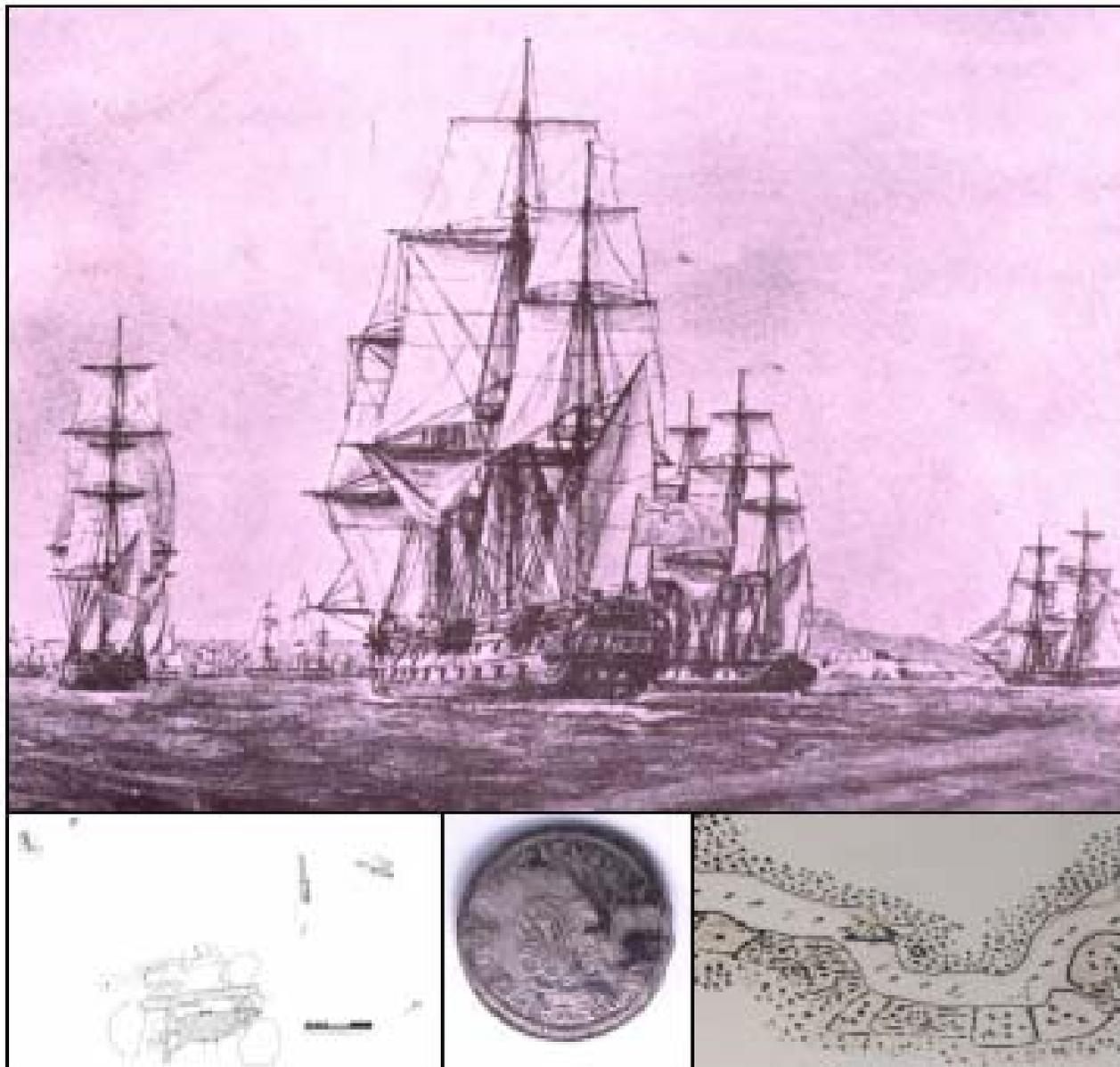


**The Penobscot Expedition Archaeological Project:
Field Investigations 2000 and 2001**

FINAL REPORT



**Prepared by:
Naval Historical Center
Underwater Archaeology Branch
805 Kidder Breese St., SE
Washington Navy Yard, D.C. 20374-5060**

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Abstract

During September of 2000 and 2001, members of the U.S. Naval Historical Center's (NHC) Underwater Archaeology Branch conducted site assessments and a multi-component remote sensing survey in the Penobscot River, Penobscot County, Maine. These projects comprise the most recent phase of an ongoing cooperative effort between the NHC, the University of Maine, and the Maine Historic Preservation Commission to research, investigate, and document shipwrecks and other submerged archaeological sites associated with the Penobscot Expedition of 1779, and ultimately to develop a management plan for their protection and preservation. The Department of Defense Legacy Resource Management Program funded both years of fieldwork.

The site investigative phase of the 2000 field campaign focused on submerged shipwreck site ME 054-004 (known locally as the "Phinney Site"). Site remains at ME 054-004 represent a middle-to-late eighteenth century vessel that almost certainly was one of nine armed American ships scuttled in the river near present-day Bangor during the final days of the Penobscot Expedition. Attributes of the vessel's construction and artifact assemblage suggest that it was American-built, owned, and operated, and preliminary data have established an association between the shipwreck and the 1779 American fleet. NHC archaeologists also conducted a magnetometer survey in a limited corridor of the river between the towns of Bangor and Brewer.

The objectives of the 2001 investigations included the following: 1) document any visible impacts to the Phinney Site; 2) note the extent and state of preservation of another submerged site (known locally as the "Shoreline Site") containing a scatter of Revolutionary War-era cannon and shot; and 3) conduct a magnetometer and side-scan sonar survey along a section of the river where local lore and historic references indicate that at least two other wrecks (the Continental Navy frigate *Warren* and the American ordnance transport *Samuel*) associated with the Penobscot Expedition were scuttled. While the *Warren* and *Samuel* sites were not positively identified, a number of magnetic and sonar contacts that may represent these and other Penobscot Expedition shipwrecks were revealed.

Table of Contents

Abstract	ii
Table of Contents	iii
Acknowledgements	vi
List of Figures	vii
List of Tables	x
I. INTRODUCTION	1
II. PREVIOUS IMPACTS AND INVESTIGATIONS	5
<i>Early Salvage Efforts</i>	5
<i>Previous Archaeological Investigations</i>	7
III. SITE ENVIRONMENT AND GEOGRAPHICAL SETTING.....	11
<i>Geography</i>	11
<i>Soil Associations</i>	11
<i>River Dynamics</i>	11
<i>Environmental Conditions Affecting Site Preservation</i>	12
<i>Site Environment(s)</i>	14
IV. HISTORIC BACKGROUND	17
<i>Exploration and Colonization</i>	17
<i>Onset of the American Revolution</i>	19
<i>The Penobscot Expedition</i>	20
V. RESEARCH DESIGN AND METHODOLOGY:	
SITE SURVEY AND INVESTIGATION	28
<i>Dive Operations</i>	28
<i>Site Investigation and Documentation—Phinney Site</i>	31
<i>Post-Disturbance Survey—Phinney Site</i>	33
<i>Reconnaissance Site Investigation—Shoreline Site</i>	34
<i>Preliminary Site Inspection—Proposed Warren Site</i>	36
VI. RECONNAISSANCE SITE INVESTIGATION RESULTS:	
PHINNEY SITE.....	39
<i>Ship’s Architecture</i>	39
Keel.....	39
Stem.....	42

	Rising Wood (Deadwood).....	46
	Framing.....	49
	Cant Frames.....	52
	Keelson.....	52
	Mainmast Step.....	54
	Hull Planking.....	57
	Ceiling.....	57
	Discussion.....	58
	<i>Artifact Analysis</i>	61
	Fasteners.....	62
	Ship's Hardware and Fittings.....	65
	Mast Step Coin.....	67
	Artillery and Munitions.....	70
	Rigging.....	75
	Tools.....	80
	Ceramics.....	82
	Glass.....	89
	Intrusive Material.....	90
VII.	RECONNAISSANCE SITE INVESTIGATION RESULTS:	
	SHORELINE SITE.....	95
	<i>Artifact Analysis</i>	95
	Artillery and Munitions.....	95
	Ceramics.....	107
	Glass.....	110
	Miscellaneous Artifacts.....	114
VIII.	CONCLUSIONS AND RECOMMENDATIONS.....	116
	<i>Phinney Site</i>	116
	<i>Shoreline Site</i>	119
	<i>Recommendations</i>	121
IX.	REFERENCES.....	126

APPENDIX A: LIST OF PENOBSCOT EXPEDITION VESSELS SCUTTLED
NEAR THE BANGOR/BREWER AREA

APPENDIX B: PHINNEY SITE HULL SCANTLINGS

APPENDIX C: CERAMICS RECOVERED FROM THE PHINNEY SITE,
1999 AND 2000 FIELD SEASONS

APPENDIX D: COLONIAL-ERA GLASS ARTIFACTS RECOVERED FROM THE
PHINNEY SITE, 2000 FIELD SEASON

APPENDIX E: RESEARCH DESIGN, METHODOLOGY AND RESULTS:
REMOTE-SENSING SURVEY, 2000 FIELD SEASON

APPENDIX F: RESEARCH DESIGN, METHODOLOGY AND RESULTS:
REMOTE-SENSING SURVEY, 2001 FIELD SEASON

APPENDIX G: SIDE-SCAN SONAR TARGETS, PENOBSCOT RIVER SURVEY,
2001 FIELD SEASON

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List of Figures

Figure 1. Aerial photograph of Bangor/Brewer area, showing locations of the Phinney Site and Shoreline Site.....	3
Figure 2. Portion of Augustus Koch's <i>Bird's eye view of the City of Bangor, Penobscot County, Maine, 1875</i> , showing approximate locations of the Phinney Site and Shoreline Site.....	15
Figure 3. <i>Destruction of the American fleet at Penobscot Bay, 14 August 1779</i> , oil painting by Dominic Serres (1722-1793).....	24
Figure 4. Detail of 1780 map of Penobscot River, showing the approximate location of burned American vessels below the falls at Bangor.....	26
Figure 5. NHC underwater archaeologist preparing to dive on the Shoreline Site.....	29
Figure 6. The Darling Marine Center's <i>R/V Ira C.</i> moored over the Shoreline Site in September 2001.....	30
Figure 7. The cast iron swivel gun (PB2-022) being recovered from the Shoreline Site.....	37
Figure 8. Phinney Site Plan.....	40
Figure 9. Close-up of starboard frames in Grid T-1, showing point of hull fracture near the wreck's centerline.....	41
Figure 10. Plan view of Phinney Site stem assembly <i>in situ</i>	43
Figure 11. Reconstruction of Phinney Site stem assembly, profile view.....	44
Figure 12. Plan and profile views of Phinney Site stern assembly <i>in situ</i>	48
Figure 13. Phinney Site cant frame assembly <i>in situ</i> , showing cant frames, filler frames, and first frame square to the centerline.....	53
Figure 14. Plan and sectional views, Phinney Site mainmast step.....	55

Figure 15. Three examples of American-built, twin-masted vessels purchased by the Royal Navy in the years immediately prior to the American Revolution.....	60
Figure 16. Copper fasteners recovered from the Phinney Site.....	63
Figure 17. Wrought-iron eyebolt (PB1-081) recovered from Grid T-1.....	66
Figure 18. Spanish 2- <i>Reale</i> coin recovered from the Phinney Site’s mainmast step...	68
Figure 19. Contemporary illustrations from late-seventeenth century and mid-eighteenth century naval treatises, showing the types of shot used aboard armed vessels.....	73
Figure 20. Example of iron bar shot (PB1-221) recovered from near the bow of the Phinney Site.....	74
Figure 21. Wooden rigging sheave (PB1-216) recovered from the bow of the Phinney Site.....	76
Figure 22. Burned double block (PB1-224) <i>in situ</i>	77
Figure 23. Three views of the wooden double block.....	79
Figure 24. Shovel or spade components recovered from the Phinney Site.....	81
Figure 25. Radiographic images of folding knife recovered from the Phinney Site....	83
Figure 26. Creamware and redware ceramic sherds recovered from Grid T-1 in sediment just above the Phinney Site’s starboard garboard.....	85
Figure 27. Other Revolutionary War-era ceramic sherds excavated from Grid T-1...	87
Figure 28. Kaolin pipe fragments recovered from the Phinney Site.....	88
Figure 29. Sample of intrusive ceramic sherds from the Phinney Site.....	92
Figure 30. Shoreline Site Plan.....	96

Figure 31. Cast iron swivel gun recovered from the Shoreline Site.....	101
Figure 32. Examples of grape and canister shot recovered from the Shoreline Site...	105
Figure 33. Examples of unique iron cannon projectiles recovered from the Shoreline Site.....	106
Figure 34. Olive jar body sherd (PB2-025) recovered from the Shoreline Site.....	108
Figure 35. Colonial-era “carboy” bottle neck (PB2-016) recovered from the Shoreline Site.....	112
Figure 36. Example of a large English “carboy,” dated 1771.....	113

List of Tables

Table 1. Shoreline Site Cannon: Some Historical and Archaeological Comparisons.....	98
Table 2. Eighteenth-Century Diagnostic Artifacts Recovered from the Phinney Site...	117

I. INTRODUCTION

In June 1779, the British sent a contingent of soldiers to Majabagaduce, Massachusetts (present-day Castine, Maine), and established the military and political headquarters of a new colony for loyalist subjects fleeing the rebellious colonies. In addition, the new fortification (Fort George) served as a source of protection for British shipping operating in the Bay of Fundy and along the coast of Nova Scotia, and prevented a land assault against southern Canada by American forces. On July 24, 1779 a combined American naval and land force of approximately 40 ships and almost 3,000 men entered Penobscot Bay and laid siege to the new fort. Just as victory appeared to be within their grasp, the Americans were forced into a disorganized retreat up the Penobscot River by a British relief squadron that arrived at the entrance to the bay during the first half of August. The British vessels rapidly overtook the fleeing American forces, causing the latter to abandon and scuttle most of their ships to prevent their capture.

Presently, the remains of many of these vessels are believed to lie submerged in the Penobscot Bay and River system, and all are potentially significant cultural and historical resources. Because the majority of these sites are near populated areas, they risk the detrimental impacts of natural forces (erosion, decomposition, etc.), land and water development, and the depredations of opportunistic relic hunters. Consequently, submerged archaeological resources associated with the Penobscot Expedition are the focus of a number of research projects, including one developed by the Naval Historical Center (NHC).

Between 12 and 20 September 2000, staff from NHC's Underwater Archaeology Branch conducted limited excavation and detailed hull recordation of a submerged shipwreck site in the river near the town of Brewer, Penobscot County, Maine. The site, ME 054-004 (known locally as the "Phinney Site"), is believed to represent the remains of one of nine armed American vessels scuttled during the closing days of the Penobscot Expedition. In addition to investigating the Phinney Site, NHC archaeologists conducted a magnetometer survey in a limited corridor of the river between Brewer and the City of Bangor (see Appendix E).

NHC researchers returned to the Penobscot River between 8 and 15 September 2001 to evaluate the post-disturbance condition of the Phinney Site, note the extent and state of preservation of ME 027-012 (known locally as the "Shoreline Site"), a submerged site containing a scatter of Revolutionary War-era cannon and shot, and conduct a magnetometer and side-scan sonar survey (see Appendix F and G) along a section of the river near Winterport that historical sources indicate is the site of abandonment for at least two other shipwrecks (the Continental Navy frigate *Warren* and the American ordnance transport *Samuel*) associated with the Penobscot Expedition. Additionally, NHC archaeologists conducted a cursory examination of submerged historic wooden ship components purported to represent the remains of the *Warren*.

Both field seasons reflect a continuing relationship between NHC and the University of Maine to locate, evaluate, and document shipwreck sites associated with the Penobscot Expedition and design a management plan for their ultimate protection and preservation. The Department of Defense (DOD) Legacy Resource Management Program has funded this partnership since 1994.

Brent Phinney, owner of a sawmill and steel fabrication shop in Brewer, Maine, first discovered site ME 054-004 on the Brewer side of the river. Shortly thereafter, he discovered a scatter of colonial-era cannon and other artifacts (ME 027-012) in the river just offshore of downtown Bangor (Figure 1). In June of 1998, Phinney contacted Warren Riess, Research Associate Professor of History and Marine Sciences, University of Maine (Darling Marine Center), to assist in recovering artifacts from these and other archaeological sites (Phinney 1998). Prior to Phinney's call, the Brewer Historical Society requested salvage rights to Penobscot Expedition archaeological sites (Higgins 1998). In response to these plans, NHC initiated the first phase of the Penobscot Expedition Archaeological Project by conducting a reconnaissance site investigation of the Phinney Site in the fall of 1999. Analysis of the shipwreck and its associated artifact assemblage led NHC archaeologists to conclude that the Phinney Site represented the remains of a small eighteenth-century vessel that may have operated as part of the ill-fated American fleet during the 1779 expedition.

Prior to conducting the 1999 reconnaissance, NHC representatives met with state officials at the Maine State Museum in Augusta, to discuss the project. Participants from the Maine Historic Preservation Commission included Earle G. Shettleworth, Jr., Director and State Historic Preservation Officer (SHPO), and Robert L. Bradley, Ph.D., Assistant Director and Deputy SHPO. Joseph R. Phillips, Museum Director, Maine State Museum, also attended. The meeting discussed the site's background and protection, as well as a variety of other issues, including the Brewer Historical Society's involvement in the decision-making process regarding the site, and the removal of artifacts. Additional discussions centered on the mutual interests of the Navy and the State of Maine and their overlapping responsibilities toward the Navy's ship and aircraft wrecks.

The principal NHC project staff during the 2000 field investigations included Dr. Robert Neyland, Principal Investigator; James Schmidt, Project Archaeologist and Remote-Sensing Specialist; Claire Peachey, Field Conservator; David Whall, Project Photographer, and Barbara Voulgaris, Project Photographer and Cultural Resources Specialist. The field crew for the 2001 campaign included all of the aforementioned serving in the same capacities as the previous year, as well as James Hunter, Project Archaeologist, and Harry Pecorelli, Remote-Sensing Specialist. Participants from the University of Maine included Dr. Warren Riess, Capt. John Higgins, and Robbie Downs. Dr. Arthur Spiess and Leon Cranmer from the Maine Historic Preservation



Base Map: U.S. Geological Survey Digital Orthophoto "BANGOR_ME_SW"
Coordinate Grid: UTM North, Zone 19, WGS 84

Figure 1. Aerial photograph of Bangor/Brewer area, showing locations of the Phinney Site and Shoreline Site.

Commission geo-referenced the relative positions of the Phinney and Shoreline sites and generated site location maps included in this report. NHC conservators Claire Peachey, Suzanne Davis, Jenifer Johnson and Melanie Pereira conducted analysis, conservation, and preservation of artifacts once they reached the NHC's conservation laboratory in Washington, D.C.

II. PREVIOUS IMPACTS AND INVESTIGATIONS

Early Salvage Efforts

As early as August 15, 1779, prior to the final defeat of American forces then fleeing up the Penobscot River, British sailors and marines began salvaging a few American vessels either captured or scuttled in the lower reaches of the river and bay system. These ships included the New Hampshire brig *Hamden*, the privateer *Hunter* (captured before they could be scuttled) and a number of small transports grounded and set ablaze at Sandy Point by their retreating crews. British forces quickly extinguished some of the burning ships, thereby saving their hulls, as well as any armament, hardware, and supplies.

By August 20, the British Navy commander at Fort George, Sir George Collier, reported salvaging a large number of cannon, including “ships guns” and 18 and 12-pounders, from the wreckage of the American transports (Riess 1999: 19). The British salvaged another shipwrecked vessel, described by American Brigadier General Solomon Lovell as “the ordnance sloop,” of “some 18 pounders & small cannon” that were “landed on Brigadier’s Island” (Baxter 1913: 84). The majority of these guns were brought back to Fort George, where they were left “at high water on the shore, loaded, and [then] fired off, to see if they were cracked, or anything else the matter with them” (Wheeler 1875: 121). The British recovered between 50 and 60 cannon from the scuttled American fleet. A few of the larger guns bolstered the garrison at Fort George, while the remainder was transported to the Royal Armory at Halifax, Nova Scotia (Cayford 1976: 54). Historical sources indicate that many of these guns were later distributed among British merchant vessels traveling in both the American colonies and abroad (Cayford 1976: 58).

As the Revolutionary War progressed, so too did the periodic salvage of Penobscot Expedition wreck sites by the British military, local Loyalists residing near Fort George, and patriots who continued to reside on the western shore of the Penobscot River (Riess 1999: 21). When most of the American ships burned, their crews and complement of soldiers abandoned nearly everything that was not quickly and easily transported. In the days, months, and years following their destruction, the wrecks yielded a variety of material, including military supplies, casks of provisions, ships’ fittings and hardware, and hull timbers. It is likely that locals salvaged these items from shoreline areas, shallows, and inter-tidal zones, and either re-utilized or used them to barter for food, money, and other necessities.

According to historical sources, the Americans made only one official attempt to salvage Penobscot Expedition wrecks during the Revolutionary War. Approximately three months after the debacle, the Massachusetts Assembly granted Timothy Fitch, a citizen of Medford, Massachusetts, permission to recover material from the remains of the Penobscot fleet. Although

the stipulations of the agreement between Fitch and the Massachusetts Assembly are well documented (Fitch and his crew were expected to turn over the entire cache of recovered items to the Board of War in exchange for half of its total value), there is no indication as to whether or not the salvage operation was successful (Baxter 1913: 418, 443-444). No other documents have yet been found that indicate the existence of other official American recovery attempts during the war, although a small number of Penobscot Expedition cannon were recaptured from British forces the following year:

A few days ago a detachment from the troops under [American] General Wadsworth went up Penobscot-river, having pass'd the fort in whale-boats in the night, and took two sloops which had been weighing up some of the cannon lately belonging to our privateers which were burnt there. They had got 8 cannon on board and were coming down the river, little expecting to be conducted by our people; but [Royal Navy] Capt. Mowat had the mortification to see them passing down by the fort, out of his reach however, in triumph. They fired at the fort to vex the enemy and got safe away (*Boston Gazette*, July 10, 1780).

Mowat pursued the Americans to Camden, but was unable to recapture the stolen ships. Instead, he encountered heavy fire from General Wadsworth's forces and was forced to retreat, leaving the Americans "in full possession of the vessels [and artillery] which were intended to invest [their] coasts" (*Boston Gazette*, July 10, 1780).

Interest in salvaging Penobscot Expedition wrecks for their military and/or utilitarian value seems to have waned over the next two decades. Nevertheless the river continued to periodically yield artifacts to those persistent enough to seek them out. In the summer of 1809, Ebenezer Clifford of Exeter, New Hampshire, arrived at Bangor with a 50-ton schooner, a "crude diving bell of his own design and engineering," and countless inquiries regarding the locations of Penobscot Expedition shipwrecks (Cayford 1976: 54 and Garvin 1975: 33). With the help of Jacob Dennett, an early Bangor settler who witnessed the destruction of the fleet in 1779, Clifford recovered approximately 30 cannon and a "few tons" of cannonballs "less than 70 rods" from Dennett's waterfront home. According to Williamson (1839: 476) some of the wrecks were still visible at low water during Clifford's visit. Clifford took his finds to Boston and sold them back to the State of Massachusetts (Cayford 1976: 54).

During dredging operations of Bangor Harbor in the 1870's, U.S. Army Corps of Engineers divers recovered an unknown number of cannon (*Bangor Daily News*, 1876 and Cayford 1976: 54, 56). Seventy-seven years later, in 1953, a clamshell crane removed four additional iron cannon during construction of the Joshua Chamberlain Bridge between Bangor and Brewer (*Bangor Daily News*, 1953). According to John E. Cayford, a welder, bridge construction revealed all four cannon at the footprint of the easternmost bridge support, close to the Brewer

shoreline. At least one of these guns, a 4-pounder, is on public display in the Bangor/Brewer area (Cayford 1976: 53, 58).

Cayford's involvement with the recovery of the salvaged cannon encouraged him to conduct historical research pertaining to the Penobscot Expedition, and attempt to locate the remains of ships and artifacts lost during the American retreat. During the next two decades, Cayford searched for, and claimed to have located, the remains of the British transport vessel HMS *Providence* and the Continental Navy frigate *Warren*. *Warren*'s remains reportedly consisted of a "charred hull" and an associated "bronze 6-pounder [cannon] struck in the Massachusetts State Foundries" (Cayford 1976: 58). This gun was reportedly recovered by Cayford in 1957 and is currently on display as part of the Penobscot Expedition exhibit at the Penobscot Marine Museum (Richardson 1983: 1).

Previous Archaeological Investigations

In 1972 Professor Dean Mayhew of the Maine Maritime Academy (MMA) coordinated a cooperative effort between MMA and the Massachusetts Institute of Technology (MIT) to locate and investigate the remains of the privateer *Defence*. Using rudimentary sonar, Mayhew and a team of students discovered the wreck off the northeast corner of Sears Island in Stockton Harbor, Maine (Riess 1999:23). This discovery compelled professors Mayhew, W.F. Searle (Captain, USN Retired) and Dave Wyman to further explore the *Defence* site. In 1973 and 1974 a team of students from MMA returned to the site and salvaged two 6-pounder iron cannon and various other artifacts (Smith 1986: 3).

Following *Defence*'s discovery, MMA contacted Robert Damm, director of the Maine State Museum (MSM), who immediately recognized the potential archaeological significance of the wreck. In 1975 Damm obtained funding through MSM and the Maine Historic Preservation Commission (MHPC) to begin a scholarly investigation of *Defence*. Additionally, MMA provided logistical support and the American Institute of Nautical Archaeology (AINA, now INA) lent archaeological expertise to the project. Between 1975 and 1980 Dr. David Switzer of Plymouth State College directed the complete excavation of the site (Riess 1999: 23 and Smith 1986: 6). At the conclusion of the project, AINA reburied *Defence*'s hull remains in the anaerobic seabed of Stockton Harbor, and all project materials (i.e., artifacts, field notes, photographs, etc) were sent to the Maine State Museum, where they are curated (Riess 1999: 23, 25).

In July of 1975 MSM contracted Martin Meylach (Meylach Magnetic Search Systems) to conduct a five-day multi-component (i.e., marine magnetometer, side-scan sonar and sub-bottom profiler) remote-sensing survey along the Penobscot River. Using the remote-sensing array,

Meylach attempted to locate additional American vessels lost during the Penobscot Expedition; unfortunately the results of Meylach's survey are vague, and provide no information pinpointing the location of the anomalies that he and his team discovered (Riess 1999:25).

The following summer, MSM hired Klein Associates, Inc. to conduct a three-week remote-sensing survey and ground-truthing project along the southern reaches of the river. Klein's primary objectives were to locate additional Penobscot Expedition shipwreck sites and obtain a magnetic profile of *Defence*. Additionally, Klein's team utilized historical data provided by Dean Mayhew to survey for the remains of scuttled transports near Sandy Point. The survey's most promising site, discovered near Oak Point, included a six-foot (1.83-meter) admiralty-type anchor and several disarticulated ship timbers (Riess 1999: 26).

In response to federal legislation, the Maine Department of Transportation contracted with Warren Riess and the University of Maine's Maritime Archaeological and Historical Research Institute to conduct a remote sensing survey for submerged cultural resources at two bridge construction sites between the cities of Bangor and Brewer. The project concluded with negative findings and recommended that construction proceed at both bridge sites (Riess 1999: 26).

Students and faculty from the University of Maine returned to the *Defence* site in 1996 and collected wood samples to determine if AINA's reburial efforts were protecting the vessel's remains. Detailed inspection of the site's structural components revealed that the upper few centimeters of the hull and main mast that protruded above the seabed were rapidly deteriorating. Further, microscopic analysis of the samples revealed that buried timbers exposed to oxygenated water during the previous excavation were extensively degraded by biota. Wood not previously exposed during excavation, such as the outer hull planking, appeared to be much better preserved (Riess 1999: 25).

Between 1994 and 1997 the University of Maine conducted a multi-component submerged cultural resources survey in several sections of the Penobscot River. The primary focus of the first phase of this project (labeled "Penobscot Expedition II" by its participants) was to locate the Continental Navy frigate *Warren* and American ordnance transport *Samuel*, and develop a plan for their study, management, and protection. In July 1995 the second phase of the project was initiated. This new phase continued the directives begun during the first phase of the survey; specifically, to locate, inspect, assess, and (possibly) identify additional shipwreck sites associated with the Penobscot Expedition. The effort located and examined a small number of sites, including the remains of four wrecks tentatively identified by Riess and his colleagues as *Warren*, *Samuel*, an unidentified wooden coal barge, and one of the transport vessels from the Penobscot Expedition (Riess 1999). The project received financial support from the Department

of Defense (DOD) Legacy Resource Management Program and small grants from the University of Maine's Maritime Archaeological and Historical Research Institute.

NHC's active involvement with shipwrecks and other submerged archaeological resources from the Penobscot Expedition began in 1999, when representatives from NHC's Underwater Archaeology Branch contacted Dr. Robert L. Bradley, Deputy SHPO and assistant director of the Maine Historic Preservation Commission in Augusta. The NHC needed to verify and account for all relevant and related archaeological investigations, terrestrial and submerged, in the area outlined in the 1999 project overview. According to Bradley, no additional investigations occurred within the NHC's proposed project area.

Between 26 August and 2 September 1999, NHC archaeologists, with the assistance of the University of Maine's Darling Marine Center, and the Maine Historic Preservation Commission, participated in a reconnaissance site investigation of the Phinney Site. Detailed examination of the hull remains and analysis of the limited number of diagnostic artifacts (including ceramic sherds, a copper-alloy buckle, various types of iron and lead shot, and two iron 4-pounder cannon) recovered from the wreck, indicated that the Phinney Site was once a small, armed eighteenth-century vessel that may have been associated with the Penobscot Expedition. Wood samples taken from a variety of hull members revealed that the ship was built of non-European timber, suggesting an American origin. The presence of native plant materials and pollen in bilge samples, moreover, indicated that the vessel rarely, if ever, operated outside the coastal and inland waterways of what is now the northeastern United States.

In addition to the reconnaissance site investigation, NHC's 1999 field investigations included a side-scan sonar survey within a limited corridor of the Penobscot River between the cities of Bangor and Brewer. The survey was designed primarily to analyze environmental conditions at the Phinney Site, but was also intended to locate additional submerged cultural resources within the prescribed search area. Although numerous side-scan sonar targets were identified during the survey, analysis of the target data revealed that none bore even a remote resemblance to a shipwreck site (NHC 2000: 14). Further, assessment of the sonar data revealed that cutting, slumping, scouring, and other forms of natural riverbed erosion did not pose an immediate threat to the Phinney Site.

Most recently, during the summer of 2000, the Program in Maritime Studies at East Carolina University was awarded a grant from the American Battlefield Protection Program to carry out a Phase II archaeological survey of one of the shipwreck sites identified by the University of Maine's Maritime Archaeological and Historical Research Institute during the mid-1990's. The site, known as the Devereaux Cove vessel, is believed to represent the remains of a scuttled American transport from the Penobscot Expedition. Fieldwork conducted during the 2000 season

sought to determine the extent of the ship's remains, produce a detailed site plan, establish the wreck's potential for further archaeological investigation, and initiate the process of nominating the site to the National Register of Historic Places (Russ Green, personal communication 2002).

III. SITE ENVIRONMENT AND GEOGRAPHICAL SETTING

Geography

Penobscot County, incorporated in 1816, is located in the geographical center of Maine. The county occupies approximately 3,408 square miles (5496.8 kilometers [km]), and is home to Bangor, the state's third largest city. The Penobscot River Basin, containing the Penobscot River and its tributaries, comprises the county's primary drainage system. The river's source is located among hills and mountains in the state's interior. As it flows southward, the river drops through a series of falls until it reaches Bangor, where it becomes a salt-water estuary for the remaining 20 miles of its length. It eventually empties into Penobscot Bay at Cape Jellison, near the present-day town of Stockton Springs. In addition to the Penobscot, the Aroostook River in the northwest region, and the Sebec River, near Newport, both also flow out of Penobscot County.

Soil Associations

According to the *General Soil Map of Maine* (Ferwerda et al. 1997) the project area contains the Swanville-Boothbay-Biddeford soil map unit, which constitutes about four percent of the land area in Maine. The soils associated with the Swanville-Boothbay-Biddeford unit are loamy and clayey soils that are moderately well drained to very poorly drained. Firm loamy sediments underlie both the Swanville and Biddeford soils, whereas clayey sediments underlie tracts comprised only of Biddeford soils. These soils formed in glacioloacustrine or glaciomarine sediments of the coastal lowlands and river valleys (Ferwerda et al. 1997: 11-12).

River Dynamics

Geologically, the Penobscot is a young river whose course is undergoing a natural adjustment to a more meandering shape. As this process occurs, the outside shorelines of bends in the river erode, displacing sediment and causing it to build up at the inside of each bend. Except in areas where rock outcrops or human development prevent the river from forming a classic meandering shape, this natural adjustment of river form and sediment deposition continues virtually unhindered. In addition to the aforementioned, this process also adds shallow areas of low tidal flow to the river basin.

The river bottom is comprised primarily of granite and slate bedrock overlaid by river cobble and a thin sediment mixture of silt and coarse-grained sand. A series of glaciers that formed the Penobscot River Basin approximately 12,000 years ago contributed not only to the formation of the bay, river, and its tributary ponds and streams, but also a number of adjacent coves. Over the

past millennia, these coves have filled with silt and developed into intertidal mud flats with associated minor streams.

The Penobscot River and its numerous tributaries cover an extensive amount of territory within Maine, stretching from Penobscot Bay on the Atlantic coast to hills and mountains well within the state's interior. As a result, the watershed provides the river with a great quantity of both fresh and salt water, which mixes in the waters of the river and bay. On average, a nine-foot tide reaches as far as the first falls at Bangor, although there is relatively little salinity in the river north of Winterport. Currents in the river channel during mid-tide vary between 0 to 2.7 knots, while those in the shallows outside of the channel range between 0 to 1.6 knots. The average current in the river channel at mid-tide is 0.8 knots (Riess 1999: 1).

Because there is no "dry season" in the region surrounding the Penobscot River Basin, the quantity of fresh water flowing downriver effects an uneven ebb of the river's waters over the course of a single year. Essentially, this leads to an abbreviated lull (slack) in river current at high tide, as the constant flow of freshwater rapidly supersedes the opposing saltwater tidal wedge. At low tide it produces the opposite effect—the stronger flow of the river prevents saltwater in Penobscot Bay from surging upriver, thereby creating a longer than average slack period.

Environmental Conditions Affecting Site Preservation

A myriad of environmental conditions, including physical, chemical, and biological impacts, adversely affect the preservation of submerged archaeological sites located in the Penobscot River. Physical forces, particularly moving ice and strong tidal currents, are one of the most detrimental of the aforementioned factors, impacting the remains of most, if not all, Penobscot Expedition vessels scuttled in the shallows along the shore of the river. Strong currents likely served to dislodge and scatter hull remains and artifacts (especially buoyant objects such as casks, clothing, and ship timbers) from many of the ships in the days, weeks, months, and years following their destruction. To a certain degree, currents still act upon these wrecks, depositing on them a variety of organic debris ranging from small leaves to entire tree trunks. Additionally, tidal currents frequently create scour zones along the surface of a submerged site, detrimentally affecting exposed artifacts and hull remains, and occasionally uncovering, dislodging, and moving small artifacts. Given enough time and sufficient tidal action, these artifacts can be displaced several kilometers from their point of origin.

Ice also acts to disturb shipwreck sites. During the winter, it forms and thickens along the shore of the Penobscot River, becoming a meter thick in some locations. As water freezes along the shoreline and in the offshore shallows, it encapsulates everything it surrounds—including, in

some cases, hull remains and artifacts. The combined weight and surface tension created by ice can warp, abrade, break, and crush archaeological objects, while its breakup and movement during the spring thaw often removes small artifacts from their archaeological context and redeposits them elsewhere (Riess 1999: 3).

Chemical degradation of a submerged archaeological site is dependent upon a number of factors, including salinity, water temperature, and the amount of dissolved oxygen in the surrounding aquatic environment (Singley 1988: 27). The salinity of the Penobscot River varies according to location, but tends to increase as the river's waters move south towards the Atlantic Ocean. For example, the water near Bangor has a salinity level of 0 (zero) parts per thousand, while that at Castine (where the river empties into Penobscot Bay) averages 30 parts per thousand. Other factors, including geographical complexity, tide height, and an almost perpetual freshwater ebb, contribute to continual variations in salinity and dissolved oxygen levels throughout the course of the river (Townsend 1985).

Likewise, water temperatures in the river vary considerably. At Bangor, the bottom temperature during the month of August averages 75° Fahrenheit (24° Celsius). By contrast, it rarely exceeds 55° F (12.5° C) at Castine during the same month. In the winter, temperatures throughout the river can reach as low as 31° F (-0.5° C). Created and influenced by strong active currents and irregular underwater topography, turbulence in the water column helps sustain a high level of oxygenated water in the river. On average, the level of dissolved oxygen along the bottom of the Penobscot varies from 2 to 8 parts per million (Townsend 1985). This in turn creates an environment conducive to the rapid chemical deterioration of exposed archaeological objects, both organic and non-organic. Metals, particularly iron, are especially vulnerable to the corrosive effects of highly oxygenated water. Active corrosion of metal artifacts is further exacerbated when the salinity of the surrounding water is increased, or if the item in question is only partially buried in sediment (Hamilton 1996: 8 and Singley 1988: 28). Other materials, such as ceramics, glass, and organics, are also affected by electrochemical degradation, but typically at a slower rate.

In addition to physical and chemical factors, biological forces play a major role in the destruction of shipwrecks and their associated artifact assemblages. The lower reaches of the Penobscot River are host to a variety of fish, shellfish, and microorganisms that feed on, or bore into, organic material. By far the worst threat to organic shipwreck material is the shipworm (*Teredo navalis*) and the gribble (*Limnoria lignorum*), both of which vigorously attack hull fabric and other wooden items exposed above the riverbed. Over time, these objects become riddled with holes, lose their structural integrity, and are reduced to unrecognizable forms. Fortunately, the Penobscot's salinity north of Winterport is generally too low to support marine borers; as a

result, submerged sites located north of Winterport should conceivably exhibit much better organic preservation than those in the lower reaches of the river.

Site Environment(s)

The Phinney Site is located in shallows just offshore of the eastern bank of the Penobscot near the city of Brewer. In the years following the vessel's demise (c. 1750-1800), the shoreline near which it is currently located appears to have advanced and completely buried at least part of the site (Riess 1999: 6). Conversely, it may have been buried during the nineteenth century, when the people of Brewer created new land by filling sections of the shallows along the waterfront (Figure 2). If the initial deposition of sediments over the wreck was rapid and sufficiently anoxic, a considerable degree of protection may have been afforded to organic materials (i.e., bone, wood, and leather artifacts) present within the hull remains. Unfortunately, attributes of the protective sediments covering the site, including their rate of deposition and aerobic or anaerobic nature, cannot presently be determined. Although limited excavation of the shipwreck in 2000 revealed the presence of at least one well-preserved organic object (a wooden block and sheave assembly), the disposition of similar artifacts buried at other points within the hull remains has yet to be elucidated.

By contrast, most of the significant archaeological features (i.e., iron cannon and shot) associated with the Shoreline Site are in deeper water and are at least partially, if not completely, exposed above the riverbed. Sediment deposition at the site appeared comparatively negligible, although it is located adjacent to extensive nineteenth-century cribbing and associated fill—installed along the Bangor waterfront during construction of an old central storage and shipping area (see Figure 2). Natural scouring of bottom sediments at the Shoreline Site appeared significant, as evidenced by the large number of artifacts (especially iron shot) found lying loose, exposed, and widely dispersed. The same currents responsible for scouring the bottom also deposited a number of large wooden logs, tree trunks, branches, modern rubbish, and other intrusive debris across the site. Because the bottom environment at the Shoreline Site is relatively dynamic, the likelihood exists that the surrounding water column is highly oxygenated much of the year. Consequently, organic materials at the site would not be expected to survive for very long, unless they were rapidly buried at a considerable depth beneath the riverbed. Not surprisingly, very few organic artifacts were discovered during limited excavations of the Shoreline Site in 2001.

The physical and mineralogical composition of the sediment matrix, combined with its recent dispersal and accumulation, largely determines the soil characteristics within both submerged sites. The content of organic matter and nitrogen in the soil is affected by native vegetation and other life forms. The loamy and clayey soils associated with glaciomarine (parent) sediments can

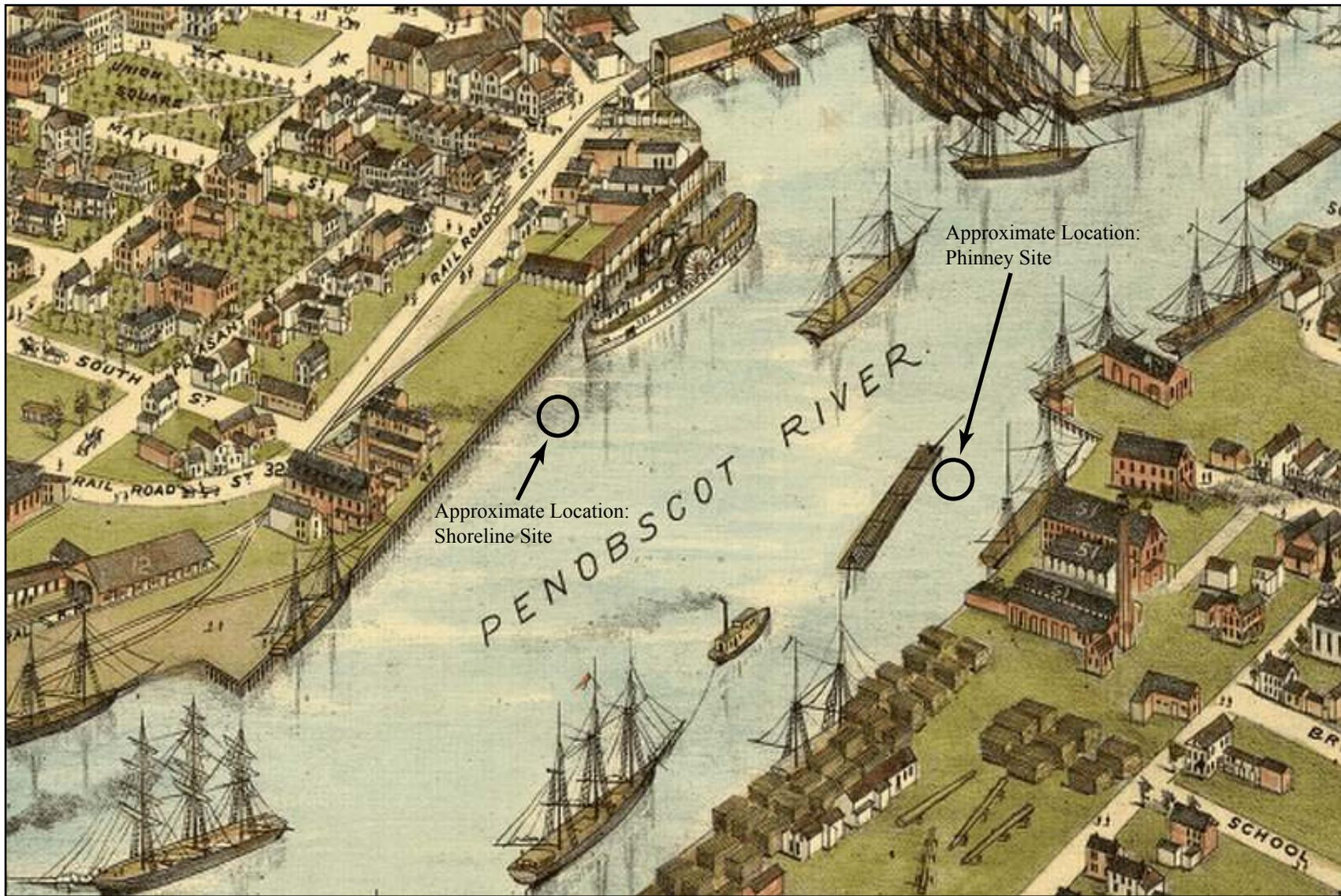


Figure 2. Portion of Augustus Koch's *Bird's eye view of the City of Bangor, Penobscot County, Maine, 1875*, showing approximate locations of the Phinney Site and Shoreline Site and nineteenth-century development along the banks of the Penobscot River. Library of Congress Geography and Map Division, Washington, D.C.

contain significant amounts of organic matter. Decaying organic material in waterlogged soils, including underlying clayey soils, creates localized anaerobic environments, which can stimulate the corrosion of iron and other metals. In addition, toxins that enter the aquatic system via point and non-point sources (including agriculture, contaminated urban runoff, and dredged sediment disposal) have a direct affect on the chemical, physical, and molecular structure of artifacts associated with both sites. The strength of this reaction is preconditioned by environmental factors including: water volume; temperature; salinity; pH level; flow; depth; amount of suspended material; particle size; and carbon content in the sediment.

IV. HISTORIC BACKGROUND

Exploration and Colonization

In September 1524 Estévan Gomez, a Portuguese navigator and explorer sailing for King Charles V of Spain, embarked on the ship *La Anunciada* as leader of a voyage of discovery to the North American continent. By February 1525, Gomez and his crew reached the Gulf of St. Lawrence, where they spent the remainder of the winter. With the arrival of better weather Gomez began searching for a westward passage to Asia. *La Anunciada*'s crew explored and mapped the Bay of Fundy, Passamaquoddy Bay, Mount Desert Island, Somes Sound, Blue Hill, Jericho Bay, Eggemoggin Reach, and the Penobscot River as far inland as the mouth of Kenduskeag Stream. Gomez probably reached the location of present-day Bangor in June 1525.

Gomez named the Penobscot River *Rio de las Gamas* because of the abundance of deer found along its banks, and reported that the natives were friendly and the land was “temperate...[and] well-forested” (Morison 1971: 329). He also noted that the area lacked gold or any other form of mineral wealth, and that the Penobscot was not the strait he sought but rather a “famous river with a great flow of water” (Morison 1971: 329). Consequently, Gomez and his crew journeyed back down the river and continued their voyage south along the Atlantic coast, sailing as far as present-day New Jersey before returning to Spain in August 1525. The Spanish and Portuguese governments, convinced there was no passage to the Pacific Ocean through North America, abandoned their exploration of Maine and the New England coast (Duncan 1992: 23 and Morison 1971: 331).

The first serious attempt to establish a self-sufficient colony in what is now Maine occurred in 1583, when an expedition led by English explorer Sir Humphrey Gilbert made landfall near present-day St. John's, Newfoundland. The expedition was comprised of three ships (the *Golden Hind*, *Delight*, and *Squirrel*) and 260 men, under a charter from Queen Elizabeth I to discover and colonize “remote heathen and barbarous lands” (Morison 1971: 566, 573). Gilbert initially settled at St. John's, but ultimately decided to move the colony to Maine as winter approached. A string of unfortunate events, including the loss of *Delight* off Sable Island, led Gilbert to abandon the idea of spending the winter in America. The remaining ships in the expedition altered course for home August 31, 1583. While en-route, Gilbert embarked aboard *Squirrel* (the smallest ship in the fleet) to dispel rumors that he was “afraid of the sea” (Morison 1971: 572). Tragically, Gilbert drowned shortly thereafter when the *Squirrel* foundered in foul weather north of the Azores (Duncan 1992: 24-27 and Morison 1971: 577).

Permanent European presence in Maine began in earnest during the first half of the seventeenth century, when French and English colonists established a small number of

settlements in the region. Penobscot Bay and River formed a natural border between the two nations' territories, with the French situated in the northeast near southern Quebec, and the English settled along the southwest coast. In 1626, agents for the Plymouth Plantation of Massachusetts directed Isaac Allerton to establish an English trading post at Penobscot (present-day Castine) to barter for animal furs with the local Penobscot Indians. It was the first European settlement founded on the Penobscot River and, because of its strategic location, it was contested by rival European powers during the remainder of the seventeenth century. The first skirmish occurred in 1635, when Charles de Menou d'Aulney de Charnissy, acting on orders from the French Governor of Acadia, attacked Penobscot and forcibly evicted its English occupants. Colonists from Plymouth Plantation attempted to retake the post shortly afterwards but were unsuccessful. Once firmly established in the region (which they called Pentagoet), the French maintained undisputed possession until 1654, although periodically raided by soldiers and militia from Pemaquid, a nearby English settlement (Wheeler 1875: 16-17).

English forces commanded by Robert Sedgewick recaptured the trading post at Pentagoet in 1654, during a successful military campaign that granted England control of all Acadia (Duncan 1992:102). The Treaty of Breda, drafted in 1660, restored Acadia to France. During the following decade, small-scale skirmishes continued to flare up between English and French colonists living in Pentagoet. Dutch privateers briefly occupied the region in 1674 and used it as a base for piratical operations, but were soon apprehended by English officials (Riess 1999: 11). Following the removal of the Dutch from the region, internecine warfare resumed between English and French forces. Political unrest in Europe and North America eventually erupted into King William's War (1678-1698) and although the French and English resolved their European conflicts at the Peace of Ryswick in 1697, colonists living in Maine saw only a brief respite from turmoil. The Acadian government, often responsible for strained relations between the two colonial powers, incited violence among French settlers and urged local Indians to attack English interests in the region. As a result of these and other factors, Queen Anne of England renewed hostilities against France in 1702. In Pentagoet, raids and counter-raids devastated both sides until the end of Queen Anne's War in March 1713. As part of the peace agreement, France ceded Acadia to England, which in turn integrated it with Maine, a province of the Massachusetts colony (Duncan 1992: 124-151).

By 1740, complex political problems in Europe led France and England into another conflict with one another. King George II of England entered the War of the Austrian Succession (1740-1748) to protect his home electorate of Hanover. France, which was allied with King George's opponents, declared war on England four years later. Although the conflict ended with the Treaty of Aix-la-Chapelle in 1748, inter-colonial battles between England and France quickly resumed with the outbreak of the French and Indian War (1754-1763). This effectively curtailed growth and prosperity in Maine until successful English campaigns resulted in French defeat and the

subsequent Treaty of Paris (1763). The Treaty of Paris removed the French presence from eastern North America by granting England control over most of France's former colonial dominions (including all of Maine). By taking advantage of extensive forest resources, renewed trade with local Indians, and elimination of French competition in the fisheries, the English inhabitants soon transformed Maine into a prosperous colony (Duncan 1992:177-200). Certain industries, such as the export of timber from forests surrounding the settlement of Majabagaduce (formerly Penobscot), provided a critical link between frontier communities located along the Penobscot River and larger metropolitan areas such as Boston (Leamon 1993: 14).

Onset of the American Revolution

In February 1775, the British Parliament enacted a strict Navigation Act that adversely affected colonists living in Maine and along the eastern seaboard. The new law punished Americans by limiting trade between their ports and those of all other nations except Great Britain and the British West Indies (Duncan 1992: 200-201). Most Americans inhabiting the Penobscot region were patriots, although a small number of British loyalists were also scattered throughout the area. Following the outbreak of the American Revolution, both sides attempted to recruit local Indian tribes as allies. Although most Indians tried to remain neutral, some tribes assisted the patriot cause by scouting, informing, and safely guiding American troops through local terrain.

British forces initially targeted two settlements in Maine: the coastal towns of Falmouth Neck (present-day Portland) and Machias (located near the Canadian border). During the first months of the war, patriot militia entered Falmouth Neck to prevent local merchants from trading with British-occupied Boston. During the ensuing fracas, the militia captured and briefly incarcerated British naval commander Lieutenant Henry Mowatt. Released by his American captors after threatening to destroy the town, Mowatt and four armed vessels (HMS *Canceaux*, HMS *Halifax*, HMS *Symmetry*, and HMS *Spitfire*) returned on October 18, 1775 to make good on his promise. Mowatt's squadron destroyed two-thirds of Falmouth Neck and left 2,000 of its inhabitants homeless (Gardiner 1996: 37 and Leamon 1993: 68).

In June 1775 the trade embargo precipitated a small skirmish between colonists in Machias and the British military. Angered by British interference in their largely patriot community, the town's militia attacked the armed sloop HMS *Margaretta*. During the assault, *Margaretta's* commander, Midshipman James Moore, was killed by small arms fire and his British crew surrendered. Capture of the *Margaretta* was an astonishing achievement that targeted Machias for reprisals throughout the remainder of the conflict. Though isolated from most forms of assistance, the Machias militia and its Indian allies made several effective raids against British interests in Nova Scotia and along the Gulf of Maine (Riess 1999: 12-13).

The inability of Maine's radicals to develop an organized military force between 1775 and 1777 did not prevent them from actively participating in the conflict. Privateering, in particular, prospered during this period and a number of expeditions were carried out against British settlements in Nova Scotia (Leamon 1993: 86, 99). Nova Scotia's inhabitants relied heavily on ineffective militias and the scant resources of the Royal Navy as their only form of defense. This encouraged American privateers to increase the number and frequency of raids against towns, farms, and shipping along the coast of Nova Scotia. Not surprisingly, the Royal Navy conducted numerous retaliatory attacks against American interests in Maine (Leamon 1993: 103).

