SACO RIVER AND CAMP ELLIS BEACH

SECTION 111 SHORE DAMAGE MITIGATION STUDY

APPENDIX H

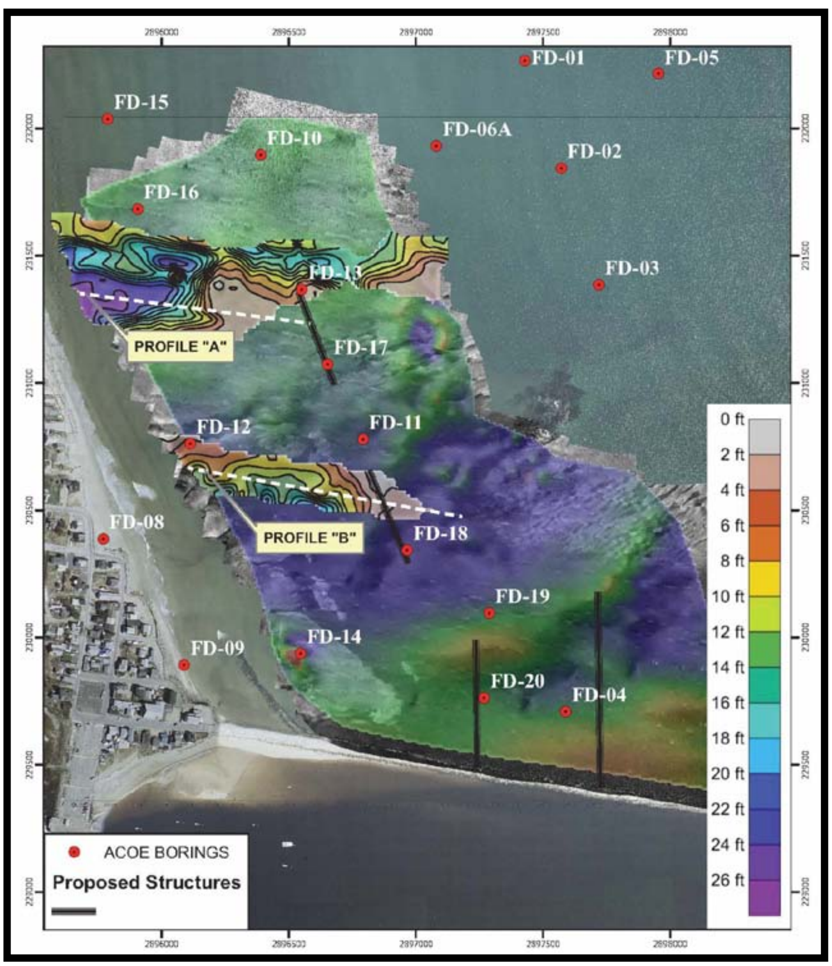
REMOTE SENSING ARCHAEOLOGY SURVEY
FINAL TECHNICAL REPORT

FINAL TECHNICAL REPORT

REMOTE SENSING ARCHAEOLOGICAL SURVEY

Camp Ellis Beach
Saco, Maine

Contract No. W912WJ-09-D-0001-0019



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FINAL TECHNICAL REPORT

REMOTE SENSING ARCHAEOLOGICAL SURVEY

CAMP ELLIS BEACH

Saco, Maine

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MANAGEMENT ABSTRACT

A systematic remote sensing archaeological survey was performed in November 2009 for the U.S. Army Corps of Engineers, New England District's proposed nearshore breakwaters and jetty-spur project study area at Camp Ellis Beach, Saco, in York County, Maine. The investigation involved archival research, field survey to record marine geophysical and geotechnical data, and analysis and synthesis of the research and survey results to assess the Project study area's archaeological sensitivity and to determine the presence/absence of prehistoric and historic period submerged archaeological deposits within it. The survey was authorized and conducted under contract with the U.S. Army Corps of Engineers, New England District to comply with Section 106 of the National Historic Preservation Act of 1966 as amended (1976, 1980, 1992, 1999) (36 CFR 800).

Performance of the remote sensing archaeological reconnaissance survey resulted in the conclusions that Project study area:

- possesses a low archaeological sensitivity for containing contextually intact formerly terrestrial and/or maritime-related submerged prehistoric archaeological deposits and a moderate archaeological sensitivity for containing submerged historic archaeological deposits, although contains no previously identified National Register-eligible or listed prehistoric or historic archaeological properties;

- contains no remote sensingl or geotechnical evidence of contextually intact paleosols with prehistoric archaeological sensitivity and:

- contains no remote sensing evidence of submerged historic period shipwrecks or maritime infrastructure.

Based on the results of this study, no further archaeological investigation of the offshore portion of the proposed Camp Ellis Beach nearshore breakwaters and jetty-spur project area is recommended.

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CHAPTER ONE

INTRODUCTION

This report presents the results of a remote sensing marine archaeological survey of the U.S. Army Corps of Engineers, New England District's (NAE) proposed nearshore breakwaters and jetty-spur project study area at Camp Ellis Beach, Saco, in York County, Maine (Figure 1-1). The NAE plans to install the breakwaters and jetty-spur as part of a Section 111 (Mitigation of Damages Caused by Federal Navigation Projects) NAE study. Marine archaeological survey work was conducted within the proposed study area to identify and document any remote sensing target areas with potential to be historic period archaeological deposits (e.g. the remains of abandoned historic vessels or coastal infrastructure) or intact paleosols with archaeological sensitivity for containing prehistoric archaeological deposits (e.g., formerly terrestrial ancient Native American habitation sites inundated by post-glacial sea level rise, watercraft and coastal infrastructure). The archaeological survey was conducted by Fathom Research, LLC, (Fathom), under a sub-consultant's contract with the Public Archaeology Laboratory, Inc. (PAL), in conjunction with project surveyors, CR Environmental, Inc. (CRE). Fathom, PAL, and CRE's work on the project was performed in support of the Woods Hole Group, Inc. (WHG)'s and their environmental services contract with the NAE. The project was conducted in accordance with NAE's project Scope-of-Work (SOW) and the approved work and safety plans for the investigation.

Scope

As a federal undertaking, the NAE's proposed breakwater and jetty-spur installation project is subject to review under Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended (1976, 1980, 1992, 1999) (36 CFR 800). Section 106 requires all federal agencies take into account the effect of their undertaking on cultural resources listed or determined eligible for listing in the National Register of Historic Places (National Register) (36 CFR 60). The agency must also afford the Advisory Council on Historic Preservation the opportunity to comment on the undertaking. The Section 106 process is coordinated at the state level by the State Historic Preservation Office (SHPO), which in Maine operates within the offices of the Maine Historic Preservation Commission (MHPC).

The scope of the archaeological investigations (Appendix A) included archival research, fieldwork consisting of a marine geophysical survey utilizing a magnetometer, side-scan sonar, a sub-bottom profiler, and a single-beam fathometer, and review of geotechnical (boring) data provided by the NAE. The fieldwork and report assist NAE in complying with Section 106 of the NHPA for the proposed project. The report is also a scholarly document that fulfills the mandated legal requirements and serves as a scientific reference and planning tool for future professional studies.

Authority

The survey was authorized by NAE to comply with the National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915) as amended (16 U.S.C. 470 et seq.); the National Environmental Policy Act of 1969 (P.L. 91-190; 83 Stat. 852; 42 U.S.C. 4321 et seq.); the Archaeological Resources Protection Act of 1979 (P.L. 96-95; 93 Stat. 721; 16 U.S.C. 470 et seq.); the Abandoned Shipwreck Act of 1987 (P.L. 100-298; 102 Stat. 432; 43 U.S.C. 2102); the National Maritime Heritage Act of 1994 (P.L. 103-451; 108 Stat. 4769; 16 U.S.C. 5401); the Advisory Council on Historic Preservation, Protection of Historic Properties (36 CFR 800); the National Register of Historic Places, Nominations by States and Federal Agencies (36 CFR Part 60); and the U.S. Army Corps of Engineers' Regulations ER 1105-2-50, Planning, Environmental Resources, Chapter 3, Historic Preservation; the Secretary of the Interior's *Standards and Guidelines for Identification* (1983); the MHPC's Contract Archaeology Guidelines; and the Maine Department of Educational and Cultural Services State Historic Preservation Officer's Standards for Archaeological Work in Maine (27 MRSA S.509).

The remote sensing archaeological survey was performed following the requirements of the NAE's Project SOW in consultation with the historic and prehistoric state archaeologists at the MHPC. No state permit was required to conduct the non-disturbance remote sensing survey.

All fieldwork was conducted in accordance with the Accident Prevention Plan (APP) and the Activity Hazards Analyses (AHA) prepared by WHG for the project. Both the APP and AHA were approved by the NAE Safety Office prior to commencement of field activities, as per the requirements of the USACE's *Safety and Health Requirements Manual* (EM 385-1-1 15 Sept 2008).

Project Description

Camp Ellis Beach is situated in southeastern Maine, in York County, within the town of Saco, approximately 16 miles (mi) (25.7 kilometers [km]) south of Portland. The Saco River Federal Navigation Project consists of an 8-foot (ft) (2.4-meter [m]) deep channel that varies from 100 to 200 ft (30.5 to 61 m) wide. The channel is protected by a 4,800-ft (1463-m) long jetty to the south and a 6,600-ft (2011-m) long jetty to the north. Camp Ellis Beach lies adjacent to the north jetty and extends about 2,500 ft (762 m) north to Ferry Beach. Installation of the navigation channel jetties has resulted in an increased rate of erosion of Camp Ellis Beach. The proposed installation of the breakwaters and jetty-spur are intended to mitigate this erosion.

Nature of Study

Fathom and project surveyors, CRE, conducted a remote sensing marine archaeological survey to identify and document any remote sensing target areas with potential to be prehistoric or historic period vessel remains or infrastructure, as well as any sub-bottom profiler reflectors suggestive of intact paleosols with prehistoric period archaeological sensitivity. The archaeological tasks performed for the investigation consisted of archival research, marine remote sensing field survey, and a review of geotechnical data (i.e., core logs) provided by the NAE. Archival research involved a review of primary and secondary documents needed to prepare environmental and historical context narratives of the survey area. The field investigation consisted of vessel-based marine archaeological survey using a towed and hull-mounted array of remote sensing instruments to document potential cultural features on and under the harbor floor, in accordance with the field methodology required by the NAE SOW. The archival research and fieldwork were designed to collect sufficient information to make preliminary determinations of National Register eligibility for any identified resources.

Project Personnel

Fathom staff involved in the project included David Robinson (principal investigator/project manager) and Ward McIntyre (project assistant/field observer). PAL project staff included Deborah Cox (project manager). CRE project staff involved in the survey included John Ryther (marine operations manager) and Christopher Wright (senior hydrographer). WHG's Lee Weishar served as the overall project manager. All work for the project performed in support of WHG's contract with the NAE (Contract No. W912WJ-09-D-0001).

Disposition of Project Materials

All information generated during the project by Fathom is currently on file at Fathom's main offices, 1213 Purchase Street, Suite 315, New Bedford, Massachusetts. Fathom will serve as a temporary curation facility for these materials until such time as the U.S. government designates a permanent repository that meets the requirements under 36 CFR 79.

CHAPTER TWO

METHODOLOGY

The systematic, interdisciplinary research methodologies employed in this investigation followed those outlined in the NAE SOW (see Appendix A). The two principal goals of this investigation were:

1) assess the archaeological sensitivity of the Camp Ellis Beach project area and;
2) determine the presence or absence of archaeological properties within it.

These goals were met through a combination of archival research and remote sensing archaeological field survey. Archaeological sensitivity is defined as the likelihood for archaeological sites to be present within a particular area based on different categories of information. In the case of the Camp Ellis Beach project area, such sites could potentially include submerged historic period watercraft and infrastructure and prehistoric period settlement sites, watercraft and infrastructure. Assessment of the Camp Ellis Beach project area's archaeological sensitivity involved conducting archival research to identify and consider previously documented offshore (and adjacent onshore) archaeological resources, the environmental and geomorphological history and sedimentary environment of Camp Ellis Beach area, and regional prehistoric through historic period settlement, subsistence and maritime activity patterns. For this aspect of the investigation a review of the following sources was completed:

- National and State Registers for any archaeological properties in the proposed Camp Ellis Beach project study area that have been listed on or are determined eligible for listing;
- Cultural resource management reports and historic and prehistoric site file databases at, and maintained on the world wide web by, the MHPC;
- Massachusetts Board of Underwater Archaeological Resources (BUAR) – Paul Sherman Collection of Shipwreck Notes and Information;
- National Oceanic and Atmospheric Administration's (NOAA) on-line Automated Wreck and Obstruction Information System (AWOIS);
- Northern Maritime Research's Northern Shipwreck Database (NSWDB) (Version 2002);
- Bruce D. Berman's *Encyclopedia of American Shipwrecks* (1972);
- Environmental studies providing information about the geomorphological history of the region and the effects of the Holocene marine transgression, and;
- Published and unpublished primary and secondary sources in the research library at MHPC, the Special Collections Department of the Raymond H. Fogler Library at the University of Maine-Orono, the Maine State Archives and State Library (Augusta), and in the research library at Fathom.

In addition to the archival research that Fathom performed for the project, a remote sensing marine archaeological survey was completed by Fathom and project surveyors, CRE, on November 4, 2009. The field investigation methodology followed the specifications outlined in the NAE's project SOW and

Work Plan and was designed to aid in determining the presence/absence of archaeological deposits within the Camp Ellis Beach project area.

Survey operations were conducted on November 4, 2009 from CRE's survey vessel, the R/V *Lophius*, an aluminum-hulled motorboat equipped with a 200-horsepower outboard engine, a fully enclosed cabin, and an array of survey and support equipment. A differential satellite global positioning system (DGPS) receiver interfaced with an onboard computer was used to precisely navigate the vessel throughout the survey area and record horizontal positioning data. Differential satellite corrections transmitted to the survey vessel via a U.S. Coast Guard (USCG) DGPS radio beacon provided adequate survey control of the vessel throughout the survey area. The accuracy of the positioning system consistently provided a digital output of positions accurate to less than 3 ft (1.0 m). Bathymetric data recorded for the project referenced the North American Vertical Datum of 1988 (NAVD88). National Ocean Survey (NOS) disk #8606A located at the Camp Ellis fishing pier (reported as 10.36 ft [3.2 m] NAVD88) was utilized as a vertical control point for the bathymetric survey data, and an Insitu, Inc. Leveltroll pressure gauge was installed adjacent to the disk and a series of water surface elevations was acquired using a six-minute recording interval.

Coordinates for the limits of coverage of the survey area are presented below in Table 2-1. The Maine State Plane (West) grid coordinate system (U.S. survey feet), referencing the North American Datum of 1983 (NAD-83), was utilized for the survey.

Table 2-1. Camp Ellis Beach Project Survey Area.

Coverage Corner Point Coordinates.

Corner	X*	Y*
1	2895732	231836
2	2895695	231484
3	2896639	229642
4	2898638	229276
5	2898666	229489
6	2898296	230225
7	2898055	230595
8	2897347	230910
9	2897000	231669
10	2896764	232072

Survey equipment used to complete the field investigation included:

- a Trimble AgGPS 132 12-channel DGPS;
- Coastal Oceanographic's HYPACK MAX PC-based navigation and data-logging hydrographic survey software package;
- an ODOM CV-100 precision digital echosounder;
- an Edgetech, Inc. 4100-P side-scan sonar system with a dual-frequency (100 and 500 kilo-Hertz [kHz]) Edgetech, Inc. 272 TD sonar towfish;

- a Marine Magnetics, Inc. MiniExplorer high resolution marine magnetometer system, and;

- a SyQwest 10-kHz Stratabox sub-bottom profiling system.

The survey was conducted to provide full seabed coverage within a 500-ft (152-m) buffer surrounding the proposed Camp Ellis Beach wave-break structures identified on a CAD plan provided to CRE by the NAE. Data was acquired along a series of planned parallel primary survey track lines spaced 50 ft (15.2 m) apart and oriented generally east – west across the longitudinal axis of the project area. The primary survey track lines were augmented by survey of "cross-tie" transects spaced 200 ft (61 m) apart and oriented north-to-south, perpendicular to the primary track lines. Side-scan sonar, magnetometer, sub-bottom profiler, and fathometer data were acquired simultaneously along all survey lines. The side-scan sonar was operated using a 25-m [82-ft] sweep range setting, thus providing greater than 200 percent sonar coverage of the seabed within the project area (i.e., all portions of the seabed were imaged at least twice). Due to the relatively shallow depth of the water within the survey area, the magnetometer sensor's altitude above the seabed never exceeded the water's maximum recorded depth (14 ft [4.3 m]). Data generated by the survey were reviewed by Fathom field personnel as they were recorded in the field and after they were post-processed and plotted by CRE. Post-processing of the data involved reconstructing survey track lines to include adjustments for sensor layback and offset, the selection and plotting of the locations of side-scan sonar and magnetic anomalies, the creation and plotting of side-scan sonar data in a mosaic format, the plotting of water depth, magnetic, and sub-bottom profiler data as color-coded contour maps, and the plotting of select sub-bottom profiles.

Criteria utilized for interpreting the various types of survey data (both during and after the survey) and selecting anomalies as targets of potential archaeological interest, either individually or collectively with other anomalies, relies on a combination of factors. These factors include the type of data being considered, environmental conditions, the predicted types of resources likely to be encountered, survey-design parameters employed, and the scientific knowledge and practical experience of the archaeologist.

Consideration and interpretation of acoustic data produced by a side-scan sonar and sub-bottom profiler is comparatively straightforward. Acoustic targets appear as visual anomalies in the ambient visual field of the sea floor in either plan view (as in the case of a side-scan sonar record) or in profile (as in the case of the sub-bottom profiler record). A side-scan sonar target is selected as a possible archaeological target based on its appearance, that is, whether or not it appears to be a shipwreck or some type of submerged historic coastal infrastructure, or if it cannot be eliminated as being one of these types of cultural resources. The size of each target, its height above the sea floor, and the relative density of its constituent parts are all obtainable from the sonar record.

Sub-bottom profiler targets generally fall into one of two categories of archaeological interest: those that appear to be shallowly buried, discrete, non-geological deposits or those that appear to be buried geological features. The former can be associated with shipwrecks, and if so, often have corresponding anomalous deflections within the magnetometer data and side-scan sonar data (e.g., low to moderate intensity and moderate duration magnetic signatures accompanied by sometimes subtle, yet distinct, changes in bottom composition). The latter are sometimes associated with anomalies in the magnetic data and/or changes in sea floor that are visible in the both the side-scan sonar and sub-bottom profiler data sets. Sub-bottom reflectors that are geological in nature and buried beneath the surface of the sea floor result from changes in sediment density caused by modern marine sedimentation processes, post-glacial inundation sequences, pre-submergence depositional events, or older geological processes. Some reflectors have characteristics that are readily identifiable as relict elements of the pre-submergence paleolandscape, such as paleochannel features, beach/shoreline features, and upland terraces; however, conclusive determination of the specific nature and cause of the acoustic reflector requires physical evidence obtained through geotechnical surveying (i.e., vibratory cores or deep borings).

Interpretation of magnetic data is typically less straightforward. Anomalies of archaeological interest can range from several to several thousand gammas in intensity and measure tens or hundreds of ft in duration, depending on the characteristics of the source and its distance from the point of measurement (i.e., the magnetometer sensor). Even though a considerable body of magnetic signature data for shipwrecks is available, it is impossible to positively associate any specific magnetic signature with a particular type or age of shipwreck or any other feature (Pearson and Saltus, Jr. 1991:49). Variations in iron content, condition, and distribution of a ship's archaeological remains, as well as the survey's design parameters (particularly track line interval and sensor tow depth) combine to influence the intensity and configuration of the anomaly produced. For archaeological surveys conducted at a tight survey track line interval (i.e., 50 ft [15 m] or less), however, such as the survey for this project, general patterns are observable in the magnetic data that provide some indication as to whether or not the target may be a shipwreck rather than a geological deposit or isolated modern debris.

Shipwreck sites commonly consist of a centrally concentrated area of large debris associated with primary hull remains that is surrounded by a more diffuse distribution of relatively smaller debris (i.e., secondary hull components and associated cargo, armament, etc.). Generally speaking, such deposits are detectable in magnetic data as "complex" anomalies (a cluster of magnetic anomalies with signatures consisting of dipolar and/or monopolar anomalies) occurring on multiple adjacent survey track lines that are accompanied by correlating side-scan sonar and/or sub-bottom profiler anomalies. In contrast, when a survey is conducted at a track line interval wider than 50 ft, in which case the magnetometer sensor is more likely to be further away from the source, anomalies associated with shipwrecks are typically lower in intensity, less complex in signature, and may be detectable on just a single line or even not at all. The reasons for these differences, the magnetometer's limited range of detection, and its implications for archaeological surveys are discussed fully by Aneskiewicz (1986), Bell and Nowak (1993), and Breiner (1973).

By comparison, magnetic anomalies associated with geological deposits are often distributed in regular patterns extending over broad areas of the sea floor, while those associated with modern isolated debris can exhibit high intensity magnetic signatures, but typically are detected for only brief durations and usually on a single track line. As noted above, the strength and signature characteristics of magnetic anomalies associated with shipwrecks vary widely depending on a number of factors, including environmental conditions (i.e., local geology [sea floor sedimentary and bedrock characteristics], water depth/distance from shore, and proximity to nearby human infrastructure [e.g., overhead bridges and electrical wires, submarine cables and pipelines, active shipping ports, dumping grounds, etc.]). In part, environmental factors are also a constraint on the types of resources that will be present/absent from a particular project area.

In all cases, interpretation and the target selection process are significantly enhanced by the ability to cross-correlate different types of remote sensing data collected simultaneously from multiple instruments with different detection capabilities. Rather than select anomalies and targets in isolation from each different data set, all of the data are examined for the presence of any correlations between them that provide clues as to the possible identity of a particular target. Additionally, data associated with spurious sources can be recorded as such during the field survey and eliminated from further consideration during the subsequent examination of the post-processed data.

The remote sensing survey data recorded during the Camp Ellis Beach survey were interpreted alone and in conjunction with the results from the NAE's geotechnical boring program and the project's archival research and to determine the presence/absence of any anomalies or targets representing archaeological deposits. Review of the geophysical and geotechnical data and archival research results provides the necessary information to formulate preliminary statements about resource significance and make recommendations regarding avoidance or further archaeological investigation and site evaluation of identified resources.

CHAPTER THREE

ENVIRONMENTAL CONTEXT

Environmental settings, conditions, and natural resources are important factors to consider when assessing the potential for the presence of archaeological deposits, including early prehistoric settlements submerged by eustatic sea level rise. As Renfrew (1976) notes, “because archaeology recovers almost all of its basic data by excavation, every archaeological problem starts as a problem in geoarchaeology.” The complexity and variability of geological processes make every region or site geologically unique, and sediments comprising the seabed with the Camp Ellis Beach project area are no exception. Understanding the evolving and dynamic geomorphic landscape of the harbor, some or all of which was once likely exposed land available for human habitation, is essential for assessing the potential archaeological sensitivity of the Camp Ellis Beach project area. Geomorphology assists in reconstructing the paleoenvironment of an area and is particularly useful for interpreting early Holocene (i.e., Paleoindian and Early Archaic Period) sites in areas that are physically different from the time corresponding with the earliest archaeological evidence of human habitation in the region, circa (ca.) 11,500 years before present (B.P.), especially when they have been inundated by marine transgression. The submergence, and, thus, burial, erosion and apparent obscurity of inundated landforms, can make it difficult to assess an area’s original pre-submergence topography and current archaeological potential (Hasenstab 1991).

The Camp Ellis Beach project area is situated in Maine State waters off of the Seaboard Lowland section of the New England Province in charted Mean Lower Low Water (MLLW) water depths of 0 to 5 ft in an exposed eastward-facing location in the Saco Bay portion of the Gulf of Maine. The project area is located within the town of Saco on the north bank of the mouth of the Saco River (Figure 3-1). The Saco River and its 1,703 square-mile (sq-mi) (4411 square-kilometer [sq-km]) drainage system stretch approximately 105-mi (169 km) in a generally southeasterly direction from Saco Lake in the White Mountains of New Hampshire to the river’s mouth at Saco Bay on the Atlantic seaboard. The Saco River is one of the largest river systems in southern Maine and gives rise to the state’s largest beach and salt marsh system (Woods Hole Group Environmental Laboratories and Aubrey Consulting, Inc. 2006 [WHGEL and ACI 2006]; Kelley et al. 1989; Kelley et al. 1995). The Saco is navigable for 7 mi (11.3 km) from the sea, up to the dams in the Biddeford-Saco city center (Hebert 1951). The Saco inlet is classified as a riverine-associated tidal inlet. The inlet experiences significant freshwater discharge, particularly in the late winter and early spring (WHGEL and ACI 2006 citing Fitzgerald et al. 2002). Historically, navigation of the inlet was impeded by the presence of a significant tidal delta at the inlet’s mouth. Navigational hazards associated with the delta became more problematic during the middle nineteenth century when the increased import of coal and export of textiles to and from Biddeford and Saco’s manufacturing industries required the services of increasingly larger and deeper drafted ships (WHGEL and ACI 2006 citing Kelley and Anderson 2000). Navigational improvements to the Saco River and the stabilization of its inlet were initiated in 1827 by the United States Army Corps of Engineers (USACE). Construction of coastal engineering structures at the mouth of the Saco River commenced in 1866. Construction and modification of coastal structures continued in the area until 1969 (WHGEL and ACI 2006).

At the turn of the twentieth century, the Camp Ellis Beach shoreline began experiencing significant erosion following a brief period of accretion (WHGEL and ACI 2006 citing USACE 1955 and Kelley and Anderson 2000). Today, the Maine Geological Survey classifies Camp Ellis Beach as “Highly Erosional.” Highly erosional shorelines are defined as those shorelines that have high erosional rates (more than two ft per year, if known), have high reinforced seawalls along their frontal dunes, are in need of beach replenishment to replace eroded sand, and have no recreational opportunities for about half the tidal cycle (WHGEL and ACI 2006 citing Maine State Planning Office 1998). To date, erosion at Camp Ellis Beach has been responsible for the loss of more than 30 homes and repetitive storm damage to roads and streets (Slovinsky and Dickson 2003).

Saco's presently varied topography, fresh and salt water resources, and abundant floral and faunal species together comprise a wide range of onshore and coastal ecozones, some of which actually would have extended eastward out into the project area and beyond when Saco Bay's floor was sub-aerially exposed prior to inundation by postglacial sea level rise (Belknap et al. 1989:31–32; Crock et al. 1993:182). In addition to the attractiveness of its varied landscape and resources, the Maine coast's oceanic climate regime produces a pattern of precipitation evenly distributed throughout the year with a more equable temperature range than that of Maine's more northerly and exposed interior locations. Mean annual temperatures range from about 65° Fahrenheit (F) (18.3° Celsius [C]) in the summer to 24° F (-4.4° C) in the winter.

Bedrock Geology

The Saco embayment lies on a foundation of pre-Quaternary igneous and metamorphic rock (Osberg et al. 1985). These Precambrian- and Paleozoic-age Cape Elizabeth and Kittery formations have been traced directly from coastal outcrops to the subsurface (Osberg et al. 1985; Belknap et al. 1989; Belknap and Shipp 1991). Subsequent fluvial erosion and Pleistocene glacial scouring have altered the basement to create an irregular upper surface featuring abundant narrow ridges and pinnacles. Bedrock is exposed within about eight percent of the bay, cropping out on the shallow submerged margins of all islands in the Bay seaward of the peninsulas at Biddeford Pool and Prouts Neck. These basement features form Ram Island, approximately 1,700 ft (518 m) north of the project area, and Eagle Island, which lies about one mi (1.6 km) east of Ferry Beach, also located north of the project area.

Surficial Geology

The surficial geology of Saco Bay is characterized by a complex interplay of multiple episodes of glaciation, isostatic crustal movement, and eustatic changes in sea level that combined to sculpt the area's present landscape and create its surficial geological record. On at least 20 different occasions during the Pleistocene epoch (ca. 2 million to 10,000 B.P.) of the early Quaternary period, great ice caps grew and coalesced with extensive ice fields in the mountain ranges. These ice fields then periodically expanded and contracted as the climatic conditions fluctuated between cold and warm (Waters 1992). The most recent of these periodic glacial episodes, the Wisconsin glaciation, began ca. 30,000 B.P., when large continental ice sheets developed in northern North America (i.e., the Cordilleran Ice Sheet formed within the northwest and the Laurentide Ice Sheet formed in the northeast) and in northern Europe (Roberts 1996; Waters 1992). The Laurentide Ice Sheet spread outward from a point in eastern/central Canada, passing over Saco and the Camp Ellis Beach project area before reaching its terminal position at ca. 21,000 B.P. about 155 mi (250 km) south of Camp Ellis Beach at the present locations of Long Island, New York, Block Island, Rhode Island, and Cape Cod, Martha's Vineyard and Nantucket, Massachusetts (Brown 1997; Knebel et al. 1992; Oldale 1985a, 1985b).

Tons of "clastic" or fragmented stone debris embedded and transported in the Laurentide glacial ice sheet eroded and polished the underlying bedrock of the areas over which it passed, scouring New England's highest mountains, as well as its valleys and flat plains before being eventually deposited as glacial "drift" along the base, sides, and terminus of the glacier (Waters 1992). The southeasterly-southerly flow of glacial ice across the Maine landscape is evidenced by bedrock striations and friction cracks caused by the glacial advance (Crock et al. 1993). The drift that was deposited on the landscape was composed of "unstratified" drift, defined by geologists as sediment deposited directly by ice transport, as well as "stratified" drift, which is composed of deposits created by running water in contact with ice (Waters 1992). More specifically, the poorly sorted, unstratified deposits of boulders, cobbles, pebbles, sand, silt, and clay that were deposited directly from the ice comprise what is called "till," while stratified drift consists of morphologically differentiated, well-sorted, glacial deposits of sand and gravel that form geological features known as "eskers" and "kames" or "drumlins" (Oldale et al. 1994).

Water that evaporated from the ocean basins created and nourished the massive ice sheets covering much of North America and Europe during the Wisconsin glaciation. The lowered temperatures resulted in reduced runoff to the ocean basins from melting snow and ice. Consequently, sea levels fell worldwide exposing extensive portions of the North American continental shelf (i.e., the low, sloping platform extending seaward from the present coastline). The peak of the Wisconsin glacial episode (ca. 21,000 to 18,000 B.P.) corresponds with a period of glacial maximum "low stand" in sea level off the eastern seaboard that is interpreted to have been about 330 ft (100 m) below our present day sea level (Gilman et al. 1988).

A sustained climatic shift toward a cycle of global warming caused the Wisconsin glacial ice sheet to began receding at about 18,000 B.P. Meltwater from the shrinking ice sheets was funneled into glacial lakes, rivers and the world's ocean basins. Sea level rose rapidly. As the Laurentide Ice Sheet retreated northwestward across Saco and the rest of Maine at ca. 14,000 to 12,000 B.P., ice and sea were in contact (i.e., the ice's retreat and marine submergence occurred simultaneously) and a significant portion of the eastern part of Maine was inundated by a marine transgression (Belknap and Kraft 1985). The late Pleistocene marine invasion reached its apparent maximum between 12,600 and 12,400 B.P., the extent of which varied across Maine and was largely dependent upon local topographic conditions (Crock et al. 1993; citing Smith and Hunter 1989 and Stuiver and Borns 1975) (Figure 3-2). As the ice melted, discontinuous ice-proximal glacial deposits and glaciomarine muds accumulated on the seabed. Large amounts of glacially pulverized rock fragments, known as "rock-flour," were discharged directly into the sea from the retreating Wisconsin glacier and, later, into rock-flour-laden subaerial glacial meltwater streams. This glacial runoff produced deposits of a glacio-marine sedimentary unit composed primarily of stiff, bluish gray to olive-gray silty clay referred to in Maine as the "Presumpscot Formation."

Along the coast of Maine, the glacio-marine Presumpscot Formation sediment unit is layered and draped in a manner that suggests rapid deposition with little disturbance from physical or biological processes. The formation overlies the later of the two aforementioned post-Wisconsin drift sequence deposits and is interspersed with generally thin (i.e., less than 6 inches [in] [15.24 centimeters (cm)] thick) lenses of sand and gravel believed to be the result of ice rafting. In many areas, it is oxidized near its upper surface (i.e., the upper 3 to 6 ft [1 to 2 m]), because of its subaerial exposure after the subsequent marine regression of the late Pleistocene and early Holocene epochs.

Deglaciation of the Maine coast was followed shortly thereafter by a rapid isostatic crustal rebound of the land, which produced an equally rapid concomitant regression in relative local sea level within the Gulf of Maine (Oldale et al. 1993). As isostatic rebound of the crust progressed, the seabed in the area was exposed horizontally. The regressing shoreline passed today's Maine shoreline between ca. 12,000 and 11,500 B.P. (Crock et al. 1993) before sea level reached a post-glacial low stand of approximately 180 to 213 ft (55 to 65 m) below present sea level at ca. 9500 B.P. (i.e., corresponding with the 10,000 B.P. start of the Holocene epoch) (Crock et al. 1993; citing Belknap et al. 1989 and Shipp et al. 1989) (Figure 3-3). During the regression and low stand, heterogeneous, texturally diverse, fluvial and estuarine sediments were deposited in small channels that were cut into the subaerially exposed upper drift and glacio-marine sediments. These deposits include fluvial, estuarine, and marine mud, sand, and gravel, and freshwater and saltwater peat (Knebel et al. 1992; Oldale and Bick 1987; Oldale et al. 1994; Redfield 1967).

Shortly after reaching its post-glacial low stand, isostatic rebound of the land appears to have slowed relative to the rate of eustatic sea level rise from the melting glaciers, causing the re-submergence of the formerly exposed shelf. Initially, the late Pleistocene to early Holocene local sea level rise was rapid (an average of about 42 ft [13 m] per 1,000 years between ca. 9500 and 5000 B.P.) before slowing dramatically to a rate of only 5 ft (1.5 m) per 1,000 years between ca. 5000 and 1500 B.P., and just 1.6 ft (50 cm) per 1,000 years from 1500 B.P. to the present (Crock et al. 1993 citing Young et al. 1992). As the shelf re-submerged, sediments were eroded and redistributed by wave and tidal current regimes.

A majority of the basement bedrock within Saco Bay and the Camp Ellis Beach project area is uncomfortably overlain by late Wisconsinan glacial till and/or glaciomarine silt and clay (i.e., the Presumpscott Formation), which, as noted above, comprises the majority of the Pleistocene deposits in the region (Bloom 1963). Kelley et al. (1986) infer from their remote sensing survey work in the bay that a thick deposit of sand derived from the Saco River covers the floor of Saco Bay and is the source of sand for the area's beaches. Further detail about the composition of Saco Bay's surficial geology reported by Kelley et al. (1995) indicates that mixed rock and gravel is the most common seafloor environment within the bay, occupying about 30 percent of its total area. Rippled coarse sand and gravel cover approximately nine percent of the Bay floor and are concentrated in areas south of Prouts Neck and Richmond Island. Medium-fine sand is found in water depths less than 50 ft directly offshore of many beaches in the region, with a northward fining trend in grain size of the sediment located in waters of 16 to 23 ft (5 to 7 m) in depth (Farrell, 1972; Kelly et al. 1995). Muddy sand, mapped by Kelly et al. in 1995, covers the Bay's Shelf Valleys between Prouts Neck and Cape Elizabeth and delineates an area where glacial-marine sediment crops out on the seafloor and may represent a lag deposit (Kelley et al. 1989). According to Kelley et al. (1995), the majority of the Saco embayment just seaward of Camp Ellis Beach is covered by Holocene sand with large ripple fields or narrow linear sand bands. Seaward of these sand bedforms, bedrock and gravel are predominant north of Biddeford Pool and Wood Island, rippled gravel is prevalent south of Prouts Neck, and the center of the bay is dominated by muddy sand and bedrock outcrops.

Analysis performed by the NAE and its consultants (e.g., WHGEL and ACI 2006) has indicated that more than 6 million cubic-yards (c-yd) (4.6 million cubic-meters [c-m]) of sand was eroded from the Camp Ellis beachfront between 1859 and 1955, amounting to average annual loss of 81,000 c-yd (61,929 c-m) (WHGEL and ACI 2006; USACE 1955; Kelley and Anderson 2000). By 1995, the NAE reported erosion rates of 3 ft (1.0 m) per year along the shore immediately adjacent to the project survey area. This erosion has been attributed by the USACE, in part, to the construction of the Saco River inlet jetty (USACE 1995; Saco Bay Regional Beach Management Plan 2000).

Marine Transgression and Site Preservation

Generally speaking, episodes of marine transgression are essentially periods of erosion, a destructive process that creates less than ideal depositional sequences from an archaeological perspective (Belknap and Kraft 1985; Kraft 1971, 1985; Kraft et al. 1983, 1987). Marine transgression proceeds in one of two ways: by "shoreface" retreat, when the coastline slowly regresses inland, or by "stepwise" retreat, when in-place drowning of coastal features occurs (Waters 1992).

Shoreface retreat describes the erosion of previously deposited sediments by wave and current processes as the shoreline transgresses. It is the dominant inundation regime during the marine transgression process (Waters 1992). As sea level rises, beach face and shoreface erosional zones sequentially pass across the subaerially exposed portions of the shelf. Older sediments that had been deposited in coastal and terrestrial environments inland of the post-glacial low-stand shoreline are reworked, first by the swash and backwash processes of the beach face, and then by the waves and currents associated with the upper shoreface breaker and surf zones. The erosion associated with the slow and continuous transgression of the sea reworks these deposits into a thin unconformable geological unit of transgressive lag (i.e., gravel and coarse sand deposits) forming the top of a time-transgressive geological unit known as the "marine unconformity" (i.e., the surface defined by the top of the buried paleosol and the base of the overlying marine deposit). Reworked terrestrial and coastal sediments are referred to as "palimpsest sediments" (Swift et al. 1971), and the erosional surface, marked by the depth of the maximum disturbance by transgression, is called the "ravinement" surface. This surface often shows up quite clearly in sub-bottom profiler data and can be a useful indicator for determining the presence/absence of relict paleolandforms (Belknap and Kraft 1985; Kraft 1971; Waters 1992:276–277). Given its exposed nature and the reported dramatic erosion of the shorefront adjacent to the Camp Ellis Beach project area, the more destructive regime of shoreface retreat is clearly the prevailing marine transgressive regime (Rampino and Sanders 1980; Sanders and Kumar 1975a, 1975b).

Post-Glacial Environmental Conditions and Human Settlement Patterns

Colonization of the region by flora during and after deglaciation is characterized by continuous changes, particularly between 14,000 and 9,000 years ago. This time frame is considered to be a marker of a transition from an open tundra-like environment to a woodland environment, and eventually a closed forest environment across much of the New England region (Davis and Jacobson 1985). Pollen and macrofossil studies from regional lake cores suggest species responded individually to climatic changes over time as the ice front retreated northward. Woodland vegetation, dominated by poplar and spruce, is believed to have spread along the coastal lowlands up to New Brunswick by ca. 12,000 B.P., and pushed into interior portions of the region by ca. 11,000 B.P. As archaeologist Bruce Bourque notes, "An observer in Maine 11,000 years ago would have seen a mosaic environment of tundra, shrubs, and trees arranged in patterns determined by latitude, elevation, local soil conditions, drainage, and exposure" (Bourque 2001:16).

The transition from woodlands to closed forests initially began in southern Maine ca. 12,000 B.P., and then developed rapidly over the region between ca. 11,000 and 10,000 B.P. The closed forests were initially dominated by spruce, balsam fir, birch, and poplar, but pine emerged as the dominant species approximately 1,000 years after closure of the forests. The simultaneous emergence of pine and the demise of spruce signaled a warming trend that reached its peak sometime ca. 5000 B.P. Studies from lake cores suggest this warming trend was characterized by a drier climate and lower water levels, particularly between ca. 8000 and 6000 B.P. (Almquist et al. 2001). Cooler, wetter conditions prevailed after ca. 4500 B.P., resulting in an increase in birch, followed by a return of spruce after ca. 2000 B.P. (Almquist-Jacobson and Sanger 1995).

Past archaeological research in northern New England has provided some indication regarding the range of environmental variables that most often correlate with human settlement and land use patterns during both the prehistoric and historic time periods. Contemporary modeling of prehistoric archaeological site locations has considered several environmental variables (e.g., proximity to water, topographic setting, soil type, and availability of natural resources), of which proximity to water ranks among the highest for predicting site location. To date, more than 95 percent of the recorded prehistoric sites in Maine have been identified along the margins of water bodies (Spiess 1992). Evidence for prehistoric human activity in the interior of Maine has commonly been found on level, moderately well-drained land surfaces near the shores of rivers, lakes, streams, and sometimes overlooking marshes and wetlands. These bodies of water would likely have represented important resource areas and transportation routes for prehistoric peoples. Along the coast, hundreds of prehistoric sites have been identified in Maine. Typically, these sites are located on southern or protected exposures adjacent to both fresh water and resource-rich areas, such as mud flats. The location of the proposed Camp Ellis Beach project fits the model for high potential prehistoric land use, because of its proximity to both a major river (i.e., the Saco River) and its location adjacent to the river's mouth and its resource-rich confluence with the open ocean.

Many of the same environmental factors that were attractive to pre-contact inhabitants were also attractive to European colonists visiting and settling in the area during the historic period. Early on in the historic period, shortly after the time of European contact, the area was favored as an excellent place to log, hunt, fish, trap, and trade with local Native populations. Rich fishing opportunities afforded by the convergence of fresh and salt waters near the mouth of the Saco River encouraged European exploration and exploitation of that resource as early as the 1500s. Seemingly limitless forests of pine, spruce, oak, and tamarack, and the region's vast system of lakes, rivers, and streams that provided easily obtainable sources of power for the milling and transportation of lumber to deep water ports and shipyards along the coast, as well as the necessary ingredients for the extensive shipping and shipbuilding industries that fueled Biddeford and Saco's early economies and supported their resident human populations.

CHAPTER FOUR

CULTURAL CONTEXT

Prehistoric Period Culture History

An understanding of regional long-term human settlement and subsistence practices is critical to assessing and interpreting the archaeological sensitivity and record of any project area. The following chapter provides an overview of the regional prehistoric through historic culture history of the Camp Ellis Beach project area. This review is by no means exhaustive, but provides a general framework from which to predict and interpret archaeological deposits encountered during the marine archaeological investigation of the project area. The information for this context has been drawn from a review of the sources described earlier in the methodology chapter of this report (Chapter Two) as well as those sources that are included in the report's bibliography.

The current inventory of known prehistoric sites documents a lengthy sequence of Native American settlement in coastal Maine and the nearby Maritime Provinces of Canada. Maine's Southwest Coast physiographic region of the Atlantic Coastal Plain where the Camp Ellis Beach project area is located is part of the larger Maritime Peninsula, a geographic formation and culture area that has been home to human populations for at least 10,500 years, and whose unique ecology influenced the prehistoric human groups who have lived there (Bourque 2001:xvii). Maine's archaeological record suggests a regional cultural history that is both complex and dynamic, and strongly linked to the resource-rich sea and the region's major rivers (Bourque 2001). This is particularly true of the Native groups that lived on Maine's coasts beginning about 7,000 years ago (Bourque 2001:xvi). The importance of the sea to Maine's Native peoples continued even long after European contact, as Native mariners were quick to adopt European nautical technologies and use sailing vessels for conducting trade and warfare far from their home territories (Bourque 2001:xvi; Duncan 1992:129–130; 144–147).

There is a considerable degree of consensus among archaeologists regarding broad patterns of regional cultural history throughout the Northeast, although debates continue about how and to what extent these patterns are related to each other over space and time. As a result of this consensus, the archaeological record of Maine has been organized into three major cultural periods: the Paleoindian Period (11,500–9500 B.P.); the Archaic Period (9500–3000 B.P.); and the Ceramic Period (3000–450 B.P.). These periods are further subdivided based on similarities in artifact forms and cultural adaptations over broad regions (Table 4-1) (Spiess 1990).

Paleoindian Period (11,500–9500 B.P.)

The Paleoindian Period in Maine corresponds with a time when much of the landscape was vegetated in a mosaic environment of tundra, shrubs, and trees, the locations of which were patterned by latitude, elevation, local soil conditions, drainage, and exposure (Bourque 2001:16, 17). As the Camp Ellis Beach project area became free from its ice and water overburden, tundra vegetation (mosses, lichen, grasses, and sedge) appeared. Thickets of willow and alder, and then stands of hardier trees, such as poplar and spruce followed (Bourque 2001:16). By ca. 11,000 B.P., an intermediate woodland environment consisting of a mix of open areas of tundra and stands of closed-canopy poplar, spruce, and birch forest would have likely prevailed in the area.

Table 4-1. Maine's Comprehensive Planning Prehistoric Period Archaeological Study Units (after Spiess 1990).

Time Period	Study Unit
11,500 – 10,200 B.P.	Fluted Point Paleoindian Tradition
10,200 – 9,500 B.P.	Late Paleoindian Tradition
10,000 – 6,000 B.P.	Early and Middle Archaic Traditions
6,000 – 4,200 B.P.	Late Archaic: Laurentian Tradition
6,000 – 2,000 B.P.	Late Archaic: Small-Stemmed Point Tradition
4,500 – 3,700 B.P.	Late Archaic: Moorehead Phase
3,900 – 3,000 B.P.	Late Archaic: Susquehanna Tradition
3,000 – 450 B.P.	Ceramic Period

Although Maine's late Pleistocene environment was generally similar to today's subarctic taiga (i.e., the area near treeline) or arctic tundra zones, it was probably biologically richer (Bourque 2001:17). In addition to its vegetation, Maine and the rest of the Northeast at this time supported a large and varied population of late Pleistocene mammal species that included mammoth, mastodon, horse, muskox, and caribou, as well as walrus, bearded seal, and cold-water species of shellfish, suggestive of a marine environment that was similar to that of the southern Labrador coast today (Bourque 2001:16).

Our understanding of subsistence and settlement patterns of Paleoindians in Maine is growing and becoming more refined, although some of the even basic aspects, such as diet, geographic range, and dating of sites remain unclear (Bourque 2001:20). Part of the reason for this may be attributed to the poor preservation of organic remains in most terrestrial contexts in the Northeast, which has left a frustratingly small archaeological record, consisting of just stone, wood, and charcoal cultural materials, and calcined bone, available for interpretation. Another part of the reason may also lie in the paucity of marine archaeological research conducted to date focusing on the inundated paleolandscape and the prehistoric period submerged archaeological deposits it contains. Ironically, it is this least-studied landscape – the intact elements of the coastal environment of the Paleoindian and Early to Middle Archaic periods that now lie offshore of the present Maine coastline, which, because of the submerged environment's uniquely preservative qualities, may hold the best evidence of Maine's earliest inhabitants.

Based on the currently available archaeological data recovered solely from the terrestrial context, archaeologists have characterized Paleoindians as highly mobile hunter-gatherers who were largely reliant on caribou that were presumably abundant at that time (Spiess et al. 1998). While caribou would have been a principal focus for Maine's Paleoindian population, they also invariably would have exploited a broad range of other resources that would have been available to them at the time (e.g., small mammals, fish, birds, and plants) (Bourque 2001:36).

Generally speaking, Paleoindian Period peoples crafted tools from very fine lithic materials obtained from a limited number of sources scattered widely throughout the region. An abundance of exotic lithic materials at early Paleoindian sites suggests frequent long-distance movement and/or broad-ranging exchange networks. Most Paleoindian site locations that have been documented to date are quite different from those of later time periods, and are typically removed from present-day water bodies (Spiess et al. 1998). However, some of the more studied Paleoindian archaeological deposits, such as, the Munsungan Lake, Michaud, and Varney Farm sites, as well as the Magalloway Valley Paleoindian Complex (i.e., the Vail and Adkins sites) described by archaeologist Bruce Bourque as one of the "richest clusters of

Paleoindian sites known anywhere in the Northeast" (Bourque 2001:27), are all proximal to areas with (or that once held) lakes, rivers, streams, brooks, or bogs.

Paleoindian Period peoples seemed to have preferred sandy soils on which to locate their settlements. Such locations may have been chosen simply because they were relatively dry and well-drained, as compared to the otherwise wet early postglacial terrain (Bourque 2001:35). The sites seem also to be strategically located at points above low-lying terrain that may have been suitable habitat for caribou and other game animals. Maine's Paleoindian archaeological deposits are typically indicative of short-term habitations by small groups of people, perhaps in some cases by even a single extended family. While smaller sites prevail, a handful of larger Paleoindian sites are known to exist in the region as well, such as the Magalloway Valley Paleoindian Complex present at the Vail and Adkins sites in northwestern Maine (Gramly 1982, 1988), the Debert Site in Nova Scotia (MacDonald 1968), and the Bull Brook Site in Massachusetts (Grimes 1979; Grimes et al. 1984). It is hypothesized that these sites possibly represent seasonal gathering places for larger groups.

The end of the Paleoindian Period and subsequent transition into the Early Archaic is poorly understood, although increasing perceptions of subtle cultural changes during the Paleoindian Period have led some archaeologists to suggest a three-phase Paleoindian occupation in Maine that may help explain some of these transitional differences (Bourque 2001:34–36; Wilson and Spiess 1990). Archaeological evidence indicates that during the later Paleoindian Period, fluted spear points were replaced by smaller, unfluted points. Other point styles also emerge in the region, most notable of which are long, slender lanceolate points with a distinctive parallel flaking technology (Cox and Petersen 1997; Doyle et al. 1985; Will and Moore 2002). These technological changes coincide with the transformation of the environment from relatively open woodlands to more closed forests. By the Early Archaic Period, the archaeological record contains a dramatically different material culture than that recovered from sites dating to the Paleoindian Period (e.g., abundant use of quartz, barbed bone spears, and a new range of implements [i.e., adzes, gouges, and whetstones] created by pecking and grinding less-brittle granular rock types) (Bourque 2001:37–74).

The presence of an important Paleoindian site (the Debert Site) off the Bay of Fundy coast in Nova Scotia (MacDonald 1968), suggests that Paleoindian Period peoples were present in and familiar with the coastal Maritimes region, and that such sites may yet be found along the Maine coast in the future, perhaps even underwater; however, no Paleoindian Period sites have been reported within the Camp Ellis Beach project area or on the adjacent shoreline. While it is hypothetically possible for such sites to exist anywhere within the Camp Ellis Beach project area, rising sea levels and the destructive shore-face marine transgressional regime that probably prevailed during the inundation of the survey area between ca. 6000 and 3000 B.P., as well as the subsequent and aggressive erosional regime presently impacting the area, have probably eroded and destroyed them.

Archaic Period (9500–3000 B.P.)

Spanning about a 6,500-year time frame, the Archaic Period represents the longest archaeologically defined cultural period in the region. It is divided into three sub-periods (Early [10,000–8000 B.P.), Middle [8000–6000 B.P.], and Late [6000–3500 BP]). Based on inferences from artifact assemblages, the Archaic Period consists of a complex mosaic of cultures with varied lifestyles and wide reaching external relations (Bourque 2001:74). In general, the period is characterized by archaeologists as one in which there are important elements that remain continuous, but also sharp discontinuities as well, with evidence of arrivals and departures of distinct groups, and important changes in subsistence, mortuary practices, technology, and other patterns that are still being identified in the archaeological record.

In addition to the cultural changes that occurred during the Archaic Period, there were also dramatic changes in Maine's flora and fauna during this time. Paleontological studies indicate a time of global warming accompanied by a drop in precipitation known as the "Hypsithermal" period, which occurred between about 9000 and 5500 B.P. (McWeeney 1999:8). During the Archaic Period, woodlands replaced tundra, and boreal tree species (spruce, poplar, and birch) declined, and were followed by oak and eastern hemlock. Animal species that had sustained Paleoindian hunters diminished and then disappeared altogether, to be replaced by fauna from unglaciated areas south and west of the region (e.g., moose, deer, bear, and other smaller mammals) (Bourque 2001:37).

Marine conditions in the Gulf of Maine also became increasingly favorable for biological productivity during the middle of the Archaic Period, as lower sea levels and shifts in the Gulf Stream and Labrador currents likely increased water temperatures while decreasing tidal amplitudes, making them lower than those of today (Bourque 2001:45). Paleontological evidence recovered from the eastern Gulf of Maine indicates that marine animal communities of the Middle Archaic were significantly different than today's, with warm-water species, such as oysters and quahogs, present in abundance (Bourque 2001:45).

