse sand with 1" lens of denser silt at top
-23.3 to -23.6; light reddish gray coarse sand and gravel
-23.6 to -23.8; black silty sand gradating to black/brown at bottom
-26.3 to -28.3
-26.8
-27.8
S
-26.8 to -27.8; very dark grayish brown fine sandy silt with shell inclusions, sandier at bottom (ID #21: uncharred seed, marine eel grass, marine fauna recovered from soil sample)
-27.8 to -28.3; dark reddish gray silty coarse sand and gravel
-32.3 to -34.3
-32.3 to -34.3; gray silt clay with a single thin sandy lens about -32.9, some shell hash

B-2 (1 of 4)

Test Bore: B-2 Elevation Range: -6.8 ft (2.07 m) to -101.4 ft (30.9 m)

Elevation (feet)	Profile	Sampled	Description
-34.3 to -36.3			Shelby tube, unobserved
-36.3 to -38.3			**-36.3 to -38.3**; gray silt clay, trace shell hash
-39.8 to -41.8	-40.4		**-40.4 to -41.8**; gray silt clay, trace shell hash
-41.8 to -43.8			Shelby tube, unobserved
-43.8 to -45.8			**-43.8 to -45.8**; gray silt clay, slightly darker than overlying levels, trace shell hash
-45.8 to -47.8			**-45.8 to -47.8**; dark gray silt clay
-48 to -50			Shelby tube, unobserved
-50 to -52	-51.3		**-51.3 to -52**; gray silt clay, trace shell

B-2 (2 of 4)


Test Bore: B-2
Elevation Range: -6.8 ft (2.07 m) to -101.4 ft (30.9 m)
Elevation (feet)
Pro-file
Sa mp led
Description
-52 to -54
-52 to -54; gray silt clay, trace shell
-57.5
-56.9 to -58.9
-57.5 to -58.9; gray silt clay
-63.3 to -65.3
-63.3 to -65.3; gray silt clay with periodic lenses of silty sand in top half
-67.7 to -69.7
-67.7 to -69.7; gray silt clay with peat inclusions
-73.6
-73.3 to -75.3
-73.6 to -75.3; gray silt clay with peat inclusions
-77.9 to -79.9
-77.9 to -79.9; gray silt clay with peat inclusions
-79.95
-79.2 to -81.2
-80.8
S
-79.95 to -80.8; gray silt clay with peat inclusions
-80.8 to -81.2; grayish brown clay silt with peat inclusions
(ID #22: uncharred sedge and seeds, oak recovered from soil sample)
-81.2 to -83.2
-82.45
-82.6
S
-81.2 to -83.2; light gray fine sand clay, inclusions of charred wood between -82.45 and -82.6 (ID #23: charred dicot wood recovered from soil sample, conventional radiocarbon age >43,500 BP)

B-2 (3 of 4)

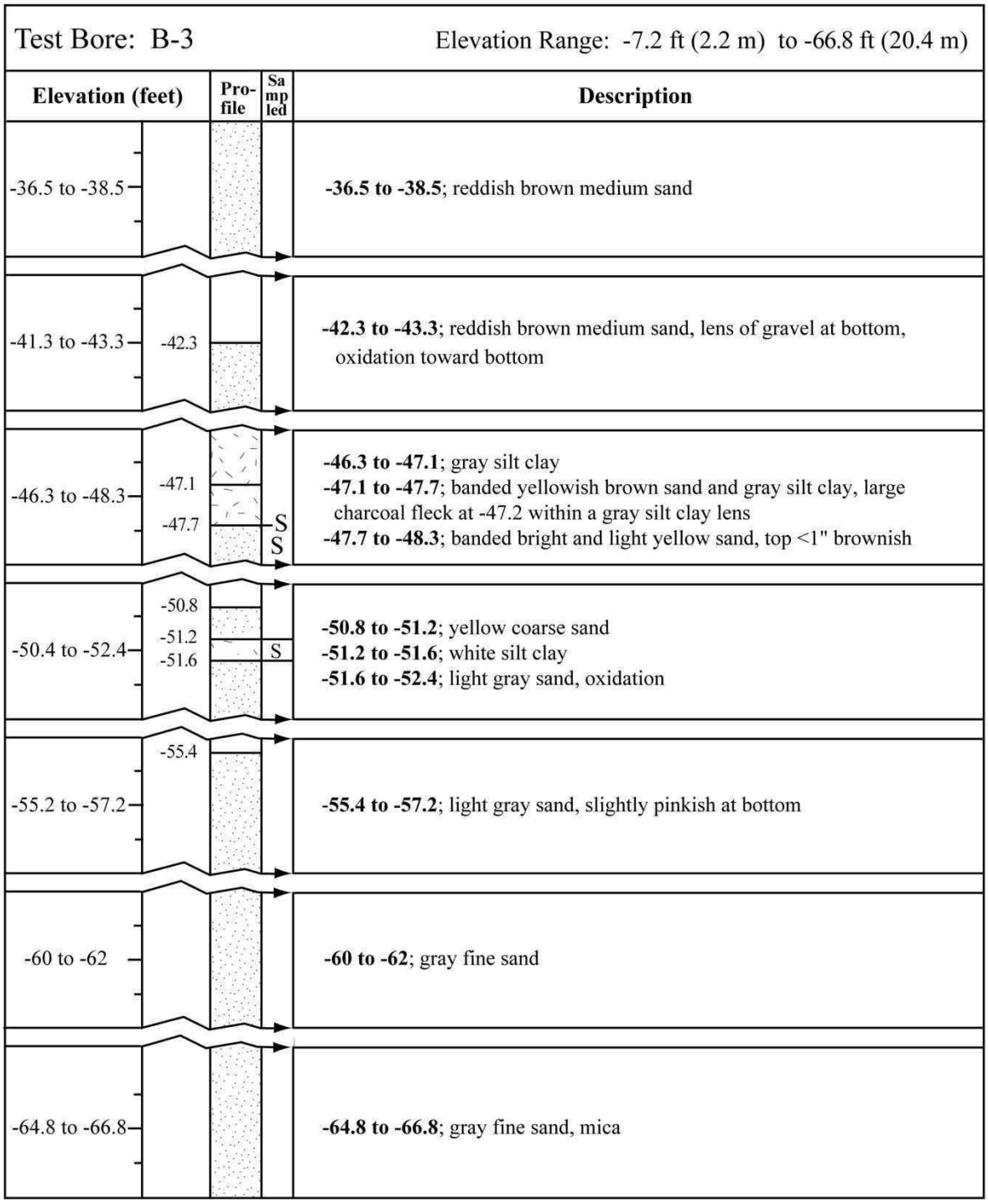
Test Bore: B-2			Elevation Range: -6.8 ft (2.07 m) to -101.4 ft (30.9 m)
Elevation (feet)	**Pro-file**	**Sa mp led**	**Description**
-94.3 to -96.3			**-94.7 to -96.3**; laminated gray clay and very light gray very fine sand
-99.4 to -101.4			**-99.9 to -101.4**; laminated gray clay and very light gray very fine sand

B-2 (4 of 4)

Test Bore: B-3 Elevation Range: -7.2 ft (2.2 m) to -66.8 ft (20.4 m)

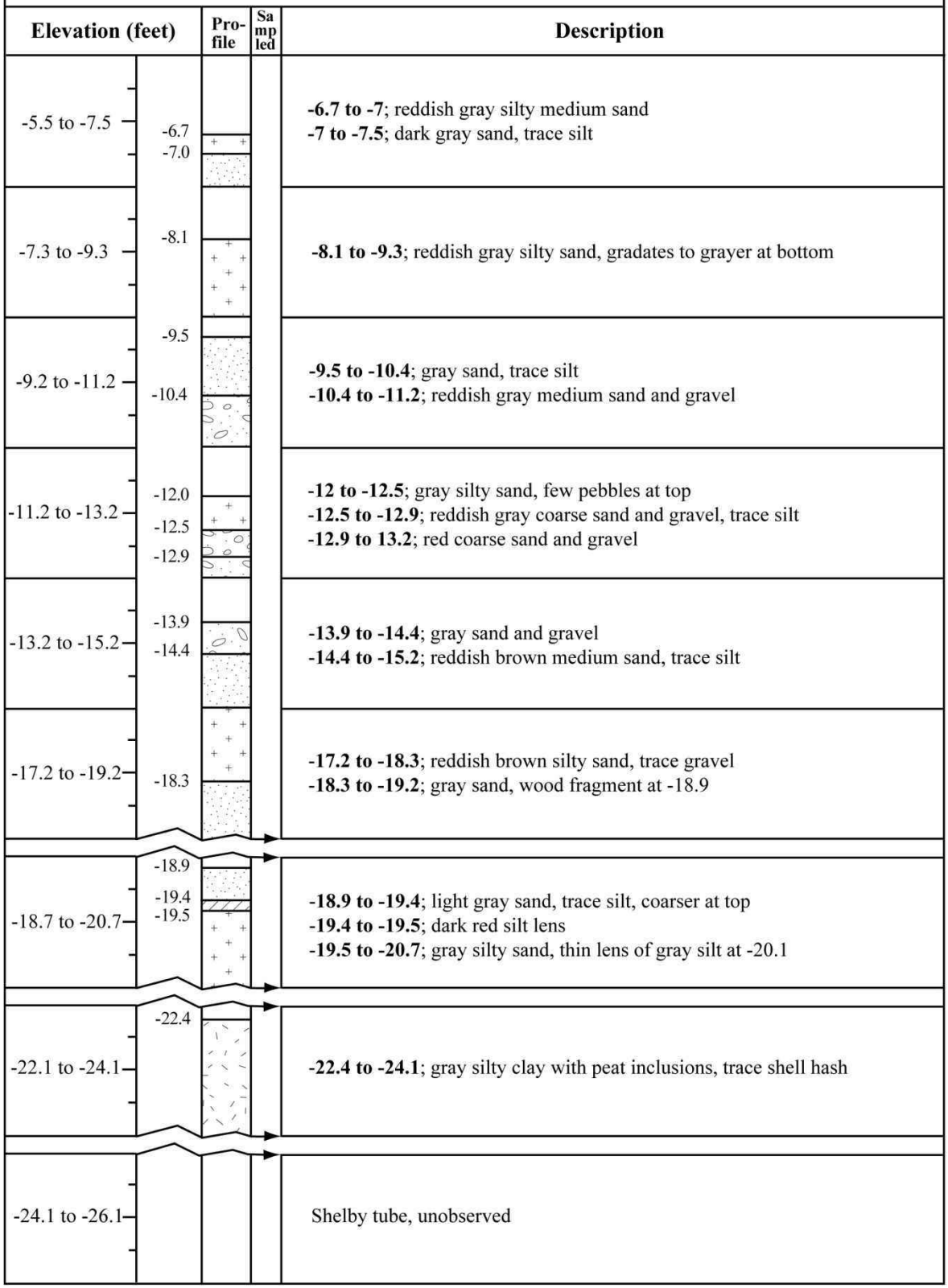
Elevation (feet)		Profile	Sampled	Description
-7.2 to -9.2	-7.7			**-7.7 to -9.2**; banded reddish gray and gray coarse sands, very top black coarse sand
-9.1 to -11.1	-9.7			**-9.7 to -11.1**; banded reddish gray and gray coarse sands
-10.0 to -12.9	-11.3			**-11.3 to -12.9**; banded reddish gray and gray coarse sand and gravel
-13.2 to -15.2	-14.1			**-14.1 to -15.2**; large gravel, some sand, cemented at bottom
-15.5 to -17.5	-16.3			**-16.3 to -17.5**; banded reddish gray and gray coarse sand and gravel, lenses of gravel with little sand
-17.8 to -19.8	-18.9 -19.3			**-18.9 to -19.3**; reddish gray coarse sand and gravel **-19.3 to -19.8**; gray silt clay with peat flecking at top
-22.5 to -24.5				**-22.5 to -24.5**; banded gray silt clay and reddish gray coarse sand
-27.1 to -29.1	-28.2			**-28.2 to -29.1;** reddish brown med-coarse sand, low gravel
-31.8 to -33.8	-32.5			**-32.5 to -33.8**; reddish brown medium sand

B-3 (1 of 2)


Test Bore: B-3
Elevation Range: -7.2 ft (2.2 m) to -66.8 ft (20.4 m)
Elevation (feet)
Pro-file
Sa mp led
Description
-36.5 to -38.5
-36.5 to -38.5; reddish brown medium sand
-41.3 to -43.3
-42.3
-42.3 to -43.3; reddish brown medium sand, lens of gravel at bottom, oxidation toward bottom
-46.3 to -48.3
-47.1
-47.7
S
S
-46.3 to -47.1; gray silt clay
-47.1 to -47.7; banded yellowish brown sand and gray silt clay, large charcoal fleck at -47.2 within a gray silt clay lens
-47.7 to -48.3; banded bright and light yellow sand, top <1" brownish
-50.4 to -52.4
-50.8
-51.2
-51.6
S
-50.8 to -51.2; yellow coarse sand
-51.2 to -51.6; white silt clay
-51.6 to -52.4; light gray sand, oxidation
-55.2 to -57.2
-55.4
-55.4 to -57.2; light gray sand, slightly pinkish at bottom
-60 to -62
-60 to -62; gray fine sand
-64.8 to -66.8
-64.8 to -66.8; gray fine sand, mica

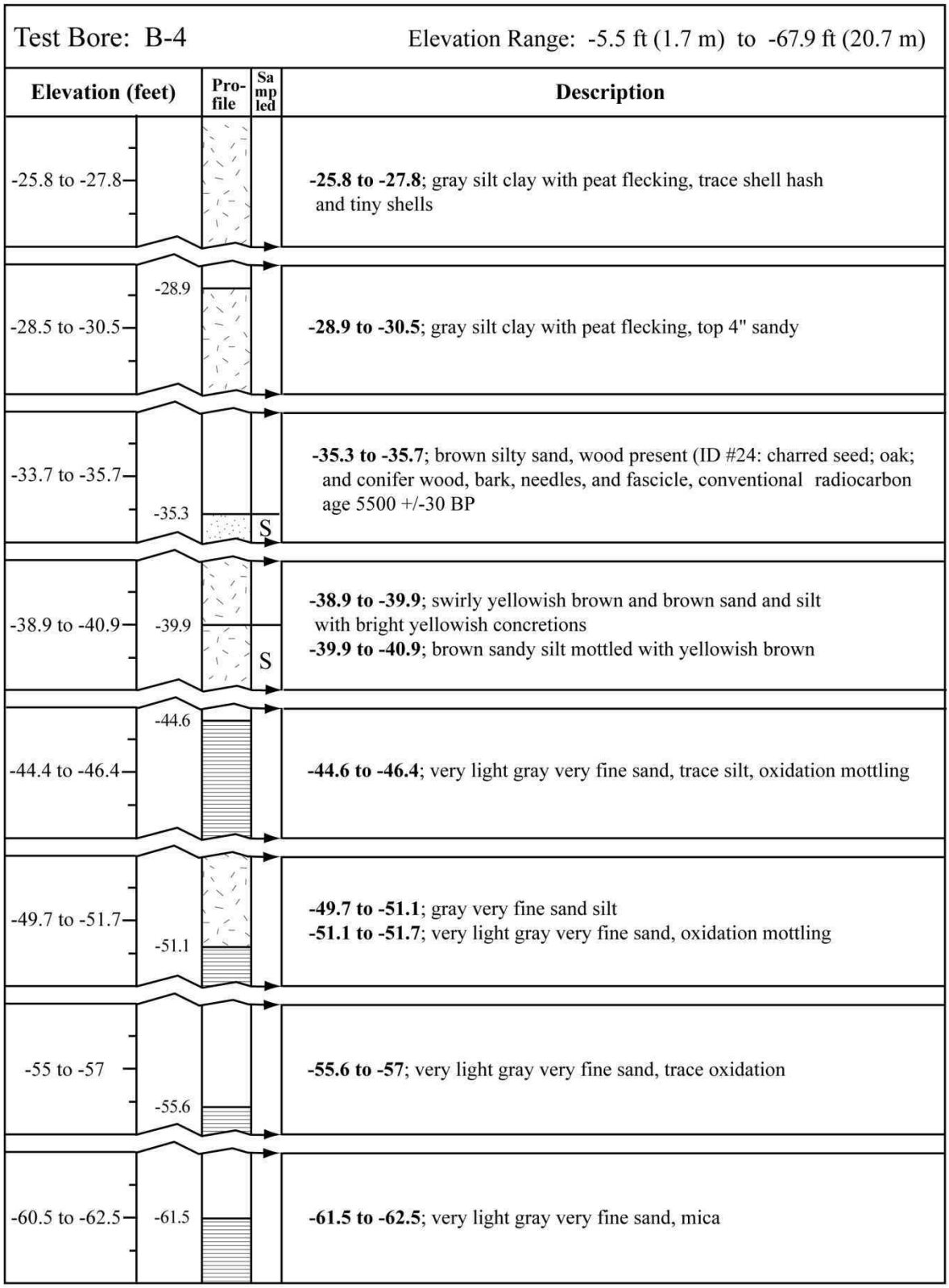
B-3 (2 of 2)

Test Bore: B-4 Elevation Range: -5.5 ft (1.7 m) to -67.9 ft (20.7 m)