In September 1775, Maine served as the staging point for American Colonel Benedict Arnold's ill-fated campaign against the city of Quebec. The Americans needed a victory in Quebec to prevent the British from campaigning west of the colonies. Further, American military planners believed that the capture of Quebec would bring French Canada into the coalition of rebellious states. Arnold's army and another expedition commanded by General Richard Montgomery joined forces on December 30 and attacked the city. Montgomery was killed during the opening phase of the battle and Arnold was wounded shortly thereafter. Dispirited by these events, the patriot forces faltered and either retreated or surrendered to the British (Duncan 1992: 214-215). Overall, Arnold's expedition made little impact on Maine, but it did reinforce the importance of the colony's location—strategically situated between the rebellious American colonies and Britain's Canadian territories.

In 1779, the British Crown authorized an expeditionary force to sail to the Penobscot River, dislodge the American presence there, and establish a fortification at Majabagaduce. In addition to protecting Nova Scotia and British merchant shipping from New England privateers, the new fort would serve as a refuge for American loyalists fleeing the rebellious colonies. Further, Majabagaduce would provide the Royal Navy with a convenient base from which to harass the New England coast and an important source of timber for building and outfitting its ships. The expeditionary force consisted of approximately 700 men, three transports, three armed sloops-of-war (HMS *Albany*, HMS *North*, and HMS *Nautilus*), and a small frigate (HMS *Blonde*). It departed Halifax, Nova Scotia for Maine in June 1779 (Goold 1889: 303, 336, 339; Rider 1977: 176 and Riess 1999: 13).

The Penobscot Expedition

The British expeditionary force commanded by Brigadier General Francis McLean landed at Majabagaduce June 16, 1779, but did not take official possession until the following day. To ensure a peaceful takeover, General McLean and his officers drafted a proclamation offering indemnity to local inhabitants who swore allegiance to King George III. With the assistance of

numerous local “converts,” British troops began clearing the area to construct “one of the strongest [fortifications] upon the coast” (Weymouth Historical Society 1881: 54). The fort (named Fort George) occupied Dice Head, a high bluff located in the center of Majabagaduce Peninsula. Fort George’s position not only added to its defensive capabilities, but also enabled its cannon to command Majabagaduce’s harbor and entrance. Moreover, the fort provided the Royal Navy a base of operations from which to curtail privateering, interrupt trade, and assault coastal settlements in Maine, New Hampshire, and Massachusetts (Duncan 1992: 228-229). Assured a successful expedition, British officials ordered HMS *Blonde* to return to Halifax, leaving *Albany*, *North*, *Nautilus*, *Santilena* (a small armed prize vessel), and the transports at Majabagaduce under the command of Captain Henry Mowatt (Cayford 1976: 4 and Weymouth Historical Society 1881: 54).

News of the British landing at Dice Head spread rapidly through the eastern colonies and reached Boston within one week (by June 18). The Massachusetts Assembly reacted swiftly, voting unanimously to attack the British and dispossess them of their newly acquired position. On June 26, 1779, the General Court of Massachusetts gave Brigadier General Solomon Lovell command of 1200 American militia and an artillery detachment, with orders to proceed to Majabagaduce “at the shortest notice” (Weymouth Historical Society 1881: 55). The Massachusetts Board of War named Captain Dudley Saltonstall, commander of the Continental Navy frigate *Warren*, as commodore of the naval contingent. The fleet consisted of three Continental Navy ships, including the 32-gun *Warren*, 14-gun sloop-of-war *Providence*, and 14-gun brig *Diligent*; three Massachusetts State Navy vessels; one New Hampshire Navy brig; and approximately 30 chartered privateers and unarmed transports (Collier to Stephens, 20 August 1779; Duncan 1992: 229; Massachusetts War Office, 11 July 1779; Memorandum Regarding Ships Lost, n.d.; Rider 1977: 177; Unsigned list of armed vessels, n.d. and Riess 1999: 14-17). According to Riess (1999: 13), archival sources are unclear as to the exact number of vessels attached to the armada; most documents, however, list a total between 37 and 42 ships.

The American fleet weighed anchor on July 19, 1779 and arrived at Penobscot Bay five days later. The following day (July 25), the armada sailed into the bay and anchored off Majabagaduce Peninsula. The British, expecting the American assault, arranged their sloops-of-war into a defensive line around the transport vessels, some of which were readied as fire ships. Late in the afternoon of July 25, ineffectual cannon fire was exchanged between the two naval forces and the Americans made an abortive attempt to land on the west side of the peninsula. Over the course of the next few days, the Americans probed the British defenses, established an artillery battery at the top of nearby Banks (now Nautilus) Island, and forced the British sloops to retreat into Majabagaduce Harbor (Rider 1977: 181-3 and Weymouth Historical Society 1881: 60-6).

Unfortunately, trouble was brewing in the upper echelons of the American operation. Despite overwhelming naval superiority, Commodore Saltonstall refused to attack the British sloops. General Lovell, unwilling to attempt a land assault until the British naval force was vanquished, was disgusted by Saltonstall's inaction. The American naval commanders were also dismayed by the Commodore's refusal to attack, and petitioned him on the morning of 27 July:

...we your Petitioners strongly impress'd with the importance of the expedition...Represent to your Honour that the most speedy Exertions shou'd be used to accomplish the design we came upon. We think delays in the present case are extremely dangerous: as our Enemies are daily fortifying and strengthening themselves...being in daily Expectation of a Reinforcement...[we] intend only to express our desire of improving the present opportunity to go Immediately into the Harbour & attack the Enemy's ships (Weymouth Historical Society 1881: 63).

Although the petition expressed the feelings of nearly every officer under his command, Saltonstall remained unmoved. A war council was convened aboard *Warren* that afternoon and resolved to land troops on the peninsula despite the presence of the British vessels. On July 28, the three Massachusetts State Navy brigs and a heavily armed privateer cannonaded Fort George while 400 to 600 American regulars landed on the beach and scrambled up the steep southwest side of the peninsula. Despite several casualties, the Americans were able to gain a foothold on the heights in front of the fort. While the bulk of the British force was occupied with the assault on the heights, Saltonstall's fleet made a half-hearted attempt to engage *Albany*, *North*, and *Nautilus*. Incredibly, Saltonstall ordered *Warren*'s crew to retreat when enemy fire struck the ship's mainmast and bowsprit (Cayford 1976: 21 and Rider 1977: 184). With the British sloops still able to direct murderous fire on positions outside Fort George, the Americans lost their momentum and advantage. Instead of overwhelming the fort, they dug in on the edge of the peninsula and began a two-week siege (Rider 1977: 183-4 and Riess 1999: 14).

The land forces arrayed against one another on Majabagaduce Peninsula were fairly evenly matched, but the British had the advantage of their fortification. In Penobscot Bay, Saltonstall's armada enjoyed undisputed superiority, commanding more than 300 cannon against the Royal Navy's 42. General Lovell and nearly all of the American officers believed the capitulation of Fort George inevitable if Saltonstall would engage and overwhelm the British sloops. Numerous councils of war were held in *Warren*'s great cabin, but all ended with the same result—Saltonstall's inexplicable refusal to attack the beleaguered British fleet. On August 8, Captain Hoysteed Hacker, commander of *Providence*, addressed a letter to the “Gentlemen of the Navy and Army present” in which he outlined a plan to attack the British ships and land batteries simultaneously (Rider 1977: 185). Army and Navy officials supported the plan unanimously, and Saltonstall finally relented to take action. A few days later however, the Army, claiming lack of discipline among its ranks, reneged. The American naval captains (less Saltonstall) were

debating whether to proceed with an attack on the ships in Majabagaduce Harbor when a powerful British naval squadron was sighted approaching Penobscot Bay on August 13. The *Diligent* and Massachusetts State Navy brig *Active* were patrolling the waters outside the bay and were the first to recognize that the expedition's success was endangered (Buker 2002: 74; Rider 1977: 188-9 and Weymouth Historical Society 1881: 67-75).

The British squadron was commanded by Sir George Collier and comprised of six vessels: the 64-gun line-of-battle ship *Raisable*, 32-gun frigates *Blonde* and *Virginia*, 28-gun frigate *Greyhound*, and 20-gun frigates *Galatea* and *Camille*. The *Otter*, a 14-gun sloop, accompanied the squadron from New York, but was lost in fog enroute and never arrived at the fleet's rendezvous point at Monhegan Island (Buker 2002: 75; Cayford 1976: 40 and Collier to Stephens, 20 August 1779). As the opposing fleet closed in on the mouth of the bay, *Diligent* and *Active* both rushed to the *Warren* to alert the Commodore. Saltonstall, greatly unnerved by the news, hastily convened one final council of war. At its conclusion, all members voted unanimously to evacuate the land forces and retreat up the Penobscot River. During the early morning hours of August 14, the Continental Army deserted their lines and re-embarked their troops and equipment aboard the transports (Gardiner 1996: 101; Rider 1977: 189 and Weymouth Historical Society 1881: 75).

The transports attempted to run up the river, but were hampered by lack of wind. The same problem prevented the armed vessels and privateers from effectively forming a defensive crescent around the retreating transports. A sea breeze finally materialized during the early afternoon, allowing the British squadron to enter the harbor under full sail. As the first of the British frigates drew within firing range of the American fleet, Commodore Saltonstall signaled to all of his subordinates that it was every man for himself. Panic rapidly consumed the Americans—three vessels (the New Hampshire State brig *Hampden* and privateers *Hunter* and *Defence*) attempted to escape along the west side of Long Island, but were cut off by *Blonde*, *Camilla*, and *Galatea* and either captured or scuttled. Several of the transports now had the wind in their favor but were unable to sail against the ebbing tide. As the British ships fired the first of several cannon salvos, the crews of most of the fleeing transports ran their vessels ashore, set them ablaze, and scattered into the countryside (Figure 3). A total of nine transports were captured (Smith 1986: 28). The rest of the American fleet—all of the naval vessels and some of the privateers and transports—escaped into the Penobscot River (Duncan 1992: 231-232; Rider 1977: 190; Riess 1999: 14 and Weymouth Historical Society 1881: 77).

The surviving American vessels managed to progress upriver, albeit slowly and with considerable effort from their crews. Unfortunately, some ships began to lag behind the others. One of these was the ordnance transport *Samuel*. Convinced that the British squadron would soon overtake his ship, James Brown, *Samuel's* master, drove the vessel on shore near two other



Figure 3. *Destruction of the American fleet at Penobscot Bay, 14 August 1779*, oil painting by Dominic Serres (1722-1793).

transports, left the sails set, and dropped anchor. Shortly thereafter, the crews of the two transports abandoned and torched their ships. Fearing that the conflagration would spread to their vessel and ignite the large quantities of black powder that it carried, *Samuel's* crew also abandoned ship. Amazingly, the vessel slipped its moorings unscathed during the next flood tide and drifted upriver without a crew before running aground a second time. As the British attempted to sail upriver to intercept the grounded craft, several Americans rowed a small boat downriver, boarded *Samuel*, and warped the ship into deeper water. They then fled up the river with the British in close pursuit. Eventually, the Americans were forced to set fire to *Samuel* approximately two miles south of where *Warren* was eventually scuttled. The two ships were in sight of one another when *Samuel's* cargo of powder exploded (Baxter 1913: 239, 255; Baxter 1910: 335 and Riess 1999: 49).

The other vessels, including *Warren*, *Providence*, and *Diligent*; the Massachusetts State Navy ships *Tyrannicide*, *Active*, and *Hazzard*; a small number of privateers, and one surviving transport (the sloop *Pidgeon*), continued to slowly move north toward the river's head. *Warren's* progress was severely hindered by its massive size, and it was soon unable to keep up with the rest of the fleet. Consequently, Saltonstall ordered his crew to heave to and anchor the flagship near Oak Point. The rest of the fleet pressed on, finally coming to anchor around midnight August 14. The following morning, they resumed the journey, sailing as far as the falls at Bangor (Figure 4). Unable to proceed further upriver, the commanders of the remaining vessels in the expedition made preparations for a final stand against the British (Rider 1977: 190). Of the approximately 40 American ships that sailed into Penobscot Bay July 25, only ten survived the retreat to Bangor (see Appendix A). The once powerful armada was now comprised of two small Continental Navy vessels, three Massachusetts State Navy ships, four privateers, and one transport (Buker 2002: 91-93; Cayford 1976: 42; Rider 1977: 190 and Riess 1999: 51, 54-6).

The captains of *Providence*, *Diligent*, *Tyrannicide*, and *Hazzard* embarked aboard the privateer *Vengeance* and sailed downriver to outline their plan of resistance to Commodore Saltonstall. While enroute, they encountered a marine captain bearing terrible news: Saltonstall planned to scuttle the *Warren* at Oak Point, and was already landing his men in preparation for the event. Dismayed, the captains elected that *Vengeance* turn around and return them to their ships. At the anchorage, they discovered that the privateer crews were preparing to burn their ships, and that their own crews were starting to panic. The growing hysteria forced the captain of *Tyrannicide* to fire on some of his men when they refused to come back aboard the ship (Buker 2002: 92 and Rider 1977: 191).

On the night of August 15, General Lovell appeared aboard *Providence* and informed the naval officers that Saltonstall needed assistance to tow *Warren* upriver. News that the flagship had not yet been destroyed invigorated the men and numerous boats were promptly manned and

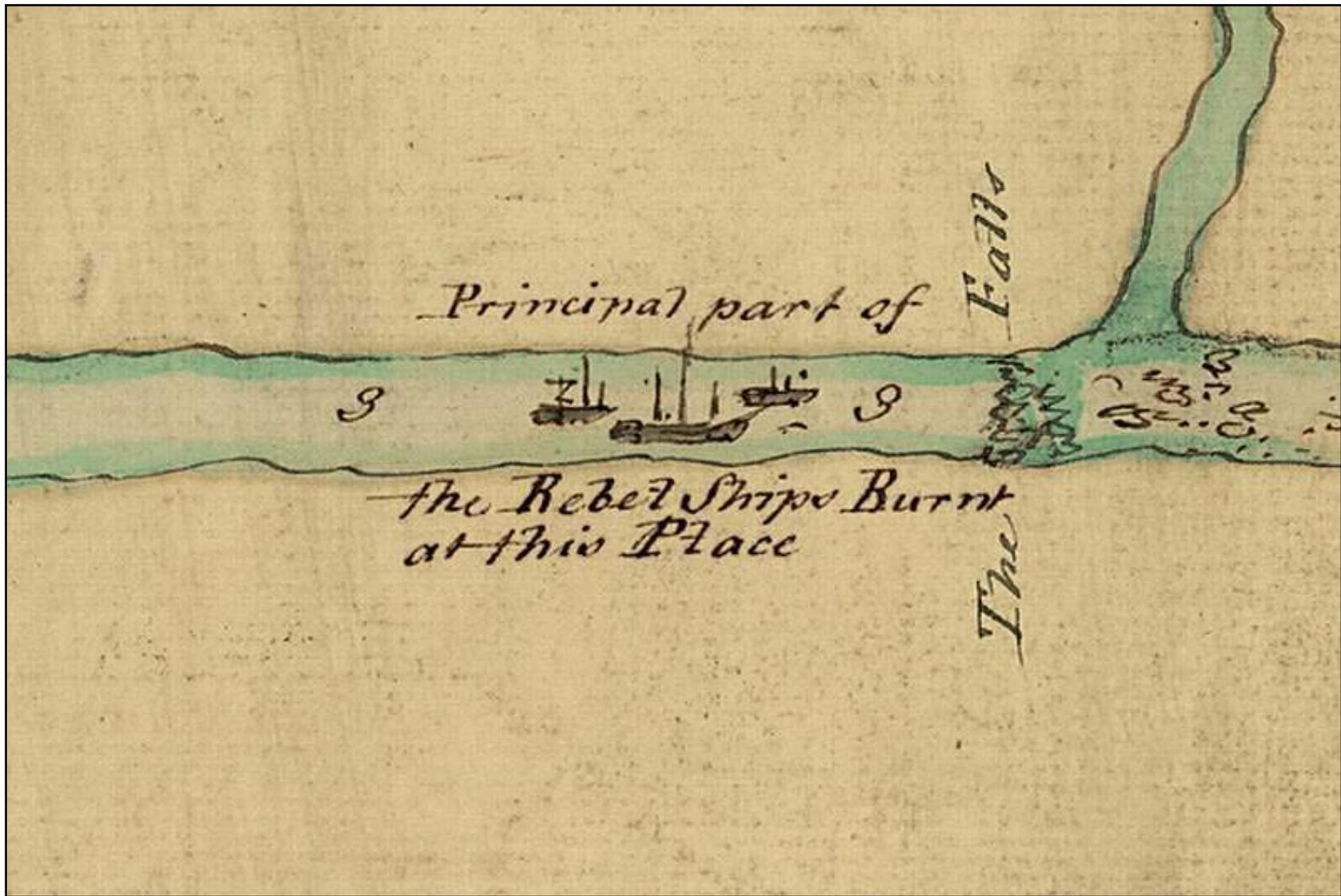


Figure 4. Detail of 1780 map of Penobscot River, showing the approximate location of burned American vessels below the falls at Bangor. From the map *Penobscot River and Bay, with the operations of the English fleet, under Sir George Collyer, against the division of Massachusetts troops acting against Fort Castine, August 1779; with full soundings up to the present site of Bangor*. Author unknown. Library of Congress Geography and Map Division, Washington, D.C.

sent down to Oak Point. Despite such good tidings, the privateer crews began scuttling their vessels during the early morning hours of August 16. The first vessel to be destroyed was the transport *Pidgeon*, followed shortly thereafter by *Hector* and *Black Prince*. *Monmouth* exploded as flames from *Black Prince* reached its deck guns and powder stores. A few hours later, a messenger arrived from Oak Point with news that *Warren* had been set ablaze and was already consumed. The same fate befell the privateers downriver (including *Vengeance*). With no other option left to them, the officers and crew of the remaining ships abandoned their craft and set them on fire. Because most were “half a pistol shot” or less apart, the flames rapidly spread from one vessel to another (Baxter 1913: 228-29, 235, 311). According to the vast majority of historical sources, most of the vessels appear to have been scuttled above and slightly below the mouth of present-day Kenduskeag Stream (Baxter 1913: 228, 245, 290 and Williamson 1839: 476). By late afternoon August 16, the river near Bangor was filled with the smoldering hulks of vessels that had either exploded or burned to the waterline and slipped beneath the water. Only 48 hours after Collier’s British squadron arrived at the mouth of Penobscot Bay, most of the American fleet lay in ruins along the course of the river (Baker 2002: 94; Cayford 1976: 42; Rider 1977: 192; Riess 1999: 54; and Weymouth Historical Society 1881: 78).

V. RESEARCH DESIGN AND METHODOLOGY

During the 2000 and 2001 field seasons, the Naval Historical Center's Underwater Archaeology (UA) Branch conducted diving assessments of three submerged archaeological sites believed to be associated with the Penobscot Expedition of 1779. One of these cultural occurrences, submerged shipwreck site ME 054-004 (known locally as the "Phinney Site"), was the subject of limited test excavation and data recovery efforts during the 2000 field operations, as well as a post-disturbance survey the following year. Another submerged site, ME 027-012 (the "Shoreline Site"), underwent cursory examination by NHC archaeologists at the close of the 2000 field season, and in 2001. A third site, rumored to represent the remains of the Continental Navy frigate *Warren*, was briefly examined at the close of both the 2000 and 2001 investigations. In addition to diving operations, UA staff continued an ongoing multi-component remote-sensing survey along limited corridors of the Penobscot River—one located between the cities of Bangor and Brewer and the other near the town of Winterport.

Dive Operations

Although low visibility and moderate to high current was encountered in the Penobscot River during the duration of both projects, the overall dive environment was considered safe enough for NHC staff to operate on Self-Contained Underwater Breathing Apparatus (SCUBA). However, due to a variety of potentially hazardous underwater conditions encountered during both field investigations (i.e. deep water, significant tidal fluctuations, and low light) all divers wore MKII AGA full-face masks with underwater lights and an OTS SSB-2010 wireless communications system (Figure 5). Additionally, divers were required to wear a safety harness attached to a 200-foot nylon safety tether during periods of moderate (approximately one knot) current. Safety protocol stipulated that all diving operations were to cease entirely when the river current exceeded two knots. At all times during dive operations on both field campaigns, a suited stand-by SCUBA diver was prepared to enter the water and render assistance in the event of an emergency. NHC field crew not employed at underwater tasks worked topside and fulfilled a variety of roles, including those of dive supervisor, time and record keeper, communications operator, photographer, and deckhand.

UA operated from two vessels during the 2000 and 2001 field investigations. The primary dive platform was the *R/V Ira C.*, a 42-foot custom-built Maine lobster boat owned and operated by the University of Maine's Darling Marine Center (Figure 6). In addition to its role as a dive platform, *Ira C.* served a limited capacity as a remote-sensing craft. An 18-foot shallow-draft motorboat owned by Mr. Brent Phinney was employed as the project's primary remote-sensing platform, but was also frequently used as a support vessel to transport divers, equipment, and



Figure 5. NHC underwater archaeologist preparing to dive on the Shoreline Site. Note the MKII AGA full-face mask and OTS SSB-2010 wireless communications system. Photograph by Barbara Voulgaris.



Figure 6. The Darling Marine Center's *R/V Ira C.* (center of photograph) moored over the Shoreline Site in September 2001. Photograph by David Whall.

visitors to and from the *Ira C.* and elsewhere. Mr. Phinney's boat was also on standby to evacuate personnel from the *Ira C.* in the event of an emergency.

Site Investigation and Documentation—Phinney Site

The primary focus of the 2000 field season was to conduct limited test excavations at the Phinney Site. This was intended to: 1) aid in the overall interpretation of the shipwreck; and 2) ascertain whether it represents one of the ill-fated fleet of American vessels that participated in the Penobscot Expedition. Prior to the commencement of fieldwork, preliminary historic research was conducted at the Navy Department Library in Washington, D.C. and the Public Records Office in London, England. Additional information was gleaned from secondary historical sources published by the following repositories: the Massachusetts State Archives, Massachusetts Historical Society, Essex Institute (Salem, Massachusetts), Weymouth Historical Society (Weymouth, Massachusetts), and Maine Historical Society. Historic documents such as ship plans, logbooks, and maps were examined to assess the attributes of American vessels that served in the Penobscot Expedition and determine the final disposition of those scuttled during the final days of the engagement.

During mid-September 2000, NHC archaeologists relocated the Phinney Site, conducted a brief examination and assessment of its exposed components, and initiated limited test excavation, artifact recovery, and documentation of the ship's architecture. Portions of the site that were not already exposed by natural processes were cleared of loose sediment, logs, modern debris, and other overburden before excavation commenced. A 28.97-meter baseline tape was reestablished along the centerline of the shipwreck, with the zero datum positioned just beyond the forward edge of the vessel's stem. A second baseline was oriented parallel to the first along the starboard (offshore) side of the ship. Although intended to provide additional coverage over the entirety of the wreck's exposed hull structure, the second baseline was used primarily to triangulate isolated artifacts as fieldwork progressed.

Initially, members of UA excavated the vessel's centerline and extreme fore and after ends. Extant hull components including the keel, keelson, stem assembly, bow and stern deadwood, floors, futtocks, planking and cant frames were partially exposed by gentle hand fanning of bottom sediments. However, hand fanning proved increasingly ineffective as excavation expanded and overburden slumped back into exposed portions of the wreck. Consequently, UA divers incorporated the use of two water-induction dredges. Dredging enabled staff members to rapidly remove sediment without disrupting existing site stratigraphy, dislocating artifacts, and losing significant archaeological data. Each dredge operated from a high-pressure, low-volume pump that supplied water to a circle-jet venturi head. Flexible suction hoses connected to the circle-jet ran underwater to areas within the site that were being excavated. Outflow hoses

carried dredge spoil comprised of sediment, shell, gravel, and small artifacts offsite, where it was discharged into heavy-duty mesh bags. Upon completion of excavation, the full mesh bag was removed and replaced. At the surface, the contents of each dredge spoil bag were emptied and sorted by staff working topside.

Although a number of small artifacts escaped detection and were subsequently recovered in dredge spoil, great care was taken to identify and record as many objects *in situ* as possible. Imbedded artifacts were carefully uncovered by gently hand fanning away sediment into the dredge. Once free of its matrix, each specimen's provenience was determined by taking at least one offset measurement (a distance measurement located at a relative right angle to a specific point along the baseline) from the centerline baseline to one or more points on the artifact. Artifacts were then sketched and photographed *in situ*, carefully removed, and transported to the surface where they were documented a second time. All specimens were then assigned provenience information, placed in water-filled plastic containers, and temporarily stored until they could be transported to NHC's archaeological conservation facility in Washington, D.C.

As excavation progressed, project archaeologists noted that the majority of the Phinney Site's centerline and starboard hull was buried under a tremendous layer of intrusive sediment and debris. Dredging in the vessel's bow, for example, revealed a consistent deposit of intrusive material from the surface of the riverbed to the base of the keel. Consequently, little effort was given to maintaining strict vertical control. However, unique stratigraphic features within the hull (i.e., the sediment within the vessel's mainmast step mortise), when encountered, were documented and excavated separately.

A 1-meter square excavation grid was established over a portion of the vessel's starboard hull, forward of the vessel's mainmast step and immediately adjacent to the keelson. The physical superstructure of the excavation grid was comprised of 1-inch diameter polyvinyl chloride (PVC) pipe graduated in 1-centimeter intervals. Prior to the commencement of test excavations, the grid was superimposed over the wreck and anchored by four stainless steel rods. Its placement was dictated by two primary factors: 1) a relatively level bottom environment, which significantly reduced the amount of peripheral sediment slumping back into the excavated area; and 2) the need to accurately record frame dimensions and spacing, as well as the vessel's starboard strake. The grid framework was positioned horizontally to run parallel with the keelson, and was leveled vertically in relation to the site's zero datum. The zero datum enabled NHC researchers to extrapolate a depth of deposition for features and artifacts encountered during excavation. Artifacts and elements of the ship's architecture encountered during the test excavation were mapped in direct relation to the PVC grid. This information was sketched on a Mylar sheet taped to a plastic slate and later transcribed to paper forms, drafted to scale, and incorporated into the preexisting site plan.

During the 2000 field campaign, UA members recorded exposed hull elements by taking a series of offset measurements from the primary baseline to specific timbers and other architectural attributes. In addition to the baseline technique, divers examined, measured, and recorded individual hull components and mapped their positions relative to one another. A plumb bob was used in conjunction with folding rules or reel tapes to ensure accurate horizontal offset measurements. Attributes of individual timbers, including molded and sided dimensions, spacing, tool marks, fastener patterns, and methods of joinery were photographed, noted, and recorded *in situ*. Composite hull components, such as the mainmast step and stem and sternpost assemblies, were completely uncovered and documented in both plan and profile views. As with all other structural data recovered during the project, offset information pertaining to the hull was later drafted to scale and added to the plan of the shipwreck. Numerous wood samples were recovered from a variety of timbers for species identification.

Photography and video were employed to record on-site finds and activities, as well as work conducted topside. The largest photographic project consisted of a series of still photographs and video segments that were taken along the vessel's centerline, from the sternpost to the bow of the wreck. A number of different underwater cameras with wide-angle lenses were used in conjunction with various slide, print, and digital films. Photographic techniques and materials varied according to specific site conditions and project priorities. Artificial light (created by strobes) enhanced the definition and contrast of photographic subjects that were often partially obscured in the dark and murky water of the Penobscot River. Digital photography was particularly valuable, as it enabled NHC staff to quickly assess underwater images and ensure that important archaeological information was not lost due to incorrect camera settings or other errors. Likewise, most film was developed locally to ensure that all information was recorded successfully.

Post-Disturbance Survey—Phinney Site

The 2001 post-disturbance survey at the Phinney Site was intended to: 1) document any visible impacts to the shipwreck since the conclusion of the 2000 field season; and 2) relocate and expose the vessel's primary site datums and correlate them to a United States Geological Survey (USGS) benchmark. Once the location of the Phinney Site was reacquired, NHC archaeologists examined the level of degradation of exposed portions of the vessel's hull, established a new baseline tape along the centerline of the shipwreck, and checked the status of a "NO GROUND DISTURBANCE" sign that was placed on the site at the conclusion of the 1999 field season. To document the site's visible state of preservation, video footage was taken along the entire length of the vessel's centerline and in areas where the hull and other archaeological features were exposed above the riverbed. UA staff relocated and exposed the wreck's two primary site datums located at each end of the vessel's centerline. Once these points were positively identified and

marked with buoys, Dr. Arthur Spiess and Mr. Leon Cranmer of the Maine Historic Preservation Commission (MHPC) used a Nikon Top Gun® D-50 Total Station and Trimble Geo-Explorer® 3 Differential Global Positioning System (DGPS) to help NHC staff plot the wreck's precise location on a USGS topographic map.

Reconnaissance Site Investigation—Shoreline Site

In September 2000, NHC archaeologists reconnoitered and sketched a deposit of widely dispersed cannon and shot (ME 027-012) beneath the Bangor Landing-Waterfront Dock Complex. During the 2001 field season, UA members returned to the site to accurately determine the extent, composition, and integrity of the scatter. The site was surveyed by a combination of techniques using multiple baselines, baseline offsets, and trilateration. Archaeologists mapped exposed artifacts and archaeological features by offsetting. This was initially accomplished with an 81-meter baseline (Baseline 1) tape stretched between two arbitrary datum points. As the overall size of the site increased, however, two additional datums and another baseline (Baseline 2) were established 8.3 meters east of Baseline 1. The new baseline measured 65 meters in length. Both baselines were oriented parallel with the course of the river (north to south), and encompassed an area of approximately 672 square meters.

In order to plot the relative positions of each artifact and feature at the site, an offset was taken in conjunction with at least two trilateration measurements—all from the same baseline. The intersection of the triangulation lines was kept between 60 and 120 (typically 45) degrees to avoid acute or obtuse angles. This survey method was most effective when an artifact or archaeological feature was located within visual range of the baseline (typically a distance of one meter or less). Offsets were measured from the baseline to two points on each feature or artifact. Trilateration, a surveying method that incorporates the use of triangulation and geometric data, was used in conjunction with offsetting to further refine the relative position(s) of archaeological occurrences. The provenience of a specific artifact or feature was pinpointed by measuring the distance from two points along the baseline (one on either side of a corresponding offset origin) to one or more points on the plotted specimen.

Plans were made to incorporate the use of 1 meter-square PVC recording grids to map artifacts and other cultural material far removed from the main site. However, due to the relatively close proximity of all archaeological components to the baselines, mapping grids were deemed unnecessary. Divers relayed most measurements via wireless communications to UA staff working topside. These data were then entered into AutoCAD® 2000, a computer-assisted drafting and illustration program that allowed NHC archaeologists to compose, view, assess, and adjust a preliminary map of the site as fieldwork progressed. Additionally, measurement data and accompanying sketch maps were recorded on waterproof Mylar sheets taped to plastic drawing

slates. These hand-written notes were later used in conjunction with the AutoCAD data to draft an accurate, detailed scale plan of the overall site. MHPC personnel and NHC staff georeferenced the site's location to a USGS benchmark using the same equipment and methods employed during the post-disturbance survey of the Phinney Site.

In order to provide complete coverage over the portion of riverbed that comprises the site, UA initiated a systematic survey in the area between and immediately surrounding both baselines. During the first phase of the survey, divers swam the area between both baselines along sixteen transects spaced at 5-meter intervals. All transects were arranged perpendicularly to the baselines. As an object was encountered, its approximate provenience was obtained by measuring perpendiculars from the nearest transect and from one or both baselines. The relative positions of significant artifacts and features were further refined by triangulation. Non-archaeological material (i.e. modern refuse, logs) was typically noted and briefly described, but not plotted. Upon completing the first phase of the site survey, divers established additional transects to the east and west of the baselines. These transects, also spaced perpendicularly to both baselines at 5-meter intervals, were surveyed for a distance of 10 to 20 meters. Archaeological material encountered during the second phase of the survey was plotted in the manner outlined above.

Still photographs and video recordings taken at various phases in the mapping and recording regime allowed NHC archaeologists to document the Shoreline Site's visible state of preservation. It also enabled UA to plan and enact future site investigation, protection, and monitoring, and established a visual medium for disseminating the project's results to a wide audience. Finally, information derived from site photography and videography provided critical details to the final draft of the site plan. All photographs and video recordings were serialized by the project photographer, saved in both digital and standard film formats, and incorporated into the overall site record.

Limited excavation with water-induction dredges was conducted to remove sediment from around cannon so that they could be inspected and recorded in detail. In some instances, small test units (typically 1 meter square) were excavated in locations when high probability for buried hull fabric or other cultural deposits existed. Site overburden and loose sediments were minimally displaced to prevent disturbing overall site provenience, accelerating preexisting erosion and/or corrosive processes, and potentially damaging fragile artifacts. Artifact recovery was limited to diagnostic specimens that indicated the site's temporal or cultural association, and exposed objects that were considered "at risk" from detrimental human or natural impacts. Collected artifacts were recorded and photographed *in situ* prior to recovery. Once free of its matrix, each artifact was carefully removed and transported to the surface where the project conservator numbered, photographed, and described it a second time. All recovered artifacts

were stored in watertight plastic containers containing river water until they could be moved to NHC's conservation laboratory for preservation and analysis. The two large cannon on the site were documented *in situ*. A small iron swivel-gun discovered by Brent Phinney in 1999 was documented *in situ* and then raised for study and conservation (Figure 7).

Preliminary Site Inspection—Proposed Warren Site

In 1994, Peter Bell, a SCUBA diving instructor from Winterport, Maine, approached faculty and students from the University of Maine and informed them about the location of shipwreck remains thought to represent the Continental Navy frigate *Warren*. The site is located near Oak Point and consists of two sections of extant wooden hull structure, numerous disarticulated ship timbers, and small, isolated concentrations of ceramic and glass artifact fragments. Most of the extant hull structure is located in the intertidal zone and is exposed during extreme low tide. The remainder of the site is a roughly linear scatter that extends from the intertidal zone into deeper water. Part of the wreck reportedly lies in the main river channel at a depth exceeding 40 feet (Riess 1999: 83-6).

Researchers from the University of Maine returned to the site in 1995 to determine its size, integrity, and identity. *In situ* inspection and documentation of the wreck's hull components and visible artifact assemblage enabled the research team to draft a preliminary site plan and suggest its temporal and cultural association. Based upon his analysis of the dimensions and construction attributes exhibited by various timbers at the site, Dr. Warren Riess of the University of Maine concluded that the extant hull components were sections of a ship's upper works that could have originated from the *Warren* (Riess 1999: 86).

UA first examined the shipwreck on two separate occasions during the 2000 field season, but were unable to conduct more than a cursory inspection due to time and tide constraints. During the 2001 investigations, NHC archaeologists conducted a brief site inspection during high tide, when all of the site's various hull and artifact components were completely submerged. Video footage was taken of extant hull sections and scantling measurements were generated for exposed futtocks and exterior planking. Additionally, UA staff examined visible fastener patterns on the extant hull sections and a few disarticulated framing components. During the site examination, another resident of Winterport approached staff archaeologists and informed them that the wreck was probably that of a late nineteenth-century schooner. According to the informant, a previous owner of the land immediately adjacent to the wreck site witnessed the schooner's loss during a severe gale in the 1880's or 1890's.

Although UA was able to assess the integrity of visible portions of the site, time constraints prevented staff archaeologists from conducting more intensive site-investigative methods such as



Figure 7. The cast iron swivel gun (PB2-022) being recovered from the Shoreline Site. Photograph by Barbara Voulgaris.

excavation, mapping, and artifact recovery. However, data obtained during the 2001 preliminary inspection will enable UA to effectively plan future archaeological investigations that may confirm or refute the site's association with the Penobscot Expedition.

VI. RECONNAISSANCE SITE INVESTIGATION RESULTS: PHINNEY SITE

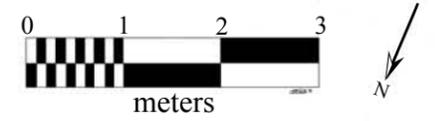
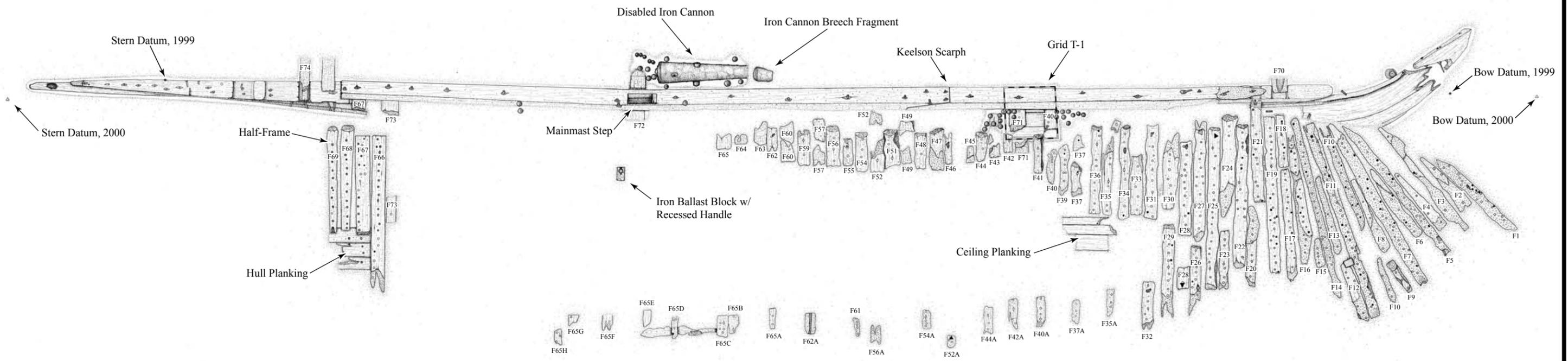
Ship's Architecture

Undoubtedly the largest and most interesting artifact uncovered during two seasons of excavation and recording at the Phinney Site is the vessel's hull, which was found to be remarkably well preserved. Documented hull members include the stem assembly, framing components, hull and ceiling planking, and various longitudinal support timbers, including the keel and keelson (Figure 8). A complete listing of the Phinney Site's principal timber scantlings is provided in Appendix B. An articulated section of starboard frames and planks that broke away from the rest of the hull and collapsed to the riverbed are located immediately adjacent to the wreck's centerline (Figure 9). This portion of the vessel's hull is extant from the bow cant frames to an area approximately in line with the beginning of the stern deadwood. It appears to have collapsed in the years following the vessel's loss and is not the result of the initial wrecking event.

The wreck's port side is believed to be largely intact, but was too deeply buried by riverbed sediments to be documented during the 1999 and 2000 field seasons. As a result, the extent of preservation for this section of the vessel is presently unknown. Portions of the centerline structure exposed at the bow and stern provide some hints about how the hull came to rest on the river bottom. Measurements taken at three separate points along the keel in the vessel's bow revealed that it lists to port an average of 60 degrees. In the stern, the list—at 25 degrees—is considerably less. Where exposed, the list of both bow and stern deadwood is oriented approximately with that of the section of keel directly beneath it. The keelson has become partially dislodged from the rest of the centerline structure and exhibits a port list of 48 degrees in the bow and 33 degrees in the stern. It also exhibits a slight horizontal warp or bend that originates at a point just abaft the mainmast step. The bend continues aft for the remainder of the keelson's length and gradually curves away from the wreck's true centerline. The reason for the bend is unclear; however, the minimal degree of warp exhibited by the keelson and the notable lack of damage from violent action (i.e., an explosion) elsewhere in the hull suggests that gradual natural or man-made processes (such as ice movement or land filling) distorted it over a prolonged period of time.

Keel

Due to the limited nature of subsurface investigations at the Phinney Site during both the 1999 and 2000 field seasons, most of the vessel's keel was not exposed and documented. However, a few of its more general construction attributes were revealed during excavation of



LEGEND	
	Treenail
	Treenail Hole
	Square Iron Spike Hole
	Iron Drift Pin
	Temporary Datum, 1999
	Iron Shot

**NHC NAVAL HISTORICAL CENTER
UNDERWATER ARCHAEOLOGY BRANCH**

Figure 8.
ME 054-004
Phinney Site Plan

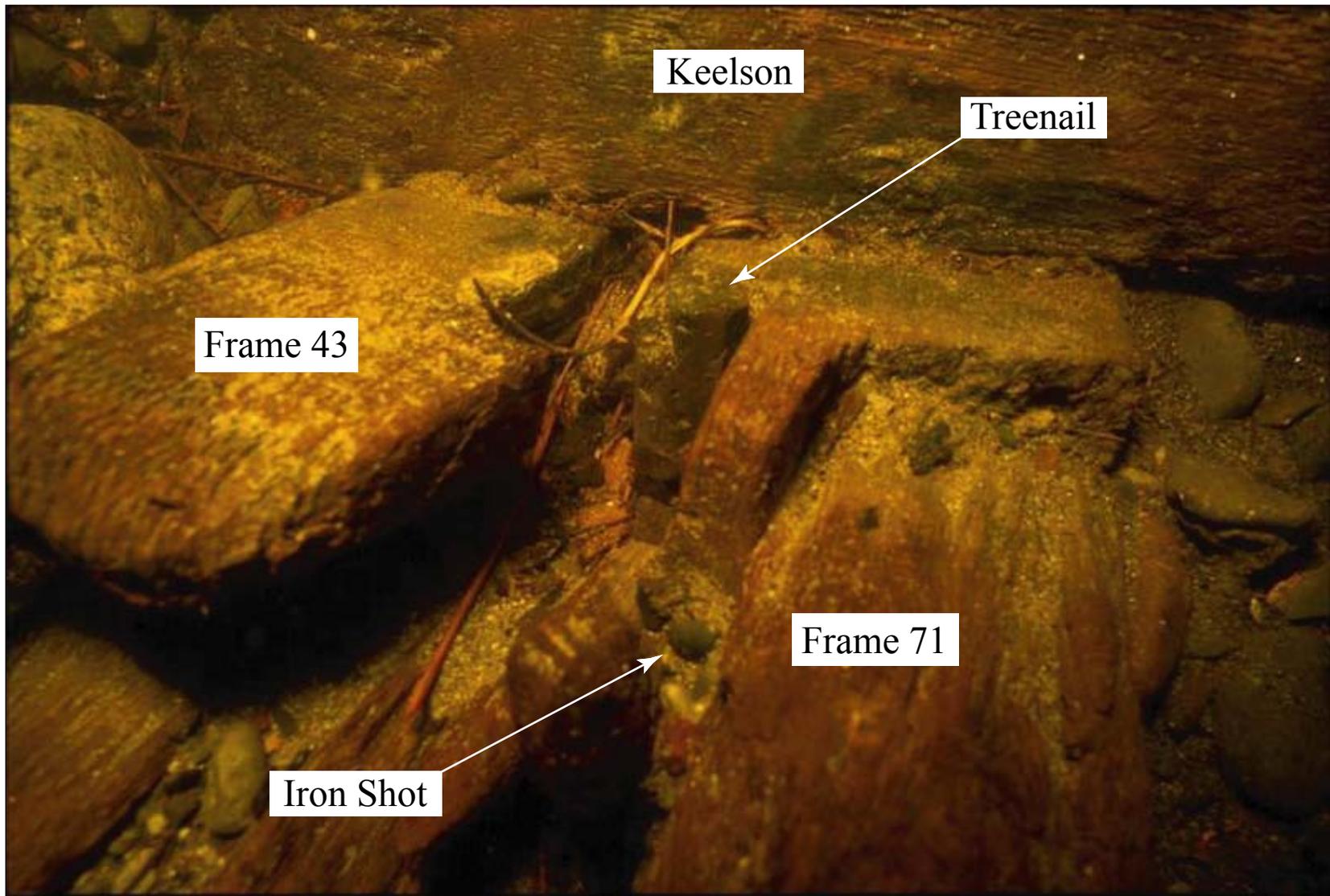


Figure 9. Close-up of starboard frames in Grid T-1, showing point of hull fracture near the wreck's centerline. Note eight-sided wooden treenail and small iron shot associated with Frame 71. Photograph by David Whall.

Grid T-1 and the wreck's stem and stern assemblies. The keel has a maximum preserved length of 24.1 meters, a maximum molded height of 38 centimeters, and is 40 centimeters sided. No scarps were visible on any of the exposed portions of the keel although it is very likely that one or more exist. At its extreme aft end, the keel was exposed for a distance of 2.8 meters; along this length it is slightly rockered (intentionally molded to a lesser dimension than that amidships) and narrows to a molded height of 25 centimeters at the approximate location of the sternpost.

The starboard garboard rabbet is let into the after portion of the keel 2.33 meters forward of the vessel's stern end. It is located 10 centimeters below the top of the keel and continues forward 47 centimeters before disappearing into bottom sediment. The approximate location of the vessel's sternpost assembly is indicated by a large oval depression located immediately forward of the keel's aft terminus. The depression is 20 centimeters long, 10 centimeters wide, and 9 centimeters deep. Based on its size and position, it appears to represent the remains of the mortise that accommodated the tenoned heel of the vessel's sternpost. This theory is further reinforced by the presence of an empty 3-centimeter diameter athwartships fastener hole that penetrates the keel immediately beneath the depression. The hole most likely held an iron through-pin or treenail that secured the sternpost's mortise-and-tenon arrangement. A single wood sample recovered from the stern end of the keel during the 2000 field season was identified as a member of the white oak group (*Quercus* sp.).

Stem

The Phinney Site's stem is an assemblage of timbers that serves as the point of attachment for the two forward sides of the vessel. The remains of the stem were found disarticulated from the rest of the hull, lying on its port side slightly forward and to starboard of the vessel's keelson and bow rising wood (Figure 10). The size and fragmentary condition of the stem assembly precluded any examination of its buried port side; however, a number of detailed measurements were obtained for the side that was exposed. At least three separate elements of the stem are preserved: these include the lowermost portions of the stempost, gripe, and cutwater. In profile, the Phinney Site's stem assembly bears a strong resemblance to that of *Betsey*, a British-built collier brig used as a Royal Navy transport and scuttled during the siege of Yorktown in 1781 (Morris 1991: 97). Similar architectural attributes are also evident in the bow of *Eagle*, a 20-gun American brig built during the final year of the War of 1812 (Steffy 1994: 178-183).

Reconstructed to its approximate original position, the stem would have butted against the chamfered forward edge of the bow rising wood and risen sharply away from the bottom of the vessel (Figure 11). However, the manner in which it was joined to the keel remains unclear. Presumably, if the vessel were built according to mid-eighteenth century standards of British (or British influenced) ship construction, its stem assembly would have been fayed to the forward

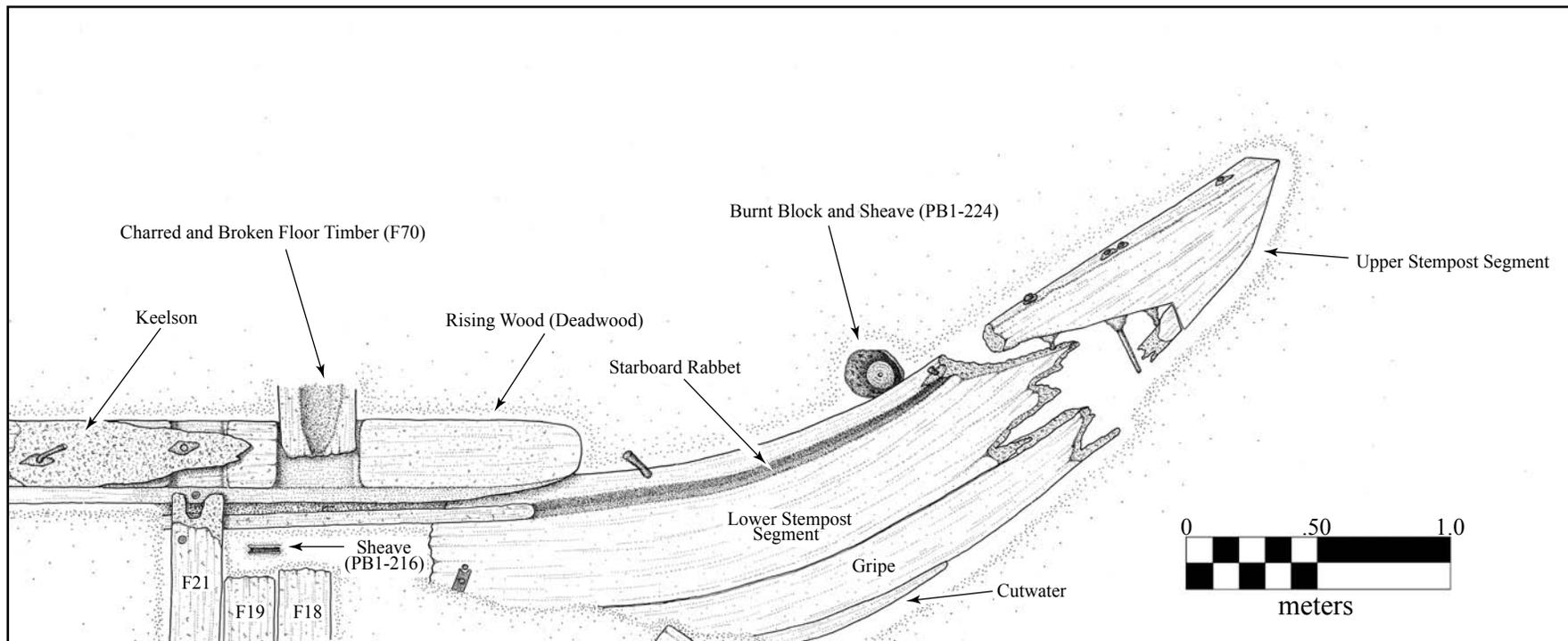


Figure 10. Plan view of Phinney Site stem assembly *in situ*.
Illustration by James W. Hunter, III.

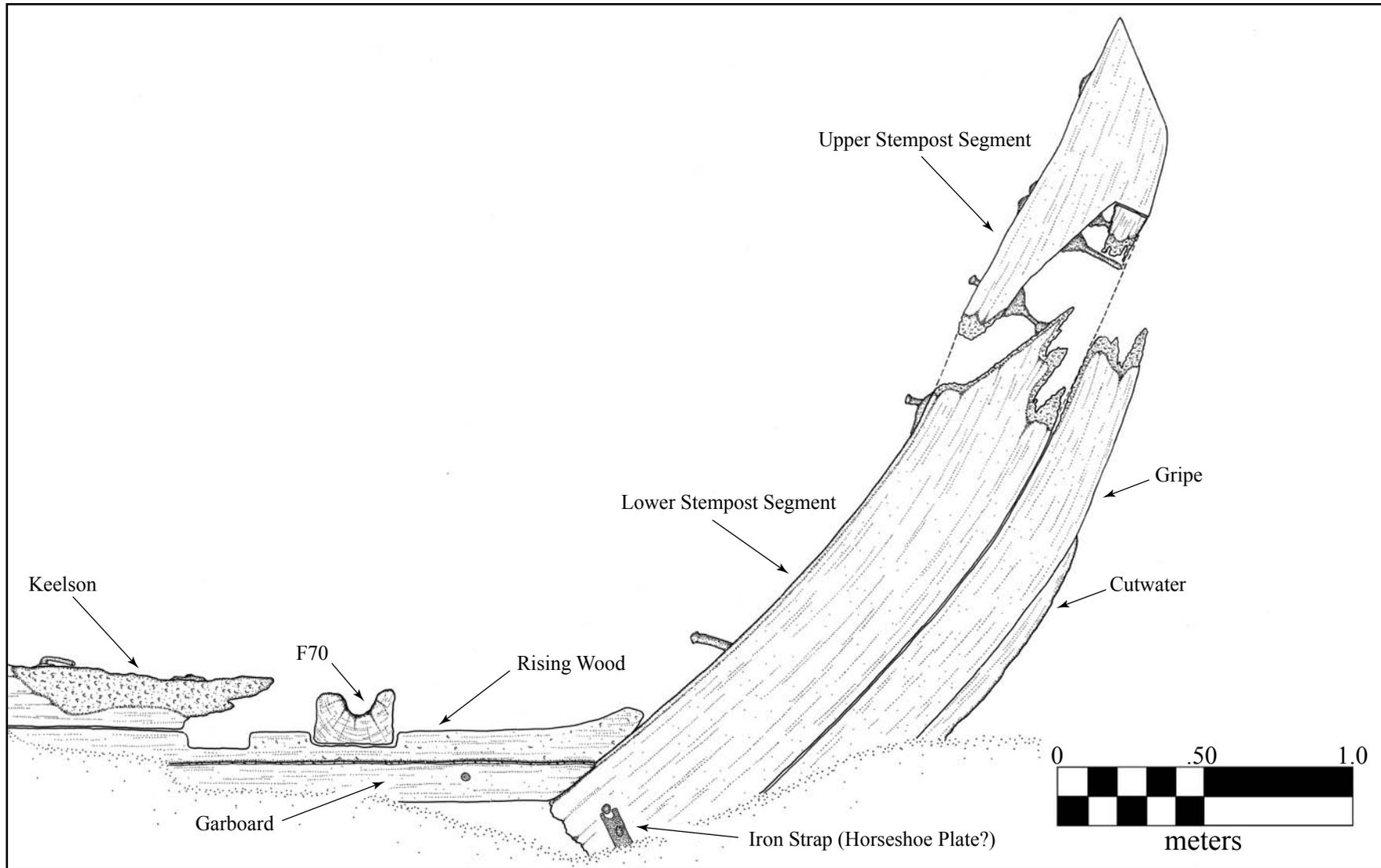


Figure 11. Reconstruction of Phinney Site stem assembly, profile view. Illustration by James W. Hunter, III.

face of the keel in a joint generally referred to as the “boxing” (Goodwin 1987: 9-10 and Steffy 1994: 268, 292). The type of boxing joint employed on a particular vessel ranged from a plain flat scarph in the vertical plane to a more complex and intricate “slotted” form in which the fore end of the keel was fashioned with a horizontal mortise to accommodate a tenon at the heel of the stempost. The latter technique was frequently employed on smaller vessels where its somewhat weaker construction was of less consequence to the overall structural integrity of the hull (Goodwin 1987: 9-10).