The Gulf of Maine region may contain the largest number of radiocarbon-dated Early and Middle Archaic archaeological sites in New England, among the most diverse eighth millennium ground stone technologies in North America, and a well-established mortuary tradition of elaboration dating from as early as 8000 to 7000 B.P. (Robinson and Petersen 1993:61). Subsistence and settlement patterns and the assemblages they produced were different from those of the Paleoindian Period, as evidenced by the stronger correlation of sites with present-day water bodies, a lithic tool assemblage that included quartz cores and unifaces, ground-stone tools, such as abraders, choppers, stone rods, full channeled gouges, and low numbers of bifacially flaked lithic tools, and subsistence practices that are reconstructed as including an apparent spring seasonal emphasis on fish spawning runs, fishing for perch, sucker and eels, some hunting of large mammals, hunting or trapping of beaver, muskrat, woodchuck, various birds, and turtles, and the collection of a variety of plant resources, as evidenced by charred nutshells and seeds. That many sites dating from the Early Archaic occur along inland waterways suggests waterborne travel and fishing were important activities of Archaic Period peoples (Bourque 2001:42).

Unlike the prevalence of exotic lithic materials found in Paleoindian assemblages, tools of the subsequent Archaic Period were typically produced from local stone, often collected in cobble form, and lack the finely crafted, chipped-stone spear points that characterize the Paleoindian Period. Instead, scrapers, flake tools, and minimally modified unifacial tools made from quartz dominate the assemblages. Projectile points resembling forms common in the Carolinas, where they may have originated, appear during the Early Archaic, and include "bifurcate" points with notched bases as well as small amounts of the Kirk Corner Notched type (Bourque 2001:41). Additionally, a new stone tool technology (i.e., adzes, gouges, and stone rods used for whetstones) manufactured from less-brittle granular rock types through pecking and grinding techniques appears for the first time in Maine's archaeological record during the Early Archaic, and becomes increasingly elaborate through the period (Bourque 2001:42; Robinson 1992). Given that these stone tools are intended for woodworking, it may be inferred that their appearance and increased presence in the archaeological record reflects an expansion of wood technology that would presumably have included dugout log boats, food vessels, and fish weirs (Bourque 2001:42). In addition to tools manufactured from stone, tools made from bone and antler, including barbed spears, have also been found in small numbers from Early Archaic sites in Maine (Bourque 2001:41).

Mortuary practices first appear in the archaeological record of the Maritime Peninsula region during the Early Archaic Period, with three mortuary sites dating from ca. 8500 B.P. found in northern New England: 1) the Tableland Site on the Merrimack River, Manchester, NH; 2) the Morrill's Point Site at the mouth of the Merrimack River, Salisbury, MA, and 3) the Ormsby Site on the Androscoggin River, Brunswick, ME. All three sites contained cremation burials, although grave furnishings (i.e., red ocher and stone tools) were present just at the Tableland and Morrill's Point sites (Bourque 2001:43).

By the Middle Archaic Period, chipped-stone spear points, bifurcate projectile points, and heavy woodworking tools (occasionally supplemented by a southern type of grooved axe), all of which were present during the Early Archaic, become increasingly more abundant. Finely ground and polished winged spear-throwing weights, and stylistically local ground slate lance points and "ulus," which are a semi-lunar stone knife, also appear.

Middle Archaic sites occur in Maine's interior as well as along its coast, but even then are nearly always associated with bodies of water, suggesting a continued or growing dependence on fishing as an important subsistence strategy and a strong maritime focus. Most sites from the period are small and represent brief seasonal encampments of 25 to 50 individuals. Archaeological evidence of a coastal focus during the Middle Archaic is concentrated along the central Maine coast, northeast of the Camp Ellis Beach project area, where even islands were occupied — another clear indication for manufacture and use of reliable watercraft.

Mortuary practices of Middle Archaic peoples are poorly represented in the archaeological record of Maine and in New England in general, with only about five such sites identified (three of which are in Maine). The use of red ocher and inclusion of burial furniture (i.e., projectile points, spear-thrower weights, adzes, gouges, and stone rods) in Early Archaic burials continues in the Middle Archaic, as well. Taken together, these various technological and mortuary attributes of the Gulf of Maine's Early and Middle Archaic cultures form a core of cultural traits that are distinct from cultural assemblages to the north and south. This distinctive nature has led archaeologists to label this Early and Middle Archaic pattern as the "Gulf of Maine Archaic Tradition" (Robinson and Petersen 1993:68).

The archaeological record of the Late Archaic Period in Maine is sparse for the sixth and fifth millennia B.P.; however, archaeological evidence of human occupation dating from ca. 5000 B.P. is much more abundant in the form of two distinct cultures from this period in Maine's prehistoric history: 1) the Vergennes phase, and; 2) the Small Stemmed Point tradition.

Vergennes phase culture sites are fairly common at interior locations between the Kennebec River and St. John drainages, and a few typical artifacts have been found as far northeast as Nova Scotia. The relative scarcity of Vergennes sites in New Hampshire, western Maine, and along Maine's coast, suggest that this culture's influence came primarily from the St. Lawrence Valley, and had an insignificant impact on the White Mountains region and coastal New England (Bourque 2001:46–49).

The robust Otter Creek spear point typifies the phase, and suggests reliance upon large terrestrial game, which is supported by the fact that Vergennes sites are confined to interior sections of the Northeast. Additional artifacts typically found on Vergennes sites include plummets, gouges, ulus, and flat rocks expediently chipped around their edges to create what archaeologists have termed "choppers." The significance of the Vergennes phase and its influence in Maine archaeology is debated, with some archaeologists seeing it as an intrusive culture of small, mobile hunting populations that originated in the St. Lawrence River valley, while others equate the culture's less formal tool styles and beautifully polished ulus as a technological continuation of those of Maine's coastal and near coastal Middle Archaic sites (Bourque 2001:46–49).

While Vergennes phase people mainly occupied Maine's interior upland areas and focused on terrestrial game, the Small Stemmed Point or narrow point tradition peoples mainly occupied the Gulf of Maine coast, where they practiced a mixed economy that included pursuit of large fish, such as cod and swordfish. The Small Stemmed tradition is characterized by archaeological deposits that have yielded thousands of small, narrow-stemmed projectile points, often found along with triangular points, both of which are generally made of quartz. Other associated stone artifacts include adzes, gouges, plummets, spear-thrower weights, and fully-grooved net weights. All of these artifact forms appear to have origins in the Middle Archaic. Small Stemmed sites found east of the Kennebec River pre-date by about 1,000 years the same types of sites located in southern New England. The earliest dated Small Stemmed sites in Maine occur in the central coastal region of the state, with the oldest coastal archaeological deposit (± 5290 B.P.) located in Penobscot Bay, on North Haven Island, northeast of the Camp Ellis Beach project area, in the Occupation 1 deposit at the important Turner Farm Site (Sanger and Kellogg 1989:119).

Available archaeological evidence indicates that between 5000 and 4500 B.P., the Small Stemmed tradition produced a striking new culture named for the pioneering Maine archaeologist, Warren K. Moorehead, who worked extensively on sites of this period. Termed the "Moorehead Phase," the most extensively studied site produced by this culture is the second component of the Turner Farm Site (Occupation 2), the contents of which were subjected to intensive analysis by Spiess and Lewis (2001) and provide a detailed record of subsistence activities during the centuries between ca. 4500 and 4000 B.P. The most striking element of the faunal assemblage from Occupation 2 is the abundance of swordfish remains, which although present on other sites, were first found at Turner Farm, and thereby provided the original indication of this formidable prey's importance. Other major food resources present at Occupation 2 included cod, deer, and shellfish – both the soft-shelled clam and the locally extinct quahog or hardshell variety. Noticeably absent from the assemblage were shallow-water fish species and sea mammals, such as seals and porpoise, which apparently were little used. Together, the evidence examined at Occupation 2 indicates the presence of a substantial year-round population at the site, who used it as a home base. Generally speaking, Moorehead Phase sites are only found east of the Kennebec River.

In addition to its distinctively coastal settlement pattern, the Moorehead phase is primarily known for its mortuary practices, which included the lavish use of red ocher, giving rise to the term "the Red Paint People," and the offering of grave goods, such as gouges, slate spear points, and stone rods (Moorehead 1922; Robinson 1992; Willoughby 1898). Present understanding of how the Moorehead phase culture may have developed focuses on its relationship to the marine environment. Sometime between 6000 and 4000 B.P., as the biological productivity of the Gulf of Maine reached high levels, a local population settled along the coast of central and eastern Maine to exploit the region's rich resources and growing stocks of cod and swordfishes, developing a highly distinctive material culture and unprecedented mortuary ceremonialism along the way (Bourque 2001:51–61). Surprisingly, the innovative and highly successful Moorehead phase maritime hunting peoples disappear abruptly from the archaeological record at around 3800 B.P., and don't seem to leave any vestiges of their culture in those that succeeded them locally.

The Moorehead phase was replaced at the close of the Late Archaic Period by another distinct cultural tradition, known as the Susquehanna tradition. Susquehanna tradition sites appear in Maine's archaeological record between 3700 and 3400 B.P. (Bourque 1995, 2001; Sanger 1979). Initially recognized by archaeologists working in the Susquehanna River valley region of southern New York and eastern Pennsylvania, Susquehanna tradition sites are widespread throughout eastern North America and are common in Maine, occurring as far east as the St. John River in New Brunswick, with a few Susquehanna tradition artifacts recently recognized from sites across the Bay of Fundy in southern Nova Scotia (Bourque 2001:62).

Once again, the Turner Farm Site proves to be the best source of data about this distinctive culture, with the largest and richest Susquehanna archaeological deposit in Maine comprising Occupation 3 there (Bourque 2001:62). The Susquehanna tradition's technology, subsistence practices, and mortuary rituals are striking in their uniformity and marked difference from those of preceding cultures. Diagnostic tool forms of the Susquehanna tradition are the largest and most skillfully manufactured stone artifacts of the prehistoric period. Susquehanna artisans excelled not only in their production of chipped-stone tools, but also worked bone by grinding, as opposed to scraping with a stone tool, as was done during the Moorehead phase. Susquehanna craftspeople also produced ground- and pecked-stone tools such as adzes and gouges, which were functionally similar to those of earlier cultures, but were different in their detail and in their use of different lithic materials, and lithic bowls sculpted from steatite, a soft, easily worked, metamorphic stone.

The Susquehanna culture was also distinctly different from the Moorehead phase in its diet, preferring terrestrial game and "mast" resources (i.e., nuts, acorns, beech nuts, butternuts, hickory nuts, and walnuts) to maritime resources, as is evident from the Turner Site Occupation 3's faunal refuse remains and diet indicators resulting from isotopic analysis of the site's human skeletal population (Bourque 2001:62–66).

The Susquehanna tradition's elaborate mortuary rituals differed dramatically from those of the Moorehead phase's Red Paint People. Despite a very large number of Susquehanna habitation sites throughout Maine, only a half-dozen or so Susquehanna cemeteries have been identified in the state, as compared to the 44 known cemeteries associated with the Moorehead phase culture. This difference may be attributed to two factors: Susquehanna occupation of the region was too brief to generate a larger number of burials, and/or, unlike the Moorehead cemeteries which included all members of their populations, the Susquehanna tradition's burial practices were more exclusive. However, age and sex do not appear to have been a basis for burial in the Susquehanna cemetery at Turner Farm. Other major distinctly different elements of the Susquehanna tradition burials are the "ritualized manipulation of the dead," consisting of the removal of whole or partial human remains from their place of initial interment to combine them with the remains of other individuals for ceremonial use in bundle burials or commitment to cremation pyres along with rich arrays of grave furnishings (Bourque 2001:62–66).

Archaeological evidence of the Susquehanna tradition disappears from the archaeological record in Maine by ca. 3400 B.P. This disappearance coincides with a "Little Ice Age" (McWeeney 1999:10) and a transition in the temperate southern character of Maine's woods back to northern hardwoods and hemlock of a colder climate, which may have resulted in a southward territorial contraction of Maine's Susquehanna tradition population.

The relationships between the various Late Archaic traditions continue to be a source of debate among Maine archaeologists. At the root of the discussion is whether the various archaeological assemblages of the Late Archaic reflect local, long-term cultural adaptations, or movement of people into the region with different cultures. Whatever the origins of the cultural changes observed, they again roughly coincide with increasing changes in the environment that provided more favorable habitat for deer and possibly other modern species of fauna as well.

No Archaic Period archaeological sites are documented within the project study area or on the adjacent shoreline. As in the case of Paleoindian Period sites, it is hypothetically possible that archaeological deposits dating from the Archaic Period could be present anywhere within the project survey area. If present, sites dating from the Middle and Late Archaic periods would likely possess features and artifact assemblages strongly coastal or maritime in nature, as the sea level rise model for the Gulf of Maine indicates that the position of the shoreline would have passed from the deepest to the shallowest portions of the project survey area between ca. 6000 and 3000 B.P. This time period corresponds with the end of the Middle Archaic at ca. 6000 B.P. and spans the entire 3,000 years of the Late Archaic Period. The destructive shore-face marine transgressional regime that probably prevailed along Camp Ellis Beach's exposed coast and the aggressive erosional regime presently impacting the area are likely to have eroded and destroyed any Archaic Period archaeological deposits that may have been present within the project survey area.

Ceramic Period (3000–450 B.P.)

The introduction of pottery manufacture and use in Maine defines the onset of what Maine archaeologists call the Ceramic Period (Sanger 1979). In other parts of the Northeast, this cultural period is referred to as the Woodland Period. The differences between the two terms is mainly that hunting and gathering for food remained the primary means of subsistence throughout much of Maine and the Maritimes, while a reliance on horticulture and a tendency toward larger, more permanent settlement patterns developed in other regions during the same time period. Ceramics first appear in the archaeological record of Maine ca. 3000 B.P., and they persist until contact with Europeans when clay pots were replaced in favor of iron and copper kettles that were traded for beaver pelts and other animal furs. Bourque's report of archaeological evidence and Samuel de Champlain's documented observations of the Maine coast indicate maize was being cultivated in western Maine as early as 1000 B.P., and along the Maine coast as far east as Saco by the first decade of the seventeenth century (Bourque 2001:87).

The picture that emerges from Ceramic Period sites is one showing long-standing cultural adaptation to the diversified use of local resources. In addition, the nature of artifact forms and certain types of stone recovered from Ceramic Period sites indicate broad trade and communication networks with peoples located far to the north, south, and west. By the end of the period, historical and archaeological evidence suggests horticulture was practiced in southern Maine. The Ceramic Period ends with European contact around 450 years ago. At this time, most of the artifacts attributable to pre-contact inhabitants of Maine disappear from the archaeological record.

During the Ceramic Period and at the time of European contact, New England and the Maritime provinces were populated by Eastern Algonquian speakers. Maine's major river drainages, including the Saco and many smaller coastal drainages, were occupied by the Eastern Abenaki (Snow 1978a:67). The name of the Eastern Abenaki derives from *wapanahki*, their own name for themselves, which means "dawn land people" or "easterners" (Snow 1978b:137). The territory of the Eastern Abenakis was covered by a mixed white pine, hemlock, and hardwood forest along the coast, transitioning to a spruce and fir forest in the interior. Neither the soil nor the climate was adequately warm enough to allow for cultivation of the available domesticates within most of Maine (Snow 1978b:138). Consequently, the subsistence pattern of the period primarily involved a seasonal round of hunting and gathering with summer residences based along the coast and winter residences in the interior.

Ceramic Period archaeological evidence indicates a strong maritime focus over much of the Maine coast, which did not exist during the preceding Susquehanna tradition (Bourque 2001:84). Native peoples living along the coast were heavily reliant on marine resources and exploited springtime runs of alewives, salmon, shad, eel, smelt, and other fish with hooks, leisters, purse-nets, and weirs. Some fishing was done with harpoons, particularly for sturgeon, which were attracted to the surface by torches at night. Harpoons were also used to hunt harbor seals, porpoise and various water fowl. Lobsters and crabs were caught in shallow water using spears. Shellfish, particularly clams, were a staple of native coastal inhabitants (Snow 1978b:139). Cod was taken, but in insignificant numbers relative to the amount of smaller fish that were sought, such as winter flounder and longhorn sculpin (Bourque 2001:84). Swordfish are markedly absent from Ceramic Period faunal assemblages, possibly as a result of becoming locally extinct due to cooling water temperatures in the Gulf of Maine (Bourque 2001:84). Two extinct species of animal were also exploited by Ceramic Period People – the great auk, a flightless, penguin-like relative of the puffin, and the sea mink, both of which were hunted into extinction during the nineteenth century (Bourque 2001:85).

Coastal peoples were quite mobile as compared to other Eastern Algonquians, and utilized watercraft for travel, hunting, and fishing. The first Europeans to arrive in the Northeast recorded three basic types of watercraft: dugout canoes, birch bark canoes, and hide-covered kayaks. Throughout northern New England and the Maritime Peninsula, birch bark canoes were used exclusively for interior travel, while dugouts made from large trees were used in coastal waters.

Ceramic Period sites are abundant in Maine, along both the coast and in the Maine interior (Sanger 1979). Along the coast, they are most visible in the form of shell middens, which have attracted the attention of professional and amateur archaeologists since the late nineteenth century (Wyman 1868). Shell midden sites contain discarded shells of clams, oysters, mussels, and quahogs, bones of both terrestrial and marine animals, as well as broken pottery sherds and discarded stone and bone tools. Sites in the interior are most common along waterways, ponds, and lakes. Assemblages from the interior differ from coastal sites in that bone assemblages are poorly represented because of differences in preservation.

No Ceramic Period archaeological sites are documented within the project study area or on the adjacent shoreline of Camp Ellis Beach, although late Ceramic to Contact period sites have been reported onshore in the surrounding area: approximately 0.3 mi (0.5 km) to the south on the Biddeford side of the lower Saco River (ME 005.003, ME 005.006, ME 005.011, ME 005.015, and ME 005.016); approximately one mi (1.6 km) to the north, near Long and Short ponds (ME 005.007); and approximately one mi (1.6 km) southeast on Basket Island (ME 005.013). Unidentified Ceramic Period sites potentially present within the project area would have been entirely maritime, rather than terrestrial, in nature, as present sea level rise models indicate the entire project study area would have been underwater by the start of the Ceramic Period. As is the case for sites from the earlier prehistoric periods, the exposed nature of Camp Ellis Beach and the aggressive erosional regime presently impacting the area make it unlikely that any Ceramic Period archaeological sites that may have been present within the project survey area have not been destroyed by erosion.

Historic Period Culture History

Undocumented visitations by coastal fishermen from many nations and adventurous woodsmen may have occurred at Saco prior to its settlement by non-Native peoples. The first documented evidence of European incursion into the area is that of the French-sponsored explorer and Italian navigator Giovanni da Verrazano, who sailed along the Maine coast in 1524 while searching for a northwest passage to the Pacific and the wealth of China and the Spice Islands that would rival the Portuguese route around the Cape of Good Hope (Duncan 1992:22). Verrazano found the natives of this coast hostile, unlike those he had encountered farther south, suggesting that they had had previous unpleasant dealings with Europeans (e.g., Portuguese fishermen who had been in the area since ca. 1522 [Brasser 1978:80]) who had perhaps been slave traders or dishonest merchants. The clearest evidence for Verrazano's presence along the Maine coast is the label at the head of one of the large inlets on his brother's map indicating the location of the Abenaki's fictitious beautiful city of gold – "Oranbega," later called "Norumbega," situated on the present site of the city of Bangor (Duncan 1992:22).

Spain's Estevan Gomes, also seeking a northwest passage to the Orient, visited coastal Maine the year after Verrazano's voyage when he sailed up the Penobscot River as far as present-day Bangor before realizing that it was just a river with a broad mouth and not the much sought after entrance of a northwest passage (Baker et al. 1994:xxv). The native peoples that greeted Gomes were, apparently, more friendly than those Verrazano met the year before, although tales of Norumbega, the City of Gold, were either uncompelling to Gomes or went untold, as the area as depicted on his map from the voyage is inscribed with the words, "no gold here" (Duncan 1992:23). Despite Gomes's pronouncement, the alluringly imaginative concept of a northern El Dorado – the paradisiacal Native American kingdom of Norumbega at the head of Penobscot Bay – was sustained throughout the middle sixteenth century by the Bay's prominence on early maps, Verrazano's idyllic description of native encampments, and boosting of the legend of a mythical city at the head of the Penobscot by French explorer Jacques Cartier following his three voyages to Canada in the 1530s (Baker et al. 1994:xxv). Ironically, Gomes repaid the relative friendliness of Maine's native inhabitants by capturing a group of them (58 people) to bring back to Spain with him (Brasser 1978:80).

In addition to the lure of wealth and discovery of a northwest passage, the English were attracted to the region for other reasons as well. Under Sir Humphrey Gilbert's direction, the English planned to build a naval station and a manorial settlement in Norumbega from which they could, among other things, harass Spain's West Indian holdings (Baker et al. 1994:xxv). The English plan of colonization was put into action when Gilbert's expeditionary five-ship fleet got underway in June 1583 to establish England's first permanent settlement in America. The effort ended prematurely shortly thereafter, however, when in September, after failing to even make the Maine coast, Gilbert's boat sank with all hands while trying to return home to England. Despite its subsequent failure, the expedition was the first serious attempt at English colonization in America and in Maine (Duncan 1992:26).

French and English incursions into the area continued unabated through the seventeenth and eighteenth centuries as the two nations struggled with each other and the area's native inhabitants for control of the region through a series of armed conflicts and treaties. In 1603, a few days after the death of Queen Elizabeth, Martin Pring set sail from Bristol, England, for the New World for the purposes of trading baubles and trinkets for sassafras and furs with America's natives, and in the process became the first European in recorded history to visit and navigate the lower Saco River (Owen 1891). Pring arrived in the New World at Penobscot Bay first, but finding no one to trade with there, continued southwestward along the Maine coast to Saco Bay. According to his log, he cleared a sandbar at the mouth of the Saco River and then sailed a distance of 5 mi (8 km) up-river (Owen 1891). Although Pring observed evidence of camp fires along the river's banks, none of the area's native inhabitants showed themselves and Pring was forced to leave the lower Saco empty-handed and continue his quest for trade goods toward the south (Owen 1891). In the same year as Pring's voyage, King Henry IV of France granted the Atlantic Coast from the Hudson River to Cape Breton to Pierre du Guast, Sieure de Monts with instructions to "explore, govern, open mines, and Christianize the Indians" (Davis 1950:19). Sieure de Monts established briefly occupied settlements first on St. Croix Island in 1604, and then at a more favorable location across the Bay of Fundy at present-day Digby, named "Port Royal," by the French, who remained there only until

1607 during the initial settlement attempt. Three years later, in 1606, King James I of England granted much of the same area to the Plymouth Company. A settlement was established in 1607 by the English in the middle of the grant at Sagadahoc, near present day Phippsburg, Maine, although it was abandoned the following year.

In July of 1604, de Monts and Samuel de Champlain explored the Maine coast and spent two days at the mouth of the Saco River (Owen 1891). Champlain, who was serving as the de Monts expedition's official geographer, produced and published in 1605 a detailed map of the Saco Bay area clearly showing a large Native American village, called "Choacoet" at the river's mouth in the same general area as the present-day location of the University of New England's Biddeford campus. Champlain's depiction of the Choacoet included a longhouse protected by a palisade and a scattering of many smaller camps and cornfields on both sides of the river (Figure 4-1). Champlain's map was accompanied by a narrative description characterizing the area at the river's mouth, including Wood Island:

> I here visited an island beautifully clothed with a fine growth of forest trees, particularly of the oak and walnut, and overspread with vines that in their season produce excellent grapes. We named it the island of Bacchus. At high water we weighed anchor and ran up the small river barred at its mouth. There is but half a fathom of water on the bar at low tide and about nine, sometimes twelve feet, at high tide; within, there is a depth of four, five and six fathoms. As soon as we had cast anchor, a number of Indians appeared on the banks of the river and began to dance. This river is called by the natives Chouacoet (Owen 1891).

In his narrative, Champlain further described the village's inhabitants as a large group of sedentary horticulturalists who resided year-round at the village site:

> They plant their corn in May and harvest it in September…The fixed abodes, the cultivated fields, and the fine trees led us to the conclusion that the climate here is more temperate and better…than at other places on this coast…The Indians remain permanently in this place, and have large wigwams surrounded by palisades framed of rather large trees placed one against the other; and into this they retire when their enemies come to make war against them (Baker 1988:3).

Prior to European contact, the population of the region's Abenaki peoples (excluding the Penacook and Micmac) may have been as high as 40,000 (i.e., 20,000 eastern; 10,000 western; and 10,000 maritime). Disease brought by Europeans, however, decimated the Native population. Early contacts with European fishermen resulted in at least two major epidemics among the Abenaki as early as the 1500s: 1) an unknown sickness sometime between 1564 and 1570; and 2) typhus in 1586. The highest rate of Native mortality resulting from European-borne disease occurred during the decade just before English settlement of Massachusetts in 1620, when three separate epidemics swept across New England and the Canadian Maritimes. Maine's Abenaki were hit especially hard in 1617, when a 75 percent mortality rate prevailed, and the population of the eastern Abenaki plummeted to about 5,000 individuals (Sultzman 1997).

Unfortunately, Champlain was the first and last European to describe in writing the Native American settlements of the lower Saco in their intact state. In 1607, the Abenaki settlement at Chouacoet was attacked by another group of native peoples from the North. This inter-tribal warfare continued for several years and resulted in great losses for Saco's native inhabitants. The surviving population was further ravaged by the "virgin soil epidemics" between 1616 and 1619 (Hardiman 1996a, 1996b).

In 1613, an English man-of-war under the command of Samuel Argall, Governor of Virginia, was sent to drive off the French and immediately lay siege to its settlements in Maine, taking into custody many of its inhabitants. These actions were significant as the first in a long-lasting campaign of violence between France and England as they fought for dominance in the New World and struggled for possession of the lands comprising today's eastern Maine and Canada.

In 1620, the Plymouth Company was reincorporated under the name of the Plymouth Council by the King for "the planting, ruling, ordering, and governing of New England in America," a territory that included the coastal lands from Philadelphia to Central Newfoundland (Owen 1891). Conflicts such as King Phillip's War in 1675, King William's War of 1689, and Queen Anne's War of 1702, however, largely prevented extensive settlement of the region. Not until the signing of the Peace of Utrecht in 1713 did conditions became more conducive for settlement in the area.

The open conflict waged between English, French, and Native elements during the French and Indian War (1754–1763) again curtailed settlement of Maine's eastern lands, and its outcome forever changed the cultural landscape of the region. The war ended with the expulsion of the French from North America in 1759, and the loss of most of Maine's Native territorial rights to the English (Snow 1978b).

Until the fall of Quebec in 1759, the few settlements east of Pemaquid were those of coastal fishermen (Duncan 1992:190). This remained the case until Massachusetts Governor Thomas Pownall decided to undertake an expedition to retake the eastern lands and build a fort on today's Fort Point to control the land adjacent to and within the waters of the Penobscot River. The fort was completed in 1759 and named Fort Pownall in honor of the Massachusetts governor. A brisk trade was initiated with the local Native peoples, and with the War over and the fort completed, a steady stream of settlers flooded into Maine. Between 1761 and 1790, Maine's population rose from about 17,500 to 96,000 persons (Duncan 1992:190).

Within a little more than a decade of Champlain's exploration of the lower Saco, its dramatic falls, islands, safe harbor, and abundant natural resources began attracting European settlers under the Plymouth Council charter. To prove that Maine's climate was not too severe for settlement, Sir Fernando Gorges, a prime-mover in securing both the original Plymouth Company charter of 1606 and the subsequent Plymouth Council charter of 1620, sent the captain of his vessel, Richard Vines, and his 32-man crew to the lower Saco to spend the winter of 1616-1617 there. The effort was a success and is memorialized in the name "Winter Harbor" - the location near Biddeford Pool where Vines and his men went into winter quarters (Hardiman 1996a; 1996b; Owen 1891).

From 1616 to 1630, Saco Bay was frequented by fishermen and adventurers. One of the latter, Christopher Levett, who visited the lower Saco area in 1623, found that its Abenaki inhabitants who had managed to survive the attacks and plagues, had abandoned their permanent settlements. Instead, Saco's native presence in the lower Saco area had been reduced to just seasonal visits and the establishment of temporary camps, most notably on today's Factory Island, formerly known as "Indian Island," and it remained so for the remainder of the seventeenth through the late-eighteenth centuries (Hardiman 1996a, 1996b).

The 1616 winter voyage was the first of several voyages to the Maine coast for Vines. In 1630, he finally made Saco his permanent home after he, John Oldham, Thomas Lewis and Richard Bonython were granted patents to tracts of land situated at the river's mouth (Owen 1891). The grants were made on the condition that Vine and the others would jointly transport 50 people to plant and inhabit their respective tracts to the advancement of the "general Plantation of that country and the strength and safety thereof amongst the natives or any other invaders" (Owen 1891).

Colonization of the lower Saco began immediately upon the issue of the patents with Vines taking possession of his plantation on west side of the river in June of 1630, and the other taking theirs on both banks of the river the following year. The first permanent European colonists on the east side of the river (present day Saco) lived near the river's mouth and included patentees Lewis and Bonython, and settlers Foxwell, Watts, and Warwick (Owen 1891). Although the settlement spanned both sides of the river in what is today the two separate cities of Biddeford and Saco, the settlement was known then simply as the "Saco" settlement. The name Saco itself is attributed to the Abenaki word for "flowing out" or "outlet" and to the word "Sawacotuck" meaning the "mouth of the tidal stream" (Hardiman 1996a, 1996b;). The area's first European settlers included fishermen, traders, lumberjacks and farmers.

By 1636, at least 37 families had settled in the area, making Saco one of the first and largest permanent settlements in Maine (Figure 4-2). In 1653, the settlement on this grant, along with the Winter Harbor area on south side of the river, were organized officially as Saco and recognized in the General Court in 1659 (Hardiman 1996a; 1996b). Foreshadowing the development of future industries in Saco, Benjamin Blackman purchased 100 acres (ac) of land that included the mill privileges on the east side of the Saco Falls and built a sawmill there in 1680. The fledgling Saco settlement thrived and slowly expanded inland up until the area was raided at the beginning of King Phillip's War (1675-1678), when a series of conflicts with the region's native inhabitants began. These wars eventually led to the destruction and abandonment of all houses and mills near the falls and the displacement of the area's settlers back to the earlier settlement sites at the mouth of the river by the outbreak of King William's War in 1690. For most of the remainder of the seventeenth century, the area remained sparsely settled due to the devastation wrought by years of conflict between the Native American inhabitants and European colonists.

It was not until after the signing of the Treaty of Utrecht of 1713 that any significant resettlement effort was made in Saco. After 1713, the Saco side of the river quickly developed and became a prosperous farming, fishing and lumbering community. Prominent among Saco's early settlers and entrepreneurs was William Pepperell, a merchant from Kittery, who in 1716 purchased 5,000 ac and timber rights to an additional 4,500 ac on the east side of the Saco River (Hardiman 1996a; 1996b). Pepperell sold off parts of his holdings to millwright Nathaniel Weare and mariner Humphrey Scamman to help further develop his lumbering business (Figure 4-3). In 1718, Saco's principal roads - Main Street and the Portland, Buxton, and Ferry Roads, were laid out on the eastern side of the river. The following year, the former Saco settlement area (i.e., the area including present-day Biddeford and Saco) was renamed and incorporated as the town of Biddeford, the fourth township in Maine.

The new town of Biddeford continued to grow steadily throughout the eighteenth century, as the area's enormous resources for fishing, lumbering, shipbuilding, and water-powered milling attracted new settlers to both banks of the lower Saco River. Pepperell donated four ac of land to the eastern part of Biddeford (present day Saco) for use as a village common, a burying ground, and the site for a new meetinghouse.

In 1762, settlers on the eastern bank of the Saco separated from Biddeford and received a separate incorporation for about 17,500 ac of land under the name of Pepperellborough, in honor of the recently deceased Sir William Peperellborough, a major proprietor of the area's lands (Hardiman 1996a, 1996b; Hebert 1951; Owen 1891; Varney 1882). Thus, the new town of Saco eventually came to be bounded by the river and Biddeford to the southwest, Scarborough to the northeast, Buxton to the west and northwest, and with Old Orchard Beach and Saco Bay to the east.

The long course of the Saco from the White Mountains in New Hampshire provided endless supplies of natural resources and countless potential markets for trade goods. Farming, lumbering, and ship building bloomed and prospered during the middle eighteenth century, and the settlement of Saco became concentrated on the riverfront at the falls. Colonel Thomas Cutts of Kittery came to Saco in 1758 and embarked on extensive enterprises, buying a share of Indian or Factory Island. Initially, Cutts built a house and a small store on the island and engaged in shipbuilding and navigation, developing a very profitable and extensive timber trade with the West Indies. By the late 1700s, Cutts owned nearly the entire island. At the start of the American Revolution, the volume of international commerce coming in and out of the port required the town's government to establish a customs house near the town wharves. Between 1762 and 1800, the town's population grew from 540 to 1,842 people (Hardiman 1996a, 1996b; Hebert 1951; Owen 1891; Varney 1882).

In 1805, the town dropped the awkward Pepperellborough name for the area's original and simpler Abenaki name, Saco, and embarked upon what was a century-long transformation into a major industrial city and port. Development of the industrial center on Factory Island was paralleled by the rapid growth of Saco's commercial center near the falls around Pepperell Square, originally call the 'haymarket.' The square was ideally situated between the mills above the falls and the wharves below the falls, and was at the cross-roads to the upper and lower bridges to Cutts Island (Hardiman 1996a, 1996b; Hebert 1951; Owen 1891; Varney 1882).

Saco's principal industries throughout the first half of the nineteenth century were sawmilling and shipbuilding. In 1800, there were 17 sawmills in operation near the falls, milling 50,000 board feet per day. By 1827, Saco's sawmills were producing and shipping 21 million board feet of lumber per year.
Heavy industry arrived in Saco in 1811 when Cutts and his business partner, Joseph Calef, established the Saco Iron Works and erected an iron-rolling and iron-slitting mill and installed 11 machines for making nails. The nail factory was followed in 1825 by the purchase of Cutts Island with its tremendous water power potential, and thriving iron works. In 1826, the Saco Manufacturing Company was established by a group of Boston capitalists who constructed the first of many of Saco's cotton milling factories. At 210 ft (64 m) long-x-47 ft (14.3 m) wide-x-seven stories tall, and powered by water directed through a canal cut through solid rock, the brick cotton mill complex employed 400 people working 1,200 spindles and 300 looms, and was the largest of its kind in the United States at that time. The venture ended prematurely in 1830, when the mill burned to the ground, but the seed of industry was planted and a new corporation, the York Manufacturing Company, built a larger brick cotton mill complex on the same site in 1831. The massive York mill complex consisted of five separate mills employing 1,200 people operating about 35,000 spindles and 800 looms that produced 6 million yards of cotton goods annually. The York and its successors milled cotton goods on Factory Island from 1831 to 1958 (Hardiman 1996a, 1996b; Hebert 1951; Owen 1891; Varney 1882).

The opening of the mills in 1826 had far-reaching effects that led to the urbanization of Saco, as the factories brought new prosperity to the area and generated business for merchants, shippers, farmers and tenement owners. With the development of massive cotton mills on the western falls of the Saco River, the sister cities of Biddeford and Saco became leaders of manufacturing in the industrial age. The enormous milling operations attracted skilled workers from other urban centers, including the textile centers of England and Scotland. The arrival of the Portland, Saco, and Portsmouth Railroad in 1842 ushered in a new era of transportation of goods and passengers in and out of Saco. Between 1820 and 1850, Saco's population more than doubled from 2,532 to 5,797. The second half of the nineteenth century saw an even more massive influx of immigrants into the region from Europe and Quebec. Irish immigrants arrived in the 1840s and 1850s, French Canadians in the 1850s, 1860s and 1870s, and eastern Europeans in the 1880s and 1890s (Hardiman 1996a, 1996b; Hebert 1951; Owen 1891; Varney 1882).

The growth of a technically-skilled population in Saco attracted other technical industries to the area, including foundries, belting and harnessing factories, and, most importantly, machine shops. By the middle of the nineteenth century, the dramatic expansion of the cotton mills erected by the York Company, the Saco Company, the Laconia Company, and the Pepperell Company in Biddeford pulled the center of commerce to York Square on Factory Island. Over the subsequent 25 years, Saco added dozens of industries to its downtown and riverfront (e.g., cotton mills, machine shops, iron foundries, and cigar factories) (Hardiman 1996a, 1996b; Hebert 1951; Owen 1891; Varney 1882).

In 1850, Biddeford first surpassed Saco in population and by the end of the century it was more than double the size of Saco. Saco's population dropped for the first time in over a century between 1860 and 1870. The Civil War and the Panic of 1873 both caused temporary declines in the cotton textile industry and in local farming, as the supply of southern cotton was interrupted and the farmers of the northeast abandoned their infertile hill farms for the more fertile lands and greater opportunities of the Midwest and the western United States. Whole towns that were occupied for one or two generations were then abandoned (Baker 1986).

Saco's economy continued to prosper through the second half of the century, despite stagnant population figures for the period. By the late 1800s, Saco had four saw-mills, three planning and molding mills, three door, sash and blind factories, several carriage factories, a tannery, a bleachery, as well as belting, boot and shoe, loom-harness, soap, and other types of factories. Saco was incorporated as a city in 1867 to better enable it to meet the pressures of growth and the increased need for services for its citizens. Part of the problem with administering services came from the development of a large suburb nearly four miles from City Hall at Old Orchard. The petition to separate Old Orchard from Saco passed in 1883, and created the city's second major drop in population in 20 years. Expansions at the York Mills in the 1880s and other improvements in the economy led to a flurry of long overdue public improvement projects (e.g., the construction of a sewer system, the establishment of the Saco and Biddeford Water Company, and the continued improvement of navigation into the river).

After the turn of the twentieth century, Saco experienced its first period of sustained population growth since before the Civil War, but the majority of the growth was in the out-lying areas, particularly in Camp Ellis and Ferry Beach. In 1900, one third of the population lived in the city's three downtown wards within half of a mile of York Square; by 1950, these three wards only accounted for a fifth of the population. Because York Mills remained the city's largest employer, the downtown commercial district continued to prosper and several building were erected before the stock market crash in 1929 and the Great Depression of the 1930s that followed in its wake.

During World War II, Saco's economy began to undergo significant changes. The city's lumber milling industry began to decline, with the last Saco River log drive in 1943. Saco's long-standing position as a major textile manufacturing center also declined. The pace of this decline was greatly accelerated by the closing of the York Division of Bates Manufacturing in 1958. For over a century, the York Mills had been Saco's largest employer and tax payer. Economic development efforts have created new opportunities through the establishment of business parks, and the development of tourism and retail. Redevelopment and adaptive reuse of Saco's mill district has become an increasingly important part of Saco's economic stimulus effort, as has the promotion of the city's natural recreation areas, which include Ferry State Beach Park, the Saco River, the Saco Heath, the Saco Bay Trails and Camp Ellis Beach.

CHAPTER FIVE

RESULTS AND RECOMMENDATIONS

Archival Research Results

Prehistoric Archaeological Sensitivity

No previously documented prehistoric sites are recorded in the Camp Ellis Beach project survey area, or in the immediate adjacent onshore area (i.e., within 0.25 mi [0.4 km]). However, MPHC's prehistoric site files do contain records of six Native American archaeological sites, dating from the late Ceramic to Contact periods, which are located less than one mi (1.6 km) from the project survey area. The location of the proposed project also fits the model for high-potential prehistoric land use, because of its proximity to a major river, the river's mouth, and its resource-rich confluence with the open ocean. Review of available environmental data and sea level rise curves for coastal Maine (Sanger 1988; Price and Spiess 2007 citing Barnhardt et al. 1995) indicates that the entire Camp Ellis Beach project survey area was likely exposed land available for human occupation from the beginning of the Paleoindian period (ca. 11,500 B.P.) up until the start of the Late Archaic period (ca. 6000 B.P.). Between about 6000 B.P. and 3000 B.P., a time frame corresponding with the beginning of the Late Archaic period to the start of the Ceramic period, the area was gradually inundated by what likely would have been a destructive marine transgressive process of shore-face retreat, as rising sea level caused the shoreline and surf-zone to migrate landward across the project survey area. By the beginning of the Ceramic period (3000 B.P.), the project survey area would have been entirely underwater.

While it is hypothetically possible that the project survey area could contain terrestrial and maritime activity-associated prehistoric archaeological deposits spanning the entire prehistoric cultural sequence, one can only conclude that the combined effects from the area's inundation through the destructive shore-face retreat process, its exposure to high-energy impacts from wind-driven oceanic waves and tidal currents, and the recent and significant erosion that Camp Ellis Beach has been experiencing have very likely eroded and destroyed any archaeologically sensitive paleosols and prehistoric sites that might have been present within the project area. Consequently, the Camp Ellis Beach project area is assessed as having a low potential for containing contextually intact, formerly terrestrial and/or maritime-related prehistoric and contact period Native American archaeological deposits.

Historic Archaeological Sensitivity

Review of the MHPC historic sites online database and other available shipwreck databases for the region report 24 vessel casualties along the Saco and Biddeford coasts; however, none of the historic archaeological sites (i.e., shipwrecks or coastal infrastructure) are recorded within the project survey area or on the adjacent shore. Review of Saco's post-contact period history, however, indicates that the lower Saco was the site of some of the earliest European incursions into the New World, as well as the location of some of the earliest European settlements in the Northeast, particularly near the river's mouth. Archival research also indicates that Saco has a long, rich history of maritime activity, including fishing and local, regional and international trade, with the mouth of the river being the focus of vessel traffic for over 400 years. Considering these variables, one might conclude initially that the project area has high archaeological sensitivity. However, most shipwrecks that are reported and included in the available databases are those that occurred close enough to land to be witnessed and recorded by shore-side observers. Given the close proximity of the project area to both shore and an active harbor entrance, it seems unlikely that if a shipwreck had occurred within the project area, that its presence would have gone un-noticed and undocumented in the historic record. It is, however, possible that the wrecks of smaller, older vessels from the contact and early post-contact periods may have grounded and wrecked on Camp Ellis Beach and been lost to history without being documented. Taking into account each of these considerations, the Camp Ellis Beach project area is assessed as having a moderate potential for containing contextually intact historic period archaeological deposits.

Archaeological Field Survey Results

CRE's remote sensing survey of the Camp Ellis Beach project area produced a high quality, comprehensive data set for determining the presence/absence of historically significant submerged archaeological deposits (Appendix B). Recorded water depths within the project survey area ranged from -5.5 to -14 ft (-1.7 to -4.3 m) below the NAVD88 Elevation (i.e., approximately +0.15 to -8.75 ft [+0.5 to -2.7 m] MLLW) (Figure 5-1). Analysis of the recorded side-scan sonar data indicated that the bay floor's sediments within the survey area are variable in nature, with fine sands appearing to comprise a majority of the substrate, particularly in its northern portion. Sand ripples and low-magnitude sand waves (i.e., sand waves with a 2 ft (0.6 m) wavelength and 0.2 to 0.6 ft [0.6 to 0.2 m] amplitude) were observed throughout the survey area. A ledge outcrop was observed along the eastern boundary of the survey area.

A total of 22 side-scan sonar anomalies, comprising 17 separate targets (i.e., some of the anomalies were the same target seen on and inventoried from adjacent survey track lines), and 9 separate magnetic anomalies (Appendices C and D) were inventoried during the survey. Recorded side-scan targets were generally small, linear and low profile, and ranged in size from just 4.80 to 22.18 ft (1.5 to 6.8 m) long, 0.77 to14.25 ft (0.2 to 4.3 m) wide, and 0.00 to 5.33 ft (0 to 1.6 m) tall. Recorded magnetic anomalies ranged from 16 to 112 gammas in amplitude and 8 to 125 ft (2.4 to 38 m) in duration. There were only three instances of correlation between side-scan sonar targets and magnetic anomalies (see Appendices C and D). The side-scan sonar and magnetometer anomalies recorded in the project survey area were interpreted to be associated with a sunken modern core drilling barge and its associated steel boring tubes and debris (Figures 5-2 and 5-3), other pieces of isolated modern debris, or exposed and buried geological features. Buried deposits of maffic rock (i.e., stone with ferromagnetic properties) were observed to produce two roughly northeasterly trending magnetic "ridges" in the ambient magnetic field (Figure 5-4). None of the documented remote sensing targets or anomalies is interpreted to be archaeological deposits.

Sub-bottom profile data acquired during the survey was limited to a penetration of depth of just 2 to 5 ft (0.6 to 1.5 m) below the bay floor, except in two areas where the profiler's acoustic signal penetrated the substrate to the acoustic basement, located approximately 26 ft (8 m) below the bay floor's surface (Figure 5-5). No acoustic reflectors indicative of buried cultural or geological features of interest were observed in the sub-bottom profiler data.

Geotechnical Data Review Results

Logs and a locator map for 20 geotechnical boring samples recovered in the Camp Ellis project area and documented by GEI Consultants, Inc. (GEI) and provided to Fathom by the NAE, were reviewed for comparison with the sub-bottom profiler data and for evidence of possible stratified paleosols (Appendix E). Analysis of geotechnical boring data revealed that the recovery depths of the borings ranged from 24 to 100 ft (7.3 to 30.5 m). The stratigraphic sequence observed in most of the samples consisted of an upper stratum composed of sand mixed with silt and gravel ranging from 2 to 52 ft (0.6 to 16 m) thick, overlying a thick stratum of clay (the Presumpscot Formation). In several cases (i.e., boring samples FD-

03, FD-05, FD-06a, and FD-18) a basement of compacted gravel or bedrock was encountered under the sand and/or clay strata at depths below the bay floor's surface ranging from 23 to 48 ft (7 to 15 m). Based on the review of the available boring logs, none of the boring samples appeared to contain sediments with characteristics strongly suggestive of archaeologically sensitive stratified paleosol deposits.

Recommendations

While the lands adjacent to the Camp Ellis Beach project area have a long history of human activity reflecting a coastally-oriented, maritime-based settlement pattern and economy that spans most of the prehistoric through historic periods, a systematic multidisciplinary investigation consisting of archival research, remote sensing archaeological field survey, and a review of available geotechnical data from the Camp Ellis Beach project area revealed it contains no remote sensing targets/anomalies or buried geological features that are suggestive of archaeological deposits or archaeologically sensitive paleosols. Based on the combined results from this study, ***no additional archaeological investigation of the proposed Camp Ellis Beach nearshore breakwaters and jetty-spur project area is recommended.***

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FIGURES

Figure 1-1. General location of the Camp Ellis Beach project area within the state of Maine (source: Fathom).

Figure 3-1. Excerpt of USGS quadrangle map showing Camp Ellis Beach project survey area location at the mouth of the Saco River, Saco, Maine (source: Fathom 2010).

Remote Sensing Archaeological Survey, Camp Ellis Beach Project, March 2010

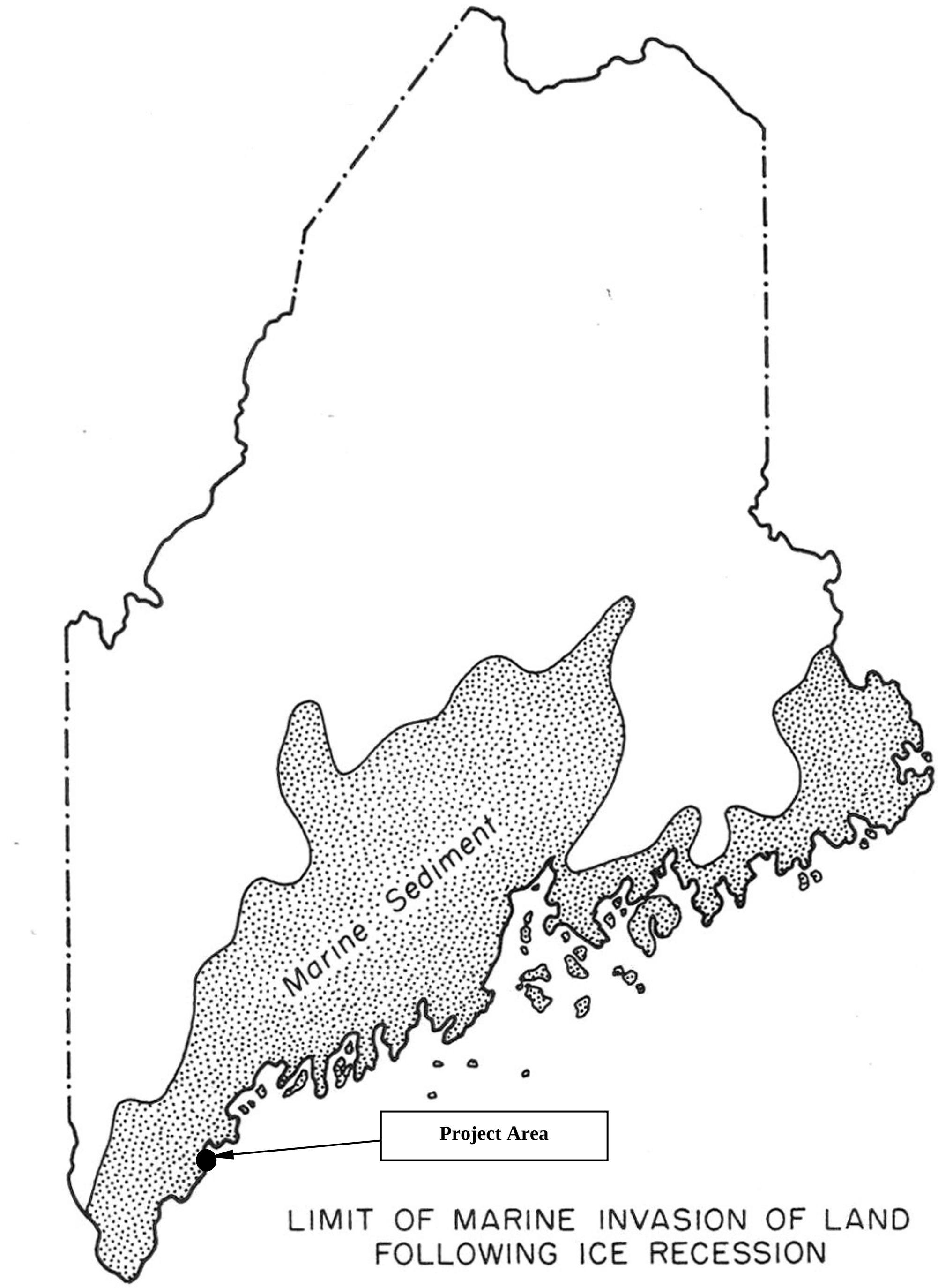


Figure 3-2. Approximate limit of the marine invasion of land following the recession of the Wisconsin glaciation (source: Kendall 1996:33).