Elevation (feet)		Profile	Sampled	Description
-5.5 to -7.5	-6.7 -7.0			**-6.7 to -7**; reddish gray silty medium sand **-7 to -7.5**; dark gray sand, trace silt
-7.3 to -9.3	-8.1			**-8.1 to -9.3**; reddish gray silty sand, gradates to grayer at bottom
-9.2 to -11.2	-9.5 -10.4			**-9.5 to -10.4**; gray sand, trace silt **-10.4 to -11.2**; reddish gray medium sand and gravel
-11.2 to -13.2	-12.0 -12.5 -12.9			**-12 to -12.5**; gray silty sand, few pebbles at top **-12.5 to -12.9**; reddish gray coarse sand and gravel, trace silt **-12.9 to 13.2**; red coarse sand and gravel
-13.2 to -15.2	-13.9 -14.4			**-13.9 to -14.4**; gray sand and gravel **-14.4 to -15.2**; reddish brown medium sand, trace silt
-17.2 to -19.2	-18.3			**-17.2 to -18.3**; reddish brown silty sand, trace gravel **-18.3 to -19.2**; gray sand, wood fragment at -18.9
-18.7 to -20.7	-18.9 -19.4 -19.5			**-18.9 to -19.4**; light gray sand, trace silt, coarser at top **-19.4 to -19.5**; dark red silt lens **-19.5 to -20.7**; gray silty sand, thin lens of gray silt at -20.1
-22.1 to -24.1	-22.4			**-22.4 to -24.1**; gray silty clay with peat inclusions, trace shell hash
-24.1 to -26.1				Shelby tube, unobserved

B-4 (1 of 3)


Test Bore: B-4
Elevation Range: -5.5 ft (1.7 m) to -67.9 ft (20.7 m)
Elevation (feet)
Pro-file
Sa mp led
Description
-25.8 to -27.8
-25.8 to -27.8; gray silt clay with peat flecking, trace shell hash and tiny shells
-28.9
-28.5 to -30.5
-28.9 to -30.5; gray silt clay with peat flecking, top 4" sandy
-33.7 to -35.7
-35.3
S
-35.3 to -35.7; brown silty sand, wood present (ID #24: charred seed; oak; and conifer wood, bark, needles, and fascicle, conventional radiocarbon age 5500 +/-30 BP
-38.9 to -40.9
-39.9
S
-38.9 to -39.9; swirly yellowish brown and brown sand and silt with bright yellowish concretions
-39.9 to -40.9; brown sandy silt mottled with yellowish brown
-44.6
-44.4 to -46.4
-44.6 to -46.4; very light gray very fine sand, trace silt, oxidation mottling
-49.7 to -51.7
-51.1
-49.7 to -51.1; gray very fine sand silt
-51.1 to -51.7; very light gray very fine sand, oxidation mottling
-55 to -57
-55.6
-55.6 to -57; very light gray very fine sand, trace oxidation
-60.5 to -62.5
-61.5
-61.5 to -62.5; very light gray very fine sand, mica

B-4 (2 of 3)

Test Bore: B-4				Elevation Range: -5.5 ft (1.7 m) to -67.9 ft (20.7 m)
Elevation (feet)		**Pro-file**	**Sampled**	**Description**
-65.9 to -67.9	-66.9			**-65.9 to -67.9**; gray silt clay very fine sand, lens of gray clay at -66.9

Test Bore: B-5 Elevation Range: -7 ft (2.1 m) to -69 ft (21 m)

Elevation (feet)		Profile	Sampled	Description
-7 to -9	-8.2 -8.6			**-8.2 to -8.6**; black sand, shelly **-8.6 to -9**; dark red coarse sand and gravel
-9 to -11				**-9 to -11**; reddish gray coarse sand and gravel, gradating to lighter gray at bottom with some rounded pebbles, very top balck, probably slough
-11 to -13	-12.5			**-11 to -12.5**; reddish gray coarse sand and gravel, some shell and rounded pebbles **-12.5 to -13**; gray coarse sand and gravel, some rounded pebbles
-13 to -15	-14.2			**-14.2 to -15**; reddish gray brown sand and gravel, some rounded pebbles
-15 to -17	-16.0 -16.2			**-16 to -16.2**; reddish brown coarse sand and gravel **-16.2 to -17**; very dark gray silty sand, few rounded pebbles at base
-17 to -19	-18.0 -18.5			**-18 to -18.5**; pinkish gray very coarse sand and gravel **-18.5 to -19**; dark brown coarse sand, few rounded pebbles
-19.2 to -21.2	-20.3 -20.9			**-20.3 to -20.9**; dark red silty coarse sand, few rounded pebbles **-20.9 to -21.2**; dark red sand
-24.4 to -26.4	-25.2			**-25.2 to -26.4**; dark red coarse sand, some rounded pebbles at top
-29.6 to -31.6	-29.9			**-29.9 to -31.6**; white gray sandy clay with cemented concretions, dark yellowish brown silt gravel at very top, laminations of light gray fine sandy clay and light gray clay at very bottom

B-5 (1 of 2)

Test Bore: B-5 Elevation Range: -7 ft (2.1 m) to -69 ft (21 m)

Elevation (feet)	Profile	Sampled	Description
-35.1 to -37.1			**-35.1 to -37.1**; light silvery gray very fine sand and silt
-40.5 to -42.5			**-40.5 to -42.5**; light silvery gray very fine sand and silt
-46.2 to -48.2	-46.4 / -47.6		**-46.4 to -47.6**; very light silvery gray very fine sand **-47.6 to -48.2**; very light silvery gray clay
-51.4 to -53.4			**-51.4 to -53.4**; very light gray very fine sand, sequences of oxidation around -52 and -52.6
-56.6 to -58.6			**-57 to -58.6**; very light gray very fine sand with lenses of oxidation
-61.8 to -63.8	-62.3		**-61.8 to -62.3**; very light gray very fine sand with some oxidation **-62.3 to -63.8**; dark gray clay banded with occasional lenses of very light gray very fine sand
-67 to -69	-68.5		**-67 to -68.5**; laminated light and dark gray very fine sand and clay **-68.5 to -69**; very light gray very fine sand

B-5 (2 of 2)

Test Bore: B-6 Elevation Range: -6.5 ft (2 m) to -67.9 ft (20.7 m)

Elevation (feet)		Profile	Sampled	Description
-6.5 to -8.5	-7.2 -7.5 -7.6 -8.0			**-7.2 to -7.5**; black silt sand, shelly **-7.5 to -7.6**; bright orange brown silt **-7.6 to -8**; greenish gray clay **-8 to -8.5**; light brown silty sand
-7.8 to -9.8	-8.2 -8.5 -9.0			**-8.2 to -8.5**; black coarse sand, shelly, possible slough **-8.5 to -9**; greenish brown clay sand **-9 to -9.8**; dark reddish brown silty coarse sand
-9 to -11	-9.9 -10.2			**-9.9 to -10.2**; olive silty clay sand **-10.2 to -11**; dark reddish brown silty coarse sand
-11 to -13	-11.7 -12.1			**-11.7 to -12.1**; dark red coarse sand and gravel, 2" quartz cobble at -12 **-12.1 to -13**; laminated dark red silty sand, dark red gravelly sand, red silt clay and gray silt clay, some oxidation, some silt clay lenses cemented and compact
-13 to -15				**-13 to -15**; dark reddish brown medium sand, pockets of coarse sand
-15 to -17				**-15 to -17**; dark reddish brown medium silty sand, some mottles of gray sand at top
-16.3 to -18.3	-17.1			**-17.1 to -18.3**; dark reddish brown sand
-17.8 to -19.8	-18.5			**-18.5 to -19.8**; dark reddish brown sand, trace silt, lenses of gravel at -19.1 and -19.5
-21.5 to -23.5			S	**-21.5 to -23.5**; dark gray rock, Palisades Diabase boulder, observed yellowish brown sandy silt clinging to base of boulder

B-6 (1 of 3)

Test Bore: B-6 Elevation Range: -6.5 ft (2 m) to -67.9 ft (20.7 m)

Elevation (feet)		Profile	Sampled	Description
-24.5 to -26.5	-25.5			**-25.5 to -26.5**; light gray very fine sand, trace silt, lens of light gray clay between -26.2 and -26.3 diabase chunk embedded in yellowish brown sand silt at top, possible slough
-30.5 to -32.5	-30.8			**-30.8 to -32.5**; very light gray silty very fine sand
-35.5 to -37.5				no recovery
-39.7 to -41.7	-40.5 -41.5			**-39.7 to -40.5**; banded gray very fine sandy clay and clay **-40.5 to -41.5**; laminated light gray very fine sand and clay **-41.5 to -41.7**; gray clay
-43.8 to -45.8	-44.1			**-44.1 to -45.8**; very light gray clay very fine sand, mica
-49.6 to -51.6	-50.2			**-50.2 to -51.6**; banded/laminated very light gray/cream and light gray fine sands and clay
-56.4 to -58.4	-57.0			**-57 to -58.4**; very light gray very fine sandy silt, mica
-61.5 to -63.5				no recovery

B-6 (2 of 3)

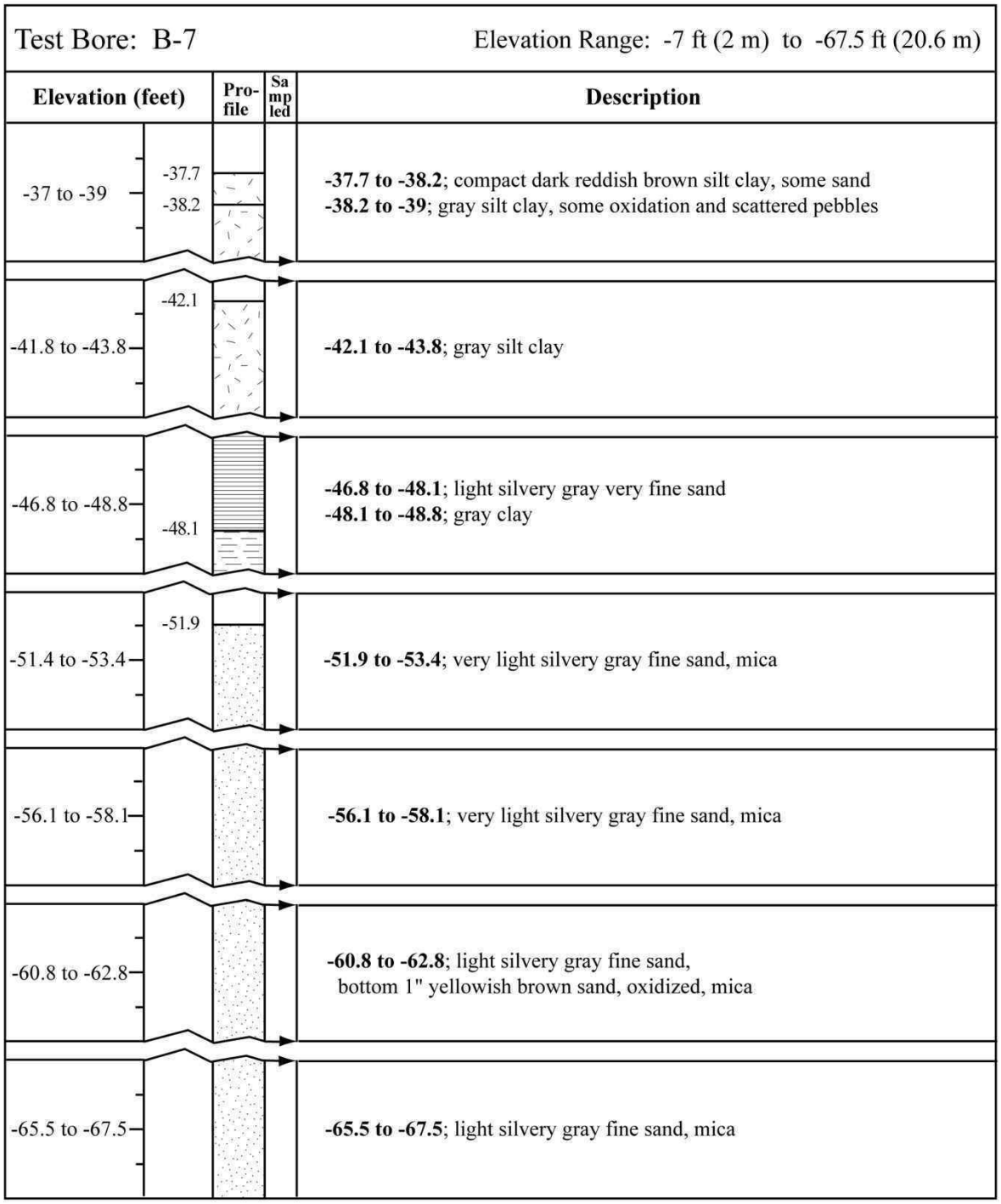
Test Bore: B-6				Elevation Range: -6.5 ft (2 m) to -67.9 ft (20.7 m)
Elevation (feet)		**Pro-file**	**Sampled**	**Description**
-65.9 to -67.9	-66.6			**-65.9 to -66.6**; banded gray very fine sand and clay **-66.6 to -67.9**; gray very fine clay sand

B-6 (3 of 3)

Test Bore: B-7 Elevation Range: -7 ft (2 m) to -67.5 ft (20.6 m)

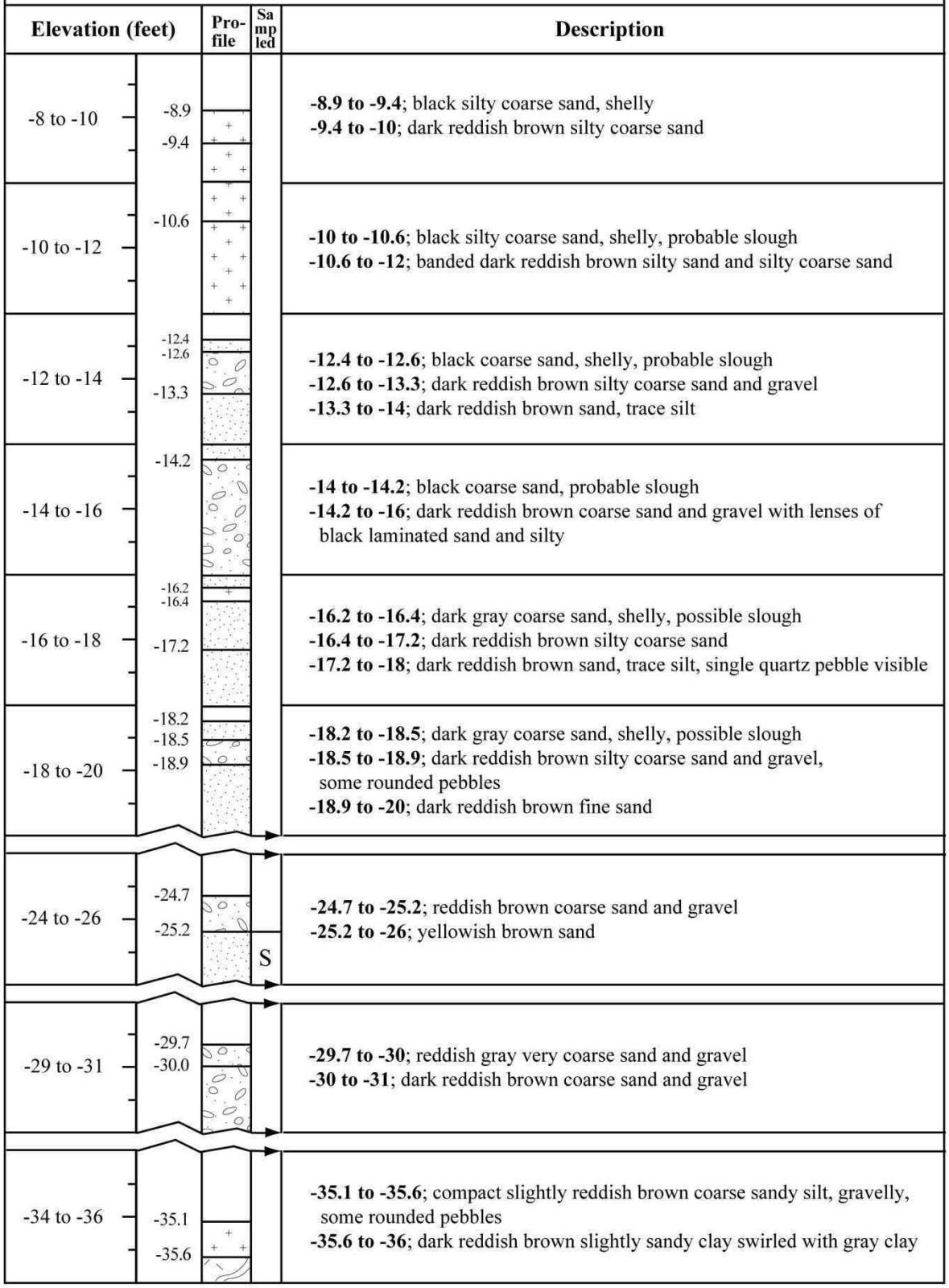
Elevation (feet)		Profile	Sampled	Description
-7 to -9	-7.8 -8.3			**-7.8 to -8.3**; black coarse sand, shelly **-8.3 to -9**; gray clay silt, oxidation mottling, trace gravel
-9 to -11	-9.5			**-9 to -9.5**; gray clay silt **-9.5 to -11**; dark reddish brown sand, gradually gets coarser toward bottom
-11 to -13	-12.0			**-11 to -12**; dark gray coarse sand **-12 to -13**; dark reddish brown coarse sand
-13 to -15	-14.3			**-13 to -14.3**; dark reddish brown coarse sand **-14.3 to -15**; dark reddish brown silty very fine sand
-15 to -17	-15.3			**-15.3 to -17**; dark reddish brown coarse sand with pockets of gravel and silty lenses, one 2" cobble
-17 to -19	-18.3			**-18.3 to -19**; dark reddish brown coarse sand and gravel with lenses of silty coarse sand and fine sand
-21.4 to -23.4	-22.1			**-22.1 to -23.4**; dark reddish brown sand, gradually coarser toward bottom
-26.6 to -28.6	-27.3			**-27.3 to -28.6**; dark reddish brown sand, gradually finer toward bottom
-31.8 to -33.8	-32.9			**-32.9 to -33.8**; dark reddish gray sand and gravel, gradual change to medium sand toward bottom, rounded pebbles, many quartz grains