The stempost is the largest surviving stem component and comprises the highest preserved portion of the vessel’s structure. It is constructed of two separate timbers that were once fayed together with a horizontal flat scarph. The lower segment of the post has a maximum preserved straight-line length of 2.49 meters, and molded and sided dimensions of 43 centimeters and 17 centimeters, respectively. It is badly eroded at its extreme upper end, obscuring all but the most general details of how it was connected to the upper stempost segment. A small portion of the lower stempost’s upper section survives at the point where it was scarphed to the upper post, indicating that the lower post was originally hewn to an approximate straight-line length of 2.89 meters.

The upper segment of the stempost has a straight-line preserved length of 1.21 meters, a maximum molded height of 39.5 centimeters, and a maximum sided dimension of 17 centimeters. At its forward upper extremity, it is chamfered diagonally along its molded surface, possibly to form part of a step for additional stem timbers or the knee of the head. Although heavily eroded and partially disarticulated, the remains of both stempost timbers are still attached to one another at the location of the scarph. The scarph is through-fastened with three iron drift pins, each 2 centimeters in diameter, 40 centimeters long, and arranged linearly along the approximate centerline of the upper post. Analysis of a wood sample removed from the upper stempost during the 2000 investigations revealed that it was fashioned from a member of the red oak (*Quercus rubra*) group.

The starboard rabbet is let into the lower stempost 2 centimeters below its upper-sided surface. The rabbet runs the entire preserved length of the lower post and still retains the hood end of the starboard garboard in its original position. Curiously, no rope fibers, resinous material, or other evidence of caulking are evident along the bearding line formed by the rabbet and the hood end of the garboard strake. There is also a notable lack of repair-related items such as lead or copper seam patches, suggesting that the vessel had not yet developed the slow leaks typical of an older hull.

A portion of an iron strap originates near the lowermost preserved extremity of the stempost and extends laterally across the timber 13.5 centimeters before disappearing into the riverbed. It

is 6 centimeters wide and secured to the lower stempost with two iron bolts 3 centimeters in diameter. The size, position, and orientation of the band suggest that it might be part of a U-shaped clamp called a horseshoe. Horseshoes were installed diagonally across the seam of a vessel's stem and gripe to secure and strengthen the join between both timbers. The only other fasteners observed on the lower stempost are a pair of 3-centimeter diameter iron bolts. These protrude from the after face of the post and are believed to have fastened it to a "false stem" or apron.¹

The Phinney Site's gripe, or forefoot, is fayed to the forward face of the stempost and forms the second largest component of the stem assembly. During the vessel's sailing career, it would have served as a point of connection between the forward end of the keel and the lower end of the knee of the head (Steffy 1994: 272). During the 2000 field season approximately two-thirds of the gripe was revealed. Unfortunately, the lowest portion of the timber was too deeply buried in bottom sediments to be adequately exposed and documented. Consequently, NHC archaeologists were unable to determine the manner in which it was connected to the keel. From its eroded upper end to the point where it is obscured by the riverbed, the gripe has a preserved straight-line length of 2.0 meters. It has a maximum molded height of 24 centimeters and a sided thickness of 17 centimeters. No fasteners were observed along its exposed portions during the 2000 investigations.

A small, thin timber attached to the forward face of the gripe appears to be the Phinney Site's cutwater. It would have functioned as the nosing that parted the water while the vessel was underway. Like the gripe, it was partially obscured by bottom sediment and could not be exposed and recorded in its entirety during the 2000 field season. From the point where it disappears into the riverbed, the cutwater extends for a straight-line length of 87 centimeters before terminating in a tapered end 75 centimeters below the eroded end of the gripe. The cutwater exhibits maximum molded and sided dimensions of 8 centimeters and 17 centimeters, respectively. It appears to have been intentionally tapered in sided dimension to facilitate water flow over the hull.

Rising Wood (Deadwood)

Two sections of rising wood were observed at the extreme fore and after ends of the vessel. Also referred to as central or keel deadwood, each section of rising wood is fayed to the top of the keel and notched on its upper-sided surface to accommodate one or more floor timbers. In addition to securing the keel and floors to one other, rising wood also would have provided the proper rising to framing components in the bow and stern (Steffy 1994: 278).

¹ A vessel's apron served primarily to reinforce the scarp of the stem components and facilitate the fastening of hull planks to the bow.

The rising wood in the bow is remarkably well preserved, but partially obscured by the forward section of the vessel's keelson. The exposed portion is 2.16 meters long, has a molded height of 12 centimeters, and a sided dimension of 26 centimeters. Two notches roughly equal in size indicate the locations for two floor timbers. The example closest to the stem is 29 centimeters wide, 5 centimeters deep, and still accommodates the charred remains of a partial floor with a sided dimension of 26 centimeters. The other notch is 21.5 centimeters wide and 6 centimeters deep. No fasteners were observed along the exposed portion of the bow deadwood.

The stern deadwood begins just forward of the aftermost preserved extremity of the keelson, and continues aft for a length of 5.26 meters (Figure 12). At its forward terminus, the timber exhibits a sided dimension of 40 centimeters that drastically narrows to 8.5 centimeters at its eroded stern end. In plan view it resembles a thin, elongated wedge with its point oriented slightly to port of the vessel's centerline. For the first 73 centimeters of its length, the stern deadwood has a molded height of 44 centimeters. From this point onwards, the molded dimension is 30 centimeters.

Three notches, each of which varies significantly in width and depth, indicate the locations where at least three floors were attached to the stern rising wood. The aftermost example is 40 centimeters wide and 5 centimeters deep. The second notch is located 21 centimeters forward of the first; it has a width of 63 centimeters, depth of 4 centimeters, and terminates at the beginning of the third notch. The third notch is narrower than the others (22 centimeters wide), but appreciably deeper (23 centimeters at its forward terminus). It retains a partial floor timber 17.5 centimeters sided and 22 centimeters molded. A pair of iron drift pins 2 centimeters in diameter protrude from the top of the floor, and fasten it to the rising wood. Similarly sized iron bolts are centrally located in the base of each of the other two notches and are uniformly spaced 10 centimeters apart.

A series of nine iron drift pins begins 32 centimeters abaft the last stern deadwood notch and continues aft for the remainder of the timber. All nine drift pins measure 2 centimeters in diameter and are spaced between 25 and 30 centimeters apart along the approximate centerline of the deadwood. The purpose of these fasteners remains unclear; however, their arrangement and frequency suggests that they may have been used to fasten additional deadwood or a stern knee to the rising wood. Conversely, they may have bolted a series of gradually narrowing and rising floors or half-floors to the vessel's centerline. Eight 3-centimeter diameter treenails are arranged transversely across the rising wood in two rows, slightly abaft the hood end of the vessel's

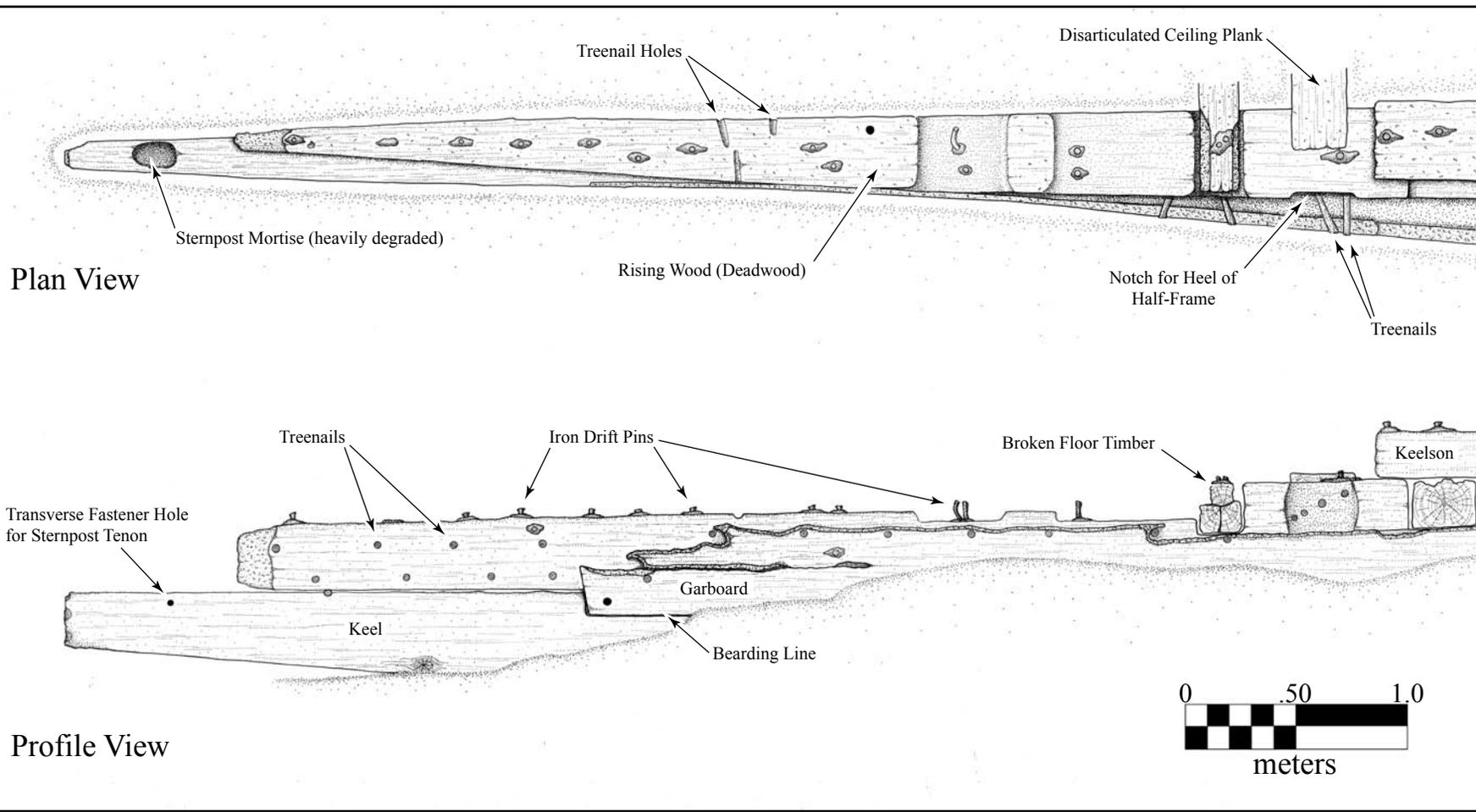


Figure 12. Plan and profile views of Phinney Site stern assembly *in situ*. Illustrations by James W. Hunter, III.

starboard garboard. These fasteners are flush-mounted, do not exhibit evidence of being wedged, and were likely used to fasten stealers between the garboard and the sternpost.²

Framing

Ship frames observed during the 1999 and 2000 investigations include floor timbers, first futtocks, second futtocks, and the remains of at least one third futtock and one half-frame. Although limited excavation made it impossible to determine the precise number and manner of construction of framing components within the Phinney Site's hull, preliminary examination of exposed elements revealed general information about their design and assembly. Overall, the site exhibits a framing pattern similar to the first of three eighteenth-century "middle style double frame types" outlined in a synthesized theory of framing evolution developed by Morris, *et al.* (1995: 125-133, see Figure 2.4). According to this theory, each frame in the flat run of the hull consists of a floor paired with an associated first futtock. Attached to these timbers is a series of subsequent rising futtocks fayed end to end. The earliest form(s) of "middle style" double frames are characterized by closely oriented frame components, increased space between frame sets, placement of first futtock heels close to the vessel's centerline, and an increase in the molded dimension of each frame component relative to its sided dimension (Morris, *et al.* 1995: 126-127).

With the exception of two floors, all of the wreck's exposed framing components are located on the starboard side, from the stem to a point just abaft the keelson's aft terminus. From the first square frame (F18) aft to the approximate midship section of the wreck, the frames appear to follow a consistent pattern of alternating floors and futtocks. Along the forward one-third of the collapsed starboard side, where frames were exposed in their entirety, each first futtock is positioned aft of its associated floor. Whether this pattern continues for the entire length of the vessel remains uncertain. Presumably, if the vessel's shipwrights followed standard eighteenth-century shipbuilding convention, frame placement would have reversed at the main or midship frame (the broadest frame in the hull) so that from midships to the stern, each first futtock was positioned forward of each floor (Morris 1991: 60; Morris, *et al.* 1995: 128-129 and Smith 1990: 114).

Twenty-four floors were exposed at the Phinney Site, nearly all of which are eroded along both their molded and sided surfaces. Average molded height for the assemblage is 20 centimeters, while the average sided thickness is 24 centimeters. They have an average center-to-center spacing of 56 centimeters. The starboard arms of all floors are broken off at or near the

² Stealers are short planks inserted between two strakes of hull planking so that the regular strakes do not have to be fashioned too wide. They are commonly used to fill out the bottom and side strakes at the bow and stern ends of a vessel.

base. The port arms of nearly all the floors are partially or completely buried by riverbed sediment. Consequently, the length of each of the vessel's exposed floors could not be determined. The longest single starboard arm exposed in its entirety is 1.92 meters. Contrary to what was a largely accepted eighteenth-century shipbuilding practice, none of the wreck's exposed floors are scored (notched) at their centerline for installation upon the keel or rising wood (Goodwin 1987: 14-18). Two triangular limber holes—apertures cut into the bottom surface of a frame to allow bilge water to flow to the pump well—were noted on each of two floors exposed during excavation of Grid T-1.

Based on the variety and position of fastener holes observed in the upper sided surfaces of each exposed framing component, a largely linear arrangement of numerous treenails and intermittent iron spikes was probably used to affix ceiling planking to the floors. Currently, the exact type, number, and pattern of fasteners used to assemble all of the vessel's exterior planks and floors together remains uncertain. However, portions of hull planking exposed during the 1999 and 2000 field seasons contained the remnants of treenails only, suggesting their exclusive use throughout the vessel.

The remainder of the vessel's exposed square frames consists of 20 first futtocks, four second futtocks, one third futtock, one half-frame, and 18 partially exposed frame segments that remain unidentified, but are likely second and third futtocks. Without exception, all futtocks and the half-frame were fastened to the vessel's hull planking with treenails, and to the ceiling with a linear arrangement of treenails and intermittent iron spikes. The dimensions of timbers in the first futtock assemblage are nearly identical to those of the vessel's floors, averaging 20 centimeters molded and 21 centimeters sided. Similarly, average center-to-center spacing for first futtocks (55 centimeters) is nearly equal to that for floors. Taken together, the uniform size and spacing of the frame components suggests that the vessel was well built, perhaps according to specific standards of ship construction.

Although located immediately adjacent to the wreck's centerline timbers, the collapsed starboard section has become dislodged and is no longer articulated with the remaining hull structure. Consequently, it is unclear whether any of the wreck's first futtocks originally butted against the keel, keelson, or rising wood. At least seven first futtocks exhibit beveled heels, suggesting that these timbers may have been offset from the centerline and connected to corresponding futtocks on the vessel's port side by cross chocks (Goodwin 1987: 16).³ Conversely, small wedge-shaped chocks called top fillets may have been affixed to the heel of each first futtock to facilitate the installation of the vessel's bilge ceiling. Top fillets were used

³ Cross chocks were installed transversely across the keel and essentially "tied" the heels of both first futtocks together. They were developed to prevent entry of bilge water into the spaces between a vessel's floors, and were used extensively in British shipbuilding from circa. 1710 until the first decade of the nineteenth century.

with some regularity in the construction of medium to large flat-floored eighteenth-century vessels (Krivor 1998: 127). Examples of these timbers are present in the hull remains of both *Betsey* and the Chub Heads Cut Wreck, an unidentified British-built merchantman wrecked in Bermuda (Krivor 1998: 19 and Morris 1991: 62). *El Nuevo Constante*, a British-built Spanish merchantman wrecked off the coast of Louisiana in 1766, also exhibits fillet pieces (Pearson and Hoffman 1995: 124). A wood sample taken from a first futtock (F66) near the stern of the wreck was identified as a member of the white oak group.

Four frames positively identified as second futtocks were exposed near the bow. None of these timbers is preserved in its entirety, and all have been heavily degraded along their molded and sided surfaces. Based on measurements taken from the best-preserved portions of each timber, the exposed assemblage of second futtocks has average molded and sided dimensions of 20 centimeters and 19 centimeters, respectively. Center-to-center spacing for this group of timbers averages 50 centimeters. The heels of two of the second futtocks (F27A and F29) are well preserved and appear to have been cut flat to butt against the wronghead (the head, or extremity) of each floor directly beneath them. According to Morris, *et al.* (1995: 8-9), the method of edge-joining a vessel's framing components with plain butt joints is a common attribute of mid-to-late eighteenth-century ship construction, and has been observed on a number of period shipwreck sites, including: the Rose Hill Wreck; Otter Creek Wreck; Reader's Point Sloop; Chub Heads Cut Wreck; and Deadman's Island Wreck (Cook and Rubenstein 1995: 103-104; Jackson 1992; Krivor 1998: 17-19; Smith 1990: 114 and Wilde-Ramsing, *et al.* 1992). Where exposed, second futtocks are butted against the forward face of adjacent first futtocks, but do not appear to have been joined to them with transverse fasteners.

The wreck's only positively identified third futtock is positioned slightly abaft F29. It has a sided thickness of 20 centimeters and a preserved length of 90 centimeters. Its molded height is unknown, as is its exact position relative to adjacent framing components. A timber (F69) tentatively identified as a half-frame is located at the aftermost exposed extremity of the collapsed starboard side. It has a preserved overall length of approximately 2 meters, exhibits respective molded and sided dimensions of 17 and 26 centimeters, and narrows in sided thickness from its beveled heel to its head. A notch cut into the starboard molded face of the stern rising wood is in direct line with the half-frame, and appears to have once accommodated its heel. The wreck's remaining square frames are likely second and third futtocks, although the precise identity and arrangement of these timbers is uncertain. Center-to-center spacing for the unidentified frames ranges between 20 and 90 centimeters, and averages 55 centimeters.

Cant Frames

The Phinney Site's bow is formed from an assemblage of radial cant frames, 16 of which were exposed and documented during investigation of the wreck's collapsed starboard side (Figure 13). As their name implies, cant frames are essentially a series of half-frames that are installed against the sides of a vessel's deadwood and arranged at gradually decreasing angles in the run forward or aft. Adopted by British shipwrights after 1715, cants were used to simplify the complex and difficult task of constructing the bow of full-bodied vessels. The construction technique was widely accepted and adapted by colonial shipbuilders over the course of the eighteenth century. By the 1770's, shipwrights modeled most cant frame arrangements on a "radial pattern" developed from earlier forms. Variations of the radial pattern were incorporated in vessels ranging from coastal trading sloops to large frigate-built warships and have been documented on a number of mid-to-late eighteenth century shipwrecks (Cook and Rubenstein 1995: 108; Goodwin 1987: 23; Morris 1991: 62-64; Morris, *et al.* 1995: 127-128; Steffy 1994: 178-180, 268 and Tidewater Atlantic Research [hereafter referred to as TAR]: 1996a and 1996b).

The Phinney Site's cant frame assemblage consists of a series of alternating half-frames and wedge-shaped filler frames. With the exception of the first three members (F1-F3), the entire assemblage is extant within the collapsed starboard section of the hull. The heels of the half-frames would have originally abutted the bow deadwood and apron, while those of the filler frames did not. The entire assemblage (both half-frames and filler frames) has an average molded height of 20 centimeters, and a sided thickness of 19 centimeters. Forward of F10, the sided dimension of each half-frame's heel is hewn to a point to facilitate its placement in the gradually narrowing confines of the bow. All of the vessel's fillers were constructed similarly to facilitate their installation in the limited spaces between the angled half-floors. Average center-to-center spacing along the preserved outboard extremity of the canted half-frames is 47 centimeters. At their heels, average center-to-center spacing for these timbers narrows to 16 centimeters. The longest preserved cant frame is 3.86 meters, the longest filler 1.54 meters. The cant frame assemblage exhibits a fastener pattern similar to that observed throughout the remainder of the wreck, indicating that a combination of wooden treenails and iron spikes were used to secure ceiling and frames together. However, considerably more iron spike holes are present in the bow frames than elsewhere, suggesting a greater need for these fasteners in areas where ceiling needed to conform to the pronounced curvature of the vessel's hull.

Keelson

The least deeply buried hull component at the Phinney Site is the keelson, which is remarkably well preserved despite being exposed to a variety of detrimental natural and man-made processes. It has a preserved length of 17.5 meters and consists of two components fayed

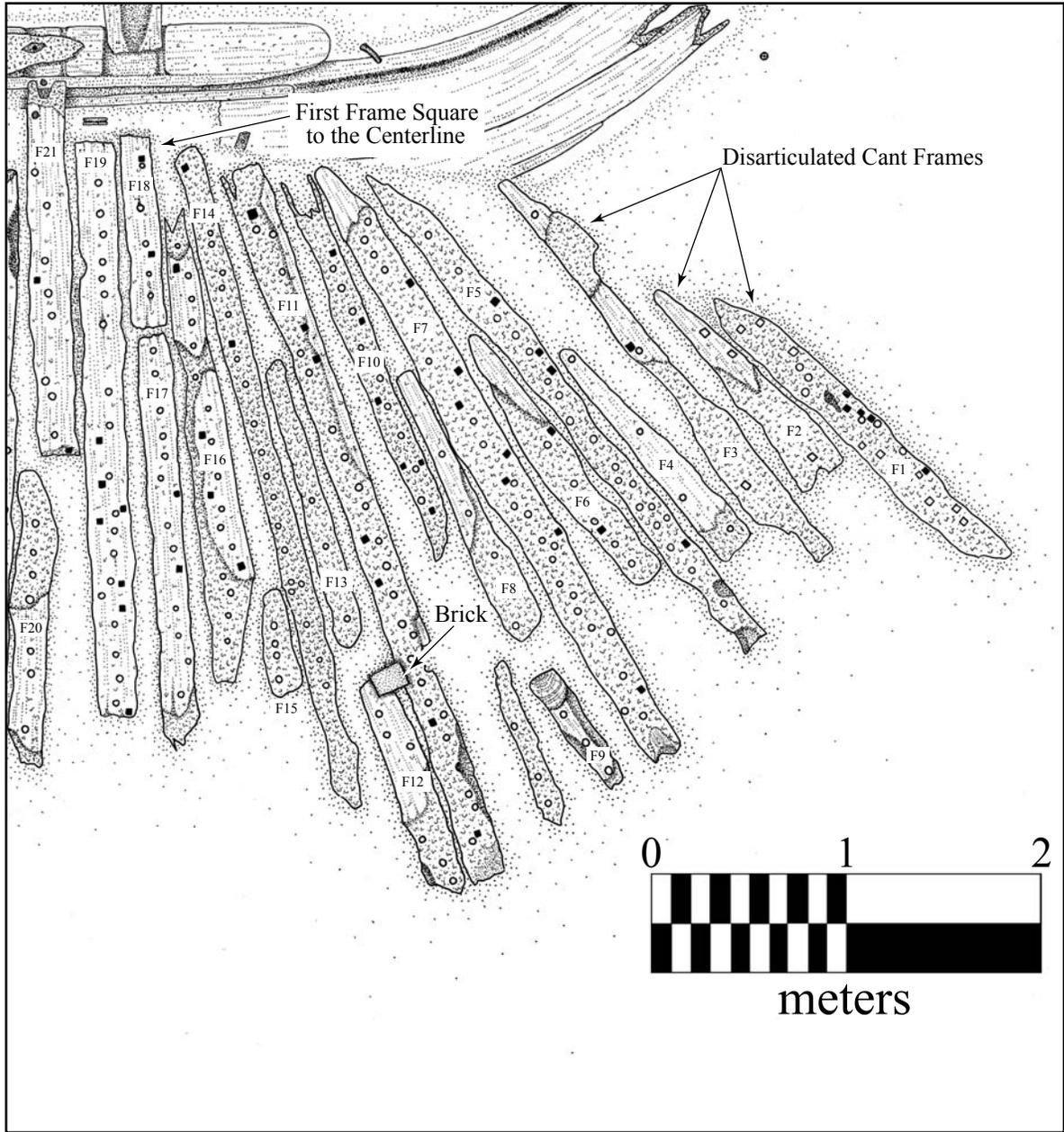


Figure 13. Phinney Site cant frame assembly *in situ*, showing cant frames, filler frames and first frame square to the centerline. Illustration by James W. Hunter, III.

together by a simple flat scarph set in the horizontal plane. The fore component begins 1.25 meters abaft the forward edge of the bow deadwood, approximately in line with the vessel's second square floor (F21). Its maximum molded and sided dimensions are 26 centimeters and 23 centimeters, respectively. It continues aft for a distance of 5.98 meters, where it is scarphed to the other keelson segment. The scarph is 80 centimeters long, 30 centimeters wide, and through-bolted with four iron pins, each 3.5 centimeters in diameter.

The after section of the keelson has a maximum molded height of 37 centimeters and maximum sided dimension of 26 centimeters. From the scarph, it continues aft for an additional 11.52 meters and terminates in a flat eroded end just atop the forward edge of the stern deadwood. Whether or not this point represents the original aft extremity of the keelson is unclear. Wood samples cut from each keelson component during the 1999 and 2000 field seasons have been identified as a species of white oak.

The keelson sits atop the vessel's frames and is through-bolted to the keel with 3.5-centimeter diameter iron drift pins at every other floor, locking the entire assembly together and contributing to the overall strength of the hull. The uniformity of the keelson's fastener pattern is disrupted in only a few places: the bolts connecting the keelson scarph; two bolts immediately adjacent to one another near the mainmast step; and two unusually long bolts protruding from an area believed to be the location of what was once a "saddle" mast step assembly for the vessel's foremast. The presence of through-bolts at every other floor to lock the keelson, frames, and keel together, is nearly identical to the fastener pattern present in the construction of *El Nuevo Constante* (Pearson and Hoffman 1995: 119). Goodwin (1987: 28) states that vessels constructed during the latter half of the eighteenth century usually incorporated a fastening pattern established by British shipwrights in which iron pins were bolted through the keel at every other floor. After 1800, this practice was rapidly superseded by the technique of through-bolting at every floor. Curiously, none of the Phinney Site's closest archaeological comparisons are fastened in this manner. Both *Betsey* and Chub Heads Cut shipwreck are through-fastened at every floor, while the *Defence* (a Massachusetts-built privateer scuttled during the Penobscot Expedition) is through-bolted only at each of its nine irregularly spaced mold frames (Ford and Switzer 1982: 108; Krivor 1998: 20; Morris 1991: 66 and Switzer 1998: 187).

Mainmast Step

Located approximately 12.2 meters abaft the foremost preserved extremity of the keel is the vessel's mainmast step. The mast step assembly is positioned aft of amidships and would have seated the tenoned heel of the mainmast. It consists of a simple mortise cut directly into the keelson, two mast chocks, and what appears to be an angled buttress or crutch (Figure 14). Similar mast step assemblies were discovered during the excavations of *Defence*, *Betsey*, the

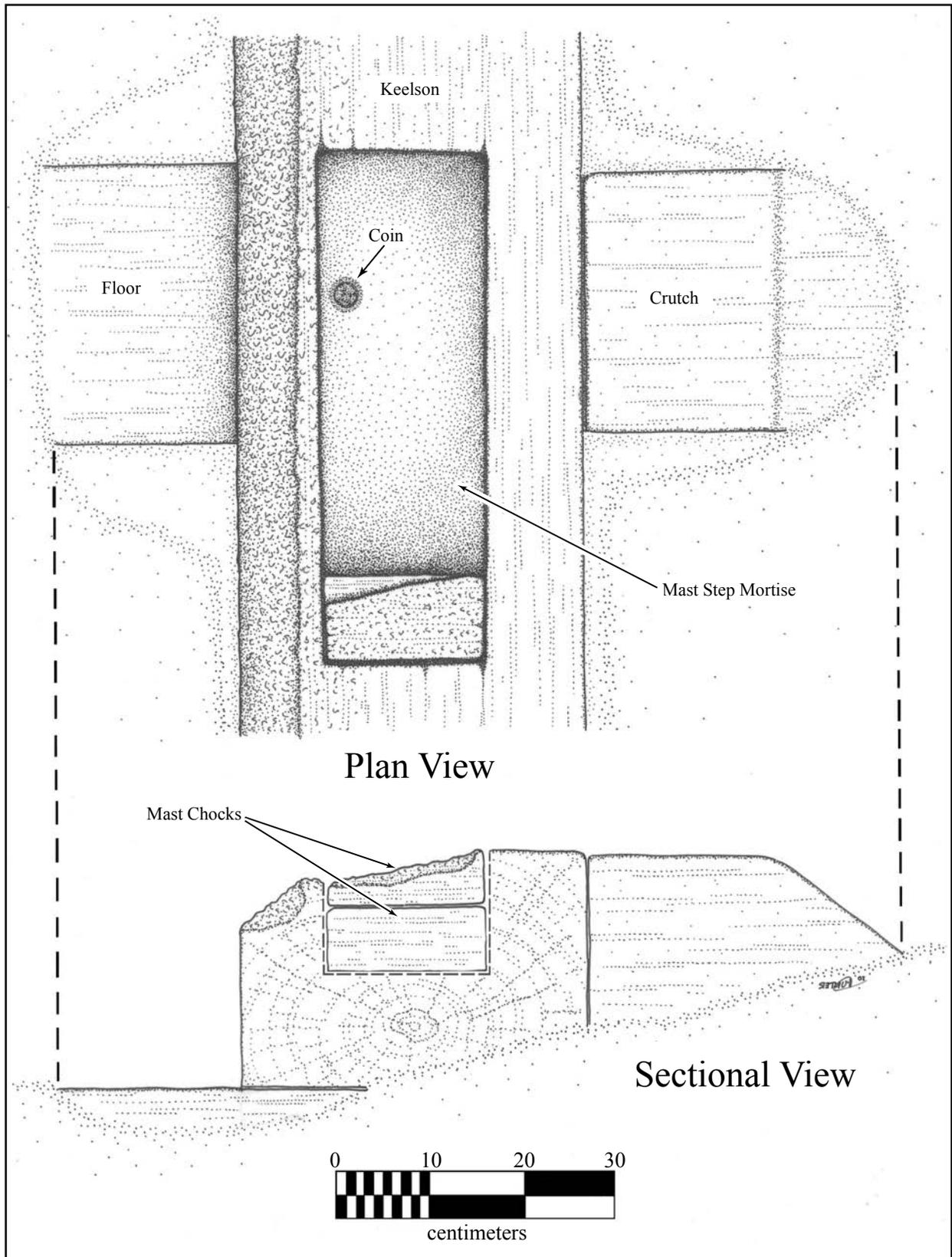


Figure 14. Plan and sectional views, Phinney Site mainmast step. Illustrations by James W. Hunter, III.

Reader's Point Vessel, and an eighteenth-century shipwreck (Vessel 2) from the Fig Island Channel Site near Savannah, Georgia (Cook 1997: 106; Morris 1991: 66-67, 106-107; Switzer 1998: 184-187 and TAR 1996a: 67). All of the aforementioned appear to be typical of small-to-medium sized vessels constructed during the mid-eighteenth century. The mortise is rectangular, has a length of 55 centimeters (including the space for the two chocks present in the forward edge of the step), a width of 18.5 centimeters, and a maximum preserved depth of 13.5 centimeters. Its depth is largely consistent and does not vary more than one-half of a centimeter between the fore and after ends.

The two chocks (PB1-080) located in the forward end of the mortise were discovered lying one atop the other (see sectional view, Figure 14). Both specimens were formed into rough, rectangular blocks and inserted athwartships across the base of the mortise to lock the heel of the mainmast into place. Prolonged exposure to the high-energy aquatic environment present at the site severely degraded the upper surface of the topmost example. It has a preserved thickness of 5.6 centimeters, a maximum preserved width of 8.7 centimeters, and a length of 17.3 centimeters. By contrast, the other chock has retained much of its original surface and appearance: it is 16.2 centimeters long, 9.2 centimeters wide, and 7.3 centimeters thick.

The crutch is located adjacent to the port after end of the mortise. It, along with a corresponding crutch (no longer present) on the starboard side of the keelson, would have acted as bracing timbers to prevent lateral movement of the mast step. From where it butts against the keelson, the crutch extends away from the centerline for a length of 20 centimeters before tapering down towards the upper-sided surface of a floor immediately beneath it (see sectional view, Figure 14). Although the crutch and floor appear to have been fayed together, their precise arrangement and manner of attachment was obscured by deep bottom sediment and remains an open question. The crutch has a maximum molded height of 25 centimeters and a fore and aft width of 28 centimeters. Because it was partially buried beneath a pile of concreted iron shot, its overall transverse length could not be determined during the 2000 field investigations.

A shallow depression located in the base of the mast step mortise contained a concreted silver coin oriented with its reverse side facing up. Conservation and analysis of the coin revealed that it is a milled Spanish 2-*Reales* piece produced in 1708 during the reign of Philip V. A detailed description of the coin is outlined in the Artifact Analysis section. The precise reason for the coin's presence in the mast step remains uncertain; however, the practice of placing one or more "good luck" coins in the mainmast step of a sailing vessel during its construction is a nautical tradition that can be traced historically and archaeologically to Roman times (Whyborn 2001). While the possibility exists that the coin was placed as a blessing or protective talisman, it is unlikely that it was used to symbolize the year the vessel was built—the radial cant frames, mast

step assembly, and a variety of other diagnostic artifacts (to be discussed in the following chapter) all indicate that the vessel was not constructed prior to 1740.

Hull Planking

The starboard garboard and sections of four runs of starboard hull—or exterior—planking were exposed and documented during the 1999 and 2000 field seasons. Each documented example is straight run planking that was attached to the vessel's framing components with 4-centimeter diameter treenails. Strake widths vary from 20 to 26 centimeters, but all recorded examples are consistently 3.5 centimeters thick. As expected, the garboard is appreciably larger than the other exterior planking. It has a width and thickness of 40 centimeters and 6 centimeters, respectively; but narrows in width to 15 centimeters at its forward hood end. The garboard likely diminishes at its stern hood end as well, but is too heavily eroded along its aft section to determine its exact width. With the exception of a single 2-centimeter bolt at its after end, the garboard appears to be fastened to the framing with 4-centimeter diameter treenails. A wood sample cut from the furthest preserved outboard hull plank was identified as a member of the white oak (*Quercus* sp.) group. By contrast, a sample removed from hull planking near the vessel's stern was identified as red oak (*Quercus rubra*). A sample recovered from the garboard was also identified as red oak. No sacrificial planking or metal sheathing was observed on the exterior surfaces of the exposed hull planks, but most of these surfaces were not visible for study.

Ceiling

Three strakes of ceiling—or interior—planking were partially uncovered along the collapsed starboard side of the wreck during the 1999 investigations. All three planks are articulated with one another, still appear to be fastened to the surrounding hull structure, and are located at the approximate turn of the vessel's bilge. The largest preserved section is 28 centimeters wide and exposed for a length of 60 centimeters from one buried end to the other. Butted against its inboard edge is a smaller strake with a width of 17 centimeters and an exposed length of 1.02 meters. The narrowest ceiling plank, located inboard of the other two examples, is 14 centimeters wide, and exposed for a length of 88 centimeters from its forward eroded end to where it disappears into riverbed sediments. The thickness of each strake of ceiling is unknown.

The only positive indication of how the ceiling was attached to the frames is represented by a single 1-centimeter diameter square iron fastener hole located at the forward outboard edge of the narrowest strake. However, based on the large number of treenail holes present in each of the wreck's exposed frames, ceiling planking was probably attached to framing elements with a combination of intermittent iron spikes and treenails. A similar means of attaching ceiling to frames was observed during excavation of the Chub Heads Cut vessel, *Betsey*, and the Terrence

Bay Wreck, an unidentified fishing schooner lost near Halifax, Nova Scotia in the mid-eighteenth century (Carter and Kenchington 1985: 15-17; Krivor 1998:21 and Morris 1991: 70). A wood sample recovered from the best-preserved ceiling plank was identified as *Quercus* (oak) wood. Unfortunately, the sample was too badly deteriorated to determine if it represented the red oak group or white oak group.

Discussion

Excavation and analysis of the Phinney Site's hull remains during the 1999 and 2000 field seasons revealed that the vessel exhibits characteristics similar to those of previously investigated mid-to-late eighteenth century shipwrecks. Although the exact rig and hull classification of the vessel remains speculative, it appears to have been twin-masted. This hypothesis is based on both the overall size of the wreck remains and the relative positions of the mainmast step and projected location of the foremast step. Overall, the exposed remains appear to most closely approximate a moderate-sized, American-built brig, brigantine, or schooner that was likely used as a small auxiliary warship.

The possibility also exists that the Phinney Site once functioned as a privateer, although its careful construction seems to indicate otherwise. American privateers constructed during the colonial era were relatively small and simple to design, build, and maintain (Chapelle 1952: 91 and Goldenberg 1976: 114). A shipwright's use of shortcuts in the design and assembly of a purpose-built privateer ensured that the vessel put to sea quickly to compensate for its potential loss. The privateer brig *Defence* is an excellent example of this type of vessel. Attributes of its architecture, including irregularly spaced mold frames and fastener patterns, roughly hewn floors and futtocks, and ill-fitting pump box and shot locker bulkheads, suggest frugality and haste in the brig's construction (Switzer 1998: 185-187).

By contrast, the Phinney Site's hull exhibits clear evidence of deliberate craftsmanship and, perhaps, considerable expense in its construction. The majority of the wreck's framing components appear to have been carefully fashioned and most retain relatively uniform molded and sided dimensions. Consistency is also evident in the spacing of the vessel's frames and the largely linear—and equally spaced—arrangement of treenails along each framing component. Distortion of the Phinney Site's exposed structural components prohibited NHC archaeologists from developing accurate hull lines, and extensive burial of the remainder of the site obscured the wreck's overall framing pattern. However, a few important details are apparent. For example, it appears that the vessel's builders incorporated the use of master frames and whole moulding during the construction process. Additionally, the framing pattern, where exposed, strongly suggests that the vessel was built according to British or British-influenced methods of hull design and construction. Specific attributes of the framing arrangement indicate that it is a mid-

to-late eighteenth century transitional variant between single frame and true double frame construction. Likewise, the wreck's cant frame assembly exhibits characteristics consistent with vessels built during the latter half of the 1700's.

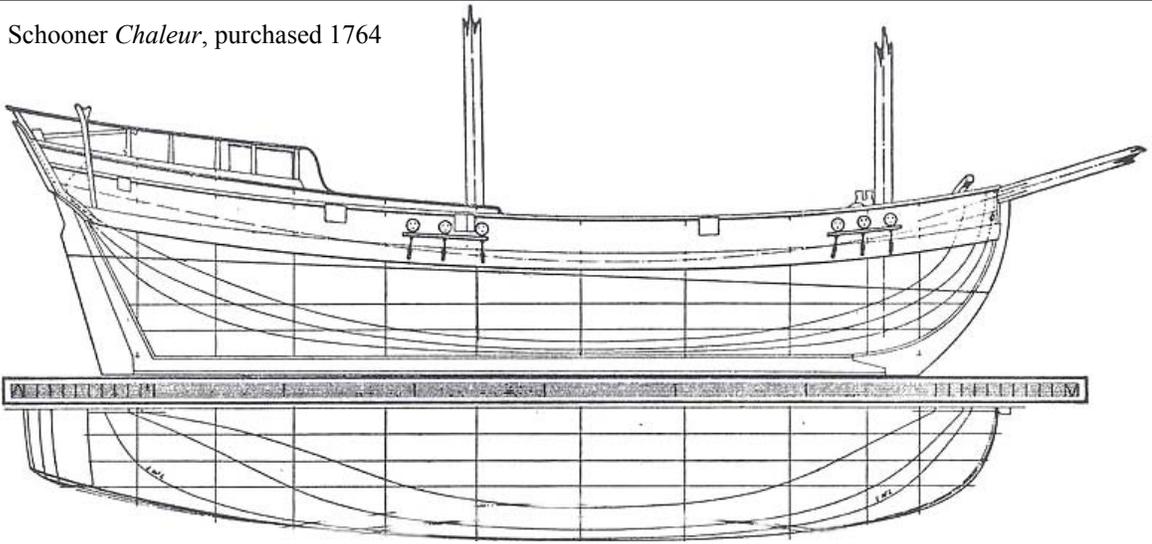
The hull remains indicate that the Phinney Site was once a bluff bowed, full-bodied, and relatively large twin-masted vessel. In many respects, it could have resembled any one of a number of American-built two-masted brigs and schooners purchased by the Royal Navy for coastal patrol and revenue enforcement in the decade prior to the outbreak of the American Revolution (Chapelle 1952: 90 and Gardiner 1996: 9-14). A small number of these vessels, including *Chaleur* (1764), *Sultana* (1768), and *Hallifax* (1768), are depicted in surviving ships draughts (Figure 15) and differ significantly from the small, sleek hull forms attributed to *Defence* and other American-built privateers by the archaeological and historical record (Chapelle 1935: 33-43, 130-140; Chapelle 1952: 97-119; Gardiner 1996: 10, 13-14 and Switzer 1998: 185-187).

Conclusions regarding the Phinney Site's overall tonnage are speculative, given the limited extent of excavation and hull recording conducted at the site. However, a rough approximation of displacement can be obtained by applying a combination of the wreck's known and estimated dimensions in an official formula used to compute tonnage for British merchant vessels constructed during the American Revolution. The formula utilizes two principal dimensions—the vessel's beam and length between perpendiculars. NHC archaeologists analyzed data derived from the Phinney Site's surviving hull to reconstruct the wreck's stem assembly (see Figure 11) and estimate both the vessel's beam (7.7 meters) and length between perpendiculars (26.5 meters). These dimensions were converted from metric to standard units and applied in the formula as follows:

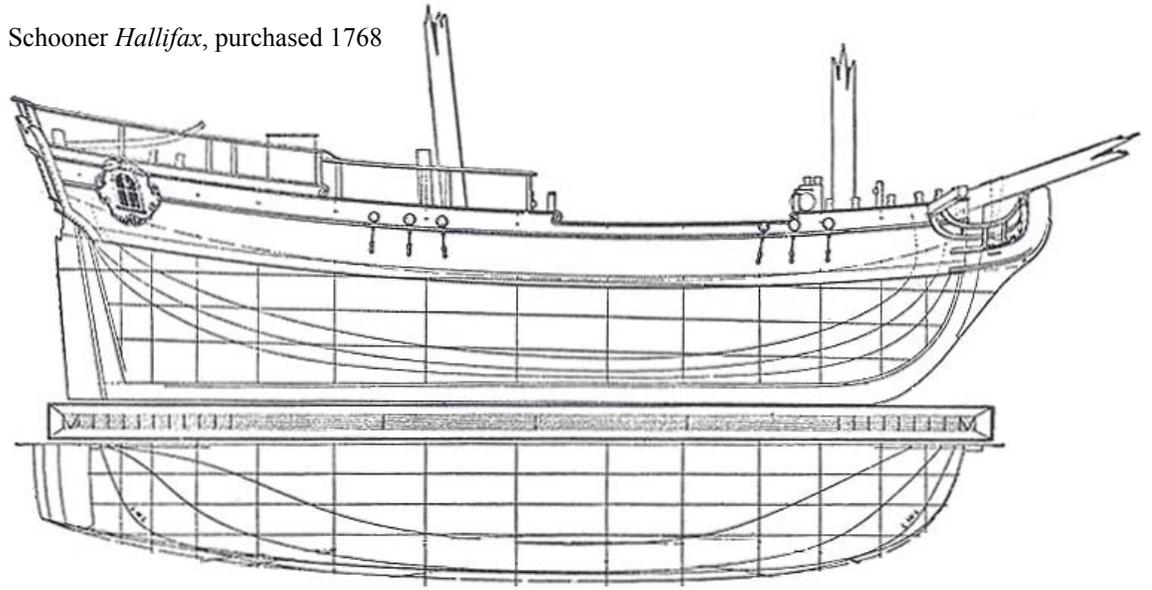
$$\begin{aligned} \text{Tonnage, burthen} &= \frac{(\text{Length Between Perpendiculars} - 3/5 \text{ Beam}) \times \text{Beam} \times \text{Beam}/2}{94} \\ &= \frac{[86.9 - 3/5 (25.3)] \times 25.3 \times (25.3/2)}{94} \\ &= 244.2 \text{ tons} \end{aligned}$$

This figure is an approximation and should not be considered a true representation of the vessel's tonnage. Given the lack of exact measurements for beam and length between perpendiculars, the tonnage estimate derived by the formula is, at best, a good median number for the Phinney Site's projected displacement range (between 200 and 300 tons, burthen). NHC archaeologists developed a working estimate of the displacement range by comparing data from the 2000

Schooner *Chaleur*, purchased 1764



Schooner *Hallifax*, purchased 1768



Schooner *Sultana*, purchased 1768

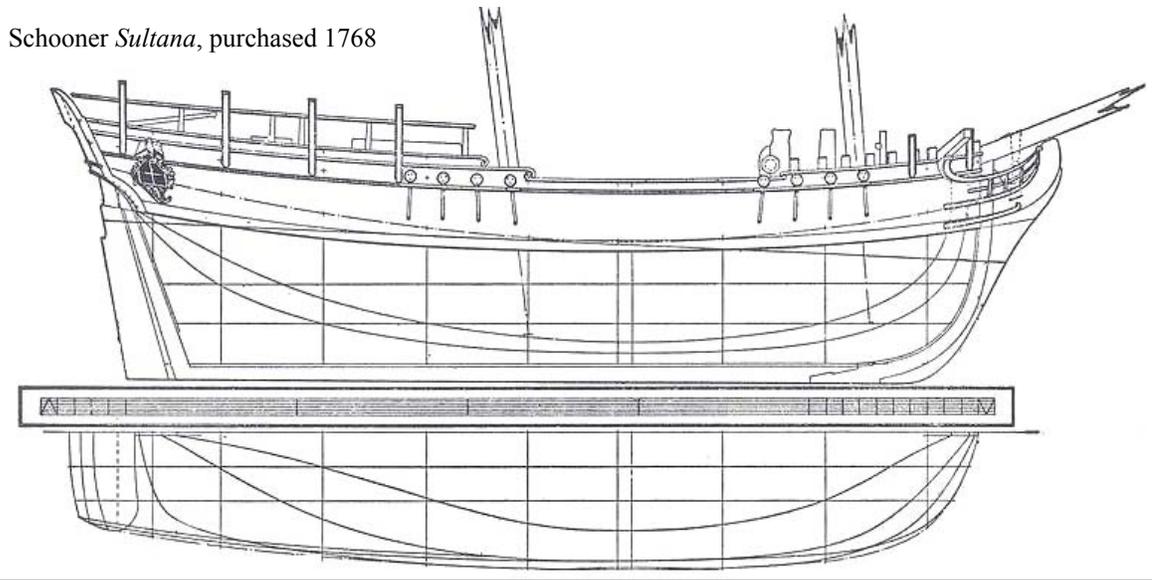


Figure 15. Three examples of American-built, twin-masted vessels purchased by the British Royal Navy in the years immediately prior to the American Revolution. Illustrations adapted from Howard I. Chapelle, *The History of American Sailing Ships*, Bonanza Books, New York (1935), pp. 35, 39, 42.

investigations with size and tonnage figures from a selection of eighteenth-century shipwrecks and historical sources.

Wood samples taken from a variety of hull members indicate that the vessel was constructed primarily of white and red oak that originated in what is now the United States. American white oak (*Quercus alba*) is a strong, durable straight-grained hardwood that is well suited for shipbuilding and was regularly used by shipwrights operating in colonial New England (Goldenberg 1976: 15 and Steffy 1994: 258). By contrast, red oak was less desirable as a shipbuilding wood because it lacks the strength, durability, and water resistance of white oak (Goldenberg 1976: 15). That the shipwright chose red oak for the Phinney Site's upper stempost, starboard garboard, and hull planking may hint that the vessel was originally intended for use as a merchantman, since naval craft were almost exclusively constructed of higher quality timber.

Conversely, red oak may have been used because it was cheaper and more readily available to the vessel's builders. Although not preferred as a shipbuilding wood, red oak was not unusual in colonial ship construction during the latter half of the eighteenth century. For example, at least three American-built shipwrecks dating to this period (the Devereaux Cove Wreck, Rose Hill Wreck, and Vessel 20 from the Fig Island Channel Site near Savannah, Georgia) feature a variety of hull components fashioned from red oak (Green 2002: 149-150; TAR 1996b: 55-56 and Wilde-Ramsing, *et al.* 1992: 56). The schooner *Chaleur* was built entirely of red oak in the American colonies in 1763 and purchased for use in the Royal Navy the following year. Interestingly, it was sold out of the Navy five years later in rotten condition (Carter and Kenchington 1985: 17 and Chapelle 1935: 37-40).

Artifact Analysis

More than 350 artifacts were recovered from the Phinney Site during the 2000 field season. These objects cover a wide variety of types and sizes, ranging from a delicate, beautifully preserved silver coin, to one surviving half of a heavily charred wooden block with sheave. Extremely large artifacts, including a disabled iron cannon and an iron cannon breech fragment, were documented *in situ* and reburied at the close of the 2000 investigations. With few exceptions, the wreck's artifact assemblage was recovered within—or immediately adjacent to—the surviving hull structure. Almost half of the entire artifact assemblage is comprised of ceramic sherds, the majority of which are intrusive specimens deposited on the site in the years following the vessel's loss. Development and disturbance along Brewer's waterfront during its heyday as a lumber entrepôt and shipbuilding center undoubtedly contributed to the deposition of nineteenth and twentieth-century debris in portions of the Penobscot River immediately adjacent to the Phinney Site. Over the course of the past 200 years, some of this material was introduced into the

wreck and combined with its Revolutionary War-era artifacts and cultural features. Because the site's cultural and temporal affiliation was not yet positively established at the beginning of the 2000 field season, all historic material encountered during excavation was collected. Once the wreck was positively identified as a Revolutionary War-era vessel, artifact analysis focused primarily on sorting and classifying eighteenth-century cultural material.

Fasteners

Fasteners of varying types were recovered from the Phinney Site during the 2000 field season. These include five hand-wrought iron spikes and nails of various sizes, one wrought-iron bolt, two copper-alloy tacks, one copper-alloy spike, and three wooden treenail fragments. With the exception of two fragmentary iron nails and the iron bolt, all fasteners recovered during the 2000 investigations are largely intact. Each intact specimen was measured from the top of the head to the base of the tip, while the overall preserved length was recorded for all fragmentary examples. The shank was measured for its dimension at the base of the head. The maximum width of each fastener head was also measured.

Two primary types of ship's fasteners were in use during the Revolutionary War era: those with round shanks (bolts) and those with square shanks (nails or spikes). Colonial shipwrights generally subdivided the latter group according to size and function. However, the relatively small size of the sample available for analysis necessitated that all but the smallest square-shanked fasteners recovered from the Phinney Site be classified under the general category "spikes" rather than differentiated according to their contemporary eighteenth century nomenclature. The only exceptions are two small tacks described in the following paragraph.

By far the best-preserved fasteners in the assemblage are those made of copper-alloy metal (Figure 16). The largest of these artifacts (PB1-022) was recovered during excavation of sediment immediately to port of the wreck's keelson. It has an overall length of 10.6 centimeters, a maximum shank width of 8 millimeters, and a partially flattened head with a width of 1.4 x 1.2 centimeters. A brass tack (PB1-060) was recovered from the wreck in the same general location as artifact PB1-022. It has an overall length of 1.7 centimeters and a maximum shank width of 1 millimeter; its dome-shaped head measures 1 centimeter in diameter. The second tack (PB1-098) was recovered during excavation of Grid T-1 and is the smallest fastener in the assemblage. Unlike PB1-060, it appears to have been manufactured from copper or bronze. It measures 1.5 centimeters in length and has a maximum shank width of 2 millimeters. The maximum diameter of its flattened head is 6 millimeters.

