MARYLAND DEPARTMENT OF TRANSPORTATION'S
STATE HIGHWAY ADMINISTRATION
ENVIRONMENTAL PLANNING DIVISION
CULTURAL RESOURCES SECTION

ARCHAEOLOGICAL REPORT NUMBER 489

PHASE I AND PHASE II UNDERWATER ARCHAEOLOGY INVESTIGATIONS OF THE NANTICOKE RIVER SHIPWRECK (SITE 18DO497) DORCHESTER COUNTY, MARYLAND REPAIRS TO FENDER SYSTEM FOR BRIDGE NO. 0902200 ON US 50 OVER THE NANTICOKE RIVER

SHA
State Highway
Administration
Maryland Department of Transportation

Project Number: AX744A55
2017

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FOR SHA ARCHAEOLOGICAL REPORTS (as of September 2016)

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PHASE I AND PHASE II UNDERWATER ARCHAEOLOGY INVESTIGATIONS OF THE NANTICOKE RIVER SHIPWRECK (SITE 18DO497) DORCHESTER COUNTY, MARYLAND

REPAIRS TO FENDER SYSTEM FOR BRIDGE NO. 0902200 ON US 50 OVER THE NANTICOKE RIVER

FINAL TECHNICAL REPORT
SHA ARCHAEOLOGICAL REPORT 489

SHA PROJECT AX744A55
CONTRACT BCS 2010-02B
TASK ORDER 26

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ABSTRACT

On behalf of the Maryland Department of Transportation's State Highway Administration (SHA), SEARCH conducted an emergency underwater archaeology investigation of a shipwreck discovered during the removal of debris associated with a vessel collision with the dolphin/fender system at the Highway 50 Bridge over the Nanticoke River near Vienna, Maryland. SHA removed the remains of a historic shipwreck while in the process of clearing the navigation hazard created by the demolished dolphin and fender. SEARCH assessed the site (18DO497) for additional remains and documented the recovered timbers, which are currently stored at the Maryland Archaeological Conservation Laboratory. Construction methods and dendrochronology analysis suggest that the Nanticoke River Shipwreck is an eighteenth century merchant vessel, approximately 40-45 feet long, and rigged with one or perhaps two masts. She was constructed in Maryland from local materials, possibly at a small shipyard or plantation, and possesses design characteristics that may represent an early stage in the evolution towards the Chesapeake Bay cargo carrying pilot schooner and eventually the famed Baltimore clipper. SEARCH argued that the Nanticoke River Shipwreck was eligible for listing in the National Register of Historic Places (NRHP) based on her design characteristics and unique ties to the Maryland and American maritime traditions. However, the Maryland Historical Trust determined that 18DO497 is not eligible for the NRHP based on its compromised integrity.

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INTRODUCTION

The Maryland Department of Transportation's State Highway Administration (SHA) contracted Skelly and Loy to conduct the initial emergency archaeological investigation of the remains of a shipwreck discovered during repair to the Highway 50 Bridge over the Nanticoke River navigation fender system in Dorchester County, Maryland (**Figure 1**) (SHA Project AX744A55). The project location resides within Maryland Archaeological Research Unit 3 (Nanticoke-Wicomico-Manokin-Big Annemessex Drainages) (**Figure 2**). Construction removed a portion of the shipwreck during debris removal. Skelly and Loy subcontracted SEARCH to complete this task between April 25 and May 8, 2015; background research continued throughout the duration of the project. Investigations included a Phase I marine remote-sensing survey (2.9 acres [ac] [1.2 hectares (ha)]), Phase II assessment of the site (0.09 ac [0.04 ha]), documentation of remains removed from the site, research at local repositories, and clearance of a temporary work zone (0.18 ac [0.07 ha]) (**Appendix A**). This work was a preliminary investigation of the site to determine what portions of the shipwreck were removed, what may remain on the river bottom, if a National Register of Historic Places (NRHP) eligibility assessment is possible, whether a vessel identification can be determined, and to recommend documentation and mitigation measures. Phase III data recovery was not part of the research design, but was considered as a future mitigation activity, depending upon the results of the present investigation.

SHA recently removed a damaged dolphin and fender along the navigation channel at Pier C-3, a central pier on Bridge 0902200 over the Nanticoke River. The damaged dolphin and fender, and associated debris, created a navigation hazard in the channel, which required removal by the US Coast Guard (USCG). SHA discovered a previously unknown historic-period shipwreck in the process of removing debris to the river bottom level. The majority of shipwreck remains were recovered from the river during the dolphin/fender debris removal, severely impacting the site; remains were delivered to the Maryland Archaeology Conservation Laboratory (MAC Lab) in Calvert County for stabilization and documentation. The USCG instructed SHA to construct a temporary dolphin following debris removal until the permanent dolphin and fender could be replaced. The permanent structures are expected to destroy any remaining features associated with the site.

SEARCH conducted this project to assist the SHA in meeting its obligation under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (89-665). The project also was conducted in compliance with the Archaeological and Historic Preservation Act, as amended (PL 93-291), the Advisory Council on Historic Preservation, revised 36 CFR Part 800 Regulations, and the Maryland Historical Trust Act of 1985. Investigative methodologies and technologies followed the Consultant Specifications for Archeological Services, published by the SHA, and the Standards and Guidelines for Archeological Investigations in Maryland, published by the Maryland Historical Trust (MHT). A Maryland Inventory of Historic Properties Archeological Site Survey form was submitted and was provided trinomial designation 18DO497 for the site (**Appendix B**). All investigations complied with US Army Corps of Engineers (USACE) EM 385-1-1,

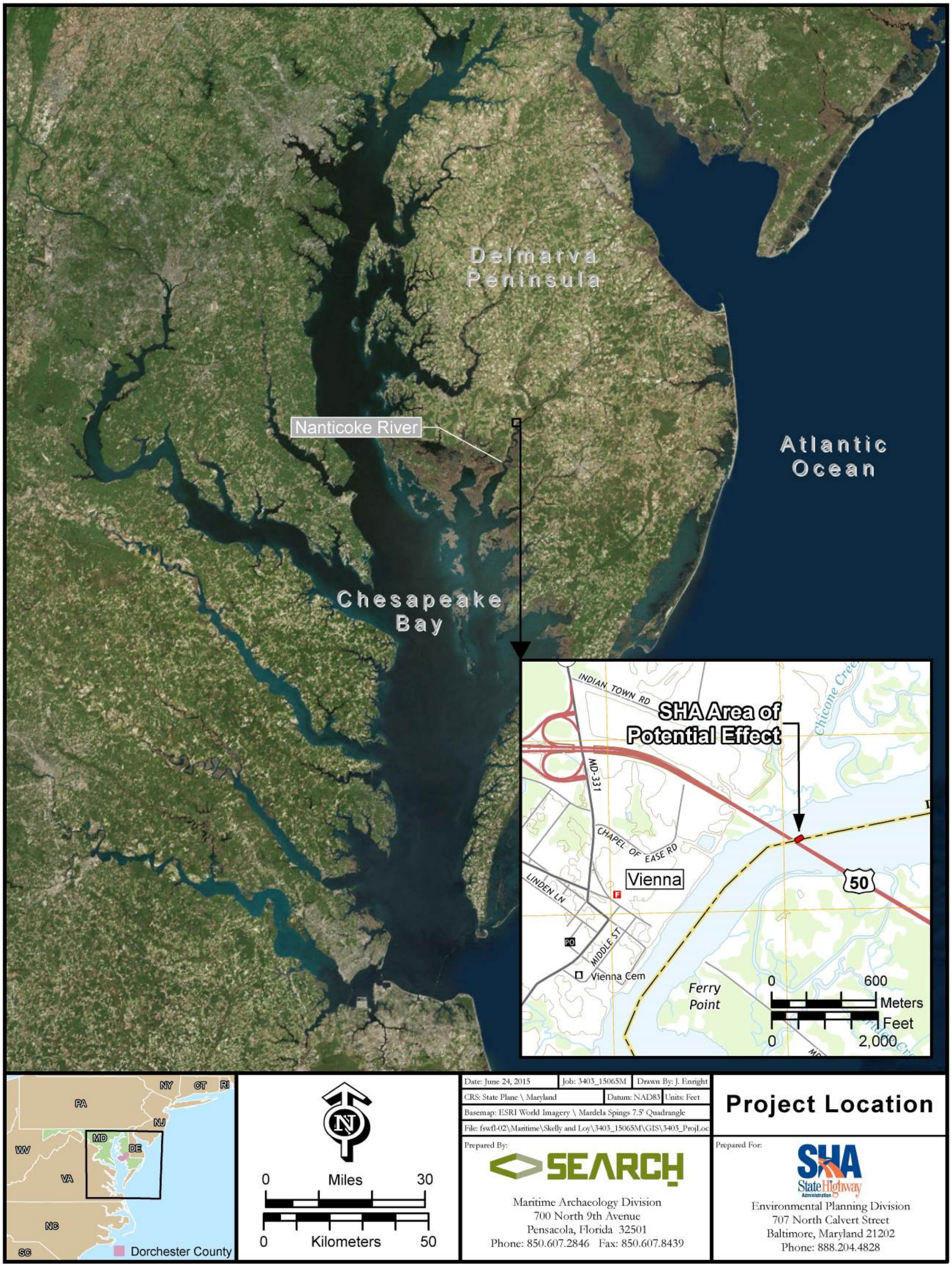

Figure 1. Project location.

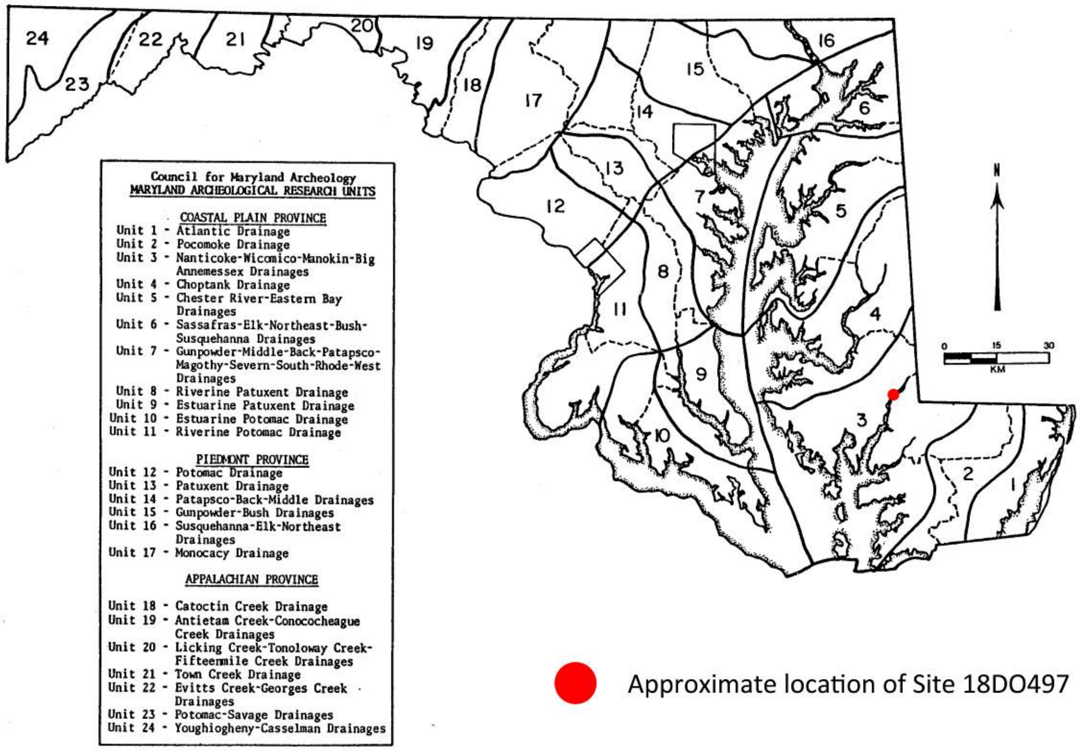

Figure 2. Project location within Maryland Archaeological Units.

Safety and Health Requirements Manual (September 15, 2008) during the Phase II investigation, which is the industry standard for safety when conducting scientific diving investigations.

Professional archaeologists who meet the Secretary of the Interior's Standards and Guidelines and who are listed on the Register of Professional Archaeologists (RPA) designed, directed, and managed all phases of work. Jason Burns, MA, RPA, served as Contract Manager, and Jeff Enright, MA, RPA, served as Principal Investigator (**Appendix C**), directed all phases of the project, and prepared this technical report. The Phase I and Phase II field crew included Matt Hanks, MA, RPA; Joe Grinnan, MA, RPA; and Ray Tubby, MA, RPA. Alicia Massey, MS, and Barry Bleichner, MS, JD, joined the field crew during the archival research and timber documentation tasks. Travis Fulk, MA, and Nick Linville, MA, assisted with archival research and prepared the background history for the report. Mr. Hanks conducted research into previous archaeological sites and surveys. Katy Harris, MS, and Rasha Slepow, BS, served as technical editors. The remainder of this report is organized into the following sections: Research Design, Results, Site Interpretation, and National Register of Historic Places Eligibility Discussion.

RESEARCH DESIGN

With the guidance of SHA, SEARCH created a research design with a number of objectives that would determine the integrity of the Nanticoke River shipwreck and the recovered remains, identify additional features that may still exist on the river bottom, and determine the eligibility for listing in the NRHP of both the site and the recovered remains. These objectives include:

1. Archival and historical research,
2. Phase I marine remote-sensing survey,
3. Phase II archaeological diver investigation,
4. Recordation of shipwreck features currently housed at the MAC Lab, and
5. Wood speciation and dendrochronology.

OBJECTIVE 1: ARCHIVAL AND HISTORICAL RESEARCH

Extensive research was conducted in order to develop the context necessary to understand the historical significance of the shipwreck and establish potential candidates for its identity and source of construction. Research included visiting libraries and repositories; speaking with local and non-local experts in the fields of maritime archaeology, ship construction, and local history, as well as local informants familiar with Vienna and the Nanticoke River; and reviewing secondary sources. SEARCH consulted the following individuals and institutions:

- Dr. Robert Neyland, Underwater Archaeology Branch Head, US Naval History and Heritage Command
- George Schwarz, Underwater Archaeologist, US Naval History and Heritage Command
- Dr. Alexis Catsambis, Underwater Archaeologist, Naval History and Heritage Command
- Colan Ratliff, Conservator, US Navy Ship Model Program
- Pete Lesher, Chief Curator, Chesapeake Bay Maritime Museum
- Michael Gorman, Boatyard Manager, Chesapeake Bay Maritime Museum
- Dr. Julie Schablitsky, Chief Archaeologist/Assistant Division Chief, Maryland Department of Transportation’s State Highway Administration
- Carol Ebright, Senior Archaeologist, Maryland Department of Transportation’s State Highway Administration
- Bruce Thompson, Research Archeologist, Maryland Historical Trust
- Dr. Susan Langley, State Underwater Archeologist, Maryland Historical Trust
- Dr. Benjamin Ford, Professor, Indiana University of Pennsylvania Department of Anthropology
- Nichole Doub, Head Conservator, Maryland Archaeological Conservation Laboratory
- Gary Lawrence, City of Vienna Community Center
- Norine Carroll, Faculty Research Associate, Archaeology Institute, University of West Florida

- Jan Lloyd, Archaeology Laboratory Director, Archaeology Institute, University of West Florida
- Dr. G. Ray Thompson, Director, Edward H. Nabb Research Center for Delmarva History and Culture, Salisbury University
- Michael Worthington, Oxford Tree-Ring Laboratory
- Justine McKnight, Archeobotanical Consultant
- Geoffrey Footner
- Jason Moser, Cultural Resource Manager, South Carolina Army National Guard Cultural Resources Division
- Tom Bradshaw, Dorchester County Council District 5
- Toby Gearhart, Dorchester County Public Library
- National Archives and Records Administration
- Mariner's Museum
- Naval History and Heritage Command
- The Archives of Maryland
- MHT Library
- Maryland Archaeological Site Survey
- Richardson Maritime Museum
- Bethel, Delaware Archives
- Maryland Historical Society
- Dorchester County Historical Society
- Donald Shomette
- Ralph Eshelman

OBJECTIVE 2: PHASE I MARINE REMOTE-SENSING SURVEY

SEARCH conducted remote-sensing survey of approximately 2.9 ac (1.2 ha), which encompassed not only the area from where SHA recovered remains, but also the area surrounding all the structures associated with the navigation channel beneath the bridge. SHA requested the expanded survey corridor to determine the presence/absence of additional underwater sites adjacent to the entire fender/dolphin system. Remote-sensing survey was conducted from a 20-foot (ft) (6.1-meter [m]) aluminum hull, riverine vessel, which was equipped with all the necessary safety equipment. Instrumentation for the survey included a Hemisphere Crescent VS110 differentially corrected global positioning system (dGPS) receiver, a Geometrics G-882 cesium vapor marine magnetometer, an EdgeTech 4125 dual-frequency (600/1,600 kilohertz [kHz]) CHIRP side-scan sonar, and an EdgeTech SB-424 CHIRP sub-bottom profiler. HYPACK navigation software provided vessel guidance along pre-planned survey lines, as well as dGPS and magnetometer data collection. SEARCH conducted the sub-bottom profiler survey separate from the magnetometer and side-scan sonar due to space limitations onboard the smaller, riverine survey vessel (**Figure 3**). The separate surveys also allowed optimization of data collection for various instruments—survey collected magnetometer data and side-scan

Figure 3. Sub-bottom profiler survey underway.

sonar imagery along survey lines spaced 30 ft (9.1 m) apart, which equates to approximately 0.8 line miles (1.3 line kilometers [km]) of survey, while sub-bottom profiler imagery was collected along survey lines spaced 10 ft (3 m) apart, or approximately 2.3 line miles (3.7 line km) of survey (**Figure 4**).

Vessel speed during the survey did not exceed 4 knots, which maximized the data collection of each instrument and achieved optimum altitudes for the magnetometer and side-scan sonar sensors (towfish). The dGPS provided HYPACK with position accuracy of less than 2 ft (0.6 m), which maintained vessel and equipment positioning, through layback calculations, and logged real-time positional and magnetic data. SEARCH operated the side-scan sonar at a frequency of 1,600 kHz and a range of 65 ft (20 m) (i.e., total swath width = 130 ft [40 m]). The combination of survey line spacing, range, tow configuration, and frequency allowed for 100 percent imagery coverage, including the nadir region beneath the towfish path, while producing high-resolution imagery. The dGPS was interfaced with the side-scan sonar topside acquisition computer operating Discover acquisition software, which embedded positional data into the raw imagery and allowed for geo-rectification of the side-scan sonar record during processing. The dGPS also was interfaced with the sub-bottom profiler through Discover acquisition software.

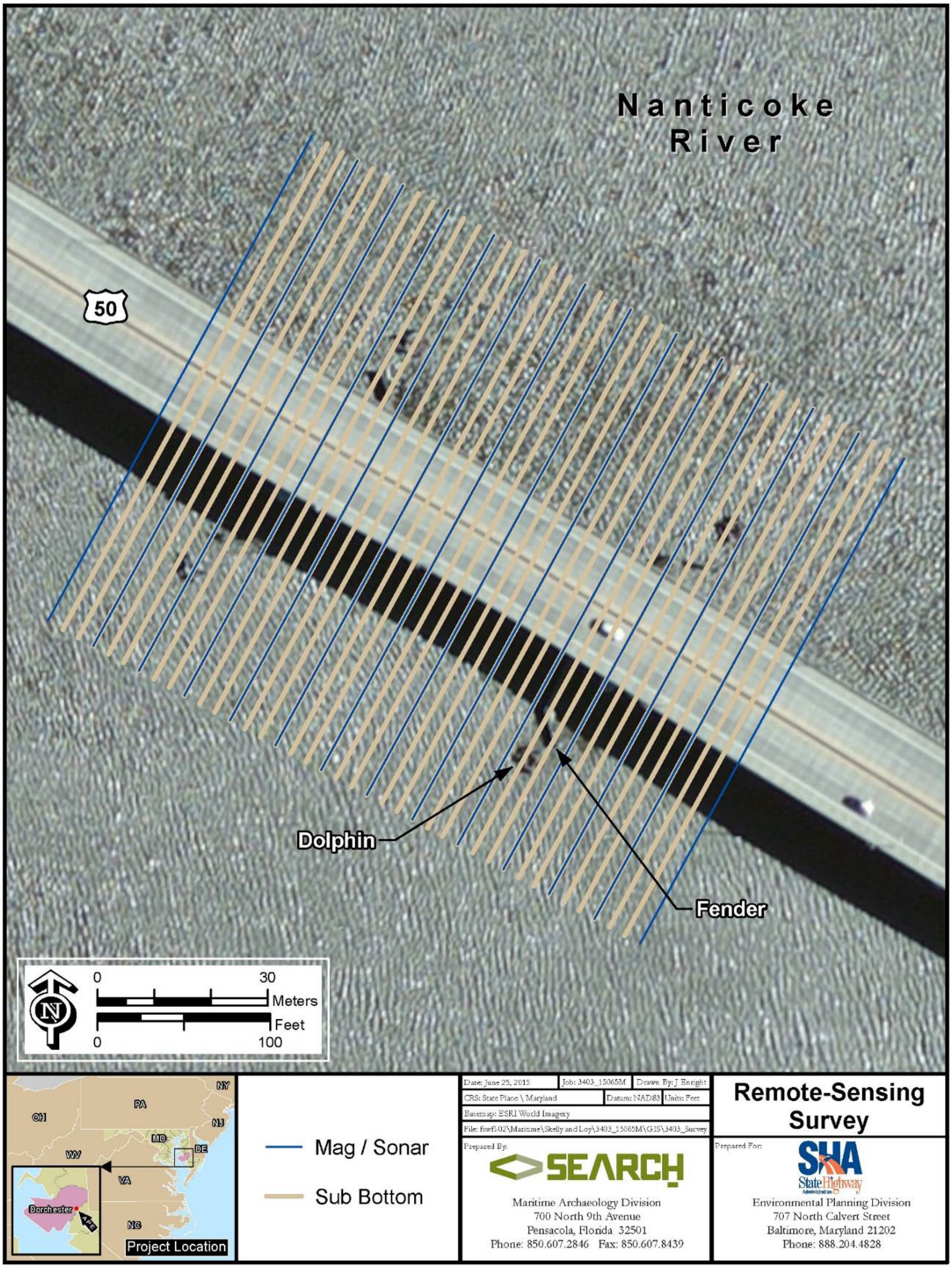

Figure 4. Remote-sensing survey lines.

The sub-bottom profiler was operated at a frequency range of 4-20 kHz with a 10 millisecond ping rate, which maximized vertical penetration in the Nanticoke River environment. Side-scan sonar and sub-bottom profiler imagery were collected at constant streams, while positional data were collected at a rate of 1 Hz and magnetic data were collected at a rate of 2 Hz. The survey was conducted in the State Plane coordinate system (Maryland Zone) based on the NAD83 datum. All project data have been incorporated into a geographic information system (GIS) geo-database for organization, scientific analyses, and archiving.

Data Processing

Magnetic data were reviewed in a profile image similar to an echogram in order to identify and edit errant data. The raw magnetic data (x, y positional coordinates + z magnetic values) were then processed into a contour map, which allows the best representation of three-dimensional data on a two-dimensional plane, and facilitates interpretation of the interaction of a magnetic source with the earth's magnetic field. The process involved with creating this contour map consists of removing the diurnal variation from the data, creating a regularly spaced grid of the irregularly spaced data points, and generating contours that are visually concise and accurately represent anomalies in the earth's magnetic field.

The earth's background magnetic value at any particular geographic location fluctuates slightly from day to day and throughout each day. This variation is evident in the raw magnetometer data (z value) and results in a cluttered map when contoured. In order to overcome this, SEARCH filtered the raw magnetometer data through a mathematical algorithm. The algorithm defines each raw z value as either higher than the magnetic background (positive) or lower than the magnetic background (negative). The algorithm replaces the raw z value with this positive or negative number, which is relative to the magnetic background at the particular date, time, and geographic location it was recorded. The diurnal variation is easily identified and removed from the relative z values, which facilitates contouring and provides a "clean" contour map. More importantly, this process affords a direct one-to-one comparison of magnetic amplitudes and negative-to-positive ratios of anomalies no matter when or where they were recorded, or to what extent the magnetic background varied—something that is not possible with raw magnetic values.

The x, y, and relative z data were imported into Golden Software, Inc.'s Surfer contouring and 3-D surface mapping software. Surfer was instructed to grid the processed magnetic data based on data collection methodology and magnetic theory as it applies to the correlation between source amplitude and its distance from the magnetometer sensor. The inline distance between raw data points, based on the rate of collection (2 Hz) and the average survey vessel speed during data collection (3.5 knots), equates to approximately 3 ft (0.9 m). Data were collected along parallel survey lines spaced approximately 30 ft (9.1 m) apart. Based on these parameters, Surfer gridline geometry was set at 3 ft (0.9 m) between nodes, with a search ellipse of 1.5 times the survey line distance (i.e., 45 ft [14 m]). A gridding interpolation method was selected, following the magnetic theory that magnetic amplitude decreases inversely proportional to the cube of the distance between the source and the magnetometer sensor

(Breiner 1999). The resulting magnetic data grid consists of regularly spaced data nodes interpolated from the irregularly spaced magnetometer data. SEARCH then contoured the filtered relative magnetometer data using the interpolated magnetic data grid. The initial contour interval was set at 5 gammas with 100-gamma index contours.

Each line of raw side-scan sonar imagery from the survey was reviewed to locate man-made features and potential submerged cultural resources protruding above the seafloor. Sub-bottom profiler imagery similarly was reviewed to identify buried reflectors that might represent man-made features. Each object was assigned a contact number, and descriptive information was collected and tabulated (e.g., length, width, dGPS position, possible identification, etc.). SEARCH also generated a mosaic image of the project area comprising all raw sonar imagery. The ability to mosaic the imagery was made possible with embedded positional data from the dGPS utilizing Chesapeake Technology, Inc., SonarWiz 5 sonar processing software. High-frequency imagery files (1,600 kHz) were imported into the software utilizing settings adjusted for the EdgeTech 4125 acquisition methods. Following importation of the raw imagery, bottom tracking was performed to identify the first acoustic return, which determines the altitude of the towfish above the seafloor, creates a slant-range-corrected record, and removes the water column from the nadir region. Gain, color, and contrast settings were adjusted for each file in order to produce an optimal and even image across the entire mosaic. Returns from the overlapping files were averaged. Thus, if a contact contrasts well on one trackline, but not on an adjacent line, averaged returns from both lines ensure significant contrast for contact detection. The mosaic was exported as a geo-rectified image with a resolution of 0.5 ft/pixel (0.15 m/pixel) and imported into ArcGIS 10 so that it could be layered with other project data (e.g., magnetic contour map, project boundary, etc.) and facilitate archaeological analysis.

OBJECTIVE 3: PHASE II ARCHAEOLOGICAL DIVER INVESTIGATION

Three tasks were established to determine the presence/absence of remains on the site following the recovery of timbers, delineate the horizontal and vertical boundaries of any remaining structure, and assess the archaeological integrity of any remaining structure:

(1) Determination of extant hull remains through a combination of surface search and sub-surface hydro-probing,
(2) Exposed feature mapping utilizing a datum and baseline, and
(3) Test excavation of buried structure.

SHA requested that SEARCH also examine the temporary dolphin work zone with archaeological divers to determine if shipwreck remains would be impacted during the installation of pilings. This investigation occurred prior to the assessment of Site 18DO497.

Safety guidelines published in USACE EM 385-1-1 (USACE 2008:717–746) were followed for the conduct of scientific diving missions employing a single, tethered diver with surface-supplied air (SSA) and topside communications. SEARCH prepared a Dive Safety Plan specific to the tasks and environmental conditions expected at the site. The plan consists of four stand-alone documents, including the Safe Practices Manual, which is the diving safety protocol approved by the SEARCH Dive Control Board; a Dive Operation Plan providing project detail, scheduled tasks, diving methodologies, equipment certification and utilization, and diver training and certification; the project-specific Activity Hazard Analysis Plan, which anticipates potential site hazards and establishes actions to eliminate or minimize each hazard; and an Emergency Management Plan with procedures to implement in the event of a diving emergency, individual crew responsibilities during a diving emergency, and the transit route and transport method to the nearest medical facility capable of handling a diving emergency. All field crew familiarized themselves with each document prior to commencement of diving operations and daily crew briefings and debriefings occurred that addressed safety and adjustments necessary to adapt to environmental conditions and task modifications. A USCG Local Notice to Mariners was secured because diving operations would occur adjacent to an active navigation channel and monitored VHF channel 16 for concerned traffic throughout the duration of diving operations. SEARCH maintained daily dive plans, pre-dive checklists, SSA pre-dive checklists, and detailed logs of each dive mission.

All dive team members meet the criteria established in Section 30 (Contract Diving Operations) of EM 385-1-1 (USACE 2008:717–746). This includes the appropriate level of scientific diver certification; current Cardiopulmonary Resuscitation, First Aid, and Oxygen Administration certifications; a current diver physical signed by a licensed physician familiar with diving physiology; and the requisite experience and training consistent with the performance requirements outlined in the scope of work. The dive team consisted of a Primary Diver tended from the surface by the Primary Dive Tender (**Figure 5**), a Standby Diver in case of Primary Diver emergency, and a Diving Supervisor. The Diving Supervisor monitored vessel traffic and VHF radio communications. Two diving platforms were utilized to accomplish the objective: the SHA construction barge for investigation of the temporary dolphin work zone and the SEARCH riverine vessel for site investigation. Both vessels provided ample deck space for safe diving operations, and were equipped with all the necessary safety equipment, including the appropriate number of life jackets, marine radio, horn, fire extinguisher, and visual distress signals. SEARCH displayed both a diver-down safety flag and an international Alpha flag, which denotes a vessel with restricted mobility, in order to alert passing vessels during diving operations.

Diving missions were accomplished utilizing SSA diving equipment and methodologies, including Kirby Morgan Superlite diving helmets (17b and 27), Diveline floating air umbilicals, and a Kirby Morgan Air Control Station (KMACS-2A). The KMACS-2A is a portable control box for use in all SSA diving operations that controls the divers' air as well as all topside and through-water communications via a built-in communication system. This allows the primary and standby divers to communicate via "round-robin" four-wire communications in emergency situations. The system allows the Diving Supervisor total control in any situation by maintaining

Figure 5. Archaeological diver with dive tender preparing to investigate temporary dolphin work zone.

air, communication, and pneumofathometer in one localized area. The umbilical hoses utilized meet all specifications listed in SAE 100-R-3 and EM 385-1-1 and are marked at 1-ft (0.3-m) intervals. Umbilical markings allow the Dive Tender to monitor the length of umbilical deployed, as well as assisting during search arcs. The SSA system additionally is equipped with a bailout backup air system. This system includes a 50-cubic-ft (1.4-cubic-m) SCUBA cylinder attached to the diver via harness. A Scubapro first-stage regulator provides backup air to the Kirby Morgan diving helmet in case of a primary air emergency.

A combination of surface searches, manual probing, and sub-surface hydro-probing was utilized to accomplish Task 1 of the objective. Archaeological divers employed both a baseline to reference probes and a central point fixed with a screw anchor from which to search and probe in concentric circles spaced at 5-ft (1.5-m) intervals. The hydro-probe system consists of a Honda centrifugal water pump, an intake hose, the required length of vinyl outflow hose, and a 6-ft (1.8-m) length of galvanized steel pipe marked at 1-ft (0.3-m) increments. The 2-inch (in) (5.1-centimeter [cm]) water pump forces water into a 2-in (5.1-cm) outflow hose and down a length of 0.75-in (1.9-cm) pipe. This stepping down increases pressure, which facilitates insertion into the river bottom. The diver inserted the probe into the seafloor until the full 6 ft (1.8 m) was reached, an object was encountered, or sediment compaction prevented further insertion. The diver relayed all probe data to the Diving Supervisor topside who recorded the information. It was not necessary to accomplish Tasks 2 and 3 for reasons described in the **Results** section.

OBJECTIVE 4: RECORDATION OF RECOVERED SHIPWRECK TIMBERS

The recordation objective was designed to capture diagnostic information helpful in reconstructing portions of the vessel and documenting construction aspects that would help identify the form, function, origin, and age of the vessel. Analysis of this information would be critical when assessing the eligibility of the shipwreck for inclusion in the NRHP, in addition to creating a permanent record of the remains. Archaeologists created hand-drawn sketches of every timber currently stored at the MAC Lab (**Appendix D**). Maritime archaeologists utilized tapes and line levels to generate half and quarter scale drawings, depending upon the size of the timber, in US customary units (**Figure 6**). Drawings document sided and molded dimensions and curvature of the skeletal timbers, and thickness and width of the shell timbers, as well as fastening patterns, tool marks, builders' marks, and any other diagnostic information from all timbers. Archaeologists also sketched artifacts utilized in construction and operation of the vessel, such as three bricks, two deadeyes, and three fasteners that were accessible to

Figure 6. SEARCH maritime archaeologists documenting shipwreck remains.

documentation —treenail, driftpin, and nail. SEARCH also collected numerous photographs of varying views and levels of detail to capture visual evidence of each timber and its respective diagnostic details.

OBJECTIVE 5: DENDROCHRONOLOGY AND WOOD SPECIATION

Oxford Tree-Ring Laboratory (OTRL) conducted the dendrochronology and wood speciation analyses on the Nanticoke River Shipwreck timbers (Worthington and Seiter 2015 [**Appendix E**]). OTRL cut sample sections from 10 timbers to conduct dendrochronology analysis, and smaller slices from six timbers were used to supplement speciation. The samples were dried, sanded, and cleaned to distinguish the ring boundaries for analysis, which were measured to a precision of 0.01 millimeters utilizing a microscope (Worthington and Seiter 2015:3). OTRL cross-matched samples from the site, combining them into a site master for both visual and computer qualified statistical comparisons to dated reference chronologies. OTRL also compared the individual samples to the dated reference chronologies in an attempt to obtain an absolute calendar date for each sequence (Worthington and Seiter 2015:4).

RESULTS

OBJECTIVE 1: ARCHIVAL AND HISTORICAL RESEARCH

Colonial Period (1608–1763)

The town of Vienna is the second oldest municipality in Dorchester County, established by an act of Maryland's General Assembly passed in 1706. While earlier attempts to establish towns at Dorchester Town and Islington lasted only a short while, Vienna remained; its success in large part due to its location on a high, well-drained site, with deep moorage not far from shore, long used by the Nanticoke Indians and referred to as "Emperor's Landing" (Touart 2010:37). In 1608, Captain John Smith and his men were the first Europeans to ply the waters of the Nanticoke River and encounter the native Nanticokes. Leaving from the Jamestown settlement on 2 June 1608, the 15-man party sailed on a narrow-beam undecked barge with one sail and covered approximately 3,000 miles (4,828 km) over a 12-week period. After being trapped by storms in Tangier Sound for several days, the party eventually turned northward into "a pretty convenient river on the east called Kuskarawaok [Nanticoke]." Smith noted that the Native American population in the area consisted of "the people of Sarapinagh, Nause, Arseek, and Nantaquak," and that they were "the best marchants" of all they had encountered (Smith 1624:57). On Smith's *A Map of Virginia: With a Description of the Countrey, The Commodoties, People, Government and Religion,* published in 1612, the name Nantaquank is depicted along the Nanticoke River, which appears to align with the present-day location of Vienna (**Figure 7**) (Nutter Associates 2003:21-22).

In 1671, Dorchester County requested that ferry service be established between present-day Vienna and "Ferry Point," on the outskirts of present-day Mardela Springs. On 19 April 1706, the Maryland Assembly passed, "An act for the advancement of trade and erecting Ports & Towns in the Province of Maryland." The Act specified that 100 ac (40 ha) would be acquired for each of several towns and ports to be developed, including one "at Emperor's Landing in Nanticoke River." Each area was to have an open square reserved for public buildings, with the remaining property divided into 100 equal lots, and each lot developed with a house of at least 400 square ft (37 square m). On 11 July 1706, the "Commission to Lay Out Ports and Towns" met at present-day Vienna and designated a site for the town "beginning at the mouth of a small creek on the north side of the Nanticoke about twenty perches (330 ft [101 m]) above Emperor's Landing then down the Nanticoke 160 perches (2,640 ft [805 m]), hence westerly 100 perches (1,650 ft [503 m]), thence north 160 perches, thence easterly 100 perches; area containing one hundred acres." The town site was situated amidst a tremendous 6,000-ac (2,428-ha) tract called "Nanticoke Manor," which was surveyed and patented to Lord Baltimore on 6 April 1664.

On 22 July 1706, a surveyor laid out 100 narrow lots in the town, in a tight grid along three principal streets, each about 1,000 ft (305 m) long; Thames Street (later Water Street) fronted the Nanticoke River, High Street (later Middle Street), and Back Street (later Market Street).

Figure 7. Detail from Smith's 1612 map of Virginia showing Nantaquank along the Nanticoke River. (Source: Library of Congress)

Building activity on the new lots was sporadic, apparently hampered by the lack of construction materials. One of the most prominent land owners in Vienna during the first quarter of the eighteenth century was merchant, planter, and provincial leader Thomas Ennalls (d. 1718). Thomas Ennalls died without direct heirs, and part of his Vienna land holdings passed to his nephew William, and then to his daughter Anne Ennalls Hooper, the wife of Colonel Henry Hooper (Touart 2010:7).

The Revolutionary War (1763–1783)

Vienna grew rapidly during the late eighteenth century, serving as a port for the shipment of timber and tobacco. With its prominent location on the Nanticoke with sufficient draft for large, ocean going vessels, the town was ideally suited for commerce and shipbuilding, and in April 1762, a State Act was passed to designate Vienna as an official customs port. At the 21 November 1763 session of the Assembly, an Act was passed amending the Tobacco Laws of the State, and designated Vienna as the location of a tobacco inspection station and warehouse (Jones 1902:61). In 1768, the office of the Customs Collector was moved to Vienna. Around that time, the first shipyard on the Nanticoke was established in the town, as the residents began to turn their attention to shipbuilding (Nutter Associates 2003:27).

At the outset of the Revolutionary War, Vienna was bustling as a center for trade and shipping. Shipbuilding thrived in the town, and at the time, the stays along Water Street were busy with the construction of Bay Schooners and other ships (Nutter Associates 2003:27). For nearly the entire Revolutionary War, the Eastern Shore was the scene of countless raids and skirmishes between the American patriots and the more formidable Loyalist contingent (Shomette 1982:49). Loyalist raids were often carried out by marauders that were a combination of privateer and pirate, referred to as "picaroons," a term derived from the early seventeenth century Spanish word *picaron,* meaning roguish adventurer. Vienna was subjected to at least three such raids, the first of which occurred on 24 September 1780, when a force of Tory sloops and barges ascended the Nanticoke and landed at the town. The Tory force numbered only 32 men, though they met little opposition from the local militia or residents and proceeded to destroy a new brigantine belonging to Captain Robert Dashiell, of the Maryland State Navy, another brigantine belonging to Joseph Dashiell, a ship belonging to James Shaw, another under construction on the stocks belonging to Pritchet Willeis, and several other small vessels (Dashiell 1780a). The ships were seized in the Nanticoke and burned to the waterline. The picaroons also "hove down a New Vessel Belonging to Prichet Willeis that was Building and Destroy'd all the Tools the poore man had & did him much more Damage" (Dashiell 1780b).

The next assault on Vienna came on 10 March 1781, when a privateer-picaroon expedition came up the Nanticoke and ascended on the town with a brig and two sloops, one of them newly built and armed with fourteen 18-pounders (Hooper 1781a). The attack was initiated by a heavy bombardment of the town with both round and grapeshot. A small determined band of patriots, led by Colonel John Dickinson and Captain William Smoot, took positions along the riverbank to mount a defense. Three times the patriots beat back an attempt by the enemy to land a barge loaded with men (Dashiell 1781). Intense fire from the Tory ships eventually pushed back the militiamen and the barge reached the shore. Casualties of the skirmish included three wounded and one killed of the attackers, with one killed of the patriots. Soon after the Tory forces landed, a flag of truce was forwarded to the militiamen. The attackers presented the proposition that the town provide them with its grain, for which the attackers would pay market price, or if the town refused to agree to the deal and resumed hostilities, the attackers would burn it to the ground and destroy everything within it. Colonel Henry Hooper, who had apparently arrived on the scene just before the landing, reasoned that as his force "could defend nothing, the Town and Grain lying under the command of their Vessels we agreed to their Terms" (Hooper 1781a).

Vienna was subjected to another picaroon raid on 27 August 1781, when two barges pushed up the Nanticoke to Vienna, plundered the town, and captured two or three fully laden vessels. One of the barges proceeded up the Nanticoke and captured two more vessels, while the other barge headed downriver with the ships captured at Vienna. Colonel Henry Hooper received belated word of the raid, quickly gathered a party of militia, and subsequently re-took three of the captured vessels. The militia then proceeded to cut off the retreat of one of the barges, forcing the picaroons to run the barge ashore and escape on foot. Three picaroons were captured and later sent to Annapolis as prisoners (Hooper 1781b). After securing the first barge, Hooper dispatched a party down the river, but the second barge had disappeared. Upon receiving the report that the enemy's barge was not in the river, Hooper discharged the militia. At one o'clock the next morning, Hooper received an urgent message that the enemy barge had returned in the night and made prisoners of Vienna's inhabitants. Orders were issued for the militia to reassemble and march to the town, but the enemy escaped before their arrival (Shomette 1985:274-275).

Early Republic and Antebellum Era (1783–1860)

During and after the Revolutionary War, commerce and investment in Vienna declined. Due to confiscation of British property and the lack of development in the town, the size of Vienna was significantly reduced in 1778 and 1785 surveys, with almost complete abandonment of the original 1706 plan of the town. Large blocks of lots were consolidated, one of which, known as "Bachelors Hall," occupied a large portion of the river frontage on Water Street (Touart 2010:9). In his 1807 *Geographical Description of the States of Maryland and Delaware*, Joseph Scott wrote of Vienna:

> Vienna, a small post town, agreeably situated on the West side of the Nanticoke river upon a plain elevated about 12 or 13 feet above the surface of the river. It contains 13 dwellings, principally, in a state of decay, four respectable stores, several granaries, two taverns, a collector's office, and an impaired brick Episcopal church, in which divine service is sometimes celebrated. Two wharves extend into the river, at which vessels of any burthen may load.
>
> The town commands very little trade, although advantageously situated for both foreign and domestic. Its decline has originated, in the absence of enterprising and active inhabitants, the obstruction of navigation of the river to its extremities, the commercial importance of Baltimore, and above all the prevailing opinion that the situation of the town is unhealthy; but the character of unhealthiness it no longer deserves; for the excluding by ditches, the tide, which supported a morass on the S. bodies of stagnant water, which lay in the bosom of the town, have been removed, by which the situation has become more healthy (101-102).

During the War of 1812, Vienna was prepared for defense against British aggressions. Breastworks were thrown up at the saw-mill wharf and guns were mounted. A company of militia was organized and equipped ready for service. British ships were frequently within sight of the town, but made no attack, save for the occasional shot from long range (Jones 1902:82).

Early efforts to improve transportation and access to Vienna during the early nineteenth century included the incorporation of the Nanticoke Bridge Company in 1818. In 1828, the first bridge was completed over the Nanticoke River at Vienna, replacing the ferry service that had been in operation since 1671. The Vienna Bridge, as it was designated on the 1849 US Coastal survey map of the Nanticoke River, was a wooden structure which spanned the 900-ft (274-m) river width and included a causeway across extensive marsh on the Somerset County side. The bridge remained until 1860 when its narrow opening, less than 30 ft (9.1 m) wide, proved too constrictive for larger ships to pass through without damage. Transportation across the river then once again reverted to ferry service (Touart 2010:10).

Civil War and National Expansion (1861–1889)

Vienna grew at a slow pace during the second half of the nineteenth century, never exceeding more than 350 residents (Touart 2010:10). The only activity in Vienna during the Civil War was the occasional blockade runner making their way up the Nanticoke River to the town, where Confederate sympathizers provided them with provisions. By 1877, signs of improvement were apparent in Vienna, which by that time had approximately 60 dwellings, four churches, and a waterfront that consisted of wharves, granaries, a steamboat wharf, and the ferry crossing at the foot of Race Street, in its same location since 1671 (Touart 2010:11). At least 16 business establishments were located in the town in 1877, including the shipbuilding of Chesapeake Bay schooners on the waterfront, mills, canneries, a blacksmith, carriage and harness factory, agricultural processing and three doctors, plus the active ferry across the Nanticoke (Nutter Associates 2003:27).

The Railroad Era to Present (1890–present)

The most significant economic boost to Vienna came in the late nineteenth century with the construction of the Baltimore & Eastern Shore Railroad, between Claiborne, in Talbot County, and Salisbury, in adjacent Wicomico. Industrial and commercial ventures in Vienna were spurred by the regular schedules of steamboats and schooners on the Nanticoke, and the newly built Baltimore and Eastern Shore Railroad, which was subsumed into the larger Baltimore, Chesapeake, and Atlantic Railroad in 1894. In 1887, a canning industry blossomed in Vienna with opening of an establishment by Isaac H. Houston, which was followed by a host of others during the early decades of the twentieth century (Touart 2010:11-12).