B-7 (1 of 2)


Test Bore: B-7
Elevation Range: -7 ft (2 m) to -67.5 ft (20.6 m)
Elevation (feet)
Pro-file
Sa mp led
Description
-37 to -39
-37.7
-38.2
-37.7 to -38.2; compact dark reddish brown silt clay, some sand
-38.2 to -39; gray silt clay, some oxidation and scattered pebbles
-41.8 to -43.8
-42.1
-42.1 to -43.8; gray silt clay
-46.8 to -48.8
-48.1
-46.8 to -48.1; light silvery gray very fine sand
-48.1 to -48.8; gray clay
-51.4 to -53.4
-51.9
-51.9 to -53.4; very light silvery gray fine sand, mica
-56.1 to -58.1
-56.1 to -58.1; very light silvery gray fine sand, mica
-60.8 to -62.8
-60.8 to -62.8; light silvery gray fine sand,
bottom 1" yellowish brown sand, oxidized, mica
-65.5 to -67.5
-65.5 to -67.5; light silvery gray fine sand, mica

B-7 (2 of 2)

Test Bore: B-8 Elevation Range: -8 ft (2.4 m) to -72 ft (21.9 m)



B-8 (1 of 2)

Test Bore: B-8 Elevation Range: -8 ft (2.4 m) to -72 ft (21.9 m)

Elevation (feet)	Profile	Sampled	Description
-39 to -41	-40.4 -40.7		**-40.4 to -40.7**; gray clay **-40.7 to -41**; compact dark reddish brown silty sand and gravel
-44 to -46	-44.2		**-44.2 to -46**; very light gray very fine sand, trace silt
-49 to -51			no recovery
-54 to -56	-54.2		**-54.2 to -56**; gray clay
-59 to -61	-59.2		**-59.2 to -61**; gray clay, some fine sand at bottom, mica
-63 to -65	-63.5		**-63.5 to -65**; very light gray very fine sand, trace silt, mica
-70 to -72	-70.4		**-70.4 to -72**; very light gray fine sand, gradually getter finer at bottom

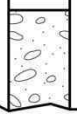
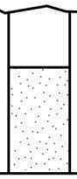
B-8 (2 of 2)

Test Bore: B-9 Elevation Range: -10 ft (3. m) to -65 ft (19.8 m)

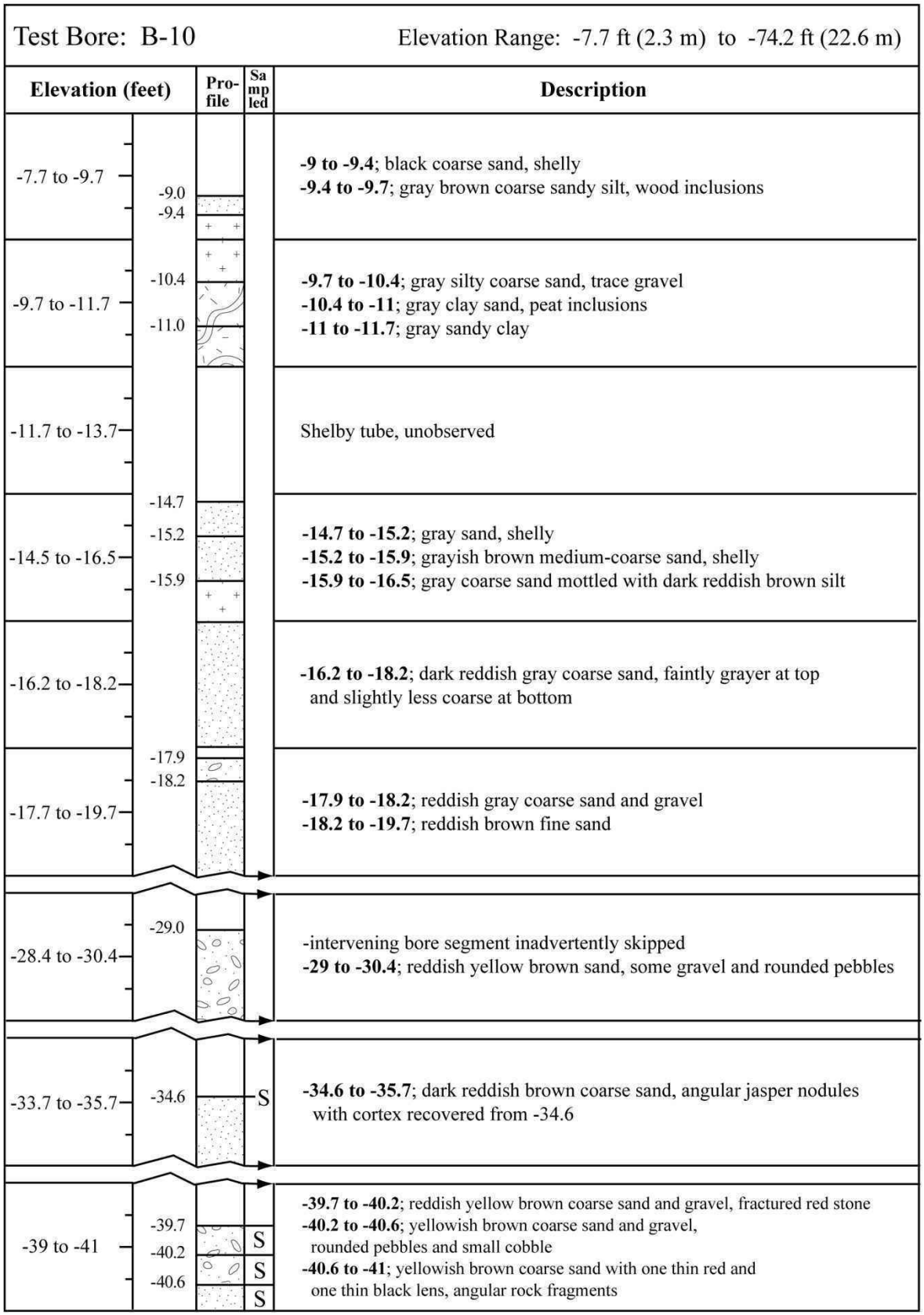
Elevation (feet)		Profile	Sampled	Description
-10 to -12	-11.2 -11.6			**-11.2 to -11.6**; gray brown coarse sand and gravel, trace silt, very top black coarse sand **-11.6 to -12**; dark reddish brown silty sand and gravel, rounded pebbles
-12 to -14	-12.2 -12.7 -13.2			**-12.2 to -12.7**; dark reddish brown silty coarse sand and gravel **-12.7 to -13.2**; dark reddish brown fine sand **-13.2 to -14** dark reddish brown sand
-14 to -16	-14.3			**-14 to -14.3**; dark reddish brown coarse sand and gravel, very top black, probable slough **-14.3 to -16**; dark reddish brown sand
-16 to -18	-17.2 -17.5 -17.6			**-17 to -17.2**; dark reddish brown very coarse sand and gravel **-17.2 to -17.5**; dark reddish brown sand **-17.5 to -17.6**; very dark reddish brown sand **-17.6 to -18**; dark reddish brown silty fine sand
-18 to -20	-18.2 -18.5 -18.8 -19.5			**-18.2 to -18.5**; reddish brown sand **-18.5 to -18.8**; dark reddish brown sand, trace gravel **-18.8 to -19.5**; dark reddish brown silty very fine sand **-19.5 to -20**; dark reddish brown fine sand
-20 to -22	-21.1			**-21.1 to -22**; dark reddish brown fine sand
-25 to -27	-26.2			**-26.2 to -27**; reddish brown sand
-30 to -32	-30.8			**-30.8 to -32**; reddish brown sand and gravel, >1.5" cobble at bottom
new location -32 to -34	-32.9			**-32.9 to -34**; dark reddish brown silty sand and gravel, rounded pebbles

B-9 (1 of 2)

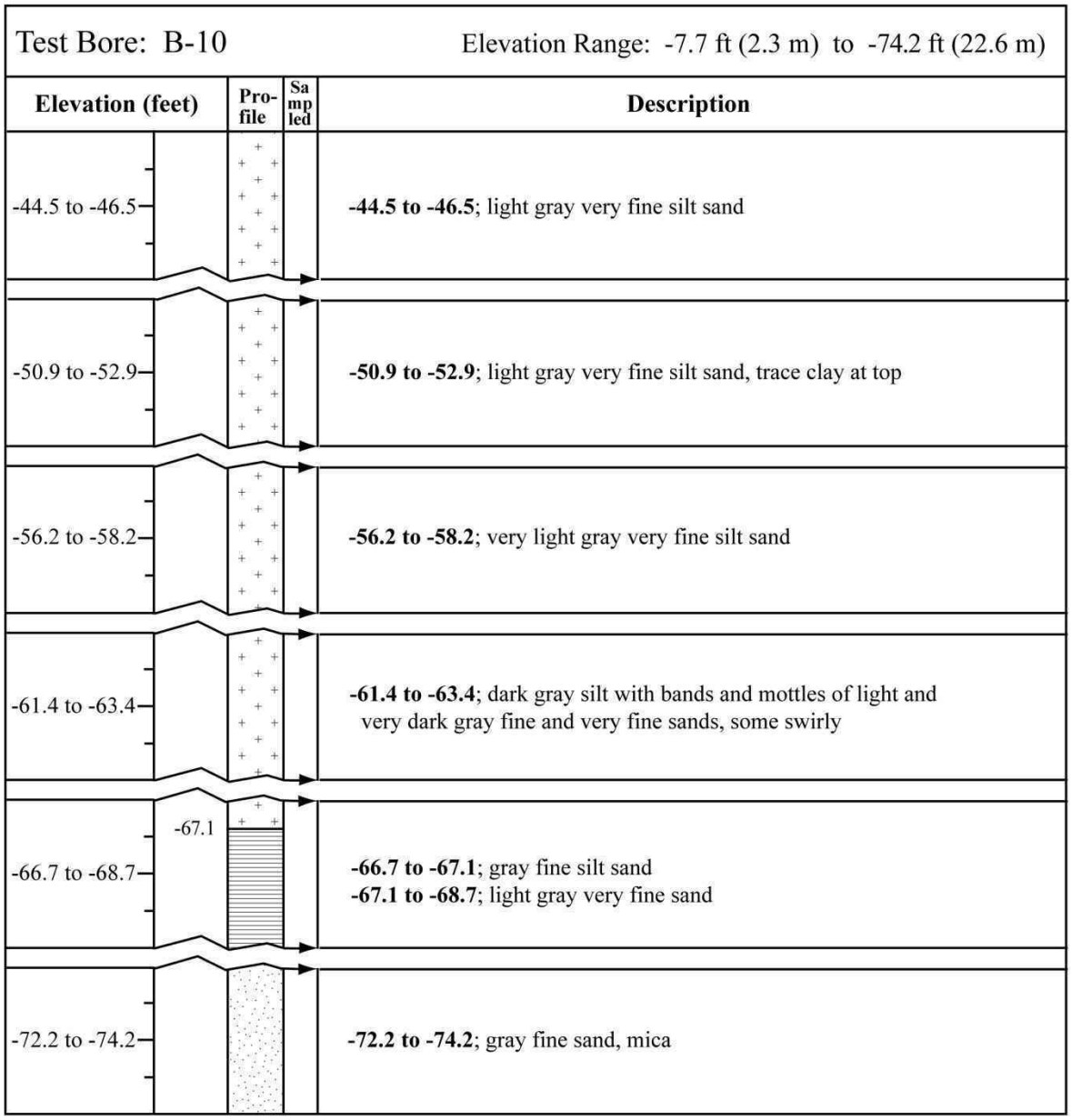
Test Bore: B-9 Elevation Range: -10 ft (3. m) to -65 ft (19.8 m)

Elevation (feet)		Profile	Sampled	Description
-38 to -40	-39.0			**-39 to -40**; faint reddish gray sand and gravel, siltier in top half, lens of silt/clay at interface, some rounded pebbles
-43 to -45	-43.8			**-43.8 to -45**; faint grayish red brown sand and gravel
-48 to -50	-48.3 -48.6 -49.6			**-48 to -48.3**; dark reddish brown sand, possible slough **-48.3 to -48.6**; gray clay **-48.6 to -49.6**; very light gray very fine sand **-49.6 to -50**; gray clay
-53 to -55				**-53 to -55**; gray very fine sandy clay
-58 to -60	-58.7			**-58.7 to -60**; light gray silty fine sand with lenses of dark gray, mica
-63 to -65	-63.7			**-63.7 to -65**; very light gray fine sand, trace clay, lenses of light gray clay

B-9 (2 of 2)

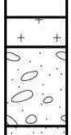
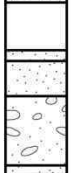
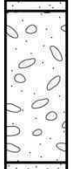
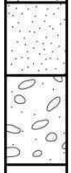
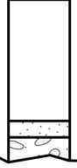
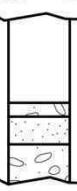
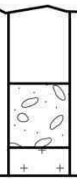

Test Bore: B-10
Elevation Range: -7.7 ft (2.3 m) to -74.2 ft (22.6 m)
Elevation (feet)
Pro-file
Sampled
Description
-7.7 to -9.7
-9.0
-9.4
-9 to -9.4; black coarse sand, shelly
-9.4 to -9.7; gray brown coarse sandy silt, wood inclusions
-9.7 to -11.7
-10.4
-11.0
-9.7 to -10.4; gray silty coarse sand, trace gravel
-10.4 to -11; gray clay sand, peat inclusions
-11 to -11.7; gray sandy clay
-11.7 to -13.7
Shelby tube, unobserved
-14.5 to -16.5
-14.7
-15.2
-15.9
-14.7 to -15.2; gray sand, shelly
-15.2 to -15.9; grayish brown medium-coarse sand, shelly
-15.9 to -16.5; gray coarse sand mottled with dark reddish brown silt
-16.2 to -18.2
-16.2 to -18.2; dark reddish gray coarse sand, faintly grayer at top and slightly less coarse at bottom
-17.7 to -19.7
-17.9
-18.2
-17.9 to -18.2; reddish gray coarse sand and gravel
-18.2 to -19.7; reddish brown fine sand
-28.4 to -30.4
-29.0
-intervening bore segment inadvertently skipped
-29 to -30.4; reddish yellow brown sand, some gravel and rounded pebbles
-33.7 to -35.7
-34.6
S
-34.6 to -35.7; dark reddish brown coarse sand, angular jasper nodules with cortex recovered from -34.6
-39 to -41
-39.7
-40.2
-40.6
S
S
S
-39.7 to -40.2; reddish yellow brown coarse sand and gravel, fractured red stone
-40.2 to -40.6; yellowish brown coarse sand and gravel, rounded pebbles and small cobble
-40.6 to -41; yellowish brown coarse sand with one thin red and one thin black lens, angular rock fragments

B-10 (1 of 2)


Test Bore: B-10
Elevation Range: -7.7 ft (2.3 m) to -74.2 ft (22.6 m)
Elevation (feet)
Pro-file
Sa mp led
Description
-44.5 to -46.5
-44.5 to -46.5; light gray very fine silt sand
-50.9 to -52.9
-50.9 to -52.9; light gray very fine silt sand, trace clay at top
-56.2 to -58.2
-56.2 to -58.2; very light gray very fine silt sand
-61.4 to -63.4
-61.4 to -63.4; dark gray silt with bands and mottles of light and very dark gray fine and very fine sands, some swirly
-67.1
-66.7 to -68.7
-66.7 to -67.1; gray fine silt sand
-67.1 to -68.7; light gray very fine sand
-72.2 to -74.2
-72.2 to -74.2; gray fine sand, mica

B-10 (2 of 2)

Test Bore: B-11 Elevation Range: -8 ft (2.4 m) to -61 ft (18.6 m)

Elevation (feet)		Profile	Sampled	Description
-8 to -10	-8.7 -9.0			**-8.7 to -9**; black silty sand, shelly **-9 to -10**; dark reddish brown coarse silty sand and gravel, cemented/compacted mottles
-10 to -12	-10.2			**-10 to -10.2**; black medium sand, shelly, possible slough **-10.2 to -12**; dark reddish brown silty coarse sand and gravel, siltier at top and bottom
-12 to -14	-12.6 -12.7 -13.2			**-12.6 to -12.7**; gray coarse sand **-12.7 to -13.2**; dark reddish brown sand, cobbles at interface with overlying level **-13.2 to -14**; dark reddish brown coarse sand and gravel
-14 to -16	-14.1			**-14 to -14.1**; gray coarse sand **-14.1 to -16**; dark reddish brown silty coarse sand and gravel, angular cobble at -15.3 overlying a 3" sand lens
-16 to -18	-16.9			**-16 to -16.9**; gray sand **-16.9 to -18**; dark reddish brown silty coarse sand and gravel, rounded and angular pebbles, concreted mottles
-18 to -20	-19.5 -19.7			**-19.5 to -19.7**; gray sand, possible slough **-19.7 to -20**; dark reddish brown silty coarse sand and gravel, some >2" cobbles
-20 to -22	-21.0 -21.2 -21.5			**-21 to -21.2**; very coarse sand and gravel, possible slough **-21.2 to -21.5**; dark reddish brown medium sand **-21.5 to -22**; dark reddish brown coarse sand and gravel with 1" lens of black silty coarse sand and gravel at top
-24 to -26				no recovery
-29 to -31	-29.9 -30.7			**-29.9 to -30.7**; dark reddish brown sand and gravel, >2" cobble at -29.9 **-30.7 to -31**; dark reddish brown fine sandy silt