Although copper-alloy spikes were not used in colonial shipbuilding with as much frequency as those produced from iron, the presence of one on the wreck is not surprising. During the

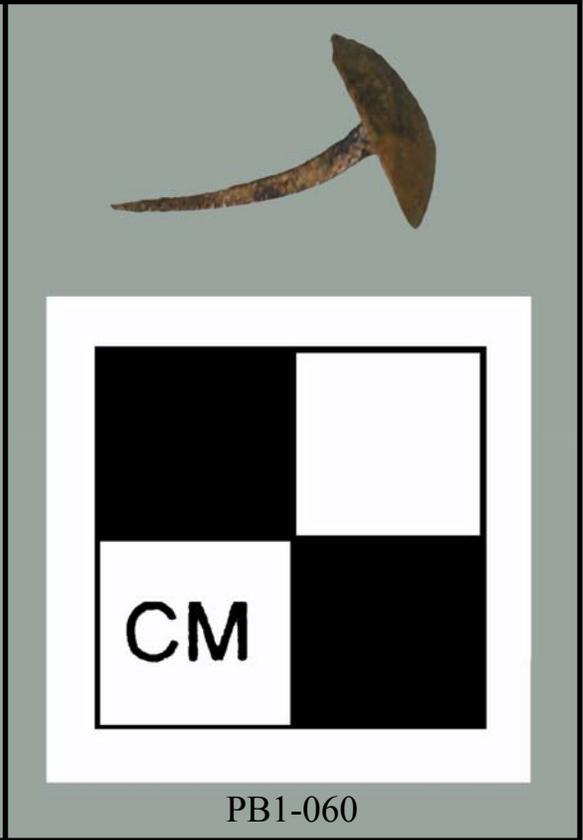
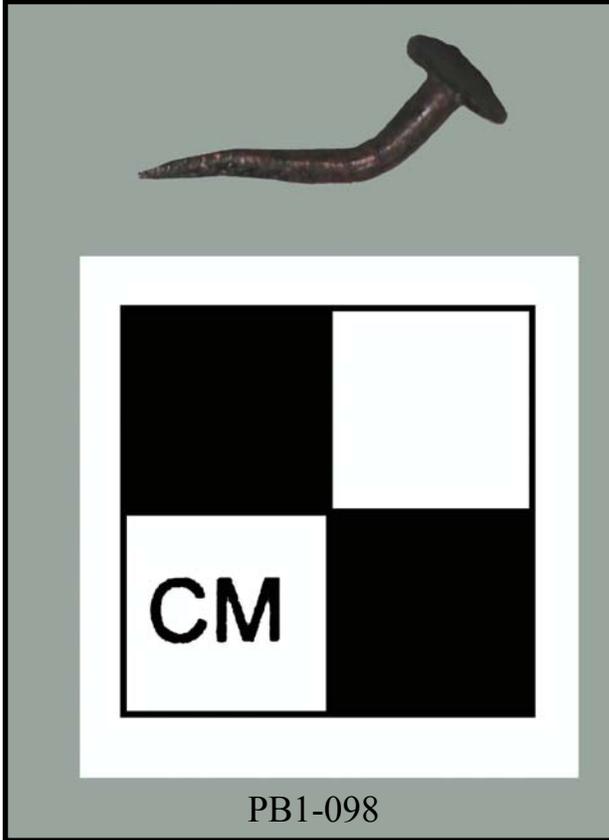


Figure 16. Copper fasteners recovered from the Phinney Site: *top*; spike, *left*; utility tack, *right*; dome-headed furniture tack. Photographs by James W. Hunter, III.

period 1650-1750, the British Royal Navy employed the use of copper and bronze spikes and bolts in the construction of hull components beneath the waterline (Goodwin 1987: 60-62). Additionally, copper and copper-alloy fasteners were used in interior portions of warships—such as powder magazines and filling rooms—where reduction or prevention of sparks was a necessity (Lavery 1987: 150). Both copper-alloy tacks may also have been employed in this manner, although their relatively small size is more characteristic of upholstery tacks used to ornament and anchor leather and/or fabric to eighteenth-century furniture. One specimen in particular (PB1-060) exhibits many of the characteristics described by Noël Hume (1969: 227-228) for decorative brass upholstery tacks manufactured during the seventeenth and eighteenth centuries. These attributes include a “circular or lozenge-shaped, concavo-convex [head]...with a welded brass shank” (Noël Hume 1969: 227).

The remaining square-shanked fasteners in the assemblage are iron. Because these items have not yet been completely conserved, most retain a dense exterior concretion of iron oxide. Consequently, the following measurements are larger than the original dimensions of each artifact. The smallest complete iron spike (PB1-147) has a maximum length of 11.8 centimeters and shank and head widths of 5 millimeters and 1.1 centimeters, respectively. The largest specimen (PB1-217) is 23.4 centimeters long, has a shank width of 1.8 centimeters, and a head diameter of 2.1 centimeters. One other intact iron spike (PB1-206A) and two fragmentary examples (PB1-206B and PB1-146) complete the assemblage. According to Goodwin (1987: 61), iron spikes of the size recovered from the Phinney Site were typically used to secure deck planks, but may also have been employed to fasten ceiling and a variety of other components.

The lower half of a wrought-iron forelock bolt (PB1-225) was recovered immediately adjacent to the keelson in the stern section of the wreck. It has a preserved length of 23.4 centimeters and a maximum shaft diameter of 2.3 centimeters. The tip of the bolt fragment still retains an iron forelock key or “gib” with an overall length of 5.5 centimeters, and a maximum width and thickness of 1.9 centimeters and 1.1 centimeters, respectively. Essentially round-sectioned rods of varying lengths and diameters, bolts served as the main structural fasteners on colonial-era sailing vessels. They were used to bind together the keel, keelson, major framing components, deadwood, and stem and sternpost assemblies. Unlike spikes, which were hammered directly into a timber, bolts were driven into pre-drilled holes and secured in place with gibs or clench rings (Goodwin 1987: 60-61 and McCarthy 1996: 191).

A forelock bolt is similar to a regular bolt, but is characterized by a slot at the end of its shank. The slot is cut transversely through the shank’s axis and is tapered from one side to the other to accommodate a corresponding iron wedge (gib). The bolt was passed through the timbers it was meant to secure, and a rove (washer) was fitted over its end. The gib was then driven into the slot until the rove was tightened hard up against the timber. If a forelock grew

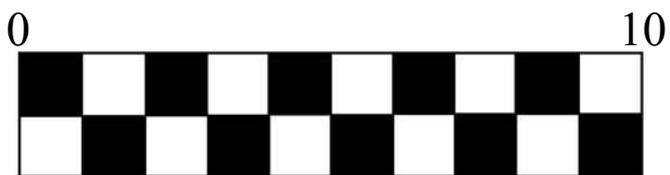
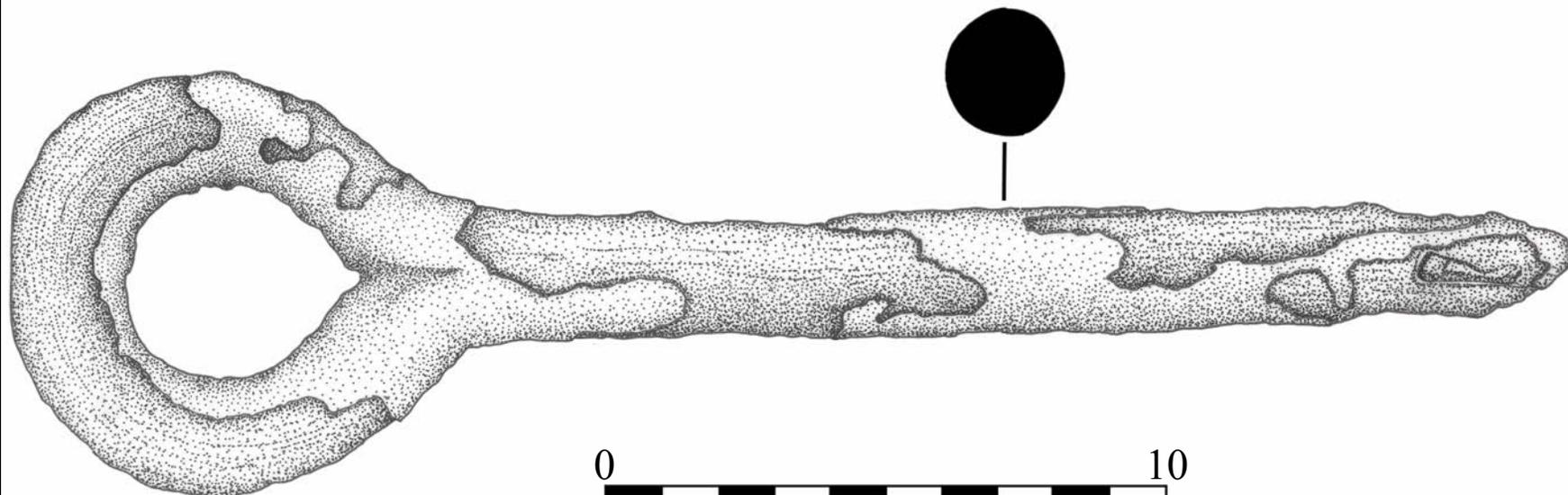
slack from the working of the ship, driving the gib further into the slot could easily rectify the problem (Dodds and Moore 1984: 48; Goodwin 1987: 61 and McCarthy 1996: 191).

Ship's Hardware and Fittings

A concreted wrought iron eyebolt (PB1-081) was recovered from Grid T-1 during the 2000 field investigations (Figure 17). Eyebolts—essentially bolts with a circular opening at one end—were driven into a vessel's hull at various locations and served as securing points for lines and various tackle hooks (Dodds and Moore 1984: 48; Pearson and Hoffman 1995: 136-137 and Steffy 1994: 271). Eyebolts were also frequently used in conjunction with iron carriage rings and installed on shipboard gun carriages to help maneuver or secure them on a vessel's deck. An excellent example of the aforementioned was recovered from the Continental gondola *Philadelphia* in 1935 (Bratten 2002: 117). The eyebolt recovered from the Phinney Site is round in cross-section, has a maximum preserved length of 28.2 centimeters, a shaft diameter of 2.4 centimeters, and an eye that measures 7.7 centimeters across. Its provenience, located among a large cluster of shot in Grid T-1, suggests that it may have been used in association with a gun carriage or gun station tackle. Conversely, it may have been installed in the upper works of the vessel and deposited in the hull during its destruction.

Excavation of Grid T-1 and an area amidships immediately surrounding the iron cannon (discussed below) resulted in the discovery of two small fragments of drawn copper-alloy sheet. The largest example (PB1-059) is roughly triangular in shape, has a preserved length of 7.5 centimeters, preserved width of 5.7 centimeters, and is less than 1 millimeter thick. One end of the fragment is rolled up; another is jagged, uneven, and appears to have been violently torn or broken. The remaining side is relatively straight and may represent the original edge of the sheet. The artifact is perforated by a small circular hole approximately 0.7 centimeters in diameter. The other copper-alloy sheet fragment (PB1-102) was discovered concreted to an example of iron shot (PB1-120) within Grid T-1. It is less than 1 millimeter thick and has a preserved length and width of 3.4 centimeters and 2.9 centimeters, respectively.

The origin and purpose of both copper-alloy fragments remains speculative. They may represent fragments of larger sheets of copper sheathing that were once attached to the outside of the vessel's hull planking. During the colonial era, wooden sailing vessels plying tropical and subtropical waters were subject to predations of the shipworm (*Teredo navalis*), which could quickly devour planking below the waterline and render a ship unseaworthy. To combat this problem, shipbuilders devised several methods of sheathing a vessel's exposed hull planks. Among the more permanent measures was the placement of thin copper or copper-alloy sheets along the exterior surface of vulnerable hull sections. In 1761, the British Royal Navy initiated the first complete coppering of a vessel's bottom on the 32-gun frigate *Alarm*. In terms of



centimeters

Figure 17. Wrought-iron eyebolt (PB1-081) recovered from Grid T-1. Illustration by James W. Hunter, III.

preserving *Alarm*'s hull from worm damage, the experiment was largely successful, but unforeseen—and undesirable—galvanic reduction of the vessel's iron fasteners occurred at areas below the waterline where copper and iron came into direct contact with one another. Consequently, the Royal Navy shelved the program until the late 1770's. By 1778, the positive effects exhibited by coppered vessels prompted several Royal Navy captains to petition the Board of Admiralty for the general application of copper sheathing throughout the fleet. In May of the following year, the Board of Admiralty ordered that all ships of 32 guns and less be coppered. Four years later, in 1783, the order was extended to all Royal Navy vessels (Goodwin 1987: 226-227 and Lavery 1987: 62-63).

Exterior hull protection was not the only function that copper sheathing served. During the latter half of the eighteenth century, the Royal Navy ordered the installation of thin sheets of copper in the powder magazines and filling rooms of all classes of warships. The copper was intended not only to prevent sparks from being produced by any iron present (such as nails on shoes, belts, or other clothing accessories), but also to keep rats in the hold from entering the magazine and eating the powder cartridges (Goodwin 1987: 122 and Lavery 1987: 150). Both copper-alloy fragments recovered from the Phinney Site were found in direct association with piles of munitions thought to be the remnants of two of the vessel's shot lockers (discussed in the following section). On most eighteenth-century warships, the powder magazines, filling rooms and shot lockers were positioned in close proximity to one another to facilitate simultaneous transport of cartridges and ammunition to gun stations during battle. Smaller armed vessels (excluding sloops and gunboats) were usually fitted with a main magazine in the forward part of the hold, where the shallow rise of the floors provided sufficient space to accommodate it. If needed, a second smaller magazine was located either amidships or in the after portion of the lower hull (Goodwin 1987: 121-123 and Lavery 1987: 144-145). Although speculative, the possibility exists that both sheathing fragments recovered from the Phinney Site originated from the vessel's magazines or filling rooms and were later deposited among the remains of the shot lockers as the hull deteriorated and collapsed.

Mast Step Coin

A concreted silver coin (PB1-150) was recovered from the base of the Phinney Site's mainmast step during the 2000 field investigations (Figure 18). According to Richard Doty (personal communication) it is a 2-*Reale* piece produced at the Royal Mint Mill in Segovia, Spain during the reign of Philip V (1700-1724). It has a maximum diameter of 2.8 centimeters, maximum thickness of 2 millimeters, and weighs 4.5 grams. The coin is ornately decorated and exhibits a variety of numismatic markings. Along the periphery of the obverse (front) face is a legend showing the year the coin was produced and the phrase **DEXTERA*D*EXALTAVIT*ME**

(The Right Hand of God Hath Exalted Me). The asterisks represent decorative “rosettes” or circles located on the coin between the legend’s words and letters. At the center of the obverse face is a royal crown above a stylized Roman numeral five (symbolizing Philip V). The coin’s reverse (back) face is embossed with the legend *PHILIP.V.D.G HISPANIAR*REX* (Philip V, King of Spain by the Grace of God). The crowned arms of Castile and León (the royal crest of Spain) are centrally displayed. A shield containing three fleur-de-lis (representing Philip V’s association with France and the House of Bourbon-Anjou) is located at the center of the crowned arms. To the right of the crest are two columns representing the Pillars of Hercules. A large capital letter “Y” is located immediately beneath the columns. The capital letter “R” and a stylized twin-arched aqueduct—Segovia’s mintmark—are displayed to the left of the crowned arms of Castile and Leon. The “R” and “Y” designations have not yet been positively identified but probably represent one or more assayer’s marks.

The coin is the result of a method of production called roller-mill (or roller-struck) coining. It involved a mechanical coining apparatus devised by the inventor Leonardo daVinci during the fifteenth century. The coin-rolling machine, coupled to a waterwheel (or a team of horses), pressed the coin design onto a strip of metal that passed between two roller dies. Coin-rolling mills allowed for production of currency with a much larger diameter by applying mechanical force to a narrow band of the coin’s surface as the strip moved between the dies. The method of producing roller-struck currency spread in usage during the mid-sixteenth century to various mints in Central Europe controlled by the Hapsburg family, whose dominions included Spain. The coinage produced by coin-rolling mills exhibited such uniform edges that illicit coin clippers (people who clipped small amounts of gold and silver from coins and later returned them to circulation individually at their face value) could not help themselves to bits of precious metal, as they had been able to do with coins produced by other less-refined methods (Friends of the Segovia Mint 2001).

The 2-*Reale* coin, also known in the English colonies as a “pistareen,” enjoyed wide circulation in the English colonies of North America prior to, during, and after the American Revolution. In fact, it is estimated that half of the coins in colonial America were various denominations of Spanish *Reales*. They were used not only as coinage but also treated as a commodity, much like silver or gold bars. Interestingly, the first coinage authorized by an English Royal patent for the colonies, the American Plantations token (minted at the Tower of London), stated its value as 1/24th of a Spanish *Reale* rather than an equivalent amount in English currency. While most of the coins used in the English colonies were minted in the New World, some Spanish coins minted in Spain circulated as well. The coins minted in Spain were referred to as “new plate” since they were 20 percent lighter than Spanish colonial coins. The 2-*Reale* pistareen was one of these coins (Jordan 2001).

Artillery and Munitions

During the colonial era, vessels of all sizes, types, and nationalities, whether actively engaged as merchantmen or warships, were typically armed with an assortment of artillery and small arms. Such armament was necessary if a ship was to be adequately defended against rival naval powers, pirates and privateers. During investigation of the Phinney Site in 1999 and 2000, one complete iron cannon, a fragment of another, and a large assemblage of artillery and small arms munitions was discovered in the bow and midship areas, attesting that the vessel was heavily armed during its sailing career.

The cannon was discovered on the port side of the wreck, lying parallel to the keelson and immediately forward of the mainmast step assembly. It has a preserved length of 1.78 meters and maximum muzzle and breech diameters of 19 centimeters and 40 centimeters, respectively. Inspection of the gun's exposed surfaces revealed that most of the casting and construction details, including all of the reinforce rings, astragals, fillets, and sight patches, are obscured by thick concretion. However, the faint outlines of the base ring, vent field and vent (or touchhole) are readily apparent. One complete trunnion 10 centimeters in diameter protrudes from the right side of the gun tube; the other trunnion and part of the cascabel are missing and appear to have been forcefully removed, possibly as an intentional effort to permanently disable the cannon.⁴ Diagnostic markings such as a weight stamp, royal cipher, foundry mark, or date of manufacture could not be discerned on the gun during *in situ* inspection.

When first recorded in 1999, approximately 1.38 meters of the cannon's upper surface was exposed above the riverbed. The gun was oriented with its breech inclined slightly upwards and muzzle completely buried beneath a layer of compact silt and sediment. During the 2000 field season, NHC archaeologists excavated around the muzzle and discovered that it was concreted to the underside of a disarticulated breech fragment from another iron cannon (discussed below). The breech fragment completely obscured the muzzle and prevented NHC staff from obtaining an accurate bore diameter for the gun. However, an estimate of this critical measurement can be inferred from the diameter of the cascabel neck, which usually "was equal to the bore in diameter" on most cannons produced during the eighteenth century (Lavery 1987: 103). If the gun's bore diameter is identical to its cascabel neck diameter (8 centimeters), it most closely approximates the standard caliber of 4-pounders cast during the mid-eighteenth century. The overall length of the barrel, which is nearly identical to the median size specified for 4-pounders by British Establishment of 1743 and 1764 British Board of Ordnance requirements, further substantiates this hypothesis (Lavery 1987: 103; Muller 1780: 6, 56; Peterson 1969:42 and

⁴ The practice of disabling cannons by knocking off the trunnions or cascabel with a sledgehammer was common during the colonial era and was usually undertaken by retreating forces to render abandoned artillery useless to an enemy (Peterson 1969: 68).

Wilkinson-Latham 1973: 86). Although the gun once probably comprised part of the vessel's working complement of artillery, its provenience and disabled state indicate that it may have been stowed in the hold as ballast when the wreck occurred. Conversely, the gun could have been disabled on deck and gradually settled to the bottom of the hull as the wreck deteriorated.

The disarticulated breech fragment was located immediately forward of the iron cannon. Like the cannon, it was probably placed in the hold as ballast. Its aftermost extremity is cemented to the upper surface of the cannon's muzzle by a thick deposit of iron corrosion product and mineralized concretion. The breech section has a maximum preserved length and width of 40.6 centimeters and 27.9 centimeters, respectively. With the exception of a portion of the base ring, no specific casting and construction attributes (i.e., breech moldings, touchhole or vent field) or diagnostic markings were evident during *in situ* inspection of the artifact. It clearly represents a portion of the bottom or side of an iron cannon's first reinforce, and appears to have broken away violently from the rest of the weapon. Because of its relatively small size, lack of diagnostic markings and heavily corroded surface, it is impossible at present to determine the type of cannon from which the fragment originated.

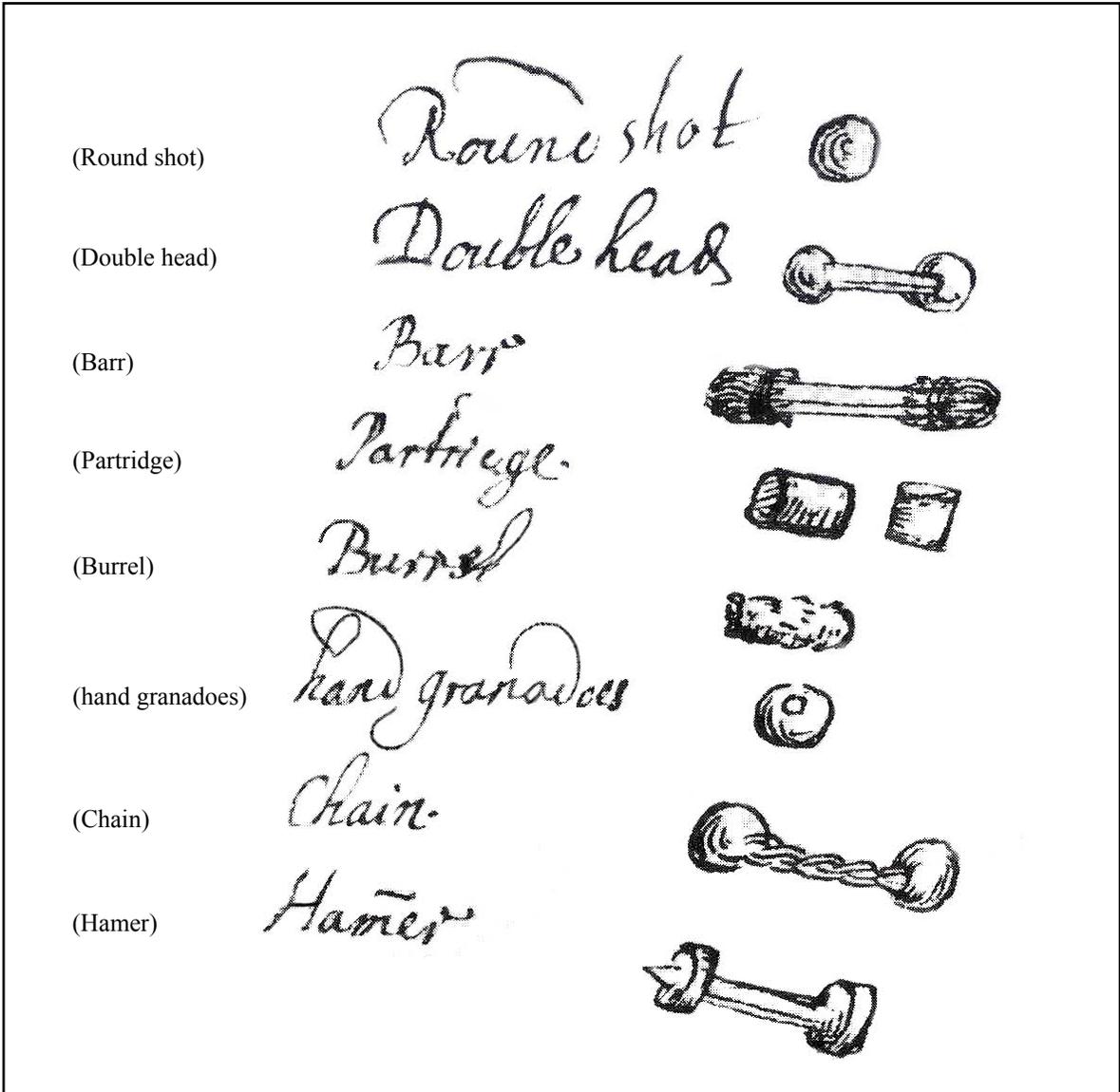
A total of 31 cast iron round shot of various sizes was recovered from the Phinney Site during the 2000 field season. The majority of the assemblage originated from two distinct shot conglomerates discovered during excavation of Grid T-1 and the area immediately surrounding the disabled iron cannon. Based on their size, content, and relative positions within the hull remains, the aforementioned conglomerates may represent the remains of two of the vessel's shot lockers. During the eighteenth century, shot lockers on most armed vessels were fitted in the area immediately adjacent to the mainmast step and bilge pump well. This was done to help keep the great weight of the shot low in the hold and ensure that the vessel maintained a low center of gravity. The locker was comprised of a simple rectangular box divided vertically into several sections and topped by an angled and hinged lid. Usually two lockers were fitted amidships—one forward and one aft of the pump well. By the mid-eighteenth century, however, it was common practice for warships to have a third locker installed just aft of the main magazine (Goodwin 1987: 126 and Lavery 1987: 150).

The Phinney Site's round shot assemblage is comprised of specimens ranging from 2.5 centimeters to 12 centimeters in diameter. Of these, the largest percentage range between 8 and 9 centimeters in diameter, and would most likely have been used as ammunition for 4-pounder cannons, based on 1764 British Board of Ordnance size specifications for iron shot (Peterson 1969: 42). The remainder of the assemblage includes projectiles for ordnance ranging in size from ½-pounder swivel guns to 18-pounder siege weapons (Cloves 1898: 11; Mountaine 1747: 103; Muller 1780: 6,56; Petersen 1965: 79-80, 83; Peterson 1969: 41-42 and Wilkinson-Latham 1973: 28-32). At least one example (PB1-124) is incised with the British Broad Arrow, a mark of

ownership placed upon British ordnance and government stores that resembles a crude arrowhead. The smallest examples (2.5 to 3.5 centimeters in diameter) best correspond to sizes specified in British artillery treatises for rounds of grape, case, or canister shot (Cloves 1898: 11; Mountaine 1781: 72; Petersen 1965: 83-83; Peterson 1969: 42 and Wilkinson-Latham 1973: 28-32). Grape shot consists of a group of iron balls packed around a central stool (a small wooden disc with a vertical wooden peg at its center) and held in place with a canvas cover and lashings. By contrast, canister and case shot incorporate the use of a sheet metal cylinder filled with numerous small lead or iron shot (Figure 19). Grape, canister, and case ammunition were intended to break apart and scatter when fired, clearing enemy vessels of sails, rigging, and personnel. In addition to the aforementioned, the smaller varieties of shot may also have been used as single projectiles for a small caliber swivel gun (Carauna 1997: 222-228; Ford and Switzer 1982: 54-55; Lavery 1987: 136-137; Peterson 1969: 27 and Wilkinson-Latham 1973: 29-32).

A single example of iron bar shot (PB1-221) was discovered lying on the riverbed 11.6 meters downstream from the Phinney Site's 2000 bow datum (Figure 20). Bar shot, also known as "double-headed shot" during the seventeenth and eighteenth centuries, are essentially dumbbell-shaped and designed to spin and tumble end over end when fired (see Figure 19). The type appeared in the late sixteenth century and was used primarily to destroy ship's rigging and cut wide swaths through ranks of men (Lavery 1987: 136-137 and Peterson 1969: 26-27). The most common examples recovered from Revolutionary War contexts consist of a wrought-iron bar with semi-hemispherical cast iron heads on either end (Cohn 2002: 86). For example, both *Philadelphia* and *Defence* were armed with bar shot matching this description (Bratten 2002: 120-121 and Switzer 1998: 191). The bar shot recovered near the Phinney Site exhibits a maximum preserved length of 33 centimeters. The central bar is hand-wrought, square-sectioned, measures 23 centimeters in overall length and is 2 centimeters thick. Each semi-hemispherical cast-iron head has a maximum diameter of 9 centimeters and is 5 centimeters thick. Based on its size, the bar shot would have most likely been used as ammunition for a 6-pounder cannon.

In addition to munitions for large weapons, two examples of lead shot (PB1-230) for small arms were recovered during excavation along the wreck's centerline. Both examples of shot are roughly spherical in shape and conform closely to the size of standard munitions (.75 caliber) used with the British Short Land Service Musket or "Brown Bess model 2" during the Revolutionary War period (Bratten 2002: 123; Broadwater 1995: P-3 and Petersen 1968: 31-33). The Brown Bess model 2 entered service with the British Army around 1740, and was used extensively by both British and American forces during the Revolution. One musket ball has a maximum diameter of 1.52 centimeters, while the other measures 1.70 centimeters (approximately 0.674 inches). Neither example exhibits clear attributes of manufacture such as a mold seam and sprue, but both are flattened on one side, indicating that they probably impacted



(Chain Shot)



(Canister Shot)



(Bar Shot)



(Grape Shot)

Figure 19. Contemporary illustrations from late-seventeenth century (top) and mid-eighteenth century (bottom) naval treatises, showing the types of shot used aboard armed vessels. Illustrations adapted from Brian Lavery, *The Arming and Fitting of English Ships of War, 1600-1815*, Naval Institute Press, Annapolis, Maryland (1987), p. 137.

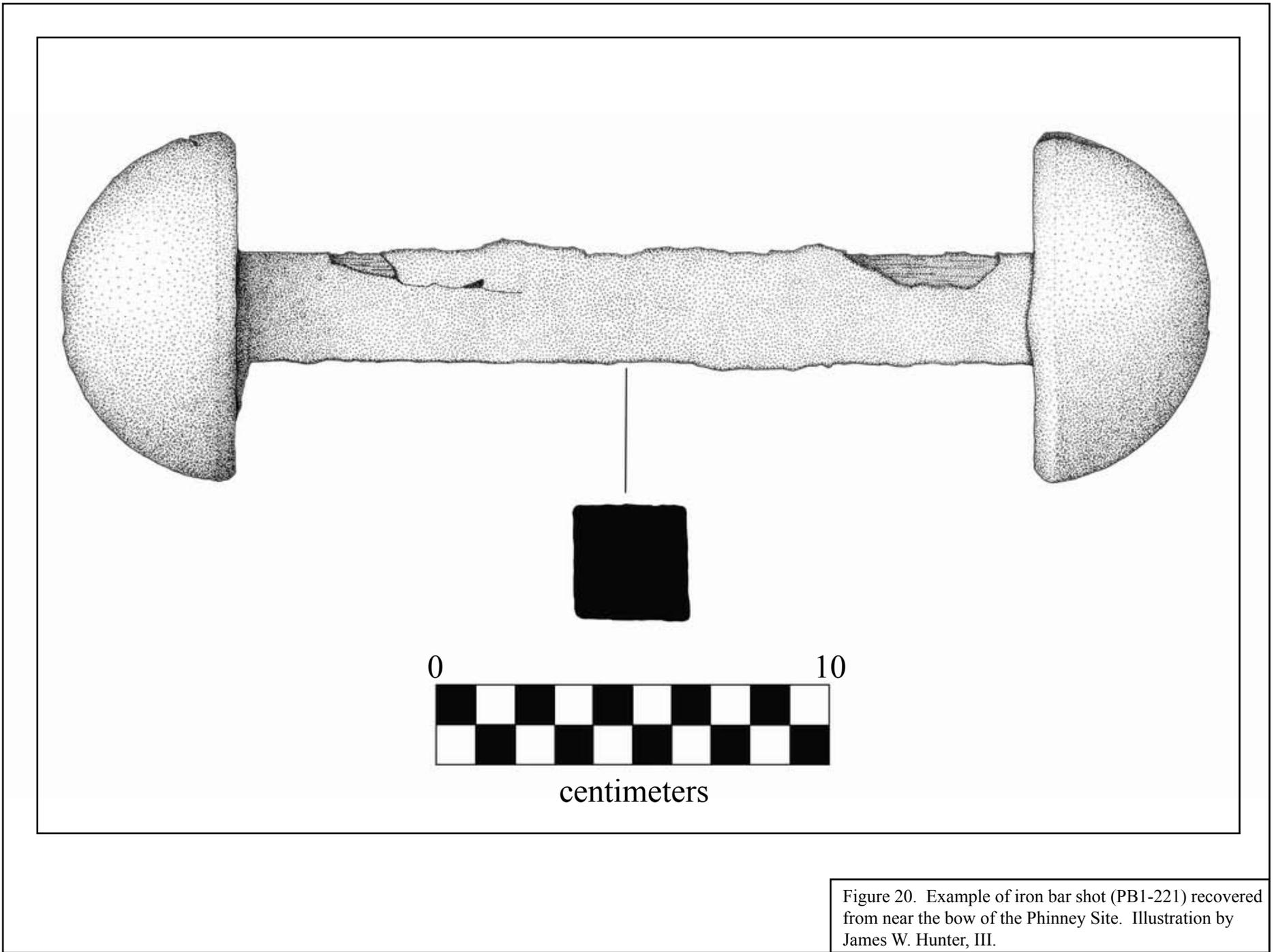


Figure 20. Example of iron bar shot (PB1-221) recovered from near the bow of the Phinney Site. Illustration by James W. Hunter, III.

with a flat surface sometime after the casting process. Similarly sized lead shot have been recovered from an abundance of Revolutionary War-era shipwrecks, including *Betsey*, *Defence*, *Philadelphia*, and the Deadman's Island Wreck (Bratten 2002: 124-125; Broadwater 1995: P-3; Smith 1990: 112 and Switzer 1998: 191).

Rigging

All colonial-era sailing vessels utilized rigging that is divided into two distinct categories: standing (stationary) and running (movable). Standing rigging consists of lines and other elements that are permanently attached to the vessel's masts, yards, spars and bowsprit, and are designed to hold them in place. By contrast, running rigging is utilized to hoist, furl, set and control the sails by positioning the yards, booms, and gaffs. A small running rigging assemblage comprised of a solitary wooden sheave (Figure 21) and the charred remains of a partial double block were recovered near the stem assembly of the Phinney Site during the 2000 investigation. The sheave (PB1-216) was excavated from compact sediment between the forward hood end of the wreck's starboard garboard and the heel of Frame 19 (see Figure 10). It is remarkably well preserved and was likely fashioned from *lignum vitae*, a dense, durable, self-lubricating tropical hardwood that was utilized almost exclusively for the manufacture of sheaves during the eighteenth century (Brown 1977: 31; Lavery 1987: 198; Lever 1998: 13; Rees 1970: 110 and Sutherland 1989: 136-137). The sheave has a maximum diameter of 11.6 centimeters and is 2.2 centimeters thick. Interestingly, the sheave's thickness and axis hole diameter are identical.

Because it was not found in association with other rigging elements and does not exhibit any discernible wear patterns or possess bushings, the sheave appears to have been a spare. Spare sheaves have been found in the forward section of a number of other eighteenth-century shipwrecks, including *Defence*, *El Nuevo Constante*, the Boca Chica Channel Wreck (a small, New World-built vessel dating to the Revolutionary War era), and *Boscawen*, a sixteen-gun sloop built and later abandoned by British forces during the French and Indian War (Crisman 1996: 145; Naval Historical Center 2003: 65; Pearson and Hoffman 1995: 144 and Switzer 1998: 192). Large assemblages of spare sheaves have also been recovered from the forward section of both the Santa Rosa Island Wreck (a wrecked early eighteenth-century Spanish frigate lost in Pensacola Bay, Florida) and a late eighteenth-century *praam* wrecked on the Zuider Zee in the Netherlands (Hunter 2001: 131-135 and McLaughlin and Neyland 1993: 37-39).

NHC archaeologists discovered the remains of the double block (PB1-224) a short distance from the sheave. It was found partially buried under the collapsed stem assembly, immediately adjacent to the scarph between the preserved upper and lower segments of the stempost (Figure 22). Although heavily degraded on one side—approximately half of the shell is missing and a significant portion of one sheave is badly charred—the block retains enough of its original



Figure 21. Wooden rigging sheave (PB1-216) recovered from the bow section of the Phinney Site. Photograph by James W. Hunter, III.



Figure 22. Burned double block (PB1-224) *in situ*. Photograph by David Whall.

surface to determine its overall dimensions (Figure 23). The shell has a preserved overall length and width of 25.6 centimeters and 21 centimeters, respectively. The block's estimated overall thickness (17.5 centimeters) was obtained by doubling the distance between its approximate center point and preserved outer edge (8.75 centimeters). The swallow, a circular channel for reeving line through the block, is located near the top of the surviving shell. It is 3 centimeters in diameter and would likely have accommodated a 1-inch (2.5 centimeter) line. A smaller, semicircular channel known as the breech is located at the opposite end of the shell and facilitated ease of the sheave's rotation within the block. A single score, or notch, is present at each end of the preserved cheek (the flat face on each side of the shell) and would have admitted a rope strop approximately 1 ½ -inches (3.8 centimeters) in diameter. An exposed portion of the block's pin—or central axle—has a preserved overall length of 15.7 centimeters and maximum diameter of 2.4 centimeters.

The best preserved of the block's two sheaves has a maximum diameter of 15.4 centimeters, maximum thickness of 2.8 centimeters, and an axle hole diameter of 2.6 centimeters. It exhibits clear evidence of wear along its periphery, most notably at the outer edge of the interior face where it came in direct contact with the interior surface of the cheek. The other sheave exhibits clear evidence of charring, including a sooty black color over much of its surface, singed odor, and numerous stress fissures around its periphery. Fire significantly altered the sheave's overall dimensions as well as its appearance: it has a maximum preserved diameter of 12.4 centimeters and is 2.7 centimeters thick. The hole for the pin has a preserved diameter of 2.9 centimeters. Although no wood samples have yet been taken from the block for identification, it is very likely that the shell was hewn from either elm or ash, and the sheaves and pin from *lignum vitae*. All three woods are extremely durable and were preferred among American and British block makers during the colonial era (Brown 1977: 31; Burney 1815: 41; Lavery 1987: 198; Lever 1998: 13; Rees 1970: 110 and Sutherland 1989: 136-137). Conversely, all of the block components may have been manufactured from native oak, as were those recovered from *Defence* (Switzer 1998: 192).

Ten-inch double blocks identical to that recovered from the Phinney Site are present in the artifact assemblages of both *Philadelphia* and *Defence* sites and are believed to have been used aboard those vessels to work the largest running rigging components (Bratten 2002: 128, 188; Ford and Switzer 1982: 34-36 and Switzer 1998: 192). Because it was located at the forward extremity of the wreck, the example recovered from the Phinney Site may have been part of the running rigging associated with the vessel's foremast. Conversely, it could have been stowed in the bosun's locker or another forward compartment as a spare. Many of the double blocks recovered from *Defence* were found nested deep within the forepeak, while all of the blocks discovered on *Philadelphia* were stowed in the gondola's forward cockpit (Bratten 2002: 173 and Switzer 1998: 192). Spare rigging blocks have also been recovered from the extreme forward



Figure 23. Three views of a charred, partial wooden double block (PB1-224) recovered from the bow section of the Phinney Site. Photographs by Claire Peachey.

section of *praams* E 14 and AZ 71 in the Netherlands (McLaughlin and Neyland 1993: 37, 75-78).

Tools

Two wrought-iron spade or shovel components were discovered at opposite ends of the wreck's centerline. Both artifacts appear to be the remnants of iron 'leaves' used to connect the wooden handle and iron blade components to one another (Figure 24). The largest example (PB1-227) was found partially exposed in riverbed sediment on the vessel's port side, immediately adjacent to Grid T-1. It consists of a semi-cylindrical shaft that widens to form a flat, spade-shaped head with a slightly concave central recess. The head is perforated by four circular fastener holes (two of which still retain 5-millimeter diameter iron rivets) and the partial remains of two others. Artifact PB1-227 has a preserved overall length and width of 20.5 centimeters and 10.9 centimeters, respectively. Its preserved maximum thickness is 2 millimeters.

The other shovel component (PB1-042) closely resembles PB1-227 and shares many of its characteristics. These similarities include the triangular shape of each artifact, and the number, type, and position of its fasteners and fastener holes. PB1-042 is missing most of the semi-cylindrical shank present on PB1-227, and therefore has a smaller maximum preserved length (12 centimeters). However, its overall width (11 centimeters) is nearly identical. Because it retains a small portion of attached shovel blade, PB1-042 is slightly thicker (1.3 centimeters) than PB1-227.

Two of the more basic tools employed by both American and British forces during the American Revolution were spades and shovels. Although similar in appearance, both implements were uniquely constructed to perform distinctly different functions (Tully 2000). Spades were characterized by a relatively flat blade and used primarily to cut sod, which was used to line various earthworks (Muller 1968: 49). Spades were also used to make fire pits and to trench around tents. By contrast, shovels exhibited slightly concave blades and served as the primary hand tool for excavating camp kitchens, graves, and trenches. They were also employed to fill gabions—defensive earthworks comprised of baskets or cages filled with rocks and sediment—during the construction of field fortifications (Tully 2000). Noël Hume (1969: 275) states that an iron “shank divided into two concave leaves” characterizes most eighteenth century spades and shovels. The two-part shank was placed around a wooden shovel handle and held in place with iron nails or rivets (Noël Hume 1969: 275).

A small iron concretion (PB1-148) recovered from Grid T-1 was initially identified as a fastener. However, radiographs revealed that the concretion contains a well-preserved folding



Figure 24. Shovel or spade components recovered from the Phinney Site: *top*; PB1-227, *bottom*; PB1-042. Photographs by Melanie Pereira.

knife consisting of what appears to be wrought-iron framework covered by a handle manufactured from wood, horn or bone (Figure 25). The knife's single blade, bolsters, pivot pins and washers also appear to be manufactured from wrought iron. A small protrusion (known today as a "Thumb-a-Bob") is located along the upper surface of the blade, approximately one-third of the blade's length from its point. As its name implies, the Thumb-a-Bob enabled the user to rapidly open the knife with a quick flick of the thumb. The knife has an overall (concreted) length of 13.8 centimeters, is 4.2 centimeters wide, and 2.2 centimeters thick. In terms of appearance, it resembles other examples of colonial-era folding knives, but most closely approximates an example recovered during archaeological excavations at Willtown Bluff, an eighteenth-century settlement located on the eastern bank of the Edisto River in South Carolina (Martha Zierden, personal communication). Eighteenth-century folding knives were manufactured in a variety of sizes and forms, and enjoyed considerable popularity among British and American soldiers during the American Revolution (Neumann and Kravic 1989: 174-175).

Ceramics

A total of 147 ceramic sherds were collected from a variety of points throughout the Phinney Site during the 2000 investigation. A complete listing of the ceramic assemblage is provided in Appendix C. Analysis of these items revealed that all but 17 originated from ceramic wares manufactured and distributed in the years following the American Revolution and are probably intrusive to the wreck site. The remainder of the assemblage, which consists primarily of American-produced redware and British-manufactured creamware, was recovered from immediately atop the starboard garboard during excavation of Grid T-1. Because these sherds positively date to the mid-to-late eighteenth century and were deeply buried within the hull remains, they comprise the best contextual material recovered from the wreck so far. Five kaolin pipe fragments discovered among the wreck remains round out the total ceramic collection.

The largest group of Revolutionary War-era ceramics recovered from the Phinney Site comprises nine sherds of American-produced redware. This assemblage can be further subdivided into two distinct redware variants: one exhibiting a mottled, brownish red glaze, and the other a dark brown or black glaze similar in appearance to that of lead-glazed Buckley earthenware (see Noël Hume 1969: 132-135). Each redware fragment is comprised of a soft, chalky terracotta-colored paste with isolated small air pockets and thinly applied glaze on both its interior and exterior surfaces. With the exception of one black-glazed example (PB1-186), which exhibits a partial ribbed band along its exterior surface, all redware sherds exhibit plain flat surfaces. Based on a variety of characteristics, the entire redware assemblage appears to have originated from two or more small thin-walled vessels. These may have included a variety of teacup, mug, tankard, jug or bowl forms. American-produced redware of similar types and forms were recovered during excavation of the privateer *Defence* (Smith 1986).



Figure 25. Radiographic images of the folding knife recovered from the Phinney Site: *top*, side view, *bottom*, top view. Photographs by Claire Peachey.

Manufacture of American redware first occurred at Jamestown, Virginia in 1625. New England variants were first produced in North America around 1760 and continued to be a dominant form of locally produced coarse earthenware until 1900. The following citation from Smith (1986: 76) discusses one of the New England type's many origins:

Red clay was abundant around the Boston area and Newburyport, near Beverly [Massachusetts], which was an early hub of the redware industry. The Bayley family moved their pottery business from Gloucester to Newburyport in 1764 and produced a variety of redwares including ale mugs, dainty bowls, porringers, teapots, pitchers, jugs, and crocks over the following 36 years. They glazed their pots in a range of colors from mahogany brown, to orange with brown streaks, to black, to green.

In addition to glazes, decorative techniques incorporating the use of powdered mineral oxides were applied to American redware. These were used primarily to highlight, color, or decorate the glaze, and the final product varied according to the type of oxide used. Copper oxide produced a green color, iron oxide produced brown, and manganese oxide produced black (Peabody-Turnbaugh 1996). Dark mottling evident on the examples recovered from the Phinney Site suggests that either manganese or iron oxide powder was introduced to the glaze during the manufacturing process.

Three fragments of creamware (PB1-131-B, PB1-131-D and PB1-131-E) were recovered during excavation of Grid T-1. All were found mixed with American redware sherds in a lens of sediment immediately above the interior surface of the vessel's starboard garboard (Figure 26). Each sherd is approximately 2 millimeters thick and exhibits a refined, cream-colored earthenware paste that is uniformly covered with a clear glaze on both its interior and exterior surfaces. None of the recovered examples are decorated; however, a fine network of discolored cracks (crazing) has developed in the glaze of each during its long immersion in the Penobscot River. The size, thickness, and appearance of the sherds suggest that they originated from relatively small, delicate items such as teacups or saucers. Since all three are physically and proportionally similar, the possibility also exists that they came from the same ceramic vessel.

Creamware—so named because of the color that resulted from the application of a clear or greenish lead glaze over a pale-yellow or cream-colored earthenware body—was manufactured between 1760 and 1820 in a variety of English potteries (Noël Hume 2001:204, 209). At the height of its popularity during the last quarter of the eighteenth century, creamware was produced mostly in Staffordshire and Yorkshire, with the most well known batches originating from the kilns of Josiah Wedgwood and the Leeds-based factory of Hartley, Greens, and Co. (Noël Hume 1969: 128). Early versions of the type are characterized by a deep yellow tint. However, a lighter-colored version emerged after 1775 when most creamware-producing centers began manufacturing ceramic vessels from kaolin clay. Many historical archaeologists consider



Figure 26. Creamware and redware ceramic sherds recovered from Grid T-1 in sediment just above the Phinney Site's starboard garboard. Photograph by James W. Hunter, III.

creamware to be the most ubiquitous English-produced ceramic type of the colonial era (Noël Hume 1969: 125). A variety of examples, including a “grog cup” found among *Philadelphia’s* remains, have been recovered from both American and British shipwrecks dating to the American Revolution (Bratten 2002: 132; Broadwater 1996 and Smith 1986).

A single triangular-shaped fragment of what appears to be Fulham stoneware (PB1-131-C) was discovered lying atop the vessel’s garboard strake in close proximity to the aforementioned examples of redware and creamware (Figure 27). It is comprised of a dense, granular light gray stoneware body with numerous dark inclusions. The sherd’s exterior is salt-glazed and exhibits a gray to buff color over much of its surface. A darker brown mottled slip characteristic of English brown stoneware is evident at one corner. Prominent rill (throwing) marks are present along the interior surface of the sherd, indicating that the vessel from which it originated was manufactured on a potter’s wheel. Smaller, barely perceptible rill marks are also evident on portions of the exterior not covered by brown slip.

Fulham stoneware derives its name from the potting center of Fulham, England, where John Dwight produced the first successful British imitations of Rhenish salt-glazed stoneware vessels circa 1675. Although Dwight secured a patent for his design in 1672, other potters in England quickly adopted it and manufactured largely identical imitations (Hildyard 1985:11; Gaimster 1997:309-310 and Green 1999:4, 13). By 1730, potters in the American colonies were producing brown stoneware that was often indistinguishable from Dwight’s Fulham-type (Watkins and Noël Hume 1967). The most common Fulham stoneware forms found on archaeological sites are bottles and drinking vessels such as tankards and mugs. Most Fulham mugs and tankards produced during the eighteenth century were undecorated—save for simple turned bands or cordons—and ranged in capacity from 0.25 pints to 2.5 quarts (Gaimster 1997: 320; Green 1999:151 and Noël Hume 2001:155). Body forms for these vessels included globular, waisted, and straight-sided varieties. According to Noël Hume (1969: 114), nearly all Fulham stoneware recovered from American archaeological sites dates between 1690 and 1775. The only exceptions are those items recovered from British military sites or areas that were under British control during the American Revolution.

Five kaolin smoking pipe fragments were recovered from various points along the centerline of the Phinney Site (Figure 28). Two stem sections and a portion of a bowl were found in the approximate location of the midship and stern; two additional stem fragments, one of which retained part of a bowl and heel, were recovered from the bow. One stem fragment (PB1-172) retains an intact mouthpiece and clearly exhibits a number of gnaw marks where it was clenched between a smoker’s teeth. It has an overall length of 7.1 centimeters, a stem diameter that increases from 5 millimeters at the mouthpiece to 7 millimeters at its broken end, and a stem bore

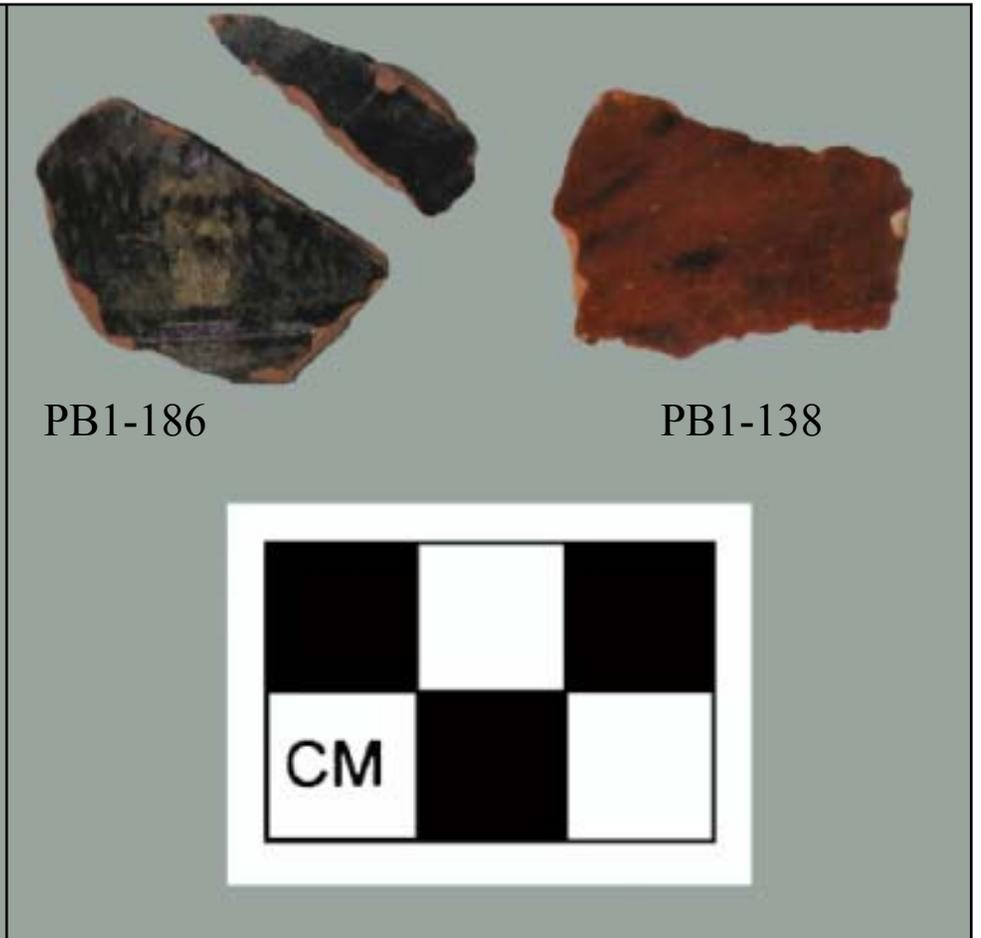


Figure 27. Other Revolutionary War-era ceramic sherds excavated from Grid T-1: *left*; Fulham stoneware, *right*; variations of American redware with red and black glaze. Photographs by James W. Hunter, III.



PB1-172



PB1-044



PB1-077



PB1-215



PB1-151

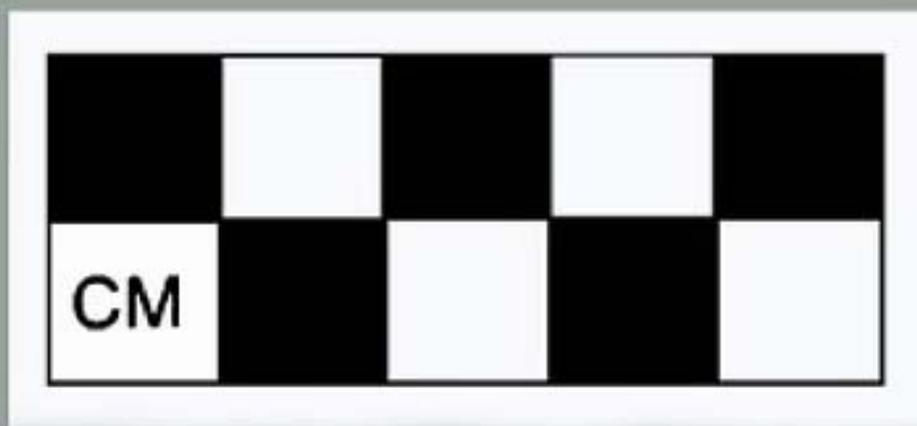


Figure 28. Kaolin pipe fragments recovered from the Phinney Site.
Photograph by James W. Hunter, III.

diameter of 2 millimeters (5/64 inch). Another stem fragment (PB1-044) has a preserved length of 5 centimeters, an exterior diameter that tapers from 7 millimeters to 5 millimeters, and a bore diameter that varies from 1 to 1.5 millimeters (4/64 inch). The smallest stem portion in the assemblage (PB1-077) is 3.5 centimeters long and has a maximum stem and bore diameter of 7 millimeters and 2 millimeters (5/64 inch), respectively.