Census records show that by 1900, the population of Vienna had grown to 1,522. Despite several fires that swept the town, Vienna shared the period of great optimism that swept across the Eastern Shore in the early twentieth century. One of the worst fires, on 22 January 1922, was pushed by northeasterly winds and ignited many of the dwellings on Water Street, including the Tavern house. Despite the setbacks, development continued in the town with the construction of Eastern Shore Gas and Electric power plant in 1926-27. The massive $1,500,000 brick power plant housed two kilowatt steam turbines (Touart 2010:12).

Following the stock market crash in October 1929, and the subsequent Great Depression, Vienna settled into a slow decline economically, particularly as nearby larger cities, such as Cambridge and Salisbury, offered better jobs and drew residents away for work. In 1931, a new concrete two-lane bridge was constructed across the Nanticoke River. Since World War II, Vienna has remained a quiet riverfront town.

Navigation Improvements to the Nanticoke River

Since the late nineteenth century, various Rivers and Harbors Acts of the US Congress have provided funding for dredging along the Nanticoke River. The first appropriation for this effort came from the 1894 Act. This appropriation was specifically for Broad Creek, a branch of the Nanticoke River in Delaware; however, the work stipulated that the appropriation for the improvement project on Broad Creek could also be used "as much as necessary" for "the removal of a bar extending from the railroad bridge at Seaford [Delaware] toward the mouth [of the Nanticoke River]" (USACE 1910:276). Via the terms of the Act, the USACE entered into a contract with an unidentified party to begin dredging the Nanticoke River, but there is no evidence this commenced until 1898 (USACE 1897:157-158, 1898:1165-1166, 1902:1078). However, in the meantime, the Army Corps studied the river in 1895 and determined that any future project should dredge the river to 9 ft (2.7 m) in depth and 100 ft (30 m) in width and also that sharp turns should be widened to 150 ft (46 m) (USACE 1904:191).

The initial dredging of the Nanticoke River focused on the Seaford area. In 1898, Army Corps contractors dredged the area around a railroad bridge at Seaford, and in 1900, they dredged a nearby bend in the river. Both of these projects were within the Delaware length of the Nanticoke. The dimensions of these dredging were 9 ft (2.7 m) in depth and 100 ft (30 m) in width (USACE 1904:191).

The Rivers and Harbors Act of 1907 called for a re-examination of the Nanticoke River from its mouth and up the northwest fork of the river (known locally as Marshyhope Creek and alternatively as simply Northwest Fork) to the town of Federalsburg. The Nanticoke River town of Vienna, as well as the project area, was included in this reexamination. The re-examination apparently resulted in the same conclusion — that the Nanticoke River and its northwest fork should be 9 ft (2.7 m) deep and 100 ft (30 m) wide. The Nanticoke and its northwest fork were variously crooked, shallow, and had numerous shoals of gravel, sand, and mud (USACEs 1907:225). In 1911, dredging of the Nanticoke River and its northwest fork was completed to the stated dimensions. The Maryland Dredging Company was the contractor that fulfilled this task for the Army Corps (USACE 1910:276, 1911:1425-1437).

Maintenance work on the depth and width of the Nanticoke River and its northwest fork continued intermittently into the 1970s. The project dimensions (9 ft [2.7 m] depth and 100 ft [30 m] width, along with 150 ft [46 m] width at sharp turns) was the standard for the river until after World War II. In 1941, the Army Corps recommended the river be deepened to 12 feet; however, the onset of the World War II shelved the plan (Secretary of War 1941). In 1945, the Rivers and Harbors Act authorized the Army Corps to dredge the river to 12 ft (3.7 m) from its mouth all the way to Seaford (Delaware). It does not appear the northwestern fork of the Nanticoke (i.e., Marshyhope Creek) was included in this deepening effort. This new depth was attained in July 1956 (USACE 1957:5, 1972:8).

Following the achievement of 12-ft (3.7-m) depth in 1956, the Army Corps appears to have maintained the dimensions of the Nanticoke River for at least 20 years. They also performed other projects, such as an anchorage basin near the mouth of the river in 1950 and jetty installation at the mouth of the river in 1960 (USACE 1972:8, 1981:20).

Archaeological Resources

SEARCH conducted background record searches for previously recorded archaeological sites, shipwrecks, NRHP listed properties, and Maryland Inventory of Historic Places (MIHP) listed properties at or near the project area. This research was conducted at the MHT in Crownsville, Maryland, and online via MHT's Medusa Cultural Resource Information System. In addition, SEARCH conducted cartographic research, including through NOAA's Office of Coast Survey's online Historical Map & Chart Collection, which produced 10 pertinent maps ranging from 1840 to 1974. The only information gleaned from the review of acquired charts, maps, and images was the location of the historic ferry crossing the Nanticoke River into Vienna, Maryland.

Previously Recorded Archaeological Sites

A total of 24 previously recorded archaeological sites were identified within 2 miles (3.2 km) of Site 18DO497. Thirteen site files provided details of prehistoric cultural resources above water and near marginal wetlands. Seven previously recorded sites contain both prehistoric and historic components, though the historic assemblages primarily consist of artifact scatters. All seven of these sites are located on land. The remaining four sites consist entirely of historic components. Three sites are described as artifact scatters and/or historic farms and associated agricultural structures. The fourth site, Vienna Ferry Landing East (18WC62), is a historic ferry landing that was constructed in the late seventeenth century to transport people, goods, and livestock across the Nanticoke River. The ferry remained in sporadic use through the nineteenth century. The site is located on Ferry Point approximately 1,000 ft (305 m) south of the current US Highway 50 Bridge and Site 18DO497. The earliest depiction of the historic ferry landing can be seen in a map dated 1794 at the Nanticoke River terminus of the road from Salsbury [sic], Maryland (Griffith 1794). The road and ferry crossing correspond to a depiction of the ferry crossing in a 1903 map (USGS 1903) that was georeferenced (**Figure 8**). The results depict the distance between Site 18DO497 and the Nanticoke ferry, and illustrate that the Nanticoke River Shipwreck is not likely associated with its historic operation.

Previously Recorded Shipwrecks

No previously recorded shipwrecks were identified within 2 miles (3.2 km) of Site 18DO497. Two shipwrecks, however, are listed on adjacent USGS 7.5' Quadrangles (**Table 1**). The Shaw Flatboat Wreck (18DO190) is depicted on the Cambridge Quadrangle near Jenkins Creek. The wreck is described in the site file form as a historic wooden flatboat of unknown origin or age. The Warwick Wreck (18DO219) is depicted on the East New Market Quadrangle and is described as a nineteenth century wooden vessel located on the north side of Warwick River. It measures 30 ft (9.1 m) long and 10 ft (3 m) wide, and may be a shallow-draft workboat.

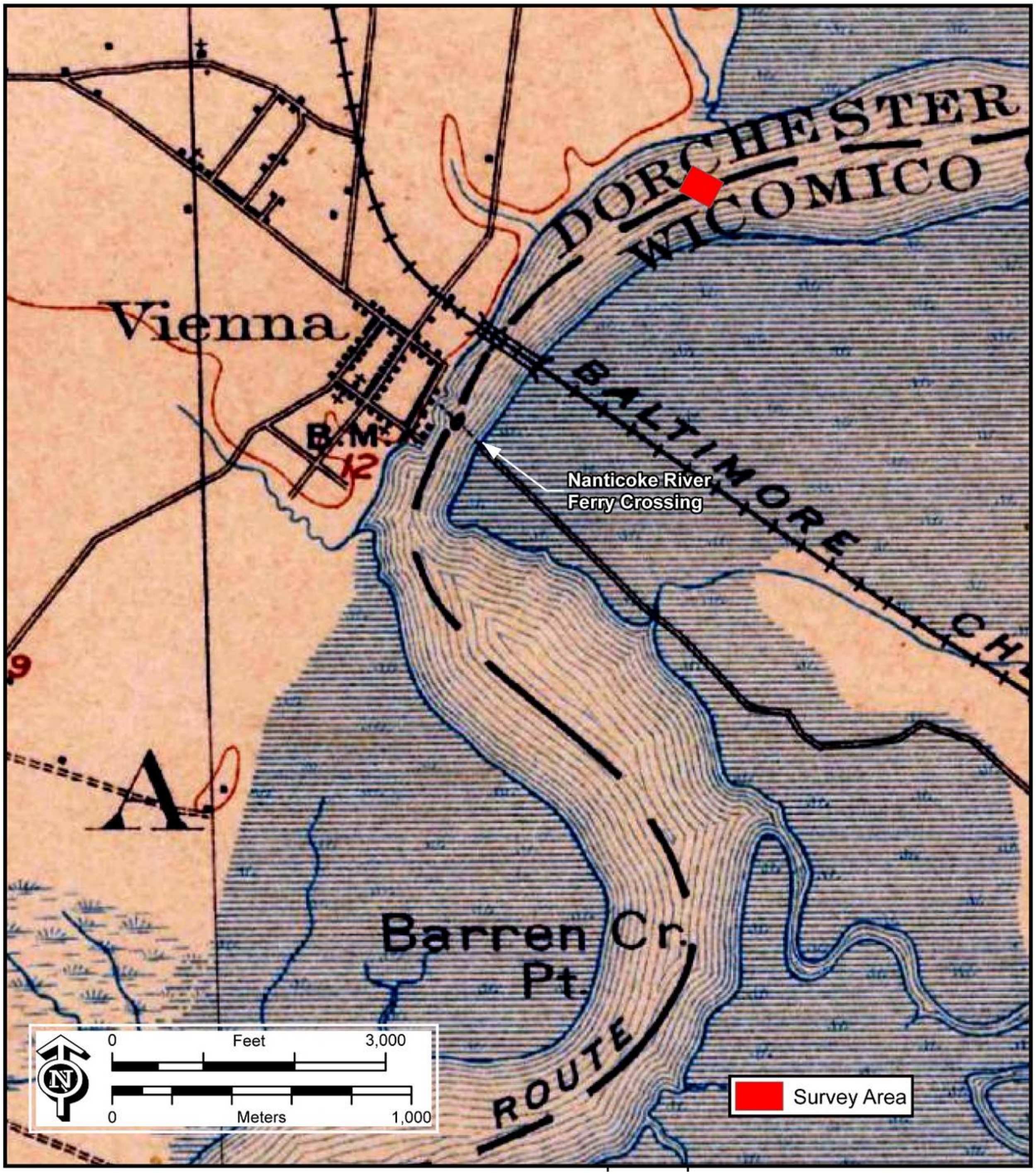

Figure 8. Georeferenced 1903 USGS map.

Table 1. Previously Identified Shipwrecks within 2 Miles of the US Highway 50 Bridge.

Site Name	MD Site Number	Source
Shaw Flatboat Wreck	18DO190	MHT
Warwick Wreck	18DO219	MHT

Previous Cultural Resources Studies

There have been seven previous cultural resource studies within 2 miles (3.2 km) of Site 18DO497. Six of the previous studies are terrestrial investigations concerned with prehistoric resources unrelated to the current project. The seventh study listed at MHT details archaeological investigations at Handsell (18DO486), a historic brick structure located west of Vienna, MD. A majority of the excavations were conducted under Dr. Edward Otter for the Nanticoke Historic Preservation Alliance. Handsell is also listed in the NRHP (8000216) and MIHP (D-127). No submerged cultural resource studies or marine remote-sensing surveys were identified in the vicinity of the US Highway 50 Bridge near Vienna.

OBJECTIVE 2: PHASE I MARINE REMOTE-SENSING SURVEY

Magnetometer

SEARCH encountered no environmental conditions detrimental to the collection of magnetic data; however, the Highway 50 Bridge piers forced SEARCH to alter planned survey lines so as to maximize data acquisition lanes. Skewed results in the magnetic record were anticipated due to the proximity of the Highway 50 Bridge and the effect it has on the background magnetism in the immediate vicinity. Magnetic data was acquired despite this expectation with the optimism that processing might yield some usefulness to the data. SEARCH processed magnetic data following methodology presented above and also adjusted a number of variables in the processing in an attempt to lessen the effect of the bridge. The bridge, particularly the steel I-beam fender system, however, presented too large of an obstacle to overcome, and the entire survey area, and any magnetic anomaly that Site 18DO497 might produce, is effectively masked in the magnetic record by the intense anomaly the bridge and associated dolphin/fender system produces. **Figure 9** presents the result of the magnetic survey; contour interval is set at 50 gammas (1,000-gamma index contours), however, to decrease the density of contour lines at a 5-gamma interval.

Side-Scan Sonar

SEARCH altered planned survey lines to maximize data acquisition lanes around the Highway 50 Bridge piers. Additionally, river current during the survey was significant at times and caused minor fluctuations in the side-scan sonar imagery as the towfish rolled when perpendicular to water flow (SEARCH collected imagery in multiple directions across Site 18DO497, aside from the planned survey). This fluctuation was neither catastrophic to affected lines nor evident on all survey transects; SEARCH collected sufficient imagery in various directions over Site 18DO497 to compensate. **Figure 10** presents the side-scan sonar mosaic for the entire survey area. A number of small, unidentifiable acoustic contacts exist within the survey area that are likely tree limbs or debris related to the bridge. A 20-ft (6.1-m) steel I-beam associated with the fender system is clearly visible in the mosaic adjacent to the extant southeast dolphin. Several

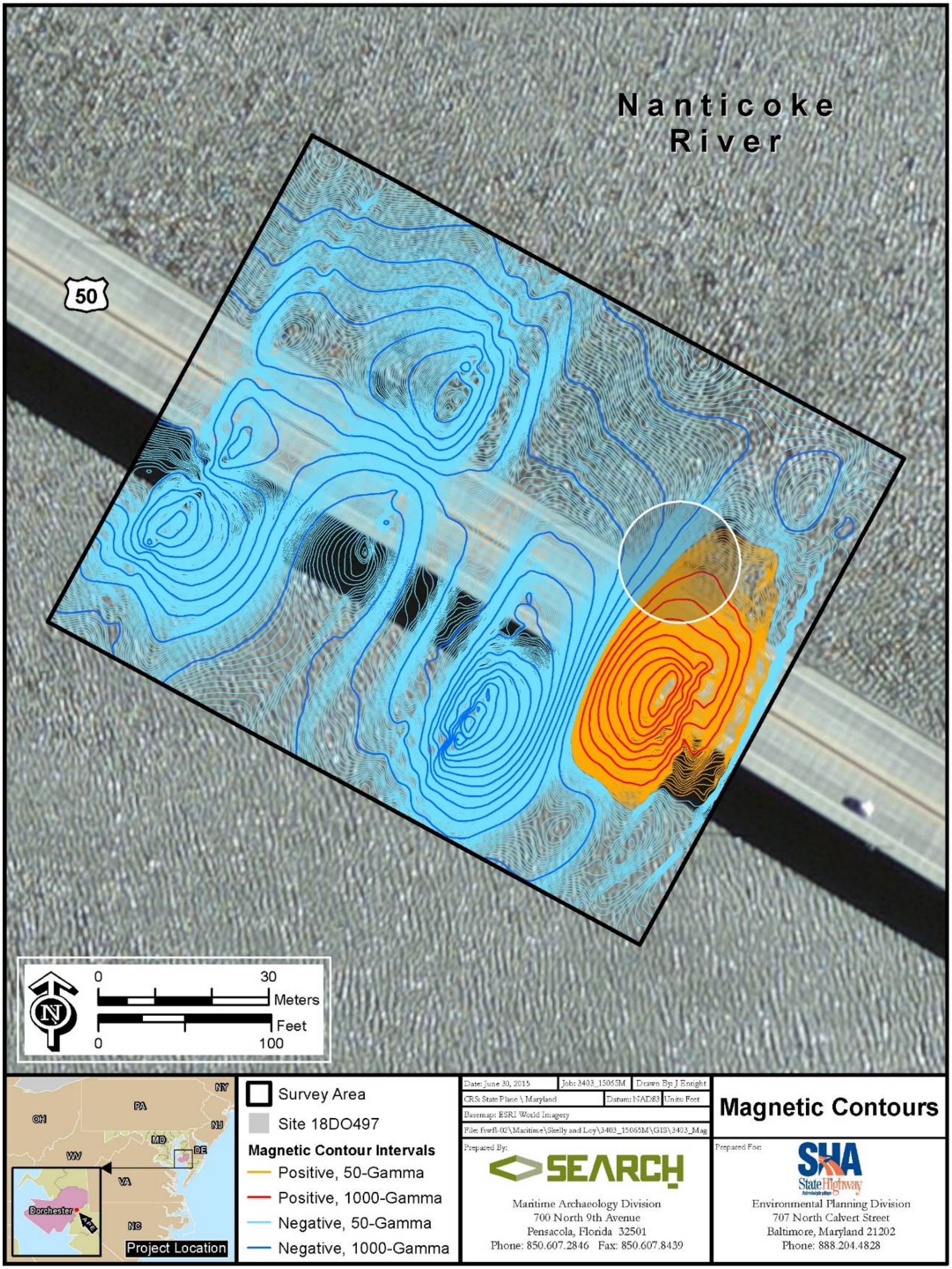

Figure 9. Magnetic contour map.

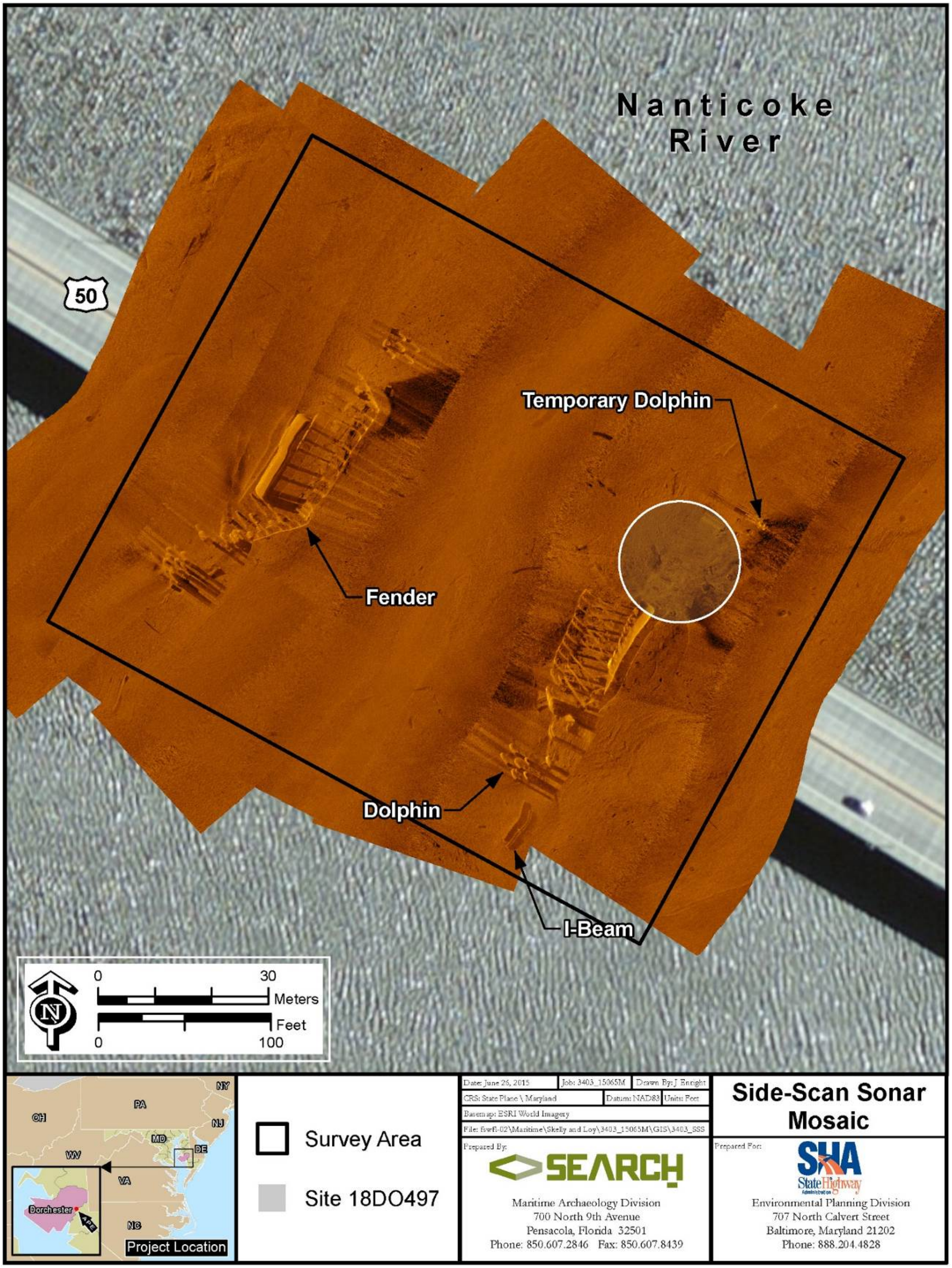

Figure 10. Side-scan sonar mosaic.

contacts are visible at closer review of individual sonar files that might represent additional I-beams on the river bottom.

The side-scan sonar imaged numerous acoustic contacts within the presumed site boundary and temporary dolphin work zone (**Figure 11**). Some contacts are identifiable (e.g., remains of the permanent dolphin that have been cut down to the sediment level), while most remained unidentifiable until archaeological diver investigation. Physical examination (discussed below) verified that the majority of acoustic contacts visible in the side-scan sonar imagery are either tree limbs or modern debris associated with the destruction of the dolphin and fender. Disarticulated timbers associated with the shipwreck are also amongst the debris field. Subsequent to archaeological diver investigation of the debris field, SEARCH reviewed the side-scan sonar record and determined that it is not possible to differentiate between modern and historic sources in the imagery (i.e., the few disarticulated historic timbers could not be identified amongst the numerous modern debris prior to physical examination).

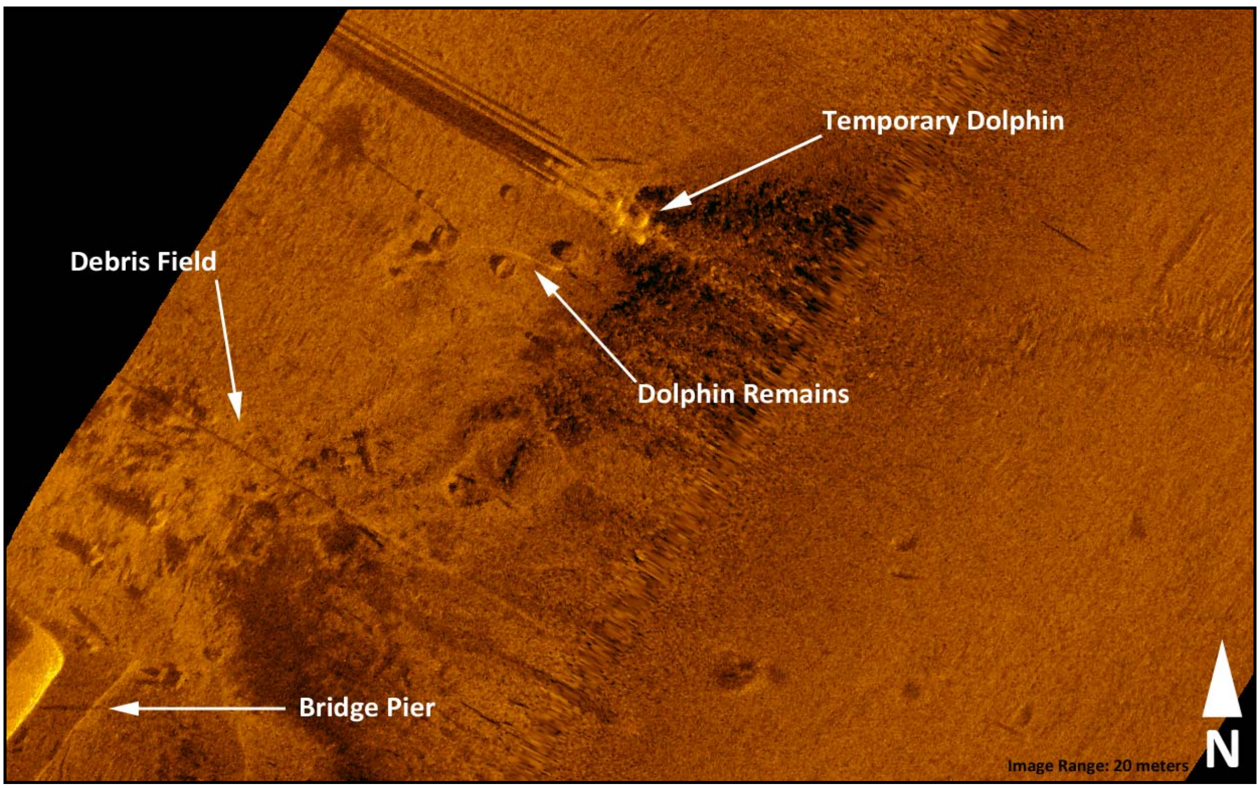

Figure 11. Close-up view of site.

Sub-Bottom Profiler

SEARCH altered planned survey lines so as to maximize data acquisition lanes around the Highway 50 Bridge piers; however, unlike side-scan sonar imagery acquisition, environmental conditions did not negatively impact collection of sub-bottom profiler imagery, due to the different towfish configuration and method of towing. SEARCH again collected imagery in various directions outside of the planned survey across Site 18DO497, and obtained greater than 20 ft (6.1 m) of penetration from the sub-bottom profiler, but did not identify any potential buried reflectors at Site 18DO497. Although the instrument is designed to document buried reflectors, exposed objects were identified as well. For example, **Figure 12** depicts a potential I-beam that was captured beneath the towfish (vertical scale is exaggerated by a factor of three). **Figure 12** also illustrates the scour created by the bridge pier footing. **Figure 13** provides better visual evidence of the scour created by the swift moving water around the concrete structure (**Figure 13** does not depict Site 18DO497).

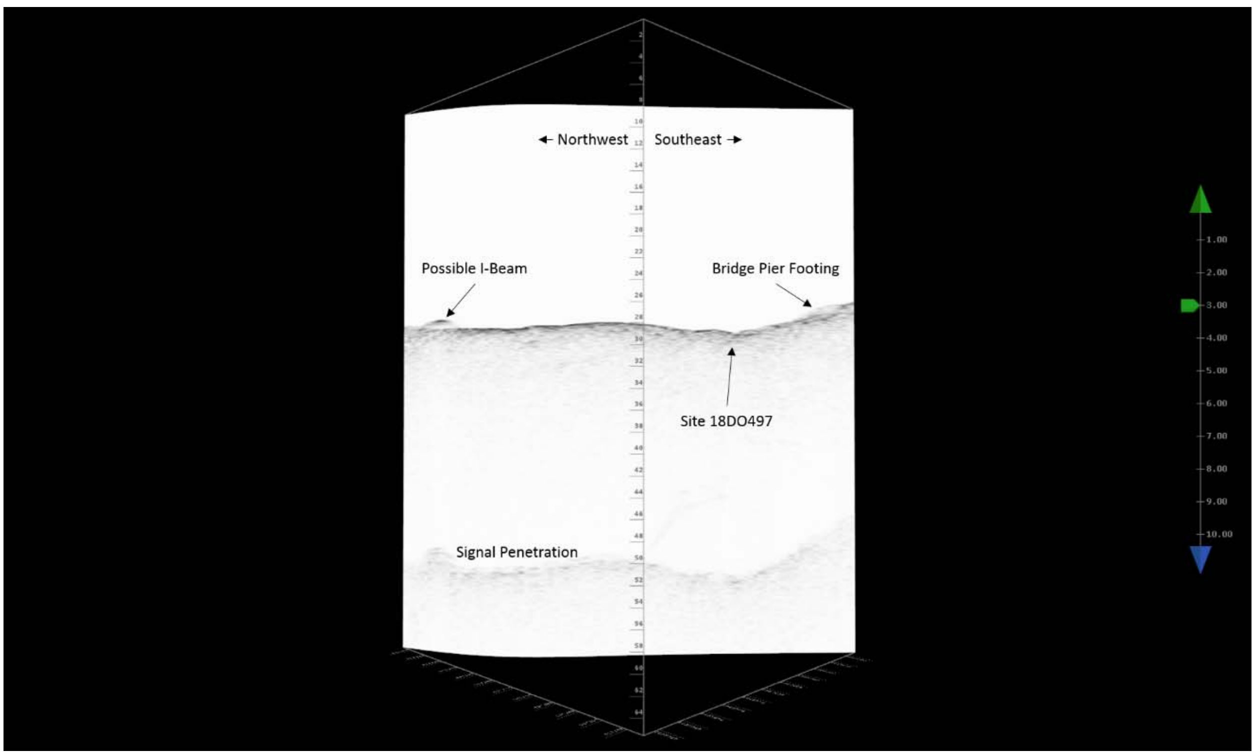

Figure 12. Example of sub-bottom profiler record over Site 18DO497.

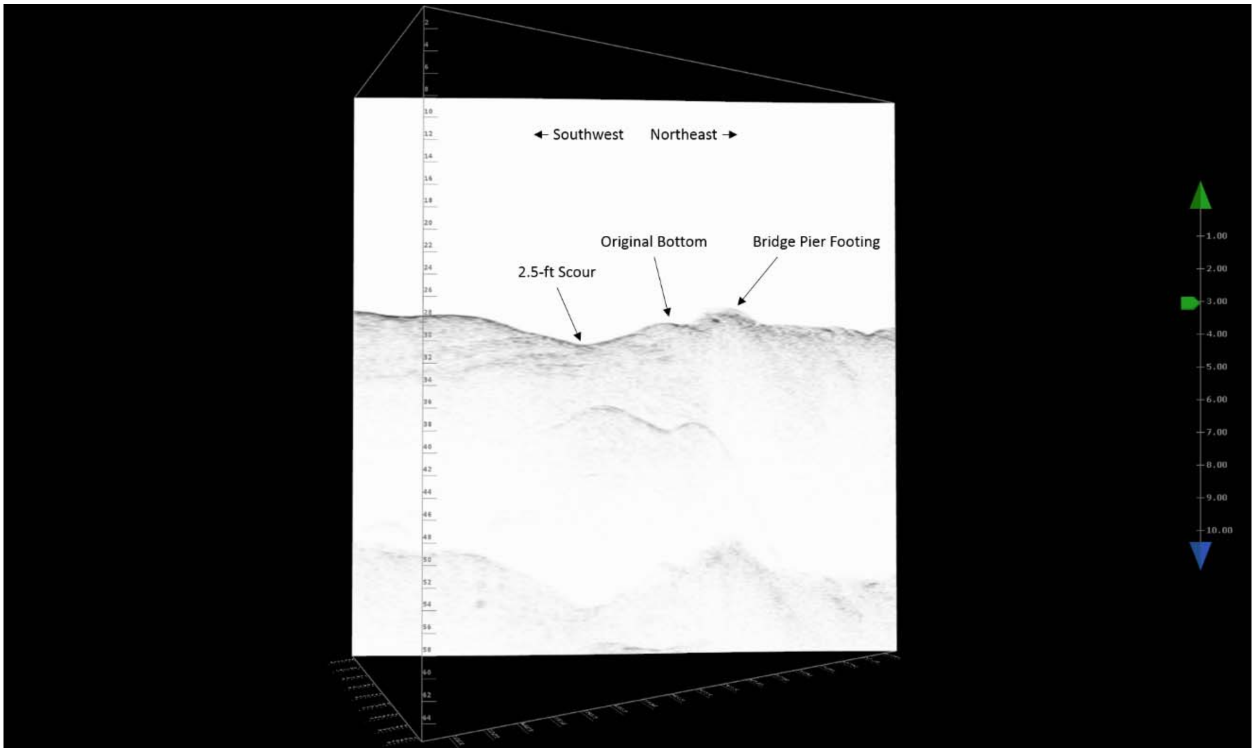

Figure 13. Current scour adjacent to the bridge pier footing.

OBJECTIVE 3: PHASE II ARCHAEOLOGICAL DIVER INVESTIGATION

Work Zone Clearance

SHA requested that SEARCH investigate the temporary dolphin area utilizing archaeological divers prior to remote-sensing survey since the installation was imminent. The investigation was conducted over a two-day period to determine whether disarticulated shipwreck remains exist within the temporary dolphin placement area. Coordinates for the temporary work zone were not available prior to mobilization, nor did a buoy exist to mark the zone once archaeologists arrived on site. Rather, the SHA barge foreman indicated that archaeological divers would need to locate the remains of the now-missing permanent dolphin on the river bottom and investigate approximately 10 ft (3 m) to the northeast. The immediate impact area (i.e. where the seven wood pilings would be driven into the river bottom) would be within an approximate 10-ft (3-m) radius of this position. The SHA barge foreman noted that archaeological divers also would need to investigate a potential indirect impact zone where the hydraulic hose driving the pilings would rest on the river bottom, which could extend up to 60-ft (18-m) from the work zone centroid. Several days later, following the remote-sensing survey, it was determined that the temporary dolphin has been positioned approximately 14 ft (4.3 m) to the northeast of the permanent dolphin, but still resided within the radius archaeological divers investigated (see **Figure 11**).

SHA allowed archaeological divers the use of the construction barge to accomplish this task, which remained fixed on site with spuds driven into the river bottom; this optimized diver safety and task completion. Weather was optimal for diving operations. Vessel traffic was light and consisted of recreational fishing vessels and a single barge; no vessel posed a threat to safety at any time and no diver was in the water during the barge transit. Archaeological divers encountered zero visibility, a river bottom consisting of a gravel/shell mix overlaying mud, water temperatures between 58 and 60°F, and swift current resulting from a tidal swing between 2 and 2.5 ft (0.6 and 0.8 m). Divers worked by touch due to the zero-visibility environment. Safe and effective task completion could only be accomplished during periods of slack tide; typically two dive windows of less than two and a half hours each, per day. SEARCH archaeological divers accomplished five dives totaling more than seven hours of bottom time.

The investigative methodology for assessing the temporary dolphin work zone involved clearing the river bottom for a radius of 60 ft (18 m) (zone of potential hydraulic hose impact), which included determining whether intact shipwreck remains exist and removing any disarticulated shipwreck features, and clearing subsurface to a depth of 6 ft (1.8 m) for a radius of 20 ft (6.1 m) (**Figure 14**). SEARCH accomplished the latter to determine whether any portion of the site exists buried within the radius that would be directly impacted by the seven temporary dolphin pilings. SHA determined during debris removal that shipwreck remains were located at, or near the sediment surface (barge foreman, pers. comm. 2015), which dictated the subsurface investigative methodology. The sediment surface investigation involved an archaeological diver sweeping in circles that radiated from a central point in the temporary dolphin work zone at 5-ft (1.5-m) increments. The same motion was accomplished during the sub-surface probing investigation.

Archaeological divers encountered modern fender debris during the bottom surface search, including cut lumber, piping, steel cable, and an I-beam (**Figures 15** and **16**). It was not anticipated that modern debris remaining on site following the dolphin/fender removal, which complicated safety and task completion efficiency. Four historic disarticulated vessel strakes and one partial iron strap/wood deadeye were located and recovered during the bottom surface search. The extent of the area investigated was marked with buoys and the barge foreman was instructed to avoid surface impacts beyond that location. The sub-surface assessment was accomplished utilizing a hydro-probe system, which resulted in negative findings. So long as SHA limited further surface impacts to the area inside the radius cleared around the temporary work zone centroid, and sub-surface impacts to a 20-ft (6.1-m) radius, construction did not disturb any shipwreck components remaining on, or under, the river bottom.

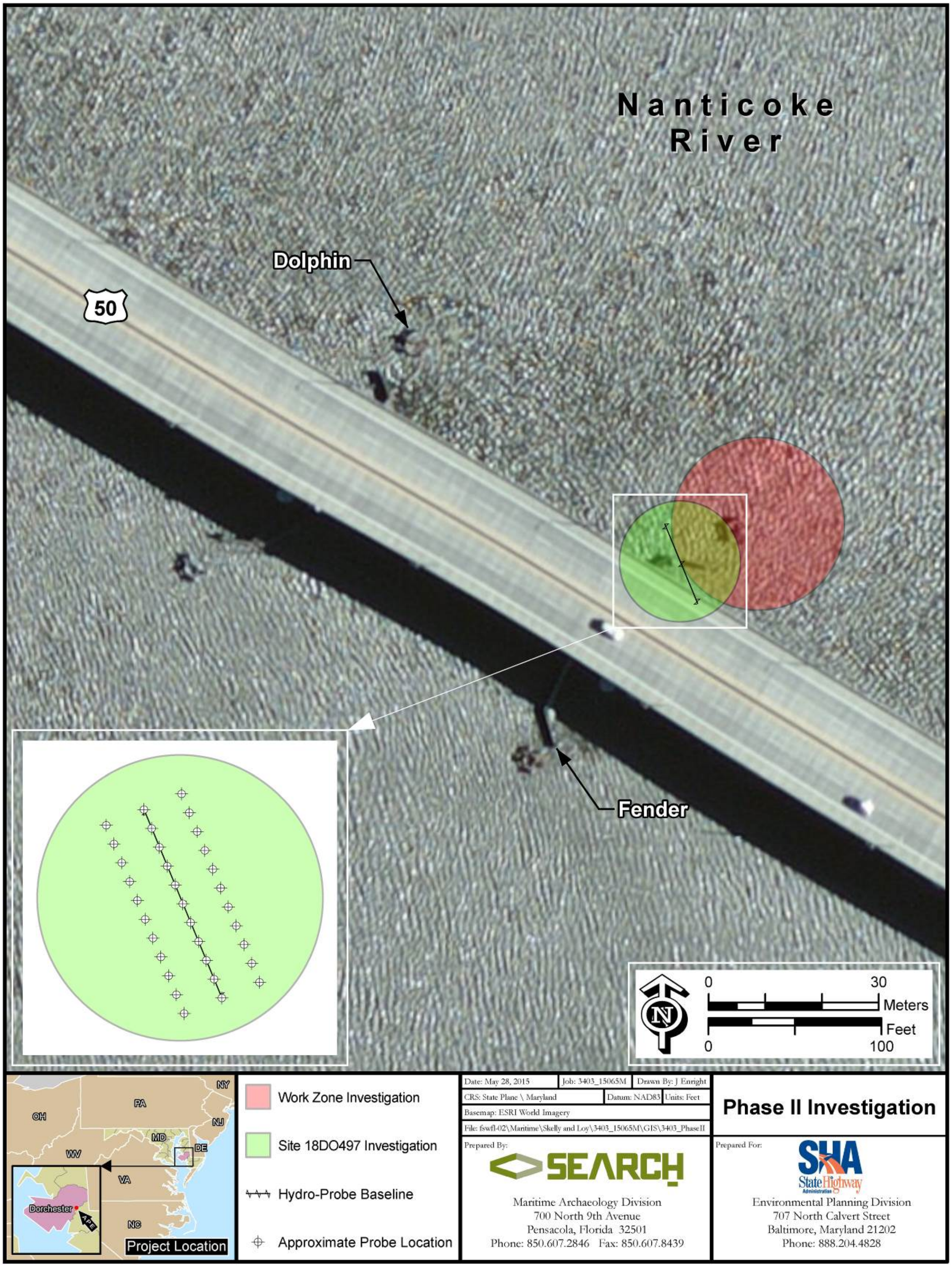

Figure 14. Phase II investigation.

Figure 15. Lumber and pipe utilized in fender construction.

Figure 16. I-beams utilized in fender construction.

Site 18DO497 Investigation

It was initially planned to spend four days investigating Site 18DO497 with archaeological divers. Actual investigation occurred over two days following a delay in the construction crew demobilization from the site. In order to help SEARCH relocate the area of the recovered remains, SHA provided a construction APE map prior to arrival, and the barge foreman informed archaeologists on site of the approximate location from where remains were recovered. SEARCH utilized the buoy positioned during the work zone clearance phase and investigated the river bottom utilizing this as a central point from which to locate additional remains and complete the first task of the objective. This position allowed archaeological divers to thoroughly investigate the area between the destroyed dolphin and the bridge pier, which SHA confirmed as the location of recovered shipwreck remains (see **Figure 14**). The same environmental conditions existed as those of the temporary work zone clearance dive missions, with the addition of scouring around the bridge pier (see **Figure 11**). The bridge was utilized pier to secure both the bow and stern of the dive platform in a position and orientation that optimized safety and task completion given the environmental conditions. Weather was optimal for diving operations. Vessel traffic was light and consisted of recreational fishing vessels; no vessel posed a threat to safety at any time. Archaeological divers accomplished five dives totaling more than seven hours of bottom time.

An investigation of the sediment surface was conducted following methodology described above, which required a radius of 35 ft (11 m) to thoroughly assess the area of interest. This resulted in overlap with the previous search accomplished to clear the temporary work zone. A significant amount of modern debris in the form of I-beams, cut lumber, iron piping, and steel cable is still extant on the site (see **Figures 15** and **16**), which complicated task completion and diver safety. Archaeological divers located several potential disarticulated shipwreck timbers and two bricks during the surface search. Several possible shipwreck timbers are located beneath modern debris and could not be recovered, but those that could be safely recovered were brought to the surface. Once recovered from the black river waters, most of the disarticulated timbers were found to be tree limbs or modern lumber (**Figure 17**). Four timbers and two bricks are historic and related to the shipwreck site; these were delivered to the MAC Lab for stabilization and documentation.

A sub-surface hydro-probing investigation was conducted next to determine whether substantial shipwreck remains are buried within 6 ft (1.8 m) of the sediment surface. The hydro-probing methodology was initially developed to include a grid centered on a baseline across the site remains. Archaeological divers were unable to locate any shipwreck structure; therefore, methodology was altered in the field. Sweeping circles radiating from the search centroid were not possible given the unexpected plethora of modern debris protruding above the sediment surface. This method was attempted, but soon abandoned because the negatively buoyant hydro-probe water hose consistently became entangled in I-beams, lumber, and steel cable. Instead, SEARCH determined the approximate direction of reported remains, based upon descriptions from the SHA barge crew during recovery and disarticulated timbers discovered during the sediment surface search, and established a 50-ft (15-m) baseline in the

Figure 17. Mix of historic timbers, modern lumber, and tree limbs recovered from the site.

appropriate direction through the site (see **Figure 14**). Hydro-probing followed this baseline with probes conducted out to 10 ft (3 m) to either side. Archaeological divers accomplished 33 probes across the location where SHA reported recovering shipwreck remains (see **Figure 14**, inset). Probes were spaced 5 ft (1.5 m) apart along the baseline and between 5 and 10 ft (1.5 and 3 m) perpendicular to the baseline; all probes returned negative results. This was expected, considering that recovered remains, consisting of the extreme lower portion of the hull, including the keel, were located at the sediment surface, as well as the negative findings in the sub-bottom profiler record. No intact shipwreck remains were located either on the river bottom in the area where SHA recovered the initial shipwreck remains, or within 6 ft (1.8 m) below the sediment surface where probing was conducted. Shipwreck timbers, however, may be trapped below modern debris.

Tasks 2 and 3 of this objective were not accomplished because no substantial, exposed, or buried ship components were identified in the investigation area. A datum was not established because a site no longer exists that requires a point of reference, nor was a baseline required because the only remains that exist are disarticulated timbers resulting from shipwreck removal. In other words, there are no intact, articulated remains to which the disarticulated timbers can be referenced, and the timbers can no longer be considered *in situ*. The research design objective allotted for test excavation (Task 3) in order to investigate potential diagnostic locales on the site, and to aid in the determination of NRHP eligibility; the research design did not include excavation with the intent to locate and document potential artifacts that may remain on site. SEARCH did not excavate test trenches because hydro-probing revealed no sub-surface remains. In addition, the potential shipwreck timbers pinned under the modern debris could not be confirmed or investigated since they were inaccessible to divers.

OBJECTIVE 4: RECORDATION OF RECOVERED SHIPWRECK TIMBERS

Appendix F provides a glossary and additional illustrations describing various terminology utilized in this section. The **Timber Sheets Addendum** should be referenced for field drawings and additional photos of every timber.

Framing

Keel

The entire length of the keel was recovered intact and measures 30 ft 1.5 in (9.5 m) long. It is molded 9 in (23 cm) at the stern and gradually increases in size so that it is 11 in (28 cm) at 3 ft (0.9 m) (all measurements are from the stern terminus), 12 in (30 cm) at 15 ft (4.6 m) (amidships), and 13 in (33 cm) at 25 ft (7.6 m) in the bow. The sided dimension on the top is 4 in (10 cm) in the bow and stern, with a gradual increase in size until it measures 5 in (13 cm) between 6 and 8 ft (1.8 and 2.4 m). The bottom sided dimension is 5 in (13 cm) between 15 ft (4.6 m) (amidships) and 25 ft (7.6 m), where it tapers from both these points until it measures 4 in (10 cm) at both the bow and stern. The bottom of the keel is rounded by 0.5 in (1.3 cm) throughout its length, as if the keel was cut from a tree that was planed flat on three surfaces, and shows no evidence that a false keel was ever attached (**Figure 18**). The rabbets to fit the garboard strakes on either side of the keel measure between 1 and 1.5 in (2.5 and 3.8 cm) wide by 0.5-in

Figure 18. Rounded keel (facing forward from aft end; keel is lying on its port side).