B-11 (1 of 2)

Test Bore: B-11 Elevation Range: -8 ft (2.4 m) to -61 ft (18.6 m)

Elevation (feet)		Profile	Sampled	Description
-34 to -36	-34.7			**-34.7 to -36**; dark reddish gray sand and gravel, rounded pebbles
-39 to -41	-40.0 -40.6 -40.7		S	**-40 to -40.6**; dark reddish brown very coarse sand and gravel, trace silt **-40.6 to -40.7**; gray clay with gray sand adhered to base, charcoal in clay, missing last couple of inches from bore Abrupt transition form reddish brown sands/gravel to gray clay/fine sands observered in this bore
-44 to -46	-44.7			**-44.7 to -46**; gray sand, oxidation
-49 to -51	-49.7			**-49.7 to -51**; orange/yellow gray sand, periodic laminations of dark gray, highly oxidized
-53 to -55	-53.8 -53.9			**-53.8 to -53.9**; dark reddish gray coarse sand, possible slough **-53.9 to -55**; bright yellowish and light yellowish gray sand, lenses of orange and dark gray, oxidized
-56 to -58	-56.7 -56.9			**-56.7 to -56.9**; reddish gray very coarse sand and gravel, possible slough **-56.9 to -58**; yellowish and light yellowish gray sand, oxidation
-59 to -61	-59.4			**-59.4 to -61**; light yellowish brown gray sand, some oxidation

B-11 (2 of 2)

Test Bore: B-12 Elevation Range: -10 ft (3 m) to -89 ft (27.1 m)

Elevation (feet)		Profile	Sampled	Description
-10 to -12	-11.3			**-11.3 to -12**; dark reddish brown silty coarse sand and gravel, top 1" black
-12 to -14	-13.1			**-13.1 to -14**; dark reddish brown silty coarse sand and gravel, lens of medium sand toward bottom, top 1" black (possible slough)
-14 to -16	-14.2 -14.7			**-14.2 to -14.7**; dark reddish brown medium sand and gravel, top 1" black coarse sand (possible slough) **-14.7 to -16**; dark reddish brown coarse sand and gravel
-16 to -18	-16.7			**-16 to -16.7**; black coarse sand and gravel, shelly, possible slough **-16.7 to -18**; dark reddish brown silty medium sand and gravel, no gravel bottom 4"
-18 to -20	-19.1			**-19.1 to -20**; dark reddish brown medium sand and some gravel
-20 to -22	-20.4			**-20.4 to -22**; dark reddish brown medium sand and some gravel
-25 to -27	-25.7 -26.2		S	**-25.7 to -26.2**; reddish tan very coarse sand and gravel, possible slough, recovered bifacial chert fragment **-26.2 to -27**; dark reddish brown medium sand, trace gravel
-27 to -29	-28.2			**-28.2 to -29**; dark reddish brown medium sand, few rounded pebbles
-33 to -35	-34.0			**-34 to -35**; reddish brown medium sand, one oxidized pebble at top

B-12 (1 of 3)

Test Bore: B-12 Elevation Range: -10 ft (3 m) to -89 ft (27.1 m)

Elevation (feet)		Profile	Sampled	Description
-37 to -39	-38.1			**-38.1 to -39**; reddish brown medium sand
-43 to -45	-44.0 -44.8			**-44 to -44.8**; reddish brown coarse sand and gravel, some rounded pebbles **-44.8 to -45**; reddish brown medium sand, >1' rounded pebbles at interface of overlying level
-47 to -49	-47.7			**-47.7 to -49**; reddish brown coarse sand and gravel, some >1" pebbles
-52 to -54	-52.3 -53.7			**-52.3 to -53.7**; light gray brown sand (very rounded grains) **-53.7 to -54**; laminated orange brown, yellowish brown, and brown silty sand
-57 to -59	-58.1			**-55.7 to -58.1**; yellow medium sand, grains very rounded **-58.1 to -59**; gray sand
-67 to -69	-68.2			**-68.2 to -69**; light gray medium sand
-72 to -74	-72.9			**-72.9 to -74**; light gray medium sand, oxidation toward bottom, 1" coarse sand slough at top
-77 to -79	-78.0 -78.8			**-78 to -78.8**; light yellowish gray sand **-78.8 to -79**; light gray brown sand

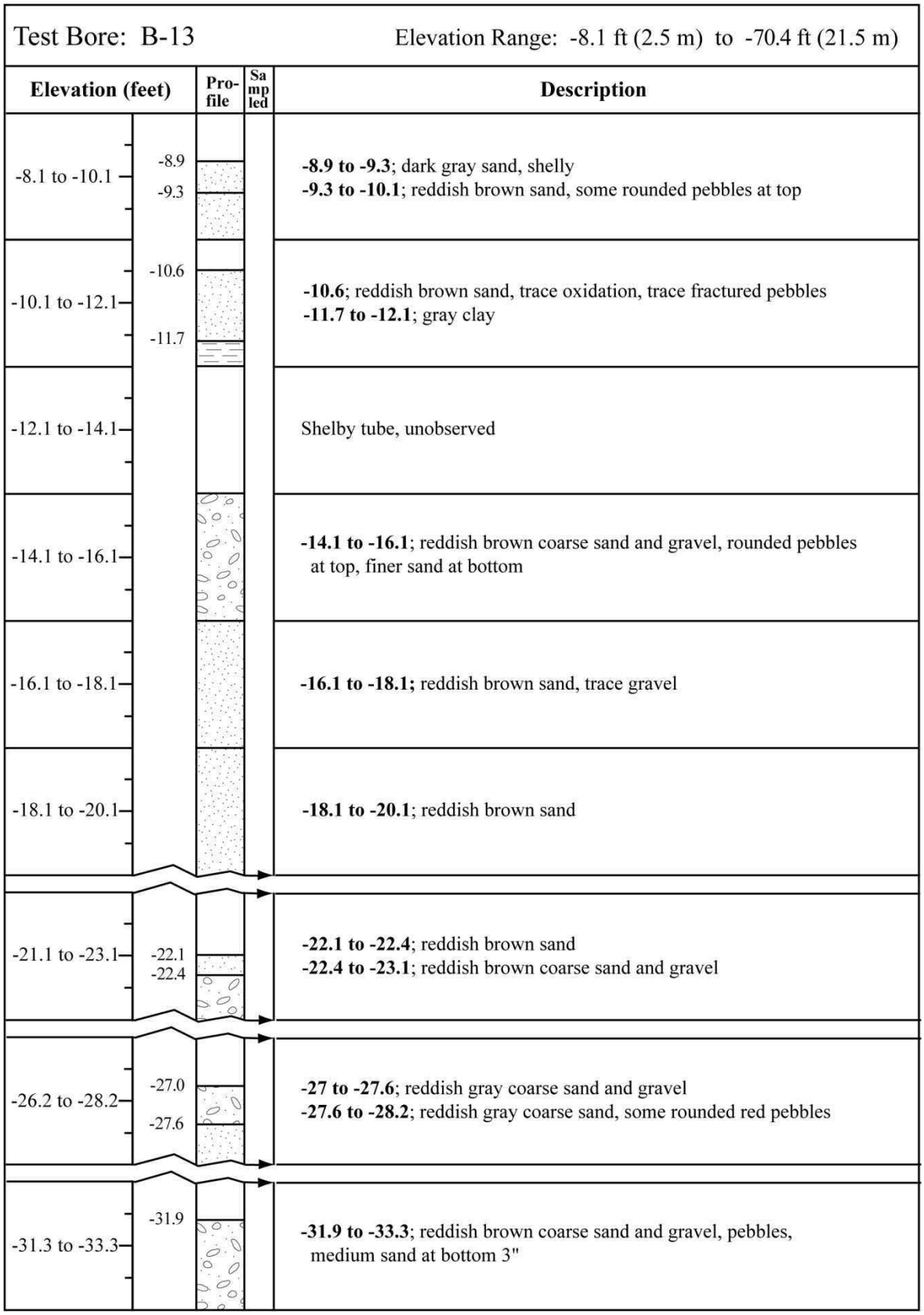
B-12 (2 of 3)

Test Bore: B-12 Elevation Range: -10 ft (3 m) to -89 ft (27.1 m)

Elevation (feet)		Pro-file	Sampled	Description
-81 to -83	-81.5			**-81.5 to -83**; yellowish gray sand
-87 to -89	-87.7			**-87.7 to -88.6**; dark yellow silty sand, concretions **-88.6 to -89**; dark gray sandy clay, blotchy and swirly
	-88.6			

B-12 (3 of 3)

Test Bore: B-13 Elevation Range: -8.1 ft (2.5 m) to -70.4 ft (21.5 m)



B-13 (1 of 2)

Test Bore: B-13 Elevation Range: -8.1 ft (2.5 m) to -70.4 ft (21.5 m)

Elevation (feet)	Profile	Sampled	Description
-37.5 to -39.5	-39.2		**-39.2 to -39.5**; light brown coarse sand, tiny fragments of shattered quartz (probable result of drilling process)
-41.7 to -43.7	-42.9		**-42.9 to -43.7**; pinkish gray coarse sand and gravel, rounded and fractured pebbles (probable result of drilling process)
-46.8 to -48.8	-47.6 -48.1 -48.5	S	**-47.6 to -48.1**; gravel and fractured pebbles, possible slough **-48.1 to -48.5**; dark orange brown coarse sand and gravel, >2" cobble at -48.5 **-48.5 to -48.8**; light gray sand
-52.1 to -54.1	-52.8		**-52.8 to -54.1**; light gray sand, some oxidation
-56.9 to -58.9	-57.3		**-57.3 to -58.9**; light gray sand
-62.9 to -64.9	-63.3		**-62.9 to -63.3**; light gray sand, aborted after 4" due to refusal
-68.4 to -70.4	-69.1		**-69.1 to -70.4**; pinkish gray sand with mottles of light yellowish brown gray and gray at bottom

B-13 (2 of 2)

Test Bore: B-14 Elevation Range: -9 ft (2.7 m) to -73 ft (22.3 m)

Elevation (feet)		Profile	Sampled	Description
-9 to -11	-10.0 -10.2 -10.7			**-10 to -10.2**; black sand, shelly **-10.2 to -10.7**; reddish gray sand **-10.7 to -11**; dark reddish brown coarse sand, trace silt
-11 to -13	-11.2			**-11.2 to -13**; reddish gray silty coarse sand and gravel, top 2" black slough
-13 to -15	-13.5 -13.7 -14.2 -14.7			**-13 to -13.5**; dark reddish brown silty coarse sand and gravel **-13.5 to -13.7**; light grayish brown silty fine sand **-13.7 to -14.2**; reddish brown coarse sand, trace silt **-14.2 to -14.7**; gray sand, 1" lens of yellowish brown silty sand and gravel at about -13.4 **-14.7 to -15**; yellowish brown sand and gravel
-15 to -17	-15.7 -16.1 -16.2			**-15.7 to -16.1**; reddish gray medium sand **-16.1 to -16.2**; greenish gray silt and coarse sand gravel, concreted **-16.2 to -17**; dark reddish brown coarse sand gravel silt, pockets of fractured shale
-17 to -19	-18.1			**-17 to -18.1**; reddish gray brown medium sand and gravel **-18.1 to -19**; gradual transition to dark yellowish brown silty sand and gravel
-19 to -21	-20.0			**-19 to -20**; reddish gray silty sand **-20 to -21**; dark red somewhat sandy clay, compact, rounded cobbles and fractured trap rock
-23 to -25	-23.7			**-23.7 to -25**; dark red clay, somewhat sandy, rounded cobbles and fractured trap rock
-29 to -31	-30.5			**-30.5 to -31**; dark red sandy clay, rounded cobbles and fractured trap rock
-34 to -36	-35.0			**-35 to -36**; reddish gray coarse sand and gravel, trace silt

B-14 (1 of 2)

Test Bore: B-14 Elevation Range: -9 ft (2.7 m) to -73 ft (22.3 m)

Elevation (feet)		Profile	Sampled	Description
-39 to -41	-39.7 -40.2			**-39.7 to -40.2**; reddish gray medium sand and gravel **-40.2 to -41**; reddish brown coarse sand and gravel, trace silt
-44 to -46	-45.2			**-45.2 to -46**; light reddish gray medium sand and gravel, rounded pebbles, one >2" cobble at bottom
-49 to -51	-50.0 -50.3			**-50 to -50.3**; yellowish gray coarse sand **-50.3 to -51**; mottled dark gray fine sandy silt, dark reddish brown coarse sandy silt, and dark yellowish gray coarse sand and gravel, high rock content, quartz pebbles at interface of overlying level
-53 to -55	-54.6			**-54.6 to -55**; dark gray/gray coarse sand and gravel, possible slough
-58 to -60	-58.9			**-58.9 to -60**; light gray silty sand, top 1" coarse sand gravel slough
-62 to -64	-62.7 -63.1			**-62.7 to -63.1**; gray coarse sand and gravel, possible slough **-63.1 to -64**; light gray sand, brownish at top, some oxidation
-66 to -68	-66.7 -67.0			**-66.7 to -67**; reddish gray silty sand and gray coarse sand, possible slough **-67 to -68**; light gray sand
-71 to -73	-72.6 -72.7			**-72.6 to -72.7**; gray coarse sand and gravel, possible slough **-72.7 to -73**; light gray sand

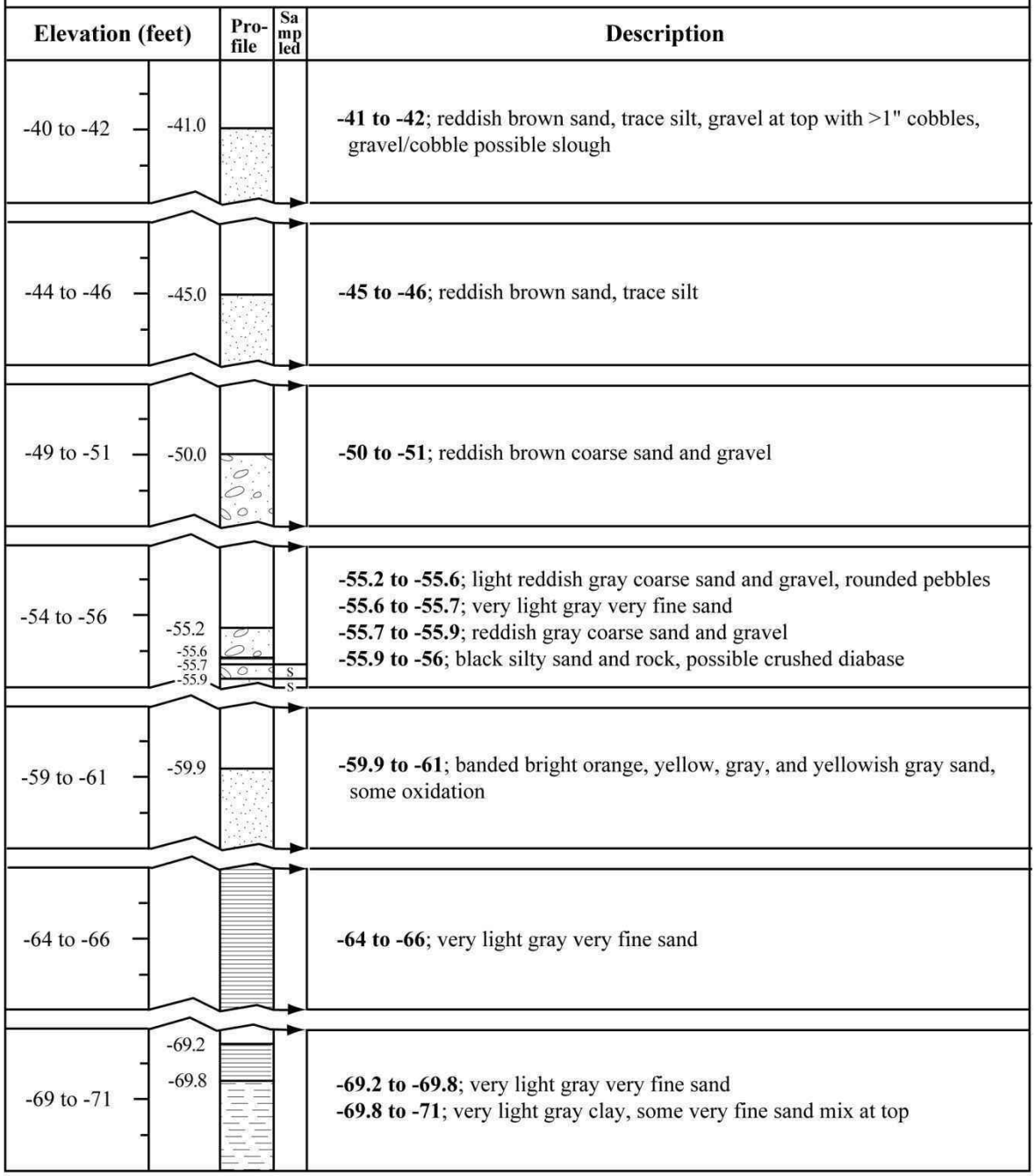
B-14 (2 of 2)

Test Bore: B-15 Elevation Range: -12 ft (3.7 m) to -71 ft (21.6 m)