One pipe fragment (PB1-151) comprises the junction between the bowl and stem, and retains most of the heel. The heel—or spur—is a protrusion at the bottom of the bowl that was used by pipe makers to add extra material or “bottom” to the pipe during the manufacturing process (Hitchcock 2002). PB1-151 has a preserved length of 2.1 centimeters and maximum preserved bowl height of 1.7 centimeters. Its stem portion is slightly oval in cross-section, measures 9 millimeters x 1.1 centimeters in diameter, and exhibits a bore diameter of 2 millimeters (5/64 inch). A small bowl fragment (PB1-215) completes the wreck’s kaolin pipe assemblage. It is 1.2 centimeters long, 1.1 centimeters wide, 3 millimeters thick, and retains a dark gray stain on its interior surface.

The American Indian habit of smoking tobacco became fashionable in the British Isles in the 1570’s, and the use of clay smoking pipes was commonplace in both England and the American colonies by the early seventeenth century. Pipes manufactured during the mid-to-late eighteenth century varied considerably in stem length, bowl form, and ornamentation, although undecorated examples with stem lengths between 9 and 18 inches (22.9 and 45.7 centimeters) were probably the most common (Noël Hume 1969: 296-297, 302-303). None of the specimens in the kaolin pipe assemblage recovered from the Phinney Site are decorated, nor do they exhibit any form of manufacturer’s mark. The most diagnostic example—fragment PB1-151—most closely resembles two undecorated eighteenth-century pipe bowl forms illustrated by Noël Hume (1969: 303) in a simplified evolutionary series of English clay tobacco pipes.⁵

Glass

The largest single collection of cultural material recovered from the wreck site during the 2000 field campaign consists of glass fragments in a variety of colors and forms. The glass assemblage is comprised primarily of fragmentary debris originating from modern alcohol, soda, pharmaceutical, and utility bottles. Other intrusive glass items include portions of electric insulators, windowpanes, and dishes. Seventeen glass shards are believed to be directly associated with the Phinney Site based upon their provenience and contextual integrity (see Appendix D). All of these items were recovered during excavation of Grid T-1—most from sediment atop, or immediately adjacent to, the interior surface of the vessel’s starboard garboard.

⁵ The pipe bowl forms referred to in Noël Hume’s typology are Number 15 (ca. 1700-1770) and Number 16 (ca. 1730-1790).

The remaining fragments were discovered in direct association with iron shot or other wreck-related cultural material.

The wreck's entire eighteenth-century glass assemblage is comprised of small indeterminate body fragments that probably originated from one or more olive-green (or 'black glass') spirit bottles. 'Black glass' was a term used by colonial-era bottle makers to describe dark green or dark brown glass produced by the inclusion of iron, manganese, or sulphur oxides as a glass constituent during its manufacture. By increasing the melting temperature and residence time, glassblowers could change the color of black glass from brown to olive green and light green. Black glass was first produced in the sixteenth century in Southern Belgium and Northeastern France, where it was known as *verre noir*. In 1615 it was introduced in England, where it grew in popularity over the next three centuries (Van den Bossche 2001: 392).

The largest black glass fragment (PB1-143) recovered from the Phinney Site forms part of the junction between a bottle's neck and shoulder. It is 4.5 centimeters long, 3.4 centimeters wide, and 5 millimeters thick. Numerous small circular 'seeds' or gas inclusions are visible within the shard's body and are evident within all of the other black glass fragments in the assemblage. The presence of 'seeds' is a common characteristic of colonial-era bottles and strongly suggests a colonial origin for the glass shards exhibiting this trait. Two fragments in the collection exhibit an unusual pale blue patina on their exterior surfaces. One example (PB1-139B) is slightly patinated at one end; the other (PB1-143) has been completely transformed and only retains a light olive green tinge along its broken edges. The discoloration present on each shard suggests that they: 1) are pieces of partially-melted glass slag; 2) originated from one or more glass containers that were burned and partially melted during the fire that destroyed the ship; or 3) are the remnants of one or more containers manufactured from opaline turquoise blue glass.

Colonial-era glassmakers produced the latter by introducing more than five percent glassgall (a turquoise blue opaque sulphate salt of sodium) into a glass mixture while it was still molten. Rather than being dissolved as sodium silicate, the excess glassgall "swam" on the surface of the molten glass and cooled to form an opaque outer shell colored various shades of blue and blue-green. Turquoise colors also sometimes occurred on the surface of black glass bottles at random, but appeared with considerably more frequency when blast furnace slag was used in a glass batch. During the eighteenth century—but especially between the years 1760 and 1780—opaline blue glass was produced in a variety of bottle forms (Van den Bossche 2001: 89, 174, 188, 313, 394).

Intrusive Material

A total of 130 intrusive ceramic fragments were recovered from the Phinney Site during the 2000 field investigations. The vast majority of these sherds appear to have originated from

ceramic items produced during the nineteenth century; the remainder date to the twentieth century (Figure 29). Some of the ceramic types in the assemblage include plain, relief-molded, hand-painted, and transfer-printed whiteware; ironstone china; edge-decorated, transfer-printed, and hand-painted pearlware; Bristol-style glazed beer bottle; American-produced salt-glazed stoneware; European and American-produced porcelain; and several varieties of yellowware. Many of the fragments in the assemblage exhibit some form of diagnostic marking, but only three examples (PB1-020-E, PB1-046-B and PB1-110) have actual manufacturers' marks. Both PB1-020-E and PB1-046-B are basal sherds from transfer-printed whiteware vessels. A cipher at the center of the foot ring of PB1-020-E bears the British Royal Arms and the words "Staffordshire, England," while that of PB1-046-B simply states "Homer Laughlin—USA." The Homer Laughlin China Company, founded in East Liverpool, Ohio in 1871, produced the latter example. It was the first pottery in the United States to produce whiteware and is still in operation today (Jasper 1993: 6-8).

PB1-110 is a white ironstone bedpan fragment comprising a portion of its side and basin. The interior surface of the sherd exhibits the phrase "PERFECTION BED and DOUCHE PAN...The Most Comfortable and Sanitary Bed Pan in the World" in black transfer-printed block letters. Portions of additional words are visible along the broken edges of the sherd but are not legible. A review of internet sources revealed the complete notation, which in its entirety should read "MEINECKE 'PERFECTION' BED and DOUCHE PAN...The Most Comfortable and Sanitary Bed Pan in the World...For Hospital and Home...Two U.S. Patents June 5, 1900. Also Pat. in Great Britain & Germany."

During the 2000 field campaign, NHC archaeologists noted the presence of whole bricks and brick fragments scattered throughout the hull remains. All intact specimens were inspected *in situ* and identified as either nineteenth- or twentieth-century building or landscaping bricks. Recovery of masonry material was limited to brick fragments located during the excavation of Grid T-1 and along buried portions of the wreck's centerline. A total of 262 items were collected. The assemblage is comprised of bricks exhibiting a wide array of colors, textures, and shapes. However, none exhibit diagnostic attributes specific to either American or English bricks manufactured during the eighteenth century (see Noël Hume 1969: 80-84). Although some of the fragments recovered from the wreck may have once comprised part of the vessel's galley hearth or complement of ballast, most were probably introduced into the site in the years following the vessel's loss.



Figure 29. Sample of intrusive ceramic sherds from the Phinney Site.
Photograph by James W. Hunter, III.

More than 200 glass fragments post-dating the American Revolution were recovered from a variety of locales throughout the wreck site. The vast majority of the assemblage is comprised of alcohol, soda, pharmaceutical, and utility bottle shards in a variety of sizes, colors, and shapes. Other glass items, including electrical insulators, lanterns, light bulbs, lamp globes, dishware, windowpanes, and buttons, are also represented. The only intact glass object recovered from the wreck is a modern screw-top pill bottle (PB1-052). It is molded from clear glass, rectangular-shaped, and exhibits a cylindrical neck with three prominent glass screw threads. An encircled capital letter “P” flanked by the numbers “22” and “3” is molded onto the bottle’s base. Vertical mold seams are evident along its opposing shoulders and sides. The bottle has an overall height of 6.8 centimeters, and a width and thickness of 3 centimeters and 1.9 centimeters, respectively. Its neck—where exposed between threads—has an exterior diameter of 1.8 centimeters.

A large, heavy, rectangular cast iron block (PB1-228) was discovered within the starboard hull remains, lying on the riverbed approximately one meter from the mainmast step mortise. One side of the artifact is heavily pitted and corroded; the other—buried for years under a protective layer of bottom sediment—is very well preserved. It has a maximum preserved length of 23 centimeters, and a maximum preserved width and thickness of 15 centimeters and 21 centimeters, respectively. Prior to undergoing conservation treatment, the block weighed approximately 20.8 kilograms (46 lbs). Located at one end of the block’s upper surface is a circular indentation bracketed by a wedge-shaped recess on one side and a square hole on the other. The square hole penetrates the entire artifact and doubles in size at a step located approximately midway between the block’s upper and lower face.

Based on its size, shape, and construction attributes, the artifact appears to be a cast iron weight intended for use as movable ballast (David Whall, personal communication). The circular indentation and associated square hole served as a partial recess for the block’s lifting ring and post, both of which are no longer present. When not in use, the lifting ring and post rested in their respective recesses, thereby creating a flat upper surface on top of which another ballast block could be securely placed. The wedge-shaped indentation facilitated access to the lifting ring from its recessed position when the block needed to be moved. Based on the size of the indentation, the lifting ring had an approximate maximum diameter of 8 centimeters and an approximate thickness of 2 centimeters. The stock post that held the ring in place was square-shanked and had a maximum thickness of 2 centimeters. A 4-centimeter square opening at the bottom of the block suggests that the thickness of the stock post doubled between its upper and lower ends. The overall length of the post is unknown, but it probably corresponded closely to the thickness of the ballast block.

The British Royal Navy first used iron ballast aboard its warships in 1727, when eight of its sloops then under construction were outfitted with blocks recast from old cannons and shot. By

1735, iron ballast (also known as *kentledge*) was being cast in the form of plates or bars called 'pigs'. During the mid-to-late eighteenth century, pigs in plate form typically measured no less than 2 inches (5 centimeters) thick, while the standard size and weight of a bar was 3 feet long x 6 inches wide x 6 inches thick (91 centimeters long x 15.2 centimeters wide x 15.2 centimeters thick) and 320 lbs (145 kilograms). In 1779, the Royal Navy adopted a smaller form of iron ballast that measured 1 foot long x 4 inches wide x 4 inches thick (30.4 centimeters long x 10.2 centimeters wide x 10.2 centimeters thick) and weighed 56 lbs (25.4 kilograms). Eighteenth-century iron ballast did not have lifting rings and stock posts. Instead, each pig had a simple circular hole at either end to make it easier to lift and move (King 1995: 15-20 and Lavery 1987: 186).

Iron pigs were preferred over shingle and other forms of stone ballast because of their relatively greater weight and density. When placed in the deepest recesses of the hold, iron ballast significantly lowered a vessel's center of gravity—an attribute that was necessary for warships that carried a considerable amount of artillery and ordnance above the waterline. Iron ballast also occupied less stowage space than stone ballast. This, in turn, increased the amount of room available for additional provisions and equipment (King 1995: 15-20 and Lavery 1987: 186). Although the iron block recovered from the Phinney Site is similar in size and weight to smaller examples of eighteenth-century pig ballast, the complexity of its lifting ring assembly indicates a much later date of manufacture. Further, the ballast block was the only artifact of its kind found on the wreck and was discovered only partially buried beneath the riverbed (and not deeply buried within the hull remains as would be expected). Taken together, all of the aforementioned attributes strongly suggest that the block is intrusive to the site.

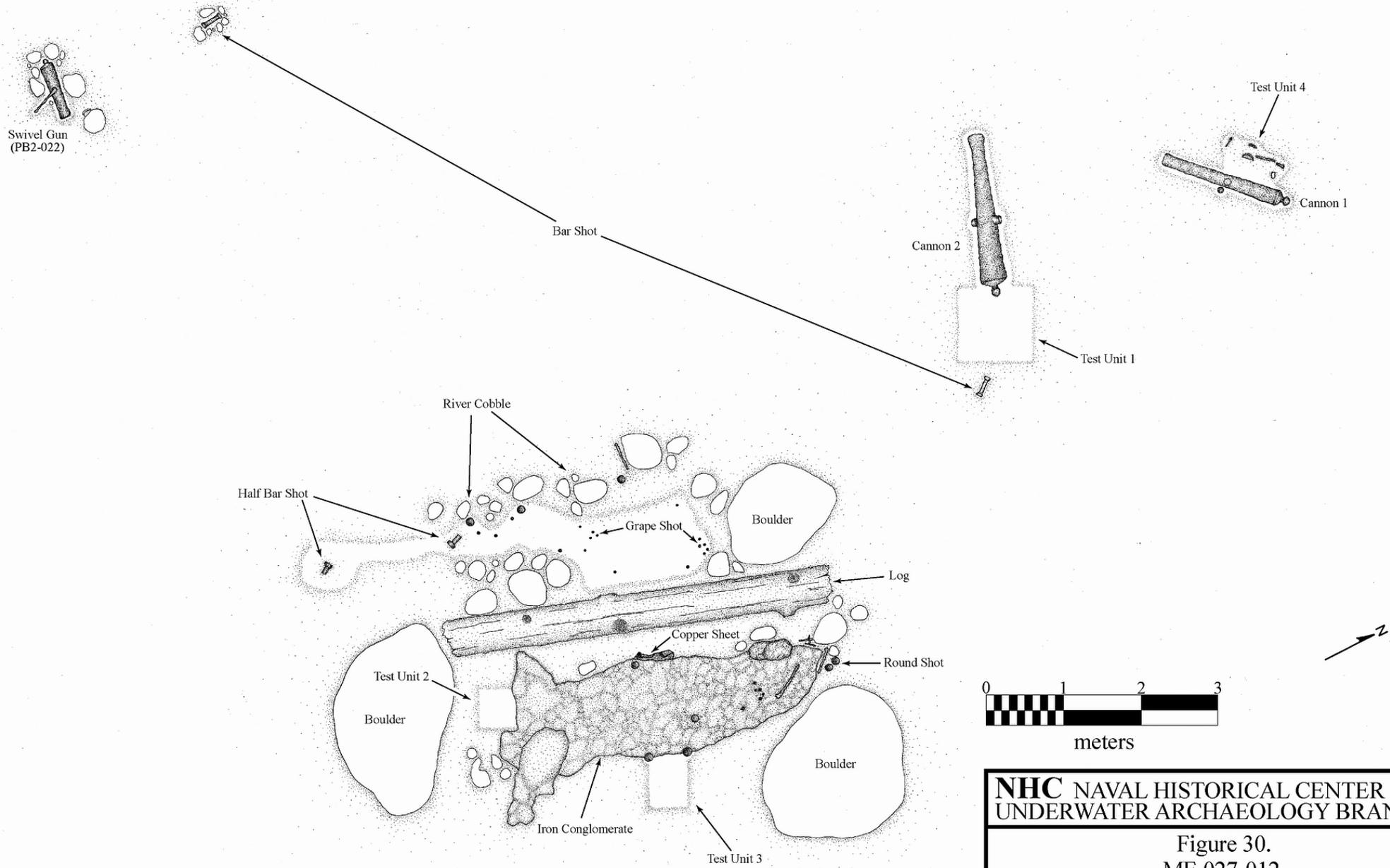
VII. RECONNAISSANCE SITE INVESTIGATION RESULTS: SHORELINE SITE

Artifact Analysis

A total of 33 artifacts were recovered from the Shoreline Site during the 2001 field campaign, ranging from small ceramic fragments to complete pieces of iron artillery. With the exception of a large ferrous conglomerate located in the east-central portion of the site, most of the artifacts observed were widely dispersed over an area measuring approximately 218.5 square meters. All of the cannon, ceramics, and glass were discovered in the western one-third of this area, forming a roughly linear scatter oriented on a north/south axis (Figure 30). The remainder of the assemblage, including the majority of iron shot, fasteners, and miscellaneous objects, were observed in the remaining two-thirds of the site. Due to its close proximity to the former historic Bangor waterfront and the present-day Bangor Landing-Waterfront Dock Complex, the site is littered with a diverse array of historic debris and modern rubbish. Continual disturbance and development along the waterfront for the past 200 years has caused much of this intrusive material to be combined with artifacts and intact cultural features from the American Revolution. Consequently, recovery of artifacts from the Shoreline Site was limited to objects that positively dated to the latter half of the eighteenth century. In some instances, artifacts of questionable temporal affiliation were collected when discovered in close association with Revolutionary War-era material.

Artillery and Munitions

The largest and most easily recognizable artifacts discovered at the Shoreline Site are two cannon and one swivel gun, all of which were manufactured from iron and date approximately to the middle-to-late eighteenth century. Each artillery piece was discovered encased in a dense matrix of iron oxide corrosion products, shell, stone, and minerals. Consequently, diagnostic markings such as a weight stamp, royal cipher, foundry mark, or date of manufacture could not be discerned on any of the guns during *in situ* inspection. Because the two larger cannon were left on site at the close of the field season, NHC archaeologists were unable to positively identify them. However, the swivel gun was recovered during the final days of the project and transported to the Maryland Archaeological Conservation (MAC) Laboratory at Jefferson Patterson Park in Calvert County, Maryland, where it is currently undergoing treatment. Detailed analysis of the gun following deconcretion revealed a wealth of diagnostic information, which ultimately will contribute to the overall interpretation of the site.



NHC NAVAL HISTORICAL CENTER
 UNDERWATER ARCHAEOLOGY BRANCH

Figure 30.
 ME 027-012
 Shoreline Site Plan

Although the two largest cannon could not be positively identified, enough information was gleaned during *in situ* inspection to formulate general conclusions about their overall size, caliber, and condition at the time of deposition (i.e., loaded, unloaded, spiked). The largest piece of artillery (Cannon 2) was discovered underneath the Harbormaster's Dock, in the 25-foot depth interval immediately offshore of downtown Bangor. When found, it was lying with its upper surface exposed above the riverbed, buried in sediment to its approximate centerline and canted slightly to the left side. Inspection of the gun's exposed surfaces revealed that most of the casting and construction details, including all of the reinforce rings, astragals, fillets, and sight patches, were obscured by thick concretion. The vent, touchhole, cascabel, and both trunnions, however, were readily apparent.

Cannon 2 has an overall length of 2.45 meters and maximum breech, muzzle, and bore diameters of 32.8, 19.2, and 6.8 centimeters respectively. The diameter of the barrel behind the muzzle flare is 16.8 centimeters, while that of the button astragal is 10 centimeters. Both trunnions have a maximum diameter of 9 centimeters and are mounted on the low line of the bore. The length of the cascabel is 19 centimeters. The vent (and associated touchhole) was partially obscured by corrosion products, but appears circular in profile, with an estimated maximum diameter of 1.5 centimeters. Corrosion in the cannon's bore prevented NHC archaeologists from obtaining a barrel wall thickness and determining if the gun was loaded. It does not appear to have been spiked or intentionally disabled before being deposited on site.¹

The smaller cannon (Cannon 1) was found approximately 3 meters north of Cannon 2, lying with its left side almost completely exposed above a riverbed matrix of coarse sediment and cobblestones. Like its larger counterpart, Cannon 1 is covered with a dense layer of ferrous concretion that obscures most attributes of its casting, construction, and operation, including the vent and touchhole. An example of round shot with a maximum diameter of 7 centimeters was located immediately adjacent to the bottom center of the gun tube. The size of the projectile corresponds closely to the cannon's bore diameter (7.8 centimeters), suggesting that the two artifacts might be directly associated. NHC archaeologists attempted to test this hypothesis by examining the interior of the gun to see if it already contained a projectile. Unfortunately, a dense plug of corrosion blocked most of the length of the bore and prevented researchers from determining whether the gun was loaded or not.

Cannon 1 has an overall length of 1.72 meters and maximum breech and muzzle diameters of 18 and 19.1 centimeters respectively. The length of the cascabel is 17 centimeters and the button

¹ The technique of "spiking" cannon developed during the eighteenth century and was done primarily to render artillery useless to an enemy. This was accomplished by driving a spike or iron rod through the vent and bending it over inside the bore of the cannon so that it could not be easily removed. In addition to spiking, guns could be disabled by knocking off the trunnions or the cascabel with a sledgehammer, or wedging a cannonball tight against the base of the bore (Peterson 1969: 68).

astragal has a maximum diameter of 12 centimeters. The diameter of the barrel behind the muzzle flare is 16.8 centimeters. Both trunnions, exposed during excavation of Test Unit 4, have identical maximum diameters of 9 centimeters, and are mounted just below the axis of the bore. Fragments of wood, including a long narrow rectangular segment, were found embedded in the concretion on the underside of the gun and were initially thought to represent a portion of its carriage. However, further excavation around the buried portion of the gun did not reveal any additional wood fragments, iron fittings, or other components associated with a gun carriage. Although the vent and touchhole were obscured by iron concretion, neither appears to have been intentionally obstructed by a spike, rod, or similar object.

A survey of selected archaeological and historical sources reveals that Cannon 1 and 2 at the Shoreline Site compare most favorably to 4 and 6-pounder cannon cast during the middle-to-late eighteenth century. Archaeological comparisons are derived primarily from shipwrecks or submerged archaeological sites dating to the American Revolution (1775-1781) or the years immediately surrounding it. These sites include the Little Landing Site in South Carolina; Valcour Bay submerged battlefield site in Lake Champlain; British supply sloop *Industry*; British sloop-of-war HMS *Swift*; and the Penobscot Expedition privateer *Defence* (Cano 1998; Cohn et al. 2002: 75-80; Ford and Switzer 1982: 38, 42; Franklin et al. 1999: 18; Mayhew 1975: 143; and Thompson 1991: 125-127). Three Revolutionary War-era cannons recovered from the Penobscot River near Bangor in the late nineteenth and early twentieth centuries were also examined. Historical references range from modern books about colonial-era artillery to contemporary eighteenth-century treatises (Cloves 1898: 11; Mountaine 1747: 103; Mountaine 1781: 72; Mulholland 1981; Muller 1780: 6, 56; Petersen 1965: 83; and Peterson 1969: 41-42). The results of the survey are outlined in the following table:

Table 1.
Shoreline Site Cannon: Some Historical and Archaeological Comparisons

Cannon Description	LOA	Bore
Cannon 1, Shoreline Site (1779?)	1.72 m	7.8 cm
Cannon 2, Shoreline Site (1779?)	2.45 m	6.8 cm
British 3-pdr, Little Landing Site (ca. 1770)	1.50 m	7.3 cm
British 3-pdr, Little Landing Site (ca. 1770)	1.36 m	7.5 cm
4-pdr, cast at Hill Foundry, S.C. (ca. 1777)	1.44 m	10 cm
British 6-pdr, sloop <i>Industry</i> (1764)	2.25 m	8.9 cm
British 6-pdr, sloop-of-war HMS <i>Swift</i> (1769)	2.28 m	N/A
British 6-pdr, Fort of Pensacola, British West Florida (1763-1781)	2.81 m	9.5 cm
6-pdr (Swedish?), Valcour Bay submerged battlefield site (1776)	2.30 m	9.0 cm
6-pdr, Privateer <i>Defence</i> (1779)	1.72 m	N/A
6-pdr, Privateer <i>Defence</i> (1779)	1.52 m	N/A
Unidentified Revolutionary War cannon (poss. 6-pdr); Brewer, Maine	1.80 m	10 cm
Unidentified Revolutionary War cannon (poss. 6-pdr); Bangor, Maine	2.02 m	9.2 cm
Unidentified Revolutionary War cannon (poss. 6-pdr); Bangor, Maine	2.02 m	9.0 cm

Table 1. (Continued)
Shoreline Site Cannon: Some Historical and Archaeological Comparisons

Cannon Description	LOA	Bore
6-pdr, Armstrong System of Standardization for Iron Artillery (1736)	1.96 m	N/A
British 4-pdr, Particulars of Service Guns (Establishment of 1743)	N/A	8.2 cm
British 6-pdr, Particulars of Service Guns (Establishment of 1743)	1.98 to 2.74 m	9.3 cm
4-pdr, British Board of Ordnance, Iron Guns (1764)	1.67 to 1.83 m	N/A
6-pdr, British Board of Ordnance, Iron Guns (1764)	1.83 to 2.74 m	N/A
4-pdr, British Iron Guns (ca. 1780)	1.83 m	8.1 cm
6-pdr, British Iron Guns (ca. 1780)	2.13 m	9.3 cm

The overall length and bore diameter of Cannon 1 most closely match the dimensions given for 4-pounders cast according to British Board of Ordnance specifications between 1743 and 1780. However, its silhouette is long and slender in proportion to its bore, which suggests the possibility that the gun is a “Rose and Crown” type first produced in Great Britain during the second half of the seventeenth century. These guns were manufactured until at least 1714, but were probably used well into the middle of the eighteenth century. Peterson (1969: 38) notes that Rose and Crown guns are one of the most common types of iron cannon found at colonial-era archaeological sites in North America.

The cannon survey also revealed a significant similarity between Cannon 1 and the largest of two 6-pounders recovered during the excavation of *Defence*. Both guns exhibit identical overall lengths but different calibers. This is best explained by the fact that the example from *Defence* was produced at the Massachusetts State Foundry in 1778, and cast according to specifications outlined in what were then the most current—and controversial—British treatises on artillery (Ford and Switzer 1982: 38; Mayhew 1975: 143; Peterson 1969: 57; and Switzer 1998: 190). While American artificers tended to adopt modern English theories about great guns (that called for shorter, lighter cannon), their contemporaries in Great Britain generally rejected new innovations and adhered to older designs. Consequently, the 6-pounder from *Defence*, like most artillery cast in the colonies during the American Revolution, is shorter in overall length than a mid-eighteenth century British gun of the same caliber (Mulholland 1981: 124-125 and Peterson 1969: 41, 57).

Cannon 2 exhibits an overall length nearly identical to the median size (2.44 meters) specified for 6-pounders by the British Establishment of 1743 and 1764 British Board of Ordnance requirements. Further, its length compares favorably to Revolutionary War-era 6-pounder cannon recovered from other archaeological sites. However, the gun’s preserved bore diameter is too small for a 6-pounder—available historical and archaeological data indicate that its bore more closely matches that of contemporary 3 and 4-pounder cannon. The most plausible explanation for the inconsistency is the presence of iron concretion on both the interior of the barrel and the face of the muzzle. As iron corrosion products within the barrel developed and enlarged, the

gun's original bore diameter—perhaps large enough for a 6-pounder—may have been obscured. Alternatively, Cannon 2 could represent an unusually long example of a 4-pounder, similar in form to the Rose and Crown weapons mentioned earlier. Future detailed examination of both guns will undoubtedly answer these and other existing questions about their size, origin, and temporal association.

The final component of the artillery assemblage at the Shoreline Site is a cast iron swivel gun (PB2-022, Figure 31). It was discovered approximately 12 meters southwest of Cannon 2 in the 23-foot depth interval, lying on its right side and partially exposed above the riverbed. Like most swivel guns manufactured during the eighteenth century, it resembles a scaled-down version of a larger cannon complete with trunnions, reinforce rings, and a cascabel and cascabel button (Peterson 1969: 45). The wrought-iron yoke and swivel assembly was found articulated with the gun's trunnions and is largely intact. Other features typical to swivel guns such as the iron components of a "monkey tail" (a separate handle attached to the cascabel and used to aim the gun) are not present. Ferrous corrosion products initially obscured most of the casting and construction details. These attributes were later revealed after conservators at the MAC Laboratory deconcreted the gun. Although manufacturing details were noted, no diagnostic markings were observed on the weapon's exterior surface. Consequently, details concerning its size, weight, origin and ownership remain speculative.

The swivel gun has an overall preserved length of 78.3 centimeters and maximum muzzle and breech diameters of 10 and 16.5 centimeters, respectively. The base ring, vent astragal, and muzzle astragal exhibit respective maximum preserved diameters of 16.5, 15.5 and 11.25 centimeters. The gun's first reinforce has a maximum preserved diameter of 14.25 centimeters; the second reinforce measures 13 centimeters in diameter. Located along the upper surface of the gun's breech are the vent block, vent pan and touchhole. The vent block is roughly rectangular-shaped for much of its length, but tapers to a rounded point at its forward end. It has a maximum preserved length of 5.20 centimeters and is 2.5 centimeters wide. The vent pan corresponds closely to the shape of the vent block and contains the gun's 5-millimeter diameter touchhole near its forward end. The cascabel button, located at the rearmost point of the gun, has a maximum diameter of 4.5 centimeters.

Conservators at the MAC Laboratory discovered that the swivel gun's yoke and swivel assembly, while largely intact, was extremely fragile and susceptible to breakage. Consequently, the yoke has not yet been completely deconcreted. It exhibits an overall preserved length of 31.25 centimeters and a maximum shaft thickness of 3.5 centimeters. Each of the yoke's arms has a maximum preserved width and thickness of 3 centimeters and 5 centimeters, respectively. Although the concreted yoke and swivel assembly largely obscure both of the swivel gun's trunnions, enough of each was visible for NHC archaeologists to obtain their general dimensions.

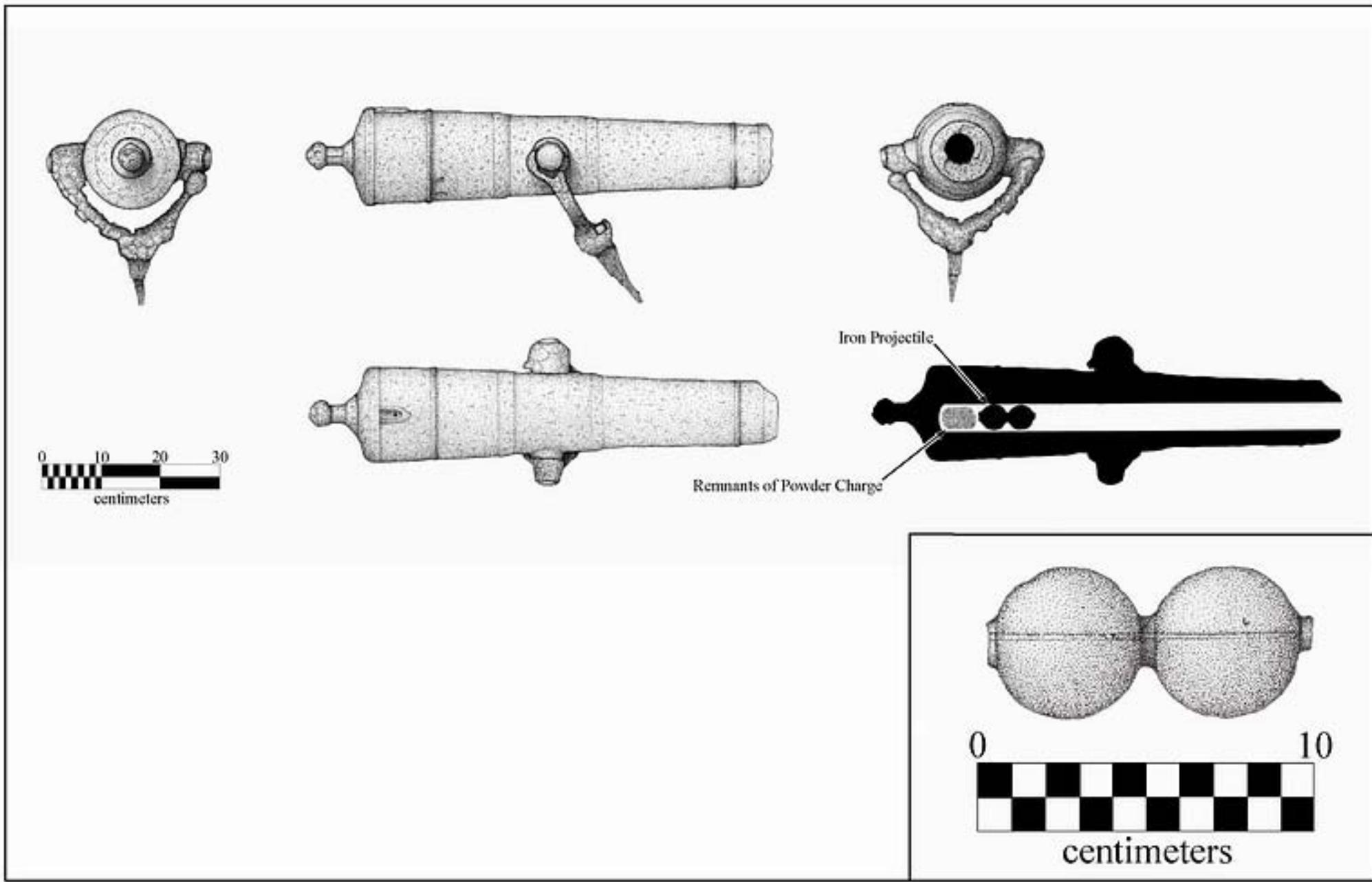


Figure 31. Cast iron swivel gun recovered from the Shoreline Site: *inset*; unusual "double-shot" iron projectile recovered from the interior bore of the swivel gun. Illustrations by James W. Hunter, III.

Each trunnion is centrally positioned near the gun bore axis, has a maximum preserved length of 6 centimeters, and a maximum diameter of 5.5 centimeters.

The swivel gun exhibits two unusual attributes, both of which may be closely associated with one another. The first and most obvious irregularity is that the gun is missing all of its muzzle and part of the barrel. The gun tube terminates at a jagged, circumferential fracture line immediately forward of the beginning of the muzzle flare. The reason for the break is unclear; it may have been the result of a casting or other manufacturing flaw that weakened the gun at its narrowest point. Such a flaw could have easily caused the gun to burst during firing and essentially blow its muzzle off. Alternatively, the end of the barrel may have been intentionally broken during the American retreat to render the piece unusable to approaching British forces. The possibility also exists that the gun was inadvertently damaged during past or recent development activities along the Bangor waterfront.

The possibility that the muzzle may have been blown off of the barrel is reinforced by the swivel gun's other curious characteristic—specifically, that its bore is “eccentric,” or positioned off-center from the gun tube's true centerline. The middle of the bore is offset 1.25 centimeters to the right of center, a discrepancy that is fairly obvious when the gun is viewed from the muzzle aspect. During the eighteenth century, most gun founders cast cannons and swivel guns as solid cylinders and then drilled out the bore manually or with motive-powered machines. Creation of a cannon bore with a core mold—a holdover process from previous centuries—was also occasionally employed by eighteenth-century gun founders, but was less popular because the bore of a hollow-cast gun was often slightly eccentric (Reilly 1991: 13). Unfortunately, the swivel gun's long immersion in the Penobscot River obscured or destroyed minute details (such as drill marks) in the bore that would have enabled NHC archaeologists to determine its method of manufacture.

Although the method by which it was produced is unknown, there is little doubt that the off-center bore was the result of an accident that occurred during its manufacture. One obvious consequence of the bore's eccentric position is that one side of the gun tube is appreciably thinner than the other. Such a significant variation in barrel wall thickness would very likely have detracted from the overall structural integrity of the gun. This in turn could have caused the gun to fail at the muzzle flare or the area immediately adjacent to it. The segment of the barrel surrounding the muzzle flare is typically the narrowest, thinnest, and structurally weakest part of the gun tube on colonial-era cannon.

Nicknamed “murderers” by colonial-era artillerists, swivel guns were typically mounted on the gunwales of ships and smaller vessels and used as anti-personnel weapons. Because of their small size, they were easily transportable and could be fired by a gun crew of only two or three

individuals. Further, because swivel guns were most effective at close range, the crew did not necessarily need to be versed in the more complex attributes of the gunner's art (Peterson 1969: 20, 45). The example recovered from the Shoreline Site has a bore diameter of 4.75 centimeters and was loaded with a curious projectile comprised of two 4.5-centimeter diameter ($\frac{3}{4}$ -pound) iron round shot connected to one another with casting sprue (see Figure 31). These projectiles were clearly cast in the same mold and would normally have been separated prior to use. For reasons that remain unclear, both were kept connected and loaded into the gun as a single piece of ammunition.

In addition to the unusual example found in its bore, a variety of other small projectiles would likely have been fired from the swivel gun during its service life. These include one or more individual $\frac{1}{2}$ or $\frac{3}{4}$ -pound iron round shot, numerous small lead musket balls (scatter shot), and a miscellaneous collection of old nails, spikes, and iron fragments tied in a canvas bag or placed loosely into the bore. The latter, known as langrage, scattered when fired and was designed to cut down rigging and kill or maim crewmembers aboard enemy vessels (Ford and Switzer 1982: 124; Peterson 1969: 27; and Switzer 1998: 191).

The fact that the gun was loaded when it was discarded suggests that its American operators elected to use the weapon in spite of its damaged—and potentially hazardous—condition. This is not surprising, given the haste with which the Penobscot Expedition was put together, the large number of privateers that comprised the fleet, and the relatively small quantity of serviceable artillery available to American forces during much of the war. Essentially, the damaged gun saw action because it was available for the task.

Nearly identical swivel guns have been recovered from a number of mid-eighteenth century and Revolutionary War-era shipwreck sites, including the Continental Gondola *Philadelphia*, British sloop *Industry*, the Little Landing Site, and an unidentified mid-eighteenth century wreck site believed to be associated with the early Spanish presidio at San Diego, California (Bratten 1997: 264; Bratten 2002: 118-119; Franklin et al. 1999; Moriarty and Crocker 1965; and Thompson 1991: 125-126). Mid-eighteenth century British systems of standardization for iron artillery, including the Establishment of 1743 and the 1764 British Board of Ordnance, indicate that most swivel guns intended for naval service had a maximum length between 2.99 feet (91 centimeters) and 3.48 feet (1.06 meters), and a caliber of 1.5 to 1.7 inches (3.9 to 4.3 centimeters) (Cloves 1898: 11 and Peterson 1969: 42). Because most American warships and privateers during the Revolution were armed with swivel guns that were either captured from British ships, stolen from British arsenals, or cast by colonial foundries according to British specifications, there was a certain degree of uniformity in the size and caliber of swivels used by the opposing fleets. Tucker (1989: 98) states that most swivel guns employed by the Americans averaged

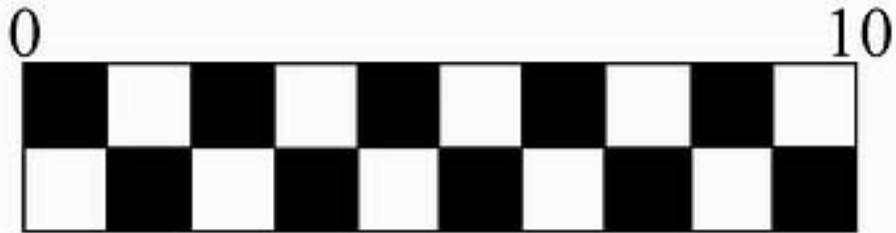
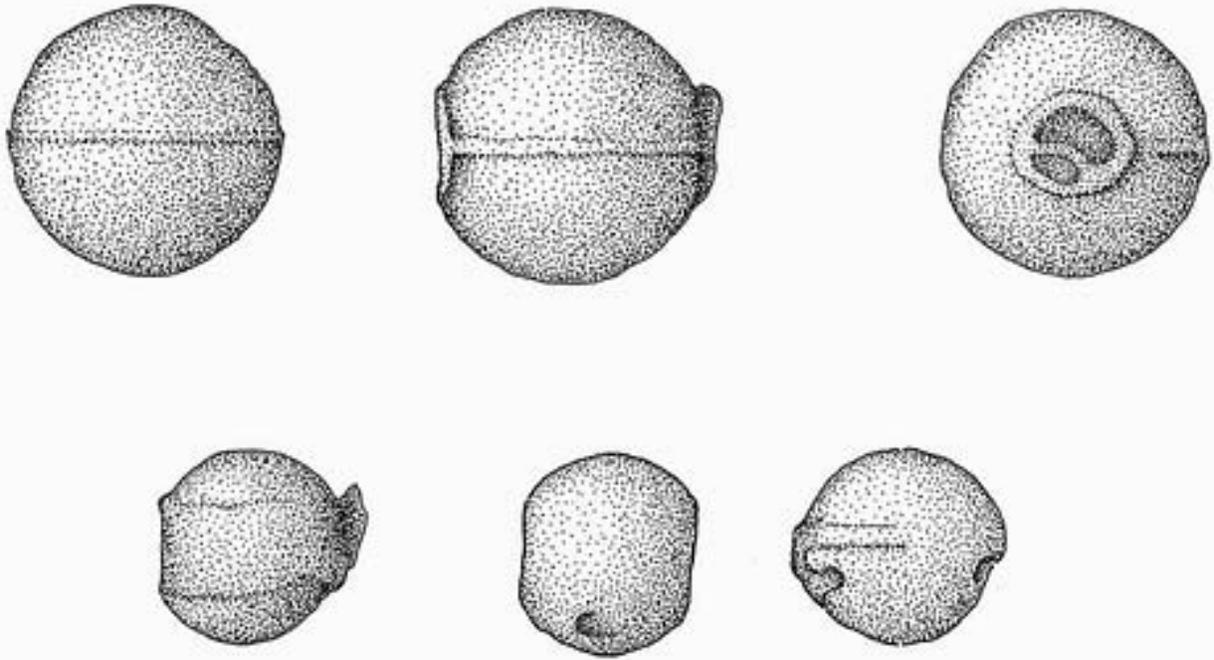
between 86 and 91 centimeters in length, had a bore diameter of 3.8 to 4.4 centimeters, and fired either ½-pound or ¾-pound projectiles.

A total of 20 cast iron cannon projectiles was recovered from the Shoreline Site during the 2001 field season, and include examples of round, grape, case, bar, and half-bar shot. All were found exposed on the surface of the riverbed within a large, diffuse scatter of shot that comprised the approximate center of the site. The largest specimens in the assemblage include four examples of solid round shot that measure either 8.9 or 9.0 centimeters in diameter. These dimensions correspond closely to the standard size of 6-pounder ammunition listed in three separate mid-eighteenth century British treatises on artillery, as well as archaeological examples recovered from *Defence*, *HMS Swift*, the Phinney Site, and the Valcour Bay submerged battlefield (Cano 1998; Cohn et al. 2002: 85, 87; Ford and Switzer 1982: 33; Mountaine 1747: 103; Muller 1780: 6, 56; Peterson 1969: 42; and Schmidt 2000: 16-17).

The remaining round shot in the assemblage correspond to two distinct groups of smaller projectiles measuring either 3.2 or 2.5 centimeters in diameter (Figure 32). Based upon comparisons with similarly sized specimens recovered from other Revolutionary War-era submerged sites, the larger diameter shot appear to have been used for rounds of grape shot. The smaller diameter examples, on the other hand, were likely used in either case or canister ammunition. In addition to the aforementioned, both varieties of shot may also have been used as single projectiles for a small caliber weapon such as a swivel gun (Carauna 1997: 222-228; Cohn 2002: 85-87; Ford and Switzer 1982: 54-55; and Peterson 1969: 27).

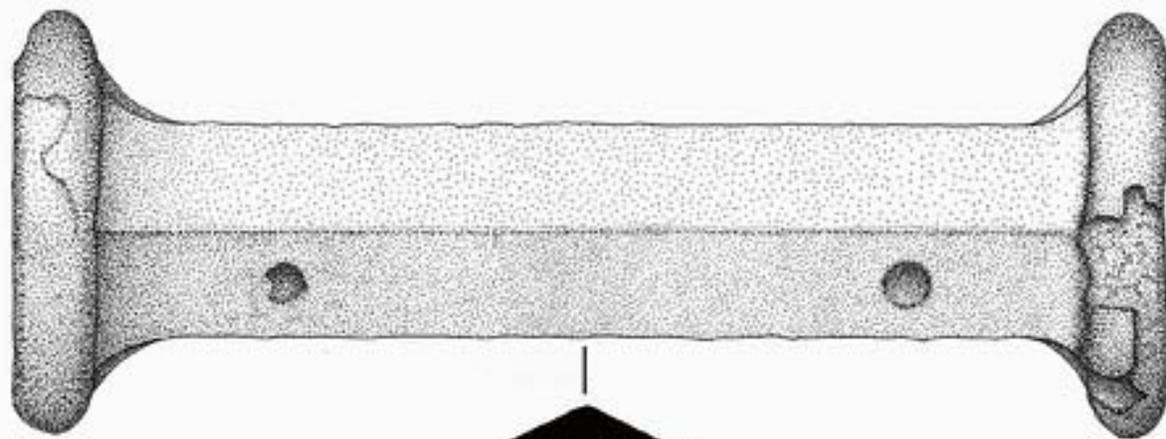
Three bar shot and one example of half-bar shot were recovered from the Shoreline Site in 2001 (Figure 33). Designed to spin and tumble end over end when fired, bar shot typically consisted of a wrought iron bar capped on either end by semi-hemispherical cast-iron “heads.” Although manufactured according to the same basic design principles as regular bar shot, the examples from the Shoreline Site exhibit two unique characteristics: 1) a thicker, six-sided central shaft or crossbar that flares out at each end to form a head; and 2) flat rather than spherical or semi-hemispherical heads. Based upon their unusual construction, it appears that each example of bar shot recovered from the site was cast in its entirety in a mold. By contrast, most other varieties of eighteenth-century bar shot were normally produced from two cast heads welded to a wrought-iron bar (Cohn 2002: 86).

All three bar shot appear similar in form, but exhibit slight variations in size and weight. The largest (PB2-007) has an overall length of 26 centimeters, a central shaft diameter of 5 centimeters, head diameters of 8.7 centimeters, and a weight of 3,503 grams (7.7 pounds). Another example (PB2-020) is 24.5 centimeters long, has shaft and head diameters of 4.8 and 8.9 centimeters respectively, and weighs 2,737 grams (6 pounds). The smallest bar shot (PB2-023),

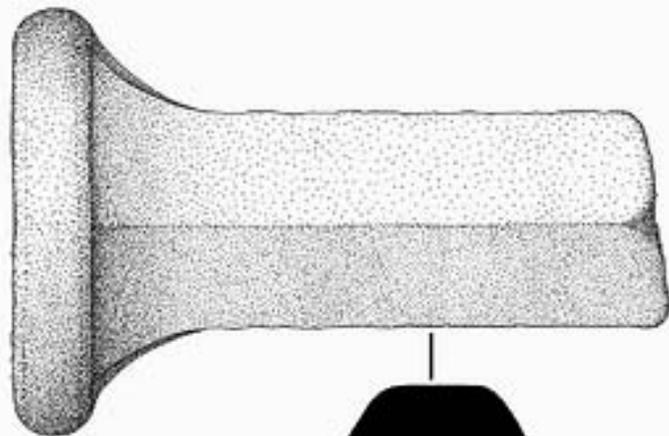


centimeters

Figure 32. Examples of grape and canister shot recovered from the Shoreline Site. Illustration by James W. Hunter, III.



centimeters



centimeters

Figure 33. Examples of unique iron cannon projectiles recovered from the Shoreline Site: *top*; bar shot, *bottom*; half-bar shot. Illustrations by James W. Hunter, III.

is the second heaviest, weighing approximately 3,251 grams (7.2 pounds). It has an overall length of 23 centimeters, a shaft diameter of 4.3 centimeters, and head diameters of 8.5 centimeters. Sometimes identified as “double-headed bar shot,” this form of projectile was used with murderous effect during the Battle of Trafalgar in 1805 (Bound 1998). In one well-documented instance, a single piece fired from the Spanish frigate *Santissima Trinidad* killed eight crewmen aboard the British flagship HMS *Victory*. Examples identical to those in the Shoreline Site’s assemblage have also been recovered from an unidentified eighteenth-century shipwreck off the coast of Uruguay, but are not reported elsewhere. Based upon its association with *Santissima Trinidad*, this variety of bar shot is presumed to be of Spanish origin (Bound 1998).

An unusual iron projectile (PB2-021) was recovered from the periphery of the loose shot scatter, approximately 1.5 meters south of a cluster of 6-pound balls and grape shot. Essentially one-half of a complete bar shot bisected laterally, the artifact is comprised of a six-sided bar that tapers outward to a circular head with a flat outer surface. It has an overall length of 13.1 centimeters, a shaft thickness of 4.3 centimeters, and a head diameter and thickness of 8.6 and 1.5 centimeters respectively. The shaft end appears to have been broken, suggesting that the bar shot half originated from a full bar shot that impacted an object and separated at its approximate midpoint. Alternatively, it may have been intentionally produced. If so, the half-bar shot’s application in warfare remains unclear. The possibility exists that half-bar shot, when fired, would spin through the air in much the same way as regular bar shot. Its ungainly shape, however, seems to suggest otherwise. Unfortunately, there are no known historical and archaeological sources with which to compare this unique projectile.

Ceramics

The 2001 field investigations at the Shoreline Site yielded a total of 11 ceramic sherds, all of which were collected from areas immediately underneath or adjacent to cannon and shot. In one instance, a sherd was removed from the ferrous concretion on the underside of one of the larger artillery pieces. Analysis of the assemblage revealed that most of the sherds originated from ceramic vessels produced in the years following the American Revolution and are most likely intrusive to the site. No complete ceramic vessels were recovered and no sherds with maker’s marks were discovered, although four specimens retained some form of diagnostic decoration.

Perhaps the oldest ceramic object recovered from the Shoreline Site is a small body sherd of coarse earthenware (PB2-025), likely from a Spanish olive jar (Figure 34). The sherd is tan on its interior and exterior surfaces, and exhibits a tan to buff colored porous paste with small sand inclusions. It appears to have originated from an incompletely fired vessel, exhibits rill marks on both its interior and exterior surfaces, and measures 8.2 x 6.7 centimeters with a thickness of 1.3



Figure 34. Olive jar body sherd (PB2-025) recovered from the Shoreline Site. Photograph by James W. Hunter, III.

centimeters. The olive jar fragment was located approximately ten meters north of Baseline One at the 47-meter mark. It was buried beneath 8-10 centimeters of gravel and coarse sand, and was located during hand fanning of bottom sediments around a concreted iron bar (PB2-024).

Low-fired coarse earthenware vessels such as olive jars were generally very porous and tended to absorb their liquid contents, which resulted in seepage. One method for solving this problem was to coat the interior of the vessel with a substance impervious to liquids, such as pine pitch or lead glaze (James 1985: 13 and Smith et al. 1999: 97). However, observation of the sherd's interior surface revealed that it was not coated with a glaze, pine pitch, or resin.

Perhaps the most ubiquitous of colonial New World ceramic containers, olive jars were derived from Mediterranean wine amphorae and were used primarily to store and transport a variety of foodstuffs and other items, including wine, olives, olive oil, vinegar, water, honey, beans, chickpeas, capers, almonds, dates, pitch, and gunpowder (Avery 1997: 89). Durable, reusable, and shaped so that they could easily be stacked in the hold of a ship, olive jars provided a stable and versatile alternative to wooden casks and barrels. The many utilitarian attributes and ten-year life expectancy of these coarse earthenware vessels ensured that they would serve as the dominant ceramic cargo container in the American colonies until the beginning of the nineteenth century (Deagan 1987: 31). Although typically associated with Spain and its New World colonies, olive jars were commonly traded to, and used by, other European powers. Excavations at a number of colonial British and French archaeological sites in the United States and elsewhere have revealed significant assemblages of olive jar material (Barton 1981; Bense 1999; Deagan 1987; and Goggin 1960).

A small base sherd of pearlware (PB2-LOT 4) was discovered lying on the riverbed just north of the iron swivel gun. The fragment measures 5.1 x 3.2 centimeters and is 0.4 centimeters thick. It appears to have originated from a molded plate, bowl, or cup and exhibits a portion of a hand-painted, light cobalt blue motif on both surfaces. The paste consists of vitreous white refined kaolin clay coated with a blue-tinted lead glaze on both its interior and exterior surfaces. Blue pooling is evident in the glaze along crevices at the edge of the footring. Underglaze hand-painted floral motifs are found on pearlware items dating from 1720, although the type was not well established in the American colonies until after 1780 (Hume 1969: 128).

Two sherds (PB2-008 and PB2-012) of what appear to be American-produced redware were also found in close proximity to the iron swivel gun. Both specimens exhibit a soft, chalky terracotta paste with numerous air pockets and small sand inclusions. The body of each sherd is covered with a thinly applied glaze that is colored dark purplish (mahogany) brown. Portions of both specimens, especially the outer edges, appear to have been scoured and eroded by sand and

water. Based upon individual characteristics, both redware fragments appear to have originally comprised part of one or more sizable wheel-thrown ceramic vessels.

Artifact PB2-008 is a rim fragment that exhibits glaze on both its interior and exterior surfaces, primarily on the former. Along the rim, the glaze has largely exfoliated and flaked away. The rim sherd was located immediately adjacent to the swivel gun, approximately 16 centimeters south of the gun's exposed trunnion. It measures 8.4 x 2.9 centimeters, has a body thickness of 0.7 centimeters, and a rim thickness of 1.2 centimeters. Based upon its shape and size, the fragment likely originated from a brimmed plate, bowl, storage jar, or cooking pot. The other example of redware (PB2-012) is a body sherd that appears to have originated from a large wheel-thrown jar or pot. Thinly applied glaze and prominent rill marks are evident only on the sherd's interior surface. The exterior, by contrast, appears to have been heavily abraded by sand and water. Although both sherds recovered from the Shoreline Site exhibit a few attributes characteristic of eighteenth-century American redwares, their overall appearance, size, and method of manufacture indicate a later (likely nineteenth-century) production date (Edward Chaney, personal communication).