(1.3-cm) deep (**Figure 19**). They are cut at a 45-degree angle along the majority of the keel until a point approximately 5 ft (1.5 m) forward of the stern, where they are cut at a 90-degree angle to accommodate the up-turning garboard strakes at this point. There is evidence of burning on the upper rabbeted face of the keel, particularly in the stern.

Figure 19. Keel rabbet (note the charring).

The keel is cut with simple, flat scarfs to accept both the stempost and sternpost. A 5-in deep (13-cm), 6-in long (15-cm) cut—one half of a flat scarf—exists to accept the sternpost (**Figure 20**). Judging from the angle of the cut, it appears there would be little rake to the sternpost. This scarf appears unfinished as there is a thin sidewall on the port side that has not been completely removed. There is no evidence of any form of attachment between the keel and sternpost, such as mortises, fishplates, or through bolts, on the three sides of the keel that can be accessed. The flat scarf face to accept the lower stempost drops 3.5 in (8.9 cm) initially and then an additional 2.5 in (6.4 cm) as it angles downward at 15 degrees over a horizontal distance of 10.5 in (27 cm) (i.e., the opposing scarf face on the lower stempost is cut 6 in [15 cm] into the keel at the forward edge) (**Figure 21**). The lower stempost originally attached to the keel with one through bolt and two iron pegs on either side of the stopwater groove—one attached to the lower stempost and one missing (**Figure 22**). A semicircular groove that would have accepted a stopwater when mated with the lower stempost was cut into the keel scarf face (see **Figures 21** and **22**).

Figure 20. Aft end of keel showing notch for sternpost.

Figure 21. Forward end of keel showing flat scarf to accept stempost (note the stopwater groove).

Figure 22. Mortises in flat scarf to accept stempost.

There is evidence, in the form of fasteners and fastener holes, for 23 frame stations along the keel, three of which originally sat atop the apron in the bow. Originally, three additional half frames would have fit into the side notches in the deadwood timber (discussed below) for a total of 26 frame stations. Three floors at approximately 10.75, 12, and 16 ft (3.3, 3.7, and 4.9 m) are still attached to the keel and two stern "Y" frames are attached at approximately 5.5 and 6.5 ft (1.7 and 2 m) in front of the deadwood (**Figure 23**). The remaining 18 floors and three half frames have been disarticulated from the keel. The average space between fasteners or fastener holes on the keel, which would equate to the approximate distance between the centers of floors, is 13 in (33 cm). Of the 20 floors attached to the keel, eight would have been attached with blind driftpins and 12 with blind treenails. There is no discernible pattern to the fastener material utilized to attach floors to the keel. One floor atop the apron was not fastened to the keel and the three half frames were mortised to the side of the deadwood.

Figure 23. Y frames still attached to aft end of keel. (Note: keel is lying on its port side.)

OTRL collected a sample from the keel on June 29, 2015, at the request of SHA. The keel was part of a series of 10 timbers sampled to build a site master chronology for dendrochronological analysis. It was necessary for OTRL to sever the keel in order to collect an adequate cross-section; the keel now exists as two pieces. The keel was thoroughly documented and photographed prior to sampling. OTRL also documented the width of the saw blade utilized during collection and calculated the total amount of material removed by both the sample and the blade. Direct Dimensions—a separate SHA contractor—additionally generated data point clouds from 3-D laser scanning of each Nanticoke River Shipwreck timber prior to sample collection. Those electronic records are held by SHA and MHT.

Keelson

The keelson (**Figure 24**) is disarticulated from the keel; however, comparison of fastener patterns and articulated floors attached to both the keelson and keel were used to determine its original positioning. It is 21 ft (6.4 m) long and is broken at the forward end approximately 15 in (38 cm) aft of where the apron originally would have been attached; there is a 7-ft (2.1-m) long crack in the center of the timber running aft from this location. The keelson varies in its molded dimension between 4.5 and 5.5 in (11 and 14 cm), with a pronounced taper at the stern where it originally rested atop the deadwood, and is sided approximately 7.5 in (19 cm) at the bow, as it widens to rest atop the apron, and gradually tapers aft to 4 in (10 cm) at the stern. Twelve fasteners, including the remains of driftpins and treenails and two complete driftpins, are driven through the keelson, which match with fastener remains in the keel and helped to align the keelson. There is no discernible pattern to which floors were attached to the keelson, nor what fastener type was utilized. The stern terminus of the keelson originally sat atop the deadwood and is notched to accept the two extant Y frames and the next two floors forward; it is not notched to accept any floors forward of this point (**Figure 25**).

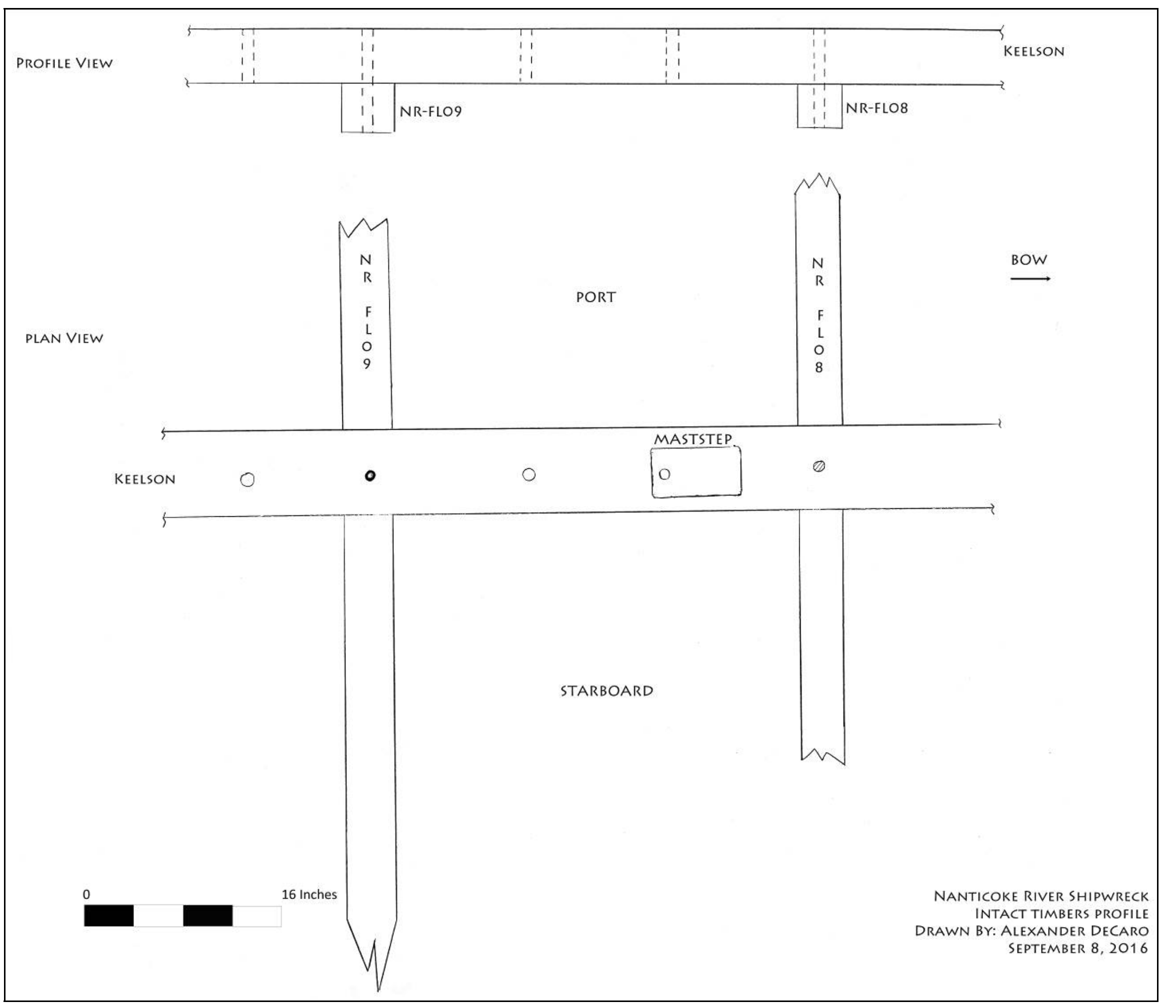

Figure 24. Partial keelson reconstruction.

Figure 25. Aft keelson floor notches. (Note: keelson is lying on its port side.)

A floor was attached in the forward-most notch when the timber was recovered from the river; however, the timber was disarticulated during transport to the MAC Lab. The notches measure 6.5 in (17 cm) long by 2 in (5.1 cm) deep, 5.5 in (14 cm) long by 1.75 in (4.4 cm) deep, 6.5 in (17 cm) long by 1 in (2.6 cm) deep, and 6 in (15 cm) long by 1 in (2.6 cm) deep. There are two floors still attached to the keelson with complete, intact driftpins (**Figure 26**). A third, partial driftpin is extant through the keelson without a floor attached.

A single mast step is notched into the keelson, the center of which is located 13 ft, 8 in (4.2 m) from the stern terminus (**Figure 27**). The center of the mast step originally would have been located approximately 2.5 ft (0.8 m) forward of the keel's midpoint. The mast step measures 8 in (20 cm) long by 5 in (13 cm) wide by 2 (5.1 cm) in deep. It tapers inward by 1 in (2.6 cm) as it deepens into the timber. The notch is cut straight into the timber insinuating that the mast had little, if any rake. There is a treenail driven through the keelson inside the mast step to attach the floor that would have been located beneath this point. It is possible a second mast step originally existed forward of the break in the keelson, which if true would have placed it immediately aft of the apron. There is no evidence of notches for deck stanchions along the top of the keelson.

Figure 26. Floor still attached to keelson with driftpin. (Note: keelson is upside down.)

Figure 27. Keelson mast step.

OTRL collected a sample from the keelson on June 29, 2015, at the request of SHA. The keelson was part of a series of 10 timbers sampled to build a site master chronology for dendrochronological analysis. It was necessary for OTRL to sever the keelson in order to collect an adequate cross-section; the keelson now exists as two pieces. SEARCH thoroughly documented and photographed the keelson prior to sampling. OTRL also documented the width of the saw blade utilized during collection and calculated the total amount of material removed by both the sample and the blade. Direct Dimensions—a separate SHA contractor—additionally generated data point clouds from 3-D laser scanning of each Nanticoke River Shipwreck timber prior to sample collection.

Floors

Nine floors exist disarticulated, while five remain attached to the keel and two to the keelson (total=16). A third floor was recovered attached to the keelson, but became disarticulated during transport. Three floors are confirmed to originally reside in the keelson notches at the stern, and SEARCH identified a floor that likely resided in the fourth keelson notch, based upon its size, curvature, and fastening. These four stern floors are discussed below in the **Stern Construction** section. **Table 2** presents the range of dimensions and average dimensions for 11 of the remaining floors. All floors consist of arms of unequal length and vary in length and state of preservation (**Figure 28**). The sixteenth floor is an anomaly at 6 in (15 cm) sided and 6 in (15 cm) molded, which may indicate it also originated in the stern of the vessel. Many floors, apart from the stern floors, are relatively flat, inferring that the vessel had little deadrise amidships (i.e., relatively flat bottom). All floors contain two rectangular limber holes, cut with a chisel, on either side of the keel, or show evidence of limber holes that have degraded. One floor has evidence of burning.

Table 2. Floor Dimensions at the Keel.

Sided Range	Sided Average	Molded Range	Molded Average	Length Range	Length Average
4-5 in (10-13 cm)	4.5 in (11 cm)	4-4.5 in (10-11 cm)	4.3 in (11 cm)	1.8-5.9 ft	4.8 ft

Figure 28. Representative example of a floor.

Figure 29. Drift pin.

Floors were attached to the keel at an average of 13 in (33 cm) between centers with either a blind treenail or blind iron driftpin (i.e., no fastener was driven entirely through the keel). Of the 23 original full floors, only 13 were fastened to the keelson. Driftpins were hand-forged, resulting in a multifaceted driftpin where the various facets terminate at differing places adjacent to the point (i.e., no two facets are the same length). **Figure 29** displays a complete driftpin attached through the keelson and an intact floor. The grain is inline and the driftpin tapers on four sides to a point. The four sides of the point are not uniform, but average approximately 2 in (5.1 cm) long and 0.75 in (1.9 cm) wide at the base of the point. It measures approximately 1 ft, 8 in (0.5 m) long and varies slightly in diameter throughout its length, but averages approximately 1 in. Floor driftpins, therefore, penetrate the keel approximately 10-11 in (25-28 cm), accounting for average keelson and floor molded dimensions (i.e., nearly, but not quite entirely through the keel).

Twelve of the 16 floors maintain one complete arm, which is chamfered at its outer end (**Figure 30**). The remaining four floors are either broken or too deteriorated to determine if a chamfer existed. The molded dimension of the complete arm tapers outward from where the floor would have sat atop the keel. SEARCH postulates that the chamfers were cut to prevent the timber from splitting when fastened laterally to a first futtock. Assuming that the long arm of each floor originally was positioned on the starboard side of the vessel (reasoning is discussed later), then the chamfer is cut into the upper, forward face of each timber. A wrought iron nail is driven laterally into the chamfer on nine floors to faye the timber to a futtock. Five floors have additional wrought iron nails driven laterally into the aft face of the starboard arm, near where the floor would have sat atop the keel. One of these five also contains a wrought iron nail driven laterally into the aft face of the port arm, again near where the floor would have sat atop the keel.

Figure 30. Floor chamfer.

All floors contain the remains of multiple fasteners to attach the outer strakes, which include 1 in (2.6-cm) treenails, none of which is wedged, and 0.5-in (1.3-cm) square iron nails. Six floors show evidence of ceiling planking in the form of blind treenails driven into the timbers within 1.7 ft (0.5 m) from the edge of the keel. SEARCH documented a partial hand-formed treenail that had become dislodged from its original location (**Figure 31**). The treenail is broken at one end, somewhat pointed with five facets at the other, and measures 6 in (15 cm) long and approximately 1 in (2.6 cm) in diameter, although it is multifaceted and not uniform. A nearly complete wrought iron nail was collected that is not obscured with concretion or much corrosion product for analysis (**Figure 32**). It is forged wrought iron (grain runs parallel with the shaft), measures 1.5 in (3.8 cm) long, and the shaft is bent in the middle, which resulted from hammering into the timber. It measures 0.25-x-0.38-in (0.6-x-1-cm) just under the head and appears to have burrs on a single face. Wells (1998:82) states that, "hand forged nails may have burrs on the trailing edge of the rod on the same face," which are the result of the tool utilized to cut the nail blank from the nail plate. The narrow face remains uniform throughout the shaft length, while the wider face tapers to a point. The head is hand-formed, judging from the irregular shape and evidence of hammering, and appears to be a hybrid between rose, although it has only two facets, and clasp, although it is not flat. The clasp head allowed the head to clasp, or stick into the timber, providing a smooth surface (McCarthy 2005:172).

Figure 31. Partial wooden treenail.

Figure 32. Wrought iron nail.

Two floors, NR-FL04 and NR-FL12, have unique characteristics and deserve additional discussion. Floor NR-FL12 is attached to the keel and measures approximately 1.5 ft (0.5 m) long, with the starboard arm broken approximately 1 ft (0.3 m) from its center point (**Figure 33**). The port arm is cut flat at approximately 6 in (15 cm) from its center point and may have formed a butt scarf with a futtock. There is a blind wrought iron nail driven into the aft face of the starboard arm at the break, likely to laterally fasten a first futtock. Floor NR-FL04 has unique carvings on its inner face that resemble two or three Roman numeral "X" marks within squares (**Figures 34** and **35**). SEARCH recorded similar markings on a futtock (discussed below). It was considered that the geometric shapes could be graffiti placed by a sailor for luck or protection, but there is no comparative research to support this (Bruce Terrell, pers. comm. 2015; Brian Hoggard, pers. comm.). SEARCH hypothesizes that the timber was marked during construction of the vessel because a treenail was driven through one of the symbols after it was created. If used as construction cues, the symbols may have distinguished the floor position in the hull or denote fastener locations (**Figure 36**). A number of floors contain treenails where their locations had been marked on the inner faces of the timbers prior to placement. **Figure 37** depicts a treenail where the placement had changed. Tool marks form a rough square and the original unused position reveals a chiseled out cavity. Additional discussion for the possible origin of these carvings is provided in the **Site Interpretation** chapter.

Figure 33. Floor NR-FL12, left. Note: the blind fastener visible in the break.

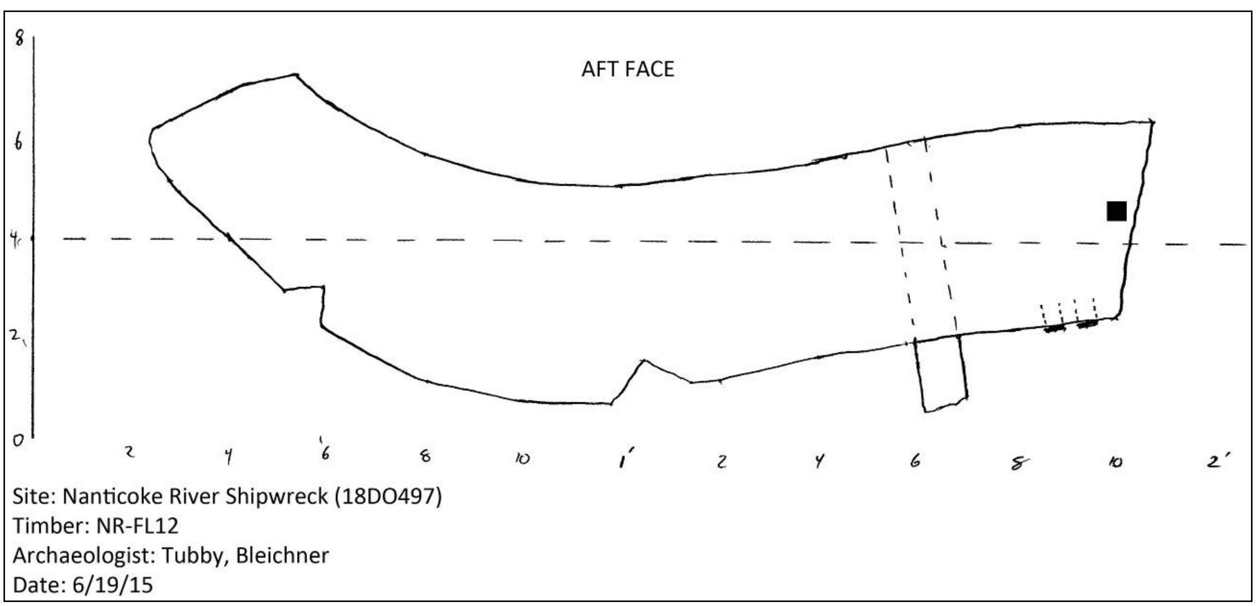

Figure 34. Floor NR-FL12.

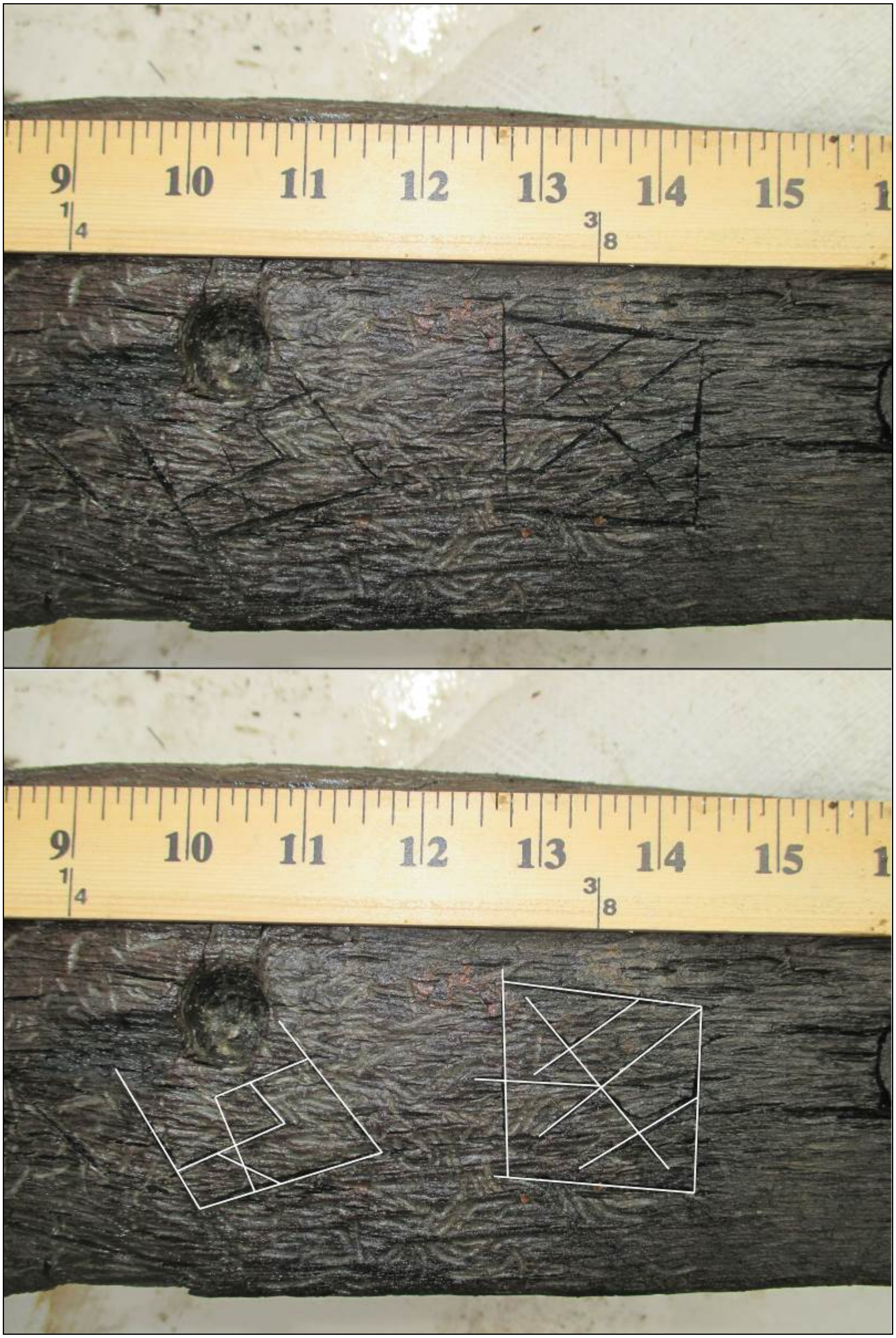

Figure 35. Markings on Floor NR-FL04.

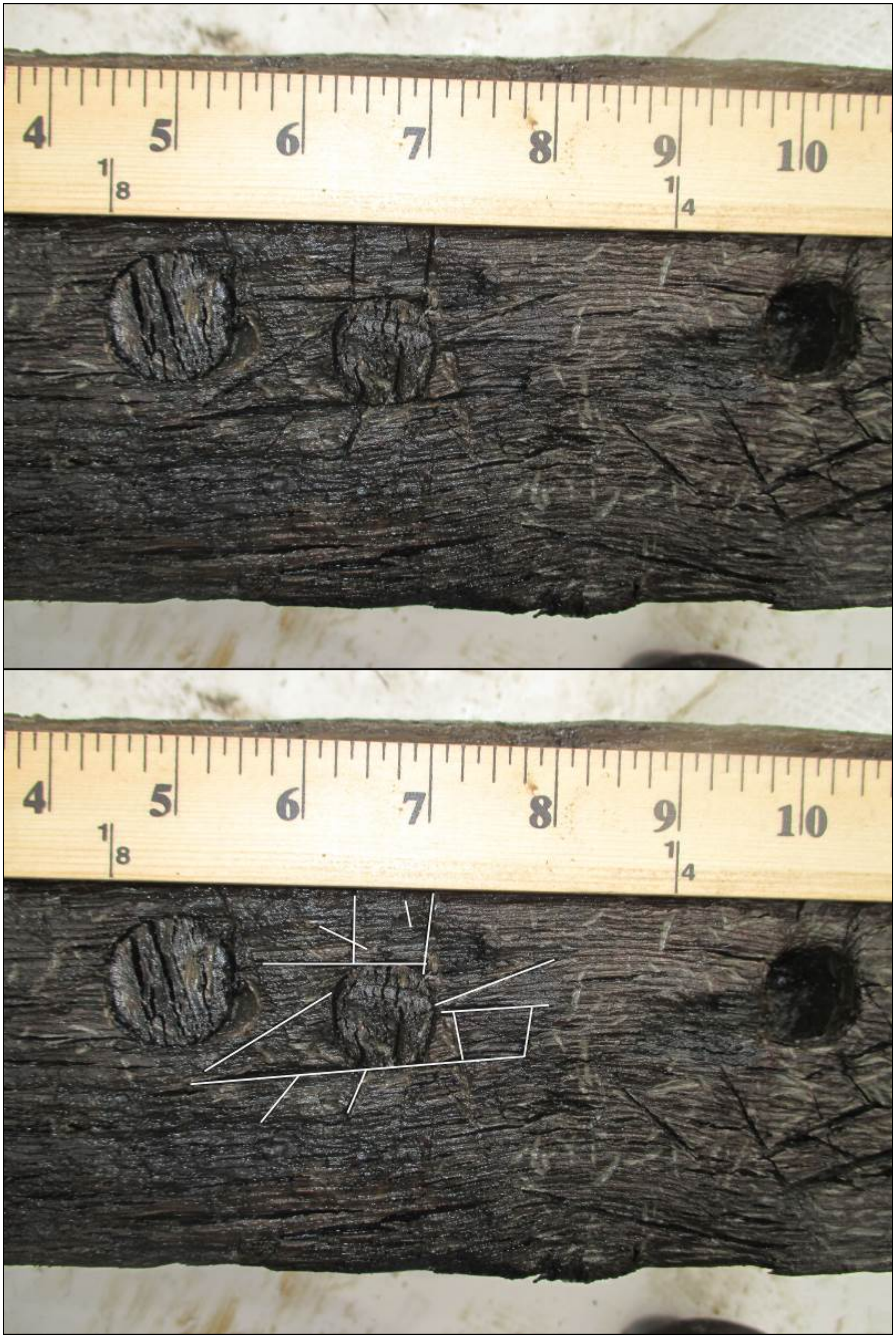

Figure 36. Tool marks around treenail.

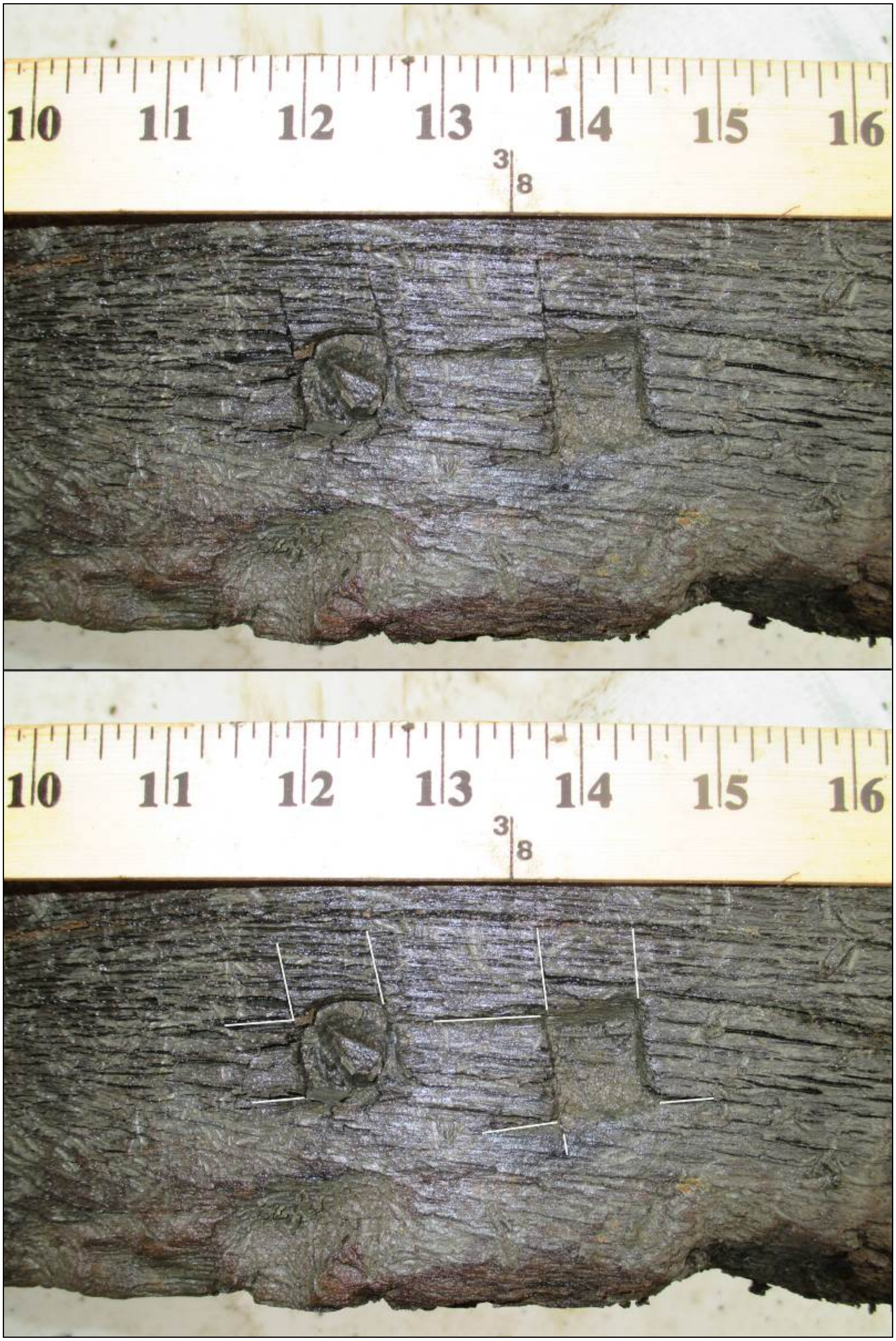

Figure 37. Treenail placement.

Futtocks

SHA recovered 15 disarticulated futtocks from Site 18DO497 (**Figure 38**). All but two timbers appear to be first futtocks. These are likely first futtocks due to the relatively flat curvature of the majority of futtocks, which indicates the bottom of the vessel, and because the site formation process resulted in survival of only the lower hold. The two possible second futtocks are too curved to reside at the bottom of the hull and the angle that the strake fasteners are driven through the timbers suggests they were originally positioned in a more vertical alignment (**Figure 39**). **Table 3** presents the range of dimensions and average dimensions of the futtocks. First futtocks are of varying lengths and states of preservation. The molded dimension of most futtocks tapers toward the outer end of the timber. Some futtocks are slightly curved; however, most are relatively flat along two-thirds their length, suggesting that the vessel had little deadrise amidships.

Figure 38. Representative example of a first futtock.

Figure 39. Representative example of a second futtock.

Table 3. Futtock Dimensions at the Keel.

Futtock	Sided Range	Sided Average	Molded Range	Molded Average	Length Range	Length Average
First	3.5-5.25 in	4.5 in	3.5-5 in	4 in	3-5.8 ft	4.4 ft
Second	4-5 in	4.5	3.5 in	3.5 in	5.5-6.7 ft	6.1 ft

Twelve futtocks are chamfered at their inner ends (**Figure 40**); the remaining three futtocks originally may have been chamfered but are deteriorated. If the futtocks were positioned on the preserved starboard side of the vessel, then the chamfer is cut into the upper, aft face of the futtocks (i.e., the opposite side of the floor chamfers). A wrought iron nail is driven laterally through the chamfer on seven first futtocks to faye the timber to a floor. Three of these futtocks also have wrought iron nails driven laterally into the forward face near the middle of the timber for additional security to the floor. There is no evidence of fasteners at the chamfer on five futtocks; however, three of the futtocks have wrought iron nails driven laterally into their forward face towards the middle of the timber. All futtocks contain the remains of multiple fasteners to attach the outer strakes, including 1-in (2.6-cm) unwedged treenails and 0.5-in (1.3-cm) wrought iron nails. Six futtocks show evidence of ceiling planking in the form of blind nails driven into the upper surfaces of timbers at various distances from the heels. At least one futtock shows evidence of burning and one futtock, NR-FK01, has faint markings scrawled into its upper face resembling either a Roman numeral "X" or partial asterisk within a square (**Figure 41**). As with Floor NR-FL04, two hypotheses have been proposed: (1) the symbols were cues utilized during construction or (2) graffiti placed by a sailor. Additional discussion for the possible origin of these carvings is provided in the **Site Interpretation** chapter.

Figure 40. Futtock chamfer.

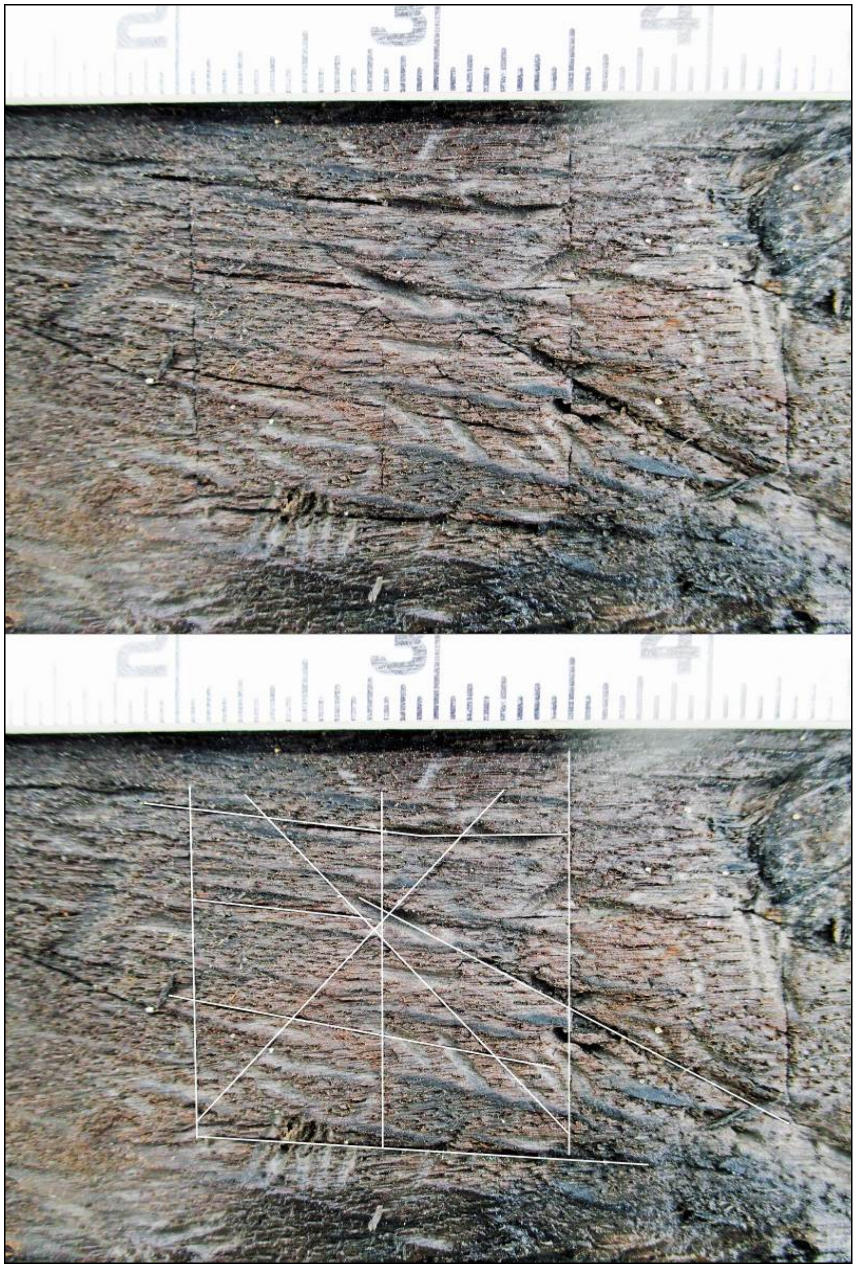

Figure 41. Markings on Futtock NR-FK01.

OTRL collected samples from eight futtocks on June 29, 2015, at the request of SHA. The futtocks were part of a series of 10 timbers sampled to build a site master chronology for dendrochronological analysis. It was necessary for OTRL to sever the futtocks in order to collect adequate cross-sections; each sampled futtock now exists as two pieces. SEARCH thoroughly documented and photographed the futtocks prior to sampling. OTRL also documented the width of the saw blade utilized during collection and calculated the total amount of material removed by both the sample and the blade. Direct Dimensions—a separate SHA contractor—additionally generated data point clouds from 3-D laser scanning of each Nanticoke River Shipwreck timber prior to sample collection.

Stern Construction

Deadwood

A single stern deadwood timber is intact atop the keel and is fastened with one blind driftpin and two through bolts with clinch rings. The bolts are driven obliquely through the keel to prevent the timber from shifting longitudinally (**Figure 42**). The extant portion measures 3 ft, 9.5 in (1.1 m) long; the aft 9.5 in (24 cm) has broken away. The molded dimension is slightly larger at the center (7.5 in [19 cm]) than the forward and aft faces (6.5 in [17 cm]); therefore, the deadwood is slightly convex. The sided dimension of the forward face is 4.5 in (11 cm) where it rests atop the keel (matching the keel's sided dimension), while 6.5 in (17 cm) at its top; therefore the forward face of the deadwood forms an isosceles trapezoid. The timber then tapers aft until it measures 4.5 in (11 cm) sided on both its top and bottom faces at its aft terminus.

The deadwood has three notches in both its port and starboard faces to accept half frames (notches on the port side are eroded). The notches average 4.5 in (11 cm) long and are cut

Figure 42. Starboard side of stern deadwood.

1-1.5 in (2.6-3.8 cm) deep. The aft two notches are 3-3.5 in (7.6-8.9 cm) tall, while the forward notch is 3 in (7.6 cm) at its forward edge and 4.25 in (11 cm) at its aft edge (i.e., right trapezoid). A 1-in (2.6-cm) treenail is driven athwartships through both the forward two notches, presumably as temporary fastening for the frames until planking was added. A blind drift pin has been driven vertically through the treenail in the forward notch. A one-in treenail is driven athwartships through the lower, aft corner of the deadwood just above the keel rabbet, presumably to attach the hood ends of the garboard strakes. There exists a second, blind treenail driven in the starboard face of the deadwood.

Y Frames

The four floors that originally rested within the aft keelson notches are more substantial timbers with greater deadrise than floors in the main run of the vessel, and are sometimes referred to as "Y" frames. The Y-frame floors are much larger in their molded dimension when compared to other floors from Site 18DO497, at an average of 6.75 in (17 cm) at the keel, and only slightly larger sided at an average of 5.2 in (13 cm) at the keel. The largest floor on the vessel is the Y frame furthest aft at 7.5 in (19 cm) molded and 6.25 in (16 cm) sided. The two frames still extant atop the keelson rake forward slightly, but it is difficult to determine whether this is part of the construction or if the site formation process altered their original position (**Figure 43**). If the design included a deliberate rake in these timbers, then the shipwright positioned them parallel to the waterline rather than the backbone of the vessel, which indicates drag to the keel.

Figure 43. Aft Y frames. (Note: keel is lying on its port side.)

Floor NR-FL05 has a unique characteristic that warrants additional discussion. This floor was recovered attached to the forward notch of the keelson. It has a steep arm angle indicative of a floor originating in the stern and a flat inner face cut into the timber to accommodate the keelson notch (**Figure 44**). NR-FL05 is unique from the other floors in that it has a deep notch cut into its aft face (**Figure 45**). The purpose of this notch is unclear, but it may have been an adjustment to account for a mistake in the construction or a post-construction repair.

Figure 44. Floor NR-FL05.

Figure 45. Notch cut into Floor NR-FL05.

Cant Frame

Futtock NR-FK04 is unique in its curvature and likely represents a futtock incorporated into a stern frame (**Figure 46**). This futtock has an "S" shape and may be more indicative of a cant frame that helped fashion a transom stern (**Figure 47**). SEARCH archaeological divers may have encountered a transom piece (see **Figure 47**) on the river bottom during the Phase II investigation; however, it was pinned beneath modern debris and could not be recovered safely. In addition to outer strake fastenings, NR-FK04 has a single fastener indicating a ceiling

Figure 46. Futtock NR-FK04.

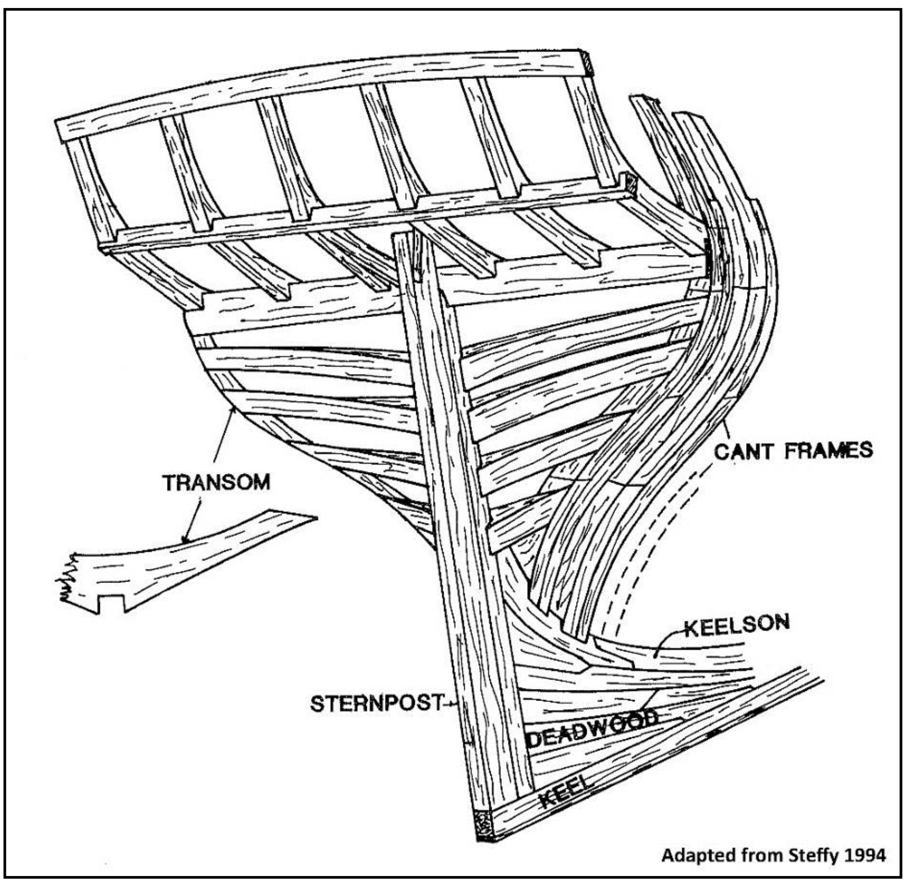

Figure 47. Transom stern construction.

plank was once attached. This fastener, unlike those in the remaining futtocks, is a treenail approximately 2 ft (0.6 m) from its heel and likely attached the first ceiling plank. Because of the type and position of this fastener, it could be inferred that this futtock originally was fastened either closer to the keel than other futtocks or against the deadwood in order to help shape the narrower stern.

Bow Construction

Apron

The apron, which was cut from a curved compass timber, is disarticulated from the remains and measures 5 ft, 3 in (2.3 m) long (**Figure 48**). Based upon the fastening pattern to the keel, the apron sat atop the keel and partially atop the lower stempost. It was attached to the keel with two blind driftpins and one possible through bolt. The forward-most fastener was driven through the lower stempost beneath the apron and into the keel. Iron corrosion on the keel and lower stempost make it impossible to determine if this is the same through bolt driven through the keel described above. The middle driftpin is driven obliquely through a notch cut for a floor, and has a clinch ring; SEARCH cannot determine whether the third fastener includes a clinch ring due to iron corrosion. The apron varies in the molded dimension from 3 to 8 in (7.6 to 20 cm) due to its curvature. It is relatively uniform in its sided dimension at 7 in (18 cm) for the first 3 ft (0.9 m), at which point it tapers towards the forward end; therefore, it is wider than the keel by approximately 3 in (7.6 cm) for the first 3 ft (0.9 m). The forward end appears broken and originally may have curved further along the stempost. Alternately, the apron may have been segmented with multiple timbers to form the upward curve.

Figure 48. Apron.

The apron is notched on its upper face to accept three floors. The notches average 6.5 in (17 cm) wide and are approximately 2 in (5.1 cm) deep. The aft notch contains a through treenail that penetrates the keel as part of the fastening for the missing floor. The center notch has a hole drilled through the apron for a non-existent treenail, which is offset from the driftpin that attaches the apron to the keel; there is no corresponding hole in the keel suggesting this floor originally was attached only to the apron. There is one through treenail driven athwartships at the forward end, one blind treenail in the lower aft port corner, and one blind treenail in the lower starboard face to attach hood ends of the garboard strakes to the apron. SEARCH documented two triangular chocks that could have been utilized beneath the bow floors, perhaps those originally attached to the apron, in order to help support the increased deadrise (**Figure 49**).