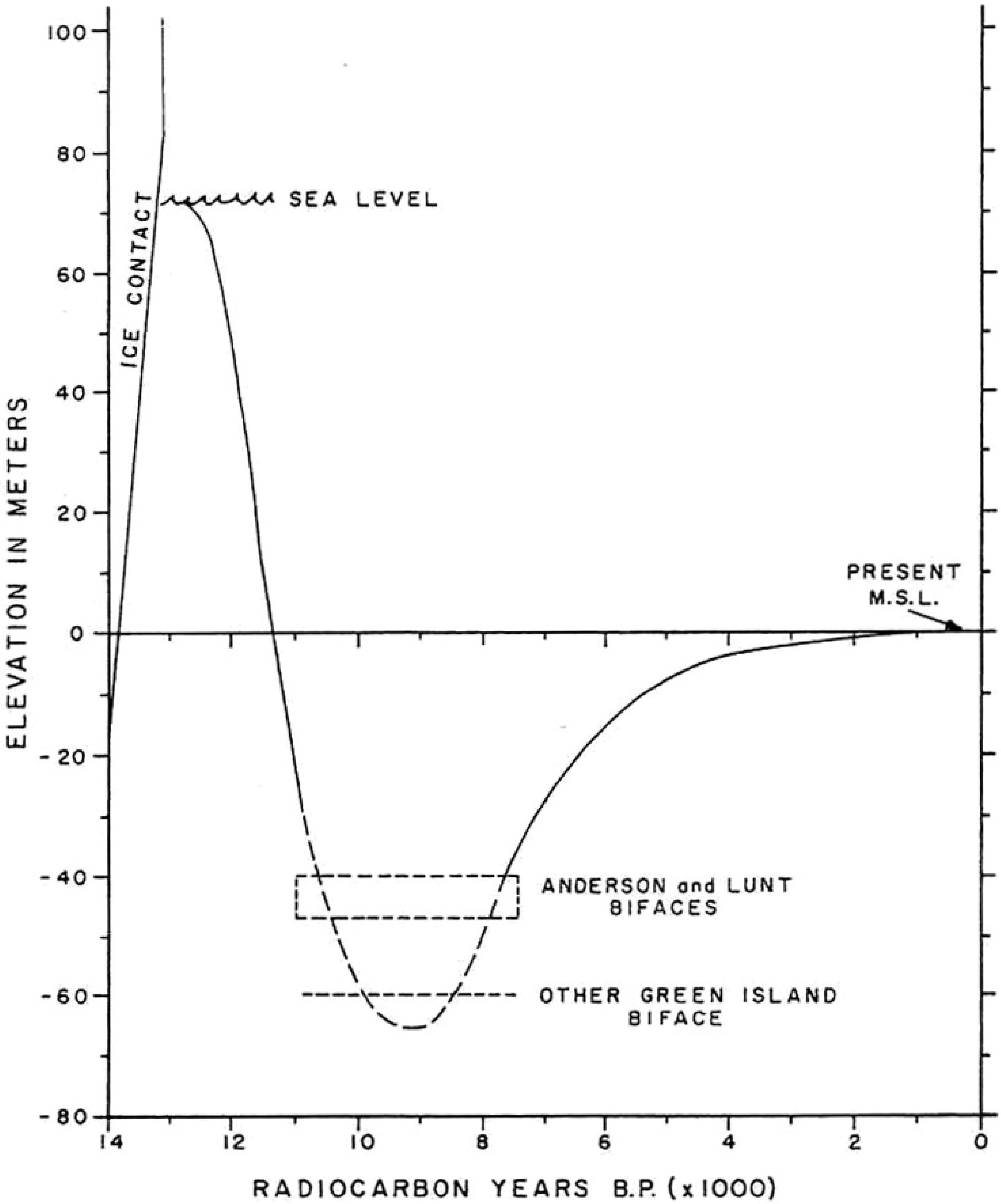


Figure 3-3. Relative sea-level curve for the coast of Maine for the last 14,000 years (source: Crock et al. 1993).

Remote Sensing Archaeological Survey, Camp Ellis Beach Project, May 2010

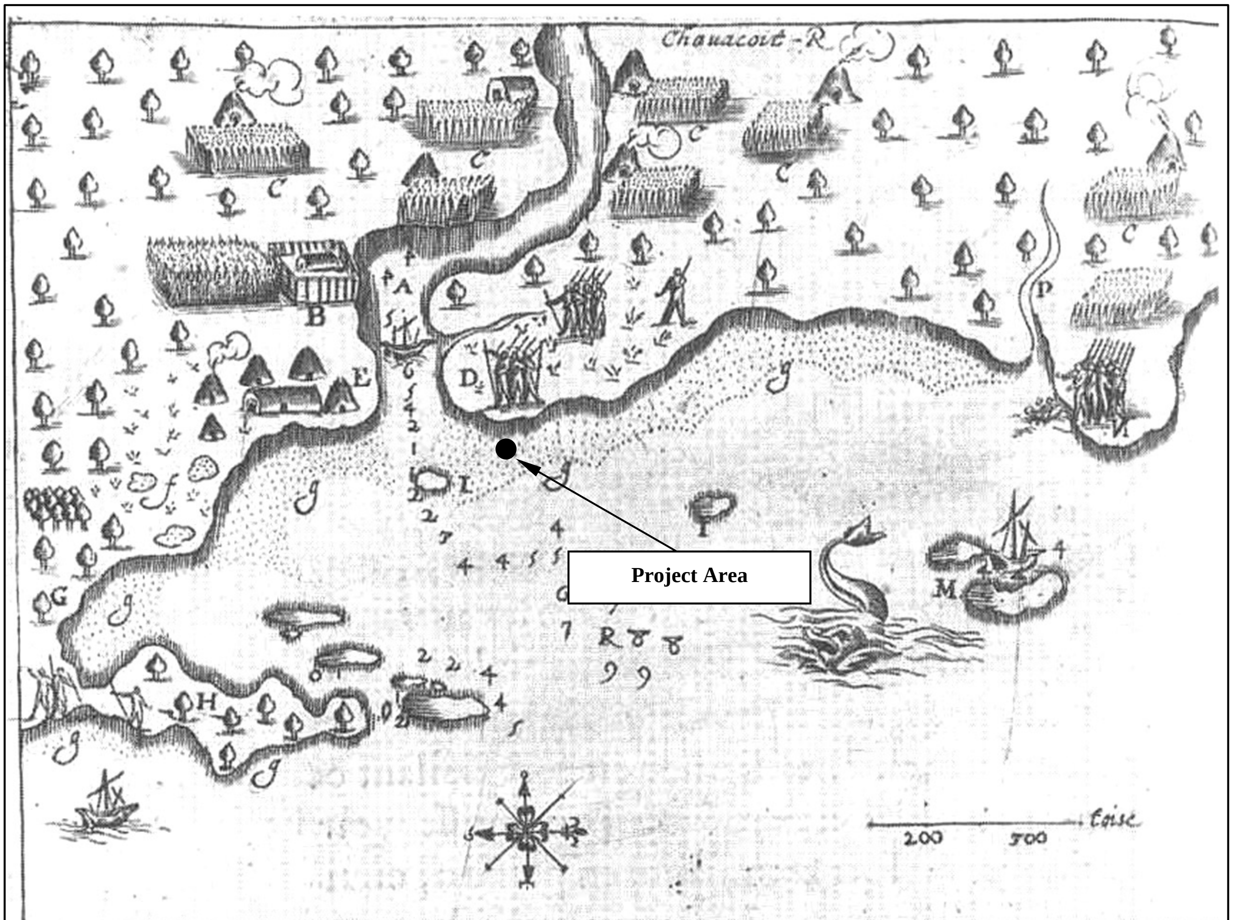


Figure 4-1. Samuel de Champlain's 1605 map showing a Native American settlement at the mouth of the Saco River, Saco, Maine (source: Bourque 2001:116).

Remote Sensing Archaeological Survey, Camp Ellis Beach Project, May 2010

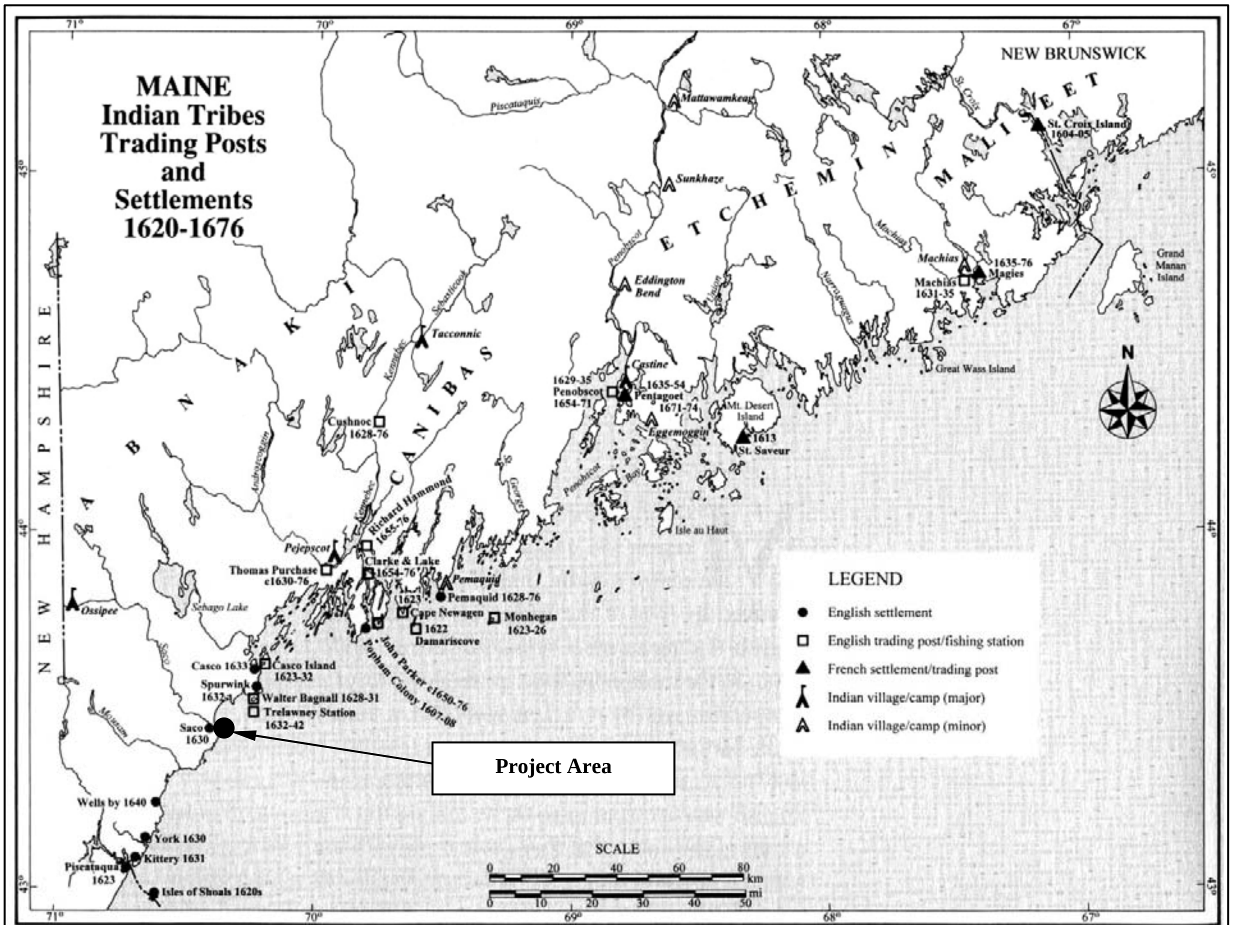


Figure 4-2. Map of native tribal territories and European trading posts and settlements 1620-1676 (source: Bourque 2001:130).

Remote Sensing Archaeological Survey, Camp Ellis Beach Project, May 2010

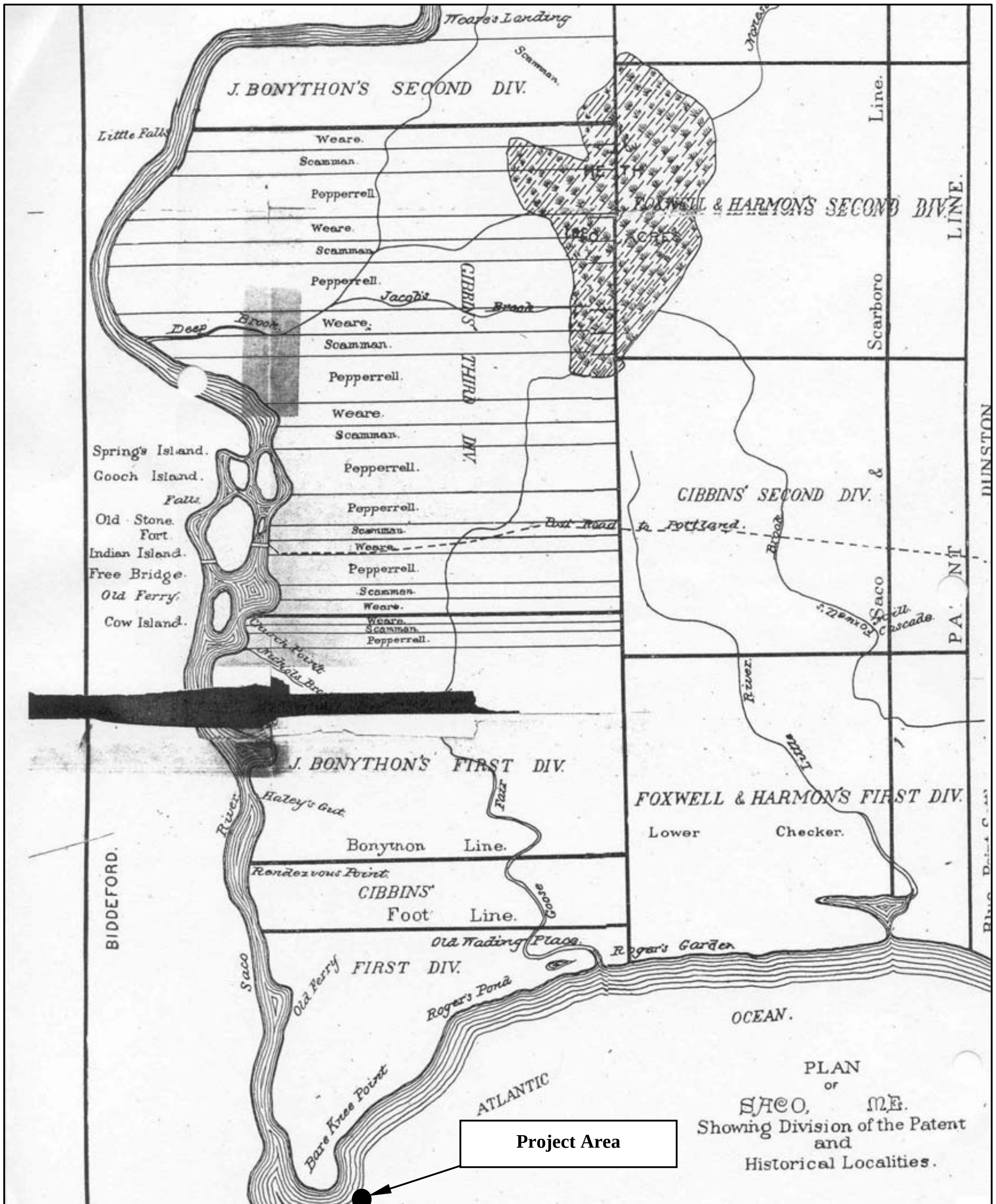


Figure 4-3. Map of the original landholdings of the Saco settlement along the east bank of the Saco River during the early eighteenth century (source: Owen 1891).

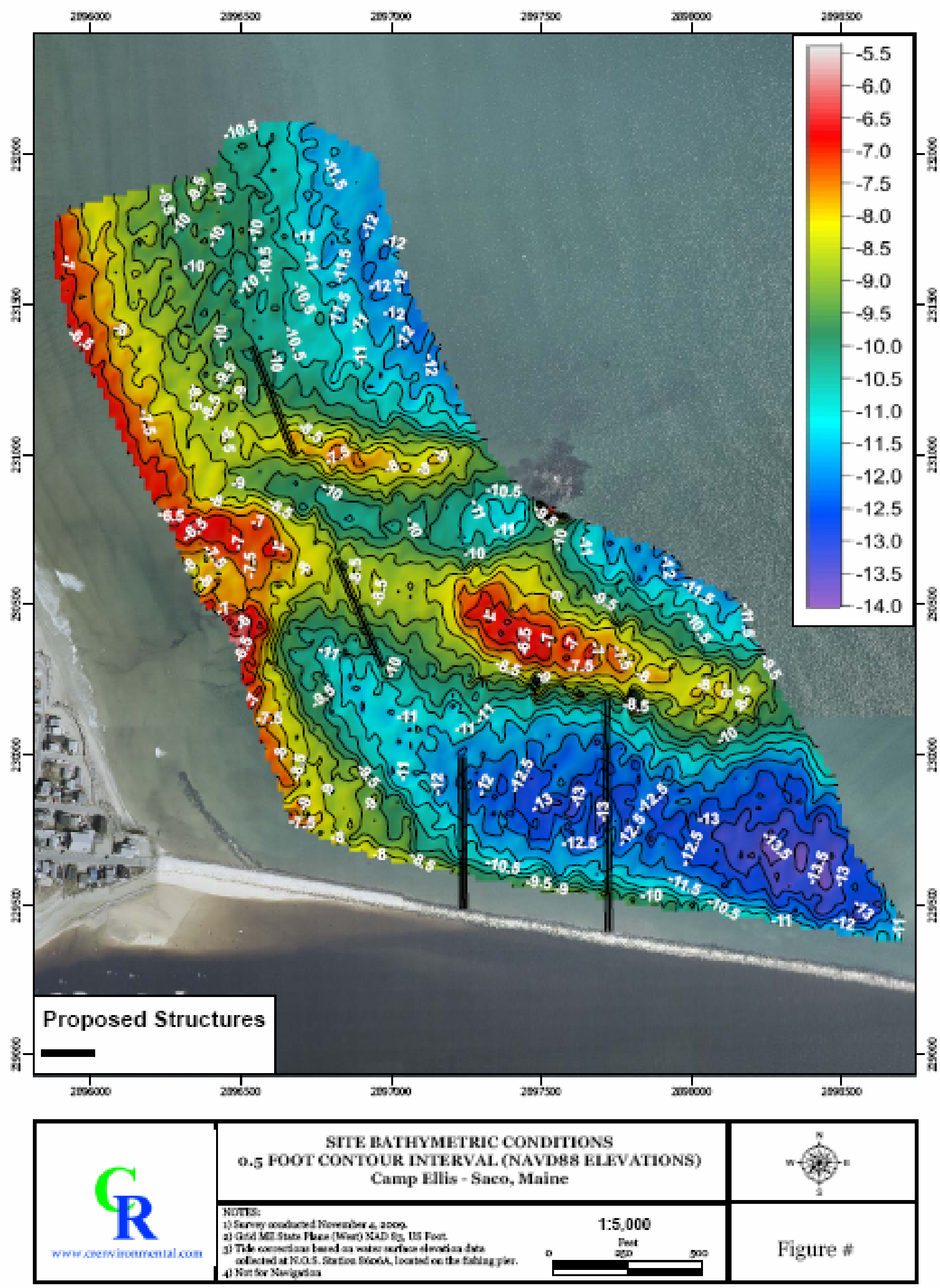


Figure 5-1. Bathymetric contours (0.5 ft contour interval) as recorded within the Camp Ellis Beach project survey area (source: CRE 2009).

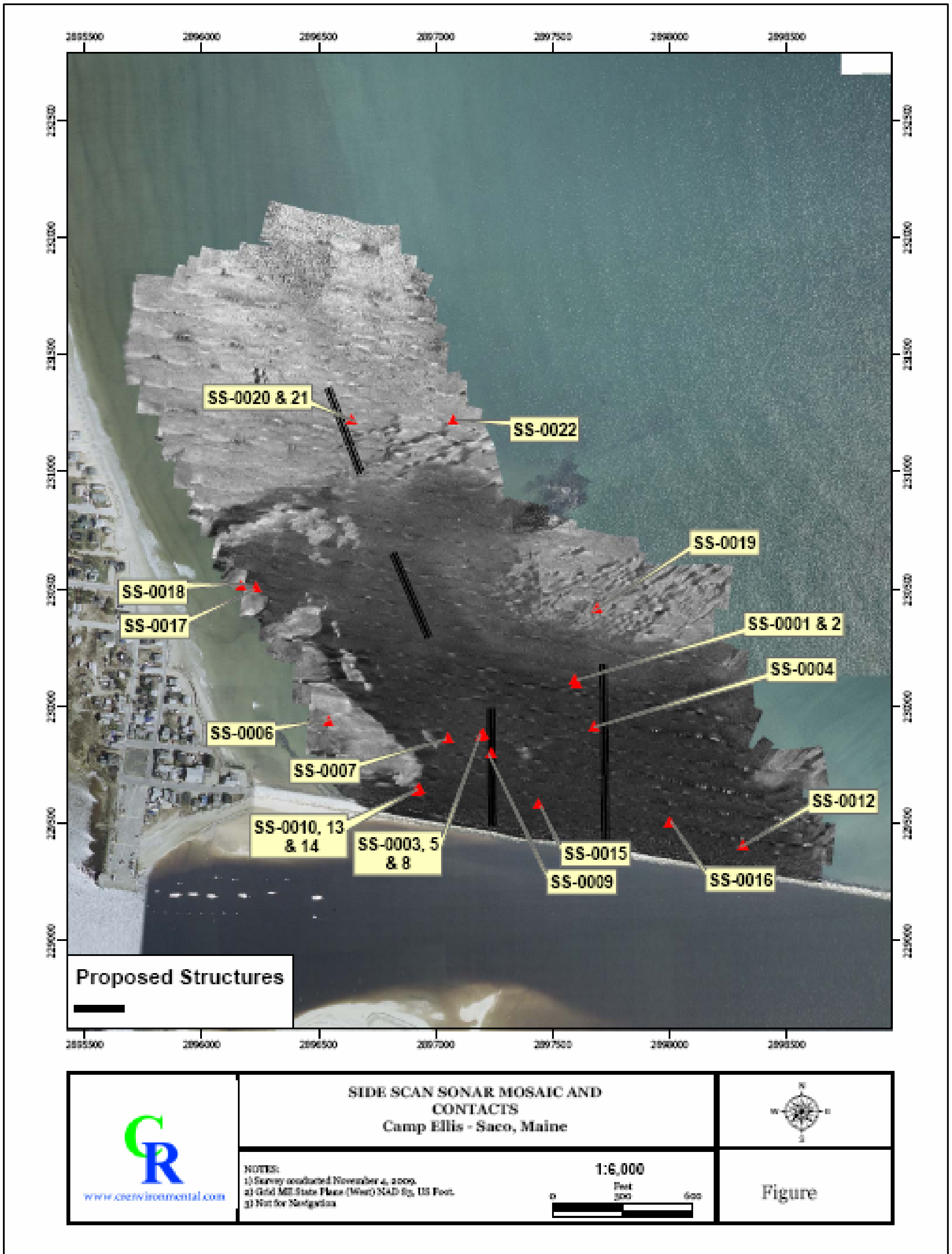


Figure 5-2. Side-scan sonar mosaic with inventoried side-scan sonar anomalies and NAE's proposed breakwater and jetty-spur structures (source: CRE 2009).

Figure 5-3. Sunken modern geotechnical boring drill-barge and displaced drill bits within the Camp Ellis Beach project survey area (source: NAE 2009).

Remote Sensing Archaeological Survey, Camp Ellis Beach Project, May 2010

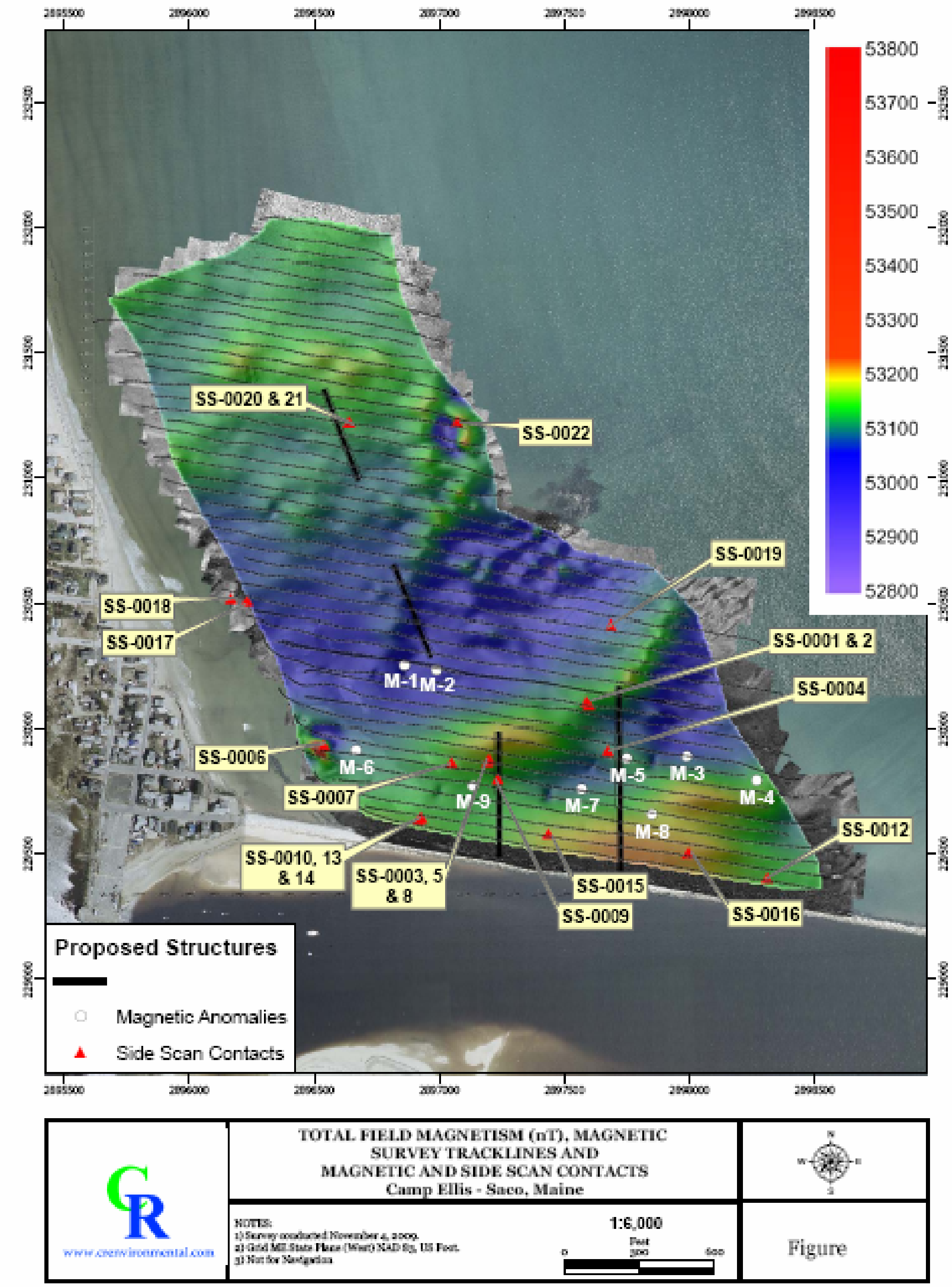


Figure 5-4. Ambient magnetic field strength, survey vessel track lines, side-scan sonar and magnetometer anomaly locations and the NAE's proposed breakwater and jetty-spur structures (source: CRE 2009).

Remote Sensing Archaeological Survey, Camp Ellis Beach Project, May 2010

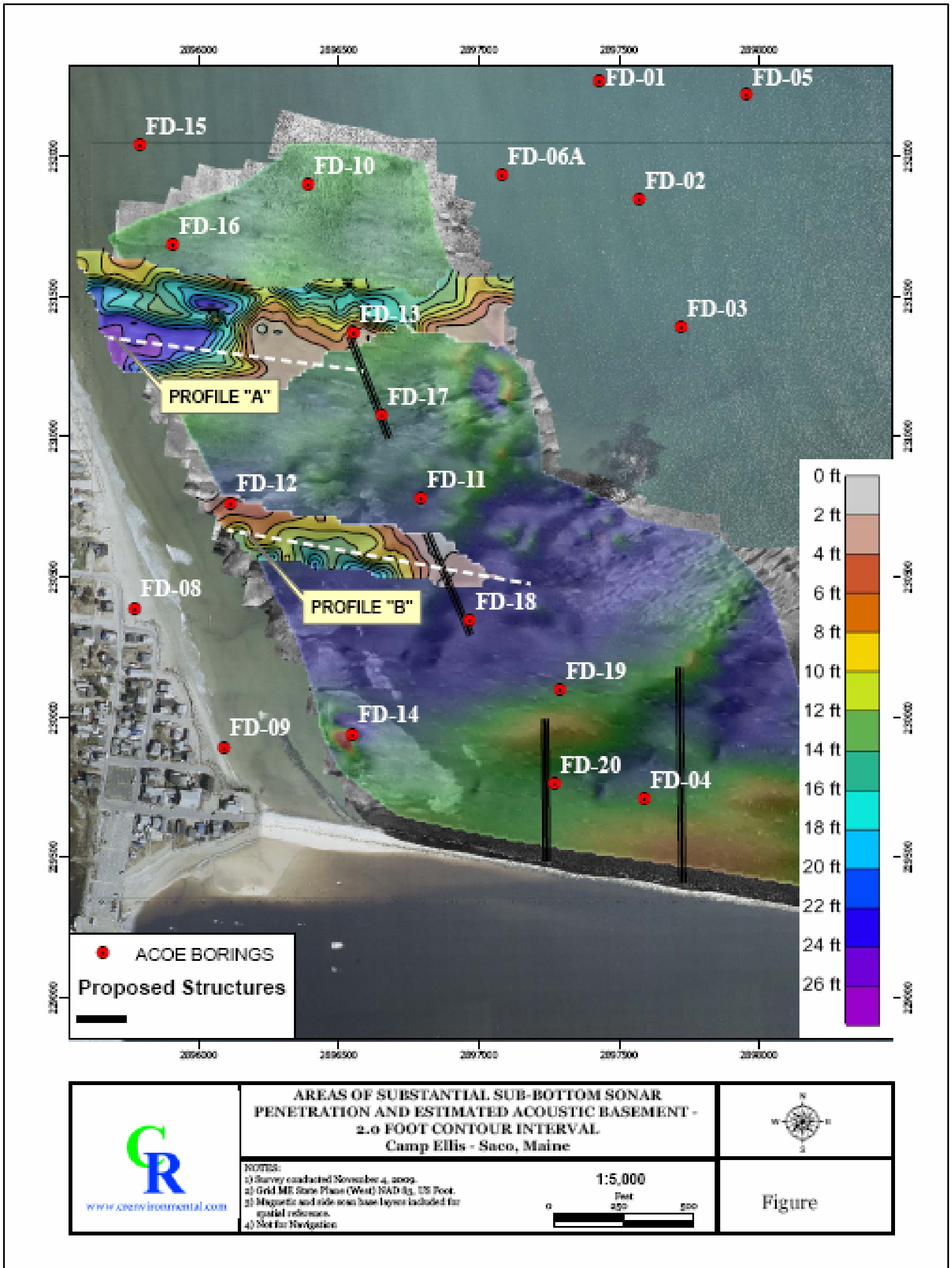


Figure 5-5. Contoured acoustic basement depths (2 ft contour interval) as recorded along sub-bottom profile transects "A" and "B" where substantial acoustic penetration was achieved with the 10 kHz sub-bottom profiler (source: CRE 2009).

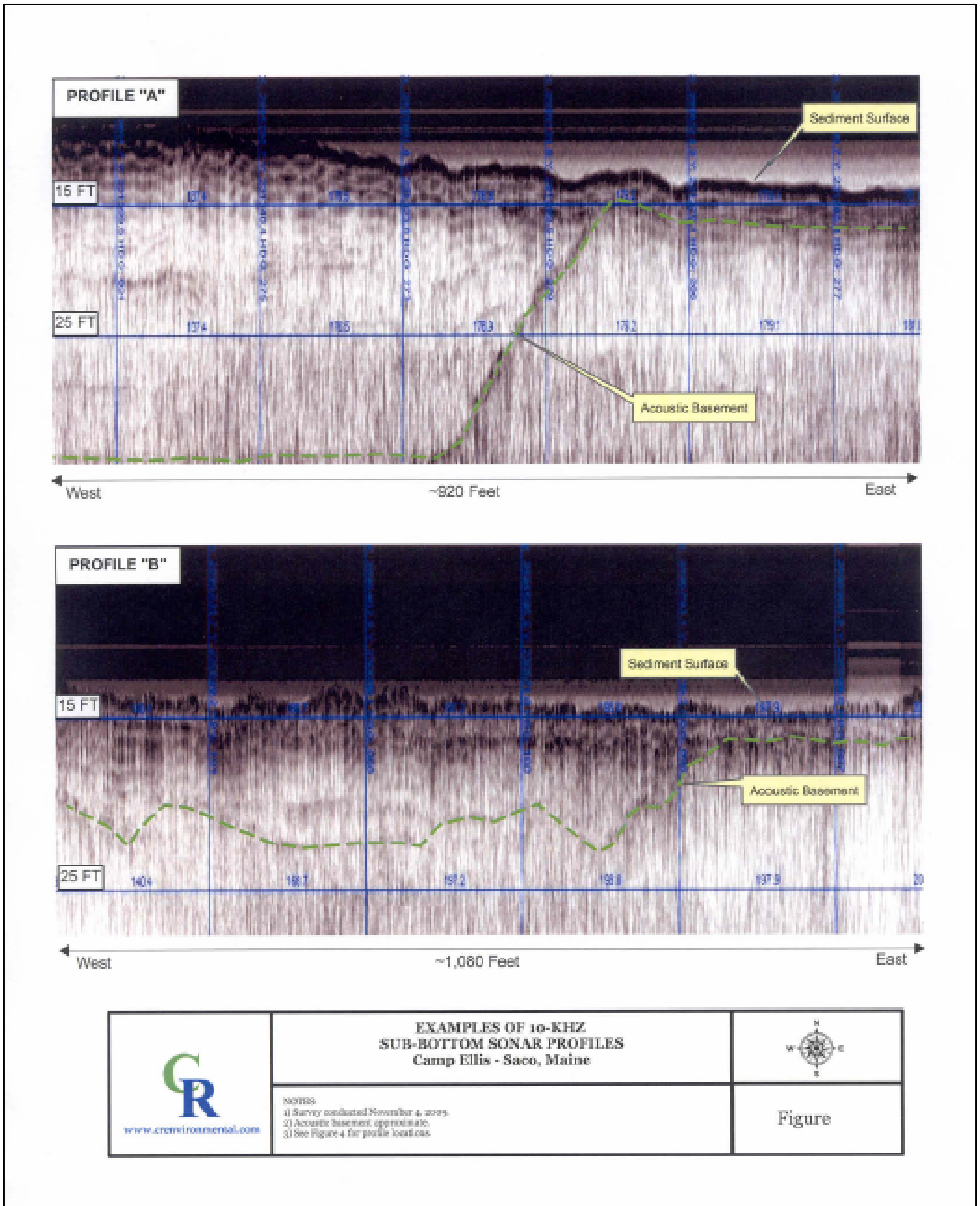


Figure 5-6. Representative examples of 10 kHz sub-bottom profiles recorded in the Camp Ellis Beach project survey area (source: CRE 2009).

APPENDIX A:

PROJECT SCOPE-OF-WORK

STATEMENT OF WORK
REMOTE SENSING ARCHAEOLOGICAL SURVEY
CAMP ELLIS BEACH, SACO, MAINE

May 28, 2009

1. GENERAL

The Contractor shall perform a remote sensing archaeological survey (magnetometer, side scan sonar, and sub-bottom profiler) at the site of construction of proposed nearshore breakwaters and a jetty spur at Camp Ellis Beach, Saco, Maine as part of a Section 111 (Mitigation of Damages Caused by Federal Navigation Projects) Corps study. The scope of this survey is to locate and identify submerged archaeological resources including but not limited to shipwrecks.

2. PURPOSE

The remote sensing archaeological survey is part of the requirement for compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA). Section 106 requires a federal agency to take historic properties into account prior to any federal undertaking. Identified properties are evaluated for significance according to criteria established for listing on the National Register of Historic Places (NRHP). Federal agencies must avoid, minimize, and/or mitigate for adverse effects upon National Register eligible historic properties from project implementation. The results of the remote sensing archaeological survey will be coordinated with the Maine State Historic Preservation Officer (ME SHPO) and others in accordance with Section 106 of the NHPA and implementing regulations 36 CFR 800.

3. SITE DESCRIPTION

A project information sheet with locus maps and a more detailed project description of the Camp Ellis Beach study area can be found in Appendix A.

Camp Ellis Beach is located in Saco, Maine, about 16 miles south of Portland, Maine. The Saco River Federal Navigation Project consists of an 8-foot deep channel that varies from 100 to 200 feet wide. The channel is protected by a 4,800-foot long jetty to the south, and a 6,600-foot long jetty to the north. Camp Ellis Beach lies adjacent to the north jetty and extends 2,500 feet north to Ferry Beach.

4. DESCRIPTION OF WORK

The proposed work consists of a remote sensing archaeological survey of the proposed nearshore breakwaters and a jetty spur off Camp Ellis Beach.

Specific activities are as follows:

Task 1 - Accident Prevention Plan

a. The Contractor shall prepare an Accident Prevention Plan (APP) specific to the work being performed. It shall include an Activity Hazard Analysis for each major phase of work. A major phase of work is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform. The analysis shall define all activities to be performed and identify the sequence of work, the specific hazards anticipated, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. The Plan shall be approved prior to any fieldwork being performed. All work shall be conducted in accordance with the APP, the U.S. Army Corps of Engineers Safety and Health requirements Manual (EM 385-1-1, 15 September 2008), and all applicable federal, state, and local safety and health requirements. A copy of EM 385-1-1 can be accessed electronically at www.usace.army.mil/inet/usace-docs/eng-manuals/em385-1-1. The Contractor shall obtain all clearances, state and local permits.

b. The APP shall detail how health and safety will be managed during the project. The APP shall address the requirements of applicable Federal, State, and local safety and health laws, rules, and regulations. The Contractor shall comply with Federal Acquisition Regulation Clause No. 52.236-13 for Accident Prevention, which is added by reference. Special attention shall focus on the requirements of the Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, Appendix A (Minimum Basic Outline for Accident Prevention Plan), Section 1 - Program Management Sub-Section 01.A.11 (page 5-6) and 01.A.13 (page 9-10), and Figure 1-2 (Activity Hazard Analysis (AHA)) (page 10). The APP shall be developed by a qualified person. The contractor shall be responsible for documenting the qualified person's credentials. Work shall not commence until the Corps Safety Office has accepted the APP and the AHA.

c. The APP shall interface with the Contractor's overall safety and health program. Any portions of the Contractor's overall safety and health program referenced in the APP shall be included in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract, the penalties for noncompliance, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.

d. The Contractor shall conduct a safety meeting at the project site on the first day of work, whenever a new activity or phase of work begins, or at least weekly during the progress of work. All safety meetings shall be documented. The safety meeting form (Appendix B) or a similar contractor-prepared form shall be used. Records of the safety briefings shall be submitted to the GDA (same as the NAE Technical Manager(s) –Kate Atwood or Marc Paiva) weekly.

e. An AHA shall be submitted for each major phase of work. A major phase of work is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform the work. The analysis shall define all activities to be performed, identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. Work shall not proceed on a phase of work until the AHA has been accepted by the GDA. A preparatory meeting shall be conducted by the contractor to discuss the AHA contents with all engaged in the activity. The preparatory meeting shall be conducted by the prime contractor and shall include all subcontractors and Government on-site representatives. The AHA shall be continuously reviewed and revised to address changing site conditions or operations as appropriate.

A draft version of the APP should be submitted to form electronically to the Safety and Occupational Health Office (sheila.harvey@usace.army.mil) and to the NAE Technical Manager. The final version should be submitted electronically along with 1 hard copy.

f. All accidents and near misses shall be investigated by the Contractor. All work-related recordable injuries, illnesses and property damage accidents (excluding on-the-road vehicle accidents), in which the property damage exceeds $2,000.00, shall be verbally reported to the GDA within 24 hours of the incident. Serious accidents as described in EM 385-1-1 Section 01.D.02 shall be immediately reported to the GDA. ENG Form 3394 shall be completed and submitted to the GDA within five working days of the incident.

The Contractor shall complete the "USACE Contractor Monthly Summary Record of Injuries/Illness and Work Hour Exposure" (for prime and its subcontractors) on the attached EXCEL spreadsheet (Appendix B and an electronic version can be obtained from USACE) and forward the completed form to the GDA no later than close of business on the 10^{th} calendar day of the following month. The method of transmission by the prime contractor to the GDA shall be electronically.

Please note that the "Monthly Record of Work-related Injuries" form is for the documentation of both job-related injuries and/or illness as well as for capturing the total number of hours the Prime contractor and its subcontractors perform work at the site. Therefore, the contractor must summarize the total number of hours worked on-site (again, for both the prime contractor and subcontractor personnel). Record the total monthly hours at the bottom of the "Monthly Record of Work-Related Injuries/Illness & Exposure" form. Use the box located on the bottom right of the form, the box labeled "Exposure Hours". This form needs to be completed on the 10^{th} day of each month for work performed the previous month. Once complete, please submit the form electronically to the Safety and Occupational Health Office (sheila.harvey@usace.army.mil) with a copy submitted to the NAE Technical Manager.

Task 2 - Remote Sensing Archaeological Survey of Camp Ellis Beach study area

Perform remote sensing archaeological survey, consisting of seafloor imaging (side scan sonar and magnetometer), and subbottom profiling (seismic reflection) within the areas being studied along Camp Ellis Beach, north of the Federal Navigation Channel in Saco, Maine.

Magnetometer, sidescan sonar, and subbottom profile line spacing should not exceed 50 feet, resulting in a total of approximately 13 nautical miles of linear magnetometer data. The study area represents the distance from the first breakwater to the north to the existing Saco North Jetty where the jetty spur is proposed. Track lines should be run to encompass both breakwaters and the jetty spur as well as the distance between each, in the event that the alignment of these structures is modified.

General research guidelines for literature review and assessment (archaeological and historic resources):

a. A literature search shall be conducted of the project area not to exceed 1 man day. This should be geared toward obtaining information pertaining to the cultural resources in the area and/or the potential of their existence. Information and data for the literature search shall be obtained but not be limited to the following sources:

(1) Published and unpublished reports such as books, journals, theses, manuscripts and dissertations.

(2) Maritime archaeological site files at local universities, the State Historic Preservation Offices, and local historical societies and museums.

(3) Consultation with qualified professionals familiar with the underwater cultural resources in the area, as well as consultation with professionals in associated areas such as history or geology, as deemed necessary.

b. Information should be included concerning any cultural resources in the proposed area that have been listed on or are potentially eligible for nomination to the National Register of Historic Places. Information gathered during the literature review may be tailored to meet the needs of the presentation required above, however, the bulk of the data shall be included in the report

All work to be accomplished will be in accordance with the Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716, September 29, 1983) and the Advisory Council on Historic Preservation's Handbook, "Treatment of Archaeological Properties" (1980).

5. QUALIFICATIONS

All personnel working on site must have the qualifications listed in the Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation as well as the standards of the state of Maine.

Task 3 – Reporting

Prepare and submit report, including (1) discussion of field work and presentation of results (field reports, magnetometer results, side scan sonar images, profiles, electronic data files, discussion of equipment and methods, etc.), (2) and archaeological assessment and survey findings, including resources identified, magnetic anomalies encountered, and, if necessary, recommendations for further investigations.

Work includes preliminary interpretation of geophysical data, technical evaluation of results with respect to project objectives, tabulated locations of wrecks, suspected wrecks, debris and debris fields. Any significant archaeological findings shall be presented, including an assessment of the current project area, preliminary statements of resource significance and the identification of anomalies requiring additional evaluation. A qualified archaeologist familiar with the area and underwater prehistoric resources shall provide an assessment of the prehistoric potential of the study area.

Submittals are as follows:

a. Draft reports. The Contractor shall submit ten copies of the draft report within 90 days of completing fieldwork The report shall be double-spaced, on 8.5 by 11 inch recycled paper with justified left margins and numbered right margins. (Figures can be submitted on 11 x 17 inch paper or as larger plans for clarity). Specific type font and format instructions will be furnished by the NAE Technical Manager. The reports should be essentially complete and include a research design, and the results of field testing and background research, and provide recommendations of potential NR eligibility.

(1) One copy of review comments from NAE shall be returned to the Contractor who shall make all necessary changes or corrections. The Contractor shall provide NAE a table indicating their response to comments and appropriate changes within 20 days of receipt of comments.

b. Final reports. The Contractor shall submit 12 copies of the single-spaced final reports on recycled paper, plus one unbound original on high quality bond paper, to NAE within 45 days of original receipt of comments. The report shall also be submitted on CD-Rom in the latest Word format as well as a PDF file in the latest Adobe Acrobat format.

(1) Photographs. The content of photographs should include, but not be limited to: environmental setting of archaeological sites, unique artifacts; and, visible evidence of cellar holes, foundations, industrial sites etc.

c. Report Contents. The draft and final reports shall include, but not be limited to, the following elements:

(1) Abstract

(2) Introduction
-brief statement of scope of study
-delineation of study boundaries
-general statement concerning the nature of the study conducted

(3) Methodology

-description of research design and sampling strategy
-quantitative and qualitative data
-brief description of information sources

(4) Text
-overview of prehistoric use of the area (pre-contact context)
-overview of historic use of the area (historic context)
-expected resource base (sites not yet discovered)

(5) Results of Survey

(6) Summary/Conclusions/Recommendations

(7) Bibliography
-includes list of personal contacts, with their addresses, affiliations, and other pertinent information

(8) Appendices
-prehistoric site forms and USGS locational maps
-historic site forms and sketch maps

d. Report Format Specifications

(1) The report shall be typed on 8 ½ x 11 inch good quality bond paper. All copies shall be made on recycled paper. A 1-inch right and left hand margin shall be used. A 1-inch top margin and a 1 ½-inch bottom margin shall be used. Larger sheets such as maps shall be folded down whenever practicable. Final reports shall be single-spaced and printed on one side of the sheet for the unbound original, both sides for copies.

(2) The title page of each report shall include the title and number of the contract, the contracting party, the principal investigator's name and date. The U.S. Army Corps of Engineers, New England District shall be listed as a secondary author of the report.

(3) All references cited and/or used shall be listed in standard American Antiquity format.

(4) The location of all sites, cities, towns, highways, rivers, and other features discussed shall be shown on an appropriate figure.

(5) Information shall be presented in textual, tabular, and graphic forms, whichever is most appropriate, effective, and advantageous to communicate necessary information. The Contractor shall give every consideration to the use of non-textual forms of presentation, particularly profile (cross-section) drawings in combination with maps to maximize the quantity and quality of information per page.

A. All tables shall have a number, title, appropriate explanatory notes, and a source note.

B. All graphic presentations, including maps, cross-sections, charts, diagrams, and other graphic forms, shall be referred to as "Figures".

C. All figures shall have a title block with the following information:
(1) Name of project and state
(2) Title of figure and date of information
(3) North arrow, scale and key if applicable
(4) Location of the project shall be clearly indicated in relation to the material presented on the figures.
(5) Figures should be 8 ½ x 11 inches whenever practicable and should be easily reproducible by standard photocopying equipment.

D. Site locations shall be shown on USGS 7.5-minute quadrangles with UTM coordinates listed.

6. PERIOD OF SERVICE:

Twelve copies of each final report covering items discussed under Task 2 shall be provided to NAE in the timeframes noted above. All background information, field and laboratory data pertaining to the project area will be included in the final report. NAE will review the report and will contact the Contractor within fourteen (14) days of receipt of the report regarding comments or corrections. One complete, unbound copy of the final report with corrections/changes and ten copies of the corrected pages for inserting in NAE's copies of the report will be submitted to NAE within forty-five (45) days of receipt of comments.

7. COST PROPOSAL:

The Contractor shall submit their cost estimate separating out the work outlined above by individual task. The cost proposal submitted by the Contractor in response to this scope of work shall indicate separately the supplies/services cost estimate for each separate task described in the scope of work including project management.

8. INVOICING:

The Contractor shall submit monthly invoices that include progress for the billing period, project activity for the next period, outstanding issues, financial status and schedule. Invoices shall reference the Contract Number and Task Order number. The Contractor shall be responsible for the accuracy of the invoices. Incorrect invoices may be returned for correction.

9. MATERIALS TO BE PROVIDED SEPARATELY BY THE GOVERNMENT:

NAE will also provide drawings, maps, engineering and environmental data, and any other materials to the extent that NAE determines necessary in order to meet the objectives of the study.

10. PROJECT COORDINATION

The Contractor shall contact the NAE Technical Manager (TM) each week when fieldwork is ongoing and during report preparation and provide a verbal progress report, and anytime, should problems be encountered. Reports shall be made, and any questions regarding this work shall be directed to the NAE Technical Manager, Marc Paiva at 978-318-8796. NAE reserves the right to observe work in progress.

11. RELEASE OF DATA

All data, reports, and materials obtained as a result of this contract shall become property of the U.S. Government and shall be turned over to the Contracting Officer, NAE Office, upon completion of the contract and cannot be released prior to written permission from NAE.

Publications that include data generated for NAE projects are permitted with NAE personnel cited as lead authors.

12. CURATION

All materials recovered during the course of fieldwork shall be cleaned, catalogued (curated), and maintained by the Contractor. The Contractor will provide temporary curation until the U.S. Army Corps of Engineers has designated a permanent repository for curation in a facility meeting the requirements of 36 CFR 79.

13. QUALITY CONTROL

The Contractor shall be held responsible for the quality of the services provided and for all damages caused the Government as a result of their negligence in the performance of any services under this contract. Although the Government performs technical reviews of all submissions required by the contract, it is emphasized that all work shall be executed using proper internal controls and review procedures. Certification of internal review and coordination procedures shall be provided along with the letter of transmittal for each submission from the contractor to insure (a) completeness for each discipline commensurate with the level of effort required for that submission, (b) elimination of conflicts, errors and omissions, and level of effort required for that submission, and (c) the overall professional and technical accuracy of the submission. Documents that are significantly negligent in any of these areas will be returned for correction, prior to completion of our review. Contract submission dates will not be extended.

APPENDIX A

SACO RIVER AND CAMP ELLIS BEACH SHORE DAMAGE MITIGATION PROJECT, SACO, MAINE
PROJECT INFORMATION SHEET

Project Information Sheet

US Army Corps of Engineers.
New England District

Saco River and Camp Ellis Beach Shore Damage Mitigation Project Saco, Maine

February 12, 2008 696 Virginia Road, Concord, Massachusetts 01742-2751

PROJECT NAME: Saco River and Camp Ellis Beach, Post Feasibility Study

AUTHORITY: Section 111 of the River and Harbor Act of 1968.

CONGRESSIONAL DISTRICT: Maine – 1st (Allen)

LOCATION AND DESCRIPTION: Camp Ellis Beach is located in Saco, Maine, about 16 miles south of Portland, Maine. The Saco River Federal Navigation Project consists of an 8-foot deep channel that varies from 100 to 200 feet wide. The channel is protected by a 4,800-foot long jetty to the south, and a 6,600-foot long jetty to the north. Camp Ellis Beach lies adjacent to the north jetty and extends 2,500 feet north to Ferry Beach.