Elevation (feet)		Profile	Sampled	Description
-12 to -14	-13.0 -13.3 -13.6			**-13 to -13.3**; black silty sand, shelly **-13.3 to -13.6**; gray sand with brown lenses **-13.6 to -14**; brown sand, trace silt
-14 to -16	-14.2 -14.7 -15.6			**-14.2 to -14.7**; black silty sand, possible slough **-14.7 to -15.6**; reddish brown silty sand **-15.6 to -16**; grayish brown sand
-16 to -18	-16.6 -16.9 -17.8			**-16.6 to -16.9**; gray sand, shelly **-16.9 to -17.8**; reddish gray brown sand and gravel, rounded pebbles **-17.8 to -18**; yellowish gray brown sand
-18 to -20	-18.3 -19.1			**-18 to -18.3**; gray sand, possible slough **-18.3 to -19.1**; reddish brown/gray silty sand and gravel, some rounded pebbles **-19.1 to -20**; yellowish gray brown sand
-20 to -22	-20.2 -21.2			**-20.2 to -21.2**; gray very coarse sand and gravel, shelly, clam **-21.2 to -22**; yellowish gray brown silty sand and gravel, rounded pebbles, some >1" cobbles
-22 to -24	-22.7			**-22 to -22.7**; gray coarse sand and gravel, shelly **-22.7 to -24**; yellowish gray brown sand and gravel, pebbles
-25 to -27	-26.0 -26.8			**-26 to -26.8**; gray sand, gradual transition to reddish brown sand and gravel **-26.8 to -27**; reddish brown silty sand and gravel
-30 to -32	-31.2 -31.7			**-31.2 to -31.7**; grayish brown sand and gravel with very light gray clay mottle **-31.7 to -32**; dark reddish brown silty coarse sand and gravel, rounded pebbles, >1" cobbles
-35 to -37	-35.9			**-35.9 to -37**; reddish brown sand and gravel, rounded pebbles, >1" cobbles at top

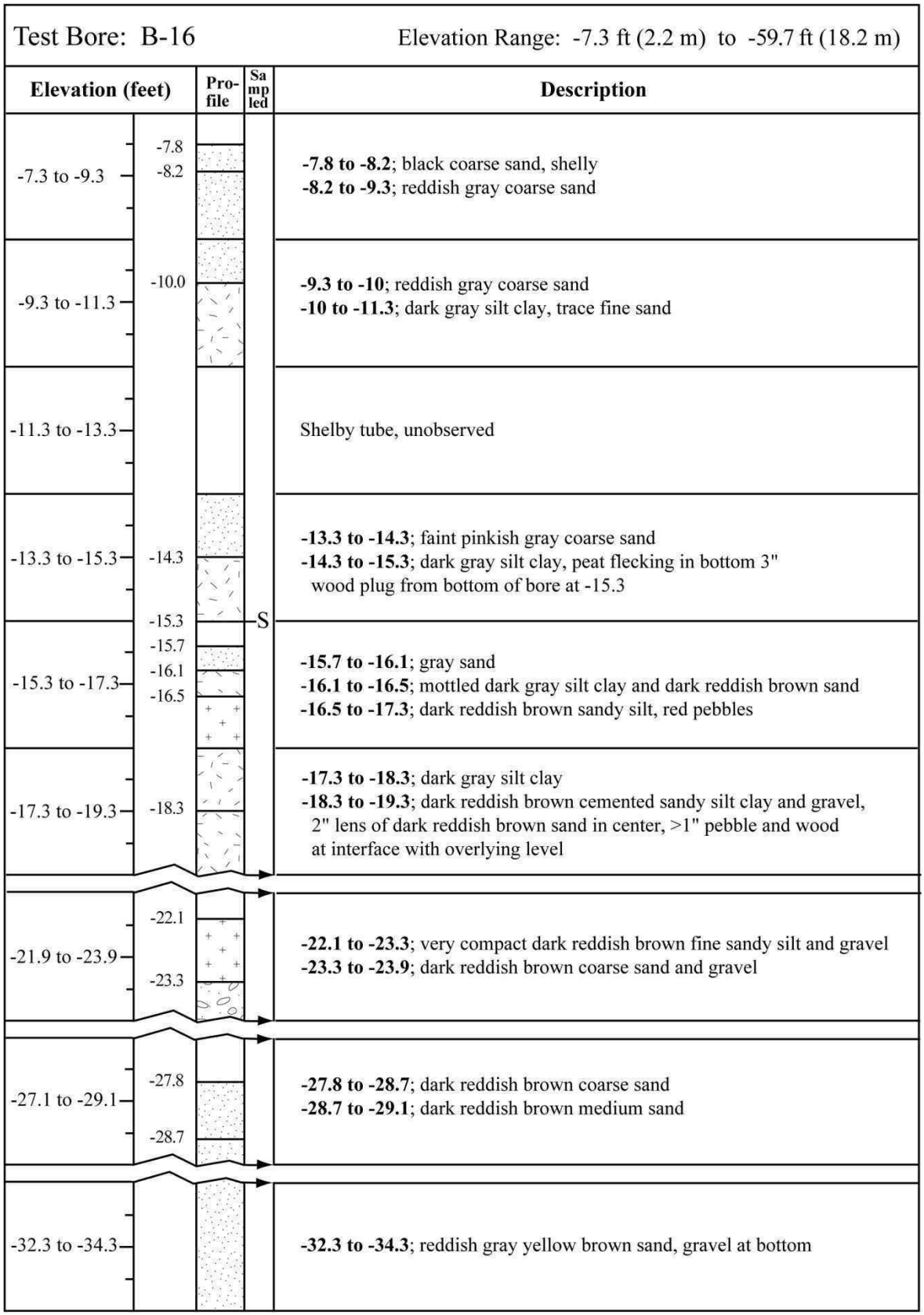
B-15 (1 of 2)

Test Bore: B-15 Elevation Range: -12 ft (3.7 m) to -71 ft (21.6 m)



B-15 (2 of 2)

Test Bore: B-16 Elevation Range: -7.3 ft (2.2 m) to -59.7 ft (18.2 m)



B-16 (1 of 2)

Test Bore: B-16 Elevation Range: -7.3 ft (2.2 m) to -59.7 ft (18.2 m)

Elevation (feet)		Profile	Sampled	Description
-39 to -41	-39.5			**-39.5 to -41**; reddish gray yellow brown sand and gravel, coarser at bottom
-42.6 to -44.6	-43.3			**-43.3 to -44.6**; reddish brown coarse sand and gravel, rounded pebbles
-47.9 to -49.9	-48.8 -49.2 -49.6			**-48.8 to -49.2**; reddish gray brown coarse sand and gravel **-49.2 to -49.6**; mottled reddish gray brown coarse sand and light gray fine sand **-49.6 to -49.9**; light gray sand
-53 to -55	-53.6			**-53.6 to -55**; light gray sand, some oxidized lenses
-57.7 to 59.7	-59.4			**-57.7 to -59.4**; light gray clay, 2" lens of thinly laminated black and light gray clay with yellowish brown sand about -58.2 **-59.4 to -59.7**; light gray sand

B-16 (2 of 2)

Test Bore: B-17 Elevation Range: -13 ft (4 m) to -74.2 ft (22.6 m)

Elevation (feet)		Profile	Sampled	Description
-13 to -15				no recovery
-15 to -17	-15.7 -16.2			**-15 to -15.7**; dark gray/black sandy silt, shelly **-15.7 to -16.2**; reddish brown sand and gravel, rounded pebbles **-16.2 to -17**; brown sand
-17 to -19	-17.3 -17.6 -18.2			**-17.3 to -17.6**; dark gray/black sand, shelly **-17.6 to -18.2**; brown-reddish brown sand, some gravel at top, some shell hash **-18.2 to -19**; yellowish brown sand
18.9 to 20.9	-20.1			**-20.1 to 20.9**; reddish brown sand, >2' cobble at top, getting grayer at bottom
-21.3 to -23.3	-22.0 -22.5 -22.8			**-22 to -22.5**; dark reddish brown coarse sand and gravel , high density gravel **-22.5 to -22.8**; dark reddish brown medium sand and gravel, low density gravel **-22.8 to -23.3**; dark reddish brown coarse sandy silt and gravel, rounded pebbles, hard nodule of dark reddish brown clay
-23.5 to -25.5	-24.3 -24.5 -25.2			**-24.3 to -24.5**; gray sand **-24.5 to -25.2**; dark reddish brown coarse sand and gravel, coarser at top, pebbles at top **-25.2 to -25.5**; reddish gray sand and gravel
-25.6 to -27.6	-27.0			**-27 to -27.6**; dark reddish brown coarse sand and gravel silt, bands of silt, >1" pebbles, about 1/2" dark yellowish brown coarse sand and gravel at very bottom
-30.3 to -32.3				no recovery
-35.6 to -37.6	-37.4			**-37.4 to -37.6**; >1" gravel, essentially no recovery

B-17 (1 of 2)

Test Bore: B-17 Elevation Range: -13 ft (4 m) to -74.2 ft (22.6 m)

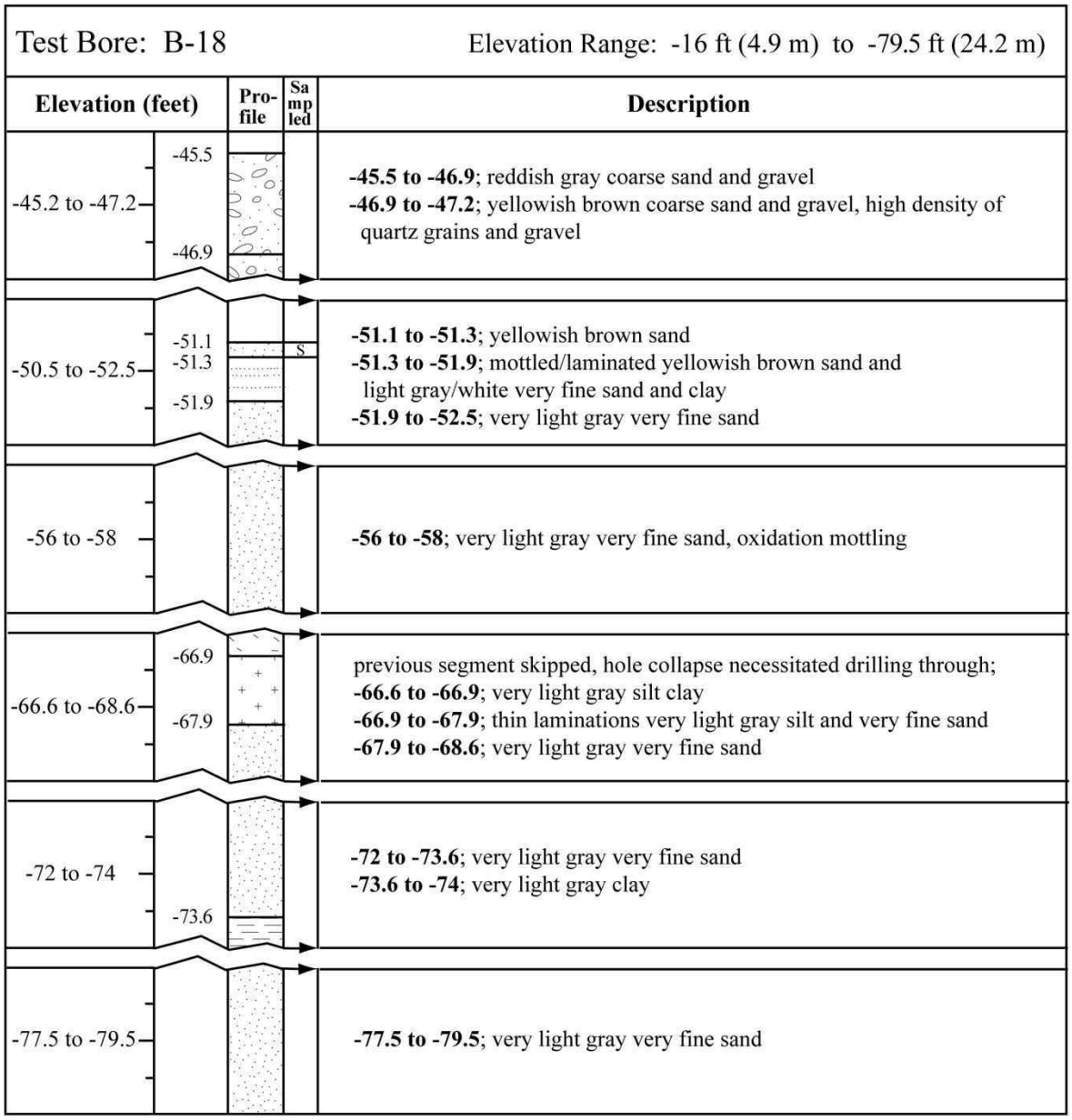
Elevation (feet)		Profile	Sampled	Description
-40.9 to -42.9	-42.0		S	**-42 to -42.9**; grayish brown very coarse sand and gravel, >1.5" pebbles, possible worked chunk of chert from top
-46.1 to 48.1	-46.8			**-46.8 to -48.1**; light gray sand, lenses of oxidation
-51.2 to -53.3	-51.8			**-51.8 to -53.2**; yellow gray to gray sand, mottles of dark and light oxidation
	-53.2			
-56.3 to -58.3	-56.9			**-56.9 to -57.2**; gray sand
	-57.2			**-57.2 to 57.7**; laminated very light gray clay and dark yellowish brown silty sand
	-57.7			**-57.7 to -58.3**; very light gray clay
-62.3 to -64.3				**-62.3 to -64.3**; light gray very fine sand speckled with black silt
-67.2 to -69.2				**-67.2 to -69.2**; light gray very fine silt sand, trace oxidation
-72.2 to -74.2				**-72.2 to -74.2**; very light gray silt, mica

B-17 (2 of 2)

Test Bore: B-18 Elevation Range: -16 ft (4.9 m) to -79.5 ft (24.2 m)

Elevation (feet)		Profile	Sampled	Description
-16 to -18				no recovery
-18 to -20	-19.0 -19.4			**-19 to -19.4**; black sand, shelly **-19.4 to -20**; dark reddish brown coarse sand and gravel
-20 to -22	-20.3 -20.7 -20.9			**-20.3 to -20.7**; black sand, possible slough **-20.7 to -20.9**; reddish brown silty sand and gravel, rounded pebbles **-20.9 to -22**; yellowish brown coarse sand and gravel, rocky, >2" cobble at interface with overlying level
-22 to -24	-22.5 -22.7			**-22.5 to -22.7**; dark reddish brown coarse sand and gravel, rounded pebbles **-22.7 to -24**; dark yellowish brown coarse sand and gravel with lens of dark gray at top and brighter yellow brown at bottom
-24 to -26	-24.6 -25.0			**-24.6 to -25**; reddish gray coarse sand and gravel, shelly at interface with underlying level **-25 to -26**; dark yellowish brown sand and gravel with red mottles, rounded pebbles >1"
-26 to -28	-26.5 -27.0 -27.7			**-26 to -26.5**; reddish yellow brown sand **-26.5 to -27**; gray coarse sand and gravel, red mottles **-27 to -27.7**; dark yellowish brown sand, some rounded pebbles **-27.7 to -28**; reddish gray coarse sand and gravel, red pebbles
-29.3 to -31.3	-30.0 -30.2			**-30 to -30.2**; gray very coarse sand and gravel, possible slough **-30.2 to -31.3**; reddish gray brown sand
-34 to -36	-35.0			**-35 to -36**; reddish brown sand
-39.8 to -41.8	-40.5			**-40.5 to -41.8**; reddish brown sand, trace pebbles

B-18 (1 of 2)


Test Bore: B-18
Elevation Range: -16 ft (4.9 m) to -79.5 ft (24.2 m)
Elevation (feet)
Pro-file
Sa mp led
Description
-45.5
-45.2 to -47.2
-46.9
-46.9 to -47.2; yellowish brown coarse sand and gravel, high density of quartz grains and gravel
-45.5 to -46.9; reddish gray coarse sand and gravel
-51.1
-50.5 to -52.5
-51.3
-51.9
S
-51.1 to -51.3; yellowish brown sand
-51.3 to -51.9; mottled/laminated yellowish brown sand and light gray/white very fine sand and clay
-51.9 to -52.5; very light gray very fine sand
-56 to -58
-56 to -58; very light gray very fine sand, oxidation mottling
-66.9
-66.6 to -68.6
-67.9
previous segment skipped, hole collapse necessitated drilling through;
-66.6 to -66.9; very light gray silt clay
-66.9 to -67.9; thin laminations very light gray silt and very fine sand
-67.9 to -68.6; very light gray very fine sand
-72 to -74
-73.6
-72 to -73.6; very light gray very fine sand
-73.6 to -74; very light gray clay
-77.5 to -79.5
-77.5 to -79.5; very light gray very fine sand

B-18 (2 of 2)

Test Bore: B-19 Elevation Range: -11.5 ft (3.5 m) to -111.3 ft (33.9 m)

Elevation (feet)		Profile	Sampled	Description
-11.5 to -13.5	-12.8			**-12.8 to -13.5**; dark gray/black silty sand, shelly
-12.9 to -14.9	-13.4 -13.9			**-13.4 to -13.9**; black silty sand, shelly **-13.9 to -14.9**; gray silt clay
-14 to -16				Shelby tube, unobserved
-16.1 to -18.1	-16.9 -17.5			**-16.1 to -16.9**; gray silt clay, shelly **-16.9 to -17.5**; mottled gray silt sand and gray silt clay, some peat flecking **-17.5 to -18.1**; gray silt sand
-18.3 to -20.3	-19.8			**-19.8 to -20.3**; reddish gray sand, trace silt, some red fractured rock
-20.5 to -22.5	-21.2 -21.8 -22.0 -22.3		S S	**-20.5 to -21.2**; gray sandy silt, shelly **-21.2 to -21.8**; reddish brown fine sand **-21.8 to -22**; reddish gray sand **-22 to -22.3**; brown sand **-22.3 to -22.5**; orange brown silty fine sand
-24.6 to -26.6	-25.1 -25.9			**-25.1 to -25.9**; olive brown sand **-25.9 to -26.6**; soft red rock, easily fractured shale
-29.7 to -31.7	-30.3 -30.6			**-30.3 to -30.6**; gray coarse sand **-30.6 to -31.7**; reddish brown coarse sand and gravel