Figure 49. Triangular chock.

Lower Stempost

The lower stempost is a gnarled, curved timber, broken at the upper end, and measures 3 ft, 2 in (1.4 m) in length. It measures 3-3.5 in (7.6-8.9 cm) in thickness at the scarf face where it originally attached to the cutout in the keel, and it is cut in such a way so that a nib would extend approximately 2.5 in (6.4 cm) beyond the forward end of the keel. The timber thins as it curves upward. A rabbet is cut into the port face of the lower stempost; however, the rabbet on the starboard face is not fully formed. It originally was attached to the keel with one through bolt and a mortise and tenon (the iron peg tenon is still extant); a blind drift pin is driven through the timber that attached the apron to the lower stempost and then to the keel. The opposite hemisphere of the stopwater groove is visible through the scarf face and there also exists a wrought iron nail athwartships in the concretion at this location. The purpose of this nail is unclear, and it may just be a disarticulated fastener that became concreted with the timber fasteners. There is a blind driftpin driven into the forward (outer) face of the lower stempost that may have attached a gripe at this location. The lower stempost rakes approximately 35 degrees; coupled with the 15-degree downward angle of the keel cut, the approximate rake of the stempost in its original position is 20 degrees. If the remainder of the stempost followed the curvature of this lower timber, the bow would have had a gradual curve to the waterline rather than a sharp rise. This is conjecture, however, without access to the remaining stempost.

Cant Frame

One recovered timber could be the lower component of a bow cant frame. This timber resembles other first futtocks in its curvature and size – 4 in (10 cm) molded, 5 in (13 cm) sided, and 4 ft (1.2 m) long – but unlike other futtocks it is chamfered on both forward and aft upper faces of its heel (**Figure 50**). This construction would prohibit faying the timber parallel to a floor; rather, the timber likely fastened against at least one other timber with a cant (e.g., apron), and perhaps in the crotch of two timbers (e.g., between the first square frame and the apron). The resulting cant of the timber created by the chamfer would negate the need to bevel the outer face of the timber in order to create a tight fit of the plank against the frame. The oblique angle of multiple cant frames form the bow of a wooden hull vessel (**Figure 51**).

Figure 50. Heel end of possible cant frame.

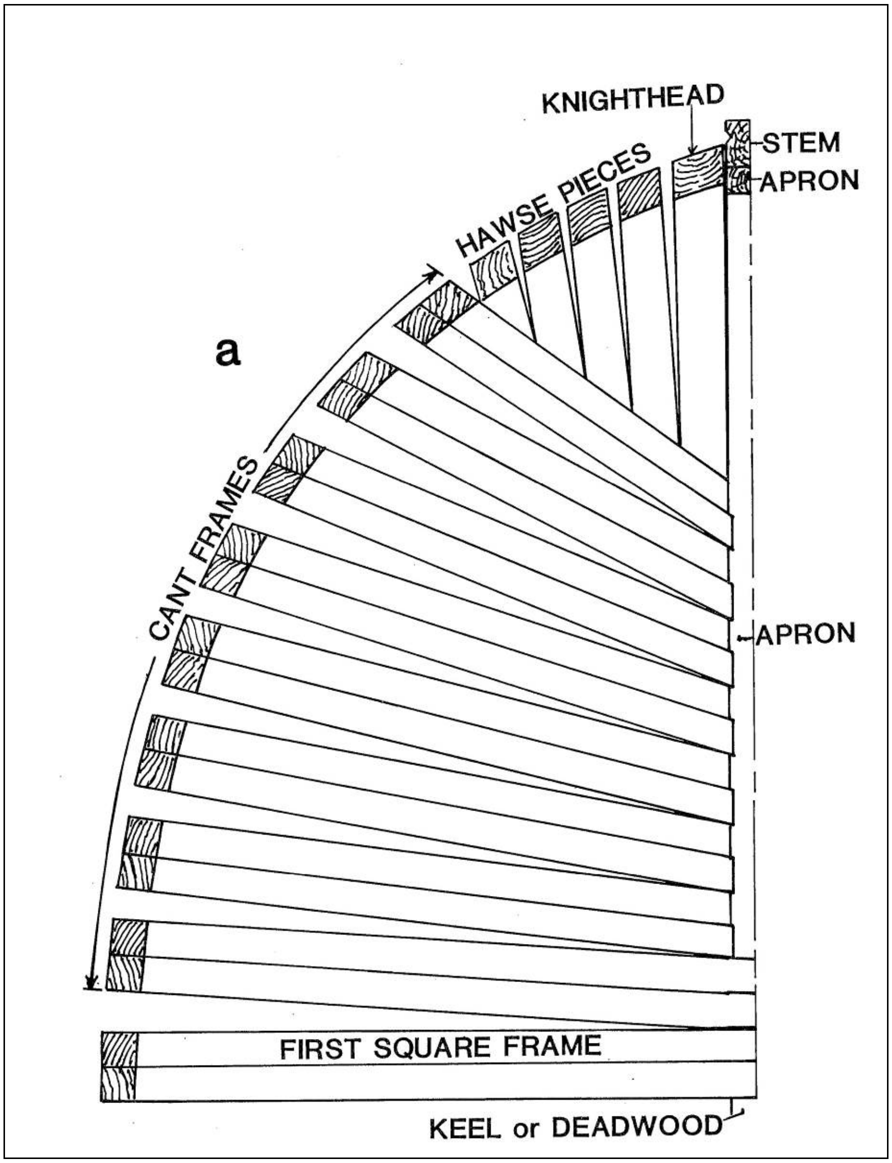

Figure 51. Radial arrangement of cant frames.
(Source: Steffy 1994:294)

Unknown

Archaeological divers recovered a complete timber from the river bottom that may have originated in the bow (**Figure 52**). Its shape somewhat resembles a futtock, but its size is too meager to act as a frame component. The timber is sided 2.5 in (6.4 cm) at one end and tapers to 1 in (2.6 cm), and molded 3.5 in (8.9 cm) for the first third then quickly tapers to 2 in (5.1 cm). It also does not have evidence of extensive fastening, with only the remains of three treenails grouped close to one end. One end is cut at an angle in its upper face tapering its molded dimension. It resembles a gripe; however, the fastening remains do not match the blind bolt driven into the forward face of the lower stempost, nor do the curvatures of timbers coincide, so this is an unlikely description. It is possible this timber is a component of the knee of the head or the stem, perhaps an inner stempost.

Figure 52. Unknown timber.

Planking

The investigation documented 25 planks or planking segments that average 1.2 in (3 cm) thick; 8.4 in (21 cm) wide, with the widest measuring 10.75 in (27 cm) and the narrowest 4 in (10 cm); and 7.3 ft (2.2 m) long, with the longest measuring 14 ft (4.3 m) and the shortest 2.5 ft (0.8 m). Numerous planks possess diagonal cut marks evident of pit sawing and impressions of where they originally would have been attached to frames. The majority of planks are outer hull strakes judging by the fastening pattern. Frame components discussed previously show that a combination of treenails and nails originally attached outer hull planking to floors and futtocks, while inner ceiling planks were fastened with either treenails to attach to floors or square iron nails to attach to futtocks, but not both. It is difficult to determine, but based upon the blind fastener evidence on the floors and futtocks, it does not seem that ceiling planks originally were attached through the frames and into the strakes. Four planks originally were attached utilizing only nails; therefore, SEARCH infers that these are ceiling planks originally attached to futtocks. Spacing between fasteners on these planks is somewhat random, suggesting that ceiling was not attached at every frame station.

Nine strakes originally were attached to both the floors and first futtocks at each frame station. The fastening pattern among these strakes is random, with an average of three fasteners per frame station. Either treenails, square iron nails, or a combination of both attached the strake to the floor, first futtock, or both timbers at each frame station. Desmond (1919:59) states that treenails resist transverse strains better than metal, while metal better resists direct separation; therefore, it is important to utilize a combination of both to secure outer hull planking. Three square iron nails attached the ends of strakes to one frame timber (**Figure 53**). The spacing between fasteners of seven strakes is large enough for the strake to originally have been attached to only one component of each frame station. Two strakes are too degraded to determine a fastening pattern.

Figure 53. Fastening at end of strake.

Three planks are confirmed as garboard strakes due to a beveled edge designed to mate with the keel rabbet (**Figure 54**). The garboard strakes originally were attached to the majority of floors with one treenail driven 2 in (5.1 cm) from the top of the plank and at least one wrought iron nail driven just above the bevel (i.e., single fastening at approximate 13-in [33-cm] intervals). The single fastening pattern is altered at seemingly random frame stations with additional nails added and sometimes treenails omitted. It is evident from frame impressions on the garboard strakes that these planks attached

Figure 54. Inner face of garboard strake. (Note: the rabbet bevel, pit saw marks, and wear patterns where the strake would have been attached to floors.)

only to floor timbers, and first futtocks did not extend to the keel (discussed in detail below). There is no evidence that sacrificial planking was utilized to protect any of the strakes.

Figure 55. Thin metal layer on strake.

A relatively thin layer of metal resembling lead covers a small portion of a strake (**Figure 55**). A sample of this substance was submitted to the Archaeology Institute at the University of West Florida for chemical analysis with a Bruker Tracer III-SD pXRF spectrometer. The sample chemical composition is mainly iron, but did test positive for a relatively small amount of lead (Carroll, pers. comm. 2015). The amount of lead is not significant enough to indicate the presence of lead paint on the wood; SEARCH is uncertain the origin of this material. One possibility is the layer of ferrous alloy was transferred to the strake by an iron fastener, or a disarticulated iron artifact associated with the shipwreck, such as a deadeye. Finally, one strake shows evidence of post-construction repair in the form of a 3-x-11-in (7.6-x-28-cm) patch (**Figure 56**).

Miscellaneous Timbers

Eight timbers were recovered that are likely sections of frame timbers, but are too fragmentary or degraded to determine their identity. Eleven fragments were recovered that remain unidentified; many are probably planking remains.

Figure 56. Strake patch.

Artifacts

The remains of two deadeyes were recovered from the river bottom (**Figure 57**). They are both iron-bound chain deadeyes—meaning they are the lower blocks in a shroud pair—that originally would have attached to chainplates (**Figure 58**). One deadeye is near complete with much of the wood block extant and the entire wrought iron circular strap still resting in the block groove with the upper link of the chain assemblage intact. The second deadeye is missing the majority of the block and upper link of the chain assemblage. The more intact deadeye has three holes to accept a lanyard; there exists some evidence in the wood that the holes were scored to help prevent twisting of the lanyard. One measures 6.5 in (17 cm) in diameter and the second 7.5 in (19 cm) in diameter, with concretion. Three hand-formed bricks were recovered from the river bottom, one of which bears undiscernible markings (**Figure 59**). Bricks could have been utilized onboard for a small hearth. Ballast is another potential use; however, few bricks were recovered from Site 18DO497 indicating this is an unlikely identity, unless salvage of the Nanticoke River Shipwreck occurred.

Figure 57. Deadeyes.

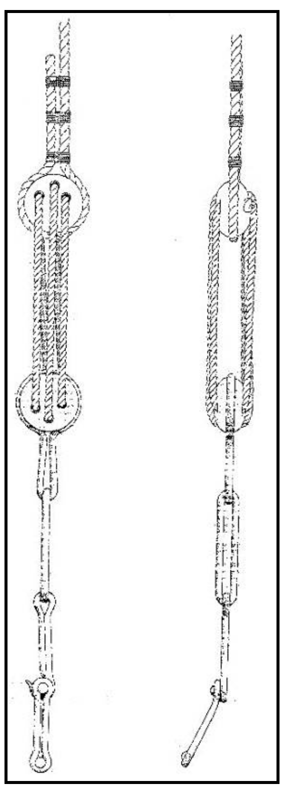

Figure 58. Deadeyes from the French merchantman *Le Machault* (pre-1760) (Bradley 1981:64).

Figure 59. Brick.

OBJECTIVE 5: DENDROCHRONOLOGY AND WOOD SPECIATION

All samples collected for dendrochronology analysis proved to be white oak (*Quercus alba*), while a single slice from a futtock is of the genus hickory (*Cary sp.*) (further segregation of the particular species was not possible from the small sample [McKnight 2015 (**Appendix E**)]). OTRL compared the Nanticoke River Shipwreck site master to more than 700 master chronologies from the East Coast of the United States and more than 1,500 master chronologies from the United Kingdom and Northern Europe. OTRL determined a high degree of cross-match between the Nanticoke River Shipwreck site master and seven reference chronologies from the shores of the Chesapeake Bay region, six from Maryland and one from Virginia (Worthington and Seiter 2015:7 [**Appendix E**]). This infers that the wood originated along the shores of Chesapeake Bay south of Annapolis and likely north of the Potomac River (Worthington, pers. comm. 2015).

The date range of first and last measured rings from the site master is 1616-1743, meaning the *terminus post quem* for the Nanticoke River Shipwreck, based upon dendrochronology analysis, is 1743. None of the samples, unfortunately, retain complete sapwood to the bark edge; therefore, it is not possible to determine a *terminus ante quem* for the Nanticoke River

Shipwreck based upon dendrochronology analysis (Worthington and Seiter 2015:7). Although dendrochronology analysis cannot determine how long after 1743 the trees were felled, Worthington (pers. comm. 2015) speculates that the number of sapwood rings suggests the second half of the eighteenth century. This assessment is based upon the number of sapwood rings extant in the samples compared to the maximum number of sapwood rings encountered in reference chronology white oak. Worthington (pers. comm. 2015) cautions that a white oak example with more sapwood rings than currently recorded may not be nonexistent, just that it has not been documented to date.

SITE INTERPRETATION

CONSTRUCTION

Framing Pattern

Few timbers from Site 18DO497 were recovered intact in their original location. This presented the unique challenge of assembling a puzzle from a pile of matchsticks. A number of clues exist, including the construction of floors, futtocks, and strakes; fastening patterns; timber impressions on garboard strakes; and shipwright markings, to formulate the following working hypothesis regarding the framing pattern for the vessel. Floors and futtocks are disarticulated from one another as a result of either the site formation process or their recovery from the river bottom. It is therefore difficult to know for certain if the frames were constructed utilizing a single frame technique or one of several double frame techniques, including never being attached (earliest form of double framing). The following interpretation, however, is a sound hypothesis based on observable clues to present the most likely method.

Two methods of vessel design and construction available to shipwrights are lofting and whole molding. Lofting is the process of scaling the plans to full size prior to construction. This method offers the opportunity to preview the finished product, establish the sequence of construction, and identify potential problem areas (Chapelle 1941:72). Timbers are cut to precise dimensions and placed in specific locations based upon the lofted plan. Lofting is time consuming and tedious, so much so that many inexperienced shipwrights or those under time constraints avoid this method and utilize whole molding. The whole molding process moves directly from design to construction. In whole molding the shipwright erects master frames (also referred to as loft frames) atop the keel to define the shape of the hull, followed by a series of ribbands or battens that form the transverse shape of the hull. Outer planking is added to the master frames and the remainder of frames are inserted and attached to the strakes. The shape of the hull is predetermined, but rather than cutting specific timbers following a lofted plan, the shipwright utilizes trial and error to fit timbers within the shell and complete the skeleton.

It is not possible to unequivocally determine the method of construction for the Nanticoke River Shipwreck, but multiple lines of evidence suggest the shipwright utilized the whole molding technique. As few as 12 floors may have been attached only to the keel and this is illustrated by the fastening pattern between the keel and keelson. These timbers may represent master frames that were attached to the keel first. In this case, the remaining frames would have been added later and fastened after the keelson was laid down. There is no evidence of a scarf joining any floor and first futtock. Instead, these timbers were likely laterally attached only with one or two iron nails. If frames were pre-assembled before installation and then inserted atop the keel, additional fasteners and a scarf would be necessary to hold the timbers together during placement. The frames, therefore, must have been inserted during planking and temporarily held in place with ribbands. Finally, SEARCH discovered a fortuitous, but likely not coincidental, occurrence when matching floor NR-FL04 and futtock NR-FK01—these are the two timbers that bear symbols scrawled into their upper faces. It is possible these symbols denote a master frame, which would provide additional evidence supporting the hypothesis that the shipwright marked the timbers.

All floors consist of arms of unequal length initially suggesting double frames paired with overlapping floors. This hypothesis results in frames approximately 9 in sided and spacing between floors of 4 in (10 cm) (i.e., room and space=13 in [33 cm]), based upon the keel fastening pattern and average size of floors. The shorter of the two arms on all floors appears broken to a point. Those floors that remain attached to either the keel or keelson are broken on the port side. It is more likely to suggest that, rather than double frames, the port side of the vessel splayed away from the keel/keelson and broke away at some point during the site formation process, while the starboard side became buried and protected in the anaerobic river mud. This would result in arms of different lengths on what originally were full floors. There is no indication of additional driftpins or treenails in either the keel or keelson that would suggest sistered floors. Further evidence to the contrary exists in the fastening pattern and size of wear marks on the extant garboard strakes. Floors at this location in the hull average approximately 4.7 in (12 cm) sided and are spaced an average of 13 in (33 cm) between centers, judging from wear marks on the garboard strakes (sample size=13). The sided dimension is a close match with the average sided dimension of floors (4.5 in [11 cm]), which suggests single timbers attached to the garboard strakes, and the distance between centers matches the fastening pattern on the keel and keelson, also suggesting single timbers sandwiched between the two.

SEARCH examined the possible construction method of single frames where the floors and first futtocks were attached end-to-end with the chamfer acting as a simple diagonal scarf and a single iron nail providing lateral security through the scarf. Single frames would result in an average space between frames of 8.5 in (22 cm) (room and space=13 in [33 cm]). Several clues disprove this frame type. First, although the lateral fasteners in the first futtocks could be explained through attachment of the second futtocks, this leaves no explanation for the lateral fasteners in the floors adjacent to where they would have sat atop the keel. Next, the curvature and tapering of both the floors and futtocks do not align with this method. When floors and first futtocks are situated in this manner, the curvature at the floor/futtock transition is awkward and the tapering of the timbers results in a 1-in (2.6-cm) lip at the transition. Finally, if it is assumed that the recovered strakes originated from the bottom of the hull, the fastening pattern suggests floors and first futtocks fayed side-by-side above the garboard strake. If the timbers originally were joined in this single frame method, the fastening pattern would not match that indicated by the strakes.

SEARCH therefore explored the possible construction method that sistered floors and first futtocks. SEARCH identified a match between lateral fasteners while manipulating the field drawings of those timbers that contain lateral fasteners. The blind lateral fastener in the aft face of floor NR-FL04 near where it would have sat atop the keel matches with the lateral fastener through the chamfered end of futtock NR-FK01. The lateral fastener through the chamfered end of floor NR-FL04 also matches the blind lateral fastener in the forward face of futtock NR-FK01 at the middle of the timber (i.e., the lateral fasteners were driven in opposite directions). The futtock therefore would have been positioned aft of the floor with the chamfers of both timbers cut towards the adjoining timber. The strake fastening patterns of both timbers also match, aside from the garboard strake. It has been shown that the garboard strake was attached only to floor timbers. This agrees with the position of futtock NR-FK01 when lateral fasteners are aligned. The alignment positions the first futtock approximately 10 in (25 cm) from the keel, leaving enough room for the garboard strake to be attached only to the floor with a single treenail. Distance between fasteners above the garboard strake matches between the floor and futtock where each successive strake would have been attached (i.e., strake fasteners are relatively parallel between the floor and futtock, similar to fastening patterns evident on the strakes). Finally, the curvature and tapering of both timbers flows smoothly in this arrangement. Sistering of the floors and futtocks would result in an average space between frames of 4 in (10 cm) (room and space=13 in [33 cm]).

This alignment results in the first futtocks on either side of the vessel not butting heels atop the keel, but rather a gap of approximately 10 in (25 cm) existed between the keel and the heel of each first futtock. The floor would overlap the first futtock by 2.5 ft (0.8 m) and end at the midpoint of the futtock, thus leaving 2.5 ft (0.8 m) to extend beyond the terminus of the floor. Presumably a second futtock would have been attached laterally to the first futtock at this point; however, there is no evidence of this fastening on this, or any other extant first futtock. Also, because of the chamfer in the floors, it is hard to imagine that the second futtocks were butt scarfed to the floors, and instead may have been positioned with a gap between the two timbers. The one example of a second futtock recovered from the river bottom does contain a lateral fastener approximately one-third the distance from its heel end. This should match with a lateral fastener at the outer end of a first futtock, leaving a small gap between the floor and second futtock. The lack of lateral fastenings insinuates either that not all first and second futtocks were attached or that second futtocks were placed in the spaces between frames rather than incorporated into the frames themselves.

The framing pattern, based upon the available evidence, resembles what Morris et al. (1995:2) describes as single, nonlinear frames utilized in eighteenth century and earlier construction, prior to the evolution of the double frame (**Figure 60**). In this pattern, the first futtock is attached to the floor with multiple lateral fasteners and an offset between the heel of the futtock and the centerline of the vessel. Subsequent futtocks also are attached with offsets and multiple fasteners. The floor and first futtock attachment of the Nanticoke River Shipwreck resembles this pattern, but there is not enough evidence to determine the norm for the first and second futtocks attachment. SEARCH identified a number of archaeological examples of shipwrecks with similar framing patterns, several of which are presented here to establish a time frame for the technique utilized in the construction of the Nanticoke River Shipwreck.

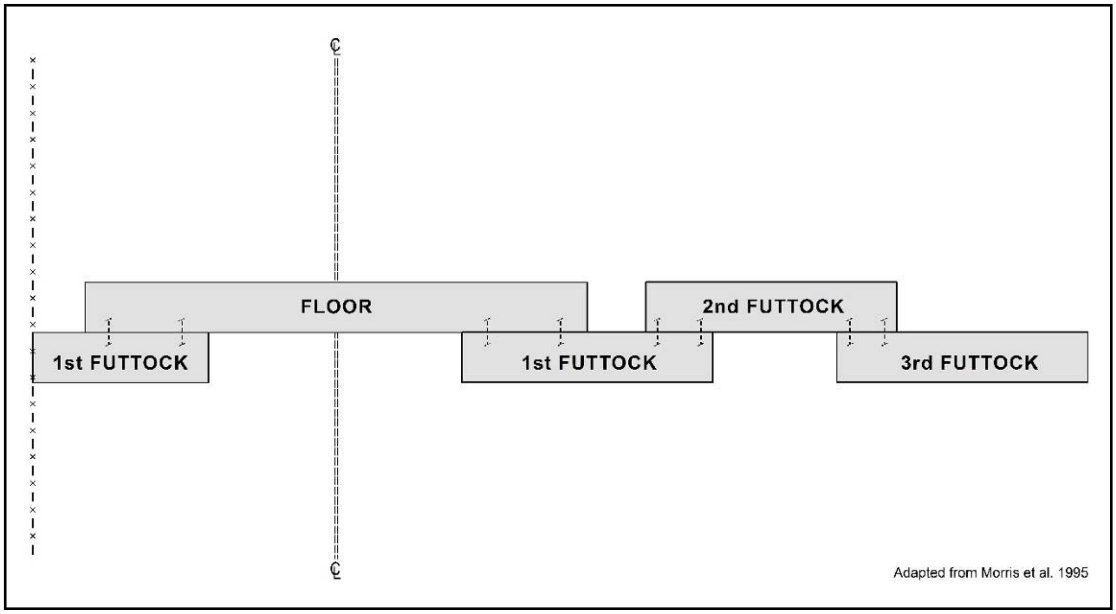

Figure 60. Early single framing pattern.

Brown's Ferry Vessel

The Nanticoke River Shipwreck resembles the irregular framing pattern of the Brown's Ferry Vessel (**Figure 61**). Archaeological investigation in 1976 determined this vessel is a shallow-draft, 50-ft (15-m) long vessel. Frames stopped at the second futtock and the lines drawing of the vessel based upon remains resulted in a depth-of-hold a little over 3 ft (0.9 m) (Steffy

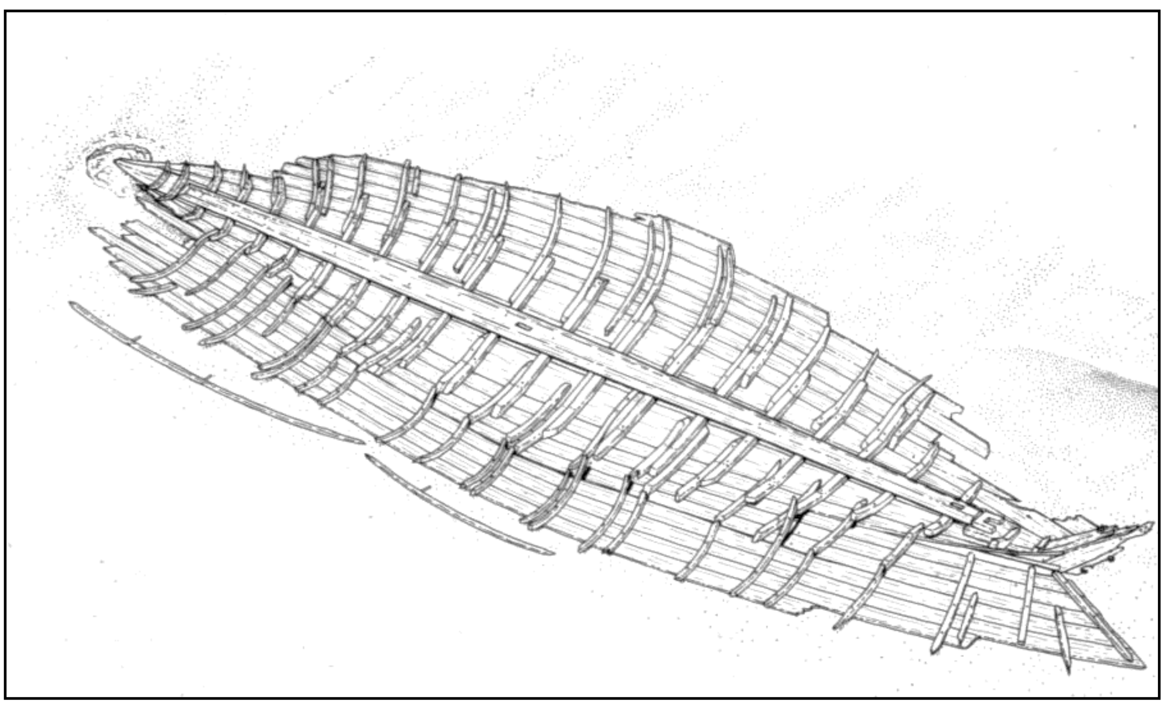

Figure 61. Brown's Ferry Vessel site plan.
(http://artsandsciences.sc.edu/sciaa/mrd/brownsferryvessel)

1979:20). Archaeologists established its likely construction date somewhere during the mid-eighteenth century. The framing pattern, similar to the single frames described in Morris et al. (1995), is comprised of symmetrical floors treenailed to the bottom plank (the vessel was not constructed with a traditional keel) and first futtocks that overlap floors and do not quite abut atop the bottom plank amidships, leaving a gap between their heels (Steffy 1979:11). First futtocks are positioned aft of floors, except for the forwardmost frame, and five of 20 frames consist of floors and first futtocks laterally fastened together with two nails and one treenail; the remaining futtocks are attached only to planking (Hocker 1992:22-23). “Intermediate frames and second futtocks beyond the floor arms added hull coverage where needed,” (Steffy 1979:11) potentially similar to the second futtocks of the Nanticoke River Shipwreck. Hocker (1992:23) states that the intermediate futtocks are arranged in pairs at regular intervals and only “two of the regular frames are reinforced by second futtocks in line with the floor timbers.” It is unclear from the description how these second futtocks are attached to the frame, if at all. SEARCH assumes that since neither source mentions fastening of second futtocks, there were no lateral fasteners. A number of frame timbers, moreover, are chamfered at their heels similar to the Nanticoke River Shipwreck.

Lyons Creek Shipwreck

The Nanticoke River Shipwreck shares characteristics with the framing pattern of the Lyons Creek shipwreck. This site was discovered in 1974 along the border of Calvert and Anne Arundel counties, Maryland, and could date as early as the late seventeenth century (Neyland 1990:1; Shomette 1995:225). Robert Neyland, then a graduate student at Texas A&M, undertook a study of the site remains in the late 1980s and reconstructed a portion of the framing pattern. Not enough remains of this shipwreck to estimate its original size. Neyland (Neyland 1990:83,111,128) determined that floors rested atop a keel plank; first futtocks butted against this plank, but did not butt against its counterpart at the centerline; and second futtocks were fastened away from the floors (**Figure 62**). Lateral fastening of frame components are not depicted in Neyland’s reconstruction. This pattern is similar to the early eighteenth century single frames described above. Floors and futtocks, moreover, are chamfered at their heels much like those of the Nanticoke River Shipwreck.

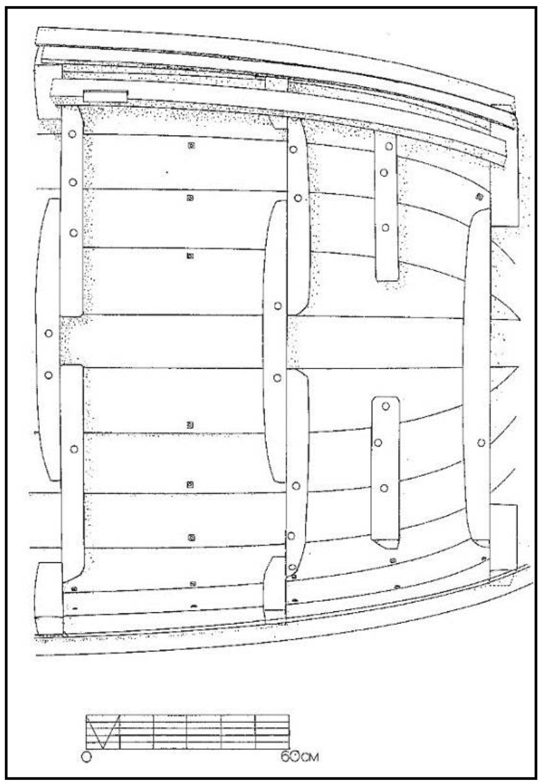

Figure 62. Framing pattern of the Lyons Creek shipwreck. (Neyland’s drawings. Shomette 1995:308).

Malcolm Boat (38CH803)

The Malcolm boat (38CH803) excavated near Charleston, South Carolina in 1992 has been dated between 1775 and 1825 (Amer et al. 1993:ii) (**Figure 63**). It has been estimated at nearly 42 ft (13 m) long on deck by nearly 12 ft (3.7 m) in beam, with a depth-of-hold almost 5 ft (1.5 m). The framing pattern resembles that of early single framing described above and that of the Nanticoke River Shipwreck. The 22 square frames along the keel consist of floors fastened to the keel and keelson with single treenails, first futtocks fayed to the forward side of the floor with the heels between 14 and 22 in (36 and 56 cm) from the edge of the keel (Amer et al. 1993:49). Second futtocks are fastened in line with the floors and third futtocks in line with the first futtocks; gaps exist between all components (**Figure 64**). Additional futtocks were added in space where needed and components of select frames are laterally fastened with treenails. Another feature that Site 18DO497 shares with the Malcolm boat (38CH803) is the shape of the keel. Not only does the Malcolm boat (38CH803) keel taper towards the stem, but it also had no protective shoe and is rounded on its bottom “suggesting that the natural shape of the tree was incorporated into the shaping of this timber” (Amer et al. 1993:46).

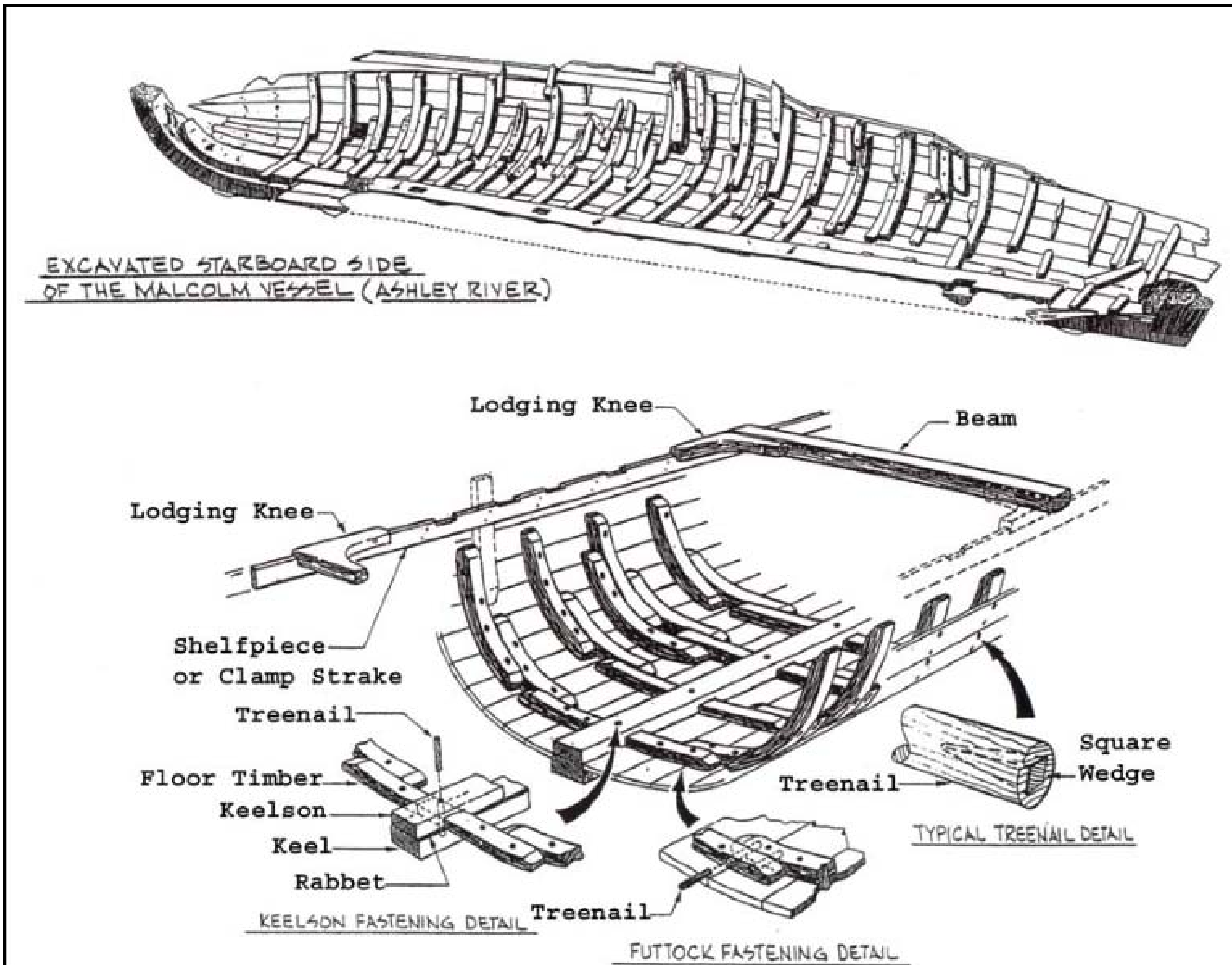

Figure 63. Malcolm boat (38CH803) site plan. (http://artsandsciences.sc.edu/sciaa/mrd/malcolmboat)

Figure 64. Malcom boat (38CH803) frames. (http://artsandsciences.sc.edu/sciaa/mrd/malcolmboat)

Nancy

Texas A&M University, under the direction of graduate student Christopher Sabick, investigated the remains of the schooner *Nancy* in 1997, which is housed at a historic site in Ontario. Historical research revealed the vessel was constructed in 1789. Extant hull remains are 68 ft (21 m) in length and 22 ft (6.7 m) in beam (**Figure 65**). Frames are comprised of two types: molded and regular (**Figure 66**). Molded frames consist of floors affixed to the keel and keelson, and first futtocks laterally fastened with iron bolts to the forward faces of floors aft of amidships, and to the aft faces of floors forward of amidships (Sabick 2004:93). Regular frames include first futtocks that are not fayed to floors, but spaced apart from the timbers (Sabick 2004:95). All first futtocks are attached away from the keel between 7 to 10 in (18 to 25 cm) (Sabick 2004:97). Judging from site drawings, spacing between frames is tight and the heels of second and third futtocks butt against floors and first futtocks. This somewhat resembles the framing of the Nanticoke River Shipwreck, but more closely matches that of an eighteenth century early double frame pattern where there is no gap between the floors and futtocks (Morris et al. 1995:5).

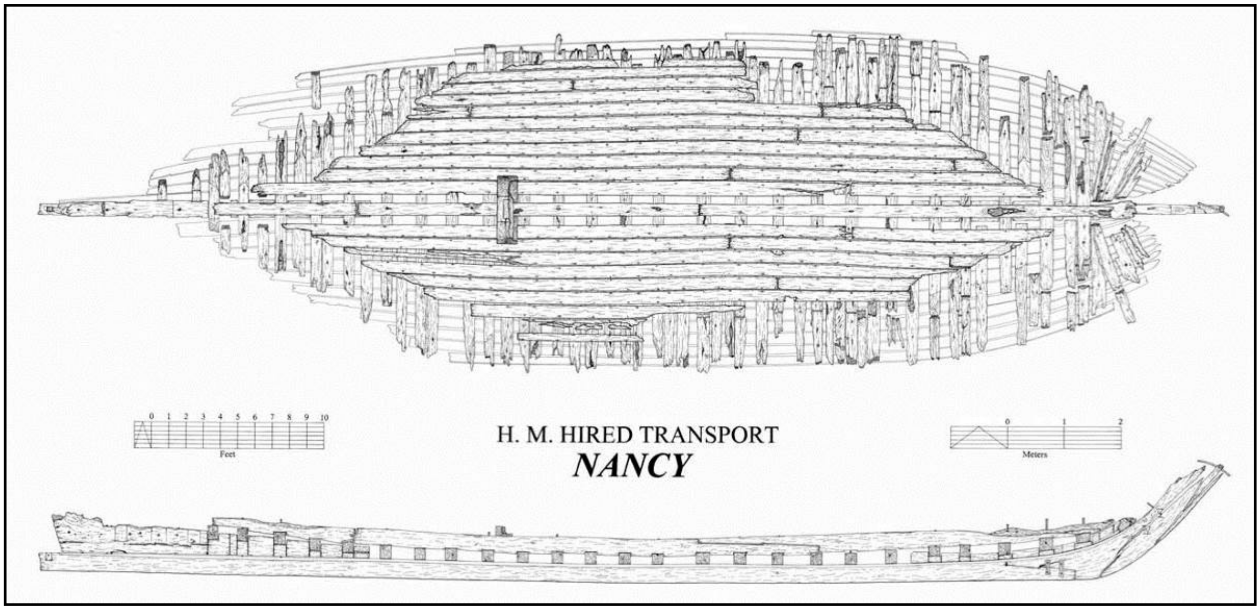

Figure 65. *Nancy* site plan. (Sabick 2004:86)

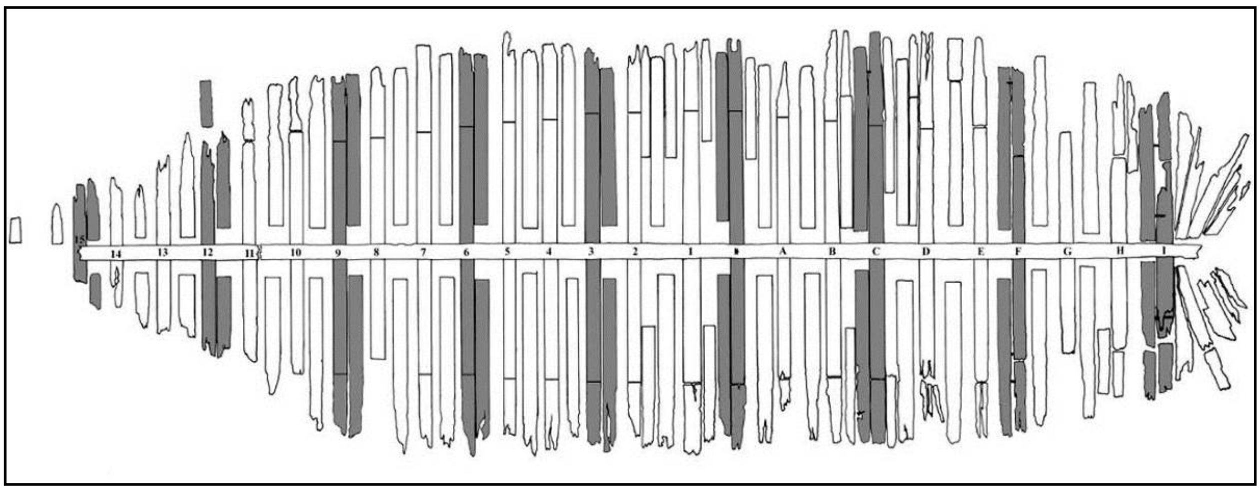

Figure 66. *Nancy* framing pattern. (Sabick 2004:94)

Newington Plantation Vessels

Tidewater Atlantic Research, Inc. (TAR) conducted archaeological investigations of two shipwrecks discovered in the Mattaponi River, Virginia. Gordon Watts of TAR determined the vessels are eighteenth century vernacular craft likely associated with Newington Plantation (Watts et al. 2013). Date was established by an examination of both artifacts and vessel framing patterns, which are indicative of English and Anglo-American vessel construction in the early- to mid-eighteenth century (**Figure 67**). Watts (2013:49) estimates the vessels likely measured between 40 and 45 ft on deck between perpendiculars and were most likely sloop rigged. The South Vessel floors are attached flush to the keel with 1-in treenails or 0.5 in iron drift pins, while the first futtocks are offset from the keel 7-15 in; TAR observed no evidence of

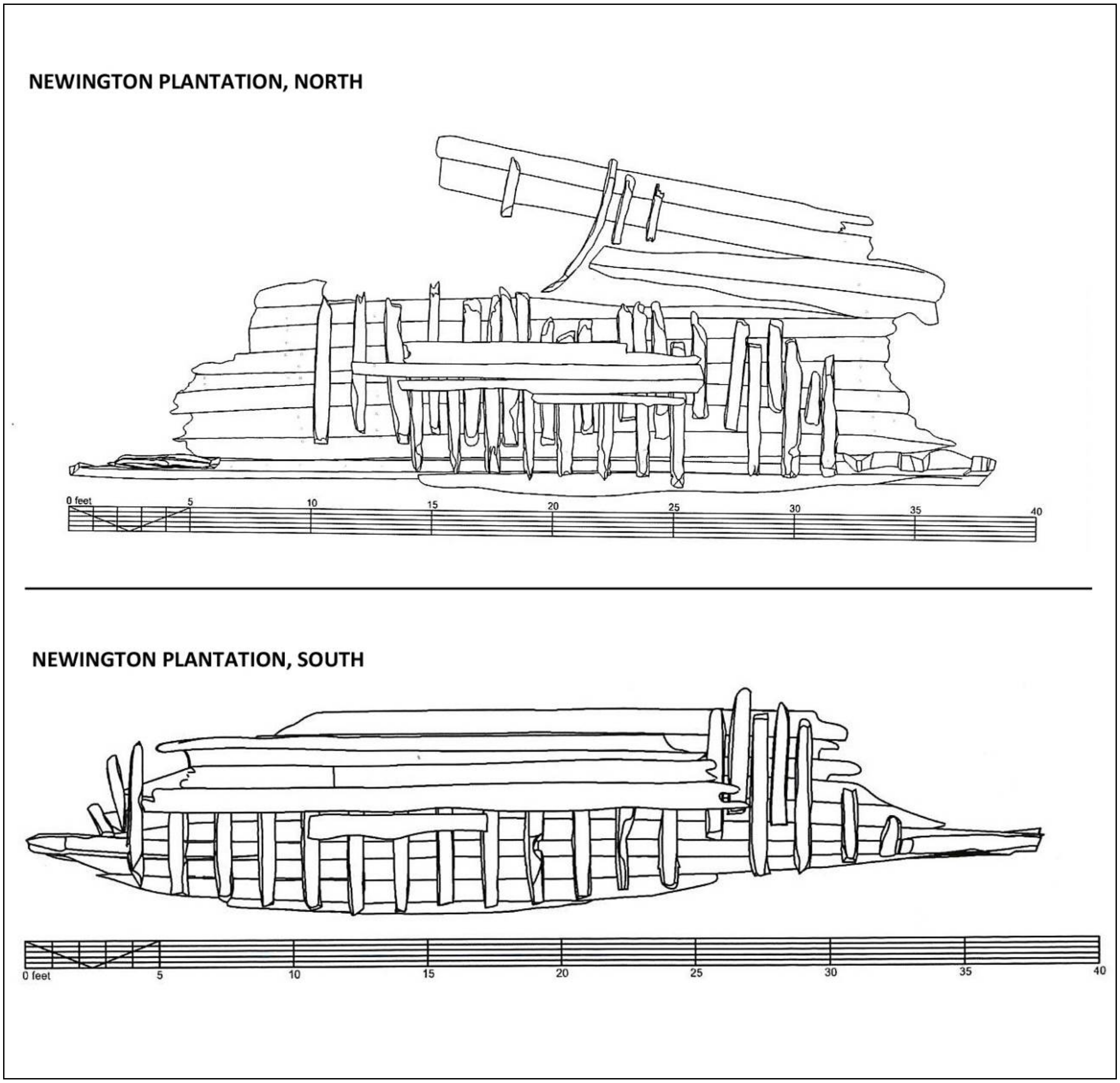

Figure 67. Newington Plantation vessel site plans (Watts et al. 2013).

fastening between floors and futtocks due to the presence of ceiling planks. Watts (2013:40) mentions the iron nails utilized to fasten hull planking are wrought iron and hand forged. Forward of the amidships bend, futtocks are fayed to the forward face of floors, while aft of the amidships bend they are fayed to the aft face. Floors on the North Vessel are attached to the keel at random centers with an inconsistent pattern of 1.5-in treenails or 1-in wrought iron, hand forged drift pins. A pattern emerges aft of the fifth floor where a drift pin attachment is separated by two floors attached with treenails. Futtocks again are offset from the keel 9-23 in and no evidence of fastening between floors and futtocks was observed. The framing patterns resemble that of the Nanticoke River Shipwreck, as does the inconsistent floor fastening pattern of the North Vessel.