Figure 1 – Saco River and Camp Ellis Beach

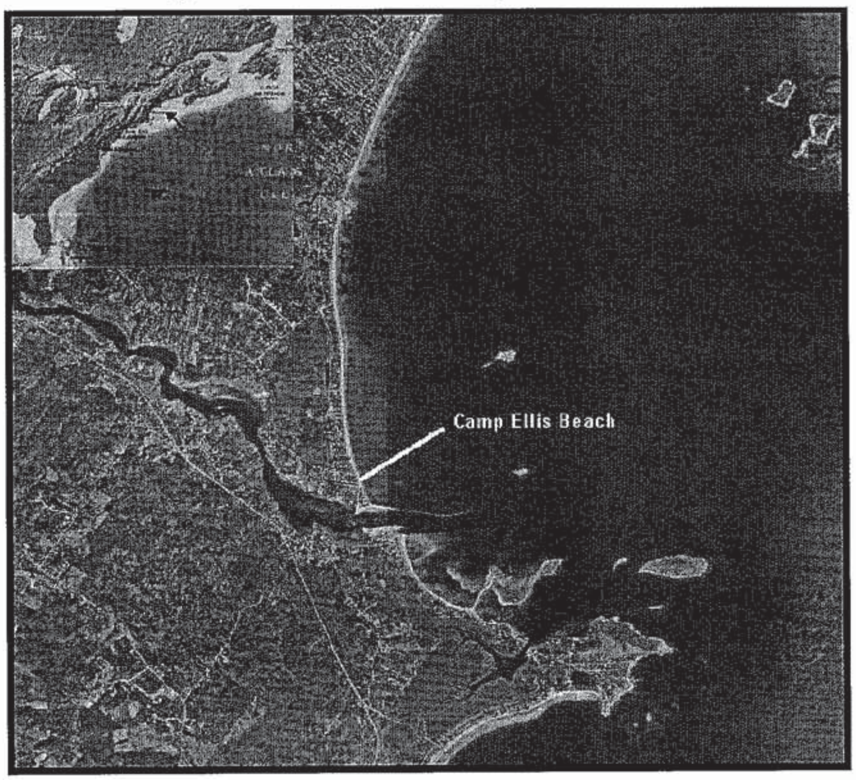
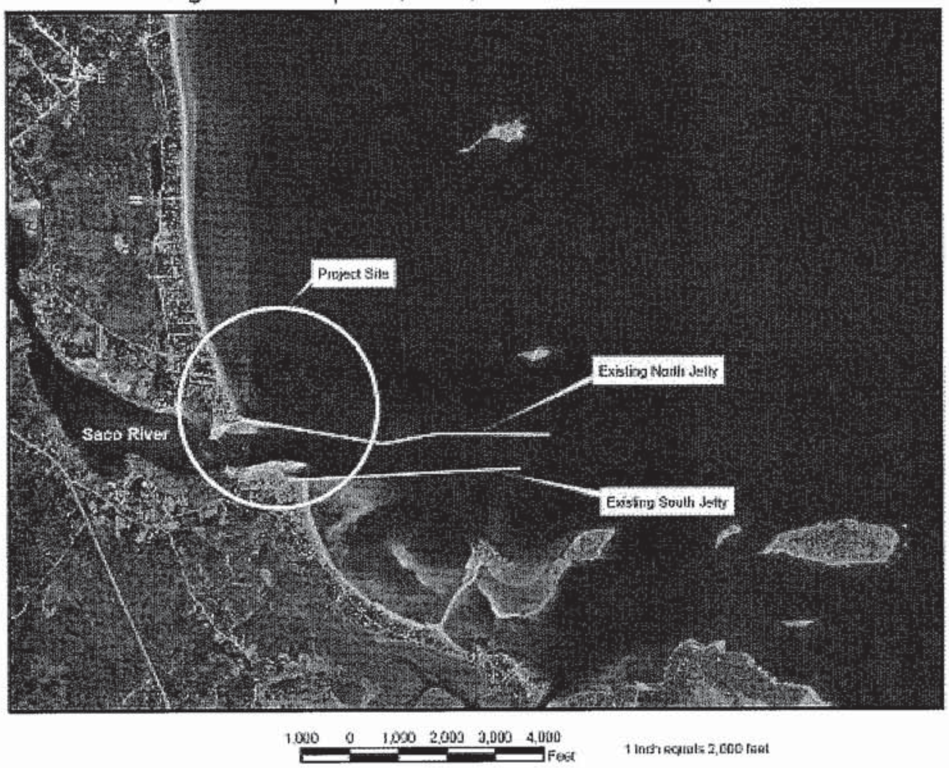


Figure 2 - Camp Ellis, Saco, Maine - Location Map



EXISTING PROBLEM AND BACKGROUND: Coastal storms have caused severe shoreline erosion along Camp Ellis Beach and the loss of over 30 homes. At the request of the city of Saco, the New England District is conducting a study to find a remedy to this ongoing erosion. Alternative solutions are being analyzed using a computer model developed by Woods Hole Group under contract to the Corps. The model is examining the effects of structures, including jetty spurs, breakwaters and T-groins, on wave climate, currents and erosion. Subsurface borings have also been taken in the Saco Bay area to assess foundation conditions. Soft clay was found under a large portion of the study area and resulted in a reanalysis of alternative solutions.

STATUS: Subsurface borings were completed in mid-November 2005, and modeling efforts were complete, including internal reviews, by early January 2006. The results of these efforts were provided to the City and State in January 2006, and at a public information meeting held in Saco on February 22, 2006. These studies indicated that a plan consisting of a 750-foot long spur jetty and periodic beachfill was the optimal Federal plan (see Figure 3). Local Interests prefer a plan with a 500-foot spur jetty, two nearshore breakwaters and less frequent beachfill (see Figure 4). Modeling of this final locally preferred plan is complete and design of project features is underway. Activities for the remainder of fiscal year 2007 and into fiscal year 2008 include completion of these design efforts, and preparation of a decision document and environmental assessment. As this project will exceed the $5 million statutory cap under Section 111 authority, Congress provided specific authority in the Water resources Development Act of 2007 to exceed this limitation. This Act authorized a maximum Federal expenditure of $26,900,000 for work under Section 111 at Camp Ellis. Fiscal year 2008 activities will include completion of design efforts, and preparation of a decision document and environmental assessment

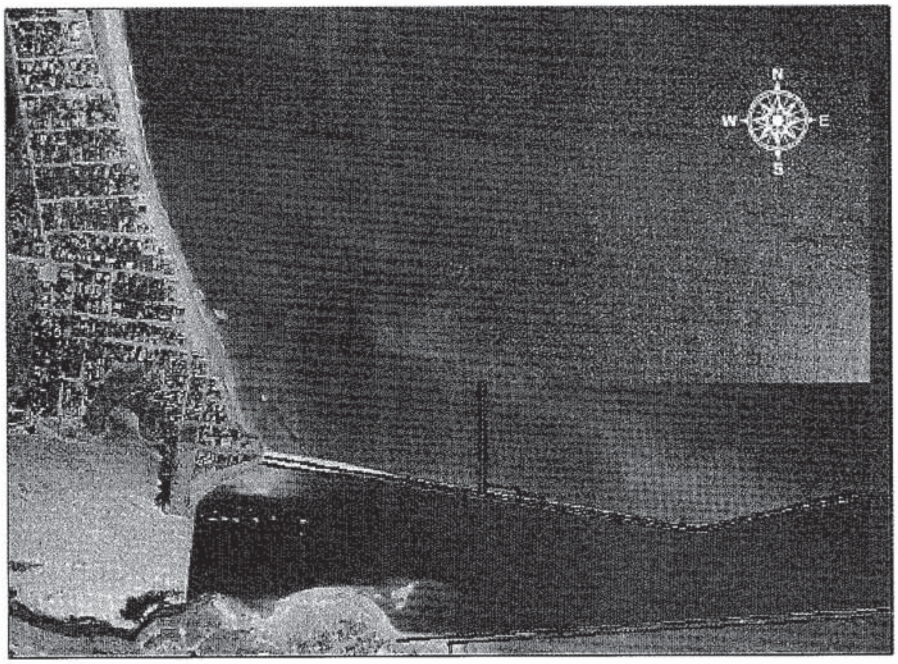


Figure 3 – Optimal Federal Plan

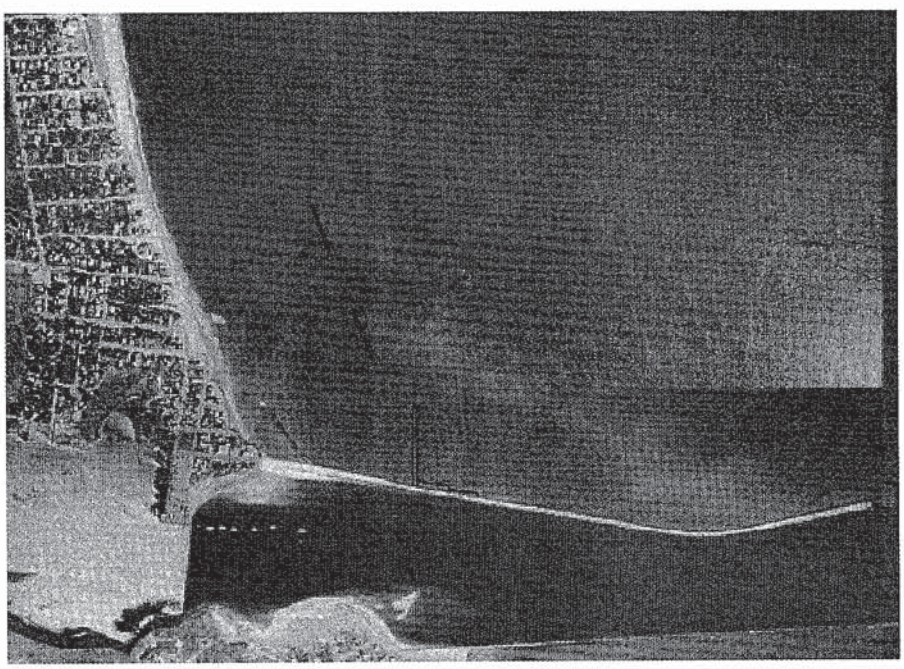


Figure 4 – Locally preferred Plan

<u>CONGRESSIONAL INTEREST</u>: Senators Collins and Snowe, and Representative Allen. The delegation has hosted two site visits by John Woodley, Jr., Assistant Secretary of the Army for Civil Works.

APPENDIX B

SAFETY MEETING AND RECORD OF ACCIDENTS TEMPLATES

WEEKLY SAFETY MEETING

Date Held: ______________________
Time: __________________________

CONTRACTOR: ______________________ Contract No. DACW33-
PERSONNEL PRESENT (check): Contractor ____ Sub. ____ Government ____

SUBJECTS DISCUSSED (check items that were discussed during meeting):

USACE EM385-1-1 ______ (Specific sections: ______________________)
On-site Accident Prevention Plan (or Site Safety and Health Plan) ______
Individual protective equipment (steel-toed boots, safety glasses, etc..) _____
Prevention of slips/falls _____
Back injury/safe lifting techniques _____
Fire prevention _____
First aid _____
Tripping hazards _____
Equipment inspection and maintenance _____
Hoisting equipment, winch and crane safety _____
Ropes, hooks, chains, and slings _____
Water safety _____
Boat safety _____
HAZMAT, Toxic hazards, contaminated sediments, MSDS, respiratory, ventilation _____
Biological hazards (poison ivy, ticks, wasps, mosquitoes etc) ______
Staging, ladders, concrete forms, safety nets, handrails ____
Hand tools, power tools, machinery, chain saws _____
Vehicle operation safety _____
Electrical grounding, temporary wiring, GFCI _____
Lockouts/safe clearance procedures _____
Welding, cutting _____
Excavation hazards/rescue _____
Loose rock/steep slopes _____
Explosives _____
Sanitation and waste disposal _____
Clean-up, trash _____

Other safety issues of concern specific to contract that was discussed during meeting:

All persons attending meeting the meeting must sign below or on the back of the form.

Contractor Representative Signature ___________________________ Date: _______
CE Inspector/QA (if present at meeting) _________________________ Date: __________

US Army Corps of Engineers

USACE PRIME CONTRACTOR
Monthly Record of Work-Related Injuries/Illnesses & Exposure

Month ________
Year ________

USACE Command ________
Contractor Name ________
Contract Number ________
Project Title ________
City ________ State ________
USACE Office Overseeing Work:

In accordance with the provisions of EM 385-1-1, Section 01 Program Management, Paragraph 01.D Accident Reporting and Recording, sub-paragraphs 01.D.05, you (the Prime Contractor) shall provide a monthly record of all exposure and accident experience incidental to the work (this includes exposure and accident experience of the Prime Contractor and its sub-contractor(s). As a minimum, these records shall include exposure work hours and a record of occupational injuries and illnesses that include the data elements listed below. Definitional criteria for each data element is found in 29 CFR Part 1904. If the maintenance of OSHA 300 Logs are required by OSHA, most of this information can be obtained from those logs. If data on log provided below is revised after it is submitted to USACE, Contractor shall provide a revised report to the GDA. You must complete the USACE ENG Form 3394, Report of Accident Investigation Report for all recordable accidents. If you're not sure whether a case is recordable, call your local Safety and Occupational Health Office for help.

Identify the person							Describe The Case		Classify the case											
									Using these categories, check ONLY the most serious result for each case:				Enter the number of days the injured or ill worker was:		Check the "injury" column or choose one type of illness: (M)					
(A)		(B1)	(B2)	(B3)	(C)	(D)	(E)	(F)			Remained at work									
Company Name	Prime or Sub (P or S)	Age	Gender	Date Employee Began Work on Job Covered by Contract	Job Title (e.g., Welder)	Date of injury or onset of illness (mo./day)	Where the event occurred (e.g. Loading dock north end)	Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	Death	Days away from work	Job transfer or restriction	Other record-able cases	On job transfer or restriction (days)	Away from work (days)	Injury	Skin Disorder	Respiratory Condition	Poisoning	Hearing Loss	All other Illnesses
									(G)	(H)	(I)	(J)	(K)	(L)	(1)	(2)	(3)	(4)	(5)	(6)
									0	0	0	0	0	0	0	0	0	0	0	0

For Government Use Only

TYPE OF WORK ACTIVITY (Choose One):

Construction	☐	Environmental Remed.	☐
Opn & Main.	☐	Superfund	☐
Eng. Services	☐	FUDS	☐
Dredging	☐	IRP	☐
Rsch. & Dev.	☐	FUSRAP	☐
Emerg. Opns.	☐	Ordinance/Expl. Cleanup	☐
Other	☐	Environmental Other	☐

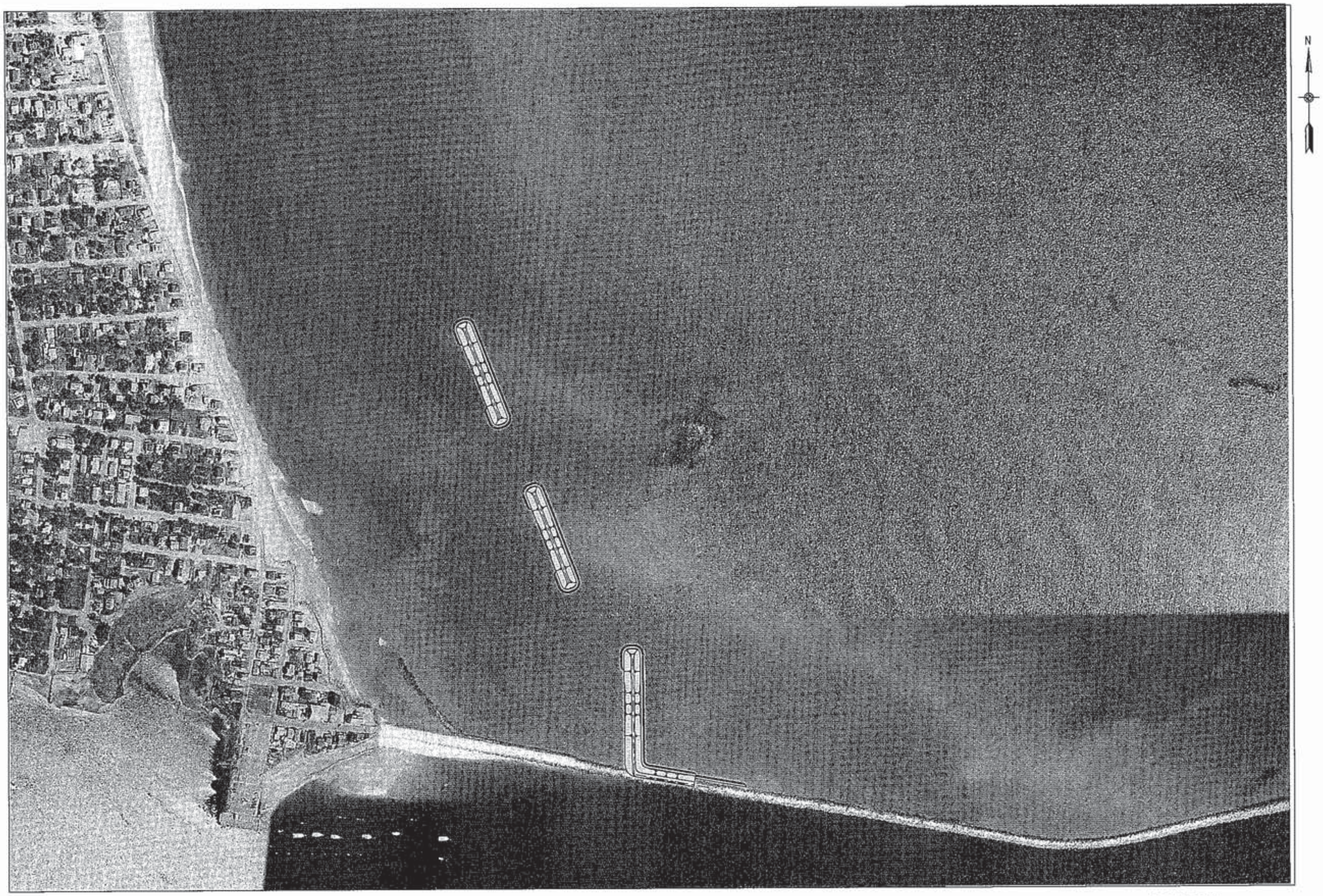
Type of Contract (Choose One):

Civil Works	☐
Military Programs	☐
Other	☐

Exposure Hours	
Month	
Year to Date	

Certification of Record

Name of Person Submit. Record ________
Signature ________
Date ________



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GRAPHIC SCALE:
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1" = 200'

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U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

DESIGNED BY: X.X.X. DATE:
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SUBMITTED BY: X.X.X. CONTRACT NO.:
FILE NAME: DRAWING CODE:
SIZE: ANSI D PLOT SCALE: PLOT DATE:

BREAKWATER
SACO, MAINE

ALTERNATIVE 25A
PLAN

SHEET IDENTIFICATION NUMBER
C-101
SHEET 1 OF 1

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PLAN

SCALE: 1" = 200'

GRAPHIC SCALE:
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1" = 200'

US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT

MARK	DESCRIPTION	DATE	APPR.	MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS

DESIGNED BY: | DATE:
DWN BY: | CKD BY: | SOLICITATION NO.:
SUBMITTED BY: | CONTRACT NO.:
FILE NAME: | DRAWING CODE:
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BREAKWATER
SACO, MAINE

ALTERNATIVE 6A
PLAN

SHEET IDENTIFICATION NUMBER
C-102

SHEET OF 1

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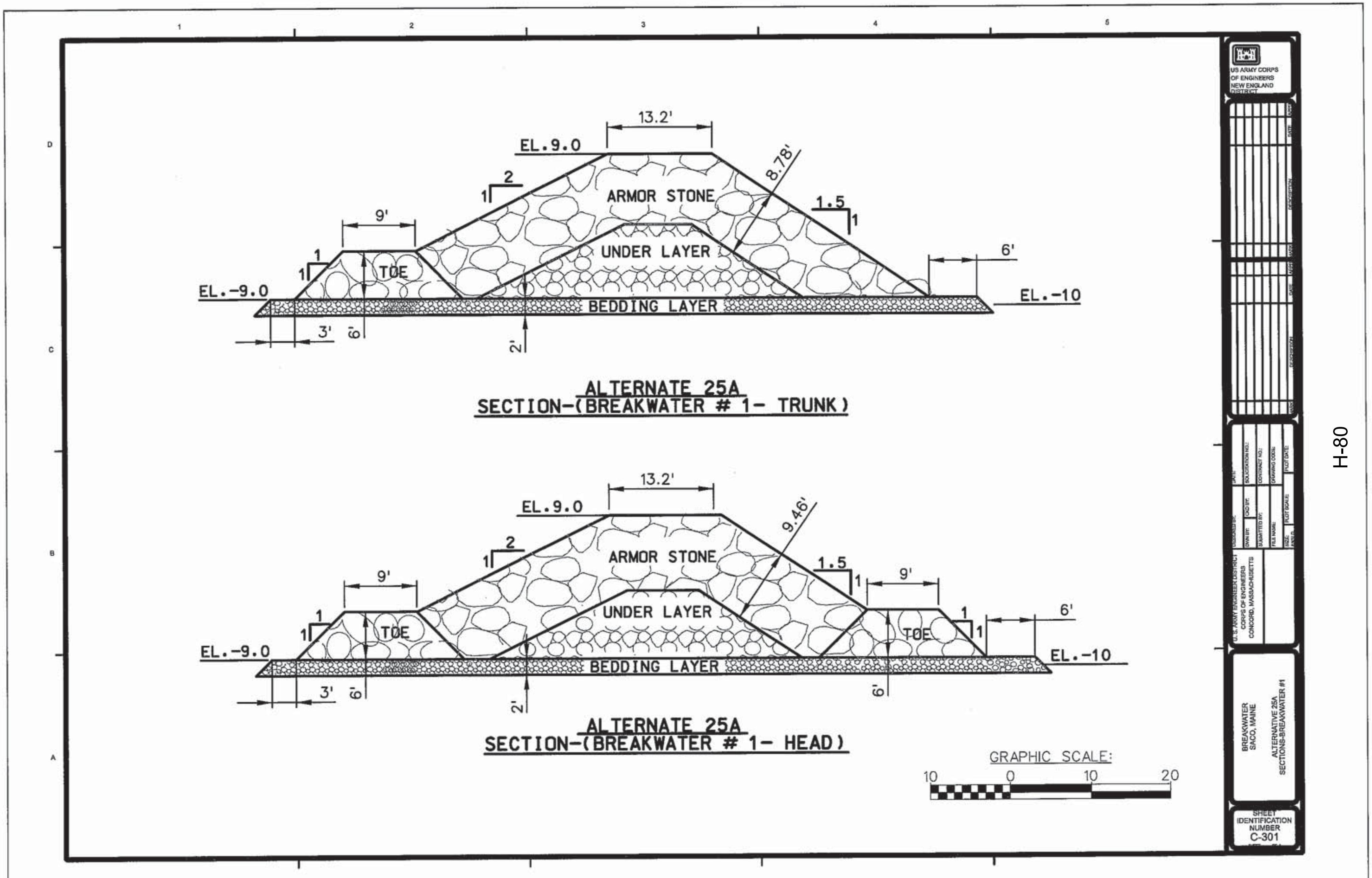
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ALTERNATE 25A
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ALTERNATE 25A
SECTION-(BREAKWATER # 1- HEAD)
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US ARMY CORPS OF ENGINEERS NEW ENGLAND DISTRICT
BREAKWATER SACO, MAINE
ALTERNATIVE 25A SECTIONS-BREAKWATER #1
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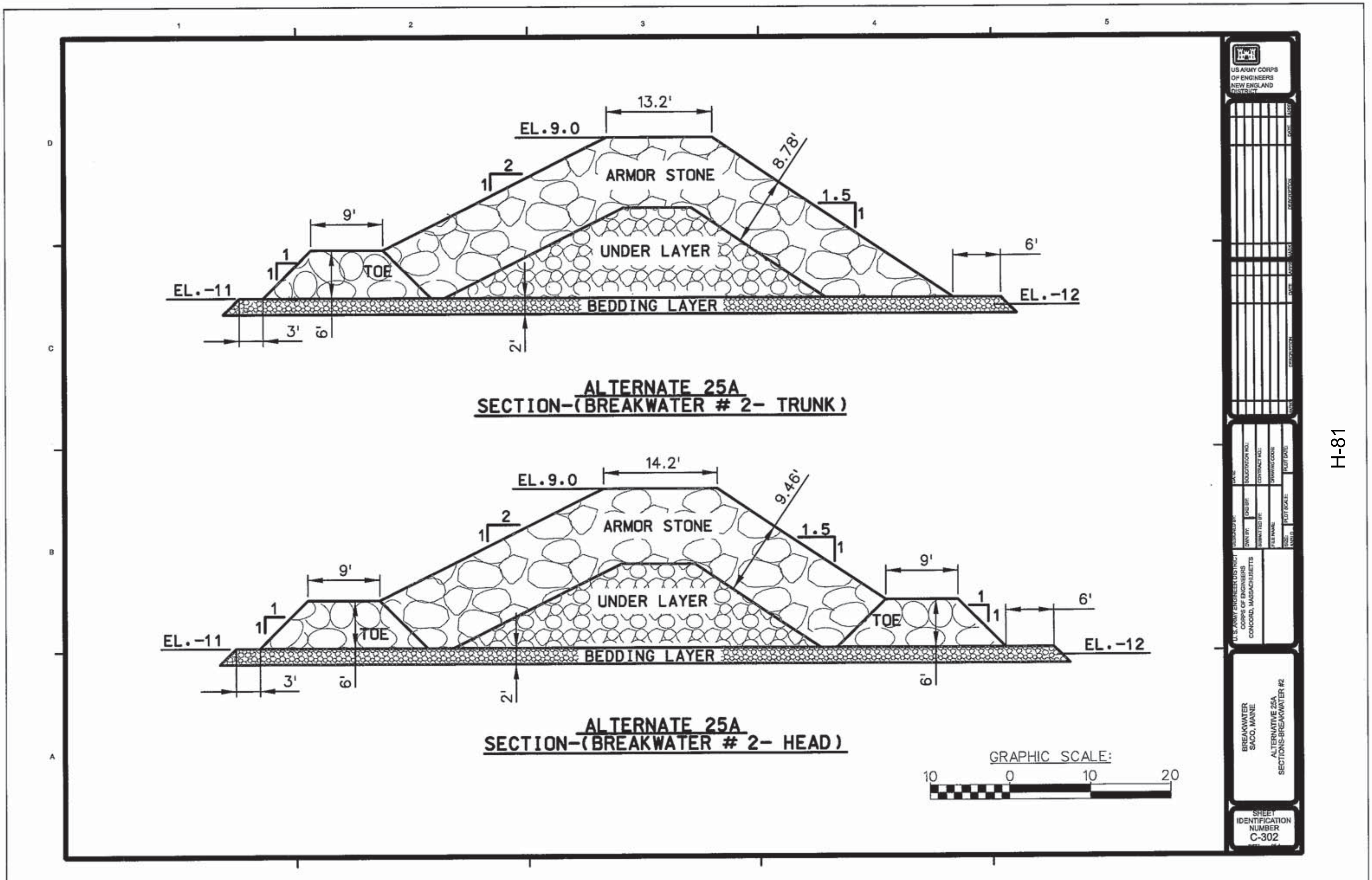
C-301

H-80



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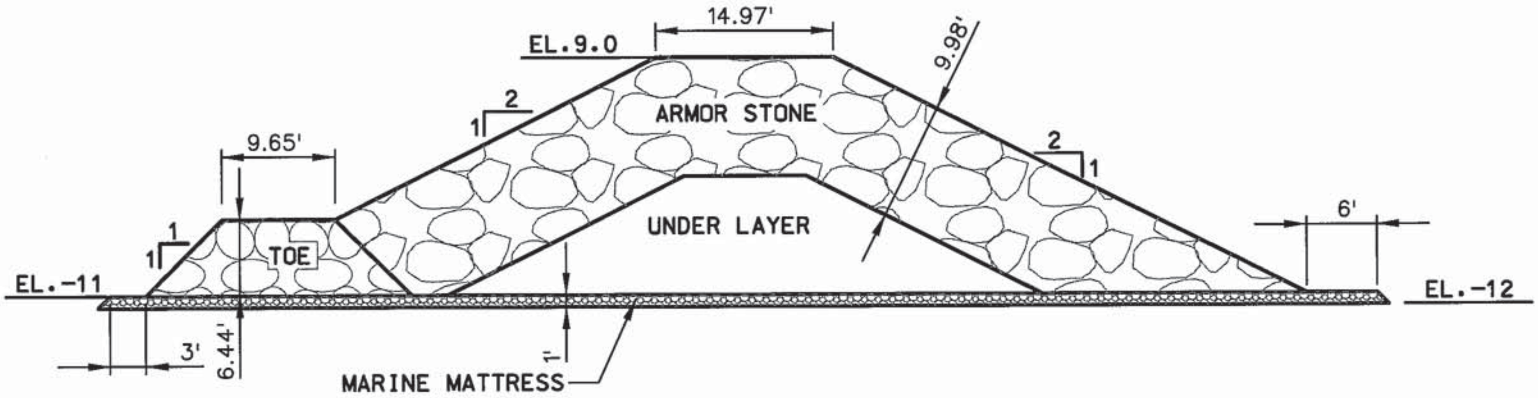

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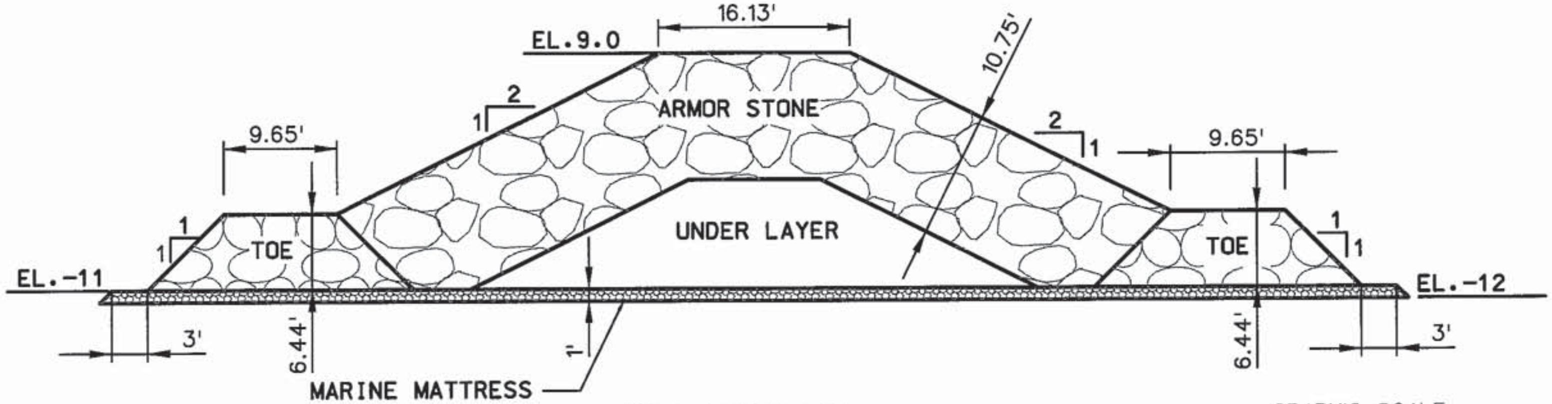

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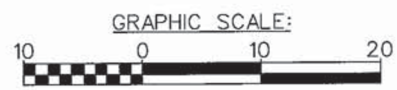


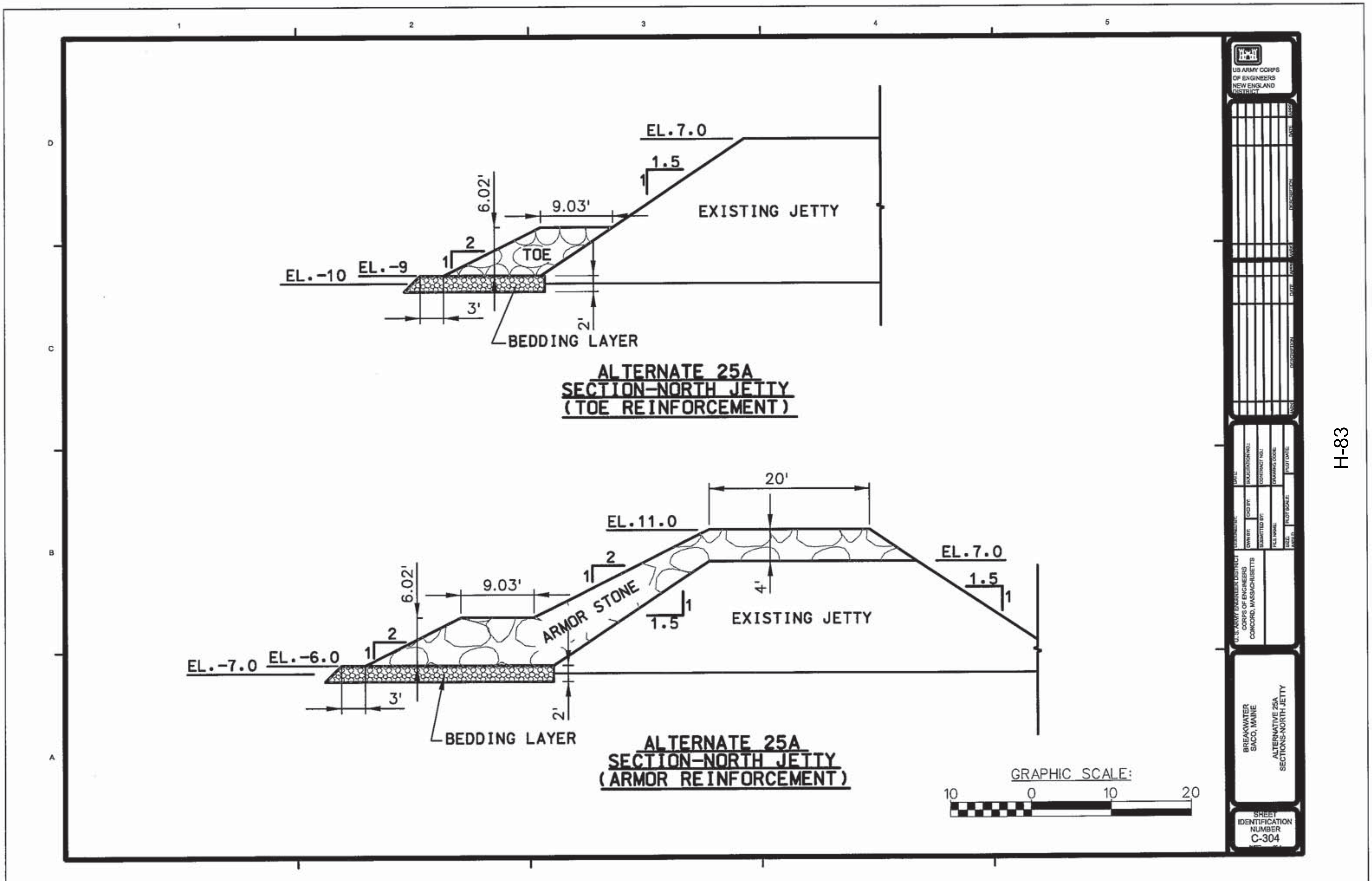
US ARMY CORPS OF ENGINEERS NEW ENGLAND DISTRICT

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS CONCORD, MASSACHUSETTS

BREAKWATER SACO, MAINE

ALTERNATIVE 25A SECTIONS-SPUR

SHEET IDENTIFICATION NUMBER C-303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ALTERNATE 25A
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(TOE REINFORCEMENT)
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6.02'
9.03'
ARMOR STONE
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4'
EXISTING JETTY
EL.-7.0
EL.-6.0
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3'
2'
BEDDING LAYER
ALTERNATE 25A
SECTION-NORTH JETTY
(ARMOR REINFORCEMENT)
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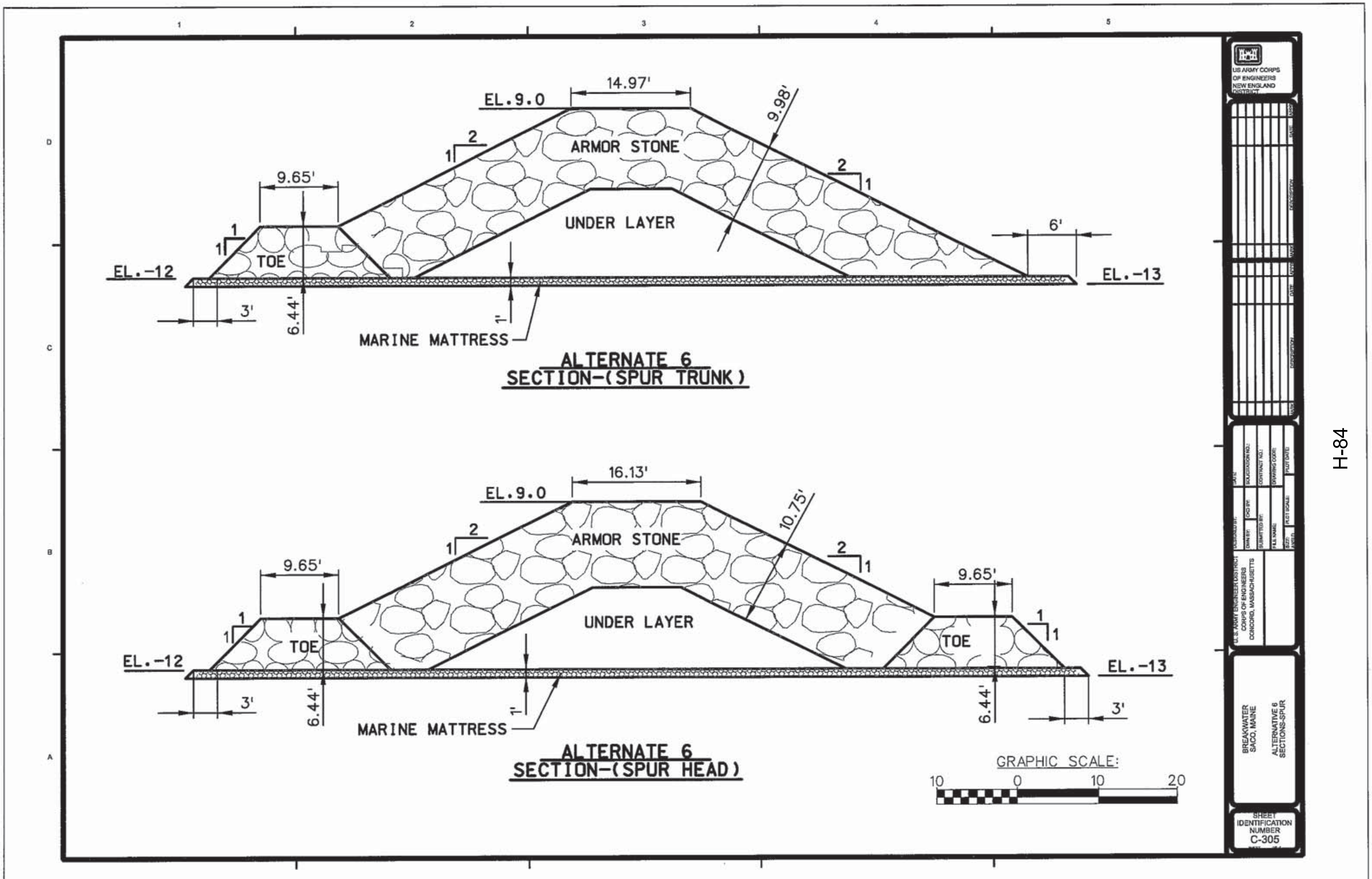
US ARMY CORPS
OF ENGINEERS
NEW ENGLAND
DISTRICT
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS
BREAKWATER
SACO, MAINE
ALTERNATIVE 25A
SECTIONS-NORTH JETTY
SHEET
IDENTIFICATION
NUMBER
C-304



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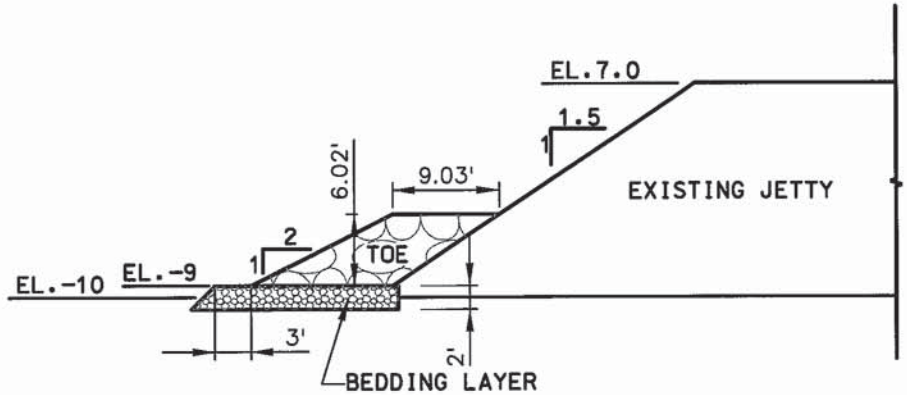

ALTERNATE 6
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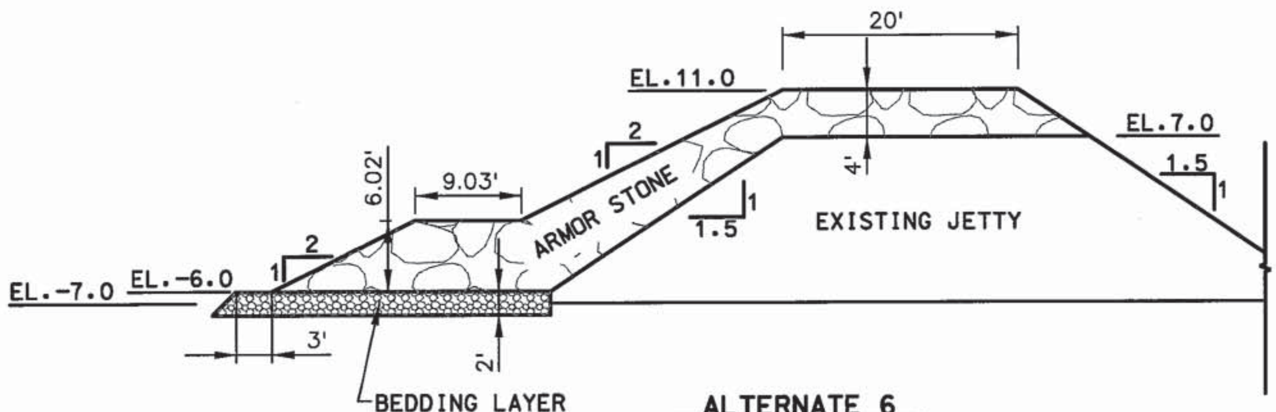
(TOE REINFORCEMENT)



ALTERNATE 6
SECTION-NORTH JETTY
(ARMOR REINFORCEMENT)

GRAPHIC SCALE:
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US ARMY CORPS OF ENGINEERS NEW ENGLAND DISTRICT

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS CONCORD, MASSACHUSETTS

BREAKWATER SACO, MAINE

ALTERNATIVE 6 SECTIONS-NORTH JETTY

SHEET IDENTIFICATION NUMBER C-306

APPENDIX B:

CRE SURVEY REPORT

CR ENVIRONMENTAL, INC.
Ecological and Oceanographic Consultants

March 13, 2010

Mr. David Robinson
Fathom Research LLC
Suite 315 1213 Purchase Street
New Bedford, MA 02536

Re: Hydrographic and Geophysical Surveys, Camp Ellis, Saco Maine

1.0 INTRODUCTION

CR Environmental, Inc. (CR) performed bathymetric, side-scan sonar, sub-bottom sonar and magnetic surveys adjacent to the jetty and breakwater on the northern side of the mouth of the Saco River in Saco, ME on November 4, 2009. The surveys were conducted in order to document existing seabed morphometry and to aid an archaeological investigation being conducted by Fathom Research, LLC.

The survey area was conservatively designed to provide full seabed coverage within a 500 foot buffer surrounding potential installation locations of wave break structures identified on a CAD plan provided by ACOE. This report summarizes survey and processing methods and presents the results of the geophysical survey.

2.0 GEOPHYSICAL SURVEY METHODS

The survey and sampling operations were performed from CR's aluminum survey and sampling vessel, the *R/V Lophius*. This vessel is equipped with a 200 horsepower gas outboard, 4-man cabin, over-the-side transducer mounts, 1kW generator, GPS antenna brackets, and a hydraulic A-frame.

Using HYPACK MAX hydrographic survey software, a set of survey transects spaced 50 feet apart was digitally created and these planned lines were occupied by the survey vessel. Background imagery including an electronic nautical chart and orthophotos obtained from USGS were also imported to HYPACK to aid survey design and real-time analysis. The primary transects were augmented by perpendicular "cross-tie" transects spaced 200-feet apart to allow verification and statistical analyses of bathymetric data accuracy.

Navigation for all aspects of the survey work was accomplished using a Trimble AgGPS 132 12-channel channel Differential Global Positioning System (DGPS) capable of receiving the U.S. Coast Guard (USCG) Beacon corrections and the OMNISTAR subscription-based satellite differential correction service. The DGPS consistently provided a digital output of positions accurate to less than 1.0 meter. The DGPS system

639 Boxberry Hill Road, East Falmouth, MA 02536
Phone/fax 508 563-7970 www.crenvironmental.com

was interfaced to a laptop computer running HYPACK MAX hydrographic survey software. HYPACK continually recorded vessel position and depth data in the Maine West State Plane grid, NAD83 (US Survey Foot), and provided a steering display for the vessel captain.

2.1 Bathymetric Survey

The bathymetric data acquisition system consisted of an ODOM CV-100 precision digital echosounder and DGPS interfaced via Ethernet and serial connections to a laptop computer running HYPACK hydrographic survey software. The echosounder's transducer was mounted to the rail of the survey vessel amidships using a high strength adjustable boom. The DGPS antenna was attached to the top of the transducer boom, eliminating the need to correct for horizontal offsets. The transducer depth below the water surface was checked and recorded at the start and end of the survey.

Echo sounder accuracy was verified at the start and end of the survey by comparing echo sounder water depth measurements to known water depths obtained using a surveyor's staff and the "bar check" method. For the bar check method, a metal plate was lowered beneath the echo sounder's transducer to several known distances (i.e., 5.0, 10.0 and 15.0 feet) below the water surface. These calibrations were consistently accurate to within 0.1 feet throughout the survey. Additional calibrations were conducted by collecting water column profiles of sound velocity calculated based on measurements of temperature and salinity performed using a Seabird SBE19 water quality profiler.

ACOE requested that bathymetric data be vertically referenced to NAVD88. Vertical control for the bathymetric survey was provided by ACOE and consisted of a National Ocean Service (NOS) survey disk (#8606A) located on the Camp Ellis fishing pier. The elevation of this control point was reported as 10.36 feet NAVD88. An Insitu, Inc. Leveltroll pressure gage was installed adjacent to the disk and a series of water surface elevations was acquired using a six-minute recording interval.

2.2 Bathymetric Data Processing Methods

Bathymetric data were processed using the HYPACK Single-Beam Processor Module. Components of bathymetric processing included removal of outlying soundings associated with water column interference (e.g., fish, vegetation or mid-water column debris) and conversion of soundings to elevations based on recorded tide data. Data were exported from HYPACK as a delimited ASCII text file, with columns for Easting (X), Northing (Y), and Elevation (Z).

This data set was imported to Golden Software, Inc. Surfer V.9.1 Surface Modeling Software. A grid of seabed elevations was created using a triangulation interpolation method and a 20-ft node interval. A contour map depicting bottom elevations using a 0.5-ft contour interval was created from this grid. A relief map was created using conventional hydrographic spectrum shading and 5-fold vertical exaggeration. This map was exported as a georeferenced TIF image file and incorporated into an ESRI ArcGIS project for comparison with other data layers.

Statistical analysis of 255 co-located soundings collected along perpendicular tracklines demonstrated a mean difference between measurements of 0.13 feet (standard deviation = 0.267 feet), likely a result of acquisition in extensive fields of shore-parallel sand waves (see Section 3.2). The 95th percentile confidence interval surrounding the mean difference between compared soundings was calculated as 0.033 feet.

2.3 Side-Scan Sonar Data Acquisition

Side scan sonar data were acquired using an Edgetech, Inc. 4100-P system. The system consisted of an Edgetech 272 TD towfish interfaced to a topside processor via an Analog Control Interface (ACI) circuit. The ACI allowed adjustment of both port and starboard signal gains as judged necessary by the sonar operator. Control of the ACI and sonar signal settings was accomplished using Chesapeake Technology, Inc. SonarWizMAP acquisition software.

Sonar data were collected using a 500-kHz frequency and 82 ft (25 meter) range scale. Data were acquired along all primary survey transects (spaced 50 feet apart) to ensure >200-percent insonification of the bottom (i.e., all portions of the seabed were imaged at least twice). The towfish was deployed from the vessel's bow A-frame and the position of the towfish relative to the DGPS antenna was recorded to allow correction during processing. A draft sonar mosaic was produced in real-time during the survey to ensure adequate survey coverage and to allow identification of noteworthy features.

2.4 Side Scan Sonar Data Processing

Side scan sonar data were processed using a combination of Chesapeake Technology, Inc. SonarWiz software and HYPACK's implementation of GeoCoder software developed by NOAA's Center for Coastal and Ocean Mapping Joint Hydrographic Center. SonarWiz was used to examine raw sonograms and to digitize and measure bottom features of interest. GeoCoder was used to create a mosaic best suited for substrate characterization through the use of innovative beam-angle correction algorithms. Sonar data processed using SonarWiz has been projected to the Maine West State Plane grid (NAD83, US Foot). The mosaic created using Geocoder was projected to UTM Zone 19 North (NAD83, US Foot).

Processing of raw side scan sonar data in each software suite consisted of adjustments of data for signal attenuation and georeferencing of sonar imagery (i.e., projection of the sonar data into real-space coordinates). Additional details regarding processing methods are provided below, and results are presented in Section 3.2.

For both processing approaches, water column portions of the acoustic returns were removed during the inspection of each survey transect. Data were then adjusted for signal attenuation with distance using moderate Time Varied Gain (TVG) corrections. Finally, georeferenced transect data and mosaics were created from these processed data.

Sonar resolution is defined as the ability of the sonar system to discriminate between two adjacent objects of a particular size and separation. This resolution decreases with increasing range from the sensor due to signal spreading. The theoretical resolution of the side scan sonar data is determined by swath width (range setting), frequency, beam width, ping duration, and vessel speed. Data collected for this survey using a 500 kHz frequency and 25 meter range has a resolution of approximately 5 to 25 cm (~2 to 10 inches) depending on the range. The resolution of the final georeferenced sonar mosaic was set to 0.4 ft per pixel (about 15 cm). Note that sonar "waterfall" image (uncorrected raw data) resolution was not constrained by this pixel size determination. The mosaic was incorporated into a GIS database for comparison with other data (e.g., bathymetry).

2.5 Magnetic Data Acquisition

Magnetic data were collected simultaneously with other data along the same set of survey transects. Magnetic data were acquired using a Marine Magnetics, Inc. MiniExplorer high resolution marine magnetometer system. The magnetic data acquisition system consisted of towfish-mounted Overhauser magnetic sensor and a pressure/depth sensor, an onboard power supply and serial interface, and a data acquisition computer. The 1 Hz data stream from the magnetic sensor was routed to the HYPACK navigation computer via serial port. HYPACK recorded magnetic readings in nanoTeslas (nT – 1 nT = 1 gamma) as a separate field within the same raw data file containing bathymetric soundings. The position of the magnetometer towfish was calculated in real-time using a HYPACK mobile device driver which considered "cable out" relative to the DGPS antenna, the cable catenary curve, and the effects of vessel course corrections.

The magnetometer towfish was kept as close to the seabed as practical. The sensor was consistently deployed at a great enough distance from the survey vessel to preclude the potential for magnetic interference from the hull or the vessel's electronics.

2.6 Magnetic Data Processing

Magnetometer data were processed using HYPACK's Single-Beam Processor Module. Each magnetic survey transect was first inspected in profile format for characteristic signals which indicate the presence of ferrous anomalies. Processed magnetic measurements were merged into a single ASCII comma-delimited database containing all total field (TF) magnetic intensity measurements for the survey area. The database contained fields for Northing, Easting, and magnitude. This combined data set was imported to Golden Software, Inc. Surfer V.9.1 Surface Modeling Software. A grid of magnetic intensity was created using triangulation interpolation methods and a 10 ft node interval. A contour map was created from this grid depicting TF magnetism using a 1-gamma contour interval and the map was exported in SHP and DXF formats. A second map was created using spectrum shading and this map was exported as a georeferenced TIF image file.

2.7 Sub-Bottom Sonar Data Acquisition

Sub-bottom data were collected using a SyQwest 10-kHz Stratabox sub-bottom profiling system on the same set of survey transects used for bathymetric acquisition. The Stratabox system consists of a cone-shaped transducer mounted to a vertical boom on the amidships rail, an on-board signal processor and amplifier, and a data acquisition computer. Data were recorded using proprietary StrataBox software running on a dedicated laptop computer. The computer was interfaced to the DGPS through a serial port. Offsets between the transducer and the DGPS antenna were recorded to allow for position correction during data processing.

2.8 Sub-Bottom Sonar Data Processing

Stratabox 10 kHz profile data were processed using Chesapeake Technology's SonarWeb software. Appropriate adjustments to TVG were made during processing. Sub-bottom profiles were exported in JPG format with accompanying HTML-navigable indices and GIS shapefiles (polygons) of transect navigation data, with the width of the polygons corresponding to sonar range settings. Two profile segments were selected and annotated to illustrate data quality, penetration and sub-surface geology. All sub-bottom data products have been projected to the Maine West State Plane grid (NAD83, US Foot).