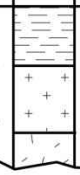
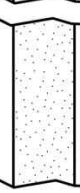
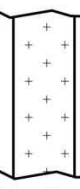
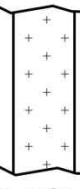
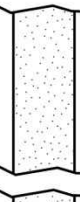
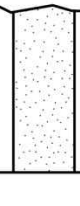
B-19 (1 of 3)

Test Bore: B-19 Elevation Range: -11.5 ft (3.5 m) to -111.3 ft (33.9 m)

Elevation (feet)		Profile	Sampled	Description
-34.6 to -36.6	-35.2			**-35.2 to -36.6**; light reddish brown coarse sand and gravel
-39.4 to -41.4	-40.4 -40.7			**-40.4 to -40.7**; gray coarse sand and gravel, large quartz cobble at top **-40.7 to -41.4**; reddish brown coarse sand and gravel, trace silt
-44.1 to -46.1	-45.0			**-45 to -46.1**; light gray coarse sand, visually all quartz grains
-48.4 to -50.4	-48.7			**-48.7 to -50.4**; light gray silty fine sand, oxidation mottling, some red fractured rock at top
-52.3 to -54.3	-52.8			**-52.8 to -54.3**; very light gray fine sand, some silt
-57.2 to -59.2	-58.8			**-57.2 to -58.8**; very light gray very fine sand **-58.8 to -59.2**; very thin laminations of very light gray very fine silt sand and very light gray/white very fine sand silt, some faint oxidation
-62 to -64	-62.3			**-62.3 to -64**; very light gray very fine sand silt speckled with black
-67 to -69				**-67 to -69**; very light gray silt clay speckled with black

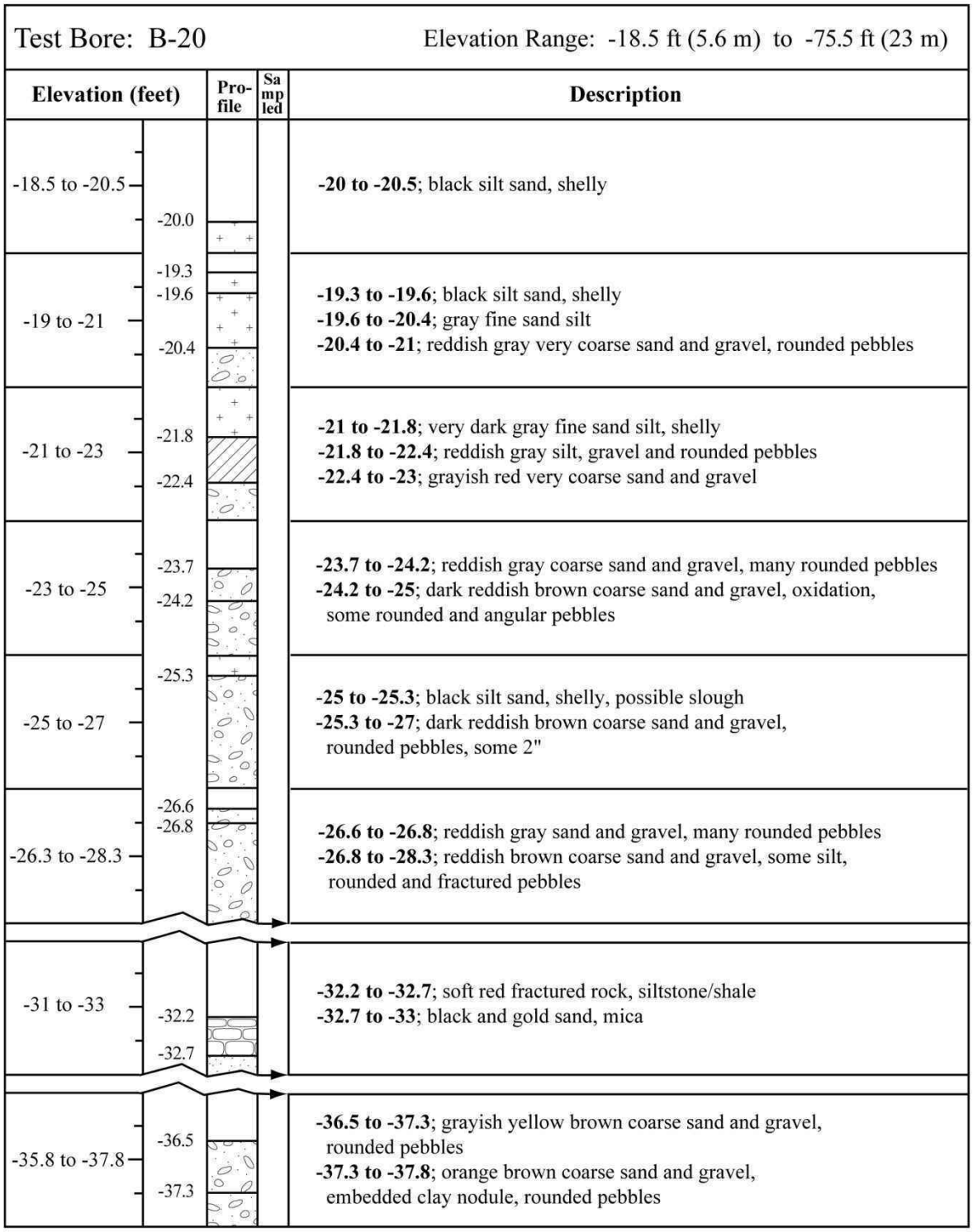
B-19 (2 of 3)

Test Bore: B-19 Elevation Range: -11.5 ft (3.5 m) to -111.3 ft (33.9 m)

Elevation (feet)	Profile	Sampled	Description
-75.1 to -77.1 / -75.9 / -76.7			**-75.1 to -75.9**; very dark gray clay, some laminations of very dark gray silt and mica **-75.9 to -76.7**; light gray very fine sand silt **-76.7 to -77.1**; very dark gray clay silt, trace very fine sand
-79.9 to -81.9			**-79.9 to -81.9**; very light gray very fine sand, mica
-84.7 to -86.7			**-84.7 to -86.7**; very light gray very fine sand silt, mica
-90.2 to -92.2			**-90.2 to -92.2**; very light gray very fine sand silt
-95.2 to -97.2			**-95.2 to -97.2**; light gray very fine sand, slightly darker and coarser than preceding levels
-100.1 to -102.1			**-100.1 to -102.1**; light gray very fine sand, same as above
-104.7 to -106.7			**-104.7 to -106.7**; light gray very fine sand, mica, getting darker toward bottom
-109.3 to -111.3			**-109.3 to -111.3**; gray very fine sand silt, mica

B-19 (3 of 3)

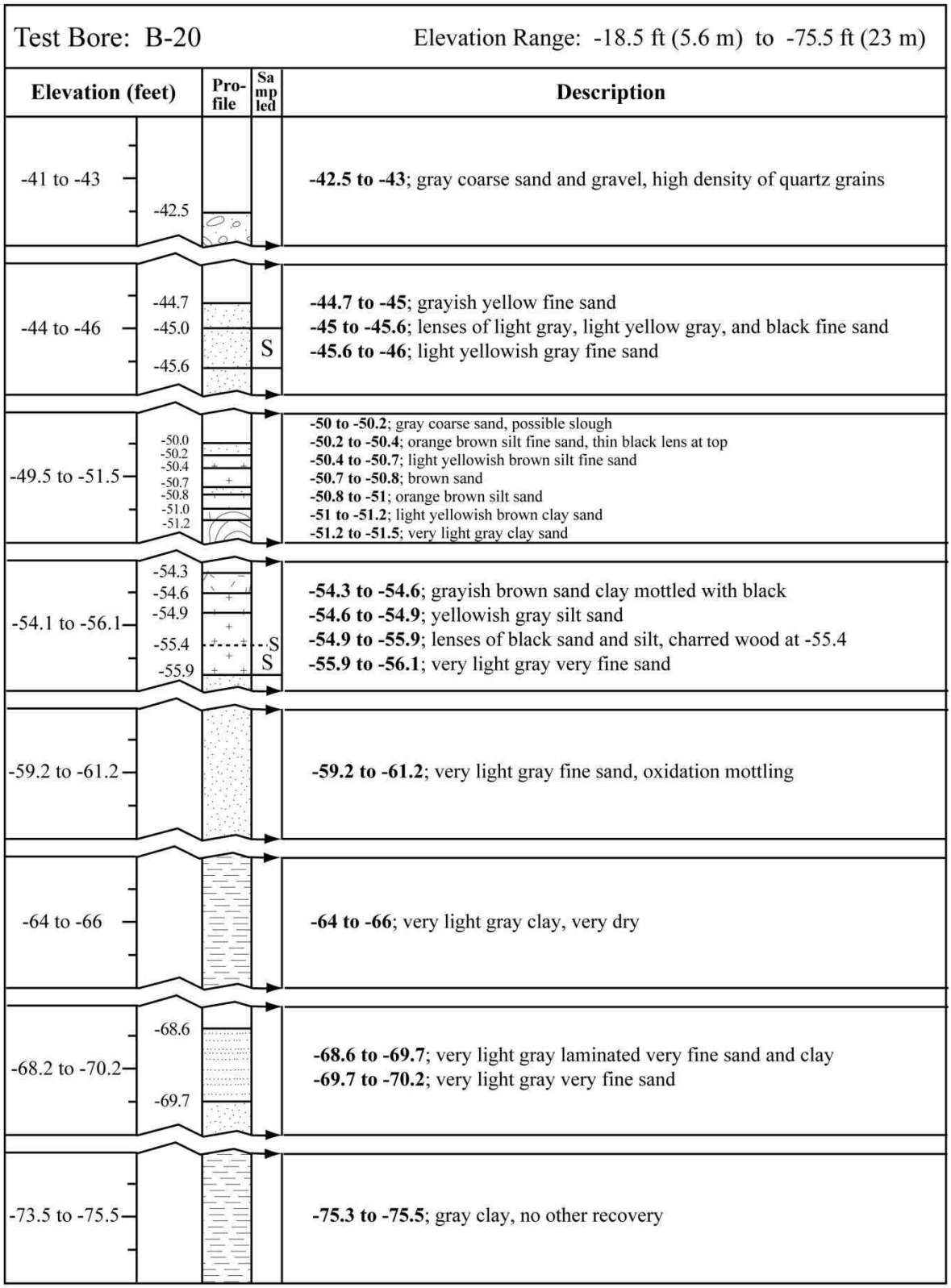
Test Bore: B-20 Elevation Range: -18.5 ft (5.6 m) to -75.5 ft (23 m)



Elevation (feet)		Profile	Sampled	Description
-18.5 to -20.5	-20.0			**-20 to -20.5**; black silt sand, shelly
-19 to -21	-19.3 -19.6 -20.4			**-19.3 to -19.6**; black silt sand, shelly **-19.6 to -20.4**; gray fine sand silt **-20.4 to -21**; reddish gray very coarse sand and gravel, rounded pebbles
-21 to -23	-21.8 -22.4			**-21 to -21.8**; very dark gray fine sand silt, shelly **-21.8 to -22.4**; reddish gray silt, gravel and rounded pebbles **-22.4 to -23**; grayish red very coarse sand and gravel
-23 to -25	-23.7 -24.2			**-23.7 to -24.2**; reddish gray coarse sand and gravel, many rounded pebbles **-24.2 to -25**; dark reddish brown coarse sand and gravel, oxidation, some rounded and angular pebbles
-25 to -27	-25.3			**-25 to -25.3**; black silt sand, shelly, possible slough **-25.3 to -27**; dark reddish brown coarse sand and gravel, rounded pebbles, some 2"
-26.3 to -28.3	-26.6 -26.8			**-26.6 to -26.8**; reddish gray sand and gravel, many rounded pebbles **-26.8 to -28.3**; reddish brown coarse sand and gravel, some silt, rounded and fractured pebbles
-31 to -33	-32.2 -32.7			**-32.2 to -32.7**; soft red fractured rock, siltstone/shale **-32.7 to -33**; black and gold sand, mica
-35.8 to -37.8	-36.5 -37.3			**-36.5 to -37.3**; grayish yellow brown coarse sand and gravel, rounded pebbles **-37.3 to -37.8**; orange brown coarse sand and gravel, embedded clay nodule, rounded pebbles

B-20 (1 of 2)

Test Bore: B-20 Elevation Range: -18.5 ft (5.6 m) to -75.5 ft (23 m)



B-20 (2 of 2)

APPENDIX D

Botanical analysis report

Flotation Analysis: Living Breakwaters Archaeological Phase I

Geo-bore Monitoring Project

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February 10, 2016

Flotation Analysis: Living Breakwaters Archaeological Geo-bore Monitoring Project

Tonya Largy, M.A., Consultant

INTRODUCTION

This report discusses the analysis of four flotation samples taken during the Living Breakwaters Archaeological Phase I monitoring of the geophysical soil sampling program in Raritan Bay along the south coast of Staten Island, New York. The monitoring project, requested by AKRF, an Environmental Planning and Consulting Firm was completed on October 28, 2015. The project and methodology are discussed fully by Dr. Kerry Lynch, Project Archaeologist, University of Massachusetts Archaeological Services (Lynch, letter to Michael Pappalardo, November 6, 2015).

As a result of the project, four flotation samples, selected by Lynch from split spoon bores, were submitted to me for analysis of biological materials. The samples came from bore locations B-2 (ID# 21, 22, and 23), and B-4 (ID# 24). All locational data for each sample are recorded in Tables 1 through 3. Results of analysis include the identification of both charred and uncharred terrestrial plant parts, marine grass, and marine invertebrates.

ANALYTICAL METHODS

Each sample was measured for volume which was recorded on data sheets before being examined. I used an Omano Zoom stereomicroscope with magnification ranging from 6.5X to 45X. Samples were sorted using standard archaeobotanical techniques. Mr. David DeMello assisted with preliminary sorting of samples using a Wild M3 Zoom stereomicroscope with magnification ranging from 6.5X to 40X. He also assisted with data entry and report preparation and identified the marine invertebrate (Ectoprota). I reviewed each sample and made final identifications of botanical specimens. The sample of eelgrass was identified at the Harvard University Herbarium with the assistance of Walter Kittredge, Curatorial Assistant.

Seeds, nuts, wood, and other selected plant materials were removed from the samples during analysis. All specimens were weighed to the nearest one hundredth gram using an A & D digital scale. Representative samples of wood and bark large enough to show diagnostic features were removed from the samples for diagnostic purposes. The larger fragments were snapped

manually to obtain a clean transverse section in order to view anatomical patterns across the growth ring. All specimens were packed in plastic microtubes along with their identifications which were written with archival pens on acid free labels. Specimens designated for possible radiocarbon dating were wrapped in aluminum foil. Acid-free labels prepared for this project were included in each sample bag.

Seeds were identified using both published manuals (Martin and Barkley 1961, Montgomery 1977) and the analyst's comparative collection of both charred and uncharred seeds and nuts. The above mentioned marine invertebrate was identified using specialized manuals for marine invertebrates (Smith 1964, Barnes, 1974). Finally, all plant specimens were identified to the lowest taxonomic level possible using the methods described. All taxonomic nomenclature follows the *Integrated Taxonomic Information System*, accessed online (www.itis.gov).

RESULTS

SEEDS

Recovered seeds include one charred and four uncharred specimens (Table 1). It is noteworthy that all identified seeds represent terrestrial plant taxa. The uncharred seeds include one unidentified, incomplete, and somewhat degraded seed from sample B-4. The remaining three uncharred seeds represent three separate genera. *Chenopodium* (goosefoot, n=1) was identified in sample B-2, ID# 21 from a depth of 20-22 feet. Both *Cyperus* (sedge, n=1) and *Polygonum* (knotweed, n=1) were found in sample B-2, ID# 22 from a depth of 80-82 feet. While sedge often grows in damp/wet soils near freshwater streams, both goosefoot and knotweed are typically found in drier disturbed soils and waste places, although some knotweeds prefer wetter soils.

The charred seed identified as cf. *Polygonum* (knotweed, n=1), was found in sample B-4, ID# 24, from a depth of 28-30 feet. The seed certainly appears to be charred. The designation "cf." means "compares with**"**, being short for the Latin verb "*conferre"*, meaning the seed closely resembles that taxon. The seed must have been carbonized while on dry land either through cultural activities or natural events, such as an accidental burn. Interestingly, Native American lithic artifacts were recovered from a similar depth from bore samples B-10. Bioturbation caused by benthic infauna also occurs in the sea floor allowing small items such as

seeds and other plant materials to filter down. However, it may be possible that some occupation or other cultural activity occurred at this level before the sea level rose.

No seeds were encountered in the sample from B-2, ID# 23.

WOOD

Charred wood fragments were recovered from bore samples B-2, ID# 22 (wt.= 0.21 gram), from ID#23 (wt.= 1.70 grams), and from bore sample B-4, ID# 24 (wt.= 0.02 gram). The entire wood sample weighs 1.93 grams (Table 2). Most of the wood fragments were small but several fragments could be identified to some level. One fragment of oak *(Quercus* sp.) was identified in the sample from B-2, ID# 22, along with fragments of hardwood and what appears to be one resin droplet. The sample from B-2, ID# 23 is identified as entirely dicot wood (hardwood).