Readers Point Vessel

Texas A&M University, under the direction of then graduate student Gregory Cook, investigated a shipwrecked sloop in St. Ann's Bay, Jamaica, in 1994. The remains measure 56 ft, 6 in (17 m) in length and 14 ft, 4 in (4.4 m) in maximum beam (Cook 1997:iii). Investigators determined the vessel dates to the eighteenth century based upon hull construction and artifact assemblage. Tightly spaced frames are comprised of floors affixed to the keel and first futtocks that are fastened approximately 1 ft (0.3 m) from the centerline of the hull (**Figure 68**). Aft of amidships, first futtocks are attached to the aft face of floors and forward of amidships they are joined to the forward face. Lateral fastening between floors and futtocks only exist for nine master frames. The heels of second futtocks butt against the ends of floors and are laterally treenailed to first futtocks in the master frames (Cook 1997:52). This pattern shares characteristics with the Nanticoke River Shipwreck, but more closely resembles that of early double framing.

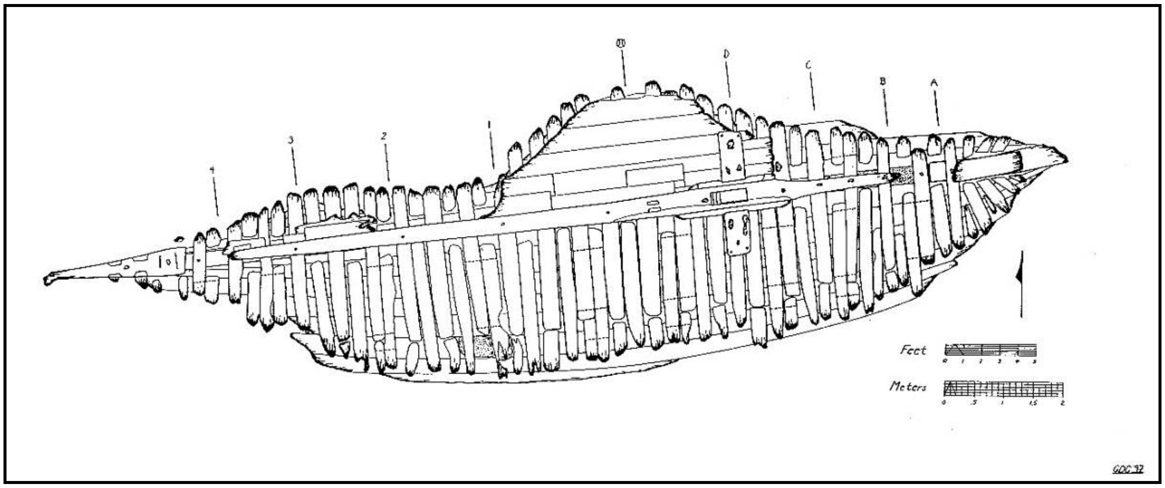

Figure 68. Readers Point vessel site plan. (Cook 1997:110)

Rose Hill Shipwreck

The North Carolina Underwater Archaeology Unit undertook an archaeological investigation of a shipwreck located near Wilmington, North Carolina in 1988. Investigators determined that extant remains of the Rose Hill shipwreck consist of a sloop approximately 67 ft (20 m) in overall length and 22 ft (6.7 m) in beam. Frames are composed of floors and first futtocks that fill the spaces between floors (i.e., room is equal to space), but are not laterally fastened together (Wilde-Ramsing et al. 1992:39) (**Figure 69**). Additional futtocks are not extant on the site so it is not possible to determine if there was a gap between the end of floors and heels of second futtocks. The first futtocks are fastened 11 in (28 cm) from the centerline of the vessel reminiscent of the single, nonlinear framing pattern of the Nanticoke River Shipwreck. Investigators of the Rose Hill shipwreck estimate construction prior to 1750 based upon, among other evidence, the tight spacing of frames and the gap that separates the first futtocks from the keel (Wilde-Ramsing et al. 1992:47).

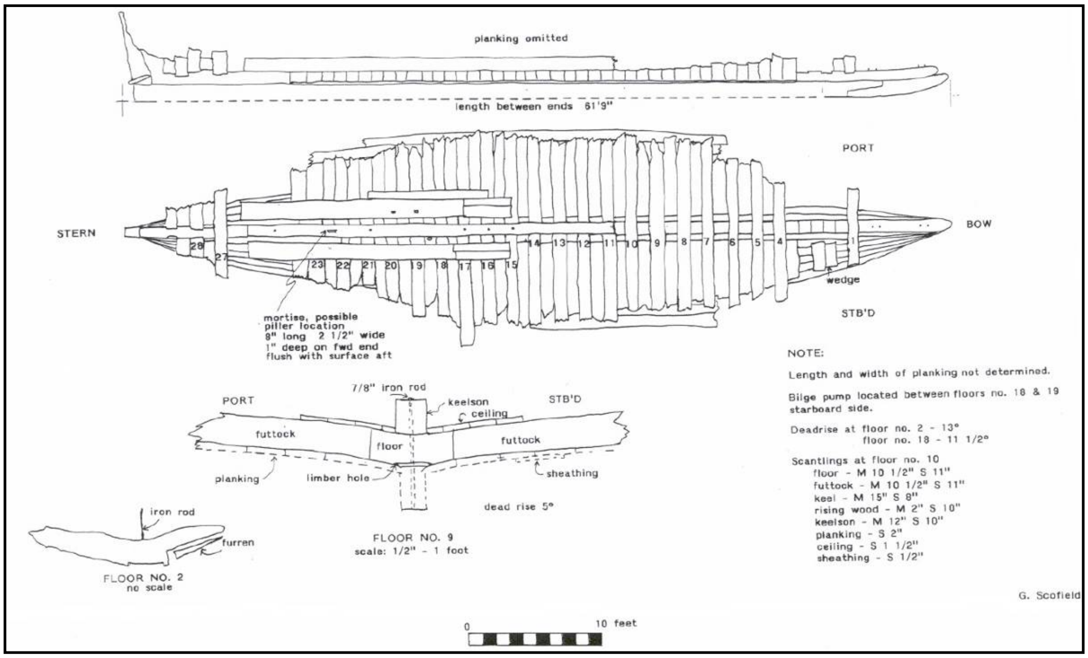

Figure 69. Rose Hill shipwreck site plan. (Wilde-Ramsing 1992:36)

Town Point Vessel (8SR983)

The Florida Bureau of Archaeological Research investigated a shipwrecked sloop in Pensacola Bay in 1991. Extant remains measure just over 35 ft (11 m) in length and 7.5 ft (2.3 m) in beam. Investigators determined the vessel dates to the last quarter of the eighteenth century based upon hull construction and artifact assemblage. Frames are comprised of floors bolted to the keel and first futtocks laterally fastened to the floors either to the forward or aft face depending upon location in the hull (Morris and Franklin 1995:36) (**Figure 70**). First futtocks are placed away from the keel and second futtocks are not attached to the frames, but placed between stations (Morris and Franklin 1995:26,36). Floors and first futtocks are chamfered at their joining ends much like the Nanticoke River Shipwreck. This pattern resembles eighteenth century single frames described above.

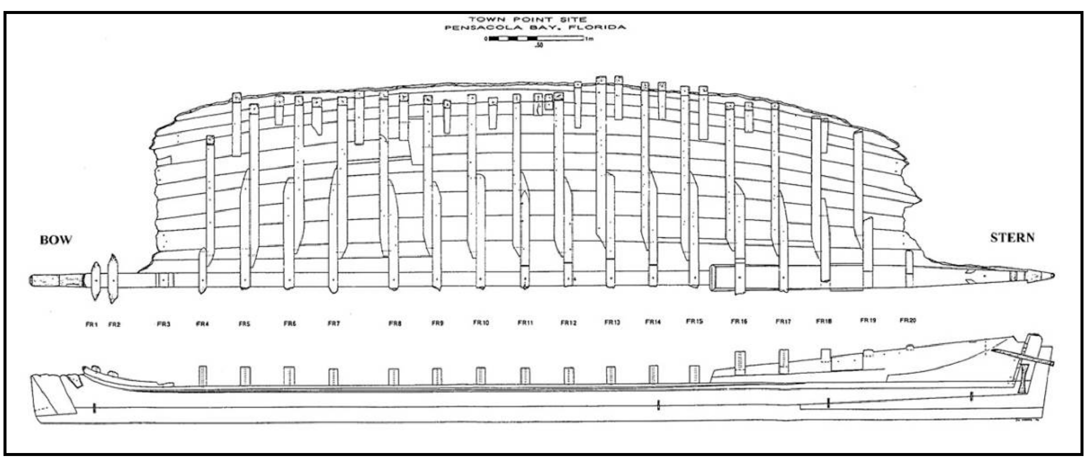

Figure 70. Town Point vessel (8SR983) site plan. (Morris and Franklin 1995:23)

Timber Markings

In the cultural examination of shipwreck timber markings, it is prudent to identify the typology of each marking. The most common form of timber marking is attributed to vessel construction, which can be categorized into two classes: carvings and more complex rase marks (Atkinson 2007). Carvings are comprised of Arabic and Roman numerals and usually one or two letters. Simple line work denotes positioning of timbers and instructions to builders, as well as simple symbols related to various other working processes (DeCaro 2015:45-46). Rase marks were created with a "U" shaped blade that afforded the ability to carve more complex symbols. Rase marks included Roman and Arabic numerals, but new symbols could be created to replace multiple carvings that denote the larger timber numbers and growing instructions. More symbols evolved to replace the growing number of repetitive carvings. In the Portsmouth Historic Royal Dockyard, for example, Wessex Archaeology accomplished a major undertaking in 2013 to identify and catalog more than 800 marked timbers on the eighteenth century ship HMS *Victory*. They determined that markings fit the two typologies—carvings and rase marks—identified by Atkinson.

Archaeologists identified Roman numeral markings on the forward faces of floor timbers found on a James River Bateau shipwreck (late 1760s) excavated in 1983 (Bruce Terrell, pers. comm. 2016; Terrell 1992:160). Roman numerals correspond with counterparts from the opposite end of the vessel. The marked frames were constructed in pairs and when placed at corresponding locations at opposite ends of the vessel, resulted in a nearly symmetrical hull. It is thought that African slaves from Virginia primarily constructed and navigated the James River Bateau, and although there is little comparability for similar graffiti on such vessels, the Roman numerals represent construction cues rather than graffiti scrawled by slaves for apotropaic purposes. Similarly, the eighteenth century transport vessel HMS *Betsy* has a number of Roman numerals inscribed into her ceiling planks. Archaeologists also attribute the *Betsy* markings to construction symbols (Broadwater 1996:76).

A second hypothesis has been postulated that many markings scrawled into American antebellum buildings represent graffiti and apotropaic symbols attributed to African-American slaves (Wright 2015), although there exists a lack of supporting comparative evidence. Binding (2015) has identified ritualistic symbols carved during the seventeenth and eighteenth centuries on a fourteenth century sarcophagus, the most prominent of which are the apotropaic symbols "V," "W," "M," and "X." These symbols may share some stylistic characteristics with timber carvings; however, they maintain a more artistic element and have been haphazardly placed to completely cover that which they are intended to protect. Cosmograms, such as the mandala, have been depicted in West African art as a means to engage with spirits, predict the future, and end injustice (*Washington Times* 2008). Historic timber markings are known to include cosmograms; however, according to Leone (2005:240), they most often are associated with specific locations such as doorsills, hearths, and rooms where a person was nurtured and cared for. The starburst is another symbol sometimes depicted. Archaeological excavation of the War of 1812 vessel *Scorpion* in the Patuxent River, Maryland unearthed a tin-plated grog ration cup belonging to an African-American sailor. The cup is adorned with numerous starbursts scratched into its surface for an unknown purpose (Neyland and Enright 2014:125-126; Shomette 1995:256,259).

The carvings depicted on the Nanticoke River Shipwreck timbers resemble Roman numerals, and based upon the apparent date of construction fit the carving category of construction symbols. Although a lack of context and other comparative timbers prevent a solid interpretation for the symbols, it is a more plausible explanation that the symbols represent construction cues placed by the builders. Assembly and construction marks provide an opportunity to learn about the cultural processes behind shipbuilding. The use of construction or other marks on timber are valuable methods of communication between the designer, builder, and timber procurer/grower (Creasman 2010:154).

Bow Construction

It is difficult to reconstruct the bow with the limited remains (**Figure 71**); however, it appears that cant frame heels butted against the apron in a radial pattern to form the desired curvature. This is reminiscent of archaeological remains of a number of eighteenth and early nineteenth century vessels, such as:

- *Betsy* (44Y088) – 1772
- Jeffersonian gunboats *137* and *138* (18CV414) – 1808
- Malcolm boat (38CH803) – 1775-1825
- Martinak boat (18CA54) – 1794-1813
- *Nancy* – 1789
- Newington Plantation South Vessel – eighteenth century
- Readers Point vessel – eighteenth century
- Rose Hill shipwreck – pre-1750
- Town Point vessel (8SR983) – 1775-1799
- US Navy brig *Eagle* – 1814
- US Navy brig *Jefferson* – 1814

Aprons on these vessels—sans *Betsy* and Newington Plantation South Vessel—are notched timbers to accept at least one and as many as five floors perpendicular to the centerline of the

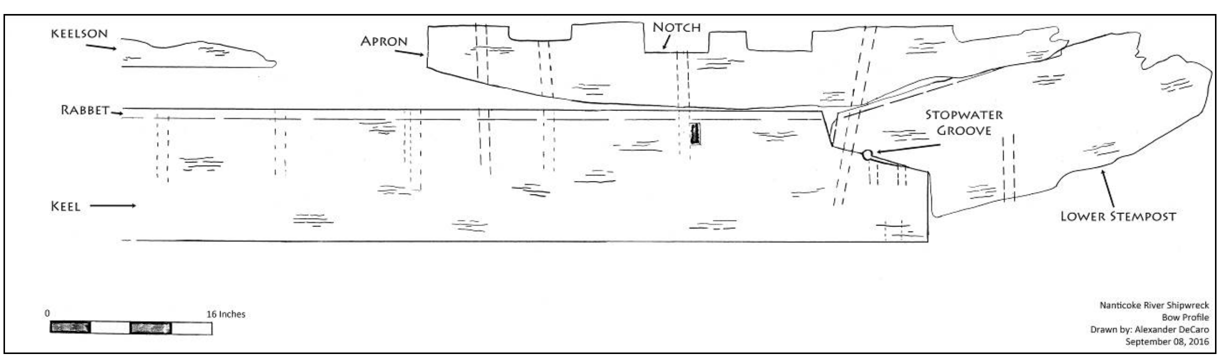

Figure 71. Bow reconstruction.

vessel. The sides of the *Jefferson* and *Nancy* aprons are deeply notched to accept the heels of the cant frames, while the sides of the *Eagle* apron, forward of the three perpendicular frames that rested in its notches, are angled surfaces to fit the heels of two pairs of cant frames (**Figure 72**) (Crisman 2014:172, 333; Sabick 2004:91). The side notches in the *Nancy* apron accept one pair of radial cant frames, while three more pairs simply butt against it (Sabick 2004:99), perhaps similar to the Nanticoke River Shipwreck (**Figure 73**).

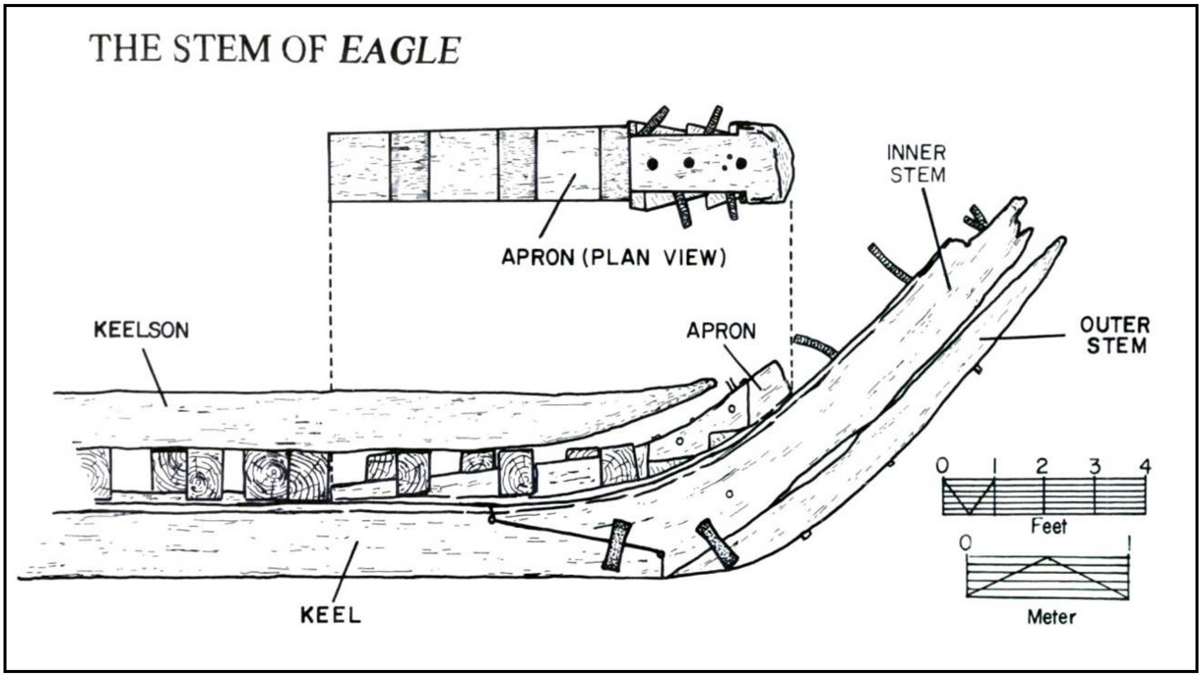

Figure 72. Bow reconstruction of the *Eagle*. (Crisman 2014:325)

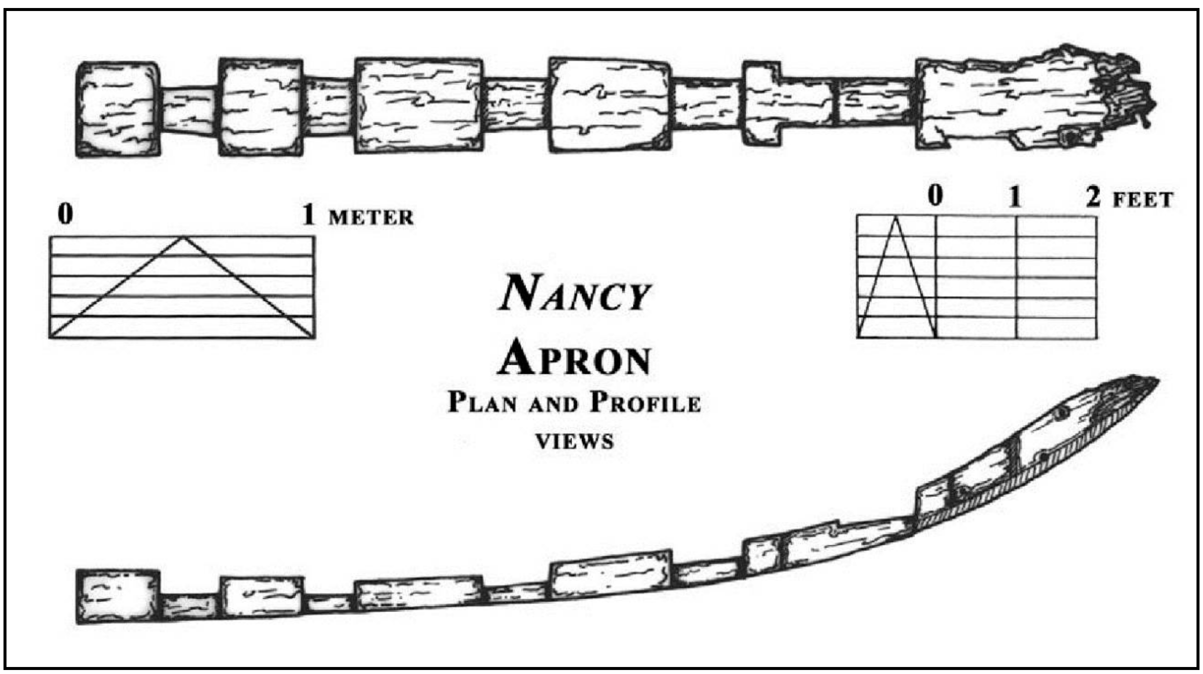

Figure 73. *Nancy* apron. (Sabick 2004:91)

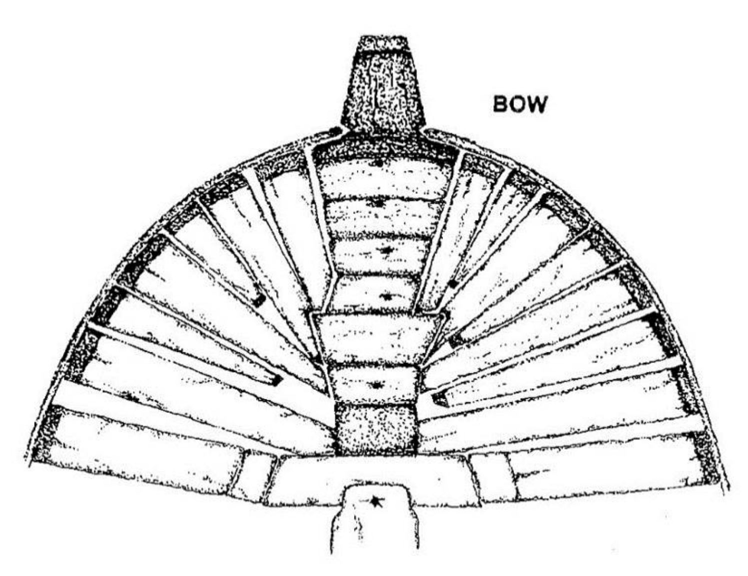

Figure 74. Bow reconstruction of the *Betsy* showing cant frames. (Morris 1991:98)

The heels of the cant frames on the Malcolm boat (38CH803) are thinned to fit against the apron, but are not fastened to the timber (Amer et al. 1993:50). The radial cant frame arrangement of the Nanticoke River Shipwreck might more closely resemble that of the *Betsy*, in which cant frames heels are chamfered to fit between a perpendicular floor and a segmented apron (**Figure 74**) (Morris 1991:98; Morris et al. 1995:9). Similar to this arrangement, the cant frames of the Newington Plantation South Vessel butt to the sides of the apron without notches and are fastened with treenails. The aft cant frame is additionally fayed to the first floor (Watts 2013:40). It is difficult to determine the sharpness of the bow, but it appears it might have been a gradual rake.

Stern Construction

The stern construction of the Nanticoke River Shipwreck includes Y frames with relatively sharp deadrise, deadwood timber with half frames notched into it, and potential cant frames, all of which infer a transom stern (**Figure 75**). There also is the possibility a transom timber exists on the river bottom beneath fender debris. The sternpost is not extant, but it appears that it would have had minimal rake. When comparing stern construction to other vessels, the deadwood timber in particular is similar to the deadwood utilized in several eighteenth and early nineteenth century vessel remains SEARCH researched, including:

- Jeffersonian gunboats *137* and *138* (18CV414) – 1808
- Martinak boat (18CA54) – 1794-1813
- *Nancy* – 1789
- Readers Point vessel – eighteenth century
- Rose Hill shipwreck – pre-1750
- US Navy brig *Eagle* – 1814
- US Navy brig *Jefferson* – 1814

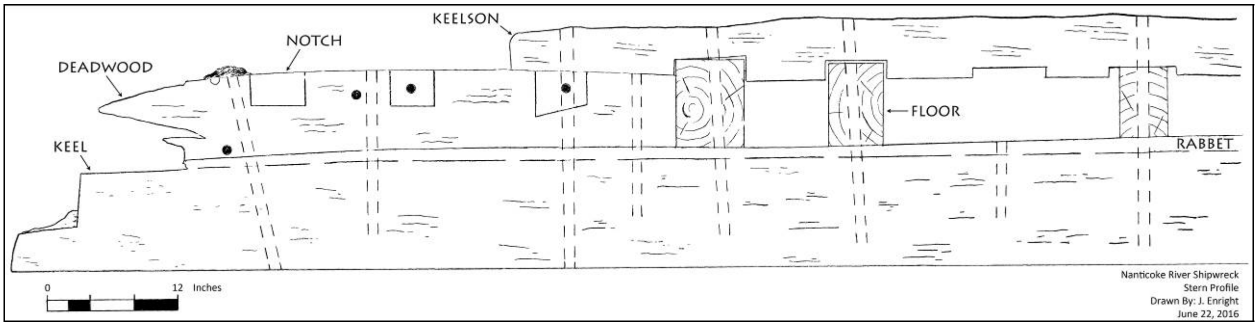

Figure 75. Stern reconstruction.

The deadwood on *Eagle*, the Jeffersonian gunboats, and *Nancy* are all trapezoidal timbers similar to the Nanticoke River Shipwreck. Crisman (1987:141) suggests that "forethought and care" went into the shaping of the *Eagle* lower deadwood in order to create a timber that both tapers toward the sternpost and is trapezoidal in shape. The deadwood timber from both Jeffersonian gunboats possess the same taper and trapezoidal cross-section (Enright 1999a:91; 1999b:9), while the Martinak boat (18CA54) utilized a trapezoidal knee (Thompson 2005:11). The deadwood on *Eagle* (top timbers), *Jefferson* (top timbers), *Nancy* (**Figure 76**), and Rose Hill Shipwreck, as well as the stern knee on the Readers Point Vessel, are all notched in the sides of the timber to accept half frames much like the deadwood from Site 18DO497 (Cook 1997:50; Crisman 2014:172,175,326; Sabick 2004:90; Wilde-Ramsing et al. 1992:37).

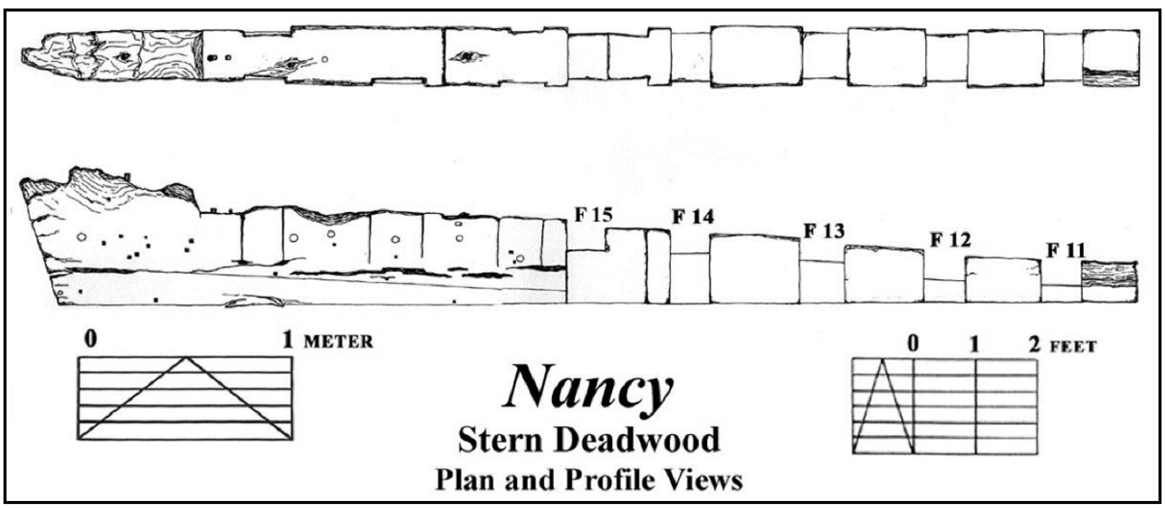

Figure 76. *Nancy* deadwood. (Sabick 2004:91)

ORIGIN

Dendrochronology analysis places the origin of timbers utilized in the Nanticoke River Shipwreck along the coastline of the central or southern Chesapeake Bay, between Annapolis and likely the Potomac River, strongly inferring that the vessel was built in Maryland. Colonial Maryland, starting in the mid-seventeenth century, focused trade almost exclusively on tobacco. Almost every county in Maryland produced the plant for export, which eventually drove the local shipbuilding industry to expand in order to meet shipping demand. Plantation owners required small coastal craft to lighter cargo to larger oceangoing vessels or to transport the plant to larger markets around the Chesapeake. Oftentimes plantation owners also employed larger vessels capable of making coastal Atlantic voyages to other American colonies or to the West Indies and beyond. Locally built vessels exporting product soon replaced English and Scottish merchants trading at plantation wharves. By the mid-eighteenth century, shipbuilding was established as a major industry in the Colony, led by the Eastern Shore (Ford 2007a:126-127).

For much of the eighteenth century the shipbuilding industry grew on the Eastern Shore until it dominated over other regions, accounting for approximately 53 percent of all shipbuilding in the Colony between 1730 and 1750 (Ford 2007b:266; Moser 2011:45). This was due mainly to the relatively poorer soil for tobacco production on the Eastern Shore and the need to diversify with other economic drivers. For the period 1700-1774, a study by Ford (2002; 2007a) documents 19 shipyards in Maryland, including one on the Nanticoke River upstream from Vienna; a number that drops to five for the period 1814-1850, due in part to centralization of the industry and deforestation (Ford 2007b:263-268). This study accounts for permanent or seasonal shipyards that constructed sizeable vessels capable of longer coastal and transoceanic voyages (Ford 2002:69-70). Additionally, individual, rural plantation owners built smaller, unregistered vessels on the shores and wharves of their lands for transportation along the rivers and shores of the Chesapeake Bay (Ford 2002:77). These “backwater” shipyards likely did not employ all the required specialized professionals skilled in the trade, and perhaps relied upon carpenters more familiar with constructing terrestrial structures. “As large plantations strove for self-sufficiency, they incorporated many of the trades that required less skill and capital, generally employing slave or servant artisans to complete them” (Ford 2002:79). The smaller, private shipyards, moreover, likely relied upon the surrounding environment for the bulk of construction materials and did not necessarily possess the capital to purchase machinery and raw material (Ford 2002:86). Lack of a professional shipwright and fewer skilled laborers coupled with limited access to proper material, would result in mistakes and even shoddy construction.

A number of clues exist to suggest the Nanticoke River Shipwreck may not have been professionally constructed, but instead originated on a plantation or rural creek. It has not been determined how the sternpost originally attached to the vessel. Perhaps the post was fastened fore-and-aft to the aft face of a second deadwood timber with additional support in the form of gudgeon straps. The lack of lower fastening, however, certainly weakens the post integrity. Other haphazard techniques recognized on the Nanticoke River Shipwreck include: the failure to completely cut away the sternpost scarf, the ill-formed garboard rabbet on the apron, the floor in the apron notch that was attached to neither the keel nor keelson, and a treenail hole for an apron floor drilled immediately adjacent to a driftpin fastening the apron to the keel (**Figure 77**). Other construction attributes question the materials available to the Nanticoke River Shipwreck shipyard, such as the absence of fishplates attached to the sternpost or the stempost and the reliance upon wood fasteners when attaching heavy timbers that typically require long bolts and drift pins (of the 20 floors attached directly to the keel,

Figure 77. Apron and floor fasteners.

potentially only 40 percent are attached with iron drift pins) draws into question the materials available to the Nanticoke River Shipwreck builder. These choices could imply that either the shipyard did not have access to the requisite iron hardware or lacked the capital to purchase a sufficient supply. Established, professional shipyards certainly had access to iron materials, since a sufficient number of foundries had developed in the Colony by the middle of the eighteenth century to supply local shipbuilders (Ford 2002:82).

Several floors were left unattached to the keelson, which weakens the backbone of the vessel, and it appears that two floors had a second fastener driven through them. In one instance, it appears that a floor was improperly placed, removed and repositioned, and reattached with a new fastener. Another floor appears to have originally been fastened with a driftpin driven so close to the edge of the keel that it was exposed (**Figure 78**). A second driftpin was driven through the floor and closer to the center of the keel. As previously noted, the deep notch cut into floor NR-FL05 could indicate a possible mistake in the shaping and/or installing of this timber, and subsequently, the builder's attempt to install a supplemental timber to compensate.

Figure 78. Exposed drift pin at the edge of the keel.

SEARCH did not identify wedged treenails in the Site 18DO497 remains. The common practice of wedging treenails in wooden hull construction serves the dual purpose of expanding the wood to resist separation and helping caulk the ends (Desmond 1919:60). Shomette notes (1995:227) on the Lyons Creek shipwreck that treenails are not wedged and could signify the "casual workmanship" of a carpenter who was not skilled as a shipwright or boat builder. There are exceptions, such as the Ronson Ship, which did not incorporate wedged treenails (Riess and Smith 2006:809), although the circumstances of this vessel's construction are unknown. Finally, there is a lack of consistency in the fastening pattern of strakes, a number of fasteners that appear driven unnecessarily close to one another, corrected fastener placement (see **Figure 35**), and in some instances an overabundance of fastening that bestows a haphazard method of planking the hull.

Any one of the previous examples could be attributed to an exception to established methods, but taken together, they suggest that the Nanticoke River Shipwreck was not constructed at a professional shipyard overseen by an experienced shipwright. The simpler construction method of whole molding, as well as analyses of fastening hardware, fastener patterns, and attachment mistakes, provides further insight into the possible skills of and materials available to the builders. There exists, therefore, the likelihood that the vessel was constructed at a small, inexperienced private shipyard—perhaps on a plantation—that lacked the experience, knowledge, skilled labor, and materials to properly construct a wooden sailing vessel. Construction workers at such a lay "shipyard" may have included enslaved African-American workers. Frederick Douglass notes that slaves were known to work in Maryland shipyards as apprentices and carpenters alongside freed black men and white laborers. Slaves contributed in multiple tasks and chores, especially calking, for which Douglass became accomplished enough to "command the highest wages given to the most experienced calkers" and secure his own employment and contracts (Douglass 1845:85-89).

DATING

Few associated artifacts that are datable were recovered from Site 18DO497; therefore, dating must rely heavily upon construction methods and materials. Morris et al. (1995:2-5) determined the general eighteenth century framing pattern evolved from tight spacing, a relatively large offset between the centerline of the vessel and the heel of the first futtock, and a sided dimension of frames that exceeds the molded. Deane's 1670 Doctrine on Naval Architecture states that late seventeenth century vessels were constructed with equal room and space, much like the Rose Hill Wreck. This practice evolved during the eighteenth century to increase space between frames to allow better airflow to the lower bilge area, but the practice of separating the first futtock heels short of the keelson continued (Wilde-Ramsing et al. 1992:47). As the eighteenth century progressed, framing transitioned into double frames with components fayed close together, an increased space between frames, the use of chock scarfs to attach the floors and second futtocks, the heels of the first futtocks moving closer and eventually butting atop the keel, and an increase in the molded dimension in relation to the sided. There are exceptions of course – for instance, coastal, shallow draft vessels maintained a larger sided dimension due to frequent grounding – but this pattern was standardized by the nineteenth century. The framing pattern of the Nanticoke River Shipwreck shares characteristic with early eighteenth century framing in that it likely was single framed with a relatively large gap between the centerline and first futtocks (approximately 10 in [25 cm]), and floors and second futtocks that were spaced apart; minimal space between frames at approximately 4 in (10 cm); and an average sided dimension of frames (9 in [23 cm]) greater than an average molded dimension (8 in [20 cm]).

The bow and stern of the Nanticoke River Shipwreck resemble construction patterns of the eighteenth century. The use of an apron as the foundation for the heels of cant frames arranged in a radial pattern developed during the eighteenth century. By the nineteenth century, cant frames were in contact with the centerline of the vessel, with some exceptions (Morris et al. 1995:5-7). Aprons are replaced by traditional deadwood sometime during the nineteenth century to provide sufficient wood depth for the cant frames, which are similarly notched into the deadwood. The difference, however, is that perpendicular floors would stop aft of the deadwood, as opposed to sitting atop the timber within apron notches (Desmond 1919:50, 54). The apron becomes a vertical timber that is a continuation of the forward deadwood (Desmond 1919:49).

SEARCH compared the Site 18DO497 remains with other vessel construction patterns to provide additional circumstantial evidence for dating the shipwreck. It has been shown that the framing pattern and bow and stern designs resemble characteristics found in eighteenth and early nineteenth century vessel construction. The framing pattern in particular infers an eighteenth century construction date as it appears to be single framing, or at the latest an early form of double framing. Shipwrights no longer employed this framing pattern by the turn of the century. The practice of attaching select floors to both the keel and keelson is another eighteenth century construction technique. By the nineteenth century it became common practice for shipwrights to attach every floor. The Clydesdale Plantation Sloop (1780-1820), for instance, bolted the keelson only to every third or fourth frame (Amer and Hocker 1995:299), while the Otter Creek Shipwreck was dated pre-1800 partly because only every other floor was bolted to the keelson (Jackson 1991:139-140). Although not definitive, Site 18DO497 remains suggest whole molding was utilized for construction. Chapelle states (1951:11) that this technique was particularly utilized to construct small boats primarily during the seventeenth and eighteenth centuries.

Tool marks evident on timbers infer a construction date that falls in line with early nineteenth century or earlier. Limber holes in floors appear to have been created utilizing a chisel, while evidence of adze and axe was observed. It is evident that strakes were created utilizing a pit saw and SEARCH identified no circular saw marks on the remains. Thompson (2005:18) determined that circular saws first appeared in American sawmills in 1813, but it is not certain how quickly they were adopted. Shomette states that the pit saw was all but extinct by 1840 (Shomette 1995:227). The iron-bound chain deadeyes are typical of those utilized during the eighteenth century, particularly on English ships (**Figure 79**) (Marquardt 2003:253). They also resemble deadeyes utilized on the French merchant vessel *Le Machault* (pre-1760) that were excavated at Chaleur Bay, Quebec (Bradley 1981:51) (**Figure 80**).

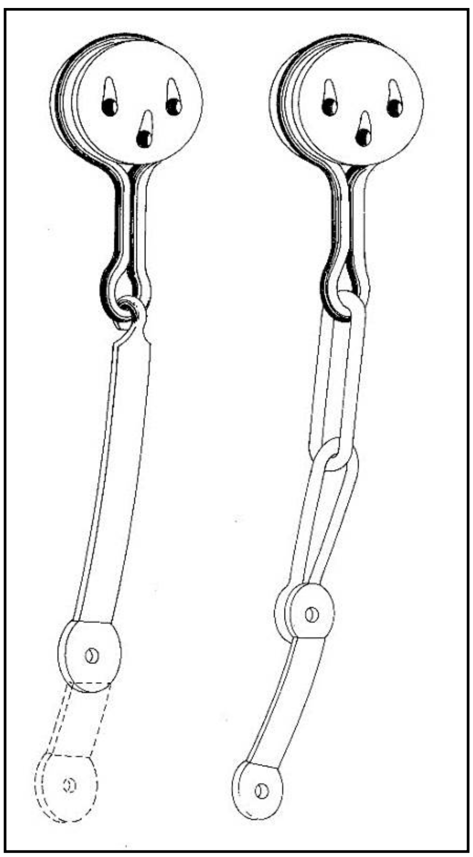

Figure 79. Iron-bound chain deadeyes typical of the eighteenth century. (Marquardt 2003:253)

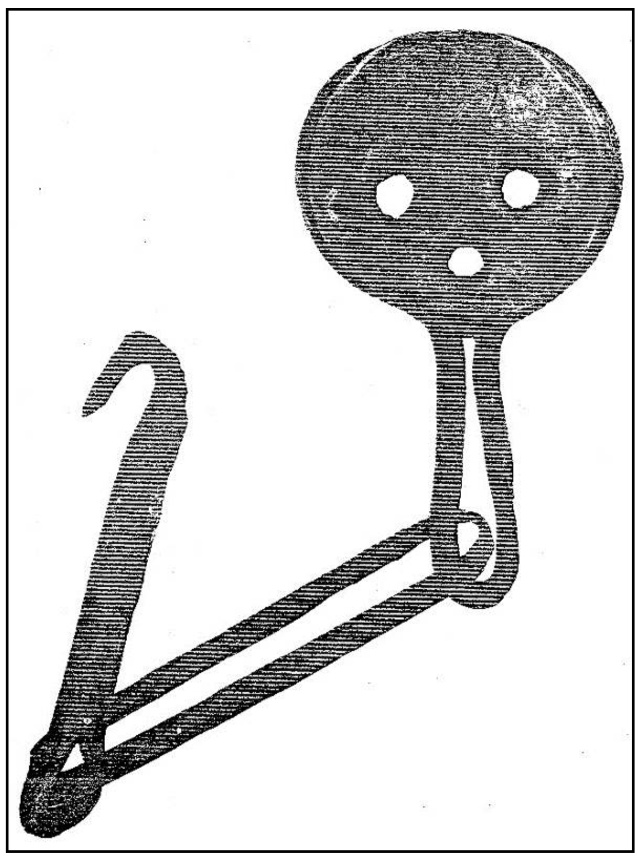

Figure 80. Lower deadeye recovered from *Le Machault* (pre-1760). (Bradley 1981:55)

Fasteners observed on the Nanticoke River Shipwreck are all hand formed. Treenails are multifaceted dowels that were cut with a hand tool, such as a spokeshave, rather than turned on a lathe. Iron drift pins and nails are not machine cut, but crude, hand forged fasteners. Forged nails were made on a limited basis well into the nineteenth century, but were less common as cut nail technology improved (Wells 1998:83). Wells states (1998:83) that forged nails are not especially useful for dating, and their presence can only suggest early nineteenth century or earlier. The Nanticoke River Shipwreck nail analyzed above, however, seems to fit in the Wells category Type 2 (Wells 1998:92). Type 2 nails are hand-forged from iron whose grain runs parallel with the shaft, have hand-formed heads, can be tapered on two sides or four, and have a rectangular to square cross-section. This nail type dates between 1769 and 1820. It should be noted that Wells' nail chronology is derived from samples collected in Louisiana, but he believes it can be utilized to establish accurate chronologies in other regions. In addition, no machine-made cut nails were identified amongst the Nanticoke River Shipwreck remains, suggesting that any repairs or alterations to the vessel over its lifespan occurred prior to this technology. A machine that could cut and head a nail in one operation was patented in 1798, which soon led to a rapid decline in hand-forged nails in most industries, except shipbuilding (McCarthy 2005:89). Early machine-made nails cut blanks crosswise with the grain, which created an unusable nail for ship fastening because it could not be clenched. It was not until after 1820 that water-powered machines facilitated larger nail blanks that could produce grain-in-line cuts and a clenchable nail (McCarthy 2005:89-90).

The use of copper for ship fasteners dates to antiquity; however, iron remained the standard until the last quarter of the eighteenth century when the Royal Navy experimented in 1762 with copper sheathing on HMS *Alarm*. Copper sheathing directly drove the improvement of copper alloys for ship fasteners and soon its resistance to corrosion and biotic growth inhibiting properties proved it a viable marine metal that rapidly replaced iron below the waterline of vessels. Shipbuilding references by the mid-nineteenth century note that although vessels are not copper fastened unnecessarily due to cost, copper is utilized at least in the fasteners below the waterline (McCarthy 2005:110). It is not surprising that SEARCH found no evidence of copper sheathing on the Nanticoke River Shipwreck. An owner of a shallow draft vessel operating in northern waters likely would not incorporate the expense of copper sheathing into a vessel subject to frequent grounding. Thompson (2005:15) recorded copper alloy drift pins, square-shank spikes, and fishplates on the Martinak boat (18CA54). Even this small Maryland vernacular craft likely dating between 1794-1813 utilized extensive copper in its fastening. Alternately, the Lyons Creek shipwreck, another archaeological example of a vessel in Maryland waters, lacks any evidence of copper alloy fasteners among its remains. This is because the period of deposition for this vessel likely ranges between 1680 and 1750 (Neyland 1990:196). The lack of any copper alloy fasteners on the Nanticoke River Shipwreck to attach strakes below the waterline and the exclusive reliance upon treenails and iron fasteners infers an early nineteenth century, and more likely mid- to late eighteenth century date of construction.