3.0 BATHYMETRIC AND GEOPHYSICAL SURVEY RESULTS

3.1 Bathymetric Results

A bathymetric contour map of the survey area is presented on Figure 1. Soundings were successfully collected from approximately NAVD88 El. -5.4 feet to El. -14 feet (approximately +0.15 feet MLLW to -8.75 feet MLLW). The bathymetric data has been statistically demonstrated to have an uncertainty of less than +/- 0.2 foot.

3.2 Side Scan Sonar Results

A side scan sonar mosaic and the locations of digitized sonar Contacts are shown on Figure 2. Sonar contacts of potential anthropogenic origin were digitized and are depicted and described Appendix A. For some objects, multiple (redundant) images and measurements have been provided using data collected along adjacent track lines.

A ledge outcrop was observed along the eastern boundary of the survey area. Side scan sonar data suggest that the dominant surficial substrates within the survey area are fine sands. The data suggests that surficial sands are finer in the northern half of the survey area. Sand ripples and low magnitude waves were widespread (e.g., see Appendix A, Contacts SS-0001, SS-0010). The wavelengths and amplitudes of most sand waves were approximately 2 feet, and 0.2 – 0.6 feet, respectively. Some of the sonar contacts appear to be associated with the reported location of drilling barge wreckage and debris (see Contacts SS-0005, SS-0006, and SS-0010).

3.3 Magnetic Survey Results

A map depicting survey area magnetism, magnetic measurements (track lines), and magnetic anomalies digitized during profile inspection is presented as Figure 3. The side scan sonar mosaic and Contacts are included on this Figure to allow comparison of data sets. Details describing digitized magnetic anomalies are provided on Table 1.

Magnetic anomalies M-6 and M-9 appeared to be associated with the barge wreckage described above. Many of the other magnetic anomalies in the southern portion of the survey area were of low magnitude and duration and may be associated with smaller debris from this drilling barge. The map of total field magnetism identified two roughly northeasterly trending magnetic “ridges”associated with underlying geology.

3.4 Sub-Bottom Sonar Results

The sub-bottom sonar system penetrated approximately 2 to 5 feet of sediment throughout the majority of the survey area. Penetration was substantially greater in two regions of the survey area. An isopach map depicting acoustic basement in these regions of the survey area is presented as Figure 4. This map also identifies the two transect segments selected for annotation (see Figure 5).

4.0 ELECTRONIC DELIVERABLES

A project DVD is enclosed, and includes this letter report, figures, geophysical data in HTML navigable and GIS/CAD compatible formats, and bathymetry in CAD and GIS compatible DXF format. Bathymetric point data is included in ASCII text format.

It was a pleasure working with Fathom on this project. Please feel free to contact us if you have any questions regarding the report or data products.

Sincerely,
CR Environmental, Inc.

Christopher F. Wright
Senior Hydrographer

John H. Ryther Jr.
Marine Operations Manager

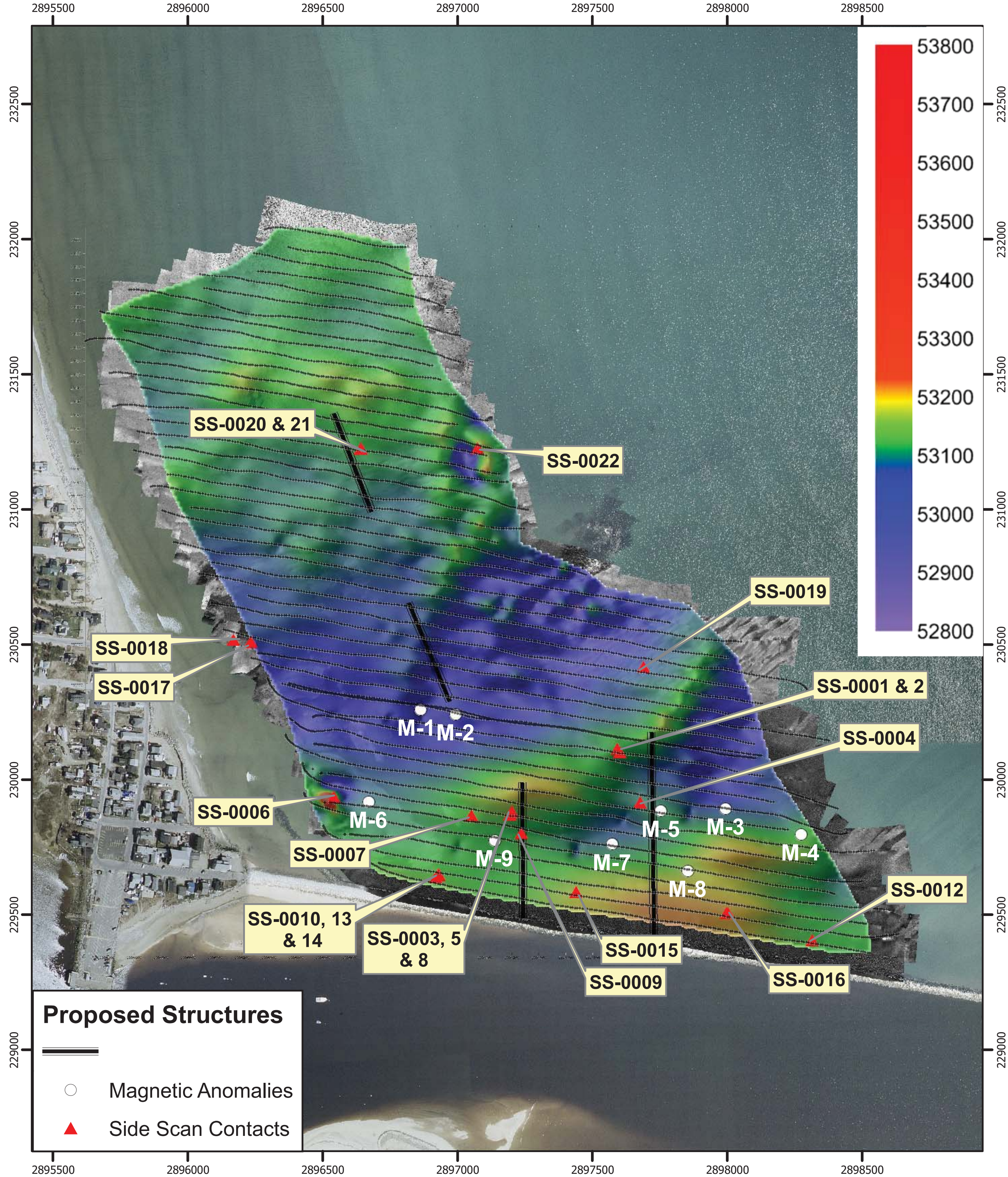
TABLE 1

MAGNETIC ANOMALIES OBSERVED IN PROFILE DATA
Camp Ellis, Saco Maine
(Values in nanoTeslas)

ID	TIME	X	Y	BACKGROUND	ANOMALY	MAGNITUDE	SIGNATURE	LENGTH (FEET)	LINE	NOTES
M-1	9:38:27	2896860.68	230260.65	53037.13	52993.2	-43.93	MP-	55	015_0937	Complex. May be related to M-2
M-2	9:38:41	2896990.98	230243.65	53042.14	53067.23	25.09	MP+	64	015_0937	Complex. May be related to M-1
M-3	9:57:55	2897992.07	229894.37	53102.25	53035.85	-66.4	MP-	8	011_0955	
M-4	10:01:54	2898270.27	229798.68	53165.75	53153.2	-12.55	MP-	17	010_1001	Single scan.
M-5	10:02:55	2897751.98	229885.87	53084.05	53059.68	-24.37	MP-	25	010_1001	Single scan, but with minor signature on either side.
M-6	10:14:34	2896668.17	229919.42	53108.43	53220.38	111.95	MP+	125	007_1014	Single scan, but with minor signature on either side.
M-7	10:16:14	2897571.68	229762.66	53113.87	53026.16	-87.71	MP-	30	007_1014	
M-8	10:20:43	2897851.38	229663.67	53181.04	53164.05	-16.99	MP-	25	006_1019	Single scan.
M-9	10:22:07	2897135.68	229777.06	53133.31	53104.36	-28.95	MP-	24	006_1019	Single scan, but with minor signature on either side.

Notes:

1 1.0 nanoTesla (nT) = 1 "Gamma".
2 Length estimated from beginning of signature to end of signature as distance along trackline.
3 MP = Monopolar. +/- indicate signature orientation relative to background.
4 Scaled profiles are included in Appendix B. Anomaly locations are shown on Figure 4.



www.crenvironmental.com

TOTAL FIELD MAGNETISM (nT), MAGNETIC SURVEY TRACKLINES AND MAGNETIC AND SIDE SCAN CONTACTS
Camp Ellis - Saco, Maine

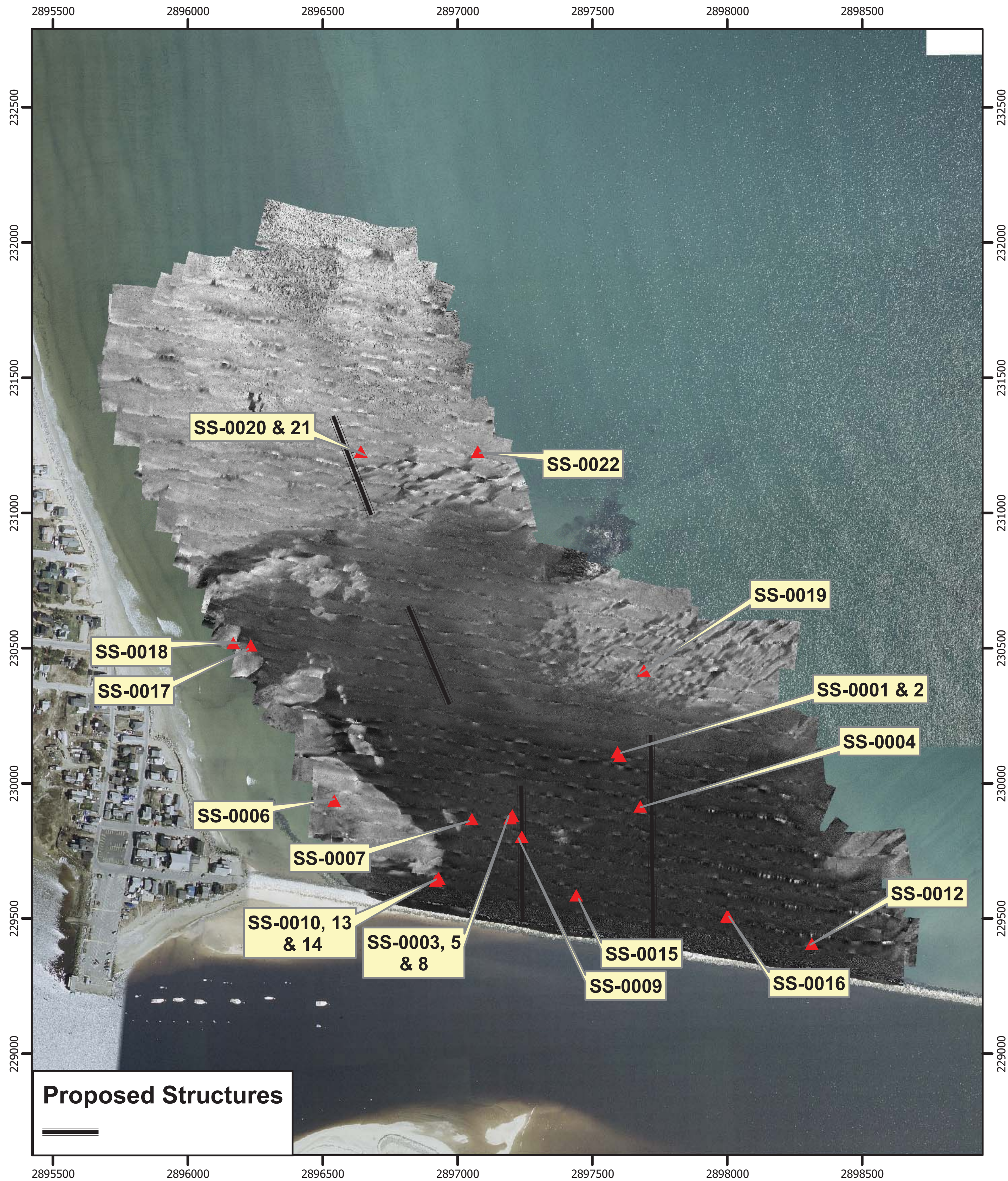
NOTES:
1) Survey conducted November 4, 2009.
2) Grid ME State Plane (West) NAD 83, US Foot.
3) Not for Navigation

1:6,000

Feet
0 300 600

N W E S

Figure #3



www.crenvironmental.com

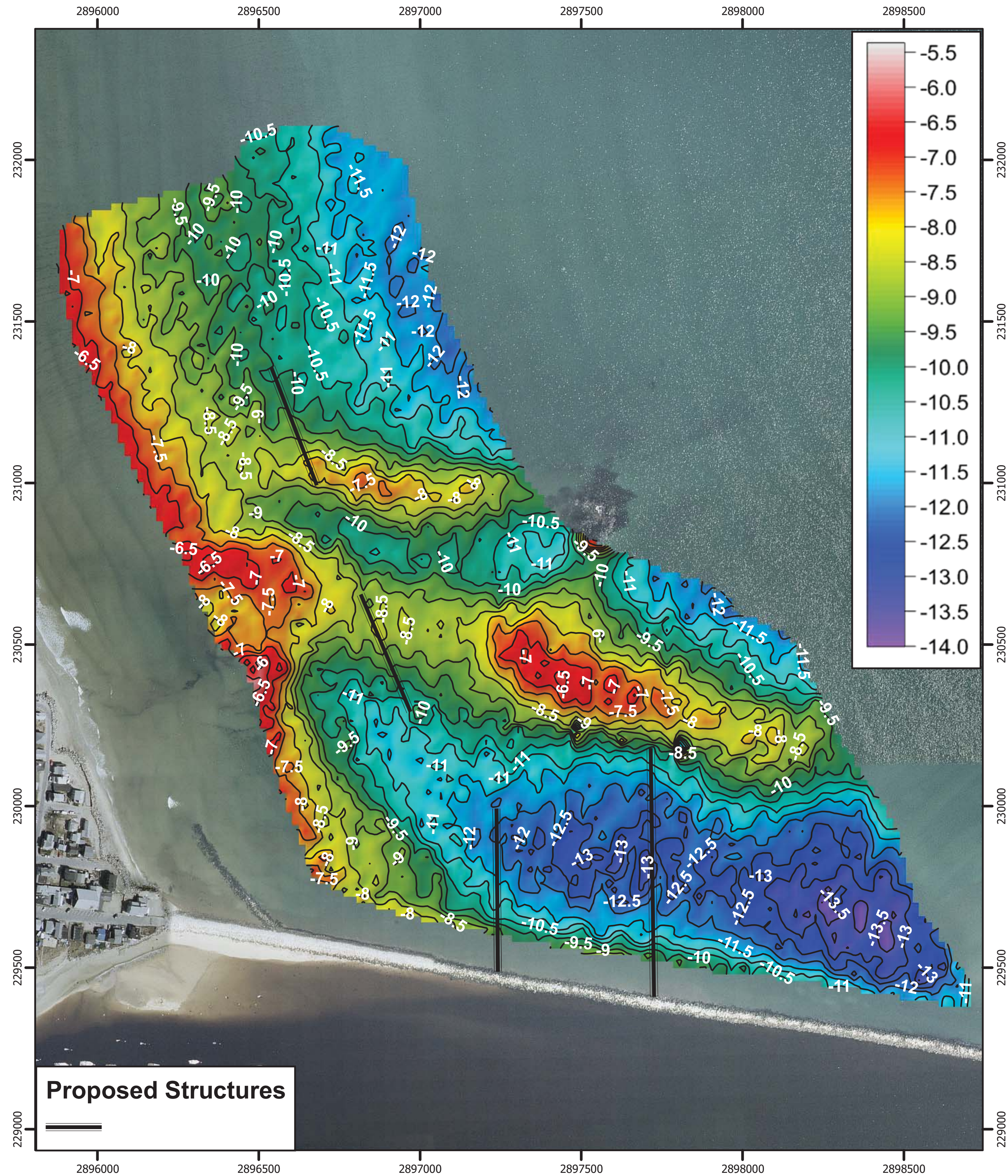
SIDE SCAN SONAR MOSAIC AND CONTACTS
Camp Ellis - Saco, Maine

NOTES:
1) Survey conducted November 4, 2009.
2) Grid ME State Plane (West) NAD 83, US Foot.
3) Not for Navigation

1:6,000
Feet
0 300 600

N W E S

Figure #2



SITE BATHYMETRIC CONDITIONS
0.5 FOOT CONTOUR INTERVAL (NAVD88 ELEVATIONS)
Camp Ellis - Saco, Maine

www.crenvironmental.com

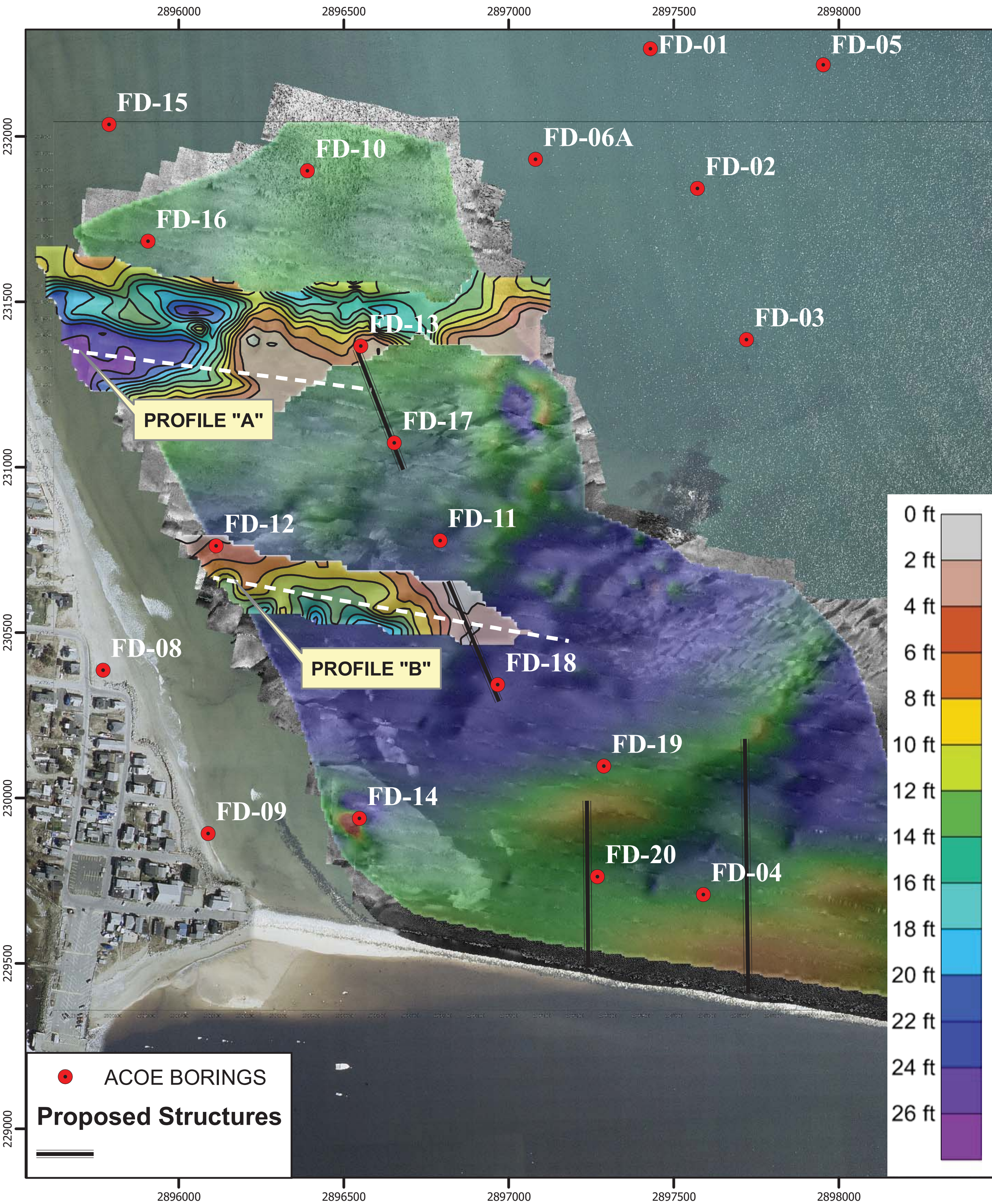
NOTES:
1) Survey conducted November 4, 2009.
2) Grid ME State Plane (West) NAD 83, US Foot.
3) Tide corrections based on water surface elevation data collected at N.O.S. Station 8606A, located on the fishing pier.
4) Not for Navigation

1:5,000

Feet
0 250 500

N W E S

Figure #1

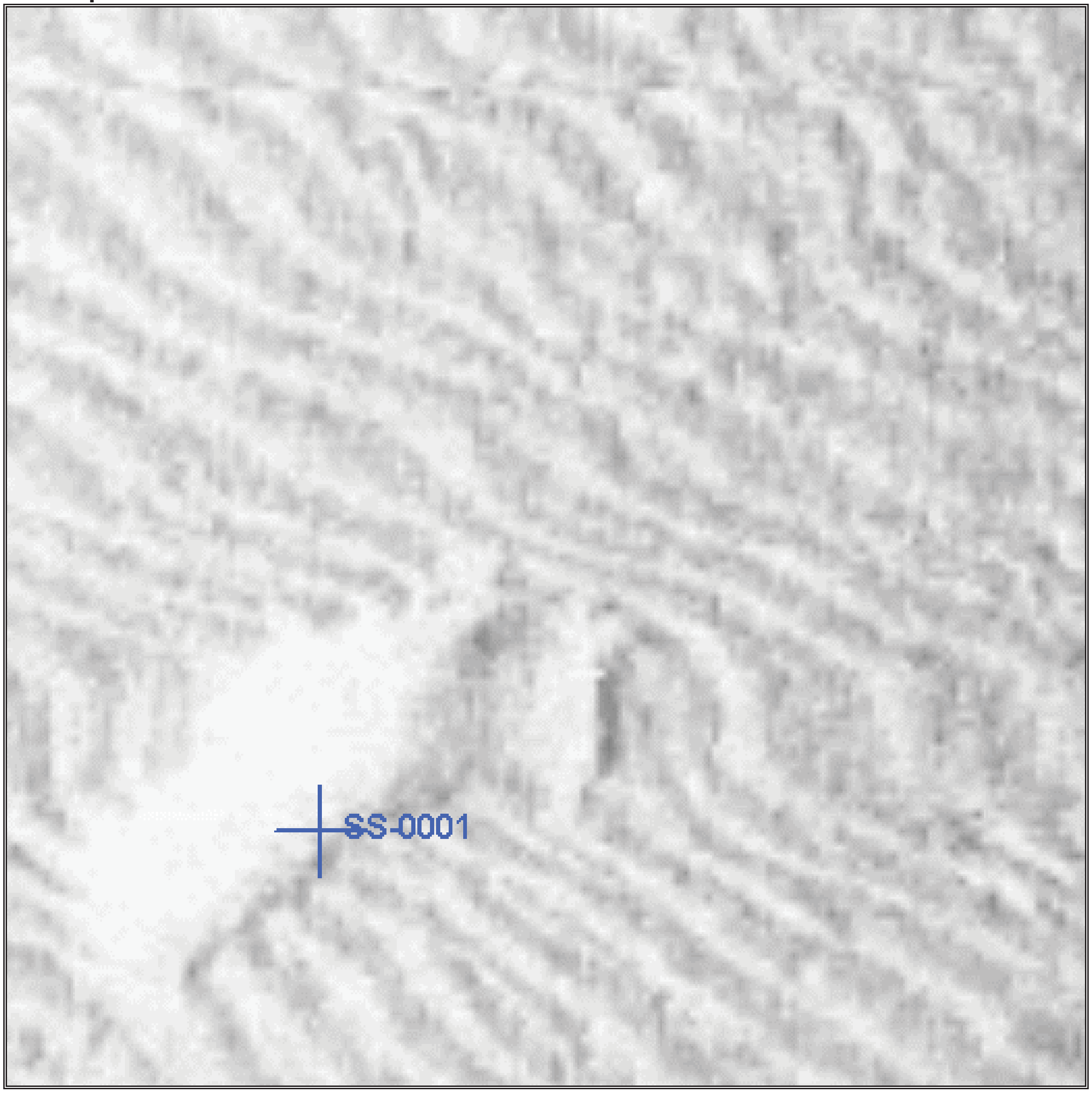


www.crenvironmental.com	AREAS OF SUBSTANTIAL SUB-BOTTOM SONAR PENETRATION AND ESTIMATED ACOUSTIC BASEMENT - 2.0 FOOT CONTOUR INTERVAL Camp Ellis - Saco, Maine	N W E S
	NOTES: 1) Survey conducted November 4, 2009. 2) Grid ME State Plane (West) NAD 83, US Foot. 3) Magnetic and side scan base layers included for spatial reference. 4) Not for Navigation 1:5,000 Feet 0 250 500	Figure #4

APPENDIX A

SIDE SCAN SONAR CONTACTS

Camp Ellis Side Scan Contacts SS-0001



Target Info for SS-0001

- Sonar Time at Target: 11/04/2009 14:33:19
- Click Position (Lat/Lon Coordinates)
  43° 27.86835' N 070° 22.46345' W (WGS84)
  43° 27.86835' N 070° 22.46345' W (Local)
  43° 27.86323' N 070° 22.49383' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,601.36 (Y) 230,102.72
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-0061.xtf
- Ping Number: 21360
- Range to Target: 53.91 US Feet
- Fish Height: 10.73 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-0061

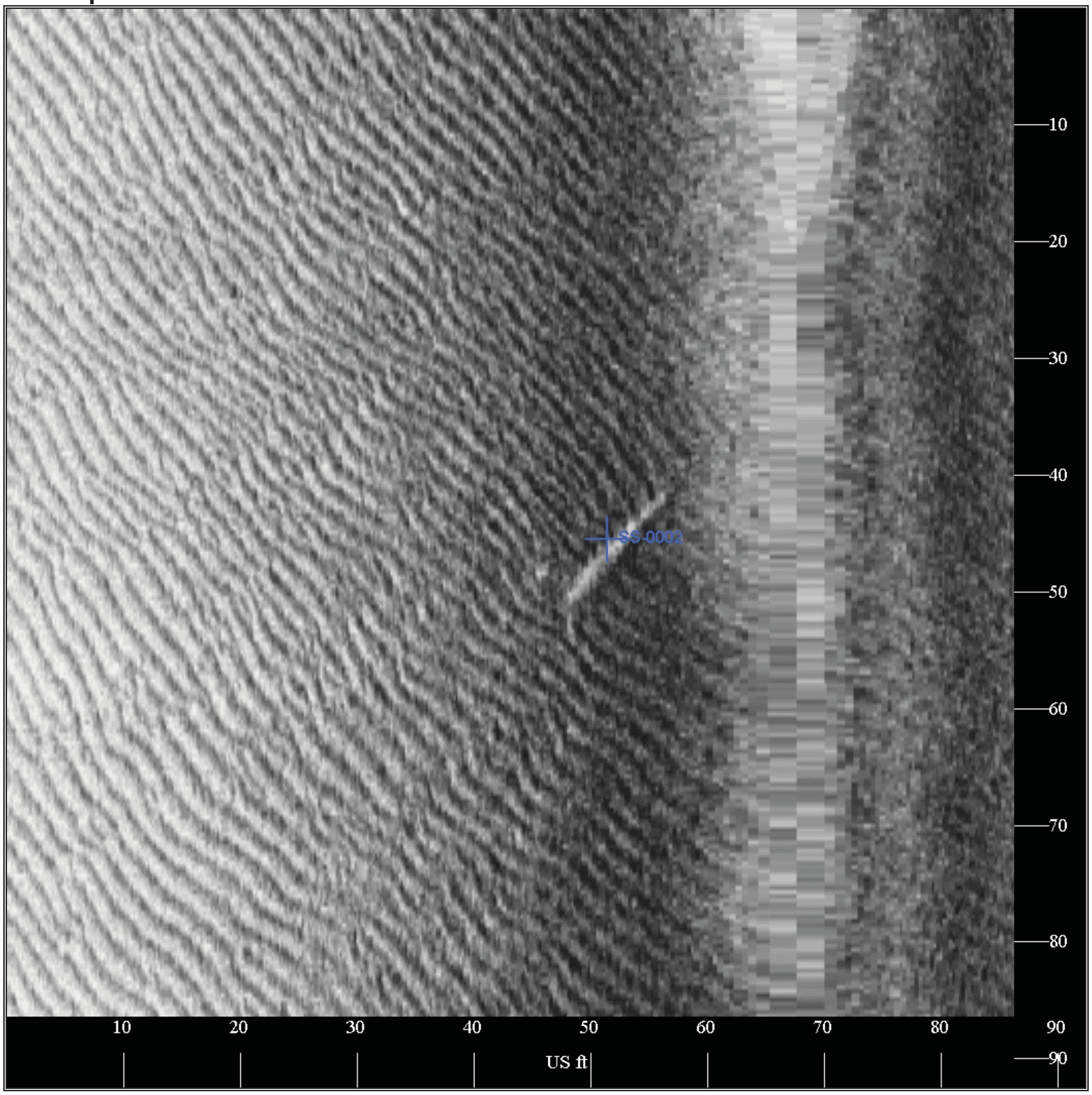
User Entered Info

Target Height = 0.5 US Feet
Target Length: 13.6 US Feet
Target Shadow: 2.8 US Feet
Target Width: 3.1 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:44 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0002



Target Info for SS-0002

- Sonar Time at Target: 11/04/2009 14:39:48
- Click Position (Lat/Lon Coordinates)
  43° 27.87055' N 070° 22.46550' W (WGS84)
  43° 27.87055' N 070° 22.46550' W (Local)
  43° 27.86542' N 070° 22.49588' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,592.35 (Y) 230,116.06
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-0062.xtf
- Ping Number: 31713
- Range to Target: 21.47 US Feet
- Fish Height: 14.06 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-0062

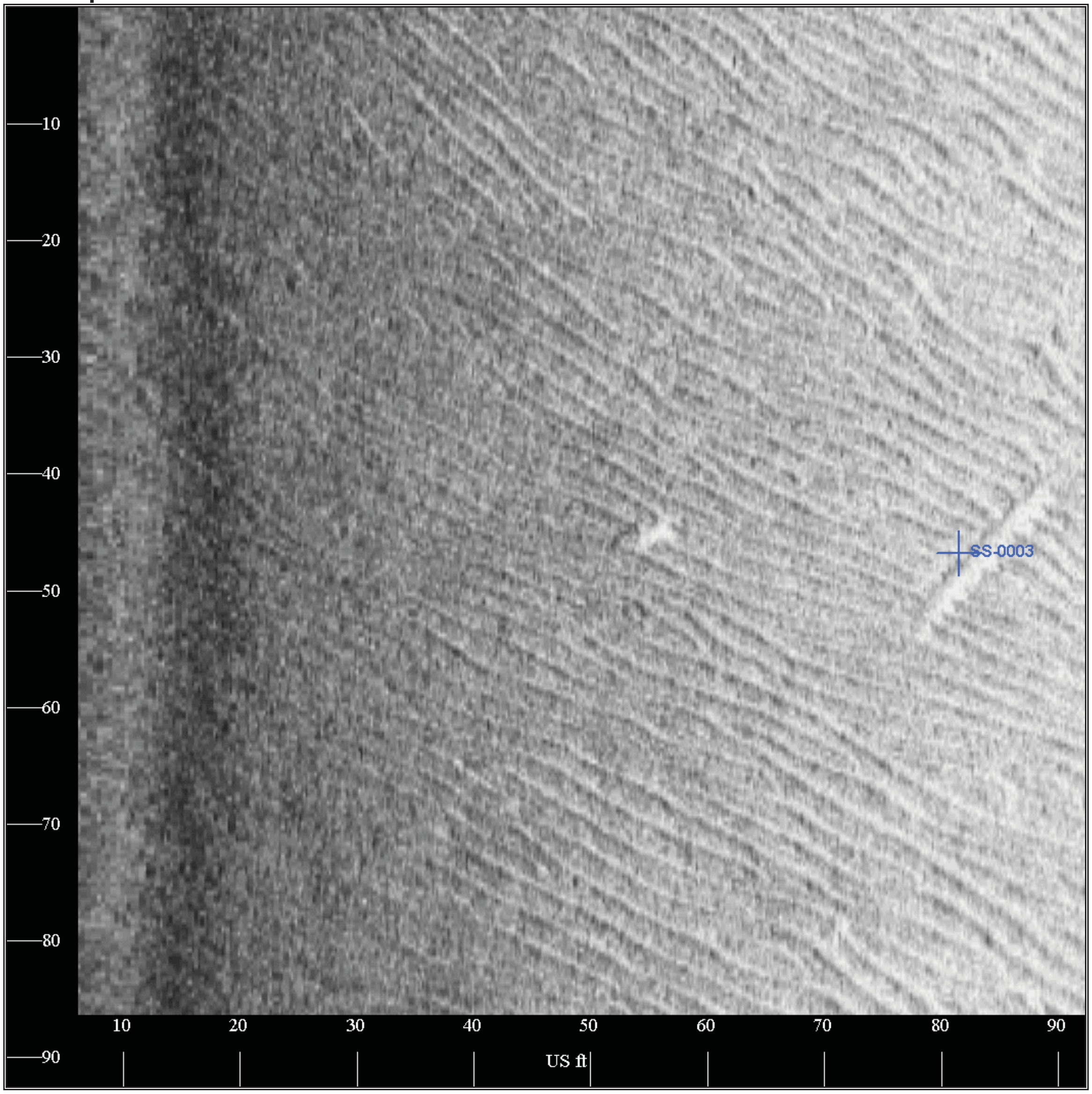
User Entered Info

Target Height = 0.0 US Feet
Target Length: 13.6 US Feet
Target Shadow: 0.0 US Feet
Target Width: 0.9 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:44 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0003



Target Info for SS-0003

- Sonar Time at Target: 11/04/2009 14:56:30
- Click Position (Lat/Lon Coordinates)
  43° 27.83183' N 070° 22.55362' W (WGS84)
  43° 27.83183' N 070° 22.55362' W (Local)
  43° 27.82670' N 070° 22.58400' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,201.83 (Y) 229,881.81
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-0011.xtf
- Ping Number: 58413
- Range to Target: 82.90 US Feet
- Fish Height: 16.05 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-0011

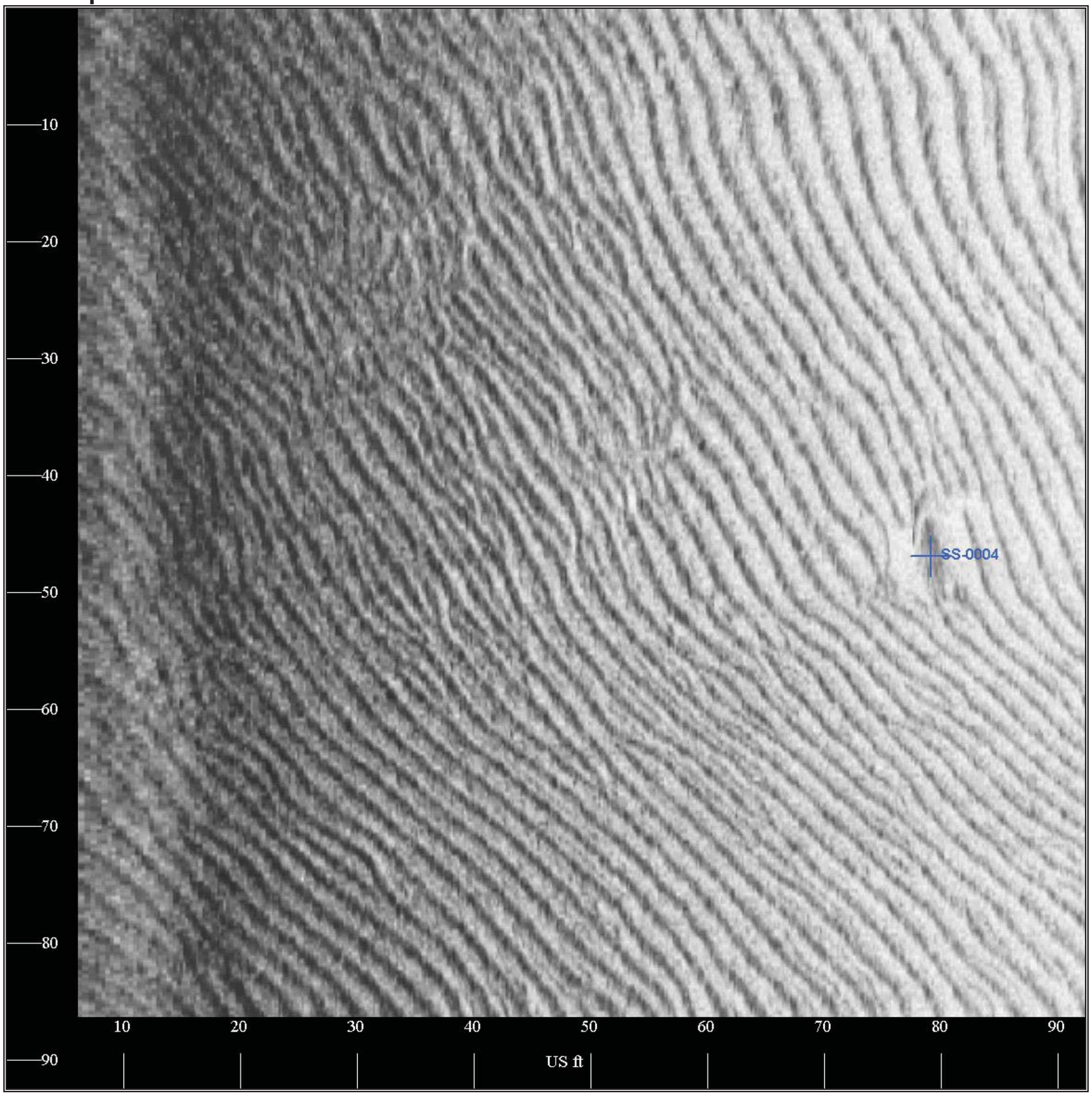
User Entered Info

Target Height = 0.0 US Feet
Target Length: 15.8 US Feet
Target Shadow: 0.0 US Feet
Target Width: 0.9 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:45 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0004



Target Info for SS-0004

- Sonar Time at Target: 11/04/2009 15:02:37
- Click Position (Lat/Lon Coordinates)
  43° 27.83745' N 070° 22.44630' W (WGS84)
  43° 27.83745' N 070° 22.44630' W (Local)
  43° 27.83233' N 070° 22.47667' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,676.81 (Y) 229,914.80
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s10.xtf
- Ping Number: 68195
- Range to Target: 80.65 US Feet
- Fish Height: 16.41 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s10

User Entered Info

Target Height = 0.0 US Feet
Target Length: 9.8 US Feet
Target Shadow: 0.0 US Feet
Target Width: 1.7 US Feet

Classification 1: debris

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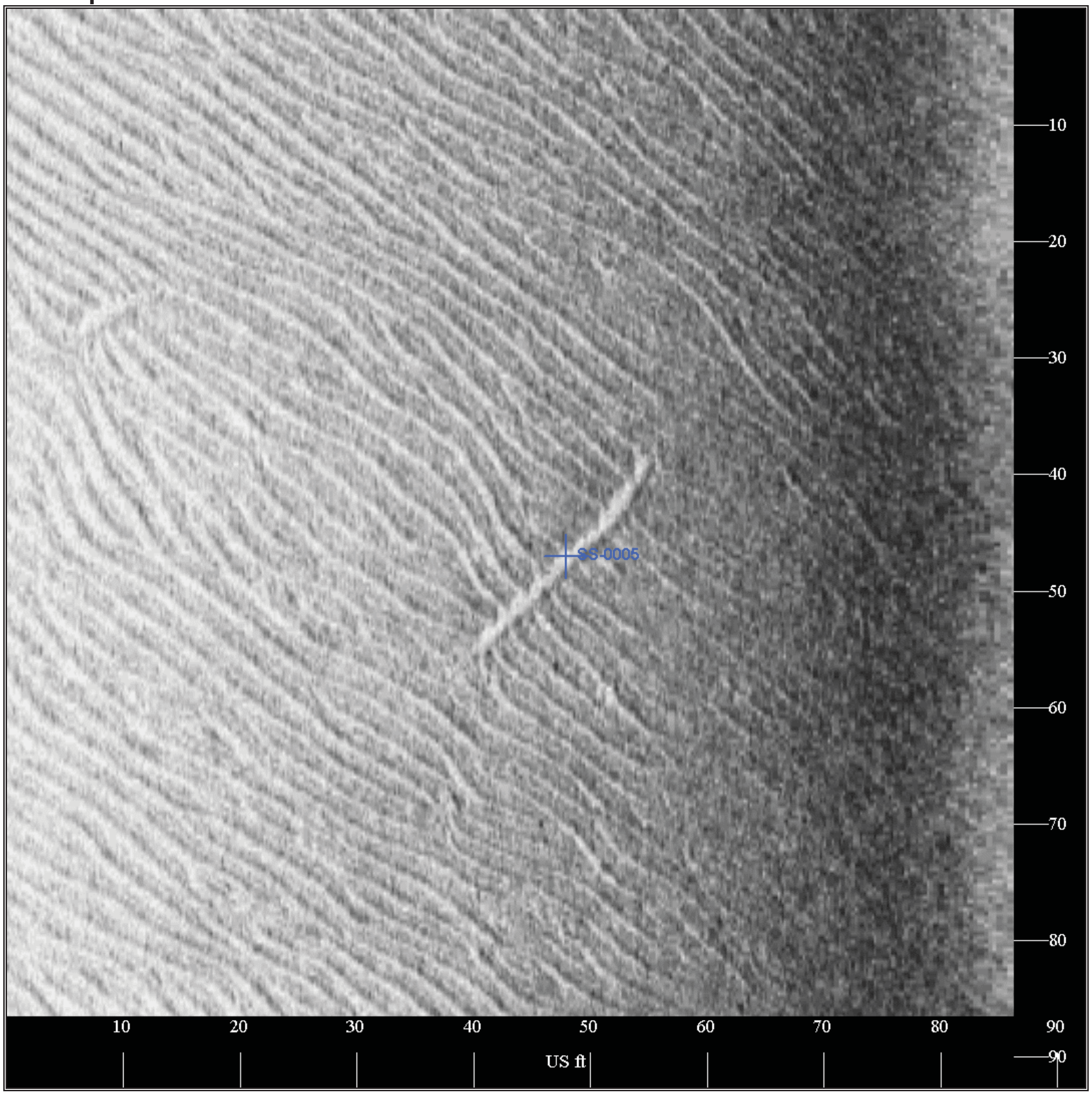
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0005



Target Info for SS-0005

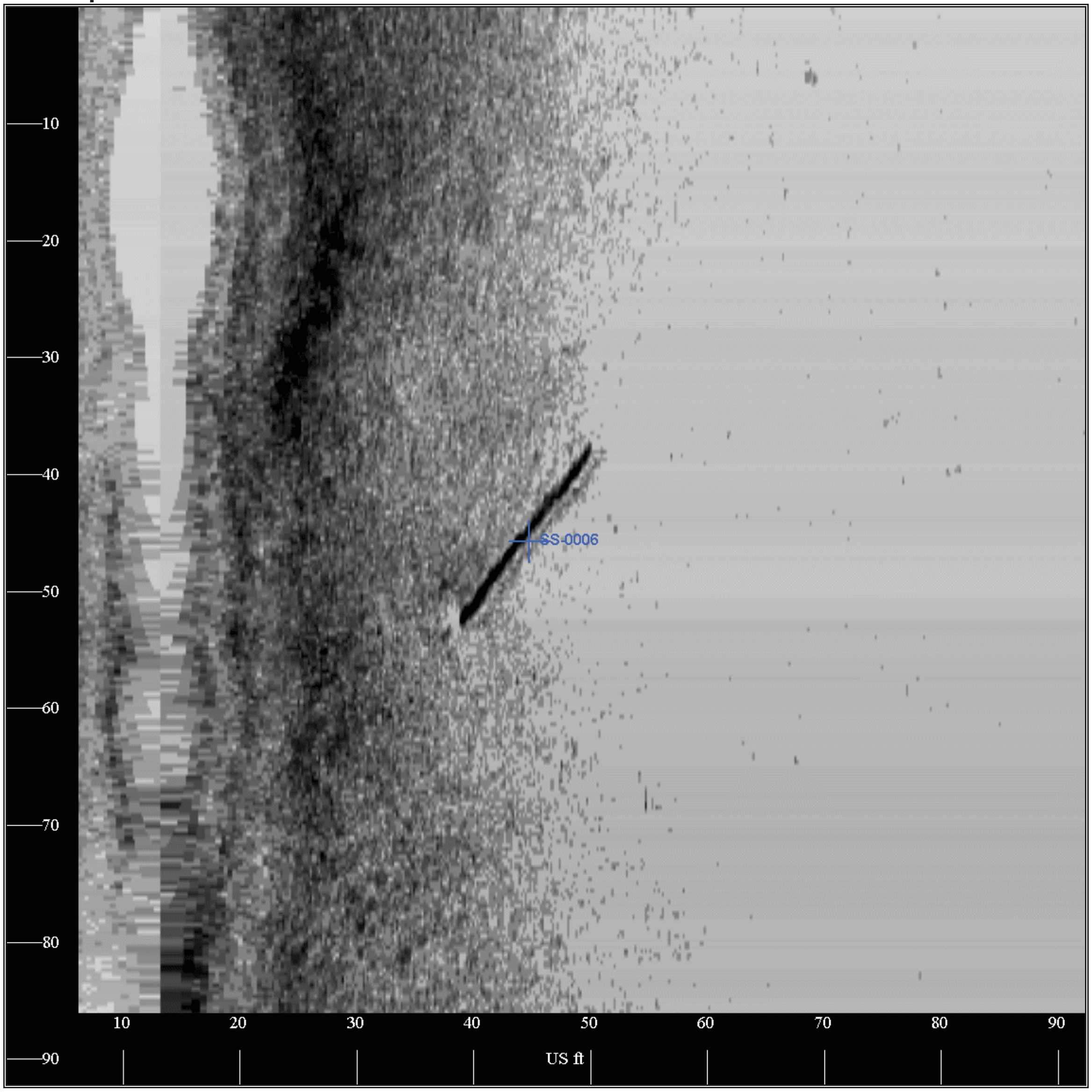
- Sonar Time at Target: 11/04/2009 15:03:28
- Click Position (Lat/Lon Coordinates)
  43° 27.83016' N 070° 22.55537' W (WGS84)
  43° 27.83016' N 070° 22.55537' W (Local)
  43° 27.82503' N 070° 22.58574' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,194.07 (Y) 229,871.69
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s10.xtf
- Ping Number: 69560
- Range to Target: 47.30 US Feet
- Fish Height: 16.41 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s10

User Entered Info

Target Height = 0.0 US Feet
Target Length: 22.2 US Feet
Target Shadow: 0.0 US Feet
Target Width: 0.8 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:46 PM
TargetReportGen (V2.4.1)



Target Info for SS-0006

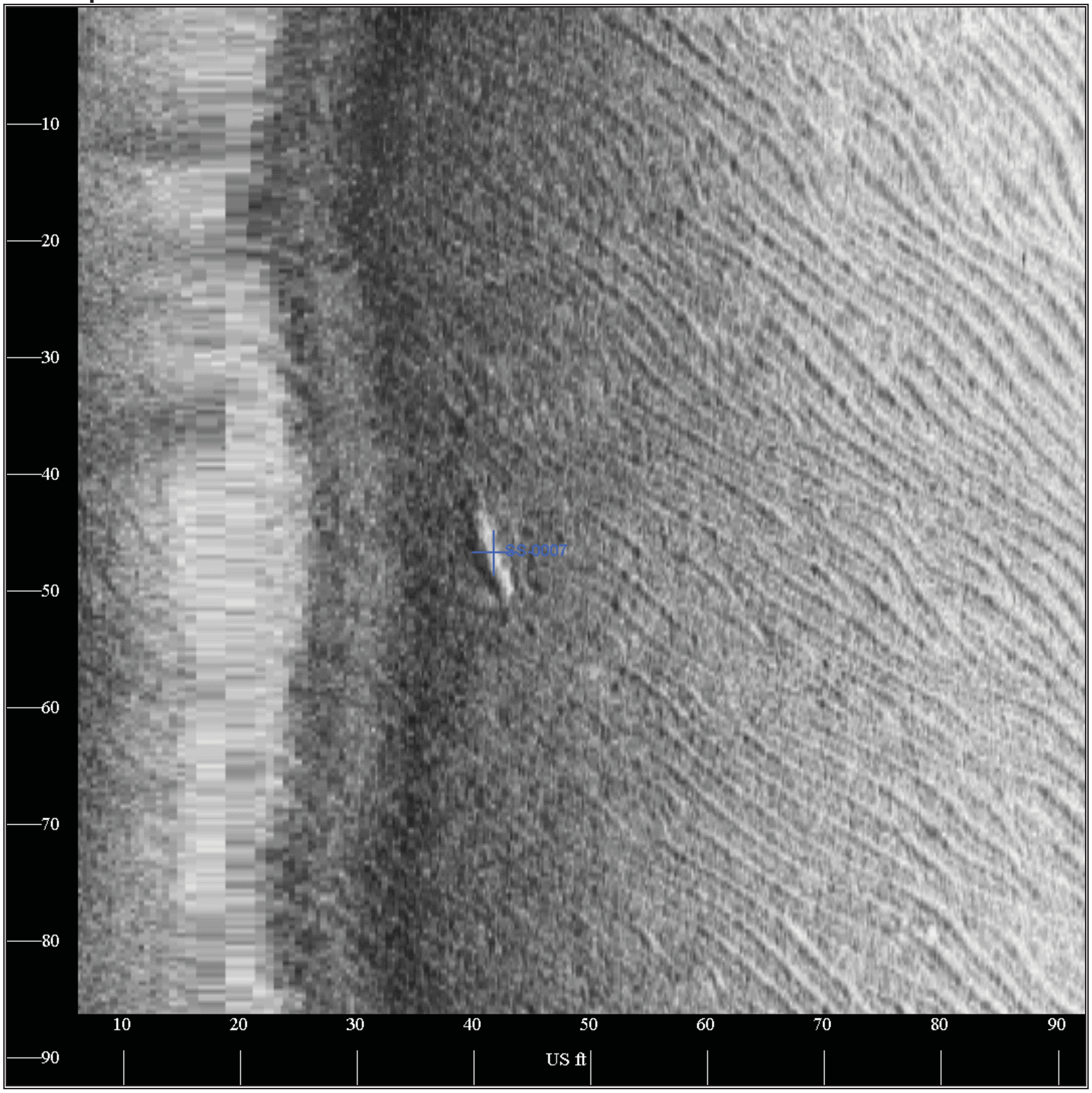
- Sonar Time at Target: 11/04/2009 15:05:23
- Click Position (Lat/Lon Coordinates)
  43° 27.84058' N 070° 22.70273' W (WGS84)
  43° 27.84058' N 070° 22.70273' W (Local)
  43° 27.83546' N 070° 22.73311' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,896,542.16 (Y) 229,936.65
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s-9.xtf
- Ping Number: 72640
- Range to Target: 33.13 US Feet
- Fish Height: 10.14 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s-9

User Entered Info

Target Height = 0.0 US Feet
Target Length: 20.5 US Feet
Target Shadow: 0.0 US Feet
Target Width: 1.9 US Feet