Bore sample B-4, ID# 24 yielded conifer parts. One small fragments of conifer wood is identified as a genus in the pine family (Pinaceae). This fragment exhibits fusiform rays indicating it is pine, spruce, or larch/tamarack, since these are the only genera with this diagnostic feature which occur in New England. One conifer bark chip, possible pine, (wt. = 0.01 gram) also was present in the same sample. An additional specimen from the same sample is identified as dicot wood (wt. = 0.01 gram) and includes one fragment of oak (Table 2).

OTHER PLANT PARTS

Plant parts other than seeds and wood are listed in Table 2. These include uncharred marine grass from B-2, ID# 21, a bark chip, and conifer needles from B-4, ID# 24.

The uncharred grass-like vegetation from B-2 (wt.= 0.04) was well-preserved, although fragile. This resembled grass rather than other types of aquatic plants. It is identified as eelgrass (*Zostera marina*), based on an exact comparison with specimens in the Harvard University Herbarium provided by Kittredge, Curatorial Assistant. Although well preserved, the leaves have broken into many small fragments due to their fragility.

"Eelgrass, is not seaweed, but a flowering underwater grass that grows in shallow marine sediments. Eelgrass forms beds and meadows that grow in bays and coves, tidal creeks, and

estuaries. These beds are a haven for crabs, scallops, numerous species of important fish, and other wildlife**.** The long blades of grass are often covered with tiny marine plants and animals. Here, these creatures find habitat, protection from predators, nursery grounds, food, and oxygen (NOAA.gov). Their recovery from the same sample as the aquatic fauna listed in Table 3 is strongly associated. Before Raritan bay became deteriorated, it was an excellent habitat for fishes and shellfishes and had high biological productivity. Its edges consisted of wide shallows which had beds of eelgrass serving as nursery areas for juvenile fishes" (MacKenzie, Jr. 1990:3).

No other plant parts were found in bore samples B-2, ID# 22, or B-2, ID# 23. However, As mentioned above, charred terrestrial plant parts were found in bore sample B-4, ID# 24. Two well preserved needle fragments from *Pinus rigida* (pitch pine) were recovered. In addition, four smaller, somewhat degraded fragments of needles, from a hard pine, possibly pitch pine, were identified. One fascicle (leaf bundle or sheath), shows evidence that it held three needles. This is diagnostic for pitch pine which is the only three needled pine extant in northeastern North America. This taxon is often identified in archaeological sites in the northeast. Pitch pines are fire dependent and highly flammable. Carbonized needles, fascicles, bark chips, and pine cone fragments are recovered occasionally in flotation samples from Native American sites.

Pitch pines "normally grow in poor, sandy to gravelly soils along river valleys or low coastal areas" (Elias 1980:67). Pitch pine is often found in association with scrub oak in pine barren habitats such as those present on Long Island and New Jersey, which no doubt once was connected with Staten Island before the marine transgression. Olsvig *et. al:*265) suggest pine barren vegetation is present on Staten Island. A more in-depth review of the literature is warranted, but is beyond the scope of this analysis.

The degree of preservation of the two positively identified pitch pine needles is curious. They may have been introduced into such deep levels by sediment slumping into the drilled hole from above, as suggested by Lynch (End of Field Letter, November 6, 2015). However, bioturbation by benthic infauna also may have played a role in their deposition (Kristenson 2000).

FAUNA

Marine fauna (n=100) were recovered from bore samples B-2, ID#21 and B-2, ID# 22. The majority (99%) of specimens came from ID# 21 (n= 99, wt.= 1.04 grams). Seventy-eight of these (79%, wt.= 0.31) are from ID# 21. These include small fragments of mollusks, many of

which are recognizable as fragments of small bivalves. Larger bivalves and fragments (n = 8, wt.= 0.67 gram) and gastropods (n = 6, wt.= 0.01) were also recovered from the sample. The larger bivalve fragments are not oysters, or scallops, but rather resemble a species of clam. Both the bivalve fragments and the gastropods likely are identifiable by a specialist in malacology.

The remaining specimens from ID# 21 include one tip of a crustacean appendage, one fish scale, and five fragments identified by DeMello as cf. Ectoprocta, a phylum of Bryozoa. The fish scale is fairly well preserved and can probably be identified at least to the family. While the Ectoprocta fragments resemble coral at first, follow-up analysis by DeMello using a marine invertebrate laboratory manual identified the specimens as cf. Ectoprocta, which are also known as Bryozoans (Smith 1964:183, Plate 25). A name change was suggested in 1959 but both taxonomic designations continue to be used. Barnes describes this taxon as follows: "With very few exceptions bryozoans are all colonial and sessile animals, and the individuals composing the colony are usually less than 0.5 mm. in length. Individuals of most species are encased in a nonliving envelopment that contains an opening for the protrusion of the lophophore. The lophophore is the food catching organ" (Barnes 1974:695).

Ectoprocta/Bryozoan colonies are found in both fresh and salt waters. Marine species range from the shore to the ocean depths but are most plentiful in the shallow waters of the continental shelf. They cover seaweeds, form crusts on stones and shells, hang from boulders, or rise from the seabed (Ryland, Brittanica.com).

CONCLUSION

This analysis has resulted in the recovery of interesting and significant data suggesting that if samples had been taken in successive incremental levels, a chronological history of this specific location might be reconstructed. If further geo-boring takes place in this location, perhaps sampling could be done in closer intervals to gain further insight into terrestrial and marine habitat as well as the rate of salt water transgression along the coast of New Jersey and Staten Island.

REFERENCES

Montgomery, F. H.
1977 *Seeds and Fruits of Plants of Eastern Canada and Northeastern United States.* University of Toronto Press, Toronto, Canada.

Barnes, Robert D.
1974 *Invertebrate Zoology*, 3rd Edition. D.W.B. Saunders Company.

Elias, Thomas S.
1980 *The Complete Trees of North America.* Van Nostrand Reinhold Company, New York.

Lynch, Kerry J.
2015 End of Field Letter, Living Breakwaters, Archaeological Phase I, Geo-bore Monitoring Project, dated November 6, 2015.

MacKenzie, Claude, Jr.
1990 History of the Fisheries of Raritan Bay, New York and New Jersey. *Marine Fisheries Review* 52(4), pp. 1-45.

Martin, Alexander C. and William D. Barkley
1961 *Seed Identification Manual*. University of California Press, Berkeley.

Olsvig, Linda S., John F. Cryan, and Robert H. Wittaker
1979 Vegetational Gradients of the Pine Plains and Barrens of Long Island, NY, in Richard Forman, Editor, *Pine Barrens: Ecosystem and Landscape.* Academic Press, Inc.

Smith, Ralph I., Editor
1964 *Key to Marine Invertebrates of the Woods Hole Region,* 9th Edition. Marine Biological Laboratory, Woods Hole, Massachusetts.

Online Resources:

NOAA.
Eelgrass – Habitat of the Month. Retrieved February 10, 2016 from http://www.habitat.noaa.gov/abouthabitat/eelgrass.html.

Ryland, John S.
Moss Animals. *Encyclopedia Brittanica.* Retrieved February 10, 2016 from http://www.britannica.com/animal/moss-animal

Living Breakwaters - Table 1. Seeds

Prov.	ID	Phase	Exc.	Depth (feet))	Volume (ml)	Qty.	Charred Seed	Qty.	Unch. Seed.	Common Name	Comment
B-2	21	1	KJL	20-22	19			1	*Chenopodium* sp	Goosefoot	
B-2	22	1	KJL	80-82	5			1	*Cyperus* sp.	Flatsedge; Sedge	
B-2	22	1	KJL	80-82	5			1	*Polygonum* sp.	Knotweed	
B-2	23	1	KJL	85-87	5		No Data		No Data		Nothing removed
B-4	24	1	KJL	28-30	7.5	1	cf. *Polygonum* sp.			Knotweed	Appears to be charred
B-4	24	1	KJL	28-30	7.5			1	Unidentified		
Total						**1**		**4**			

Living Breakwaters - Table 2. Wood and Other Plant Parts

Prov.	ID	Phase	Depth (feet)	Volume (ml)	Wt.(g)	Wood	Qty.	Wt.(g)	Other Plant	Comment
B2	21	1	20-22	19				0.04	*Zostera marina*	Marine grass
B2	22	1	80-82	5	0.21	Wood				Includes oak (*Quercus*), dicot wood, resin
B2	23	1	85-87	5	1.70	Dicot wood				Hardwood
B4	24	1	28-30	7.5	0.01	Pinaceae*				Pine family wood; fusiform rays present
B4	24	1	28-30	7.5	<0.01				Pinaceae*	Pine family bark chip
B4	24	1	28-30	7.5	0.01	Dicot wood				Includes one fragment of oak (*Quercus*)
B4	24	1	28-30	7.5			4	<0.01	cf. *Pinus* sp.*	Pine needle fragments; degraded, may be P. rigida
B4	24	1	28-30	7.5			2	<0.01	*Pinus rigida**	Pitch pine needles; well preserved
B4	24	1	28-30	7.5			1	0.01	*Pinus rigida**	Fascicle (leaf bundle) with 3 needles
Total					**1.93**		**7**	**0.01**		
*** Charred**										

;

Living Breakwaters - Table 3. Fauna

Prov.	ID	Phase	Exc.	Depth (feet))	Volume (ml)	Qty.	Wt.(g)	Fauna	Comment
B-2	21	1	KJL	20-22	19	78	0.31	Mollusk fragments	Mostly bivalves
B-2	21	1	KJL	20-22	19	8	0.67	Bivalve	
B-2	21	1	KJL	20-22	19	6	0.01	Gastropod	
B-2	21	1	KJL	20-22	19	5	0.03	cf. Ectoprocta	A phyllum of Bryozoa
B-2	21	1	KJL	20-22	19	1	0.01	cf. Crustacean	Tip of an appendage
B-2	21	1	KJL	20-22	19	1	0.01	Fish scale	
Total						**99**	**1.04**		
B-2	22	1	KJL	80-82	5	1	<0.01	Shell	Very small fragment
Total						**1**	**<0.01**		

Total # = 100
Total Wt. = 1.04

APPENDIX E

Radiocarbon dating analysis

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. Kerry Lynch — Report Date: 3/11/2016

University of Massachusetts — Material Received: 3/2/2016

Sample Data	Measured Radiocarbon Age	d13C	Conventional Radiocarbon Age(*)
Beta - 432748	NA	-21.0 o/oo	> 43500 BP
SAMPLE : UM748B2ID23			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (organic material): acid/alkali/acid			
COMMENT:			
(1) The 14C activity was extremely low and almost identical to the background signal. In such cases, indeterminate errors associated with the background add non-measurable uncertainty to the result. Always, the result should be considered along with other lines of evidence. The most conservative interpretation of age is infinite (i.e. greater than).			
(2) A Measured Radiocarbon Age is not reported for infinite dates since corrections may imply a greater level of confidence than is appropriate.			
Beta - 432749	5520 +/- 30 BP	-26.1 o/oo	5500 +/- 30 BP
SAMPLE : UM748B4ID24			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal BC 4365 to 4330 (Cal BP 6315 to 6280)			

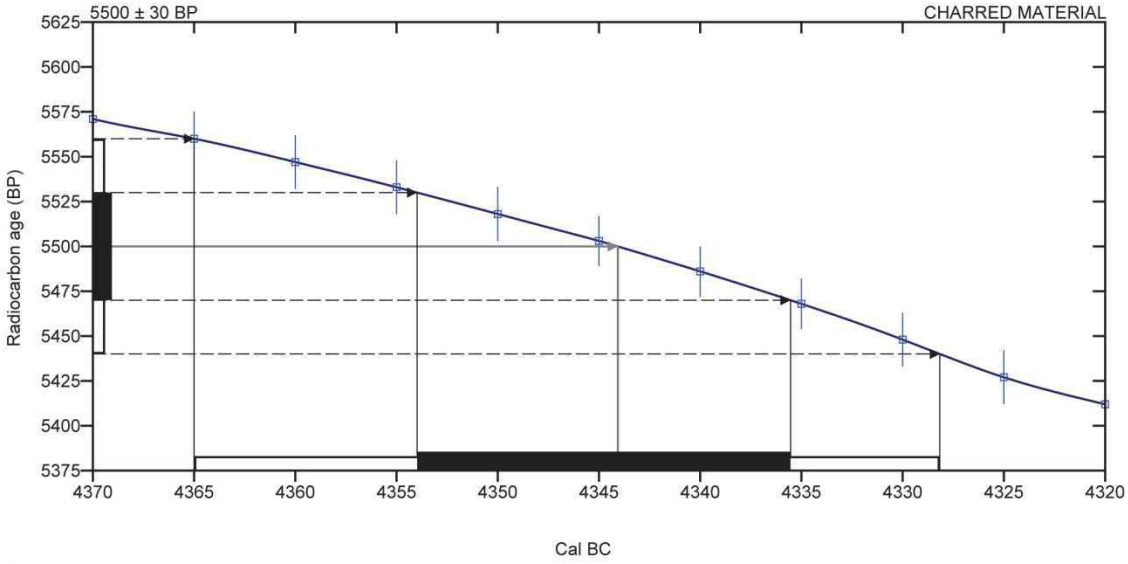
Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -26.1 o/oo : lab. mult = 1)

Laboratory number	**Beta-432749 : UM748B4ID24**
Conventional radiocarbon age	**5500 ± 30 BP**
Calibrated Result (95% Probability)	**Cal BC 4365 to 4330 (Cal BP 6315 to 6280)**
Intercept of radiocarbon age with calibration curve	Cal BC 4345 (Cal BP 6295)
Calibrated Result (68% Probability)	Cal BC 4355 to 4335 (Cal BP 6305 to 6285)



Database used

INTCAL13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

References to INTCAL13 database

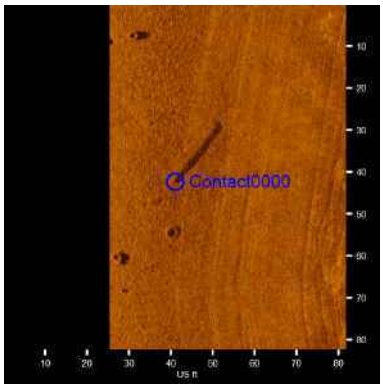
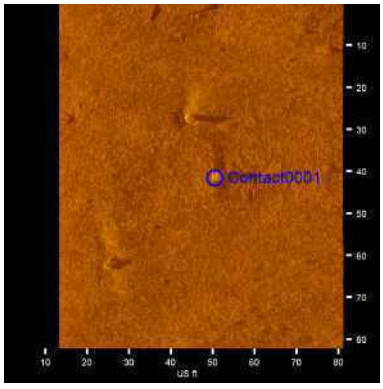
Reimer PJ et al. IntCal13 and Marine13 radiocarbon age calibration curves 0– 50,000 years cal BP. Radiocarbon 55(4):1869– 1887., 2013.

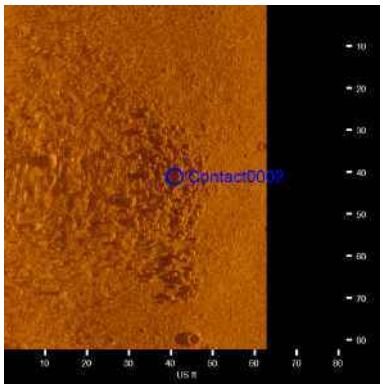
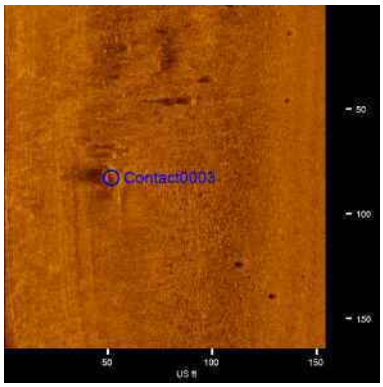
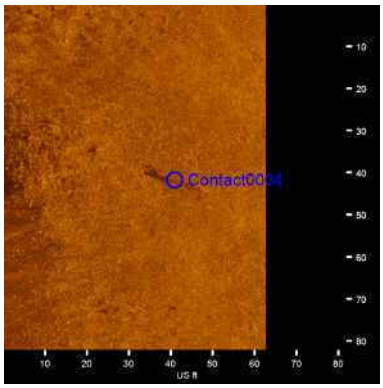
Beta Analytic Radiocarbon Dating Laboratory
4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • Email: beta@radiocarbon.com

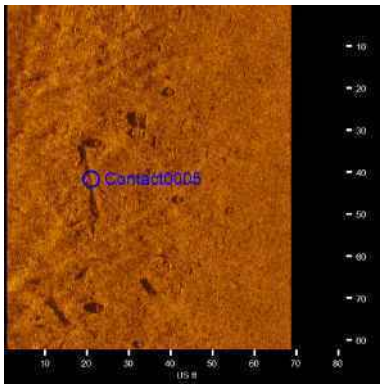
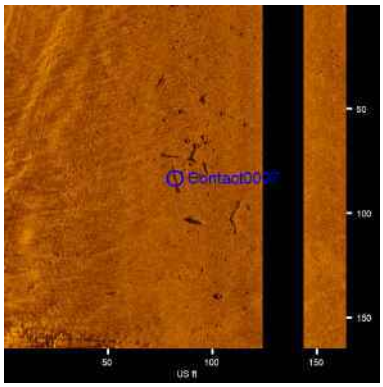
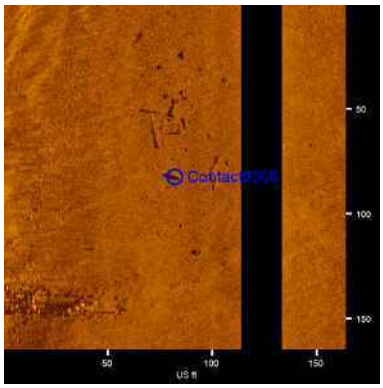
Appendix B: Sonar Analysis