Many of the components from the Nanticoke River Shipwreck consist of naturally curving timbers with limited alteration. Dendrochronology analysis determined the Nanticoke River Shipwreck wood was felled no earlier than 1743 and identifies the region from where it originated as either shore of Chesapeake Bay, likely between the Potomac River and Annapolis (**Appendix E**). The availability of extensive compass timber from this region intimates a date for construction sometime during the second half of the eighteenth century. Deforestation of Maryland due to the shipbuilding industry began in the middle to late eighteenth century and became serious enough by 1760, particularly on the Eastern Shore, that shipbuilders were forced to import sufficient timber from other colonies (Ford 2002:71). Shipbuilding in Talbot county on the Eastern Shore of Maryland, for instance, disappeared by 1820 due to deforestation (Ford 2007b:268). Trees utilized for timber to construct the Nanticoke River Shipwreck likely were felled during the eighteenth century, while the availability still existed, and then left unattended for a time in order to season. It is feasible that seasoning was not lengthy, however, as American shipwrights tended to utilize wood sooner than English shipwrights, and that construction occurred prior to the turn of the century. Carpenters constructing terrestrial structures, for instance, prefer green or unseasoned timber, usually commencing within 12 to 18 months of felling and rarely waiting beyond two years (Miles 1997). This seems even more likely when considering the shipbuilding recessions during the first quarter of the nineteenth century. Cessation of trade with France and Great Britain, the War of 1812, and a nationwide depression severely depressed shipbuilding in the State of Maryland through the 1820s. Ford states (2002:84-85), “the St. Michael’s area of Talbot County, that had up to this point been a major shipbuilding center, all but ceased production and did not resume until the 1840s.”

Dendrochronology has provided a *terminus post quem* for the Nanticoke River Shipwreck; however, evidence, which typically takes the form of artifacts, is not extant that can produce a definitive *terminus ante quem*. SEARCH, therefore, is left with interpreting construction patterns and materials to infer a reasonable date range that matches all available circumstantial evidence. SEARCH maritime archaeologists examined the remains and conducted comparative analysis with other archaeological shipwreck sites and determined that the Nanticoke River Shipwreck predates circa 1820 and most likely predates 1800. Dendrochronology analysis cannot provide a decisive *terminus ante quem* for the felling of the trees utilized in the Nanticoke River Shipwreck construction, but it does suggest the second half of the eighteenth century, supporting the analyses presented above.

VESSEL USE

Reconstructing a disarticulated shipwreck from timbers no longer *in situ* is fraught with a number of challenges, not the least of which is determining the original size of the vessel. The remains of the Nanticoke River Shipwreck do not incorporate enough intact components to allot an estimation of original size. An entire frame from amidships is required to determine a maximum beam and depth-of-hold, and SEARCH cannot confirm among the remains at this time if these timbers exist and exactly which timbers assimilate into which frames. Moreover, it has not been determined what size gap existed between any particular floor and second futtock, which would have to be incorporated into any equation designed to determine frame sizes. Based upon the reconstruction of floor NR-FL04 and futtock NR-FK01, however, a rough estimate for the beam probably was approximately 10-12 ft (3-3.7 m). Depth-of-hold approximation is more problematic to determine, but judging by the curvature of second futtock NR-FK05, it could have been approximately 6 ft (1.8 m). This should be considered quite tentative since the identity of NR-FK05 is conjectural and its original location within the vessel is unknown. This of course leads to the most speculative measurement – length. Too many questions remain to accurately determine this measurement, such as sternpost rake, upper stempost rake, and definitive depth-of-hold measurement, but an educated guess based upon keel length, lower stempost rake, and tentative depth-of-hold could yield a length between perpendiculars of approximately 40-45 ft (12-14 m). Gross tonnage cannot be estimated, but builders' tonnage could have been 18-26 tons, placing the Nanticoke River shipwreck in the lighter or coastal trading category.

She appears to have had a rather bluff bow, given the long, slow rake of the lower stempost; a transom stern, based upon the available evidence; a shallow-draft hull judging by the limited deadrise in floors and first futtocks; and ample cargo space for her size based upon the approximated depth-of-hold. It does not appear as if the vessel was decked, since no evidence of knees was found in the remains and the keelson does not contain notches for deck stanchions. Initially the vessel seems to have been fitted with a single mast; however, due to the break in the keelson it is not possible to determine if it originally was rigged with a second, smaller foremast. This is a plausible hypothesis given that the extant mast step is located at approximately the midpoint on the keel. There is approximately 12 ft (3.7 m) between the center of the mainmast step and the upturning stem within which to place a foremast. Different sized deadeyes on a vessel whose rigging only included lower mast shrouds, moreover, intimate two masts. If she had a single mast, with little if any rake, the Nanticoke River Shipwreck might resemble a cutter-rigged sloop (**Figure 81**), or more akin to a colonial shallop if rigged with two masts (**Figure 82**). Baker (1966:20) notes that considering their use for transporting casks of tobacco, it is probable that most colonial shallops were open vessels, with perhaps only small cuddies to shelter the crew (i.e., no deck). There is not sufficient evidence to precisely establish the sailing rig, as a number of variations existed during this time period.

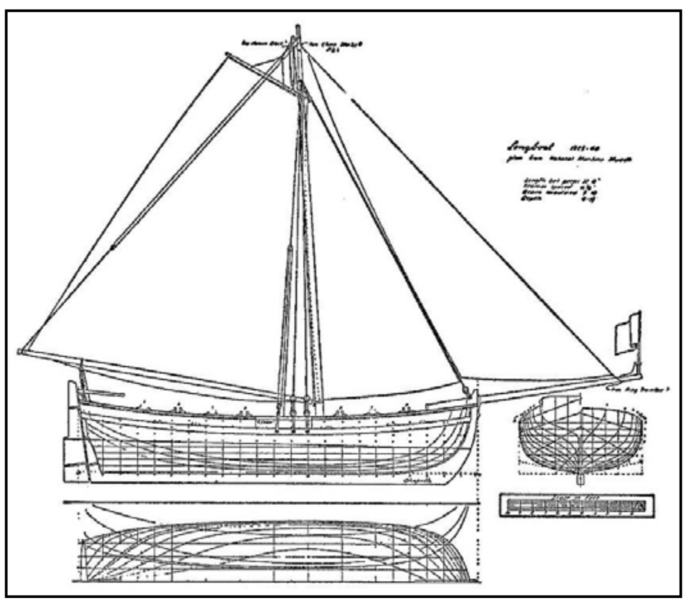

Figure 81. Example of colonial cutter-rigged sloop. (Chapelle 1951:19)

It is not possible to determine whether she was originally constructed for military or commercial purposes, but some circumstantial evidence does exist to help infer a function. Bradley notes (1981:51) that deadeyes that incorporate the upper chain link into the same piece of iron as the binding strap "is generally regarded as a merchant method as opposed to a naval method of setting up the chains, where the upper link would have been a separate entity." The shoddy construction techniques also do not imply a professional shipwright, who certainly would have been employed to construct a military vessel. Even if the shipwright cut corners to complete a vessel under time constraints during a conflict, certainly the necessary skills and materials would have been made available. There are of course exceptions, but this is one viable line of evidence that supports a merchant ship.

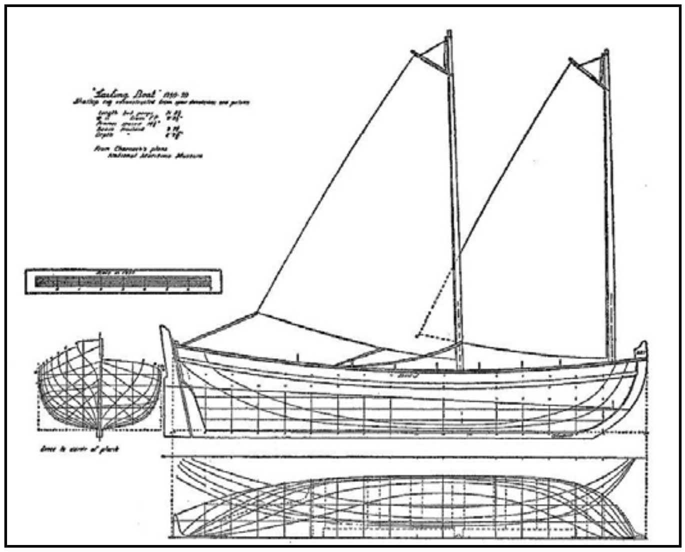

Figure 82. Example of colonial two-masted shallop. (Chapelle 1951:21)

The waters within which the Nanticoke River Shipwreck operated can be deduced from various lines of circumstantial evidence. The substantial rounded keel might be an attempt to lessen the impact of frequent grounding, but the size of the keel also is a strong indicator that this vessel operated in waters outside of a riverine environment. A keel as deep as that on the Nanticoke River Shipwreck – a relatively small, flat-bottomed vessel – implies a keel utilized to improve lateral resistance when sailing in open water with a powerful rig. There also exists evidence that she did not venture too far from the protected waters of Chesapeake Bay. It was standard practice on ocean-going ships to have a stern knee joining the top of deadwood to the sternpost (Crisman 2014:172). The lack of a stern knee, or evidence supporting its existence, is support that the Nanticoke River Shipwreck was not constructed for ocean-going voyages. The tight frame spacing would have increased strength for open water sailing, but the heavy reliance upon treenails for floor attachment likely would have been a weakness for Atlantic travel. The absence of a deck for protection of cargo and crew also is a strong clue that she did not venture far from her home port. Babits (2011:20) states that smaller sloops of the colonial era were open decked and worked in protected waters. Finally, SEARCH did not identify sacrificial planking or evidence of extensive *teredo navalis* damage on the strakes that would indicate she traveled to southern waters.

The Nanticoke River Shipwreck was likely designed and constructed to operate within the relatively protected waters of the Chesapeake Bay, and along the shallow margins where frequent grounding would occur. Her bluff bow, transom stern, and lack of deck would maximize cargo carrying capacity. She likely was a merchant vessel constructed at a small plantation or private yard for the transportation of small loads of cargo – such as tobacco, grain, and flour – on short voyages from farm to market elsewhere in the Chesapeake Bay. Local shipwrights were constructing small sloops by the 1660s predominantly for the transportation of tobacco in the coastal and Caribbean trade, which peaked between 1730 and 1750 when half the registered vessel tonnage in Maryland consisted of sloops averaging 41 tons

(Moser 2011:40,47). The schooner began replacing the sloop early in the eighteenth century. By the turn of the century, few sloops were built in the Chesapeake region. During the period 1780-1820, schooners were the most commonly built vessel on the lower Eastern Shore (Moser 2011:59). Smaller vessels, however, such as the Nanticoke River Shipwreck, did not require registration, so the numbers are skewed towards larger vessels.

The final resting place of this vessel could indicate it operated for a plantation along the Nanticoke River, but it also could have been at Vienna for transferal of cargo to warehouse, as the port was a shipping point for timber and tobacco during the late eighteenth century, or for inspection purposes after the Customs Collector was moved to the port in 1768. There is evidence of burning; however, the reason for its sinking may never be known. Hypotheses certainly could include scuttling; accidental fire; or destruction during conflict, perhaps at the hands of Tory invaders during the American Revolutionary War. Perhaps it was a vessel under construction at the Vienna shipyard that was abandoned. This seems unlikely, however, because given the documented repairs – strake patch mentioned above and multiple refastening of strakes (**Figure 83**) – it appears she was in service prior to her demise. SEARCH cannot attach historic significance to the events surrounding the construction, career, or destruction of the Nanticoke River Shipwreck.

Figure 83. Example of refastening (center of photo).

NATIONAL REGISTER OF HISTORIC PLACES ELIGIBILITY DISCUSSION

Site 18DO497 falls into the National Park Service (NPS) defined vessel category of "shipwreck." The NPS (1992:3) defines shipwreck as "a submerged or buried vessel that has foundered, stranded, or wrecked. This includes vessels that exist as intact or scattered components on or in the seabed, lakebed, riverbed, mud flats, beaches, or other shorelines, excepting hulks." Three key concepts help determine if a shipwreck qualifies for listing in the NRHP, according to National Register Bulletin 15 (NPS 1990) and National Register Bulletin 20 (NPS 1992): historic significance, historic context, and historic integrity.

"The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association" (NPS 1990:2). The significance of any shipwreck is based on a "representation of vessel type and association with significant themes in American history and comparison with similar vessels" (NPS 1992:4). To be considered for inclusion in the NRHP, a shipwreck must meet one or more of the four National Register significance criteria:

A. be associated with events that have made a significant contribution to the broad 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 represent the work of a master, or possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; or
D. have yielded, or be likely to yield, information important in prehistory or history (NPS 1990:5–6).

Historic context is defined as "information about historic trends and properties grouped by an important theme in the prehistory or history of a community, state, or the nation during a particular period of time" (NPS 1977:4). Historic context provides the link between the shipwreck and unique, representative, and/or pivotal historic trends. Historic integrity is defined as "the authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property's prehistoric or historic period" (NPS 1977:4). A shipwreck must exist "in sufficient form to address architectural, technological, and other concerns [and generate data] that will permit the development of anthropological inferences and/or the formulation of testable research questions" (NPS 1992:17).

The age, origin, function, and identity of the Nanticoke River Shipwreck may never be known with certainty; however, circumstantial evidence exists to provide strong inference to answer these questions. Remains appear to be that of a shallow-draft vessel originally about 40-45 ft (12-14 m) long. She was undecked and probably constructed with a transom stern, which combined made for ample cargo space. The existence of a single mast step in the keelson would normally allude to sloop rigged, but a second mast should be considered based upon closer examination of particular clues. She may have resembled a cutter-rigged sloop, with either Bermuda or gaff mainsail, or a two-masted shallop of any number of square, fore-and-aft (schooner), or hybrid rigs. Construction patterns and dendrochronology indicate a vessel built during the mid- to late eighteenth century along the shores of the central Chesapeake Bay. Construction techniques do not suggest a professional shipwright constructed her at an established shipyard, but perhaps she was launched at a small, private yard associated with a plantation.

Research was unable to identify the vessel, and therefore the circumstances of her career and demise remain a mystery. She was probably utilized to transport small loads of cargo–likely tobacco, grain, and flour–from a small plantation to market somewhere on the shores of Chesapeake Bay, perhaps at Vienna on the Nanticoke River where her remains were found. No clear evidence exists to suggest a cause for her sinking, but it appears fire was involved. Historic documents mention Tory picaroon forces that invaded the Nanticoke River and destroyed a number of vessels at Vienna during three separate raids in 1780 and 1781. It is plausible the Nanticoke River Shipwreck is related to this event, and it is the only event that SEARCH has uncovered that fits the time period and circumstances of destruction. SEARCH cannot unequivocally link the Nanticoke River Shipwreck to a particular significant person or event; therefore the site does not qualify for listing in the NRHP under either Criteria A or B.

SEARCH does believe Site 18DO497 is eligible for listing in the NRHP under both Criteria C and D. The vessel remains represent an important and rare example of Maryland ship construction in its infancy that eventually evolved into the uniquely Maryland pilot boat schooner, pungy schooner, and Baltimore clipper. English and French vessels accomplished the trade and transport during the early history of the Colony. Tobacco was the driving factor in the construction of small riverine vessels until circumstances in the mid-seventeenth century shifted focus to local shipbuilding with local materials. Colonial farmers, merchants, and entrepreneurs found it necessary to own their own vessels, and at the start of the eighteenth century began funding construction. By mid-century Maryland had established a strong, internal shipbuilding industry. The Eastern Shore in particular was at the forefront of the shipbuilding boom, as it was forced to supplement its less than ideal tobacco-growing soils with maritime-related industry. Less tobacco also meant fewer imports, and as a consequence the Eastern Shore relied upon coastal trade closer to home, which meant smaller vessels better suited to brown water conditions (Ford 2002:76-82).

What became known as the Baltimore clipper evolved from the eighteenth century Chesapeake Bay pilot and cargo carrying schooners. Pilot schooners first developed from small craft designed to take advantage of the confined waters of the Bay to larger, ocean-going vessels better suited to the West Indies trade. Agriculture and economic diversification around the 1730s increased commerce in Chesapeake Bay as farmers added grain and flour production to tobacco, which influenced the evolution of the schooner in order to increase speed and deliver the new perishable commodities more swiftly to the West Indies (Footner 1998:10-11).

Military conflicts in the period served as additional impetus for swifter, maneuverable craft to avoid pirates and privateers. Footner (1998:9) infers that the design began with the Maryland backwater shipwrights. Chesapeake Bay is schooner water with its shifting and variable winds, restricted riverine channels, and tidal estuaries. The pilot schooner offered increased maneuverability and ease of sail handling in the Bay environment for smaller crews over the more unmanageable large mainsails of sloops, which required much effort and concentration from crews (Footner 1998:10). Eventually the fuller cargo carrying schooners progressed into sharper vessels for the West Indies trade with more deadrise that sacrificed cargo capacity. The Chesapeake Bay pilot schooner was fully formed by 1750, but by the turn of the century it had evolved into larger offshore schooners that then developed separately from Bay shooners. The Bay pilot schooners continued to carry cargo within the limits of Chesapeake Bay, however, and survived in some form throughout the nineteenth century – the pungy, for example, became a variation but can still be considered the same vessel type (Footner 1998:12,14,33).

Prior to about 1730, internal transport and commerce occurred onboard open shallops and pinnaces or small sloops, mainly carrying tobacco and supplies from plantation to plantation. Early Maryland merchants, mariners, and shipwrights experimented throughout the eighteenth century with new ideas and designs in a constantly evolving vessel type. The wide beam; short, full bows; short masts; and open decks of their predecessors changed to sleeker cargo carrying schooners with decks and sharply raking masts. Footner (1998:17) suggests that certainly Maryland shipwrights must have incorporated characteristics of the shallop, pinnace, and sloop into the first Bay pilot schooners. Footner (1998) discovered scant information to describe the early Bay cargo schooner; there exists no pictures or descriptions of these small craft. The first written description Footner uncovered is a “for sale” notice for a vessel in 1776 and the first recognizable image dates to the American Revolutionary War; Chesapeake Bay shipbuilding records are non-existent for the period 1776-1783. Baker (1966:20) also mentions that information is scattered concerning details of many colonial shallops of Maryland.

The Nanticoke River Shipwreck dates to an era of decline in Maryland shipbuilding and shipyards, particularly the Eastern Shore. Small shipyards declined later in the eighteenth century as the industry centralized into fewer yards. The ecological disaster of deforestation further sped the decline until it disappeared from the Eastern Shore in the nineteenth century. Plantation-based small boat construction persisted for a time, but “gone were the smaller dispersed shipyards of the colonial period; they had been replaced by corporate ‘iron works’ such as Baltimore’s Columbia Iron Works” (Ford 2002:86). Earlier in the century many of the predecessors to the Chesapeake Bay pilot schooner launched into Maryland’s merchant marine fleet were small plantation craft (Footner 1998:12). Evidence suggests that the Nanticoke River Shipwreck was constructed on a plantation or small yard utilizing Maryland resources before deforestation forced importation of timber from other colonies, and likely represents an antecedent, perhaps even a prototype to the Chesapeake Bay pilot schooner. There may be similarities between the Nanticoke River Shipwreck and the cargo carrying pilot schooner, including the shallow-draft hull, ample cargo space, and the sailing rig with a potential foremast located well forward in the hull. It is dissimilar in that it has minimal rake in the sternpost, only slight deadrise amidships, no deck, and does not possess the most distinguishable feature of the pilot schooner – sharply raking masts. The latter is interesting to note as Footner (1998:40) states that early cargo carrying schooners employed masts that did not rake. The Nanticoke River Shipwreck could be the remains of a descendent of the Chesapeake Bay pilot schooner; a design in its infancy built during an experimental period in Maryland shipbuilding history.

While researching archaeological examples of eighteenth century ship construction, it became obvious that representative examples from Maryland waters are scarce. There are the partial remains of the Lyons Creek shipwreck dredged from the river, much of which may still lie beneath a spoil pile, but there is some conjecture to its origin, which is likely European (Neyland 1990:194-198). The early nineteenth century vessels associated with Joshua Barney's War of 1812 Chesapeake Flotilla exist buried in the Patuxent River and its tributary St. Leonard's Creek, two of which were constructed at Baltimore (Neyland and Enright 2014:129). These vessels date to a later period and were constructed at large shipyards from designs originating from the US Navy, and therefore not purely part of the Maryland shipbuilding tradition. The Martinak Boat is an example of late eighteenth or earlier nineteenth century small boat construction. Additional archaeological investigation and research could determine whether or not she was constructed locally from local materials. This vessel unfortunately has been exposed to the elements for 50 years and suffered at the hands of vandals. What makes the Nanticoke River Shipwreck unique is that it may be an earlier stage in the evolution of the Chesapeake Bay pilot schooner; preserving characteristics later incorporated into the design of these significant Maryland vessels. The origin of materials utilized in the construction, moreover, can be acknowledged as Maryland. It also can be strongly inferred that she was constructed in Maryland by plantation builders who were not necessarily skilled in the trade.

SEARCH did not have the opportunity to assess Site 18DO497 prior to its removal from the river bottom, so it is not possible to determine what the initial, direct impact from the bridge and dolphin/fender system construction may have been. It also is difficult to determine what impact the site may have incurred as a result of the vessel collision with the dolphin/fender. The initial archaeological site integrity prior to its removal, therefore, remains unknown. It is clear that the debris cleanup following the collision has decimated the remains of the site and removed all but a few timbers, disarticulating them from the shipwreck.

The initial sinking event is unknown at this time, but it is possible fire was involved. SEARCH posits that part of the site formation involved the indirect impact of current scouring around the bridge pier. The vessel likely sunk into the relatively soft mud of the river, which protected the lower portion of the hull. It is possible that the lower hull sat protected beneath the sediment level until the bridge pier unearthed any remains during construction and subsequent scouring from the strong eddy, which inadvertently exposed the shipwreck to removal as debris and a potential navigation hazard. The components that have been recovered have survived immersion well and are in relatively sound condition, owing in part to the oak material utilized in construction and its burial in anaerobic mud (until recently). Reconstruction of the components housed at the MAC Lab is achievable, and could conceivably restore the structural integrity of the remains.

Because site remains have been removed from their original context, the National Register would no longer consider the Nanticoke River Shipwreck an archaeological site. The disarticulated remains, moreover, would preclude it from being considered a structure, which is reserved for "mostly intact hulls" (National Park Service 1985:14). The structural integrity of the timbers and the potential to digitally reconstruct the extant remains may override the removal from its original archaeological context. "Shipwreck integrity [after all] is not limited to the survival of intact hulls. Integrity may also extend to a structure that exists in sufficient form to address architectural, technological, and other concerns" (National Park Service 1985:17), which the Nanticoke River Shipwreck preserves, even in its present form.

Although it is less than ideal that the remains were removed from their original archaeological context, there exists an opportunity to properly conserve, reconstruct, and preserve an important component of colonial shipbuilding in America. The Nanticoke River Shipwreck is the only archaeological example from this era in which its origin and direct link to Maryland's shipbuilding tradition can be strongly inferred. This is a unique opportunity to learn from an example of backwater Chesapeake Bay construction that played a short-lived, yet vital role in the evolution of Maryland and American shipbuilding. This evolution resulted in the Chesapeake Bay pilot schooner and eventually the famed Baltimore clipper. Integrity of the remains, as well as the site's research potential, can be preserved, which will develop additional anthropological inferences and testable research questions. This is a rare chance to seize an opportunity presented by an unfortunate event and study an important historic vessel, which otherwise would have remained out of site beneath 30 ft (9.1 m) of black water.

A strong argument has been made that the Nanticoke River Shipwreck form and method of construction are significant to the colonial shipbuilding tradition, and possess distinctive characteristics of a transitional period in Maryland shipbuilding history (Criterion C) (**Table 4**). Representative examples of early American ship construction techniques, particularly those of Maryland's eastern shore, are relatively rare. This shipwreck will contribute data important to the understanding of vessel use, operation, method of construction, and material utilized (Criterion D) (see **Table 4**). The compromised integrity, however, may preclude the Nanticoke River Shipwreck from eligibility. The fragmentary nature of the surviving remains does not preserve the form and function of the vessel and complicates a defensible evaluation of Site 18DO497.

Table 4. National Register of Historic Places Eligibility Criteria.

NRHP Criterion	Site 18DO497 Eligible	Reason
A	No	Cannot establish historic events related to career
B	No	Cannot associate with significant person(s)
C	Yes	Design represents early stage in the evolution of Maryland shipbuilding
D	Yes	Will yield important information concerning Maryland shipbuilding

MHT concluded that Site 18DO497 may have been eligible for the NRHP prior to construction. However, because the integrity of the resource was unintentionally compromised during bridge construction activities, "the majority, if not all of the site, has been destroyed, thus negating the ability to make a conclusive and defensive evaluation of National Register eligibility. The collection of recovered timbers and artifacts from the shipwreck does not constitute a property in itself. Nevertheless, the recovered materials contain important information that may inform our knowledge and understanding of shipbuilding in the Chesapeake region during the eighteenth century."

FINAL DISPOSITION OF TIMBERS

As part of the mitigation for the adverse effect to the Nanticoke Shipwreck, SHA committed to the conservation of the two dead eye and five timbers (the deadwood, a floor, two futtocks, and a strake) (**Appendix D**). These timbers were chosen based on their diagnostic attributes. In November 2016, these artifacts entered conservation treatment at the Maryland Archaeology Conservation Laboratory. They will be permanently curated here and will be made available for exhibit and display once conservation is complete.

Since the remaining timbers had been photographed, scanned, and drawn, MHT determined there was no additional data to be gained from their conservation and curation. As a result of consulting party interest in future conservation and exhibit of these remaining timbers, SHA, in consultation with MHT, arranged indefinite submersion of these ship timbers in an undisclosed location on state property. The timbers were wrapped in geotextile fabric and floated to the center of a deep pond and sunk. The timbers, arranged immediately adjacent to each other, were covered in a single layer of geotextile fabric that was buttoned down on the edges with concrete blocks. The geotextile fabric will encourage natural siltation and temporary stabilization of the timbers.

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APPENDIX A:

SCOPE OF WORK

Nanticoke River Shipwreck
Dorchester County, Maryland
Phase I & II Underwater Archaeological Research
SHA Project No. AX744A55
BCS 2010-02B Task Order 26

Skelly and Loy Team
April 23, 2015
P09-0380.000 Phase TO26

TECHNICAL PROPOSAL

INTRODUCTION

In response to a Request for Proposal (RFP) dated April 22, 2015, the Maryland State Highway Administration (SHA) has requested Skelly and Loy to submit a proposal to complete emergency Phase I and Phase II underwater archaeological research on an accelerated schedule for an identified shipwreck located near Bridge Number 0902200 over the Nanticoke River, Dorchester County, Maryland (Figure 1). Skelly and Loy's underwater archaeological subcontractor Southeastern Archaeological Research, Inc. (SEARCH) will complete the research. All work conducted for this project will be in accordance with our BCS 2010-02B contract, the 1986 Specifications for Consulting Engineers Services Manual, Section IV, the Scope of Work dated May 22, 2012, and the Maryland Historical Trust's (MHT) archaeological standards and guidelines (Shaffer and Cole 1994). Due to the specialized nature of the requested research, and SHA's request that SEARCH complete the research under this task order, no DBE usage will be achieved on this task order. However, the DBE usage for the overall agreement (BCS-2010-02B) continues to exceed the 25 percent goal set.

The research objectives presented below are designed to determine the integrity of the Nanticoke River shipwreck, identify further features and shipwreck components, and determine the shipwreck's eligibility for listing to the National Register of Historic Places (NRHP). Professional services to be provided include:

1. Background archival and historical research;
2. Phase I marine remote sensing survey;
3. Analysis of remote sensing survey data;
4. Phase II diver investigation and evaluation;
5. Recordation of shipwreck features currently housed at the Maryland Archaeological Conservation Laboratory; and
6. Report production.

Bridge repairs to the fender and dolphin system have impacted the previously unknown shipwreck. Currently the SHA is removing a damaged dolphin and fender along the navigation channel at one of the central piers on Bridge Number 0902200 in the Nanticoke River. The dolphin and fender were recently damaged and debris fell into the channel creating a hazard to navigation. The US Coast Guard instructed SHA to remove all debris to the river bottom level, which revealed a historic-period shipwreck during the process. Several timbers associated with the shipwreck were removed from the river bottom and delivered to the Maryland Archaeology Conservation Laboratory (MAC Lab) in Calvert County. Following removal of the damaged dolphin/fender and associated debris, SHA will install a temporary dolphin away from the shipwreck site. Although it is believed that this temporary structure will be located outside of the shipwreck site, SHA requires a marine remote-sensing survey to verify that there will be no impact to the site during the temporary structure installation which is to take place on April 29-30, 2015.

Subsequently, SHA will install a new, permanent dolphin to replace the damaged structure. The new dolphin will be placed within the shipwreck site and is expected to completely destroy any remaining structure associated with the shipwreck. If the site is determined eligible for listing to the NRHP, a Phase III data recovery investigation will be necessary. This research will occur under a separate task order and is not included in this proposal.

PROPOSED SERVICES

1) Background Archival and Historical Research

SEARCH will conduct a thorough archival and historical review in conjunction with SHA and MHT. SEARCH will also consult with other interested parties and documents, maps, records, previous archaeological reports, and local experts/informants that may provide additional information to the known history and prehistory of the area. Repositories may include; MHT, SHA, Maryland Historical Society, Chesapeake Bay Maritime Museum, Calvert Marine Museum, Maryland Hall of Records, Maryland State Archives, Jefferson Patterson Park and Museum, St. Mary's College, Salisbury University, the US Naval Academy, Library of Congress, and the National Archives.

2) Phase I Marine Remote Sensing Survey

Mobilization/Demobilization

Mobilization includes equipment preparation, safety check, field maps and forms compilation, a safety meeting, a research design meeting, and confirmation of travel arrangements. Additionally, SEARCH will meet with SHA throughout the project to discuss progress, obstacles, and any outstanding issues. Demobilization will occur at the end of the project and will include the cleaning and repair of equipment and boat; transmittal of project photographs, field notes, and maps to Skelly and Loy for delivery to SHA; and a post-field meeting with both Skelly and Loy and SHA.

Survey Methodology

SEARCH will complete a remote sensing survey of the proposed project area. Instrumentation for the survey will include a Hemisphere differentially corrected global positioning system receiver (dGPS), a Geometrics G-882 marine magnetometer, an EdgeTech 4125 dual frequency (600/1600 kHz) side-scan sonar system, and an EdgeTech 3100 (with SB-424 towfish) portable sub-bottom profiler. SEARCH will preplan survey lines at 10-foot intervals and utilize HYPACK navigation software to guide the survey vessel. Vessel speed during the survey will not exceed 4.5 knots in order to maximize the data collection of each instrument. HYPACK will maintain vessel and equipment positioning, by means of layback calculations, with sub-meter accuracy, and log real-time positional and magnetic data. SEARCH will operate the side-scan sonar at a frequency of 1600 kHz, in order to provide the highest acoustic resolution possible, and a maximum range of 25 meters (82 feet) (i.e., total swath width = 50 meters [164 feet]). The combination of survey line spacing and range will allow for 100-percent imagery coverage of the project area, including the nadir region beneath the towfish path. Sub-bottom profiler frequency will be determined by environmental conditions at the time of survey.

3) Analysis of Remote Sensing Survey Data

All remote-sensing datasets will be collected with real-time, sub-meter accurate positional data. Once processed, all datasets will be layered within a geographic information system (GIS), along with the project boundary, a high-resolution aerial image, and an up-to-date NOAA navigation chart. SEARCH will correlate and analyze all remote-sensing datasets and make archaeological recommendations for diving based upon observation and recent theory regarding archaeological interpretation of remote-sensing data. SEARCH will provide visual and tabular representations for those remote-sensing targets recommended for further archaeological investigation.

The raw magnetic data (x, y positional coordinates + z magnetic values) will be processed into a contour map utilizing Golden Software, Inc.'s Surfer contouring and 3-D surface mapping software, which allows the best representation of three-dimensional data on a two-dimensional plane, and facilitates interpretation of the interaction of a magnetic source with the earth's magnetic field. The process involved with creating this contour map consists of removing the diurnal variation from the data, creating a regularly spaced grid of the irregularly spaced data points, and generating contours that are visually concise and accurately represent anomalies in the earth's magnetic field. SEARCH will review each line of raw side-scan sonar imagery from the survey to locate wreck features protruding above the seafloor. Each object will be assigned a contact number, and descriptive information will be collected and tabulated (e.g., length, width, dGPS position, possible identification, etc.). SEARCH also will generate a mosaic image of the project area comprising all raw sonar imagery. The ability to mosaic the imagery will be possible with the embedded positional data from the dGPS utilizing Chesapeake Technology, Inc., SonarWiz 5 sonar processing software. Finally, SEARCH will review each line of raw sub-bottom profiler imagery, utilizing SonarWiz 5, to identify and delineate buried reflectors indicative of geologic features or potentially representative of the wreck itself. Data for each reflector will be tabulated and include location, length, and depth of burial.

4) Phase II Diver Investigation and Evaluation

Diving

Prior to dive operations, SEARCH will prepare and submit a Dive Safety Plan to Skelly and Loy and SHA. The Dive Safety Plan will include the SEARCH Safe Diving Practices Manual, a Dive Operations Plan, an Emergency Management Plan, and an Activity Hazard Analysis Plan. All four documents will be provided to Skelly and Loy and SHA for approval prior to project activities. The Safe Practices Manual (SPM) encompasses the entire SEARCH dive program and includes safety procedures, dive team responsibilities, equipment certifications, and emergency procedures.

The Dive Operations Plan (DOP) is a project-specific document that details contractor, contract number, dive team members, dive equipment to be used, description of the work to be accomplished, duration/time of the project, project area environment/conditions, surface support (i.e., dive platform), planned depths for dives, and means of communication between involved parties. The DOP also will include up-to-date resumes denoting diving-related training and experience for each diver, medical certifications outlining each diver's fitness/suitability for diving, copies of CPR/first aid training for each dive member, equipment certifications, and identification of emergency and first aid equipment to be available at the dive location. The DOP outlines the entire project and provides an in-depth assessment of project activities. If for any reason the dive plan is altered in mission, depth, personnel, or equipment, SHA will be contacted in order to review and accept the alteration prior to actual operation.

The Emergency Management Plan (EMP) is a project-specific document outlining the emergency contacts and procedures to be employed in the case of an emergency. The EMP identifies the nearest recompression chamber, location and phone numbers for the nearest hospitals, nearest United States Coast Guard Rescue Coordination Center, emergency transport (i.e., ambulance), and other emergency numbers pertinent to the project. The EMP also addresses specific procedures to be followed in the event of an emergency. This includes, but is not limited to, procedures to deal with an entrapped/fouled diver, loss of vital support equipment, loss of air supply, loss of communication, lost diver, injured diver, loss of consciousness, and injury of surface crew.

The Activities Hazard Analysis Plan (AHAP) addresses project-specific potential hazards, delivers a method of prevention, and proposes actions to be taken in case of an emergency. The AHAP is communicated with every team member during a tailgate kickoff meeting. SEARCH recognizes that field conditions may change after the plan has been developed and distributed, and our team will update and redistribute the AHAP as necessary.

All SEARCH dive team members meet the criteria established in Section 30 (Contract Diving Operations) of the U.S. Army Corps of Engineers Safety and Health Requirements manual EM 385-1-1 (2003:611-630). This includes appropriate level of diver's certification (commercial or federal); a current diver physical signed by a licensed physician, and current Cardiopulmonary Resuscitation (CPR), First Aid, and Oxygen (O2) Administration certifications.

Decompression diving will not be required for this project and all dive operations will strictly adhere to no-decompression dive limits. All work platforms will be anchored and secure prior to any dive operations. The date, time, duration and location of dive operations will be variable depending upon weather conditions, tidal/current influence and water depth. Each dive will be recorded on SEARCH dive logs to monitor each diver's bottom time, air consumption, and to document each target investigated.

To minimize the hazards associated with boat traffic at the dive site SEARCH will request the US Coast Guard broadcast a Local Notice to Mariners prior to dive operations. The entire dive team assumes that small vessel operators have varied knowledge of seamanship and will take precautions to ensure these vessels do not enter the dive area. The boat captain and all topside personnel will keep a careful watch for any potentially hazardous boat traffic at all times during dive operations. The proper dive flags (Code Alpha and civilian Sport Diver Flag) will be flown at all times (at a minimum of 3 feet above the dive platform) during all dive operations.

Initial Site Documentation

Determination of Extant Hull Remains - SEARCH will delineate the horizontal and vertical extents of the hull utilizing a hydro-probe over the entire wreck site. Hydro-probing allows divers to quickly and non-intrusively determine the extent of buried hull remains. A 5-foot hydro-probe would be adequate to delineate the remaining hull structure. If buried hull structure is suspected, a longer hydro probe will be used. The most effective method to determine the amount of lower hull remains is to utilize a hydro-probe in a grid format, spaced at 10-foot intervals perpendicular to the established baseline. The results of the hydro-probing will assist archaeologists with recommendations relative to future investigations and allow for a better delineation of the remaining hull structure associated with the unknown shipwreck site.

Exposed Feature Mapping - SEARCH will establish a datum(s) and baseline across the site, to include exposed and buried features, once its extent is determined through hydro-probing. Archaeologists will investigate exposed and articulated features to assist with assessing site integrity and determining NRHP eligibility. Disarticulated features and ship fragments will be mapped and removed from the river bottom during this phase of investigation; SEARCH will maintain provenience of any object removed from the river bottom with trilateration to the baseline. If environmental conditions permit, underwater photography may be used to assist in documenting the site.

Test Excavation - SEARCH may excavate areas of the site based upon the findings of the initial surface investigation and allotted time. The Principal Investigator will determine the location and extent of any test excavation onsite following the initial surface investigation. SEARCH may excavate up to 2 trenches that measure approximately 4 feet by 10 feet long, or other unit configurations that allow proper investigation of the buried site. Excavation will be accomplished through the use of a water induction dredge and sediment exhaust will be screened for small artifacts with the use of a mesh bag. Excavation will occur only to investigate potential diagnostic locales on the site and to aid in the determination of NRHP eligibility of the shipwreck; detailed mapping of test excavation units will not be accomplished at this time. Instead, horizontal and vertical limits of structural components will be defined through direct physical observation and examination, and include minimal dimensional measurements to aid in identifying and determining the size of the wreck.

Field Records - SEARCH will maintain accurate and up to date field notes, dive logs, maps, site plans, sketches, photographs, and drawings. All field drawings, including site plans, sketches and maps, will be scanned into digital format. Copies of maps and plans, in digital and/or hard copy format depending upon preference, will be provided to Skelly and Loy for delivery to SHA.

Conservation and Curation of Artifacts - Any materials collected from the site during the project will be submitted to the MAC Lab for processing and analysis. Artifacts and associated records will be cataloged, packaged and labeled in accordance with 36 CFR 79, and all applicable state, and federal curatorial regulations and guidelines.

5) Recordation of Wreck features currently Housed at the Maryland Archaeological Conservation Laboratory

Numerous structural elements of the shipwreck have been recovered and are being stored and stabilized at the MAC Lab. SEARCH will measure and analyze these elements before May 6, 2015. SEARCH will collect detailed measurements on the structural elements housed at the MAC Lab. Examples of archaeological documentation will include sided and molded dimensions of framing timbers, as well as extant lengths, and width and thickness dimensions of planking. Archaeologists will carefully document patterns and characteristics of fasteners located within each structural element. SEARCH will utilize a combination of tracing, goniometer, and line level/plumb bob measuring to accurately document curvature of timbers. SEARCH also will collect numerous, detailed photographs of each element, all of which will include a proper scale for reference. Elements include 27 frames, 19 planks, 1 plank with scarph and repair, 1 lot of small fragments (14 fragments total), 1 keel, 1 keelson, 1 formerly attached frame piece (refit), 1 stem assembly, 2 stem post, 3 breast hook, 1 brick, 1 deadeye, 1 metal fragment, and 2 treenail fragments.

6) Dendrochronology and Wood Speciation

Five samples of wood removed from the shipwreck will be submitted for dendrochronology. In addition, remnants of the shipwreck will be submitted for wood species identification. However, since it is not known the total quantity or type of remnants that will be recovered, a maximum of 70 samples including: the frame, plank, stem, hook, keel, keelson, and treenail, will be submitted for speciation during the Phase I & II research. SHA has recommended the use of Michael Worthington for both the dendrochronology and wood speciation; however, we have been unable to confirm with Mr. Worthington whether he can provide this research. If he can't, we will find a substitute subcontractor to complete the work. The dendrochronology will be completed by May 6, 2015.

7) Report Production

The report will comply with the standards set forth in the Department of the Interior's "*Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines*," regarding archaeological documentation and the *Standards and Guidelines for Archaeological Investigations in Maryland*. This will include the nature of the project, the project area location, a description of the areas context, a shipwreck inventory referencing known vessel losses and inundated terrestrial sites. All of this information will be correlated with the data collected during the remote sensing survey.

A methodology chapter will describe in detail the project area environment (i.e. water depth, weather conditions), survey procedures, navigation parameters, survey vessel utilized during the survey, remote sensing equipment, and collection of data. The chapter also will address methodologies and technologies utilized for the initial site investigation (Phase II). The report will also include a site form.

DELIVERABLES

Deliverables will comply with the Master Contract between Skelly and Loy, Inc. and SHA. The report will be Number 489 in SHA's archaeological report series. Two (2) hard copies of a draft report and one (1) electronic version of the report will be submitted. Following review of the draft archaeological report by SHA and MHT, one (1) CD containing PDF and Word versions of the revised final report and Year in Review Abstract (if requested), two (2) CDs containing only a PDF version of the report (graphics with a minimum of 300 dpi resolution), and four (4) bound copies of the final report will be delivered. Final reports will utilize SHA's cover style and include a list of repositories for distribution on the inside cover. All bound reports will utilize white, comb-type biding. Additionally, SEARCH will provide fourteen (14) CDs containing the final report in PDF format to the appropriate repositories under consult letterhead on behalf of SHA.

SCHEDULE

SEARCH will mobilize after Notice-to-Proceed from SHA, or when notified by the archaeology liaison for the project, Julie Schablitsky. Diver investigation of the temporary dolphin site and exploratory dives of the shipwreck site are scheduled for April 27-28, 2015. Documentation of the shipwreck elements at the MAC Lab is scheduled for April 29-30, 2015. Remote sensing survey of the project area is scheduled for May 1, 2015, to be followed with additional diving on the shipwreck site May 2-3, 2015. No work will be conducted at the site April 29-30, 2015 in order to allow for installation of the temporary dolphin structure. SEARCH understands that these dates may be adjusted if intact ship remains are found within the temporary dolphin footprint during the diver investigation of April 27-28, 2015.

The draft report will be delivered within 60 days of the completion of fieldwork, or no later than July 1, 2015. The final report will be delivered within 15 days of receipt of agency comments. A draft report will be produced immediately after the completion of fieldwork. Upon receipt of comments from the client a final report, addressing these comments, will be submitted.

PROJECT PERSONNEL

Barbara J. Gundy, Ph.D., R.P.A. – Assistant Vice President (Skelly and Loy, Inc.) – Dr. Gundy will serve as contract liaison for this task order. She will oversee all managerial and technical aspects as well as coordination of the task with SHA and SEARCH. She will provide QA/QC for project process and deliverables.

SEARCH retains the most highly-regarded team of cultural resource professionals, archaeologists, and historians. The Project Manager, Principal Investigators, and senior staff all have extensive knowledge of and experience in meeting the national standards governing archaeological, historical, geomorphologic, and historic architectural studies. The Key Personnel all exceed the qualifications presented in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (Federal Register V.48 N. 190 Part IV p. 44738-44739, September 30, 1983). All archaeologists who will participate in this investigation are certified by the Register of Professional Archaeologists (RPA).

For this project, Jason M. Burns, M.A., RPA will serve as the Underwater Archaeologist/Project Manager. Jeff Enright, M.A., RPA, will serve as the Principal Investigator, Ray Tubby, M.A., RPA and Matt Hanks, M.A., RPA will serve as Archaeologists and Joe Grinnan, M.A., RPA will serve as the Field Technician. Mr. Grinnan also serves as the SEARCH Dive Safety Officer. Support staff including SEARCH Research Assistant/Historian, Nick Linville, M.A., and Technical

Editor/Graphic Artist, Katy Harris, M.S. will be assigned upon receipt of Contract Award. No temporary personnel are proposed for use on this project.