Classification 1: debris

Camp Ellis Side Scan Contacts SS-0007



Target Info for SS-0007

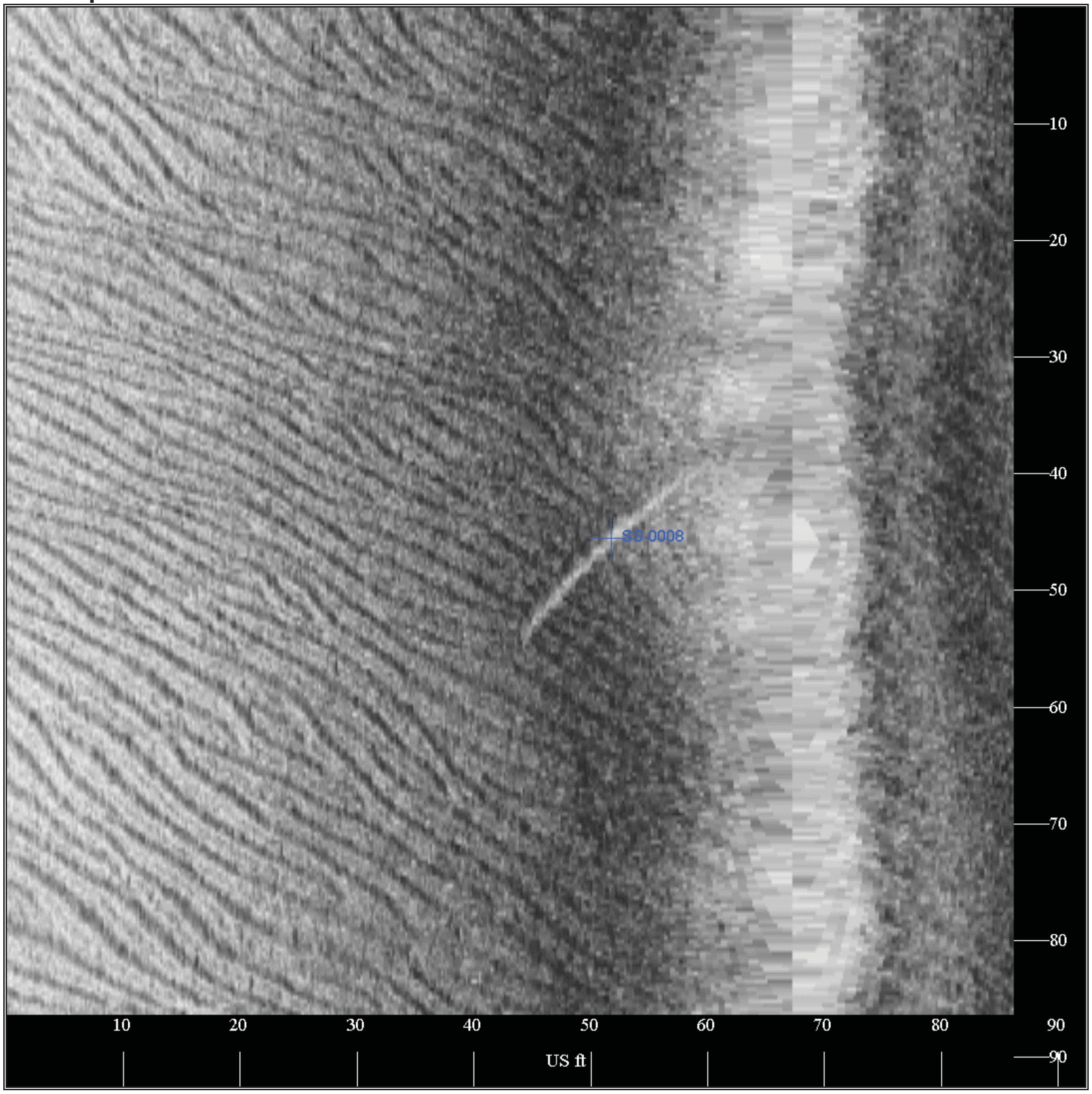
- Sonar Time at Target: 11/04/2009 15:06:20
- Click Position (Lat/Lon Coordinates)
  43° 27.82960' N 070° 22.58750' W (WGS84)
  43° 27.82960' N 070° 22.58750' W (Local)
  43° 27.82448' N 070° 22.61788' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,051.86 (Y) 229,868.69
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s-9.xtf
- Ping Number: 74140
- Range to Target: 27.49 US Feet
- Fish Height: 15.15 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s-9

User Entered Info

Target Height = 0.0 US Feet
Target Length: 8.5 US Feet
Target Shadow: 0.0 US Feet
Target Width: 1.5 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:48 PM
TargetReportGen (V2.4.1)



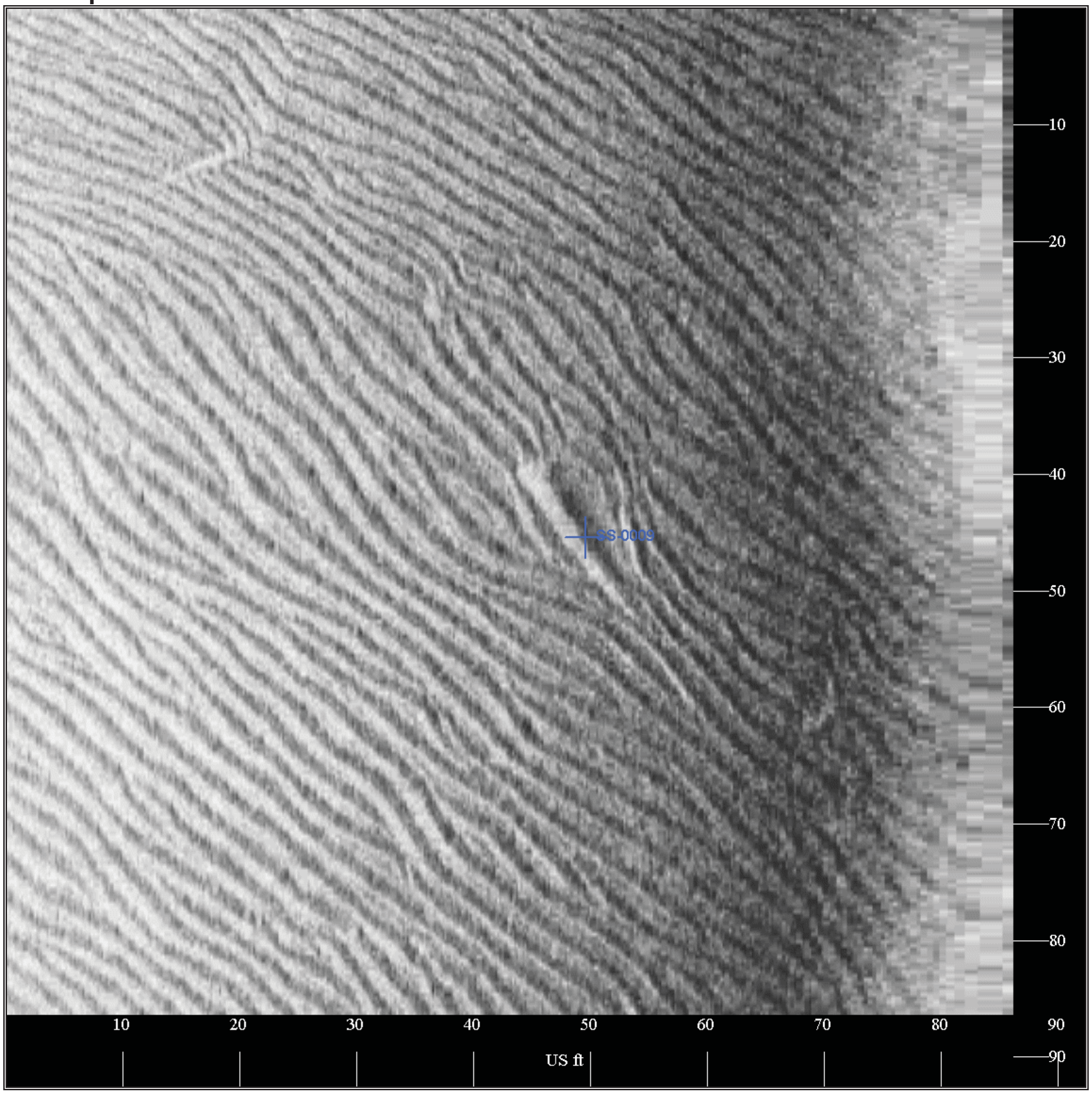
Target Info for SS-0008

- Sonar Time at Target: 11/04/2009 15:06:35
- Click Position (Lat/Lon Coordinates)
  43° 27.83166' N 070° 22.55374' W (WGS84)
  43° 27.82654' N 070° 22.58411' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,201.31 (Y) 229,880.83
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s-9.xtf
- Ping Number: 74557
- Range to Target: 21.19 US Feet
- Fish Height: 14.45 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s-9

User Entered Info

See SS-0007

Camp Ellis Side Scan Contacts SS-0009



Target Info for SS-0009

- Sonar Time at Target: 11/04/2009 15:15:34
- Click Position (Lat/Lon Coordinates)
  43° 27.81894' N 070° 22.54559' W (WGS84)
  43° 27.81894' N 070° 22.54559' W (Local)
  43° 27.81382' N 070° 22.57597' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,237.17 (Y) 229,803.46
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s7.xtf
- Ping Number: 88922
- Range to Target: 39.20 US Feet
- Fish Height: 16.22 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s7

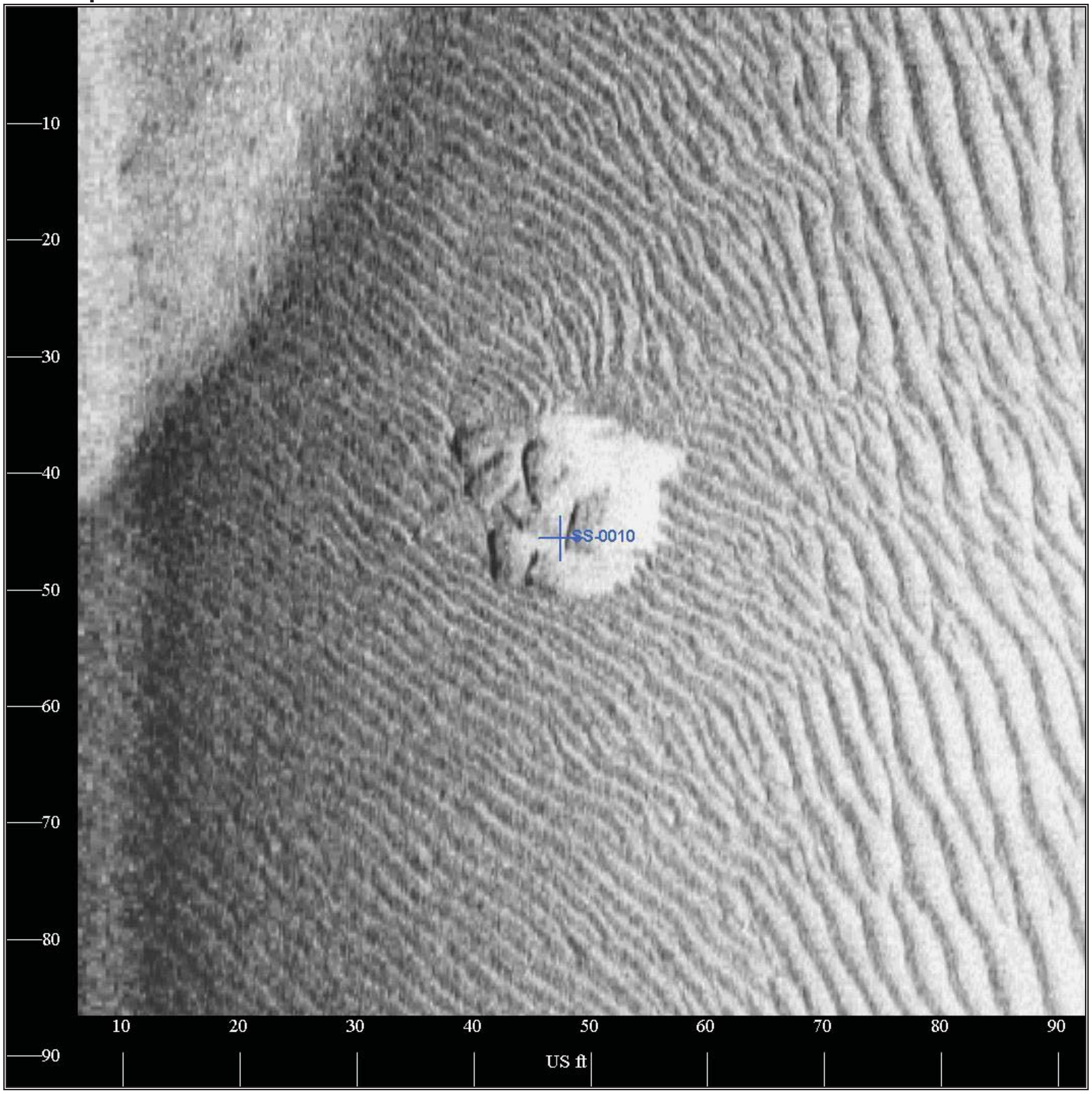
User Entered Info

Target Height = 0.0 US Feet
Target Length: 16.3 US Feet
Target Shadow: 0.0 US Feet
Target Width: 2.7 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:49 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0010



Target Info for SS-0010

- Sonar Time at Target: 11/04/2009 15:24:03
- Click Position (Lat/Lon Coordinates)
  43° 27.79314' N 070° 22.61489' W (WGS84)
  43° 27.79314' N 070° 22.61489' W (Local)
  43° 27.78802' N 070° 22.64526' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,896,930.14 (Y) 229,647.48
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s5.xtf
- Ping Number: 102488
- Range to Target: 49.25 US Feet
- Fish Height: 13.93 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s5

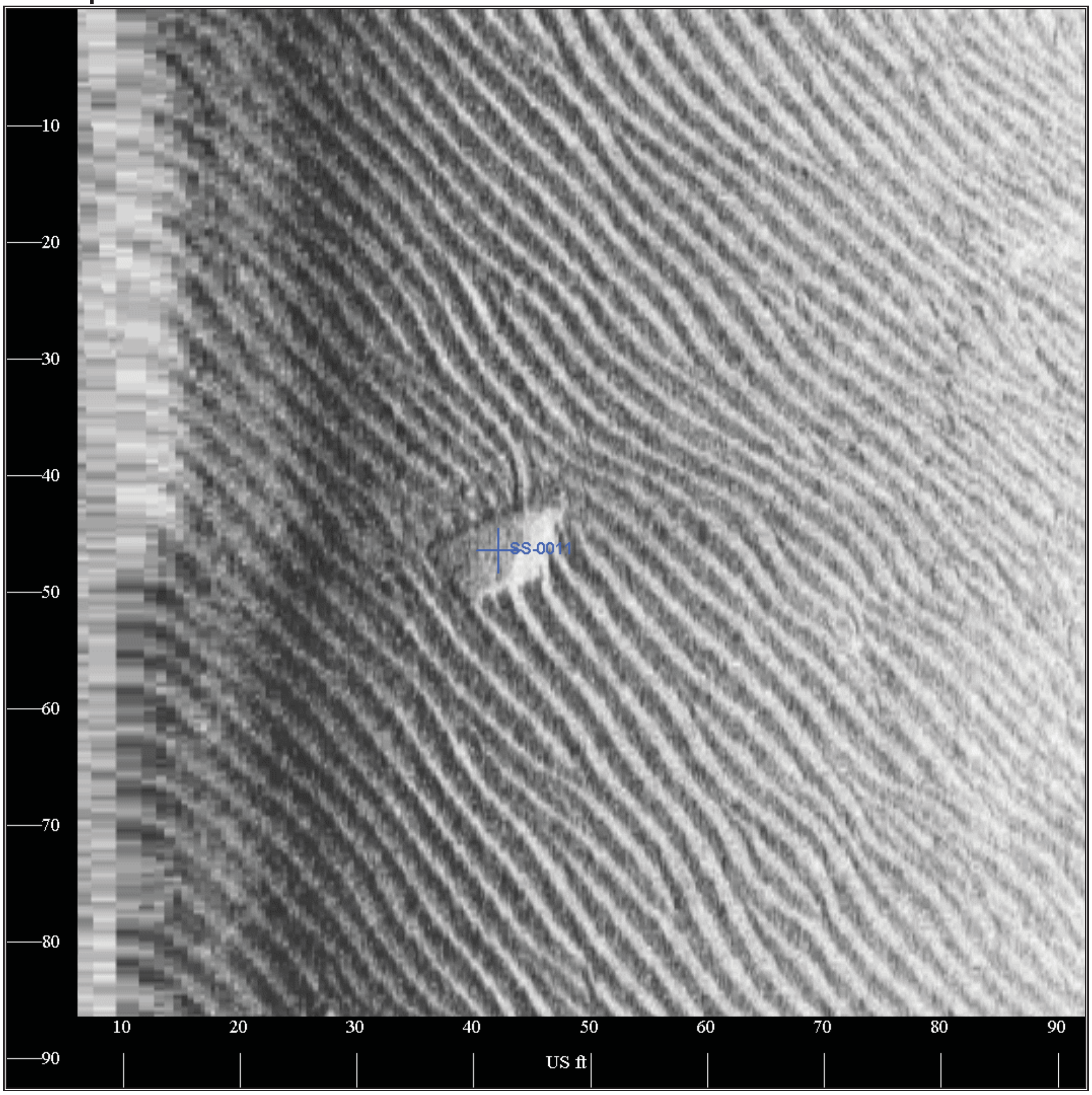
User Entered Info

Target Height = 2.6 US Feet
Target Length: 14.9 US Feet
Target Shadow: 11.1 US Feet
Target Width: 11.7 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:50 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0011



Target Info for SS-0011

- Sonar Time at Target: 11/04/2009 15:25:59
- Click Position (Lat/Lon Coordinates)
  43° 27.77088' N 070° 22.37369' W (WGS84)
  43° 27.77088' N 070° 22.37369' W (Local)
  43° 27.76575' N 070° 22.40407' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,997.09 (Y) 229,509.59
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s5.xtf
- Ping Number: 105561
- Range to Target: 36.92 US Feet
- Fish Height: 16.97 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s5

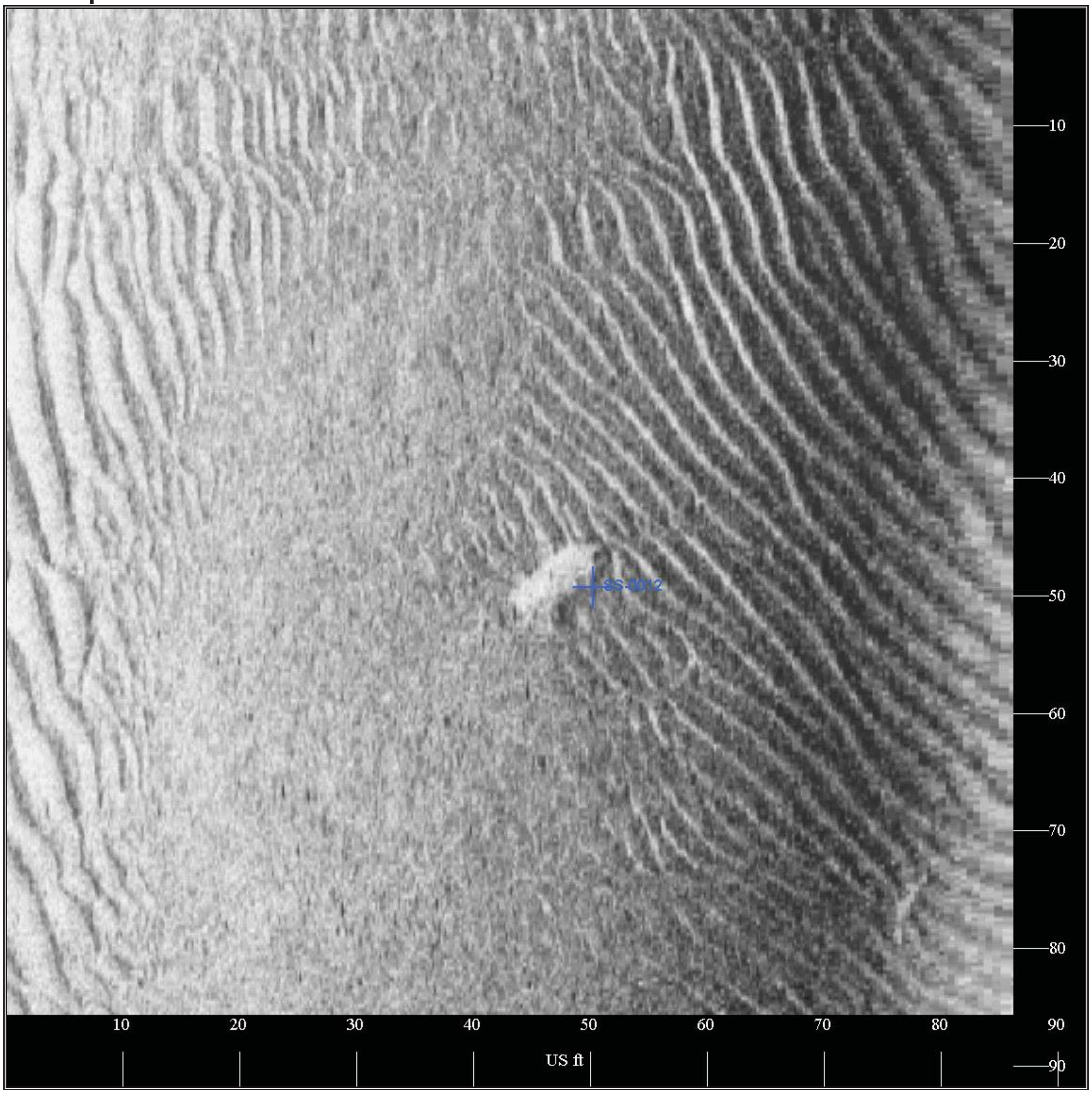
User Entered Info

Target Height = 1.5 US Feet
Target Length: 11.8 US Feet
Target Shadow: 3.6 US Feet
Target Width: 6.6 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:50 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0012



Target Info for SS-0012

- Sonar Time at Target: 11/04/2009 15:28:34
- Click Position (Lat/Lon Coordinates)
  43° 27.75419' N 070° 22.30225' W (WGS84)
  43° 27.75419' N 070° 22.30225' W (Local)
  43° 27.74907' N 070° 22.33263' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,898,312.94 (Y) 229,407.44
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s4.xtf
- Ping Number: 109710
- Range to Target: 43.29 US Feet
- Fish Height: 18.30 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s4

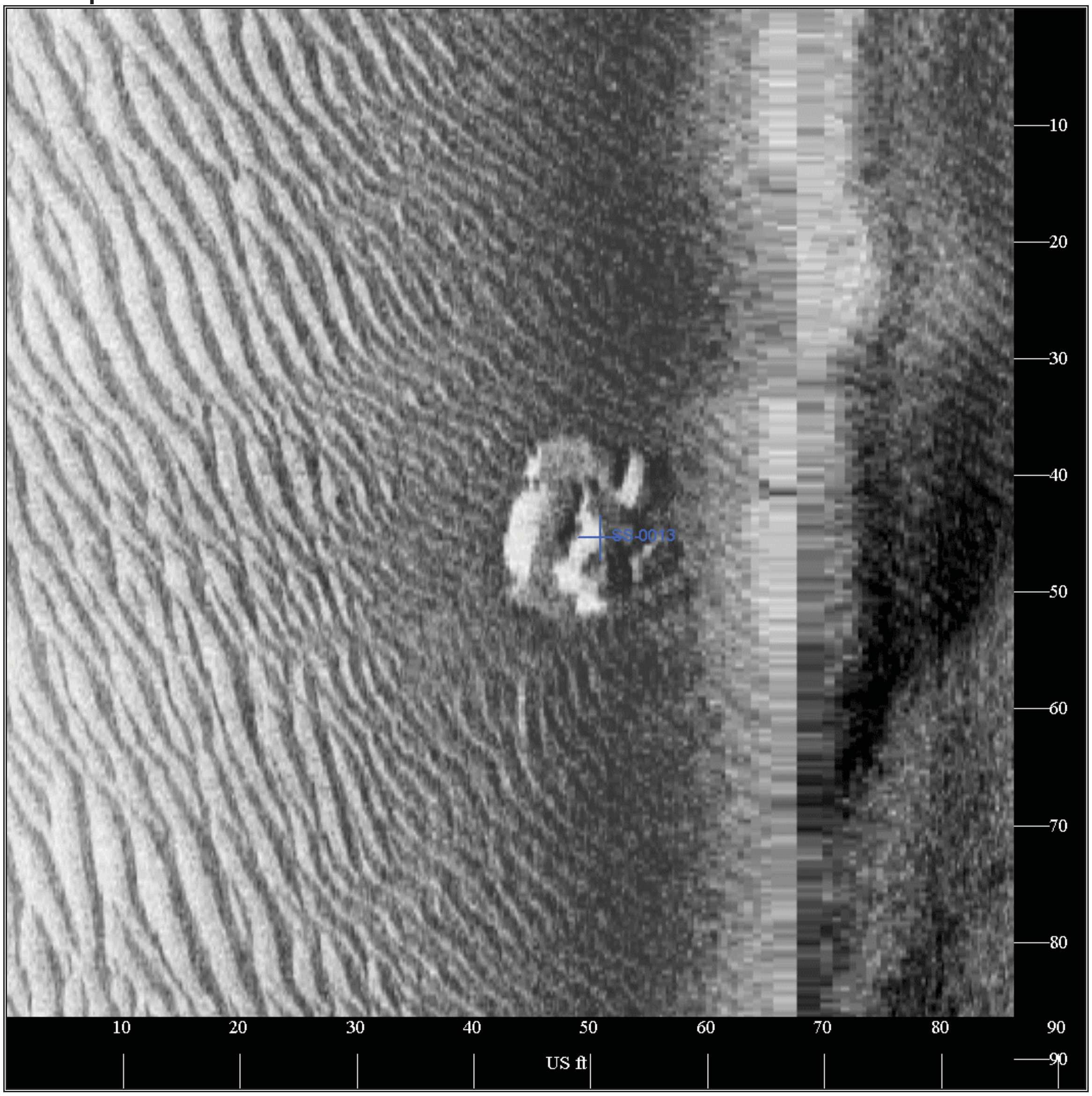
User Entered Info

Target Height = 0.0 US Feet
Target Length: 8.3 US Feet
Target Shadow: 0.0 US Feet
Target Width: 5.2 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:51 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0013



Target Info for SS-0013

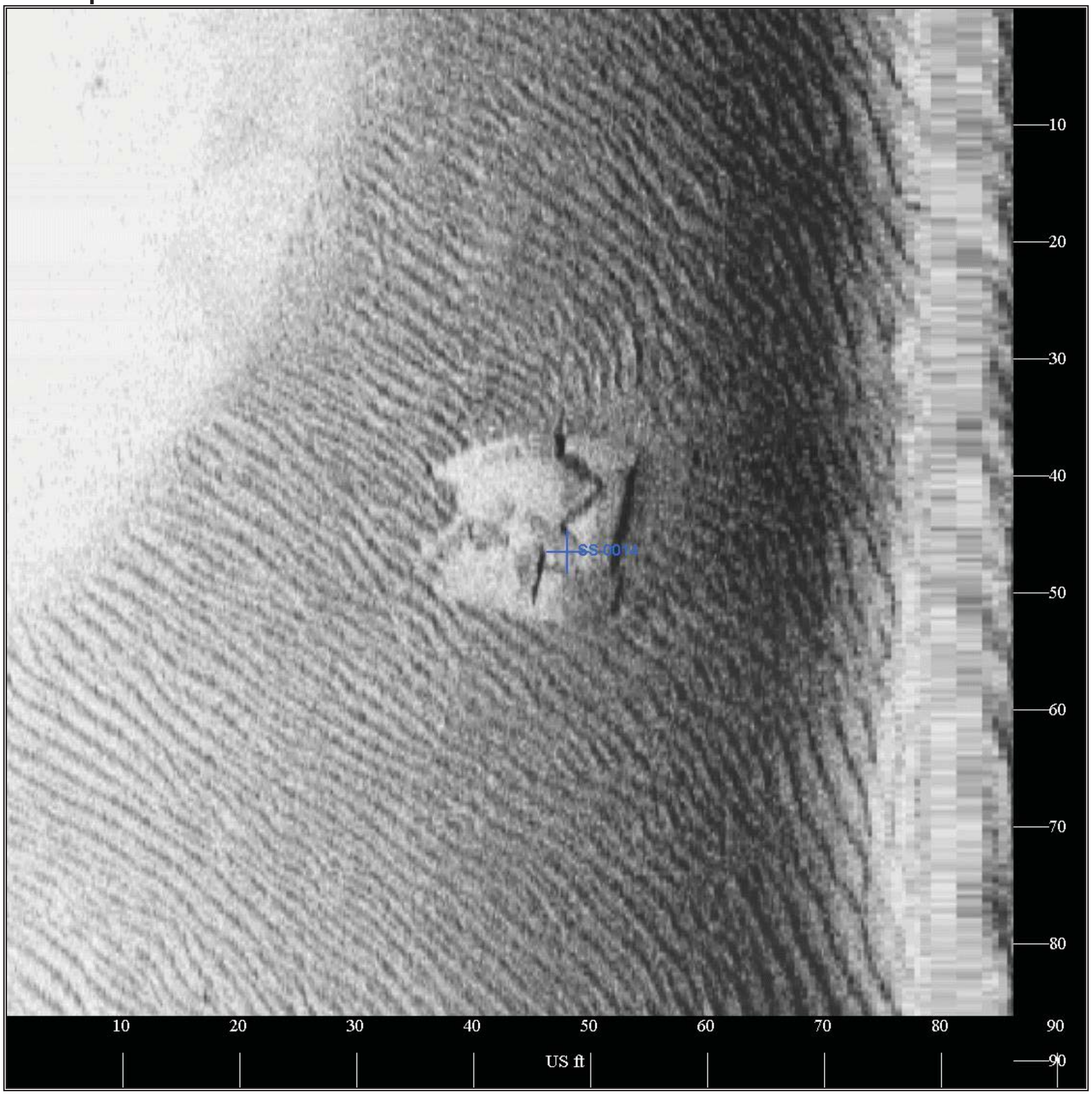
- Sonar Time at Target: 11/04/2009 15:31:07
- Click Position (Lat/Lon Coordinates)
  43° 27.79221' N 070° 22.61736' W (WGS84)
  43° 27.79221' N 070° 22.61736' W (Local)
  43° 27.78709' N 070° 22.64773' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,896,919.19 (Y) 229,641.88
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s4.xtf
- Ping Number: 113786
- Range to Target: 21.54 US Feet
- Fish Height: 13.52 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s4

User Entered Info

Target Height >= 1.2 US Feet
Target Length: 17.1 US Feet
Target Shadow: 2.0 US Feet
Target Width: 14.2 US Feet

Classification 1: debris

Camp Ellis Side Scan Contacts SS-0014



Target Info for SS-0014

- Sonar Time at Target: 11/04/2009 15:33:46
- Click Position (Lat/Lon Coordinates)
  43° 27.79359' N 070° 22.61528' W (WGS84)
  43° 27.79359' N 070° 22.61528' W (Local)
  43° 27.78847' N 070° 22.64566' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,896,928.39 (Y) 229,650.25
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s3.xtf
- Ping Number: 118031
- Range to Target: 35.17 US Feet
- Fish Height: 11.36 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s3

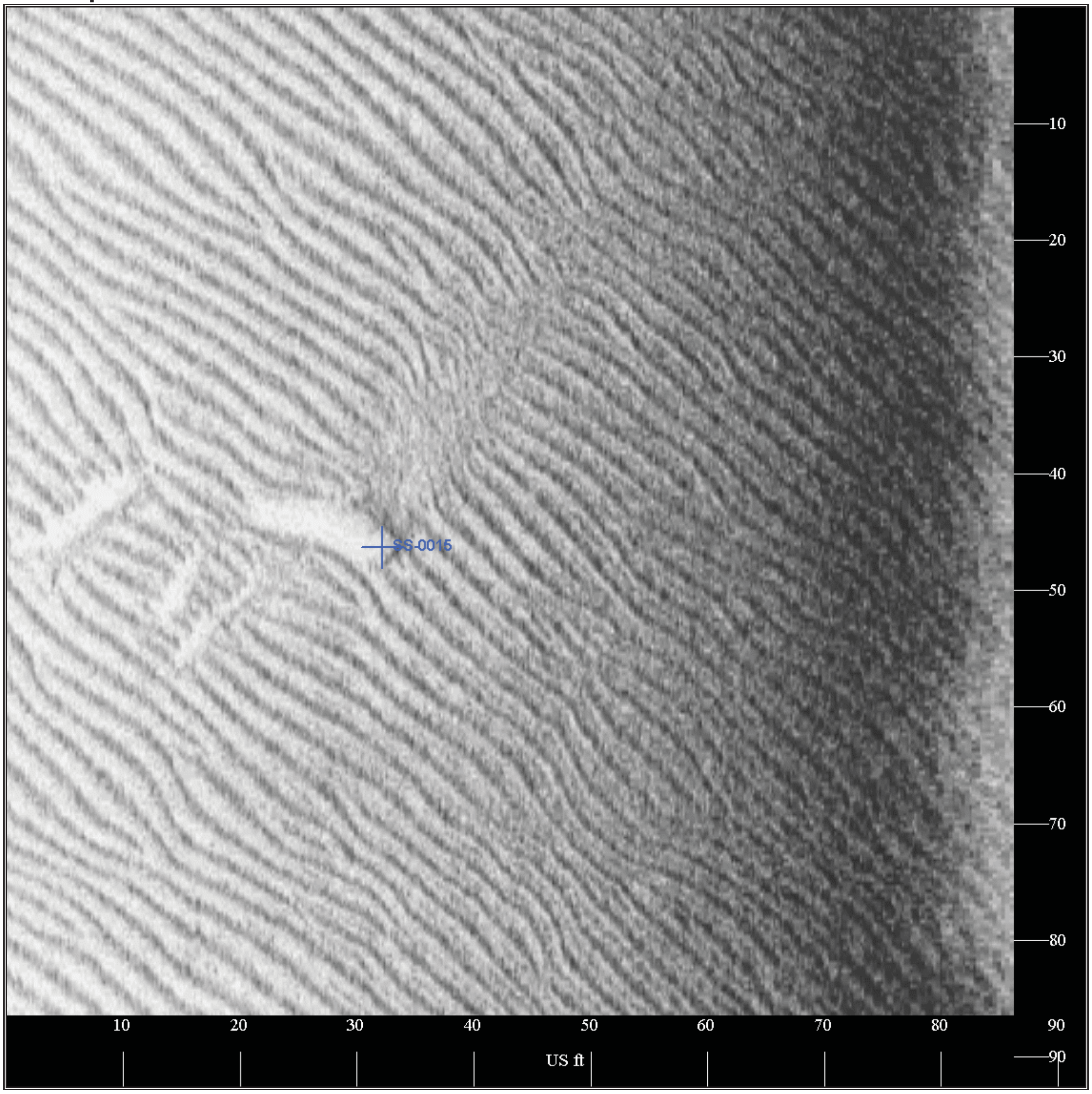
User Entered Info

Target Height >= 2.1 US Feet
Target Length: 15.5 US Feet
Target Shadow: 7.8 US Feet
Target Width: 11.4 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:53 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0015



Target Info for SS-0015

- Sonar Time at Target: 11/04/2009 15:34:45
- Click Position (Lat/Lon Coordinates)
  43° 27.78336' N 070° 22.49987' W (WGS84)
  43° 27.78336' N 070° 22.49987' W (Local)
  43° 27.77824' N 070° 22.53025' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,438.90 (Y) 229,586.80
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s3.xtf
- Ping Number: 119579
- Range to Target: 61.53 US Feet
- Fish Height: 12.80 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s3

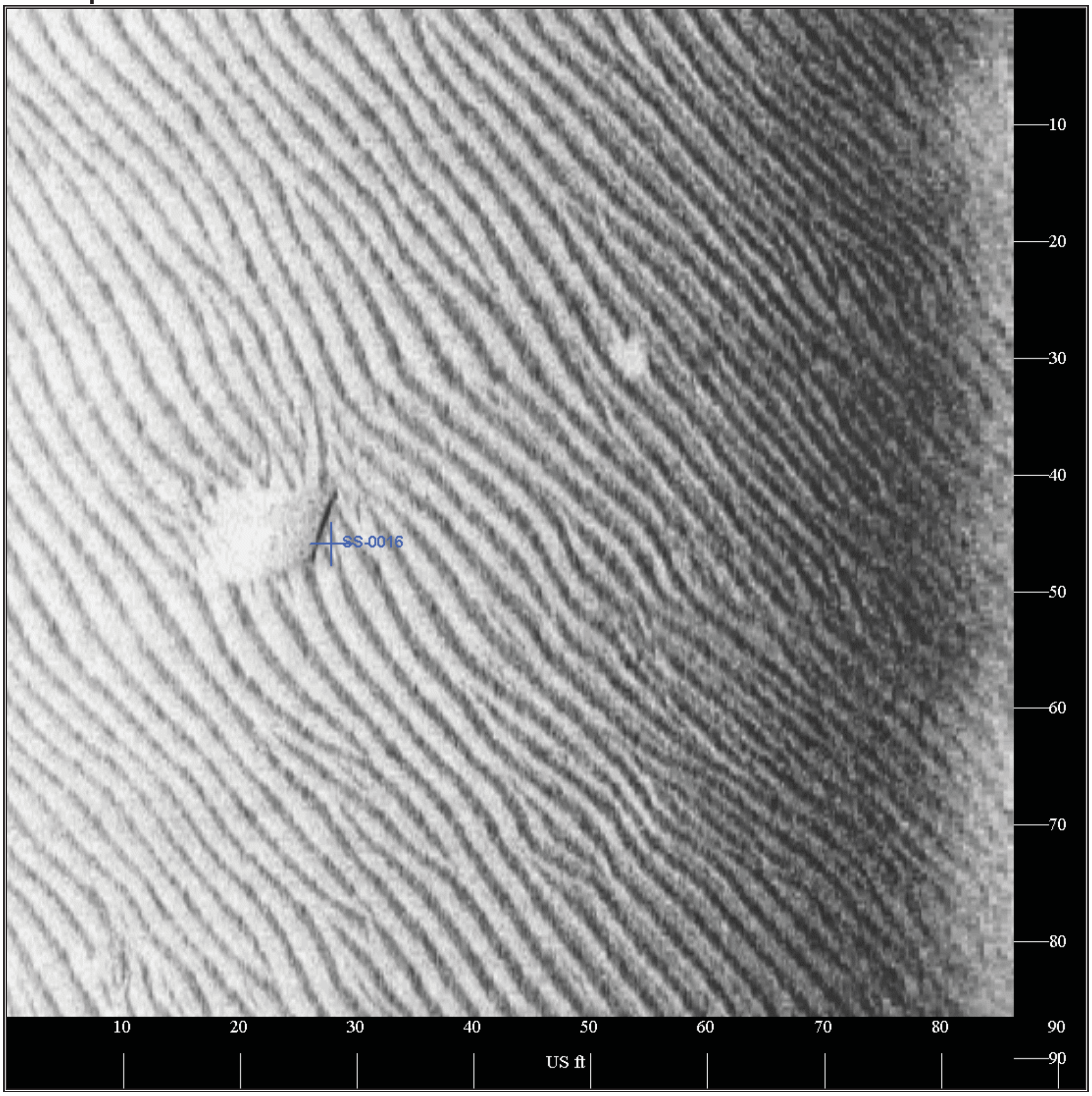
User Entered Info

Target Height = 0.0 US Feet
Target Length: 12.3 US Feet
Target Shadow: 0.0 US Feet
Target Width: 2.7 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:53 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0016



Target Info for SS-0016

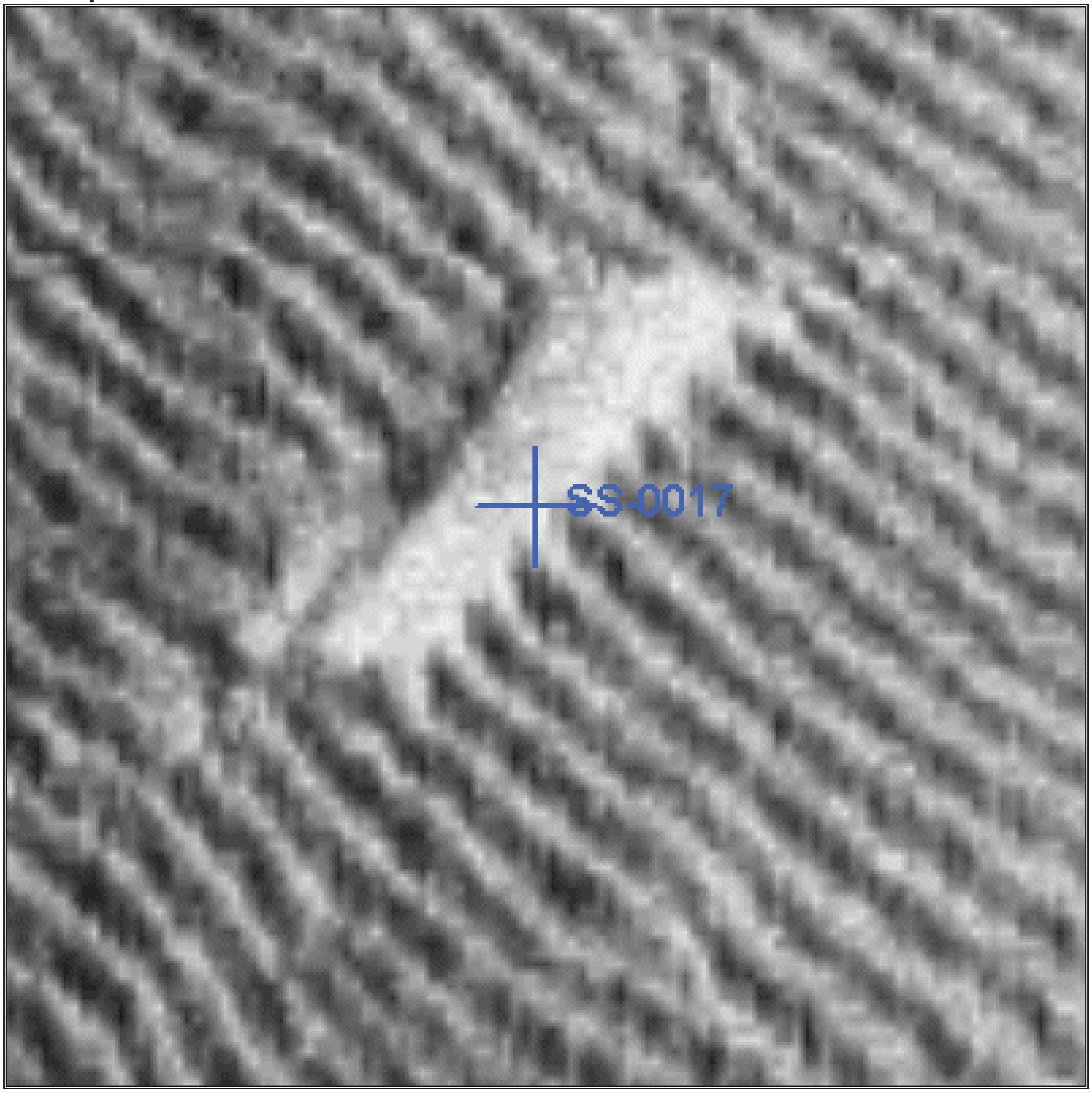
- Sonar Time at Target: 11/04/2009 15:35:48
- Click Position (Lat/Lon Coordinates)
  43° 27.77060' N 070° 22.37257' W (WGS84)
  43° 27.77060' N 070° 22.37257' W (Local)
  43° 27.76547' N 070° 22.40295' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,898,002.01 (Y) 229,507.86
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s3.xtf
- Ping Number: 121259
- Range to Target: 66.03 US Feet
- Fish Height: 14.06 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s3

User Entered Info

Target Height = 1.2 US Feet
Target Length: 8.7 US Feet
Target Shadow: 6.0 US Feet
Target Width: 5.5 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:54 PM
TargetReportGen (V2.4.1)



Target Info for SS-0017

- Sonar Time at Target: 11/04/2009 15:56:31
- Click Position (Lat/Lon Coordinates)
  43° 27.93500' N 070° 22.77298' W (WGS84)
  43° 27.93500' N 070° 22.77298' W (Local)
  43° 27.92988' N 070° 22.80336' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,896,232.77 (Y) 230,511.03
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s18.xtf
- Ping Number: 154410
- Range to Target: 39.13 US Feet
- Fish Height: 10.82 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s18

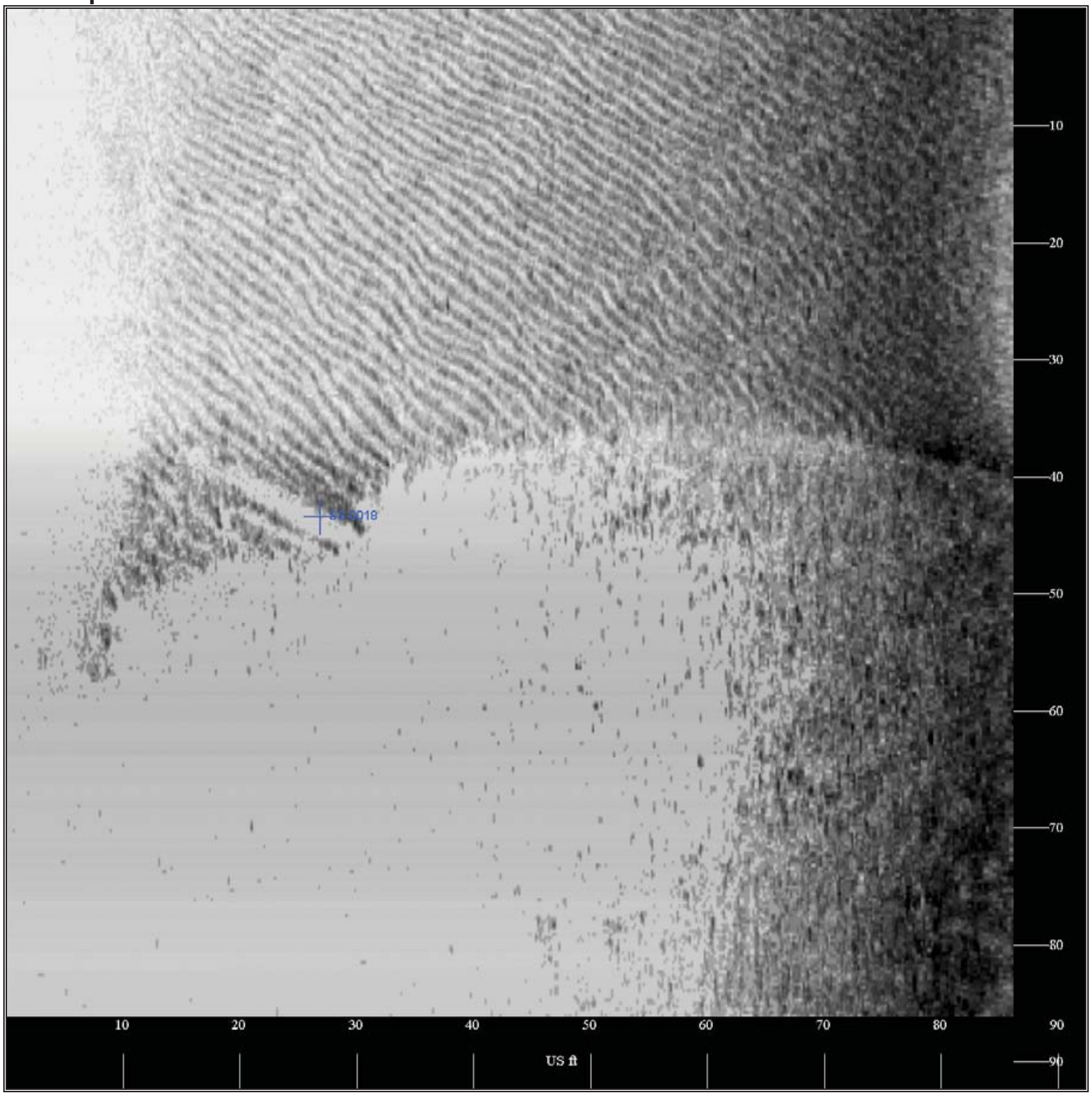
User Entered Info

Target Height = 0.5 US Feet
Target Length: 11.0 US Feet
Target Shadow: 1.7 US Feet
Target Width: 1.9 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:55 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0018



Target Info for SS-0018

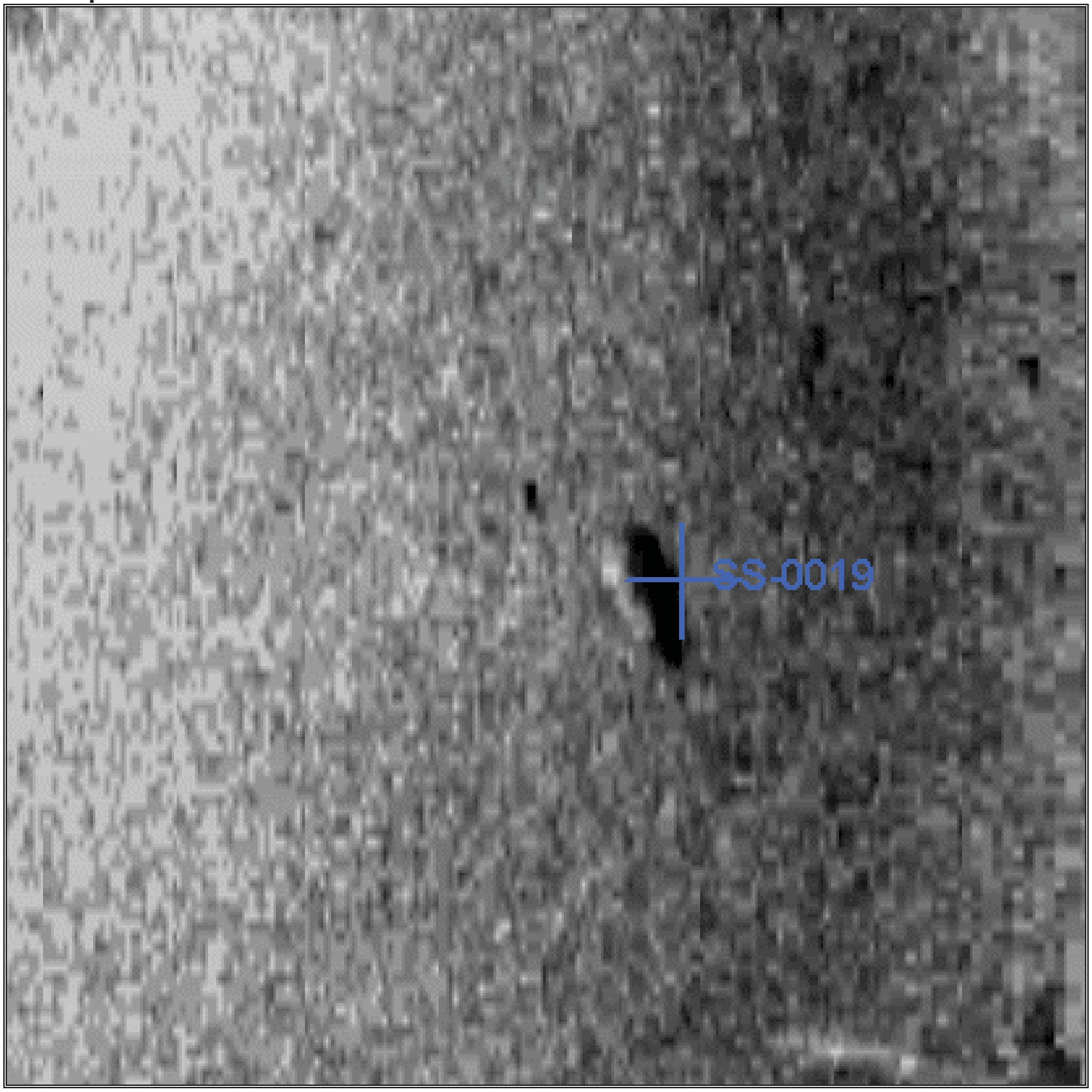
- Sonar Time at Target: 11/04/2009 16:05:07
- Click Position (Lat/Lon Coordinates)
  43° 27.93631' N 070° 22.78772' W (WGS84)
  43° 27.93631' N 070° 22.78772' W (Local)
  43° 27.93119' N 070° 22.81809' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,896,167.57 (Y) 230,519.17
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s20.xtf
- Ping Number: 168141
- Range to Target: 66.51 US Feet
- Fish Height: 11.81 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s20

User Entered Info

Target Height = 0.0 US Feet
Target Length: 15.0 US Feet
Target Shadow: 0.0 US Feet
Target Width: 3.7 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:56 PM
TargetReportGen (V2.4.1)