The remainder of the Shoreline Site's ceramic assemblage (eight sherds) is comprised of a wide variety of decorated and undecorated whiteware. All of these items, including examples of plain ware (1820-present), transfer-printed ware (1850-present), plain Ironstone (1850-1900), and Scottish Spongeware (1840-1920) are unquestionably intrusive to the site. During the two centuries following the American Revolution—particularly the latter half of the nineteenth century—the Bangor waterfront witnessed a tremendous increase in development and usage by a variety of industries, shipping and shipbuilding foremost among them. The sheer volume of watercraft present in the river at that time, combined with myriad commercial and noncommercial activities along the waterfront, meant that a significant amount of material was either accidentally or intentionally discarded into the waters of the Penobscot. Not surprisingly, many of these objects came to rest among the cannon and shot that comprise the bulk of the Shoreline Site. In at least one instance, an intrusive sherd of whiteware (PB2-015) was deposited close enough to Cannon 1 that it was eventually incorporated into the ferrous corrosion matrix on the underside of the gun.

Glass

A significant amount of glass material was observed at the Shoreline Site during the 2001 field season, but only two artifacts—one of which positively dates to the colonial era—were recovered. A glass marble (PB2-013) was recovered during excavation of sediment from around and beneath the shoreward side of Cannon 1. It is machine-manufactured, has a maximum diameter of 1.6 centimeters, and exhibits a mottled and swirled pattern comprised of emerald

green and milky white glass. Prolonged immersion in the Penobscot River has caused the glass to acquire an abraded and slightly pitted exterior, which in turn has given the glass an opaque, frosted appearance. Machine-made glass marbles were first developed in 1902 by Martin F. Christensen, patented by the United States government in 1905, and produced by a variety of companies during the remainder of the twentieth century (Cooper 2000). Although its precise identity is difficult to pinpoint, artifact PB2-013 most closely resembles the “Onyx/Snake Corkscrew” and “Limeade Swirl” varieties of machine-made glass marble manufactured by the Akro Agate Company, Inc. between 1910 and 1951 (Block 1999: 86-88).

The colonial-era artifact (PB2-016) is a large olive-green glass bottleneck with an applied string lip (Figure 35). Its early origin is indicated by a number of identifying characteristics, including the color, large number of small air bubbles in the glass, and the artifact’s crudely applied rim. Although too large to have originated from a standard spirit or wine bottle, it is about the right size for a carboy or demijohn.

Archaeological examples nearly identical to PB2-016 have been recovered from colonial contexts in downtown Pensacola, Florida, and at the Oxon Hill Manor site in Maryland (Garrow and Wheaton 1986: 431 and Lloyd, personal communication). The neck fragment exhibits evidence of breakage along both its base and lip, and appears to have been heavily scoured by riverbed sediment over much of its exterior surface. The interior surface of the neck, by contrast, remains largely unaffected by scouring. It was located during excavation of bottom sediments immediately adjacent to the shoreward side of Cannon 1. The specimen has a preserved length of 12.3 centimeters and preserved diameters at the base and lip of 5.7 centimeters and 5.1 centimeters, respectively. The thickness of the neck varies between 0.9 centimeters at the base and 1.1 centimeters at the lip. The preserved width of the applied string lip is 2.9 centimeters.

The terms “carboy” and “demijohn” were first used by mid-eighteenth century manufacturers and merchants to describe large bottles that were typically hand-blown, covered with wicker casings, and used to ship and store bulk quantities of liquids (Figure 36). Prior to 1800, differentiation between demijohns and carboys apparently did not exist, and the names were used interchangeably to describe similar glass vessels. While most examples were imported from England, a sizable number of large bottles were produced in American glasshouses, including those in New York, Pennsylvania, and Connecticut. Imported bottles ranged in size from 4 to 20 gallons, while their American counterparts rarely exceeded 5 gallons. Although a wide assortment of sizes was available, the gallon was the largest glass bottle in regular production during the Revolutionary War era (McKearin and Wilson 1978: 255-256).

Advertisements from the early-to-middle eighteenth century reveal that demijohns and carboys were used to store and transport a wide assortment of noncorrosive liquids including



Figure 35. Colonial-era glass 'carboy' bottle neck (PB2-016) recovered from the Shoreline Site. Photograph by James W. Hunter, III.

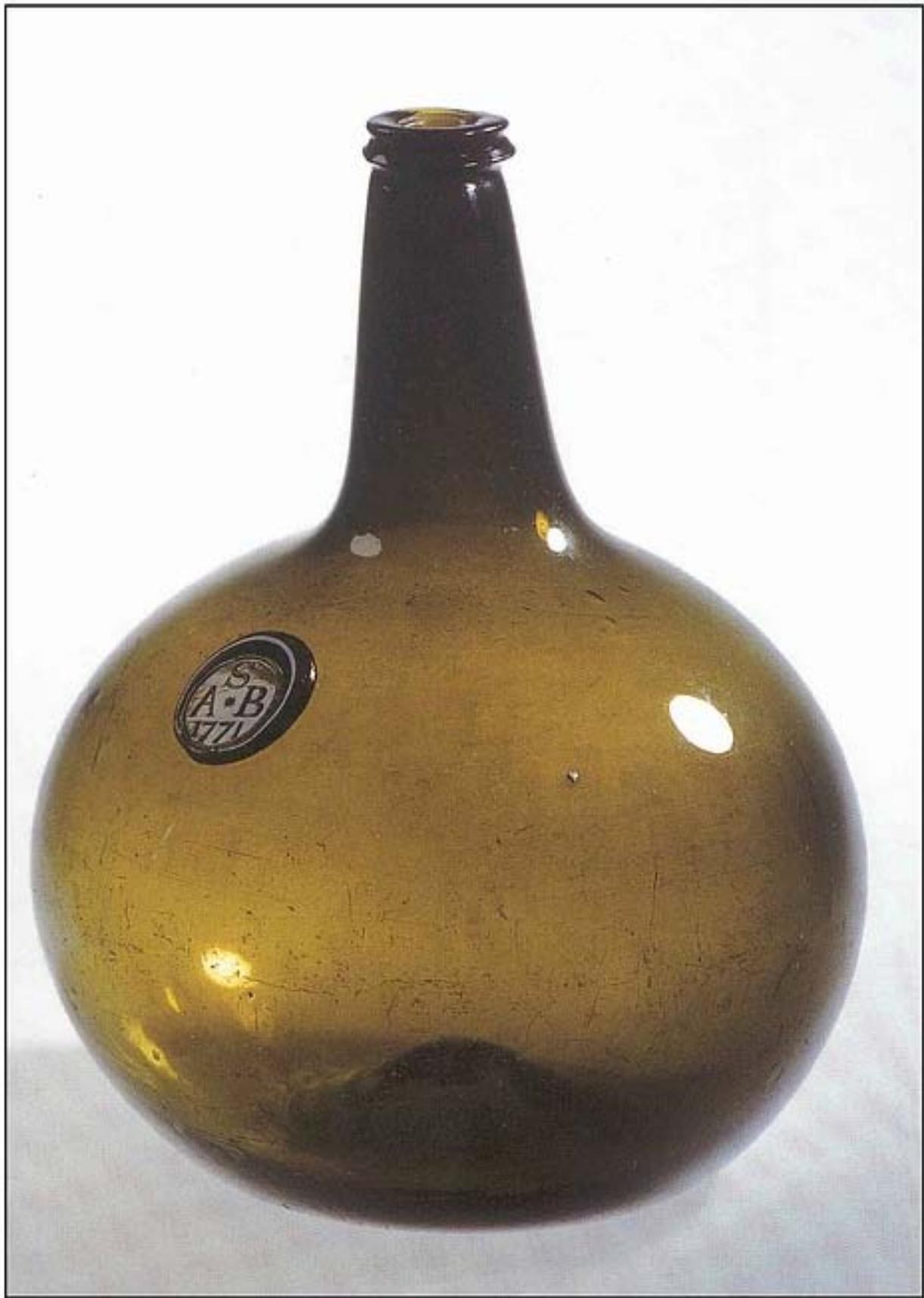


Figure 36. Example of a large English "carboy," dated 1771. Bottle height is 30 centimeters; maximum diameter is 24 centimeters. Photograph adapted from Willy Van den Bossche, *Antique Glass Bottles: Their History and Evolution (1500-1850)*, Antique Collector's Club, Woodbridge, England (2001), p. 96.

spirits, wines, fruit juices, medicinal cordials, oils, honey, and toilet water. Toward the end of the century, however, carboys were modified to carry liquids such as oil of vitriol, Aqua Fortis, Nitre Fortis, muriatic acid, ether, and a variety of varnishes. As befitted their functions, most demijohns and carboys were sturdy, thick-walled, “big bellied” globular or ovoid bottles of hand blown glass. Almost every example from the mid-eighteenth century was produced of olive green or black glass and few, if any, were created in molds (McKearin and Wilson 1978: 257).

Miscellaneous Artifacts

A small number of miscellaneous iron items of undetermined origin were recovered at the close of the 2001 field season. The largest is a stubby tube-like object with small, centrally located circular openings at each end (PB2-033). It has an overall length of 35 centimeters and a maximum diameter of 13.4 centimeters. The openings at each end of the artifact are both 3.8 centimeters in diameter. The wall thickness of the object varies between 2.0 and 3.1 centimeters. Initially, NHC archaeologists identified PB2-033 as a breech chamber for an early colonial-era cannon. However, radiographic analysis of the artifact following its recovery revealed attributes consistent with post-colonial manufacture. Although its exact identity remains uncertain, the tube-like object is most likely a section of steel utility pipe or a piece of modern machinery.

A section of hand-wrought iron bar (PB2-024) with an overall length of 84 centimeters was located approximately 12 meters southwest of Cannon 2, in close proximity to a colonial-era olive jar sherd (PB2-025). It is roughly square in cross-section, gently curves over its entire length, and terminates in a blunt, flat edge on one end and a wedge-shaped point on the other. The bar has a maximum width of 3.6 centimeters and tapers down to 2.8 centimeters at the wedge-shaped end. Its thickness varies from 3.6 centimeters at the blunt end to 3.0 and 3.3 centimeters at its center point and angled end, respectively. Currently, the age and identity of PB2-024 remain uncertain—the object appears to be a fragment of modern angle iron, but could just as easily be a piece of colonial-era bar stock. Conservation of the artifact may reveal diagnostic markings or other attributes that will aid in its identification.

Two fasteners and an unidentified iron object were located in the immediate vicinity of the large ferrous conglomerate (discussed below). Both fasteners appear to be hand-wrought and have shanks with square-shaped profiles. Their heads (a diagnostic feature on some varieties of colonial-era fastener) are badly distorted by the combined effects of use and corrosion. The smallest example (PB2-032) exhibits an overall length of 10.2 centimeters, a shank width of 0.9 x 1.0 centimeters, and a head diameter of 1.9 x 1.7 centimeters. The other fastener (PB2-001) is a large spike with an overall length of 21 centimeters and a shank width of 1.9 centimeters square. Its head is roughly circular and measures 3 centimeters in diameter. The unidentified object (PB2-002) most closely resembles a U-shaped handle and has a maximum length of 10.8

centimeters, width of 5.4 centimeters, and shaft thickness of 1 centimeter. Each end is square in profile and measures 2.6 x 1.9 centimeters and 1.8 x 1.5 centimeters, respectively. Its age, origin, and function remain unclear.

A large ferrous conglomerate containing a variety of items, including multiple round shot, bar shot, fasteners, a fragment of copper sheathing, and miscellaneous unidentified iron fragments, was located approximately 6.2 meters southeast of Cannon 2 (see Figure 30). When found, its upper surface was partially exposed above a surrounding riverbed matrix of coarse sand, cobble, and large granite boulders. Once completely removed of its overburden, the conglomerate appears roughly oval in shape and measures 4.0 meters (north/south) x 1.3 meters (east/west). Excavation of sediments from around and beneath the conglomerate at two different points revealed that it has a maximum thickness of only 15 centimeters. The exposed portion of copper sheathing is approximately 40 centimeters long, 20 centimeters wide, and 2 millimeters thick. It is folded over at two different points and retains a small number of tack-sized fastener holes. Because copper sheathing was found concreted to the underside of the conglomerate, NHC archaeologists speculated that articulated hull remains might be located nearby. However, excavation in this area did not reveal any ship's timbers or other hull-related architectural components.

Based on its size and composition, the conglomerate appears to best represent the concreted contents of a ship's shot locker. Further, the presence of various-sized fasteners and miscellaneous fragments of iron suggest that the shot locker may have been filled with langrage. A similar assemblage of concreted scrap iron, fasteners, and small shot was recovered from the stern of *Defence* in 1981 (Ford and Switzer 1982: 124). How the conglomerate arrived at its current location remains unclear; one possibility is that it was deposited on site with a wrecked vessel that has since completely deteriorated. Alternatively, it may have been formed from a pile of munitions that was hastily discarded into the river during the final hours of the American retreat in 1779.

VIII. CONCLUSIONS AND RECOMMENDATIONS

Phinney Site

The Phinney Site represents the remains of a mid-to-late eighteenth century vessel that comprised one of the fleet of American warships scuttled at Bangor during the final hours of the Penobscot Expedition of 1779. Based upon the overall extent of exposed hull remains, the number and relative positions of the vessel's mast steps, and the dimensions of individual frames and timbers, the wreck is most likely that of a twin-masted brig, brigantine, or schooner. In terms of overall appearance, it was bluff bowed, full-bodied, and had an overall length between 85 and 95 feet. Conclusions regarding the Phinney Site's tonnage are speculative; however, data gleaned from the 1999 and 2000 field investigations indicate that it had a displacement range between 200 and 300 tons burthen.

Examination of the Phinney Site's hull remains revealed clear evidence that the vessel was built according to British or British-influenced methods of hull design and manufacture, and that considerable time, money, and effort were expended in its construction. For example, the majority of the wreck's surviving hull components appear to have been carefully fashioned, arranged, and fastened. There is some indication that the vessel's builders incorporated the use of master frames and whole moulding during the construction process. Specific attributes of the framing arrangement indicate that it is a mid-to-late eighteenth century transitional variant between single frame and true double frame construction. Likewise, the wreck's bow cant frames and mainmast step assembly exhibit characteristics consistent with vessels built during the latter half of the 1700's.

Analysis and identification of wood samples taken from a variety of the Phinney Site's hull components revealed that American white oak and red oak were the predominant timber species used in its construction. The prevalence of both of these wood types—which were used regularly by New England shipwrights throughout the eighteenth century—strongly suggest that the vessel was built in the American colonies, possibly at a shipyard in what is now the northeastern United States. This hypothesis is reinforced by data obtained from bilge sediment samples recovered from the wreck in 1999. The samples were almost exclusively comprised of pollen and phytolith types originating from trees, grasses, and flowering plants native to the northeastern United States.

Charred timbers, charcoal, and singed artifacts are present throughout the wreck and indicate that the vessel burned just prior to sinking to the river bottom. However, there is no evidence to suggest that the fire reached the vessel's powder magazine and precipitated the kind of catastrophic explosion that claimed approximately half of the American fleet scuttled at Bangor.

Frames associated with the disarticulated section of the wreck’s starboard hull are clearly broken, but this appears to have resulted from the gradual collapse of the wreck fabric in the years following the vessel’s loss rather than from a single destructive event.

The assemblage of diagnostic artifacts recovered from the Phinney Site, though small, reveal much about the wreck’s temporal and cultural affiliation, as well as its operational status prior to being lost in the Penobscot River. Almost every contextually sound diagnostic artifact recovered from the wreck encompasses a temporal span that includes both the American Revolution (1775-1781) and the Penobscot Expedition (1779):

Table 2.
Eighteenth-Century Diagnostic Artifacts Recovered from the Phinney Site

Artifact Type	Date Range
American Redware	1760-1900
Creamware	1760-1820
Fulham Stoneware	1690-1775
Kaolin Pipe Fragments	1700-1790
Copper-Alloy Shoe Buckle (recovered 1999)	1750-1800
<i>2-Reale</i> Coin	1708 +

The ceramic fragments with the best archaeological context have manufacturing and use dates that range between 1690 and 1900; however, all of these types peaked in popularity during the latter half of the eighteenth century. The Spanish *2-Reale* coin recovered from the wreck’s mainmast step mortise was minted in 1708—establishing that year as the *terminus post quem* for the vessel’s construction—but it is unlikely that it symbolizes the year the vessel was built. The radial cant frames, mainmast step assembly, and other diagnostic artifacts all indicate that the vessel was probably not constructed prior to 1740.

The presence of American redware fragments and the copper-alloy shoe buckle provide material evidence of the wreck’s American ethnicity. Redware similar to that found on the Phinney Site was widely produced in Massachusetts and distributed to nearby ports (such as Boston), where its greater availability, durability, and lower cost probably made it an attractive commodity for common seamen and ship captains alike. The shoe buckle—recovered from the Phinney Site during the 1999 field investigations—bears a striking resemblance to shoe buckles recovered from the privateer *Defence*, Continental gondola *Philadelphia* and the Terrence Bay Wreck. These latter vessels were colonial-built and operated, and each bore an artifact assemblage comprised primarily of items manufactured and/or distributed in New England and the northern colonies. In addition to indicating ethnicity, the shoe buckle also suggests a

differentiation in status aboard the vessel. Copper-alloy buckles were considered finer quality than their pewter or steel counterparts, and were usually worn by officers rather than seamen.

Another of the Phinney Site's status indicators may also hint at British ownership or operation of the vessel during its sailing career. Creamware, an English-produced refined earthenware that is commonly associated with higher status occupations on archaeological sites, comprised a portion of the wreck's contextually sound ceramic assemblage. Because creamware is more prevalent on sites that were subject to British military and civilian administration during the American Revolution, its presence on the Phinney Site suggest that the vessel may have been under British control prior to having an American crew. Likewise, the discovery of Fulham stoneware, which typically only occurs on sites that received British exports during the war, suggest a prior British presence on the vessel. Of course, the possibility also exists that American crewmembers obtained these items through illicit or third party trade, or by acquiring them secondhand.

The disabled cannon, cannon fragment, lead shot, and large conglomerates of iron round shot all indicate that the vessel served in a military capacity when it was lost, either as a small auxiliary warship or armed privateer. Further, the size of the cannon and the majority of the wreck's iron shot suggest that the vessel was armed primarily with 4-pounder cannon. Most historical sources (see Appendix A) agree that only three of the ten vessels that managed to reach Bangor included 4-pounders in their complement of shipboard artillery. The remainder of the wreck's munitions assemblage includes projectiles for ordnance ranging in size from ½-pounder swivel guns to 18-pounder siege weapons. All of these items were probably intended for use as ammunition, and the large caliber examples may have found their way into the vessel's shot lockers during the hasty evacuation of American ground forces and their siege equipment from the Majabagaduce Peninsula. Conversely, they may have been stowed in the vessel's hold as ballast or scrap metal. The disabled gun and the cannon fragment were clearly being used as ballast when the vessel wrecked, although both probably once comprised part of the working complement of shipboard artillery.

Currently, the NHC cannot conclusively assign an identity to the Phinney Site; however, enough notable parallels exist between the historical and archaeological records to tentatively identify the wreck as the Continental brig *Diligent*. *Diligent* was built in Boston and commissioned for service in the Royal Navy in 1776. It had an overall length of 88 feet, 5 ¾ inches, a beam of 24 feet, 8 inches, and a depth of hold of 10 feet, 10 inches. One documentary source records *Diligent*'s displacement as 236 tons. Originally rigged as a schooner, the vessel was modified to a brig shortly after it was commissioned. HMB *Diligent* participated in a number of small British naval engagements, including a month-long operation against American

positions on the Hudson River in October of 1777. Historical sources indicate that the vessel was armed with 3-pounder cannons during the Hudson River assault.

While on patrol off Sandy Hook, New Jersey on May 7, 1779, *Diligent* encountered and engaged the Continental sloop *Providence*. During the battle that followed, *Diligent* was hit with two broadsides and two volleys of musketry, which caused extensive damage to its masts, rigging and hull, and killed 11 of its crew. Nineteen other crewmen, including all but one of the brig's officers, were wounded. The remainder of its crew of 54 cowered below decks and refused to fight. Faced with such overwhelming odds, *Diligent's* commander surrendered to the crew of *Providence*. The defeated brig was then escorted to Boston, where it was repaired, refitted, given a new commander and crew, and entered into the service of the Continental Navy. Although *Diligent* was armed with twelve 3-pounders when captured, it is unclear whether it retained this armament as a Continental Navy vessel. Some historical sources suggest that the brig's 3-pounders were replaced with a larger complement of 4-pounders in preparation for its role in the Penobscot Expedition.

Following the failure of the siege at Majabagaduce, *Diligent* accompanied the remainder of the American fleet's armed vessels in their frantic retreat up the Penobscot River. Upon reaching the head of navigation, *Diligent's* commander, Lieutenant Philip Brown, ordered his vessel brought to anchor approximately two miles below the falls near Bangor. Documentary sources are unclear about the brig's actual location in the river when it was finally scuttled, but it was reportedly "a safe distance away" from the other vessels in the anchorage and appears to have been moored along the eastern (Brewer) shore "opposite Bangor" (Buker 2002: 93, 95). On the morning of August 16, 1779, the remaining naval captains convened and elected to destroy their ships. *Diligent's* crew set their vessel on fire shortly thereafter. According to Colonel John Brewer, the Continental Navy brig burned to the waterline, but did not explode. It was one of only three vessels whose powder magazines did not detonate as their hulls were consumed by flames.

Shoreline Site

The Shoreline Site is a scatter of Revolutionary War-era artillery and munitions that was likely created by retreating American forces as they hastily discarded their equipment into the Penobscot River. Both of the larger cannons in the assemblage date to the mid-to-late eighteenth century and appear to be either 4 or 6-pounder weapons, based on their respective overall lengths and bore diameters. Further, it appears that both guns comprised a complement of shipboard artillery, because neither is large enough to match the size of iron siege weapons described in historical accounts of the Penobscot Expedition. Although both cannons appear to have been intentionally dumped in the river, neither example exhibits evidence of being spiked or otherwise

disabled. This is curious but not surprising, given the hasty, disorganized manner in which American crews abandoned their vessels at Bangor. Anticipating the arrival of British forces within hours, panicked seamen and soldiers initiated a haphazard, wholesale abandonment of anything that could not be easily transported. Since disabling a cannon is a time-consuming, laborious task, it was probably easier to dump the Shoreline Site guns in the river rather than spike them. Of course, the possibility also exists that the cannons were not disabled because their owner(s) intended to return to the dumpsite at a later date to retrieve them.

The swivel gun, like the larger pieces of artillery, dates to the mid-to-late eighteenth century and originated from one of the armed vessels' assemblage of shipboard weapons. Its more curious attributes—poorly constructed and severely damaged, but loaded and ready to fire when discarded in the river—makes it perhaps the most unique and revealing artifact recovered from the site. The weapon's off-center bore suggests poor craftsmanship, a limited knowledge of cannon manufacture, considerable haste on the part of the founders that produced it, or a combination of these factors. This, in addition to the gun's distinctive lack of diagnostic markings, seems to imply that a small American foundry cast it. Conversely, it may have been produced by one of the United States' European allies and sold into American service because it failed to meet strict production standards that characterized artillery accepted by Europe's various armies and navies.

The variation in barrel wall thickness resulting from the swivel gun's off-center bore very likely detracted from the weapon's overall structural integrity. This in turn probably led to a catastrophic failure of the gun at the muzzle flare or the area immediately adjacent to it. In spite of its damaged condition, the weapon continued to see service. The fact that the gun was loaded when it ended up in the Penobscot River attests to this. Given the haste with which the Penobscot Expedition was put together, the large number of privately contracted vessels that comprised the fleet, and the relatively small quantity of serviceable artillery available to American forces during much of the war, the broken swivel gun very likely saw action because it was available for the task.

Iron projectiles discovered at the site provide a glimpse of the variety of munitions used by American ground and naval forces during the Penobscot Expedition. The size of the largest round shot specimens (6-pounders), and the prevalence of bar shot, grape shot, and canister ammunition suggest that most of these items were intended for use with shipboard artillery; however, a few examples could have been used with land-based siege weapons. Examples of bar shot recovered from the site do not resemble bar shot forms that were commonly used by American and British forces during the American Revolution. Interestingly, the only other documented examples of this type of projectile appear to be Spanish in origin, indicating that they may have been supplied to American forces by the Spanish military. This is not surprising,

because Spain entered the war on the side of the Americans in April 1779 and sent numerous arms shipments to the colonies for the remainder of the conflict.

The large iron conglomerate located at the center of the site appears to be the remnants of a large pile of langrage. This corroborates first-hand accounts of the expedition that state that guns aboard the privateers *Hector* and *Black Prince* were loaded with langrage. How the conglomerate arrived at its current location remains unclear, although it is possible that it was deposited on site with a wrecked vessel that has since completely deteriorated. More likely, it was formed from a pile of munitions hastily discarded into the river by retreating American sailors and soldiers.

Although the assemblage of cannon and munitions at the Shoreline Site almost certainly originated from one or more Penobscot Expedition vessels, it is presently impossible for NHC archaeologists to ascertain exactly which member(s) of the fleet the site is associated with. The close proximity of individual artifacts seem to suggest that the entire assemblage originated from one source. However, the lack of definitive shipwreck remains indicate that deposition of the cannon and shot assemblage probably occurred independently of an actual wrecking event. Further, the loaded swivel gun and undamaged cannons imply that the discard of artillery overboard may have been a deliberate act and not the result of a catastrophic explosion. Of course, the possibility also exists that the site is associated with a shipwreck that is now buried under the shoreline due to past landfill operations and waterfront development along the riverfront.

Recommendations

Both the Phinney Site and Shoreline Site are significant to maritime archaeology and state, regional, and national history. As two of only four known submerged sites linked to the Penobscot Expedition, both have the potential to yield additional archaeological information about an incident in United States naval history that has traditionally been overlooked. Each site can contribute significantly to research in such specific areas of study as Revolutionary War-era ship construction, armament, and outfitting. Perhaps most importantly, both sites have the potential to provide rare insight into lifeways aboard American warships and privateers during the American Revolution. Each also creates a vivid snapshot of the final, desperate actions of American soldiers and sailors as they abandoned their ships and equipment and retreated into the Maine wilderness.

A number of questions remain to be answered regarding both sites. For example, the exact identity of the Phinney Site is still an open question and should be verified. Among other things, this would help determine ownership of the wreck and what specific state and/or federal laws apply to its continued management and protection. Investigation of the Phinney Site in 1999 and

2000 indicated that a significant portion of the vessel's port side might be deeply buried in the riverbed. Any future investigations should determine the extent and degree of preservation of these remains, and develop research questions and methodologies for positively identifying the wreck. Additionally, further work at the site should strive to develop and improve our current knowledge of the vessel's complete history, its role in the Penobscot Expedition, the lifeways of its crew, and the events that contributed to its loss.

The Shoreline Site's origins are also speculative and in need of verification. A definitive link between the site and a particular Penobscot Expedition vessel would clear up custodial issues. The lack of timbers and other hull remains makes this task difficult; however, the two cannons still *in situ* may retain diagnostic markings that link them to a specific warship or privateer. Future recovery and conservation of these guns may provide the "smoking gun" that verifies the Shoreline Site's point of origin. Recovery would also effectively prevent relic collectors or treasure hunters from attempting to remove either artifact from the riverbed. Partial or complete recovery and conservation of the iron conglomerate may also provide clues—both to the artifact's identity and the origins of the site.

Remarkably, both sites are well preserved, despite their relatively shallow depth and presence in a portion of the Penobscot River traditionally characterized by extensive boat traffic, maritime activity, and waterfront development. Sonar data from the 1999 and 2000 field seasons indicate that neither resource is immediately threatened by riverbed erosion. Further, submerged portions of the riverbank immediately adjacent to each site appear stable and do not exhibit evidence of cutting, slumping, or scouring.

Oddly enough, the presence of continual boat traffic and waterfront activity, combined with the river's characteristic cold water and poor visibility, has probably helped protect both resources from the depredations of artifact collectors and treasure hunters. However, media coverage of NHC's 1999 and 2000 field seasons raised concerns that unwanted attention may have been attracted to one or both sites. Consequently, senior members of the Underwater Archaeology Branch met with Maine state officials and agreed to post a "NO GROUND DISTURBANCE" sign at the Phinney Site and arrange temporary monitoring of the Shoreline Site from the Bangor Harbormaster's facility, which is situated almost directly over the site. Other enacted measures included site concealment and the arrangement of protection and enforcement through the Harbormaster's office, local law-enforcement authorities, and the U.S. Coast Guard Group, Southwest Harbor, Maine.

Although the Phinney and Shoreline Sites have been preserved so far, their continued protection is not guaranteed. A modified, comprehensive site protection plan needs to be implemented for both resources. This plan should be the result of a cooperative effort that

includes the Navy, the Maine Historic Preservation Commission, elements of local law-enforcement, and local historic preservation groups. Because both sites are located on State-owned bottomlands, they are officially protected under the Abandoned Shipwreck Act of 1987 (43 U.S.C. 2101 et seq., Public Law 100-298 [April 28, 1988]). Additionally, the State of Maine affords protection to its submerged cultural resources under Maine Statute 27 MRSA, Sections 371-378.

If the Phinney Site were positively identified as the Continental Navy brig *Diligent*, it would be considered government property and the U.S. Navy would assume jurisdiction over the wreck. Navy custody of its shipwrecks is based on the property clause of the United States Constitution and international maritime law. This is consistent with Articles 95 and 96 of the Law of the Sea Convention, which establish that right, title or ownership of federal property is not lost to the government due to the passage of time. Seemingly abandoned shipwrecks remain the property of the federal government until either the Navy or Congress takes formal action to dispose of them. In addition, the sovereign immunity provisions of Admiralty Law enable the Department of the Navy to retain ownership of all of its wrecked ships and aircraft, whether lost within U.S., foreign, or international boundaries.

The Navy is obligated to protect the submerged archaeological resources for which it has custodial responsibility under provisions outlined in the National Historic Preservation Act (NHPA). The NHPA directs federal agencies to manage their cultural resources in a manner that emphasizes preservation and minimizes the impact of potential adverse effects on such properties. In addition to serving the needs of historic preservation, the Navy's management of its submerged wreck sites also addresses the issues of war graves, unexploded ordnance, and military reutilization of recovered weapons systems.

The Phinney Site and Shoreline Site are two of the earliest submerged archaeological sites from Maine's historic period. Although both are very fragile and located in shallow water, the archaeological integrity of each—particularly the Phinney Site—appears to be intact. Both resources represent a period in American history that has been largely overlooked, and from which a majority of archaeological sites have either been destroyed or have not yet been located. Further, each site's association with both the American Revolution and Penobscot Expedition makes it particularly significant to the early history of the United States.

Historic watercraft, both as intact floating vessels and archaeological shipwrecks, are recognized as a distinctive type of historic property. The National Park Service (1985) published *National Register Bulletin 20: Nominating Historic Vessels and Shipwrecks to the National Register of Historic Places* to specify the procedures and rationale for determining a historic watercraft's significance and its nomination to the National Register of Historic Places (NRHP).

Bulletin 20 identifies five categories of historic vessels that can be nominated to the NRHP. One of these categories, “Shipwrecks,” includes the Phinney Site. Based on its constituents and the circumstances surrounding its creation, the Shoreline Site could potentially be classified as a shipwreck as well. The NRHP defines a shipwreck as:

A submerged or buried vessel that has floundered, stranded, or wrecked. This includes vessels that exist as intact or scattered components on or in the sea bed, lake bed, river bed, mud flats, beaches, or other shorelines, excepting hulks (National Park Service 1985: 2-3).

Bulletin 20 notes that a vessel must meet certain requirements for eligibility to the National Register. These specify that it:

...be significant in American history, architecture, archaeology, engineering, or culture, and possess integrity of location, design, setting, materials, workmanship, feeling, and associations (National Park Service 1985: 5-6).

Finally, one or more of the four National Register criteria must be exhibited by the vessel for it to be considered significant:

- A. [The historic vessel should] be associated with events that have made a significant contribution to the patterns of our history; or
- B. be associated with the lives of persons significant in our past; or
- C. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- D. have yielded, or may be likely to yield, information important in prehistory or history (National Park Service 1985: 5-6).

In the case of shipwrecks, significance is dictated by the degree of physical integrity exhibited by the wreck remains. Sufficient integrity is required to address architectural, technological, and other research issues. An assessment of the wreck site’s significance must also be considered within well-developed archaeological and historical contexts. A wreck site’s archaeological context requires consideration of the nature and scope of known shipwreck resources, while its historic context requires an assessment of the individual vessel within the broader spectrum of its associated political, social, military, economic, and technological spheres.

The Phinney Site and Shoreline Site each meet at least two of the criteria (A and D) for significance and are eligible for inclusion on the NRHP. Both sites: 1) have retained their

archaeological integrity; 2) are associated with events that have made a significant contribution to the patterns of our history; and 3) have the potential to yield important historical and archaeological information at the local, state, regional, and national level. The Phinney Site, as one of only two armed American vessels from the Penobscot Expedition to be discovered and documented, also embody the “distinctive characteristics of a type, period, or method of construction” outlined in Criterion C. If identified as *Diligent*, the Phinney Site would be one of only a handful of colonial-era American naval warships ever discovered, and the only physical remains of a Continental Navy brig currently known to exist.

Both sites represent unique historic properties and their remains are invaluable public resources. Each has become the subject of considerable local interest since its discovery, and a cooperative effort—involving the Navy, State of Maine, and local museums and historic preservation groups—should be undertaken to educate the public about the continued preservation and protection of both resources. This would include, among other things, the custodial transfer of artifacts from the Naval Historical Center to an institution in the State of Maine (such as the Maine State Museum in Augusta) where the assemblages from both sites could be housed and curated as a single collection. Subsequent local and state traveling exhibits could feature these artifacts in their displays. Although the majority of artifacts should be returned to Maine, some cultural material should be retained by the NHC for display at the Navy Museum at the Washington Navy Yard. These artifacts could be the centerpiece of an exhibit that introduces museum visitors to the Penobscot Expedition and its significance in American naval history.

Since it is presently unclear whether the artifacts recovered during the 2000 and 2001 field seasons originated from a Continental Navy vessel, Massachusetts State Navy vessel, or privateer, the ownership interests of the Navy and the State of Massachusetts—in addition to those of the State of Maine—must be addressed. The Department of the Navy, State of Maine, and State of Massachusetts should work together to draft a Memorandum of Understanding (MOU) that recognizes the ownership concerns of each signatory. Additionally, the MOU would establish provisions for the custodial transfer of artifacts back to the Navy or State of Massachusetts should these items be positively associated with a particular Continental Navy or Massachusetts State Navy shipwreck.

The investigations of the Phinney Site and Shoreline Site have provided archaeologists, historians, and the public with a tangible and unique link to a significant but largely overlooked incident in our nation’s past. It is hoped that this study will encourage efforts to keep the story of each site alive and promote the continued attention, interest, and protection that both so rightly deserve.

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APPENDIX A.

**LIST OF PENOBSCOT EXPEDITION VESSELS SCUTTLED NEAR THE
BANGOR/BREWER AREA**

Name	Vessel Type	Affiliation	Commander	Tons	Guns (Number and size vary according to source)	Crew	Additional Notes
<i>Active</i>	Brigantine	Massachusetts State Navy	John Allen Hallet	180	Sixteen 6-pounders (Riess 1999 and Rider 1977); Eighteen 6-pounders (Allen 1927); Fourteen 4-pounders (Buker 2002)	N/A	Riess (1999) reports that <i>Active</i> was scuttled along with an unidentified transport (probably <i>Pigeon</i>) near the mouth of Kenduskeag Stream.
<i>Black Prince</i>	Ship	Massachusetts Privateer	Nathaniel West	220	Eighteen 6-pounders (Allen 1927 and Calef 1910); Twenty 6-pounders (Buker 2000)	100 to 120	Allen (1927) states that the name "William Steward" is shown on the privateer bond as the commander of <i>Black Prince</i> . George Williams, owner. Reported by several deponents as burnt and blown up in close proximity to the privateer <i>Hector</i> .
<i>Charming Sally</i>	Ship	Massachusetts Privateer	Alexander Holmes	300	Twenty 9-pounders (Riess 1999); Eighteen 9-pounders (Allen 1927); Twenty-two 9 and 6-pounders (Calef 1910); Twenty 9 and 6-pounders (Buker 2002)	70 to 200	William Erskine, owner. Reported by Col. John Brewer as "burnt and blown up" (Buker 2002).
<i>Diligent, Dilligent, or Diligence</i>	Brig	Continental Navy	Philip Brown	236	Fourteen 4-pounders (Riess 1999; Rider 1977; Bauer 1970; Chapelle 1949; and Calef 1910); Twelve 3-pounders (Buker 2002)	90	Ex-HMB <i>Diligent</i> . According to Riess (1999), Rider (1977), Bauer (1970), Colledge (1969), Clark (1968), and Chapelle (1949) HMB <i>Diligent</i> was built in North America in 1776, purchased by the Royal Navy, and later captured by the Continental Sloop <i>Providence</i> off Sandy Hook, N.J., 7 May 1779. Because it was formerly a British warship, <i>Diligent</i> may have been copper-clad. Bauer (1970) gives the following dimensions for the vessel: Length on Deck 88 ft., 5 ¾ in; Beam 24 ft., 8 in.; Depth of Hold 10 ft., 10 in. <i>Diligent</i> was mistakenly called <i>Delaware</i> by Col. John Brewer in an 1846 article in the <i>Bangor Daily Whig and Courier</i> ; reported by Col. Brewer as "burnt" (Buker 2002).

Name	Vessel Type	Affiliation	Commander	Tons	Guns (Number and size vary according to source)	Crew	Additional Notes
<i>Hazard</i> or <i>Hazzard</i>	Brig	Massachusetts State Navy	John F. Williams	120	Eighteen 6-pounders (Rider 1977 and Calef 1910); Fourteen 6-pounders (Riess 1999 and Buker 2002)	90 to 100	<i>Hazard</i> constructed by a Mr. Davis and Mr. Peck in the State of Massachusetts (poss. Boston) in 1776. Reported by Col. John Brewer as “burnt” (Buker 2002).
<i>Hector</i>	Ship	Massachusetts Privateer	John Carnes	220	Twenty 9-pounders (Riess 1999; Allen 1927; and Calef 1910); Eighteen 6-pounders (Buker 2002)	120 to 130	Jonathan Peale, owner. Reported by several deponents as burnt and blown up in close proximity to the privateer <i>Black Prince</i> .
<i>Monmouth</i>	Ship	Massachusetts Privateer	Alexander Ross	200 or 250	Twenty 6-pounders (Allen 1927; Calef 1910 and Buker 2002); Twenty-four 6-pounders (Riess 1999)	100 to 120	Joseph Marquand, owner. Reported by Col. John Brewer as “burnt and blown up” (Buker 2002).
<i>Pigeon</i> or <i>Pidgeon</i>	Sloop	Private transport	Luther Little	80	Unarmed	N/A	Riess (1999) reports that <i>Pigeon</i> was carrying provisions and artillery.
<i>Providence</i>	Sloop-of-War	Continental Navy	Hoysteed Hacker	95	Fourteen 6-pounders (Riess 1999; Millar 1978; Rider 1977; and Bauer 1970); Twelve 6-pounders (Calef 1910); Twelve 6 and 4-pounders (Buker 2002)	63	Ex- <i>Katy</i> . Built at Providence, R.I. about 1768. Bauer (1970) lists the <i>Providence</i> as a twelve-gun ship armed with six 6-pounders, six 4-pounders, and two 2-pounders during the Penobscot Expedition. Rider (1977), however, asserts that the ship was armed with fourteen 6-pounders and ten swivel guns. <i>Katy</i> fired the first naval cannon shots of the American Revolution, was the first vessel authorized for use by the Continental Navy (Oct. 1775), and, as <i>Providence</i> , was John Paul Jones’ first command. Described as a “fast sailer” <i>Providence</i> was copper-clad below the waterline. Millar (1978) provides dimensions for Providence: LOA 67 ft., 6 in.; Length on Deck 59 ft.; Keel Length 49 ft., 5 in.; Beam 19 ft., 6 in.; Depth of Hold 7 ft.; Draft 9 ft. Reported by Col. John Brewer as “blown up” (Buker 2002).

Name	Vessel Type	Affiliation	Commander	Tons	Guns (Number and size vary according to source)	Crew	Additional Notes
<i>Tyrannicide</i> or <i>Tiranicide</i>	Brig	Massachusetts State Navy	John Cathcart	170	Twenty 6-pounders (Rider 1977); Sixteen 6-pounders (Riess 1999); Fourteen 6-pounders (Allen 1927; Calef 1910 and Buker 2002)	75 to 90	According to Allen (1927), <i>Tyrannicide</i> was one of the first vessels built for the Massachusetts State Navy. Construction of the vessel took place at Salisbury, Massachusetts between February and June of 1776. <i>Tyrannicide</i> 's first cruise, under Captain John Fisk, began on July 8, 1776. She entered service as a sloop, but was converted to a brigantine within a few months. The vessel's name is spelled <i>Tiranicide</i> on the privateer bond for the Penobscot Expedition. Reported by Col. John Brewer as "burnt" (Buker 2002).

APPENDIX B.

PHINNEY SITE HULL SCANTLINGS

Keel

Preserved Length: 24.6 m.

Molded: 38 cm.

Sided: 40 cm.

Keelson

Preserved Length: 17.5 m.

Molded (maximum): 37 cm.

Sided: (maximum): 26 cm.

Deadwood (forward)

Overall Length: Not Available

Molded: 12 cm.

Sided: 26 cm.

Deadwood (aft)

Overall Length (preserved): 5.26 m.

Molded: 44 cm.

Sided: 40 cm.

Stem Post

Preserved Length (both segments, reconstructed): 3.71 m.

Molded: 43 cm.

Sided: 17 cm.

Gripe

Observed Length: 2.0 m.

Molded: 24 cm.

Sided: 17 cm.

Cutwater

Observed Length: 87 cm.

Molded: 8 cm.

Sided: 17 cm.

Floors

Molded (average): 20 cm.

Sided (average): 24 cm.

Center-to-Center Spacing (average): 56 cm.

First Futtocks

Molded (average): 20 cm.

Sided (average): 21 cm.

Center-to-Center Spacing (average): 55 cm.

Second Futtocks

Molded (average): 20 cm.

Sided (average): 19 cm.

Center-to-Center Spacing (average): 50 cm.

Third Futtock

Molded: Not Available

Sided: 20 cm.

Center-to-Center Spacing: Not Available

Half-Frame

Molded (maximum): 17 cm.

Sided (maximum): 26 cm.

Center-to-Center Spacing: Not Available

Cant Frames

Molded (average): 20 cm.

Sided (average): 19 cm.

Garboard

Preserved Length: Not Available

Width: 40 cm.

Thickness: 6 cm.

Hull Planking

Preserved Length: Not Available

Width: 26 cm.

Thickness: 3.5 cm.

Ceiling

Preserved Length: Not Available

Width (minimum): 14 cm.

Width (maximum): 28 cm.

Thickness: Not Available

Main Mast Step Mortise

Length: 55 cm.

Width: 18.5 cm.

Depth: 13.5 cm.

Main Mast Step Lower Chock

Length: 16.2 cm.

Width: 9.2 cm.

Thickness: 7.3 cm.

Main Mast Step Upper Chock

Length: 17.3 cm.

Maximum Preserved Width: 8.7 cm.

Maximum Preserved Thickness: 5.6 cm.

Main Mast Step Buttress (Port Side)

Length: Not Available

Molded: 25 cm.

Sided: 28 cm.

APPENDIX C.

**CERAMICS RECOVERED FROM THE PHINNEY SITE
2000 FIELD SEASON**

Artifact Number	Quantity	Description	Provenience
PB1-008	1	Hand-painted porcelain figurine, female, prob. 19 th century	26-29 meters on baseline, stern area, dredge spoil
PB1-011A	1	Transfer-printed whiteware base sherd, brown floral design	Stern area dredge spoil, 26-29 meters on baseline
PB1-011B	1	Porcellaneous whiteware, undecorated	Stern area dredge spoil, 26-29 meters on baseline
PB1-011C	1	Undecorated whiteware, possibly Ironstone	Stern area dredge spoil, 26-29 meters on baseline
PB1-011D	1	Undecorated whiteware, possibly Ironstone	Stern area dredge spoil, 26-29 meters on baseline
PB1-011E	1	Undecorated whiteware, possibly Ironstone	Stern area dredge spoil, 26-29 meters on baseline
PB1-011F	1	Salt-glazed stoneware, unknown variant	Stern area dredge spoil, 26-29 meters on baseline
PB1-011G	1	Undecorated whiteware, possibly Ironstone	Stern area dredge spoil, 26-29 meters on baseline
PB1-011H	1	Whiteware, possibly Ironstone, molded relief	Stern area dredge spoil, 26-29 meters on baseline
PB1-017	10	1 Mocha Ware; 1 plain pearlware; 1 UID earthenware w/ brown slip; 1 UID molded earthenware w/ yellow glaze; 6 plain whiteware	Starboard side of keelson, aft of Frame 66
PB1-020-A, E	2	1 American gray stoneware w/ interior brown slip; 1 transfer-printed whiteware w/ maker's mark: Royal crest and "Staffordshire, England"	Keelson, around cannon and mainmast step
PB1-020-C	4	Plain Ironstone whiteware	Keelson, around cannon and mainmast step
PB1-020-D, H	2	1 UID molded earthenware w/ yellow glaze; 1 porcellaneous whiteware	Keelson, around cannon and mainmast step
PB1-020-B, D, F, G	6	1 Bristol-style glazed bottle; 1 yellow ware; 4 porcellaneous whiteware	Keelson, around cannon and mainmast step
PB1-024	1	Unidentified object, possible degraded ceramic sherd, resembles stone	Keelson, around cannon and mainmast step
PB1-028	4	1 American gray stoneware w/ interior brown slip; 1 plain whiteware; 1 transfer-printed whiteware; 1 flow blue decoration	Along keel at 26-meter mark on baseline
PB1-031	1	Handle fragment, gray salt-glazed stoneware, prob. American stoneware	24.90 meters along keelson baseline
PB1-034	3	1 Undecorated whiteware, possibly Ironstone; 1 modern whiteware; 1 porcellaneous whiteware (extremely thin body)	Grid T-1, NW quadrant, surface and below
PB1-039	4	1 brown floral transfer-printed whiteware; 1 porcellaneous whiteware; 2 undecorated whiteware, possibly Ironstone	Grid T-1, NW and SW quadrants, below surface
PB1-046-A	1	Plain pearlware w/ scalloped rim	Along keel at 27.2-meter mark on baseline
PB1-046-B	1	Transfer-printed whiteware w/ maker's mark: "Homer Laughlin—USA"	Along keel at 27.2-meter mark on baseline
PB1-046-C	1	Plain pearlware with scalloped and molded rim design	Along keel at 27.2-meter mark on baseline
PB1-046-D	1	Plain whiteware—large utilitarian vessel	Along keel at 27.2-meter mark on baseline
PB1-048	1	Modern whiteware (poss. Fiesta Ware)—blue glaze w/ scalloped rim	Surface find
PB1-051A	1	Undecorated whiteware, possibly Ironstone, rim fragment	24.6 meters on keelson baseline
PB1-051-B, C, D, E	4	1 Porcellaneous whiteware teapot spout or handle; 1 transfer-printed porcellaneous whiteware basal sherd; 2 undecorated whiteware	24.6 meters on keelson baseline

Artifact Number	Quantity	Description	Provenience
PB1-054	6	3 undecorated whiteware; 1 porcellaneous whiteware; 1 transfer-printed whiteware rim fragment (design is heavily degraded); 1 UID coarse earthenware w/ thick walls, brown slip, and tempered w/ sand and grit inclusions	24 to 23 meters along centerline baseline in stern, along top and side of keel, dredge spoil
PB1-062	1	Transfer-printed whiteware sherdlet, dark green design	Between mast step and cannon, dredge spoil
PB1-066	1	Hand-painted whiteware, unidentified orange and brown decoration	Offshore of mainmast step, looking for frames
PB1-069	6	1 base fragment from American gray stoneware jug w/ brown interior slip; 1 hand-painted whiteware (green leaf pattern); 2 undecorated whiteware; 1 UID brown stoneware (prob. 19 th century); 1 milk glass	Upstream end of keelson, shore side
PB1-076	10	7 plain whiteware; 1 porcellaneous whiteware; 1 transfer-printed pearlware; 1 "Chicken-foot" edge-decorated pearlware	Top of keel 24-27meters on baseline, dredge spoil
PB1-076-C	3	2 American gray stoneware w/ brown slip; 1 poss. Rockingham Ware	Top of keel 24-27meters on baseline, dredge spoil
PB1-086	1	UID lead-glazed, poss. American redware	Grid T-1, dredge spoil
PB1-092A	1	American salt-glazed gray stoneware	Top and port side of keel, 23-28.5m along centerline baseline, dredge spoil
PB1-092B	1	Undecorated whiteware	Top and port side of keel, 23-28.5m along centerline baseline, dredge spoil
PB1-092C, D	2	1 UID stoneware w/ brown interior slip and white-glazed exterior; 1 Rockingham ware rim fragment	Top and port side of keel, 23-28.5m along centerline baseline, dredge spoil
PB1-096	7	2 undecorated whiteware; 1 porcellaneous whiteware; 1 relief-molded whiteware; 1 hand-painted whiteware w/ gilt rim band; 1 American gray stoneware; 1 modern porcellaneous whiteware w/ manganese blotch decoration	26 meters along baseline, starboard side of keel, bottom of keel
PB1-100	3	UID earthenware, poss. creamware, shows evidence of burning	Grid T-1, between floors, not yet to planking
PB1-103	3	Small fragments, undecorated whiteware	Grid T-1, beneath shot forward of eyebolt
PB1-110	1	Handle fragment of Ironstone chamber pot w/ maker's mark "PERFECTION BED and DOUCHE PAN...The Most Comfortable and Sanitary Bed-Pan in the World" (retains other markings, but these are illegible)	Surface find at Frame 54, 60 centimeters from centerline baseline
PB1-114	2	1 relief-molded whiteware rim fragment; 1 UID tin-glazed sherd with hand-painted blue-on-white decoration (possible delftware)	Starboard side of keelson at mainmast step

Artifact Number	Quantity	Description	Provenience
PB1-131-A	1	Black-glazed redware	Grid T-1, above garboard strake and beneath keel
PB1-131-B	1	Creamware	Grid T-1, above garboard strake and beneath keel
PB1-131-C	1	Fulham stoneware	Grid T-1, above garboard strake and beneath keel
PB1-131-D	3	1 creamware; 1 American redware; 1 UID earthenware	Grid T-1, above garboard strake and beneath keel
PB1-131-E	2	1 creamware; 1 American redware	Grid T-1, above garboard strake and beneath keel
PB1-131-F	3	UID unglazed, poss. American redware	Grid T-1, above garboard strake and beneath keel
PB1-132	1	Transfer-printed whiteware with molded rim—green floral design	Surface find immediately adjacent to Grid T-1
PB1-138	1	American redware	Grid T-1, dredging to top of garboard strake
PB1-154	6	1 American gray stoneware w/ interior brown slip; 1 yellow ware; 1 Ironstone whiteware; 1 UID earthenware w/ interior brown slip and exterior white glaze; 1 UID earthenware w/ yellow glaze; 1 milk glass	Dredge spoil from excavation 5 feet downstream of bow side of keelson
PB1-167	2	1 American brown stoneware w/ portion of handle; 1 UID earthenware w/ thick white glaze	On top of keel, bow area, 2.70 meters on baseline
PB1-173	3	Undecorated Ironstone	4.30-5.20 meters along baseline, starboard side keel
PB1-175	1	UID earthenware w/ greenish-brown lead glaze, poss. American redware	Starboard side of keelson, 3.60 meters on baseline
PB1-181	3	Undecorated whiteware (including one fragment of Ironstone)	Grid T-1, surface to top of floors, dredge spoil
PB1-186	2	Black-glazed redware	Grid T-1, dredging to top of garboard strake
PB1-207	2	1 undecorated whiteware (poss. Ironstone); 1 hand-painted whiteware w/ “star” pattern and gilt edge on light blue rim	Bow area, starboard side and top of keel and keelson, 2.5-3.0 meters along baseline
PB1-211	1	Transfer-printed whiteware rim fragment w/ floral motif, hand-painted gilt pattern, and relief-molded bands along edge of rim	20 to 50 meters along baseline, starboard side of keelson
PB1-213	6	1 UID earthenware w/ brown glaze; 4 plain whiteware; 1 UID earthenware w/ white salt glaze	Starboard side of keelson at 17, 18, 19, and 20 meters on baseline, dredge spoil
PB1-223	1	Undecorated whiteware	4-5 meters along baseline, dredge spoil
PB1-234	2	UID ceramic fragments, probable stoneware, one retains brown glaze (Rockingham?), the other a bright yellow glaze	20-22 meters along baseline, dredge spoil
PB1-240	1	Undecorated whiteware basal fragment, grayish green pooling evident in foot ring crevice	Grid T-1, surface, between keelson and shot B, C, and D

APPENDIX D.