Jason Burns, M.A., RPA - Mr. Burns is responsible for maritime business development, research integrity, strategic growth, and industry leadership. Burns will serve as the Underwater Archaeologist/Project Manager. He has 20 years of professional experience on submerged remote-sensing survey, diver investigation, data analysis, and public outreach projects. His research specialties include nineteenth-century sailing vessels, ship construction, and marine recovered artifact conservation. Mr. Burns worked on the recovery of the Civil War-era submarine CSS Hunley off Charleston, South Carolina, and the Confederate commerce raider CSS Alabama near Cherbourg, France. He served as the Director of Conservation for the Lighthouse Archaeological Maritime Program (LAMP) in St. Augustine, Florida; as Deputy State Archaeologist–Underwater for the Georgia Department of Natural Resources, where he created a statewide program for underwater archaeology; and as an Archeologist for the USACE Mobile District. Two books have been published on his maritime research, and he has authored numerous articles, papers, presentations, and web-based media. Mr. Burns has worked on offshore, nearshore, and inshore waterways across the United States and internationally across the West Indies, Europe, Africa, and the Pacific. Mr. Burns is an AAUS Scientific Diver, and holds current certifications in surface-supplied air diving and dive safety, including his USACE Work Diving Safety/Supervisor certificate in compliance with the USACE Safety and Health Requirements Manual EM 385-1-1. Mr. Burns holds Transportation Worker Identification Credentials (TWIC), IADC Rig Pass, Safe Gulf Endorsement, and HUET and Offshore Water Survival certifications for work offshore in the Gulf of Mexico as well as CPR, First Aid, HAZWOPER and Oxygen First Aid for Scuba Diving Injuries. Mr. Burns is a US Navy veteran.

Jeff Enright, M.A., RPA - Mr. Jeff Enright will serve as the Principal Investigator for the project. Mr. Enright received his Master of Arts degree in Maritime History and Nautical Archaeology in 1999 and he meets the Secretary of the Interior's Guidelines for Archaeology and Historic Preservation Professional Qualification Standards. Since receiving his degree, he has worked as a professional archaeologist and GIS specialist in the cultural resources management industry, and achieved 12 years of experience as a Project Manager, Principal Investigator, GIS Manager, Project Archaeologist, and Diving Supervisor. In these roles, he has designed, directed, and/or participated in nearly 100 Section 106 underwater and terrestrial investigations, geophysical surveys, and GIS projects for federal, state, and private clients, and produced more than 40 publications. Mr. Enright has more than 12 years of professional experience working with GIS and CADD in support of environmental compliance and permitting projects. He has designed, created, and managed complex GIS geodatabases of submerged cultural resources, underwater biological habitat, and terrestrial biological inventories in support of multiple disciplines, including marine and terrestrial archaeology, marine and terrestrial biology, and archival and cartographic history. Mr. Enright is experienced efficiently and effectively managing large, multi-component datasets; intelligently organizing attribute tables and spatial layers into functional geodatabases; analyzing spatial relationships and solving geographic challenges; geo-referencing historic cartography and aerial photography; and presenting geographic data as visually accurate and informative graphics for scientific study.

Raymond E. Tubby, M.A., RPA - Mr. Tubby has over 20 years of experience as a professional maritime archaeologist and is proficient in all aspects of underwater archaeology, including remote-sensing survey, data analysis, historic research, archaeological diving, and site documentation. Mr. Tubby will serve as an Archaeologist. His research specialties include eighteenth- and nineteenth-century New World ship construction, Civil War wreck sites, and small vernacular craft construction. Mr. Tubby earned his master's degree in Maritime Studies from East Carolina University in 2000, his bachelor's degree from the University of Maryland in 1986, and a Geographic Information Systems post-baccalaureate certificate from Penn State in 2012. He has experience across the Southeast, Southwest, Mid-Atlantic, Northeast, Midwest, West Coast, and West Indies. He has worked for the US Navy Historic Center, the State of Wisconsin, and the Instituto de Investigaciones Costaneras in Puerto Rico. Mr. Tubby is an AAUS Scientific

Diver and holds Transportation Worker Identification Credentials (TWIC), IADC Rig Pass, Safe Gulf Endorsement, and HUET and Offshore Water Survival certifications for work offshore in the Gulf of Mexico. He is certified for Advanced Diver, SCUBA, CPR, First Aid, HAZWOPER, and Oxygen First Aid for Scuba Diving Injuries. Mr. Tubby is listed on the Register of Professional Archaeologists.

Matthew Hanks, M.A., RPA - Mr. Hanks conducts submerged remote-sensing surveys, diver identifications, and data recoveries. Hanks will serve as an Archaeologist. His research specialties include submerged World War II aircraft and assault vehicles, submerged cultural resource management, and the development of maritime heritage trails. He has five years of professional experience with the Lighthouse Archaeological Maritime Program (LAMP) in St. Augustine, Florida, and the Maritime Branch of the South Australian Department for Environment and Natural Resources. Mr. Hanks earned a master's degree in Maritime Archaeology from Flinders University in Adelaide, South Australia, and a bachelor's degree in Archaeology and Anthropology from Baylor University in Waco, Texas. He has experience across the Southeast, Oceania, and Australia. Mr. Hanks is an AAUS Scientific Diver and holds Transportation Worker Identification Credentials (TWIC), IADC Rig Pass, Safe Gulf Endorsement, and HUET and Offshore Water Survival certifications for work offshore in the Gulf of Mexico. He is certified for Nitrox, SCUBA Rescue Diver, CPR, First Aid, and Oxygen First Aid for Scuba Diving Injuries. Mr. Hanks is listed on the Register of Professional Archaeologists.

Joseph Grinnan, M.A., RPA - Mr. Grinnan is responsible for dive safety and supporting submerged remote-sensing survey, diver identification, and data recovery projects. Mr. Grinnan will serves as a Field Technician and Dive Safety Officer for this project. Mr. Grinnan has seven years of professional diving experience, and he holds a Master Scuba Diver Training rating through PADI and is a US Environmental Protection Agency Scientific Diver. His research specialties include maritime cultural landscapes, sailing vessel technology, and maritime archival research. Mr. Grinnan earned his master's degree in Anthropology/Historical Archaeology from the University of West Florida in 2013 and his bachelor's degree from the University of Florida in 2009. He has worked across the southeastern and northeastern United States and in Ghana, Africa. His experience includes the discovery and recovery of sixteenth-, seventeenth-, eighteenth-, and nineteenth-century vessels. Mr. Grinnan is an AAUS Scientific Diver, is an Eagle Scout, and holds Transportation Worker Identification Credentials (TWIC), Safe Gulf Endorsement, and HUET and Offshore Water Survival certifications for work offshore in the Gulf of Mexico. He is certified in SCUBA, CPR Instructor, First Aid, and Oxygen First Aid for Scuba Diving Injuries. Mr. Grinnan is listed on the Register of Professional Archaeologists.

Figure 1. Project Area.

APPENDIX B:

MARYLAND INVENTORY OF HISTORIC PROPERTIES ARCHAEOLOGICAL SITE SURVEY: BASIC DATA FORM

MARYLAND INVENTORY OF HISTORIC PROPERTIES

ARCHEOLOGICAL SITE SURVEY: BASIC DATA FORM

Date Filed: 06/25/2015

Check if update: ☐

Maryland Department of Planning
Maryland Historical Trust
Division of Historical and Cultural Programs
100 Community Place
Crownsville, Maryland 21032

Site Number: 18DO497

County: Dorchester

A. DESIGNATION

1. Site Name: Nanticoke River Shipwreck

2. Alternate Site Name/Numbers: ______

3. Site Type (describe site chronology and function; see instructions):
Late 18th century, early 19th century shipwreck

4. Prehistoric ______ Historic X Unknown ______

5. Terrestrial ______ Submerged/Underwater X Both ______

B. LOCATION

6. USGS 7.5' Quadrangle(s): Mardela Springs | (For underwater sites) NOAA Chart No.: 12261

(Photocopy section of quad or chart on page 4 and mark site location)

Latitude in decimal degrees 38.489067 Longitude in decimal degrees -75.812947

7. Maryland Archeological Research Unit Number: 3

8. Physiographic Province (check one):
   - ______ Allegany Plateau
   - ______ Ridge and Valley
   - ______ Great Valley
   - ______ Blue Ridge
   - ______ Lancaster/Frederick Lowland
   - ______ Eastern Piedmont
   - ______ Western Shore Coastal Plain
   - X Eastern Shore Coastal Plain

9. Major Watershed/Underwater Zone (see instructions for map and list): Nanticoke River

C. ENVIRONMENTAL DATA

10. Nearest Water Source: Nanticoke River Stream Order: ______

11. Closest Surface Water Type (check all applicable):
   - ______ Ocean
   - X Estuarine Bay/Tidal River
   - ______ Tidal or Marsh
   - ______ Freshwater Stream/River
   - ______ Freshwater Swamp
   - ______ Lake or Pond
   - ______ Spring

12. Distance from closest surface water: 0 meters (or 0 feet)

C. ENVIRONMENTAL DATA [CONTINUED]

13. Current water speed: ______1-2 knots

14. Water Depth: __8__ meters

15. Water visibility: _____0__________

16. SCS Soils Typology and/or Sediment Type: ______

17. Topographic Settings (check all applicable):

_______ Floodplain
_______ Interior Flat
_______ Terrace
_______ Low Terrace
_______ High Terrace
_______ Hillslope
_______ Hilltop/Bluff
_______ Upland Flat
_______ Ridgetop
_______ Rockshelter/Cave
_______ Unknown
___X___ Other:
___River_________________

18. Slope: ____

19. Elevation: _0__ meters (or __0__ feet) above sea level

20. Land use at site when last field checked (check all applicable):

_______ Plowed/Tilled
_______ No-Till
_______ Wooded/Forested
_______ Logging/Logged
_______ Underbrush/Overgrown
_______ Pasture
_______ Cemetery
_______ Commercial
_______ Educational
_______ Extractive
_______ Military
_______ Recreational
_______ Residential
_______ Ruin
_______ Standing Structure
___X___ Transportation
_______ Unknown
___X___ Other:
___Next to highway bridge/navigation channel________

21. Condition of site:

____X__ Disturbed
_______ Undisturbed
_______ Unknown

22. Cause of disturbance/destruction (check all applicable):

_______ Plowed
_______ Eroded/Eroding
_______ Graded/Contoured
_______ Collected
_______ Vandalized/Looted
_______ Dredged
___X___ Heavy Marine Traffic
___X___ Other:
___Recovered during debris removal process______

23. Extent of disturbance:

_______ Minor (0-10%)
_______ Moderate (10-60%)
__X____ Major (60-99%)
_______ Total (100%)
_______ % unknown

C. ENVIRONMENTAL DATA [CONTINUED]

24. Describe site setting with respect to local natural and cultural landmarks (topography, hydrology, fences, structures, roads). Use continuation sheet if needed.

The resource is on the northern side of the of the Highway 50 bridge as it crosses the Nanticoke River near Vienna, Maryland and immediately east of the main channel just outside the fender system (between the fender system and eastern back of the river).

25. Characterize site stratigraphy. Include a representative profile on separate sheet, if applicable. Address plowzone (presence/absence), subplowzone features and levels, if any, and how stratigraphy affects site integrity. Use continuation sheet if needed.

Most of the wreck was recovered during removal of a destroyed fender system in preparation of the new fender system's installation. Some portions of the wreck may be buried beneath debris related to the old fender.

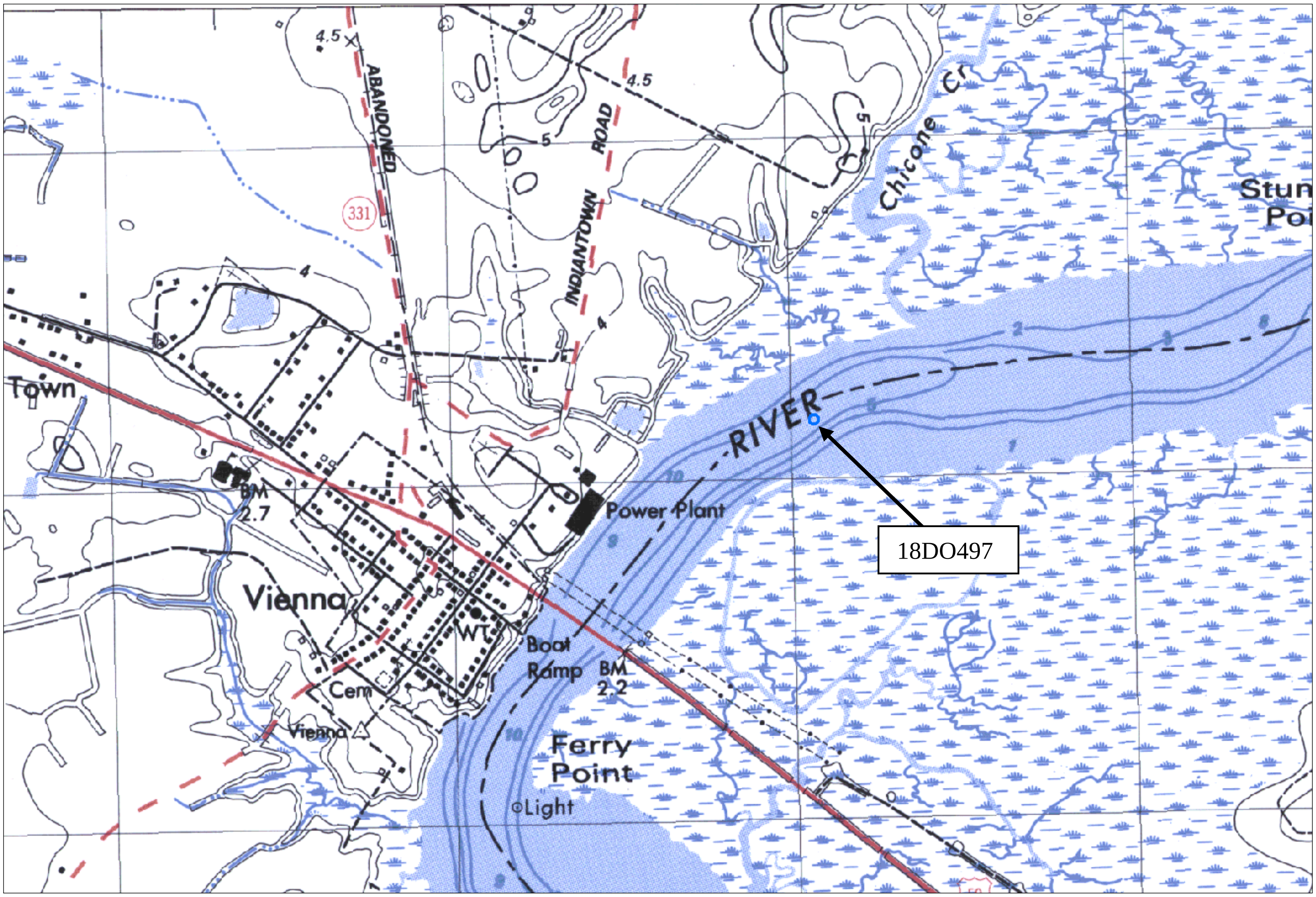
26. Site size: __21____ meters by __21____ meters (or _70____ feet by ___70_ feet)

27. Draw a sketch map of the site and immediate environs, here or on separate sheet:

National Web Map Service 6" Orthophoto Map, c. 2014

Scale: North arrow:

Photocopy section of quadrangle map(s) and mark site location with heavy dot or circle and arrow pointing to it.



Mardela Springs quadrangle 1982

D. CONTEXT

28. Cultural Affiliation (check all applicable):

PREHISTORIC
_______ Unknown
_______ Paleoindian
_______ Archaic
_______ Early Archaic
_______ Middle Archaic
_______ Late Archaic
_______ Terminal Archaic
_______ Woodland
_______ Adena
_______ Early Woodland
_______ Middle Woodland
_______ Late Woodland

_______ CONTACT

HISTORIC:
_______ Unknown
17th century
_______ 1630-1675
_______ 1676-1720
18th century
_______ 1721-1780
___X___ 1781-1820
19th century
_______ 1821-1860
_______ 1861-1900
20th century
_______ 1901-1930
_______ post-1930

____ UNKNOWN

E. INVESTIGATIVE DATA

29. Type of investigation:
____X__ Phase I
____X__ Phase II/Site Testing
_______ Phase III/Excavation
____X__ Archival Investigation
_______ Monitoring
_______ Field Visit
_______ Collection/Artifact Inventory
_______ Report From Informant
_______ Other: _______________

30. Purpose of investigation:
____X__ Compliance
_______ Research
_______ Avocational
_______ Regional Survey
_______ Site Inventory
_______ MHT Grant Project
_______ Other: _______________

31. Method of sampling (check all applicable):
____X__ Non-systematic surface search
_______ Systematic surface collection
_______ Non-systematic shovel test pits
_______ Systematic shovel test pits
_______ Excavation units
_______ Mechanical excavation
___X___ Remote sensing
_______ Other: _______________

32. Extent/nature of excavation: Hydroprobing to determine extent of buried remains and surface collection of exposed remains.

F. SUPPORT DATA

33. Accompanying Data Form(s):
_________ Prehistoric
_____X___ Historic
_____X___ Shipwreck

34. Ownership: _______ Private _________ Federal ___X____ State _________ Local/County _______ Unknown

35. Owner(s): State of Maryland
Address: ______
Phone: ______
Email: ______

36. Tenant and/or Local Contact: Julie Schablitsky
Address: 707 N Calvert St, Baltimore, MD 21201
Phone: 410-545-8870
Email: jschablitsky@sha.state.md.us

37. Other Known Investigations: ______

38. Primary report reference or citation: Enright, Jeffrey (2015) Phase I and Phase II Underwater Archaeology Investigations of the Nanticoke River Shipwreck Dorchester County, Maryland (working title, report in progress)

39. Other Records (e.g. slides, photos, original field maps/notes, sonar, magnetic record)?

___ Slides	___ Field record	___ Other: ___
X Photos	X Sonar	
___ Field maps	X Magnetic record	

40. If yes, location of records: SEARCH, Inc 315 NW 138th terrace Newberry, Florida 32669

41. Collections at Maryland Archeological Conservation (MAC) Lab or to be deposited at MAC Lab?
X Yes
___ No
___ Unknown

42. If NO or UNKNOWN, give owner: ______
location: ______
and brief description of collection: ______

43. Informant: ______
Address: ______
Phone: ______
Email: ______

44. Site visited by Jeffrey Enright
Company/Group name: SEARCH, Inc.
Address: 315 NW 138th Terrace Newberry, Florida 32669
Phone: 850-607-2846
Email: Jeff@searchinc.com Date: 06/18/2015

45. Form filled out by: Joe Grinnan
Company/Group name: SEARCH, Inc.
Address: 315 NW 138th Terrace Newberry, Florida 32669
Phone: 850-607-2846
Email: joseph.grinnan@searchinc.com Date: 06/25/2015

46. Site Summary/Additional Comments (append additional pages if needed):

The eastern fender marking the main shipping channel underneath the highway 50 bridge, which crosses the Nanticoke River near Vienna, Dorchester County, Maryland was destroyed during a boating accident. The Nanticoke River Wreck site was encountered during the removal of debris from the eastern fender. During the fender system removal a number of timbers were encountered that did not resemble the fender system. It was determined that these represented a submerged cultural resource and the timbers were transferred to the Maryland Archaeological Conservations (MAC) Laboratory. It was at this point that SEARCH, Inc. was brought in to determine the significance of the recovered remains and determine if any extant remains existed on the river bottom. SEARCH recovered a number of disarticulated ship timbers and brought these to the MAC lab. Some extant ship timbers remain on the river bottom underneath debris from the old fender system.

MARYLAND ARCHEOLOGICAL SITE SURVEY: HISTORIC DATA FORM

Site Number 18DO497

1. Site class (check all applicable, check at least one from each group):

a.
- ______ domestic
- ______ industrial
- ___X__ transportation
- ______ military
- ______ sepulchre
- ______ religious
- ______ commercial
- ______ educational
- ______ non-domestic agricultural
- ______ unknown
- ______ other: ________________________

b.
- ______urban
- ___X__ rural
- ______ unknown

c. standing structure:
- ______ yes
- ___X__ no
- ______ unknown

d. above-grade/visible ruin:
- ___X__ yes
- ______no
- ______ unknown

2. Site Type (check all applicable):
- ______ artifact concentration
- ______ possible structure
- ______ post-in-ground structure
- ______ frame structure
- ______ masonry structure
- ______ log structure
- ______ farmstead
- ______ plantation
- ______ townsite
- ______ road/railroad
- ______ wharf/landing
- ______ bridge
- ______ ford
- ______ mill (specify:____________________)
- ______ raceway
- ______ quarry
- ______ furnace/forge
- ______ other industrial (specify): ________________________
- ______ battlefield
- ______ military fortification
- ______ military encampment
- ______ cemetery
- ______ unknown
- ___X__ other: shipwreck

3. Ethnic Association:
- ______Native American
- ______ African American
- ______ Angloamerican
- ______ Hispanic American
- ______ Asian American
- ______ other Euroamerican (specify): ________________________
- ___X__ unknown
- ______ other: ________________________

4. Categories of material remains present (check all applicable):
- ______ ceramics
- ______ bottle/table glass
- ______ other kitchen artifacts
- ___X__ architecture
- ______ furniture
- ______ arms
- ______ clothing
- ______ personal items
- ______ tobacco pipes
- ______ activity items
- ______ human skeletal remains
- ______ faunal remains
- ______ floral remains
- ______ organic remains
- ______ unknown
- ___X__ other: Ship Timbers, Deadeyes, Bricks

5. Diagnostics (choose from manual and give number recorded or observed):

forged iron spikes

hand-drawn treenails

6. Features present:
   - __X__ yes
   - ______ no
   - ______ unknown

7. Types of features present:
   - ______ construction feature
   - ______ foundation
   - ______ cellar hole/storage cellar
   - ______ hearth/chimney base
   - ______ posthole/postmold
   - ______ paling ditch/fence
   - ______ privy
   - ______ well/cistern
   - ______ trash pit/dump
   - ______ sheet midden
   - ______ planting feature
   - ______ road/drive/walkway
   - ______ depression/mound
   - ______ burial
   - ______ railroad bed
   - ______ earthworks
   - ______ raceway
   - ______ wheel pit
   - ______ unknown
   - __X__ other:
   ship structural remains

8. Flotation samples collected:
   - ______ yes
   - __X__ no
   - ______ unknown

   analyzed:
   - ______ yes, by ______________
   - ______ no
   - ______ unknown

9. Soil samples collected:
   - ______ yes
   - __X__ no
   - ______ unknown

   analyzed:
   - ______ yes, by ______________
   - ______ no
   - ______ unknown

10. Other analyses (specify): Magnetometer, Side-Scan Sonar, dendrochronology, wood species

11. Additional comments:

12. Form filled out by: Joe Grinnan
    Address/Company: SEARCH, Inc.
    Date: 06/25/2015

MARYLAND ARCHEOLOGICAL SITE SURVEY: SHIPWRECK DATA FORM

Site Number 18DO497
Site Name Nanticoke River Shipwreck

1. Vessel Identification (if known):
   - Name: ____
   - Hull Number: ____
   - Origin:
     - X Local (Chesapeake Bay Region) (specify): Eastern Shore
     - ____ US (specify): ____
     - ____ European (specify): ____
     - ____ Other (specify): ____
     - ____ Unknown

   Source of Information:
   - X Archives
   - X Direct (on vessel or artifact(s)
   - ____ Other: ____

2. Orientation of wreck (compass direction of bow): unknown

3. Dimensions (in metric measurements):
   - Maximum length: 9.1m
   - Maximum width: unknown
   - Depth of Hold (if known): ____
   - Draft (if known): ____

   Note where dimensions were measured if other than at maximum points and explain why (i.e., portion of vessel missing; approximated from other construction details, etc.)

   Approximated from construction details

4. Site Condition (A) [choose 1]:
   - X exposed
     - height off bottom: no longer on bottom
   - ____ partially buried
     - height off bottom: ____
   - ____ buried
     - burial depth: ____

   Site Condition (B) [choose 1]:
   - ____ intact
   - X scattered/broken up

   Site Condition (C) [choose approximate degree of survival]:
   - ____ 100%
   - ____ 75%
   - ____ 50%
   - ____ 25%
   - ____ 10%
   - X <10%

5. Use (check all applicable):
   - ____ military vessel
   - ____ merchant/commercial
   - ____ fishing/oystering/crabbing/etc.
   - ____ pleasure
   - ____ ferry
   - X unknown

6. Material:

______ iron/steel
______ ferrocement
______ aluminum
______ composite (iron frame/wooden planking)
______ fiberglass
______ unknown

___X__ wood
____ log boat (monoxyl, dugout, etc.)
____ log built (log canoe, log bugeye, etc.)
___X carvel built
____ clinker built
______ other
____

7. Hull configuration

(A)
___X__ keel
______ centerboard
______ leeboard
______ none
______ unknown

(B)
_____ double-ended
______ square stern
______ round stern
___X__ unknown
______ other
____

(C)
______ flat bottom
______ round bottom
______ V-bottom
______ S-bottom
___X__ unknown

8. Primary means of propulsion:

______ tow
______ oar/paddle/pole
___X__ sail
Number of masts: _________
______ motor (gas/diesel)
Number of screws: ________

______ steam (screw)
Number of screws: ___________
______ steam (sidewheel)
______ steam (sternwheel)
______ steam (unknown)
______ unknown

9. Fasteners (check all applicable):

___X__ treenails
___X___ hand drawn ______ with shim
______ lathe turned ______ with shim
______ unknown

___X__ iron nails
___X___ square
__X_____ forged
________ cut
________ unknown
______ round
________ wire
________ unknown

___X__ spikes and/or bolts
___X__ iron
______ copper/brass/bronze
______ unknown

______ rivets
______ tacks
______ mortise and tenon joints
______ other
____

10. Artifacts observed: Deadeyes, Bricks

11. Artifacts collected. Include locations(s) and address(es): Deadeyes, Bricks

12. Sampling and analyses (Please describe sampling methods, materials, analyses, results, and provide the name and address of the laboratory or professional that conducted the work): Dendrochronology, MAC lab;
Wood species Analysis, MAC lab
Michael Worthington – Oxford Tree-Ring Laboratory
25 E Montgomery St, Baltimore, MD 21230

13. Additional comments (use continuation sheets if needed):

Majority of recovered remains consist of disarticulated shipwreck components; therefore, it is unclear at this time the original relationship of the timbers. Further investigation is required to answer numerous research questions.

15. Form filled out by: Joe Grinnan
Address/Company: SEARCH, Inc.
Date: 06/25/2015

APPENDIX C:

RESUME OF PRINCIPAL INVESTIGATOR

Jeffrey M. Enright, MA, RPA

Maritime Principal Investigator and GIS Specialist

Jeff Enright, MA, has 16 years of professional experience, and he is one of the nation's leading submerged remote-sensing specialists. Mr. Enright joined SEARCH in 2010, and he oversees remote-sensing surveys, GIS geodatabases of submerged cultural resources, multidisciplinary underwater biological and archaeological projects, marine spatial planning, and hydrographic surveying. His research specialties include early American maritime history, ship construction, and remote-sensing data analysis. He has worked on the data recovery of a variety of shipwrecks spanning several centuries, including a number of military conflicts. Mr. Enright earned his master's degree in Maritime History and Nautical Archaeology from East Carolina University in 1999 and his bachelor's degree in Anthropology and History from the University of Miami in 1995. He has worked across the Southeast, Southwest, Mid-Atlantic, West Coast, and West Indies, and he has conducted several large-scale submerged cultural resource GIS database projects that span the Atlantic Ocean, Gulf of Mexico, and Pacific Ocean Outer Continental Shelf. Mr. Enright has directed or participated in more than 125 maritime projects, and he has authored or co-authored over 50 reports, professional papers, and articles. He has served as a guest maritime archaeology lecturer at ECU. Mr. Enright is an AAUS Scientific Diver and holds current certifications in Sidescan Acquisition, Processing, and Mosaicing, Transportation Worker Identification Credentials (TWIC), IADC Rig Pass, Safe Gulf Endorsement, and HUET and Offshore Water Survival certifications for work offshore in the Gulf of Mexico as well as SCUBA, Enriched Air Nitrox, Emergency Responder, California Boater Education, CPR, First Aid, HAZWOPER, and Oxygen First Aid for Scuba Diving Injuries. Mr. Enright is listed on the Register of Professional Archaeologists.

EDUCATION

MA	**1999**	Maritime History and Nautical Archaeology. East Carolina University.
BA	**1995**	Anthropology and History. University of Miami

RESEARCH SPECIALIZATIONS

Submerged Cultural Resources Management
Maritime Archaeology
Remote-Sensing Survey
Scientific Diving
Geographic Information Systems

PROFESSIONAL EXPERIENCE

2010-present	Maritime Principal Investigator/GIS Specialist, SEARCH, Inc.
2006-2010	Director of Maritime Archaeology and Hydrographic Surveying, BIO-WEST, Inc.
1999-2006	Scientist II/Nautical Archaeologist, PBS&J, Inc.
1998-1999	Principal Investigator, Site 18CV414, Maryland Historical Trust

AWARDS AND CERTIFICATIONS

2013	Emergency Responder (Emergency First Response Corp.)
2013	California Boater Education
2012	HAZWOPER (Safety Unlimited)
2011	Helicopter Underwater Egress Training (Marine Survival Training Center)

2011 SafeGulf (PEC Premier)
2011 RIGPASS HSE Orientation (International Association of Drilling Contractors)
2009 YSI Training (Water Monitoring Solutions, Inc.)
2006 Project Management Training (40 professional development hours)
2004 Enriched Air Nitrox (National Association of Underwater Instructors)
2002 Sidescan Acquisition, Processing, & Mosaicing (CODA Technologies, Ltd.)
1998 Roy N. Lokken Scholarship in Early American History (East Carolina University)
1997 Scientific Diver (American Academy of Underwater Sciences)
1997 Enriched Air Nitrox (International Assoc. of Nitrox & Technical Divers)

PROFESSIONAL REGISTRATIONS AND ASSOCIATIONS

Register of Professional Archaeologists
Society for Historical Archaeology
Council of Texas Archaeologists

SELECT PROJECT LIST

Phase I and Phase II Underwater Archaeology Investigations of the Nanticoke River Shipwreck (Maryland State Highway Administration), **Principal Investigator**

Maritime Archaeological Remote-Sensing Survey and Diver Investigations for the Mississippi Coastal Improvement Project (USACE, Mobile District), **Principal Investigator/GIS Manager**

Maritime Archaeological Remote-Sensing Survey for Mobile Harbor Sediment Placement Project (USACE, Mobile District), **Principal Investigator/GIS Manager**

Maritime Archaeological Remote-Sensing Survey and Diver Investigations Pensacola Bay Bridge Expansion Project (Florida Department of Transportation), **Principal Investigator/Diving Supervisor**

Maritime Archaeological Remote-Sensing Survey and Diver Investigations for the Bayport Ship Channel Project (USACE, Galveston District), **Principal Investigator**

Phase II Evaluation of the Nova Scotia Fishing Schooner *Frances Geraldine* (Site 16CU74), (USACE, Galveston District), **Project Manager/Principal Investigator/GIS Manager**

Site Monitoring of a World War I Emergency Fleet Corporation Vessel (Site 41OR90) (AmaTerra/TxDOT), **Project Manager/Principal Investigator**

Submerged Cultural Resources Geodatabase Creation for the Pacific Ocean Outer Continental Shelf (Bureau of Ocean Energy Management), **Database & GIS Manager**

Maritime Context Study of Gulf of Mexico Training Ranges (Eglin Air Force Base), **GIS Manager**

Submerged Cultural Resources Response for the Gulf of Mexico Oil Spill, Gulf-Wide Response (HDR, Inc./BP), **Database & GIS Manager/Remote-Sensing Specialist**

Phase II Investigation of the American Civil War Vessel *Westfield* (Site 41GV151) (USACE, Galveston District), **Project Archaeologist/Diving Supervisor**

National Register of Historic Places Evaluations of Submerged Sites on the Gulf of Mexico Outer Continental Shelf (Minerals Management Service), **Project Archaeologist/Lead Diver**

APPENDIX D:

SCANTLING LIST/ARTIFACT CATALOG

SEARCH Field ID	SEARCH Timber ID	SHA ID	Length (inches)	Molded (inches)	Sided (inches)	Photos
LONGITUDINAL TIMBERS *[Note 1]*						
NR-Keel	NR-Keel [Note 5]	9, 10	361.5	13	5	1940-1950
NR-Keelson	NR-Keelson [Note 5]	13	252	5.5	7.5	1951-1958
NR-Apron	NR-Apron	8	63	8	7	1959-1969
NR-Deadwood	NR-Deadwood	Conserved/ Curated	45.5	7.5	6.5	1749, 1754-1756, 1941-1942
NR-Stempost	NR-Stempost	44	38	12	3.75	1924-1929
NR-FF01	NR-Gripe	36	54	2	2.75	0683-0701
FLOORS *[Note 2]*						
NR-F04	NR-FL01	32	46	5.75	5	1869-1875
NR-F07	NR-FL02	4	48.8	4.5	5	1881-1888
NR-F06	NR-FL03	46	68	4.5	4.75	1889-1899
NR-F16	NR-FL04	Conserved/ Curated	65	6	6	1912-1923, 1849-1858
NR-F17	NR-FL05	34	45	6.5	4.5	1970-1980
NR-F21	NR-FL06	25	66	4.5	4	2070-2072, 2084-2089
NR-F33	NR-FL07	62	54	4.5	2.5 [Note 3]	2090-2097, 1065-1080
NR-F08	NR-FL08	15	54	4	4	1951, 1199-1216
NR-F09	NR-FL09	14	71	4.5	5	1951, 1181-1198
NR-F10	NR-FL10	12	36	7.5	6.25	1943, 1217-1218, 1221-1226
NR-F11	NR-FL11	11	47	7.25	5	1943, 1217-1220, 1223-1226
NR-F12	NR-FL12	1	21	4.5	5	1944, 1163-1166
NR-F13	NR-FL13	7	65	4.25	5	1944, 1167-1180
NR-F14	NR-FL14	18	71	4	4.25	1946, 1149-1162
NR-F22	NR-FL15	24	53.5	4	4	2098-2101, 1039-1046
NR-F25	NR-FL16	2,3	61	4	4	1055-1064
1st FUTTOCKS *[Note 2]*						
NR-F05	NR-FK01	Conserved/ Curated	58	4.5	5	1859-1868
NR-F01	NR-FK02	63	42	3.5	4.5	1900-1903
NR-F34	NR-FK04	Conserved/ Curated	45	5	5	1981-1990
NR-F35	NR-FK06	20	69	4	4.5	2001-2013, 0973-0998
NR-F27	NR-FK07	17	57	4	5.25	2014-2024, 0702-0729
NR-F28	NR-FK08	16	59	3.75	4	2025-2035, 0780-0802
NR-F26	NR-FK09	35	59	4	4	2043-2046, 1015-1026
NR-F31	NR-FK10	30	56	4.25	4.5	2056-2059, 0953-0972
NR-F36	NR-FK11	5	53	4	5	2066-2069, 1027-1038
NR-F20	NR-FK12 [Note 5]	66,67	54	4	4	0816-0831
NR-F24	NR-FK13 [Note 5]	68,69	51	4	4.5	0658-0682
NR-F30	NR-FK14	6	39.5	3 [Note 3]	[Note 3]	1007-1014
NR-F32	NR-FK15 [Note 5]	72,73	47	3.5	3.5	1047-1054
2nd FUTTOCKS *[Note 2]*						
NR-F23	NR-FK05	38	80	3.5	5	1991-2000, 1081-1088
NR-F37	NR-FK16	42	66	3.5	4	0890-0910
CANT FRAMES *[Note 2]*						
NR-F18	NR-FK03	19	47	4	5	1930-1939, 0924-0952

SEARCH Field ID	SEARCH Timber ID	SHA ID	Length (inches)	Molded (inches)	Sided (inches)	Photos
UNKNOWN FRAME TIMBERS						
NR-F03	NR-FR01	43	32	3.75	5	1904-1907
NR-F02	NR-FR02 [Note 5]	51,52	39	4.75	4.5	1908-1911
NR-F19	NR-FR03 [Note 3]	70,71	35	4.4	4.8	0803-0815
NR-F29	NR-FR04	37	34	4	4	0866-0889
NR-F38	NR-FR05 [Note 5]	55,56	32	4.5	4	0911-0923
NR-F39	NR-FR06 [Note 5]	53,54	24.5	4.5	4.75	0999-1006
NR-F40	NR-FR07	40	15	4	4	0855-0865
NR-F15	NR-FR08	65	19	4.25	4	0846-0854

Note 1: measurements provided from the most substantial portion of the timber. Note 2: measurements taken at the center of floors (i.e. atop the keel) and the heel of futtocks and cant frames.
Note 3: timber is too deteriorated to obtain accurate measurement.
Note 4: fragments less than 2.0 feet long.
Note 5: sample removed for dendro analysis.

SEARCH Field ID	SEARCH Timber ID	SHA ID	Length (inches)	Width (inches)	Thickness (inches)	Photos
STRAKES						
NR-GS1	NR-GS01	Conserved/ Curated	167	10.75	1.25	0289-0346
NR-GS2	NR-GS02	57	112	9	1.25	1089-1104, 1119-1120
NR-GS3	NR-GS03	33	79	8	1.25	1105-1118
NR-S01	NR-S01	Unassigned	66.25	2.5	1.25	n/a
NR-S23	NR-S02	28	68.5	5	0.75	1081-1088
NR-S03	NR-S03	47	133.25	5	1	0094-0137
NR-S02	NR-S04	45	124.75	9.5	1.25	0002-0027
NR-S05	NR-S05	Unassigned	56	5	1.25	0028-0039
NR-S06	NR-S06	31	75	10	1.5	0140-0165, 0169, 0170
NR-S07	NR-S07	58	156	10	1.25	0048-0093
NR-S08	NR-S08	59	111	9.5	1	0245-0288
NR-S09	NR-S09	26,27	44.5	6.5	1	0171-0187
NR-S10	NR-S10	41	39.5	9	1.25	0219-0244
NR-S11	NR-S11	60	104.5	9.5	1.25	0188-0217
NR-S12	NR-S12	22	95	10	1.5	0435-0476
NR-S13	NR-S13	61	109.9	9.5	1.25	0361-0414
NR-S14	NR-S14	50	100.75	9.25	0.75	0347-0360
NR-S15	NR-S15	29	47.5	5	1	0415-0434
NR-S16	NR-S16	21	65	6	1	0500-0520
NR-S17	NR-S17	23	48.5	10	1	0521-0552
NR-S18	NR-S18	Unassigned	50	4	1.5	0477-0499
NR-S19	NR-S19	49	60.75	9.5	1.25	0578-0598
NR-S20	NR-S20	39	29.25	7.5	1	0564-0577
NR-S21	NR-S21	Unassigned	61.75	4	1.75	0599-0616
NR-S22	NR-S22	48	33.5	9.75	1.25	0617-0657
FRAGMENTS *Note 4*						
MISC	NR-MISC11	Unassigned	n/a	n/a	n/a	0553-0563
MISC	NR-MISC 1, 2, 3, 4, 8	Unassigned	n/a	n/a	n/a	1121-1124
MISC	NR-MISC 5, 6, 7, 9, 10	Unassigned	n/a	n/a	n/a	1125-1128
MISC	NR-MISC (bucket)	Unassigned	n/a	n/a	n/a	1129-1132
DEADEYES						
NR-DE01	NR-DE01	Conserved/ Curated	n/a	n/a	n/a	2036-2042
NR-DE02	NR-DE02	Conserved/ Curated	n/a	n/a	n/a	2064-2065
BRICK						
NR-Brick	NR-BR01	Curated	n/a	n/a	n/a	776-779, 2047-2055
NR-Brick	NR-BR02	Curated	n/a	n/a	n/a	n/a

Note 1: measurements provided from the most substantial portion of the timber. Note 2: measurements taken at the center of floors (i.e. atop the keel) and the heel of futtocks and cant frames.
Note 3: timber is too deteriorated to obtain accurate measurement.
Note 4: fragments less than 2.0 feet long.
Note 5: sample removed for dendro analysis.

APPENDIX E:

DENDROCHRONOLOGY AND WOOD SPECIATION ANALYSES

Justine Woodard McKnight

Date: May 15, 2015

To: Michael Worthington
25 East Montgomery Street
Baltimore, Maryland 21230

From: Justine McKnight

This letter reports details the results of my examination of select wooden elements retained structural members identified from the Nanticoke Shipwreck. The samples were excised for identification from intact wooden elements identified as keel, keelson, strake, floor and treenail. Taxonomic identification was attempted on each of the wooden elements. All of the samples were water-saturated. The specimens ranged in physical condition from good to excellent (decomposition was minimal).

Taxonomic identification relies upon obtaining a cross section of wood fibers, and good results were achieved by slicing across the grain with a razor blade. Identifications were made under low magnification (10X to 40X) with the aid of standard texts (Edlin 1969; Panshin and deZeeuw 1980; Hoadley 1990). Identifications were ultimately secured by comparison to wood specimens from a modern reference collection.

Table 1: Taxonomic identification of select wooden elements from Feature 11.

Specimen Number/Description	Material
Keelson	wood, *Quercus sp.* (white oak group)
NR-G5 Starboard Strake	wood, *Quercus sp.* (white oak group)
Treenail	wood, *Quercus sp.* (white oak group)
NRF12	wood, *Carya sp.* (hickory)
Keel	wood, *Quercus sp.* (white oak group)
NRF16 Floor Timber	wood, *Quercus sp.* (white oak group)

Most of the elements examined were confirmed as white oak *(Quercus spp. LEUCOBALNUS group).* Although segregation of the particular species of oak is not possible based on minute anatomy (Panshin and deZeeuw 1970:586-587), the structure of the two groups of the genus *Quercus* can be accurately identified: The white oak group *(LEUCOBALANUS)* eastern North

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America includes such species as white oak (*Quercus alba*), swamp chestnut oak (*Quercus michauxii*), swamp white oak *(Quercus bicolor)*, post oak (*Quercus stellata*), chinkapin oak *(Quercus muehlenbergii)*, bur oak *(Quercus macrocarpa)*, chestnut oak *(Quercus prinus)*, and overcup oak (*Quercus lyrata*). The European oak *(Quercus robur)* also belongs to the *LEUCOBALANUS* group. Unfortunately, there is no discernible difference between the American and European white oak species based on minute anatomy. White oaks exhibit positive qualities for shipbuilding, general construction, tool and implement manufacture, as well as for firewood (Panshin and deZeeuw 1970: 568-570). Hough notes the particular importance of American *Quercus alba, Quercus lyrata* and *Quercus macrocarpa* to historic shipbuilding (1928: 232, 262, 264). And the deforestation of portions of Maryland's Eastern Shore by the early nineteenth century as *Quercus alba* was harvested to meet shipbuilding demand is detailed by Ben Ford (2002: 70-71). Slow-growing European oak was used extensively for ship construction (Coggins 1969; Logan 2005).

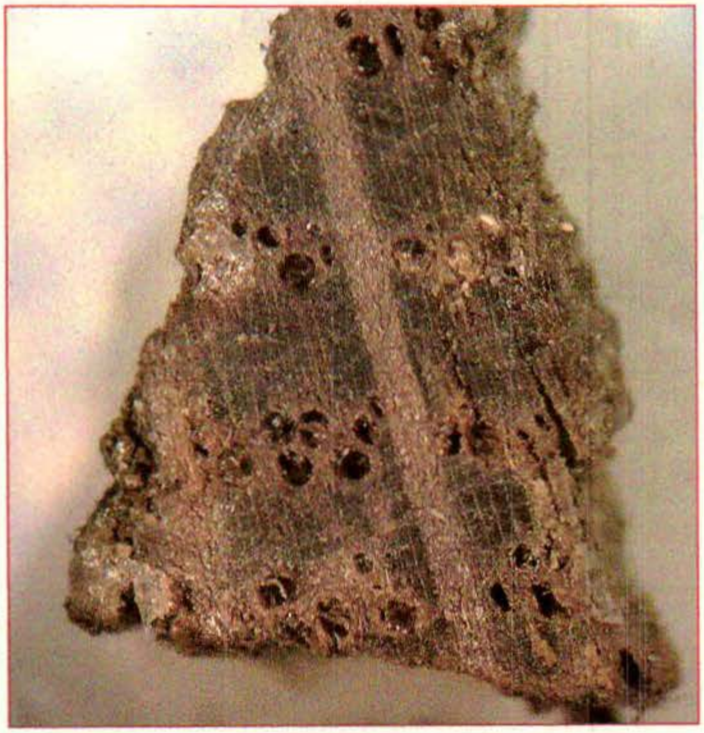

Figure 1: White oak structure is clearly evident under magnification. (Keelson).

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Oxford Tree-Ring Laboratory
Report 2015/06

The Tree-Ring Dating of a Shipwreck Found in the Nanticoke River in Vienna, Maryland

Michael J. Worthington and Jane I. Seiter

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July 2015

Summary:

Nanticoke Shipwreck, Vienna, Maryland (38.489103, -75.813447)

(a) Shipwreck *Felling date:* **After 1743**

(a) Futtocks (3/8) 1689, 1697, 1743; Keel (1/1) 1723; Keelson (0/0).
Site Master 1616-1743 NRx1 (*t* =5.86 MDOAK; 5.29 WCCHHS3; 5.13 Maidstone).