Target Info for SS-0019

- Sonar Time at Target: 11/04/2009 16:08:35
- Click Position (Lat/Lon Coordinates)
  43° 27.92027' N 070° 22.44369' W (WGS84)
  43° 27.92027' N 070° 22.44369' W (Local)
  43° 27.91515' N 070° 22.47407' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,689.60 (Y) 230,417.90
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s21.xtf
- Ping Number: 173703
- Range to Target: 23.64 US Feet
- Fish Height: 13.16 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s21

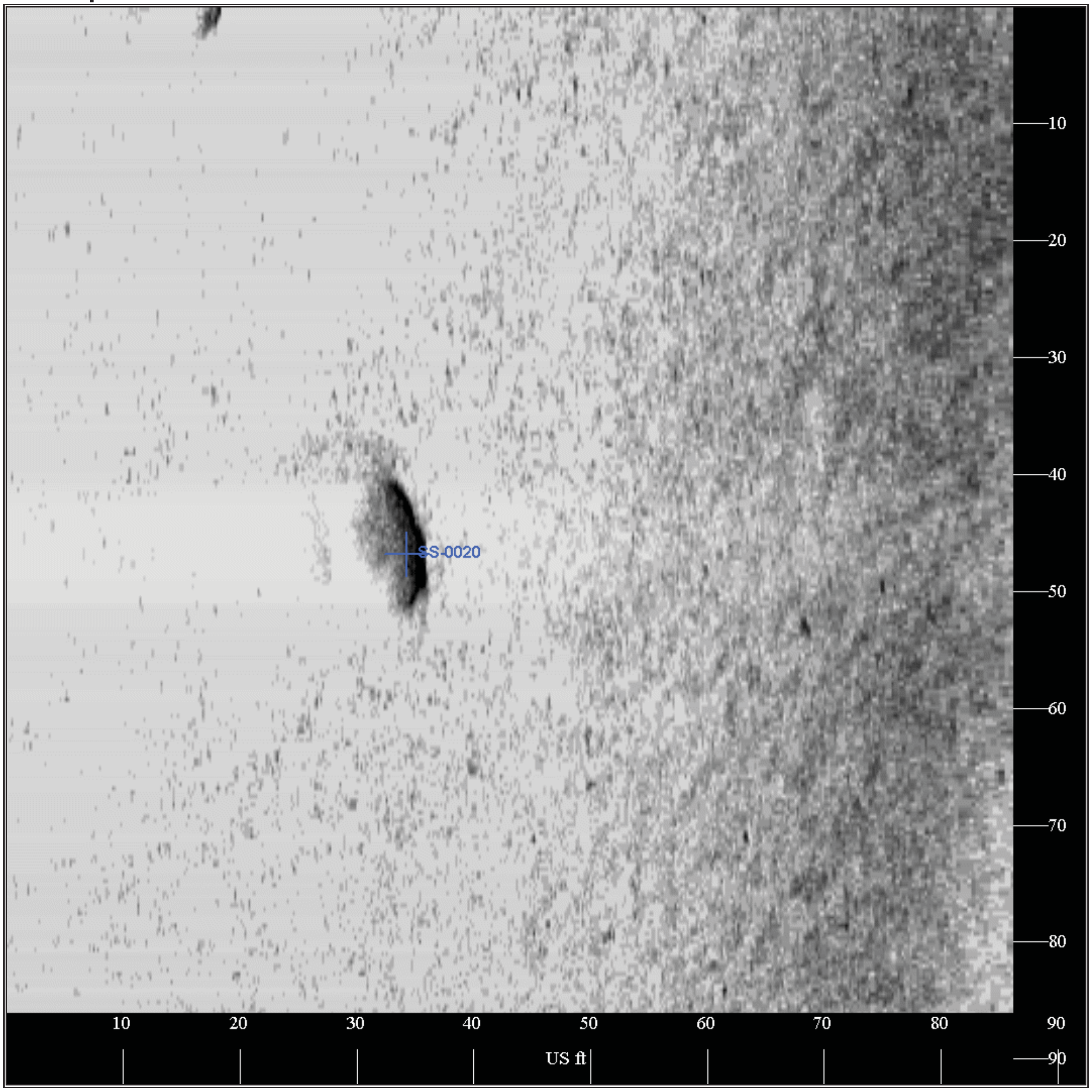
User Entered Info

Target Height = 0.0 US Feet
Target Length: 4.8 US Feet
Target Shadow: 0.0 US Feet
Target Width: 1.2 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" TargetReportGen (V2.4.1) 12/11/2009 2:12:56 PM

Camp Ellis Side Scan Contacts SS-0020



Target Info for SS-0020

- Sonar Time at Target: 11/04/2009 16:52:58
- Click Position (Lat/Lon Coordinates)
  43° 28.05306' N 070° 22.68102' W (WGS84)
  43° 28.05306' N 070° 22.68102' W (Local)
  43° 28.04794' N 070° 22.71140' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,896,641.48 (Y) 231,227.20
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s33.xtf
- Ping Number: 244681
- Range to Target: 60.29 US Feet
- Fish Height: 16.35 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s33

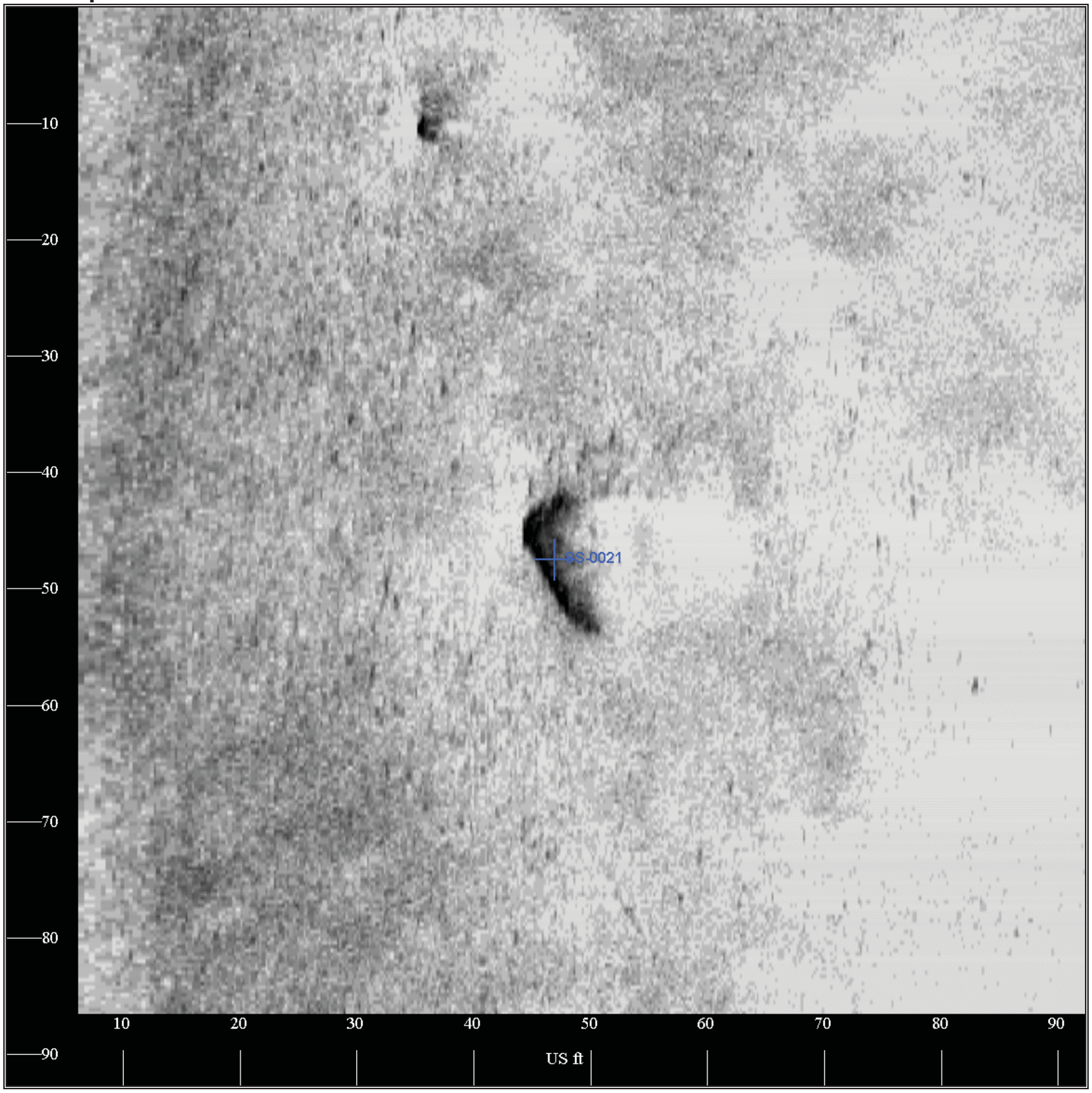
User Entered Info

Target Height >= 5.3 US Feet
Target Length: 12.6 US Feet
Target Shadow: 29.1 US Feet
Target Width: 5.3 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:57 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0021



Target Info for SS-0021

- Sonar Time at Target: 11/04/2009 16:59:19
- Click Position (Lat/Lon Coordinates)
  43° 28.05320' N 070° 22.68124' W (WGS84)
  43° 28.05320' N 070° 22.68124' W (Local)
  43° 28.04808' N 070° 22.71162' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,896,640.51 (Y) 231,228.07
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s35.xtf
- Ping Number: 254820
- Range to Target: 49.85 US Feet
- Fish Height: 17.26 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s35

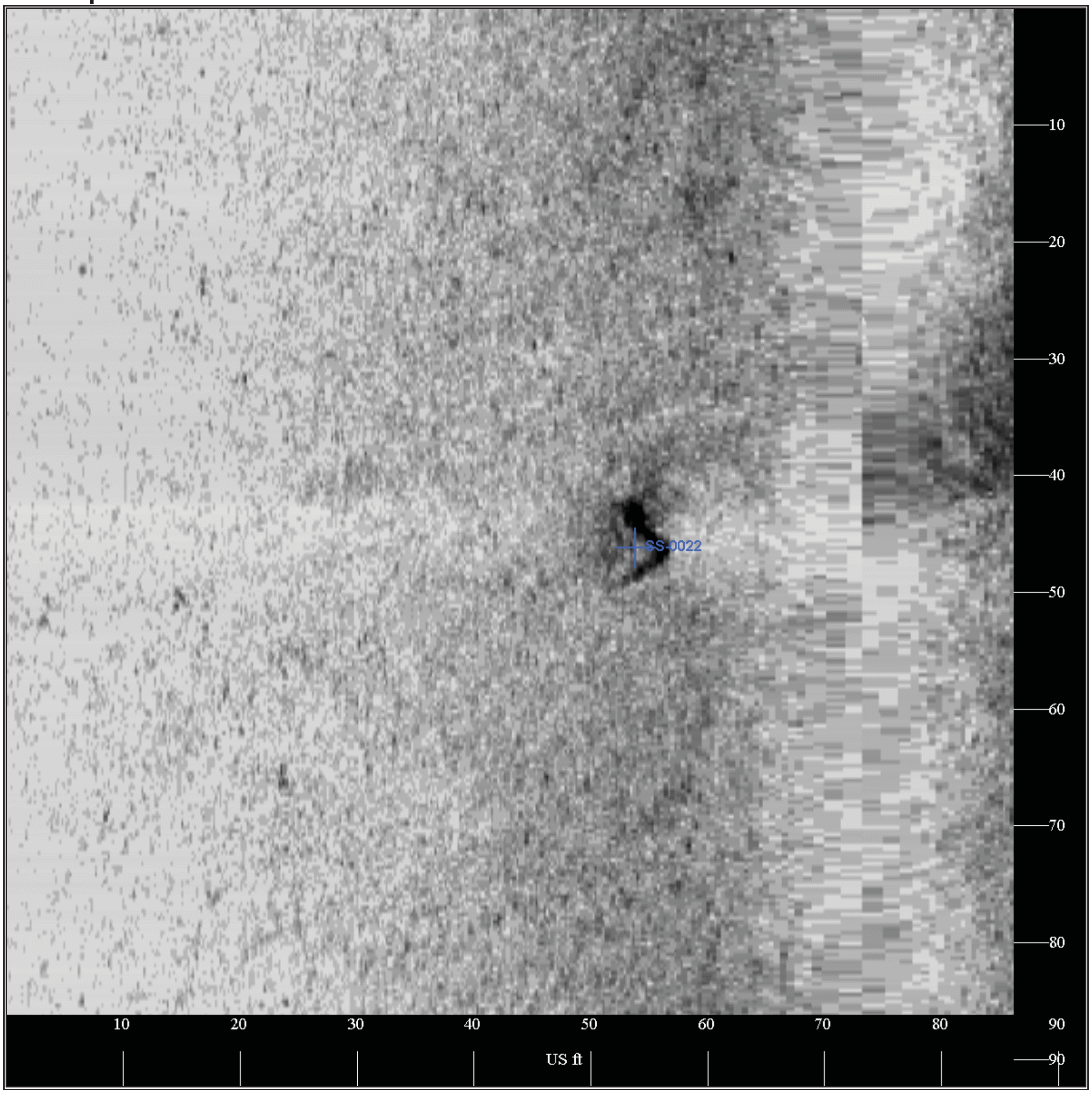
User Entered Info

Target Height = 4.3 US Feet
Target Length: 12.9 US Feet
Target Shadow: 16.6 US Feet
Target Width: 6.6 US Feet

Classification 1: debris

Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:58 PM
TargetReportGen (V2.4.1)

Camp Ellis Side Scan Contacts SS-0022



Target Info for SS-0022

- Sonar Time at Target: 11/04/2009 17:00:08
- Click Position (Lat/Lon Coordinates)
  43° 28.05338' N 070° 22.58329' W (WGS84)
  43° 28.05338' N 070° 22.58329' W (Local)
  43° 28.04826' N 070° 22.61366' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 2,897,073.95 (Y) 231,228.05
- Map Proj: NAD83 Maine State Planes, Western Zone, US Foot
- Acoustic Source File: C:\HYPACK 2008\Projects\WHG-Saco\saco sss\XTF\Line-s35.xtf
- Ping Number: 256142
- Range to Target: 27.10 US Feet
- Fish Height: 18.90 US Feet
- Heading: 0.00000000
- Event Number: 0
- Line Name: Line-s35

User Entered Info

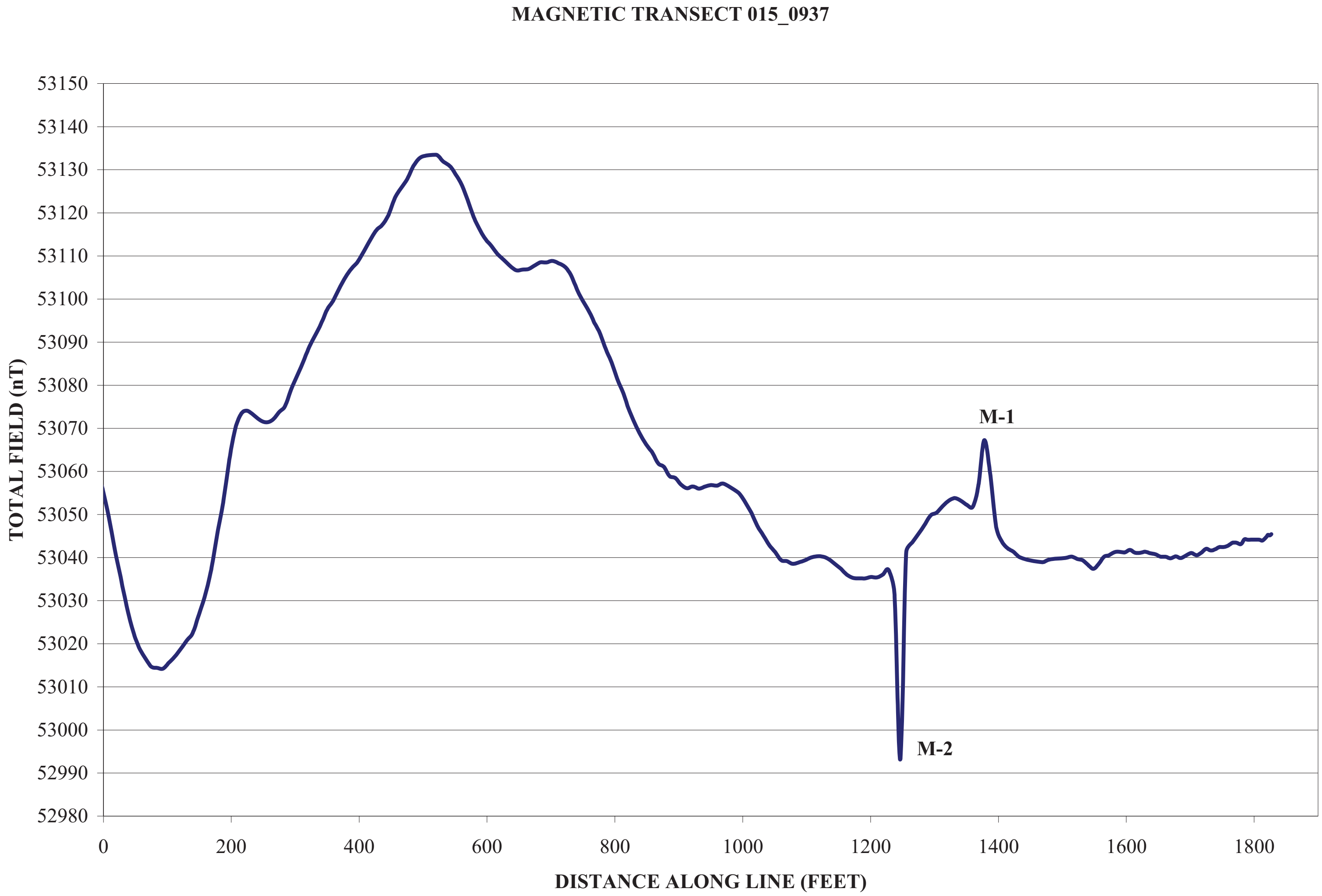
Target Height = 0.0 US Feet
Target Length: 6.9 US Feet
Target Shadow: 0.0 US Feet
Target Width: 5.4 US Feet

Classification 1: debris
Description: Appears partially buried.

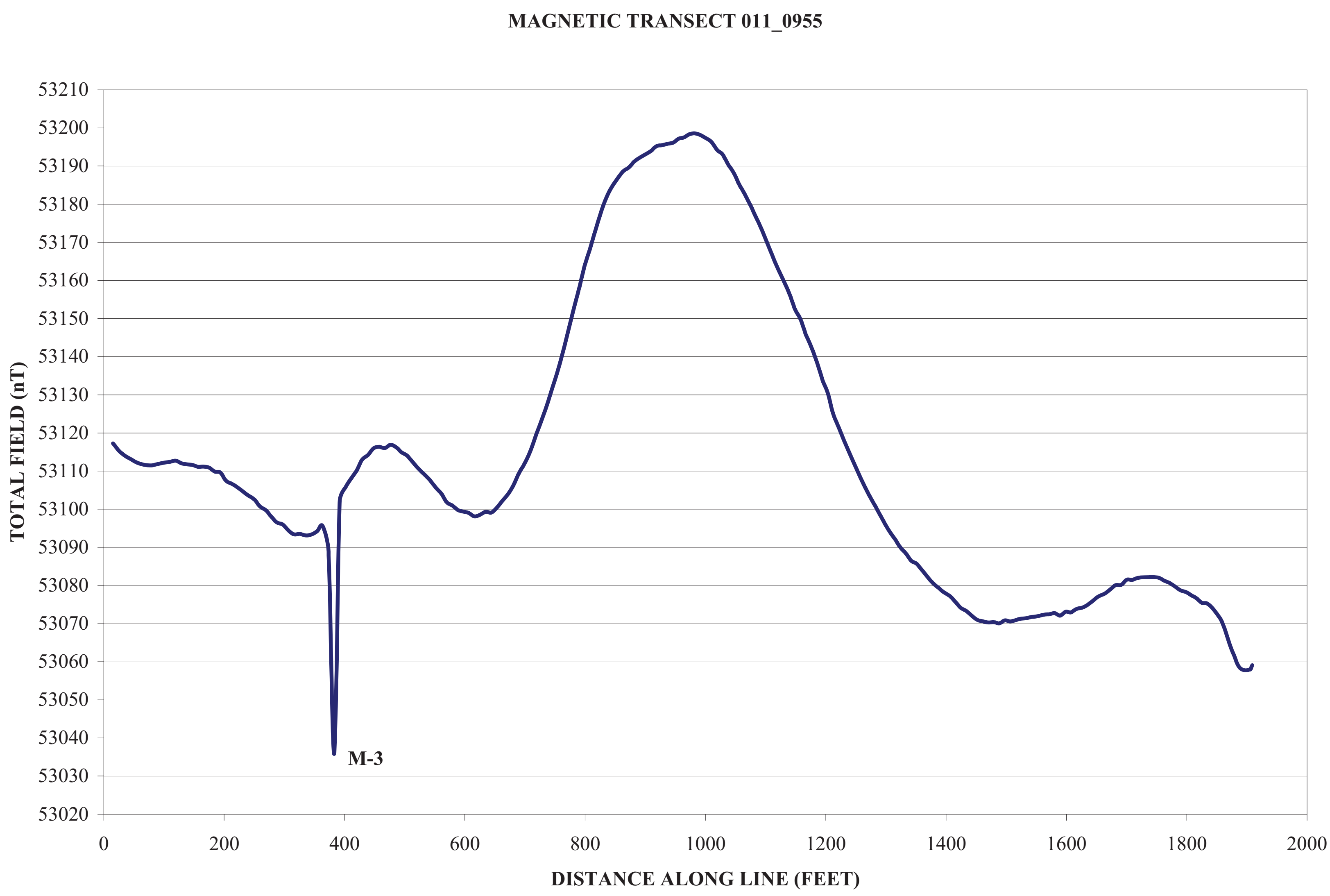
Camp_Ellis_Side_Scan_Contacts..doc" 12/11/2009 2:12:59 PM
TargetReportGen (V2.4.1)

APPENDIX B

MAGNETOMETER PROFILES

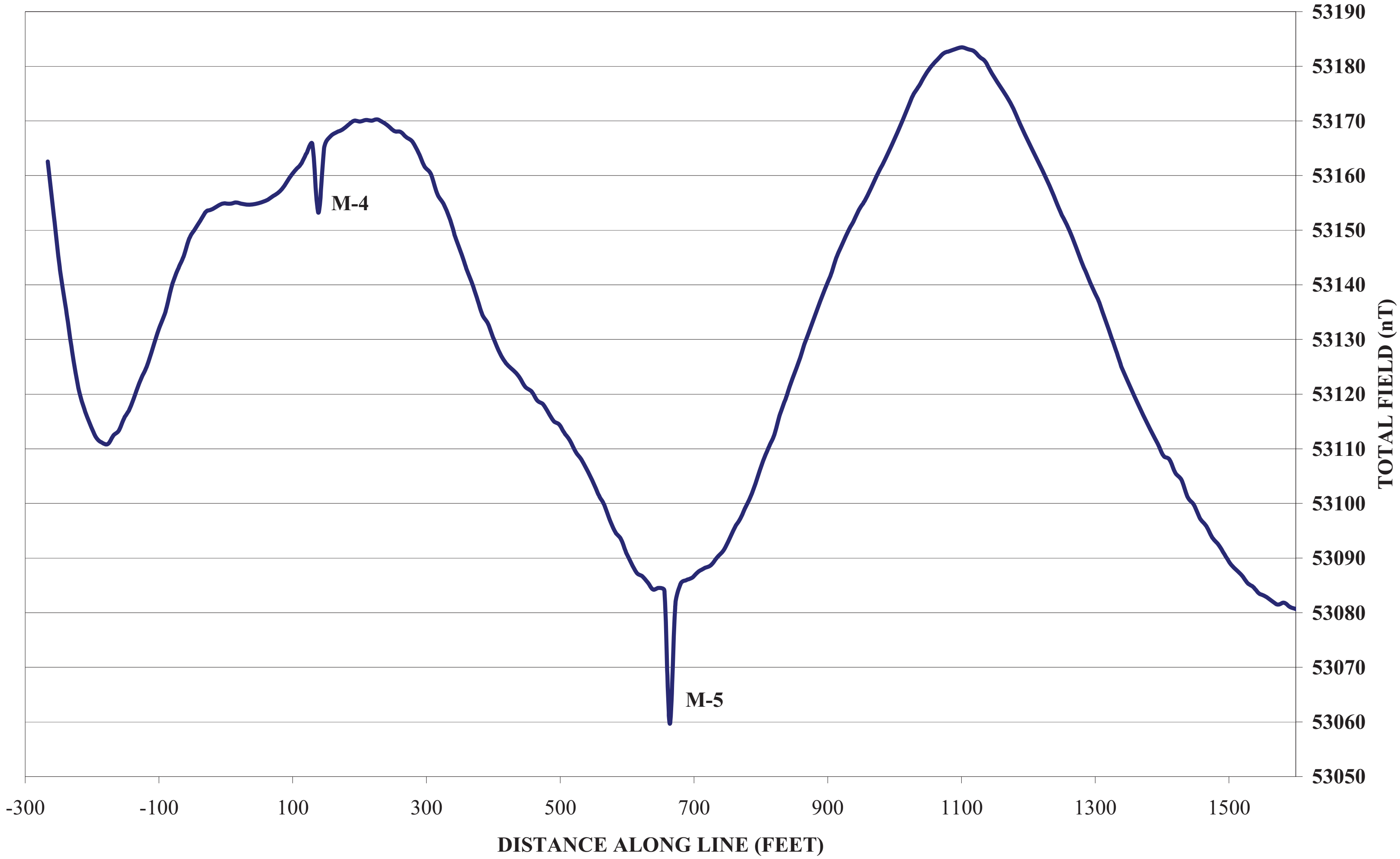


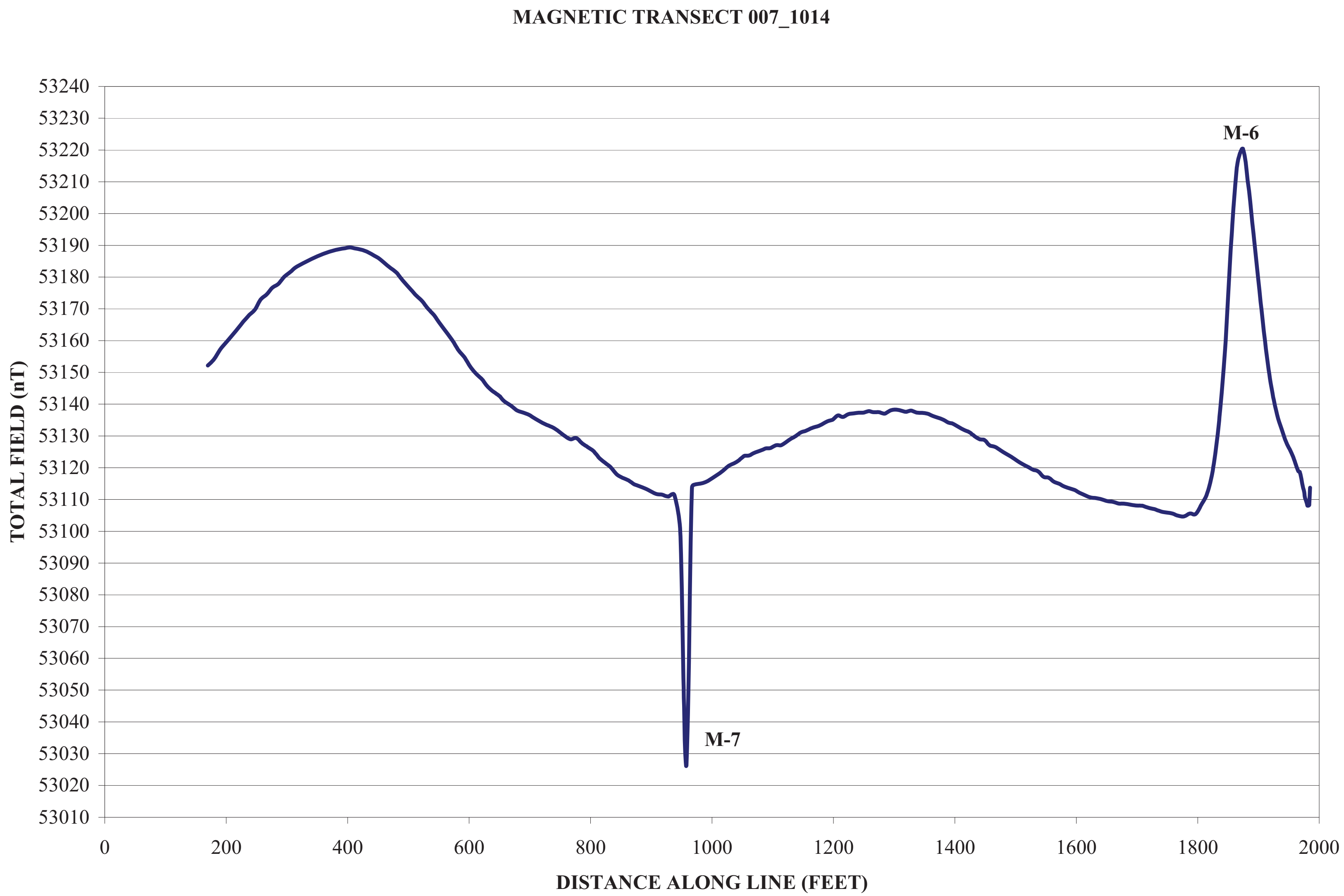
MAGNETIC TRANSECT 015_0937
TOTAL FIELD (nT)
53150
53140
53130
53120
53110
53100
53090
53080
53070
53060
53050
53040
53030
53020
53010
53000
52990
52980
0
200
400
600
800
1000
1200
1400
1600
1800
DISTANCE ALONG LINE (FEET)
M-1
M-2



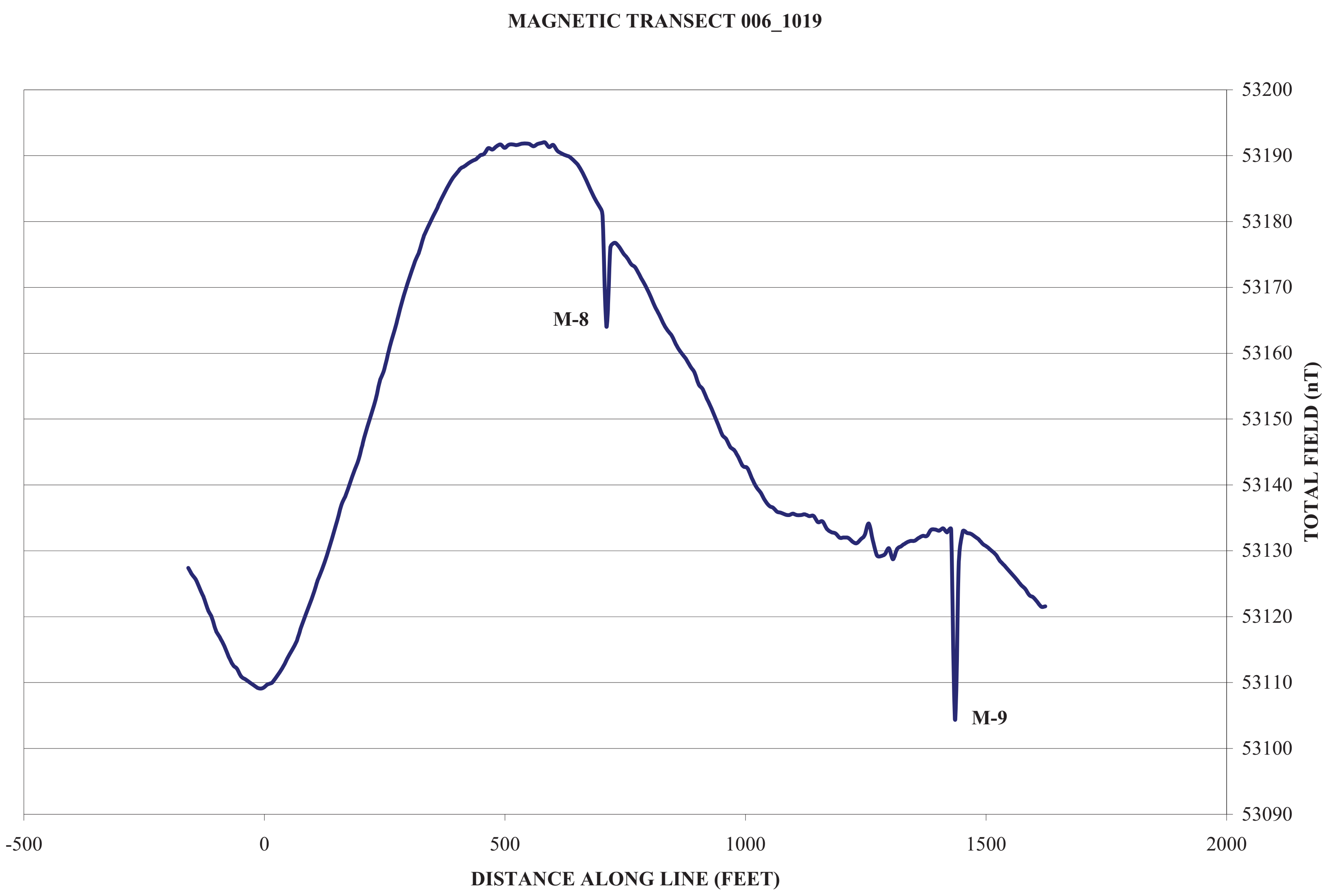
MAGNETIC TRANSECT 011_0955
53210
53200
53190
53180
53170
53160
53150
53140
53130
53120
53110
53100
53090
53080
53070
53060
53050
53040
53030
53020
TOTAL FIELD (nT)
M-3
0
200
400
600
800
1000
1200
1400
1600
1800
2000
DISTANCE ALONG LINE (FEET)

MAGNETIC TRANSECT 010_1001





MAGNETIC TRANSECT 007_1014
TOTAL FIELD (nT)
53240
53230
53220
53210
53200
53190
53180
53170
53160
53150
53140
53130
53120
53110
53100
53090
53080
53070
53060
53050
53040
53030
53020
53010
0
200
400
600
800
1000
1200
1400
1600
1800
2000
DISTANCE ALONG LINE (FEET)
M-6
M-7


MAGNETIC TRANSECT 006_1019
M-8
M-9
TOTAL FIELD (nT)
DISTANCE ALONG LINE (FEET)
53200
53190
53180
53170
53160
53150
53140
53130
53120
53110
53100
53090
-500
0
500
1000
1500
2000

APPENDIX C:

INVENTORY OF SIDE-SCAN SONAR ANOMALIES

INVENTORY OF SIDE-SCAN SONAR ANOMALIES
Camp Ellis Beach, Saco Maine
(dimensions in US feet)

ID	TIME	X	Y	LENGTH	WIDTH	HEIGHT	CORRELATION	LINE	NOTES
SS-0001	14:33:19	2897601.36	230102.72	13.56	3.15	0.53		Line-0061	small area of bottom disturbance; assoc. w/SS-0002
SS-0002	14:39:48	2897592.35	230116.06	13.56	0.87	0.00		Line-0062	low relief linear target - modern debris; assoc. w/SS-0001
SS-0003	14:56:30	2897201.83	229881.81	15.79	0.90	0.00	M9	Line-0011	low relief linear target - modern debris; same target as SS-0005 and SS-0008
SS-0004	15:02:37	2897676.81	229914.80	9.82	1.67	0.00	M5	Line-s10	small area of bottom disturbance
SS-0005	15:03:28	2897194.07	229871.69	22.18	0.77	0.00	M9	Line-s10	low relief linear target - modern debris; same target as SS-0003 and SS-0008
SS-0006	15:05:23	2896542.16	229936.65	20.48	1.89	0.00	M6	Line-s-9	low relief linear target - modern debris
SS-0007	15:06:20	2897051.86	229868.69	8.51	1.53	0.00	M9	Line-s-9	low relief linear target - modern debris
SS-0008	15:06:35	2897201.31	229880.83	15.79	0.90	0.00	M9	Line-s-9	low relief linear target - modern debris; same target as SS-0003 and SS-0005
SS-0009	15:15:34	2897237.17	229803.46	16.25	2.71	0.00	M9	Line-s7	low relief linear target - modern debris
SS-0010	15:24:03	2896930.14	229647.48	14.86	11.71	2.55		Line-s5	low relief amorphous target - modern debris; same target as SS-0013 and SS-0014
SS-0011	15:25:59	2897997.09	229509.59	11.81	6.59	1.49		Line-s5	low relief amorphous target - modern debris
SS-0012	15:28:34	2898312.94	229407.44	8.34	5.20	0.00		Line-s4	low relief amorphous target - modern debris
SS-0013	15:31:07	2896919.19	229641.88	17.12	14.23	1.15		Line-s4	low relief amorphous target - modern debris; same target as SS-0010 and SS-0014
SS-0014	15:33:46	2896928.39	229650.25	15.47	11.44	2.06		Line-s3	low relief amorphous target - modern debris; same target as SS-0010 and SS-0013
SS-0015	15:34:45	2897438.90	229586.80	12.26	2.72	0.00	M9	Line-s3	low relief oblong target - modern debris
SS-0016	15:35:48	2898002.01	229507.86	8.75	5.46	1.16		Line-s3	low relief amorphous target - modern debris
SS-0017	15:56:31	2896232.77	230511.03	10.99	1.87	0.46		Line-s18	low relief oblong target - modern debris
SS-0018	16:05:07	2896167.57	230519.17	15.04	3.65	0.00		Line-s20	low relief linear target - modern debris
SS-0019	16:08:35	2897689.60	230417.90	4.80	1.16	0.00		Line-s21	low relief oblong target - modern debris
SS-0020	16:52:58	2896641.48	231227.20	12.60	5.31	5.33		Line-s33	moderate relief oblong target - rock or modern debris; same target as SS-0021
SS-0021	16:59:19	2896640.51	231228.07	12.89	6.58	4.32		Line-s35	moderate relief oblong target - rock or modern debris; same target as SS-0020
SS-0022	17:00:08	2897073.95	231228.05	6.86	5.41	0.00		Line-s35	low relief 'L'-shaped target - modern debris

Notes:

1 Reported coordinates are Maine State Plane (US feet), West Zone, referencing NAD-83.

APPENDIX D:

INVENTORY OF MAGNETIC ANOMALIES

INVENTORY OF MAGNETIC ANOMALIES
Camp Ellis Beach, Saco Maine
(magnitude values in nanoTeslas)

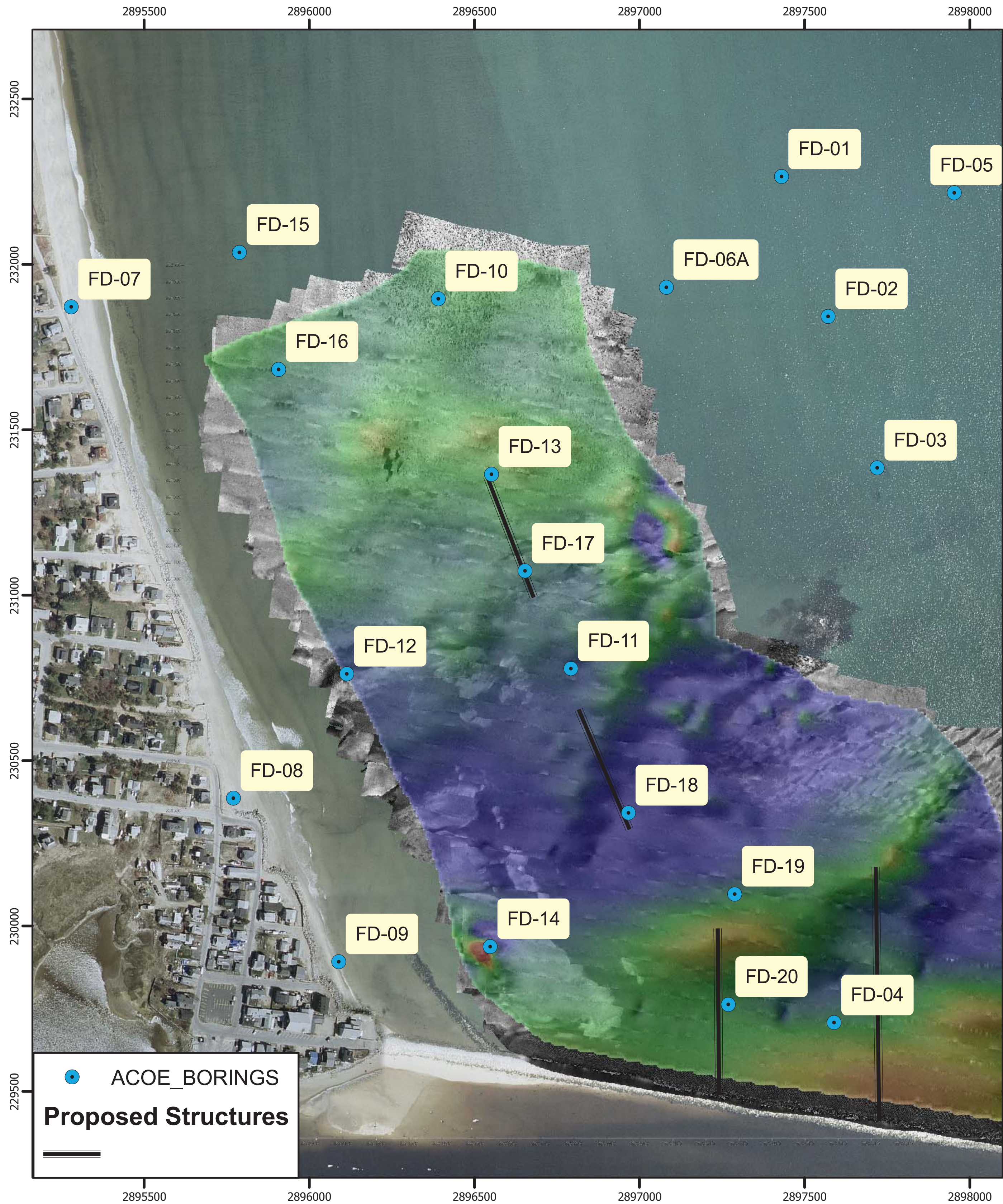
ID	TIME	X	Y	BACKGROUND	ANOMALY	MAGNITUDE	SIGNATURE	DURATION	LINE	CORRELATION	NOTES
M-1	9:38:27	2896860.68	230260.7	53037.13	52993.2	-43.93	MP-	55	015_0937		Complex. May be related to M-2.
M-2	9:38:41	2896990.98	230243.7	53042.14	53067.23	25.09	MP+	64	015_0937		Complex. May be related to M-1.
M-3	9:57:55	2897992.07	229894.4	53102.25	53035.85	-66.4	MP-	8	011_0955		
M-4	10:01:54	2898270.27	229798.7	53165.75	53153.2	-12.55	MP-	17	010_1001		Single scan.
M-5	10:02:55	2897751.98	229885.9	53084.05	53059.68	-24.37	MP-	25	010_1001	SS-0004	Single scan, but with minor signature on either side.
M-6	10:14:34	2896668.17	229919.4	53108.43	53220.38	111.95	MP+	125	007_1014	SS-0006	Single scan, but with minor signature on either side.
M-7	10:16:14	2897571.68	229762.7	53113.87	53026.16	-87.71	MP-	30	007_1014		
M-8	10:20:43	2897851.38	229663.7	53181.04	53164.05	-16.99	MP-	25	006_1019		Single scan.
M-9	10:22:07	2897135.68	229777.1	53133.31	53104.36	-28.95	MP-	24	006_1019	SS-0003, SS-0005, SS-0007, SS-0008, SS-0009, SS-0015	Single scan, but with minor signature on either side.

Notes:

1 1.0 nanoTesla (nT) = 1 "Gamma"; Duration is measured in US feet and estimated from beginning of signature to end of signature as distance along trackline.
2 MP = Monopolar. +/- indicate signature orientation relative to background.
3 Scaled profiles are included in Appendix B of CRE's attached report. Anomaly locations are shown in Figure 5-_.
4 Reported coordinates are Maine State Plane (US feet), West Zone, referencing NAD-83.

APPENDIX E:

GEI GEOTECHNICAL BORINGS DATA



BORING LOCATIONS RELATIVE TO SIDE SCAN MOSAIC AND MAGNETIC RELIEF MAP
Camp Ellis - Saco, Maine

www.crenvironmental.com

NOTES:
1) Survey conducted November 4, 2009.
2) Grid ME State Plane (West) NAD 83, US Foot.
3) Not for Navigation

1:5,000
Feet
0 250 500

N W E S

Figure #na

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, maine
GEI PROJECT NUMBER: 04376-0

BORING LOG

PAGE 1 of 2

FD-19

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT) WATER	CASING	HOLE
				FD-19

BORING LOCATION: FD-19
TOTAL DEPTH (FT): 47.5'
SURFACE ELEVATION (FT): -0.6
VERT. DATUM: MLLW
NORTHING: 4813312.79 EASTING: 388726.89
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring B. Thompson
DATE START: 11/09/05
LOGGED BY: Steve Sarandis
DATE END: 11/09/05

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	2 3 4 4	24	14			SAND	S1: POORLY GRADED SAND (SP); Fine to medium sand, ~25% coarse sand, ~5% non plastic fines, Gray.
4							SILTY SAND	Top of SILTY SAND at about 4'
5	S2	3 1 1 2	24	18			SILTY SAND	S2: SILTY SAND (SM); Fine sand, ~20% slightly plastic fines, occasional shell, Dark Gray, one-3" layer sandy silt (ML-MH), medium plasticity, possibly organic
10	S3	14 10 13 17	24	11			SILTY SAND	S3: SILTY SAND (SM); Fine sand, ~10% medium to coarse sand, ~20% slightly plastic fines, ~10% subangular to subrounded fine gravel (black), Gray.
14							SILTY SAND	Wash color change at 14'
15	S4	7 8 10 6	24	4			SILTY SAND	S4: CLAYEY SAND (SC); Fine sand, ~35% low plasticity fines, Tan.
18							CLAY	Top of CLAY at about 18'
20	S5	WOR/18" 3	24	24	0.25 0.30 0.60 0.65		CLAY	S5: LEAN CLAY (CL); Low plasticity, ~5% fine sand, Top 12" Gray with black layers, Bottom 12" Olive Gray.
22							SAND	Top of SAND at about 22' Wash color changes every 6"-12" from 20'-25' (tan/gray)
25	S6	13 16 23 26	24	15			SAND	S6: POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~10% non plastic fines, ~5% coarse sand, Tan.
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S7	30 23 18 18	24	14			Sand	S7: WELL-GRADED SAND WITH GRAVEL (SW); Fine to coarse sand, ~20% subrounded fine gravel, ~5% non plastic fines, Brown.
35	S8	21 20 26 23	24	17			Sand	S8: WELL-GRADED SAND WITH GRAVEL (SW); Fine to coarse sand, ~30% subrounded fine gravel, ~5% non plastic fines, Dark Gray.
40	S9	10 8 11 11	24	8			Sand	S9: WELL-GRADED SAND WITH GRAVEL (SW); Similar to S8.
45	S10	26 25 50 55	24	15			Sand	S10: WELL-GRADED SAND WITH GRAVEL (SW); Fine to coarse sand, ~35% subrounded fine to coarse gravel (some gravel pieces fractured during sampling), ~5% non plastic fines, Dark Brown.
								Bottom of Boring at 47.5' 1. Boring advanced using drive and wash technique with 4" (HW) casing from 0-47.5'. 2. Unable to drive casing past 47.5'.
50								
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, maine
GEI PROJECT NUMBER: 04376-0

BORING LOG
PAGE 1 of 2
FD-18

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE
			FD-18	

BORING LOCATION: FD-18
TOTAL DEPTH (FT): 46.5'
SURFACE ELEVATION (FT): -2.3
VERT. DATUM: MLLW
NORTHING: 4813388.88 EASTING: 388629.94
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring B. Thompson
DATE START: 11/8/05
LOGGED BY: Kevin Duffy
DATE END: 11/8/05

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	2 2 4 6	24	10				S1: POORLY GRADED SAND (SP); Fine to medium sand, ~5% fines, Tan-Gray.
5	S2	12 11 11 13	24	10				S2: Top 3" - POORLY GRADDED SAND (SP); Similar to S1 with ~10% coarse subrounded gravel. S2: Bot. 7" - SILTY SAND WITH GRAVEL (SM); Fine to coarse sand, ~25% fine to coarse gravel, ~15% slightly plastic fines, Tan-Gray.
10	S3	35 22 14 5	24	9				S3: POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~10% non plastic fines, 50% subrounded coarse gravel, bottom 1" is clayey sand, ~40% low plastic sand, Tan.
15	S4	19 7 3 6	24	24				S4: CLAYEY SAND (SC); Mostly fine sand, ~35% low plasticity fines, layers of sandy clay and silty fine sand, layers ranging 1/2" -2" thick, one piece angular gravel @ top of sample, gravel fractured during sampling, Tan.
20	S5	8 6 7 7	24	17				S5: POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~10% silt, clay layers throughout sample, 1/2" in length, ~1.5" area of liquefaction, no silt in area, Brown-Tan.
25	S6	12 13 17 22	24					S6: WELL-GRADED SAND (SW); Mostly fine to coarse sand, ~15% fine subangular gravel, <5% fines, Tan.
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- **SILTY SAND**
- **GRAVEL**
- **SAND**
- **CLAY**
- **ORGANIC SILT**
- **SILT**

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PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, maine
GEI PROJECT NUMBER: 04376-0

BORING LOG

FD-18

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
31-33	S7	14 13 19 22	24	16			SAND	S7: WELL-GRADED SAND (SW); Similar to S6.
33							SAND	Hard drilling at 33.0'
35-37	S8	18 17 18 16	24	16			SAND	S8: WELL-GRADED SAND WITH GRAVEL (SW); Mostly fine to coarse sand, ~20% fine to coarse gravel, ~5% non plastic fines, Tan.
40-42	S9	13 17 21 13	24	13			SAND	S9: WELL-GRADED SAND WITH GRAVEL (SW); Similar to S8.
43.5							SILTY SAND	Top of SILTY SAND at about 43.5'
45-46.5	S10	65 85 100	18	3			SILTY SAND / ROCK	S10: Interface of glacial till and weathered rock. One piece fractured rock, less weathered.
46.5								Bottom of Boring at 46.5'
								1. Boring advanced from 0-46' using drive and wash technique with 4" (HW) casing

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

BORING LOCATION: Offshore
TOTAL DEPTH (FT): 32.0'
SURFACE ELEVATION (FT): -4.9
VERT. DATUM: MLLW
NORTHING: 4813613.17 EASTING: 388537.53
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring B. Thompson
DATE START: 11/03/05
LOGGED BY: Steve Sarandis
DATE END: 11/03/05

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	7 6 7 8	24	14				S1: POORLY GRADED SAND WITH SILT (SP-SM); Fine sand, ~10% non plastic fines, top 8" light brown, bottom 6" gray.
5	S2	10 10 6 7	24	8				S2: Top 4" - Similar to the bottom 6" of S1. S2: Bot. 4" - SILTY SAND WITH GRAVEL (SM); Fine to coarse sand, ~15% slightly plastic fines, ~20% subangular fine gravel, Tan, Brown Mottlen. Difficulty washing out casing from 5-13'. Large amount of gravel in wash/rollerbit binding up inside casing.
10	S3	6 9 12 13	24	3				S3: SILTY GRAVEL WITH SAND (GM); Fine to coarse subangular gravel, ~15% slightly plastic fines, ~25% fine to coarse sand, Tan.
15	S4	15 20 17 13	24	5				S4: SILTY GRAVELWITH SAND (GM); Fine to coarse subangular gravel, ~15% slightly plastic fines, ~30% fine to coarse sand, Tan.
20	S5	15 24 9 11	24	9				S5: Top 3" - WELL-GRADED GRAVEL WITH SAND (GW); Fine to coarse subrounded gravel, ~25% fine to medium sand,~5% fines, Gray. S5: Bot. 6" - POORLY GRADED SAND WITH SILT (SP-SM); Fine sand, ~10% non plastic fines, Light Brown.
25	S6	14 8 8 9	24	13				S6: WELL-GRADED SAND WITH SILT (SW-SM); Fine to medium sand, ~10% non plastic fines, ~5% coarse sand, ~5% fine subrounded gravel, Light Brown. Hard Drilling at 27'.
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S7	20 15 21 18	24	0				S7: Three pieces of coarse gravel in tip sample.
35								Bottom of Boring at 32'. 1. Advanced boring from 0-32' using drive and wash technique with 4" (HW) casing. 2. Stopped boring at 32' and returned drilling barge to dock due to deteriorating weather conditions.
40								
45								
50								
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND **- SAND** **- ORGANIC SILT**
- GRAVEL **- CLAY** **- SILT**

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	CITY/STATE: Saco, maine	PAGE 1 of 3 — **FD-16**
	GEI PROJECT NUMBER: 04376-0	

BORING LOCATION: Offshore	TOTAL DEPTH (FT): 70.0'
SURFACE ELEVATION (FT): -4.0	VERT. DATUM: MLLW
NORTHING: 4813802.11 EASTING: 388312.85	HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring Greg Leavitt	DATE START: 11/02/05
LOGGED BY: Steve Sarandis	DATE END: 11/02/05

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	7 6 8 8	24	13				S1: POORLY GRADED SAND WITH SILT (SP-SM); Fine to very fine sand sand, ~10% non plastic fines, Gray.
5	S2	1 1 2 1	24	24	0.25 0.25			Top of CLAY at about 4.5' S2: LEAN CLAY (CL); Low to medium plasticity, ~5% fine sand, lamina of silty fine sand, Light Gray.
10	S3	WOR/12" WOH/12"	24	24	0.25 0.30			S3: LEAN CLAY (CL); Medium plasticity, ~5% fine sand, Gray with layers and zones of black, medium dry strength.
15	U1	PUSH/24"	24	24	0.25 0.30 0.25			U1: LEAN CLAY (CL); Simialr to S3.
20	S4	WOR/24"	24	24				S4: LEAN CLAY (CL); Simialr to S3.
25	S5	WOR/24"	24	24	0.20 0.20			S5: LEAN CLAY (CL); Simialr to S3.
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S6	WOR/24"	24	24	0.20 0.25			S6: LEAN CLAY (CL); Medium plasticity, ~5% fine sand, Dark Gray with Black.
35	S7	WOR/24"	24	24	0.20 0.20			S7: LEAN CLAY (CL); Medium plasticity, ~5-10% fine sand, Olive Gray.
40	S8	WOR/24"	24	24	0.30 0.30 0.30			S8: LEAN CLAY (CL); Similar to S7.
45	S9	WOR/24"	24	24	0.35 0.35 0.35			S9: LEAN CLAY (CL); Similar to S7.
50	S10	WOR/12" 3 4	24	24	0.35 0.40			S10: LEAN CLAY (CL); Similar to S7.
55	S11	WOR 4 7 6	24	24				S11: Top 6"; LEAN CLAY (CL); Similar to S7. Top of SILTY SAND at 55.5' S11: Bot. 18" SILTY SAND (SM); Fine sand, ~20% slightly plastic fines, fragmented layers of Sandy Silt (ML), up to 1" thick, Dark Gray.
60	S12	2 1 1 7	24	24				S12: SILTY SAND (SM); Fine sand, ~15% slightly plastic fines, bottom 6" has numerous layers of sandy silt, Gray.
65	S13	5 9 10 14	24	24				S13: POORLY GRADED SAND WITH SILT (SP-SM); Fine sand, ~10% non-plastic fines, Gray.