**COLONIAL-ERA GLASS ARTIFACTS RECOVERED FROM THE
PHINNEY SITE, 2000 FIELD SEASON**

Artifact Number	Quantity	Description	Provenience
PB1-108	3	3 indeterminate black bottle glass; all appear to be body shards	Grid T-1, beneath shot forward of eyebolt
PB1-127	6	Indeterminate black bottle glass; all appear to be body shards	Grid T-1, from shot cluster to stbd. garboard
PB1-139-A	1	Small indeterminate black bottle glass; probably body shard	Grid T-1, dredging to top of starboard garboard
PB1-139-B	1	Small indeterminate black bottle glass w/ light blue surface patina at one end	Grid T-1, dredging to top of starboard garboard
PB1-143	4	3 indeterminate black bottle glass; 1 black glass w/ extensive blue patination	Grid T-1, below tops of frames
PB1-185	1	Small indeterminate black bottle glass; probably body shard	Grid T-1, floor timbers to starboard garboard
PB1-241	1	Small indeterminate black bottle glass	Grid T-1, concreted to iron shot PB1-201 or 202

APPENDIX E.

**RESEARCH DESIGN, METHODOLOGY AND RESULTS:
REMOTE-SENSING SURVEY, 2000 FIELD SEASON**

RESEARCH DESIGN, METHODOLOGY AND RESULTS: REMOTE-SENSING SURVEY, 2000 FIELD SEASON

By
James S. Schmidt

Field investigations during the 2000 field season included an archaeological remote-sensing survey of the Penobscot River between the State Street Bridge crossing and South Brewer, just below the I-395 bridge crossing. This effort occurred over a two-day period, 18-19 September, encompassed 61 survey lines, and, covered an area of river bed totaling about 43.7 hectares (ha).

Remote-Sensing Survey Parameters

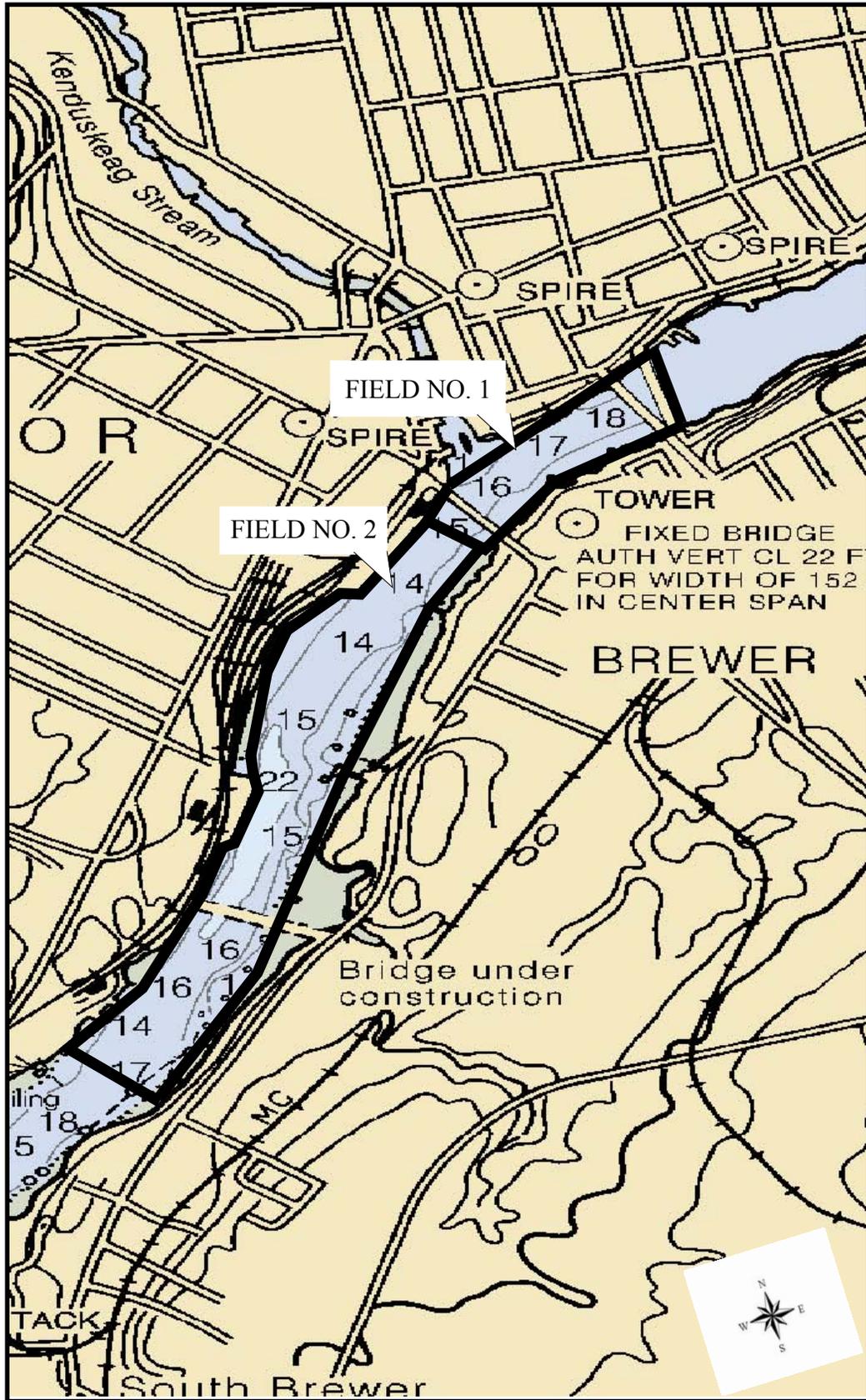
The Penobscot River project area (Figure 1) covered two contiguous survey grids, called fields, totaling approximately 47.3 ha. The two contiguous fields are rectangular in format with the survey lines running parallel to the river's shoreline. The survey design defined each of the two fields as indicated in Table 1. To provide overlapping coverage across the entire field, a maximum 10-meter (m) interval separated the survey lines.

Table 1.
Survey Field Parameters

Field No.	Upper Left Corner	Lower Right Corner
Field No. 1	518691.52 E 4960273.35 N	518271.70 E 4960041.33 N
Field No. 2	518005.80 E 4960167.47 N	517666.84 E 4958402.51 N

Field No. 1 encompassed 14.5-ha of river bottom between the State Street and Wilson Street bridges. To provide complete coverage over Field 1, the NHC collected magnetic data over 30 survey lines. Each line ran the full length of the field except where shoreline changes or obstructions forced termination. Lines 1-3 terminated on the Bangor side of the river at the Wilson Street bridge abutment. Lines 22-30 terminated at the shoreline on the Brewer side of the river, at the Interstate Route 395 (I-395) bridge abutment.

Field No. 2 encompassed 32.8-ha of river bottom extending from a point below the Wilson Street Bridge to South Brewer, just below the I-395 bridge crossing. To provide complete coverage over Field 1, the NHC collected magnetic data over 31 survey lines. Each line ran the



 Project Boundary Lines

FIGURE 1
 PROJECT AREA MAP
 PENOBSCOT RIVER
 PENOBSCOT COUNTY, MAINE

Base Map: Maptec® Raster Chart 13309_3 "Continuation to Bangor"

full length of the field except where shoreline changes or obstructions forced termination. Lines 1-4, on the Bangor side, terminated short due to shoreline changes. Lines 24 through 31 on the Brewer side were diverted in several sections of the river due to shoreline obstructions.

Survey Procedures

Survey Equipment

Trimble DMS PRO

The Trimble DMS Pro ® is a high-performance GPS receiver that uses differential correction services to calculate sub-meter positions in real-time. The DMS Pro ® allows the user to choose between satellite-based private subscription differential correction services and the government's differential correction radio-beacon network. The DMS Pro® includes an integrated 12-channel receiver/dual-channel MF differential beacon receiver/satellite differential receiver (L-band); a built-in virtual reference station (VRS) that ensures satellite differential correction uniformity; and RTCM SC-104 and NMEA-0183 differential correction input.

The NHC acquired the Trimble DMS Pro ® through Mr. Brett Phaneuf, a colleague at the Institute of Nautical Archaeology (INA). INA is a nonprofit scientific and educational organization that strives to gather knowledge of our human past from studying the physical remains of maritime activities. INA disseminates this knowledge through scholarly and popular publications, seminars and lectures. INA's headquarters and research facilities are located at College Station, Texas on the campus of Texas A&M University.

OmniSTAR Inc., (OSI)

OmniSTAR Inc., (OSI) is a member of the Fugro group of companies. The company provides a satellite-based (private subscription), specialized DGPS broadcast service for survey and positioning applications that require a high level of real-time integrity monitoring and quality control. The OmniSTAR network provides a high-performance, sub-meter, multi-reference station positioning solution through a unique "Virtual Base Station" technology that generates corrections optimized for the user's location. INA provided the NHC this service subscription *pro-bono* during the fieldwork.

Geometrics G-880 Marine Magnetometer

The Geometrics G-880 is a high-resolution marine Cesium magnetometer system that operates on a self-oscillating split-beam Cesium Vapor (non-radioactive Cs133) with automatic hemisphere switching. The system features include very high sensitivity measurements of total

field and gradient combined with rapid sampling. The G-880 is completely digital, unaffected by shipboard noise, easily deployed, and simple to operate. The G-880 sensitivity measures within a peak-to-peak envelope of 0.05 nanotesla (nT) at a 0.1-second cycle rate and 0.01 nT at a 0.1-second cycle rate. The heading error is limited to +/- .05 nT.

The sensor or “Fish” is contained in a heavy-duty filament wound fiberglass cylinder with stabilizer ring-fin assembly. It measures about 83 inches in length, 4.5 inches in outside diameter, and weighs about 17.2 kilograms in air (5.4 kilograms in water).

The tow cable consists of a shielded twisted pair of #12 conductors with 8 separate #20 conductors and measures 0.65 inches (1.65 centimeters) in outside diameter. The cable is made of a Kevlar strain member rated at a 10,000-pound breaking strength and has a maximum working load of 1,250 pounds. The cable weighs approximately 215 pounds per 1,000 feet (304.8 meters) in air (70 pounds per 1,000 feet in water).

Hydrographic Software

HYPACK® 8.9, produced by Coastal Oceanographic, Inc. (Middlefield, Connecticut), is PC-based Windows® software (Windows® 95, 98, or NT) used for planning, conducting, editing, and publishing hydrographic surveys. It supports GPS, Range-Azimuth, and Range-Range navigation systems. HYPACK® 8.9 can function on almost every known geodetic projection and has the tools to determine datum transformation parameters to convert between Lat-Long and X-Y, and to compute geodetic inverses and traverses. GPS data unit can be transformed to a local datum and then converted to X-Y on pre-defined, user-defined, or local grids. HYPACK® 8.9 has a powerful drawing engine that can display background files in DXF, DGN, TIFF, S-57, BSB raster, C-Map, and VPF files at any rotation and scale.

The HYPACK® 8.9 SURVEY program can be configured to display and track single vessels, multiple vessels, or track the main vessel and an ROV or towfish. SURVEY supports GPS, Range-Range, and Range-Azimuth positioning systems. The program interfaces with more than 150 survey devices (e.g., single beam, dual frequency, multiple transducer, and multibeam echo sounders, heave-pitch-roll sensors, magnetometers, etc.). The information for each sensor is time tagged to within .001 second and logged to file for post processing.

Equipment Configuration

Navigation And Positioning

The NHC configured the Trimble DMS Pro ® to receive an OmniSTAR DGPS signal and output an industry-standard NMEA 0183 message via an RS 232 port. A serial Y cable split the signal to HYPACK® 8.9. The geodetic editor in HYPACK® 8.9 converted the NMEA (Latitude and Longitude) data string to UTM North, Zone 19 (72W-66W, Ellipsoid WGS 84).

Marine Magnetometer

The NHC towed the G-880 marine sensor behind the motor vessel, at an optimum distance and depth to minimize magnetic and acoustic interference from the vessel. To determine the location of each sensor on the boat, a select point on the stern was selected as the "boat origin." Each sensor was then referenced based on the distance it is "to starboard"(X-direction) and "forward" (Y-direction). The tow point arrangement on the motor vessel placed the magnetometer sensor at the stern and about 21-meters (m) aft. The DGPS antenna, mounted on a mast arm, measured two meters forward of the boat origin at a height of two meters.

The G-880 operated at a .01-second sampling interval uploaded to a PC laptop running HYPACK® 8.9. The automated Start Line Gate feature in HYPACK® 8.9 enabled automatic "On Line" data logging when the boat origin point came within a specified distance of the start line point. The Start Line Gate automatically suspended data logging when the boat broke a line projected perpendicular from the end segment point of the planned line.

Remote-Sensing Data Analysis

Magnetometer Data Processing

HYPACK® MAX (a software upgrade to HYPAC ® 8.9) contained the software tools necessary to process the raw data files. The raw data record contains time, raw depth (amplitude in nT), and position (X, Y) for every sample. In HYPAC, the raw data file is edited and corrected for each sensor offset. In Editor program, each magnetic anomaly is tagged with a user-created designation and compiled into a Target Manual containing all of the pertinent data. The TIN (Triangulated Irregular Network) Model program creates surface models from the HYPACK® edited files or XYZ data files. The surface model can be a two-dimensional or three-dimensional display and include options such as color filling and smoothing. The Export Mode is used to create final products from the TIN Model program, such as several DXF entities (2D Contour, 2D Tin, 3D Contour, 3D Tin, 3D Face, and Sections). All DXF output information is written in real

world coordinates. The surface model is extremely useful for ascertaining the features and the distribution of anomalous masses.

Magnetic Data Contour Mapping

HYPACK® MAX contained the software tools to complete contour mapping of the magnetic data at a 10-nT contour interval. Although sometimes profile data can be adequate, contour mapping is more useful for ascertaining the features and distribution of anomalous masses. This information is essential to comparing and correlating contour characteristics with known or suspected magnetic sources (e.g., navigation buoys).

The overall objective of the analysis process is to utilize information relative to the physical environment and historic context as guidelines to evaluate which anomalies might indicate sources of potential historical significance. Those anomalies considered most likely to represent significant resources are then prioritized for future recommendations and assessments.

Remote-Sensing Data Results and Data Correlations

Field No. 1

In Field No. 1 a series of high-amplitude anomalies correlated to the charted bridge spans along the rail line and at State and Wilson streets. Several other identified sources include: two barges; one motor vessel; cribbing; a navigation buoy; and pier. Unidentified sources account for five anomaly clusters of various size, complexity and amplitude, and herein designated localities L001-L005 (Figures 2 and 3).

Locality L001 is mid-channel, oriented perpendicular to the shoreline, and consists of two anomalies that ranged in maximum variation of 161 nT. The moderate-amplitude and simplistic dipolar structure associated with these two anomalies is not indicative of a complex wreck signature. The mid-channel location is a strong indicator that the potential source is modern, such as pipe or scrap metal. In addition, the relatively narrow and sharp vertical profile is a strong indicator that the potential source is extant off the bottom.

Locality L002 is mid-channel, about 20-m southeast of L001. The anomaly is a moderate-amplitude (+115 nT) monopole, relatively proportional in profile and overall simplistic in structure. Its signature is not indicative of a complex wreck signature and is a strong indicator of an uncomplicated magnetic source. Its mid-channel location is a strong indicator that the potential source is modern.



□ FIGURE 2
 □ PENOBSCOT RIVER SURVEY
 □ PENOBSCOT COUNTY, MAINE
 □ FIELD NO. 1
 NHC Field Season 2000

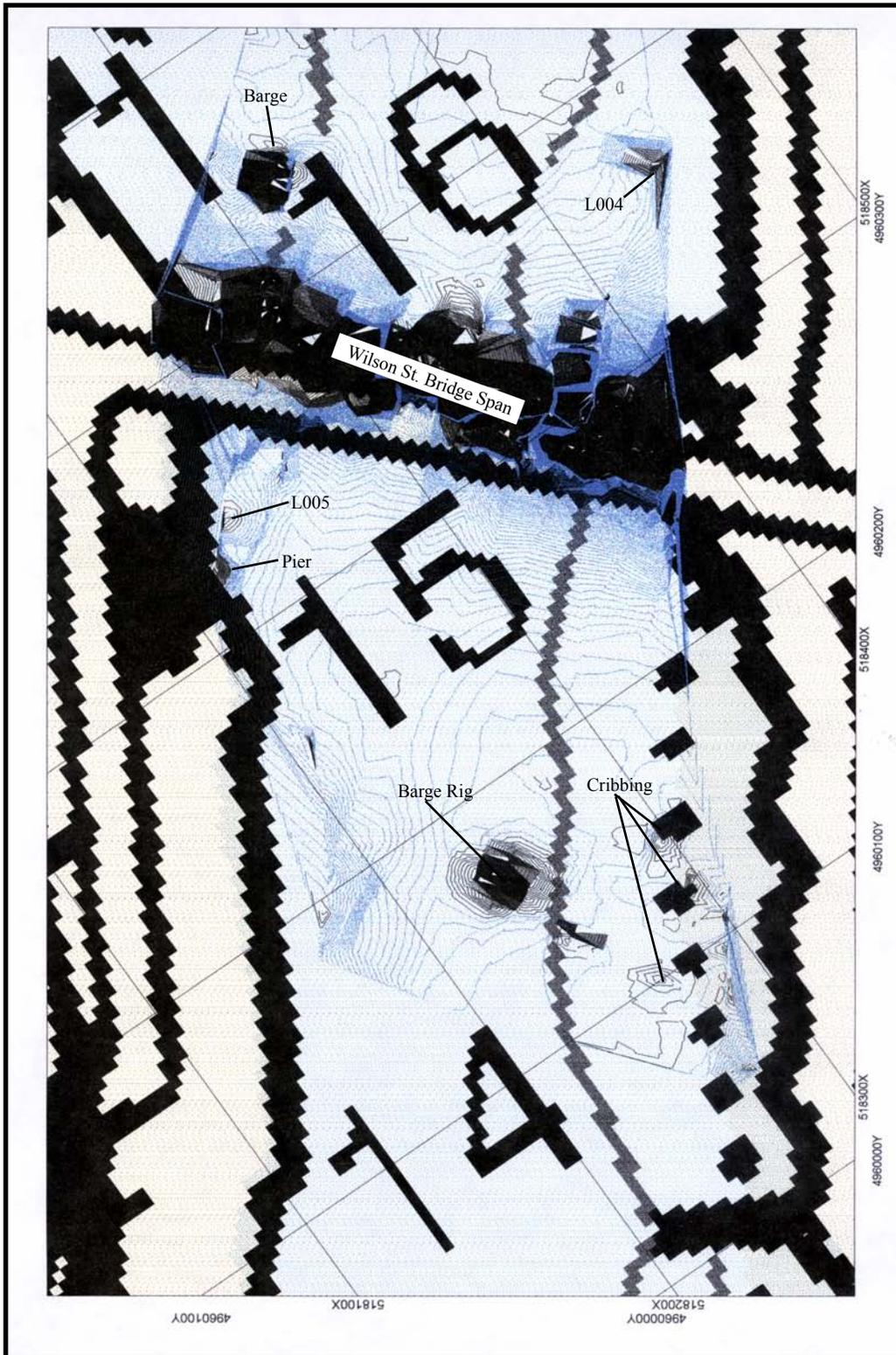


FIGURE 3
 PENOBSCOT RIVER SURVEY
 PENOBSCOT COUNTY, MAINE
 FIELD NO. 1 CON'T □
 NHC Field Season 2000

Base Map: Maptec® Raster Chart 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 84

Locality L003 is mid-channel, oriented parallel to the shoreline, and consists of two anomalies that ranged in maximum variation of 106 nT. The moderate-amplitude and simplistic dipolar structure associated with these two anomalies is not indicative of a complex wreck signature. The relatively proportionate but unbalanced profile is indicative of a partially buried source and the mid-channel location is a strong indicator that the potential magnetic source is modern, such as pipe.

Locality L004 extends from the Brewer shoreline at a point about 120 m NW of the Wilson Street bridge. The anomaly is a moderate-amplitude monopole (+120 nT) and displays a very simplistic structure. Its monopole signature is not indicative of a complex wreck signature and is a strong indicator of a simple source, such as culvert pipe. Moreover, the relatively proportionate profile suggested a shallow burial in the shoreline.

Locality L005 extends from the Bangor shoreline, at a point about 19 m up river from the city dock facilities. The anomaly is a low-amplitude monopole (+40 nT) and displays a very simplistic structure. Its overall structure is not indicative of a complex wreck signature and its broad profile is a strong indicator that the potential magnetic source is buried in the shoreline.

Field No. 2

In Field No. 2 a series of high-amplitude anomalies correlated to the charted bridge span along I-395. Other identified sources include: a steel sheet erosion barrier; two motor vessels (one at anchor); cribbing; culvert pipe; navigation buoy; commercial facilities (e.g., docks and piers), train wheels (i.e., scrape metal), steel I-beam, and, a power line crossing. Unidentified sources account for four anomaly clusters of various size, complexity, and amplitude, and are herein designated localities L006-L009 (Figures 4, 5 and 6).

Locality L006 is on the Brewer side of the river, about 25-m inshore of the channel and well within the shoulder. It consists of two anomalies that ranged in maximum variation of 64.6 nT. The low-amplitude and simplistic dipolar structure associated with these two anomalies is not indicative of a complex wreck signature. The relatively narrow and unbalanced profile indicates that the sensor passed close to one end of a potentially small magnetic source (i.e., a section of culvert pipe).

Locality L007 is on the Brewer side of the river, about 156 m upriver from the charted bridge span along I-395. It consists of two anomalies that ranged in maximum variation of 33.5 nT. The anomalies appeared along only one run line, about 13-m inshore of the channel and well within the shoulder small. The low-amplitude and simplistic dipolar structure associated with these two anomalies is not indicative of a complex wreck signature. The short wavelength (about 8 m) and

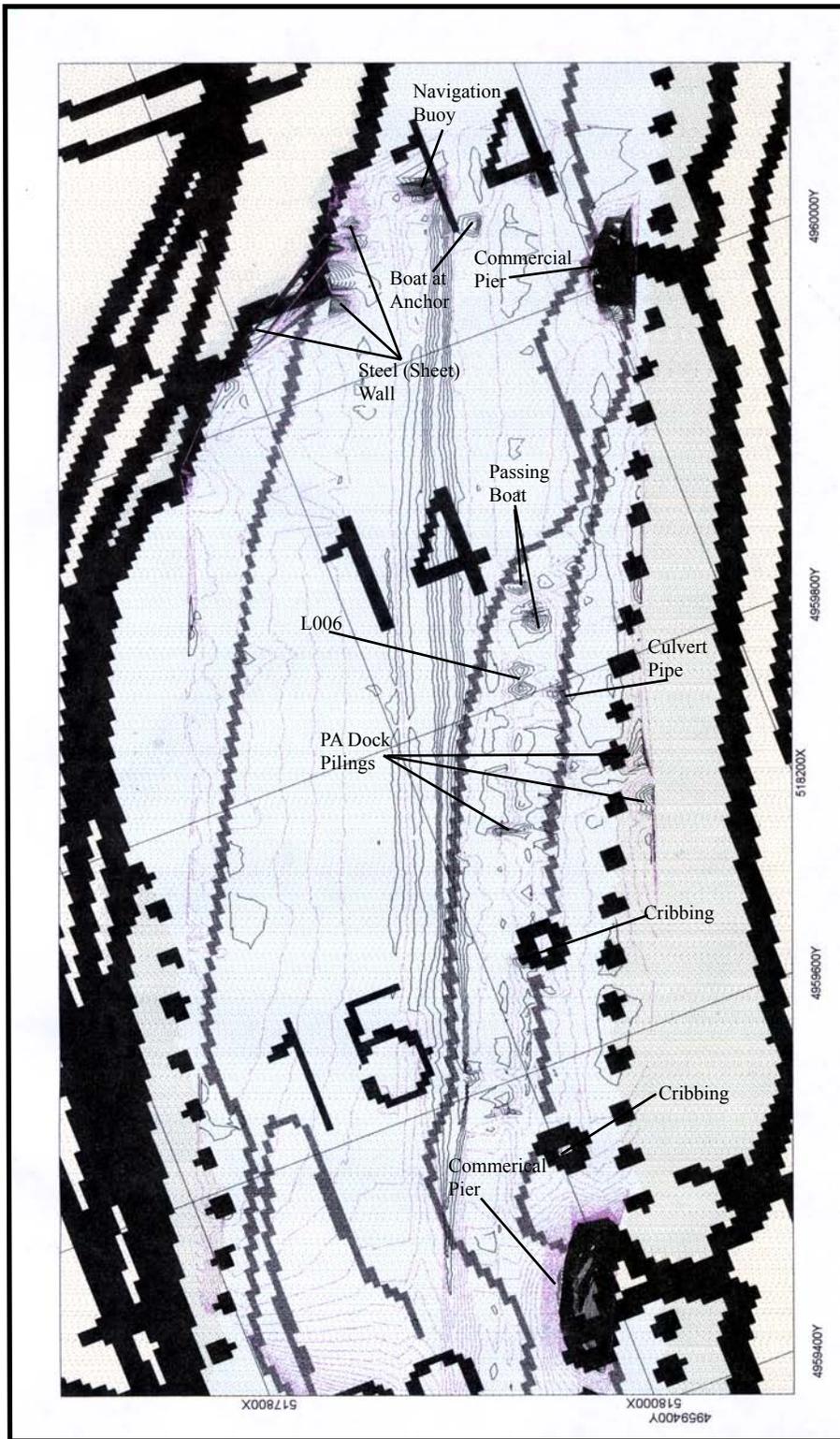


FIGURE 4
 PENOBSCOT RIVER SURVEY
 PENOBSCOT COUNTY, MAINE
 FIELD NO. 2
 NHC Field Season 2000

Base Map: Maptec® Raster Chart 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 84

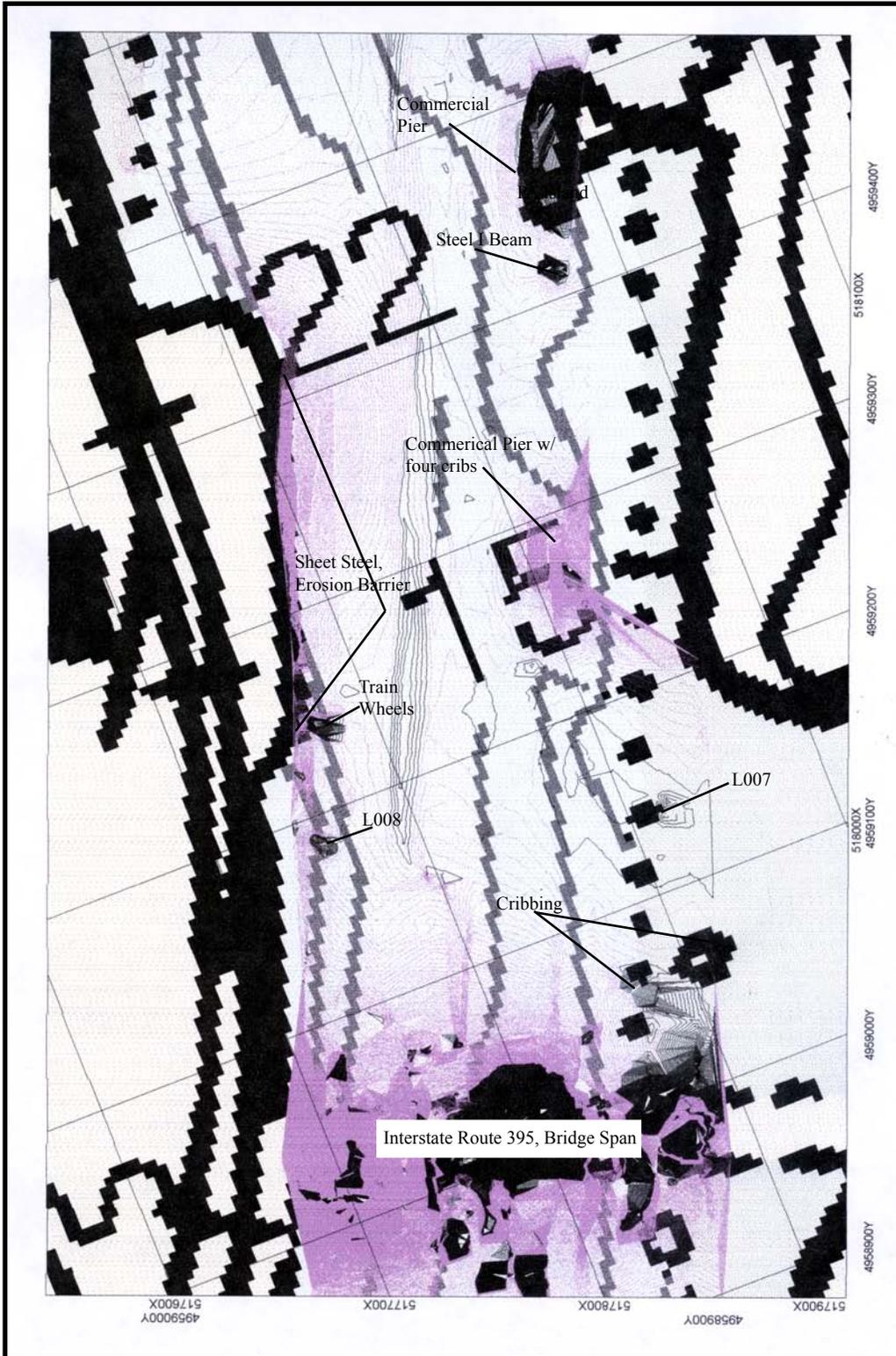


FIGURE 5
 PENOBSCOT RIVER SURVEY
 PENOBSCOT COUNTY, MAINE
 FIELD NO. 2 CON'T...
 NHC Field Season 2000

Base Map: Maptec® Raster Chart 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 84

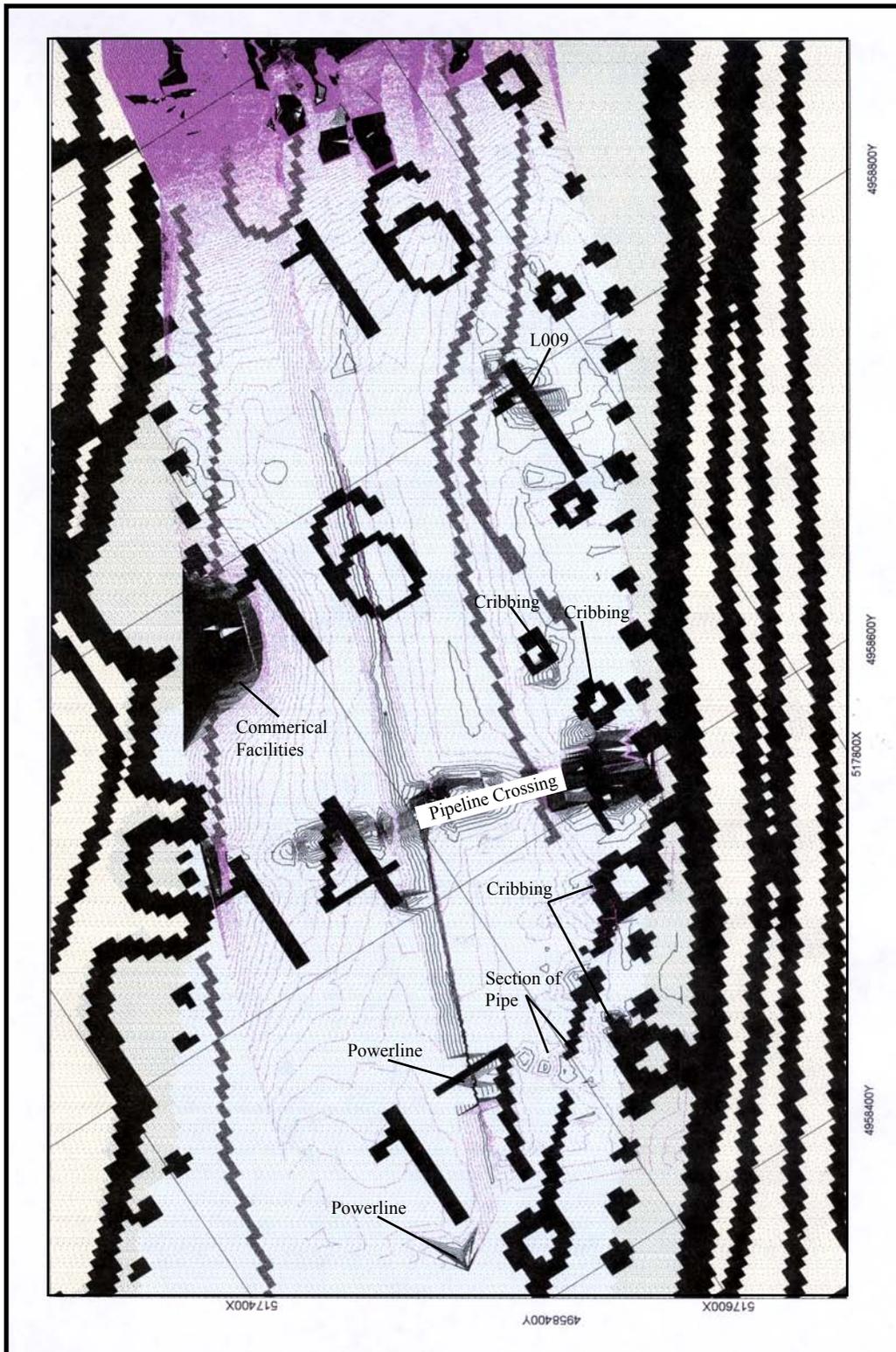


FIGURE 6
 PENOBSCOT RIVER SURVEY
 PENOBSCOT COUNTY, MAINE
 FIELD NO. 2 CON'T...
 NHC Field Season 2000

Base Map: Maptec® Raster Chart 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 84

relatively narrow profile is a strong indicator that the potential magnetic source is a small, buried object.

Locality L008 is on the Bangor side of the river, approximately 143 m upriver from the charted bridge span along I-395. The anomaly is a high-amplitude monopole (+180 nT) and displays a very simplistic structure that is not indicative of a complex wreck signature. Its relatively narrow profile is a strong indicator that the sensor passed close to magnetic source. The high-amplitude and short wavelength indicates that the source is a relatively small object with a high ferromagnetic content.

Locality L009 is on the Brewer side of the river, about 323 m down river from the charted bridge span along I-395. It consists of at least four anomalies that ranged in maximum variation between -65 and +20 nT. The anomalies appeared along two adjacent run lines, about 37 m parallel to the charted shoreline. The relatively unbalanced profile indicates that the sensor passed close to one end of the magnetic source. The greatest distance between nodes (about 31 meters) indicates that the source is a relatively large object with a moderate ferromagnetic content.

Remote-Sensing Survey Recommendations

Field No. 1

In Field No. 1, a series of high-amplitude anomalies correlated to the charted bridge spans along the rail line and at State and Wilson streets. Most of the other anomalies correspond to sources identified during the survey, or charted features. Unidentified sources account for five anomaly clusters (localities L001-L005) of various size, complexity, and amplitude. None of these anomalies presented characteristics typical of wreck remains. The NHC does not recommend further investigations of any anomalies within Field No. 1.

Field No. 2

In Field No. 2, a series of high-amplitude anomalies correlated to the charted bridge span along I-395 and two power line crossings. Most of the other anomalies correspond to sources identified during the survey, or charted features. The unidentified sources account for four anomaly clusters (localities L006-L009) of various size, complexity, and amplitude. Because Localities L006-L008 did not present characteristics typical of wreck remains, the NHC does not recommend additional investigations at these localities.

One Locality, designated L009, consisted of at least four low-to moderate amplitude anomalies (-65-to +20 nT) within a confined area over more than one survey transect. Although L009 does not correspond to any charted wreck or known historic feature, its relatively complex signature could represent potentially significant historical resources. As a result, the NHC deems L009 worthy of further investigation. Because the magnetic signature alone is the basis for investigation, it is recommended to proceed with an initial site reconnaissance to ensure that modern, uncharted features (e.g., a crib, buoy, etc) are not the source of the magnetic signature.

APPENDIX F.

**RESEARCH DESIGN, METHODOLOGY AND RESULTS:
REMOTE-SENSING SURVEY, 2001 FIELD SEASON**

RESEARCH DESIGN, METHODOLOGY AND RESULTS: REMOTE-SENSING SURVEY, 2001 FIELD SEASON

By
James S. Schmidt

The 2001 field season included a multi-component (magnetometer and sonar) remote-sensing survey of the Penobscot River, along segments of its shoreline and channel shoulder between Oak Point and Winterport. Two project archaeologists performed this survey during the flood tide periods between 14 and 16 September. The project area included 48 survey lines and covered 43.7 hectares (ha) of river bottom. This report includes maps that show the locations of all detected side-scan sonar and magnetometer targets, as well as the contour imagery for each magnetic anomaly. Visual records of detected acoustic anomalies, as well as their accompanying tabulated data, are included in Appendix G.

Remote-Sensing Survey Parameters

Oak Point Area

North Segment

The North Segment of the Oak Point Area, selected based on information provided by a local resident, encompassed five survey lines spaced at 15-meter (m) intervals. The rather small rectangular area totaled about 1.24 ha. Line 8 could not be run due to shoaling, barely visible in the navigation photo, which also forces a temporary data suspension along lines 7 and 9.

Kempton Cove

UA utilized historical documents accounting the *Warren's* grounding and subsequent loss to design its survey in the Kempton Cove segment of Oak Point. The environment at Kempton Cove presented a challenging survey due to rapidly changing water depths and extreme low water level at ebb tide. The rectangular survey grid encompassed 16 survey lines spaced at 15-m intervals and totaled about 9.5 ha.

Western Shoreline

The Western Shoreline area totaled about 5.3 ha and included four survey lines paralleling the shoreline at 15-m intervals. An additional four lines, inserted and offset 15-m parallel to line 5 (the outermost pre-planned line), covered about 614 m of the river bottom below Kempton Cove.

North Bucksport Area

The North Bucksport area is on the eastern shoreline, along the river's bend across from Oak Point. Four survey lines placed at 15-m intervals parallel to the shoreline covered an area that totaled about 3.65 ha. The water depth at mean low tide averaged about 1.5 m.

Winterport Area

The Winterport area is on the western shoreline, across the river from Bucksport Center and Durchm Point Point. Fifteen survey lines placed at 15-m intervals paralleling the shoreline covered an area about 31.1 ha. A charted cable area extends across the river between Durchm Point and Winterport. About 453 m up river, a commercial terminal and pier extended into the channel.

Survey Equipment

Geometrics G-880 Marine Magnetometer

The Geometrics G-880 is a high-resolution marine Cesium magnetometer system that operates on a self-oscillating split-beam Cesium Vapor (non-radioactive Cs133) with automatic hemisphere switching. The system features include very high sensitivity measurements of total field and gradient combined with rapid sampling. The G-880 is completely digital, unaffected by shipboard noise, easily deployed, and simple to operate. The G-880 sensitivity measures within a peak-to-peak envelope of 0.05 nanotesla (nT) at a 0.1-second cycle rate and 0.01 nT at a 0.1-second cycle rate. The heading error is limited to +/- .05 nT.

The sensor or "Fish" is contained in a heavy-duty filament wound fiberglass cylinder with stabilizer ring-fin assembly. It measures about 83 inches (2.1 m) in length, 4.5 inches (1.1 decimeters) in outside diameter, and weighs about 17.2 kilograms (kg) in air (5.4 kg in water).

The tow cable consists of a shielded twisted pair of #12 conductors with 8 separate #20 conductors and measures 0.65 inches (1.65 centimeters) in outside diameter. The cable is made of a Kevlar strain member rated at a 10,000-pound breaking strength and has a maximum working load of 1,250 pounds. The cable weighs approximately 215 pounds per 1,000 feet (304.8 m) in air (70 pounds per 1,000 feet in water).

Marine Sonic Technology, Ltd., Sea Scan ® PC

The Marine Sonic Technology, Ltd (MSTL) Sea Scan ® PC is a high-resolution side-scan sonar system designed for a variety of survey applications. The Sea Scan ® PC system electronics consists of a full size ISA card installed in a Fieldworks 7000 containing an Intel Pentium/Celeron processor with 32 MB RAM a 6 GB hard drive, 3.5-inch internal drive, and a PCMCIA card slot. All sonar functions are software controlled. The software features acoustic range scales, magnetometer range scales, color display scales, time gain compensation, speed control, zoom, length/area/height measurement, channel selection, annotations, markers, event markers, range delay, navigation plotter, and more than 50 mathematical filters to enhance the acoustic images.

The sonar sensor or 'Fish' is constructed of solid polyvinyl chloride (PVC) and other non-corrosive materials. The 300-kilohertz (kHz) Fish measures 1.1 m in length, 10.2 centimeters (cm) in diameter, and weighs 15.9 kg in air. The pulse length is 20 µsec (6 cycles) and has a typical range resolution of 29 cm. The 300-kHz unit has a maximum range of +200 m.

The tow cable is approximately 0.36-inches in diameter and constructed using three coaxial cables and a 545-kg Kevlar strength member covered by either a polyurethane or polyethylene outer-jacket. The 100-m cable length weighs 9.1 kg in air (4.1 kg in water).

Field Procedures

Navigation and Positioning

The Trimble AgGPS® 132 is a high-performance GPS receiver that uses differential correction services to calculate sub-meter positions in real-time. The AgGPS® 132 includes Trimble's The Choice™ technology that allows one to choose between satellite-based private subscription differential correction services and the government's differential correction radio-beacon network. Wide Area Augmentation System (WAAS) corrections can also be used. The AgGPS® 132 includes an integrated 12-channel receiver/dual-channel MF differential beacon receiver/satellite differential receiver; a built-in virtual reference station (VRS) that ensures satellite differential correction uniformity; and RTCM SC-104 and NMEA-0183 differential correction input.

HYPACK® MAX, produced by Coastal Oceanographic, Inc. (Middlefield, Connecticut), is PC-based Windows® software (Windows® 95, 98, or NT) for planning, conducting, editing, and publishing hydrographic surveys. It supports GPS, Range-Azimuth, and Range-Range navigation systems. HYPACK® MAX can function on almost every known geodetic projection and has the

tools to determine datum transformation parameters to convert between Lat-Long and X-Y, and to compute geodetic inverses and traverses. The GPS data unit can be transformed to a local datum and then converted to X-Y on pre-defined, user-defined, or local grids. HYPACK® MAX has a powerful drawing engine that can display background files in DXF, DGN, TIFF, S-57, BSB raster, C-Map, and VPF files at any rotation and scale.

The HYPACK® MAX SURVEY program can be configured to display and track single vessels, multiple vessels, or track the main vessel and an ROV or towfish. SURVEY supports GPS, Range-Range, and Range-Azimuth positioning systems. The program interfaces with more than 150 survey devices (e.g., single beam, dual frequency, multiple transducer, and multibeam echo sounders, heave-pitch-roll sensors, magnetometers, etc.). The information for each sensor is time tagged to within .001 second and logged to file for post processing. The Export program allows users to import HYPACK® MAX data into CAD and GIS packages in either DXF or DGN format. The TIN MODEL program creates surface models from HYPACK data or any ASCII XYZ data file. Once the model is created, it can display the results in a 2-D and 3-D TIN, 2-D and 3-D contour, solid rendering (gray scale) and depth-colored rendering.

Data Analysis

Magnetometer Data Processing

HYPACK® MAX contains the software tools necessary to process the raw data files. The raw data record contains time, raw depth (amplitude in nT), and position (X, Y) for every sample. In HYPACK, the raw data file is edited and corrected for each sensor offset. In Editor program, each magnetic anomaly is tagged with a user-created designation and compiled into a Target Manual containing all of the pertinent data. The TIN (Triangulated Irregular Network) Model program creates surface models from the HYPACK® edited files or XYZ data files. The surface model can be a two-dimensional or three-dimensional display and include options such as color filling and smoothing. The Export Mode is used to create final products from the TIN Model program, such as several DXF entities (2D Contour, 2D Tin, 3D Contour, 3D Tin, 3D Face, and Sections). All DXF output information is written in real world coordinates. The surface model is extremely useful for ascertaining the features and the distribution of anomalous masses.

Magnetic Data Contour Mapping

HYPACK® MAX contains the software tools to complete contour mapping of the magnetic data at a 10-nT contour interval. Although sometimes profile data can be adequate, contour mapping is more useful for ascertaining the features and distribution of anomalous masses. This information is essential to comparing and correlating contour characteristics with known or suspected magnetic sources (e.g., navigation buoys).

The overall objective of the analysis process is to utilize information relative to the physical environment and historic context as guidelines to evaluate which anomalies might indicate sources of potential historical significance. Those anomalies considered most likely to represent significant resources are then prioritized for future recommendations and assessments.

Sonar Data Processing

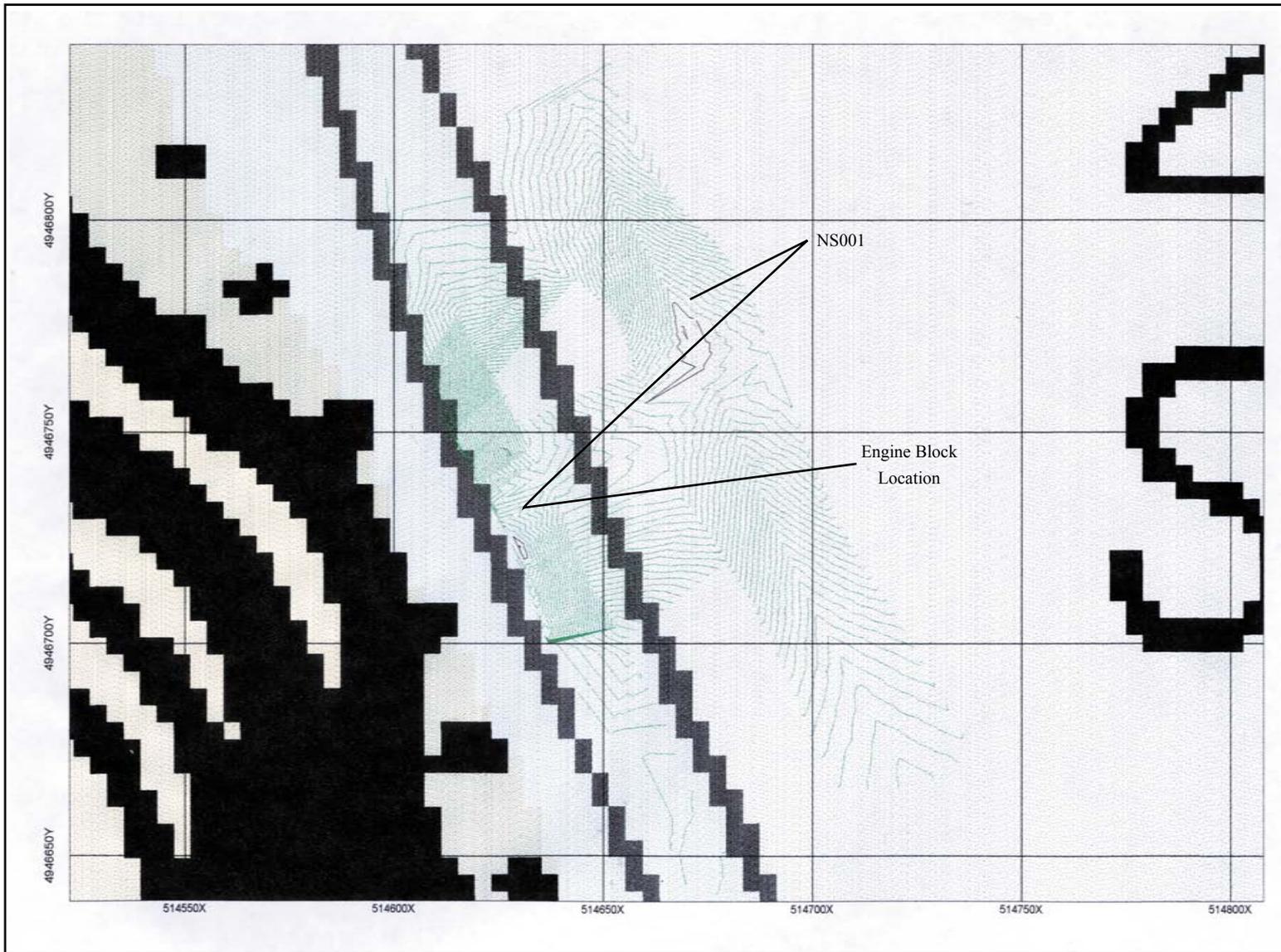
Sea Scan® PC Review software processes the acoustic data. Software tools provide various imagery editing options such as filtering, target measurements, creation of target lists, and the ability to annotate records. The actual digital image is stored in a proprietary graphics file format (*.MST), and converted to a *.TIFF graphics format. The application enables the Remote Sensing Specialist to review and process all MST data files. The plotter program allows related navigational information stored within the data to be viewed and retrieved.

Remote-Sensing Data Results and Data Correlations

Oak Point

North Segment

In the North Segment of Oak Point (Figure 1), an unidentified source (NS001) created a high-amplitude monopole (+450 nT). Although the long wavelength and simplistic monopole signature is characteristic of geological sources, the high amplitude indicated that the source represented a man-made object. It's thought that the broad wavelength signified an object superimposed on a broader regional gradient. The NHC conducted a brief ground truthing excursion on the target and identified a six-cylinder engine block as the primary anomaly source. In addition, limited exploration around the block revealed several eel traps, their magnetic signature masked by the engine block.



Base Map: Maptec® 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 1984

FIGURE 1
PENOBSCOT RIVER SURVEY
PENOBSCOT COUNTY, MAINE
OAK POINT, NORTH SEGMENT
 NHC Field Season 2001

Kempton Cove

Locality KC001 (Figure 2) is an anomaly cluster that contained at least four nodes of various sizes, complexity, and amplitude that ranged 167 nT in maximum variation. Its location on the southwest shoreline, about 68-m north of KC002, may be a peripheral indication of a potential magnetic source that extends farther inshore. Also, the relatively short wavelength and narrow, steep profile of each node indicated that the source is most likely close to the surface, although the shallow water depth could be more of an influencing factor in the signature.

Locality KC002 (see Figure 2) extends from the outer edge of the southwest shoreline. The anomaly is a moderate-amplitude (-130 nT) monopole. Its overall simplistic shape is not indicative of a complex wreck signature. Its broad appearance could be due to the regional gradients, or, even more likely, indicate more distant sources that extend inshore.

Locality KC003 (see Figure 2) extends from the northwestern shoreline. The anomaly is a low-amplitude monopole (+30 nT) and displayed a very simplistic shape. Its overall structure is not indicative of a complex wreck signature. Its predominant permanent magnetization (steep and narrow in profile) is a strong indicator that the potential magnetic source is a single fabric unit.

Western Shoreline

Locality WS001 (Figure 3) exhibited a moderate-amplitude (195 nT) dipole anomaly. The amplitude behavior (e.g., steep in the positive direction [+170 nT] and narrow in wavelength) indicated the sensor passed close to one pole or end of the object. In general, the moderate amplitude suggested a good measure of detectability (i.e., ferromagnetic mass); however, WS001 was too simplistic to produce a meaningful interpretation without an associated sonar target.

Locality WS002 (Target 16_002) appeared as two amorphous-shaped reflectors. The good angle of incidence returned a high level of energy to the tow fish, which allows a more accurate record interpretation. The shadow area behind the area of high reflectance indicated that the object lay in a small area of depression and projected about 0.35 m off the bottom. However, the object is not thought to represent a potentially significant historical resource due to the amorphous shape and lack of apparent complexity indicated in the shadow zone.