The Maryland State Highway Administration recovered the remains of a wooden shipwreck during the removal of a damaged fender in the navigation channel under the Highway 50 Bridge in Vienna, Maryland. The remains were delivered to the Maryland Archaeological Conservation Laboratory at Jefferson Patterson Park for storage, stabilization, and analysis. SHA contracted Skelly and Loy and SEARCH to conduct an emergency assessment of the remains. SEARCH determined that the shipwreck was of a sailing sloop, and based upon circumstantial evidence, dated it to between the late eighteenth and early nineteenth century, most likely before 1820.

Dendrochronological analysis has shown that the shipwreck is of a ship constructed after 1743, while dendrochronological provenancing suggests that the timbers were made from trees that grew in the Chesapeake Bay area south of Annapolis.

Date sampled: June 29, 2015

Commissioner: Skelly and Loy, Inc.

Street address: Vienna, Maryland 21869

Summary published: **www.dendrochronology.com**

How Dendrochronology Works

Dendrochronology has over the past few decades become one of the leading and most accurate scientific dating methods. While not always successful, when it does work, it is precise, often to the season of the year. Tree-ring dating to this degree of precision is well known for its use in dating historic buildings and archaeological timbers. However, more ancillary objects such as doors, furniture, panel paintings, and wooden boards in medieval book-bindings can sometimes be successfully dated.

The science of dendrochronology is based on a combination of biology and statistics. In temperate zones, a tree puts on a new layer of growth underneath the bark every year, with the effect being that the tree grows wider and taller as it ages. Each annual ring is composed of the growth which takes place during the spring and summer and continues until about November, when the leaves are shed and the tree becomes dormant for the winter period. For the two principal American oaks, the white and red (*Quercus alba* and *Q. rubra*), as well as for the black ash (*Fraxinus nigra*) and many other species, the annual ring is composed of two distinct parts: the spring growth or early wood, and the summer growth, or late wood. Early wood is composed of large vessels formed during the period of shoot growth which takes place between March and May, before the establishment of any significant leaf growth. This is produced by using most of the energy and raw materials laid down the previous year. Then, there is an abrupt change at the time of leaf expansion around May or June when hormonal activity dictates a change in the quality of the xylem, and the summer growth, or late wood, is formed. Here the wood becomes increasingly fibrous and contains much smaller vessels. Trees with this type of growth pattern are known as ring-porous, and are distinguished by the contrast between the open, light-colored early wood vessels and the dense, darker-colored late wood.

Other species of tree, such as tulip poplar (*Liriodendron tulipifera L.*), are known as diffuse-porous. Unlike the ring-porous trees, the spring vessels consist of very small spring vessels that become even smaller as the tree advances into the summer growth. The annual growth rings are often very difficult to distinguish under even a powerful microscope, and one often needs to study the medullary rays, which thicken at the ring boundaries.

Dendrochronology utilizes the variation in the width of the annual rings as influenced by climatic conditions common to a large area, as opposed to other more local factors such as woodland competition and insect attack. It is these climate-induced variations in ring widths that allow calendar dates to be ascribed to an undated timber when compared to a firmly-dated sequence. If a tree section is complete to the bark edge, then when dated a precise date of felling can be determined. The felling date will be precise to the season of the year, depending on the degree of formation of the outermost ring. Therefore, a tree with bark that has the spring vessels formed but no summer growth can be said to be felled in the spring, although it is not possible to say in which particular month the tree was felled.

Another important dimension to dendrochronological studies is the presence of sapwood and bark. This is the band of growth rings immediately beneath the bark and comprises the living growth rings which transport the sap from the roots to the leaves. This sapwood band is distinguished from the heartwood by the prominent features of color change and the blocking of the spring vessels with tyloses, the waste products of the tree's growth. The heartwood is generally darker in color, and the spring vessels are usually blocked with tyloses. The heartwood is dead tissue, whereas the sapwood is living, although the only really living, growing, cells are in the cambium, immediately beneath the bark. In the American white oak (*Quercus* alba), the difference in color is not generally matched by the change in the spring vessels, which are often filled by tyloses to within a year or two of the terminal ring. Conversely, the spring vessels in the American red oak (*Q* rubra) are almost all free of tyloses, right to the pith. Generally the sapwood retains stored food and is therefore attractive to insect and fungal attack once the tree is felled and therefore is often removed during conversion.

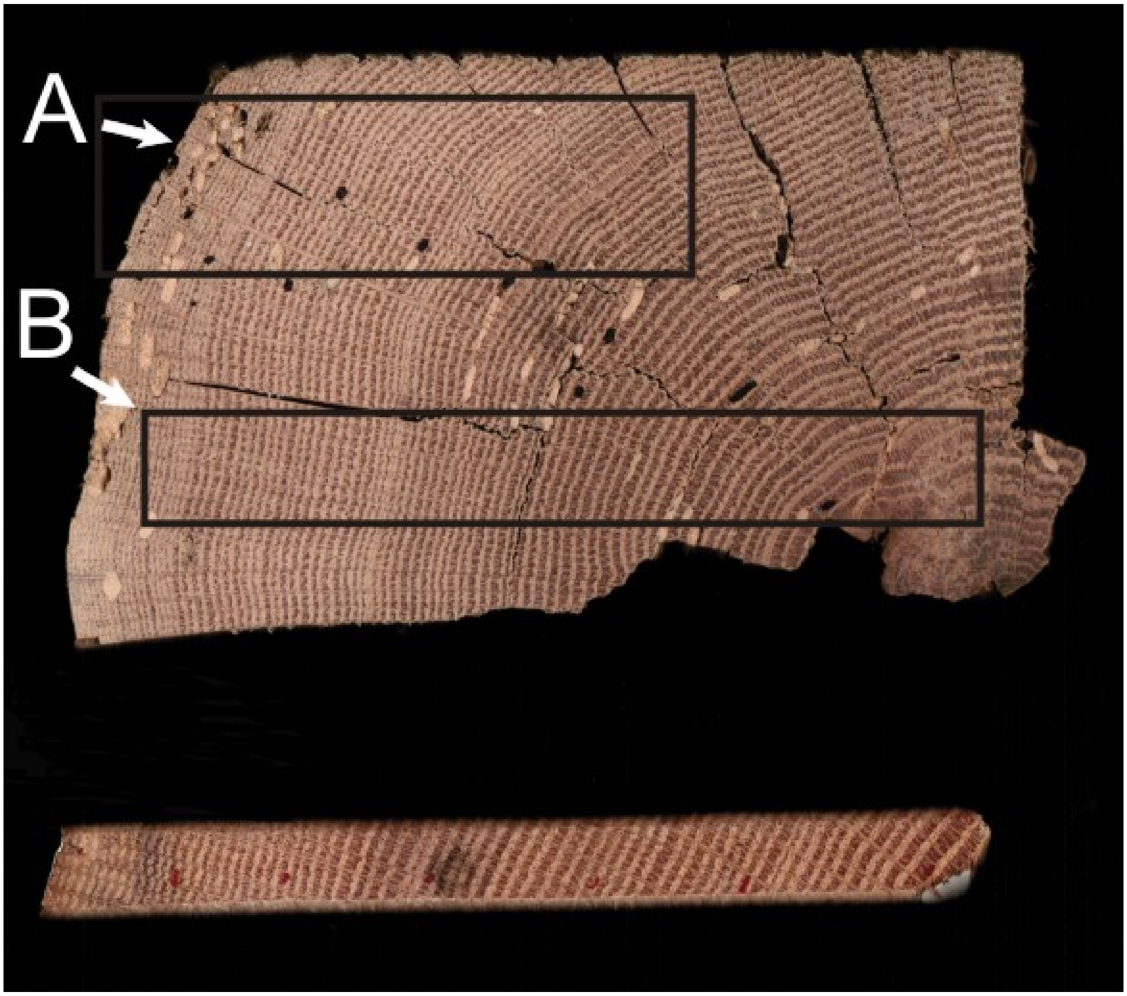

Figure 1. A cross-section of an oak timber with sapwood rings on the left-hand side (above). The boxes illustrate conversion methods resulting in **A)** a precise felling date and **B)** a *terminus post quem* or felled-after date. Also pictured is a core showing complete sapwood (below).

Methodology: The Dating Process

Ten samples were taken from the timbers recovered from a shipwreck found in the Nanticoke River in Vienna, Maryland, all of white oak (*Quercus alba*). All samples were from what appeared to be primary first-use timbers. Due to the condition of the timbers, cutting sections was the only sampling procedure deemed suitable. The possibility of the timbers being saved for museum display restricted sampling to the less diagnostic timbers, which meant that some of the most suitable timbers for dendrochronological analysis could not be sampled.

The dry samples were sanded on a linisher, or bench-mounted belt sander, using 60 to 1200 grit abrasive paper, and were cleaned with compressed air to allow the ring boundaries to be clearly distinguished. They were then measured under a x7/x47 microscope using a travelling stage electronically displaying displacement to a precision of 0.01mm. Thus each ring or year is represented by its measurement which is arranged as a series of ring-width indices within a data set, with the earliest ring being placed at the beginning of the series, and the latest or outermost ring concluding the data set.

As indicated above, the principle behind tree-ring dating is a simple one: the seasonal variations in climate-induced growth as reflected in the varying width of a series of measured annual rings is compared with other, previously dated ring sequences to allow precise dates to be ascribed to each ring. When an undated sample or site sequence is compared against a dated sequence, known as a reference chronology, an indication of how good the match is must be determined. Although it is almost impossible to define a visual match, computer comparisons can be accurately quantified. While it may not be the best statistical indicator, Student's (a pseudonym for W S Gosset) *t*-value has been widely used among dendrochronologists. The cross-correlation algorithms most commonly used and published are derived from Baillie and Pilcher's CROS program (Baillie and Pilcher 1973).

Generally, *t*-values over 3.5 should be considered significant, although in reality it is common to find demonstrably spurious *t*-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-value ranges of 5, 6, or higher, and for these to be well replicated from different, independent chronologies with local and regional chronologies well represented. Users of dates also need to assess their validity critically. They should not have great faith in a date supported by a handful of *t*-values of 3s with one or two 4s, nor should they be entirely satisfied with a single high match of 5 or 6. Examples of spurious *t*-values in excess of 7 have been noted, so it is essential that matches with reference chronologies be well replicated, and that this is confirmed with visual matches between the two graphs. Matches with *t*-values of 10 or more between individual sequences usually signify having originated from the same parent tree.

In reality, the probability of a particular date being valid is itself a statistical measure depending on the *t*-values. Consideration must also be given to the length of the sequence being dated as well as those of the reference chronologies. A sample with 30 or 40 years growth is likely to match with high *t*-values at varying positions, whereas a sample with 100 consecutive rings is much more likely to match significantly at only one unique position. Samples with ring counts as low as 50 may occasionally be dated, but only if the matches are very strong, clear, and well replicated, with no other significant matching positions. This is essential for intra-site matching when dealing with such short sequences. Consideration should also be given to evaluating the reference chronology against which the samples have been matched: those with well-replicated components that are geographically near to the sampling site are given more weight than an individual site or sample from far away.

It is general practice to cross-match samples from within the same phase to each other first, combining them into a site master, before comparing with the reference chronologies. This has the advantage of averaging out the "noise" of individual trees and is much more likely to obtain higher *t*-values and stronger visual matches. After measurement, the ring-width series for each sample is plotted as a graph of width against year on log-linear graph paper. The graphs of each of the samples in the phase under study are then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, are averaged to form a mean curve for the site or phase. This mean curve and any unmatched individual sequences are compared against dated reference chronologies to obtain an absolute calendar date for each sequence. Sometimes, especially in urban situations, timbers may have come from different sources and fail to match each other, thus making the compilation of a site master difficult. In this situation samples must then be compared individually with the reference chronologies.

Therefore, when cross-matching samples with each other, or against reference chronologies, a combination of both visual matching and a process of qualified statistical comparison by computer is used. For this study, the ring-width series were compared on an IBM compatible computer for statistical cross-matching using a variant of the Belfast CROS program (Baillie and Pilcher 1973).

Ascribing and Interpreting Felling Dates

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. For samples that have sapwood complete to the underside of, or including, bark, this process is relatively straight forward. Depending on the completeness of the final ring, i.e. if it has only the early wood formed, or the latewood, a *precise felling date and season* can be given. Where the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then the question of when the tree was felled becomes considerably more complicated. In the European oaks, sapwood tends to be of a relatively constant width and/or number of rings, and it is possible to estimate the approximate number of sapwood rings that are missing from any given timber.

Unfortunately, it has not been possible to apply an accurate sapwood estimate to either the white or red oaks at this time. Primarily, it would appear that there is a complete absence of literature on sapwood estimates for oak anywhere in the country (Grissino-Mayer, *pers comm*). The matter is further complicated in that the sapwood in white oak (*Quercus alba*) occurs in two bands, with only the outer ring or two being free of tyloses in the spring vessels (Gerry 1914; Kato and Kishima 1965). Out of some 50 or so samples, only a handful had more than 3 rings of sapwood without tyloses. The actual sapwood band is differentiated sometimes by a lighter color, although this is often indiscernible (Desch 1948). In archaeological timbers, the lighter colored sapwood does not collapse as it does in the European oak (*Q rober*), but only the last ring or two without tyloses shrink tangentially. In these circumstances the only way of being able to identify the heartwood/sapwood boundary is by recording how far into the timber wood boring beetle larvae penetrate, as the heartwood is not usually susceptible to attack unless the timber is in poor or damp conditions. Despite all of these drawbacks, some effort has been made in recording sapwood ring counts on white oak, although the effort is acknowledged to be somewhat subjective.

As for red oaks (*Quercus rubra*) it will probably not be possible to determine a sapwood estimate as these are what are known as “sapwood trees” (Chattaway 1952). Whereas the white oak suffers from an excess of tyloses, these are virtually non-existent in the red oak, even to the pith. Furthermore, there is no obvious color change throughout the section of the tree, and wood-boring insects will often penetrate right through to the center of the timber. Therefore, in sampling red oaks, it is vital to retain the final ring beneath the bark, or to make a careful note of the approximate number of rings lost in sampling, if any meaningful interpretation of felling dates is to be made. Similarly, no study has been made in estimating the number of sapwood rings in chestnut oak, tulip-poplar, black ash, or any of the pines.

Therefore, if the bark edge does not survive on any of the timbers sampled, only a *terminus post quem* or *felled-after* date can be given. The earliest possible felling date would be the year after the last measured ring date, adjusted for any unmeasured rings or rings lost during the process of coring.

Some caution must be used in interpreting solitary precise felling dates. Many instances have been noted where timbers used in the same structural phase have been felled one, two, or more years apart. Whenever possible, a group of precise felling dates should be used as a more reliable indication of the construction period. It must be emphasized that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure under study. However, it is common practice to build timber-framed structures with green or unseasoned timber and therefore construction usually took place within twelve to eighteen months of felling (Miles 1997).

Details of Dendrochronological Analysis

The results of the dendrochronological analysis are presented in a number of detailed tables. The most useful of these is the summary **Table 1**. This gives most of the salient results of the dendrochronological process, and includes details for each sample, such as its species, location, and felling date, if successfully tree-ring dated. This last column is of particular interest to the end user, as it gives the actual year and season when the tree was felled, if bark or bark edge is present. If bark edge is not present, it gives a *terminus post quem* or date after which the timber was felled. Often these *terminus post quem* dates begin far earlier than any associated precise felling dates. This is simply because far more rings have been lost in the initial conversion of the timber. If the sapwood was complete on the timber but some was lost during coring, an estimated date range can sometimes be given.

It will also be noticed that often the precise felling dates will vary within several years of each other. Unless there is supporting archaeological evidence suggesting different phases, all this would indicate is either stockpiling of timber, or of trees that had been felled or died at varying times but were not cut up until the commencement of the particular building operations in question. When presented with varying precise felling dates, one should always take the latest date for the structure under study, and it is likely that construction will have been completed for ordinary vernacular buildings within twelve or eighteen months from this latest felling date (Miles 1997).

Table 2 gives an indication of the statistical reliability of the match between one sequence and another. This shows the *t*-value over the number of years overlap for each combination of samples in a matrix table. It should be born in mind that *t*-values with less than 80 rings overlap may not truly reflect the same degree of matching and that spurious matches may produce similar values.

First, multiple radii have been cross-matched with each other and combined to form same-timber means. These are then compared with other samples from the site and any which are found to have originated from the same parent tree are again similarly combined. Finally, all samples, including all same timber and same tree means, are combined to form one or more site masters. Again, the cross-matching is shown as a matrix table of *t*-values over the number of years overlaps. Reference should always be made to **Table 1** to clearly identify which components have been combined.

Table 3 shows the degree of cross-matching between the site master(s) and a selection of reference chronologies. This shows the state or region from which the reference chronology originated, the common chronology name, the publication reference, and the years covered by the reference chronology. The number of overlapping years between the reference chronology and the site master is also shown together with the resulting *t*-value. It should be noted that well replicated regional reference chronologies, which are shown in **bold**, will often produce better matches than individual site masters or indeed individual sample sequences.

Figures include a bar diagram that shows the chronological relationship between two or more dated samples from a phase of building and any plans showing sample locations, if available.

Publication of all dated sites for English buildings occurs annually in *Vernacular Architecture*, but regrettably there is at the present time no vehicle available for the publication of dated American buildings. However, a similar entry is shown on the summary page of the report, which could be used in any future publication of American dates. This does not give as much technical data for the samples dated, but does give the *t*-value matches against the relevant chronologies, provides a short descriptive paragraph for each building or phase dated, and gives a useful short summary of samples dated. These summaries are also listed on the web-site maintained by the Laboratory, which can be accessed at www.dendrochronology.com. The Oxford Tree-Ring Laboratory retains copyright of this report, but the commissioner of the report has the right to use the report for his or her own use so long as the authorship is quoted. Primary data and the resulting site master(s) used in the analysis are available from the Laboratory on request by the commissioner and bona fide researchers. The samples form part of the Laboratory archives, unless an alternative archive, such as the Colonial Williamsburg Foundation in association with the Oxford Tree-Ring Laboratory, has been specified in advance.

Sampling

A dendrochronological study of the timbers from a shipwreck found in the Nanticoke River in Vienna, Maryland, was undertaken in an attempt to date the primary construction phase of the ship and to investigate the possibility of using dendrochronological provenancing of timbers to help find the location of the ship's origin.

Ten white oak timbers were sampled in total: eight from futtocks, one from the keel, and one from the keelson. Each sample was given the code **NR** (for Nanticoke River, Maryland) and numbered according to the timber numbers assigned during the archaeological study (see table 1).

Summary of Dating

None of the ten timbers sampled retained complete sapwood. On preparing the samples it was seen that one timber (**NR-39**) did not have a sufficient number of annual rings to produce an accurate date, so the remaining nine timbers were used in the analysis.

To help retain as many annual rings as possible, multiple samples were taken from two of the timbers. The multiple samples from the keel were found to match each other and were combined to form one new individual sample sequence, **NR-KEEL**, which was used in the rest of the analysis (see table 2). The multiple samples from **NR-22** did not match each other and were used individually in all further analysis.

All of the timber sequences were compared with each other. Four of the timbers (**NR-KEEL**, **NR-F03**, **NR-F20**, and **NR-F24**) were found to match each other, allowing them to be combined into the 128-year site master **NRx1**.

The site master and the remaining unmatched samples were compared with more than seven hundred master chronologies from the East Coast of the United States and with over 1500 master chronologies from the UK and Northern Europe. **NRx1** was found to date spanning the years 1616 to 1743 (see table 3) against the master chronologies from the East Coast of the United States. The individual samples did not match against any of the dated master chronologies.

Interpretation

The tree-ring analysis has resulted in the successful dating of the shipwreck. As no complete sapwood survived on any of the timbers, a *terminus post quem* date of after 1743 was assigned to the shipwreck, meaning that the timbers were found to have been felled at some point after 1743. The chronology from the sampled timbers matched with the master chronologies from the East Coast of the United States, and particularly with the chronologies from around the southern Chesapeake Bay region, suggesting that the timbers were felled from trees that grew around the Chesapeake Bay area south of Annapolis.

Recommendations

At the time of sampling it was hoped that the timbers from the ship would be put on public display. This meant that visible damage was ruled out for many of the best-preserved timbers, limiting the sampling to timbers that were more degraded and less diagnostic. As a result, the timbers that were sampled were not always the most suitable for dendrochronology. It was observed during assessment that some of the unsampled timbers contained longer sequences of annual rings in better condition than the timbers that were sampled. If, in the future, it becomes possible to sample these remaining timbers, they may potentially produce a date closer to the timbers' actual felling date and may match more strongly with the local chronologies, thus helping to refine the location of the area in which the trees grew.

Acknowledgements

Thanks are given to Nichole Doub, Head Conservator of the Maryland Archaeological Conservation Laboratory, and to Julie Schablitsky, Chief of the Cultural Resources Section of the Maryland State Highway Administration, for their help collecting the samples. Thanks are also due to Jeff Enright, Maritime Principal Investigator of the SEARCH - SEARCH2O Maritime Archaeology Division, for his useful discussions on the shipwreck and to Christine Nell Heikkenen, who has donated the Heikkenen Archives in loving memory of her father, Dr. Herman J. Heikkenen.

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Photographs of timbers sampled

Figure 2. Photograph of timber NR-F03.

Figure 3. Photograph of timber NR-F39.

Figure 4. Photograph of timber NR-F38.

Figure 5. Photograph of timber NR-22.

Figure 6. Photograph of timber NR-5.

Figure 7. Photograph of timber NR-F24.

Figure 8. Photograph of timber NR-F20.

Figure 9. Photograph of keelson (left) and keel (right).

Table 1: Summary of tree-ring dating

NANTICOKE SHIPWRECK, VIENNA, MARYLAND

Sample number & type		Species	Timber and position	Dates AD spanning	Last Ring	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
NR-5	s	QUAL	Futtock	-	h/w only	84	1.26	0.28	0.136	
NR-22a	s	QUAL	Futtock	-	h/w only	52	0.90	0.35	0.202	
NR-22b	s	QUAL	ditto	-	h/w only	19	1.01	0.27	0.220	
NR-22c	s	QUAL	ditto	-	h/w only	32	1.00	0.25	0.216	
NR-KEELA	s	QUAL	Keel	1618-1722	h/w only	105	1.39	0.41	0.163	
NR-KEELB	s	QUAL	ditto	1616-1723	h/w only	108	1.53	0.54	0.161	
* **NR-KEEL**	m		Mean of **NR-KEELA** + **NR-KEELB**	1616-1723	h/w only	108	1.47	0.45	0.148	After 1723
NR-KS	s	QUAL	Keelson	-	h/w only	63	1.77	0.65	0.208	
* **NR-F03**	s	QUAL	Futtock	1623-1689	h/w only	67	1.83	0.50	0.183	After 1689
* **NR-F20**	s	QUAL	Futtock	1682-1743	h/w only	62	1.45	0.78	0.321	After 1743
* **NR-F24**	s	QUAL	Futtock	1629-1697	h/w only	69	1.34	0.44	0.200	After 1697
NR-F38	s	QUAL	Futtock	-	h/w only	96	0.70	0.21	0.162	
NR-F39	s	QUAL	Futtock	-	h/w only	38	3.02	1.51	0.424	
* = **NRx1 Site Master**				1616-1743		128	1.48	0.51	0.193	

Key: *, †, § = sample included in site master; c = core; mc = micro-core; s = slice/section; g = graticule; p = photograph; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (last partial ring not measured), ½C = summer/autumn (last partial ring not measured), or C = winter felling (ring measured); h/w only = heartwood only; nm = number of unmeasured rings; std devn = standard deviation; mean sens = mean sensitivity; QUAL = *Quercus alba* (white oak)

Explanation of terms used in Table 1

The summary table gives most of the salient results of the dendrochronological process. For ease in quickly referring to various types of information, these have all been presented in Table 1. The information includes the following categories:

Sample number: Generally, each site is given a two or three letter identifying prefix code, after which each timber is given an individual number. If a timber is sampled twice, or if two timbers were noted at time of sampling as having clearly originated from the same tree, then they are given suffixes '**a**', '**b**', etc. Where a core sample has broken, with no clear overlap between segments, these are differentiated by a further suffix '**1**', '**2**', etc.

Type shows whether the sample was from a core 'c', or a section or slice from a timber's'. Sometimes photographs are used 'p', or timbers measured *in situ* with a graticule 'g'.

Species gives the four-letter species code used by the International Tree-Ring Data Bank, at NOAA. These are identified in the key at the bottom of the table.

Timber and position column details each timber sampled along with a location reference. This will usually refer to a bay or truss number, or relate to compass points or to a reference drawing.

Dates AD spanning gives the first and last measured ring dates of the sequence (if dated),

H/S bdry is the date of the heartwood/sapwood transition or boundary (if identifiable).

Sapwood complement gives the number of sapwood rings, if identifiable. The tree starts growing in the spring during which time the earlywood is produced, also known also as spring growth. This consists of between one and three decreasing spring vessels and is noted as *Spring* felling and is indicated by a ¼ C after the number of sapwood ring count. Sometimes this can be more accurately pin-pointed to very early spring when just a few spring vessels are visible. After the spring growing season, the latewood or summer growth commences, and is differentiated from the proceeding spring growth by the dense band of tissue. This summer growth continues until just before the leaves drop, in about October. Trees felled during this period are noted as *summer* felled (½ C), but it is difficult to be too precise, as the width of the latewood can be variable, and it can be difficult to distinguish whether a tree stopped growing in autumn or *winter*. When the summer growth band is clearly complete, then the tree would have been felled during the dormant winter period, as shown by a single C. Sometimes a sample will clearly have complete sapwood, but due either to slight abrasion at the point of coring, or extremely narrow growth rings, it is impossible to determine the season of felling.

Number of rings: The total number of measured rings included in the samples analysed.

Mean ring width: This, simply put, is the sum total of all the individual ring widths, divided by the number of rings, giving an average ring width for the series.

Mean sensitivity: A statistic measuring the mean percentage, or relative, change from each measured yearly ring value to the next; that is, the average relative difference from one ring width to the next, calculated by dividing the absolute value of the differences between each pair of measurements by the average of the paired measurements, then averaging the quotients for all pairs in the tree-ring series (Fritts 1976). Sensitivity is a dendrochronological term referring to the presence of ring-width variability in the radial direction within a tree which indicates the growth response of a particular tree is "sensitive" to variations in climate, as opposed to complacency.

Standard deviation: The mean scatter of a population of numbers from the population mean. The square root of the variance, which is itself the square of the mean scatter of a statistical population of numbers from the population mean. (Fritts 1976).

Felling seasons and dates/date ranges is probably the most important column of the summary table. Here the actual felling dates and seasons are given for each dated sample (if complete sapwood is present). Sometimes it will be noticed that often the precise felling dates will vary within several years of each other. Unless there is supporting archaeological evidence suggesting different phases, all this would indicate is either stockpiling of timber, or of trees which have been felled or died at varying times but not cut up until the commencement of the particular building operations in question. When presented with varying precise felling dates, one should always take the *latest* date for the structure under study, and it is likely that construction will have been completed for ordinary vernacular buildings within twelve or eighteen months from this latest felling date (Miles 1997).

Table 2: Matrix of *t*-values and overlaps for same-timber mean and site master

Components of timber mean **NR-KEEL**

Sample:	**NR-KEELB**
Last ring date AD:	1616-1723
NR-KEELA 1618-1722	8.97 105

Components of site master **NRx1**

Sample:	**NR-F24**	**NR-F03**	**NR-F20**
Last ring date AD:	1629-1697	1623-1689	1682-1743
NR-KEEL 1616-1723	5.46 69	4.67 67	6.01 42
	NR-F24	6.02 61	No Test
		NR-F03	No Test

Table 3: Dating of site master **NRx1** (1616-1743) against reference chronologies

	State or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap:*	t-*value:*
	Maryland	Area Master Chronology	Heikkenen Archive	**MDOAK**	1570-1981	128	5.86
*	Maryland	Charles Carroll House, Annapolis	Heikkenen Archive	WCCHHS3	1565-1748	128	5.29
*	Maryland	Maidstone, Calvert County	Heikkenen Archive	Maidstone	1598-1751	128	5.13
*	Maryland	Mulberry Fields, St. Mary's County	Heikkenen Archive	MFC3	1590-1837	128	5.13
*	Maryland	Brome Granary Shingles	Heikkenen Archive	BFS3	1627-1785	117	5.01
	Virginia	Eyre Hall, Cheriton	Miles and Worthington 2003/08	EYREHALL	1514-1806	128	4.98
	Maryland	Preston Oak	Columbia unpublished	**MONTP**	1508-2000	128	4.92

Chronologies in **bold** denote regional masters

* = Possible component of **MDOAK**

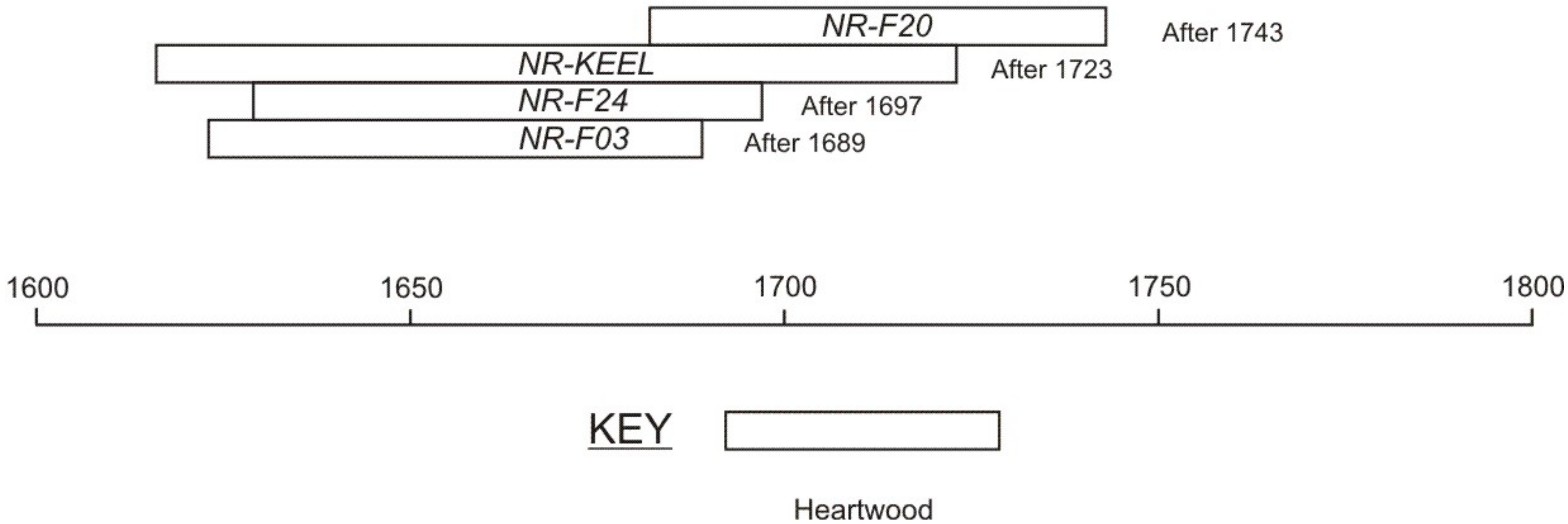


Figure 10. Bar diagram showing dated timbers in chronological order.

APPENDIX F:

GLOSSARY OF SHIP CONSTRUCTION TERMS AND ADDITIONAL ILLUSTRATIONS

The following glossary and illustrations have been adapted from Desmond (1919), Paasch (1885), and Steffy (1994).

Amidships: The middle of a vessel, either longitudinally or transversely.

Athwartships: Across the ship from side to side; perpendicular to the keel.

Apron: A curved piece of timber fixed to the after surface of the stem or to the top of the forward end of the keel and the after surface of the stem; an inner stempost.

Batten: A thin plank or strip of wood used to determine hull curvatures or to temporarily connect timbers during construction.

Beam: The width of a hull.

Bow: The forward end of a vessel.

Butt Scarf: The union of two planks or timbers whose ends are cut perpendicularly to their lengths.

Cant Frame: A framing member mounted obliquely to the keel centerline in the ends of a vessel.

Ceiling: The internal planking of a vessel.

Chainplate: Iron plates to which the deadeyes are secured to the side of a vessel.

Chamfer: The flat, sloping surface created by slicing the edge off a timber.

Chock: An angular block or wedge used to fill out areas between timbers or to separate them.

Clench: To secure a nail or bolt by bending or flattening its projecting end over the surface it last penetrated.

Compass Timber: Naturally curved timbers used for frames and construction in the ends of the hull.

Deadeye: Pieces of elm, ash, or lignum vitae, of a round shape, used for reeving the lanyards of standing rigging.

Deadrise: The amount of elevation, or rising, of the floor above the horizontal plane.

Deadwood: Blocks of timber assembled on top of the keel, usually in the ends of the hull, to fill out the narrow parts of a vessel's body.

Depth-of-Hold: The distance between either the bottom of the main deck or the bottom of its beams and the limber boards, measured at the midship frame.

Diagonal Scarf: An angular junction of two planks or timbers.

Draft: The depth to which a hull is immersed.

Driftpin: A cylindrical bolt, headed on one end that is slightly larger in diameter than the hole into which it is driven.

False Keel: A plank, timber, or timbers attached to the bottom of the keel to protect it in the event of grounding or hauling.

Faye: To fit or join timbers closely together.

Fishplate: A metal plate used to join two timbers externally.

Flat Scarf: The union of two planks or timbers whose diagonal ends are nibbed (cut off) perpendicular to their lengths.

Floor: A frame timber that crosses the keel and spans the bottom; the central piece of a compound frame.

Frame: A transverse timber, or line or assembly of timbers, that describes the body shape of a vessel and to which the planking and ceiling are fastened.

Futtock: A frame timber other than a floor, half frame, or top timber; one of the middle pieces of a frame.

Garboard Strake: The strake of planking next to the keel; the lowest plank.

Gripe: A curved piece joining the forward end of the keel to the lower end of the knee of the head.

Gudgeon: A metal bracket attached to the sternpost into which a rudder pintle is hung; the female part of a rudder hinge.

Half Frame: A frame whose heel begins at or near one side of the keel or deadwood and spanned part or all of that side of the hull; half frames are normally used in pairs.

Hood End: The ends of planks that fit into the stem and sternpost rabbets.

Inner Stempost: The inner timber or timbers of a double-layered stem; unlike an apron, an inner stempost ends at the keel-stem scarf.

Keel: The main longitudinal timber of most hulls, upon which the frames, deadwoods, and ends of the hull are mounted; the backbone of the hull.

Keel Plank: A thick bottom plank used in lieu of a keel.

Keelson: An internal longitudinal timber mounted atop the frames along the centerline of the keel that provides additional longitudinal strength to the bottom of the hull.

Knee: An angular piece of timber used to reinforce the junction of two surfaces of different planes.

Knee of the Head: A knee or knee-shaped structure fixed to the forward surface of the stem that formed the cutwater at its lower end and supported the headrails and figurehead at its upper end.

Limber Hole: Apertures cut in the bottom surfaces of frames on either side of the keel to allow water to drain into the pump well.

Mast Step: A mortise cut into the top of the keelson into which the tenoned heel of a mast is seated.

Molded Dimension: The various dimensions of timbers as seen from the sheer and body views of construction plans. Thus, the vertical surfaces of keels, the fore and aft sides of posts, and the vertical surfaces of frames. Molded and sided dimensions are used because of the changing orientation of timbers.

Mortise: A cavity cut into a timber to receive a tenon.

Planking: The outer lining, or shell, of a hull.

Port: The left side of a vessel when facing forward.

Rabbet: A groove or cut made in a piece of timber in such a way that the edges of another piece could be fit into it to make a tight joint. Generally, the term refers to the grooves cut into the sides of the keel, stem, and sternpost, into which the garboards and hooding ends of the outer planking are seated.

Rake: The inclination of the stem and sternpost beyond the ends of the keel; also, the inclination of the masts from the perpendicular.

Ribband: Long, flexible strips of wood used as temporary keeps by nailing them across the outside of standing frames while the vessel is being built.

Room and Space: The distance from the molded edge of one frame to the corresponding point on an adjoining frame, usually measured at or near the keelson. The part occupied by the frame is called the **room**, while the unoccupied distance between it and the adjacent frame is called the **space**.

Scarf: An overlapping joint used to connect two timbers or planks without increasing their dimensions.

Sheathing: A thin covering of metal or wood to protect hulls from marine growth or fouling.

Shell: The external planking of a vessel.

Shipwright: A master craftsman skilled in the construction and repair of ships.

Shoe: A protecting piece at the bottom of a keel.

Shroud: A rope or wire support used to steady a mast to the side of the hull.

Sided Dimension: The dimension of an unmolded surface; the distance across an outer frame surface, the forward or after surface of a stem or sternpost, or the upper surface of a keel or keelson.

Skeletal: The main support structure of a hull, including keel, keelson, stem and sternpost, and frame timbers.

Stanchion: An upright supporting post for deck beams and bulkheads.

Starboard: The right side of a vessel when facing forward.

Stempost: A vertical or upward curving timber or assembly of timbers scarfed to the keel into which the sides of the bow are joined.

Stern: The after end of a vessel.

Sternpost: A vertical or upward curving timber or assembly of timbers stepped into, or scarfed to, the after end of the keel.

Stopwater: A wooden dowel inserted athwartships in the scarf of seams of external timbers to prevent shifting of the joint or to discourage water seepage along the seams.

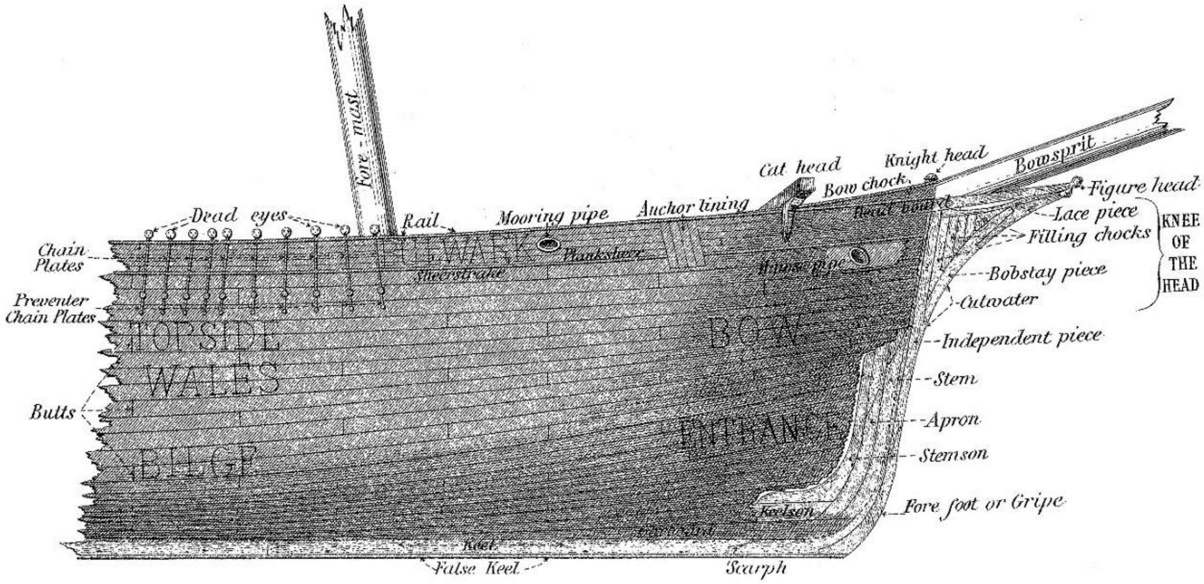
Strake: A continuous line of planks running from bow to stern.

Tenon: A wooden projection cut from the end of a timber or as separate wooden piece that was shaped to fit into a corresponding mortise.

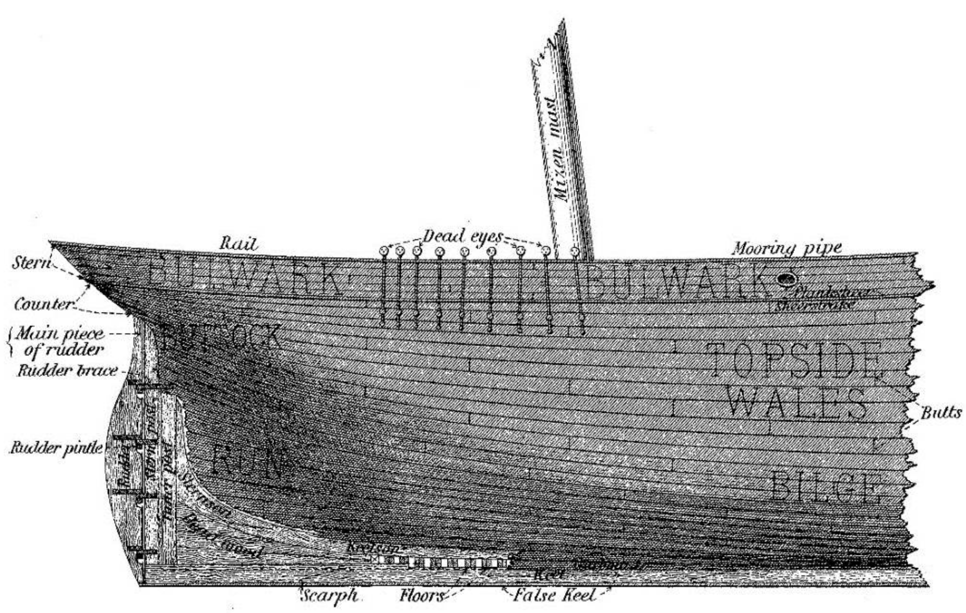
Transom: One of the athwartship members, fixed to the sternpost, that shapes and strengthens the stern.

Treenail: A round or multi-sided piece of hardwood driven through planks and timbers to connect them.

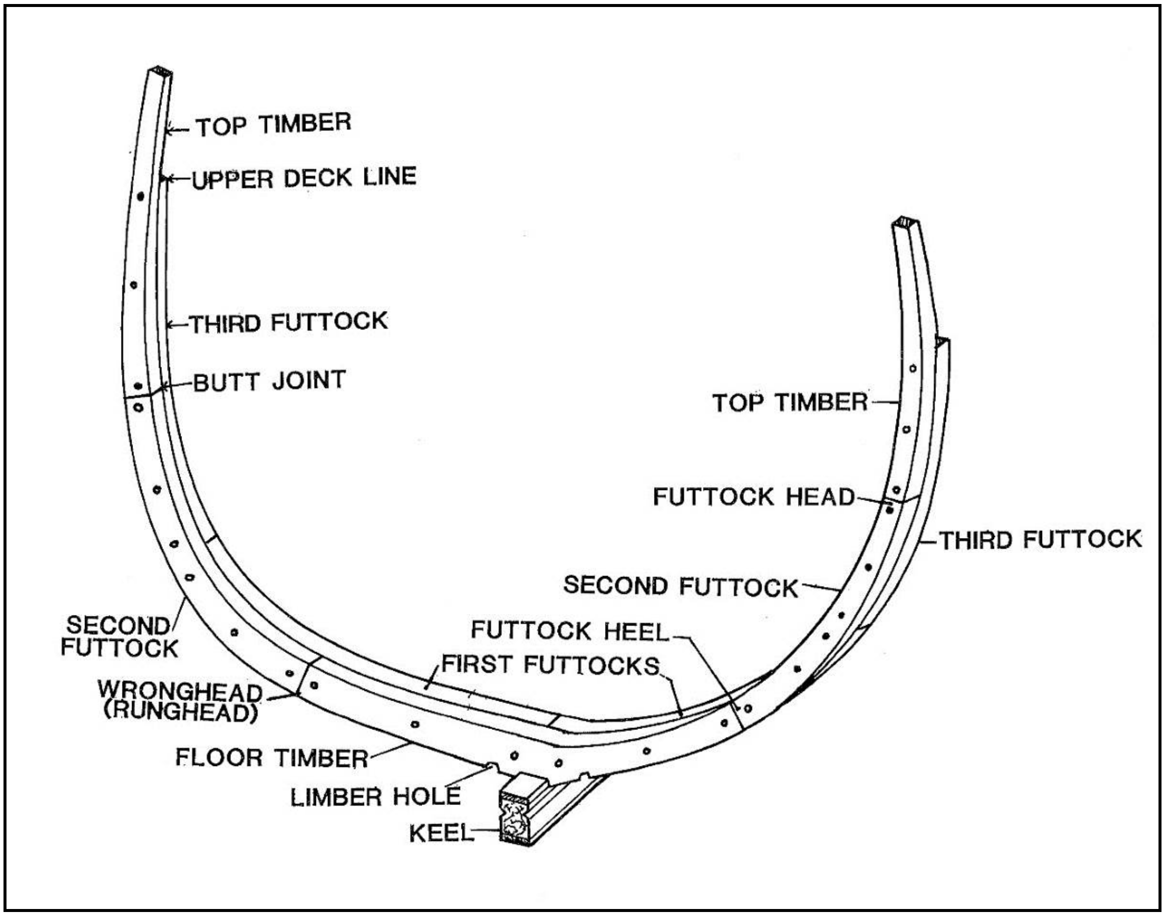
FORE BODY OF A WOODEN SHIP



AFTER BODY OF A WOODEN SHIP



Source: Paasch (1885)



Double frame. Source: Steffy (1994)