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc. 1021 Main Street Winchester, MA 01890	PROJECT NAME: Camp Ellis Beach CITY/STATE: Saco, maine GEI PROJECT NUMBER: 04376-0	BORING LOG PAGE 3 of 3	FD-16

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
70								Bottom of Boring at 70.0' Advanced boring to 70' with roller bit, attempted to sample; hole would not stay open. Drilling and wash indicated sand at 70'. 1. Advanced boring from 0 to 10' using drive and wash technique with 4" (HW) casing. 2. Advanced boring open hole below 10'. 3. Advanced boring to 70' with roller bit, attempted to sample but hole would not stay open. Drilling and wash water indicate we are still in sand. Did not have sufficient time to advance the casing to 70' to continue boring.
75								
80								
85								
90								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, maine
GEI PROJECT NUMBER: 04376-0

BORING LOG

FD-15A

BORING LOCATION: FD-15A
TOTAL DEPTH (FT): 17.0'
SURFACE ELEVATION (FT): NM
VERT. DATUM: MLLW
NORTHING: 4813907.55 EASTING: 388279.65
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring B. Thompson
DATE START: 9/11/05
LOGGED BY: Steve Sarandis
DATE END: 9/11/05

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE
			FD-15A	

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
15	U1		24	24			CLAY	U1: LEAN CLAY (CL); Medium plasticity, <5% fine sand, Olive-gray

Bottom of Boring at 17.0'

1. This hole was advanced adjacent to FD-15 to a depth of 15' to take an undisturbed sample. Shelby tube sample was taken from 15' to 17'.

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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PROJECT NAME: Camp Ellis Beach	BORING LOG
CITY/STATE: Saco, maine	PAGE 1 of 2 — FD-15
GEI PROJECT NUMBER: 04376-0	

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE
			FD-15	

BORING LOCATION: FD-15 — TOTAL DEPTH (FT): 62.0'
SURFACE ELEVATION (FT): -3.4 — VERT. DATUM: MLLW
NORTHING: 4813910.24 EASTING: 388278.32 — HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring B. Thompson — DATE START: 10/20/05
LOGGED BY: Steve Sarandis — DATE END: 10/20/05

DEPTH FT.	SAMPLE TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	9 6 5 5	24	14			Sand	S1: Top 2"; POORLY GRADED SAND WITH SILT (SP-SM); Very fine sand, ~10% non plastic fines, Gray. S1: Bot. 12" POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~10% non plastic fines, Gray.
5	S2	3 3 4 5	24	24	0.60 0.60		Clay	S2: LEAN CLAY (CL); Low to medium plasticity, trace fine sand, Olive Gray.
10	S3	WOR/12" 1 2	24	24	0.20 0.20		Clay	S3: LEAN CLAY (CL); Low to medium plasticity, occasional layer of fine sand, ~1/8" max size, Gray, with layers of black.
15	S4	1 1/12" 1	24	24	0.25 0.20 0.25		Clay	S4: LEAN CLAY (CL); Simialr to S3.
20	S5	WOR/24"	24	24			Clay	S5: LEAN CLAY (CL); Simialr to S3.
25	S6	WOR/24"	24	24	0.15 0.15		Clay	S6: LEAN CLAY (CL); Low to medium plasticity, occasional layers and lamina of fine sand, ~1/16" max size, Dark Gray to Black.
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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PROJECT NAME: Camp Ellis Beach	BORING LOG
CITY/STATE: Saco, maine	PAGE 2 of 2
GEI PROJECT NUMBER: 04376-0	**FD-15**

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S7	WOR/12" 3 3	24	24	0.30 0.30		CLAY	S7: LEAN CLAY (CL-CH); Medium plasticity, Dark Gray.
35	S8	WOR 4 4 5	24	24	0.45 0.50 0.55		CLAY	S8: LEAN CLAY (CL); Low to medium plasticity, trace fine sand, Dark Gray.
40	S9	WOR/12" 3 4	24	24	0.35 0.35 0.35		CLAY	S9: LEAN CLAY (CL); Similar to S8.
45	S10	3 4 5 6	24	12	0.40 0.40		CLAY	S10: LEAN CLAY (CL); Low to medium plasticity, Dark Gray.
50	S11	WOR 1 2 3	24	24			CLAY	S11: LEAN CLAY (CL); Low to medium plasticity, frequent layers and lamina of fine sand, Gray.
55	S12	WOR	24	24			CLAY	S12: LEAN CLAY (CL); Low plasticity, ~20% fine sand, layers of fine sand ~1/2" thick, Gray.
								Top of CLAYEY SAND at about 58.5'
60	S13	14 14 14 18	24	18				S13: CLAYEY SAND (SC); Fine sand, ~20% low plasticity fines, Gray.
65								

Bottom of Boring at 62.0'

1. Boring advanced from 0-15' using drive and wash techniques with 4" (HW) casing.
2. Boring advanced open hole below 15'.
3. Advanced an adjacent hole to 15' to take an undisturbed sample. Shelby tube sample was taken from 15' to 17'. Coordinates for the undisturbed sample are 4813907.55 N , 388279.65 E. Boring designated FD-15A.

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc. 1021 Main Street Winchester, MA 01890	PROJECT NAME: Camp Ellis Beach	BORING LOG
	CITY/STATE: Saco, ME	PAGE 1 of 2 — FD-14
	GEI PROJECT NUMBER: 04376-0	

BORING LOCATION: Offshore			TOTAL DEPTH (FT): 37'	
SURFACE ELEVATION (FT): -2.5			VERT. DATUM: MLLW	
NORTHING: 4813267.53	EASTING: 388500.66		HOR. DATUM: NAD 83 (m)	
DRILLED BY: New Hampshire Boring D. Thompson			DATE START: 4/26/05	
LOGGED BY: Steve Sarandis			DATE END:	

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	8 4 4 6	24	7				S1: SILTY SAND (SM); Fine to very fine sand, ~15% non-plastic fines, gray
5	S2	8 11 12 14	24	7				S2: POORLY GRADED SAND WITH SILT (SP-SM); Mostly fine to medium sand, ~10% non-plastic fines, trace of coarse sand and fine gravel, brown
10	S3	29 17 14 20	24	12		Rig Bouncing @ ~9-10'		S3: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Mostly fine to medium sand, ~15% subrounded and subangular fine gravel, one piece of coarse subangular gravel at top of sample, ~10% non-plastic fines, gray
								Top of SANDY SILT at 13.5'
15	S4	2 2 2 11	24	12				S4: SANDY SILT (ML-OL); Low plasticity, ~40% fine sand, occasional peat fiber, organic odor, olive gray
20	S5	1 2 1 2	24	15				S5: SANDY SILT (ML-OL); Medium plasticity, ~25-30% fine sand, occasional piece of subrounded fine gravel, peat fiber, shell fragment; organic odor, dark olive gray
25	U1	P U S H	27	27	0.65 0.55			U1: Similar to S5; except low plasticity (ML-OL)
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
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GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

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FD-14

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S6	4 4 3 6	24	24				S6: SANDY SILT (ML-OL); Low plasticity, ~35% fine sand, peat fiber, shell fragments, organic odor, dark olive gray
35	S7	2 1 4 5	24	24				S7: Similar to S6; lower 12" of sample has several layers of fine to medium sand up to 1" thick
								Bottom of boring at 37' Boring terminated prematuraly due to unanticipated marine conditions
40								
45								
50								
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- SAND
- ORGANIC SILT
- GRAVEL
- CLAY
- SILT

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Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

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FD-13

BORING LOCATION: Offshore
TOTAL DEPTH (FT): 44.9'
SURFACE ELEVATION (FT): -6.6
VERT. DATUM: MLLW
NORTHING: 4813702.65 EASTING: 388507.88
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring D. Thompson
DATE START: 4/25/05
LOGGED BY: Steve Sarandis
DATE END: 4/22/05

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	1 1 2 3	24	15			SAND	S1: POORLY GRADED SAND WITH SILT (SP-SM); Mostly fine sand, trace of medium sand, ~10% non-plastic fines, gray
3							CLAY	Top of CLAY at about 3'
5	S2	WOH/18" 2	24	18			CLAY	S2: LEAN CLAY (CL); Low to medium plasticity, gray
8						Rig Jumping @ 8-9'	SAND	Top of SAND at about 8'
10	S3	18 27 25 20	24	18			SAND	S3: WELL-GRADED SAND WITH GRAVEL (SW); Fine to coarse sand, ~40% subrounded fine to coarse gravel, ~5% fines, brown
15	S4	15 17 17 19	24	2			SAND	S4: WELL-GRADED SAND WITH GRAVEL (SW); Similar to S3
20	S5	11 12 9 8	24	2			SAND	S5: WELL-GRADED SAND WITH GRAVEL (SW); Similar to S3
25	S6	10 8 5-5/4" 23/0"	22	7			SAND	S6: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Fine to coarse sand, ~20% subrounded fine gravel, ~10% non-plastic fines, gray

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- **SILTY SAND**
- **GRAVEL**
- **SAND**
- **CLAY**
- **ORGANIC SILT**
- **SILT**

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PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

FD-13

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
30	S7	25 14 11 16	24	8			SAND	S7: POORLY GRADED SAND WITH SILT (SP-SM); Mostly fine sand, ~10% non-plastic fines, several pieces of fractured gravel at top of sample, gray
35	S8	15 16 16 16	24	5			SAND	S8: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Fine to coarse sand, ~20% subangular fine gravel (some pieces fractured by sampler), ~10% non-plastic fines, gray
40	S9	32 24 17 29	24	1			SAND	S9: Piece of coarse gravel wedged in tip of sampler
						Casing driving hard @ 42'	SILTY SAND	
45	S10	27 100/4"	10	2			SILTY SAND	S10: SILTY SAND (SM); Mostly fine to medium sand, ~15% slightly plastic fines, ~10% subangular fine gravel, one piece of coarse gravel in tip of spoon, gray
								Bottom of borehole at 44.9' 1. Boring was advanced using drive and wash technique with 4" (HW) casing and a 3-7/8" roller bit.
50								
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- **SILTY SAND**
- **GRAVEL**
- **SAND**
- **CLAY**
- **ORGANIC SILT**
- **SILT**

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Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

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FD-12

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

BORING LOCATION: Offshore
TOTAL DEPTH (FT): 76'
SURFACE ELEVATION (FT): -1.8
VERT. DATUM: MLLW
NORTHING: 4813520.59 EASTING: 388371.83
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring D. Thompson
DATE START: 4/20/05
LOGGED BY: Steve Sarandis/Justin deWolfe
DATE END: 4/22/05

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	4 5 4 6	24	15			SAND	S1: POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~10% low plastic fines, brown
5	S2	10 4 2 3	24	0 (10)		2nd Attempt = 10"	SAND	S2: SANDY CLAY (CL); Low to medium plasticity, ~15-20% fine to medium sand, gray
						Cobble @ 8'		
10	S3	11 19 10 19	24	1 (7)		1st attempt coarse piece of gravel wedged in tip of spoon	SAND	S3: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Fine to coarse sand, ~10% non-plastic fines, ~10-15% subangular fine gravel, brown
15	S4	5 25 15 17	24	12			SAND	S4: Similar to S3
20	S5	12 17 16 13	24	12			SAND	S5: POORLY GRADED SAND WITH SILT (SP-SM); Mostly fine sand; trace of medium to coarse sand, ~10% non-plastic fines, brown
25	S6	17 13 11 11	24	0		wash water changed to gray @ 27'	SAND	S6: No recovery

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

FD-12

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
30	S7	10 8 9 8	24	13			SAND	S7: Top 10" SILTY SAND (SM); Mostly fine sand, ~15% slightly plastic fines, gray Bottom 3" CLAYEY SAND (SC); Mostly fine sand, ~40% low plastic fines, gray
35	S8	3 6 5 5	24	24			CLAY	Top of CLAY at about 32.5' S8: LEAN CLAY (CL); Low to medium plasticity, several layers of fine sand up to ~3" thick, gray
40	S9	3 2 2 2	24	18	.25 .30		CLAY	S9: LEAN CLAY (CL); Low to medium plasticity, trace of fine sand, gray
45	U1	P U S H	24	24	.55 .50 .50		CLAY	U1: LEAN CLAY (CL); Similar to S9
50	S10	7 13 14 18	24	2			SAND	Top of SAND at about 47.5' S10: CLAYEY SAND (SC); Mostly fine sand, ~15-20% low plasticity fines, gray
55	S11	22 28 56 43/3"	21	15		Blow counts inflated casing going down with sampler last 4"	SAND	S11: Top 3" SILTY SAND (SM); Fine to coarse angular sand, ~20% low plastic fines, gray Bottom 12" WELL-GRADED SAND WITH GRAVEL (SW); Fine to coarse subrounded sand, ~15% subrounded fine gravel, gray
60	S12	12 9 5 6	24	7			SAND	S12: WELL-GRADED SAND WITH SILT (SW-SM); Fine to coarse sand, ~10% non-plastic fines, ~5-10% fine subrounded gravel, gray

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG
PAGE 3 of 3
FD-12

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
65	S13	16 10 8 15	24	6				S13: Similar to S12
70	S14	20 15 13 16	24	0				S14: No recovery
75	S15	10 7 8 10	24	8				S15: WELL-GRADED SAND WITH SILT (SW-SM); Similar to S12
80								Bottom of borehole @ 76' 1. Boring was advanced using drive and wash technique with 4" (HW) casing and a 3-7/8" roller bit.

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

PAGE 1 of 2

FD-11

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION: Offshore
TOTAL DEPTH (FT): 50.8'
SURFACE ELEVATION (FT): -7.1
VERT. DATUM: MLLW
NORTHING: 4813522.59 EASTING: 388578.71
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring D. Thompson
DATE START: 4/19/05
LOGGED BY: Steve Sarandis/Justin deWolfe
DATE END: 4/20/05

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	9 6 8 8	24	4				S1: POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM); Predominantly fine sand, ~10% non-plastic fines, ~20% subangular coarse gravel, gray
5	S2	23 13 9 11	24	10				S2: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Mostly fine to medium sand, ~10% coarse sand; ~10% non-plastic fines; ~10% fine subangular gravel; brown
10	S3	13 13 5 9	24	10				Top of CLAY at 9.0' S3: Top 7" Similar to S2 Bottom 3" LEAN CLAY (CL); Low plasticity varved appearance, Brown
15	S4	2 8 9 13	24	20				S4: LEAN CLAY (CL); Low to medium plasticity; two ~1" layers of fine to medium sand, varved appearance, Brown
20	S5	16 15 16 19	24	10				Top of SAND at about 17.0' S5: WELL-GRADED SAND WITH SILT (SW-SM); Fine to coarse sand, ~10-15% non-plastic fines; 5-10% subangular fine gravel, Brown
25	S6	31 17 12 11	24	11	.3			S6: Top 8" SILTY SAND (SM); Fine to coarse sand, ~15% low plastic fines, 5% fine subangular gravel, occasional pockets of clay, brown Bottom 3" LEAN CLAY (CL); Low to medium plasticity, 5% fine sand,

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

FD-11

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
							SAND	Brown
30	S7	10 8 8 12	24	12			SAND	S7: WELL-GRADED SAND WITH SILT (SW-SM); Fine to coarse sand, ~10% low plastic fines, Brown
35	S8	11 13 10 11	24	12			SAND	S8: POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~10% low plastic fines, Brown
40	S9	7 8 15 10	24	10			SAND	S9: WELL-GRADED SAND WITH SILT (SW-SM); Fine to coarse sand, ~10% low plastic fines, Brown
45	S10	12 16 20 37	24	14			SAND	S10: WELL-GRADED SAND WITH SILT (SW-SM); Fine to coarse sand, ~10% low plastic fines, ~5% fine subrounded gravel, brown
50	S11	33 18 53 100/4"	20	4			SAND	S11: POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~10% low plastic fines, ~3% fine subrounded gravel, Brown
								Bottom of borehole @ 50.8' 1. Boring was advanced using drive and wash technique with 4" (HW) casing and a 3-7/8" roller bit.
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG FD-10

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

BORING LOCATION: Offshore
TOTAL DEPTH (FT): 72
SURFACE ELEVATION (FT): -5.1
VERT. DATUM: MLLW
NORTHING: 4813864.85 EASTING: 388461.04
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring D. Thompson
DATE START: 4/18/05
LOGGED BY: Steve Sarandis
DATE END: 4/19/05

DEPTH FT.	SAMPLE TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	9 6 5 8	24	8			SAND	S1: POORLY GRADED SAND WITH SILT (SP-SM); Predominantly fine to very fine sand, ~10% non-plastic fines, Gray
4							CLAY	Top of CLAY at about 4'
5	S2	WOH/ 9" 1/3" 1-1	24	24	.15 .15		CLAY	S2: LEAN CLAY (CL); Low to medium plasticity, ~5-10% fine sand, Gray
10	S3	WOR/ 12" WOH/ 12"	24	24	.15 .20		CLAY	S3: LEAN CLAY (CL); Similar to S2
15	S4	WOR/ 24"	24	24	.15 .15		CLAY	S4: LEAN CLAY (CL); Similar to S2
20	S5	WOR/ 24"	24	24	.15 .15		CLAY	S5: LEAN CLAY (CL); Similar to S2
25							CLAY	
30							CLAY	

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

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1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

FD-10

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S6	WOR/ 12" WOH/ 12"	24	24	.10 .20		CLAY	S6: LEAN CLAY (CL); Low to medium plasticity, ~5% fine sand; occasional piece of medium to coarse sand, gray-blue
35								
40	S7	WOR/ 6" WOH/ 18"	24	18	.20 .20		CLAY	S7: LEAN CLAY (CL); Similar to S6
45								
50	S8	WOR/ 18" WOH/ 6"	24	24	.15 .20		CLAY	S8: LEAN CLAY (CL) Medium plasticity, ~5% fine sand, Gray
55								
							SAND	Top of SAND at about 59'
60	S9	14 18 43 28	24	9			SAND	S9: POORLY GRADED SAND WITH SILT (SP-SM); Predominantly fine sand, ~5% medium to coarse sand, ~10% non-plastic fines, gray
65	S10	3 4 3 12	24	11			SAND	S10: POORLY GRADED SAND WITH SILT (SP-SM); Similar to S9 with several layers of sandy silt ~ 1/2" thick, gray

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

FD-10

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
70	S11	4 5 9 17	24	10			SAND	S11: POORLY GRADED SAND WITH SILT (SP-SM); Similar to S9 with ~5-10% medium to coarse sand, gray
72								Bottom of Borehole @ 72' 1. Advanced borehole to 19' using drive and wash technique with 4" casing and a 3-7/8" roller bit 2. Advanced boring open hole below 19'.
75								
80								
85								
90								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
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GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach		BORING LOG
CITY/STATE: Saco, ME	PAGE 1 of 1	FD-09
GEI PROJECT NUMBER: 04376-0		

BORING LOCATION: Beach, North Ave. & Riverside	TOTAL DEPTH (FT): 27'
SURFACE ELEVATION (FT): 2.33	VERT. DATUM: MLLW
NORTHING: 4813255.54 EASTING: 388360.67	HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring Steve Garside	DATE START: 2/17/05
LOGGED BY: Mary Nodine	DATE END: 2/17/05

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	WOH/ 12" 1 2	24	10			SAND	S1: WELL-GRADED SAND (SW); Fine to coarse sand; tan-gray
5	S2	WOR/ 12" 6 14	24	5		encountered resistance from~4-8 feet this may have been caused by gravel, cobbles or boulders	SAND	S2: POORLY GRADED SAND WITH GRAVEL (SP); Mostly fine to medium sand, ~20% subangular gravel, (1 piece, 1.5" diam.); tan with black gravel
10	S3	10 6 6 7	24	6			SAND	S3: WELL-GRADED SAND WITH GRAVEL (SW); Mostly fine to medium sand, ~15% subrounded - subangular gravel, max size 1";~5% nonplastic fines; gray with black gravel. Gravel possibly broken off adjacent cobble or boulder.
15	S4	3 5 7 5	24	13			SAND	S4: WELL-GRADED SAND (SW); Mostly fine to medium sand, <5% nonplastic fines; gray. Wood fragments in tip of spoon
20	S5	WOH/ 18" 2	24	24			CLAY	Top of Clay at about 18.5' S5: SANDY LEAN CLAY (CL); Mostly low plastic fines, ~40% sand, mostly fine sand; trace wood fragments; moderate organic odor; dark gray
25	S6	3	24	17			CLAY	S6: LEAN CLAY (CL); Mostly low plastic fines, ~10% fine sand; trace shell fragments; moderate organic odor; dark gray
30								BOTTOM OF BOREHOLE AT 27.0'/EL.-24.7 FEET Boring terminated at 27' due to incoming tide. Boring advaced using drive and wash technique with 4-inch (HW) casing and N drill rods wtih a 3-7/8-inch roller bit. Boring was advanced open hole beyond 20'

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc. 1021 Main Street Winchester, MA 01890	PROJECT NAME: Camp Ellis Beach CITY/STATE: Saco, ME GEI PROJECT NUMBER: 04376-0	BORING LOG PAGE 1 of 2 **FD-08**

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

BORING LOCATION: Beach, North Ave. & Riverside TOTAL DEPTH (FT): 44'
SURFACE ELEVATION (FT): 13.32 VERT. DATUM: MLLW
NORTHING: 4813407.42 EASTING: 388265.70 HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring Steve Garside DATE START: 2/16/05
LOGGED BY: Mary Nodine DATE END: 2/16/05

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	1 1 1 2	24	10			SAND	S1: POORLY GRADED SAND (SP); Mostly medium to coarse sand, tan
5	S2	2 2 3 3	24	10			SAND	S2: POORLY GRADED SAND (SP); Mostly medium sand, tan-orange
10	S3	2 3 5 7	24	12			SAND	S3: WELL-GRADED SAND (SW); Fine to coarse sand, tan
15	S4	4 4 5 12	24	12			SAND	S4: WELL-GRADED SAND (SW); Mostly medium to coarse sand, ~20% fine sand, ~10% subrounded-subangular gravel, max 3/4", tan-orange with black and white gravel
20	S5	9 13 13 12	24	16			SAND	S5: POORLY GRADED SAND WITH SILT (SP-SM); Mostly fine to medium sand, ~5-10% non plastic fines; gray; wood fragments in top 5"
23.5						Interbedded CLAY and Fine SAND	CLAY	Top of CLAY at about 23.5'
25	S6	1 1 1 1	24	9			CLAY	S6: SANDY LEAN CLAY (CL); Mostly low plastic fines, ~30% fine sand, trace wood fibers, trace shell fragments, mild organic odor, dark gray
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

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FD-08

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S7	2 1 2 2	24	8		Interbedded CLAY and Fine SAND	CLAY	S7: LEAN CLAY (CL); Mostly low plastic fines, ~10% fine sand; mild organic odor, dark gray
35	S8	3 7 7 9	24	17			CLAY	S8(0"-5"): SANDY LEAN CLAY (CL); Mostly low plasticity fines, ~40% fine sand, ~10% angular-subangular gravel, max size 1", dark gray S8(6"-17"): LEAN CLAY WITH SAND (CL); Mostly low plastic fines, ~20% fine sand, dark gray
40	S9	6 8 12 13	24	16		Fine Sand	SAND	Top of SAND at about 38.5' S9: POORLY GRADED SAND WITH SILT (SP-SM); Mostly fine-medium sand;~10% nonplastic fines, seams of brown organic material, mild organic odor, gray
45								Driller indicated roller bit hit bedrock at 43'. Drilled 1' into rock with roller bit. Fine black shards observed in wash water. BOTTOM OF BOREHOLE AT 44.0'/EL.-30.7 FEET Boring advaced using drive and wash technique with 4-inch (HW) casing and N drill rods wtih a 3-7/8-inch roller bit. Boring was advanced open hole from 20' to 40'. Driller drove casing to 40' before taking final sample.
50								
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc. 1021 Main Street Winchester, MA 01890	PROJECT NAME: Camp Ellis Beach CITY/STATE: Saco, ME GEI PROJECT NUMBER: 04376-0	BORING LOG PAGE 1 of 3 **FD-07**

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

BORING LOCATION: Beach, End of Fairhaven Road TOTAL DEPTH (FT): 100
SURFACE ELEVATION (FT): 14.17 VERT. DATUM: MLLW
NORTHING: 4813862.28 EASTING: 388122.17 HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring Steve Garside DATE START: 2/14/05
LOGGED BY: Mary Nodine DATE END: 2/15/05

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	1 1 1 1	24	17				S1(0-13"): POORLY GRADED SAND (SP); Mostly medium sand, some coarse and; black, white, tan, purple S1(13"-17"): POORLY GRADED SAND (SP); Medium to coarse sand, tan-orange
5	S2	2 3 5 5	24	16				S2: POORLY GRADED SAND (SP); Moslty medium to coarse sand, ~10% fine sand; tan-orange
10	S3	1 2 2 4	24	10				S3(0"-5"): POORLY GRADED SAND (SP); Mostly medium sand, ~20% coarse and fine sand; gray S3(5"-10"): PEAT (PT); Wood fibers, moderate organic odor, tan
15	S4	4 11 13 9	24	15				S4: POORLY GRADED SAND (SP); Mostly fine to medium sand, trace of wood fibers, gray Top of CLAY at about 18'
20	S5	WOH/ 24"	24	24				S5: LEAN CLAY (CL); Low-placticity, homogeneous, gray
25	U1	PUSH	24	0				U1: No recovery
	S6	WOH/ 24"	24	24				S6: LEAN CLAY (CL); Similar to S5, except contains several layers of fine sand
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	SOIL / BEDROCK DESCRIPTION
	U2	PUSH	25	25	0.20		U2: LEAN CLAY (CL); Medium-plasticity, seams of fine sand observed in bottom of sample, gray
35	S7	WOH/ 24"	24	24			S7: LEAN CLAY (CL); Low-plasticity, homogeneous, gray with streaks of black, mild organic odor, high dry strength
40	S8	WOH/ 18" 2	24	24			S8: LEAN CLAY (CL); Similar to S7
45	S9	WOH/ 18" 2	24	24			S9: LEAN CLAY (CL); Similar to S7, except dark gray, with streaks of black in top ~7". Clay appears stiffer toward bottom of sample
50	S10	WOH/ 12" 3 4	24	24			S10: LEAN CLAY (CL); Medium-plasticity, ~5% fine sand, homogeneous, trace shell fragments, dark gray
55	S11	WOH/ 12" 2 4	24	24			S11: LEAN CLAY (CL); Similar to S10, except no shell fragments
60	S12	WOH/ 12" 2 2	24	24			S12: LEAN CLAY (CL); Medium-plasticity, ~5% fine sand, homogeneous; gray
65	S13	1 7 7 4	24	24			S13: Interbedded LEAN CLAY (CL~60%) and CLAYEY SAND (SC ~40%); Clay portion is medium plasticity, Sand portion is fine to medium sand with ~20% low plastic fines. Sand layers occur at 5-8", 10-13", and 18-20".

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, ME
GEI PROJECT NUMBER: 04376-0

BORING LOG

FD-07

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
70	S14	WOH/ 24"	24	24			CLAY	S14(0"-8"); LEAN CLAY (CL); Similar to S12 S14(8"-14"); CLAYEY SAND (SC); Mostly fine sand, ~40% low plastic fines, dark gray S14(14"-24"); LEAN CLAY (CL); Similar to S12
75						Interbedded CLAY and Fine SAND	CLAY	
80							CLAY	Advanced hole without sampling in an attempt to establish extent of clay (due to time constraints).
85							CLAY	
90						Interbedded CLAY and Fine SAND	CLAY	
95							CLAY	BOTTOM OF BOREHOLE 100' FEET/EL. -85.8 FEET
100								Boring terminated at 100'. Wash water and roller bit resistance indicated that soil was soft clay to 100'. Boring advanced using drive and wash technique with 4-inch (HW) casing and N drill rods with a 3-7/8-inch roller bit. Boring was advancedopen hole from 20' to 40'. Driller drove casing to 40', then advanced the boring open hole to 100'.

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, Maine
GEI PROJECT NUMBER: 04376-0

BORING LOG
PAGE 1 of 2
FD-06A

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION: Offshore
TOTAL DEPTH (FT): 48.0
SURFACE ELEVATION (FT): -8.4
VERT. DATUM: MLLW
NORTHING: 4813872.55 EASTING: 388671.67
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring Dave Thompson
DATE START: 12/22/04
LOGGED BY: Steve Sarandis
DATE END: 12/23/04

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	19 8 13 14	24	15				S1: SILTY SAND (SM); Fine sand, ~15% non-plastic fines, Gray.
								Top of CLAY at about 3.5 feet.
5	S2	WOR/ 24"	24	12				S2: LEAN CLAY (CL); Low plasticity, <5% fine sand, Gray.
10	S3	WOR/ 12" WOH/ 12"	24	17	0.20 0.22			S3: LEAN CLAY (CL); Low plasticity, <5% fine sand, Gray.
15	S4	WOR/ 6" WOH/ 18"	24	15				S4: LEAN CLAY (CL); Low plasticity, <5% fine sand, Gray.
20								
25	S5	WOR/ 6" WOH/ 18"	24	18				S5: LEAN CLAY (CL); Similar to S4.
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, Maine
GEI PROJECT NUMBER: 04376-0

BORING LOG

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FD-06A

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
35	S6	WOR/ 24"	24	22	0.19 0.17		CLAY	S6: LEAN CLAY (CL); Low to medium plasticity, <5% fine sand, Dark Gray. Section of sample have a varved appearance with alternating dark and light layers.
40								
43							SAND	Top of SAND at about 43.0 feet. (drill rig starting to chatter at 43 feet)
45	S7	7 8 8 33	24	8				S7: POORLY GRADED SAND WITH SILT (SP-SM); Fine sand, ~10% non-plastic fines, Gray.
48								Bottom of borehole at 48.0 feet.
50								Drill rig bouncing at 47 feet. Advanced boring from 47 to 48 feet with roller bit. Drilling very hard and slow, possible top of bedrock. 1. Boring advanced from 0 to 48.0 feet using drive and wash techniques with 4-inch (HW) casing. Driller used N-rods with 3-7/8-inch roller bit to clean out the casing. Casing driven to a depth of 5 feet. Boring advanced open hole below 5 feet.
55								
60								
65								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
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PROJECT NAME: Camp Ellis Beach		BORING LOG	
CITY/STATE: Saco, Maine		PAGE 1 of 2	FD-05
GEI PROJECT NUMBER: 04376-0			

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

BORING LOCATION: Offshore		TOTAL DEPTH (FT):	26.5
SURFACE ELEVATION (FT):	-11.5	VERT. DATUM:	MLLW
NORTHING: 4813955.94	EASTING: 388938.67	HOR. DATUM:	NAD83 (m)
DRILLED BY: New Hampshire Boring Dave Thompson		DATE START:	12/22/04
LOGGED BY: Steve Sarandis		DATE END:	12/22/04

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	35 13 10 20	24	15				S1: POORLY GRADED SAND WITH SILT (SP-SM); Fine sand, ~10% non-plastic fines, lt. and dk. banding, Gray.
								Top of CLAY at about 3.0 feet.
5	S2	WOR/6" 2 1 1	24	18	0.17 0.20			S2: LEAN CLAY (CL); Low to medium plasticity, <5% fine sand, Olive Gray.
10	U1	WOR/ 12" PUSH/ 12"	24	17	0.20 0.22			U1: LEAN CLAY (CL); Similar to S2.
15								
20	S3	WOR/ 24"	24	15	0.14 0.12			S3: LEAN CLAY (CL); Low to medium plasticity, occasional layer of fine sand ~1/16-inch thick, Gray to Dark Gray.
								Top of GRAVEL at about 23.0 feet.
25	S4	42 53 93/5"	17	2				S4: FRACTURE PIECES OF DARK GRAY ROCK.
								Sampler bouncing hard at 25"-5". Advance boring from 25'-5" to 26'-6" with roller bit. Drilling very hard and slow. Possible bedrock.
								Bottom of borehole at 26.5 feet.
30								See Next Page

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, Maine
GEI PROJECT NUMBER: 04376-0

BORING LOG

FD-05

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
								1. Boring advanced from 0 to 26.5 feet using drive and wash techniques with 4-inch (HW) casing. Driller used N-rods with 3-7/8-inch roller bit to clean out the casing. Casing driven to a depth of 5 feet. Boring advanced open hole below 5 feet.
35								
40								
45								
50								
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- **SILTY SAND**
- **GRAVEL**
- **SAND**
- **CLAY**
- **ORGANIC SILT**
- **SILT**

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach	BORING LOG
CITY/STATE: Saco, Maine	PAGE 1 of 2
GEI PROJECT NUMBER: 04376-0	FD-04

BORING LOCATION: Offshore			TOTAL DEPTH (FT): 52.5	
SURFACE ELEVATION (FT): -6.9			VERT. DATUM: MLLW	
NORTHING: 4813193.07	EASTING: 388817.03		HOR. DATUM: NAD 83 (m)	
DRILLED BY: New Hampshire Boring Greg Leavitt			DATE START: 12/17/04	
LOGGED BY: Steve Sarandis			DATE END: 12/17/04	

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	11 3 5 7	24	5				S1: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Fine to coarse sand, ~10 % non-plastic fines, ~15% subangular fine gravel, shell fragments, Brown.
5	S2	33 16 5 6	24	0 (5)				S2: POORLY GRADED SAND WITH SILT (SP-SM); Mostly fine sand, ~10% non-plastic fines, samples has stratified appearance with several 1/4-inch layers of widely graded sand, Gray. (First attempt no recovery, rock wedged in tip of sampler; second attempt with 3-inch OD sampler, recovery = 5")
								Top of SAND and SILT at about 9.0 feet.
10	S'3	2 1 1 2	24	12				S3: SILTY SAND (SM); Fine sand, ~20% slightly plastic fines, shell fragments, marine-organic odor, Dark Gray.
15	S4	WOH/ 18" 3	24	24				S4: SILTY SAND (SM); Fine sand, ~20-25% slightly plastic fines, occasional layers of sandy silt(ml) 1/4to 3/4 -inch thick, peat fibers, shell fragments, marine-organic odor, Dark Gray.
								Top of SANDY SILT/ ORGANIC SILT at about 18.5 feet.
20	S5	2 WOH/ 12" 2	24	24				S5: SANDY SILT/ ORGANIC SILT (ML/OL); Low plasticity, ~30% fine sand, layers of silty fine sand with ~30% fines, up to 1-inch thick, pockets of peat, occasional shells, marine-organic odor, Dark Gray.
25	S6	WOH/ 12" 4 4	24	24				S6: SANDY SILT/ORGANIC SILT (ML/OL); Similar to S5.
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc. 1021 Main Street Winchester, MA 01890	PROJECT NAME: Camp Ellis Beach CITY/STATE: Saco, Maine GEI PROJECT NUMBER: 04376-0	BORING LOG PAGE 2 of 2 FD-04

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S7	WOH/6" 2 - 3 4	24	24	0.25 0.30		ORGANIC SILT	S7: SANDY SILT/ ORGANIC SILT (ML/OL); Low to medium plasticity, ~15% fine sand, pockets of peat, occasional shells, marine-organic odor, Dark Gray.
35	S8	1 1 5 7	24	24	0.25 0.25		ORGANIC SILT	S8: SANDY SILT/ ORGANIC SILT (ML/OL); Low plasticity, ~30% fine sand, peat fibers, occasional shells, lower 12" of sample has numerous layers of silty fine sand up to 1/2-inch thick, marine-organic odor, Gray.
40	S9	12 18 21 23	24	12			SAND	Top of SAND at about 39.0 feet. S9: POORLY GRADED SAND WITH SILT (SP-SM); Fine sand, ~10% non-plastic fines, Gray.
45							SAND	
50	S10	46 73 78 86	24	10			SAND	S10: POORLY GRADED SAND WITH SILT (SP-SM); Similar to S9 with one 2" layer of sandy silt.
55								Bottom of borehole at 52.5 feet.
60								
65								

1. Boring advanced from 0 to 52.5 feet using drive and wash techniques with 4-inch (HW) casing. Driller used N-rods with 3-7/8-inch roller bit to clean out the casing. Casing drivien to a depth of 30 feet. Boring advanced open hole below 30 feet.

2. Driller did not have enough casing to advance hole below 40 feet. After sampling at 40 feet the driller ran the drill rods and roller bit down to 50.5 feet to try and encounter rock. Driller did not encounter hard drilling advancing boring to 50.5 feet. Driller attempted to sample at 50.5 feet. The hole collapsed and the sampler and rods would only go down to about 45 feet. The driller was able to push the sampler down to the correct depth with the drill rig. Driller obtained sample from 50.5 feet to 52.5 feet. Sample recovery was about 10-inches. The remainder of the sampler was completly filled with sand that had collapsed into the borehole. The blowcounts for sample S10 are inflated.

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME:	Camp Ellis Beach
CITY/STATE:	Saco, Maine
GEI PROJECT NUMBER:	04376-0

BORING LOG

PAGE 1 of 1 — **FD-03**

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION:	Offshore	TOTAL DEPTH (FT):	25.0
SURFACE ELEVATION (FT):	-10.1	VERT. DATUM:	MLLW
NORTHING: 4813703.57	EASTING: 388863.95	HOR. DATUM:	NAD 83 (m)
DRILLED BY:	New Hampshire Boring Greg Leavitt	DATE START:	12/16/04
LOGGED BY:	Steve Sarandis	DATE END:	12/16/04

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	22 10 15 20	24	12				S1: Top 6" - POORLY GRADED SAND WITH SILT (SP-SM); Fine to very fine sand, ~10% non-plastic fines, Gray. S1: Bot. 6" - POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~ 10% non-plastic fines, ~15% angular rock pieces, Gray.
	S2	14 19 100/4"	16	9				S2: POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM); Fine sand, ~10% non-plastic fines, ~10-15% subangular to subrounded fine gravel, Brown.
5	S3	32 27 18 18	24	7				S3: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Fine to coarse sand, ~10% non-plastic fines, ~15% subangular to subrounded gravel, Brown.
10	S4	13 25 21 19	24	7				S4: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Similar to S3.
15	S5	17 66 30 32	24	8				S5: SILTY SAND (SM); Fine to coarse sand, ~15% non-plastic fines, ~25% subangular to subrounded fine to coarse gravel, pieces of fractured cobble wedged in tip of spoon.
20	S6	12 27 17 19	24	24				S6: Recovered 6" of gravel wash. Driller advanced casing to 24 feet before we opened sampler.
25								Casing refusal at 24.0 feet, Roller bit very hard from 24.0 to 25.0 feet. Black rock chips in the wash. Possible bedrock.
30								Bottom of boring at 25.0 feet 1. Boring advanced using drive and wash technique with 4-inch (HW) casing and and N drill rods with a 3-7/8-inch roller bit. 2. The Driller drove the HW casing to 24 feet with the 300lb hammer.

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
S' - 3 inch O.D Split spoon sample

STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890

PROJECT NAME:	Camp Ellis Beach
CITY/STATE:	Saco, Maine
GEI PROJECT NUMBER:	04376-0

BORING LOG

PAGE	FD-02
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GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION:	Offshore	TOTAL DEPTH (FT):	30.75
SURFACE ELEVATION (FT):	-9.5	VERT. DATUM:	MLLW
NORTHING: 4813843.53	EASTING: 388820.69	HOR. DATUM:	NAD 83 (m)
DRILLED BY:	New Hampshire Boring Greg Leavitt	DATE START:	12/15/04
LOGGED BY:	Steve Sarandis	DATE END:	12/15/04

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	23 13 15 12	24	14				S1: POORLY GRADED SAND WITH SILT (SP-SM); Fine sand, ~10% non-plastic fines, occasional piece of fine gravel. Gray.
								Top of Clay at 2.0 feet
	S2	WOR/ 24"	24	12	0.15			S2: LEAN CLAY (CL); Low plasticity, <5% fine sand, Gray.
5								
10	U1	WOR/ 24"	24	24	0.13			U1: LEAN CLAY (CL); Low plasticity, Gray to Dark Gray.
15								
20	S3	WOR/ 24"	24	24	0.13 0.15			S3: LEAN CLAY (CL); Low plasticity, Gray.
25								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
TSF - Tons per square foot
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STRATIGRAPHIC LEGEND

- SILTY SAND
- GRAVEL
- SAND
- CLAY
- ORGANIC SILT
- SILT

GEI Consultants, Inc. 1021 Main Street Winchester, MA 01890	PROJECT NAME: Camp Ellis Beach CITY/STATE: Saco, Maine GEI PROJECT NUMBER: 04376-0	**BORING LOG** PAGE 2 of 2 **FD-02**

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
								(rig chattering at 29.0 feet)
								Top of Sand at 29.0 feet
30	S4	10 17/3" 50/0"	9	9				S4: SILTY SAND (SM); Fine sand,~15% slightly plastic fines, ~20% subrounded to subangular gravel, fractured gravel pieces in the tip of the spoon. Gray.
								Bottom of Boring at 30.75 feet
35								1. Boring advanced using drive and wash technique with 4-inch (HW) casing and and N drill rods with a 3-7/8-inch roller bit. The Driller was able to advance the casing to 10 feet by pushing the casing with the drive head of the drill rig. Boring was advanced open hole below 10 feet.
40								
45								
50								
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
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STRATIGRAPHIC LEGEND

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- CLAY
- ORGANIC SILT
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Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach	BORING LOG
CITY/STATE: Saco, maine	PAGE 1 of 2
GEI PROJECT NUMBER: 04376-0	FD-01

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

BORING LOCATION: Offshore
TOTAL DEPTH (FT): 45.0
SURFACE ELEVATION (FT): -10.1
VERT. DATUM: MLLW
NORTHING: 4813973.06 EASTING: 388779.19
HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring Greg Leavitt
DATE START: 12/13/04
LOGGED BY: Steve Sarandis
DATE END: 12/14/04

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0–2	S1	10 16 10 10	24	14				S1: Top 8" - POORLY GRADED SAND WITH SILT (SP-SM); Fine to very fine sand, ~10% non-plastic fines, Gray S1: Bot. 6" - POORLY GRADED SAND WITH SILT (SP-SM); Fine to medium sand, ~10% non-plastic fines, shell fragements, Gray.
4.5								Top of Clay at 4.5 feet
6–8	S2	WOR/ 24"	24	12				S2: LEAN CLAY (CL); Low to medium plasticity, occasional shell fragment, Lt. Gray.
11–13	S3	WOR/ 12" WOH/ 12"	24	20				S3: LEAN CLAY (CL); Low to medium plasticity, ~10% very fine sand, Gray.
16–18	S4	WOR/ 24"	24	24				S4: LEAN CLAY (CL); Similar to S3, with a layer of fine sand about 1/16-inch thick.
21–23	S5	WOR/ 24"	24	24	.15 .18			S5: LEAN CLAY (CL); Similar to S3
26–28	S6	WOR/ 24"	24	24	.17 .19			S6: LEAN CLAY (CL); Similar to S3

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
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STRATIGRAPHIC LEGEND

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Winchester, MA 01890

PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, maine
GEI PROJECT NUMBER: 04376-0

BORING LOG

FD-01

DEPTH FT.	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S7	WOR/ 24"	24	24	.20 .20			S7: LEAN CLAY (CL); Similar to S3
35								
	S8	WOR 24"	24	24	.19 .20			S8: LEAN CLAY (CL); Similar to S3
40								S9: Top 2" - LEAN CLAY (CL); Similar to S3
	S9	27 19 18 22	24	14				Top of Sand at 41.25 feet S9: Bot. 12" - POORLY GRADED SAND WITH SILT (SP-SM); Fine sand, ~10 % non-plastic fines, Gray. (drill rig chattering at 43.5 feet)
45	S10	25/0"	0	0				Bottom of Boring at 45.0 feet 1. Boring advanced using drive and wash technique with 4-inch (HW) casing and N drill rods with a 3-7/8-inch roller bit. The casing was driven to 6 feet with a 300 lb hammer. The Driller was able to advance the casing to 16 feet by pushing the casing with the drive head of the drill rig. Boring was advanced open hole below 16 feet.
50								
55								
60								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
S - 2 inch O.D Split spoon sample
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STRATIGRAPHIC LEGEND

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PROJECT NAME: Camp Ellis Beach	BORING LOG
CITY/STATE: Saco, maine	PAGE 1 of 3
GEI PROJECT NUMBER: 04376-0	FD-20

BORING LOCATION: Offshore	TOTAL DEPTH (FT): 77.0
SURFACE ELEVATION (FT): -7.3	VERT. DATUM: MLLW
NORTHING: 4813211.08 EASTING: 388719.56	HOR. DATUM: NAD 83 (m)
DRILLED BY: New Hampshire Boring Greg Leavitt	DATE START: 11/11/05
LOGGED BY: Steve Sarandis	DATE END: 11/11/05

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

DEPTH FT.	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
0	S1	5 4 5 6	24	12				S1: WELL-GRADED SAND WITH GRAVEL (SW); Fine to medium sand, ~10% coarse sand, ~15% subrounded fine gravel, ~5% fines, Gray.
5	S2	2 9 19 14	24	16				S2: Top 6" - Similar to S1. S2: Bot. 6" - SILTY SAND WITH GRAVEL (SM); Well-graded sand, ~15% subrounded fine gravel, ~15% slightly plastic fines, Gray. Rig chattering at 8'.
10	S3	1 1/12" 2	24	24	0.15 0.20			Top of SILT at 10'. S3: Top 12" - SANDY SILT (ML-OL); Low plasticity, ~30% fine sand, shells, peat fibers, organic odor, Gray. S3: Bot. 12" - SILTY SAND (SM); Fine sand, ~30% slightly plastic fines, Gray.
15	S4	WOR 1 1/12"	24	24				S4: SANDY ELASTIC SILT (MH-OH); High plasticity, ~35% fine sand, shells, pieces of wood, organic odor. Gray.
	U1							U1: SANDY ELASTIC SILT (MH-OH); High Plasticity, ~40% fine sand, Gray.
20	S5	1 2 5 3	24	24				S5: SANDY ELASTIC SILT (MH-OH); High plasticity, ~35% fine sand, numerous zones of peat, Gray.
25	S6	WOH/12" 2 2	24	24	0.35 0.40			S6: SANDY ELASTIC SILT (MH-OH); High plasticity, ~20% fine sand, peat fibers, shells, occasional layer of fine sand.
30								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
QD - Pocket penetrometer
Sv - Shear strength from torvane
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PROJECT NAME: Camp Ellis Beach
CITY/STATE: Saco, maine
GEI PROJECT NUMBER: 04376-0

BORING LOG

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FD-20

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
	S7	WOH 1 2 2	24	24	0.40 0.40		SILT	S7: SANDY ELASTIC SILT (MH-OH); Similar to S6.
35	S8	2 2 1 2	24	24	0.45		SILT	S8: SANDY ELASTIC SILT (MH-OH); Similar to S6; with ~25% fine sand, and frequent layers of fine sand up to 1" thick.
40	S9	WOH/12" 4 8	24	24			SILT	S9: SANDY ELASTIC SILT (MH-OH); Similar to S6; Bottom 12" of sample appears drier and more stiff. Drilled through something hard from 42.5-43.0'
							CLAY	Top of CLAY at about 43'.
45	S10	WOR/24"	24	24	0.20 0.20		CLAY	S10: LEAN CLAY (CL); Low plasticity, ~5% fine sand, Gray. Hard drilling at 48'
50	S11	WOR/12" 1 2	24	24	0.25 0.30		CLAY	S11: LEAN CLAY (CL); Low plasticity, ~5% fine sand, Gray.
55							CLAY	
	S12	WOR/12"	24	10			CLAY	S12: LEAN CLAY (CL); Similar to S11.
60	S13	WOR/12" 1 2	24	24	0.20 0.15		CLAY	S13: LEAN CLAY (CL); Low plasticity, ~5% fine sand, Gray.
65	S14	WOR/12" WOH/12"	24	16	0.20 0.15		CLAY	S14: LEAN CLAY (CL); Similar to S13.

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
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GEI Consultants, Inc. 1021 Main Street Winchester, MA 01890	PROJECT NAME: Camp Ellis Beach CITY/STATE: Saco, maine GEI PROJECT NUMBER: 04376-0	BORING LOG PAGE 3 of 3 FD-20

DEPTH FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Sv (tsf)	REMARKS	STRATA	SOIL / BEDROCK DESCRIPTION
70								
75	S15	WOR/12" 13 16	24	8				S15: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Fine to medium sand, ~10% coarse sand, ~10% non plastic fines, ~15% subrounded fine gravel. Gray.
								Bottom of Boring @ 77' 1. Boring advanced to 15' using drive and wash technique with (HW) casing. 2. Boring advanced open hole below 15'.
80								
85								
90								

BLOWS PER 6 inch - 140lb. hammer falling 30 inches
PEN - Penetration length of sampler or core barrel
REC - Recovery length of sample
U - 3 inch Shelby tube sample
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