Locality WS003 (see Figure 3), a moderate-amplitude (183 nT maximum) dipole anomaly, exhibited two positive nodes (+109 and +183 nT). The amplitude behavior of each node (e.g., steep in the positive direction [+183 nT] and narrow in wavelength) was probably a function of the shallow water depth and sensor orientation. Overall, Locality WS003 appeared to represent

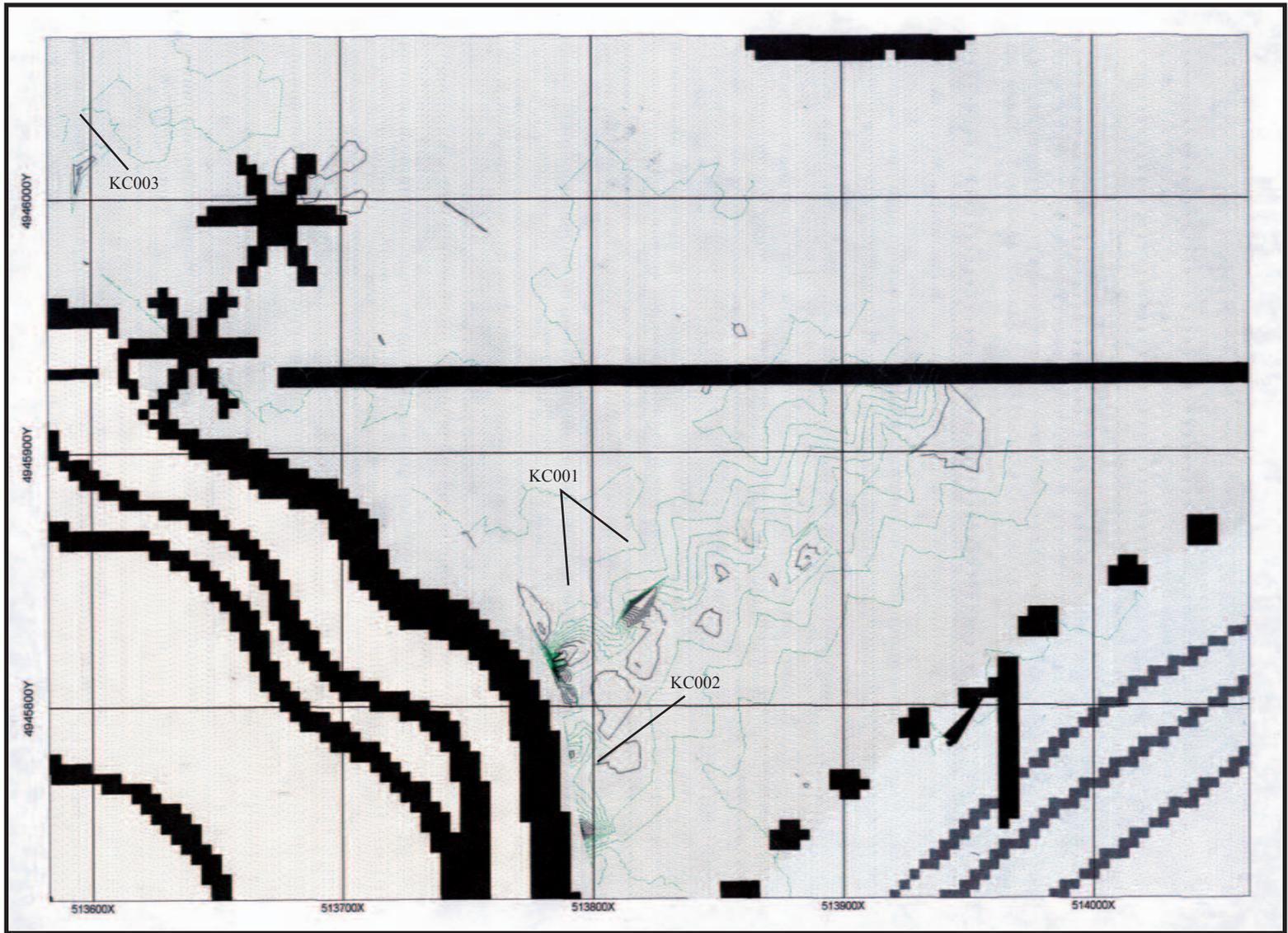
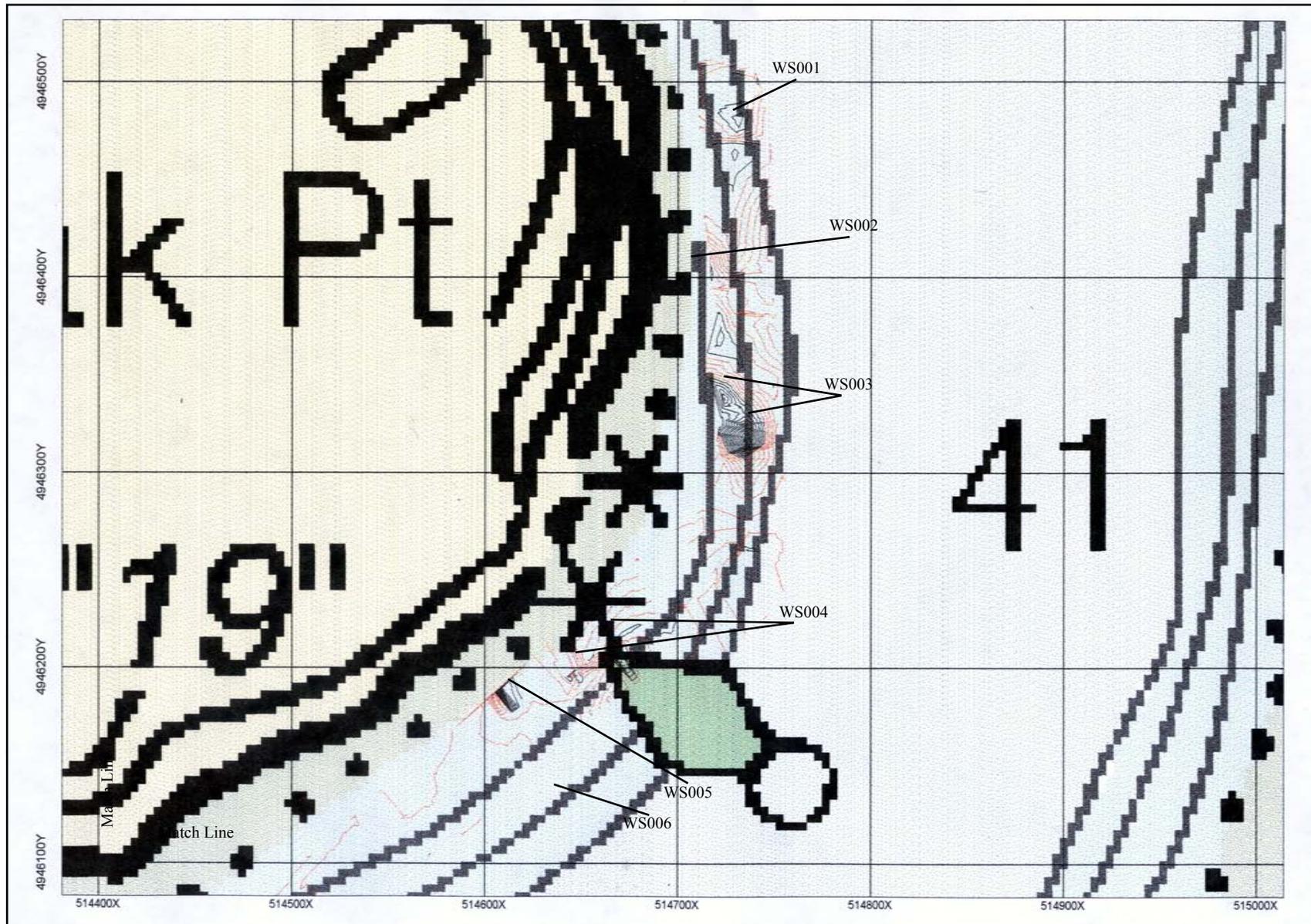


FIGURE 2
PENOBSCOT RIVER SURVEY
PENOBSCOT COUNTY, MAINE
KEMPTON COVE
NHC Field Season 2001

Base Map: Maptec® 13309_3 "Continuation to Bangor"
Coordinate Grid: UTM Zone 19, WGS 1984



■ FIGURE 3
 ■ PENOBSCOT RIVER SURVEY
 ■ PENOBSCOT COUNTY, MAINE
 ■ OAK POINT, WEST SHORELINE
 NHC Field Season 2001

Base Map: Maptec® 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 1984

the periphery of potential magnetic source that most likely extends inshore. In addition, the high-amplitude nodes could be masking smaller near-field sources.

Locality WS004 (see Figure 3) marked two low-amplitude dipole anomalies on the channel shoulder. The more pronounced dipole (± 45 nT) anomaly coincided with a charted channel buoy (green can). In addition, a smaller dipole (-41 nT- $+19$ nT), just 20 m down river, is probably associated with the channel buoy and/or its mooring and chain. In addition to the low amplitude, the profile is steep and narrow, indicating a small, exposed source of a relatively simplistic structure.

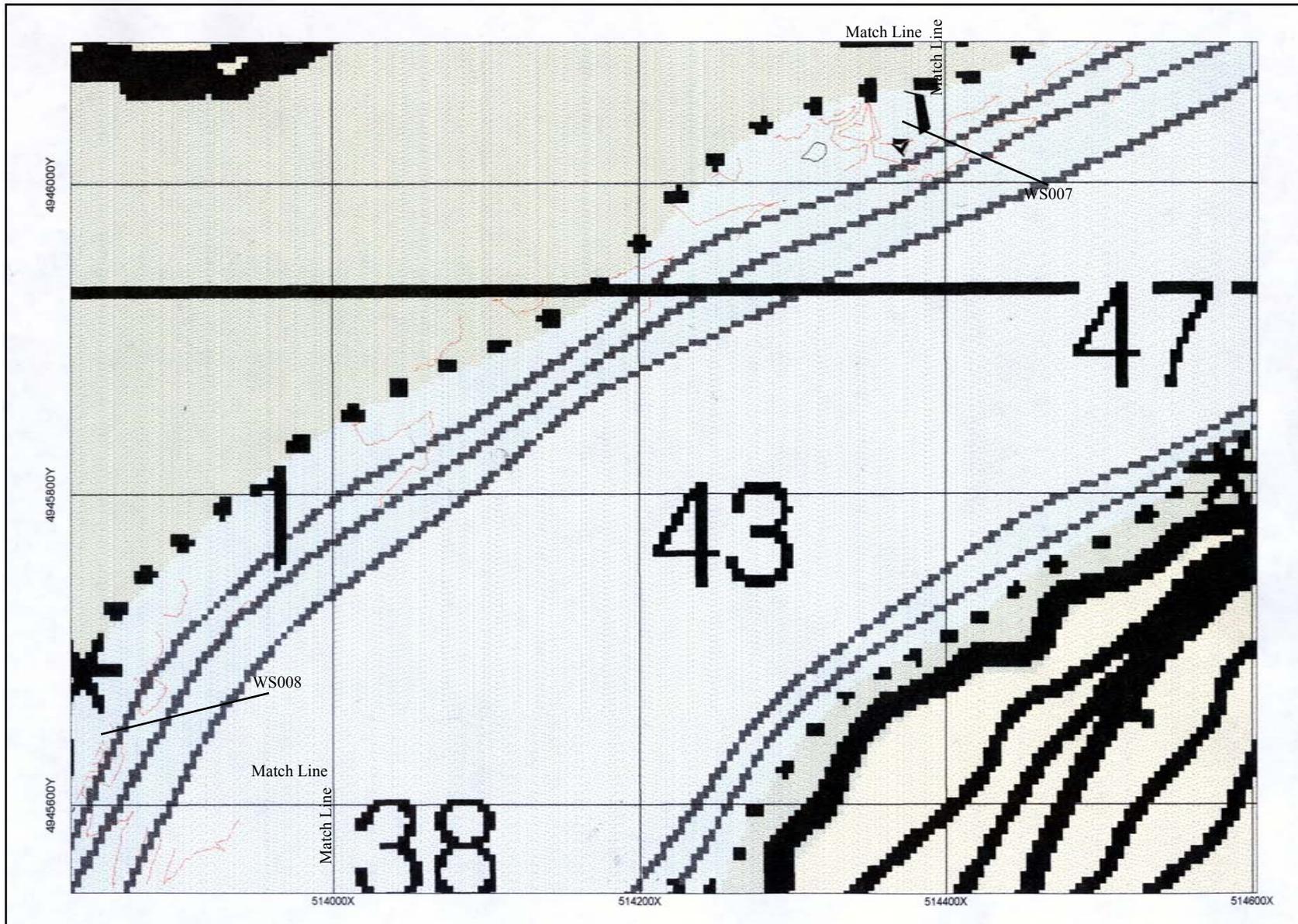
Locality WS005 is a low-amplitude dipole anomaly that extended from the western shoreline into the shallows (see Figure 3). The amplitude behavior, steep in both the positive and negative direction and narrow in wavelength, was probably a function of the shallow water depth and sensor orientation. The observed anomaly may only represent the periphery of potential magnetic source; however, its overall simplistic shape is not indicative of a complex wreck signature.

Locality WS006 (Target 16_006) appeared as a hull-shaped object with a rectilinear internal structure. The poor angle of incidence returned a low level of energy to the tow fish, which prohibited a more detailed record interpretation. Although the target is outside the area of magnetic data collection, its complex internal structure and overall measurement presented a very compelling image, which could represent the remains of a small vessel.

Locality WS007 (Figure 4) represents an unbalanced, low-amplitude dipole anomaly (35 nT maximum range), just around the south bend of Oak Point. The unbalanced configuration resulted as a function of amplitude and the nature and orientation of the source. The amplitude behavior, steep in the positive direction, broad in the negative direction and relative long in wavelength, indicated a partially buried object. The simplistic shape is not indicative of a complex wreck signature and because the anomaly was not detected on an adjacent survey track, it is unlikely to represent a potentially significant historical resource.

Locality WS008, a low-amplitude ($+35$ nT) monopole anomaly that likely represented the periphery of potential magnetic source extending into the river from inshore (see Figure 4). The weakness in amplitude detected may be the effect of a distant point of measurement. The simplistic shape is not indicative of a complex wreck signature and an isolated magnetic pole alone is not sufficient evidence to merit recommendation.

Locality WS009 (Target 16_001) appeared rectangular, about 18.8 meters long and approximately 1.8 m wide. The lack of a distinct shadow zone indicated either poor towfish-to



■ FIGURE 4
 ■ PENOBSCOT RIVER SURVEY
 ■ PENOBSCOT COUNTY, MAINE
 ■ OAK POINT, WEST SHORELINE
 NHC Field Season 2001

Base Map: Maptec® 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 1984

target geometry or partial burial. In general, the absence of an associated magnetic anomaly suggested a very poor measure of detectability (i.e., a low ferromagnetic mass).

Locality WS010 marked a -700 nT anomaly detectable over three survey tracts at the southern end of the Oak Point survey area (Figure 5). Near-field sources, including a fuel dock and several vessels anchored for service, influenced the anomaly's high magnetic contrast.

North Bucksport Area

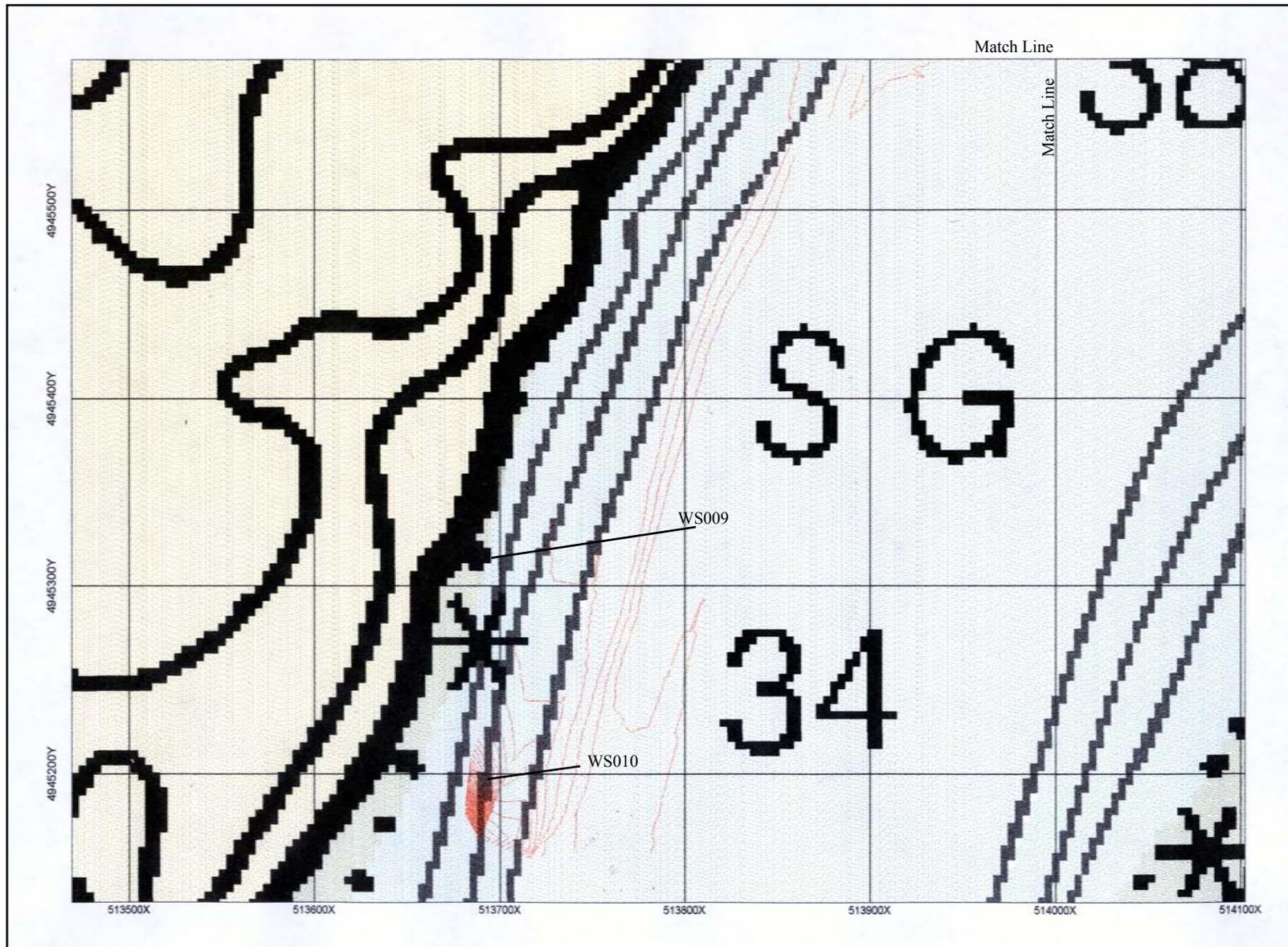
Along the North Bucksport shoreline (Figure 6), a series of unidentified sources account for five anomaly clusters (NB001, NB002, NB003, NB004, and, NB006) of various size, complexity, and amplitude, and one side-scan sonar target (NB005).

Locality NB001 extended from the North Bucksport shoreline into the shallow (1.8 m) bank. The anomaly is a moderate-amplitude dipole that ranged 120 nT in maximum variation. In general, the profile is relatively proportional and its simplistic shape is not indicative of a complex wreck signature. However, the observed anomaly may only represent the periphery of potential magnetic source that most likely extends inshore.

Locality NB002 is a complex anomaly cluster that contained at least three nodes of various sizes, complexity, and amplitude that ranged 154 nT in maximum variation. Its location, extending just 10 m off the shoreline, may be a peripheral indication of a potential magnetic source farther inshore. The strongest node, +137 nT, is relatively proportional. On the adjacent line, closest to shore, the positive node (44 nT) masked the negative node (27 nT). The complexity observed in Locality NB002 is more characteristically associated with a shipwreck or other composite man-made object.

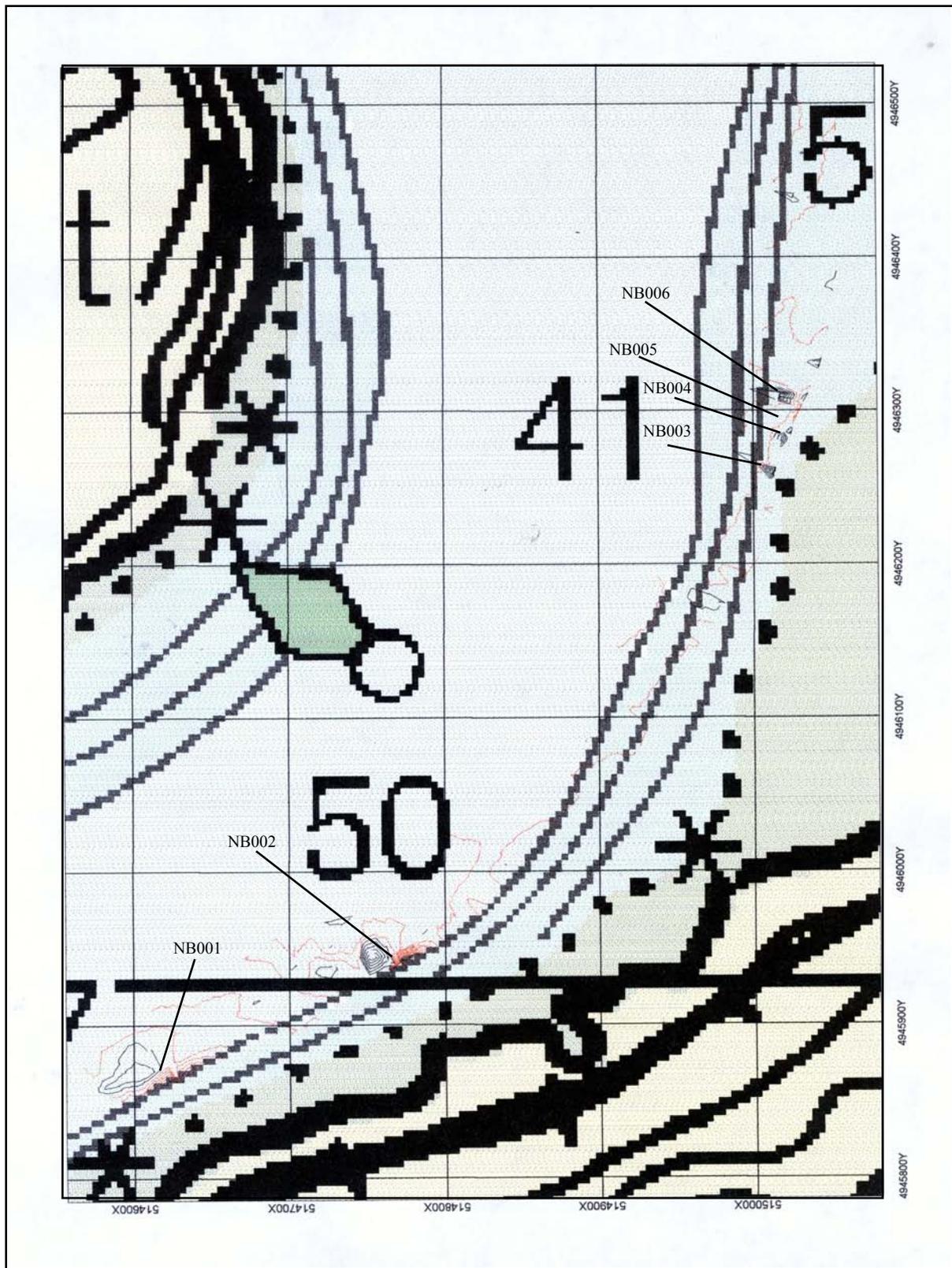
Locality NB003 exhibited a moderate-amplitude (-87 nT) monopole anomaly that reached out from the shoreline. The anomaly did not appear on an adjacent track and its overall simplistic shape is not indicative of a complex wreck signature. Although a magnetic monopole is rarely indicative of an object containing a large mass of ferromagnetic material, its location may be a peripheral indication of a more complex magnetic source onshore.

Locality NB004 emanated from the riverbank and extended about 4 m off shore. It's represented by a low-amplitude dipole anomaly that ranged 69 nT in maximum variation. The anomaly did not appear on an adjacent track and its overall simplistic shape is not indicative of a complex wreck signature.



■ FIGURE 5
 ■ PENOBSCOT RIVER SURVEY
 ■ PENOBSCOT COUNTY, MAINE
 ■ OAK POINT, WEST SHORELINE
 NHC Field Season 2001

Base Map: Maptec® 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 1984



■ FIGURE 6
 ■ PENOBSCOT RIVER SURVEY
 ■ PENOBSCOT COUNTY, MAINE
 ■ NORTH BUCKSPORT
 NHC Field Season 2001

Base Map: Maptec® 13309_3 "Continuation to Bangor"
 Coordinate Grid: UTM Zone 19, WGS 1984

Locality NB005 (Target 16_007) marked a linear sonar target. The strong reflected energy and intense shadow created a quality three-dimensional record of a non-descript linear object. The target lacked a corresponding magnetic anomaly, which served as an indicator of a low ferromagnetic content. Overall, the target did not appear to represent a potentially significant historic resource.

Locality NB006, about 13 m north of target 14, represented a low-amplitude dipole anomaly that ranged 84 nT in maximum variation. The unbalanced configuration (+77 nT and -7 nT) probably resulted as a function of amplitude and the nature and orientation of the source. The low-amplitude (-7 nT), and relatively broad profile expressed by one node that extended from the shoreline, is usually an indicator that the source is distant or buried. Offshore, the higher-amplitude (77 nT) node was narrow in profile, and indicated that the sensor passed close to the source. Based on these findings, it is unlikely that NB006 represents the remains of a potentially significant historic resource.

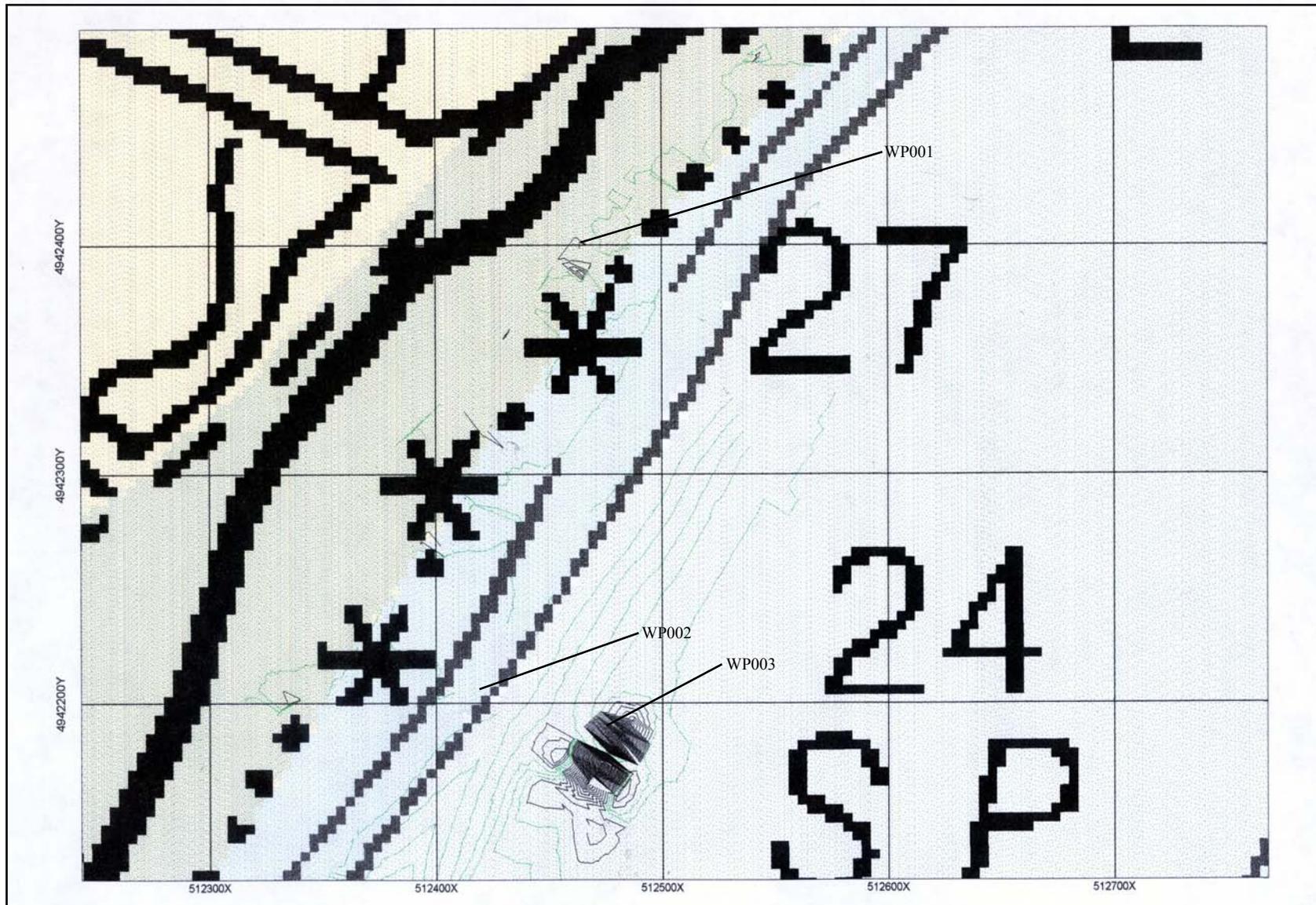
Winterport Area

Locality WP001 marked a low-amplitude (+41.6 nT) monopole anomaly on the channel's western shoulder (Figure 7). The amplitude is relatively high in magnetic contrast for a geologic source; therefore, a small man-made object is likely the potential source. The weakness in amplitude detected was likely the effect of a low ferromagnetic mass. The simplistic shape is not indicative of a complex wreck signature and an isolated magnetic pole alone is not sufficient evidence to merit recommendation.

Locality WP002 (Target 15_008) exhibited a low-amplitude reflector that appeared slightly convex in shape. The target lacked a distinct shadow zone, which could indicate either a poor tow fish-to target geometry and/or partial burial. Target 15_008 could represent a geological feature such as a natural ridge.

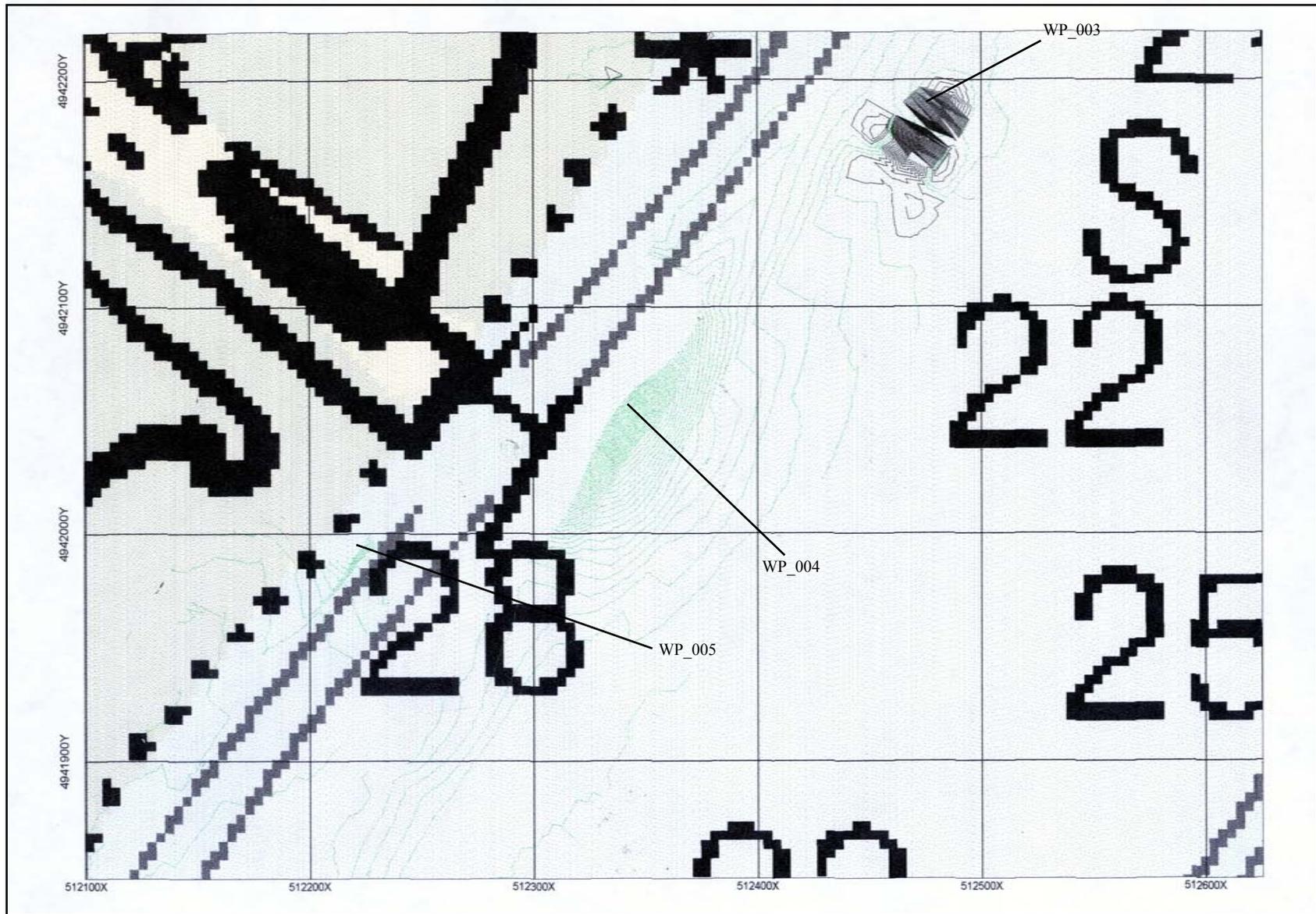
Locality WP003 indicated a high amplitude dipole that ranges 674.5 nT in maximum variation (see Figure 7). The amplitude behavior, steep in both the positive and negative direction and narrow in wavelength, was a function of the sensor orientation and nature of the source. Although the anomaly lacked an associated sonar target, the high magnetic contrast of the two nodes (+335/-339.5) may have masked proportionally smaller anomalies in the near field.

Locality WP004 (Figure 8), a high-amplitude (+585 nT) monopole anomaly, corresponded to the terminal pier at Winterport. The terminal pier consisted of a converted iron barge about 61 m long. Its high magnetic contrast influenced the recordings observed on six adjacent survey lines.



■ FIGURE 7
 ■ PENOBSCOT RIVER SURVEY
 ■ PENOBSCOT COUNTY, MAINE
 ■ WINTERPORT SHORELINE
 NHC Field Season 2001

Base Map: Maptec® 13309_1 "Penobscot River, ME"
 Coordinate Grid: UTM Zone 19, WGS 1984



□ FIGURE 8
 PENOBSCOT RIVER SURVEY
 □ PENOBSCOT COUNTY, MAINE
 □ WINTERPORT SHORELINE
 NHC Field Season 2001

Base Map: Maptec® 13309_1 "Penobscot River, ME"
 Coordinate Grid: UTM Zone 19, WGS 1984

The sonar record that covered this bottom area lacked any compelling targets, which might have been masked by the terminal's influence.

Locality WP005, a low-amplitude (+28/-48 nT) anomaly, corresponded to the down-river end of the terminal pier at Winterport (see Figure 8). The anomaly appeared at the end of the line; about 60 meters downstream from the terminal head and clearly demonstrated the terminal's magnetic contrast and influence over the ambient background recordings.

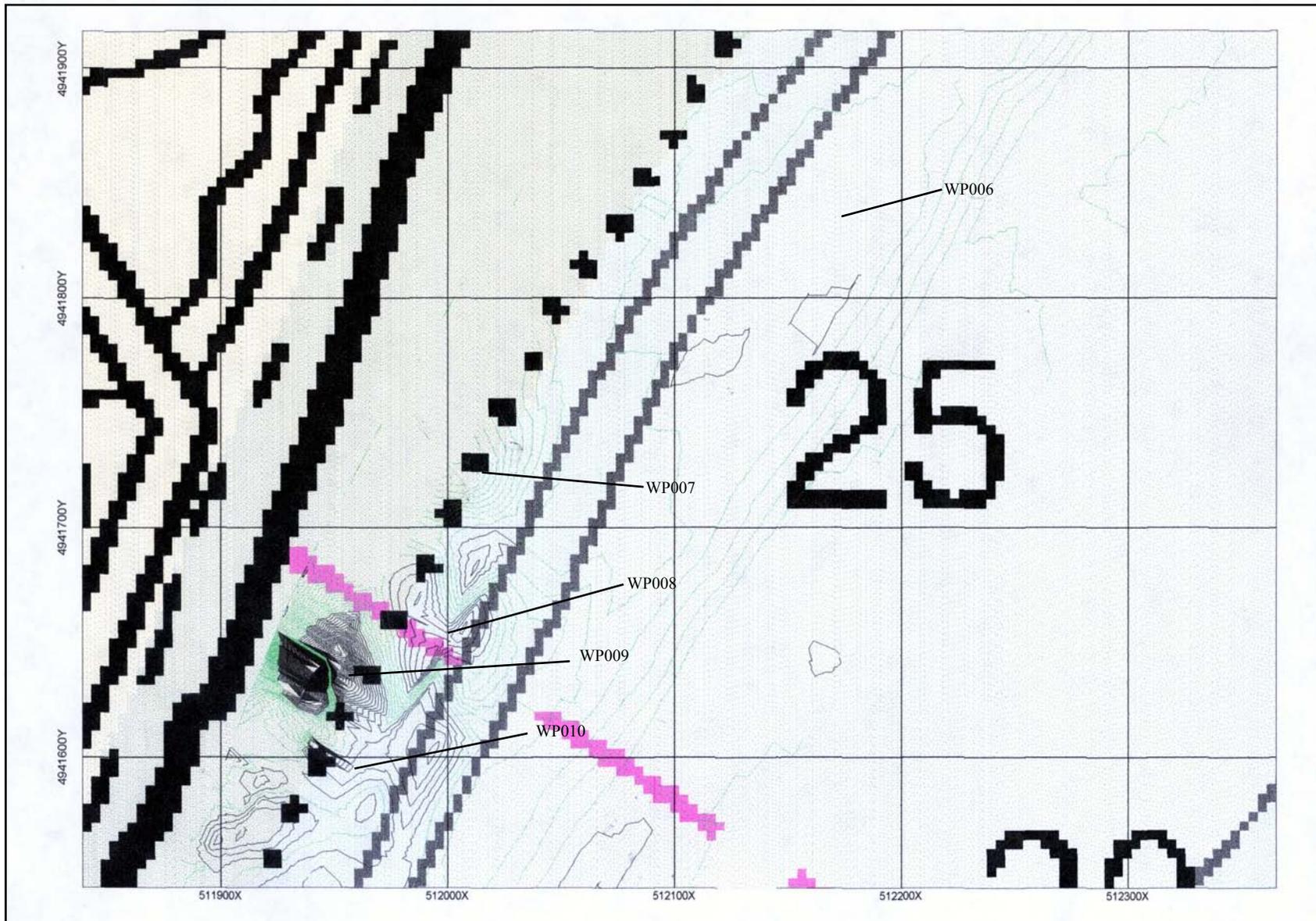
Locality WP006 (Target 15_003) marked a shallow 60 square meter (m^2) depression in the river bottom, which contained an amorphous-shaped object (possibly a sediment berm) and one rectangular structure. The target, directly in the towpath along line 25, failed to yield a corresponding magnetic anomaly, a strong indicator of a very low ferromagnetic mass.

Locality WP007 marked a moderate-amplitude (+138.7 nT) monopole anomaly (Figure 9). The amplitude, relatively high in magnetic contrast for a geologic source, and, broad and simplistic shape, provided a peripheral indication of a man-made object some distance inshore. A visual observation verified that the anomaly probably correlated to a 5-x-3-foot (1.5-x-0.91-m) rectangular tank (possibly an old fuel or oil tank) partially exposed at low tide.

Locality WP008 marked a low-amplitude (149.2 nT) anomaly complex containing three nodes that ranged about 149 nT in maximum variation (see Figure 9). The two weaker nodes, about 52 nT each, expressed negative values and appeared relatively proportional in contrast to the higher amplitude (+96.6 nT), steep, positive node. The unbalanced configuration probably resulted as a function of amplitude and the nature and orientation of the source. Its proximity to the charted cable crossing and leads the interpretation to deduce modern sources created the magnetic source.

Locality WP009 corresponded to a high-amplitude (848 nT), unbalanced (+646/-202 nT), dipole anomaly (see Figure 9). The anomaly, discovered on line 31 in the charted Cable area and observed over three survey lines, demonstrated a high magnetic contrast and influence over the ambient background recording. The high magnetic contrast and proportionally narrow profile represented a function of the shallow water depth (about 2 m at flood tide), sensor orientation, and the source's ferromagnetic content. The lack of a compelling sonar target and the locale inside the cable crossing area leads to the interpretation that the potential source is likely a modern object.

Locality WP010 (Target 15_006) marked a moderate-amplitude (139 nT), unbalanced (+34/-105 nT), dipole anomaly and an associated sonar target (see Figure 9). The weak negative value and proportionally narrow profile represented a function of the sensor orientation passing close to



■ FIGURE 9
 PENOBSCOT RIVER SURVEY
 ■ PENOBSCOT COUNTY, MAINE
 ■ WINTERPORT SHORELINE
 NHC Field Season 2001

Base Map: Maptec® 13309_1 "Penobscot River, ME"
 Coordinate Grid: UTM Zone 19, WGS 1984

one end of the source. The corresponding sonar target, a relatively narrow, linear-shaped object probably represented the magnetic source.

Locality WP011 (Target 15_004) marked an amorphous-shaped, high-amplitude reflector at the outer range of the sonar swath (about 53 m). The lack of a distinct shadow zone indicated poor towfish-to-target geometry. The amorphous shape and lack of a distinct shadow zone prohibited making an accurate interpretation of the potential source. Nevertheless, the target did not appear to represent a potentially significant historic resource.

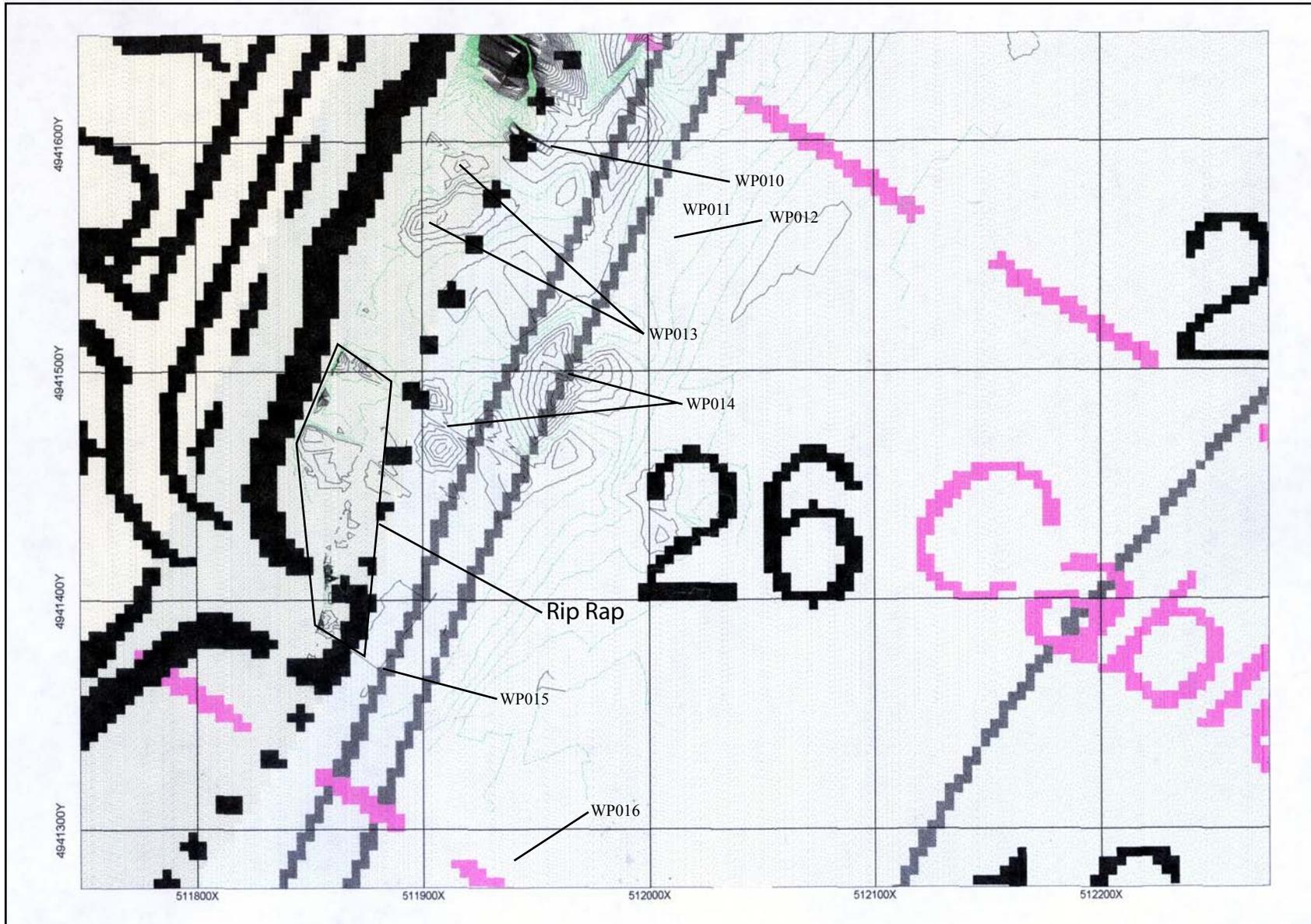
Locality WP012 (Target 15_007) marked a series of high-amplitude linear reflectors arranged in a relatively complex geometric shape. The lack of a distinct shadow zone indicated at least partial burial, but prohibited making an accurate interpretation of the potential source. Although the target presented a somewhat compelling image, the lack of any magnetic anomaly or near field source reduced its potential to represent a significant historic resource.

Locality WP013 corresponded to an anomaly complex that contained five nodes of various size and amplitude that ranged 229 nT in maximum variation (Figure 10). Although a relatively simplistic signature, the low-to moderate contrast appeared on two adjacent lines. The unbalanced configuration and proportionally broad profile appeared indicative of a deeply buried source. Overall, its long wavelength and broad profile is not indicative of a complex wreck signature.

Locality WP014 represented a low-amplitude (110 nT), unbalanced, anomaly complex (see Figure 10). The complex contained six nodes varying in amplitude from -53 to +57 nT. Its influence appeared on five adjacent lines and exhibited the greatest magnetic contrast closest to shore. The relatively low amplitude and proportionally broad profile are indicative of a buried source. The lack of a compelling sonar target, the long wavelength (about 75 m), and, its locale inside the cable area, leads the interpretation to deduce that the potential source is likely discarded cable.

Locality WP015 (Target 15_005) marked a series of low-amplitude, linear reflectors collected in an area just 17 m offshore from a small point of land. The simplistic shadow zone, uncharacteristic of complex man-made objects, and lack of magnetic data in the near field, led to the interpretation that these linear reflectors represented submerged logs.

Locality WP016 (Target 15_002) corresponded to two high-amplitude reflectors about 14 meters off the end of line 15 (on the channel side). The two reflectors, linear-shaped, appeared to be composite and may represent paired frames. A shadow zone behind the area of highest



■ FIGURE 10
 ■ PENOBSCOT RIVER SURVEY
 ■ PENOBSCOT COUNTY, MAINE
 ■ WINTERPORT SHORELINE
 NHC Field Season 2001

Base Map: Maptec® 13309_1 "Penobscot River, ME"
 Coordinate Grid: UTM Zone 19, WGS 1984

reflectance indicated the objects stood roughly one m off the bottom. Because the target fell outside the survey area, it lacked the magnetic data vital to the record interpretation.

Remote-Sensing Recommendations

Guidelines established in the selection process were used to recommend and prioritize the magnetic and acoustic data. This selection process did not focus on complex magnetic anomalies with a high-amplitude or an associated side-scan sonar target. Instead, the process established an accurate method for setting priorities for each target according to the historic potential.

In a much-generalized explanation, a magnetic monopole is usually characteristic of geologic sources and its expression is rarely indicative of an object containing a large mass of ferromagnetic material (i.e., a significant historic object). Magnetic dipoles are of additional significance to archaeological exploration since the magnetic properties of cultural features are relatively intense compared to the surrounding medium and are extremely complex. However, experience indicates that an isolated magnetic dipole alone is not sufficient evidence to merit recommendation. Shipwrecks are complex objects and tend to produce convoluted clusters of small and large anomalies. Therefore, an isolated anomaly must meet some additional criteria, such as a related side-scan sonar target or charted wreck to justify a recommendation.

Side-scan sonar targets without related magnetic anomalies must present a particularly compelling image to justify a recommendation. The visual expression of the bottom record and the sonar target is vital in identifying a potentially historic wreck, wreck site, or other significant artifact. More often, the absence of a detailed acoustic shadow, which can provide important clues to an object's identification, makes it impossible to recognize target components. The unfortunate situation whereby an object cast no shadow is a possible consequence of the shallow burial and/or geometry between the object and sonar beam.

Oak Point Area

North Segment

In the North Segment of Oak Point (see Figure 1), a six-cylinder engine block created a high-amplitude monopole, NS001 (+450 nT). In addition, exploration around the block revealed several eel traps. Although ground truthing concluded without encountering any potentially historic resources, the only way to ensure that the engine block created the anomalous mass is to remove the block and re-scan the area. However, the NHC does not recommend additional investigations given the absence of historical data to indicate the potential loss of a ship in this area.

Kempton Cove

In Kempton Cove (see Figure 2), a series of unidentified sources account for three anomaly clusters of various size, complexity, and amplitude (KC001, KC002 and KC003). All three of these localities extended from the shoreline area and represented the periphery of unidentified magnetic sources.

KC001 is the only locality that exhibited the complexity and amplitude more characteristically associated with a shipwreck or other composite, man-made object. Because the area is exposed to partially inundated at low tide, a pedestrian reconnaissance may help identify the potential magnetic source; however, to completely define the source's boundaries, a terrestrial magnetic mapping regime is recommended. This task should be completed with dual magnetic sensors, providing both traverse and vertical gradient measurements to remove the regional gradient and increase the resolution of local anomalies.

Western Shoreline

Along the western shoreline at Oak Point, a series of unidentified sources account for five anomalies of various size, complexity, and amplitude (WS001, WS003, WS005, WS007, and, WS008). At localities WS004 and WS010, a channel buoy and fuel dock (respectively) influenced the magnetic contrast. The side-scan sonar target at WS002 lacked the visible complexity to be considered a potentially significant historical resource.

Locality WS001 exhibited a good measure of detectability (i.e., ferromagnetic mass); however, it appeared too simplistic to warrant additional investigations without an associated sonar target. Its dipolar signature is not considered characteristic of a complex wreck structure.

Localities WS003, WS005, WS007, and WS008 probably indicated the periphery of a magnetic source that extends inshore. These localities are too simplistic to produce a meaningful interpretation without an associated sonar target or additional magnetic data collected from the inshore extension.

Locality WS006 (Target 16_006) expressed a hull-shaped object with a rectilinear internal structure. Its complex internal structure and overall measurement presented a visually compelling image that could represent the remains of a small vessel. Although the absence of magnetic data limited a more definitive interpretation, WS006 is deemed worthy of additional investigations.

Locality WS009 (Target 16_004) appeared rectangular, but lacked a distinct shadow zone, which limited visual interpretation. In addition, the absence of an associated magnetic anomaly

indicated a very poor measure of detectability (i.e., a low ferromagnetic mass). Nevertheless, the target's proximity to a suspected early nineteenth-century shipwreck site adds priority to conduct additional investigations.

North Bucksport Area

In North Bucksport, a series of unidentified sources account for five anomaly clusters (NB001, NB002, NB003, NB004, and NB006) and one side-scan sonar target (NB005). Three localities, NB001, NB003 and NB004, presented a peripheral indication of magnetic sources that extended inshore, and simplistic signatures uncharacteristic of complex shipwreck sites. Similarly, NB005 cast a non-descript linear target, which lacked the complexity to represent a potentially significant historic resource.

Locality NB002 presented a peripheral indication of magnetic sources that extended inshore; but unlike NB001, NB003 and NB004, this locality displayed the complexity and amplitude more characteristic of a complex source, such as a shipwreck. Additional site investigations are recommended to determine the extent on shore and provide additional clues to the object's identification.

Winterport Area

In the Winterport area, unidentified sources accounted for six anomaly clusters (WP001, WP003, WP008, WP009, WP013, and WP014). Of these six, the source of magnetic contrast at WP008, WP009, WP013, and WP014, is thought to be associated with discarded construction materials in the charted cable area. Two localities, WP004 and WP005, represented the near-field influence of the terminal pier at Winterport. In addition, WP007 and WP010 (Target 15_006), are thought to be associated with modern materials, which included a metal tank and section of pipe, respectively.

At Locality WP001 on the channel's western shoulder, the low-amplitude monopole anomaly is not indicative of a complex wreck signature and an isolated magnetic pole alone is not sufficient evidence to merit recommendation. However, at WP003, the high magnetic contrast may have masked proportionally smaller anomalies in the near field. Although not overly complex, its signature may not be an accurate representation of the true magnetic source. The lack of an associated sonar target reduced its historical potential in the recommendation process; however, the overall intensity of WP003 is thought warrant additional investigations.

It is thought that WP002 represented a natural bottom feature and WP0015 reflected the collection of submerged logs. However, at WP006, WP011, and WP012, the rather indistinct

sonar targets, coupled with the lack of an associated magnetic anomaly, prohibited making an accurate record interpretation. The relatively complex geometric shape insonified at WP006 and WP012 created an intriguing image, but the absence of any magnetic anomaly, even in the near field, reduced the potential of these two locales to represent a significant historic resource. The amorphous shape at WP011 cannot be correlated to any recognizable bottom features or objects and did not merit a recommendation.

The two linear signatures at WP016 appeared to represent a single object, sitting about one meter proud off the bottom. Although the target did not exhibit a distinct shadow zone to make an accurate record interpretation, a 2x zoom revealed what might be frame sets along its axial length. Although magnetic data would be vital to a more complete record interpretation, the compelling image at WP016 could represent a potentially significant historic resource that merits additional investigation.

Miscellaneous Sonar Targets

The data-processing phase revealed 16 sonar targets in the bottom records along the river's shoreline and channel. Of these targets, four (15_001, 15_009, 16_003, 16_004, and 16_005) fell mid-channel, offline, and outside the survey area at either Oak Point or Winterport. None of these four targets presented a compelling visual expression and therefore did not merit a recommendation; however, tabulated data on each these targets are provided (see Appendix G).