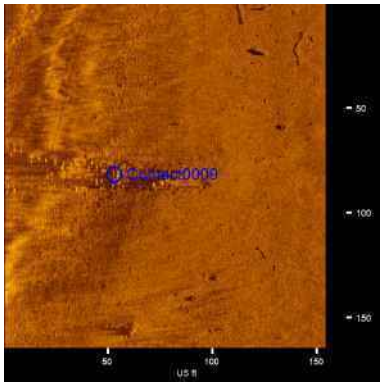
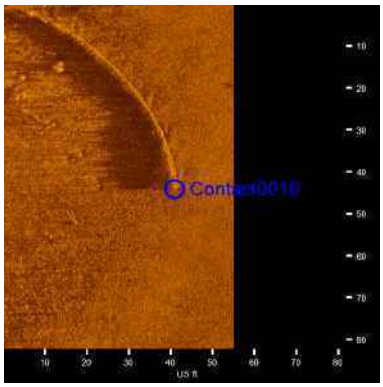
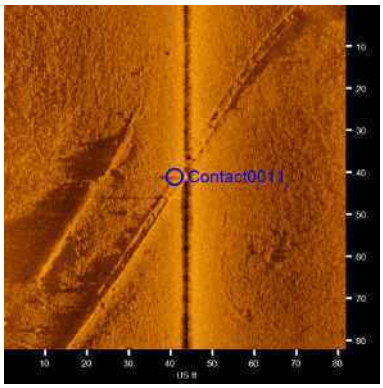
Report PDF Small English

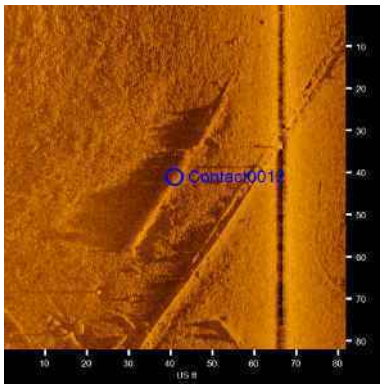
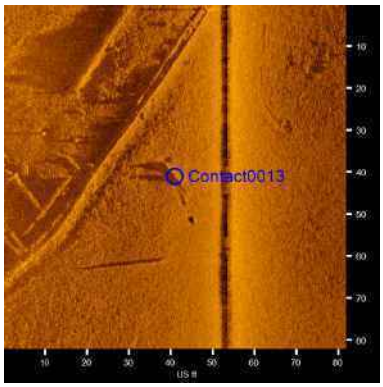
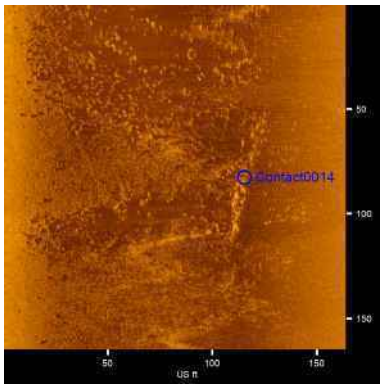
Generated on 5/31/2015 5:00:22 PM

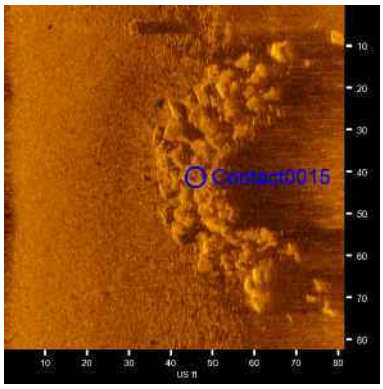
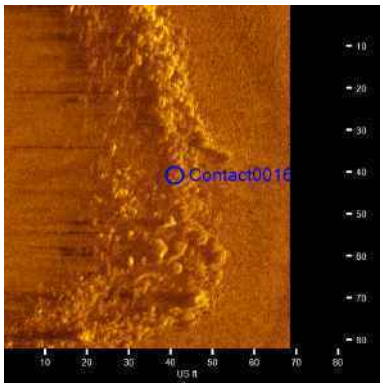
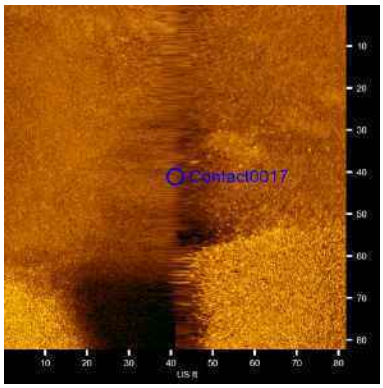
Target Image	Target Info	User Entered Info
	Contact0000 • Click Position 40.5026421215 -74.2548008901 (WGS84) (X) 913389.55 (Y) 122505.82 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 1.4 US ft • Target Height: 0.3 US ft • Target Length: 17.3 US ft • Description: log/piling
	Contact0001 • Click Position 40.5021726924 -74.2552291303 (WGS84) (X) 913269.96 (Y) 122335.15 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 2.1 US ft • Target Height: 0.8 US ft • Target Length: 2.2 US ft • Description: possible crab pot

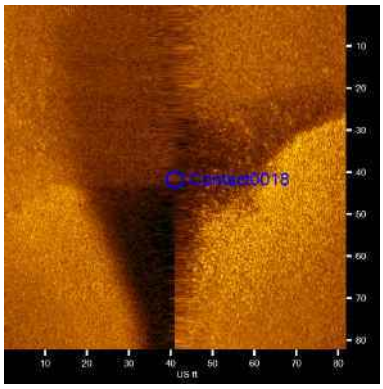
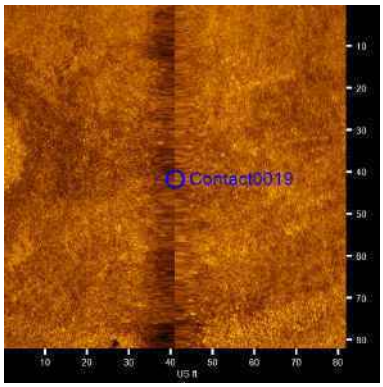
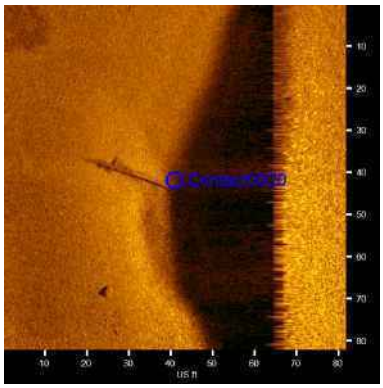
	Contact0002 • Click Position 40.5018759610 -74.2544253207 (WGS84) (X) 913493.18 (Y) 122226.39 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 32.6 US ft • Target Height: 0.0 US ft • Target Length: 47.0 US ft • Description: rock pile
	Contact0003 • Click Position 40.5012940384 -74.2540007651 (WGS84) (X) 913610.64 (Y) 122014.04 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 8.7 US ft • Target Height: 0.8 US ft • Target Length: 28.2 US ft • Description: rock pile
	Contact0004 • Click Position 40.5006447085 -74.2545786219 (WGS84) (X) 913449.25 (Y) 121777.94 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 1.2 US ft • Target Height: 0.4 US ft • Target Length: 15.2 US ft • Description: log/piling

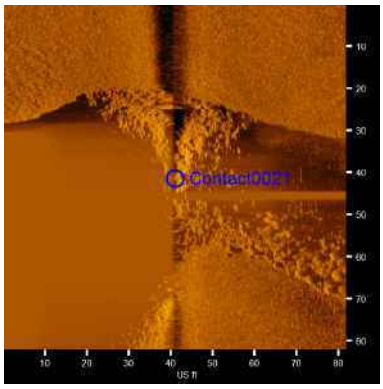
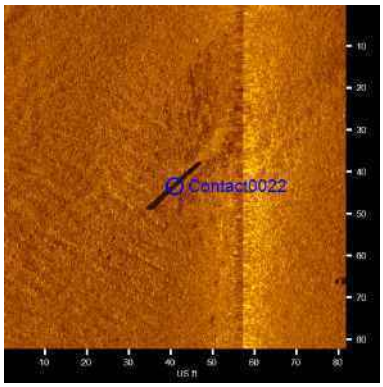
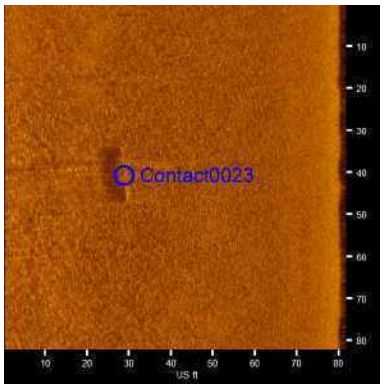
	Contact0005 • Click Position 40.5002866817 -74.2537970576 (WGS84) (X) 913666.23 (Y) 121646.87 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 0.8 US ft • Target Height: 0.2 US ft • Target Length: 17.8 US ft • Description: log/piling
	Contact0007 • Click Position 40.4994953117 -74.2531452555 (WGS84) (X) 913846.67 (Y) 121358.04 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 0.5 US ft • Target Height: 0.2 US ft • Target Length: 16.1 US ft • Description: log/piling
	Contact0008 • Click Position 40.4994304142 -74.2531376689 (WGS84) (X) 913848.71 (Y) 121334.39 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 1.2 US ft • Target Height: 0.6 US ft • Target Length: 9.3 US ft • Description: log/piling

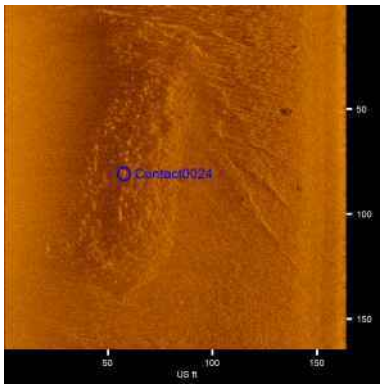
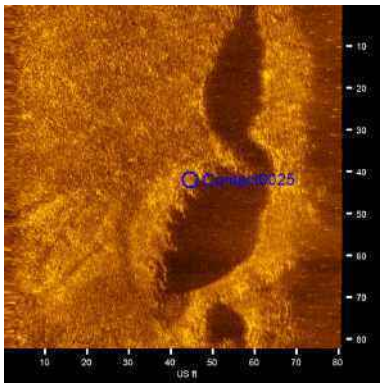
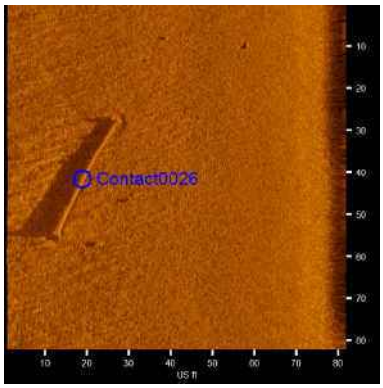
	Contact0009 • Click Position 40.4993886123 -74.2528165550 (WGS84) (X) 913937.97 (Y) 121318.90 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 14.6 US ft • Target Height: 0.0 US ft • Target Length: 101.0 US ft • Description: rock pile
	Contact0010 • Click Position 40.4969118107 -74.2521837934 (WGS84) (X) 914111.36 (Y) 120416.04 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 1.2 US ft • Target Height: 1.4 US ft • Target Length: 58.8 US ft • Description: short side of "obstruction"
	Contact0011 • Click Position 40.4971677345 -74.2518557848 (WGS84) (X) 914202.85 (Y) 120509.02 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 2.2 US ft • Target Height: 1.4 US ft • Target Length: 198.8 US ft • Description: long side of "obstruction"

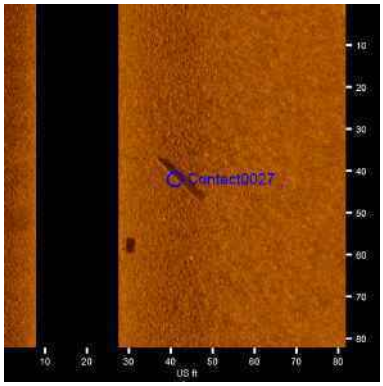
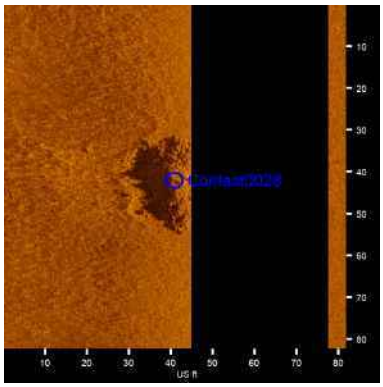
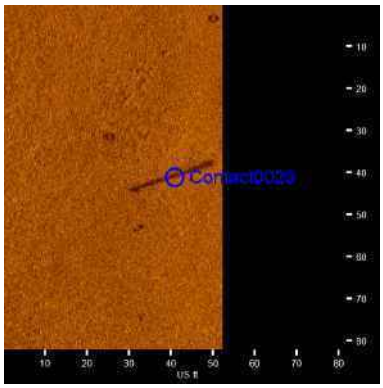
	Contact0012 • Click Position 40.4971320646 -74.2519271932 (WGS84) (X) 914182.95 (Y) 120496.08 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 2.3 US ft • Target Height: 1.0 US ft • Target Length: 48.6 US ft • Description: portion of "obstruction"
	Contact0013 • Click Position 40.4972284865 -74.2520027725 (WGS84) (X) 914162.03 (Y) 120531.27 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 1.1 US ft • Target Height: 1.0 US ft • Target Length: 10.3 US ft • Description: portion of "obstruction"
	Contact0014 • Click Position 40.4966278465 -74.2514089332 (WGS84) (X) 914326.57 (Y) 120311.97 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 5.7 US ft • Target Height: 0.4 US ft • Target Length: 61.0 US ft • Description: rock pile

	Contact0015 • Click Position 40.4956095289 -74.2516073478 (WGS84) (X) 914270.32 (Y) 119941.13 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 19.6 US ft • Target Height: 1.8 US ft • Target Length: 65.1 US ft • Description: rock pile
	Contact0016 • Click Position 40.4998251133 -74.2321806564 (WGS84) (X) 919677.53 (Y) 121462.04 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 30.1 US ft • Target Height: 0.8 US ft • Target Length: 125.0 US ft • Description: rock pile
	Contact0017 • Click Position 40.4979639078 -74.2265568461 (WGS84) (X) 921239.83 (Y) 120779.87 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 126.0 US ft • Target Height: 0.0 US ft • Target Length: 223.3 US ft • Description: pit

	Contact0018 • Click Position 40.4978427799 -74.2270564442 (WGS84) (X) 921100.76 (Y) 120736.10 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 104.6 US ft • Target Height: 0.0 US ft • Target Length: 190.1 US ft • Description: pit
	Contact0019 • Click Position 40.4983857454 -74.2251016299 (WGS84) (X) 921644.95 (Y) 120932.51 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 85.2 US ft • Target Height: 0.0 US ft • Target Length: 169.5 US ft • Description: pit
	Contact0020 • Click Position 40.4974833382 -74.2264982137 (WGS84) (X) 921255.68 (Y) 120604.74 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 118.8 US ft • Target Height: 0.0 US ft • Target Length: 145.8 US ft • Description: pit w/ log

	Contact0021 • Click Position 40.5014869002 -74.2189170715 (WGS84) (X) 923367.81 (Y) 122057.97 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 31.4 US ft • Target Height: 0.6 US ft • Target Length: 107.3 US ft • Description: rock pile
	Contact0022 • Click Position 40.4953962060 -74.2430599285 (WGS84) (X) 916647.39 (Y) 119856.70 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 0.2 US ft • Target Height: 0.5 US ft • Target Length: 15.3 US ft • Description: log/piling
	Contact0023 • Click Position 40.4945420652 -74.2493142484 (WGS84) (X) 914906.99 (Y) 119550.41 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 0.6 US ft • Target Height: 0.3 US ft • Target Length: 12.6 US ft • Description: log/piling

	Contact0024 • Click Position 40.5010295329 -74.2247885884 (WGS84) (X) 921734.48 (Y) 121895.47 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 47.7 US ft • Target Height: 0.8 US ft • Target Length: 108.0 US ft • Description: rock pile
	Contact0025 • Click Position 40.4983969351 -74.2535910381 (WGS84) (X) 913721.53 (Y) 120958.23 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 15.5 US ft • Target Height: 3.4 US ft • Target Length: 73.5 US ft • Description: rock pile
	Contact0026 • Click Position 40.4989722770 -74.2260423697 (WGS84) (X) 921383.86 (Y) 121146.87 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 2.0 US ft • Target Height: 1.1 US ft • Target Length: 30.5 US ft • Description: log/piling

	Contact0027 • Click Position 40.4962597265 -74.2509495743 (WGS84) (X) 914453.94 (Y) 120177.49 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 1.0 US ft • Target Height: 0.1 US ft • Target Length: 14.5 US ft • Description: log/piling
	Contact0028 • Click Position 40.5014361550 -74.2209114135 (WGS84) (X) 922813.13 (Y) 122040.87 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 11.0 US ft • Target Height: 1.8 US ft • Target Length: 22.3 US ft • Description: rock pile
	Contact0029 • Click Position 40.4954369261 -74.2433547253 (WGS84) (X) 916565.44 (Y) 119871.77 (Projected Coordinates) • Map Projection: NY83-LIF	Dimensions and attributes • Target Width: 0.5 US ft • Target Height: 0.1 US ft • Target Length: 19.8 US ft • Description: log/piling